A STUDY OF THE DESIGN AND CONSTRUCTION OF BUILDINGS IN THE POMBALINE QUARTER OF LISBON.

A dissertation submitted by

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Thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy, (PhD), of the UNIVERSITY OF GLAMORGAN
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July 1996
DECLARATION

I declare that, this thesis is the result of my own studies, it has not been accepted for any other award or degree and is not concurrently being submitted in candidature for any other award or degree.

Signed: 

Date: 08/02/96.
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In the year 1755, the lower part of the city of Lisbon was hit by a severe earthquake. Immediately following the earthquake a complex reconstruction process began, which introduced new urban, architectural and constructional concepts. This resulted in the creation of new innovative rentable buildings termed the Pombaline rentable buildings, after the Marquis of Pombal who directed their construction.

This thesis comprises a wide ranging and detailed study of these buildings.

At the beginning of this work, in Chapter I, "The Pombaline rentable building" is placed in its historical context. The origins of the old city are described and its historical development within Portugal. The results and consequences of the 1755 earthquake are outlined, and the subsequent process of reconstruction is described. All immediate measures, decrees, and proposals for the reconstruction of the city, plus Manuel da Maia's Dissertations, are carefully compared and analysed, as are the various plans proposed for the reconstruction.

The preceding periods of Portuguese Architecture are studied to identify possible origins for the architecture of the Pombaline rentable buildings. Also a clear definition of the Pombaline Rentable building and the limits of the genuine Pombaline area are established.

In Chapter II the general methodology used in the research is described, which includes a survey of 315 buildings and a documentary search for material relating to the construction of the buildings.

In Chapter III an analysis is made of the general external and internal architectural characteristics of the rentable buildings. An extensive search for original drawings, produced drawings only of the elevations of the main streets. These are carefully analysed and compared with existing buildings and a classification system is developed. A complete survey by the author of the buildings' interiors, for which no documentary information exists, reveals a great complexity and variety of interior plans. To achieve a systematic classification of the interiors particular aspects are analysed including, the types of stairs, the organization of the interior spaces, the building location and the finishing details.

Chapter IV describes some of the technical innovations shown by the rentable buildings, particularly those referring to earthquake resistance in construction and to prefabrication. During the survey of plans and elevations the Author identifies evidence for the existence of prefabrication, in terms of sizes of components, tolerances and detailing. This evidence is supported indirectly by documentary material although the extent of documentation is very limited.
Possible evidence for an evolutionary development in the internal plan and design of the buildings based upon the position of stairs in the buildings is presented in Chapter V. An attempt is made to relate this classification to the dates of construction of the different buildings. This is achieved by an analysis of previous tax records which enable numbers of buildings constructed on different streets at different periods to be determined. Based on this analysis the evidence for an evolutionary development is discussed.

In Chapter VI the Pombaline rentable buildings of Lisbon are compared with other contemporary developments at Porto Côvo, Vila Real and Manique do Intendente in order to assess the influence of the Pombaline development, both in terms of the architecture and the construction processes, on other construction projects outside Lisbon.

Chapter VII discusses the principal findings of the research and their importance in the context of Portuguese architecture.
Acknowledgements

First of all, I would like to express my deep thanks to Dr. Stanley Wild, whose intelligent collaboration, constructive criticism and methodical mind contributed so much to this work. Its successful completion is due to the fact that my interest in the subject was met by great understanding and interest on his part. He contributed considerably to the general definitive structure and organization of the thesis.

I also wish to thank the following people:

Mr. Richard Penn for his valuable comments and queries on points that he felt required further explanation as well as all the support he has given to the project. Richard also assisted me in the preparation and revision of published articles.

Professor José Augusto-França for his help in proof reading and revising, also documentation and prestigious support during the investigation.

Mr. Wayne Forster who gave an initial critical analysis and greatly improved the project in the early stages.

The support of the British Council for the grant to cover the cost of travel during part of the period of the investigation.

I also wish to thank the Escola Superior de Tecnologia de Tomar for their part in financial support.

My wife Sónia Marques for the patience and wide comprehension demonstrated.

My colleagues - especially Professor António Paulino Paiva, for all the help he gave in dealing with bureaucratic problems connected with the project.

I would also like to give special thanks to all those from whom I learnt something, whether through knowing them personally or only through their work, and finally, the residents who allowed me to enter and study the buildings where they live.
Glossary

Alfugere-courtyard between buildings
Cêrca - city walls
Gaiola-cage, wooden structure providing earthquake resistance.
Palmo - palm = 22.5 cm
Praça - square
Rio - river
Rua - street
Saguão-Courtyard inside a building

Names
Casa do Risco - School of Building and Architecture
Marquês de Pombal-Marquis of Pombal
Rua da Prata - Silver Street
Rua do Ouro - Gold Street
Rua dos Sapateiros - Shoemakers' Street
Rua dos Douradores - Gilders' Street
Rua dos Fanqueiros - Drapers' Street
Rua dos Retroseiros - Haberdashers' Street

Before 1755 After 1755
Terreiro do Paço Praça do Comércio

Title Real Name
Marquês de Pombal Sebastião José Carvalho e Melo.

Pombaline Rentable Building
Built by private owners for habitation, ground floor occupied by commerce or industry

Pombaline area
Limits for this study, where are located the genuine Pombaline rentable buildings

Transition areas
Buildings similar to the Pombaline rentable buildings, built later than those of the reconstruction, and without the rigid restrictions of the Pombaline area.

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I. THE HISTORICAL AND ARCHITECTURAL BACKGROUND TO THE POMBALINE RENTABLE BUILDING

1.1. The context and aims of the current project.

In the year 1755, the lower part of the city of Lisbon was hit by a severe earthquake and consumed immediately afterwards by a fire which lasted several days.

A complex reconstruction process directed by the then Prime Minister, the Marquis of Pombal, began immediately. It was an extensive, unique undertaking that was ahead of its time\(^1\).

With it began a new urban, architectonic and constructive mentality which would produce a specific style of rentable building, with important innovations at both an architectural and constructional level (see Fig.1)\(^2\).

This work seeks to study the architectural and constructional aspects of the Pombaline rentable buildings in detail in order that a better knowledge of them will lead to their conservation.

---

Fig.1 - Pombaline quarter (end of XIX century).
The principal aims of the study are:

i) To determine the origins of the Pombaline rentable building.

ii) To identify the principal distinguishing characteristics of the Pombaline rentable buildings with particular reference to earthquake resistance and form of construction, and to determine the extent of technical innovation, standardisation, dimensional co-ordination and pre-fabrication in the construction of the buildings.

iii) To analyse the internal layouts of the buildings and determine whether these represent an evolutionary sequence.

iv) To relate the Pombaline rentable buildings to preceding, contemporary and subsequent styles of Portuguese architecture, and to determine whether there is, at a constructional and architectural level, sufficient evidence to classify the Pombaline rentable building as an identifiable style of Portuguese architecture.
1.2. The settlement and historical development of the centre of Lisbon.

The complex system of construction of the Pombaline buildings was a consequence (see Fig. 2), of the characteristics of the ground conditions of the lower part of the city. It is important in approaching this subject to take account of the formation of the enormous alluvium upon which the lower part of the city was founded(3).

The lower part of the city was in a small creek which was the result of the action of two water courses; the streams of S. Sebastião da Pedreira and of Arroios. During prehistory they converged into a generous valley that separated two hills, those of S. Roque and Castelo. An immense Miocene rock-bed had been eroded by the two streams to form the valley.

Before the rock-bed silted up, this place situated on the vast Tagus estuary, offered excellent conditions for settlement. The river was navigable far above the river mouth and down-stream it opened widely into the sea. The abundance of fish, fresh water and arable soil made conditions ideal to set up a hamlet. The defence of the site was also possible. The hill where the Castle presently stands with its steep slopes formed a huge cone which blocked access from either the north or the west and made any attempts to besiege it a difficult task. The other sides descend into water(4).

This rock-bed was slowly but successively silted up by sands lodged by the river current, by the constant collapse of the slopes due to the action of the rain, or by light earth movements which expelled the brackish waters and completely obstructed the waterway. All this seems to have happened before the Christian Era.

This area is presently occupied by Rossio, Figueira, and Martim-Monis squares. It continues between Ouro and Fanqueiros streets and ends in Terreiro do Paço Square.

Fig. 2-The creek.
Due to the reasons mentioned above, the area where the Alfama and the Castle sit was occupied by numerous peoples over a period of time, (Figure 4 shows the initial nucleus before the Roman occupation).

The Phoenicians, who were great navigators, were the first to settle due to "the beautiful and exceptional exposition of the hill standing by the calm river inlet", named thus "Allis Ubo". The corrupt version was "Olisipo" which was later to become "Lixbuna"(2, 5).

The Romans took the city after conquest of the Lusitanians by the Roman General Decimus Junius Brutus, between the years 100 B.C. and 45 B.C.. The Emperor Julius Caesar promoted the city to the category of Roman Municipality and at the same time named it Felicitas Julia. By the kind of vestiges found, it seems that it was an important city full of life and splendour, and remained so for nearly 400 years, (Figure 3 shows the oldest iconographic reference to the city)(2, 3).

During the fifth century the Barbarians, the Alani, Vandals, and Visigoths, succeeded the Romans without leaving any significant vestiges(3).

Fig. 3-An old iconographic reference.  Fig. 4-Initial nucleus, before the 2nd century B.C., Roman and Visigothic occupation.

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- Brief summary of the history of Portugal:

Portugal and Spain together, form the Iberian Peninsula. Thousands of years before these two Countries became Nations, other people lived in the Peninsula.

The Ligurians were the first, followed by the Iberians, the Phoenicians, the Greeks and the Celts, mingling from which later the Lusitanians resulted.

The Lusitanians were subdued by the Roman Invasion of the Peninsula. The Romans remained for hundreds of years leaving behind numerous evidence of their occupation.

After the fall of the Roman Empire, many different peoples invaded the land. The Teutonic tribes subdued and converted all the other peoples to Christianity.

An army of Berbers invaded the Iberian Peninsula defeating the Teutons and pushing them up North.
The Moslems occupied the city in 714 A.D. They built walled compartments on the Castle hill transforming it into a prime war fortress. Then in the beginning of the IX century, it was taken by Afonso, "The Caste" king of Galicia and Asturias. The city was re-taken by the Arabs in 831 A.D. and subsequently in 851 A.D., it was taken and plundered by Afonso IV, king of Leon. Later it was again reoccupied by the Arabs. It was then taken by Afonso VI King of Leon and Castilla in 1093 A.D. and a few years after, it was once again retaken by the Moslems.

On October 24th, 1147 A.D., Lisbon was finally taken into the Christian faith by D. Afonso Henriques, first king of Portugal, after a three months' siege (see Fig.5). He was helped by the Crusades of English, German and French origins. Immediately after the conquest of the City, it was necessary to settle it in order to ensure its occupation by people of the Christian faith, (Fig.6).

---

**Fig.5**-The conquest of Lisbon by D. Afonso Henriques.

**Fig.6**-The Moorish walls and the urban growth.

---

The Asturias became the first Christian Kingdom in the Peninsula assuming the name of -kingdom of Lion.

As a result of the constant fights against the Arabs, other parts of the Peninsula became new Christian Kingdoms such as Navarra and Aragon.

The king of Leon -Afonso VI- was helped by a French nobleman -D. Henrique- in his fights against the Arabs. As a reward for this help, D. Henrique was given the Portuguese country to rule.

D. Henrique died during a crusade to Palestine. His son D. Afonso Henriques succeeded him in ruling the country.

D. Afonso Henriques, defeated the Arabs in "Ourique" and claimed the title of King of Portugal.
Measures of a religious character were taken by setting up Military Orders, in which monks also operated as soldiers. This led to widespread building of monasteries which attracted surrounding development and promoted demographic growth(3).

However the real urban growth and development took place during D. Afonso III's rule. He was the first king to establish residence in Lisbon, in 1255 A.D. and Lisbon became the new capital (see Figure 7), a fact that helped to increase the trading with Mediterranean ports. During this period the city's defensive belts became obsolete since the Arab military activities slowed down. In this way, construction started taking place beyond these belts (see Figure 8)(3).

The nature of building form and construction was determined by the abundance of local calcareous materials and clay and the lack of forests in the Lisbon area. This, along with the surviving Arab building tradition of single storey dwellings may have restricted the development of multi-storey buildings(3).

Fig. 7-View of Lisbon, between 1175-1275. Fig. 8-The urban growth upon the obstructed alluvium.

Brief summary of the history of Portugal.

D. Afonso Henrique, the founder of the Nation died. His son D. Sancho I took special care of the then new territories which were settled and fortified during his rule.

D. Afonso II became King. The Portuguese society divided itself into three distinct classes -Clergy, Nobility and Commons.

D. Sancho II succeeded D. Afonso II. Under his rule war with the Arabs, resulted in the annexation of new lands and cities mainly south of the Tagus.

These conquests were followed up by D. Afonso III who became king, due to the fact that D. Sancho II in spite of being a good soldier, was a poor ruler.

The first 'Cortes' (parliament) took place. The Commons had the right to participate and thus, to claim their rights against the abuses of the upper classes.
The reign of D. Dinis (1279), brought wide economic reform which resulted in an increase in land values. A certain street parallel to the river (Nova dos Ferros Street) took on a special role. Here merchants would carry out important commercial and financial business.\(^{(7)}\)

The growth of the city was always parallel with the river and therefore occupied a narrow band.

In 1356, the city suffered a very severe earthquake which caused considerable damage. Several years later the city suffered further damage due to a different cause. Due to the war between Portugal and Castille, in 1373, Lisbon was placed under siege by an enormous Castillean army, (see Fig.9), during which the city was victim to many horrors as the suburbs were set on fire. Lisbon thus became restricted to a cluster of houses within the city walls which were built by order of D. Fernando I, (see Fig.10)\(^{(7, 8)}\).

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**Fig.9**-Lisbon besieged by the Castillean Army. **Fig.10**-D. Fernando walls

---

D. Dinis one of the most intelligent and educated men that ever ruled the country, became king. Besides intellectual developments, he also brought about wide ranging economic reforms.

D. Afonso IV followed up his father's work extending the economic developments, as well as developing the navy.

He sent two expeditions to the Canaries.

Peter I become king. He strongly curbed the abuse of the commons by the upper classes. Under his rule the kingdom experienced its first economic boom.

D. Fernando succeeded D. Pedro I. He was involved in several wars with Castille, from which he always came out as a loser.
In 1384, D. Juan I of Castille besieged the city by land and sea. After five months of fighting characterized by extreme violence, the enemy withdrew leaving behind many ruined buildings and warships. After the death of D. Fernando I, in 1385, many rebellions took place, both in Lisbon and in the interior of the Country, when the people wanted D. Joao I for King. During this period, the streets were sombre, badly paved, irregular in layout and frequently the tenants’ nick names were used as toponymic locations. Most of the houses were small in area and façades were out of line. The drainage systems were very poor and conditions were very unhealthy and unhygienic. (Figure 11 shows a general view of Lisbon in XIV century)(7, 8, 9).

During the reign of D. João I, came the beginning of long sea voyages and the great conquest of Ceuta by D. João I, and so the XV century proved to be a period of great prosperity for Lisbon, (Figure 12 shows Lisbon in XV century). Also the Monarchy took a certain number of measures, in order to prepare Lisbon for its future role as a dynamic operations centre(8, 9).

**Fig.11-A general view of Lisbon (XIV century).**

**Fig.12-Lisbon in XV century.**

---

The King Juan of Castille, invaded Portugal and forced the Portuguese king to give him his daughter Beatriz for wife. This event endangered the Portuguese independence.

The Castillians although superior in number were defeated in the Atoleiros battle, by the Portuguese troops led by D. Nuno Álvares Pereira.

D. João I was proclaimed king of Portugal. As a result of an alliance between the Portuguese king and the Duke of Lancaster, which established a bilateral pact of help, The Treaty of Windsor was established. D. João I took D. Filipa de Lencastre for wife.

D. João I conquered Ceuta. His son D. Henrique, founded the "Escola de Sagres" where he trained the navigators who later would achieve so much glory with their discoveries.

D. Duarte became king but died five years later victim of the plague. After becoming king, D. Afonso V conquered Azila, Tangiers and Alcacer-Kabir.
The golden era of discovery really began during the reign of King D. Manuel I (1495), and after the arrival of Vasco da Gama in India. The king left the medieval Castle on the hill and installed his court near the river, (see Figure 14). The city port was modernized in order to accommodate the Royal Palace plus several customs services, thus concentrating the urban centre in that area, but resulting in there not being any available spaces to build in the areas immediately adjacent to this urban centre (8).

In spite of its wealth, with its new important buildings and connections, Lisbon was a dirty city, crowded with pedlars and possessing a defective water supply. There was no clear urban strategy. The streets were terrible; they were narrow, irregular and interrupted with steps (10).

During the reign of King D. João III (1521), Portugal had begun to amass a vast empire and the bourgeoisie, wealthy due to the commercial development, started to build extensively, (Fig. 13) (8, 9).

Fig. 13-A general view of Lisbon (XVIII century).

Fig. 14-D. Manuel installed the Court near the river.

Two discoveries were made.
-The Cape Verdes in 1460.
-S. Tome e Principe in 1471.

D. João II became king. During his rule, the golden dream of the Portuguese was to find the route by sea to India, from where fine expensive spices were brought to Europe by land.

Diogo Cão discovered the Zaire and Congo rivers.
D. Manuel I became king, and the Portuguese Golden Era of discoveries really began.

After making extreme sacrifices Vasco da Gama and his crew arrived in India. The Maritime route to India had been found.

Another important discovery placed Portugal ahead of all nations; Pedro Álvares Cabral, sailing towards the west discovered Brazil.
The city began enlarging rapidly and the fields that surrounded it soon became new districts. However the city still maintained its previous image, acquired in its Moorish past, together with the influence from its close relations with the Flemish and with other Northern European ports (11).

The second quarter of the XVI century brought several disappointments. The spice trade from India declined. The Tribunal of the Inquisition was established, resulting in repugnant events like the persecution of the Jews. The great plague brought suffering and death. The earthquake of January 9th, 1531 caused deplorable loss of life and property (11).

On the western extremity of the plan below (Figure 15), there is a network of streets which intersect orthogonally, the lay-out of which is easily distinguished from the rest of the area. This is the Bairro Alto and its occupation was determined by a complex system of letting, (see Figure 16). This orthogonal layout might have had some influence on the design of the Pombaline area after the earthquake in 1755.

Fig. 15-A general view of Lisbon (XVI century)  
Fig. 16-Plan of Lisbon (XVI century), on the left extremity is the Bairro Alto.
A further earthquake occurred on the 28th of January 1551, and in 1569 the plague struck again\(^\text{(10)}\).

The loss of D. Sebastião in 1578 in war with Morocco, instigated a consequent crisis, which enabled "D. Filipe II" of Spain to invade the country and transform Portugal into a simple Spanish province (1580). It was a period of pain and ruin for Lisbon. (Figure 17 shows a general view of Lisbon in 1593)\(^\text{(12)}\).

In 1640 Portuguese independence was restored, and the situation changed rapidly. D. João IV, making use of an able political acumen, achieved the reorganization of the economy, in a nation eager to overcome the crisis. The city acquired a new look with the construction of many new buildings. With the Brazilian settlement in the late part of XVII century, there was an expansion of religious buildings typical of that period (see plan on Figure 18), but the streets were unsafe (obstructed by buildings) and unhygienic \(^\text{(13)}\).

Fig. 17-A general view of Lisbon, (1593)

Fig. 18-João Nunes Tinoco’s plan 1650
By the beginning of the XVIII century, the lower part of the city was a maze of streets and alleys which intersected between the two main squares, the Rossio and Terreiro do Paço. It was then a Medieval city, densely populated and constantly vibrant with economic activity, (Fig. 19). However all was not well as the country had been using its gold reserves for imports and the country was sliding into economic decline(13).

Then a terrible disaster struck. In 1755 the lower part of the city was wholly destroyed by earthquake and subsequent fire and had to be rebuilt. The King, D. José I gave to the Prime Minister, Marquis de Pombal, extensive powers to rebuild the city(14) (Fig. 20, plan of the rebuilt city).

However, twenty-two years after the earthquake D. José I died and with his death the period of Pombal domination came to an end and all public building work, which had already been progressing very slowly for some time, was temporarily suspended(2).

The Court moved to Queluz, as if rejecting Pombal’s Lisbon. Although the city was enjoying a certain prosperity Lisbon had little magnificence or majesty(15).

---

Fig. 19 - A general view of Lisbon (XVIII century)

Fig. 20 - The lower part of the city was completely razed to the ground and the Pombaline centre built in its place.

---

At the Pope’s request the Portuguese fleet contributed to defeat the Turks. The King died leaving the country in difficulties caused by using gold reserves for imports.

D. José I, his successor, attempted drastic changes. He nominated the Marquis of Pombal prime minister who became the symbol of the new spirit that he wanted to establish.

Under the protection of an absolute King feared and obeyed, Pombal easily became an “almighty Minister”. Through the implementation of drastic solutions to resolve the commercial crisis, he slowly consolidated his position.

D. José I died and D. Marta came to the throne, bringing the period of Pombaline despotism to an end. The prisoners were released and the persecuted rehabilitated. Until his death, Pombal was banished from the Court and ridiculed by his enemies.

With the French revolution, the Portuguese crown allied itself to the English and Spanish crowns, and attacked France.
The rebuilding of the lower part of the city, initiated by the Marquis of Pombal in 1756, was carried out over a period of 74 years (15). Within this period (1806-1812) there occurred the French invasions which were notable for the depredations carried out by the French army. In 1822 Brazil became independent creating a certain economic instability.

Later, during the period of the Liberal Struggles (1826-30), only a small section of the nobility and the bourgeoisie continued their economic activity. There was a small boom in the construction of strictly utilitarian buildings, but for economic reasons; there was no artistic or architectural development whatsoever (4).

After 1830 the population of Lisbon stabilised at around 200,000 inhabitants, (a general view and plan of the city in 1844, is given in Fig. 21). Due to a series of crises and consequently an appalling economic situation all building construction was practically paralysed until 1855. Gradually the reconstruction plans came to be ignored (16).
1.3. The 1755 earthquake and its effects.

1.3.1. The precursors.

Lisbon, in the XVI century had been a real cosmopolitan city and the commercial trading centre of South Western Europe. It started to decline towards the end of the XVII century, (see a general view of Lisbon on Fig. 22a)(2).

The violent earthquake (of 1755) completely changed its urban and architectural features. It caused the destruction of its cultural and economic roots and changed a Moslem city into a new modern Renaissance city.

Since Roman times and more frequently after the XI century, Lisbon had always been subject to seismic movements, in particular the earthquake of 1531, but the worst shock was to come two centuries later, in 1755 (*), (Fig. 22b).

(* in Expresso, 6th May 1969, Lisbon.

668B.C.-Accompanied by a tidal wave, destroyed entire townships on coast of Portugal and Galicia.

47-44B.C.-Tidal wave followed by earth tremors.

33A.D.-Strong earthquakes occurred causing great damage

382A.D.-Caused great damage, submerging islands situated in front of the Cape of St. Vincent.

22.2.1279-Strong tremor felt throughout country.

9.12.1321-Three violent earthquakes

1344- Accompanied by long subterranean sounds caused considerable damage in Lisbon area.

1355-Two major earth quakes registered: 11th July and 4th August.

24.7.1356-quakes hit Lisbon of similar intensity to that which was to occur in 1755.

1504-Strong earthquakes throughout this year which destroyed whole townships

1512-Lisbon fell terrible earthquake which took around 2.000 lives.

26.1.1531-One of the biggest earthquakes occurred affecting the Portuguese continent, the epicentre of which was the Lisbon region. Some Houses were levelled and seven people died.

27.12.1722-Very strong earthquake in south of the country.

Fig. 22a and 22b-Lisbon before and during the earthquake.
I.3.2. Description of the catastrophe.

Prior to All Saints day the population of Lisbon noticed that the river waters had risen and new springs had appeared. On All Saints day, the first day of November of 1755, all the churches were full of people attending services. At exactly 9:40 a.m. of that Saturday morning, a weak northeast wind blew over the city. The sun was shining and had started to warm up the morning of that Autumn day, when the first shock wave was felt. During the following 17 minutes the earth shook violently with South-North movement, together with a frightening noise. The main earth movement lasted for two minutes and the walls of many buildings were destroyed, being unable to resist the movements \((6, 17)\).

The earthquake reached 10 on Mercali’s scale, and was accompanied by terrible noises and clouds of dust that darkened the sunlight. The earthquake was felt in the South of France, Belgium, in Hamburg and more strongly in the North of Spain. The orientation Southwest-Northeast that it took in Lisbon was due to the fact that the city sat on an enormous alluvium which is precisely orientated, and unstable in the region of the river \((6, 17)\).

The instability of the great alluvium allowed the city, under the influence of the earthquake, to vibrate and shake with the major movement in the direction of the river. The collapse of buildings and the chaos that ensued resulted in the widespread outbreak of fires, \((6, 17)\).

More than anything, it was these fires that during the ensuing five or six days destroyed most of the buildings which had resisted the earthquake. For instance, Rua dos Ourives in the central part of downtown was completely destroyed by fire, which made any attempt at reconstruction impossible. In certain cases the fires were started by bandits and army deserters \((6, 17)\).

There were also a number of secondary shocks which made the situation even more devastating \((6, 17)\).

When the earth movements finally stopped, northeast winds became very strong and changed direction constantly, turning the city into an immense inferno covered by a thick cloud of smoke. This made criminal acts such as robbery, rape and murder easy \((6, 17)\).

During the following ten days, four abnormally high tides were registered \((6, 17)\).
It has been estimated that ten to fifteen thousand people died in the earthquake, and 2/3 of all houses were no longer fit for habitation, (Fig. 24 illustrates its effect on some buildings(2)).
Although the earthquake is always associated with the destruction of Lisbon, its epicentre was located South of the Algarve in the area of Cadiz Bay between Cape S. Vicente and Rabat (see Fig. 25) (2, 5, 17). Its direction was SW-NE making wall vibrations stronger in that direction.

In Lisbon although the tremor was weaker, its effect reached catastrophic proportions due to the high population density, the particular geological location and the fires which lasted for five to six days.

The sea action was in part dissipated due to the fact that the city was located on an estuary defended by reefs which caused transverse wave movements. This fact was confirmed by an inquiry made of all priests all over the country, which established that the Southern coastal regions were where the earthquake was felt most strongly (15, 17).

Fig. 25-Intensity of the 1755 earthquake over the Iberian Peninsula.

1.4. Identification of the new commercial area that was to be developed.

1.4.1. The city plan before the earthquake.

The part of the city flattened by the earthquake was a picturesque and commercial area which had been a great trading centre and world market during the XVI century. It had, however, grown in a chaotic fashion to suit the commercial aspirations of the merchants (2).

The lower part of the city built prior to XVIII century and destroyed by the earthquake was a real maze. It is illustrated by the plan produced by João Nunes Tinoco which is shown in Figure 26, (on next page). It included eight Kilometres of streets, courts and alley-ways. There were 70 dead end streets, 50 open streets and 16 squares. It was here that the new commercial centre was to be built and re-established under the direction of the Marquis de Pombal (2, 17).
The areas indicated in João Nunes Tinoco’s plan (Fig. 26) are:

1. The lower part of the city.
2. Alfama, on the southern slopes.
3. Mouraria, on the northern slopes of the Castle hill.
4. Castle hill, an area densely built up with narrow tortuous streets.
5. Bairro Alto which is a typical example of Middle Age planning, (see section 1.1)

The lower part near the river was more humid and was occupied by ordinary people living in flats whereas higher up the aristocracy settled in small palaces.

1.4.2. The Pombaline reconstruction area.

For the purpose of this study, the Pombaline area is considered as a rectangular area (see Glossary), of 0.24 Km², (300 by 800m), sitting between the Castle Hill and that of S. Francisco which bound it at the east and the west respectively. It is limited at the north by Rossio Square and at the south by the River Tagus. To this rectangular area is linked a narrow strip which runs towards Cais do Sodré, (Fig.27 shows the proposed plan of the reconstruction commissioned by Eugénio dos Santos).
This area is characterized by the uniformity and regularity of the buildings in extreme conformity with the requirements of the reconstruction plan. It includes 53 blocks, 400 rentable buildings, of which 315 are Pombaline and approximately 1344 flats, ((170x2+108)x3, 170 buildings with two flats per floor and 108 buildings with one flat per floor and each building with 3 floors). There are also areas which may be termed transition areas. These areas were built to conform with the plan but were constructed at a later stage, so the buildings are more elaborate and less austere than the original buildings, (Fig.28 shows an aerial view of the Pombaline area)\(^{18}\).

Fig. 27-After the earthquake (1755)

The proposed plan of the reconstruction.

Fig.28-Aerial view of the town area rebuilt by the Marquis of Pombal
1.5. The background to the reconstruction of the new city

1.5.1. The Marquis de Pombal’s role in the reconstruction.

The Marquis de Pombal, who was the Prime Minister of King D. José I, handled the crisis caused by the devastation competently and kept in good spirits. His energies were directly channelled into overcoming the devastation created by the disaster (19).

He immediately mobilised all the available troops to clear paths through the debris and to search for survivors, (see Fig. 29). In order to avoid the danger of plague, the dead were promptly buried (20). Provisional hospitals were created to care for the sick and camp sites were set up to give shelter to the injured and the homeless (21).

A survey was carried out to gather information about what had been destroyed. All kinds of construction outside the city limits were forbidden. The destruction of any unauthorised construction was decreed and also no construction was to take place until there was a new plan for the city (17).

All available foodstuffs were collected and fairly distributed and it was decreed that food prices be fixed to prevent speculation (17).

Nothing at all was overlooked. It was as if the Prime Minister of King D. José I had already foreseen the catastrophe and had beforehand planned the way to overcome it, (Fig. 30).

As early as the day following the earthquake he took measures to study the reconstruction of the new city. Thus the Marquis de Pombal’s power was reinforced. His actions were summed up when he said it was necessary “to bury the dead and look after the living” (1).
In order to explain how Pombal was able to begin the regeneration of the city so soon after the earthquake it is necessary to understand his political ambitions and his position during the period prior to and immediately after the earthquake.

The reconstruction of Lisbon provided Pombal with the opportunity to regenerate not just Lisbon but Portugal, as he had felt that the former economic and maritime power had waned (2).

So to understand the process of renovation of the downtown city it is important to investigate the complex relationships between Pombal and Portuguese society. Pombal, (Sebastião José de Carvalho e Melo - 1st Count of Oeiras) - the Minister of King D. José, was the most notable Portuguese statesman of his time being influential both in Europe and the New World (22).

In 1739 Pombal held the post of ambassador in London, where he negotiated on behalf of the Portuguese merchants in London to obtain privileges then enjoyed by the British merchants in Portugal. His stay in England was excellent preparation for his future government responsibilities (20).

On 21st July 1750, when King João V died, his son D. José I became king (Fig. 31) and nominated the Marquis de Pombal as Counsellor of the Court Minister. Slowly but surely Pombal gained the reputation of being an excellent Minister, continually accumulating great prestige (2).

Pombal planned to put into practice a plan for significant reforms but there were serious difficulties due to the depletion of the state treasure as a result of extreme extravagance during the reign of the Magnanimous King, D. João V. He also knew, that to carry through his reforms, he would have to destroy the two classes that most benefited under D. João V, the Nobility and the Jesuits (2).

As he became more powerful he tried to displace them by giving the common people more privileges. By attempting this, he would reduce the power and wealth of the Nobility, creating many enemies.

Pombal governed in a despotic way. It was said that even the king feared him, but it was in this way that he was able to introduce his controversial reforms. In 1750 Pombal started to put his reforms into action. First he limited the flow of currency. He favoured industry by selectively abolishing taxes and reorganised the collection of taxes. He also established the efficient running of public services which had previously been chaotic (22).

He fought to free, the country from foreign economic control. He set up the silk industry and prohibited exports of raw materials. Industry began to flourish (23).

This was followed by granting full commercial concessions to Portuguese merchants which permitted them to sail to Asian ports. Later he concentrated his efforts on creating Brazilian Companhias, (Grão-Pará, Maranhão and Paraíba), in order to manage the commercial wealth of these regions (21).
All these actions were greeted with very fierce opposition and created for him many more enemies. These in particular included the Jesuits and the Nobility, (24) who did not agree with the rise of the new commercial class. This was the type of environment which existed immediately prior to the earthquake.

In spite of possessing all the qualities of a Statesman, the Marquis of Pombal demonstrated a certain ruthless and cruel streak which in a way erased some of his good deeds. One such example, which occurred after the earthquake, was the repression in Oporto in 1757. This was when there was created the Companhia do Alto Douro, which caused a tremendous protest because it interfered with the free trade in wine. A serious revolt took place (25), and a detachment of troops was sent to the city. Thirty people were executed and many others were sentenced to lesser penalties and punishments.

As a result of this persecution and many other similar events, the Duke of Aveiro planned the assassination of the King D. José I. He thought that this would see the end of Pombal, but the plot failed and the Duke of Aveiro and his family were executed (26).

Pombal blamed the attempt on the king’s life on the Jesuits, whom he particularly hated and who had been closely connected with the Aveiro household. As a result Pombal asked the Pope to disband the Society of Jesus (6). Without awaiting a reply, he ordered immediate expulsion of all their members from Portugal in 1759. France and Spain followed his example and eventually the Pope gave way and terminated the Society of Jesus in 1773 (21, 27).

When the nobility and the clergy had been suppressed, the Marquis dedicated himself to the new reforms. Education was reformed, for example, at the University of Coimbra where the old traditional methods were replaced by new methods (28). In spite of achieving all these reforms, Pombal encountered many problems and suffered as a result of the existing inefficient government structures. His period of administration was therefore short.
On the 24th of February 1777, the king D. José I died and this ended Pombal's reign of terror. His subsequent fall from power was accompanied by personal misfortune. He was ordered into exile at his palace in Pombal and the population was allowed to jeer and insult him. The jubilation of his enemies was undisguised and the people's feelings rose to fever pitch. The prisons were all opened and all his political prisoners were released. Pombal was accused of having abused his power to gain personal power and wealth. (2)

1.5.2. The relationship between the Marquis de Pombal and leading elements in society.

The Marquis de Pombal was in continual conflict with the Jesuits, whom he persecuted and against whom he encouraged anti-clerical theories (21).

However this should not be considered a religious quarrel. The relationships between the Prime Minister and the Catholic church and other religious orders, were cordial (21). He had close contact with the Franciscans amongst whom he found some of his best and most loyal collaborators. It was the Jesuits who caused the dissention between Pombal and the Pope. This quarrel created particular impressions of the Marquis de Pombal, which have filtered down to the present day. Although this problem was not exclusive to Portugal (France and Spain forced the Jesuits out of their territories about the same time), it underlines Pombal's political determination and courage. The causes of the dispute were political and socio-economic not religious, and some were related to Brazil (29).

After the expulsion of the Jesuits from Portugal, by Royal Decree on September 3rd of 1759 (see Fig. 32), Pope Clement XIV, himself an anti-Jesuit, disbanded the Companhia de Jesus thus restoring relations with the Portuguese crown.

Fig. 32-The Marquis de Pombal is informed that his orders have been carried out, as all the Jesuits have left.
The Marquis de Pombal was also in conflict with the nobility. A large part of the Portuguese Nobility were disturbed by the rise of the commercial and industrial bourgeoisie protected and encouraged by Pombal. This resulted in a kind of cold war attitude from the nobility since it could not fight Pombal openly (21). Several attempts to remove him from power took place. His fiercest critics even considered the King's attempted assassination as a way to strike at Pombal. As previously mentioned an attempt on the life of D. José I was made on September the 3rd, 1758, when he was ambushed by the Dukes of Aveiro following a Jesuit plot (see Fig. 33). The King and the Prime Minister decided to cover up the attempt while investigations were made. On January the 9th the accused were found guilty of the crime of lèse-Majesty and on January the 12th, they were sentenced to death. The next day they were taken to a Square in Belém, and savagely executed (26). This is illustrated in Fig. 34.

![Fig. 33-Assassination attempt of D. José I](image)

![Fig. 34-Execution of the Távoras](image)

Pombal however found close allies in the Bourgeoisie, who were the new Nobility, enriched by overseas trading and made powerful by new important public posts. Prior to the earthquake all Portuguese trade both import and export was conducted through foreign trading houses. Even the retail trading was in the hands of foreigners. Only the trade with Brazil was still operated by Portuguese (21).

Foreign traders resident in Portugal represented many important foreign firms. All profits were channelled back home. This situation worsened during the rule of D. João V and Pombal's interventions were intended to encourage Portuguese trade and industry (2).

After the earthquake some foreign firms went bankrupt, however others who chose to compete fairly saw their interests increase placing them on an equal basis with the national bourgeoisie, with whom they often intermarried. This group were able to gain high positions in the Public Administration, the Public Treasury, the Chamber of Commerce and the Customs Service in Lisbon. In this way a new nobility grew from this ambitious bourgeoisie.
The Prime Minister protected the new merchant class, so that Portuguese trade and industry could be encouraged and re-generated to compete with the foreign traders. Consequently tax and trading concessions were guaranteed (22). This was the nature of the socio-economic climate which prevailed during and subsequent to the reconstruction of the city.

1.5.3. The reconstruction and the Chief Engineer Manuel da Maia.

To execute the reconstruction, Pombal relied on the expertise of certain technicians including Manuel da Maia, the Kingdom’s official engineer. He was an expert in fortifications and it was he who planned and executed the reconstruction of the new city. Figure 35 shows an eighteenth century portrait of Manuel da Maia.

The reconstruction of the city proved to be the peak of the notable career of this military engineer, who was then in his eighties. By looking at his rational proposals, we can see a "practical" man, a man of "good sense" and a professional who was always conscious of problems concerning safety and hygiene as much at the urban level as at the architectural level. He created the very specific "Pombaline style", characterized by its austerity and rationality (2, 30).

The proposals by Manuel da Maia for the reconstruction of the city comprised three major evolutionary stages. These are outlined in the flow chart presented in Figure 36. The first stage consisted of proposals for five possible basic approaches, which are discussed in the following sections.

1.6. Outline proposals for the first stage of the reconstruction.

The original texts of the proposals are presented in the Appendix I. They are in Archaic Portuguese and there are no illustrations. The following descriptions with illustrations of proposals and the licence are interpretations by the author.
Reconstruction of the new city

Immediate measures taken by the Marquis of Pombal

The first stage of the proposals
4th, December 1755

First approach
To rebuild exactly what had previously existed

Second approach
To rebuild to former heights but convert the narrow streets into wide ones

Third approach
To restrict the buildings to two floors and widen the narrow streets

Fourth approach
To demolish any remnants of the previous buildings and rebuild to a completely new plan

Fifth approach
To abandon the city

Second solution to build a new city at Belem

The second stage of the proposals
16th, February 1756

To follow a rational plan

To substitute wide streets for the previous lanes and alleys without otherwise changing property boundaries

To retain the wide streets and widen the narrow ones, without otherwise changing property boundaries

The third stage of the proposals
31st, March 1756

Innovation and preventative measures

Suggestion to solve bureaucratic problems

Licence of 12th of May 1755; official permission to begin reconstruction

Plan of 12th of June; 1758 special cases

Fig. 36-Flow chart showing Manuel da Maia's proposals for the reconstruction of Lisbon.
1.6.1. The first approach.

The first plan proposed to return the city to its former layout, rebuilding to the previous height and keeping the streets the same width (see Fig. 37). This first approach assumed that the earthquake which had occurred was not the forerunner of another. As there had not been an earthquake for many years, there was no reason to expect another one in the near future.

![Fig. 37-The first approach proposed to return the city to its former layout.](image)

There were distinct advantages in following this approach. These were:

i) Lisbon could rapidly return to its former state.

ii) The improved buildings could accommodate the same number of people and permit landlords to obtain the same income from their properties.

iii) Lisbon could be slightly improved using the same material from the ruins for the rebuilding, cutting the work and the expense of clearing the area of rubble.

However there were also distinct disadvantages. These were:

i) If the city was to be rebuilt keeping its original narrow streets and very tall houses, there would be criticism that no advantage had been taken to improve the living conditions of the people.

ii) It would encourage a return to the former laissez-faire attitude to building lines and height.

1.6.2. The second approach.

In the second plan, it was proposed to rebuild to former heights but convert the narrow streets into wide ones. This second approach also ignored precautions against future earthquakes by maintaining the buildings at their original heights, (see Fig. 38).
a)-Before the earthquake:
Narrow streets and heights more than two floors.

b)-After the earthquake:
Widening of the streets

c)-After the earthquake:
Building with the same heights.

Fig. 38-The second approach proposed just to convert the narrow streets into wide ones.

The advantages of doing this were as follows:

i) Better access to buildings could be achieved from street widening whilst still guaranteeing landlords most of their income.

ii) Improvements could be made to some of the biggest ruined buildings.

iii) The landlords could keep the same number of tenants and consequently receive the same income.

The disadvantages were:

i) While keeping the beauty of the city in mind, as far as the width of the streets was concerned, it did not pay sufficient attention to the problems of earthquakes, because it maintained the height of the houses.

1.6.3. The third approach.

It was proposed in the third plan to keep the heights of the buildings to three floors above the street level and widen the original narrow streets, (see Fig. 39 on next page). This then had the advantages that:

i) The limit on building heights was a precaution against earthquake damage.

ii) The advantages of wider streets improved appearance and access.

The disadvantages were that:

i) It did not please the owners of the ruined buildings as it would have meant lower incomes.

ii) Surplus rubble from the ruined buildings would have to be disposed of.
The fourth approach.

This involved using the rubble to create a new ground level and restricting the height of the buildings to the width of the streets, (see Fig. 40).

The advantages of using this approach were:

i) Using the rubble to increase the level of the city, would improve the drainage of streets and properties. Also Lisbon would be protected against the flooding to which it was so often victim at high tide.

ii) Risk of future disaster from earthquake damage could be reduced by limiting the height of the buildings and the width of the streets.

The principal disadvantage was:

i) Problems of compensation to owners resulting from loss of income would still remain.

The fifth approach.

The fifth approach involved abandoning the ruined city of Lisbon, (see the possible places in Fig. 41).

One proposal was to build a city from Alcantara to Pedrouços (see Fig. 41) and give permission to houseowners in Lisbon to rebuild on the new site as they saw fit.
A Second proposal was to build safer buildings on better land in Belém and its surroundings.

The advantages of building outside Lisbon’s walls were:

i) If the second, third or fourth approaches were adopted the widening of the streets and the reduction in the numbers of floors would mean that a large number of people would be homeless and would need temporary housing due to the shortage of accommodation. Gradually moving people into new permanent accommodation outside the old ruined city as it became available, would partly avoid this problem.

ii) This approach was supported by observations of what appeared to have happened in previous disasters. There were a number of examples of cities and towns in Portugal which had taken the names of previous ones that had been destroyed by earthquakes, but the original ruins could still be seen nearby without any obvious reason being apparent for the repetition of name.

iii) One curious reason given for a change of site was the conviction that earthquakes were magnified in heavily populated places due to the quantity of human excreta penetrating and permeating the earth below, thus producing more violent tremors and their effects producing more devastating results.

The advantages in moving to a new site were:

i) The new site would provide a flat area free from the problems inherent in old Lisbon and without the need to decide which buildings to keep or demolish. Also compensation and rental incomes would not be a problem.

ii) Without the need to clear and organise the congested site, the building of new Lisbon could be faster, without the landlords of old Lisbon having anything to complain about.
The main disadvantage of moving to a new site was:

i) It would be opposed by the owners of buildings in the main streets of Lisbon, who would be afraid that their incomes would be reduced by the building of more houses in different areas of Lisbon. They considered that creation of new centres as alternatives to the lower city would be against their interests.

1.6.6. The choice for the first stage of reconstruction.

To choose one of the five approaches, which was very difficult, it occurred to Manuel da Maia that if his Majesty were to choose the site for the new royal palace, this could help to reach a decision. The site which afforded better conditions than any other for the new palace was Belém, so the fifth approach would be the best one to choose in his opinion. His considerations took into account the fact that it was a healthier site, with good means of access to the country and was well levelled and had running water.

Manuel da Maia at this stage of the proposals, indicated some recommendations for the rebuilding of the city. The rebuilding, he suggested should start with the government buildings and then with rentable buildings. The streets of houses could be built partly in wood rather than completely in stone, and whitewashed. This form of construction would be faster and would overcome the public aversion to building totally in timber, due to their fear of fire.

The height of buildings would never exceed the width of the streets and even if some streets were wider than the height of two-storey houses above ground level, it would not be permitted to add a third storey, (see Fig. 42). In these conditions, escape via streets in the event of any emergency would be made much more effective.

Fig. 42-The height would never exceed the width of the streets

Fig. 43-The arcades should be built in the main streets

To be able to make the streets as straight as possible, all the destroyed streets would be marked out with flags in order to show where the original streets and houses had been. Also arcades should be built in the main streets of the flat lower area, as there used to be in the street of Nova dos Ferros and Confeitaria street, (see Fig.43).
This would provide greater public comfort and convenience on rainy winter days.

It was also necessary to allow sufficient passage of time, in order that the great number of corpses buried under the rubble did not produce unacceptable odours when uncovered. For the same reason, it was recommended that the level of the streets was raised to avoid the necessity of turning over the rubble. In the first part of his proposals, Manuel da Maia had tried to give a general outline of the approach to take account of criticism and willingly listened to suggestions for amendment.

After consideration of the proposals, his Majesty decided to build the new Royal Palace at Belém but, as far as the city was concerned, he decided to build the main body of the destroyed city in accordance with the fourth approach.
1.7. The second stage of the proposals by Manuel da Maia for the reconstruction of Lisbon.

1.7.1. The possible methods of carrying out the reconstruction.

Seeing that the first part of his proposals for the rebuilding of the city was well received, Manuel da Maia produced the second part of his plan in which he considered important questions relating to the legal and financial aspects and also the details of how to proceed.

For the renovation of lower Lisbon, Manuel da Maia suggested three possible approaches, which were:

i) Completely razing Lisbon to the ground and rebuilding it following a rational plan (see Fig. 44).

Fig. 44a-How a new street could be envisaged.  
Fig. 44b-A new rational plan over the medieval plan.

ii) Razing Lisbon but keeping the wide streets and widening the narrow ones, (see Fig. 45).

Fig. 45a-Rebuilding the same properties.  
Fig. 45b-Widening the narrow streets.

iii) Not razing Lisbon, just changing the alleys and lanes into wide streets, (see Fig. 46).

Fig. 46a-Rebuilding the same buildings.  
Fig. 46b-Changing the alleys and lanes into wide streets.

The new streets formed by widening the narrow streets, reducing the alleys and lanes and also correcting the irregularities on many houses, would have created difficult problems with adjustments and compensation. These would make these innovations more of a problem than an advantage so the first approach was the one which he recommended.
1.7.2. The ideal method for redistribution of land and property.

If renovating lower Lisbon was essential, what remained to be decided was the best way to achieve this objective. Da Maia admitted to having some difficulties in devising the second stage of his plan, because when he outlined the fourth approach to renovation, which included razing lower Lisbon to the ground, it was in the expectation that his Majesty would first choose to take over all the buildings in this part of the city and evaluate whatever was left of them. After they had been completely razed to the ground and new streets and buildings had been planned, the value of the destroyed houses could be divided by the number of plots, after all the measurements had been taken, and each owner could receive in land the value attributed to his property.

In cases where the owners refused the land, it could be sold and the money given to the owner instead or, if doubts of ownership still existed, his Majesty could finance the rebuilding and the income from the new buildings could be vested in favour of the crown.

This solution, which is illustrated in Figure 47 seemed to be the most fair and effective way in which to proceed. However, it was not easy to apply, because the fire had destroyed a part of the National Archive, in which was included a catalogue of the city buildings and their valuations.

Example

Fig. 47-The ideal renovation.
To reform the lower city in the way indicated in the first of the three approaches all the churches, convents and chapels had to be roughly in the same place and of the same size.

Determination of the value of property in the newly rebuilt city was done in the following way:

If the total floor area of all the old city property was $A$ and the total purchase price of all the old properties was $V$, then the valuation factor $F$ for the old city (i.e. cost/unit area of property) is $F = V/A$, this could be estimated.

If the total floor area of the planned new city buildings is $A'$ and the total purchase price for all the new buildings is $V'$ then the valuation factor $F'$ for the new city (i.e. cost/unit area) is $F' = V'/A'$.

However the total value of the new buildings is taken as equal to the total value of the old buildings i.e. $V = V'$.

Therefore $F'A = FA'$ and the valuation factor for the new buildings, $F'$, is then given as $FA'/A$.

Once the valuation factors $F$ and $F'$ had been determined it was relatively simple to determine what each person's entitlement was in terms of area of new property and what remuneration or additional costs would be attributed to them if they were not allocated exactly their official quota.

Depending on the value of the demolished houses, the owner could receive on the new plan the equivalent number of square palms of land, having in mind the relation between the old plan and the new.

Also in an attempt to give each owner the same type of site that he had had before, the ones with sites near the sea, for example, would be given another site close to the sea, the ones with sites near the Rossio would be given sites near there and so on.

1.7.3. The buildings in accordance with the reconstruction.

Lower Lisbon was the commercial and trading centre of the city and had previously consisted of shops with accommodation for workers, traders and merchants. The new plan was aimed at standardising this type of accommodation in order to provide a much more effective and efficient environment and infrastructure.

The buildings were to be constructed in accordance with plans produced by the Senate Architect Cap. Eugénio dos Santos, so that each street maintained the same symmetry with respect to doors, windows and heights.
As far as height was concerned, the shops would be at ground floor level with two storeys above the shops, for living, (see Fig.48). The walls dividing the different houses would be higher than the fronts as protection against fires which easily pass from one roof to another if this practice is not followed.

![Fig.48-The buildings proposed](image)

Eugénio dos Santos suggested that each street or each quarter would have some distinctive feature, in for example its colour. However, the lower city was to be entirely in the same colour in order to distinguish it from the other parts of the city.

Making the houses symmetrical and as standard units, would make the task of relating the old properties to new ones a much simpler process.

Once the siting of the new buildings had been determined on the new plan, with the correct symmetry, it would be necessary for them to be put up for sale. They could first be offered to the creditors on the following conditions:

i) If a creditor received a new site that was more valuable than the one that he had owned, he would have to pay the difference in cash to satisfy other creditors, (see Fig.49).

![Fig.49-Process of selling properties, 1.](image)

ii) If a creditor received an area of less value than that which he had previously owned, he would be compensated by receiving in cash the difference in value between an equivalent area of new site and the actual area, (see Fig.50).

![Fig.50-Process of selling properties, 2.](image)
iii) If there were areas which the creditors did not wish to purchase these would be sold to non-creditors so that the creditors would receive in cash what was due to them, (see Fig.51).

Fig. 51-Process of selling properties, 3.

iv) If there were creditors who wished to purchase much larger areas than they had previously owned, they were allowed to negotiate with other creditors who wanted cash rather than property, (see Fig.52).

Fig. 52-Process of selling properties, 4.

In order to overcome the fear of there not being anyone to buy some of the areas or of creditors not accepting them in exchange for those that they had lost, it occurred to Manuel da Maia that he should persuade the King to start the rebuilding of Lisbon with those buildings which were to be built with Royal Treasury funds. Then because it was very convenient for businessmen to have their homes near the public buildings, that would encourage the businessmen to also start rebuilding. Such an attraction would make the rebuilding of Lisbon much easier with the advantages already discussed of razing it to the ground and completely rebuilding.
1.8. The third stage of the proposals by Manuel da Maia for the reconstruction of Lisbon.

1.8.1. The plans presented for the reconstruction.

Due to the high priority given to rebuilding the destroyed area of the city, which was the economic centre and the traditional commercial sector, three teams were constituted which prepared a total of six draft versions superimposed on the old city plan (2, 20, 21).

Manuel da Maia felt that the churches and chapels should be rebuilt on their previous sites, with the land that had previously belonged to them (2, 20, 21).

An area within the new plan was to include a seaward extension of the Terreiro do Paço, formed by raising the level of the land with material from demolished buildings.

These rules applied only to three teams; more freedom was given to the teams of Captain Eugénio dos Santos (2, 20, 21).

All the six plans presented, had tried to preserve the Rossio and Comércio Squares.

Fig. 53-The Marquis of Pombal discussing the plans.
The Assistant Architect Pedro Gualdr da Fonseca, helped by the practitioner (articled pupil of Architecture) Francisco Pinheiro da Cunha, was given the task of preparing a plan (known as plan number one, see Fig. 54), for the lower part of the area that had been destroyed. This included widening and straightening the narrow streets with minor improvements to the wider ones, and in some cases the extension of dead ends to link with other streets. It was expected that this plan would emphasise the need for these types of improvement (2, 20, 21). Maintaining many of the features of the surrounding areas did not present problems of transition or conflict with them.

An important aspect of this plan was that the building of the stock-exchange occupied the centre of Praça do Comercio (2, 20, 21).
Captain Elias Sebastião Poppe (architect), helped by his son, Jose Poppe (articled pupil of architecture), was asked to prepare another plan (known as plan number two). In this plan the narrow streets were not to be widened; and Captain Poppe was given the freedom to decide on the extent of alteration of the street lay-out which he considered appropriate (2, 20, 21).

