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*Erkki Liikanen, European commissioner for enterprise and the information society: 'The importance of this recommendation for European harmonisation in the construction industry cannot be underestimated.'*

# European Commission formally recommends Eurocodes

by Simon Fullalove, Editor

The European Commission has formally recommended the impending set of 56 structural Eurocodes as 'a suitable tool' for designing construction works, checking the mechanical resistance of components and checking the stability of structures.

Recommendation 4639 of 11 December 2003 says member states should recognise that construction works designed using Eurocodes will conform with the essential requirements of mechanical resistance and stability, safety in use and safety in case of fire.

Erkki Liikanen, European commissioner for enterprise and the information society, said: 'The importance of this recommendation for European harmonisation in the construction industry cannot be underestimated. Eurocodes are a state-of-the-art tool which will provide a better level of safety for our citizens. Member states should encourage their use as the standard for designing buildings and civil engineering works.'

## Most significant document to date

According to chairman of the Eurocodes Expert advisory group Haig Gulvanessian: 'This is the most significant document ever published on adopting Eurocodes. It's the first time that the EC has given a strong recommendation to member states on adoption – all we had before were objectives. This recommendation tells the construction industry that the Eurocodes are here and we need to get ready.'

The Commission has warned member states that they should only diverge from recommended values in Eurocodes when 'geographical, geological or climatic conditions, or specific levels of protection make that necessary'. States diverging too far from recommended values, such that they result in 'unjustified hindrance to free trade,' will be told to change their nationally determined parameters.

Member states need to notify the Commission of the nationally determined parameters in force in their territory with two years of the date of which the each Eurocode part become available.

## Application to construction products

To guarantee the free movement of structural construction products within the European Community, the Commission says that member states should make national provisions for the mechanical strength of such products to be assessed by the Eurocodes.

Member states are also encouraged to undertake research to ensure the latest research developments are integrated into Eurocodes. National research funding should be pooled – particularly with regard to earthquake and fire resistance – so that it can be used at community level.

Finally member states have been told to promote instruction in the use of the Eurocodes, especially in engineering schools and as part of continuous professional development courses for engineers and technicians.

The European Commission's core recommendations are printed in full on page 2 of this issue. ■

## in this issue:

# Editorial:

By Haig Gulvanessian

In this second issue of *Eurocodes News* we lead with the story of the European Commission's December 2003 recommendations for universal adoption of the structural Eurocodes, which are set out in full on this page. This recommendation, which asks member states to use the codes for all construction works and products, sets the wheel in motion for full-blooded implementation across the board.

It is anticipated that all the Eurocodes will be positively voted by 2005. Following a period that allows for the production of the national annexes, and co-existence with the national codes, the national codes will be withdrawn. The date of withdrawal will depend on the appropriate package, and should be between 2008 to 2010.

What decisions will influence the management of an organisation to implement the Eurocodes? The Eurocodes will open European and world markets and encourage innovation in the construction industry.

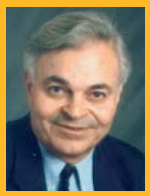
The single, most important question an organisation has to make is when to implement the Eurocodes: as soon as national annexes are available or to wait until national codes are withdrawn? This is a commercial / business decision.

Such decisions will require the consideration of the following factors.

- *Timing,* which needs to consider the dates when the Eurocodes will be available, the timetable for implementation, the dates for withdrawal of national codes (i.e. BSI) and when Government will require their use. Product manufacturers and those organisations involved in public works will be the first to use the Eurocodes under the Construction Products and Procurement Directives.
- *Office procedures* that will require the consideration of the technical differences between the Eurocodes and national codes, availability of designers' guides, the training needs for all levels of staff and any differences in quality assurance procedures.
- *IT implications*, where the availability of good quality software will be essential before implementation can be considered.
- *Competition* – although the Eurocodes will provide opportunities in Europe and overseas, any company must be conscious of threats. Where there is an opportunity there is a threat.

Decisions on implementation will be different for the larger international organisations where market forces will be a key factor, compared to smaller companies only working nationally.

This newsletter and the **www.eurocodes.co.uk** website will provide the latest information to help those making the decisions.



*Professor Gulvanessian is construction division director of BRE, visiting professor at Imperial College and chairman of the EN1990 and EN991 drafting committees. He is also chairman of the Eurocodes Expert advisory group.*

# European Commission Recommendation of December 2003

This following is an extract from *Commission recommendation of 11/12/ 2003 on the implementation and use of Eurocodes for construction works and structural construction products*, document number C(2003) 4639.

'The Commission Of The European Communities, having regard to the Treaty establishing the European Community, and in particular the second indent of Article 211 thereof…hereby recommends:

1. Member States should adopt the Eurocodes as a suitable tool for designing construction works, checking the mechanical resistance of components, or checking the stability of structures. Member States should recognise that, in the case of construction works designed using the calculation methods described in the Eurocodes, there is a presumption of conformity with essential requirement No 1 'Mechanical resistance and stability', including such aspects of essential requirement No 4 'Safety in use' as relate to mechanical resistance and stability, and with part of essential requirement No 2 'Safety in case of fire', as referred to in Annex I to Directive 89/106/EEC.

2. Member States should lay down the parameters usable in their territory, hereinafter 'the nationally determined parameters'.

3. Member States should use the recommended values provided by the Eurocodes when nationally determined parameters have been identified in the Eurocodes. They should diverge from those recommended values only where geographical, geological or climatic conditions or specific levels of protection make that necessary. Member States should notify the Commission of the nationally determined parameters in force on their territory within two years of the date on which the Eurocodes become available.

4. Member States should, acting in coordination under the direction of the Commission, compare the nationally determined parameters implemented by each Member State and assess their impact as regards the technical differences for works or parts of works. Member States should, at the request of the Commission, change their nationally determined parameters in order to reduce divergence from the recommended values provided by the Eurocodes.

5. In the absence of technical specifications, as referred to in Article 4 of Directive 89/106/EEC, Member States should refer to the Eurocodes in their national provisions on structural construction products.

6. Member States should undertake research to facilitate the integration into the Eurocodes of the latest developments in scientific and technological knowledge. Member States should pool the national funding available for such research so that it can be used at Community level to contribute to the existing technical and scientific resources for research within the Commission, in cooperation with the Joint Research Centre, thus ensuring an ongoing increased level of protection of buildings and civil works, specifically as regards the resistance of structures to earthquakes and fire.

7. Member States should promote instruction in the use of the Eurocodes, especially in engineering schools and as part of continuous professional development courses for engineers and technicians.

Member States should inform the Commission of all national measures taken in accordance with this Recommendation.

This Recommendation is addressed to the Member States. Done at Brussels, 11 December 2003.

