Webinar: Advances in scour assessment

Question	Answer
The HECRAS hydraulic design function generally deals with the scenario where a bridge spans over a floodplain and the abutments block a portion of the floodplain. Where we are only dealing with a channel or river, how do we adjust the HECRAS inputs for scour e.g. L and L' in Froehlich's abutment scour equation. Thanks.	FHWA is archiving the Froelich and HIRE methods anre recommends the NCHRP 24-20 method that does not require evaluation of the L' value.
	What's the workaround for pressure flow scour when using NCHRP 24-20 method?
	I have the same question as regarding pressure flow scenarios. Is it typical to treat vertical contraction like lateral contraction in its contribution to the discharge contraction ratio?
	No, it is separate to lateral contraction, as it can occur even without lateral contraction
	I don't want to belabor the point, but just to confirm I understand, are you saying that vertical contraction scour should be treated as an independent and additive component of total scour near abutments? I believe NCHRP 24-20 was developed based on free-flow conditions, and the little I've read on this topic (e.g., https://doi.org/10.1061/(ASCE)HY.1943-7900.0001002) suggests that the same basic scour prediction method used for free flow based on amplification of contraction scour using the discharge contraction ratio can be applied to submerged orifice flow and overtopping flow. I'd love to read more on the topic if you have suggested references--thank you for your time!
	I'd echo on the above comment
I've noticed some deficiencies in the HEC-18 equations for vertical contraction scour as it seems to not be linked with velocity or shear, rather only a ratio of flow and depth. Also it appears the ratio of impact on the soffit to flow depth is not well represented. The vertical scour continues to increase with upstream depth, despite if there is only a very small depth of impact on the soffit. And even with very low velocities. Is there going to be any update to this?	what is the numerical method used to discretize the sediment transport equation ? there is any real meadurements to validate the software and calibration parameters ?
	Good comment and observation. The current pressure flow (vertical scour) calculation in HEC-18 essentially offsets the horizontal contraction scour vertically based on the flow blocked by the soffit and the separation distance (t) . FHWA does have current research based on computing scour with a shear decay approach, which will likely benefit the pressure scour approach. Stay tuned for the 6th edition of HEC-18 that is currently in development.
	Thanks, I think there should be should be some practical upper limit for certain parameters to limit the scour depth. Also linking the scour potential to velocity and/or shear to determine if scour is even likely. At the moment, if you have Q1=1m3/s and Q2=1m3/s in a large bridge and even if there is limited change in width i.e. W1/W2 ratio, the equations will give you a large computed depth of scour because of the large Q1/Q2 ratio.
Many of our current equations are very simplistic for an idealised, uniform, 1d channel with equations often based on the average channel depth and velocity. Interpretation of the appropriate approach parameters in more complex situations where there is variable depth and skew etc or multiple structures across a wide floodplain makes determining parameters very subjective to some degree. How do we make sure that parameters extracted from 2d models are relevant to the empirical equations?	Scott will be covering this later in the presentation, if we do not answer your question please let us know.
For contraction scour, what is the perferred method if, like in the image shown on slide 12, the floodplain contracts, but expands right before the embankment?	NCHRP method is preferred
	But where do you put the contraction arc?
	i'll talk about it in my section but defintely needs engineering judgement, as it might be different in a case by case basis
any tutorial about scour downstream a spillway with high velocity ?	see next webinar abouth Rock scour, this topic will be covered there