The plan presented (see Fig.55) was a grid plan but it maintained the existing sites of the churches. It had three streets running from Rua Nova dos Ferros towards Rossio. One of the streets ended at the midpoint of one of the sides of the square, accentuating its symmetry. Five east-west streets crossed the set of north-south ones, while another three ran slightly obliquely to Rua Nova dos Ferros. The Comércio Square was parallel to the river and only one street ran from Rossio to Comercio Square. This plan also did not present problems of transition or conflict with the surrounding areas.

Fig. 55-Plan number two.
Captain (also Architect) Eugenio dos Santos de Carvalho, assisted by Antonio Carlos Andreas (Assistant Architect), was commissioned to prepare another plan (known as plan number three). He was free to plan as he wished. It was recommended that squares should be built on sites considered convenient, so that the inhabitants of the new city could enjoy the benefits of the open air. The result was a rational plan, (see Fig. 56) (2, 20, 21). "Rua Nova dos Ferros" was respected in its location. It articulated the "Terreiro do Paço" and Rossio Square with three major thoroughfares. There was planned a new square as central space of the entire plan. The grid was adjusted to the dimensions of the squares and in particular to the new shape of the Terreiro do Paço. Consequently the blocks were elongated with their longer sides running approximately north-south.

Fig. 56-Plan number three.
A second plan prepared by Assistant Architect Gualder da Fonseca, (known as plan number four), consisted of an orthogonal grid of streets oriented in the north-south and east-west directions, (see Fig. 57) (2, 20, 21). It was a rigid grid of eleven streets crossing five east-west ones. The dimensions of the Terreiro do Paço were reduced compared with the previous square. It had some squares, including S. Nicolau, a square placed diagonally at the centre of the composition. In spite of providing many linear metres of façade of high commercial value, it did not possess the healthy living conditions which were regarded as essential. The grid had very elongated blocks and probably this contributed to its failure. The plan appeared to conflict with the surrounding areas.

Fig. 57-Plan number four.
The second plan prepared by Captain (also Architect) Eugénio dos Santos (known as plan number five) did not maintain the churches on their original sites. It consisted (see Fig.58), of an orthogonal grid with eight streets, perfectly parallel and rectilinear, oriented in the north-south direction, giving accesses to Comércio Square. Nine streets cross orthogonally in an east-west direction, and the main ones are the three near the Comércio Square, which run parallel to the old Rua Nova dos Ferros (2, 20, 21). There were transitional areas which are bounded by the edges of flat land where the Madalena and S. Francisco hills begin.
The final plan, known as plan number six (see Fig. 59), prepared by Captain Elias Sebastião Poppe (also Architect), did not maintain the original sites of the churches. It consisted of an orthogonal grid, composed of eight north-south streets and eleven east-west ones. Three streets led off from the north side of the Terreiro do Paço square and a different three led off from the south side of the Rossio square. An intermediate square of an irregular hexagonal shape was proposed, with S. Nicolau Church in its centre. An important feature of this project was that the Terreiro do Paço, was planned as an enclosed square with the Bolsa (Stock-Exchange) and the Customs office on its west side (2, 20, 21).

This plan was considered to be insufficiently commercial. The small square blocks of which it was composed, wasted too much land by its extensive repetition.

Fig. 59—Plan number six.
Of the six plans the one chosen was plan number five prepared by Captain Eugenio dos Santos (see Fig.60). This project offered a large number of commercial façades with high density. This satisfied economic interests but also took account of the need for secure and healthy conditions for tenants.

Eugenio dos Santos was an inspector of the Royal Construction works and an Architect of the Senate. His high standing and background could well have influenced Manuel da Maia, in choosing this plan. The plan was particularly successful in integrating two separate areas with different functions. These were the Comercio Square which formed the new administrative and commercial quarters, and the Rossio Square with its meeting place and daily social functions. Part of Comércio Square would occupy land reclaimed from the river. In order to avoid fires the scale of churches was reduced, and the public buildings which were concentrated in the Comércio Square were clearly separated from rentable buildings.

Most of the blocks, with the exception of Comércio Street, were oriented in a north-south direction, precisely in the same direction as the earth movements (and the same as the flow of the alluvium), with the object of minimising the effect of earth tremors.

I.8.2. Comparison of the six plans

In order to fully compare and explain the advantages and disadvantages of the different projects for the reconstruction of the city, a sample of the whole area is considered. The plan is broken down into manageable areas of 10 000 square metres, (100x100m), the use of which is common practice in Portugal for economic studies. Each of these units is referred to as a "typical hectare". Figure 61 shows a typical hectare located on a plan of the reconstructed Pombaline area, Figure 62 shows this "typical hectare" with the old city plan superimposed and Figure 63 shows that part of the old city plan contained within the typical hectare. Figure 64 shows a three dimensional plan of the buildings prior to the earthquake.
Fig. 61-The "typical hectare", location on the approved plan.

Fig. 62-The "typical hectare", over the approved plan.

Fig. 63-The "typical hectare", superimposed on the old city plan.
Fig. 64-Lisbon before the earthquake.

Fig. 65-Perspective of the "typical hectare".

Fig. 66-View inside the "typical hectare," before the earthquake.
The figures below are comparisons between the six plans using a selected typical hectare.

In plans one, two and three there seemed to be more coincidence of building areas between the proposed plans and the original plan (see Fig. 67).

Plan one tried to respect the previous streets, plans two and three, just the important ones. The remaining plans ignored the old streets (see Fig. 68).

In plan one, the previous blocks coincide more often with those proposed, in plan six large areas were devoted to the proposed streets, plan five is more balanced and there was not a great difference in width between the main and the secondary streets (see Fig. 69).

In the approved plan (number five), all blocks had alfugeres (courtyards) in order to avoid internal rooms (see Fig. 70).

As is shown in the perspectives (see Fig. 71), the approved plan had blocks of regular shape.
As is shown in the perspectives of the approved plan, the total area of buildings per "typical hectare" (see Fig. 72) physically occupied half a "hectare". In plans one to four the total area occupied by the buildings was in excess of a half hectare and in plan six it was less.

In the approved plan the length of the façades, as is shown in figure 73, is between the shortest (plan number three) and the longest (plan number two), which means more shops façades to the streets in relation to the interior spaces.
1.8.3. The approved plan - Its innovative aspects and limitations.

The new approved plan, for which the public works were started on 15th May 1756 by the builder Manoel Martins, incorporated not only new urban concepts, but also innovations in terms of functional and preventive measures, related to possible calamities.

For example separate thoroughfares for pedestrians and vehicles were established with exact widths for streets and pavements. However the pavements were the target of serious criticism because they were unpleasant, badly paved, and uneven, thus dangerous at night.

Manuel da Maia suggested a street width of 60 palmos, divided into three parts, in imitation of some in London. The central carriageway 40 palmos wide was for carts and people on horseback and was to be paved with small stones. The two side ones 10 palmos wide were for pedestrians and sedan chairs, and were separated from the carriageway by stone bollards, frades, which aimed to protect pedestrians from the vehicle's wheels, (see Fig. 74).

To enable the water to flow down from the upper areas, and allow for the cleaning of the pipes that come from the buildings, the cloaca or Royal pipe was created (see Fig. 74).

According to Architect Carlos Mardel, the rigorous alignment of the buildings as well as the observance of the planned widths, were highly beneficial, (see Fig. 75). They avoided possible injuries caused by structural damage in case of an earthquake and made fire fighting easier. They also provided better lighting and air circulation.
The side streets, which crossed the main ones and were necessary for service purposes and to provide better ventilation and lighting for the city, had to be 40 *palmos* wide; 20 for the carriageway and 10 to each footpath. On these streets French windows were not permitted and the ground floor had to be left for the construction of stables, (see Fig. 76).

![Fig. 76-The width of a side street.](image)

In the Terreiro do Paço, for the new plan, Manuel da Maia suggested building public buildings in a more aristocratic style than had previously existed, with pediments and arcades providing protection from inclement weather and with two storeys above the arcade in which windows could be formed (2, 20).

The height of the rentable buildings had to conform with that of the buildings of the Terreiro do Paço, but the number of floors allocated to each building could be varied. Only shops had to be of a standard height of 16 palms, and the remaining height could be divided between the upper floors as desired (see Fig. 77) (31).

The introduction of mezzanines was not difficult to achieve in buildings constructed on sloping streets (see Fig. 78).

![Fig. 77-The height of the buildings.](image) ![Fig. 78-The buildings on sloping streets.](image)
The first floor would have French windows with balconies. The windows of the second and higher floors were to have fairly low cills and were to diminish in height from one floor to the next one above. When the buildings had stables the access to these was to be from side streets (3). Any upward extension of the buildings including timber framed extension, was prohibited (31). The attic floors were intended to be used for domestic storage, but it was required that a lath-and-plaster finish should be applied to all ceilings and vertical framing. Dormer windows were proposed for the attics, both to ventilate the roof timbers and to contribute to the appearance of the front elevation, (see Fig.79 and 80) (31).

Another innovation was introduced due to the fact that with all buildings being of the same height, fire could spread easily between them unless precautions were taken. Therefore walls were extended above the roofs. These walls were party walls and built in a way almost invisible from the street (31).

Next to the church of each parish, there was a water pump together with a large number of leather buckets for fighting fires (31) (see Fig.81).
The supply of water to these low parts of the city was regarded as essential. The ideal objective was the existence of a fountain in each street and a water tap in each house (31). If this ideal objective could not be entirely achieved, it could at least be in part, by for example, limited extension of the piping system from the old aqueduct (2, 20).

Fig. 82-A fountain

Fig. 83-The transport of water from fountains to the buildings.

Provision was made for a piping system to feed water to the fountains (see Fig. 82), to supply the inhabitants of the new buildings (see Fig. 83) and for fire fighting purposes. This was to be achieved with a number of fountains. For example, the Terreiro do Paço fountain (supplied with water coming from the Cruzes da Sé), the fountain in Rossio Square (received water from the Bairro Alto), the fountain in the Hospital of Todos os Santos (fed by a conduit coming from Desterro), and the Vitoria Square fountain (supplied through Bairro Alto) (2).

At the time when the rebuilding proposals were being drawn up, the usual method of sewage disposal in most areas consisted of transporting, in large horse drawn carts to appropriate locations outside the town, all the solid and liquid detritus thrown out of the windows (2).

Three suggestions were proposed by Manuel da Maia to improve this situation.

The first, which had already been used in some countries, consisted of the construction of underground sewers running down the middle of the main streets with the necessary capacity to receive both solid and liquid waste from the buildings (2).
From these sewers a subsystem of underground sewers would be provided to drain the main sewer (see Fig. 84). The city already had sewers of this type which served convents and manor-houses, which were connected to the Royal system of sewage. However much of the system was eroded and the proposed new street layout implied its replacement (2).

![Fig. 84-The system of sewerage, cloaca.](image)

The second method, consisted of collecting, early in the morning from the streets, only the solid waste and other debris that might block the street, leaving the liquid waste which would rapidly dissipate (2).

The third method, consisted of leaving free space between the backs of all the rows of buildings comprising narrow "streets" of five or six palmos (see Fig. 85), which would be called alfugeres (open sewer). No doors would open on to them, and waste could be thrown into them from the windows of upper floors. Once a year, in Autumn, this waste could be removed and transported by means of large, horse-drawn, carts to appropriate locations. This solution had the disadvantage to the tenants of generating unpleasant odours. This could be reduced by glazing the rear windows of the buildings (2, 32, 33).

The use of underground sewers and establishing alfugeres seemed to Manuel da Maia to be the best solution. The sewers were therefore built beneath the middle of the street and were 10 palmos wide by 14 high. Unfortunately, due to technical flaws such as abrasive walls, and square sections, sedimentation and build up of solid waste occurred which prevented the inflow of the river waters into the sewers' interior. Thus the sewers were not effectively self-cleansing and the Municipal authority did not provide an effective and regular cleansing service. Also the rubbish collection system from alfugeres proved to be deficient and people had to remove their own waste (Fig. 86).
Manuel da Maia seemed very concerned about the possibility of these inner yards harbouring infectious diseases. Every Autumn this rubbish was to be collected, because in winter, the higher density of the air due to the cold weather could cause the stench to be unbearable (33).

But the system did not operate and the stench caused by the rubbish attracted many dogs. Therefore the environment left much to be desired and was compounded by the unevenness of the pebbles that covered the streets. Also during the night the illumination of the streets was inadequate as it left many shadows where criminals could lurk. In order to be able to defend themselves from attacks by criminals, people usually walked accompanied by servants carrying lanterns and torches (33).

Street lights consisted of lanterns of olive oil or even physic-nut which was much cheaper (see Fig. 87). When there was moonlight, or when funds ran out, public lights were not lit. In order to help pedestrians at night, a stone plinth ran along the façade of the buildings to guide them (see Fig. 88)(33).
1.9. The precursors of the Pombaline period.

The Pombaline rentable buildings possess very specific characteristics especially as regards their simplicity, and their respect to austerity on the economic use of materials and construction processes. This is due to the special economic and political circumstances which prevailed at that time. These rentable buildings are clearly distinct in style, in architectural terms, from those adopted both before and after the period of the Marquis of Pombal’s ministry.

In Portugal, before the Pombaline phenomenon, there were two periods of architectural exuberance, corresponding to two periods of economic prosperity. These were the Manueline period, when prosperity arose through trade with India (late Portuguese Gothic, 1500-1550), and the Joanino period, associated with the discovery of gold and diamonds in Brazil (Portuguese Baroque, 1700-1750). In between these periods there was a period of great austerity when the architecture was characterized by a return to simplicity and elegant proportions, the "Chá Architecture", (Fig.89) (34).

Prosperity in the Manueline period, was achieved through trade with the Orient. It created an architecture characterized by the overworking of excessively decorated stone surfaces. The period of prosperity ended with the decline of that trade due to competition from other European powers and over spending on the defence of faraway possessions. This decline was further accelerated by the defeat of the Portuguese King Dom Sebasteão at Alcácer Quibir (1570).

Having lost its independence to Spain in 1580, the country subsequently experienced a period of penury and pain. During this period of economic decline the architecture was marked by sobriety, by emphasis on volume and proportion and an end to the practice of carving. This period termed the period of "Chá" architecture was conditioned by old traditions. It represented a return to the frugal principles of vernacular architecture rather than being conditioned by the direct influence of what was in fashion, and was characterized by clarity, order, repetition, proportion and simplicity. As in the later Pombaline period, "Chá" architecture, was also started by military architects, due to the circumstances of the time, (Fig. 91, 92 and 93) (34, 35).
A dichotomy has generally been apparent in Portuguese architecture between an instinct for simple elegance in the form of buildings and love of sumptuous embellishment.
In the architecture of this period and especially toward its end it is possible to find some compositions that may have influenced the architecture of the Pombaline rentable building.

However regardless of these links it is clear that the Pombaline building is the result not of simple copies of buildings that already existed but of a new concept in building, a building adapted to rational mass production, carefully designed to produce an economic, hygienic and safe building founded on the simple, traditional way of building, without neglecting the clarity and order of classical antiquity (36).

The composition of the façade, the number of floors, the shape of the stones around the spaces and the use of balcony windows on the first floor of the buildings, had its origins in the composition of the Ludovice Palace (1740) situated in the "Upper Quarter" (Bairro Alto), (Fig.90). However the elements that formed the façades were simplified, with the aim of standardizing the production of components (2).

The pilasters finishing off the blocks, the solidity of the ground floor stone walls, the stones forming the cornerstones, the connecting elements, the arches and solid brick vaults and the staircases with the first two flights in carved stone, seem to originate in the large urban mansions, like the Galveas Palace (1650-70) which were the homes of the nobility , (Fig.91).

The straight frontons (heads) of the balcony windows of the Pombaline buildings on Arsenal Street and Rossio, had occurred much earlier, as in the case of the Palace of the Duques de Aveiro in Azeitão (before 1619), (Fig.92). and also in the upper floor windows of the dormitory in the Alcobaça Monastery (1716), (Fig.93).
There are also other aspects such as the repetitive nature of the Pombaline buildings which have equivalents in previous structures. For example around 1600 continuous inflation and a deep depression obliged the religious orders to invest in property, and in particular to construct convents with long dormitories.

The rigorous modulation and continuous repetition of the facades of the Pombaline buildings, (spaces on the facade were perfectly lined up both vertically and horizontally), appear to be closely related to the impressive modulation and simplicity of the Jesuit Architecture. Due to constant expansion in new territories, especially in Brazil, the Jesuits had, like the Marquis de Pombal, to build quickly and economically. Their buildings had a sober character with rigid, disciplined lines (see Fig. 94). At the beginning of the eighteenth century due to the discovery of gold mines in Brazil, the buildings became sumptuous, dominated by excessive decoration of the interiors with carved wood (the Joanino period). But the austerity and repetition were maintained in the dormitories of religious buildings, like in the Convent of Santa Clara a Nova de Coimbra (1713), where the dormitories extend to more than 400m, (Fig. 95).
In addition the professionals in charge of the reconstruction of the Pombaline quarter were mainly military personnel or people with previous military experience. Due to their training and the fact that the leading mentors of the "Casa do Risco" held military posts(2), it is highly likely that the principles of rigid discipline which are apparent in the reconstruction plans were a practical reflection of the disciplined education at the Military Academy(39).

The construction system was simplified and standardized in order that pre-fabricated components could be used. The "cage", structure, that had already existed before the earthquake, was studied, tested and improved to allow buildings with three levels to be built safely on unstable land (40).

The interior typologies started with a typology that existed in old areas of Lisbon, and were immediately developed in order to adapt to the rigid economic principles and the imposed street elevations of the buildings.

1.10. European and Colonial influence on the design of Pombaline Quarter

Whilst Portuguese buildings seem to provide the models for the design of the Pombaline elevations, the urban planning is more likely to have been influenced by developments abroad. London and Turin are specifically mentioned by da Maia in his dissertations(2) and he would also no doubt have been aware of recent developments in Paris and Spanish colonial cities in América.

Paris is the site of some early, large scale residential developments with repetitive façades. In the Place Dauphine (1606, Fig.96) the plans of the houses are also repetitive, but later in the Place Vendome (41), in 1685 the facades were built without buildings behind them. It was planned to build a series of public buildings behind them, but before this could be done the plan was changed and the facades were demolished. Between 1699 and 1708 they were again built and the plots behind sold to individual buyers.

Fig.96-Paris, Place Vendome and Place Dauphine.
It is not recorded whether the individual buyers were allowed to build to their own individual layouts, but the principle of a unified, repetitive, common facade fronting a number of individually owned and constructed buildings had been established.

The rebuilding of London (42, 43) after the Great Fire of 1666 at first sight seems to bear little relation to the Pombaline quarter (see Figure 97). However the plan by Captain Valentine Knight, which was not executed, includes rules governing the sizes of components in the facades, the height of buildings and widths of streets, and this may well have provided the precedent for a similar regulative framework controlling the Pombaline area.

![Fig. 97-London, plans for reconstruction after the great fire of 1666, first plan proposed by Evelyn and by Wren.](image)

Orthogonal plans (41, 44) are found in a number of Spanish colonial cities in America, such as Candelaria (1627, Fig. 98), Mexico City (1688), Quito (1734) and Caracas (1750), in all of which developments the existing urban fabric was destroyed to make way for the imposition of the new plan (45).

![Fig. 98-Colonial city, Candelaria](image)

Turin was possibly the most influential development in relation to the Pombaline rebuilding. The original city was enlarged in 1714 with a series of orthogonal streets and squares (see Fig. 99). The buildings were similar to those of the Pombaline quarter in being a mixture of commercial properties at ground level and residential floors above. The proportions of the elevations are similar in the two developments, and Turin also has narrow access courts in the interior of the blocks, similar to the alfugeres of the Pombaline quarter.
Possible models for the construction system used in the Pombaline buildings, particularly the *gaiola* or cage, are considered in Chapter IV.

1.11. The originators (creators) of the Pombaline rentable building.

To coordinate the reconstruction of the city after the earthquake the Marquis of Pombal set up a group under the name of "*Casa do Risco das Reais Obras Públicas*", (The Planning House for Royal Public Works). The group consisted of competent and determined Professionals who worked with industry and commitment, each one of them contributing significantly to the creation of the rentable building. Among them were several deserving special mention. These were:

Manuel da Maia (1672-1768), *Engenheiro-Mór do Reino*, (Royal Engineer-in-Chief) was the one who set out the principles of the reconstruction. As we have seen, he was the author of written proposals for the reconstruction of the city in which the basic characteristics that the buildings should possess in terms of comfort, safety and hygiene were described along with the first drawings of them. (240)

Eugénio dos Santos (1711-1760), *Arquitecto do Senado*, (Senate Architect), a disciple of Manuel da Maia and the author of "*Aula da Fortificação*" (lesson in constructing military buildings), was the author of the approved plan. He dedicated himself totally to the reconstruction, working almost to the point of exhaustion. He provided the practical interpretation of the principles established by Manuel da Maia, both at the urban level and in the plan of the rentable buildings themselves and he was very aware of the need to create a modern city. (236)
Carlos Mardel, Arquitecto dos Palácios Reais e das Ordens Militares, (architect to the Royal palaces and the military Orders), (see Fig. 100) With Eugenio dos Santos, he was the co-author of the approved plan and took over the co-ordination of the works in 1760, after Eugénio dos Santos' death. He was responsible for the alterations made to the plan, as well as being the architect of the rentable buildings in the Rossio, characterized by their French mansard roofs and the alternating pattern of door/window at first floor level,(2)(see Fig. 101).

Fig. 100- Carlos Mardel

Fig. 101- Rossio Square, South elevation.

Miguel Ângelo Blasco, a General in the infantry and an Engineer, succeeded Manuel da Maia as Engineer in chief, having previously been responsible for numerous rentable building projects(2, 4).

Reinaldo Manuel also a military engineer, and author of the plan of Vila Real de Santo António (new city). He made a modest contribution to the reconstruction of the Pombaline area(46).
1.12-The reconstruction of the city as the driving force behind Pombal’s economic policy.

The highly disciplined plan for the reconstruction appears to have represented a conscious effort to push forward the Pombaline social and economic reforms. Up to the time of the earthquake, Pombal had difficulty in imposing reforms. As minister he had tried to dynamise a rudimentary, ageing economy, redeemed from the evils of the inquisition, living from casual business, dependent on the scarce riches from Brazil, and on the importation of manufactured goods from Britain. The traditional nobility, powerful, but undynamic, used to every privilege, confusing their own interests with those of the state, fought against any move towards change. The Clergy, especially the friars, took advantage of their position, gained throughout the Inquisition and with religious fears they instigated and acquired vast sums for their own expenses (26).

The earthquake and the consequent flight of the king and other officials of the kingdom, left Pombal, as representative of the Crown, to order the first drastic measures in the name of the "public interest". With these measures successfully imposed and thus being immediately named Secretary of State for the Interior, he began his period of absolute rule. Faced by Pombal’s growing power in the state apparatus and by the complacency of the King, a few "clans" from the nobility decided to react, making an unsuccessful attempt against the King’s life. With the King’s support, the failed attempt led to opportunities to cruelly punish the nobility, reducing it to a bankrupt and persecuted class (2).

Shortly afterwards in 1759, taking advantage of the fact that measures had been taken in both France and Spain to persecute numerous religious orders, Pombal adopted the same attitude, even to the extent of expelling the Jesuits. A new organism took the place of the Inquisition, the Royal Censorial Table, directed by Pombal’s brother, which led to the creation of a fearsome police force (27).

In the earthquake disaster many British Merchants who had a privileged position in the market, suffered terrible casualties compelling some of them to leave. For Pombal it was an opportunity to replace them with his allies, the new merchant bourgeoisie, made up of many New Christians who were given special privileges like the creation of monopolies to exploit national and colonial wealth (28).
After the earthquake these initial measures gave Pombal the opportunity to establish absolute power. During the reconstruction process, many different mechanisms were created in order to strengthen the emerging new class, at the expense of the nobility and clergy. These included:

i) The attribution of political motives in the decision to rebuild the city in situ could be discounted, as the city was founded on unstable lands of alluvium, where the middle-class had their interests.

ii) The decision to rebuild the main body of the city in situ rather than to expand into the Belém area led to a further decision to rebuild the Royal Palace in Belém (2), which meant that the nobility were obliged to move out of the city and away from the commercial area.

iii) The prohibition of building outside the city walls on pain of demolition, (2) must have resulted in increased custom and land values for the middle-class businessmen and landowners within the city centre, which was the only permitted area for rentable buildings.

iv) In contrast to what normally occurred in a medieval urban structure where the planning was radial and the demand for land diminished with distance from the centre, the rebuilt central area of Lisbon, contains not a single focus to attract buyers, but three straight lines of equal importance, Ouro (gold), Prata (silver), and Augusta Streets, plus the Rossio and Comercio Squares, increasing the value of a large number of properties.

v) There were no significant variations in the architectural design of the buildings; the only form of hierarchy was in the width of the streets. There was no place for buildings, (e.g. great churches or palaces), which by their sumptuousness would upset the balance of property values. The few churches that were rebuilt, such as Concepção Velha, Concepção Nova and São Julião, were removed from the central area and relegated to the periphery and reduced in dimensions to an extension of the rentable buildings. The uniform, abstract style of the façades excluded palaces, and the nobility had to move out of the city limits to build their palaces.

vi) The strong aversion to the church, to the nobility and even to the royal family was epitomised in the changing of street names, for example:

Concepção (Immaculate Conception) to Retrozeiros (hazardshers') street,
Bela Rainha (Pretty Queen) to Prata (Silver) street,
Nova Princesa (New Princess) to Fanqueiros (Drapers) street,
Príncipe (Prince) to 1º de Dezembro (1st December) street.
vii) The rules and standards adopted for the detailed layout, planning and design of the reconstruction of buildings in the new central area appear to have contained subtle mechanisms which favoured the amassing of private fortunes by individual members of the newly emerging commercial and professional classes. Documents (47) confirm that most of the owners of the area belong to this class (2, 47).

viii) In the allocation of space in the new buildings, small property owners were given priority over large ones increasing the size of properties of the growing class (2). Whenever there were problems in evaluating property and awarding compensation in the more important streets, this was undertaken by the Senate (31), which ensured that the interests of the new middle class were catered for.

ix) When a landowner gained in terms of space with the new plan, he could not compensate other landowners with property, only with cash (31). This also favoured the new middle class who tended to be wealthy in cash terms whereas the assets of the nobility were mainly held in land.

x) Members of the newly emerging middle class could build in the Pombaline area if they were able to find tenants (31). The Lisbon Senate itself took over some of the reconstruction, selling off buildings to the highest bidder to satisfy creditors, thus preventing the land being occupied by less well-off landowners.

xi) The proprietors were given five years in which to rebuild (31). Where they were unable to do so the property could be immediately acquired and disposed of by the Ministers, giving first option to buy to those with adjoining properties, that is to say those who were in tune with the policy of building fast.

xii) The interest to rebuild the city faster meant a rapid repayment of loans and also ensured that homeless people did not have to move to other parts of the city.
I.13. Summary

This chapter places in context the aim of this work which is to study the Pombaline rentable building, that emerged with the rebuilding of the city of Lisbon, after the 1755 earthquake. The first part, accompanied by a summary of the history of Portugal, gives an overview of the development of the city of Lisbon from its beginnings to the beginning of this century. The earthquake is described in the second part of this chapter which is followed by an outline of the social, enivironmental and political climate which existed subsequent to and during the rebuilding of the centre of Lisbon after the 1755 earthquake. It has indicated how this climate was influenced by and also influenced the rebuilding programme. It includes a description of the first measures taken by the Marquis of Pombal to rebuild the city. It also outlines the proposals, plans and concerns presented by the Royal Engineer to rebuild a new city. The scale of the rebuilding programme was enormous and many of its concepts were new and innovative for that period. The end product, much of which is still in existence today, although in some cases significantly modified, stands as a monument to the Marquis of Pombal who initiated and organised it, to the architects such as Eugénio dos Santos and Carlos Mardel who designed it, and the workmen who constructed it. The origins of the buildings are found in the architecture of previous periods of austerity in Portugal.

At the end of this chapter, it becomes clear how the reconstruction of the city of Lisbon was the principal driving force behind Pombal’s economic and social reforms. Very little work has been carried out on the details of the design and construction of these buildings, the principles behind their construction and the way in which they evolved. The author therefore embarked on a detailed investigation of the buildings and their historical record in relation to the principal aims of the study listed in section 1.1.

Placed in the context of the aim of this work, the next chapter explains the methodology adopted in order to achieve the objectives.
CHAPTER II.
SURVEY AND DOCUMENTARY SEARCH

II.1. Background

In 1962 Professor and Historian, José-Augusto França presented in Paris a thesis entitled "Une Ville des Lumières: La Lisbonne de Pombal". This impressive work describes the reconstruction of Lisbon after the 1755 earthquake by analysing its social, cultural and economic aspects. As in other "Enlightenment" developments in Europe, the Pombaline period is characterized by the predominance of rentable buildings. In this work little is said about the interiors or the construction of its rentable buildings. It was suggested that the rentable buildings were prefabricated but no details of their construction were given to support this suggestion. One main objective of the current study is to confirm or disprove this suggestion. Another aim is to classify the interior plans of the rentable buildings, and establish whether there was any evolutionary development in their layout, construction and ornamental details over the eighty year period during which they were built. This is particularly important, in that over time these buildings are being systematically destroyed. Another aim of this study is to classify the Pombaline rentable building as a style of Portuguese architecture, identifying its characteristics.

The evidence needed to confirm or otherwise the use of pre-fabrication, the existence of an evolutionary development and the definition of the Pombaline rentable building as a style of Portuguese Architecture, should be apparent, both in the details of the style and construction of the buildings and in existing historical documents. A detailed survey was carried out on a large sample of all the buildings and a search was made for historical documents from the period, in order to identify evidence relating to the specific aims of the study.

II.2. Introduction

In chapter I, accompanied by a summary of the History of Portugal is an overview of the development of the city of Lisbon from its beginnings to the 1755 earthquake. The description of the hecatombe was made based on "The Lisbon earthquake of 1755-British Accounts"(17). The first measures to rebuild the city, (taken by the Marquis of Pombal), and the proposals and concerns presented by the Royal Engineer (known as "Dissertations of Manuel da Maia") are kept in the "Livro IV das Intendências do Ministério da Justiça" (31) in Torre do Tombo. These were carefully analysed, in order to understand the procedures adopted during the reconstruction.
To better understand the rentable buildings, the author decided to study their possible origins in the previous and well established periods of architecture. Similarities with the modulated Pombaline façades were found in the simplicity, proportion and repetition of the preceding austere period of architecture, the Architecture "Chã" (1580-1700). Therefore the book, "A Arquitectura Portuguesa Chã" (34) of George Kubler, was consulted for source material.

To achieve the main objectives, the author attempted to discover how the mentors saw the rentable buildings, and to determine exactly how they were built. This formed the basis of the investigation of whether pre-fabrication was used and of how the buildings developed and evolved.

II.3. Definitions

The Pombaline period was dominated by rentable buildings, which are the subject of the current study, for this reason it is necessary to define the concept of the Pombaline rentable building.

The exteriors are defined in the "Dissertations" of Manuel da Maia (see 1.8, Fig.79), whereas the interiors are not defined in any detail.

The "dissertations" suggest that a typical rentable building has a ground floor used for commercial or industrial purposes, with three upper residential floors and one attic floor later used for residential purposes, and these are characterized by a great austerity. At the beginning of this century, in most of the buildings located in the principal streets, two or three residential levels were added. For the purposes of this study, these buildings have been investigated, but their extensions have not, as they are not from the relevant period.

After the definition of the concept of the Pombaline rentable building, it was necessary to define an area for the study. The third part of the Manuel da Maia's "Dissertations" had defined the area to be reconstructed, (see 1.8, Fig.58), but the reconstruction dragged on for many years and was not carried out completely as planned, so the actual limits of the urban area for this study must be clearly defined over the proposed plan for the reconstruction. For this reason an area was selected, which strictly followed the reconstruction plan and does not contain structures that withstood the earthquake. This flat and rectangular area is situated between the Rossio and the Comércio Square, plus a narrow strip of buildings in Arsenal Street, (see Figure 27). In this area all the buildings from before the earthquake had been razed to the ground, giving way to blocks of a regular geometry. For the purpose of this work, the Pombaline public buildings in Comércio Square and churches are excluded. In
addition, transition areas were also defined, where the plans proposed for the streets were not fully respected, or in some cases the plans were just modified by the widening of the streets. These are outside the defined area and are also excluded from the study.

In the area defined for this study (0.24 Km²) (see Glossary, p.viii), usually known as the Pombaline area, there are 53 blocks comprising 400 buildings, of which the interiors of some had been systematically destroyed. Of these buildings, 85 of them are not Pombaline rentable buildings or are radically altered, thus only 315 are considered by the author to have kept their original characteristics. The author has analysed the interiors of 304 of these buildings, (for the purpose of this study the 315 Pombaline buildings are considered to be the total i.e. 100%) containing a total of approximately 1422 flats, (\((170x2+108+26)x3\)). There are 170 (54.0%) buildings with two flats per floor, 108 (34.3%) buildings with one flat per floor, and 26 (8.3%) buildings for which two buildings share one stair (see location in Fig.102). The mansard flats are not considered due to the fact that at the beginning they were not designated as residential accommodation and the disposition of their interiors is irregular.

11.4. Basic knowledge about the buildings

To record and understand the architectural characteristics of these buildings is fundamental to the aims of this study. The exteriors, the elevations imposed and the interiors should reveal the intentions of their designers about compositions or size of components, in relation to a possible prefabrication. The interiors and exteriors should also reveal aspects related to dimensional coordination and possible features which indicate any evolutionary trends over the construction period.

The study of the buildings commenced by recording details of the exterior, (the elevations) because they were immediately visible and accessible and because it was thought there could be relationships between the exteriors and the interiors of the buildings which would help to understand the internal plan and design of the interiors.

At first sight the elevations of the blocks of the area seem to be similar, but on closer observation a certain number of design details, such as French windows, lintels, and mansards, are seen to vary from street to street and in some cases from one building to another. The regularity of the compositions was strictly adhered to in the important streets and squares but in less important streets their distribution seems to be more varied.
Studied area 0.24km²
Number of blocks 53
Number of buildings 400
Pombaline buildings 315 100%
Visited buildings 304 96.5%
Not recorded 11 3.5%
Single 108 34.3%
Left/right 170 54.0%
Asymmetrical 94 29.8%
Symmetrical 32 10.2% 54.0%
Strictly symmetrical 44 14.0%
Sharing stairs 26 8.3%

Fig. 102 - Location of buildings by classification
Knowing that the reconstruction was not done exactly as planned, the author decided to look first for the original drawings of the buildings which supported the text of the dissertations of Manuel da Maia for the reconstruction. This document is kept in the Arquivo Nacional da Torre do Tombo, (Archives where old documents are kept), known as Livro IV das Intendências do Ministério da Justiça(31). The author began the investigation at the Arquivo Histórico Municipal de Lisboa, (Archives of the Municipality), where copies of the original drawings to be consulted exist. The originals are kept in the Museu da Cidade (City Museum) in Lisbon. The elevations specified in these drawings were imposed by the authorities for the reconstruction, and as previously stated, the drawings were published as a catalogue for the exhibition "Lisboa e o Marquês de Pombal", Museu da Cidade de Lisboa, Municipality of Lisbon, 10th November 1982. The catalogue was carefully analysed, and the buildings were selected by streets in order to see which streets the ones in the drawings corresponded to. Also details of the elevations proposed during the initial dissertations were examined. In a small number of cases some drawings showed three floors instead of the standard four floors. Clearly these must have been subsequently abandoned as no buildings with only three floors appear to have been constructed. The intention during this phase of the study was to try to find out exactly what the designers intended to build during the reconstruction. In order to find details of the elevations of all the buildings the following Archives were investigated but nothing was found:

- Biblioteca Nacional, (The National Library), section of Illustrations, Entre-Campos, Lisbon.
- Amigos de Lisboa, (Association of the Friends of Lisbon), Açucar Street, Lisbon.
- Arquivo Histórico do Ministério das Obras Públicas Transportes e Comunicações, (Archive of Ministry of Public Works), Comércio Square, Lisbon.
- Serviço Geral de Obras Arco do Cego, (Local Department of Public Works), Lisbon C.M.L., Arco do Cego, Lisbon.
- Gabinete de Estudos Oisiponenses, Estrada de Benfica, Lisbon.
- Arquivo dos Monumentos Nacionais, (Archive of National Monuments), Comércio Square, Lisbon. In this archive the only drawings found related to the Comercio Square, which is considered to be part of the National Heritage.
- Biblioteca e Museu da cidade de Pombal, (Library and the City Museum of Pombal)

As the designers of the Pombaline buildings were military men the "Arquivo Histórico Militar" (Military Historic Archive), Largo dos Caminhos de Ferro, Lisbon, was consulted, especially the documents of the fifth section (1736-76). Many military documents written by the Marquis of Pombal or the other designers were
found, but the only one relating to the Pombaline area was about the equestrian statue of D. José in the Comércio Square. Having failed in the search to find details of the totality of the elevations, the existing drawings were carefully studied in order to distinguish details and to compare with the existing buildings in order to find out if the plan was followed exactly. This study did in fact suggest that the original drawings were respected during the reconstruction. However it should be noted that the original drawings only cover a part of streets. During all this search not one interior drawing of a Pombaline rentable building was found.

For the study of the elevations the classification proposed by Professor França, in his book "Lisboa Pombalina e o Iluminismo", Bertrand Editora, Lisboa, Dezembro 1983 was adopted. Due to the impossibility of doing a complete survey of the elevations of all buildings, the author confirmed if buildings of each street were in proportion to the original drawings of the catalogue. For that purpose one building of each facade of a block was observed and recorded and the proportions were verified. In fact, they were all found to be in proportion to the original drawings, bearing in mind that all buildings have the same height as the Comércio Square buildings. A standard measuring tape was used to record dimensions. The measurements were taken horizontally on the ground floor and the first floor. The vertical heights of the ground-floor and the openings of the first floor were also confirmed. One by one the streets and buildings were observed and recorded photographically in order to verify the classification. Detection of new details and variations to compositions were noted in order to establish a full record of the buildings and the streets and produce a complete classification.

Also during this part of the study the author tried to confirm if the components and compositions of the façades were modulated or interchangeable.

As far as the interior plans are concerned, the author tried to find original drawings detailing the interiors. It seems that the interior plans were not imposed by the authorities which suggests that the interiors were built according to the requirements of the owners over a period of time. The ground levels, normally occupied by shops and warehouses are mostly identical. For the purposes of the investigation of the interiors, the author concentrated on the upper residential floors, and in particular the layout of the first floor, as well as the access staircases.

In searching for original drawings of the interior of the buildings, the author again investigated the Arquivo Histórico Municipal de Lisboa, Lisboa, (Archives of the Municipality) where exist documents related to the buildings of Lisbon, and then the Archive of the Museu da Cidade, (Lisbon Museum), but without success. The drawings found related only to the exteriors mentioned above, which were mandatory for the reconstruction. Here, the explanation given to the author, for the non existence of any original drawings of the interiors or any written documents about each building, was
because they were not imposed and the later documents containing plans which were produced for clients were destroyed in two extensive fires, (one on 10th June 1821 which destroyed the south side of Comércio Street, between Augusta and Ouro Streets where the public offices were located, and the other on 11th November 1863, in which a fire destroyed the archive of the Municipality building) (48).

Therefore, the above mentioned Archives were investigated again but nothing was found.

Due to the lack of success in finding any original drawings, the author decided to search the archives of the municipality Arquivo do Alto da Eira, Municipality of Lisbon, where documents are kept related to all buildings in Lisbon from the beginning of the century. The existence in these surveys of parts of old buildings are normally a result of alterations to the buildings. Most of the drawings which related to the Pombaline area were of the ground floors, because of the constant alterations of shops. Only a few cases had a complete survey which had to be checked "in situ", because normally the surveys ignored the original layout and only reported the latest alterations.

It was therefore necessary to do a new rigorous and complete survey. Knowing that the plans of the upper residential floors were similar at each level of a building, the author decided to survey only the first floor. If the first floor was inaccessible or modified, the author would then visit the upper floors in order to understand the plan of the first floor, because the walls are aligned vertically. The author decided to visit each building in the defined area and using an infra red device ("Sonytape"), to make a survey on the scale 1/400. The study of the interiors of houses was not easy because of the fears and suspicions of residents, as a result of the climate of insecurity in the area. Due to the vastness of the area, this survey took two years to complete after which almost all the buildings had been visited. A bona fide document with the author's credentials was issued by Escola Superior de Tecnologia, explaining to residents the objectives of the study. This was shown to every visited resident. In many cases it was necessary to visit residents on different occasions, in order to gain access to the interior, and nine buildings were found to be completely closed.

The verandas were not represented because they were registered in the elevations and their representation in the plan, would make the comparison of the interior plans more confused.

The drawings of the plans which the author has made are a unique and valuable historical record of the Pombaline buildings. To appreciate the importance of this survey, it should be noted that there are no existing copies of plans of the Pombaline rentable buildings, and the plans are completely different from one building to another. They are presented in Appendix 5 rather
than as a major chapter in the thesis, because of the quantity and detail of the material. During the survey, numerous notes were made and photographs taken of the internal architectonic details, variations and finishings, but these notes were more related to the finishings rather than the construction details, (see Appendix 3) in order to provide evidence regarding the possible prefabrication of components. It was noted from the variations in the interiors, that there are certain distinct types of stairs, which are classified in III.2, which suggest the existence of a possible evolution of the interior plans (see Chapter V).

During the survey the author also tried to identify the technical innovations introduced in these buildings (see section IV.1) in order to better understand them, in relation to the possible use of pre-fabrication, care being taken to record and observe dimensions, shapes, construction details and finishing details.

II.5. The Pombaline rentable buildings and prefabrication.

During the survey a number of major questions presented themselves to the author. These included the question of why modulated façades were employed, and how the general urban dimensions were established? Also as dimensional coordination was employed, was there interchangeability of components, were standard modules used as basic units and what combinations were created? In addition were there special marks or signs to facilitate assembly, why did the blocks have this or that dimension and how did the buildings relate to the vast Pombaline area as a whole?

Trying to prove the existence of possible prefabrication, the urban plan was first examined. Later the author's survey of buildings made it possible to identify particular innovations introduced by the rentable buildings, which influenced the shape of buildings. The survey also revealed interesting geometrical compositions and the use of a basic repeat unit of measurement exercised in the modulation of the plans, and in the cage structure and the design of the façades. Also the compositions and arrangements of tiles, iron work or masonry and their interchangeability were studied, for suggestions of dimensional coordination and possible prefabrication.

II.5.1. Documentary search

The search for documents was important in providing evidence of whether the components were prefabricated or were just those of a standardized construction process.
The documentary search of pre-fabrication started by analysing the references to prefabrication made by França(2), and the articles by Architect Porfirio Pardal Monteiro (died in 16.12.1957). The author found the following articles in Biblioteca Nacional: Os Portugueses percursores da Arquitectura Moderna e do Urbanismo, (s.d., Porto, Circulo Dr. José Figueiredo (Imp. Moderna Ltd) and Eugénio dos Santos, Percursor do urbanismo e da Arquitectura Moderna, (in Museu, V, nº11, Porto, 1949). These articles emphasise the importance of Pombaline Architecture as prefabricated construction but they were written without making any reference to documentation or factual reference or to any detailed observation or investigation. The author decided to contact the nephew the Architect António Pardal Monteiro to enquire about documents that could support the articles. In the reply (see Appendix 4.6) he said that the articles must have been supported by experimental knowledge of the subject which must have originated from oral tradition passed down by P. Monteiro’s ancestors. In his letter reference was made to Manual do Convento, written by José Saramago, a book which described the construction of a large convent, Convent of Mafra, during the period before the earthquake. However no relevant fact was found relating to the Pombaline area in this book.

In Livro IV das Intendências do Ministério da Justiça (referred to before) references were found to some measures to encourage mass production and stockpiling of building materials and manufactured items, but without evidence of establishing any norms for components.

In order to avoid speculation and scarcity of materials, the decrees of 15th May 1756 and 12th May 1757 make reference to free circulation of building components and to monopolies by some companies to produce building components (see section IV.2.2.). An edict of 29th June 1757 mentioned the existence of a stock which would guarantee the availability of the products but none of the documents mentioned imply pre-fabrication.

In the Arquivo Histórico do Tribunal de Contas, the document "Vários alvarás de criação de novas industrias1757/1829" (a charter about the creation of new industries) was studied but nothing was found.

Professor José Eduardo Capa Horta Correia, in his thesis “Vila Real de Santo António, Urbanismo e poder na política Pombalina(46), mentioned that some materials and components came from Lisbon and some from the North, which implies that some components used in Vila Real were similar to the ones used in Lisbon. His evidence was based mainly on documents of a single building contract held in Faro Notarium (a local government archive in the Algarve). However this is not substantiated and further evidence to support this proposal is not presented. The author tried unsuccessfully to contact Professor Horta Correia in order to ask for further information.
The author also made an exhaustive search in the Archives of Torre do Tombo for building contracts between 1760-1830. Twelve relevant contracts were found, in two huge Notarium Archives. These presented considerable difficulties because the contracts were written in archaic Portuguese with interconnected words and with a difficult calligraphy, (see Appendix 4.5). The author consulted specialists who demanded exhorbitant prices for translation, but without giving guarantees of a successful outcome. The author therefore decided to carry out his own translation over a period of a number of months and this objective was achieved. Some of these provided useful evidence of prefabrication.

II.5.2. Survey

The author's survey of the construction details of buildings included recording all marks, size of components, complexity and variation of the processes of construction, types of wood used, tolerances and forms and shapes which would make the assembly of components simple.

The Pombaline town centre is currently the economic centre of the city, where many companies, especially banks, have sought to establish themselves and have systematically destroyed or altered the interiors of the buildings. Up to now, little or nothing was known about the construction system employed in the buildings, but over the last ten years the author has been present during all instances of the destruction of buildings and has also visited buildings undergoing alterations in the area. The buildings were photographed and highly detailed drawings were made with all the construction details, thus creating a unique record of the construction system employed. It provides a unique opportunity to study the construction details of different buildings, from the foundations upwards. Due to the danger involved in carrying out this study, many documents were required to gain access, and it often proved difficult to obtain authorization to regularly visit the buildings, during the period of complete destruction. This reluctance to allow access was because, in Lisbon, if something of archeological interest is found during demolition on a site, all work has to be interrupted often for many months creating major economic difficulties for the builder. There is also the responsibility of the builder in allowing someone to visit the buildings during their destruction, and in a few cases they did not allow photographs to be taken. Although the destruction of buildings has been somewhat random the range of buildings destroyed has been quite diverse, so it has been possible to obtain a complete picture of the construction system and its variants since it
embraces buildings corresponding to 9 of the 12 categories proposed by the author in Chapter V. It is also possible to understand how certain details of construction are related to an established hierarchy, which with the passing of time and the waning fear of possible earthquakes resulted in changes in the construction details. Small alterations to buildings were also visited and recorded in order to obtain more examples.

The following lists the buildings that were studied during their partial or total destruction:

<table>
<thead>
<tr>
<th>Location</th>
<th>Type*</th>
<th>Total destruction</th>
<th>Partial destruction</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. 9-13, Correeiros Street,</td>
<td>4</td>
<td>x</td>
<td></td>
<td>08.95</td>
</tr>
<tr>
<td>B. 15-23, Correeiros Street,</td>
<td>7</td>
<td>x</td>
<td></td>
<td>08.95</td>
</tr>
<tr>
<td>C. 25-35, Correeiros Street,</td>
<td>3</td>
<td>x</td>
<td></td>
<td>08.95</td>
</tr>
<tr>
<td>D. 76-84, Augusta Street,</td>
<td>12</td>
<td>x</td>
<td></td>
<td>08.95</td>
</tr>
<tr>
<td>E. 86-94, Augusta Street,</td>
<td>8</td>
<td>x</td>
<td></td>
<td>08.95</td>
</tr>
<tr>
<td>F. 50-54, Ouro Street,</td>
<td>5</td>
<td>x</td>
<td></td>
<td>89</td>
</tr>
<tr>
<td>G. 56-60, Ouro Street,</td>
<td>9</td>
<td>x</td>
<td></td>
<td>89</td>
</tr>
<tr>
<td>H. 185-195, Douradores Street,</td>
<td>6</td>
<td>x</td>
<td></td>
<td>90</td>
</tr>
<tr>
<td>I. 85-91, Prata Street,</td>
<td>9</td>
<td>x</td>
<td></td>
<td>94</td>
</tr>
<tr>
<td>J. 2-8, Santa Justa Street,</td>
<td>11</td>
<td>x</td>
<td></td>
<td>93</td>
</tr>
<tr>
<td>K. 51, São Nicolau Street,</td>
<td>5</td>
<td>x</td>
<td></td>
<td>93</td>
</tr>
<tr>
<td>L. 75, Conceição Street,</td>
<td>9</td>
<td>x</td>
<td></td>
<td>89</td>
</tr>
<tr>
<td>M. 110, São Julião Street,</td>
<td>5</td>
<td>x</td>
<td></td>
<td>89</td>
</tr>
<tr>
<td>N. 185, Prata Street,</td>
<td>5</td>
<td>x</td>
<td></td>
<td>90</td>
</tr>
<tr>
<td>O. 107-111, Correeiros Street</td>
<td>9</td>
<td>x</td>
<td></td>
<td>90</td>
</tr>
<tr>
<td>P. 69, Ouro Street</td>
<td>3</td>
<td>x</td>
<td></td>
<td>90</td>
</tr>
<tr>
<td>Q. 179, Correeiros Street</td>
<td>7</td>
<td>x</td>
<td></td>
<td>95</td>
</tr>
<tr>
<td>R. 141, Augusta Street</td>
<td>4</td>
<td>x</td>
<td></td>
<td>96</td>
</tr>
<tr>
<td>S. 84, Sapateiros Street</td>
<td>8</td>
<td>x</td>
<td></td>
<td>96</td>
</tr>
</tbody>
</table>

* (see section V.2)

A complete description of the interior of these buildings was produced (see Appendix 3).

The importance of this survey cannot be overestimated due to the fact that the interiors of some buildings have now disappeared for ever without any other institution having made any record of the details. Some interiors had been changed during small maintenance jobs which normally involved alterations to kitchen and stairs to introduce lifts, or just removal of tiles for economic reasons.

Unfortunately no marks which could give an indication of the source of the components and their method of fabrication, resulting from fitting or identification of components, were found on any of the components examined.

A study of the individual elements of the buildings which gave them stability, was also carried out, which helped to provide a better understanding of the reasons behind some of the assigns (for example the composition of the spaces in a façade) or structural forms (for example the geometry of the "cage" or of the vaults), (see Appendix 6).
II.6. The Pombaline rentable buildings and their evolution.

The analysis of the interior of buildings during the survey revealed the existence of certain types of stairs which, when compared, suggested the existence of a possible evolution of the interiors. Due to the vast number of buildings, the author decided to study only plans of buildings with two flats per floor rather than one flat per floor. This had the advantage that in the case of two flats per floor it would be easy to identify any later alteration of the interior partitions.

After developing a classification that appeared to represent phases in an evolutionary sequence it was necessary to establish the dates when particular buildings and streets were constructed in order to verify this sequence. However, as already indicated, it is impossible to determine the precise date of construction of the buildings as the archives where the documents were kept (Archive in Comércio Square), were destroyed by two extensive fires. Descriptions by foreign residents were also studied but comparing the information carefully, revealed them to be contradictory and unreliable (see Appendix 4.3) in addition to the fact that most of the descriptions are incomplete and are of little relevance.

In the Biblioteca National a book by Luis Pastor de Macedo, "A Baixa Pombalina" was found, which gives some numbers for the reconstruction of buildings but unfortunately without any reference to particular buildings.

It was therefore decided to carry out a search of the Archives of Tribunal de Contas, where there was a collection of the tax register "Decima da Cidade de Lisboa e o seu Termo, 1760-1840, (Register of Tax Collection between 1760 to 1840), not published, and belonging to the Arquivo Histórico do Tribunal de Contas, serial volumes 0302 (streets), Lisbon). Unfortunately this collection is written in archaic Portuguese, is very detailed and includes registers of tax paid by people living in single rooms. It was compiled in separate volumes covering the different Parishes, in which in some cases parts of a single street belong to different parishes. Therefore due to the associated difficulties in extracting documentation from the archive information, it was decided to do the survey only at intervals of approximately 10 years, between 1760 (when work began) up to 1830 (when most of the streets had been completed, a fact confirmed later in the data from this Archive), and also to include one main street (Augusta Street), half each of two secondary streets (Sapateiros Street and Correeiros Street), and half each of two transverse streets (Conceição Street and S. Julião Street). The number of the buildings in existence in each selected period was determined as well as the names of the owners, but it was not possible to locate the exact buildings, as the order of the register has no relation to the order of numbering of the buildings in their location in the streets. The tax register was compiled in order to
record payment by people living in the buildings rather than the owners of the buildings (i.e., these people must have been known to the authorities of each parish). Corner buildings presented a further problem because the external facades were on two streets and these streets or part of them may have been in two different parishes. Thus the number of buildings from the tax register was greater than the true number. For example, in 1790, Augusta Street had 71 buildings listed and later only 51. Although individual buildings could not be identified comparisons were made between the numbers found in the archives during each period and the number that actually existed on final completion of the construction programme. This gave a general picture of the progress of rebuilding different streets, and revealed that the major period of reconstruction was between 1760 and 1830.