For the Commission
Erkki Liikanen
Member of the Commission' ■

# Thirteen more parts sent for voting

by Malcolm Greenley

Thirteen more parts of the European structural design codes have been circulated for formal vote in the past few months, bringing publication and adoption of all Eurocodes a significant step closer.

The parts include the key 'general rules' sections of the Eurocodes for concrete, steel, steel-concrete composites and timber structures as well as for geotechnical and seismic design.

The eleven parts circulated just before Christmas 2003 were

prEN1992 *Eurocode 2: Design of concrete structures*
– *Part 1-1: General rules and rules for buildings*
– *Part 1-2: Structural fire design*

prEN1993 *Eurocode 3: Design of steel structures*
– *Part 1-1: General rules and rules for buildings*
– *Part 1-2: Structural fire design*
– *Part 1-8: Design of joints*
– *Part 1-9: Fatigue*
– *Part 1-10: Material toughness and through-thickness properties*

prEN1995 *Eurocode 5: Design of timber structures*
– *Part 1-1: General – Common rules and rules for buildings*
– *Part 1-2: General – Structural fire design*

prEN1998 *Eurocode 8: Design of structures for earthquake resistance*
– *Part 1: General rules, seismic actions and rules for buildings*
– *Part 5: Foundations, retaining structures and geotechnical aspects.*

A further two parts were circulated on 22 January 2004, which were

prEN1994 *Eurocode 4: Design of composite steel and concrete structures*
– *Part 1-1: General rules and rules for buildings*

prEN1997 *Eurocode 7: Geotechnical design*
– *Part 1: General rules.*

For further information please contact Malcolm Greenley at BSI on 020 8996 7232, email malcolm.greenley@bsi-global.com ■

# IStructE heads up UK implementation strategy

By David Nethercot, President of the Institution of Structural Engineers

The UK Government has asked the Institution of Structural Engineers (IStructE) to lead a team from across the engineering and construction sectors to develop a strategy for implementing the Eurocodes in the UK.

By the end of April 2004, the IStructE-led strategy committee – which includes a representative of the Eurocodes Expert advisory panel – has been asked to deliver to the Office of the Deputy Prime Minister a co-ordinated scheme outlining: the range of guidance documents, software and training required; the documents and software already in production; preferred authors; estimated costs; funding arrangements and timescales.

## A formidable burden

It is commonly considered that many engineers in the UK will postpone adoption of the suite of Eurocodes until such time as the handbooks, guides and software become available. This is to be expected in view of the formidable burden presented by the 56 Eurocode parts; many of which are relatively complex and incorporate different approaches to current UK practice.

Moreover, many engineers will no doubt only wish to adopt the new codes if they should become mandatory. However, whereas the Eurocodes are not mandatory (except in the case of public works), they will become the *de facto* UK design codes when national codes are withdrawn.

## Urgent need for guidance

As the co-existence period – which is when both UK current codes and the Eurocodes are available for use – is likely to extend effectively for only a 3 to 5 year period, the various aids and guidance documents need to be in place as soon as possible in order to encourage engineers to exploit the co-existence period to their advantage. The timescale is even more urgent in the case of public works.

It is thus extremely timely that the Government has begun to address the issue of the introduction of the Eurocodes and IStructE is pleased it has recognised the importance of developing a coherent and wide-ranging strategy for implementation. It is clearly imperative to begin work now to ensure engineers across the UK are fully prepared for their introduction and adoption.

For further information please contact Dr Sue Doran, IStructE Technical Director, on 020 7201 9110, email doran@istructe.org.uk ■

# Eurocodes Expert advisory group has first meeting

by Simon Fullalove, Editor

The Eurocodes Expert advisory group met for the first time on 4 December 2003 in London. Chaired by Haig Gulvanessian, director of BRE's construction division and chairman of the first two Eurocode committees, the 16-strong group consists of representatives from all parts of the construction industry.

The purpose of the group is to advise Eurocodes Expert, the UK Government-backed campaign to promote the 10 new European structural design codes. The campaign was launched at the Institution of Civil Engineers in April 2003 with a view to becoming the primary reference for all Eurocode users, advising them on the latest developments, training events and support resources.

## Implementation issues identified

At its first meeting the group identified Eurocode implementation issues facing different sectors of the construction industry, including international consultancies, national consultancies, other construction professionals, building control departments, contractors and product manufacturers. Systems were also set up to ensure all information and resources relating to Eurocodes are identified and disseminated through the Eurocodes Expert website and Users' Group.

The members of the advisory group are as follows.

- John Bennett, Institution of Civil Engineers
- John Carpenter, SCOSS
- Susan Doran, Institution of Structural Engineers
- Amrit Ghose, Faber Maunsell
- Malcolm Greenley, BSI
- Robert Hunter-Jones, London Borough of Ealing
- Richard Lawson, Arup Consulting Engineers
- Ian MacPherson, Consultant
- John Mills, Babtie Group
- John Moran, Steel Construction Institute
- Alastair Piper, Cooper & Withycome
- John Redmond, Hurst Pierce & Malcolm
- Howard Taylor, Tarmac
- John Tebbit, Construction Products Association
- Robert Vollum, Imperial College

## Terms of reference agreed

The group also agreed its terms of reference at the meeting as follows.

- To identify and advise on the needs of the profession with regard to implementation – including education, training courses, handbooks and guides, design aids and general information – via the Eurocodes Expert website and *Eurocodes News* newsletter.
- To identify ways of increasing awareness of importance of Eurocodes, through relationships with other professional institutions and low-cost events.
- To identify articles and information for the website and newsletter.
- To advise Government and trade organisations on Eurocodes initiatives through Eurocodes Expert.
- To advise and inform product manufacturers seeking CE markings.
- To report on bidding success and failures of use of Eurocodes.
- To monitor the intended benefits to industry, including success in the international area with regards to opportunities and threats.

For further information please contact Rekha Thawrani, Eurocodes Expert Manager, on 020 7665 2446, email eurocodes@thomastelford.com or visit www.eurocodes.co.uk ■

# EC funds training materials

By Milan Holický, Klokner Institute of the Czech Technical University

The European Commission is funding a three-year project to develop Eurocode training materials.

Due for completion in 2005, the project aims to develop five training handbooks and associated software programmes that will help engineers and students alike to understand and use the Eurocodes.

The planned topic areas of the handbooks will be as follows.

- Handbook 1: Basis of structural design.
- Handbook 2: Basis of structural reliability and risk engineering.
- Handbook 3: Design of buildings.
- Handbook 4: Design of bridges.
- Handbook 5: Design of buildings under fire situation.

