

Virtual Horizons

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This essay explores directions for Computer Aided Architectural Design. It focuses on the state of the 'art' in the Netherlands - a country which is renowned for a high density of planning, both in its cultivated landscapes and in its urban environments - and investigates in which ways computer aided techniques may be broadening the horizons of Dutch design practitioners and builders. An attempt is made to characterise recent developments within the architectural design community, with respect to the influence of (digital) design media on - stylistic - architectural developments and on the building methods of the nineties.

Virtual Horizons

Investigating the influence of Computer Aided Methods of Architectural Design and Building Production in The Netherlands

Reflections

The architectural 'landscape' of the twentieth century fin de siècle offers a constantly changing panorama.

The 'output' of the architectural practice - realised buildings, but also visual representations of plans which are not necessarily built - has attained an unprecedented level of attention in the media. There is a growing interest in the - often seductive - imagery of contemporary designers and an obsessive interest in the unpredictable outpourings by the 'stars' of the profession: the jet-setting international circus of the - often self proclaimed - avant-garde. Coming after the somewhat dull, bland building production of the sixties, seventies and early eighties, contemporary architecture has been 'discovered' by a broad public and even become 'fashionable'. A new generation of students is lured to the profession, whispering the names of the enigmatic gurus of these times and quoting sound-bites by philosophers that few have actually read.

At the same time, on a much more local, down to earth level the 'blessings' of the changing living and working environments are as hotly - if less eloquently - debated. The world is gradually, but noticeably growing fuller and many new additions to the built environment do not aspire to the higher intentions or aesthetic ambitions of the happy few balancing on the (media) tip of the architectural iceberg. Despite the technological advancements of the information age, many buildings still come across as poorly designed (or hardly designed at all), but are no less 'present' in the dynamic perception of the hastily mobile, on-line inhabitants of the 'first world'. The city of the late twentieth century increasingly comes across as a cacophony of singular 'actors', each trying harder to be noticed than the next, self-consciously conspicuous in appearance. Urban yuppiedom sprawling along the highway...

Although the world would appear to have become smaller by the increased interaction of 'information', this does not mean that the design culture has become more universal, on the contrary, overlooking the field of architectural design, the situation seems to be more 'pluriform' than ever...

There are designers working on creative levels within the international design scene that ignore traditional boundaries and cut through conventional cultures, inventing new solutions, often simultaneously.

Groups working in different places, yet communicating via new platforms such as "the Net".

On the other hand there are very significant regional and even local developments, which can be the result of a number of parameters specific to a given area, such as the cultural and political climate and specific constraints such as all kinds of laws and by-laws. Of great importance is the economic situation and monetary activity (which types of individuals or institutions are investing in which types of buildings in which place at what time).

Underlying all of these activities is a steady transformation of the building industry. Recent changes have affected both the disciplines connected directly to the *building process* (the building and engineering firms) and those active in the *design process* (the architectural firms and their consultants).

The changes which are taking place in the working methods and forms of organisation of the building disciplines - both in design and building production - can be contributed to a very large extent to the growing use of Computers.

What is the influence of computers on the built environment? Has Computer Aided Architectural Design (CAAD), heralded by many as a revolutionary design medium and an indispensable creative tool, led to more imaginative architecture, to technical innovation and durability, to more economical even more comfortable buildings?

Aldo van Eyck, considering the role of architectural designers, stated in the early eighties: "*Quality* as such is *not* important. What is important is the *quantity* ...of that quality!"¹

Is it possible to claim that computers have led to a greater quantity of architectural quality, or have they helped make architecture worse? Are they contributing to a more stimulating design environment or have they just made it easier to make lots of money - and if so, by whom? By the architects or by clever entrepreneurs, busy marginalising the architect's influence in the design process?

What value has been *added* by the influx of computers into the architectural practice and what new blessings may be expected in the (not too distant) future?

A brief investigation of these developments, concentrating on the 'case' of the Netherlands...

Designing the Netherlands

The Netherlands is a relatively small, but densely populated country on the western fringe of continental Europe.

