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Stephen Edwards

FRUSTRATIONS OF AN ASPIRING ECO WARRIOR

John Payne

Architect, Lecturer in Architecture, Edinburgh School of Architecture and Landscape Architecture.

Abstract

The author recently designed and subsequently built a low cost 150 sq m building in the west highlands of Scotland. The site is relatively isolated with mains electricity but no mains drainage or water supply. From the earliest stages, he wished to make the end result as environmentally sound as possible by making the building energy efficient, heated by a wood burning stove, fuelled by sustainable sources of timber from the site and employing locally sourced materials wherever possible. The end result was partly successful and the paper consists of a case study, outlining the decision making and physical processes involved in design and construction as well as an evaluation of the end result in terms of economy, energy consumption and minimised carbon footprint.

Keywords: Architecture, Sustainability, Detail Design, Carbon Footprint, Local Materials.

MINIMUM IMPACT HOUSE: Prototype for Sustainable Building in the City Centre

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TU Delft Chair for Landscape Architecture*

Abstract

The Minimum Impact House in Frankfurt am Main is a sustainable solution for low cost living in city centers - a prototype typology with a minimal footprint on a left-over urban space. The planning process itself became part of a scientific study. The ecological advantages of building in the city were integrated into a real building project with a new typology, ecological construction and materialization. The goal was to minimize environmental impact through construction and operation of the building. In a comparative study, we analyzed advantages and disadvantages of a single-family house in the city center versus new building zones. This included qualitative and quantitative comparisons over a life cycle of 50 years, and included such factors as construction, operation and maintenance, disassembly and location related mobility. DGJ found that in conventional construction, operation of the house uses roughly 50% of the primary energy; the rest is divided into the module fabrication and mobility. The total energy use of the prototype is 63% lower than compared to conventional new construction under existing rules and regulations. The climate-change effect could be reduced by 68% per housing unit. The façade pattern is the shadow of a birch tree that was standing next to the house. It was removed because of illness without our influence.

CARDIFF CENTRAL LIBRARY: DELIVERING A MORE SUSTAINABLE PUBLIC BUILDING

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Abstract

This paper discusses the challenging process and successful design management of achieving a BREEAM 'Excellent' rated public building. As part of the St David's development in Cardiff City Centre BDP Architects, Interior Design and Sustainability Consultants have designed a BREEAM 'Excellent' rated building to house the new 55,000 ft² Central Library. The team's design responded to a strong environmental brief from the client: St David's Partnership (Land Securities / Capital Shopping Centres). A major driver was the Bespoke BREEAM Assessment. Planning conditions required a 'Very Good' rating, however the team were keen to achieve an 'Excellent' rating within budget. By implementing the principles of sustainable design from the early stages – inherently sustainable design rather than 'bolt-on' – the team were able to deliver an 'Excellent' building for minimal additional cost. Throughout construction, BDP Sustainability worked closely with the contractors, to help maintain the BREEAM 'Excellent' rating in a BREEAM Post Construction Review. Regular sustainability reviews with the contractor and advice on alternative design solutions increased the BREEAM score from 72% at the design stage to 80% in the BREEAM post construction review, which is the highest score ever achieved in a BREEAM Post Construction Review to date. The processes used to design and construct the library were a slight departure from typical methods; however they were readily adopted by the project team and have the potential to be applied to other projects to help deliver more sustainable buildings and drive continuous improvement.

Keywords: Sustainable buildings, Library, BREEAM excellent, Cardiff

LIVING SUSTAINABLE DESIGN –Lessons Learned

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Hill Holt Wood

Abstract

This paper describes the experience of a family designing and building an off-grid home located in an ancient woodland. The objective was to achieve a low impact affordable and simple to construct house. This paper explores the problems and barriers faced up to and including the experience of living in the house and proposes changes that could be made to encourage significant progress in low-energy house development. The author challenges accepted views and solutions and proposes that radical changes are required to significantly address climate change.

Keywords: **Planning, off-grid, community, social enterprise, straw, log.**

SUSTAINABILITY AND HEALTH - PAST, PRESENT AND FUTURE

R.A. Hobday

Abstract

Buildings are changing to meet the demands of sustainability. Natural lighting and ventilation, water consumption, adaptability, health and productivity are nearer the top of the designer's agenda than they were only a few years ago. Yet many of the recommendations now being made to promote sustainable development are not new. They were considered good practice by leading exponents in the 1930s and 40s. Then, as now, designers were encouraged to arrange buildings in ways that were sympathetic to the environment. But the health of occupants was of greater concern; particularly in office buildings. The admission of natural light and fresh air was a priority. This paper explains how these elements fell from favour in the years following the Second World War. In particular, it examines how the practice of office development failed to meet the standards set out by the Royal Institution of British Architects in the 1940s. Had measures proposed then been more widely adopted in the years that followed, it could be argued that much of Britain's commercial building stock would be more sustainable, and profitable, than it now is. Town planning might also have taken a different course.