Entitled 'Development of skills facilitating implementation of structural Eurocodes', the project is being funding through the Commission's Leonardo da Vinci vocational training programme. Project partners are drawn from seven European countries including BRE in the UK.

For further information please contact Milan Holický on +420 224 353 529, email holicky@klok.cvut.cz, or visit http://eurocodes.cz ■

# UK roadshows planned for March

By Rekha Thawrani, Eurocodes Expert Manager

Eurocodes Expert is running a series of low-cost half-day presentations throughout the UK this month on the implications of the new structural Eurocodes for the British construction industry.

Supported by BSI and the Office of the Deputy Prime Minister, the roadshow-style events will explain the potential benefits of using the Eurocodes, the steps to their adoption and the role of national annexes and nationally determined parameters.

The events will also include an introduction to the head Eurocode, BS EN 1990:2002 *Eurocode – Basis of Structural Design*, and information will be provided on products and services being offered to support implementation of the new codes.

The 10 two-and-a-half-hour presentations are planned in Birmingham, Cardiff, Glasgow, London and Manchester between 17 and 31 March 2004. The cost is £65 + VAT, less 10% discount for additional delegates from the same company. Delegates can also get a £25 discount on BS EN 1990.

For further information please contact Rekha Thawrani, Eurocodes Expert Manager, on 020 7665 2446, email eurocodes@thomastelford.com or visit www.eurocodes.co.uk ■

# EN1990
# UK national annex to head Eurocode circulated

By Malcolm Greenley

BSI has circulated a draft of the proposed national annex to the UK's first European structural design code – BS EN 1990: 2002 *Eurocode - Basis of Structural Design*. The comment period closed on 31 August 2003 and the final version is now being prepared. All comments received have been considered by the BSI committee B/525/1 Actions and Basis of Design.

EN 1990 is the head Eurocode providing the basic rules for design with all the main construction materials. The national annex will give the UK values for the nationally determined parameters in the code, which include

- design working life
- load-combination expressions for ultimate-limit-state verifications
- partial factors for actions
- combination coefficients for accompanying variable actions.

It also provides guidance on the use of the serviceability-limit-state verification rules, together with recommendations for deflections.

Both the draft national annex – the full title of which is DPC: 03/700353 DC: Draft BS EN 1990 National Annex to BS EN 1990: *Eurocode: Basis of Structural Design* – and BS EN 1990 : 2002 are available from BSI Customer Services at 389 Chiswick High Road, London W4 4A, telephone 020 8996 9001, email cservices@bsi-global.com.

For further information please contact Malcolm Greenley at BSI on 020 8996 9000, email malcolm.greenley@bsi-global.com ■

# EN1991
# UK status of Eurocode on snow loads (EN 1991-1-3)

By Paul Sims, BRE

EN 1991-1-3: *Eurocode 1 – Actions on structures – Part 1.3: General actions – Snow loads* was published in the UK by BSI in July 2003 as BS EN 1991-1-3:2003. To enable this document to be used in the UK, nationally determined parameters will be included in the corresponding UK national annex, currently under development at BRE. Following public consultation, the approved national annex will be incorporated in to BS EN 1991-1-3 by amendment.

BS EN 1991-1-3 gives guidance on determining imposed roof loads due to distributions of snow on a selection of standard roof shapes. Site ground snow loads are calculated from a UK ground snow load map using the appropriate specified altitude function. Roof snow load values are obtained by multiplying the site ground snow load by the following specific coefficients

- shape coefficient ($\mu_i$) – determined from the roof shape
- exposure coefficient ($C_e$) – relates to the site topography
- thermal coefficient ($C_t$) – relates to the thermal transmittance of the roofing material.

Shape coefficients are given for load distributions on roof shapes including local conditions due to both uniform and drifted snow conditions. These include

- monopitch roofs
- pitched roofs
- multi-span roofs
- cylindrical roofs
- roofs abutting and close to taller construction works
- drifting at projections and local obstructions
- snow overhanging the edge of a roof
- snow loads on snow guards and other obstacles.

Snow drifts experienced in the UK's maritime climate differ from those in a continental climate such as Alpine Europe. The normative annex B of BS EN 1991-1-3 covers snow drifting in maritime climates and gives shape coefficients for multi-span roofs, roofs abutting and close to taller structures and drifts occurring at projections, obstructions and parapets. Drifting in a continental climate is assumed to be represented by appropriate distributions given in the main body of BS EN 1991-1-3.

BS EN 1991-1-3 introduces the concept of exceptional, or very infrequently occurring, snow loads. Statistical analysis and consideration of the combination of actions given in BS EN 1990: 2002 *Eurocode - Basis of structural design* were used to specify a criteria for exceptional snow loads.

The nationally determined parameters to be included in the national annex are

- advice for the treatment of snow loads at altitudes not covered in the main text
- the choice of design situations and load arrangements
- the use of annex B
- specification of different drift load shapes for some roof types
- specification of the map and expression to be used to determine characteristic ground snow loads
- location and treatment of exceptional snow loads
- values for the exposure and thermal coefficients
- decisions on the application of informative annexes
- references to non-conflicting complementary information.

CEN rules require the national annex to be published within two years of the date of the availability of BS EN 1991-1-3, that is before July 2005. The target date for the national annex to be issued as a draft for public consultation is autumn 2004.

For further information please contact Paul Sims at BRE on 01923 664626 or email simsp@bre.co.uk ■

# EN1992
# A new era in structural design for concrete

By Pal Chana and John Moore, British Cement Association

As reported on page 2, Parts 1-1 and 1-2 of *Eurocode 2: Design of concrete structures* were circulated for formal voting at the end of last year and, all being well, should be published in late 2004. This first generation of these and all other Eurocodes will contain some elements of choice for countries, although recommendations will usually be given for the choices.

One important exception lies in EN 1990 *Eurocode-Basis of structural design*, in which the criteria for choosing between three load-combination expressions for structures are not specified. The choice will be given in the national annex and affects, among other things, the consistency in reliability over the range of potential designs.

## Concrete industry study

In order to help their members in their national discussions, the European Cement Associations (Cembureau) together with the International Bureau for Precast Concrete (BIBM) and the European Ready Mixed Concrete Organisation commissioned Haig Gulvanessian of BRE, who was chairman of the EN1990 drafting committee, to review the implications of the possible choices. The final report was reviewed independently and separately by three other members of the same committee.

Gulvanessian reviewed an earlier study prepared by the Joint Nordic Group for Structural Matters (SAKO). This had been carried out with the objective of 'comparing the level of consistency of safety for various ratios between the permanent and variable actions by considering the three principal structural materials: concrete, steel and glulam timber'. The Nordic report demonstrated that the three load-combination expressions give quite differing levels of reliability for different ratios of variable load to total load ($\chi$).

