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Karel Doorman, Rotterdam, the Netherlands: Unconventional with a Sense of History

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Abstract *Unconventional with respect for tradition*: The Karel Doorman building stands in the heart of Rotterdam's shopping area and is a remarkable combination of restoration and new development. On top of the Ter Meulen shopping centre - a monument of the post-war reconstruction period - we have built an extremely light-weight construction in steel and wood (See Figure 1 & 2). This unconventional building method - at least in the Netherlands - enabled the construction of a 70 metres high 'glass' residential building with 114 apartments and 156 parking places. In this way a remarkable historic Rotterdam building was preserved for the future while at the same time new housing was created on a sheer impossible location, contributing to the quality of life and social safety in this part of the city.

Keywords Light-weight construction, Timber, Flexibility, Sustainability, Urban regeneration

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1. Respectful approach

'Demolish or preserve?' That question was on our minds when we started to design the Ter Meulen building. The building was constructed in 1948 as a shopping centre for Ter Meulen, Wassen and Van Vorst and designed by the famous Dutch architects Van den Broek en Bakema. Back then, its large expanses of glass gave the building an exceptional transparency. Fifty years later, the often renovated building was languishing away (See



Figure 1. The Karel Doorman is a combination of restoration and new development. (Photo: Ossip van Duivenbode)



Figure 2. The Ter Meulen Shopping centre in 1952. (Photo: J.F.H. Roovers)

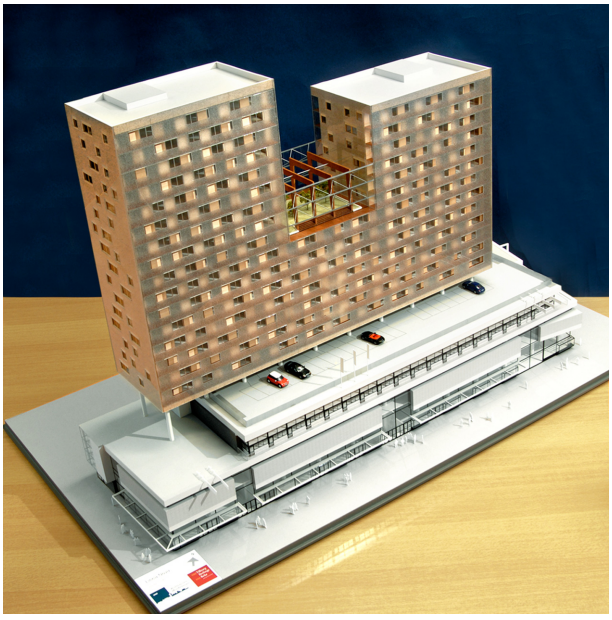


Figure 4. Top-up with ultra-light building with parking on the top floor and roof of the historic shopping centre. (Photo: Iemke Ruige)

Figure 3). We opted to restore the old building to its former glory as much as possible and 'top it up' with new homes. The new residential building is recessed in relation to the shopping centre's building line, which ensures that seen from the street the Ter Meulen building - which is home to fashion shops once more - has retained much of its former character. On the roof of the shopping centre and on the second floor an intermediate layer was added to create parking places for the residents (See Figure 4).

In this way we were not only able to preserve an



Figure 3. Fifty years later, the often renovated building was languishing away. (Photos: Ibelings van Tilburg architecten)

