

CSIRO - Building the Future Down Under

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Abstract

Australia has recently unified technical building regulations throughout its eight states and territories. As technical adviser to the Australian Building Regulations Co-ordinating Council (AUBRCC), CSIRO Division of Building, Construction and Engineering is heavily involved in the development of many aspects of building regulation. It offers advice on the technical content, format and drafting of regulation, administers a national accreditation scheme and has developed commercially available interactive software to support the regulations. It is now developing a data base to access the background information used in all its regulation-related activities.

Introduction

Remember last time you looked at your globe? Most of the world looked straight back at you from the top half, but if you craned your neck and looked down and under you might have noticed the continent we call "home". Yes, Australia is still there, and, despite its sunny climate, there are plenty of buildings. In fact we spend approximately \$30,000 million dollars Australian per annum on building construction.

Building Regulations Down Under

Until recently, each of the eight states or territories had its own set of building regulations. Although these were based on a national model code there were considerable differences from state to state. But things have changed, and now all states except Tasmania refer to one code, the Building Code of Australia (BCA), for technical requirements. We hope that the BCA will be called up by Tasmania before the end of this year.

The BCA has taken the Australian Uniform Building Regulations Co-ordinating Council (AUBRCC) over ten years to produce. In its present form, it contains some variations for each state. Every effort is being made to reduce these variations and AUBRCC hopes to see their demise within three years.

The Role of CSIRO

CSIRO DBCE provides continuous intellectual and technical support into research for the building industry. It has been involved with building regulation and reform since 1948. It is technical adviser and exclusive agent for AUBRCC and helps in formulating and providing support for better building regulations. Part of this work involves assessment of revisions of the BCA, the production and maintenance of a comprehensive commentary to the BCA, the development of interactive computer software and the administration of the national accreditation and building product registration schemes. This paper describes some of the ways in which CSIRO is making life easier for those using building regulations.

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The BCA and Performance

At its inception over ten years ago, the aims of AUBRCC were to produce a uniform building code that was clear, easy to use and expressed in terms of building performance. Uniformity has now (nearly) been achieved, but there is still a way to go before we can say that the BCA is fully performance-based.

Performance regulation offers many advantages to code users and code writers. It encourages the code writer to adopt a logical approach to regulation, which in turn leads to clarity and good organisation. It allows a variety of solutions to be provided for each regulatory problem. It reduces the likelihood of unnecessary requirements appearing in the regulations and of commercial pressure influencing the regulations. An accreditation scheme can only work successfully if regulatory intentions are clearly spelled out. More details on the structure of performance regulations proposed for Australia can be found in Jane Blackmore's paper "The Building Code of Australia - A Performance Code for the Global Village?" which is to be included in the proceedings of the CIB World Building Congress.

At CSIRO we have researched the background of performance regulation and restructured parts of the BCA in terms of performance. As a result of our work, the BCA now includes statements of objective, and many clauses have been written in terms of a performance requirement supported by a "credence", or means of fulfillment. The technical committees who write the regulations are adopting a two-tier performance approach which noticeably enhances the effectiveness of their deliberations.

Accreditation and Registration

The national accreditation scheme is administered by CSIRO on behalf of AUBRCC. The scheme provides a means whereby innovative products and building systems for which there is no means of compliance in the BCA may gain technical approval for use on a national basis. The national accreditation scheme is different from the proposed national registration scheme for building products and systems for housing construction, which will offer certification of non-generic building materials for which there is a means of compliance.

Accreditation

To comply with the BCA, buildings must be constructed in a proper and workmanlike manner using materials that are not faulty or unsuitable for the purpose for which they are intended. There are several ways of showing suitability, but the latest is a "certificate of accreditation". A certificate of accreditation is defined in the BCA as "a certificate issued by AUBRCC or a State or Territory accreditation authority stating that the properties and performance of a building material or method of construction or design fulfils specific requirements of the BCA".