For most practical cases, concrete structures have a value of $\chi$ between 0.2 and 0.6 whereas steel and timber have a value between 0.5 and 0.8. Hence the choice of load-combination expressions in the national annex for EN 1990 is crucial in order to obtain a consistent level of safety.

## The findings

The study concluded that the choice of the loading expressions should be governed by the following considerations

- potential for achieving adequate consistency in reliability over the range of potential designs
- ease of use for designers, considering both the superstructure and the substructure
- use of the same load-combination rules and partial and combination factors for actions for all the materials
- reliability currently implied nationally, by using the appropriate national codes of practice
- improved economy.

*The UK national annex for the snow-load part of Eurocodes is due out in Autumn 2004*

*Concrete industry study findings of considerations governing choice of load-combination expressions*

| Consideration | Case A (expression 6.10) | Case B (expressions 6.10a, 6.10b) | Case C (expressions (6.10a (mod), 6.10b)) |
|---|---|---|---|
| Level of reliability from use of national codes | Dependent on the country (e.g. same in UK) | Dependent on the country (e.g. same in Nordic countries and The Netherlands) | Dependent on the country |
| Consistency of reliability for range of $\chi$ | No<br>Higher reliability for $\chi$ between 0.2 and 0.6 | Yes | No<br>Lower reliability for $\chi < 0.3$ |
| Usability | As for current national codes that use the format of expression 6.10 | Additional checks required compared to case A. | Exceptionally, additional checks required compared to case A. |
| Economy considering actions only, for a given resistance | As for UK practice | Greater economy for $\chi$ between 0.15 and 0.6. As for Nordic countries and The Netherlands practice | Greater economy for $\chi$ between 0.15 and 0.6. |

The findings can be summarised in a table for the three expressions (cases A, B and C) against four of the criteria, assuming that the same expression would be used for design in all materials in a structure (see bottom of page 4).

### Conclusion

Each of the expressions is already in effective use in one country or another. Case B gives a greater consistency of reliability over the range of load ratios than case A and is therefore more equitable to all materials. When used with appropriate partial and combination factors for all materials, case B would still achieve current target levels of reliability.

Cembureau / BIBM / ERMCO have made the report available on-line at www.cembureau.be as they believe it will make a valuable contribution to the practical implementation of the Eurocodes and in particular to the process of making choices by national competent authorities.

For further information please contact Pal Chana on 01344 762676 or email pchana@bca.org.uk. ■

## EN1993
## Design of steel towers and masts (EN1993-3-1)

By Brian Smith, Flint & Neill Partnership

The need to have specific codes for the design of steel towers, masts and chimneys was recognized by the European Commission from the outset of the programme for EN1993 *Eurocode 3: Design of steel structures*. The draft part of the code for towers and masts was published in 1997 and is currently subject to final editing and translation into French and German prior to going for formal voting.

Towers and masts, by their very nature, are tall flexible structures loaded predominantly by wind – although ice loading on guyed masts has been responsible for many failures. As such they are dynamically sensitive and, in terms of their strength characteristics, they are light frame structures that need to be designed as efficiently as possible – not only from an economic point of view but in order to fulfil their function.

This created problems within the context of the suite of Eurocodes as the part on wind actions (EN1991-1-4) does not deal with either the response of structures in multiple modes of vibration – which is a characteristic of guyed masts, nor does it deal with the drag of lattice structures when mounted with ancillary items such as feeders, ladders and antennae – a fundamental requirement of broadcasting towers and masts. Also, the general Eurocode on steel strength (EN1993-1) is geared to buildings rather than to these light structures.

### Specific rules for towers and masts

Accordingly EN1993-3-1 contains specific rules for the strength assessment of the range of lattice structures that are likely to be met, providing more efficient designs than the use of the standard rules – although these may be used. As far as the wind response is concerned, rules are provided in an annex dealing with both drag and the treatment of dynamic response. Procedures to assess drag are included based on many wind tunnel studies and incorporated in the UK Code (BS8100) as well as in international codes such as the American, Canadian and Australian standards for these structures.

For the response of lattice towers the annex uses the procedures from EN1991-1-4, with adjustments for the particular form of lattice towers, and for guyed masts a static 'patch' loading procedure is incorporated to simulate the dynamic response. Again this has been based on procedures in both the UK code and other international standards, in which it is recognized that full dynamic analysis is not justified for every design. However criteria are provided in the code to determine whether such quasi-static methods can be used, although the design of major masts should always be checked by dynamic response procedures.

### Steel chimney code progressing in parallel

It should be noted that a specific Eurocode for steel chimneys (EN1993-3-2) has also been drafted, in parallel with EN1993-3-1 and by joint project teams, to provide rules for the design of these equally wind-sensitive structures. The draft for this code is also subject to final editing prior to going for formal voting.

It is expected that the two codes will be finalized by mid 2004 and work on the national annexes has already started with a view to completing these by the end of 2005.

For further information please contact Brian Smith at Flint and Neill Partnership on 020 7202 6699 or email bws@flintneill.co.uk. ■

## EN1995
## Timber Eurocode progress in the UK

By Christopher Mettem, TRADA Technology

At the end of January 2004, the UK Structural Timber Codes Committee agreed to transmit a positive vote to CEN for the two main parts of the timber Eurocodes – EN 1995-1-1 *Eurocode 5: Design of timber structures – Part 1-1: General – Common rules and rules for buildings* and *EN 1995-1-2 Eurocode 5: Design of timber structures – Part 1-2: General rules – Structural fire design*.

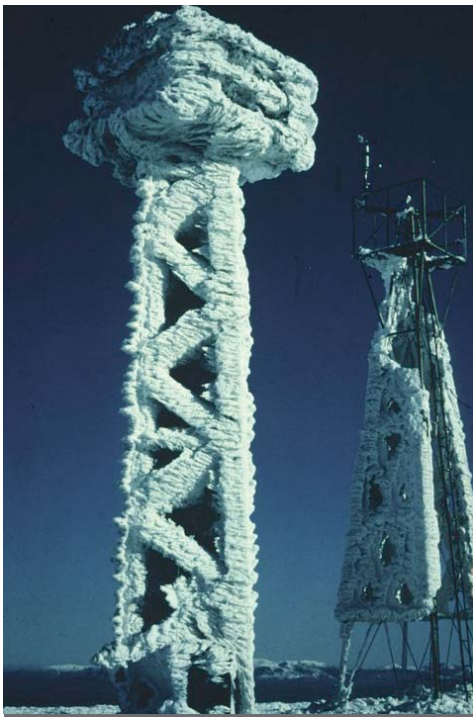
Both documents are founded on the principles and requirements for the safety and serviceability of structures, as well as the basis of design, given in EN 1990, which is already published. Hence for the first time in the UK, timber will have the same safety format for design as steel or concrete, for example.

