

## INDEX

<b>1 – 1755 LISBON EARTHQUAKE .....</b>	<b>I</b>
1.1. – INTRODUCTION .....	1
1.2 – HISTORICAL FRAMING .....	1
1.3 – LISBON’S 1755 EARTHQUAKE DESCRIPTION .....	2
1.4 – SOCIAL IMPACTS .....	3
<b>2 – LISBON BEFORE THE EVENT.....</b>	<b>3</b>
2.1 – LISBON PARISHES .....	3
2.2 – THE HABITATIONAL PARK BEFORE THE EVENT .....	3
2.2.1 – <i>Introduction</i> .....	3
2.2.2 – <i>Buildings Typology</i> .....	4
2.2.3 – <i>Constructive Materials and Details</i> .....	4
2.2.4. – <i>Habitacional Park Quantified</i> .....	5
2.3 – POPULATION BEFORE THE EVENT.....	5
<b>3 – LISBON AFTER THE EARTHQUAKE .....</b>	<b>6</b>
3.1 – MEASURES IMPLEMENTED AFTER THE EVENT .....	6
3.1.1 – <i>First Measures</i> .....	6
3.1.2 – <i>City Reconstruction</i> .....	6
3.1.3 – <i>The new Parish Division Plan</i> .....	7
3.2 – SURVIVORS AND VICTIMS .....	7
3.3 – POPULATION MOVEMENT AFTER THE EARTHQUAKE .....	7
3.4 – BUILT DESTROYED BY THE EVENT .....	8
3.5 – MISSING NOBLES AND FOREIGNERS .....	8
3.6 – MATERIAL LOSSES WERE SIGNIFICANT .....	8
3.7 – FOREIGN SUPPORT.....	9
<b>4 – CONCLUSIONS .....</b>	<b>9</b>
<b>SELLECTED REFERENCES .....</b>	<b>13</b>

## FIGURES INDEX

FIGURE 1 – LISBON POPULATION JUST BEFORE DE EVENT .....	10
FIGURE 2 – PEOPLE/DWELLINGS RATIO JUST BEFORE DE EVENT .....	10

FIGURE 3 – TOTAL NUMBER OF DWELLINGS IN LISBON BY 1755 ..... 11

FIGURE 4 – GRAPHIC OF THE TOTAL NUMBER OF DESTROYED DWELLINGS IN 1755 EVENT..... 11

FIGURE 5 – TOTAL NUMBER OF DEATHS IN THE 1755 EVENT ..... 12

**TABELS INDEX**

TABLE 1 – TOTAL NUMBER OF HOMES IN LISBON BY 1755 ..... 5

TABLE 2 – LISBON POPULATION ESTIMATES BEFORE THE EARTHQUAKE..... 5

# 1 – 1755 Lisbon Earthquake

## 1.1. – Introduction

1755 Lisbon's earthquake was a significant event in Europe and North Africa history, not just for the victim's record but for its destruction effects.

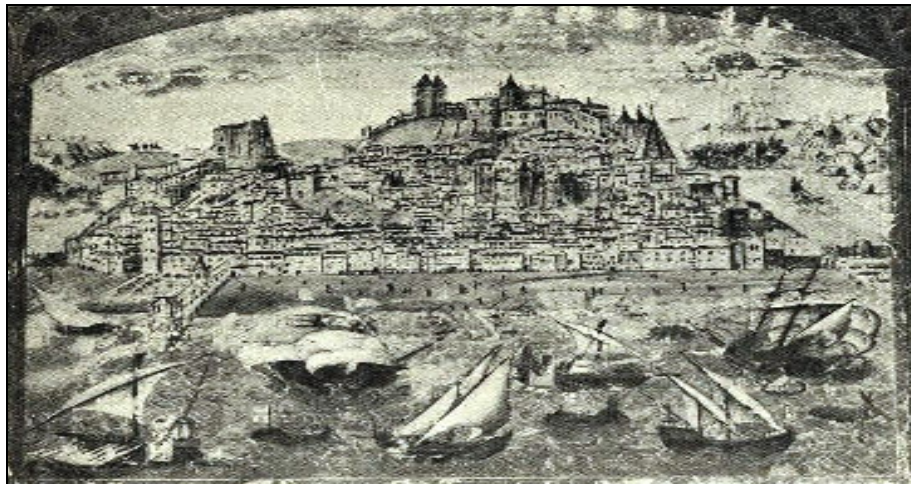


Figure 1 – Lisbon before November 1, 1755

The object of this essay is to reflect on the direct and indirect effects of the Lisbon earthquake over the habitational park and the burned areas, as well on Portugal wealth and the reconstruction process.

