

Energy Efficient Buildings for
Retail and Logistics

Shopping Centre

Easy Bridge[®]



New Ruukki[®] Concepts in Building and Infra Construction

Doc. of Tech. Vesa Järvinen

RUUKKI

Energy-efficient steel solutions for better LIVING. WORKING. MOVING.

Energy Efficient Buildings for Retail and Logistics

Technology contact person: Ilkka Lehtinen

Offering in a Nutshell

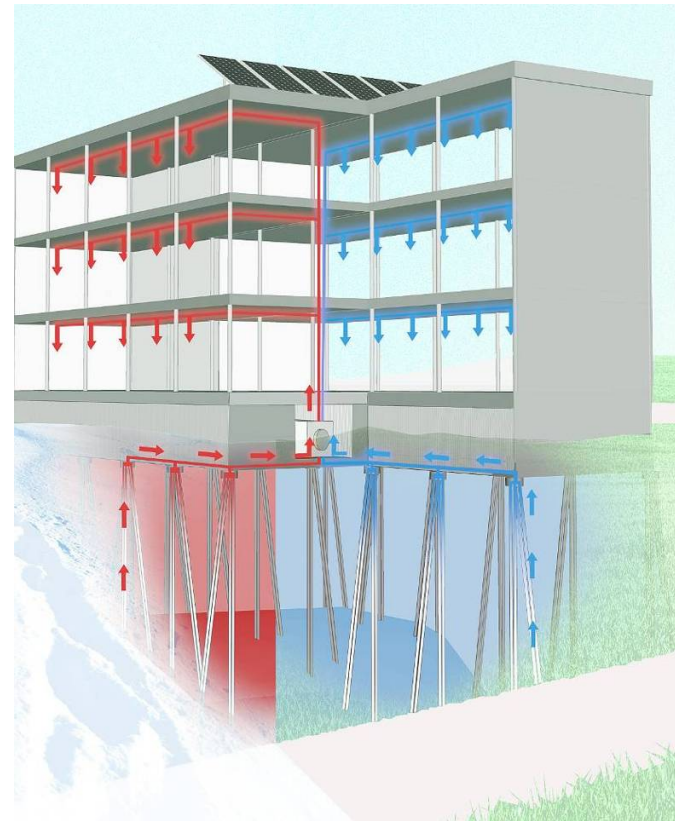
- Energy piles for ground heating and cooling
 - Steel frame
 - Air tight roof and walls
 - Sandwich panels
 - Load bearing sheet and roofing
 - Windows, doors, gates and other accessories
 - Concrete elements
 - Sockle elements
 - Hollow core slabs
 - Energy simulation
 - Installation
 - Air tightness measurement
 - Energy management
- ⇒ A complete package from Ruukki which ensures an airtight building and energy efficiency during building's life cycle



Products

Energy Piles

- Enhances the use of renewable energy
 - Integrated in Ruukki's piling system
 - Driven RR-piles (RR90-RR1200) and drilled RD-piles (RD90-RD800)
 - Minimum distance 5 m between piles and pile length >15 m
 - Provides heating energy during winter and cooling energy during summer
- ⇒ Improves energy efficiency of the building



Steel Frame

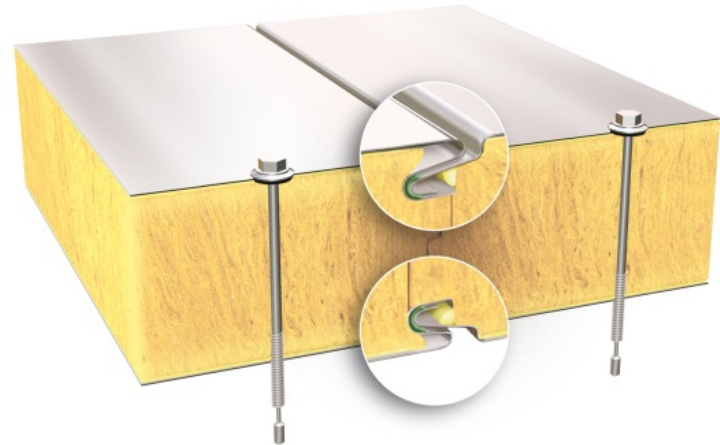
- Optimised steel frame
 - Foundation loadings can be affected by structural system \Rightarrow optimisation
 - Frame spacing c/c 6 m \Rightarrow installation of piping, cable racks etc. economical (not necessarily need for additional support)
 - Installations possible through trusses
 - Light components
 - Possibility for long spans and open space inside the building
- Frame components
 - Girder
 - Hollow section truss
 - Columns
 - Steel (hollow section, hot rolled or welded I) columns
 - Composite columns
 - Stabilising system
 - Bracings
 - Rigid connections between columns and trusses

\Rightarrow The most suitable solution based on the requirements



Walls

- Energy panels
 - Up to 35% savings in heating bills (use phase)
 - Up to 35% lower CO₂ emissions
 - Life-panels with recycled raw material
 - Air tightness guarantee $n_{50} \leq 0,3$ 1/h (q_{50} depends on the building's geometry)
 - Air tightness measurement of the building included
 - Thicknesses 150, 200 and 230 mm
 - Windows, doors, gates and other accessories
 - Energy windows available in combination with energy panels
 - Ruukki details that ensure air tightness of the building
- ⇒ Energy savings



Roof

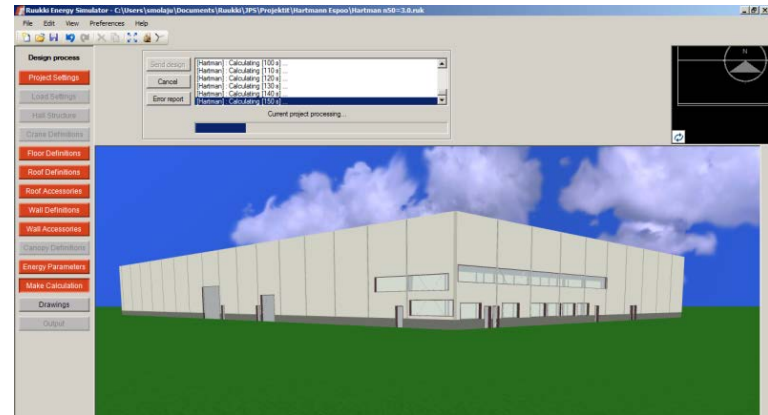
- Load bearing sheet T30M and T153
 - Smart roof option enables real-time snow load monitoring ⇒ snow removal from the roof only when needed
 - Roofing and accessories
 - Insulation
 - Water membrane
 - Smoke vents and other accessories
 - Ruukki details that ensure air tightness of the building
- ⇒ Safety and energy efficiency



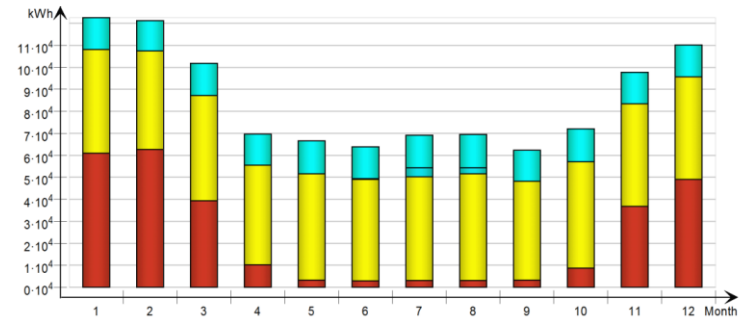
Services

Energy Simulation

- Total energy consumption to be considered
 - Possibility to compare different scenarios
 - Ruukki's own simulation tool in use
 - Based on IDA-ICE simulation program
 - Customer needs and requirements are to be taken into account
- ⇒ Optimisation of the total energy usage of the building



Monthly Delivered Energy



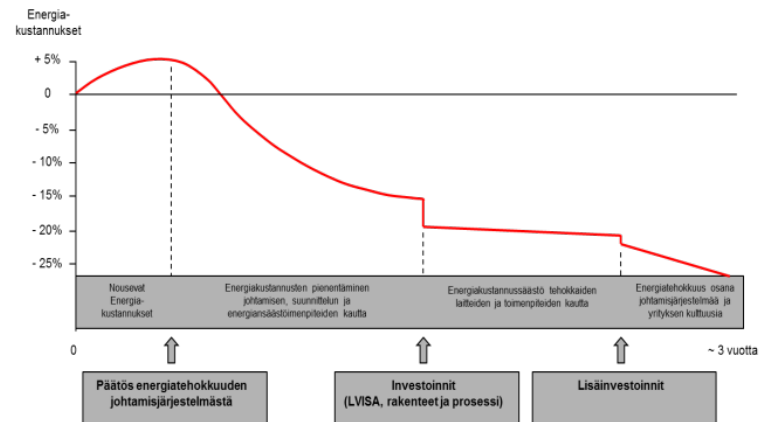
Air Tightness Measurement

- Included in energy panel delivery
 - According to EN 13829
 - Independent company to carry out the measurement
 - Ruukki organises
 - Money back guarantee
- ⇒ Verification of the air tightness promise



Energy Management

- Target for energy consumption to be agreed on
 - Real energy usage is monitored and compared against the target
 - In cooperation with a partner
- ⇒ Real time information for the user about the energy consumption and possibility to notice potential energy saving possibilities

