

LAUNCHING COMPLEXITY

Bridge launches are highly technical engineering operations that involve moving a pre-assembled bridge structure into its final position, often over obstacles like rivers, motorways or operational railways. While this method can reduce on-site construction time and minimise disruption to existing infrastructure, it introduces significant complexities.

Gavin Pearson reports.

One of the most satisfying moments in civil engineering can be the successful launch of a bridge. The deck being slid, rolled or jacked into place is a precision combination of mechanical and civil engineering ingenuity. And there are indications that this process is becoming more common.

This has implications for the industry, entailing complexity around structural stability, site constraints and environmental variables, as well as the challenge that comes with ensuring permanent and temporary works design teams and contractors are aligned throughout.

CORE ENGINEERING COMPLEXITIES

The primary challenge in a bridge launch is managing the changing structural behaviour of the bridge as it moves. Unlike a static bridge, a launching structure often faces extreme cantilever forces.

For instance, during the construction of the A422 overbridge (NCE, April), engineers noted that “the behaviour of the bridge in this temporary case completely changed as a considerable length of the central span was cantilevering off the SPMT supports”. This required temporary bracing to prevent excessive deflections.

Moving massive structures also

requires specialised equipment like hydraulic jacks, skid shoes, or tubular steel truss guiding structures. In some cases, bespoke fabrications like cradles with skate tracks and tapered bearings are used to guide the bridge with precision.

This whole process requires a number of things to align and for design to factor in the needs of

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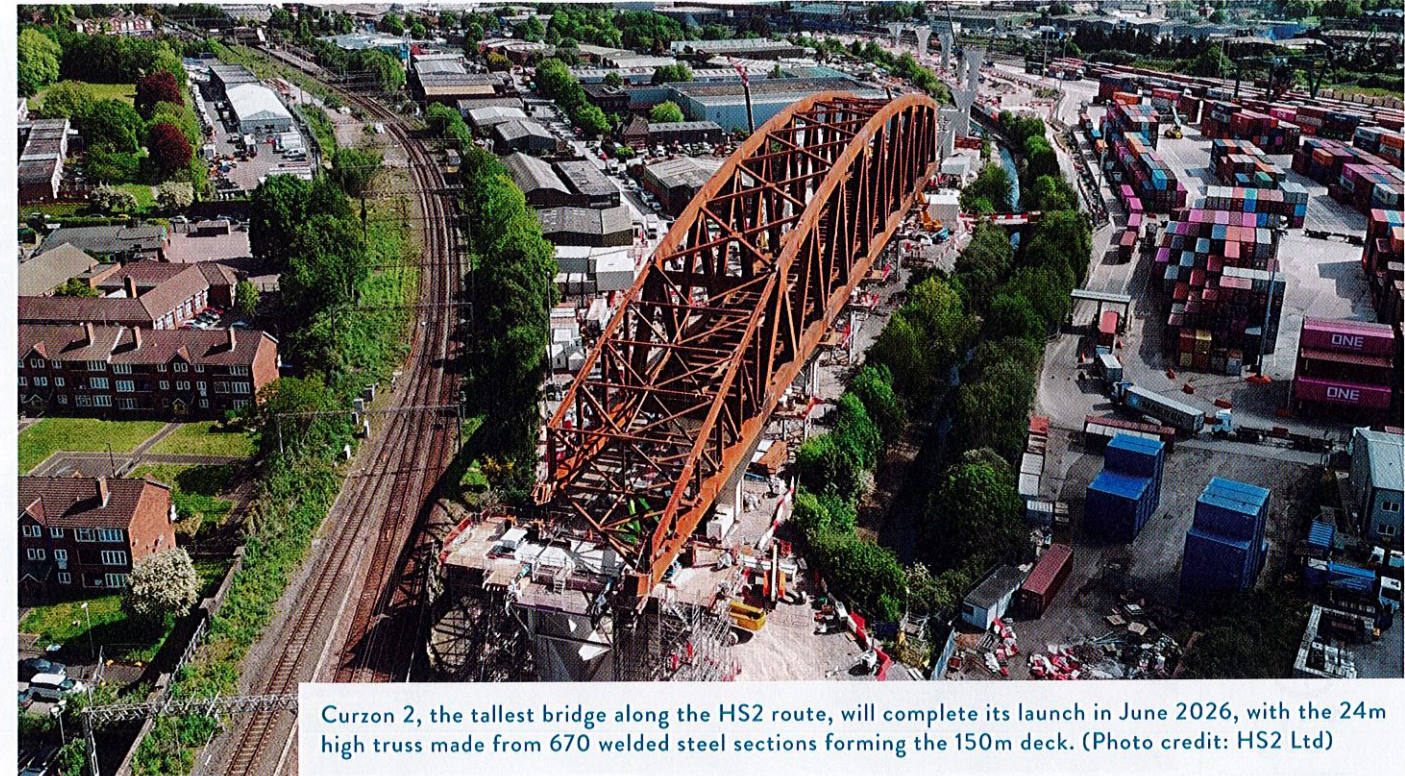
deliverability early. Urban environments often lack the space for traditional launching platforms. The same is true of projects where staggered abutments and curved roads force engineers to build and move the deck in smaller sections.

