Kansas Local Bridge Rating Program

AD ASTRA PER ASPERA
Kansas
Department of Transportation

GBA

TranSystems

Presentation Outline

- Past and Present Requirements Leading to KLBRP
  - KDOT Project Manager – Colby Farlow, P.E.
- Program Details
  - Consultant Team Project Manager – Scott Moeder, P.E.
- Load Rating Local Bridges using BrR
  - Load Rating Engineer – Derek Harth, P.E., S.E.
  - Load Rating Engineer – Clark Volker, P.E.

HOW DID WE GET HERE???

BRIDGE COLLAPSES

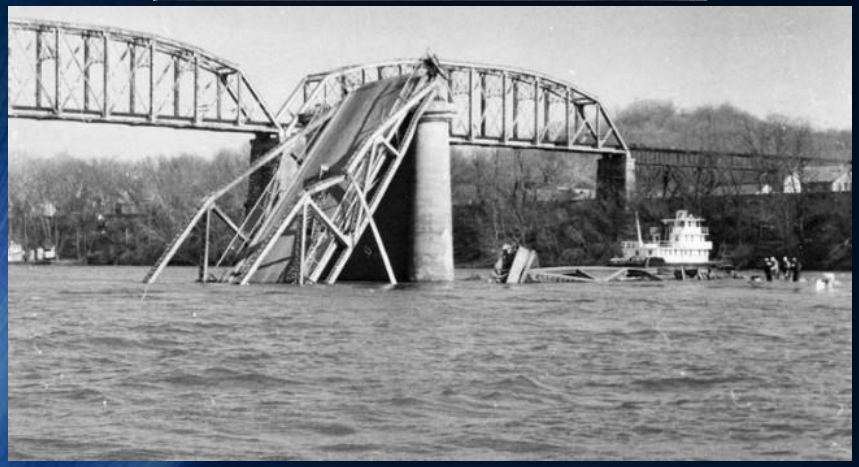
INVESTIGATIONS

FINDINGS

LAWMAKERS ATTEMPTING TO ENACT LEGISLATION OR REGULATIONS TO PREVENT IT FROM HAPPENING AGAIN

Local Bridge Rating

SILVER BRIDGE OVER THE OHIO RIVER- OH/WV



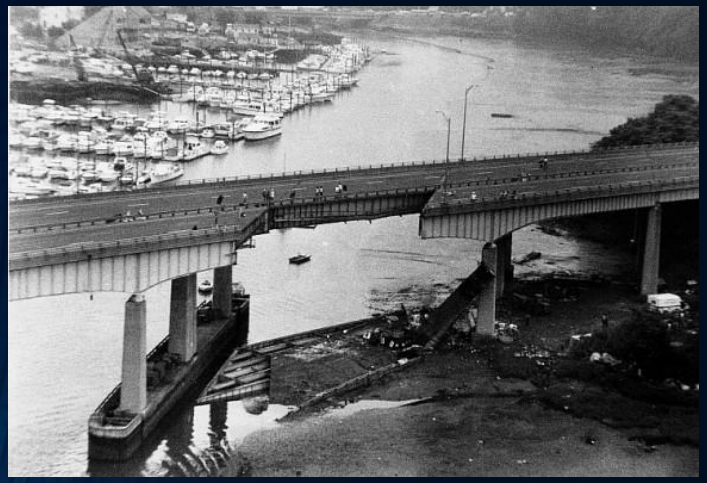
Built 1928, Collapsed December 1967

RESULTED IN.....

- NATIONAL BRIDGE INSPECTION STANDARDS (NBIS)

  - National Bridge Inventory (NBI)
  - Biennial Inspections
  - Inspector Qualifications
  - Data Reporting Requirements

I-95 OVER MIANUS RIVER BRIDGE - CT

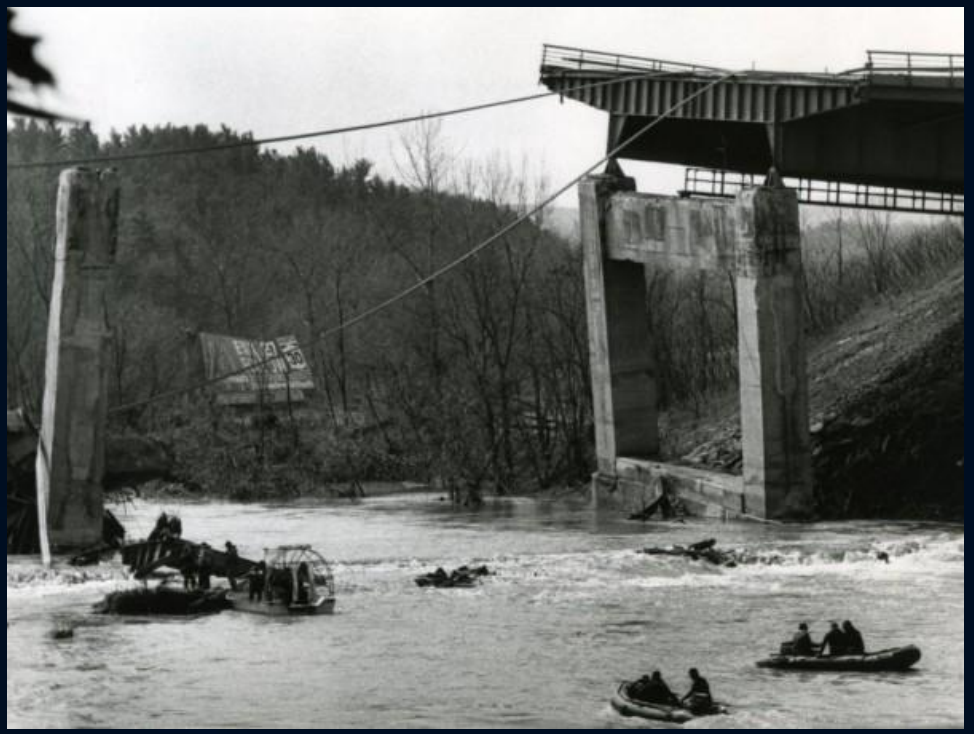


Built 1958, Collapsed June 1983

RESULTED IN.....

- FRACTURE CRITICAL INSPECTION REQUIREMENTS
  - Visual “HANDS ON” /“ARMS LENGTH” Inspection Every 2 Years
  - Pin and Hanger Inspections Non-Destructive Testing (NDT) Methods Improved

NYS THRUWAY OVER SCHOHARIE CREEK BRIDGE-NY

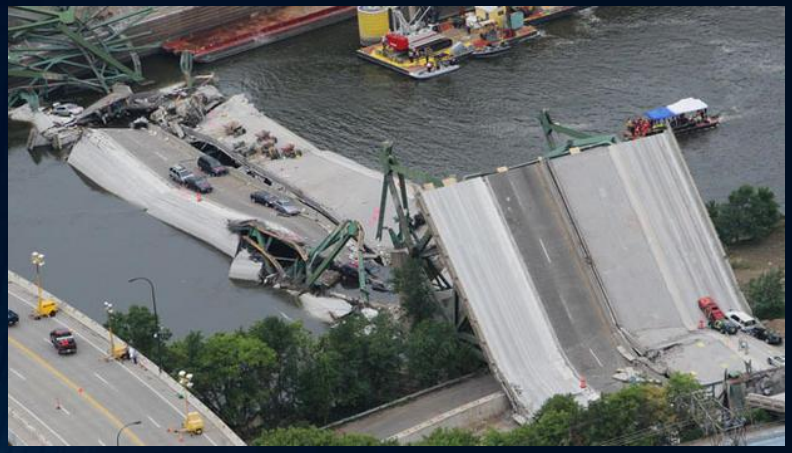


Built 1954, Collapsed April 1987

RESULTED IN……

- IMPROVED HYDRAULIC AND SCOUR EVALUATIONS
  - Evaluating Scour at Bridges (HEC-18)
  - Stream Stability at Highway Structures (HEC-23)
  - Need for Underwater Inspections

I-35 OVER THE MISSISSIPPI RIVER - MN



Built 1967, Collapsed August 2007

RESULTED IN……

- STATE BY STATE AUDIT BY THE FHWA
- FOR KANSAS…..
  - State System – Minimal List of Items
  - Local System – Bullet Point List of Required Improvements for Compliance with the NBIS
  - Plan of Action Submitted by KDOT BLP
    - Standardization of Bridge Inspection Program
    - Standard Bridge Inspection Scopes of Services
    - Manuals
    - Inspector Requirements
    - Inspection Data Entry
    - Need for Statewide Programs

KANSAS LOCAL BRIDGE EVALUATION PROGRAM (KLBEP)

- 5 (+) YEARS / $21.4 MILLION 2010-2015
- 6 (+) CONSULTANTS INVOLVED/CONTACT WITH LOCAL OWNERS
- IDENTIFY ALL SCOUR SUSCEPTIBLE BRIDGES
  - Evaluate scour vulnerability
  - Prepare scour plan of actions where necessary
- IDENTIFY ALL FRACTURE CRITICAL BRIDGES (Aprox. 550 Bridges)
  - Perform first fracture critical inspection
  - Load rate bridges where deemed necessary

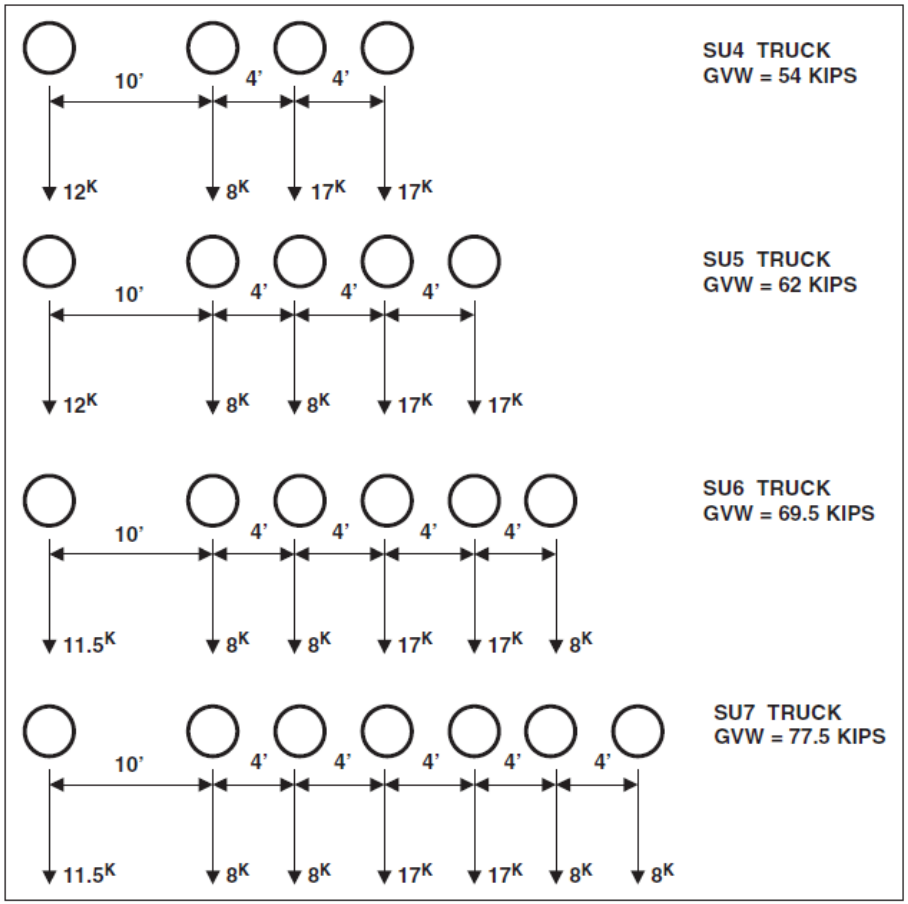
KANSAS LOCAL BRIDGE RATING PROGRAM (KLBRP):

- 10 Year Program ($5 Million/year) 2015-2024
- 7 Consultants Involved
- Load Rate all remaining local structures (about 19,000)
- Next step to meet current regulations
- Updates local system for changes to Legal Loads
- Delivers a valid, legal load rating for every local structure

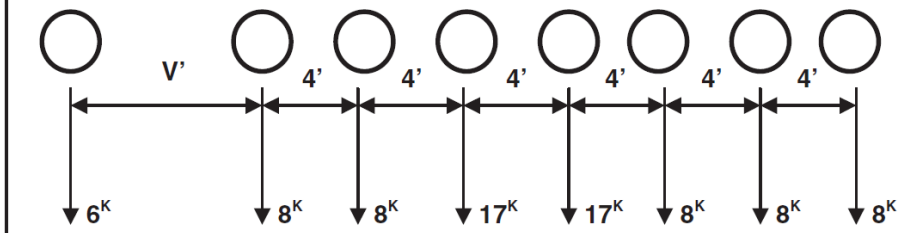
Previous Load Ratings Projects (1990s)

- Very few included Special Haul Vehicles
- No consistency from consultant to consultant
  - Assumptions
  - Load Rating Methods
  - Stamped/Sealed by P.E.
  - Reporting methods
  - Not all counties/bridge owners took advantage of the program
  - No ability to easily modify load ratings
  - Structures w/o plans – some ultra-conservative; others less so

Unfunded Mandates – The SHVs



NRL – Notional Rating Load



V = VARIABLE DRIVE AXLE SPACING — 6'0" TO 14'-0". SPACING TO BE USED IS THAT WHICH PRODUCES MAXIMUM LOAD EFFECTS.

AXLES THAT DO NOT CONTRIBUTE TO THE MAXIMUM LOAD EFFECT UNDER CONSIDERATION SHALL BE NEGLECTED.

MAXIMUM GVW = 80 KIPS

AXLE GAGE WIDTH = 6'-0"

Figure 25. NRL for single-unit SHVs that meet Formula B requirements.

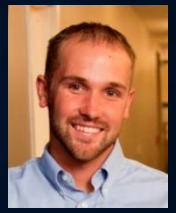
Applicable on all bridges unless explicitly excluded by State Law…Kansas Laws do not exclude SHVs.

KLBRP -STATEWIDE CONTRACT

- Transystems ratings program team leader

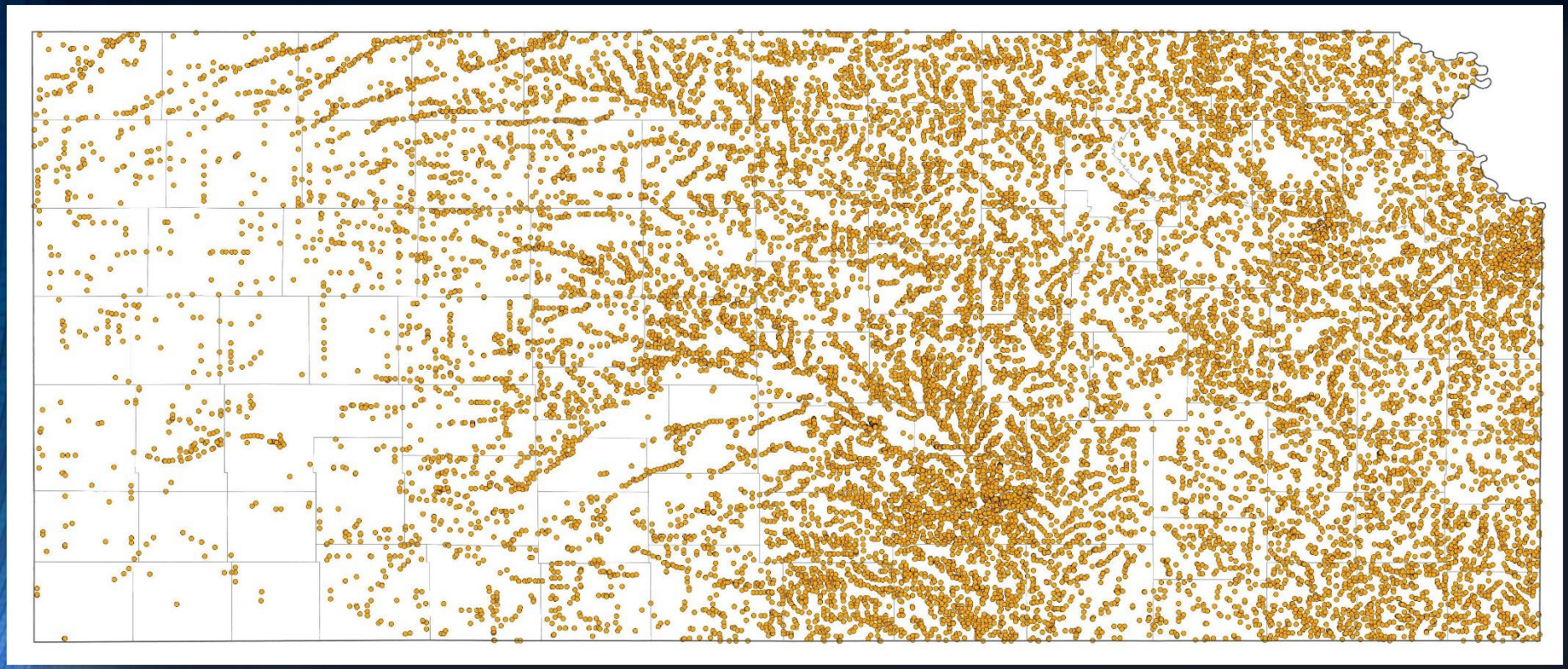
Lindsay Madsen 

- George Butler & Associates ratings program team leader

Scott Moeder 

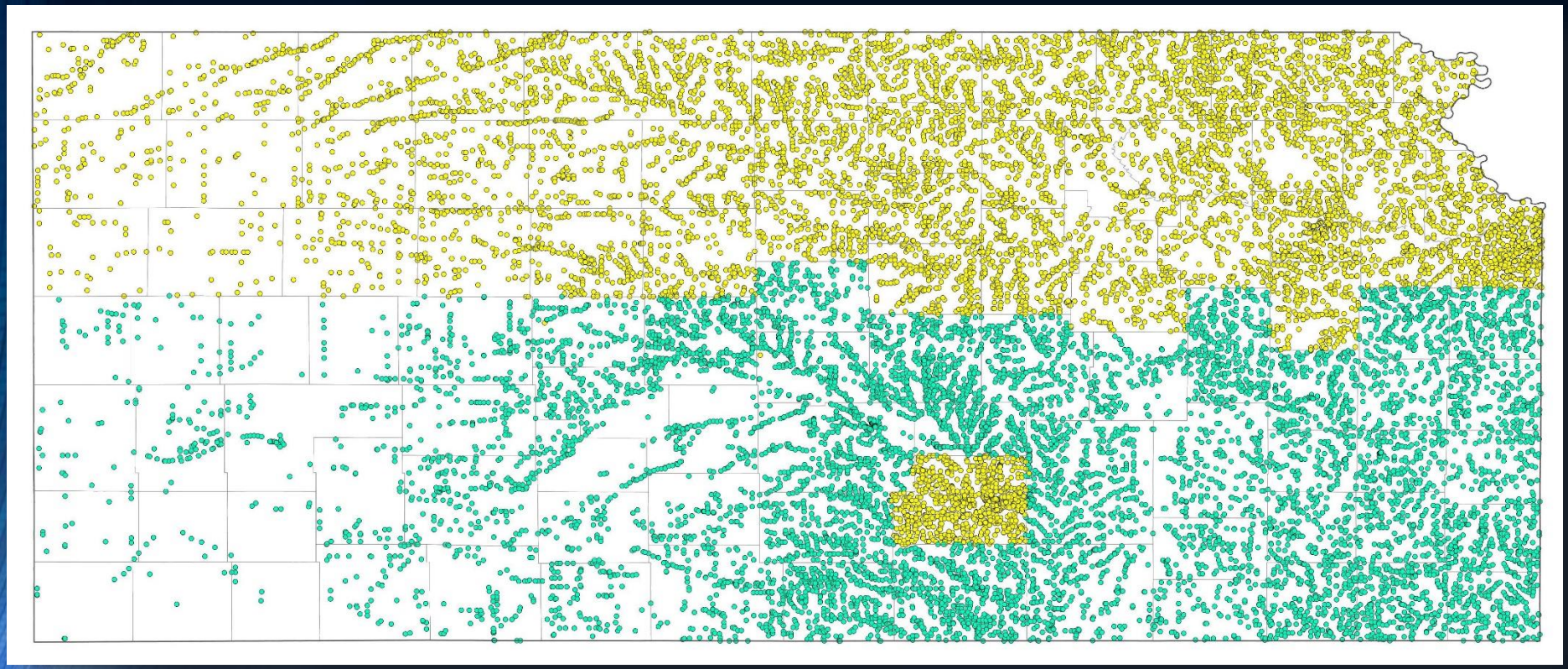
Local Bridge Rating

~19,000 Off-System Bridges Statewide



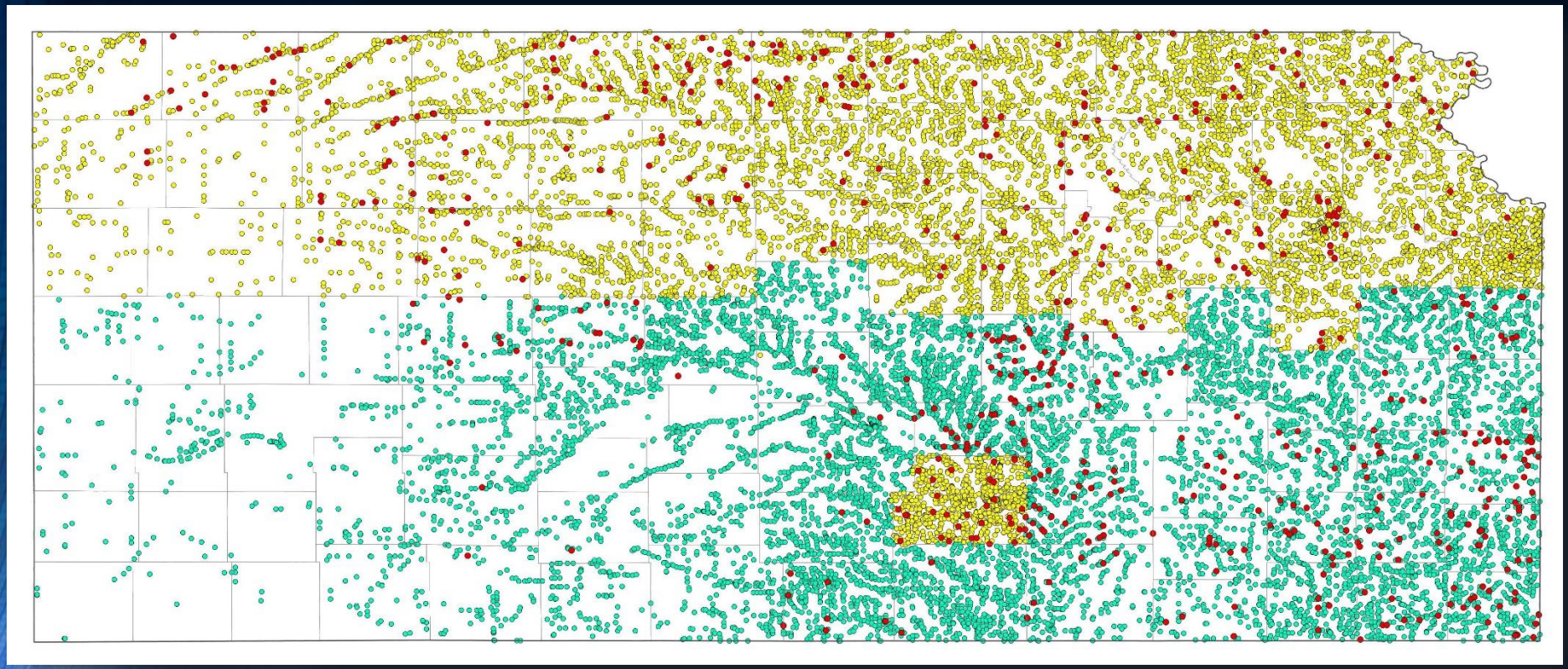
Local Bridge Rating

Two Teams



Local Bridge Rating

Completed During the 1st Year



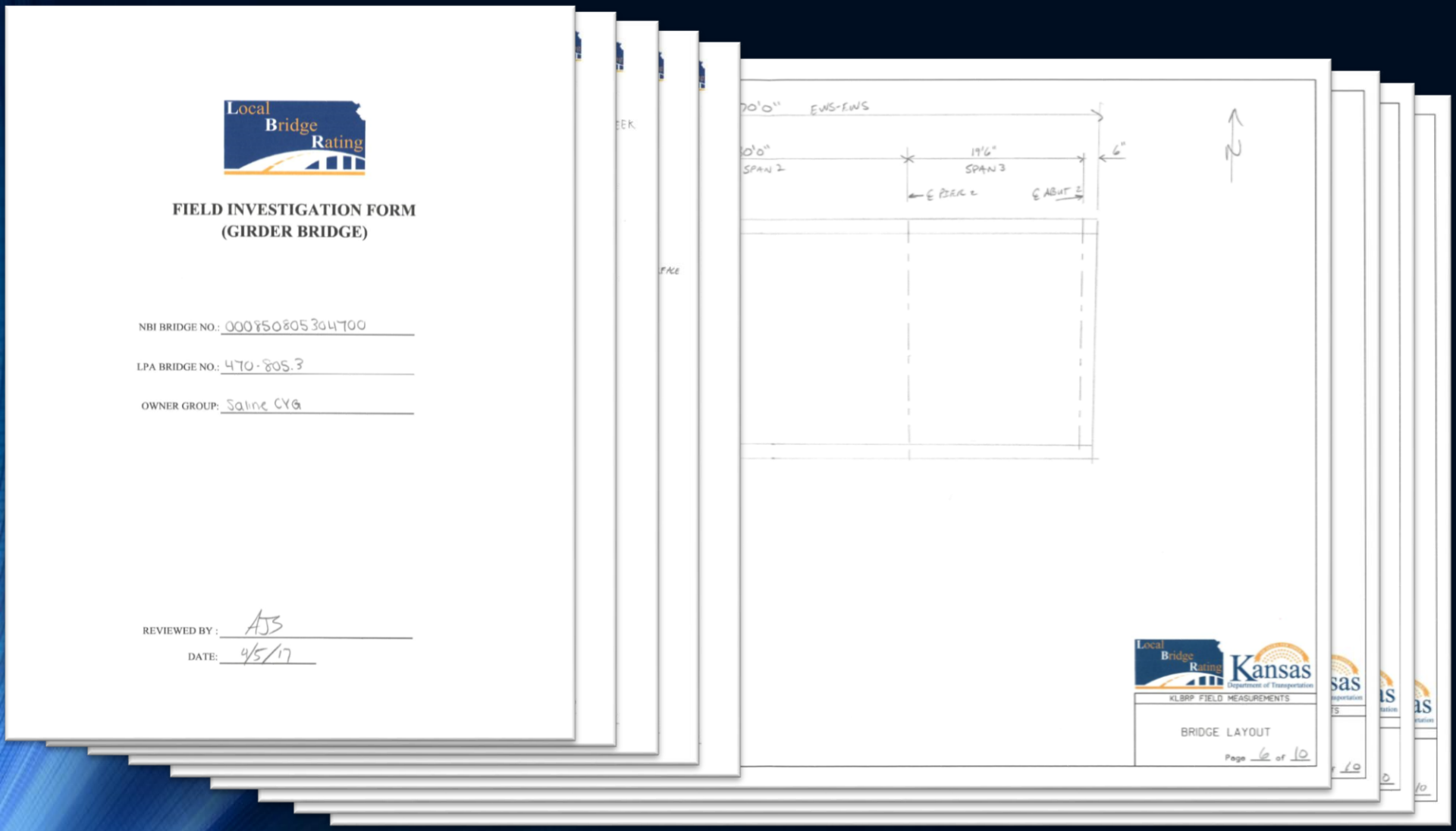
PLAN OF ATTACK

- Step 1 – Data Gathering
- Step 2 – Field Investigation
- Step 3 – Load Rating

Data Gathering

Data Gathering

Field Investigation



Load Rating

Load Rating Summary Sheet for Local Bridges

NBI Bridge # :	000700969905060	County: Osage	Inspection Key :	XDHQ	ADT : 45
LPA Bridge ID :	164	Owner: County	Year Built :	1925	ADTT : 1
Route Carried :	W 309TH ST over Unnamed Stream		Year Reconst. :	N/A	f'_c : 2.5 ksi
			Design Load :	Unknown	f_y : 30.0 ksi

NBI Item 43: 302 SBMS — Structure Type: Steel Beam, Simple

Rating Information Provided : ☐ Plans ☑ Field Measurements ☐ Testing ☐ No Information Exists

Load Rating Manuals:

LFR/ASR Version : 2002 AASHTO Std. Specs
LRFR Version : 2014(2016 Interims) AASHTO
MBE Version : MBE 2nd Edition (2016 Interims)

General Load Rating Information:

Overburden Type : Gravel
Overburden (in.) : 3.0
Overlay Type : None
Overlay (in.) : 0.0
Culvert Fill Height (ft.) : N/A

Condition Ratings:

Deck: 6
Superstructure: 6
Substructure: 6
Culvert: N
Channel: 6

Method Used: LFR — LFR or ASR — LRFR

A_1 : 1.3
$A_{2\,INV}$: 2.17 — RF_{INV} — Ton_{INV}
$A_{2\,OP}$: 1.3 — RF_{OP} — Ton_{OP}

$\gamma_{LL\,INV}$: 1.75 — γ_L : 1
$\gamma_{LL\,OP}$: 1.35 — γ_S : 1

	Truck	Tons	RF_{INV}	Ton_{INV}	RF_{OP}	Ton_{OP}
Design	HL-93	---	-------	-------	-------	-------
	HS20-44	36	0.33	11.9	0.56	20.0
AASHTO Load Rating	T3	25	0.40	10.0	0.67	16.8
	T3S2	36	0.41	14.6	0.68	24.4
	T3-3	40	0.49	19.5	0.82	32.6
	SU4	27	0.34	9.0	0.56	15.0
	SU5	31	0.31	9.4	0.51	15.8
	SU6	34.75	0.28	9.7	0.47	16.2
	SU7	38.75	0.27	10.5	0.46	17.6
	NRL	40	0.26	10.5	0.44	17.6

	RF_{INV}	Ton_{INV}	RF_{OP}	Ton_{OP}
HL-93	0.33	11.9	0.40	14.4
	γ_{LL}		γ_S	
T3	1.3	9.6	0.52	13.0
T3S2	1.3	14	0.53	18.9
T3-3	1.3	18.7	0.63	25.2
SU4	1.3	8.6	0.43	11.6
SU5	1.3	9	0.40	12.2
SU6	1.3	9.2	0.36	12.5
SU7	1.3	10.1	0.35	13.6
NRL	1.3	10.1	0.34	13.6

Load Rating Evaluation Summary :
(Areas investigated in load rating)

+M Girder/Beam ☑ Int ☑ Ext
-M Girder/Beam ☐ Int ☐ Ext
☐ -M Slab ☐ +M Slab
☐ Culvert Walls
☑ Shear at/near Supports
☐ Truss Members
☐ Floor Beams
☐ Stringers
☐ Pins
☐ Hangers
☐ Fatigue Prone Details
☐ Deck Overhang
☐ Deck between Girders
☐ Substructure (NBI Item 60 < 4)

Operating Ratings Only. This serves as the maximum posting load for the LPA. (Only necessary to fill out if Posting is REQUIRED)

Maximum (Operating) Rating:	Standard Posting (R12-5, MUTCD)						Single Posting (R12-1, MUTCD)	
	Truck T3		Truck T3S2		Truck T3-3		Truck T3	
	Load:	16 tons	Load:	24 tons	Load:	32 tons	Load:	16 tons

NBI Item 70 (Relationship of Operating Rating to Maximum Legal Load) : 30.0-39.9% below legal loads

Additional Comments *(include any section loss, assumptions, hand calc. references, etc.)*

5% section loss modeled. LFR ratings based on exterior girders. LRFR ratings based on interior girders.

AASHTOWare BrR Version 6.8.X model was used to generate this load rating. The model is available from KDOT BLP for download and modification for future load ratings. A new, sealed Load Rating Summary Sheet will be required with any new load rating or if the BrR model is modified.

Controlling Structural Element
+M Girder/Beam Ext

Printed Name (P.E.): Derek W. Harth
License #: 17477
P.E. Licensed in Kansas
Seal & Date

DEREK W HARTH LICENSED 17477 07/19/2017 KANSAS PROFESSIONAL ENGINEER

The Rating(s) for this structure is (are) based on a theoretical analysis of the structural elements involved, and on a limited amount of information concerning their condition. The calculated values are the maximum posting limits. The LPA shall not post the structure at a load exceeding these values. The LPA may decide to post the structure at lower load limits.

Revised 2017-02-20 Statewide Program KLBRP 106 C-4505-XX

Company : GBA
Analyst : SDB
Analysis Date : 06/19/2017

Maximum Legal Posting Limits

NBI Bridge ID: 000700969905060
LP Bridge ID: 164

R12-1

R12-6

Our Project Guidelines -

Local Bridge Rating

American

Association of

State

HIGHWAY and

Transportation

Officials

Is it a Highway???

Is it a Highway???

Is it a Highway???

Is it a Highway???

Is it a Highway???

Code Interpretation Areas

Some common gray areas:

- What to do with unusual exterior girders?
- When is something one lane vs. two lane?
- When is a flange laterally supported?
- How much overburden is too much overburden?

Close the bridge? Or not?

Interior Girder:

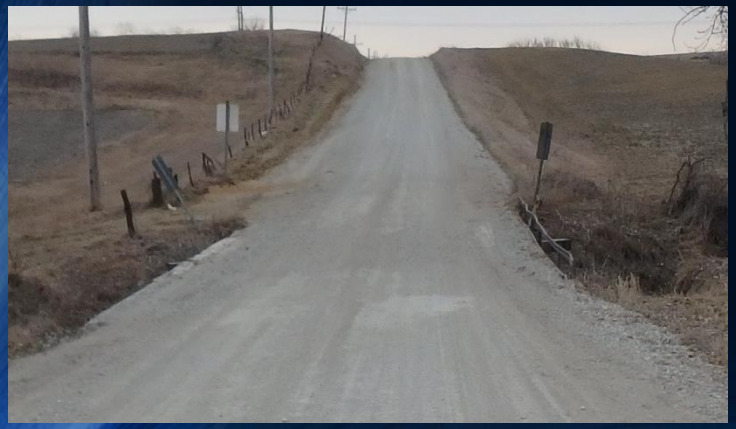
2 lane distribution factor for timber deck: S/3.75 = 0.53 wheels

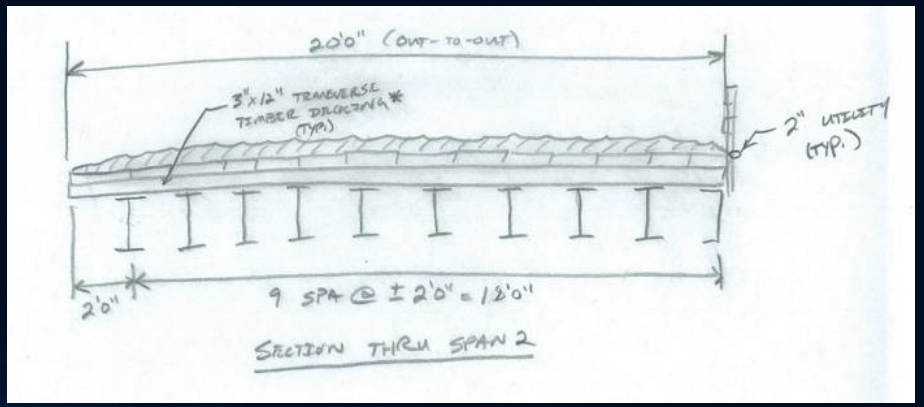
Exterior Girder:

LLDF = 1.0?

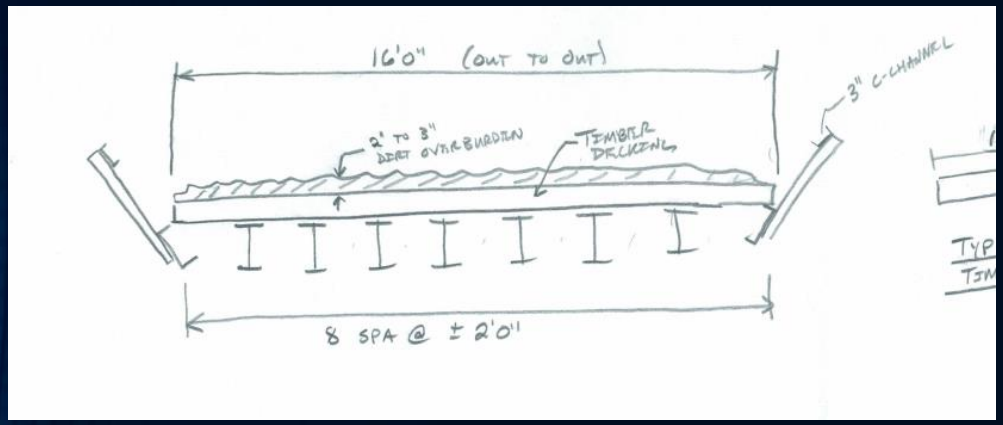
Timber Deck with a cantilever?

ADT = 10 vpd





Close the bridge? Or not?



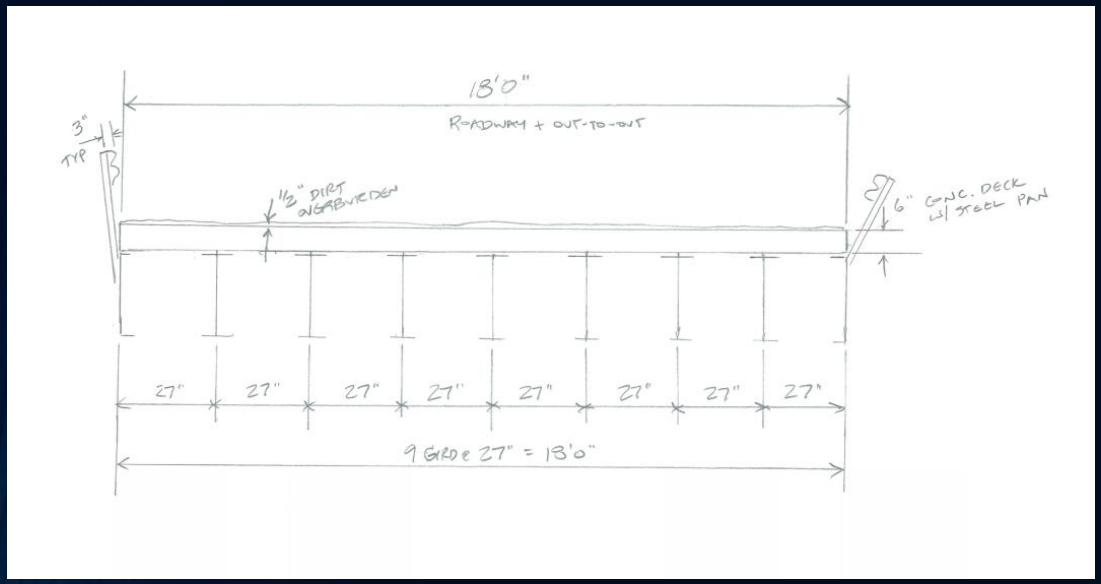
Interior Girder:

1 lane distribution factor for timber deck: S/4.0 = 0.50 wheels

Exterior Girder:

LLDF = 1.0?

One lane or two?



Roadway width = 18’-0”

ADT = 20

S/5.5 or S/7 ?

When is a flange laterally braced?

Yes – braced.

No – not braced.

Maybe?

Overburden

Overburden

Overburden

Overburden

Overburden

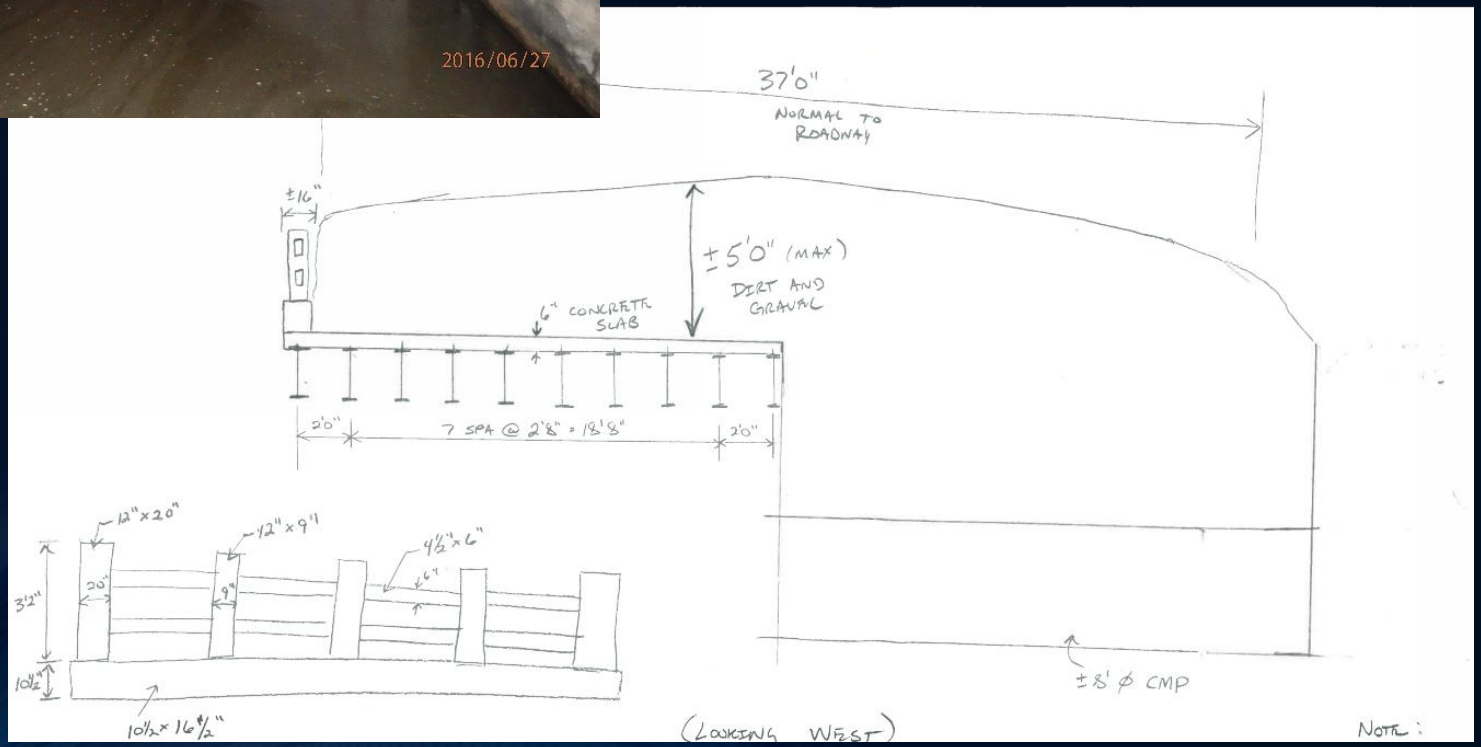
The bridge is….where?

The bridge is here.

Soil Weight = 21’ x 28’ x 4.0’ x 120 pcf = 282,240 lbs !

Is this even a bridge anymore?

- Skewed 60 degrees +/-
- 5’ max fill
- LL distribution factors?
- Impact?

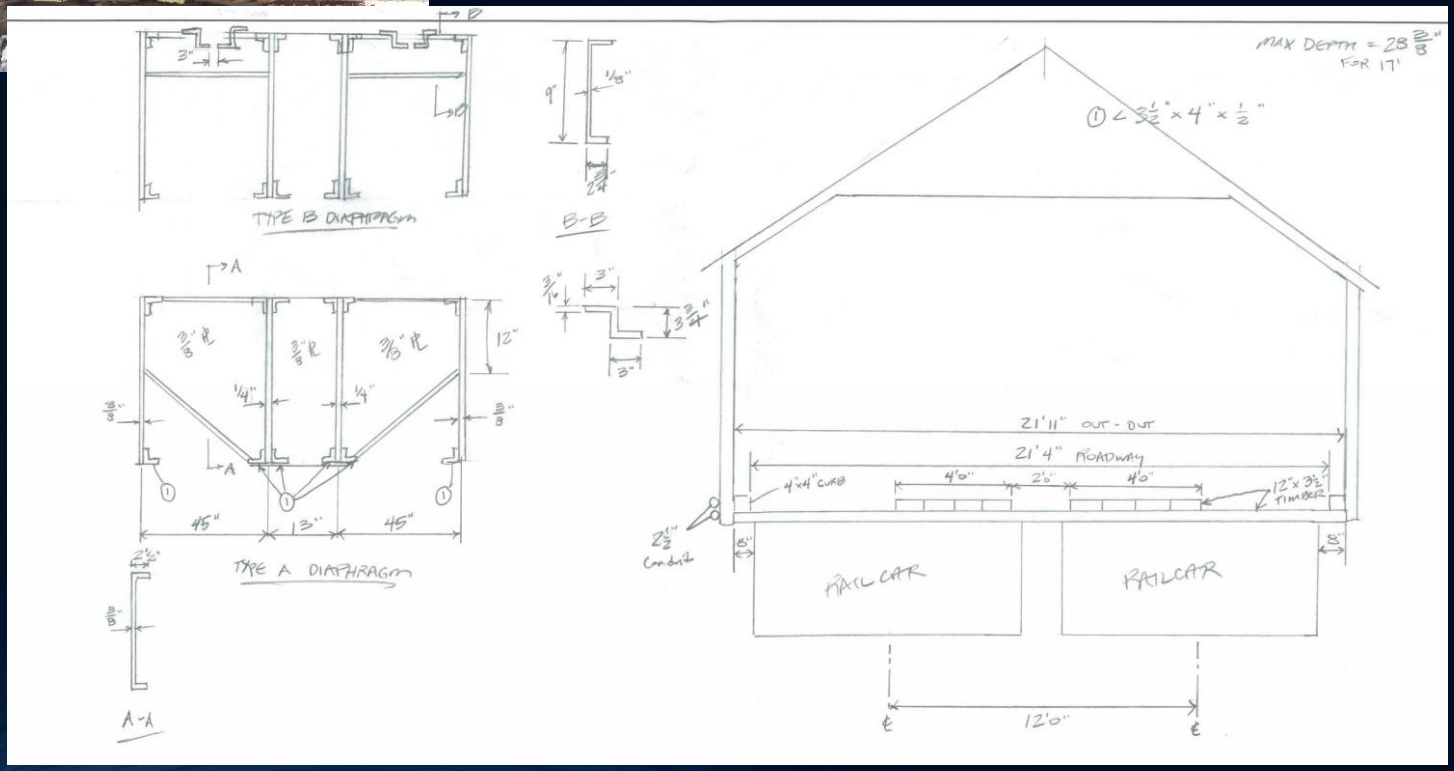


Other unusual structures…

Girders provided by ATSF Railroad – used railcar superstructure

Other unusual structures…

- One lane bridge due to timber runners/signed as one lane
- Used a distribution factor of 1 wheel per railcar
- Modeled as a series of built up sections



Bourbon County

Steel Girder Stringer Floorbeam Bridge

1 - 29’ Simple Span

Year Built Unknown

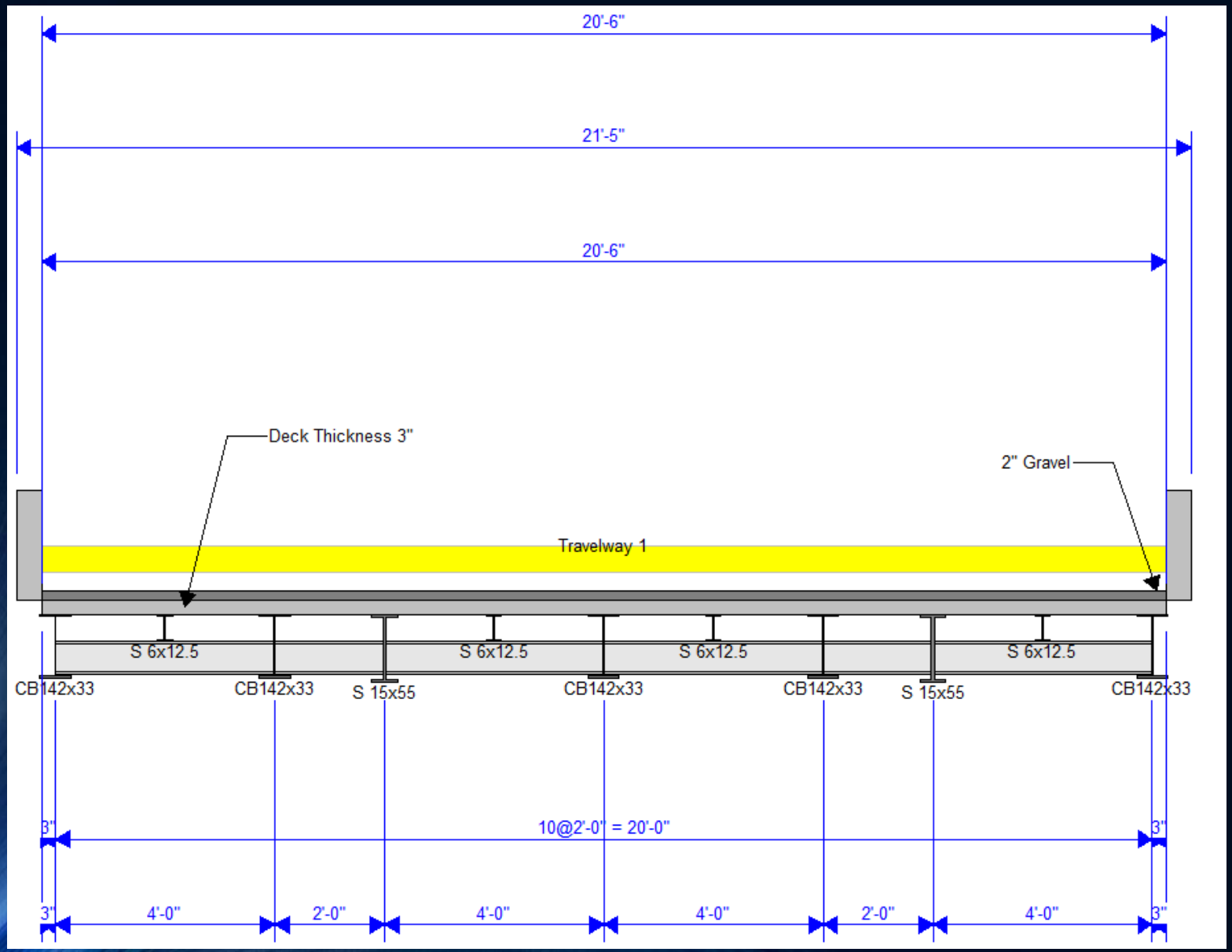
No plans

ADT of 75

Local Bridge Rating

Local Bridge Rating

Local Bridge Rating


20'-6"
21'-5"
20'-6"
Deck Thickness 3"
2" Gravel
Travelway 1
S 6x12.5
S 6x12.5
S 6x12.5
S 6x12.5
CB142x33
CB142x33
S 15x55
CB142x33
CB142x33
S 15x55
CB142x33
3"
10@2'-0" = 20'-0"
3"
3"
4'-0"
2'-0"
4'-0"
4'-0"
2'-0"
4'-0"
3"

Bourbon County

Steel Girder Bridge with Ext. Channels

2 - 21’ Simple Spans

Built in 1935

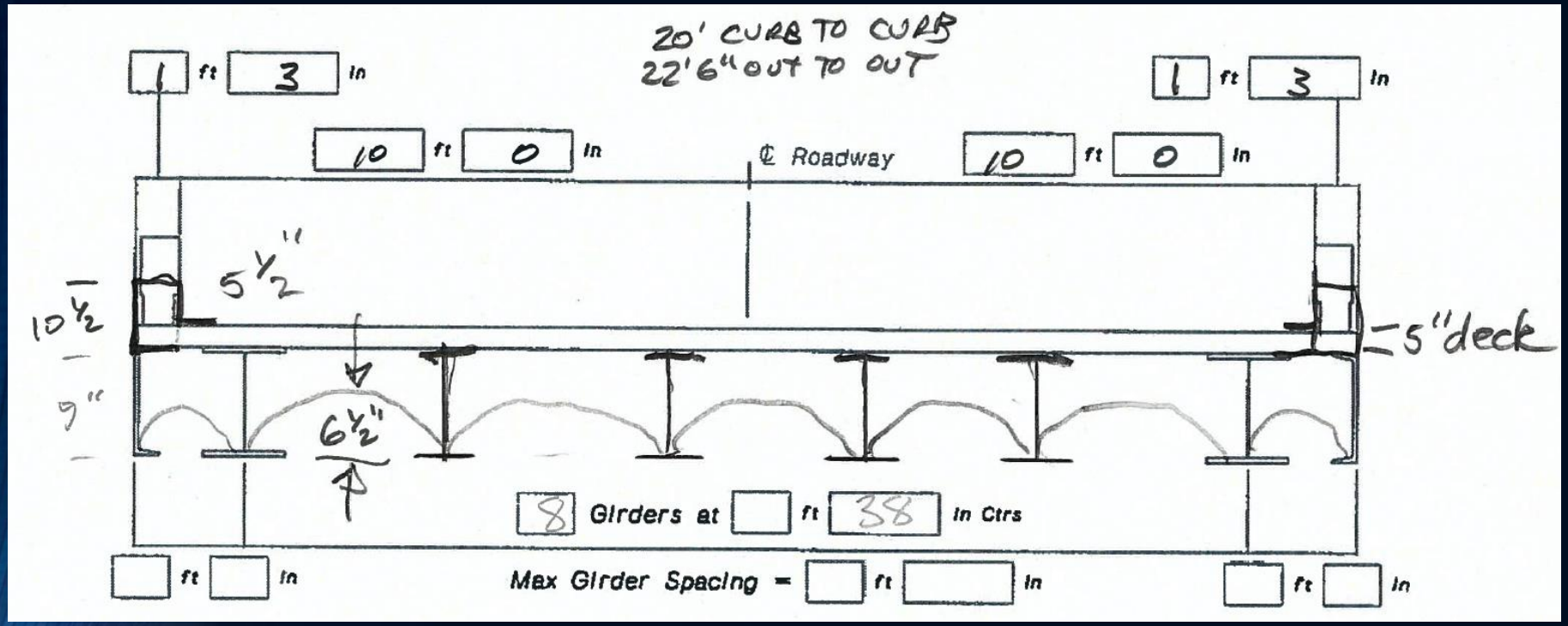
No plans

ADT of 30

Local Bridge Rating

Local Bridge Rating

Local Bridge Rating


20' CURB TO CURB
22'6" OUT TO OUT
1 ft 3 in
1 ft 3 in
10 ft 0 in
℄ Roadway
10 ft 0 in
5½"
10½"
9"
6½"
5" deck
8 Girders at ft 38 in Ctrs
ft in
Max Girder Spacing = ft in
ft in

Bourbon County

Steel Girder Stringer Floorbeam Bridge

2 - 25’ Continuous Spans

Built in 1966

No plans

ADT of 25

Local Bridge Rating

Local Bridge Rating

Local Bridge Rating

Osage County

Continuous Steel Girder Bridge

4 Spans, 66′ – 2 @ 80′ – 68′

Built in 1940

No plans

ADT of 90

Local Bridge Rating

Local Bridge Rating

Local Bridge Rating

Local Bridge Rating

Bourbon County

Steel Girder Bridge

1 - 22’ Simple Span

Built in 1954

No plans

ADT of 25

Local Bridge Rating

Local Bridge Rating

Local Bridge Rating

Local Bridge Rating