

National University Rail Center - NURail US DOT OST-R Tier 1 University Transportation Center

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Railroad Engineering: Hands-On Experience

By

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DISCLAIMER

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TECHNICAL SUMMARY

Title Railroad Engineering: Hands-On Experience Rose-Hulman Institute of Technology

Introduction

The project was designed to enhance the learning experience of the students enrolled in CE 483 Railroad Engineering. In addition to the classic classroom content of the course the students participated in a *Hands-On Experience* at Haley Tower, a local railroad museum. The students constructed a section of track – transporting and placing ties, installing tie plates, transporting rail, spiking rail and bolting together rail sections. After completion of the exercise the track was disassemble and stored for future use. Students were also introduced to a variety of rail components including rolling stock, turnout and switch operation, and signaling.

Additionally, a program for *STEM Outreach* to elementary and junior high school/middle schools and youth groups was developed to introduce railroad operations. A number of different rail scenarios was presented to the participants to develop and model viable solutions to the problem. Using wooden track sections and small wooden cars the participants constructed track layouts to demonstrate their solution of the rail design challenge presented. Additionally a locomotive simulator and associated computer equipment was acquired to allow the participants to operate a locomotive in one of many different geographic and operational scenarios.

Description of Activities

CE 483 Railroad Engineering - Hands-On Learning Experience

RHIT partnered with the **Haley Tower Historic and Technical Society** to provide the students in CE 483 Railroad Engineering a *Hands-On Experience* with some of the aspects of railway construction and operation.

The hands-on experience was divided into 2 sessions:

Session 1 - Track Construction Session 2 - Rolling Stock & Turnouts

Session 1 – Track Construction

Session 1 allowed the students to construct a 29 foot (temporary) section of 90 pound track. A suitable site within the museum grounds was chosen to provide adequate support for the construction effort. Twenty four ties were moved to the site by students utilizing tie dogs. Tie spacing to support the temporary construction was determined to be approximately 24 inches. A 29 foot long rail section and two shorter rail sections – 20 foot and 10 foot – was moved to the site by students using rail dogs. Tie plates - two per tie – were put in place and the rail was moved on top of the tie plates. After ensuring proper track gage the rail was spiked to the tie plates and ties. The two shorter rail sections were bolted together utilizing joint bars. After the track construction was finished the joint bars were removed, the spikes pulled, the rail sections, ties, and tie plates were returned to appropriate storage location.

Session 2 - Rolling Stock and Turnout Mechanism

The students toured Haley Tower facilities and participated in rail operation demonstration. Air hose couplings, air brake operation, coupler operation, and brake shoe removal was demonstrated. Students were encouraged to operate these various rail components. Students toured the Museum's PRR N6b caboose and the Pullman Troop Sleeper car. Interlocking controls were introduced during tours of the Haley and Springhill Interlocking Towers. Turn out components - electric and hand switch stand operation – were introduced and operated.

RHIT Civil Engineering & AREMA Student Chapter STEM Program

A STEM outreach program was designed to target local elementary and junior high/middle school students to introduce students to many technical aspects of the railroad industry. Specifically the institutions identified for delivery of the initial program are:

- Saint Patrick Elementary School
- Woodrow Wilson Middle School
- Vigo County Girl Scout Troops
- Central Indiana Girl Scouts Discovering STEM Program

A series of railroad operations and associated challenges was presented to the participants. Wooden track pieces and small wooden rail cars were used to design and build a viable solution that solves the operation challenge. The design challenges included:

- 1. Hump Yard track layout for classification of cars bound for several different destinations.
- 2. Siding with turnouts to allow bi-direction traffic (meets) on a single track mainline.
- 3. Siding with turnouts to allow faster trains to pass slower traffic on a single track mainline
- 4. Crossing traffic solution to include: diamonds, interlocking, and grade separations (bridges/underpass).
- 5. Reversing direction using turning wye.
- 6. Given the weight and length of a short piece of rail determine the rail section size lbs/yard.
- 7. Use the Rail Driver (locomotive simulator) and associated computer software to simulate the operation of a METRA passenger locomotive from Aurora to Union Station downtown Chicago.

The program for the **Central Indiana Girl Scouts Discovering STEM Program** also involved evaluating a number route alternatives for the Amtrak Empire Builder. Given a construction budget, a project time table, and the route from Chicago to Minneapolis to Glacier National Park to Fargo and terminating in Seattle. Using an atlas they determined the distance between cities and calculated a time table of arrival and departure times. They were tasked to determine alternatives to cross the Mississippi River, the Great Plains, the Rocky Mountains and how to deal with snow.

