

## **Design for Deconstruction in Old Reinforced Concrete Structures in Turkey**

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### **Abstract**

The aim of this study is to give an overview of the reinforced concrete structures increasing rapidly in Turkey and to expose the lack of the demolition practices by pointing out economic, management and organisational aspects relating to deconstruction. For the future economic and ecological conditions in Turkey, today's buildings should be preserved, refurbished, reused or broken down into salvageable and reusable components rather than demolished at the end of their useful life. It is possible that buildings design for deconstruction will have the greatest value. In this study, a deconstruction planning model is developed according to the existing deconstruction system in Turkey and the design processes which constitute this deconstruction planning model are identified and described. Furthermore, to encourage legislatives to design for deconstruction, its supporting goals are such as the rapid removal of the building from the site, reduction in environmental, health and safety stress for workers, easy access to components and materials, material recovery with high efficiency of reuse and recycling and eliminating toxicity in buildings materials are mentioned. As a result, deconstruction, the systematic taking apart of a building for the purpose of materials reuse as opposed to destructive demolition, is not a new concept, but it has not previously been the topic of research in Turkey. This study presents the current state of building deconstruction in Turkey and a deconstruction planning model is developed for the purpose of the future deconstruction activities.

## 1 Introduction

Deconstruction, although having the meaning of “destroying”; recently, is defined as “selective deconstruction”, which is done in definite sizes and under control for healthy recycling of the structures and their reuse [1]. Before a deconstruction process is performed, for a successful deconstruction, the evaluation of the sources (when, by whom and which method will be used) and the algorithm of the processes should be defined. Briefly; a deconstruction has to be planned. In this study, the methods, from the beginning of a deconstruction till the final level and the deconstruction steps are studied.

The most important aims of planning are; improvement of the source productivity and economy, reducing the pollution effects during deconstruction and adaptation and reuse, obtaining the materials for recycling and reconstruction. However, the aim is certainly not limited by the topics listed above. First of all, the first step of planning is the definition of deconstruction objects. As it is performed in construction projects, defining the project aims will help to understand the route of the planning and to come to a decision of the deconstruction method. To avoid any dangerous situations during demolition, the actions of deconstruction can be defined as the second step. The actions, hold before demolition, are the studies to find out if the structure is suitable for deconstruction. The actions, hold during the demolition, are including the application steps of chosen deconstruction method. Another important step of planning is; the search of source and cost sufficiency. The cost analysis of deconstruction plays an important role in planning. After the definition of source and cost information, the calculation of approximate demolition duration, the earliest and latest start-end times should be determined. The time is effective to the costs as it is affecting to the project productivity. After the questions are answered, it can be decided if a deconstruction will be done or not. If a deconstruction will be performed, then the deconstruction type should be determined and planned.

## 2 Planning of Deconstruction

The examples of deconstruction show us that, it is a professional sector especially in European Countries. There are specialised companies and at the universities, scientific researches are being done. Every year, scientists from universities all over the world and people from industries meet at *Task Group 39* work shops and publish their studies. From the side of Turkey, it can unfortunately be said that deconstruction is not a sector yet and demolition processes are performed by small companies. According to the deconstruction methods, applied all around the World, a deconstruction model is developed for Turkey [2]. At the sketch below, the steps of the model is shown Fig.1.