A colour coded plan of the Pombaline area was produced by the author (see Fig. 305) in order to see if the phases proposed by the author could be correlated with the chronology of the reconstruction and with their distribution inside of blocks, and their location, size and shape.

Historical factors were analysed in order to determine whether historical events could have interfered with the possible evolution of the buildings. Also, finishing details of buildings belonging to the different phases were compared in order to detect variations or similarities which would have supported an evolutionary sequence.

In order to obtain more information about possible pre-fabrication, the author, using the names of the owners of the buildings from the tax collection records, attempted to find building contracts in the Archives of Notarial Documents of Torre do Tombo. Some were in fact found, but unfortunately they were not related to the Pombaline buildings.

II.7. Investigations of other contemporary "Pombaline" developments within Portugal

In his book Lisboa Pombalina e o Iluminismo, França mentioned the existence of other "Pombaline" developments in Portugal, at Vila Real de Santo António in Algarve, at Porto Côvo in Alentejo, at Manique do Intendente North of Lisbon, and in a part of the city of Oporto, Porto dos Almadas. Although the subject of this work is not Portuguese "Pombaline" developments in general but is about the rentable buildings in the Pombaline quarter of Lisbon, it is useful to examine other contemporary developments for which the constraints and priorities imposed by the earthquake were absent. These developments were chosen. The first was Vila Real, the second a much smaller development Porto Côvo and the third Manique do Intendente.
Vila Real of Santo António is described in the thesis of Professor José Eduardo Capa Horta Correia, "Vila Real de Santo António, Urbanismo e poder na política Pombalina", presented in Universidade Nova de Lisboa in 1984. This work contains much historical background information and also detailed information about the architecture of the buildings. After reading the mentioned work the author made many visits to Vila Real particularly to sites where alterations to buildings were being carried out which allowed details of the construction system to be obtained, making it possible to compare this with the Pombaline rentable buildings in Lisbon.

The author also searched for references to Porto Côvo in Arquivo da Torre do Tombo and Biblioteca National. The ones found were: Arquitectura Popular Portuguesa, Porto Côvo, 3rd edition, vol.3, p.156, Associação dos Arquitectos Portugueses, Lisboa 1988. and in Municipality of Sines Porto Côvo, Gabinete de Informação, Câmara Municipal de Sines, n. d.. The references described a possible initial plan attributed to António Martim Quaresma, but this was completely different from the actual existing buildings. The Author had therefore to make a complete survey of the buildings, including the architecture and the form of construction.

It appears to be generally accepted by architectural historians (6) in Portugal that Pombal’s Superintendent of Police (a hated and feared man) Pina Manique owned land in Manique do Intendente and developed that land probably towards the end of the development of the Pombaline rentable buildings. It might therefore be expected that similarities would exist between these later developments. In the search of archive material the author was able to find only one document relating to the development of Manique do Intendente. This was Azambuja, Manique do Intendente, published by Pelouro do Turismo, Câmara Municipal da Azambuja.

II.8-Summary

This chapter has outlined the approaches adopted and has described the methods and techniques employed, to achieve the major objectives of this study. This has involved a detailed survey of the architectural and constructional details of the majority of the buildings in the Pombaline quarter of Lisbon.

The survey has recorded in the form of photographs, drawings, numerical data and written observations a comprehensive description of the buildings for further analysis. It has in addition included an extensive search of historical archives and has attempted the interpretation, and also is some cases the translation of a wide range of historical documents relating to the Pombaline buildings.
From the information obtained the next chapter identifies the origins of Pombaline architecture, and defines the architectural characteristics of the Pombaline rentable buildings.

To investigate the origins of the composition of the façades created and imposed by the designers of the reconstruction, it is necessary to compare the architecture and style of the Pombaline buildings with those of previous periods of Portuguese architecture taking into account the prevailing economic situation in the country.

The study of the architectural characteristics begins with an analysis of the imposed elevations and the existing elevations in terms of their details. From an existing classification a more complete classification is proposed. This analysis is important in determining the degree of standardization of the elevations and its influence on the variation of interior plans.

Also care is taken to describe the interiors of most of the buildings and identify aspects which influence and control the distribution and layout of the interiors such as dimensions, interior lighting and the sharing of staircases. The designation of particular typologies enables a classification system to be developed for the interiors of the rentable buildings.
CHAPTER III-GENERAL ARCHITECTURAL CHARACTERISTICS OF THE POMBALINE RENTABLE BUILDING

III.1. The exterior of the buildings.

As previously established the architectural style of the rentable building referred to as "Pombaline", grew out of the need to house rapidly a large population and to reconstruct the city quickly. It is characterised generically by its economy of style, its solidity, its regularity and its simplicity, (2)(see Fig.103).

The Pombaline rentable buildings comprise 448x3 flats, contained within 315 units (buildings) grouped into 53 blocks, located in the Pombaline reconstruction area as defined in 1.4.2.. Each rentable building has a commercial ground floor and three residential floors. For the purpose of this study buildings are also included with later extensions in height, (see Fig.103b)

The Pombaline rentable building has very specific characteristics in both the exterior and the interior form as well as in the system of construction, although many buildings have been modified over time. In addition outside the "Baixa Pombalina", whenever the building type was repeated in new urban areas, it was adapted and at times some of its characteristics were altered or even eliminated. However, all subsequent drawings by the author attempt to show the buildings as originally built, and ignore later alterations.
França has indicated number 2, Avenida 24 de Julho as a representative type for the Pombaline rentable building, (2) (see Fig. 104).

From the outside one is not able to identify specific rentable buildings as they do not appear as individual entities but rather as blocks defined by continuous austere façades with small variations according to the importance of the streets, often making it difficult to tell where one building starts and another ends. (4)

There are no decorative or even utilitarian appendages since, for safety reasons, the License of June 16th 1759 forbade them; steps, misulas (stone ledges) for plant pots, gelosias (shutters) and even rings in the walls to tie horses to were all forbidden (see Fig. 105).

In the Pombaline rentable buildings the design of the façades follows a rigid scheme. Visual enrichment or conversely impoverishment of the façades is limited to variation in small details. The variations in the façades do not occur in individual buildings or blocks but according to the “hierarchy” or relative importance of the streets.

The design of the façades in the principal streets is more elaborate than that seen in the secondary and side streets.
The rectangular blocks generally run north-south and define both main and secondary streets running in that direction. The ends of the blocks which normally comprise two buildings (occasionally one) define the transverse street. The facades of these buildings sometimes adopt the facade of the main street and sometime adopt the facade of the secondary street. If there are two end buildings adjoining a main and secondary street the one on the main street adopts the facade of the main street and the one on the secondary street adopts the facade of the secondary street. If however there is a single end building it can adopt either facade, (see Fig.106). The survey carried out by the author identified a number of general characteristics which define the exteriors of the rentable buildings. These are:

i) A scheme for the façade, including four composite levels beneath a cornice, which is of the same height as that of the buildings in the Comércio Square, (see Fig. 107).

Fig.107-Partial elevation of Ouro Street

ii) A cornice which runs all the way around the buildings and which, above the pilasters forms a small capital. The joint between cornices of different buildings in a level street is perfect.

iii) The corners of the blocks are decorated with stonework pilasters, (see Fig.108).

Fig.108-The corners of the blocks

Fig.109-a, vaos ; b, nembos

Fig.110-The perfect alignment of the masonry.
iv) With the exception of the ground floor, there is perfect alignment of the masonry both horizontally and vertically, (see Fig. 110).

v) The width of the vaös, (window spaces), on the higher levels is the same as that of the nembos, (space between windows), (see Fig. 109).

vi) There is an attic storey, set back from the others above the cornices which, in the main streets and squares takes the form of a mansard roof, while elsewhere it takes the form of a hipped roof, (see Fig. 111 and 112).

vii) The hipped and mansard roofs have dormer windows set back from the face of the wall with small hipped roofs over them.

Fig. 111-Mansard roof

Fig. 112-Hipped roof

viii) On the third floor the windows have waist-level sills and in the main streets they have arched lintels with small decorative keystones, (see Fig. 113).

Fig. 113-Typical elements (windows) for second and third floor.

ix) On the first floor in the main streets there are french windows, with iron balustrades, whereas in the secondary streets the windows all have waist-level sills, (see Fig. 114).

Fig. 114-Typical elements (windows) for first floor.
x) At ground floor level the vaño (window space) is wider than at higher levels and this floor is normally higher than the rest, sometimes including a sobreloja, (mezzanine level); in these cases the ground floor and mezzanine level openings are combined into a single element, (see Fig. 115 and 116).

![Fig.115-Typical elements (windows) for ground floor 1.](image1)

![Fig.116-Typical elements (windows) for ground floor 2.](image2)

xi) The ground floors show fewer similarities but rather multiple variations in order to adapt the buildings to the changes in the gradient of the streets, (see Fig. 117). The maximum gradient of the streets is 14°. The changes of properties occurred between windows and perpendicular to façades.

xii) Above the rooftops the party walls are taken up as parapets to form fire barriers, which are the only real indication of the limits of the property or building, (see Fig. 118).

xiii) The original colour of the façades was ochre.
The different types of façades in the Pombaline area form a hierarchic system in which five types have been identified by the author, each type with its own specific façade design. There were also some isolated examples of different designs which can be described as hybrids. Examples of the five types and their characteristics are listed below.

Type 1 - Important streets and squares, (Arsenal Street, Corpo de Deus Square, Rossio Square and Municipio Square), (see Fig. 119 and 120).

The main characteristic of type 1 is the existence of a straight pediment with the appearance of a corbel on the upper parts of the lintels of the first floor windows.

Other characteristics are:

i) A stone string course connecting all the pediments. This string course is never seen in a secondary street, being exclusive to the main streets or those of greater importance. It seems it served as a point of reference on dark nights.
ii) All the first floor windows are french windows connected by a narrow band in stone, (except in Rossio Square where the french windows alternate with normal ones).

iii) The lintels and the jamb stones of the french and normal windows have decorative shaped cuts.

iv) In the normal windows the jamb stones project below sill level, simulating props.

v) The lintels on the third floor windows are embellished with a key stone and their soffits are curved.

vi) Above each window on the third floor the lower part of the cornice projects, forming a capital.

vii) In Arsenal Street the portals at ground level have polygonal decorative panels in the upper part.

viii) The roof is a mansard shape, except in the Municipio Square.

Type 2 - Main streets, (Augusta, Ouro, Prata and Comércio Streets), (see Fig. 121 and 122).

The composition is very similar to that of type 1, with the exception of the following features:

i) The straight pediments disappear, however the string course which normally would connect them remains as if to mark the line of the second floor.

ii) In this type the roofs are not the mansard type.
iii) The dormer windows have small scrolls on either side.
iv) On the ground level the portals may or may not have panels in the upper part.

Fig. 121-Type 2 façade
Fig. 122-Type 2 façade, with a variation on the ground floor where the portals have panels

Type 3 - Main square and principal alleys, (Figueira Square, Comércio and São Nicolau Streets), (see examples Fig. 123, 124 and 125).

The composition is significantly simpler than type 1:

i) The first floor windows have normal height sills.

ii) The pattern of the dormer windows can be continuous or alternate.

iii) The dormer windows have a small balcony guarded by a low parapet.

iv) The stone string course at first floor window head level exists only in Figueira Square.

Fig. 123- Type 3 façade-1
Fig. 124- Type 3 façade-2
Fig. 125- Type 3 façade-3
Type 4 - Secondary streets of some importance, (*Fanqueiros and Madalena Streets*), (see Fig. 126 and 127).

![Fig.126-Type 4 façade](image)

![Fig.127-Variation of type 4 façade](image)

In this type the composition is even simpler.

i) The lintels are rectangular except for the soffits on the ground and third floors.

ii) The first floor windows are still french windows with or without a connecting band in stone.

iii) There is no stone string course at the higher level.

iv) The keystones also disappear in most of the cases, as do the scrolls on the dormer windows.

v) There is no projection of the cornice above the third floor windows.

Type 5 - Less important secondary streets, (*Sapateiros, Correeiros, Crucifixo, Douradores and Nova de São Domingos Streets*), (see Fig. 128, 129, 130, 131, 132 and 133, on next page).

In this type of composition the fitting of the windows is clearly more utilitarian and also less disciplined. This is characterized by:

i) The lower edge of the lintels over the third floor windows is no longer curved.

ii) The jamb stones no longer project below the sills.

iii) In some cases the first floor windows are not french windows but normal ones. In other cases there are french windows on the second level (continuous or alternating).

iv) In *Douradores* Street in most cases the ground floors incorporate a mezzanine level.
Type 6 - Hybrid alleys of little importance, (Santa Justa, Vitória and São Nicolau Streets), (see Fig. 134, 135 and 136).

The composition shows no rigid discipline, since the alleys in question are defined by the narrow ends of the blocks, the composition varying in accordance with the streets which cross the alleys.
These six types with their minor variations appear to be consistent without any significant deviation, for all of the Pombaline buildings. This suggests that the exterior design of buildings was rigidly imposed throughout the whole construction period (1760-1830), fully complying with the hierarchy of streets and squares. On the other hand, it would appear that the interiors of the buildings were in part constructed to each owner’s requirements over the full construction period. Therefore in this case it is possible to identify substantial variations in style, decoration and planform and hence to define possible evolutionary sequences which may have arisen in the form of interior construction and finish.

Therefore details of the interiors of the 304 buildings selected for this study were carefully recorded.

The next two sections give a general overview of the interior design and plan of these buildings, and of the form of decoration present within them.
III.2 The interior of the buildings

III.2.1. Individual features at different levels.

The interior of the rentable building, like its exterior, is quite simple, (see Fig.137) with finishings extremely austere.
The interior at ground floor level which is occupied by shops is basically a succession of spaces paved with heavy square flagstones, that may be covered by quadripartite vaults, (used in the past as stables on the transverse streets, see Fig.138) or arches and beams (see Fig.139) or just beams (see Fig.140), supported by thick walls and pillars.

Access to the upper levels, (exclusively residential) is through an entrance, normally placed in the centre of the façade, which leads into a narrow, dark hallway (Fig.141). Normally behind the entrance door existed a cupboard that opened to allow the area to be used as a small shop, (Fig.142).

The first flight of stairs was usually of stone. The stairs, normally positioned in the middle of the building, are narrow with two flights separated by a half-landing. There are different types of stairs, the most simple ones climb alongside a wall, or alongside a "solid" balustrade which continues through the height of the staircase and forms a wall, but with breaks above hand rail height and below the soffit of the next landing. Others are adjacent to an open space (see Fig.143, 144, 145 and 146). The balustrades can be smooth-finished wood or modulated iron work, (Fig.147 and 148). They can also be decorated with tile dados (see Fig.149).
Some buildings have elaborate stairs without half-landings, (Fig.150 and 151). The first floor landing serves two flats, (each flat with one or two entrances). This is a common arrangement in Lisbon and the flats are normally designated esquerdo/direito, (left/right) and in most cases are symmetrical, (see Fig.152, 153 and 154).
The interior arrangement of the flats is very basic. The most important rooms, (dining and living rooms) always face the street, so they are well-lit and airy, (Fig. 156). They can also be decorated with tile dados. The kitchens, on the other hand are very simple without decoration, (see Fig. 155), and always have windows facing the interior space of the block, the "alfugere" or inner courtyard.

There were no separate toilets, a small basin used for the purpose always being situated in one of the kitchen corners, (see Fig. 157, 158 and 159).
Cupboards, when present, are crude and the tiling on the walls continues behind them, (see Fig. 160, 161 and 162).

The kitchens are always dominated by an enormous fireplace, with walls on either side and a hearth stone placed between them, (see Fig. 163, 164 and 165). In some cases the interiors of fireplaces were covered with tiles. The location of the fireplace is always near the façade but varies from one flat to another (see Fig. 166). In some buildings there are separate flues for each flat, (see Fig. 167).
Between the front rooms and the kitchens, always there are numerous inner rooms without direct light or ventilation, positioned in a rigidly modulated way. These compartments have no independent access via corridors, (see Fig.168). Instead there are numerous interconnecting doors,(see Fig.169), which result in much space being needed for circulation through the inner rooms.

Because the lower flats have excessively high ceilings, especially at first floor level, the doors have large fanlights which allow some light to enter the inner rooms (Fig.169).

Interior decoration when present is limited to small, tiled dados, (Fig.170). The floors are always made of soft pine boards and the ceilings are of unpainted wooden boards with cover strips at the joints (Fig.171), or just wood laths covered with plaster.
The front doors are panelled, the interior doors are simpler. Originally the windows were the vertical slide sash type, (Fig. 172).

On the upper levels the ceilings become lower, (Fig. 173, 174, 175, 176 and 177), with finishings of poor quality, taking on a rustic style especially in the attics.

![Fig. 172-A sash window](image1)

![Fig. 173-On the top landing of the stairs, the windows are lower](image2)

![174-On the top floor the entrance is immediately at the top of the stairs](image3)

There, the living conditions are poorer due to the small number of windows and the irregular ceilings.

![Fig. 175-A rooflight over a kitchen](image4)

![Fig. 176-The entrance to an attic flat.](image5)

![Fig. 177-A room in an attic flat.](image6)

Although there is considerable variability in the features discussed in this section, the principal features and their variations have been presented.
III.2.2. Details of the plans of some of the rentable buildings.

The Pombaline rentable buildings never emerged as isolated units but were always grouped into blocks (mainly rectangular), which besides reinforcing the composition effect and making better use of the land, also gave them greater structural stability. Today many buildings have been altered, (in height, for example), diluting the unity of the design.

Drawings of a complete block which illustrate typical interior structures in relation to the external façade for these buildings are presented in the next pages (Fig.178, 179, 180, 181, 182 and 183) and a survey of the first floor of further blocks is included as Appendix number 5. In the original buildings the plan layout of the first, second and third floors was usually the same or similar.

Fig.178-Plan of a complete block.
Block: Conceição, S. Julião, Prata and Augusta Streets

Fig.179-Elevation of the block, S. Julião Street
Note: This and the following elevations are shown with the ground, first, second and third floors as originally built but with later extensions at fourth and higher floor levels.
Later extension

Fig. 180 - Elevation of the block, Augusta Street.

Later extension

Fig. 181 - Elevation of the block, Prata Street.

Later extension

Fig. 182 - Elevation of the block, Conceição Street.
The internal subdivision of the buildings varies from building to building because the area proportion and position of each building in the blocks is different and also because the reconstruction process took a long time. To better understand the internal arrangement it is necessary to identify the factors that may have determined it. The factors investigated are: the classification of buildings by their stairways, the design of the stairs, and the interior areas of the flats, and their access to natural light.

### III.2.3. The classification of buildings by their stairways.

All the Pombaline rentable buildings can be classified as either "left/right", (Fig. 184), (two flats to a staircase on each level) or "single" (one flat to a staircase on each level), (Fig. 185). The former are far more common, and represent 54.0% of the total whereas the latter represent only 34.3%. This tendency for the former is explained by the fact that one stairway serving two flats per floor is more economical to construct as well as saving space, (see location of buildings on Fig. 102).
The "left/right" layout can be asymmetrical as in Figure 186 or asymmetrical but with a central staircase as in Figure 187 (both combined represent 29.8% of the total number of buildings), almost symmetrical as in Figure 188 (which represents 10.2%), or strictly symmetrical as in Figure 189 (which represents 14.0%).

Fig. 186-Example of asymmetrical layout.

Fig. 187-Example of asymmetrical layout but with central staircase.

Fig. 188-Example of almost symmetrical layout but with central staircase (all the space in front or behind the stairs belonging to only one of the apartments).

The corner buildings of the "left/right" standard type have asymmetrical flats. The flat which is on a corner has two façades facing the street, which means that there is a greater number of windows and this allows for a different arrangement of spaces. Normally this type of flat has a greater area than the other, (see Fig.190).

Fig. 189-Example of strictly symmetrical layout.

Fig. 190-A corner "left/right" layout.
The construction of strictly symmetrical flats is rather difficult; the central wall on the axis of the stairs is supported only by the floor over the entrance hall on the ground floor. This situation was dealt with in two rather ingenious ways, (see Fig. 191): One solution was to place the stairway next to the street façade, (Fig. 192), and the second was to create an entrance corridor with an offset towards one of the sides, (Fig. 193).

There are in some cases pairs of buildings which share the same stairs, and for these cases two forms of design are prevalent. They represent only 8.3% of buildings and it is assumed that in these cases this was sometimes done for reasons of economy. In the first case the stairway is built entirely on the inside of one of the properties and the thicker of the two adjoining walls forms the party wall. (Fig. 194). In the second case the stairway is built on the axis of the party wall, (Fig. 195).
Fig. 194 - Examples of a stairway built inside one of the properties

Fig. 195 - Example of a stairway built on the axis of the party wall

III.2.4. The design of the stairs

The stairs themselves can be divided into seven different types. Type number one which is the most common, has stairs which climb alongside a central "solid" balustrade, with two flights and a half landing between each level, (see Fig. 196).

Fig. 196 - Example of type number one stairway, (plan, section and perspective)
In type number two the stairway is constructed with principal sections occupying most of the height between floors and smaller sections of limited depth giving access to the flats, (see Fig.197).

Fig.197-Example of type number two stairway, (plan, section and perspective)

In type number three the principal stairway is similar to type number one but alternate landings have a secondary stairway which provides independent access to the kitchen, (see Fig.198).

Fig.198-Example of type number three stairway, (plan, section and perspective)

In building at the ends of the blocks there is normally a small flight of stairs from the ground level to link with the main stairway, (see Fig.199).

Fig.199-Example of type number four stairway, (plan, section and perspective)
In type number five the stairway runs next to the street façade and there is a single flight of twenty steps to reach the next level, (see Fig. 200).

In type number six the stairway begins directly inside the entrance to the building with one single flight up to the first floor after which it continues in the same direction until reaching the alfugere façade, (see Fig. 201).

In type number seven, the stairway is normally located in the middle of the building and climbs around an open newel with two flights and a half landing between each level, (see Figure 202)
III.2.5. The interior areas of the flats, and their access to natural light.

Due to the wide variation in the dimensions of the buildings, the number of windows per building varies substantially ranging from two to eight windows facing onto the street, (see Fig.203).

As shown in Table III.1 most of the "single" flats have three or four windows, and most of the "left/right" flats have five or six windows and always more than four windows.

Table III.1 Percent of a specific building type having a given number of external windows, as a percentage of the total number of buildings. (Corner buildings and buildings belonging to narrow blocks, as the case of n.1, which represent 140 buildings (42%), are not included due to their unique situation. The 42% and the 56.6% of Table III.1 make approx.100%).

<table>
<thead>
<tr>
<th>Number of windows (to street)</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left/right type flat %</td>
<td>0</td>
<td>0</td>
<td>3.5</td>
<td>9.2</td>
<td>8.6</td>
<td>5.4</td>
<td>1.5</td>
<td>0.6</td>
<td>28.8</td>
</tr>
<tr>
<td>Single type flat %</td>
<td>3.5</td>
<td>11.4</td>
<td>6.3</td>
<td>4.1</td>
<td>2.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>27.8</td>
</tr>
</tbody>
</table>

Flats are normally built three rooms deep from front to back. The rooms adjacent to the street and the alfugere have natural daylight, whereas the rooms located in the middle are the unlit areas which occupy as much as 18.5% of the habitable area for the two flats. Below (Fig.204) are illustrated two examples of corner buildings each with a corner flat and an intermediate or linked flat (the former tending to be different from the flats in intermediate buildings). Corner flats in spite of having more windows also have proportionately more unlit interior areas than the other flats.
Two different approaches were employed to overcome the problem with lighting in the end flats. The first, which constitutes 3.1% of buildings, was to extend the alfugere (courtyard) into the corner flat, (see Fig.205). The second, which constitutes 10.8% of buildings, was to provide a separate lightwell, (see Fig.206).
The creation of a separate lightwell appears to have been necessary in the following situations:

i) When flats at the end of a block are too big, (Fig. 207).

ii) When two different buildings are joined reducing the alfugere of the block, (Fig. 208).

iii) When flats extend from one side of a block to the other, this situation occurs for narrow blocks, (Fig. 209).

iv) When the apartments are situated in the corner of the block and the small area is not able to have a common alfugere, (Fig. 210).

Fig. 207-Separate alfugere in the end of block

Fig. 208-Two opposite buildings when joined

Fig. 209-Example of a narrow block illustrating the "left/right" case (left) and the "single" case (right).
III.3. Summary

The present chapter has examined the architectural characteristics of the Pombaline rentable buildings, firstly describing and classifying the exteriors and then describing and classifying the interiors. After a careful analysis of the exteriors, and the details and different compositions of the façades, a complete classification has been proposed from which it is concluded that the exteriors of the buildings were rigidly imposed during the whole construction period (1760-1830) with minor deviations. The interiors of the buildings are however diverse. In order to understand the internal arrangement, a number of factors which probably influenced and conditioned the interior plan layouts and disposition have been identified and analysed.

It is possible to classify the buildings in a number of ways which include the type of stairway, the number of windows, and the disposition and location of each building within a block. Of these three classifications, the type of stairway, which is less restricted by external constraints than the other two, clearly has a significant influence on the definition of the interiors and could be related to a possible evolution.

In conclusion there appears to be no relation between the different types of interiors and the six different classifications of types of exterior. Although the different types of exterior were clearly imposed, with respect to the locations of the buildings, the interiors which have a great variation seem not to be conditioned by location, position or size.

Before studying their possible evolution the next chapter describes the technical innovations and the health and safety measures incorporated within the design and construction of the buildings and discusses the evidence that dimensional co-ordination and prefabrication strongly conditioned the form of buildings produced.
The author analyses the layout of the streets, the composition of the façades of the buildings and the internal plans and identifies underlying geometrical relationships and presents evidence and argues the case for dimensional coordination and for prefabrication of components.
CHAPTER IV-TECHNICAL INNOVATIONS

In the past, in periods of relative stability cities have evolved by gradual adaptation to change, and building systems have developed in an empirical manner. The 1755 earthquake produced immediate devastation and a period of very rapid change which demanded innovation and instantaneous response in order to meet the enormous challenges and ensure survival in the event of another serious earthquake.

What was required was large scale rapid construction to restore the area to the successful commercial centre which it had been. However, coupled with this was the need to construct buildings which would resist any future earth movements and would avoid some of the worst features of the previous buildings with respect to safety and hygiene. These undesirable features had compounded the problems caused by the earthquake, with respect to fire, access, injury and subsequent disease and illness.

Some of the principles adopted to ensure safety, such as symmetry and simplicity, coincided with the need for rationalisation demanded by the scarcity of resources. In addition the need for rapid reconstruction of the city was satisfied by innovations in standardisation of construction and by the pre-fabrication of many components.

IV.1 Health and safety measures

The reconstruction of the new city started with a remarkable feat of engineering. What remained of the old city was razed to the ground, creating a raised platform above the water level with the rubble. This reduced the likelihood of flooding by rising tides and also reclaimed some of the land from the river, (Fig.211) (2).

A sewage system was built, which not only removed domestic waste that could inundate the land thus increasing its instability, but also drained away all the water from the neighbouring hillsides (Fig.212) (20).
The plan adopted for the reconstruction achieved an interesting balance between safety and functional demands in an area of intense economic activity.

According to descriptions, during the earthquake the tremors were predominantly oriented in the longitudinal direction of the creek. Therefore in the new plan, care was taken to line up the blocks in this direction so that they would be better able to withstand any tremors. The only exception was that of the very important, old "Rua dos Ferros", next to the Praça do Comércio, which remained unchanged, (Fig.213)\(^2\), possibly due to its particular historical significance.

The orientation of the blocks also created a clear link between the two main squares to make it easy for people to escape in case of disaster. Also to improve safety, the streets were widened and had separate zones for horses and for people on foot with handcarts (2, 22).

The buildings were grouped together in rectangular blocks which increased their stability. The cornerstones were solidly built in stone with the windows placed at a fixed distance from them, (Fig.214).
In order to guarantee the necessary ventilation and lighting for the buildings, the maximum height of each building was equal to the width of the main street and all the blocks had a courtyard (*alfugere*) which allowed people to be rescued in the event of disaster. Rubbish was also deposited in the *alfugere* rather than in the streets (2).

As discussed in the previous chapter the façades were carefully defined, simple and repetitive. No obstacles such as steps, flower beds, or any other decorative or utilitarian element was allowed, so that in case of disaster there would be nothing to impede the inhabitants in escaping. Also verandahs were only allowed on the first floor in the main streets and squares (2, 22).

Most of the building units had the stairway placed over the axis, which as well as increasing the stability of the building in terms of torsion, also made them more economical. This is because it allowed owners to share the same stair, consolidating a typology which is still today that most commonly seen in Portugal, that of two homes per level, (Fig.215).

The plans of the different levels were always divided into three parallel sections, two next to the façades and one in the interior. The partition walls were highly flexible (constructed of lath and plaster), which was safer than solid walls, in the event of a tremor, (Fig.216).
The spaces in the façades were composed to achieve a perfect balance of forces, (Fig. 217). The stonework around the spaces was designed with shapes that adapted perfectly to the tensions within the façade. Also it was tied to the structure of the building and thus, stone elements would not be projected onto the street below in the event of a minor tremor (Fig. 218), although in a major tremor it would allow release of the walls from the structural cage.

The roofs of the different buildings had to be at the same height and were separated by fire walls, making it difficult for fire to spread from one building to another, (Fig. 219A) (49). Care was also taken to separate the buildings from one another with thick walls, and no openings whatsoever were allowed to be made there, (Fig. 219M).

To guarantee the stability of the buildings on unstable land, an ingenious system using stakes was built, (Fig. 219B). It has been possible for the author to study and record details of the foundations and the superstructure, because over the last ten years nineteen of the buildings have either been partially or totally destroyed (see section II.5.2.) to make way for more modern new buildings. In the event of an earthquake, the system of solid arches (Fig. 219C) sitting on the timber rafts which are themselves supported by a distribution of short timber "piles" about 1.5 metres in length (see Figure 219B), would allow movement but would prevent the foundations from collapsing (50).
The ground level was usually covered by vaults (Fig.219D) resting on thick stone walls and pillars, so that if there were a fire at shop level this would not spread to the apartments above. The stones in the pillars were carefully worked so that these would fit exactly into one another. Care was also taken to isolate the hall leading to the stairs, which went up to the apartments from the shops, and when there were doors these were covered with metal sheet. For the same reasons, the stairs to the first floor, were made of stone (Fig.219E).

For both economic and safety reasons, the stairs mainly had two straight flights with a landing between them. The stairs in most cases climbed around a wall which made it difficult for the smoke to rise in case of fire. Also the stair network with its five walls contributed to the stability of the building, (Fig.219F). In some cases the stairs were positioned next to the courtyard façade and this made it easier to provide light and to enable residents to be rescued in the event of a disaster, (Fig.219G).

Eaves were designed with the lowest three courses of tiles at a more shallow angle to prevent them slipping off into the street, (Fig.219 I).

The austerity of the decoration also contributed towards safety, the only decorative feature being the three courses of tiles of the dado (Fig.219J) which were non-combustible.

Balconies consisted of a stone slab in order to prevent the spread of fire from the warehouse or shop doors to the french windows on the first floor, (Fig.219K)

The ceilings are simple consisting either of wood planks from the floor above which are clearly visible, without any plastering, or of plaster, and in both cases without decoration. Decorative features could easily be broken away in a tremor and injure the residents (Fig.219L): Also the floor beams are fixed to perimeter walls by means of metal straps, (Fig.219N) (49).

In order to be able to construct, on unstable land, buildings with three floors which would remain intact in the event of an earthquake, an ingenious wooden structure was adopted which already existed in some buildings before the earthquake. Examples of early medieval buildings on Castle Hill are currently being restored by the Municipality in Lisbon (Gabinete Técnico de Alfama) and have been observed by the author. However the wood structure in these buildings appears to be much more rudimentary than that of the Pombaline buildings which have a much more regular and systematic cage structure. The structure, called the "cage" or "gaiola" is made up of a series of vertical and horizontal struts joined by diagonal pieces forming Saint Andrew's crosses, (Fig.219H). The positioning of the sections is based on the empirical principle that it is difficult to deform a triangle (51, 52). On the lower levels, the modulation is repeated whereas in the area of the stairs it is reinforced with horizontal sections.

It is claimed by França (20) that the "gaiola" was carefully tried out and perfected by military engineers before being applied, (between 1756-1760). It had a complex
Fig. 219-Isometric showing construction
(drawing made from 110, S. Julião Street).
network of connections so that its elasticity would absorb the vibrations. It also allowed the internal walls to be of low mass. The introduction of such a system facilitated rapid construction of the superstructure(2). To reduce the risk of fire spread at ground floor level, in many buildings the "cage" was only built from the first floor up. For example of the nineteen buildings listed in Appendix 3 (p.46), 16 of the buildings were constructed in this way.

The exterior walls which formed the façades were much too heavy to adjust to earth movement, and it could have been self defeating to attempt to keep them intact and upright during a severe tremor since their weight could put the stability of the whole building at risk. Thus, that part of the cage structure which is adjacent to the external walls consists only of vertical and horizontal sections. This system allows the heavy walls to be released from the rest of the building, (Fig.220). The lintels and jamb stones of openings are tied to the cage with iron fixings (Fig.219 0).

Internally the gaiola panels were filled with irregular stones or pieces of bricks and mud, or just covered with wooden laths, to which wet clay was applied. In the event of an earthquake the plaster would disintegrate without harming the residents and the gaiola would retain its integrity and maintain its elasticity in resisting the earthquake, (Fig.221).

Even today these buildings built with a wooden frame structure, and an earth and rubble façade are greatly admired for their elegance and basic simplicity and for their degree of perfection, (Fig.222).
Clearly the architects of the Pombaline quarter achieved technical innovations, which may be unique for this period\(^2, 30, 49\).

The exteriors of the Pombaline buildings are protected by law, but their interiors and therefore much of their unique construction are not, and many of them have been altered beyond recognition. Action is needed now to protect those which remain.

Fig. 222-isometric showing construction 2
(drawing made from 56-60, Ouro Street)
IV.2. Dimensional co-ordination and prefabrication.

Up to the time of the earthquake, the construction of buildings in Portugal tended to be highly protracted. As the work progressed, small workshops and specialised craftsmen would produce components to order\(^2\). However after the earthquake the urgent need to rehouse the inhabitants of a whole city demanded a new and revolutionary approach.

As already stated, the whole process of reconstruction followed strict principles of uniformity, simplicity and economy. Clearly the use of dimensional co-ordination would make the standardization and consequent pre-fabrication of the components easier, and there is substantial evidence that this was in fact the case\(^{37}\).

IV.2.1. Dimensional co-ordination and the plan.

There appear in the approved plan (plan number 5, see section 1.8.1) to be a number of rules of proportion underlying the standardisation, which are outlined below:

i) The Rossio Square is contained by a rectangle where the diagonal is the square root of five which is a rectangle formed from two equal squares, (Fig. 223).

![Fig. 223-The Rossio Square and the VS.](image)

ii) The main body of the planned reconstruction area, where the streets are all orthogonal is contained within a Golden Rectangle, (the sides are in the proportion of the Golden Number, 1.6180339..., see Fig.224). The peripheral region to the east in which blocks vary in size and shape and are not arranged in a regular repeat pattern, is probably a result of the fact that the area is one of difficult
topography, (see Figure 224 A) and also a church was reconstructed in the same position as that which it occupied before the earthquake, (see Figure 224 B).

iii) The dimension of the diagonal of the Golden Rectangle is the same as the distance, from the Rossio Square to the Southern limit of Comércio Square before the earthquake (see Fig. 224).

iv) It is possible to establish a chain of three Golden Rectangles, within the principal Golden Rectangle, (see Fig. 225). Two consist of two rows of blocks running N-S and one consists of one row of blocks running N-S and two rows of blocks running E-W. The diagonal of the large rectangle formed by the three small golden rectangles also defines the Southern limit of the blocks and the Northern limit of Comércio Square.
v) In addition the flat area from Rossio Square to Old Ferros Street, (the main important street before the earthquake), also forms a Golden Rectangle, (see Fig.226), of which the upper two rows of blocks make up a further golden rectangle and the lower four blocks make up a square.
vi) The distance between Rossio and Comércio Squares is three times the dimension of a side of Comércio Square, (Fig. 227).

Fig. 227-The established distance between Rossio and Comércio Square

From these examples it would appear that there was a basic underlying geometrical development to the creation of the urban plan and it is unlikely that these geometrical properties are a result of pure coincidence. It is likely that the dimensions of the golden rectangle defining the area of reconstruction was determined by the distance between the Southern limit of Rossio Square and the Northern limit of Comércio Square, both of which were important squares prior to the earthquake. However it is impossible without additional information to understand the reasoning underlying the other geometrical properties and their relationships and any further interpretation would be pure speculation.

IV.2.2 Dimensional coordination and the facades

The Pombaline style, although normally seen as an undecorated façade which is very repetitive and relieved only by the corner pilasters, is in reality far from being monotonous, in the same way that constantly repeated shapes in nature are not monotonous but harmonious.

Geometrically regulated rules also appear to control the construction of the façades, giving them an equilibrium, rhythm and harmony which could adapt to the needs of the construction process and the division of property. The design of the façades is developed from a basic unit of exactly twelve palms in width, that is, the width of one window, and two half-portions of masonry on either side of it. Each façade comprises a whole
number of these basic units.

It is possible to identify geometrical development of the basic unit from drawings of
the façade by Eugénio dos Santos, (number 12 of the "Lisbon and Marquis of Pombal"
catalogue (21)). The following are some examples of rules which can be deduced from
these drawings.

i) The heights of the floors could be established from the diagonal of a square, the
side of which has the same dimension as the façade modulation (see Fig. 228).

ii) Two modulations are established from a diagonal of a square, the side of which is
the same as the height of a floor, (Fig. 229)

iii) By taking the upper and lower edges of the dressed stone window surrounds, and
the centre lines of the masonry portions between the windows, a square is
established the diagonal of which is also the height between the lower edges of the
stone window surrounds on succeeding floors, (Fig. 230).

iv) The dimensions of window surrounds, windows and dormer windows are
established in a similar way, as are the heights of openings and spacings of door
posts, (Fig. 230).

Fig. 228 - The heights established by diagonals of squares
Fig. 229 - Proportion between the height and two modulations
Fig. 230 - Establishing the stone window surrounds
The palm, an anthropometrically based unit, can from the evidence available, be shown to be the basis of all the designs undertaken in the rebuilding of the Pombaline quarter.

For example, the various dimensions that regulate the façades are, (Fig. 231):

i) The height of the window sill above the floor, (four palms).

ii) The width between the outsides of the window surrounds, (six palms).

iii) The height of the window head above the floor, (12 palms).

iv) The floor to floor height (15 palms)

Fig. 231 - The palm used in the composition of the façades
IV.2.3. Dimensional coordination and internal spaces.

It can be deduced from the numerous plans which the author has produced, (see Appendix 5), that in the dimensioning of a working drawing of a building, a simple reference system was used which could co-ordinate the position and dimensions of all the elements. In this system the basic module, m, was a multiple of the palm, that is, four palms.

\[ m = 4 \text{ palms} = 4 \times 22.5 \text{ cm} = 90 \text{ cm} \]

For example, to make the fabrication and assembly of the timber frame sections easier, care was always taken to ensure that the vertical supports of the cage obeyed a strict system of modular dimensions, by which they were placed so that the dimension of a construction element, plus its joints and tolerances was always a multiple of m.

This is shown in the plan below, (Fig.232).

Also as the width of a Pombaline building (plot) depends on the strict modulations of the façade, in the manner described in section IV.2.2., so its depth is related to its width by a similar set of well-defined rules of proportion. This is achieved even though units of different widths in the same block all have the same depth. The following examples of internal plans illustrate this principle:
i) The diagonal of the units with two vãos (spaces) in the façade is equal to the square root of 5 (Fig. 233), and can be considered as consisting of two squares each of side length 24 palms.

![Fig. 233-Plot with a width of two vãos.](image)

ii) In the unit with three vãos, this produces a square, whose diagonal, the square root of 2, is equal to the depth, (Fig. 234).

![Fig. 234-Plot with three spaces and square root of two](image)

iii) Four vãos in the façade consequently result in a unit which has a square shape, (Fig. 235).

![Fig. 235-Unit with four spaces and square root of two](image)

iv) In units with five spaces (vãos) in the façade the unit is nearly (1.625) equal to two golden rectangles (1.618), (Fig. 236).
The positions of the interior walls also appear to follow certain principles which produce particular geometrical properties.

The units within the Pombaline buildings always have a structure comprising three rows of rooms running parallel with the façade. The positions of the dividing walls are determined by the projections of the diagonals of defining squares or rectangles, this is illustrated in Figure 237.

In many cases the rooms immediately behind the street façade are based on squares and typically their diagonals give the depth of the front two rows of rooms, (Fig.238 and 239).
Fig. 239-The square rooms behind the street façade define the depth of the second row of rooms: example 2

It is possible to discern from the plans of the rooms the existence of a modular grid in which each individual module is made up of a square or rectangle the dimensions of which are determined (see Figure 240) by the distance between the centre lines of the spaces between the windows on the façade.

This therefore clearly establishes that the underlying principle on which the plans were devised was that of modulation. The modulation was achieved from the construction of a relatively small number of geometrical operations. These were repeated in various ways to build up the matrix of different rooms from an underlying grid pattern which was based on the repeat distance between spaces in the façade.
IV.2.4. Prefabrication.

To answer the need to rebuild the city quickly, at a time when the production of components in the capital was small and there was a shortage of specialised labour, França (2) and the late Portuguese Architect Porfirio Pardal Monteiro (40) have both suggested that a decision was made to turn to prefabrication and mass production.

These suggestions were no doubt influenced by the repetitive and standardised nature of the buildings. They incorporated a great number of pre-conceived elements such as dressed stone, joinery items, pillars, beams, props, tiles, rods, doorposts, stairs, etc., which were multiplied over and over again, without any variation, and which produced buildings of great uniformity in architectural and constructional terms. This is clear from the records of the observations made by the author of a large number of these buildings, (see Appendix 3). The suggestion is further supported by information passed down by the ancestors of architect Porfirio Pardal Monteiro, who was involved in the reconstruction or alterations of some of the Pombaline buildings, during his professional life. He claimed from his observations and knowledge that prefabrication had been used in the construction of the buildings (40) but he did not provide documentary evidence of this. The author contacted his nephew António Pardal Monteiro (see letter in Appendix 4.6) to ask whether the family had any past documents relating to the Pombaline buildings and prefabrication. The reply was that the family does not possess such documents but, they are sure from oral tradition and from analysis of the buildings by Porfirio during the alterations that prefabrication was involved. However there is no documentary evidence to prove this.

Prefabrication of building components was not unknown elsewhere at the time of the earthquake. The idea of using prefabrication for the rebuilding of Lisbon is thought to have come from wooden huts which were imported from Holland immediately after the earthquake, to provide temporary accommodation for the inhabitants whose homes had been destroyed. The huts were sent by boat and were easy to erect and to stabilise with gypsum plaster (2). British accounts of the earthquake state that the hut components were sent by sea and could be erected in twenty four hours, and dismantled and re-erected just as quickly (17).

It is also known that in the years immediately following the earthquake, the King and the Marquis of Pombal took measures to encourage the mass production and stockpiling of building materials and manufactured items in order to avoid speculation. A decree passed on the 15th May 1756 (31) states that "given the serious shortage of wood, roof tiles and bricks, and in order to facilitate the rebuilding of properties, all the materials and merchandise produced in the country's
factories could rightfully be brought into or out of the country without embargoes or debts, this has been conceded to products of the Grão Para and Maranhão Companies".

The decree of 12th May, 1757 (31), also more specifically encourages manufacture of materials and components. "As king, I hereby declare this licence to be lawful, considering it's utility, being for the rebuilding of the City of Lisbon, the multiplication of the factories of lime, bricks, wood and stone, and to ensure an abundance of these materials at fair prices. Reason and experience show that duties and coercion discourage all those who produce and transport the above mentioned materials... in order to prevent intermediaries and speculators, fabrication, transportation and competition are to be promoted.... I establish that with the desired duplication, no longer may anyone embargo or prejudice those who fabricate or order to be fabricated, transport or order to be transported...".

The references to "factories of wood and stone", "desired duplication". and "fabrication" in relation to wood and stone, suggest that mass prefabrication of wood and stone components was envisaged, as opposed to mere extraction and processing of the materials.

An edict of 29th June, 1757 (31) states "His Majesty, considering it to be in the public's interest and for the benefit of residents and manufacturers that prices be maintained, ....the treasury should proceed to purchase all materials produced in the Kingdom that do not find immediate buyers and should stock up, supplying when necessary at the price at which they were bought... Anybody may deliver the above mentioned materials to the Rua Nova do Arsenal (Arsenal Street) where their right price will be paid and where also these materials will be sold at the right price to those who need them, in small or large quantities, to carry out their building work". The reference here is to materials, but the Portuguese word would not exclude manufactured components.

A search has been made for documents contemporary with the rebuilding which would confirm the oral tradition about prefabrication and the effect of the government measures described above (16, 51). Unfortunately many documents have been destroyed by a fire in the main Lisbon archives (16), but building contracts have nevertheless been found relating to the period.

There were found by the author 13 building contracts between 1757 and 1790 (54). In 11 contracts the master mason is effectively the General Contractor, with responsibility for "all the works" including masonry, carpentry, joinery, ironmongery and "finishing" (presumably plastering and painting) (see Appendix 4.5). In both contracts translated in the Appendix, payment is to be in relatively large, infrequent instalments, with most of the payment being towards or at the end of the construction, after a complete inspection and measure of the work done. The general contractor was not merely a self-employed tradesman, but a businessman who
conducted a substantial operation and could raise substantial amounts of capital. In most cases the payment was made with the rents paid to the general contractor with a tax of 5% and in some cases with parts of the buildings, a shop or a flat. In one case payment was made with materials.

In view of this it would not be altogether surprising to find that the contractors were expected to obtain prefabricated, mass-produced components from already existing stock. The contracts included evidence suggesting this. They give dimensions in "palms" (22.5mm) as follows:

Boards and beams (contract n.6)

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Building plan size (contract n.12)

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In one contract (n.6) it is stated that the stonework for the stairs, and the dormer windows must come from the Stock Exchange of the Terreiro do Paço. The Rua Nova do Arsenal leads from the Terreiro do Paço (Comércio Square), and hence it seems highly likely that the "Stock Exchange" referred to is in fact the stockpile of building materials established by the Treasury as a result of the edict of 1757, just over three years before the date of the n.6 contract (1760). If this is so then the stockpile contained prefabricated components such as windows and stonework for staircases, perhaps stone treads, and the incorporation of these components was facilitated by dimensional coordination based on the module of the palm.

The site of the building referred to in the n.6 contract has not been identified, but the description of the semicircular arches indicates that it was not in the Pombaline quarter itself. Neither was the building in the n.4 contract referred to, but the latter was close to the Pombaline quarter in an area in which the design of the existing eighteenth century buildings is very similar to those of the Pombaline quarter itself. If prefabricated, mass-produced components from already existing stocks were being used for buildings outside the quarter, then it seems even more likely that they were used inside where the design of the buildings is even more repetitive and standardised.
The Pombaline buildings were not completely prefabricated - they included, for example substantial amounts of rubble stone walling - but they did incorporate many standardised and possibly prefabricated components, especially dressed stone and joinery items, the use of which relied on effective dimensional co-ordination. These components did not differ greatly from those which were already produced by craftsmen to order, and which can be seen in surviving buildings from before the earthquake such as Ludovice Palace. They were merely simplified and standardised in a way which would have accelerated their manufacture by mass production. They could then have been produced in an anonymous and abstract way in workshops scattered through the outskirts of the city as well as within it. Few workshops or factories from the period remain, except for a wall tile factory at Amoreiras, the Fabrica do Rato which is believed to have produced many ceramic wall tiles which were used in the reconstruction.

Observation of buildings in areas built before the earthquake suggest that symmetrical (Fig. 241) and elaborate panel compositions (Fig. 242), were in vogue. However these would be difficult to adapt to the simple repetitive style envisaged for the Pombaline buildings. Also the previous excessive use of material (Fig. 243) would not be appropriate to the austere economic climate prevailing after the earthquake. Thus modulated simple repetitive compositions were adopted which were easy to adapt to different spaces.

Fig. 241-A symmetrical composition
Fig. 242-Panel composition

Before the earthquake
Before the earthquake
A detailed study of external features and internal fittings and construction details of buildings by the author suggests that the standardization of the traditional components obeyed the following principles:

i) The number of variants adopted was small and there was a strong uniformity of components.

ii) Measurements and modulation for the manufacture of the traditional components were carefully selected, and those chosen were ones providing maximum flexibility and adaptability, (Fig.244).

iii) The design of the components was simplified, and decorative elements were stylized or eliminated from them, in order to facilitate mass manufacture. For example, on the façades, the greatest degree of refinement was in the stonework of the windows, and this was achieved not with any rich decoration, but through a stylisation of forms, (Fig.245). The same happened with the railings of the balconies, the design of which was very simple, but highly effective, because of the proportions used.
iv) In other cases attempts were made to substitute more elaborate elements, which had been common in the past, with others which were simpler to fabricate and assemble. For example, a railing along a stairwell could be substituted by a solid tiled balustrade, (Fig. 246).

v) The combination of modular components was easy to adapt to different dimensional situations. For example, the railings could be reduced or adapted easily during construction, (Fig. 247).
vi) Modulation of elements was conceived in such a manner that they could be used for different functions, or in various forms. As we can see the designs of the patterns for the metal railings were so simple in composition that they could be used in any situation for steps or balconies, (Fig. 248).

![Fig. 248-A metal railing used in two different situations, balcony and stairs.](image)

vii) Only a few types of components were selected and produced and the richness and versatility of the compositions which were achieved, derive from the mix of the different components. For example, the patterns of tiling made with three or four different tiles, show a great versatility that can be used in several different situations, such as window recesses dados and staircase balustrades, (Fig. 249 and 250).

![Fig. 249-Examples of dados at window recesses](image)

![Fig. 250-Examples of dados at balustrades](image)
viii) The components were easily interchangeable which allowed for a variety of different combinations and resulted in the creation of numerous styles, (Fig. 251 and 252).

Fig. 251-Example of interchangeable border, the same border for different compositions.

In Chapter III (see Figures 160 to 162) it was noted that the wall tiles continued without a break, behind the cupboards, which means that the walls were tiled first and the cupboards assembled independently at a later stage.

Fig. 252-The versatility of the borders

The evidence suggests (40) that the components were produced, (Fig. 253) in an anonymous and abstract way by craftsmen, remote from the workers who would assemble and fit them quickly and simply, on the sites in the new city. It is suggested that this was achieved by making use of the numerous materials workshops scattered around the outskirts of the city as well as by organising the workforce already within the city which was not necessarily specialised in an appropriate way. This would then divorce the craftsman producing the components from the building work.
From the detailed observations of the components of the Pombaline buildings made by the author (see Appendix 3), it is suggested that the following measures must have been taken in order to make the pre-fabrication of components viable:

i) Simple, traditional models and traditional ways of building were chosen, where the components had been clearly, formally and functionally well defined, (Fig.254).

ii) Architectural and constructional details were simplified, without any special embellishments, in order to make it easier for the components to be assembled on site. For example, the components of the gaiola compared with sixteenth century British practice, used relatively unsophisticated, jointing techniques which were largely limited to notching, lapping and halving, although in some cases halved dovetail joints are found (Fig.255 and 256). The use of iron and bolts is frequent, and neither carpenter's marks nor mortice-and-tenon joints are generally in evidence.
iii) The simple nature and uniformity of the components and methods of assembly meant that specialized workmen were not required to fit and erect them. The components were easily adapted to allow for simple interruptions, (Fig. 257).

iv) Abstract compositions were chosen, in order to adapt to different situations, whilst still maintaining repeatability, (Fig. 258).
v) In fitting and erection it is clear that solutions were found which allowed for small dimensional adjustment to be made. For example the iron balustrade modules could be easily cut to adapt to different size requirements, (Fig.259 and 260).

vi) Components of great solidity without any special finish or decoration were conceived, which also hid imperfections in the manufacture or assembly, (Fig.261).

The manufacturing process of the time inevitably produced small variations in the dimensions of the components. It must, therefore have been necessary to establish certain limits for the dimensional variations, which we will call "tolerances". This would then have attained a certain degree of precision both in production and in assembly on site, ensuring that components could be incorporated satisfactorily into the building so long as the variations were within the required limits (Fig.262). Evidence for this is apparent in a number of components in the internal fittings.
To study the assembly on site, of a pre-fabricated building element, an example has been chosen with a relatively high potential for complexity both in its assembly on site and its prior conception. The example chosen is one of three doors at the entrance to a flat in the building number 75, Conceição Street. (Fig. 263 and 264) The set of doors was inserted into the modular space on the plan, which, in the design, would measure approximately six palms (6x22.5cm). In the case of 75, Conceição Street the actual measured width of the opening was 130 cm (Fig. 265).

If an attempt had been made to manufacture components totalling exactly six palms wide, any error within a small tolerance would make it impossible to fit the component into the space.
To overcome this problem, "tolerances" were introduced. A "tolerance" is seen as the difference between the maximum and minimum component dimension allowed (permitted upper limit and permitted lower limit respectively).

