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MOVES TOWARDS PERFORMANCE-BASED STANDARDS IN THE U.K. AND IN THE EUROPEAN COMMITTEE FOR STANDARDISATION (CEN)

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ABSTRACT

This paper focuses on the moves towards the use of Performance-based Codes and Standards in the U.K. and in European Standards, and deliberately does not discuss parallel developments in other Countries. It is written from a background in smoke movement and control. The historical development in the U.K. is outlined, and the importance of the "Relaxation" procedures available under the pre-1985 U.K. Building Regulations is indicated. Since 1985 the U.K. Building Regulations have been completely performance-based, although the supporting documents provide a fully prescriptive approach for the most commonly-found types of building.

It was realised that for widespread use, performance-based standards require a strong educational base, and the last few years have seen the development of a National Core Curriculum in Fire Safety Engineering (FSE), and of courses up to First Degree level in three U.K. Universities. One of these courses has formed the basis of a first degree course at the City University in Hong Kong.

At the same time as these developments, there was a growing feeling that a Standard Code of Practice was desirable to provide an agreed structure for the application of Fire Safety Engineering principles. This has lead to the drafting of a British Standard Draft for Development (BS DD 240), which is currently being reviewed in the light of comments received; and to work currently under way in ISO, the International Organisation for Standards, to produce an equivalent draft. Meanwhile there is a trend to rewrite Means of Escape and other Standards in a form which facilitates the use of FSE, by specifying the critical limiting values of important parameters without specifying a mandatory calculation methodology.

CEN has not yet agreed to the preparation of a European Standard for Fire Safety Engineering, although this is said to be only a matter of time. It is probable that the ISO draft will provide a starting point. Meanwhile attempts to draft design ENs in the field of smoke control using "Normative" critical values for parameters, and "Informative" calculation procedures are intensely controversial.

1. INTRODUCTION

The trend towards performance-based Codes and Regulations aimed at achieving fire safety in buildings is world-wide. Ideas have been exchanged between Countries, and have been modified to meet local circumstances. At different times there have been advances from the U.S.A., from Australia, from New Zealand, and from elsewhere. The present paper focuses on the U.K. experience as a means of identifying the trends and to put them into a single historical context, but the contributions of these others should not be overlooked in any wider study.

The present author has approached the subject from a background as a researcher into methods of smoke control, which have been essentially performance-based in the U.K. since the 1960s. Consequently many examples have been drawn from the field of smoke control.

Most fire safety Regulations, in most Countries, have historically been expressed in the form of "Prescriptive" rules. That is, the building designer and the regulator enforcing the Regulations are guided by detailed instructions allowing for no deviation from the authorised approach. This has the advantage of clarity (not always realised in the actual wording!) as well as giving little room for corrupt approvals, but has the disadvantage that it makes no provision for innovation in building or fire precautions techniques. Another disadvantage is that it is relatively difficult to update the requirements as techniques advance, sometimes threatening to "fossilise" the requirements despite advances in other less prescriptive Countries.

An alternative approach has been to allow any combination of fire precautions which achieve a required minimum level of safety, subject to confirmation by the regulator that the methods used have been: appropriate to the problem; correctly applied; and meet the intentions of the Regulations. This approach to achieving safety is described as being "Performance-Based". This approach allows for innovation without any difficulty, but can be more controversial.

2. U.K. BEFORE 1985

The history of Fire Regulations in the U.K. has been told elsewhere [e.g. 1]. Some early attempts at legislation in London date from 1189 (not a success because there was no provision for enforcement [1]), and 1246 (banning wooden chimneys), but the first really effective regulations essentially started with the Great Fire of London in 1666, after which the first regulations specified minimum separation distances between buildings on main streets, as well as placing restrictions on the materials which could be used for construction. Various other controls were developed piecemeal over the following centuries, and continued to focus on the prevention of fire spread within and between buildings by containing the fire or by physical separation. The design of structural compartmentation and of separation had been largely empirical, and the controls were expressed in a very prescriptive manner, often going into considerable detail.

This piecemeal development gradually refined the regulatory controls so that by the middle of this century they primarily covered life safety and the protection of Means of Escape within buildings, while continuing to be concerned with the prevention of conflagration i.e. with the prevention of fire spread between buildings. Unfortunately these controls were enacted in a variety of separate Acts of Parliament [e.g. 2-4], as well as many Local Acts setting out different rules for different parts of the Country.

Between the mid-1960s and 1973 (when Means of Escape in case of fire was first introduced to them), the Building Regulations consolidated most of these into a single Act, although Local Acts continue to allow additional requirements to be applied in parts of the U.K. where appropriate. It should also be realised that Scotland and Northern Ireland have their own Regulations, which have developed in a manner closely linked to those for England and Wales.

The new Building Regulations were still prescriptive in form and in detail, although much of the detail was left to separate British Standards which could be called up by the Regulations and thus be given regulatory status indirectly. The Regulations made it clear that there was an alternative route available for compliance, based on "Relaxations from the Regulations". In the present author's words, this allowed the building designer to use any combination of measures which, in the opinion of the Building Control Officer responsible for enforcing the Building Regulations, would give at least as good a level of safety as the prescribed measures even though the actual measures were different. In practice the Building Control Officer received assistance and guidance from Fire Officers and from the Central Government Departments, especially on the more complex building designs. This effectively constituted a Performance-Based approach to regulation, but without being codified as such.

A good example of this system in operation concerns Covered Shopping Malls, which from 1972 in the U.K. could not be built without breaking the "fire compartment maximum volume" prescriptive rules, but for which there was a centrally-published document advising regulators of the minimum package of measures which would allow "Relaxation" [5]. This system allowed the acceptable package of measures to be updated frequently as new research results became available.

The principle of using National Standards and Codes of Practice to give details which can be called up by Regulations is used in many Countries. There is much variation, though, in how this principle is applied. Some Countries had, and still have, a much closer link between Regulations and prescriptive Standards, with the equivalent of Relaxations being more difficult. Germany is a good example of this. Hong Kong was until recently another such example, although Hong Kong has found it easier than many European Countries to update its Fire Service Department Ordinances and Building Regulations. It is not uncommon for some European Countries to find that their prescriptive rules lag behind the "state of the art" by 10 or even 20 years.

3. U.K. SINCE 1985

In 1985, the UK adopted a different formal approach to regulating for fire safety. The Regulations became simpler. In effect, and deliberately over-simplifying, they now said "You must build a safe building", without any details being given in the Regulations themselves as to how this should be done. In other words, the UK Building Regulations, including the Fire Safety provisions, became totally performance-based.

At the same time, a new series of government documents was created - the Approved Documents to the Building Regulations. Approved Document B [6] covers fire precautions, and gives prescriptive rules for many of the more common (and the simpler) design scenarios. The Approved

Document continues and extends the practice of calling up much of its detail from British Standards. It also continues to make it clear that non-prescribed design solutions can be adopted on a case-by-case basis, subject to the provision of convincing proof.

It can be seen from this that the UK has, for more than a quarter of a century, allowed "performance-based" approaches for satisfying the safety requirements of the Building Regulations.

As the number of performance-based Relaxations increased, it became obvious to many Building Control Officers and to the Fire Services that their own people were being forced to become conversant with the new techniques in order to be able to do their jobs. Some, it has to be said, coped better than others. In general, however, we have seen in the UK a significant improvement in the ability of many regulators to assess performance-based building designs. This process still has a long way to go, and we have also seen a growth in the use of specialist Consultants employed by regulators to check the validity of performance-based designs submitted for Building Regulations Approval.

4. FIRE SAFETY ENGINEERING

The term "Fire Safety Engineering" became established in the UK in the early 1980s. Many designers of fire protection systems who had been taking advantage of the "Relaxation" procedures suddenly found that they had been Fire Safety Engineers for years, without having known!

The biggest change accompanying the new name was, however, a gradual shift in perception. People increasingly realised that it was not sufficient to calculate (i.e. to engineer) separate aspects of fire protection: they should instead be thinking of the entire building as a whole, with every fire precaution fitting into the greater whole.

This process of a "paradigm shift" is still in progress, and has a very long way still to go before everyone in the field of fire safety accepts the concept of "integrated" fire protection measures contributing to overall safety. We can still see buildings where the fire resistance of structure takes no notice of sprinklers, which in turn take no notice of smoke control, which in turn take no notice of the materials making up the linings and contents. And in every case vice versa is often true, and in every combination imaginable.

