

Collapsing Building: Recent Norms in Tbilisi, Enemy to Neighbors and Owners

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Abstract

This project investigates the reasons building collapse has become rampant in recent times (2009 – 2012), in the Capital City of Georgia Tbilisi. Then provide an adequate solution to this problem, which has to do with human lives, properties and resources.

Keywords: Structural defects, structural analysis, Engineering design, Foundation failure, quality management, Disaster recovery

Introduction

This study is to find out why building collapse has recently increased

- What might be the possible causes,
- How it can be prevented, and
- Proffer solution to the problem of collapse, because it affects lives, Properties, waste resources and creates much distress to all involved.

Buildings as we all know, is like every other structure, it is design to support some certain loads without deforming due to weight and load. Loads are weight of people and objects; live load is the weight of rain and pressure of wind, while dead load is the constant weight of a structure or the building itself.

Any type of building can collapse, but the multi floor buildings are more prone to catastrophic collapse. Collapsing building, has become alarming, killing people as well as destroying properties, some cases took place in our state capital “Tbilisi”. In 2009, Georgian state-owned television Rustavi-2 partially collapsed, injuring nine persons and burying two film editors alive under debris. 2010, In Ortachala district, a building was undergoing large-scale renovation when it collapse, four construction workers inside died. Another section of nine floor building collapsed, killing at least two construction workers. The re-occurring incident of 2012, gave me much concern, three different collapse in less than two months. In June 7, A construction worker died as one wing of the new parliament building in Kutasi collapsed. According to eyewitness, 22 people were injured. In same June 25, another one collapse due to inadequate supporting wall of the building and needed to be reinforced, although the owner of the house refused to do so. As reported, nobody was in the building during the collapse. In the month of August, another one happened in Kiketi settlement of the Didgori district of Tbilisi, where four years old child died in the ruins of an old building. Dideba, the

territory where a new play ground will be constructed. According to some eyewitnesses, when the emergency brigade arrived at the place of the incident in a few minutes, the doctors could not save the child, the father of the same child, and his ten years old Nephew were also Injured in the collapse of the building, they both were transferred to the hospital.

Late Prof. D.N. Nwokoye a professor of civil/structural engineering, during his Innaugural lecture, titled “ENGINEERING DESIGN, A SOCIAL RESPONSIBILITY, 1983” said “medical doctors bury their mistakes in the grave but CIVIL ENGINEER FOR FOREVER DAMNED BY THEIR MISTAKES”.

The picture shown on next page, are some of the affected collapse building of those years mentioned.

In some decades ago, we do our building design with drawing board, rotting pen and hand which is manual design, but in these generation, we design with computer using Autocad which makes it very easy to design and also analyze the structural details. Such as foundation, structural section details, structural analysis etc.

Reasons Why Buildings Collapse In Georgia Tbilisi.

The cause of structural failure are so many and can be complex, all depends on the type and complexity of the structure. (Folagbade,1997) The inability of an engineer to carryout proper site investigations, the inability to calculate design loads accurately, the inability to prevent the use of substandard building materials, the inability of the engineers/planning authority to have good design layout and inability of the engineers to understand structural analysis and design principles lead to structural failures.

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Seven-floor Building Collapse in Tbilisi

What is still the problem with collapse?

The possible causes of building collapse in Georgia Tbilisi.

- The absence of soil test report.
- Old and over stayed without renovation
- Foundation failure.
- Poor quality of building work.
- Substandard building materials.
- Structural designs and details handled by none professionals.
 - Lack of adherence to specifications by the unqualified and unskilled personal.
 - Inadequate enforcement of the existing building regulations.
 - Bad design.
 - Faulty construction.
 - Workers not adhering to instruction given by the engineer on site.
 - Natural occurrence.

Absence of Soil test: for any construction to be complete, soil test is very important because it helps both the architect and structural engineer. It will able them to know the type of foundation to be used. Also they will as well know precaution to be taken to avoid collapse of such structure due to settlement and other foundation problems. Buildings in some cases, above the ground floor level do not have structural designs and details, and most times lead to the structure failure.

Old and over stayed without renovation: Most collapse are old building, some have stayed for decades without reinforcement in terms of renovation.

Foundation failure: The most important part of a building is foundation, if the foundation is solid, fifty percent of your work is secured. Lack of attention to monitoring and evaluation is the root cause of most of the problem. In this case, a registered structural engineer is very important while planing on building a strong and solid multi storey building. Building has a life span, most building in Tbilisi Didgori have spent

30 years and above, despite non-solid foundation and very low quality materials usage.