The detailing of the doorway is such that it allows for adjustment of the partition, the width of the door leaves, and the height of the door leaves, (Fig. 266 and 267).
The thickness of the partition, and therefore also the width of the door lining is adjusted by varying the thickness of packing pieces. These are planted on the face of the post in the gaiola next to the doorway, to bring it flush with the face of the nogging over the doorway which is lapped over the post on either side (Fig. 269). The thickness of these packing pieces could be varied by as much as 10mm above and below the norm.

The width of the door leaves, or strictly speaking the space occupied by the door leaves, is adjusted by packing pieces planted on the doorway face of the gaiola post, which pack out the door lining. These packing pieces can vary in thickness from nil to 100mm (Fig. 268).
Both this variation and the variation in thickness of the packing pieces described above can be used to accommodate inaccuracies in the construction of the *gaiola* as well as variation in the widths of door linings and door leaves. However the mechanism for adjusting the height of the door leaves involves altering a dimension of the *gaiola* itself and its presence can only be explained by substantial variations in the heights of mass-produced door leaves obtained as standard components from stock, or "off the shelf" (Fig. 270).

The dimension of the *gaiola* which is altered is the height of the nogging which forms the head of the structural opening for the doors. The alteration is effectuated by varying the size of wooden inserts which fit into recesses in the *gaiola* posts on either side of the doorway, (Fig. 271). The height of the door leaves can be varied up to 20mm above and below the norm (Fig. 272).
Precision costs money because of the discipline that is imposed, which along with the craft-based manufacturing process meant that it was not always possible to reduce the size of the "tolerance". Consequently, in the Pombaline rentable building, in an attempt to build in a simple, and quick method of adjustment, the "tolerances" became very large and also became more simple using short pieces of wood, (Fig. 273).

These are greater than the variation which we would expect in mass-produced standardised door leaves today, but this is probably due to inconsistencies in measuring instruments used in eighteenth century Portugal, together with the large number of small workshops from which the door leaves would have been obtained.

To make assembly easier the gaps were covered by planed architraves, with simple joints, which were easily adjustable to the size required on site, covering any further imperfections with other decorative finishes. The tolerances are not only seen at the building level but also at the urban plan level.
Because the measuring instruments used at the time were very rudimentary, the setting out of the plan on the ground resulted in small errors in measurement which were promptly covered up through the subtle use of tolerances in the building's facades.

The pilasters in the centres of some blocks covered up the difference between the aesthetic harmony of the design and the size actually built, (Fig. 274 and 275). This is also due to the fact the elevations had to have exact dimensions because the components of façades such as windows do not have any "tolerances".

Fig. 274 - The pilaster

Fig. 275 - Locations of the pilasters
IV.3. **Summary**

In this chapter the innovations introduced in the Pombaline buildings, with respect to health and safety measures, have been identified and described. Many of these innovations were clearly in response to the devastating experience of the effects of the earthquake on the original buildings and their inhabitants. This resulted in an ingenious building design. Below ground level the buildings were supported on a network of vaults resting on wooden stakes. Short stone columns interconnected by stone arches rested on the timber platforms and supported the buildings above ground level. The ground floor space was covered by stone vaulted ceilings and above this the structure consisted of a wooden cage or *gaiola*. Many of the design features of this structure and the internal details associated with it were clearly produced to resist any future earth tremors.

In the plans of the area of reconstruction, the distribution of the buildings within that area, the building façades and dimensions and the internal plans, there is clear evidence of dimensional co-ordination. Running through all these is evidence of geometrical relationships which must have derived from the application of a number of geometrical principles. This is particularly apparent in the modulation of the façades which show a twelve palm repeat and also an underlying square grid pattern (of repeat length 12 palms) which it would appear was used to generate the room plans.

Almost certainly developing from this strong element of dimensional coordination is the use of prefabricated building components, of which there is abundant evidence in the buildings which have been surveyed. Prefabrication has been suggested previously by a number of authors but not substantiated. The previous chapter has shown that there is not only evidence of use of prefabrication in old documents of the period but also in doors, windows, balustrades, doors surrounds and even the cage structure itself at the existing buildings. Also many cases, designs and systems were clearly developed to allow for variability in component dimensions and unsightly joints or joins.

The documentary and physical evidence discussed above, all suggest that the standardisation of huge numbers of windows, doors and their associated dressed stone lintels, jambs and sills enabled their prefabrication, mass-production and supply from stock when required. Ceramic wall tiles and wrought iron staircase balustrade components were also produced and supplied in this way. This standardisation of components and the associated standardisation of the design of the buildings, into which they were incorporated on such a large scale is, to say the least, unusual for the eighteenth century, and surely deserves international recognition.

From the knowledge of the detailed characteristics of the Pombaline rentable buildings derived from the survey the next chapter will analyse a possible evolution of
particular aspects of the buildings. During the survey (the results of which are reported) it became apparent that different types of plans had in common certain types of stairs (see Chapter II.2.), the location of which in the plans seemed to be related to an evolution.

At the beginning of the next chapter, it will be seen that the process of reconstruction dragged on for a long time. From the analysis of the exteriors and the interiors of the buildings in Chapter III it was concluded that the elevations had been strictly imposed and had been followed during the whole period of reconstruction, whereas the interiors had been defined by the owners' own tastes. This should make it possible to identify any evolutionary developments which may have occurred over the construction period. Based on the variations in the internal plan a classification system is developed based mainly on the position of the stairs, and particular phases are identified. The internal details associated with these different phases are recorded and historical records are consulted to obtain data on the number of buildings erected in different streets at different stages of the total construction programme (see Appendix 4). The classification system of the different phases is then compared with the historical data.
CHAPTER V. FACTORS WHICH INFLUENCED THE INTERNAL PLAN OF THE POMBALINE RENTABLE BUILDING.

V.1. The progress of the building programme.

The reconstruction of the business centre of the city was not immediate. It continued for many years and extended beyond the five year time limit for completion set down in the "12th May 1758 licence". Although the procedure for the redistribution of properties had been established in advance, this took time. The levelling and clearing of rubble from the land was, in many cases, dependent on the owners making use of the materials from the ruins, which in turn, delayed the building of the infrastructure. Progress was also no doubt impeded by the profusion of wooden shacks which were erected despite public notices prohibiting them. The account of a foreign traveller who visited the city nine years after the earthquake throws some light on this matter: "The damage caused by the earthquake still appears to have been recent; the majority of the streets still show signs of demolition and ruin".

The progress of the reconstruction of rentable properties was "irregular"; Pombal had planned financial arrangements to compensate land owners for their efforts to reconstruct, but these did not prove adequate in practice, especially in cases where they had to take out mortgages, so in 1769 and 1771 the unbuilt properties were compulsorily sold. In the 13 Kilometres of streets that constituted the Pombaline area there were in 1766 only 59 buildings, 31 of which were in Augusta Street (the street which linked the two main squares).

Ten years later a total of just 140 buildings had been completed.

With the fall of Pombal in 1777, due to problems at the Treasury, public works were immediately suspended. At this stage only 25% of the Pombaline area had been rebuilt. Many more buildings were built around 1790 and then a process of decline set in during the French Invasions (1810/1830).

The Rossio was only finally completed in 1840.
V.2. A study of the possible evolution of particular aspects of the buildings

The reconstruction by Pombal of the Lisbon town centre, constituted an important urban development. As outlined in previous chapters it involved a complex reconstruction process, over a large area with technical innovations and, the standardisation and mass production of components. It also included various hygiene and safety measures, including in the latter case resistance against earthquakes, through the systematic incorporation of a wooden cage structure which allowed buildings to accommodate movement without collapsing when built on unstable terrain. This marked an important period in the panorama of Portuguese architecture.

As outlined in Chapter II the author carefully studied the plan form and exterior details of 304 buildings, which includes in particular the location, construction, design and style of stairways (see Appendix 5). The author noted that there were no two plans alike although there were building lots that were the same in size and where, as previously established, the position of the walls had been defined by simple, regulatory lines (see Chapter IV). Faced by this great diversity the author began to analyse carefully the stairways and established that there were a number of well defined types (see Chapter III). There also exist types very similar to those that could be found in the medieval parts of the city and others which were similar to those found in the parts of city that were built much later. Although many of the technical innovations were imposed right at the start, there must have been others that were defined during the construction work, during the prolonged period of reconstruction. This would particularly be so in the development of the interiors of the buildings (2).

In order to understand any possible evolution of the existing plans it is necessary to determine how the planners initially intended to divide the properties internally. Careful observation of the drawings of the elevations shown in the early plans (catalogue of exhibition "Lisboa e o Marquês de Pombal"(21), volume II, illustrations 108 to 111) showed that properties in four of the initial drawings had dividing walls between buildings coincident with the window alignments (see Figure 276). This suggests that division of properties behind the façades would be irregular. This was clearly abandoned as properties are in practice divided in a regular manner.

As has previously been established the plans were not made in a haphazard way but were restricted by the modulation of the spaces in the façades, which determined the dimensions of the individual buildings within each block.
By carefully analysing the plans it was possible to group them clearly by stair types, keeping in mind the principal requirements of the residents. These are still relevant today such as the need to have the kitchen facing the courtyard, and the sitting room facing the street, with immediate access from the staircase. This development was accompanied by what appeared to be an evolution in the definition of the spaces in the plan. In the Pombaline area there can be found rentable buildings of interior plan similar to medieval plans of houses. These are without corridors and the room divisions are crossed via multiple doors situated in the middle of the interior walls and with a single straight flight of stairs to the first floor, (Fig.277 and 278). There can also be found rentable buildings with plans similar to many still built today, (Fig.279), with corridors and double stairs in the centre.
Fig. 279 - Pombaline building plan and a recent (1940-45) plan of a building in Lisbon

For this study Pombaline rentable buildings were selected with two homes per level "Left/right", with the advantage of being able to confirm if there had been specific alterations later on in the case of one of the pair of flats not being exactly the same as the other. In the flats which have one flat per stair, the types of stairs present still conform with the seven types classified in section III.2.4.

As we saw previously (Chapter IV) each flat comprises three rows of rooms parallel to the façade, (see Fig. 280). The first, immediately behind the street façade, consisted of the most important rooms in the flat: the living room and the dining room. The second, an interior row, with no natural light or ventilation contained the bedrooms and the third row, next to the internal courtyard façade, was where the kitchen was normally positioned.

Fig. 280 - Plan of a flat and the three rows of rooms
To better understand the possible evolution of the plans it is necessary to postulate what was intended by this evolutionary process. It is suggested that in making only one stairway, to gain access to the flats, it was desirable for the purposes of convenience to locate the entrance near both the sitting room and the kitchen. Location of the stairway in the centre of the building would be ideal, but this would create problems due to the necessity to illuminate it with an expensive and complex skylight. Locating the stairway behind the façades would make it easy to provide illumination by windows, but then the stairway would be far from the kitchen or far from the sitting room. There appear to have been different phases, in which attempts were made to solve this problem. This was thought to start with the stair behind the street façade, which was usual in medieval areas of Lisbon, then moving the stairway progressively to the rear of the building and ending with the stairway in the centre of the building, a solution very common in Portugal even today. The particular types and subtypes, (where in some cases elaborated solutions can be identified), were originally thought to be part of an evolutionary process. The suggested evolutionary sequence of types is presented schematically in Figure 281.

Fig. 281-Suggested sequence of evolution of plans
The proposed types are described in the following sections as three phases.

V.2.1. The first phase, stairs at the front, types 1, 2 and 3.

Type 1: In type 1, the stairs were built to a very simple design. They climbed alongside a wall and were positioned next to the street façade, reaching the first floor in a single flight, with no landings in between, as is the arrangement in buildings in medieval areas of Lisbon. The internal subdivision of the flats was very basic and there was no interlinking corridor. The doors were generally central in the partitions, (see example in Fig.282).

![Fig.282-Typical plan of first type and a typical section](image)

It is interesting to note that when Manuel da Maia suggested the street width (see section 1.8.3) he presented a plan of a street and partial plans of the adjacent buildings in which the stair is next to the street façade similar to the above example (see Fig.283)(21). This suggests that this was a common arrangement at that time and would probably have been used in the early buildings.

![Fig.283-Drawing presented by Manuel da Maia suggesting the width for the streets](image)
There were a number of advantages and disadvantages associated with this design. The positioning of the stair next to the street façade eliminated the need for a skylight, which was both difficult to install and costly. Also in the event of fire, the rescue of the inhabitants could easily be carried out through the stair windows, which would also disperse smoke. On the ground floor, the shop could operate freely behind the stairs without interruption.

However the flats lost a window on each floor overlooking the street because of the stairs, and the entrance to the flats on alternate floors was immediately behind the street façade, which created problems in the internal arrangement of the flats. For example, the entrance was too far from the kitchen, and the internal arrangement was different on different levels in that the space left beneath the stairs on alternate levels was owned by only one of the flats.

Type 2: In order to overcome this last problem, in the second type three alternatives were created.

Sub-type 2A: Dogleg stairs were used so that all the flats were similar, but with the inconvenience of the entrance being far from the kitchen, (Fig. 284).

Sub-type 2B: As in 2A but the entrances to the flats were positioned in the centre of the building, next to the kitchen.

However, this device was not suitable for the Pombaline buildings where the windows are strictly aligned horizontally and vertically, because the landings are no longer in synchrony with the windows which have to open onto the stairs, (see Fig. 285).
Sub-type 2C: Here the intermediate landings were immediately behind the façades, but as it was not possible to align the landings with the windows, another solution was created, a stair with a long landing, which allowed entrances in the centre of the flat. However this made the way of escape much longer in case of fire and the stairs were therefore protected with vaults made from stone, which was a more elaborate and expensive solution, (Fig. 286)

Type 3: In the proposed third type dogleg staircases were used with the half-landings at the opposite end from the street façade and the flat entrances next to it, (see Fig. 287).

Access to the kitchens is via a special flight of stairs which rises from the half-landing. However this must have increased construction costs.
V.2.2. The second phase, stairs at the rear, types, 4, 5, 6, 7 and 8.

Type 4: In this type the stairs begin from the street façade with a straight flight rising to a landing at first floor level in the centre of the building. Thereafter the stairs are doglegs similar to type 2A but with half landings on the alfugere façade and landings in the centre of the building, (see Fig.288). In one case the staircase is a newel rather than a dogleg arrangement.

This meant that the system of construction of the stairs was complex and the flats on the first floor lost space to the stairs both at the back and at the front. Also the accommodation in the first floor flats differed from that in the other flats, which made this system more complicated to build.
Type 5: The fifth type marks a very distinct type as it seems to be the culmination of a process in which the stairways have moved from the front of the building as in type one to the rear of the building in this type. Thus in this type the stairs climb all the way up next to the *alfugere* (courtyard) façade, in contrast to type one where they climb up adjacent to the street façade, (see Fig. 289).

This simplified the stair construction and meant that the flats had rooms backing onto the stairs with windows facing onto the street.

![Fig. 289- Examples of plans and a typical section for type 5](image)

However access from the street to the stairs was via a narrow corridor which divided the shop space into two. Also the room facing the stairs was too deep, unless it was divided into two, in which case one of the rooms was internal with no windows. There is also a variation of type five, sub-type 5A in which access to the kitchen is via a special flight of stairs. However this more elaborate design must have been expensive. It was used in Arsenal street and on top of blocks where the properties are not as deep, (Fig. 290).
Type 6: This type appears to be a modification of type 5, in which the stairs were brought slightly forward drawing part of the alfugere to within the perimeter of the building, (see Fig. 291). It is thought that this was done in order to connect the two shops on the ground level and place the entrance to the flats more in the centre of the building preventing the need to subdivide the sitting room which was opposite the stairs.

Type 7: Type seven appears to be a further development in which the windows which open onto the intermediate landings became deeper, (Fig. 292).
Type 8: This type appears to represent yet a further development in which cupboards were constructed in the extra space created in front of the landing windows, which were then blocked off, making the stairs dark. This meant that a skylight had to be installed above the stairs which must have added extra cost, (see Fig.293). It is clear however that this change was not effected by modifying existing buildings, because this type also represents a distinct modification in internal design. For the first time the doors are placed not along the axis of the rooms but in the corners.

Type 8A is a variation of type 8 in which the stairs are moved noticeably closer to the interior of the building, with the space behind the stairs being used in some cases to install a kitchen fireplace, (see Fig.294).
V.2.3. The third phase, stairs in the centre, types, 9, 10, 11 and 12.

Type 9: In this type the stairs are located at the centre of the building with a glass skylight above to provide light and with an open newel around which the stairs rise, (see Fig.295). The space between the stairwell and the wall of the alfugere (courtyard) is seen as a useful area for rooms.

Type 10: Type ten is a variant of phase 9. In this phase the entrance landing is designed to provide two entrances for one of the flats, one of which is near to the kitchen, (Fig.296), and the kitchen is moved closer to the entrance.
Type 11: In this type, the stairs still remain at the centre of the building but the central row of rooms become narrower and the stairs much more complex. The height between adjacent floors is spanned by three flights of stairs each rotated by 90°, the 360° rotation being completed by the landing leading to the doors of two adjacent flats, (Fig. 297).

Type 12: Type twelve seems to be a development of type eleven in which the three flights of steps between each floor are replaced by a continuous flight of steps forming a 180° half spiral, the full 360° turn again being completed by the landing leading to adjacent flats, (Fig. 298).
V.3. Details associated with the various types.

The proposed evolution seemed to be in synchrony with the evolution of the construction process for stairs (see Fig.299).

In types 1, 2B and 2C, the stairs climb alongside a wall, which was simple to build. In type 2A the wall is a "solid" balustrade and in some cases this arrangement persists to type 7. In type 4 in some cases the stairway climbs alongside an open newel, a much more complex situation because it was supported only by two walls. In type 9 the stairs are much more elaborate with three flights per floor and this is maintained in the 10th type. In type 12 the intermediate landings were eliminated and possibly for economy of space, the stairs have a helical form, so they were lit from above by complex skylights that took up little space.
The records in the building survey of the finishings and construction details associated with the stairs, reveal if there are details which evolved; there are others where their complexity did not increase in a gradual way with the established development and, in some cases, it seemed that the finishes became simpler and even of poorer quality. This did not seem to be restricted by technical availability (for example railings were made of cast iron in the early types, wrought iron in later types and a combination of both in even later types). However these variations could be due to changing economic circumstances of the owners. An analysis was made of the historic events in Portugal between 1760 and 1830 (see Appendix 4.2) which would have produced serious economic upsets, and could have affected the owners’ circumstances, obliging them to cut down on the expense of the final stages. Also the finishings could have changed due to fashion as in the case of opting for wooden or plaster ceilings or the absence or profusion of tiles.

Not all differences in detail are associated with the different types. The details for which it is possible to establish a link with the proposed types are:

i) The "solid" balustrade wall

Between types 1 and 6 the balustrade wall shows a continuous change of form from a continuous "solid" wall to a zig zag pattern, "solid" balustrade. In type 7 although the overall form of the balustrade wall is similar to the previous types, the construction is different. In types 1 to 6 the balustrade has a timber frame structure similar to that of the cage, (see Fig.300), but in type 7 they were made with planks similar to the "costaneiras" walls.

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Fig. 300 - Variations in the balustrade wall

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ii) Handrails

In types 1 to 3 there is a mopstick handrail fixed to the side wall. In types 3 to 7, the top of the wall balustrade is covered with three simple boards which in type 5 are carved to act as a handrail. After type 6 a more complex moulded handrail was used along the tops of the balustrade, (see Fig. 301)

![Fig. 301 - Variations in the balustrades](image)

iii) Steps

Different types of steps on the stairs are also linked to the different types. In types 2A, 2B, 2C, 3 and 4 the steps were made with simple boards. In types 5 and 6 a shaped riser supports the tread. In types 8A and 9 the moulded riser was substituted by a simple strip of wood. In type 11 the tread has additional nosing which could be replaced (Figure 302).

![Fig. 302 - Variations in the steps](image)
iv) Doors

Over the years doors and windows have been changed. For example the original windows in the Pombaline Area were similar to those shown in Figure 110, with small panes, which today are rare. In types one and two the entrance doors seemed not to be the original ones because, in the interior of the flats of these types there were found ledge doors which are associated with type 3. In types 5 and 6 the boards are replaced by two panels which in types 6, 7, 8, 9, and 10 are further divided to produce four panels. In types 9, 10, 11 and 12 the panels are more sophisticated and are held in grooves rather than lapped and rebated (Figure 303).

![Door Types](image1)

v) Skylights

Skylights only apply to types 9, 10, 11 and 12 which have a central staircase. Skylights in types 9 and 10 were positioned on one of the slopes of the roof. In the 11th and 12th types a dual pitch or pyramid skylight was positioned on the ridge of the roof, (Fig.304).

![Skylight Types](image2)
V.4. Evidence for an evolutionary sequence in the internal plan of the buildings.

Section V.2. identified twelve different types of internal plan for the stairways which represent a possible chronological development. The sequence 1-12 tended to go from simple to more complex and also the siting of stairways tended to go from medieval to modern. There is a trend to go from stairs at the front, phase 1 (types 1-3), to stairs at the rear, phase 2 (types 4-8), to stairs in the middle, phase 3 (types 9-12).

Based on the information of the survey reported in Appendix 5 a plan was produced in which the type to which each building belonged was marked on the plan by a particular colour (see Figure 305). Table 5.1 below gives the percentage of these buildings which fall within each of types 1 to 12.

<table>
<thead>
<tr>
<th>Types</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>n. of buildings</td>
<td>1</td>
<td>21</td>
<td>8</td>
<td>21</td>
<td>62</td>
<td>21</td>
<td>16</td>
<td>41</td>
<td>60</td>
<td>15</td>
<td>34</td>
<td>22</td>
</tr>
<tr>
<td>% of buildings</td>
<td>0.3</td>
<td>6.6</td>
<td>2.5</td>
<td>6.6</td>
<td>19.7</td>
<td>6.6</td>
<td>5.0</td>
<td>13.0</td>
<td>19.0</td>
<td>4.8</td>
<td>10.8</td>
<td>7.0</td>
</tr>
</tbody>
</table>

Attempts were then made to verify the hypothesis of an evolutionary sequence by attempting to locate historical data that would provide dates either for buildings or streets.

Unfortunately no documents could be traced which related to individual buildings and their dates. The documents in existence in the Archives of the Municipality which relate to each rentable building are records from the beginning of this century. However there is a document, which mentions that in 1766 in the streets of the Pombaline area there existed 59 buildings (31 in Augusta Street) and 140 in 177616).

Luis Pastor de Macedo16) mentioned in his book a period of construction, between 1766 and 1778, but without any reference to the source of this information (see Appendix 4.4). Subsequent work by the author, reported in this section, suggests a more extensive period of construction.

Descriptions by foreign writers about the reconstruction were also studied (see Appendix 4.3).

However in the historical survey conducted by the author useful documents were obtained from another source. The procedure is described in Chapter II and the relevant information acquired is listed in Appendix 4. This information which is in the archives of the Tribunal de Contas is a collection of documents referring to tax collection by parishes "Décima da Cidade de Lisboa e o seu Termo"(47), which give a guide to the number of buildings built each year on the different streets, but without giving the exact location of the buildings. These records refer to payment of taxes by people living
In all Pombaline Area

<table>
<thead>
<tr>
<th>Phases</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>0.3</td>
<td>6.6</td>
<td>2.5</td>
<td>6.6</td>
<td>19.7</td>
<td>6.6</td>
<td>5.0</td>
<td>13.0</td>
<td>19.0</td>
<td>4.8</td>
<td>10.8</td>
</tr>
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<td>21</td>
<td>8</td>
<td>21</td>
<td>62</td>
<td>21</td>
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<td>41</td>
<td>60</td>
<td>15</td>
<td>34</td>
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<tr>
<td>2</td>
<td></td>
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<td></td>
<td></td>
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</tbody>
</table>

Fig.305 - Location of buildings of different types
in buildings and the documents are divided by parishes and the parishes by streets. The numbering of the buildings in the register is arbitrary and does not correspond with the numeration today. Parts of a street can belong to different parishes, the registers are not constant or similar, they do not exist for all years and for some years they are incomplete. Also each parish contains different parts of many streets, corner buildings sometimes belong to one street and sometimes to another. A determining feature is the name of the owner of a building, (although the registers also include payments by servants or people living in single rooms). Therefore considerable interpretation of the information is required. Due to the excessive time needed for a detailed search of all volumes in archaic Portuguese, the analysis was done in approximately ten year intervals (between 1760 and 1830) and was restricted to Parishes of S. Julião and S. Nicolau which include two main streets, Augusta Street and part of Aurea (Ouro) Street, three secondary streets, half Sapateiros Street, half Correeiros Street, half of two transverse Streets, Conceição Street and S. Julião Street (see Fig. 306). The data are presented in Appendix 4.1. An analysis of the data for these streets is presented below in Table 5.2:

Table 5.2 Number of buildings on the six selected streets at particular periods

<table>
<thead>
<tr>
<th>Year</th>
<th>1760</th>
<th>1763</th>
<th>1769</th>
<th>1782</th>
<th>1790</th>
<th>1801</th>
<th>1810</th>
<th>1820</th>
<th>1831</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augusta Street</td>
<td>0</td>
<td>18</td>
<td>42</td>
<td>51</td>
<td>51</td>
<td>51</td>
<td>54</td>
<td>55</td>
<td>55</td>
</tr>
<tr>
<td>Aurea Street(a)</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>14</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>Correeiros Street(b)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>23</td>
<td>22</td>
<td>23</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>Sapateiros Street(b)</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>11</td>
<td>16</td>
<td>15</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Conceição Street(b)</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>S. Julião Street(b)</td>
<td>4</td>
<td>4</td>
<td>9</td>
<td>11</td>
<td>14</td>
<td>17</td>
<td>15</td>
<td>17</td>
<td>17</td>
</tr>
</tbody>
</table>

(a) just a part of street (b) half street

In 1900 (when the streets had been completely rebuilt), Augusta Street had 58 buildings, Aurea Street had 43 buildings, half Correeiros Street had 24 buildings, half Sapateiros Street had 19 buildings, half Conceição Street had 13 buildings and half S. Julião Street had 17 buildings. These are therefore considered as the final numbers of buildings for those streets.

Table 5.3 expresses the number of buildings completed at each period as a percentage of these final numbers.

By 1790 (Table 5.3) approximately 85% of the final number of buildings had been constructed on all streets. Therefore the major differences occurred during the period up to 1790.
Parish of S. Nicolau
Parish of S. Julião
Pombaline area (see Glossary)

Phase 1
Phase 2
Phase 3

Fig. 306 - Location of buildings of different phases
Table 5.3 Evolution of construction between 1763 and 1900 (in each ten years)

<table>
<thead>
<tr>
<th>Years</th>
<th>1763</th>
<th>1769</th>
<th>1782</th>
<th>1790</th>
<th>1801</th>
<th>1810</th>
<th>1820</th>
<th>1831</th>
<th>1900</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streets</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Augusta (a)</td>
<td>31.0</td>
<td>72.4</td>
<td>87.9</td>
<td>87.9</td>
<td>93.1</td>
<td>93.1</td>
<td>93.1</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Aurea (a)</td>
<td>16.3</td>
<td>16.3</td>
<td>16.3</td>
<td>32.6</td>
<td>44.2</td>
<td>44.2</td>
<td>44.2</td>
<td>41.9</td>
<td>100</td>
</tr>
<tr>
<td>Correeiros (b)</td>
<td>00.0</td>
<td>00.0</td>
<td>12.5</td>
<td>95.8</td>
<td>91.7</td>
<td>95.8</td>
<td>95.8</td>
<td>95.8</td>
<td>100</td>
</tr>
<tr>
<td>Sapateiros (b)</td>
<td>00.0</td>
<td>15.7</td>
<td>57.9</td>
<td>84.2</td>
<td>78.9</td>
<td>84.2</td>
<td>84.2</td>
<td>84.2</td>
<td>100</td>
</tr>
<tr>
<td>Conceição (b)</td>
<td>23.0</td>
<td>46.1</td>
<td>76.9</td>
<td>84.6</td>
<td>92.3</td>
<td>84.6*</td>
<td>84.6*</td>
<td>84.6*</td>
<td>100</td>
</tr>
<tr>
<td>S. Julião (b)</td>
<td>23.5</td>
<td>52.9</td>
<td>64.7</td>
<td>82.3</td>
<td>100</td>
<td>88.2*</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

* The less number of buildings is due to the fact corner buildings sometimes belong to one street and sometimes to another.

It is clear from the table that most of Augusta Street was built before 1782, which may be due to its importance linking Comércio Square and Rossio Square. The small growth of Aurea Street is in part due to the fact that on the left side from Comércio Square the properties were large and also due to the fact that in some years parts of streets are omitted from the registers. Due to the obvious incompleteness of this data it was decided to omit Aurea Street from the analysis. The secondary streets only showed significant construction activity for 1782 and after. Although transverse streets, Conceição Street and S. Julião Street were of some importance due to the fact that they link the Castelo Hill and S. Francisco Hill. Until 1769 the construction of other secondary streets, Correeiros Street and Sapateiros Street was insignificant, and even by 1782 the half of Correeiros Street investigated had only three buildings out of the final 23. From the table it is possible to conclude that, between 1760 and 1782, there was a significant amount of construction in the main streets and a lesser extent in the transverse streets, a fact also confirmed by descriptions of travellers in 1771, "...everyday a new building starts to be built..."(20)(see Appendix 4.3). After 1782 construction activity clearly declined. This coincided with the end of Pombal's regime (1778) and the instability created by the intentions of Spain and France to invade the country (see in Appendix 4.2 a resume of historical events during the reconstruction period). The discontinuity of the data register in 1801 may be due to the French and Spanish invasion.

The tables of building completions on different streets do not identify individual buildings, although it should still be possible, by comparison of this data (Table 5.3) with data of the frequency of occurrence of the proposed building phases on the different streets (see Fig. 305), to determine whether the different proposed phases do indeed represent an evolutionary sequence.

The three proposed principal phases are phase 1 with stairs at front (which includes types 1 to 3) phase 2 with stairs at the rear (which includes types 4 to 8) and phase 3 with stairs in the middle and corridors consolidated (which includes types 9 to 12).
The distribution of buildings belonging to the different types and phases is represented in Figures 305 and 306 respectively. The numerical distributions of the different types within streets are presented in Table 5.4 below.

Aurea Street is not considered for the reasons given previously and also due to the fact that most of the left side of this street from Comércio Square was rebuilt at the beginning of this century and in addition part of the street was destroyed by a fire in 1991.

Table 5.4 The distribution of buildings within the three proposed phases

<table>
<thead>
<tr>
<th>Types</th>
<th>stairs at front</th>
<th>stairs at rear</th>
<th>stairs in middle</th>
<th>total n. of buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n.</td>
<td>n.</td>
<td>n.</td>
<td></td>
</tr>
<tr>
<td>phase 1</td>
<td>phase 2</td>
<td>phase 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Augusta</td>
<td>0 6 1</td>
<td>6 8 1 5 2</td>
<td>4 3 3 6</td>
<td>45</td>
</tr>
<tr>
<td>Correeiros</td>
<td>0 3 3</td>
<td>2 5 0 2 5</td>
<td>11 3 5 3</td>
<td>42</td>
</tr>
<tr>
<td>Sapateiros</td>
<td>0 3 1</td>
<td>0 6 0 3 4</td>
<td>5 3 4 4</td>
<td>33</td>
</tr>
<tr>
<td>Conceição</td>
<td>0 3 0</td>
<td>1 6 5 1 1</td>
<td>2 0 3 3</td>
<td>25</td>
</tr>
<tr>
<td>S. Julião</td>
<td>0 0 0</td>
<td>2 3 1 0 2</td>
<td>0 0 0 1</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>20 71</td>
<td></td>
<td></td>
<td>63</td>
</tr>
</tbody>
</table>

It is clear (Table 5.3) that most of the buildings in Sapateiros Street and Correeiros Street were built later than the buildings in Augusta Street. One would expect that if the 12 types identified are in a chronological sequence there would be a much greater percentage of buildings belonging to the "earlier" types (phase 1) for Augusta Street and a much greater percentage of buildings belonging to the "late" types (phase 3) for Sapateiros Street and Correeiros Street. When the data are amalgamated as below into three principal categories of, stairs at the front, stairs at or near the rear, and stairs in the middle, there is no strong trend apparent between different streets.

Table 5.5 Distribution of buildings within the position of stairs.

<table>
<thead>
<tr>
<th></th>
<th>Stairs at the front</th>
<th>Stairs at the rear</th>
<th>Stairs in the middle</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Augusta Street</td>
<td>15.6</td>
<td>48.8</td>
<td>35.6</td>
<td>100</td>
</tr>
<tr>
<td>Correeiros Street</td>
<td>14.3</td>
<td>33.3</td>
<td>52.3</td>
<td>100</td>
</tr>
<tr>
<td>Sapateiros Street</td>
<td>12.1</td>
<td>39.4</td>
<td>48.5</td>
<td>100</td>
</tr>
<tr>
<td>Conceição street</td>
<td>12.0</td>
<td>56.0</td>
<td>32.0</td>
<td>100</td>
</tr>
<tr>
<td>S. Julião Street</td>
<td>00.0</td>
<td>88.9</td>
<td>11.1</td>
<td>100</td>
</tr>
<tr>
<td>average</td>
<td>13.6</td>
<td>47.6</td>
<td>38.8</td>
<td>100</td>
</tr>
</tbody>
</table>

However in comparing Augusta Street with the two other streets there is a small but significant change in the balance of buildings with stairs in the middle and stairs at the rear, suggesting a later emphasis on stairs in the middle.
Although there does appear therefore to be a tendency during the later stages of the development to construct interiors of buildings with stairs in the middle there is clearly no distinct chronological demarcation between the three suggested principal phases, which must have been built alongside each other at different times.

Moreover, S. Julião Street does not follow the pattern set by Augusta, Sapateiros and Correeiros Streets. It has a higher proportion of late (1782-1790) buildings than Augusta Street, yet it only has one building with a middle staircase.

There are a number of factors, other than the adoption of specific types at specific periods, which may have produced the wide variation observed in the internal plans.

One is client demand allied to the wide range of different architects or builders involved in the projects. For example older well established architects may have opted for more traditional designs whereas younger less experienced architects may have been more innovative. Second it is also probable that builders linked specific types of stairs to different clients, (see Fig.307) who had different preferences for the interior plan of their accommodation related to their lifestyles, different perceived functions and probably of most importance, the levels of their wealth. This could have influenced their choice of architect, possibly including foreign architects.

Fig.307-Examples of particular buildings not falling into the three principal categories.
A third possibility is that it was a deliberate decision on Pombal’s part to pander to the requirements of the new merchant class, so that some of the early houses were the residences of important people, built with some of the characteristics of palaces, such as complex stairs, or the absence of corridors. In other cases, people built in order to rent so the stairs are economical and narrow and the houses have corridors for better circulation which is more appropriate for rented rooms. Thus, a range of different internal plans were devised, some more elaborate and expensive than others, to cater for the differences in importance or wealth of different clients. Fourth, in some cases, perhaps due to financial constraints, construction of a building may have taken many years, resulting in a late occupation and a consequent later registration in the Tax Collection record. Financial constraints may also have limited the use of skylights and hence also of central staircases. There are also a few cases (about ten) where it is difficult to identify the particular phase to which the building belongs (see Fig. 307). In these cases the form of staircase and the corridor arrangement clearly indicate later building but the position of the stairs could be due to the particular preference of the client.

Whatever the reasons for this diversity they were clearly sufficient to prevent the severe repetition, modulation and standardisation of the façades from dictating the internal plans and restricting variation.

V.5. Summary

The current chapter has described the differences in the internal plans of the Pombaline rentable buildings principally in relation to the design and location of the stairs and the detailing and finishing of the stairways. This enabled the author to classify the stairs into certain distinct types, from type 1 to type 12. The similarity of some of the internal plans with those of medieval buildings and some with those of more modern buildings suggested to the author that the different types of internal plan represented an evolutionary sequence, and these were presented as three separate phases. These phases represent the movement of the stairs from the front of the buildings, in the early phase, to the rear of the buildings, in the intermediate phase, to the middle of the buildings, in the final phase.

From existing records, data were obtained of the number of buildings completed at approximately ten year intervals over the complete period of the rebuilding programme (1760-1831) for five of the streets. Comparing the distribution of
buildings of different types or phases within each street with the numerical growth of the buildings in each street, it was possible to assess whether the suggested phases represent an evolutionary sequence. For example, Augusta Street was mainly completed at a relatively early stage in the rebuilding programme whereas other streets (i.e. Sapateiros Street and Correeiros Street) were completed at a later stage. One would therefore expect a much greater proportion of buildings in Augusta Street to belong to the proposed early types and the reverse to be true for Sapateiros Street and Correeiros Street. Although such a strong relationship was found not to be the case and the distribution of the different types tended to be similar in all streets there were significant trends apparent in the data. In particular the proportion of buildings with stairs in the middle tended to be higher in the streets built later and lower in the streets built earlier. The reasons for this trend are however not clearly apparent. The wide variability in types of internal plan cannot therefore be simply attributed to an evolutionary process and may have resulted from a number of possible influences. These are suggested to be client choice, variation in style and approach by the many architects and builders involved in producing the interiors, economic factors and the Marquis of Pombal pandering to the requirements of the new merchant class. It is suggested that a combination of these influences together with the possibility of a number of other unknown factors, contributed to the final result which can be seen today.

It would be expected that the massive rebuilding programme initiated in the capital city of Portugal after such a devastating earthquake would have repercussions much wider than the confines of the city of Lisbon. Therefore the next chapter will try to determine if the innovations brought about by the Pombaline buildings were exclusive to the Lisbon area, or whether other areas were influenced by these developments. To do this, a number of developments contemporary with or following the Pombaline rebuilding will be examined. These are the nuclei of Vila Real de Santo Antônio, Manique do Intendente and Porto Côvo. A comparison will be made of these developments with that in Lisbon, to determine whether the type of reforms introduced by Pombal in Lisbon influenced these more outlying areas.
CHAPTER VI. THE POMBALINE RENTABLE BUILDING IN PORTUGUESE ARCHITECTURE.

VI. 1. Other contemporary Pombaline developments

VI. 1.1. Introduction

In the half century preceding the 1755 earthquake, the Portuguese economy was apparently buoyant since important reserves of gold and diamonds had been discovered in Brazil. This unexpected flow of wealth was increased still further as valuable wood, tobacco, sugar and hides were sent over. The court of D. João V in its extravagance was to squander this wealth on costly monumental buildings and displays, and was not in the least concerned about modernising industry and agriculture. With the plentiful supply of gold and diamonds they simply bought manufactured products from abroad, especially from Britain, instead of consolidating the national economy, and the country’s industry and agriculture remained neglected.

Following the death of D. João V, D. José I inherited a deep crisis: the coffers at the treasury were completely empty and gradually all the wealth from Brazil was drained away. The economy was virtually paralysed as it was dependent on the production of manufactured goods from abroad. Without any gold to purchase goods and with uncompetitive national production, commerce was in a serious crisis and this affected the revenue of the state. The conflict in Europe, the "Seven Years War", found the country in a difficult situation not only in economic but also in military terms.

In order to achieve a good balance of payments Pombal, the minister of the Crown, first attempted to reduce imports and to provide incentives for the production of those goods that were necessary to the population. Alongside the attempted economic and industrial reorganisation of the country there was also a military reorganisation.

The imposition of a new economic and administrative order was to be affirmed with the construction of urban developments in certain parts of the country with economic potential, (Fig.308). This increase in the construction of urban developments in Portugal was not an isolated phenomenon. All over Europe planned cities, such as St Petersburg, Bath, Edinburgh and Amsterdam, were being built or reconstructed(46) in some cases as a utopian display. In Spain many cities were built. In Portugal urban centres were built or rebuilt in order to implement Pombal’s reforms, and were all to some extent characterized by simplicity and austerity dictated by functional necessity rather than theoretical choice.
VI,1.2. The urban developments

The reconstruction of Lisbon was not an isolated phenomenon although it is better known than other contemporary developments due to the importance of its location, size and the techniques involved given the urgency of the situation and the particular conditions of the unstable land on which it was built.

If the case of Lisbon is more complex, the other developments can not be ignored as they enable an understanding of the amplitude of the Pombaline phenomenon. To understand completely the Pombaline phenomenon in Lisbon, it is necessary to understand the other developments which have in common: the fact that buildings are organized in blocks, where the rentable buildings dominate; construction is standardized, modulated and repetitive; and their character is austere in relation to the contemporary architecture of the time. On the other hand different conditions led to some different characteristics in each development.

Vila Real de Santo António, a completely new planned town, on a flat site free of buildings, designed along very similar lines to colonial cities, was built because of the country's economic policy in relation to the Algarve (46).

Porto Côvo Bandeira is a development that was financed by a merchant, in order to improve the development of the Alentejo. Its most important feature is the way in which the traditional style of housing in the region was adapted to the Pombaline concepts (59).

Manique do Intendente was built after the fall of the Marquis of Pombal, by an important police superintendent in order to develop a large, fertile agricultural area (60).
VI.1.3. Vila Real de Santo António

The construction of Vila Real de Santo António was undertaken from 1773 onwards as part of the attempt to reorganise the economy of the country through industrial development and tighter tax and customs controls. The Algarve, a region where fish were plentiful, had up until then been practically abandoned (46). The Portuguese treasury annually lost huge sums through tax evasion and smuggling, while the Spanish made huge profits (46). As the difficulties of a period of economic depression grew, the economic potential of the region and its strategic position in relation to Spain began to be regarded in a new light. The need to create an urban centre for the control of port transactions at the end of the Algarve coastline by the Spanish border was recognised and the new town was intended as a display of political power to the neighbouring Spanish city of Ayamonte (Fig. 309) (46).

Thus on the 17th of December 1773 the first building work on the new city was begun on wetlands by the mouth of the Guadiana River, and as in the Pombaline quarter of Lisbon, military engineers were in charge. Monopolistic and private companies were invited to establish themselves in accordance with the plan drawn up by the architect Reinaldo Manuel, by express order of the Marquis of Pombal, with the same rights and duties as those who had taken part in the rebuilding of Lisbon (61).

The first building to be constructed was the Customs House, followed by the military barracks, public buildings and Company offices. Homes came last, which is why, in order for them to be built faster, fishing villages such as Monte Gordo, were torn down or burnt down, to provide new inhabitants (46). The construction of the new town was finished in 1786.

The plan, as in Lisbon, consisted of a rectangle, with one of the long sides facing the river, to the east. The rectangle was cut by 5 streets in a North-South direction and six orthogonally in an East-West direction. All the streets were the same width and they contained 43 blocks; 32 of which were identical in size, being 240 palms by 100, (Fig. 310).
Like the Pombaline area the grid has a North-South orientation, but in contrast to Lisbon the whole area was organised around a large central square close to the river, (Fig. 311 and 312), with no separation between the location of rentable buildings and Public buildings.

Fig. 310-The darker area represents the original town of Vila Real

Fig. 311-The Central Square

Fig. 312-The Central Square
Whereas in the Pombaline quarter of Lisbon the hierarchy of the rentable buildings was reflected only in street widths and architectural details, here the number of storeys was an additional and important distinguishing feature, (Fig.313).

![Fig. 313-The hierarchy of the buildings](image)

The most important rentable buildings had two levels whereas the less important only had one, and houses of the same type usually had the same area.

In terms of decoration, only the Custom House and the Church had individually designed façades and the volume and proportion of the Custom House were very close to those of the rentable buildings. However, the height, proportions and volume of the Church (Fig.313) are significantly greater than those of the other buildings, and it has a central position in the Square, and in this way the church is given greater emphasis than the few rebuilt churches in the Pombaline quarter in Lisbon.

In Lisbon there had been problems over the redistribution of property, from the old urban plan to the new one, resulting in different frontages; this problem, however did not arise in Vila Real. Only the two storey buildings have the corners of the blocks decorated with stonework pilasters, as all the blocks do in Lisbon.

The most important buildings, the Customs House and the buildings at the ends of the riverfront avenue and the corners of the square, had balcony windows on the first floor and mansard roofs very similar to those of Arsenal Street and Rossio Square in Lisbon, (Fig.314), but there is more extravagant ornament in the Custom House, and the combinations of mansard and dual pitched roofs and single storey and two-storey buildings give the whole town a more varied and less austere character than the Pombaline quarter of Lisbon.
After the Customs house and the corner buildings in the hierarchy came the
Company buildings (situated on the seafront) which are also distinguished by first
floor balcony windows. Later on the buildings in the square were built, with two
floors only. The remaining buildings, as they were less important, had only one level,
(Fig.315).

![Fig.315-The Society buildings]

At the rear of the blocks along the river front were single storey salting houses,
and the next blocks back from the river front were occupied by warehouses which
were a combination of single and two storey buildings, and were used for storing salted
fish, (Fig.316). Apart from the two-storey buildings in the square with mansard
roofs, the remainder of the town was occupied by single storey houses.

![Fig.316-The single storey houses]

The central square formed an important focus of the plan. The buildings here have
two floors, and as usual the first floors were occupied by flats and the ground level
was used for commerce. On the north side of the square was the Church, on the south
side the Guardsmens’ Quarters and on the east side was the prison.
VI.1.3.1. Architectural typology

As in the Pombaline quarter of Lisbon, there is a hierarchy of types of streets and squares rather than blocks. In Lisbon, different levels in the hierarchy are distinguished only by architectural details such as window types and surrounds; in Vila Real, however, there are four quite distinct architectural types: the river front buildings, the buildings in the square, the single storey houses with towers and the single storey houses without towers.

The river front buildings: Twelve company buildings are grouped in six blocks of two buildings each. They have two main storeys, and a third lit by dormer windows. First floor French doors opened onto stone balconies with iron balustrades, connected by a stone string course, and there are mansard roofs at the ends of the blocks, (Fig.317 and 318). The iron balustrades are more ornamented than in Lisbon with a non modular composition but they are repetitive and symmetrical, as in some later Pombaline buildings in Lisbon.
As in some of the buildings in the Pombaline quarter of Lisbon, here there is a stairway in the centre of each building serving the two flats on the first floor. Hence the main entrance is always located in the middle of the property, and is emphasised by a decorative dressed stone surround.

The interior of the houses was very simple with all the rooms interconnecting and no corridor, but unlike in the Pombaline quarter, here the rooms were well-lit and airy as the larger ones had windows on opposite sides and a spacious rear courtyard.

The one room deep river front flats contrast with the two room deep flats in the square and the three room deep ones in the Pombaline quarter of Lisbon.

In terms of construction the ground floor had thick stone walls, and some rooms were vaulted, (Fig.319). As in Lisbon the stairs had two flights, the first being in stone for safety reasons. The walls of the residential floor had an anti-seismic wooden structure incorporated into them, similar to that seen in the Pombaline quarter in Lisbon.

Fig.319-Isometric showing construction of a sea front house, Company building

Finishes were very similar to those in Lisbon, with façade stonework, steps, skirting boards, ceilings, windows and doors being identical, (Fig.320 and 321), with the exception of the main entrance door which is more Baroque than in Lisbon. The elevational treatments of each block were those appropriate to their respective streets as in Lisbon.
The roof structure was very simple and repetitive, covered by wooden boards on which the tiles were laid, (Fig. 323, 324 and 325).

The houses at the ends of the blocks of river front houses have mansard roofs, similar to the Rossio buildings in Lisbon; but they are square in plan, were referred to as towers (Fig. 326), and create more variety than is found in the Pombaline quarter.

The river front houses have a rear courtyard with arcaded salting houses on three sides, (Fig. 327), another feature not found in the Pombaline quarter.
The buildings in the square: The openings in the front elevations are perfectly aligned both vertically and horizontally, and are five palms wide, (Fig. 328).

In each building the upper residential level had two flats both served by the same stairway. Each flat was two rooms deep with the front rooms facing the street and the rear rooms facing the garden. There was no internal circulation space: the rooms were interconnecting. As in Lisbon these buildings have repetitive elevations with the internal layout varying from one building to another. As all buildings of the square were built simultaneously, the interior layout must have been defined by the occupants' needs.
Typical corner house in the square: The buildings at the corners with mansard roofs, had shorter frontages and each building had two first floor rooms and a third room in the mansard roof, (Fig. 329).

The finishings are similar to those of the river front houses (Fig. 330), but the structure of the mansard roof is quite complex, (Fig. 331 and 332).
The single storey houses: The sixteenth century military roots of the authors of the plan are revealed in the perfect alignment of these houses in blocks.

Their height was 12 palms, the height of the first floor of the houses on the square, edged by a frieze on which the eaves rested. Most of the houses have been altered. The short side of each block was divided into two houses, (Fig.333 and 334). Unlike the Pombaline buildings in Lisbon, here parapets alternate with eaves.

In keeping with the smaller scale of the buildings, the window widths were reduced to 5/6 palms, whereas on the squares the windows were 6/7 palms wide. The long sides of each block had two identical halves each with five doors and 5 windows, placed alternately but with "twin" doors in the centre and windows at the ends.

There were four types of houses A, B, C and D, (Fig.335). All the single storey house types had gardens, the size of which varied in accordance with a 10 palm modulation. The length of the garden was planned to allow for extensions. Modulated design has been used to regulate the plans as it has been in the Pombaline Area, but in a rather different way.
The type A houses have two or three interconnecting rooms, two facing onto the street with a door and a window respectively. The third room, when present, has the same length as the other two combined and faced onto the garden, forming the kitchen area.

In constructive terms, the single storey houses were characterised by their extreme simplicity and the absence of any decorative feature, (Fig.336).

![Fig.336-Isometric showing construction](image)

These houses have stone walls on which couples of rafters rest, tied by collars and with no ceiling. The tiles were laid on reeds which helped to insulate the houses. The floors were tiled. The openings, especially the doors, were very simply designed. The stonework on the façade was similar to that seen in Lisbon on less important streets, (Fig.337)

![Fig.337-A window from the interior and structure of the roof](image)

V.1.3.2. The construction system

Mass production of building components, a basic principle of Pombaline architecture in Portugal, accompanied by standardisation and pre-fabrication of
components, was also used in Vila Real de Santo António\(^{(46)}\). Due to administrative requirements it was necessary to build a large new town rapidly, in a place where the existing organization in the building sector was inadequate. Many of the stone components such as plinths, quoin, lintels, steps and pilasters, and most of the wooden components such as doors, windows, beams and floorboards were prefabricated, possibly in North Portugal and in Lisbon, and were transported by sea\(^{(46)}\). The components used in the river front buildings are exactly the same in dimensions and form as those used in Lisbon. Those used on other buildings are however different in dimension.

Pre-fabrication of the components was only made possible by the easily permutable nature of the components established at the outset of the project. Thus, for example, the eight palm long stones could be used equally well as doorposts on the façades of the river front buildings and for the first floor windows of the buildings in the square, or even for the ground floor window sills of the buildings in the square or window jambs of the single storey houses.

The form of construction was also very similar to that of Lisbon, the party and exterior walls being in stone, while inside there were timber framed partition walls with St Andrew’s crosses incorporated into them. Arches in brick were used to tie the foundations together and for some walls. Some rooms, especially those next to the stairs, had vaulted ceilings supporting the first floor in order to guarantee greater safety in the event of fire or earthquake.

The stairs rise in the centre of the building, so as to give them greater stability, with two identical straight flights but with the first in stone. The roofs had wooden structures which were covered in tiles.

VI.1.4. Porto Côvo

Between Lisbon and the Algarve there is a large, rich, cereal-growing region which also has substantial mineral deposits. During the period of the Pombaline reforms, an attempt was made here also to develop the economic potential of the region. Early in the nineteenth century, a merchant called Jacinto da Costa Bandeira (1786-1853) sought to turn the small fishing and farming town of Porto Côvo into an important trading post\(^{(62)}\). The choice of Porto Côvo was due to the fact that it was situated next to a natural harbour on a long coastline that is dominated by cliffs. In the First Century, the Romans are said to have used the harbour as an anchorage point and the town as a trading post\(^{(59)}\).

In the Archives of the Torre do Tombo it is possible to find the original plan attributed to António Martim Quaresma which was abandoned. The actual urban plan of the town is more simple and practical, with a central square and one main street running from it towards the sea, (Fig. 338).
The whole urban centre is made up of numerous single storey houses all aligned (Fig. 339), with the exception of the four houses at the corners of the square which have two floors (Fig. 340), similar to the square of Vila Real de Santo António.

From an architectural point of view we can see the typology of traditional housing in the region being adapted to a repetitive scheme and built in a rational manner, using the same principles of austerity as in Lisbon, (Fig. 341).

In the square each house had a window and a door at the front; the openings had projecting lintels, jambs, and sills or doorsteps in stone which like the plinth were painted with a blue oxide; the houses were not distinct from one another since the façade and the eaves were continuous. As in Lisbon the symmetrical dual pitches were punctuated, but by chimneys in this case rather than by parapet walls as in Lisbon.
There is a great variety of heights and forms in Porto Covo compared with Lisbon, for example the two-storey towers in the corners of the square, the different scale of the church compared with the rentable buildings and its focal position in the square.

Generally speaking, the majority of the houses consisted of two equal rooms, similar to those of Vila Real, with a back garden. The main room had two doors, one onto the street and the other at the back, and an enormous fireplace where food was not only prepared and cooked but also eaten (Fig. 342 and 343). Unlike the Pombaline area and Vila Real, here the interiors are repetitive.

