

# King Fahd University of Petroleum and Minerals



COLLEGE OF ENVIRONMENTAL DESIGN

**CEM-520**

CONSTRUCTION CONTRACTING

**TERM PROJECT**

**Design-Construction Interface Dissonance**

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**Abstract:**

*This Paper reveals results of research study on **design and construction interface dissonances** in large building projects in the contextual boundaries of Eastern province of Saudi Arabia. To accomplish study objectives, the researcher carried comprehensive literature review of subject through periodicals, dissertations, previous research studies & books written on professional relationships on project interfaces.*

*Initially the researcher carried out a pilot study based on survey questionnaire developed through literature review. Pilot study encircles three large building projects, eventually the validity of tentative questionnaire was evaluated and final questionnaire for survey at macro perspective was organized. Responses from (48) forty eight consultants and contractors were analyzed through statistical analysis tool “STATISTICA”, the results indicate that lack of coordination, insufficient working drawing details, involvement of designer as consultant, involvement of contractor as consultant & participants’ honest wrong beliefs are considered as most important origins of professional dissonances on project design and construction interfaces. Whereas the project management as individual professional service, nationality of professional firms & involvement of contractor in design phases are interestingly revealed as least important origins of dissonances between professionals on project design and construction interfaces in large building projects.*

**1.0 Introduction:**

Saudi Arabia is one of the most promising developing countries in the world. The Kingdom of Saudi Arabia has experienced a massive construction program since the early seventies, it has gone through a construction boom of unprecedented volume during that time.

Construction project involves three main parties in conventional practices of construction industry. These three concerned parties are the Owner, the Designer, and the Contractor. Communication for coordination of these parties is the key element to be considered for successful completion of project. It is postulated that dissonances among the concern (Designer and Constructor) most active parties initiates barriers in the design phases and construction process.

Eliminating the dissonances which exist in peak intensity, enables the projects to be completed rather successfully. Discords on interfaces of concern authorities either result in delay in project duration, or compromise on quality or increase in cost. Considering these prominent issues which ultimately shape up any construction project, augments the need to have better comprehensive solutions of those discords and to coordinate on the interfaces. The most important is to figure out the most potential dissonances occur in project life cycle. These potential areas are the actual dissonances which linger the project progress substantially.

This Research is aimed to assess the professional interfaces between Design & Construction. To identify potential dissonances of Design and Construction common boundaries. To provide suggested solutions and recommendations to trounce the interface dissonances. This research study would cover the Large Building Projects in Eastern Province of Saudi Arabia . Three conspicuous large building projects (Completed or under Construction) would be selected for comprehensive analysis, where large building projects considered as one of the value of SR 20 million or more. This excludes roads, highways, dams, industrial construction, and most residential buildings. Small or medium size projects would not be selected because of the nature of tentative working approach of the team on the low budget project, known as “ not well thought projects”. Large building would be considered with value of Ten million Saudi Riyals or more, because these are “well thought” projects and usually completed under systemized working approach.

Selection criteria concentration would be in the Eastern Province for convenient approach to every project at site for better comprehension of scenario in reality and precise data collection. The grade-2 or above construction contractors, eminent architectural consultants in the Eastern province of Saudi Arabia, would be considered for the questionnaire survey.

## **2.0 Literature Analysis:**

### **2.1.1.1 Architectural Design & Specifications:**

There are numerous convincing definitions for architectural design, most frequently and conventionally it is defined as “ Creating or Designing space while accommodating the essential requirements of the space stipulated by client” . Architectural design has very vast boundary, it includes all kind of design for human

shelter, landscape and monumental designs. Conventionally, the designer communicate their ideas to the physical world through drawings and sketches. Architect/ Engineer develop the design according to the requirements of the owner while considering the regulation and building laws relevant to that design premises, for this purpose first of all the designer consider all the available information and then analyze it for develop a design accordingly.

*Roy Mendelsohn* (1997) articulated that a Designer has a conceptual mind and a contractor has a concrete mind. One relates to intangibles and the other relates to tangibles.

### **2.1.1) Construction:**

All the parties involved in a construction project, Owner, Designer and the Constructor, strive for the same goal which is ultimately meeting the expectations of the owner or the user. Concepts expressed by the owner are turned into design drawings, specifications, and purchase orders by the designer, and that project on paper transforms into reality by the constructor.

*Peurifoy et al* (1996) expressed that construction is the step in which the plans, specifications, materials and permanent equipment are transformed by a constructor, usually called contractor, into a finished facility and the process called construction process.

### **2.1.2) The Parties In Construction Projects;**

*Fisk* (1997) uttered that whether the project is a building, bridge, dam, pipeline, sewage treatment plant, water supply system, or any one numerous other types of projects, it requires the skills and services of a project team comprised of three principal participants;

The Owner.

