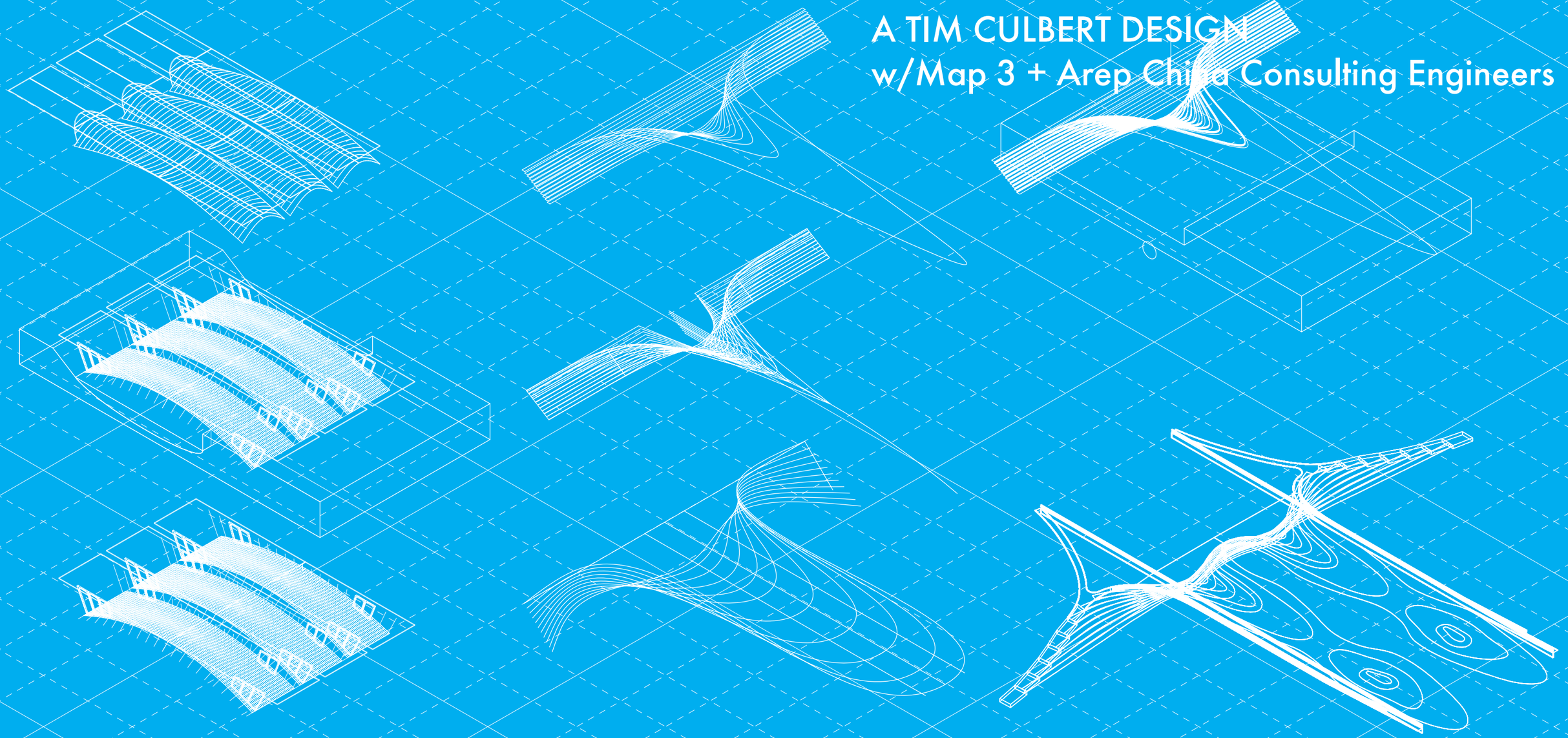
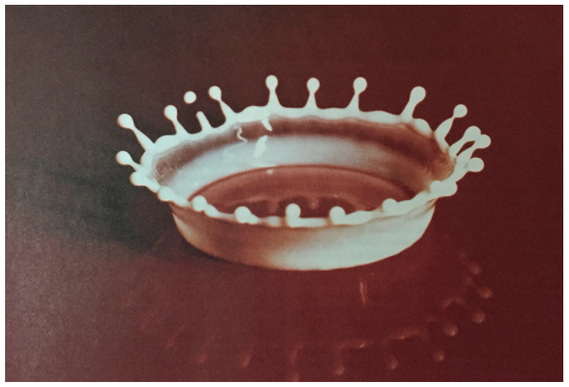


A TIM CULBERT DESIGN
w/Map 3 + Arep China Consulting Engineers

应征设计方案 - 正本

CAN DROPPING A STONE IN THE WATER AND FREEZE-FRAMING THE RESULTING RIPPLES ON THE SURFACE BE SOURCE OF A CANTILEVERED BRIDGE STRUCTURE ?