In constructive terms, the walls of clay, lime and stones were whitewashed both inside and out, (Fig. 344). The external walls were thick but the partition was thinner. Given the fragility of the material of which the walls were made, all the openings had relieving arches above the lintels. The roof structure was timber, consisting of a ridge tree and pairs of rafters.
Two storey houses

These houses, on the four corners of the square, are similar in some ways to the ground floor houses. The upper floor with a complex roof structure housed a single room, (Fig. 345 and 346).
VI.1.5. Manique do Intendente

The creation of Manique do Intendente is attributed to a Police Superintendent during the reign of D. Maria I, called Pina Manique, who, being from the area, is said to have wanted to build a town that would accommodate workers and their families to develop a very rich agricultural region, \(^{60, 61}\) at the end of eighteenth century.

The authorship of the plan is questionable, but is attributed to José da Costa e Silva. It is defined in urban terms by an unpaved central hexagonal space (Fig. 347), the Imperial Square, defined in turn by four trapezium shaped residential blocks, with a column in the centre and the Town Hall building (now a police headquarters), on the North side of the hexagon, (Fig. 348).
The rentable buildings in the square are terraces of two storey houses with no courtyards or garden at the back. Each block consists of seven buildings, five of which are rectangular while those at the end have greater areas and a trapezium shape. The composition of the façade is very simple, each building has a ground level with two openings, one door and one window, and on the upper level there are two windows that line up perfectly with the openings on the lower level. All the openings are surrounded by dressed stone work with a stone plinth at the base and eaves above, (Fig. 349 and 350)

Compared with Lisbon there is a greater diversity of form and space exemplified by the hexagonal central space and the trapezium plan-shape of the blocks. As with the Church in Porto Covo and the Customs House in Vila Real de Santo António, there is considerable contrast in both scale and lavishness of ornament between the Town Hall in Manique and the residential blocks. There is no hierarchy of buildings and there are no dormer windows or alfugeres.
As in Lisbon all buildings have the same height, but there is no variation of details of facades. Although the overall plans and overall building forms are more varied than the Pombaline quarter, and could be considered as "Baroque" by comparison, the same principles of austerity and repetition as in Lisbon can be seen in the façade design. The interior is also extremely simple, (Fig. 351, 352, 353 and 354).
The modulation of spaces was established in a simple way: half of the total area of the ground level was occupied by the kitchen, a quarter by the sitting room and the rest by the hall and the stairs. On the upper level there was a room which had the same area as the kitchen and another smaller one identical in size to the sitting room, thus there was a perfect alignment of the internal walls on the upper and lower levels. Unlike Lisbon and Vila Real the interiors are repetitive without any variation.

The stairs were a single straight flight of fifteen steps and fitted in between the two walls. On the upper floor the landing was protected by a wooden balustrade. The floors were all in wood as were the ceilings; the internal walls were thin wooden partitions without any stonework. The outer walls were of brick and thicker on the lower level, (Fig.355). The houses are finished in a very simple style with no skirting boards, in a similar manner to those of Vila Real.

![Fig.355-Isometric showing construction](image)

The Pombaline area in Lisbon is richer in variation of details of compositions, as in the case of the elevations. In common, however are the principles of simplicity, repetition, economy and standardization. The dressed stone window and door surrounds are not identical in all the developments, but there are some common sizes and the palm is the common module. (Fig.356)
Fig. 356 - Comparison of dimensions from elements of façades
VI.2. The Pombaline architecture as architecture of rentable buildings

The new Portuguese urban developments of the later eighteenth century appeared at a time when the construction of palaces, public buildings, or churches took second place, since throughout this period of austerity, in an attempt to lead the country towards economic recovery, priority was given to utilitarian blocks of rentable buildings.

Pombaline architecture, in stylizing, systematizing and homogenizing the pre-existing elements, in a rational way, found a form, a complexity and an elegance of its own.

The architects and engineers with their military background, removed from an explicitly artistic environment, opted for a neo-classical style, more out of functional necessity than theoretical choice, returning to the values of the architecture which had previously been adopted during a period of economic austerity, the "Chã" architecture.

This was not the architecture of outstanding buildings but the type of architecture which is born under the sign of urbanism where the fundamental typology was the rentable building. It was a period in which churches were considered to be of little or no importance when compared with the preceding periods.

As the construction of whole blocks of buildings in Lisbon continued for many years, it is difficult to distinguish individual attributes. However, it is possible to find in the style the characteristics, which are:

i. The buildings were always grouped in blocks with repetitive modulated façades.  
ii. The hierarchy of buildings is established only through the variation of minor details.  
iii. A practicality in terms of construction is evidenced by a great simplicity and repetition.  
iv. Technical innovations against earthquakes are incorporated in the form of an anti-seismic structure.  
v. A standardized construction is adopted to facilitate prefabrication.  
vi. A careful selection of traditional components without decoration is made in order to achieve maximum flexibility, adaptability and ease of assembly on site.  

vi. There is a great variety of interiors; the plans are different from one building to another.
VI.3. Summary

The urban developments described above were all planned and built under the Enlightened régime of the Marquis of Pombal. The period was dominated by rentable buildings always grouped in blocks within a rational urban plan. Whilst, however, the Pombaline quarter is characterised by extreme repetitiveness, uniform building height and elevational treatment and a completely orthogonal plan, the other three developments all have greater variety of one kind or another, giving them a character which could be described as "Baroque", as opposed to the "Classicism" of the Pombaline quarter.

In Vila Real and Porto Covo, the "Baroque" character is achieved through the punctuation of the residential blocks by "tower" buildings, and in Vila Real, by the contrast between parapets and eaves in the single storey houses, and the variety of form given by the arcaded salting houses. In Manique do Intendente, the "Baroque" character is generated by the use of the hexagonal central space and trapezium shaped blocks. In all three developments, focal points are provided by public buildings which differ radically in height, scale and lavishness of ornament from the rentable buildings.

In the Pombaline quarter, the public buildings in Praça do Comércio are far more richly ornamented than the rentable buildings, and they are given a grander scale by the use of a classical order extending over two storeys, but their identical overall height with the rentable buildings ensures a substantial homogeneity.

The strict adherence to both earthquake and fire precautions in the Pombaline quarter of Lisbon diminished to the observance in Vila Real of anti-seismic measures only. By the time Porto Covo and Manique were planned, even these seem to have disappeared, although possibly this can be attributed to their smaller scale.

Nevertheless it can be seen that the extreme practicality and austerity of the Pombaline quarter of Lisbon soon gave way to a richer variety of contrasting form and scale. At the same time, paradoxically, the variety of internal layouts in Lisbon and Vila Real gave way to repetition in Porto Covo and Manique do Intendente.

Perhaps the most lasting influence of the Pombaline quarter of Lisbon was the standardisation of window and door components and even more, the developments of symmetrical internal layouts frequently with staircases serving two flats on each floor, the rooms of each flat being accessed independently from corridors or hallways. This contrasts with the previous arrangements of staircases serving a single flat on each floor and within each flat, interconnecting rooms.

In Britain the change from interconnecting rooms to independent access to each room, from a central hall, linking with the staircase and the entrance, is seen as a change from sub-medieval to Renaissance layouts(63).
VII.1. The creation of the Pombaline rentable building in relation to the prevailing political and economic climate.

Unlike that which often happens to cities that have been destroyed by earthquakes, (which are either abandoned or are restored to their original state without major changes in concept or design), the centre of the city of Lisbon was totally transformed and the same unstable site was chosen to rebuild the city.

The decision to reconstruct the city on its previous site supported the interests of the new ascendant bourgeoisie. In the new plan there was no place for palaces for the nobility and churches were reduced to the same dimensions as the rentable buildings. The prohibition of rebuilding outside the city walls, increased trade demand and the values of land belonging predominantly to the middle class. During the complex transfer of property from the old grid to the new one, there was evidence that the process reinforced the interests of the new rising class. For example, small property owners had priority over the large ones and if they gained more space over other proprietors they were allowed to compensate with cash rather than property. (see Section 1.12). The chosen plan from the six considered, was the one prepared by Captain Eugénio dos Santos. This consisted of an orthogonal grid, which offered a more functional system to accommodate the extensive shop façades to the street and the economic interests of the owners, and also provided better and safer conditions.

Due to the particularly difficult circumstances, the Marquis of Pombal, the prime minister, relied on the expertise of architects and engineers with military background such as Manuel da Maia, Carlos Mardel and Eugénio dos Santos. Their influence marked the "Pombaline Style" by its austerity, rationality and practical necessity(see Section 1.11). During this period of economic crisis, precipitated by the earthquake, Portuguese Architecture again took refuge in a style dominated by repetition and the play of proportions. The simple and austere rentable buildings had their origins in the simplicity, proportion and repetition of the preceding austere period of architecture, the Architecture "Chà", (1580-1700) (see Section 1.9).

The mass-production of components used in the buildings from the social point of view, made it possible to level out external differences because it allowed most proprietors to achieve certain standards and levels of quality. The rebuilding programme created an economic and practical form of construction accessible for the first time to a much wider cross-section of the population.
There is no doubt that the reconstruction process encompassed several mechanisms which reinforced the position of the new rising class, (see Section 1.12), and the Pombaline Architecture as "Chã" Architecture, was a return to the frugal principles of the traditional architecture, in a period of great austerity.

VII.2. Innovative elements of the Pombaline Rentable buildings.

The decision to rebuild on unstable land and the necessity to minimise the effects from future possible earthquakes and consequent fire, stimulated many improvements and technical innovations providing also better living conditions (see Chapter IV).

The reconstruction was defined and regulated by precise rules and procedures right from the start at both the urban planning and architectural level. The imposition of orthogonal plans over an existing plan, was similar to contemporary new colonial cities such as México City (1688), Quito (1734) and Caracas (1750), with two large squares at the ends of the main streets enabling rapid escape from earthquake or fire (see Section IV.1). The rectangular blocks were generally aligned in a north-south direction to better withstand any tremors which tended to propagate in that direction in the area. Strict rules were imposed for the height of buildings and width of streets, with separated zones for vehicles and horses, and pedestrians, and with rigorous alignment of the façades. This would avoid possible injuries caused by collapsing of buildings and would make fire fighting easier (see Section I.8.3). In order not to hinder the escape of inhabitants, the profusion of decorative or utilitarian elements from the façades was not allowed. Separating the backs of the rows of buildings was a free space, the alfugere, where rubbish could be deposited and people would be more easily rescued in the event of a disaster. The wider streets and the alfugeres also allowed better daylighting and ventilation (see Section IV.1).

The instability of the land caused by the domestic waste and waters from the neighbouring hillsides were avoided by the creation of a sewage system (see Section IV.1).

In order to prevent the buildings from being damaged by a further possible earthquake, several features were included in their construction. An ingenious foundation system was created making use of solid arches supported on short timber rafts. Additional stability was given by vaults over the ground floor supported on thick stone walls and pillars (see Section IV.1). The height of the rentable buildings was established as the same as the Public buildings of Terreiro do Paço (see Section
with a commercial ground floor 16 palms in height and the remaining height divided into 3 floors. The composition of facades was conceived with a rigorous alignment of openings achieving a perfect balance of forces (see Appendix 6). To be able to construct a stable structure of three floors in height, a wooden structure or cage, which had already existed before the earthquake, was perfected and applied systematically with a complex network of struts (see Section IV.1). The elasticity of its connections would absorb the vibration of a quake. It would also allow more rapid construction (see Section IV.1). The external walls of the façades were tied into the cage in such a way that in the event of a severe quake the external walls would be released from the rest of the building without putting at risk the stability of the whole building, and the inhabitants could remain in the relative safety of the interior sections or compartments (see Section IV.1). The stairs were positioned preferentially on the axis of the building thus increasing its stability.

Other innovations were adopted in rebuilding the centre of the city as a result of the unusual and exceptional circumstances created by the disaster and also as a result of the need (for economic and social reasons) to rebuild in a short time period with a great shortage of materials and of specialized labour (see Section IV.2). The urgency and scarcity led to the development of new concepts and innovative methods, which involved elements of dimensional coordination, standardisation, modulation and mass production.

The approved plan followed a number of rules of proportion underlying the dimensional coordination and standardisation. For example, the urban plan was based on a series of Golden Rectangles enclosing rectangular blocks of buildings bounded on all four sides by streets (see Section IV.2.1).

The modulation of the facades, which conforms to regulated, geometrical relationships, not only gave equilibrium, rhythm and harmony but also allowed adoption of standardized construction processes for which the palm was the basic repeat unit of measurement (see Section IV.2.2). In general the overall lengths and widths of the blocks of buildings are exact numbers of palms and must have been determined by the design of the elevations. Also the dimensions of the internal plans were dependent on the modulation of the façades and this determined the depth of buildings via well-defined rules of proportion. Also the position of the interior walls followed certain principles which relied on particular geometrical rules (see Section IV.2.3).

Influenced by the repetitive and standardised nature of the buildings, it has been suggested by many authors (2, 20, 37), but not adequately demonstrated, that prefabrication was employed as a central feature of the reconstruction programme.
This was in order to accelerate the reconstruction and alleviate the problems of scarcity of materials and shortage of specialised labour, allowing the production of a great number of pre-conceived elements (see Section IV.2.4). It has been demonstrated in the current work that certain measures were taken by the Authorities to encourage mass production and to avoid speculation, creating facilities for the production and transportation of materials and components and even creating stockpiles by the establishment of a "stock exchange", to guarantee the supply of these (see Section IV.2.4). A search has been made for contemporary documents relating to the rebuilding which would confirm the oral tradition about prefabrication but unfortunately many documents have been destroyed. However, 13 buildings contracts have been found, and two of them include specific mention of building materials and components including stone steps, windows sills and jambs with dimensions in palms (see Appendix 4.5.iii and iv).

Observation in situ by the author does not reveal manufacturer's marks or signs for assembly but there does exist evidence that the components were conceived to adapt to any buildings. The production methods used at that time for the manufacture of components must have been inaccurate in both the external and internal layout. This is confirmed by the observation by the author of substantial manufacturing tolerances built into the design of some components. This allowed for a wide variability in dimensions. Thus for satisfactory assembly on site, the components were designed in such a way that they could be adjusted to fit spaces with varying dimensions or forms (see Section IV.2.4). For example, in the fitting of doors use was made of packing pieces to accommodate inaccuracies of construction of the gaiola and to adapt the doors in height, width and thickness. This provides a strong indication that some components were prefabricated and mass-produced (see Section IV.2.4). The joints were also conceived in such a way as to conceal any imperfection or to close off a composition easily without the need for special tools (see Section IV.2.4).

The façade components appear to be a simplification and modulation of those of an already existing building, the Ludovice Palace in Lisbon, such that they could be adapted to rational mass production. Other elements of the compositions of the façades clearly derived from other existing buildings of the period. For example, the cornerstones, frontons, balcony windows, brick vaults and stone staircases were common in homes of the nobility at that time (see Section I.9). A detailed study revealed that traditional components such as railings were, in order to be standardized, simplified to give uniformity of components, with stylized decoration to provide modulation (see Section IV.2.4). The designs selected were ones which offered the maximum flexibility and adaptability to different dimensional and
functional situations, with repeat patterns offering great versatility and allowing interchangeability. Components were chosen with an eye to function, without any embellishment, with great solidity and which allowed simple repeated composition. This suggests that the components were conceived to be produced in an anonymous and abstract way by craftsmen, remote from the workers who would assemble them.

Clearly the mentors of the Pombaline quarter did not achieve the extent of dimensional coordination current in some buildings of the twentieth century. The extent of prefabrication in the Pombaline buildings is not as great, and they included, for example, substantial amounts of rubble stone walling. However they did incorporate many standardised and possibly prefabricated components, especially dressed stone and joinery items, the use of which relied on effective dimensional co-ordination and mass-production and supply from stock when required (see Section IV.2.4). The components did not differ radically from those which were already produced by craftsmen to order, which can be seen in surviving buildings from before the earthquake, such as Ludovice House. They were merely simplified, standardised and designed with tolerances to allow adaptation and to accelerate their manufacture, by mass production and assembly on site. They could then have been produced in an anonymous and abstract way in workshops scattered throughout the outskirts of the city as well as the interior.

VII.3. Classification of the diversity of internal plan.

If many of the technical innovations were imposed right at the start, there were other innovations that appear to have been developed and refined during the long period of the reconstruction. This is evident in the internal plans which although restricted by the modulation of the spaces in the façades, and the standardized dimensions of the components (like doors or the cage struts) (see page 143) showed a high degree of variability. There were no two plans alike, although there were building lots that were the same. Also the great variety of the interior plans does not bear any relation to the orientation, location, or size of the property or to the composition of the external façade (see Section III.2).

The author has identified and classified 12 different types of internal plan based on the distribution of spaces with reference to the location of the stairs in the buildings. Some of them were similar to previous medieval buildings in Lisbon and others to more modern buildings which suggested the existence of an evolution (see
The suggested evolution is in 3 principal phases and represents the movement of the stairs from the front of the building to the rear and then later to the centre. In the earliest proposed internal plan, type 1, in order not to divide the shop, the stairs climb behind the street facade, reaching the first floor in a single flight. The single flight created the inconvenience of alternate plans for different floors with some entrances far from the kitchen. This was solved in type 2A with the use of dogleg stairs but then the synchrony of stairs with the openings of the façades was lost. In type 3, the use of a third dogleg staircase, made possible the synchrony of the stairs with the façades and simultaneously provided the entrance near to the kitchen, but this was an expensive solution. In the proposed phase 2, beginning with type 4, stairs start to be located at the rear of the building from the first floor up, and in type 5, they were completely located at the rear behind the alfugere façade, the openings of which could be synchronized because they did not need to be aligned. From type 6 to type 8 the stairs were brought slightly to the centre of the building in order to make use of a space behind the stairs to provide natural light. In phase 3, from type 9, there is the introduction of a glass skylight and the abandonment of stairs which climb alongside a wall or a "solid" balustrade. There was also the adoption of more complex open newel stairs, which made it possible to locate the stairs in the centre of the building and illuminate them with natural light. The complexity of the details associated with the proposed three phases did not change in a gradual way, and sometimes the finishes were of poorer quality in the proposed later phases (see Section V.3). An attempt was made to confirm the suggested evolution based on a documentary search to establish the dates of buildings but it was found impossible to determine precise dates for individual buildings. However a survey of tax records was undertaken in the Archives of Tribunal de Contas, which although not revealing the dates of individual buildings, gave the number of buildings completed on different streets at different periods (see Section V.4 and Appendix 4.1). Comparing this information with the distribution of the proposed phases amongst the buildings on different streets suggested that the proposed phases do not represent an evolution in the form of internal plan (see Section V.4). However the comparison does suggest a trend towards stairs in the middle in later buildings with a great abundance of stairs at the rear in earlier buildings. The wide variety of internal plan is attributed principally to client demand with different clients having different preferences for their accommodation, related to its perceived function, the client lifestyles and the levels of their wealth.
VII.4. The Pombaline area and other developments.

As a result of the great reforms inspired by the Enlightenment, during the eighteenth century numerous urban centres were built throughout Europe. Some examples are Bath, Edinburgh and Amsterdam (46).

In Portugal the phenomenon cannot be seen as an isolated development that only occurred in Lisbon as it was reflected all over the country as a response to the economic and administrative reforms that Pombal wished to impose. In Lisbon, where construction was dominated by the immediate need to reconstruct a city destroyed by an earthquake, the Pombaline quarter is characterised by extreme repetitiveness, uniformity of building height and elevation and a completely orthogonal plan. However in the other three contemporary developments studied in this work, although they contain elements of the Pombaline building they all have greater variety, giving them a character which could be described more as "Baroque", as opposed to the "Classicism" of the Pombaline quarter.

This was not the architecture of outstanding buildings, but the type of architecture which is born under the sign of urbanism, where the fundamental typology was the rentable building, with a commercial ground level and residential floors above, similar to those existing in Turin (44). It was a period in which churches were considered to be of little or no importance when compared with the preceding period.

The Pombaline rentable building appeared at a time of affirmation of administrative and political power and this is demonstrated in the construction of the new developments. The reconstruction of the city of Lisbon by the "Enlightened" regime of Pombal is an interesting case, not only because of its size but due to the fact that the reconstruction had been precipitated as a result of a severe earthquake, which had destroyed the original city centre.

In Vila Real and Porto Covo, the "Baroque" character is achieved through the punctuation of the residential blocks by "tower" buildings, and in Vila Real, by the contrast between parapets and eaves in the single storey houses, and the variety of form given by the arcaded salting houses (see Section VI.1.3 and VI.1.4). In Manique do Intendente, the "Baroque" character is generated by the use of the hexagonal central space and trapezium shaped blocks (see Section VI.1.5).

The strict adherence to both earthquake and fire precautions in the Pombaline quarter of Lisbon diminished outside Lisbon and the presence of anti-seismic measures was only observed in Vila Real (see Section VI.1.3). By the time Porto Covo and Manique do Intendente were planned, such measures were omitted, although
possibly this can be attributed to their smaller scale (see Section VI.1.4 and VI.1.5).

At the same time, the variety of internal layouts apparent in the Lisbon and Vila Real developments gave way to repetition in Porto Covo and Manique do Intendente, perhaps because the latter were small developments belonging to one particular entity, whereas the buildings in Vila Real were built by or for a number of individual owners, promoted by the regime.

Perhaps the most lasting influence of the Pombaline quarter of Lisbon was the development of dimensionally co-ordinated internal layouts, frequently with staircases serving two flats on each floor, the rooms of each flat being accessed independently from corridors or hallways. This contrasts with the previous medieval form of arrangement with staircases serving a single flat on each floor, and with interconnecting rooms within each flat.

In the Pombaline Area the most important rooms (dining and living rooms) were well-lit and airy and always faced the street. The kitchens always faced the interior space of the blocks and the unlit rooms, not existing in the other developments, were located in the middle and occupied about 18.5% of the habitable area.

VII.5. The contribution of the Pombaline rentable buildings to Portuguese architecture.

The destruction of a part of the original city by the 1755 earthquake disaster presented a unique combination of circumstances. There was a need for precautions to prevent a repetition of the disaster, and a desire for a rational, regular urban plan in keeping with the Enlightened thinking of the time and the military training of the engineers and architects who were thought to be most able to deal with the emergency which presented itself.

Due to the need to rebuild quickly and to ensure adequate production of components the construction was standardized allowing maximum prefabrication of components. The resulting Pombaline architecture identified by its stylizing, systematizing and homogenizing of the pre-existing elements in a rational way, produced an elegance of its own which is probably unique for that period, conforming to the simple, regular external appearance that was expected in the Age of Enlightenment. The end result was a combination of a totally rational urban plan with extremely repetitive, austere and individually unremarkable façades and a unique and rigorously regulated
construction system, together with internal plans of great variety in layout design, decoration and detailing. The precautions to prevent a repetition of the disaster included an anti-seismic construction system, wide and straight streets to facilitate quick escape to the safety of the squares, and the absence of external features or ornament which might fall on escaping residents or impede their escape in the event of emergency.

The architects and engineers with their military background, removed from an explicitly artistic environment, opted for a neo-classical style, more out of functional necessity than theoretical choice. They produced an innovative, simple, repetitive, cheap and standardized style of architecture with neo-classical tendencies, marking an important change to the panorama of Portuguese Architecture (36,40).

In the Pombaline area the rentable buildings were predominant with no place for palaces and with churches adopting the appearance and dimensions of the rentable buildings. From outside, the buildings appear not as individual entities but as blocks defined by continous austere façades rigidly imposed, with the only variations being in small details according to the hierarchy or relative importance of streets. These different types of façades form a hierarchy system in which six types have been identified each one with its specific design. The composition varies in accordance with the streets with perfect alignment of the masonry both horizontally and vertically. The design of the facades in the principal streets is rather more elaborate (see Section III.1).

In complete contrast with the regulated, repetitive external facades, the interior layout of each building was individually designed to the requirements of the building owner and occupants, and as discussed previously there appears to have been a shift in preference as time went on, from a rear to a central staircase and from a "medieval" to a "modern" plan (see Section V.4). This shift in preference took place without any change at all in the external treatment and with only minor and unrelated changes in the construction system.

This wide variation in internal layout, associated with purpose-designing and purpose-building for individual clients, contrasts with the standardised, repeated internal layouts characteristic of, for example, eighteenth century speculative terraced housing in Bath and Edinburgh. Although elements of the Pombaline buildings are present in other contemporary developments outside Lisbon the peculiar combination of all elements which characterise them is unique to Lisbon. These elements are the following. The buildings, with one commercial floor and three upper residential floors, were always grouped in blocks with repetitive modulated
façades with openings aligned vertically and horizontally, characterized by a great simplicity and repetition. The hierarchy of buildings is established only through the variation of minor details. Technical innovations against earthquakes are incorporated in the form of an anti-seismic structure. The interior has a great diversity, the plans are different from one building to another. There is no relationship between the exterior types (related to the location of buildings), and the interiors.

The Pombaline phenomenon holds a major lesson for architects today - that standardisation, prefabrication, and a uniform external public façade can coexist with individually designed, infinitely variable interiors, and that a static, regulated external façade design, repeated in different buildings over a period of time can coexist with internal layouts varying with time over many decades.

Near to the 300th anniversary of the birth of the Marquis of Pombal much of the area built under his direction still exists today, standing as a monument to him and to the Engineers such as Manuel da Maia who organized the buildings process and the Architects Eugénio dos Santos and Carlos Mardel, who planned and supervised the work. This is in contrast to what has happened to many European cities which were destroyed during the Second World War.

VII.6. Recommendations for future development of the work.

Due to the complexity, vastness and importance of the Pombaline area many aspects still need to be investigated. Owing to the extensive nature of the subject under study in this work the author was unable to study in depth many of the aspects observed. The following are therefore suggested as fruitful areas of further study:

i. The innovations brought about by the Pombaline rentable buildings of Lisbon, the development of the anti-seismic wooden structure, the standardization of components, the standardization of the elevations of buildings on such a large scale and their adaptation to different and innovative internal layouts, is in itself totally unique for the eighteenth century, and surely deserves immediate protection and international recognition possibly as a World Heritage Site. So it is necessary to begin the complex process of further study to achieve this objective.

ii. The study of most of the construction details was limited to the analysis of the buildings which have been destroyed over the past ten years, numbering nineteen. From the observations of these buildings the author was able to conclude that no two buildings are exactly alike in their construction and whilst on the one hand, there
were general construction principles common to groups of buildings, there were also some elements peculiar to particular buildings. It is therefore necessary to record additional construction details during any future destruction or substantial alteration of further buildings in order to understand these variations. There are also some finishings, for example the tile dados created expressly for the decoration of particular buildings, which due to their high commercial prices are being systematically removed, which should be recorded in detail.

iii. A much greater in-depth study of the behaviour of the "cage" structure is required. During the research period, the author did not have the technical and financial means at his disposal to collect and test samples of parts of buildings in the laboratory or to conduct "in situ" field tests to determine the loads to which the external walls are subjected as well as their field stress and to determine the deformation of floors and walls subject to loads in the interior of the living rooms at the different levels, so as to gain a better understanding of their behaviour during an earthquake.

iv. A careful physical and chemical analysis of samples of stone and wood used in the structure or in the finishings may reveal their type and origin. This could provide information on the number of suppliers and their location.

v. During the Pombal regime building was also carried out as part of an expansion of the city of Oporto. There are existing studies of the urban and architectural aspects of this development, however little is known about the construction details of the buildings which were erected. The construction was in a stable zone in seismic terms and with abundant materials and human resources and therefore the result could show marked contrasts with the Pombaline development in Lisbon. Also during the Pombaline period and after, numerous cities in the Portuguese colony in Brazil developed rapidly and it would be interesting to study how cities and buildings were conceived there, especially during the period of the French invasions in 1806-1812 when the Portuguese government was transferred to Brazil. It might be expected that the massive rebuilding programme, initiated in the capital city of Portugal after such a devastating earthquake, would have repercussions that would be felt beyond the confines of the city of Lisbon. It would be interesting to know how buildings evolved later in these other regions outside the Pombaline area.
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A STUDY OF THE DESIGN AND CONSTRUCTION OF BUILDINGS IN THE POMBALINE QUARTER OF LISBON.

VOL. II APPENDICES

A dissertation submitted by

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Licenciado em Arquitectura

Thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy, (PhD), of the UNIVERSITY OF GLAMORGAN
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Collaborating Establishment
Instituto Politécnico de Santarém
Escola Superior de Tecnologia e Gestão de Tomar

July 1996
DECLARATION

I declare that, this thesis is the result of my own studies, it has not been accepted for any other award or degree and is not concurrently being submitted in candidature for any other award or degree.

Signed: [Signature]
Date: [Date]
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1.2 Alvará De 12 De Maio De 1758

1.3 Interpretation by the Author of the Alvará De 12 De Maio De 1758, (Licence of the 12th May 1758).
   i) Guidelines for the redistribution of land for building
   ii) Indications of how to solve bureaucratic problems and to encourage construction

This appendix contains copies of Manuel da Maia’s dissertations, which are divided into three parts. The first part is about the decision that was to be taken regarding the location of the construction of the new city. The second part, written after it had been decided to construct on the same site, proposes various ways of renovating the old city or opting for a new plan. The third part proposes various plans for reconstruction as well as some innovations to prevent further calamities and improve the hygiene and safety conditions in the new development. The Alvara De 12 De Maio De 1758, licence of May 12th, gives some indications as to how bureaucratic problems were to be solved and how to encourage construction.

The documents were written in archaic Portuguese making it difficult to read particularly with its constant repetitions. The dissertations were analysed in Chapter 1.6. As for the licence of May 12th, the author interpreted and translated the main aspects, which included incentives for rapid construction and the process of redistribution of property from the old to the new urban grid.

The dissertations by Manuel da Maia were copied from:

Appendix 1 - The original proposals for the reconstruction by Manuel da Maia and Alvarã De 12 De Maio De 1758

1.1 Dissertação De Manuel Da Maia

i) Primeira Parte

1. — Reconhecida, e observada a destruição da cid. de Lix. he precizo intentar-se a sua renovação, e como esta se pode executar por diversos modos, parece também precizo que estes se preponderem p. entre elles se fazer eleição do q se conhecer com mais rentagens, e menos inconvenientes. Os modos que me ocorrem são os seguintes.

2. — O primr.° restituila ao seu antigo estado, levantando os edificios nas suas antigas alturas, e as ruas nas suas mesmas larguras. Este 1.° modo suppoem, q o terremoto passado não he pronostico de outro; e que assim como em m.°° annos ant.° senão experimentou outro sem.° assim se não pode esperar subsequente: e q por esta forma se restituirá Lix.° promptissimam.° ao seu antigo estado, e com edif.°° melhorados por novos; recebendo e acomodando o mesmo n.° de gente; e obtendo os proprietários os seus antigos rendim.°° ficando Lix.° deste modo com alguma melhora q dantes era; servindo os mesmos destroços, e ruinas p.° a erecção dos edif.°° evitando o trab.° e despeza dos dezenhuihos; cuja acomodação se faz mui difícil, e talvez de prejuiz; onde os quizerem acomodar, ou seja no mar ou na terra.

3. — O 2.° modo, levantando os edificios nas suas antigas alturas, e mudando as ruas estreitas em ruas largas. Este 2.° modo tambem despreza a precaução do terremoto, e attende em pr.° logar a melhor serventia do publico pela largura das ruas, e conservando nas alturas as casas abundantes commodos p.° os habitadores, q restarão livres de horrível flagello, e p.° os proprietarios a mayor p.°° dos rendim.°° ficando a cid.° mais formosa do q dantes era, com boas entradas, q p.° ella se poderão fazer no terr.° do Paço, evitando passagens cobertas, e melhorando alguns edificios mayores arruinados; ficando deste modo Lix.° com conhecidas vantager s, e conservando em m.°° p.°° os interesses dos prejudicados nas ruinas, o q não deixa de merecer attenç;

4. — O 3.° modo, diminuindo as alturas a dois pavim.°° sobre o terreo, e mudando as ruas estreitas em largas.

5. — Este 3.° modo se acautela contra sem.° assaltos, diminuindo as alturas dos edif.°° por se temerem nor; mais altos as ruinas mais certas, e de mayores prejuizos: como p.°° contra nas ruas mais largas mayor facilid.° p.° se escapar dos destroços, q nas estreitas servè de grande impedim.°° ao retiro.
6. — O 4.º modo, arrazando toda a cid. baixa, levantando-a com os entulhos, suavizando assim as subidas p. e as p. altas, e fazendo descenso p. o mar com melhor correnteza das águas, formando novas ruas com liberd. competente, tanto na largura, como na altura das edif. 4.º nunca poderá exceder a largura das ruas. Este 4.º modo não só atende, como o terceiro, a prevenção de se m. flagello, assim na observação da altura das casas, como na largura das ruas, mas a faci litar a difícil acomodação dos dezenhulos, servindose delles p. suavizar a aspereza das serventias da cid. baixa p. a alta, e expelindo também as águas com melhor efeito p. o mar, livrando Lix. baixa das inundações 4 padece em occasioens de mare cheio.

7. — O 5.º modo, desprezando Lix. arruinada, e formando outra de novo desde Alcantara até Pedrouços; com permissão porem de q os donos das casas de Lix. arruinada as podessá levantar como quisessem. Este 5.º modo se facilita mais q todos; porq em pr. 0 lugar não tem q vencer dificuld. de dezenhulos, e suas acomodações: oferece campo docil, e livre das emin.4.º de Lix. antiga, sem necessid. de atergir o estado das casas s. se devam conservar ou derribar, nem ouvir clamores dos donos das q inteiram.4.º se desprezarem, e sobre tudo a grande despeza, q na compensação destes prejudiz se fará por qualquer modo q se pretenda fazer. Edificarse com mais gosto pelas melhoras que geral.4.º se reconhecem no terreno e prays da situação de Belém, e suas vizinhanças, livrando os habitadores dos horror q conseguem na destruição da cid. arruinada; e com incomparavel brevid. e boa organização de ruas e de edif.4.º q formará húa Lix. nova, sem q os dominantes dos edif.4.º de Lix. destruída tenham de q se queixar, pois se lhe não faz viol.4.º algúem, nem se lhes impede a redificação dos seus edif.4.º p. se valerem delles á sua vontade. Acrece mais, q ainda q se lanse mão de qualquer dos ant.4.º modos, 1.º, 2.º e 4.º em q as ruas se alargam, sempre hade ser precípito estendêrse Lix. até Belém, ou ainda a maior dist. p. acomodação da m.4.º gente q ficará necessitada de com modo por causa da diminuição das casas; pois q as de quatro e cinco pavim.4.º ficarão convertidas som.4.º em dous; e em hú sitio em q havia quatro ou 5 ruas, ou mais, se converterão em duas ou 3 ao m.4.º e se depois de vencer m.4.º dificuld. com grandíssimo trabalho, dispêndio, e dilação de tempo, se hede procurar o asylo de Belém, melhor parecia buscar-se logo p. m.4.º mais facilid. satisfação do público, e esqua de despeza. Também a obtenção do novo caes de Alfandega do tabaco, parece estar aconselhando q se não averigúem a hum lugar q mostra estar combatido de co ntr.4.º fortíssimo, q poderá continuar em o perseguir, a a tudo q o acompanhar. Também parece favorecer esta opinião o achar-se em Porto gai algúas cid.4.º e povoações q conservão os nomes de outras destruídas, cujas ruinas se percebem ainda em dist.4.º proximas, sem se especificar a razón daquela repetição de nomes, e de lugares; mas discordando qual podeza ser, nenhúa razão me ocorre mais própria e competente p. este feito do q outra sem.4.º a q temos diante dos olhos, fazendo antes eleição de formar húa cid.4.º e povoação nova em sitio mais favorável, do q renovar húa destruída por sem.4.º acidente. Também pode fazer pezo nesta eleição a observação de ser mais violento e eficaz o efeito do terremoto na p.4.º mais repleta de habitantes cujos excretos, penetrando e permeando mais os poros da terra, possam concorrer com maior adjutorio p. a formatura do terremoto, ou atrair a si os seus efeitos com mais sem.4.º e abund.4.º simili. O q podendo ser assim também avisa, q se evite q.4.º for possível a continuação de hum tal atractivo. Persuado-me teê li é já Lix. padeceo perseguição de terremotos por tempo de um
anno; e como o fogo me consumiu todo o adjutorio de q me valia p. a narrar com
segurança, não poderei determinar o tempo nem o vigor de seu princípio, nem algües
mais especiald. que ocorrerão; mas sempre pode servir de exemplo, de q. a
comunicação dos tres excretos possa servir de alim. p. sem. destruo. A mul-
tiplicidade de terremotos, que tem padecido Constantinopla cid. p. populosissima
parece corroborar esta suposição: quae sola non profunt, multa colutta juvant.

8. — Até aqui o q. me ocorreu dizer a favor de cada hum dos cinco modos possíveis
p. a renovação de Lix. p. ressum de declarar o q. se poderá dizer em contr. p. vê se com
estas ponderações me poderei determinar a tomar algum partido em forma q. se não
possa dizer q. o faze sem estas antecedências.

9. — No 1.0 modo encontro a falta de atenção ao melhorar. de huá cid. q. se
edifica de novo conservando-lhe as ruas estreitas, o q. as fas de aborecível uso, e as casas
m. altas com o horror que das suas alturas se tem concebido; não obstante poder se
dizer, q. este horror hade ser de pouca duração, porq. em fazendo algüa pessoa vendaria
edif. de maior altura de dous pav. logo outras de qualquer vendaria a 1.º imitando,
e consequentem. todas as q. tiverem com q. o fazer; porq. ao mesmo passo q. vai
esquecendo o horror do terremoto, se irá esquecendo o da ley dos dous pavim. Sirva
de exemplo a ley do alinhame. p. q. as casas se renovassem, e recolhessem até q. as rias
ficassem em certa largura, como a da rua dir. das portas de S. C. onde se executou
ato certo tempo, e se não continuou e m algüa das casas q. depois se renovassem ou se
edificassem de novo.

10. — O 2.º modo, ainda q. atende às formas da cid. p. toca a largura das
ruas, tem o defeito de se não acutelar contra o flagello dos terremotos nas alturas dos
edifícios; e posto q. favorece aos donos dos edif. restantes em lhes conservar o n.º dos
moradores, e consequentem. os rendimentos, e também possa dizer q. a ley dos dous
pavim. terá o mesmo efeito q. a ley do alinhame. não são razoáveis subsistentes por
dependerem do futuro.

11. — O 3.º modo q. parece mais admissível, pol. atende assim às formas da cid. no
espaço das rias, e precaução dos terremotos nos dous pavim. só permitidos, tem
contra si os cláusulos dos donos dos edif. extintos, e outros diminutos de rendim. pela
diminuição dos inquilinos, entre cujos cláusulos, serão m. distinctos os dos
Morgados, Eccles. e Irm. que costumam ser m. attendidos; como também tem
contra si a acomodação dos desenlouhos, porq. alem dos q. se acham já ocupando as rias
largas e estreitas, hade acrecer o de todas as casas q. se não de extinguir inteiram. e mais
q. tudo a gravissima despeza com q. se hende substituir a diminuição dos edifícios extintos
ou em p. ou em todo.

12. — O 4.º modo, posto q. vence ao 3.º em evitar o embarazo dos desenlouhos, e em
dar melhor serventia à cid. sempre fica com o grave pezo de dar a cada hum a justa
satisfação do q. lhe pertencer.

13. — O 5.º modo, q. parece o mais facilitado, não deixará de ter contra si o interesse
dos donos das casas edificadas nas rias principaes de Lix. recebendo q. se lhes diminuir o
rendimento dos seus alugueis, aumentandose m. o n.º das habitações em p. de
diferente eleição.

14. — O q. assim ponderado, resta fazer escolha de algum dos cinco modos de q. se
não possa seguir arrependim. no q. encontro grande dificuldade, e p. poder sair della,
me tem ocorrido, có só a eleição é S. Mag. e fazer do sitio p. o seu Real Palácio poderá fazer pezar a opinião do lhe for mais apropriada; poróe S. Mag. e for servido querer o seu novo e real Palácio no sitio de Bellém, fica o modo n. do infalivelmente adoptado e preferido a todos os outros; porém se S. Mag. e for servido querer lançar mão de hum sitio salútero, e superior apropriado p. cabeça de Corte com boas 4 comunicacoes p. a cid. e p. o campo, aproveitando-se prim. do beneficio da agua livre de Belas, e terreno firme e solido com bom nivelam. e capacidade p. edificar com grandez, he este o sitio entre S. João dos Bemcasados e o conv. de N. Sr. da Estrela, com 4 comunicacoes de bom uso; a 1. p. o campo, interior do paiz por Campolide, e Sete rios; a 2. pelo Rato, Novicado da Cotovia etc: a 3. p. sua nova de S. Bento, ou nova colonia; a 4 p. cam. do S. da boa Morte, Fonte Santa, N. Sr. das Necessidades etc. até o mar, caminhos todos de bom nivelam. e correntezas de aguas p. limpeza dos edif. e rues depois de terem servido nas fontes e tanques do Real Palácio, e de hum Hospital na quebrada da cerca de S. Bento p. a p. do nascente, cuja posição já escolhi q. se tratou do sitio p. o Hospital real de todos os Santos, por o reconhecer melhor no prez. tempo do q. o de junto a S. D. no rocio. Também não posso deixar de lemar que o tal novo e real Palácio se poderá formar húa Biblioteca publica por evitar o justo reparo de a não haver na Corte de Portugal, e junto a ella a casa do Real Archivo, e ainda q. o terremoto o não destruir, sempre necessitava de húa tal acomodaçao a imitaçao do Archivo Romano, pera o qual se entra pela Biblioteca do Vatican. E p. o duplicado, de q. tambem ha grande precisão, se escolher sitio separado.

15. — E determinado e escolhido este lugar d'entre S. João dos Bemcasados e o conv. de N. Sr. da Estrela p. o novo e real Palácio, me parece se deve principiar a renovaçao da cid. pelos edificios publicos, que são fabricados por conta da real fazenda, por serem os pr. fundam. dos reaes subsídios quasi todos na marinha, p. o q. largará S. Mag. e o seu Palácio antigo, assim como os Sr. Reys seus antecessores havião largado os em q. habitavão, q. se achão hoje servindo de outros usos; e poderá tambem formarse a caza da bolca do neg. e tudo com as direccoes, e formalid. não só segundo as not. das outras Cortes, mas com as melhores q. ocorrerem, e o bom discurso alcançar. 

16. — As comunicacoes da 1. praça do terr. do Paço p. dentro da cid. se devem abrir as 1. em correspod. às duas rues dos ourives do ouro e da prata, evitando todas as passagens cubertas q. são incidiosas de noite.

17. — As rues de caza à de novo se fabricarão p. a communicaçao do novo Palácio com a cid. antiga se empreenderão depois das d. reaes obras; mas ou seja edificadas de madeira ou de pedra e cal, nunca a altura das caza excederá a largura das rues, e q. deas rues forem mais largas q. a altura dos dous pavim. sobre as logeas, nem por isso as caza podezio subir a terceiro pavimento.

18. — E pelo q. pertence a renovaçao da cid. arruinada me acomodo ao 4. modo já assinado, valendome de conservar os entulhos p. dar maior altura ao pav. da cid. baixa, principiando a altura do adro do conv. da Annunciada, adro do conv. de N. Sr. da Boa Hora, adro do adro da Ernida de N. Sr. da Assumpção da rua dos ourives da prata, e a esta imitaçao todas as mais rues q. estiverem no mesmo nivelam. formandose húa tal descida p. o mar q. vá fencêr pela porta da Alfandega do tabaco.
19. — P. se poderem dirigir as ruas na forma mais regular se sinalizá-lo primeiramente com bandeirolas firmes todas as ruas destruídas no s. se reconhecer por este modo o terreno que ocupavam as casas e ruas, e poderia emendar com clareza, o que se julgar necessário, evitando-se. deste modo o perigo que pode haver que se guiarem por plantas, como já tem sucedido, e poderia sobre esta notável prática e palpável tomar a resolução de como se não de suprir as diminuições que haverem nas propriedades, o que necessita demais especial atenção.

20. — Parece porém preciso determinar-se se nas ruas principais deste bairro baixo e plano se devem formar columnatas como havia na rua nova dos ferros e confetaria no caminho da gente em tempo de inverno e chuvisco, não excedendo porém a altura das casas os de dous pavimentos hum dentro das columnatas, e outro sobre elas.

21. — Declaro que o reservar p. último lugar esta operação he dar tempo a que o grande número de corpos imersos pelos entulhos não possa produzir alguma corrupção nas suas, descobrindo-se, e pelo mesmo razão procuro também alterar as ruas p. não haver tanta necessidade de os reviver; pertendendo também com esta dilatação suspender o horror em que o público se acha contra os edifícios que não são de simples madeira alem de que por falta de meios receio major de dificuldade em edificar de outro modo, por que os incêndios extinguir-se quasi todos os cabedais dos habitantes de Lix.

22. — Nesta parte da prez. dissertação procurei expressar em generalidade o que na imaginação embasceria com hum tão raro caso me foi possível reviver, sujeitandome de boa vontade a toda a correcção judiciosa, que emmende melhor ou prove o que achar que deixarei de me impregar em segunda e individual parte, se na pr. me tiver afastado o que for mais conveniente ao Real serv. e bem do público; pois que nas individuações perigo maior o acerto que ao a generalidade se tem afastado da rectidão, 4 de Dez. de 1751, Lix. M. e. da Maya.

### Segunda Parte

1. — Visto parece que vai tendo alguma aceitação que a t. p. da minha dissertação sobre a renovação da Cidade e de Lix. he preciso animar-me a individuá-la, como prometi no ult. § do t. no, não obstante terihe reconhecido maior dificuldade. Vale-me-hei porém do mesmo método que segui na t. indagando por p. a natureza de todas as que me propuser p. fazer eleição, p. o que não chegue a determinar-me inteiramente, ao menos mostrarei à adoração até onde a minha possibilidade pode alcançar, ficando assim aberto o caminho da melhor vista possa reconhecer distintamente as vantagens e os defeitos que eu não chegar a perceber.

2. — Procedo na suposição de S. Mag. de fazer eleição do sitio mediano entre S. João dos Bemcasados e o Conv. de N. Sr. da Estrela p. o seu novo e real Palácio satando aquele sitio cabeça e parte principal da Corte e Cidade de Lix. ao que precisan-se haver seguido a renovação do corpo da mesma cidade destruída, p. o que os mostrou apropriado o modo da renovação da cidade expressado no § 6 da d. t. parte 4 diz assim etc.
3. — Que se queira renovar a cid. e baixa he p. a mim indubitavel; porq ainda sem haver ocasião tão forçosa, se tem mostrado esta vont. assim na rua nova do Almada q se formou q. o bairro alto não tinha melhor serventia que a rua, ou beco dos Fornos, as ruas dos ouíveis de prata, e do Ouro, por onde não podia passar mais q. hum carro, e proximam. a preparação p. se alargar mais a d. a rua nova do Almada até a rua larga das portas de S. C. a, formada assim em sinocontra e quatro palmos de largo pela ley do alinhamento q. não teve procurador q. a fosse fazendo executar em todas as p. em q. houvesse renovações de casas: e á vista dos referidos exemplos parece indubitavel a renovação de Lix. baixa. O que porem resta he eger o meyo mais ajustado p. se conseguir este muy louvavel benef. o q. o declaro q. o expuz aq. 4.º modo da renovação de Lix. baixa, arrazando a sua p. baixa, foi na expectação de q. S. Mag. poderia escolher o meyo de tomar a si todos os edificios de tal p. de da cid. depois de avaliados no estado em q. se achassem, p. q. depois de derribados e extintos, formadas novas ruas e novos logares p. os edificios novos, e repartida por elles a import. ou valor das casas destruídas, e conhecido o q. correspondia a cada palmo, vara ou braça quadrada, cada acredor de edificio recebesse em terreno a avaliação q. se lhe havia feito, e q. do lhe não agradasse, se vendesse aq. desse a sua importancia p. a receber o acredor: e no caso q. ainda nisto houvesse algüa duvida, mandasse S. Mag. edificar por sua conta p. recolher a seu patrimonio o rendimento p. eu o havia proposto, derribando, e destruindo a Cid. e baixa, levantando a q. fosse proveitoso com os seus entulhos, p. A d. depois com novos e melhores materiaes e nova forma, se reedificasse a cid. e do q. a cuja ideia parece descansada com a nova deligencia da accomodação dos entulhos e dos materiaes q. comprehende.

4. — Mas porq se não pode entender q. S. Mag. mandar conservar a cid. e baixa com a mesma especie das ruas q. tinha, mas q. sempre hede querer q. os donos dos edificios as reduzão a melhor forma, me parece ser o tal modo o de conservar algüs ruas no seu próprio estado, como as ruas dos ouíveis de Ouro da Prata, a rua nova dos ferros, e ainda a dos Escuder. e Odeiros; mas que as ruas da correria, das arcas, cutelaria, cipingardr. M. Gonçal, Pixilr. estreiras, e Mercadores, por detrás de S. Julião p. a Conceição, a e rua nova da Palma se alarguem por huma p. ficando a outra conservandose no estado em q. se acha, mas q. esta p. conservada pela melhor q. alcançã e sem detrimento, na tal largura, concorda p. compensar a q. contraria o detrimento q. experimenta, assim na diminuição do valor da propriedade como da despeza da obra aqui fica sujeita cuja resolução diretamente pertence aos Ministrs de S. Mg. de O que assim vencido resta saber se hede passar a mais a renovação da cid. e baixa, formando-se ruas novas, como de S. Nicolau p. a rua nova dos ferros; do largo da Igr. da Victoria p. o Tronco, e dahi ao
meyo da calcetaria; e outras q se poderão formar de novo, destruindo m.12c casas intiriram. e cortando outras com m.12c irregularidade, noq me parece se encontrarão embarcações muy dificil de ajustar e de compensar e q serão mayores q os proveiros q se poderão tirar das tres innovações de ruas: pelo q me parece q nesta forma de inovação- seria mais conveniente q sejam entendidas, alem de alargar as suas estaes, conservadas: por hum lado; porq os despedaçar becos e casas q os acompanhou só me parece praticável. q.12e se arruinasse a cid. e baixa inteira. e se usasse da sobred. com pensamento expressada.

No § 3. He preciso tambem determinar se as ruas q se conservarão inteiras, como a rua nova dos ferros, a dos Douradores, a dos Escudr.6 e dos Odreiros, q não são inteiram. em linha reta, se se hão de obrigar seus donos a q as emendem, oq também hão de causar grande viol. e m.12c requerem.6 e deprecam, pelo q dos 3 modos da renovação da cid. baixa, o 1.0 arrazandos toda e renovando toda, tenho por superior e melhor; o 2.0 de conservar as suas largas, a alargar as estaes mencionadas tenho por medido; e o 3.0 de quere também acrescentar ao 2.0 a redução dos becos e travessas a suas largas tenho por inimeno.

O abrir serventia descoberta e larga do terreiro do Paço p. a rua nova, em todos os tres casos hâe indispensável; se for hâa só, poderá sair ao meyo da rua nova; e se forem duas, poderá ser a 1.0 em frente da rua dos ourives do ouro. A rua nova do Almada sempre se deve adoçar, não só p. a facilitar a subida do Bairro Alto, mas p. a dar melhor saída às aguas, onde se junta com a calcetaria e p. a calçada de S. Franc.6 e largo da Patriarcal. A calçada de Pedro de Novaeas também está pedindo a q a facilitem, principiando este beneficio da rua e largo detrás da Igr.6 de N. S.6 da Vitoria, travessa dos Espingardas. e e calçadinha q sobe p. a Cruz do Carmo, fazendo-se logo calçada em tudo o q se for entulhando, p. a a agua da chuva não descomponha logo o entulho. Esta rua de Pedro de Novaeas tambem necessita de se alargar por hâa lado e tambem a comq se entra do largo da Victoria p. o q se lhe segue em frente das casas altas da congregação do Oratorio, dando por ella principio a melhora da d.6 calçada de Pedro de Novaeas, como tambem necessita m.12c de alargada q a fas serventia da rua das Flores p. a cruz de Cathequeiras.

3. — Para se reformar a cid. baixa na forma apontada no d.0 pr.0 modo dos 3. expressados nesta 2. p.6 (a q me inclino) a pr.6 dilig.e consiste em q, feitas as avaliaçãoos de todas as propried. de casas q se hão de derribar, cada hâa de per si com o nome de proprietario, qualid. de suas obrigações, ou seção morgados, cap. ou foros, p. a compensação q se der a cada proprietario, fique com as mesmas obrigações primitivas; e sobre hâa planta nova da cid. baixa com as suas vivr.0 desenhadas, conservando porem as Igr.6 Paroquiadas, Ermidas e Conv.6 e as extensoes das Freg.6 nas suas mesmas situações o mais ajustado q for possível, se calcule q.12c palmos superficiaes vão comprehendidos nas areas determinadas para serem ocupadas de edificios; e sabido ao todo o valor de todas as casas derribadas, se reparte este pelo n.0 de palmos superficiaes comprehendidos nas d.6 areas, e desta repartição se conhecerá o valor que compete a cada palmo, e segundo o valor de cada edificio derribado se lhe comprometêr o tal valor com o n.0 de palmos superficiaes q lhe competirem; com advertencia porem q sempre se attendederá a qualidade dos sitiios, recompensando o sitio de cada acreedor com outro sitio semelhante: ao que fosse mais proximo ao mar, com sitio mais proximo ao mar, e ao q fosse mais proximo ao rocio, com sitio m.0 proximo ao rocio; e assim aos mais acreedores;
e a todos se determinará tempo certo para darem principio ao edifício. O terem também completo a tempo determinado, segredo os desenhos à lhes forem comunicados. Architecتو de senado o Cap. Eugenio dos Santos e Carvalho, p. que cada rua conserve a mesma simetria em portas, janelas e alturas; e pelo toca a cortes me parece seja todas de dois pavimentos sobre as logias; porém que as paredes que dividem os edifícios excedem a altura das paredes das frontarias pelo que se julgar bastante o fogo senão possa comunicar de uns teltados a outros, como costuma suceder por não haver esta cautela, e não deixa de ser bem empregada a despeço de demais se faz naquela porção de parede, pela defeza com a cada edifício se prepara contra hum tal inimigo. Disse assim que cada rua conserve a mesma simetria em portas e janelas e alturas, porém me parecia melhor que cada rua ou cada Freg. tivesse alguma diversidade ao menos na cér de pintura do que por toda a cidade baixa inteiramente. uniforme, até que não ficarem tão distintas as outras da cidade que se conservarão na mesma forma em que se acham, por degol moralmente por impedir a renovação inteira de Lix. em todas as suas Freg. mas esta minha imaginação não impede que depois de vencida a reformação da cidade baixa, se possa com melhor segurança empreender o que agora tanto me dificulta.

