New ways in teaching Visualization of design aids and of carrying mechanisms of concrete structure

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September 1999

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Visualization of design aids and of carrying mechanisms of concrete structures

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Abstract:
Traditionally, technical documents are only available as printed reports. By the advancement of the German design standard for concrete structures DIN 1045-1 [1] the idea came up to develop a technique for publishing in a multimedia environment. The project intends to provide a multimedia version of a technical handbook on a CD-ROM or via World Wide Web. The ´Multimedia Technical Handbook´ can be used with a standard web browser.

Due to an efficient development of new technologies it became possible, to present documents in a new way. Beside texts, figures and tables the handbook embraces interactive graphical tools and applets, illustrating design models and load carrying mechanisms. This type of presentation offers a better understanding and can be used as a new way in teaching at university. For the representation of the multimedia handbook a hypertext structure of all elements is used.

The ´Multimedia Technical Handbook´ should be a medium for education of university students but also for continuing education of experienced civil engineers, who have to deal with the new German design standard DIN 1045-1 in the future.

Keywords:
Visualization, Interactive Graphical Tools, Applets, Hypertext, Multimedia, Teaching, World Wide Web, JAVA

1   Introduction

In Germany a new version of the national standard DIN 1045-1, which is based on the regulations of Eurocode 2, will be published at the end of this year. With respect to this new version including a number of changes in the design format it seems useful to offer explaining comments, illustrating tools and examples. Internet techniques with integrated JAVA programs offer the possibility to provide multimedia versions of any technical document. In form of a ´Multimedia Technical Handbook´ helpful background information about the content of the future design standard should be given to unexperienced but also to experienced civil engineers. With help of different techniques like hypertext, interactive tools and animations a better understanding of facts is provided.

2   Description of the ´Multimedia Technical Handbook´

The ´Multimedia Technical Handbook´ is a tool for civil engineers, which embraces several components and documents. The principle aspect for the development of the interactive handbook is a hypertext structure of all documents. Hypertext, with its linked structure, enables information to be stored and presented in manageable sections, which can be linked together and searched. It also enables graphics, spreadsheets and interactive elements to be linked and embedded with the text. Reading from a computer screen is less pleasing than reading a book. Consequently the information was structured into much smaller units than in printed documents in order to avoid overcrowding of the screen.

The main part of the multimedia package is a document on design, which provides technical background information of all regulations in the design standard. Technical information is given in form of texts, explaining diagrams and summarizing tables.

In contrast to printed papers the multimedia version provides integrated interactive graphical tools. The aim of these interactive tools is to explain complex theoretical facts by animations, graphs, evaluations and parameter studies. Each of these interactive graphical tools is a applet, which can be activated in a separate window.

Different types of illustrating applets were realized:

- Applets may be used as interactive and calculating tools, with which single formulas or cohering formulas can be calculated with varying parameters. Users can watch the results with regard to their varying inputs. Results are given as values (e.g. required tension reinforcement), as graphs (e.g. stress strain diagrams) or in form of spreadsheets. The applet shown in Fig. 1 calculates the maximum allowable bar diameter to ensure an appropriate limitation of crack width.
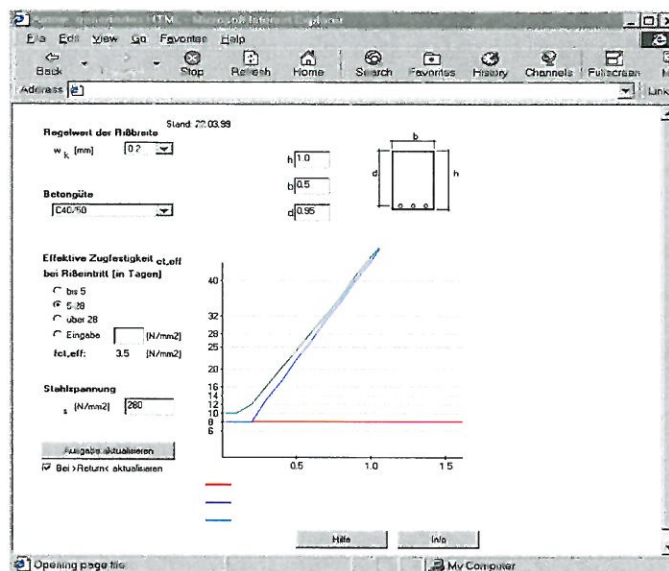
Fig. 1: Applet ´Limitation of Crack Width´