A DESIGN PROPOSAL FOR THE FENGZIGOU CANAL, BEIJING

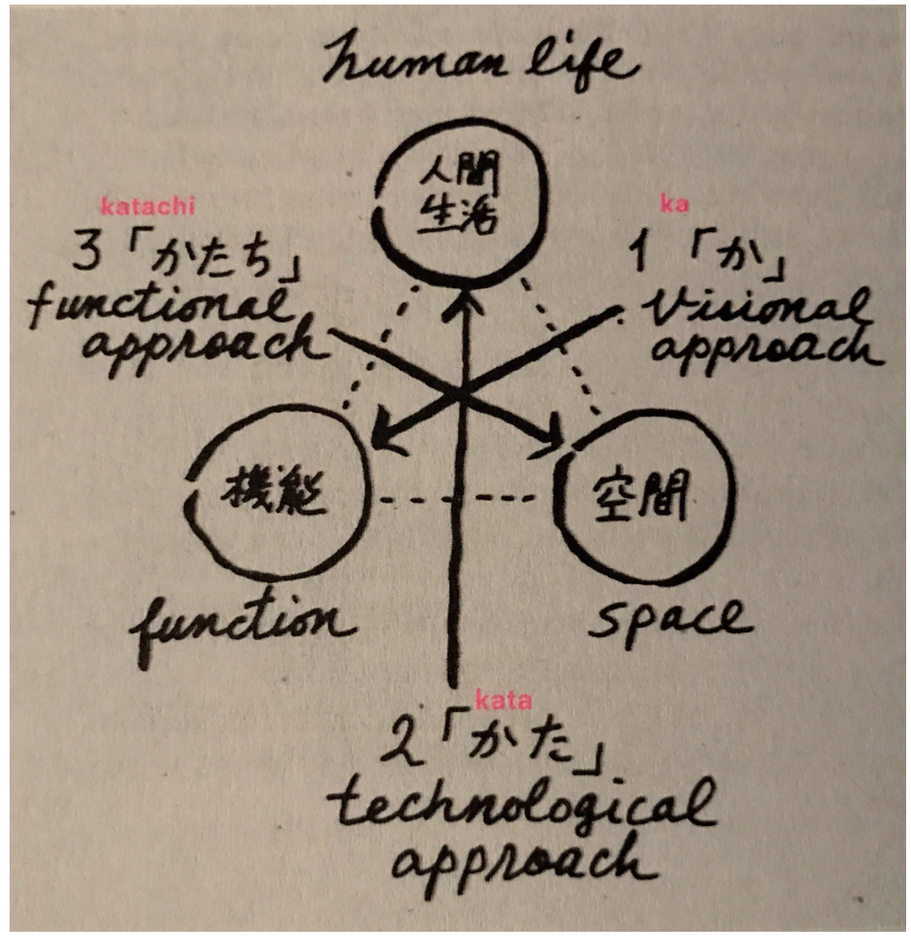


Can dropping a stone in the water and freeze-framing the resulting ripples on the surface be the source of a cantilevered bridge structure?

