VLA Test Memo # 214

Holland Company Track Survey
Gauge Restraint Measurement System (GRMS)
February 2, 1998

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Contents

Abstract/Overview

On February 2, 1998 the Holland Company inspected the VLA track system. They used a High Rail Track Vehicle equipped with a prototype Gauge Restraint Measurement System (GRMS) which operates on standard gauge track. The GRMS equipment provides a non-destructive method for checking track gauge strength. To avoid causing any damage to an existing track system applied loads are based on an index, Projected Loaded Gage (PLG), developed through research. Using the test load data for loaded and unloaded gauge the PLG index is used to project (extrapolate) track gauge at severe loads.

With the information gathered from a survey a Tie Planning Report is generated. Included in a typical report is a strip chart reading of the track by tenths of a mile, listing and locating exceptions which exceed preset threshold limits and a Tie Planning Report prioritizing which areas to work on first. In addition we asked for a foot by foot readout of our track system. The data were converted into Excel files so we could review areas more closely.

VLA Track Class

The Federal Railroad Administration (FRA) publishes minimum guidelines for construction and maintenance of track. The FRA maintains guidelines for six classes of track Class 1 being 10mph and below and Class 6 for high speed. NRAO construction drawings correspond more closely to threshold limits established for a Class 6 track (high speed) while our speeds are less than 5mph. The NRAO Construction Specification draws heavily from the American Railroad Engineering Association (AREA) standards.

FRA thresholds are as follows:

	Class 1	Class 6	NRAO Construction Spec.	
Unloaded Gage Wide	1.500"	.750"	To Gage 4'-8-1/2" (<.250")	
Unloaded Gage Tight	.500"	.500"	To Gage 4'-8-1/2" (<.250")	
Cross Level Max.	3.000"	.500"	<.250" individual track	
			<.500" track to track	Industry

Guidelines using GRMS are as follows:

	Class 1	Class 6	
Loaded Gage Wide	1.800"	.900"	--
Projected Loaded gage	2.250"	1.125"	--
Delta Gage	.900"	.250"	--

The FRA guidelines allow for some variation while the NRAO Specification holds a tighter tolerance. Eventually the FRA may incorporate GRMS testing into their standards.

GRMS Equipment

(References Attached: 1) Donald E. Gray and Daniel Stone, Nondestructive Evaluation of Aging Railroads, The International Society for Optical Engineering (SPIE), Oakland, California, June 1995. 2) A.B. Perlman, P. Tong, A. Kish, M. Coltman, and D.P.McConnell, Structural

Characterization of rail strength capacity for track gage widening, Rail International, April 1986.)
The GRMS equipment was developed by the Federal Railway Administration (FRA) in co-operation with the Railroad Industry. Its purpose is to measure a tracks ability to support gage widening forces marking locations where there is a risk for derailment.

Rail gage is maintained by ties and fasteners. The loads applied by a track vehicle or train are distributed through the rail and ties to the track foundation. When the holding capacity of the ties and fasteners are exceeded the rails tend to spread eventually causing a derailment.

The intent is to develop a performance based evaluation of a track structure. GRMS allows a more objective approach. This non-destructive evaluation is based on an index, projected loaded gage (PLG). PLG was developed to extrapolate the response of a track to heavy loads based on gage measurements at lighter loads. Test loads have been designed to locate weak track without damaging the track.

Inspection/Survey
The inspection of the VLA's track system took two days to complete. Holland Company started on 2/2/98 and finished on 2/3/98.

Work progressed as follows: DE1 inside track to AE9 inside.
AE9 outside track to DE1 outside.
DW1 outside track to AW9 outside.
AW9 inside track to DW1 inside.
DN2 inside track to AN9 inside.
AN9 outside track to DN2 outside.

Before starting the on board equipment were calibrated. The datum for track gage was set at approximately 56-1/2". The Software allowed for continuous collection of the data as the vehicle proceeded along the track. From the data strip chart recordings of unloaded gauge, loaded gauge and delta gauge (calculated) were generated. Based on plus or minus (+/-) threshold limits, exceptions reports were also generated. Locations exceeding the threshold limits were marked with paint. A threshold limit of +/-.5" (a range of 56"- 57") was set initially. We monitored the spray painting of track over the first mile and quickly realized that +/-.5" was too tight a threshold. We were spraying much of the track so we increased the limit to +/-.75" and held this threshold level throughout the system.

Some minor concerns with Hollands' equipment: 1) Spray painting was hindered by brush in between the rail. We had to reset the spray nozzle many times. 2) Elevation differences at the rail joints caused the load axle to derail (3) times. There was no apparent damage caused. 3) Mile markers and other location information had to be manually entered. Although minimal there was a real time lag when spray painting and entering track identification symbols. When symbols were entered incorrectly they could not be edited. 4) Holland is still in the development stages with their software. 5) A review of the foot by foot data compared to the Tie Planning

Report indicate some discrepancies in the number of clusters found especially on the East Arm Inside. This is being reviewed with Holland. 6) The software does not allow for easy manipulation of data. In order to accomplish this the Holland contact had to transfer all data to an Excel file.

Results of Inspection

The Report provides a Tie Statistics Sheet and a Tie Planning Sheet. The Tie Statistics sheets lists the total number of ties exceeding a threshold limit as compared to the total number of ties in the section of track. The Tie Planning sheets lists ties in four categories establishing a priority sequence. Using three threshold levels a listing of Safety Ties, Priority Ties and Warning Ties are generated. An additional list of Tie Clusters is also supplied. A tie cluster is any grouping of more than 5 ties exceeding the threshold limit. The tie planning reports are also accompanied with an exceptions list locating all areas exceeding the threshold.

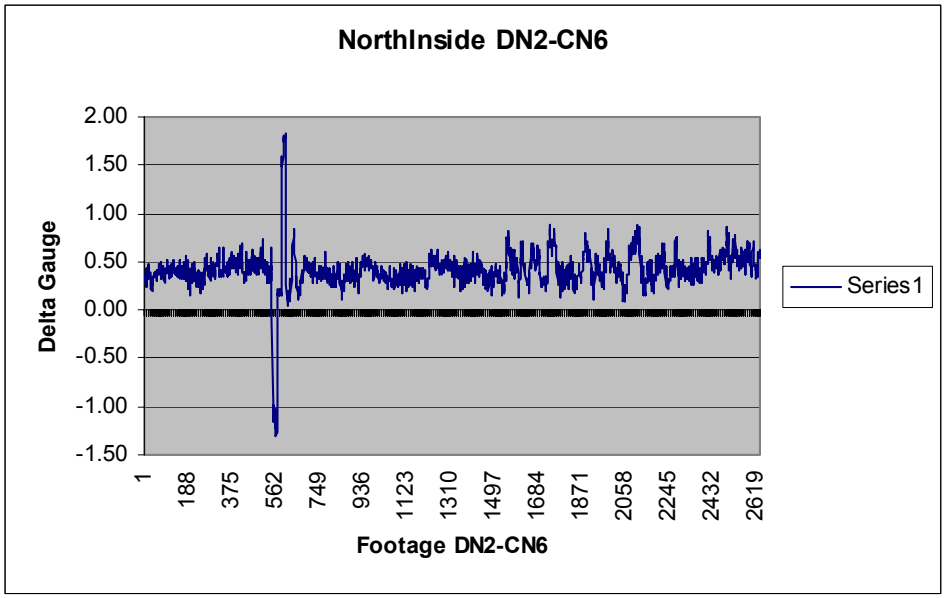
The Tie Planning Report provided by Holland projects bad ties with a delta gauge of .5" or greater and .75" or greater. Delta is the difference between the Loaded and Unloaded axles.

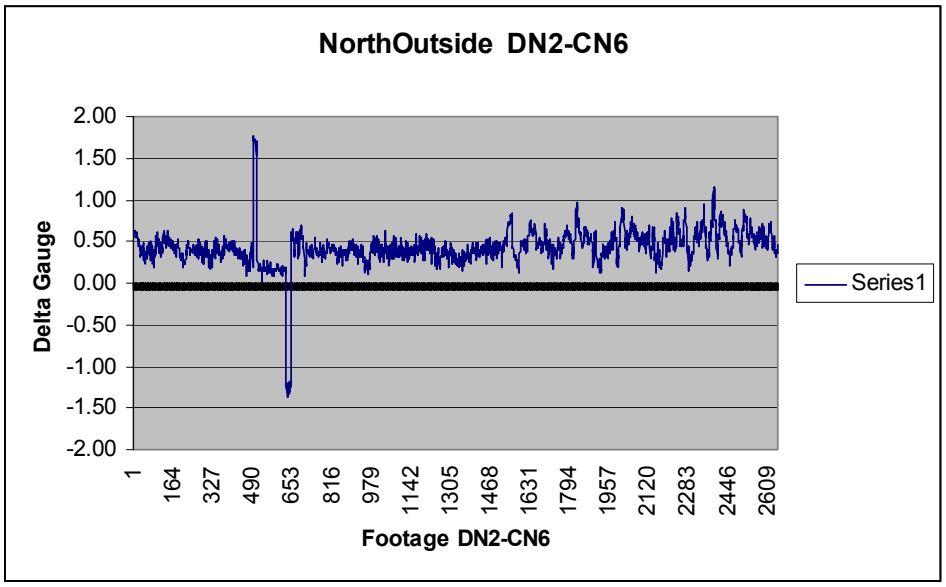
	Delta>.5	Delta >.75	Delta >.90
West Arm Inside Track	5542	421	34
West Arm Outside Track	6280	691	47
East Arm Inside Track	9618	642	81
East Arm Outside Track	9543	891	71
North Arm Inside Track	10145	785	43
North Arm Outside Track	10957	945	200

Using the excel files a separate clusters report was generated in-house. This report will be used along with the Holland report to identify and repair bad areas. The in-house report identifies three or more consecutive bad ties where Holland's report only indicates groupings of 5 or more bad ties.

Some areas of track had been leveled and tamped prior to the Holland survey. One area leveled was DN2 to CN6 on the North Arm. When the delta results are graphed (shown page 4) for this area the track leveled and tamped is seen to be consistently within tolerance (<.75") where adjacent track is out of tolerance (@Approx. 1600'). The large spike at about 500 feet is the load axle being disengaged at a switch.

NORTH ARM DELTA GAUGE PLOT DN2-CN6





HOLLAND TIE PLANNING SHEETS

CLUSTERS 0F 5 OR MORE

Holland Company
Februaury 1998

REFERENCES

1) Donald E. Gray and Daniel Stone, Nondestructive Evaluation of Aging Railroads, The International Society for Optical Engineering (SPIE), Oakland, California, June 1995.
2) A.B. Perlman, P. Tong, A. Kish, M. Coltman, and D.P.McConnell, Structural Characterization of rail strength capacity for track gage widening, Rail International, April 1986.)

TIE CLUSTERS 3 OR MORE

IN-HOUSE COMPILATION

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September 1998

Note! Clusters are blocked.
Hatched blocks are non clusters.
Load axle was dis-engaged in these areas.