¹ Aldo van Eyck speaking at the Faculty of Architecture in Delft and to NRC Handelsblad in 1980 (translation by the author).

A characteristically ‘horizontal’ county, dominated by low hanging, windy skies and the ubiquitous presence of water. For the Dutch, living in such low-lying lands, situated in the delta of three major European rivers and facing the turbulent North Sea, this has always meant that - if they wanted to keep dry feet - they needed to work together. This need of reaching a consensus concerning the course for - collaborative - action has led to a relatively ‘horizontal’ society with a strong communal tradition and a reputation for tolerance, mirrored in a religiously and ethnically diverse society. The outward-looking spirit, resulting from the country’s geographical position and relative lack of natural resources, has contributed to a national economy which is based more on (international) trade, services and (intensive) farming rather than on industry.

The economic activity is largely concentrated in the densely populated western part of the country, the so called ‘Randstad’ (literally: ‘Edge city’), a ring of cities and towns concentrated around a ‘green heart’ in the counties of Northern- and Southern Holland and Utrecht. For decennia, building production has been dictated primarily by social housing programmes and by the needs of commercial enterprises. Recent waves of privatisation and commercialisation have meant that the task of building development, previously carried out largely by (local) governments and subsidised building corporations, has increasingly been taken over by the large financial institutions seeking durable investments. After the collapse of the booming office market some years ago, project developers are presently concentrating on ambitious housing programmes within the framework of the government’s strategic ‘Vinex’ programme.¹

The country has a very long tradition of planning. A proven method is the practice of reclaiming land from the water and then developing these polders for new purposes. Without much exaggeration, the Netherlands as a whole can be considered as a kind of grand, ongoing design project. Dutch decisionmakers often emphasise that the project at hand is never ‘finished’. A pioneering spirit still runs through the country’s administrative layers and there are few - if any - countries that are as thoroughly and comprehensively ‘organised’ as the Netherlands.

The atmosphere is generally ‘down to earth’ although experiments are not shunned. Designers are used to exercising their creative talents within strict (financial) frameworks, having to work within relatively narrow margins. The Netherlands is a country where creativity is respected, but the budget is holy!

It should be ideal to use computers to organise and control the different levels of such a country and indeed this is the case. Although the Netherlands were never a fore-runner in the field of automation, and digital machines were originally used principally for financial computation, the Netherlands now has one of the highest levels of computer density in Europe². Computers are to be found in offices and homes and are involved in running and controlling just about everything.

¹ The political document which serves as a guideline for new housing developments is the so called ‘Vierde Nota Extra’ (Vinex) of 1990.

² According to statistical information from the CBS (the Dutch central bureau for statistical information).

This 'computer presence' can frequently be felt. If one drives down a Dutch motorway it is possible to pass under digitised signs which inform the motorist that there is nothing to report or even that the system is currently not in operation. Digital networks charting geographical and demographic information are becoming consistently more fine tuned and all-embracing, leading to discussions concerning the privacy of the individual. One of the most successful applications for CAD systems has proved to be Facility Management: creating interactive information systems in order to register and specify the existing infrastructure, monitor maintenance projects and integrate new additions and alterations. Many sizeable firms, corporations and municipalities have documented their domains digitally and, although these databases are mostly not yet linked with each other, the information web covering the country is steadily becoming more close-knit. A small step to go to a complete 'facility' network registering all facets of "Holland Inc."¹?

Travelling through the country, one is aware of a constant building activity, with the landscape steadily filling up. The horizon is becoming increasingly obscured by new 'growths' of buildings and all the time designers and decisionmakers are hard at work preparing new - as yet virtual - realities that will further alter the country's dynamic horizons...

Design Practice

Holland has quite a high density of 'official' architectural designers (the latest figures count 9145 registered architects² on a population of 15.6 million). The Dutch situation is characterised by relatively many small offices and few large ones (less than 10% of all offices has more than 15 employees and truly large offices (50 persons and more) amount to no more than 1% of the total; half of all the offices consist of only one person)³. In the eighties, the stagnation of building activity gave rise to a thorough reorganisation of the architectural practice. Many bigger offices either had to close or became considerably smaller, their place being taken in by smaller, younger offices with very little overhead. Although the building activity has since grown considerably, the architectural branch has not grown at the same rate. There is much competition and without guaranteed rates many offices have very small or almost non-existent profit margins, leading to a lack of structural investments.