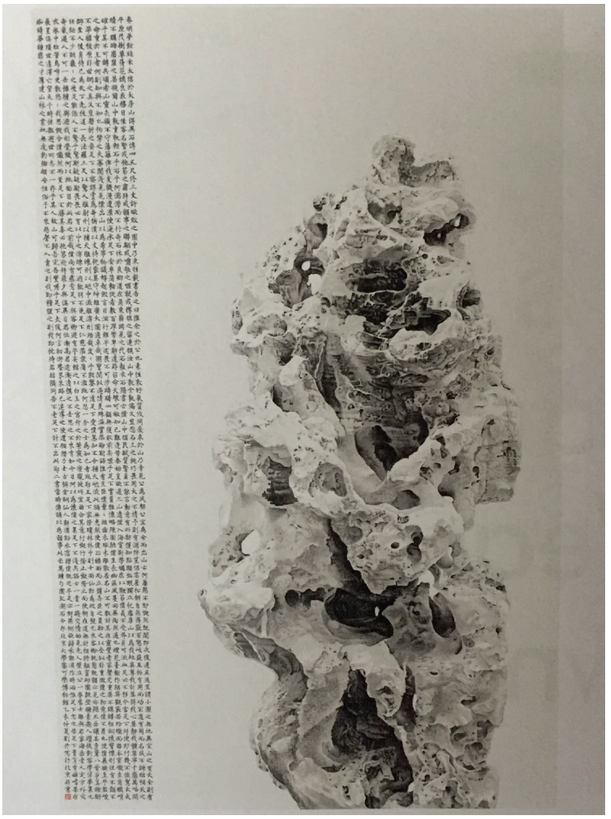
The challenge: Design a structure that embodies dual aspects that are often perceived to be opposites: a structure that is organic in form, yet rigorous; modular, yet sculptural, transparent, yet opaque; solid and robust, yet appears lightweight.

Our design achieves in reconciling these opposites into one coherent design, both structurally and in its form. Through the use of horizontal plates, the concept of the traditional bridge arch is transformed into a transparent object of art from multiple viewing angles. This duality is often found in Chinese culture and arts, and finds its place naturally in this visually modest - yet radical - spanning technique that we have designed for the Fengzigou bridges in Beijing.

Trilogies
kikutake's insistent systematization of architectural thought leads to series of trilogies, first inspired by phycicist Mitsuo Taketani, fellow native of Kurume.



1960s ka, kata, katachi: essence, substance, phenomenn. "Any educated person can grasp it."



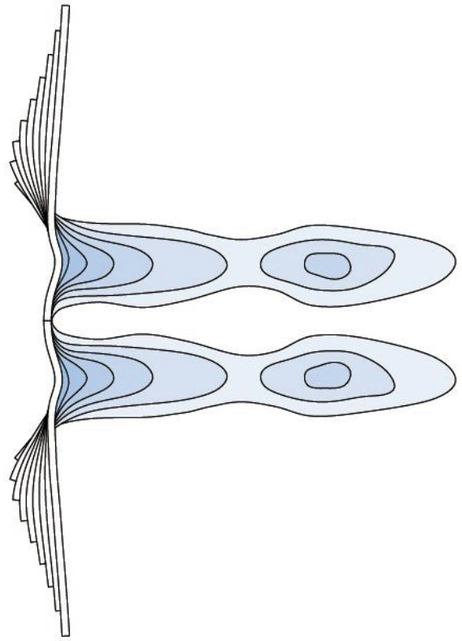
Drawings by LIU DAN, 2015.

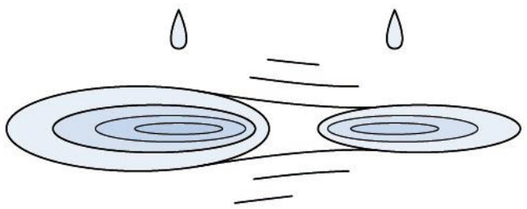
Concept:

Looking at classical Chinese philosopher stones, and notably the drawings by the Beijing-based contemporary artist Liu Dan, we found that the solid forms were in large part equal to the voids. This, in fact informed our design intent for these bridges: It allows that the appearance of the mass to be equal to or less than that of the corresponding voids which would support the roadway and to do so from one side of the canal only.

Thus from the spring point embankment ends of the bridges, at some angles the organic shaped supports will appear significantly transparent, save the horizontal lines of the metal stepped steel. Shifting viewpoints, they become entirely opaque and monolithic; the viewer then discerns the silhouette of the bridge arch, its half curvilinear parabolic form overlapping with the similar arches of adjacent bridges spreading off into the perspective.

In this way, the nine bridges become both presence and absence, structure and rational gesture.





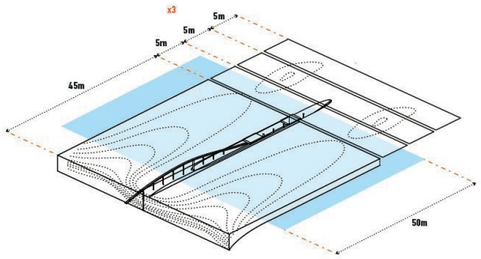
Design details

In detail, the floating planes of steel - a highly efficient and safe spanning means, yet still relatively new at this scale using CNC cutting of single sheets, are based on a topographic outline of water reflections (like mountains and valleys drawn on graph paper) - and are structured by a matrix of steel columns and diagonal bracing, allowing an unanticipated transparency to the massive side, the spring-point, of the half-arch.

