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THE EVALUATION OF TEMPORARY EARTHQUAKE HOUSES DISMANTLING PROCESS IN THE CONTEXT OF BUILDING WASTE MANAGEMENT

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ABSTRACT The construction of buildings and production of the building materials generate environmental effects and problems by various ways. Wastes are formed during the life cycle of buildings such as construction, renovation and demolition phases. A rationalist management and planning can decrease the environmental and economic effects of building wastes. The process of dismantling/deconstruction is as important and costless as the construction process. Thus, the planning for the dismantling process of the building materials that can not be re-used is important from the point view of non forming wastes. This study explores and examines the dismantling/deconstruction process of temporary houses that were constructed after 1999 Marmara and Düzce Earthquakes in Düzce after occupancy. The problems observed during dismantling/deconstruction processes were investigated thoroughly from the point view of building waste management. As a result of the study, it is determined that there were no planning studies for the dismantling/deconstruction phases before, during and after the disaster. Consequently, there were no infrastructures for the organization of the dismantling/deconstruction operations. The operations were made by the inexperienced subcontractors so that they made great damages during dismantling and deconstruction. The control and orientation of dismantling/deconstruction processes by such subcontractors increased the material losses and wastes. This unproductive approach caused resource losses as well.

INTRODUCTION

Disasters are events which occur within some specified periods of time and spaces, and threat a society or a relatively self-sufficient part of a society with major unwanted consequences. They are mostly unavoidable events coming in unexpected times. However, settings of pre and post disaster activities have important roles in reducing the future hazard risks in disaster prone areas (Tercan, 2001). Individuals and communities are affected in ways which prevent their normal functioning. All appropriate actions after the disaster are taken to enable individuals and their communities to return to their normal life as soon as possible both physically, socially and psychologically (EMA, 1996).

Worldwide losses from disasters are increasing. This is not only from the number of natural and manmade disasters but also from the cost in property to the human life. For natural disasters worldwide, the annual economic losses averaged $4, 9 billion in the 1960's, $15, 1 billion in the 1980's and $75,9 billion annually in the 1990's (Siembieda et al., 2002). However, disasters cause also technological, societal and environmental problems.

Thousands of people died and most of the houses were demolished or damaged after 1999 Marmara and Duzce earthquakes. Finally, significant shelter problems occurred for the disaster victims. The central government considered that permanent housing construction process will take more than one year or longer. So the central government constructed temporary houses in many sites by the help of national and international aids in order to solve the sheltering problems of the victims. After the construction of permanent houses, some temporary house settlers who were home owners passed to their permanent houses and some of the temporary housing sites became vacant after this evacuation process. Planning for temporary housing before the disaster is very crucial during and after the disaster from the point view of solving the sheltering problem. At the same time, while considering from the view point of Life Cycle Assessment (LCA) the process of temporary housing dismantling/deconstruction is at least as crucial as and as costly as the construction process. Planning and organization of the deconstruction/dismantling process is not only important in reducing the building wastes but also important for decreasing the re-use potentials of the temporary houses.

This study explores and examines the dismantling/deconstruction process of temporary houses that were constructed after 1999 Marmara and Düzce Earthquakes in Düzce after occupancy. The problems observed during dismantling/deconstruction processes were investigated thoroughly from the point view of building waste management.

PLANNING FOR DISMANTLING OF TEMPORARY HOUSES

Temporary housing draw resources of reconstruction facilities of the disaster affected regions and especially seen expensive and waste of money and time. However, judging by the frequency of recent large-scale disasters, the supply of temporary housing units can be essential for quick recovery of the population and to allow time for safe rebuilding (Cassidy, 2007). So the Construction/Building Demolition (C&D) Wastes which is defined as the waste building materials, packaging, and rubble resulting from construction, renovation, repair, and demolition operation on pavements, houses, other buildings and structures is very crucial in the decrease of the cost of post disaster temporary houses by giving re-use and recycle options [1]. Ideally, after a disaster, temporary housing would be immediately available, offering a level of comfort consistent with the prevailing standard of living, at a cost proportional to intended length of use and easily eradicated or transformed once it is no longer needed; but in reality temporary housing is overly expensive and later on, temporary housing sites can become an environmental blight and a hotbed of social dysfunction (Cassidy, 2007).

