Freyssinet


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Les Gures Bridge (France) 1
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Freyssinet

CONSTRUCTION METHODS

OVERPASSES CONSTRUCTION & UPGRADING

Motorway overpasses

With the construction of a new motorway, it becomes necessary to rearrange the liaisons within the secondary network (with an average of one bridge per kilometre).

However, it is also essential to be able to maintain, adapt and modify these structures without hindering traffic on these fast motorways.

Freyssinet have thus participated in the development of several construction methods, involving an innovative technology and a know-how resulting from fifty years experience in civil engineering structures:

- industrialized construction of overpasses on undeveloped sites or over existing motorways;
- raising of overpasses for replacement of bearings or following an increase in the road clearance gauge;
- extension of existing overpasses due to an increase in the number of lanes of the spanned motorway (2 x 2 lanes to 2 x 3 lanes for example);
- demolition of structures, with no interruption to motorway traffic.

AREA

Overpasses

■ Quantities

- Concrete: 0.38 m³/m².
- Prestressing steel: 27 kg/m².
- Reinforcing steel: 8 kg/m².

The programme included the construction of 146 three-span overpasses crossing 2 x 2 or 2 x 3 lane motorways, with spans varying from 18 to 30 m. The total length of the decks is 6,500 linear metres.

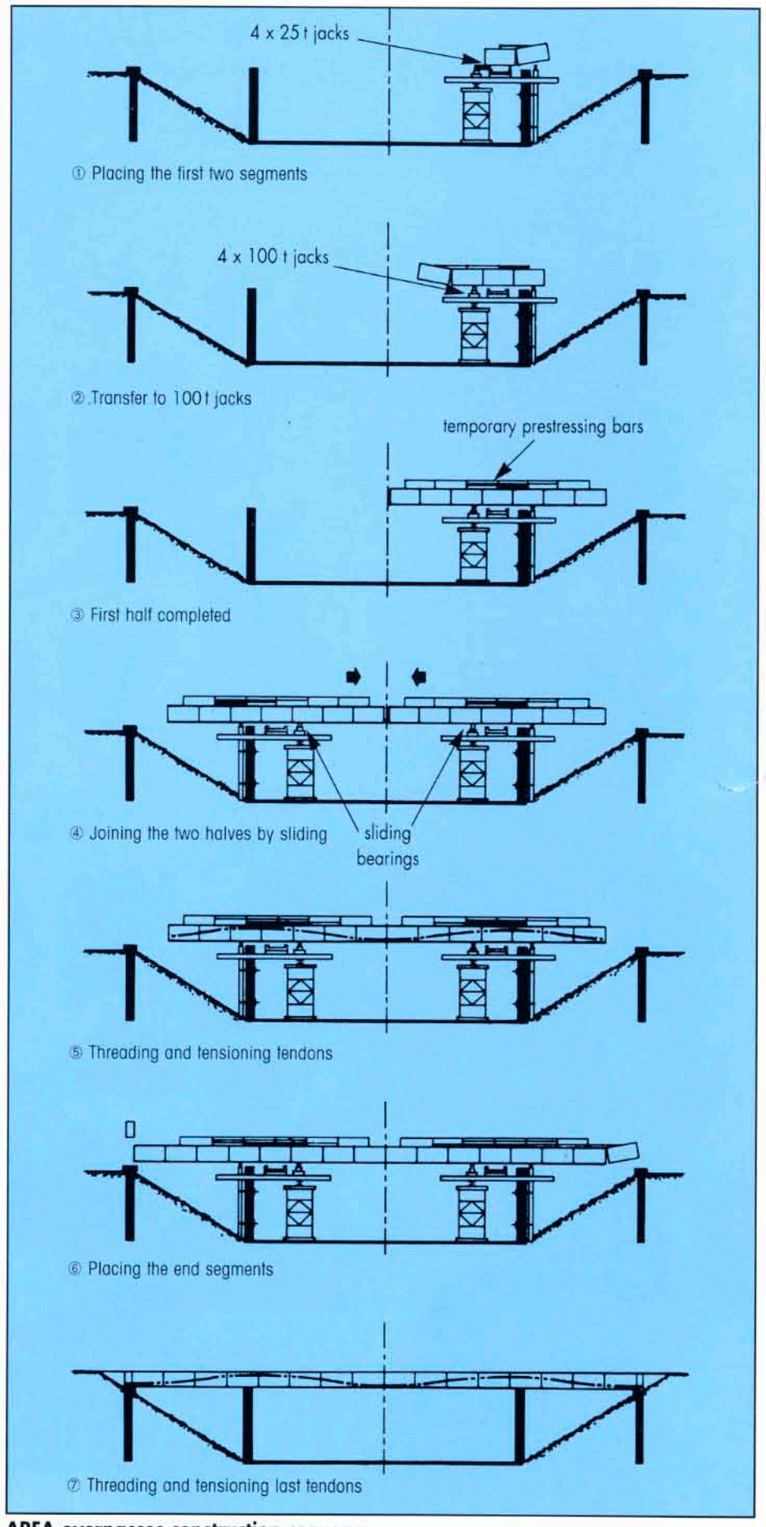
The large number of similar structures to be built allowed the contractors to develop a cantilever construction method using precast segments with match-cast joints, manufactured in a central plant, transported by road and assembled on site. The average transport distance was 60 km, with a maximum of 120 km. Transportation costs amounted to 3% of that of the total structure.

