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Potential Failure Causes of Newly RC Built Structures in Kabul, Afghanistan

Mohammad Naeem Dost[1], Sardar Wali Din[2] and Mohammad Sorgul Abdul Rahman[3]
[1] Vice Chancellor (Academic & Student's Affair) and Assistant Professor Department of Civil Engineering, Helmand University, Helmand Province, Afghanistan
[2] Assistant Professor Department of Civil Engineering, Helmand University, Helmand Province, Afghanistan
[3] Chancellor and Assistant Professor Department of Civil Engineering, Helmand University, Helmand Province, Afghanistan

Abstract:- This investigation puts emphasis on the potential failure causes of newly RC structures (buildings) in Kabul city. Since Kabul city has been experienced rapid growth problem due to unexpected urbanization. However, great number of building structures are required for the housing, industrial units, commercial buildings, and other infrastructure. In keeping with the Kabul municipality, the major product of these recently built buildings in the Kabul city is of RC structures. Although, very few of them are constructed after approval and accordance with the standards. The technique performed in the assemblage of data comprises the distribution of questionnaires to technical specialists in the structural activities as well as case studies for the building sites. Simple Random Sampling method was conducted for choosing the sites visited. For selecting structural professionals, relevant organizations such as Kabul municipality and MUDH, Ministry of Urban Development and Housing were consulted. Graphic statistical method such as ranking of failure sources with against the participant's feedback was carried out to analyze the data. The primary data that was intended from questionnaires expressed that, the use of substandard materials in building, design faults, illegal modification to present building and natural disasters (earthquake) were the major sources for failure of newly RC built structures in Kabul city respectively. In two case studies accomplished in case study areas, the buildings were inspected for three focal purposes. For instance, maintenance insufficiency, seismic effects and fire damages. Consequently, the studies found that fire effects on buildings especially on commercial building are an extraordinary concern and it could be evaluated as the core factor for building failures.

Keywords:- *Seismic Pounding, Potential Failure, Natural Disaster, Blast Effects, Collapse.*

I. INTRODUCTION

Increase in population is directly proportionate to the urbanization (Monteiro 2006). However, Kabul city has been experienced rapid growth problem due to unexpected urbanization. According to the reports, received from the Kabul municipality, inhabitants living in this city has been grown nearly to 4.22. Millions. This number of Inhabits are still living in 22 sub-districts of Kabul city (Kabul municipality). Considering this fact, massive quantities of building structures are required for the housing, industrial units, commercial buildings, and other infrastructure. In keeping with the Kabul municipality, the major product of these recently built buildings in the Kabul city is of RC structures. Although, very few of them are constructed after approval and accordance with standards. Vast majority of these buildings are constructed using typical drawings and designs rather than consulting professional and licensed design engineers. Despite of the fact, construction has been permitted by municipality authorization. Table 1.1

Table 1.*1* Estimated Population by Type of Built-up Area in Kabul City for 2008

Category	Flat Area<10%	Hillside Area >10%	Total	%
Planned	1,101,117		1,101,117	26.1
Unplanned	2,502,430	577,835	3,080,265	73.0
Old City	23,943	14,931	38,874	0.9
Total	3,627,490	592,766	4,220,256	100.0

Source: Kabul municipality

Consequently, structural, construction engineers, architects, and real estate developers are mostly required to understand those main potential causes they are mainly expected to result in serious failure of building structures. Accordingly, this requirement is properly highlighted to identify the serious destructive and damaging failures that are typically attentive to RC structures built in the recent yours. Considering all these facts, I was encouraged to conduct an investigation so as to collect useful and appropriate data in various categories. Collecting of this data may help to reduce restively the occurrence of building failures in Kabul city.