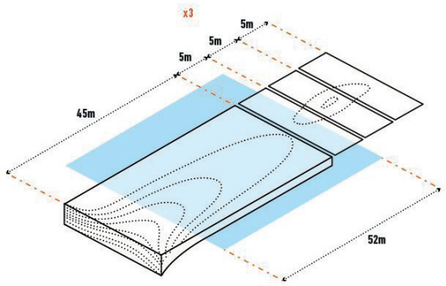
The topographic lines seen from the underside on the water, give the bridge an organic form, like stacked petals, but of steel. These topographic lines follow the profile of the structural moment curve needed to support the dead and live loads of the roadway above. They will be refined in later studies. At this stage, scaled models were created to define the forms of each metal "petal", both from an aesthetic and structural standpoint.

Again, our tendency to look beyond our own fields of architecture and engineering, it was natural to look at forms that span by virtue of their inherent bending or tensile qualities of the material - like bamboo, or long stems of rice grass. Gabriel Orozco's sculptures of fine curved branches and feathers were an ideal starting point to image the bridge: could somehow a single curve of a stem and leaves, like feathers with their own structural rigidity to bending despite their lightness, provide us with a new direction to design these nine bridges?

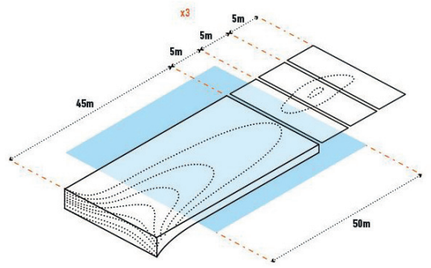
The solution came to us, to use stack metal plates, held in place by vertical ladder structures, that would follow the calculated inertia or bending of the bridge. Thus the result would be an organic "petal" form seen on the underside of the bridge.