The material properties section of EN1995-1-1 includes modifications for service class, load-duration and time-related deformations. The first two of these aspects will be not unfamiliar to users of BS 5268: 2, although that is a 'permissible stress' code. The material types are called up through normative references to the new-style harmonised European standards. The latter include indications of means of complying with the Council Directive 89/106/EEC on construction products.

### Glulam product standard imminent

For timber, the types referenced are: solid timber; glued-laminated timber (glulam); laminated veneer lumber and certain structural wood-based panels. Because of timing of accompanying work programmes in the standards committees, it seems likely that the first structural timber product standard to be published by national standards bodies, including BSI, may be EN 14080 *Timber structures – Glued-laminated timber – Requirements*. This could be seen as soon as summer 2004.

In the main timber Eurocode, the section on ultimate limit state design is broadly similar to that for other materials, such as steel. The serviceability limit state section addresses creep in timber structures and deals with methods to limit excessive vibrations. 'Connections with metal fasteners' is a large section, embracing all of the generic lateral load-carrying dowel-type devices.



*The Eurocode for designing towers and masts such as those used for telecommunications should be finalized in mid 2004*

*Sibelius Symphony Hall, Lahti, Finland – glued laminated timber and laminated veneer lumber are among the material types addressed by Eurocode 5*

Manufacturers of prefabricated components and assemblies will welcome the thoroughness with which these are addressed. Items include thin-webbed beams (I-beams are in this category) and also thin-flanged beams, such as stressed-skin panels. Trusses and diaphragms for roofs, floors and walls are also present. For the former, there is a sub-section on connections made with punched-metal plate fasteners.

## Timber bridge Eurocode following

Timber bridges are being included, slightly later, in the Eurocode 5 series as Part 2. This will be the first time that there will have been a structural code of practice on the subject in the UK, making it easier for organisations such as TRADA Technology and Transport Research Laboratory to address needs such as pedestrian crossing bridges.

Liaison has been established with the BS Eurocodes Horizontal Group, Bridges. In line with the intended hierarchy of Eurocodes publications, for many aspects of timber bridge design, Part 2 defers to Part 1-1. However, specialist topics covered include stressed laminated and timber-concrete composite decks and the achievement of durable solutions by means of protective design features.

The bridge part of the code is currently under preparation for formal voting, which is expected to take place in a few months time.

## Designing for fire resistance

The structural fire design code, Part 1-2, is at the same advanced stage as Part 1-1. It identifies prescriptive and performance-based approaches to the task. The former uses nominal fires to generate thermal actions. Hence, cross-reference is required to EN1991-1-2 *Eurocode 1: Actions on structures – Densities, self weight and imposed loads*. The performance-based approach uses fire safety engineering principles.

The material properties section of EN1995-1-2 includes clauses dealing with charring propensities. Both protected and unprotected surfaces are considered in this. In the design procedures for mechanical resistance under fire conditions, simplified rules are included for determining cross-sectional properties through the effective charring depth approach. Connections between members of structures under standard fire exposure are considered and important guidance is included on how to protect metal connections, so as to diminish the tendency for increased heat flux to occur through the fasteners.

For further information please contact Christopher Mettem, TRADA Technology, on 01494 569600, email cmettem@trada.co.uk or visit www.trada.co.uk ■

# Designing footbridges with Eurocodes

By Jean-Armand Calgaro, Ecole Nationale des Ponts et Chaussées

Excessive lateral vibrations of high-profile footbridges such as the Millennium Bridge in London (Fig. 1) have highlighted a potentially critical loading effect not currently solved, or even considered, in international bridge design codes. The Eurocodes give first preliminary answers, but more research is still needed.

The design of footbridges is covered in various Eurocodes, in particular in section 5 of part 2 (*Traffic loads on bridges)* of EN1991 *Eurocode 1: Actions on structures* and, as regards combinations of actions and comfort criteria, in annex A2 (*Application for bridges*) of EN 1990 *Eurocode – Basis of structural design*.

## New footbridges reveal code limits

One consequence of society's desire to improve the quality of life in urban areas has been the increasing number of footbridges being built across roads, railways and rivers and even between buildings. Static loads from pedestrians or cycles are light compared to road or rail traffic so footbridges can be very slender structures. As such footbridges may give rise to specific structural problems that are not (or less) relevant for road and railway bridges. Dynamic instability due to wind actions or to footbridge-pedestrian interaction is an example.

When crossing a footbridge, people can walk in various ways or run, jump or even dance. These types of movements may give rise to vibrations that are not yet adequately covered by design standards – particularly when there are a significant number of people on the bridge deck simultaneously. Vandalism may also occur, such that the structural behaviour is significantly modified and again this is not explicitly considered in the Eurocodes or other standards.

Pedestrian interaction with bridge movements also need to be taken into account. Forces exerted by several pedestrians are not normally synchronised and have different frequencies. But, if one of the natural frequencies of the deck is close to the frequencies of the forces exerted by pedestrians, they tend to modify their walk to synchronise with the vibrations of the bridge. Resonance then occurs, increasing the response of the bridge considerably.

*EN1990 requirements for verifying comfort criteria of footbridges*

| Fundamental frequency of the deck | Verification |
|---|---|
| > 5 Hz for vertical vibrations, and<br>> 2.5 Hz for horizontal vibrations | No verification of comfort criteria is needed |
| 3 – 5 Hz for vertical vibrations, and/or<br>1.5 – 2.5 Hz for horizontal vibrations | A verification of comfort criteria may be required for the individual project |
| < 3 Hz for vertical vibrations, or<br>< 1.5 Hz for horizontal vibrations | A verification of comfort criteria is always needed. |

## EN1991 gives static load models

Simulations based on appropriate dynamic load models are required. At present, section 5 of EN1991-2 (*Actions on structures – Traffic loads on bridges)* gives only static load models for pedestrian and cycle loads. The field of application of these static load models is only weakly bounded by the footbridge width – a value of 6 m is suggested in a note – but this value is only an order of magnitude. In fact, various human activities may take place on wide footbridges and special dynamic analysis may be needed for individual projects.

Three static models of vertical loads are defined in the Eurocode, which are not intended to be used for fatigue verifications

- a vertical uniformly distributed load $q_{fk}$, applicable to footways, cycle-tracks and footbridges, with a recommended value of 5 kN/m² for footways and cycle-tracks and, depending on the loaded length, between 2.5 kN/m² and 5 kN/m² for footbridges
- a concentrated load $Q_{fwk}$, applicable to footways, cycle-tracks and footbridges
- a load representing a service vehicle $Q_{serv}$, applicable only to footbridges as a 'normal' or an 'accidental' load.

