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Integrated Management System For Managing Of Construction And Demolition Waste

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Abstract
The reconstruction and redevelopment of the existing housing are greatly on the rise, according to economic growth and the improvement of living conditions. A lot of construction waste is generated, but the research of adequately handling and managing the waste is insufficient. In this regard, this study presented a deconstruction and control system as a means to minimize the generated quantity of construction waste and to enhance the recycling ratio of resources, unlike the existing traditional demolition concept. This system has been organized to plan and manage ranging from the estimation of demolition quantity to the demolition method by each structural section, and utilization plan of the generated resources by integrated computerization system. This system aims at contributing to the minimization of environmental load by devising a method to identify and reduce the quantity of the entire national construction waste. This system consists of the following four modules: a prior survey plan for demolition, estimation of demolition quantity, deconstruction plan, and waste management plan. These modules have been constructed to make it possible for users to use the system by individual module.

Keywords
Deconstruction, Demolition Waste, Waste Management, Integrated deconstruction Management System

1. Introduction

Redevelopment and reconstruction are greatly on the rise in Korea, due to improvement in welfare and living conditions along with economic growth. In line with changing social environment, the size of construction work is gradually becoming large. Owing to the activation of such redevelopment and reconstruction, the generation of construction waste continues to increase, as demolition work in city

centers rises. The generated quantity of construction waste was 148,489 tons/day in 2004, which is five-fold higher than 28,425 tons/day in 1996: About 10%-38% of annual increase rate has been demonstrated. Out of total generated waste quantity, construction waste took up the highest ratio of 48.9%, and the ratio rose from 16% in 1996 to 49% in 2004(Ministry of Environment, 2005). Meanwhile, everyday life waste quantity is on the declining with the Korean government's continuous effort. As mentioned above, the greatest factor for the construction waste generation is the activation of construction work, such as residential environmental improvement, reconstruction and redevelopment. However, everyday life waste is on the diminishing or balancing trend. Under the situation, the Korean government enacted the "Construction Waste Promotional Act" in order to reduce construction waste quantity and enhance its recycling rate. The Act stipulates that construction waste has to be discharged in separation at the construction sites to minimize the generation of mixed waste, and that recycling is compulsory.

The demolition of buildings discharge the most construction waste quantity, thus, a system to manage from the planning of demolition to final disposition of construction waste in an integrated manner is urgently needed. This study presents a deconstruction management system to minimize construction waste quantity and enhance the recycling rate of resources. This system aims at minimizing the environmental load through plan and operation within one system in advance ranging from the estimation of demolition amount to demolition method by each structural section(Wall, Roof, Stair, Foundation…), and a recycling plan of generated resources.

2. Overview of Demolition Work System

The purpose of the system in this study is to manage from the planning of demolition work to finish of it, and waste management in an integrated manner. This system also focuses on the automation of demolition quantity estimation. Currently, there are no standards for estimation of waste quantity in Korea, therefore, the waste quantity is estimated depending on the past experiences of demolition companies and clients, and huge errors are caused by institution. This system uses the estimation standards of waste quantity per basic unit (Estimating Unit) so as to easily estimate demolition amount. When there are drawings, the system is also configured to facilitate the real measurement of the drawings. Based on the estimated quantity, the weight and volume can be calculated by using weight conversion coefficient and volume conversion coefficient by waste. Also, waste taking out expenses and utilization plan can be established. Demolition scheduling management function is built in the system so that smooth demolition work can be performed easily. Major configuration modules of the integrated system for demolition work are pre-demolition survey plan, demolition quantity estimation, demolition work plan, and waste management plan as demonstrated in Fig. 1.

