Early Modernists Claim—and an Overview of Contemporary and Future Opportunities

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PAST:

The early modernists claimed to use to a large extent modern, new or as I would rather like to refer to them, non-traditional materials.[1] This is true merely in a handful of the new buildings. For example the Le Corbusier house in Stuttgart Weissenhof or the Barcelona Pavilion by Mies van der Rohe.

When one look's in detail at the early modern architecture this has not been realised in most cases, resulting in modern straight-line ornaments. (Resulting in copycatting of design elements and features and pretence of modern building envelope.)

The modern architectural form had been derived from the technological opportunities as was outlined in the book 'Vers une architecture' by Le Corbusier.

A close assessment of the show pieces for modern architectural housing in the 1920's shown that merely 43%[2] of the Modernists buildings were designed by non-traditional means of construction, whereas the remainder (57%) was designed by traditional means of construction.[3]

One of the housing estates recognised to portray a high degree of utilisation of new or alternative methods of construction was the Praunheim housing estate in Frankfurt by Ernst May, H. Boehm and W. Bangert.[4] Seen at the time as the first steps into industrialisation, taylorisation of the construction process.[5]

The estate was laid out as a row development. The eastern side of the estate, the houses were orientated along a north-south axis, whereas the development towards the west was set out along an east west axis (see figure). The construction of these dwellings were carried out in solid brick masonry construction and in unreinforced pumice concrete panel construction (see figure 4). The RFG (Reichsforschungsgesellschaft fuer Wirtschaftlichkeit im Bau- und Wohnungswesen e.V.) experiment was to determine the benefits of the pumice concrete panel construction compared to the traditional means of construction. However, in the first construction phase a mere 10 building units were erected in the pumice concrete panel construction for experimental purposes. In the second phase a total of 900 houses (23%) were being built in the pumice concrete slab construction method and the remaining 696 houses (77%) were built in traditional brick masonry construction. The factory in Osthafen [6] which was supposed to produce the pumice concrete slabs (see figure 5) was not operational until October 1928, as a consequence the productions of the slabs was given to Eurich, a private company.[7] The slab construction, was based on reinforced pumice concrete panels of 1.10m width x 0.20m thick, with varying lengths of up to 3.00m.

The masonry construction was based on a cavity wall construction with a total thickness of 0.30m, two 12 cm thick walls with a 6 cm cavity connected by galvanised wires.[8] However, it has to be noted that the common masonry wall construction of the times was of 0.38m deep solid wall construction. The RFG was aware of this discrepancy, but the municipal authority in Frankfurt had advised on a 0.30m deep masonry wall construction.[9]

One can only assume that this was to obtain more beneficial/positive results for non-traditional construction methods. The lack of data regarding modern alternative methods of construction in the estate is not a current phenomenon, but was also much criticised at the time, as the following statement extracted from the Journal 'Stein Holz Eisen', clearly shows.

All the talking in generalised expressions, all talk regarding opportunities for economic measures without the figures to prove this, is in most cases entirely valueless. Furthermore the whole profession has generally grown tired of these talks. For example if Herr May, town planner in Frankfurt, would publish the figures related to his experiments and therefore make them accessible to the experts, this would achieve exceptionally more than all the published articles and illustrations of last year. New building methods have only a real value, when they save time, work and building materials…[10]

This argument regarding the pumice concrete slab construction and its economic efficiency was further supported by the fact that the 'Bauplattenfabrik' was only in business from 1928-30. During these three years that the 'Bauplattenfabrik' was in business, it actually never worked at full capacity.

The Praunheim estate in Frankfurt was also set out as an experiment for rationalisation of the building process but by off-site factory like production of concrete slabs. The RFG report seems to have been based on a collation of illustrative material and research undertaken prior to the RFG involvement, on behalf of the municipal authority in Frankfurt, who had original tendered for the inclusion of their estate under the RFG in order to obtain funding. It has to be noted that the comparison of traditional to non-traditional methods of construction had an added complexity, since it not only allowed that several new building materials and constructional methods were tried within the same housing unit, but further added the difficulty of non-traditional design features such as flat roofs, flash walls, no overhangs etc. Further the traditional and were rather adaptations of the traditional methods, for example the wall reduction of the brick masonry houses in the Frankfurt Praunheim estate. This resulted in the difficulties of a conclusive analysis for the RFG, whether deficiencies at the buildings were due to architectural design features or of constructional or structural nature or a combination of these. A further problem was the lack of guidelines and established parameter in order to assess the estates at the time.[11]

It can be seen that the use of non-traditional materials and methods at the time was misrepresented at the time, through a combination of limited research and lobbying from the profession, politics, economy, press.

