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| **UTC Project Information – Project 2.11** | |
| Project Title | Culvert Rehabilitation using 3D Printed Diffusers |
| University | University of Maine |
| Principal Investigator | Roberto Lopez-Anido |
| PI Contact Information | [rla@maine.edu](mailto:rla@maine.edu) |
| Co-PI(s) | Sunil Bhandari |
| Co-PI Contact Information | sunil.bhandari@maine.edu |
| Funding Source(s) and Amounts Provided | UMaine (Phases I and II + Phase III) : $158,467+ $142,566  MaineDOT(Phase I): $6,500  NHDOT (Phase III) : $20,000 |
| Total Project Cost | $327,533 |
| Agency ID or Contract No | 69A3551847101 |
| Start and End Dates | 07-01-2020 to 06-30-2022 |
| Brief Description of Research Project | **What are** [**culvert diffusers**](https://research.transportation.org/wp-content/uploads/sites/31/2020/07/Sweet16Presentation-Maine-Culvert-Diffuser.pptx) **and why are they used?**   * Culverts are installed in highways to control water flows * Culverts deteriorate with age and need repairs.   **Current culvert retrofit technology:**   * Use slip-liners * Problem: reduction of the cross-section and hence the capacity of the culvert.   **New culvert outlet diffusers technology:**   * Increase the culvert capacity and compensate for the losses due to liner retrofit * Reduce outlet flow velocity and minimize erosion.   **Project objectives:**   * Explore the feasibility of using large scale 3D printing to manufacture culvert outlet diffusers with site-specific optimized designs. * Design and manufacture an experimental 3D printed culvert diffuser prototype to evaluate hydraulic capacity at the site * Assess the use of bio-based renewable polymer composites for manufacturing culvert diffusers. * Explore segmental manufacturing of 3D printed culvert diffusers. * Evaluate the performance of 3D printed culvert diffuser in the field. |
| Describe Implementation of Research Outcomes (or why not implemented) | A person standing next to large barrels  Description automatically generated with low confidence   |  |  | | --- | --- | | 3D printed culvert outlet diffuser segments. | Assembled culvert diffuser segments | |
| Impacts/Benefits of Implementation (actual, not anticipated) | * Design of the diffuser is unique depending on the culvert and the site conditions. * Significant cost reduction to current manufacturing methods. * 3D printing is more cost effective for larger parts. * Segmental manufacturing of long and narrow parts enables faster manufacturing times. * Optimized designs of culvert diffusers based on site-specific hydraulic conditions can be manufactured using large-scale 3D printing at lower cost than current methods. * Hydraulic performance evaluation in the field, as well as ease of installation and durability have to be demonstrated for technology transfer. |
| Web Links   * Reports * Project website | Bhandari, S., Lopez-Anido, R.A., Anderson, J. and Mann, A. “Large-scale extrusion-based 3D printing for highway culvert rehabilitation,” [ANTEC 2021](https://www.4spe.org/i4a/pages/index.cfm?pageid=6098), Society of Plastic Engineers, Hybrid Edition, Mar. 22-23, 2021. |