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).

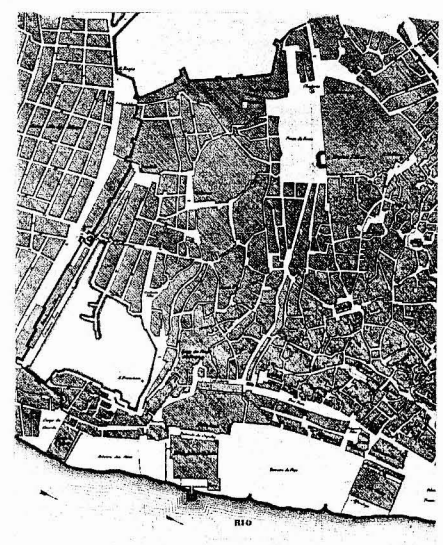

Fig 1: The city centre destroyed by the earthquake of 1755, as shown on João Nunes Tinoco's plan of 1650. (Reproduced with permission from José-Augusto França, *Lisboa Pombalina e o Illuminismo*, 3rd edition, Livraria Bertrand Editora, Lisbon, 1983, p 26).

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.[1]

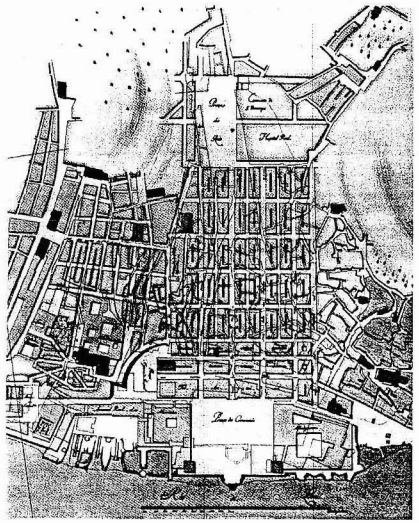

Fig 2: After the earthquake of 1755: the adopted plan of the reconstruction. E. Santos, Poppe, Plan number 5 (Reproduced with permission from José-Augusto França, *A Reconstrução de Lisboa e a Arquitectura Pombalina*, 3rd Edition, Biblioteca Breve, Vol. 12, Lisbon, 1989, Plate 7).

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 may ways personified the Age of Enlightenment; he was above all 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 fir (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

Fig 3: Pombaline rentable buildings: Figueira Square. (Drawing by Jorge Mascarenhas).

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[2] 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.

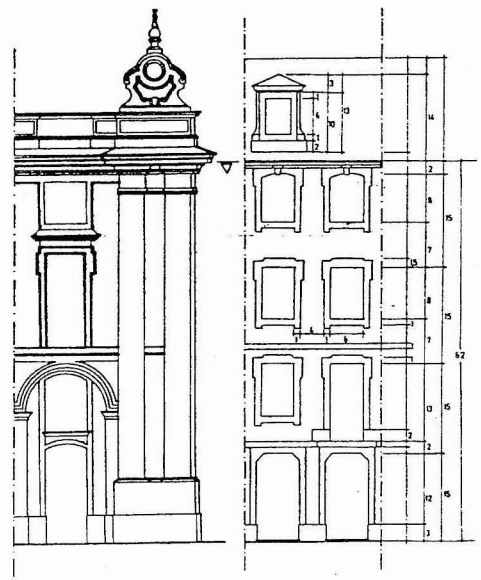

Fig 4: Typical construction of a Pombaline rentable building: 60 Ouro Street. (Drawing by Jorge Mascarenhas).

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 Mafra 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[3] Professor França[4] and the late Portuguese architect Porfirio Pardal Monteiro[5] 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 1756[6] 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 would have the same right to be brought into or out of the country without embargoes or debts, which had been conceded 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*

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...."[5]

The references to "*factories of....wood and stone*" 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 29 June 1757 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 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.*"[6] The reference here is to materials, but the Portuguese word for materials' would not exclude manufactured components any more than would the English word.

