DEVELOPMENT AND REALISATION OF THE CONCEPT HOUSE 'DELFT' PROTOTYPE

AN EXAMPLE OF A COLLABORATIVE CONCEPT DEVELOPMENT FOR ENERGY POSITIVE APARTMENTS

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PREFACE

Jón Kristinsson

The building industry in general and the housing industry in Western Europe in particular are facing a turning-point. At first glance, this turning-point does not seem too remarkable; definitely not from a safe vantage point of 500 kilometres away. The announcement that, as of 1 January 2013, gas boilers may no longer be sold in Denmark is of great importance for the building industry and installations technology. It heralds a new era of thinking about the different forms of energy, and thus exergy as well. The background behind this radical decision is to avoid burning a resource as valuable as natural gas at 1200° Celsius to achieve temperatures of 20° Celsius in our homes. In Denmark, process heat for low caloric heating is seen as an unwise and unnecessary exploitation. The functional lifespan of a gas boiler is approximately 12 years, thus it will take ten years before the gas flame goes out in Danish houses, and the transition to district heating and sustainable energy will be carried out on a large scale.

In the Netherlands, the only sustainable source of energy is the sun; a large nuclear fusion reactor at a safe distance of 149 million kilometres away. Fossil energy is the raw material for upcoming generations. From a technical point of view, we have been able to build minimum energy dwellings for thirty years. Now we are witness to a completed self-sufficient dwelling, the Concept House Delft Prototype at Heijplaat in Rotterdam. Here, on the other side of the Nieuwe Waterweg on Woudhoek Noord 184 minimum energy dwellings were built in 1980-1982. During the designing phase, the architect of these flats, Jón Kristinsson, discovered that the then common two pilot flames in the kitchen geyser – practically a second heating device – consumed half of the gas that the new energy efficient apartments required. Thus, electronic ignition was devised. Since then, gas appliances with pilot flame are no longer available in the Netherlands. We live in the land of the Gasunie (gas union); thus things will not continue at that speed. But changes are coming. We can drastically reduce the heating demand of new and existing dwellings by handling ventilation intelligently, based on CO_2 inside air quality measurements. And most importantly, by switching to very low temperature heating. Solar energy and waste heat in

the industry and cooling water in electric power plants is low temperature water, albeit with seasonal heat storage in the ground.

The electric heat pumps that, in the Netherlands, will replace the gas boilers have a useful yield (COP) of 3 to 4. At very low temperatures the yield can increase to 8 to 10, i.e. twice as much. The new coal plant on the Maasvlakte has a yield of 40 to 45%, the remaining 55 to 60% of the thermal energy either goes into the air or to the North Sea as valuable cooling-water; but it does not contribute to district heating.

A sustainable society is very comprehensive, and energy is an important subject that requires solutions. My definition of sustainability is short and simple: 'Anything that future generations would like to inherit and use and are able to maintain is sustainable'.

The long history of the recently completed concept house Delft prototype, in 'Het Nieuwe Dorp' of the workers district Heijplaat next to the former RDM dry-dock terrain in Rotterdam, which at presence undergoes a transformation into a sustainable knowledge and innovation campus, is invisible. At the time of completion, this energy positive experiment is a snapshot of the 'state of the art' in 2012 of sustainable, stacked industrial wood skeleton construction in the Netherlands; based on existing and relatively affordable technology. The innovation lies in the way that these technologies are industrialised, developed, integrated and realised in a process of close cooperation and adjustment between various industry partners and academic researchers. The initiative of the underlying academic research originated in 2005 from Harry Oude Vrielink, a retired contractor in Vriezenveen. What is to be commended is how high the bar has been set for this difficult task that designers, producers and researchers have taken upon them to find integral solutions for all the problems of self-sustained industrial building. In spite of financial adversities and administrative meanderings, and with some delay, a habitable prototype has been realised. General Dwight D. Eisenhower supported the view "The process of working together on a solution is more important than the solution". Since 2005, two of the main academic scientific staff members of the long process concept house have also been appointed professors. Thus, the acquired knowledge is certainly heard and spread at the two technical universities.

Time will tell in how far super-components such as the sanitary unit, preassembled ducting channels with connected installations and home automation devices will be considered and applied in the future renovation of residential dwellings in the Netherlands. "Predictions are difficult, particularly as far as the future is concerned", Dutch cabaret artist Wim Kan once said. My prediction is that from an architectural point of view the concept house Prototype will remain unchanged for a while, but the installations and execution of the energy concept will be caught up with. Luckily the concept is developed as a 'plug and play' system which anticipates such a development. It seems plausible that in a few years time, for renovation projects, very low temperature air heating will appear in addition to underfloor heating. Unfortunately, this is one of only a few highlights without governmental political visions about renovation that allow Dutch voters to keep warm in the future, even without natural gas.

