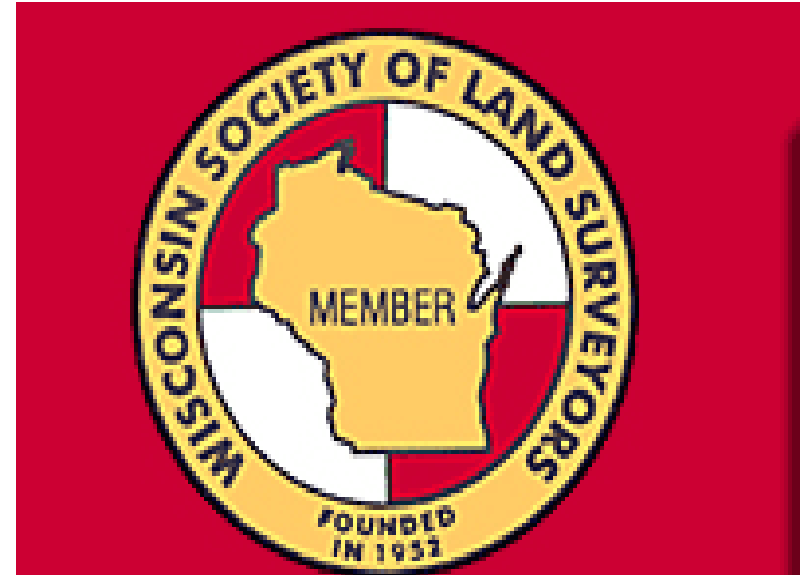


AREMA PRESENTS:
RAILROAD SURVEYING 101
(VIRTUAL SESSION – UW/Stevens Point)

JANUARY 28, 2021



Facilitated by:



JOB BRIEFING

Safety considerations/RR standard briefing prior to starting task(s) in the office or the field...

Safety Briefing

Fire Exits / Place of Safety

CPR/IED Use

MEETING PLACE

DESIGNATED CALLER / 911

Designate Known Hazards

Changes During The Day



Railroaders will always start with a job briefing, it's just good practice.

Qualifying caveat(s), 49CFR214 compliance course not taught here Try ContractorOrientation.com or other designated instruction for that railroad...

What you should take away from this course today



SAFETY SERMON (AREMA C-24)

Surveyors' Right of Entry vs.
49CFR214(d) On Track Safety

*THERE IS NO EXEMPTION BY
STATUTE FOR SURVEYORS IN
WISCONSIN OR ANY OTHER STATE
FOR BEING ON OPERATING
RAILROAD R/W OR FOULING LIVE
TRACK. (FEDERAL RULE WILL
TRUMP STATE AND LOCAL RULE
EVERY TIME – Federal Exemption)*



- Security Camera Video Courtesy FRA

WHY ON-TRACK-SAFETY:

**IN THE UNITED STATES, A SURVEYOR IS KILLED ON THE
TRACKS AT ROUGHLY THE RATE OF ONE PER YEAR.**

THIS HAS GOT TO STOP

Right of Entry vs. Safety

- 49 CFR 214 “ON TRACK SAFETY”
- Railroad Property is PRIVATE Property
- Railroad Police (Special Agents) are licensed federal marshals (complete w/ guns and badges!)...can arrest YOU!
- You can be arrested for criminal trespass!
- You most likely are not insured to work on railroad rights-of-way... (special risk area)
- OSHA/FRA can fine you \$10,000 +

Last Occurrence: Joliet, IL



APRIL 3, 2019

NO PROTECTION
NO SITUATIONAL
AWARENESS
NO PERMISSION
(TRESPASSER)
NO INSURANCE



THE SAD STATISTIC REMAINS
THAT AT LEAST ONE
SURVEYOR A YEAR IS KILLED
ON OR AROUND MOVING
TRAIN (AMTRAK)
COMPLACENCY KILLS AND
ANOTHER PRIVATE CROSSING
STATISTIC ON THE BOOKS

This was AMTRAK/UP
(SPCSL)/CN at a PRIVATE
CROSSING. USING A RAILROAD
R/W ROAD AS A SHORTCUT...



TO BE EXAMINED TODAY:

- Common Misconceptions & Blunders
- Basics of Railroad Survey Control
- Following in the Footsteps of The Railway Location Engineers (The ORIGINAL Surveyors)
- Evidence and Official Record
- Abandonment / Rails to Trails
- Federal Rule & Evidence



TO BE EXAMINED TODAY:

- Federal Laws & Regulations
- Reference Material and Where to Find It
- The ABANDONMENT Issue
- Right of Entry vs. Safety Regulation (49CFR214 On Track Safety)...Insurance Coverage
- Contact Sheet for Wisconsin Railroads



THE DIRTY DOZEN (COMMON ERRORS)

#1 Railroad curves (100 Ft Chord vs. Arc)

#2 IF in doubt, the Assessor's Map / GIS is WRONG!

#3 Slope Chaining ! (ICC GO-1 and ICC GO-4)

#4 Center of Track in mainline curve is NOT center of right-of-way, there is no such thing as parallel spirals and 3-point on curve solution is VERBOTEN!!!



Dirty Dozen (cont.)

#5 All railroad R/W's are strip conveyances, right?

#6 Pulling off a milepost (It's got legs!!)

#7 Misinterpreting Control Point

#8 Equations and scaled items (“sc.” and “pro”)



Dirty Dozen (cont.)

#9 Misinterpreting chaining and map calls

#10 T-Rails (Why was it set and where's the actual point?)

