

# An Integrated Approach to Codes, Standards and Products

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## Abstract

This paper describes "IDEA", a commercially available software product that provides an integrated approach to building codes, related standards and product data. It provides hypertext access to various Canadian codes and standards and is cross linked to a database of products and suppliers. The result is a highly responsive information access system of which codes are one integrated element.

## Introduction

IDEA is an acronym for Integrated Data for Engineers and Architects. IDEA is a software product which provides a number of data sources in an easy-to-access manner for the design and construction industry. IDEA was conceived, developed and is marketed by Innovative Technology Inc. (ITI) of Ottawa, Canada.

In 1983, ITI developed its first product -- a specification writing system based on the Canadian National Master Construction Specification. As architects, engineers and owners used the system, they provided feedback and suggestions on its application.

One recurring theme was the need for additional reference information while writing specifications. Since the NMS is a performance specification, it contains many references to standards and codes. Specification writers were expending a lot of effort looking for and checking the many references in each section. Even with the summary documents provided by many of the agencies, the task was often formidable.

As a result, ITI conceived the idea of a system incorporating several data elements used in the design process. The system needed to be flexible, allowing access to the information in the most "natural" manner possible. It also needed to contain as much useful information as possible. Aside from these general criteria some specific design criteria were important. These are shown in figure 1.

With these criteria in mind we developed IDEA. It was first introduced in late 1989. It has evolved somewhat from its introduction but the basic design still is valid.

## System Description

Although IDEA is a stand-alone product, it can also be used in conjunction with other software. This permits a user to see a standard or code reference while writing a specification and immediately research that reference without leaving his specification task. They do this by highlighting the reference on the screen and pressing a "hot-key" to initiate the action.

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<b>IDEA Design Objectives</b>	
<b>Multiple platforms</b>	The resulting product needed to run on multiple platforms. It would originally be developed under DOS on PC compatibles but it also needed to run on the Macintosh line of computers. The human interface would be Mac-like to increase usability and reduce design and documentation effort.
<b>Designer orientation (not examiner)</b>	The product was aimed at the building designer -- not the code examiner. Many other systems (mostly experimental) were aimed at code examiners whose job was to ensure building compliance. The designer is more concerned with ensuring overall compatibility with the code, examining multiple options before committing to a particular design, and examining a wider range of information than just a building code.
<b>Other sources for data</b>	Since the designer has to look at the whole design and specification process, he needs access to multiple codes (i.e., building, fire, plumbing...), standards (CSA, CGSB, ASTM ...) and product data.
<b>Modular</b>	In the Canadian environment there are different codes applicable in different provinces. Sometimes different standards were used in different areas. It was important that the resulting product be modular so different data elements could be plugged in to meet customer and regional requirements.
<b>Non CD-ROM</b>	The design/construction industry in Canada is notoriously slow at adopting new technology. None of the potential customers surveyed owned CD-ROM drives. Requiring them to buy one would present a significant obstacle to product acceptance. Moreover the market size was small enough that the pre-press costs would make the production of a CD-ROM based system prohibitive.
<b>Seamless integration</b>	Architects especially were computer neophytes. They did not want to learn a lot of computer specialized information. The interface needed to be easy-to-use and intuitive. The object oriented approach exemplified by the Apple Macintosh was obviously the way to go. The designer needed to see no difference in accessing similar types of data, regardless of the source agency.

Figure 1 Criteria and Design Objectives

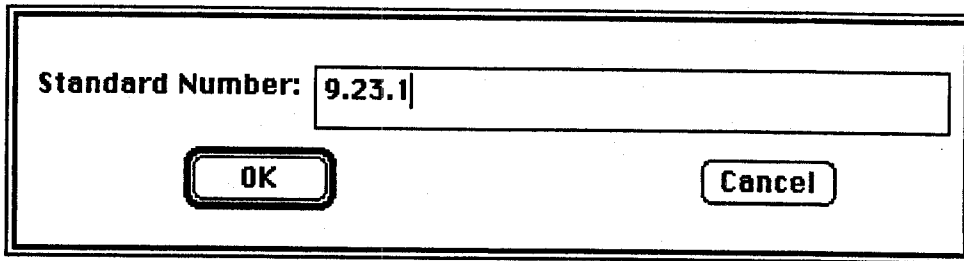
Once in IDEA a user can initiate his research in many different ways. He can perform keyword searches across all the databases, or he can initiate his research based on a code or standard reference. He also has the option of starting from a product category, product name or company name.

Once the search has started, there are many more directions in which he can go, based on what he has found so far. It's this flexibility that makes IDEA unique. Perhaps the best way to describe it is to follow an example search.

A user can pull down the "Select" menu and pick "Reference Standard". At the request dialog, he enters a code reference: 9.23.1.

