

IDENTIFYING THE CAUSES OF ARCHITECTURAL DESIGN PROCESS FAILURES

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Construction is performed with interdisciplinary cooperation, as it requires the preparation of various projects across numerous areas of engineering and architecture. To ensure that projects are complete and coherent, it is important to manage the design process efficiently. It is known that several design failures occur which cause construction reworks if design process could not manage well. Therefore, the current study analyzed causes of design process failures, and adverse effects regarding these failures during the construction. The opinions of architects who were actively involved in design and construction stages of projects were recorded through 354 questionnaires. The opinions of building audit firm employees and employers, that one of the important stakeholders, took in consideration regarding design failures. A total of 351 survey forms were collected from the building audit firms. Data were analyzed using SPSS 22 software. Results indicated that the architectural projects did not include detailed drawings and that concurrent engineering was not applied during the architectural design process. This incompatibility among the projects negatively influenced the construction process.

Keywords: Construction management, Construction industry, Design failures, Construction professionals, Architectural design firms.

1 INTRODUCTION

Design and construction are a collaborative social act that relies on effective interaction between project stakeholders (Gorse and Emmitt 2007). Continuous development and improvement of knowledge and experience and serious increase in expertise increase quality of design process as well as its complexity and duration (Isa *et al.* 2016). Design team of a project may be composed of firms from different occupations and disciplines and these groups might be located in different geographies. Moreover, other stakeholders such as building audit firms, local authorities, contractors, sub-contractors, material suppliers, structural engineers, and clients participate during the architectural design process.

Issues such as physical size, structural system, internal equipment etc. which would directly affect cost, and construction process should be determined in design process. In order to increase precision level of decisions and enable projects which are prepared by different engineering fields should be coherent with each other. Therefore, planning the design process well-coordinated and managed is significant.

When this process is not managed sufficiently and coordinational, many failures and deficiencies are encountered in construction stage (Ayuba *et al.* 2012). Incompatibility between projects, deficiencies and errors are the most common failures among these.

These deficiencies have various negative reflections on duration, cost and quality of project (Mo and Ng 1997). One of them is rework that is most frequently encountered problem. Rework is the unnecessary effort of re-doing a process or activity that was incorrectly implemented the first time because of project uncertainties and incompatibilities. Love *et al.* (2002), indicate that rework is an endemic feature of the construction procurement process and is a primary factor that cause time and cost overruns in projects.

Architectural design failures and incompatibility between projects are commonly experienced in construction process in Turkey. It is known that these deficiencies and failures influence construction process and construction quality negatively. Therefore, knowing the main source of mentioned failures is significant to minimize these adverse effects. Therefore, in this study, it was aimed to analyze failures during design process, their reasons and negative reflections of them on construction. To reach these aims data were collected with questionnaire from architects and building audit firms.

2 DESIGN PROCESS FAILURES IN TURKISH CONSTRUCTION INDUSTRY

The construction industry is a labor-intensive industry that directly affects the level of socio-economic welfare in the overall economic structure (El-Gohary and Aziz 2014). Quite a lot of sources are reserved for construction in Turkey as well as in the world (Altuncu and Kasapşekin 2011). In addition, because of Turkey being a developing country, not only infrastructure investments towards the industry, but also superstructure investments deriving from the intensive migration from rural areas to cities, continue to increase (Gürcanlı *et al.* 2021).

It is known that among various problems of construction industry in Turkey, especially failures during design process which influences cost and quality is significant.

Design failures refer to the execution of work that is unnecessary or incorrectly done (Tucker and Edmonson 2002). Design failures can seriously endanger safety and lead to errors in engineering and construction projects. These kinds of failures can have disastrous economic, social and environmental consequences (Love *et al.* 2013). Design failure represents significant deviations from specifications or drawings, including omissions and ambiguities (Salihu and Babarinde 2020).

Determination of design failures in deep during design process is significant for offering efficient solution. Therefore, it was aimed to analyze reasons of architectural design failures and their impacts on construction process.

