incremental launching of bridges in Europe

owner's targets for a new bridge

- optimized initial investment
  - reasonable construction cost (not necessarily the lowest)
  - architecture (aesthetics is a virtue and implies costs)
  - low impact on environment
- long service life and low maintenance
  - continuous box-girders
  - no internal expansion joints → sliding bearings
  - high quality of design and construction
- accelerated construction → reduced impacts to public

contractor's targets for a new bridge

- low quantities of materials ? not necessarily…!
- optimized industrialization
  - low labor demand in industrialized countries
  - safety of workers
  - affordable equipment with high reuse expectations
  - short work duration for low indirect costs
  - innovation and technological progress for increased export capability

HNTB

is high industrialization always affordable ?

bridge length governs :

- number of production cycles within the project time-schedule
- optimum level of industrialization
- amortization of investments and reuse expectations for specialized construction equipment
- risk of innovation

obstacles (rivers, highways, railroads, inhabited areas, steep slopes) govern bridge construction

Courtesy
Thyssenkrupp

HNTB

from simply supported to continuous beams

- no internal expansion joints → durability
- minimum number of bearings (two on every pier)
- use of seismic I/D devices for reliable seismic response and avoidance of structural damage
- optimum fatigue response
- more slender superstructures → aesthetics
- higher structural efficiency and lower quantities of materials

what affordable industrialization for continuous spans ?

HNTB

casting on falsework ?

- complete occupation of the areas underneath
- high labor costs, long construction duration, poor industrialization
- quality ?

casting on trusses ?

- risks for workers and the areas underneath
- highest labor costs, long construction duration, poor industrialization, high crane demand
- form deflection: quality ?

risks for workers and the obstacle, high labor costs, long construction duration, high crane demand ……

- **can bridge construction efficiency be improved ?**
- **is innovation avoidable ?**

gantry erection of precast I-girders ?

Courtesy
Comtec

gantry erection of precast I-girders

- risks for workers
- risks for the obstacle to overpass
- investment amortization for the gantry
- transportation, assembly & dismantling (TAD) costs
- transportation and erection costs for the I-girders
- poor site industrialization
- complex operations for structural continuity
- poor quality and durability of the deck slab

Courtesy
Comtec

HNTB

gantry erection of precast segmental box-girders ?

Courtesy
Deal

gantry erection of precast segmental box-girders

- risks for workers and the obstacle
- amortization of the investment for the gantry and its transportation, assembly & dismantling costs
- amortization of the investment for the precasting plant
- transportation cost of precast segments
- quality and number of epoxy joints

Courtesy
Deal

HNTB

gantry erection of macro-segments ?

