

Fiberglass Mat-roll Carryover:

Executive Summary



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The asphalt shingle is a type of roof shingle that uses asphalt for waterproofing. Its low cost and easy installation make it one of the most common roof covers in North America. General Aniline and Film (GAF) is one of the nation's largest manufacturers of roofing materials and produces asphalt shingles at their Shafter, California manufacturing facility. To manufacture asphalt shingles, a base material of fiberglass passes through a series of processes that sequentially add asphalt, ceramic-coated mineral granules, and thermoplastic adhesive. The fiberglass base-material arrives at the manufacturing facility in large rolls that workers must periodically splice together in series at the intake of the manufacturing line to maintain continuous production. The splicing process begins when workers hoist a new fiberglass roll with an integrated shaft onto open-mouth bushings behind the current production roll. Next, a worker manually rotates the roll in small increments while another worker carries the leading end into the splicing station. Then, two workers splice the lead end of the new fiberglass mat-roll to the trailing end of the current production-roll. Rotating the mat-roll requires the worker to apply a large force to overcome the inertia of the roll and the friction between the shaft and bushings, which presents an ergonomic hazard. The scope of this project is to design a system that rotates the fiberglass mat-roll mechanically.

The final prototype consists of two primary assemblies: the support and the carriage. The carriage assembly consists of single-channel slotted aluminum-extrusions. Off the shelf brackets and hardware secure the extrusions into a cube-like framework. The exoskeleton-like framework provides mounting points for a motor that drives a roller subassembly that sits on the top face of the carriage. The roller subassembly consists of four urethane drive-rollers and one sprocket set on a keyed shaft that mounts to the slotted extrusions through pillow-block bearings. Linear-bearing rails mount vertically on each edge of the carriage. These rails mate with linear bearings that connect vertically on the support assembly and allow the carriage to translate vertically under the power of tie-rod air-cylinders. The air-cylinders mount between the support and carriage assemblies through custom, CNC machined, aluminum brackets. The support assembly consists of two-channel slotted aluminum-extrusion and provides mounting points for brackets to anchor the system to the factory floor beneath the centerline of the fiberglass mat-roll.

Design phase challenges included meeting sponsor requirements and design preferences, project management, and manufacturing. Initially, the sponsor required that the system accommodate a diameter-range in the fiberglass mat-rolls that proved challenging to meet. Given the limited scope of the project, the sponsor modified the requirement and decreased the diameter. Modifying the requirements lead to two ground-up redesigns during the last quarter, which put the project behind schedule. Manufacturing challenges included consistently cutting the slotted extrusions to the correct length, fitting the carriage and support assemblies together, and aligning the linear bearing-rails with the bearings. Recommendations include improving the manufacturability of the carriage and support assemblies to improve fitment, designing a more robust linear bearing system, and adding guarding around the machine. The next steps include developing a controls architecture for the system and testing the system at the GAF mock-up staging station.

Deliverables to GAF include the final prototype and exposition poster (Figure 1) and a Final Design Review (FDR) containing all information required to justify the engineering decisions made during the project and inform future design revisions. Additional deliverables include a detailed bill of materials and files for all CAD parts, assemblies, and drawings. Per the sponsor's request, this executive summary serves as a replacement for the FDR to avoid non-disclosure conflicts.

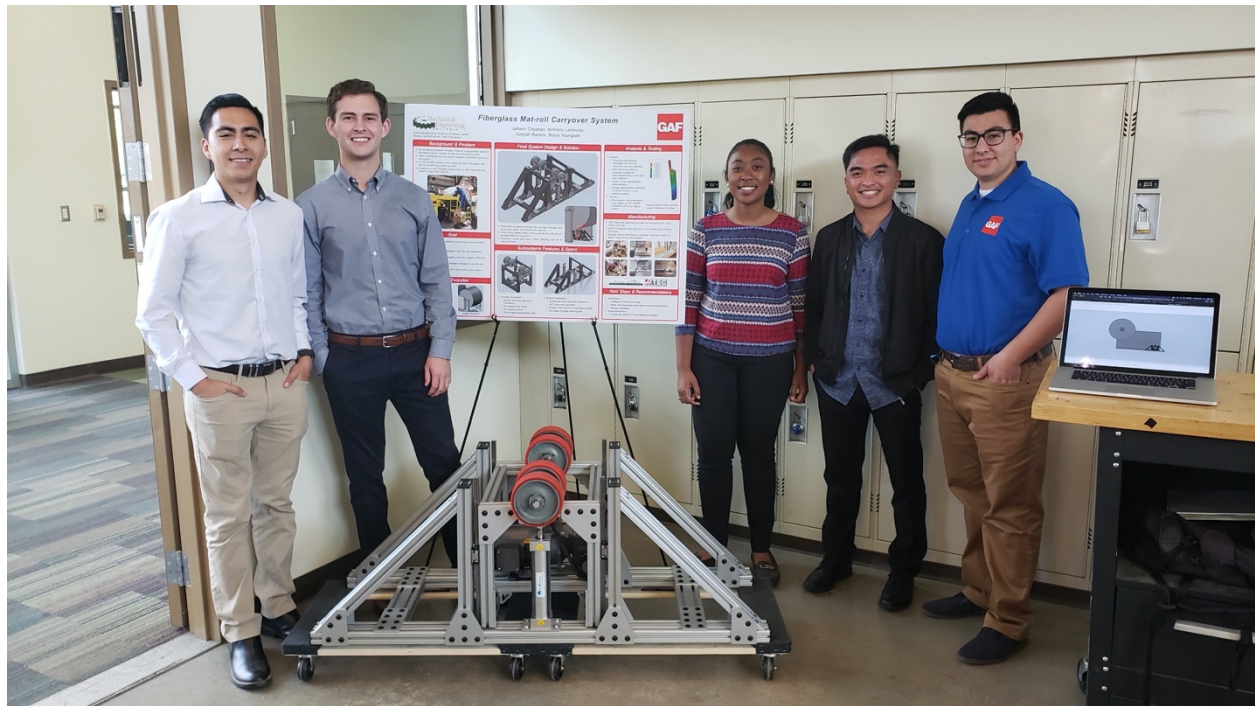


Figure 1. Senior-project exposition. From left to right: Ergomigos senior-project team members Anthony Ledesma, Bryce Youngson, Aaliyah Ramos, Johanne Cayaban, and GAF mechanical engineer Javier Davila.