

## Historical Influences on the Use of Cement in Mexican Domestic Construction

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### Introduction

Visitors to Mexico City are often struck by the prevalent use of concrete in houses of all sizes, and representative of all social classes. Indeed, cement is a central component of domestic construction in Mexico City. A recent article on the state of the cement market in Mexico notes that among the constructors of low-income informal housing (who account for between 60 and 70 per cent of all new housing built in the capital city), "More than 60 per cent [of the constructors] use concrete block in the walls and 90 per cent of those interviewed will make the floors and roofs out of cement".<sup>1</sup> The result is that "Seen from the slopes of Ajusco, Mexico City is a valley covered with solid cubic constructions".<sup>2</sup>

More detailed investigations of the constructive methods used in the informal sector confirm those findings. Cement is used in the form of reinforced concrete in the foundations, in the structural framework, composed of ring beams and columns in the walls, in the slab roof and in internal staircases and floors. The walls take the form of panels of concrete bricks or blocks, finished with cement plaster (Figs 1&2).

The use of cement as a basic building material is less immediately obvious in higher income houses, which tend to manifest an investment in more complex stylistic features, in particular the use of elements such as wood, brick and ashlar cladding, and pitched, tiled roofs (Fig 3).

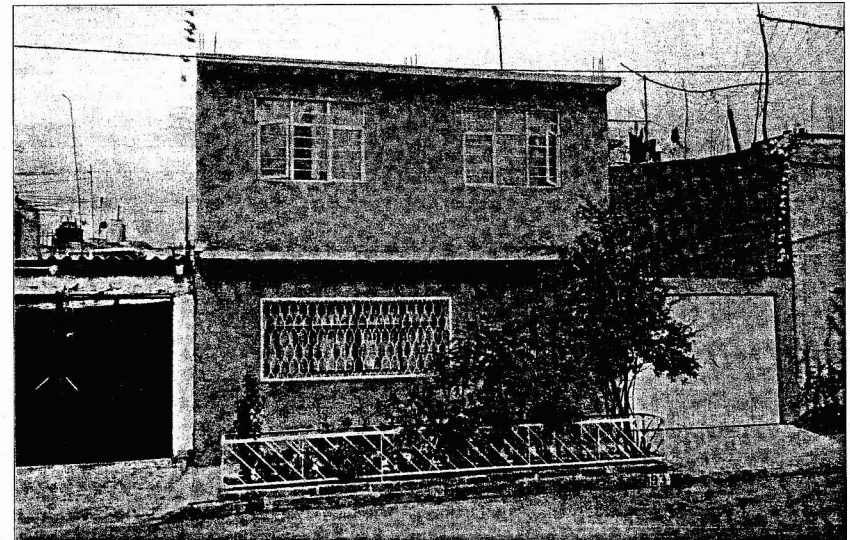


Fig. 1 Typical low-income house in the peripheral area of Mexico City. (Photo by the author).

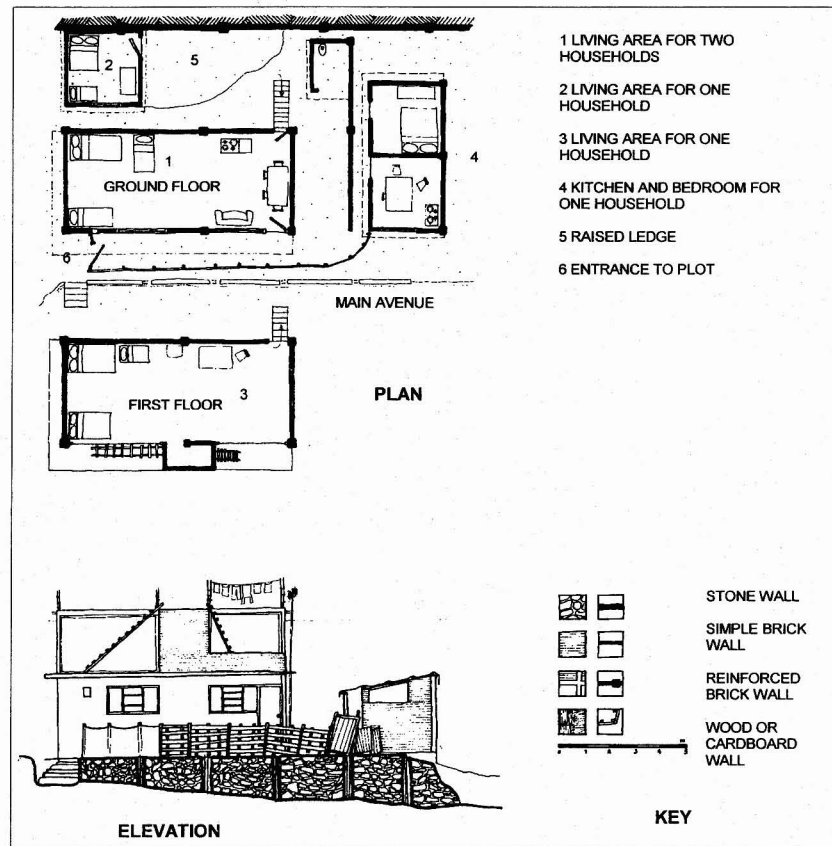


Fig. 2 Structural form of low-income auto-produced house in Mexico City. (Drawings by the author).

