

## Estimation of Construction Waste Amount Generated by Worn-out Detached Houses in Daegu, Korea

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**Abstract.** Construction waste is 49% of the entire waste, the biggest share and has increased for the recent decade. Still, little research was carried out on worn-out buildings that generate construction waste. In this regard, this study intended to analyze the distribution of worn-out detached houses in Daegu, South Korea and to estimate the amount of construction waste. According to the findings of the study, 78.81% of all the detached houses in Daegu are decrepit. And the amount of construction waste stemming from demolished worn-out detached houses is 25,378 kt. By composition, it consists of concrete waste of 21,540 kt (84.88%), metal and steel waste 734 kt (2.89%), and mixed waste of 3,103 kt (12.23%).

**Keywords:** Worn-out detached houses, Construction waste, Estimation

### 1 Introduction

Construction waste makes up 49% of the entire waste generated in the country, the biggest share [1]. It has increased for the recent 10 years [2]. As more and more buildings constructed in the 1960s and 70s become old, there is a need for their redevelopment and thus the amount of construction waste will continue to go up [3]. Therefore, in terms of sustainable social development, we should predict the amount of construction waste and respond to it accordingly. Moreover, it is very important to analyze the cause of construction waste generation and raise their recycling rate.

Nevertheless, almost none research has been carried out on worn-out buildings as the cause of construction waste generation. So this research aimed to analyze the distribution of worn-out detached houses by selecting Daegu with a big population density and a great demand of reconstruction. And, this research aimed to estimate the amount of construction waste generated by worn-out detached houses in Daegu, Korea.

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## 2 Theoretical consideration

### 2.1 Criteria of worn-out detached houses

The criteria of worn-out or inferior detached houses are defined in Daegu's Ordinance on the Maintenance and Improvement of Urban Areas and Dwelling Conditions for Residents. This study sorted out worn-out detached houses based on the construction year of the structures as the physical criterion of the relevant ordinance. It is shown in the Table 1 [4].

**Table 1.** Daegu's Ordinance on the Maintenance and Improvement of Urban Areas and Dwelling Conditions for Residents

Classification	Criteria of worn-out or inferior structures
Multi-family Homes	Structures built after 1994 : 30 years after its completion From 1985 to 1993 : 21 years after its completion + (the completion year - 1985) Before 1985 : 20 years after its completion
Others (Detached houses)	Reinforced concrete structures, steel concrete structures and steel structures : 30 years after its completion Other structures : 20 years after its completion

This study applied the ordinance of Daegu as of 2015. So structures constructed before 1986 for reinforced concrete structures, steel concrete structures and steel structures is classified as worn-out structures. And, structures constructed before 1996 for other structures is classified as worn-out structures.

### 2.2 Literature review on basic unit of construction waste generation

In Korea, studies on basic unit of construction waste generation have been conducted by various agencies such as Asia Pacific Environment Management Institute, Korea National Housing Corporation and Korea Institute of Civil Engineering and Building Technology (KICT). This study adopted the basic unit of KICT that is widely used and separates detached houses as a basic unit. The basic unit appears in the Table 2 [5].

**Table 2.** Basic unit of construction waste generation of KICT (Residential housing)

Classification		Concrete waste (ton/m <sup>2</sup> )	Metal and steel waste (ton/m <sup>2</sup> )	Mixed waste (ton/m <sup>2</sup> )	Total (ton/m <sup>2</sup> )
Residential	Detached houses	1.409	0.048	0.203	1.660
	Apartment	1.566	0.061	0.169	1.796

### 2.3 Outline of database

A building register contain all summarized information of structures permitted to be used in Korea (address, purpose of use, area, number of stories and date of permission, etc.). To classify worn-out detached houses according to the ordinance of Daegu, information such as the purpose of use and the date of permission for using the building is necessary. Information on its area is also needed to estimate the amount of construction waste. So this study utilized a building register as DB as it includes all the data [6].

## 3 Estimation of construction waste amount generated by worn-out detached houses in Daegu, Korea

### 3.1 Distribution of detached houses in Daegu

As a result of analyzing the building register, the total number of the structures in Daegu was 249,321 and the building area was 47,457,409m<sup>2</sup>. The number of detached houses was 161,013 and their area was 10,276,080m<sup>2</sup>. Dong-gu has the largest number of detached houses or 27,187 units and Jung-gu has the smallest number or 9,205 units. The distribution of detached houses in Daegu is shown in Figure. 1.

