GIS IN ARCHITECTURAL EDUCATION

Design as a place-making process

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Abstract. Responsiveness to site conditions and environment is one of the axioms of architectural design. However, most students’ design is made in a non-geo-coordinated cyberspace through CAAD design and thus leading to “flying” proposals that are not attached to the context. GIS teaches students in architecture to initially refer to real locations as the space in which they design is geo-coordinated and provides the wider context of the project. Along the design process, the project surroundings from macro scale; that is the globe, to the micro-scale that is reflected in the existing buildings, the road network and the topography are constantly present. At the end stage, the project is seen not as a free standing building but rather as an integral part in a real place on Earth. The 3-D urban visualization gives the possibility of evaluating the degree of success of place-making and the fitness of the project to its context. The aim of the paper is to present how a GIS course can support CAAD and improve the architectural design process as well as the quality of the design output towards a contextual architecture. The paper is based on the experience of the author who is architects and urban planner, in teaching design studios and Urban Planning based on GIS as an elective course to graduating students in architecture at the University of Bahrain. It presents an alternative method that is called Permanent Presence of the Real World PPRW.

1. Introduction: Digital Architecture; Is It a Continuity of Modernism?

Despite the fall of modernism and the raise of many post modern movements that praise cultural context, vernacularism, neo-traditionalism and regionalism architectural education is still maintaining a lot of the modern traditions especially in architectural education (Ozkan 2005, Frampton 1986, Steel 1997).
One major deficiency of modern architecture is its failure to respond to local considerations and context, the loss of “sense of being” (Speed 2007, p292), and the belief of its predecessors in the universal location-less solutions. Factors such as climate, geographic conditions, and culture and tradition ways of living were often neglected.

In the Arab Gulf countries the abundance of financial resources and the booming but imported IT made of the countries large laboratories of unusual forms and bizarre projects that praise “creativity” and disregard the local circumstances.

Projects were mostly iconic and were developed at an abstract world that is in the minds of architect and in the design workshop. They are then parachuted on site with a few modifications. Often sites are rather modified or remodeled to accommodate the idea of the architect.

Projects are often made to please the ego of the designers, glorify their names or that of the political leaders. Digital Architecture seems to have played an important role in supporting the wave of iconic projects trend, sorting out the desired miraculous projects, and convincing the wealthy clients. Strangeness and amazement became the major currency in this domain and a sign of creativity, progress and success. By paving the path to this trend, “homelessness” that was promoted by modernism was reincarnated through digital architecture.

It is evident that the information technology is an irreversible trend and that the old free-hand sketching era has gone for ever. CAAD is therefore gradually becoming the design tool for the future. However, the hypothesis of this paper is that under the influence of the powerful new tools and graphics of CAAD, students are fascinated by the “strange” forms they can achieve and thus often tend to produce irrealist projects. One aspect of this irrealism is the decontextualised forms that disregard the socio-cultural and physical environment (Salingaros, 2004).

One of the alternatives to achieve realism and contextualization is through the return to the user and the involvement of the public in the process of design. Public participation is thus becoming a target of new IT in the field of architecture and urban planning (Appleton & Lovett 2005, Barton, Plume, Parolin 2005, González et al. 2008, Hudson-Smith et al. 2003). Residents were given an opportunity to shape their homes, their environment, map their community and form a shared interpretation of community assets (Elmasry and Farid 2007). This system was believed to acts as a catalyst for the formation of the sense of place (Barton 2005, p631). Networking and interactive design would also serve bridging the gap between the designer and the user and thus contribute in re-creating the sense of place.

Away from the public participation approach that is mostly professional, GIS in the educational environment, presents a technical support to
architecture students using CAAD and IT in general, in achieving the contextual architecture and applying the place-making process in their design. In its essence, GIS aims at representing the world as it is and understanding its deep structure through the analysis of the physical, socio-economic, cultural and political context. Its “degree of realism” depends on the level of detail (Paar, Schroth, Wissen & Lange, 2004) and the depth of analysis (Lange, 1999).

