Cabling Innovations

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The Braidy Bunch

* Alex Wainscott: Team Leader, Management Communications, Structural Design Leader
* William Murray: Mechanical Leader, Motor/Plate Design Leader, Fabrication Leader
* Grace Morriss: Lead Systems Integrator, Electrical Leader, Written Reports Editor

Initial Problem

* General Cable only runs C-Cell a few months out of the year and next year are looking at running 50% of the year
* They currently run Category 3 Cable
* They would like to be able to run Category 5 on the line

Economic Motivation

Labor Savings				
Line Speed (ft/min)	100	200	300	350
Min/hr	60	60	60	60
Hrs/day	24	24	24	24
Days/year	158	158	158	158
Ft/year	22,752,000	45,504,000	68,256,000	79,632,000
Boxes (1000ft)	22,752	45,504	68,256	79,632
Labor cost / Box	$2.82	$2.82	$2.82	$2.82
40% Labor Reduction	$25,664.26	$51,328.51	$76,992.77	$89,824.90

Construction of Category 5 Cable

* Primary conductors fed into bows to twist them
* Twinned pairs (4) fed into central line to be bunched
* Bunched pairs immediately jacketed

C-Cell

Our Task

* Create a “bunching” stage for the line
* Investigate bunching patterns to prevent crosstalk (interference between the wires) by changing lays
* Hold the bunched pairs until jacketed
* Integrate our design with the current PLC system running the line
* Explore the use of a faceplate system to bunch the pairs

Quantitative Parameters

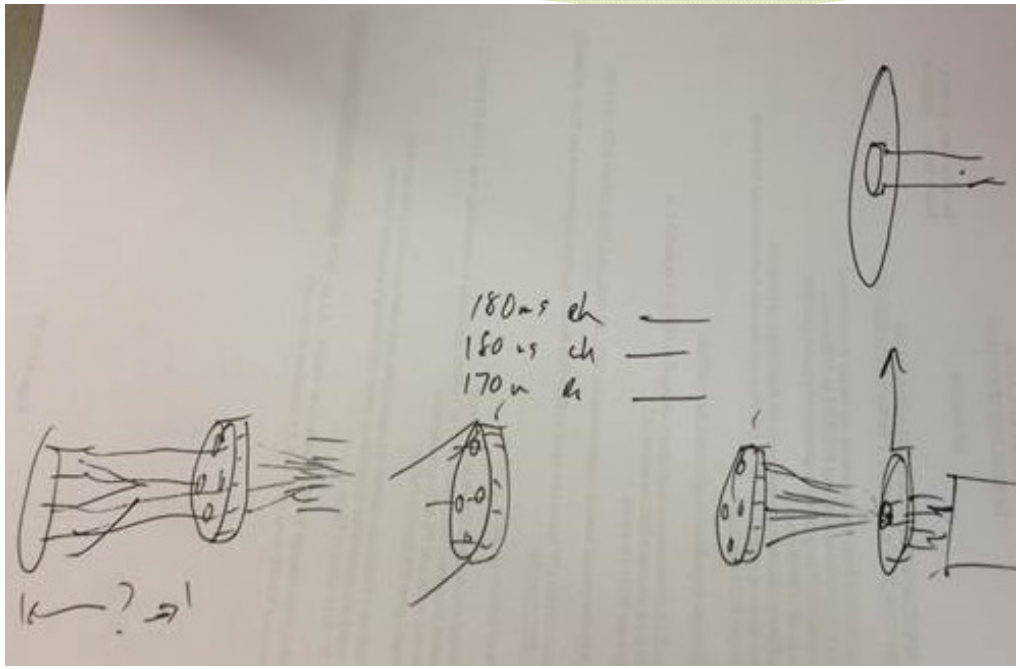
* Space: approximately 6x3x4 feet with obstacles
* Tension: no more than 2 ½ lb/pair
* Line speed: 100 fpm constant with 200 fpm maximum
* Lay length: 3” to 5”
* $\{Line\ Speed\ \left(\frac{feet}{\text{minute}}\right) * \frac{1\ minute}{60\ seconds}\} / \{Lay\ Length\ \left(\frac{inches}{twist}\right) * \frac{1\ foot}{12\ inches}\} = \frac{Rev\ (or\ twist)}{sec}$
* Model can produce 10,000 feet of Cat 5 cable