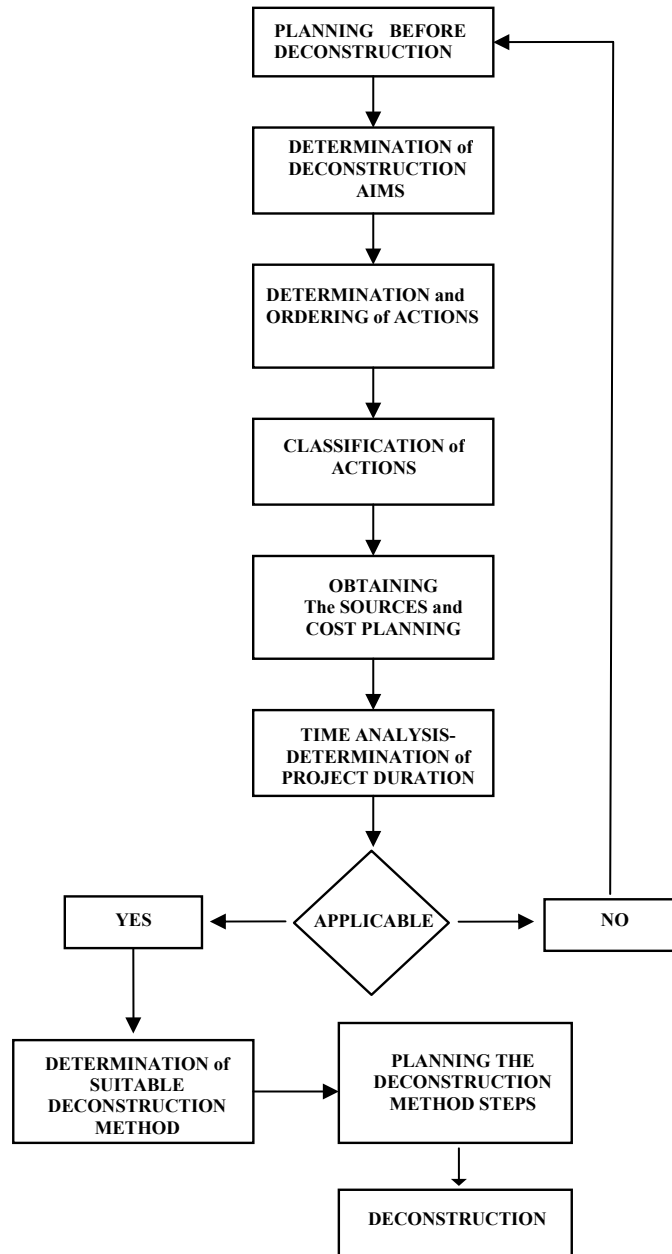


Figure 1: A Deconstruction Model Example for Turkey [2]

## 2.1 Determination of Deconstruction Aims

As like in construction planning; first the Project aims should be determined [3]. At the Fig.2, the general aims of a deconstruction project is shown.

In addition to the aims listed above, some admissions and restrictions, which can effect the application of the project, should be defined, too. As an example; to find sources to the chosen deconstruction method, financial aims and limitations, local administrative decisions, environmental aspects, effectiveness of the management decisions and performance at field.

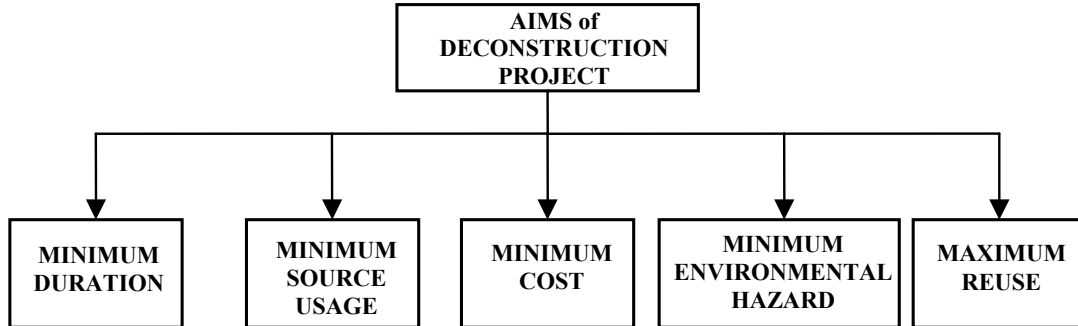


Figure 2: Aims of a Deconstruction Project

## 2.2 Determination of Actions, Ordering and Classification

The determination of investigation areas and ordering according to their importance forms these step [4]. They are;

