MAX STEEL; THE (D)EVOLVING HOUSE

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Abstract
The title both refers to the sturdy toy-character saving the world from all conceivable problems, as well as to whether steel used as a building material in adaptable housing could be an answer to the altering housing market.
A survey of experiments in prefabricated steel housing in the post-war Netherlands till present day is being presented. The question is raised why all of these attempts ended in an early stage. Are there common factors to be recognized? Possible explanations for the failure of much of these dreams in steel will be proposed. In conclusion, reflection on Alfred Bemis’ 1936 book The Evolving House, tries to answer the question where the contemporary status of the adjustable prefabricated steel dwelling has devolved so far.

1. INTRODUCTION

Who is Max Steel? Those among us, who have children in the age between 5 and 10, probably have heard of this man. He is a toy-character, a sturdy ‘good-guy’, who rescues the world from all conceivable problems, anyhow in the fantasies of the kids. He is a dreamt hero who belongs to the same species as Action Man, Batman, etc. By the way, I never saw any of these heroes acting in solving housing problems. Those are either too difficult or, more probably, not exciting enough.

However he is entirely made of plastics, Max is called ‘Steel’. He fits in the tradition of Ironside and Archie the Man of Steel. Their names appeal to the beneficial properties of the material. Steel is hard, strong, durable and therefore invincible. Most of these properties are equally useful for building materials.
Besides being ‘tough’, steel has other suitable qualifications. It is also clean, dry, readily available and relatively easy to recycle. All this, at first sight, makes steel an excellent material for housing, especially there where a large degree of adaptation, alteration or customization is to be expected. As we see in the next paragraph, this is likely an expanding market.

2. INTRODUCTORY STATISTICS

There is statistically supported reason to believe that (continuous) customization in housing might become an expanding issue in the Netherlands:

- If we consider the development of the average size of Dutch families over the last 40 years, we see a constant significant decrease from 3.56 in 1960 to 2.31 persons/family in 1997.
Houses in the Netherlands have a very long life-span. From the total housing stock that will be available in 2030, 80% already now exists.

Another important indicator is the number of times the average inhabitant of the Netherlands moves to another house during his lifetime. This number has changed from 6.91 times in 1978 to 8.00 in 1997.

A confusing statistic fact, considering the above, is the strong decrease of non-divided waste originating from housing-alterations by households. It has dropped dramatically from 72 tons to 47 tons in the 4 years from 1995 to 1998. (However proper figures are not available, it is probably a justified explanation to assume that the volume of waste that has been divided (in portions for different ways of recycling), has proportionally increased. The Dutch government has encouraged waste-separation, directly at the source where it is created, over the years corresponding with the above-mentioned.)

Of course we have to be careful with the interpretation of these statistical data. The increase of the frequency of moving to another house by the Dutch could also be interpreted as a decrease of the demand for customization. In that case the reason they move to another house is because they don't need to alter their current accommodation. On the other hand everyday practice learns that the first thing people do when they move, is to adapt their new house to their specific needs and, most of all, their taste.

The conclusion from the facts that households strongly tend to decrease in size in combination with the existing housing stock (which is also a substantial part of the future stock) is that alteration and customization are inevitable issues.

**3. WHY STEEL?**

It is obvious that the process of customization or alteration of dwellings has an explicit preference for dry, clean and accessible building methods. It is also logic to aim at developing a system consisting of relatively small parts that can be easily assembled, also by laymen. Finally there is the general demand for sustainable building methods and materials, to burden the environment as little as possible.

Steel meets all these requirements. It is therefore not surprising that numerous attempts have been made in history using steel as basic material, both for structural skeletons, separations and finishing. Anybody with a toolkit of spanners and wrenches can build, alter, refurbish or re-model his house in a cheap, quick and easy way.

We will now survey some tangible results in the supposition that steel is an ideal material in building (adaptable) houses. I will merely focus on housing systems in (predominantly) prefabricated steel elements in the post-war Netherlands, which made it up to (at least) a prototype stage. Customization was not always the major goal, but in most cases (except perhaps 1. and 4.) considered as an important topic.

