▲ A2 STUDIO I.O.V. VENHOEVENCS ARCHITECTURE+URBANISM – ARTIST IMPRESSION

The Platform

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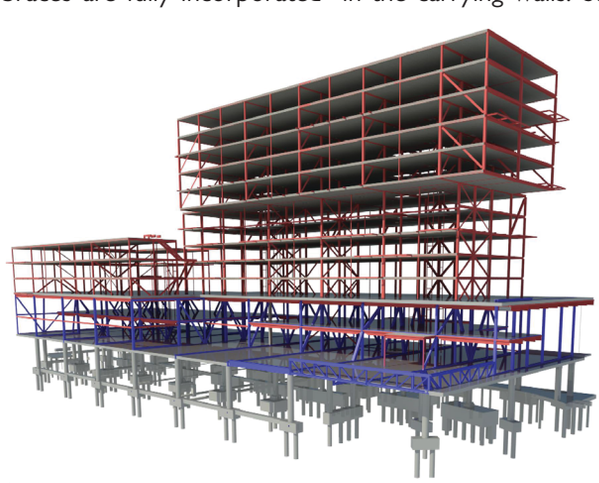
The platform is a building of 18.500 m2 on top of a new tram-/bus terminal "Uithoflijn". This building is situated at the east side of Utrecht Central Station. It is designed by VenhoevenCS architecture + urbanism and the development was done by ABC Planontwikkeling. IMd Raadgevende Ingenieurs was responsible for its structural design.

The building is designed as a smart and sustainable "Microcity", aiming for a healthy lifestyle with an inspiring atmosphere. The building will include a large quantity of light, fresh air and greenery. A perfect mix of living, working and facilities within walking distance. The designers aspired to circular economy and sustainable metabolism in this project. The intended residents are progressive people who desire a healthy lifestyle, direct access to the city and believe in sharing space, products and services. Apart from sale and renting of apartments, the Platform offers additional facilities like a fitness suite, a restaurant, a lounge bar and also a concierge for all services for the inhabitants and visitors. The occupant will share facilities like a common roof and indoor garden with fellow inhabitants.

INTEGRATED STRUCTURE

The request for this project was to develop a building above the tram-/bus terminal. Due to the function at ground level, some serious conditions had to be met in terms of column placement. The original plan was to construct a heavy concrete table-structure (ca. 1,80 m) and then place the building on top.This concrete slab creates the transfer structure between the columns underneath and the building on top. By using a truss at the lower two levels, an integrated structural system is created. This sytem is much lighter than the original slab. The structure is more sustainable, easier to construct and will cause less nuisance during construction phase. It also enhances spatial quality at the station by using less, more slender

columns. In-between the trusses of the lower levels, the commercial areas can be found. On top of these commercial layers, the apartments are situated. This structure is built-up using a light- weight steel structure with hollow core slabs to limit the weight on the Transfter structure (lower trusses) as much as possible. By using lightweight, elements, it is possible to construct a tall building on a slender table-structure. The building achieves its structural stability by applying steel braces. The brace locations are well- considered, taking into account the architectural lay-out of the spaces. Stability considerations have not compromised the architectural design since braces are fully incorporated in the carrying walls. Stability



▲ IMD RAADGEVENDE INGENIEURS – 3D-MODEL

underneath the table-structure is achieved by columns with a fixed connection in transverse direction, while concrete walls provide stability in lateral direction.

TRANSITIONAL STRUCTURE

To limit the amount of columns in the terminal as much as possible, a column grid of 12,0 meters has been chosen in longitudinal direction. The grid for the line of forces continues over the full height of the building. This ensures a freely subdivisble space of 12,0 meters in the commercial area. Apartments will have a width of 6,0 meters. Due to the 12,0 meter- span of the floors, a light separation wall is constructed to subdivide the space. The columns at the top floors will carry their load to the trusses at the commercial levels (level 1 and 2). These trusses will in their turn, transfer the loads to the columns of the table-structure. In transverse direction, the columns are positioned in accordance with the platforms of the OV- terminal.

