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Double or Nothing: Reflections on Bridge Design

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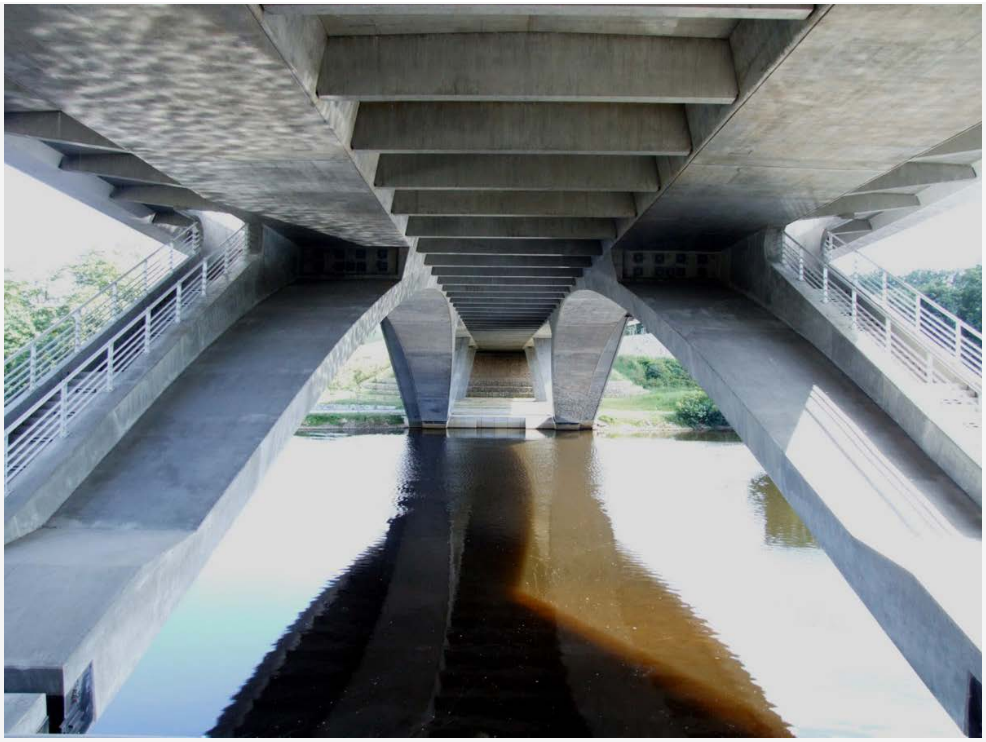
The term "solving for pattern," borrowed from Wendell Berry's land use ethic, has application in the planning of critical infrastructure. As a potential framework for optimizing infrastructure investments, it encourages thinking in multiple- as opposed to single-functioning systems. Such a paradigm may be increasingly warranted worldwide, as growing populations converge in real estate-scarce urban areas. In lieu of stand-alone, single-purpose urban systems, *combinatory* solutions may more readily deliver more, more quickly, and for less.



Today’s award-winning bridge designs, premiated for their structural innovations, graceful profiles, sweeping approaches and tautly-arched spans are handsome feats of engineering. Mostly, however, they share one limiting feature: they are single-purpose structures. Besides accommodating high-volume vehicular traffic, few of these connectors perform other consequential work. They are, in this respect, sub-optimal. Designing for shared use—accommodating multiple vs. single transit modes or combining other uses—offers opportunities for shared financing and operating savings.

Consider the $ 4 billion replacement Tappan Zee Bridge (fig.1), now more than halfway completed in construction. It’s double the width of the woefully under-maintained (and only 62-year old) structure it’s now urgently replacing. This behemoth will now accommodate 4 vehicular lanes in each direction, even though its approach lanes on both sides are only 3 lanes wide.[1] Sadly here as well, the State failed to act on commuter preferences, which would have included accommodating mass transit or dedicated bus lanes across this busy Hudson River crossing.