The convenient 'prefabrication pageant' in chronological order consists of:

<table>
<thead>
<tr>
<th>System*</th>
<th>architect</th>
<th>started</th>
<th>prototype</th>
</tr>
</thead>
<tbody>
<tr>
<td>'No Emergency...Houses'! [4]</td>
<td>CEPEZED</td>
<td>1981(?)</td>
<td></td>
</tr>
<tr>
<td>'Detached Council House'</td>
<td>CEPEZED</td>
<td>1985</td>
<td>1986</td>
</tr>
<tr>
<td>STEW</td>
<td>J. Westra</td>
<td>1990</td>
<td>2000</td>
</tr>
</tbody>
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* Some systems are omitted in this survey for various reasons. The De Meeuw system [4] is left out because it was initially meant for temporary accommodation and mostly applied for non-housing purposes. About the 'Gerssen'-system was too little information available. Smarthouse by Robert Winkel Architects is an interesting recent development of which the first three prototypes will be realised in Zoetermeer, but not yet published.
Some of the prototypes were, and some still are, inhabited during a considerable time (Heiwo and Shell), while others only lasted (intentionally) for a short time. Without exception, none of the attempts has been successful so far. In other words: it has never resulted in a mass-produced system. It predicts quite gloomy prospects for STEW, of which the prototype has barely been finished yet.

4. DEVELOPMENT TRIGGERS

The sequence of industrialization and prefabrication approaches also show that we did not learn much from former attempts. Still semi-new or renewed ideas keep popping up. History shows that architects and other building participants are confirmed obstinate.

Why have these initiatives been set off in the first place? Basically three different triggers can be distinguished, but in several occasions it is a mix of the following three factors.

- **Housing problems.** The urgent need for cheap houses. Necessity is the mother of invention. Examples: No Emergency... Houses 1981 and Detached Council House 1986

\[\text{Figure 2. Impressions from the Detached Council House by CEPEZED taken from a brochure by the architect. Intended to be realised in Haarlem in a series of 40 in the early '80's.}\]

- **Companies spreading their trade.** Several historic examples show industries that, in order to spread their risks or to expand their sales, try to penetrate the 'endless' housing market. Examples: Fokker was an airplane company, Shell oil multinational involved in plastic manufacturing and Polynorm a Dutch manufacturer of sheet steel products as doorframes.

\[\text{Figure 3. Artists Impression from the 'No Emergency ... Houses'. A series of 66 houses was realised in Breda. [4]}\]

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Innovation urge. Architects or builders develop a building system to expand the housing market. They experiment in order to create new products, new needs or react to future social developments. Sometimes the experiments are merely academic. Examples: Heiwo, ISB and STEW.
5. FAILURE ANALYSIS

So far all these enterprises eventually failed. All those dreams made out of steel made it to a prototype or incidentally a small series. Despite the mentioned advantages of steel for adaptable housing they lived a short life.

A closer look at the reasons of failure allows us to determine several factors in order to gain a better understanding of their failure.

- **Relative ignorance** of steel as a building-material for housing.
  Steel is generally considered as an industrial material, therefore only suitable for industrial buildings or related artefacts (bridges, pylons). Steel still is a *terra incognita* as a building material for (adaptable) housing. This applies for consumers, real estate developers, contractors and government institutions. The ignorance is understandable though. It is true that not many appealing good examples of successful prefabricated steel housing (-systems) have been realised in the Netherlands.

- **Persistent prejudices** concerning the physical properties in thermal and acoustic behaviour.
  This is not only the case with consumers, but these prejudices are also in the minds of contractors and construction companies. We must admit that there have been made construction mistakes or design errors in the past that have endorsed this opinion. Tragedies from the past with noise pollution, condensation and overheating still pursue steel.

- **Ineradicably associations** with ‘temporary’ and ‘perishable’.
  Steel rusts. Experience with, for example, cars have ‘convinced’ consumers that even coated steel cannot exceed a life span of ten years. Houses are not regarded as a consumer-product,
but as a long-term investment, which is in conflict with the assumed perishable nature of steel. A house is not a car.

