B-14.3.2 A Research on CO2 Emission in Urban Development and the Control Technologies

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Abstract For the purpose of global warming mitigation, induced CO2 emission from construction sector in Japan is estimated using Input/Output Table. Induced CO2 emission process caused by construction activities is analyzed from a viewpoint of emission reduction potential. Recommendable main options for countermeasures are low CO2 structural designs, low cement concrete technologies and reduction of transportation weight-km.

Key Words Construction, Input/Output Table, CO2, Cement, Iron Steel, Transportation

1. Introduction

Nowadays in Japan, about 70% of the population is concentrated in urban districts, where such high density social and economical activities as production, freight distribution, and consumption are compiled. Agglomeration and upgrading of urban functions, and extension of urban activities as regional scale increases demands for social infrastructures as road or sewerage networks and traffic systems. Such concentration of urban activities in megalopolis accelerates construction or renewal of buildings and urban development.

The constructing activity in urban area has so large share in industrial activities as 20% of GNP, but the load to the global environment as CO2 emitted directly from constructing activities is rather small.

However, indirect CO2 emission induced by constructing activities, in production process of cements, ceramics, and iron steel products, or in transportation relating to constructing is not small. Therefore, it is needed to take into account the indirect process of material production and transportation, as well as the constructing technologies on evaluation of global warming influence caused from construction activities.

2. Purpose and Outline

The purpose of this study is to develop evaluation methodology of global warming influence caused by urban development activity, and to survey mitigation technologies in this sector. For the basis of implementation against global warming, the CO2 emission amount related with construction activity in Japan is estimated using 1985 Input/Output Tables and its Construction Sector Tables, by which induced emission process is analyzed from a viewpoint of the emission reduction potentials. Secondary, the control technologies to reduce CO2 emissions are surveyed all through the induced production process including indirect emissions.

The emission reduction potential in construction sector is estimated based on present emission state and control options.

3. The Method of Analysis

This study is consist of two parts, i.e., (1) Estimation of CO2 emissions from construction activity including urban development activities. (2) Evaluation of reducing potential derived from control options.

(1) Estimation methodology of induced CO2 emission from Input/Output Matrix Table

The schematic flow to estimate induced emission amount from construction sector using 1985 input-output table is shown in Fig-1. Starting from basic matrix table of 529 lines by 408 columns, basic matrix of construction sector I/O 66 by 213 table is combined, then 441 by 441 quadrate I/O matrix is made. Induced emission caused by construction sectors is estimated from per unit product yen by 441 columns. At this step unit CO2 emission from iron steel products are modified by the ratio of pig iron and scrap iron, which modification can make accurate evaluation of the recycling effect.

(2) Reduction Potential Study of CO2 Emission

Emission reduction potential by several kinds of options is studied mainly on cement, iron steel and transportation from demand side and production side.

4. Results

(1) Induced CO2 Emission

Fig-2 shows CO2 emission amount from construction sector and its share in Japan total emission. Induced emission caused from construction sector is about 195 million ton(1985), 55 million tons from urban development sector. Within induced emission from construction sector, cement production process CO2 emission is the largest, and contribution of pig iron steel is the second largest.

(2) Reduction potential study

Fig-3 shows emission result of emission reduction potential study. 23% of emission reduction can be expected on cement use, by cement saving on concrete technologies and replacement of clinker by slug cement from blast furnaces. 12% of iron steel emission can be reduced by replacement from pig iron to scrap iron recycling and penetration of energy save technologies on iron steel production process. 13% of emission from transportation is expected to be reduced by modal shift from vehicles to freight trains or vessels and efficiency improvement in trucking. Comprehensively 16.4 million tons, 8.4% emission can be reduced by these options, which 10.0% reduction in civil engineering sector, 7.1% in building sector.

(3) Recommendable options

Low CO2 structural design, which needs small amount of cement, iron steel, should be preferred. For example, PS Concrete is very good, S is better than RC. SRC is bad.

