INTERACTIVE COMPUTER AIDED DESIGN FOR HIGH PERFORMANCE CONCRETE MIX DESIGN

PROJECT WORK DONE AT

STRUCTRAL ENGINEERING RESEARCH CENTRE ,CHENNAI

PROJECT REPORT

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF

M.Sc. (APPLIED SCIENCE) SOFTWARE ENGINEERING

OF BHARATHIAR UNIVERSITY,COIMBATORE.

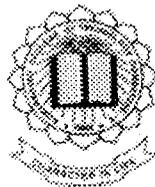### SUBMITTED BY

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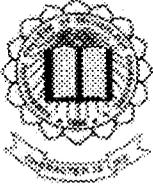### SEPTEMEBER 2003

CERTIFICATES

Department of Computer Science and Engineering

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CERTIFICATE

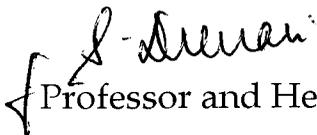This is to certify that the project work entitled

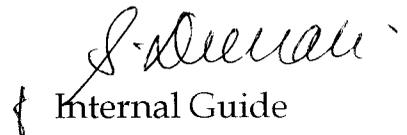## INTERACTIVE COMPUTER AIDED DESIGN FOR HIGH PERFORMANCE CONCRETE MIX DESIGN
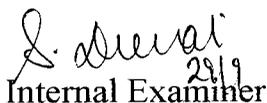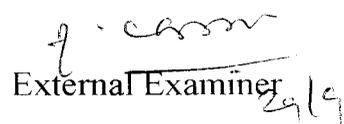
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Sangeetha . P
0037S0101

Submitted in partial fulfillment of the requirements for the award of the degree of M.Sc (Applied Science) Software Engineering of Bharathiar University.

Professor and Head

Internal Guide

Submitted for the university examination held on &9·09·03

Internal Examiner

External Examiner

Dr. K.R. SRIDHARAN
ASST. DIRECTOR & HEAD,
INFORMATION DIVISION

SS-01-INF/LI/22/2003-I
Dated: 17th September 2003

STUDENT PROJECT TRAINING CERTIFICATE

This is to certify that **Ms.. P. Sangeetha,** Reg. No.0037S0101, M.Sc[Applied Science - Software Engg.], *Fourth Year* student *of Kumaraguru College of Technology, Coimbatore, has done her project using the facilities and under the external guidance Shri N.P.Rajamane, Asst. Director, Concrete Composites Labartory at Structural Engineering Research Centre (SERC), Chennai, on project work entitled* **"INTERACTIVE COMPUTER AIDED DESIGN FOR HIGH PERFORMANCE CONCRETE MIX DESIGN"** *during the period from June to September 2003.*

(K. R. SRIDHARAN)

DECLARATION

I here by declare that the project entitled *"INTERACTIVE COMPUTER AIDED DESIGN FOR HIGH PERFORMANCE CONCRETE MIX DESIGN"* submitted to **Bharathiar University** as the project work of Master Of Applied Science (Software Engineering), is a record of original work done by me under the supervision and guidance of **Mr. Rajamane N.P.** at **Structural Engineering Research Centre ,CSIR, Chennai** and this project has not found the basis for award of any Degree / Diploma / Associatship/ Fellowship or similar title to any candidate of any university.

Place : COIMBATORE

Date : 27·09·03

Sangeetha. P

Signature of the Student

Counter Signed By

(Internal Guide)

ACKNOWLEDGEMENT

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I wish to express my deep sense of gratitude to Dr. K.K.Padmanabhan, B.Sc.,(Engg), M.Tech, Ph.D., Principal, Dr. S.Thangasamy, Ph.D., Head Of the Department, Department Of Computer Science and Engineering, Kumaraguru College of Technology,Coimbatore for providing me opportunity to take up this project.

I would like to place on record my thanks to my internal guide Ms.Shantha Kumari B.E, Department of Computer Science and Engineering whose encouragement proved to be stimulating. I am also grateful to all the staff members of the Department for their support and guidance throughout this project work.

I am grateful to Dr.Lakshmanan ,Director , Structural Engineering Research Centre ,CSIR, Chennai for giving me the opportunity to work on this project. I also wish to express my sincere gratitude and thanks to Mr. Rajamane N.P for his keen interest and valuable suggestions throughout the project.

I am proud of my family for encouraging me whenever I was depressed, to face the challenges in the life and made the project a great success

Above all with my whole heart I thank Lord Almighty for all the things he has given me and made me to face the world with enough boldness and courage to make each and every part of life and carrier to be a successful one

Sangeetha . P

SYNOPSIS

SYNOPSIS

In *CIVIL Engg*, Concrete forms the main material for building purposes. The ingredients of the concrete should be selected in right proportion and according to the need of application which helps to target the desired fresh and hardened stages of concrete.

The ingredients generally used for concrete mix are Cement, Coarse aggregate Fine aggregate, Water, Fly ash, Superplasticisers, etc..The entire part of preparing the concrete mix evolves the following steps which are at present done manually. The various tasks which is being done in this project entitled as *"INTERACTIVE COMPUTER AIDED DESIGN FOR HIGH PERFORMANCE CONCRETE MIX DESIGN"* are

> ❧ *Clauses of IS : 456-2000 will be scanned. Information relating to mix design will be collected.*

> ❧ *The data regarding requirements of the concrete mix with reference to the actual application /construction will be collected as input from the user .*

> ❧ *Experimentally determined data or characteristics of ingredients of concrete will be collected and listed .*

> ❧ *Final list of data required to proceed with the computations will be prepared .*

> ❧ *Series of computations for arriving at proportions of concrete ingredients would be undertaken . These proportions would be used to prepare first batch of trial mix*

> ❧ *Suggestions for possible changes in mix proportions based on the observations on first batch would be given .*

> ❧ *A model technical report would be prepared for use of the construction agency.*

> ❧ *A detailed instruction manual containing the actual scope of the programme will be prepared .*

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INTRODUCTION

1. Introduction

1.1   Project Overview :

    "INTERACTIVE COMPUTER AIDED DESIGN FOR HIGH PERFORMANCE CONCRETE MIX DESIGN" software is to serve for construction agencies using concrete as structural material . The software will be used for computing the proportions of concrete ingredients to produce concrete mix, suitable for any particular application using the provisions of Indian standards.