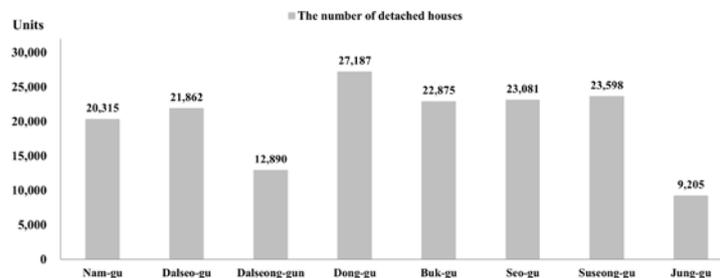


Fig. 1. Distribution of detached houses in Daegu

### 3.2 Distribution of worn-out detached houses in Daegu

This study classified worn-out detached houses based on the criteria in Table 1 presented in Section 2.1 of the building register. As a result, the total number of old separate houses was 126,897 units, 78.81% of all the detached houses. Dong-gu has the largest number of decrepit detached houses in the city. Seo-gu has the highest ratio of the number of worn-out detached houses to that of all detached houses or 87.12%. The distribution of worn-out detached houses in Daegu appears in Figure. 2.

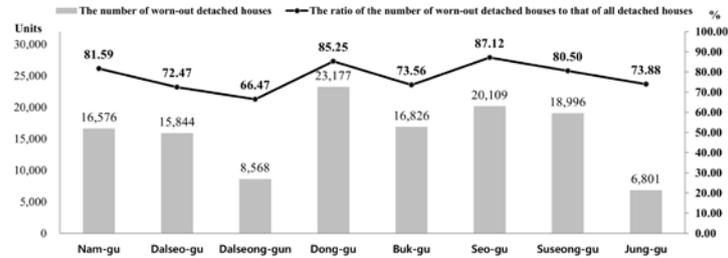


Fig. 2. Distribution of worn-out detached houses in Daegu

### 3.3 Estimation of construction waste amount generated by worn-out detached houses in Daegu

This study estimated the amount of construction waste by multiplying the basic unit of construction waste generation in Table 2 and the area of worn-out detached houses. The total area of worn-out separate houses in Daegu was 15,287,792m<sup>2</sup> and the amount of construction waste was 25,378 kt. The total area of worn-out detached houses and the amount of construction waste of are shown by district in Table 3.

Table 3. The total area of worn-out detached houses and the amount of construction waste by district

District	Total area of worn-out detached houses (m <sup>2</sup> )	Amount of construction waste (kt)
Nam-gu	1,985,042	3,295
Dalseo-gu	2,424,299	4,024
Dalseong-gun	738,307	1,226
Dong-gu	2,538,407	4,214
Buk-gu	1,942,148	3,224
Seo-gu	2,572,867	4,271
Suseong-gu	2,714,398	4,506
Jung-gu	372,325	618
Total	15,287,792	25,378

In classifying the amount of construction waste by composition, concrete waste took up 21,540 kt (84.88%), metal and steel waste 734 kt (2.89%), and mixed waste 3,103 kt (12.23%). The findings are demonstrated in Figure. 3.

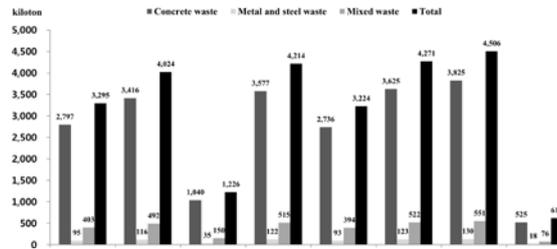


Fig. 3. Classification by composition of construction waste generated by worn-out detached houses in Daegu

## 4 Conclusions

This study analyzed the distribution of worn-out detached houses as the cause of generating construction waste. It also estimated the amount of the construction waste by composition. The summary of the results is as follows.

First, the total number of worn-out detached houses was 126,897 units, which shows that 78.81% of detached houses are decrepit.

Second, the total amount of construction waste generated from worn-out detached houses was 25,378 kt: concrete waste 21,540 kt (84.88%), metal and steel waste 734 kt (2.89%), and mixed waste 3,103 kt (12.23%).

This study is meaningful in that there has been almost no research on worn-out detached houses as the cause of construction waste. In that vein, its results will be able to be used as basic data to analyze the cause of an increase in construction waste and to devise a plan for handling it. Moreover, the amount of construction waste by composition set forth in the study will be beneficial in working out a policy to raise the recycling rate of construction waste.

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