This is one of the reasons why - apart from a small group of 'pioneers' - many offices were relatively slow at getting involved in computation. The starting-shot for most offices was the introduction of Word Processing on PCs, which was perceived as a revolution. Computer aided drafting (Cad) was adopted seriously by medium sized and larger offices

¹ "De BV Holland" in Dutch media jargon.

² According to the count per 1st of January 1997 by the Stichting Bureau Architectenbestand, the official institute guarding position of the architectural profession and registering those practitioners allowed to carry the title 'architect'.

³ Figures published in Cobouw, 28 January 1997.

around the end of the eighties and beginning of the nineties, initially mainly in the technical office and still very little in creative design. Many of the small offices continued working 'traditionally', but for a growing number the computer has become an indispensable part of the organisation as a medium for 'shared' working...

Architectural practices in the Netherlands are notorious for their lack of job security. Commissions come in waves, and this often makes it difficult to keep up a group of regular employees. Many offices operate largely with temporary staff and some have even set up pools for sharing work with other offices. This practice has also given rise to a growing number of 'service' bureau's. Computer based firms have jumped out of the ground, offering specific services such as price calculation, energy-efficiency calculation, legal advice and complete technical drawing and project management facilities. The central medium is the computer, with information being exchanged via floppy and now gradually through interdisciplinary on-line collaboration. The most commonly used CAAD platforms are 'marketleaders' Arkey (an architectural program developed specifically for the Dutch market) and AutoCad (relatively little Mac).

The practice of 'linking up' with service bureau's has made it easier for relatively small offices with little overhead and a compact staff (often just a small, constantly changing team of designers and media specialists) to take on serious commissions. This concentration on their 'core' tasks does pose a threat. The role of the designer is constantly in danger of being restricted, losing control over the design as a whole after the early 'idea' phases and not being able to create a finished product. Architects are continually encountered with the struggle to keep influence over the total 'production'.

In this light it can be relevant to compare present-day architects with movie directors: feeling responsible for a creative project in an ongoing process, complete with a demanding 'producer' primarily interested in financial success, with difficult 'actors' and specialised technicians. The architect/director not only playing the central role as generator of ideas, but also trying to hold both the 'plot' and the team together, while constantly on the lookout for overspending.

The Dutch building situation, coupled with the compactness - and relative youth - of many offices, means that there is still a reasonable amount of room for a personal 'signature', for some experimentation and novelty. To stay in terms of movie-making metaphor, this does not often lead to streamlined -Hollywood style - productions but rather to a relatively large number of small budget 'cult' films.

This practice is reflected in the way commissions are divided. In the Netherlands. Particularly in the West, private commissions are scarce. Standard usage is that reasonably large housing or office estates are developed in one go, on sizeable locations. Vinex housing projects often amount to controlled development of some 50.000 housing units at a time. However, unlike the situation in previous decades, when there used to be a tendency to give large segments of developments to one - very large - office, there is now a tendency to divide projects up into medium

sized parcels divided amongst a number of different - small to medium sized - offices. From a financial viewpoint, such constructions are often only just interesting for the architects, but it is important to participate as this may lead to publicity and to new commissions. This competitive approach has contributed to more differentiated neighbourhoods with contributions by various architects attempting to distinguish themselves, quite often in somewhat exaggerated ways...

Design Media: Enquiry and Communication

Architectural conceptions always need to be noted down in some way, so that the intentions of the plan can be specified and communicated to others (clients, builders etc.). This activity of *notation* is not only of importance in order to communicate with others, but also for the benefit of the designer him/herself and for other members of the design team. This recurring process of *imaging*¹ is the core of every creative architectural design activity.

In 'primitive' planning processes, the plan was probably drawn up 'in situ' by scratching the contours into the earth (using lines) or by marking the corners with rocks or sticks (using co-ordinates). Gradually designs were laid down in a system of two-dimensional projections (plan, cross section, elevation), drawn to scale.