It includes the following steps and procedures for the development of the above software

> ❖ *IS:456-2000 Structural Information.*
>
> ❖ *Data preparation for mix design for the particular practical application.*
>
> ❖ *Experimental data and/or information collection.*
>
> ❖ *Preperation of first data set for starting the computations.*
>
> ❖ *Actual computations for concrete proportions.*
>
> ❖ *Suggested changes for the batch of concrete mix proportions based on first trial mix.*
>
> ❖ *Preperation of technical report for the construction agencies use.*
>
> ❖ *Detailed instruction manual preparation.*

1.2 Organisation Profile :

STRUCTURAL ENGINEERING RESEARCH CENTRE

Structural Engineering Research Centre (SERC), Chennai, India is one of the national laboratories under the Council of Scientific & Industrial Research (CSIR), India.

SERC has built-up excellent facilities and expertise for the analysis, design and testing of structures and structural components. Services of SERC are being extensively used by the Central and State Governments and public and private sector undertakings.

Scientists of SERC serve on many national and international committees and the Center is recognised at the national and international levels as a leading research institution in the field of structural engineering. SERC has recently been certified as ISO:9001 quality institution.

Charter :

SERC acts as a clearing house for the latest available knowledge and develops know-how on design and construction of all types of structures.

It undertakes application-oriented research in all aspects structural engineering- both design and construction, including rehabilitation of structures.

It provides design consultancy services, including proof checking, to organisations in the public and private sectors in developing a variety of structural designs.

SERC also organises specialised courses on structural engineering for the benefit of practising engineers to familiarise them with the latest developments in analysis, design and construction.

Services

Many organisations have been benefited by availing the services of SERC. The beneficiaries, include Central and State Government departments, public and private sector organisations in India and same organizations from abroad. Scientists of the Centre serve on many national and international committees and the Centre is recognised as a leading research institute in the field of structural engineering. SERC organises short term specialised courses in structural engineering for the benefit of consulting engineers and other professionals drawn from various organisations.Major Facilities available at SERC include heavy testing, structural dynamics, experimental stress analysis, construction engineering, concrete composites and fatigue testing laboratories, computer centre and Tower Testing Research Station.Our Scientists serve in many committees of the Bureau of Indian Standards(BIS) in the formulation of Codes of practice in various areas of Structural Engineering. SERC also has international collaboration project under the Indo-German bilateral program with Forschungszentrum Juelich, Germany. The Centre has also been publishing the Journal of Structural Engineering since 1973, to participate, promote and disseminate research in Structural Engineering.

Research and Development :

Research and Development efforts at SERC deal with development of improved analysis, design and construction techniques for different types of complex structures such as shell roofs, transmission line and micro wave towers and other tower-like structures, ships, offshore structures and machine foundations. A number of time and cost saving precast construction techniques and products have been developed by the Centre. High strength deformed bars, funicular shells, fibre reinforced concrete manhole covers, ferrocement water tanks, service core units, etc., developed by the Centre have been extensively used in many organizations in the country. Over the years, several general purpose computer software packages have been developed for computer-aided analysis, design and drafting of various structures and structural components.

Research in Concrete Composites :

Research and Development in concrete composites have led to several formulations characterised by superior tensile strength and impermeability compared to conventional cement concretes.

 ● **Major Areas of Expertise**

   ● Design, development, and testing/evaluation of new concrete composites

⬤ Evaluation / characterisation of building materials, concrete chemicals/repair materials

⬤ Development of building blocks from different kinds of soils and industrial wastes

⬤ Design and production technology for Steel Fibre Reinforced Concrete (SFRC) products

⬤ Products/Technologies Developed

⬤ Fibre Reinforced Concrete Manhole Covers
⬤ Light Beacon Towers
⬤ Lato Blocks
⬤ Building blocks from mine wastes

SYSTEM STUDY & ANALYSIS

2. SYSTEM STUDY AND ANALYSIS

System Study

System is an activity that encompasses most of the task that we have collectively called computer system engineering. System study is conduced with the following objectives.

- *Identify the needs*
- *Evaluate the Existing System*
- *Perform the Analysis about Proposed System.*

System Analysis

System Analysis is conducted to identify the customer need; evaluate the system concept; database and other system elements; establish cost and schedule constraints and create a system definition that forms the foundation for all subsequent engineering work. The system analysis has identification of need,feasibility study,economic analysis and technical analysis.

During the analysis a large number of relatively unstructured data is collected from all staffs in the company from the top level staff managers to the end users of the software.The traditional approach is to organize and convert data through system flowcharts, which support future developments of the system and simplify communications with the users. But the system flowcharts represent a physical system rather than a logical system. It makes it difficult to distinguish what happens and how it happens in the system.

Feasibility Analysis

Every project is feasible for given unlimited resources and finite time. Feasibility study is an evaluation of system proposed regarding its workability ,impact on the organization, ability to meet user-needs and effective the use of resources. Thus when a new application is proposed it normally goes through a feasibility study,before it is approved for development.

Feasibility and risk-analysis are related in many ways. If a project risk is great, the feasibility of producing software is reduced.

In the case of the Computer Aided Design For High Performance Concrete Mix Design system the feasibility is analyzed and the system is checked for it workability and the impact on the organization and also the ability to meet user-needs and effective use of resources.

During Feasibility analysis in this project, the following 3 primary areas of interest were considered carefully

❖ *Technical Feasibility*

❖ *Economic Feasibility*

❖ *Behavioral Feasibility*

2.1 Existing System

The existing system is maintained manually and more difficulty arises in the formulation of a mix design as it is done on a trial and error basis. Generally to evolve relative proportions of ingredients of concrete such as cement, fine aggregate, coarse aggregate, water, fly ash, super plasticizer,etc.

1. *Note the quantitative information on the properties of concrete ingredients and also the desired proportions of the concrete*
2. *Compute the properties of concrete*
3. *Compute the relative proportions of ingredients for the first batch of a concrete mix to be prepared in the laboratory*
4. *Compute the weight of each of ingredients required for first batch of concrete mix*
5. *Record the observations on first batch of concrete after mixing the concrete in the laboratory*
6. *Compute the weight of each of ingredients for the second batch of concrete mix*
7. *Record the observations on second batch of concrete after mixing the concrete in the laboratory*
8. *Repeat steps 5 to 7 till fresh concrete with satisfactory properties is obtained*
9. *Cast the specimens with the batches containing ingredients with known variations representing tolerances to understand the effects of changes in proportions on properties of concrete*
10. *Prepare a detailed report on concrete mix design.*

The above steps are taken up to prepare a mix design in the laboratory which is done manually at present.The development work was carried out at Structural Engineering Research Centre , CSIR, Chennai.