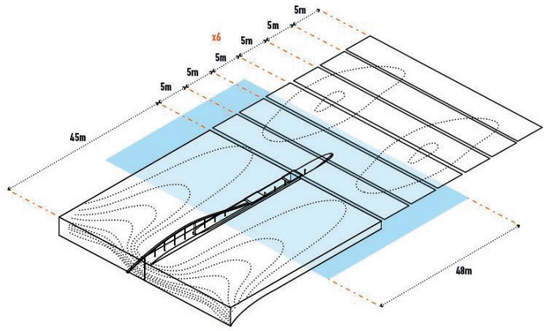
Bridge N°1 - 50m-60m



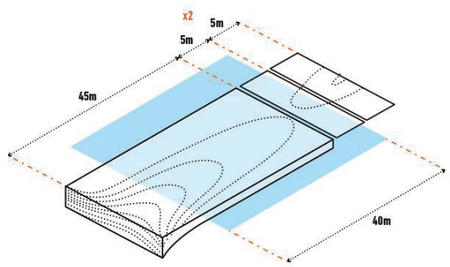
Bridge N°2 - 52m-60m



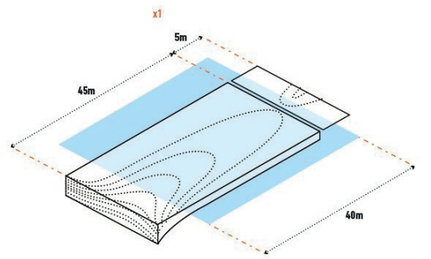
Bridge N°3 - 50m-60m



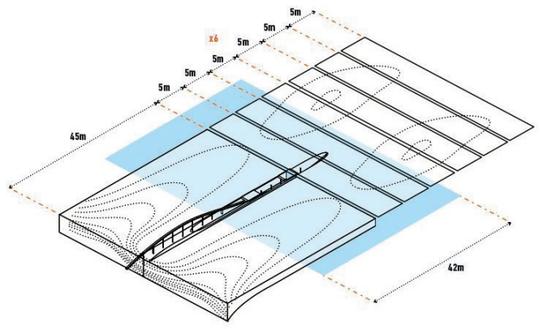
Bridge N°4 - 48m-75m



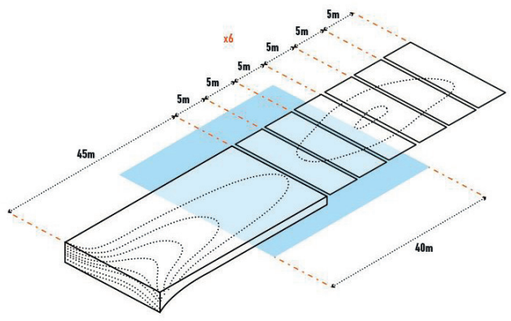
Bridge N°5 - 40m-55m



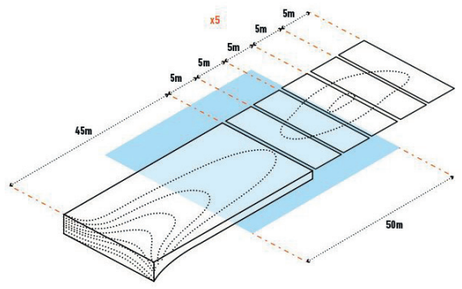
Bridge N°6 - 40m-50m



Bridge N°8 - 42m-75m



Bridge N°8 - 40m-75m

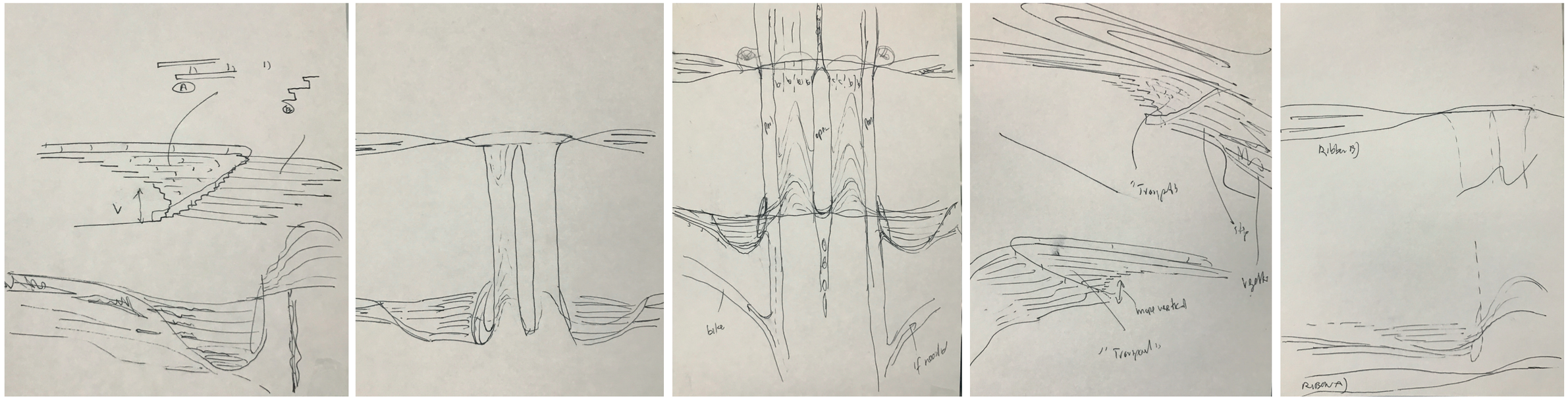


Bridge N°9 - 50m-70m

For the longest spans, and the two roadways that are significant routes to the New Town or City Hall, we chose to compliment the mostly under road-way support by an above roadway bow-truss. This truss at center of the split bridges, dips down under the bridge and becomes the king-post up-lift position where critical bending could occur.

Thus the bow-truss performs a double duty of providing an emphatic - though not heroic - visible profile at the street level, while its unique "S" shape, reflects exactly the inertia and bending of the stacked steel plate scheme as seen from below. These plates frame the one supporting side of the catenary arch and create a series of seats carved into the embankment.

In this way, by modest adjustments to a single structural principle, the 9 bridges allow for two major visual aesthetic spanning solutions, and that at each roadway may have slight changes in site resolutions of the sloped landscaped site, the bridge handrails and finish to make each of them distinguishable as unique in and of themselves (we have also designed a sole pedestrian-cycling bridge as well, to allow for a looped flow along the water's edge and across the canal without having to rise to the street level).