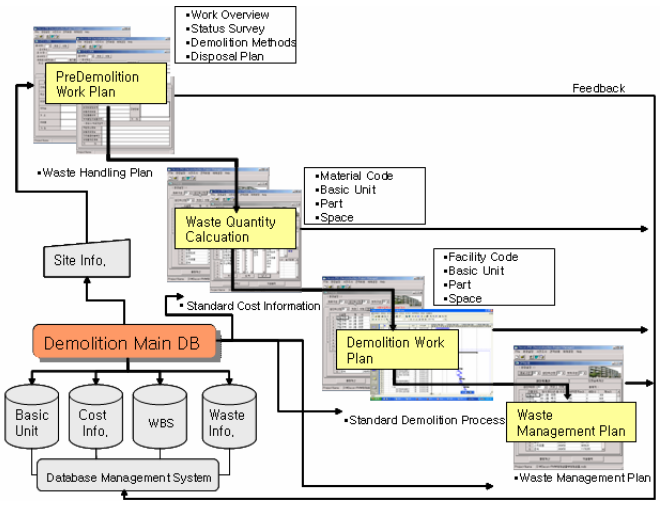

Figure 1. Outline of DCON-PM

3. Integrated Deconstruction System and Module Configuration

The integrated deconstruction system proposed in this study is named DCON-PM. Fig. 2 indicates more detail the connection process of DCON-PM by each module. The data entered in this system are stored in the main DB by demolition or deconstruction project, and therefore, the data can be consulted or utilized in the future demolition project. Therefore, more precise demolition management plan can be improved through past construction's status analysis.

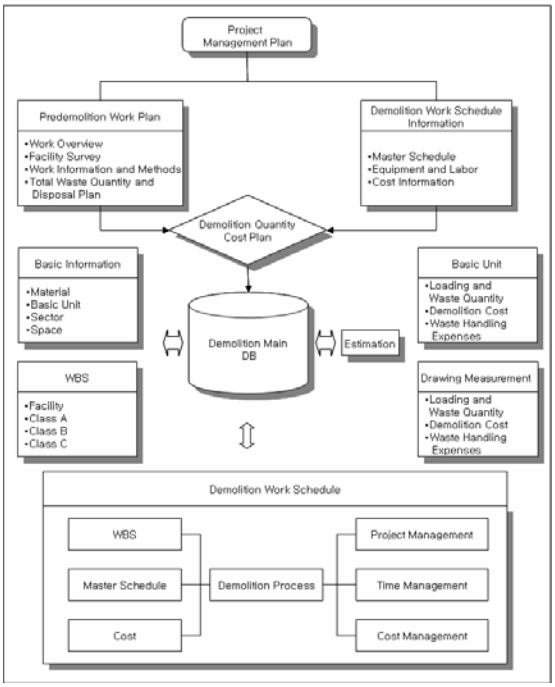

Figure 2. Connection Process of DCON-PM

3.1 Composition of Predemolition Work Survey Module

This module is the stage to establish a basic plan for demolition as the prior planning module before starting the project. This module has been composed to enter overall project overview, building status, work content, and the demolition method. The outline chart of this system is seen in Fig. 3.

3.1.1 Building Status Survey

The status of facilities and work before starting the main demolition work can be recorded in the form for building status survey. In particular, the reporting content can be made on time by including authorization and permission forms necessary for demolition work within the system.

- Factors to Enter for Facility Status
  - Finished time, structural type, floor height, total floor area, number of buildings, surrounding situation, site information, and overviews for others

- Factors to enter before starting project
  - Workplace securing status, root to take out waste, hazardous material handling plan, and a plan to handle obstruction

