SHRP-C/UWP-91-501

NCSU Concrete Materials Database

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Strategic Highway Research Program
National Research Council
Washington, D.C. 1991

SHRP-C/UWP-91-501
Contract C-205
Product Code 2014, 2023, 2024

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January 1991
Reprinted November 1993

key words:
computer
concrete
database
fiber-reinforced concrete
materials
mechanical properties
reinforced concrete
relational database

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50/NAP/1193

Acknowledgments

The research described herein was supported by the Strategic Highway Research Program (SHRP). SHRP is a unit of the National Research Council that was authorized by section 128 of the Surface Transportation and Uniform Relocation Assistance Act of 1987.

SHRP Contract C-205 is concerned with an investigation of the mechanical behavior of high-performance concretes. The research is being conducted by a team from three universities: North Carolina State University, the University of Arkansas, and the University of Michigan.

This report is based on the author's independent study project which is a requirement for the Master of Civil Engineering degree. The author has benefited greatly from the frequent discussions with his professors: Mr. Michael L. Leming, Dr. Paul Zia, and Dr. Shuaib H. Ahmad. Their guidance is gratefully acknowledged.

Contents

Abstract

The NCSU Concrete Materials Database Program was designed to collect and organize research data on the mechanical properties of high performance concrete.

The NCSU Concrete Materials Database program is based on the relational model and was developed using commercial software. It contains a menu system and other user interfaces that guide users with little database knowledge to extract desired data for data analysis.

The development of the NCSU Database program represents the first attempt to collect research data in the concrete area. It also demonstrates the feasibility of establishing a general database that encompasses all aspects of concrete properties.

Executive Summary

Since the early 1970s efforts have been devoted to collecting numeric data of different engineering materials such as metals and ceramics. However, no attempt has been made to assemble research data concrete. The only known electronic databases available in the concrete area are bibliographic in nature.

While a bibliographic database is valuable in literature searches, a numeric database would allow quick data retrieval, establish relationships among different mechanical properties, and also eliminate duplication of research work or omission of useful data.

As part of the research conducted under the Strategic Highway Research Program Contract C-205, the NCSU Concrete Materials Database Program was developed to collect and organize data on the mechanical properties of concrete.

The program is a relational database, developed by using Oracle, a commercial software package. It is composed of a series of interrelated tables structured to meet the needs of both researchers and practicing engineers. Several levels of interface sophistication are available. The program provides menu-driven interfaces which can be used by the novice to query or add data. Additional menu-driven interfaces are available for moderate-to high-expertise users as are guidelines for advanced database programmers. A user's manual for the program is available in a separate volume.

The database program consists of three sub-databases. One sub-database contains numeric data on mix characteristics and mechanical properties of concrete; users may query this sub-database to establish relationships between different properties based on variation of mix proportions. The second sub-database contains conclusions of research articles reviewed by investigators; users can query this sub-database by subject indices, year of publication, author's name, and other attributes. The third sub-database contains information on graphs and formulas reported in articles--similar to the conclusion sub-database, this sub-database may also by queried by subject indices, year of publication, author's name and other attributes.

Utilizing Oracle's high portability among computer systems allows the program to be run in any mainframe, mini-computer, workstation, and personal computer in which Oracle has been installed. To run the program on a PC, an AT machine with a minimum of three megabytes of extended memory and ten megabytes of hard disk storage is required.

1

Introduction

A database is a means of organizating and storing information electronically and providing easy access to data. While business databases account for more than 90 percent of existing databases, engineering databases, characterized by a much higher percentage of numeric data and more-complex structure, have just begun to grow in recent years. One branch of engineering databases is concerned with data generated in research on composition and mechanical properties of engineering materials such as concrete.

The advantages of having a concrete materials database are significant. A tremendous amount of research data is generated every year about concrete materials technology. A database can effectively store and update this data, and allows more sophisticated search strategies. It also enables data transfer to other software for further analysis, reduces error, and accidental data omission, and costs lower in the long run.

However, developing a concrete materials database requires considerable effort. Concrete is highly processing-sensitive; mix proportions, curing environment, and testing methodology all influence its mechanical properties. Thus, for a concrete database to be of any use, its data structure must be well organized so it can store and recall all relevant information correctly.

Developing a concrete materials database requires more than simply digitizing numbers from research reports or rearranging tabular files of values. Much more attention must be paid to annotation and definition of values and terms.

There have been other efforts to establish materials databases The Numeric Data Information Analysis center at Battelle, Ohio has collected data on different metals and ceramics since 1970. In addition, the professional society, CODATA, was established in the 1960s and publishes proceedings annually. No such endeavor had been made in the concrete area. The database program described in this report is believed to be the first attempt to collect and organize research data on concrete properties.

The intent of this program is for the SHRP C-205 project team to gather and organize existing research data on the mechanical properties of concrete. Furthermore, experimental data generated in the second phase of the SHRP C-205 project will also be put into the program.

This report is a general overview of the program and its development process. A user's manual for the program is presented in a separate volume.

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Development of The NCSU Concrete Materials Database

Goals

When the development of the NCSU Concrete Materials Database began in 1989, the first task was to clarify the intended use of the database. Two kinds of uses were identified.

First, the database may be used for data synopsis. The user knows at which article to look. The database should produce the data quickly and provide an easy way for the user to manipulate the data.

Second, the database may be used to establish relationships among different mechanical properties. The user queries the database based on subject fields. For example, the user may want to gather all the data concerning elastic modulus and compressive strength based on certain criteria such as age of the concrete at testing.

With these two intended uses in mind, the next step was to establish the conceptual model.

Conceptual Model

There are three data models for the vast majority of database management systems used today: hierarchical, network, and relational models. The relational model is characterized by its simplicity of structure and ease of modifications. Consequently, this model was selected to develop the conceptual model of the NCSU Concrete Materials Database.

A relational model database is perceived by the user as just a collection of tables. Relationships are implemented through columns common to two or more tables. A simple example is shown in Figure 2.1 in which the TEACHER table and the CLASS table are the two entities and the teacher # column provides the relation between the two entities. This concept is formally called an entity-relationship representation.

In order to eliminate data duplication and to ensure data integrity, all entities should at least be broken down to the third Normal Form for relational databases. Refer to Appendix A for a quick overview of basic relational database model concepts.

Mapping concrete properties to the entity-relationship representation is neither simple nor straightforward. In the broadest sense, concrete properties may be mapped into three entities. Specimen and processing history are two entities that, in combination, define a set of mechanical properties. This is shown in Figure 2.2.

