# Some problems when using Excel for construction cost management

## Or for that matter, of any general purpose program

The problems derived from the use of Excel for the BoQ or in any other stage of a construction operation are well known:

- Lack of communication between the agents
- Difficulty for the analysis and the operation with data
- Impossibility of re-using, referencing and tracking information

Excel is an outstanding creator of "underground" information systems and islands of know-how, converting construction experts in low level computing technicians devoted to reinventing the wheel.

## The main problem when using Excel

Excel is a wonderful tool for its intended use: performing numerical calculations in rows and columns and displaying data or results with very effective graphic resources.

But Excel it is not a database: values may be entered with no predefined structure. Cells and ranges may have a name but data are not referenced in a formal way, other than location.

On the contrary, databases may be shared and understood by different actors, even with a custom design, as the table structure and the fields are defined before data is entered. Databases satisfying relational restrictions are formal and unique descriptions of the underlying model.

In this way, the use of Excel means that the calculations aspects of BoQ (which actually are trivial) receive the priority, instead of focusing on the information content, whose exploitation is by far much more important.

The fact that information is clearly understood by a human reader in a well designed Excel file does not imply that the data can be processed in a digital environment, as the human reader is able to resolve many small deficiencies and complete the gaps. But a construction project with several agents and may be thousands of work units requires a real information system, in which computers can interact, independent of the ability of the human operators.

## Some examples

The difficulty of exchanging information is self-evident, and no Excel file is free of this problem, no matter how strict is the set of procedures and the power applied to comply with them. Excel is not designed for exchanging information.

The common defects of isolated Excel files tend to appear in most spreadsheets. Here we will comment some of them.

## Coding

Lack of coding or improper coding are not a specific problem of Excel, but Excel encourages this deficiency as there is no need to define a reference system between concepts.

In some cases, the code for chapters is adopted from international standards, i.e., CSI 16 divisions, helping to group related work units. This is accomplished most times creating tabs, which is convenient for human readers but it is not very useful when information has to be computer processed. For this, a long list is a much better solution.

About work units, Excel users tend to create custom positional coding, like letters ("A", "B",...) or decimal numbering (1.1, 1.2,...) which prevent any type of stable reference to the elements, as inserting a new work unit (for example, in subsequent stages of the initial estimate) will modify the coding of the following units.

| I | Suspended slab - 350mm thick | 961 | m3 | |
|---|------------------------------|-----|----|---|
| J | Ramp slab - 350mm thick | 910 | m3 | |
| K | Suspended slab - 350mm thick | 961 | m3 | |

*The lack of proper coding makes it doubtful whether there is a mistake or not in works unit "I" and "K".*

In reference samples, when the number of work units exceeds a physical page (strange enough criteria for an Excel sheet), coding begins again from "A", preventing even more creating a unique reference to the work unit, as there might be two, three or any number of "A" work units under the same division.

| | | | | |
|---|---|---|---|---|
| | DIVISION - 3 : CONCRETE (Cont'd) | | | |
| | SUPERSTRUCTURE | | | |
| | Reinforced vibrated concrete 400 kg/cm$^2$ with ASTM C-150 type-1 cement, including reinforcement, formwork, expansion & contraction joints, etc. all complete and all as required. **(All exposed faces of the concrete elements shall be fair face finish)** | | | |
| A | Beams | 61,238 | m3 | |

| | | | | |
|---|---|---|---|---|
| | DIVISION - 3 : CONCRETE (Cont'd) | | | |
| | SUPERSTRUCTURE | | | |
| A | Staircases complete | 2,635 | m3 | |

*Same coding, different work unit*

## Text

Excel is neither a database nor a text processor. As long texts are difficult to manage and display in Excel, texts are most times entered using independent lines, very difficult to export to other information systems using automatic procedures. Excel also lacks resources for formatting text (indents, bullets).



| | | | |
|---|---|---|---|
| | Reinforced concrete - Sulphate resisting; include | | |
| | all formwork, reinforcement etc.; as specified | | |

*Text in separate cells*

## Difficulty of visualizing large or complex information

The resources of hiding rows and columns and folding or unfolding levels (not always understood by casual users) is not enough to visualize large or complex information. Data on several tabs cannot be seen at a glance or easily operated.

If text or detailed takeoff lines are entered, the amount of information is so high that it is generally impossible to select the data that is really relevant in a given moment.

## Impossibility of n-dimensional analysis

Even Excel appears as a two dimensional information system, it is not. One dimension, normally the vertical or lines structure, is used for concepts, and the other one, the columns, is used for displaying different items of data or values.