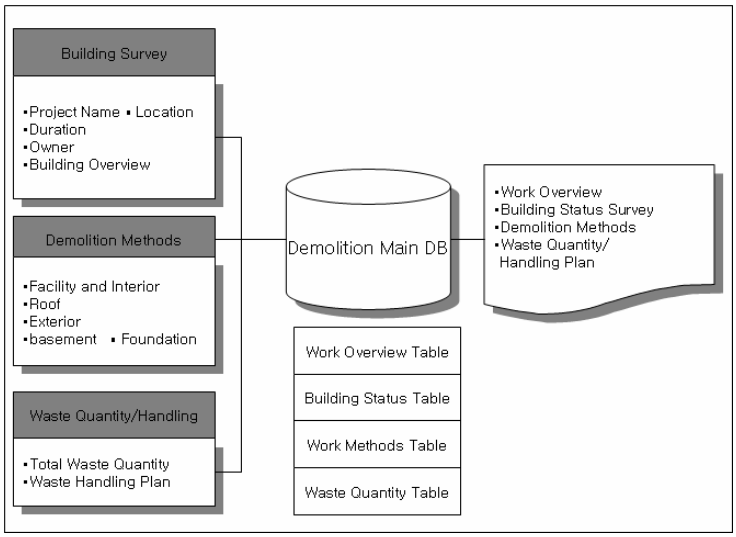

Figure 3. Composition of Predemolition Work Survey Module

- Authorization and Permission job

Building deconstruction reporting, building cancellation reporting, dust generation reporting, prior reporting of specific construction, and waste discharger reporting

3.1.2 Demolition Method Plan

For demolition method planning, the work content, job order, major considering event and major equipments should be entered in advance; therefore, User can consider equipment operation plan and risk factors before the demolition work starting.

3.1.3 Total Waste Volume and Handling Plan

Total waste quantity and handling plan include the total quantity of demolition waste, and the waste handling plan for the prior plan of the recycling and reuse of waste. In particular, when the total quantity of demolition waste is calculated, the quantity by generated section is recorded. For handling the waste, the onsite recycling quantity and commissioned handling quantity can be recorded separately.

3.2 Estimation of Demolition Waste Quantity

Fig.4 demonstrates the module composition for the estimation of demolition amount. The estimation of demolition amount can be calculated whether through the utilization of basic unit or real measurement through drawings. In particular, the waste quantity per basic unit can be utilized when material is difficult in the case of real measuring estimation through drawings. As seen in the overview chart of Figure 4, this system is configured to estimate the quantity of demolition waste by minimizing the user's input.

3.2.1 Estimation of Waste Quantity per Basic Unit

The estimating unit by facility was calculated by statistical analysis via real measurement of drawings, after classifying facilities, year, floor, type, and area. Based on the estimation, the standard input quantity by material per area (m^2, m^3) was estimated. Then, it was adjusted by comparative analysis through case demolition.

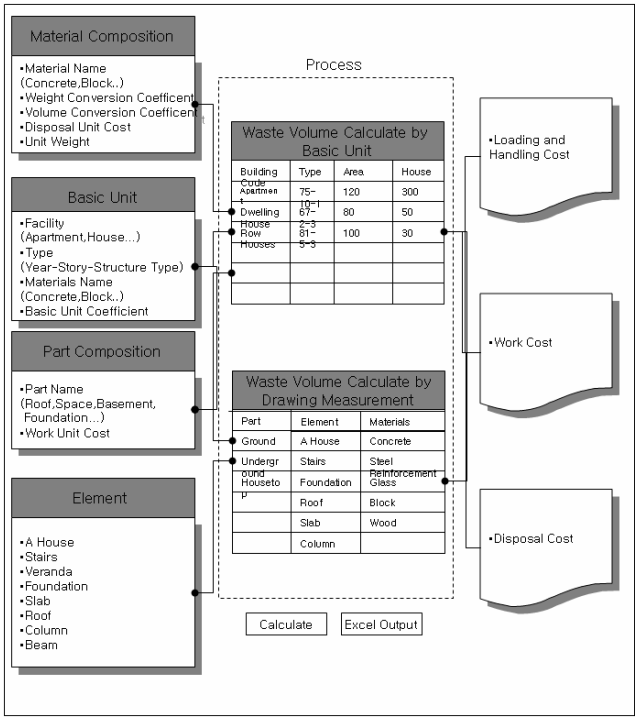

Figure 4. Composition of Estimation of Demolition Waste Quantity

3.2.2 Utilization of Estimating Unit

The Estimating Units consist of total estimating unit and sectional estimating unit. It is estimated by the facility type to be selected through WBS (work breakdown structure) generator. The estimating unit by materials is automatically generated in association with classification code. Thus, the generated waste quantity can be estimated by multiplying it by the floor area. WBS generator is stored in the DB by the classification type set in advance; therefore, the user can easily find it through the set process. The example of total estimating unit is like Fig. 5. Fig. 6 is diagram to explain calculating process of sectional estimating unit by using WBS generator.