DEADLY BLUNDER: "I'm a surveyor and I don't need any permission to send my crews out on the tracks and besides: (1) the trains go slow here and I can always get a schedule"

My insurance will cover me while working on the railroad.....



OTHER CURRENT PET PEEVES

WHAT RAILROADERS SEE FROM THEIR SIDE OF THE FENCE (GUESSING GAMES)

- “EASEMENTS” (REMAINS A DIRTY WORD AROUND RAILROADERS)
- CONTRACTS (FAILURE TO DOCUMENT OR KEEP OR ASSIGN, TITLE COMPANY BLUNDERS – REPEATED IGNORANCE OF THE TITLE INDUSTRY)
- LABELING OF PLATS (CURRENT OWNER vs. TITLE COMPANIES OPINION)
- MISUNDERSTANDING OF WHAT FEDERAL GRANT RIGHT OF WAY (FGROW) IS
- MISUNDERSTANDING OF RAILS TO TRAILS STATUTE LAW (16USC1247d)
- UTILITIES CROSSING RAILROADS (RECKLESS, IN A HURRY, NOT THINKING, CHEAP)
- WHEN IS A ROAD CROSSING PUBLIC (LOCAL GOVERNMENT FAILS)
- ASS-U-ME-D R/W WIDTHS AND OWNERSHIP (+NARPO), FENCE LEMMINGS
- WALL STREET & THE PSR GANG (HUNTER HARRISON’S GHOST LEGACY)
- “BACKING-IN” UP AGAINST R/W’s, Curves & Spirals
- MONUMENTS SET IN TRACK OR TOO CLOSE (inside 25 feet or in foul zone)
- COUNTY ASSESSOR MAPPING/GIS DATA THAT WON’T LOOK BEYOND COURTHOUSE
 - IGNORING FEDERAL AND STATE RECORD
- RAILROADS HAVE COLOR OF TITLE TO THEIR LANDHOLDINGS AND CAN USUALLY BETTER DEFINE THEM THAN MOST ROAD AGENCIES AND CORRIDOR OWNERS. WHY DO SO MANY THINK ALL RAILROAD R/W’s ARE SOME FIXED WIDTH EASEMENT (ALMOST NEVER) THAT AUTOMATICALLY REVERTS AT ABANDONMENT? - THE FAIRY TALES, WIVES TALES, BAD GUESSES, ETC. HAS TO CEASE.... EXPENSIVE



**PLEASE AVOID THE
STUPID ZONES!**



STUPID ZONES



- New Roads and highways crossing railroad curves at grade... (Really bad assumptions happen here.)
- Vertical curves within 30 Ft. of the nearest rail at an at-grade crossing (+/- 3" Rule)
(AASHTO/AREMA JOINT STANDARD FOR GEOMETRY AT ROAD CROSSINGS – AREMA 5.8.6.3 or AASHTO GREEN BOOK / A Policy for Geometric Design of Highways and Streets; 2019 is the current version (#7))

STUPID ZONES

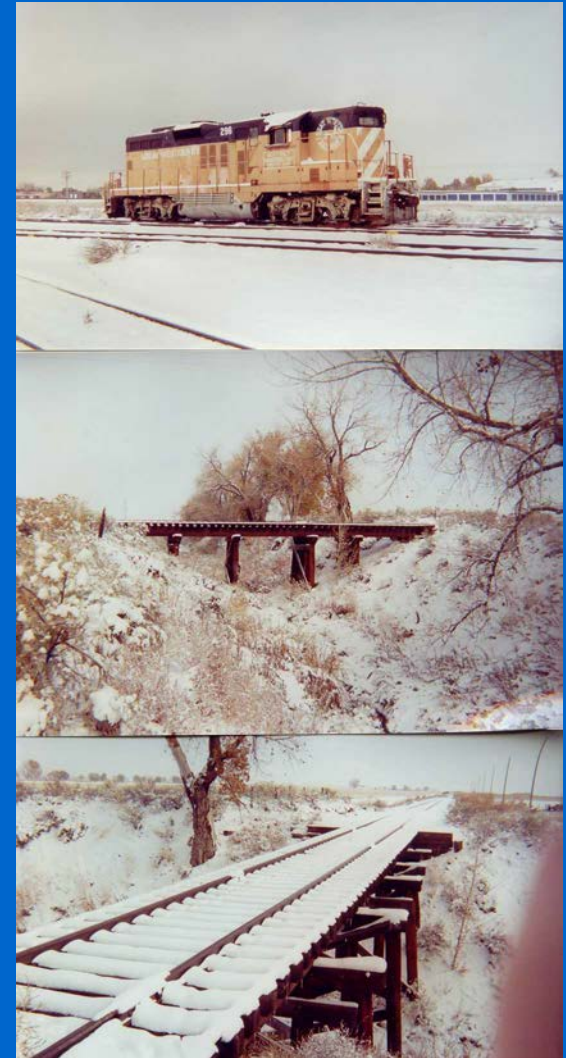
- “FOULING” the standard clearance envelope
- Utilities too shallow or too close to railroad switches, bridges and structures
- Creating sight distance problems (FRA & FHWA VISION DISTANCE RULE)



2. Basics of Railroad Survey Control

HIERARCHY (best to least)

- (1) T-Rails (called out in mapping)
- (2) Crossing frogs
- (3) Bridges & Tunnel Portals (including stone arches)
- (4) Pipes, Culverts & Treated Timber Boxes
- (5) Headblock / Point of Switch (Turnouts)
- (6) Centerline of road crossings
- (7) Signage
- (8) Map Calls to land lines (PRO & SC Standard Warning)



OK, Where am I on the RR?

Learn to communicate with the railroad in terms that they more readily understand

I'm interested in finding map data at:

State: _____ **WYOMING**

Region: _____ **Northern**

Division: _____ **Powder River**

Subdivision: _____ **CASPER LS-5**

Between: STATION and STATION : **Casper (202.2) & Bishop (213.0)**

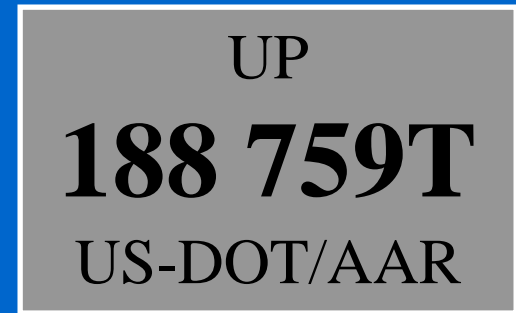
Between: Milepost and Milepost **MP 202 and MP (213)**

Near Crossing: (DOT Number) _____
064 978M (1st Street in Casper)



US-DOT/ AAR Crossing Numbering System

- Typical DOT number tag found attached to poles, cross-bucks, mast-mounted flashing lights/gate/bells, bridges and also stenciled on signal department instrument cases
- UP & BNSF Now include those numbers on the “Panic” signs found at all crossings (UP is 4” x 8” Blue & White, BNSF’s are 14” x 18” Black and White steel signs...
- Tags can be gray-metal license plates (4”x 9”) and/or 5”x9” laminated cardboard tag
- DOT Numbers are unique to a particular crossing in the USA, Number is a 6-digit number and a check code letter....Tag also shows track owner !



PANIC SIGNS LOOK LIKE:

- UNION PACIFIC



- BNSF



If All Else Fails, Before You Panic:

- THOSE EMERGENCY NUMBERS AGAIN (PANIC NUMBERS)
- UNION PACIFIC
 - 1-800-848-8715 Dispatcher
 - 1-800-877-7267 POLICE
- BNSF
 - 1-800-832-5452 Emergency
- CN-IC
 - 1-800-465-9239 Emergency
- CPR-Soo
 - 1-800-551-2553 Emergency
- WSOR
 - 1-414-438-8820 ext 223₂₄₋₇
- E&LS
 - 1-906-786-0693_{24-7 SWITCHBOARD}

D.O.T. TAGS & ENS SIGNS



ENS SIGN 49 CFR 234.309



ORIGINAL 1970's PLASTIC COATED PAPER TAG

- DOT Numbers are unique to a particular crossing in the USA, Number is a 6-digit number and a check code letter...Tag also shows track owner and are referenced as Public, Private, Pedestrian or Company Use
- DOT Number also shows up on signage for “panic” emergency number posted at EVERY public crossing (Blue ENS Sign)
ENS = Emergency Notification Sign
- www.fra.dot.gov (FRA safety homepage)
<https://safetydata.fra.dot.gov/OfficeofSafety/publicsite/crossing/crossing.aspx>
(Inventory of tag and location)

Information on New or Modified Crossings

The **ONLY** arbiter of what crossing is public or private in Wisconsin is the **WISCONSIN Office Of The Commissioner of Railroads (OCR)** under its application/ decision process.
Wisconsin Statutes Section 195.29

The **ONLY** agency that can permit placement of, change width of or dictate change type of crossing protection of a public crossing is the **WI Commissioner of Railroads(OCR)**

WiDOT-Intermodal now administers the DOT Crossing Number database for Wisconsin (Issues new numbers and does record corrections)



Heritage: Burlington Northern



- Burlington Northern, Inc. (1970-1996)
GN+NP+CB&Q+SP&S+SLSF
- Chicago Burlington & Quincy Railroad 1853
- Winona, Alma & Northern RR 1882-1883
- Chicago, Burlington & Northern RR 1883-1899
- Winona Bridge Company (Minn.)

- 1/1/96 all BNSF per merger



Canadian National / Illinois Central

- Illinois Central Gulf
- Chicago Madison & Northern (1886-1980)
- Wisconsin Central
- Duluth, Missabe & Iron Range



Heritage: UNION PACIFIC

- Chicago & Northwestern Railroad
- Chicago, St. Paul & Fond du Lac (1855)
- Chicago, St. Paul, Minneapolis & St. Paul
- Tomah & Lake St. Croix RR 4/1/1863
- Tomah & Chicago (NG* in SW Wisconsin)



Heritage: Chicago Milwaukee St. Paul & Pacific

- Milwaukee & Waukesha RR 1847
- La Crosse & Milwaukee RR 1858
- Milwaukee & St. Paul 1863
- Milwaukee & Prairie du Chien 1867
- Milwaukee & Mississippi 1850
- Milwaukee Road/ St. Paul Road 1920's
- 1977 Re-Organization (PCE removed)
- Soo Line purchases 2/85, Merges 1/86

CANADIAN PACIFIC

- Canadian Pacific/ Soo Line

- Duluth, South Shore & Atlantic Ry
- Mineral Range RR
- Wisconsin Central (1st, pre 1909 line)
- Minneapolis, St. Paul & Saulte Ste. Marie (Original soo Line)
- Duluth, Winnepeg & Pacific (Superior, WI)/ Grand Trunk 1909



SHORTLINES & INDUSTRIALS

- Wisconsin & Southern RR (MILW+ WI)
- Escanaba & Lake Superior RR (MILW)
- Iowa, Chicago & Eastern RR / Cedar American (CNW, MILW)
- Camp 5/ Laona & Northern Ry. (LN)
- MCRM Mid Continent Railway Museum
- Progressive Railway / Wisconsin Northern (PGR/CStPM&O)
- Tomahawk Railway (Marinette, Tomahawk & Western)
- METW - Municipality of East Troy (interurban)
- Wisconsin Great Northern (CNW/CStPM&O)
- Wisconsin Northern RR (WN) & Wisconsin Rapids RR (WIRR)
- **NO MORE:**
 - Wisconsin & Calumet (WICT - Back to state or WC)
 - Wisconsin Central (to CN-IC in 2001)
 - Green Bay & Western (Now mostly CN-IC)
 - Duluth, Missabe & Iron Range (To CN-IC in 2004)
 - Ahnapee & Western (Gone, some went to GBW for 6 years)
 - Chicago, Madison & Northern (WS Embargoed or Gone)



CURVE TAGS / SPIRAL PARTS

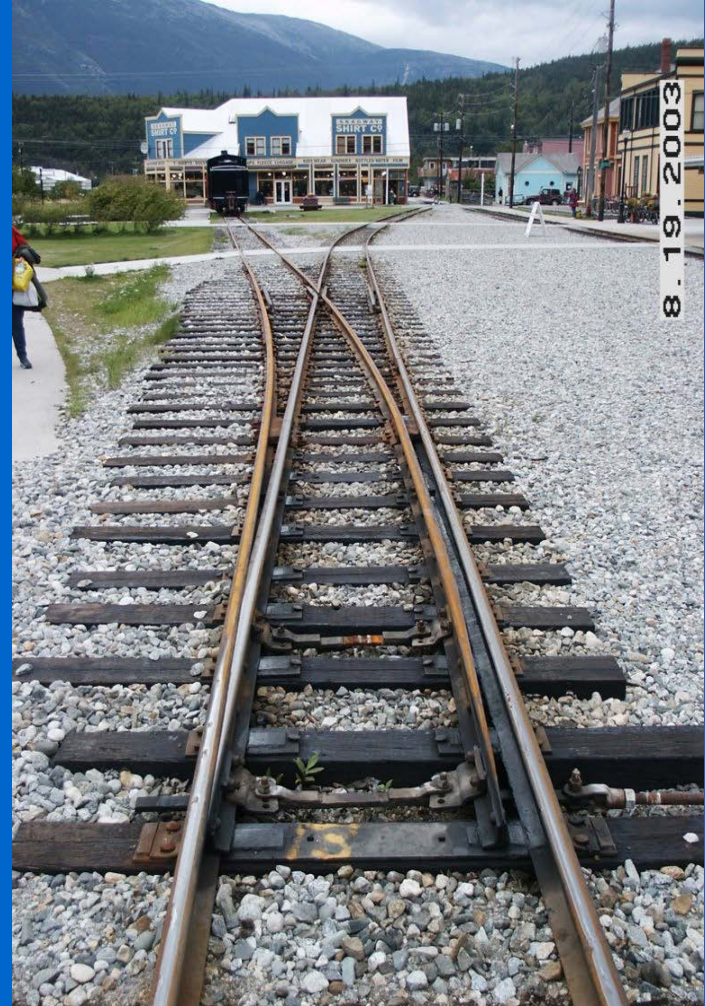


Track & Switch Geometry

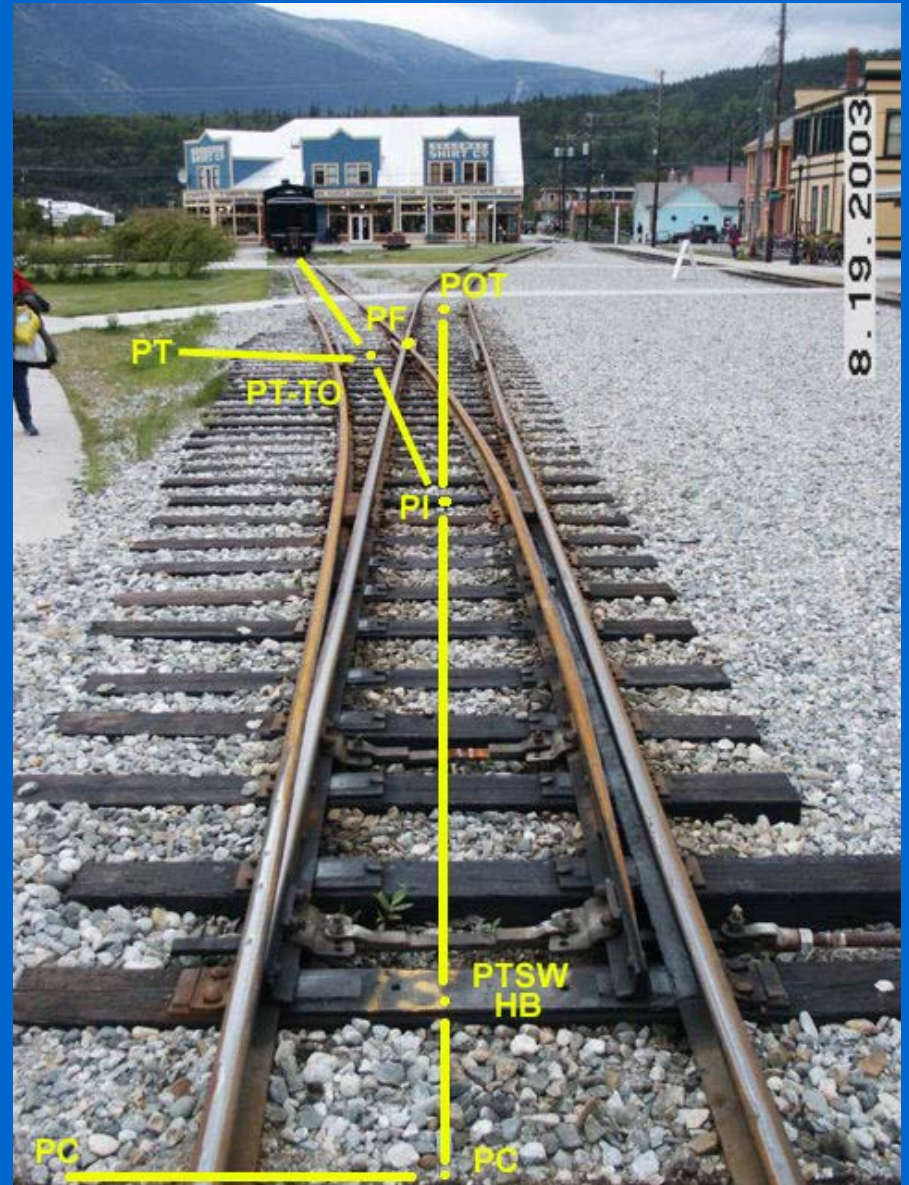
- Headblock, Point of Switch HB/Pt Sw
- Point of Frog (PF) =PT-TO
- Turnout Lead
- Size of Turnout (Unit Triangle = Frog #)
- Equivilent Curve vs Switch & Lead Curves
- Rail Size
- Crossing Frogs / DIAMONDS



WHEN LOOKING AT THIS



THINK LIKE THIS!



Narrow Gauge In Wisconsin

Robbins Railroad (Last Common Carrier NG in the Midwest-1941)

Chicago & Tomah Railroad CNW

Fond du Lac, Amboy & Peoria Railroad MILW*

Galena & Southern Wisconsin Railroad CNW

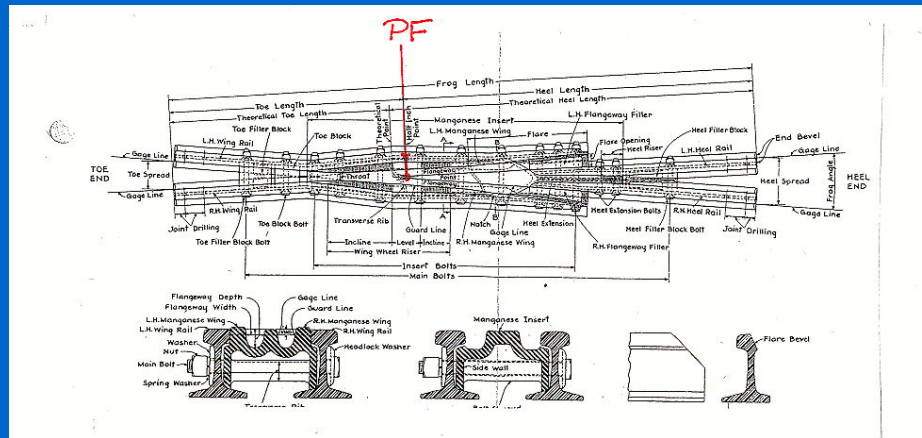
Pine River Valley & Stevens Point Railroad MILW*

Milwaukee & Madison RR CNW

Wisconsin & Michigan RR CNW

Wisconsin Peninsula RR (Door County, Never Completed)

BASIC TURNOUT GEOMETRY



- SIMPLE CURVES, CHORD DEFINITION (Not Arc, What's Radius good for?)
- The typical boundary surveyor need only be concerned with HB (PtSw), PF, measured lead, frog angle, frog size & description, degree of equivalent curve, switch point length and weight of rail. (This is what you need to communicate to the railroad with!)
- If elevation is important, please note end of long switch ties! (Defines plane)

