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Abstract

This is an environmental study on concrete that follows the standard protocol of life cycle assessment (LCA). The primary environmental indicator is the CO_2 footprint when concrete is assessed and compared with other structural designs. However, even though concrete is known to have a relatively high CO_2 emission during production it is of paramount importance to include the service life of buildings in this type of calculations. The thermal mass of concrete helps improve the energy performance of a building which again will reduce the effect of a high initial CO_2 footprint. A slight difference in the energy performance of a building design may tip the balance from an environmentally sound design to the direct opposite in terms of energy performance. After end of service life concrete is suitable for recycling back into construction applications. Furthermore, the concrete rubble will carbonate and absorb CO_2 from the atmosphere.

This study shows that the utilization of life cycle approach provides a methodology which could be used to minimize the environmental impacts in construction industry. This could be demonstrated through breaking down the concrete construction life into five phases showing how to make even small improvements to get a significant effect on the energy consumption and CO_2 emissions associated with the use of concrete structures along its life cycle.

Table of Contents

List of Figures

List of Tables

List of Photos

List of Terminology

AAC …………………..Autoclaved aerated concrete.

CEM I ……………….. Portland cement without any addition.

CEM II ……………….Portland cement with partially SCM replacement.

ECO_2 …………………Embodied Carbon Dioxide.

FEES ……………….....Fabric Energy Efficiency Standard.

HSC ………………….High Strength Concrete.

LCA …………...……..Life Cycle Assessment.

LWC …………………Light Weight Concrete.

OPC ……………….….Ordinary Portland Cement.

RCA ………………….Recycled Concrete Aggregate.

RHA ………………….Rice Husk Ash.

RMA …………………Recycled Mixed Aggregates.

SCM ……………...…Supplementary Cementitious Materials.

UHSC ………………..Ultra High Strength Concrete.

CHAPTER 1

Introduction

Chapter 1

1.1 Introduction

Concrete is globally one of the most important building materials. The environmental impact per cubic meter is not high, but the total effect is significant because of the large volumes produced. Even small improvements will have a significant effect.

A “holistic” approach is needed to achieve real environmental improvements in the construction sector. A building or any other structure has to be considered as a product. Consequently the total environmental impact associated with the “product” during the entire life cycle from cradle to grave has to be considered.

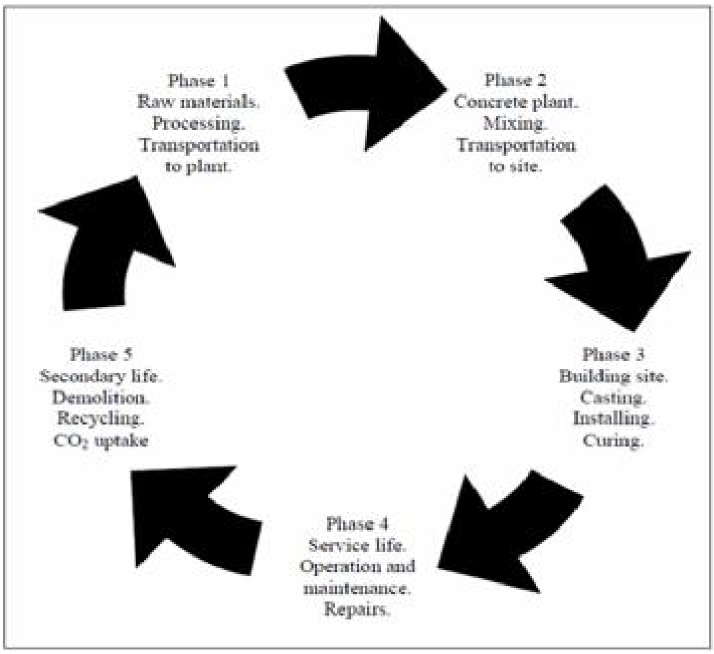

Figure 1-1 life cycle of concrete structures.

This means that it is no longer sufficient to address environmental issues associated with the production of the individual building materials. The environmental impacts associated with the use and disposal of a structure have to be considered. The energy consumption and CO2 emissions associated with the use of a structure are generally much larger than the energy consumption and CO2 emission associated with production of the individual construction materials. Use, maintenance and durability are therefore important aspects, which have to be considered.

The primary environmental indicator is still the CO2 footprint when concrete is assessed and compared with other structural designs.

However, even though concrete is known to have a relatively high CO2 emission during production it is of paramount importance to include the service life of buildings in this type of calculations.

The thermal mass of concrete helps improve the energy performance of a building which again will reduce the effect of a high initial CO2 footprint. A slight difference in the energy performance of a building design may tip the balance from an environmentally sound design to the direct opposite in terms of energy performance.

After end of service life concrete is suitable for recycling back into construction applications. Furthermore, the concrete rubble will carbonate and absorb CO2 from the atmosphere.

1.2 Objectives

The aim of this study is to analyze the impact of application of life cycle assessment approach to minimize impacts in construction industry. The objective is to show which phases in the life cycle of concrete have a high impact and why. The phases included are raw material production, concrete production, service life and demolition.

CHAPTER 2

Manufacturing of raw materials Phase.