In addition horizontal forces are defined and accidental design situations are suggested. For loads on access steps, reference is made to EN 1991-1-1 (*Actions on structures – Densities, self-weight and imposed loads*).

## Verifying comfort criteria

EN 1991-2 does not define dynamic load models of pedestrians. However, it does give a few recommendations and establishes a link with general comfort requirements set out in annex A2 to EN 1990 (see table at top of page).

It is clear that a dynamic study starts with the determination of the relevant natural frequencies of the main structure of the footbridge deck from an appropriate structural model, depending on the dynamic characteristics of the structure. In the absence of significant response of the bridge, a pedestrian normally walking exerts on it simultaneous periodic forces which are

- vertical, with a frequency that can range between 1 and 3 Hz, and
- horizontal, with a frequency that can range between 0.5 and 1.5 Hz.

Groups of joggers may cross a footbridge with a frequency of 3 Hz.

The following comfort criteria are given in draft annex A2 to EN 1990 at the present stage. The maximum acceleration of any part of the deck (excited by the most unfavourable dynamic load model) should not exceed

- $0.5\sqrt{f_v}$ or 0.7 (m/s²), whichever the lower, for vertical vibrations,
- $0.14\sqrt{f_h}$ or 0.15 (m/s²), whichever the lower, for horizontal vibrations,

where $f_v$ and $f_h$ are the natural vertical and horizontal frequencies of the deck (in most cases the fundamental ones) for which resonance with the traffic may occur, that is a natural frequency in the ranges 1.5 – 2.5 Hz for vertical vibrations and 0.75 – 1.25 Hz for horizontal vibrations.

## Dynamic models still not reliable

EN 1991-2 was positively voted (formal vote) on 18 October 2002. Tentative dynamic pedestrian load models had been developed, based on rules given in ENV 1995-2 (*Design of timber structures - Bridges*) and on Professor Kreutzinger's studies, but these load models, with the associated comfort criteria, did not give reliable results when applied to well-known footbridges such as Solferino footbridge in Paris (Fig. 2) or the Millennium Bridge in London. They were therefore not proposed for the formal vote.

Many studies, sometimes very complex, started during the last two to three years but they do not permit, at present, any codification. A major research programme at the European level, associating universities, research centres and consulting companies is needed.

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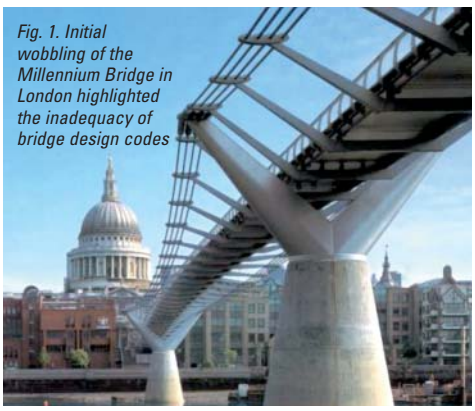

*Fig. 1. Initial wobbling of the Millennium Bridge in London highlighted the inadequacy of bridge design codes*

*Fig. 2. Solferino footbridge in Paris - proposed pedestrian loads models were tested on it but not satisfactorily calibrated*

# Frequently asked questions

**Eurocodes Expert aims to develop a database of responses to frequently asked questions about the Eurocodes. The latest additions to the list of FAQs on the website at www.eurocodes.co.uk are as follows.**

### What is the current situation regarding positively voted Eurocode parts?

Six Eurocode parts – EN 1990 *Eurocode - Basis of structural design* and five parts from EN 1991 *Eurocode 1: Actions on structures* – have been voted positively and have been made available by CEN to the national standards organisations for publication. In the UK, BSI has published them all as British Standards. A further 15 Eurocode parts – including EN 1992-1-1 *Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings* and EN 1993-1-1 *Eurocode 3: Design of steel structures – Part 1-1: General rules and rules for buildings* – are being voted on at the present time.

### What are packages of Eurocodes?

To facilitate the adoption of the Eurocodes, their various parts will be grouped into packages which generally relate to different types of structures (e.g. buildings, bridges, etc) and materials (e.g. concrete, steel, masonry, timber etc). The date of withdrawal of conflicting national standards and/or conflicting national provisions will take place at the end of the agreed co-existence period, which may only begin when all parts in a package are available. The material-independent parts from EN 1990, EN 1991, EN 1997 and EN 1998 are part of every package as appropriate.

### When are the first packages going to be available?

It is highly likely that the first packages for concrete and steel buildings will be available in early 2005, after the final document within the package – EN 1991-1-7 *Eurocode 1: Actions on structures – Part 1-7: General actions – Accidental actions* – is made available by CEN.

### Explain the importance of EN 1990 *Eurocode—Basis of structural design*?

EN 1990 is the head Eurocode and gives the requirements for safety, serviceability and durability for all the Eurocode parts. It has to be used with every Eurocode part as it provides the information for safety factors for actions and combinations for action effects for the verification of both ultimate and serviceability limit states.

### Do the Eurocodes cover the same scope as BSI codes of practice?

Generally the Eurocodes cover a more comprehensive scope than the equivalent BSI codes. Where items covered by BSI codes are not covered in the Eurocode, BSI will issue 'residual standards' covering these items. The residual standards will be written to conform to the principles of the Eurocodes.

# Eurocodes Expert Users' Group

Eurocodes Expert has established a Eurocodes Users' Group to provide support and aid on the use, interpretation and implementation of the new codes.

Joining the Users' Group will help you and your organisation to understand Eurocode developments as well as feed back your views and needs to Eurocodes Expert.

Users' Group membership benefits include

- free copy of the *Eurocodes News* newsletter with updates on the Eurocodes programme and timetable, case studies and articles by industry experts
- email help for basic queries on the Eurocodes programme, implementation and available support
- low-cost presentations to organisations on conversion and implementation
- regular email updates on the Eurocode programme
- 20% discount on Eurocode publications.

Membership of the Users' Group will be free until May 2004. To subscribe, visit www.eurocodes.co.uk or call the Eurocodes Expert Manager on 020 7665 2446.