The scheme has been developed for products for which there is no specific means of compliance in the BCA. These are usually innovative materials or components for which no credence (or means of compliance) exists in the BCA. Applicants for accreditation must submit a full product description, a list of the sections of the BCA relevant to the accreditation, a technical appraisal of the product by an organisation with the necessary skills and expertise and copies of any relevant trade literature including instructions for use, installation and maintenance.

Accreditation is only possible where regulations are based on building performance. An innovative product cannot be accredited where regulation is prescriptive although an accreditation authority may be happy to look at the implied performance in the prescriptive regulations.

Registration

The purpose of the registration system is to simplify the building approval process where standard products are used and to enhance the quality assurance of housing construction. The scheme will validate the information in support documents such as technical opinions, certificates and test reports. This will provide local councils, designers and builders with an authoritative and independent source of recognition that a registered product or system complies with the relevant regulation. We hope that registration will lead to consistency in the use of building products, making it unnecessary for an applicant to apply repeatedly to local councils for approval. The scheme is voluntary and will initially apply only to products used in domestic construction.

Again, every application for registration will need to be supported by documentation that assures compliance with the regulations. Registration will not be made on the basis that a product has been in use for a long time without causing problems.

BCaider Computer Software

CSIRO DBCE in collaboration with AUBRCC, Jennings Housing and Butterworths Pty Limited has developed a knowledge-based system (or expert system) for the BCA. We believe BCAider will lead to widespread savings through:

- faster and easier checking of building designs to ensure compliance with the BCA,
- on-line help and commentary to assist users and provide background explanations and examples,
- presenting the BCA to users in a state-of-the-art computer-based format (including use of simple menus, help facilities via hypertext, error checking and colour graphics),
- allowing designers to explore a wider range of design options by quickly testing out variations (for example, changes to dimensions, exit locations, fire protection),
- checking that the BCA and proposed amendments (including state variations), are logical and consistent,
- assisting with future restructuring of the BCA into a fully performance-based code by checking for any contradictions, obscurities and omissions,
- automatically generating compliance report files for checking authorities for printing and electronic storage,
- automatically generating job files which may be stored and later recovered for modification or perusal, and
- assisting in the education of building designers and checking officials.

The first version of BCAider was released in April 1991 and at the time of writing there are over 220 installations. We expect use to accelerate as the BCA becomes more widely adopted. Copies have already been sold overseas.

The BCAider project began in late 1989 with a planned budget of \$1.5 million Australian and 15 person years of effort from 1989-93. The project is currently on target with the release of Version 2.1 in March 1992. This version:

- processes all the BCA including state variations;
- displays background reference material including diagrams (BCA Commentary);
- displays keywords and other references in hypertext;
- has a keyword index to help find appropriate clauses;
- displays only those clauses relevant to a particular building class;
- has on-line help and tutorial system;
- is able to add notes;
- generates compliance reports;
- displays related product information such as ABSAC appraisals and Speci-Data database;
- has an interface to the Australian Standards CD-ROM containing over 800 related building standards; and
- has IBM PC compatible computer operation running under Microsoft Windows 3.0.

Operation

BCAider is very user friendly and requires minimum computer skills (except the use of a mouse which may be quickly mastered). It conducts a dialogue with the user (just as an expert might) by asking which parts of the building or BCA are to be checked and then helping to decide whether or not the design complies. The user is only asked to supply information relevant to the part of the building being checked.

For example, if the user wishes to check a particular component of the building, he may use the "BCA index" button in the main menu to find which clause or clauses deal with that component (Figures 1 and 2). Alternatively the user can select the relevant section and part from the main menu and then go directly to the set of clauses for that part (Figure 3). If there are any state variations to clauses these are highlighted with an asterisk on the left, and if the user has saved any previous notes these are highlighted with an "n" (Figure 3). The notes may be read by selecting "notes" or pointing to "n" with the mouse arrow.

