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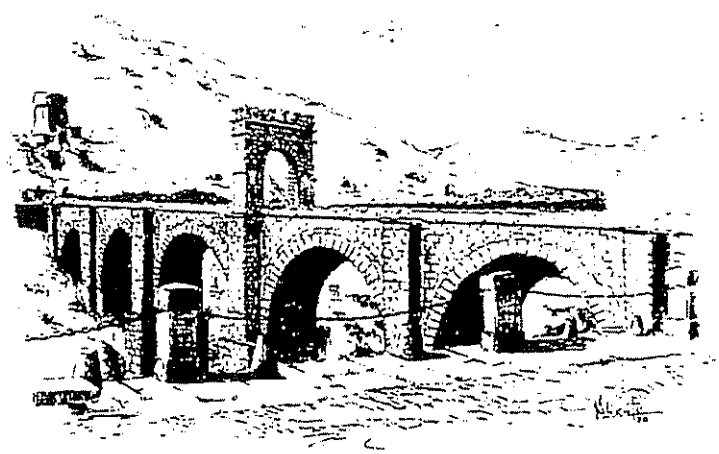

Puente Romano Alcántara

Architecture and structural engineering. A walk through Madrid

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1. Introduction

Once upon a time a *madrileño* (a person from Madrid) was wondering about the best place to hide away from his unpaid taylor. A cultivated friend advised him to go to the Prado Museum, since nobody would have the idea of visiting one of the most important museums of the world.

This sketch, taken from a theater play of the beginning of the 20th century shows a common aspect to the inhabitants of other cities: other places are probably much better known than home towns. The presence of such distinguished visitors like students, colleagues, from IACES has been the perfect pretext to the authors to learn more about Madrid and, even more, to write some notes like these.

A city like Madrid contains, of course, several examples of different architectonical styles in its buildings, and also an extensive variety of structural typologies and different materials. This short *walk* tries to show a certain panorama of Madrid and implies an excursion through time and space, that is, history and places.

2. Pre-capital times

The Neolithic Revolution (in which Mankind is still living, since it meant the settlement on fixed places, the exploitation of agriculture and cattle, instead of a nomade, risky and poor civilized life) left in Madrid some rests from Iron and Bronze Ages.

The following stop in time, after an apparently empty period without manifestations of celtic-iberians, belongs (no wonder) to the Roman Empire. Some relics of a defensive wall and foundation of typical roman villas, founded in the neighbourhood of the Royal Palace indicate the presence of a minor Roman settlement.

The Visigoths (from the 5th to the beginning of 8th century) built, together with the Spanish-roman population a Spanish State whose capital was Toledo (70 km south of Madrid).

The invasion of the Arabs destroyed the Visigothic State, using the old one partially. So they built some advanced fortifications or castles sorrounding the symbolic and strategic Toledo. One of those castles was Madrid (*Magerit*). In addition to the walls and water supply system (the so called *viajes* or tunnels dug to extract water), two towers are still the witnesses of that time: **S. Nicolás de los Servitas** (C-12) and **S. Pedro el Real** (C-12) (both from 13th century). Probably they were part of transformed musks. The Brickwork construction, square forms and details like the typology of windows are proof of their origin.

By the end of the 11th century, Madrid was reconquered by christians but maintained the character of a village although of increasing importance. At the end of the 15th century, when the Spanish Kings (Ferdinand and Elisabeth) completed the reunification of most peninsular kingdoms, the role of Madrid became more and more significant. So, when then *Cortes* (Parliament) of Castille celebrated the first meeting in Madrid (1510), the monastery of **S. Jerónimo el Real** (F-12) was already built.

Designed in a non orthodox late gothic style, this is the first important monument of Madrid. The alternative use of brickwork with stone ashlars is typical for this central region of Spain (Toledo was again the State´s capital under Charles I, half way through the 16th century). The temple has only one wide nave and vaults made of brick and plaster, following a *mudéjar* building tradition of this region. (Mudéjares were the muslims that remained under the rule of christian kings at the end of the Middle Ages.)

Another example of this Renaissance period is the **Capilla del Obispo** (C-12) (Francisco Giralte, around 1530). The main characteristic of this Spanish late gothic period is called *plateresco* and has its best and most beautiful examples in Toledo and Salamanca. The vaults are ribbed, according to the gothic pattern. From the technical point of view, the existence of rules to determine the thrust of such elements is emphasized, as known thorugh the texts of Rodrigo Gil de Hontañón.

3. Capital of a "never sun-setting" Empire

Phillip II, under whom the Spanish Empire knew the most splendorous times, decided to move the capital to the Villa de Madrid (town, not yet City of Madrid). Of course, this promoted a rapid increase in the construction of infra-structure facilities and buildings of different types.

Among such constructions the **Puente de Segovia** (A-12) (Juan de Herrera, 1584, famous for his sober and solid style and designer of the monastery of El Escorial). The impressive robustness of the bridge contrasts with the kind of ridiculous and poor river of Madrid, called Manzanares, *an apprentice of a river* according to the famous description of Quevedo, one of the most important Spanish writers of the 17th century). This bridge is shown here because it is also a good example of what architects-engineers symbolized during that time: a unified concept of engineering and architecture. For the sake of specialization or whatever reasons, the splitting into two careers, not always convergent, meant a step back that must be overcome, not in a personal way but in the mainframe of coordinated teams.

Similar to the Alcázar Real, destroyed by a fire in 1735, is the **Palacio de Uceda** (B-12) (Alonso Turrillo, 1613-1618), built by the Duke of Uceda, ambitious politician who overthrow his father as a Prime Minister. His idea of architecture was closely related to the power. Brickwork combined with ashlar stones are present here too. The back facade seems more a fortress than a palace.

Two last examples of that period are the **Ministery for Foreign Affairs** (C-12) (Cristóbal de Aguilera, 1634) and the **Plaza Mayor** (C-12) (Juan de Herrera / Juan Gómez de Mora, 1590). The last kings of this dinasty (The Habsburgs) did not offer original proofs of architecture. From the structural point of view, half circular arches and vaults, or decks made from wooden joists, cover the space transmitting the loads to solid piers or walls (made of brick and covered with granite) which support the vertical loads without suffering.

The towers and inclined roofs (more inclined than required in a city with only a couple of snow days per year) have an Austrian influence through the origin of the dinasty.

The Ministery for Foreign Affairs was a former prison (rather luxurious and well located) and the Plaza Mayor represents one of the many examples of suh an archirtectural concep present not only in Spain but also in South America.

4. Baroque and Neoclassicism

The beginning of the 18th century brought a change of dinasty: Borbons (still working) instead of the Habsburgs. With Phillip V came a set of new artistic ideas. Triumphant Baroque in the rest of Europe adopted here particular forms that were then re-exported to South America. No important news from the construction point of view.

The **Royal Palace** (B-11) (Felipe Juvara / Juan Bautista Sachetti, 1734-1764) is the most highlighting example of the Italian architecture in Madrid. The new dinasty took advantage of the fire that destroyed the old Alcázar to build a new residence according to the status and taste of the new dinasty, as well as the fashion of that time. From the technical point of view there are no special aspects to be pointed out. Its symbolic and, of course, artistic value, is above any other considerations.

The **Puente de Toledo** (B-15) is, again, a good example of an architect-engineer of that baroque time (1720): Pedro de Ribera.

The **Hospicio** (D-9) (Pedro de Ribera, 1725) is the corresponding example of the same author. Again, horizontal forms, (absence of towers) rather conventional, even boring, is compensed by the exuberant decoration of the main entrance.

The arrival of Italian architects brought a renewal of the Spanish Baroque and its substitution by a Rococo style. The most representative example of that is the **Church of Santa Bárbara** (E-10) (Francisco Carlier, 1750-57). No brickwork, but granite stone is another of the features of this important monument.

The last example of religious architecture of the 18th century shown here is the impressive church of **S. Francisco el Grande** (B-13) (Francisco Cabezas / Antonio Plo, 1761-84). Decidedly neoclassicist, its huge circular plant, had similar problems to other church built in Venice almost 50 years before: the thrust of the dome was excessive to the rather weak abutments.

The influence of the great Fischer (designer of S. Karls Kirche in Vienna) and Wren (designer of S. Paul´s in London) and other architects was present in the aim of the designers of S. Francisco el Grande, who proposed a huge dome with tambour. Although by that time the rules of Rational Mechanics already permitted some calculations and, apart from other considerations, the aesthetic and resistant proportions were already well established, the non-reliable robustness of walls and abutments forced the repairing and strengthening of them and disregarded the erection of the tambour.