As with most activities undertaken on an installation, the first step to establishing a successful and responsible environmental program for construction and demolition projects is planning. Some of the plans may already be in place and need only to be reviewed. These are the policies and plans set forth by the installation. Others will need to be developed on a project-by-project basis, though consistent standards will mean that plans do not have to be recreated for each activity. The project plans will usually require that specific requirements be set forth in contracts. Finally, it is important to plan for disaster. Debris created in a natural disaster or during the deconstruction facilities of temporary houses attack must be properly managed. Planning ahead can ensure proper management options are available in times of severe stress [2]. After the end of occupancy of temporary houses there is a need for planning of waste management specifically on dismantling operations. The works during this phase listed below.

- Designate a person responsible for waste management
- Examine design details of building to ensure efficient use of materials
    - Favor designs using standard sizes
    - Favor the use of materials which are made from recycled materials and are recyclable
    - Favor durable materials which are energy saving

  - Reuse materials from renovation or demolition sites
  - Look for opportunities to reuse materials on site
- Evaluate materials ordering and storage procedures on site
  - Identify how materials are wasted onsite
  - Investigate storage methods in terms of preventing damage from careless handling or weather
- Evaluate site layout
  - Analyze where new, reusable and waste materials can be stored on site
  - The size and location of the site will significantly impact how wastes can be managed – are regular pick-ups required?
- Estimate waste production on site
  - Estimate the types and amounts of recyclable and non-recyclable wastes which are expected to be generated
- Investigate waste disposal options
  - Identify local landfill bans and regulations
  - Identify local waste recycling companies
- Investigate waste separation, storage, and transportation systems [3].

TEMPORARY HOUSING DISMANTLING PROCESS

On 12 November 1999 the devastating earthquake with 7.2 magnitudes occurred in Duzce province. Approximately 43,000 buildings were damaged. Generally 84% of damages occurred to the houses and 16% to the work places. Also 980 people died and 38,939 were injured (Ministry of Public Works and Settlements, 2000). In all, 11 temporary housing site 6669 temporary houses were constructed in Duzce province (Arslan, 2007). These temporary houses constructed as prefabricated panel systems.

After the construction of permanent houses, some temporary house settlers who were home owners passed to their permanent houses and some of the temporary housing sites became vacant afer this evacuation process and the dismantling works started.

In this case temporary house were sold to the related (private firms, individuals, etc.) people or firms. The peoples or firms went to the Ministry of Public Works and Settlements (MPWS) province directorship for dismantling works. The MPWS guided the people and firms to the subcontractors who had made some dismantling works of the MPWS before. The dismantling processes of temporary houses did not have a planned organization and the decision for dismantling determined due to the situations and quickly by the central government. In Düzce case two options were observed;

-Dismantling by the public sector: the provincial authorities of the MPWS dismantled the houses through the agency of subcontractors. The provincial authorities' role was limited with control. The dismantled materials were stored. The materials were used according to the available purposes (e.g. donation to the other disaster affected areas) approved by the central government.

-Dismantling by the private sector: The housing units were sold to the private firms or person. The private firms dismantled the housing units according to the method selected by the subcontractor (Arslan 2004).

THE EVALUATION OF DISMANTLING OPERATIONS IN DUZCE CASE STUDY:

The case study conducted on the site that is located 3 km east from the Duzce centre, on the Asar Stream border. 875 earthquake victims live in the site in 252 housing units. Houses which were made by the Disaster Work General Directorship were in double house type. Constructions were made by sandwich panel system. Panels which formed

interior and exterior wall were cement-wood shaving's mixture named chip panel. Sizes of the house are 5.50mx10.60m, approximately 30 m^2. Each unit has a concrete foundation with height of approximately 35-40 cm. (Figure 2-3).