2. Cyberspace Vs Place-Making Process

One of the major landmarks in the age of information society, that is now, is the emergence of the cyberspace and the virtual reality (Heim 1998, Langendorf 2001, p. 339, Speed 2007, p. 292). Gibson (2000) commented on the origin of the term in the 2000 documentary No Maps for These Territories: “All I knew about the word "cyberspace" when I coined it, was that it seemed like an effective buzzword. It seemed evocative and essentially meaningless. It was suggestive of something, but had no real semantic meaning, even for me, as I saw it emerge on the page. (See http://www.nomaps.com). Heim (1998) considers VR as an ill-defined concept that has many forms of implementation and that involves both special hardware and software. The frontiers are between cyberspace and real space in education within which architecture is consequently gradually blurring. Furthermore, architecture seems to have witnessed the domination of the virtual over the physical (Castle 2005, quoted by Speed p. 297).

With reference to modern movement, CAAD seems to have insured the continuity of philosophy design for every where and nowhere through the continuous work on cyberspace and reliance on VR. “Cyber-Architects” (coined by Speed p. 295) have in this sense modern architects.

In education, new design instruments and graphics that provide students with powerful tools of representation and display often drive students to forms beyond the human mind and disregard the laws of nature and logic. Abstraction and fiction in design achieve their azimuth through the neglect of gravity, order and coherence. Architects dream in cyberspace, ascaping the constraints of matter and gravity. They dream of folds and dynamic forms, or constant fluidity. A visual pornography of space denied, as yet, to biological material until it too can vaporize and control. Our stable fleshy bodies remain on the outside looking on to windows filled with representations of forms and spaces we can never touch (Dunne and Raby 2001, quoted from Speed 2007, p. 296).

Arbitrariness in design is too often hidden by the notion of “creativity”. In the absence of site constraints, students during the design process often feel “too much” free in deciding about the nature of their projects. It is
evident that the wider the scope of freedom i.e. with less constraints, the more the domain of reflection becomes larger, and the more the feeling of loss in thought is felt.

Despite the confrontation of students with the functional requirements of the programme and the conditions of the site their efforts at the middle and the end of the project is mostly concentrated on developing the building masses and organizing the internal spaces. Landscape and external spaces, such as parking and greenery are treated afterwards as remaining land between the footprint of the created masses and the boundary of the site. Outer context is rarely presented.

The weak attachment to the context and the continuous work in the cyberspace often leads to “flying projects” that could be placed anywhere. The absence of the notion of scale due to the easy operations of zoom-in and zoom-out and the rapid navigation over the site regardless of its size and topography would have decreased the sensitivity towards the environment and real world.

A remedy to this trend consists of developing a design process that insures a permanent presence of the real-world PPRW. This approach is believed to raise students’ awareness and sensitivity about the environment and consequently leads to the emergence of place-making CAAD process.

GIS through its scale sensitivity, attachment to the location would be a major contributor in the establishment of the PPRW, and thus the establishment of the place-making CAAD process. The introduction of the GIS in the early education of the students in Architecture will lead to a balance between the cyberspace that is provided by CAAD and the real-world that is reflected in GIS representation.

The omnipresence of context through GIS has also the role of reducing the unlimited margin of freedom in conception, and consequently limiting the students’ scope of thought, and directing it to the making of a place in a real world.

3. CAAD and GIS: conflicts or Complementarities?

According to Langendorf (2001, p. 318) CAAD programmes have been better for modeling of 3-D physical objects, and GIS programmes have been better for representing the underlying, spatially coded data. However, it seems that the major divergence between the two fields is the degree of realism in each of them. While GIS deals with real world that is the geography of the earth, CAAD is mostly a tool that drive designer to the cyberspace and imaginary world.

Architecture is a field where a multitude of disciplines, arts and sciences converge. Besides its artistic side that is mostly related to abstraction and
creativity, it deals with the real world that is constituted from society, environment, economy and politics. Blurring the two worlds and creating a mixed reality is a double sided knife with regards architectural education. It would be a good instrument of design that makes available real images, maps and video tapes together with the virtual objects of representation. But it is sometimes misused to overpass realities, convince the viewer with illogic outputs, or hide weaknesses of solutions. Only balanced doses of virtual and real worlds and conscious use of both can lead to a successful formation in architecture.

A curriculum that joins CAAD and GIS will have the positive effects on bridging the two worlds towards inventive solutions to our real world problems. Working for a place-making architecture requires a consideration of local conditions in terms of buildings materials, socio-economic and culture specificities of local societies and sensitivity of physical environment. Imagination and creativity in the information age will inevitably not stop or be hindered by the consideration of local conditions. Providing a continuum of choices on realism to CAAD users is a desirable goal in the teaching of architecture.

