Building engineering physics as the key to buildings of the future

With the increasingly demanding requirements for the energy performance of buildings comes the need for growth in the discipline of building engineering physics — opening up major new opportunities for building-services engineers.

Building-services engineers have long understood how the type of building for which they are designing the services installation impinges on their design — but have generally had little influence on the building design itself.

For centuries, one of the main requirements of a building was to temper the internal environment by interacting with the ambient environment. The limited range of materials available also constrained the design of buildings.

With the industrial revolution making possible new materials for construction and advances in science and mathematics making it possible to engineer larger buildings without the risk of them failing, it became possible to better design buildings for their purpose as commercial and industrial environments. Cheap energy made it possible to design highly serviced buildings to achieve comfortable internal conditions — almost without regard to the form of the building itself.

More recently, concerns about global warming have led to the energy consumption of buildings becoming a major political issue. Building Regulations and Part L have demanded major step reductions in the energy consumption of new buildings and major refurbishments. The current regulations, dating from 2006, required a 25% improvement over the 2002 regulations. The forthcoming 2010 regulations will require a further 25% improvement.

Looking to the future, the target is for zero carbon emissions from new domestic buildings by 2016, with non-domestic buildings close up behind by 2019.

Whereas in the 20th century many buildings were totally dependent on fossil-fuel energy to make them habitable, in the 21st century, buildings must be designed to function with much lower levels of energy dependency.

Achieving that objective is beyond the scope of building-services engineering by itself, and there is a growing appreciation of the role of building engineering physics, which is discussed in a report from the Royal Academy of Engineering* prepared by Prof. Doug King, principal with King Shaw Associates and Visiting Professor of Building Physics with Bath University.

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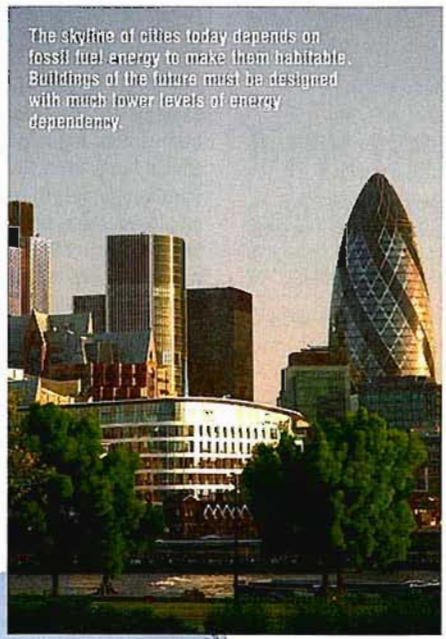


The skyline of cities today depends on fossil fuel energy to make them habitable. Buildings of the future must be designed with much lower levels of energy dependency.

◀ What not to do — on-site renewable energy makes negligible contribution to the energy demands of conventionally designed buildings. The priority must be to engineer building to minimise energy demands in the first place.

So what is building engineering physics? A simple definition is it being the science of optimising the physical characteristics of buildings and their systems to balance these energy demands, exploit natural energy sources and minimise the reliance on artificial energy.

Building engineering physics complements and supports the discipline of building-services engineering. Its scope also includes the engineering performance of parts of the building not traditionally considered to be systems, such as the architectural form and envelope.

The problem is that there is a shortage of building engineering physicists. Doug King observes in his report, 'The discipline that traditionally deals with energy conservation and building performance, building-services engineering, has risen to the challenge to some extent, but engineers in this field typically have had little engagement with architectural or structural design and therefore often lack understanding of the total construction. Architects and structural engineers who understand the construction may not have encountered energy-conservation issues. This position is further exacerbated by the severe engineering skills shortage in the construction industry generally.'

CIBSE's guidelines for the accreditation of undergraduate degrees recognise the importance of building engineering physics. The requirement is that 25% of the taught content comprises the fundamentals of engineering and building engineering physics.

Unfortunately, there are very few courses. CIBSE itself accredits only 16 undergraduate degrees as suitable for chartered engineer in building-services engineering. They are from 12 institutions, including the Open University. Of these degrees, only three courses of full-time study and one from the Open University lead to MEng, and so satisfy the requirements of the Engineering Council for Chartered Engineers without additional studies.

In contrast, the Joint Board of Moderators for civil, structural and highway engineering sets no requirement for building engineering physics at all. JBM accredits courses from around 50 universities, with over a hundred degree courses at MEng alone. Only about 10 universities offer any identifiable building engineering physics contents, but this can be as little as one unit.

The situation is better at postgraduate level. There are some 30 masters degrees accredited by CIBSE for studies on top of a bachelors degree to achieve chartered-engineer qualification. Some courses are designed as conversion degrees for students from a wide range of backgrounds, so they can lack engineering rigour.

Even courses teaching the fundamental

* 'Engineering a low-carbon built environment — the discipline of building engineering physics' can be downloaded from www.raeng.org.uk

principles of building engineering physics often insufficiently explore its application to low-carbon buildings to attract students to take up the challenge.

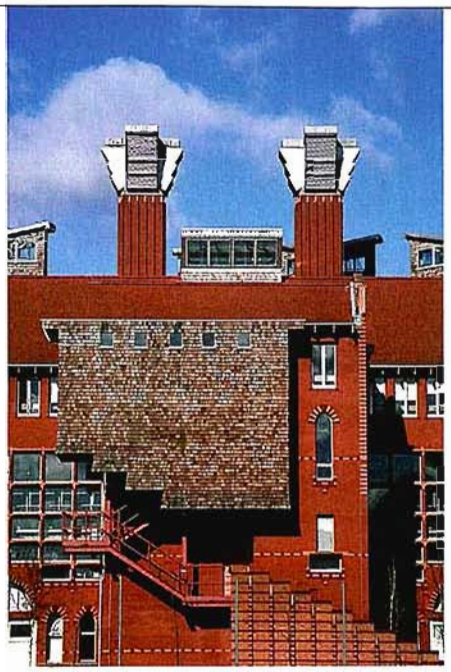
The building-services-engineering sector has punched above its weight in helping to achieve major reductions in the carbon footprint of buildings. The increasing need to consider the thermal elements of a structure as part of the overall environmental control system means architects often look to the building-services engineer to define their performance and design detailing — an area in which building-services engineers traditionally have little training.

The detailed calculations of building carbon emissions required by Building Regulations are generally undertaken by building-services engineers, who may not be fully conversant with the construction details, or by a third-party consultant, who may have only scant knowledge of the design.

Doug King's recommendations at the end of the report are wide ranging and attach much importance to the role of building-services engineering and CIBSE.

He urges the Government to establish how many new building-engineering physicists will be required to enter the profession over the next decade, both at chartered-engineer and engineering-technician level.

The message to universities is that building engineering physics is an engineering discipline for the future of the built environment. The subject, and particularly its application to the design of low-carbon buildings, needs to become a core part of all civil, structural and architectural degree courses — not just building-services engineering courses.



The Queens Building at De Montfort University was designed by Short Ford Architects with Max Fordham LLP as environmental engineer. It is designed to be naturally ventilated and daylit, the results being explicit in the architecture. The tall chimneys provide natural ventilation for the lecture theatres..

His recommendations to professional engineering institutions include finding a replacement for the term building-services engineering. Doug King believes the term does not convey the importance of the field or adequately describe all the actual work of practitioners. He says, 'Finding appropriate technology to describe it will be fundamental to attracting the brightest and best into the most critical field of engineering that exists today. The emerging field of low-carbon engineering must be afforded the respect and status that will attract the best engineers of each new generation.'

He also asserts that one of the established institutions must adopt the field of building science/building engineering physics/low-carbon engineering and nurture and promote it to provide recognisable status, career progression and appropriate codes of practice, education and continuing training for professional building engineering physicists. There is a need to highlight the types of work in the field appropriate to the levels of registration. It must be possible to become a chartered engineer whilst engaged in the field of building engineering physics.

CIBSE is presented with the challenge of urgently embracing all aspects of low-carbon building design — not just the energy-efficient design of mechanical and electrical systems. He comments, 'When CIBSE champions these issues, of which building-services engineering is a sub-set, it will justifiably be a leading professional engineering institution in the sustainability debate.

It all feels very much like the road that CIBSE is already travelling along.