In a construction project, there are at least two crossed or matrix substructures for arranging the information: trades and locations.

If trades (like CSI divisions) are used for the main dimension, information for the second dimension is very difficult to extract from Excel files.

A new temporal dimension is needed along the execution, further complicating the information system.

## Common mistakes and ad-hoc layout

Most complex Excel files are only completely understood by only one person, as it is very difficult to avoid entering data out of the general, visible structure of the sheet. When a second user tries to operate or modify the data, this information often remains out of sight, giving the way to mistakes. Even experienced users sometimes insert lines that fail to affect an expression, like sums by range when insertion of new lines is not carefully done.

| | | |
|---|---|---|
| | **MEMBRANE WATERPROOFING** | |
| | Waterproof membranes applied to below ground structures | |
| | **FLUID APPLIED WATERPROOFING** | |
| a | Cold applied fluid waterproofing to various areas | |
| b | **PLASTIC VAPOUR BARRIER** | |
| c | Polythene membrane layer: | |

*Wrong coding*

| | | | | | |
|---|---|---|---|---|---|
| | LS | 11.895,820 | 11.895,820 | | 11.955,600 |
| | LS | 196.795,080 | 196.795,080 | | 197.784,000 |
| | LS | 3.365,590 | 3.365,590 | | 3.382,500 |
| | LS | 619.060,050 | 619.060,050 | | 622.170,900 |

*Personal color codes and calculations off-structure*

Personal codes, exceptions and local behaviors that would not affect a human professional are very dangerous when the information is to be processed by digital systems.

## Difficulty of interpretation

Many Excel files are designed for human reading and paper printing, not for data automation. In digital times there is not any more a need for synthetic or simplified definitions; the information size is not the main criteria, as long as there are ways to extract the information.

Let us check the example below.

To understand "G: Columns necks", the lines above have to be carefully analyzed. First, it appears to be an exception of a former concrete unit, with a different strength. But the reference is not the underlined line immediately above ("Suspended slab"), but the text above "C" work unit ("Reinforced vibrated concrete..."). Again, this text is not enough; the expert human reader will deduct that this concrete requires sulfate resistant cement, as stated in the line beginning with "SUBSTRUCTURE...").

No computer program could reconstruct this reasoning!

| | | | | |
|---|---|---|---|---|
| | DIVISION - 3 : CONCRETE | | | |
| | 03 10 00, 03 20 00, 03 30 00 - CONCRETE FORM WORK, REINFORCEMENT, ACCESSORIES, CAST IN-PLACE CONCRETE & FINISHES | | | |
| | SUBSTRUCTURE (with sulfate resisting cement) Foundation & related works up to and including GF slab | | | |
| | Plain concrete (140 Kg/cm$^2$) with Sulphate resisting cement type V including formworks, additives etc. complete. | | | |
| A | Blinding bed 70 mm thick | 240,500 | m2 | |
| | Cement and Sand (1:4) with sulphate resisting cement type V | | | |
| B | 50 mm thick cement & sand screed over waterproofing membrane on horizontal surfaces | 263,400 | m2 | |
| | Reinforced vibrated concrete (400 KG/cm2) with ASTM C-150 type V cement including formwork, reinforcement, water stops, expansion & construction joints, filler, additives etc. complete as described. | | | |
| C | Raft slab - 2000 mm thick | 97,500 | m3 | |
| D | Raft slab - 1500 mm thick | 261,740 | m3 | |
| E | Thickening below raft | 101,440 | m3 | |
| | Suspended Slab | | | |
| F | Suspended slab - 400mm thick | 2,200 | m3 | |
| | Ditto - but concrete strength 550 kg/cm$^2$ | | | |
| G | Columns necks | 149 | m3 | |
| H | Circular neck columns | 639 | m3 | |

*Digital document needing human interpretation*

A more proper text in a digital environment could be:

> "Columns necks.  SUBSTRUCTURE (with sulfate resisting cement). Reinforced vibrated concrete (550 KG/cm2) with ASTM C-150 type V cement including formwork, reinforcement, water stops, expansion & construction joints, filler, additives etc. complete as described."

Next work unit will contain the same text, except the difference: "Circular neck columns".

## Presto

Any specific construction information system addresses the above mentioned problems, with different solutions.

Presto has very powerful resources:
- Multidimensional information (by trades, locations, stages, approval states, agents)
- Fixed data structure for every agent, although the content is very flexible
- Good coding is enforced

Presto supports many other specific options, representing a complete but easy to understand economic model of a construction operation.