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. Unfortunately many documents have been destroyed by a recent fire in the main Lisbon archives, but 13 building contracts have been found dating from between 1757 and 1777, which places them all within the period of the rebuilding of the Pombaline quarter[7] Two of these include specific mention of building dimensions, materials and components, and English translations are included here as Appendices 2 and 3. In ten out of the 13 contracts (contracts nos. 1-3, 5, 6, and 8-12) the contractor is a master mason with responsibility for at least masonry and carpentry, and in some cases for other trades also. In only one of the 13 contracts (no. 4) is carpentry specifically excluded. In the contracts translated and given in the Appendices, a master mason is effectively the general contractor, with responsibility for "all the works" including masonry, carpentry, joinery, ironmongery and "finishing" (presumably plastering and painting) in the 1760 contract (Appendix 2), and for masonry, carpentry, joinery, ironmongery, roof tiling and glazing in the 1776 contract (Appendix 3). In both contracts, payment is to be in relatively large, infrequent instalments, with most of the payment being towards or at the end of the construction process in the 1760 contract. In another four of the contracts found (contracts nos. 3, 6, 9, and 13) there is provision for half or more of the payment to be made on or after completion, and in three of these cases, some or all of the payment is to be made from the rents of the completed buildings (contracts nos. 6, 19, and 13).

The contract sum for the 1760 contract is 144,000 Reis (Appendix 2). For the 1776 contract it is not clear, but it is probably 48,000 Reis. The values of other contracts found are 840,000 Reis, 467,000 Reis and 760,000 Reis (contracts nos. 1, 2, and 6). An indication of these values in terms of modern currency can be given by comparing them with salaries paid at the time. In 1760, salaries at the Real Herário Hospital in Lisbon were as follows:[8]

Director	500,000 Reis per annum
First Doctor	150,000 Reis per annum
Second Doctor	50,000 Reis per annum
Surgeon	100,000 Reis per annum
Nurse	42,000 Reis per annum

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 £420,000.

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 1760 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. França 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.[9]

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 Ludovice House. 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 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 Amoreiras, the *Fabrica do Rato,* which is believed to have produced many of the ceramic wall tiles which were used in the reconstruction.[10]

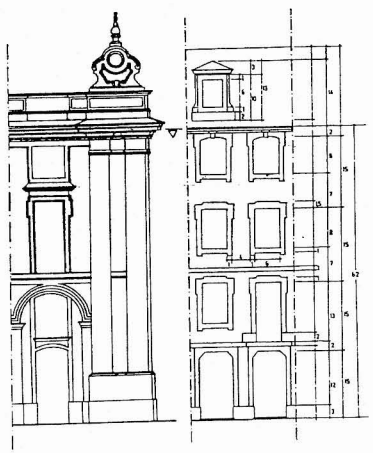

Fig 5: The palm used in the composition of the façades. (Drawing by Jorge Mascarenhas).

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 *alfugere* 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. 5) 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.

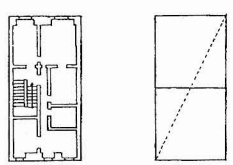

Fig 6a: Plan of a two-window façade width building: double square: 177 Correiros Street. (Drawing by Jorge Mascarenhas).

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. 6a) and the four-window façade width building is a square (Fig. 6b). 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.

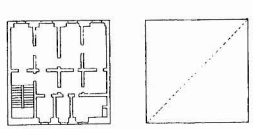

Fig 6b: Plan of a four-window façade width building: square: 187 Prata Street. (Drawing by Jorge Mascarenhas).

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 Mardel, one of the team, of the internal layout of a comparable building elsewhere in Portugal has survived.[13]

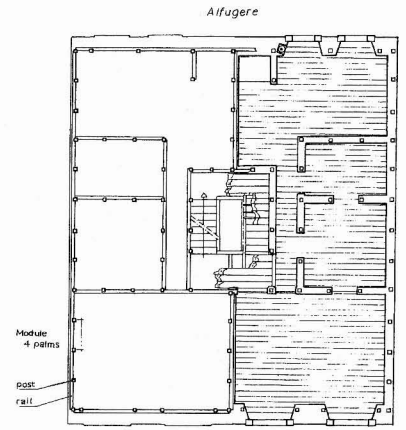

Fig 7: Modular Planning: Floor plan of no.75 Conceição Street. (Drawing by Jorge Mascarenhas).

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[15] and so it is to be expected that the design of *gaiolas* 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.