A word or explanation is due at this point. IDEA considers all codes and standards as equivalent. That is to say, they are all searched and handled in the same way. Therefore,

whenever IDEA gets a reference, it looks for it in a list of available reference types to determine what sort of reference it is. In this example, "9.23.1" looks like a code reference to IDEA so it automatically selects the building code.



This automatic association of reference types is part of the design intent to make IDEA seamless. The user does not need to specify what to look for and where to look. — just indicating what to look for is sufficient.

IDEA searches for the reference and displays it on the screen, as in figure 2:

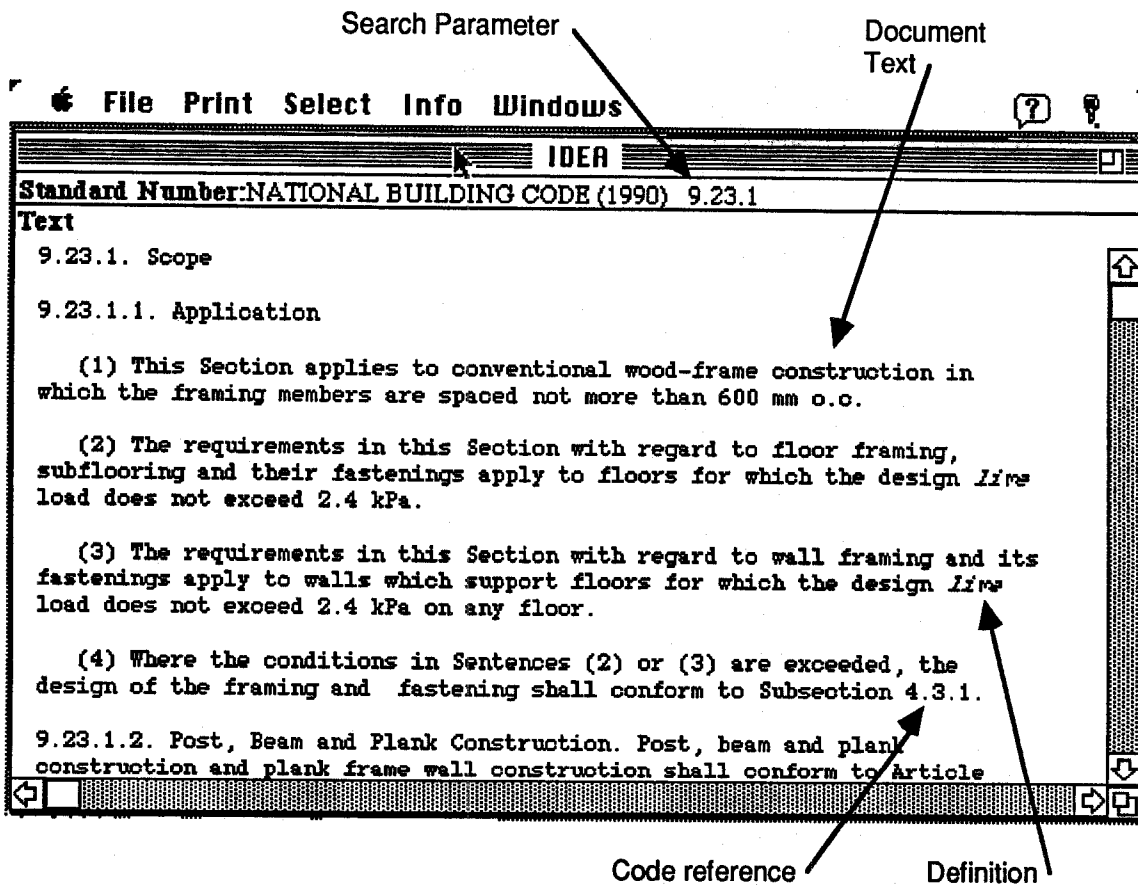


Figure 2 Screen capture for code reference

In the window that appears, the search parameter appears in a title bar, as does the name of the parent document. Below this is the text of that portion of the document. In a building code an entire section of the code is shown, allowing the user to scroll through

the section and view the article in context. In codes especially, seeing the article or paragraph within its larger context is often very important.

