

Innovation of the Dutch window frame: The Kapla® Concept

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ABSTRACT: The development of the Kapla® window frame means a breakthrough in the timber window frame market in the Netherlands. This development is a typical example of a combined process and product innovation, a joint project with the relevant branch organizations. The success of the Kapla® window frame proved that the methodology developed works well for such innovations. Special tools for mounting the window frame have been developed.

KEYWORDS Building System, Window Frames, Multidisciplinary Design.

1. INTRODUCTION

Within the building process in the Netherlands, the window frame has a special place. Traditionally, the window frame is placed first, before further work to the façade is started. In this process, the window frame is used as the basis for positioning the other parts in the façade, such as the masonry. This gives a typical Dutch image of a building site in the early stage (see Figure 1.). The vulnerable timber, primed but not finished, window frame has to withstand all weather conditions in the building stage. Also, all materials needed within the building are transported through the frame, frequently leading to damage and therefore extra costs.

In this paper, an innovative change of the Dutch window frame is presented. This innovation could not have been successful without cooperation between branch organizations of carpenters, brick factories and the window frame industry. The innovation described is a success thanks to the integral approach of innovation of the product and of the process.

2. THE TRADITIONAL DUTCH WINDOW FRAME

In the current Dutch building practice, the window frame has an important function for the brick laying process. The bricklayer uses the window frame to outline the brickwork. This means that the window frame is placed at the early stage of



Figure 1. Typical image of Dutch building site; first placing the window frames

the building process. This leads to a number of problems:

1: The window frame is present during the whole building process, and has to withstand all influences year-round. Building materials, workers and equipment are entering the building through the frames, and weather effects can freely effect the frame. All this has a negative effect on the quality of the window frame. Often, a large

amount of small damages are present on the window frame when the building is finished.

2: Many parties are involved in the mounting of windows and doors, for:

- Positioning
- Mounting the frame
- Glazing
- Mounting doors
- Painting
- Plastering the edges

The latter activities are done at the final stage, just before finishing the building. This increases the need for coordination needed throughout the process, and consequently the costs.

3: Most of the work on the frame is done on the building site, from the outside of the building. This is very labour unfriendly, and leads to planning problems in case of bad weather.

4: The traditional window frame is not demountable;

5: The design lifetime of the brickwork usually determines the design lifetime of the building. Window frame usually has a shorter lifetime.

As a result, in the Netherlands, often tropical wood species are applied. Also, there is a growing dissatisfaction about:

- The uncertainties in the planning of the weather sensitive activities
- The life of the frame compared to the life time of the building;
- Restricted productivity on the building site;
- Use of tropical wood in buildings.

It is not possible to mechanize the painting and glazing process on the building site. Therefore a new approach to the typical Dutch, timber, window frame was needed: A multidisciplinary, sector-exceeding approach was chosen, to come to a combined product- and process innovation. This innovation would also open the way to use other wood than tropical wood.

3. COMBINED PROCES AND PRODUCT INNOVATION

Innovation in building are initiated by different parties. Traditionally, two types of innovation are applied, which are the domain of different parties:

- Product Innovation is the domain of the building industry. The industry needs to innovate to continue their business. Most

parties have an R&D department. The industry is very money intensive, has a long-term vision and has continuity in employees. Most innovations concern innovations on the product itself or on the production process. In situations where mounting is also done by the industry, process innovations are influenced or encouraged.

- Process Innovation is the domain of the building contractors. Innovations are motivated by money-saving or by rules by government, e.g. for working conditions. Most parties do not have an R&D department.

Product innovation and process innovation are incremental innovations. Small steps lead to a more and more optimised product or building process. In current Dutch and future international building codes, performance based design becomes more and more important. Design rules are no longer based on products, but on the functions that need to be fulfilled. This opens the way for a new approach of designing building parts, and requires a breakthrough for both the building industry and the building contractor. Such a breakthrough can only be possible by innovating both products and process simultaneously. These innovations are characterized by:

- Dissatisfaction about the functions that are fulfilled by a building part, which can not be solved by product or process innovation solely.
- Involvement of branch organizations of both building industry and contractors.
- Projects over many years, with increasing role for the building industry.