Keywords: design, health, productivity, sustainability, office history.

VERNACULAR ARCHITECTURE AND CONTEMPORARY DESIGN IN OMAN: CHALLENGES IN A CHANGING CLIMATE

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Abstract

The buildings sector accounts for a considerable proportion of global energy and resource use and anthropogenic CO₂ emissions. In Oman, the widespread introduction of mechanically air-conditioned and energy-inefficient buildings accompanied rapid economic growth and modernisation during the 1970s. Primary energy use continues to escalate and the supply of electrical power to residential buildings is the principal end-use sector. The vernacular architecture of the region illustrates economic means for creating comfortable environments utilising only natural, renewable forms of energy. However, the feasibility of incorporating traditional cooling techniques in contemporary buildings will depend upon the acceptance of cycles and variations in indoor climates and crucially on what is considered the upper limits of comfortable thermal conditions by occupants. The lack of energy performance targets is a barrier to improving the energy performance of the future housing stock in Oman. Buildings need to be assessed according to the added demands they place on local and global ecosystem services with reference to acceptable environmental limits of performance.

Keywords: Vernacular architecture, passive cooling, Oman climate, environmental limits, sustainable development.

EFFECT OF ARCHITECTURAL DETAILING OF THE EXTERIOR WALL – R.C. FLOOR SLAB INTERSECTION ON THE HYGROTHERMAL PERFORMANCE

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Abstract

In buildings with a reinforced concrete (r.c.) skeleton structural system, components of the structural system like, beams, columns or cantilevered slabs in the external envelope mostly break the continuity of the thermal insulation layer or the self-insulated wall, causing “thermal bridges”. In addition junctions between the exterior wall and other building elements like other walls, roofs, slabs, windows or doors are creating areas where the heat transfer is higher than a part of a wall free from thermal anomalies. Such “thermal bridges” not only increase heat transfer but also are potential cold surfaces for moisture accumulation. Different architectural details for the intersection of building elements and the structural system are resulting in different hygrothermal performance. In this context, the intersection of the “exterior wall-floor slab” area is studied, considering the heat flow through the combined construction. Various architectural details in different constructions are analysed and evaluated. In the analysis, the selected materials for construction of walls and floor slabs, placement of the thermal insulation are utilised as variables. The thermal performance is determined with the PC-program “HEAT 3”. The program works with a transient or steady-state, three dimensional, finite difference model for the heat transfer. The hygrothermal performance of different “exterior wall-floor slab” details are evaluated. A detail is redesigned in order to upgrade the hygrothermal performance.

Keywords: Architectural detailing, hygrothermal performance, thermal bridges, exterior wall, r.c. slab.

DETAILING THE EFFECTIVE USE OF RAINSCREEN CLADDING TO PROTECT STRAW BALE WALLS IN COMBINATION WITH HYGROSCOPIC, BREATHABLE FINISHES

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Abstract

Straw bale buildings are still a relatively unfamiliar sight within the UK's building stock. However, the drivers of sustainable construction combined with a rising profile as a construction technique have increased the general awareness of this form of construction in the UK. This has led to an increasing number of buildings of this type being planned and constructed in the UK. However, the effects of moisture on these materials, particularly in a temperate maritime climate, are of some concern. Research being undertaken at the universities of Plymouth and Bath has produced interesting evidence of the efficacy of simple timber rain-screens as additional protection to these potentially vulnerable materials, particularly when compared to the traditional lime based finishes currently advocated for this type of construction. The use of a permeable, hygroscopic finishes such as lime renders are considered essential as this allows vapour dispersal from the wall. However, the traditional render only system can allow ingress of moisture to the interior of the wall if subjected to adverse weather conditions, such as driving rain. This paper discusses the detailing of exterior wall constructions that combine the use of rain-screens with a vapour permeable finish to form an outer layer that can resist the weather while still allowing for the dispersal of any moisture. It also summarises findings of a PhD research project at the University of Plymouth, which is investigating the moisture performance of straw bale construction in a temperate maritime climate. This paper will be useful to Architects, Designers and Contractors involved in the design and construction of straw-bale buildings in temperate climates.

Keywords: Moisture, Monitoring, Rainscreen, Straw-bale, Construction.