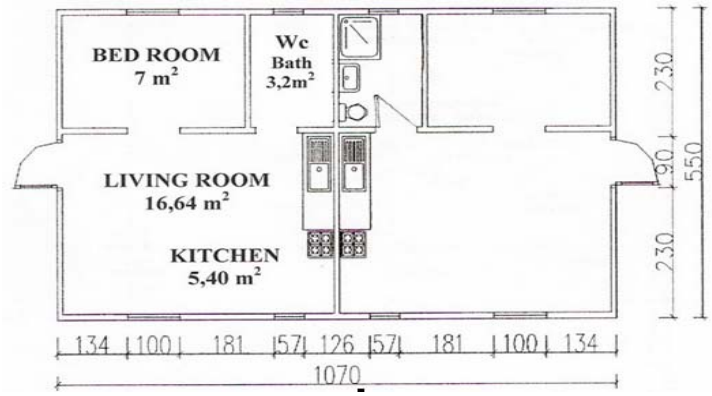

Figure-1. Fevzi Cakmak Temporary House Plan

Figure-3. Fevzi Cakmak Temporary House

The study is related to the site observations about the temporary housing dismantling works and operations conducted by subcontractors. But it was surprising that neither the firms nor the people who have bought the temporary housing units were at the site. There was no reliable control system. They did not have a control on the dismantling process. Thus the subcontractors made their operations according to finishing the works and operations as fast as they can. The firms and people did not acquaint with how they will rejoin and construct the temporary houses in their new locations and land. The operations and their order can be seen below (Table 1).

Table–1. Temporary housing dismantling process

Düzce Province Fevzi Çakmak (East Side) Prefabricated temporary housing site

(1) Dismantling starts from the roof materials

(2) Dismantling of roof pannels

(3) The roof pannels were numbered

(4) Stowing of the roof materials

(5) Dismantling of corner profiles

(6) Slackening of the corner profiles

(7) Dismantling of the panels

(8) Dismantle of building materials

First the operation began from the roof materials. The roof materials have conjunctions to the structural system of the temporary houses with screws. These conjunctions dismantled and the roof materials piled orderly. After this operation, sandwich panels numbered consequently. After the slackening and dismantling of the corner profile, the dismantling for the front panels started. The panels were between the profiles so as the profiles displaced the panels come away easier. The front panels numbered consequently for easy reconstruction. The front panels piled orderly as well. The subcontractors had high losses to the materials but by the time and operation number increases they had fewer losses according to the first operations.

STORAGE: after deconstruction/dismantling of the materials the need for storage occurred. MPWS province directorship formed a storage site for the temporary housing units. But, because of the lack of planning they were all insufficient and not appropriate for storage (Figure3). Thus, losses caused especially on sandwich panels of the

temporary units. The storage of building materials were not planned and they stored in other prefabricated housing units. Some of the materials are stolen and some are (especially sandwich panels) decomposed in unavailable storing areas (Figure 4).

Figure-3. Inappropriate storage of electrical materials

Figure-4. Inappropriate storage of sandwich panels

There is also no planning and reuse option for the infrastructure of the temporary housing sites. Each housing unit has a foundation with height of approximately 35-40 cm that means 21-24 m3 concrete can be recycled. But after the dismantling of the houses the infrastructure did not used and concrete foundations only used as landfill material (Figure 5).

Figure-5. View of foundations of the temporary housing site

Problems in Dismantling Phase: The general problems during the dismantling phase were determined and they can be summarized as;

- Unplanned and unorganized interventions and implementations by the local authority of MPWS (no short or long term planning).
- Lack of legal infrastructure for deconstruction and dismantling operations.
- Unqualified and inexperienced subcontractors.
- The complicated details of the housing units.

According to case study it can be pointed out that;

- The subcontractors did not have enough knowledge and qualifications so that they did not know the ropes of the dismantling operations and works. So the material losses were high. But they had high capacity to learn during the process.
- The dismantling planning and decisions were given during the operations. So this cause use of in appropriate labor tools (Figure–7) and inappropriate use.

Figure-7. Dismantling operations with inappropriate labor tools

TEMPORARY HOUSING RECYCLE AND RE-USE PROCESS

In Duzce case study three options of recycle and reuse potential were determined for the temporary houses;

1. Donation: the housing units were donated to the disaster affected areas, self governing office for mukhtar's and to the low income families in the villages of Düzce.
2. Selling: the central government sold the housing units in exchange cash money.
3. Old/New Function: the housing sites and houses were used with their old function (eg. temporary house) or with a new function (e.g. permanent house, worker dining hall and dorm, construction site office, etc.) (Arslan, 2007)

The general problems during the recycle and re-use phase were determined and they can be summarized as;

- Planning and organization structure were not determined
- Decision for short and long term were not determined
- The lack of storing lands and/or buildings for the houses materials (Arslan 2004).