# Eurocodes events

**Listed below are all forthcoming Eurocode-related training events listed on the Eurocodes Expert database. Please let the editor know of any other Eurocode-related events organised by recognised construction industry associations.**

| Date | Event | Venue | Duration | Cost | Organiser | Telephone | Email |
|---|---|---|---|---|---|---|---|
| 17 March 2004 | Eurocodes Expert Roadshow - Implications for the UK Construction Industry | Britannia Hotel, Birmingham | Half day (am or pm) | £65.00 | Eurocodes Expert | 020 7665 2446 | eurocodes@thomastelford.com |
| 18 March 2004 | Eurocodes Expert Roadshow - Implications for the UK Construction Industry | Manchester Conference Centre, Manchester | Half day (am or pm) | £65.00 | Eurocodes Expert | 020 7665 2446 | eurocodes@thomastelford.com |
| 22 March 2004 | Eurocodes Expert Roadshow - Implications for the UK Construction Industry | London | Half day (am or pm) | £65.00 | Eurocodes Expert | 020 7665 2446 | eurocodes@thomastelford.com |
| 24 March 2004 | Eurocodes Expert Roadshow - Implications for the UK Construction Industry | Cardiff City Hall, Cardiff | Half day (am or pm) | £65.00 | Eurocodes Expert | 020 7665 2446 | eurocodes@thomastelford.com |
| 31 March 2004 | Eurocodes Expert Roadshow - Implications for the UK Construction Industry | Ramada Jarvis Hotel, Glasgow | Half day (am or pm) | £65.00 | Eurocodes Expert | 020 7665 2448 | eurocodes@thomastelford.com |
| 14 May 2004 | Impacts of EC7 on British and European Practice | Institution of Civil Engineers, London | 1 day | FREE | British Geotechnical Association | 020 7665 2233 | bga@britishgeotech.org.uk |
| 25 May 2004 | EN1990 Eurocodes— Basis of structural design | Altrincham | 1 day | £225.00 | Eurocodes Expert Training | 0800 1830133 | eurocodes@thomastelford.com |
| 29 September 2004 | EN 1991 Eurocode 1: Actions on structures NEW | Altrincham | 1 day | £225.00 | Eurocodes Expert Training | 0800 1830133 | eurocodes@thomastelford.com |
| 8 November 2004 | EN 1991 Eurocode 1: Actions on structures NEW | Ascot | 1 day | £225.00 | Eurocodes Expert Training | 0800 1830133 | eurocodes@thomastelford.com |
| 17 November 2004 | EN1990 Eurocodes— Basis of structural design | Ascot | 1 day | £225.00 | Eurocodes Expert Training | 0800 1830133 | eurocodes@thomastelford.com |

# Eurocodes publications

Eurocodes Expert aims to provide details of all significant publications relating to Eurocodes, including the codes themselves, guide books, journal papers and articles.

Several of the documents are free to download via the Eurocodes website at www.eurocodes.co.uk, which also includes contact details for all other publications.

Listed below are all publications in the Eurocodes Expert database published during the past three years. They are categorised by the Eurocodes they relate to, with the most recent publications shown first.

Please let the editor know of any errors or omissions. In due course it is hoped to include software titles.