Limitations

Traditionally cement concrete(CC) is prepared with four components Cement ,Fine aggregate(FA),Coarse Aggregate(CA) and Water (W). However , modern cement concrete consists of several additional ingredients such as Chemical admixtures(Superplasticizers,Retarders,Air Entertaining agents) and Mineral admixtures(Fly Ash ,Silica Fume, Carbon Black Powder. Lime Stone Powder). It is thus recognized that cement concrete is heterogeneous material consisting of ingredients with several choices .Characteristic properties to define and describe ingredients are also very different. Moreover , there are no standard test methods for any of the above Characteristics. Therefore, it is difficult to quantitatively consider all the above in any mix design procedure and it becomes necessary to consider any mix design procedure only as a guideline and a particular mix has to be always evolved for the given ingredients of concrete and the type of field application of the concrete.

2.2 Proposed System:

The existing procedure of mix design utilizes a number of table for computations of ingredients of concrete.Softwares are not readily available for design of concrete mixes. A computer spread sheet approach was recently suggested (Rajamane N.P, 2002), but ,this is not fully interactive one. Hence, attempts were made in this thesis to develop an interactive software. For this purpose, Visual Basic 6.0 was utilized as it has a GUI (Graphical User Interface). The following are the steps involved in development of a mix design, which is the basis for the development of the system.

&ere; *Study of the provisions in the IS 456 -2000 code and collection of information about the structure and the concrete for which mix design is to be made:*

- Determination of Exposure Conditions
- Determination of Nominal Cover to Reinforcement
- Selection of Cement
- Selection of Coarse Aggregate
- Selection of Fine Aggregate
- Selection of Water
- Selection of workability of Concrete
- Selection of Fly Ash
- Selection of Superplasticisers
- Estimation of Standard deviation of concrete strengths

ભ *Experimental Determination of the parameters required for mix design for the materials available selected :*

    ⋘ Determination of the properties of Cement
    ⋘ Determination of the relationship between Water/Cement (W/C) ratio and compressive strength of concrete for the cement selected
    ⋘ Determination of the properties of Coarse Aggregate selected
    ⋘ Determination of the properties of Fine Aggregate selected

ભ *Quantitative check for the information required to start the computation for the trial mix:*

    ⋘ Cement
    ⋘ Coarse Aggregate
    ⋘ Fine Aggregate
    ⋘ Concrete
    ⋘ Hardened Concrete Properties
    ⋘ General conditions during concreting

ભ *Computation of proportions of trial mix :*

    ⋘ Selection of Concrete Grade(f_{ck}) for mix design
    ⋘ Computation of Target Mean Strength (f_m) of concrete
    ⋘ Estimation of the Water/Cement ratio(wcs) for desired concrete grade using the curve , wc V_s Concrete Strength
    ⋘ Selection of Water Content of Concrete Mix
    ⋘ Determination of Air Content of Concrete Mix
    ⋘ Calculation of Cement Content of concrete for the selected water-cement ratio, wc.
    ⋘ Obtaining the Cement Content of Concrete for mix design purpose
    ⋘ Computation of Absolute volume of Cement
    ⋘ Estimation of Coarse Aggregate Content of Concrete
    ⋘ Computation of Fine Aggregate Content of Concrete
    ⋘ Calculation of Proportions and Density for Fresh Concrete
    ⋘ Calculation of Contents for Trial Mix

ભ *Provision of Full Description of Concrete Mix*

2.3 <u>Requirements on New System :</u>

There are number of drawbacks in the existing system and the proposed system aims to remove most of the drawbacks found extensively in the existing system. It can be easily maintained,faster development ,annual maintenance cost ,cost of upgrading and adapting to new and hanging technologies, unification of business process across all units.

Thus the following benefits are occurred from the proposed system

> *Automated activity*
> *Faster when compared to the existing system*
> *Comparatively less error prone*
> *Maintaining proper flow of control and relationships.*
> *More than one user can access the data in network.*

PROGRAMMING ENVIRONMENT

3. PROGRAMMING ENVIRONMENT

3.1 Hardware Configuration

Processor : Intel PIII

Clock Speed : 450 Mhz

Primary Memory : 64 MB RAM

Hard Disk Drive : 10 GB

Floppy Disk Drive : 1.44 MB, 3.5" Samsung

CD Drive : 48x Acer

Monitor : Samsung 14" SVGA Color

Keyboard : TVS Gold Keyboard

Mouse : Logitech

3.2 Description of Software

Operating System : Windows 98

Front End : Visual Basic 6.0

Back End : Oracle 8.0

VISUAL BASIC 6.0

Visual basic has been chosen as it provides a *GUI* based environment for creating user-friendly forms. Visual basic is an ideal programming language for developing sophisticated applications in window platform. The 'visual part' refers to the graphical user interface (GUI). Rather than writing numerous lines of code to describe the appearance and location of interface elements, you simply add rebuilt objects in to place on screen. The 'Basic' part refers to the basic language.

Visual basic has evolved from the original BASIC language and now contains several hundred statements, functions and keywords, many of which relate directly to the windows GUI.

Beginners can create useful applications by learning a few keywords yet the power of the language allows professionals to accomplish anything that can be accomplished using any other windows programming language. It makes use of Graphical User Interface (GUI) for creating robust and powerful applications. The GUI enables the users to interact with an application. This feature makes it easier to comprehend things in a quicker and easier way. In a GUI environment coding is similar to linear programming methods and it is highly interactive and user-friendly. One of the interesting features of Visual Basic is the Integrated Development Environment [IDE]. Another important feature of Visual Basic is that it has easy methods to allow users to control and access databases. Due to this property databases like MS Access, Oracle, etc. The front end can also be connected to the databases via ODBC, JDBS, etc.

SPECIAL FEATURES OF VISUAL BASIC 6.0:

Visual Basic provides the quickest and easiest way to create application for Microsoft Windows families like Windows 3.11, Windows 95, Windows NT and for INTERNET through ACTIVEX controls. This programming language allows creating attractive and useful application that fully exploits the Graphical User Interface. This is a Front End Generator or Front Tool with the quickly create a database Front End Application for a wide variety of Desktop and CLIENT SERVER RDBMS.