Fortunately, in spite of a less slender and minor perspective, technicians found a challenge to overcome. This aspect seemed forgotten among such a amount of empirical rules valid, in practice, for standard conditions but unsafe for new situations. This idea is especially interesting in a moment in which some engineers (like Coulomb) were setting the basis of Structural Analysis.

The **Prado Museum** (F-12) (1785) is one of the most important and beautiful works of the Spanish Neoclassicism. Together with Ventura Rodríguez, Juan de Villanueva (the designer) provides a perfect combination of orthodoxy, functionality and selection of material (the typical brickwork of Madrid is present again).

Villanueva is also the designer of the **Observatorio Astronómico** (F-13) (1790), following the classical palladian architecture again. The revival of classicism (beauty, but cold and not original) coincide with the end of an Era. The French Revolution and subsequent napoleonic wars shook Europe and, in a very dramatic way, the political, economical and cultural status of Spain. A dark beginning of the 19th century was dramatically drawn by Goya.

5. The 19th Century

The **Barrio de Malasaña** (D-9), in the middle of Madrid, offers a strange feeling to the visitor. Three or four storeys high, the houses of this neighbourhood provide a town-like sensation. They are chosen here because of their peculiar style: wooden structures (piers embedded into brickwork walls and joists covered by a sort of concrete made of plaster or mortar. The structure, that can still be seen in lateral facades, is the typical one of the buildings of the 19 th century (and even before).

As sáid before, the beginning of the 19th century was rather turbulent. Political instability, civil wars, revolutions and so on reflected their sad and cruel faces in the absence of relevant monuments in the capital. Only under Elisabeth II Madrid lived a period of relative calm and interest for art and culture. An example of this rather empty and non original architecture is the **Royal Theater** (C-11) (Antonio López, 1818), opened in the middle of the century. Nothing new from the technological point of view.

The Parliament or **Palacio de las Cortes** (E-11) (Narciso Pascual), built between 1840 and 1850, is of more political than architectonical interest. The beginning stucture is made of brick.

The **Church of S. Manuel y S. Benito** (G-10) (Fernando Arbós, 1911) belongs to the post-Romanticism, the time of medieval revival. In this case, the imitated style is the bizantine.

1874 represents the starting period of a liberal monarchy in Spain. After long and repeated revolutions, a stable regime is finally installed. While the literature follows the *Realism*, the architecture and engineering adapt themselves to the reality of new civil necessties (infrastructure, industrial buildings, official houses...) New materials appear giving to the technicians the possibility of working with completely new arrangements: iron and concrete will progressively substitute wood and stone, as also happened all over Europe during the last quarter of the 19th century.

The **Bank of Spain** (E-11) (Eduardo Adaro / Sainz de la Lastra, 1874) still follows a classicist style, which meant richness and elegance for such a building, reflecting the power of a new, modern and powerful society and State. It is, probably, the last example of the *old architecture*.

At the same time the **Crystal Palace** (G-12) (1887) was built. Following the examples of similar buildings in the rest of Europe, Ricardo Velázquez made use of wrought iron and glass. From the structural point of view, it is interesting to mention the use of bar or linear elements (arches and supports) instead of massive surface elements (vaults or walls), according to a similar pattern to the gothic style, rediscovered during the romantic period not more than two decades before.

The **Atocha Station** (F-13) (Alberto del Palacio, 1890) is the most evident example of the architecture of engineer. The wise combination of brickwork, iron and glass, symbols of the progress of 19th century, is right now the sorroundings of a tropical garden, exhibitions and shop areas. The new station, under the authors´ opinion does not have the charm of the old one.

From the urbanistic point of view the **Barrio de Salamanca** (D-9) (1868) must be mentioned. Rectangular areas contain interesting buildings that were soon occupied by members of the high "bourgeoisie". It was designed and financed by the tycoon Marqués de Salamanca (Carlos María de Castro).

6. Pre- and post Civil War times

The loss of the last colonies (1898) after a humbling defeat against the Northamericans induced a very interesting movement of regeneration with manifestations in politics, cultural and social activities. The wish for renewal and the confidance in a better future inspired many of the new buildings, especially the most symbolic ones. This is the case of the Main Post Office (**Palacio de Correos y Telecomunicaciones** (F-11)) (Antonio Palacios, 1904). It combines elements from the Spanish late-gothic (*Plateresco*) and Renaissance, with monumental Northamerican (why not?) buildings of that time. Its symbolic value is so important that functionality is subordinated. Traditional materials and buiding procedures are still used.