How little we carry forward from our past! Many of the the heavily occupied, multipurpose spans of pre-industrial eras (Old London Bridge and Paris' Pont Notre-Dame, (fig. 2) are two superb examples) supported dense, mixed-use real estate, responding to the confines of medieval walled cities. Multi-story houses, shops and civic space topped out these superstructures, bank to bank. Soon, more accretions, utilities such as water-powered mills and water-pumping towers, affixed themselves to these spans. An architectural gem, Isfahan's seventeenth century Khaju Bridge (fig. 3), perhaps best exemplifies the notion of "compound" infrastructure. Its single structure fuses transport functions with hydraulic regulation of the Zayandeh River (supporting upstream irrigation), while its steps, walkways and interior spaces accommodate civic activities.Built along the Silk Route**, its twenty-three supporting arches spanning the** Zayandeh River **were erected** on the foundations of an older crossing. Khaju is perhaps one of the world's first multi-modal and double-decker bridges.

Today, a mere handful of successes point to the benefits of multimodal crossings. Bangladesh's Bangabandhu Bridge (fig. 4), for example, a conduit between the eastern and western halves of that nation across the Jamuna River, is a multipurpose structure that forges a vital link between Southeast Asia and northwestern Europe. It incorporates two-lane carriageways, a dual gauge railway, a high-pressure natural gas pipeline as well as high-voltage and telecommunication cables. These several functions were combined when feasibility studies for each revealed that none were viable independently. Amsterdam's handsome IJburg bridge (fig. 5), designed by Grimshaw Architects accommodates two tram lines, two bike lanes, two pedestrian crossings and dual vehicular lanes. Moreover, the deck carries utilities beneath it from the mainland to this island community. Such integration we would not find at home.

Still, Portland, Oregon's promotion of alternative transit sets an unusual new bridge benchmark. The newly completed Tilikum Crossing (fig. 6) over the Willamette River refuses private vehicle and truck passage. Its 1,700 ft.-long deck accommodates public buses, streetcars, emergency vehicles, and future light rail, with 13 ft.-wide bike/pedestrian paths straddling both sides. Opened in September, 2015, it is the largest car-free bridge in the United States.[2]

There has always been a disconnect between vehicular travelers vaulting high above river traffic and pedestrians or cyclist below, enjoying the lengths of the riverbank. Although a handful of bridges embellish their piers or anchorages with viewing platforms (for example, Minneapolis' new St. Anthony Falls Bridge replacing the I-35 Mississippi River Bridge that collapsed in 2007), few have simultaneously accommodated both vehicular crossing and riverbank pedestrians. One elegant dual deployment grew out of the designers' respect for both a social and scenic context. The concrete arch bridge across Rive La Vilaine in La Roche-Bernard, France, provided a crossing connection for users of jogging paths on either side of the riverbank. Building on this innovation, the designers again provided privileges to riverbank pedestrians in a similar arch bridge, the Pont du Clos Moreau (fig. 7) over the Vienne in Limoges, France. The design, which pays tribute to nearby medieval arched bridges, again prompted bankside pedestrians to use the supporting arch as a crossing. Here, however, the bridge deck bulges out toward midspan to allow the stairways from each side to pierce the deck, offering foot travelers the same views as crossing vehicles before dropping them again to the other bank below.[3] A now-celebrated Vierendeel arch foot- bridge (fig. 8), the Passerelle Senghor in Paris, merges riverbank passengers from below with upper quay travelers on the wood deck at the intersection of two arching forms.

"Future-proofing" infrastructure by compounding use runs counter to the traditional siloing of infrastructural sectors. In an urbanizing world, the diversified use of bridges increases their efficacy. Importantly, such projects can accrue capital cost savings through shared components and/or economies of scale. Co-benefits can also include operational and energy efficiencies and reduced construction-related impacts of noise, traffic disruption and pollution. Sadly, New York State has forfeited these and other opportunities with its latest megaproject, the Tappan Zee.

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[1] Philip Mark Plotch, "Lessons from the Tappan Zee Bridge," *The Atlantic,* September 7, 2015.

[2] "TriMet to build first multi-use transit bridge in U.S." METRO Magazine, http://www.metro-magazine.com/article/story/2009/08/trimet-to-build-first-multi-use-transit-bridge-in-us.aspxæ (Jan. 14, 2014)

[3] Amman Singstad, A. Amman Singstad on infrastructure (DVD), (2006), Museum of Modern Art Archives, New York.