Based on this general representation the three entities can be broken down further as shown in Figure 3. In this form seven entities are identified. With this form, information on plastic properties and effects of different testing environments on concrete properties can be stored.

However, this form is still far from complying the relational model's third Normal Form requirement; further break down of entities is needed. For example, the Test Setup attribute in the testing environment entity alone should be broken down to testing equipment types and loading types.

Model Revision

Although the form proposed in Figure 2.3 seems applicable and further break downs would lead us to the form that is conceptually correct, three practical considerations necessitate changes.

First, time and budget constraints do not allow development of a completely general database. For a data point to be meaningful, all relevant information describing that data point must be included. For example, a data point on compressive strength would be meaningful only if the mix design, the shape and size of specimen tested, and test setup are known. However, because the diversity of data formats used in research articles, reorganizing and then entering every piece of data from reviewed research articles would be a monumental task which is not feasible within the present budget and time constraints.

Since SHRP C-205 project has a goal of obtaining information on certain mechanical properties of high performance concrete, one knows what kind of data is needed. Thus, data input can be quite selective. Consequently, a structure that is based on Figure 2.3 is unnecessarily complex.

Second, user interface suffers with an increasingly complex data structure. One of the major considerations in the development of this database is keeping the database structure simple and easy to use. A complex structure would prohibit users with limited database knowledge from using the program effectively. A database structure with more than a few entities and relations would make any query complex.

Third, not all data are relevant. There are many research articles for which only a few conclusions or observations are pertinent to the SHRP C-205 project. Therefore, a different type of database structure should be included to contain only textual data.

Because of these concerns, a revision was required. The revised structure became the framework of the NCSU Concrete Materials Database program.

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Structure of The NCSU Concrete Materials Database

The structure of the NCSU Concrete Materials Database contains three parts, each with a distinctive function.

The first part incorporates the conclusion sub-database that contains the author's conclusions. Its structure is similar to a bibliographic database.

The second part incorporates the numeric sub-database which contains pertinent, published data.

The third part incorporates the formula/graph sub-database that contains information on graphs and formulas that are deemed important, but cannot fit into the numeric sub-database. The actual data are stored in Lotus 1-2-3 files.

Figure 3.1 shows the entity-relationships for the three sub-databases. A total of eleven tables were created based on these entity-relationships.

Tables

Each table in a relational model contains a number of attributes (also called columns or fields) that characterize the table. Within each table a column that is used to distinctively identify a record and provides linkage to other tables. This column is called the primary key.

The NCSU Database program contains a total of eleven tables. Of the eleven, seven tables are used in different table combinations to form three kinds of queries. The remaining four are auxiliary tables used to assist input and query. A brief discussion of each table is given below.

The BASE table contains information such as article title, its first author, and year of publication. The article ID number column is the primary key for the BASE table.

The CONCLUSION table contains the text of conclusions. Its primary key is composed of the article ID number and the conclusion number.

The KEYWORD table contains the keywords of each article's conclusion. Its primary key is composed of the article ID number and the conclusion ID number.

The TABLEA table contains information on mix proportions and curing conditions. Its primary key is composed of the article ID number, the specimen ID number, and the mix ID number.

The TABLEB table contains information on test setup and strength data. Its primary key is composed of the article ID number, the specimen ID number, and the mix ID number.

The TABLEF table contains information on figures and graphs stored in Lotus 1-2-3 spreadsheets. Its primary key is composed of the article ID number and the figure/graph ID number.

The FIGURE KEYWORD (FKW) table contains the keywords of each figure/graph record. Its primary key is composed of the article ID number and the figure/graph ID number.

Described below are the four auxiliary tables.

The KWMENU table is a single-column table containing the reference keyword list that can be accessed in the conclusion sub-database.

The FKWMENU table is a single column table containing the reference keyword list that can be accessed in the formula/graph sub-database.

The COLUM table contains the attributes of the BASE table, the TABLEA table and the TABLEB table. This table is used to print out attribute names to assist users in querying the numeric sub-database.

The LISTVAL table contains a list of values that can be accessed by certain attributes of

TABLEA and TABLEB. Its primary key is the field name from either TABLEA or TABLEB.

Table Joins

In order to provide correct query results, tables are interconnected by their primary keys. Linking tables by the primary keys is called a table join. Figure 3.2 shows the schematic diagram of each table join for the NCSU database.

For the conclusion sub-database, BASE, CONCLUSION, and KEYWORD are connected together through their primary keys.

For the numeric sub-database, BASE, TABLEA, and TABLEB are connected together through their primary keys.

For the figure/graph sub-database, BASE, TABLEF, and FKW are connected together through their primary keys.

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Implementation

The NCSU Database program is implemented using Oracle database software. All the data and table definitions are stored in Oracle's Relational Database Management System (RDBMS). The program contains three modes of operations: input mode, query mode, and maintenance mode. In addition, a menu system links the different operations in the three modes together and forms the complete package. The relationship among different modes, the menu system and Oracle RDBMS is depicted in Figure 4.1, and the relationship among different tools that are used in the program is shown in Figure 4.2. Descriptions of the products used in the database is presented in Appendix B and C.

Menu System

The menu system, called Application Menus, provides a user friendly medium to access various operations of the program. The complete Application Menus tree is shown in Figure 4.3-4.4. SQL (Structured Query Language) Menu, Oracle's menu design tool, was used to develop the menu system. The Application Menus guides the user through different menu screens to reach the desired operation. Along the way, useful help messages are provided. In addition, the Application Menus sets up three different levels of users to ensure security.

Level 1 users can only access the query mode of the program. At this level, the user can not input or update data.

Level 2 users can access the query mode as well as the input mode of the program. At this level, the user can input or update data.

Level 3 users can access the entire program. In addition to input and query, users at this level may maintain the program.

Query Mode

Query procedures have been set up for all three sub-databases (Figs 4.4 and 4.5). All the query procedures in this program are executed in SQL*Plus, Oracle's interface software to its RDBMS. In each of the three types of query, scripts have been written to link the appropriate tables together. Therefore, the users only need to enter search criteria and display order.

Input Mode

The NCSU Database Program provide easy-to-use input forms to enter data into the three sub-databases. These input forms, which are created using the SQL*Forms, Oracle's form design tool, contain extensive error checking mechanisms and help screens.