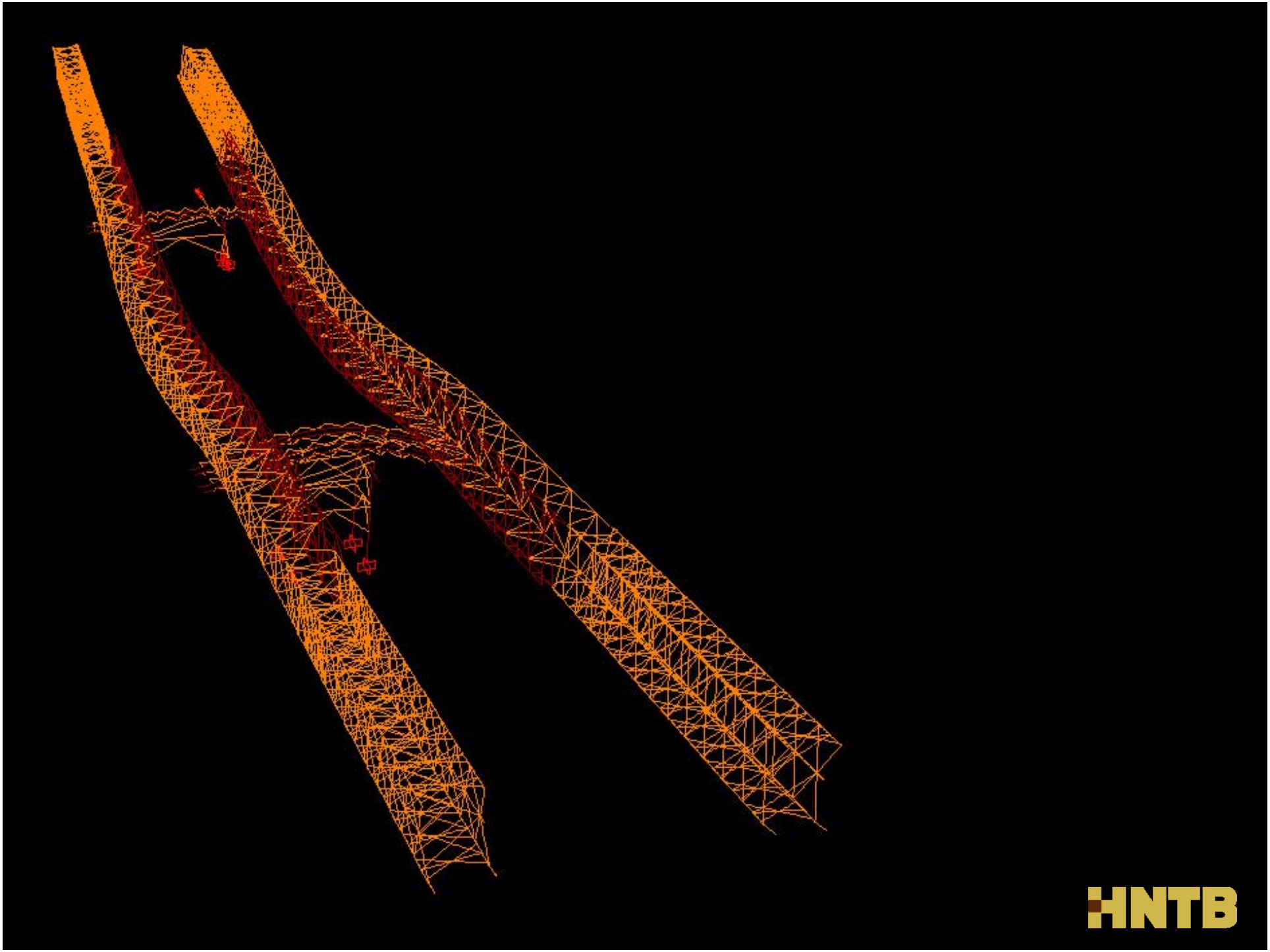
gantry erection of macro-segments

- risks for workers and the obstacle
- amortization of the investment for the gantry and its transportation, assembly & dismantling costs
- risks of launching gantries amplified by segment weight

launching gantries are extremely delicate structures, designed for highest stress levels in different load conditions, prone to instability and out-of-plane buckling, assembled and dismantled many times, and reused by different crews

span-by-span casting with an MSS ?

(Movable Shuttering System)


HNTB

high quality, but . . .

. . . affordable industrialization ?

balanced-cantilever construction with an MSS ?

Courtesy
Thyssenkrupp

HNTB

. . . affordable industrialization ?

Courtesy
Thyssenkrupp

balanced-cantilever construction with deck-supported form-travelers

- safety and quality of working on a cantilever ?
- delivery of construction materials ?
- number of construction joints ?
- adequate industrialization ?
- really accelerated construction ?

