Saving Modulex

I first came across LEGO when I was three, and have continued to enjoy it ever since. Whenever it comes up in conversation that I "still play with LEGO", the immediate reaction is that I have simply not grown up – and grown out of it. However, if I explain what it is I actually do with LEGO, they tend to become somewhat abashed by their earlier response. I, along with around fifty thousand other adult or teenage fans of LEGO, build models that are far removed from the blocky and multi-coloured creations many associate with the toy, but which are intricately detailed, cleverly constructed and, as some put it, works of art.

A major part of this hobby involves sharing photographs of these models on the internet, with other fans. As advanced building techniques are frequently discussed, the actual components that are used in them are also a talking point, to the extent that numerous databases of the different LEGO parts exist online. As such, it is possible to readily identify components – and even buy them. One develops an almost catalogue-like ability to recognise parts after some time immersed in the world of advanced LEGO building – and I am no exception.

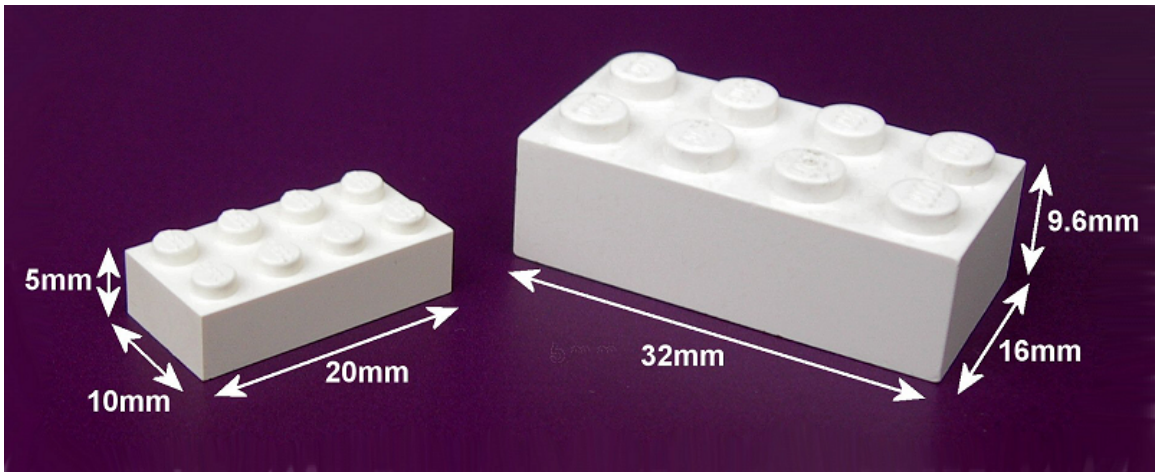
However, a source of perplexity, whenever they cropped up, were smaller-than-standard LEGO bricks, in weird colours and shapes. They are often used as bricks for LEGO people to play with; but it transpired that these bricks had far more behind them. They were, in fact, Modulex bricks.

A little delving told me they had been used for architectural modelling and planning during the 1960s – but little more information than that was readily available. It also transpired that they were no longer available for purchase; generally, LEGO products are phenomenally successful, so why had Modulex met its demise? Tying in with my interest in engineering, and to a lesser extent architecture, it seemed a good premise for research and investigation.

What was Modulex?

It is surprisingly difficult to gauge what Modulex actually was, due to the hugely limited availability of reliable facts about it, and the variety of forms and products it took. With the help of a unique – and valuable – collection of vintage Modulex promotional materials, catalogues and correspondence, alongside more conventional sources, it has been possible to piece together its character and history, and begin to decipher why it is obsolete. It is imperative that one does not come at it from a "LEGO's little cousin" perspective: it was a commercial product, and must be treated as such. The mental shackles that such a perspective gives make it difficult to comprehend Modulex's true nature – but one must be mindful nonetheless of these connotations and their possible impact on Modulex's past.

Modulex was created in 1963 by Godtfred Kirk Christiansen[1], owner of The LEGO Group, as a means of adapting LEGO bricks to build a scale model of a house he was designing[2]. Given the success of the LEGO system as a toy, the transition to use in architectural modelling was both obvious and had economic potential[3]. Working with Danish industrial designer Jan Trägårdh[3], he modified the LEGO system so that it was able to accurately represent buildings, to the needs of architects for use in both designing buildings and presenting them to clients[4]. They created the company Modulex A/S (although a variety of names seem to have been used by the company, depending on date and location), selling the Modulex construction system. It was launched with M20, a line of products specifically designed for detailed architectural modelling.



(Fig. 1)
A Modulex brick on the left; a LEGO brick on the right.

The bricks themselves were modified so that they represented the dimensions of a regular building brick more accurately[2]: whereas standard LEGO bricks have sides in a ratio of 10:5:3, Modulex bricks were based around a 5mm cube, as in Fig. 1. This 1:1:1 ratio, when multiplied up, approximates a standard building brick (215mm x 102.5mm x 50mm[5]) better than a LEGO brick. Thus, whilst a single 2x4 Modulex brick is not intended to represent an actual brick (the scale would have to be 1:10, which is

impractical for most applications), it fits the dimensions of multiple bricks – such as the width of a wall. The name M20 was derived from the intended 1:20 scale of the modelling system[2], but the clean metric dimensions of the bricks enabled them to be easily used in most common architectural scales; a scale-converting ruler was produced to assist British modellers who were still using Imperial measurements at the time[6].

