Return to Main Body

APPENDIX A

SAMPLE CALCULATIONS

Following are sample calculations detailing the entire process for calculating the various values reported. This example is entirely for the exterior girder, EGL, from the Haunched Girder specimen.

Load Capacity:

Determine Moment Capacity:

$$M_y = A_{BC}*F_{yBC}*d_{eBC} + 0.25*A_{TC}*F_{yTC}*d_{eTC}$$

$$a = \frac{A_{BC}F_{yBC} + 0.25A_{TC}F_{yTC}}{0.85 * f_c' * b_1}$$

$$d_{eBC} = H - y_{BC} - a/2$$

$$d_{eTC} = h + y_{TC} - a/2$$

$$M_d = 0.6 * M_y$$

For EGL, with nominal material properties:

$A_{BC} = 5.7188\ in.^2$

$A_{TC} = 2.875\ in.^2$

$F_y = 50.0\ ksi$

$f_c' = 4.0\ ksi$

$b_1 = 47.5\ in.$

$$A_{BC}F_{yBC} + A_{TC}F_{yTC} = 5.7188*50 + 0.25*2.875*50 = 321.88\ kips$$

$$a = \frac{321.88}{0.85 * 4.0 * 47.5} = 1.9931\ \text{in.} \qquad a/2 = 0.9965\ in.$$

$d_{eBC} = 35.0 - 1.138 - 0.9965 = 32.8655$ *in.*

$d_{eTC} = 10.0 + 0.842 - 0.9965 = 9.8455$ *in.*

$M_{yn} = A_{BC}*F_y*d_{eBC} + 0.25*A_{TC}*F_y*d_{eTC}$

$= 5.7188*50*32.8655 + 0.25*2.875*50*9.8455$

$= 9751.4$ *k-in.* = ***812.6 k-ft***

$M_{dn} = 0.6 * M_{yn}$ = ***487.6 k-ft***

Determine Load Capacity:

$M_{CL} = R_L(15) - R_{sj}(5) - 15(15/2)w_g - P(5)$

$R_L = R_{sj} + 15w_g + P$

For EGL,

$w_g = 0.220$ *klf*

$R_{sj} = 1.464$ *kips*

$R_L = 1.464 + 15*0.220 + P = 4.764 + P$

$M_{CL} = 4.764*15 + 15P - 1.464*5 - (15^2/2)*0.220 - 5P$

$= 39.39 + 10P$

Solve for P using $M_{CL} = M_{yn}$

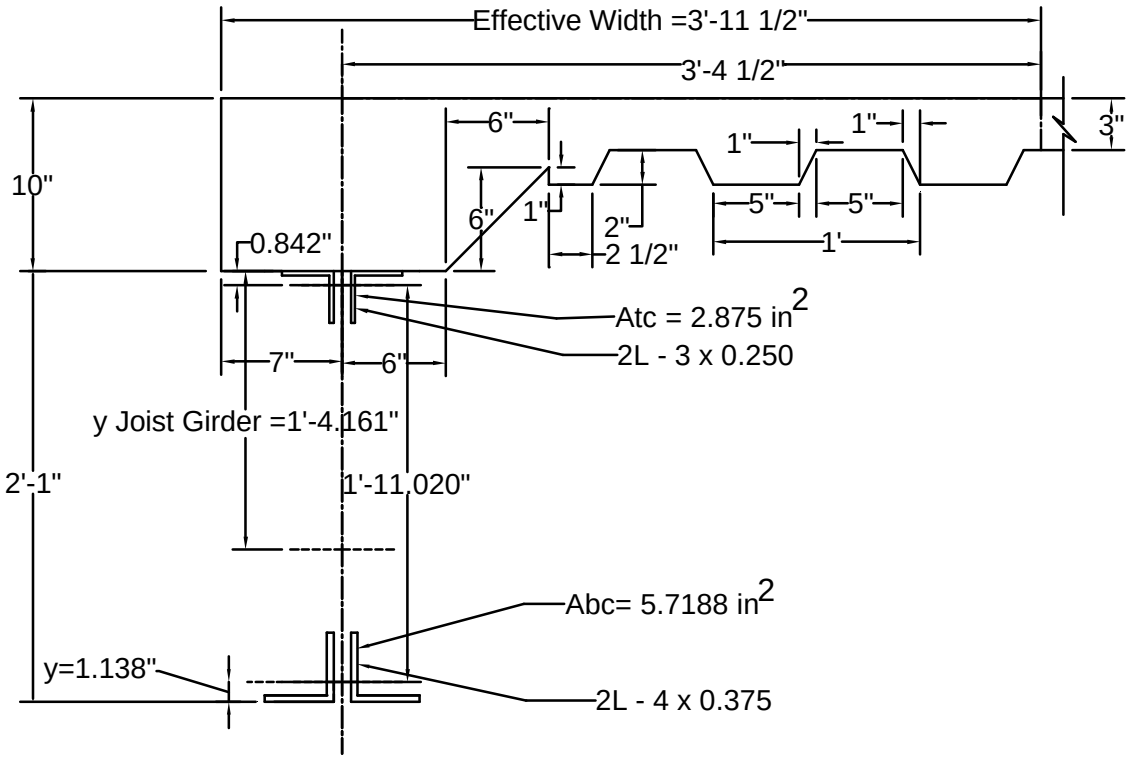
$10P = M_{yn} - 39.39$

For $M_{yn} = 812.6$ *k-ft*, $P = 77.3$ *kips*

$TL_{yn} = 2*(P + R_{sj}) + 30w_g = 2(77.3 + 1.464) + 30*0.220$

= ***164.1 kips = Total Load on EGL***

Moment of Inertia: (Provided by D. Samuelson, Nucor Research and Development.)



Detail No. 1

Calculate Joist-Girder Noncomposite Moment of Inertia

$$y_{Joist\ Girder} = \frac{A_{TC}y_{TC} + A_{BC}(d_{Joist\ \ Girder} - y_{BC})}{A_{TC} + A_{BC}} = \frac{2.875\,(0.842) + 5.7188\,(25 - 1.138)}{2.875 + 5.7188} = 16.161\,\text{in}$$

$$I_{Joist\ Girder\ \ Noncomposite} = I_{TC} + I_{BC} + \frac{A_{TC}A_{BC}d_e^{\ 2}}{A_{TC} + A_{BC}}$$

Where:

$d_{Joist\ Girder}$ = Depth of steel joist girder = 25 in

I_{TC} = Moment of Inertia for both top chord angles = 1.244 in^4 x 2 angles = 2.488 in^4

I_{BC} = Moment of Inertia for both bottom chord angles = 4.359 in^4 x 2 angles = 8.718 in^4

y_{TC} = Location for centroid of top chord = 0.842 in

y_{BC} = Location for centroid of bottom chord = 1.138 in

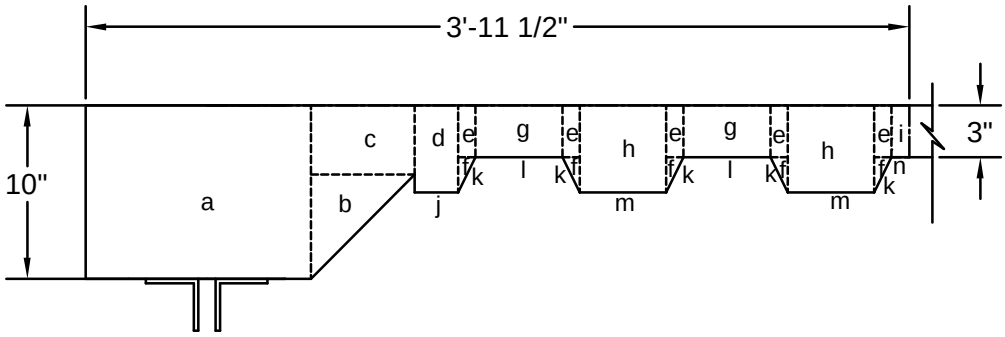
d_e = Joist girder effective depth = 25 in - 0.842 in - 1.138 in = 23.020 in

A_{TC} = Area of both top chord angles = $1.438\,\text{in}^2$ x 2 angles = $2.875\,\text{in}^2$

A_{BC} = Area of both bottom chord angles = $2.859\,\text{in}^2$ x 2 angles = $5.7188\,\text{in}^2$

$$I_{Joist\,Girder\,Noncomposite} = 2.488\,\text{in}^4 + 8.718\,\text{in}^4 + \frac{(2.875\,\text{in}^2)(5.7188\,\text{in}^2)(23.020\,\text{in})^2}{(2.875\,\text{in}^2 + 5.7188\,\text{in}^2)} = 1{,}025\,\text{in}^4$$

Calculate Transformed Moment of Inertia for Concrete Slab



Detail No. 2

$$n = \frac{E_s}{E_C}$$

$$E_c = 33 w_c^{1.5} \sqrt{f_c'} = 33\,(145\text{ pcf})^{1.5} \sqrt{4530} = 3{,}878.1\,\text{ksi}$$

$$\text{n} = \frac{29{,}000\,\text{ksi}}{3{,}878.1\,\text{ksi}} = 7.4779$$

2VL 18 Ga. deck, deck thickness = 0.0474 in
1 layer 6 x 6 – W1.4 x W1.4 welded wire fabric

Table No. 1

	Element Area (in^2)	Element Area/ n (in^2)	[1]No. Pieces	Area (in^2)	Area Trans-formed (in^2)	y to top slab (in)	A_{trans} x y (in^3)	h (in)	A_{trans} x h^2 (in^4)	I_o (in^4)
a	130.00	17.384	1	130.0	17.3844	5.00	86.9221	-1.3253	30.5346	144.87
b	18.00	2.4071	1	18.00	2.4071	6.000	14.4424	-2.3253	13.0152	4.8141
c	24.00	3.2094	1	24.00	3.2094	2.00	6.4189	1.6747	9.0012	4.2792
d	12.50	1.6716	1	12.50	1.6716	2.500	4.1789	1.1747	2.3066	3.4825
e	3.00	.4012	5	15.00	2.0059	1.500	3.0088	2.1747	9.4865	1.5044
f	1.00	.1337	5	5.00	.6686	3.666	2.4517	.0080	0.0000	.1486
g	15.00	2.0059	2	30.0	4.0118	1.500	6.0177	2.1747	18.9730	3.0088
h	25.00	3.3432	2	50.00	6.6863	2.500	16.7158	1.1747	9.2265	13.93
i	3.00	.4012	1	3.000	.4012	1.500	.6018	2.1747	1.8973	.3009
j	.1185	.1185	1	.1185	.1185	5.000	.5925	-1.3253	.2081	0.0000
k	.1060	.1060	5	.5299	.5299	4.000	2.1198	-.3253	.0561	.1767
l	.2370	.2370	2	.4740	.4740	3.000	1.4220	.6747	.2158	.0001
m	.2370	.2370	2	.4740	.4740	5.000	2.3700	-1.3253	.8325	.0001
n	.0474	.0474	1	.0474	.0474	3.000	.1422	.6747	.0216	0.0000
mesh	0.1116	0.1116	1	0.112	0.1116	2.909	.3248	.7654	.0654	.0001
Totals	232.3575	31.8152		289.2555	40.2018		147.7294		95.8404	76.5157

Haunch flashing metal was ignored in the above calculation.

$$y_{transformed} = \frac{\sum A_{trans} \cdot y}{\sum A_{trans}} = \frac{147.7294}{40.2018} = 3.6747 \text{ in to top of slab}$$

$$I_{transformed} = \sum A_{trans} h^2 + \sum I_o = 95.8404 + 176.5157 = 272.3561 \text{ in}^4$$

Calculate Combined Transformed Moment of Inertia for Concrete Slab & Girder

Area of top and bottom chord = 2.875 in^2 + 5.7188 in^2= 8.5938 in^2
Distance from centroid of joist to top of slab = y= y_{joist} +10 =16.161 + 10= 26.161 in

Table No. 2

Element	[1]Element Area (in^2)	Y to top of slab (in)	Area *y (in^3)	h (in)	Area x h^2 (in^4)	I_o (in^4)
Joist Girder	8.5938	26.161	224.82	18.5261	2,949.5	1,025
Slab	40.2018	3.6747	147.7295	3.9602	630.492	272
Total	48.7956		372.5496		3,580.0	1,297.4

[1]Element area shown for slab has been transformed into equivalent area of steel . See Table No. 1

$$y_{centroid} = \frac{\sum A\ y}{\sum A} = \frac{372.5496}{48.7956} = 7.6349" \text{ from top of slab}$$

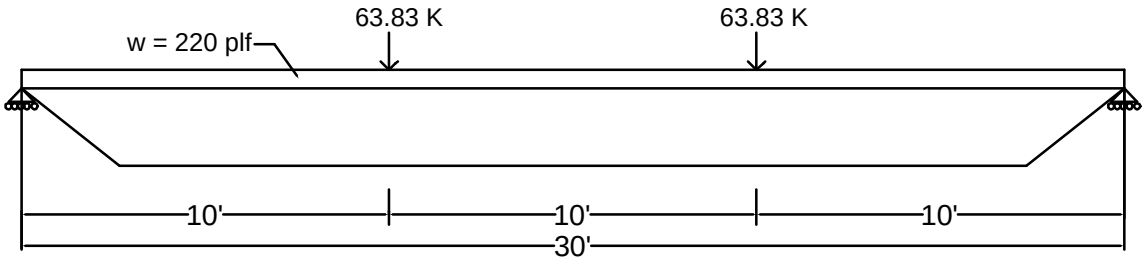
$$I_{composite} = \sum A\,h^2 + \sum I_O = 3{,}580 + 1{,}297.4 = 4{,}877.4 \text{ in}^4$$

Adjustment to $I_{composite}$ for Shear Stud Slippage

Adjusting for slipage between the shear studs and the concrete, a shear stud slip factor of 1.05 was assumed.

$$I_{non-adjusted\ for\ span/depth} = \frac{I_{composite}}{1.05} = \frac{4{,}877.4}{1.05} = 4{,}645 \text{ in}^4$$

Adjusting for Web Shortening Effects



Detail No. 3

$$\Delta_{centerline\ for\ uniform\ load\ on\ noncomposite\ joist\ girder} = \frac{5w_g l^4}{384EI_{noncomposite}}$$

$$\Delta_{centerline\ for\ uniform\ load\ on\ noncomposite\ joist\ girder} = \frac{5(220 \text{ plf})(30 \text{ ft})^4 (12 \text{ in/ft})^3}{384(29\text{x}10^6 \text{ psi})(1{,}025 \text{in}^4)} = 0.1349"$$

$$\Delta_{centerline\ for\ concentrated\ loads} = \frac{Pa\left(3l^2 - 4a^2\right)}{24EI} = \frac{63{,}830 \text{ lb}\,(120 \text{ in})\left[3(360 \text{ in})^2 - 4(120 \text{ in})^2\right]}{24(29\text{x}10^6 \text{ psi})(1{,}025 \text{in}^4)} = 3.556 \text{ in}$$

$$\Delta_{Total\ Noncomposite} = \Delta_{Uniform\ Load\ Noncomposite} + \Delta_{Concentrated\ Load} = 0.1349 \text{ in} + 3.556 \text{ in} = 3.6909 \text{ in}$$

Using the Vulcraft Joist Design Program, the deflection of the noncomposite joist under the loading shown in Detail No. 3 was calculated to be 3.97". The Vulcraft joist program assumes that: 1) The top chord is a continuous member and 2) That the webs and chords are connected to the top and bottom chords by pinned joints.