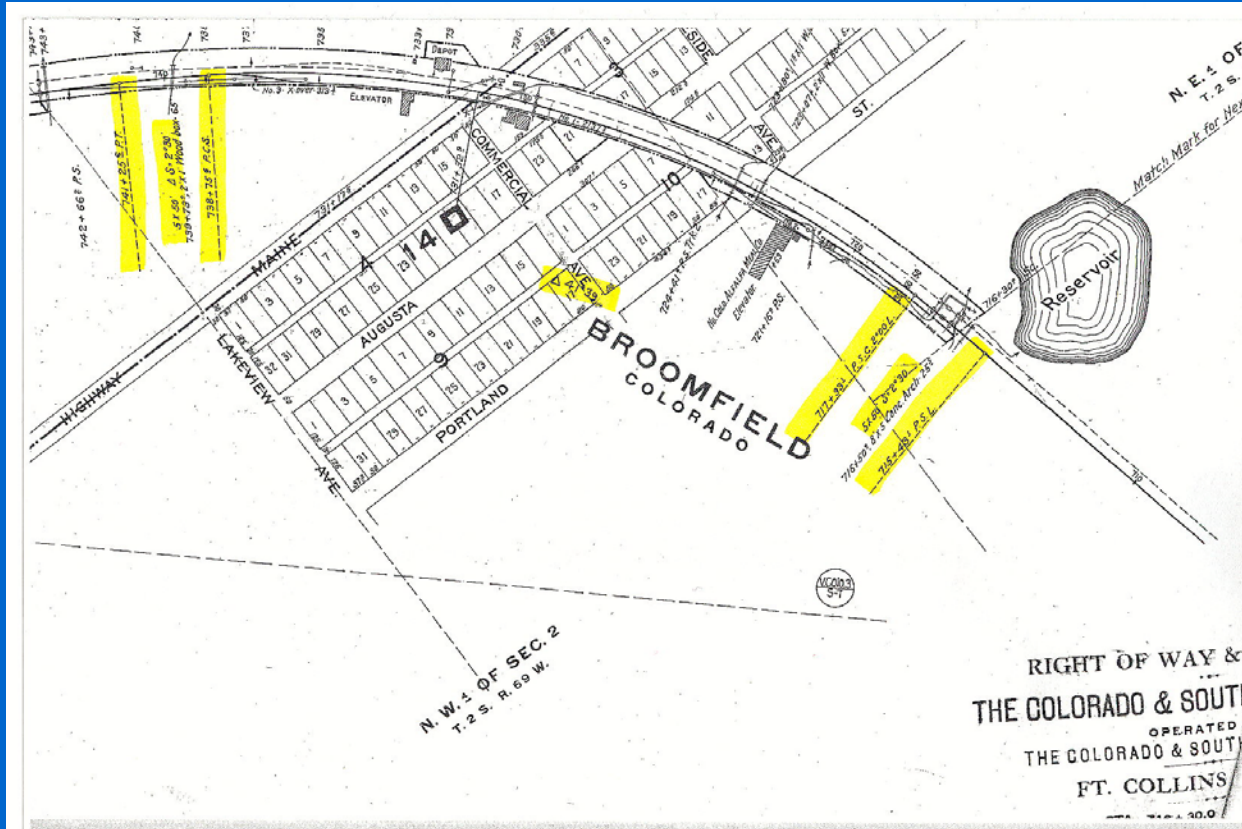
MORE TO FOLLOW IN PART 4

POP QUIZ:

- What goes on here?



SEARLES SPIRAL NOTATION



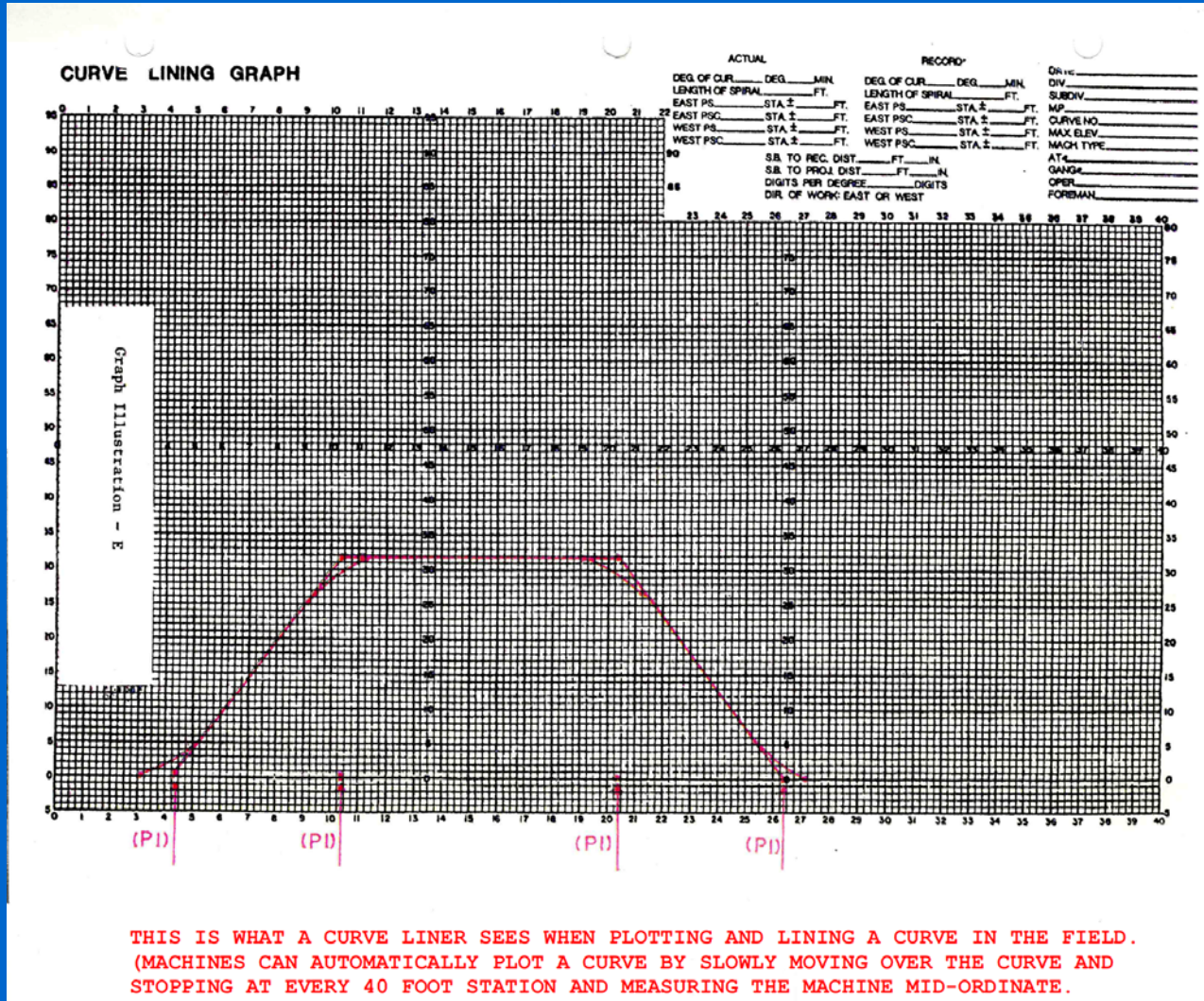
- Curve in the field is anything BUT the curve on the map (USE 3-Point On A Curve Solution and be prepared to dance with the devil in survey hell!)
- Searles vs. Arema/ AREA 10-Chord Spiral
- The track may show spiral data on the map, but the right-of-way is most likely NOT spiralled (99% of the time)...Look for the original intent!

STRING LINE SOLUTION AND MACHINE CURVES

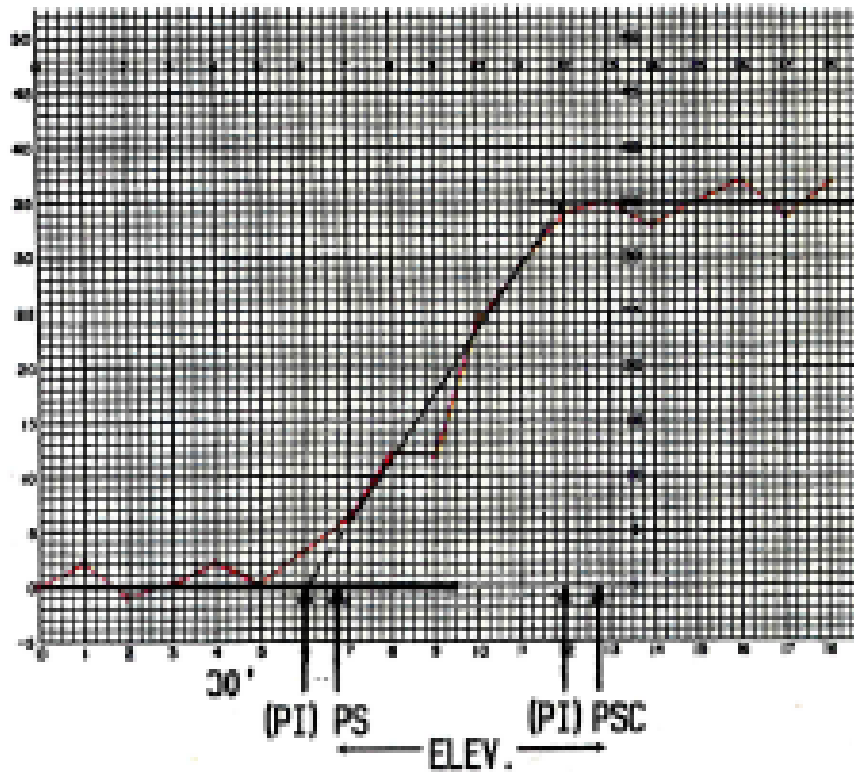
- Stringline solution and machine graphed curves smooth the curve given existing track conditions...
- These curves are not engineering or survey correct.
- Over time, curves tend to get elongated, have doglegs at the ends & main body of curve gets pulled to inside of cut/fill



TYPICAL OF CURVE LINERS



CURVE LINERS (TYPICAL)



SPIRAL PARTS SHOWN

ALL YOU CALCULUS FANS: THIS IS A PLOT OF THE SECOND DERIVATIVE OF A SPIRAL CURVE EQUATION. YOU ARE A CONSTANT RATE OF CHANGE (SINGLE CURVE), NO CHANGE (TANGENT) and VARIABLE CHANGE (SPIRAL / CUBIC PARABOLA AS APPLIED TO THE MAIN TRACK CURVE...THE MACHINE CANNOT GO FROM TANGENT TO CURVE DIRECTLY!

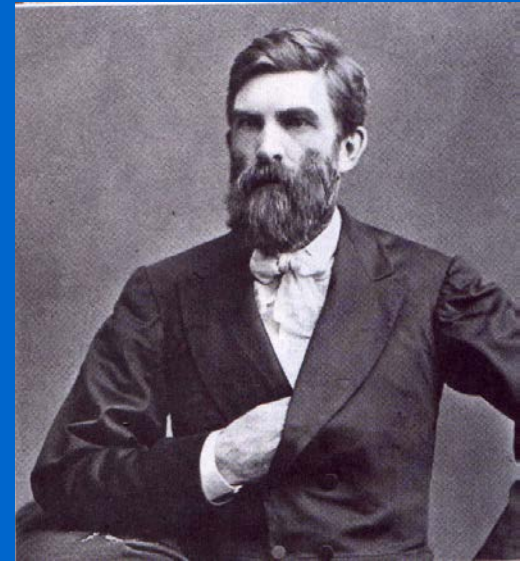
The Original Surveyors

- Most were trained by the U.S. Military
- Vernier Transits, Wye Levels, Chains, Books, tables and slide rules (walk a mile in the shoes of these folks!)
- Many were also GLO Deputy Surveyors.



