

ENERGY AND CO2 EMISSION EVALUATION OF CONCRETE WASTE

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I declare that this project report entitled “*Energy and CO2 Emission Evaluation of Concrete Waste*” is the result of my own study except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

A significant amount of solid wastes produced every year from construction and demolition activities, and had caused significant pollution to the environment and risen public concern. Therefore, the minimization of construction wastes has become a critical issue in construction industry. Concrete is the most commonly used construction material in the world, and after water is the second most consumed product on the planet. The huge popularity of concrete also carries environmental costs, the most harmful of which is the high energy consumption and CO₂ release during the production. This paper investigates the amount of energy used and CO₂ emission generated during the production of concrete. Furthermore to estimate the total impact of both indicators based on concrete wasted generated on site. Data were obtained through questionnaire survey and interview within the building construction projects in U.T.M. These impact assessment were followed the life cycle assessment (LCA) methodology. The results show that the production of the raw material and the transports of the concrete are the main contributor to the total environmental load. The highest impact value was generated during the production of cement at upstream level. The amount of energy used and CO₂ emission by cement production was about 70 percent of the total embodied energy and 95% of the carbon dioxide emissions of concrete production and. Within the transportation operations, the transportation of concrete is the largest contributor equal to 25% to 28% the production of concrete and on the other hand 12% to 14% for CO₂ emission.

ABSTRAK

Jumlah sisa pepejal daripada kerja pembinaan bangunan menyebabkan pencemaran alam sekitar dan meningkatkan keprihatinan masyarakat awam akan perkara ini. Oleh yang demikian, pengurangan akan sisa tersebut menjadi isu yang kritikal dalam industri pembinaan. Konkrit merupakan bahan yang digunakan dalam kerja pembinaan. Penggunaannya yang berlebihan menyebabkan kesan kepada persekitaran iaitu pembebasan gas CO₂ semasa proses penghasilannya. Kajian ini menyiasat tenaga yang digunakan dan pembebasan gas CO₂ semasa menghasilkan konkrit. Kajian ini juga menganggar kesan bagi kedua-dua perkara tersebut. Data diperolehi dengan dapatan soal selidik dan temu bual yang dilakukan di sekitar projek pembinaan di UTM. Seterusnya penilaian kitar tenaga (LCA), di jalankan dan keputusan mendapati penghasilan bahan mentah dan pengangkutan konkrit merupakan penyumbang utama kepada beban persekitaran. Kesan tertinggi diperolehi semasa penghasilan simen pada peringkat akhir. Jumlah tenaga yang digunakan dan pembebasan gas CO₂ oleh penghasilan simen ialah 70 peratus daripada jumlah sebenar tenaga yang digunakan dan 95 % pembebasan gas karbon dioksida. Dalam tempoh operasi penghantaran, iannya merupakan penyumbang terbesar iaitu 25% ke 28 % bagi penghasilan konkrit dan 12 % ke 14 % bagi pembebasan gas CO₂.

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DEFINITIONS

Embodied energy: The sum of the energy used to manufacture a product from cradle up to the product is ready to be delivered from the producer and of its feedstock.

Emission: Release or discharge of any substances, effluents or pollutants into the environment.

Environmental impact: A change to the environment, whether adverse or beneficial, and the associated consequences for both humans and other ecosystem components caused directly by the activities of product or service development and production, wholly or partially resulting from an organization's activities, products, or services, or from human activities in general

Recycling: Recycling is used as a generic term for different forms of recycling. The here included forms are; reuse, material recycling and combustion with heat recovery.

Reuse: The material is used for about the same purpose as initially. Reuse might imply upgrading or some renovation.

Recycling Potential: The environmental impact from production of that material the recycled material will be a substitute for less the environmental impact from the recycling processes and connected transport. In this thesis the environmental impact is limited to embodied energy and use of resources. The recycling potential can therefore shortly be described as a way to express so much of the embodied energy and natural resources which, through recycling could be conserved.

CHAPTER I

INTRODUCTION

1.1 Introductions

The construction industry plays a vital role in meeting the needs of its society and enhancing its quality of life. The industry remains as a major economic sector, thus the pollution generated from construction activities continuously presents a major challenge to implement environmental management in practice. The investigations demonstrated that construction business is a large contributor to waste generation.

