

1. WELCOME TO EUCON®

1.1 Introduction

In all concrete constructions besides the common strength problems, in presence or not of seismic activity, serious problems from environmental attack may be presented which decrease significantly their *durability and service lifetime*. In the literature there is a vast majority of papers dealing with the degradation mechanisms, attempting either to study them experimentally or to simulate them using fundamental or empirical models. The lots of experimental results and the complicated mathematical models on the other hand, make difficult their wide use from the concrete engineers. It is time all this information to be included in *a software package, where the user by giving the minimum required data will be receiving reliably the concrete mix design, ensuring the specified strength level and service lifetime, at the minimum cost.*

A such software package entitled *EUCON®* was developed by the present authors. Using this software an optimum concrete design can be achieved by estimating reliably the concrete strength, durability and production cost. **The base for the development of this computer modelling is presented in detail in a companion work: *the theoretical background* [1].** After the definition of mix design and structure characteristics, as well as an assumption regarding the environmental conditions where the structure will be found, the concrete service life can be reliably predicted using fundamental mathematical models that simulate the deterioration mechanisms and rate. The prediction is focused on the basic deterioration phenomena of the reinforced concrete, such as carbonation and chloride penetration, and on various chemical attacks. Aspects on concrete strength and production cost are also considered. This approach enable mixture proportions to be accurately specified and concrete performance reliably predicted. The work structure presented herein is in full compliance with the new *European Standards for cement: EN 197* [2] and *for concrete: EN 206* [3]. A general guidance on the use of alternative performance-related design methods (such as EUCON®) with respect to durability is already given in the European Standard EN 206 and it could be evolved in further generation standards.

1.2 Logical flowchart for concrete design

As given in [1], all *physical and mechanical mechanisms* for concrete deterioration, except direct loading and imposed deformations, may exhibit their effect on concrete performance during the first year of the service life. The *chemical and biological mechanisms* actually start from the early beginning; however, their detrimental results are observed after the first year. In reinforced concrete, the most serious deterioration mechanisms are those leading to corrosion of the reinforcement, which occurs after depassivation due to carbon dioxide or chloride ion penetration. Almost all other deterioration mechanisms can be controlled since the mix design and cast. It is therefore necessary the modelling attempts to turn towards the **corrosion initiation mechanisms and the chemical attack processes**.

In Fig. 1.2.1, the logical flowchart followed in the software package EUCON® for the estimation of concrete service life is presented. First, the essential parameters that characterize a concrete composition (**mix design**) are selected or calculated, and this is the main source on which all other concrete characteristics depend. Afterwards, the main **chemical and volumetric characteristics** of concrete are calculated (chemical composition of hydrated cementitious materials, porosity and related characteristics) and this is also another source to receive more information. Based on the selected mix design (cement type and strength class, cement content, water/cement ratio, air content, aggregates type, type and activity of additions, etc.), a first approximation of the **compressive strength class** of concrete is estimated [1].

For each significant deterioration mechanism, according to the specific environment where the structure would be found, an appropriate proven predictive model is used [1]. Concrete **carbonation and chloride penetration** are the most common causes for reinforcement corrosion and further concrete deterioration. The **service life of the structure** found in these environments that cause either carbonation or chloride attack is calculated. The degree of deterioration from a possible **chemical attack** is also estimated. Finally, **cost and environmental aspects** regarding concrete composition are full analysed. Now, for the initially selected concrete composition the most essential properties have been predicted, such as strength, service life and cost. The **designer** can then modify accordingly the concrete composition **to improve further** every required property.