These innovations are necessary in cases where building parts are built from mass product and assembled by many, mostly small, companies. In the Netherlands, this is typical in building domestic dwellings. In many cases, these innovations include one or more forms of mechanization or prefabrication.

The development of the Kapla® window frame is a successful example of such an innovation. The branch organizations of the joiners, brick layers, and contractors have supported this project from the beginning.

4. THE KAPLA® PROJECT

The idea for developing an innovative window frame for the Dutch market, based on a change in both the product and process, was motivated by the list of problems in the traditional window frame, both in the product (damaged window frames during erection) and in the process (co-ordination between parties, and labour friendly working).

4.1. The project team

A steering group guards the process of the project, with the financing parties and TNO as secretary. The work is done in several working groups, in which both industrial parties and building parties take part. These working groups are led by a TNO project leader.

The Kapla® project was initially supported by:

- Branch organizations of Building Contractors, currently BouwNed;
- Branch organization of joiners NBvT;
- Branch organization of brick layers AVM;
- The silica block industry CVK;
- The union of Dutch Architects BNA;
- The labor union FNV;
- Building product industry

4.2. The structure of the project

The Kapla® project is one of a range of projects in which combined product and process innovation is done. These projects are so-called building-part projects. These project are structured by a phase-by-phase approach. The phases in the Kapla® project are:

1: Exploration phase

In this phase, a neutral party (in this case TNO) explores the need for innovation of the building part under consideration. Both the needs for product and for process innovation are investigated. This part usually is paid from subsidies, and none of the intended parties are yet involved, other than as interviewed partners. This phase typically takes one year, and is finished by a go-no go decision.

2: Project definition phase

If the needs for innovation are clear, the project definition phase is initiated. In this phase, branch organizations are usually contributing to the project. In this phase, the requirements for the

final result of the projects are defined. This phase typically takes one year.

3: Development of concepts

The required result may be defined in terms of one or more concepts. For the Kapla® window frame, a new concept was required, with the following specifications:

- The new concept has to fit into the building process, where the brick layer uses the window frame as basis;
- There was a need for an early closing of the window spaces during the construction phase;
- Tools need to be developed for mechanized mounting of the frame;
- The price for this new concept is not more than the traditional concept;
- A shift of labour from the building site to the factory is needed.

Based on these demands, the Kapla® window frame was developed.

4: Building of prototypes and testing

When the concept is ready, prototypes have been tested in the laboratory to prove the performance. Application of the Kapla® concept in a real building was used to test the applicability of the concept in full scale, and as a check whether the specifications of point 3 are met. After successful implementation, the new window frame was made available for small-scale projects.

5: Introduction in building practice

The Kapla® window frame was applied first in projects with domestic dwellings. The results were used to improve the window frame concept. The mounting of the window frames was coordinated and monitored by the project team. After these initial projects and after making necessary improvements, the Kapla® window frame was ready for introduction in practice.

6: Knowledge transfer and training

For a successful implementation of the new process and products in the existing process, clear and complete knowledge transfer should be aimed for. Digital techniques, e.g. video-DVD's are used to show the advantages of the newly developed product and process. Video presentations and on-line information (see e.g. figure 2) are available for:

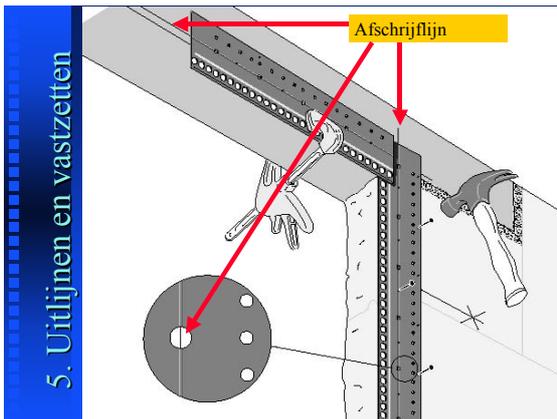


Figure 2. Example from one of the instruction manuals for mounting the Kapla® window frame

architects;
 cost calculators of the contractor;
 window frame manufacturer;
 mounting personnel;

Finally, courses for all parties involved in the building process are given.