| Author | Title | Year published | Publisher | Cost |
|---|---|---|---|---|
| **General** | | | | |
| Calgaro J-A | The Eurocodes in France | 2003 | Eurocodes Expert | FREE |
| Commission of the European Communities | Commission Recommendation of 11/12/2003 on the implementation and use of Eurocodes for construction | 2003 | Commission of the European Communities | FREE |
| Fullalove S | Eurocodes Expert gets government backing | 2003 | Eurocodes Expert | FREE |
| Highways Agency | Highways Agency Structural Eurocodes - Eurocodes implementation newsletter July 2003 | 2003 | Highways Agency | FREE |
| Office of the Deputy Prime Minister | Implementation of Structural Eurocodes in the UK | 2003 | Office of the Deputy Prime Minister | FREE |
| A N Beal | Eurocodes: Factors of Ignorance? | 2001 | Institution of Structural Engineers (The Structural Engineer) | FREE |
| Gulvanessian H and Driscoll R | Eurocodes - the new environment for structural design | 2001 | Institution of Civil Engineers (Civil Engineering journal) | FREE |
| **EN1990 *Eurocode – Basis of structural design*** | | | | |
| Mills J | The London Eye: selection of safety factors | 2003 | Eurocodes Expert | FREE |
| BSI | BS EN 1990 Eurocode: Basis of Structural Design | 2002 | BSI | £124.00 |
| Gulvanessian H, Calgaro J-A and Holicky M | Designers' Guide to EN 1990 Eurocode: Basis of structural design | 2002 | Thomas Telford | £50.00 |
| Gulvanessian H | EN 1990 Eurocode: | 2001 | Institution of Civil Engineers (Civil Engineering journal) | FREE |
| **EN1991 *Eurocode 1: Actions on structures*** | | | | |
| Sims P | Current UK status of Eurocode on snow loads (EN 1991-1-3) | 2004 | Eurocodes Expert | FREE |
| BSI | BS EN 1991-2: 2003 Eurocode 1. Actions on structures. Traffic loads on bridges | 2003 | BSI | £164.00 |
| BSI | BS EN 1991-1-3: 2003 Eurocode 1. Actions on structures. General actions. Snow loads | 2003 | BSI | £110.00 |
| Calgaro J-A | Eurocode for traffic loads on bridges published | 2003 | Eurocodes Expert | FREE |
| Calgaro J-A | Designing footbridges with Eurocodes | 2003 | Eurocodes Expert | FREE |
| Gulvanessian H and Smith B | Eurocode 1 on thermal actions receives unanimous positive vote | 2003 | Eurocodes Expert | FREE |
| BSI | BS EN 1991-1-2: 2002 Eurocode 1. Actions on structures. General actions. Actions on structures exposed to fire. | 2002 | BSI | £110.00 |
| BSI | BS EN 1991-1-: 2002 Eurocode 1. Actions on structures. General actions. Densities, self-weight, imposed weight | 2002 | BSI | £104.00 |
| Gulvanessian H | EN1991 Eurocode 1 | 2001 | Institution of Civil Engineers (Civil Engineering journal) | FREE |
| **EN1992 *Eurocode 2: Design of concrete structures*** | | | | |
| M Y H Bangash | Structural detailing in concrete: A comparative study of British, European and American codes of practice | 2003 | Thomas Telford | £75.00 |
| Moss R | Eurocode 2 and BS8110 compared | 2003 | Eurocodes Expert | FREE |
| Moss R | Approaches to the design of reinforced concrete flat slabs | 2001 | BRE | £40.00 |
| Narayanan R S | EN1992 Eurocode 2: Design of concrete structures | 2001 | Institution of Civil Engineers (Civil Engineering journal) | FREE |
| **EN1993 *Eurocode 3: Design of steel structures*** | | | | |
| Armstrong S | EU funds learning programmes for steel codes | 2003 | Eurocodes Expert | FREE |
| King, C. | Influence Eurocode design factors and limits | 2003 | Steel Construction Institute | FREE |
| King, C. | Eurocode 3: the first five Parts are about to appear | 2003 | Steel Construction Institute | FREE |
| Owens, G. | The Eurocodes are coming! | 2003 | Steel Construction Institute | FREE |
| Teng, J.G. and Rotter, J.M. (eds) | Buckling of thin metal shells | 2003 | Spon Press (Taylor & Francis) | £99.00 |
| Thomson P and Rogers D | Eurocodes could cost UK steel industry £10 million a year | 2003 | Emap (Construction News) | FREE |
| Rotter, J.M. | Advanced computer calculations in the design of shell structures | 2002 | Elsevier (Advances in Steel Structures) | £162.00 |
| Rotter, J.M. | Shell buckling and collapse analysis for structural design | 2002 | Kluwer (New Approaches to Structural Mechanics, Shells and Biological Structures) | £138.00 |
| Kamtekar A G, Little G H and Cunningham A | The plastic design of steel sway frames | 2001 | Institution of Civil Engineers (Structures and Buildings journal) | FREE |
| Rotter, J.M. | Guide for the economic design of circular metal silos | 2001 | Spon Press (Taylor & Francis) | £65.00 |
| Taylor J C | EN1993 Eurocode 3: Design of steel structures | 2001 | Institution of Civil Engineers (Civil Engineering journal) | FREE |
| Taylor J C and King C M | Comparison of National Application Documents for Eurocode 3: Part 1.1 and Eurocode 4: Part 1.1 | 2001 | Steel Construction Institute | £15.00 |
| **EN1994 *Eurocode 4: Design of composite steel and concrete structures*** | | | | |
| Johnson R | Analyses of a composite bowstring truss with tension stiffening | 2003 | Institution of Civil Engineers (Bridge Engineering journal) | FREE |
| Johnson R P and Anderson D | EN1994 Eurocode 4: Design of composite steel and concrete structures | 2001 | Institution of Civil Engineers (Civil Engineering journal) | FREE |
| Taylor J C and King C M | Comparison of National Application Documents for Eurocode 3: Part 1.1 and Eurocode 4: Part 1.1 | 2001 | Steel Construction Institute | £15.00 |
| **EN1995 *Eurocode 5: Design of timber structures*** | | | | |
| Harris R, Kelly O | Downland Gridshell - an innovation in timber design | 2003 | Institution of Civil Engineers (Civil Engineering journal) | FREE |
| TRADA Technology | Multiple fastener joints: guidance on BS 5268-2 and Eurocode 5 | 2003 | TRADA | £12.00 |
| Drummond I, Kermani A, Wamuziri S | Reliability of timber structural systems - a review | 2001 | Institution of Civil Engineers (Structures and Buildings journal) | FREE |
| Steer P J | EN1995 Eurocode 5: Design of timber structures | 2001 | Institution of Civil Engineers (Civil Engineering journal) | FREE |
| **EN1996 *Eurocode 6: Design of masonry structures*** | | | | |
| Haseltine B A | Eurocode 6 Session Report, 6th International Masonry Conference, London | 2002 | British Masonry Society | FREE |
| Haseltine B A | EN1996 Eurocode 6: Design of masonry structures | 2001 | Institution of Civil Engineers (Civil Engineering journal) | FREE |
| **EN1997 *Eurocode 7: Geotechnical design*** | | | | |
| Driscoll, R. | European geotechnical codes and standards | 2003 | Institution of Civil Engineers – Geotechnical Engineering journal | FREE |
| Orr T L L, Farrell E R | Geotechnical Design to Eurocode 7 – Second Edition | 2003 | Springer-Verlag | £55.00 |
| Driscoll R and Simpson B | EN1997 Eurocode 7: Geotechnical design | 2001 | Institution of Civil Engineers (Civil Engineering journal) | FREE |
| **EN1998 *Eurocode 8: Design of structures for earthquake resistance*** | | | | |
| Lubkowski Z A and Duan X | EN1998 Eurocode 8: Design of structures for earthquake resistance | 2001 | Institution of Civil Engineers (Civil Engineering journal) | FREE |
| **EN1999 *Eurocode 9: Design of aluminium structures*** | | | | |
| Mazzolani F M | EN1999 Eurocode 9: Design of aluminium structures | 2001 | Institution of Civil Engineers (Civil Engineering journal) | FREE |

Constructive contributions to the newsletter are always welcomed and should be emailed to the editor Simon Fullalove at simon@fullalove.com telephone: 020 8744 2028 fax: 020 8891 2462

The current issue of the newsletter is also available on the Eurocodes Expert web site at www.eurocodes.co.uk.

All other enquires should be made to the Eurocodes Expert manager
Rekha Thawrani, Thomas Telford Ltd, 1 Heron Quay, London, E14 4JD
telephone 020 7665 2303 fax 020 7538 2847 e-mail eurocodes@thomastelford.com

## New guide to Eurocode design of composite structures

Eurocodes Expert is publishing next month a new guide for designing composite steel and concrete structures in accordance with EN1994-1-1 *Eurocode 4: Design of composite steel and concrete structures – Part 1-1: General – common rules.*

Written by Roger Johnson and David Anderson, the aim of the 248-page, £50 book is to provide users with guidance on the interpretation and use of Part 1-1 of the code and to present worked examples.

It also explains the relationship with other Eurocode parts and relevant British codes and provides background information and references to enable users to understand the origin and objectives of its provision. Cross-references are made in the guide to sections, clauses, sub-clauses, paragraphs, annexes, figures, tables and equations of EN1994-1-1.

For more information please contact the Eurocodes Expert Manager on 020 7665 2446 or email eurocodes@thomastelford.com

## New course on EN1991

Eurocodes Expert Training is running a new one-day course on EN1991 *Eurocode 1: Actions on structures*. The first will be held in Altrincham on 29 September with a further event at Ascot on 8 November.

The new course aims to describe the various parts of Eurocode 1 and differences to the equivalent BSI codes being replaced. The national implementation and programme of release and withdrawal will also be covered.

The following parts of EN1991 will be examined in detail

- Part 1-1: Densities, self-weight and imposed loads
- Part 1-3: Snow loads
- Part 1-5: Thermal actions
- Part 1-6: Actions during execution
- Part 1-7: Accidental actions.

General clauses of Part 1-2: Actions on structures exposed to fire and Part 1-4: Wind actions will be covered more comprehensively in future courses.

The aim of the new course is to help delegates become familiar with the objectives, development and working of the Eurocode system and to understand how Eurocode 1 applies to buildings and other structures (except bridges).

The cost is £225 per delegate. For further information please call Eurocodes Expert Training on 0800 1830133 or email eurocodes@thomastelford.com.