post-war housing in brussels

student homes by Willy Van Der Meeren on the VUB campus in Elsene 1971-1973

Stephanie Van de Voorde
Ine Wouters
Inge Bertels
This report fits within the framework of the research project RetroCo: Understanding and conserving the post-war housing stock in Brussels (1945-1975). Retrofit for continuity!

The project was carried out in 2012-2016 by Stephanie Van de Voorde in collaboration with Ine Wouters, Inge Bertels, Ann Verdonck and Filip Descamps, all members of the research lab for architectural engineering of the Vrije Universiteit Brussel (www.vub.ac.be/ARCH/ae-lab/).

The research was funded by the Brussels Capital Region through the Innoviris Strategic Platform Environment 2012: Brussels Retrofit XL (www.brusselsretrofitxl.be). Through this platform, Innoviris supports collaborative and multidisciplinary research projects in priority fields for the Brussels Capital Region and for which economic enhancement in Brussels may be envisaged.
Within the framework of this research project, in 2015 a trilingual book and website on post-war building materials were published. They document eight particular building materials that were applied in houses in the Brussels Capital Region between 1945 and 1975: lightweight concrete, thermal and acoustic insulation, glass and glazing, prefab floor systems, window frames, cladding and sandwich panels, precast concrete façade panels and heavy prefab systems (www.postwarbuildingmaterials.be).

Following this research on post-war building materials, in 2016 the authors studied two buildings in which a number of these typical post-war building materials were applied. This current report deals with one of these buildings: the student homes on the campus of the Vrije Universiteit Brussel in Elsene, designed by architect Willy Van Der Meeren. A second report deals with the Miramar apartment building, designed by architect Claude Laurens, in Sint-Joost-ten-Node.
The student houses on the university campus of the Vrije Universiteit Brussel (VUB) in Elsene are an extraordinary example of a high-quality post-war housing estate in the Brussels Capital Region constructed with an industrialized building system. These houses, designed in 1971-1972 by the Belgian architect Willy Van Der Meeren, were built in 1972-1973 with a Swiss building system called Variel. This consists of open, three-dimensional prefabricated modules made of reinforced and post-tensioned concrete. Van Der Meeren combined these modules to create housing units for 352 students in the heart of the green campus. Although the construction technique was innovative and experimental, the architectural and urban quality of the housing complex are unparalleled. Yet today, at almost fifty years of age, the student homes are threatened by new building projects. Some modules have already been demolished. The time is now to look at the history of the housing complex and bring to light its special qualities, in order to safeguard its future.
the Variel system
brainchild of Fritz Stucky
the Belgian version of Variel
building in Belgium with Variel

5 x WVDM and Variel
Van Der Meeren: an inspired master builder
first acquaintance: housing for the elderly
chaotic rationalism: VUB student homes
building materials and technical details
exploration of the possibilities

young heritage under pressure
bibliography
endnotes
image credits
acknowledgements

construction of the student homes (1973)
axonometric drawings of the Variel modules: structure, assembly and linking options
During the post-war period, many systems for prefabricated construction were developed throughout Europe. Rationalization, industrialization and prefabrication were the watchwords in a time of housing shortage, when more houses had to be built in ever shorter time spans [1]. In Belgium, however, this trend rarely transcended the level of theoretical pleas or one-off experiments: a 1969 investigation pointed out that in Belgium, only 2% of houses were built with industrialized building systems. This was substantially lower than in neighbouring countries such as Germany (9%), France (10%), Great-Britain (12%) and the Netherlands (19%), while in Eastern Europe, as much as 30% of housing units were built with industrialized systems [2]. A reason for the low level in Belgium was the general structure and organization of the Belgian building industry, which mainly consisted of small and medium-sized enterprises that did not have access to, or had not invested in, large-scale building techniques or specialized equipment. Furthermore, government policy did not encourage changing the traditional housing typology. Seeking to solve the housing problem in a swift and easy way (by limiting the need for technical innovation and keeping supervision by the government to a minimum), Alfred De Taeye, representing the Catholic People’s Party, submitted a law in 1948 that was intended to stimulate private initiative. The law provided grants to private individuals to build modest family houses [3]. It was an immediate success: in only six years, 100,000 grants were awarded. Although the law did not specify construction techniques or architectural styles, it (unintentionally) encouraged conservative practices: by bringing back the (collective) housing problem to an individual scale, the law stimulated the construction of individual houses, which were often constructed by small, local building companies. Indirectly, experimental, alternative or industrialized building systems were sidelined, as they were economical only in large-scale projects. In the meantime, in other countries, governments did create conditions for experimental or innovative building systems to be implemented, by actively supporting large-scale, alternative housing programs [4].

One of the systems that was used frequently throughout Europe was the Variel system, designed and patented in the 1950s by the Swiss architect and entrepreneur Fritz Stucky (born in 1929). The Variel system is based on three-dimensional, storey-high modules 2.7 m wide, 2.5 or 3 m high and between 8.4 and 10.8 m long. The modules are open: they consist of two reinforced concrete portal frames forming the front and back façades, with a reinforced concrete floor plate in between. The modules were fully fabricated in the factory, often completely finished and fully equipped, and transported to the construction site where they could be stacked and combined in various configurations for different programs, from houses to offices, schools to hospitals. Thanks to the high degree of industrialization, the projects using the Variel system could be built quickly and economically. Also the polyvalent yet robust character of the modules enhanced their success: between 1968 and 1976, total production increased from 10,000 to 50,000 modules [5].

In 2006, the Swiss Federal Institute of Technology in ZUrich (ETH) created an exhibition on the work of Fritz Stucky. An accompanying publication shows the rise and development of the Variel system between 1958 and 1982. It illustrates numerous applications of the system around the world and also describes the material and technical evolution of the system in this period. After launching it in 1958, Stucky and his team would continuously adapt and improve the system. The loadbearing structure of the modules initially was constructed with timber and steel, but from 1965 onwards, the structure was often made in reinforced and/or prestressed concrete, to better meet the demand for durable, fireproof constructions. The transition to concrete also allowed the product to be used for ever higher buildings: in the early 1970s a program was established for the French market for apartment buildings.
The dimensions of the modules, especially the width of 2.7 m, were also specifically tailored to the size of the trailers with which the modules were transported, via motorways, railroads or waterways.

In the 1970s, the modules were prefabricated in large numbers and licences were sold in 13 European countries, including our neighbouring countries Germany, the Netherlands and France, in 1959, 1964 and 1965 respectively. Belgium followed soon after: the 2006 publication mentions a Belgian licence and the foundation of the plc Variel Belgium by the company Eternit in 1970. However, it does not give information on the application of Variel in Belgium. Further research shows that in Belgium too, the Variel system was used to a large extent in the 1970s. Initially the Variel modules were imported from a French factory in Montsoult, located at some 25 km north of Paris. In 1968, this factory was taken over by S.C.E.P.E.R. S.A. (Société de Construction, d’Etudes et de Préfabrication), at that time a subsidiary of Dumez Bâtiment S.A. Upon the takeover, S.C.E.P.E.R. continued to produce and export Variel modules, also to Belgium. Only in 1974 did Belgium-based production begin; Eternit erected a Variel factory in Seilles, on a site between the river the Meuse and the railroad between Namur and Liège.

**The Belgian version of Variel**

The Variel modules produced in Seilles differed in a number of respects from the modules imported from France. In the latter, of which over 400 were used in Belgium in the early 1970s (e.g. for a housing complex for the elderly in Evere and student homes in Elsene), one comes across materials that are relatively unknown in Belgium but largely used in France. Among these are Fontex panels and Matfor panels, which were used for the inner walls of the Variel modules. Fontex panels are based on agglomerated wood fibers, finished on both sides with compressed cardboard or asbestos cement. A special feature of these panels is the internal, longitudinal hollow cores. To enhance the acoustical capacity and fire resistance of the panels, the cores could be filled with sand, in which case they were sold
PROGRAMME

CONSTRUIT CLF SUR PORTE:

ECOLE
JARDINS D’ENFANTS
CRECHES
INTERNATS
LOGEMENTS D’ÉTUDIANTS
HOMES
HOPITAUX
BUREAUX
APPARTEMENTS
ETC...

48 appartements + 3ème
âge = pour compte de la
S.C. = leder zijn huis = à
Evere.
Architecte Willy van der
Meeren à Londerzeel.

