

March 2018 ABC-UTC Webinar Featured Presentation: Construction Methodology for Alconétar Arch Bridges in Spain		
#	Q&A Session: Questions	Responses
Project - Design		
1	What software, if any, was used to design/verify the construction stages?	We used a commercial software called Robot (similar to SAP2000) and some in-house pre-processors and post-processors SW.
2	Is prestress used in any case for increasing the efficiency of the connection between the two halves of the arch?	No, prestressing was not used for the connection. During the manoeuvre, simple contact steel-steel was needed. When the manoeuvre was finished, a CJP weld was performed at the connection.
3	How was the lower arch section "hinged" to allow tilting into final position? Who provided the erection scheme?	The lower arch hinge is shown in slides 134 till 137. The erection scheme was provided together by the designer, the contractor and the subcontractor of the manoeuvres.
4	How were temperature effects on the arch ribs accommodated?	Temperature affects the lengths of the semi-arches. However, at the end of the tilting manoeuvre. See Q #5.
5	What was your approach during the design phase to accommodating fit-up issues in the final middle section of the arch?	Explained in slides 139 till 164. As it is a three hinged arch, geometry can be adjusted with the degrees of movement of the lower arch hinge shown in slides 134 to 137. If the closure had occurred at a lower level than expected, by pushing the jacks of slide 137 then the crown will automatically go up.
6	What type of check did you do or what type of concern did you have when you tilted the upper arch that was 196 ft long and 250 Tonnes?	Checks regarding survey and forces at the jacks. See Q. #5.
7	Where was the point of no return in this procedure?	There was not a point of no return during the tilting manoeuvre. The jacks were able to pull back the semi-arches at any time.
Project - Construction		
8	What specific construction equipment was used for the bridge installation?	Skid-shoes, strand jacks with double grip for heavy lifting manoeuvres, one crawler crane, steel frames made of modular steel pieces, jacks with long stroke (25 ft) at the beginning of the tilting manoeuvre, spherical swivels.
9	What is the name of the machine that was used to skid the arch sections into place, and how does it work?	They are called skid-shoes. The way they function is explained in slides 56 to 60.
10	What survey control measures were used?	Standard total survey stations were used.
11	196 ft arch section: delivered in sections & assembled on-site? Sizes of dis-assembled sections?	The quarters of the arches were shipped in pieces that measured a third of its length, that is 66 ft.
12	What was the construction time to build this bridge?	28 months. Design started 4 months prior to construction.
General		
13	How do bridge design codes differ between European countries? How do they differ from the US's AASHTO and AREMA codes?	Eurocodes have a more theoretical base than the AASHTO that is based more on empirical rules. Eurocode is more prepared to design bridges that are different than the normal ones.
14	How are claims settled in an ABC environment?	In Spain, claims do not depend of an ABC.
Questions during Webinar		
15	How are the arch interiors inspected and how often are they inspected?	Every 2 years.
16	The bridge support-to-arch connection was shown but appears to show a section that cannot be inspected on the inside. Is it possible to inspect the arch interior at these locations?	Yes they are inspectable. See in slides (12 & 14) that there are access holes in the intermediate diaphragms (slide 12) and in the connection with the piers (slide 14).
17	Slide 79: Did the crane walk with the load to raise the arch piece?	Yes, it did. See slides 78 &79 or 87 & 91.
18	Slide 166, 167 - what kind of weld was used to complete the connection and how was it inspected?	Complete joint penetration was performed with some backing plates. Inspected with ultrasonic test (UT).
19	What was the main reason to choose welding over plate bolted joint connection at mid arch joint?	Welded connection does not require such an accuracy in the geometry prior to doing the connection.
20	Was a concrete structure also considered for the arches?	In order to speed construction, concrete was not considered.
21	What was the total construction time?	28 months.
22	Are the CAD drawings of the bridge available for download? I'd be interested in studying them.	No.
23	The youtube link for the wind problem video is not working.	Search "arcosalconetar vibracion" in youtube and you will see several videos
24	Did the wind deflectors become permanent on the arches?	Yes they are. They are still required to avoid vortex-shedding problems, although the movement would be much less under service.

