UTC Project Information	
Project Title	Thermoplastic Composites by 3D Printing and Automated Manufacturing to Extend the Life of Transportation Facilities
University	University of Maine
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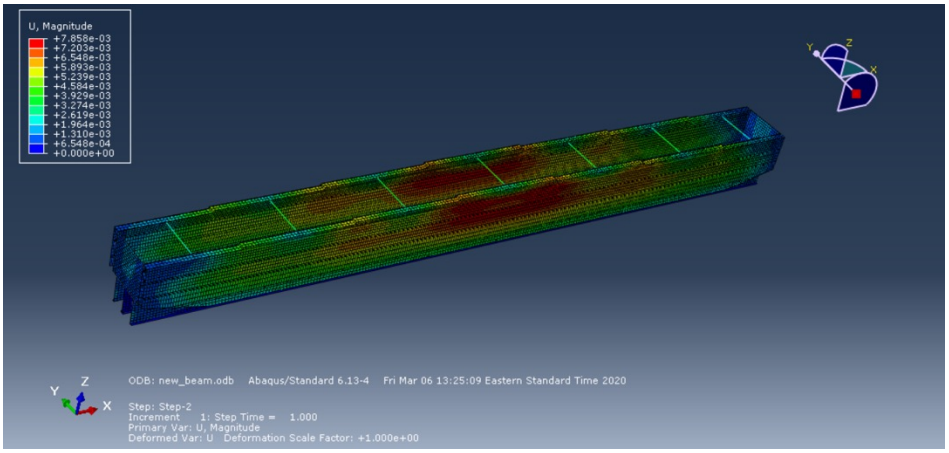
Funding Source(s) and Amounts Provided (by each agency or organization)	Federal: $104,403 University of Maine: $203,976
Total Project Cost	$308,379
Agency ID or Contract Number	69A3551847101
Start and End Dates	01/01/2019 - 12/31/2022
Brief Description of Research Project	Recent advances in large-scale 3D printing and thermoplastic composite materials with bio-based fillers and reinforcements have great potential for expanding the possibilities of making forms for precast concrete structures. The 3D printing technology for making molds, forms, and tooling for precast concrete is expected to reduce labor cost. 3D printed molds allow design optimization of precast concrete parts since the additive manufacturing cost is only a function of thermoplastic material weight and is independent of part complexity. Additionally, 3D printed molds become an asset, since thermoplastic composite materials can be reprocessed. However, the performance and durability of such molds needs to be evaluated to ensure optimal performance with repeated casting and demolding operations. The work of this research project will evaluate the mechanical performance of 3D printed molds after repeated use during casting of concrete and removal of the cured concrete part. Additionally, the work conducted by the research team will evaluate the durability and dimensional tolerance of bio-based 3D printed forms. The objectives of the project are to: a. Identify potential applications for large-scale 3D printing of forms and tooling for precast concrete parts in transportation using bio-based fillers and reinforcements and cost-effective thermoplastic materials. b. Determine the feasibility of making 3D printed forms for optimized precast concrete parts and elements to extend durability and reduce cost. c. Document the demonstration of large-scale 3D printing of precast concrete forms and assess the quality of the parts. Establish material and

	manufacturing specifications to assist the DOTs implementation of this technology in transportation applications. d. Investigate the potential for recycling the 3D printed forms and tooling and reusing/reprinting the wood-filled thermoplastic material to make it a capital asset for precasters.
Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	We expect the DOTs to use the results of this research as follows: (1) Specifications for design 3D printed forms for precast concrete, and (2) Hardware platform for large-scale 3D printing of forms for precast concrete.  Figure 1: FEA model of the 3D-printed formwork showing deformations due to fresh concrete loads.
Impacts/Benefits of Implementation (actual, not anticipated)	This project will enhance the transportation infrastructure durability as follows: a. DOTs will be able to specify durable and cost-effective thermoplastic composites with optimized designs using large-scale 3D printings for precast concrete forms and tooling. b. Optimized 3D printed forms will increase the longevity of precast concrete elements and parts.
Web Links • Reports • Project website	https://www.tidc-utc.org/