4. The PPRW Design Approach

The hypothesis of this study is to show that a hybrid approach of CAAD and GIS would change the present trend in the automated architectural education towards a contextual architecture and a place-making process (Paar 2006). The introduction of GIS in architectural design as a support tool in design studios will have a long-lasting impact on the raising of the students sensitivity towards the surrounding environment.

GIS software in architecture is still at its early stage and does not contribute sufficiently in the design process. It is to now used at large scale of urban planning, urban design, documentation and location of historical buildings for preservation policies (Tolba 2007), location of unused building for revitalization purposes Loemker 2007), and environmental impact assessment of industrial and sizeable buildings (Loh, Dawood and Dean 2007, Speed 2007, p. 300).

The proposed approach is not limited to the output of the design but embraces the successive stages of design that are examined below.

4.1. THE PRE-DESIGN STAGE

It consists of introducing the project since the early sessions as a place-making process in a given but unique location on earth. The design should aim at achieving solutions that best fits that unique place. Only the most
integrated built form in the given context is thus regarded as successful. The inverse testing of this criterion would be the extend to which the developed form has a meaning outside this context. In a relative level of integration, the more the project is inserted in its given context, the more is successful. One of the means of recognizing the special character of the site during this stage is through its geographic coordinates on the globe. Opposite to the cyberspace that is often presented on the computer screen, students should learn to geo-reference their working space and grasp its uniqueness on Earth. This uniqueness is expressed physically through the X, Y and Z values of the boundary points of the site (Figure 1).

Figure 1 a and b. A non-coordinated geo-space and a geo-coordinated space. A site in Old Manama, Bahrain.

Geo-coordinating a space is one of the compulsory steps in GIS. ArcGIS provides for instance the GLOBE as a means to recognize the unique position on earth of any location through the quick surfing from the macro to micro-level (Figure 2). By browsing the globe, the information tagged on the virtual globe is tracing back to its origin where no boundaries existed and make the marking of preferred places possible and easy (Zeile, Farnoudi and Strich 2007, p. 143).
Surfing through GLOBE from the global scale to the selected location, through a GOD-Perspective (Zeile, Farnoudi and Strich 2007, p. 144), and navigating over the architectural site will take the student mind in a virtual journey that shows gradual changes of land cover (water, greenery, sand, urban) and geographic features (mountains, rivers, oceans, deserts) in which the selected location is positioned. It is evident that such a step although futile in the process of design it may seems, will attach the student both metaphorically and physically to the context as his project will be regarded as a place-making action on Earth surface. Google-Earth provides similar effects and a free and very useful support in this sense (Zeile, Farnoudi and Strich 2007).

Site analysis is one of the major steps in the pre-design stage of architectural design that GIS may also heavily contribute. An architectural site in GIS could be presented in different graphical ways and multi-media, such as maps, aerial views, attached picture through hyperlinks and video. Its analysis embraces most affecting factors that will later-on conditions the new project. Spatial Analysis provides a spectrum of analysis tools in this sense. Road networks, surrounding morphology, dominant typology could be efficiently presented through this tool. Distribution of services such as educational, health and religious buildings with their catchment’s areas and buffering could also help deciding upon the location of new buildings.
In the presence of such real factors, “imaginary architecture” mostly driven by creativity and “strangeness”, will thus shrink and leave place to a realistic place-making approach

4.2. THE ON-DESIGN STAGE

One of the major deficiencies of the present studio design approach is that during the design stage, students often leave the site specificities behind due to their concentration on the functional requirements and the creativity black-box creative process. Despite the long site analyses made individually or collectively during the pre-design stage, direct contact with the surrounding during the design stage is often lost.

The support of GIS during the on-design stage consists of insuring the Permanent Presence of the Real World. The continuous and quick switch between CAAD and GIS allows the reviewing of the on-development envelope with regards its context. A feedback could be easily assessed in the presence of the larger context as shown in GIS. Linkage with the existing roads, relationships with the surrounding building heights, types and forms will provide a continuous auto-correction to students with regards the insertion of their proposals in its context.

Below are the vital considerations for the place-making approach of architectural projects in their context that GIS could provide efficiently.

1. The road pattern and circulation network define different types of accessibility, services, pedestrians, public transport, etc to the selected site. Security from accidents is sometimes major determinant of the site selection such as for housing, schools and parks in the vicinity of major roads (Figure 3).