5. EDUCATION

It became clear in the UK that the move toward the new philosophy would require major efforts in education: for the designers, for the regulators, and for the creators of Standards and Regulations. This lead to the development of a "National Core Curriculum" in FSE by 1993/4, with contributions from government departments, academics, professional Institutions such as the Institution of Fire Engineers and the Institute of Fire Safety, the Fire Services, and others. This in turn assisted the establishment of FSE courses, including the Degree courses at the University of Lancashire, the South Bank University (London), and the University of Leeds. It is worth noting here that the first of these is the basis of the Degree course at the Hong Kong City University. I would also like to mention here the MSc course in Fire Safety Engineering at the University of Edinburgh established in 1973, which helped to create the conditions for the later developments.

6. FIRE SAFETY ENGINEERING CODES OF PRACTICE

It was felt by many that education, while essential, was not enough. In the early 1990s moves began to prepare a Standard Code of Practice which would guide both the designer and the regulator in how to apply FSE principles to a building. This idea was (and still is) full of traps for the unwary drafter of such Standards. For example, FSE is now an academic discipline - and who can standardise an academic discipline? Who would try to write a standard for the application of Physics, for example? Nevertheless, it was felt that it would be useful to prepare a document which identified which problems should be considered in fire safety design, and in which order they should be tackled.

This lead to the preparation of what became British Standard Draft for Development 240 [7], and to the simultaneous development of the initially similar, but now diverging, ISO draft on FSE (not yet published). DD240 attempts to lead the user through all the aspects which might influence the designer of fire safety for buildings, including the psychological and physical aspects of human behaviour. Risk analysis is introduced as an important technique for assessing the overall threat, and to establish the relative importance of different fire precautions for the circumstances of the individual building. It very clearly recommends the creation of a design review team to treat the entire building in an integrated manner. It establishes a "route map" which can be followed from problem to problem, and points the way to solution methods for each problem, in a systematic way. Inevitably in any such systematic approach, large areas have been revealed as needing further research to supply the data needed by the designers.

DD 240 is still very controversial. Some argue that it is too complicated to apply to any except the largest and most complex buildings. This is countered by the suggestion that it should be modified to allow its application to only those parts of the design which depart from the prescribed rules in the relevant Codes and Standards called up by the Approved Document. Some argue that the inclusion of design equations has lead to the inclusion of too few/too many/too complicated/too simple formulae. This author's personal opinion is that it would be better to eliminate all design equations from the draft and instead to "call up" other, non-standard documents which describe the calculation procedures required for each aspect of the design. The DD would then serve to guide the user on how to integrate those generic procedures without having to focus on a single procedure which might soon be replaced by new research leading to better methods. Meanwhile, at the time of writing, the DD is being reviewed in the light of comments received, and should not be regarded as being the eventual full British Standard.

This performance-based philosophy has taken root in some of the BSI committees which have historically written prescriptive standards. The intention is to structure the new standards in ways which will make it easier for them to fit into a performance-based world. For example, BS 5588 Part 10 [8] mixes a mainly prescriptive approach on most matters with a performance-based approach to smoke control. It specifies critical values of key parameters (e.g. the minimum acceptable height of clear air beneath the buoyant smoke layer in the smoke ventilation system in the Malls), while simply referring the reader to another document [9] describing how to design the smoke ventilation system. This has the effect of telling the user of the Standard that the drafting committee regarded the "outside" document as describing an acceptable method for design calculations, and is in effect a "default option" if the designer does not know of any better alternative. The same approach is adopted even more clearly in the more recent BS on atrium buildings [10].

7. CEN (STRUCTURE AND ORGANISATION)

The primary function of the European Standards Organisation (CEN) is to create common standards throughout Europe and thus to remove non-tariff barriers to trade. It is not its primary function to improve the levels of safety overall. Related to this is the fundamental restriction that no CEN Standard can overthrow what is a regulatory requirement in any member Country. This can create problems where Standards are closely linked to the Regulatory system in many countries - as is the case for smoke control.

There has been a great confusion in many minds over the relationship between CEN and the EU, especially as the number of EU member states increases. CEN is a body established by international treaty. Its member countries include some which are outside the European Union (e.g. Switzerland).