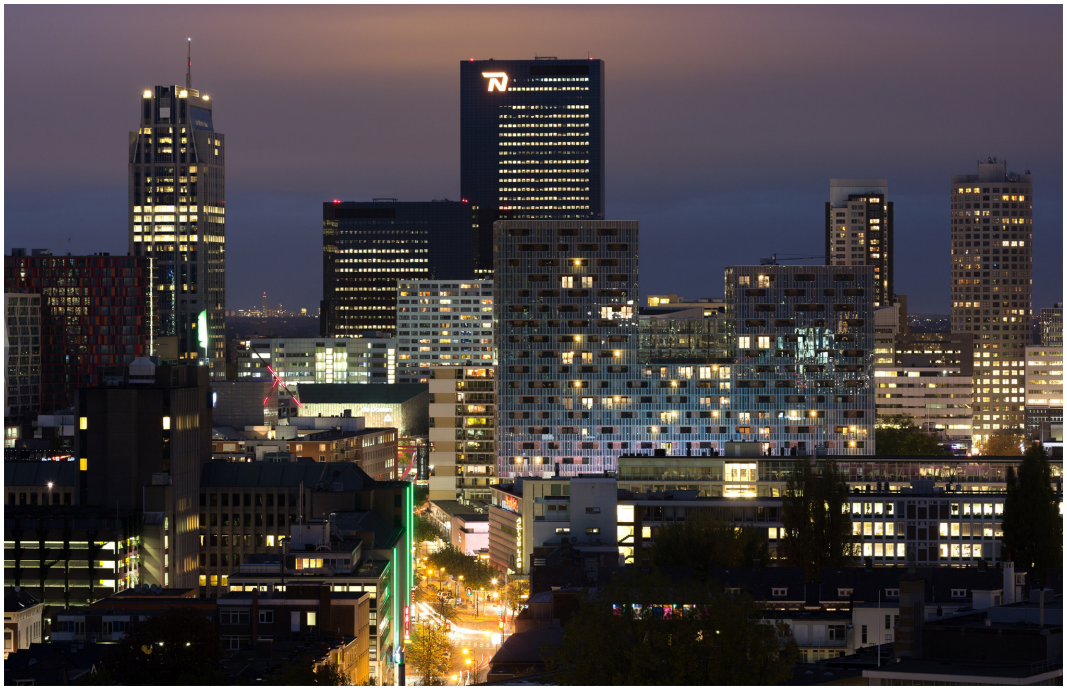


Figure 5. The Karel Doorman building has become a reference for urban intensification. (Photo: Ossip van Duivenbode)

important architectural monument, but also contributed to the repopulation of the city centre, that until then was dominated by office buildings and shops. In addition, The Karel Doorman has become a point of reference for its low-impact construction method, which eliminated the need for a large building site, which is a considerable advantage in the city centre.

