CAPSTONE EXPERIENCE 2011
Return Elevator Sampler

PURDUE UNIVERSITY

Agricultural & Biological ENGINEERING

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Problem Statement:

This project will address an issue on how to safely and accurately measure the amount of material that must be returned to the threshing system on a John Deere class 7 test combine. The objective is to devise a way to allow the cab operator to use pneumatic and electronic controls to allow for the collection of materials that are in the return elevator of John Deere test combines. The plan will also attempt to devise a way to collect and extract multiple samples during a single test run.

Introduction:

This project was giving to us from the advanced functions divisions for combines at John Deere. They would like to remotely Sample the amount grain in the return elevator during a test run. John Deere provided us with a test stand for us to be able to mount and test our design. We hope that this test stand will be able to help John Deere optimize their part selection for their combines so that they become more efficient and thus more valuable.

Solution:

In order to determine the best solution for this problem we came up with 3 different ideas on how to solve this problem. Each solution was then put into a decision matrix in order for us to decide which design solution would work best. The design matrix is shown below in figure 1. Our wedge shape design was shown to be our best option.

			Jake's Tracks	Meet	Not Meet	Mike's Slide/Chute	Meet	Not Meet	Wedge Design	Meet	Not Meet
WANTS - Score good = 10, poor = 0		WT		PT			PT			PT	
Performance/Functionality		85			610			570			660
	Durabilty/Maintenance	20	Tight to combine frame, better w/ knockdown bar	6	120	Slide will wear quickly/multiple moving parts/joints	6	120	Rugged, Self Contained	9	180
	Attachement (ease and timeliness)	15	Bolt brackets/tracks	4	60	2-piece attachment (slide * sensor part) Complicated brackt	6	90	1-2 components, easy bolt on	8	120
	Grain Flow	20	Straight Drop	10	200	Straight Drop	10	200	Slides probably needed, Not dropping straight down	7	140
	Complexity	20	Heavy motor hanging off the end	8	160	Sensors, hinges, chute hanging	4	80	Torque to move bins, a few sensors	7	140
	Access & Removal of Samples	10	Pull Out. Push cylinder out	7	70	Drop off back/ Loading chute accessible	8	80	Either gate access w/ common slope pt or removal of bins	8	80
Cost		15			95			85			110
	Material	5	Additional Solenoid(my be difficult/expensive to find	5	25	Additional Solenoid/sensors	5	25	Bin repositioner	8	40
	Assembly	10	Many parts contained in end unit	7	70	Multiple joints/components/ specialized machining	6	60	Most will be in the bin positioner	7	70
Final Point Summary (Keep hidden until ranking is finished)											
Total Score					705			655			770

Figure 1: Design Matrix with 3 design options considered and how they were weighted

Initial Design:

Our original design called for wedge shaped bins mounted to the underneath of the combine with a ramp system off of the return elevator in order to direct the flow of grain to the desired location. Original concept drawings of our design are shown in figure 2.

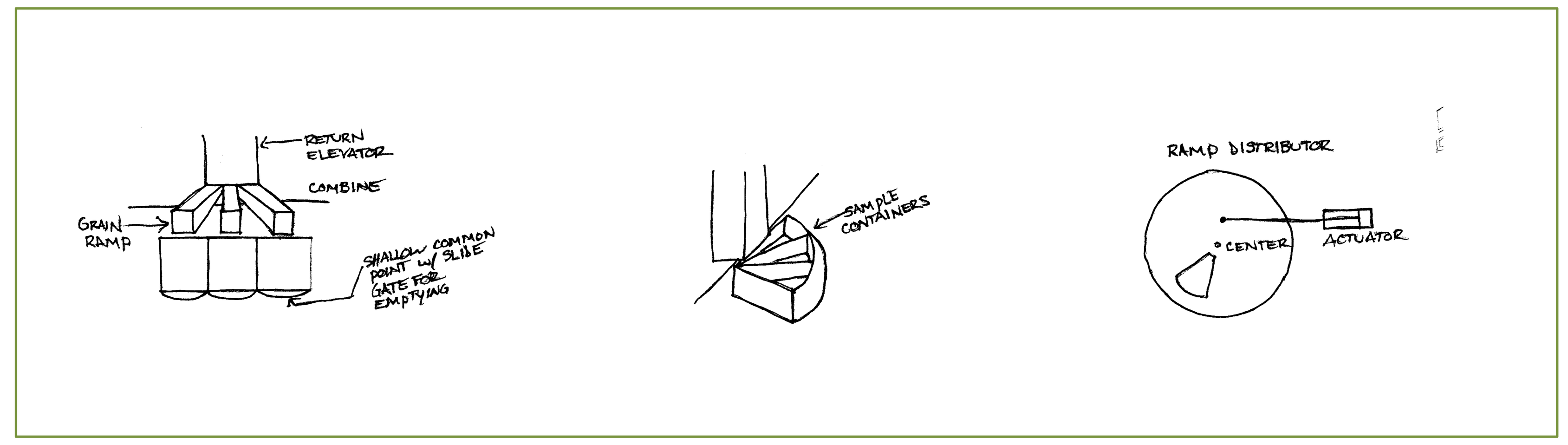

Figure 2: Original wedge shaped bin concept

Final Design:

Like with every design problem arose that made us reconsider aspects of our original design.

For example, It was decided that the bins should rotate because it was thought that the ramp design would restrict the flow of grain too much.

Also, we would limit our sample size to two bins. This is because of restrictions of space in the area where we are to mount our sampler Pictures for our test stand, bins, bin slide and mount, new clean out door, and bin design are in figures 3,4,5, 6, and 7 respectively..

Figure 3: Test stand with motors mounted and some modifications shown

Figure 4: The collection bins, the wide part sits on casters and the point is mounted on a bearing allowing for it to swing into position under the return elevator.

Figure 5: The slide and mount for the bins. At the top is the bearing that allows for the bins to rotate. The "wings" at the bottom are slides for the castors to roll on.

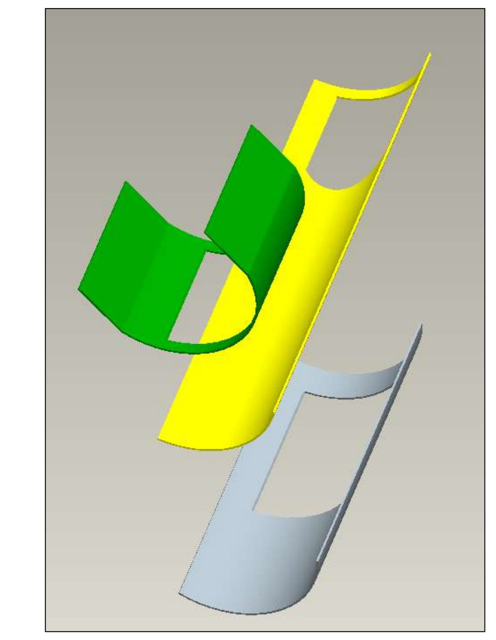

Figure 6: This shows the new clean out door (top), the new slide gate that allows the grain to flow out of the elevator and into the bins, and the support for the slide (bottom).

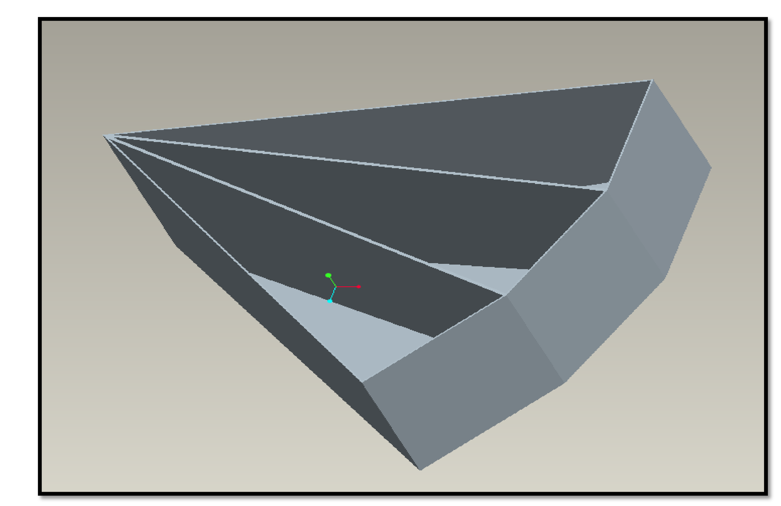

Figure 7: Original Bin design with 3 wedges to hold samples.

Budget:

Our original budget was $2,400. We ended up exceeding this because of some issues that arose throughout the project. We had to spend more money on steel because in our original estimate we did not account for the steel that would be needed to modify the test stand. Also a major source of our overage was the electric motors to run the test stand.

Budget

Item	*Price*	*QTY*	*Total*
Pivot Bracket	$95.46	2	$190.92
Foot Bracket	$10.00	2	$20.00
Pivot Mount	$11.32	2	$22.64
Mil Spec Hex Head Cap Screws	$7.20	1	$7.20
Allow Hex Head Cap Screw	$9.76	1	$9.76
Steel Hex Nut	$6.11	1	$6.11
Machinable Flat Sprocket	$22.32	1	$22.32
Machinable Flat Sprocket	$99.44	1	$99.44
Air Compressor	$205.00	1	$205.00
swivel jack	$55.53	2	$111.06
Converter	$299.50	1	$299.50
Mics. Air Fittings	$100.00	1	$100.00
Motor Mount	$65.81	1	$65.81
Electric Motor	$744.81	1	$744.81
Chain	$56.92	1	$56.92
Air Hose	$196.25	1	$196.25
Mics. Steel	$500.00	1	$500.00
Total			$2,657.74

JOHN DEERE

Sponsor: John Deere Co.

Kurt Elpers, Glenn Pope, Colter Kinney, Jared Puvak

Technical Advisor: Patrick Murphy

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