Clauses are processed with a series of "yes/no" questions as in Figure 4, and a copy of the dialogue of previous questions is displayed. The user may select the "BCA Commentary" to provide background information including diagrams (Figure 5). Any terms underlined, such as swimming pool, ASxxxx code references and Figure G1.1 in Figures 4 and 5, may be used to display further information in pop-up windows on the screen. If the Australian Standards CD-ROM disk is available on the user's computer, then the text from AS codes can be displayed.

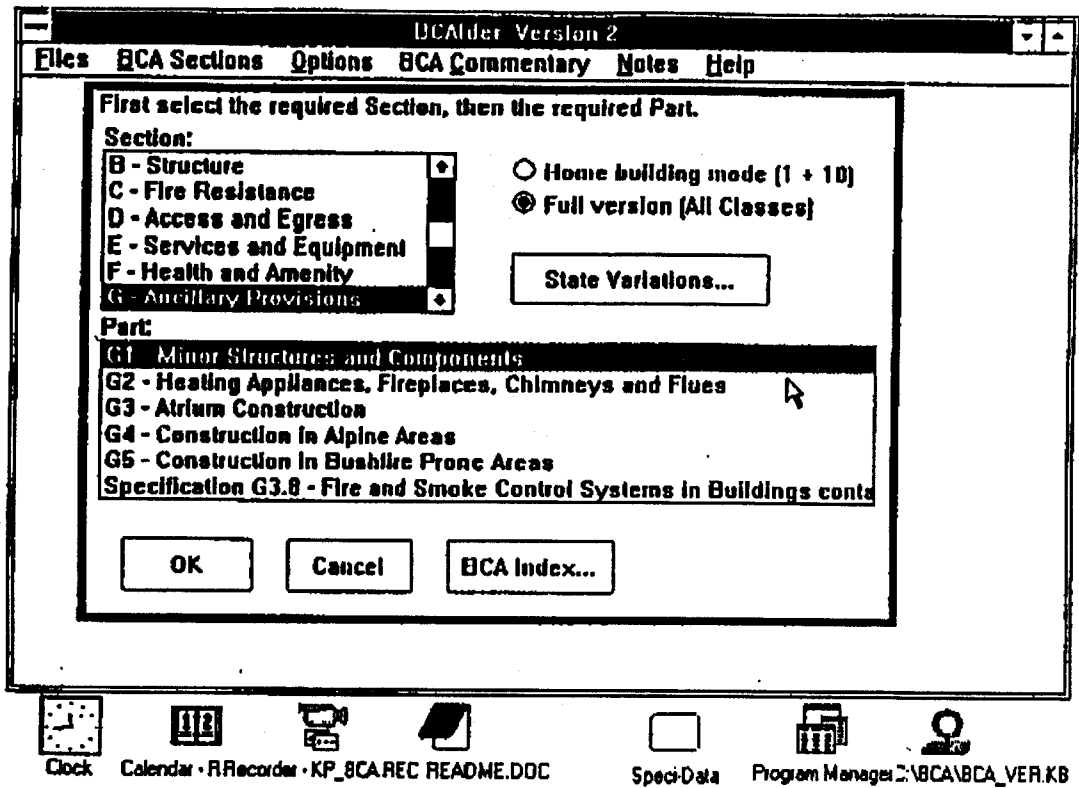


Figure 1 Main menu showing selection of Section G and Part G1.