DESIGN AND ITS SUB PROCESS: DETAILED DESIGN - APPROACHES IN TURKEY

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Abstract

An important part of the design process goes on in the designers head, also known as the black box. Detailed design is one of the sub processes of design and it also includes some phases which cannot be examined easily as it also happens in the black box. A verbal or written expression by the designer him/herself is one of the most efficient ways of understanding the process. Twenty architects in Istanbul, Turkey, were interviewed to gain information on their individual design processes. In the interviews the architects were mainly asked to explain their design processes as a whole and the detailed design sub process. Three different approaches to design and detailed design will be presented as a result.

Keywords: Actors in architectural design, architectural design processes, detailed design, Turkish architects, architectural offices.

A SUSTAINABLE WINDOW - DESIGN, PROTOTYPING AND TESTING

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Abstract

The essence of building comes down to the joints, the details. The most wonderful example to illustrate this would be the “hole in the wall”, the window in which we can analyse and synthesize a building and its components according to three aspects we can distinguish:

(1) The building as a Mediator (pragmatic) controlling the passage of Light, Air, Warmth, Moisture, Sound, Field, View, Minerals, Plants, Animals and People.

(2) The building as a Creator (syntactic), the Execution, Durability and Maintenance.

(3) The building as an Informator (semantic) by the factors Material, Image and Control.

Joint Origin has designed and developed a sustainable window and has previously presented this in various papers. The focus of this paper is the further development of the window design. This includes the further development of scale models (1:10) and prototypes (1:1) and testing / monitoring performance in co-operation with a builder and a manufacturer. In consideration of the theme of this conference the focus will be on the Creator aspect, but the aspects of Mediator and Informator will also be dealt with in the light of an integral sustainable development in building / architecture.

Keywords: **Detailing, sustainability, prototyping, testing**

PRACTICAL IMPLEMENTATION OF RENEWABLE HYDROGEN & FUEL CELL INSTALLATIONS IN THE BUILT ENVIRONMENT

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Abstract

There is significant interest in fuel cells for use in the built environment, as a technology that has the potential to produce localised heat and power, with increased efficiency and reduced carbon emissions which give it an advantage over alternative technologies. Whilst fuel cell technology is easy to understand on paper, there is a paucity of information on practical implementation of fuel cell technology in the built environment for architects. This paper discusses some of the practical aspects of implementing *renewable hydrogen* installations in the United Kingdom, that is to say installations that produce their own hydrogen on-site from renewable energy sources.

Keywords: built environment, Fuel cells, Hydrogen.

THE PROSPECTS OF ADOPTING GREEN SPECIFICATIONS FOR PUBLIC SECTOR CONSTRUCTION WORKS - THE CASE OF HONG KONG

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Abstract

Public sector used to be the largest employer in the construction industry. In order to promote sustainable development and set a good example for the industry at large, the public sector has been adopting green measures in procuring building and infrastructure works. At the contract level, the specifications are considered as useful tools for making things happen. As part of a university-funded research on a suitable green specification framework for use in Hong Kong, a series of semi-structured interviews has been carried out with 3 major work commissioning entities, being responsible for government buildings, public housing and infrastructure. Issues which have been expounded include:- the expected roles of green specifications in construction; examples of existing use of green specifications in the construction industry; expectation on how green specifications should be like and what they should achieve; time cost and quality concerns, etc. Information on the status quo and projections ahead can serve as good indicators on the future roadmap for wider adoption of green specifications in the construction industry.

Keywords: Green Specifications, Public Sector construction, Hong Kong

BIOMASS BUILDING STRUCTURE (BMBS): RESEARCH & DEVELOPMENT OF A LOAD-BEARING BUILDING STRUCTURE

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(2) RED Research Education Design, The Netherlands and Hungary

Abstract

This paper contribution is a report on current research & development on, plus design for load-bearing structures and constructions, made of biomass material. Therefore, a number of related concepts can be grouped under the cupola term **BioMass Building Structure (BMBS)**. Concept and detailing, both are based on an approach towards sustainability, and hand in hand with this background, on use of natural, this means rather untreated materials for the building structure as well as for some of the building components. Reed, papyrus, topinambour (*Helianthus tuberosus*), sunflower (*Helianthus annuus*), elephant grass (*Erianthuselephantinus*), Jerusalem artichoke, bamboo, etc. belong to the preferable building materials, because they all are annually re-growing, thus – renewable and sustainable. From history we know already about the art to build with soft plant material, like for example in cases of the firstly papyrus-based boats, and load-bearing columns in ancient Egypt, or reed roofing, and many building methods making use of straws or branches from different plants, also elsewhere. Floors, walls, columns, roofs, and other building parts can be made of more or less pressed plant material implants or slices, sandwich panels, bundled straws, woven or knitted fibrous material, etc. – where needed – complying with high form efficiency also for load-bearing functions. BMBS will be applicable for various functions, as for dwellings, public buildings, and many other types of buildings, up to an urban scale. BMBS, due to the used, locally available resources, can be produced either by hand – important in less industrialized countries – or mechanically, even by computer-aided design and manufacturing. Therefore, the related building components and the connectivity of joints can get their own identity. We expect an extremely low environmental impact and a positive contribution to health and wellbeing of the producers and users of the BMBS, because the structures and constructions are biodegradable and they don't contain toxics. BMBS gives a chance for a new architectural approach, language, and expression.