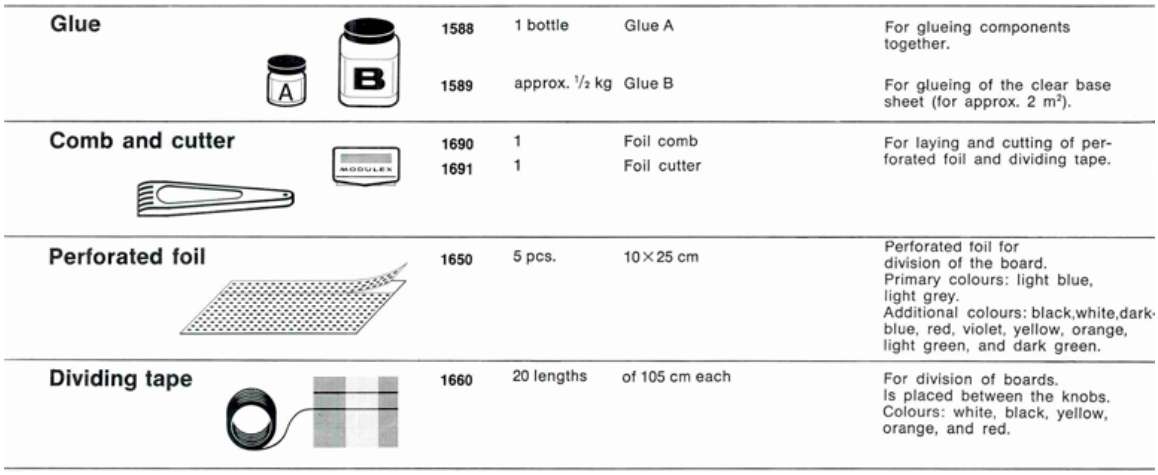
As with LEGO, a variety of brick sizes were sold, predominantly the 2-stud wide variety, shown in Fig. 1. On a 1:20 scale, this accurately represented the width of an exterior housing wall, of two bricks wide. Architect Tim Neville-Lee commented that when making scale drawings, architects frequently approximate widths to 100mm (or 4 inches) to simplify things[7]; and a 1-stud wide Modulex brick fits this width perfectly on a 1:20 scale. Certainly, this was something Modulex A/S used as a selling point: "The scale 1:20 is of particular interest within building, as the Modulex unit in this scale represents 10cm, i.e. the basic module for the coordination of dimensions in metric countries [...] For statistical purposes etc. the Modulex base unit may be applied as a symbol of definite quantity, size or period."[8]

M20 was marketed primarily in kits containing an assortment of parts, designed to cover a variety of buildings and functions[9]; but individual parts were also available in bulk, via telephone or mail order catalogue[10]. The company had a strict policy of not visiting customers in person, implying M20 was only used on relatively small projects[11]. A variety of sloped parts and tiles were produced, much like in the standard LEGO system, mainly to hide the studs on top of the bricks – to make a finished Modulex model look like a professional tool, rather than a toy[2]. M20 windows, doors, furniture and figures were available in a 1:50 scale[6,12], although these were not widely used, due to their rather abstract design[13]. Moreover, as is discussed later, M20's use for finished models was rare, as making one presentable was so difficult – hence demand for these accessories was not as great.

The colour palette was modified from the bright LEGO colours to more neutral tones, suitable for realistic buildings[4]. Architectural modeller Jemma Rowe was quick to point out that bright colours, even if they are accurate in real-life, look bad when scaled down, so more tempered tones are used[14]. New colours, such as terracotta, reflected the architectural styles of the time, particularly post-war minimalism[15], whilst interior design colours, such as lemon, pastel blue, buff and pastel green, were also available.[10]

As Modulex was designed specifically for work, not play, it had to be both economical and time efficient to use. Plates (half-height bricks) were sold that could be cut to the right length with a craft knife[16], rather than making up lengths out of numerous smaller parts, as in the LEGO system, hence reducing the necessary number of components. Likewise, model bases were only available in sizes of multiples of 0.25m squared, designed to be trimmed to size once the model was complete[6]. Solvent glue was available for creating a durable finished model[13]; it also enabled the modeller to attach parts in otherwise unachievable ways, such as angled walls[10]. The system as a whole was designed to be integrated with non-Modulex materials, where necessary, such as stacking up foam washers or wooden dowel to make storage vats[17]. Yvonne Doyle, a hobbyist,

recalls 1:50 scale chairs and tables made out of tiles glued together[18]; tribute to Modulex's versatility.