Within the body of the section are definitions which are italicized words or expressions. The user can click (or double click) on these to read the definition. Once again the definitions are shown in context for easier reference. The following illustration shows the result of double clicking on "live load". A new window is opened and the definition of "live load" is displayed, as in figure 3:

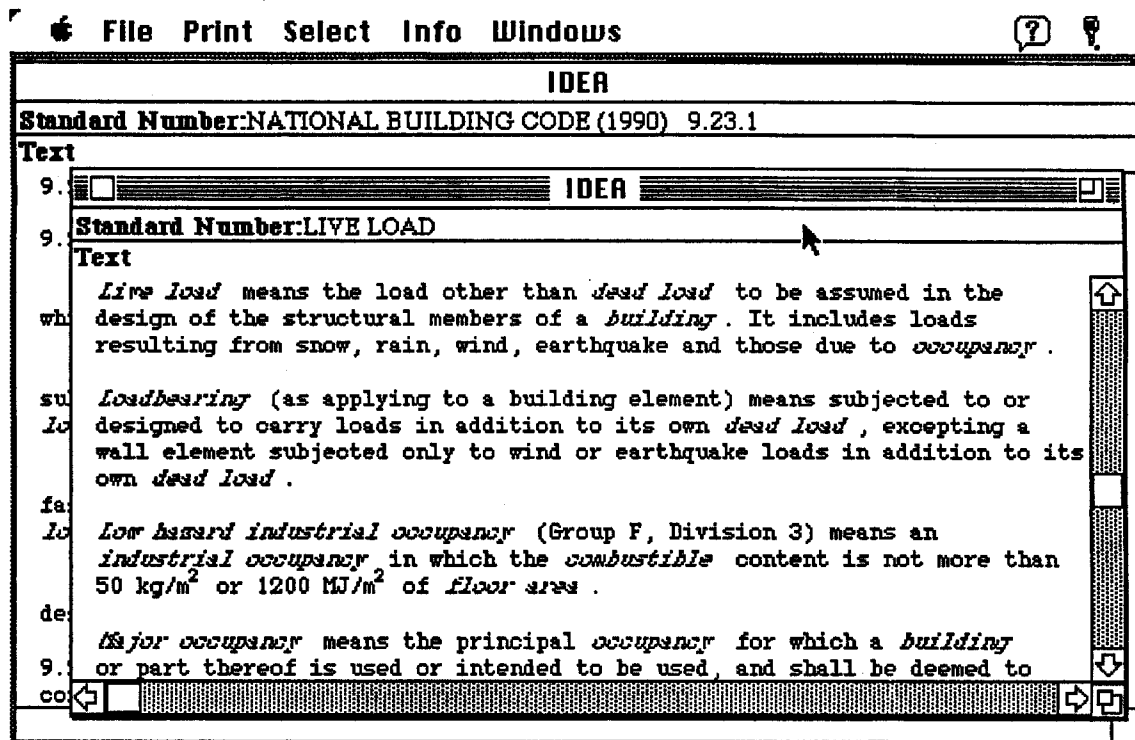


Figure 3 Definition of Live Load

After considering this definition and its implications, the user can close the window to return to the 9.23.1 text.

Another special type of data in the body of a section are references to other parts of the code. In 9.23.1.1.(4). there is a reference to article 4.3.1. Following the same convention as before, positioning the pointer over the "4.3.1" and double clicking opens a new window containing that part of the code for study, as shown in figure 4.

This is probably the most common type of link in the code -- from one article to another. The example in figure 4 shows us one other type of link in the data. In article 4.3.1.1 there are references to two standards (CAN3-O86 and CAN/CSA-O86.1-M).

As with internal code references and definitions, standard references are links that may be explored. Once again, positioning the pointer over the reference and double clicking displays the data for that reference. In this case a summary of the CSA standard referenced is shown in figure 5.

For standard references, most agencies supply only summary information -- not the full text. This is a policy decision on their part based primarily on the consideration that they

wish to sell as many copies of the standard as possible. It is also affected by the fact that many standards have never be captured electronically.