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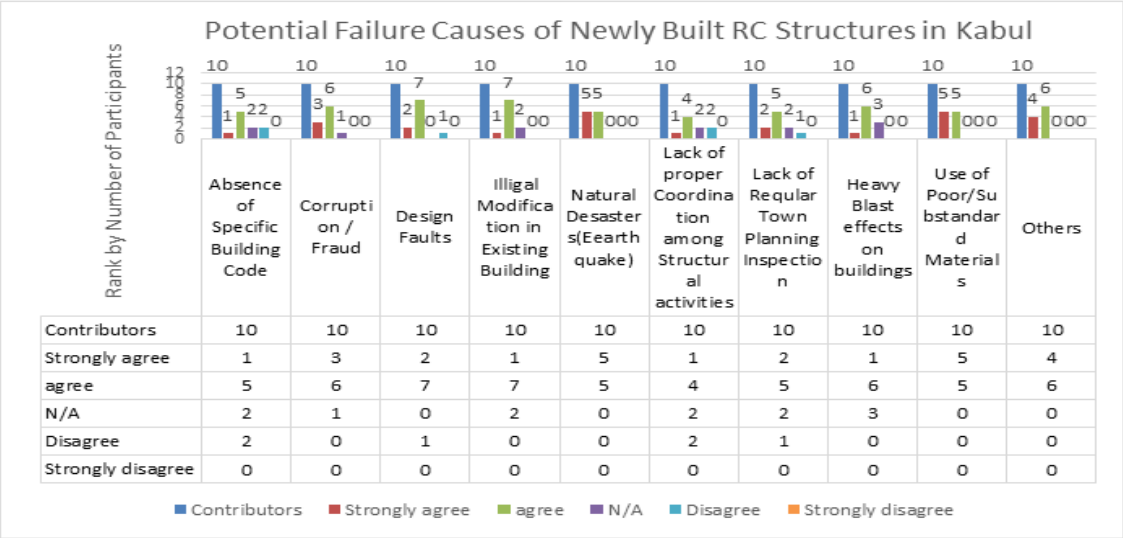
II. RESEARCH METHODOLOGY

To validate this work, the data collection was classified into two major categories; namely, primary data and case studies. For primary data, a questionnaire was developed that contained two types of questions; namely, Part I & Part II. Questions in part I focused on the ranking of participants' opinions and perspectives about the main causes. Questions in this part were more concentrated about the faults and deficiencies that are commonly involved in the failure of newly built RC structures in and around Kabul city. The interviewees in this work included three main categories of engineers; namely, Civil Engineers, Structural Engineers, Architects and Town Planner Engineers because they are more involved in structural engineering activities. Their views concerning the specific deficiencies are describing in the following lines. The second part of the research was completed by site visits (case studies) from the newly RC built structures around the Kabul city for this purpose two sub-districts were randomly selected as a case study namely, sub-district five and three. All those fault; deviations and other deficiencies they were noted on the site from the RC structures are analyzed and reported in the further sections. Figure 2.1 is a graphic presentation showing the percentage of various failure causes. The major reason agreed upon by many interviewees is the improper modification in the structures. Same number of the interviewees believed that design faults are another major failure cause. Heavy blast effects have been believed as the second major failure cause. The absence of specific code, fraud, natural disaster, low coordination, lack of regular planning and others have been found as other failure causes.



	Absence of Specific Building Code	Corruption / Fraud	Design Faults	Illigal Modification in Existing Building	Natural Desasters(Eearthquake)	Lack of proper Coordination among Structural activities	Lack of Regular Town Planning Inspection	Heavy Blast effects on buildings	Use of Poor/Substandard Materials	Others
Contributors	10	10	10	10	10	10	10	10	10	10
Strongly agree	1	3	2	1	5	1	2	1	5	4
agree	5	6	7	7	5	4	5	6	5	6
N/A	2	1	0	2	0	2	2	3	0	0
Disagree	2	0	1	0	0	2	1	0	0	0
Strongly disagree	0	0	0	0	0	0	0	0	0	0

Figure 2-1 Rank of Potential Failure Causes of Newly Built RC Structures in Kabul from Town Planners Perspective

Figure 2-1 is a graphic presentation of the percentage of the structural and civil engineers for the failure causes of the recently built RC structures. Majority of the professionals believe that the major failure cause of the structures is the fraud, corruption, and natural disasters. Most of the contractors at the time of construction do not respect code provision and recommendations. 40 % of the interviewees have agreed that unavailability of specific building code is the also one of the dominant reasons for failure.