- Studying the type and carriage systems of the structure
- The situation of dangerous materials
- The amount of reusable material
- If exists, the determination of damaged zones on the structure
- General situation of the are, the structure is located, ... etc

Before the demolition starts, the topics should be clearly defined and the studies should be completed. The information gained will be useful for the decision making of demolition method. For the deconstruction method decision, the actions can be divided into 3 main groups. They have the following properties, (Fig.3,4,5);

### a) Studying the Structure

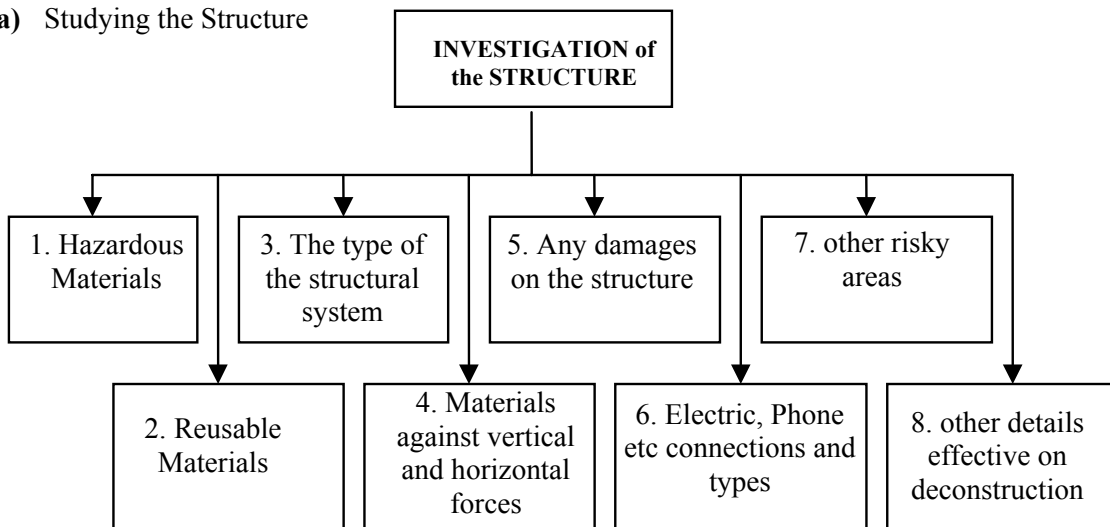


Figure 3: Search Topics of Structure Study

b) Investigation of the Site

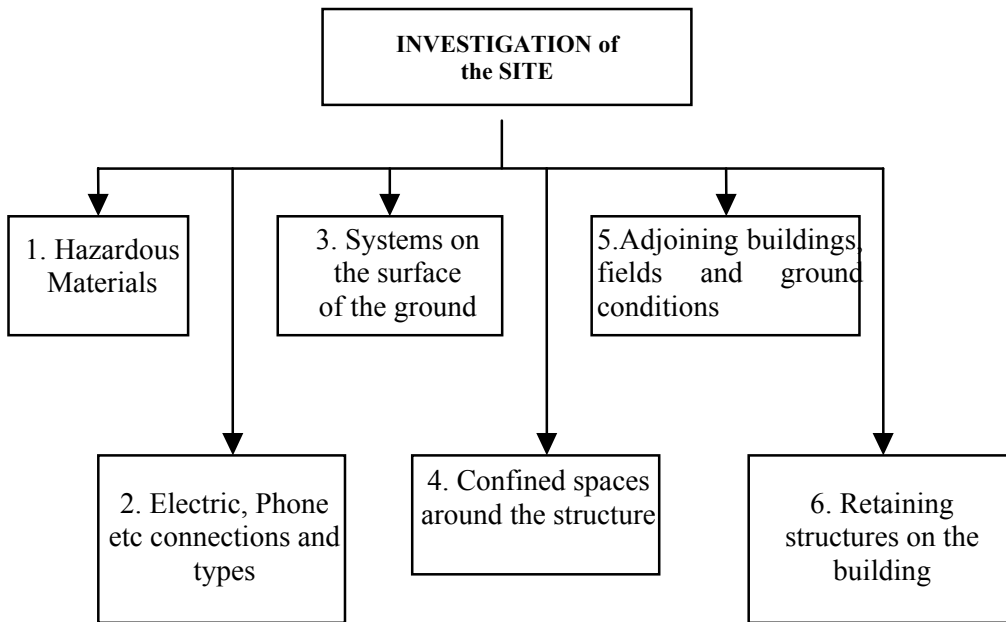


Figure 4: Search Topics of Structure Environment Study

c) Determination of General Works

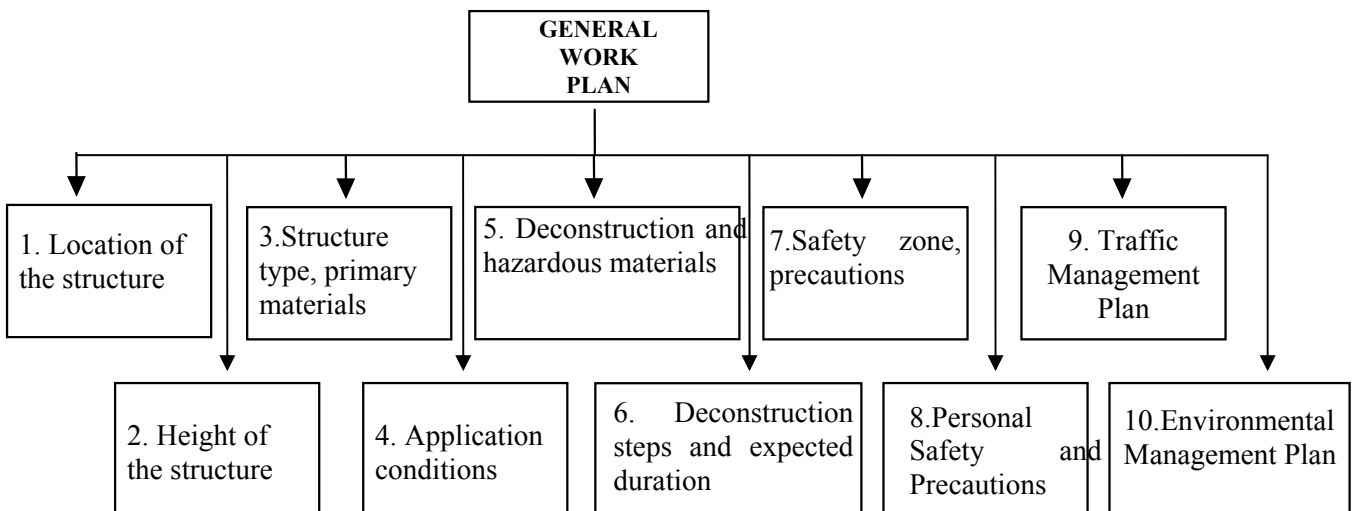


Figure 5: Main Steps of General Work Plan

### 2.3 Obtaining the Sources and Cost Planning

For the applicability of a deconstruction project, the sufficiency of the source and cost information plays an important role. What's more, for the calculation of the total cost and budget, every work step should be defined clearly.

The cost of a deconstruction process contains the work site establishment, workers costs, machine and equipment costs, subcontractor costs and others. They all should be taken into account at a deconstruction works, as they are done during construction planning.

### 2.4 Calculation of Deconstruction Duration

At planning stages, before deconstruction, the actions should be defined and classified, as it was mentioned above. According to this, the duration of the actions determines the total duration of the deconstruction. Any delay of these stages would effect the whole project completion time.