3 RESEARCH METHOD

In order to identify the cause of design failures and their negative impacts at construction, data were obtained from architects and building audit firm employers and employees via a questionnaire.

Building audit is carried out by private building audit firms formed by legal regulations in Turkey. All construction technical drawings including architectural ones are supervised by these firms before construction license. To gain a different point of viewpoint for architectural design failures opinions of building audit firms were obtained. In this scope two survey forms were organized, one for architects and the other for building audit firms.

The target population for this study included architects and building audit firm employees. The questionnaires were sent to 1000 participants for each group via e-mail using random sampling method. A total of 354 survey forms were returned from architects, 351 survey forms were returned from building audit firms. SPSS 22 software was used in the analysis of data reliability analyses and descriptive analyses were conducted.

4 FINDINGS

4.1 Reliability Analyze

The Cronbach Alpha coefficients (α) of questionnaires conducted to architects and building audit firms were measured to be 0.722 and 0.794, respectively, which are both higher than the minimum requirement of 0.7 (Tavakol and Dennick 2011). These statistics reveal that the responses are remarkably consistent.

4.2 Descriptive Statistics

Within the scope of descriptive statistics, percentage (%) and frequency (f) distributions of data were analyzed. First, data were analyzed according to city of participants that they live, it was determined that participation was enabled from 37 cities by architects and from 40 cities by building audit firms. In other words, when it is considered that there are 81 cities in Turkey, it is understood that survey forms could be collected from nearly half of Turkey. According to this data, it was accepted that results of survey represent Turkey in general.

As it is known, detail sheets are indispensable parts of architectural technical drawings. However according to the evaluation of architects and building audit firms in Table 1, details included in architectural projects are quite insufficient. What is interesting is that 72.1% (15.5+21.2+35.4) of architects accept that architectural projects do not involve sufficient details as well (Table 1).

Table 1. Evaluation of architects and building audit firms about frequency of detail inclusion in architectural projects.

What is the frequency of including detail of architectural projects?	Building audit firms		Architects	
	Frequency	%	Frequency	%
Always	23	6.5	49	13.8
Often	81	23.0	50	14.1
Sometimes	143	40.6	55	15.5
Rarely	98	28.1	75	21.2
Never	6	1.8	125	35.4
Total	351	100.0	354	100.0

It is undoubtedly the responsibility of architects to prepare projects completely and without failure and include enough details. The distributions of reasons why architects do not include detail sheets in their projects are given in details in Table 2. It is understood that the role of each factor given in this table is great in not giving enough details in architectural projects.

There might be various reasons for incompatibility and project failures between projects. One of the most important reasons among these is not architects do not hold meeting with representatives of other engineering fields in design process, in other words they do not act with the sense of concurrent engineering. It is seen that architects do not hold periodic meetings with other engineering groups in required frequency, they only negotiate with engineers they think necessary at specific intervals, therefore do not act according to the perception of concurrent engineering (Table 3). However, architects should carry out planning process coordinately with all project owners.

Table 2. Evaluation of architects about reasons of detail inadequacy in architectural project.

Reasons of not including details in architectural projects	I completely agree	I agree	Neutral	I disagree	I completely disagree	Total (%)
Detail drawing is ignored during architecture education.	17.3	35.9	12.7	29.1	5.0	100.0
Depending on working in different fields apart from project, detail drawing is not given too much time.	14.1	44.2	16.3	22.9	2.5	100.0
Laws do not impose detail drawing as condition for taking license and do not have sanction.	31.3	45.6	10.9	11.6	0.6	100.0
Detail drawing is not given to much time since the price of architectural project is low.	40.2	41.2	7.4	10.2	0.9	100.0
Drawing technicians and engineers do not have sufficient level of information.	16.9	45.4	14.7	18.8	4.2	100.0
Demands of the owner and/or contractor continuously change during construction.	20.6	38.4	18.1	20.3	2.5	100.0
The owner is not will not to pay extra price since s/he does not have enough knowledge about detail drawing.	42.9	37.9	8.8	8.5	1.9	100.0

Table 3. The frequency of periodic meetings carried by architects with all the other engineering representatives.

