
COST IMPLICATION OF BUILDING COLLAPSE IN ABUJA NIGERIA

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ABSTRACT

The incessant incident of building collapse in Nigeria is becoming another challenge to the government. The challenges seem it has no solutions because the government tried to create policies to solve the menace but it seems the problem is increasing. The recent collapse of a 21 – storey building in Lagos Nigeria indicated that all the policies of the government to stop the menace of building collapse are not working. The question on everyone's lips now in Nigeria is how to stop this problem? Because of these, the paper aimed to examine the cost implications of the building collapse on the national economy and to identify effective ways of solving the menace. In achieving this aim some selected incidents of building collapse were reviewed and the cost implications were estimated. This cost was presented in a tabular form also questionnaire was designed to examine from a professional view the solutions to the problem of building collapse in Nigeria and also to analyse the view of the professionals on the cost implications. The questionnaires were analysed by the use of descriptive analysis (RII). The relative important index was ranked and the solutions that have the highest mean scores were ensuring that every building project has a mandatory soil test environmental impact analysis and structural analysis it was ranked first with a relative importance index of 0.09, Followed by Esurance of the SON (Standard Organization of Nigeria) that only certified building materials are allowed in the market this was 0.86 and Strict adherence to the provisions of the building code. The paper recommended that the government should ensure to have a monitoring group that will comprise professionals that have enough experience in building construction to ensure that the building is built by the specifications.

Keywords: *Building, Challenges, Collapse. Cost. Solutions*

INTRODUCTION

Buildings are structures that are constructed to serve as shelters for man, his properties and activities. There must be properly planned, designed

and constructed to obtain desired satisfaction from the environment. The factor to be observed in building construction include durability, adequate stability to prevent failure or discomfort to the users, resistance to weather, fire outbreak and other forms of accidents (Qurix, and Doshu, 2020). Okeke *et al.* (2021) opined that the frequency of collapse of building structures in Nigeria in the past few years had become very alarming and worrisome. According to Okeke *et al.* (2021), many lives and properties have been lost as a result of building collapses, primarily in Port Harcourt, Abuja, and Lagos; additionally, many property owners have developed high blood pressure, and some have died prematurely as a result of this scourge in the country. A visit to the collapsed scenes was as revealing as they are pathetic and one could not but wonder why such contraption could have been allowed to stand or to what extent people can go out corners at the expense of respect for safety and respect for lives. Unfortunately, there are still several buildings of similar circumstances dotting the skylines of many cities in Nigeria, and the fact that building collapse incidence is still occurring regularly despite increasing diffusion of engineering knowledge over the years necessitates a re-examination of development in building production and control processes. As observed by Ojo (2021) why must a preventable incidence continue to traumatize us all, the times these incidences have brought to question the effectiveness of contractors in the country.

Building collapse or failure is not a strange thing in the construction industry all over the world with particular reference to the developing countries but it is never designed to happen. Incidents of collapsed buildings collapsed bridges or other structures of various types are not peculiar to Nigeria alone, but, the continuous reports of collapsed building most especially in Abuja and Lagos state are of Nigeria needs to be checked urgently (Ongbali *et al.*, 2021). According to Ike *et al.* (2021), an informal survey done by the Nigeria Institute of Buildings (NIOB) has found that more buildings may have collapsed during construction in Abuja and Lagos state than in the rest of the country combined over the preceding 45 years (1955 - 2000). According to Oboirien and Windapo (2020), the menace of building collapse in Nigeria in the past twenty years is very worrisome, because many lives are lost and huge investments are wasted. Several causes of building failure have been attributed to either natural or man-made phenomena. In Nigeria, surveys conducted by Obodoh *et al.* (2019) revealed that the use of substandard building materials; poor workmanship, the use of quacks instead of professionals,

non-enforcement of building codes or construction regulations, corruption in the building industry, and other factors have all played a significant role in the majority of recorded cases of building failure. Consequently, these often result in building collapse which has adverse effects on both people and investments in the building industry. In the past ten years (2010- 2020), an overwhelming number of buildings (forty-eight) have collapsed in Nigerian urban cities, with about 77% rise from the previous decade (Hillary and Chinedu 2021; Hamma-adama *et al.* 2020; Mrabure and Awhefeada 2020). As a result, individual perspectives on who is to blame for the building collapse varied greatly. According to Ede *et al.* (2021), the calamity of building collapse in Nigeria is man-made, and it is highly preventable if all stakeholders and the government take it seriously. However, the world is becoming unsafe as a result of the geometrical order of population expansion, urban development in coastal areas, poor planning and housing development, and building collapse in the country's major cities ABUJA and LAGOS. (Boateng, 2020).