Environmental and human health impacts of materials are a hidden cost of our built environment. Impacts during manufacture, transport, installation, use, and disposal of construction materials can be significant, yet often invisible. A broad and complex web of environmental and human health impacts occurs for each of the materials and products used in any built landscape, a web that extends far beyond any project site. Construction materials and products can be manufactured hundreds, even thousands, of miles from a project site, affecting ecosystems at the extraction and manufacturing

locations, but unseen from the project location. Likewise, extraction of raw materials for these products can occur far from the point of manufacture, affecting that local environment. Transportation throughout all phases consumes fuel and contributes pollutants to the atmosphere. Disposal of manufacturing waste and used construction materials will affect still another environment. These impacts are “invisible” because they are likely remote from the site under construction and the designer’s locale.

Parallel to rapid economic growth and urbanization in Asia, environmental impacts from construction and demolition (C&D) waste are increasingly becoming a major issue in urban waste management. C&D waste management in developing countries in the Asian region is relatively undeveloped and emerging. Environmental issues such as increase in volume and type of waste, resource depletion, shortage of landfill and illegal dumping, among others are evident in the region. Furthermore, the Asian countries have limited or no available data on C&D waste and the management aspects, particularly with regards to their C&D waste generation and composition; practices and policy, key actors and stakeholders’ participation. (Asian Institute of Technology,2008)

1.2 Background of the study

Concrete is the most commonly used construction material in the world, and after water is the second most consumed product on the planet. Each year worldwide the concrete industry uses 1.6 billion tons of cement, 10 billion tons of rock and sand, and 1 billion tons of water. Every ton of cement produced requires 1.5 tons of limestone and fossil fuel energy inputs (Mehta 2002). The huge popularity of concrete also carries environmental costs, the most harmful of which is the high energy consumption and

CO₂ release during the production of Portland cement. While the resources for aggregate and cement are considered abundant, they are limited in some areas, and more importantly, mining and extraction of the raw materials results in habitat destruction, and air and water pollution. (Mehta 1998).

Several measures can be taken to minimize the environmental and human health impacts of concrete and some can result in improved performance and durability of the concrete as well. Perhaps the most important strategy is to minimize the use of Portland cement by substituting industrial by-products (e.g., fly ash, ground granulated blast furnace slag, or silica fume) or other cementitious materials for a portion of the mix. Recycled materials substituted for both coarse and fine natural aggregates will minimize use of nonrenewable materials and the environmental impacts of their excavation. (Mehta 2002)

1.3 Problem statement

In Malaysia, the construction industry generates a lot of construction waste which cause significant impacts on the environment and increasing public concern (Begum et al., 2005). Thus, the minimization of construction waste has become a pressing issue. The source of construction waste at the project site includes materials such as soil and sand, brick and blocks, concrete and aggregate, wood, metal products, roofing materials, plastic materials and packaging of products. Concrete and aggregate is the largest component with 65.8% of total waste generation (Begum et al., 2005). CO₂ production has been directly linked to climate change and global warming and governments have set specific targets to reduce national emissions. Production and demolition of concrete in sites are of direct importance both in terms of the contribution

to CO₂ and energy. Environmental and human health impacts of materials are a hidden cost of our built environment. Impacts during manufacture, transport, installation, use, and disposal of construction materials can be significant, yet often invisible

1.4 Aim and Objectives

The aim of this research is estimate the impact of concrete waste in construction sites in term of energy consumption and CO₂ emission:

- i. To estimate the amount of energy used and CO₂ emission for production of concrete in addition with transportation to the site.
- ii. To determine the amount of concrete waste in construction sites.
- iii. To estimate the total energy and CO₂ emission based on the different weight of concrete waste on site.
- iv. To evaluate the disposal option of concrete waste.

1.5 Scope of the Study

The scope of this study is as the following:

- i. Areas of study were within the building construction in U.T.M
- ii. The impact indicator used in the study were limited to the energy usage and CO₂ emission only. The evaluation of total impact will be based on the percentage of concrete wastage on sites.