COMPONENTS OF VISUAL ENVIRONMENT:

The components of VB environment are

1. *VB window*
2. *Project window*
3. *Menu Bar*
4. *Tool box*
5. *Properties Window*
6. *Form Window*
7. *Data Report Designer*
8. *Data Environment Designer*

The project window

A project window is a collection of files that make up your application. A single application might consist of several files. These files might contain code and descriptions of screens inside their respective form window. The project window manages all your applications components. Its lists its components in a tree structured listing. So it is also called *Project Explorer*. Related objects appear together. The project window contains toolbar with three buttons. The code window button displays the code related to the object. The view object button displays the visual elements. The toggle folders button groups and ungroup the project window's items in an explorer like interface.

The properties window

A property helps to differentiate a control from other controls because the property shows appearance and behavior of a control. When you place a control on a form, you assign properties that make that control show how unique from the other controls. The properties window lists every property related to that control. You can modify its initial property values.

Developing an application in visual basic

It takes just a few minutes to build your first visual basic application. You create the user interface by "drawing" controls, such as text boxes and command buttons, on a form. Next, you set properties for the form and controls to specify such values as captions, color, and size. Finally, you write code to bring the application to life. The basic steps you take in creating your first application will show you principles that you will use with every other application you develop.

FEATURES OF VISUAL BASIC:

❖ Compile a VB project to native for faster execution
❖ Open multiple projects in the same instance of VB
❖ ActiveX document boost the Visual Basic application to the intranet and intranet browser windows.
❖ Ability to do single, multiple, or Microsoft explorer style document interface application
❖ The new model allows us to programmatically extend the development environment and control project, events, code visual elements
❖ The application wizard is new and the set up wizard has been enhanced to enable creating a dependency file for a standard project.
❖ Most control now support drag and from components specifically for employment of the web.
❖ The implement features allows your classes to support multiple interfaces
❖ Command lines switches provide a way to control how VB executes
❖ The resources file allows you to collect all of the versions, specify text and bitmaps for an application in one place.
❖ VB provides built-in templates for creating an about dialog box, option dialog box, or splash screen.

ORACLE 8.0 :

ORACLE corporation was the first company to offer a true relational DBMS commercially and has continually led innovation in the field of RDBMS. The ORACLE corporation strategy of offering an RDBMS that is portable, compatible and connectable results in a very powerful tool for users. You learn the basic concepts across various hardware and software platforms.

The collection of tools, utilities and application that constitute the ORACLERDBMS let you manipulate an ORACLE database. Many of these products are fourth generation language tools; they let you interactive screens to create application programs.

The ORACLE database was designed using the relational model and gives uses of many advantages, including the following:

◆ A database structure that is easy to visualize and understand
◆ The ability to create any number of temporary relationships between the tables
◆ Freedom from concern about to query the database through the use of SQL

♦ Tables are easy to visualize
♦ Relational joints that provides temporary set of data from multiple tables in the model.

The ORACLE system uses the non-procedural structured query language (SQL) to communicate with its database kernel. In 1986, the American National Standard Institute (ANSI) made SQL the standard for all DBMS.SQL is a query language used with IBM's SQL/DS and DB2 database system on mainframes. SQL is a powerful query language so powerful, that all the application development tools that ORCALE provides are SQL based.

ORACLE provides the following Advantages over the Relational database:

- Direct SQL interface to the database through SQL*PLUS lets developers and user interact with the database and manipulate direct.
- The interactive forms developers SQL*PLUS LETS our procedures prototype applications quickly. These prototypes can be used as the base units for the real application. Additionally, change to these applications during development and maintenance can be accomplished in very little time.
- The transferability of data from the files and formatted into the table structure of ORACLE database, using the utility SQL*Loader, reduces problems in the data conversion to ORACLE database.

ORACLE UTILITIES:

Some of the most important ORACLE products and utilities available for PCs are as described below.

*SQL*PLUS* this programming tool and query platform allows users to directly manipulate database information using SQL.

*SQL*FORMS* This collection of programming is used for creating compiling and running interactive full screen forms.

*SQL *MENU* This collection of programs is used for creating and running a standardized ORACLE menu system.

*SQL * REPORTWRITER* Oracle's new report generator is a full-screen interactive report generation system for creation, compiling and running reports.

SYSTEM DESIGN AND DEVELOPMENT

4.SYSTEM DESIGN AND DEVELOPMENT

4.1 Input Design

Input design is the link that the entities with the mini world of databases to the real world of users. *The following guidelines are to be followed while designing the input .*

❖ Format of the same data in different screens are the same.
❖ Only required data is collected and similar data are grouped.
❖ Error or exceptions information handling properly provided.
❖ Consistent terminologies are to be used throughout the system.
❖ Screens should be clear and sufficiently informative so as to enable the user to enter the correct data.
❖ Inputs through the keyboard should be minimal so as to reduce the Typographical and transcription errors.

Input design for Cement :

The various input parameters in this ingredient include Type of cement, Specific Gravity, Maximum Cement Content, Minimum Cement Content, strength. Here the various exposure conditions, and reactions due to sulphate attack , Alkali aggregate reaction, under water exposure, sea water exposure are all analysed in detail and the corresponding input values are obtained from the user.

Input design for Fine Aggregate :

This ingredient includes with input parameters like Type of Fine aggregate, specific Gravity, Fineness modulus, Water absorption and Free water. The user is given with the multiple type of choices of input data such as either to choose a default value, or choose a value from the given range of values or finally the user can enter a valid value directly.

Input design for Coarse Aggregate :

The input parameters in this ingredient are Type of Coarse aggregate,Specific Gravity, Nominal maximum size, Bulk Density,Water Absorption and Free water. Here the user is provided with the option to give the detailed input data about the structural member of the Coarse Aggregate.

Input design for Fly Ash :

Fly Ash is dealt with getting input data such as Cement Replacement Level, Specific Gravity, and Water demand factor. Here also the user can either choose a default value, or choose a value from the available range of values or enter any valid value.

Input design for Superplasticisers :

Superplasticisers ingredient gets the input parameters such as the Physical Nature, Chemical Base, Optimum Dosage, Solid Content and Manufacturer. The entire detailed data required about the Chemical admixture is obtained in this stage i.e.., about the Manufacturer etc.

Input design for Concrete :

The Concrete form is used to get the input data such as the Structural Design, Durability, Standard Deviation, Water Cement Ration, Workability, Retention Period, Value, Temperature, Volume Of Concrete, Minimum Volume of Concrete .

4.2OUTPUT DESIGN :

It is the Output design that makes a system useful information generator.Without timely and quality reports a system cannot be considered as an efficient one. This section discussed about the output design of the system taking into consideration at the level of reporting. The layout design is to show the location and position of every detail of the intended output clearly.