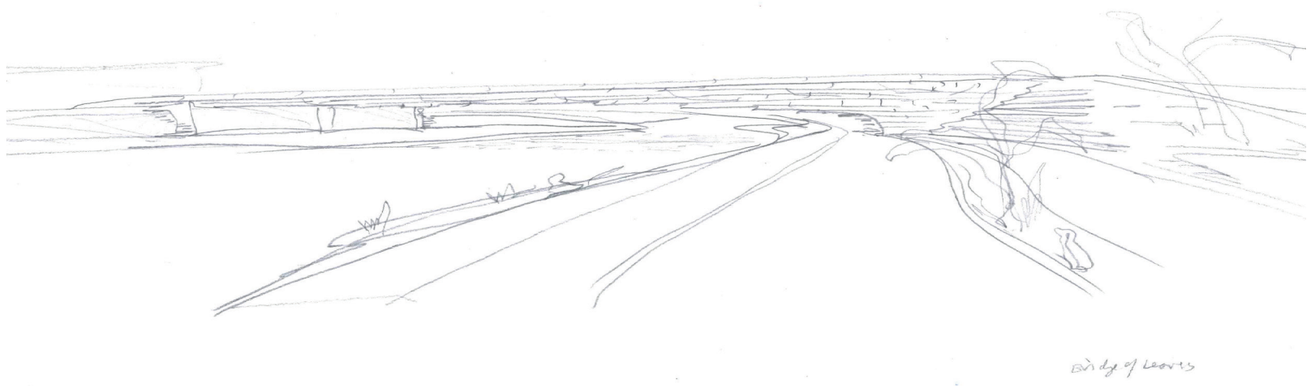
Sketchs, Tim culbert

Visual Intent and public use

The intention to develop an asymmetrical bridge, springing from one embankment and lightly held at the opposite side of the New Town Hall, came out of a respectful reading of this site: to allow the public to sit alongside the bridge and down towards the canal, in a directional viewing towards the New Town Hall area.

This directionality of the bridge and how we have designed the stepping that embraces the bridge structure as well as the landscape - a ribbon of greenery and land-art - shows a modest deference to the institutional buildings on the opposite bank. It also allows for a diverse landscape treatment and use of the undulating canal water's edge.

Modest in terms of any visible structural supports above the roadway - limited to the two main axis with the "S" curve bow-truss - this design successfully unifies landscape design, land-art; environmental lighting; design for people and for bicycles, with that for automotive traffic; with an "organic" shaped assemblage of metal petals as support, as opposed to using heroic cable-stayed support systems - as is often the trend these days. And lots of natural planted plants and trees on the road deck.