- **Underestimated marketing aspects.**
  This has probably a great share in the failure of prefabricated steel houses in the past. It has been proved that you cannot basically change people’s behaviour. *Homo Habitans* is a stubborn species. You cannot take people out of their cars and convince them to travel by public transport. The same is true for housing traditions that are over centuries old. Dutch houses are traditionally made of brick and roofing tiles. Scantily wood and concrete are tolerated. In general: unknown is unloved. A steel-based housing system will nowadays prove only to be successful if it can also be provided with brick façades and a tilted roof with tiles.

- **Misjudged capital investment.**
  Developing an operational building-system brings initially huge costs and is consequently risky. Investors drop out during the process, because time span, final results and/or financial consequences were misjudged in an overoptimistic manner.

- **Architectural poverty.**
  This is often a sad result of the overabundant attention that non-architectural topics absorb. Architects involved often endeavour to create a housing system with (too) universal applications. The will to create a neutral, abstract system in order to attract as much consumers as possible, results in just the opposite. Many designs suffer from mediocrity.

- **Lack of evaluation** of the prototype.
  Sometimes the prototype stage is even skipped. In various cases participants are disappointed by the properties of the prototype.

6. **RECOMMENDATIONS**

- Most of the future profit in customization of houses is obviously to be found in the approach of the existing housing stock. In 10 to 20 years time a surplus of dwellings for families consisting of 4 or more persons and a shortage of housing for singles and 2-person-families can be predicted. Surprisingly enough this domain is hardly explored until now. To give an example; last December some hundred plans were presented in connection with the Dutch IFD-program. This is a program supported by the government to promote Industrial, Flexible and Demountable building. Among those were only a few that were dealing with existing houses.

- Architects should consider the appearance of a proposed system in connection with the predicted acceptance by consumers. They also should give equal attention to the developments of failure-free building details. The development of such a system is therefore best to be undertaken by a team with at least an architect, an engineer and a marketing specialist taking part in the project. This seems a very obvious recommendation, but considering that most of the attempts mentioned were rather small-scale enterprises, not at all superfluous.

- The step from prototyping to an operational housing system has often appeared to be an insurmountable big leap. It might be a good suggestion to insert as an intermediate between the prototype and the initial series, a second modelling stage: the defterotype.

7. **CONCLUSION**

It is very hard to find a copy of *The Evolving House* by Albert F. Bemis. In the catacombs of our university I found a hardcover bound photocopy. I have never even seen a genuine copy. I cannot imagine it has to do with this problematic availability, but his book hasn’t made Bemis very famous. It is nevertheless worthwhile to leaf through the book and be surprised by the recognizable statements. Several of his considerations on modular design and rational production echo over and over from the 1950’s till the 1980’s. He also includes a comprehensive supplement listing all known building systems at that time (1936). It is interesting as well as surprising to stroll around in these endless files of historic efforts to try to make the production of houses logic, easier, modern, cheaper or adaptable. Even great names appear: Buckminster Fuller, Gropius, Neutra and Le Corbusier, but with housing systems which have fallen into oblivion (with perhaps an exception for Fullers Dymaxion house). It seems a tragic scenario applicable for most attempts to industrialize housing.
Considering steel as building material for housing in the post-war Netherlands, it is obvious that the advantages did not counter-balance the disadvantages. The search for an all-steel dwelling or even a max steel dwelling should be dissuaded from. Steel will probably never cause a revolution in housing. I am convinced however that a slow but steady introduction of innovative steel applications will finally lead to the acceptance of steel as an adequate building material for (customization in) housing. If we contemplate Bemis’ book and compare it to the current state of the art, we can conclude that it takes generations both to speak and to understand the language of industrialization, prefabrication and standardization. There is still a long way to go for Max Steel.

8. BIBLIOGRAPHY

The latest Tweets from Max Steel the Movie (@MaxSteelMovie_). Official page of MAX STEEL MOVIE. Starring @BenWinch, @aanavee, @maria_bello & Andy Garcia. Directed by @stewarthendler, written by @yost. #MaxSteelMovie.