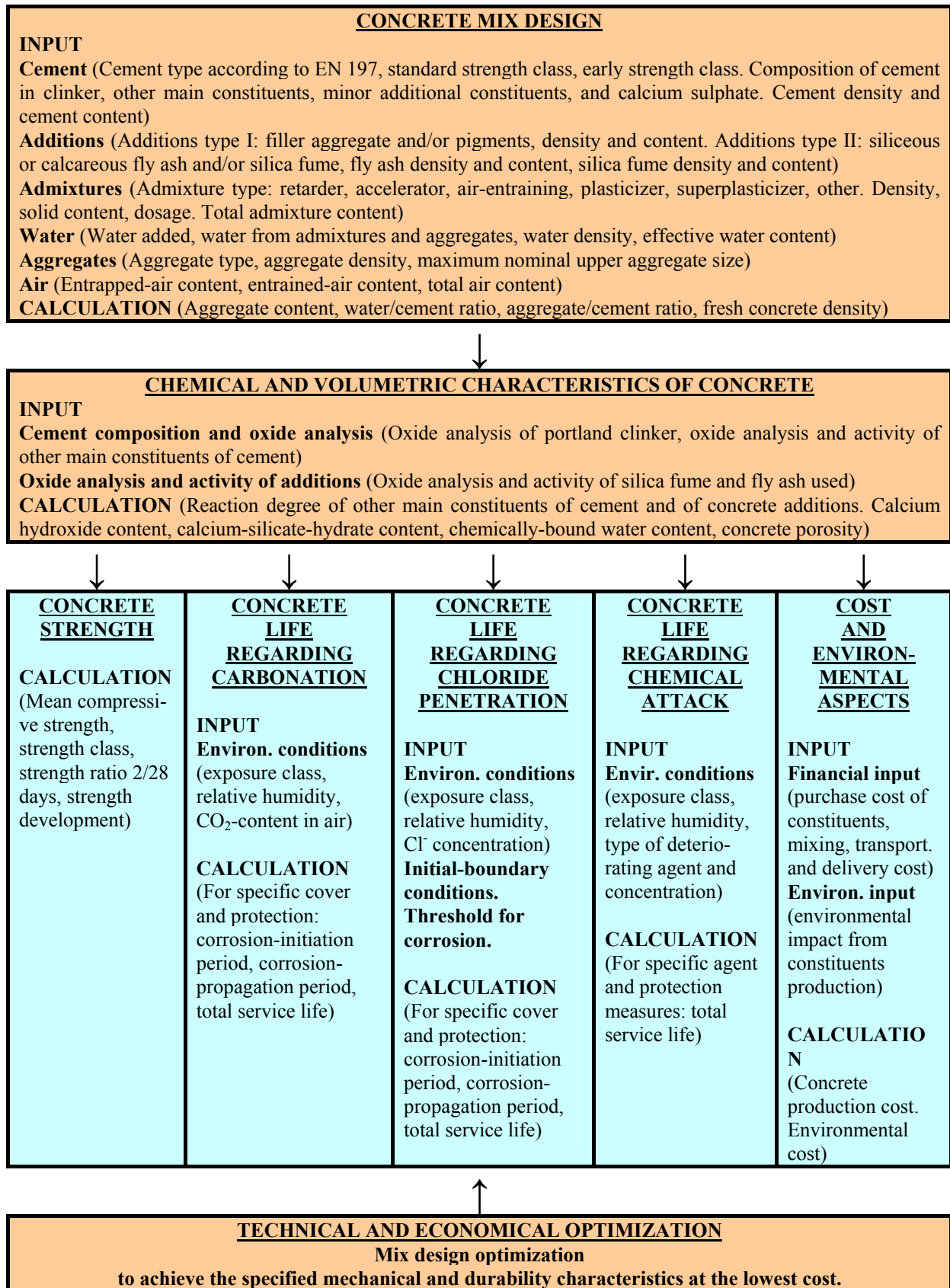


Figure 1.2.1 Logical diagram for computer design of concrete mix for specified strength class, service life and cost.

1.3 Installation

Operating System:

The installation of EUCON is successfully carried out on computers that have one of the following operating systems: Windows 98/2000/XP or Windows NT.

Screen Resolution:

Screen Resolution must be at least 1024x768.

