Installation of viaduct over the Tajo River, Spain
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CLIENT
Spanish Ministry of Public Works

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LA PLATA A-66 HIGHWAY
ALCONETAR BRIDGE
Road section: Cañaveral-Enlace de Hinojal
Cáceres, Spain

Highway passing over Alcantara Reservoir, at Tajo River
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ALCONETAR BRIDGE
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Highway passing over Alcantara Reservoir, at Tajo River
Conceptual design integrated with the construction process project
Dimensions

722 ft

Span of the steel arch
Dimensions

140 ft

Air draft
Deck support: piers spaced 85 feet in between axes
Deck section

Composite structure

Twin-girder steel – concrete slab, without diaphragms

A 709 Grade 345 W- Weathering steel

44 ft
Arch area. Structural elements

- Deck slab
- Steel girders
- Steel piers
- Steel bracings ("X" shaped)
- Arch (2 Girders – box)
Girder-box section
Approaches. Structural elements

Concrete piers
(2 shafts linked by a lintel)

Special concrete pier
Special concrete pier

Steel diaphragm

Transverse buffers
(Transversal guidance and constraint)
Alcantara Reservoir
Construction Sequence
Foundation of piers and abutments
Elevation of piers and abutments
Construction of complete bridge section on dry land
Launching of bridge section up to the piers closer to the Reservoir.
Removing 42 frontal feet belonging to the steel girders

Launching of bridge section up to the piers closer to the Reservoir.
42 frontal feet removed
Assembling on dry land a quarter of arch and skidding over the bridge section built
Tilting of the arch section
Tilting of the arch section
Tilting of the arch section
The tilted arch section is supported on the concrete pier base.
Assembling second quarter of arch and skidding over the bridge section built.

Coupling both arch sections in an area provided with a hinge.
Tilting of the rear section by lifting with a crane placed on the bridge section

(The crane is not represented in the slide)
Semi-arch on vertical position
Tilting of the second rear section by lifting with a crane placed on the bridge section.

(The crane is not represented in the slide.)
Both semi-arches in vertical position.
The built arch sections are 394 feet high.
Installation of holding back and TILTING down system
Semi-arches in position previous TILTING down
TILTING DOWN of semi-arches
Closure of arches
A three-hinged arch is set up
Both arches are TILTED down
The hinges are blocked and the arches keep bi-embedded
Pushing bridge sections at time at both sides up to beyond the built piers
Construction of the steel piers placed at the central zone.

Assembling with crane placed on the bridge section
Assembling of bridge section up to closure.
Works of completion (Paving, barriers, etc)
Assembly of the Steel girders on dry land
In situ construction of the top slab
Assembling arch pieces on the bridge deck
First launching of decks
First launching of decks
Assembly of frame for rotation and lowering of semi-arches
Skidding of Semi-arches
REDUCCION TEORICA DE APOYO
SECUENCIA D1

SI EXISTENCIA DE CANTAPIESOS
R10(A1) R20(A1)
150 (40) 138 (40)

CON CANTAPIESOS 2x150 mm
684 (40) 683 (40)

ALZADO SECUENCIA D1

D1-1 -Montaje, mediante orugas del extremo inferior sobre las ruedas, colocadas sobre los marcos de chavetona.  
D1-2 -Aplicación del sistema de retención intermedio del puente.  
-Localización de las piezas principales que forman el primer cuarto de arco en los puntos finales de transporte sobre el tablero mediante orugas sobre pales de deslizamiento.
Skidding of Semi-arches on top of Deck
Skidding of Semi-arches on top of Deck
Functioning of Skid-Shoes
Functioning of Skid-Shoes

Vertical Jacks activated
ALZADO SECUENCIA D9
DEPO 1/36

DESE - MOVIMIENTO SEQUENCIAL CENTRO LATERAL
DE LOS SISTEMAS DE D40.
Detail of hinge for lowering down
Lowering of first quarter of arch
Lowering of first quarter of arch
Coupling second quarter of arch. Joined by a hinge
Second quarter of arch over bridge section

Coupling both arch sections with hinge
Lifting with crane the rear section of the arch, rotating on intermediate hinge
Lifting stops 4 meters from the vertical of the centre of gravity
Removal of Crane

Installation of holding cables

Installation of jacks onto an auxiliary structure
Lifting by crane of the upper section of the arch.
The lifting stops 13 ft distanced of the c.o.g. vertical
Installation of jacks onto auxiliary structure
Crane withdrawing

Installation of provisional holding cables
The rotation is completed operating over the jacks

Tilting of second quarter of arch

Reservoir
Accurate fitting of the joint area. Welding
Crawler crane over bridge section

Dead load: 385 US t
Crawler crane over bridge section
<table>
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<th>H1 (ft)</th>
<th>V1 (US t)</th>
<th>V2 (US t)</th>
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<tr>
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<td>101.2</td>
<td>131.4</td>
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<tr>
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<td>107.4</td>
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<td>26</td>
<td>110.7</td>
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</tbody>
</table>
Support on jacks and unloading of crane
Sección 7.
Proceso de distribución del pendiente

[Diagrama de un proyecto de ingeniería, probablemente relacionado con la construcción de un puente o estructura similar]
Lowering down of semi-arches

Combined manoeuver of pushing with horizontal cylinders and holding back with cables
Installation of steel piers by means of crane placed on the bridge section
Installation of steel piers by means of crane placed on the bridge section
New phase of pushing bridge section
Arch construction. Lowering down semi-arch
Holding back system
Holding back jacks
Arch Hinge

Bars to pull back the semi-arch

Bars to pull back the semi-arch

Vertical bars to compensate uplift forces
Arch Hinge

Jacks for longitudinal adjustment

Sliding surfaces for longitudinal Adjustment
Arch Hinge

Holes to accommodate Spherical hinges
Arch Hinge
Arch Hinge blocked and casted
TILTING DOWN. Closure

Automatic locking system
Positioning of semi-arches up to the steel elements come into contact
Housing “V” shaped
Closure. Elevation

Spherical axial swivel

Housing “V” shaped

Front cap

Spherical axial swivel

Closure. Elevation
Sliding surface

Closure. Elevation
Closure. Elevation

Housing “V” shaped

Front cap

Spherical axial swivel
Welded Connection
Lessons Learned
Wind induced problems during construction

January the 10th 2006
Analysis with CFD of Vortex Shedding problems
Wind Speed: 13 Miles/h Constant
Wind Tunnel Test
Deflectors
Final phase of the project - Execution speed

Status of the works: 28th January 2006

Load test: 5th July 2006
Compulsory in Spanish regulations

5 ½ months
Cost: 15.4 M $ (year 2006)

Construction Time: 28 Months

The adopted construction system provided a 10 month reduction in the time schedule in comparison with a classic cantilever construction.

Video of Construction Sequence
https://www.youtube.com/watch?v=o4eM0qoUhaE

Video of Wind Problems
https://www.youtube.com/watch?v=OdeBjYuhoGQ
Conclusions

- **Construction 100% on dry land**: Quality control and speed construction.
- **Steel arches**: High Stiffness and lightness as compared with their external dimensions.
- **Possibility of handling** big elements.
- **Constructive system with minimal** environmental impact.
- **Suitable to avoid** major natural obstacles.

Performance:

- **Coordination** Design-Construction. Equipment multidisciplinary.