CONCLUSIONS

The result of the study clearly shows that there are two methods for temporary housing dismantling/deconstruction processes in Düzce. Primarily temporary houses dismantled/deconstructed by the public sector in which the central government had an organizational role. The second method is the dismantling/deconstruction of the temporary houses by the private sector initiative that includes private firms and/or peoples. As a result of the observation acquired in the study area it is determined that there were no planning studies for the dismantling/deconstruction phases before, during and after the disaster. Consequently, there was no infrastructure for the organization of the dismantling/deconstruction operations. The operations were made by the inexperienced subcontractors so that they made great damages during dismantling and deconstruction. The control and orientation of dismantling/deconstruction processes by such subcontractors increased the material losses and wastes. This unproductive approach caused resource losses as well. So the dismantling phase must be planned before the disaster and the phases must be determined with their sub action plan levels (Figure 8).

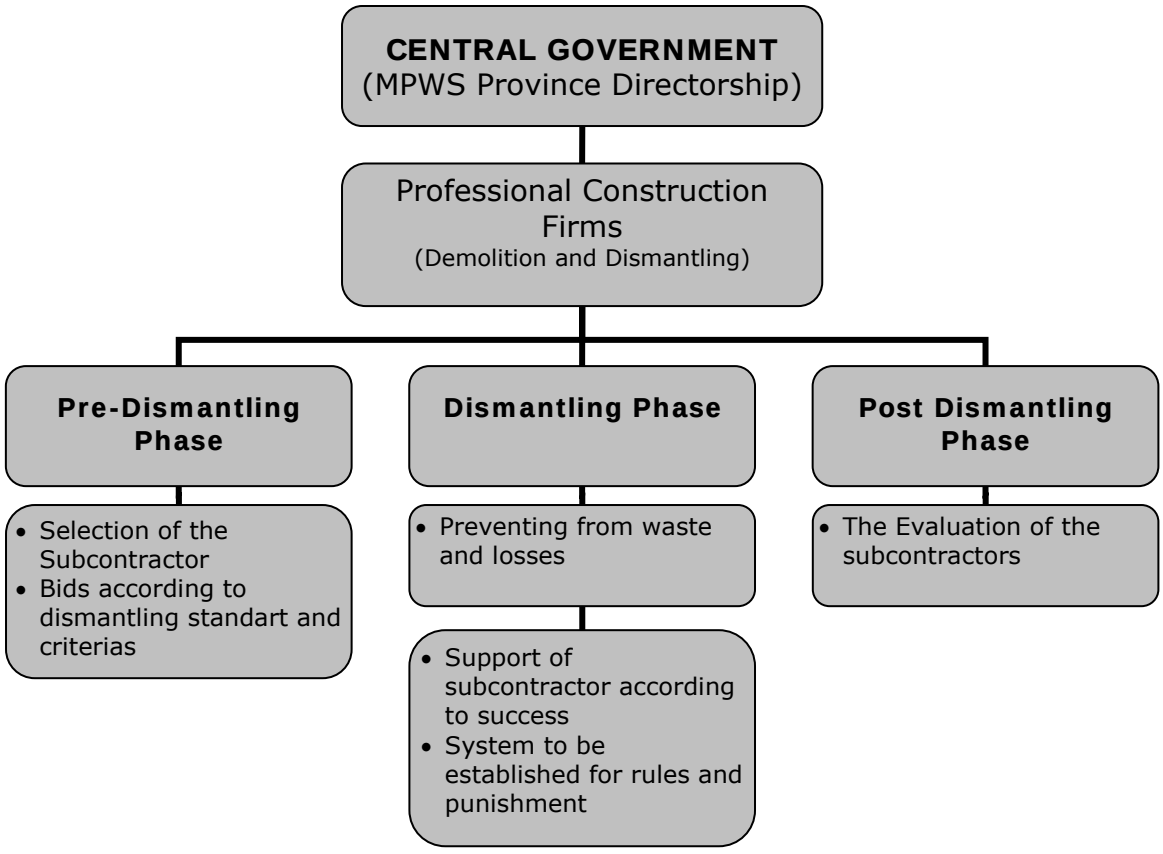

Figure-8. Dismantling Organization Recommendation for Temporary Houses

Areas for the temporary storage of temporary deconstruction materials should be clearly designated on pre disaster phase. The dismantling phase is the reverse of the construction. So the building details must be considered before the dismantling works and sub works must be determined according to the professionals in the team.

Different building types or different detailed buildings must be analyzed by the experts such as architect or design team who designed the building.

It is a crucial issue to consider the efficiency in dismantling phase which is re-use and recycle options of the wastes and losses.

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