6. — É posto que se reproduz este projecto o mais expedito, e mais livre dos embaraços que nos outros dos concorrem, e a vantagem de ser o que depois de conseguido não padecer a desagraça de arrependimentos por ser vae acompanhado de todas as melhores possíveis, não fica lugar a que se lhe notem os defeitos que nos outros se poderão notar. Reta ainda vencer o embaraço da cidade como p. e as casas conservem húm boa simetria, devem todas conservar entre si correspondência, e será muito para a ocasião em que o n.º de palmos superficiais ou áreas que corresponder pelo preço estimado a húl acredor p. edifício em haver diferença de mais ou menos área; p. é vencer esta dificuldade será preciso que determinados na nova planta os novos edifícios com a sua ajustada simetria se ponham estes em venda, preferindo que os acredores com a condição que no caso que a área à cada hú receber tiver maior valor que a deixou, entregue o excesso p. com ele se ir satisfazendo a outro credor que receber área de menor valor que a que deixou, e nessa formalidade de entregarem os acredores em dinheiro o excesso da área que receberem de maior preço de que lhes competia ou recebendo em dinheiro que completar o valor da área que deixou no caso de não querer lançar mão de maior área, se ajustará a compensação; e que sobejarem áreas que os credores não queiriam comprar, se venderem aos que não forem credores, p. que os acredores receberem em dinheiro o que lhes pertencer; e se houver credores que queiram comprar mais áreas das que lhes pertencerem, com esta extensão de compras poderá ser prejudicial a outros acredores que quiserem também áreas, e não dinheiro; neste caso se suspenderá o dito excesso de compras, e só lhes será permitido que faltarem acredores que queiram antes dinheiro do que áreas.

7. — É p. vencer o receio de faltar qualidade queira comprar alguma área, nem acredores recebidas pelas que deixou, e que ocorre responder p. como a todos os homens de negócios conveniente terem as suas habitações próximas no Lix. a renovação de S. M. como já apontei no § 15.º da minha parte, pelos edifícios públicos, que são fabricados por conta da Real Fazenda quasi todos na Marinha, me faz persuadir que com este atractivo procurarão todos os que tiverem dependência dos seus tribunais alcançar sitios e áreas que edificar, não reparando em dar por hú a vez hú que se afaste de um grande em esperança de que com o tempo recuperarão...
abundantem. os seus interesses, e, com há tal atração se facilitará m. a reedição de Lix. baixa com as vantagens premeditadas no d. modo de a renovar, arrasando-a; mas emq. me conservo na esperança de que possa ser efetivo o projecto proposto com o atração dos Tribunais publicos feitos, em 1.º lugar me lembro de que o Tribunal da Alfândega é a custa de o. sito, e diversas estações, segundo a variedade de fazendas que nelas se despacham, se podia reduzir a huma simulação, imitando da Inglaterra, que as fazendas despachadas ainda dentro dos navios, vão dali p. casa de seus donos, determinando-se casas próprias p. o desembarque e conferência dos despachos, evitando o trabalho dobrado de as levar primeiro a Alfândega, e os perigos de algumas vezes na mesma Alfândega experimentar de agua, fogo e roubos; e não posso persuadir-me que os Ingleses cuidão menos no interesse dos dir. reaes, que os Portugueses; e como a casa da Alfândega se acha tão arruinada parecia boa ocasião de mudar de estilo, poupando tempo e dinheiro que na sua criação se ha de gastar.

8. — Até que me tenho aplicado a individual a renovação da cid. baixa, como na suposição em q. procedo de S. Mag. lançar mão do sitio de S. João dos Bemcasados e o convento de N. Sr. da Estrela, toda a Freg. de S. Isabel fica inclusa na cid. e Corte de Lx. emq. se vae edificando sem ordem nem simetría, oq. já no tempo do Sr. Rey Dom João V se havia principiado a fazer, sobre o que fiz hua representação ao mesmo Rey e Sr., p. q. quisesse ser servido ordenar ao senado da Câmara dêse forma a inovação das ruas que se hão aumentando nos suburbios determinando-lhes as larguras, que havidão de ter assim as principaes como as travessas, determinando p. estas 25 palmos ao menos, e p. as ruas principaes a largura da rua dos Ourives de Ouro e de Prata. Determinando também lugares maiores p. praças e mercados; e foi o mesmo Rey e Sr. servido ordenado assim per seu Real Decreto q. ficou registado no Secret. de Estado, e no cartório do d. Senado não pode também deixar de estar registado; e não posso nomear o dia nem o ano, porque não tenho hoje memorias de quem me valer, e agora no prez. tempo emq. vão crescendo tanto os edif. sem regul. algum, me parece ainda mais necessário regul. mais ajustado, q. bem entendido deve ser, q. o senado, com o seu Arquitecto e Mestres, vá demarcar e balizar os comprimentos e larguras das ruas, q. se vão acrecentando à cid. antigá, e ao mesmo tempo formando a planta das suas novas, porque deste balizam, depende a boa ordem que as suas novas podem observar ficando as plantas servindo p. tirar algumas duvidas q. depois das demarcações podem sobrevir. Advertindo q. p. esta inovação de ruas hei mais próprio o balizam e demarcação sobre o terreno à q. deve seguir a planta p. memoria, doq. fazer pr. a planta ideada p. a demarcação do terreno.

9. — E porq. depois de determinadas as ruas e praças he conveniente q. os edif. observassem simetria na altura das casas, forma das janelas e portas, seria também justo q. o mesmo Arquitecto do senado, assim como ha de dar desenhos para a renovação da cid. baixa arruinada, os também p. esta p. de novo se edifica.

10. — Também se me faz preciso advertir q. se devem aclarar os limites da fortificação de Lix. p. q. os novos fabricadores de edificios não vão ocupando terreno proibido, cuja incumbência poderá ter o sarg. mor Filipe Rodrigues de Oliveira, acompanhado do Vedor Geral das Fortificações, e de seu escrivão, assim porq. já andou observando na averiguação das fazendas q. p. a d. fortificação foram compradas, como também por ter sido privilegiado do fogo q. lhe não roubou os seus papeis, entre os
quases conserva o da d.ª fortificação; e p.ª esta diligência ser completa se porto balizas firmes nos lugares prohibidos, assim dentro, como fora da fortificação, que determinem os lugares exceptuados p.ª se não fizerem nelhas obra alguma de pedr.º, e alguma que houver já de carpint.,º não possa ter posse de conservação, com a obrigação feita na Vedoria p.ª a desribarem todas as vezes que for ordenado, sem se poder requerer satisfação alguma, antes pagarão na mesma Vedoria, o que também da Fortificação, e que este lhe ordenem em reconhecimento de vassalagem. E ao Marquez Estribr.º mor Gov.º das Armas da Província da Extremadura e Corte, como Superintendente das Fortificações me parece pertencer mandar executar esta dilig.º ordenando-s.º assim S. Mag.º.

11. — E he q.º me ocorre dizer nesta p.ª reservando p.ª a 3.º o q. depende de planta, p.ª cuja execução me tenho achado m.º salvo de preparativos e comodidade porq.ª a destruição experimentada que penetrou os lugares ainda mais reservados, como se fosse enviada p.ª a destruir q.º pudesse ter algum uso aos v.ºs que restarão, ficando por este modo excitados nos seus exercícios, ainda q. vivos p.ª se lembrem do q. perderão, também fez caso de mim p.ª mostrar q. lhe não escapou cousa alguma, por diminuta que fosse. A mat.ª q. se trata, ainda q. não seja tão nova que deixe de ter havido outras semelh.,º he comum necess.º ponderá-lhe as diferenças das ocasiões em que se fizerão, porq. nem em Londres, nem em Turim se acharão os povos flagelados como os de Portugal quando se reformaram aquellas cortes, e v.ªs.ª diferença de obras em tempo mais ou menos calamitoso p.ª ser mais ou menos facilitada a execução. P.ª esta se conseguir sempre será h.º grande adjuvatorio a saúde bem conservada; as aguas corruptas, e sem movimento, assim na rua nova dos ferros como no Rocio, sem despejo, não deixarão de correr perigo de corromper o ar; he ponto pertencente ao Tribunal da Saúde e do Senado da Câmara, que o governa, e entendo senão deve desprazer sem ofensa ao bom regime. L.º 16 de Fevereiro de 1756.

iii) Terceira Parte

§ 1.º No § último da segunda parte da Dissertação sobre a renovação de Lisboa, prometi esta terceira muy dependente de plantas, e desenhos que não posso executar como costumava fazer, tendo-me precisão valer-me de outras pessoas sem ser em minha presença por falta de comodidade que ainda me não tem sido possível conseguir, consequência dos fatalíssimos flagelos q. se tem manifestado á nossa admiração: Valendo-me porem dos officiais Engenheiros e Praticantes da Academia Militar, de que me pareceo fazer eleição, e comunicandolhes a planta da parte baixa de Lisboa destruída que só me escapou da voracidade por se achar fora da minha mão, lhes expliquei a mudança que pretendia mostrar por plantas novas em que se podesse fazer conceito dos remedios prescindidos, intimando ao Ajudante Pedro Gualter da Fonseca, acompanhando do Praticante Francisco Pinheiro da Cunha, tomasse por sua conta expressar em huma planta sobre a representação da parte baixa de Lisboa destruída, a emenda das ruas estreitas, de mais uso, e algum melhoramento nas largas, para que se quizer lançar mão d'esta emenda proposta no principio do § 4.º da segunda parte, se antevisse a melhoria que se conseguia: e que também sobre os becos miúdos spontane
novas ruas, para que se podesse sobre elas observar se seria escusado aquele melhoramento, ou inevitável, conservando nos seus próprios sitos os Templos, Ermidas e Freguezias com o seu terreno competente; e mudando a largura do terreiro do Paço em comprimento, extendendo-se para a parte do mar a emparelhar com o comprimento da ponte da Caza da India, ficando a sua largura desde o Forte e á face do poente da Alfândega do Tabbaco, e formando a Caza da bolsa dos homens de negócio entre a dita Alfândega e o arco do Assougue, separada por duas ruas, huma da parte da mesma Alfândega, e outra da parte do mesmo Assougue para darem serventia para a praça restante, entre a dita bolsa e Caza dos Contos, que servirá para os usos que costumava servir, mas sem inóciar a praça principal, desembando-se o baluarte, e sua cortina, e fazendo-se no extremo do comprimento desta nova praça escadas para desembargar em toda a maré sem necessidade de pranchas, e dando-se commodo para a Vedoria e Academia Militar entre a ponte da Caza da India, e o Forte, o que vay representado na planta n.º 1.

2.º Ao capitão Elias Sebastião Pope, acompanhado de seu filho o Praticante Joze Domingos Pope; entreguey outra planta da parte baixa de Lisboa destruída intimandolhe outra (planta da) renovação (para o mesmo fim), com a diferença porque não tratasse de melhorar ruas estreitas, nem aproveitar-se das largas inteiramente, mas que com a liberdade julgasse apropriada formasse huma nova planta com as mais condições apontadas na primeira intimação: O que appareceu executado na planta n.º 2.

3.º Ao Capitão Eugenio dos Santos de Carvalho, acompanhado do Ajudante Antonio Carlos Andreas, entreguey outra planta da parte de Lisboa baixa destruída, para que sobre o terreiro que ocupara formasse outra nova planta com toda a liberdade inteiramente, e sem súcieio nem preceito algum que a conservação dos Templos, Ermidas e Freguezias: o que vay executado na planta n.º 3. Recomendando geralmente a todos três formassem algumas prat as em lugares convenientes para o que nesses vazios tivesse o ar commodos em que produzisse os seus bons efeitos.

4.º E porque entre os três pensamentos propostos se achão diversidades que podem ser mais ou menos agradáveis, e o meu intento he somente sopenal, não duvidando (ainda sobre os três modos propostos) se possão sinalar outros melhores, para que poderão servir de grande adjutorio estas três representações, porque á vista das diversas configurações de hum objecto, he alguma vez pode observar a sua propriedade, ou impropriedade, aproveitando-me do mesmo socorro, noto na planta n.º 5. que o terreiro do Paço na desenhará, excede quanto a mim a grandezza de praça; mas que o molhe e forma na Alfândega para que os barcos carregados e nelle recolhidos possa com toda a comodidade descarrégar dentro da mesma Alfândega, sem adjutorio da ponte, me parece muito bem advertido.

5.º Suppondo (porem) que se aceita algum dos planos propostos, resta ainda depois de demarcados os sitos edificandos, e determinada a commutação dos destruidos, escolher com antecedencia o modo com que se devem preservar as ruas livres dos embaraços que as fazem immundas, fazendo elleição do mais apropriado para este fim; e porque sobre o ordinario de que se costuma usar, q se consiste em serem conduzidas pelos carretes em cargas de bestas todas as superfliuidades que se lançam das janelas, ha somente três q podem concorrer para a elleição, declaro que o primeiro (de que se tem uzado alguns países) consiste em que, fabricadas pello meyo das ruas (principaes) cloacas com
capacidade para receberem as aguas e (todas as) superfluidades dos edificios, são destes os conductos subterrâneos pelos quais os edificios se aliviam nas cloacas: alguns conductos destes se fizeram em Conventos e edificios particulares desta Cidade, e se introduziu nos canos reais, mas tem sido em pouco numero; advertindo que os canos reais são as cloacas antigas de Lisboa, pela maior parte se não achar capazes de bom serviço por estarem muito corruptos e pela mudança das ruas, que provavelmente se seguirá, poderá ser preciso haver mudança nas suas situações.

6.º Consiste o segundo em reconhecer que em algumas partes se usa de carretas que vezitando de manhã nas ruas, e recolhendo os lixos e superfluidades solidas, as alivião, e defendem do maior embarago, ficando só sogeitas ás aguas e com facilidade se dicipão.

7.º Consiste o terceiro em deixar uma entre cada duas ruas, e as duas ordens de edificios de formação por hói de suas partes huma rua estreita de sinco ou seis palmos que chamão, alfigure, sem que haja para ella portas, mas só janelas de que se lancem nella as tais superfluidades, que no Outono costumão ser extraiadas pelos carretoes, para serem lançadas em lugares determinados; e em algumas partes desta Cidade, se achavão as tais alfigures, posto que com o inconveniente de infecçãorem o olfato dos moradores daquellas casas a que fico contigüas, à necessidade de vidraças para moderarem aquelle inconveniente, ou custumaram-se a sofrello; pello que dos quatro modos referidos, sempre o do conductor subterráneo para as cloacas me parece o melhor onde as houver: o dos carros, ou carretas, havendo a quantidade suficiente, custo em segundo lugar; e em terceiro, o commum e usados carretoes, e ultimamente o das Alfigures, que além do seu perpétuo inconveniente, deminuem o terreno dos edificios. A consideração porem da diversidade das despezas, poderá alterar muito este meu parecer, que sempre como tudo o mais deixo pendente da melhor ponderação.

8.º A esta consideração de conservar as ruas de Lisboa livres dos embaracos que as fazeim immundas, para o que concorrerá muito a maior largura das ruas, e a menor altura dos edificios, não excedendo de dous pavimentos sobre as loges, se segue necessariamente outra não menos importante, e consiste em determinar melhor lugar em que possço os tais embaráculos ser lançados com menores inconvenientes; e por que me ocorre hum mais livre dello do que os já observados, e promete huma grande conveniencia ao bem publico, sejame licito presentalo neste lugar. Consiste elle em que os tais embaráculos se vão lançar dentro do Rio de Sacavém, para que com este adutorio se chegue a formar nesse hum valle á imitação do de Chelas, em que as aguas salgadas chegão em algum tempo ao templo das Virgens Vesteres, hoje Convento de religiosis de Sancto Agostinho; por que este pequeno Valle socorre tão agradavelmente a Corte com as suas hortalicas e frutas, quanto melhor o fará o Valle de Sacavém com a sua muitas vezes maior grandezza, e sem se poder dizer que os embaráculos ali lançados podem causar algum impedimento na barra, como se pode temer de qualquer dos outros modos em que se não lanção em terra: pode esta consideração ter contra si o embaráculo do refugio das embaráçoes no tempo em que se recolhem a busca; mas a isso se pode responder que nem as embaráçoes necessitão de todo o estoyo de Sacavém para se refugiarem, nem seria justo e inteiramente se lhe impedisse o refugio, mas que só se formasse em Valle aquilo que lho não impedisse e sempre será de grandezza muy proveitoza.
9.º Também parece preciso atender-se com antecedência aos conductos da água para as fontes de que he muito justo se mostre esta cidade baixa destruída, para alimento dos povos para extinção dos incêndios, e para adorno das praças; no terreiro do Paço pode servir a água q vem das Cruzes da Sé; na praça do Rocío, pode o seu chafariz receber maior água, e mais segura do bairro alto, ficando a que de presente lança ao Desterro de donde traz a sua origem, onde também he necessária para acodir ao muito povo que naquela circunvizinhança tem crescido; O Hospital Real de todos os Santos pelos seus grandes privilégios se faz acreedor de toda a água q lhe é necessária; O largo da Victoria está pedindo com muita razão ao bairro alto hum soccorro de água; o bairro de S. José o imita com a mesma justiça, por que ali a virão buscar do Campo do curral onde não ha a suficiente; e estes lugares da Cidade baixa que temo acometido, são os inexcusáveis deste soccorro, porque se fosse possível q em cada rua houvesse huma fonte, ou cada casa tivesse huma chave de água, nunca se poderia chamar superfluo este melhoramento; mas pois q o não pode ser em todo, para q ao menos o possa ser em parte, se devia fazer alguma diligencia, para se convocarem, e ajuntarem mais aguas, pois para isso formados douss encañamentos no Acueducto q conduz a água para o bairro alto, no que se não tem posto aq o presente aquella aplicacão q a matéria merece, e com que se poderão conseguir, segundo os apontamentos que para esse fim foram feitos, q posto o fogo os consumice todos, ainda se acharão alguns vestígios na idéia.

10.º E porque a água sem instruimentos com q se aplique he como espada sem braço, e as bombas o custumo ser, devem estas achar-se repartidas em lugares convenientes, e ao menos hão em cada fregueza, e junto da mesma Igreja para o que se determinará edifício particular de que poderá ter a chave o andador da Irmandade do Santíssimo Sacramento, por se achar ordinariamente assistindo na Igreja, ou perto della: Os baldes de couro em bom numero são inseparáveis das bombas, para com promptidão e segurança ajudarem neste conflito: cuja reposição deve ser muito observada por meio de alguma horrozoa penna contra quem tiver o desacordo de os não repor em seu lugar, achando-se em qualquer mão fora dela.

11.º Não posso deixar de acrescentar aqui ser muito preciosa huma especial atençao na eleição das pessoas que hão de ter por sua conta a execução desta dificultosa obra da renovação de Lisboa baixa, para a guiar livres dos embaraços q se poderão encontrar, ou incluir entre a correspondência do antigo com o moderno, no caso de haver alguma commutação do velho, com o novo que he ondse consiste a maior dificuldade; para cuja solução não julgo inteiramente sufficientes adjutorios das plantas, e se faz muito preciso que se vão observando no terreno com todo o gênero de precaucões q a matéria merece; por que sendo certo q se não usa de getipé nos planos das cidades antigas tão irregulares como custumão todas ser, não se pode usar delles como de hum plano regular de hum Convento ou de hum Palacio: E ainda q a nossa planta de Lisboa antiga se avantaje em se lhe ter assignado getipé, nem por isso se deve caminhar por ella, sem ser como com huma continuada sonda reta por causa da dita commutação; porque o formar huma Cidade de novo sem atençao mais q a ella própria, unindo a outra antiga como em Turim, será mais divertimento que trabalho; para esta execução me persuado estarem em primeiro lugar o Tenente Coronel Carlos Mardel e o Capitão Eugénio dos Santos de Carvalho, porque além de serem Engenheiros de profissão, são também na Architecquia Civil os primeiros Arquitectos.
12.0 E como até o presente se não sabe o modo de comutação que se uzará com os donos das casas destruídas, e a conjectura que eu fazia era na suposição de que na diligência que em forma de tombo se executava pelos bairros, se incluia a avaliação dos edifícios, o que com efeito não he assim, mas só consiste na medição de áreas, e algumas clarezas que não compreendem a avaliação, me vejo obrigado a entender que, ou esta avaliação se fará separadamente por segunda diligência, prezentes os mesmos edifícios ou não prezentes, ou que se não quer uzar mais que de medições das áreas, para serem communadas por áreas; porque como na renovação da Cidade baixa por ruas largas, se mudou totalmente os sitios dos edifícios que não são mandados avaliar, parece poder ser o intento da comutação por áreas correspondentes, assim aos sitios mais ou menos proximos do mar, como a grandeza maior ou menor, correspondente á do edifício destruído; mas como se não pode entender que por causa da maior largura das ruas restem áreas para suprir as dos edifícios destruídos, segue-se deste conhecimento que comutando-se as áreas com igualdade, hão de faltar áreas para completar as de muitos edifícios antigos, que ou se hão de suprir com áreas em outros sitios novamente determinados, ou em dinheiro no caso dos donos dos tais edifícios se não conformarem com a tal comutação. Se porém se julgar lícito que se faça huma comutação de áreas proporcionada de outro modo, isto he, sabendo ao todo a área de todos os edifícios destruídos, e sabendo também ao todo a área dos terrenos edificandos, e observando a proporção entre estas duas áreas totais; e fazendo sobre ella, e á sua imitação, a comutação das áreas particulares, não seria necessario suplemento de áreas, e ficarião todos com áreas correspondentes, ainda que menores das que tinham; no que serão mais interessados os das ruas estreitas extintas pelas vantagens das ruas largas; e no caso de não servir de obstáculo esta diversidade para se fazer a compensação, resta ainda averiguar como se hão de suprir o mais ou menos de área que a alguns acreedores faltar, ou crescer para bem edificar; o que já no § 6.0 da segunda parte desta dissertação suprimimos por meyo das avaliações que supunha se fazendo: mas como já reconheço se não tem feito, e que sem ellas me não ocorre suplemento para os tais casos, parece que para elles são as avaliações inevitáveis se se houver de abranger o dito modo de compensação; e no caso de se fazerem seria bom que fosse prezente os edifícios e renovadas as medições, para se fazer correção em algumas de que tenho noticia necessitio dela, pois nem sempre as principaes pessoas as prezenciam.

13.0 O Senhado de Lisboa que já cultivou esta materia nas ruas dos ourives da prata, e do ouro, e dos douradores, não achou melhor meyo que tomar a si as casas avaliadas que queria emendar, e fazendo a obra á sua custa, vendel-as a quem mais déce, para satisfazer aos acreedores; e poderá ser que avaliados os edifícios destruídos de huma freguezia, e formados os edifícios novos da mesma, e postos depois em venda, possa o seu produto satisfazer assim o valor dos edifícios destruídos, como a obra dos edifícios novos: e como a Cidade baixa destruída, se não pode reedificar toda ao mesmo tempo, parecia justo que a experiência se fizesse em huma de suas partes, que poderia ser em parte da freguezia de S. Julião no sitio incluzo entre a rua dos ourives do ouro e a rua nova do Almada, por haver nelle muitos becos e ruas estreitas he onde pode haver a maior duvida —, advertindo parecer conveniente que o Senhado determinasse os arraumentos, para que segundo elles se formassem logo os edifícios com os commodos proporcionados.
14.º As duas renovações mais celebres das Cortes da Europa, tem sido a de Londres, e a de Turim; e dezejando eu saber o como se procedeu com os particulares na sua execução, sem ter Livro de que me valer, nem Bibliotheca publica & nunca mais preciza me parece que na prezente occasião, nem occasião mais propria para se lhe dar principio que esta, ainda que não seja logo tam numeroza como hoje são as maiores & não principiando tão grandes, me achey obligado a mendigar huma historia de Inglaterra que incluice o anno de 1666 em & não consegui noticias de proveito; e vendo no Diccionario Geografico de Martiniere a descrição de Londres, em que lhe delineã as ruas como as nossas da Villa de Thomar, também não achey nelle clareza de quo me servisse; o que poderia conseguir se tivesse mais & revolver. A renovação da Corte de Turim, não he como alguns dizem, fora arrazando Turim velho, para fazer Turim novo, porque só foi acrescentar Turim novo a Turim velho, fazendo em hum sitio plano contiguo a Turim, hum aditamento a Turim, no que não havia dificuldade que vencer; donde venho a concluí que a renovação de Lisboa destruída teem muito mais que ponderar que o augmento da de Turim acrescentada.

O que resta ainda determinar he se as ruas mais principais se devem dividir em tres partes como as de Inglaterra; e se se hão de fazer porticos, ou columnatas em algumas ruas como havia na rua nova dos ferros, e na Confeitaria: sobre o que me parece dizer & nas obras do terreiro do Paço as columnatas serão de bom uso, e bom adorno, mais que nas ruas de logegas me parece mais conveniente que não haja columnatas e que as antigas da rua nova dos ferros servissem aos homens de negocio por falta do edificio da bolça, & fazendo-se no terreiro do Paço como espero, he escuzado suplemento em outra parte; declaro que as ruas de Inglaterra são formadas de tres divisões, a do meio mais larga para as carreagens, e as duas dos lados para a gente de pé; aquella calçada de pedra muda, e as duas de enchelharias groças com seus postes que as separe da do meio, para que as carreagens não vão embasar os dos passeys; as principais são de larguras excessivas, o que nós poderiamos suprir com quarenta e cinco ou cinquenta palmos de largo, dando dez palmos a cada hum dos dos passeys, ficando o resto no meio para uso das carreagens; mas não me inclino a esta divisão de ruas, porque nas ocasiões de festas, e de concursos, se não poderão concervar bem em seu estado proprio, não sendo de huma largura muito mayor, o que no grande comprimento de algumas ruas de Inglaterra se faz mais adequado, e na nossa Cidade de Lisboa destruída consumirá muito terreno, em prejuizó dos donos dos edificios que obrigados a não levantar mais & dous pavimentos sobre as logegas, clamarão contra a maior largura das ruas do que as tres divisões serão cauza.

Na planta n.º 4.º apresento mais huma renovação da cidade baixa arruinada expressada pelo Ajudante Pedro Gualter da Fonseca com toda a liberdade possível, sem atender a conservação dos sitios das Igrejas Parroquiais para no caso de não servir de embaracao a tal mudança possa tambem entrar na conta dos pensamentos ponderados.

15.º Em 5.º lugar offereço a planta de huma rua de 60 palmos de largo a imitação de algumas da de Londres dividida em tres partes, a do meio de 40 palmos de largo para carreagens, e gente de cavalo, e as duas dos lados de dez palmos de largo cada huma para a gente de pé e Cadeirinhas, com a separação de pilares e pavimento que o perfil mostra, e no mesmo perfil a figura da Cloaca, ou Cano Real para serventia das agoas dos montes e limpeza dos conductos, que dos edificios se lhe introduzem.
16.º Em 6.º lugar offereço o primeiro prospecto em que se mostra a altura e simmetria dos edifícios com dois pavimentos sobre as logegas com janelas rasgadas no primeiro, e com janelas de peitoris no segundo, e divisões de paredes altas sobre os telhados para defensa da comunicação dos incêndios.

17.º Em 7.º lugar offereço o segundo prospecto em que se mostra a altura e simmetria dos edifícios com dois pavimentos sobre as logegas, ambos de janelas rasgadas, e com divisões de paredes altas para defensa da comunicação dos incêndios.

18.º Em 8.º lugar offereço o 3.º prospecto em que se mostra a altura e simmetria dos edifícios, com seus portícios, ou columnatas, contra as inclemências do tempo com dois pavimentos sobre as logegas, e ambos de janelas rasgadas, e divisões de paredes altas sobre os telhados para impedimento dos incêndios.

19.º Em 9.º e último lugar offereço huma forma de edifício mais nobre para o Terreiro do Paço com seus portícios com mezaninos contra as inclemências do tempo, dois pavimentos de janelas rasgadas (dos quais hum se poderá abater parecendo grande a altura) e outro pavimento de mezaninos junto aos telhados; e divisões de paredes altas para defensa da comunicação dos incêndios; e todas estas cinco últimas representações são expressadas pelo Capitão Eugénio dos Santos e Carvalho.

E he quanto me foi possível unir nesta 3.ª parte, guardando o restante para a quarta. Lx.º 31 de março de 1756.

ADDITAMENTO

Em decimo lugar offereço a planta n.º 5 p.ª a renovação da cidade de Lisboa baixa arruinada sem atenção á conservação de sitios de templos ideada pelo Cap.º Eugenio dos Santos e Carvalho na qual a cor amarela mostra o que se fará de novo, e o vermelho o que se conserva do antigo.

Alvará que estabelece os direitos públicos e particulares da reedificação da Cidade de Lisboa, e os benefícios às pessoas que para ella concorrerem com dinheiro, materiais ou mão de obra.

Eu, ELRey faço saber aos que este Alvará com força de Ley virem, que contemplando a grande vantagem, que seria para os meus Reinos, e Estados a reédification da Capital delles por hum novo plano regular, e decoroso: Houve por bem resolver, que a Cidade de Lisboa fosse promptamente reedificada com os limites declarados no meu Real Decreto de 3 de Dezembro do anno de 1755, para que nos Bairros, cujos edifícios forão abrazados, e demolidos, se allinhes as Ruas com a rectidão, e largura competentes à commodidade dos seus habitantes, e ao serviço dos que por ellas passão; e que nos outros Bairros, cujos edifícios ficarão no estado de admitirem concerto, se melhorem as Ruas aos ditos respeitos, quanto possível for. E para que huma obra tão útil, e necessária ao Bem Commun, nem padeça as demoras, que nella serão intoleraveis, nem se faça com prejuízo dos particulares, que seja attendível: Sou servido ordenar o seguinte.

1 Assim nos referidos Bairros, cujos edifícios forão abrazados, e demolidos, como nos terrenos das casas dos outros Bairros, que foram inteiramente arruinadas; querendo os donos dos respectivos solos edificar na conformidade do sobredito plano; e obrigando-se eficazmente a darem as obras acabadas no termo de cinco annos, successivos, e contados do dia, em que assimirem a obrigação, o poderão livremente fazer. E sendo os ditos terrenos enfyteuticos, preferirá neste direito de edificar os enfyteutas dos prazos aos senhores directos delles.

2 Não querendo porém, ou não podendo os donos dos referidos terrenos edificar na sobredita fórma, no caso de serem as propriedades deles allotidas, se adjudicarião pelos Ministros, que Eu for servido nomear para este effeito, às pessoas que se obrigarem a edificar na mesma conformidade, e dentro no referido termo: pagando aos donos dos terrenos o justo valor delles, e dos materiais, que nelles se acharem: sendo tudo avaliado com assistência dos respectivos Ministros, e ciração das partes, por Louvados nomeados na fórma de Direito, e do costume praticado em semelhantes casos: e preferindo sempre para edificarem os vizinhos confrontantes das respectivas propriedades.

3 Quando as mesmas partes se considerarem gravadas nas avaliações dos bem allotidos, e enfyteuticos, que se fizeram na sobredita fórma, excedendo a propriedade o
valor de trezentos mil reis no juizo dos Louvados, ou conforme o parecer de algum delas, recorrerá à Casa da Supplicação com o processo verbal do arbitramento, de que interporão o recurso, o qual será nella também verbalmente julgado pelos Juízes, e Adjuntos, que nomear o Regedor; preferindo sempre o despacho dos sobreditos recursos à expedição de todo, e qualquer outro negócio; sem que com tudo se suspenda, em quanto os taes recursos se julgarem, na edificação, ou reedição, que se houver de fazer nos terrenos, de cujas avaliações se trata.

4 Nas edificações, e reedições, que se fizerem nas propriedades sujeitas a Morgados, ou Capellas, preferirá-se sempre semelhantemente os respectivos Administradores, para fazerem por sua conta as referidas obras, parecendo-lhes, e podendo a isso obrigar-se na sobredita fórma. Porém quando elles não quiserem, ou não puderem obrigarse eficaz, e effectivamente, se adjudicarão os terrenos das taes propriedades a outras pessoas, que queira, e bem possa obrigarse a edificar na conformidade dos respectivos planos, e dentro do referido termo de cinco annos: com tanto, que ao mesmo tempo se obriguem a pagar aos Administradores dos Morgados, e Capellas, a que os terrenos pertencerem, a título de Prazo fatoextim perpetuo, com o laudemio de vintena, a pensão annua, que lhes for imposta por arbitrio da Mesa do Desembargado do Paço: e que lhes faça título nesta conformidade, no caso de não haver renitencia da parte dos sobreditos Administradores; porque havendo-a, farão as adjudicações, que se fizerem dos taes terrenos, servindo de titulos communs.

5 Porque ao mesmo tempo podem concorrer muitas pessoas a querer edificar em hum só terreno vinculado, estabeleço, que neste caso fique livre aos Administradores dos Morgados, ou Capellas, darem a preferencia ao que melhor lhes parece entre os dous visinhos confrontantes, que o forem ao tempo, em que se tratar da preferencia. E não concorrendo visinho confrontante, poderá preferir qualquer outra pessoa, que lhes seja mais grata: bem visto, que em qualquer destes dous casos hão de ser os emprazamentos aprovados pela Mesa do Desembargo do Paço na sobredita fórma: e que em quanto à natureza dos Prazos, e quantidade das pensões annuas, e laudemios, não poderão os Administradores alterar por algum modo o que tenho acima ordenado.

6 Considerando, que não seria conforme à equidade natural, que os proprietários dos terrenos, que hão de ficar sitos nas Ruas, que devem allinhar-se com a rectidão, e largura, que tenho estabelecido, recebendo os benefícios do menos perigo nos terremotos, e incendios, da maior claridade da luz, da maior liberdade do ar, da maior facilidade nas conduções, da maior frequência na passagem, e do maior valor, que por todas estas vantagens, e pelos privilegios abaixo declarados, ha de accrecesser às suas propriedades, assim na estimação dos capitais dellas, como nos alugueres; se locupletem com o prejuizó dos outros proprietários, cujos terrenos se hão de devassar para serem incluídos nas taes Ruas: Mando, que estes terrenos perdidos sejam avaliados na sobredita fórma: que o total valor delles seja rateado pelas varas das frentes dos dous lados de cada huma das sobreditas Ruas: e que seja pago repartidamente pelos primeiros dos referidos proprietários, pagando cada hum delles a favor dos segundos a proporção das varas, que tiverem as frentes dos seus respectivos edificios.

7 Achando-se, que os referidos terrenos perdidos pertencem a Capellas, ou Morgados, se porá o seu valor em deposito para se empregar em bens capazes de nelles
subsistem os vinculos. O mesmo se praticará a respeito dos terrenos, que já são
enfyeuticos, para que com o preço delles sejam inteirados os respectivos Prazos.

8 Fazendo-se porém de novo alguma Praça publica, ou ampliando-se as que hoje
existem, não serão os particulares donos das propriedades, que presentemente estão
situadas nas mesmas Praças, e que nelas ficarem conservadas, obrigados a pagar causa
alguma pelos terrenos, que para a sua ampliação se comprarão, os quaes serão avaliados
na sobredita forma, e pagos a seus donos conforme as Providencias, que Eu for servido
dar, segundo a exigencia dos casos.

9 Para que não haja demoras nem nas sobreditas avaliações, nem nas eleições das
pessoas, que houverem de ser preferidas para edificarem, por falta de assistencia das
partes interessadas, ordeno que estas sejam notificadas por Editos, ou a bem da Justiça
para as avaliações, ou à instancia das pessoas, que pretenderem edificar no terreno livre,
ou vinculado; para que por si, ou por seus bastantes procuradores venham as sobreditas
partes assistir à avaliação, ou declaração das pessoas, de que fazem eleição; a saber,
achando-se presentes na Cidade de Lisboa, ou no Termo della dentro de dez dias; e
achando-se ausentes dentro de trinta dias, todos contados contínua, e sucessivamente;
com pena de que, findos elles, se procederá à revelia, na maneira acima declarada.

10 Para mais facilitar os meios necessários de beneficiar os meus vassallos, com as
vantagens, que a todos elles se hão de seguir das sobreditas edificações, ou reedificações,
estabelecendo, que as pessoas, que emprestarem dinheiro, ou concorrerem com materias, ou
mãos de obreiros para se edificar, ou reedificar dentro do recinto da Cidade de Lisboa,
que foy expresso no meu sobredito Decreto de 3 de Dezembro do ano proximo passado,
figuem só com Real Hypotheca em concorrente quantia nos edificios, ou
bemfeitorias, que nelles se fizessem em todo, ou em parte; mas também com preferencia a
todos, e quasequor outros credores ainda hypothecarios, que fizerem penhoras
posteriormente às edificações, ou reedificações, como se os mutuantes tivessem penhoras
filhadas anteriores, e feitas em execução de sentenças havidas em Juizo contencioso com
pleno conhecimento de causa: o que se executará, posto que os outros credores sejam
privilegiados, ainda que seja a minha Real Fazenda; porque a todos os outros privilegios
ordenó, que se prefira sempre o dos sobreditos mutuantes.

11 Formando-se concurso sobre os bens de qualquer reedificante, ou edificante,
o Juiz deste concurso, conhecendo breve, e sumariamente da verdade da divida
procedida da edificação, ou reedificação total, ou parcial, faça logo pagar ao credor della
peço pelo producto das logens, casas, ou armazens reedificados, eximindo-o assim da longa
disputa dos mais preferentes, e de esperar a final decisão de todo o concurso ordinario.

12 Determino, que havendo de ter administração ordinaria, ou extraordinaria a
pessoa, casa, ou bens do que houver tomado de emprestimo, e empregado dinheiro na
sobredita forma, não passará ter os taes edificios, e bemfeitorias, que com elle se fizerem,
o outro administrador, que não seja o mesmo credor, que houver feito o emprestimo, ou
concorrido com os seus materiaes, ou mãos de obreiros; ao qual credor será dada neste
caso a administração dos referidos edificios, e bemfeitorias, para por elles, ou por elles
haver seu pagamento, debaixo da obrigação de dar contas a Juiz competente dos
rendimentos das casas, que tiver na sua administração, e do que pelos productos delhas
embolçar annualmente até o seu inteiro pagamento.
Contemplando especialmente ao mesmo tempo sobre as grandes despesas, a que hão de ser obrigados os proprietários dos terrenos, e casas, que fizerem as sobreditas edificações, ou reedificações, em benefício da utilidade pública, e do decoro da Capital dos meus Reinos, o muito que importa favorecer Eu, quanto possível for, o Commercio, as manufacturas, e as pessoas, que nesse, e nesses se empregam: Sou servido eximir absoluta, e perpetua e de aposentadoria activa, e passiva as Praças, e Ruas, que tenho destinado para bolca do Commercio, e para habitação dos Homens de negócio, Mercadores, e Traficantes, que nesse se empregam, as quais são as seguintes: nos Bairros de Alfama, do Limoeiro, da Rua Nova, e do Rocío, tudo o que jaz das Portas do Chafariz de dentro, até S. Pedro de Alfama; desta Igreja até a de S. João da Praça; della pelas Cruzes da Sé, e pelo Arco da Consolação, até à Igreja da Magdalena; com tudo o mais, que está situado da Rua das Pedras Negras, até o Beco, que sahe defronte da Igreja dos Torneiros; do largo, que fica por detrás da Igreja de S. Nicolá; da Rua das Arcas, até a extremidade meridional do Rocío; e della pelas Ruas dos Escudeiros, e dos Odeiros, até à Calçatária. Nos referidos Bairros do Rocío, Rua Nova, e no dos Remolares, tudo o que jaz da boca da Rua Nova do Almada, do largo da Santa Igreja Patriarcal, da Porta da Campainha, da Tanoaria, do Corpo Santo, da Cruz de Catequefarras, do largo de S. Paulo, da Baixa-Vista, da Poço dos Negros, e da Esperança para a mesma banda do mar; incluindo-se sempre ambos os dos lados das referidas Ruas em todos os terrenos acima declarados. O mesmo se observará nos arruamentos, que Eu for servido determinar para habitação dos Artífices no Plano da Cidade acima referido. Porém nos outros Bairros, e Ruas, que não forem do Commercio, e dos arruamentos dos Artífices, mas da habitação dos outros moradores sómente se observará o sobredito privilegio de isenção de aposentadoria por tempo de trinta annos a favor dos proprietários daquelles edificios, que forem, ou de novo edificados, ou reedificados desde os fundamentos.

Pelo que mando ao Presidente da Mesa do Desembargo do Paço, Védores da Fazenda, Regedor da Casa da Supplicação, Governador da Relação, e Casa do Porto, e Ministros, Oficiais, e Pessoas destes Reinos, que cumpra, e guarde, e faça inteiramente cumprir, e guardar este meu Alvará, como nesse se contém, sem embargo de quaisquer outras Leis, ou Disposições, que se opoem ao conteúdo nesse, as quais se derrogadas para este efffeito sómente, ficando aliás sempre em seu vigor. E mando ao Desembargador Manoel Gomes de Carvalho do meu Conselho, Chanceler mór do Reino, que faça publicar este na Chancellaria, e remetêlo aos lugares onde se costuma remeter, registando-se nos livros onde se registra semelhantes Leis, e mando-se o original para a Torre do Tombo. Escrito em Belem a 2 de Mayo de 1758. = REY. = Sebastião José de Carvalho e Mello.
1.3 Interpretation by the Author of the Alvará De 12 De Maio De 1758, (Licence of the 12th May 1758).

i) Guidelines for the redistribution of land for building

In order to easily overcome obstacles that might arise in trying to relate old to new properties, Manuel da Maia drew up the following guidelines:

a)-Each case had to be observed on site because it was difficult to define measurements exactly from available plans of Lisbon.

b)-Apportionment of land in the new proposals was to be based on the proportion of total area of destroyed buildings to the total area of new buildings.

c)-The advantages of wider streets should be impressed on the owners especially those who had owned property in the old narrow streets, in order to persuade them to accept smaller building areas in the new proposals (see Fig. 1.1).

Figure 1.2 Better location

d)-Where the areas attributed to an owner, in the new plan, were less than those derived from the proportion described above, they were substituted by other sites or, if owners were not satisfied with this, by monetary compensation (see Fig. 1.3).

Figure 1.3

e)-In cases where the previous owners declined to accept the equivalent buildings in the new proposals, the Lisbon Senate should undertake the rebuilding at its own expense, selling them to the highest bidder. The income thus generated would be set against the value of the destroyed buildings as well as the cost of the new ones (see Fig. 1.4).

Figure 1.4
Indications of how to solve bureaucratic problems and to encourage construction

In this licence the king made public that he considered of great importance, the private and public rights to the reconstruction of the Capital city by means of an elegant and regular plan. Also to avoid any intolerable delay he established that:

f) The city could be rebuilt at once within the limits defined by the Cerca, (see Fig. 1.5).

g) The individuals who had participated in the reconstruction with money, materials or labour were given preference over any other parties in property disputes.

h) In the areas where it was possible to rehabilitate buildings the streets were to be widened, (see Fig. 1.6).

i) In other areas where buildings had crumbled, the new streets were planned straight to provide greater convenience.

Fig. 1.5-The plan and the Cerca

Fig. 1.6
j)-The land owners wishing to build on their own were required to have this work completed within a five-year time period, counted from the date of completion and legitimisation of the contract, (see Fig. 1.7).

k)-If an owner was unable to build under the established conditions, the case could be adjudicated by the Ministers expressly nominated for that purpose and the owner would receive only the value of the land plus that of the materials. As customary in such cases the adjoining owners were given a preferential option to purchase the land. Only the landlord of properties worth over 300 thousand Reis could appeal to the Casa da Suplicação, (court) when he considered that the lease was wrongly valued attributed by the Ministers (see Fig. 1.8).

l)-Owners with properties served by new streets, with additional benefits such as ventilation, lighting, location and a greater volume of traffic which increased the real value of the property, had to compensate others whose lands were expropriated to allow construction of new streets (see Fig. 1.9).

m)-In order not to delay in receiving bidders or evaluations it was ordered that the interested individuals should be notified by public notices to be present in the City Conservatory within 10 days, or 30 days in case of their being away from the city. If they were not present, decisions in default were made.

n)-When loans were granted towards reconstruction or improvement of a building, the loan could only be administered by the creditor, who must report annually to the judge, on the profits obtained during administration until the full payment of the debt, (see Fig. 1.10).
Appendix 2 - A photographic record of buildings studied during the research.

2.1 Photographs of the Pombaline area, its streets and its buildings.

2.2 Photographs of other contemporary Pombaline developments at Vila Real, Porto Covo and Manique do Intendente.

This appendix mainly consists of a photographic record of the buildings and streets which make up the Pombaline area. Most of these buildings have been surveyed by the author and many of the streets shown are referred to in the main text of the thesis. The appendix also includes other contemporary Pombaline developments. The photographs therefore form a useful record of the state of the buildings at the current time. All the photographs were made by the author.

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Appendix 3 consists of a description of the construction details of the Pombaline rentable buildings. The descriptions are based on detailed records of 230 buildings made by the author, over a ten year period from 1985 to 1995. During this period 19 buildings have been completely or partially demolished except for the external walls, and six further buildings have been substantially altered. Because most of the construction details are only visible during alterations or destruction of buildings, for the majority of buildings it is difficult to specify the exact way in which they were built although the method must be clearly similar or identical to the twenty-three for which the author was able to make very detailed studies.

The buildings which were partially or completely demolished during the period of study are listed below.

<table>
<thead>
<tr>
<th>Location</th>
<th>Total destruction of interior</th>
<th>Partial destruction of interior</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. 9-13, Correeiros Street</td>
<td>x</td>
<td></td>
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<tr>
<td>B. 15-23, Correeiros Street</td>
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<td></td>
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<tr>
<td>C. 25-35, Correeiros Street</td>
<td>x</td>
<td></td>
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<tr>
<td>D. 76-84, Augusta Street</td>
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<tr>
<td>E. 86-94, Augusta Street</td>
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<td></td>
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<tr>
<td>F. 50-54, Ouro Street</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>G. 56-60, Ouro Street</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>H. 185-195, Douradores Street</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>I. 85-91, Prata Street</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>J. 2-8, Santa Justa Street</td>
<td>x</td>
<td></td>
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<tr>
<td>K. 51, São Nicolau Street</td>
<td>x</td>
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<tr>
<td>L. 75, Conceição Street</td>
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<td>M. 110, São Julião Street</td>
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<td></td>
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<tr>
<td>N. 185, Prata Street</td>
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<td></td>
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<tr>
<td>O. 107-111, Correeiros Street</td>
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<td></td>
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<tr>
<td>P. 69, Ouro Street</td>
<td>x</td>
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<tr>
<td>Q. 179, Correeiros Street</td>
<td>x</td>
<td></td>
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<tr>
<td>R. 141, Augusta Street</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>S. 84, Sapateiros Street</td>
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<td></td>
</tr>
</tbody>
</table>
3.1 The foundations.

Examination of these buildings while they were being completely or partly demolished revealed an ingenious foundation system. This had been developed using wooden piles that allowed the buildings to "float" on the underlying alluvium, (Fig.3.1).

The author observed (buildings A, B, C and G) that the piles were similar and repetitive, on average 15 cms in diameter and under 1.5 m in length, forming two parallel rows in the directions of the main walls, which were linked at the top by horizontal cross-members attached by thick iron nails. Three rows of poles, three to five metres in length, were nailed longitudinally on top of the cross-members. The system of using piles consisting of green pine logs below the watertable, without light or air made it impossible for any kind of infestation to develop. Thus, the wood was preserved indefinitely.

Beneath the internal walls, the use of piles was limited to the points of intersection. At these points, a stone foundation pier was built. A stone foundation wall, about 0.80 m thick, was built on top of the assembly of piles and horizontal poles for the external walls.

The continuity of the construction was established (building F) by connecting the foundation walls and piers with brick arches, surmounted by stone walls which were the base for the walls or piers of the building, (Fig.3.1).
The author also observed a few cases (building G) in which piles and horizontal poles, as described above, were used at foundation level throughout the building, making a complete platform on which the building was set, (see Fig. 3.2) The adoption of this solution seems not to be related to the soil conditions, as the two different systems have been found in adjacent buildings on identical soil conditions. Possibly the second solution was adopted later in order to avoid the complex arch construction.

Fig. 3.2-"Platform" foundation system.

3.2 The ground floor.

The construction between the ground and first floors consisted of (buildings D, F and I) solid walls and piers linked by a system of arches (Fig. 3.4). In more elaborate cases, especially on secondary streets where stores and stables were located, (buildings A, B and C) thick groined vaults spanned between the arches, (Fig. 3.3). This solution enabled the building to withstand the movement of the land in the event of tremors or any imbalance caused by neighbouring buildings, and protected all the construction from the spread of any fire that might start at ground floor level, which was occupied by storehouses or coach houses.
In more elaborate cases there were thick groined vaults over the arches. The shops were made up of solid walls and piers linked by arches.

The walls were always built with large stones which had been crudely cut and the spaces between them were filled with smaller stones and a lime/clay mortar, which helped to bind the large stones together and make the surface of the walls smoother. For fire safety reasons at ground floor level the structure of the cage was rarely incorporated into the walls.

At the points where partition walls crossed on the upper floors, thick piers of notched, interlocking stones were built at ground floor level.

Spanning over ground floor rooms of varying proportions was achieved by using quadripartite vaults. This type of vault is distinguished by the fact that it is made up of four curved surfaces which intersect at the diagonals of the space covered, (Fig.3.5) and for ease of construction, bricks were used.

Toral brick arches were built (buildings A, B and H) on the perimeters of the vaults; they were needed for structural reasons, and there was a strong tradition of building them which extended back long before the earthquake, (Fig.3.6).
Next to the façades, these arches fulfilled the additional function (buildings B and C) of supporting the inner half of the external wall, the outer half being supported by lintels. The wooden structure of the upper floor, rested over the vaults, (Fig.3.7).

In the main streets, where there are no vaults over the ground floor rooms, there are two variations of the form of construction: arches in parallel lines (building E) (Fig.3.8); and arches perpendicular to one another, forming a grid in plan (building I) (Fig.3.4). On the internal faces of the external walls, segmental brick arches (building I) (Fig.3.9) or flat stone arches (building E) (Fig.3.10) are found.
Fig. 3.8-Parallel line of arches

Fig. 3.9-Segmental brick arch on internal face of external wall.

Fig. 3.10-Flat stone arch with detail of the balcony
3.3 The *gaiola* (cage).

The *gaiola* or wooden cage structure may have been based on traditional wooden structures, such as those of some houses on the Castle Hill in Lisbon (Fig. 3.11). The cage in the Pombaline buildings was quite ingenious in its simplicity of construction and besides offering improved safety for both people and property, it allowed the buildings to be higher than the previously stipulated two floors on land that was very unstable, (see Fig.3.13 on next page).

The structure of the *gaiola* is basically made up of a matrix of panels with horizontal, vertical and diagonal members which form a series of Saint Andrew's crosses, (Fig.3.12 and 3.14). This design of the structure is probably derived from empirical knowledge of the fact that it is difficult to deform a triangle. Thus, the squares or rectangles, defined by the crossing of the vertical posts and the horizontal rails, are transformed into triangles through the use of diagonal struts.
Fig. 3.13 - Isometric of a gaiola (cage),
85, Ouro Street
Fig. 3.14 - Isometric of a gaiola (cage) corresponding to the first floor
85, Ouro Street
As the structure was made up of numerous short and repetitive struts, with reduced sections, it was possible to overcome the problem of the scarcity of wood in the Lisbon area, and at the same time, allow for better modulation in plan and in elevation, with the options of being able to leave open spaces wherever they were required.

The module size allowed for the lower floors, which had higher ceilings, to be three or four modules high, while the upper floors would be two and half, and the attic floor only two, (see Fig.3.15 and 3.16). The reduction in the number of modules was occasionally accompanied by the appearance of vertical and horizontal reinforcement, (building F)(Fig.3.17).

The structure of the stairwell and staircase were generally reinforced by horizontal elements so that there would be multiple support points for the structure of the stair landings, (Fig.3.18 and 3.19).
Fig. 3.19 - The cage on the stairs, (building B).