The segments had a standard length of 2.45 m, suiting the road transportation clearance and a constant depth of 1.25 m. The segment width was 6 m, 7.50 m and 8 m for a single box-girder and 10 m for a twin box-girder. The weight varied from 18 to 25 tonnes. 2,600 segments were cast at a rate of 25 to 30 bridges per year.

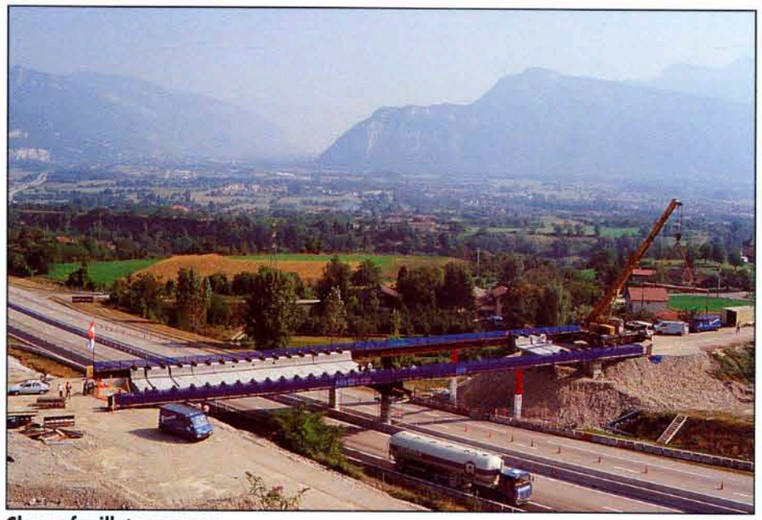
The segments were transported by trailer and erected by mobile crane. The spans were simultaneously cantilevered on both sides of the two piers.

A bridge was assembled by 8 workers within one week and the construction of an entire overpass required 15 days, foundations included.

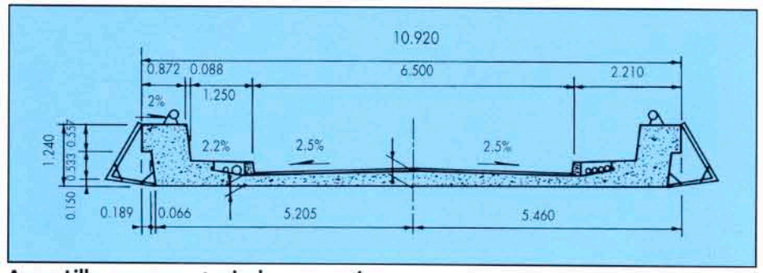
- Client: **Société des Autoroutes Rhône-Alpes (AREA).**
- Contractor: **Campenon Bernard, J.V..**
- Prestressing: **Freyssinet.**