Any member country within CEN, or the Commission of the EU, can request the creation of a European Standard (known as a European Norm, or EN). If agreed, this becomes a Work Item (or if the Standard has more than one Part, as is the case for smoke control, several Work Items), and it takes its place in the hierarchy of committees which will do the drafting.

When a draft has been produced to the satisfaction of the committee having responsibility, it is referred back to the National Standards bodies for comment. Comments go back to the responsible committee, which discusses them and amends the draft. The final version undergoes editing, and then goes for National Vote via the National Standards bodies. There is a complicated system weighting the national votes by size of country, and setting a minimum number of votes for acceptance.

When/if a draft is accepted, its adoption as a Standard becomes mandatory for all member Countries within CEN. The EN replaces all existing national Standards (where they exist) on the same subject.

The EU Commission has created a document known as the Construction Products Directive (the CPD) which details (at least for the fire safety field) which building functions and some generic types of product are important. The CPD is very wide-ranging, but lacks detail in terms of the important parameters, etc. There is an additional document, known as the Interpretative Document (or ID) which expands on the generic products and parameters which have to be standardised. The ID includes for example both smoke control using pressure differentials and Smoke and Heat Exhaust Ventilation Systems (SHEVS)., and details a list of generic products needing standardisation.

It also recognises that some additional Standards will be needed to support the proper application of the product Standards.
Those topics identified as requiring European Standards are Mandated - i.e. CEN has been asked

to produce these Standards. Note however that the Mandates are not CEN categories. Mandates are provisions of the EU.

8. CEN (FIRE SAFETY ENGINEERING)

There is not yet any definite proposal for an EN explicitly on FSE. Nevertheless, there have been discussions in several committees about the need for such a Standard, and it seems likely that one will be required before too much longer. The Vienna Agreement has a provision that if CEN wants to start work on a new Standard where there is already an actual or a draft ISO Standard on the same topic, then that ISO document will serve as the starting point for CEN. It follows that the current ISO draft may be adopted by CEN, but that this is not certain.

Meanwhile, there are some performance-based features of some existing draft ENs currently being drafted. In the field of smoke control, there is a Mandate for the preparation of a "design" standard for smoke and heat exhaust ventilation systems (SHEVS) in support of the product standards being prepared for SHEVS hardware such as smoke ventilators, fans, and smoke curtains, et cetera. It has long been recognised in the UK and many other (mainly Northern) European countries that the design of a SHEVS inevitably requires considerable calculation, and must be performance-based.

The approach adopted has been to make Normative (i.e. mandatory) key procedures (e.g. calculating the amount of air which mixes into the smoke plume on its way to the smoke reservoir; and calculating the deflection of smoke curtains due to a smoke layer's buoyancy) and key values (e.g. the clear height below a smoke layer on an escape route); while keeping the actual calculation procedures "Informative" (i.e. not mandatory) in separate Annexes. Each annex effectively acts as a "default option" for the designer and regulator in the absence of convincing evidence for a better method. It can be readily seen that this approach is very similar in principle to that currently being developed in such British Standards as BS 5588 Parts 7 and 10.

This philosophy has caused difficulties for those Countries which feel they must have completely prescriptive Standards. This especially affects Germany and France. The resulting controversy continues, with a polarisation of views between Countries' representatives. Attempts to resolve the problem have included changing the drafts into a "Design Guide" format - i.e. using "should" instead of "shall", and trying to clarify to what extent regulators in affected Countries can be selective in calling up different requirements from within an EN. We still await resolution of this fundamental problem, but meanwhile work continues.

9. CONCLUSION

As buildings become more complicated, and as fire precautions become more versatile in allowing architects greater design freedom without any reduction in levels of safety, the pressures to adopt performance-based designs become more compelling. This has lead to the recognition of a need for better education in Fire Safety Engineering, and has also lead to the development of Codes of Practice which guide the user in the best methods of integrating different fire precautions into the optimum overall safety plan.

It is also becoming the practice to write Codes of Practice for individual fire protection techniques which are compatible with Fire Safety Engineering. These are based on the idea that performance targets should be mandatory; while the calculation procedures can be "informative", thus allowing for the easier introduction of innovative or improved methods arising from new research.

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