In order to build a column which is slender and in line with the architectural vision but also able to support the integrated table-structure, steel-concrete composite columns were used where concrete is casted around H-shaped steel profile. This configuration enables an easy connection to the upper steel structure and furthermore enhances the fire safety by enclosing steel with concrete.

FOUNDATION

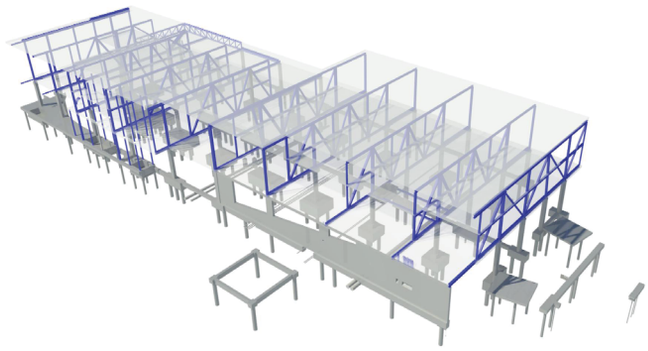
The combined steel and concrete columns in the terminal are supported by a concrete base. Below this base, soil displacing grout injection piles are positioned. These piles are screwed into the soil by using grout. Considering the lay-out of the platforms at the terminal, limited space is available for the concrete bases. Therefore, high-performance piles are chosen with a maximum load-bearing capacity of 4700 kN. By using these piles, dimension of the concrete base can be optimized.

STRUCTURE - COMMERCIAL LEVELS

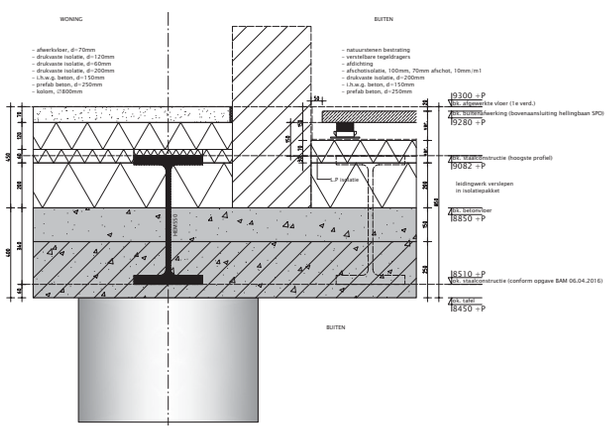
At the commercial levels, the trusses of the integrated table-structure are positioned. Between the trusses, floors span the 1st, 2nd and 3rd floor. The lowest floor in the table-structure (Level 1) is designed as a prestressed concrete slab with a pressure layer. Due to additional requirements of the “Uithoflijn”, an extra 150 mm layer of poured concrete is added to the standard prefab slab, so a solid slab of 400 mm thickness is realized. Between the steel profiles, there is still sufficient space to draw the horizontal cables and pipes. On top of the structure, a pavement is installed and the outside floor has a finishing of 70mm. The commercial levels are constructed using a composite floor system with concrete beams in combination with composite steel-concrete columns. This configuration enhances the space available for installation and also due to the composite nature this structural system has several advantages. For example, it can withstand higher loads and the stiff floor is able to distribute horizontal loads. Small floor elements also have the advantage of easy assembly for larger spans.

