

Development of new construction systems



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VFT-WIB technology

The VFT® technology combines the advantages of a high degree of prefabrication and low transport weights with short installation times, thus minimising downtimes for lifting the precast parts into place. The VFT-WIB® technology is a further development of the VFT® technology that combines these advantages with the robust characteristics of the traditional method of rolled girders in concrete. The new technology stands for composite precast parts with rolled girders in concrete.

The VFT-WIB® girder is a prefabricated composite precast part with a T-shaped steel girder as load-bearing element on the underside of the girder; the steel component consists of a rolled profile without top chord or a welded cross section. Composite dowels which are part of the steel girder itself form a shear-stiff connection between the steel girder and the top chord precast plate (Fig. 1). Ideally, the T-shaped steel girders are made from one rolled girder. The girder is cut in two using a geometry which divides it into two simply symmetrical halves while generating the composite dowel geometry at the same time (Fig. 2). This combination of cut geometry, arrangement and part combination constitutes a future-oriented development for VFT® girders.

The T-shaped steel girder acts as external reinforcement. This new design principle with a shear-resistant connection between steel and concrete also permits new cross sections as shown below.

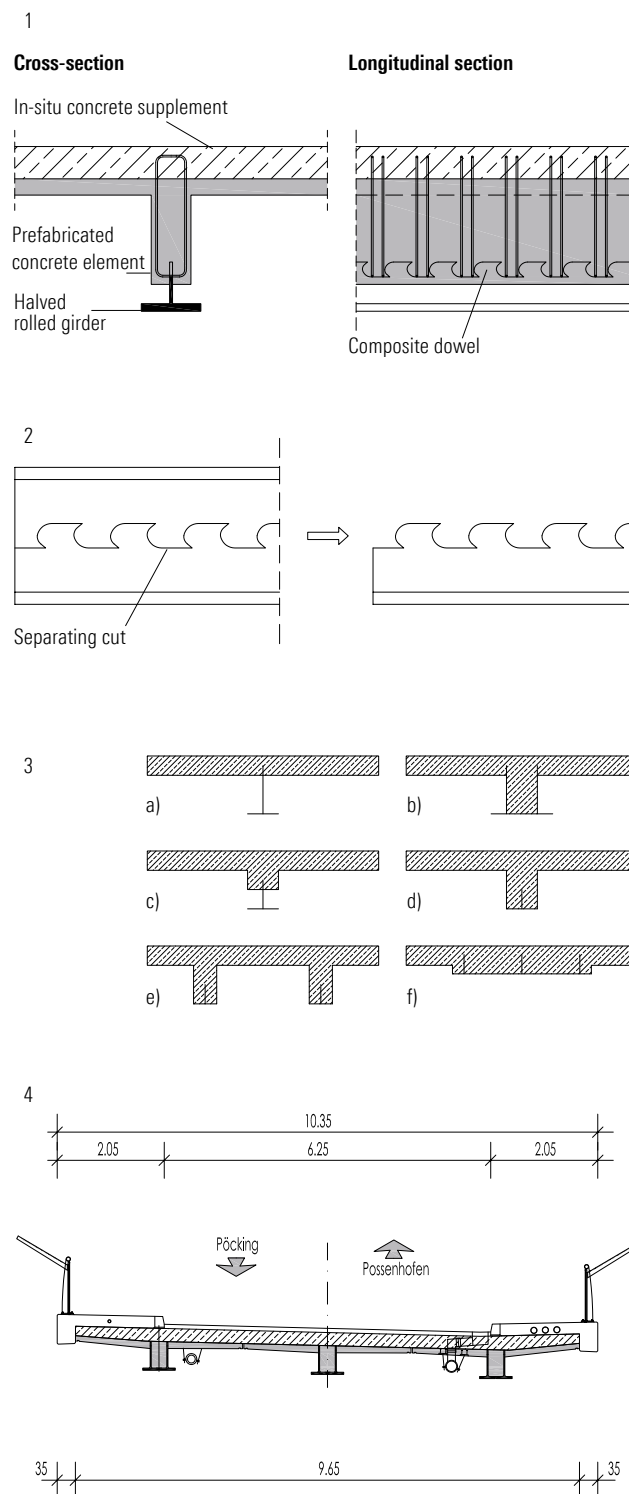
Fig. 3 shows various cross section types.