## 1.2 – Historical Framing

Just before the event, Portugal monarchy was headed by King D. José I<sup>1</sup> (“Rei Fidelíssimo”). Lisbon was a cosmopolitan city with strong trade relationships with England and an economy dependent from Brazilian products (e.g. gold). Although Portugal didn't presented major political and social problems its public finances demanded diplomatist's bows with other several European states.

---

<sup>1</sup> D. José I, son of D. João V and D. Maria Ana from Austria, assumed Portuguese throne in 1750, although since 1742 was head of Portugal general administration [37, p.277,278]. Its personality was influenced by the enlightenment culture and, on a personal basis, by Sebastião José de Carvalho e Melo, its public minister better known as *Marquês de Pombal*.



Figure 2 – D. José I

### 1.3 – Lisbon’s 1755 earthquake description

Although with historic seismic records nobody expected the intensity of the event in the first of November of 1755. In that Saturday morning a large part of the population was within churches services when, around 9:40 am, arose an intense underground noise with the first quake, which was followed by others during nine minutes.

During the second minute Lisbon precipitated into systematic destruction. Fires emerged and a large part of the buildings collapsed. Around 11:00 am the city was bathed by the tsunami [2, p.45], that entered through Terreiro do Paço with a giant wave, which reached six meters high. In Figure 3 it’s possible to identify the main areas affected in Lisbon by fire and seismic impact.

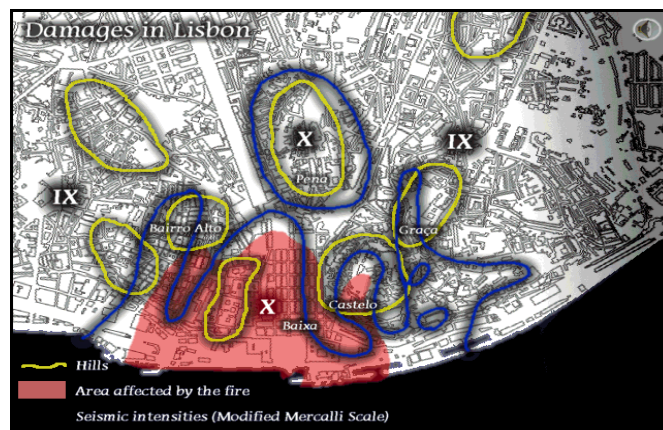


Figure 3 – Area Affected by the fire and Seismic intensities (Mercalli Scale)

After the first quake twenty eight others were felt during eight days, two hundred fifty in the following six months and five hundred until next September.

## **1.4 – Social Impacts**

In Europe this event had a significant impact, both in culture and philosophical aspects, taking renowned intellectuals of that time to assume public interventions, such as Leibnitz and Voltaire in its *Candide* and its poem *Poème sur le désastre de Lisbonne*.

These social discussions developed two different analysis of the cataclysm event. By one side emerged the divine cause and, on the other side, natural causes were defended. Due to the weight Church possessed in values, education and political arenas the first assumed major relevance in Portuguese society. Although, the public minister, Marquês de Pombal isolated himself from any divine reason when sent pure seismic based enquires to its Lisbon, Lagos and Faro parishes.

## **2 – Lisbon before the event**

### **2.1 – Lisbon parishes**

In accordance with the records available the first people established in Lisbon region were the Phoenician calling it *Allis Ubo* (calm bay). Later the Roman Empire established forum in Lisbon, followed by the Alans, the Vandals, the Visigodos and Arabs. In 1147 Lisbon was conquered to the Arabs by D. Afonso Henriques, the first Portuguese King, after successive battles during from IX to XII century.

Since then the city was occupied by Christians and divided in specific regions under Church authority. These regions became parishes governed under each matrix church. Until 1755 the city grew with the birth of new parishes until they were thirty seven.

### **2.2 – The Habitational Park before the event**

#### **2.2.1 – Introduction**

The object of this chapter is to classify, characterize and quantify the Lisbon buildings that existed before the event.

In 1755 Lisbon was a medieval city, in which its urban structure were kept as a burg, immense and disorganized without any structured plan. The main exception was the new streets in the Bairro Alto area.

## 2.2.2 – Buildings Typology

Under a first attempt to classify Lisbon buildings we may use its aspect. Although being a rough classification we may consider three different buildings groups: high quality, less quality and buildings with a rebounded floor.

On a more detailed classification, it is possible to classify buildings in accordance with its architectural, structural and constructive built. Five typologies emerge:

1. Close front houses, with coverage of four waters or two perpendiculars to the facade and external nogging halls creating a rebound.
2. Close front houses, with coverage of four waters or two perpendiculars to the facade and stone masonry halls.
3. Close front houses, with coverage of two waters perpendiculars to the facade and stone masonry halls.
4. Close front houses, with coverage of four waters or two perpendiculars to the facade and mixed noggin and stone masonry halls.
5. Large front houses, with coverage of two waters perpendiculars to the facade or “multiple ceilings” and stone masonry halls.