The difference between the theoretical centerline deflection and the deflection from the Vulcraft Program is due to web effects. Correcting the moment of inertia for web effects:

$$I_{adjusted\ for\ web\ effects} = 4{,}645\,\text{in}^4\left(\frac{3.6909\,\text{in}}{3.97\,\text{in}}\right) = 4{,}645\,\text{in}^4(0.9297) = 4{,}318\,\text{in}^4$$

Correcting Composite Moment of Inertia for Span / Depth Effects

Using results of 18 prior full-scale composite joist tests, an empirical equation to adjust for Span / Depth joist ratios was derived. This additional adjustment was required after taking into account shear stud slip and web shorting effects so that the measured deflections would more closely match predicted deflections.

The equation sellected for adjusting for the span \ depth effects is of the form $y = a + \frac{b}{x^2}$

where $y = \frac{I_{non-adjusted\ for\ span/depth}}{I_{adjusted\ for\ span/depth}}$

$a = 0.91775$

$b = 79.1692$

$$x = \frac{Joist\ Span}{Joist\ Depth} = \frac{30\,\text{ft x}\,12\,\text{in/ft}}{25\,\text{in}} = 14.4$$

$$\text{Adjustment factor for Span / Depth} = a + \frac{b}{x^2} = 0.91775 + \frac{79.1692}{14.4^2} = 1.2995$$

$$I_{adjusted\ for\ span/depth} = \frac{I_{non-adjusted\ for\ span/depth}}{\text{Adjustment factor for Span / Depth}} = \frac{4{,}318\,\text{in}^4}{1.2995} = 3{,}323\,\text{in}^4$$

The calculated value for $I_{composite}$ for IG after adjusting for shear stud slip, web effects, and span / depth ratio is $= 3{,}323\,\text{in}^4$

$I_{calc} = 3{,}323\ \text{in}^4$ for EGL

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APPENDIX B

COMPOSITE JOIST-GIRDER TEST RESULTS

Following are plots of the data obtained from the various composite joist-girder specimens. The data is plotted as total load on the girder versus the measured displacement or force (vertical deflection, chord member strain, web member strain, concrete strain, slip, etc.) The test data is organized according to girder for each specimen. Each section begins with a summary of the girder configuration and related information. Total load refers to the combined loading of the structure self-weight plus the applied load introduced through the hydraulic rams.

The first load point of each data set establishes a zero position. The second data point within each set accounts for the self-weight of the steel in the specimen. The third point indicates effect of the placement of concrete. All subsequent data points refer to the effects of the cycles of live load applied during testing.

COMPOSITE FLUSH FRAMED JOIST-GIRDER TEST SUMMARY SHEET

GIRDER DESIGNATION: EGL(EG3) TEST DATES: 28-30 November 1995

TEST DESCRIPTION

Joist-Girder:	Span:	30'-0"	Weight:	48.9 plf
	Depth:	30 in.	Spacing:	7 ft
	Top Chord:	2L-3.00x3.00x0.250	Yield Stress:	58.0 ksi
	Bottom Chord:	2L-4.00x4.00x0.375	Yield Stress:	60.2 ksi
Deck:	Type:	2 VL	Gage:	18 ga
Slab:	Total Depth:	5 in.	Compressive Strength:	4900 psi
Shear Connector:	Type:	3/4 in. x 4 1/2 in. Welded Headed Shear Studs		
	Quantity:	15 per half-span, 30 total		

THEORETICAL CALCULATIONS

Theoretical Max. Total Load per Joist-Girder: 189.5 kips
Theoretical Moment of Inertia: 2705 $in.^4$

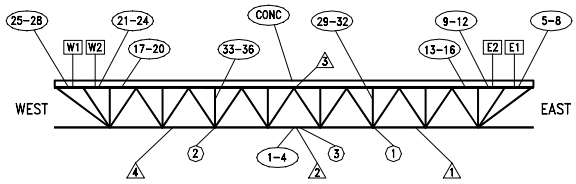
TEST RESULTS

Total Load on Joist-Girder at Failure: 160.8 kips
Maximum Total Load on Joist-Girder: 174.3 kips
Midspan Deflection at Failure: 2.74 in.
Experimental Moment of Inertia: 2965 $in.^4$
Mode of Failure: Compression buckling of web member W3R

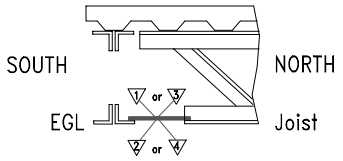
COMPARISON OF ACTUAL TO THEORETICAL

$$\frac{\text{Maximum Total Load on Joist-Girder}}{\text{Theoretical Max. Total Load on Joist-Girder}} = 0.92$$

LOCATION OF INSTRUMENTATION ON JOIST-GIRDER



Location of Strain Gages on EGL Braces:



Strain Gages:

1-4	BC	21-24	TC5
5-8	TC1	25-28	TC6
9-12	TC2	29-32	V3
13-16	TC3	33-36	V6
17-20	TC4	CONC	CONCRETE

Slips:

E1	SLIP E1
E2	SLIP E2
W1	SLIP W1
W2	SLIP W2

Strain Gages on EGL Braces:

1 BR E1 2 BR E2 3 BR W1 4 BR W2

Location of Strain Gages on Cross-Section:

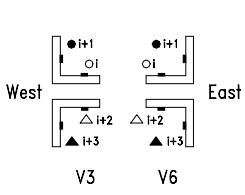
Vertical Defl.:

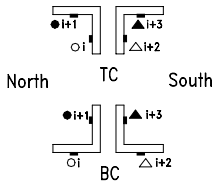
1	EQ BOTTOM
2	CL BOTTOM
3	CL TOP
4	WQ BOTTOM

Lateral Defl.:

1	LAT E*
2	LAT W*
3	LAT M**

* Measured on EGL & EGR
** Measured on IG





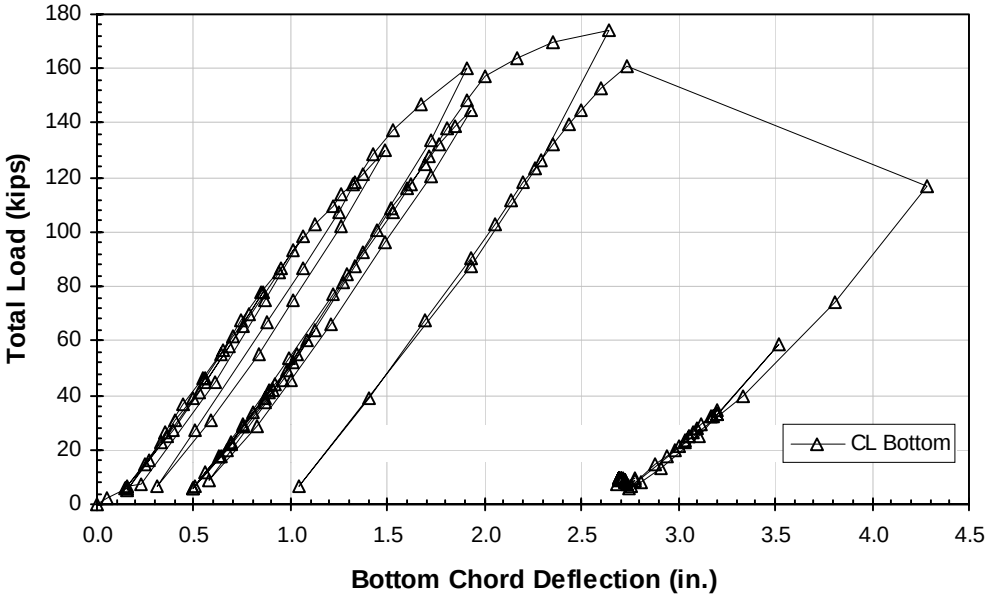


Figure B.1.1 Total Load vs. Bottom Chord Midspan Deflection of EGL

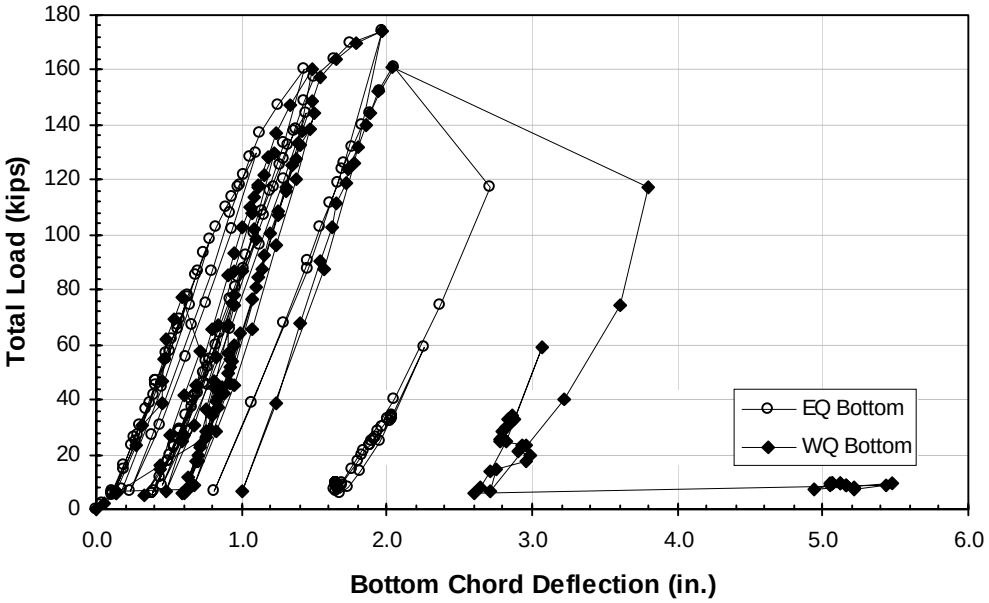


Figure B.1.2 Total Load vs. Bottom Chord Quarter Deflections of EGL

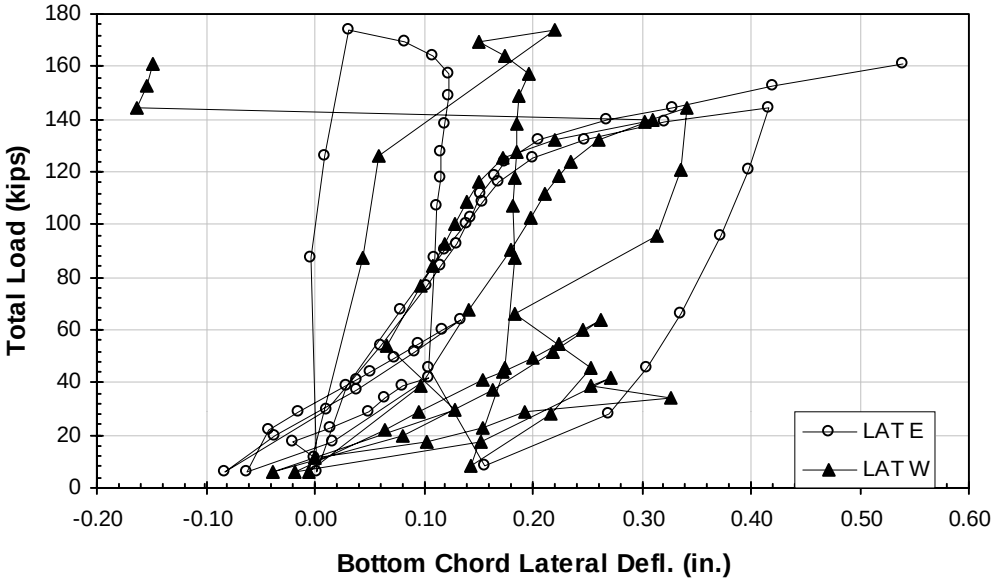


Figure B.1.3 Total Load vs. Bottom Chord Lateral Deflections of EGL

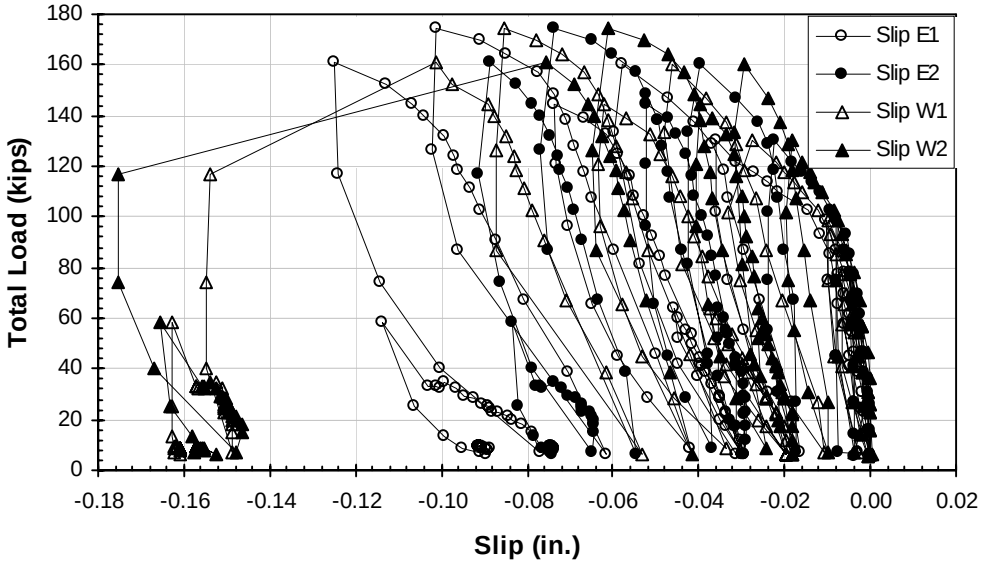


Figure B.1.4 Total Load vs. Slip of EGL

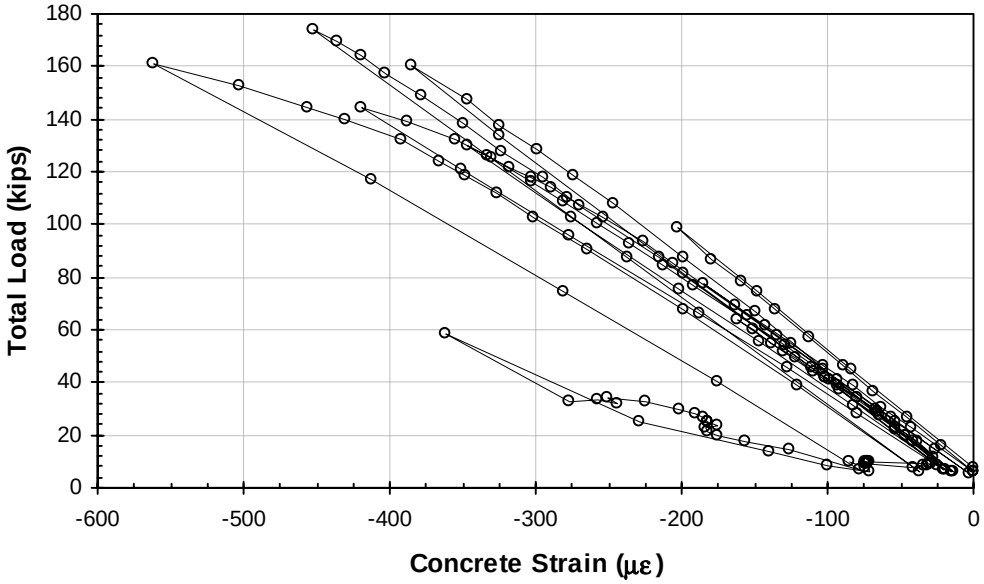


Figure B.1.5 Total Load vs. Concrete Strain of EGL

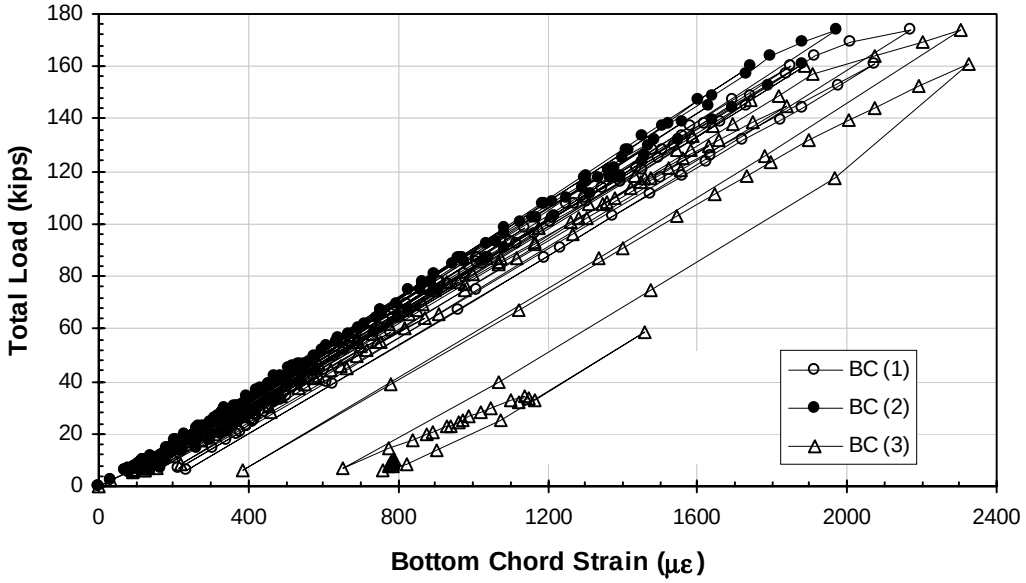


Figure B.1.6 Total Load vs. Bottom Chord Strain of EGL

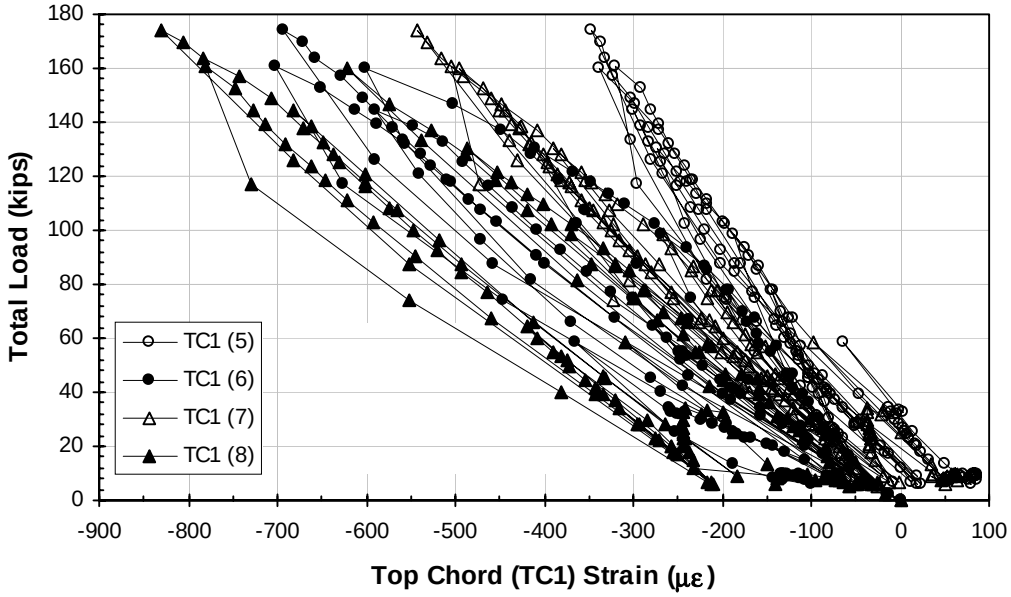


Figure B.1.7 Total Load vs. Top Chord (TC1) Strain of EGL

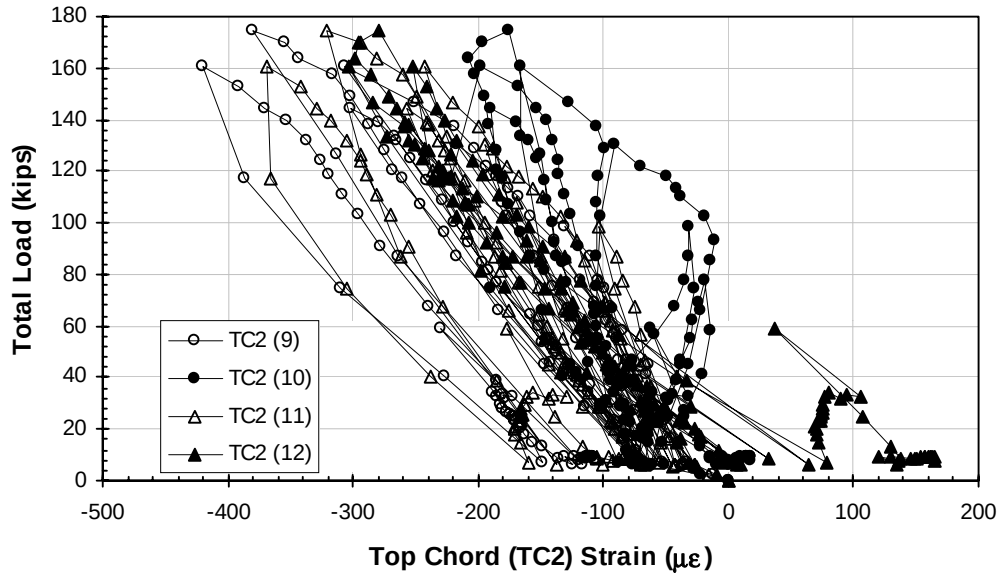


Figure B.1.8 Total Load vs. Top Chord (TC2) Strain of EGL

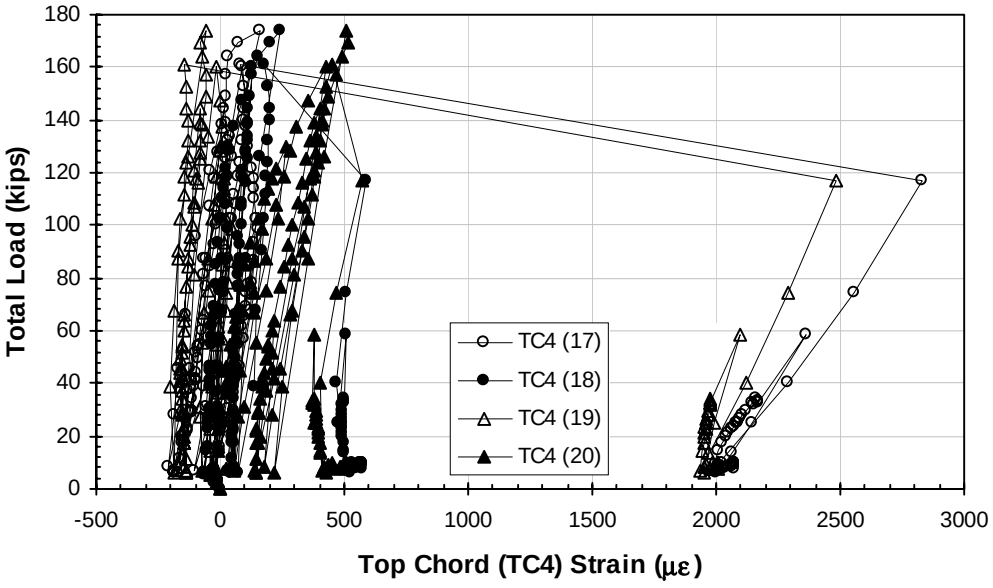


Figure B.1.9 Total Load vs. Top Chord (TC4) Strain of EGL

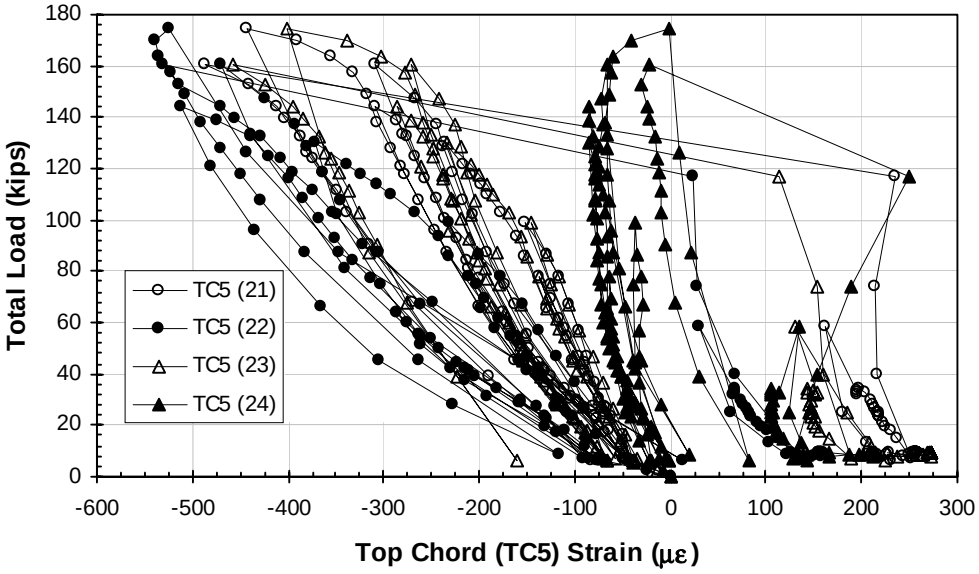


Figure B.1.10 Total Load vs. Top Chord (TC5) Strain of EGL

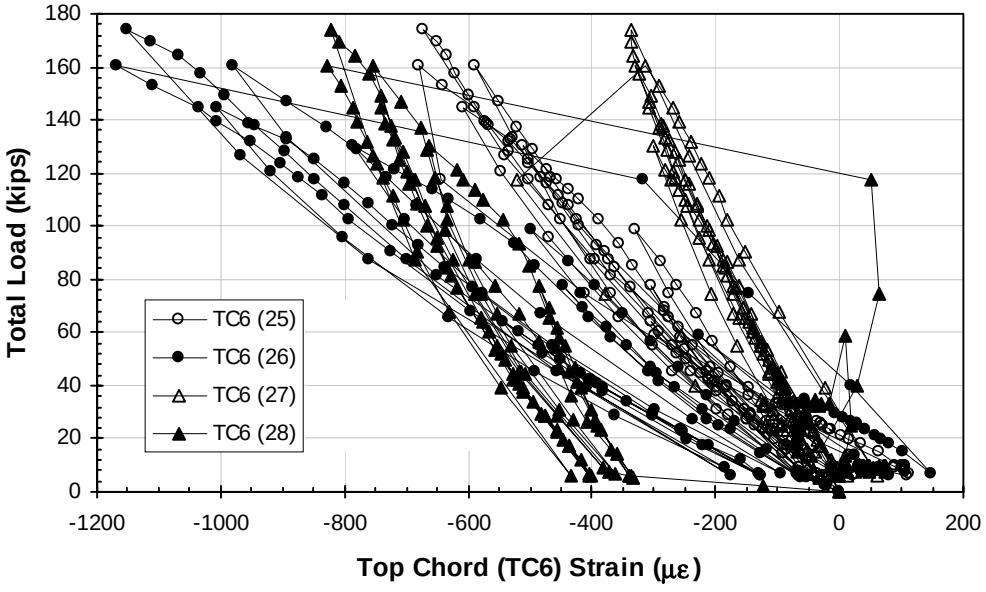


Figure B.1.11 Total Load vs. Top Chord (TC6) Strain of EGL

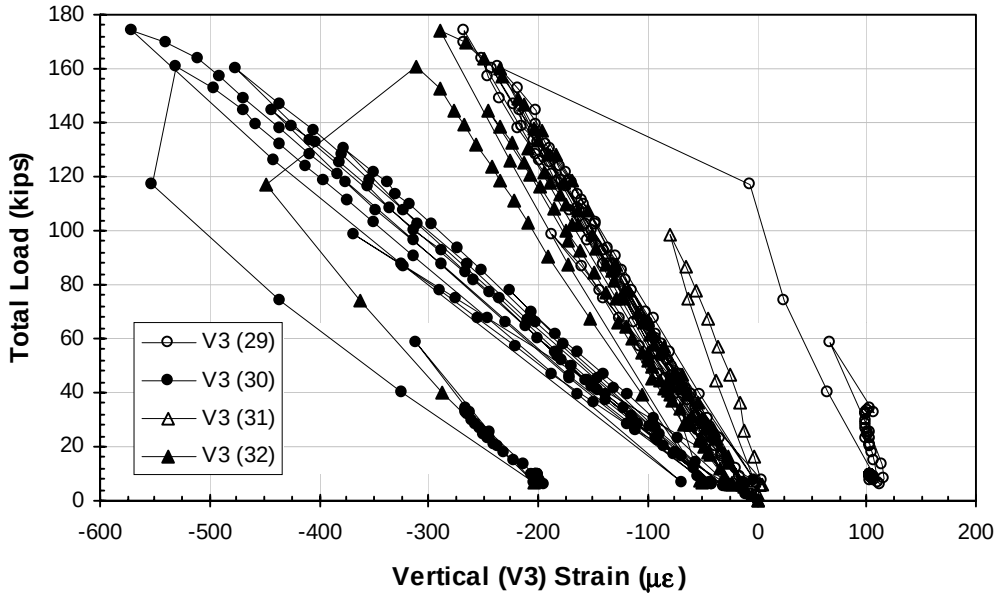


Figure B.1.12 Total Load vs. Vertical (V3) Strain of EGL

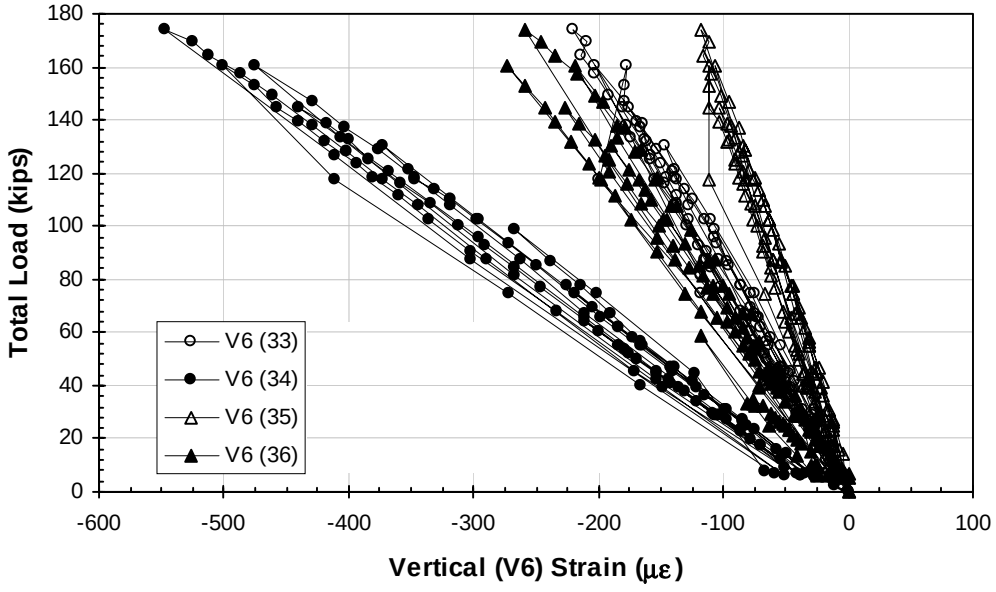


Figure B.1.13 Total Load vs. Vertical (V6) Strain of EGL

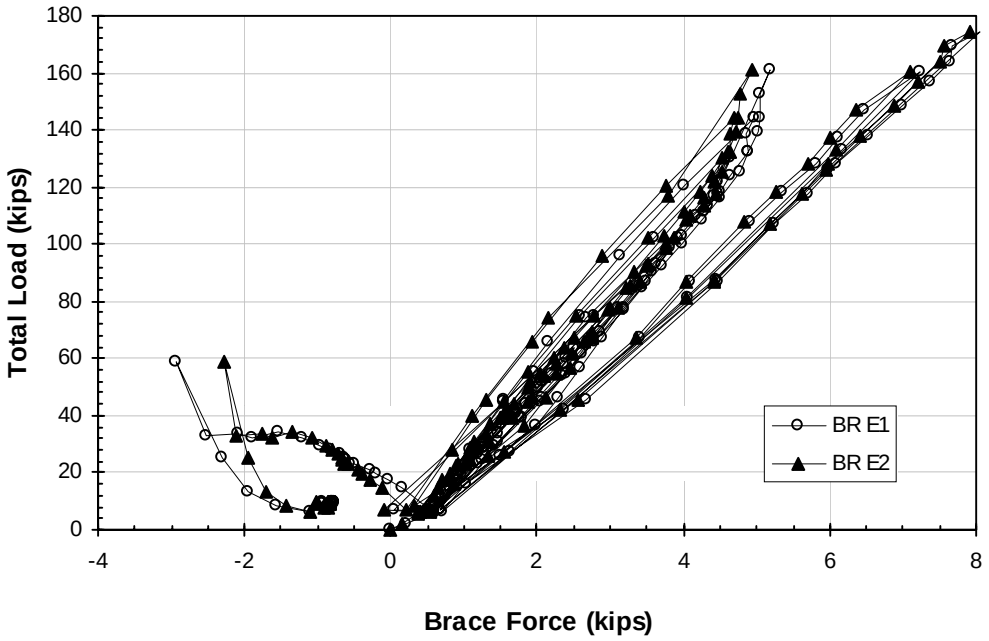


Figure B.1.14 Total Load vs. Brace Force of EGL (East Braces)

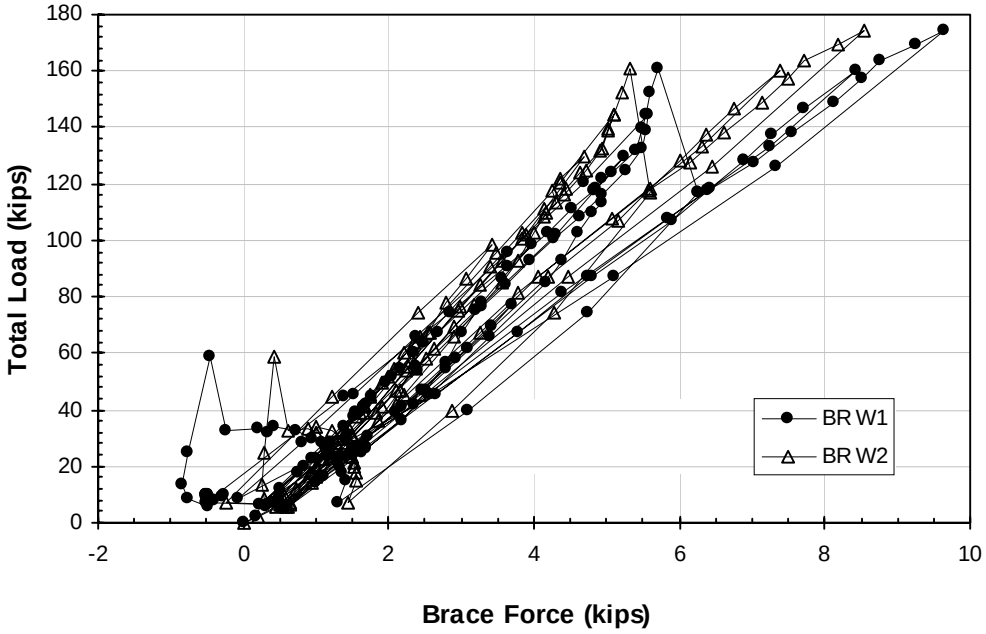


Figure B.1.15 Total Load vs. Brace Force of EGL (West Braces)