Cross section b) was applied at the composite bridge in Pöcking over the railway line from Munich to Mittenwald. The replacement of an aging structure more than 100 years old, consisting of rolled girders in concrete (WIB), demanded a very slender new superstructure, so that the cross section seen in Fig. 4 has been chosen for the frame construction. In this particular cross section, the rolled girders are embedded directly in the concrete flange.

Double-T girders are fabricated up to a height of approx. 1100 mm. This means that the cross section with two T-shaped steel girders is limited to a structural height including the in-site concrete slab of ≈ 0.85 m.

This permits spans of up to 20 m. For larger spans, the necessary structural height can be achieved with a concrete web (Fig. 3c, d, e).

The steel girders are rolled and cut in the workshop with a gas burner or plasma cutter, with the cut being placed down the middle according to the geometry for the composite dowels. The camber from the tension-free workshop form is applied to the girder. Continuous flow systems then add the head plates and coat the finished processed girders.



1 Principle sketch of a VFT-WIB® girder
 2 Cut form for parting of a rolled girder or a web plate
 3 Kerf geometry of rolled girder
 4 Cross-section of VFT-WIB®-bridge in Pöcking



Following transport to the precasting plant, the steel girders are reinforced and concreted in a conventional formwork unit for prestressed concrete girders. After a defined rest period, the VFT-WIB® girders are brought to the building site and placed flange-to-flange on the substructures. The in-situ concrete slab is then reinforced and concreted without needing additional formwork.

The design combines major advantages in terms of economic efficiency and durability:

Economic efficiency in production

- high degree of prefabrication reduces imponderability on the building site
- standardized girders of rolled steel simplify availability and delivery times
- low-cost rolled profile steel without welding in the workshop
- optimum material use for low consumption of structural steel
- standard formwork can be used for the prestressed concrete precast girders; no new investment necessary in the precasting plant
- the girders can be produced in any required height even with concrete haunches, without additional outlay
- small cranes can be used thanks to the low installation weight of the girders

Economic efficiency in the system

- ideal leverage of the precast concrete flanges as external reinforcement
- VFT-WIB® girders with concrete haunches for adapting to the development of forces
- simple embedding of the girders in in-situ cross girders
- scarcely any need to close the traffic routes passing under the bridge

Durability

- fatigue-resistant structure with no notch cases
- minimised corrosion protection surfaces
- robust reinforced concrete cross section
- high standard of quality thanks to the large degree of prefabrication in the rolled girders and the precast parts
- good insight into all parts for easy structural inspection
- by welding on the slats, reinforcement is simple to implement

Other than using the VFT-WIB®-method for construction of road bridges, the above mentioned advantages are also of great benefit for railway bridges. Excellent experience has been gathered in building railway bridges using rolled girders in concrete (WIB) for small and medium spans. The majority of these bridges have meanwhile reached the end of their service life. New replacement bridges will have to fulfil the following requirements:

- slender supportive structures within existing clearance gauges
- low production costs
- minimum interference in operations from construction of the replacement structure
- minimum lifecycle costs
- simple inspection of the substance

VFT-WIB® cross sections fulfil these demands to a very high degree. The prefabricated girders can therefore be put to advantageous use particularly when building replacement bridges over main lines with the requirement for the shortest possible closure times. Furthermore, this technology makes it possible to erect simple auxiliary bridges at very low costs and for longer service lives in the track network. Steel girder fatigue in such structures is irrelevant.

SSF Ingenieure AG
Consulting Engineers

Munich
Berlin
Halle
Cologne

www.ssf-ing.de