Poor quality building work: The mixture of cement, sand, concrete, water, laying of blocks, and then plastering without an accurate mixture, led to weakening and eventual collapse. As the construction work is going on, take some steps away from the site to watch the building then you will see the quality of your construction, which may result in a poor quality building work at the end of that project.

Substandard building materials: According to building and engineering experts, substandard building materials are the major cause of house cracks that leads to building collapse if used for construction. Their lifespan is shorter and hence have lower sustainability.

Structural design and details handled by non-professionals: when a structural design and details are given to non-professionals to handle, the interpretation of such design will be a problem because he has got less knowledge about what was given, and when structural design and details are not really done by a professional, the end result is collapse. What ever is on the paper, is usually what is on the ground provided there is no other external forces. When a column fails, it transfer its loads to other columns which are ill prepared to receive such and hence those columns fail too leading to massive collapse of the structure. This is the most prevalent in Tbilisi. The reason is simple, such columns were designed by inexperience designer, they are under-designed and may not be robust enough to withstand the load impose on them.

Lack of adherence to specifications by the unqualified and unskilled personnel: There are some specifications to beams, columns, irons, cement, concrete, masonry, for example a library is 5.0kN/m² while a residential building is designed to a maximum of 2.0kN/m², usually, 1.5kN/m². Thus, a building for residential purpose should not be converted to places of assembly like a church, a party hall, a school or library, if such activities must take place, let it be limited to the ground floor. Thus, a major precaution is that the usage of the structure as imaged during the design should not significantly change during the real occupation. The factor of safety embedded in the design procedure may not be strong enough to withstand such change.

Inadequate enforcement of the existing building regulations: Every building has its regulation and code; a building code official may determine that building, structure or equipment is unsafe because of inadequate means of positioning, inadequate light and ventilation, fire hazard, other dangers to human life or the public welfare, illegal or improper occupancy or inadequate maintenance.

Bad design: Bad design fails to connect with people's eyes because it's cannot be appreciated by their neighbors and who walk past every day. It cannot be appreciated by anyone.

Faulty Construction: Is one of the most common causes of early deterioration. Common construction

faults include inadequate compaction and failure to place the reinforcement so that it has adequate concrete cover that is another reason for collapse.

Workers not adhering to the instruction given by the engineer: Sometimes, It's hurt to hear that the workers refuse the instruction given to them by the engineer, simply because they assume they have been on field for a long time and can use their past experience, but forgot that area test is different. This is one of the reasons why buildings collapse in Tbilisi. Each building has its own mixture specification, and then if the engineer on site directs you on what to do, failure to adhere to that; results to poor workmanship, which can also lead to collapse of building.

Natural occurrence: One of the major natural factors that result into building collapse is earthquake; others may include rainfall, temperature, pressure, etc. When an earthquake happens, the shaking caused by seismic waves can cause building collapse. The fact remain that this is a natural factor that cannot be stopped, so having it in mind, buildings need to be constructed adequately because it is an uncontrollable factors.

Methodology

Interview carried out with some Engineers on site in Vaja-Pshavela Avenue, Tbilisi.

Marab Ugulava, Giorgi Datuashvili, Tamar Abeshadze. These engineers said safety and economy is the central objective of a building structure designing. So what then makes a structure to withstand all the forces of nature that are willing to pull it down? That leads us to three major components:

a) The materials used for the structure;
b) The techniques or construction methodology adopted for the structure.

c) The professional behind the structure.

Then, who are the professionals?

From the structural analysis of every design, we are mean to understand that the only sets of professionals that make or harm a structure in terms of safety are the Structural Engineers. No other, not even the civil engineers.

Prof. D.N. Nwokoye, an erudite Professor emeritus of Structural Engineering, University of Benin, Benin City, Nigeria. Defined a Structural Engineer, in his book titled The Philosophical Bases in Education and Practice of Structural Engineering as: “An Engineer who is having attained the prescribed academic standard in the field of Structural Engineering or cognate fields and who having reached professional maturity in the practice of Structural Engineering is recognized as such by the Regulating Professional Body or bodies”. In terms of practice, a structural engineer, in a country should be,

a) A WELL registered Structural Engineer

b) A WELL registered Civil Engineer.

So the professionals are those trained in the field of civil/structural engineering and registered by the government of that country.

The method of construction is very important and all the rules and regulations must be followed. In every project, quality control and a good result is very important to the engineer. So where there is a lot of concreting like the slab, the mixture of concrete must be properly mixed in order to achieve the concrete grade specification. The quantity of cement, sand and water are not left out.