The Designer

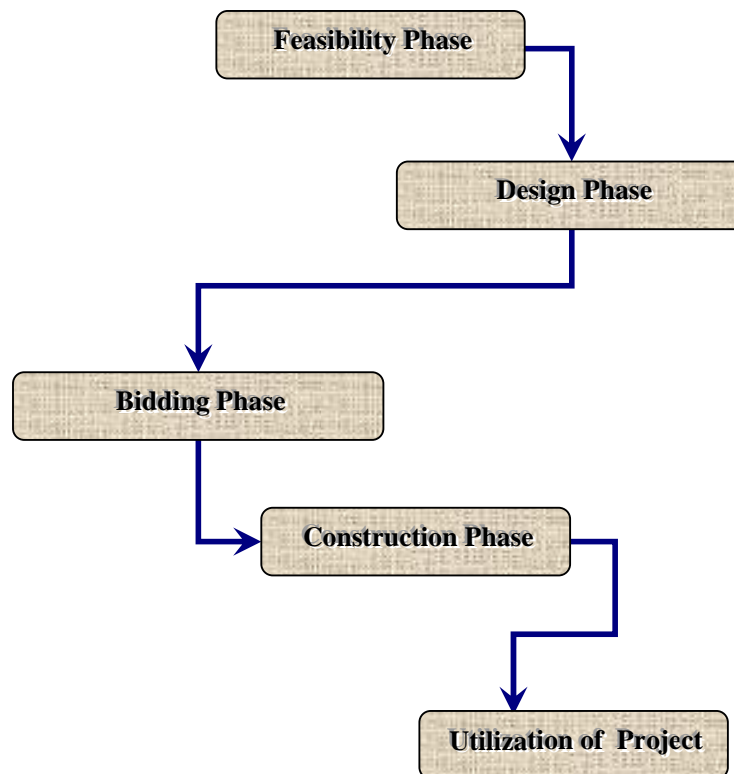
The Constructor.

### **2.1.3) Phases Of Project Life Cycle:**

Phases of project, through which a project prevails and comes to completion stage, is the life cycle of the project construction process. Essentially there are five phases of project life cycle mentioned below;

- 1) Feasibility Phase.
- 2) Design Phase.
- 3) Bidding Phase.
- 4) Construction Phase.
- 5) Utilization of Project.

The main participants of the project prevails in all these project phases and their combined efforts make it possible to bring the project to the completion stage and then to the utilization phase. Team effort in all the phases is the integral part of the project completion process.(*Adrian, 1982*).



**2.1.4) Types Of Construction Projects;**

The field of construction is as diversified as the uses and forms of the many types of structures it produces. However, construction is commonly divided into four main categories, although there is some overlap among these divisions and certain projects don't fit nearly into anyone of them. In general, contracting firms specialize to some extent, limiting their efforts to a relatively narrow range of construction types. Specialization is usual and necessary because of the radically different equipment requirements, construction methods, trade and supervisory skills, contract provisions, and financial arrangements involved with different construction categories.

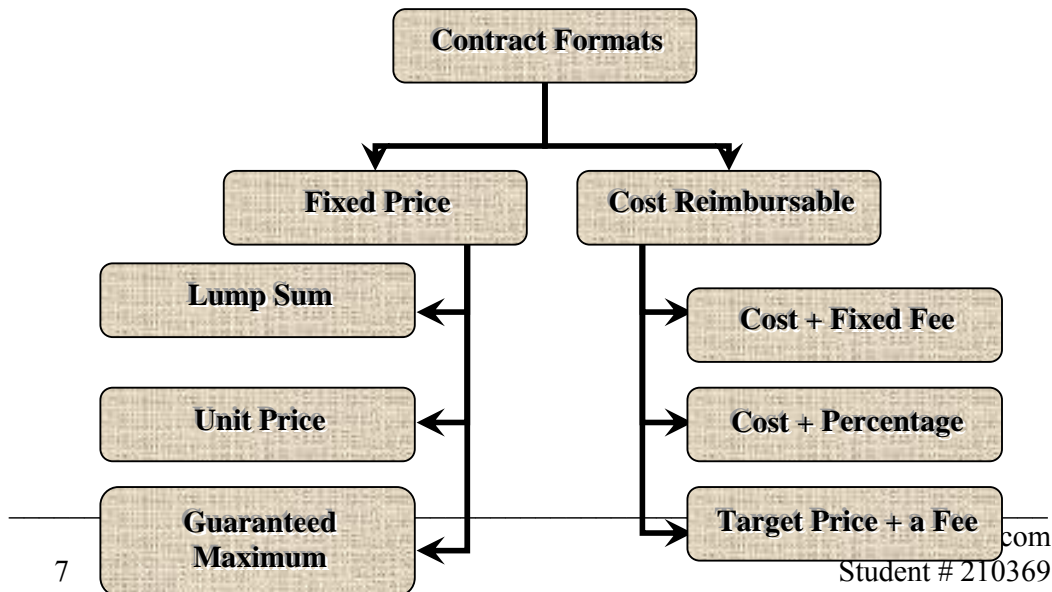
*Clough & Sears* (1994) articulated about the construction categories that there are four main divisions of construction categories; **residential, building, engineering, and industrial construction.**

