



9th International Conference on Applied Energy, ICAE2017, 21-24 August 2017, Cardiff, UK

Biomimetic reinvention of the construction industry: energy management and sustainability

Olusegun Aanuoluwapo Oguntona^{a*}, Clinton Ohis Aigbavboa^b

^{a,b}*Sustainable Human Settlement and Construction Research Centre, Faculty of Engineering and the Built Environment, University of Johannesburg, Johannesburg, South Africa*

Abstract

High energy use, consumption and depletion of natural resources, and environmental degradation and pollution are few of the numerous impacts of the construction industry. These are traceable to the unsustainable construction practices employed by most of the construction industry globally. Hence, the need for effective energy management and sustainability. With biomimicry, the study and emulation of nature's entirety to offer sustainable solutions to human challenges, an era of novel and eco-friendly source of inspiration is heralded. This study sets out to examine the biomimetic energy management and sustainability for the reinvention of the construction industry. Literature review was conducted on nature-inspired ways and strategies of energy management and sustainability. Findings from the study revealed technology, policy, and education as major areas where biomimicry seeks to sustainably address energy challenges. The adoption and application of biomimetic strategies is important, as it offers much potential in energy management and sustainability.

© 2017 The Authors. Published by Elsevier Ltd.

Peer-review under responsibility of the scientific committee of the 9th International Conference on Applied Energy.

Keywords: Nature-inspired; biomimicry; energy; construction industry

1. Introduction

The construction industry plays a cogent part in improving the population's quality of life and in meeting the requirements and needs of the society in question [1]. The use of construction investments as a tool by the government to stabilize the economy also shows the industry's key position in the national development strategy of many countries [2]. As affirmed by Shi et al. [3], urbanization is closely linked to the construction industry owing to its associated

* Corresponding author. Tel.: +27-74-207-6075.

E-mail address: architectoguntona12@gmail.com.

developments through provision of infrastructures. These include the provision of critical infrastructure such as bridges, roads, rail, water and wastewater treatment plants, plants for the production and transmission of energy, and facility assets such as office and residential buildings [4]. These products of the construction industry – buildings and infrastructure – have a long-term negative impact on the environment and the inhabitants as they continuously emit large amounts of pollution [5]. Use of fossil fuel, generic resources and mineral consumption, waste production requiring land disposal, and pollution of the living environment are identified as forming part of the environmental impacts of construction [5,6]. The replacement of forests and vegetation by impervious concrete surfaces of roads and buildings [7] attests to the belief that the industry negatively impacts the environment. Table 1 summarizes the main environmental and social impacts of the construction industry according to the United Nations Environment Programme (UNEP).

Table 1. Environmental and social impacts of the construction industry [8].

Impacts	
1	Energy use and associated emissions of GHGs covered by the UNFCCC/Kyoto Protocol. These include carbon dioxide (CO ₂), methane (CH ₄), nitrous oxide (N ₂ O), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF ₆) and perfluorocarbons (PFCs).
2	Other indoor and outdoor emissions.
3	Noise pollution.
4	Land use change, including clearing of existing flora.
5	Raw material extraction and consumption; related resource depletion.
6	Aesthetic degradation.
7	Water use and waste water generation.
8	Increased transport needs (depending on citing).
9	Various effects of transport of building materials both locally and globally.
10	Waste generation.
11	Opportunities for corruption.
12	Disruption of communities, including through inappropriate design and materials.
13	Health risks on worksites and for building occupants.

Globally, one of the major and widely reported characteristics of the construction industry is its consumption of large amounts of energy. This is energy consumed during the manufacturing of building materials ('embedded' or 'embodied' energy), transporting these materials from production plants to building sites ('grey' energy), constructing the building/structure ('induced' energy), operating the building/structure ('operational' energy) and demolishing the building/structure and recycling of its parts, where this occurs [4]. For instance, buildings in use account for about 50 percent of total energy used in the United Kingdom (UK) and the construction phase accounts for another 5-10 percent [9]. In China, the construction industry consumes around 28 percent of the total energy, a figure expected to rise to 35 percent [5]. Energy use in buildings for cooling, refrigeration, fire suppression, and in the case of halocarbons, insulation materials also are major emitters of other non-CO₂ greenhouse gas emissions such as halocarbons, chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) [4]. In order to mitigate this, it is imperative to reinvent the construction industry, drawing inspiration from the natural world.

Nature has been found to exhibit functional, efficient, effective, eco-friendly as well as aesthetically pleasing attributes through its resulting designs and solutions. Natural organisms manufacture without heat, beat, and treat; ecosystems that runs on sunlight and feedback; and creating opportunities rather than waste. These sustainable attributes are methodologies and approaches all perfected through nature's research and development (R&D) of its 3.8 billion years of evolution [10]. This has led architects, engineers, designers and innovators to start consulting nature's superb forms, processes and policies in their quest for solutions to the numerous challenges of sustainability facing the world. Hence, biomimicry, the new field of discipline which studies nature's models and then emulates their forms, processes, systems, and strategies to solve human problems sustainably [11]. This paper presents biomimetic ways of

متن کامل مقاله

دریافت فوری ←

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