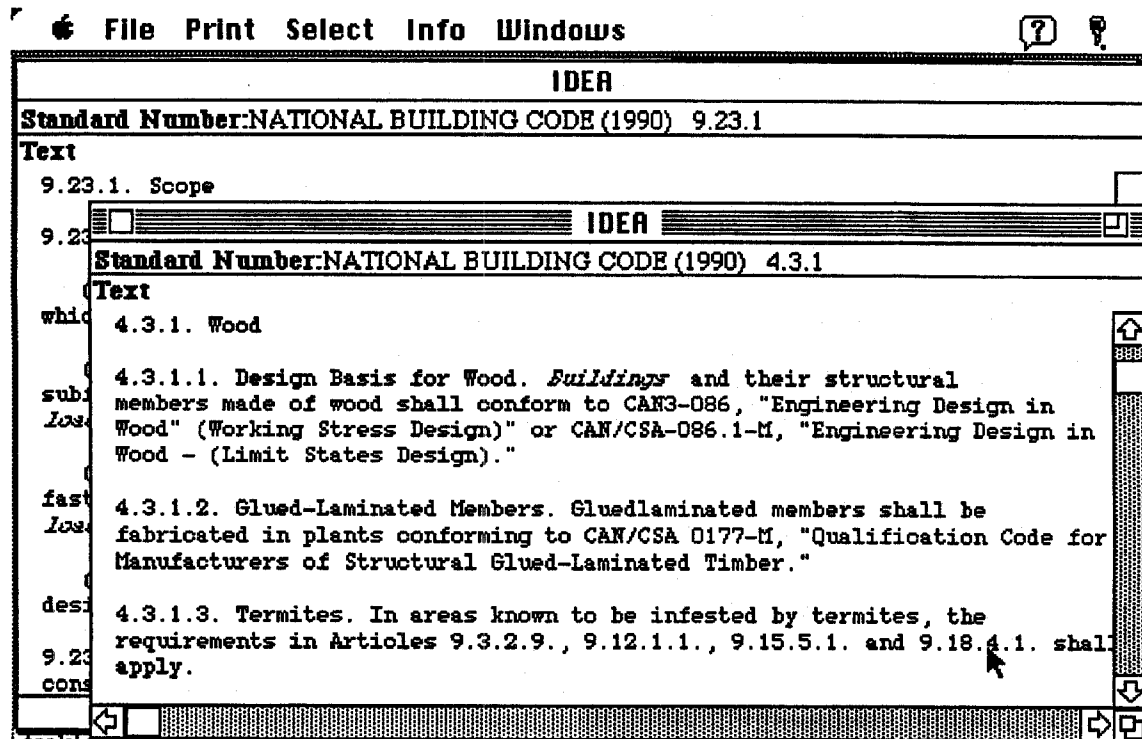


Figure 4 Cross reference to 4.3.1.

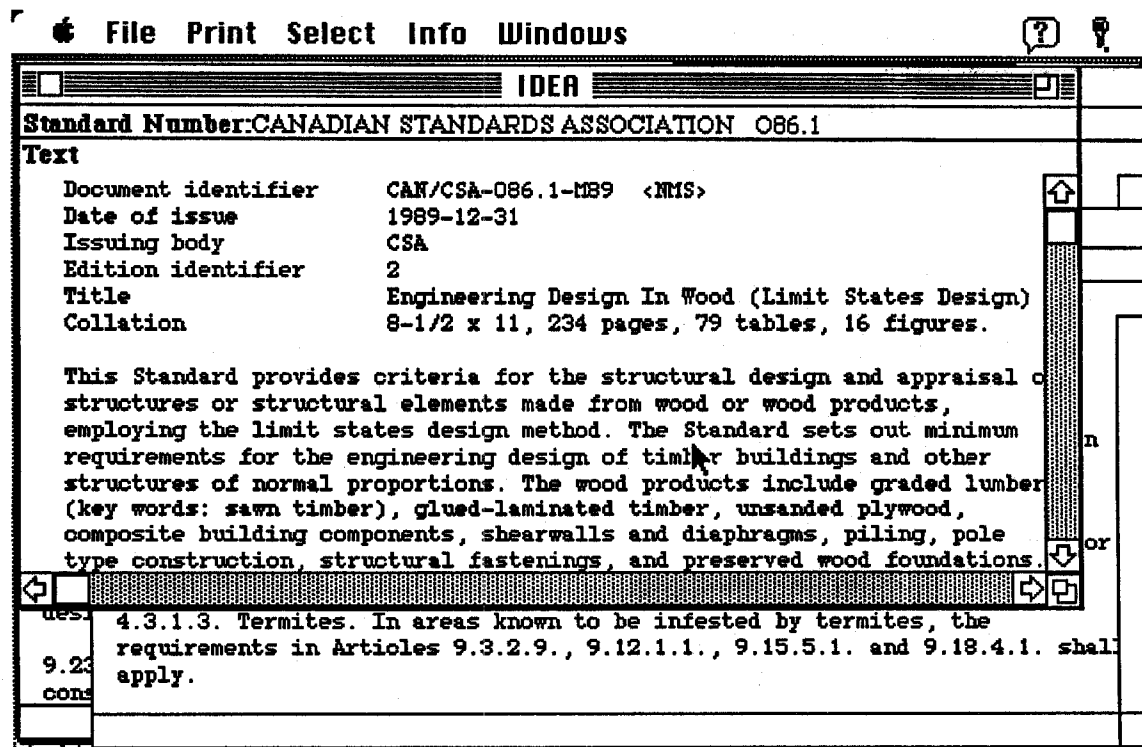


Figure 5 Cross reference to CSA Standard

This process of seeing references to other information and linking directly to it is the principle behind IDEA's ease of research. Wherever there is a reference to other information, the user can use it as a hot button. He can quickly and comfortably explore multiple options and research alternatives until his design is optimal.