The government has put in place specific rules and regulations required to maintain a sense of safety of buildings to prevent disastrous occurrences in addition to generally ensuring that players and referees in the building construction industry abide by certain acceptable standards of moral conduct and behaviour. For accountability purposes especially as it relates to the proper observance of Town planning roles and regulations, those administering the rules must be held responsible and accounted for their actions. However, accountability in Nigeria is generally weak because of the lack of the political will to enforce the same and this view was supported by Douglas and Muhammad (2020). In Nigeria, the most common causes of building collapse have been identified as bad desires, faulty construction, foundation failure, extraordinary loans, the use of unqualified contractors, poor workmanship, and poor project monitoring, and, most importantly, a failure by relevant town planning officials to enforce building codes (Akinyemiet *al.* 2016; Akata and Osung, 2020; Anihet *al.* 2020; Douglas, and Muhammad 2020; Falana and Ipindola 2020 Anosike 2021).

LITERATURE REVIEW

The Effect of The Collapse of Building

The most common effect of building collapsed in Nigeria as pointed out by different authors are as explained below;

- a. **Economic Effect:** most of all the building that collapsed was believed to serve its purpose for many years. The collapse of buildings affects the economic sector of the nation in such a way that is going to be a huge upturn of money to rebuild and also demoralise the interest of foreign investors. They would not want to invest his or her money where it will not yield profit or be sceptical of the building is a loss to society, the government, the owner and also the construction industries. It also creates a bad impression in the mind of the outside world such as a country in which many collapses happen (Anosike, 2021)
- b. **Effect on the Construction Industry:** this has a great effect on the construction industry. This is because industry suffers the outcome of this collapsed building will be awarded to the foreign construction industry. After all, the industry within must have lost reputation in the sight of government and private individuals, which causes instability in the construction (Adeniya 2009; Adebowale *et al.* 2016; Awoyera *et al.* 2021)
- c. **Loss of Life and Damage to Properties:** when a building collapses, people within the collapse area are in danger. The lives of the occupant or the operatives and workers are at stake. Some who lost their lives during the process of building collapse are affected in one way or the other because when rubbles of concrete and block of falling walls drop beyond the premises of the building construction. It damaged properties and people sustained injuries and thus lead to additional lost which were not supposed (Anihet *al.* 2020; Ogbemudia *et al.* 2021; Israel and Kukoyi 2021; Awoyera *et al.* 2021).
- d. **Security Effect:** Many times the collapse of a building creates an entrance to a particular place. This comes as a result of the collapsed wall falling on the fence. Creating an opening. If that happens the building is not secured also the properties can be used as a shortcut to elsewhere (Akinyemiet *al.* 2016; Akata and Osung 2020; Falana, and Ipindola 2020)

Reasons for Building Collapsing in Nigeria

The causes of building collapse in Nigeria can be traced back to unusual factors that are not available in many other developing countries. Aside from the well-known reasons for the collapse, such as design defects, ageing, material fatigue, harsh operating and environmental circumstances, accidents, terrorist attacks, and natural disasters, the Nigerian factor emerges as a significant concern to reckon with (Ede et al. 2021). The Nigerian factor in the building sector manifests itself in several ways, such as corruption, lawlessness, and our assumptions that any engineer or expert in the built environment may assume all forms of responsibility in a building process without the basic skills required (Anosike, 2021). Corruption manifests itself in avarice and a proclivity to deceive in almost every aspect, from bad materials and work quality to the quantities we use. Because civil law disobedience is frequent in Nigeria, the case of corruption manifests itself in avarice and a proclivity to deceive in almost every aspect, from bad materials and work quality to the quantities we use. Because civil law disobedience is rampant in Nigeria, the situation in the construction business cannot be different. Lawlessness finds fertile ground in our disregard for building codes and hurried development. The employment of unskilled labour, inexperienced professionals, certain experts' proclivity to cross-carpet to lucrative specialised responsibilities where they lack the skill, ignorance, and the abundance of quacks in the building sector are all facts to reckon with (Anih et al. 2020; Ogbemudia et al. 2021; Israel and Kukoyi 2021; Awoyera et al. 2021). Excessive rainfall and inadequate drainage systems pose a severe threat to structures along Nigeria's beaches. Sinking historic buildings are a familiar sight in Lagos and the surrounding coastal districts due to water-related issues and inadequate foundations, however not all stakeholders pay appropriate attention to this problem because many new structures exhibit the same problem while the structures are still under development (Ede et al. 2021). The majority of the confirmed collapses in recent years occurred during the construction stage. Unregistered engineers and other professions are a common occurrence in the field. Even people with no formal training in any of the crafts required in the building sector frequently infiltrate the system to do critical duties. The Council for the Regulation of Engineering in Nigeria (COREN) proposed in 2006 that a pharmacist be prosecuted for supervising a collapsed building in Port Harcourt in 2005. (Adeniya 2009; Adebowale et al. 2016; Awoyera et al. 2021). If we can address these concerns, the negative effects on our population will be greatly lessened,