Département de neuro-
chirurgie, hôpital cantonal
d’Aarau (Suisse).
Constructeur :
VARIEL A.G. Fertigbauten
CH 5644 - Aarw (Switzerland).

«Vrij Universiteit Brussel»
un aspect des 382 appa-
tements pour étudiants et
bureaux.
Architecte Willy van der
Meeren à Londerzeel.
Hall d’Ecole Maternelle à
Hambourg.
Constructeur : Roland-Bau
GmbH & Co. KG
D 2150 - Buxtehude / Ger-
many.

from a commercial leaflet by Variel Belgium (early 1970s)
SOUPLESSE DE CONCEPTION

Ecole à Ichenheim (Allemagne Fédérale)
Dipl. Ing. Fred Wolf, Freier Architekt
7801 Stegen / Freiburg
Constructeur : Karl Kübler AG
D 732 - Göppingen / Germany.
under the brand name Matfor. In the ‘Belgian’ modules, i.e. produced in Belgium, the Fontex and Matfor panels were replaced with Gyproc plasterboard.

This leads to probably one of the main reasons why Eternit bought a Variel licence. Founded as a producer of building elements and products in asbestos cement in the early 20th century, Eternit sought to diversify its activities around the middle of the 1950s. It held a strong position in the Belgian market for insulation materials, with products like glass wool Eterglas, expanded perlite Lithoperl and synthetic insulation foam Eterfoam. The company then established subsidiaries making new products, for example, Gyproc-Benelux (a daughter company founded in 1957 and the first producer of plasterboards in the Benelux), Fademac (a company that specialized in plastic materials for walls and floors based on asbestos and PVC) and Plastic-Benelux (which produced raw materials for plastics and synthetic materials) [6]. While Eternit did not have expertise in the loadbearing structure of the Variel modules, it manufactured a variety of building materials and products that were used to finish the modules. Eternit shared ownership of the Variel factory in Seilles with the Dutch building company Verenigde Bedrijven Nederhorst, which produced the precast concrete elements and delivered them to the factory in Seilles.

The layout of the Seilles factory (see following pages) nicely illustrates the production process, which was entirely based on dry assembly techniques. First, the reinforced concrete portal frames and floor slabs, precast in the Netherlands, were connected with rebars by means of post-tensioning. Then, using special wagons, the 3D module was rolled to the various work stations, where successively the façades, the walls, the ceilings, the sanitary and electrical equipment and the finishings were provided.

After a few years, Eternit sold the licence and the Variel factory to the plc Jumatt. This building company, established in 1965 in Deerlijk, specialized in prefabricated 3D structures in timber. Jumatt displayed its expertise in this domain in the model houses with timber structures
plan of the Varie factory in Seilles (1974)
Système moderne de construction s'est imposé à
L'ATHENEE ROYAL de JAMBES (3ème tranche)
that were part of the Villagexpo or ‘model village’ in Limal (1972-1973) of the public housing company Nationale Landmaatschappij [7]. Around 1980, Jumatt ceased the production of Variel modules in Seilles: they continued to produce prefabricated, 3D housing modules there, yet solely with timber structures.

**building in Belgium with Variel**

Although the Variel system entails a strict and industrially determined grid, it nevertheless leaves room for the designer. Stucky strove to create modules that were neutral and as basic as possible, without premises or implications for the architectural style and layout. While in some applications the Variel modules are clearly recognizable, in other applications – as shown in the ETH-book on Stucky’s life and work, and the commercial leaflets published by Variel Belgium – the modules could also be used in a less apparent or visible way. Technical developments, such as the use of exterior insulation, enhanced the formal independence even further [8]. In Belgium, buildings in which the use of Variel structures is obvious have been located thus far. A comparison of the buildings designed by Van Der Meeren and a number of others in Belgium shows that to avoid banality or mediocrity, the (experienced) hand of the architect is necessary.

A commercial leaflet, edited by Variel Belgium in the early 1970s, contains a list of the buildings that could be delivered fully equipped and turnkey on site: it goes from (primary) schools, kindergartens, boarding schools, student homes, family houses, hospitals, offices and apartment buildings (see p. 15) [9]. Although the leaflet shows only two applications in Belgium, namely Van Der Meeren’s houses for the elderly in Evere and the student homes in Elsene, the Variel modules were also used in a number of other projects in Belgium during the 1970s. First there is the Variel office building located on the factory site in Seilles; this building, albeit in a slightly modified form, still functions as an office and showroom for Jumatt today. There are a number of other projects in the same region, for instance the secondary school Koninkijk Atheneum in Jambes, designed by architect José Ledoux. The school building has three floors, each of them made with 32 Variel modules. The whole is covered with a pitched roof to comply with the local building regulations. A commercial leaflet edited by Variel to highlight this building illustrates the fast pace of construction [10]. After the foundations had been constructed with traditional techniques in March 1973, the prefabrication and assembly of 96 Variel modules started in June 1973. Between June 15 and 29, the modules were delivered to the site and put in place. Next the traditionally constructed parts of the superstructure (e.g., stairwell and roof) were completed, between August and November 1973. Classes started November 3, 1973, so about eight months from the start of construction. Later on, a primary school was erected with Variel modules just across from the secondary school, on the other side of the grass court. This primary school was not designed as one massive, rectangular block, but had a more fanciful layout, with modules that were rotated and clustered, only one storey high.

Also in and around the Brussels Capital Region, Variel buildings are present in the streetscape. The kindergarten and primary school Saint-Roch near the Brussels-North train station is a rectangular block made of Variel modules stacked four storeys high, to which volumes in traditional masonry were added for staircases, etc.

More remarkable are the Variel villas: these are detached houses or twin villas of one or two storeys under a pitched roof, for example, those in Kraainem and Hoeilaart. Variel invested strongly in this market, as is shown in the commercial leaflet entitled *Votre villa est fin prête à vivre heureux* [11]. The company promoted these houses with clear and powerful slogans: *une révolution, une conception résolument nouvelle de l’art de construire, la solution rapide, la solution économique, la solution de qualité, la solution flexible.* Rather than the technical characteristics of the system, the leaflet highlights the ease of the system and the high degree of architectural freedom.
that was possible. To substantiate this claim, it pointed out – without any sense of irony - that one could choose between three different roof inclinations and various finishing materials for the roof and the façades. A perfect finish, a fully equipped kitchen and bathroom, mineral wool insulation and double glazed Thermopane windows to save on heating expenses, etc.: Variel y a pensé. The leaflet came with basic designs for floor plans and elevations, similar to those spread by the public housing societies. The designs included various types or models, small and large, and variations of these types. For instance, type 3, 3a and 3b consisted of three modules of 2.7 m by 10.8 m under a pitched roof, for a total living area of 140 m². It contained three to as many as five bedrooms, if the garage and the office were sacrificed. The price for this type of house, turnkey and with minimal finishing, varied between 1,384,000 and 1,560,000 old Belgian francs [12]. With an underground garage or basement, the cost increased by 345,000 francs.

This type of Variel villa with a pitched roof received little recognition within the progressive, critical architectural circles because of the (perceived) inconsistency between...
architecture and structure, form and construction [13]. Nevertheless, there was a market for such villas. The Variel villas corresponded closely to what was put forward by the public housing companies in the early 1970s in the model villages at Mouscron, Limal and Knokke-Heist. The loadbearing structure and construction technique of the turnkey model houses were usually modern yet invisible: often the façade consisted of exposed brick veneer (in front of a precast concrete wall for instance), resulting in a traditional appearance. Surely Variel could have been part of the model villages had its entry in the Belgian market occurred a few years earlier. That Variel was fully aware of the competition in this market segment is nicely illustrated by a list of five competitors noted in pencil on the cover of a Variel commercial leaflet: Jumatt, Remacle, I.B.B., Delmulle and Polyvilla-Sodibat. All of these companies had shown their expertise in prefabricated houses during the second half of the 1960s or the early 1970s, in the model villages or in other public housing estates [14]. Delmulle, Remacle and I.B.B. (or ‘Industrialisation Belge du Bâtiment’, an alliance with Rhodius-Devile, E. Ronveaux, Istawess, Remacle and others) relied on a concrete structure, either visible or concealed. They used either patented systems for heavy prefab such as the French system Camus, or their own systems such as the Danilith-bungalows by Delmulle [15]. The company Polyvilla-Sodibat exploited new developments in synthetic resins and plastics, offering a concrete skeleton frame covered with PVC and polyester [16]. While most of the model homes were constructed with 2D precast panels and slabs, the plc Jumatt built houses with 3D prefab modules. These modules had a timber structure, making Jumatt one of the exceptions to the concrete and brick that dominated the Belgian market. The structure was completed with mineral wool and finished inside with plastered wood fibreboards, and outside with fibre cement panels and a render on a metal mesh or a brick masonry wall [17]. Although the structure was made in timber, this system was relatively similar to the Variel system in its three-dimensional execution and concept. Thus, Jumatt seemed the perfect successor to Eternit when the Variel factory in Seilles was sold in the middle of the 1970s. Today, Jumatt is still active on the same site, but now manufacturing solely timber, 3D prefab modules for housing construction.
CECA-houses in Vierwindenbinnenhof in Tervuren by Willy Van Der Meeren (2016)
5 x Willy Van Der Meeren and Variel