Low cement concrete technologies should be developed and penetrated. For example, Light weight concrete, earth rock dam.

To reduce transportation weight-km, aggregate supply system or residual soil treatment system should be reconstructed.

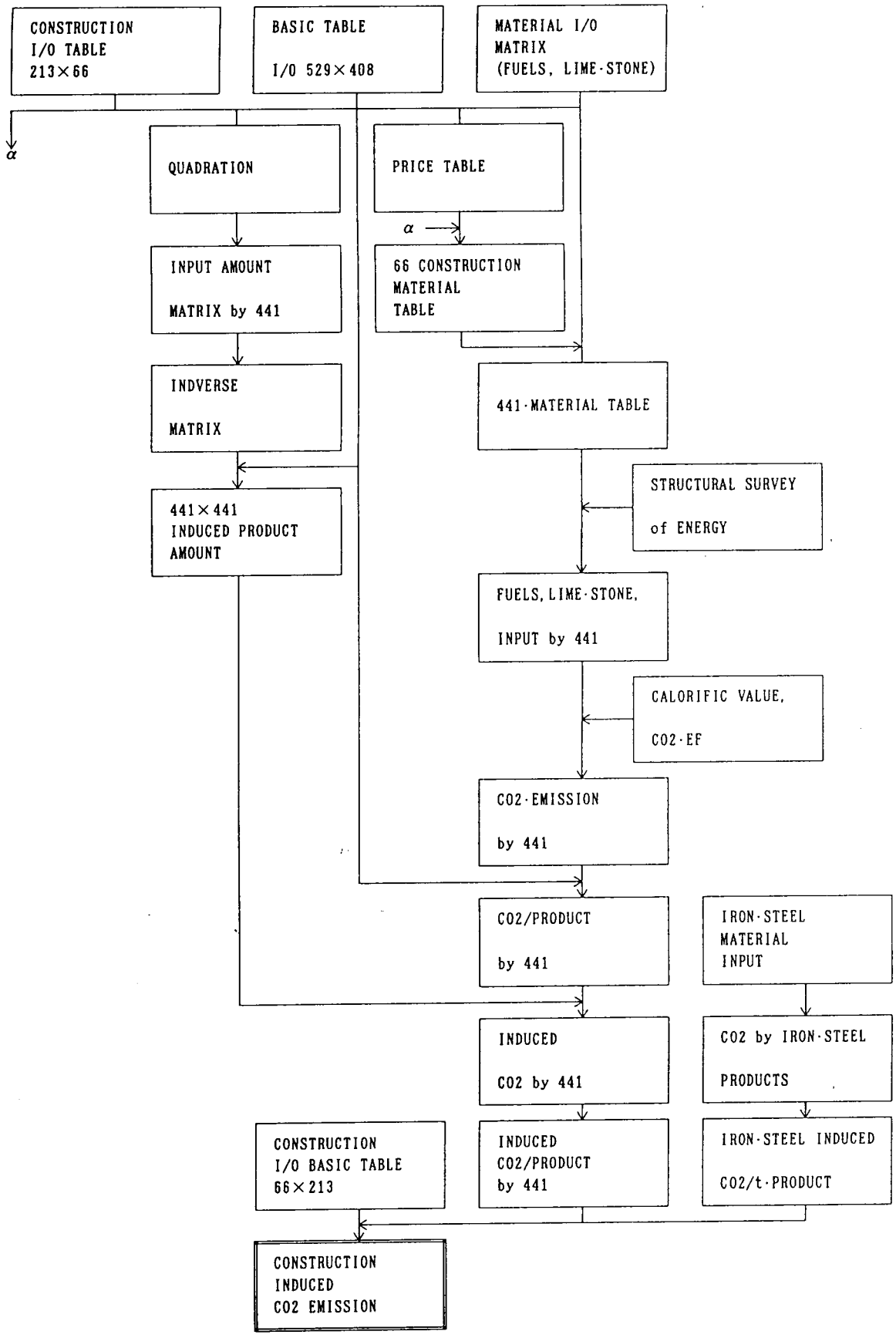

Fig-1 Schematic Flow of CO2 Emission Estimation in Construction Sector
(Based on I/O 441 Sectors Table)