However, an examination of typical middle- and high-income houses built since the 1920s demonstrates that the basic structure of the house is the same as in the low-income houses described above. The decorative elements are superimposed on this structure. Even pitched, tiled roofs are almost invariably constructed of slabs of reinforced concrete, cast in situ, with the tiles laid on top.

This generalised, and well established, use of cement as a basic ingredient of domestic construction contrasts with the more limited use the material has enjoyed in other industrial countries. In the United States a range of house construction techniques can be found, many of which depend heavily upon the use of timber and brick for structural as well as decorative purposes, and, compared with Mexican urban construction, a very limited use of cement. The same can be said of many European countries.

It is true that Mexico is not alone in having a construction culture which strongly favours the use of cement. Many other recently industrialised countries show a similar preference, China being a good example. There are two major differences, however, in the Mexican case. The first is that of the early introduction of this building material. Cement was introduced to Mexico towards the end of the nineteenth century, and began to flourish as a building material in the first decades of the twentieth century, a process described by Ayala:

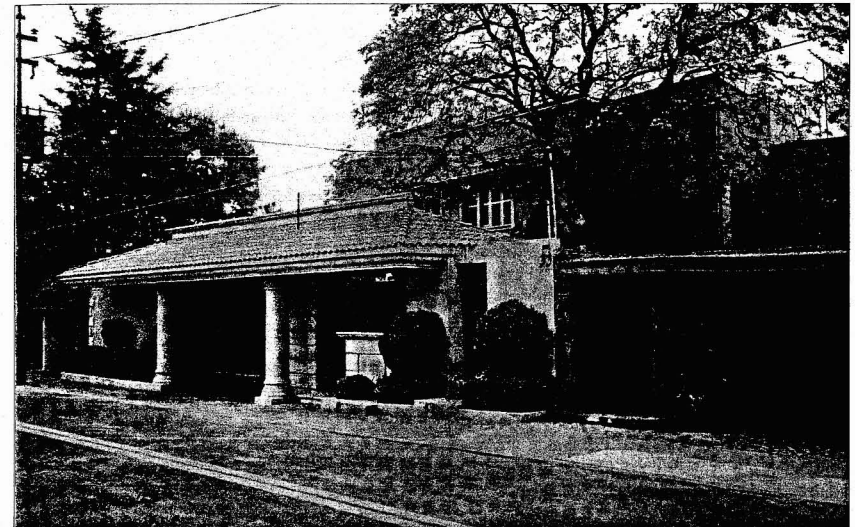


Fig. 3 High income house in Jardines de Pedregal, Mexico City, showing elaborate decorative elements. (Photo by the author).

“Stone and tiles were only used to produce ornamentation and certain details of the façade; the rest was made with a new and revolutionary material: cement. This material allowed the elaboration of artificial stones, which could be used in the form of ashlar blocks, and could also be moulded. This allowed the elaboration of many works not lacking in artistic intention, both at the urban level and at the level of the house itself.”

This citation also illustrates the second difference which is that, unlike in China, for example, cement was not introduced as part of a package of modernisation, which implied a rejection of traditional buildings, and their replacement with a broad international style. Rather, cement was initially presented as a versatile material, with aesthetic advantages, which was absorbed into the traditional constructive culture.

The results of this early adoption of cement in the use of concrete constructions in Mexico City can be seen in the decaying mansions in the once rich areas of La Roma and La Condesa, as well as in art deco monuments such as the Edificio Basurto and the Parque de México and Parque de España, which have elaborately decorated public furniture cast in reinforced concrete (Fig 4).

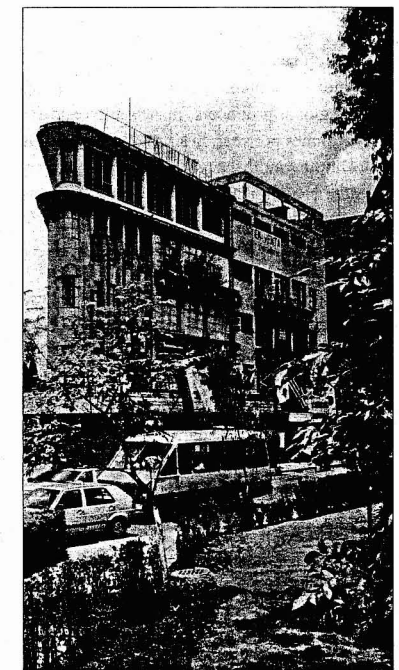


Fig. 4 Decorative use of concrete in art-deco building in Colonia Anzures, Mexico City. (Photo by the author).