Van Der Meeren: an inspired master builder
Willy Van Der Meeren (1923-2002) was one of the leading post-war architects in Belgium [18]. He preferred to be called a master builder rather than an architect: he incorporated implications of manufacture and construction processes in his designs, resulting in rational, logical constructions [19]. His predilections for technical experiments and innovative material solutions were coupled with a social commitment: in an article for the leading Belgian architectural journal Architecture, Van Der Meeren pleaded for ‘construire pour le plus grand nombre’ or building for the masses [20].

A perfect illustration of his intention to create high quality and affordable housing for the masses is the CECA house he developed with architect Léon Palm in 1954. The house, designed as a cheap workman’s house for the European Coal and Steel Community, was based on a prefabricated steel skeleton frame, and was completed with other prefabricated, modular building elements, materials and furniture. The CECA house is, according to architectural historian and professor Mil De Kooning, “the only working-class house worth mentioning, being included time and again in general works on modern Belgian architecture” [21]. For various reasons, the CECA house was not mass-produced: only a few of the houses were built, including eight in the Vierwindenbinnenhof in Tervuren, one of which was the personal house of Van Der Meeren [22].

Although the CECA house did not pass beyond the stage of prototyping, Van Der Meeren continued to produce designs for industrialized building systems, which had proven their worth and were being adopted in other countries. A design commission that lent itself to the application of an industrialized building system was for a third group of housing for the elderly (1969-1972). These houses were located near a high-rise apartment building and two groups of low-rise flats for the elderly built from Van Der Meeren’s designs a few years before, all commissioned by the public housing company of Evere. For the last part of the public housing estate, the architect chose to use the Variel system, which had been introduced in the Belgian market around that time.

During the next decade, Van Der Meeren used this system on other occasions as well, namely for the 352 student homes at the university campus of the Vrije Universiteit Brussel (VUB) in Elsene (1971-1973), the office and commercial building Etercenter for Eternit in Kapelle-op-den-Bos (1974-1975), an extension to the VUB student village (1978-1979) and a building for socio-cultural activities (1980-1981), the latter two also on the university campus in Elsene. Although all were constructed with the same system, Van Der Meeren gave each project unique and personal touches. How he learned about the Variel system is still unclear - possibly through internationally renowned architectural journals such as Bauen + Wohnen, Werk or Detail in which the Variel system and its applications were showcased [23].

The five Variel projects by Van Der Meeren are inevitably very similar because the same system was used, yet they differ slightly from each other. This was partly because the system was in constant evolution: after initially being imported from France, the system was adapted to the Belgian market during the 1970s by incorporating Belgian materials, not only those manufactured by Eternit but also by other Belgian manufacturers such as Chamebel, one of the largest manufacturers of metal window frames in Belgium in those days. The system was also subject to the changing expertise of the licensees and developments in the building sector. Furthermore, the system could be moulded and mastered by the architect, as is illustrated in Van Der Meeren’s oeuvre.
(preliminary) design for the houses for the elderly in Evere (1969-1972)
first acquaintance: housing for the elderly
Van Der Meeren first used the Variel system in three low-rise buildings with 16 housing units each for the elderly in Evere. The architect’s successive design sketches show how the Variel system was introduced and influenced the architectural design. After having explored the CECA building system very briefly for this housing project, in early 1970 he sketched forty or so rectangular blocks clustered in small groups, spread irregularly over the plot. The length to width ratio of these blocks (approximately two to one) suggests that he did not think of these blocks as being Variel [24]. The next set of drawings shows a new design of three parallel buildings, relating closely to the existing housing units for the elderly. For the first time, the drawings also clearly show the Variel modules. However, the design was not yet fully ‘captured’ by the Variel modules: partition walls were used to create irregular floor plans, denying the alignment of the Variel modules. This capricious character gradually disappears from the subsequent sketches: the Variel grid would increasingly serve as a basis for the separation between the apartments. Van Der Meeren introduced a small shift in the building blocks, both in elevation and in plan, not solely because of the building site’s topography [25]. As for circulation, the design evolved from individual access on the ground floor or via continuous balconies on the first floor, to two central entrances and stairwells in each block. For the stairwells, Van Der Meeren initially stacked two Variel modules on top of each other. But because it was difficult to insert a staircase through the precast concrete floor slabs, he opted for an independent structure in brick and concrete, cast in situ. These structures preserved the dimensions of the modules to achieve a continuous Variel roof structure.
The traditionally constructed staircases would disappear in Van Der Meeren’s next Variel project: the student homes on the VUB campus. Here he demonstrated more ingenuity and creativity, truly building according to Stucky’s motto, Raum auf Raum statt Stein auf Stein [26].
preliminary design sketch, drawing and model for ‘mobil-homes’ on the VUB campus (1971)
chaotic rationalism: VUB student homes

In 1969, the year he was commissioned to design the third phase of the elderly housing in Evere, Van Der Meeren was also invited to teach Architectural Theory in the Department of Civil Engineering of the newly established university, the Vrije Universiteit Brussel (VUB). From 1970 until 1988, Van Der Meeren held an academic position at the VUB [27]. In addition, he was appointed as the architect for several buildings on the VUB campuses in Elsene and Jette. For the student homes in Elsene, Van Der Meeren’s first design was based on the idea of ‘mobil-homes’: individual, movable units that were clustered and plugged into fixed units with collective facilities. The intention was to allow the units to be rearranged according to the needs of the expanding campuses. But the rector thought these mobile homes, which were to be executed in polyester, would not be durable enough, although their resemblance to a nomads’ camp probably was another strike against them. When even a full-scale prototype could not convince the rector, Van Der Meeren switched to fixed, prefabricated modules in concrete. With the houses for the elderly in Evere still on his drawing table, it is not surprising that he came up with a design that used Variel modules [28].

The expectation of a substantial order of a few hundred modules encouraged Variel to put in some extra effort to obtain the contract. On the 23rd of June 1972, J. Carette, the authorized representative of Variel Belgium, brought Van Der Meeren on a private aircraft to Stuttgart and Bern to visit some Variel projects in Germany and Switzerland, as well
as to the Variel factory in Göppingen operated by Karl Kübler, who in 1959 became the first licensee of the Variel system [29].