DPI Setting:

For the best display of EUCON interface, set the DPI setting of your computer to *Normal size (96 DPI)*. To do this, do the following:

- Right-click on your desktop
- From the menu, click on *Display Properties*
- Click on the Tab *Settings*
- Click the button *Advanced*
- On the *General* Tab, set the *DPI setting* to *Normal size (96 DPI)*

Graphs:

For the successful creation of EUCON graphs, your computer must have installed Microsoft Office Excel.

Security:

To prevent piracy, the electronic key Sentinel™ UltraPro of SafeNet is used which is included in the EUCON package. The electronic key is attached to an available USB port of your computer, Fig. 1.3.1. When this is connected, the LED on the key is illuminated to verify that the key has been plugged-in properly.

*** Without the presence of the electronic key at the USB port, EUCON cannot be executed ***

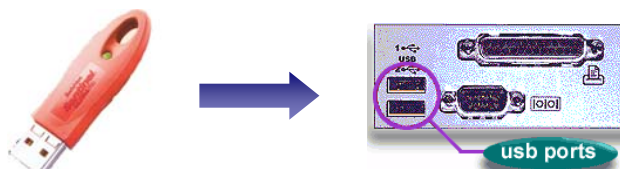


Fig 1.3.1 The electronic key UltraPro is attached to a USB port.

Note: USB UltraPro electronic key is not supported on computers whose operating system is Windows NT. In this case, the USB key is replaced with a parallel port key.

Installation:

- Insert the EUCON installation CD into the CD-ROM drive of your computer.
- The Setup Application will automatically run on your computer.
- If not, you will have to open the CD yourself and double-click on the file **Setup.exe**.
- Follow the suggested steps presented on your computer screen. If you wish, you may change them. At the end of the installation procedure you may be prompted to restart your computer.

After installation:

After the installation setup of EUCON is successfully completed, a folder *C:\Program Files\EUCON* will have been created containing all the necessary files for the proper execution of EUCON.

Execution:

First attach the electronic key to an available port of your computer. The first time you attach the key, the computer will need a couple of seconds to properly identify the new hardware device attached to it. Then you can start EUCON (Start→Programs→eucon→EUCON).

Note: The first time you execute a calculation, EUCON will need a couple of seconds to present the results. This is due to the configurations that need to take place between the application and the key.

Questions & Support:

For questions regarding EUCON, please contact: Dr. V.G. Papadakis

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1.4 How to use EUCON®

The program EUCON® was developed on the logical flowchart presented in section 1.2, and a general view is given as Fig. 1.4.1. The program is divided into several **tabs**, each of them performs specific calculations. These tabs **have to be used in a successive way**, as follows.

