

## Classification of Construction Techniques of Architectural Components- Examples from Istanbul, Turkey

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**Abstract.** New materials, developments in technology, increasing need for new buildings and changing requirements has dictated a large variety of new construction techniques. According to specific conditions of each project, global new industrialized construction techniques or local traditional construction techniques or combinations of them all are used in erecting “the building”. The use of different kinds of construction techniques in combination on a single project creates a complex and sometimes irrational situation. For improving or rationalizing construction techniques the current situation needs to be determined. In the study construction techniques used in projects under local environmental conditions of Istanbul – Turkey are investigated. In the study 55 different construction phases of architectural components, in 16 different construction sites, were observed. Analyses were done in the context of operations in the construction process, location of construction and the construction inputs, namely; materials, tools and labour force. Results of the analyses are presented.

**Keywords:** construction techniques, construction process, on-site observations, architectural components, building elements.

### 1. Introduction

The number of building materials has exploded in the last century, caused by the industrial revolution and aftereffects of WWII. New building materials, developments in technology and the increasing need for housing caused by population growth and changing requirements has dictated a large variety of new construction techniques [1]. Today highly industrialized techniques are used together with traditional techniques in building construction. Some construction techniques are used in the same way all over the world as a consequence of globalization. On the other hand some construction techniques do have still a local and traditional character, affected by environmental conditions, such as economics, culture, climate etc. The building “industry”, differs from other industries, with its mostly “unique” end product, “the building”. According to specific conditions of each project, global industrialized construction techniques or local traditional construction techniques or combinations of them all might be used in erecting “the building”. The random use of different kinds of construction techniques in combination on a single project creates a complex and sometimes irrational situation. For improving or rationalizing construction techniques the current situation needs to be determined [2].

In the study construction techniques used in projects under local environmental conditions of Istanbul – Turkey are investigated.

### 2. Method of Study

55 different construction phases of architectural components, in 16 different construction sites, were observed in the study.

Architectural components are considered here to be sub-systems of building elements. Those sub-systems can be listed as; core layer, insulation layer(s) and finish layer(s) of exterior walls, windows and

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doors, floors, roofs, stairs and interior partitions. The observations were done on 16 different construction sites, comprising typologies such as; housing, office, hotel, laboratory, library and municipal facility in Istanbul – Turkey. Areas of different construction were varying from 560m<sup>2</sup> to 20.000m<sup>2</sup>. The observations were done between the years 2007 – 2009. Photographs were taken in certain intervals of each distinctive construction phase and also of materials and tools used in the construction process. A questionnaire survey was conducted on-site for gathering information on labour force [2].

For the analysis and classification of construction techniques a variety of methods are available [3, 4, 5, 6]. In the analysis, each construction phase is observed in the context of operations in the construction process, location of construction and the construction inputs, namely; materials, tools and labour force. Materials are analysed with the criteria of origin and industrial process level. Tools are analysed with the criteria of function, type and power source. Labour force is analysed with criteria of experience and education level. Construction techniques are classified according to criteria listed above.

### 3. An Example for The Analysis of Construction Techniques

An example of the construction technique analysis from the 55 investigated applications is presented below [2]. The selected example comprises the exterior finishing system of the exterior wall (Figure 1).

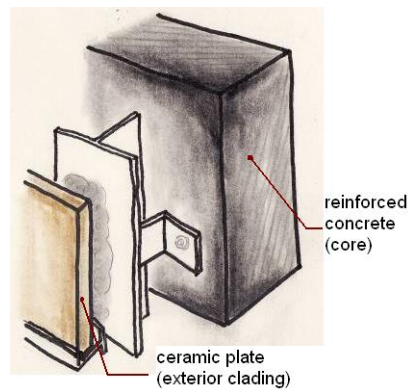


Figure 1. Ceramic tile finishing on reinforced concrete wall core.

Materials used in construction were; ceramic tiles (60x120cm), mineral fiber insulation, adhesive silicone, aluminum T-Profiles (600x7x7cm), joint profiles, joint sealants and screws with plugs. Tools used in construction were; power drill, electric circular saw, ceramic cutting machine and silicone gun. The application was carried out by three skilled construction workers with 23, 10 and 8 years of experience. Steps of construction are listed below (Figure 2):

- Aluminum profiles were cut to size with circular saw.
- T-Profiles perpendicular to the anchorages were mounted to the wall using screws and plugs.
- Mineral fiber insulation was applied on the wall with large head wall plugs.
- Horizontal joint profiles were installed between the T-Profiles with screws.
- Ceramic tiles were cut to size with a ceramic cutting machine if necessary.
- Adhesive silicone was applied on the T-Profile with a silicone gun.
- Ceramic tiles were applied on to the T-profiles.