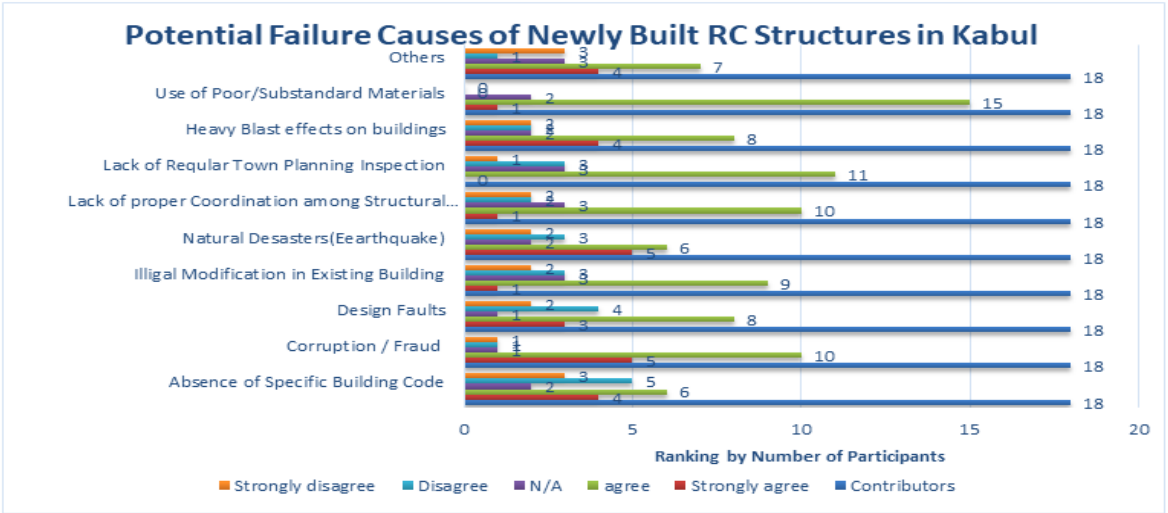


Figure 2-2 Rank of Potential Failure Causes of Newly RC Built Structures in Kabul from Civil/structure Engineers Perspective

Figure 2-2 presents the failure causes from Architectural engineer's prospective. Majority of the interviewees of this category believe that design faults and corruption are the major reasons of the failures. Few of them also believe that absence of specific code is another major reason of failure. Lack of regular town planning, lack of cooperation, use of poor quality material and others have been in the third rank of major failure causes.

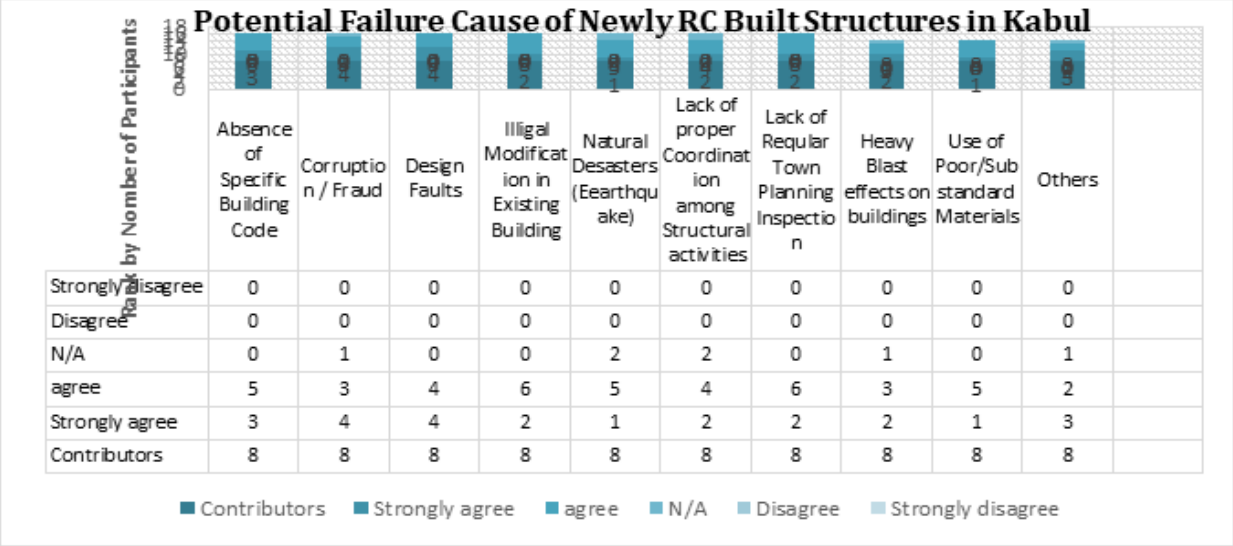


Figure 2-3 Rank of Potential Failure Cause of Newly RC Built Structures in Kabul from Architects Perspective