Details of the cage can be different (see Fig. 3.20, 3.21 and 3.22) using complex connections (building G) (see Fig. 3.23) or can have simplified connections using just nails and even round sections (building L) (Fig. 3.24).
Fig. 3.20 - Different types of structures and connections 1
Buildings B and I

Building E

Buildings C, E and Q

Building F

Fig. 3.22—Different types of structures and connections 3
Doorways were preferably formed in the middle of a panel, care being taken to ensure there were complete modules on either side so that there would be a more stable structure without it being necessary to place struts in the space for the fanlight. When a doorway was formed at the end of a panel, the fanlight area was strengthened by diagonal struts (building B) (see Fig.3.25).
Fig. 3.25-Doorways formed in panels

Where workmanship is better the panels are covered with wooden lath and plaster (building L) (Fig. 3.26), making the internal walls virtually hollow and light in weight. In the event of an earthquake the finish would disintegrate without harming the residents unduly and the *gaiola* would retain its elasticity in order to withstand the earthquake, (building L) (Fig. 3.28). In other cases the interiors of the panels are filled with stones and mud, (building C) (Fig. 3.27)

The party and external walls were built of stone with the *gaiola* structure within them but on their inner surface in order to avoid destruction if the stone wall collapsed.

Fig. 3.26-Panels covered with lath and plaster  Fig. 3.27-Panels infilled with stones and mud.

The connections between the various oak and pine struts in the structure were flexible, which meant that in the event of an earthquake, the whole structure could adapt to the movements of the land, such movement as would be facilitated by any rigidity in the joints. Although great deformation would be limited by the triangulation of the *gaiola*, it would stay upright and still support the wooden floors, even though the plasterwork would crumble.
The section dimensions of the *gaiola* members varied with the species of timber used and the location, with larger sections generally being used for lower floors. The following dimensions are typical for pine members in major buildings:

- **Posts** 12 x 10 cms.
- **Beams** 12 x10 cms (upper floors) or 15 x12 cms (lower floors).
- **Noggings** 12 x16 cms
- **Diagonals** 7 x 10 (lower floors) or 10 x10 cms (upper floors).

Chestnut and oak members, normally located near the windows or in the roofs, have different dimensions (buildings A, C, E, G and H), for example the diagonals are longer (Fig.3.29).

On the attic floor, the sizing of the timber sections was extremely inconsistent (buildings A, C, E, G and H). The sections were always smaller and irregular and often consisted of small, circular logs which even had bark left on them(Fig.3.30)
The posts and studs are extended upwards using a *topo de gazepe* (scarf joint) reinforced with an iron staple, (buildings P) (Fig. 3.31), or using a nogging placed between two floor joists, with a built up joint rather than a scarf joint between the two lengths of stud and with or without an iron staple (buildings A, F and G) (Fig. 3.32).

When panels in adjacent storeys are aligned, they have a common beam at or just below floor level, (buildings A, F and G) (Fig. 3.33, 3.34, 3.35 and 3.36).
Fig. 3.34 - Example of connections between vertical and horizontal elements

Fig. 3.35 - The panels of the upper and lower floor share the same beam.

Fig. 3.36 - The panels of the upper and lower floor share the same beam.
In order to increase solidity, in all observed cases (buildings D), the floor joists are anchored to parallel walls with metal straps, (Fig. 3.37).

The junctions of the panels are normally formed on the perpendicular with a T connection. The following are ways of achieving this (building B) (see Fig. 3.38 and 3.39).

i. By using a thick post shared by the two panels (building F).

ii. By doubling up the studs at junctions (building G and B).

iii. By making a connection at an intermediate point between the studs of each panel, and connecting the noggings and diagonal struts of each panel to one another (building F and G).
In all cases from the first floor upwards, all the walls in the building have the gaiola structure. However, the internal walls adjacent to the street and the internal courtyard were of a more simplified structure (Fig. 3.40 and 3.41) than the other internal walls. In these walls the diagonal bracing disappeared leaving a few vertical and horizontal elements to which were fixed the wrought iron cramps which held in place the masonry around the door and window openings.
The *gaiola* also had to support the staircase. In the case of *dogleg* staircases, the half landings spanned between the stairwell walls at either end of the half-landings, and these stairwell walls were reinforced typically by more horizontal members dividing them into a larger number of panels (see Fig. 3.18). The flights were supported on carriages which spanned between the half-landings; however additional support was provided by the apparently solid balustrades, which in fact have a timber structure similar to that of the *gaiola*, and are continuous throughout the height of the staircase, (building A) (Fig. 3.42).

Fig. 3.18 - The structure on the façade walls, detail

Fig. 3.41 - The structure on the façade walls, detail

Fig. 3.42 - Typical "solid" balustrade of staircase
The wooden partition walls (tabiques) do not belong to the gaiola as they do not continue on the floor above or below. They were made in order to subdivide a space on a floor and are positioned in the gaiola structure by uprights inserted between two joists, to which diagonal struts were attached.

Planks called "costaneiras" were nailed (normally vertically rather than horizontally) onto the struts, then covered with laths and plastered, (buildings B, E and F) (Fig. 3.43).

Fig. 3.43-Example of a wood partition with "costaneiras"
3.4 The stairs.

For reasons of fire safety, in most buildings the steps of the first flight of stairs that give access to the residential floors were made of stone and above this the stair was made of wood, (Fig. 3.44).

From a construction point of view, the wooden stairs in the rentable building can be classified as follows:

i) Straight flight stair climbing alongside a wall which provides support, (Fig. 3.45). This arrangement appeared in building types 1, 2B, 2C, 3 and 4. This form of stair had bearers which were placed laterally under the flights, transferring their weight onto timber walls, (Fig. 3.46).
ii) A dogleg stair with a central "solid" balustrade, which partially supported the flights and incorporated a cage; this arrangement is present for building types 5 to 7, (Fig. 3.47 and 3.48).

iii) Stairs with an open newel to allow natural light. The flights were basically supported on two or three carriages with a cross-section of 0.14 x 0.08 m, inclined parallel to the flight, the ends being supported by the landing bearers, (Fig. 3.49 and 3.50). This arrangement includes buildings types 8 to 10.

iv) Stairs which were made with three different flights around the open newel. This arrangement includes only building type 11, (Fig. 3.51 and 3.52).
v) A helical stair, the most complex of all. This arrangement appeared only in buildings of type 12 (building D) (Fig. 3.53 and 3.54).

In all forms of stair the treads usually rested upon the carriages. Both the treads and the risers were simple planks, 0.04m thick, which were rebated into one another; the edge of the tread was either rounded, (Fig. 3.55) or had a separate nosing nailed to it, (Fig. 3.56). In some cases the edges of the stairways were finished with a skirting board which was scribed to the treads and risers, (Fig. 3.57).

The staircases with open newels sometimes had solid balustrades, covered with lime or gypsum plaster (later), in the same way as the panels of the cage walls, finished off with carefully fitted moulded handrails and decorated with tiles (Fig. 3.58). Others had iron balusters made up of modular sections that were easily made and simple to install as they were riveted to each other and were easily adapted to the required sizes and angles, (Fig. 3.59).
3.5 The façade

The solid parts of the façades are aligned both vertically and horizontally and in all buildings the wooden cage structure on the inside face of the external wall, (building P)(Fig. 3.60 and 3.61) is without diagonal struts. In the event of an earthquake, it was probably not intended to support the stonework but merely to support the floor joists and to fix the masonry around the openings in order to prevent it from collapsing into the street, (Fig. 3.62 and 3.63).
The pilasters and their bases were faced with ashlar stone, 0,15m or less in thickness, and the various parts were fixed to the structural wall with iron cramps; the same system was used for the quoins, (building P)(Fig.3.64).

The materials used in the construction of the façade varied. The rubble stonework which made up the main body of the façade, the bases, keystones, friezes, lintels, doorposts, parapets and window sills were all in stone. However, the cornices, the walls beneath the sash windows and the relieving arches were all in brick, (Fig.3.65, 3.66, 3.67 and 3.68).
Fig. 3.65 - Connections of the interior panels to the façade gaiola (buildings D and E)

Fig. 3.66 - Façade construction details viewed from inside (building P).

Fig. 3.67 - Façade construction details viewed from outside (building P).
Fig. 3.68-Façade construction details (building L)
3.6 The roof.

The Pombaline rentable buildings are covered by mansard or dual-pitched roofs, with the party walls rising 0.80 m above the roof to prevent fire spread.

The buildings situated on corners have hipped roofs with valleys at the junction of the inside roof slopes.

The buildings situated in squares and main streets have mansard roofs. These had a more complex structure, allowing for a reasonable ceiling height throughout the attic as well as easy access to the windows, (Fig.3.69 and 3.70).

Dual-pitched roofs covered most buildings. These were simple in construction and close to the traditional style. The habitable space in the roof was reduced and access to the windows was via a long narrow, bay projecting into the dormer, (Fig.3.71 and 3.72).
In both types, the roof structure was connected to the structure of the cage. In some cases trusses act as supports to the heavy load of the roof, (Fig. 3.73, 3.74, 3.75, 3.76 and 3.77). This was necessary because in most cases the wood used was of poor quality, and the spans are excessive for normal-sized common rafters.

![Diagram of roof structure with labels: ridge tree, collar, king post, rafter, struts, tiebeam, ceiling joist, tiling battens.](image)

Fig. 3.73 - Structure of a triangular roof, section

![Isometric view of a building with a triangular roof.](image)

Fig. 3.74 - Structure of a triangular roof isometric. (building L)
The common rafters are at 0.40m (40cm) centres and are supported at the ridge by a ridge tree ("trave de fileira") with a section measuring 0.18x0.08m and at intermediate points on the slope by purlins ("madres") with sections measuring 0.15x0.10m, the ends of which were supported on the gable walls.
The various parts which made up the frame structure were held together by metal connections, (building B) (Fig. 3.78).

The construction of the frames was not always perfect and there were many cases, especially on the additional extensions where there were circular or semi-circular section truss members, and it often proved necessary to place props where the structure began to deflect under the weight of the tiles, (Fig. 3.79 and 3.80).
Thin planks were sometimes nailed on top of the rafters perpendicular to them. As the planks were not jointed on their edges, they never fitted neatly and the joints were therefore covered with wooden strips which acted as tiling battens. As a covering, Spanish tiles were used which allowed for the construction of an elegant and long-lasting roof but one that was quite heavy.

The tiles were laid down forming strictly parallel channels, following the direction of the roof slope and above the cornices of the façades were eaves with gentle slopes using three tiles, which became progressively more horizontal, towards the eaves with the help of sprockets nailed to the ends of the rafters, (Fig.3.81, 3.82, 3.83 and 3.84).

Fig.3.80—Aspect of the structure from inside
(building P)

Fig.3.81—Tilting of the tiles at the eaves, section
(building L)

Fig.3.82—Tilting of the tiles at the eaves
(building B)
The lowest tiles on the eaves were bedded in mortar to prevent them falling onto passers by, which was a danger especially with the steeper slopes of the mansard roofs; in order to allow for easy access to the roof for cleaning or repair purposes, tiles were placed over the channel next to the dormer windows. These were laid transversely and bedded on mortar, in order to act as steps, (Fig. 3.85).

The dormer windows were always made with a ridge aligned with the roof frame. The dormer cheeks have a compact structure on the inside formed of vertical and horizontal planks which are supported by the two adjacent rafters, (Fig. 3.86, 3.87, 3.88, 3.89 and 3.90). The perimeter of the habitable area of the roof was defined by wooden partitions.
Fig. 3.88 - Dormer window, detail of structure (building B)

Fig. 3.89 - Dormer windows, detail of construction (building P)

Fig. 3.90 - Dormer windows, from inside (building P)
3.7 Skylights, floors and ceilings

The construction process usually consisted of extending the stairwell structure above the roof and covering the inside with planks and the outside with metal plates, (Fig.3.91 and 3.92).

A structure of riveted metal struts held the glass which was fixed to it with lead, except for the lower edge, which was rounded and was free to move with the expansion caused by the heat.

![Fig.3.91-Section through skylight monopitch (building J)](image)

![Fig.3.92-Section through dual pitch skylight. (building D)](image)

Usually the floor joists extend from one external wall to the other, (Fig.3.93).

![Fig.3.93-View of the structure of floors (building B)](image)
Their bearings ends were always supported on transverse beams inside the external walls, reinforced with iron straps, (Fig. 3.94 and 3.95) except near the balcony (Fig. 3.96).

Fig. 3.94-Connection of the floor joists to the walls (building D)

Fig. 3.95-The beams at the balcony (building D)

The joists adjacent to the cross walls are fixed to them with iron straps, (Fig. 3.97). Openings for chimneys and stairs are formed with trimmed, trimmer and trimming joists as in UK construction, (Fig. 3.98).

Fig. 3.97-Joists strapped to cross walls (building B)

Fig. 3.98-Trimming for a chimney (building B)

Timber or brick nogging was used to maintain the joist spacing over internal walls, (Fig. 3.99 and 3.100).
When joists are jointed over internal walls, only every other joist is jointed over any one wall, (Fig.3.101).

The floors consist of pine boards, without knots, planed on both sides and of equal width, (Fig.3.102). They were joined in the Portuguese way with rebates, 0.022m in depth, (Fig.3.103). The width of the floor boards could vary by 0.16m on the landings and by 0.08/09m in more refined areas. To make the floor more resilient and comfortable, there are softwood packing pieces below the boards, on top of the joists, (Fig.3.103).
On the upper levels, the wooden floors were plain, that is to say, all the boards were perpendicular to the joists, (Fig.3.104).

There are many cases where in the sitting rooms next to the walls, two boards were placed perpendicularly and in the corners there were 45° mitres. This type of floor was called "encabeirado", meaning, with boards placed parallel to the walls around the perimeter (Fig.3.105). For this purpose, noggings were inserted next to the walls. The skirting boards were planed on one side only and nailed to the cage supports.
The ceilings were made of boards, planed only on the side that was visible. Firstly, boards were nailed directly to the joists with gaps between them. Subsequently, further boards with cavetto-moulded edges were planted over the gaps, lapping over the edges of the previously fixed boards, (Fig. 3.106 and 3.107). This type of lining was called "overlapping mat style". The whole lining was "encabeirado", as, next to the walls, there was a concave border where the walls and the ceiling met, which was supported by noggings provided for the purpose, (Fig. 3.108).

There were also lath-and-plaster ceilings, (Fig. 3.109).
3.8 Windows, doors and cupboards

The doors in the Pombaline rentable building were basically divided into two types, ledged and battened, and panelled. The ledged and battened doors consisted of a series of vertical battens, which were tongued and grooved, with the whole being held firmly together by three horizontal ledges, (Fig. 3.110). These doors, which though solid, were more rudimentary in construction, were used as inner doors on the upper floors, for kitchen cupboards and often for ground floor doors. In the latter case, the battens and ledges became very thick. There are interesting examples of this type of door, where one of the batten sections acted as a window for a shop or workshop; the door would be installed in the entrance stairway to the homes (Fig. 3.111).
The panelled doors consisting of stiles, rails and sometimes muntins enclosing panels. Two types of panelled doors are found: a more rudimentary type where the panels are rebated and lapped to the stiles, rails and muntins (Fig. 3.112), and a more sophisticated, tongued and grooved type, similar to those found in Britain from this period (Fig. 3.113) with one or more panels (Fig. 3.114). These were more careful and elaborate in construction and normally had a glass fanlight or an iron grille above them. They were normally used for entrance doors.
There were also two distinct types of windows, French windows and sash windows. The French windows, seen on the first floor in the more important streets and squares were rebated casement windows (with central meeting stiles) with larger panes than the windows of the higher floors, (Fig. 3.115). The lower part of the window up to height of 0.60 m consisted of a wood panel.

The sash windows, seen on the higher floors and on the faç ade of the internal courtyard, have smaller panes, (Fig. 3.116). They had two sashes, an outer one fixed to the upper part of the frame and a lower vertical sliding one. Both window types had internal shutters as protection against light and cold.
The cupboards are of two types, those on the landings (Fig. 3.117), of which there are few examples and those inside the flats in the kitchen, that exist in all buildings, (building L) (Fig. 3.118).

The hinges, three for each section, were simply made and were popularly known as "rudders without tillers". The handles on the inner doors were of the "moleta" type or round, and were connected to a small latch. The doors on the ground level, the entrance to the flats, had more elaborate handles either in iron or brass. In the double doors, the less used sides had barrel bolts, on the upper and lower parts, which fitted into staples that were fixed to the frames. The doors of the various flats which opened onto the stairs, had rudimentary latches operated by keys, only from the outside, (Fig. 3.119 and 3.120). They also had openings with protective grilles to look through to the outside. To close the windows, espagnolette bolts were filled.
3.9 The fireplace and chimney.

The fireplaces that were in the kitchens in the flats had a dual function. As well as being used for cooking, they also provided heating in winter, (Fig.3.121 and 3.122).

They were very basic in construction and had no decorative features. The fire was laid on top of a large flat stone and there was a space below for storing firewood (Fig.3.123 and 3.124). They had no system whatsoever for air to enter to activate combustion, which meant having to keep the windows half-open even in cold weather.

Fig.3.121-Example of a fireplace
(building J)

Fig.3.122-Detail construction of a chimney
(building P)
Considering that the speed at which smoke is drawn out is proportional to the square of the height of the outlet, each fireplace had to have its own flue which went right to the top of the building making it very difficult for gases to return down. To increase the efficiency of the draught, the hood section of the vertical flue was made as narrow as possible and grouped together with other flues in order to prevent loss of heat, and to encourage the flue gases to rise, (Fig.3.125, 3.126 and 3.127). The tops of all the flues were covered with curved tiles to prevent rain water from entering, (Fig.3.128). The abutments of the roof to the chimneys were weathered with zinc flashings, (Fig.3.129).
3.10 The drainage system.

A sink was the only waste water disposal point in the flats, (Fig. 3.130). It consisted of a small square-section block of stone with a hollowed out concave surface on top, in the centre of which was an outlet. It was always situated in one of the corners of the kitchen and always on an outer wall, (Fig. 3.131 and 3.132).
Below the sink a siphon pipe came out which was connected to the building's main drainpipe, (Fig.3.133). The soil stack was formed by a series of socketed ceramic pipes, which are very similar to the glazed stoneware ones in use today, except for the fact that the section was elliptical. In order to hide it better in the alfugere wall, where it extended above the roof, there was a rounded ventilation pipe made of stone about 1,20 m in height, (Fig.3.134).
Its lower part ended in an open stone box, from which the waste ran into a stone gutter before entering the main pipe of the *alfugere*. The fact that there was an opening in the lower part of the drainpipe made it easier to clean it as well as making the flow of waste from the vertical to horizontal easier, (Fig.3.135, 3.136 and 3.137).
3.11 Access to the flats.

A bell system was fitted to the flats to announce the arrival of visitors. This basically consisted of a wire which, when it was pulled at the entrance to the building, rang a small bell in a cage made of metal strips, which was located on the first floor landing, (Fig.3.138).
The door opening device for the building which gave access to the flats consisted of a vertical iron shaft in conjunction with levers on every level which, when they were pulled, set off an articulated system which opened the front entrance door latch, (Fig. 3.139).
3.12 Drawings of some of the buildings which have been partly or completely demolished.

The following figures 3.140 to 3.158, show the construction details of buildings that were either completely demolished or substantially altered see section 3.1. They form a complete record of the construction details of the buildings which were carefully observed and recorded during demolition.
Fig. 3.140 - Isometric showing the construction, (building A)
Fig. 3.141-Perspective showing the construction, (building B)
Fig. 3.142 - Perspective showing the construction, (building C)
Fig. 3.143 - Perspective showing the construction, (building D)
Fig. 3.144 - Perspective showing the construction, (building E)
Fig. 3.145 - Perspective showing the construction, (building F)
Fig. 3.146-Perspective showing the construction, (building G)
Fig. 3.147 - Perspective showing the construction, (building Q)
Fig. 3.148 - Isometric showing the construction, (building M)
Fig. 3.149-Section showing the construction, (building M)
Fig. 3.150 - Isometric showing the construction, (building M)
Fig. 3.151-Isometric from alfugere showing the construction, (building M)
Fig. 3.152-Construction section, (building L)
Fig. 3.153-Isometric showing the construction as originally built, (building L)
Fig. 3.154-Isometric showing the construction with the later extension, (building L)
Fig. 3.155-Isometric (from alfugere) showing the construction with the later extension, (building L)
Fig. 3.156 - Perspective showing the construction, (building R)
Fig. 3.157-Perspective showing the construction and tiles, (building R)
Fig. 3.158 - Perspective showing the construction, (building S)
Appendix 4 - Supporting historical material relating to the construction period 1755-1820

4.1 Register of tax collection between 1760 and 1840.

4.2 The reconstruction process in relation to key historical events.

4.3 References to the chronology of the reconstruction.

4.4 Completed buildings (by street) between 1766 and 1788
   (After Luís Pastor de Macedo(32))

4.5 Records of building contracts during the construction period.
   i) Source of references to the contracts.
   ii) Resumé of significant aspects of the contracts.
   iii) First example of a contract of 1760 and respective translation.
   iv) Second example of a contract of 1776 and respective translation.

4.6 Letter from António Pardal Monteiro and respective translation.

In this appendix the author has brought together data from research done on records of the progress of construction in the development area and of evidence of prefabrication. Section 4.1 refers to the survey carried out in the archives of the Tribunal de Contas, into the collection of taxes during the reconstruction period, in three streets. Section 4.2 examines the development of the reconstruction in a historical context. Section 4.3 refers to accounts from the period about the reconstruction and in Section 4.4 to facts presented by a Lisbon writer. In addition to this, there is some documentation of great relevance to the investigation regarding the prefabrication of buildings. Section 4.5 deals with building contracts of the period with reference to prefabrication and section 4.6 contains a letter written to the author by an architect descended from a family involved in the reconstruction over several generations.
4.1 Register of tax collection between 1760 and 1840.

Source:
DÉCIMA DA CIDADE DE LISBOA E O SEU TERMO 1760-1840,
not published, owned by the Arquivo Histórico do Tribunal de Contas, serial volumes
0302 (streets), Lisbon.

Observations:
-Augusta Street belongs to two different parishes.
-The numbers of the owners or properties do not correspond with the numbers of doors. In
1830 it appears that the number of doors, was different from today, so that is why the right
or left side of the street has odd and even numbers.
-The names are written as in the original document, in Archaic Portuguese.
-Between 1760 and 1830, some corner buildings changed from one street to another or in
some cases from one parish to another, for example in 1782 Augusta Street had 51 buildings,
in 1790, in 1801 71 buildings and later 51 buildings.

Chronology of building construction on some streets

1762/63
Aurea-7
Augusta-18
Sapateiros-
Correios-
Conceição-3
S. Juliao-4
1769
Aurea-7
Augusta-42
Sapateiros-3
Correios-
Conceição-6
S. Juliao-9
Arsenal-5
Comércio-7
Prata-4

1760-Started the reconstruction process
-Manuel da Maia died
1763-Carlos Mardel died
1769-Public selling of unbuilt properties
1771-Public selling of unbuilt properties

1772
Aurea-7
Augusta-51
Sapateiros-11
Correios-3
Conceição-10
S. Juliao-11
Prata-13
Douradores-6
S. Nicolau-2
1790
Aurea-14
Augusta-51
Sapateiros-16
Correios-23
Conceição-11
S. Juliao-14
Prata-12
1801
Aurea-19
Augusta-51
Sapateiros-15
Correios-22
Conceição-12
S. Juliao-17
S. Nicolau-2
Prata-15
Douradores-4
1810
Aurea-19
Augusta-54
Sapateiros-16
Correios-23
Conceição-11
S. Juliao-15
Prata-15
Douradores-9
1820
Aurea-19
Augusta-55
Sapateiros-16
Correios-23
Conceição-11
S. Juliao-17
S. Nicolau-8
Vitoria-9
Arsenal-6
Assunção-5
Santa Justa-11
1831
Aurea-18
Augusta-55
Sapateiros-16
Correios-23
Conceição-11
S. Juliao-17
1832/34-Important liberal fights
-Religious orders were extinct
-The King D. Pedro IV died
1800-War with Spain
1806-1st French invasion, the Royal
family took refuge in Brazil.
1809-2nd French invasion
1810-Commercial treaty with England
1810/11-3rd French invasion
1815-Brazil became Kingdom of Portugal
1816-The Queen D. Maria died
1818/1834-Liberal revolution
1821-Portugal became again a Kingdom
1822-Independence of Brazil
1820-The absolutists intentions
AUGUSTA STREET - Parish of S. Julião-Augusta
Street, right side from Comércio Square; Ouro Street, left and right sides from Comércio Square; S. Julião Street, left and right sides from Boa Hora; Conceição Street, right and left sides from Boa Hora; Nova do Almada left and right sides; Ribeira das Naus Street; Nova Del Rei Street and Santa Justa Street.

1762/63 (S. Julião 572)
Right/from Comércio Square
1.91-
3.191-Ordem Gregoriana de S. Francisco
4.101-Imundade do Santíssimo Sacramento
5.30
6.187
7.184-Imundade da Congregação da ... 8.29-Francisco G. Marquis
9.180-Luis Serqueiro?
10.178-Propriedade da Igreja Patriarcal
11.174-Francisca Teresa viúva de Eugénio dos Santos
12.171-António Grogano Raposo
Left/from Comércio Square
13.88
14.7-
15.29-Feliz Laluca?
16.12-D. Rodrigo António de Noronha Menezes
17.103
18.27-António Lourenço de Seixas
19.21
20.26
21.52
22.104

1769 (S. Julião 575)
Right/from Comércio Square
1.91-Ambrósio Araújo de Sá
2.193- Dr. João Tavares de Almeida
3.191-Ordem 3º de S. Francisco
4.101-Imundade do Santíssimo Sacramento de S. Julião
5.30-Manuel Gemarins (Guimarães)
6.187 - D. Bras Baltazar da Silveira
7.184-Imundade da Diretora
8.29-João Rodrigues Caidaz
9.180-Jose Ferreira Dias
10.178-Santa Igreja da Patriarcal
11.174-João Gonçalves Rebelo
12.171-Padre António Raposo
Left/from Comércio Square
13.88-Manuel José Curvo Semedo
14.7-José Lopes de Miranda
15.29-Hercules Alves Lima
16.12-Dom Bras Baltazar Silveira
17.103-Jose Pereira de Almeida
18.27-António Lourenço Seixas
19.21-Manuel dos Santos Lopes
20.26-João Costa Araújo
21.52-João Dias da Silva
22.104-
1799 (S. Julião 584)
Right/from Comércio Square
1.91-Doutor Xavier Araújo
2.193-Herdeiros de Dr. João Tavares de Almeida
3.191-Ordem 3ª de S. Francisco
4.101-Immandado do Santíssimo Sacramento de S. Julião
5.30-Manuel António da Silva Bravo
6.187-D. Bras Baltazar da Silveira
7.184-Hospital Real de S. José
8.29-João Rodrigues Calçada
9.180-António Gonçalves
10.178-Santa Igreja da Patriarcal
11.174-Herdeiros João Gonçalves Rebello
12.171-José Gonçalves Marques
Left/from Comércio Square
13.88-Herdeira de Manuel José Curvo Semedo
14.7-José Lopes de Miranda
15.29-José Lopes Alves
16.12-Dom Bras Baltazar Silveira
17.103-Jose Pereira de Almeida
18.27-António Lourenço Seixas
19.21-Manuel dos Santos Lopes
20.26-Herdeiros de João Costa Araújo
21.52-D. Rita Gertrudes Margarida Marreca
22.104-Freguesia de S. Nicotau

1810 (S. Julião 586)
Right/from Comércio Square
1.91-Francisco Correia Borges
2.193-António José da Fonte
3.191-Ordem 3ª de S. Francisco
4.101-Immandado do Santíssimo Sacramento de S. Julião
5.30-Manuel António da Silva Bravo
6.187-D. Nuno José Baltazar Piedade da Silveira
7.184-Hospital Real de S. José
8.29-João Rodrigues Calçada
9.180-António Gonçalves
10.178-Francisco Pereira Lima
11.174-Herdeiros João Gonçalves Rebello
12.171-Manuel José Marques
Left/from Comércio Square
13.88-Herdeira de Manuel José Curvo Semedo
14.7-José Ferreira Troca
15.29-Sebastião José Oliveira Guimarães
16.12-Dom Nuno Maria Baltazar Silveira
17.103-Dona Joaquina Gertrudes de Almeida
18.27-António Lourenço Seixas
19.21-Jacinto Pereira Lima
20.26-Herdeiros de João Costa Araújo
21.52-D. Rita Gertrudes Costa
22.104-Freguesia de S. Nicotau

1820 (S. Julião 588)
Right/from Comércio Square
1.91-Francisco Correia Borges
2.193-António José da Fonte
3.191-Ordem 3ª de S. Francisco
4.101-Immandado do Santíssimo Sacramento de S. Julião
5.30-Francisco Saravia
6.187-D. Nuno José Baltazar Piedade da Silveira
7.184-Hospital Real de S. José
8.29-João Rodrigues Calça
9.180-António Gonçalves
10.178-Francisco Pereira Lima
11.174-Herdeiros João Gonçalves Rebello
12.171-Manuel José Marques
Left/from Comércio Square
13.88-Herdeira de Manuel José Curvo Semedo
14.7-José Ferreira Troca
15.29-Sebastião José Oliveira Guimarães
16.12-Dom Nuno Maria Baltazar Silveira
17.103-Dona Joaquina Gertrudes de Almeida
18.27-António Lourenço Seixas
19.21-Jacinto Pereira Lima
20.26-Herdeiros de João Costa Araújo
21.52-D. Rita Gertrudes Costa
22.104-Freguesia de S. Nicotau
AUGUSTA STREET  Parish of S. Nicolau
Duque, Carmo, Sapateiros, Manuel Gonçalo Streets; Augusta Street, left and right sides; Béla
Rainha Street, right side; Conceição Street, right side; Crucifixo street, right side; Nova do
Almada Street; Nova do Carmo Street; Ouro Street and Rossio Square.

1762/63 (S. Nicolau 787)
1-António Ribeiro da Silva
2-João Pires
3-Pedro Rangel
4-Cechose? Marques
5-Pedro Cardoso Puleiro
6-Gaêleir Grô?
7-Lourenço da Silva

1769 (S. Nicolau 789)
Left/from Comércio Square
17-João Henrique de Sousa
18-Rodrigo Caetano de Almeida
19-Pedro da Costa Guimaraes
20-José Rodrigues Bandeira
21-José Rodrigues Bandeira
22-Genero da Olmara
23-José da Costa Soares
24-Padre Domingos dos Santos
25-Maria João...
26-Pedro da Costa Soares
27-Francisco Silva e Abreu
28-Convicto de Rosário
29-Religiosas do Convento

Right/from Comércio Square
30-João dos Santos Mattos
31-Maria Joaquina de Melo
32-Pedro da Graça
33-Maria Pereira
34-Pedro Manoel Rangel
35-Francisco Sales Monteiro
36-Joaquim José Perez
37-António José Rebelo
38-José Antunes
39-Manuel Francisco
40-Herd. de António Ribeiro da Silva
41-Domingos Bastos Viana
42-Amaro Monteiro da Cunha
43-Padres da Congregação
44-José Domingos
45-José da Mota
46-D. Juliana de Menezes
47-Joaquim Alves Guerra
48-Teres Teixeira Matos
49-Teres Teixeira Matos

1780 (S. Nicolau 794)
Right and left/from Comércio Square
58-José Maria de Jesus
59-Maria Joaquina de Melo
60-Padres da Graça
61-João Gonçalves Rabello
62-José dos Reis
63-Manoel Rangel
64-Desembargador Luís Ribeiro Quintella
65-Francisco de Salles
66-Francisco da Silva
67-Joaquim José Pires
68-Duque do Cadaval
69-António José Rebelo
70-José Antunes
71-Francisco Xavier da Sepulveda
72-Heerdeiros do Desembargador Luís Estanilao da Cunha Coelho
73-Junta do Comércio
74-Domingos Bastos Viana
75-António da Costa
76-Amaro Monteiro
77-Manuel Pereira
78-Padres da Congregação
79-José Domingues
80-Herd. de José Matta
81-Juliana Menezes
82-Joaquim Alves Guerra
83-Felix Teixeira de Matos
84-Felix Teixeira de Matos
85-Amaro Monteiro
86-Antonio da Costa Araújo

1790 (S. Nicolau 793)
Left/from Comércio Square
57-Gaspar Tavares
58-Maximiano Fernandes Oliveira
59-Maximiano Fernandes Oliveira
60-Heerdeiros de José Rodrigues
61-Pedro Azvedo Vequelle
62-José Frederico Lavolice
63-Patriarcal
64-Heerdeiros de Domingos dos Santos Franco
65-Heerdeiros de Maria João
66-Padres Paulistas
67-José Domingues
68-Heerdeiros de João Fernandes Oliveira
69-Heerdeiros de João Fernandes Oliveira
70-Heerdeiros de João Fernandes Oliveira
71-Machado Miranda
72-José Domingues
73-Heerdeiros José antônio Monteiro
74-Convicto de Obidos
75-Heerdeiros de José Antônio Monteiro
76-Heerdeiros de José Joaquim Ewy?
77-Religiosas da Esperança
78-?
1821 (S. Nicolau 810)
Left/from Comércio Square
132-Manuel Flora
133-João Batista da Silva
134-Conde de Ovidos
135-Heerheiros de Antonio Jose da Silva
136-Felix Costa
137-D. Anna de Oliveira Grijio
138-
139-Manuel Moreira Marques
140-Heerheiros de Felix
141-Francisco Ambrosio Leal
142-Manoel Fernandes
143-Antonio Jose Moreira
144-
Right/from Comércio Square
145-Heerheiros de Alexandre Ferreira Castelo
146-
147-Manuel Alves Guerra
148-Joana Roca Basto
149-Maria Vitória Rocha
150-Antonio Gomes de Campo
151-Antonio Duarte Loures
152-Antonio Francisco Tainha
153-Teixeira Marques
154-Antonio Francisco Chaves
155-
156-Thorne Gonzaga
157-Duque do Cadaval
158-Jose Nunes Lobo
159-Antonio Francisco dos santos
160-Antonio Simoes Roubado
161-J.M.
162-Rapozo
163-Francisco Nicolau dos Reis
164-D. Maria do Marro Alves

1830 (S. Nicolau 812)
Left/from Comércio Square
131.34/36-Manuel Mº Flora
132.37/39-Batista de Sousa
133-
134.42/44-Antonio Jose de Sousa
135.45/49-Felix Costa
136.60/65-Felix Oliveira G7
137.66/72-Felix Oliveira G7
138.75/78-Manuel Moreira Marques
139.73/82-Filipe Nere da Silva
140.83/85-Francisco Ambrosio Leal
141.86/89-Mario Ferreira Garces
142.97/98-João Ferreira da Cunha Bastos
143.99/101-Angelo Oliveira
Right/from Comércio Square
144.105/107-Alexandre Jose Ferreira Castro
145.108/109-Francisco Manuel Correia Lopes
146.110/111-Manuel Guerra
147.112/113-Carlesco Subena
148.114/116-Maria Vitória da Rocha
149.121/122-Sebastiao Gomes de Carvalho
150.123/125-Antonio Duarte Loures
151.126/128-Francisco Machado
152.129/132-Domingos Teixeira Marques
153.133/134-Antonio Francisco Chaves
154.138/139-Francisco?
155.140/142-Thome Joaquim Gonzaga
156.143/147-Duque do Cadaval
157.148/149-Jose Nunes Lobo
158.150/151-Antonio Francisco da Silva
159.153/157-Simoes Roubado
160-Jose Mario Rapozo
161-Francisco Reis
162.162-Duarte Rey
163.163-Maria do Marro Alves

CONCEIÇÃO STREET (S. Juliao S72)

1762/63
22-Gerónimo Vitória
23-Domingas Maria
24-João Ignacio

1769
53-Imandade do Santissimo da freguesia da Conceição Nova
54-Gerónimo Vitória
55-Domingas Maria
56-Francisco Ribeiro*
57-António Lourenço Seixas
58-João Ignacio

1782
53-Imandade do Santissimo da freguesia da Conceição Nova
54-Gerónimo Vitória
55-Domingas Maria
56-D. José Xavier Telles
57-Francisco Xavier Natal
58-Francisco Ribeiro
59-António Soares
60-António Lourenço Seixas
61-Maria de Sousa Rey
58-João Ignacio

1789
Right
60-Imandade do Santissimo da Freguesia da Conceição Nova
61-Gerónimo Vitória
62-Jose Campos Lima
63-Jose Pedro
64-D. Ana Romário Aquino
65-Ribeiro da Silva
1801
Right
58-Santíssimo da Conceição
59-Gerônimo Vitória
60-Luis Campos
51-Jose Teles
62-Jose Domingues
63-Francisco Rebelo da Silva
Left
64-Dionízio António
65-Jose Rodrigues Lima
66-Antonio Salgado
67-Antonio Lourenço Seixas
68-Luis dos Santos Gonçalves

1810
Right
65-Conceição Nova
66-Gerônimo Vitória
67-Jose Campos Lima
68-Jose Teles
69-D. Ana Maria Aquino
70-Manuel Jose da Silva Ribeiro
Left
71-Dionízio Antonio Verney
72-Jose Lima Viana
73-Ana Joaquina Salgado
74-Pedro Lourenço Seixas
75-Luis de Santa Maria de Sousa

1820
Right
67-Conceição Nova
68-D. Rosa Joana Vitória
69-Jose Campos Lima
70-Jose Teles
69-D. Anna Thomasa
70-Manuel Jose da Silva Ribeiro
Left
73-Dionízio Antonio Verney
74-Domingos Alves de Mendonça
75-D. Perpétua Pereira Faria
76-Pedro Duarte da Silva
77-Jose Pereira de Almeida Silva

1831
Right
68-Conceição Nova
4.2 The reconstruction process in relation to key historical events

Historical events based on:
MARQUES, A. H. de Oliveira, História de Portugal, Vol II and III, Palas Editores, Lisboa 1984

A-Augusta Street, main street
S-Sapateiros Street, secondary street
C-Conceição Street, transverse street

1760
A-0 S-0 C-0 0 0 0
1763
A-18 S-0 C-3 21 +21 0
1769
A-42 S-3 C-6 51 +30 +3
1782
A-51 S-11 C-10 72 +21 +8
1790
A-51 S-16 C-11 78 +4 +5
1801
A-51 S-15 C-12 78 0 0

1756/63-Seven years war/Portugal is neutral
1759-The Jesuits were expelled
1760-Started the reconstruction process
1762-Seven years war/Spain, France and Italy signed the "Pact of Family" (Bourbons)/Portugal refuses to sign and is invaded
1763-The peace treaty is signed
1769-Public selling of unbuilt properties
1771- Public selling of unbuilt properties
1777/86-The Court moved to Queluz as a rejection of Pombal’s Lisbon
1790-War with Spain
1791-The queen D. Maria I became mad
1792-D. João became King and ruled the country with indecision and fear.
1793-French corsairs attack Portuguese vessels.
1795-The peace is signed with France
1797-97-Spain and France prepare an invasion against Portugal
1801-France and Spain declare war against Portugal. Portugal is the loser and has to pay a heavy compensation to Spain.
1801/1807-Portugal becomes militarily and economically very dependent on Britain.
1806-Portugal does not respect Napoleon’s blockade to English ports. The Royal family took refuge in Brazil.
1806-1st French invasion by Junot’s troops
1808-Wellington’s troops defeat the French army
1809-2nd French invasion
<table>
<thead>
<tr>
<th>Year</th>
<th>Code</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1810</td>
<td>A-54 S-16 C-11</td>
<td>81 +3 0 1810-3rd French invasion 1815-Agriculture and commerce are in a deplorable situation. 1808/21-Brazil becomes a Kingdom of Portugal and Portugal with Beresford became an English protectorate. 1818/34-Liberal Revolution</td>
</tr>
<tr>
<td>1820</td>
<td>A-55 S-16 C-11</td>
<td>82 +1 0 1821-During the absence of Beresford in Brazil a successful rebellion takes place. A council rules the country. 1822-Brazil becomes independent. 1823/40-Civil war between Liberals and Absolutists with the interference of Spain and France</td>
</tr>
<tr>
<td>1831</td>
<td>A-55 S-16 C-11</td>
<td>82 0 0</td>
</tr>
<tr>
<td>1900</td>
<td>A-63 S-16 C-16</td>
<td>0 0</td>
</tr>
</tbody>
</table>
4.3 References to the chronology of the reconstruction.

(13) França, José-Augusto,

"The evolution of works was irregular....."

"In 1765, there was no hurry to rebuild the city...... and in the centre there was much of debris of destroyed buildings.... just as followed 1755...."
J. Gorani (Portugal a corte e o pa's nos anos de 1765 a 1767, trad. port, Lisboa 1945.
In 1766, "... it is possible just to see one house here and one there...."
"In 1771... Lisbon is in the same situation of destruction, but everyday a new building starts to be built...."

"In 1774, The destruction of the earthquake looks to be recent, most of the streets are in ruins...."
"In 1780 the progress of the reconstruction seemed to be slow...."
In 1780 "the rubbish looked to be the same as in the cursed year"
Madame Junot

In 1766 - there were 59 buildings on streets in the Pombaline area (31 in Augusta street); by 1776 there were 140.
Manuscrito de José Monteiro de Carvalho"Relação das propriedades.... edificadas ou reedificadas entre 1755 e 1778, Arquivo Municipal de Lisboa
1765-The east side of Rossio Square was built.
1840-Rossio was complete.
"The minister left more than half built"...

"Immediately after the Marquis de Pombal’s death, in 1777, all public works were suspended...."

1776-"There were built 140 buildings"

"By 1766 there were 59 buildings, of which 31 were on Augusta Street."
1776-"There were approx. 200 buildings"
4.4. Completed buildings (by street) between 1766 and 1788 (After Luis Pastor de Macedo\(^\text{(32)}\)).

Without any reference.

<table>
<thead>
<tr>
<th>Street</th>
<th>1766</th>
<th>1760-88</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augusta Street</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Prata Street</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>Fanqueiros Street</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Sapateiros Street</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Correeiros Street</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Douradores Street</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Comércio Street</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>S. Julião Street</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Conceição Street</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Augusta Street (East)</td>
<td>19</td>
<td>22</td>
</tr>
<tr>
<td>(West)</td>
<td>12</td>
<td></td>
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</table>
4.5 Records of building contracts during the construction period

i) Source of references for the contracts

Contract n. 0
Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 12, Caixa 3, number 15, Junho de 1759, Arquivo Nacional da Torre do Tombo, Lisbon. Between Manuel de Sousa Alves Coutinho and the mason Mateus Luis.

Contract n. 1
Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 12, Caixa 3, number 4, Junho de 1759, Arquivo Nacional da Torre do Tombo, Lisbon. Between José Manuel da Fonseca and the mason Joaquim Madeira.

Contract n. 2
Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 9, Caixa 2, number 87, Janeiro de 1761, Arquivo Nacional da Torre do Tombo, Lisbon. Between João Batista Terrabuse and Jacinto Pereira.

Contract n. 3
Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares Carvalho, Cartório 4, Livro 18, Caixa 4, number 23, May 1766, Arquivo Nacional da Torre do Tombo, Lisbon. Between António Monteiro Godinho and Francisco José Fonseca da Silva.

Contract n. 4
Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 46, Caixa 5, number 55, May 1776, Arquivo Nacional da Torre do Tombo, Lisbon. Between António de Melo and the master Francisco Fernandes Bento.

Contract n. 5
Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 49, Caixa 10, number 13, Abril de 1777, Arquivo Nacional da Torre do Tombo, Lisbon. Between António Pedro and the master Manuel dos Santos Torres.

Contract n. 6
Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 8, Caixa 2, number 91, Agosto de 1760, Arquivo Nacional da Torre do Tombo, Lisbon. Between João Batista Terrabuse and Jacinto Pires.

Contract n. 7
Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 18, Caixa 4, number 26, Fevereiro 1766, Arquivo Nacional da Torre do Tombo, Lisbon. Between Francisco António Vieira and the mason Manuel Luís António Sousa.

Contract n. 8
Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 47, Caixa 5, number 4, Agosto de 1766, Arquivo Nacional da Torre do Tombo, Lisbon. Between Cipriano Joaquim António and others.

Contract n. 9
Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 34, Caixa 7, number 35, Março 1771, Arquivo Nacional da Torre do Tombo, Lisbon. Between Dom Henrique da Silva and others.

Contract n. 10
Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 10, Caixa 2, number 74, Junho de 1761, Arquivo Nacional da Torre do Tombo, Lisbon. Between Francisco António Vasconcelos and Luís da Cunha e Castro.

Contract n. 11
Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 3, Caixa 2, number 75, Maio de 1757, Arquivo Nacional da Torre do Tombo, Lisbon. Between Gaspar Teixeira and António Luís.

Contract n. 12
Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 8, Caixa 2, number 85, Maio de 1760, Arquivo Nacional da Torre do Tombo, Lisbon. Between Giraldo Roiz da Fonseca and Filipe Caetano.
ii) Resumé of significant aspects of the contracts.

a) Master mason acting as general contractor:

Master mason coordinating all works including those of mason, blacksmith, and carpenter. Contract n.1

Master coordinating all masonry and carpentry works. Contracts n. 0, 2, 3, 7, 8, 9 and 11

Offices of mason and carpenter completely separated Contract n.12

b) Payments:

All construction costs about 840 thousand Reis, to be paid on arrival of a ship. Contract n.1

All the money must be paid after all the work has been completed and carefully inspected and measured, any delay has a penalty of 5 %. Contract n.0

Consigned construction: The master builds the building and has the right to be the owner of one shop and one flat. The payment would be made with the rents of the other flats. The penalty was 5%. Contract n.5

Payments in two parts. Contract n.7

The cost will be presented at the end of the works and payment would be made with the rents from the flats and annual payments of 80 thousand Reis during the necessary period of time to pay the full amount. Contract n.3

If the owner disappears or the mason fails all respective belongings must be appropriated. Contract n.0

The payment would include a part of the wood from a dismantled ship (in a proportion of one to three) and eight years of rents. Contract n.4

600 thousand Reis paid in advance. Contract n.7

All iron works must be paid for by the mason and the payment will be made with rents. 7,600 Reis during the present year, 160 thousands Reis at Christmas and 300 thousands Reis at the end of the works. Contract n.2

An amount of 760 thousand Reis must be paid with rents and tax. Contract n.11

c) Dimensions given in palms:

Materials from the stock Exchange of Praça do Comércio. Contract n.6
iii) First example of a contract of 1760 and respective translation

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 8, Caixa 2, número 91, Agosto de 1760, Arquivo Nacional da Torre do Tombo, Lisbon. Between João Batista Terrabufe and Jacinto Pires. Copy of original
In the name of God, Amen. For knowledge of all this instrument of building contract the subscribers put themselves under obligation, on the 4th day of August in the year of our Lord Jesus Christ 1760, in the City of Lisbon, St Lourdes Street, parish of ... at my office being present, of the one part João Batista Terrabufe, conservator of Your Majesty, resident in Casas do Chito courtyard, in the place of Algolana of Belém, and the other Jacinto Peires, mason, living in front of Sapato Bay on the land side, it was agreed by me, notary and by the witnesses whose names are hereunder mentioned, that we subscribe the contract in which he, Jacinto Peires in a property of houses belonging to His Majesty, (on the land side), which is situated between the properties of the Marquis of Anoja to the North, measuring 28 palms and 40 palms at the bottom on which he intends to build shops and flats with hipped roofs, under which contract the master subscribes to build the aforementioned buildings on the following conditions, without any delay, undertaking the hallowed art of his office as mason as necessary, having in mind to return the buildings to João Batista strictly as follows: first, on the ground floor the shop is to have a door of six palms width and ten in height with an arch over, and another door to the stair of four palms width and 8.5 in height with an arch over, with a step and a window with a round arch of 6 palms width. On the first floor will be a French window of twelve palms height and 6 width, two
windows with half-circle arches with four panes one palm each wide and six in
height. The stonework for the stairs must be from the stock exchange of the
Terreiro do Paço, as the dormer windows must be from the Terreiro do Paço, with
the exposed surfaces limewashed. The first floor beams must be squared, the
thickest ones must be used for the attic. The other beams and the softwood for the
floors must also be from the Terreiro do Paço, and the floor boards must be
carefully planed on their faces, also the beams and boards used in the roof
structure must be in softwood with the eaves of the roof to be mouriscado, with
good tiles. All iron fixtures must be paid for by the builder with the exception of
one item of ironwork which will be paid for by the owner because he intends it to
be ornamental to his requirements. The same arrangement will apply to the
materials for the fireplaces.

The wood used for floors and ceilings must be the same as that used for
windows, and the same for the stairs. On this contract the owner must provide the
necessary water.

The Contract Sum of 144 thousand Reis will be paid as follows:

In November the owner will finance a fund to be used during a calendar year.

One thousand Reis for the cost of the shops.

Sixty six thousand Reis on commencement of occupation of the flats.

The remainder of the 144 thousand Reis when the three flats have been completed.

All the works including the finishing are included in the 144 thousand Reis and
there shall be no departure from the contract sum after payment has been made.

All lime, stone, wood and iron fixtures will be included in the payments with the
exception of the water. The total agreed payment as stated above will not be
exceeded.
iv) Second example of a contract of 1776 and respective translation

Indice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 46, Caixa 5, number 55, May 1776, Arquivo Nacional da Torre do Tombo, Lisbon. Between António de Melo and the mason Francisco Fernandes Bento.

Copy of original
Translation

1776 Building Contract

From the Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário
Eugénio Carvalho e Silva, Livro 46, Caixa S, No. 55, May 1776, Arquivo
Nacional de Torre de Tombo, Lisbon.

To the knowledge of everyone obligated in this building contract, established on
the second of May in the year of our Lord Jesus Christ 1776, in this city of Lisbon,
in Broad Street of S. Roque, in my office were present his Excellency Caetano de
Sousa Coelho as agent (attorney) of his Excellency Mr António de Melo, by the
letter of attorney which was present and previously copied. Of the other part
Francisco Fernandes Bento, Master Stonemason, who lives on Oliveira Hill Street,
Parish ...

It was stated by Caetano de Sousa Coelho that his client is the owner of houses
situated in Carvalho Street in the Parish of Merces adjoining his Palace, which
need some repairs in order to be let. For this the stonemason, to make the essential
repairs, was contracted as follows:

- The façade wall of the house belonging to the property which is 36.5 palms long,
must be demolished, but the floor beams must be replaced and straightened. In the
new wall there must be windows 6 palms high and 5 palms wide, taking advantage
of the existing arch. Another window opening must be formed, facing the back
yard.
- On the backyard elevation over the kitchen floor beams at second floor level, a
  wall must be built with stone and lime 36.5 palms long and 1/2 palm thick to the
  height of the roof.

In this wall three window openings must be formed, 5 palms high and 4 palms
wide, assembled on the *gaziola* of oak or Brazilian wood from dismantled ships.

The door garrison must be executed in Flanders wood and the panels in soft pine,
following a simple pattern with the necessary ironmongery.

- In the case of the front façade the owner must provide all stone needed. The cost
  of bedding the stones is included in the contract which could compensate for the
  wood used for the *gaziola*. Also included is the cost of two glass windows in soft
  pine 5 palms high and 4 palms wide.

- The owner must provide all necessary masonry starting by the windows.

- The cost of daywork and the sand, lime and tiles (for the roof) needed to repair
  the building is included in the cost of the contract, compensated if any wood is
  found which can be used in the building.

All wood found which is unsuitable for the repair work is for the builder in order
to compensate for the work of dismantling ships in a proportion of one to three.

All rubble must be disposed of in the orange groves and vineyard behind the
building.

The builder is to lower the roof structure of the second floor kitchen in order to
connect it to the new wall throughout its length.

It is necessary to build an internal wall 12 palms long.

It is also necessary to extend the stone doorway at first floor level to a height of 9
palms, with a width of 4 palms, with a door made of wood of the same quality as
the windows, namely soft pine, with good ironwork.

In all work the builders must follow the best traditions of their respective trades,
with all perfection, safety and commodity, beginning by depositing 1000 Reis without obligation.

Because the owner intends to rent the property to Dom João Ambrósio Bartolomeu, Venetian citizen for a period of eight years and ... months, starting on St John's day with the sum of 33,600 Reis paid or to pay between St John's day and Christmas, with the obligation to pay for the repair work, and also with the benefit of the other rents or sales, Dom João Ambrósio Bartolomeu is to pay the builder 120000 Reis. Under this contract 48000 Reis will be paid.

The owner solemnly undertakes to pay the remaining amounts as follows:
- 12000 Reis when the work is finished.
- 70000 Reis in three instalments
  - On 5th November this year
  - On 5th May 1777
  - On 5th November of the same year (1777)

If Dom João Ambrósio Bartolomeu does not keep his word, all the dwellings will be advertised for rent and he will forfeit all privileges, rights to charge rent and advance payments. To obtain the remaining amount all his properties and belongings would be pledged.

Before the expiry of the agreed 8 year term of the lease the tenant may vacate the property if he can find another tenant willing to pay a higher rent, in which case the owner will receive this amount and pay it to the builder. During this period the tenant is not allowed to undertake any repairs until the total sum due has been paid. On expiry of the 8 year term a new rental contract will be established.

The builder undertakes to complete the works as soon as possible, before St John's day, forfeiting any interest or any increase above the agreed sum, and paying for any damage caused.