Courtesy
Egnatia Odos

HNTB

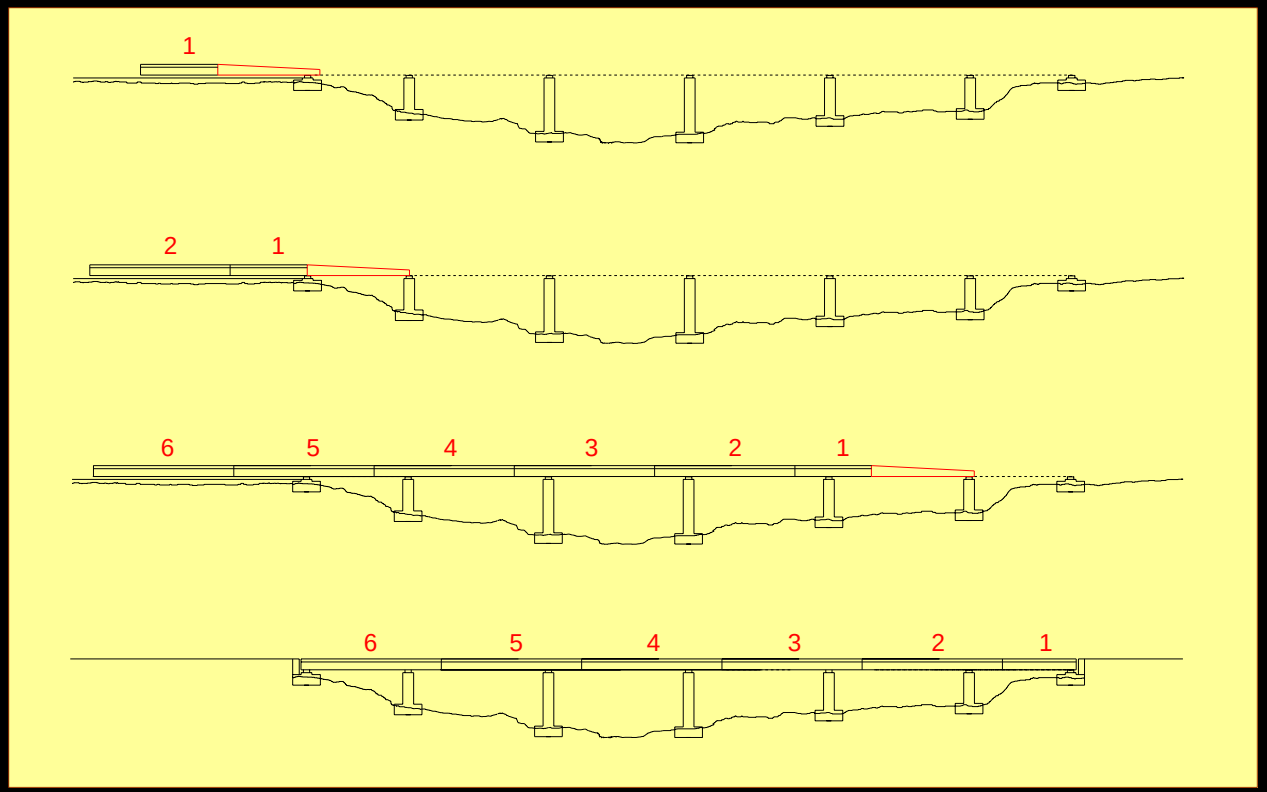
industrialized in-place casting

- risks for workers
- risks for, and interference with, the obstacle to be overpassed
- investment amortization for the movable shuttering system under low reuse expectations
- transportation, assembly & dismantling costs and times for the movable shuttering system
- long duration of balanced-cantilever construction with deck supported form-travelers
- load deflections of the casting cell and induced cracks in curing concrete
- application of prestress at short curing
- complex MSS-deck interaction
- time-dependent losses and cambers
- quality ?

HNTB

bridge launching !

- no risks for workers
- no risks for, and no interference with, the obstacle
- adaptable industrialization with low-cost equipment
- smallest casting yard
- highest construction quality
- rapid construction



smallest casting yard – precious in urban ambit !