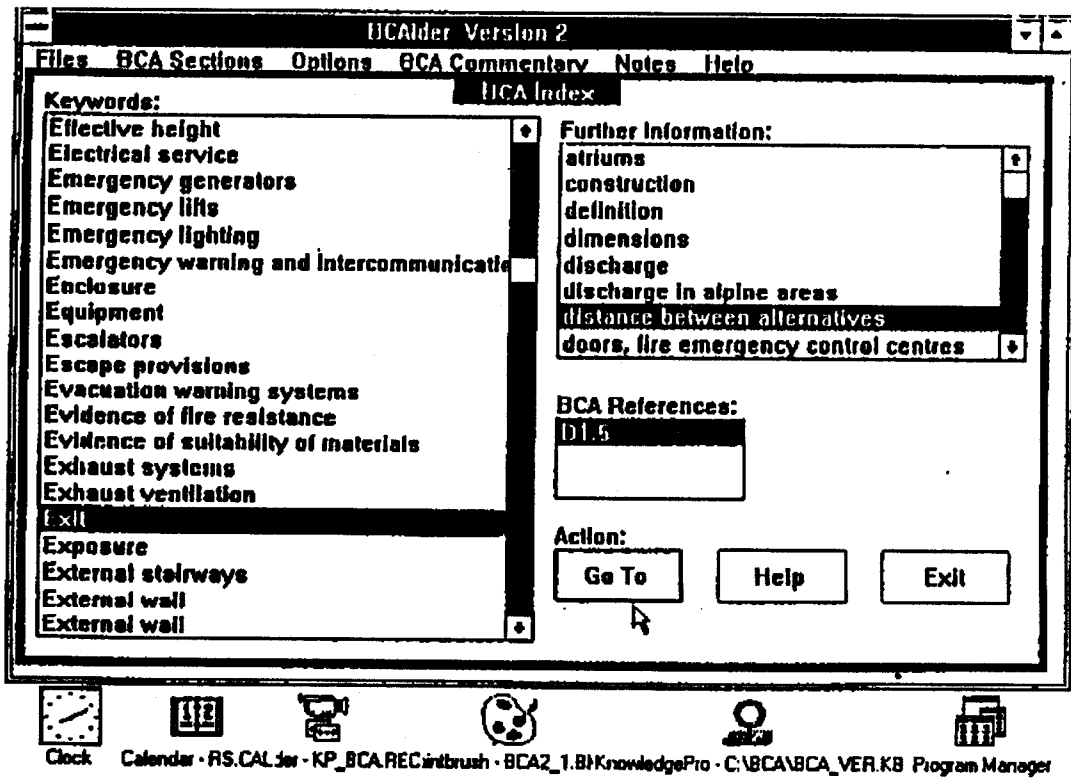


Figure 2 Using the NBA Index to locate building features and relevant Clauses

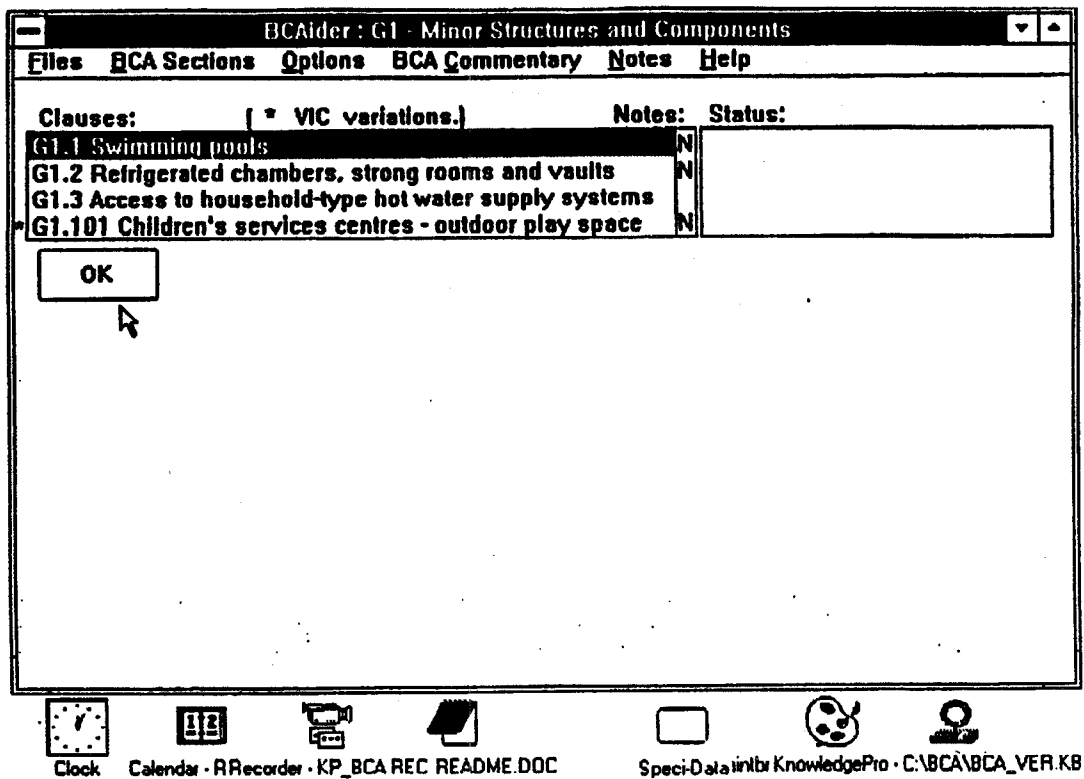