The following criteria are considered while designing the output :

- All reports should be in a format as suggested by a user and the management.
- There should be a provision to view reports before taking a final hard copy of the report is taken. This is to eliminate the wastage of stationery.
- The reports should be printed either in ascending or descending order based on the important fields.
- The fields in reports should be listed in such a way that location of a particular record should be easily identifiable.
- Not all the users are allowed to take or view the reports.Proper rights should be checked before printing the report.

Output Design for Computations of the ingredients of the Concrete Mix :

The Computations are performed with the obtained input parameters from the user and also by various other variables. The result hence obtained is contains the following output.

- ✐ The content about Water, fly ash ,Binder ,Initial Binder,Cement and Maximum Cement.
- ✐ Volume of Cement Fly Ash and Cement
- ✐ Air content and Volume of Air entrapped
- ✐ Bulk Volumness and Coarse Aggregate Content
- ✐ Volume of Coarse Aggregate Content, Total Volume, Volume of fine Aggregate
- ✐ Fine aggregate Content ,Binder Content and Density of Concrete
- ✐ Proportions of Binder, Cement ,Fly Ash, Fine Aggregate,Coarse Aggregate and Water.

Output Design for the Observations Of the Ingredients Of the Concrete :

By the results obtained from various calculations performed, the following observations of the ingredients are given as output

- ✐ Fresh Concrete Density
- ✐ Initial Workability
- ✐ Workability After Retention Period
- ✐ Segregation
- ✐ Cohesiveness
- ✐ Compatibility
- ✐ Temperature

Output Design for the Computations of the Ingredients Of the Concrete :

The Computed results from the procedures followed for obtaining the trial mix with the available data on the ingredients of the concrete obtained are given as output. They are,

- ✐ Minimum Volume of Concrete suitable for mixture machine
- ✐ Weight of Concrete suitable for mixture machine

- ❧ Contents of concrete such as
  - ➤ Binder
  - ➤ Cement
  - ➤ Fly Ash
  - ➤ Fine Aggregate
  - ➤ Coarse Aggregate
  - ➤ Total Water
  - ➤ Water in Aggregate
  - ➤ Net water

Output Design for the Properties of the Concrete :

The properties of the concrete analysed with the obtained results of the trial mix of the concrete which was calculated are given as output as follows.
- ❧ Characteristic Strength
- ❧ Standard Deviation
- ❧ Workability for mix Design
- ❧ Mean Strength
- ❧ Water Cement Ratio for Mean Strength
- ❧ Adjusted Water Cement Ratio for Fly Ash in concrete for mean strength
- ❧ Water Cement Ratio for Mix design

Output Design for Cost of the Concrete :

The contents along with the cost and net amount for the following ingredients is given as output.
- ❧ Cement
- ❧ Fly Ash
- ❧ Coarse Aggregate
- ❧ Fine Aggregate
- ❧ Water
- ❧ Super plasticizers.

4.3 Database Design :

Table Name : bulkvolume

S.NO	Fields	Data Type	Width
1.	Nms	Number	10
2.	Fm	Number	10
3.	Vca	Number	10

Table Name : cementstrength

S.NO	Fields	Data Type	Width
1.	wcr	Number	10
2.	cs	Number	10
3.	cos	Number	10

Table Name : concretereq

S.NO	Fields	Data Type	Width
1.	mcc	Number	10
2.	fwcr	Number	10
3.	toc	Varchar2	30

Table Name : exposure

S.NO	Fields	Data Type	Width
1.	ec	Varchar2	30
2.	mcec	Number	10
3.	cs	Number	10
4.	mgc	Varchar2	30
5.	mfwcr	Number	10
6.	D1	Varchar2	30
7.	D2	Varchar2	30
8.	D3	Varchar2	30
9.	D4	Varchar2	30
10.	sd	Number	10

4.4 Process Design :

Context Diagram :

Level -0 : CEMENT
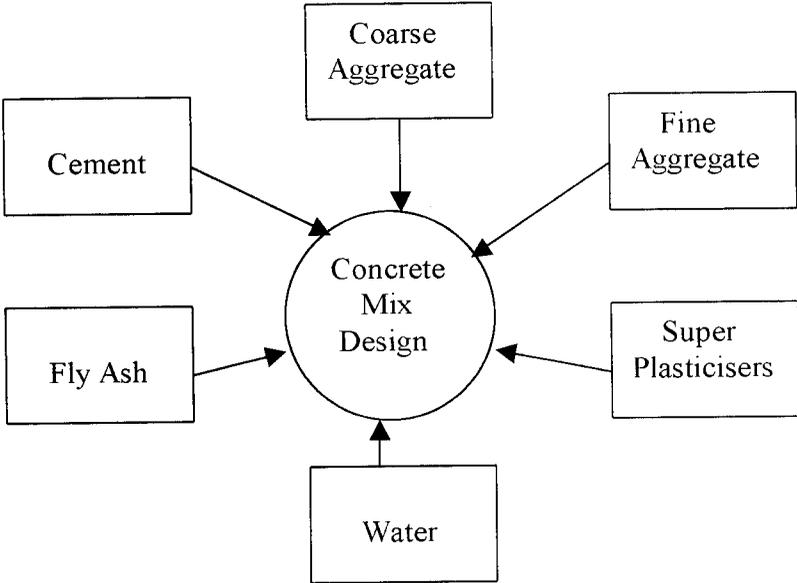
Specific Gravity → CEMENT
Type → CEMENT
Maximum Cement Content → CEMENT
Minimum Cement Content → CEMENT
Cement Strength → CEMENT
CEMENT → cement
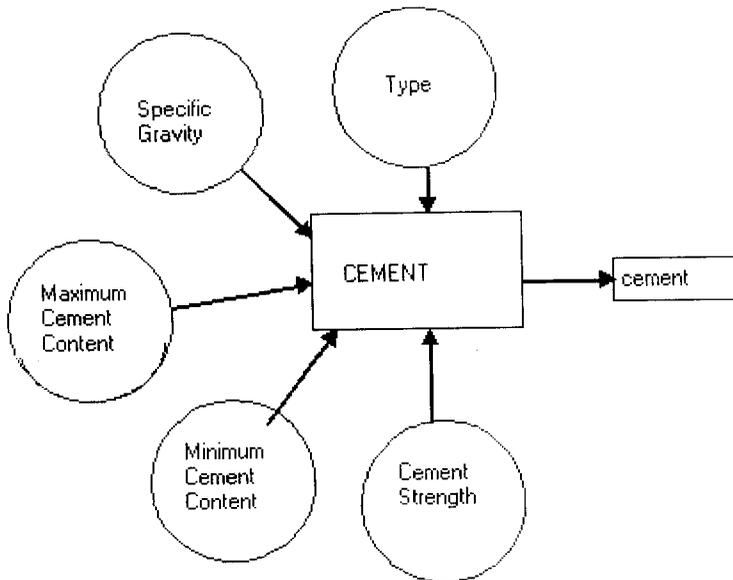
Level-0 : Coarse Aggregate :