This article will discuss a number of influences on this enthusiastic adoption of cement into Mexican construction activity. There is not space here to explore in detail the multitude of factors which may have influenced the adoption of this building material. However, it will be argued that a central factor influencing the use of cement in Mexico has been the easy adaptation of this material to the already established construction culture, and that this adaptation was recognised, and encouraged by a sustained marketing drive by the cement industry.

### Sources of Cement

Cement is produced from limestone and clay, in ratio of approximately three to one. These raw materials are crushed, mixed and burnt. The resulting clinker, mixed with a small proportion of gypsum, is milled to form a fine powder, called Portland cement. Cement is commonly mixed with coarse and fine aggregates and water, to produce concrete, the cement undergoing a chemical reaction called hydration, which produces an extremely hard crystalline material.

The raw materials for producing cement are common in Mexico, as they are in many parts of the world, and an important cement producing industry has developed. Imports of cement to Mexico are negligible, while it constitutes an important export item.<sup>6</sup> Cement production in Mexico is dominated by two companies. Cemex, founded in 1906, grew increasingly rapidly over the century, in the process acquiring a number of smaller enterprises in Mexico, such as Cementos Maya, Cementos Guadalajara, Cementos Anahuac and Cementos Tolteca, to become the main cement producer in Mexico, with an annual production capacity of 27.2 million metric tonnes, in 18 production plants. Cemex has also moved into cement production abroad, and has acquired plants in a number of countries including Spain, Venezuela, the Philippines, Egypt, and Taiwan.

Cemex's main competitor in Mexico is Cementos Apasco. Founded in 1928, Apasco also took over other regional producers, in Acapulco and Honduras. Apasco has a production capacity of 8.9 million metric tonnes per year, in six production plants. While Cemex concentrates on the export market, Apasco concentrates more heavily on the internal market, which has continued to grow, even in the face of repeated economic crises in the country.

### Influences on the Use of Cement in Mexico

The strongly marked preference for cement as a construction material in Mexico is commonly explained in terms of available supplies of materials: since markets for high quality timber, burnt brick and adobe have never fully developed, the argument runs, cement has taken the role occupied by these materials elsewhere. Nevertheless, the raw materials for these alternatives do exist in Mexico. Although the popular image of Mexico is of a desert country, there are extensive forests in the North-west, Central-west and South of the country. Indeed, there is an important timber export trade, especially from the state of Chihuahua. However, no major internal market in timber for construction has ever developed. The same is the case for burnt bricks, which are produced, especially in the Puebla area, but mostly for very local consumption, and as a decorative item. This article will argue that rather than cement gaining importance in the face of the unavailability of other construction materials, the production of alternative materials has been eclipsed by the whole-hearted embracing of cement as the fundamental material in twentieth century Mexican domestic architecture.

The question of the thermal insulation capacities of cement, which has been demonstrated to be of importance in other settings, seems to have had very little influence in Mexico. The whole of the central plateau of Mexico, including Mexico City, Puebla, Guadalajara, Cuernavaca and Toluca, with almost half of the country's population, has a very mild climate. In Mexico City the average temperatures are around 25° centigrade. While the temperature may drop to 9° or 10° at night in winter, with occasional frosts in

the outlying hills, and might climb as high as 32° for a short time in summer, excessive heat and cold have never constituted a problem in this climate, and thermal insulation is only a minor preoccupation among housing producers.<sup>7</sup>

It is probable that the danger of earthquakes in Mexico City has had an important influence on the use of cement as a building material. This is a factor which will be discussed subsequently. However, while the building regulations in Mexico City do make explicit reference to earthquake resistance as well as to specifications for resistance to fire, load carrying, and so on, these regulations limit themselves to general structural resistance criteria. The only direct reference to specific materials in the building regulations for Mexico city comes in Article 118, which discusses fire-resistance, and in which it is stated that façade walls must be made of non-combustible materials, which it lists as being "adobe, tiles, bricks, cement blocks, plaster, asbestos, concrete, glass and metals".<sup>8</sup> It would seem therefore that the construction regulations cannot be credited in themselves for the widespread use of cement in the country.

There are numerous other factors, such as availability of raw materials and aggregates, and the availability of cheap oil to power the fuel-hungry cement plants, which have almost certainly played a role in the use of cement as a construction material, but which do not provide convincing explanations for the wholehearted acceptance of this construction material from the earliest years of its introduction.

The reason why cement has developed a central role in urban Mexican construction culture must be explained, it will be argued, in terms of cultural values that have developed with regard to this building material. It will be proposed that the ready acceptance of cement at the beginning of the twentieth century can be explained with reference to a combination of two main factors: a close conformity between the traditional construction methods and the potentials offered by cement; and a strong marketing drive by the cement producing interests at the beginning of the twentieth century. These influences will be discussed in the following sections.

