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FUTURE DIRECTIONS FOR EUROCODE 8

Edmund BOOTH[1]

This paper argues that the European seismic engineering community should be looking beyond the publication of the second generation version of the seismic Eurocode, EN1998 (EC8), expected in around 2020, to a third generation version appearing some five years later. It reports the establishment of a European Association of Earthquake Engineering (EAEE) Working Group entitled 'Future directions for Eurocode 8'. This is charged with considering, at a high level of general principle, the third generation needs of EC8. The paper invites comments and input to the Working Group, which the author chairs. The Working Group is expected to report in 2015.

Background to the process of revising the Eurocode suite

After a gestation period of nearly 20 years, the first generation version of EC8 was finally published in 2004, and (with a few detailed changes) this version remains current. However, the process to publish a second generation of EC8 (together with all the other Eurocodes) has now started, and is expected to be concluded in around 2020. The process is rather complicated, but essentially is in two concurrent parts, as follows.

Firstly, a 'Systematic Enquiry' (an invitation to National Standards Bodies to provide comments and proposed revisions to the existing text, using a specified format) has already been launched for a number of the 58 parts of the Eurocode suite, including EC8 Parts 1 and 3, and will close in the autumn of 2014. Enquiries for the remaining parts will follow in subsequent years. Further information on the 'Systematic Enquiry' is given on the British Standards Institution (BSI) website.

Secondly, a wider ranging 'evolution' of the Eurocode suite will take place. The European Standardisation Organisation CEN has made a submission to the European Commission, setting out a detailed proposal for this evolution. Project Teams, which are expected to receive limited funding from the Commission, will be set up by CEN to produce revised drafts of all the Eurocodes incorporating the changes set out in CEN's proposal. The Project Teams will also be charged with taking account of such responses to the 'Systematic Enquiries' as their responsible CEN technical sub-committee (sub-committee CEN/TC250/SC8, in the case of EC8) decide to pass on to them; however, the Project Teams will not receive any funding from the Commission for this additional part of their activity.

The drafts which emerge will be reviewed, and most likely modified, by the responsible sub-committees. Final drafts will then be submitted to the National Standards Bodies representing the 33 member nations of CEN (for example, BSI in the case of the United Kingdom) for approval by qualified-majority voting. Only then can the Eurocodes be published for general use.

At the time of writing, formal European Commission approval for CEN's evolution proposals had not been given, but it is hoped that the Project Teams for the first phase of the process will start work in early 2015, with phases two and three following in 2016 and 2017.

[1] Principal, Edmund Booth Consulting Engineer, Tring UK, edmund@booth-seismic.co.uk

Guiding principles for the second generation of Eurocodes

There are three principles guiding the changes that will be acceptable in the evolution process. The **first principle** is 'stability'; having been faced with the major upheaval posed by adopting a completely new set of governing standards, European structural engineers would be unlikely to take kindly to having to take on board further radical changes at this stage. So radical changes are not envisaged, although provisions for the retrofit of existing building and bridge structures will be an additional topic for the second generation of the Eurocode suite.

The **second principle** is improving ease of use. Many structural engineers consider, sometimes with justification, that some of the present Eurocode rules are hard to follow, unnecessarily complex and 'over-academic'. Moreover, there are difficulties presented by the organisation of the material, particularly the need to refer to many different parts of the Eurocodes during the design of a single structure. The goal is to make the second generation of Eurocodes easier to use than the first.

The **third principle** is harmonisation of Nationally Determined Parameters (NDPs) which allow National Standards Bodies to make choices (sometimes quite major ones) on the values of parameters and the application methods to be used within their countries. The original reason for embarking on the creation of a suite of European structural standards was to create a 'level playing field' for structural design across Europe, and NDPs clearly interfere with this goal.

The evolution of EC8 and the EAEE Working Group

Given a blank sheet of paper, though, would further changes be desirable which did not comply with these guiding principles? Ease of use is without question an admirable goal, though of course balancing it with producing safe and efficient rules for such a complex process as seismic design is not easy. Harmonising NDPs is a matter of finding an international consensus; since earthquakes and the physics which drives structural response to them don't respect national boundaries, that should not in principle be a problem, although of course building practices and materials do vary between countries, and it will be harder to achieve in practice. Maintaining 'stability' in EC8 does however present a significant problem; as Booth and Lubkowski (2012) argue, seismic engineering is a fast evolving discipline, and many of the ways of tackling problems which were appropriate when EC8 was originally being developed in the 1990's have now been superseded by better, and in many cases radically different, methods. As one example, defining design response spectrum by scaling a number of fixed spectral shapes to a 475 year return period peak ground acceleration is now widely agreed to have serious limitations as an approach; Booth and Lubkowski (2012) cite a number of others. Waiting until 2020 to consider what more radical changes might be needed to the second generation EC8 would, they argue, be too late; the process of looking ahead to the long term possibilities for change should start now.

Accordingly the EAEE has established a Working Group (WG1) entitled 'Future directions for Eurocode 8'. The purpose of WG1 is not to draft detailed new clauses for EC8; that is the prerogative of the CEN Project Teams and sub-committee TC250/SC8. Rather it is to set out broad principles which it recommends that EC8 should try to achieve by the time of its third generation appearance, in the same way that US earthquake engineers did in their seminal Vision 2000 report (SEAOC 1995). WG1's terms of reference are as follows.

1) Review state-of-practice and state-of-art methods in the seismic design of new buildings and their contents which are currently employed by engineers in Europe and elsewhere, and identify the ways in which EC8 currently does not address these methods.
2) Set out a long term vision for EC8 to be achieved by the year 2025.
3) In the light of the CEN proposals for the current evolution process, identify those changes necessary to achieve this long term vision which would be feasible within the current process.
4) Recommend changes to EC8 to take place during the subsequent evolution period, in order to achieve the long term vision more fully.
5) Prepare notes on additional aspects to consider for the seismic resistant design of non-building structures (bridges, towers & chimneys, pipelines, tanks, silos)
6) Prepare notes on additional aspects to consider for the seismic retrofit of buildings & bridges.

7) Deliver the report on the Working Group's findings and recommendations to the EAEE executive committee, with a copy to CEN sub-committee TC250/SC8.

Current members of the Working Group come from consulting practices and academies in Austria, Belgium, France, Greece, Italy, Portugal, Slovenia, Switzerland and the United Kingdom. It is hoped that a Turkish engineer will join in future. Some secretarial and other practical support is kindly provided by JRC Ispra. The Working Group intends to produce its final report during 2015.

The Working Group has organised a Special Session during 2ECEES, to present to the European earthquake engineering community its findings to date, and to invite discussion of its work. Further comments are welcome at any time, and should be sent to the author of this paper, who chairs the Working Group, and whose contact details can be found on the first page of this paper.

REFERENCES

Booth E and Lubkowski Z (2012) "Creating a vision for the future of Eurocode 8", *Proceedings of the 15th World Conference on Earthquake Engineering*, Lisboa, Portugal, 24-28 September

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