Weight issues can also prevent launching a bridge with its concrete deck already poured.

Hewson associate director Matthew Baxman explains: “It is very common for a composite deck to be launched before it is composite. So, the steel is doing all the load bearing itself. Precast concrete slabs are lifted on and launched with it, but they’re just a dead load at that point, so additional redundancy is needed in the steel.”

This all adds to the complication that each pier along the bridge must take not only the weight of a completed bridge deck, but the movement of that deck along it, and often with large bridges, that means the deck sliding along it.

“It’s moving – that’s the interesting thing because civil and structural engineering doesn’t do moving. A moving structure has very different variables that we have to have the tools for detailed analysis and prediction of. Our launch analysis can assess each phase all the way along at small increments so we can calculate the weights and so on



Curzon 2, the tallest bridge along the HS2 route, will complete its launch in June 2026, with the 24m high truss made from 670 welded steel sections forming the 150m deck. (Photo credit: HS2 Ltd)

accurately. The variable is the friction, so the design will be based on conservative assumptions on the friction,” says Baxman.

The nature of the project determines the means of launching, as well as whether it is launched. For smaller bridges, rollers are often used, but this becomes impractical for larger projects. That means sliding is more common for larger bridge launches, which is where friction becomes a bigger challenge, explains Baxman.

“In terms of the more complicated Enerpac style – because it is sliding, there is a lot of friction, which somewhat pulls a pier along with it. So a tall, slender pier is at risk of being pulled over with it.”

The engineering complications also often carry a cost implication.

“There is definitely a cost associated with launching compared to more conventional methods,” says Systra senior design manager Remant Doorgakant. “But that’s when it becomes important to understand the factors involved. Is the impact on users higher than that extra cost – and who is the client, are they willing to spend that rather than close something and impact on users?”

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“A lot of this is down to engagement with stakeholders like Network Rail, National Highways or the Environment Agency to help understand their requirements and the potential impacts on users of the infrastructure or nature under the bridge. We can do works in possession time, but some conventional builds need multiple possession times across construction. So, despite the cost, a bridge launch can be best because it can be built on the site behind the abutment and then pushed into place relatively quickly.”

That may be why there appears to be a rise in the use of bridge launches in the UK. Closing a road or railway under the new bridge being built is always unpopular and is increasingly unpalatable for not only the public but client organisations. Likewise, falls from height remain the highest cause of workplace fatalities in the UK. As a result, the additional cost may seem acceptable to avoid this risk.

However, there is also a sense that the cost may be misunderstood, at least to an extent.

Mott MacDonald technical director Patricia Garcia points out that much of the additional cost for a bridge launch stays within the bridge rather than being simply for construction process.

“The balance comes because

sometimes the cost analysis is not done properly. If we install by crane, we need access for the cranes and cranes are very heavy and cost money. With a bridge launch, something clients like is that the additional steel and concrete that costs money is in the bridge. That means the client is not consuming a cost beyond the structure itself, because a road below it has to be closed or a crane has to be hired, and so on. And that may offer benefits for long-term durability and strength, which could be an additional value because the value stays in the bridge,” she says.

MANAGEMENT COMPLEXITY

The divergence of outlooks on the details around costs does not translate into any divergence on the much wider complexity of managing bridge launches.

WSP executive director and head of civil engineering Steve Denton explains: “Bridge launches involve quite a number of parties – temporary works designers, permanent works designers, contractors, specialists and the client.

“That means that responsibilities need to be fully understood. The Eurocodes are designed to ensure works are safe and durable, so they represent an appropriate set of standards for the design of transient situations like bridge launches. But



A 45-strong crew were assembled to carry out the slide and subsequent checks on a 107m section of the west deck over an M6 slip road, with the slip road being scheduled for closure for less than 48 hours. (Photo credit: HS2 Ltd)

while that is good for safety, serviceability and durability, the codes don't set a standard for who does what because we don't want their purpose blurred."

Doorgakant adds: "The site management is very different to conventional bridge builds. There are a lot of logistics. You have to determine whether you have the space to build your deck offline behind the abutment – usually on the approach to the bridge. And there is a lot of preparation."

"So, if an embankment is going to be built for the approach, it will likely also be the launching platform – the equipment and the beam is likely to be quite wide so can't be formed offsite and shipped in. That means you have a casting yard with welding beside the site of the launch."

"There's also all the theoretical analysis to be done, and that takes quite a long time to understand and get understanding from everyone involved. We also put some hold points into the launch programme because where we expect a certain amount of deflection, we need to check it."

"Hold points typically operate support by support – because if you think about the cantilever of the bridge deck, there is some bend down

but also lift at other end, so you have the nose to compensate for deflection to bring it back to the right level. Sometimes this involves using hydraulic jacks to bring it back to the right level and slide across the pier – and there have been some advances as well to slide itself on the right level."

"Contingencies are discussed ahead of time, and we have equipment to adjust the deflections within reasonable limits, but if it is going very wrong you can pull it back. So it's very important to measure how it is compared to the theoretical model. Fortunately, we've not had cases like that."

COLLABORATION AND BUILDABILITY
All this means that the way organisations work together on a bridge launch is vital.

"Bridge launches are ahead of the game on this," explains Garcia. "I worked for a construction company before, so I have that knowledge of incorporating it into design. When we receive inputs from the temporary works designer, we have experts who lead with that – so when we are doing the launch, there are a number of critical issues we check for when

we receive them as inputs and we also have internal review to be 100% sure."

"But it is important to have the team in place early. That allows us to all be on the same page – all the impacts on the temporary works design, regular meetings need to be had, and we try to promote joint-working everywhere."

This isn't always easy, especially at the start when those involved don't know each other yet. "It's a new team every time," says Garcia. "We are openminded on what will work that makes it easier for all. That takes time, but when each party sees that we understand their concerns, it's easier to work towards a buildable solution."

Baxman agrees that this early process is key to getting things right. "The method with which you launch has a huge impact on permanent works design. You need the expertise and Hewson is rare in dealing with all these aspects, but launching is so specialist, the launch designer does the temporary works themselves and that makes sense because they know exactly what they are going to do and the equipment they have and are going to use."



The four huge piers for Curzon 2 in Birmingham reflect both the needs of the bridge in its permanent state, and the stresses that the piers experience during one of the longest bridge launches ever undertaken in the UK. (Photo credit: HS2 Ltd)

"Working with a specialist contractor like that works well, but they need to be on board early so you can incorporate that into the assumptions about the bridge. You need the iterative process of going back and forth to get both sides aligned."

This is often reflected in long design lead-times for bigger launches. "This level of input is needed years in advance," says Baxman. "And I would argue where launching is significant, it has to be considered at tender stage – because you can't put that off until design stage and look at it then."

The alternative to that strong early interaction is ever greater complexity as the project develops.

"If the client has employed a designer separately from the contractors," says Denton, "then because of the complexity of all the different cases as a bridge is launched, there is definitely some complexity in play because the design of the permanent works needs to be checked to make sure transient conditions during launch don't adversely impact on the design. And if it is delivered in a different way to what was originally conceived by the permanent works designer, the contractor has a role, and this can create real complexity about how this can be best handled."

"There is then a further complexity in

the blurring of liabilities and accountabilities, which adds interface risk and means you need clarity and a strong driving mind behind the whole thing."

"The strong driving mind is the role of the temporary works coordinator. But the situation is different with a design-build, which is simpler."

Doorgakant agrees, though he notes the perfect route isn't always available. "It depends on the stage of the project. You can't get engagement from everyone at concept stage, but closer to construction, you need everyone on board. With lots of parties involved and finalising design for construction,

you have lots of interface meetings to improve communication across all parties and understand the scope for everyone and the responsibilities of each party."

"And you need to make sure people are communicating. We have a robust process and continually seek to improve it, but communication needs to be clear because you need everyone to understand processes for this – who does what, where the gaps are and who can fill those gaps."

Calls for greater collaboration and for early contractor engagement are relatively universal across most infrastructure sectors now, though in practice it seems bridge launches are culturally further advanced.

What's clear is that this is an area of infrastructure delivery in which expertise – as well as collaboration – is at a premium.

"The solution to complexity is having the right people to cut through it and get to the best solution," says Baxman. "When I run a project, I manage it and lead the technical side. And what you want is if we're in a meeting and a particular challenge comes up, we can get straight from technical to workflow because we're the right people around the table." **N**

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