DESIGN BY GRADING?

ELECTRONIC BUILDABILITY DESIGN APPRAISAL SCORE (eBDAS) AS A MAJOR DESIGN CONSIDERATION IN ARCHITECTURAL DESIGN IN SINGAPORE

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Abstract: Singapore is possibly the first country in Asia to implement a nation-wide electronic system for the evaluation and approval of building plans called ELECTRONIC BUILDABILITY DESIGN APPRAISAL SCORE (eBDAS). The system is a systematic and comprehensive method of computing a building design’s buildability efficiency through a scoring methodology. Using this methodology, the building authorities make the decision as to whether a building is approved for construction. Poh and Chen (1996) have found that a design with a higher buildable score results in more efficient labour usage in construction and therefore higher site labour productivity. However, the relationship between construction costs and buildable score was found less distinct. This paper discusses the existing implications of eBDAS on the architectural profession and potential implications on educational institutes.

Keywords. Buildability; Standardization; Design Assessment; Design Education.

Introduction

Singapore is possibly the first country in Asia to implement a nation-wide electronic system for the evaluation and approval of building plans, as part of the Government’s nation-wide plan to make the country into an intelligent island in the 21st century through the intensive use of Information Technology. The government-led initiative called CORENET (Construction and Real Estate Network) aims to leverage on the use of advanced CAD and Information Technology (IT) Tools. A major component within the CORENET initiative is the Electronic Buildability Design Appraisal Score (eBDAS). This software tool is the electronic version of the present BDAS, which was first published in 1993 by the then Singapore Construction Industry Development Board, CIDB (now part of the Building and Construction Authority). It further enhances the current systematic and comprehensive method of computing a building design’s buildability efficiency through a scoring methodology by reading CAD data submitted by architects and engineers. Using this methodology, the building authorities make the decision as to whether a building is approved for construction.
The current eBDAS

It comprises of pre-processing which demarks the input into the system, the processing which computes the input using a specific algorithm and the post-processing returning the results.

Pre-Processing Phase

Presently, eBDAS resides locally on a stand-alone workstation as a standalone software module. It takes data input from 2D CAD floor plans, i.e. AutoCAD (dwg) or MicroStation (dgn) or their derivative formats. They are to be drawn in compliance to the Singapore Code of Practice 83 (CP83), which is the Statutory Standards for CAD-layering and CAD Symbols in Singapore. This has been mandated by the building authorities for about 3 years already because of the introduction of electronic plan submissions, and all building plans submitted within this period would have complied with this standard. All floor plans need to be labeled according naming convention. Further general project information i.e. building type and gross floor area is required.

Processing Phase

The eBDAS process the building in batch mode and deciphers the number of stories, and their corresponding storey based on the file names. It then reads information based on attributes attached to the vector data and derives the specifications therein by isolating the building elements by layer and processing them according to the scoring methodology. The minimum buildability score requirement is derived as a function of the building type and its respective gross floor area. The formula used depends on which section is being evaluated and can be rather complex. It ranges from 52 for small residential houses to 70 for Industrial buildings. Briefly, the scoring methodology looks at three major areas of the building assembly, namely the:

- Structural System (maximum 50 points). Points are awarded for various types of structural systems used. Upon closer examination, one will observe that widespread use of off-site fabricated components, and extensive use of metal roofs score considerably better at 0.85 labour-saving index and above, trickling down to a mere 0.6 for in-situ concrete and other structural elements.
- Wall System (maximum 30 points). Points are awarded for various types of wall systems used. Again, one will observe that factory-built pre-cast wall systems and dry wall panels score far better than masonry or traditional wet-work trades.
- Other Buildable Design Features (maximum 20 points). Points are awarded for extensive use (from 85%) of the three key units of measures, namely Standardization, Grids and Pre-fabrication. The scores double once the building employs 80% or greater in the use of these features.

Post-Processing Phase

The sum total of the three indices will form the final buildability score. The system then looks up the table of minimum scores to establish if the building design meets the minimum BDAS.

Architects will then have to make the submission to the Building Authorities. The scores are then attached with the building plans and submitted as a package, via the electronic plan submission system, for development approvals. Eventually when the building is completed, the architect must then submit another set of BDAS calculations, based on the as-constructed set of plans, to satisfy the Building Authorities that the as-constructed design did not deviate too much.

Table 1. Example of an actual score in comparison to the quantum
from the approved set, otherwise, costly rectifications and possible legal action may be enforced to regularize the deviations.