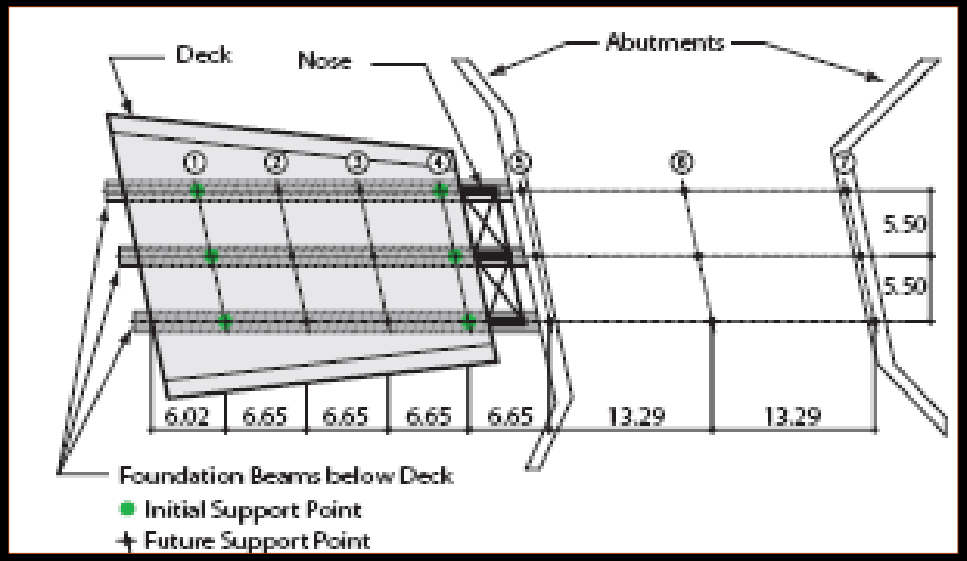
no interference with the obstacle

- rivers, channels, fjords
- highways and railroads – with no clearance reduction
- deep valleys, steep slopes
- piers of any height

Courtesy
Dywidag
Systems
International

HNTB

applicable to simply supported spans



HNTB

temporary piers can improve the support scheme

Courtesy
Greisch

HNTB

applicable to cable-stayed bridges …

HNTB

HNTB

HNTB

… and to arches …

- safety of workers
- high structure quality
- short construction duration
- lower load unbalance and longer spans than with span-by-span casting with a movable shuttering system
- less temporary bracing systems and counterweights
- continuous ribbed slabs for short spans