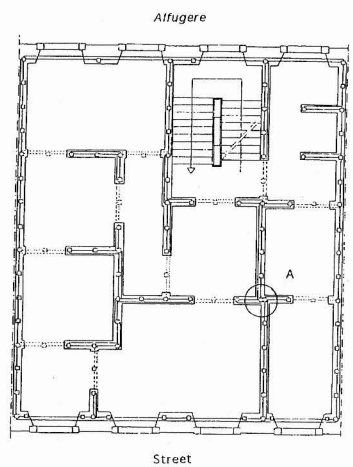

Fig 8: A variant of the module: Floor plan of no. 110 São Nicolau Street. (Drawing by Jorge Mascarenhas).

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

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 São Nicolau 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.

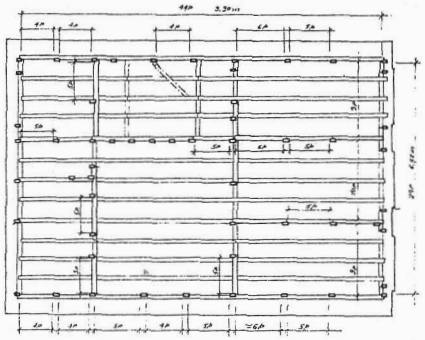

Fig 9: Planning on a 'tartan' grid: Floor plan of no. 60 Ouro Street. (Drawing by Jorge Mascarenhas).

In the third recorded example of the *gaiola*, no. 60 Ouro Street (Fig. 9), the palm 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 tartan' grid. Moreover, distances of five palms (1125mm) and six plans (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.

Hence 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.

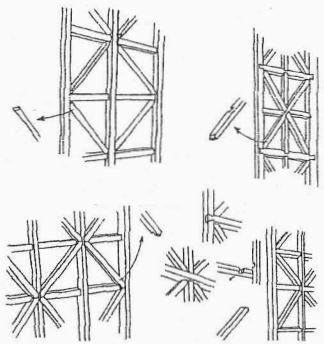

Fig 10: Typical connections between the members of the *gaiola*. (Drawing by Jorge Mascarenhas).

Tolerances

An essential characteristic of any building design based on dimensional co-ordination and prefabrication of components is the