(Fig. 2)[10]
Example of specialised tools and materials

By the mid-1970s, however, it became clear that the business was not taking off – there was no consistent use of M20 in architectural modelling, on a wide scale[2]. This was not a sudden trait, however: a Modulex catalogue from February 1967 recognised its failure in a rather macabre and public manner: "The Modulex planning model is realistic and clear. It represents the result of many hours of study and discussion – but it has not yet had its day – in the future when decisions have to be made on new layouts and extensions, these can be made quickly."[19] Despite this, the Modulex system was gaining support as a planning medium – moving words or blocks around on a base was useful in everything from factory floor planning to neighbourhood zoning[2,20]; similarly, teacher Kim Thomsen recounted its use in numerous Danish schools to schedule lessons[21]. In 1966, the Modulex Planning System was released, which culminated in the award-winning Interior-10 architectural sign system[2]. This built upon the board-and-component system that had emerged from M20's failure, but with new special components, such as perforated foil (for rapidly colouring sections of board), number tiles, nylon activity lines (to show, for example, roads or pipes) and nameplate holders[10], as in Fig. 2. This allowed the system to be used not only for behind-the-scenes planning, but also for public signs, such as building directories[22]. The company, by now a separate entity from The LEGO Group, took up architectural signage solutions as their main product in 1984, and are now world leaders in the field, still often basing their designs around interlocking or modular components[1].

Confusingly, however, M20 was still in production under the same name until the early 1980s, although designed more obviously for planners (notably in factories) than for the crisp architectural models the early promotional material depicts[23,24]. The Modulex system was still produced in its recognisable form until 2004[25], albeit in limited quantities, mainly for Plancopy, an office management system introduced by Modulex

A/S in 1982[26]. Nonetheless, it undeniably failed to secure long-term usage or recognition as a valid professional tool at the time, due to a variety of factors.

How Modulex was actually used is far more difficult to understand than its already hazy history. As early promotional materials – and its original conception by Godtfred Kirk Christiansen – show, it was intended originally for detailed, accurate architectural modelling, albeit on perhaps a less professional basis[27]. Architect Goh Ong recognised the need for an effective, simple tool for non-professionals to involve themselves in the conceptual design of a building[28]. Certainly, this trait is seen with LEGO itself; at shown by Cowley St. Laurence's Primary School. In a governors' meeting, a LEGO model was used to demonstrate the need for a sheltered passageway between two buildings – and so inspired was architect Anthony Hoete by this, that LEGO was incorporated into the final design, as decorative cladding[29]. However, by around 1965, it had a clear layout and planning skew; to the extent that a brochure from the time asks the client to put aside their instinctive response to the medium: "Remember Modulex is intended as a tool which will enable you to build reasonably quickly a model which will be easily recognisable for what it is. It is not intended to produce a model which is exact in texture, colour or detail."[30] Again, confusion arises from the parallel lines of realistic modelling versus representation, both of which were marketed simultaneously, under the same brand names of M20, Modulex Layout Planning, Modulex 3-Dimensional Planning, and so forth.

One thing is certain, however: Modulex was used in different ways by a whole range of clients. Some, such as prominent architect Eero Saarinen, famed for his Gateway Arch in St. Louis, liked to use Modulex to prototype buildings as part of the design process[2]. Others used it to work out the more complicated aspects of designs, such as routing pipework through a factory[31], and some as a means of presenting the finalised concept to clients – a display model[32]. Modulex claims customers as well known as Siemens, The Bank of England, General Motors Corp. and Dunlop[31], yet there is evidence to suggest it was also used by smaller businesses or individuals. The availability of Modulex nowadays – strictly limited to hobbyist websites, online marketplaces and car-boot sales – indicates localised distribution. Chris Rozek's recollections support this: "the Modulex letter system that I have, about 1000 different letters, numbers, and symbols, 100 aluminum mounting brackets, and wall rails came from a small domestic airport in Ohio."[20] Why such widespread and varied use came about must be down to Modulex's multiple applications, but also due to its confusing marketing and somewhat inexplicable regional variations in availability.

Why did M20 'fail'?

It would not be fair to say that M20 failed simply because it is no longer produced: flint knives are no longer produced, yet they were phenomenally successful in their heyday. Thus, only in terms of contemporary attitudes, alternatives at the time and its fundamental limitations can it be deemed as unsuccessful. There are a multitude of reasons why it was not a commercial success (at least in its original, most architectural incarnation), but, along the previously outlined parameters, there are clear indications that it was a success at what it did. Whether what it did was useful is another matter; M20 was a victim of its own making, at least in part. The way the system was produced and marketed was problematic, yet there were also underlying flaws in the concept behind the system – and, much like the flint knife, there was a backdrop of rapid technological improvement, with which M20 could not keep up.

M20, as its relatively rapid adaption into a planning tool shows, was totally impractical for realistic architectural modelling and design. A contemporary architectural modelling series marketed by LEGO at the same time as M20 had an even shorter production span[2] – from which we can infer that whilst the adaptations of M20 were beneficial to its professional use, there is an underlying flaw in the role of an interlocking-component-based system during the 1960s – and nowadays.