Courtesy
Leonhardt

HNTB

Courtesy
Leonhardt

HNTB

… and launching is also rotation

Courtesy
Greisch

possibility of high industrialization …

… with affordable investments, smallest yard …

… and the highest quality control

HNTB

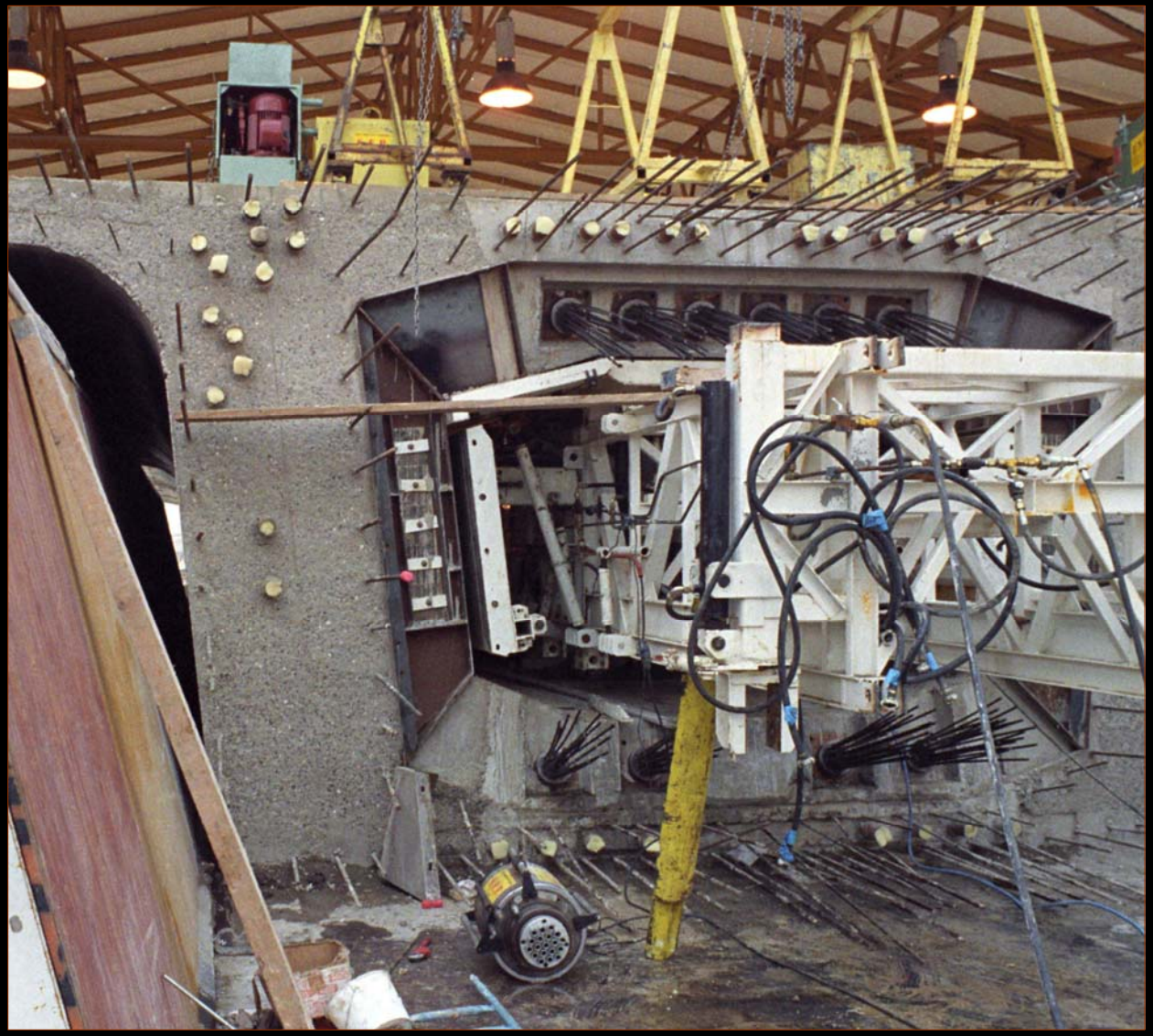
HNTB

optimized deck segmentation for short forms …

… and transverse shifting for a second launch

HNTB

only two match-cast joints with through reinforcement in every span



main advantages of incremental launching

1. simple standard equipment : a formwork supported on the ground, a thrust system, and a steel nose for reduction of the launch stresses
2. smallest casting yard for the formwork, the cage assembly template (if any), and the storage areas – this is a major advantage for urban bridges
3. use of a tower crane : stocking and handling of materials are considerably simplified
4. deck built in a fixed, sheltered location : each operation is simpler and safer than on a falsework or at the tip of a cantilever and may be organized in parallel rather than in series
5. highest level of quality control : the construction of durable structures is in the best interest of contractor
6. no falsework between the piers : no risks for the workers and the obstacle, no use limitations for overpassed railroads or highways, no need for temporary clearance reductions
7. casting long deck segments reduces the number of construction joints and shortens construction duration