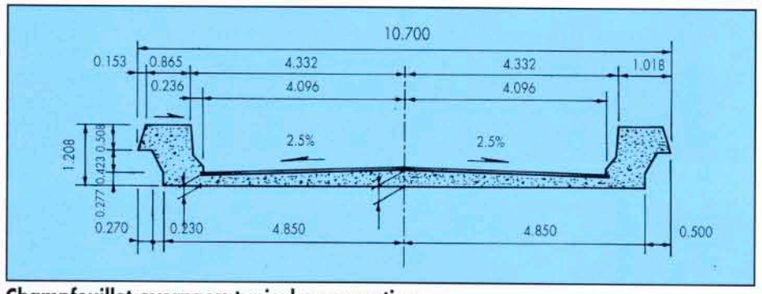
AREA overpasses construction sequence



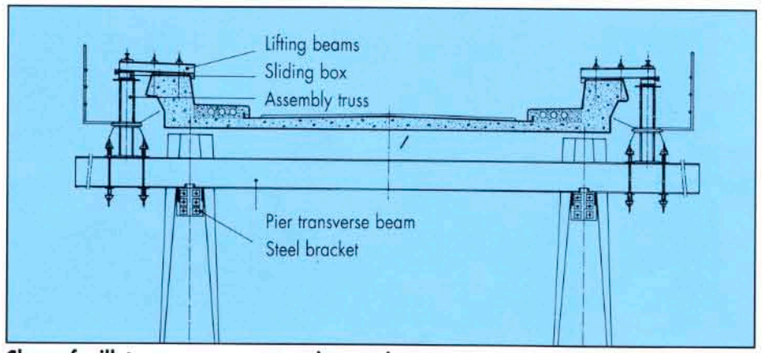
Champfeuillet overpass



Arras-Lille overpass: typical cross section



Champfeuillet overpass: typical cross section



Champfeuillet overpass: construction equipments

CHAMPFEUILLET & ARRAS-LILLE OVERPASSES

France

The design and construction of the Champfeuillet overpass (A48 motorway, about thirty kilometres north of Grenoble) and of the Arras-Lille overpasses (A1 motorway) was a real innovation in the industrialization of civil engineering structures.

The decks are made up of deep lateral ribs connected by a thin deck without any cross beams, with longitudinal and transverse prestressing.

Each segment, with a weight of about 27 tonnes, was match-cast. In the factory, the segments were fitted with lifting beams which constituted their bearing on the falsework, the translations and minute adjustments being achieved using specific sliding boxes. Within only two days the segments had been transported to the site, handled by crane and shifted to their quasi-permanent location on the steel assembly truss.

After the application of epoxy resin at the joints, the longitudinal prestressing was installed.

■ Champfeuillet

- Client: **Société des Autoroutes Rhône-Alpes (AREA).**
- Design: **Jean Muller International.**
- Contractors: **Freyssinet and Campenon Bernard Régions.**

■ Arras-Lille

- Client: **Société des Autoroutes du Nord de la France (SANEF).**
- Consultant: **Jean Muller International.**
- Contractors: **Quillery and Freyssinet.**

A1 MOTORWAY

Overpass 135

The upgrading of a motorway sometimes requires a modification in vertical clearance, resulting in overpasses needing to be raised.

Raising operations have to follow severe restrictions:

- continuous traffic flow under the overpass ;
- safety of highway users and workers ;
- speed of erection ;
- safety of the structure itself.

To meet all these restrictions, all the jacks are monitored from a single computer controlled lifting station. These jacks have a sufficient stroke and reduced dimensions. They are usually bolted on both sides of each pier.

A1 Motorway: overpass 135

A7 MOTORWAY

Overpass 63

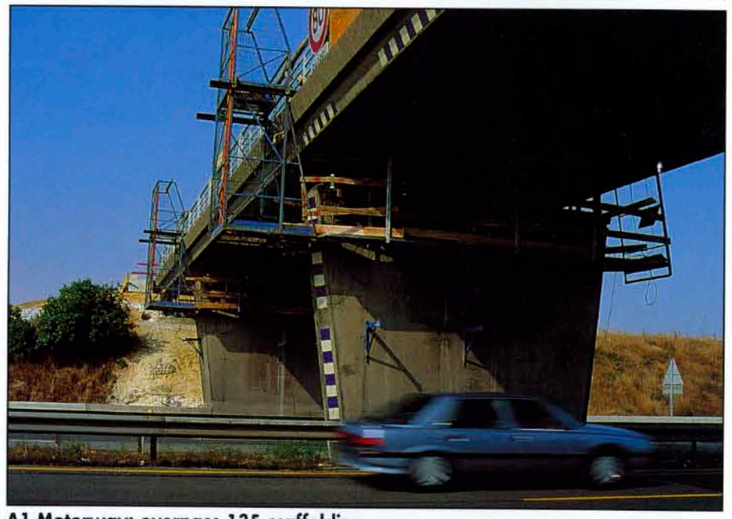
ASF (Autoroutes du Sud de la France) requested that overpass 63 be demolished due to the widening of A7 motorway. Traffic could not be interrupted for more than five hours during one night only.