Tim Neville-Lee, an architect, commented on architects' general desire to stand out from the crowd – to be seen to be designing something original and different[7]. A component-based system, which could theoretically be used by every architect without prior training, would severely limit this unique-selling point: whilst the actual buildings may be very different, the models would all look similar. Moreover, a system with a wider variety of components, which could overcome this problem, begins to beg the question of where to stop: eventually said components would only be manufactured for one project, which thus defeat the purpose of a unified modelling system. In fact, the only place that a unified system could work is for the aspects of models that are generally similar (or purposefully generic) – the people, the trees, the cars – which, somewhat unsurprisingly, are all readily available[14].

Tim also spoke of the scale limitations that such a system imposed on design. In the final stages of architectural design, minor 'tweakings', often in the order of centimetres, make a large difference to the overall appearance of a building – which is something that such a rigid system as M20 does not permit. For example, building instructions advise that "if the measurements are not divisable [sic] by 25cm – e.g. 168cm – and you want to build it in 1:50, you should choose 7 knobs representing 75cm."[17] However, these minor adjustments only take place at the very end of the design process, and a rarely mirrored to such a degree of accuracy in the architectural model (particularly on scales such as 1:100), so M20's limitations here only extend as far as those of conventional modelling materials.

Ostensibly, M20, much like LEGO, is limited to 90° angles, greatly limiting its possibilities in comparison to conventional modelling materials. This is a fallacy on three counts. An M20 instructions manual from 1967 is quick to point out that there are different techniques for incorporating angled walls, such as the rather cryptic "one-knob component (art. No. 1111) placed under the wall unit enabling it to be swivelled."[17] It also encourages that "the ends should be bevelled to fit flush with the other walls, after which the walls can be glued together" – which is exactly the same technique employed today by modellers, using acrylic, foamboard, or the like[33]; hence, these alternatives have no advantage over M20 in this instance. Finally, the use of angled walls in architecture is frequently exaggerated. AHMM partner Peter Morris described how the majority of the company's buildings could easily be built out of LEGO[34]; and how similar they are, at least in terms of shape, to the "pristine boxes" made of concrete that architect Ludwig Mies van der Rohe proliferated in the early 1950s![35]

LEGO and architecture are intrinsically linked: the first LEGO catalogue in German laid out the toy's educational aspects in verse, culminating in the couplet:

Der Vater lächelnd hat entdeckt
Mein Bub wird einmal Architekt![36]

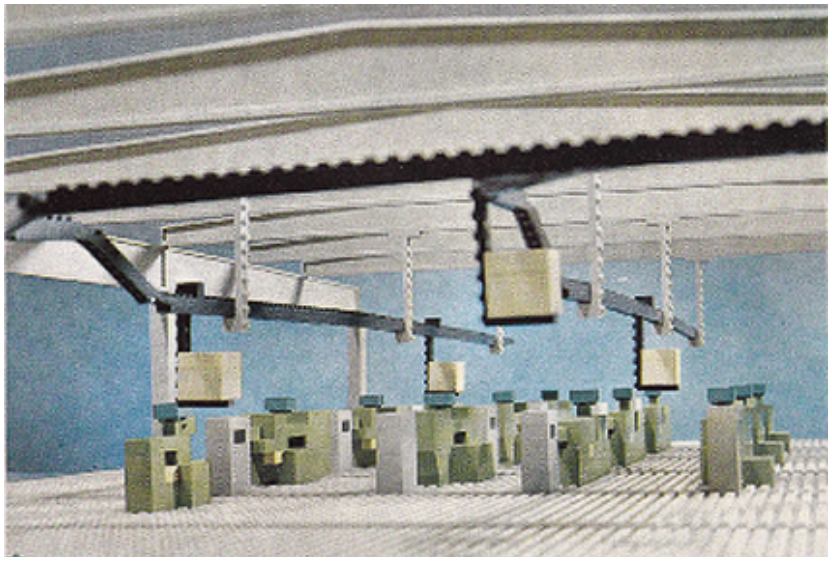
Which roughly translates to "The smiling father has discovered / That his son will be an architect someday!" Peter Morris did not, however, feel particularly comfortable with the suggestion that his building designs could have been modelled out of LEGO in their conception! M20's similarity to LEGO, which had become very popular by the late 1960s[27], was certainly a hindrance, as architects – and potential clients – could not overcome M20's connotations with a toy. Even with tiles to hide the studs, the seams between the bricks convey a distinct vibe of LEGO[32], which looks unprofessional. This is heightened by how rarely bricks and mortar are used in modern construction[7]: a steel and concrete building has an entirely different texture.

It would thus appear that Modulex was a solution looking for a problem[40]: the idea of adapting LEGO for architectural design was perhaps too whimsical and idealistic. Certainly, The LEGO Group has a history of flogging dead horses when it comes to product lines – ask any adult fan of LEGO – and, given Godtfred Kirk Christiansen's rose-tinted glasses, it could be fair to say that the company's persistence, even after M20's abject commercial failure, served to tarnish its career further. The underlying flaws in such a system based around interlocking components were not, however, M20's only problem: it suffered from marketing problems and the very nature of the components that were produced.

