Selecting Demolition Waste Materials Disposal Alternatives Using Fuzzy TOPSIS Technique

By

Mohamed AbdElrazek Abu HaggarElshamy

A Thesis Submitted to the
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In Partial Fulfillment of the
Requirements for the Degree of
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In
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Under supervision of

Prof. Mohamed Mahdy Marzouk

Professor of Construction Engineering and Management
Structural Engineering Department
Faculty of Engineering, Cairo University

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Approved by the Examining Committee

Prof. Mohamed Mahdy Marzouk .....
Professor of Construction Engineering and Management - Structural Engineering Department - Cairo University - Thesis Main Advisor

Prof. Ibrahim Abdel-RashedNosir .....
Professor of Construction Engineering and Management – Structural Engineering Department – Ain Shams University

Dr. Mohamed Abd El Latif Bakry.....
Manager of Strategic Management Department – Social Development Fund

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2016

Engineer's Name: Mohamed AbdElrazek Abu HaggarElshamy
Date of Birth: 05/02/1989
Nationality: Egyptian
E-mail: Eng_mabdelrazek2011@yahoo.com
Phone: 00201027419471
Address: Dar El-Salam, Cairo
Registration Date: 01/10/2010
Awarding Date: …./…./……..
Degree: Master of Science
Department: Structural Engineering

Supervisors:

Prof. Mohamed Mahdy Marzouk

Examiners:

Prof. Ibrahim Abdel-RashedNosir- Ain Sham University
Dr. Mohamed Abd El Latif Bakry- Social Development Fund
Prof. Mohamed Mahdy Marzouk –Cairo University(main advisor)

Title of Thesis:

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Key Words:
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Summary:
In developing countries, millions of tons of Construction and Demolition Wastes (CDWs) are lost every year due to lack of knowledge of the recycling significance and/or procedures. Despite the high value of CDWs, high percentage of this waste is either dumped illegally or disposed in the landfills. Disposal methods should consider saving natural resources and maintaining the environmental conditions through maximizing the value of CDWs. This research aims at choosing the most sustainable disposal alternative using Multi-Criteria Decision Making (MCDM) Process. The research introduces a list containing the most relevant and significant sustainable indicators that affect the selection of alternative for disposal of CDWs. Then, it determines the composition of demolished waste materials and estimates the generation rate of each demolished material inside the city of Cairo with corresponding alternatives. Finally, fuzzy TOPSIS techniques applied considering the significant indicators on each alternative to rank and choose the best alternative for disposal of CDWs.

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Nomenclature

CDWs	Construction and demolition waste
MCDM	multi-criteria decision making
TOPSIS	Technique for Order of Preference by Similarity to Ideal Solution
GDP	Gross domestic product
EEAA	Egyptian Environmental Affairs Agency
EPA	United States Environmental Protection Agency
DSD	the Division for Sustainable Development
CSD	Commission on Sustainable Development
CAPMAS	Central agency for public mobilization and statistics
AHP	Analytical Hierarchy Process
IUCN	International Union for Conservation of Nature
NOHSC	National Occupational Health and Safety Council
OCED	Organization for Economic Co-operation and Development

Abstract

Nowadays, a solution for Construction and Demolition Wastes (CDWs) is considered as a key demand for the construction industry. A lot of research efforts have discussed this problem in different aspects, providing several alternatives for disposal of Construction and Demolition Wastes (CDWs). In developing countries, millions of tons of CDWs are lost every year due to lack of knowledge of the recycling significance and/or procedures by both individuals and decision-makers. Despite the high value of CDWs, high percentage of this waste is either dumped illegally or disposed in the landfills. Disposal methods should consider saving natural resources and maintaining the environmental conditions through maximizing the value of CDWs.

This research aims at choosing the most sustainable disposal alternative using Multi-Criteria Decision Making (MCDM) Process. It presents a list of gathered sustainable indicators that are considered significant and relevant to the problem and affect the selection of disposal alternatives. Relative importance and weights of these indicators are determined using Analytical Hierarchy Process (AHP). A model is developed to estimate quantities for materials contained in the demolition waste of Cairo where masonry (brick) is chosen as a representative of demolition waste materials to be applied for this research. Five alternatives for waste disposal have been introduced. The list of indicators is applied on the five alternatives for brick disposal. Fuzzy TOPSIS method is chosen as a tool for MCDM to choose the most sustainable alternative for waste disposal, and to rank the alternatives based on their superiority versus all indicators.

CHAPTER 1 INTRODUCTION

1.1 General

No one can deny the great participation played by the construction industry in the global economy during the earlier period [1]. The value added by construction is estimated to be between of 7% to 10% for highly developed economies, whereas it decreases to be around 3% to 6% for underdeveloped economies.

This observed contribution in economy reflects not only the volume of this industry, but also reflects the enormous number of jobs that can be provided, which lead to a reduction in the unemployment rate. According to the ministerial conference on youth employment, Construction Industry represents the 3rd largest industry by employment in 2010 and represents the 2nd place in 2012 [2].

As mentioned before**,** the problem isn't with the construction industry in itself where the main concern focuses on the remnants resulting from this industry. The numbers that describe the situation are terrifying as they cover all these amounts of emissions, natural resources depletion & energy consumption rates. Several attempts tried to provide various alternatives for using CDWs, but there is no acceptable response till now, especially in developing countries such as Egypt. Recycled waste in Egypt form about 9.5 % of total municipal solid waste as found in [3], while this percentage increases dramatically in developed countries. Holland, Germany and Denmark had reached 80% of the recycled waste [4].

1.2 Problem Definition

With the wide expansion in the construction industry which means by default that the incoming CDWs will also increase. This problem caught a lot of attention lately where enormous researches discussed this problem in different aspects and provided various alternatives for using CDWs. With the increasing numbers of these alternatives, it becomes a problem for the decision-maker to choose between them especially with the growing attention with the environmental issues. The target of this research is providing the aid to decision-maker to take the right decision based not only on the economic view but also taking into consideration other sustainable concerns.

1.3 Research Objectives

The main objective of this research is to develop a decision support tool to help decision makers in choosing the most sustainable alternative for disposal of demolished waste materials, which eliminates the serve impact of this waste. To achieve the main objective, the following sub-objectives will be carried out: