USED BUILDING MATERIALS FOR LOW-COST CONSTRUCTION [*]

ABSTRACT

Demolition contractors in Turkey usually expend a lot of effort on salvaging as much building material as possible from the buildings they demolish. The reason being that used building materials (UBM) are in considerable demand by lower-income urban communities for house repairs and construction, and a substantial amount of profit is made by selling such material. Although a number of demolition contractor's yards (DCY), which are also the outlets for UBM, exist in all major urban centres of Turkey not much is known about their existence or merchandise by the public at large; the buyers being mostly squatters.

In larger cities, the demand for low-cost housing is growing parallel to the growth of rural-to-urban migration. This demand is met by the informal housing sector, which constructs new dwellings with UBM acquired from the DCY. This study focused on the type of material being procured from such outlets, the mode of construction of these dwellings, and the way in which material and components from demolished buildings were being incorporated into the "new" structure. In addition to a survey on low-cost housing, a case study was conducted on some very presentable buildings that were built entirely with materials recovered from deconstructed ones.

The survey has revealed that all types of salvaged building material and components are being used to lower the construction costs, while the case study has demonstrated that buildings constructed with UBM need not be derelict, uncomfortable or sub-standard. To the contrary, the use of UBM has many advantages, which need to be explored by architects, designers, and builders. Moreover, the construction industry needs to focus its attention on designing and producing building components with the potential for reuse; the overall benefits are far too many to be ignored.

1. INTRODUCTION

Construction and demolition (C&D) activities generate large amounts of solid waste, which have to be disposed off appropriately. The best way to reduce demolition waste is to "deconstruct" the building, and reuse or recycle as much recovered material as possible. In Turkey, the tradition of reusing building materials is very old. It is therefore not surprising that second-hand building materials and components have considerable market value. Consequently, demolition contractors also aim at recovering as much material as possible through partial deconstruction of the buildings, as anything reusable is also re-saleable. Used building materials and components are offered for sale at the demolition contractors' yards, which exist in all major cities of Turkey.

The DCY stock up on all kinds of building material and components that can be salvaged with the least amount of damage from the demolition job, such as roofing sheets and tiles; timber joists, studs and boards; all types of floor covering; door-sets and fenestration; sanitary and electrical fittings; heating equipment, and fixtures. Old clay brick is usually recovered but masonry units in general are discarded, since it is more difficult to recover them in intact or remove the plaster from their surfaces (Elias-Ozkan 2002). Nevertheless, some examples of such blocks being reused for building squatter houses were seen during the survey.

Used building materials and components are recovered from four types of buildings: large industrial structures that include factories and warehouses; multi-storeyed commercial buildings, residential buildings; and old and sometimes very ornate villas. A lot of finishing material and fixtures are also recovered from renovation projects of hotel or commercial buildings. Some of the material is sold in the state it was recovered in, while other may be repaired before offering for sale. At times, a client can ask for specific alteration to some components, as in the case of the buyer who wanted

[*] S.T. Elias-Ozkan is assistant professor, Department of Architecture, Middle East Technical University, Ankara, Turkey.

square glass panes to be inserted in the hitherto flush doors that had been recovered from the renovation project of a five star hotel in Izmir.

An unexpected source of UBM at the DCY were the thousands of earthquake damaged buildings in the Marmara region, which was struck by an earthquake of magnitude 7.2 on the Richter scale, in 1999. Dangerously damaged buildings had to be pulled down and the demolition teams as well as the owners made an immense effort to salvage as much material as possible from the demolished buildings (Elias-Ozkan 2003). These materials are being sold at the DCYs in Istanbul and Izmir; cities that are quite far from the scene of disaster, since they were a constant reminder of the massive destruction to the local population.

Buyers of UBM have been identified as (Elias-Ozkan 2002):

1. Antique-hunters who tend to frequent used building material stores in Izmir and Istanbul, as numerous historical buildings with exquisite woodwork, wrought iron and brass accessories have been pulled down in these cities. Such salvaged items are works of art that are no longer produced.
2. Interior decorators looking for matching components or decorative finishing materials for renovation projects; like solid timber panelling, decorative glass, wrought iron grills and weathered brick etc.
3. Home-owners looking for reasonably priced replacements for damaged components like doors, radiators, and bathroom fittings etc.
4. Builders looking for timber for formwork and scaffolding.
5. Builders from the Anatolian villages, who also use UBM for lowering construction costs.
6. Squatters, who use just about everything second-hand to build their shelters quickly and inexpensively. (It must be added here that all squatters do not construct their houses with used building materials.)

1.1 Literature Review

Low-income communities in Turkey have been using second hand building material to build their homes for years, yet, documented evidence of research in the field of used building materials conducted by professionals or academicians could not be found. In order to obtain pertinent information, a thorough search was conducted at the libraries and/or web pages of Turkish universities, Citation indexes, the State Institute of Statistics (DIE), Turkish Scientific and Technical Research Council (TÜBTAK), Turkish Standards Institute (TSE), Turkish Chamber of Architects and the local municipalities. Nonetheless, statistical data or qualitative information regarding this field could not to be located, apart from a short article written by S. Ozkan in the early seventies, and a news-story in a local magazine called *"Is Fikirleri".*

The Higher Education Council (YOK) library retains a copy of every graduate thesis produced in the country since the past 20 years [1]; these theses were examined at the library in Ankara but apart from the author's Ph.D dissertation, no other dissertation or thesis was available on the subject of re-use of building materials [2]. A search into dissertations/theses related to squatter settlements was also conducted to no avail. This search was carried further by checking likely sources enumerated in the bibliographies of these theses, to find any information regarding the use of UBM in squatter houses. Of these sources, only M. Turan's article on squatter settlements makes a fleeting reference to the squatters' use of second hand building material from demolished buildings [3].

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[1] The theses catalogue can be searched from the *"tezler"* link on the council's website www.yok.gov.tr in English also

[2] In December 2003 one more thesis has been completed; that of the author's advisee A. Isik on reused timber components.

[3] Turan, M., "Poverty, prudence, and place-making: Strolling through *gecekondus*". Habitat International, Vol. 11, No. 3, p. 93, Pergamon Press, 1987.

1.2 Objectives of the Research

Even though UBM yards are thriving in all major Turkish cities, so much so that in Ankara alone there are more than 30 DCY located on either sides of a main road in the old quarters, architects, engineers or building contractors do not frequent them. Either they are not aware of the existence of these yards, or if they are, they do not consider them as alternative sources of building material. The formal construction sector regards UBMs as sub-standard and therefore not worthy of use in new and prestigious buildings. Moreover, the Turkish Building Codes also do not allow for the use of second hand building materials in new construction works.

In view of the present state of affairs, the premise of this research was that UBM are contributing greatly towards lowering construction costs, yet this resource is not getting the recognition it deserves. The aim of this study was to first bring to light the ways and means in which UBM are being used in low-cost construction, thereby, attracting the attention of professionals related to the construction industry; and then to point out the fact that second hand material can be used to produce buildings of acceptable quality also. If UBM are recognized as a viable resource, then only will steps be taken to incorporate them into the design of new buildings. Once they are recognized and accepted officially (through codes and regulations) Turkey, like other environmentally concerned communities, will be able to greatly reduce its C&D waste and its consumption of virgin resources. Also, once academicians, researchers and architects realize the importance of UBMs in reducing costs and wastage of resources, research can be directed towards improving the conditions of UBM recovery, storage and marketing, as well as design of building components that facilitate the deconstruction of buildings and maximize reuse.

2. SURVEY ON APPLICATIONS OF USED BUILDING MATERIAL

According to information collected from the demolition contractors, of the five categories of clients the first two, i.e. antique hunters and interior decorators, who visit their yards are few and far between. Likewise, sales to homeowners, who are listed as the third category, are also not significant. Thus, the bulk of the material is supplied to the last three categories of buyers, namely, small builders, villagers and squatters. It is important to note that a number of DCY are located in every city of Turkey, which are also the source of UBM for squatters; although it does not mean that all squatters build with second hand material. The fact that squatter- or “informal-“ settlements house almost half of Turkey’s urban population indicates that a significant number of low-cost housing is being produced with the salvaged UBM.

Since the demolition contractor does not acquire UBM from a formal supplier but salvages them from the buildings he demolishes, he does not feel obliged to keep records of his stock. Also, since he sells his merchandise mostly to squatters or rural builders who do not require receipts, he does not go to the trouble of keeping a record of his sales, and is even less inclined to divulge information about the identity of his clients. This lack of data regarding a resource, which is already being utilised by the informal sector to bring down construction costs, is detrimental to the dissemination of knowledge about its existence. As a result, lack of pertinent knowledge has led to ignorance about the potential advantages of using UBM for low-cost construction.

In order to fully exploit this resource, it is necessary to first study how it has been utilised so far. For this reason a research was conducted, in two parts, on low-cost construction in the three largest cities of Turkey, namely: Istanbul, Ankara and Izmir. The first part dealt with a survey on low-cost housing in informal and regularized settlements, and the second was a case study of a DCY near Izmir, where all the structures had been built with UBM that the demolition contractor had salvaged from his jobs. The methodology of the survey and the case study are presented in the following section.

2.1 Methodology

As mentioned earlier, this study comprised of two parts: a survey of low-cost housing and a case study. The first part of the research was conducted as a visual survey of low-cost housing in formal and squatter settlements with a view to determine the types of UBM utilised and the way in which they were incorporated into the structure of the houses. All the photographs presented in this study were taken by the author in 2002–03. It should be noted here that squatters are usually suspicious of strangers asking for information regarding their houses, as the illegal nature of their dwellings poses a threat of eviction and demolition. For the same reason they may not take kindly to having their houses photographed. Since it was not possible to get the squatters to cooperate or to get permission to enter their houses, a visual survey from outside the houses gave a fair idea of the building material used to construct them. Hence photographs were taken of such houses in Ankara, Istanbul and Izmir. The results of the survey are given in the following section

One DCY in Izmir featured an office building and other ancillary structures constructed entirely with UBM. The yard was visited in the summer of 2003, and the two-storied office building was measured to produce the floor plans; the building was also photographed to record its quality and type of construction. The DCY owner and the head carpenter, who claims to have produced the entire woodwork single handed, were interviewed to gather details of the construction work and its cost. Since no written records of expenditure on material or workmanship were available, the information presented in the following sections is based on verbal interviews only.

2.2 Findings of the Survey

Records regarding the type and amount of building materials recovered from demolition or renovation works, or the material sold at the DCY are not maintained. Most sales are contracted without receipts and DCY owners are not inclined to discuss their dealings with outsiders, since they fear prosecution for conducting business with squatters. Even though it is not easy to gather information about the amount of sales, it is possible to collect visual data about the type of used building materials in the market and the way they are used in the construction of low-cost buildings, by visiting the DCY and squatter settlements. This survey was conducted on squatter settlements as well as low-income localities that were once illegal but have now been granted property rights by government decree. The following sections present the findings of the survey regarding the application of UBM in low-cost housing in Turkey and the case study of a very presentable building located at a DCY in Buca near Izmir.

2.2.1 Low-:Cost Housing. Squatter settlements are thickly populated densely built areas. Unlike their counterparts in Asia or Africa, squatter houses in Turkey are permanent structures built of brick and mortar, the roof is made of timber protected with clay tiles and they have electricity and water connections, which are sometimes illegally obtained. Lack of security is manifest in the presence of iron grills in the windows of all buildings, to keep out potential intruders (Figure 1).

The visual survey regarding low-cost houses, which was conducted in Ankara, Istanbul and Izmir revealed the following facts:

- The structures were usually one or two storeys high, built with load bearing brick or concrete block masonry, mostly plastered and painted. Sometimes walls were made of used concrete blocks that still carried traces of old plaster and paint (Figure 2). Buildings with more than two storeys had a reinforced concrete column and beam structure; such buildings were usually located in informal settlements of past which have now been granted land tenure.
- If the structure was made of load bearing masonry walls then the foundation was either stone or concrete, which came up to plinth level.
- It was possible to see a variety of masonry, from concrete blocks to clay bricks, all in the same building.
- The roof was generally constructed with timber joists and planks or fibreboards, protected by clay roofing tiles. In poorer quarters, the roofs were covered with corrugated roofing sheets made of galvanised iron, aluminium, asbestos or PVC.

- Finishing material for topmost floor ceiling, as observed from the undersides of the projected eaves, was timber boards, fibreboards, or even cardboard. Heat proofing was not visible; therefore it cannot be stated with certainty whether there was any or not.
- Fenestration did not usually match and neither did the door sets. It was possible to see a mix of steel doors and/or windows with timber ones, on the same floor. None of the houses observed had doors or windows made of PVC or aluminium.
- Stairs were built of used timber or second-hand spiral staircases made of galvanised iron were installed.
- Steps leading to the building were either of stone or concrete blocks.
- Protective iron grills over the openings varied in sizes and designs and, generally, did not fit properly. It was also possible to see that when a set of matching grills, that were obtained from the DCY, did not fit all the windows because the windows themselves were not of a standard size, some were rotated to cover the openings as best as they could (Figure 3)
- Although it was not possible to survey the interiors of these houses, information obtained from the DCY owners indicates that sanitary-ware, fittings and fixtures were also acquired from their outlets.

Figure 1. A squatter house in Ankara, built with salvaged material, mismatched windows and iron grills.

Figure 2. A squatter house in Ankara, built with salvaged concrete blocks that still have bits of old plaster and paint sticking on them.

Figure 3. A squatter house in Ankara: the iron-grills are rotated to fit the windows.

2.2.2 Case Study in Buca. The case study was conducted on a small office building, which belongs to a leading demolition contractor of Izmir and is part of the facilities present at the contractor's yard in Buca, near Izmir. All the three buildings, two workshops and the three sheds at the yard were built from UBM that the owners had salvaged from demolition and renovation projects. The small double storied office building, which was the most recent addition, was surveyed in detail and as can be seen from Figure 4 below, it did not lack in quality or style just because it was a low-cost construction using salvaged material. Although no records were kept about the amount or type of UBM used for the construction, their cost and the number of worker employed, an educated guess could be made from the measured building. The concrete and masonry work was done by hired labour but the carpenters in the employ of the contractor did the finishing work.

Figure 4. Front view of the double storied office building in the demolition contractor's yard in Buca.

The office building has a covered area of 75 m² on the ground floor and 70.2 m² on the first floor, excluding balcony and overhangs. The balcony has a covered area of 21 m². The ground floor consists of three rooms; all were accessible from the yard, which is paved with a variety of salvaged concrete terrazzo tiles. A winding wrought iron staircase leads up to the balcony where the entrance to the two rooms is located. The larger room, which is being used as the owner's office, is connected to the smaller one through a door and a toilet is attached to this room. The single storey timber structure next to this building measures 32 m², with a covered patio on three sides measuring another 50 m² of space. The measured plans of the office buildings can be seen below in Figure 5.

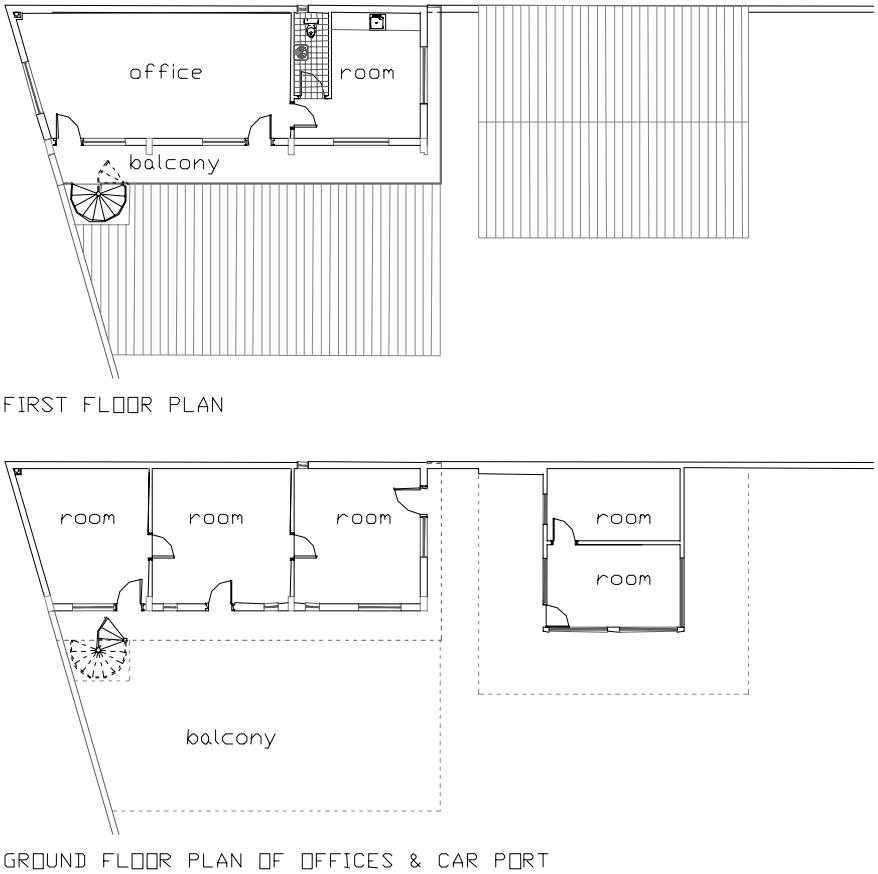

Figure 5. Floor plans of the office buildings in a demolition contractor's yard in Buca, near Izmir.

The building has a reinforced concrete column and beam structure and masonry walls on the ground floor while the upper floor was built with load-bearing masonry walls. The sloping roof is constructed of timber joists and planks covered with layers of water- and heat- proofing and protected with clay roofing tiles. All doors and windows on the ground floor are made of aluminium painted with white enamel but those on the upper floor are made of solid wood, finished off with clear varnish. The walls are plastered and painted, except on the interior of the large office room, which has off-white "Sunkalam" (laminated fibre board) panelling. All the building material, including the timber components, bathroom tiles, fenestration and carpet are salvaged materials; even accessories like lamps and bathroom fittings were old; only the Sunkalam panels, concrete and paint was new. Interior views of the office and bathroom on the first floor can be seen in Figures 6 and 7 below.

Figure 6. Interior view of the office building at the demolition contractor's yard in Buca.

Figure 7. Interior view of the toilet in the office buildings in Buca.

3. DISCUSSION

From the survey of low cost houses, especially those that belonged to squatters, it was evident that the owners built incrementally. Individual rooms or whole floors were added to the structure as

the need arose, or when there were enough funds to meet the cost of additional space. Whether the buildings consisted of one storey or more, it was possible to observe the different stages of construction from their exteriors, as they presented a haphazard configuration of elevations as well as a potpourri of styles, shapes, sizes, material and quality. Moreover, the locations of openings at all floors appear to be at random, which is an indication of an organic expansion of the building (Figure 8).

Figure 8. Low cost buildings showing evidence of incremental construction, with squatter housing in the background, in Izmir.

Since access to building interiors was denied it was not possible to gain first hand knowledge about their interior finishes, fittings and fixtures. However, information gathered from the DCY indicates that the houses were equipped with fittings and fixtures that were also salvaged from the demolished buildings.

It was also apparent that buildings were constructed not according to a pre-determined plan or design, but in abeyance to the constraints set by the types and sizes of UBM the owners could afford to buy. The reason that the parapet or lintel heights were not consistent and the openings did not align horizontally or vertically was probably that matching fenestration could not be found at the DCY. By and large, utility and affordability took precedence over aesthetics or even comfort in squatter housing. However, in some low-cost housing examples in Izmir, a concern for visual harmony was witnessed (Figure 9).

Figure 9. Low-cost buildings in Izmir, built with used building components.

Pertinent information and a rounded off figure for the total cost of construction was obtained from the owners and the carpenter of the case study office building. This cost did not include the cost of UBM, as they were considered free, nor did it include the wages of the workforce in permanent employ at the DCY. It only accounted for the concrete and masonry works and the workmanship for electricity and plumbing jobs. The cost of new materials and hired labour amounted to approximately 5,000,000,000 Turkish Liras (TL), which was equivalent to US $24000 at the rate of exchange of that time. This works out as $160/m², which amounts to a saving of 40% over the cost of a new building with comparable specifications.

It must be noted here that the figure pertaining to the actual cost of the building was not arrived at as a result of diligent accounting, but was offered as an approximate amount and hence, cannot be considered absolutely accurate. On the other hand we know from a previous research that it is possible to purchase used building components, fittings and fixtures at prices that are at least 50 to 60% lower than the cost of new products, and depending on the condition of the merchandise the price may even go down to as low as 25 to 33% of the cost of a similar brand new one (Elias-Ozkan 2002).

This survey on UBM and their utility in bringing down construction costs is by no means comprehensive in that it was conducted only in 3 cities and that too, not in all the squatter settlements. It should be noted that the results of this survey alone, though reliable, should not be considered as a basis for countrywide generalizations. A lot of data, especially regarding comparative pricing of all possible building components needs to be compiled in order to predict the amount of savings that can be made by using UBM in place of new material. Nevertheless, the case study buildings have demonstrated that the use of UBM does not take away from the quality of a building provided that they are planned as carefully as those being built with new material.

4. CONCLUSIONS

Results of the survey and the case study may seem self-evident to communities who are aware of the advantages of reusing and recycling building materials and components. However, it is not a forgone conclusion in this country. The connection between the used building materials market and the squatters is also not a well-known fact. Consequently, the research was aimed at bringing this useful resource to the attention of architects and academicians in Turkey, and to promote it so that it may gain acceptance, and be put to use more efficiently.

For years, the use of second hand building material has enabled low-income communities to build affordable housing. However, since architects and engineers were not involved in the design and construction of such houses, the result has not been attractive enough to encourage others to follow suit. If buildings are planned by professionals with the intention of using as much UBM as possible instead of new material, we will not only achieve a significant reduction in construction costs but also produce comfortable and presentable buildings at the same time. What is more, savings in construction costs will be accompanied by a saving in raw material, in energy for manufacturing new materials and also reduction in environmental damage caused by C&D waste disposal. It is therefore imperative that attention be paid to the utilization of UBM for lowering construction cost.

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