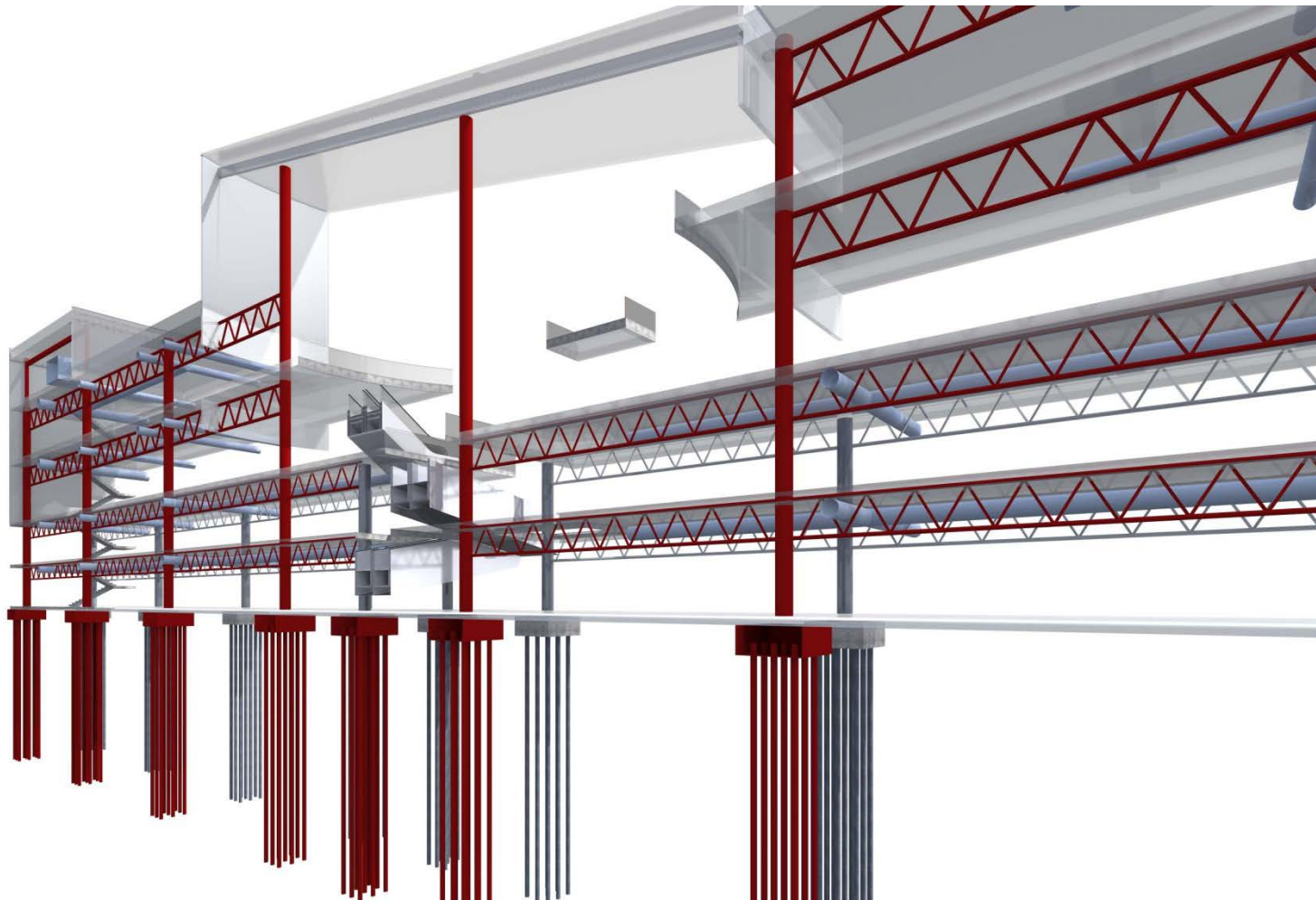


Ruukki® Shopping Centre

Technology contact person: Tarmo Mononen

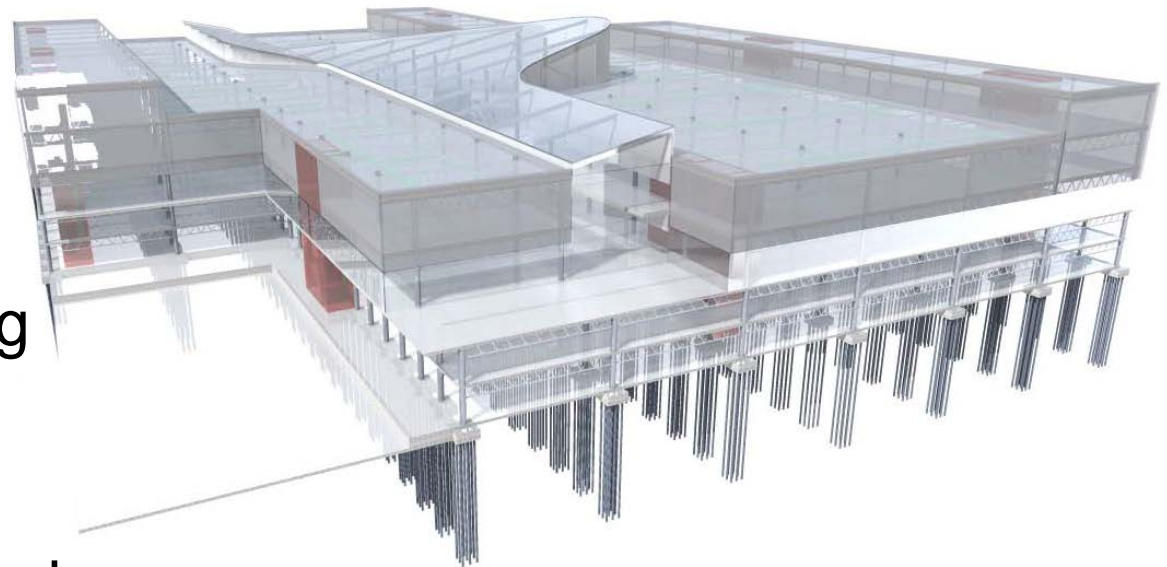
Benefits of New Solution During Whole Life Cycle

Ruukki® Shopping Center Concept – Adaptable and Profitable Premises

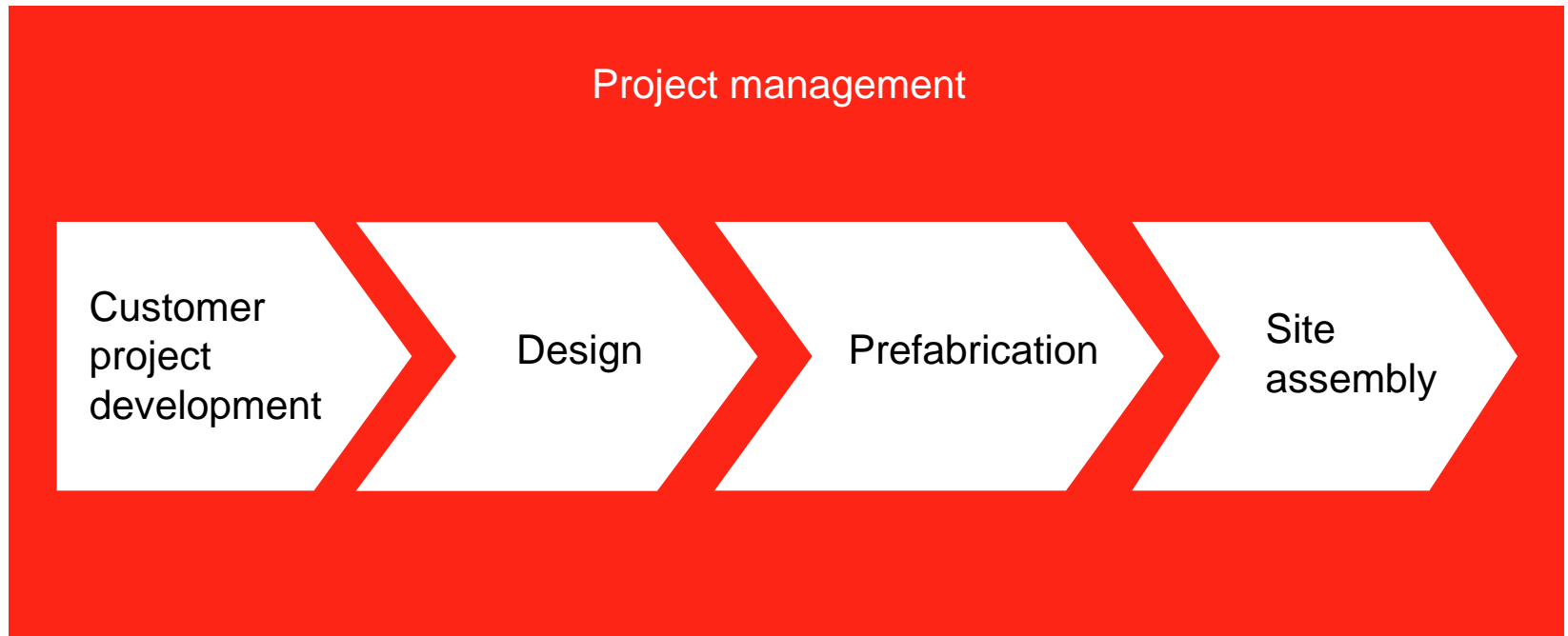


Benefits of the Concept

- Adaptable and profitable spaces
- Spacious and welcoming shopping environment
- Fast construction and reliable timetables