HNTB

launch of the steel girders of composite bridges

HNTB

Courtesy
Rizzani deEccher

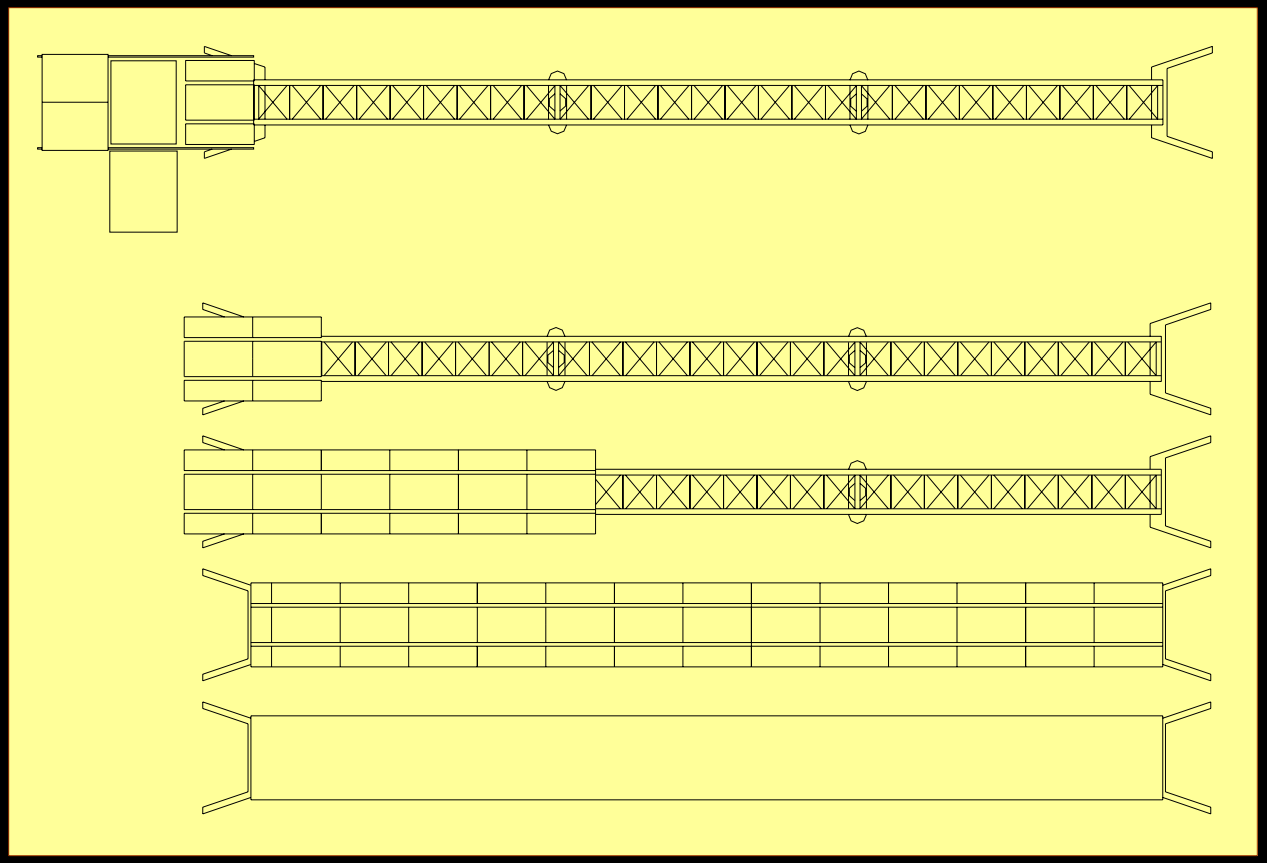
HNTB

HNTB

HNTB

launch of the deck slab onto pre-launched girders

- continuous slab cast segmentally in a fixed location
- less expensive than segmental slab precasting or in-place casting with a movable shuttering system
- longitudinal slab prestressing in the negative-moment regions is particularly inexpensive