### Traditional Urban House Form in Mexico

The history of house form in Mexico is an extensive topic, and it will not be possible to go into it in detail here. Instead, a brief discussion will be presented of certain key elements of the traditional construction of domestic dwellings by the Aztecs, the Spanish conquerors, and of the house forms which emerged during the colonial period and, from 1821, the independence period.

Elements of the contemporary urban Mexican house form can be traced back to both the pre-Colombian houses and to the housing brought by the Spanish conquerors. The traditional Aztec house comprised bedrooms, workshops, storerooms and steam baths arranged around a central courtyard, or patio, where most of the day-to-day activities were conducted.<sup>9</sup> Living areas comprised roofed, but open, sections of the patio. The rooms seldom had windows, reflecting the lack of importance given to activities conducted inside the houses. Often several households, normally representing extended families, shared the same patio.

The materials used for house construction varied according to social rank. The poorer houses were constructed of adobe or plastered sticks in the walls, with roofs of thatch, palm or shingles.<sup>10</sup> The houses of the richer merchants, nobility and priests, however, were built of stone, with roofs of beaten earth laid on heavy wooden beams, and were often several stories high. These richer houses appear to have presented the model of house form followed in that society, and were reflected in religious art and decoration.

The housing model brought by the Spanish conquerors was, in many respects, remarkably similar to the house form of the Aztec aristocracy. The majority of the conquerors came from the regions of Andalusia, Extremadura and Castille. Coincidentally, the houses typical of these regions of Spain in the sixteenth century were similar in many ways to the indigenous house types already described.<sup>11</sup> They were built of similar materials, normally adobe or stone, and wood, although with pitched, tiled roofs,

rather than the flat roofs used as work areas by the Aztecs. They consisted of various rooms arranged around a central patio where most of the social and productive activities took place. The interior rooms had small windows, if any, and scarce, mobile furniture. The houses were occupied by extended families, with low levels of privacy. There were a number of important differences between the two house forms, such as that in the Spanish houses there was a greater segregation of men and women, and of productive and social activities, but generally the similarities in the models resulted in an easy blending to provide a new colonial model of housing.<sup>12</sup>

With regard to the discussion of building materials, it can be seen from this brief description that both the house forms were characterised by the use of solid and durable building materials: thick stone walls, and heavy beams in the floors and roofs.

The result of the blending between the pre-Colombian and Spanish construction cultures was a mixed house form, which was identifiable by a number of key features. The most outstanding characteristics of the colonial house form were that it was low-lying, built of solid materials, stone walls and flat roofs laid on heavy beams, and relatively undecorated on the outer walls - another Islamic inheritance (Fig 5).

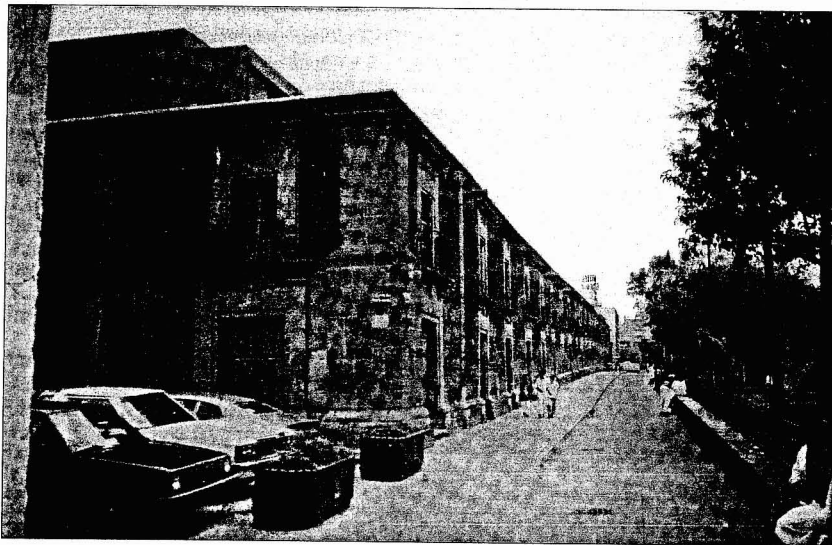


Fig. 5 Colonial period buildings in central Mexico City. (Photo by the author).

This house form developed in several ways during the following centuries, but the emphases on solidity and limited decoration were maintained, as is demonstrated by a description of the houses of Mexico City sent in a letter from a member of the American delegation to Mexico in 1840:

*"The houses in Mexico are constructed, generally, of the most resistant of materials, stone or brick, and with no great architectural pretensions. They have, in the middle, a patio; and they are of thirty or forty feet in front, the living room generally occupying the full length of the house."*<sup>13</sup>

This description of Mexican urban housing in the nineteenth century highlights one of the most characteristic elements of this house form, which persisted from the conquest to the present day: the

concentration on resistant materials, combined in a structure with limited use of decorative elements. This was a pattern of housing which, it will be suggested, allowed an easy cultural acceptance of cement as a basic building material.