Maintenance Mode

Maintenance Mode contains some forms that do the housekeeping chores of the program. For example, the reference keyword list input forms allows additional keywords to be used in the conclusion and figure/graph sub-databases. All these forms were also created using SQL*Forms.

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Discussion of Operation

An overview of operational procedures is presented in this chapter. For a detailed description, refer to the NCSU Concrete Materials Database Program User's Manual. In addition, some input considerations and limitations are also discussed.

Procedures

The NCSU Database Program contains three modes: query mode, input mode, and maintenance mode. Turn on the computer. To start the program, enter 'SHRP'. Then you are prompted to give your username and password. Depending on your user level, you can perform operations in one, two or all three modes.

To make a query to the database, navigate through the Application Menus until you reache the screen that contains an option to execute the query statement. From then on, the general procedure is to 1) enter search criteria, 2) execute the query, 3) display the query result, then 4) print the result.

To input data into the database, navigate through the Application Menus until the proper input form displays on the screen. Then you can enter data, save data, and then exit back to the menu system.

The procedure to update or input data in maintenance mode is identical to adding data in the input mode.

Input Considerations

There are some peculiarities that are intrinsic to any materials database, including the NCSU Database. Solutions to these peculiarities lie in consistent input. In the following, those peculiarities and the input rules are presented.

Journal articles frequently contain incomplete information. If the data in an attribute is not reported in the article but an estimate can be made, the best estimated value should be entered into that attribute. However, if a reasonable estimate can not be made, then it should be left blank. The reason for leaving unknown values blank is twofold: It saves memory space since blank cells in Oracle tables do not occupy memory space, and if the article does not show the value, then it is not critical information.

In materials testing data precision is different for different testing equipment. In this database, field standard precisions are to be followed. For example, cement quantity is measured to the nearest 1 pcy.

Different units are used in research. The American customary units will be followed. See Appendix C in the user's manual for the exact units in each field.

By adopting the simpler database structure, there will be more data duplication. Users who input the data should be selective, otherwise the amount of data duplication could become unmanageable.

Many research articles contain data from other sources for comparison purposes. In general, comparison data should not be included, but the original articles may be reviewed. If comparison data are included, it should be noted in the note fields of TABLBEA and TABLEB.

Testing frequency is difficult to evaluate. One potential use of the database is to determine the amount of data available in a research area. However, what constitutes a data point is subject to interpretation. Is a data point the result of single measurement based on one test specimen, or an average from several tests of different specimens? For this database, it is determined that if only one data point is reported, even though several specimen were tested, then only one data point is accepted.

Limitations

There are certain limitations of this program; some are program-imposed, and others are intrinsic to Oracle. These limitations are discussed below.

A maximum of 128 characters are accepted in any of the execute query statement operations.

In querying the conclusion sub-database and the formula/graph sub-database, queries rarely approach that limit. However, queries in TABLEA and TABLEB are usually complex, and the 128-character limit may be exceeded. To overcome this limitation, use ORACLE FOR 123 when querying Table A and Table B. If ORACLE FOR 123, which has no limit on query-string length, is not available, a more complex query option in the program may be used as another alternative. Refer to the user manual for details.

If a relationship between two different mechanical properties is desired, compressive strength vs. indirect tensile strength, queries provided by the program may not extract all available information. This is because records are specimen-specific. Therefore, unless values of different mechanical properties are stored in the same record, regular queries cannot extract that record. However, a more elaborate query can be executed to accomplish this task. Appendix E in the user manual provides guidelines.

If the Oracle software is a PC trial version, then data size is limited to one megabyte.

This program was developed in a PC environment. Even though Oracle claims high portability among different systems, no such transfer has been attempted with this database.

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Recommendations for Future Development

The benefits of having a general numeric database of concrete materials can be substantial. For example, researchers who undertake a study on creep and shrinkage of certain kinds of concrete can consult the database to see what existing data are already available. On the other hand, researchers who want to examine the relation between fatigue behavior of high-strength concrete and normal-strength concrete can search the database and analyze the data. While the intent of the NCSU Concrete Materials Database is highly focused, nonetheless it has demonstrated the feasibility of establishing a general database that can cover more than just the mechanical properties of concrete.

During the development of this database program, many ideas emerged that may be considered in future development.

1. Any database project requires a lot of memory space. This is true particularly for a materials database because, in order for a data point to be meaningful, all relevant information to that data point must be stored as well. Therefore, any sizable materials database will not be suited for a personal computer. Workstations or larger computers will be required to handle large amounts of data.

2. While the relational model makes development simpler and modifications easier, it does have the drawback of slower execution speed and a larger memory space requirement. In a more elaborate database, these two conditions may significantly

hinder database program performance. Therefore, even though the relational model may still prove to be the most applicable method, other types of models should be investigated in preliminary studies.

3. Unit conversion tables should be set up to permit data entry and query in any unit with complete clarity to the users.

4. The NCSU Database program does not include graphic or statistical capabilities. Such features would be desirable. If Oracle is used in future development, it is advisable to look into its graphic and spreadsheet tools.

5. The program was developed in Oracle's PC version. However, Oracle PC is a weak system that contains many limitations and program bugs. In this program some features to be eliminated to accommodate the PC. In future development, a workstation version is highly recommended.

6. Since the intent of the NCSU Database program is narrowly focused, it was able to achieve better user interface by simplifying the table structures. This approach was possible because the amount of data duplication due to a larger table size was acceptable. However, in a more elaborate database where a large amount of data is anticipated, data structures that comply more closely with the relational model are needed to ensure minimum data duplication. The form in Figure 2.3 would be a more suitable conceptual model than Figure 3.1. However, with the large number of entities and varied kinds of table joins, it is unlikely that a user with little database background can operate it. A more likely scenario is a technical staff familiar with database concepts being put in charge of the data searches. In fact, almost all existing data banks such as the Battelle center in Ohio operate this way.

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Conclusion

The main purpose of the NCSU Concrete Materials Database program is for the SHRP C-205 project team to gather and organize existing research data on the mechanical properties of high-performance concrete. Furthermore, experimental data that will be generated in the second phase of the SHRP C-205 project will also be put into the program.

This program was developed using the relational database model and was constructed using the commercial database software, ORACLE. Necessary table structures and pertinent input/query procedures have been incorporated. When enough data have been input into the program, users can access research data quickly and selectively.

Using the query procedures in the program, investigators can quickly retrieve research data in seconds. Duplication of work or omission of data is also substantially reduced.