**2.1.5) Types Of Construction Contract;**

There are numerous contract types used in construction depending on owner and project requirement. The more common types are reviewed as follow;

Construction contracts are typically drafted by the Owner or his representative (consultant) and contain the subject matter and terms and conditions. The construction contract is typically comprised of the following (*Ashly & Workman, 1986*): *Bid Form, Agreement Form, General Conditions or Standard Specifications, Special Provisions, Plans, Addenda*

Construction contracts must also include a compensation system and generally are classified according to the compensation system as followed in the table below:



### **2.1.6) Design-Construction Interfaces;**

*Songer & Molenaar* (1996) expressed about the historical proof of design-construction interfaces, they articulated that design-construction interfaces has been traced to ancient Mesopotamia, where the Code of Hammurabi (1800 BC) fixed absolute accountability upon master builders for both design and construction. In Classical Greece, great temples, public buildings, and civil works were both designed and built by master builders. Enduring structures such as the Parthenon and Theater of Dionysis are testimony to this master builder process, (*An introduction, 1994*).

### **2.1.7) Schism between Designer & Constructor Dyad:**

Since the renaissance period, when the design and construction was recognized as two separate entities, the rift between these eventually combined disciplines initiated to amplified. In the present times, design and construction are considered and treated as two different educational and professional platforms. Schism between architect/constructor dyad is one of the most adversely influential factors for any project regardless of the volume of project.

*Stinchcombe* (1995) articulated that the nature of the construction industry is such that a single proposal for the integration of design and construction is an overly idealized solution to improving project performance.

### **2.1.8) Constraints of Conventional Approach:**

The segregated working approach of the professional, based on the schism which has been developed during the history, considered as the conventional approach of working environment in the construction industry. Because of that isolated working boundaries various adversarial issues initiate and affect the project quite enormously.

### **2.1.9) Constitutive Stipulated Project Objectives:**

The essential stipulated objective affiliated with any project vary according to the perception of the concerned parties. In the owner's perception the constitutive objectives are attaining a project completion with best quality, minimum time and with minimum budget. Whereas the objectives of the architects and the constructors are different than owner, where the architects shows their concern with the best quality affiliated with their design in the reality and the constructor stipulates the



construction period to be as convenient to him and doesn't show much concerns with reducing the cost of the project rather intends to stretch the budget as much the abilities and the opportunities allows.

#### **2.1.10) Significance of Collaboration:**

Teamwork is one of the most commonly perceived ideology to perform actions in better way. In the construction industry, teamwork stems many solutions to dissonances which the participants face in their routine construction project process. The phenomena is emphasized by *Puddicombe* (1997) “ The major tools for achieving organizational integration can be broadly classified as contractual and social psychological. These two approaches embody different assumptions about inter-firm dynamics and as a consequence develop different approaches for integrating the project team.

#### **2.1.11) Emerging Concept in Construction Industry:**

The construction industry, due to its exploratory and innovatory nature, subject to changes with the time. There are many new philosophies have taken place in the industry during the last two decades. Each and every new concept in construction industry has its own constraints and advantages. In the following sections we would consider the conventional perception, impact of information technology, design build philosophy, constructability & concurrent construction.

#### **2.1.12) Interface Dissonances:**

Most common dissonances in the conventional construction project process, discovered in various research studies in the context of the Saudi Arabian construction industry practices, are mentioned as follow,.

*Assaf & Al-Hammad* (1992) articulated about the most influential interface problem in construction projects in Saudi Arabia, they indicated following factors as the most influential in construction projects;

- 1) Involvement of the contractor in the design.
- 2) Variation Orders.
- 3) Unfamiliarity with local conditions.
- 4) Unfamiliarity of site conditions.

- 5) Complete & adequate plans and specifications.
- 6) Lack of a specialized construction manager.
- 7) Design simplicity.
- 8) Lack of designer knowledge of available material and equipments.
- 9) Builability.
- 10) Work packaging design.
- 11) Working drawing details.
- 12) Building codes and other governmental regulations.
- 13) Owner's progress payments.
- 14) Economic situation.
- 15) Fast track construction.
- 16) Weather conditions.
- 17) Nationality of both construction and design firms.