### Promotion of the Use of Cement in the Early Twentieth Century

Towards the end of the nineteenth century, there were a number of developments in the materials used in urban construction in Mexico. The most important of the newly introduced materials were iron, principally used in joists, and cement.

The introduction of this material is documented by a journal, entitled "*Cement: Towards a Refinement of Construction*"<sup>14</sup>, published between 1925 and 1932, with an initial circulation of 8,000 copies, growing to more than 12,000 at its peak in the late 1920s. The journal was published in Mexico City by the "Committee for the Propagation of the use of Portland Cement", a title which succinctly identifies the aims of the journal.

An analysis of the content of the articles published during the seven years of circulation of this journal shows that they concentrate of three main themes: the practical advantages of cement as a construction material; the decorative potential that cement provides; and the benefits to hygiene and the environment provided by cement.

Within the first category, the concentration of the majority of the articles is upon the technical qualities of cement, principally its strength, for example:

*"the concrete post has an advantage over other types, which is that of a depreciation factor which is practically null; that is to say, it acquires greater consistency with time, and can thus be considered to have an indefinite life"*.<sup>15</sup>

Other articles make similar claims about the potentials of cement as a construction material, explaining, to an audience not familiar with the properties of cement, what it is, how it works, how it can be moulded, reinforced, and discussing its durability.

A recurrent theme is that of the resistance of concrete to earth tremors. Articles such as "*The Resistance of Reinforced Concrete in Earthquakes*", and "*The Behaviour of Reinforced Concrete in Earthquakes*"<sup>16</sup>, both of which provide detailed discussions of the specific advantages provided by reinforced concrete in comparison to masonry, adobe and timber-based constructions, are two examples selected from among many. This concentration on the resistance of reinforced concrete in earthquakes was an important selling point for the new material, in a city built on a site peculiarly susceptible to earth tremors. Occasionally there are serious earthquakes, the effects of which are greatly exacerbated by the fact that large parts of the city are built on the deep, soft sediments of the drained lake beds, which vibrate violently in the event of earth movements<sup>17</sup>. The most recent example is the great earthquake of 1985, in which as many as 18,000 people might have died<sup>18</sup>.

Another article in the journal summarises the technical capacities of cement as follows:

*"In the landscape of Santa Cruz, in the Colonia del Valle, . . . there is a cheerful bungalow, which despite its small proportions, was built by its owner to resist the calamities which we refer to as time, rain, earth tremors, humidity, rats, etc. etc. It is built of concrete blocks."*<sup>19</sup>

In other words, to cement is attributed the capacity to overcome all of the normal agents of decay to which houses are subject. This acclaimed property appears to have been welcomed in a country deeply preoccupied with durability and longevity in construction.

The second category of articles about cement identified above was those dedicated to illustrating its decorative potential. This is summarised in an article entitled "*The Magic Powder*", which begins in a more literary style than the technical articles:



*“There exists a grey powder which, if someone were to resuscitate an author of the Thousand and One Nights, would provide the theme for a marvellous story. This powder is as fine as the talcum which we use for our face after shaving. It is mixed with particles of stone, and water, and the resulting paste, as plastic as the clay with which sculptors model, can give form . . . to what you might wish or imagine.”<sup>20</sup>*

This plasticity, and the consequent decorative potential of cement, is illustrated by drawings and photographs of well known buildings constructed with cement, including the Church of Sainte Terese in Montmagny, the Palacio de Hierro department store in Mexico City, and Lens railway station in France<sup>21</sup>, as well as a series of illustrations of “funerary monuments made of concrete and artificial granite, erected in the cemetery of Zitacuaro, Michhoacan, by Mr. L. E. Heredia”,<sup>22</sup> and an article on “Simplicity in Modern Art”.<sup>23</sup>

The authority of tradition is given to the new material in an article which provides a discussion of the “friezes of the Temple of Amman in Thebes, by which it is seen that the Egyptians used concrete 1,950 years before Jesus Christ”<sup>24</sup>

At the same time, there are numerous articles illustrating specific techniques for the production of decorative elements such as porticoes, baroque columns and balustrades, very much in vogue at the time, in the so-called “Californian Colonial Style” of architecture, a pastiche of Spanish colonial architecture developed in the United States, and re-exported with great success to Mexico, a country which had only relatively recently divested itself of the original of that architectural form.<sup>25</sup>