Freyssinet, in collaboration with Europe Etudes Gecti, proposed an innovative method consisting of strengthening the structure in order to shift it to the access ramp backfill and to subsequently demolish it outside the motorway limit. This technique obviously had the major advantage of necessitating no interruption of motorway traffic.

■ The works consisted of four phases:

- General preparation:
  - preparatory works alongside the structure (demolitions, earthworks);
  - testing and checking existing concrete deck and prestressing;
  - ground beams construction (on backfill) to receive the structure;
  - providing access to the various zones.
- Lifting the deck with Freyssinet corbel jacks so as to install the additional prestressing; placing sliding saddles over 200 t jacks together with safety wedges.
- Placing the rear support.
- Shifting the deck in two phases with four SL 12 jacks. Demolition of the deck in two phases following sawing operations.

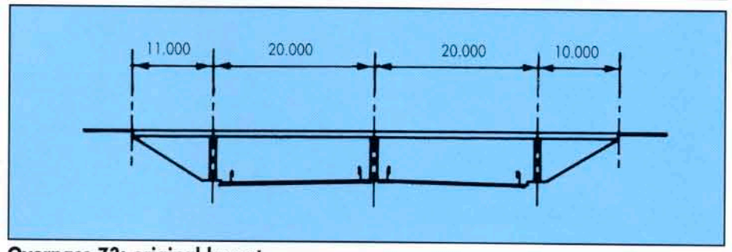
- Client:
Autoroutes du Sud de la France (ASF).
- Design office:
Europe Etudes Gecti.
- Contractor:
Freyssinet.



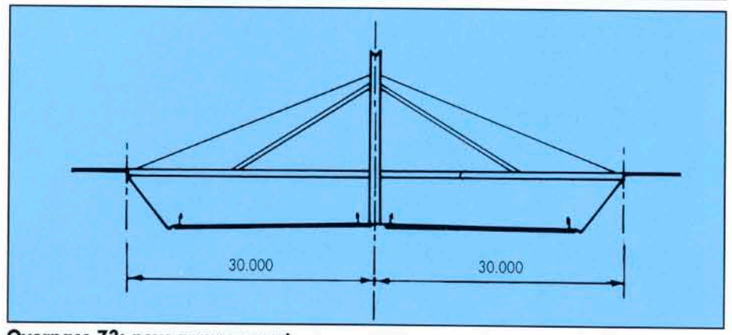
A1 Motorway: overpass 135 scaffolding

A7 Motorway: Reventin-Vaugris overpass demolition

Overpass 73



Overpass 73: original layout



Overpass 73: new arrangement

Overpass 73 stay cable deck anchorage...

and installation

A6 MOTORWAY

Overpass 73
Beaune - France

An increase in traffic has resulted in the A6 motorway being widened from 2 x 3 lanes to 2 x 4 lanes.

Overpass 73 was saved by transforming the continuous concrete slab into an elegant cable stayed bridge.

■ Operation sequences:

- pylon foundation ;
- pylon construction using precast segments ;
- placing the stay cables across the pylon using special saddles ;
- construction of prestressed concrete girders to anchor the stay cables on the deck ;
- tensioning of the stay cables ;
- demolition of the old piers.

Only five months were needed to complete the works.

■ Stay cables:

Six pairs of 27 x 15 mm strands threaded into an HDPE sheath.
Corrosion protection is provided by petroleum wax injection.
Saddles are designed to allow for retensioning and removal of strands.

■ Traffic:

There was no interruption of traffic on the motorway or the overpass.

- Client:
Société des Autoroutes Paris-Rhin-Rhône (SAPRR).
- Consultant:
SETRA.
- Contractor:
Razel.
- Prestressing and stay cables:
Freyssinet.

■ Cable stayed overpasses:

Freyssinet also supplied and installed the stay cables of several elegant overpasses:

- **Volcans Rest Area - A71 - France**
  Prestressed concrete deck suspended to a steel arch.
- **Gures Overpass - National Road 205 - France**
- **Farges Rest Area - A71 - France**
  Prestressed concrete deck with a longitudinal central rib, suspended by eight stay cables to a pyramid of four steel columns.

A1 MOTORWAY

Demolition of overpasses 106 & 107

Overpasses 106 and 107 were continuous, prestressed concrete slab bridges consisting of four spans. It was out of question to demolish them in phases for two reasons:

- Difficulty in achieving stability.
- Considerable hindrance to the very dense road traffic.