#### **2.1.13 Owner's Representative (Conventional Practice):**

*Clough & Sears* (1994) implicitly articulated that the scope of services required of the architect-engineer is subject to considerable variation, depending on the needs and wishes of the owner. As the owner and the architect-engineer are joined together by contract, their exact relationship depends somewhat on the duties being performed by the architect-engineer. In the preparation of construction documents, the architect-engineer firm functions primarily as an independent contractor, but its role is more that of a “*an agent*” of the owner during the construction phase.

### **3.0) RESEARCH METHODOLOGY**

#### **3.1) Research Methodology:**

The research encircles the large building projects in eastern province of Saudi Arabia. First of all whole concentration of research is on acquiring the knowledge through extensive literature analysis about the real scenario of professional dissonances between parties. Few large eminent buildings projects would be selected, for better comprehension about the actual professional dissonances. The selected projects will be visited personally and an extensive documentation regarding the project characteristics regarding the research intentions, would also be carried out. All

the projects will be analyzed according to the pre-developed guidelines for critical analysis of the potential dissonances.

The research methodology constitutively distributed into following phases of research program;

- Literature Analysis.
- Development of guidelines for Project Comprehensive Documentation.
- Development of initial tentative questionnaire.
- Identification of most influential dissonances.(detail documentation of few eminent edifice projects ).
- Development of Final questionnaire for survey.
- Questionnaire survey.
- Data Collection.
- Data Analysis.
- Conclusions & Recommendations.

#### **4.0) POTENTIAL DISSONANCES :**

Through extensive literature research, the most prevailing dissonances were summarized and defined as baseline for questionnaire regarding the further investigation of these dissonances to figure out which are the most intense ones in the construction industry. Following is the classification of dissonances according to the timeframe these conventionally occur.

Basically the dissonances are categorized as Design Phase, Construction Phase and those which exist on the interface named as Design-Construction Phases. Following is the explanation of dissonances which were considered in the research questionnaire.

#### **5.0) PILOT STUDIES:**

The chapter discusses the selected edifice building projects as pilot study. For the pilot study, Three conspicuous edifice projects were selected in eastern province, these projects are commercial projects and considered as large building projects in construction industry, each project costs more than 20 millions Saudi Riyal.

Following projects are selected and considered for detailed analysis, all concerned professionals were individual met and interviewed for in depth comprehension of actual scenario defining the dissonances between designers and contractors.

- 1) **Al-Rashid Tower.** (Al-Khobar).
- 2) **Al-Hussaini Commercial Tower.** (Dammam).
- 3) **Al-Subaei Commercial Center.** (Al-Khobar).

## **6.0) SURVEY QUESTIONNAIRE**

### **6.1) Questionnaire Design:**

The questionnaire design was developed while considering the vital objective of the study as mentioned in the section of “Statement of Issue” and the main target was to get comprehension to answer the research questionnaire. Pilot study and meetings with professionals of the construction industry were carried out to identify the appropriate questionnaire stipulated and to convey them in unambiguous format. Special consideration were taken care off in phrasing the questions in simple and comprehensive language that would be conveniently comprehended by the respondents. Most professionals in the construction industry are quite well proficient with English language therefore the researcher didn’t perceive the idea of interpreting the questionnaire in Arabic, because the target sample of the questionnaire respondents was considered to be the qualified engineers and architects.

#### **6.1.1) The Statistical Sample:**

Four restrictions were imposed on the selection process of respondents:

1. Restricted to large building projects (20 million SR or more)
2. Restricted to large contractors (Grade 2 or better as classified by the Chamber of Commerce)
3. Restricted to building projects (excluding industrial, highway, and other types of construction)
4. Restricted to Eastern Province of Saudi Arabia

With these restrictions in mind, the researcher would targeted both populations i.e. all the list of contractors and consultants as presented in the Chamber of Commerce

classification. This listing included *forty two* (42) contractors and *forty one* (41) consultants in the Eastern Province. A summarized list is also attached, which is referred from previous research projects in the eastern province of Saudi Arabia.

The size of the sample required from each population was determined on the basis of statistical principles for this type of exploratory research. For such research, sample size was determined as follows (*Al-Dubaisi, 2000*)

$$n_0 = (p*q) / V^2 \dots\dots\dots (1)$$

$$n = n_0 / [ 1 + ( n_0 / N)] \dots\dots\dots(2)$$

Where:

**n<sub>0</sub>** : First estimate of sample size

**p** : The proportion of the characteristic being measured in the target population

**q** : Complement of ‘p’ or 1-p

**V** : The maximum standard error allowed

**N** : The population size

**n** : The sample size

To maximize n, p is set at 0.5. The target populations N are 42 and 41 for contractors and consultants respectively. To account for more error in qualitative answers of this questionnaire, maximum standard error V, is set at 10% or 0.1.