Design Goals for Evaluation

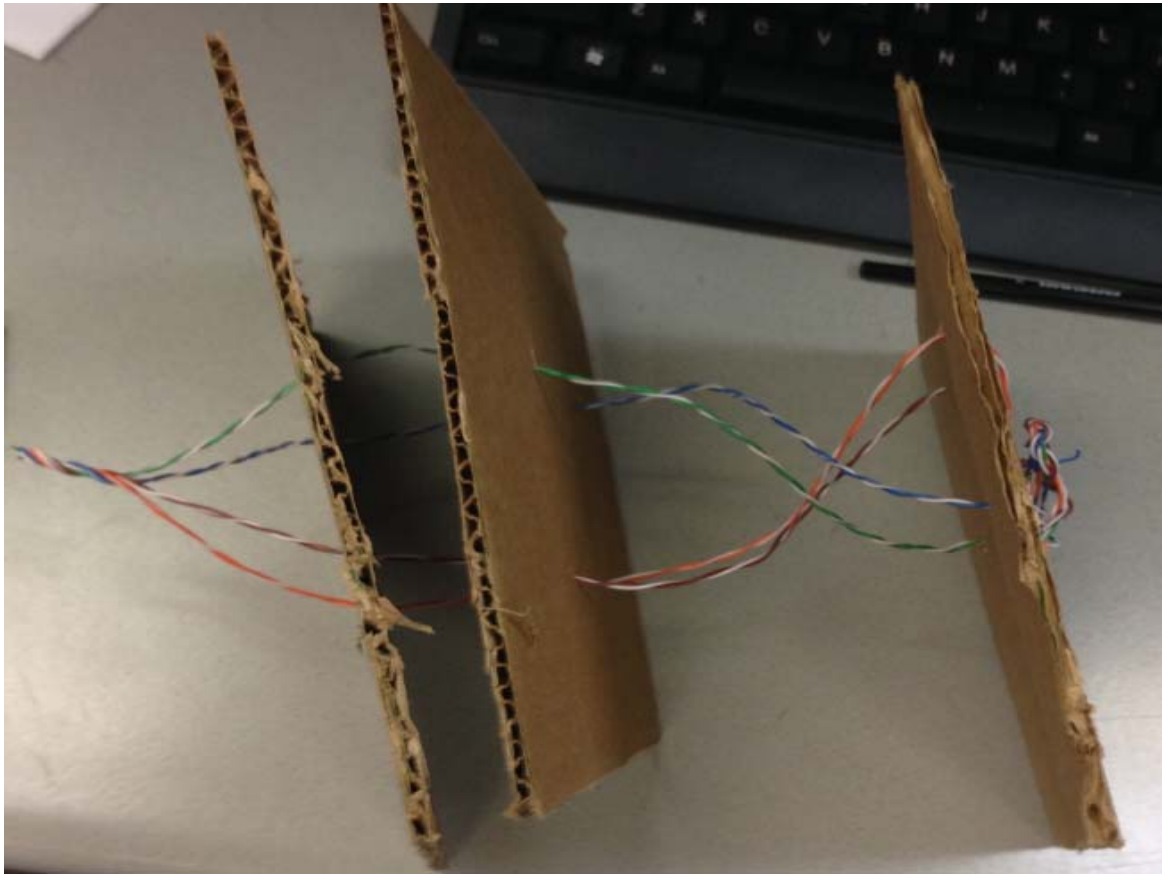
Goals	Ratings	Weight
Safety	9	100
Performance	7.5	95
Reliability	6.5	60
Acceptance	6	80
Ease of Operation	5.5	60
Durability	5.5	31
Ease of Maintenance	5	45
Ergonomics	4.5	45
Standard Parts	2.5	30
Minimal Cost	1.5	35
Environment	.5	17.5

Mr. Booker's Request

* Three driven face plates
* Questionable vortex and spacing between plates
* Different speeds for each plate

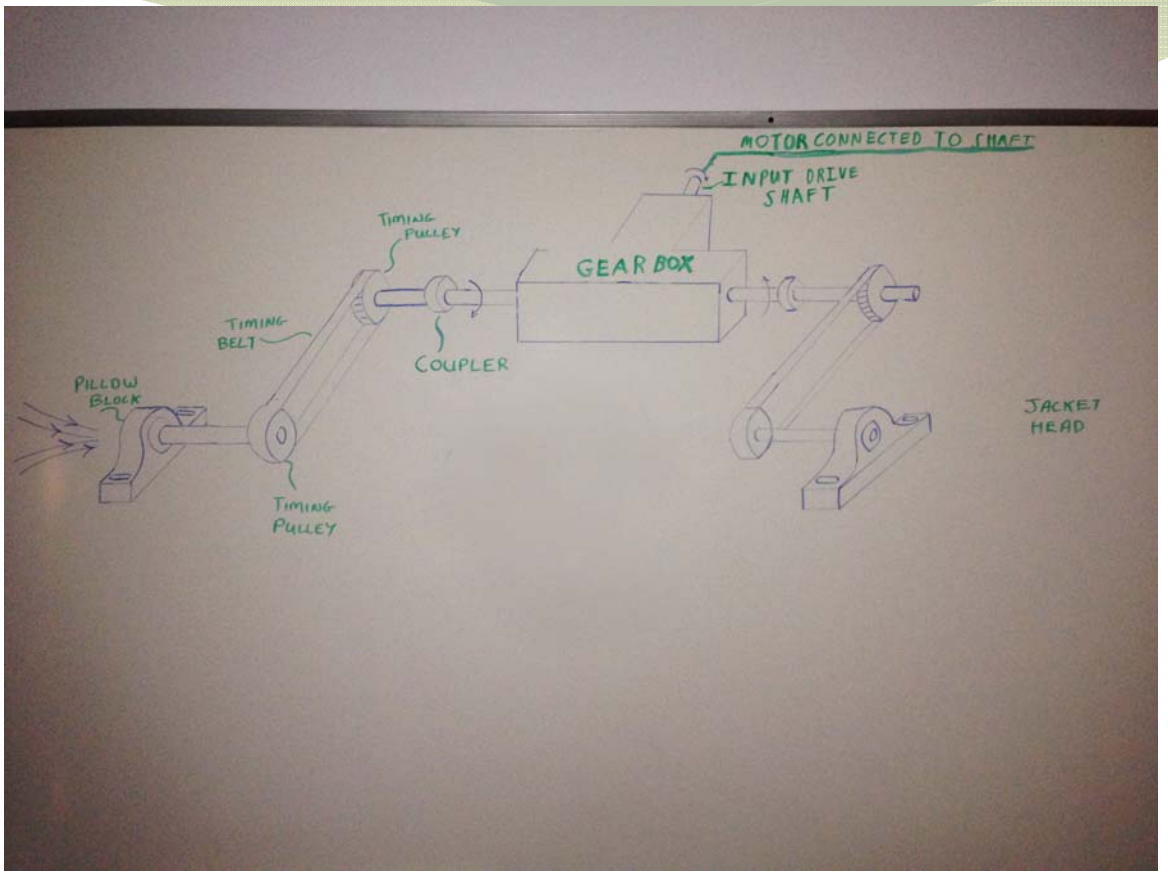


Our Analogic Model



Design Option 1: Gear Box

- Advantages
  - Two driven timing pulleys
  - Controlled by one motor
  - Minimized vortex
- Disadvantages
  - No premade one available
  - Time frame did not allow manufacturing
  - Spacing would be difficult to predict
  - Cost was difficult to justify



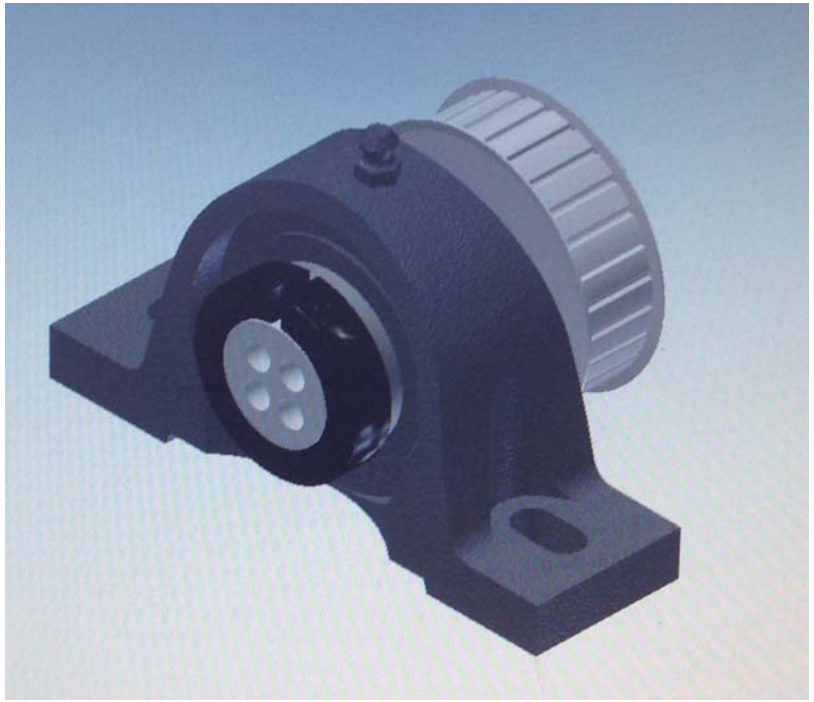
- Gear Box Sketch

Design Option 2: Pulley System

* Advantages
  - Minimized design time
  - Simpler construction
  - Proves concept with one motor
  - Variability of spacing
* Disadvantages
  - Some uncertainties in number of pillow blocks required for final system
  - Wear and tear on belt

