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Materials in building construction

by **Denis H. Camilleri**

THE Malta Group of Professional Engineering Institutions recently organised an eye-opening video presentation of the UK Institution of Civil Engineers Centenary Brunel Lecture on materials in building construction.

Professor Michael Burdekin of the University of Manchester Institute of Science and Technology presented the video lecture. Several professional engineers and architects attended the presentation, which was followed by a lively discussion.

Various innovations in building materials were highlighted. Steel sections up to 200 mm thick are now being produced, when up to 30 years ago the maximum thickness was in the 60 mm range. This greater thickness creates problems in the weldability of the material, so now the more economical structures are worked with sections of smaller thickness.

A material that interested the audience was self-compacting concrete. The material cost could be 10 per cent more expansive, but reductions are obtained in the labour content and noise disturbance. This method is very popular in Japan. This new material requires an alteration to the conventional slump test, which now becomes a flow test. One of the fillers of this flowable concrete was mentioned as limestone dust, something very common in Malta.

Fibre-reinforced concrete was mentioned as one of the innovations. One member of the audience said that the new Playmobil factory under construction at Hal Far is to avail itself of this new material for the construction of the ground slabs.

Anyone who is interested can contact the project manager, and it would be of interest that any tests carried out are analysed and the condition of the material is monitored over a working period of time. Ferro-cement used since Roman times was mentioned as it is again gaining popularity due to its architectural features and in relining sewers.

New uses for masonry structures were highlighted. The diaphragm wall in one-storey-high buildings resisting wind loading was noted as being seven times stiffer than a plain wall, with a prestressed building being 50 times stiffer.

The structural shapes availed of in steelwork were noted as being applicable also for masonry piers, enhancing their buckling resistance. This type of construction is very pertinent for Malta and was recently highlighted in BICC's CPD course on structural masonry. There is a request for a repetition of this course, very pertinent to practising architects. A date will be fixed once enough applicants have registered.

Other new materials included aluminum, of which a new alloy was mentioned as having better welding properties, bronze, stainless steel, composites and glass, which are becoming more important as architectural materials. Their properties were compared in relation to strength, durability, scratch and fire resistance.

Developments in the construction methods and the instruction of robots were also considered. Robots' use is mostly limited to the assembly of panels and welding of steel joints. Although many robots are used in the manufacturing industry, an insignificant number is availed of in the construction industry, with most ending up idle in a yard.

Slim floors were mentioned and it is to be noted that they are availed of in Malta – steel beams have plates welded on to their webs and prestressed floor slabs are inserted, obtaining a flush construction and minimising construction depths.

Cellular steel beams, on the other hand, useful as the building services pass through the cores, have not yet been introduced to Malta. The advantages of steel housing were also highlighted, however this is an alien form of construction for Malta.

Construction, unlike the manufacturing sector, is seen as assuming a traditional role. Design lives in manufacturing for economic reasons rarely exceed 15 years, while constructions have lives varying from 25 years up to 120 or even longer. The maxim "as safe as houses" still holds. The risks are far too great for a failure to occur. Consider an accident where five people are killed and compare this with the ensuing public outrage and inquiry.

The overall cost of a project is quoted at one-third for structure, one-third for finishings and one-third for services, with only six per cent of total costs allocated for the material cost. Yet the risk associated with innovative material, is considered far too great.

However, cladding material is an area where improvements are to be expected. These should take account of the thermal and acoustic properties of the enclosing space, more than the structural strength which here assumes a secondary role. Considering the local context, due to the porous absorptive properties of the limestone masonry, our walls are too hot in summer and too damp in winter.

Work by the Masonry Institute on reconstituted stone has been unsuccessful, but this should be an area where further research should be encouraged. A waste management problem is being created, with the majority of waste being disused limestone, while quarries are being denuded of this very mineral. What was uneconomic 20 to 30 years ago could not be in 40 years' time.

Testing of a new construction material, for it to be acceptable, has to pass the test of time.

A new technology evolving is carbon strips being utilised to strengthen existing structures. A cautionary point was highlighted, where to gain its full increase in strength, unloading first of the existing structure is necessary, otherwise the gain in strength would be only a fraction of that obtained by unloading. Thus beware of glossy fact sheets – the engineer has to do his homework well.

Mention was made of the innovative buildings in Manchester and of the Millennium projects. Although this presentation was made before September 11, reference to terrorist measures after the Manchester attack was expected, which could include simple stand-off points such as bollards, with the specification of special glazing, capable of withstanding an amount of blast pressure.

New risk and reliability measures are now being introduced into building designs. With our increasing wealth, safety is an ever-increasing requirement from society. Whereas absolute safety is an illusion, tools exist for achieving a trade-off, which is an optimum with respect to the aims of the decision-maker. This concept has progressed from its infancy into its youth, with the recent happenings fast driving it into its adulthood.

This presentation ends with the importance of material semesters in engineering courses. Two 36-hour semesters are suggested. By studying and testing the properties of materials, traditional and innovative, knowledge can be furthered and an improvement of our enclosed environment achieved.

Structural engineering, faced with these new materials, in the structural Eurocodes has an unrivalled set of unified international codes of practice for designing buildings and civil engineering structures and to prove their compliance with the essential requirements of mechanical resistance and stability, fire safety and durability.

The Building Industry Consultative Council (BICC) is currently conducting CPD courses on the use of these Eurocodes, for members of the profession to be made aware of these innovative developments.

The presentation ended with the suggestion made by the Malta Group of Professional Engineering Institutions, that a follow-up is now required on the practical applications of these materials – something to be commended, in filling a void on the knowledge and practice of these new materials.

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