**Future developments**

While the present system is in a 2D realm, it is envisaged that with the eventual deployment of IFC-enabled CAD tools, the eBDAS would eventually take on a 3D paradigm, and process the BDAS using 3D CAD files. IFC brings with it the promise of a totally seamless CAD communication layer, which is acceptable by the major vendors today. The seduction of IFC-2x, however is in its 3D capabilities; it makes the case for building plans of the future to be designed, and evaluated in its 3D form—almost a virtual model of its real-world counterpart. The time to market realities and the commercial pressures of having to deliver a building by having its virtual replica graded even before the first stone is further discussed below.

Currently, only buildings greater than 5,000m² in gross floor area are required to submit the BDAS, but legislation is being passed to lower this area threshold to encompass more buildings into the scheme.

**Consequence for the Professional Architect**

The architect has to comply with eBDAS in order to get his buildings built. Effort and time is necessary to get adapted to meet the requirements. In order for the generic eBDAS system to understand the building components to be used in the design, a common data type must exist, be learnt, and used extensively at all levels of design conceptualization and management. This makes for more work being shifted upfront for architects, since traditionally, the architect does not annotate specifications on the drawings, but rather it is recorded in detail in the tender documentation in a textural format. The statutory responsibilities and commercial realities associated with this manner of design process makes it more difficult for the architect to fulfill his professional obligations.

Because the results arising from the eBDAS score determines if the Building Plan Approval is granted, it becomes almost mandatory that the system becomes the yardstick to determine which designs become reality, no matter how the conceptual design form may take, at least from the construction buildability point of view. However, since the scoring system weighs heavily on features which promote economies of scale in the use of building elements, the counter-balance to this would be cost—buildings can still be fabricated off-site, even if each component is different, but this would drive up the building cost because the repetition is insufficient to derive economies of scale in its production method. This will not auger well with the developers, as the cost will have to be borne by them, with little or no recourse for alternative means for appeal. Although waivers have been known to be granted for certain cases, this is not envisaged to be the path taken by architects who believe that spatially and visually-exciting but poor BDAS-scoring schemes should be exempt from the requirement.

**Consequence for Education**

When viewed from a romantic perspective, the non-tangible aspects of design: proportion, scale, craft and such tectonic concerns seems to become lost in world of actual and exactness. Proportions become millimeters and square meters, while extrusions and other features so lovingly crafted in cornices and friezes, become inefficient and costly items in a world where factories become the principal craftsmen and guilds. Where would the celebration be if the great Gothic
cathedrals in Europe, or the enigmatic works of Antonio Gaudi, be if they were all subject to the eBDAS scoring methodology? Yet, it is timely to be reminded that the birth of any building structure stems from a repetitive unit, be it a brick, a timber post, or a steel element. Bauhaus architecture and the early modernism style would have easily passed eBDAS. It is heartening to see that with the lead of Singapore’s leading design offices, lessons learnt from the past suggest that standardization does not necessarily mean identical, but rather when used creatively, repetitive and micro-design of building elements could yield promising and aesthetically-pleasing solutions. Examples can be seen from the new Espalanda-Singapore's newest performing arts centre, as well as the numerous award winning secondary schools—all passing the BDAS with flying colours.

Regardless the discussion whether a school of architecture has to train students to become architects or has to generate new architecture, students should be given the opportunity to become familiar with eBDAS. They may employ the system to simulate a series of “what-if” design scenarios, juggle with the building elements used in the design to balance aesthetics with cost, and other factors which may influence the BDAS. How did Darwin put it: not the strongest species will survive, but the one most adaptable to change. Students should learn the tool not just to comply but to be able to reflect and conceptually contribute to its development. Looking at the potentially increasing importance of 3D CAD based on IFC, it seems worthwhile investing effort in developing curricula where design teaching meets these requirements. Architects seem to have lost too many ground and say to IT specialists, by harnessing the recent tools they should be able to regain ground.

But becoming familiar with IT tools is secondary compared to the raising notion that construction becomes a bigger part of the Architects practice. Hence students should deal with construction upfront. It always seems to be very challenging and not welcome to overcome the invisible border between architectural design and construction but from the past we have learnt that this marriage generated a rich vocabulary of architectural styles and famous buildings.

**Conclusion**

Singapore has always been known for its efficiency and quick implementation of public policies, and eBDAS has the benefit of this fast-track implementation. While eBDAS can be counted on to further the country's goal of lowering its dependency on unskilled foreign labour, and making every brick count economically, the resultant could potentially limit the present state of design alternatives in the light of the overwhelming variety of contemporary architectural solutions. Critics to the system have highlighted the overemphasis on building element quantities within the scoring methodology, which do not have direct impact on design decisions, should be re-evaluated, since the fundamental intention of the system is to measure the quality, while quantity should be the secondary concern. Nonetheless, for a resource-scarce country such as Singapore, eBDAS is important for the quality control of building construction as an entire industry, and from an architectural design perspective, also shows a high prospective paradigm for the future analysis of architectural building designs.
References


