

# IFD Building<sup>1</sup> in Europe

A blueprint for production and delivery of customer satisfaction oriented buildings

Geert-Jan van den Brand

Co-authors: Hans van Gurchom and Ton Damen, Damen Bouwcentrum

*Damen Bouwcentrum, PO Box 598, 2600 AN Delft*

*Technische Universiteit Eindhoven, PO Box 513, 5600 MB Eindhoven*

**ABSTRACT:** This paper discusses the advanced concept of Industrial, Flexible and Demountable (IFD) building. The IFD concept aims to balance the interests of all construction industry stakeholders. The use of industrial building methods for offices, schools and factories has gained broad popularity in the practice. However, the building clients conventional view does not give high appreciation on uniformity in terms of modular and industrialised components of architecture. Besides, the fragmented nature of the construction sector, which concentrates mainly on cost-based competition, provides little incentive for innovations. The office of Damen Bouwcentrum in Delft can be considered as a breakthrough out of the traditional culture in the construction industry. The IFD based office building received the grant from the Dutch innovation programme. It has been presented as a response to the changing market, from supply-driven to demand-oriented. It is an example of projects where the construction industry is encouraged to cooperate in the search for better alternatives. Based on the experiences in the project and being inspired by the exploration of the IFD market potential, a European research project has been conducted. The project results in:

- an IFD organisation model, based on comakership;
- an IFD process protocol for the development, production and delivery of IFD buildings, and
- a system morphology for IFD buildings: dwellings and offices.

The implementation of the IFD concept into the traditional construction industry is not simple. The Dutch IFD programme demonstrates the availability of innovative technology. The real bottleneck appears to be the organisation of the construction process. Implementing the concept of co-makership will bridge the gap and lead to a substantial breakthrough in the construction industry.

**KEYWORDS:** building process innovation, industrial, flexible, demountable, customer satisfaction, collaborative engineering, comakership, product development

## 1. INTRODUCTION

IFD Building stands for Industrial, Flexible and Demountable Building. Originally IFD is a Dutch construction innovation programme, challenging the construction industry to improve their overall performance. Some characteristics of IFD are summarized in table 1 (Source, v.d. Brand and Vos; 1999). The primary motive for *industrial building* is the improvement of the building production process. *Flexible buildings* aim at the fulfilment of the user's demands and wishes at the first delivery of a building and the following periods. The primary motive for *demountable building* is reducing environmental pressure. Industrial, Flexible

and Demountable construction principles are not brand new. For some time, innovative designers and suppliers have been active in developing new industrial concepts and products for the construction industry, which could justifiably be included into the IFD category. However IFD has a Dutch origin, its potential certainly reflects the whole European construction industry.

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<sup>1</sup> IFD Building is Industrial, Flexible and Demountable Building

Table 1.

	Characteristic	Explanation
Industrial	Assembly	production preparation in the factory, on site only assembly, no improvisation on site.
	Project independent product development	Repetitive use of developed product, re-use of knowledge and experience.
	Weather independent	Building progress does not depend on weather and wind
Flexible	Freedom of choice	There's enough attention for freedom of choice of first-use users.
	Adaptability	Successive users adapt the building to their specific needs
Demountable	Building re-use	Buildings can be adapted to new functions
	Recycling	Building components or parts are suited for worthwhile re-use
	Waste reduction	The production of waste is reduced

## 2. EXPLORING THE IFD MARKET POTENTIAL

In 1997, Damen Consultants carried out an investigation into the market potential of IFD Building (Damen 1997). The Dutch Ministry of Economic Affairs published the results. The main conclusion that came from this investigation was that IFD building principles embodied an integrated concept, which could unite environmental and economic interests by offering creative solutions to the use of raw materials, labour and technologies. IFD balances all construction industry stakeholders' interests (figure 1).