Key words: Architecture, Biomass, Concept, Construction, Detailing, Structure, Sustainability

EXPERIENCING THE CREATION OF ENVIRONMENTAL STRUCTURES

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Abstract

Sheffield Hallam University's Architecture and Environmental Design and Architectural Technology degree courses have for many years built the assessment of sustainable design into the curriculum. Environmental Technology (ET) is a distinct module in each year of the courses. The Design Studio module in each year is used to apply the scientific knowledge gained in the associated ET module, from design inception to completion, so that the design solution reached has sustainable design credentials. The challenge is to develop the students' thinking from good environmental design formal solutions to the consideration of design criteria from the perspective of sustainable construction technologies and building sequences. This takes the students into the realms of creative thinking related to constructional processes, modern methods of construction, material selection and transportation, and the labour intensity of the alternative construction technologies under consideration. Links between the design process and the construction process can be investigated in the academic setting. However, the premise of this paper is that there is no better setting in which to investigate this pragmatically than the building site. The case study illustrates the lessons learnt from the translation of design to construction of two types of structural systems. Issues of sustainability were reinforced by linking the activity to the guest lecture series: specifically to the work of an internationally renowned sustainable practice who were engaged in the design, construction and erection of one of the types of structural systems.

Keywords: Constructional learning activity, Structural Design.

CREATIVE ARCHITECTURAL DETAILING: LEARNING TO PUSH THE BOUNDARIES

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Abstract

Students typically learn to detail buildings by ‘borrowing’ details from publications (journals, construction technology books), from manufacturers’ details and more recently from surfing the internet. This approach to learning how to detail is common to architectural technology and architecture programmes, usually linked to architectural design projects. The difficulty with this approach is that students may fail to understand ‘why’ the detail is composed as it is and hence find it difficult to learn ‘how’ to detail buildings. This article describes an approach taken at Loughborough University to teach architectural detailing to students on an *Architectural Engineering and Design Management* undergraduate programme. The coursework is deliberately designed with demanding performance parameters, which makes it impossible to apply current details. Students are required to develop conceptual details from first, sustainable, principles using a simple decision support tool, and then develop these concepts into working drawings. Reflecting on the students’ work, student feedback from two cohorts, and reflection on the module by the author it appears that students appreciate the link between design and production – appreciating the ‘why’ and the ‘how’ - while also developing a better understanding of sustainable design.

Keywords: Architectural detailing, education, first principles, innovation, sustainability

ARCHITECTURAL DETAIL DESIGN METHODS – SIMPLIFIED AND ANALYSED

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Abstract

In the design process there are several approaches for developing details of an architectural product. Starting from “copying” or “adapting” typical details from manufacturers’ websites, catalogues or “best practice” handbooks to “designing” genuine details. Each approach has advantages or disadvantages in the context of different projects. In designing a “genuine” detail, designers have to cope with the complexity of a huge amount of criteria related to requirements, resources, constrains etc. As “intuitive” design approaches might be insufficient in overcoming those difficulties, using “detail design methods” is a rational way. Especially for design students and inexperienced designers “detail design methods” are an important aid in the design process. In the paper three “architectural detail design methods” from the literature, namely; *Principles of Element Design* by P. Rich, *Architectural Detailing; Function, Constructability, Aesthetics* by E. Allen and *Principles of Architectural Detailing* by Emmitt *et al*, are examined. Those methods are analysed and the stages of the proposed processes are defined. Finally each “detail design method” is simplified and transformed into a “step by step” process flow chart, easy to use for inexperienced designers. As a result those “step by step” procedures of the methods and their “easy to use” rating from the inexperienced designer’s point of view, are presented.

Keywords: Detail design, architecture, detail design method.