Jim Hughes summarises the inherent problems in the kit-based marketing of M20 – "this limited assortment [of parts] seemed suitable for the international-style buildings pictured in the idea book, but it fell far short of the architectural possibilities of the entire system."[2] This was, perhaps, a deliberate feature, as a catalogue from 1963 points out: "only if the model is intended for display is it advised to separately purchase window and door components."[37] Moreover, it is certainly a possibility that modellers were expecting an accurate modelling tool – thus promotional material from M20's later phase as a planning tool placed a huge emphasis on how it was not meant as such: "We use the word

"symbol" to show that a Modulex planning model is not a 'prestige model' showing all the smallest details. When planning, such details are not necessary. Planning with Modulex involves the use of symbols containing the most important measurements in all three dimensions which are at the same time easy to recognise."[37] This confusion over the product's purpose inevitably led to disappointment, which could only have furthered frustration with M20's functionality.

It would be expected that Modulex suffered from the high cost of plastic in a post-war world – certainly, LEGO sets at the time were expensive, as toys went[36]. However, sales of the iconic green army men figures increased hugely during the 1950s – which casts considerable doubt over the allegedly high cost of the raw materials, from which we can infer that there was another reason for its high cost. This was, presumably, the manufacturing and distribution process: the high quality control that goes into LEGO products was carried over into Modulex production[38]. Compared to contemporary modelling materials, such as card, it is little wonder that its cost meant M20 was unfeasible in large quantities, despite its re-usable nature[8]. It is surprising, however, that an advert from 1967 quotes such low prices as "Modulex kits cost less than 1d for every square foot to be planned in quarter inch scale."[19] It is very difficult to assess this value in modern terms, due to inflation, raw material costs and the decimal switchover, but given the significant investment modern companies make in planning and display models[33], this seems a very reasonable figure. Indeed, these costs were greater before the rise of the personal computer – and so Modulex could claim their product was cost-effective: "To give you some idea of cost, the two Basic Industrial Kits cost some £39 and £80 each. Not a lot really when you consider that it costs most companies 30/-d. an hour for draughtsmen's time with overhead included. How many drawings had to be made before you last layout was finally agreed?"[30] Nonetheless, had Modulex been cheaper, it would no doubt have been used – or at least tried – on a wider scale.



(Fig. 3)[30]
M20 bricks in tension, planning a conveyor belt above machinery.

This high quality production ensured that Modulex bricks had a very strong clutching strength, as the aforementioned advert was quick to highlight: "Modulex lasts almost indefinitely and the quality of the components ensures a lasting grip." This invariably led to frustrations when building or dissembling[39], as the grip was simply too strong for the bricks' size. However, an introductory catalogue claims that "it is often the space above the machines [in a factory] which is the most difficult to plan. In this picture [Fig. 3], the fitting of a conveyer belt above the machines has been solved by the use of the model."[30] Thus, their strong clutching power had a clear purpose – enabling them to be used in both tensions and compression – even if it did not relate directly to M20's original role in architectural design.

Similarly, another complaint with Modulex was that the components were too small and fiddly. Naturally, this was a requirement, to both differentiate it from LEGO, and allow for greater flexibility in creating scale models than larger components would permit. Nonetheless, the difficulties this caused in modelling were annoying to the extent that tweezers were employed to assist in construction[40]! This, coupled with the clutch-power of Modulex bricks inevitably meant it was time consuming to use. This is supported by the company's offer of "made up models of machines also made to customers order if required (runs of 15 minimum)."[26]

It would not be entirely true, however, to solely blame the realization and marketing of M20 for its failure. Much like the flint knife, technological advances and changing attitudes were integral to its demise; had architectural styles remained the same and computer aided design never become widespread, Modulex's history may well have been more successful.

Given the era that Modulex declined in, it is hard not to link this with the increasing use of computers for commercial design in the 1970s. Whilst Modulex introduced flexibility (at least to a certain extent) to the planning process, virtual design brought almost limitless possibilities, without any of the aforementioned hindrances Modulex experienced: it is faster, less wasteful and cheaper[32]. Of course, physical models can be interacted with and are far more personal than a computer screen, but the dramatic change to computer design is tribute to the huge benefits of digitalising the process. It must be noted that architectural modelling techniques have changed very little over the past 50 years; with the exception of the introduction of certain technologies such as 3D printing, which is used very rarely, as it is expensive and very slow (for example, a model $15cm^3$ takes around 10 hours and costs up to £500[33]). Thus, it is not M20's modelling incarnation that was affected by the rise of the computer, but the later planning version, where a computer program can effectively substitute for a physical model. A similar decline is seen with Modulex's modular signage and office management systems, the last of which, Plancopy, was discontinued in 2004. Flat-screen displays are commonly used nowadays in similar situations, often with touch-activated interface, which enables vastly more functionality – and avoids the rather clunky aesthetics that the Modulex components gave[41]. Such a widespread use of display screens is a relatively recent development, however, implying that the rise of the computer only totally put Modulex to death in the past decade or so. Nonetheless, the promulgation of computer

aided design certainly hindered Modulex commercially, as it was ultimately a superior technology in most aspects.