The user can open a number of windows this way and stack up many references. At some point there is a limit of what is reasonable for him to coordinate. IDEA's limits in this regard are usually system imposed to between 10 and 20 windows.

To assist users in finding their way through the maze of windows they can create this way, IDEA implements the usual "window" menu. A window menu contains a list of the open windows to permit users direct access to the one they want to see.

One point of note is that the hot buttons are not marked in any particular way. A reference in the text is all that is used. Architects and engineers are used to reading code documents and automatically understanding the meaning of terms. When they see an italicized word, they understand that it is a key definition. When they see a number like 5.3.2.5, they understand it as a link in the text to another part of the code. They also recognize a standard reference for what it is.

Showing these hot buttons in a special font or some other special way detracts from the readability of the text and adds no useful information for the reader. The objective is a smooth system. For codes and standards this is easily achieved without artificial aids.

Most codes include drawings and illustrations. In IDEA these are marked with an indicator showing that an illustration is present. Double clicking on the marker expands the illustration into a window of its own, as shown in figure 6. When faced with the need to display diagrams, we decided to keep them separate from the text of the code. This allowed us to support IDEA for PC users without graphics capability.

## **Code Searching**

We have shown the general use IDEA in the context of codes and standards research. We alluded earlier to other mechanisms for starting a data search. The most important of these alternate methods is the keyword search.

A keyword search is started by entering the word to be found. The algorithm automatically scans for plurals and other verb tenses as appropriate. Since IDEA is not restricted to one code, the search is performed on all the databases at one time. An indexing system makes the search very quick.

The user sees a list of standards and codes containing the requested keyword. He can then expand or reduce his search by specifying other keywords. We studiously avoided presenting users with boolean operations. We chose instead the terms "reduce" and "add to" for the standard "AND" and "OR" operations. By expressing the same concepts in more natural terms we make the system more natural and friendly.

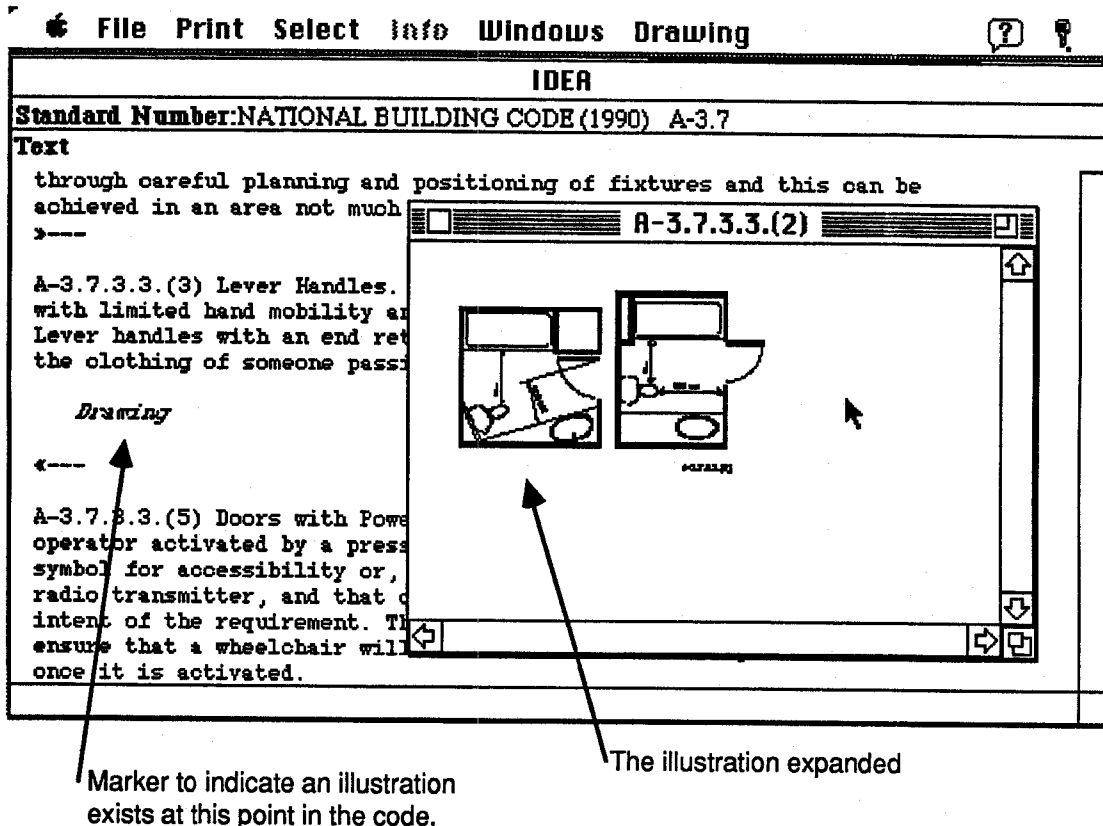


Figure 6 Cross reference to illustrations

From the keyword list, the user is just a click away from the data he has requested. Highlighting a selection from the list and double clicking it displays the indicated code or standard. Figure 7 shows the results of a keyword search on the word fire.