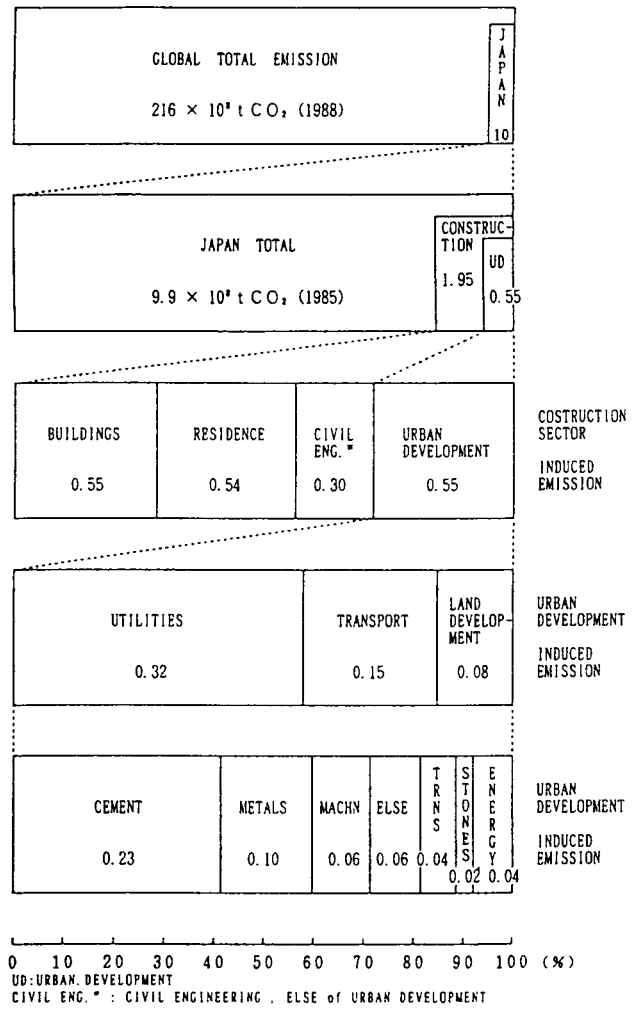

Fig-2 CO2 Emission Component and Share
(CO2 emission in Japan is estimated from 1985 I/O Tables.)

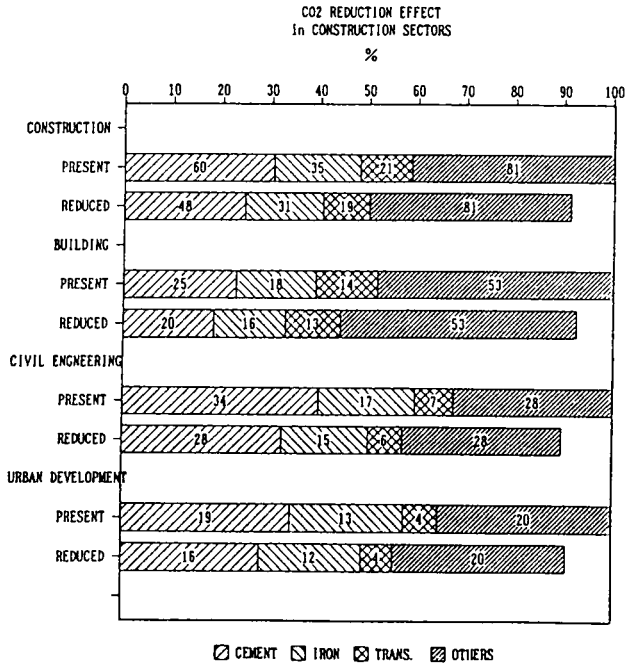

Fig-3 Expected Reduction Potential by Options Related in Construction Sectors