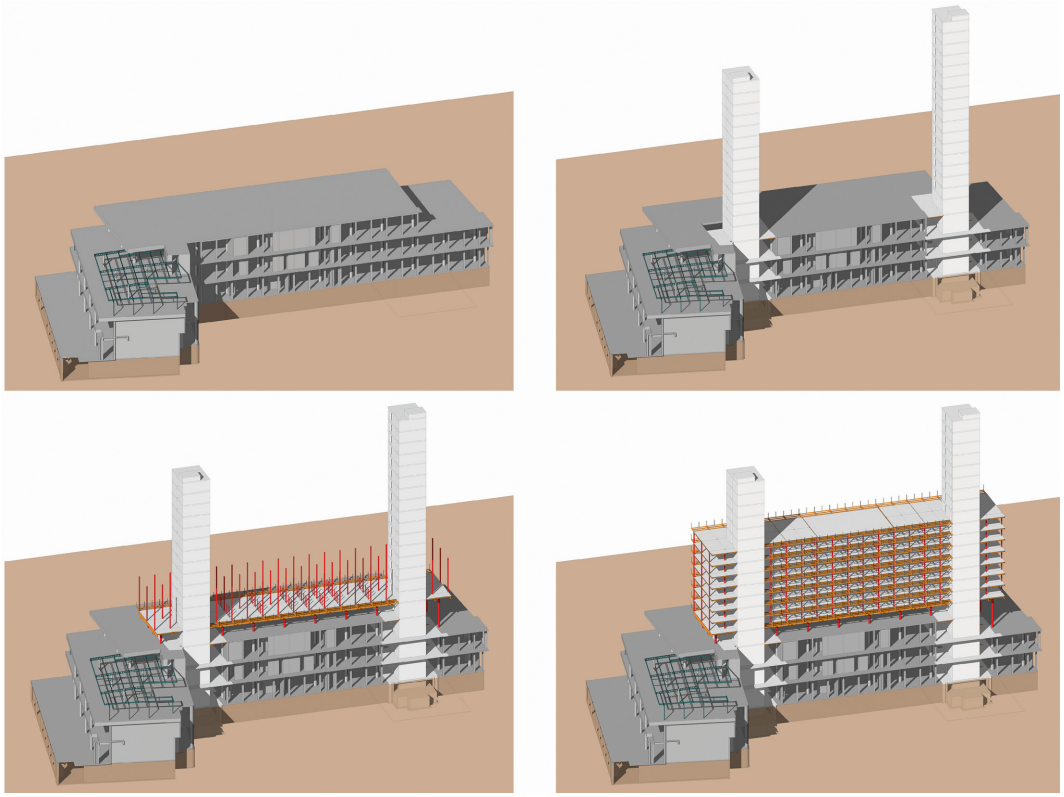


Figure 6. Structural. Existing building, new stabilizing cores, light weight steel structure & timber floors. Every 6 days one floor was added. (Images: Royal HaskoningDHV)

2. Quality of life and social safety

An urban society, economy and culture strongly benefits from a well populated inner city. The relatively low number of people living in the centre of Rotterdam is an ongoing concern for the local council. In recent years, however, the city centre population has been steadily increasing, a trend to which the Karel Doorman contributed significantly. This development has led to an increase in the quality of life and social safety in this part of the city. Over the years, the Karel Doorman building has become a reference for urban intensification while preserving the existing historical layer (See Figure 5).

3. Light-weight construction

The new construction has been placed on the pillars and foundations of the existing building. This was made possible by releasing extra load capacity in the existing building in combination with an extremely light-weight new construction of steel and wood that is five times lighter than traditional construction methods for apartment buildings (See Figure 6 & 7). This had the additional advantage that the building could be manufactured in large prefabricated elements, which could be lifted and fitted straight from the truck (See Figure 8). This eliminated the need for a large building site which is a considerable advantage in the city centre.

The apartments have a wooden facade with galleries on the outsides and a second skin of tempered glass. The glass is covered with a screen print consisting of small dots that hide the loggias and galleries from view.

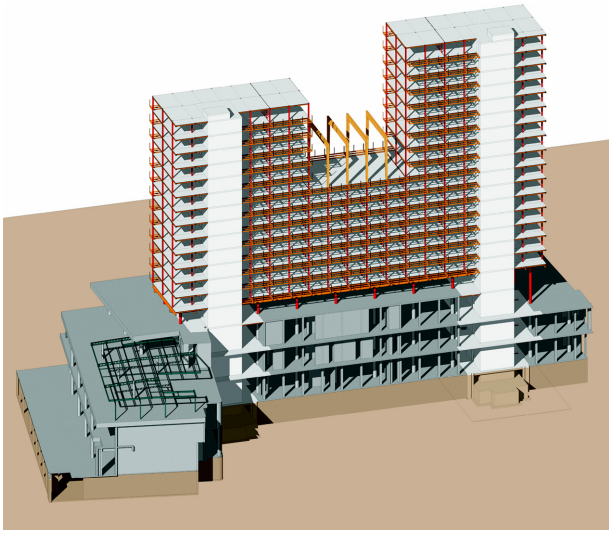


Figure 7. Between the lower and higher tower trusses of Larch timber have been placed for the roof garden. (Image: Royal HaskoningDHV)

4. Timber

There are three major areas in which timber is used on the project. The primary use is in the floor system, where a grid of laminated veneer lumber beams supports a plywood floor (See Figure 9). A secondary (non-structural) use is of prefabricated Oregon pine timber paneling, comprising the exterior envelope (See Figure 10). Wooden decking, made from untreated Bilinga is used on the top and bottom of the balconies and the decking of the 9th-floor roof garden (See Figure 11). A third use consists