Specific Gravity → Coarse Aggregate
Type → Coarse Aggregate
Nominal Maximum Size → Coarse Aggregate
Bulk Density → Coarse Aggregate
Water Absorption → Coarse Aggregate
Coarse Aggregate → Coarse
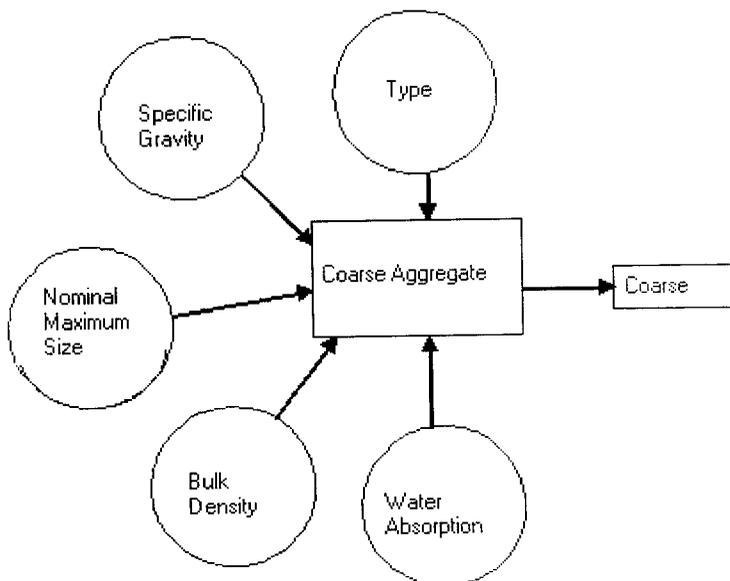
Level-0: Fine Aggregate :
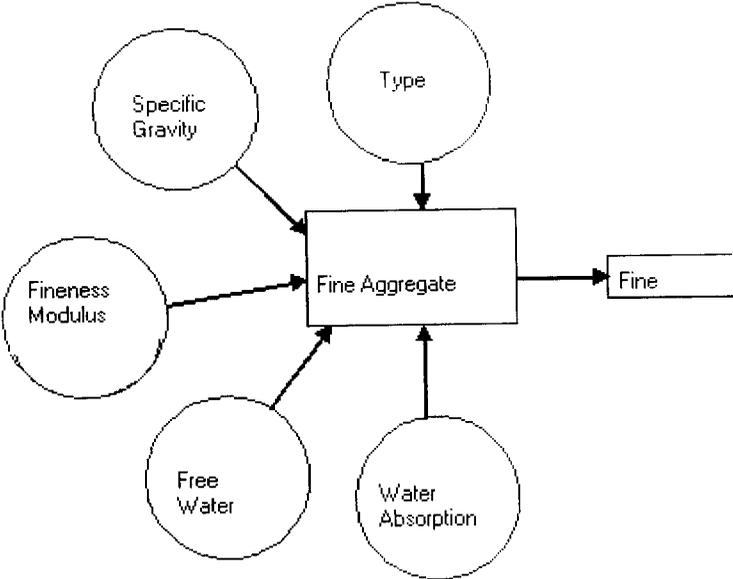
SYSTEM IMPLEMENTATION AND TESTING

5.SYSTEM IMPLEMENTATION AND TESTING

5.1 System Implementation:

Implementation is the process of converting a new or revised system design in to an operational one. The first task is implementation planning,i.e deciding on the methods and time scale to be adopted. The proper implementation involves conversion of existing clerical files into computer media and hence these files as they get converted. Then the actual changeover from the existing system to the new system takes place.

Implementation is an important stage in the project life cycle of the new system. Implementation means converting a new or revised system into an operational one. it is placing the system into operation. Computer programs are written and tested and user is trained to use the new system.

After exhaustive acceptance testing the system was implemented successfully on site. Bugs found during implementation were fixed immediately, after the bug-fixing next round of testing was done at the site.
No non-conformities have been reported till now and the system meets the user requirements.

Before implementation the system, it is forced into many server-testing phases. After the system clears all the tests, it is released for implementation. After the data has been initially set, the system is ready for use. The implementation type or the changeover technique from the existing system is a step by process.

First a module in the part of the system is implemented and checked for suitability and efficiency. if the end user related to a particular module is satisfied, the next step of implementation is processed with. Thus modules related to the previous module are implemented.

The following processes were conducted in the implementation stage;

- *Testing of developed modules with sample data.*
- *Correction of errors*
- *Testing the system to meet user requirements*
- *New files with actual data can be created*

Changes were made according to users suggestion.

User Training:

Training is given to all the particular users from the client's side. The training varies from user to user depending upon the information needed pertaining to the user. For example the applications users need help only on ad-hoc queries and how to take suggestions based upon the reports, whereas data entry operators need information's on how to key in suitable data.

5.2 System Testing:

Testing presents an interesting anomaly for the software engineer. Earlier in the software process, the engineer attempts to build software from an abstract concept to a tangible implementation. The testing is one step in the software engineering process that can be viewed as destructive rather than constructive. Testing is the process of executing a program with the intent of finding an error. A good test is the one that has a high probability of finding an undiscovered error. a successful test is the one that uncovers an undiscovered error.

System testing is process of checking whether the development system is working according to the original objectives and requirements. The system should be tested experimentally with test data so as to ensure that the system works according to the required specifications. When the system is found working, test it with actual data and check performance.

Software testing is critical element of software quality assurance and represents the ultimate review of specification,design andcoding.the increasing visibility of software as a system element and the attendent"cost"associated with a software failure is motivating forces for a well planned, through testing.

Testing Objectives:

The Testing objectives are summarized in the following three steps:testing is the process of executing the program with the intent of finding an error. A good test case is one that as high probability of finding an as yet undiscovered. A successful test is one that uncovers an –yet-undiscovered error.