The third set of articles revolve around the benefits to hygiene, health, and the environment of the use of cement. A typical example is “Cement as an Evolutive Factor in Hygiene”,<sup>26</sup> which discusses the ways in which concrete structures are resistant to vermin, and, being smooth and easy to clean, prevent the build-up of microbes. An article on “The Destruction of the Woods and Cement”,<sup>27</sup> argues that an environmental catastrophe is imminent as a result of the cutting of the woodlands of central Mexico to provide timber for construction purposes, and that this catastrophe could be avoided through the use of reinforced concrete rather than wood in posts and beams. The article does not discuss the provenance of the wood for the form-work required to produce such buildings. With respect to the beneficial effects of cement on health, there is an article, somewhat bizarre or even sinister in its implications, entitled “Cement Powder and Health” which was written in the face of concerns regarding the possible health dangers of cement in its raw form. The article starts off by arguing that “Far from being prejudicial, cement contains elements with curative properties for the lungs”.<sup>28</sup>

The general line of the journal is summarised by an article which ends with the assertion that:

*“There is no doubt at all that Portland cement will always be the idea material for all types of constructions.”<sup>29</sup>*

The magazine “Cement” went out of circulation in the early 1930s, but it was immediately replaced by “White Portland Cement. A Magazine Dedicated to the Illustration of the Innumerable Uses of ‘Monterrey’ White Portland Cement”, published in Mexico City from 1934-1955, in the hands of the same editor (Raul Arrendondo E.) under the auspices of the early Cementos Mexicanos (Cemex), with an almost identical content to that discussed above.

### Contemporary Propagation of the Use of Cement

There is no contemporary journal published with the direct aim of promoting the use of cement in the Mexican construction industry, probably because the aim of the journals of introducing cement to the construction industry was fully realised by the time the second journal closed in the 1950s. However, recent market research<sup>30</sup> has demonstrated that what is commonly referred to in Mexico as the “self-build”

of houses in the low-income periphery is a growth industry even when the country is in recession. Fixing on this largely hidden market for their product, and combining this marketing drive with corporate philanthropic activities in the poorest parts of the Mexican cities, the large cement producers have engaged in the production of construction training manuals, mostly in comic form, which are distributed through retail outlets, and training courses given in new housing areas on the growing peripheries of large Mexican cities.

Both the Cemex subsidiary Cementos Tolteca and Cementos Apasco have published manuals, the “Manual Tolteca de Autoconstruccion y Mejoramiento de la Vivienda” (The Tolteca Manual for the Self-Building and improvement of the House<sup>31</sup>), and “Mi Casa; Manual de Autoconstruccion”\* (My House; Self-Build Manual<sup>32</sup>).

\* The Apasco manual was prepared in collaboration with the Mexican Federation of Architectural Colleges. It was designed for didactic purposes, and is distributed free together with a training video in the Apasco centres located in various sites around the larger cities of Mexico. All teaching material, and technical assessment provided within the “Mi Casa” programme are provided free of charge. (Arq. Humberto Herrera, personal communication).

These manuals provide instructions for the rational production of low-income housing, being based on the established construction system in the low-income settlements discussed in the introduction. The basic system of construction disseminated by these manuals is the following: masonry foundations, with a reinforced ringbeam (the *dala*) placed on top at ground level; reinforced columns (*castillos*), at 3m centres, anchored to the ring beam; a concrete floor panel, reinforced, or not, this depends on the manual; concrete block panel walls between the columns; an upper ring beam, reinforced (the *trabe*), poured at the same time as the reinforced concrete slab roof (*losa*). The construction is finished with cement plaster and the windows and doors are steel or aluminium (Fig 6).

These manuals clearly serve as marketing tools: the recipes for the mixing of the concrete recommend the use of the particular brand of cement which is sponsoring the publication. However, they have also been designed to serve a didactic purpose. As well as dealing with the structure, built of concrete, they explain the process of installation of services, drainage, etc. Furthermore, the manuals explain very clearly how to mix concrete properly, how to bend reinforcing rods to shape, how to construct the form-work correctly; in short, all of the necessary technical details for the construction of a house. In this sense, it can be argued that these auto-construction manuals serve the philanthropic aims of the cement producing companies, at the same time as promoting their product.

There is some difference in the spirit of the manuals. The *Apasco* manual concentrates almost entirely on technical instructions,

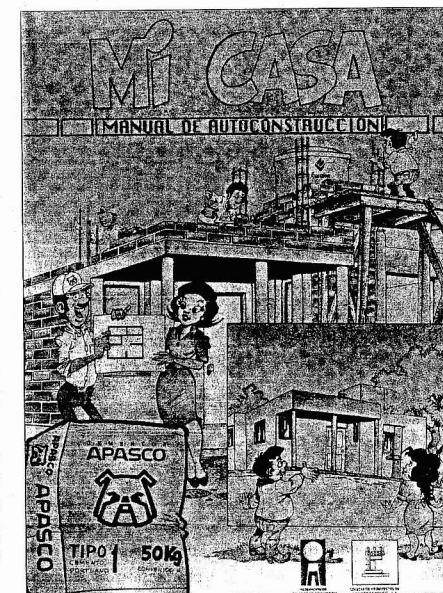


Fig. 6 Completed house from Apasco training manual (illustration reproduced with permission from Cementos Apasco S.A. Copyright by Cementos Apasco S.A. 1996).

presented in a light, populist way, using the language and jokes of Mexican television comedy shows (Fig 7).