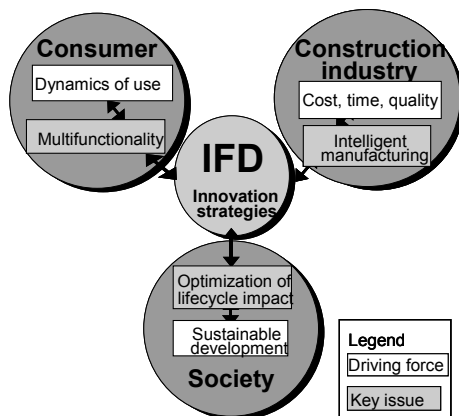


Figure 1. IFD balances industry, consumer and society interests

The use of industrial building methods for offices, schools and factories has become more or less common practice. In some circumstances containing pressing demands for temporary accommodation as the result of

natural catastrophes or war, IFD construction methods have been proved to be an appropriate choice because of the speed at which buildings can be erected and the fact that a uniform solution can be offered in response to tremendous volume requirements. In the conventional market, uniformity has been less appreciated since "modules" and "industrial products" are not favourable to the commissioners of building work. They want a building that reflected their own companies' identity, not just as one of many others. A solution to this dilemma can be found in the flexible product automation whereby standard basic modular products can be adapted to the customer's specific requirements and desires from project to project.

Until now, however, these developments seem to come to an end after the one-off application of IFD concept or product in a single project, and it has not been proved possible to take the next step to products, which are totally unrelated to a specific project. The construction industry is not used to project independent innovation and long-term co-operation. They spend no more than 10% of their annual turnover on R&D, and even then most of that investment can be attributed to the suppliers. The fragmented nature of the construction sector, with many small businesses, and the way in which tendering is mainly concentrated on cost-based competition, provides little incentive for innovation. The European Commission's report on the competitiveness of the construction industry (EU 1997) shows this applies to the construction industry all over Europe.

### 3. IFD EXPERIMENTAL PROGRAM

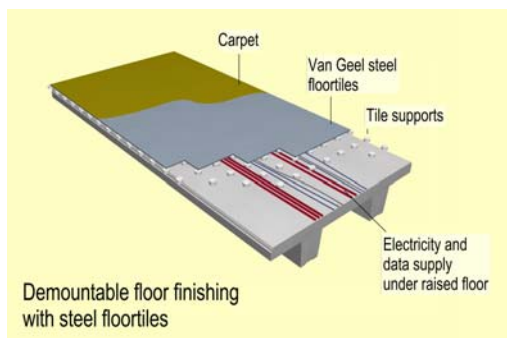
As a result of the exploratory study, the Dutch government started up the IFD (Industrial, Flexible, Demountable) building program. Their aim is to promote the application of IFD construction principles by the industry and the market, so that the method can become embedded in conventional building practice. It must demonstrate it is possible to build more consumer-oriented, with better labour conditions and deliver a higher building quality.

The initial acquisition of projects took place in the spring of 1999. From each tender, the best and most renewing projects will be selected as demonstration project. The project-tenders of 1999, 2000 and 2001 together acquired 286 project submissions, 71 demonstration projects were eventually selected. They serve to

demonstrate innovative applications of IFD technologies, for new construction and renovation, public housing and utility building projects. The intention of the demonstration projects is to stimulate other parties to make use of IFD techniques. The last round of acquisition will take place in the autumn of 2003.

#### 3.1 IFD example project: Delftech Office

The office of Damen Bouwcentrum and ABT was one of the granted IFD projects in the first round. This provided the opportunity to put the IFD ideas into practice. The intention was to develop a prototype for an office for SMEs. For that purpose a consortium of designer, contractor and suppliers was set up. The design starting points were: **long life, loose fit, low energy and less waste.**



Figures 2. and 3. IFD Delftech Office of Damen Bouwcentrum and ABT in Delft, The Netherlands, floor composition (2), façade picture (3).

The IFD Delftech Office consists of two office-wings, separated by an atrium. Car parking is provided on the ground floor. If this parking is redundant this space can easily be transformed into extra office space. Also an extra floor can easily be added, and for that purpose the load bearing structure can be reinforced later on (long life). Most building parts are produced industrially and assembled on site. The load bearing structure consists of prefabricated demountable columns and beams of steel and concrete. The prefabricated and demountable floor elements are made of concrete, extra span cables and reinforcement strips enable to carry additional load in time (figure 2; loose fit, less waste). The building has double façade, the internal one consists of interchangeable (open and closed) parts, while

the outer skin is fully glazed with a sunscreen for cooling (figure 3). The shaft in-between is ventilated (low energy).