Figure 3 Clause menu for Part G1 and selection of Clause G1.1.

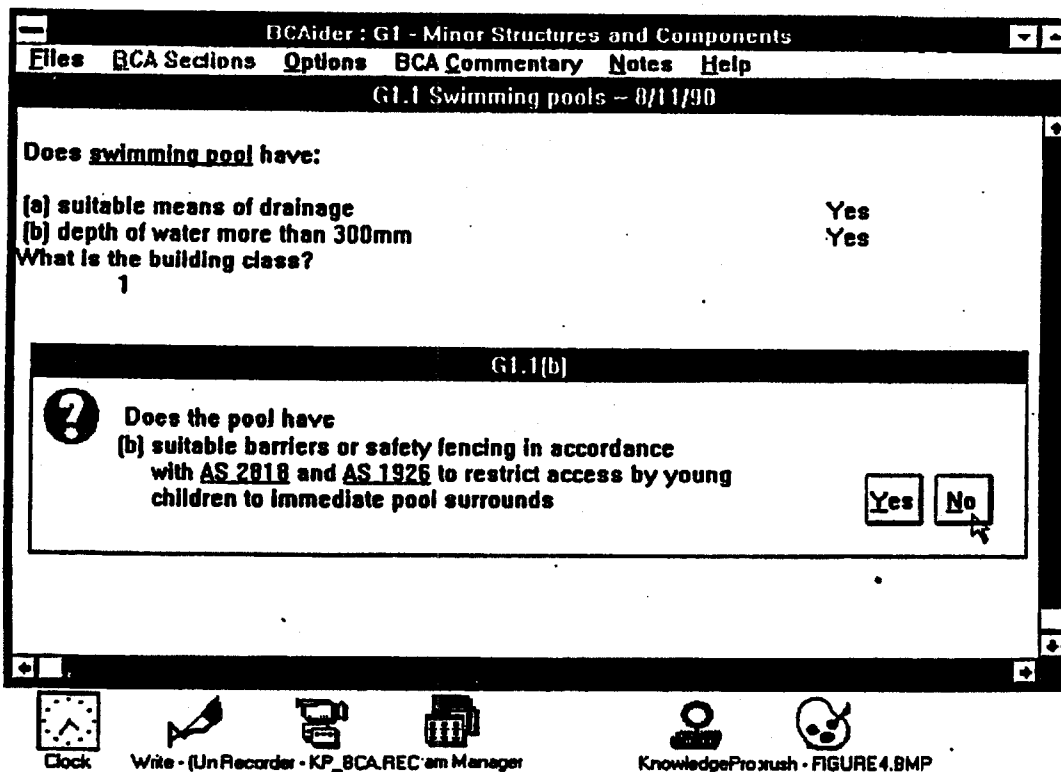


Figure 4 Clause processing as a series of questions for Clause G1.1.