Substituting in

Equations 1 and 2 above, minimum required sample is calculated to be 15.67 and 15.53 for contractors and consultants respectively. This means that minimum sample size for each populations is 16.

## **7.0) ANALYSIS & RESULTS**

The analysis of the obtained data from the received questionnaires, carried out according to the segments on distributions of questionnaire, for instance the general industry profile. The first section discusses the results on general information and the prevailing construction industry characteristics, that includes type of firms and level of experience etc. These features would provide comprehensive manifestation about the perception of the particular participants’ perceptions about the actual origin of professional dissonances on design – construction interfaces.

In the second section, data on professional dissonances origins is analyzed. The result of analysis is shown as Mean, Confidence level, Median, Maximum Minimum, Variance and Standard Deviation as well as Standard Error. Each professional dissonances origin is ranked according to the mean value as the representation of the responses of respondents.

In the last section of analysis the results are filter down according to the value of mean and further the dissonances origins were selected as the top ten ranking eventually filter down for the top five origins of professional dissonances in the whole research study.

### **7.1) General information & Profile:**

The general information section contains information on the respondents profile and level of experience of the contractor and designers in the field of large building construction in the eastern province of Saudi Arabia. It also contains the information about the perception of contractors and designer regarding their professional working relationship.

### **7.2) Potential Dissonances between Professionals.**

The responses on the potential dissonances origins between the professionals, are analyzed into the segments. The first segment contains the responses from the designers only and it analysis, in that analysis the Mean, Median, Maximum, Minimum, Variance, Standard deviation and standard errors are discussed and revealed for coming up with conclusion based on these information. The second segment contains the same procedure for the responses from the contractors. The third segment consist of the analysis as combined evaluation including all the respondents.

Eventually the combined evaluation of the respondents responses, is filtered according to the mean values on the table and the top ten dissonances and the least five ranked origins as revealed through the analysis in form of mean values, are taken for further elaboration and detailed descriptions.

#### **7.2.1) Consultants Responses (Statistical Analysis):**

The revealed statistics of analysis about the responses from the designers respondents, indicates the all the necessary statistical results for filtering the information and to evolve with some more sophisticated and targets potential dissonances origins between professionals on design and construction interfaces. According to the mean value divulged, the top five ranking to the dissonances are marked and the least five ranked origins are marked for distinction between the most important and least important potential dissonances between professionals.

<b>Most Important Origins of Potential Dissonances</b>		
<b><u>Actual #</u></b>	<b><u>TEXT</u></b>	<b><u>Rank</u></b>
Q_24	Contractor's lack of comprehension of Drawings details and specifications.	01
Q_02	Lack of designer knowledge of available material and equipments.	02
Q_27	Design Complexity.	02
Q_28	Buildability.	02
Q_33	Obstinate nature of participants.	02
Q_06	Time limitation in design phase.	03
Q_08	Incomplete & inadequate plans and specifications.	03
Q_03	Lack of stipulated data.	04
Q_05	Lack of human resources for design firm.	04
Q_17	Design Errors.	04
Q_20	Lack of coordination between professionals.	04
Q_09	Insufficient working drawing details.	05
Q_11	Lack of mutual respect between designer and contractor.	05

**(MOST IMPORTANT DISSONANCES)**

<b>Least Important Origins of Potential Dissonances</b>		
<b><u>Actual #</u></b>	<b><u>TEXT</u></b>	<b><u>Rank</u></b>
Q_01	Involvement of contractor in design conceptual phase.	01
Q_02	Involvement of contractor in design development phase.	02
Q_45	Project construction management as individual professional service.	03

Q_38	Nationality of both Construction and Design firms	04
Q_12	Exotic design and technology.	05

TABLE: 7.2.3a (LEAST IMPORTANT DISSONANCES)

**7.2.2) Contractors Responses (Statistical Analysis):**

The revealed statistics of analysis about the responses from the contractor respondents, indicates the all the necessary statistical results for filtering the information and to evolve with some more sophisticated and targeted potential dissonances origins between professionals on design and construction interfaces. According to the mean value, the top five ranking to the dissonances are marked and the least five ranked origins are marked for distinction between the most important and least important potential dissonances between professionals.