## 2.2.3 – Constructive Materials and Details

Building history can be obtained by the type of materials and techniques used in its construction. Under this point of view, the principle type of materials used previous the earthquake were: wood applied in floors structure, halls and ceilings; stone in masonry, pavement and resistant elements; nogging in halls (filled with pieces of brick or brick and stone towed with lime mortar) and barrel tiles that quilt the roofing.

With regards to the constructive details:

- Floors height were between 2,20 m and 2,60 m;
- Inside doors have 0,60 m;
- Windows were, normally, chess height with 0,85 m by 1,05 m and without glazing materials;
- Ceilings were generally formed by three waters when the building slopes to a higher wall, or by two or four, parallels or perpendicular to the facade;
- Floors access is obtained by one stairs bid.

## 2.2.4. – Habitacional Park Quantified

With regards to the bibliography used about the number of homes existing in Lisbon before November 1755, four historian's views are presented. Ajuda parish, by its suburb position, it's not considered.

Table 1 – Total number of Dwellings in Lisbon by 1755

	Francisco Santana	Bautista de Castro	Ana Temudo Barata	Padre Luís Cardoso	Pinho Leal
Total Number of Dwellings	36 643	32 735	33 454	32 878	39 615

By analyzing this data, according to those authors, the total number of dwellings are between a range of 32 735 and 39 615. Under a more simple view, we can assume that the total number of homes in Lisbon, just before the 1755 earthquake, were around thirty and forty thousand which, automatically we can assume an average of 35 000.

## 2.3 – Population before the event

The estimates over Lisbon population are quite diverging. Numbers vary from 160 000 to 350 000 inhabitants. Analyzing available documents from three selected authors:

- Father Castro presents 132 837 inhabitants;
- Father Luís Cardoso presents 151 079 inhabitants;
- Ana Maria Temudo Barata presents 180 043 inhabitants.

For a more detailed comparison of the authors was necessary to:

1. Withdraw the values referring to Ajuda parish;
2. Estimate the total population under seven years old, since the values presented by Father Castro and Luis Cardoso hadn't them;

Adjusting the higher and low limits by using average numbers per dwellings, table 2 presents a more accurate number of Lisbon Population before the event.

Table 2 – Lisbon population estimates before the earthquake

	Father Castro	Father Luís Cardoso	Ana Temudo Barata	Peoples/Home Ratio
Lisbon population (inhabitants)	152 763	168 092	174 432	134 214 to 170 349

It's possible to consider that, in accordance to the documents analyzed, Lisbon population were under a range of 150 000 and 175 000 inhabitants. In conclusion, and using a simple average, 162 500 inhabitants are assumed to live in Lisbon just before the 1755 earthquake.

## **3 – Lisbon after the Earthquake**

### **3.1 – Measures Implemented after the event**

#### **3.1.1 – First Measures**

Lisbon, one of the richest cities of the pre-modern world, suffered considered with the 1755 earthquake and its effects were felt all over Portugal. Sebastião José de Carvalho e Melo immediately took first measures to minimize negative effects. This first measures were:

- Assure minimal survival conditions (housing, food, etc.);
- Dispose corpses;
- Mantain public order;
- Monitor vessels;
- Prevent people from escaping;
- Avoid the speculation of goods;
- Restore urban functionality;
- Lift all the streets and properties and send questionnaires to all parishes, to collect information on the consequences of the earthquake.

#### **3.1.2 – City Reconstruction**

In the period preceding the earthquake of 1755, Portugal saw the construction of three distinct works, namely by its size:

1. The “Aguas Livres Aqueduto”;
2. The structure transposition of the Alcântara valley and;
3. The gigantic Mafra Royal Palace [39].

These works served as a learning school for engineering, architecture and construction practices. The knowledge developed created the work foundations, procedures and rules for the reconstruction process.

In December 1755 five reconstructions views are presented. In February 1756 is selected the reconstruction plan for Lisbon, which proposes to enlarge common streets and eliminate deadlocks. In May 1758, almost three years after the event, it is given authorization to initiate the reconstruction.

Besides the rapid measures adopted significant construction innovations in anti-seismic techniques, fire safety, health and hygiene and standardization of pre-production products were implemented.



### 3.1.3 – The new Parish Division Plan

After the earthquake many houses collapsed itself as well former parish boundaries. A new plan of distribution and division of parishes emerged and, according to the available records, was presented in April 8, 1770. Subsequently there was new readjustment on the limits of Lisbon.

## 3.2 – Survivors and Victims

The available records at the time couldn't present a reliable data for the victims and survivors in Lisbon. According to credible studies conducted its assumed to consider a value between 8 to 100 thousand dead victims.

When considering detailed parish values and using pessimistic estimates, were accounted 9 771 dead people caused by the event, with 443 religious representatives dead. This value is assumed to be the highest and it's very close from Moreira de Mendonça studies, cited by author [24, 28].

Confronting the above cited limit, with the estimates presented by F.L.P. Sousa, where 3 060 people died in 15 burned parishes, we can extrapolate that for the other 22 parishes and the total victims number may have been 7 548, which isn't too far from the latter. And using F.L.P. Sousa analysis is reasonable to accept a minimum of 3 060 victims.

Consequently, it seems reasonable to consider that the total number of deaths, due to the 1755 earthquake, may be observed on the average of previous limits (3 100 – 10 000), that is, 6 550 died immediately after the event. This figure represents about 4% of the total population.

## 3.3 – Population Movement after the earthquake

For the survivors that lost their home the first priority was finding new shelter. Thus, scattered throughout the capital tents were improvised, mostly without the minimum of comfort and many were made only with clothes and treadmills. Of all the accommodations, there was the palatial tent of the King and his family with 400 rooms and 25 windows on each side.

The living conditions of the vast majority of the survivals were terrible. People were preferably organized within the following parishes: Santa Isabel, Santa Marinha, São Mamede, Santíssimo Sacramento, Campo Grande, Ajuda, Graça, Anjos, São Vicente, Campo de Santa Clara, Cardal da Graça, Quinta do Alcaide and Cruz dos Quatro Caminhos.

In the same level, the event interrupted the practice of religious services because churches were largely ruined or destroyed. Thus, the parish priests required new locations for the offices of religious practices.

### **3.4 – Built destroyed by the event**

Given what has been previously described, it is assumed that the earthquake destroyed 17 017 dwellings, or approximately 49% of the total built in Lisbon.

This value was obtained by looking to the values registered in lost dwellings per parish, estimating the destruction provoked by the seismic intensity (on the Mercalli scale) and by comparison between built data existing before and after the earthquake.

### **3.5 – Missing Nobles and Foreigners**

The nobles were the social group that suffered fewer casualties. At the time a vast majority were on vacations or on the outskirts of Lisbon, less affected areas. On the other hand, church services were given around 11:00 am, two hours after the event, which enabled them to be outside the main affected areas. For instance, the royal family passed the night within Palácio de Belém.

The foreign community was significant in Lisbon society, especially due to trade relationships and favorable regulation. They represent a social class with specific meeting places. Although after the earthquake they suffered significant property losses, few lives were lost. In a list of the Public Record Office State Papers Portugal it's mentioned that 77 Britons were killed by the earthquake [2, p.259]. On other example, Father Manuel Portal reports 57 Italians lost their lives in Lisbon [28, p.758].

### **3.6 – Material losses were significant**

The joint action of earth, water and fire, almost completely destroyed Lisbon. The city was confronted with a situation for which it was not prepared. The quake, the fire and the tsunami generated exponential damage, which is summarized as follows:

- Monasteries: 17 were destroyed by fire and 34 collapsed to ruins;
- Church parishes: 17 were destroyed just by fire and 34 collapsed by the join conjunction of the earthquake and fire;
- Convents: from the 65 existing only 11 were habitable but partly destroyed;
- Hospitals: the existing 6 hospitals were destroyed by fire;
- Jails: all were destroyed, with all surviving prisoners escaping;
- Palaces: 33 palaces noble families were destroyed by fire and the direct impact of the earthquake. Along with the palace building many goods were also lost, including paintings, tapestries, furniture, jewels, etc;
- Royal House: suffered incalculable losses. Destruction of the Ribeira Palace, the Patriarcal church and the Opera all by fire. All the wealth stored disappeared... the 70

thousand volumes stored in the Royal Library, the stores treasures from India, the ornaments, the jewels... everything disappeared. The value was incalculable. However, F.L.P. de Sousa, presents a manuscript [28, p.547] in which estimates the value of the lost materials:

- For the Royal Palace, the Patriarchate, Customs, seven houses and theater - one hundred million reais;
- For 12 000 private homes - fourteen million pesos;
- Missing money - about 100 million reais.

It is also estimated the value of losses associated with assets belonging to foreigners. Thus it is proposed a total value of losses of around forty million strong pesos.

Overall, to the Lisbon disaster is an estimated loss of 40% to 65% of GDP.