5 THE KAPLA® FRAME

The project resulted in a number of innovations, both in the process and in the product. Special equipment has been developed to make mounting quicker and easier.

5.1. Process innovations

A temporary window is placed at the early stage of the construction of the façade. During construction of the building, no work is done on the window frame. At the end of the construction period, the temporary window is removed and made available for recycling. The Kapla® window frame is manufactured in the factory, including priming, finishing and glazing. It is installed by using a special device and a crane.

In table 1, an comparison is given of the activities needed in installing a traditional and a Kapla® window frame.

TABLE 1. Comparison of activities in the building process of the traditional window frame versus Kapla window frame

TRADITIONAL	KAPLA®
Structural work phase	
storage at building site	
measuring	measuring
supply, lifting and mounting by hand	placing Kapla strip, and placing temporary window
placing of thermal insulation	placing of thermal insulation
brick working	brick working
joining	joining
demounting scaffolding	demounting scaffolding
Plastering the edges	Plastering the edges
Completion phase	
cleaning	Mechanical placing of frame
glazing	
finishing outer side	
placing windowsill	placing windowsill
woodwork inside	woodwork inside
completing door and window furniture	
repairing glass	
finishing inside	

5.2 Product innovations

The concept of a temporary window is not new, but the way this window is fitted in the structure, using the mounting structure for the Kapla® frame is innovative.

A special Kapla® strip was developed to make the placing and mounting of both the temporary window and the Kapla® frame easy and accurate. This strip is giving a contribution to the air tightness of the building and is also basis for plastering of the edges.

5.3. Mechanization

Special tools have been developed for transporting and mounting the Kapla® window frame. The window frames are placed on a special structure, which ensures an easy to handle process on the building site (see Figures 3 to 5).

For placing the frame, one person is handling the mobile crane which carries the special Kapla® hook. The window frames are carried to the

position where the frames are needed. Two persons guide the frame from the inside into the position. Using three specially developed clips, the frame is secured, and using 10 bolts, the frame is fixed in its final position. In this way, about 2 houses per day are served.



Figure 3. Placing of the Kapla Window Frame



Figure 4. The window frame in the special mechanical device

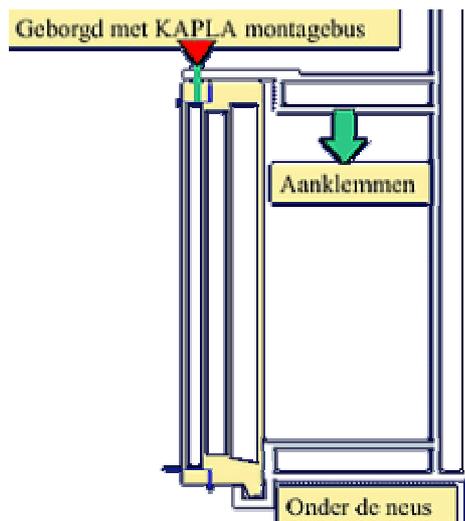


Figure 5. Fixing the window frames on the clamp on site

6. CONCLUSIONS

The Kapla® concept is a successful alternative for the traditional Dutch timber window frame. The methodology developed for this project has proven its applicability.

The national introduction is coordinated by the Timber Information Center in the Netherlands.

The amount of Kapla® frames installed is small, but every year an increasing number are installed.

The methodology developed forms the basis for further process and product innovations, such as new concepts for the building façade, floors and installations.

The price for a Kapla® window frame is potentially smaller than the traditional frame. An increase of installed Kapla® window frames is necessary to achieve this.

Experience with many projects, including several different windows and doors, is needed to identify the need for improvements.

7. ACKNOWLEDGEMENTS

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8. REFERENCES

Information on the Kapla® window frame is available on the internet:

<http://www.tno-kapla.info/>