Though the introduction of new techniques and instruments for design visualisation does not necessarily lead to revolutionary changes in the *products* of design, new tools have in the past given new impulses to the *practice* of design. For instance, the introduction of squared paper was instrumental in the development of many geometry-based, neo-classicist designs and transparent paper greatly stimulated freehand design sketching. Similarly, the introduction of pencils, fountain pens, felt pens and adhesive tone foils extended the creative palette of the designers in the past.

What is the influence of *computer* aided techniques on the practice of design and in what way has CAAD possibly changed design products? In order to be able to say something sensible about this issue, it can be useful to distinguish some characteristic aspects of design.

One distinction which can be made is between the design *activities* on the one hand and types of design *information* on the other hand.

Generally speaking, a design activity is either a form of *enquiry*, probing and testing the design at hand, with the intention of bringing it further, or an activity directed towards *communication*, for instance laying down information for a client or builder or for a design milestone, such as a presentation.

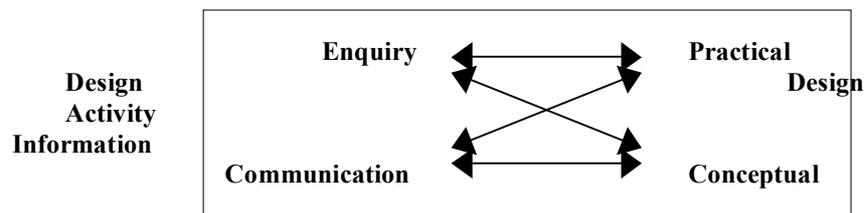
The kind of information involved in such activities might be primarily *practical* in nature, for instance concerning quantities, structural and technical aspects or rules and regulations, but can also be more

¹ Zeisel, J. : 'Inquiry by Design: Tools for Environment - Behaviour Research', Cambridge University Press, 1984.

conceptual, concerning aspects of a design which are often more difficult to convey to others but which are of great importance if a plan is to become a compositional whole, rather than merely a sum of separate solutions.

There are in principle four possible combinations of the above design aspects to consider (see the scheme). These four combinations are used here, as typological categories for design activity, in order to give an indication of the value of - existing and emerging - Computer Aided Architectural Design applications.

Scheme: CAAD Design visualisation applications:



A brief overview of the four combinations of design visualisation categories, appearing in the order of their relative success as CAAD applications - *in the Netherlands* - up to now:

1 Practical Communication applications

The first successful application, essentially CAAD used simply as computer aided *drafting* (Cad). Taking the place of traditional technical drawing (meant for the contract and realisation phases of design). Important assets of the computer in this respect have been the ability to work in different scales from the same basic drawing, the possibility to work in different layers and the use of changeable components.

2 Practical Enquiry applications

Another influential application of CAAD and other, more specific computer software. Useful applications, discovered relatively quickly by the architectural community, include the possibility to calculate items, such as the number and sizes of specific building components (in order to get an early indication of building costs), of measuring in the drawing and applications concerning the consequences of different technical options (construction, building physics etc.).

3 Conceptual Communication applications

Initially introduced as a 'sideline' to the more prominent drafting functions of Cad, computer visualisation for presentation purposes has steadily gained importance. At first anything coming out of the computer (including illegible wireframe drawings) was considered of interest, but recently - especially since the introduction of texture mapping techniques - many and varied, often sophisticated computer aided presentations (varying from 'realistic' imagery to more atmospheric, conceptual visualisations) are being generated.

4 Conceptual Enquiry applications

Probably the application slowest to develop. Partly because complex computer modelling applications have recently become more efficient and accessible, this direction has gained momentum in the last few years. Initially adopted in the early design phases mainly by active Cad users, primarily by creating different design options simultaneously, comparing images and choosing the appropriate course for further action. Presently groups of architects are busy exploring and extending the possibilities of the computer as a design visualisation medium, creating images of new, dynamic architectural forms.