Commonly used cement, sand and gravel for concrete mixtures:

Construction	Materials Volume Ratio			Materials Required		
	Cement	Sand	Gravel	Cement (sacks)	Sand (CY)	Gravel (CY)
Normal static loads, no rebar, not exposed	1	3	6	4.2	0.5	0.95
Foundations and walls, normal static loads, exposed	1	2.5	5	5.6	0.45	0.9
Basement walls	1	2.5	4	5.6	0.5	0.8
Basement walls, waterproof	1	2.5	3.5	5.9	0.55	0.8
Floors, light duty, driveways, sidewalks	1	2.5	3			
Reinforced roads, walls, exposed	1	2	4			
High strength, floors, columns	1	1	2			

1 CY = 1 cubic yards = 0.7646 m³ = 27 ft³.

This brings us to the relevant and necessary data of past investigation of building collapse in Tbilisi. In order to achieve the aim of this research, which is to investigate collapsing building-recent norms, in Tbilisi, enemy to neighbors and owners, and then we can

suggest various ways of eliminating the incidence. The following factors are considered as the bases of findings.

- Names of floor building
- Type of the building(private or public)

- Purpose of the building (commercial, residential, educational or religious)
- Year of collapse

Causes of building Collapse	Names & nos of floor building	Type of building private public	Year of building collapse	Calamities of Death each year	Injury per year	Count
Absence of soil test report	3	1	2009	2	12	1
Poor foundation	5	1	2009	1	0	1
Poor quality of building	2	2	2010	1	0	1
Substandard building materials	2	1	2010	4	1	1
Structural designs and details handled by none professionals	7	2	2010	4	0	1
Lack of adherence to specifications by the unqualified and unskilled personnel	9	2	2011	0	1	1
Inadequate enforcement of the existing building regulations	2	2	2012	0	2	1
Bad design	4	1	2012	1	14	1
Workers not adhering to instruction given by the engineer on site	5	1	2012	5	30	1
Faulty construction	1	1	2012	0	14	1
Natural occurrence	7	2	2012	9	14	1

Discussion of Findings

The findings revealed that private building has the highest number of collapse than the public ones. This is because government officials are not paying enough attention to private buildings; all they are interested in is just ensuring that appropriate approvals are obtained. The owner may decide not to even use an engineer on his site; He / She can as well use the road side designer for his building. They prefer the cheap building materials. The analysis also confirmed that poor substandard building material quality with structural designs and details handled by nonprofessionals has accounted for more than 50% of causes of building collapse in Georgia.

Future Preventive Measures

In order for us to reduce the problem of building collapse, preventive measures are proposed following a manageable proportion from the causes above.

- Government should look into these and ensure that all structural design and detailing are handled by professionals.
- As an engineer on site, you have to reject such substandard materials, moreover if you are building high floor buildings; develop the habit of taking your building materials for test in order to establish their durability, sustainability and quality as well.
- Continuing professional development should

be emphasized by both the professional bodies and the government on modern trends in the building industry. To keep members of the building industry familiar with new trends in construction.

- Construction work should only be carried out by registered contractors and supervised by registered architects, engineers and builders rather than engaging unskilled contractors.
- Government should provide an enabling law for the training, and effective control of designer and workers in the building industry.
- A regular check of defective structures must be carried out and such structures should be marked for demolition, and be demolished before it causes havoc on lives and properties.

Conclusions

About 30% of building collapse in Tbilisi is accounted for by poor maintenance culture, design error, poor quality of material, structural design and details handled by nonprofessional, natural and excessive phenomenon contributed to building collapse in Tbilisi with most of them emanating from the private sector. Let us not be in too much of a hurry while building, so we will not be like the surgeon who performs an operation and forget the scalpel in the patient's stomach and they do not care because no one has a proof of it.

Thus, a civil engineer who is not a Corporate Member of Registered engineering body, should not

be entrusted with the structural safety of any structure - buildings, culverts, bridges, dams, etc. In other words, to ensure safe building, the designer must be someone who is certified to carry out the design. The best design by the best and most qualified designer does not guarantee safe structure except the materials for construction is of the correct quality. The materials mostly used for building structure in the country are cement, sand, concrete (gravel and granite) and iron rods. We ensure that all building materials undergo their different test to ascertain the quality and durability of each before use for construction work. In this case it will be possible that most of the recent building collapse can be avoided.

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