The **Hospital de Maudes** (D-5) (Antonio Palacios, 1908) is also a unique building of this period. Worried about giving light to the interior space, its designer made a star plant, typical of prisons, but with a more pleasant atmosphere. Stone walls and vaults show a difficult compromise between robustness and slenderness (with the exception of gothic structures).

The **Palacio Longoria** (E-9) (José Grases, 1902) is a very interesting peculiar building. Today this building is the main office of the Author´s Society. It is an example of the modernist style, with profusion of curves, ceramic and sculpture. The

bearing structure, hidden to the viewer, is made of brick. To the designer as well as his modernist colleagues, this architecture implied a synthesis of all kind of arts. This was the situation during the mythical Middle Ages, when painters, sculptors and other artists worked together with architects.

A very interesting example of the industrial architecture of that period is the **Water Tower** (D-6) (Diego Martín, 1907) part of the water supply system of Madrid. With a capacity of 1.500 m^3, this building provides a beautiful combination of brick walls, arcades and butresses (within the so called *neo-mudéjar* style) and a wrought iron dome. It shows the concern with integrating engineering needs into architectural concepts of an urban space.

The **Casa Garay** (F-8), today the main office of the Civil Engineers Order must be mentined here. Built in 1914 by Manuel María Smith, this small and beautiful building (whose purchase was probably the best decission ever taken by the Order) is another example of the splendid architecture of that period. Conventional and good materials (stone, brick and wood, with special mention made of the cornice) are combined, providing a pleasant satisfactory result.

As we have seen so far, iron and steel, were gaining a proper position, with a personality of their own, since the 1850's (the already described estación de Atocha is the most representative example of it in Madrid). Then a strange phenomenon takes place: as the gap between architects and engineers increases (not only from the professional but also from the technical and even social point of view), an implicit symbiosis between architects and engineers is present when dealing with steel, particularly in forms and decorations.

Suddenly (between 1890 and 1900) a new material comes up in building construction all over Europe: reinforced concrete. It makes its way to Spain through an incredible technician and businessman: Hennebique. In 1910 (the same year the first Reinforced Concrete Department of this School was founded), Léon Monnoyer built in Madrid the first luxurious example: the **Palace Hotel** (E-12). The French influence is clear in structure and technology, and also in architectural design.

The 1920´s represent, not only in Spain, the decided entrance into Modernity. During this high interesting period all over Europe and America, the prosperity (rather weak, as demonstrated later on), the new ideas (which resulted in the radical ideologies of the following decade), the new urbanism and architectural proposals and a sufficient knowledge of the already mentioned new materials (steel and concrete, in theory and in praxis) produced many examples in different scales. The **Telefónica Building** (D-11) (Ignacio de Cárdenas, 1926) is probably the most representative one in Madrid. The emerging new technology (telephon), and the good business it implied, justified also the erection of the first skyscraper in Madrid. Reinforced concrete structural elements and steel profiles were used in a way that could be considered similar to the one used today.

The **Plaza de Toros** (J-8) (Manuel Muñoz / José Espeliú, 1929) represents a new repeated revival of the already mentioned *neo-mudéjar* style, with a peculiar and good finished brick masonry and ceramic decoration and also a hidden steel structure. With room for 20.000 people, it is the largest one in Spain. The use combines bull-fighting (of course), rock concerts and pre-election political meetings.

Secundino Zuazo completed in 1932 the **Casa de las Flores** (B-8) (Flowers' House), a very sober and rational set of parallel buildings, that break with the idea of blocks leaving na inner patio, offering a central garden. Brick and reinforced concrete are the materials chosen to solve the structure.

Example of engineering work incrustated in the urban landscape is the so called **Viaducto** (B-12) (José Luis Aracil / Luis Aldaz / Fco. Javier Ferrero), near the Royal Palace and the Palacio de Uceda. The massive reinforced concrete, built between 1934 and 1942, consists of four parallel arches that give no new relevant technical or aesthetical interest. Nevertheless, there is no doubt that the bridge takes part in the city.