COMPOSITE FLUSH FRAMED JOIST-GIRDER TEST SUMMARY SHEET

GIRDER DESIGNATION: IG TEST DATES: 28-30 November 1995

TEST DESCRIPTION

Joist-Girder:	Span:	30'-0"	Weight:	91.3 plf
	Depth:	30 in.	Spacing:	7 ft
	Top Chord:	2L-4.00x4.00x0.375	Yield Stress:	58.7 ksi
	Bottom Chord:	2L-5.00x5.00x0.625	Yield Stress:	55.0 ksi
Deck:	Type:	2 VL	Gage:	18 ga
Slab:	Total Depth:	5 in.	Compressive Strength:	4900 psi
Shear Connector:	Type:	3/4 in. x 4 1/2 in. Welded Headed Shear Studs		
	Quantity:	28 per half-span, 56 total		

THEORETICAL CALCULATIONS

Theoretical Max. Total Load on Joist-Girder: 350.9 kips

Transformed Moment of Inertia: 5324 $in.^4$

TEST RESULTS

Total Load on Joist-Girder at Failure: 329 kips

Maximum Total Load on Joist-Girder: 341.4 kips

Midspan Deflection at Failure: 7.2 in.

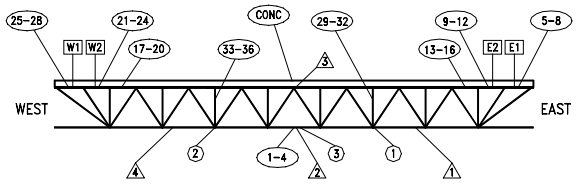
Experimental Moment of Inertia: 5541 $in.^4$

Mode of Failure: Failure of filler welds; Web buckling

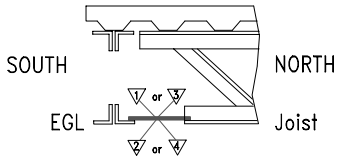
COMPARISON OF ACTUAL TO THEORETICAL

$$\frac{\text{Maximum Total Load on Joist-Girder}}{\text{Theoretical Max. Total Load on Joist-Girder}} = 0.97$$

LOCATION OF INSTRUMENTATION ON JOIST-GIRDER



Location of Strain Gages on EGL Braces:



Strain Gages:

1-4	BC	21-24	TC5
5-8	TC1	25-28	TC6
9-12	TC2	29-32	V3
13-16	TC3	33-36	V6
17-20	TC4	CONC	CONCRETE

Slips:

E1	SLIP E1
E2	SLIP E2
W1	SLIP W1
W2	SLIP W2

Strain Gages on EGL Braces:

1 BR E1 2 BR E2 3 BR W1 4 BR W2

Location of Strain Gages on Cross-Section:

Vertical Defl.:

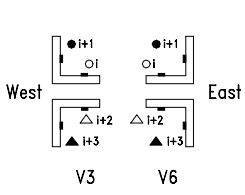
1	EQ BOTTOM
2	CL BOTTOM
3	CL TOP
4	WQ BOTTOM

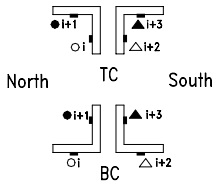
Lateral Defl.:

1	LAT E*
2	LAT W*
3	LAT M**

* Measured on EGL & EGR

** Measured on IG





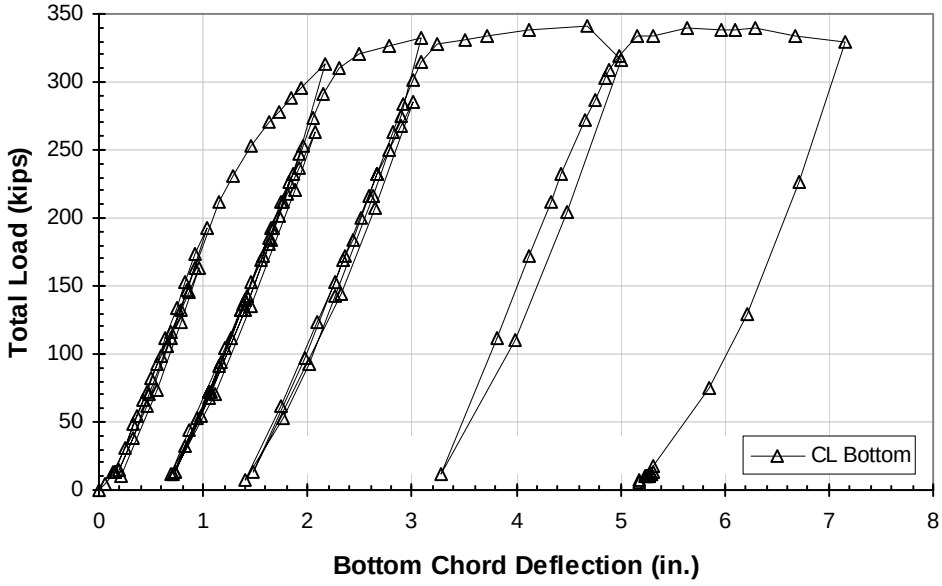


Figure B.2.1 Total Load vs. Bottom Chord Midspan Deflection of IG

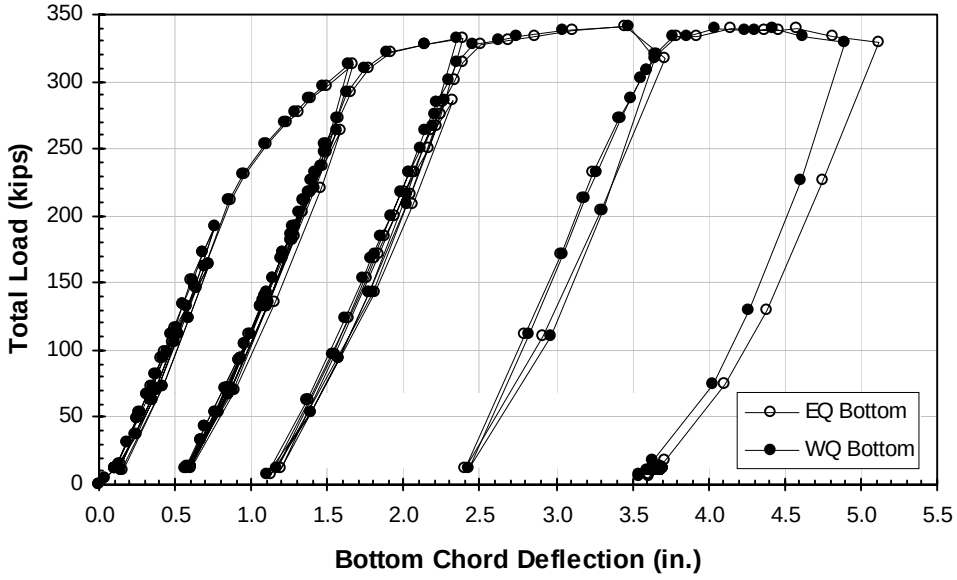


Figure B.2.2 Total Load vs. Bottom Chord Quarter Deflections of IG

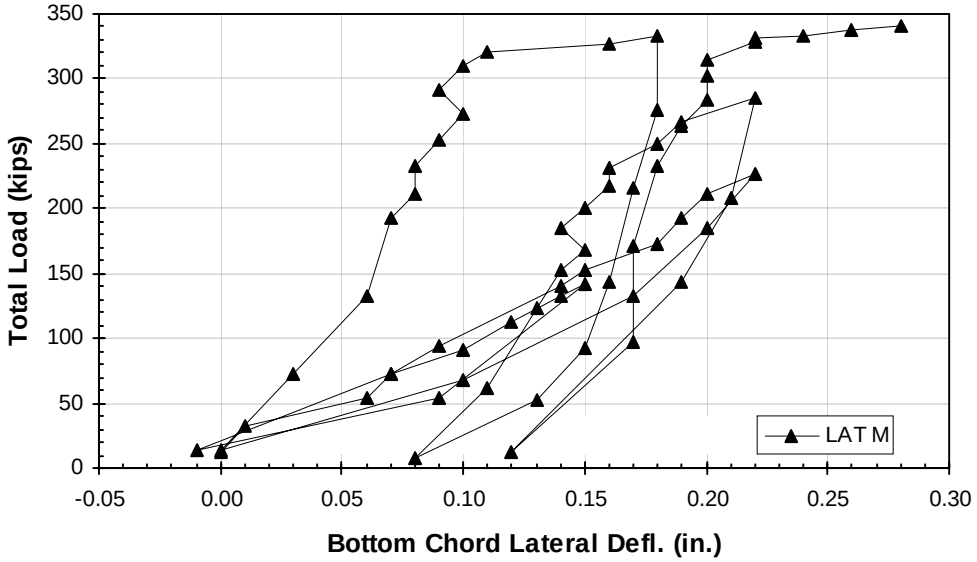


Figure B.2.3 Total Load vs. Bottom Chord Lateral Deflections of IG

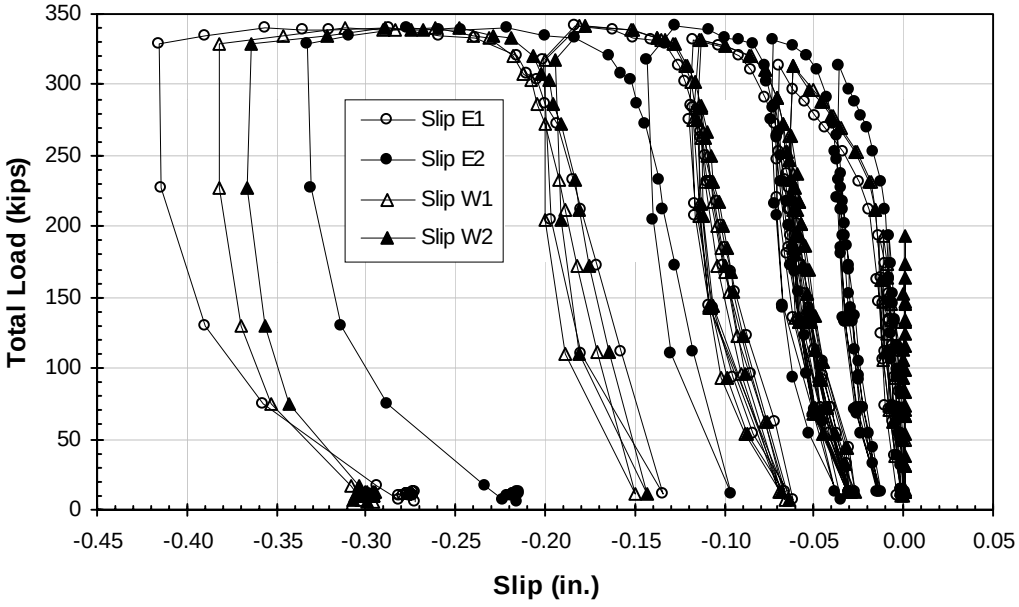


Figure B.2.4 Total Load vs. Slip of IG

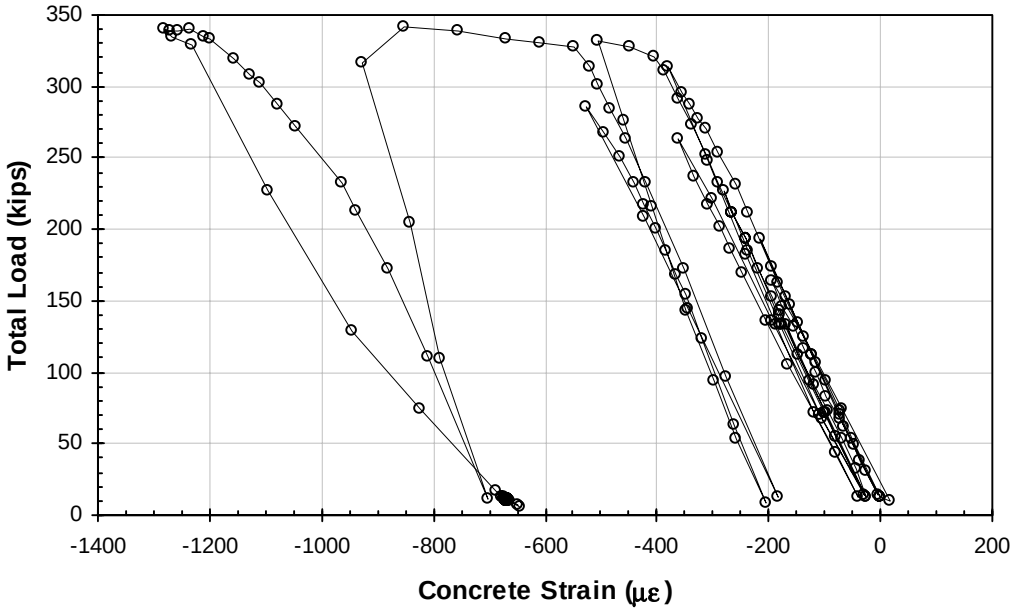


Figure B.2.5 Total Load vs. Concrete Strain of IG

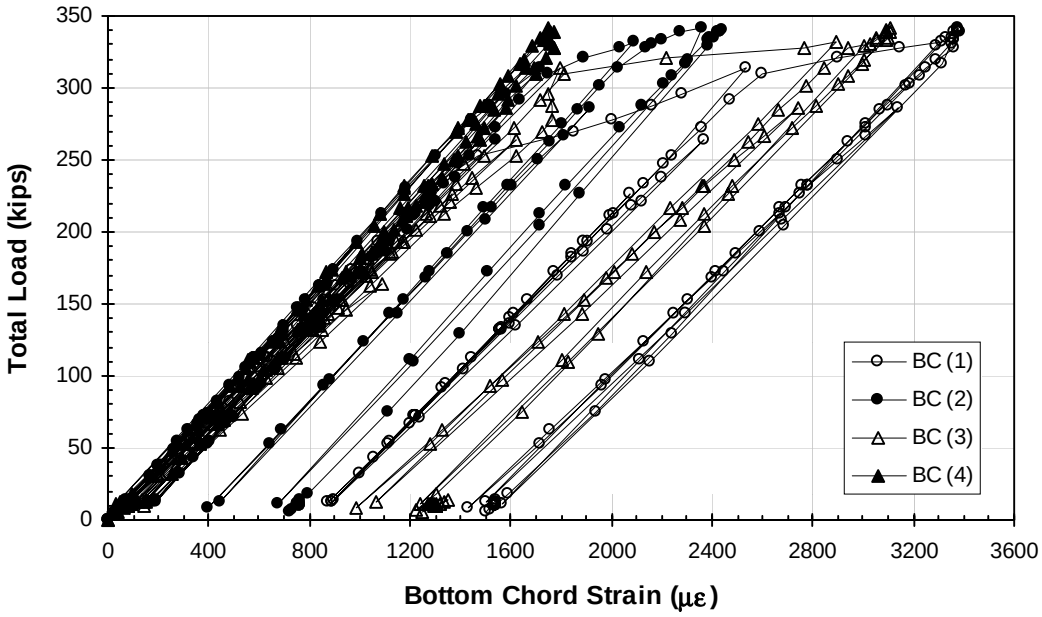


Figure B.2.6 Total Load vs. Bottom Chord Strain of IG

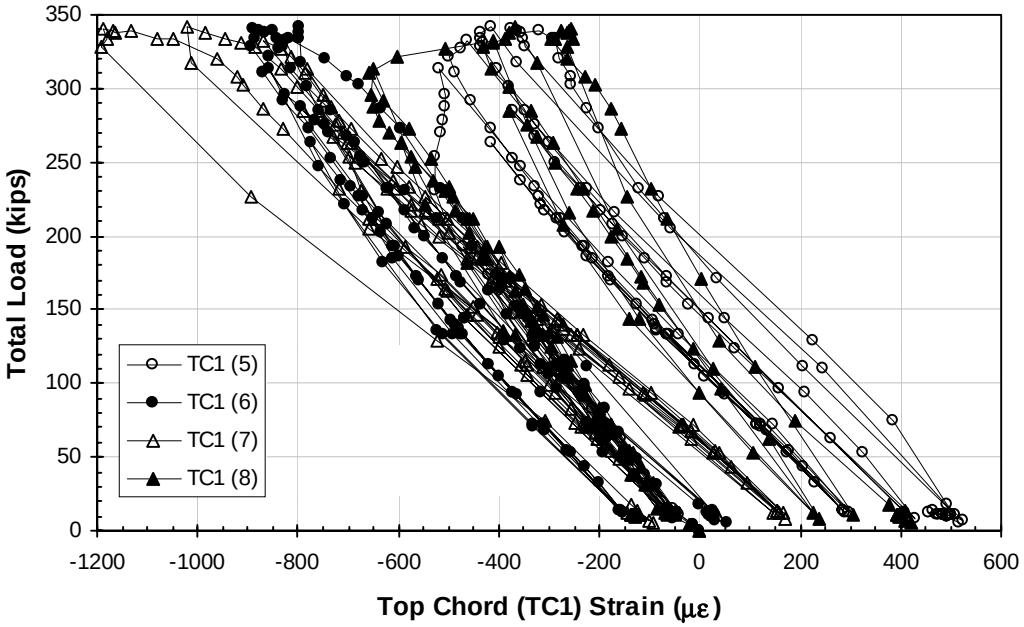


Figure B.2.7 Total Load vs. Top Chord (TC1) Strain of IG

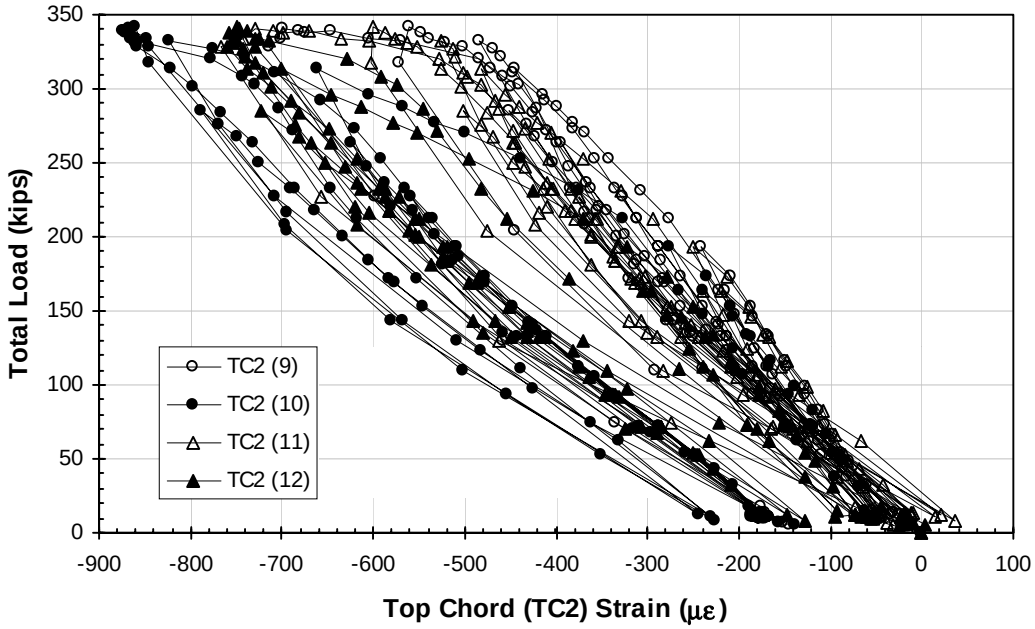


Figure B.2.8 Total Load vs. Top Chord (TC2) Strain of IG

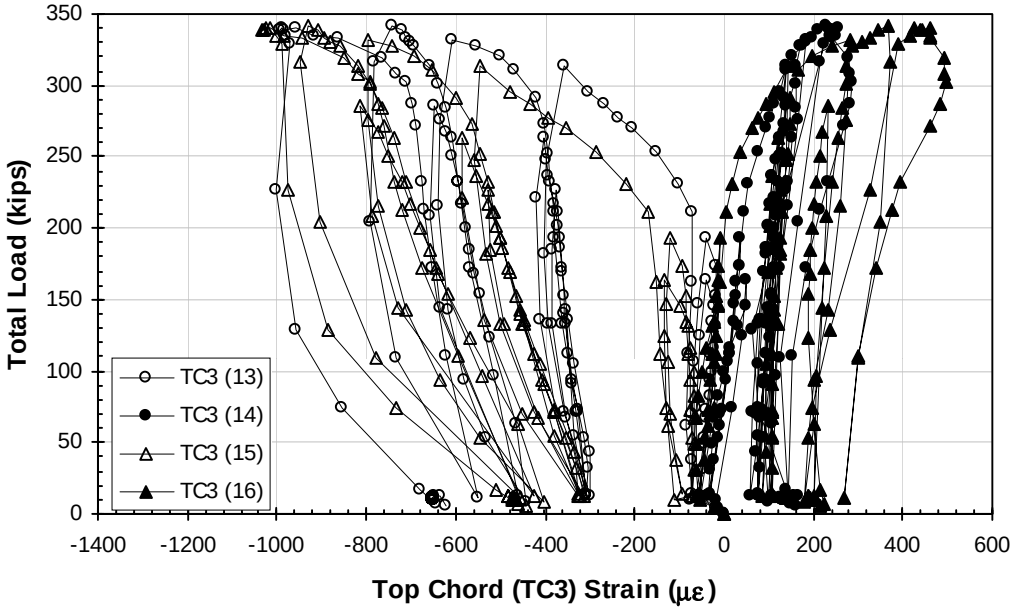


Figure B.2.9 Total Load vs. Top Chord (TC3) Strain of IG

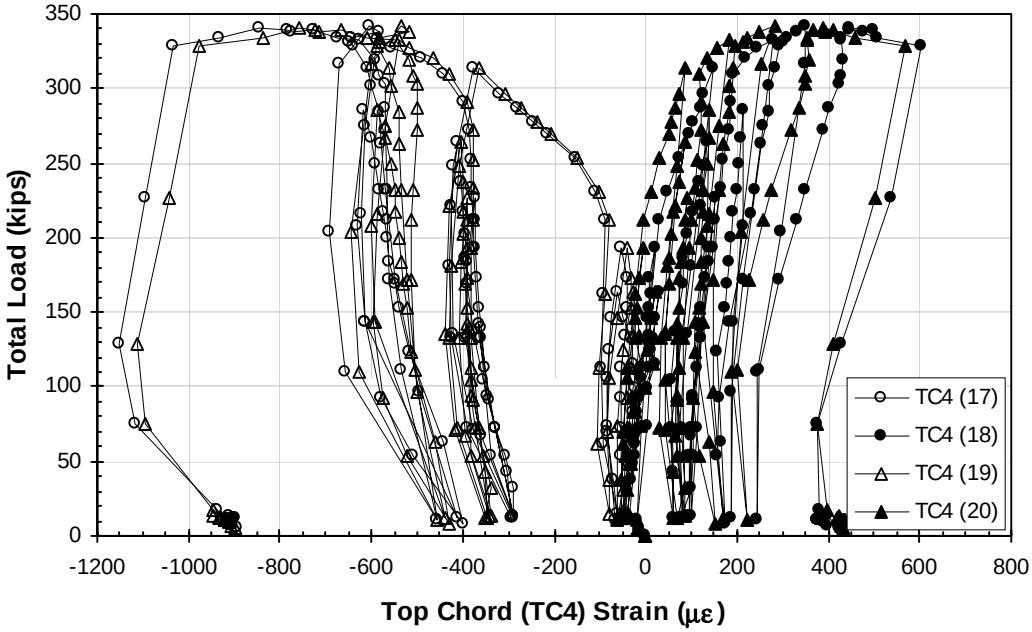


Figure B.2.10 Total Load vs. Top Chord (TC4) Strain of IG

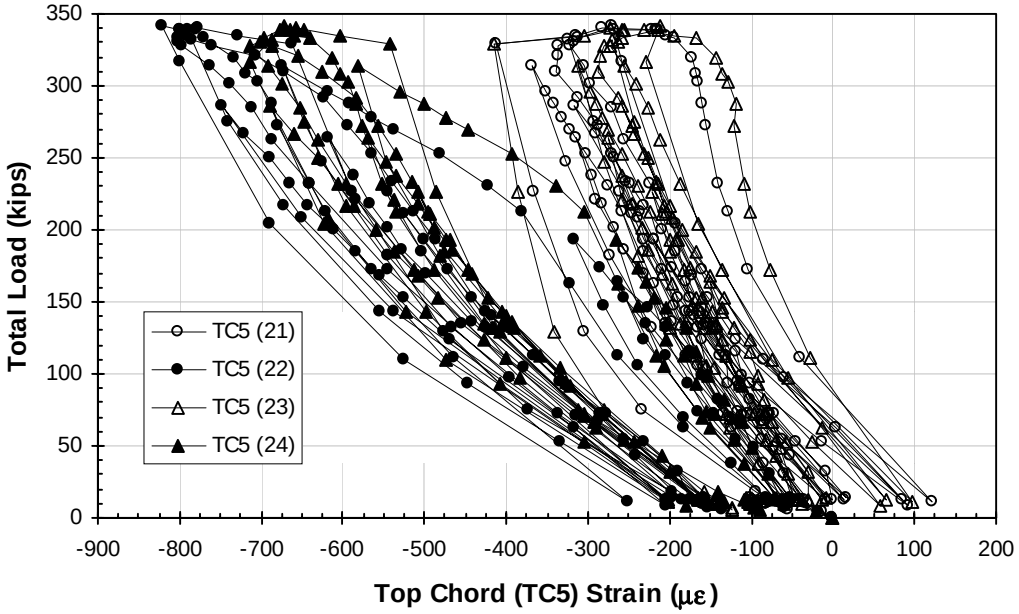


Figure B.2.11 Total Load vs. Top Chord (TC5) Strain of IG

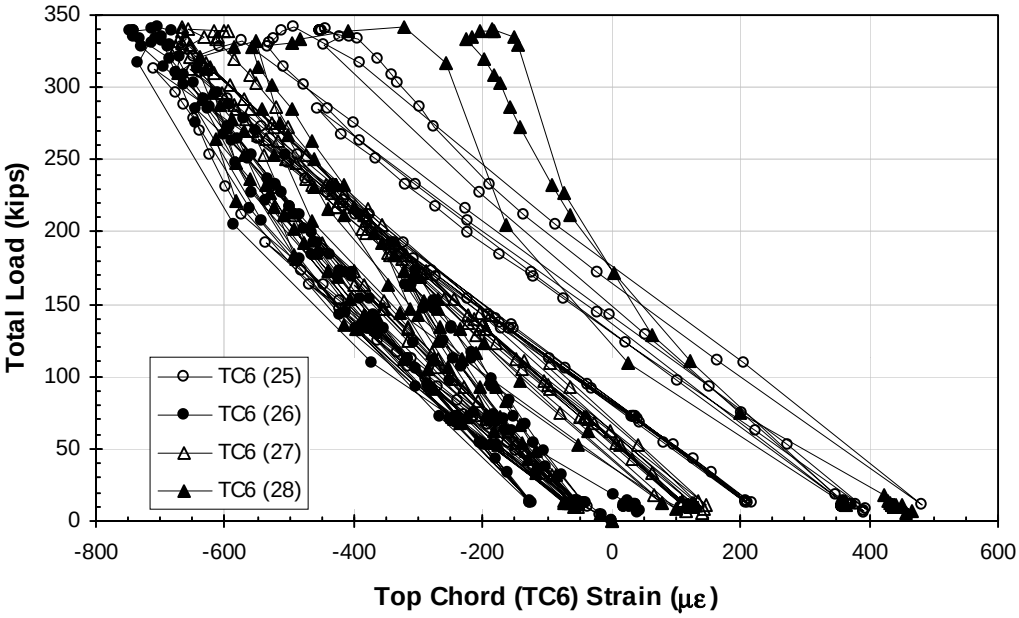


Figure B.2.12 Total Load vs. Top Chord (TC6) Strain of IG

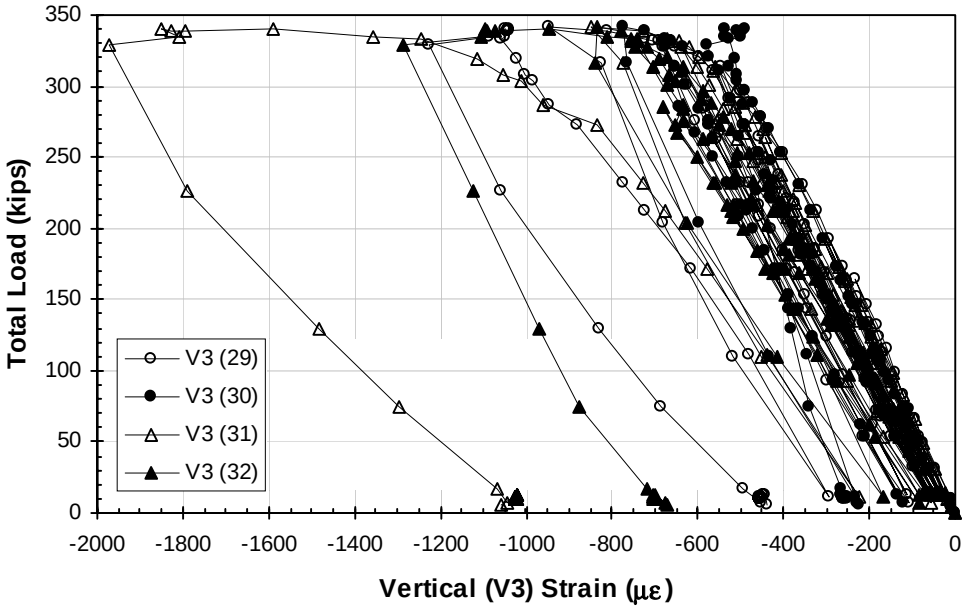


Figure B.2.13 Total Load vs. Vertical (V3) Strain of IG

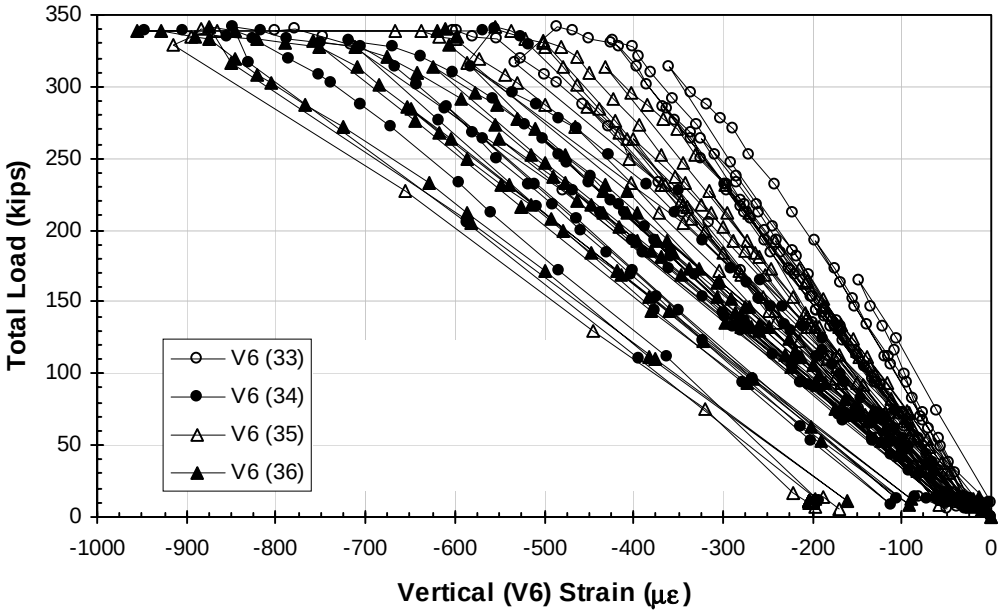


Figure B.2.14 Total Load vs. Vertical (V6) Strain of IG

COMPOSITE FLUSH FRAMED JOIST-GIRDER TEST SUMMARY SHEET

GIRDER DESIGNATION: EGR(EG4) TEST DATES: 28-30 November 1995