### **3.7 – Foreign Support**

The shortcomings and needs of Lisbon inhabitants were immense, especially on food and sleeping. Portugal needed a quick and effective response from their European neighbors, more specifically of their trade partners. England and Germany promptly sent generous donations but all Europe countries presented words of encouragement and comfort.

## **4 – Conclusions**

In 1755 Lisbon was a medieval city, in which its urban structure were kept as a burg, immense and disorganized without any structured urban plan.

Lisbon population in 1755 was, with regards to the documents and studies analyzed, estimated between 150 000 and 175 000, which represents an average of 162 500 inhabitants. The following figures present this figures on a parish level:

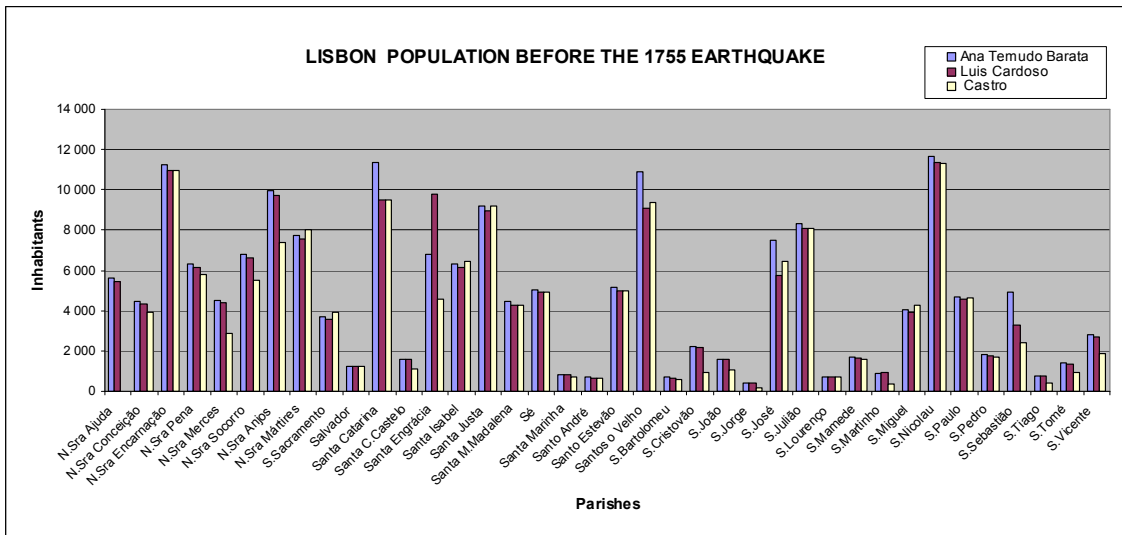


Figure 1 – Lisbon Population just before de event

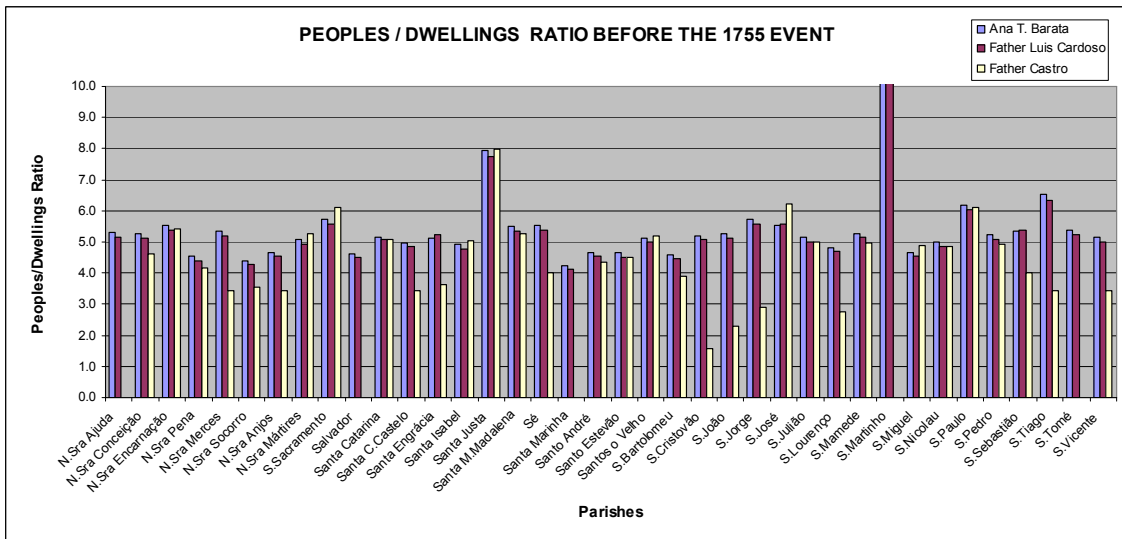


Figure 2 – People/dwellings ratio just before de event

By analyzed data we can assume that the total number of dwellings in Lisbon, just before the 1755 earthquake, were around thirty and forty thousand which, in average we can assume a value of 35 000. To better understand these values in Figure 3 we present a graphic with the number of homes in each parish. By examining the graph it appears that the worst affected area was the down-town Lisbon.