When the aspects of 'industrial, flexible and demountable' are considered, the process can be evaluated as partially successful. Some new innovative solutions that fit the IFD concept were successfully developed and implemented. However, the construction process itself took more time than originally planned (+50%). In addition to this, the mutual collaboration in the design phase of the project was dysfunctional. The result was a change of contractor in the building team. At the end, most of the actors were satisfied about the result, but the client was less satisfied (van Gurchom, 2002).

### 3.2 IFD program first results

While there is plenty of interest in IFD construction products and ideas from the supply side, there still is little interest from the market, and IFD construction principles are still far from becoming the daily practice in the construction industry. In recent years, however, the users of buildings have become more outspoken, and the requirements and wishes they are now expressing display far more dynamics and variation than ever before. At the same time, the market is changing from the supply-driven one to the demand-driven one, and these are compelling the contractors to seek new alternatives. At this point, Industrial, Flexible and Demountable construction techniques can meet the expectations and offer many advantages.

## 4. IFD BUILDING IN EUROPE

### 4.1 Project outline

Based on the experiences with our own office and inspired by the exploration of the IFD market potential we have defined a European research project to conceptualise and develop the organisational, technological and commercial framework and supporting communication/information system to deliver client-oriented Industrialised, Flexible and Demountable (IFD) Buildings –in short *IFD Buildings*. The research consortium comprises all key building partners: principal organisation, architect, contractor, service contractor and research institute, from Italy, Finland, France, The Netherlands and the UK. The project results are:

- an IFD **organisation model**, based on **comakership**
- an IFD **process protocol** for the development, production and delivery of IFD buildings, and
- a **system morphology** for an IFD buildings: houses and offices.

### 4.2 IFD organisation model

The IFD Buildings project starts from the initiation of an **IFD co-maker consortium**. IFD partners will collaborate in a long-term relationship and build upon mutual knowledge and experience. They will invest in market research and image-building around their product brand. At the same time they will explore possibilities to establish long-term relationships with their customers (‘join the IFD family’). For this purpose an integral organisation model has been set up, containing 4 main clusters: **market research, product development, production and sales** (figure 4). Within these clusters the essential processes supporting IFD have been worked out (table 2). By adopting the IFD approach a serious change in roles will occur. Table 3 briefly describes the effects of changing from a traditional approach towards IFD Building.

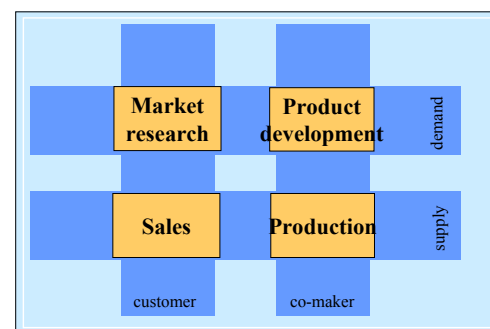


Figure 4. IFD Building organisation model

Table 2. IFD process outline

<b>Market research</b>
• Market survey
• Client profiles
• Product market combinations
<b>Product development</b>
• Performance specifications
• Building morphology
• Product catalogue
<b>Production</b>
• Production facilities
• Production process
• Assembly and delivery
<b>Sales</b>
• PR & promotion
• Sales facilities
• Client support process

Table 3. Changing roles IFD

Party	Current role	IFD role
Building user	passive	active
Architect	designer	industrial designer intermediary
Building contractor	builder/site manager	product development assembly
Government	project approval	system approval (by certification)

One of the basic principles driving the IFD comakership process is **collaborative engineering**. The development of building concepts demands multidisciplinary team efforts. Based on market information, defined in client profiles, these concepts will be worked out in detail. In order to reach an optimal product in terms of costs and productivity production and sales representatives will be actively involved. This will reduce the time to market of these products.