and we will have more time and resources to deal with other problems and the unanticipated repercussions of global warming, which has become a permanent fixture in our lives. Most of the facts highlighted above were confirmed by the recent collapses of 21 – storey buildings in Lagos Nigeria on Monday 1st November 2021 which has left over 38 death and many injured.

Effects of Building Collapse in Nigeria

All human endeavour indeed has a cost, but the cost paid in the Nigerian building sector cannot be justified. Each collapse has far-reaching consequences that cannot be readily forgotten by any of its victims. Typically, the consequences take the shape of economic and societal ramifications. These include the loss of human lives, injuries, economic waste in the form of lost assets, investments, jobs, and incomes, loss of trust, dignity, and aggravation among stakeholders, and environmental calamity (Anih et al. 2020; Ogbemudia et al. 2021; Israel and Kukoyi 2021; Awoyera et al. 2021). Because there are so many components involved, including emotional and subjective factors, quantifying the whole effects of any collapse is extremely difficult. Aside from the number of deaths that can typically be accurately recognized, the remainder of the consequences is shrouded in mystery by so many uncertainties which make the analysis only approximate. Leaving aside the grossly quantifiable economic sums, the stress, trauma and shocks may have some far-reaching (Adeniya 2009; Adebowale *et al.* 2016; Awoyera *et al.* 2021). The paper tries as much as possible to bring out some selected building collapse and their approximate cost implications.

METHODOLOGY

The methodology adopted in this paper was survey methods, primary and secondary data were used for the study. The review of the collapsed buildings was gotten from the previous works why the assessment of the cost implications and solutions were gotten from the use of a well structured closed questionnaire. 80 questionnaires were distributed to professionals and stakeholders in the construction industry. 65 questionnaires were retrieved and used for the analysis. The breakdown of the distribution is as shown in table 1.

Table 1. Distribution of Questionnaire

Professionals	Number distributed	Number retrieved	% retrieved
Quantity surveyors	25	20	25
Builders /contractors	10	7	15
Architect	15	12	9
Structural/ civil engineers	15	13	16
Estate surveyors/developer	15	13	16
Total	80	65	81

Source: author 2021

The distribution shown in table one shows that quantity surveyor responded more than the other professions. This is because they were easily assessable by the author. The structural engineer and the estate surveyors and the builder has a 15% response. This will help the research because the view of engineers and the developers are very important in building collapse issues. The builders responded closely with 15%. The result is a balanced one because the view of all the professionals is well captured.

Table 2: Some selected Building Collapse in Abuja

House	Location	Cause of collapse	Casualties
Three storey building	Aminu crescent Wuse 2	Kano Use of Poor construction materials	No casualty
Four storey shopping mall	230/1101 Utako District	Structural defects	Over 50 people trapped
Uncompleted three-storey building	Asokoro near AYA junction	Structural defects	3 people died, several were injured and 30 were trapped
One storey building	Plot 528, Durumi District	Use of substandard materials	No casualty
Four storey building	Plot 1007, No 2, Ikole street Garki II	Structural Defects	21 persons died
Uncompleted four storey building	Okolie street off Gimbiya street, Abuja	Substandard materials Disregard for building regulations	23 died 11 injured
6 suspended floors for commercial purpose with a basement	Plot 702 Port-Harcourt crescent Garki 11 Abuja	Substandard materials Unqualified professionals	
The collapse of a 2-storey Zenith Bank Plc Expansion Building	Mararaba (near Abuja)	Geotechnical investigation, Undersized Reinforcement, Large span slab, No specific	2 died 11 injured