From the study trip, Van Der Meeren gained a better understanding of the system and its potential, in view of its application to the student homes in Elsene. Van Der Meeren merged four Variel modules into one apartment unit for four students, providing for both private and shared spaces. The units were clustered and stacked to create a village for 352 students. Although the modules were constructed in concrete, the idea of individual homes around a collective core was kept. Also, the idea of creating a movable complex was not completely lost: the modules could be moved and reused, although by means of a heavy crane. Horizontally, the floor plates of the modules were connected in certain places by means of a local welding joint, while vertically the modules and the roof elements were stacked ‘dry’, with only loose neoprene rubber between [30]. The Variel modules were basically an open, spatial structure, yet the industrial production process forced Van Der Meeren to comply with the prefabrication prerequisites. He aimed to create varied façades, irregular volumes and unexpected vistas, yet creating such a playful architectural layout with a rigid prefab system proved rather difficult to achieve. In particular, the dimensions presented a difficulty. In the preliminary design for mobile homes in polyester, units were easily combined and rotated because of the two-to-one ratio of the floor plan. The Variel modules provided fewer perpendicular linking options, as the length of 9.6 m was not a multiple of the width, 2.7 m. Van Der Meeren raised this issue with Stucky, requesting modules 10.8 m long [31]. Stucky supported this idea and implemented it a few years later. Van Der Meeren used these larger two-directional modules for an extension of the student village at the end of the 1970s, but for the initial student homes, he had to work with modules of 2.7 m by 9.6 m.
TYPES OF UNITS
TYPES DE CELLULE

A

B

C
Van Der Meeren designed three different plan layouts: in each case, half of the module was for a bedroom while the other half was designed to be either a living room/sitting area, a kitchen with a dining table, or a bathroom and a small storage space. Van Der Meeren combined four modules to create one apartment with four bedrooms, a common living room, a kitchen and two bathrooms. He designed two types of combinations: the modules were put next to each other to create an apartment with an almost square ground plan, or they were put two by two to create an elongated rectangular ground plan. The square and rectangular apartments were combined in a seemingly random and fanciful way to create four large clusters. The four clusters were finished in different colours to facilitate a sense of orientation. Next to these four clusters, in red, yellow, grey and blue, a fifth cluster in green was added (1978-1979) for students with disabilities.

To enhance the social interaction and gradual transition from collective to individual, from public to private spaces, Van Der Meeren created a circulation plan with variegated walkways and several entrances, rather than a single main doorway. He created little front gardens leading to the front doors of three to six apartments, via external spiral staircases to first floor apartments. There were no central entries, hallways or stairwells, which would have been difficult to integrate in a Variel module. In addition, there was no negative ‘residual space’ such as often occurs in systems with unidirectional linkages.

The result was a fanciful, varied unity in which the pragmatic benefits of the prefabrication system were exploited to the full but without an architecturally dull or monotonous result. Whilst respecting the strict constraints of the industrial prefabrication process, Van Der Meeren succeeded in maintaining creative control and not lapsing into the uniform, monotonous image of prefab. He did this without tricks, without hiding the fact that he used 352 similar elements, without concealing the modular structure: on the contrary, the individual modules, and therefore the tectonics of the production process, are clearly visible and inherent to the architectural expression.
The design was appreciated on an international level, as it was published in the internationally renowned journal *Architectural Review* in 1973.

Van der Meeren’s unique arrangement of apartment units resulted in accommodations for 352 students instead of the 350 budgeted. Yet still he managed to save 2.5% of the expected cost, while completing the project on time [32]. In September 1972 the final construction cost estimate was sent to the VUB by the building contractors: the Antwerp contracting company Van Riel & Van den Bergh, and Variel Belgium. Van Riel & Van den Bergh started to prepare the construction site in October 1972. The first modules arrived by truck from the factory in Montsoult on January 16, 1973. The modules were put in place at a pace of nine modules per day. Less than nine months later, on the first of October 1973, students could move into their new homes. Final details and finishing were completed on December 14, 1974 [33]. The process could have been more striking had the modules been completely finished in the factory and delivered ready to go. Instead, the kitchens, furniture, equipment etc. were installed on site. This slowed construction but facilitated more precise connections and linkages. In addition, it allowed the builders to intervene during construction and make some adjustments [34].

**building materials and technical details**

the Variel modules, as applied it the VUB student homes, consist of two portal frames and a floor slab in reinforced concrete. The columns of the portal frames have a tapered section: they are 35 cm deep, and the width increases from 17 cm at the exterior to 18 cm towards the interior. The base of the columns has a somewhat irregular shape, inverse to that of the top corners of the portal frame to ease the stacking of two modules. Two hoisting anchors on top of the portal frame allow the module to be lifted. According to the building specifications drafted by Van Riel & Van den Bergh, the floor and accessible roof slabs were designed to resist a service load of 300 kg/m², while the inaccessible roof slabs should resist 150 kg/m².
axonometric drawing of the Variel structure showing options with two or three 'monofils'
The floor slabs are approximately 8 cm thick and are supported underneath by two longitudinal ribs and three transverse ribs (one central rib and two ribs at approximately 40 cm from the edges), all adequately reinforced with rebars 5 and 12 mm thick. Within the longitudinal ribs were also two or three ‘monofils’ or bars to connect the slabs and the frames by means of post-tensioning. The bars were not horizontal in the ribs, but were slightly lower in the middle than at the ends of the ribs where they connected to the portal frame, in order to increase their structural performance. When the portal frames and floor slabs were put together, the wires were tensioned and bonded to the concrete with a dark, high-grade cement grout (based on the sulphate-proof cement Thiodur, as the technical drawings by Variel indicate). The bars were fixed in their tensioned position by means of an anchor and wedges. The decision to use two or three monofils depended on the loads intended for the floor plates. In the case of the student homes, the builders used both: modules that had a bathroom were made with three bars because, given their solid reinforced concrete walls, they had a higher dead weight. The bathroom was in fact an oversized shower: the showerhead could be placed on a high hook in the wall (to take a shower) or on a lower hook near the sink (to use it as a tap). The floor was slightly sloped, and a higher guard in the doorway prevented the water from overflowing into the living room. Another peculiarity of the bathroom modules was that the floor slab was approximately 40 cm shorter than the others. The part of the slab that cantilevered beyond the transverse rib was omitted so that ducts could be installed and maintained in the cavity.

The roof elements were also executed in reinforced concrete and their shape was very similar to that of the floors, i.e. a thin slab with longitudinal and transverse ribs (in the middle and along the edges of the slab). Yet, depending on the position of the floor module, when at the corner or the edge of the building, the depth of the ribs increased to create a curb. The roof elements were put in place by means of the
successive phases in the demolition of 20 modules in August-September 2016: the façade panels in asbestos cement are removed, as well as parts of the thermal insulation (white expanded polystyrene) and 'Fontex' wood panels in the side façades.

the concrete structure of the first two units is being demolished, the yellow and pink glass wool insulation between the modules is visible
Seven modules have been demolished, the concrete rubble is piling up.

The partial demolition works are almost finished. In the remaining modules, the concrete bathroom is clearly visible in the otherwise completely stripped structure.
1) expanded polystyrene (30 mm)
2) vapour barrier in polyethylene
3) ‘Fontex’ hollow wood panel (50 mm)
hoisting anchors provided on top of the longitudinal ribs. These were not flush mounted like the hoisting anchors of the portal frames, but had to be cut off after being installed. The roof was finished with a sloping screed, two layers of roofing and an aluminium edge profile.

The concrete structure of the student homes was precast in the S.C.E.P.E.R. factory in Montsoult. To ensure a good execution, the Belgian office for quality control in the construction sector SECO sent three of its engineers (Broucke, De Proost and Van Dam) to Montsoult in December 1972 to oversee the production process, and to guarantee the technical quality and durability of the modules. Among their observations was that the concrete cover of the precast floor slabs was not guaranteed to be the minimum required by the Belgian norm NBN15 for concrete. A first attempt to solve this involved inserting distance pieces under the reinforcement; however, the weight of the reinforcing bars and fresh concrete pushed these pieces into the 30 mm layer of expanded polystyrene that was at the bottom of the formwork. SECO then proposed attaching the insulation only after the casting process. Most of the Variel modules that were already fabricated by that point were rejected because of the insufficient concrete cover. For 15 floor slabs SECO agreed to a compromise: these could be used at the first level, where the risk of corrosion was less [35].

Once the structure was assembled, each module was completed with partition walls and ceiling panels. Also the ducts for water, electricity and heating were provided in the factory, as well as the fixed parts of the window frames. The semi-finished modules were then transported 300 km by truck to Brussels. The first modules arrived on the construction site on January 16, 1973. The anticipated advantages of this prefabricated system were immediately demonstrated: on the first day, Van Riel & Van den Bergh installed five modules. The construction pace would even increase during the following days, with the installation of up to ten modules and six roof elements in one day [36]. But the potential of the system was not fully exploited, since the contractors ordered not fully but semi-finished modules. Kitchens, façade cladding panels and the remaining parts of the aluminium window and door frames were installed onsite. This increased the construction time, but the project still met the deadline of October 1973.

The architectural drawings and sections, complemented by onsite investigations by the authors undertaken during the demolition of part of the blue cluster in August-September 2016, show that a variety of materials were used in the walls, floors and roofs. Some materials are typically French, e.g. the Fontex wall panels: these were installed at the Montsoult factory. Yet, as the modules were positioned one by one, many other materials and building elements needed to be put in place, such as additional glass wool insulation blankets, roofing layers and façade panels. For this, materials and products available on the Belgian market were used, often produced by Eternit.

The side façades were made of 35 mm ‘A.C.E. CR’ hollow, grey cladding panels (A.C.E. stands for extruded asbestos cement and CR stands for ‘creux’). Behind this was an 85 mm air space (which also contained wooden battens and steel sections, to support the cladding panels and joinery), 30 mm of expanded polystyrene, a vapour barrier in polyethylene and a 50 mm Fontex panel, which was hollow and made of agglomerated wood. Above and below the door and window frames, Fassal panels of solid asbestos cement, 8 mm thick, were used. These Fassal panels were painted in one of the main colours of the housing complex. The Fassal and the A.C.E. panels, both manufactured by Eternit, were put in place at the construction site: the A.C.E. panels were screwed on, while the Fassal panels were glued.

In the front façades, the Variel portal frame was a prominent feature, accentuated by the 20 cm recess of the infill walls. These façades were made with different materials, depending on the function behind it (bathroom, kitchen, bedroom or entrance/living room). The bathroom façades were closed with 35 mm A.C.E. CR-panels and 30 mm expanded polystyrene; these blind walls covered the large
un nouveau matériau en asbeste-ciment extrudé

L’A.C.E. profil n° 2
pour parois industrielles
bardages extérieurs
et décoration intérieure

Revêtement mural en panneaux A.C.E. profil n° 2, gris clair, garnis d’aspo, dans un magasin de fleurs à Bruxelles (Arch. Ph. Wittevanden, Brux.)

Bardage en panneaux A.C.E. profil n° 2, gris clair, garnis d’aspo, à la S.A. Eternit à Kapelle-op-den-Bos

C’est un produit Eternit

ETERNIT S.A. - Kapelle-op-den-Bos - Capital 1,205 million - Tel. Q55 7151, 7141, 7101 - Sede d’expansion : 35, bd du Jardin Botanique, Bruxelles - Tel. 177198 - Distributeurs dans tout le pays : voir indicateur des Téléphones sous « Eternit »

LES PANNEAUX EN ASBESTE-CIMENT EXTRUDÉ

Éternit

Corps creux en asbeste-ciment, de teinte gris clair, fabriqués par extrusion sous forte pression et autocollants, pour parois, colonnes, planchers et cloisons industrielles.

VIND TYPES :
CI 50 : parement par enduit
CD 80 : parement par enduit
CD 90 : parement par enduit

CARACTÉRISTIQUES :
 Ils peuvent être
 - imperméables
 - incombustibles
 - pose horizontalement et verticalement
 - démontés et réutilisés

ÉTERNIT S.A. - Kapelle-op-den-Bos - Capital 1,205 million - Tel. Q55 7151, 7141, 7101 - Sede d’expansion : 35, bd du Jardin Botanique, Bruxelles - Tel. 177198 - Distributeurs dans tout le pays : voir indicateur des Téléphones sous « Eternit »

Voici le nouveau panneau GYPROC

Le planage préfbriqué.

Gyproc : une fine lèche placine entre deux feuilles figées rigide. Gyproc supprime le travail du plâtre au chantier.
La pose est on ne peut plus facile et rapide. Les locaux, exemptes de toute humidité, peuvent être occupés et parachevés immédiatement.

Demandez notre documentation technique ; nos services sont à votre entière disposition.


Gardez à l’intérieur : toute cette chaleur

...c’est surtout par le toit ; qu’elle s’en va !
Dans les ateliers, hall d’usines,
une soufflure de GYPROC-ALUMINIUM,
 maintient :
une température plus élévée.

Isolant thermique remarquable
Les panneaux Gyproc-Aluminium, en refléchissant la chaleur vers le centre de la pièce, réduisent considérablement les dispersions de chaleur, économisent le combustible et permettent ainsi une réduction des éléments de chauffage.

Plafonnage préfabriqué
Les panneaux Gyproc-Aluminium supprimant le travail du plâtre, se jouent des conditions atmosphériques. Ils se posent sans aucun retardement, offre un revêtement intérieur idéal pour sanitaire, murs, plafonds, etc., sans aucun joint disgracieux.

service cavities behind the bathroom walls. The kitchen walls are very similar, but instead of the service cavity, there was a 50 mm hollow Fontex panel, which formed the surface for the kitchen cabinets. The vertical joints between the portal frame and the A.C.E. panels were closed with a sealer called Sikaflex, and the horizontal joints were closed with Sikaflex and neoprene.

The bedroom façades were formed of concrete parapet walls (attached to the portal frame with metal bolts and plates), glass wool insulation and solid Fontex panels, the layers approximately 80 mm, 40 mm and 27 mm thick, respectively. The aluminium window frames and window sills were connected to the concrete frame and wall by means of bolts and plates in precast rails.

The last type of front façade is the entrance and living room with large windows. The technical detailing is similar to that of the doors and windows in the side façades, with glued Fassal panels and side-to-side aluminium window frames. While the side façades were mainly grey because of the A.C.E. panels, the front façades stand out for their use of colour: the Fassal panels, the concrete parapet walls, the concrete roof edges and the A.C.E. panels in the front façades were painted in matching colours.

As for the interior walls, these were made of Fontex and Matfor panels. Walls between two bedrooms were composed of a 50 mm hollow Fontex panel, 45 mm of glass wool insulation stitched onto kraft paper, a 50 mm air cavity and a 50 mm Matfor panel. The latter is the same as a Fontex panel, but its hollow cores were filled with sand to improve acoustical insulation and fire resistance. The Fontex and Matfor panels were attached to the concrete structure by means of U-shaped channels in galvanized steel and sealed with polyether foam. Walls between the bedrooms and living rooms were made with a 50 mm Matfor panel. In addition, large parts had a double wall structure, resulting from the cupboards made with 50 mm Fontex panels and a layer of glass wool.
technical drawing showing a vertical section through the ceiling below the roof (1973)

1) glass wool insulation (45 mm)
2) 'Resogil' wood panel (22 mm)
3) glass wool insulation (45 mm)
4) 'Calorouate' acoust. insulation
5) Gyproc with aluminium (13 mm)
technical drawing showing a horizontal section through an inner wall between two bedrooms (1973)

6) 'Matfor' panel (50 mm)
7) neoprene joint
8) glass wool insulation (45 mm)
9) hollow 'Fontex' panel (50 mm)
10) solid 'Fontex' panel (27 mm)
MAINTENANT Eternit MET A VOTRE DISPOSITION, PRÊT A L'EMPLOI PARTOUT

UN MATÉRIAU ISOLANT IDÉAL pour votre confort et votre protection

FIBERGLAS

QUI REND LA MAISON REPOSANTE.
FRAICHE L'ÉTÉ, CHAÎDE L'HIVER

* Avec tous ses distributeurs dans toutes les régions du pays, la S.A. ETERNIT met à votre portée, sous ses différentes formes et qualités, les feutres en rouleaux de fibre de verre ouatée et bakelisée, fabriqués par la OWENS-CORNING FIBERGLAS CORPORATION.

* Pour isoler vos murs et vos plafonds, vos cloisons et votre sous-toiture, en un mot pour "conditionner" votre habitation, rationnellement, économiquement et facilement, demandez la documentation à

S.A.
Eternit
Capital: 1,5 milliard de frs.
KAPELLE-OP-DEN-BOS. TÉL. Malines (015) 711.11
Visitez la salle d'exposition : 35, Bd. du Jardin Botanique, Bruxelles
<table>
<thead>
<tr>
<th>BL (Kraft)</th>
<th>BL (Nu)</th>
<th>700 (Kraft)</th>
<th>700 (Nu)</th>
<th>701 (Nu)</th>
<th>702 (Nu)</th>
<th>SONOSOL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Feutre souple de fibres de verre, imprégnées de résines synthétiques polymérisées; feuille collée sur papier kraft bitumé.</strong></td>
<td><strong>Feutre souple de fibres de verre, imprégnées de résines synthétiques polymérisées; feuille collée sur papier kraft bitumé.</strong></td>
<td><strong>Panneau de fibres de verre fines, imprégnées de résines synthétiques polymérisées; feuille collée sur papier kraft bitumé.</strong></td>
<td><strong>Panneau de fibres de verre fines, imprégnées de résines synthétiques polymérisées.</strong></td>
<td><strong>Panneau de fibres de verre fines, imprégnées de résines synthétiques polymérisées.</strong></td>
<td><strong>Feutre souple en rouleaux, avec revêtement kraft, muni d'une languette latérale de recouvrement (10 cm) ou panneau nu de fibres de verre fines, imprégnées de résines synthétiques polymérisées.</strong></td>
<td></td>
</tr>
<tr>
<td>Longueurs :</td>
<td>Longueurs :</td>
<td>Longueur :</td>
<td>Longueur :</td>
<td>Longueur :</td>
<td>Longueur :</td>
<td><strong>A)</strong> Rouleaux (diamètre ± 50 cm) (largeur 120 cm)</td>
</tr>
<tr>
<td>12,5 15 7,5 m</td>
<td>30 20 15 m</td>
<td>1 m</td>
<td>25 mm</td>
<td>30 mm</td>
<td>30 mm</td>
<td></td>
</tr>
<tr>
<td>Épaisseurs :</td>
<td>Épaisseurs :</td>
<td>Épaisseurs :</td>
<td>Épaisseurs :</td>
<td>Épaisseurs :</td>
<td>Épaisseurs :</td>
<td><strong>Longueurs</strong></td>
</tr>
<tr>
<td>30 45 60 75 mm</td>
<td>45 30 60 75 mm</td>
<td>45 mm</td>
<td>30 mm</td>
<td>40 mm</td>
<td>30 mm</td>
<td><strong>Épaisseurs</strong></td>
</tr>
<tr>
<td>Largeurs :</td>
<td>Largeurs :</td>
<td>Largeurs :</td>
<td>Largeurs :</td>
<td>Largeurs :</td>
<td>Largeurs :</td>
<td><strong>Rouleaux d’environ 50 cm de diamètre, en paquets de 1, 2 ou 3 rouleaux.</strong></td>
</tr>
<tr>
<td>40 40 40 cm</td>
<td>40 40 40 cm</td>
<td>50 cm</td>
<td>25 mm</td>
<td>50 mm</td>
<td>40 mm</td>
<td><strong>λ = 0,033 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td>50 50 50 cm</td>
<td>60 50 50 cm</td>
<td>60 mm</td>
<td>40 mm</td>
<td>60 mm</td>
<td>50 mm</td>
<td><strong>λ = 0,031 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td>60 60 60 60 cm</td>
<td>70 60 60 60 cm</td>
<td>70 mm</td>
<td>50 mm</td>
<td>70 mm</td>
<td>60 mm</td>
<td><strong>λ = 0,030 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td>100 100 100 100 cm</td>
<td>100 100 100 100 cm</td>
<td>80 mm</td>
<td>60 mm</td>
<td>80 mm</td>
<td>70 mm</td>
<td><strong>λ = 0,027 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td>120 120 120 120 cm</td>
<td>120 120 120 120 cm</td>
<td>100 mm</td>
<td>70 mm</td>
<td>100 mm</td>
<td>80 mm</td>
<td><strong>λ = 0,025 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td>Rouleaux d’environ 50 cm de diamètre, en paquets de 1, 2 ou 3 rouleaux.</td>
<td>Rouleaux d’environ 50 cm de diamètre, en paquets de 1, 2 ou 3 rouleaux.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Indices d’affaissement sonore aux bruits d’impact :</strong></td>
</tr>
<tr>
<td><strong>λ = 0,033 kcal/m. h. °C à 20° C</strong></td>
<td><strong>λ = 0,031 kcal/m. h. °C à 20° C</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>λ = 0,030 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td>Isolation thermique et acoustique des toitures, planchers et plans de combles.</td>
<td>Isolation thermique et acoustique des toitures, planchers et plans de combles.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>λ = 0,027 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td>Isolation thermique et acoustique des parois verticales, plans de combles et plans de façades.</td>
<td>Isolation thermique et acoustique des parois verticales, plans de combles et plans de façades.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>λ = 0,025 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td>Isolation thermique et acoustique des parois verticales, plans de combles et plans de façades.</td>
<td>Isolation thermique et acoustique des parois verticales, plans de combles et plans de façades.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>λ = 0,023 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td>Isolation thermique et acoustique des parois verticales.</td>
<td>Isolation thermique et acoustique des parois verticales.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>λ = 0,021 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td>Isolation thermique et acoustique des parois verticales.</td>
<td>Isolation thermique et acoustique des parois verticales.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>λ = 0,019 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td>Isolation thermique et acoustique des parois verticales.</td>
<td>Isolation thermique et acoustique des parois verticales.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>λ = 0,017 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td>Isolation thermique et acoustique des parois verticales.</td>
<td>Isolation thermique et acoustique des parois verticales.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>λ = 0,015 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td>Materiaux en rouleaux, collés sur kraft ou panneaux nu en paquets.</td>
<td>Materiaux en rouleaux, collés sur kraft ou panneaux nu en paquets.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>λ = 0,013 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td><strong>λ = 0,011 kcal/m. h. °C à 20° C</strong></td>
<td><strong>λ = 0,010 kcal/m. h. °C à 20° C</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>λ = 0,009 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td><strong>λ = 0,008 kcal/m. h. °C à 20° C</strong></td>
<td><strong>λ = 0,007 kcal/m. h. °C à 20° C</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>λ = 0,006 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td><strong>λ = 0,005 kcal/m. h. °C à 20° C</strong></td>
<td><strong>λ = 0,004 kcal/m. h. °C à 20° C</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>λ = 0,003 kcal/m. h. °C à 20° C</strong></td>
</tr>
<tr>
<td><strong>λ = 0,002 kcal/m. h. °C à 20° C</strong></td>
<td><strong>λ = 0,001 kcal/m. h. °C à 20° C</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>λ = 0,000 kcal/m. h. °C à 20° C</strong></td>
</tr>
</tbody>
</table>

overview of Fiberglas product range, distributed by Eternit (1967)
With respect to the floor sections, the ground floor slab was insulated underneath with 30 mm of expanded polystyrene. Upon the advice of SECO, this was installed during construction instead of during manufacture at the factory. Inspection onsite reveals that this insulation is still in place and in good condition. The ceilings were heavily insulated. Between two rooms, ceilings had the following composition: a 13 mm plasterboard covered with aluminium foil (to increase fire resistance and reflect heat), a Placostyl grid to attach the plasterboards, a layer of Calorouate acoustical insulation (approximately 20 mm) inserted between the structural steel ceiling frame, 22 mm wood fibreboard Resogil, a 60 mm blanket of glass wool insulation and a layer of roofing. The composition of the ceiling on the first floor is very similar with this difference: 45 mm glass wool blankets were inserted in the cavity between the steel ceiling frame, while the top layer of insulation was only 45 mm thick and did not cover the whole surface, but just a 40 cm strip beneath the ribs of the roof element.

Insulation materials were an important part of the structural assemblies. Van Der Meeren’s drawings include particular types and brands of glass wool insulation, for instance BLK (a ‘BL’anket stitched onto ‘K’raft paper, intended for the interior walls) and BLN (a ‘BL’anket ‘N’u or without kraft paper, which were to go on top of the ceiling structures), and IBR (‘Isoverbel’s insulation glued on to a ‘B’ituminous kraft paper, available in ‘R’oles). Van Der Meeren specified products available in the Belgian market at that time: yellow IBR was produced by the Belgian company Isoverbel, while the pink glass wool in BLK and BLN was an Owens-Corning Fiberglas product distributed by Eternit. However, the insulation in the modules built at the factory in Montsoult departs from the designs.

The interior walls and the ceiling structures were insulated with yellow glass wool insulation produced by the French company Saint-Gobain. This had approximately the same properties as the specified material. The pink insulation on
top of the ceiling structures seems to be executed according to the plans. This was applied at the construction site, by rolling it out on top of the modules, before the next module or the roof element was put in place.

