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Somewhere between CAAD-past and -future

Is this where practise is?

Computers are commonplace in architecture: as CAD for drawing production, special text databases for specification writing and software for construction budget calculation. Far less common is their application in the earlier stages of design. This article discusses the options available to the architect and facility planner. The bottomline is that there are many lowkeyed tools around that can serve any practice very weel.

Case 1: Speadsheets for Net Present Value decision support

In practise an architect spends a lot of time with budgetting and cost calculation, but Net Present Value calculation rather looks beyond his expertise. The NPV indicates the worth of a project net by discounting all future receipts and expenditures into equivalent present day values. NPV-calculation is the instrument par excellence to assess the longterm feasibility of capital investment: it shows how much and when project money will actually be spent, reflects future cash flows and their timing, shows the borrowing capacity and the cost of borrowed money and the possible return on the investments that are to be made. The case demonstrated compares the cost part of two building extension strategies for an approximately $60 million project. Here the present value cost calculation indicated that even with different growth projections it is marginally more feasible to construct a new building than to upgrade the existing one, which actually swung the decision in favour of a new design. Setting up the spreadsheet and running it with a variation of parameters took only a few days.

[Ill.1 Present Value for the cost of two alternative development strategies - text to be translated into english]

Like every prediction method the weakness of NPV-calculation is that its outcome is as reliable as the data it is based on. Expenditures and receipts of over 10 years hence are generally discounted to have a very low present value, but even within 10 years there often is considerable uncertainty about for instance market growth or borrowing rates. In a building project it is also difficult to establish essential factors like future cost of maintenance and energy use. Several NPV-calculation runs may be needed to ablish the sensitivity of such factors. But the magnitude of the decisions to be taken is definitely worth the effort.
Although the NPV-analysis is financial in character, the sensitivity factors are the domain of the building expert. The the calculations should be made at the architects' or facility planners' office, this case shows such calculations can well be made using ordinary spreadsheets, and do not require a computer- nor a financial wizard to suit a design situation and purpose.

Case 2: Databases for Space Books

A large part of the Programme of Requirements consists of a more or less elaborate specification of each functional space. Space Books are a common medium to carry such specifications. Typical data are the size and capacity of a space, the internal climatic and lighting conditions, levels of safety and security, utility and communications connections, fittings and furnishing and adjacency relations with other spaces and the outside. Preferably not only the bare data should be noted down, but also the calculations, logic and argumentation that led to these data.

Storage and processing of such data are typically what computer databases are made for. In the past non-computer professionals steered away from databases as they required more than basic PC- expertise. But over the last couple of years desktop computing has progressed from just wordprocessing and spreadsheets into what are grandly called "Office Solutions" such as MicroSoft Office or Corel Office (formerly Perfect Office), which do include some very easy to handle database software.

[Ill.2 Space Book input form - to be translated into english]

The case shows a Space Book page made up with MicroSoft Access. The database structure and input page layout shown took less than two days to put together by a firsttime database user.

While in itself an efficient way to put together a Space Book, using a database has the added advantage over producing the same by wordprocessor or spreadsheet, that it can be made to produce a large variety of reports using one and the same database. Moreover, that database needs not to be static, but can grow with the design process into a Building Manual for the facility manager or be transformed into part of the Building Specifications.

CAD today: taken for granted

In the architects'office Computer Aided Drafting is predominantly used for production drawing. However, more and more designers have also started to use it for sketch design and design studies - in fact one often has to, since at the office there are no more drawing tables left. Also for the designer it is a way to maintain his own CAD-skills and keep in touch with the way the drawing room operates.

There is the notion that the CAD-produced sketch design can directly be taken on by the draftsmen for further production drawings. There is software that can clean up the drawing (straightens lines that are just not straight or discontinuous, sets almost rectangular corners at 90° exactly, snaps everything onto grid, closes space perimeters) or that replaces single lines representing walls with double lines or even more elaborate detail, including automatically drawing correct wall junctions between different materials. Clearly in such conversion many instances still need to be dealt with separately and often between sketch and final design large parts need to be resized and shifted on the site layout, thus making it more efficient to set the drawing up anew without much use of the conversion facility. Other special software applications are available that include links between CAD-drawings and Space Book-databases of the type mentioned earlier. But as the designers' requirements are varied and project-specific, these applications only cover too small a part of what one needs and in practice are seldom considered worth the cost of purchase, implementation and learning. There also is the problem that the graphical description of the building will be spread out over many different drawing files, which together may not cover the whole project, contain doublures, inconsistancies, or may just be difficult to trace on the office network.

[Ill.3 Preliminary design floorplans]

So despite the availability of the above special software, in most cases for preliminary design drawings the same drawing software as for production drawing will be used - albeit that some, such as AutoCAD, are rather clumsy for laying out and positioning spaces -. Still, using (existing) CAD for preliminary and sketch design studies can be very effective. In particular in setting up the site and other fixed items as a background for sketches and studies, in the use of library items as cars, aircraft and furniture to check out complex layout details, and for quick area calculation.

3D-modelling is here (or is it?)

Three dimensional CAD-use is promoted for two entirely different reasons:
3D-modelling and 3D-visualisation.