It is also necessary to form a window opening in the dining room 5 palms high and 4 palms wide, in the way described above for the other windows. The following are the names of the witnesses...
Caro colega

Relativamente à questão que me põe, não tenho conhecimento de qualquer consulta feita por meu tio, o arq. Porfírio Pardal Monteiro.

O conhecimento da sua pessoa proveniente de laços familiares e, sobretudo, do facto de com ele ter trabalhado vários anos, levam-me a pensar que as afirmações por ele produzidas resultam de um conhecimento experimental das matérias em causa.

Com efeito, sei que se dedicou ao estudo pormenorizado da construção pombalina que lhe foi facilitado por intervenções que efectuou em edifícios da Baixa Pombalina.

Por outro lado, o contacto com gerações de canteiros (nas quais se incluía o seu próprio pai) que trabalharam no final do século XIX deve ter-lhe servido de fonte de informação, porquanto essas profissionais relatavam acontecimentos que os antecedem e que não me custa a crer que se relacionassem com o fornecimento de cantarias destinadas à reconstrução de Lisboa.

Eu próprio ouvi da boca de meu avô, entre outras, descrições pormenorizadas relacionados com o transporte das colunas monolíticas destinadas ao Convento de Mafra, descrições essas que embora não coincidindo rigorosamente com o descrito por José Saramago no seu Memorial do Convento, na essência são plenamente concordantes. Ora, processando-se a reconstrução de Lisboa em data muito mais recente, não se me afigura inverosímil uma memória mais viva dos factos com ela relacionados.

Estas as razões que me levam a crer que, sem excluir a hipótese de consulta de documentação, esta não terá sido a sua principal fonte de informação e que se apoiou, sobretudo, na memória de gerações antecedentes e num exaustivo trabalho de análise dos edifícios.

Ao seu dispor para o que lhe possa ser útil, apresento os meus cumprimentos.
Translation of letter from António Pardal Monteiro

'Dear Colleague,

Concerning your question, I do not know anything about any bibliographical research made by my uncle Porfirio Pardal Monteiro.

My knowledge about him comes from my family, and especially from the fact that he had worked with me for many years, which leads me to think that what he said is a result of experimental knowledge of the subject.

In fact, I know that he dedicated himself to the detailed study of Pombaline construction, which was readily done through the interventions he undertook in some of the buildings.

In another way, the contact with generations of stoneworkers (including his father, who worked at the end of the 19th century) could be his basis for the information, because these tradesmen recounted events from before their time, which could I believe be related to the supply of the masonry work for the reconstruction of Lisbon.

I have heard from my grandfather, among others, detailed descriptions related to the transportation of monolithic columns destined for the Convent of Mafra, which do not exactly coincide with those of José Saramago in his "Memorial of the Convent", but fully agree on the essential points. The reconstruction of Lisbon was undertaken later, so the memories of it are more alive.

Whilst not excluding the possibility of a documentary survey, these reasons lead me to believe that his main source of information could be the memories of previous generations and the exhaustive work of analysing buildings.
Appendix 5 - A record of the plans of the Pombaline rentable buildings made by the author.

Appendix 5 presents the drawings of the internal plans of the buildings surveyed by the author. Each plan is numbered and the numbers correspond with the numbers on the blocks in Fig. 5.1 which is a general plan of the Pombaline area. It was not possible to survey all the buildings as some had been changed and access to some was prohibited. These are therefore left blank. A list of all the plans and their location is given on the following three pages. This survey is related to the first floor of the buildings.

All plans are to a scale of 1/400 with the exception of plans 2, 16 and 45 which are to a scale of 1/800.

Fig. 5.1 Plan of the blocks of Pombaline rentable buildings
List of plans

Plan 1 Block bounded by Calçada do Carmo, Primeiro de Dezembro Street, D. João da Câmara Square and Rossio Square.

Plan 2 Block bounded by D. Duarte Street, Igreja de S. Domingos Street, Amparo Street and Figueira Square.

Plan 3 Block bounded by Santa Justa Street, Ouro Street, Rossio Square and Sapateiros Street.

Plan 4 Block bounded by Santa Justa Street, Ouro Street, Rossio Square and Sapateiros Street.

Plan 5 Block bounded by Santa Justa Street, Augusta Street, Betesga Street and Correeiros Street.

Plan 6 Block bounded by Santa Justa Street, Correeiros Street, Figueira Square and Prata Street.

Plan 7 Block bounded by Santa Justa Street, Prata Street, Figueira Square and Douradores Street.

Plan 8 Block bounded by Santa Justa Street, Douradores Street, Figueira Square and Fanqueiros Street.

Plan 9 Fanqueiros Street between numbers 320 and 274.

Plan 10 Block bounded by Assunção Street, Ouro Street, Santa Justa Street and Sapateiros Street.

Plan 11 Block bounded by Assunção Street, Sapateiros Street, Santa Justa Street and Augusta Street.

Plan 12 Block bounded by Assunção Street, Augusta Street, Santa Justa Street and Correeiros Street.

Plan 13 Block bounded by Assunção Street, Correeiros Street, Santa Justa Street and Prata Street.

Plan 14 Block bounded by Assunção Street, Prata Street, Santa Justa Street and Douradores Street.

Plan 15 Block bounded by Assunção Street, Douradores Street, Santa Justa Street and Fanqueiros Street.

Plan 16 Fanqueiros Street between numbers 268 and 78.

Plan 17 Block bounded by Vitória Street, Ouro Street, Assunção Street and Sapateiros Street.

Plan 18 Block bounded by Vitória Street, Sapateiros Street, Assunção street and Augusta Street.
<table>
<thead>
<tr>
<th>Plan</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Block bounded by Vitória Street, Augusta Street, Assunção Street and Correeiros Street.</td>
</tr>
<tr>
<td>20</td>
<td>Block bounded by Vitória Street, Correeiros Street, Assunção Street and Prata Street.</td>
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<tr>
<td>21</td>
<td>Block bounded by Vitória Street, Prata Street, Assunção Street and Douradores Street.</td>
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<tr>
<td>22</td>
<td>Block bounded by Vitória Street, Douradores Street, Assunção Street and Fanqueiros Street.</td>
</tr>
<tr>
<td>23</td>
<td>Block bounded by São Nicolau Street, Ouro Street, Vitória Street and Sapateiros Street.</td>
</tr>
<tr>
<td>24</td>
<td>Block bounded by São Nicolau Street, Sapateiros Street, Vitória Street and Augusta Street.</td>
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<tr>
<td>25</td>
<td>Block bounded by São Nicolau Street, Augusta Street, Vitória Street and Correeiros Street.</td>
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<tr>
<td>26</td>
<td>Block bounded by São Nicolau Street, Correeiros Street, Vitória Street and Prata Street.</td>
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<tr>
<td>27</td>
<td>Block bounded by São Nicolau Street, Prata Street, Vitória Street and Douradores Street.</td>
</tr>
<tr>
<td>28</td>
<td>Block bounded by São Nicolau Street, Douradores Street, Vitória Street and Fanqueiros Street.</td>
</tr>
<tr>
<td>29</td>
<td>Block bounded by Conceição Street, Ouro Street, São Nicolau Street and Sapateiros Street.</td>
</tr>
<tr>
<td>30</td>
<td>Block bounded by Conceição Street, Sapateiros Street, São Nicolau Street and Augusta Street.</td>
</tr>
<tr>
<td>31</td>
<td>Block bounded by Conceição Street, Augusta Street, São Nicolau Street and Correeiros Street.</td>
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<tr>
<td>32</td>
<td>Block bounded by Conceição Street, Correeiros Street, São Nicolau Street and Prata Street.</td>
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<tr>
<td>33</td>
<td>Block bounded by Conceição Street, Prata Street, São Nicolau Street and Douradores Street.</td>
</tr>
<tr>
<td>34</td>
<td>Block bounded by Conceição Street, Douradores Street, São Nicolau Street and Fanqueiros Street.</td>
</tr>
<tr>
<td>35</td>
<td>Block bounded by Ouro Street, São Julião Street, Nova do Almada Street and Conceição Street.</td>
</tr>
<tr>
<td>36</td>
<td>Block bounded by Augusta Street, São Julião Street, Ouro Street and Conceição Street.</td>
</tr>
</tbody>
</table>
Plan 37 Block bounded by Prata Street, São Julião Street, Augusta Street and Conceição Street.

Plan 38 Block bounded by Fanqueiros Street, São Julião Street, Prata Street and Conceição Street.

Plan 39 Block bounded by Fanqueiros Street, São Julião Street, Madalena Street and Conceição Street.

Plan 40 Block bounded by Augusta Street, Comércio Street, Ouro Street and São Julião Street.

Plan 41 Block bounded by Prata Street, Comércio Street, Augusta Street and São Julião Street.

Plan 42 Block bounded by Fanqueiros Street, Comércio Street, Prata Street and São Julião Street.

Plan 43 Block bounded by Fanqueiros Street, Comércio Street, Madalena Street and São Julião Street.

Plan 44 Comércio Street between numbers 85 and 109.

Plan 45 Arsenal Street between numbers 44 and 172.
Plan 2
Plan 29
Plan 32
Plan 39
Plan 42
Appendix 6 - A brief study of the stability of the Pombaline rentable buildings.

6.1 Foundations
6.2 Walls at ground floor level
6.3 Arches
6.4 Vaults
6.5 The facade
6.6 The cage

In this appendix the static behaviour of a building is explained so as to make it possible to understand the underlying principles behind the particular form and design of the buildings as well as to represent the porticos of the complete cage of a building in detail, 50-54, Ouro Street.
6.1 Foundations

The piles, 12 mm in diameter and not more than 1.5 m long, have only a modest capacity of transmitting the building's load to the ground through their surfaces. Their essential function was to allow the commencement of construction on flooded soil, but partly also to prevent the building from sinking into the alluvium. The capacity of the building to resist small earthquakes was due to the solid construction of the walls, the foundation arches and the vaults which covered the groundfloor, which prevented the lower part of the building from being crushed.

On a wall with a linear foundation, the balance of the loads can easily be understood, (Fig.6.1):

- la - Arch thrust
- P - Foundation wall and upper floors' self weight.
- F - Ground impulsion.
- R - Resultant of the forces of impulsion and weight, direction moves towards the vertical by the action of force F. After the construction of the building, as the force P is very high, the influence of force F is of little significance.

6.2 Walls at ground floor level

The estimate of the exterior lateral wall thickness on the ground-floor is shown in the following scheme, (Fig.6.2):

- P - Is the minimum wall thickness.
- S - Vault thrust.
- P1 - Upper wall self weight.
- T - Wall self weight.

By summing P and T we get force Q, whose line of action concurs with that of force S on point A, resulting in force R.
The force \( R \) must fall into the base CE of the wall.

The wall thicknesses were lessened because the self weight of the wall in the Pombaline buildings was high, due to their number of floors. The pressure of \( R \) in the CD interval is nil in D, and double the average in C.

6.3 Arches

An important factor in estimating the stability of the groin arches, which joined the vaults together is the magnitude of the rise.

The higher the rise, the greater its stability, because the thrust is more and more vertical, not demanding too thick a wall.

On the rentable building the choice was for depressed arches.

To determine the value of the thrust it is sufficient to consider half of the arch, whose forces are the following, (Fig. 6.3):

\begin{itemize}
  \item \( R \) - Reaction or impulsion exercised on D at 2/3 of the height in the keystone section.
  \item \( P_1 \) - Semi-arch’s own weight.
  \item \( P \) - Total overload of the material used in completing the extrados.
  \item \( F \) - Wall’s reaction applied at A to the imposed load at one third of the depth of the arch.
\end{itemize}

The vault will only be in equilibrium, if forces \( S, R, R, P \) and \( P_1 \) nullify themselves.

![Fig. 6.3-Stability of the arches](image)

It is easy to see that, in the keystone of the arch the materials are subject to unequal charges. At point E they are null, increasing progressively until they are double at G.

The arch’s function is to normalize the thrust created by the vaults during and after construction.

6.4 Vaults.

Vaults with flattened edges are the result of the intersection of two depressed vaults, equally high, at right angles on plan, having dissimilar spans, as happens with rectangular rooms. Because they have equal heights in horizontal projection the intersection edges are represented as two diagonal straight lines.
To study the balance of forces, we will consider a rectangular vault in which X and Y are its axes.

Considering only section A of the depressed vault we have, (Fig.6.4):

- \( I_a \) - Impulse of one area of the vault.
- \( P_a \) - Vault's own weight plus weight of the materials used in completing the extrados.
- \( L_a \) - Distance between the axis and the centre of the vault's starting junction.

To calculate the section's moment we have:

\[
I_{af1} = P_a L_a \frac{l_a}{f1}
\]

Therefore for section b we have:

\[
I_{bf1} = P_b L_b \frac{l_b}{f1}
\]

The thrusts are not discharged directly to the walls but through the ogees' planes, where both the barrel's thrust produce a force which goes from the ogees' edges to the supporting piers.

The greater the flattening of the layout, the greater the vault's barrel thrust, therefore the thrust of the barrel b has the same rise as a, but because it covers a larger span, it produces a greater thrust. This imbalance of thrust is lessened by the neck piece arches placed between the vaults.

There is also a logical reason why the brick voussoirs are arranged almost in circles around the centre of the vault.

If the bricks were placed in rows, perpendicular or parallel to the axis, and as
their dimensions are not exactly equal, some rows would be overloaded whilst others would have no load at all, which would result in the crushing of the latter and the failing of the former. Placed in curves, with staggered joints they tie the vault together and allow the thrust to be distributed evenly, (Fig. 6.5).

Fig. 6.5-Placement of bricks

On the ogees the bricks are disposed perpendicularly to the concentric courses, so that they can receive the loads better, and effectively change a round form into a square or rectangular one.

In the round part, as we advance to the sides, the bricks are still positioned so that they can transfer the weight more effectively onto the arches or onto the walls.

6.5 The façade.

The windows are aligned both vertically and horizontally in order to maintain the balance of forces.

On the stonework between each window-sill and the lintel immediately below, there are always two brickwork features. The first one is almost straight and is called a "pressed up beam", and the second is curved and called a relieving arch. The latter is supposed to lighten the loads above the window lintel, which, because it is made of stone, would not be resistant to great flexural pressures, (Fig. 6.6).

Because of the façade’s symmetry, the different arches’ thrusts balance themselves producing vertical forces, which, with the self weight of the masonry between the openings, increase vertically.
6.6 The cage, (Fig.6.7 to 6.23)

The framework's conception followed certain principles which led to increased stability. These principles include, (Fig.6.7):

- The triangular structure of the panels would prevent their distortion.
- Whenever possible the doorways were in the centres of the panels, so that loads could be distributed evenly and at the same time the panels were more solidly buttressed at their corners, (Fig.6.8).
- The joints were designed to work in compression, so that nails were not needed.
- The panels' disposition as sketched (Fig.6.8 and 6.9) was always orthogonally allowing it to react better to the moments caused by horizontal forces.

The noggings placed between the floor joists as well as over partition walls, besides allowing frames to be placed above them, kept the joists in place.
The following dimensioned drawings show the gaiola of number 54, Ouro Street as a typical example.
Fig. 6.9—Structural plan of first, second and third floors.
Fig. 6.10 - The ground floor.

Fig. 6.11 - Floor joist layout
Fig. 6.12-Section showing construction.
Fig. 6.13 - Isometric of the gaiola.
Fig. 6.14 - Isometric of a gaiola corresponding to the first floor
Fig. 6.15-Vertical plane of gaiola, number 1, (façade).
Fig. 6.16 - Vertical plane of galola, number 2
Fig. 6.17 - Vertical plane of gaiola, number 3
Fig. 6.18 - Vertical plane of galota, number 4
Fig. 6.19 - Vertical plane of gaiola, number 5
Fig. 6.21 - Vertical plane of gaiola, number 7

Fig. 6.22 - Vertical plane of gaiola, number 8
Fig. 6.23 - Vertical plane of gaiola, number 9
Appendix 7 - Published material


Notes from the Committee

The Management Committee's work involves two distinct aspects of the Society's affairs; the first is those matters that required regular consideration at each meeting and second, during each session, one or two major matters that have a wider importance, to do with the aims of the Society.

The regular items are ongoing things, such as the visits; where should we visit next, (any suggestions from members would be welcome), will there be something to see not usually open to view? What is to go into the Newsletter? Have we any copy available from members, is there any information we should send out? Finance, have we sufficient funds, how many members have not yet paid their subscription?

Arrangements for the Annual Seminar, AGM and lecture are two more items that require continuous review, especially trying to decide on themes that will be of interest to members. Suggestions for the future would be helpful.

One of the major matters that has taken up a good deal of time recently is the promotion and publicising of the Society. With just over 200 members we have limited opportunities to recruit new members for the Committee and to expand the Society's activities. Various ways of increasing numbers have been discussed and one result is the new membership application leaflet, which has been sent to all existing members, (get someone to join) and distributed as insets in journals of societies with similar interests.

Publicity for the 1991 Seminar helps to keep the Society's name in the press.

Part of an approach to a wider audience is the 1992 joint event, being organised with the help of Jane Morley, a member in the USA, much involved with the Society for the History of Technology, Construction Industry Interest Group. The event will involve various other groups in the UK, such as the ISE History Group, the Newcomen Society and the Institution of Civil Engineers.

As part of an attempt to develop another aspect of our alma, Christopher Powell is preparing a guide to writing a history of a building firm, and the Society, in conjunction with the Business Archives Council will publish a guide on the selection of documents for preservation.

Some of these items will no doubt continue to require attention, but new subjects will come up. Next year is the tenth anniversary of the first annual meeting of the Society; any ideas for a way of commemorating the event?

Stan Smith
Understanding Structures

Bruce Marsden, a chartered architect has sent the Editor a copy of this thesis outline for his PhD at the Bartlett School. It may be of interest to other members and is produced here in full.

The Column: A study of the growth in structural understanding in architecture from 1100 to 1860

A description within a chronological framework of the development from germinal ideas in structural thinking to the formulation of the earliest useful structural theory of the column possessing reliable predictive characteristics.

Architecturally, the dissertation encompasses the times of the Gothic cathedral builders and continuing through into the period of ironwork constructors.

Most of the essential constituents of the theory originated in the studies of mechanics, strength of materials, theory of structural action, and also mathematical and experimental investigations often undertaken for purposes not directly bearing upon structural matters. Aspects of intuitive, logical, empirical, cultural, philosophical, aesthetic, architectural and structural design thinking are discussed where such impulses are evident.

The study of structural behaviour and development in structural aspects of structural action gather momentum following the work of Galileo, who founded the science of the strength of materials using the principle of the balance and the lever. This principle, which also is an essential ingredient of the theory of structural action, had been established by Aristotle and Archimedes and treated by Jordanus and Leonardo, amongst others. Subsequent contributors who dealt with mathematical and experimental considerations include Hooke, members of the Bernoulli family, Euler, M"uchsenbroek, Coulomb, Young, Tredgold, and Navier, culminating in the experimental confirmation by Hodgkinson, of Euler's mathematical theory of column failure due to buckling, made available in a useful form by Rankine.

Others, whose work bears upon the development include Vitruvius, architects of the Gothic cathedrals, Alberti, Bblidor, Laugier, Bage and Strutt, Telford, Girard, Rondelet, Barlow, Rennie, Robison and Viollet-le-Duc.

Not only were the threads of conscious learning from experience, experiment and abstract theory developed independently but there is very little evidence of interaction between structural theory as a whole and architectural and structural design until the threads became intertwined towards the close of the period defined in this study.

For those readers who wish to learn more of the project a copy of the contents of the dissertation is available from the Editor. Alternatively, contact can be made with Mr Marsden at his office at 35 Alfred Place, London WC1E 7DP.

Publications received

VAG Newsletter, June 1991.
Business Archives Council. Minutes of the Annual General Meeting held on Thursday 5 July 1990.

Design and construction of the Pombaline Area of Lisbon

Wayne Foster contributes the following item which is based on studies carried out with Jorge Mascarenhas who is studying for a MPhil at the Polytechnic of Wales.

Introduction

Following the massive earthquake of 1755, the commercial heart of the city of Lisbon was re-built. The Marquis of Pombal, Minister of the crown, was responsible for the plan. The result was a fully developed modularised urban design. The buildings are an extension of the system. Speed of re-construction was a guiding principle along with the need to construct buildings that could withstand future seismic activity and prevent subsequent firespread. The result is an architecture as cold as ice but a building form and system which may be described as proto modern in many ways. The research being undertaken is in two main parts:

- The urban design
- Building form and construction

Lisbon's planning codes do not protect the area in any way and the buildings may be considered at risk of unsympathetic redevelopment and in some cases neglect.

Brief background

The city of Lisbon, like some other European cities, was founded and developed on a defensible hill alongside a large estuary.

By the 18th century two main squares, the Paco Real and the Rossio were connected by a network of narrow medieval lanes and alleys. On the 1st of November 1755 Lisbon was subjected to massive tremors. The subsequent effects destroyed the commercial centre of the city.

Urban plan

Under Pombal and the chief engineer to the crown, Manuel de Maia, three teams produced six different redevelopment plans. In spite of difficulties of property ownership the scheme chosen was based on a rigid orthogonal network of large city blocks. It was based on a sophisticated approach to the economics of retail and residential development.
Building form and construction
The buildings are simple, repetitive and (for the period) very plain. However, they are constructed using an anti-seismic structural frame or cage made of softwood. The whole constructional system is based on modular measurement and the introduction of a set of building regulations. Components were prefabricated wherever possible and the construction process was designed for ease and speed of erection.

The Museum of Brighton in the Lanes
A fund raising campaign launched by the Arts & Leisure Department of the Brighton Borough Council has as an objective the creation of a museum entirely devoted to development of Brighton as a resort, encompassing its traditions, its history and its people. The Holy Trinity Church in Ship Street will be the home of the museum and it is due to open in April 1994. Needless to say the museum requires extensive funding and the campaign is intent on raising £1.2M. The museum is seeking the Society's support in helping to raise funds and they suggest this might be carried out in two ways.

'Adopt-a-Brick' is a scheme exclusively designed for individuals who wish to continue their involvement, or to join the scheme at a later date; there will also be an opportunity to adopt prints and other small artefacts, starting at £7.50 upwards.

The second means by which the Society is asked to support the museum is in sponsoring a display. For those who wish to support the 'Adopt-a-Brick' initiative are invited to send their donation to Sarah Carthew, the Museum's Development Officer at the Royal Pavilion, Art Gallery & Museum, Brighton, East Sussex BN1 1UE.

FMB Celebrates 50 years
The Federation of Master Builders, one of the two major trade associations representing builders, celebrates its 50th anniversary this year and incorporated in the July issue of 'Master Builder', is a pull-out supplement which provides a history of the Federation.

Although only of relatively recent foundation the development of the Federation makes interesting reading, not least in relation to its relationship with the NFBTE or Building Employers Confederation as it now is. The motivation for the creation of the Federation is summed up in a remark made by the solicitor, Leslie Venning, who as Secretary of the Chamber of Commerce in Islington felt that the problems of representation for smaller builders in London should be addressed. At their second meeting, on 8 November 1940 at which 37 builders were present Mr Venning said 'There is only one existing organisation for builders and that is the London Master Builders Association. It has about 250 members who consider they are the elite of the industry; I have even seen letters rejecting applications from small builders.

My conclusion is that the LMBA gives the impression that it wants to retain its exclusive character. This approach generated a firm resolve by the smaller builders to create their own organisation and thereby seek adequate representation. Despite this, overtures were made by both sides throughout the succeeding years in an attempt to achieve some rapprochement between the two Federations and thereby ensure a single point of reference for builders. The fact that both organisations are still in existence demonstrates how these initiatives came to nothing.

The fascinating account provides a valuable insight into those issues which affect builders, in particular those relating to wage bargaining, industrial relations problems and training, and the fight to obtain representation on CITB.

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Journal of the Construction History Society

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Construction History is an international journal devoted to the study of all aspects of the history of building and construction, and to the development of construction history as a scholarly discipline. Founded in 1979 it is the only English language periodical on the subject. The journal is published by The Chartered Institute of Building on behalf of the Construction History Society.

Editorial correspondence, including manuscripts for submission, should be addressed to Christopher Powell, Welsh School of Architecture, UWCC, Sarn Building, King Edward VII Avenue, Cardiff CF1 1AP, United Kingdom. Articles should not normally exceed 3000 words in length, including references, although they may be much shorter. All editorial correspondence must be sent to the Editor a copy of the 'Notes for Contributors', which lists the main editorial conventions that should be followed.

Books for review, and book reviews, should be sent to Robert Theum, Institute of Historical Research, Senate House, London WC1E 7HU, Great Britain.

Material for abstracting should be sent to Professor Simon Pepper, School of Architecture and Building Engineering, University of Liverpool, P.O. Box 147, Liverpool L60 2EJ, United Kingdom.

Business correspondence, including orders and remittances relating to subscriptions, back numbers, offprints, and advertisements, should be addressed to the publishers, The Chartered Institute of Building, Drummond, Kings Ridge, Ascot, Berkshire SL5 8BB, United Kingdom.

This journal is published annually. This annual may constitute one volume. ISSN 0263-7768

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CONSTRUCTION HISTORY
Journal of the Construction History Society

Volume 11, 1995

The Pombaline Quarter of Lisbon: an Eighteenth Century Example of Prefabrication and Dimensional Coordination

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ROGER H. HARPER

Embarkment and Cuttings on the Early Railways

A. W. SAMPION

The Mechanisation of Architectural Woodwork from the late Eighteenth Century to the early Twentieth Century, and its Practical, Social and Aesthetic Implications Part III: The Retreat of the Handicrafts

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Construction History is published with the generous assistance of The Long Charitable Trust
The Pombaline Quarter of Lisbon: an Eighteenth Century Example of Prefabrication and Dimensional Co-ordination

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Introduction

The Pombaline quarter of Lisbon in its present form originated as a complete rebuilding of 19.04 hectares of the city after it was destroyed in 1755 by a disastrous earthquake. The whole area is densely built up with mainly five-storey high blocks which were originally flats and shops. The original number of dwellings cannot be stated exactly as some of the buildings have been rebuilt completely internally, but it is estimated at 1980. This gives a density of just over 100 dwellings to the hectare. The quarter has many unique characteristics, some of which anticipated later developments by a century or more.

The City and the Earthquake

The area now known as the Pombaline quarter was originally a tidal inlet which became silted up in pre-Christian times, and so the ground consists of unstable alluvium. It was incorporated into the city in the Middle Ages, and by 1650 it was covered with an irregular network of streets and alleyways winding between equally irregular buildings, all situated between two large squares, the Rossio to the north and the Praça do Comércio to the south. This pattern persisted until 1755 (Fig. 1).

The earthquake of 1 November 1755 registered between 8 and 10 on the Mercalli scale and lasted for seventeen minutes. Its epicentre was south of Lisbon near the Algarve, but its destructive effects were worst in Lisbon, and especially in the area later known as the Pombaline quarter, because of its dense population and unstable ground conditions. It was accompanied by a tidal wave and followed by a fire, which lasted for six days and destroyed all the buildings in the Pombaline quarter which had survived the earthquake. The narrow, winding streets did not enable the inhabitants to escape quickly enough, and about 10,000 are thought to have died. Panic overtook many of the survivors, including the King, who sought refuge away from the city.
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Planning the Reconstruction

The Marquis of Pombal, a Government Minister, remained in the city and organised emergency measures. He invited a military engineer, Manuel da Maia, to oversee the reconstruction of the city. Along with his team of architects and engineers, da Maia in many ways personified the Age of Enlightenment; he was both rational and practical. He presented reconstruction proposals to the Senate in three stages, and at each stage, from a number of approaches, the one chosen was the boldest and the most rational. As a result, in May 1758, a licence was granted to begin reconstruction of the city, including the Pombaline quarter. The reconstruction of this area was based on a completely new rectilinear plan (Fig. 2) and on a strict set of rules governing the design and construction of the new buildings.

The Need for Earthquake Resistant Construction

Da Maia and his team were determined to avoid a repetition of the 1755 disaster. This was one of the reasons for the choice of a rational, rectilinear layout with straight, wide streets which would enable people to escape quickly to the safety of the Rossio or Praça do Comércio squares in the event of an earthquake. The architectural details of the buildings were to be simplified to eliminate features which could in any way endanger passers-by or promote the spread of fire (Fig. 3). However, as well as minimising the number of deaths which would be caused if buildings did collapse, they also attempted to reduce the possibility of buildings collapsing in the first place by using earthquake resistant construction. It had been noted that many timber-framed buildings in the Castle Hill area of Lisbon had survived the earthquake intact, so a system of timber-framed construction was adopted for the reconstruction, albeit in combination with masonry (Fig. 4). This alone made the adoption of some degree of modular planning inevitable in the design of the buildings. To increase the stability of the buildings the façade openings were to be perfectly aligned and the overall height of the buildings was limited adding further to the uniformity of the buildings. The use of prefabrication and mass production for some of the components could have been another reason for the use of modular planning as a means of ensuring dimensional co-ordination, on a large scale and in a way that anticipated much later developments.

The Adoption of Prefabrication

Up to the time of the earthquake, the construction of buildings in Lisbon tended to take a long time. Usually as the work progressed, specialised craftsmen on site or in small workshops produced components to order. An example is the building of the Palace at Vila between 1717 and 1735, for which there was a specific, precise and limited production of components in workshops, many of them on site whose function changed as the work progressed. Professor França and the late Portuguese architect Pombal Pardal Monteiro have both suggested that a decision was made to turn to prefabrication and mass production in answer to the need to rebuild the city quickly. These suggestions were no doubt influenced by the repetitive and standardised nature of the buildings, but the main basis for them appears to be an oral tradition passed down by Pardal Monteiro's ancestors. A letter has been received from Pardal Monteiro's nephew, Antonio Pardal Monteiro, confirming this: an English translation is included as Appendix 1.

It is also known that in the years immediately following the earthquake, the King and the Marquis of Pombal took measures to encourage the mass production and stockpiling of building materials and manufactured items. A decree passed on 15 May 1755 states that "given the serious shortage of wood, roof tiles and bricks, and in order to facilitate the rebuilding of properties...all the materials and merchantile produced in the country's factories would have the same right to be brought into or out of the country without embargoes or delays, which had been concede to products of the Grão Para and Maranhão Companies." This decree would have given general encouragement to building materials manufacturers to mass produce and stockpile, by giving them easier access to overseas markets. However, a licence of 12 May 1757 more specifically encouraged manufacture of materials and components for the home market. "As King, I hereby declare this licence to be lawful, considering its utility, being for the rebuilding of the City of Lisbon, the multiplication of the factories of lime, bricks, wood and
Taking these salaries as a guide, and bearing in mind that relative values of goods and services in eighteenth century Portugal would have been quite different from those of modern Britain, it can nevertheless be seen that one Rei in 1760 was worth approximately 50p in modern UK currency. Hence the values of the contracts found range from about £24,000 to £42,000.

A picture emerges of master masons, acting as general contractors, who were not merely self-employed tradesmen. Rather, they were businessmen who were expected to organise substantial building operations including most of the principal trades, and to raise substantial amounts of capital; more so even than many general contractors at present in the UK, where stage payments under most contracts are far more frequent than in the eighteenth century Portuguese contracts. Although none of the contracts found has been positively identified as relating to the Pombaline quarter itself, it is reasonable to suppose that the contractual arrangements indicated were typical of the period and that similar arrangements would have applied to the quarter. In view of this it would not be altogether surprising to find that the contractors were expected to obtain prefabricated, mass-produced components from already existing stock. Both contracts translated in the Appendices include further evidence suggesting that this was the case. They both give dimensions in palms: the palm is an anthropometrically derived unit of measurement, being 225mm or the distance from the tip of the thumb to the tip of the little finger on the outstretched hand. In both contracts door and window opening sizes are given as whole numbers of palms, and in the 1750 contract (Appendix 2) it is stated that the stonework for the stairs, and the dormer windows must come from the Stock Exchange of the Terreiro do Paço.

The Rua Nova do Arsenal leads from the Terreiro do Paço, and hence it seems highly likely that the "Stock Exchange" referred to is in fact the stockpile of building materials established by the Treasury as a result of the edict of 1757, just over three years before the date of the 1760 contract. If this is so then the stockpile contained prefabricated components such as windows and stonework for staircases, perhaps stone treads, and the incorporation of these components was facilitated by dimensional co-ordination based on the module of the palm.

It may be considered strange that only the dormer windows in the 1760 contract were to be obtained from the Treasury stockpile, not the other windows. The reason for this may be that the other windows were to have semicircular arches over them, unlike those of the buildings in the Pombaline quarter itself, and hence would have to be purpose-made.

The site of the building referred to in the 1760 contract has not been identified, but the description of the semicircular arches indicates that it was not in the Pombaline Quarter itself. Neither was the building referred to in the 1776 contract, but the latter was close to the Pombaline quarter in an area where the design of the existing eighteenth century buildings is very similar to those of the Pombaline quarter itself. If prefabricated, mass-produced components from already existing stocks were being used for buildings outside the quarter, then it seems even more likely that they were used inside where the design of the buildings is yet further repetitive and standardised.

The idea of using prefabrication for the rebuilding of Lisbon is thought to have come from wooden huts which were imported from Holland immediately after the earthquake, to provide temporary accommodation for the inhabitants whose homes had been destroyed. France refers to contemporary British accounts of the earthquake, which state that the hut components were sent by sea and could be erected in twenty four hours, and dismantled and re-erected just as quickly. * The Pombaline buildings were not completely prefabricated - they included, for example, substantial amounts of rubble stone walling - but they did incorporate many standardised and possibly prefabricated components, especially dressed stone and joinery items, the use of which relied on effective dimensional co-ordination. These components did not differ radically from those which were already produced by craftsmen to order, and which can be seen in surviving buildings from before the earthquake, such as Ladovice House. They were merely simplified and
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standardised in a way which would have accelerated their manufacture by mass production. They could then have been produced in an anonymous and abstract way in workshop scattered through the outskirts of the city as well as within it. Few workshops or factories from the period remain, except for a wall tile factory at Amoreira, the Fábrica do Rato, which is believed to have produced many of the ceramic wall tiles which were used in the reconstruction.\(^{10}\)

Dimensional Co-ordination at Urban Planning Level

Given the densely built up nature of the Pombaline quarter, modular design at individual building level would have been difficult without a rectilinear urban plan. It can be shown that the urban plan was based on the Golden Rectangle consisting of a series of rectangular blocks of buildings bounded on all four sides by streets with a narrow courtyard or *aljugere* in the centre of each block to light the rooms at the rear of the buildings (Fig. 2). Almost every elevation of every block was drawn by da Maia’s team and these drawings survive.\(^{11}\) The design of the elevations is based on the palm, like that of the buildings referred to in the contracts discussed above. The heights on the elevations of the rentable buildings in the Pombaline quarter are aligned with the heights on the elevations of the public buildings in the Praça do Comércio (Fig. 3) and the dimensions of window and door openings, their dressed stone surrounds and the space between them are all exact numbers of palms. Thus in general the overall lengths and widths of the blocks of buildings are also exact numbers of palms, and must have been determined by the design of the elevations.

The blocks are divided into individual buildings of various sizes, each size having a different number of windows across the width of the street façade. In many of the blocks, the two-window façade width building is a double square in plan (Fig. 4a) and the four-window façade width building is a square (Fig. 4b). No particular proportion can be satisfactorily applied to the three- and five-window façade width buildings of the same depth: this is not surprising since the same window widths and spacings are used and these, together with the plan depth determine the overall plan dimensions of the building.

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Dimension Co-ordination in the Internal Planning of the Buildings

No original drawings are known to have survived showing the internal planning of any of the rentable buildings in the Pombaline quarter, and it is not known who designed the internal layouts. It is clear, however, from da Maia’s dissertations that individual owners were responsible for the actual construction of the buildings, so it can be presumed that they were also responsible for determining the internal layouts.\(^{12}\) They may have had help from architects in doing this; indeed there may even have been private arrangements between building owners and members of da Maia’s team; a drawing by Carlos Mendel, one of the team, of the internal layout of a comparable building elsewhere in Portugal has survived.\(^{13}\)

Apart from the overall size of the building and the pre-designed street elevations, the other main constraint on the internal layout was the *gaiola* or timber frame structure, the incorporation of which was a requirement.\(^{14}\) It is known that a prototype *gaiola* was built and tested by da Maia’s team and so it is to be expected that the design of *gaiolos* in individual buildings would be closely controlled. The *gaiola* is not normally exposed, but three examples have been recorded in detail during recent internal alterations to buildings, at no. 75 Conceição Street, no. 110 São Nicolau Street and no. 60 Ouro Street.

In the plan of no. 75 Conceição Street (Fig. 7), 900mm, a multiple of the palm, is normally the distance between the centre of the studs in the *gaiola*. However the module is varied to accommodate both the stairwell and the windows, and the overall width of the *gaiola* of this building is not a multiple of 900mm.

The floorplan of no. 110 São Nicolau Street is illustrated in Figure 8. At first sight this appears to show a more consistent use of modular planning. However the basic module is no longer an exact multiple of the palm, being 831mm, and at point A on the plan the post is doubled up, making the overall plan width of the *gaiola* of this building exceed an exact multiple.
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of the basic module by the thickness of the extra post. Here the module is not varied to accommodate the windows; instead the members of the gaiola which would obstruct the windows are merely left out.

Both no. 75 Conceição Street and no. 110 Sra Nicolas Street have gaiolas with plan depths equal to an exact number of modules, but a different module in each case. In spite of this the plan depths, and indeed the widths of the two buildings, are identical to within 100mm.

In the third recorded example of the gaiola, no. 60 Ouro Street (Fig. 9), the plan again appears to be the dimensional basis of its design in plan, but this time the module of four palms or 900mm is the space between the posts of the gaiola, not the distance between their centres; it is planned on a tartar grid. Moreover, distances of five palms (1125mm) and six palms (1350mm) are also found, and as in no. 75 Conceição Street the modular planning, such as it is, is varied to accommodate the stairwell and windows.

Here the evidence from these three examples is that the design of the gaiola, although to some extent modular, was fitted imperfectly into the space available; if the overall design of the blocks of the buildings and their elevations was intended to allow for a perfectly modular gaiola, it was not successful in this.

It seems more likely that this was never the intention. The joints between members of the gaiolas are typically lapped, halved or lapped and dovetailed (Fig. 10); there are no carpenters' marks so the joints are unlikely to have been prefabricated, although the timbers may have been cut approximately to length before being sent to site. Other than doors, windows and their dressed stone surrounds, and possibly staircases, no other prefabricated components were dependent on the dimensional accuracy of the gaiola. Therefore, provided that the components listed above could be accommodated, that the design of the elevations was respected and that the gaiolas were sufficiently similar to the prototypes to be adequate structurally, no problems would have been caused by dimensional irregularities in them.

Tolerances

An essential characteristic of any building design based on dimensional co-ordination and prefabrication of components is the

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Fig 9: Planning on a 'tartar' grid. Floor plan of no. 60 Ouro Street. (Drawing by Jorge Mascarenhas).

Fig 10: Typical connections between the members of the gaiola. (Drawing by Jorge Mascarenhas).

Fig 11: Tolerances: A door to a flat in no. 75 Conceição Street. (Drawing by Jorge Mascarenhas).
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inclusion of manufacturing tolerances for the components. Even a perfect manufacturing process is governed by the accuracy of measuring instruments, and in eighteenth century Portugal measurement of dimensions is almost certain to have been less consistent than it is today. It will be no surprise, therefore, to find that substantial manufacturing tolerances were built into the design and construction of the Pombaline buildings. The component chosen to illustrate these tolerances is one of three doors at the entrance to a flat in no. 75 Conceição Street.

The detailing of the doorway allows for adjustment of the thickness of the partition, the width of the door leaves and the height of the door leaves. The thickness of the partition, and therefore also the width of the door lining, is adjusted by varying the thickness of packing pieces which are planted on the face of the post in the gaiola next to the doorway, to bring it flush with the face of the nogging over the doorway which is lapped over the posts on either side (Fig. 11). The thickness of these packing pieces could be varied by as much as 10mm above and below the norm.

The width of the door leaves, or strictly speaking, the space occupied by the door leaves, is adjusted by packing pieces planted on the doorway face of the gaiola post, which pack out the door lining. These packing pieces can vary in thickness from nil to 100mm (Fig. 12). Both this variation and the variation in thickness of the packing pieces described above could be used to accommodate inaccuracies in the construction of the gaiola itself and as well as variation in the widths of door linings and door leaves. However, the mechanism for adjusting the height of the door leaves involves altering a dimension of the gaiola itself and its presence can only be explained by substantial variations in the heights of mass-produced door leaves obtained as standard components from stock.

The dimension of the gaiola which is altered is the height of the nogging which forms the head of the structural opening for the doors. The alteration is effected by varying the size of wooden inserts which fit into recesses in the gaiola posts on either side of the doorway. By this means the height of the door leaves can be varied by up to 20mm above and below the norm. This is greater than the variation which we would expect in mass-produced standardised door leaves today, but this is probably due to inconsistencies in measuring instruments used in eighteenth century Portugal, together with the large number of small workshops from which the door leaves would have been taken.

No documentary evidence has been found to show that door leaves in the rentable buildings in the Pombaline quarter were prefabricated, but it is known that at the time of the rebuilding door leaves manufactured in Lisbon were sent by sea to be incorporated in buildings elsewhere in Portugal. Together with the physical evidence of tolerances discussed above, this provides a strong case for the proposition that the door leaves were prefabricated and mass-produced in much the same way that they are today, though without the mechanisation of the production process.

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Site Assembly of Prefabricated Components

When prefabrication of building components is employed special provision sometimes has to be made for assembling and fixing them on site. In the Pombaline rentable buildings this was the case with the staircase balustrades, examples of which are illustrated in Figure 13. The running track—shaped wrought iron components of the balustrades are screwed together on site, and they can easily be adapted to any pitch of staircase. This is further evidence to suggest that components were mass-produced with no particular building in mind, and then obtained ex-stock when they were required.

Conclusion

Clearly the architects of the Pombaline quarter did not achieve the extent of dimensional co-ordination that is present in some late twentieth century buildings, and they did not need to, for the extent of prefabrication is not so great. Nevertheless the documentary and physical evidence, discussed above all suggest that the standardisation of huge numbers of windows, doors and their associated dressed stone lintels, jambbs and sills enabled their prefabrication, mass-production and supply from stock when required, and that ceramic wall tiles and wrought iron staircase balustrade components were also produced and supplied in this way.

This standardisation of components and the associated standardisation of the design of the buildings into which they were incorporated, on such a large scale is, to say the least, unusual for the eighteenth century, and surely deserves international recognition. Such recognition now seems imminent with a proposal having been made to designate the Pombaline quarter as a World Heritage site; it is to be hoped that this proposal will be realised as soon as possible, since although the exteriors of the Pombaline buildings are already protected by law, their interiors and therefore much of their unique construction are not, and many of them have already been altered beyond recognition.

Appendix I

Translation of Letter from Antonio Pardal Monteiro

"Dear Colleague,
Concerning your question, I do not know anything about any bibliographical research made by my uncle Períoio Pardal Monteiro.
My knowledge about him comes from my family, and especially from the fact that he had worked with me for many years, which leads me to think that what he said is a result of experimental knowledge of the subject.
In fact, I know that he dedicated himself to the detailed study of Pombaline construction, which was readily done through the interventions he undertook in some of the buildings.
In another way, the contact with generations of stoneworks (including his father, who worked at the end of the nineteenth century) could be his basis for the information, because these craftsmen recounted events from before their time, which could I believe be related to the supply of the masonry work for the reconstruction of Lisbon.
I have heard from my grandfather, among others, detailed descriptions related to the transportation of monolithic columns destined for the Convent of Mafra, which do not exactly coincide with those of José Sarmento in his "Memorial of the Convent", but fully agree on the essential points. The reconstruction of Lisbon was undertaken later, so the memories of it are more alive."
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Whilst not excluding the possibility of a documentary survey, these reasons lead me to believe that his main source of information could be the memories of previous generations and the exhaustive work of analysing buildings.

Appendix 2

1760 Building Contract

From the Indice das Escrituras de Outubro of 1757 and January of 1790, Notário Eugênio Carvalho e Silva, Livro 8, Caixa 2, no. 91, Agosto de 1760, Arquivo Nacional do Torre do Tombo, Lisbon.

"In the name of God, Amen. For the knowledge of all this instrument of building contract the subscribers put themselves under obligation, on the 4th day of August in the year of our Lord Jesus Christ 1760, in the City of Lisbon, St Lourdes Street, parish of... at my office being present, of the one part João Baista Teraube, conservator of Your Majesty, resident in Casas do Chito courtyard, in the place of Algolena de Brit, and the other Jacinto Peires, mason, living in front of Saparo Bay on the land side, it was agreed by me, notary and by the witnesses whose names are hereunder mentioned, that we subscribe the contract in which he, Jacinto Peires in a property of houses belonging to His Majesty, (on the land side), which is situated between the properties of the Marquis of Angola to the North measuring 28 palms and 40 palms at the bottom on which he has to build shops and flats with hipped roofs, under which contract the master subscribers to build the aforementioned buildings on the following conditions, without any delay, undertaking the hallowed art of his office as mason as necessary, having in mind to return the buildings to João Baista strictly as follows: first, on the ground floor the shop is to have a door of six palms width and six in height with an arch over, and another door in the stair of four palms width and 8.5 in height with an arch over, with a step and a window with a round arch of 6 palms width. On the first floor will be a French window of twelve palms height and 6 width, two windows with half-circle arches with four panes one palm each wide and six in height. The stonework from the stairs must be from the stock exchange of the Terreiro do Paço, as the door windows must be from the Terreiro do Paço, with the exposed surfaces lined-washed. The first floor beams must be squared, the thickest ones must be used for the attic. The other beams and the softwood for the floors must also be taken from the Terreiro do Paço, and the floor boards must be carefully planed on their faces, also the beams and boards used in the roof structure must be in softwood with the caves of the roof to be mortised (corbelled and spuncted) with good tiles. All iron fixtures must be paid for by the builder with the exception of one item of ironwork which will be paid for by the owner because he intends it to be ornamental to his requirements.
The same arrangement will apply to the materials for the fireplaces.
The wood used for floors and ceilings must be the same as that used for windows, and the same for the stairs. On this contract the owner must provide the necessary water.
The Contract Sum of 144 thousand Reis will be paid as follows:
In November the owner will finance a fund to be used during a calendar year.
One thousand Reis for the cost of the shops.
Sixty six thousand Reis on commencement of occupation of the flats.
The remainder of the 144 thousand Reis when the three flats have been completed.
All the works including the finishing are included in the 144 thousand Reis and there shall be no departure from the contract sum after payment has been made.
All lime, stone, wood and iron fixtures will be included in the payments with the exception of the water. The total agreed payment as stated above will not be exceeded."

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Appendix 3

Translation of the 1776 Building Contract

From the Indice das Escrituras de Outubro of 1757 and January of 1790, Notário Eugênio Carvalho e Silva, Livro 46, Caixa 5, no 35, May 1776, Arquivo Nacional do Torre do Tombo, Lisbon.

"In the knowledge of everyone obligated in this building contract, established on the second of May in the year of our Lord Jesus Christ 1776, in this city of Lisbon, in Broad Street of S. Roque, in my office were present his Excellency Cautano de Sousa Coelho as agent (attorney) of his Excellency Mr. Antônio de Melo, by the letter of attorney which was recent and previously copied. Of the other part Francisco Fernandes Bento, Master Stonemason, who lives at Oliveira Hill Street Parish.

It was stated by Cautano de Sousa Coelho that his client is the owner of houses situated in Carvalho Street in the Parish of Mercês adjoining his Palace, which need some repairs in order to be let. For this the stonemason, to make the essential repairs, was contracted as follows:

- The façade wall of the house belonging to the property which is 36.5 palms long, must be demolished, but the floor beams must be replaced and straightened. In the new wall there must be windows 6 palms high and 5 palms wide, taking advantage of the existing arch. Another window opening must be formed, facing the backyard.
- On the backyard elevation over the kitchen floor beams at second floor level, a wall must be built with stone and lime 36.5 palms long and palm thick to the height of the roof.
- In this third wall three openings must be formed, 5 palms high and 4 palms wide, assembled on the gables of oak or Brazilian wood from dismantled ships.
- The door garrison must be executed in Flanders wood and the panels in soft pine, following a simple pattern with the necessary inromenery.
- In the case of the front façade the owner must provide all stone needed. The cost of building the stones is included in the contract which could compensate for the wood used for the gables. Also included is the cost of two glass windows in soft pine 5 palms high and 4 palms wide.
- The owner must provide all necessary masonry starting by the windows.
- The cost of daywork and the sand, lime and tiles (for the roof) needed to repair the buildings is included in the cost of the contract, compensated if any wood is found which could be used in the building.

All wood found which is unsuitable for the repair work is for the builder in order to compensate for the work of dismantling ships in a proportion of one to three. All rubble must be disposed of in the orange groves and vineyard behind the building.

The builder is to lower the roof structure of the second floor kitchen in order to connect it to the new wall throughout its length. It is necessary to build an internal wall 12 palms long.
It is also necessary to extend the stone doorway at first floor level to a height of 9 palms, with a width of 4 palms, with a door made of wood of the same quality as the windows, namely soft pine, with good inrometry.
In all work the builders must follow the best traditions of their respective trades, with all perfection, safety and commodity, beginning by depositing 1000 Reis without obligation.
Because the owner intends to rent the property to Don João Ambrósio Bartolomeu, Venetian citizen for a period of eight years and ... months, starting on St John's day with the sum of 33,600 Reis paid or to pay between St John's day and Christmas, with the obligation to pay for the repair work..."
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work, and also with the benefit of the other rents or sales, Dom João Ambrosio Barcelosma is to
pay the builder 120,000 Reis. Under this contract 48,000 Reis will be paid. The owner solemnly
undertakes to pay the remaining amounts as follows:

- 12,000 Reis when the work is finished
- 70,000 Reis in three installments
  On 5th November this year
  On 5th May 1777
  On 5th November of the same year (1777)

If Dom João Ambrosio Barcelosma does not keep his word, all the dwellings will be advertised
for rent and he will forfeit all privileges, rental rights and advance payments. To obtain the
remaining amount all his properties and belongings would be pledged.

Before the expiry of the agreed 8 year term of the lease the tenant may vacate the property if
he can find another tenant willing to pay a higher rent, in which case the owner will receive this
amount and pay it to the builder. During this period the tenant is not allowed to undertake any
repairs until the total sum due has been paid. On expiry of the 8 year term a new rental contract
will be established.

The builder undertakes to complete the works as soon as possible, before St John’s day,
forfearing any interest or any increase above the agreed sum, and paying for any damage caused.

It is also necessary to form a window opening in the dining room 5 palms high and 4 palms
wide, in the way described above for the other windows. The following are the names of the
witnesses…

Acknowledgements

Professor José-Augusto França has given the authors much help and advice especially in
directing them towards sources of information and in allowing illustrations to be reproduced from
his own works.

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Contract no. 1. Notário Tavares de Carvalho, Livro 3, Caixa 2, No. 75, May 1757, between
Gaspar Teixeira and António Lous.

Contract no. 2. Notário Eugénio Carvalho e Silva, Livro 12, Caixa 3, No. 4, June 1759,
between José Manuel da Fonseca and the master Joaquim Madeira.

Contract no. 3. Notário Eugénio Carvalho e Silva, Livro 12, Caixa 3, No. 15, June 1759,
between José Manuel de Soeza Alves Coutinho and the master Marcus Lous.

Contract no. 4. Notário Tavares de Carvalho, Livro 8, Caixa 2, No. 85, May 1760, between
Giraldo Roiz da Fonseca and Felipe Cezano.

Contract no. 5. Notário Tavares de Carvalho, Livro 8, Caixa 2, No. 91, August 1760,
between João Batista Terrabafe and Jacinto Pereira.

Contract no. 6. Notário Tavares de Carvalho, Livro 9, Caixa 2, No. 87, January 1761,
between João Batista Terrabafe and Jacinto Pereira.

Contract no. 7. Notário Tavares de Carvalho, Livro 10, Caixa 2, No. 74, June 1751,
between Francisco António Vasconcelos and Luís da Cunha e Castro.

Contract no. 8. Notário Tavares de Carvalho, Livro 18, Caixa 4, No 26, February 1766,
between Francisco António Vieira and Manuel Luis António Sousa.

Contract no. 9. Notário Tavares de Carvalho, Cartório 4, Livro 18, Caixa 4, No 23, May
1766, between António Monteiro Godinho and Francisco José Fonseca da Silva.

Contract no. 10. Notário Eugénio Carvalho e Silva, Livro 47, Caixa 3, August 1766,
between Cipriano Joaquim António and others.

Contract no. 11. Notário Eugénio Carvalho e Silva, Livro 34, Caixa 7, No 35, March 1771,
between Dom Henrique da Silva and others.

Contract no. 12. Notário Eugénio Carvalho e Silva, Livro 46, Caixa 5, May 1776, between
António de Melo and the master Francisco Fernandes Bento.

Contract no. 13. Notário Eugénio Carvalho e Silva, Livro 49, Caixa 10, No. 13, April 1777,
between António Pedro and the master Manuel dos Santos Torres.

9 França. Lisboa, p 165.
10 França. Lisboa, p 165.
13 José-Augusto França. A Reconstrução de Lisboa e a Arquitectura Pombalina, Vol 12, 3rd
14 França. Reconstrução, p 56.
15 França. Reconstrução, p 57.
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