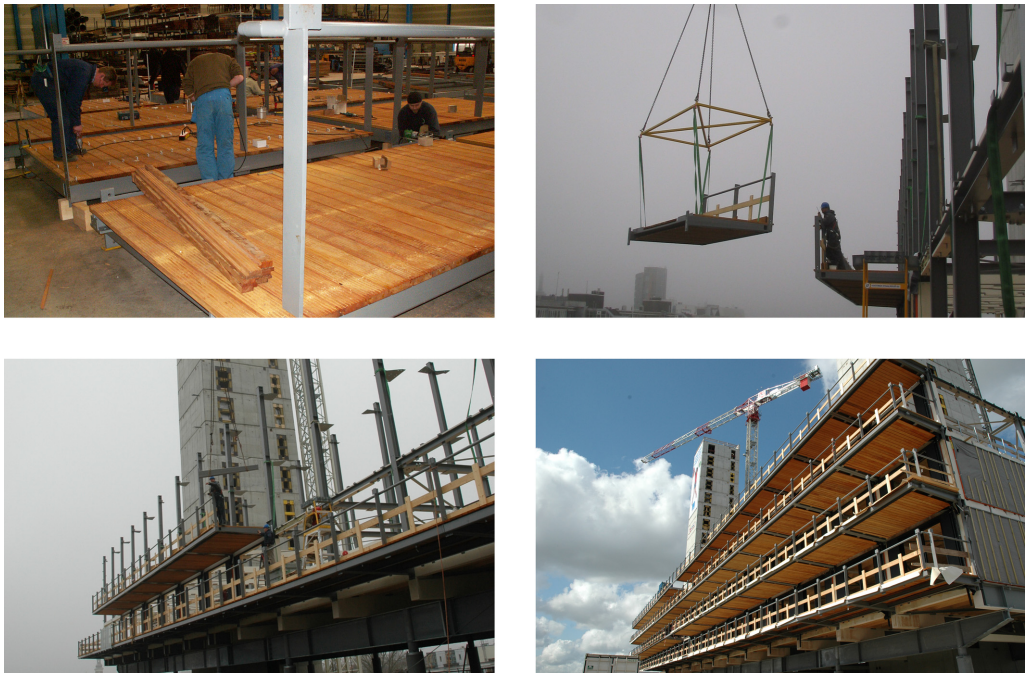


Figure 8. Construction with prefab components. (Photos: Ibelings van Tilburg architecten)



Figure 9. laminated veneer lumber beams & plywood floor. (Photo: Ronald Tilleman)

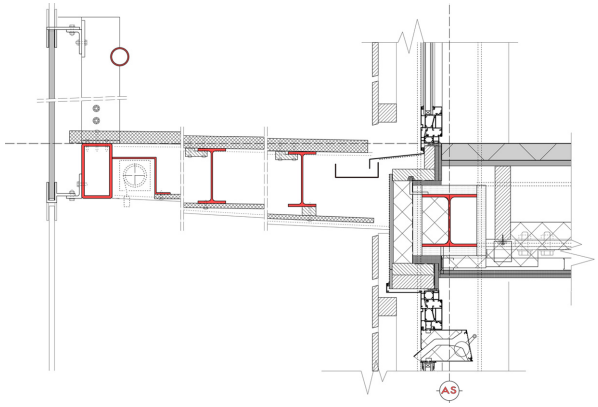


Figure 11. Section through loggia with wooden decking. Loggia- en gallery components are prefabricated. (Image: Ibelings van Tilburg architecten)



Figure 10. Prefabricated Oregon pine timber paneling. All timber of the façade is impregnated with a fire-retardant chemical. (Photo; Rob Hoekstra)



Figure 12. Communal garden at 40m height. laminated larch portal trusses that span the roof garden. (Photo: Rob Hoekstra)



Figure 13. Steel structure cladded with gypsum board, a fire resistant material. (Photos: Ronald Tilleman)

of a series of laminated larch portal trusses that span the roof garden on the 9th floor (See Figure 12). These are not structurally integrated with the rest of the building, but they do support a high glass windscreen on either side of the garden, via steel tie rods.