Part II

In this part the participants were typically interviewed for their experiences, whether they have seen or observed any structural failure in newly RC built structures nearby the Kabul city. The survey data has been tabulated in Table 1. As shown in the table, majority of the participants have observed beams as of the failure causes. According to their experience, professional engineers do not usually design the structures. According to them, most of the owner's employee the contractors or skilled labor to conduct a practical design and construction without having theoretical calculations and design checks. The second major cause of failure has been indicated as of lack of the soil investigation. According to them, most of the owners do not test the sub-structural soil textures. This has caused several structure fail at the time of natural disaster and other dynamic forces. Some of these interviewees have believed that excessive deformation has also been a cause of the failure of those structures.

Table 2 .1 Reported cases, interviewers they have seen or observed any structural failure in newly RC built structures in Kabul.

Participants	Type of building failure						Cause of failure	Location
	Partially					Totally		
	Parts or Members has been affected					N/A		
1	Beams					N/A	Developments of serious cracks due unknown reason	Shahr- e-Naw, Kabul city
2	Beam	column				N/A	Excessive bending in beam and development of cracks in column	Karte-e - 5e,Taimani,district three, Kabul city
3			Foundation			N/A	Building settlement/tilted to a degree	Abdul Haq Square, Kabul city
4			Foundation			N/A	Lack of proper soil investigation prior to construction	Tahya-e-makans blocks
5	Beam			Slab		N/A	Not designed by an engineer, construction was carried out practically by skilled labors	Qargha,Kabul

A. (Case Studies)

Some case studies were initiated in order to complete the second part of the research (case studies). This data was originally anticipated to support second part of the research as it was intended from some site visits of newly built RC structures around the case study area.

Two important purposes such as, seismic effects and fire damages on buildings were intended to be considered in these studies. The buildings surveyed in this phase were located in (Sub-district 5 and three). The reason of selecting this area was construction of numerous newly RC building structures. There are too many multi-story buildings which are designed, constructed and maintained by different

designers, workers, and real estate developers in this area. According to the information received from the owners, none of them has shared the necessary and relevant technical information to each other for construction of those buildings, whereas all these structures are built quite close to each other. Naturally, all behaviors of buildings are distinguished to each other considering their use and sort of occupancy. Lack of properties and land for housing and other commercial structures is a common problem in the cities, especially in the rapidly progressive capital cities. This circumstance can lead to nonconformity in the structural activities as well as other building ethics. The focal purpose of this inspection is to draw attention to those challenges and problems that are exceedingly perilous in structural accomplishments.

Case Study No.1

In the sequence of site visits for inquiry of the case study data as stated in the above lines, on Saturday 11, 2, 2017 a site visit was conducted (first case study) in Polytechnic University campus which is ideally the part of the estimated case study area that was selected for the inquiry. In this campus, some of the buildings were technically inspected representing the others. Among all well-suited buildings, one of the buildings was sensibly affected nearby the expansion joints. Removal of finishing and other cladding from exterior faces of the members indicated that they are seriously stressed by some unexpected ampules. Fig 2.3

Figure 2-3 Beams nearby the joint, indicates pounding by unexpected ampules.

Expansion joints are normally designed and intended to prevent mid-separated parts of the structure from contiguity of each other while excessive stress and movement is produced at the time of thermal change, wind sway as well as in dynamic responses during seismic activities in the buildings. Investigations found, that after the October 2015 Hindu Kush earthquake a magnitude 7.5, the main members such as beam and columns nearby the proposed expansion joints were seriously pounded to each other.Technically analyze of the proposed occurrence indicates that the joints are principally to be treated by using the soft and smooth substance (expanded polystyrene) in order to only cover the joint appearance rather than to keep them in touch such as a motionless manner, were filled by some unsuitable and hard materials(shotcrete and concrete particles) .The inquiry found that the maintenance for buildings which is normally to be done was not considered as appropriate as it was reuqired,since it is comon when the earthquke shaking is occure the mateials used between the separation joints(polyethlyne) are occasionally removed due to wheathering reactions so it is appropriat ot treated again by the same substance Fig 2.4

Figure 2-4 Expansion joint treated by improper materials (shotcrete and mortar)

B. Case Study No. 3

To integrate case study data, third case study was also conducted. In this observations and information of a building that was severely damaged in a fire incident was collected as well as analyzed. The building was used as one of the big shopping centers in Kabul city. As the fire had been set on, the building couple of months ago, the occupants could not flee since the building was not constructed maintaining the standards. During the inspection, the building was under repairing activities. Some of the covering activities were done for interior and exterior faces of the building. It was somewhat difficult to observe and inspect the damaged part of the elements. Therefore, to complete this task, Kabul municipality was consulted for those reports and documents that their technical team was obtained in a technical assessment of the building site, on August 9, 2016.