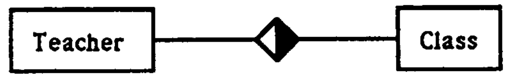
The program provides ways to search the database based on mix constituents, processing histories, and mechanical properties. Consequently, relationships among different mechanical properties with variance in mix proportions, curing histories and test setups can be quickly established.

In addition, this program is capable of transporting selected data to a Lotus 1-2-3 spreadsheet for further data analysis.

Although the primary users of this program are the principal investigators internal to the SHRP C-205 project, it is envisioned that this program can also be utilized by other researchers and engineers even with little database experience.

8

Figures



TEACHER

teacher id #	name

CLASS

class id #	course name	teacher id #

FIGURE 2.1 ENTITY-RELATIONSHIP EXAMPLE.

"◆" represents one to many relation

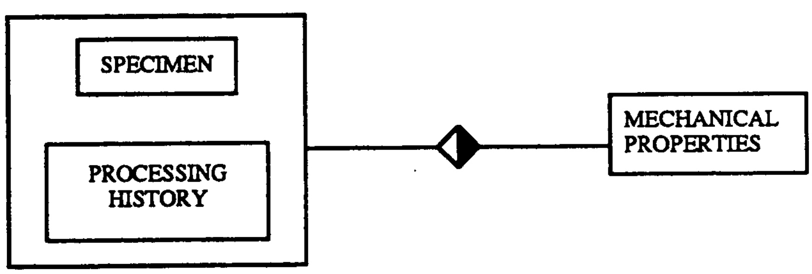
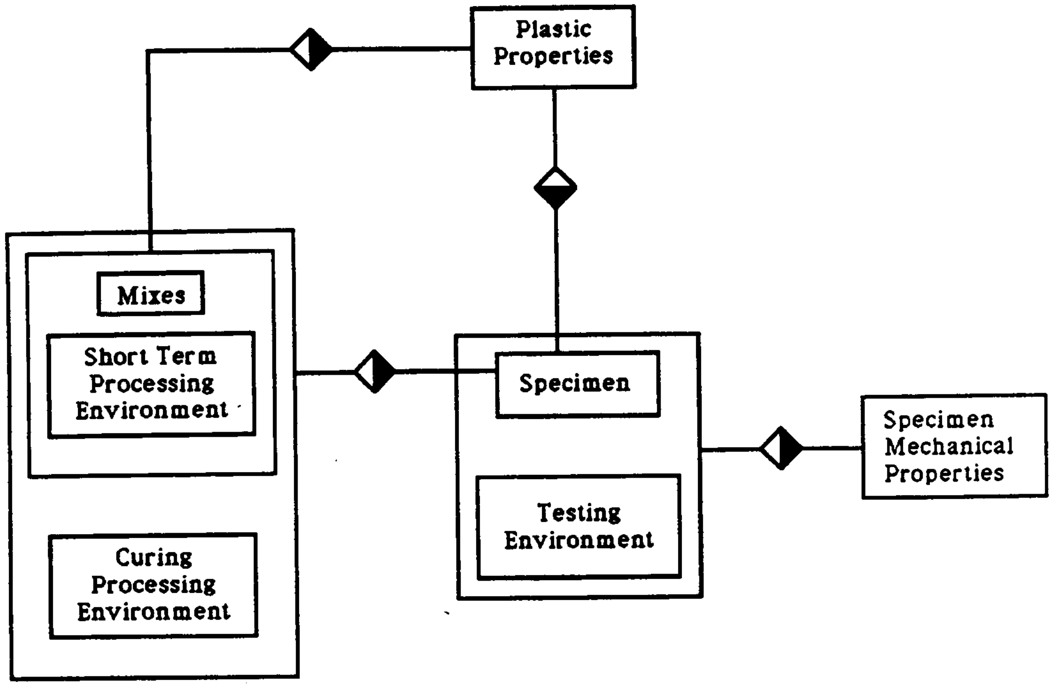


FIGURE 2. 2 ENTITY-RELATIONSHIP FOR CONCRETE



Attributes

Mixes

cement
admixture
aggregates
water amount
etc.

Short Term Processing Environment

mixing time
time in drum
etc.

Plastic Properties

w/c ratio
air content
test location
workability
unit weight
temperature
etc.

Curing Processing environment

curing method
curing time

Specimen

specimen type
specimen size

Testing Environment

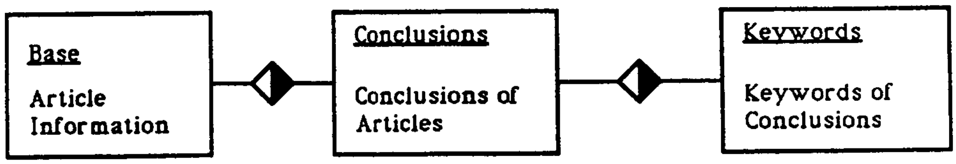
test type
moisture @ test
age @ test
capping
mold
test setup
etc

Specimen Mechanical Properties

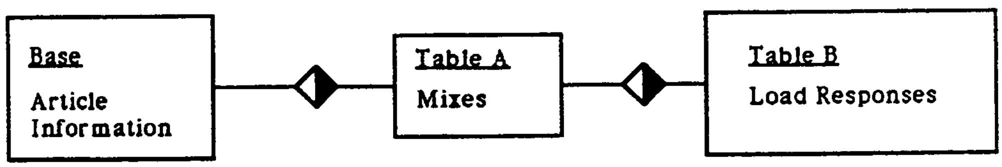
stress
strain
permeability
porosity
fatigue
creep
shrinkage
etc.