SUSTAINABILITY IN STRUCTURAL TIMBER (DETAILING)

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Abstract

Being a renewable material, (fast) growing natural materials like wood are in principle sustainable materials. Furthermore, these materials play a vital role in the green house gasses balance, expressed in the so-called CO₂ footprint, around the world. This paper deals with some basics of the CO₂ footprint (of wood). Beside other aspects described in the paper, this is one of the main input parameters for determining the “sustainability” for which two rating systems are mentioned in this paper.

Keywords: Sustainability, Wood, Timber, CO₂ footprint, NIBE, LEED

LEARNING FROM THE PAST: PERFORMANCE CHARACTERISTICS OF HERITAGE BUILDINGS

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(3) Cardiff School of Art and Design, University of Wales Institute Cardiff, Cardiff.

Abstract

This paper evaluates selected heritage properties; assessing their suitability for use as a vehicle, to test and inform the design and construction of sustainable new buildings – capable of addressing demands posed, by climate change. Design, joint inter-faces and the application of visual, condition survey methods are utilised, to establish the performance of building details and architectural features. From the evidence collected, recommendations are made to support future practice. Fieldwork research, recorded a number of heritage properties, and from this, a case-study sample, of 20 traditionally constructed buildings was selected for further evaluation. These properties were either: ‘Listed as of special architectural or historical significance’ and/or ‘Scheduled Ancient Monuments’. It is argued, they have been tested, by exposure to the rigors of time, weather, and widely changing use requirements and expectations - throughout their functional lives. Their resulting changes and developed characteristics, are evaluated, against current and proposed, regulatory standards and building practices, existing within the United Kingdom (U.K.). It is believed this methodology could be of assistance, when establishing details and methods suitable for incorporation into a ‘future’ built heritage. This paper will be of interest to Architects and Architectural Technologists, Surveyors, Contractors and Heritage Managers.

Key Words: Performance in use, Climate change, Sustainability, Heritage Buildings

MODELLING, SIMULATING AND MONITORING THE THERMAL PERFORMANCE AND CLIMATIC DATA FOR THE ATLANTIC COLLEGE STUDENT ACCOMMODATION

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Abstract

In early 2009 the refurbishment of the first of three student accommodation blocks at Atlantic College (AC), was completed. AC is An international sixth form college situated on the south Wales coast, UK, with its own micro climate. One of the key design and construction targets for the project was to minimise energy use for space and water heating and lighting, yet still retain comfort conditions for their occupants. This paper discusses how the tough design and construction targets were achieved by using a combination of building information modelling software throughout the design and construction process and building thermal performance simulation software through the design process. This paper also discusses how staff from UWIC's Ecological Built Environment Research and Enterprise (EBERE) group mapped out a strategy to monitor the thermal performance in comparison with the climatic conditions for the refurbished and one existing accommodation block.

The monitoring equipment will measure air temperature, relative humidity and the temperature of the heat emitted from the space heating systems in 28 rooms across the two blocks including two teacher's dwellings. In addition, a wireless weather station will record exterior air, solar radiation, relative humidity, wind speed and direction and rainfall. The monitoring study is expected to last for at least one year and the results will be used to compare with the predicted simulation results, in order to inform AC staff and design team for the next accommodation block to be refurbished. It is argued that there is a lack of useful seasonal case study data for practitioners to calibrate their building thermal performance simulations and for learning by students.

Keywords: existing student accommodation, sustainable design and construction, building information modelling, thermal performance, thermal monitoring.

SHIFTING THE PARADIGM FROM TECHNOLOGY-FOCUSSED SUSTAINABLE DESIGN TO LIFESTYLE-FOCUSSED SUSTAINABLE DESIGN FOR CONSTRUCTION

Stephen Edwards

Abstract

Are architects placing too much emphasis on techno centric approaches to sustainable construction? Can sustainable construction achieve greater success with a more effective design strategy that understands lifestyle impacts? In recent years, with increasing public concern about climate change, there has been a groundswell of interest in sustainable building methods and technologies. Despite this step change, UK energy consumption has been steadily increasing. A key contributing factor is lifestyle and behavioural patterns that undermine improvements in technology. Research suggests that lifestyle changes can affect carbon footprints as much as or even more than technological changes. This paper investigates the impact of lifestyle on ecological footprints and why architects are not placing more emphasis on designing buildings that inherently cultivate more sustainable lifestyles. Design has a key role to play in influencing behaviour and therefore sustainability and this will be explored through the perspective of some of the latest thinking in eco design strategies. It is proposed that, if sustainable design is going to achieve carbon emissions targets in the construction industry, a paradigm shift is required, away from a technologically focussed approach, and towards more innovative approaches that understands and integrates the impact of behaviour and lifestyle.

Keywords: People, Technology, Lifestyle factor, Creative visioning, User participation