CONTINUING EDUCATION IN STRUCTURAL CONNECTIONS

František Wald, Czech Technical University in Prague, Czech Republic
David Moore, Building Research Establishment, United Kingdom
Milan Veljkovic, Luleå University of Technology, Sweden
Martina Eliášová, Czech Technical University in Prague, Czech Republic

ABSTRACT

The European project Continuing Education in Structural Connections (CeStruCo) under Leonardo da Vinci initiative No. CZ/00/B/F/PP-134049 was prepared by partners from seven European countries to disseminate the latest results in research and standardization during the period of transferring the European Pre-Standard into the European Standard. The project has started by a collection of questions from the European practice. The answers to those questions have been prepared in the form of textbooks in the project partners national languages. The material is available as an easily accessible Internet/CD (www.fsv.cvut.cz/cestruco) media, and includes video and audio files, slides and worked examples.

INTRODUCTION

Education has always been seen as an essential part of the introduction and dissemination of new methods for the design of steel connections. One of the first educational packages specialised on connections was produced by Owens and Cheal (1) who prepared educational material for structural connections. This material has been extended and is now incorporated into a European educational package called the European Steel Design Educational Programme, ESDEP (2). This programme is used today by educational establishments throughout Europe. Other educational packages which build on the work of ESDEP are available some of which include WIVISS (3) and (4), a set of lectures on CD, SteelCall (5) and (6), a virtual steel designers office, and SSEDTA which consists of a set of

Figure 1. Screens from collection of questions on project Internet page – a) in partners languages; b) format of collection
basic lectures on PowerPoint for the design of steel and composite elements, see (7). The project NFATEC - A New and Flexible Approach to Training for Engineers in Construction (8), is transferring the successful lessons of SSEDTA into the Internet based lectures and worked examples (9).

For more than twenty year the European Convention for Constructional Steelwork’s Technical committee for structural connections (ECCS TC10) has supported the development and implementation of a common set of design rules for steel connections. It is therefore not surprising to find that one of this committee’s priorities is to facilitate the transition of EN1993-1-8 from a European pre-standard; see (10), (11) and (12), to a full Euro-norm (13). Part of this activity is the development of the necessary educational material to encourage designers throughout Europe to adopt EN1993-1-8. Consequently, a programme called “Continuing Education in Structural Connections” (CESTRUCO) was formed under the European Commission’s Leonardo initiative to collect commonly asked questions on the background, implementation and use of prEN1993-1-8 and to publish expert answers to these questions. The CESTRUCTO project was developed from an idea by Mr. Marc Braham (Astron, Luxembourg), Mr. Jan Stark (TU Delft, The Netherlands) and Mr. Jouko Kouhi (VTT, Finland) to provide designers with more detailed information on the background and implementation of the design methods given in prEN1993-1-8.

Figure 2. Project textbooks in project partner’s languages
The project partners were Aristotle University of Thessaloniki, Greece; Bouwen met Staall, Netherlands; Building Research Establishment Ltd., United Kingdom; Czech Constructional Steelwork Association Ostrava, Czech Republic; Czech Technical University (contractor), Czech Republic; EXCON a.s., Prague, Czech Republic; KREKON Design office, Rotterdam, Netherlands; Luleå University of Technology, Sweden; University of Coimbra, Portugal; Politechnica University of Timisoara, Romania. The project team consist of the following people: Prof. C. C. Baniotopoulos (in charge of Chapters on Welding and on Aluminium); Prof. F. S. K. Bijlaard; Ir. R. Blok (internal review), Mr. J. Brekelmans; Prof. L. S. da Silva (Chapter on Fire design); Prof. D. Dubina (Chapter on Seismic design); Mrs. M. Eliášová; Mr. H. G. A. Evers (Chapter on Good and bad detailing); Mr. D. Grecea (Chapters on Hollow section connections and on Cold-formed connections); Ir. A. M. Gresnigt (Chapter on Moment connections); Dr. V. Janata (internal review); Prof. B. Johansson; Mr. T. Leino; Mr. T. Lennon; Mr. T. Měřínský (internal review); Dr. D. B. Moore (editor and Chapter on Simple connections); Mrs. A. Santiago; Mr. R. L. Schipholt; Dr. Z. Sokol (Chapter on Structural modelling, Windows help Internet lessons); Ir. C. M. Steenhuis; Dr. M. Veljkovic (Chapter on Bolts); Prof. F. Wald (project promoter, editor and Chapter on Column bases). The material was reviewed externally by Prof. D. Beg, Mr. M. Braham, Prof. J. P. Jaspart, Dr. G. Huber, Mr. J. Kouhi, Prof. F. Mazzolani, Mr. A. J. Rathbone, Prof. J. Studnička, Dr. F. Turcic, Dr. K. Weynand and Mr. N. F. Yeomans.

PROJECT WORKED PACKAGES

Collection of questions

The collection was based on publications in national journals and on local seminars. The questions were collected by project internet page, Figure 1, and in paper form as well. The questions located during the conversion of ENV 1993-1-1 (including Annexes J (11), K (12), L (10)) into EN 1993-1-8 were taken into account. Together 632 questions were collected related to the topic.

Answering

All obtained questions were very good. Answers to 101 selected questions were chosen in the second part of work based on its educative contribution. The agreement between all partners was not reached for all answers. This is the reason that some nice questions are missing in final material. The review of answers was prepared in tree steps: locally between partners, by delegated partners and externally by members of ECCS TC10.

Dissemination

Under the third part of the project, dissemination, were prepared the educational materials Textbooks and Internet/CD lectures. To facilitate easy of use questions/answers are split into the following Chapters: Introduction, Bolts, Welding, Structural Modelling, Simple Connections, Moment Resistance, Connections, Column Bases, Seismic Design, Fire Design, Hollow Section Joints, Cold-Formed Member Joints, Aluminium Connections, and Design Cases. Each chapter starts with a brief over-view of the method use in prEN1993-1-8. This is followed by the commonly asked questions together with their answers. The materials were localised for use in the partner’s national languages, Figure 2: Czech (300 copies of textbook was printed), Dutch (200 copies), English (1500), Greek (200), Portuguese (1000), Rumanian (300) and Swedish (200). The translations into Polish and Spanish are under preparation (written in February 2004). The pilot Seminars of the project
were organised in project partner’s countries to test the material in local environment and to start to disseminate the material.

Figure 3. Example from Textbook Chapter 13 Design cases - a), c) bad solutions of beam to column joint, b), d) good cases

Figure 4. Example from Textbook Chapter 13 - Design cases a) bad solution of column base, b) good design
The pilot Internet Seminar was included in the project. It showed the ability to use in an efficient way the prepared educational material. The pilot Internet seminar was broadcasted to seven project partners from Luleå University. Very robust software MARRATECH, Figure 5 was used to establish an interactive communication between partners. The easy to use and simple to managed tool consists of windows showing the view of camera from each partner, a white board and a text messenger. The quality of connection was indicated at each partner window. By clicking on camera window the particular partner’s picture is enlarged to allow high quality projection. The white board allows all partners to draw by mouse and to share with other participants in the session available material such as figures, slides, videos and files (in MS PowerPoint and Word format). The text message window was very reliable and helped partners to begin communication. The weak point of the Seminar was audio quality which was strongly influenced by the internet traffic. This is an important issue since it is essential part of the lecturing. We all have learned how sensitive is the audio quality, especially in a case of simultaneous broadcasting to various partners. A communication between two partners, using so called node to node communication is more robust and easier to establish. However, our laboratories, well equipped by computers and cameras, have to be upgraded with adequately equipment for video broadcasting. All the partners were pleasantly surprised with the performance of the communication tool under routine Internet connection.

![Figure 5. Window of MARRATECH software, a) white board with Microsoft PowerPoint presentation and text connection; b) from preparation of Internet Seminar](image)

**INTERNET / CD LESSONS**

The Internet/CD version, Figure 6, of project materials is based on Microsoft Windows help format, which is a robust tool for education. The material prepared by RoboHelp tool (14) allows the easy navigation in partner's languages and in German and French. The Internet/CD lessons are equipped with worked examples, Figures 3 and 4, PowerPoint presentations, slides, videos, worked examples (15) and (16), animations of design cases, educational software for connection modelling, and design tools available round the Europe. Partners were so kind to equipped us with their demo version to show how easy may be nice connection checked by EN1993-1-8. 3000 copies of CD first version were printed at the end of the project in December 2003. The second version was disseminated in June 2004 based on evaluation of first ones. Third upgraded version is intended to be published based of interest of structural steel practice in June 2005.
Figure 6. Lesson in Microsoft Windows – a) Title page, b) example of Chapter Bolts, c) example of Chapter Column bases, d) example of Chapter Aluminium connections

On the CD may be found the NASCon (Non-linear Analysis of Steel Connections) program that offers a computer user-friendly tool for the component method. The tool allows modelling the nonlinear behaviour of different components; see (17) Figure 7. The video film, see Figure 8, demonstrates the correct design of T-stub connections and bolted splices to avoid a fatigue failure of bolts. The related to the fire design is equipped with the PowerPoint lessons including video/audio sequences, see Figure 9.

Figure 7. Program nonlinear analysis of steel connections NASCon (17)
Figure 8. The flow of the stresses in the connection in video film Statically Stressed Bolts in Dynamically Loaded Connections

Figure 9. a) Front page of PowerPoint lesson “Connection Design for Fire Safety”, b) a slide from the lesson “Heating and Cooling of Structure”

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REFERENCES


Key words: Structural Steel, Education in connection design, Internet/CD lessons, Frequently asked questions, Bolted connections, Welded connections, Steel joints, Fire design, Seismic design, Aluminium connections, Eurocode 3, Design cases.