FIGURE 2.3 MORE DETAILED ENTITY-RELATIONSHIP FOR CONCRETE

1. Conclusion sub-database



2. Numeric sub-database



3. Formula/Graph sub-database

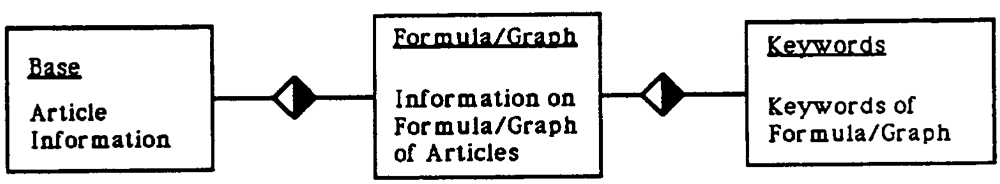


FIGURE 3.1 ENTITY-RELATIONSHIPS FOR NCSU CONCRETE MATERIALS DATABASE

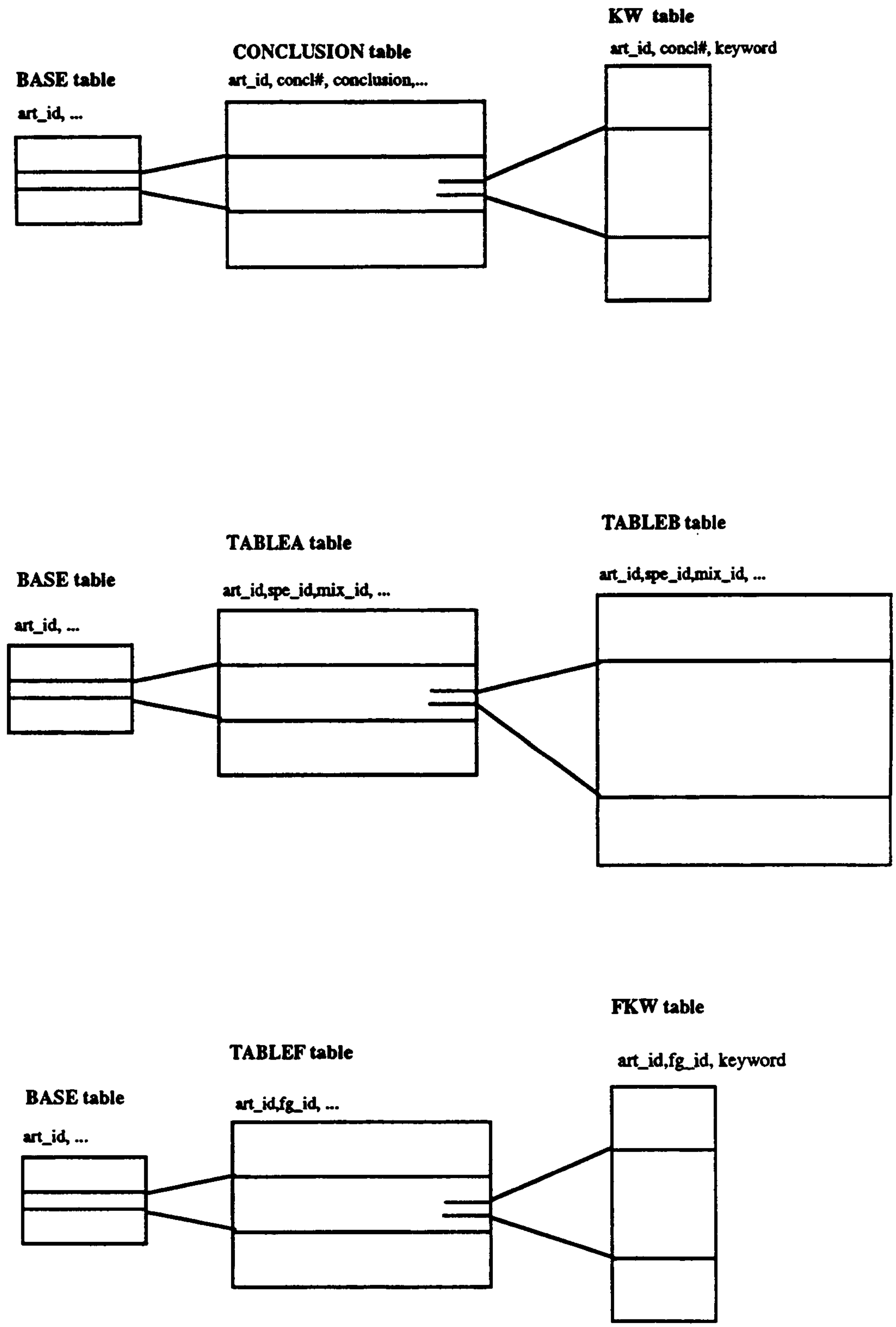


FIGURE 3.2 TABLE JOINS FOR NCSU CONCRETE MATERIALS DATABASE

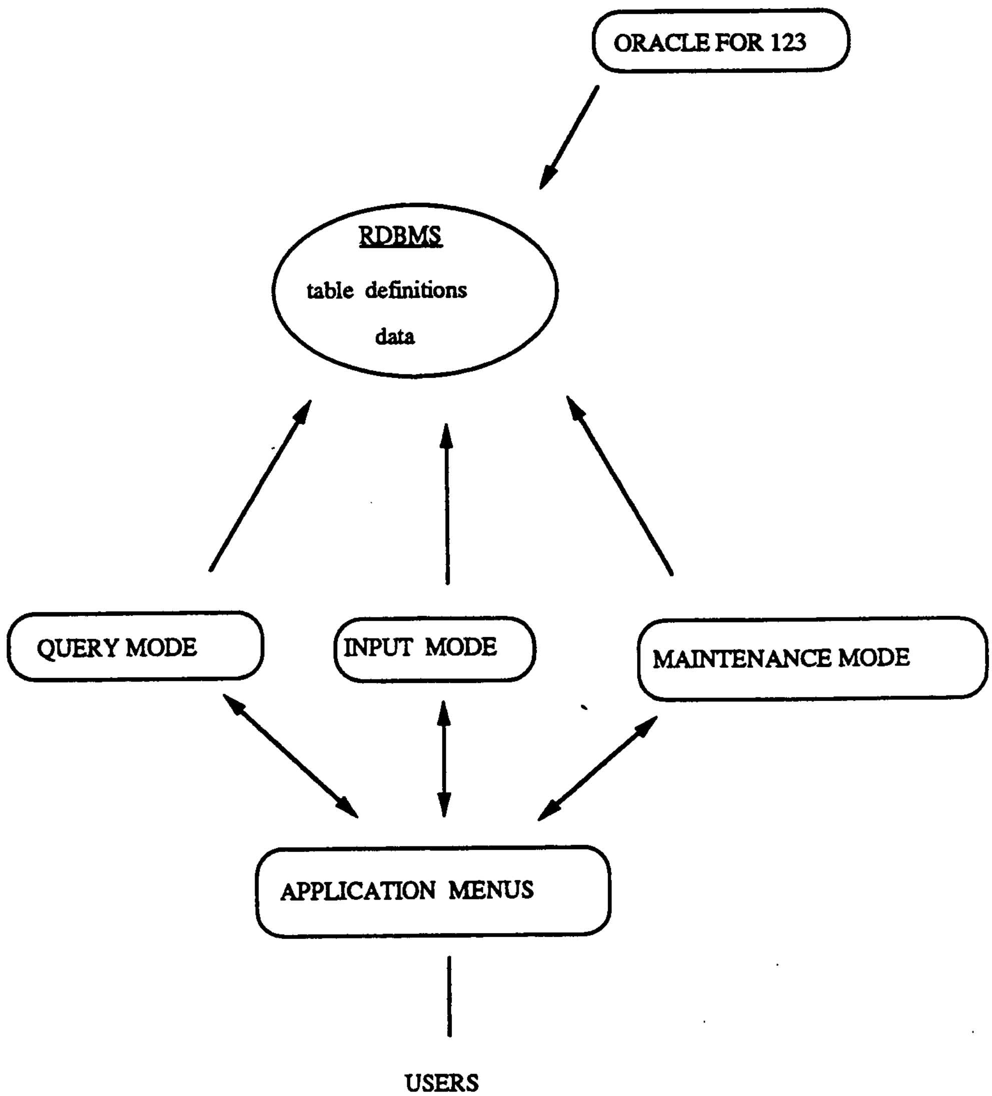


FIGURE 4.1 NCSU CONCRETE MATERIALS PROGRAM STRUCTURES