Comparing the drawings with material samples taken during the partial demolition, brings a number of issues to light. First of all, the execution is not always true to the design. This suggests that destructive research and material samples are necessary for future studies and possible renovation projects, to understand the projects as-built. Secondly, the student homes can be considered a ‘transition project’ for Variel Belgium: it strongly relied on the French building practice and materials that were available on the French market (e.g. Fontex, Matfor, Saint-Gobain insulation). Nevertheless, newly introduced Belgian materials were finding a market, including materials made by Eternit (A.C.E., Fassal, Massal, BLN insulation) and other Belgian building companies (e.g. Chamebel), and these complied with Belgian building codes (e.g. SECO’s intervention). Thirdly, Van Der Meeren paid much attention to thermal and acoustical insulation, as well as to fire safety. So it is surprising that the windows were made with single glazing, although by the early 1970s, double glazing was increasingly being used to improve their thermal and acoustical properties.

**exploration of the possibilities**

In his designs for the Variel system, Van Der Meeren never tried to conceal the prefabricated, modular structure. He gradually explored the boundaries of the system and took it a step further, at various levels. His first project using Variel modules was housing for the elderly: this was a relatively basic and somewhat reserved design. At the university campus, because of the larger size of the project, he was able to explore the possibilities of the Variel system on an urban scale. In his arrangement of 352 modules, nothing seems incomplete or forced, even though the modules lacked the dimensions that Van Der Meeren preferred. In the next project, the Etercenter in Kapelle-
op-den-Bos (1974-1975), Van Der Meeren played with floating modules on the first floor [37]. Given the client, it does not come as a surprise that Van Der Meeren used a large number of Eternit products in the building, from waste pipes and insulation, to (translucent) corrugated sheets, doors and partition walls made with Glasal and Exterelo façade panels. As the building had to be a full-scale showcase for Eternit products, this left little room for the architect. In his next two projects, new buildings at the VUB campus, and especially the building with socio-cultural facilities, Van Der Meeren had the latitude to experiment more boldly on a technical level.

In December 1978, the board of governors of the VUB ratified the decision to build extra student homes. The following spring, an order for 28 Variel modules was given to Jumatt, the new owner of the Variel factory in Seilles. By this time the dimensions of the modules had changed to 2.7
m by 10.8 m so the length was 4 times the width. However, this did not benefit Van Der Meeren entirely as he did not change the orientation of the modules to enhance their integration with the existing complex. The layout of the units at the ground floor level differed slightly from the earlier student houses because the new ones were designed specifically to house disabled people: each apartment contained a double bedroom with a private bathroom, accessibility was improved and door openings were widened [38]. The materials used in this green cluster were different from those used in the original student houses. Some of the heavy concrete components were replaced by lightweight materials. The inaccessible roof elements and bathrooms were executed in timber instead of concrete - probably influenced by Jumatt’s expertise in dry building constructions. Instead of concrete panels, the façades were made of timber frames covered with Glasal asbestos cement panels, and were finished with plasterboard on the inside.
the ‘Kultuurkaffee’ at the VUB campus (2015)
On the edge of the campus, less than 100 m from the student village, a new building for socio-cultural activities arose in 1980-1981. It housed a multipurpose (exhibition) room and the café KultuurKaffee within 29 Variel modules. The most unusual feature of this building was the composition of its walls. In collaboration with Jan Van Loeij, at the time professor building physics at the VUB, Van Der Meeren introduced a system of passive solar energy in the southeast and southwest façades of the building. The interest in passive solar energy was stimulated by the second oil crisis and increasing energy prices. The system used was based on a particular composition of the walls called ‘Trombe’: glass sheets were placed in front of the concrete walls that were painted black to absorb as much heat as possible. By means of ventilation valves in the baseboards, indoor air was conducted through a cavity behind this concrete wall, where it was warmed and increased the indoor temperature. During summertime, the valves were closed to avoid overheating. As the system was part of a research project, both single and double glazed windows were used, and the difference between them was monitored [39]. The façades that did not receive sunshine did not have Trombe walls, but rather dark brown Glasal panels made of asbestos cement.

This building was demolished in August 2015 to make room for a new residential complex for students, and this was an opportunity to do some destructive research and collect material samples. When investigating the anchor points of the post-tensioning cables at the base of the portal frames, four anchors were discovered, rather than the two or three in the student houses. This demonstrates once again that the Variel system, although it was a manufactured system, was capable of being varied and adapted to particular requirements. The anchor heads were corroded, yet the actual anchorage and the cables were not affected [40].
young heritage under pressure

Recently, 20th-century built heritage, and in particular post-war heritage, has been gradually receiving attention for its architectural and historical value [41]. This heritage, which makes up a substantial part of our built environment, has reached a critical point: having stood for approximately half a century, many buildings are in need of repair. Should they be preserved, renovated, demolished or any possible option in between? Making informed decisions is complicated by the fact that even researchers, historians, scholars and experts, let alone the public at large, find it difficult to interpret and value this architectural heritage. Often the broader context within which to evaluate a building is still lacking. Was the building experimental, innovative or typical for the period in which it was built? A predecessor, or one of the few examples left of a structural type or style? The first steps to construct such a context have been taken and several research projects have been completed [42], yet there is still an urgent need for more surveys and in-depth investigations, especially when it comes to contemporary building materials and construction techniques.

The Variel system is a typical example of post-war developments and innovations in the field of construction and building techniques: a system of prefabricated elements designed for rapid and cheap construction. As such, it was congruent with international trends yet also had national and regional characteristics. The book on Fritz Stucky and the Variel system published in Switzerland in 2006 nicely illustrates this: the system is situated within the history of architecture and construction in Europe and thus becomes part of the built heritage. The book also shows that the detailing, technical design and use of materials were related to the precise context, licensee, specific timeframe, building codes and environmental regulations. The publication is an important source of information, yet two important aspects are missing. It provides no information on recent
renovation campaigns, the condition of the buildings today and how they are perceived. Moreover, Belgium is almost completely absent from the study. Yet our research shows that Belgium fits perfectly within this history, since there was a Belgian patent, a Belgian factory, a national version of the international system and several realizations. The evolution in the use of materials and technical detailing found in the buildings on the VUB campus also show that the modules of the successive building phases corroborate the seeming paradox of regional internationalism, whereby an internationally patented system was adapted to create a national variation.

Van Der Meeren put the properties and benefits of the system to good use. His projects, especially the buildings on the VUB campus, have achieved an iconic status. The value of having an architect like Van Der Meeren work with the Variel system in terms of architectural quality can be seen by comparing his work with other applications of the system. No monotonous assembly or anonymous blocks in the student village, but rather a fanciful layout and surprising vistas and volumes. Not only are the buildings of the student village high quality, but so is the ‘negative,’ residual space between them: he created a pleasant living environment, with a gradual transition from collective spaces to individual rooms. No boring hallways or uninspiring stairwells, but new perspectives in which nature and architecture are balanced. As for the quality of the living space, the combining of four student rooms into one apartment, and the way in which Van Der Meeren accomplishes this, are architecturally appealing.

The layout of the student houses is, still today, very interesting. Moreover, many students have enjoyed living in these apartments; they testify to the agreeableness of the spaces created with a minimum of means. The urban and architectural values remain, and the buildings are still structurally sound: samples and destructive research show that the materials are often in very good condition. The structures in reinforced and post-tensioned concrete show hardly any damage. On the other hand, after forty years of intensive use the finishing materials need refreshing. The student homes are a valuable and high quality entity from the standpoint of urban design, architecture and technology. Yet their future is highly uncertain. Despite its apparent heritage value, the student village is not listed as a monument. It is threatened by a large-scale development project, to build approximately 650 student homes, on the campus. The socio-cultural activities building has already been demolished to make room for this development. And 20 of the blue modules in the original student village have been demolished for the expansion of the VUB swimming pool in a neighbouring building. Also other Variel buildings, like the Etercenter in Kapelle-op-den-Bos, are threatened with demolition [43].