STRUCTURE- RESIDENTIAL LEVELS

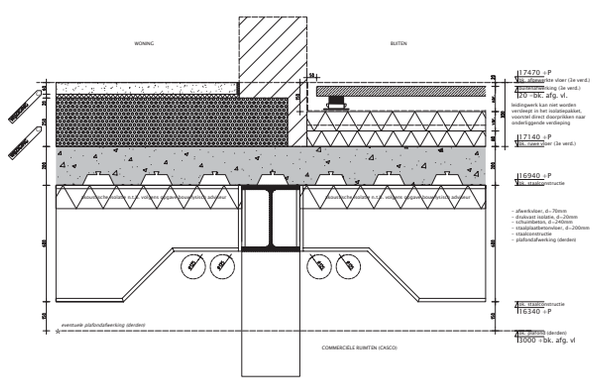
To achieve minimum material use and a lightweight structure a steel structure is used to construct the apartments. The grid for the load-bearing steel structure is 12,0 meters. For the floors, hollow core slabs in combination with a screed are used. Considering the bearing capacity of these floors, an important condition is to execute all separation walls as a lightweight structure. Due to the necessary fire resistance of 120 minutes, a compression layer is not possible. Floor fields are therefore enclosed by steel beams to enable diaphragm action. It was important to concentrate stabilizing elements above each other to avoid distributing horizontal forces



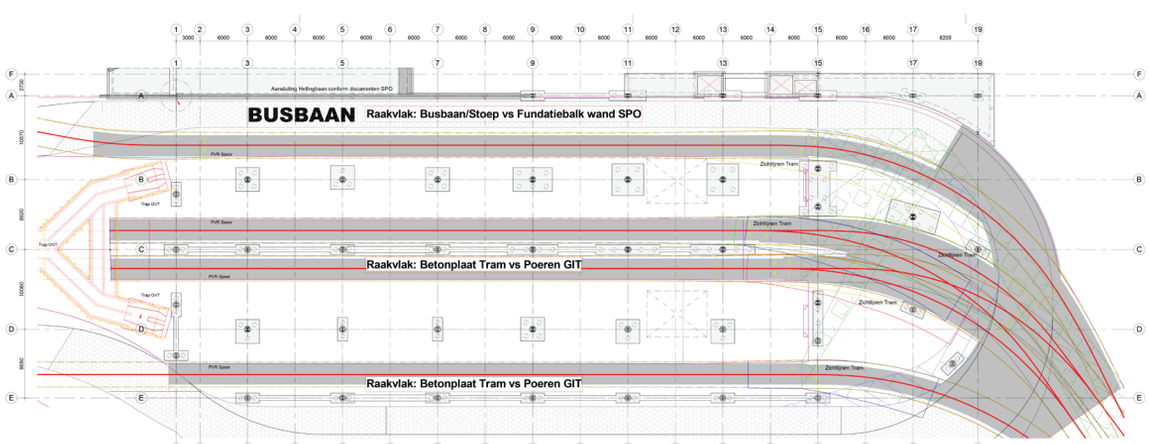
▲IMD RAADGEVENDE INGENIEURS – TRANSFER STRUCTURES



▲VENHOEVENCS ARCHITECTURE+URBANISM – DETAIL 1ST FLOOR



▲VENHOEVENCS ARCHITECTURE+URBANISM – DETAIL FLOOR FINISHING RESIDENCES 3RD FLOOR



▲ BAM – OVERVIEW TRAIN TRACKS AND PLATFORMS

in floors. The representative value of the self-weight of the apartment floors, including quasi permanent live load, is larger than 5 kN/m2. This fact satisfies the condition of having an eigen-frequency larger than 3 Hz and resonance by moving objects and persons is therefore prevented.