3.2.3 Estimation of Demolition Work Cost

Demolition work cost is to conform to basic statement system. The statement is categorized into material expenses, labor cost, and general expenses. Recording of those are based on the waste quantity per basic unit or the quantity by a drawing analysis, and the demolition work cost is estimated in this manner.

3.3. Waste Management Module

When quantity by material is calculated in the quantity estimation module, the waste handling plan by material is established. The waste management module consists of waste and loading quantity calculation, waste handling cost calculation, and waste taking out management.

3.3.1 Waste and Loading Quantity

Concerning waste and loading quantity, the weight is calculated by multiplying the waste that was obtained from the quantity calculation by weight conversion coefficient (unit weight), and the increasing cubic quantity is calculated by multiplying the volume conversion coefficient. When they are divided by the weight or volume of the concerned transportation vehicle, the number of waste transporting vehicles can be obtained.

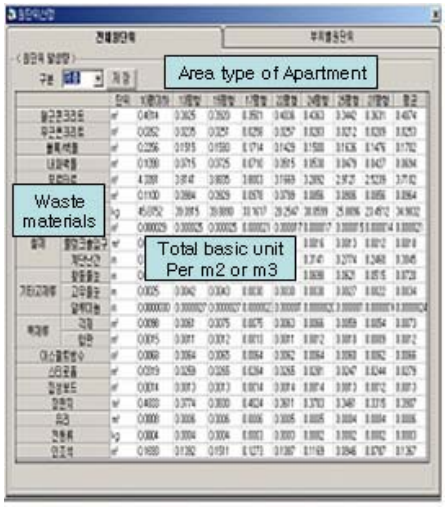

Figure 5. Total Waste Quantity per Basic Unit

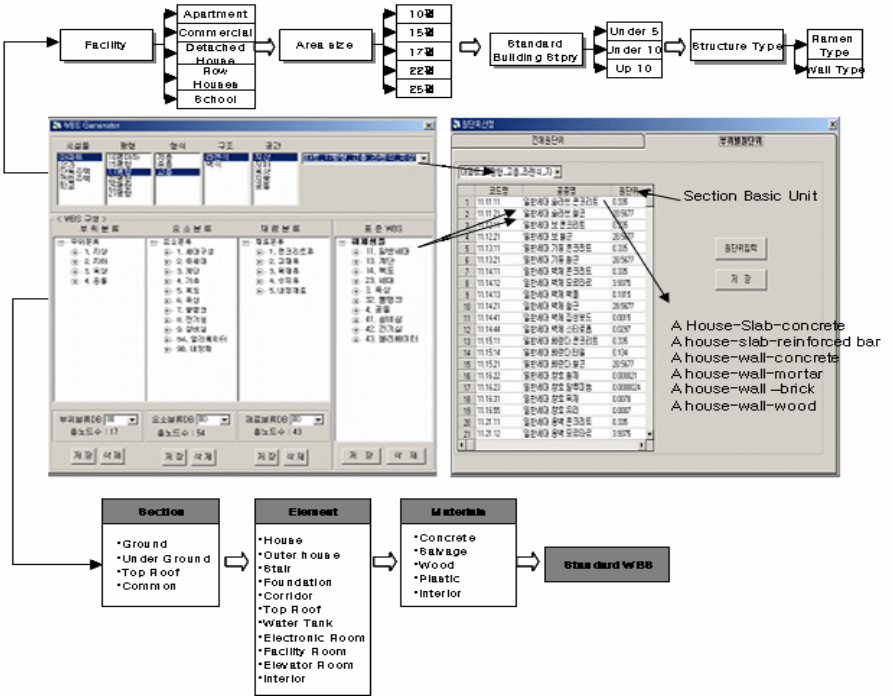

Figure 6. Section Waste Quantity per Basic Unit

3.3.2 Waste Handling Expenses

The waste handling expenses are estimated by the type of waste. The waste handling expense is calculated through waste quantity x unit price.