Therefore, it was decided to firstly shift each deck onto the adjacent backfills.

The originality of the demolition technique implemented by Freyssinet for overpasses 106 and 107 of the A1 motorway, consisted in not - or hardly - modifying the decks mechanical scheme during the shifting operations, as long as the structures were above the traffic.

Consequently, when the structure is stable before being demolished, it will automatically remain stable during its transfer, without the condition of its constituting materials having to be assessed to carry out its strengthening.

A1 Motorway: demolition of overpass 106

Shifting principle

■ Steel equipments

Structural arrangement:

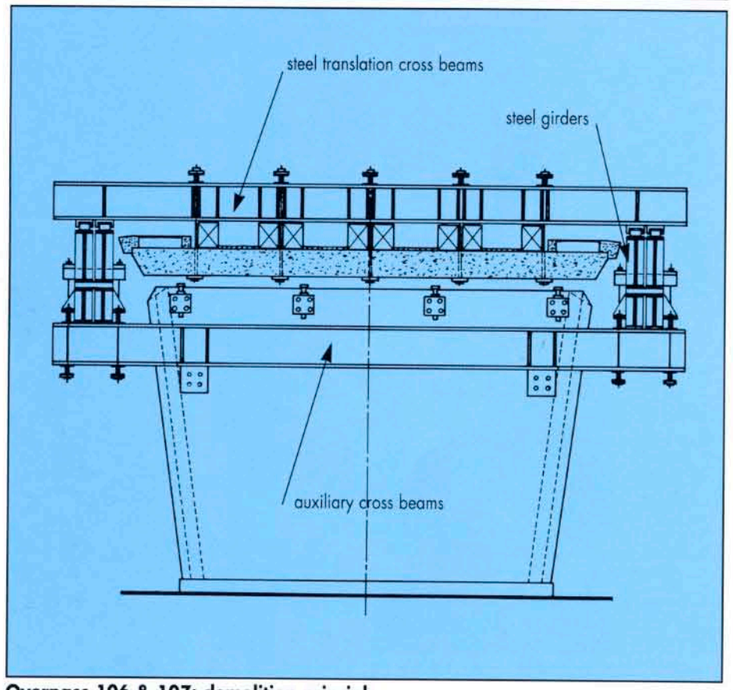
- on each side of the structure, two high inertia girders capable of supporting the deck without any important strains;
- at the piers, auxiliary steel cross beams, supporting the beams mentioned above;
- at the supports, steel translation cross beams onto which the deck was restrained by prestressing.

This arrangement was completed with two reinforced concrete ground beams on the backfill, supporting the deck and the pulling system.