TEST DESCRIPTION

Joist-Girder:	Span:	30'-0"	Weight:	48.9 plf
	Depth:	30 in.	Spacing:	7 ft
	Top Chord:	2L-3.00x3.00x0.250	Yield Stress:	59.5 ksi
	Bottom Chord:	2L-4.00x4.00x0.375	Yield Stress:	60.0 ksi
Deck:	Type:	2 VL	Gage:	18 ga
Slab:	Total Depth:	5 in.	Compressive Strength:	4900 psi
Shear Connector:	Type:	3/4 in. x 4 1/2 in. Welded Headed Shear Studs		
	Quantity:	15 per half-span, 30 total		

THEORETICAL CALCULATIONS

Theoretical Max. Total Load on Joist-Girder: 189.0 kips
Theoretical Moment of Inertia: 2705 $in.^4$

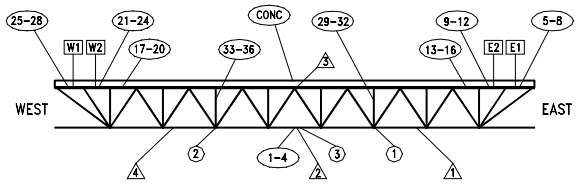
TEST RESULTS

Total Load on Joist-Girder at Failure: 165.9 kips
Maximum Total Load on Joist-Girder: 172.9 kips
Midspan Deflection at Failure: 3.1 in.
Experimental Moment of Inertia: 2944 $in.^4$
Mode of Failure: Compression buckling of web member W3R

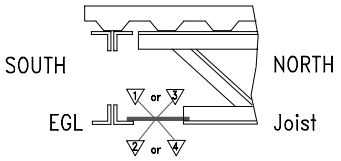
COMPARISON OF ACTUAL TO THEORETICAL

$$\frac{\text{Maximum Total Load on Joist-Girder}}{\text{Theoretical Max. Total Load on Joist-Girder}} = 0.91$$

LOCATION OF INSTRUMENTATION ON JOIST-GIRDER



Location of Strain Gages on EGL Braces:



Strain Gages:

1-4	BC	21-24	TC5
5-8	TC1	25-28	TC6
9-12	TC2	29-32	V3
13-16	TC3	33-36	V6
17-20	TC4	CONC	CONCRETE

Slips:

E1	SLIP E1
E2	SLIP E2
W1	SLIP W1
W2	SLIP W2

Strain Gages on EGL Braces:

1 BR E1 2 BR E2 3 BR W1 4 BR W2

Vertical Defl.:

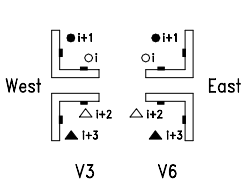
1 EQ BOTTOM
2 CL BOTTOM
3 CL TOP
4 WQ BOTTOM

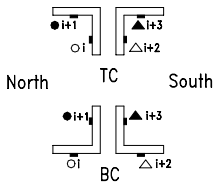
Lateral Defl.:

1 LAT E*
2 LAT W*
3 LAT M**

* Measured on EGL & EGR
** Measured on IG

Location of Strain Gages on Cross-Section:





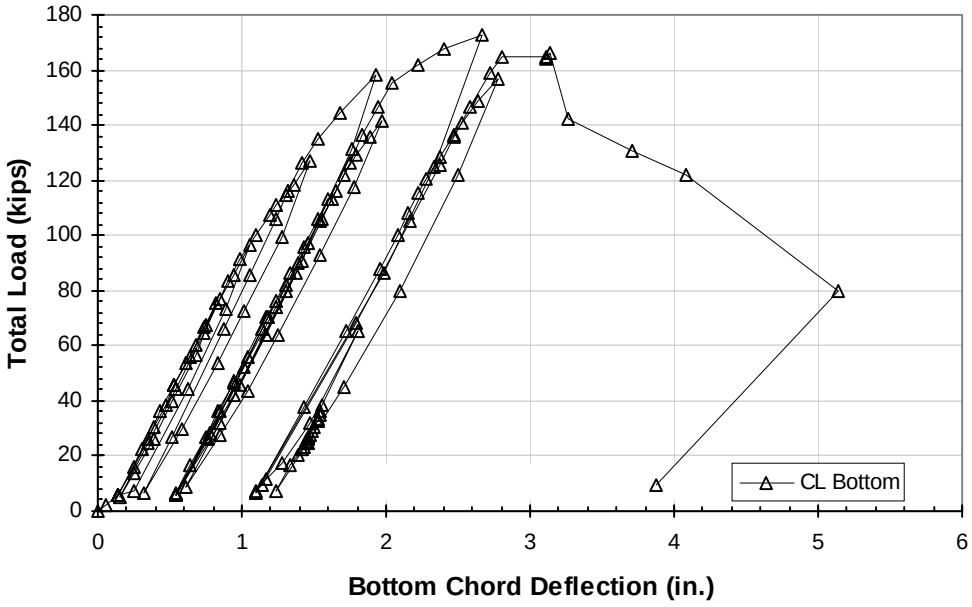


Figure B.3.1 Total Load vs. Bottom Chord Midspan Deflection of EGR

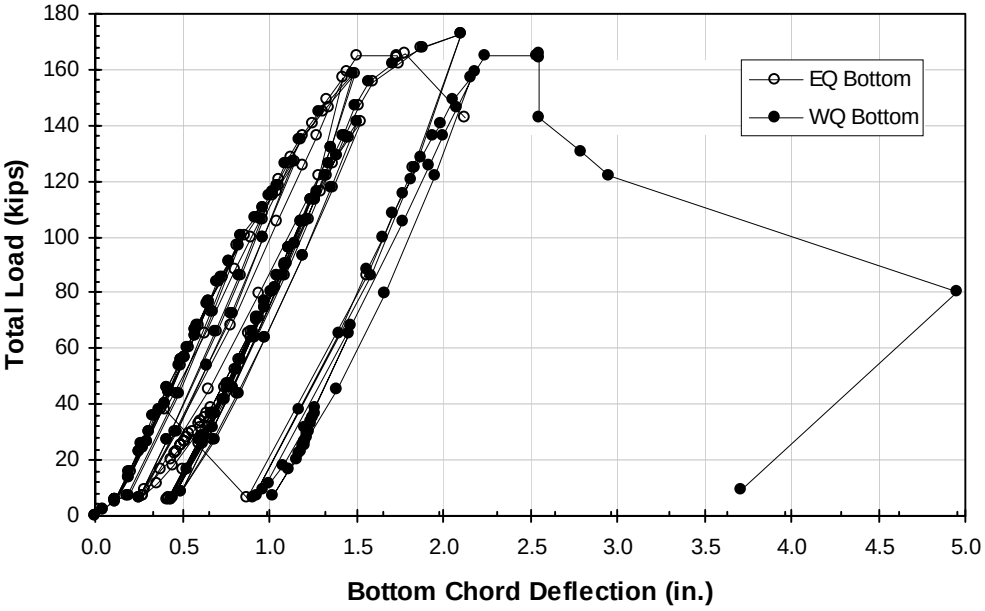


Figure B.3.2 Total Load vs. Bottom Chord Quarter Deflections of EGR

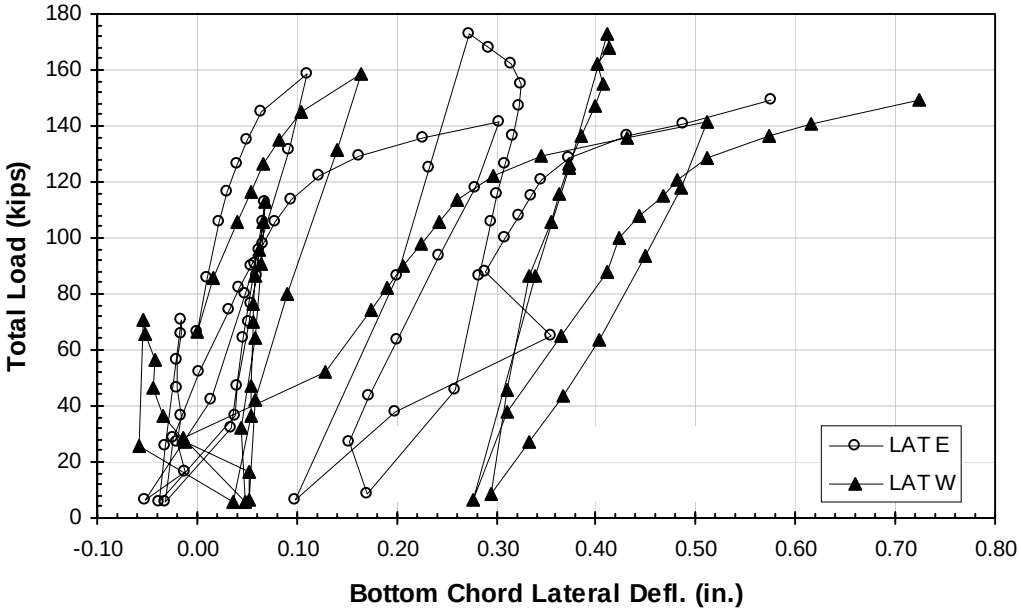


Figure B.3.3 Total Load vs. Bottom Chord Lateral Deflections of EGR

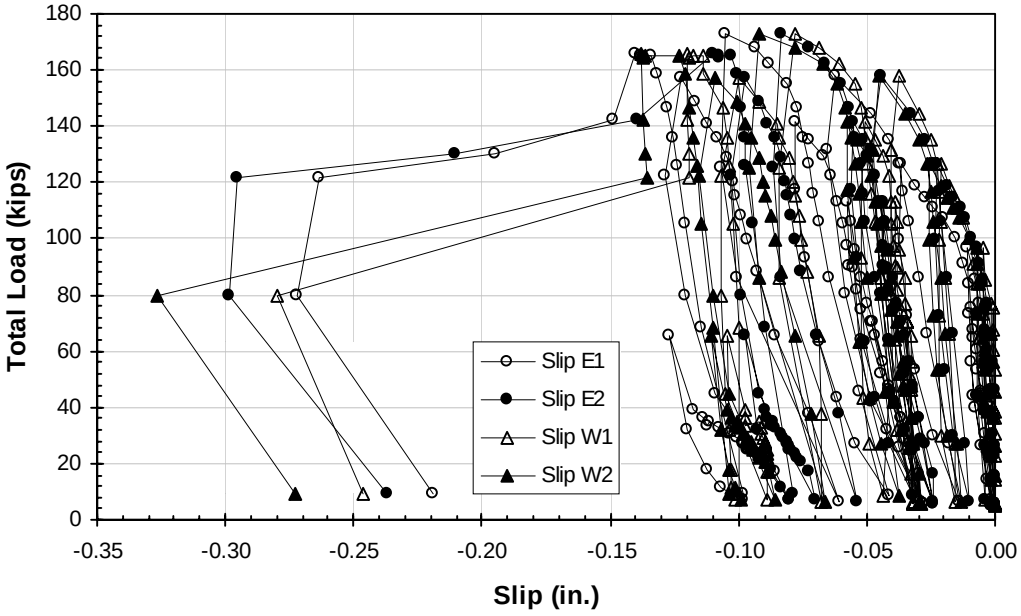


Figure B.3.4 Total Load vs. Slip of EGR

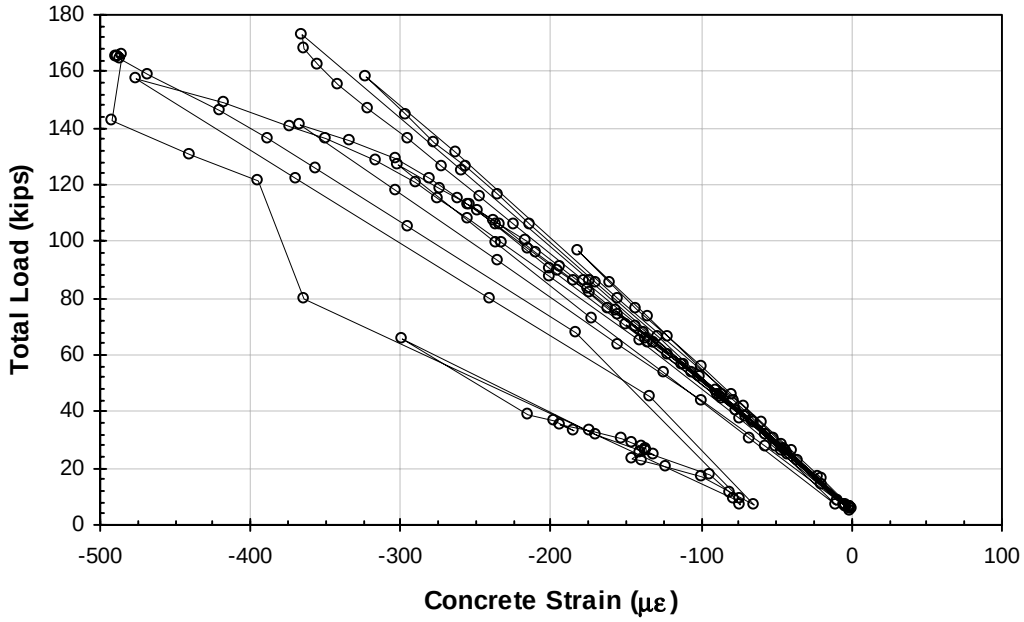


Figure B.3.5 Total Load vs. Concrete Strain of EGR

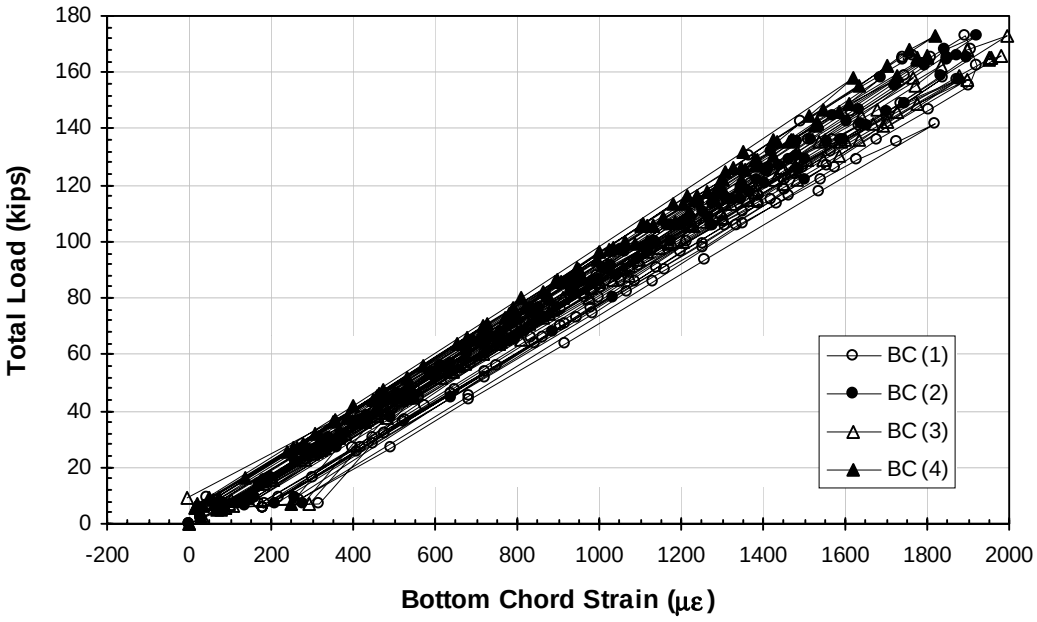


Figure B.3.6 Total Load vs. Bottom Chord Strain of EGR

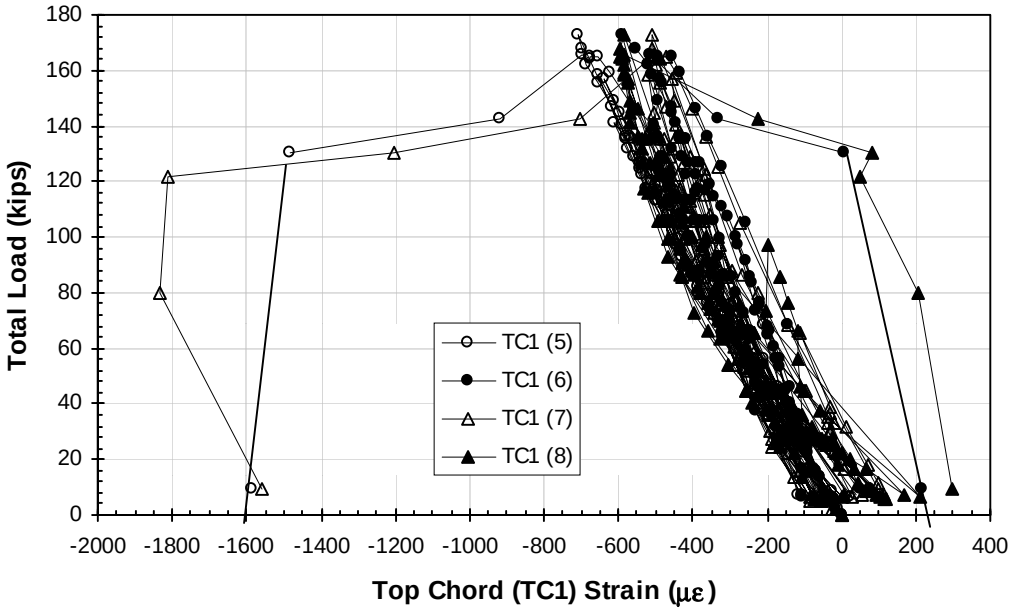


Figure B.3.7 Total Load vs. Top Chord (TC1) Strain of EGR

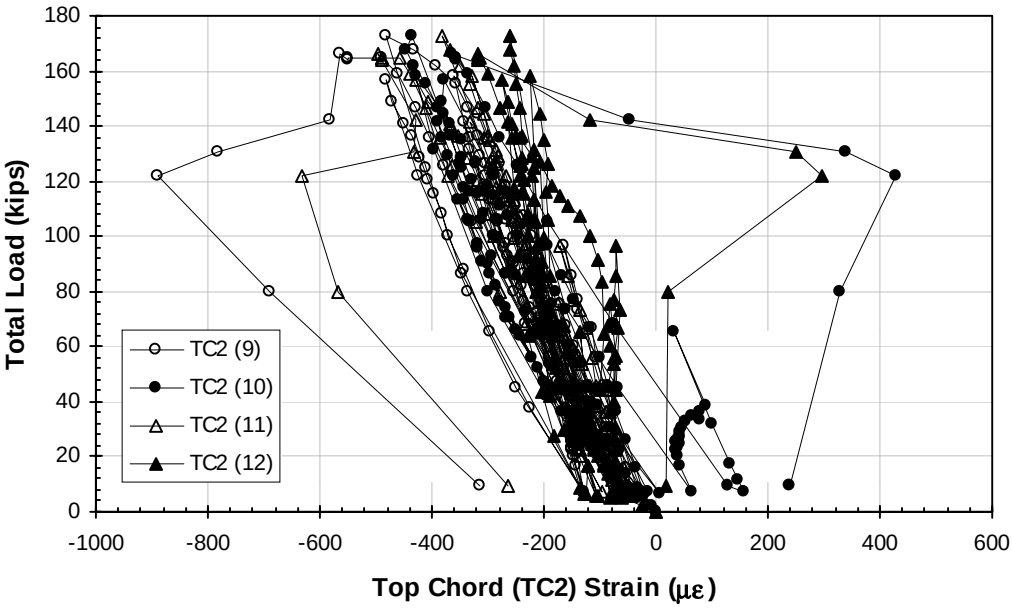


Figure B.3.8 Total Load vs. Top Chord (TC2) Strain of EGR

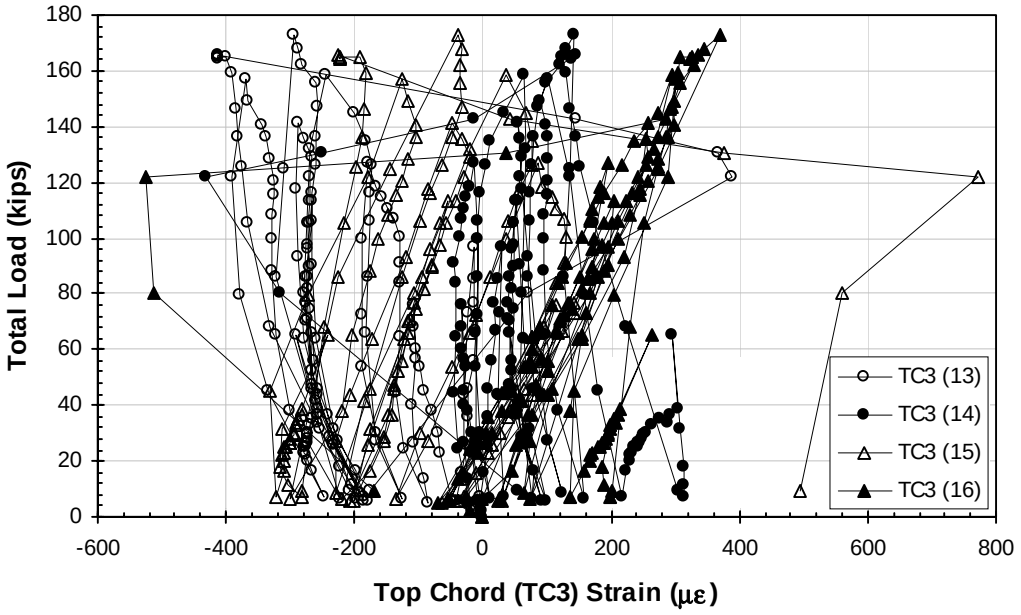


Figure B.3.9 Total Load vs. Top Chord (TC3) Strain of EGR

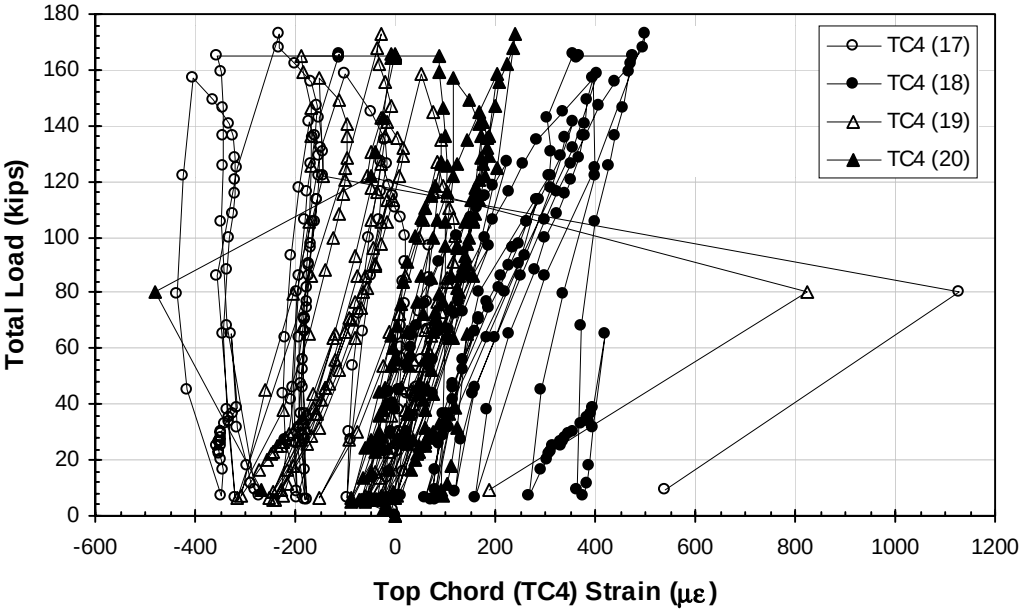


Figure B.3.10 Total Load vs. Top Chord (TC4) Strain of EGR

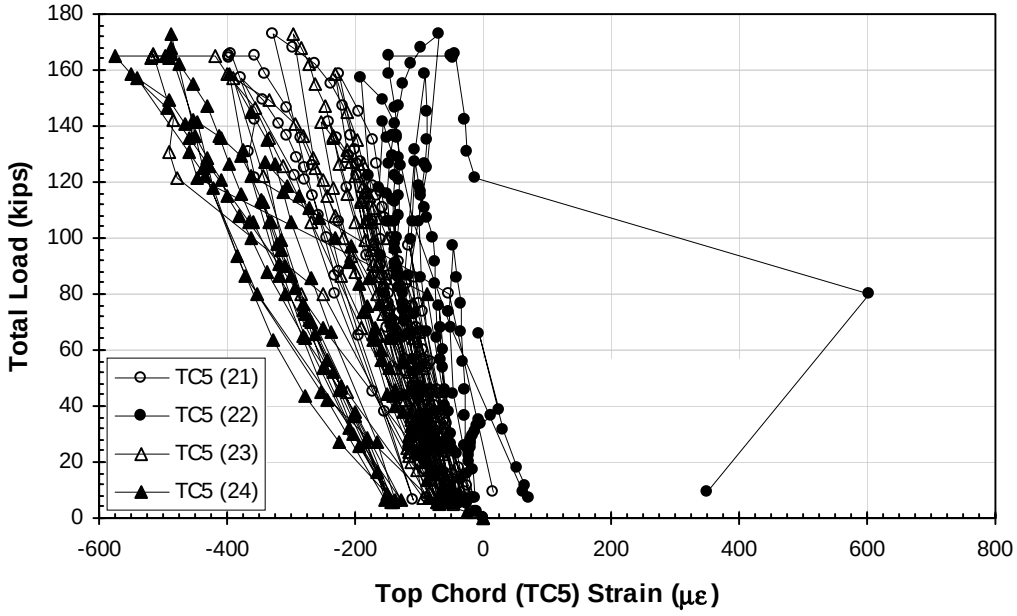


Figure B.3.11 Total Load vs. Top Chord (TC5) Strain of EGR

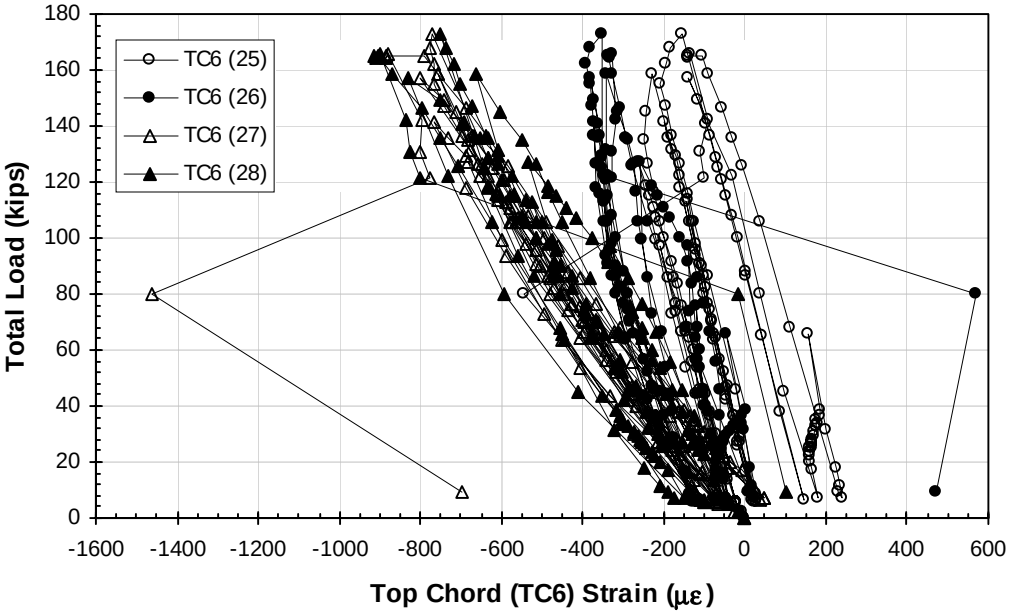


Figure B.3.12 Total Load vs. Top Chord (TC6) Strain of EGR

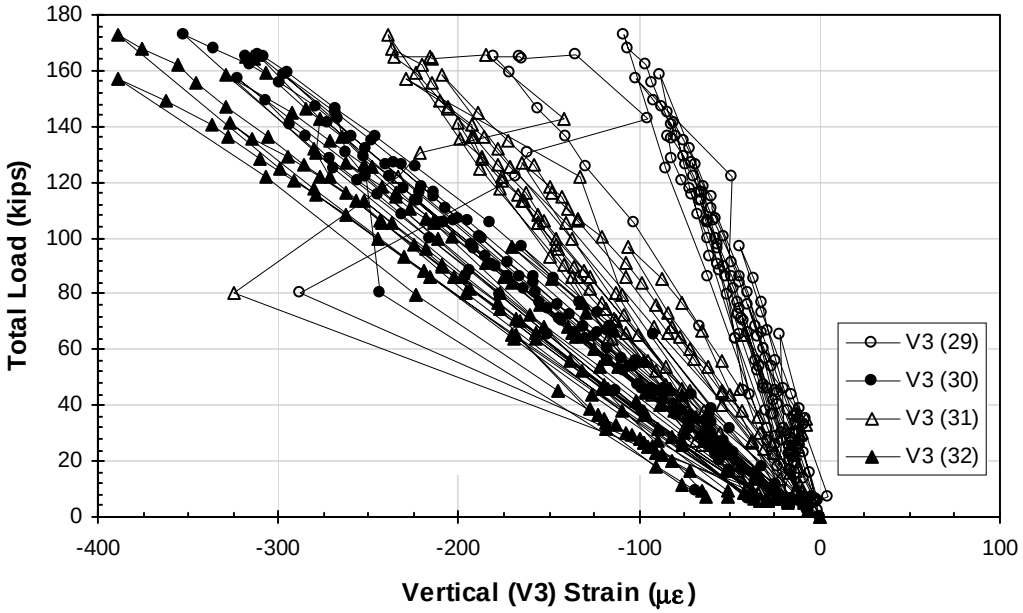


Figure B.3.13 Total Load vs. Vertical (V3) Strain of EGR

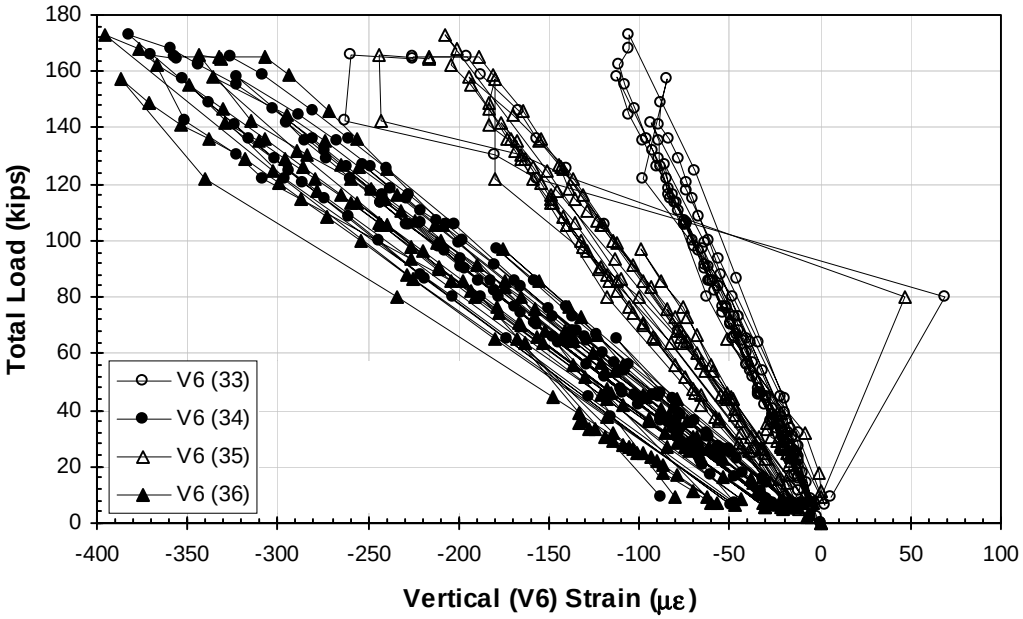


Figure B.3.14 Total Load vs. Vertical (V6) Strain of EGR

COMPOSITE STUB JOIST-GIRDER TEST SUMMARY SHEET

GIRDER DESIGNATION: EGL TEST DATES: 4-6 June 1996

TEST DESCRIPTION