Ruukki Services

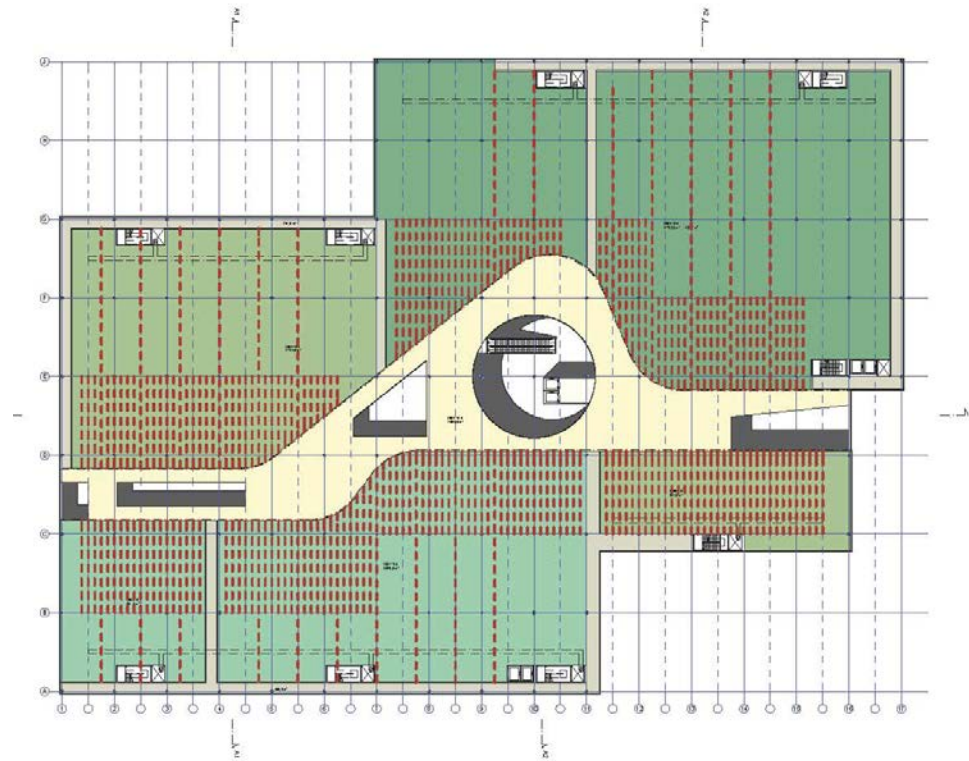


Customer Project Development and Design Phase

- Customer driven development
- Structures and M&E solutions for designed and future user needs

→ **Profitable and adaptable spaces**

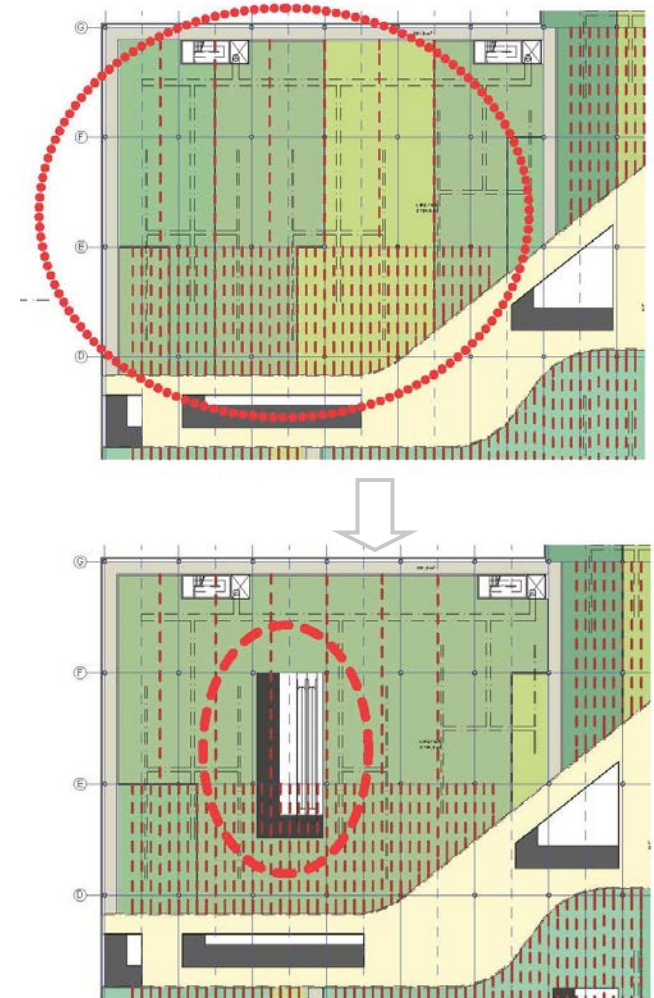
- Modelling to ensure performance of spaces
- Energy simulations
- Fire safety analyses



Customer Project Development and Design Phase

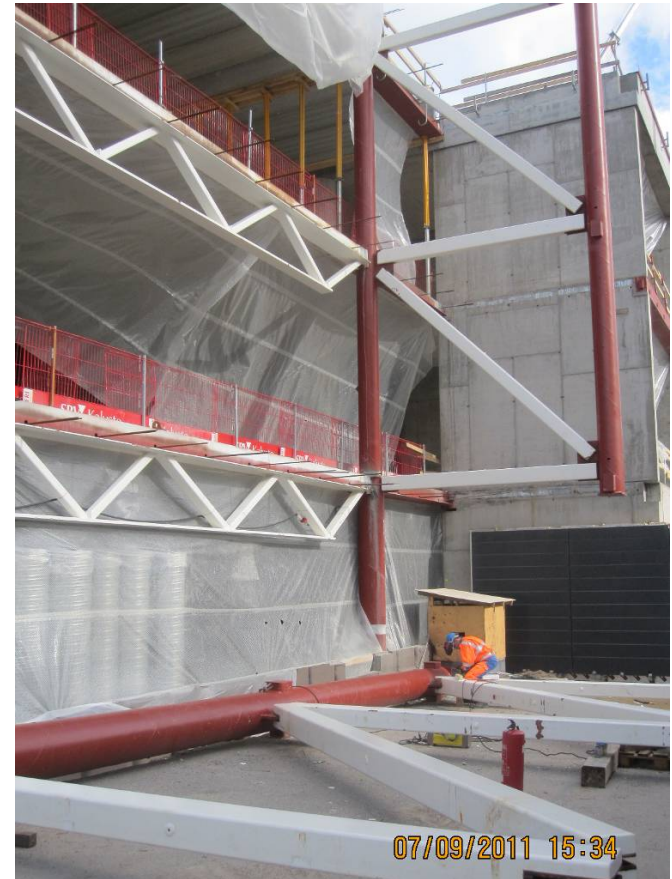
Thanks to frame system:

- spaces and tenants could be fixed in late phase in building process
- two storey spaces could be created by freely located staircase openings in the floor deck
- large sale rooms could be divided into smaller units or smaller into bigger ones
- modifications in M&E solutions are easily done in design phase



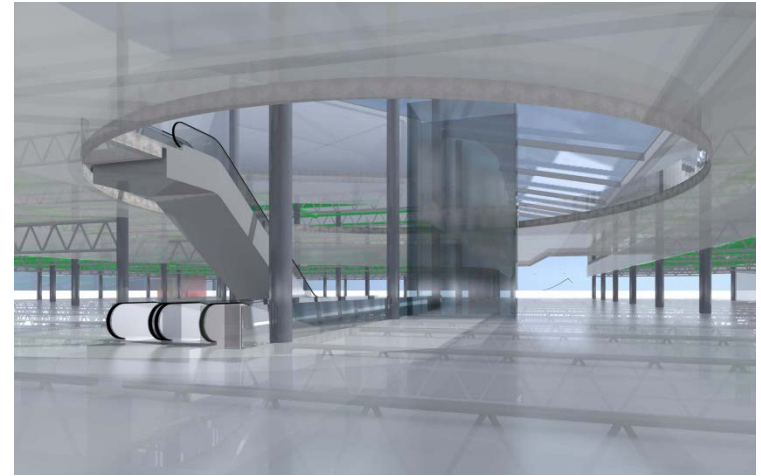
Construction Phase

- One supplier =>
One deal =>
Less risk
- Flexibility for changes in construction phase
- Reliable and fast timetable



Construction Phase

- Customisation and optimisation of spaces and technics according to needs of tenants
 - Free and spacious rooms
 - Freedom in the location of rooms
 - Freedom in the design and routing of M&E solutions
- Ensured opening of shopping centre for designed season



Use Phase

- Fast modifications of rooms and technics during use phase
- Energy efficient facade and roof solutions and energy piles will minimize operating cost
 - Ruukki® energy panel
 - Ruukki® energy piles



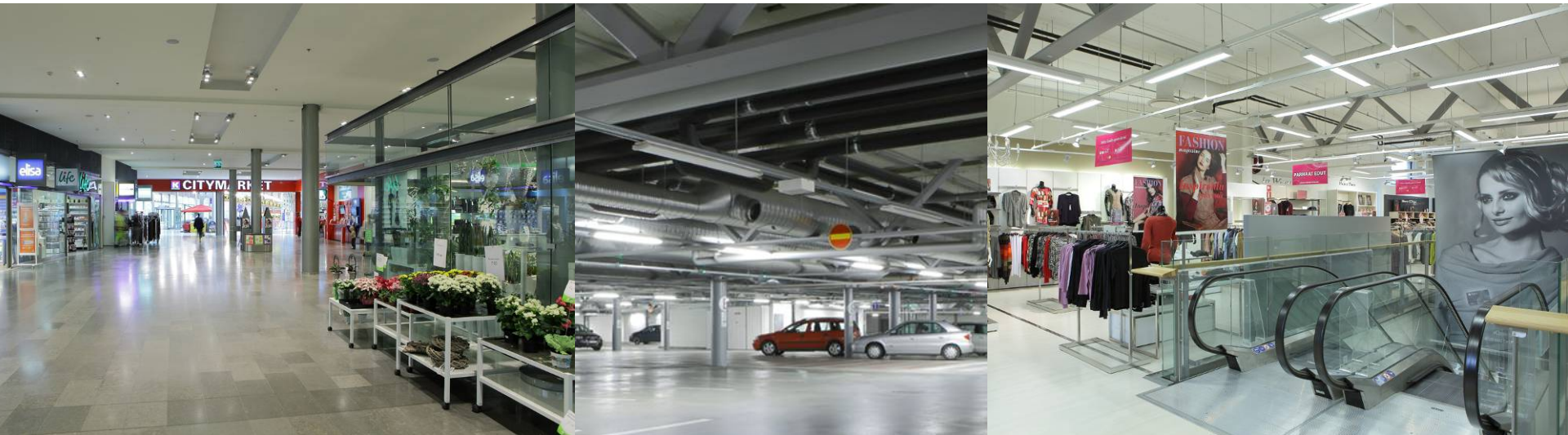
Use Phase

- Visual aspects => welcoming and spacious rooms
- Lightness and slenderness of structures is creating open and free space
- Use of massive and shady walls are minimized