When BCAider has sufficient information from the dialogue with the user, it will advise whether or not the design complies (Figure 6). It gives reasons for non-compliance which may be annotated and written to a report file. After this it returns the user to the clause menu (Figure 3) and the status of the clause just processed is updated to "complied" or "not complied" as the case may be. The user may then process other clauses in the same part or move to another part via "BCA Sections".

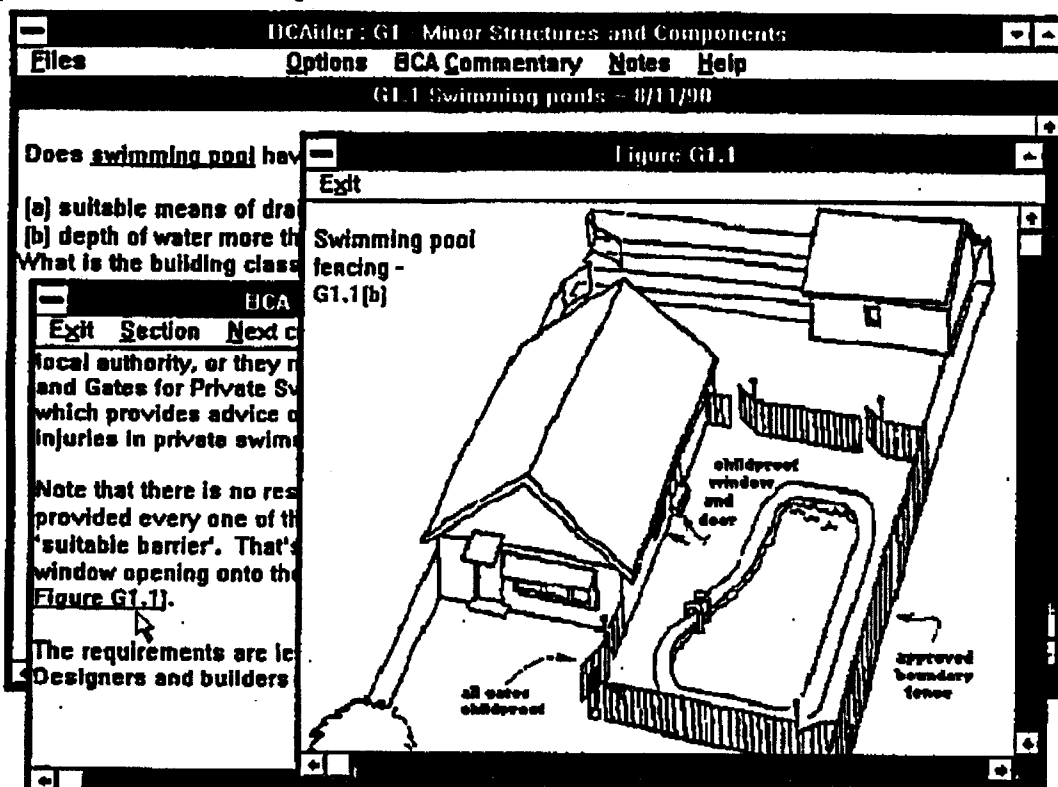


Figure 5 Displaying BCA Commentary and diagrams during Clause processing.

The user may save job details or recover and modify previously saved jobs by selecting the "files" option. The report file may be printed or merged with other files using any word processor. The user may also choose to save the complete dialogue (shown in Figure 4).

BCAider can be configured for any state as shown in Figure 7. Building properties such as class of building, rise in storeys and type of construction may be viewed and modified under "options".

The above gives a brief overview of the system. More details are provided in the user manual and also the on-line "help" facility.

Future Developments

Future developments include a networking version and a CAD interface, initially to Autocad (Windows).