There are several rules that can serve as testing objectives. They are:

- Testing is a process of executing a program with the intent of finding an error.
- A good text case is one that has a high probability of finding an undiscovered error.

- *A successful test is one that uncovers an undiscovered error.*

If testing is conducted successfully according to the objectives as stated above, it would uncover errors in the software. Also testing demonstrates that software functions appear to the working according to specifications, that performance requirements appear to have been met.

<u>There are three ways to test a program :</u>

1. *For correctness*
2. *For implementation efficiency and*
3. *For computational complexity*

Tests for correctness are supposed to verify that program does exactly what it was designed to do. This is much more difficult that it may appear; especially for large programs.

Test for implementation efficiency attempt to find ways to make a correct program, faster or use less storage. It is a code-refining process, which re-examines the implementation phase of algorithm development.

Tests for computational complexity amount to an experimental analysis of the complexity of an algorithm or an experimental comparison of two or more algorithms, which solve the same problem.

<u>As the system was totally GUI based the following were tested in this phase:</u>

1. *Tab order*
2. *Reverse tab order*
3. *Field length*
4. *Menu testing*
5. *Front end validations*

Testing principles:

All tests should be traceable to customer requirements. Tests should be planned long before testing begins, that is, the planning can begin as soon as the requirements model is complete. Testing should begin *"In the small"* and progress towards testing: *"In the large"*. The focus of testing will shift progressively from programs, to individual modules and finally to the entire project. Exhaustive testing is not possible. To be more effective, testing should be one, which has highest probability of finding errors.

The following are the attributes of good test :

- *A good test has a high probability of finding an error.*
- *A good test is not redundant*
- *A good test should be "best of breed"*
- *A good test should be neither too simple nor too complex.*

Level of testing :

The details of the software functionality tests are given below. The testing procedure that has been used is as follows

> *Unit Testing*
> *Integration Testing*
> *Validation Testing*
> *Output Testing*

Unit Testing :

United testing focuses verification effort on the smallest unit of software design the module. The module interface is testing to ensure that information properly flow into and out of the program unit under test. Tests of data flow across a module interfaces are required before any other test is initiated. The test cases has related to error handling paths, boundary conditions, local data structures and interfaces to modules.

System testing :

System testing is actually a series of different tests whose primary purpose is to fully exercise the compute-based systems. all works to verify that all systems elements have been properly integrated and perform allocated functions. The system testing has places from as recovery testing, stress testing and performance testing.

The system testing comprises of three levels of testing and they are:

- *Integration testing*
- *Function testing*
- *Acceptance testing*

Integration testing :

   Integration testing address the issues associated with the dual problems of verification and program construction. After the software has been integrated a set of high –order tests are conducted. The main objective in this testing is to take unit-tested modules and build a program structure that has been dictated by design. When collection of modules has been unit tested, the next step is to ensure that the interfaces among the modules are defined and handled properly. Integrations testing is the process of verifying that the components of a system work together as described in the program design and system design specifications.

Validation testing :

   At the end of integration testing, software is completely assembled as a package, interfacing errors have been uncovered and correction testing begins. Software testing and validation is achieved through a series of black box tests that demonstrate conformity with requirements are achieved, documentation is correct and other requirements are met.

Output testing :

   Output testing is a series of different test whose primary purpose is to fully exercise the computer-based system. Although each test has a different purpose all the work should verify that all the system elements have been properly integrated and performance allocated functions.

   Output testing is the stage of implementation, which is aimed at ensuring that the system works accurately and efficiently before live operations commences. The input screens, output documents, database structures etc. were checked and required modifications made to suite the program specifications. Then using the test data prepared, the whole system was tested and found to be successful.

Test data :

   Test data should be prepared carefully since the data only determines the efficiency and accuracy of the system. Artificial data are prepared solely for the purpose of testing. Every program validates the input data. All the above testing was successfully undertaken in this project.

CONCLUSION

6.Conclusion

The software developed in this project can be considered as a comprehensive guide for concrete mix design. The programme is interactive and user friendly as all the required inputs for the mix design are provided by the user as response to the queries raised by the software. Checks are also provided in the programme to inform the user about the validity of the input data supplied by the user since the possible extreme values for each input are also included in the project and the input data has to be within this limits.

In this project , a number of functions have been developed ,based on *Visual Basic 6.0* to provide a more efficient and faster computations. A few more modifications to include more characteristics of ingredients of concrete like Fineness of cement and chemical nature of Super plasticizers in the software enhances the scope of the project to a greater extent

Mix design procedure for concrete given in the project uses provisions of *BIS code IS 456-2000*, besides information from other standards such as American Concrete Institute.Procedure adopted in this project considers concrete strength as a main parameter for mix design, even though durability is also an important aspect of the properties of the concrete.

SCOPE FOR FUTURE DEVELOPMENT

7.SCOPE FOR FUTURE DEVELOPMENT

Further Development of the software is required to consider the following aspects

- ❖ Data from the specific tests carried to establish different durability characteristics of concrete

- ❖ Improvement in microstructure of concrete due to addition of pozzolanic materials

- ❖ Particle packing nature of different ingredients of concrete and there influence in mix proportion of concrete.

- ❖ Properties of Coarse Aggregates such as sieve analysis(Particle Size distribution), shape and texture of particles etc.

- ❖ Properties of Coarse Aggregates such as sieve analysis(Particle Size distribution), shape and texture of particles ,void ratio etc.

- ❖ Effect of type and quantity of ingredients on concrete strength

- ❖ Improved Durabilitiy of concrete through incorporation of different chemical and mineral admixtures.