5. Fire Engineering

The main load-bearing structure is rated for 2 hours of fire resistance. Fireproofing of the main structure is by way of encapsulating columns and beams with gypsum board (See Figure 13). For additional protection, all timber was impregnated with a fire-retardant chemical, and intersections of steel and timber elements were caulked with Permatex, a sealant, which also helped control moisture transmission. The suspended ceiling uses double gypsum board affixed to thin metal profiles, protecting the underside of the timber frame and flooring. The inter-apartment fire-resistance rating is 1 hour. The metal stud walls separating the apartments are enclosed in two layers of gypsum board on either side.

6. Acoustics

Acoustics and vibrations drove many of the design decisions on the project. To prevent excessive vibration

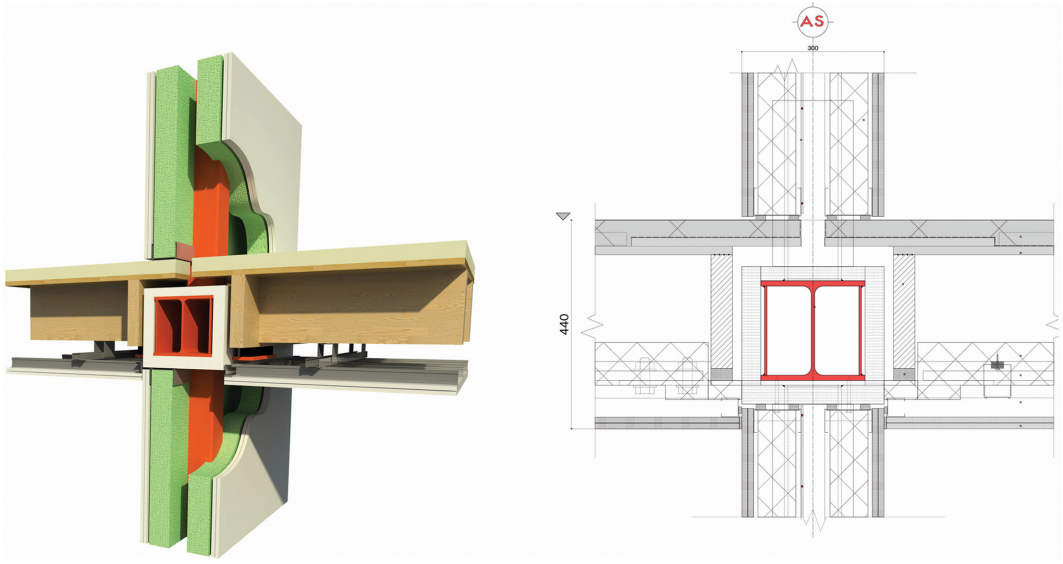


Figure 14. Steel-timber hybrid system. Apartment separating node for a 'box-in-box' principle (image: Royal Haskoning DHV & Ibelings van Tilburg architecten)