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For multiple openings, what is the current guidance to splitting the upstream flow width?	this why 2D models are preferred, the splitting will be automatically computed for you
	But how is that determined upstream? Vectors, or flows?
	both vectors and dxV grids
Sorry for asking a question about basic knowledge about bridge scour. I heard bridge scour affects bridge failure. Are segments and soil on the bottom of the river part of the design for the safety of the bridge structure? If so, how much is bridge scour considered in advance when we design the bridge, and how can we decide whether the bridge scour observed or predicted is serious or not?	Where I am, we always look at scour for bridges, 500-year to be exact. Bridge piles go at least 20' deeper than the 500-year scour.
	Scour should be assessed for the design of a new bridge using methods in HEC 18 or equivalent document where you are located. The same methods can be used to estimate scour at an existing bridge, in addition to observations during various flows and scenarios. Working with a geotecnical and structural engineer is recommended to determine whether computed scour may be an issue for an exisitng structure and the design for a new strucuture.
	Great. Thanks a lot.
Any thoughts on taking a staged approach to calculating total scour. By that I mean calculating contraction scour from the 2D model results, then lowering the bed in the 2D surface by the scour depth and re-running the model before calculating the pier/abutment scour based on the updated model results. It means multiple model runs (time and cost) and complexity. It's an approach that we've been recommended to take by a reviewer.	This could be an acceptable approach, but the challenge is estimating the upstream and downstream extends of the contraction scour. It's not just as easy as adjusting the elevations beneath the bridge.
	Scott, thanks. We're thinking of trying the staged approach on a few example bridges, then test the results against an 'all-in-one' scour calcs approach and see if there's a material difference in the final total scour depths.
In a case, new proposed bridge is located at 20-30m downstream of an existing culvert. Where can we locate the approach section for bridge scour calcs? There is standstill water trapped between two embankments on both banks.	This sounds like a challenging scenario. The consideration to think about is how much sediment may be consistently transported through the culvert to the bridge section. Conservatively, you may consider computing clear water scour and using it for design.
Can you comment on the consideration of the variability of sediment gradation with depth? This varies the scour potential/resistance as scour continues over the course of an event. But equations typically only use one D50.	Working with geotechnical engineers on obtaining appropiate sediment gradations with depth is important, especially at the contracted section. For equations that utlize a D50 it is recommended to also assess underlying material size if your estimated scour will encounter a different sediment characteristic with depth.
	Thanks. My point being that the top layers may have a certain D50 and all of that layer is calculated to scour. So the next layer with a different D50 is then exposed, but the equations aren't flexible to switch during the scour event. Hence the equations force us to select one D50 to represent the entire strata over the depth of scour.
How compatible is the toolbox with outputs from other hydraulic packages. can maximum value raster outputs (for depth, velocity etc) from hydraulic simulations be used as inputs?	The Hydraulic Toolbox is compatible with input from any hydrualic model, but maximum values should not be used for computing contraction scour or abutment scour.
Are abutment scour and lateral migration scour considered seperate / independant of each other, where there is no contraction? And will lateral migration be covered as part of this session?	Lateral migration potential feeds into what abument scour conditon is used with the 24-20 method (condition a vs condition b). if there is lateral migration potential, condition a should be used.
Typically I will take two bed samples upstream and downstrem of the bridge. Is sounds from Scott that the two samples shoudl be at the bridge and upstream of the bridge. Correct?	At a minimum you need a sample at the approach section location (upstream) and at the contracted section (bridge).
What's the difference between using HECRAS and TUFLOW 2D modelling in terms of their ability to assess bridge scour?	none, both can be used to calculate scour

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In order to calculate more realistic flow patterns and velocities through the bridge in a 2D HEC-RAS model, can a bridge be created in HEC-RAS with the piers and abutments created within the terrain, and the bridge deck assigned in the bridge editor for pressure and weir flow?	You can, but you will need to go to fine mesh and might not create diofferences in the overall results,not even with CFD you will be able to create the complex patterns behind piers (Horseshoe vortex)
I'm jealous of those of you with good input data and clients with budget/time to allow detailed assessments. It can be very different working in data-poor environments in developing countries.	And usually clients do not care about the detailed assessment
Any thoughts on accounting for existing sediments in the stream changing the scour rate? Would this change the flow behaviour of the water?	
How would you approach modelling scour under an oscillating flow (waves)	You would need a spectral wave model for that.
	2D models are depth average = no waves
	FHWA HEC-25 may be a helpful resource: https://www.fhwa.dot.gov/engineering/hydraulics/pubs/hif19059.pdf
Is it appropriate to use a calculated scour layer in HEC-RAS to evaluate solar piers given they're not located in a channel?	
Will the new 2D scour equations utilize sediment size?	Yes, they will.
At least the additive approach of the components of bed scour is conservative (i.e. you are likely to overestimate the scoured depths).	This is true, but many have criticized HEC-18 methods for being overly conservative in some cases.
Also any use of 3D modelling of scour? E.g., in Flow 3D?	
In my experience in NZ, too often the hydraulic side of bridge design is seen as an after-thought (and an annoying one) by roading structure designers and some of the results are not believed.	Show the road designers some pictures from the Gabriel floods :)
	Too true, though in Gabrielle you had the complicating factor of woody debris caught on the bridges