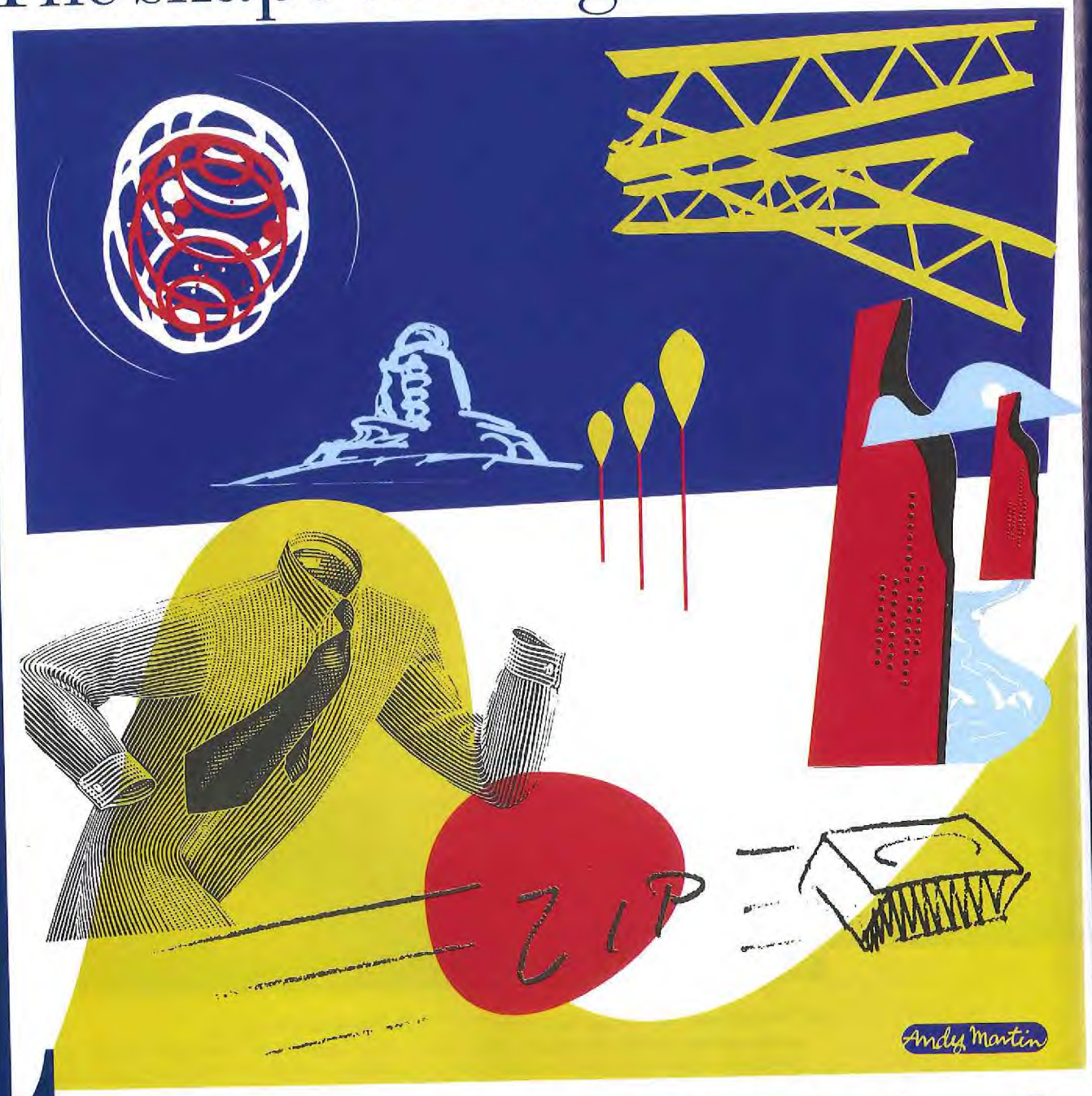
The shape of things to come



Structural engineering is not renowned for changing course rapidly. But increasing environmental and financial pressures mean the search never ceases for innovative methods and materials that will allow extra efficiency in the construction process and the lifespan of structures. James Macneil talks to seven engineers about the developments they expect to see over the next 10 years.

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The cost of a construction is always a balance of materials and labour costs. In the 1950s and 1960s, labour costs were relatively low and the choice of structure was influenced by the cost of materials. The balance of labour costs to materials and energy costs has gradually changed – we now have minimum labour construction, which maximises the use of machine-produced prefabricated elements.

Recent developments in this field have been towards eliminating the process of protecting steelwork against fire, which is a messy, on-site, labour-intensive job. The process can be avoided by using heavier sections with some off-site concrete filling, which means more materials and less labour.

It is likely that this process will continue for major buildings, and that there will be further changes that will reduce on-site labour. Maintenance now accounts for something like 60% of building industry output, and it is rising.

The long-term performance of motor cars has improved enormously over the past 29 years, through huge investment in development engineering and prototype testing. But buildings, which do not get the same level of development and testing, are expected to last much longer than cars.

It is likely that building expertise will move to consultants, who will set the standards of performance and who will find ways of controlling their liability for the end product. The outcome will probably be a greater number of standardised details, developed and tested to ensure satisfactory performance.

There is a strong pressure towards better environmental performance – the control of the flow of heat, light and air through the skin of buildings. The mass of the construction can be used to smooth out fluctuations in temperature, and clever glass and steel structures can provide the light. Both of these are controlled by the selection of suitable structures by the structural engineer.

In recent years, there have been dramatic developments in the field of translucent skins. Glass has been used for structural beams or compression members within a space frame. These developments look set to continue, with more complete rod and strut elements supporting glazed walls and roofs. It will require a change in glass manufacturing, with, say, the production of an insulating glass foam to make a major change.

We have seen the introduction of coated fabrics – mainly PVC-coated polyester and PTFE-coated glass. Both materials have serious environmental disadvantages for permanent buildings, because they give insufficient insulation and their translucence gives a yellow/brown light. They also tend to discolour or collect dirt.

We now have several examples of the use of ETFE foil as a cladding material. This has magic properties as far as environmental control is concerned. It can be used in three or four layers to give effective insulation and it allows a wide range of translucencies, as well as staying clean. But the material is difficult to fabricate and has unusual structural properties. Although it has been around for 15 years, engineers and fabricators are only now learning how to use it.

It is likely that new foils and fabrics will appear. The problem with most of these developments is that the new high-performance materials are horrendously expensive, so their use is discouraged. An example of this is woven PTFE fabric (Tenara). This is a very attractive material that has excellent durability and stays clean. But as well as being expensive, it is difficult to fabricate and almost impossible to repair. Therefore, it has been used only for special projects, mostly with deployable canopies.

There is increasing pressure to use low total energy materials to protect the environment. However, the process of defining this is unclear. Another similar pressure is recyclability. One can envisage this becoming a requirement for building materials, which would put additional pressure on their selection.

Today, there is a move towards high-strength and monolithic materials. These give durability but, on demolition, they are only suitable for hardcore. Future generations may not thank us for this. If recyclability becomes a requirement, it could bring into question all the materials we use.