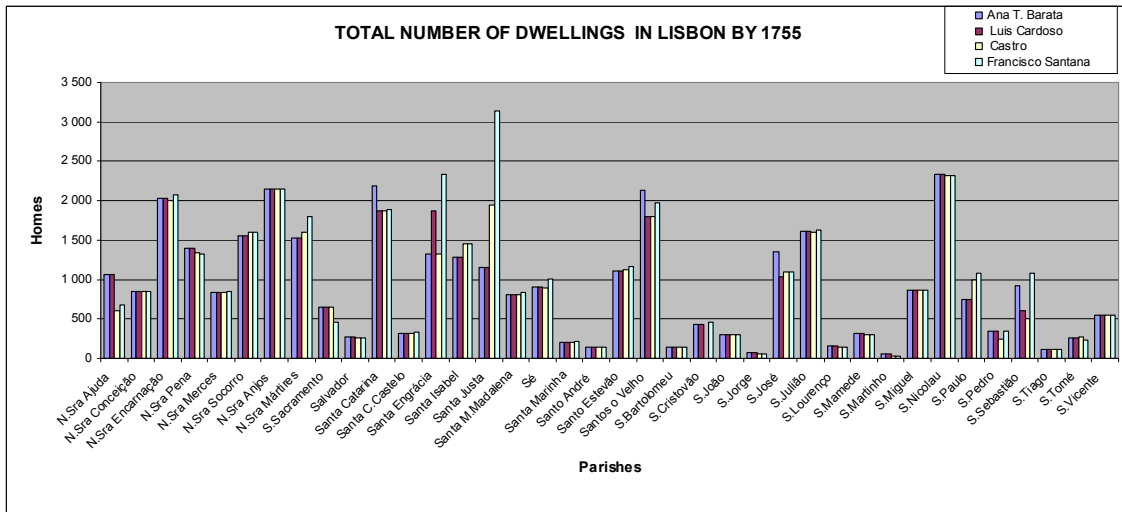


Figure 3 – Total Number of Dwellings in Lisbon by 1755

One of the main consequences of the earthquake of 1755 in Lisbon was the partial or total ruin of much of the built dwellings. Given what has been previously described, it is assumed that the earthquake destroyed 17 017 homes, or approximately 46% of the total housing stock in Lisbon. For better understanding of the values presented, please see Figure 4 for the number of homes destroyed in each parish.

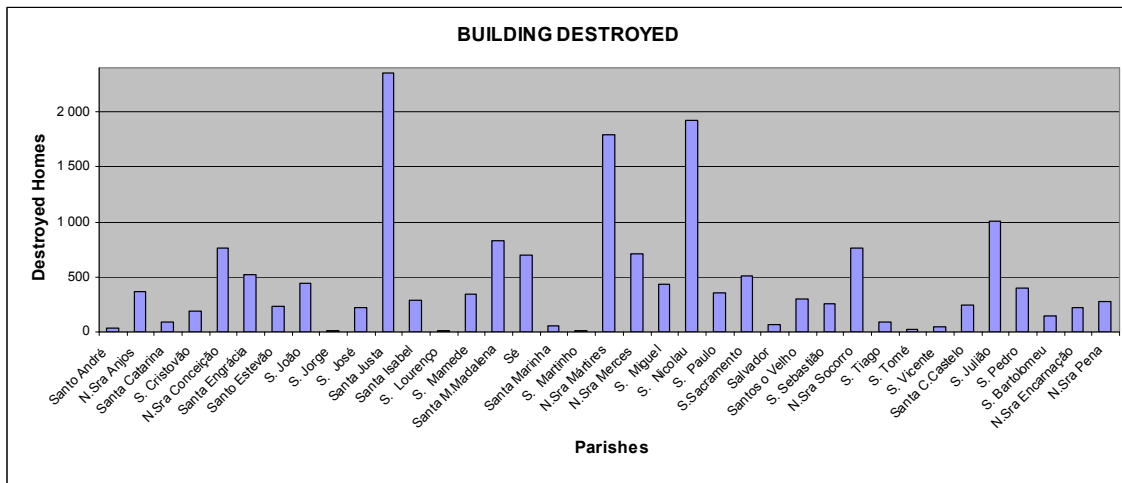


Figure 4 – Graphic of the Total Number of Destroyed Dwellings in 1755 event

The available records at the time couldn't present a reliable data for the victims and survivors in Lisbon. According to credible studies it is assumed a value between 3 to 10 thousand dead victims. Consequently, it seems reasonable to consider that the total number of deaths, due to the 1755 earthquake, may be observed on the average of previous limits, that is, 6 550 died immediately after the event. This estimative represents about 4% of the total population. These values can be examined in more detail in Figure 5.