The G+ 11-story building was intended to be used as a commercial building constructed on 1622.73 square meter plan area and 91.68 by17.7 plan dimensions. The first seven floors are monolithic reinforce concrete frame structures and the three supplementary floors are constructed as of steel structure. (Kabul municipality, Abasin Zadran Market, technical assessment report, August 9, 2016). Fire is one of the most destructive and damaging source for a RC building failure, and severity as well as duration of the fire is directly proportional to the amount of damage for the building. For better safety of personal and goods, when the fire is controlled, all structural members of building should be

patterned and examined to maintain further serviceability. Increase of temperature, in reinforced concrete structures (RC) could generate various damages to the structural elements, (1) because of high heat the concrete is expanded to a considerable rank; as a result, steel to concrete bond is significantly reduced. This occasion could lead the elements to expressively decrease in strength. (2) When concrete is set on fire it normally alters its color and appearance, the burnt look of the concrete could judge severity of the destruction for the RC members Table 2.3. (Yüzer, Aköz, & Öztürk, 2004).

Table 2.3 Physical Effects of Temperature on Concrete [xx]

Temperature	Color Change	Concrete Condition
0 to 550 °F (0 to 290 °C)	None	Unaffected
550 to 1100 °F (290 to 590 °C)	Pink to red	Sound but strength significantly reduced
1100 to 1740 °F (590 to 950 °C)	Whitish Grey	Weak and friable
1740+ °F (950+ °C)	Buff	Weak and friable

C. Visual Assessment:

Due to the recent fire, all main elements of the building have been received serious cracks, in some of the members this faults are considerably visible. Column no.8 and 21 for floor four are good examples Fig 2.9 & Fig 2.10

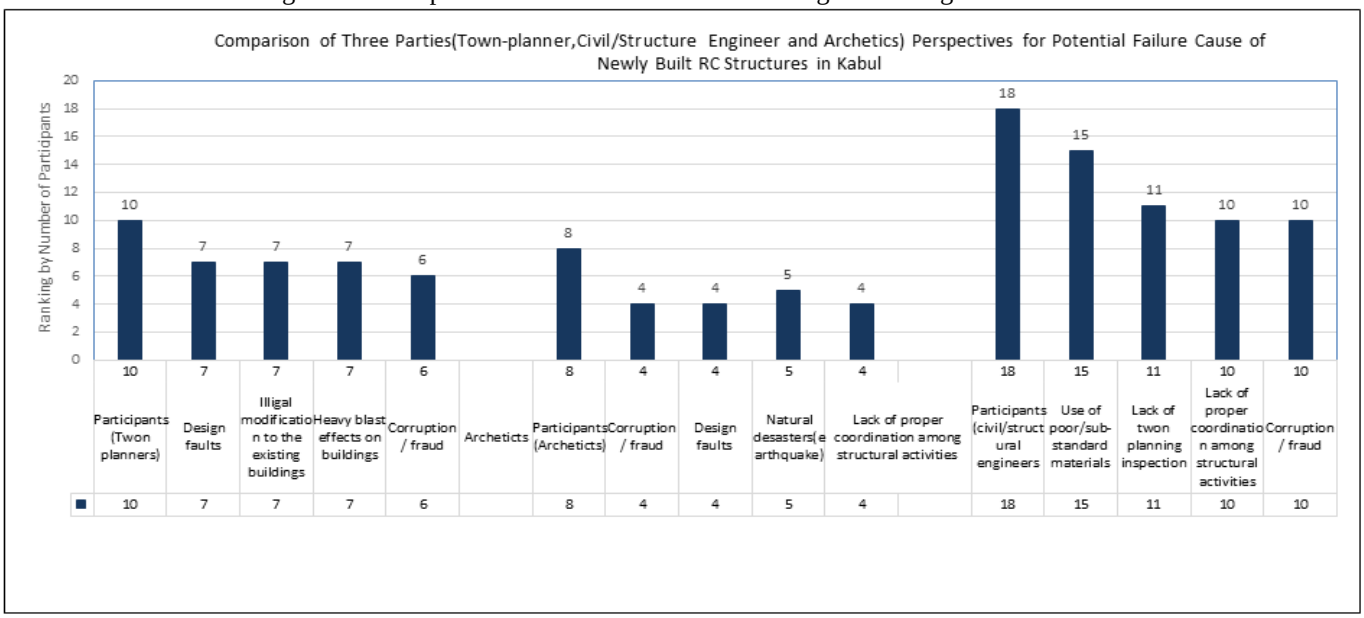
Figure 2-9 Shows cracks on the 21st column