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1-storey commercial building under construction material	Apo Village	Mechanic	floor thickness on drawing No professional on-site, poor supervision, use of poor quality	
Collapse of two storey building	Gwarinpa Abuja	Estate	Structural Defect, Demolition operation	3
Collapse of 2-storey building under construction	No 3 Awosike Kubwa III, Abuja	Ademola 8 th Road Extension	Poor quality material, poor workmanship, weak foundation, failure of a structural element	3 died 9 injured
Three storey building	Naval Gwarimpa	Quarters	Structural defects	4 people died
One storey building	Apo village	mechanical	Structural defects	4 people died
Uncompleted two-storey building	Dutse council	Bwari Area	Use of substandard materials	3 people died and 9 people injured
Two storey building under construction	Dutse near church	Powerline Living Faith	Poor workmanship	4 people died several people injured

Source: National emergency management Agency 2021



Plate 1: Location Gwarimpa State: Date March (2013)
Source: National emergency management Agency 2021



Plate 2: Location Apo Village: Date September (2011)
Source: National emergency management Agency 2021



Plate 3: Location: Lugbe Federal Housing Estate: Date April (2014)
Source: National emergency management Agency 2021



Plate 4: Location Garki Village: Date (2006)
Source: National emergency management Agency 2021

Plate 1 to 4 show pictures of the collapsed building and the extent of damage and loss. The nature of the collapse and the rubble shown in the pictures is a clear indicator of poor workmanship and the use of inferior or substandard materials.

Table 2: Estimated Cost Implication of Some Selected Incident

	House	Updated Cost of The Building That Collapse	Cost of Treating Casualties/compensation to the dead family	Total Cost Implication
1	Three storey building	100,000,000.00	0	100,000,000.00
2	Four storey shopping mall	150,000,000.00	400,000.00	150,400,000.00
3	Uncompleted three storey building	50,000,000.00	500,000.00	50,500,000.00
4	One storey building	50,000,000.00	0	50,000,000.00
5	Four storey building	200,000,000.00	1,500,000.00	201,500,000.00
6	Three storey building	160,000,000.00	100,000.00	160,100,000.00
7	One storey building	60,000,000.00	2,000,000.00	62,000,000.00
8	Uncompleted two storey building	30,000,000.00	5,000,000.00	35,000,000.00
9	Two storey building under construction	35,000,000.00	4,000,000.00	39,000,000.00
10	21 storeys building under construction	500,000,000,000.00	5,000,000,000.00	505,000,000,000.00

Source: Researcher's Survey 2021

Table 2 show the estimated cost of some selected incidences of building collapsed this range from 100 million to 505 billion. The last case which was the case of a recent collapsed 21 storey building at Lagos was a typical example of a loss to the nation. According to the report from media houses most of the intending occupant has deposited as high as 500 million dollars for an apartment.

Table 3. Assessment of Cost Implication of Building Collapse on Nigeria Economy

	VSE		SE		NSE	
	Freq	%	Freq	%	Freq	%
The cost incurred due to loss of human lives	50	77	12	19	3	4
Cost incurred due to loss of materials	45	69	15	23	5	8
Cost incurred due to loss of capital investment	34	52	20	31	11	17
The cost incurred due to injury and pain to the body.	46	71	14	21	5	8

N = 65, VSE – very significant effect, SE – significant effects, NSE – no significant effect

Source: Researcher’s Survey 2021

Table 4 shows the respondents assessment of the cost implication of the collapsed buildings. 77% agreed that there was a very significant effect of the cost incurred due to loss of human lives as a result of collapsed buildings on Nigeria economy, 19% also agreed that there was a significant effect of the cost incurred due to loss of lives only 4 % pointed that there was no significant effect, this is in line with the findings of Ojo (2021) and Okeke *et al.* (2021). 69%, 23% agree there was a very significant effect and significant effect respectively of the cost incurred due to loss of materials on Nigeria economy. The same agreement goes with the cost incurred due to loss of capital investment (52%,20%) and costs incurred due to injury or pain to the body (71%,21%). These findings were in line with different authors who have carried out researches on building collapse (Akinyemi *et al.* 2016; Akata and Osung 2020; Falana, and Ipindola 2020).

Table 4. The solution to building collapse in Nigeria

Solutions	RII	Ranking
Ensuring that every construction project includes a soil test, environmental impact analysis, and structural analysis.	0.90	1
The SON's (Standard Organization of Nigeria) assurance that only certified building materials is allowed on the market.	0.86	2
Strict attention to construction code regulations.	0.83	3
All building developers are required to submit building plans to town planning authorities.	0.84	4
The use of quacks should be avoided.	0.82	5
Adherence to pre-determined reinforcement.	0.81	6

High-quality materials are used.	0.78	7
Professional supervision is always present.	0.76	8
To assess the soil bearing capacity, a soil test must be performed.	0.75	9
Building projects must show the seals of the construction professionals who worked on them.	0.74	12
Bribes from developers or contractors are not permitted to be collected by government authorities for the approval of building designs.	0.73	13
Before construction can begin, every building design must be authorized by certified professionals.	0.72	14
Any construction project that does not meet the requirements of the national building code must be abandoned.	0.69	15
Contracts must be awarded directly to certified firms by the government.	0.66	16
Award contract direct to certified professionals and not political counterparts.	0.63	17

Researcher's Survey 2021

Table 4 highlights various expert solutions to the problem of building collapse in Nigeria. Ensuring that every building project has a mandatory soil test environmental impact analysis and structural analysis has the highest relative importance index of 0.9, followed by ensuring that only certified building materials are allowed in the market, strict adherence to the provisions of the building code, enforcement of submission of building plans to town planning authorities by all building developers and avoiding the SON (Standard Organization of Nigeria). They were rated 2, 3, 4, and 5, which corresponded to the findings of Adeniya (2009), Adebowale et al. (2016), and Awoyera et al (2021).

Findings

The study found out that building collapse in Nigeria has a very significant effect on the economy the professional who responded were between over 70%. The results revealed that the most important solutions to building collapsed in Nigeria are ensuring that every building project has a mandatory soil test environmental impact analysis and structural analysis, Esurance of the SON (Standard Organization of Nigeria) that only certified building materials are allowed in the market, strict adherence to the provisions of the building code, enforcement of submission of building plans to town planning authorities by all building developers, avoid the use of quacks.

RECOMMENDATION

This study presents pertinent information on the state of the nation in terms of building collapse incidents and the propensity for the situation to worsen if appropriate steps are not implemented immediately. To reduce or eliminate the occurrences of building collapse, it was recommended that all stakeholders in the construction industry ensure adherence to the provisions of the building code and that the SON (Standard Organization of Nigeria) ensure that only certified building materials are allowed in the market. Similarly, to sanitize the construction business, the authorities should set in motion mechanisms for close supervision of construction sites by enforcing relevant legislation.

REFERENCE

- Adebowale, P. A., Gambo, M. D., Ankeli, I. A. & Daniel, I. D. (2016). The Understanding Causes of Building Collapse in the Nigeria Construction industry. *International Journal of Scientific & Engineering Research*, 8, (7) 1729-1740.
- Adeosun, J. O., Fadipe, O. O., & Adejumo, A. O. Assessment of Quality Management Practices and Building Collapse in Osogbo, Osun State, Nigeria.
- Akata, N., & Osung, W. (2020). Building Collapse Study Using Near-Surface Geophysical Method in Parts of Akwa Ibom State, Nigeria. *structure*, 10(4).
- Akinyemi, A., Dare, G., Anthony, A., & Dabara, D. I. (2016). Building collapse in Nigeria: Issues and challenges. In *Conference of the International Journal of Arts & Sciences, CD- ROM* (Vol. 9, No. 01, pp. 99-108).
- Anih, G. N., Okolie, K. C., Ugochukwu, S. C., & Kanu, D. O. (2020). A Review of The Leadership Roles of Construction Stakeholders In Curbing Building Collapse In Enugu State, Nigeria. *Tropical Built Environment Journal*, 7(1).
- Anosike, N. M. (2021). Views of construction professionals on the causes and remedies of building collapse in Nigeria. *International Journal of Engineering Technologies and Management Research*, 8(6), 68-85.
- Awoyera, P. O., Alfa, J., Odetoyan, A., & Akinwumi, I. I. (2021). Building Collapse in Nigeria during recent years–Causes, effects and way forward. In *IOP Conference Series: Materials Science and Engineering*. IOP Publishing, 1 (1036), 1.