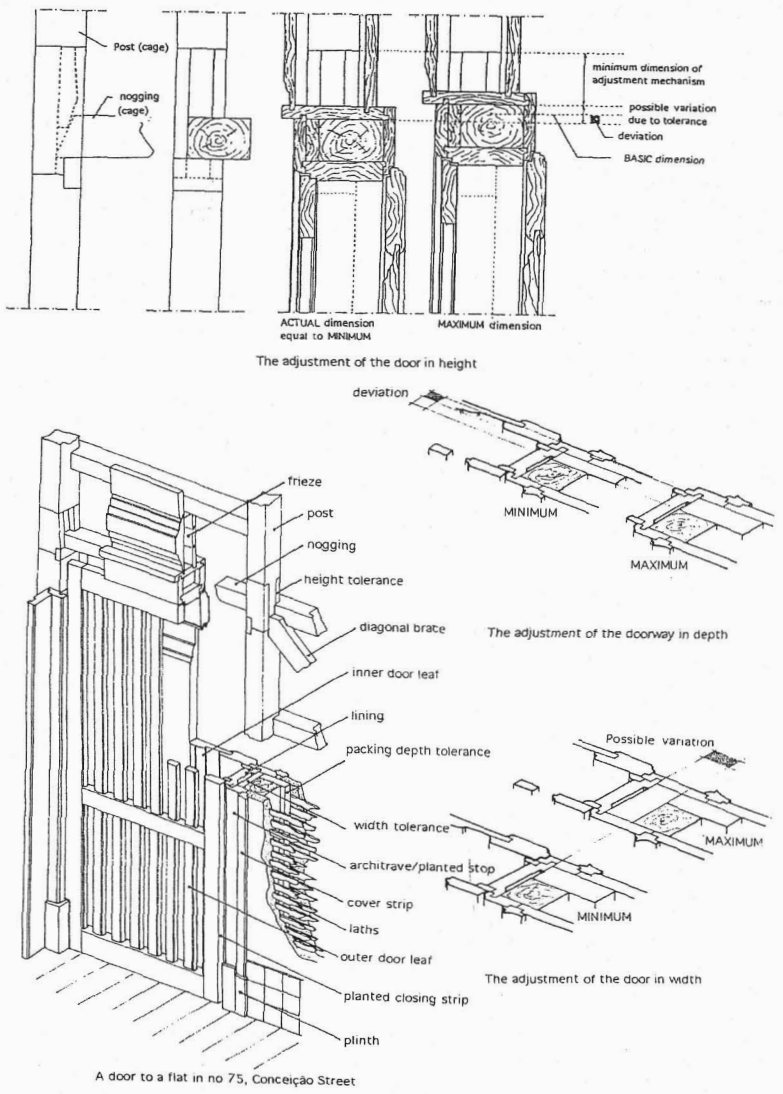

Fig 11: Tolerances: A door to a flat in no. 75 Conceição Street. (Drawing by Jorge Mascarenhas).

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.

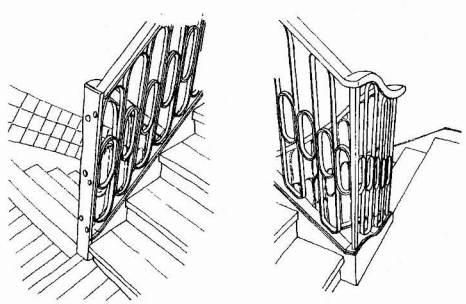

Fig 12: Site assembly of prefabricated components: wrought iron staircase balustrade at no. 56 Assunção Street. (Drawing by Jorge Mascarenhas),

The width of the door leaves, or strictly speaking of 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 he 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 obtained.

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.[16] 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.

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 as 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, jambs 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 1

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 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 nineteenth 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 2

1760 Building Contract

From the Indice das Escrituras de Outobro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 8, Caixa 2, no. 91, Agosto de 1760, Arquivo Nacional da 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 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 Angoja 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 from 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 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 eaves of the roof to be *mouriscado* (corbelled and sprocketed) 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."

Appendix 3

Translation of the 1776 Building Contract

From the Indice das Escrituras de Outobro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 46, Caixa 5, no. 55, May 1776, Arquivo Nacional do Torre do 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 resent 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 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 gaiola 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 gaiola. 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 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 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 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, 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, 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...."

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2 Manuel da Maia. *Dissertações*, (Lisbon, 1756), in França, *Lisboa* p314.
3 França, *Lisboa*, p161.
4 França, *Lisboa*, pp 163-5.
5 Montero Pardal. *Of Portugueses Percursores da Arquitectura Moderna e do Urbanismo*, in Museu V. (Oporto, 1983), p12.
6 Ministério da Justiça. *Livra das Intendèncias* (Collection of Original Documents).
7 All the contracts found are in the Arquivo Nacional da Torre do Tombo, Lisbon, Indice das Escrituras de Outobro de 1757 até Janeiro de 1790. They are listed below in chronological order and numbered for ease of reference.

Contract no. 1. Notário Tavares de Carvalho, Livro 3, Caixa 2, No. 75, May 1757, between Gaspar Teixeira and António Luis.
Contract no. 2. Notário Eugénio Carvalho e Silva, Livro 12, Caixa 3, No. 4, June 1759, between José Manuel da Fonseca and the mason Joaquim Madeira.
Contract no. 3. Notário Eugénio Carvalho e Silva, Livro 12, Caixa 3, No. 15, June 1759, between José Manuel de Sousa Alves Coutinho and the mason Mateus Luis.
Contract no. 4. Notário Tavares de Carvalho, Livro 8, Caixa 2, No. 85, May 1760, between Giraldo Roiz da Fonseca and Felipe Caetano.
Contract no. 5. Notário Tavares de Carvalho, Livro 8, Caixa 2, No. 91, August 1760, between João Batista Terrabufe and Jacinto Peires.
Contract no. 6. Notário Tavares de Carvalho, Livro 9, Caixa 2, No. 87, January 1761, between João Batista Terrabufe and Jacinto Pereira.
Contract no. 7. Notário Tavares de Carvalho, Livro 10, Caixa 2, No. 74, June 1761, between Francisco António Vasconceios and Luis 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 5, 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 mason 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.
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15 França. *Reconstrução*, p 57.
16 Horta Correia, José Eduardo, Vila Real de Santo Antonio / Urbanismo e Poder na Politica Pombalina, Ph.D Thesis, Universidade Nova da Lisboa, 1984., pp 52-60, XXI, LXXIX.