- Applets can provide models of the real world in form of animated, controllable simulations. For example these animations can illustrate sequences of structural behaviour under load or sequences of cross-sectional strain changes (Fig. 2).
- With help of applets design aids can be created. Design charts for reinforced columns and beams can be calculated for any material properties, safety factors and cross sections. They can be printed and subsequently be used for practical work (Fig. 2).
- Applets can be used to visualize technical facts by using a sequential output on the screen. Thereby facts can be described with help of texts, pictures and diagrams. The display on the screen changes, when the user is clicking on a ´Continue´-Button. This kind of applets is comparable with a slide show.

All applets are clearly structured and partitioned in input and output sections to facilitate also unexperienced software users the application of all interactive applets.

Beyond it all important verifications of the design standard and the structural rules for detailing of reinforcement are illustrated in several examples, which can partly be used in combination with applets. These applets are activated with the parameters of the examples.

Beside explaining texts, illustrating applets and clarifying examples the complete version of the design standard will be included in the multimedia package. All these elements are linked together, thus the user can get quick and extensive information in fourfold manner. Links within the design standard are also realized.

In contrast to printed reports it is possible to get the requested information in a very fast way. The electronic index quotes all positions of the corresponding headwords located in the document on design, in the interactive graphical tools, in the examples and in the accompanying chapters of the design standard. Tutorials how to apply the different applets, how to find one´s way and how to use the `Multimedia Technical Handbook´ are provided for an appealing guidance of the users.

3 Example: Applet ´General design diagram´

The realisation of the applet ´General design diagram´ (Fig. 2) is a representative result of the project. This applet is used to design rectangular sections under bending of concrete structures. In consideration of different assumptions concerning action effects, material properties and geometrical values of the cross section, the user can design rectangular sections interactively. With default of the stress strain diagram the applet generates the resisting forces. As a consequence, correlations of cross sectional carrying mechanisms become clearer for the user. Specific diagrams can also be printed out.
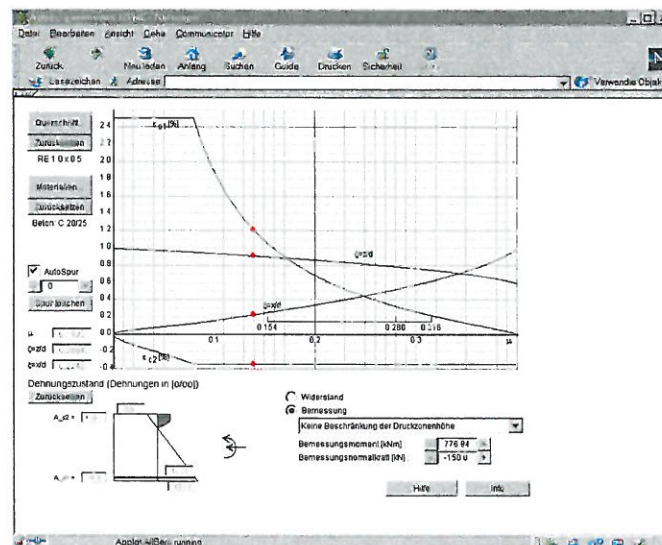

Fig. 2: Applet ´General design diagram´

4 Structure and Layout

In order to enable a comfortable application of the whole multimedia package, it is clearly structured. Standardized elements of a computer desktop like pull-down-menus, windows, scrolling bars, buttons etc. are applied. For a clear representation a frameset (Fig. 3) is used, which comprehends in the left frame the structure of the multimedia package and in the right frame the document on design. All other documents (e.g. design standard) and programs (e.g. applets) can be activated in separate windows, in order to enable the display of two different documents on screen at the same time.