<b>Most Important Origins of Potential Dissonances</b>		
<b><u>Actual</u></b> #	<b><u>TEXT</u></b>	<b><u>Rank</u></b>
Q_25	Involvement of Designer as design consultant.	01
Q_10	Insufficient communication between contractor and designer dyad.	02
Q_09	Insufficient working drawing details.	03
Q_20	Lack of coordination between professionals.	03
Q_05	Lack of human resources for deign firm.	04
Q_34	Participant’s honest wrong beliefs.	05

TABLE: 7.3.2a (MOST IMPORTANT DISSONANCES)

<b>Least Important Origins of Potential Dissonances</b>		
<b><u>Actual</u></b> #	<b><u>TEXT</u></b>	<b><u>Rank</u></b>
Q_45	Project construction management as individual professional service.	01
Q_37	Weather conditions.	02
Q_38	Nationality of both Construction and Design firms	03
Q_42	Unforeseen problems.	04



<b>Q_31</b>	<b>Lack of professional experience and judgment.</b>	<b>05</b>
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**TABLE: 7.3.3a (LEAST IMPORTANT DISSONANCES)****7.2.3) All Participants Responses (Statistical Analysis):**

The revealed statistics of analysis about the responses from all respondents, indicates the necessary statistical results for filtering the information and to evolve with some more sophisticated and targeted potential dissonances origins between professionals on design and construction interfaces. According to the mean value divulged in the table 7.4.1, the top five ranking to the dissonances are marked and the least five ranked origins are marked for distinction between the most important and least important potential dissonances between professionals.

**TABLE: 7.4.1****Descriptive Statistics (Combined Evaluation)**

	<b>Mean</b>	<b>Median</b>	<b>Rank</b>	<b>Min.</b>	<b>Max.</b>	<b>Variance</b>	<b>Std Dev.</b>	<b>Std Error</b>
<b>Q_01_D</b>	2.204082	2	<b>28</b>	1	4	1.540816	1.241296	0.177328
<b>Q_02</b>	2.306122	2	<b>27</b>	1	4	1.30017	1.14025	0.1628929
<b>Q_03</b>	3.204082	3	<b>10</b>	2	4	0.37415	0.611678	0.0873825
<b>Q_04</b>	2.959184	3	<b>15</b>	2	4	0.456633	0.675746	0.0965351
<b>Q_05</b>	3.306163	4	<b>6</b>	2	4	0.454932	0.674486	0.0963552
<b>Q_06</b>	3.285714	3	<b>7</b>	2	4	0.375	0.612372	0.0874818
<b>Q_07_C</b>	3.306163	3	<b>6</b>	2	4	0.288265	0.536903	0.0767005
<b>Q_08</b>	3.285755	3	<b>7</b>	2	4	0.284014	0.532929	0.0761328
<b>Q_09</b>	3.44898	3	<b>2</b>	2	4	0.335884	0.579555	0.0827936
<b>Q_10</b>	3.306163	4	<b>6</b>	2	4	0.454932	0.674486	0.0963552
<b>Q_11</b>	3.081633	3	<b>12</b>	1	4	0.618197	0.786255	0.1123222
<b>Q_12</b>	2.530612	2	<b>24</b>	1	4	0.837585	0.915197	0.1307424
<b>Q_13</b>	2.734694	3	<b>21</b>	1	4	0.990646	0.995312	0.1421874
<b>Q_14</b>	2.77551	3	<b>19</b>	1	4	1.052721	1.026022	0.1465746
<b>Q_15</b>	2.857143	3	<b>18</b>	1	4	0.583333	0.763763	0.1091089
<b>Q_16</b>	2.877551	3	<b>17</b>	1	4	0.693027	0.832483	0.1189261
<b>Q_17</b>	3.265306	3	<b>8</b>	2	4	0.365646	0.604687	0.0863838
<b>Q_18</b>	2.897959	3	<b>16</b>	1	4	0.635204	0.796997	0.1138567
<b>Q_19</b>	2.897959	3	<b>16</b>	1	4	0.635204	0.796997	0.1138567
<b>Q_20</b>	3.469388	4	<b>1</b>	2	4	0.420918	0.648782	0.0926832
<b>Q_21</b>	2.77551	3	<b>19</b>	1	4	0.511054	0.714881	0.1021258
<b>Q_22</b>	3.102041	3	<b>11</b>	1	4	0.385204	0.620648	0.088664
<b>Q_23</b>	3.020408	3	<b>14</b>	1	4	0.437075	0.661116	0.0944452
<b>Q_24</b>	3.326531	3	<b>5</b>	2	4	0.47449	0.688832	0.0984046
<b>Q_25</b>	3.408282	3	<b>3</b>	2	4	0.665816	0.815976	0.116568
<b>Q_26</b>	2.877551	3	<b>17</b>	2	4	0.568027	0.753676	0.107668
<b>Q_27CD</b>	3.204082	3	<b>10</b>	1	4	0.37415	0.611678	0.0873825