The **Hipódromo de la Zarzuela** shows the print of a genius: Eduardo Torroja, in cooperation with Arniches and Domínguez. Master in the knowledge of structures, Torroja exploited reinforced concrete to its outmost possibilities. His structures are splendid, brave but not arrogant, and elegant. They show engineers another special virtue: they are sincere, not hidden. They represent a perfect equilibrium between architectural, aesthetical design and strict use of materials. The design of the roof and its link with the rest of the structure, by means of an intelligent set of compensating supports and counter-effects, highlights the previous comments. Somebody wrote that, in this structure, Torroja raised reinforced concrete to the most misterious heigths of art.

By the end of the Civil War, the dictatorship also needed symbolic buildings to show its power. In such a framework, the lack of original production had to be compensated by a historical revival. In this sense, the architecture of the most glorious period of the Spanish Empire was a perfect source of inspiration, because of ideological and economic reasons: this sober herrerian style was cheaper than others (i.e. plateresco). In the **Air Force Building** (A-8) (the most representative one in Madrid), the author (Luis Gutiérrez Soto, 1939) combines the use of traditional materials (brickwork) with the monumental aspect.

Other exceptional buildings of those post-war years are the **Torre de Madrid** (B-10) (1954) and **Edificio España** (C-10) (1947) (both by Joaquín and Julián Otamendi), with aspects that sound familiar in the architecture of the 1950's in America and in Europe. The construction is then characterised by a tremendous shortage of materials (steel and cement) that forced the design of non slender structures, geometrically robust, leading to low stresses values.

7. From the 60's onwards

The great economic development (real but rather disordered) during the 1960´s leadet to the construction of hundreds of tenement halls, cheap houses, industrial buildings and urban viaducts to facilitate the traffic of thousands of vehicles. Unfortunately, only a minority of those buildings can be considered really relevant. As a result of the improved situation and the cool winds coming from young technicians (architects and engineers) the following examples can be mentioned:

Torres Blancas (rather grey) (Saenz de Oiza/Fernández Casado, 1964) is a building structurally based on a robust reinforced concrete nucleus and protruding rings and platforms. Apart from other considerations, this building creates landscape and has an important value also from the urbanistic point of view in a area where old and poor buildings were there beforehand.

The urban **viaduct over Paseo de la Castellana at Juan Bravo** (F-8) (Fernández Ordóñez / Martínez Calzón, 1968-70) is a splendid example of architecture of engineers. Not only is it a functional structure but it also creates a space of art (air opened sculpture museum). From the technical point of view, this bridge was one of the first ones in which white concrete and auto-protected steel in composite (structural steel and concrete) structures were used. Also the building process made use of innovative techniques of evolutive posttensioning and concreting.

The **Torres de Colón** (F-9) (Antonio Lamela / Fernández Casado, 1967-76, unfortunately uglied in 1990) have something special about them to be mentioned: they consist of two nuclear towers and respective big huts from which the storeys hang from top to bottom. This solution avoided the need to use scaffolding for the storeys, since a fixed bottom formwork was enough to fabricate every storey, lifted later on and hung from the mentioned hut. Ideas like this, repeated in other unique buildings even greater, are valueable for testing new procedures of which conventional construction can take advantage.

The **BBV Building** (F-5) (Sáenz de Oiza, 1971-80) is also a good example of a compact building: two interior gross reinforced concrete nuclear towers act as supports of very stiffned storeys (authentic platforms) which provide a great freedom of space. The self-protected steel of facades gives a peculiar and interesting look to this building.

The name of the **Europa Tower** (F-4) (Miguel Oriol, 1974-82) reflects a certain kind of obession of the Spanish society of those years of political transition to democracy. Within an economic crisis, the confidence in a better future (of which the feeling of belonging to Europe was part) encouraged investors to erect representative buildings along the left side of Paseo de la Castellana, in a small Manhattan area called AZCA. In particular, the Europa Tower has an peculiar shape and outer facades. Like the previously mentioned buildings, this one consists of a semicircular core of reinforced concrete and storeys without intermediate supports.

The **Picasso Tower** (E-4) (Minoru Yamasaki / Genaro Alas, 1983-88) is the highest building in Madrid and the first one showing the triumphant socialist power, in a period of economic expansion. Following strictly the American School of Skyscrapers, the daily 6.000 visitors (non-inhabitants) make use, unawarely, of a vertical steel structure (whose quality control was especially strict) and a horizontal one made of composite slabs of a ribbed steel plate connected to a *in situ* casted concrete slab.