Bridge N° 4

Bridge N° 7

Bridge N° 7

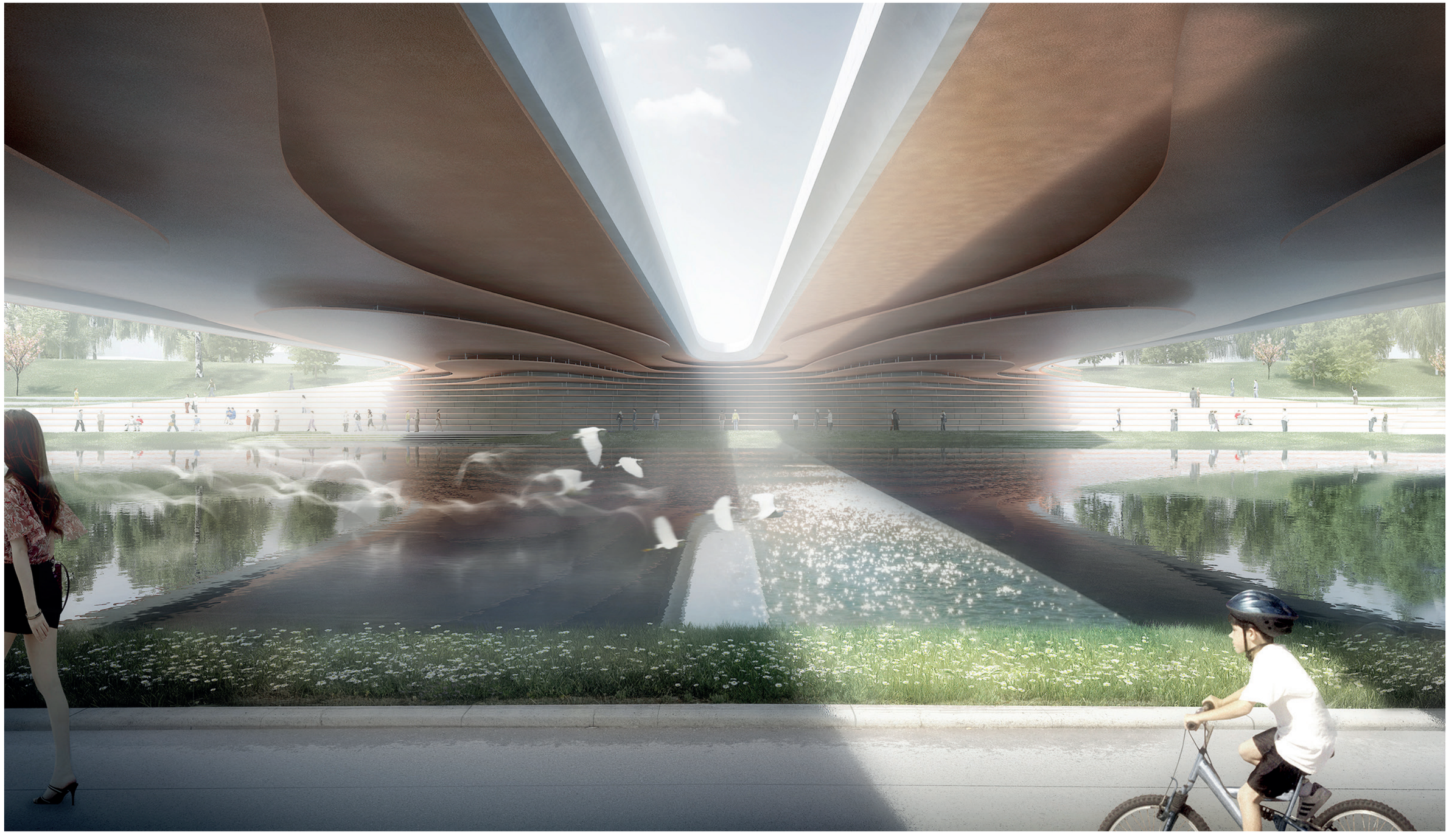
Bridge N° 2

Dark-Sky

Bridge N° 3

At night the bridge is brightly lit from the water's edge, becoming a visual spectacle from a distance. With the underside of the metal contours lit from below, all artificial light is held "within" the structure and avoids stray light upwards to the sky – light pollution in other words – a key fault of bridge structures with over lighted structures above the roadway.

From an environmental point of view, the bridge thus respects a "dark-sky" approach to night lighting without losing in iconic impact and night light effects or use.



Bridge N° 4

Conclusion

Our design is thus both contemporary and classic. Its efficient use of materials - the hollowed steel plates reduce material - that can be repeated for each bridge span, even for less large spans, by reducing the arch module or extending the ribbon slope of the garden inward or outwards to optimize the spring or landing points.

Importantly they have been conceived with a built-in adaptability of the competition brief's program of user lanes: the future technological city, with automated cars, may indeed reduce the requirement of car lanes to the benefit of bike or pedestrian traffic. For this reason, we are showing in some perspectives that the outboard pedestrian walkway could be transformed into a full planted space, visually and physically linking the trees on both embankments to create a continuous "green-space" experience that spans the water - a bridge that has yet to be realized.

It is worthy to note that new parametric calculations to laser cut these panels, most all the same for each bridge, is a modern technology and will prove to be a cost-effective spanning solution. Chemical treatment of the steel will allow for long-term color tones close to shades of natural copper, to avoid painting and the resulting maintenance.

Our design scope also included 8 kilometers of landscaped park land on both sides of the canal. Warping along it's length to embrace vertical supports of the bridge on one side and sloped surfaces directly on a the opposite bank to create a seating forum - this new urban park was conceived as a linear Land-Art space. Acting as art curators as well as landscapers, justified our bridge design as a green link for pedestrian and bike flow, back and forth across the 60 meter canal, to experience both sides of the embankment.

The asymmetrical single bow-truss bridge among the 9 bridges serves to mark the primary axis - and longest spanning bridge - to the new Town Hall. The half-arch (symmetrical as reflected in the canal water) is or will become a classic iconic shape for this district of Beijing. It is the first bridge we can recall that merges spanning and site embankment seating as one continuous design element.