Q_28	3.102041	3	11	1	4	0.676871	0.822722	0.1175316
Q_29	2.530612	3	24	1	4	0.962585	0.981114	0.1401592
Q_30	2.530612	2	24	1	4	0.879252	0.937684	0.1339549
Q_31	2.571429	2	23	1	4	1	1	0.1428571
Q_32	2.530612	3	24	1	4	0.712585	0.844148	0.1205925
Q_33	3.22449	3	9	1	4	0.636054	0.79753	0.1139329
Q_34	3.326522	4	5	1	4	0.67517	0.821687	0.1173839
Q_35	2.755102	3	20	1	4	0.938776	0.968904	0.1384149
Q_36	2.673469	3	22	1	4	0.84949	0.921678	0.1316682
Q_37	2.387755	2	26	1	4	0.70068	0.837066	0.1195809
Q_38	2.204082	2	28	1	4	0.832483	0.912405	0.1303436
Q_39	2.755102	3	20	1	4	0.522109	0.722571	0.1032244
Q_40	3.204082	3	10	1	4	0.332483	0.576613	0.0823733
Q_41	3.22449	3	9	1	4	0.844388	0.918906	0.1312722
Q_42	2.408163	2	25	1	4	0.663265	0.814411	0.1163444
Q_43	3.061224	3	13	1	4	0.517007	0.719032	0.1027188
Q_44	3.387824	3	4	1	4	0.892007	0.944461	0.134923
Q_45	2	1	29	1	4	1.416667	1.190238	0.170034

TABLE: 7.4.1

TABLE: 7.4.2 (MOST IMPORTANT DISSONANCES)

<b>Most Important Origins of Potential Dissonances</b>		
<b>Actual #</b>	<b>TEXT</b>	<b>Rank</b>
Q_20	Lack of coordination between professionals.	01
Q_09	Insufficient working drawing details.	02
Q_25	Involvement of Designer as design consultant.	03
Q_44	Involvement of contractor as consultant.	04
Q_34	Participant's honest wrong beliefs.	05
Q_24	Contractor's lack of comprehension of drawings details & Specifications.	05

TABLE: 7.4.2a (MOST IMPORTANT DISSONANCES)

<b>Least Important Origins of Potential Dissonances</b>		
<b>Actual #</b>	<b>TEXT</b>	<b>Rank</b>
Q_45	Project construction management as individual professional service.	01
Q_38	Nationality of both Construction and Design firms.	02
Q_01	Involvement of contractor in design conceptual phase.	02
Q_02	Involvement of contractor in design development phase.	03

Q_37	Weather Conditions.	04
Q_42	Unforeseen problems.	05

TABLE: 7.4.3a (LEAST IMPORTANT DISSONANCES)

**7.4.3.1) Correlation:**

Correlation (r) is used to find the relationship existing among different factors or parties and the degree of this relationship. There is the spear correlation is considered as the one method suitable for determining the correlation between the ranking by the professionals.

**Spearman Correlation**

The spearman correlation is used to find and compare how well any two parties agree, the following Table 7.4.4 shows the calculations used to find the agreement between the consultants and contractors on ranking. The result is 62.96% it confirms that there is substantial correlation between professionals on the ranking of professional dissonances origins.

Spearman Rank Order Correlations		
	Consultants	Contractors
Consultants	1.000000	.629668
Contractors	.629668	1.000000

TABLE: 7.4.3 (SPEARMAN RANK ORDER CORRELATIONS)

**7.4.3.2) Test of Agreement:**

in this section, the test of agreement on the professional dissonances origins is carried out. To carry out that we would use the T-test for independent samples. The analysis here was done on the mean values for potential dissonances.

The null hypothesis can be formulated as follows,

**$H_0$  : the Contractors and Consultants don't agree on the ranking of potential dissonances**

The T-value calculated is 5.31496 where the critical value of t is 1.675 (df=42,  $\alpha = 0.05$ ) the statistical decision therefore is to reject the null hypothesis. Eventually the contractors and consultants do agree on the ranking of potential dissonances origins.

## **8.1) Conclusion:**

The extensive process of the entire research evolves through various stages of refinement. Elementary phase of the research consist of pilot study assisted the researcher in comprehending the actual scenario on reality grounds of design and construction interfaces of large building projects. The final questionnaire research was concluded with the analysis based on the responses of all the professional respondents from construction industry of Kingdom of Saudi Arabia.

The first phase of conclusion elucidates information about general profile of professional firms of construction industry. Based on the field survey, the concluding information is expressed follow.