Modulex was built on the shaky foundation that were the conflicting and ever-changing architectural styles of the 1960s and 1970s. Post-war architecture was often founded in urban utopianism: rebuilding society for the better through compact, cubic buildings[35], often infamous for their harsh, displeasing appearance. Modulex fits in perfectly with this style: the Golden Lane Estate in London, a notorious example of late 1950s brutalism – that is, the low-cost, concrete and blocky, could have been built expressly out of M20. Indeed, they tie in so well that the pastel blue panels used to hide the water-stained concrete are identical in shade to the blue from the Modulex colour palette. Moreover, its purpose – compact inner-city housing – is a close parallel to M20's emphasis on special management and planning[20]. It was a time of paradox, however: whilst some looked to brutalism as the way forward, some looked to a space-age future, as embodied by the curvaceous Seattle Space Needle. This conflict is almost shown well by Eero Saarinen, the designer who worked with Christiansen to create Modulex: this blocky construction tool bears little resemblance to his sweeping, futurist designs, such as the 1965 Gateway Arch in St Louis, Missouri. It was Modulex's adherence to a single architectural style – not so much through choice, but through the very nature of the construction system – that meant a shift in attitudes would undermine it. The movement away from post-war minimalism has certainly contributed to Modulex's irrelevance to modern architectural design, as it is geared to representing a different type of building.

(Fig. 4)
Pastel blue panelling on the Golden Lane Estate, London.

These changes in architectural styles also reflect the changing availability of materials and construction techniques in buildings. With the decreasing use of brick and mortar, as aforementioned, Modulex loses its immediate connotations with a building modelling system; making it appear more like a LEGO set, where anything is built out of the same components, rather than having components representing different aspects of buildings. Bayko, a contemporary modelling system to Modulex, albeit designed for children to use, followed genuine construction techniques more closely, with panels which slotted over metal rods inserted into the foundations. It is widely acknowledged by hobbyists today that LEGO was ultimately more flexible – but that Bayko was more realistic, something which Modulex was to lose out on, as construction techniques and materials changed over time. Certainly, the glass and steel buildings of today can be imitated poorly by M20 in terms of form, and even worse in terms of texture.

Summary

Modulex occupied the uncertain era of technological transformation, between the beginning of modern building styles and the rise of the computer. Its ambiguous nature – a cross between a planning system and a modelling tool – is tribute to this. Modulex's underlying ambition was improved communication, claiming "Communication is perfect. Everything is easy to understand and explain – irrespective of the professional background of the participants."[19] Certainly, 3-dimensional models are very accessible, as they are not liable to misinterpretation, unlike regular plans. Moreover, architectural clients frequently find models very exciting[33], and the atmosphere this creates in a professional meeting is conducive to positive recollections of the situation, which is inevitably beneficial for all parties.

The adaption of LEGO from toy into professional tool was obvious in fulfilling this aim – but was achieved with a questionable degree of success, hindered all along by the limiting nature of a component-based modelling system. Whilst Modulex achieved some degree of success with its planning system, its overtly 3D products did not take off in the manner which Christiansen had hoped. Certainly, a combination of product shortcomings, shifting tastes and styles and technological change conspired to make Modulex's modelling role short-lived. The final nail in the coffin was computer aided design, but the shift away from post-war building materials such as concrete was also influential in making Modulex unfeasible for modern use. Moreover, on balance, it was time consuming and expensive – in short, impractical and obviously flawed.

It is then surprising that Modulex managed to exist in a business environment for so long, given this comprehensive review why it should be consigned to the realm of collectors and hobbyists. The philosophy behind it – improved communication and simplifying the planning process – was crucial, and is apparent in much of Modulex's advertisement material. The architectural style of the 1950s and 1960s was also important in aligning what could be built from Modulex with reality. However, these two fundamental principles of Modulex have since been trumped by modern ideas and technologies.

When formulating this research project, my underlying question was, "Could Modulex be used today?" And the clear answer is no. That is not to say, however, that the process in establishing this answer – understanding what Modulex actually was, how it functioned and why it 'failed' – has not been enlightening. I had originally thought that I would produce some custom components which would revolutionise the Modulex system so that it could be used today; but having identified why this would be a futile endeavour, I have not done so. However, as part of the research – to see just how far the Modulex system could be pushed – I designed a few components which could be used with Modulex to expand its capabilities. The report detailing the design process is attached as an appendix to this report, as are the components themselves.

Thus, whilst Modulex cannot be saved, it can be understood.

Glossary

It is probably worth explaining a few key terms; words that are used amongst LEGO hobbyists to describe certain parts, features or techniques. Whilst, in general, the context will give an understanding of any specialist language (such as a "slope part" in relation to a pitched roof), it is nonetheless worth clarifying some things first.

Part/piece – any LEGO or Modulex component
Brick – the iconic cuboid part, which functions, on its most basic level, as a brick!
Plate – a flat brick
Studs – the "bobbles" or "knobs" on top of the bricks that allow them to interlock
Tile – like a brick or a plate, only without the studs on top
Slope – a brick that is cut-away on one side so that it forms an angle
2 x 4 (or two-by-four etc.) – describes a brick that is two studs thick and 4 studs long; and can be applied to all shapes and sizes

Bibliography

Bricklink, 2010. Bricklink catalogue [document on the internet]. Online 15/10/09 [cited 27/06/10]. Available from: http://www.bricklink.com/catalogList.asp?catID=727.

