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Building under Extreme Conditions and Development of Appropriate Construction Technologies

Construire dans des conditions extrêmes et évolution d'une technologie de construction appropriée

Bauen unter extremen Bedingungen und Entwicklung passender Bauverfahren

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It is interesting to look at the City of Bath which, with its complex of Georgian buildings, respresents one of the most perfect expressions in Europe of a single approach to architecture. It was designed by men who, in many cases, had never left the city and who based their designs on books about classical buildings. The root of their building style goes back to the Doric temple of 600 BC so it is perhaps not surprising that with 2300 years of study the architectural achievement was spatially superb. Yet these buildings are certainly not functionally perfect, and are often structurally weak, have few services and are damp, cold and ill built.

Compare the City with the new University at the top of the hill. The University is unusual among the new universities in Britain in that it is one single building. It is planned not only to achieve a unity but also to be adaptable for an ever evolving academic society. The cars are parked at ground level where the heavy duty laboratories are also sited. Above is a pedestrian concourse, the offices of the Schools, the library, social elements and main lecture theatres. Above these are the lighter laboratories and staff rooms while at either end of the main concourse are tower blocks providing student accommodation. The site is very exposed and the grouping considers this. The change from an individual craft based society to an industrial one is recognised economically by building with a series of standardised component parts. The realisation has entailed a whole range of clients, planners, architects, structural and environmental engineers, contractors and fabricators. Group interaction has produced it and it represents a much broader and more recent view of what is required. A view which started with the Bauhaus in the 1920's.

Modern design in civil engineering has become no different. The problems of a road are not only those of excavation, alignment and pavement design but also respond to the social and economic reasons for the road, the use of the road and its impact on the adjacent environment. The biggest volume of work lies with the civil engineer but the important decisions lie equally with the economic planners, landscape architects and environmental engineers.

Due to our density of populations, increased aspirations and new possibilities we need broader solutions which satisfy wider needs. Many professions are engaged in making design decisions and determining our built environment. These professions bring to the design and construction process different areas of knowledge and sensibility. We need these differences to achieve quality. But our biggest problem is how to work well together, how to understand what we each do best, how to have a common language and values. In other words how to evolve better methods of design and construction.

The congress in Vienna in 1980 gives an opportunity for this, perhaps more so because looking at the extreme conditions of a total construction problem exaggerates certain aspects and requires a very conscious approach. Case study papers on method and approach are needed in this area.

In a sense all civil engineering is the design of structure and has a very long history. Yet structural engineering really started about 200 years ago when the development of iron started a profession designing structures in man made materials which considers current fabrication and erection processes (for example the Central London stations, the Crystal Palace etc). This is the core of what we do, we apply rather than explain because we aim at producing a useful product. The knowledge we use need not be objective or complete as long as the product works. We redirect nature.

But in all we do we must have an aim and that aim is usually value; the cheapest appropriate structure combined with serviceability. Success in designing a structure which is cheap to build, cheap to run and cheap to maintain must depend on economic factors which are themselves dependent on geographical and other influences. No mathematical model can be evolved to optimise such a design as it would have too many variables. So we usually take a strong central 'belief' (or even two or three) as the thread to pin our design on. But to do that we need a very broad knowledge of a country's resources, materials and construction industry, climatology and other factors. For example there is no doubt that in Arabia a conditioned environment in most buildings is required for people to be able to work. Yet the indigenous population is relatively small and there is a lack of maintenance skills. So while recognising the need to air condition many buildings the minimising of electrical and mechanical servicing is essential. It has been predicted that by the year 2000 one third of the building industry in Britain will be engaged in maintenance, how much worse the problem could be in Arabia. So when we were working on the infrastructure design of the University of Riyadh we decided no building, except for symbolic ones, should be over three storeys high to reduce the need for elevators and went on to a whole series of built form studies to determine the fenestration, insulation, orientation and spacing of the buildings in order to reduce the servicing load. Climate, effective determination of land use and so on are the patterns which define the planning. While Arabia is a monetarily rich country the 'cost' of foreign skilled labour is high and the efficiency of their use of prime importance. Prefabrication in building is essential. The choice of structural materials and the choice of type and sizes of members taking into account labour skills and availability, problems of importation and the varying needs of the buildings is a complex one. Papers on projects in the context of a country's industrial abilities, its economic situation, its climate and location are needed.

The process of analysis of structural behaviour is quite developed. What the engineer is often less skilled in is the process of erection in extreme environments. The limitations of working conditions in extreme environments has been experienced by few. It may be that the giving of knowledge will lead to better proposals. We have strong social obligations to the countries we work for, our children will live in the world we leave them. Working in extreme conditions accentuates the problems which occur in all situations and should provide a learning tool at both the general and detailed levels which should enable us to be better at our professions.