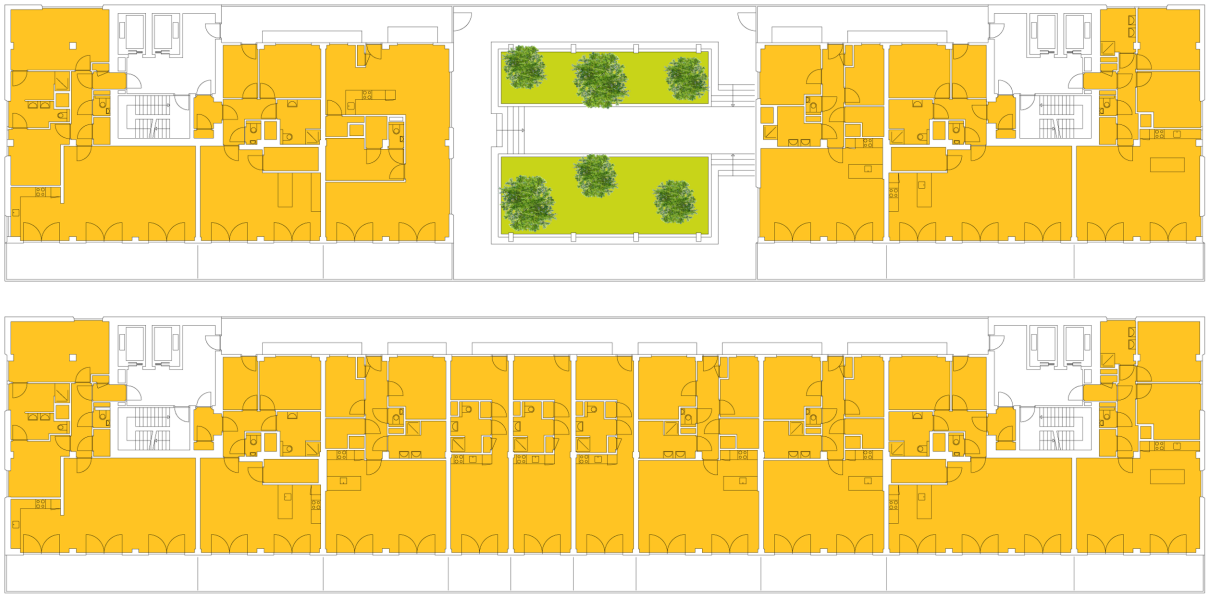


Figure 15. Floorplans of the 7th - 13th floor and the 14th – 22nd floor. (Image: Ibelings van Tilburg architecten)

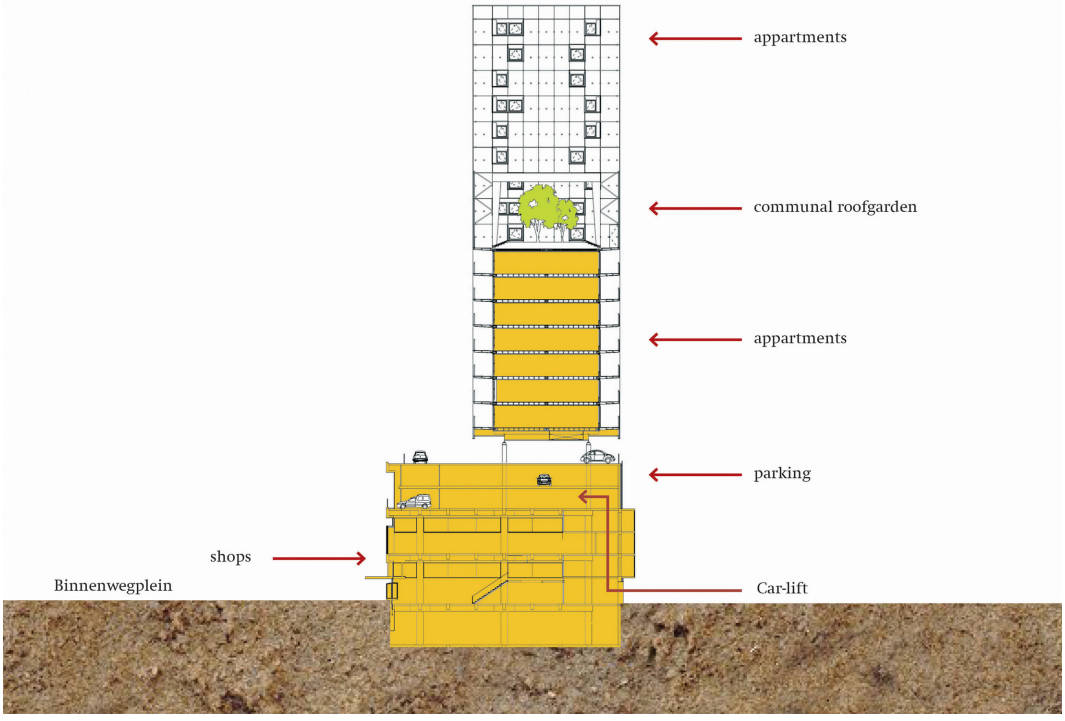


Figure 16. Parking on the top floor & roof of the existing building. (Image: Ibelings van Tilburg architecten)