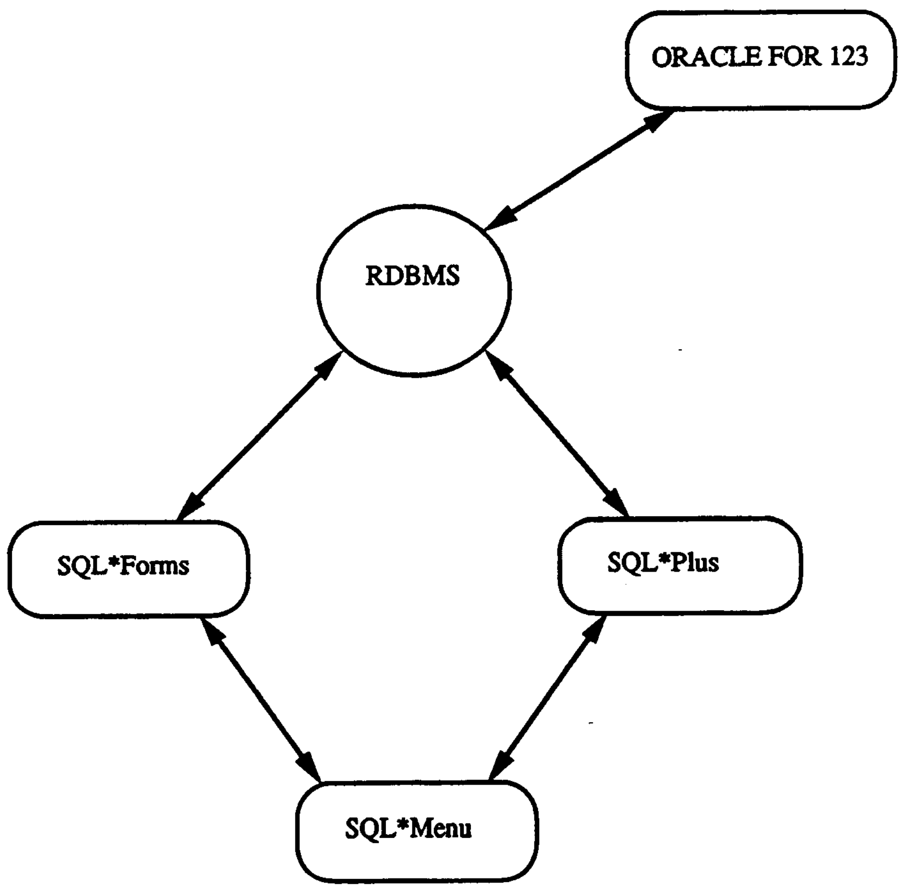


FIGURE 4.2 ORACLE RDBMS AND ITS TOOLS

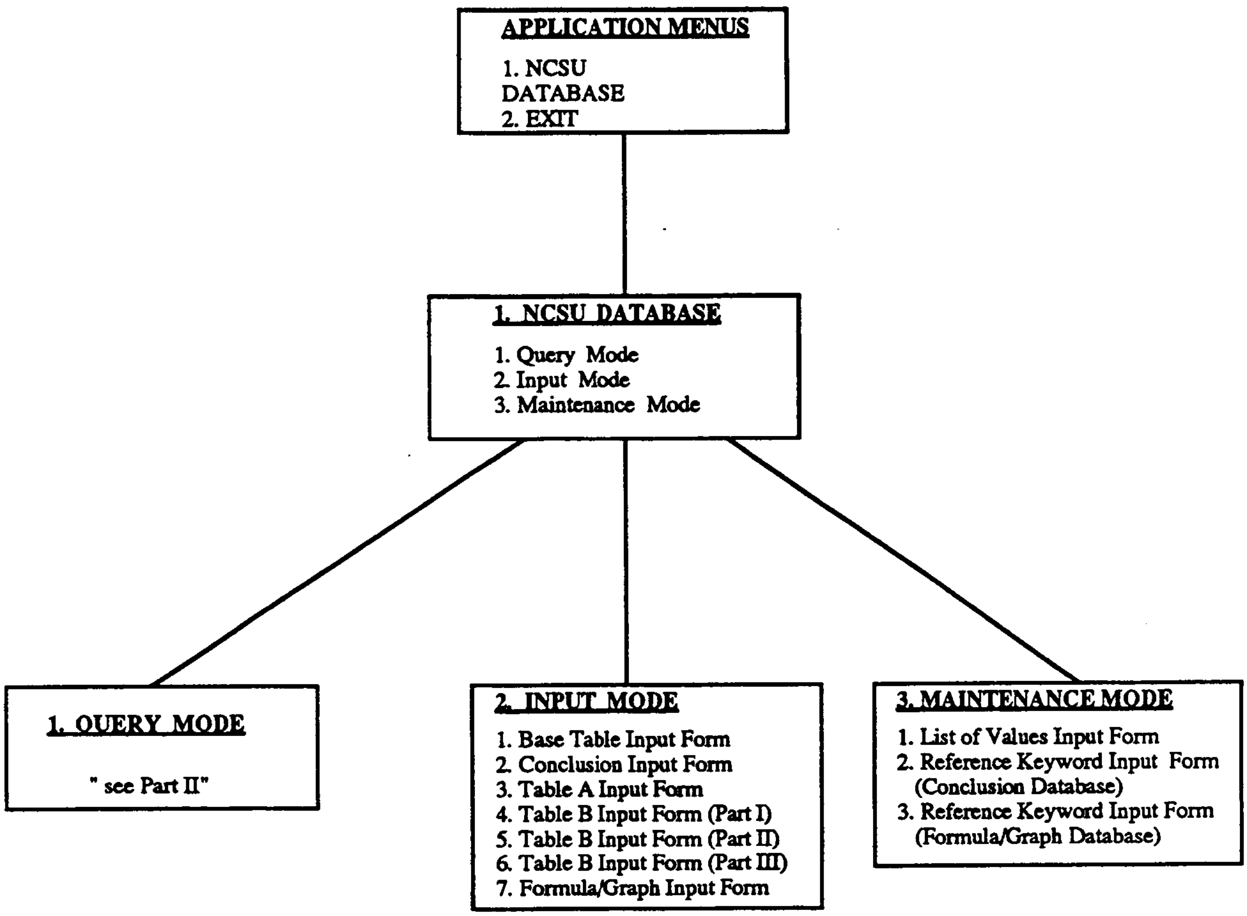


FIGURE 4.3 APPLICATION MENU (PART I)

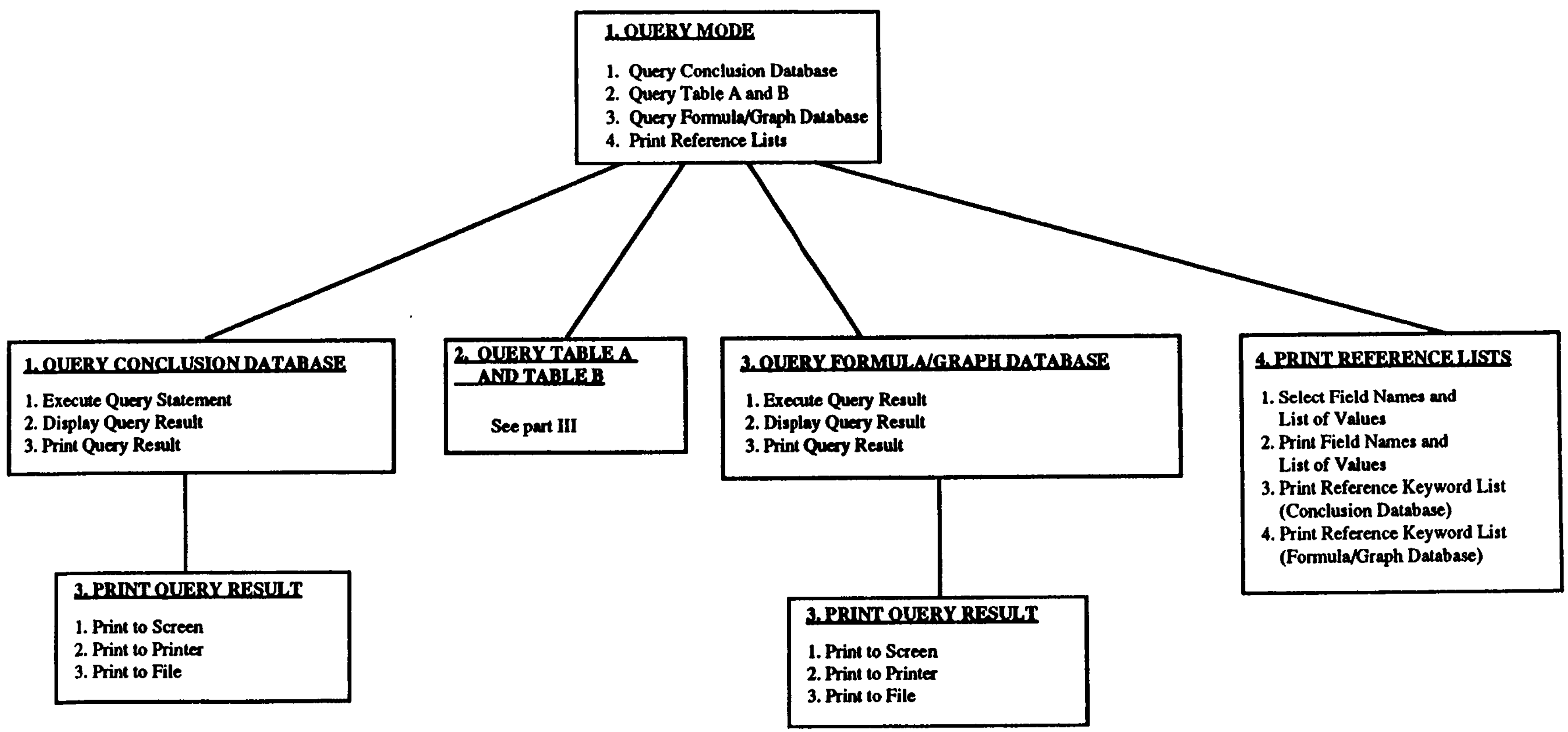


FIGURE 4.4 APPLICATION MENUS (PART II)