How often do you conduct meeting with the participation of all other engineering groups in design process?	Frequency	%
At least once a week	67	19.1
Biweekly	38	10.8
Once a month	26	7.4
Once in design process	21	5.9
Contact is done with the engineers when necessary, during design process.	196	55.2
Never	6	1.5
Total	354	100.0

One of the important negative outcomes of not acting according to the sense of concurrent engineering is to require project amendments during practice stage. Great majority of architects, 74.1%, stated that they have to make amendments according to demands during application of project (Table 4). This reflects not conducting design process concurrently.

Table 4. The frequency of architects' needs of making amendments.

Need of Project Amendment during Application	Frequency	%
Projects are completed without requirement of amendment.	92	25.9
I have to make amendments in projects according to demands.	262	74.1
Total	354	100.0

One of the negative outcomes of not acting according to concurrent engineering in construction process is incompatibility between projects. The frequency of building audit firms' confronting incompatibility between projects and related evaluations are given in Table 5. According to this table, great majority of architectural projects have deficiencies and there are many incompatibilities

between projects. In other words, there are scarcely any projects without deficiency or incompatibility.

Table 5. Frequency of building audit firms' confronting with project deficiency and incompatibility between projects.

Project deficiency and failures building audit firms confront	Always	Often	Sometimes	Rarely	Never	Total (%)
Architectural projects include many deficiencies and failures.	6.9	40.6	39.7	9.6	3.3	100.0
There is incompatibility between architectural projects and other projects (static, electricity etc.).	6.0	26.0	43.2	22.1	2.7	100.0

It is seen that deficiencies and failures in architectural projects hardens audit of projects, cause irresolution during practice and prepare grounds for building out of project (Table 6).

Table 6. Evaluations of building audit firms upon how deficiencies and failures in architectural project influence construction process.

The Effects of deficiencies and failures in architectural process on construction process	Frequency	%
Effects construction quality negatively.	87	24.81
Causes requirement for preparing amendment project	159	45.38
Causes irresolution during application process in detail construction.	147	41.95
Pave the way for sub-contractors to make arbitrary applications.	112	31.92

Note: Total frequency and percentage values were not given since participants marked one or more than more option in this question.

3 RESULTS

As a result of the current research, specific points were determined about "Architectural Design Process Failures" and "Causes of Architectural Design Process Failures".

i. Architectural Design Process Failures

- Great majority of architects in Turkey operate on different fields (such as furniture manufacturing, decoration etc.) apart from design and project planning,
- Preparation of requirement program is not paid enough attention,
- There are not enough details in technic drawings of architects,
- There are serious and common incompatibilities between projects,
- Architects do not give enough importance to participation of all stakeholders in design process, in other words they do not act with the sense of concurrent engineering.

Design failures cause amendments in projects, arbitrary applications, disagreement and therefore this situation influence construction security, aesthetics, cost and duration negatively.

ii. Causes of Architectural Design Process Failures

- Inexistence of legal regulation which obliges detail drawing,
- Architects not giving enough importance to detail drawing, preparation of requirement program etc.,
- Low cost of projects,

- Architects not being enough corporate yet and working as an individual enterprise,
- Drawing technicians and engineers working in architecture bureaus not having sufficient level of information.

Studies to be carried out in order to compensate deficiencies can be divided into two groups. One of them is education the other is legal sanctions. The importance of concurrent engineering and its vital importance should be emphasized elaborately during architectural education; it must be more emphasized that detail drawing is quite important for controlling construction process and therefore actualize the project and the subject should be consolidated in design studio courses. Moreover, it is no doubt that including subjects which would develop solution for project-based problems in application would contribute to the increase of awareness and sensibility of member of profession within the scope of postgraduate education studies of professional chambers.

Moreover, supporting inclusion of detail sheets in application projects with legal sanctions, for example including such an obligation to the conditions of building bylaws about taking license would have important contributions to the elimination of increasing deficiency about this issue.

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