CONTEMPORARY:

Nowadays we are in a much better position, scientific research into building materials and construction techniques have been well established, building codes offering the parameters for new developments are firmly set in place and the exchange of knowledge is much easier.

The maybe most commonly used new materials within the design of buildings are solar panels. Example Brisbane Solar Skyscraper that has solar panels integrated within its façade.[12] The research work undertaken into the use of solar panels can be traced back to the 1960's, whereas over that 10-15 years a noticeable amount of solar panel integration in architecture is noticeable.

Once again the utilisation and research of non-traditional materials and systems is strongly supported and financed by the various governments and professional bodies and the press.

Use of plastics is slowly making its way into structural design and therefore architecture. As can be seen in some bridge designs in the USA and the UK.[13]

So are architectural practices and the building industry too slow in adapting/adopting new materials and technologies? Let's compare the integration of technology in other fields. For example in medicine, where pharmaceutical products of medical procedures take also several years to become an integral part in practice, due to set out clinical test procedures. In most cases this takes about 10 years.

In the car industry this situation is similar, developments and introduction of new models or technical innovations take similar length of time.

The question why I guess will lead to as many answers as there are professionals here in the room. (-> historic, -> economic, -> individual designs compared to serial industrial production, -> philosophical etc.)

This short summary however shows the developments throughout the past 80 odd years and this enables a prediction of shortening of the technology transfer into architecture to about 10-15 years.

FUTURE:

In Future we may see buildings that are using structures and constructional materials made out of nano materials. Due to improves structural and material characteristics it will be possible to reduce the depth of structural systems. It is predicted that nano steel 22 times stronger as current structural steelwork. Currently still science fiction-however research is carried out in these areas. Super strong materials-composite materials with nanotubes will offer a high degree of elasticity and tensile strength. Buildings with an in built form memory bank that will with stand, safely re-form themselves after an earthquakes. These building material developments in turn would revolutionise not only structural engineering, but further the concepts or architectural aesthetics. However, current problems are that nano tube materials production costs are about 10-1,000 times more than that of common composite materials such as carbon fibres.[14]

Architects and engineers are intrigued about the opportunities opening up with alternative materials.[15]

FOR EXAMPLE:

Development of textile materials set within resin or plastics. (Material is extremely lightweight and strong, replacing aluminium in space shuttle designs). Research is currently on their way for example at Dundee University, ETH in Zuerich [16] and at MIT university to develop building systems based on these innovations.[17] Trials are currently undertaken in the UK for testing fibre-reinforced polymers for bridge designs.[18] The material advantages are light-weight, structural strength and being up to 50 years maintenance free.

Glass fibre reinforced polymer (GFRP), carbon fibre (CFRP) and aramid fibre reinforced polymers (AFRP).[19] These materials offer good thermal as well as static characteristics.

In addition there are self-healing smart fibres. The hollow fibres are filled with a fluid, that allows to reduce or avoid the crack development in concrete.[20] Combined with glass fibre technology embedded in the structure as well as control of the whole structure throughout a building.

Further the alternative developments in the areas of substituting the reinforcement in concrete. For example the US traffic department account refer to 40% of the reinforced concrete bridges are so damaged through corrosion that they no longer can take the full design load and require repair work. This not only applies to bridges but also to other reinforced concrete construction. The Technical University in Dresden is leading in the area of replacement of steel reinforcement by textile tissues.[21]

Both these developments will be a challenge for engineers and construction companies on the one side whilst on the other side offering great opportunities for the architects and engineers. They might challenge our as well as the publics perception of architecture — of what looks stable and balanced.

