Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 83 (2015) 434 – 443

Energy Procedia

International Conference on Sustainability in Energy and Buildings 2015, SEB-2015

Sustainable Design and Building Information Modelling: Case Study of Energy Plus House, Hieron's Wood, Derbyshire UK

Dr. Boris Ceranic[a*], Derek Latham[b], Angela Dean[c]

[a, c] *University of Derby, Markeaton Street, Derby DE22 3AW, UK*
[b] *Hieron's Wood, Vicarage Lane, Little Eaton, Derby DE21 5EA, UK*

Abstract

In this paper the method for sustainable design analysis (SDA) integration with building information modelling (BIM) is explored, through the prism of a complex case study based research. BIM model federation and integration challenges are reported, including issues with combining geometry and managing attribute data. The research defines SDA as rapid and quantifiable analysis of multitude of sustainable alternatives and 'what if' questions posed by a design team during the early stages of the project, when the benefits of correct decisions can significantly exceed the actual investment required. The SDA concept and BIM integration findings are explained from conceptualisation to calculation stage, emphasising the importance of an iterative over a linear approach.
The research approach adopted has led to more informed sustainable solutions at earlier stages of project development, with a generally lower level of development (LOD) and computational/modelling effort required.

© 2015 Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Peer-review under responsibility of KES International

Keywords: Sustainable Design Analysis, BIM, Case Study

Nomenclature

BIM	Building Information Modelling
SDA	Sustainable Design Analysis
SBE	Smart Built Environment

* Corresponding author. Tel.: +44-1332-593-136
E-mail address: b.ceranic@derby.ac.uk

1876-6102 © 2015 Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Peer-review under responsibility of KES International
doi:10.1016/j.egypro.2015.12.163

1. Introduction

This case study based research presents the method and technology for integration of sustainable design analysis (SDA) with building information modelling (BIM). The uptake of building information modelling (BIM) has been rapid in recent years, and the research published into its interoperability and project collaboration aspects since its inception is considerable [1]. However, whilst a significant amount of work has been undertaken on the technical interoperability aspects of BIM and sustainable design analysis (SDA) [2], the practice is still fairly new and general practitioners are perplexed by both the amount and complexity of software solutions on the market. Therefore, given that the BIM interoperability is technically possible, what benefits can it bring, how well can it be adopted and in time can it prove itself over the conventional stand-alone approach?

2. SDA and BIM Integration

As defined in [3], "sustainable design analysis could be referred to as rapid and quantifiable feedback on diverse sustainable alternatives and 'what if' questions posed by a design team and client during the early stages of the project". Its main purpose is to maximise environmental versus cost benefits of the project through informed choices based on timely feedback, such as building materials and construction specifications, energy consumption and generation, CO_2 emissions, water use and harvesting, waste and pollution management. Indeed, there are other aspects which are inherently linked and therefore considered, such as: functional (constructional, operational), human (safety and security, comfort health and wellbeing), socio-cultural (context, sense of place, aesthetics) and economical (profits, environmental impact versus cost analysis, life cycle costing etc.) [3].
Krygeil and Nies [5] propose a holistic approach, a form of sustainable design chronology that considers the following facets:

- Understanding climate, culture and place
- Understanding the building typology
- Reducing the resource consumption need
- Using free local resources and natural systems
- Using efficient man made systems
- Applying renewable energy generation systems
- Offsetting negative impacts

Sustainable design analysis broadly follows two stages; conceptualisation and calculation [3]. Each necessitate different design methods and serve different purpose for a distinct outcome. Conceptualisation is about challenging, interrogating and problem solving, understanding broader creative and rational constructs, the macro scale and the directional decisions. The calculation stage is less directional and more analytical in its nature, aiming to quantify qualitative directional decisions and compare different design alternatives
The site and building(s) are assessed considering microclimate, wind parameters, surrounding surfaces, landscape and topology, massing and orientation, the form and nature of the building envelope, location and percentage of fenestration, zoning, day-lighting, heating and cooling loads, air change rate, occupant behavior, services and the range of acceptable indoor climate variation [4]. This indeed is not an extensive list, nor should it be considered isolated from the design process itself. Each and every design must be a unique and contextually sensitive place making response to the site location and client brief, one that fully takes into the account environmental, social and economic aspects, including whole life cycle costing analysis [6].
There is a growing number of environmental performance building analysis programmes on the market, such as Integrated Environmental Solutions © IES <VE>, Autodesk © Revit, Ecotect, Vasari and Green Building Studio, Graphisoft © EcoDesigner STAR, EDSL © TAS Building Designer, EDR California © eQuest, U.S. Department of Energy © Energy Plus etc. Without favouring one over another, they do vary in terms of their results accuracy and data representation, the knowledge required to operate and the way in which they interpret the results, visual display and input/output type, building regulations compliance etc. Programmes range from simple, user friendly and often free tools to extensive, sophisticated software that require expert knowledge use by specialist

دریافت فوری ← متن کامل مقاله

ISIArticles
مرجع مقالات تخصصی ایران

✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
✓ امکان دانلود نسخه ترجمه شده مقالات
✓ پذیرش سفارش ترجمه تخصصی
✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
✓ دانلود فوری مقاله پس از پرداخت آنلاین
✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات