

ABSTRACT

The Indiana Department of Transportation (INDOT) uses full-sized paving vehicles for pavement repairs, but many smaller jobs don't require such large equipment. INDOT developed a smaller asphalt spreader prototype that can attach to the rear of a dump truck, addressing size and transport issues, Figures 1 and 2. However, this design lacks some important features, and the width is an issue when transporting down the road on the front of a plow truck. The design team was tasked with creating a new spreader that matches the full-sized features but is compact enough to be moved by a dump truck and can be adjusted for various paving widths from 8 to 12 feet. This new design will improve efficiency for medium to large paving jobs without needing a full-sized paver.

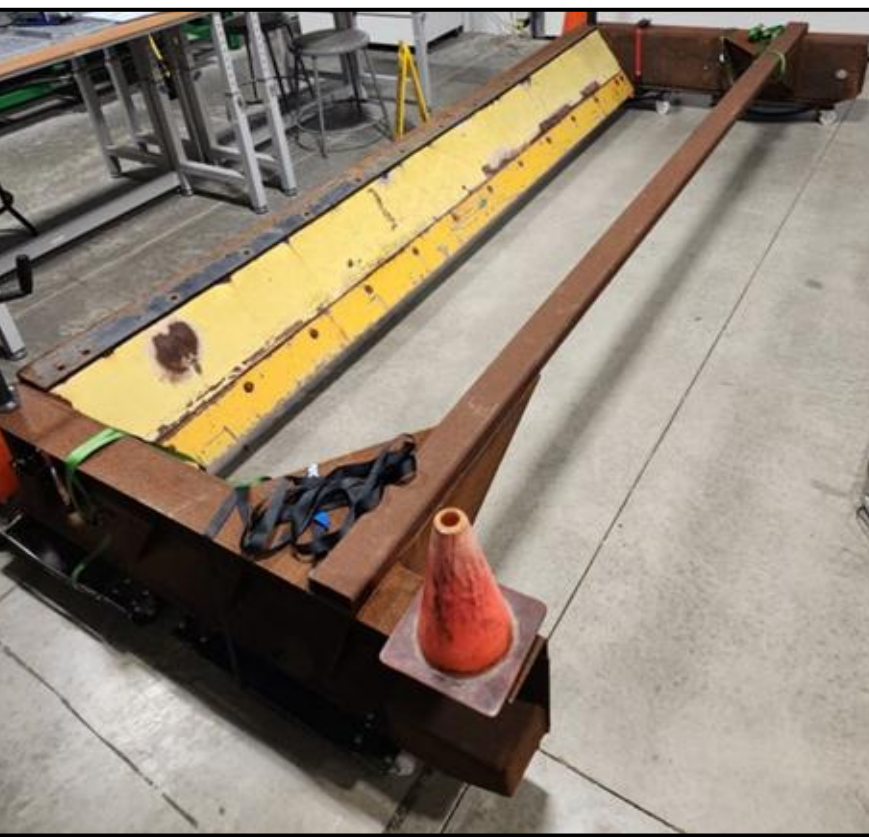


Figure 1: Original Paver Prototype



Figure 2: Paver Attached to Truck

CUSTOMER NEEDS/SPECS

INDOT had several desired needs and requirements for the redesigned spreader. These are shown in Table 1.

Table 1: Customer Needs and Specifications

Customer Needs	Specifications
Must attach to utility truck	Expense <\$10,000
	Extends 8'-12' paving width
Must be able to load from same utility truck	3 tons of asphalt capacity
Must be large enough to complete medium-sized jobs	Minimum 2 operators for safety
	High strength steel
Low maintenance after jobs	Attaches < 1' away from chipper bar
	Blade angle of 45-degrees
Easy maneuverability to fulfill job requirements	Withstand high temps./weight
Possible adjustability based on job requirements	Overall weight < 1800lbs
	D-ring for snowplow mount

DESIGN CONCEPTS

Three concepts were created using the team's understanding of INDOT's needs. Concept one (Fig 3) has a hinge system for adjustability and a blade leaf insertion to slide in place. Concept two (Fig 4) used a rack and pinion system with a one-unit pillow block hitch mechanism.

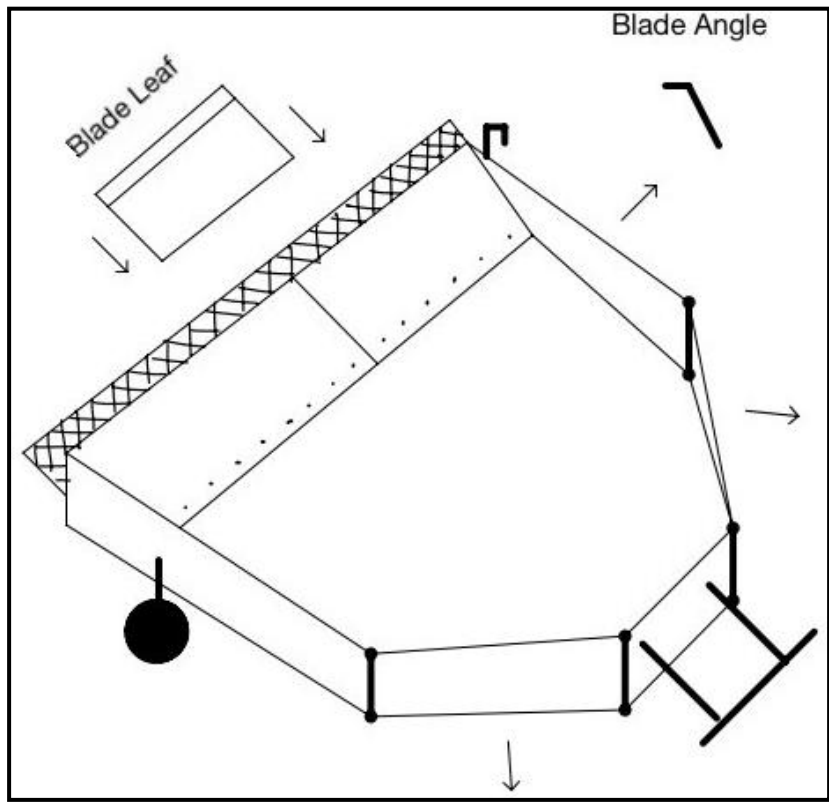


Figure 3: Concept 1 Design

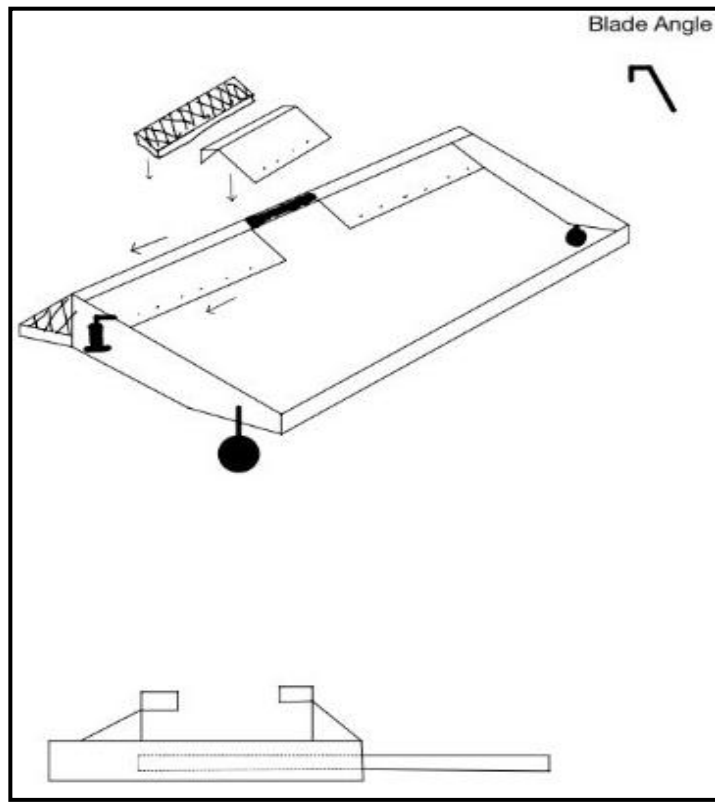


Figure 4: Concept 2 Design

Concept three (Fig 5) uses the same rack and pinion system for extendibility. It then has two separate pillow block bearings that slide to meet and necessary position needed for a job.

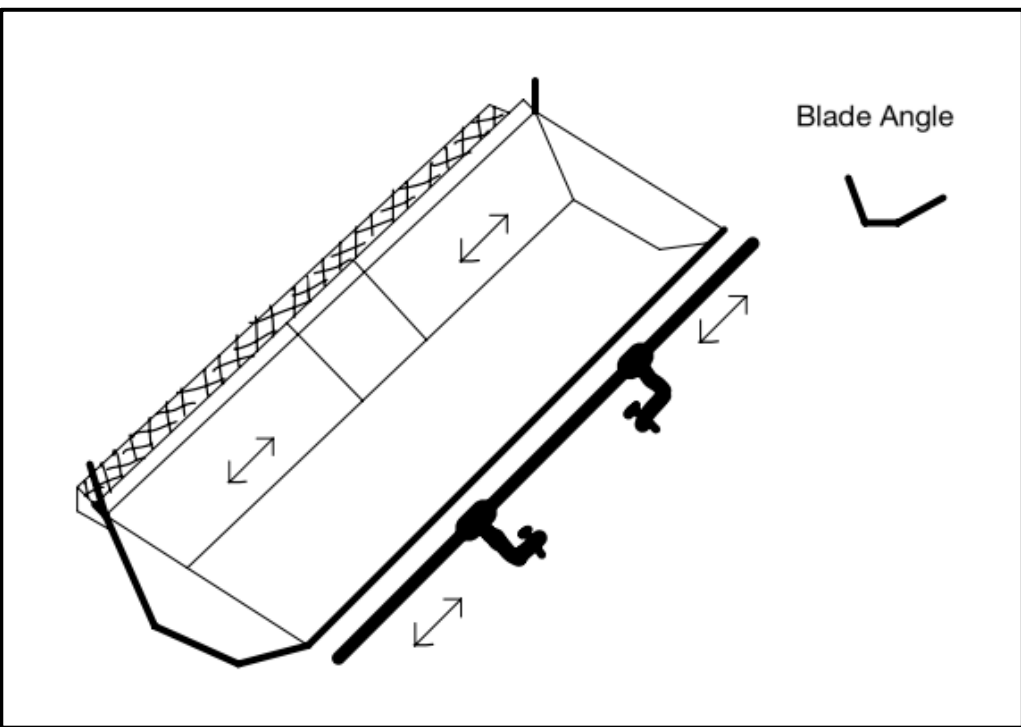


Figure 5: Concept 3 Design

Concepts 2 and 3 each had aspects that the INDOT wanted in the final design. Because of this, the team chose the desired aspects from each to create the final design.

INITIAL DESIGN

The team took the aspects that INDOT wanted and created a CAD model of the initial design, Figure 6. Preparation of the materials was part of a contract that state had with an approved vendor and so assembly did not start for a few weeks. The completed working prototype is Figure 7. One issue with this design that quickly became apparent was the rack and pinion drive to extend and retract the sides was not working as intended. This was later confirmed in testing.

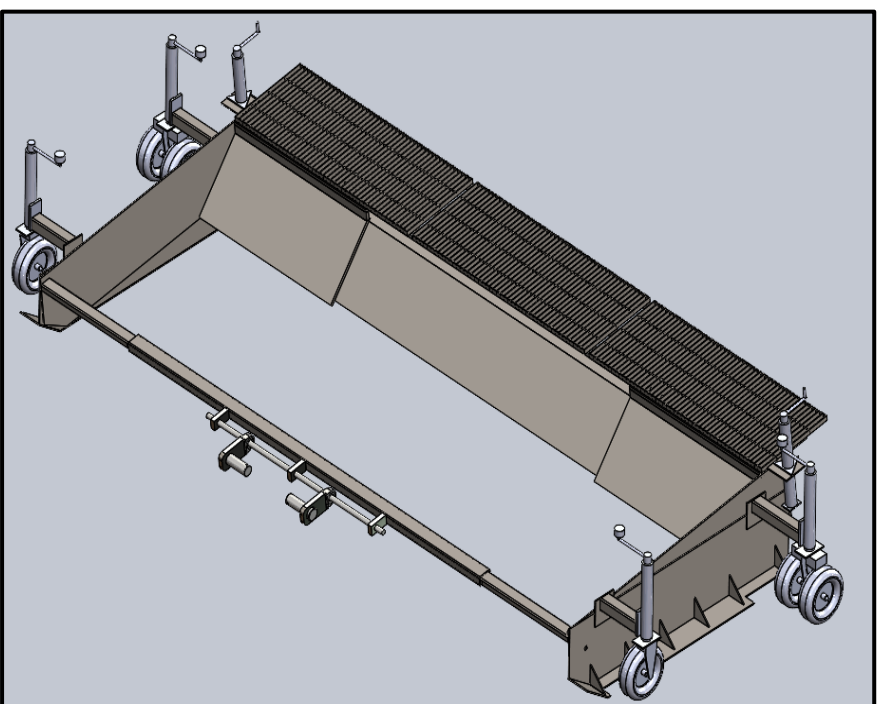


Figure 6: CAD Model Design



Figure 7: First Paver Build

FUNCTION TESTS

Most spreader components were manually tested, both individually and on the spreader. At the Angola INDOT facility, the spreader opened and evenly spread gravel (Fig 8). The hitch adjusts for movement and aligns with the chipper bar (Fig 9). The catwalk's three segments allow D-ring access (Fig 10). Wheel jacks lifted the spreader easily (Fig 11).



Figure 8: Overall Spreader Test

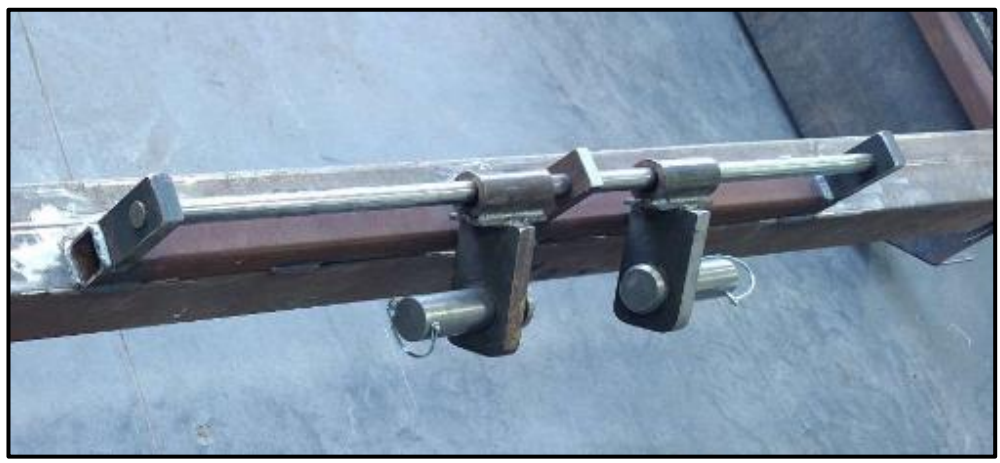


Figure 9: Hitch System



Figure 10: Jacks & Wheels



Figure 11: Catwalk

FINAL DESIGN

The teams final design consisted of many aspects from the entire year and testing revisions including:

- Jacks and Wheels
- Catwalk
- New Adjustability Mechanism
- Hitch Assembly

After the teams' original test, a different approach for the adjustability was needed. A pair of trailer jacks were installed instead of the rack and pinion. This eliminated the main blade rotation as well as the force needed to open the spreader. Figure 12 shows this design and Figure 13 shows the full collapsed paver system.



Figure 12: Adjustability Mechanism



Figure 13: Final Design Collapsed

CONCLUSION

The team has worked through the complete product design cycle phases for this project. These efforts began with discussing the problem with the sponsor. This led to researching and identifying different areas of focus all the way to testing the team's designed prototype and ending with a final product design. The design team and INDOT have created a functioning prototype that adequately performs the desired tasks. This design allows the efficient transport and use of the spreader by an INDOT utility truck, as well as requiring only 1-2 individuals to setup and operate. Figure 14 shows the final design.



Figure 14: Final Design Extended

LESSONS LEARNED

With the project completed, the team has learned:

- Engineering documentation skills
- Engineering design methods and processes
- Professional problem-solving skills
- Teamwork
- Time Management

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