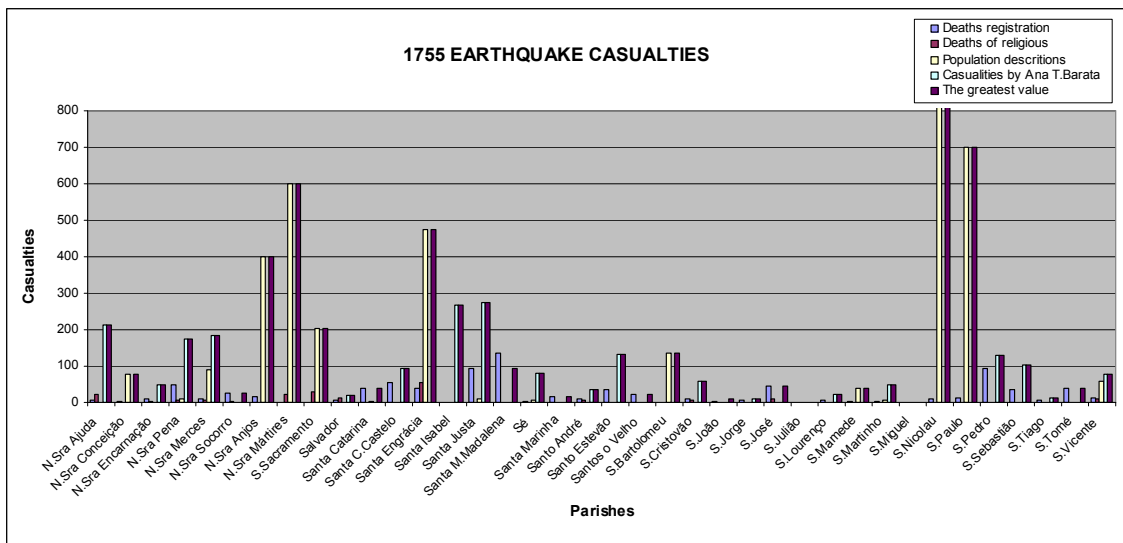


Figure 5 – Total Number of deaths in the 1755 event

Compared with the figures previously presented it is estimated that the surviving population was between 146 900 and 165 000, with a significant lack of basic living conditions.

The economic effects were immense. Several authors estimated that, due to the fact that a significant part of public wealth and main economic affairs were concentrated in Lisbon, 40% to 65% of Portuguese GDP was destroyed by the event.

1755 earthquake damaged significantly Portugal and represented a major discussed event in Europe, which responded to Portugal with unusual solidarity.

Although significantly destroyed the reconstruction plan developed in Lisbon allowed it to rise and became a modern, safer and well organized city, promoting Portugal to a new modern era.