All figures are on slides

NOTES

Trends in the area of building materials can be grouped into standardisation of use of traditional materials and its' underlying techniques, alternative of substitute development and the development of new materials for building.

[2] This figure includes the adaptation of traditional brick masonry construction

[3] Loehlein, G. Role of the Reichsforschungsgesellschaft fuer Wirtschaftlichkeit im Bau-und Wohnungswesen e.V. in supporting non-traditional construction methods in German public housing in the late 1920s, PhD thesis, 2000, Cardiff University, UK.

[4] Das neue Frankfurt, journal published to promote the new building materials and construction methods in architecture, 1928

[5] The RFG assessed and financed the construction of the estate

[6] RFG, 'Taetigkeitsbericht 1927', p.16 (translated by Loehlein, G.), slab factory was established under the control of Frankfurt's municipal authority and in some of the unofficial documents it is hinted that the Frankfurt's authority for the construction of the estate was rather used on establishing the factory.

[7] RFG, internal document, 'Bericht ueber den Stand und die bisherigen Ergebnisse des Grossversuches Frankfurt a. M., Reichsarchiv Berlin', R3901, 11216, pp.242

[8] Reichsziegelmass format 12 cm × 25 cm × 6.5 cm

[9] RFG, Sonderheft Nr.4, 'Bericht ueber die Versuchssiedlung in Frankfurt am Main-Praunheim', April 1929

[10] Stein Holz Eisen, 1928, 'Eine Eroerterung zum Thema Haeuserfabrik im Freien', p.124 translated Loehlein, G.

[11] Loehlein, G. 'Role of the Reichsforschungsgesellschaft fuer Wirtschaftlichkeit im Bau-und Wohnungswesen e.V.' in supporting non-traditional construction methods in German public housing in the late 1920s', PhD thesis, 2000, Cardiff University, UK, pp.151

[12] *www.infolink.com.au* it is the $40 million New Hall Chadwick Centre at 120 Edward Street. This new building includes 18 levels of office and storage space, six retail stores, a conference facility and 2.5 levels of car parking. This type of high-rise building is new to Australia in that it has photovoltaic panels incorporated into its structure. Property developer Forrest Kurts' Properties and Energex have developed the solar powered building. The building is producing enough energy for most of its own lighting and backup power supply. Subcontractor Interlec installed more than 300 solar panels over the top of the 23-storey building, a job, which presented some difficulties.

[13] *www.hq.usace.army.mil* and also: *www.csa.com*

[14] Further nano-tubes are so smooth that under loading they can slip pit of the matrix in which they are embedded.

[15] The building industry and the building codes are restrictive and protective to ensure safety.

[16] Kuenzle, O., Wyss, U., 'Fibre-reinforced materials as load bearing elements contacts', <*www.arch.ethz.ch*>.

[17] Research at MIT Building technology unit, *http://web.mit.edu*, 'Natural fibre reinforcement of large-scale composite polymer panels'.

[18] Plastic road bridges a possibility for the UK? An innovative research project to test the performance of fibre-reinforced polymers in bridge decks is being undertaken by the Highway Agency. The introduction of FRP as the first new material for bridge construction in a century provides exciting opportunities for engineers for cheaper, durable bridges. Fibre-reinforced polymers (FRP) have the potential to provide a cost-effective alternative to conventional materials used in construction, such as concrete and steel. It has the advantage of being strong, yet, lightweight and its resistant to attack from de-icing salts. It has a track record in the aerospace and automobile industries and is already being used on footbridges an, in the form of bonded fabric and plates, for strengthening bridges on the trunk road network. A full-scale sample bridge deck, made of FRP components is undergoing rigorous fatigue tests at the Transport Research Laboratory <*www.pm.gov.uk*>.

[19] <*www.netcomposites.com*> and <*www.ecn.purdue.edu*>.

[20] Fernandez, John, F., 'Self-healing smart fibre inclusion into an air/vapour barrier textile substrate material', MIT University Building Technology Unit, USA, <*www.web.mit.edu*>.

[21] Technische Universitaet Dresden, <*www.tu-dresden.de*>.