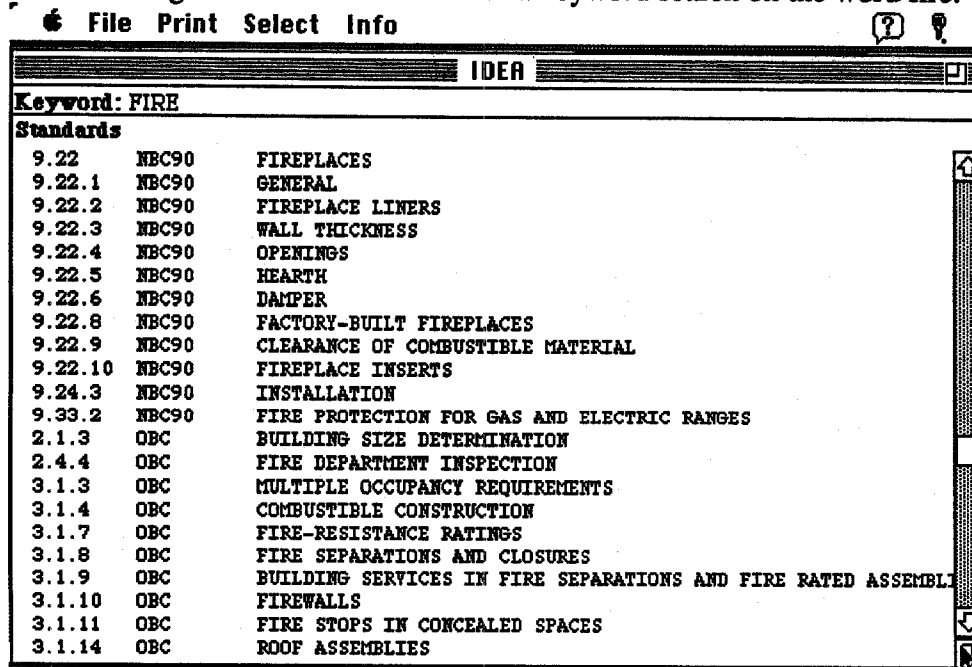


Figure 7 Search Mechanism

We have scrolled the list in figure 7 to show some NBC (National Building Code) and OBC (Ontario Building Code) references. (There are also CSA and CGSB references, but they are further down the list and cannot be seen in this window view.)

IDEA has been designed in a modular fashion. Codes and standards can be added or removed from the product at any time. Users can select what components they wish to order. The standard package contains one building code (user's choice), but a user can add other building codes if he wishes. This is especially useful for companies working in more than one jurisdiction.

When a user has multiple codes and he selects a reference to one, and there is doubt as to which one he intends, IDEA will ask by presenting a list of possible choices. In most cases, however, it is quite obvious what the user meant.

IDEA is currently available with the following codes and standards:

- National Building Code (1985 edition)
- National Building Code (1990 edition)
- National Fire Code (1990 edition)
- National Plumbing Code (1990 edition)
- Ontario Building Code (1990 edition)
- Canadian Standards Association - Summaries of standards for the building industry
- Canadian General Standards Board - Summaries of standards for the building industry
- Construction Specifications Canada - Masterformat

## **Product Data**

As well as codes and standards information, IDEA also contains a great deal of product information. Users can start with keywords, product names, product classifications, or company names to access specific information about products or companies. From a keyword specification, the user is given a list of product classifications based on Masterformat (the North American standard for construction product classification). Once he has chosen a specific product classification, he sees a list of companies providing that product. This is shown in figure 8.

From the list of companies, he can get specific information on any selected company by double clicking on its name. Users are more inclined to look up companies with "diamonds" beside their names. The diamonds indicate that the company has provided extra technical information about this product in their information records.