25	How is the cost of the construction plant (jacks, strand jacks, launching system) included? Is it distributed over several projects, or just on this project?	All plant equipment was existing and standard in our company. Only new specific equipment for this job was the strands for the different phases, and even we did reuse some for the second arch. All hydraulic systems and temporary steel as: + 8x150 ton skid shoes, tracks and pushing systems used for sliding arch sections on concrete deck + 4x200 tons Strand units to tilt and lower down the first arch section + 4x 70tons holding strand units to give the arch vertical shape and for launching + Sliding launching supports on piers and side guidances +4 x 250 ton x 5 feet double acting jacks for giving de arch shape on vertical position to the semi arches + 4 x 50 ton x 25 feert single act long stroke jacks to push the semi arch to force tilting + 8 x 60 tons x 6" stroke to control lower hinge point + 4x 500 tons strand jacks to allow and control tilting. + All computers + All electronics + Even all temporary steel work was modular existing and strandard elments.
26	Cost?	15,4 M USD (year 2006).
27	Is the mid-span welded connection designed to carry any force?	Yes of course. The mid connection of the arch will carry axial compression forces and bending forces as well.
28	Did you have laboratory tests done on the weathering steel to make certain it was made in accordance with the metallurgy requirements?	Yes, there was a quality plan for the materials, the workshops and the welding procedures.
29	Outstanding presentation and very innovative design and construction. I was thoroughly impressed and not certain why I hadn't heard about this project before. Is the structure performing as expected, as identified through subsequent inspections?	Yes it is. The bridge is performing as expected and no more wind-induced problems have occurred after 12 years.
30	Any chance of settlement at the site?	No. Only instability problems of the slopes on one side could occur due to the existence of schist. Micropiles and anchors were provided for that purpose.
31	Is there any actual construction video available?	Search in youtube "puente arcosalconetar" or https://www.youtube.com/watch?v=o4eM0qoUhaE .
32	The structure model is based on the 3-hinge model?	Only during construction and after the tilting of the arches. As shown in slide 138, the arches are rigidly connected to the footings under service.
33	How are the field welds inspected and certified at mid-span of the arch? Also, does the arch act as a three-hinge arch only during erection, or do you still consider a hinge at mid-span after the arch is welded?	Mid-span arch joint was inspected with ultrasonic test (UT).
34	Have there been other bridges constructed using this same construction method?	There are several bridges in Spain built by a tilting manoeuver, but no one has some many and different manoeuvres (skidding, tilting, rotating, lowering) as this one.
35	Do you have any expansion joints on the deck?	Only at the abutments. The deck is continuous throughout its entire length (1308 ft).
36	Once the two arch halves are welded, the arch becomes a two-hinged arch. How were temperature changes handled for the final condition?	When the tilting manoeuver is completed, then the mid-arch connection is welded, and the base of the arches are rigidly connected to the foundations (movements and rotations). Temperature variations will result in vertical movements and mainly axial forces on the arches.
37	How much and how the load from crane was transferred through deck to piers?	The load from the crane was transferred by shear and bending of the deck. This is why the section of the deck should be completed at this stage. Top slab fully concreted.
38	Were arches modeled by using a EF model in order to verify possible buckling modes of cross section?	No, they were modeled by frame elements. General buckling of the arches was analyzed by a 3D frame model. Local buckling of the plate of the cross-section of the arches was analyzed with standard spreadsheets according to Eurocodes.
39	Did you have laboratory tests done on the weathering steel to make certain it was made in accord with the metallurgy requirements?	Yes, there was a quality plan for the materials, the workshops and the welding procedures.
40	Did you develop a set of procedures or manual for the Bridge Safety Inspection for the owner?	No, the designer did not develop a Manual for inspection. However, the client (Spanish ministry of public works) did.
41	Amazing details... wish all your presenters show such high definition and detailed stuff!!	Thanks.
42	Legendary team, presentation, and project!!!	Thanks.
43	Very informative presentation. Well done presenters and of course the design and construction team !	Thanks.
44	Kudos to all involved. Very nice presentation and very interesting project/concepts. Thank you for sharing.	Thanks.
45	We should get the contractor to upgrade and construct our aging bridges infrastructure!! It would surely be cheaper for the tax payers!!!!	