launching of prestressed composite bridges with corrugated-plate steel webs

Courtesy
Campenon
Bernard

HNTB

corrugated-plate box-girders

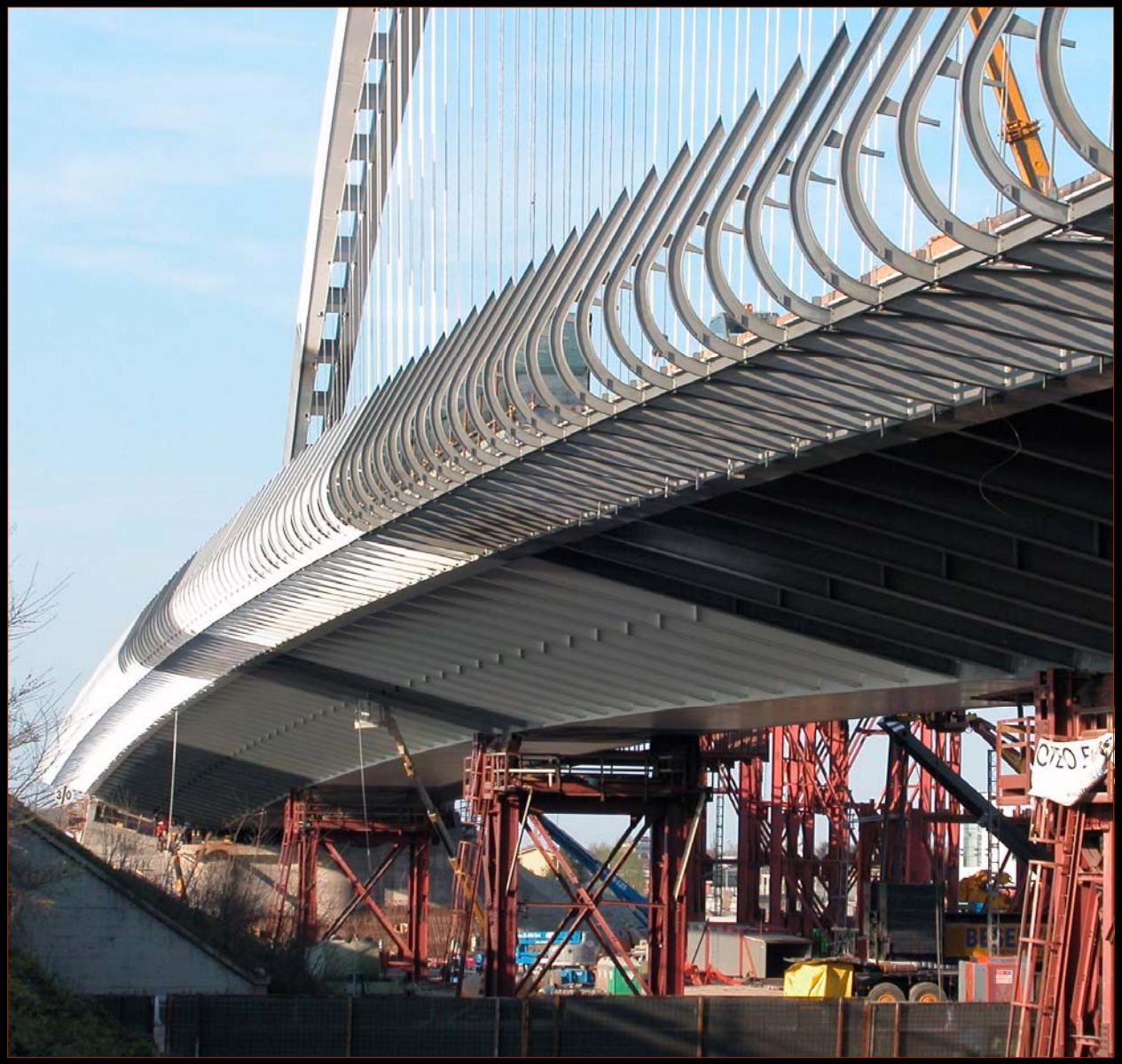
- no migration of axial stresses into the steel webs
- no need for welded stiffeners
- no need for complex steel components