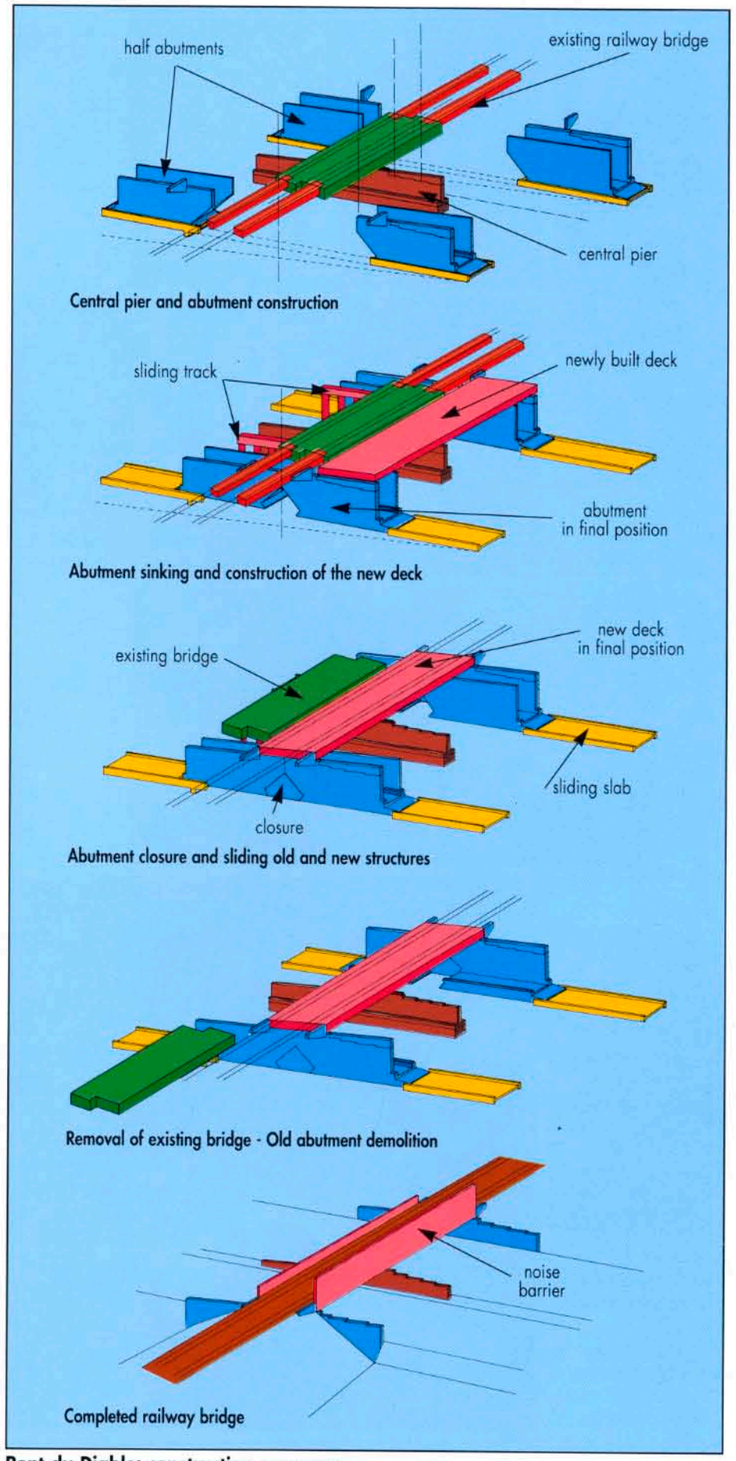
Temporary, reinforced concrete supports were also disposed near the TGV (High Speed Railway) side abutment.

■ The shifting operations took place as follows:

- Raising the deck using a system of jacks fixed to the supports. This operation was computer assisted.
- Interposition of "permanent rollers" between the translation cross beams and the lateral girders.
- Disconnection of the lifting jacks.
- Shifting the deck using the Freyssinet Transpac System.
- In accordance with the progress of the travel, interposition of skid pads between the ground beams and the deck slab.
- When the structure was entirely installed on the ground beams, the demolition operations could start.



Overpass 106 & 107: demolition principle



Pont du Diable: construction sequence

THE PONT DU DIABLE

France

As part of the widening of the A12 motorway, the two decks and the footbridge of the SNCF (French Railways) structure, near Saint-Cyr, were replaced.

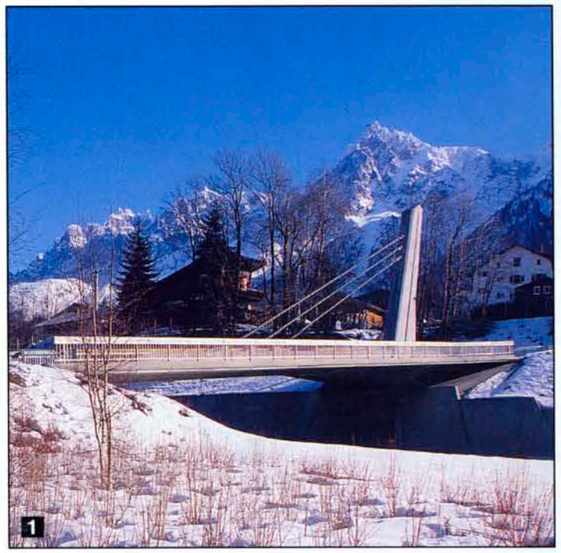
The former 24 m long steel deck weighing about 300 tonnes, plus the concrete footbridge weighing about 100 tonnes, were changed for two 44m long 700 tonne decks with composite girders.

The entire operation was carried out with no hindrance to road traffic and with very minor interruptions on the railway.

■ Freyssinet was in charge of the following:

- the construction of the new deck's abutments using the self-sinking technique through the backfill by means of prestressing tendons;
- the raising by 850 mm and the shifting of the two old decks on temporary bents installed on each side of the motorway;
- the simultaneous shifting of the two new decks, using hydraulic launching systems;
- the removal of the original decks and footbridge towards a demolition yard located on the other side of the motorway.

Freyssinet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