Outcomes

The **Hands-On Rail Project** was offered to the students enrolled in CE 483 Railroad Engineering during the spring quarter of AY 2015/2016. Class enrollment was 11 senior Civil Engineering, Mechanical Engineering and Brazilian exchange students. However, CE 483 enrollment for the AY 2016/2017 was only 5 students. These students were able to participate in Session 2 - Rolling Stock and Turnout Mechanism. However due to low enrollment (a minimum of 8 students needed) Session 1 – Track Construction was not offered.

Central Indiana Girl Scouts Discovering STEM Program – sponsored by the Rose Hulman academic departments and technical societies. Through our AREMA Student Chapter we were able to continue to offer our rail program as part of the STEM program.

Conclusions/Recommendations

The Hands - On Rail Project was successful. However increased enrollment in CE 483 Railroad Engineering is needed if the entire program is to be offered. Support from the Haley Tower Historic and Technical Society has been outstanding.

The Central Indiana Girl Scout Discovering STEM Program provides an avenue to present to elementary and junior high school student's opportunities in the railroad industry- education opportunities as well as future employment.

Publications/Examples

Hands on Experience Haley Tower Final Report



RHIT STEM Final Report



Principal Investigator

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HALEY HANDS-ON LAB

CE 483 RAILROAD ENGINEERING

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Haley Hands-On Lab Specifications

- 2 Sessions
- Late Afternoon
- End of Year May
- Topics
 - Track Construction
 - Turnouts & Switches
 - Rolling Stock





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Haley Hands-On Lab

Track Construction - Temporary

move ties and rail
establishing proper track gage
spike rail to tie plates and ties
install a joint bar
remove spikes
remove rail, plates & ties

Turnouts and Switches

mechanical switch stand
electric motor switch drive
Springhill Tower Interlocking
Haley Tower Interlocking

Rolling Stock

- •knuckle & coupler operation
- •air hose coupling
- brake shoe remove/install
- •Pennsylvania Railroad N6b caboose
- C&EI/L&N Pullman Troop Sleeper









HALEY HANDS-ON Track Construction





HALEY HANDS-ON Track Construction SEQUENCE OF OPERATIONS

Operation Safety Briefing	<u>Tools</u> Briscoe & Johnson	<u>Comments</u> Employed CN – June 2016
Place Ties	4 man tie dog	24" spacing for 8 gage ties & 4 support ties
Place Tie Plates	by hand	16 @ approximate 4' 8.5" spacing
Place Rail	6 man rail dogs	long rail 1 st
Temp. Spike Long Rail	2 spike mauls	as needed @ support end ties
Place Rail	6 man rail dog	2 piece short rail
Joint Bar-2 piece	Wrench	4 bolts/nuts
Spike Long Rail	2 spike mauls	2 spikes/plate
Spike Jointed Rail	2 spike mauls	4' 8.5" spacing gage
Disassemble Rail	Wrench Spike puller Rail dog Tie dog	National University Rail Center







Ties

Indiana Rail Road

- 7" x 9" x 8 foot
- Plugged
- 2 Tie dogs
- 4 Students











Tie Lay Down Area

- Tie Spacing
- ~24" C-C
- Tie Plates
- Double Shoulder

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90# Rail

- HTHTS
- 29 ft
- 3 tie dogs
- 6 students





90# Rail – 29' = 870 lbs











90# Joint Bar

- 4 Oval Neck Bolts
- 4 Square Nuts
- Square Nut Wrench





90# Joint Bar









Spiking













Rail Gage

- 4' 8-1/2"
- Rail Jack
- Gage Bar





Spike & Tie Plate Removal



Disassembly Joint Bar











GRS Interlocking Machine

- Haley Tower
- Model Board









Electric Switch Motor





Pizza – Post Job





CE 483 Railroad Engineering – Spring 2016





THANK YOU!

Acknowledgements:

Haley Tower Historic Technical Society



Indiana Rail Road



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> U.S. Department of Transportation Office of the Secretary of Transportation

















MIDDLE SCHOOL STEM



















Effingham or Paris?

Just west of Indiana State University, trains must decide whether to travel to Paris or Effingham, Illinois.



Your Job: Using the available track pieces, create a configuration that will allow trains to go to



Amtrak Problem:

Amtrak shares track owned by freight railroads. Sometimes, Amtrak has to wait for the freight train to pass by.



Your Job: Create a configuration that allows a freight train to pass a waiting Amtrak train.







$\frac{9.21 \text{lbs}}{2.50 \text{ in}} \times 36 \frac{\text{in}}{\text{yd}} = 132 \text{ lbs/yd}$

Terre Haute Problem:

CSX trains pass through Terre Haute travelling to St. Louis. Indiana Rail Road (INRD) brings coal to a power plant north of Terre Haute.



Your Job:

Create a track configuration to allow INRD and CSX trains to continue to their destinations.









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