2. Activities and land-uses surrounding the new projects are also presented in GIS, through different thematic layers and maps. It is evident that the design of a mosque, a school, a house or a hospital will greatly depend on the existing infrastructure of activities either as a potential or as a constraint (Figure 4).
Figure 3 Road network Old Manama, Bahrain (Using ARC-MAP 9.2).

Figure 4 Land-Use and Community Services. (A hypothetic map based on a portion of a map from Old Manama, Bahrain) (Using ARC-MAP 9.2).
3. Architecture of the surrounding context could generally be displayed under the large themes of typology, morphology, urban fabric and historic eras. Their presence as part of the context is made possible through the continuous IT and multimedia developments. The context could be continuously displayed through Animation, VRML, Hyperlinks to the image library and thematic layers of GIS. Despite its coarse form, 3D representation through Arc-Scene in ARC-GIS can be of interest to students during the on-design stage (Figure 5).

![Figure 5 Mass-Void, Typology and Morphology in an existing urban fabric. Old Manama, Bahrain (Using ARC-MAP 9.2).](image)

Satellite images and aerial views displayed through GIS also show a high degree of realism and thus could serve students to keep in touch with the context of their projects. Surface coverage such as sand, water, vegetation, forest will be of sensitive value in the architectural proposal in terms of preliminary site works as well as environmental sustainability etc.

3D tools are often used by students for the jury sessions and to show their projects as an end product (Orland, 1992, p. 244). That is similar to the conduct of professional architects that use visualization for market purposes. Lange (2001, p. 381) suggests that visualization should rather form an integral part of the planning and design process.

Hybrid approach CAAD/GIS may, however, face problems. GIS is not only a representation tools but also a powerful tool of spatial analysis. It links different forms of geo-data with graphics. Teaching GIS to architecture
students should thus be related to many other allied fields, such as such as geography, urban planning, statistics, mathematics and urban design. Only a background in these fields permits a full understanding and use of GIS techniques.

Despite the continuous efforts of the vendors of GIS software in adding capabilities to their systems, existing GIS has not yet gained wide acceptance in the allied fields to geography such as landscape, urban planning let alone architecture. CAAD and GIS programs, are not fully compatible with each other (Langendorf 2001, p. 314). Interoperability is thus one of the major challenges that faces the hybrid approach (Barton et al. 2005, p. 641). Technical support is provided to view, display and query CAAD files in GIS software. However, conversion, change of properties and editing of the imported files is still at its early stage.

4.3. THE POST-DESIGN STAGE

Hard models have always been nightmare of students once the project is finished. It is materially costly and time consuming. In CAAD and GIS The use of 3D visualization of project on the earth surface would be an efficient way for displaying the end-product and assessing the impact of proposals on the given context (Figure 6).

Figure 6 A 3D model of an area as a context for an architectural project (Height of buildings are hypothetical). (Old Manama, Bahrain, Using ARC-MAP 9.2).
Presenting the final project in its wider context using 3D model and virtual reality with the surrounding will show to what extent the projects fits in its context. A feedback could be easily set and a reviewing of the results could be made if a negative impact is felt.

Opposite to the powerful tools of CAAD in 3D presentations, GIS shows a certain weakness due to its reliance on simple extrusion of height. However, the shift towards 3D and environmental visualization of cities is becoming more and more refined due to the increasing availability of data on environment and the progress pace of IT.

Presenting the project in its geographic and environmental context makes assessment of integration very easy and reliable as the surrounding will be fully present. Animation and dynamic 3Ds could bypass the selective traditional perspectives that architects display from preferred vision angle to persuade viewers. It should therefore be used as a means of assessment for the degree of responsiveness to the context and the success in conducting the project as a place-making target.

4. Conclusion

Architecture is increasingly relying on the design in a cyberspace due to the continuous progress in IT. This reliance, if not corrected, seems to be leading to a domination of virtual reality over real space.

The PPRW is presented in this paper as a method that bridges the gap between virtual reality and the real context. Architectural design could be saved from the pro-modern, “de-contextual-ised” architecture through a hybrid approach that interactively joins CAAD and GIS.

The role of GIS is a support domain that insures permanent presence of the real world. Geo-coordinating the selected site, displaying the context through GIS, satellite imagery and 3D presentation of the project’s context during the 3 stages of design would significantly contribute in turning the CAAD into a process of place-making and thus reduces the effect of flying projects.

References


http://www.nomaps.com