Main activities in the construction process can be listed as “subtracting” and “adding”. The subtracting activity comprises; cutting of “ceramic tiles” to size and cutting of aluminum profiles to size. Adding activities are; application of insulation to the wall, mechanical fixing of aluminum T-profiles to anchorage plates, joint profiles to T-profiles and organic fixing of ceramic tiles to T-profiles.

Though aluminum profiles and ceramic tiles are pre formed and ready-to-use manufactured materials, they are reshaped on site in cutting to size where necessary in this example.



Figure 2. Steps of construction.

## 4. Results

Result of the analysis of architectural components are compiled in the context of relating building elements. Analysis of materials, tools and labor force used in the constructions are given in Table 1, Table 2, Table 3 respectively. Analysis of the activities in the construction process are given in Table 4. Analysis regarding the location of construction are given in Table 5.

Table 1. Analysis of materials according to origin and form, used in the construction of different building elements.

building elements	origin								form	
	wood	natural stone	earth/clay	cement	metal	glass	polymer	bitumen	pre-formed	formed on site
exterior wall	6%	6%	12%	40%	12%	12%	6%	6%	78%	22%
roof	17%	---	---	17%	32%	---	17%	17%	100%	---
floor	---	20%	20%	30%	10%	10%	10%	---	47%	53%
internal partition	---	---	22%	56%	22%	---	---	---	67%	33%
stairs	---	25%	---	50%	25%	---	---	---	50%	50%
window & door	---	25%	---	---	25%	25%	25%	---	100%	---

Table 2. Analysis of tools according to function, size and energy source, used in the construction of different building elements.

building elements	function			size		energy source	
	drilling	cutting	moving	hand tools	const. machine	muscle power	energy
exterior wall	31%	42%	27%	71%	29%	58%	42%
roof	21%	43%	36%	63%	37%	44%	56%
floor	13%	50%	37%	69%	31%	46%	54%
internal partition	25%	50%	25%	86%	14%	62%	38%
stairs	25%	75%	---	100%	---	57%	43%
window & door	38%	24%	38%	100%	---	50%	50%

Table 3. Analysis of labour force according to experience level in the construction of different building elements.

building element	labour force	experience (years)				
		<5	5-10	11-15	16-21	>20
exterior wall	skilled	5%	41%	20%	27%	7%
	unskilled	34%	66%	---	---	---
roof	skilled	---	20%	47%	27%	6%
	unskilled	80%	20%	---	---	---
floor	skilled	---	20%	29%	44%	7%
	unskilled	38%	62%	---	---	---
interior partition	skilled	---	39%	15%	31%	15%
	unskilled	95%	5%	---	---	---
stairs	skilled	---	14%	43%	43%	---
	unskilled	2%	98%	---	---	---
window & door	skilled	---	29%	42%	29%	---

Table 4. Activities in the construction process of different building elements.

building elements	adding	subtracting	forming
exterior wall	62%	33%	5%
roof	47%	47%	6%
floor	38%	38%	24%
internal partition	65%	35%	---
stairs	38%	38%	24%
window & door	67%	33%	---

Table 5. Analysis of location of construction process

building elements	mostly on site	mostly off site
exterior wall	81%	19%
roof	50%	50%
floor	85%	15%
internal partition	70%	30%
stairs	75%	25%
window & door	25%	75%

## 5. Conclusion

55 different construction phases of architectural components were observed, analysed and classified according to process inputs, activities and location of construction. The obtained results are given below:

- Most used materials in the construction of building elements are cement based. Other often used materials are; natural stone based, metal based, glass based and earth/clay based.
- Mostly muscle powered, hand tools are used in the construction of building elements.
- Most of the labour force is skilled and experienced 5-20 years.
- “Adding” and “subtracting” are the most activities in construction process.
- Most of the construction process takes place on site.

In the context of the investigated examples it can be stated that in the construction of architectural components; labour intensive traditional or improved traditional techniques are used. Even ready-to-use manufactured materials are processed on site, according to design decisions. Further study on collecting data on construction techniques and analyses on advantages and disadvantages is needed for improving or rationalizing.

## 6. References

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