The *Tolteca* manual also provides technical instructions which, apart from the brand of cement used, are almost identical to those given in the *Apasco* manual. However, as well as serving as a manual for construction techniques, the *Tolteca* manual also takes a socially didactic approach, with a somewhat paternalistic attempt to train the social consciences of the users, apparently on the assumption that the inhabitants of the houses, being poor, are unaccustomed to urban ways of life. For example, in a discussion of the use of walls, the manual explains that:

*“All of the members of the family need personal spaces, this contributes to family harmony. Women and men grow and develop as such, for this reason they require their own spaces in order to conserve their intimacy, even more so couples . . . It is better to have three small rooms than one big one. This way living together is more agreeable.”*”

Although these manuals have a marketing goal, the strategy is different from that of the journals published in the early years of the century. While those promoted the use of cement in the Mexican construction industry in general, this goal has long since been achieved. The marketing goal of the construction manuals is to gain ground in the large informal construction sector. Since the use of cement in construction is firmly established, it is not necessary to promote this. Rather, the construction manuals follow the established patterns of construction culture current in the low-income settlements. That this is the case can be seen from descriptions of the production of irregular housing in Mexico City over the past forty years<sup>34</sup>, which show that the basic method of construction used in the informal settlements is that described in these manuals. Since the manuals are a relatively recent phenomenon, it can be deduced that the manuals have concentrated on the demonstration of the correct methods for construction within the existing model, rather than proposing a new one.

Although the construction manuals published and distributed by the cement producers draw upon the existing construction culture, it seems likely that the contents of these publications exist in a dialectical relationship with the established methods of construction. While on the one hand, they are based on this culture, on the other hand, the production of such publications on a large scale is likely to influence, through their intervention, the nature of that construction culture on which they draw. It is probable that the existence of these self-build manuals has helped to establish the fundamental place of cement in the construction culture of urban Mexico.

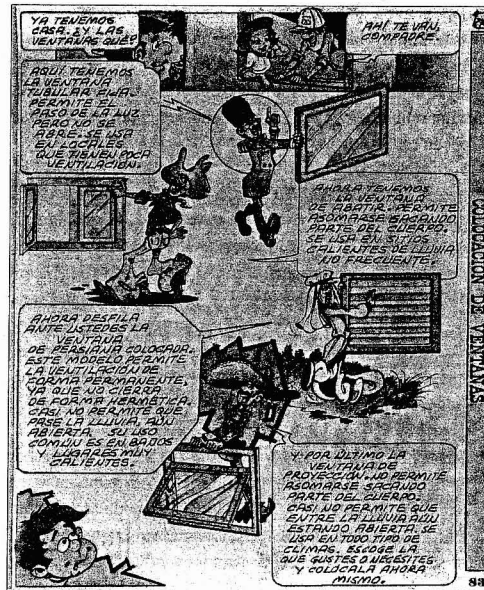


Fig. 7 Page from “Mi Casa: Manual de Autoconstrucción” (illustration reproduced with permission from Cementos Apasco S.A. Copyright by Cementos Apasco S.A. 1996).

## Conclusions

There have been numerous influences on the domestic architecture of Mexico City, which have not been discussed in detail in this article. However, it would seem that there is one thread which runs through the changing forms of houses in the city; both the houses of pre-conquest Mexico, and the house types brought by the Spanish conquerors, were solidly built of durable materials. The resulting hybrid colonial house form was characterised by the solidity of its construction, combined with a relatively formal simplicity.

The characteristics which identified colonial Mexican architecture appear to have persisted to the present day. Modern Mexican urban domestic architecture is characterised by a superficially eclectic range of architectural styles, but which all demonstrate adherence to a basic construction culture, one of the main identifying features of which is the use of concrete throughout.

In Europe cement was broadly seen as being a useful tool for reducing costs in construction, and was, and to a certain extent still is, used predominantly in large-scale engineering constructions, and in low-income housing, as a result of which it has acquired a range of negatives connotations. In Mexico, on the other hand, cement was initially introduced into the higher-income end of the construction market, as was documented by the journals discussed. The characteristic features of durability and formal simplicity, it is argued, provided ideal conditions for the introduction of cement into the construction culture of Mexico. Once it was established in the country, cement was used widely in Mexico, as in Europe, in the large housing blocks built after the war, but, since these were occupied largely by the small middle classes, being inaccessible to more than 70 per cent of the population, this type of construction did not acquire such negative connotations as it seems to have acquired in Europe and the United States. Instead, its use appears to have continued to be firmly established in the construction of houses from all social classes, and to have spread rapidly to the informal settlements which surrounded the cities.