Chung, M., 2010. AHMM. Oral communication. August 2010.

Curtis, W., 1987. Modern architecture since 1900. Phaidon Press Ltd; 1987.

Dickson, T., 2009. Dansk design. Sydney, Australia: Murdoch Books.. p. 84,145:490.

Dorling Kindersley, 1999. LEGO Timeline. The ultimate LEGO book. London: p. 12-16.

Doyle, Y., 2004. Modulex – a world of tiny bricks. The Brick Issue;9: p. 6-7

Doyle, Y., 2009. Before I throw it out… (Brickish Association discussion) [document on the internet]. Online 2009 [cited 7/8/10]. Available from: http://www.brickish.org/members/discuss/viewThread.aspx?msgID=76692.

Harshbarger, E., 2009. Calista LEGO Mosaic [document on the internet]. Online 25/01/02 [cited 03/06/10]. Available from: http://www.ericharshbarger.org/lego/calista.html.

Heitbrink, B., 2010. Modulex [online]. Email to Barney Main (slyowl@hotmail.co.uk) 2/8/10 [cited 7/8/10].

Hope, S., 2004. Response to Modulex planning systems enquiry. Letter to Darren Smith: 18/6/2004.

Hughes, J., 2010. 1963 – Modulex [document on the internet]. Online 10/11/09 [cited 03/06/10]. Available from: http://www.brickfetish.com/timeline/1963.html.

Jackson, J., 2000. Bricks and blocks [document on the internet]. Online 2000 [cited 03/06/10]. Available from: http://www.hintsandthings.co.uk/workshop/bricks.htm.

Königswinter, 2008. 50 years of the LEGO brick. HEEL: p. 5-26.

Kroes, M., 2010. Modulex [online]. E-mail to Barney Main (slyowl@hotmail.co.uk) 31/7/10 [cited 7/8/10].

Modulex 3-Dimensional Planning Ltd., 1963. Building instructions. Denmark: Horsens.

Modulex 3-Dimensional Planning Ltd., 1964. Advertisement catalogue. Pewsey: United Kingdom.

Modulex 3-Dimensional Planning Ltd., 1965. Modulex layout planning. Pewsey; United Kingdom.

Modulex 3-Dimensional Planning Ltd., 1967. Building instructions. Denmark: Horsens.

Modulex 3-Dimensional Planning Ltd., 1967. Advertisement poster. Denmark: 10/2/67.

Modulex 3-Dimensional Planning Ltd., 1974. Retail catalogue. Salisbury: United Kingdom: Morrish: 1/5/74.

Modulex A/S, 1967. Kontorplanlænings-sortiment. Denmark: Horsens.

Modulex A/S, 1975. Industriplanlægning. Denmark: Horsens.

Modulex A/S, 1981. Industriplanlænings-sortimenter. Denmark: Horsens.

Modulex A/S, 2010. About us [document on the internet]. Online 2009 [cited 7/8/10].

Modulex AS, 1975. Modulex visual control board catalog. Denmark: Egtved Bogtrykkeri.

Modulex Modul-elemente GMBH, 1964. 2354 Hohenwestedt. Denmark: 22/4/1964.

Modulex Systems Ltd., 1991. User's guide – planning systems. Denmark: Bogtrykkeri: 1/8/91.

Morris, P., 2010. AHMM. Oral communication. August 2010.

Neville-Lee, T., 2010. AHMM. Oral communication. August 2010.

Ong, G., 2010. AHMM. Oral communication. August 2010.

Riba Journal, 2009. Toy storey. 8/2009; p. 68-70.

Rowe, J., 2010. AHMM. Oral communication. August 2010.

Rozek, C., 2010. 1Modulex [online]. E-mail to Barney Main (slyowl@hotmail.co.uk) 31/7/10 [cited 1/8/10].

Salingaros N., Mehaffy, M., 2006. A theory of architecture. Umbau Verlag Harald Püschel. p. 99-102.

Schwartz, J., 2010. Modulex [online]. E-mail to Barney Main (slyowl@hotmail.co.uk) 31/7/2010 [cited 12/11/2010].

Smith, D., 2010. Modulex [online]. Email to Barney Main (slyowl@hotmail.co.uk) 26/7/10 [cited 7/8/10].

Soren, 2010. Modulex [online]. E-mail to Barney Main (slyowl@hotmail.co.uk) 31/7/2010 [cited 12/11/2010]

Spencer, C., 1964. Response to Modulex layout planning enquiry. Letter to Boorman.

The LEGO Group, 1959. LEGO System – das Spielzeug für jedes Alter [catalogue].

The Modulex Group, 1993. The tools for better visual planning. Denmark: Kerteminde Tryk A/S.

Thomsen, K., 2010. Modulex [online]. E-mail to Barney Main (slyowl@hotmail.co.uk) 31/7/10 [cited 1/8/10].