Figure 2-10 Demonstrations cracks on the column

III. RESULTS AND DISCUSSION

Figure 4.1 is a graphic demonstration of the comparison of the final three main specialists (structural/civil engineering, town planners as well as architects) perspectives for the failure causes of the recently built RC structures in Kabul. Majority of the civil/structural engineers believe that the major failure causes of the structures are the use of sub-standard materials and lack of town planning inspection. Fifth five percent of them believe that the corruption and lack of proper coordination between main parties they are played major role in structural activities are also sizable concern against structural dealings, and could lead to have substandard and poor products of RC structures. This problem is more considerable when a big and expensive project is implemented without consultation among related specialist Vast Majority of town planner engineers are the same idea. They are claimed that, illegal modification to the existing building, design faults and heavy blast effects on structures are the core factors for building failures, however they are similarly involved in structural deficiencies. Their concern is, as many heavy blasts are occurred nearby the vulnerable RC structures, whereas for common buildings, blast effect consideration is not intended during design procedure. On the other hand, participant argue that many private companies are provided engineering services. They normally design and undertake major projects (multi-story buildings) although there is no any proper source to check and control their activities.in spit of this fact majority of the consultancies are employed fresh graduated engineers, as they have no sufficient experience. Majority of the architects believe that natural disasters (earthquake) are the major basis for building failure in Kabul city; this is might be Kabul is located on highly active seismic zone of the map. Seismic history of area moreover indicates that, buildings located in this city have experienced many earth jolts as the most recent and destructive one was Hindu Kush earthquake with a magnitude of 7.5 on 26 October 2015.

Figure 3-1 Comparison of different views concerning to building failure causes



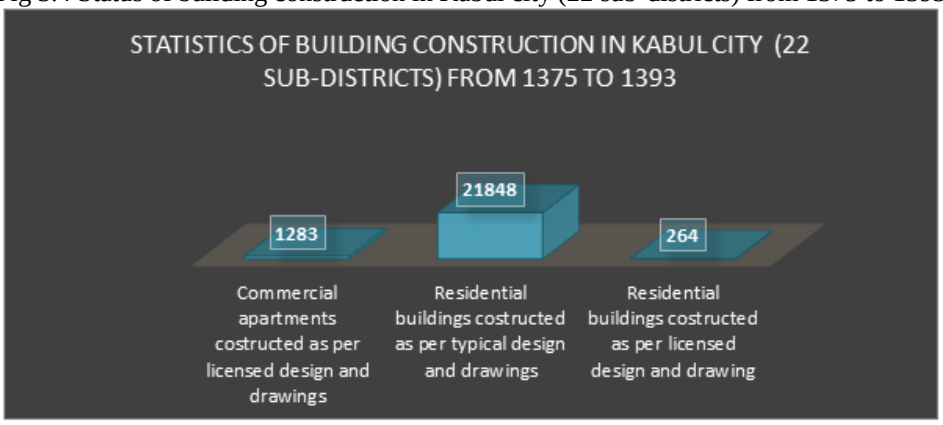
Altogether, statistics collected as a primary data could be summarized by a table displaying the percentage as well as ranking of the severity of failure causes for newly RC built structures with compared to the participant's viewpoints. Table 4.1 is an indication of the results using all participants' perspectives to rank likely causes of failure in RC built structures.