- Boateng, F. G. (2020). Building collapse in cities in Ghana: A case for a historical-institutional grounding for building risks in developing countries. *International Journal of Disaster Risk Reduction*, 50, 101912.
- Douglas, U. M., & Muhammad, B. (2020). Building Collapse in Nigeria: A Review and Delivery of the Future Using Big Data & IoT. *International Journal of Innovative Research and Development*, 9 (8).
- Ede, A. N., Akpabot, A. I., Oyebisi, S. O., Olofinnade, O. M., Okeke, C. A., Oyeyemi, K. D., & Gambo, F. (2021). The trend of the collapse of buildings in concrete materials in Lagos State, Nigeria (2013-2019). In *IOP Conference Series: Earth and Environmental Science* 655(1), 012078
- Falana, J. N., & Ipindola, O. O. (2020). Stakeholders' Perspective on the Perceived Causes of Building Collapse in Lagos State, Nigeria.
- Hamma-adama, M., Iheukwumere, O. & Kouider, T. (2020). Analysis of Causes of Building Collapse: System Thinking Approach. *Jordan Journal of Civil Engineering*. 14, (2) 188-197
- Hillary, W. & Chinedu M. K. (2021). Residential Building Collapse in Nigeria: Incidence, Causes, Effects, Solution and Implication for Technical Education *International Journal of Innovative Education Research* 9(2):153-162, ©Seah I Publications, 2021 www.seahipaj.org ISSN: 2354-2942
- Ike, C. O., Mbuba, F., & Nwot, F. (2021). Federal Government Housing Policy and Building Collapse in Anambra State: A Study of Awka Metropolis. *Available at SSRN* 3835073.
- Imafidon, M. O., & Ogbu, C. P. (2020). A taxonomy of building collapse causes in Lagos State Nigeria. *Nigerian Journal of Technology*, 39(1), 74-86.
- Israel, E. O., & Kukoyi, P. O. (2021). Social Security and Building Collapse in Lagos State, Nigeria. *AIPGG Journal of Humanities and Peace Studies*, 2(2).
- Mrabure, K. O., & Awhefeada, U. V. (2020). The menace of building collapse incidences in Nigeria. The need for strict enforcement of applicable planning laws. *Commonwealth Law Bulletin*, 1-22.
- Obodoh, D., Amade, B., Obodoh, C. & Igwe, C. (2019). Assessment of the Effects of Building Collapse Risks on the Stakeholders in Nigerian Building Environment. *Nigerian Journal of Technology (NIJOTECH)*, 3 (4) 41-49.

- Oboirien, M. O., & Windapo, A. O. (2020). Contribution of the construction industry to economic development in Nigeria–The mediatory role of building control. In *Proceedings of the 46th Builders Conference/Annual General Meeting*.
- Ogbemudia, C. E., Ndububa, E. E., & Mbaezue, N. D. (2021). An Investigation into Causes of Building Collapse in Abuja, Nigeria. *GSJ*, 9(2).
- Ojo, O. O. (2021). Considerations for Building Projects Execution, Monitoring and Control in Parts of Nigeria. *European Journal of Material Science*, 8(1), 13-20.
- Okeke, F. O., Sam-Amobi, C. G., & Okeke, F. I. (2020). Role of Local Town planning Authorities in Building collapse in Nigeria: evidence from Enugu metropolis. *Heliyon*, 6(7), e04361.
- Ongbali, S. O., Afolalu, S. A., Oladipupo, S., Akra, S., & Bello, K. A. (2021). Building structural health monitoring: a tool for building collapse mitigation. In *IOP Conference Series: Materials Science and Engineering* (1036) 1, 012028. IOP Publishing.
- Qurix W. B. & Doshu R. G. (2020). Building Collapse In Nigeria: The Trend of Casualties In The Last Decade (2000 -2010) *International Journal Of Civil & Environmental Engineering IJCEE-IJENS* 10, (06) Doi: <https://doi.org/10.30822/arteks.v5i3.596>