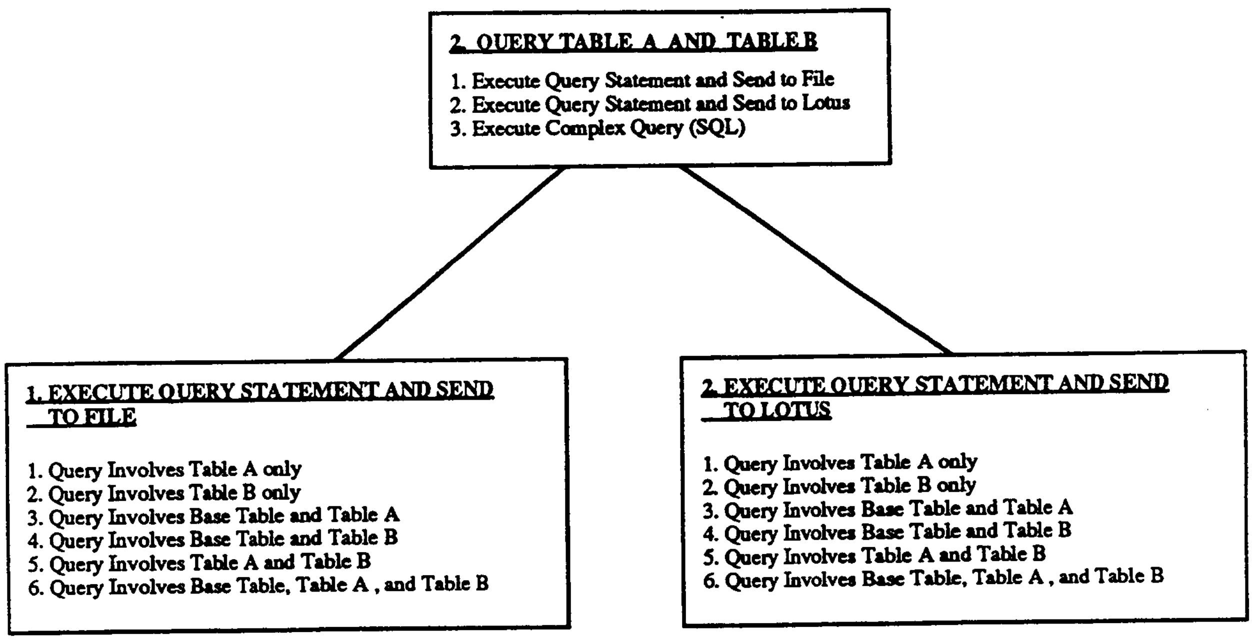


FIGURE 4.5 APPLICATION MENUS (PART III)

Appendix A

Basic Database Concepts

A quick overview of basic database concepts is provided below. Interested readers may consult any database textbook for more in-depth understanding of the subject.

Normal Forms

The "Normal Form" concept is used by database designers to develop database structures which eliminate data duplications. The Normalization process helps identify potential problems in database design. It is also used to identify methods for correcting these problems.

The process involves various types of normal forms. First Normal Form, Second Normal Form, and Third Normal Form are three of these types. They form a progression in which an entity that is in Second Normal Form is better than an entity that is in First Normal Form; and an entity in Third Normal Form is better yet.

Even though there are more-advanced normal forms, the Third Normal form is generally adequate for most database applications.

Table Definitions and Characteristics

1. A relational database such as Oracle is based on two-dimensional tables. Vertical columns are called "fields". Horizontal rows are called "records". Data is entered in "cells", the boxes created by the fields and records.

2. Data types must be predefined. If a field is defined as numeric, then data in that field may have only numeric values. The data base accepts numeric and alphanumeric (up to 240 characters per field) types.

3. Only single values may be entered in a cell, just as in many commercial spreadsheet programs.

4. New columns may be added to an existing table. A table may have a maximum of 254 columns.

5. An empty cell does not take up memory space.

6. A standard SQL statement would be in the following form:

   Select [field heading, field heading,...]
   From [table name, table name,...]
   Where [conditions]

As an example:

```
Select Age_at_Testing, Peak_Stress_1
From Table_B
Where  Age_at_Testing=28
```

This query produces all peak-stress data in the (first) principal direction for age at testing equal 28 days. The data, in this case, exist only in TABLEB.

Of course, actual queries may be much more elaborate. In the above example, for instance, we might need to know whether peak stress is under biaxial or uniaxial stress condition, and under monotonic loading or cyclic loading.

7. From the query structure mentioned above, it is obvious that each individual field name must be unique. Secondly, table names must be specified individually.

8. No two records may be identical in a table. Thus, a "primary key" is defined as the field or fields used to identify individual records uniquely.

Appendix B

Oracle Characteristics

Oracle is a popular database software program for workstations and mini-computers while IBM's DB2 and DBASE continue to dominate mainframe and PC markets, respectively.

Oracle Database was the first commercial software following the lead of IBM DB2 in using the relational model as its development scheme. Oracle works on mainframes and many workstations as well as the IBM PC.

In the following, Oracle's advantages and disadvantages are discussed in the perspective of materials database development. Some of them are Oracle-specific while others are intrinsic to the relational model.

Advantages

1. The relational model is characterized by its simplicity of concepts and ease of modifications. Therefore, it is relatively easy to construct and revise database structures using Oracle compared with other models.

2. Oracle's biggest selling point is its claim of 100% portability among its supported machines is. For example, applications developed on Sun workstations can be run on Apollo workstations without modification. However, certain limitations exist when running applications in the PC environment.

3. Oracle tools, such as SQL*Menu and SQL*Forms, are sophisticated and user friendly. Menus, forms and other user interfaces are simple and fast to develop.

4. Oracle offers a PC trial version which costs substantially less than its workstation versions. Designers can accomplish a lot even with this trial version.

Disadvantages

1. The relational model is slower in execution speed and requires more memory space than either hierarchical or network models.

2. Oracle's tools in the PC versions contain a number of program bugs and limitations, and the manuals are not entirely consistent. Apparently, there are still a number of technological difficulties in accessing extended memory in a PC. Designers of database programs should be aware of these difficulties when working with the PC version.

3. Oracle for the PC version, requires a minimum of at least 3 megabytes of extended memory to maintain the same functions as other systems. If only a small database is to be developed on the PC, then many features of Oracle become unnecessary

and can be burdensome. In such cases different software, specifically written for use on a PC, may be more suitable.

4. In most relational software including Oracle, multiple values may not be embedded in a cell. However, some newer programs have special features that allow the user to assign multiple values to a cell. This would be a desirable feature for materials database because all related data may be contained in a single cell to simplify the database structure.

Appendix C

Oracle Tools Used

The NCSU Concrete Materials Database program uses Oracle's Relational Database Management System (RDBMS) as its central data depository. Table definitions and data are stored in the Oracle's RDBMS. In addition, four Oracle tools are used. Their inter-relationship is shown in Figure 4.2.

SQL*Plus is Oracle's interface tool to its RDBMS, in which SQL can be written and executed. In this program, all querying operations and all printing operations are written as scripts in SQL*Plus. A script is a batch file which may be executed from SQL*Plus.

SQL*Forms is Oracle's input form generation tool. In this program, SQL*Forms is used in all input forms in input mode and in maintenance mode, as well as certain portion of operations in query mode.

SQL*Menu is Oracle's menu screen generation tool. In this program, SQL*Menu is used to generate the application menus.

ORACLE FOR 123 is Oracle's add-in to the Lotus 1-2-3 spreadsheet program. This addition enhances Lotus's database management capability. ORACLE FOR 123 may be used as an alternative in querying TABLEA and TABLEB, for the NCSU Concrete Materials Database Program.

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