and noise transmission between apartments, each apartment is entirely acoustically separated from the other (See Figure 14). The wooden beams in the floors are isolated from the steel beams via 25-millimeter-thick rubber dampers. Additional non-structural steel tubes were placed between the studs in party walls and around the H-section beams and columns to further damp vibrations. The LVL beams were doubled in key areas, while the double layer of gypsum required for fireproofing the party walls also serves as an acoustical separator. Suspended ceilings add further sound insulation. The entire assembly was laboratory- and field-tested.

7. Flexibility

The apartment building has sixteen floors and 114 apartments. The apartments are distributed over seven adjoining floors, topped by two towers with nine and six floors. Between these towers, at a height of 40 metres, there is a sheltered communal rooftop garden. The size of the apartments varies from 45 to 124 square metres (See Figure 15 & 16). The selected building method based on steel columns, gypsum partition walls and wooden floors is not only light, but also very flexible. Even during construction some of the apartments were split in separate units while others were combined.

8. Sustainability

By choosing to 'top up' the building we prevented demolition and the need to remove 15,000 tonnes of concrete from the city centre. In addition, the available space is used intensively which contributes to sustainable urban development (see Figure 17). The flexibility to split up or join apartments also makes the building more future-proof. The light-weight construction materials can be recycled and have a low impact on the environment, for example during transportation. Galleries and loggias with a width of 2.4 metres prevent the apartments from heating up too much as a result of direct sunlight. The apartments are also connected to the district heating network.



Figure 17. Available space is used intensively. Renovated shopping building with on top the residential building (Photo: Ossip van Duivenbode)



Figure 18. 3 fases of the building process. (Photos: Iemke Ruige, Ronald Tilleman & Ossip van Duivenbode)

9. Urban regeneration

The Karel Doorman building, completed in October 2012, has proved to be a trend-setter for the urban regeneration that has taken place – and is still ongoing – in the heart of Rotterdam. In recent years, the increasing availability of housing in the city center has considerably improved the quality of life in the area.

In this way the Karel Doorman building has become an inspiration for the construction of lightweight high-rise buildings using wood, a construction method which is extremely suited to the realization of urban intensification projects in a city like Rotterdam, and doing so in a sustainable way (See Figure 18). In the recent publication 'Rethinking Timber Buildings' by the government-financed Transition Team Circular Building Economy, the Karel Doorman Building, which has proved its continued potential over the last ten years, was included as one of the reference projects.

References

For more technical information read 'Tall Timber: Mass Timber for High Rise Buildings - De Karel Doorman Case Study' by Antony Wood, Daniel Safarik and Will Miranda. 2023. This paper was also made in cooperation with Ibelings van Tilburg architecten and Royal Haskoning DHV. For the parts concerning 'Timber, Fire Engineering & Acoustics' this paper was used.

Apendix

Colophon
Client: WM Projectontwikkeling and DW Nieuwbouw, Rotterdam
Structural Engineer: Royal Haskoning DHV
Architect: Ibelings van Tilburg architecten Project architects: Aat van Tilburg and Marc Ibelings
MEP Engineer: Wichers en Dreef
Acoustics, Fire & Life Safety: Peutz Associes
Project Manager: Objectum
Main Contractor: Van Wijnen Dordrecht
Gross floor area: 12,450 m^2 shops, 10,500 m^2 apartments (114 units) and 156 parking places Start and completion: Start June 2006, Restarted June 2010, Completion October 2012.