It is also to be expected that intelligent decentralised balanced ventilation in residential dwellings is easier to install than today's central ventilation with air ducts. The concept house Prototype, the ambitious pilot project of the Concept House Urban Villa, and the simultaneously conducted zero series developments (with several ongoing initiatives) should be able to accommodate such transformations of subsystems without abandoning the core of the concept. It is also precisely this flexibility for change, together with addressing the urgent task, the (new) necessity along the path of integral design as well as building and maintaining the buildings over the entire time of use, and even the unavoidable end of life that forms the power of this concept. It forms the basis for the correct effect of sustainability in the sense of perseverance.

In short: All praise for the initiative, the persistence and the final result of the concept house Delft prototype, which will prove its service.

Jón Kristinsson
Emeritus Professor Environmental Design TU Delft, architect and inventor. [Kristinsson, 1991, 2001, 2006, 2012]

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INTRODUCTION

During the first 4-year period beginning in 2004, the research project Concept House by Mick Eekhout's Chair of Product Development at TU Delft is set up with a broad orientation; the second 4-year period from 2008 to 2012 focuses on designing, developing, engineering, producing and building a single prototype of a concept house apartment, the 'Concept House Delft Prototype' on the estate of Concept House Village in Heijplaat (former shipyard village), Rotterdam. From the start of the prototype process it takes one and a half years before the focus is established on industrialisation and sustainability, depending on the project leader. Mick Eekhout focuses on industrialisation, Wim Poelman on material innovations and Arjan van Timmeren on sustainability. Although it is unusual that an academic chair is responsible for this type of product innovation, the practical experiences of the chair holder ensures the continuation of the process, despite all problems. This scientific report treats the prehistory and the development and realisation process of the prototype up to the building technical completion after which the prototype is provided with furniture and a garden, and is opened in October 2012. The technical content of the process is heavily influenced by social behaviour.

The prototype is a single apartment of a not yet realised Concept House Urban Villa which consists of 16 apartments on 4 floors. The urban villa and the prototype show the characteristics of high level industrial production with an extremely low ecological foot print, energy positive use, and both are suitable for multi-storey housing. This research, development, production & built project result in a unique novelty on the Dutch building market: a sustainable energy-positive apartment system for medium-rise energy-positive housing.

The development was initiated by the chair at specific request from the building industry and is performed in close collaboration with a consortium of partners from the SME building supply industry. The project is entirely externally financed for 8 years (crowd{1><1} funding). Innovation progresses further in these partner industries. Apart from initiative and natural project leadership, the novelty introduced by the chair is the design, co-ordination and integration of the many components into one coherent entity of the prototype as an artefact.

The building technical composition shows an assembly of floor, roof, wall and façade components and a central sanitary unit which concentrates all services of the apartment. The extreme level of prefabrication of the 'plug & play' concept leads to the integration of all cables and service elements in the building components. The sanitary unit is furnished with all installations, and is hoisted in completely finished, which enables an extremely short building time. The cables and other installations are designed to be reallocated and adapted for the benefit of future generations of users.

The project is realised by Jaap van Kemenade, Rutger Wirtz, Arjan van Timmeren and Mick Eekhout on the chair side and the SME partners: VDM, Unica, Faay, Icopal, Itho Daalderop, Niko, Raab Karcher, Renson, Solarlux and Woonplaats. Further materials sponsoring is realised by some 30 SME building supply companies. Subsidies from 'Pieken in de delta' and Concept House Village Facility.
[www.concepthouse.bk.tudelft.nl; contact: a.c.j.m.eekhout@tudelft.nl / m.eekhout@octatube.nl].

The prototype will be used from the time of opening to November 2015 for further building technical development under supervision of Mick Eekhout and Arjan van Timmeren. For that purpose, the partners and sponsors have been invited to install new components and to replace existing components with innovated ones. The prototype will also be used to measure and evaluate the true sustainability of the apartment by temporarily housing different inhabitants or guests. These guests and their reactions will be monitored and evaluated. The prototype also welcomes visits and presentations organised by partners and sponsors, if planned well. A three year long research program is laid out by the Faculty of Industrial Design Engineering, focussing on the behaviour of the guests, user friendliness of the equipment, and mainly energy consumption. This research sees the prototype itself as a laboratory environment: in this case the SUSLab under Prof. David Keyson.

Third period of the concept house research will be the development and realisation of the concept house urban villa, for which a developer and a location are being searched for. The chair will hand over its leading and pulling role and concentrate only on an advising, researching and developing role.