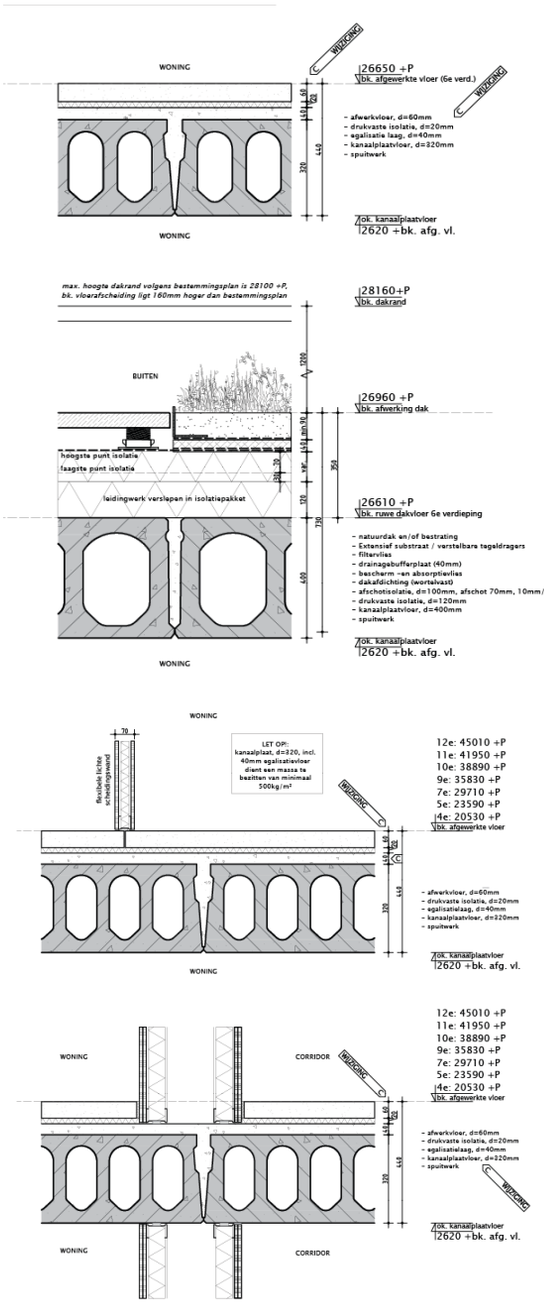
Due to the initial curvature present in the hollow core slabs, an equalization layer is applied, because a full compression layer could not be used. The average thickness of the equalization layer will not be larger than 35mm. With respect to the required fire safety of the hollow core slabs, the thickness of this top layer will suffice to the boundary conditions i.e. detail requirements conform to the "de Bond van Fabrikanten van Betonproducten in Nederland (BFBN)" acoustic conditions. The light-weight, non-load bearing separation walls have to satisfy the set requirements of noise isolation between apartments. At the locations the main load-bearing structure is integrated in the separation walls, the walls have to contribute to the required fire resistance of 120 minutes.

CONCLUSION

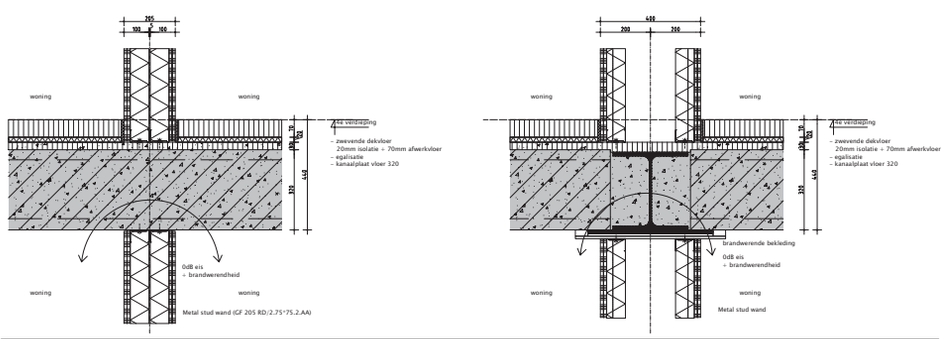
By choosing an integrated, lightweight steel structure, this building promises to be a new icon in the station area of Utrecht. By integration of the stable structure into the lower two layers of the building, the costs, construction time and environmental impact have been limited. Altogether a sustainable and economical solution can be achieved for a complex case.

INFO

Client: ABC Nova
Developer: ABC Planontwikkeling en Westplan Investors
Architect: VenhoevenCS architecture+urbanism
Structural designer: IMd Raadgevende Ingenieurs
Installation advisor: Techniplan Adviseurs
Contractor integrated table structure: BAM Bouw en Techniek
Contractor upper structure: Platform Bouw



▲ VENHOEVENCS ARCHITECTURE+URBANISM – DETAIL FLOOR FINISHING HOUSES 4TH FLOOR



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▲ VENHOEVENCS ARCHITECTURE+URBANISM – DETAILS (PARTITION) WALL