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A fast and inexpensive erection procedure was used for the construction of a new arch bridge in Kazakhstan.

The process of infilling the Ishim River in Astana, Kazakhstan, for the construction of the Ramstore Bridge deck, allowed for a simple and fast approach in constructing the main support arch with the minimum possible interruption to the deck construction.

The new bridge is a road bridge which includes a pedestrian walkway on each side of the structure. The Russian-designed bridge consists of a four lane orthotropic steel deck of approximately 120m span, supported by cables from a single skewed arch with a height of 60m and span of 180m. The steel box arch, with a weight of 600t is made up 19 segments ranging from 10m to 14m in length and a short segment fixed to the foundation at each end.

Samko Engineering of Turkey and Byelkamit of Kazakhstan, the steel contractors on the bridge, tasked Wiecon, a consultant from Taiwan, with providing a fast and inexpensive construction method for the arch.

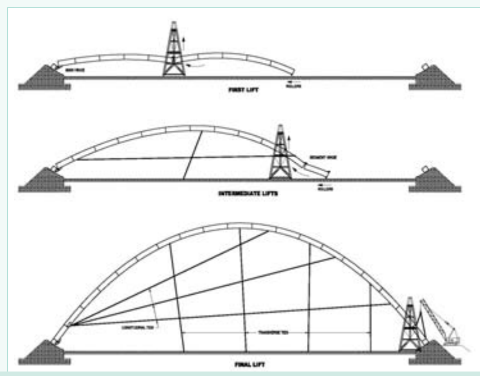
Work started on on site at the end of 2007, and the erection of the arch itself took place between May and November last year – including some unrelated interruptions during the erection process. Steel fabrication was carried out in Astana and the bridge elements were brought to site by road.

The method of arch construction adopted was to hinge the first two segments at one end and then progressively add segments at the other end while lifting with a relatively small mobile gantry. The lifting was done using two 250t strand lifting jacks mounted at the top of the gantry and a lifting beam connected to the underside of the segments to be lifted. To allow the gantry to remain stationary during the lift, the lifting jacks were pivoted to compensate for the longitudinal displacement of the lifting points on the arch. The free end of the arch was also transversely restrained at the gantry during lifting for additional stability.

The first step was to connect segment one to the foundation segment at the main hinge and then align it to allow segments two through to five to be added and fully welded while on temporary supports. Segment six was hinged to segment five and then segments seven through to ten added.

With the free end of segment ten supported on rollers, the arch was then lifted at segment five until closure with segment six was achieved. After welding the gantry was launched to the next segment lifting position. Further segments were hinged and lifted in pairs or individually depending on the gantry height restriction.

Transverse stability of the arch was maintained by installing four stays on each side of the arch. One of the four, the main transverse tie, was used for stability control during lifting. This tie consisted of a long steel cable, attached to the arch, fed around a drum at a distance from the arch and then passing through a cable tensioning device to maintain the required force while feeding the cable.



Top: The arch showing the temporary ties in position.
Bottom left: Aerial view shows the skew. Bottom right: Schematic of erection process

An emergency clamping system for lock-down in case of sudden eccentric loads, such as wind gusting, was added to the system. The tensioning and locking devices were situated centrally under the arch and manually controlled during lifting. The remaining transverse ties each consisted of an anchored chain block attached by means of a clamp to a steel cable in turn attached to the arch.

Initially these ties were only intended for static stability however they were later used during the lifting operation for additional stability. This was achieved by releasing the chain blocks as required. The transverse stays were also used for axial geometric control during lifting. A total of three longitudinal ties were installed at various stages of the construction to maintain the longitudinal geometry of the arch as well as ensuring that stresses remained within required limits. Horizontal displacements due to rotation about the lifting point as well as deflection from resting the arch on the temporary foundations were carefully calculated to ensure accurate positioning of the gantry for each lift as well as maintaining controllable geometry.

The arch was surveyed during and after each lifting operation and compared to the model to allow for any geometric adjustment by means of the longitudinal ties. Due to space restraints, the final two segments were positioned using a mobile crane while the arch was held in position by the gantry. On final segment installation the arch was welded at both foundation segments. Deck construction was completed ahead of arch erection allowing stay cable works to start immediately. and it was completed at the end of November 2008