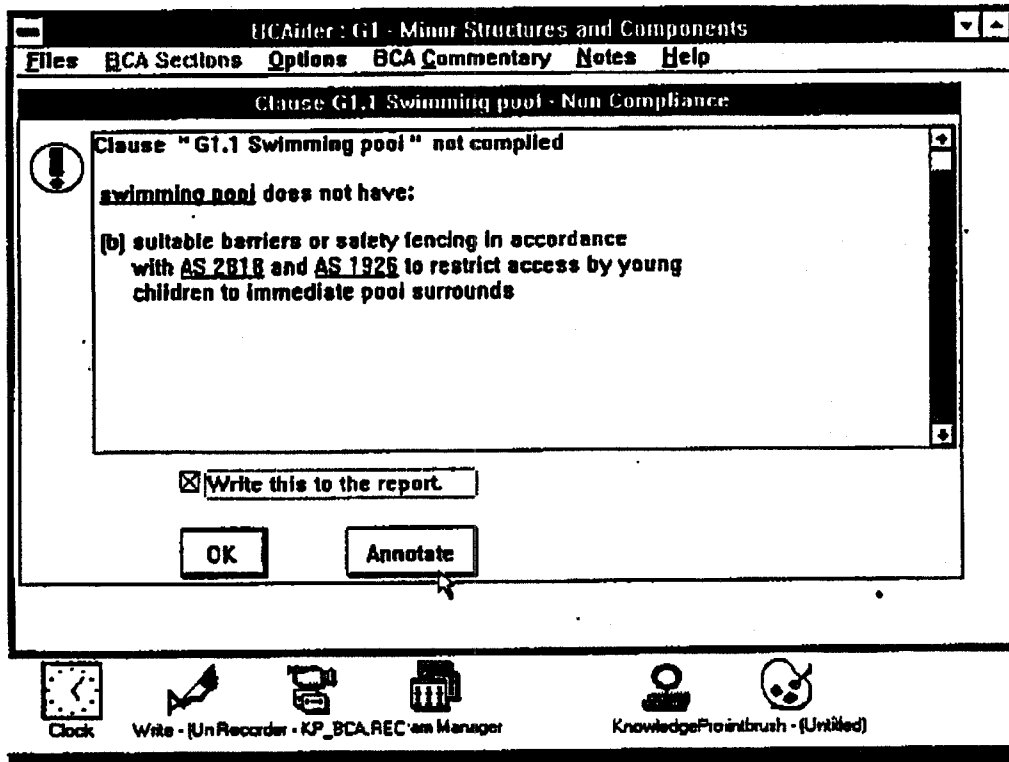


Figure 6 Non-compliance window resulting from failure to meet BCA requirements. Note selection to write result to the report file.