These settlements, as a result, represent an enormous market for cement, a market, furthermore, which does not diminish notably in times of economic crisis. The cement producers have taken account of this market, and have engaged in a marketing drive within the settlements, to encourage their market share. But in contrast to the journals distributed in the early decades of the century, which actively engaged in the introduction of a little used building material, it would appear that the comic-format house building manuals, distributed by cement companies in the informal urban settlements, reflect the existing construction culture, rather than trying to establish a new one. The use of cement already represents a central feature of the established culture of construction in Mexico City.

It is hard to say to what extent the widespread acceptance of cement as a basic building material in Mexico can be attributed to the success of the marketing strategies of the cement board in the years between the wars, and to what extent to the easy substitution of earlier building materials, predominantly stone and plaster, by cement. Probably it can be explained largely as a combination of these two factors, together with others which have not been discussed in this article. Nevertheless, although not constituting a complete explanation of the phenomenon, the discussion of this article gives an insight into the early history of a building material which has become fundamental to the construction methodology of urban Mexico.

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## References:

1. Z. Ramírez Tamayo, ‘APASCO: Primeros Cimientos en un Mercado Olvidado’, *Expansión*, (Aug. 1996). Author’s translation.
2. *ibid.*, p.58.

3. A.G. Walker, 'House Form and Social Identity: The Formal consolidation of Irregular Housing in Mexico City' (Ph.D. thesis, University of London, 2000); J. Legorreta, *La autoconstrucción de vivienda en México. El caso de las ciudades petroleras* (Mexico City, 1984); J. Bazant Sanchez, *Autoconstrucción de Vivienda Popular* (Mexico City, 1985).
4. S. Meikle & J. Walker, 'El Cambio de la Ciudad China/The Changing Face of the Chinese City', 2G, *International Architecture Review*, 10 (Oct. 1999).
5. E. Ayala Aonso, *La Casa de la Ciudad de México; Evolución y Transformaciones*, (Mexico City, 1996), p.96. Author's translation.
6. <http://www.cemnet.co.uk> web page. 30 Aug. 2000.
7. Walker, 'House Form'.
8. Reglamento de Construcciones para el Distrito Federal; Ley del Desarrollo Urbano para el Distrito Federal; Reglamento de la Ley del Desarrollo Urbano para el Distrito Federal (Mexico City, 1998). Author's translation.
9. J. González Aragón, 'La Casa Tradicional Azteca', (Ph.D. thesis, School of Architecture, UNAM, Mexico, 1996).
10. Ayala, *La Casa*.
11. *ibid.*
12. H. Thomas, *The Conquest of Mexico*, (1993).
13. B. Mayer, 'Carta IX, 1840', in S. Novo, *Seis Siglos de la Ciudad de Mexico*, (Mexico City, 1974), pp.73-4. Author's translation.
14. Comité para la propogación del uso de cemento "Portland", *Cemento: Hacia un refinamiento de la construcción*, (1925-1932). Author's translation.
15. Cemento Portland, *Cemento*, 21, (Jan. 1928), p.26. All translations by author.
16. *ibid.*, 23, (May 1928) & 28, (May 1928), unpaginated.
17. T. González de León, A. Rosas Robles, A. Kalach, G. Quadri de la Torre, *La Ciudad y sus Lagos*, (Mexico City, 1998).
18. E. Poniatowska, *Nada, Nadie; Las Voces del Temblor*, (Mexico City, 1988).
19. Cemento Portland, *Cemento*, 10-11 (Oct.-Nov. 1925), unpaginated.
20. Cemento Portland, *Cemento*, 21, (Jan. 1928) p.30.
21. *ibid.*
22. Cemento Portland, *Cemento*, 23, (May 1928), p.16.
23. Cemento Portland, *Cemento*, 25, (Sept. 1928), unpaginated.
24. Cemento Portland, *Cemento*, 29, (no date), p.22.
25. Ayala, *La Casa*.
26. Cemento Portland, *Cemento*, 38, (Nov. 1930), p.41.
27. Cemento Portland, *Cemento*, 36, (July 1930), unpaginated.
28. Cemento Portland, *Cemento*, 14, (June 1926), unpaginated.
29. Cemento Portland, *Cemento*, 23, (May 1928), unpaginated.
30. Ramirez Tamayo, 'APASCO: Primeros Cimientos'.
31. Cementos Tolteca S.A., *Manual Tolteca de Autoconstrucción y mejoramiento de la vivienda*, (Mexico City, 1984).
32. Cementos Apasco, *Mi Casa; Manual de Autoconstrucción*. (Mexico City, 1996).
33. Cementos Tolteca, *Manual Tolteca*, p.58.
34. Walker, 'House Form'; Legorreta, *La Autoconstruccion; Bazant, Autoconstruccion*.