All of these aspects are of importance, in order to achieve success in a complex design. It is not opportune to over-emphasise the (early phase) conceptual idea phase, A brilliant conceptual sketch does not convince most clients and is certainly not enough to get a building off the ground. Computers, just like other design media, do not have to be used for *all* aspects of design and may be at their best when used for specific tasks in the design process. The prediction, made by computer enthusiasts in the past, that CAAD would completely replace all other design media has not come true. We currently witness an increased interest and renewal of all kinds media and creative designers often use different techniques in combination. The choice which media to use and when is up to the individual designer...

Although it seems justified to state that computers have initially been used most successfully in the more 'practical' aspects of design and that in many offices this is still the case, that there appears to be a steady movement towards more conceptual applications which influence the stylistic developments of contemporary architecture...

Architectural Styles of the Nineties

There is no universal architectural 'style' of the nineties, but rather a complex, hybrid network of recycled previous styles and new influences. The Dutch architects of the nineties share an almost obsessive interest in the expressive qualities of architectural form and materialisation, feeling free to combine different themes. The mood of the twentieth century fin-de-siècle in the Netherlands could well be characterised with the term 'Radical Eclecticism', introduced by Charles Jencks¹ in his Post-Modernist manifesto, except that the situation does not correspond with the kind of ironic neo-classicism he anticipated.

Dutch architects have grown up in a Functionalist tradition and after the somewhat boring sixties, the 'cosiness' of the seventies and the free-for-all of the eighties, the atmosphere of the nineties is predominantly one of a playful, almost frivolous Modernism. Not a modernism in the sense of "less is more", nor of "bigness" and "smallness", but rather a modernism with an appetite for "muchness". The emphasis is on proportion and contrast, on pattern, texture, material expression and colour. The emphasis on composition and expression is such that one could almost

¹ Jencks, C. amongst others in: 'A Genealogy of Post-Modern Architecture', in Architectural Design nr. 4, 1977.

speak of architectural ‘fashion’. A recent architectural city-guide even introduced the term “Nineties-Look”.¹

The traditional boundaries between disciplines are shifting, with architects getting involved in urban design, and artists, graphic designers and even cartoonists getting involved in architecture. There are attempts to give large scale housing developments a sense of ‘atmosphere’ and ‘meaning’ by introducing romantic, often pseudo-historic themes. Although this kind of alternative regime does sometimes give rise to the occasional post-modern, classicist pastiche realised in modern materials, the stylistic undertone is generally (neo) modern.

What is the influence of the computer in all of this? Has CAAD made architecture more interesting or more bland?

Both seem to be the case as the computer appears to make the architecture of ‘lazy’ architects even lazier (the computer makes repetition dangerously easy and many buildings lining the country’s motorways come across as manifestations of this trait), while on the other hand the ‘ambitious’ architects seem to have become ever more ambitious, using CAAD to cross traditional boundaries. Influential architects like Ben van Berkel emphasise the important role of computers in the creative evolution of their work.²

An attempt to characterise some notable ‘streams’ (of influential practitioners using CAAD) running through the Dutch architectural ‘delta’ (with the names of some exemplary offices per stream):

1 Mainstream ‘Corporate’ approach (Articon, EGM, Kraaijvanger, Bonnema etc.)

Mostly large scale ‘professional’ buildings created by the professionally organised, multi-disciplinary, larger category offices, mainly for corporate clients. Relatively ‘safe’ architectural expression, usually with considerable repetition of a limited number of elements and some occasional ‘playful’ articulation. The effect is often comfortably modern with ‘representative’ detailing intended to underline the corporate identity and importance of the client.

Cad absorbed into office organisation as necessary tool for working efficiently and competitively.

2 Technological ‘Montage’ approach (Zwarts & Jansma, Benthem Crouwel, Cepezed etc.)

Offices that started experimenting with ‘technical’ themes such as industrialisation and prefabrication and the innovative development of structural details and joints some years ago. Initially often forerunners in

¹ In the guide ‘Architectuur in Amersfoort, Een overzicht van de bouwkunst na 1800’, by Max Cramer and Anton Goot, THOTH, Bussum, 1995. For the period 1980 - 1995 the authors distinguish the categories Modernism, Historicism, Contextualism, Regionalism, Transformism and Nineties-Look (“Jaren ’90-Look”).