While the above mentioned buildings in AZCA fight to become the king or, at least, to occupy a post of dignity in this small constellation, the **Edificio Sollube** (E-4) (José Luis Íñiguez and Félix Íñiguez, 1985) tries only to take part in this modern urban landscape, even reflecting what is sorrounding by means of its interesting courtain-wall. Less espectacular than its neighbours, it is undoubtly the most fresh, happy and dynamic of this area.

The last but not the best example shown here are the inclined towers of **Puerta de Europa** (F-1). Again the name of Europe is present, but by the time of the erection (Burgee and Associated, 1990-1995) the number of euro-skeptics had already appeared (the economic recession after 1992, Maastricht and the decline of socialists). Apart from aesthetical aspects (the authors of this brief paper think that Nature advises vertical towers), it is to admit that the design and construction of such unique buildings entailed a first-class technological effort in the structure and installation of facilities. From the point of view of the structure, it is similar to that described for Picasso Tower. A number of questions remain unanswered: Are such solutions really justified? Is the fulfillment of the rational solution (on the basis of the engineers´ mentality) transgreded? Probably a time perspective can help to answer those questions. Maybe the next generation of IACES Students in a similar (even better) course in Madrid have the key.

Annex. List of recommended monuments

1. **San Pedro el Real (C-12)**
   C/ Costanilla de San Pedro.
   Mudéjar tower, 13th Century.

2. **San Nicolás de los Servitas (C-12)**
   Pl. San Nicolás.
   Mudéjar tower, 13th Century.

3. **San Jerónimo el Real (F-12)**
   Between Streets of Moreto, Academia, Ruiz de Alarcón y Casado del Alisal.
   Late Gothic style (Toledan), year 1502.

4. **Capilla del Obispo (C-12)**
   Pl. de la Paja.
   Renaissance, although of Gothic style, years 1520-1535, Tombstones and paintings by Francisco Giralte.

5. **Puente de Segovia (A-12)**
   Over the Manzanares River. From Segovia St. to Puente de Segovia Pl.
   Renaissance, year 1584, by Juan de Herrera.

6. **Plaza Mayor (C-12)**
   Pl. Mayor.
   Renaissance, year 1590, by Juan Gómez de Mora.

7. **Palacio de Uceda (Capitanía General) (B-12)**
   C/ Mayor, 79.
   Renaissance, years 1613-1618, by Alonso Turrillo.

8. **Palacio de Santa Cruz (Ministerio de Asuntos Exteriores) (C-12)**
   Pl. de la Provincia.
   Renaissance, old Court Prison, year 1634, by Cristóbal de Aguilera and José de Villareal.

9. Puente de Toledo (B-15)
Over the Manzanares River, between Pirámides Pl. and Marqués de Vadillo Pl.
Baroque, years 1717-1735, by Pedro de Ribera.

10. Antiguo Hospicio (Museo y Biblioteca Municipales) (D-9)
C/ Fuencarral 93.
Tipical Baroque facade, year 1725, by Pedro de Ribera.

11. Iglesia de Santa Bárbara, Las Salesas (E-10)
Pl. de las Salesas, Bárbara de Braganza.
Most characteristic example of the borbonic baroque style, years 1750-1757, by Francisco Carlier and his assistant Francisco Moradillo.

12. San Francisco el Grande (B-13)
Pl. de San Francisco.
Neoclassical facade, years 1761-1784, by Francisco Cabezas and Antonio Plo.

13. Museo del Prado (F-12)
C/ Paseo del Prado.
Neoclassical, year 1785, by Juan de Villanueva.

14. Observatorio Astronómico (F-13)
Parque del Retiro.
Year 1790-1845, by Juan de Villanueva.

15. Palacio Real (B-11)
C/ Bailen.
Year 1737-1764, by Felipe Juvara and Juan Bautista Sachetti.

16. Barrio de Malasaña (D-9)
Between San Bernardo, Fuencarral and Manuela Malasaña streets.
Typical popular neighbourhood of the19th Century.