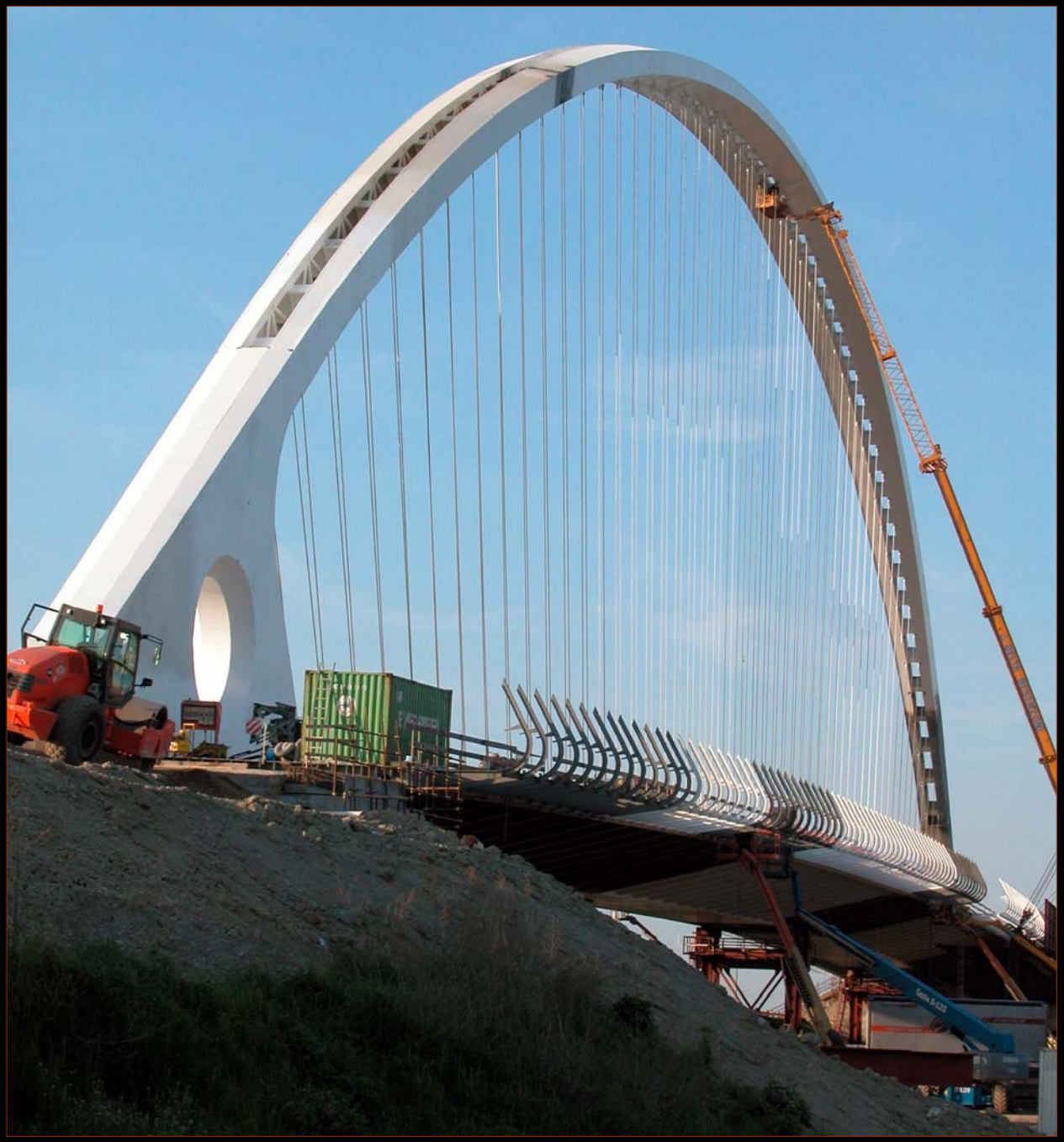
Courtesy
Virlogeux

HNTB

launch of steel orthotropic-plate decks …

… and suspension from an arch





HNTB