- a) Designers involved in large building projects in construction industry are mostly categorized as design consultant, and the contractors involved in large building projects are mainly classified as Grade 02 and above. The majority firms are reported as Saudi national and as 5-10 years of experience. The common completed large building projects were from government sectors and carried out as lump sum contract format. The contractor firms were involved in large building projects as traditional type construction only, and the designers carried out the projects as design only. Results indicates that the design of the large building projects were developed inside Kingdom of Saudi Arabia. The primary driving factor in large building projects are revealed as quality and cost from almost equal proportion of professionals. Working relationship between contractor and designer in the construction process is generally considered as good working relationship.
- b) According to the analysis, the **top five important** origin of professional dissonances are:
  1. lack of coordination between professionals
  2. Insufficient Working Drawing details
  3. Involvement of Designer as consultant
  4. Involvement of contractor as consultant

5. Participants' Honest Wrong Beliefs & Contractor's lack of comprehension of drawing details and specifications.
- c) According to the analysis, the **Top Five least important** origin of professional dissonances are:
1. Project management as individual professional service.
  2. Involvement of Contractor in design conceptual phase & Nationality of contractor and design firms.
  3. Involvement of Contractor in design development phase.
  4. Weather Conditions.
  5. Unforeseen Problems.

## **8.2) Recommendations:**

Recommendations are developed while considering the conclusion of the research, and also referring to the findings of previous studies expressed in the literature review. The recommendations are revealed as follow;

- a) It is recommended that contractors should provide their input in Design phases for not only improving the design on reality ground but also providing an opportunity to overcome the discrepancies in working drawing details as well as an opportunity for professionals to develop better coordination for optimum working relationship.
- b) It is suggested that considering other models being used in various construction industries for instance, the construction model used in English construction industry which indicates that consultant should be an individual professional, the one combines in a professional participants circle to commence project. Those models would rather be appropriate for construction industry in Saudi Arabia, as conceived from the conclusion based on both respondents responses that they look forward to agree on an individual professional as consultant rather than the same contractor or designer on the project professional premises.
- c) It is recommended to establish numerous periodicals professional meetings to explore and communicate project scopes & development, these meetings would be considered under the surveillance of consultant of project,

eventually that would provide the better opportunity for professionals to develop better where the lack of communication between professionals is considered as one of the vital origins of dissonances.

- d) As concluded earlier, “insufficient working drawing details” considered as one of the most important origin of potential dissonances. It is recommended that an Accrediting body should be developed, who eventually established the guideline standards for stipulated drawings for any construction project to be commenced in proper way and also initiate better comprehension through professionals. For instance, the accrediting bodies in various part of world like in Canada the CACB , in Britain the RIBA etc. who carry out the particular task for standardization of basic parameters for professional requirements.
- e) It is recommended to have a neutral participant who intends to act as bridge between the two professionals and to bring them on some amicable professional platform to reduce schism between professionals. That neutral participant would be the designer or the contractor depending on the circumstances if the designer or contractor is hired as independent party and has nothing to do with actual design and construction activities, whereas the professional supposed to be only concerned with the consultation of design and construction activities of project.
- f) More sophisticated and updated contemporary courses about technology, materials and equipment should be introduced at the professional education level for developing better professionals with adequate contemporary knowledge about materials and equipment, whereas concluded earlier, the inadequate knowledge about contemporary materials and equipment is considered as one of the most vital origins of potential dissonances on design and construction interfaces.
- g) Project construction management as individual professional service is considered by professionals as highly recommended aspect to be implemented, it would rather provide more confidence in managing project activities and assist in eliminating the risk in involving the designer or contractor as consultant. For instance the model of professional bodies on construction project in USA pursues that the designer or contractor already

involved in project should not be allowed to act as consultant on that particular project.

### **8.3) Recommendations for Future Researchers:**

Recommendations for further studies, that can be explored in the referring light of information revealed in this research study, the recommended area of studies are mentioned as follow;

- a) Considering the contextual boundaries of the research study, that addresses the subject for large edifice projects. It would be interesting to elaborate the study of design-construction interface in the context of industrial projects and would be informative to compare the results with the outcome of this research study.
- b) The study included two main participants of project, as contractor and designer, it would be an excellent option of further study to evaluate the participation of third professional as neutral party, the relevant discrepancies due to the triangular professional team on design and construction interface of large building projects.
- c) As the study was constrained due to the selected area of eastern province only, one would explore the entire Saudi construction industry or emphasis on western province and then amalgamate the result with the analysis outcome of this particular project.
- d) Carrying out the same research while considering the population of contractor classified as grade 03 or below would be interesting to compare the ranking of the other contractors with ranking by the grade 01 –02, as considered in this research study. There is a possibility to reveal some surprising aspects which would be indicated by the lower grade contractors with their specifics problems and professional perceptions.

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