Table 3.2 the focal causes of failure in newly RC built structures in Kabul city from different opinions

S/N	Sources of failures	Percentage %	Rank
1	Use of Substandard Materials (Deficient material principally reinforcements, steel sections and cement can contribute vastly to failure of RC buildings.).	83	1s1 s1st
2	Design faults (e.g., faults of calculation, incorrect selection of material or understanding of their properties etc.)	70	2
	Illegal Modification to Current Buildings (e.g. In some cases, existing buildings are renewed to two or three-story without any approved drawings and supervision by experienced workers.)		
	Unexpected Failure Types(Heavy Blast Loading and Blast Effects on Structures)		2nd
3	Natural disasters(earthquake)	63	3
4	Absence of town planning Inspection or monitoring of project Sites (sometimes, Town Planning Professional staff occasionally visit building sites to inspect or monitor progress of approved work in sites, the result of which is documented in their forms. Unfortunately, in many cases, this inspection is non-existent. Consequently, buildings are put up without the authority knowing anything about the details of the construction.)	61	4
5	Corruption and fraud (unfortunately, Many contractors, professionals in building industry and sometimes the government sectors are corrupt and selfish, the contractors could minimize costs by buying substandard materials, so as to keep some money in their personal pocket.)	60	5
	There is no any proper coordination between main specialists they are more involved in structural activities (e.g. client, architects, structural engineer and town planner.)		
6	Absence of specific building code.(there is no any specific building code uses for construction of various sort of buildings)	50	6

Table 3.2 demonstrates that the widespread cause of building failure is the use of sub-standard materials in building constructions. This reason could be principally authenticated, since there is no any specific source to control and test-building materials, as vast majority of them are imported from other countries. Design fault leads to building failure is the second concern of the participants, this might be due to the fact that all over the Kabul city small amount of license and permits are received from Kabul municipality by the owners of buildings. In fact, over, then 75 % of buildings are constructed without any authorized approval Fig 3.4. Generally, their understandings are stated that, use of poor of materials in building construction, design deficiency and illegal modification to the existing building all over the Kabul city are the key concerns.

Fig 3.4 Status of building construction in Kabul city (22 sub-districts) from 1375 to 1393



Source: Kabul municipality

Case studies found that fire is the principal cause of building failure. This truth is more applicable for commercial buildings and structures in Kabul city. The studies moreover found that these buildings are further prone to structural failure since there were not reported any case of building failure in residential and industrial buildings throughout the case studies. This may be because of the fact that there is not considered any proper fire controlling systems in these buildings and are erected without construction permits and standards. In accordance with the case study, proposed building (Abasin Zadran Market) is no longer efficiently enable to withstand the intended service loads. Considering the size of the building, it was an expansive building whereas there is no any reported source of failure in such expensive building around the Kabul city. Finally, it could be judged that fire is the chief potential failure cause for newly RC built structures in Kabul.

IV. CONCLUSION

The intention of this investigation was to demonstrate core causes of failures in newly RC Built Structures in Kabul. Both primary and case studies information confirmed in chapter – 3 indicated that use of sub-standard materials and fire is the most significant challenger for newly RC built structures. Though, in long term these challenges could result in very bad disasters for the buildings. It founds, that current construction scheme for commercial buildings is furthermore not sustainable and fire risk is thoroughly attentive to them. However, materials use in these buildings are also not as sure as it is required. The study is concluded that potential failure cause for newly RC buildings structure in Kabul were fire effects, use of substandard materials, design fault and illegal modification to current buildings respectively.

RECOMMENDATIONS

All those buildings they are subjected to fire should be examined and inspected in a professional means to assess the extent of damage and prevent further disasters in reuse of the structures. The author suggests the government agencies responsible for controlling construction activities in Kabul city for forming the forensic engineering section in Kabul municipality in order to investigate all materials, products, structures or components that fail or do not execute or function as anticipated, affecting personal injury or damage to assets. The author recommends the relevant authorized to conduct a professional advertising system through social media to help all individuals such as engineers, architects, and contractors in preventing building failures. As Kabul is located on active seismic zone, government agencies they are responsible for providing visa to building construction in Kabul city should make sure that the buildings being constructed have sufficient separation distance to avoid unexpected pounding during seismic waves. Normally, Seismic activities leave significant damages to RC structures in Kabul city after every seismic incidence, construction administrators are suggested so as to check the extent of failure and damages as soon as the shakes are eliminated for all those buildings their importance category is in high level. This effort could help to avoid the owners from the hiding of the serious structural failures on the buildings by plastering and other covering finishes to the structural elements.

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