The student village, or what remains of it, is considered as the most interesting result of the collaboration between Van Der Meeren and Variel. Furthermore, as it is still largely intact, it offers an extraordinary and unique opportunity to preserve and revalue this part of our architectural heritage. However, if the modules must be removed, it is possible to revive Van Der Meeren’s original idea of ‘mobil-homes’ because the modules can be relocated. Indeed, the university undertook an experiment to try to move and reuse two modules that were going to be demolished. Before moving them, the horizontal connections in the floor (a small welded plate) and ceiling were cut. The modules and roof elements were lifted, using the original hoisting anchors (in the portal frames) or new anchors (for the roof elements), put on a truck, transported to the other side of the campus, and lifted again and placed in their new positions. Although it is regrettable to see the student village partially amputated, and ideally, to preserve the architectural and landscape qualities, the buildings should remain in place, still the successful outcome of this experiment shows that the modules can, on a new site, continue to contribute to future, sustainable building projects.
Archive A&D 50 vzw, Mechelen.
Archive Technical Service VUB, Brussels.
Centre for Academic and Secular Archives (CAVA), VUB, Brussels.
Private Archive of P.D., Oudergem.


[3] The proposed ‘Law regarding special conditions to encourage the private initiative when erecting a cheap house and acquiring small land properties’ was submitted in May 1947 by the Member of Parliament (and later Minister of Health and Family) Alfred De Taeye. He considered the actions to recover from the war to be insufficient and wanted to solve the housing shortage, both quantitatively and qualitatively, with this law. See for instance Theunis K., ‘De Wet De Taeye. De individuele woning als bouwsteen van de welvaartsstaat’, in: Van Herck K., Avermaete T. (eds.), *Wonen in welvaart. Woningbouw en wooncultuur in Vlaanderen, 1948-1973*, Antwerp, 2006, p. 68-70.

Converted in the today’s euros and including VAT, this corresponds to 144,000 and 152,000 euros, which comes close to the cost price of turnkey bungalows put on the market today (For instance Danilith offers a turnkey house of 120 to 130 m² with four bedrooms, completely finished, for 150 to 160,000 €. See http://www.danilith.be/nl/bouwen/comfort/warwick). For the conversion, the price index from 1975 and 2015 (basis 100 in 1971) was used; see http://www.vub.ac.be/SGES/scholliers1.html and http://statbel.fgov.be/nl/statistieken/cijfers/economie/consumptieprijzen/.

An example of the critical attitude is given in the publication ‘Préfabrication: mythe ou réalité?’, accompanying the exposition organized in the Design Centre in Brussels in 1970, in which Renaat Braem stated that it was often buildings such as these that confirm his opinion that Belgium was ‘the ugliest country in the world’.

Villa expo Limal, op. cit., p. 96.


De Kooning M., Willy Van Der Meeren. Architectuur. Stedebouw. Design. Research. Onderwijs, unpublished doctoral thesis, Ghent University, 1997 (introduction, no page numbers). The rational undertone in his design is also illustrated by the use of the SAR-grid as underlay in his projects from 1967 onwards. The SAR-grid is a modular sizing system, based on 30 cm, developed in the Netherlands by John Habraken and other members of the Stichting Architecten Research.


De Kooning, Horta and After, op. cit., p. 194.


[25] In some drawings, the structure and size of the Variel modules are not clearly discernable, yet the layout reflects the final design, with central staircases for eight apartments each. Since those drawings are not dated, it is difficult to position them chronologically in the successive design stages.
[26] Jenatsch, op. cit., p. 117
[29] Archive Technical Service VUB, Brussels; Jenatsch, op. cit., p. 16
[30] This became clear during the demolition of the socio-cultural activities building in the summer of 2015. See also De ViDts, op. cit., p. 88.
[31] De Kooning, Willy Van Der Meeren, op. cit., p. 245.
[32] Ibidem. In an archival document of the contractors Van Riel & Van den Bergh, dating from November 1972, the total cost price of the student homes is estimated at 74,619,000 francs (Archive Technical Service VUB, Brussels).
[34] Ibidem.
[35] As for the connection between the prefabricated portal frame and the floor slab, both pre- and post-tensioning systems were commonly applied in other countries. In North Germany and Switzerland the Dywidag system was mostly applied. In France the Freyssinet patent prevailed (according to the book by Jenatsch). However, as most of the systems were patented, details of the connecting methods generally were not provided in building specifications. The patent of the company founded by Stucky, Elcon AG, entitled ‘Brevet d’invention. Structure préfabriquée et procédé pour l’établissement de ses joints’, which was issued in 1971 in Belgium, more or less simultaneously with the design of the VUB student homes, mentioned two options. The first method consisted of casting two short horizontal steel anchorage bars in the longitudinal ribs of the floor slab. The frame was then slid over the anchorage bars and fixed by post-tensioning the bars. This method implies that the capacity of the floor slab was not influenced by the condition of the anchorage bar. In the second method, the steel strands for post-tensioning the floor ribs ran through the columns of the frame, meaning that the anchors assure both the post-tensioning of the slab and the rigidity of the connection. In the latter case, the strands were inclined as they run through the rib. Initially a visual inspection of the two anchorage points of the concrete frames did not give a decisive answer which of the two connection systems was used for the student homes, yet during the partial demolition of the modules in August 2016 it became clear that the second system was used.
[37] The building has been renovated and the floating aspect has disappeared, as the ground floor is now also closed.
[38] Archive Technical Service VUB, Brussels.
[40] Investigations by the authors in the summer of 2015.
[42] See for instance note 41 and Van De Voorde, Post-war building materials, op. cit.
[43] In two years’ time, the Etercenter should have made room for a new building.
cover, 28-29: photograph by Hilde Braet, circa 1990 [Centre for Academic and Secular Archives (CAVA), VUB, Brussels].
4-5: photograph by Jean Laurent, 1975 [Centre for Academic and Secular Archives (CAVA), VUB, Brussels].
6-7: photographer unknown, 1973 [Archive Technical Service VUB, Brussels].
8<, 8>, 10-11, 12-13, 18, 20<, 20-21: from commercial leaflets by Variel Belgium [private archive P.D.].
14-15, 16<, 16>, 17: drawing and pictures of the former Variel factory in Seilles [private archive P.D.].
24<, 24>, 26<, 26>, 26>, 27, 32-33, 49, 50-51: archival documents by Willy Van Der Meeren [Archive A&D 50 vzw, Mechelen].
25, 30-31, 37, 38<, 38>, 39<, 39>, 40>, 40<, 40<->, 40->, 40<, 40<->, 43<, 44<->, 44<->->, 45<-><-><->, 50<, 52, 53<: photographs by Ine Wouters, 2015-2016.
34-35: watercolour by Roger Reip [Kunstpatrimonium VUB, Brussels].
42<: advertisement Eternit: A.C.E. [La Maison, 1969, n° 12.]
42>: advertisement Eternit: Gyproc [La Maison, 1956, n° 11.]
42>: advertisement Eternit: A.C.E. [La Maison, 1968, n° 2.]
42>: advertisement Eternit: Gyproc aluminium [La Maison, 1956, n° 12.]
46<: advertisement Eternit: Fiberglas [La Maison, 1964, n° 8.]
This publication is funded by the Brussels Capital Region through the Innoviris Strategic Platform Environment 2012: Brussels Retrofit XL (www.brusselsretrofitxl.be).

The authors wish to thank the Board of Directors, the Technical Service and the Centre for Academic and Secular Archives (CAVA) of the Vrije Universiteit Brussel, the Museum of Old Techniques (MOT) in Grimbergen, as well as prof. Mil De Kooning and A&D 50 vzw, Pierre Durt (former Variel Belgium), Anita Verhest (Jumatt NV), Kris Asselman (Eternit NV), for the use of archival and graphical information. We would also like to thank colleagues and (former) students of the department of Architectural Engineering of the Vrije Universiteit Brussel for sharing their insights.
During the post-war period, house building in the Brussels Capital Region, as elsewhere in Europe, boomed. Yet these once so modern buildings are aging. But how do you renovate or transform a post-war building properly, so as not to lose the elegance and liveliness of its original design?

This book sheds light on the construction of one particular post-war residential complex in Brussels, namely the student houses on the VUB campus in Elsene, designed by architect Willy Van Der Meeren in 1971-1972 and built in 1972-1973. The structure of the buildings is made with 3-dimensional open modules in precast concrete called ‘Variel’, while the façades, inner walls and floors are finished with various types of thermal and acoustical insulation, cladding panels, finishing materials, etc.

By ‘deconstructing’ the student homes, it becomes clear which materials were used and how they are connected. This will aid in retrofitting the buildings of this complex and similar projects. The information on the materials that were used leans on previous research on the characteristics of typical and innovative building materials produced in the post-war period, which is available via www.postwarbuildingmaterials.be.