² Dutch Architect Ben van Berkel states: “To me the computer is a way of radically breaking with traditions. The mediation techniques enabled by the computers signify a complete overthrow of many architectural assumptions, from the typology of organisational structures, to the hierarchical order of planning a structure, ending with details. The computer entails a radical rethinking of the valuations implicit in architectural design. In this sense computational techniques could represent the first important development in architecture since modernism.” From: ‘Conversation by *modem* with Ben van Berkel, by Greg Lynn, *El Croquis* 72, nr. 1, 1995.,

the application of computers in design (preferably Mac), this type of office introduced CAAD as a logical step towards developing somewhat manifest hi-tech architecture. Computer-based techniques are often used particularly effectively in modelling building components.

3 Articulated ‘Sculptural’ approach (DKV, Christiaanse, Neutelings, Reijers etc.)

In the Nineties formal vocabulary, an important trend appears to be the (re)discovery of sculptural qualities in architectural composition, emphasised by the use of contrasting facade patterns, materials, surface textures and (semi)transparent materials. Though projects are often presented using a variety of means, including models, collages and even cartoons, CAAD techniques, applied primarily in design composition, include solid modelling techniques (combination, addition and subtraction of volumetric shapes) and texture mapping software (surface treatments, colour and lighting).

4 Experimental ‘Solid Liquid’ approach (van Berkel & Bos, NOX, Oosterhuis etc.)

Restless groups specialising in exploring novel, computer-generated environments. Originally on the fringe, complete with futurist/activist rhetoric and provocative predictions such as the imminence of “artificial intuition”¹, these designers have recently gained influence by securing a number of prominent commissions. The computer is considered as a revolutionary new tool, central in generating new formal concepts. After a phase centring on deconstructivist computer-aided collage techniques, the latest direction has been dubbed “solid liquid architecture”, using a technique of flowing, cross-section based morphing.

5 Sophisticated ‘Neo Modern’ approach (Mecanoo, van Velsen, Coenen, Egeraat etc.)

A number of influential architects, the previous ‘young dogs’ who were catapulted into the limelight some years ago - before the influx of computers - have adopted computer aided techniques in the search for new architectural solutions. Their modernist work has become increasingly sophisticated though not predictable. Next to standard Cad, a whole range of techniques (digital and otherwise) is applied selectively, mainly as a means of bringing across architectural intentions, rather than as images in their own right.

The collection of design approaches listed above is limited in its scope and naturally not complete. It is intended to give an indication of typical issues and digital approaches in the Dutch architectural scene. There are no clearly defined boundaries between the groups and the particular techniques mentioned. Combinations are possible, working methods are dynamic and shifts - both conceptual and instrumental - regularly occur. A trend which may even intensify in the near future...

It should be clear that the developments of the many-faceted 90’s ‘style’ cannot be attributed solely to the influx of computers.

The excitement of being part of a fin de siècle, formal renaissance seems to be in the air, at least in the Netherlands. Part of this stylistic activism can be attributed to the attention of the media: particularly the printed

¹ Oosterhuis, K. : ‘Artificial Intuition, Arbeiten am Computer’, Aedes, Berlin, 1989.

media and television. In their quest for issues and photogenic items, these have 'discovered' architecture. This has made architects even more aware of the developments around them and fuelled their ambition to be a part of what's going on. To do so one has to produce designs that catch the eye, and preferably should be enigmatic enough to provoke a response from influential critics. To get noticed a lot of architects have learnt to change constantly and to shout, if not in words, then at least by means of powerful, seductive visual images.

In the shadow of the media-hype 'opinion leaders' of the Dutch architectural design scene, there is a vast group of more anonymous designers, busy absorbing and evaluating the themes and trends of the nineties, sometimes as 'followers of fashion' but often with an individual interpretation, and with varying degrees of integrity, originality and refinement...