[1] Modulex A/S. About us [document on the internet]. Online 2009 [cited 7/8/10].
[2] Jim Hughes. 1963 – Modulex [document on the internet]. Online 10/11/09 [cited 03/06/10]. Available from: http://www.brickfetish.com/timeline/1963.html.
[3] Thomas Dickson. Dansk design. Sydney, Australia: Murdoch Books: 2009. p. 84,145:490.
[4] Eric Harshbarger. Calista LEGO Mosaic [document on the internet]. Online 25/01/02 [cited 03/06/10]. Available from: http://www.ericharshbarger.org/lego/calista.html.
[5] June Jackson. Bricks and blocks [document on the internet]. Online 2000 [cited 03/06/10]. Available from: http://www.hintsandthings.co.uk/workshop/bricks.htm.
[6] Bricklink catalogue [document on the internet]. Online 15/10/09 [cited 27/06/10]. Available from: http://www.bricklink.com/catalogList.asp?catID=727.
[7] Tim Neville-Lee. AHMM. Oral communication. August 2010.
[8] Modulex 3-Dimensional Planning Ltd. Advertisement catalogue. Pewsey: United Kingdom: 1964.
[9] Modulex 3-Dimensional Planning Ltd. Retail catalogue. Salisbury: United Kingdom: Morrish: 1/5/74.
[10] Modulex AS, US. Modulex visual control board catalog. Denmark: Egtved Bogtrykkeri; 1975.
[11] CGC Spencer. Response to Modulex layout planning enquiry. Letter to Boorman: 1964.
[12] Modulex A/S. Kontorplanlænings-sortiment. Denmark: Horsens: 1967.
[13] Darren Smith. Modulex [online]. Email to Barney Main (slyowl@hotmail.co.uk) 26/7/10 [cited 7/8/10].
[14] Jemma Rowe. AHMM. Oral communication. August 2010.
[15] N Salingaros, M Mehaffy. A theory of architecture. Umbau Verlag Harald Püschel; 2006. p. 99-102.
[16] Yvonne Doyle. Modulex – a world of tiny bricks. The Brick Issue. 2004;9: p. 6-7
[17] Modulex 3-Dimensional Planning Ltd. Building instructions. Denmark: Horsens: 1967.
[18] Yvonne Doyle. Before I throw it out… (Brickish Association discussion) [document on the internet]. Online 2009 [cited 7/8/10]. Available from: http://www.brickish.org/members/discuss/viewThread.aspx?msgID=76692.
[19] Modulex 3-Dimensional Planning Ltd. Advertisement poster. Denmark: 10/2/67.
[20] Chris Rozek. Modulex [online]. E-mail to Barney Main (slyowl@hotmail.co.uk) 31/7/10 [cited 1/8/10].
[21] Kim Thomsen. Modulex [online]. E-mail to Barney Main (slyowl@hotmail.co.uk) 31/7/10 [cited 1/8/10].
[22] Bruce Heitbrink. Modulex [online]. Email to Barney Main (slyowl@hotmail.co.uk) 2/8/10 [cited 7/8/10].
[23] Modulex A/S. Industriplanlænings-sortimenter. Denmark: Horsens: 1981.
[24] Modulex Modul-elemente GMBH. 2354 Hohenwestedt. Denmark: 22/4/1964.
[25] S Hope. Response to Modulex planning systems enquiry. Letter to Darren Smith: 18/6/2004.
[26] Modulex Systems Ltd. User's guide – planning systems. Denmark: Bogtrykkeri: 1/8/91
[27] LEGO Timeline. The ultimate LEGO book. London: Dorling Kindersley: 1999. p. 12-16.
[28] Goh Ong. AHMM. Oral communication. August 2010.
[29] Toy storey. Riba Journal. 8/2009; p. 68-70.
[30] Modulex 3-Dimensional Planning Ltd. Modulex layout planning. Pewsey; United Kingdom; 1965.
[31] Modulex A/S. Industriplanlægning. Denmark: Horsens: 1975.
[32] Michael Kroes. Modulex [online]. E-mail to Barney Main (slyowl@hotmail.co.uk) 31/7/10 [cited 7/8/10].
[33] Ming Chung. AHMM. Oral communication. August 2010.
[34] Peter Morris. AHMM. Oral communication. August 2010.
[35] William Curtis. Modern architecture since 1900. Phaidon Press Ltd; 1987.
[36] The LEGO Group. LEGO System – das Spielzeug für jedes Alter [catalogue]. 1959.
[37] Modulex 3-Dimensional Planning Ltd. Building instructions. Denmark: Horsens: 1963.
[38] 50 years of the LEGO brick. Königswinter: HEEL: 2008. p. 5-26.
[39] Jordan Schwartz. Modulex [online]. E-mail to Barney Main (slyowl@hotmail.co.uk) 31/7/2010 [cited 12/11/2010].
[40] Soren. Modulex [online]. E-mail to Barney Main (slyowl@hotmail.co.uk) 31/7/2010 [cited 12/11/2010]
[41] The Modulex Group. The tools for better visual planning. Denmark: Kerteminde Tryk A/S: 1993.