### 4.3 IFD product

Within this project an IFD building system has been developed. The basic structure consists of three parts: a core for services and transport, space modules and a shell (façade and roof). This structure applies for both dwellings and offices (figure 5 and 6). The development from the IFD system to a specific building is divided into three steps, for housing this is done accordingly. Firstly, several dwelling types, for specific client groups, are developed. These types have a predefined external volume. Secondly, within these types various layouts are worked out. Finally, these dwellings can be materialised and fitted out according to individual customer preferences.

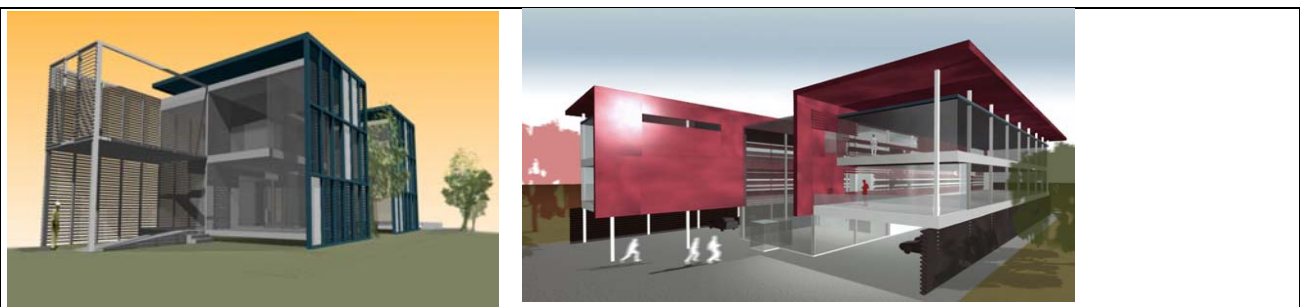


Figure 5 and 6. IFD House (5), IFD office (6) (source, IAA/Ipostudio Architetti Ass., 2003)

An IFD building is: ‘a building, assembled from pre-designed building system components. The system is based on market research resulting in product market combinations (PMC’s). The PMC’s are matches between client profiles and building types. The building system consists of a mix of prefabricated components and –if preferred- locally available materials. From this system arises a limited range of solutions focussed on predefined client groups. An IFD building is flexible –now and in the future- its components are interchangeable, expandable and replaceable to meet future user needs. This prevents the building from becoming obsolete.’

## 5. IMPLEMENTING THE IFD CONCEPT

The results of IFD Buildings project will be presented in a workshop format, in order to support training and implementation of the concept. The workshop contains three parts: aim and motivation, the co-maker model and the roadmap to implementation. This outline consists of presentations, reports, tools and assignments. Part I introduces the concepts and supports the discussion on the need for IFD. Practical tools for

marketing, design, development, production and sales of IFD Buildings are available in part II. Some of these results are worked out in an interactive format allowing people to get familiar with the IFD Building concept. On product level, as an example a practical building concept for both dwellings and offices has been elaborated. Scale models and VR presentations of these are available. Part III focuses on the definition of scenario’s for establishing IFD consortia.

The implementation of the IFD concept into the traditional construction industry is not simple. The initiative can rather be expected from the supply industry. However a mere upscaling of their existing distribution channels will not be sufficient. A new IFD company will integrate new disciplines into their enterprises. This mainly concerns marketing and customer relations. Also methods for product development will have a more remarkable position. Expertise will be mobilized to integrate client information and product evaluation results in the improvement of the development of new products.

## 6. CONCLUDING REMARKS

While the Dutch IFD program has reached the final stage, IFD principles are not yet being widely adopted. By demanding higher quality building clients are increasingly compelling the industry to seek alternatives for their traditional, labour-intensive and rather inaccurate, construction technology. This is where Industrial, Flexible and Demountable building can contribute most advantages. The IFD program demonstrates the availability of innovative technology. But, as we have experienced once more in realising our new office building, the real bottleneck appears to be the organisation of the construction process.

The approach in the European IFD Buildings project represents a new business challenge towards producing and selling of buildings, introducing the concepts of comakership and collaborative engineering (CE). These concepts respond to actual shortcomings in the construction industry and pave the way for the application of advanced technology in order to satisfy building clients. Implementing the concept of co-makership and CE will result in a significant breakthrough in construction industry. Moreover it will be a breakthrough for building end-users, who will experience an increase of building value for money.

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