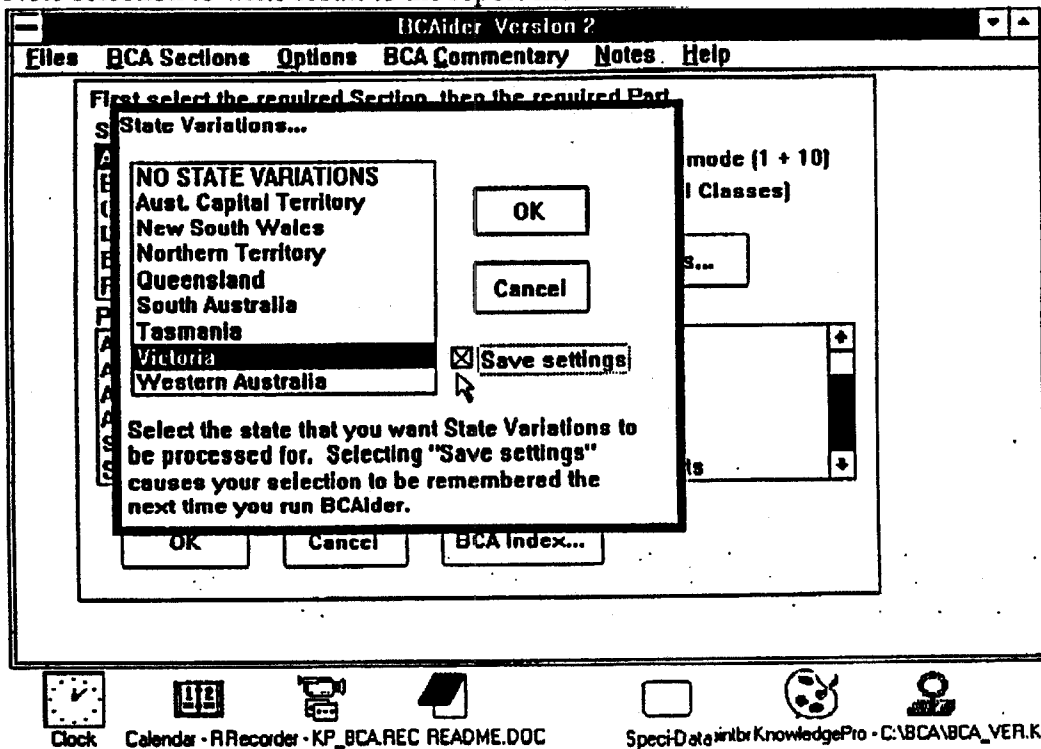


Figure 7 Selecting State Variations

Reference Knowledge Base

CSIRO's involvement with building regulations over many years has led to the accumulation of a massive store of information. This information is used in many different ways for different purposes. To avoid repetitive searches and to ensure that all relevant information is brought to the attention of the user, CSIRO is developing a reference knowledge-base system. Ultimately, we hope that the system will become a reference tool for the building regulators and the building industry.

The anticipated user groups include:

- CSIRO staff, dealing with a multitude of activities related to building regulation;
- the regulators - those developing and interpreting the regulations;
- building designers in optimising their designs;
- manufacturers seeking compliance through appraisal, accreditation and deemed-to-comply solutions;
- construction industry seeking compliance with building design and manufacturers' installation procedures;
- developers, owners and managers seeking compliance with the BCA.

Procedure

The information system will cater for a wide user group. It must be flexible, allow for quick retrieval and be interactive and user friendly. One route of access will be through the BCAider. The proposed design procedure can be set out in three stages:

- i **Data Identification** Data must be identified in ways that will suit the needs of the users. The vast supply of available data will need to be classified and decomposed into attributes, links and values. Identified sources of data include previous regulations, research and technical documents, legal rulings on regulatory matters, reports from fire brigades, overseas research and codes and a multitude of interpretations of the regulations.
- ii **Relational Analysis** This will be done by: first, investigating the areas of data flow and utilisation under existing procedures; second, by cross-checking to ensure that relevant data can be identified through goal decomposition; and lastly, by deriving an inference network that uses hierarchical rules to access the facts base.
- iii **Knowledge-base Design** This will involve two modules for interfacing with the users, depending on the extent of the user's knowledge.

Module A will consist of a filter/rule-base system which will allow the user who is seeking assistance to act with partial information through reason, learning and explanation to access Module B.

Module B can be accessed directly when the user has known requirements and seeks knowledge about the background of a particular clause in the BCA or a performance attribute. It will consist of a database that will provide an integrated development environment.

Conclusion

CSIRO is deeply involved in the development of effective, economic and flexible building regulations. It is showing initiatives in the fields of regulation development, approval processes and in the development of computer technology.

Performance regulation that is supported by an effective accreditation system provides flexibility with a degree of certainty to code users. A simple, two-tier performance structure is now being used in the BCA, and CSIRO is developing supportive accreditation and product registration schemes.

BCAider has achieved its initial goal and created much excitement amongst building professionals. It shows that the advanced information technology tools, such as knowledge based expert systems can be used to develop commercially viable software for building regulations. More importantly, it can help to improve the accuracy, ease and speed of applying the BCA and contribute to much needed productivity improvements in the building sector. The reference knowledge base will enhance the usefulness of BCAider and provide CSIRO with a powerful tool for every aspect of its involvement with building regulations.

We hope that with a co-ordinated and progressive approach, building regulations will become less of a necessary evil and more of a simple way of ensuring that we meet our social responsibilities.