3.3.3 Waste taking out management

The disposition plan is established for generated waste. When the waste is recycled onsite, it has been regarded as own-handling. Taking out from the demolition site is composed of commissioned handling. This has been organized that recording of waste generation quantity and taking out quantity for each day can be a means to verify the generated waste quantity.

3.4. Demolition Process Plan Module

The process plan module of this system has been established to perform the same functions that can be implemented in the process management program. Figure 7 demonstrates the configuration diagram of the demolition work plan module. Through built-in standard WBS for the establishment of process management plan of demolition work, the process management plan can be easily established. When using this system, it is possible to easily manage through integrated demolition plan by work type, resources mobilization plan, manpower management, working hours, and demolition expenses. Even non-experts can easily draw up the process management plan for any demolition work by the built-in standard WBS. Figure 8 is an example of scheduling in the demolition work. All these data can be freely exchanged with general spreadsheet.

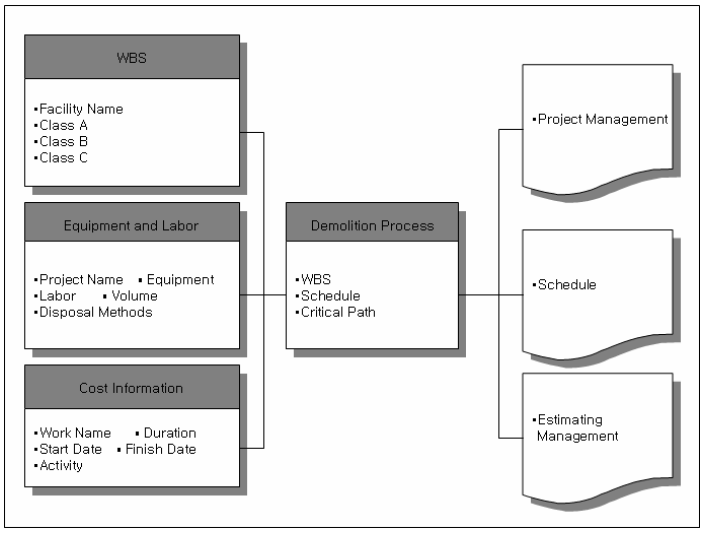

Figure 7. Composition of Process Plan Module

Figure 8. Scheduling Diagram

4. Conclusion

In Korea, much technological development in demolition industry has not been carried out till the present

day; the importance of management system for adequate management of waste is on the rise along with the development of reduction technology for waste. Looking into the existing research results, construction waste is generated most in the process of demolition of structures. For higher recycling of the waste and reducing mixed waste has been identified to be the best by changing conventional demolition method. Though it is important to precisely forecast waste quantity, and plan and manage the recycling measures in advance, the research in such a filed has been minimal. Accordingly, this study established a computerized system, in which the forecast of construction waste generation, work plan and management, and final disposal plan can be conducted within one system. For the forecast of demolition waste quantity, this system uses estimating unit through many drawings analyses, which has been configured with the volume and weight of demolition quantity. Therefore, the volume and weight can be calculated with only the type and area of a demolition structure. If this system is applied to wider scope, the entire national construction waste quantity can be easily forecast, which is judged to be useful for waste management. This system enables the demolition plan, work plan, forecast of waste quantity, and disposal plan to be carried out within the same system; therefore, user convenience can be maximized. This system is considered to be of help to developing the outdated demolition industry, and resource recycling of society through adequate management of construction waste.

5. References

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