Pulley System

* Features of the Final Design
  - Pillow block:
    - Delrin insert
    - QD bushing
    - Timing belt pulley
    - Shaft collar
  - Motor
    - QD Bushing
    - Timing Belt Pulley
  - Timing Belt



Support Structure

Motor Selection

Options:

* Servo
  - Allowed speed control
  - Difficult to control distance turn
* Stepper
  - Allow position control
  - Hard to control speed

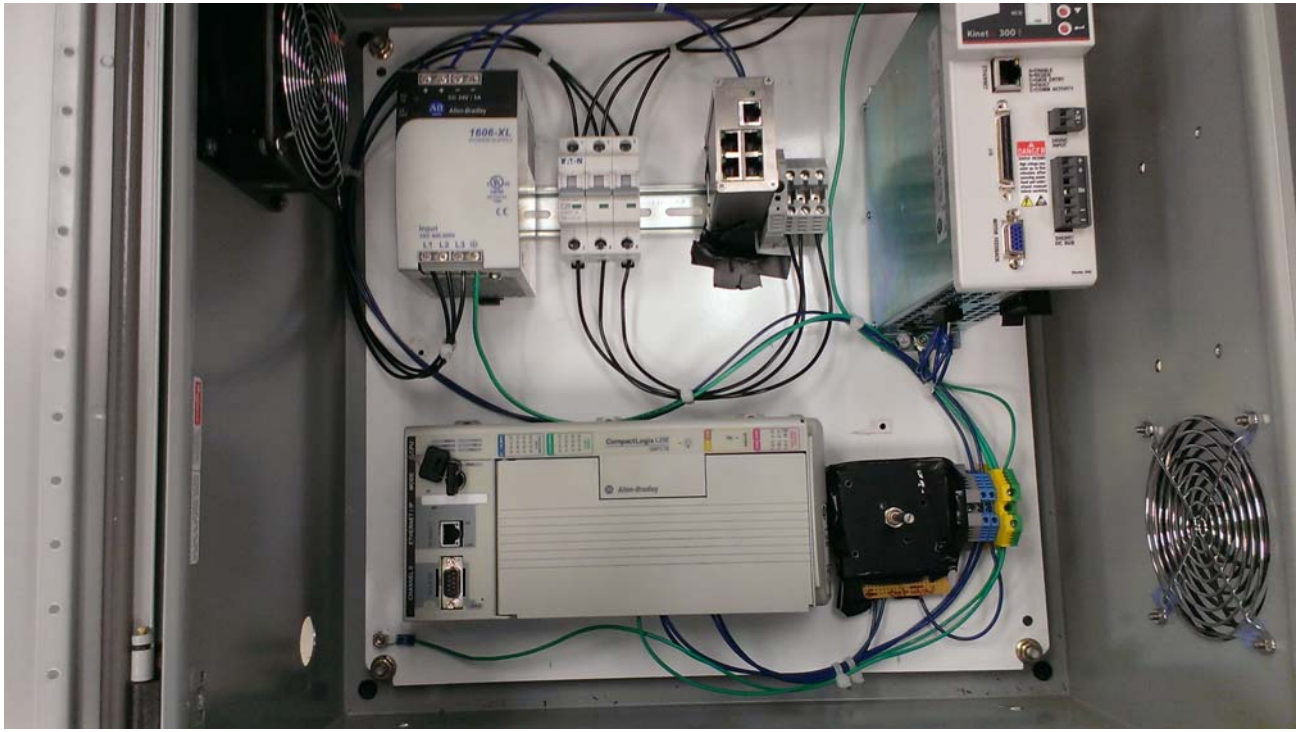
Final Choice:

* Indexing Servo motor
  - Allows speed or index commands
  - Can be adapted to run as a mixture
  - Readily available as a spare part
  - 5000 rpm max exceeds our requirements

Drive and PLC

* Drive: Kinetix 300
  - Also a spare part
  - Ethernet communication
  - Motor feedback
* PLC: CompactLogix L23E
  - Free sample
  - RSLogix 5000 for programming
* Potentiometer
  - Will be used to control lay length input
  - Input can be scaled to any range
* Periphery Parts
  - Circuit breaker
  - 480V AC to 24 V DC power supply
  - Ethernet Switch

Electrical Panel Implementation



Current Testing Goals

- Accel/Decel rates for the drive
- Integration to run real wire, avoiding back-twist
- Find the best combination of settings for the wire
  - 1 pulley system being turned or 2?
  - Lay length
  - Line speed
  - Number of turns per operation

Suggestions for Full Scale Implementation

* Safety
  - Guard for the belt
  - Remove STO bypass and include E-Stop
  - Additional circuit breakers, larger enclosure, 120V DC supply to run fans
* Functionality
  - Integrate with line SLC
  - Permanent Structure
  - Second driven pulley system potentially

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- Colin Sikorski

Questions?