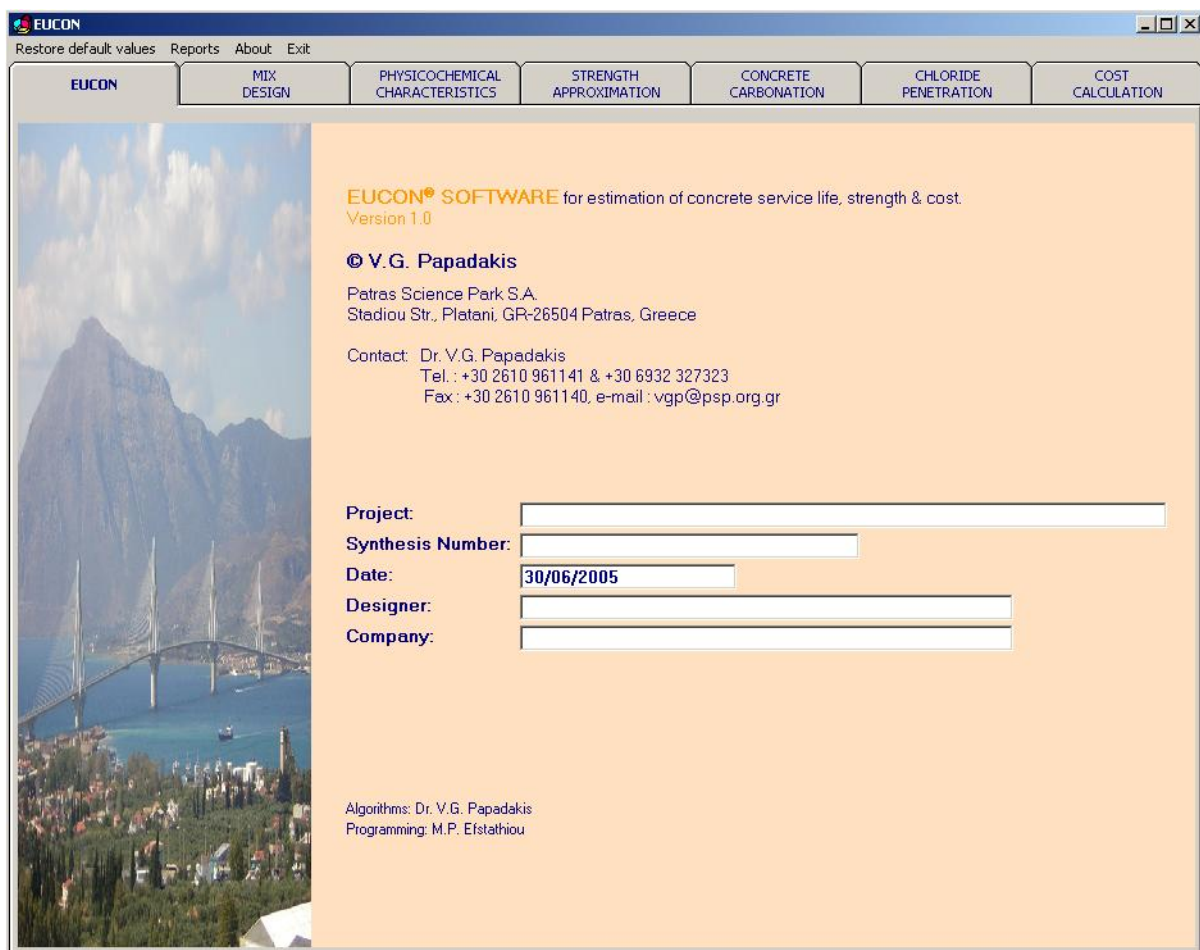


Figure 1.4.1 General overview of EUCON® program showing its cover page and the main tabs for the individual estimations.

In the **cover-1st tab**, the **general information** for the project under examination may be introduced (*optional tab*). This includes the identification of the project, the serial number of the trial concrete mix, the present date, and the names of the designer and the company that undertake the design study.

The **2nd tab** concerns data and calculation for the **concrete mix design**, and together with the **3rd tab** that calculates the **chemical and volumetric composition** of the concrete, are basic tasks that all other calculations are depend on (*mandatory tabs* that have to be used initially in a successive way: first the tab for mix design and then the tab for chemical and volumetric composition).

All other remaining tabs, i.e., the **4th tab** for **strength approximation**, the **5th tab** for **estimation of service life regarding concrete carbonation**, the **6th tab** for **estimation of service life regarding chloride penetration**, and the **7th tab** for **cost estimations**, are based on the previous two tabs and they can be used independently in order to estimate each specific characteristic they deal with.

All tabs contain:

- a field that the user introduces the **data** (default values that can change from the user: the “*white boxes*”, dependent variables that cannot change: the “*yellow boxes*”),
- a **calculation button**, and
- a field of the **results** (“*orange boxes*” with results in *blue bold colour* that cannot change).

Finally, there are separate actions such as **save, clear, reports, help, about, exit**, that can be used in order, respectively, to save the introduced data as default, to return to the default values, to create a report file or to print, to guide the user, to give general information and, finally, to exit.

All tabs and actions are described in detail in the sequence.