## Selected References

1. Tavares, Rui; O Pequeno Livro do Grande Terramoto; 2006; 223 p.
2. Sousa, M. L. M. e Nozes, J; Testemunhos Britânicos; MCMXC; 269 p.
3. Campos, I. M. B; O Grande Terramoto (1755); 1998; 693 p.
4. Fonseca, João D; 1755 O Terramoto de Lisboa, 2004; 139 p.
5. Sousa, Francisco. L. P; Ideia Geral dos Efeitos do Megatismo de 1755; 1914; 79 p.
6. Sousa, Francisco. L. P; Efeitos do Terramoto de 1755 nas Construções de Lisboa; 1909; 222 p.
7. Araújo, Ana C; O Terramoto de 1755 Lisboa e Europa; 2005; 168 p.
8. França, José A; Lisboa Pombalina e o Iluminismo; Lisboa; 1965; G.E.O; cota AU 234-G.
9. Saraiva; J. Mendes C; Limite do Incêndio que se Seguiu ao Terramoto de 1755 na Cidade de Lisboa; G.E.O; cota TER24/27; pp. 285-291.
10. Macedo, Luís; O Terramoto de 1755 na Freguesia da Madalena; G.E.O; cota TER28/29.
11. Andrade, Ferreira; A Freguesia de São Cristóvão; 1945; VOL.II; pp.1-301; G.E.O; cota MON 88-P.
12. Andrade, Ferreira; A Freguesia de São Cristóvão; 1945; VOL. I; pp.1-311; G.E.O; cota MON 87-P.
13. Lima; Durval R. P; O Terramoto de 1755 e a Freguesia de Santa Isabel; pp.1-15; G.E.O; cota MISC 35; pp.3-15.
14. Alves, M.P; Infante, S; Lisboa Freguesia de Santos o Velho; pp.1-61; G.E.O; cota MON 330-P.
15. Calado, M; Ferreira, V.M. ; Lisboa Freguesia de São Sebastião da Pedreira; pp.1-60; G.E.O; cota MON 333-P.
16. Calado, M; Ferreira, V.M. ; Lisboa Freguesia dos Mártires; pp.1-60; G.E.O; cota MON 320-P.
17. Janeiro, H.P; Lisboa Freguesia do Castelo; pp.1-77; G.E.O; cota MON 325-P.
18. Janeiro, H.P; Lourenço, A.C; Lisboa Freguesia da Sé; pp.1-65; G.E.O; cota MON 324-P.
19. Lima; Durval R. P; Vinte e Cinco Anos na Vida de uma Capital; pp.1-96; G.E.O; cota AU 28-G.
20. Portugal, Fernando e Matos, Alfredo; Lisboa em 1758 Memórias Paroquiais; 1974; pp.1-442; G.E.O; cota MON 46-G.
21. Oliveira, Cristóvão R; Lisboa em 1551 Sumário; 1987; pp.1-149; G.E.O; cota MON 116-P.
22. Sousa, Francisco. L. P; O Terremoto de 1755 do 1º de Novembro de 1755 em Portugal, Vol. III, Lisboa; 1926

23. Santana, Francisco; Lisboa na 2ª Metade do séc. XVIII; G.E.O; cota MON96-P; pp.1-157.
24. Pereira, Jorge P; Lisboa durante o Terramoto do 1 de Novembro de 1755; 2005; 33 p.
25. Serrão, Veríssimo; História de Portugal, vol.6 – Editorial Verbo, 1970.
26. Rodrigues, Teresa F; Os Recenseamentos da População Portuguesa de 1801 a 1849; Edição Crítica; 2001; INE.
27. Rodrigues, Teresa F; Lisboa. Das Longas Permanências Demográficas à Conquista da Modernidade; Conferencia GEO, 18 Abril de 2008.
28. Sousa, Francisco L.P; O Terremoto de 1755 do 1º de Novembro de 1755 em Portugal Um Estudo Demográfico, vol. III, 1928, Micro filme Biblioteca Nacional; cota F.2606.
29. Pereira; Alvaro S; The economic Impact of the Lisbon 1755 Earthquake; Department of Economics; University of York; 41 p.
30. Oliveira, Carlos S.; Review of the 1755 Lisbon Earthquake Based on Recent Analyses of Historical Observations; 2008; in *Historical Seismology*, J. Fréchet, M. Meghraoui and M. Stucchi, editors, Springer, pp.255-295.
31. Silva, Augusto V; As freguesias de Lisboa; 1943; pp.1-83; G.E.O; cota MON 248.
32. Mascarenhas, Jorge; Sistemas de Construção; Volume V.
33. C.M.L – Vereação do licenciamento urbanístico e reabilitação urbana; Baixa Pombalina; Pedido de inclusão na lista indicativa nacional para candidatura a património mundial; 2004; 91p.
34. Oliveira, Francisco X; Discurso patético sobre as calamidades presentes sucedidas em Portugal; 2004
35. Leal, Augusto S.A.B. P; Portugal antigo e moderno; vol. 4; Lisboa; 1874.
36. Almeida, A. Betâmio; Tese de Mestrado; O sismo de 1755 na historia da gestão do risco; 2005; 85 p.
37. Medina, João; Historia de Portugal dos tempos pré-históricos aos nossos dias – Portugal Absolutista II; Vol. IX; Edita Ediclube; 2004; 471p.
38. Barata, Ana M.S.T; Tese Mestrado; As crises de Mortalidade em Lisboa no séc. XVIII; Faculdade de Ciências Sórias e Humanas; cota T453/1 e T453/2.
39. Appleton, João; Seminário; Projectos de Reabilitação de Edifícios Pombalinos; Modulo 1,2 e 3; 2008.
40. Appleton, João; Sismos e Edifícios; Capítulo 9 – Tipologias Estruturais; Edição Mário Lopes; 2008.
41. Santos, Natália B; Cunha, Rui M; Alves Rui R; Rodeia, Teresa B; A Arquitectura e os Processos Construtivos entre os séculos XVI e Meados de XVII; LNEC; 1993; 276p.



42. Oliveira, Carlos S; Levantamento dos Monumentos de Lisboa; IST; Comunicação Pessoal; 1980.