REFERENCES

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Web sites :

www.vbonline.com

www.Microsoft.com

www.Oracle.com

www.google.com

APPENDICES

SAMPLE CODES

SAMPLE CODES :

```vb
Dim v1 As Variant
Private Sub cmdadd_Click()
dccement.Recordset.AddNew
End Sub
Private Sub cmdnext_Click()
fineaggregatedata.Show
End Sub
Private Sub Combo1_KeyPress(KeyAscii As Integer)
v1 = Val(Combo1.Text)
If KeyAscii = 13 Then
If v1 < 3 Or v1 > 9 Then
MsgBox "the value is not reasonable"
Combo1.Text = " "
Combo1.SetFocus
Else
txtcs.SetFocus
End If
End If
End Sub
Private Sub comcg_KeyPress(KeyAscii As Integer)
If KeyAscii = 13 Then
txtmicc.SetFocus
End If
End Sub
Private Sub comcs_KeyPress(KeyAscii As Integer)
v1 = Val(comcs.Text)
If KeyAscii = 13 Then
If v1 < 30 Or v1 > 60 Then
MsgBox "the value is not reasonable"
comcs.Text = " "
comcs.SetFocus
Else
commcc.SetFocus
End If
End If
End Sub
Private Sub comct_KeyPress(KeyAscii As Integer)
If KeyAscii = 13 Then
comcg.SetFocus
End If
End Sub
```

```vb
Private Sub commcc_KeyPress(KeyAscii As Integer)
v1 = Val(commcc.Text)
If KeyAscii = 13 Then
If v1 < 400 Or v1 > 600 Then
MsgBox "the value is not reasonable"
commcc.Text = " "
commcc.SetFocus
Else
comct.SetFocus
End If
End If
End Sub
Private Sub comsg_KeyPress(KeyAscii As Integer)
v1 = Val(comsg.Text)
If KeyAscii = 13 Then
If v1 < 2.5 Or v1 > 3.5 Then
MsgBox "the value is not reasonable"
comsg.Text = " "
comsg.SetFocus
Else
comcs.SetFocus
End If
End If
End Sub

Private Sub Form_Load()
comsg.Text = cementdata.txtsg.Text
comcs.Text = cementdata.txtcs.Text
comct.Text = cementdata.lblcementtype.Caption
commcc.Text = cementdata.txtmcc.Text
If cementdata.txtmicc.Text >= cementdata.txtsa.Text Then
txtmicc.Text = cementdata.txtmicc.Text
Else
txtmicc.Text = cementdata.txtsa.Text
End If
Select Case Val(comcs.Text)
Case 53 To 100
        comcg.Text = 53
Case 43 To 52
        comcg.Text = 43
Case 33 To 42
        comcg.Text = 33
End Select
```

```
End Sub
Private Sub optextreme_KeyPress(KeyAscii As Integer)
If KeyAscii = 13 Then
cmdnext.SetFocus
End If
End Sub
Private Sub optmild_KeyPress(KeyAscii As Integer)
If KeyAscii = 13 Then
cmdnext.SetFocus
End If
End Sub
Private Sub optmoderate_KeyPress(KeyAscii As Integer)
If KeyAscii = 13 Then
cmdnext.SetFocus
End If
End Sub
Private Sub txtexpo_KeyPress(KeyAscii As Integer)
If KeyAscii = 13 Then
cmdnext.SetFocus
End If
End Sub
Private Sub txtmicc_KeyPress(KeyAscii As Integer)
If KeyAscii = 13 Then
cmdnext.SetFocus
End If
End Sub

Dim v1 As Variant
Dim v2 As Variant
Private Sub cancel1_Click()
txtbd.Text = " "
txtsel.SetFocus
End Sub
Private Sub cancel2_Click()
txtbd.Text = " "
combd.Text = "Bulk density "
txtbd.Text = 1700
End Sub
Private Sub cancel3_Click()
txtwa.Text = " "
txtsel1.SetFocus
End Sub
Private Sub cancel4_Click()
```

```vb
comwa.Text = "Water absorption "
txtwa.Text = " "
txtwa.Text = 0.5
End Sub

Private Sub cancel5_Click()
txtfw.Text = " "
txtsel2.SetFocus
End Sub

Private Sub cancel6_Click()
txtfw.Text = " "
comfw.Text = "Free water "
txtfw.Text = 0.2
End Sub

Private Sub cmdnext_Click()
courseaggregate.Show
courseaggregate.txttype.SetFocus
End Sub
Private Sub combd_KeyPress(KeyAscii As Integer)
If KeyAscii = 13 Then
txtbd.Text = " "
txtbd.Text = combd.Text
End If
End Sub
Private Sub comfw_KeyPress(KeyAscii As Integer)
If KeyAscii = 13 Then
txtfw.Text = " "
txtfw.Text = comfw.Text
End If
End Sub
Private Sub comnms_KeyPress(KeyAscii As Integer)
If KeyAscii = 13 Then
txtnms.Text = " "
txtnms.Text = comnms.Text
End If
End Sub
Private Sub comwa_KeyPress(KeyAscii As Integer)
If KeyAscii = 13 Then
txtwa.Text = comwa.Text
End If
End Sub
```

```vb
Private Sub Form_Load()
framenms.Visible = False
End Sub
Private Sub no_Click()
txtnms.Text = " "
txtchoice.SetFocus
End Sub
Private Sub no1_Click()
txtnms.Text = " "
comnms.Text = "Nominal maximum size "
txtchoice1.SetFocus
End Sub
Private Sub No2_Click()
txtnms.Text = " "
framenms.Visible = False
txtnms.Text = 20
End Sub
Private Sub ok1_Click()
txtbd.Text = " "
txtbd.Text = 1700
End Sub
Private Sub ok2_Click()
txtbd.Text = " "
combd.SetFocus
End Sub
Private Sub ok3_Click()
txtwa.Text = " "
txtwa.Text = 0.5
End Sub
Private Sub ok4_Click()
txtwa.Text = " "
comwa.SetFocus
End Sub
Private Sub ok5_Click()
txtfw.Text = " "
txtfw.Text = 0.2
End Sub
Private Sub ok6_Click()
txtfw.Text = " "
comfw.SetFocus
End Sub
Private Sub optcru_Click()
```

SAMPLE INPUT SCREENS

CEMENT FORM :

COARSE AGGREGATE FORM :

Form3   _ □ X

| Type | Specific Gravity | Nominal Maximum Size | Bulk Density | Water Absorbtion | Free Water |

Frame1

Would u like to choose a value ?　　　● YES　　　　○ NO

[12.5　　　　▼]

Would you like to have guidelines from IS: 456-2000 Provisions ?
　　　　　　○ YES　　　　○ NO

The chosen Nominal Maximum Size Value of coarse aggregate is : [12.5]

Frame7

Enter the minimum dimension of structural member : [ ]

Is the member thin or closely spaced or has a small cover ?

　　　　　　○ YES　　　　　　○ NO

Is there minimum distance between main bars ?

Is there minimum cover to reinforcement ?

FINE AGGRAGATE FORM :

SAMPLE OUTPUT SCREENS

COMPUTATIONS FOR INGREDIENTS OF CONCRETE MIX :

OBSERVATIONS ON CONCRETE :

COMPUTAIONS FOR INGREDIENTS :

COMPUTATIONS FOR PROERTIES OF CONCRETE :

COST OF CONCRETE :