One method of encouraging users in active learning is to invite them to explore and to discover for themselves. The user should be empowered to take active control of his learning process and of choosing, which problems to solve and which information to get. With help of the predisplayed structure in the left frame (Fig. 3) the user can navigate through the whole multimedia package. The other way to change between different pages is to use links in the text. In doing so the new position in the structure tree is shown blue coloured in the left frame to enable the orientation of the user.
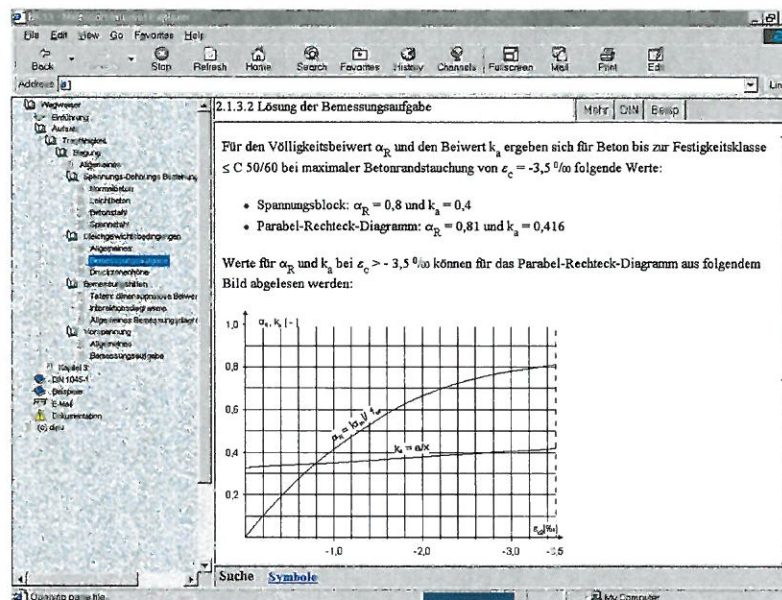
Fig. 3: Screenshot representing structure, diagram and text

The parts of the ´Multimedia Technical Handbook´ (document on design, examples, applets, standard) are represented in different styles to show, which elements are activated at the moment. They are displayed with different typesizes and -colours, fonts and background colours.

With regard to a usage via World Wide Web all desktop elements are arranged in World Wide Web usual style.

5 Technical Realisation

The aim of the project is to run the ´Multimedia Technical Handbook´ on a maximum number of workstations with internet based techniques. The reason for using internet based techniques is platform independence, usage of HTML - format [2] and the simple integration of JAVA programs. Limitations of hardware requirements were only made with regard to the display resolution. As the minimum standard a 17 inch monitor with a resolution of 1024 x 768 pixels is necessary. To keep flexible for possible following versions, all applets are programmed with the JAVA Development Kit (JDK) [3] [4]. In addition the appearance of JAVA programs is favorable, because the display on screen is automatically adapted on the environment of the operating system being used.

For the program execution a standard web browser with a JAVA virtual machine (e.g. Netscape Navigator, Internet Explorer) is required.

The text and the examples were written with the text system LaTex. With help of converting tools the LaTex-files were converted in HTML-files. New LaTex command definitions were developed, in order to support links between the different components of the handbook. This technique enables the automatic converting of the LaTex source file.

6 Perspectives

The general intention of the 'Multimedia Technical Handbook' is to promote the motivation and activity in the learning process of all users. Learning is a process of development and it is different for each individual. Learners must engage actively in the process and that will only happen if they are motivated to do so. Reading printed scripts may be passive, but computer aided learning promotes activity [5].

The aims of the whole project can be split depending on the specific interests of the different user groups of the 'Multimedia Technical Handbook'. The interactive graphical tools are suitable for teaching at university. During the lessons the teacher can explain difficult subjects with animations. Students are learning by viewing and doing. Due to the fact, that the technical handbook is runable with a standard web browser, the possibility exists to make use of the World Wide Web. Students can repeat actively lectures at their own computer at home or can get and solve exercises via World Wide Web.

In addition, the whole multimedia version of the handbook can be used as electronic reference book not only for students but also for experienced civil engineers. It offers the possibility to inform in a very effective and extensive way. If information about a special subject is needed, the 'Multimedia Technical Handbook' offers facts in multiple manner: explaining texts, design standard, practical examples and illustrating graphical tools.

7 Conclusion

The experiences, which have so far been made with multimedia versions of technical handbooks, can also be applied on any other technical document. This will become interesting, as in the course of the unification of Europe many new European technical documents will be written. With help of computer technology these documents could be offered in multimedia polyglot versions.

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