## 3 Deconstruction Methods

Before deciding the deconstruction method, the material type and the construction technology of the structure should be known, and it is the first topic, which should be studied. The main factors affecting the deconstruction method are summarized below, Fig.6;

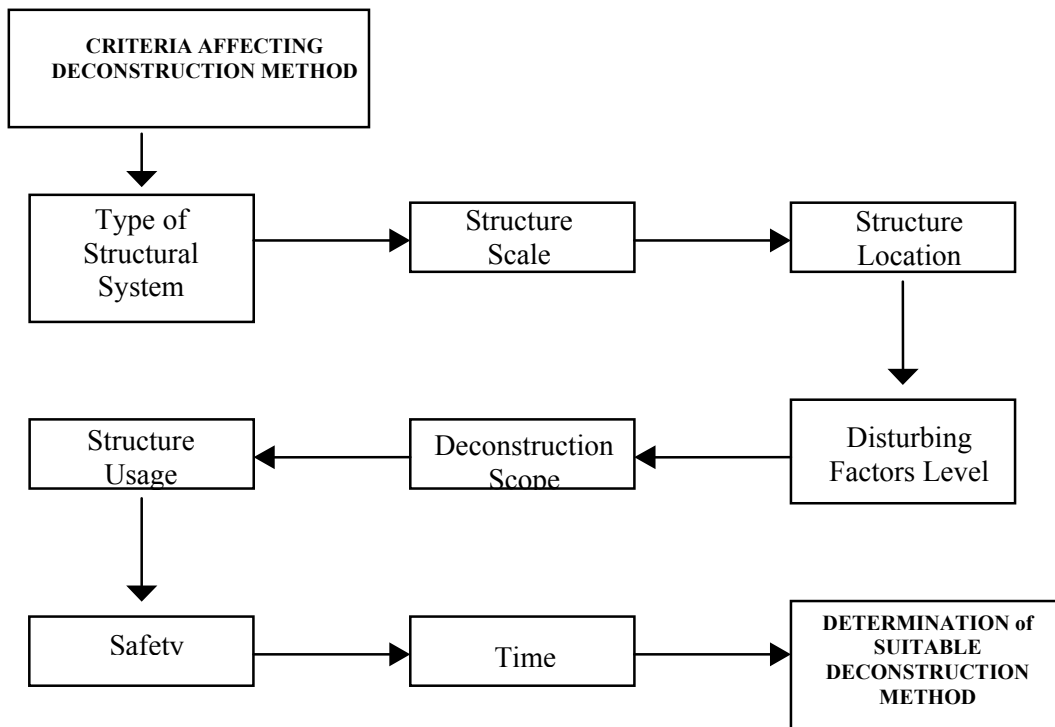


Figure 6: Main Criteria for Deconstruction Method Decisions [5].

The factors given on Fig. 6, are evaluated together to decide the most suitable deconstruction method. Main methods can be divided into 3 groups [6], these main methods are shown in Fig.7,8.;

- 1.By hand,
- 2..Mechanical Deconstruction
- 3.Using explosives



Figure 7: Deconstruction Examples by Steel Ball [7], [8].



Figure 8: Deconstruction of a High Building by Explosives [9].

## 4 Conclusion

Deconstruction is an unavoidable end for old building is the main idea, which has lead us to study deconstruction and its planning, and prepare an example model for Turkey. This final decision can only provide high utility and minimal hazard to environment as long as it is done by “selective deconstruction”. Selective deconstruction means controlled and defined limited deconstruction to gain healthy reuse and recycling. What’s more, by planning not only reuse and recycling is obtained, also for a successful deconstruction, the sources are defined; when, by whom and by which method they will be evaluated.

In Turkey, especially in crowded cities, new buildings are needed due to increasing population. In addition, because of being threatened by earthquake, people living in old houses are under danger. Therefore, it is not just a need, more an obligation, to deconstruct old building and replace them with new ones.

The need of rebuilding new buildings instead of the old ones and also the need of deconstruction the buildings, which are build illegal, shows that deconstruction sector will be more and more important in the future in Turkey.

A deconstruction conscious should be gained; for standardisation, for quality, to give minimum hazard to the environment and to the people and not to waste our sources. All the works should be done by planning.

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