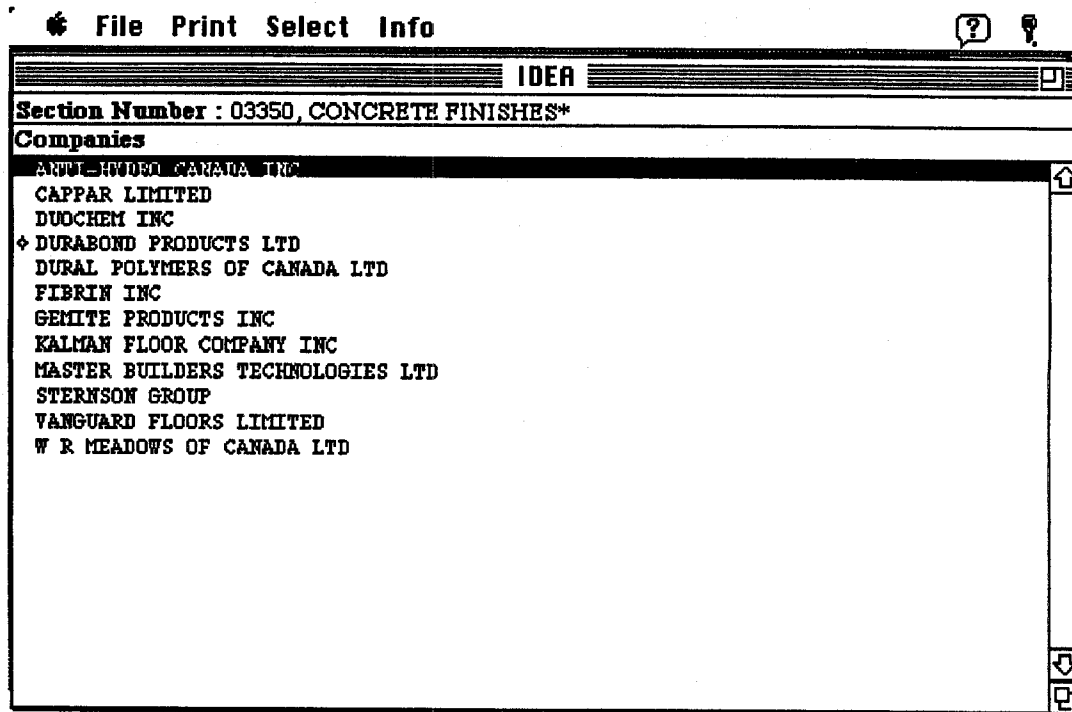


Figure 8 Company lists

In the next illustration, the user picked "Durabond" for more information.

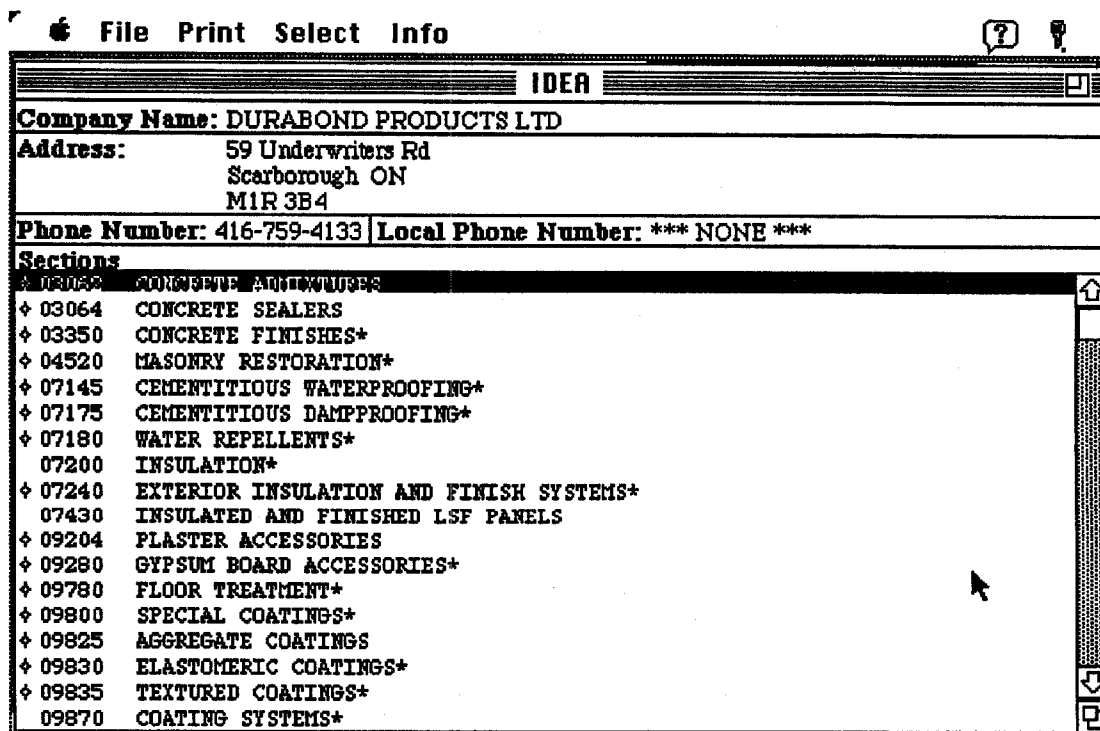


Figure 9 Information on Durabond

The data for a company shows its name, address and phone number as well as a local phone number if there is one. The local phone number is the number of a branch office or agent who sells the products in the users local area. The bottom part of the window lists all the product categories sold by this supplier.