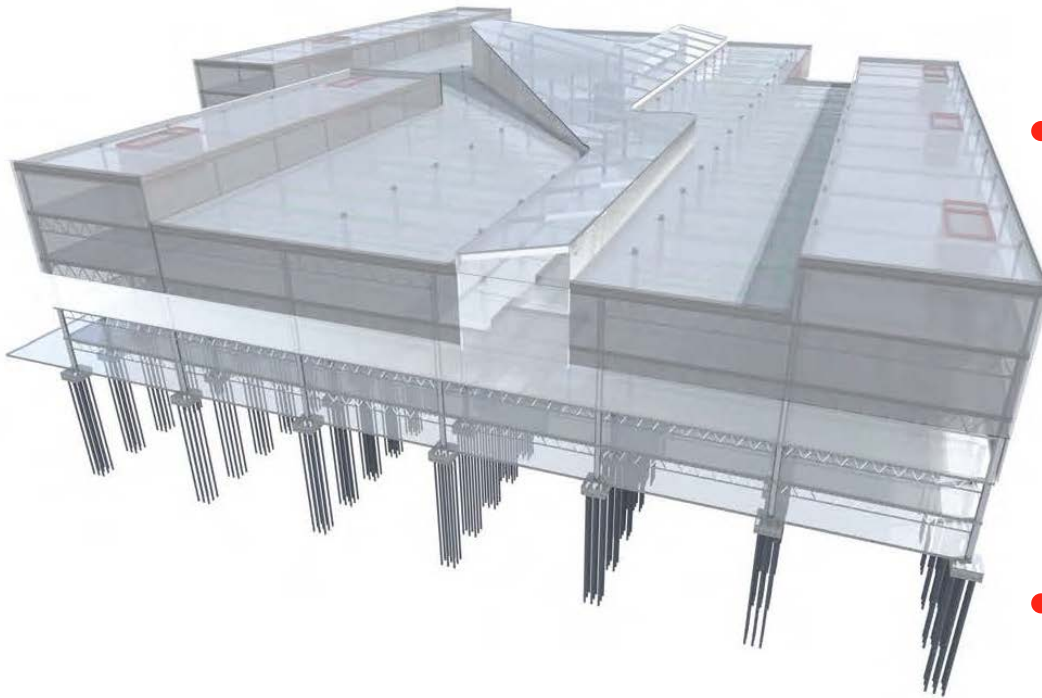
Ruukki® Shopping Centre Concept

- Already utilized in many projects: Skanssi, Sello 2, Ikano, Willa, Veturi, ...
- In the future adaptive and profitable premises by Ruukki® shopping center concept



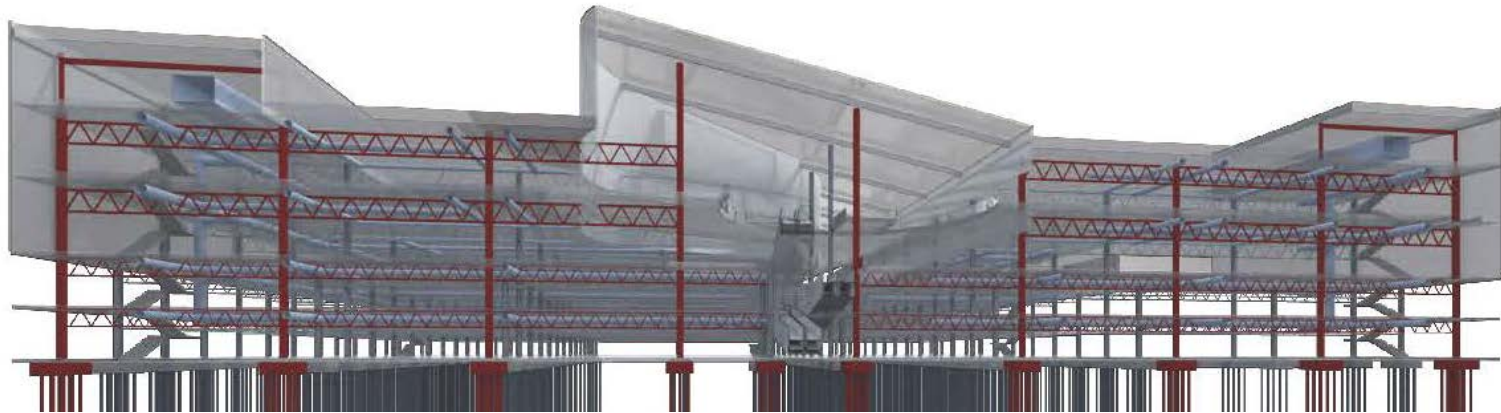
Technical Solution

Structural System



- Foundation
 - steel piles
 - energy piles
- Steel frame
 - optimised portfolio of beams: WQ-, WQ-gerber beams and/or trusses with hinge or rigid joints (main focus here)
 - composite columns
 - braces
- Envelope
 - energy panels
 - roof structures
- Other structures

General

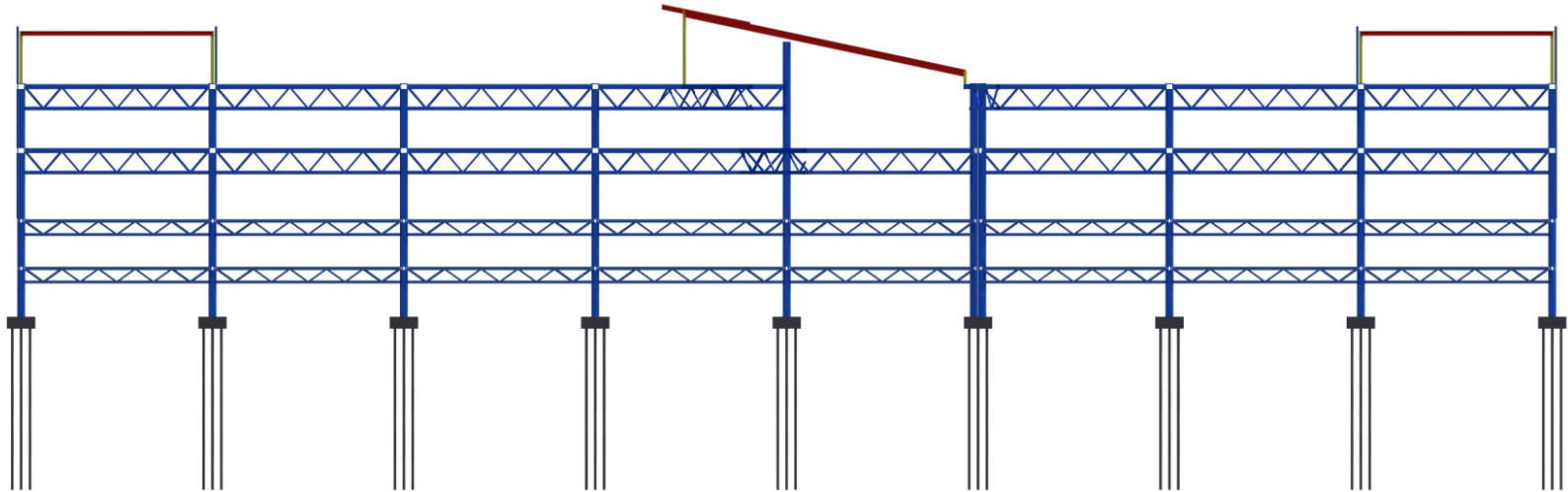


- Modules, e.g.
 - 16,2*5,4 parking floors
 - 16,2*10,8 m commercial floors
- Live loads 2,5-10,0 kN/m²
- Structural height ~1500 - 1900 mm
- Options for M&E routings ~800 - 1000 mm in transverse direction

M&E routings - example



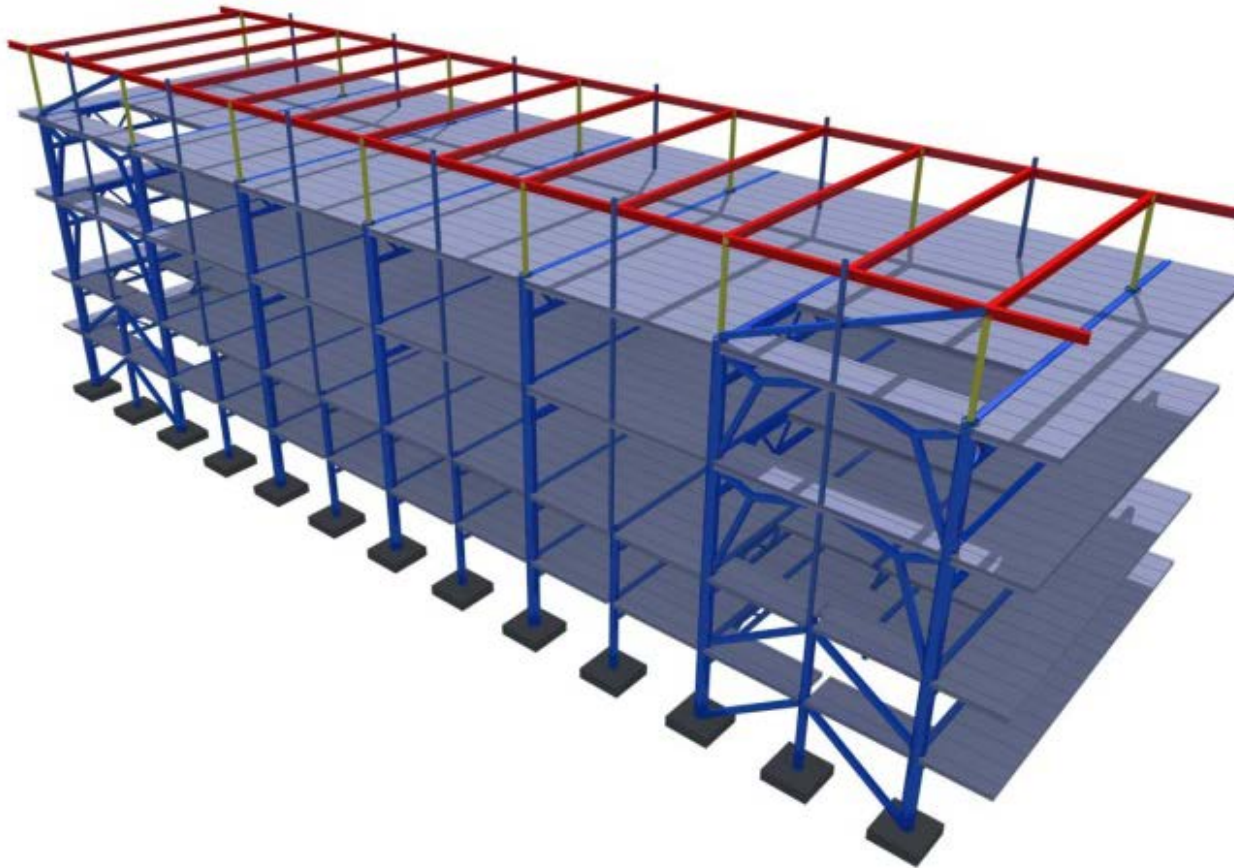
Steel Frame



- Rigid frame

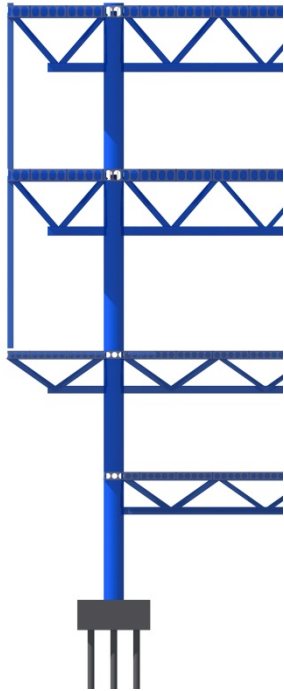
- no stabilising shafts => foundation loads are even
- free placing of lift and staircase shafts
- new rigid and ductile structures and joints
- flexibility during installation

Steel Frame – Transverse Stabilisation



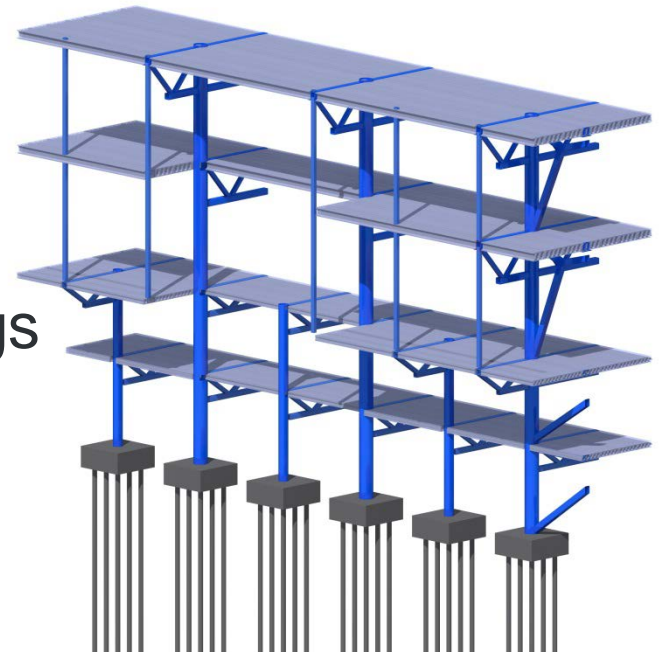
- Stabilisation in transverse direction with braces
 - as low as possible disturbance for routes in commercial floors
 - diagonal bracings in outer walls
 - modifiability

Steel Frame – Cantilever Structures

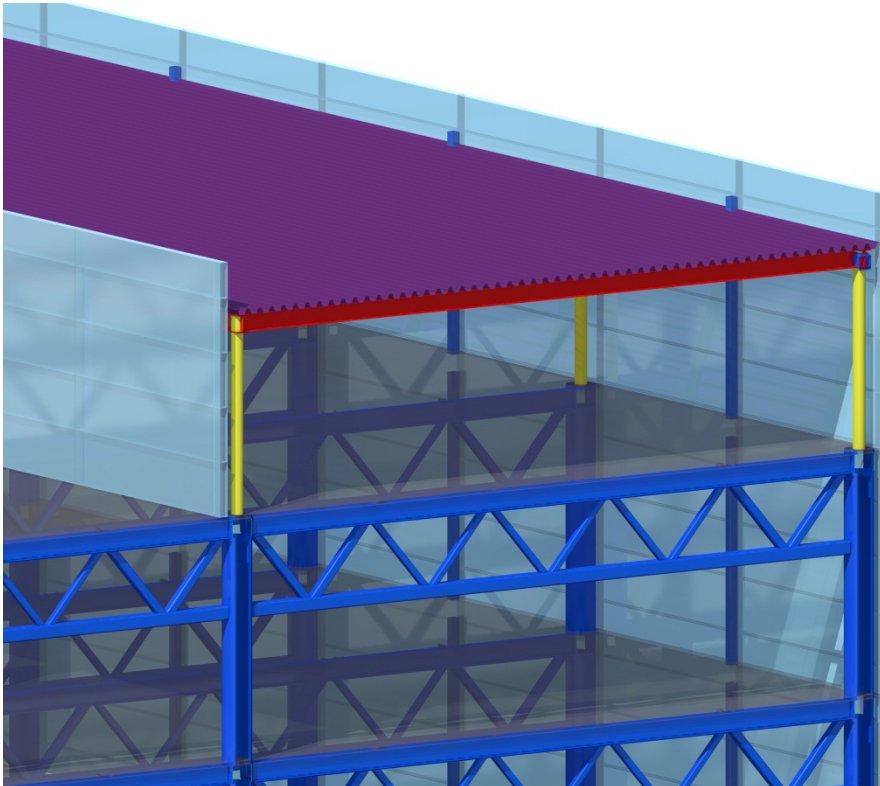


Outer wall may be placed in different level compared to column line

Allows cantilever floors and multiform openings e.g. in entrances

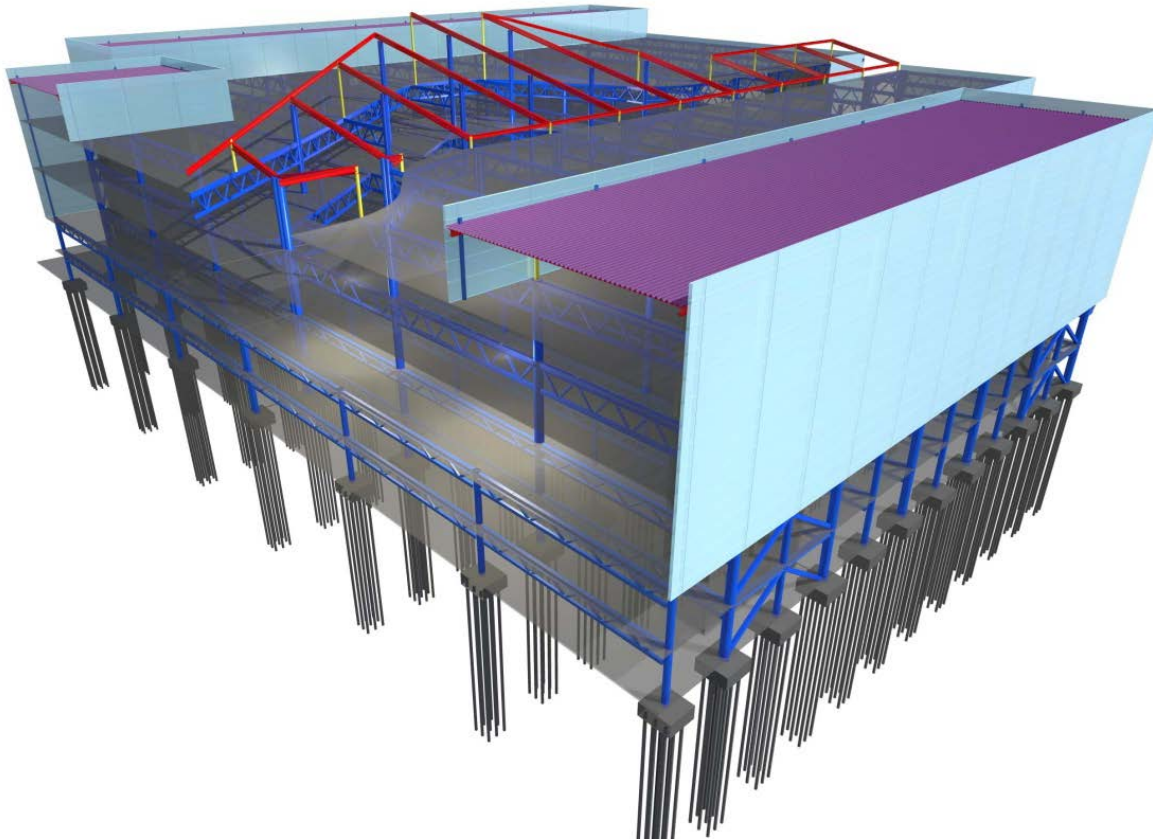


Technical Rooms



1. Light weight slim solution based on steel beams
 - steel beam, load bearing steel sheet
 2. Light weight solution based on steel trusses
 - steel truss, load bearing steel sheet
 - routings through trusses
- Ruukki® smart roof –solution with load bearing steel sheets
3. WQ-truss & hollow core slab -solution

Frame and Envelopes



- Energy efficient wall structures
- Tight joints and inlets in walls and roofs
- Easy integration with frame
- Facade to be chosen freely

Fire Safety

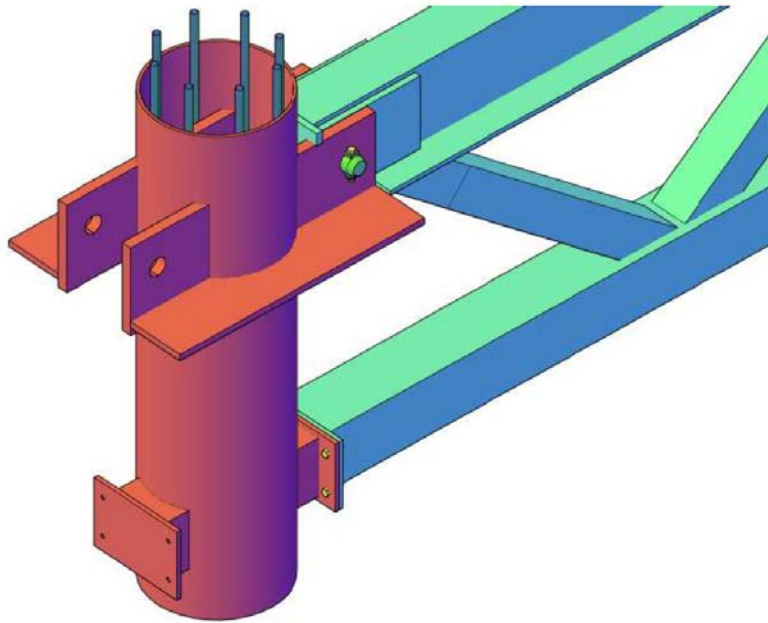
- With help from traditional or sophisticated methods
 - Right solution to right place
- ⇒ Solution to be chosen based on project requirements in order to secure personal and structural safety

Frame Components

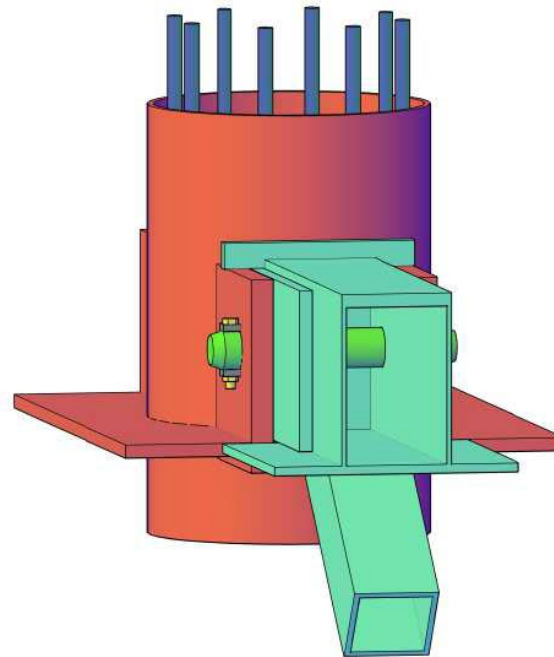


- WQ-truss, weight appr. 6-7 tons
- Composite columns, weight appr. 1,5-2 tons
- Hollow core slab 400 mm, weight appr. 5-5,5 tons

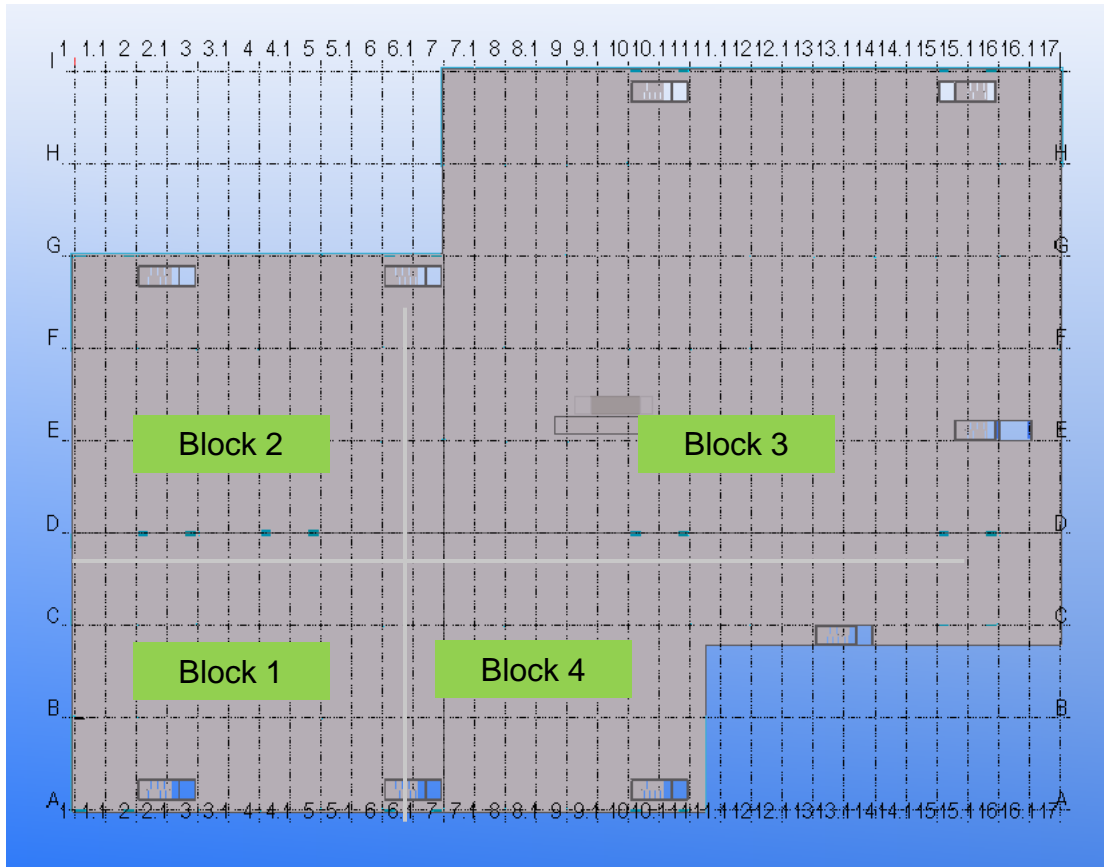
Details



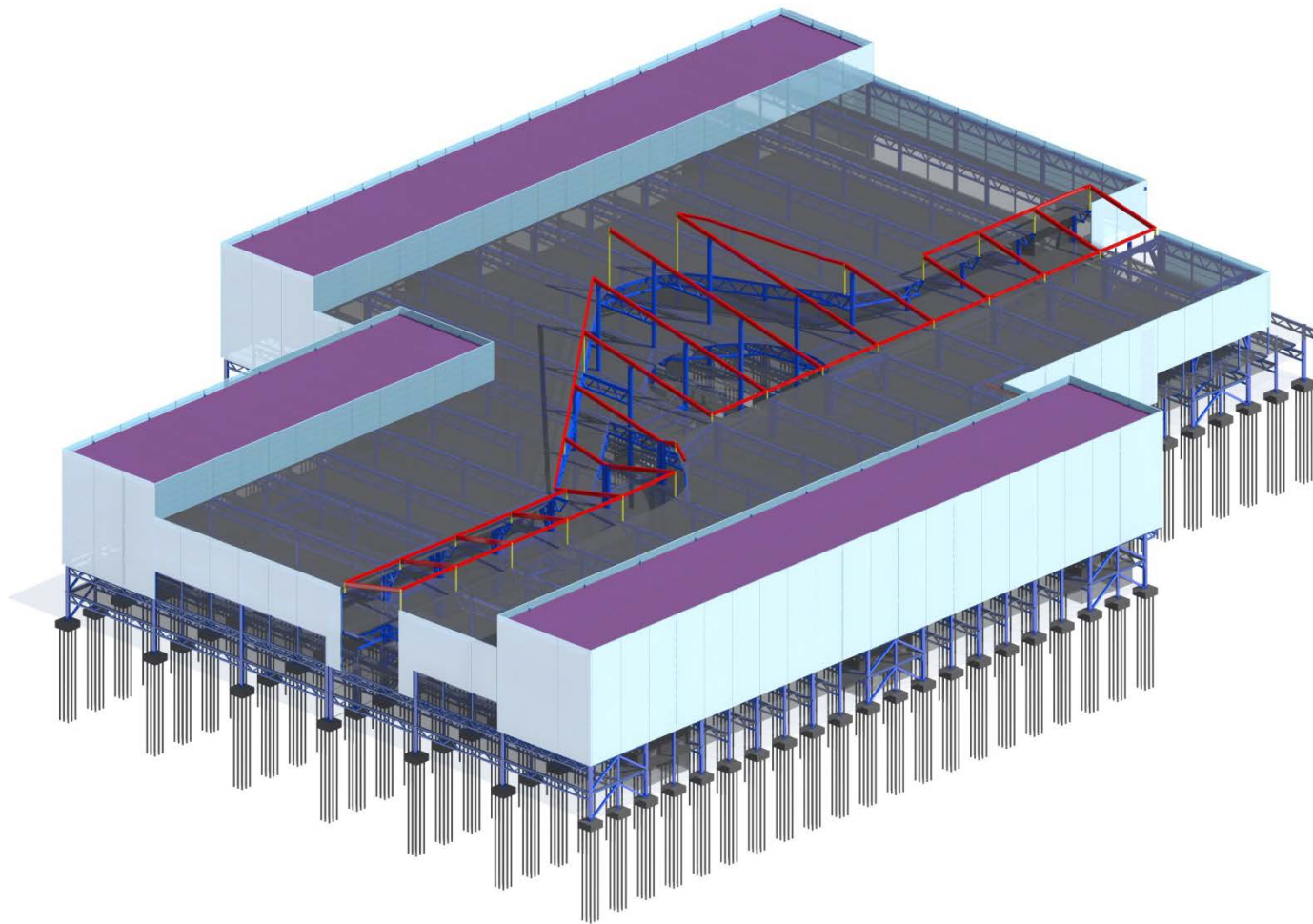
- S460, I macro M 800
- Upper chord = 2200 kN
- Diagonal = 2700 kN



Installation



Installation order to be chosen freely based on project requirements, such as foundation work



Ruukki Easy Bridge[®]

Technology contact person: Vesa Järvinen

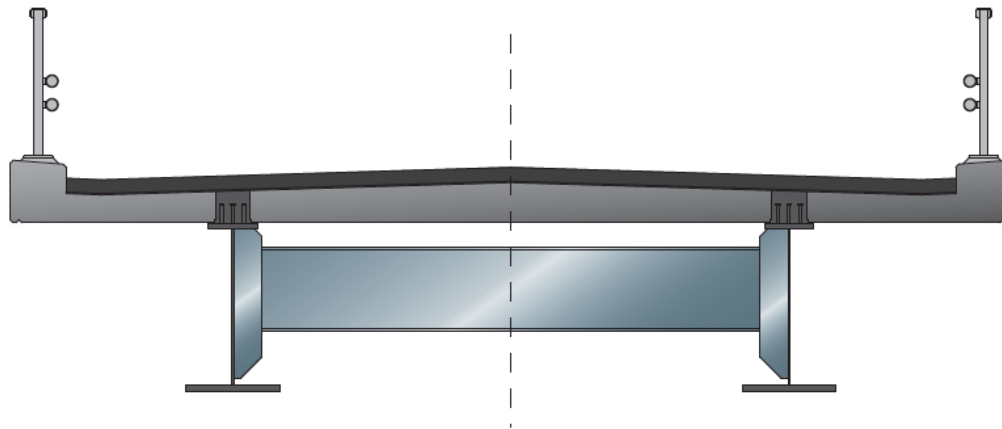
Fast and Reliable Bridge Solution

- Predesigned standard solution for Finnish roads
 - Complete designs ready after fitting of bridge to site
- Suitable for new and existing bridge sites
- Quick completion schedule
 - Installable in one day
 - Less disturbance to traffic
 - Shorter project payback time
- High degree of prefabrication
 - Smaller construction-related risks
 - Improved occupational safety
 - Reduced need of resources at site
- Documented quality product
 - Ruukki's CE marked structural steel products meet European quality and safety requirements
- Strong and durable
 - Design life 100 years



Bridge Types

- Two bridge types:
 - Ruukki Easy Bridge Classic
 - Ruukki Easy Bridge Premium
- One span integral bridge as well as traditional version with expansion joints
- Can be applied also when the bridge's end is skew ($\leq 20^\circ$)
- Bridges has been designed according to Eurocodes and the design instructions of the Finnish Transport Agency and is inspected and approved by the Agency



Ruukki Easy Bridge[®] Classic

- Applications: For local roads with low amount of traffic and lower fatigue stresses
- Span length: 11-29 m
- Effective width: 4,5 and 6,5 m
- Traffic loads:
 - Load Model 1 × 0,8
(sufficient load level for state subsidised bridges on private roads)
 - Fatigue Load Model 3
(traffic type medium distance and category 4: local roads with low flow rates of lorries)



Ruukki Easy Bridge[®] Premium

- Applications: For highways with normal/high amount of traffic and roads and projects subject to a requirement level above that of the Classic
- Span length: 15-35 m
- Effective width: 6,5 or 8,5 or 10,5 m
- Traffic loads:
 - Load Model 1 and nationally determined Load Model 3 for special vehicles
 - Fatigue Load Model 3 (traffic type medium distance and category 2: roads and motorways with medium flow rates of lorries)

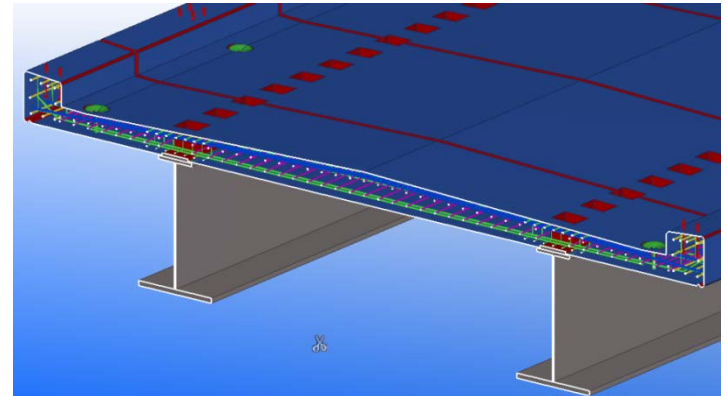


Ruukki Easy Bridge[®] Structure



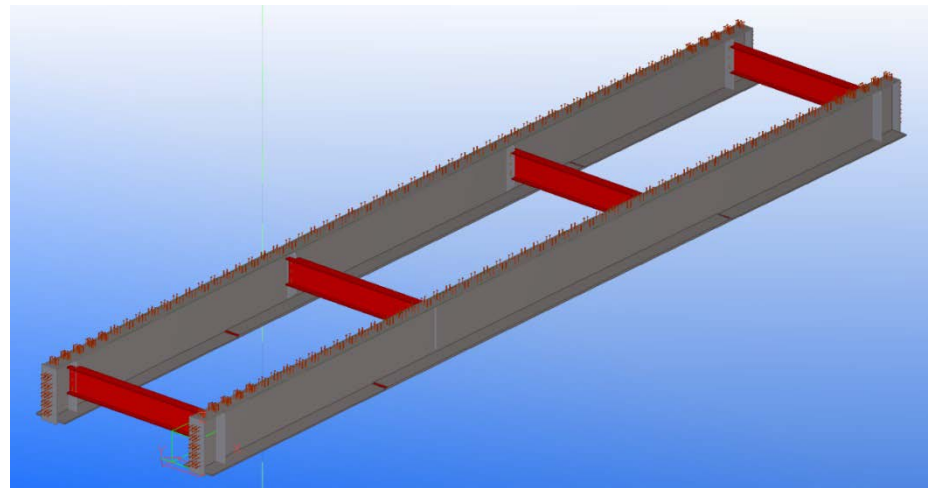
Bridge's Structural System

- Ruukki Easy Bridge consist of steel girders, concrete deck slab as well as end structure, wall and wings, made out of structural steel or concrete. All the structural parts can be prefabricated, or in the case of concrete structures, also cast in situ.
- Steel girders and concrete deck work as a composite structure for the live loads and after grouting dead loads with the help of stud bolts
- Prefabricated components can be installed safely
- Superstructure is built on large diameter piles or concrete foundations



Steel Girders

- Main girders are welded plate girders. Their length is span length + 1,2 m. Vertical plate stiffeners are used on the line of the cross girders.
- Cross girders situated on the third point of the span are hot-rolled IPE-profiles or corresponding welded plate girders. They connect to the main girders by bolting or welding.



Steel Materials

- Main girders steel material is S355NL/ML and cross girders are made out of S355J2+N or by utilising same material than fittings: S355K2+N. Stud bolts are material S235J2+N+C450. Steel end sections are made out of S355J2H structural hollow sections.
- If weathering steel, which resists atmospheric corrosion, is used, are all steel structures made out of steel S355K2W+N excluding stud bolts. Due to the plate availability limitations must the effective width of the Premium bridge be 8,5 m at the maximum when the span is over 33 m. Alternatively cross girders can also be made out of common steel quality, if they are hot galvanized.

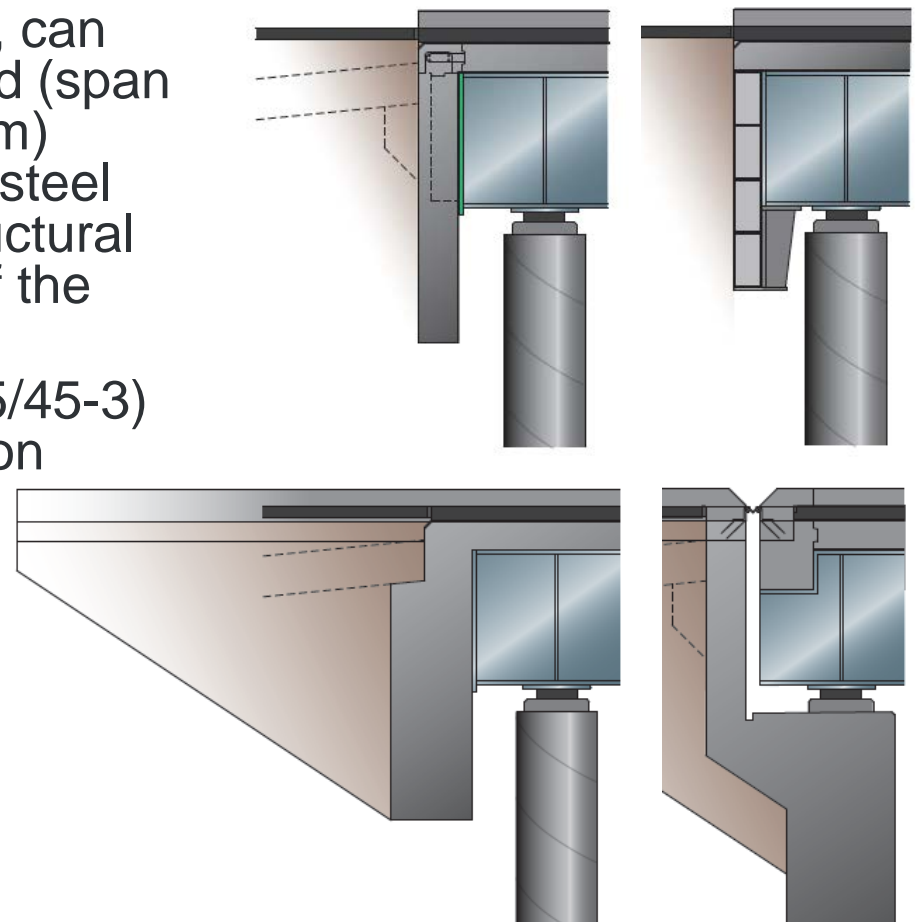
Deck Slab

- Concrete deck slab (C35/45-3) can be made of prefabricated element or cast in situ
- Environmental exposure classes and frost resistance classes P according to the technical specification
- Edge beam can be high or low
- At the local roads also the solution without the edge beam is possible



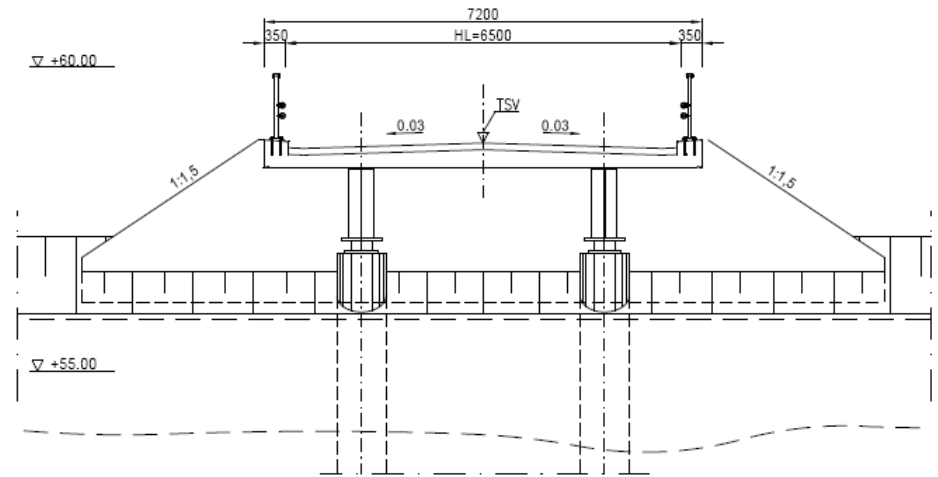
End Sections

- End sections, wall and wings, can be cast in situ or prefabricated (span ≤ 29 m, effective width $\leq 6,5$ m) concrete structure as well as steel structure made out of the structural hollow sections in the case of the Classic bridge (span ≤ 23 m)
- Concrete end structures (C35/45-3) can be equipped with transition slabs
- With the cast in situ structure the wings are parallel to the over going road. Otherwise they are parallel to the bridge's support lines



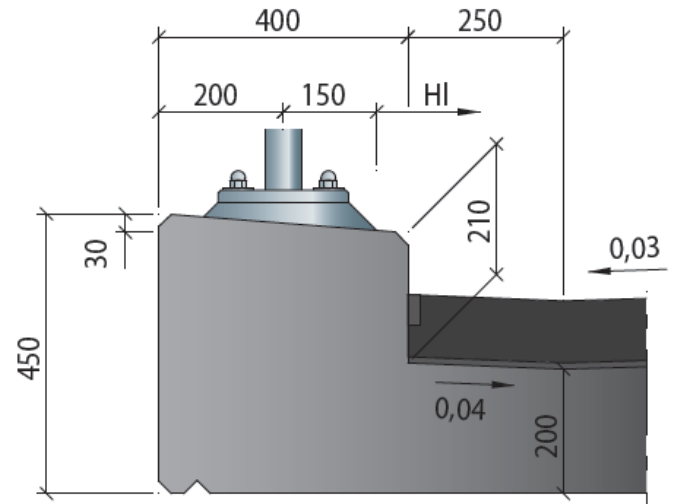
Accessories

- Spherical bearings, pot bearings or, together with steel bars for horizontal forces, laminated rubber bearings are used between the bridge sub- and superstructures
- Surface-water drains are used with the high edge beams. In other cases water runs over the edge of the deck.
- Finnish Transport Agency's containment level H2 safety barrier is normally used



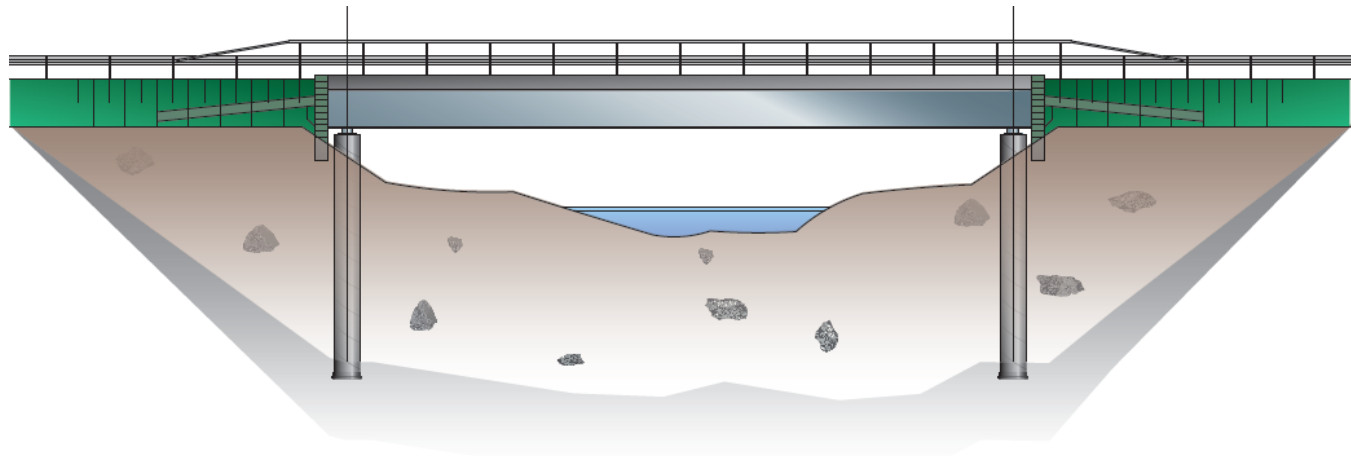
Road surface

- Road surface is normally done by using Finnish Transport Agency's generally used system (asphalt concrete layers and two layer of bitumen polymer membrane as water-proofing, total thickness 110 mm, FTA's NCCI 1, Chapter H.11.7.1, Pic. 1a), but also other surfacing is possible
- Classic bridges can also be done without any surfacing by using additional concrete cover as a wearing surface



Substructure

- Suitable substructures are large diameter piles (RR[®]- and RD[®]-piles), concrete foundation girder or existing foundations
- Substructure is needed to be designed case-specific for the condition of the bridge site so that it can carry the support reactions of the superstructure, which are given in the design manual

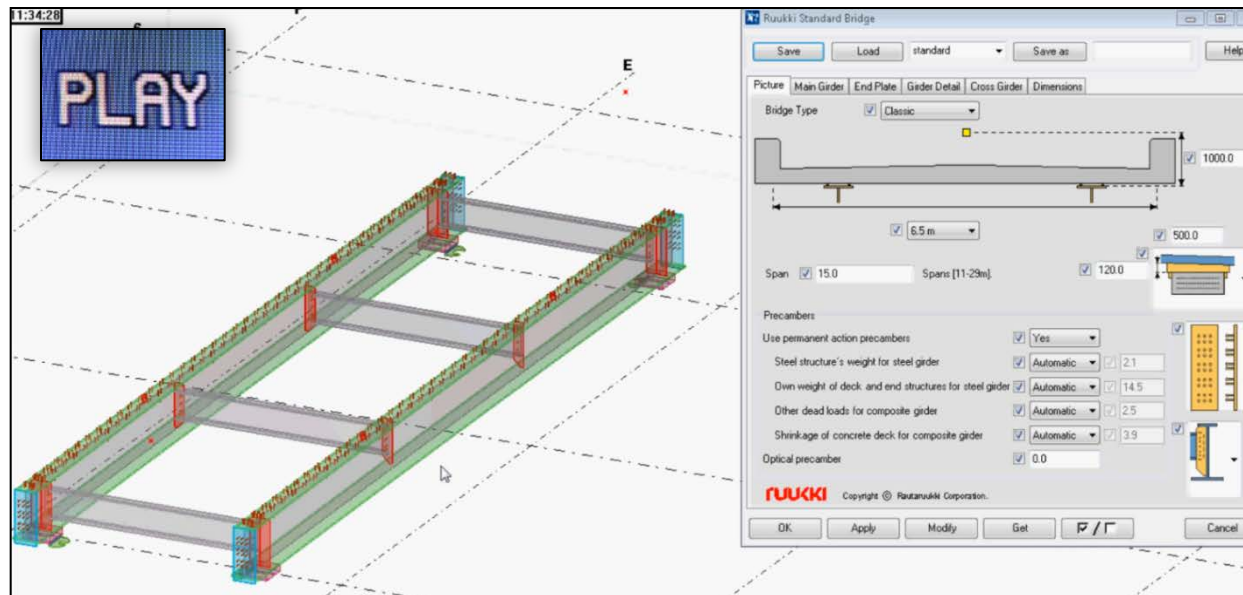


Long-Term Durability

- Surfaces of structures are treated under carefully controlled plant conditions to ensure paint coating performance and long-term durability. Used coating system is FTA's generally used TIEL 4.12. End structures as well as alternatively cross-girders are hot galvanized.
- Steel structures can alternatively delivery made out of maintenance free weathering steel. Used corrosion allowances are 0,6 or 1,0 mm, while the corresponding environments are clean rural environment without salt exposure and clean urban environment with occasional salt exposure
- Bridge's designed service life is 100 year

Design Support Material

- Bridge design can be done easily and quickly
- Ruukki's offerings of support material consist of design manual, building information model (BIM) of the steel girders made by parametric Tekla Structure tool, as well other superstructure's standard drawings in dwg-format



Order and Delivery



- The scope of Ruukki's delivery is agreed case by case. Basic delivery includes manufacturing of the steel members of the bridge superstructure and transportation of fabricated components to the site.
- Ruukki steelwork has the right to use the CE marking defined in execution standard EN 1090.
- The CE marking is an official way to show that load-bearing steel structures designed according to EC meet EN standards.



Ruukki Easy Bridge[®]



Design

Manufacturing

Installation

Complete structure

10 weeks



Shortening the construction time



Reducing risk on construction



Reducing numbers of workers and site managers at site



Improving working safety at site



NUUKKI

LIVING. WORKING. MOVING.