Although the use of computers has contributed widely to generating influential imagery of new, virtual environments, this may not really be where the computer's greatest power lies. Possibly the most important benefit for designers is that the introduction of CAAD has contributed to creating circumstances in which new kinds of designs can actually get built...

The Building of Designs

One of the most important qualities of computers is their *precision*. However, this quality is often seen as a major drawback for - more intuitive - creative design activities. Working with the computer, the designer has to adopt another way of thinking and learn to anticipate.¹ The computer-assisted designer does not draw abstract lines on a flat surface, but positions components in a virtual framework using a system of co-ordinates. The information is not scaled down but essentially scale 1 to 1. It can be viewed or printed out in different ways by zooming in or out. Because the information can also be represented in the form of three-dimensional projections, the computer offers the opportunity to approach a design in progress as a *model*, or even as a kind of *digital building site*.

The system of working with *components* means that there is a greater correspondence between the Cad method of notation and the built product than was previously the case with traditional technical drawing. Aspects of a plan can be changed without having to redraw. The computer-based method makes it easier to get insight into the numbers, sizes and different types of elements in a plan - and as such the cost factors - from the early phases of design.

The relationship between designer and builder has also changed, as computer information can be exchanged between architect and contractor, and because the building discipline itself has also become increasingly computerised. Although it is not often emphasised, the concept of *Cad-Cam* (Computer aided drafting, linked with Computer aided *manufacturing*) in the building profession has increasingly become a reality in the

¹ Bridges, A. : 'Computing as a Vehicle for Teaching Architectural Design', ACSA Proceedings Prague, Washington, 1993.

Netherlands. Whereas in the seventies the trend was towards limited series of standardised building components, which could easily lead to monotonous designs, computer aided *prefabrication* has made it economical to create specific components in relatively small series. Different elements are made beforehand in computer-supported workplace surroundings and assembled - using a *montage* approach - on the building site.

The opportunity of storing information in different *layers* has also given rise to improved communication between architects and building *consultants* who can add their building information to the computer model, using their own Cad layers. This has contributed to new forms of teamwork with service bureau's outside the architect's office.

Lastly, CAAD has helped to make complex forms *measurable*, and as such affordable. This means that even a relatively unconventional design can fetch a competitive price (as long as the information is clear to all parties involved). The creative collaboration between designers and builders in finding solutions for new forms and has meant that even relatively unusual building designs - quite inconceivable to many a few years ago - can nowadays actually get built...

Shifting Horizons

With the maturing of software applications and the growing computer-literacy of designers, the computer is becoming less of an 'added' value for designer and more and more an intrinsic part of the design process.

As such the computer is steadily losing its romantic aura and becoming what it ought to be: a stimulating *instrument* for creative design.

The situation in the Netherlands, as we approach the third millennium, should not be viewed as a controlled experiment, but it may contribute to creating insights concerning the development of the design practice, its relation to the building industry and concerning the influence of CAAD.

Of course it is difficult to imagine how architecture would have developed without the computer and as such it is difficult to know what its influence truly is. Many of the design trends of the nineties were already starting up more than 10 years ago, when computers were still hardly used. Nonetheless it does not seem exaggerated to state that the computer has been very influential as an - interactive - means of charting, documenting and sharing information about both existing and projected environments. Its role as a generator of ideas is still marginal but clearly growing..

The device has been absorbed into both the design and building disciplines. Instrumental developments are dynamic and hard to predict. Just as when we move towards the horizon and it appears to be continually shifting and we can never be fully aware of what is behind it, so it is difficult to speculate about what new generations of computers will really have to offer. One thing we can definitely expect is that they will continue to become faster and have an even more extended capacity. With this it will become increasingly important to 'tame' the enormous amounts of complex information and to structure data imaginatively. Both structural

and desktop clarity¹ will need to be further improved in order to attain the kind of user-friendliness necessary to create truly *new* opportunities for designers - and researchers !

¹ Breen, J. and Stellingwerff, M.C. : 'A Case for Computer assisted Creativity through Clarity, Project 12Cad and beyond...', Proceedings Computer Creativeness conference, Bialystok, 1996.