There is a lot more information available for a company. The "Info" menu lets the user select which information he wants to see in the bottom of the window: His choices include:

Agents	A list of agents who sell this company's products
Branches	A list of the company's branch sales offices
Comments	A list of products for which the company has included additional technical information in the database. The user can select a product from the list to get the full technical information which can include: <ul style="list-style-type: none"><li>• Descriptive or technical text,</li><li>• Detail drawings,</li><li>• Guide specifications,</li><li>• Photographs.</li></ul>
Library	A database of reference binders in the customer's library for this company.
Notes	A database of this user's experience with this company's products
Trade Names	A list of trade names used by this company.

Linking product data to the standards and codes takes IDEA beyond the realms of simple code checking into actual design information and product selection. This makes the system a key component of the design process.

Because, no list of companies is ever fully up-to-date and accurate, IDEA allows users to enter new companies and amend information about existing companies. New companies can be entered and their section lists edited. Although some information cannot be entered this way, it does allow users to expand the company list for library and note maintenance.

When ITI's master lists are updated, they are merged automatically with user entered information to ensure complete data integrity at all times.

## **Operating environment**

The great majority of architectural and engineering design companies in Canada are very small. Most of them are not yet using workstations -- they use micro computers instead. IDEA is currently available for both PC compatibles and Macintosh computers.

IDEA is distributed on diskettes which are then loaded onto the user's hard disk. This eliminates the need for a CD-ROM drive (still an expensive piece of hardware) and increases speed as hard drives are much faster than CD-ROMs at this time.

Moreover the amount of storage required for the system is minimal. Only one or two diskettes (720K/800K) are required per building code. By using data compression on the information, the storage space can be kept to a reasonable level without causing a negative impact on data access time. The entire system occupies less than 3.5 M bytes. An approximate breakdown of disk requirements is shown in table A.

Table A - IDEA Storage Requirements	
IDEA software	700K
CGSB data	113K
CSA data	251K
Masterformat construction product index	110K
National Building Code ('90)	820K
Construction product database (~3500 companies)	1330K

Appropriate care has also been taken with most of the drawings. Wherever possible, illustrations have been converted to line drawings rather than being kept as bit mapped images. This significantly reduces the space required per image.

IDEA was written entirely in the "C" programming language. It is not based on Hypercard or any other similar product. This was done to get maximum flexibility and speed and at the same time to reduce disk and hardware requirements. Other database systems were evaluated but rejected as too wasteful of disk space or inappropriate. This choice has proved worth while. It undoubtedly added to the development cost but the product quality is much higher than would have been achieved otherwise.

IDEA was originally implemented on the PC using "Turbo C". It has since been transported to the Macintosh using "Think C".

## Future

IDEA is a polished and finished product. But user experience and time always indicate new avenues for development. IDEA will soon be converted to run under Windows 3.1 on the PC.

Among the features to be added in future versions is the ability to scan the content of a code or standard for a particular phrase. In 98% of the cases, the current keyword search is more than adequate for finding the required material. Occasionally it would be helpful to be able to search through a code for a word or phrase. This is a much slower operation, so it will always be a secondary option.

Another feature we will add is the ability to copy text from a code into a word processing document. Until now we haven't permitted this, since it is a clear contravention of Canadian copyright law. Discussions with codes agencies indicate that they don't consider this to be a problem, so the operation will be added in a future version of IDEA.

Another key area will be adding more codes to the suite already available. This is easy from the technical point of view. The difficulty lies in negotiating an agreement with the responsible agencies for the right to produce the codes electronically. Most agencies are only now struggling to understand the implications of such an agreement.

Even when an agreement is reached, the agencies involved have a great deal of trouble delivering the code in electronic form. Delivery is usually delayed and is full of problems and inconsistencies. As electronic delivery systems for codes like IDEA become more common, issue will have to be faced squarely.

## **Conclusions**

IDEA has proven the concept of a seamless approach to building design data. The viability, in the long run, will continue to depend on market acceptance. Most architectural and engineering design offices are very slow to adopt new technology and concepts.

Furthermore, the acceptability of the system is largely dependent on the suite of codes available. That in turn depends upon the code agencies to make the codes available and to provide them in a timely and accurate manner.

These two limitations will continue to slow the acceptance of IDEA for some time. For those companies who have started to use IDEA, the benefits are apparent.