Essentially a building is a 3-dimensional object. Traditionally it has always been represented through media that were 2-dimensional only, because we had no better way. As a result the vertical dimension in design has tended to be the stepchild of the floorplan. But with computer tools capable of 3D-modelling a revolution in design has been heralded? Though the hype and various tools supporting it are with us already for quite a while, they did not really deliver. Partly because, as yet, these tools are just not good enough, and partly because making things fit in plan first and solving the vertical connectivity later is perhaps a reductionist method of design, but at the same time it seems to be a pretty effective way to tackle the complicated issue of design modelling.

Then there is the 4th dimension: take 3D-modelling and and the CAD-database. In contrast to a representation consisting of many flat drawings, a 3D model is one complete representation and without doublures, so all building parts are there to be tagged with non-graphical data. The representation detail as well as that of the attached data grows with the design process. The 3D-model becomes the basis for a complete description of the building, from design until actual construction and beyond.

The idea is a grand, but except in special circumstances, the efford/benefit-ratio still is too high for practice. This is likely to change over time, but may still take quite a while.

Case 3: 3D-visualisation

3D-modelling as proposed above, is not to be confused with 3D-modelling for visualisation, which is about making a graphical model that performs much the same function as the physical cardboard or wooden scale model used traditionally.

Software to produce and manipulate 3D visualisation models is already with us for many years but only the last couple of years it comes at bearable cost and is managable without too much overhead. For only a few $100 AutoCAD add-ons like 3D-Studio, AutoVision, and AccuRender have become available. Other CAD-systems have similar options. They are easy to learn and provide all one needs and more: a wide choice of materials that can be stuck onto CAD-surfaces, including transparant and reflecting materials, shadowcasting, elaborate facilities to set the sun and other lightsources, standard skies and backgrounds and additional libraries with men, cars, aircraft and house-, office- and street-furniture are available at very reasonable prices. And the essential functions can be learned in half a day.
The difficulty, though, is not in the rendering, but in making the model to be rendered. With AutoCAD, which is not a very good architectural 3D-modeller but as mentioned above often the only one readily available, it will take a few days to a week to produce an acceptable 3D building and site model (see example). Add a number of days if the site is sloping or when there is a complicated roof shape. Also be aware that rendering is a heavy computational process and 3D-CAD-files tend to grow quite large and may require a special CAD-workstation.

[Ill.4 Areal view of Curaçao Int’l Airport in July of the year 2000 at 5.30pm - in color]

Consequently, 3D-rendering is hardly a design vehicle for the designer. In many cases conventional handmade sketches may still be more effective. But for client and public communication the possibilities of computer rendering is great, and more flexible and adaptable than the artist impressions and physical models which they might replace or complement.

Clustering and design automation: little earning value
The above represents software options relevant to almost any design project, and applicable to the entire design proces. More specifically for the early stages there is a whole family of clustering software available or bubble diagram and/or blocking and stacking software. Basically from a large list of spatial arrangement requirements and an ajacency matrix of the spaces, these systems have a set of algorithms that determine which spaces should be close to one another. Stacking software also checks which closely related spaces may fit one floor level and sorts the arrangement out vertically. Blocking software typically arranges the spaces over the available area of a specific floor. Particularly when used in connection with user organisation interviewing methods in cases where a large existing facility has to be functionally rearranged, it can be a very useful tool. In most other cases, however, the results are not demonstrably better, and much less controllable than the architects’ conventional manual methods of work.
This type of software comes very near to what may be called "design automation" or "artificial design". In academia there exists a long line of development that takes this issue much further with very elaborate software for plan-, space- and even style-generation. While these are worthy exercises in exploring the limitations of

design computing, they have found little practical application as the problems they solve tend to have a rather narrow scope.

Evaluation software: a scattered promise

As most major design decisions are taken early on in the process, then is when one likes to simulate and measure the performance of various alternatives, in terms of building cost, running cost, walking distances, appearance, and last but not least: internal climatic performance and energy consumption. A number of software packages that can make an integral appraisal of design alternatives exist, but mainly in the academic world, where they have proven their value in making students aware of the importance of these design parameters. In design practice, building cost (like NPV-calculation), visualisation and energy studies are generally evaluated seperately. Climatic and energy behaviour tend to be studied in more detail and depth in later design stages and through specialised consultants.

For specific project types specialised space capacity software, transport flow simulation software, building code checking or even explosion impact simulation is available, sometimes for direct use by the designer, sometimes only through specialised consultants, but always as separate packages.

Conclusion

It may be clear from the above that there is a considerable amount of software around to facilitate and enhance specifically the early design process. Some of it is more generally applicable and feasible than other.

There is still much room for improvement in tools specific for facility planning. Problem variation, the need for flexibility in use, and project uniqueness make it very difficult to develop them for practice, particularly if one aspires to integrate different design or evaluation aspects. Moreover, from a developers' point of view there is only a relatively small market for such software and it is not an easy to convince one. That, and the fact that they are often already available in the office, shifts the focus to what can be done with the common software tools like spreadsheets, desktop databases, CAD and visualisation. The price /performance rate of these tools has decreased tremendously. Their tailoring and application to specific projects is expert work no more, it should be considered a routine job for the design or facility planning professional. Most of the parameters involved are his domain: exploring their sensitivity is actual design work.

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