17. Teatro Real (C-11)
Pl. de la Reina Isabel II.
Year 1818, by Antonio López Aguado.

18. Palacio de las Cortes Generales (E-11)
C/ Carrera de San Jerónimo.
Years 1843-1850, by Narciso Pascual y Colomer.

19. Banco de España (E-11)
C/ Paseo de la Castellana.
Years 1874-1891, by Eduardo Adaro and Sainz de la Lastra.

20. Palacio de Cristal (G-12)
Parque del Retiro.
Steel and Glass building, year 1887, by Ricardo Vázquez Bosco.

21. Estación de Atocha (F-13)
Emperador Carlos III Pl.
Steel and brick structure, years 1890-1892, by Alberto del Palacio Elissague.

22. Palacio de Longoria (Edificio de la Sociedad de Autores) (E-9)
C/ Fernando VI.
Modernist style, año 1902, autor José Grases Riera.

23. Palacio de comunicaciones (F-11)
Glorieta de Cibeles.
Year 1904, by de Antonio Palacios Ramillo.

24. Depósito del Canal de Isabel II (D-6)
C/ Santa Engracia.
Example of an Industrial Engineering construction, year 1907, by Diego Martín Montalvo.

25. Hospital de Jornaleros (D-5)
C/ Raimundo Fernández Villaverde.
Year 1908, by de Antonio Palacios.

26. Hotel Palace (E-12)
Plaza de las Cortes.
Firsr Reinforced Concrete Building in Madrid. Years 1910-1911, by León Monnoyer.

27. San Manuel y San Benito (G-10)
C/ Alcalá
De neo-bizantine style, year 1911, by Fernando Arbos.

28. Casa Garay (F-8)
C/ Almagro.
Year 1914, by Manuel María Smith.

29. Edificio de Telefónica (D-11)
C/ Gran Vía.
Year 1926, by Ignacio de Cárdenas.

30. La Ciudad Lineal (K-2)
C/ Arturo Soria.
Lineal Urban Development, years 1893-1930, by Arturo Soria y Mata.

31. Plaza de Toros (J-8)
C/ Ventas.
Neo-mudéjar style, año 1931, by Manuel Muñoz Monasterio and José Espeliú.

32. La Casa de las Flores (B-8)
Between Hilarión Eslava and Rodrígez Moñino streets.
Housing block, years 1930-1932, by Secundino Zuazo.

33. Viaducto (B-12)
C/ Bailén, sobre la calle Segovia.
Concrete arch bridge, year 1934-1942, by José J. Aracil, Luís Aldaz and Francisco Javier Ferrero.

34. Hipódromo de la Zarzuela
Carretera de la Coruña (Cuesta de las Perdices).
Years 1935-1945, by Eduardo Torroja, Arniches and Domíngez.

35. Ministerio del Aire (A-8)
C/ Princesa.
Official post Civil War Architecture, Herrerian style, year 1939, by Luis Gutiérrez Soto.

36. Edificio España (C-10)
Plaza de España.
Year 1954, by Joaquín y Julián Otamendi.

37. Torre de Madrid (B-10)
Plaza de España.
Year 1954, by Joaquín y Julián Otamendi.

38. Torres Blancas
Avenida de América.
Year 1964, by Francisco Saenz de Oiza and Fernández Casado.

39. Paso Elevado sobre la Castellana (F-8)
Calles Eduardo Dato y Juan Bravo.
Composite Steel-Concrete bridge, year 1968, by José Antonio Fernández Ordoñez and Julio Martínez Calzón.

40. Torres de Colón (F-9)
Pl. de Colón.
Suspended buildings, years 1967-1976, by Antonio Lamela.

41. Edificio del BBV (F-5)
C/ Paseo de la Castellana y C/ Raimundo Fernández Villaverde.
Years 1971-1980, by Francisco Javier Sáenz de Oiza.

42. Torre Europa (F-4)
Paseo de la Castellana y C/ General Perón.
Years 1974-1982, by Miguel Oriol e Ibarra.

43. Torre Picaso (E-4)
AZCA.
Years 1974 (design) by Minoru Yamasaki and years 1985-1989 (construction) Genaro Alas.

44. Edificio Sollube (E-4)
AZCA.
Year 1985, by José Luís and Félix Iñiguez de Onzoño.

45. Puerta de Europa (F-1)
Pl. de Castilla.
Years 1990-1993, by Burgee and Asociados.

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