WSDOT 2023 Scour Training

5/30/2023 – 6/01/2023

Q&A for Module 9: Pier Scour (Casey Kramer)

- **Q: How do we account for pier interference at abutments when piers are in close proximity to the abutments?**
    - Plotting total scour results is a key step to see if the total scour of the pier is likely to significantly impact the abutment. When designing new bridges, caution should be taken when placing piers in proximity to abutments.
    - When piers are in close proximity to abutments, it is prudent to assume that the maximum local total scour at either component could occur at both components.
- **Q: I was wondering if the 2D model is depth averaged or width averaged?**
    - The 2D model used is SRH-2D which is depth averaged.
- **Q: Casey mentioned the "rule of thumb" of maximum scour at a circular pier. Caveats regarding bed material, pier groups, etc. aside, does WSDOT have a policy or recommendation that treats that as a limit for design or is it one data point to consider when determining the pier scour component?**
    - This rule of thumb is helpful for quick onsite estimation. While this provides an estimate for basic configurations, complexity e.g., debris racking, can quickly change the maximum pier scour depths. This can also be used to flag outliers or unrealistic results and assess parameters used. This should not be used for a design recommendation.
    - As noted in HEC-18, the rule of thumb range only applies to round nose piers which are aligned with the flow.
- **Q: For large depth stream, does pier scour increase as the depth increases, where is the limit? Is the pier scour limited to 2.4*width if this is the case?**
    - You would not limit the pier scour estimate to the pier scour rule of thumb.

- **Q: You've mentioned in each of the modules that we should manually verify that the data being extracted by SMS is correct. Is there a recommendation for how to fix the data if it is being extracted incorrectly?**
  - Verify the arcs are defined correctly and if you suspect a bug, report this to Aquaveo. The Hydraulic Toolbox allows you to change data.
  - For pier scour, by default SMS extracts the velocity and depth at the maximum unit discharge location upstream of the bridge to account for future lateral migration. The values directly upstream of the bridge at each pier are in the output under the "view values" tab and you can manually transfer those to the hydraulic toolbox.

- **Q: Please clarify what the angle of attack is.**
  - The angle of attack is measured from the direction of flow as it is approaching the a pier geometry (for some pier geometries or spacing, the area may change with different directions of flow). This parameter is thoroughly explained in HEC-18.

- **Q: To clarify when Casey said plot the pier scour and see if it overlaps the abutment scour, do you mean in Hydraulic Toolbox or outside the program? I believe the Hydraulic Toolbox plotting functions don't always function as desired.**
  - There are limitations to the built-in plotting abilities, these are currently being amended. Do not use the plotting technique in the hydraulic toolbox. Once you have computed all total scour components, plot scour components and coordinate with the geotechnical and bridge and structures office for the final elevations to be used for design and structure type.
  - If the scour prism at a pier or abutment is relatively close one another, then your foundation and countermeasure design needs to account for whichever component is the worst case.

- **Q: Regarding contraction scour, we've been using the proposed D50 for all our scour designs. This seems different than what HEC-18 recommends. When do we follow this guideline from HEC-18 vs. using the proposed D50?**
  - Evaluate the scour with the proposed and existing D50. Additionally, if the underlying material is different and the long-term degradation or scour depth is greater than the depth of the proposed material, then the scour analysis should also use the underlying material. See Module 7 for an example calculation using different materials.

- **Q: A clarification about this question on contraction scour. HEC-18 recommends increasing the sediment size by 25% for calculating clear-water scour (Attached screenshot). Does Hydraulic toolbox account for it automatically by increasing it by 25%?**
  - The Hydraulic Toolbox does automatically include this increase.
- **Q: How about doing sensitivity runs using a certain scour depth of the bed? How does it change with flow magnitude and direction parameters?**
  - Yes, the engineer should be analyzing multiple scenarios and considering how changes in the stream may impact scour. As the system changes the hydraulics will too, thus impacting scour results. Assessing the sensitivity of parameters, for example different angles of attack and magnitudes of flow within the active channel, is a best practice for computing total scour.

- **Q: I think it was said that HEC-18 pier scour method is required by WSDOT when LWM/debris racking is expected. Is the coarse bed pier scour method/equation recommended to also be evaluated based on Geotech subsurface info provided (if considered applicable)? Or is the direction to typically use the HEC-18 method for design and bridge scour analyses?**
  - HEC-18 methods can be used, but there are limitations. These are developed empirically with somewhat specific applicability. For example, the pier scour coarse bed method was developed for a clearwater condition. Collaborating with the geotechnical office to understand the subsurface information is important for assessing pier scour.