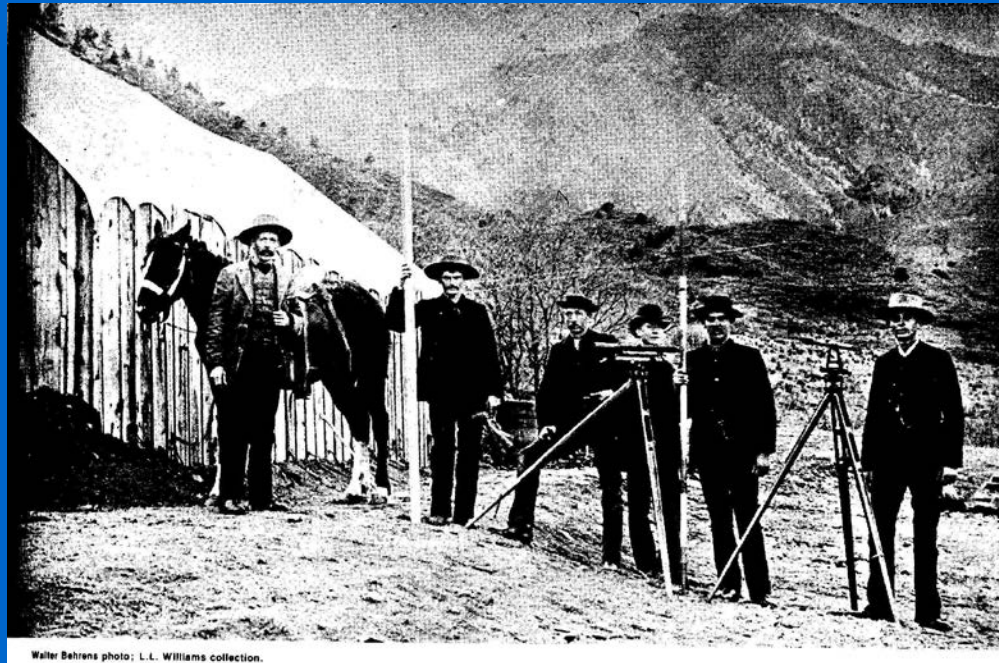
UNION PACIFIC SURVEYORS /LOCATING ENGINEERS

- General Grenville Dodge
- James Evans
- Robert Blickensderfer
- Samuel B. Reed
- L.L. Hill (Arapaho Indians 6-18-1867)
- Percy Brown (Sioux Indians 7-8-1867)
- J. M. Eddy



The Railroad Surveyors

- Union Pacific/Kansas Pacific/ Denver Pacific/ LHP&P
- Colorado & Wyoming (CF&I)
- Chicago & Northwestern / F&MV
- CB&Q
- Milwaukee Road



Walter Behrens photo; L.L. Williams collection.

Evidence and Official Record

- Looking Beyond The Courthouse
- Surveyors collect, examine & evaluate “EVIDENCE”, they are not “Judge and Jury” (Even though at times we ought to be)
- The assessors map is “a best guess estimate” - It should not be gospel !
- Official record does not automatically imply that it will be found in the local courthouse!

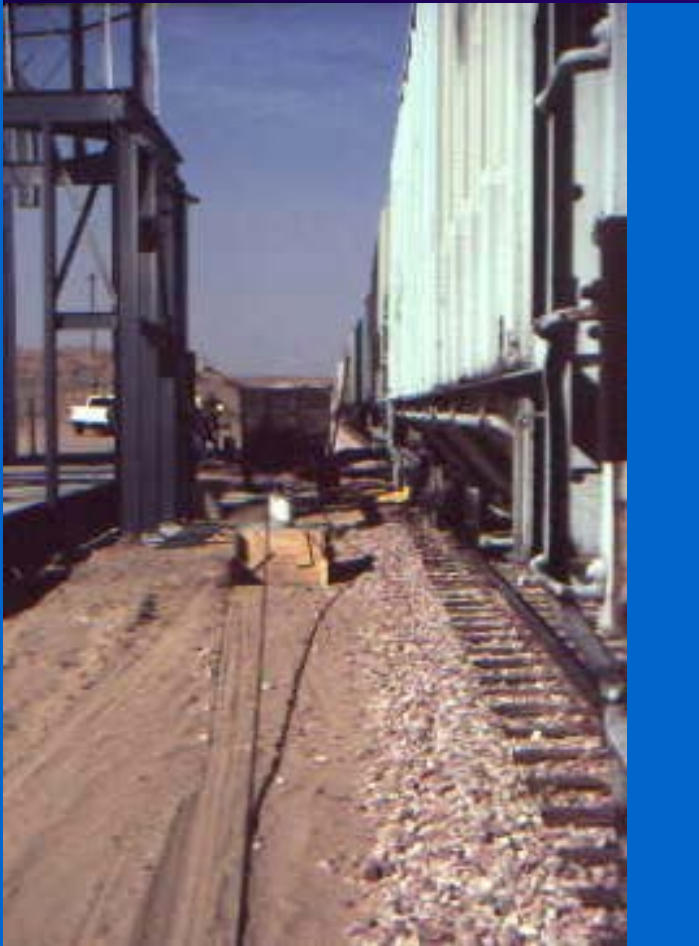
5. Federal Laws and Regulations



- Acts of 1862, 1866, 1872, 1875
- Interstate Commerce Act of 1913 (hint: Valuation Maps)
- Staggers Act of 1983
- ICCTEA, NexTEA and TEA-21 transportation Acts
- Titles 16, 43 and 49 of the Federal Revised codes (CFR's)

WILL IT FIT?





Can you see what scares the daylights out of a trained railroad observer when he/she encounters something like this?

Intermodal *n.*



ON TO PART 2