Joist-Girder:	Span:	30'-0"	Weight:	52.8 plf
	Depth:	25 in.	Spacing:	7 ft
	Top Chord:	2L-3.00x3.00x0.250	Yield Stress:	50.1 ksi
	Bottom Chord:	2L-4.00x4.00x0.375	Yield Stress:	54.6 ksi
	Stub:	S5x10	Yield Stress:	49.0 ksi
Deck:	Type:	2 VL	Gage:	18 ga
Slab:	Total Depth:	5 in.	Compressive Strength:	3000 psi
Shear Connector:	Type:	3/4 in. x 4 1/2 in. Welded Headed Shear Studs		
	Quantity:	14 per half-span, 28 total		

THEORETICAL CALCULATIONS

Theoretical Max. Total Load per Joist-Girder: 169.7 kips

Theoretical Moment of Inertia: 3077 $in.^4$

TEST RESULTS

Total Load per Joist-Girder at Failure: 148.7 kips

Maximum Total Load per Joist-Girder: 148.7 kips

Midspan Deflection at Failure: 3.19 in.

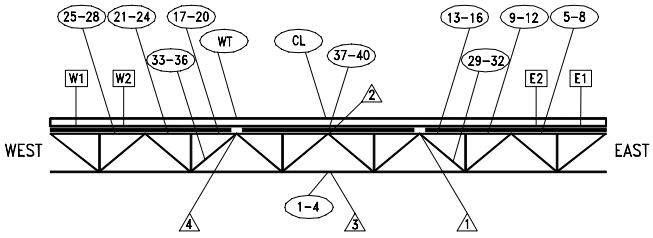
Experimental Moment of Inertia: 3096 $in.^4$

Mode of Failure: Loss of shear connection along east third of span

COMPARISON OF ACTUAL TO THEORETICAL

$$\frac{\text{Maximum Total Load per Joist-Girder}}{\text{Theoretical Max. Total Load per Joist-Girder}} = 0.88$$

INSTRUMENTATION LOCATIONS



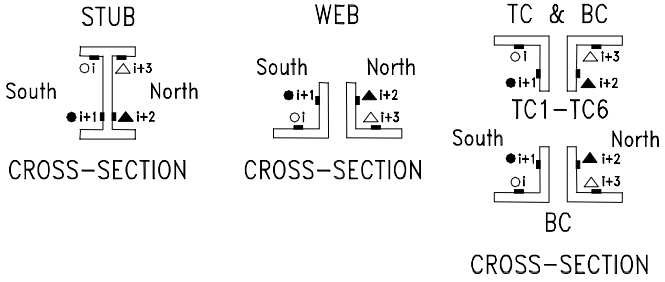
Strain Gages:

1-4	BC	25-28	TC6
5-8	TC1		
9-12	TC2	29-32	W5R
13-16	TC3	33-36	W5
17-20	TC4		
21-24	TC5	37-40	STUB

CL CONCRETE CL

WT CONCRETE WT

Location of Strain Gages on Cross-Section:



Slips:

E1 SLIP-E1

E2 SLIP-E2

W1 SLIP-W1

W2 SLIP-W2

Vert. Defl.:

1 ET TOP

2 CL TOP

3 CL BOTTOM

4 WT TOP

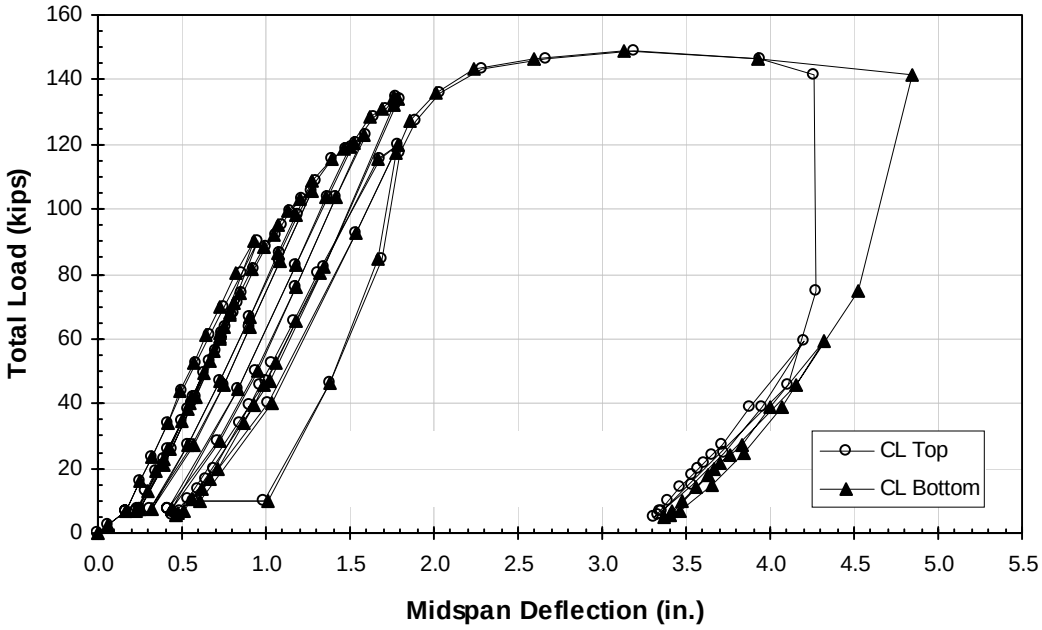


Figure B.4.1 Total Load vs. Midspan Deflections of EGL

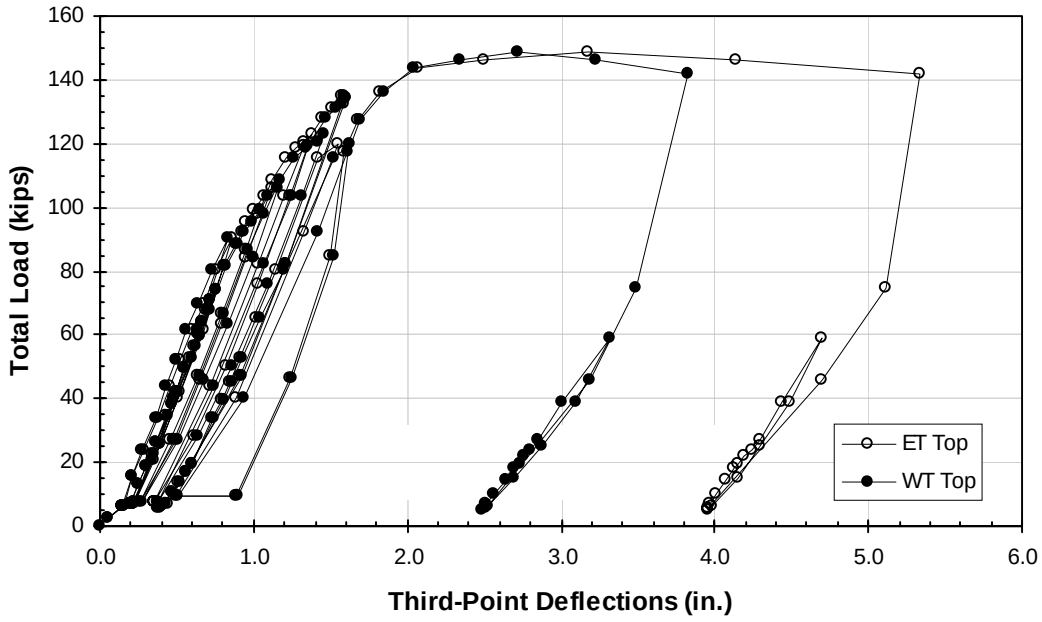


Figure B.4.2 Total Load vs. Third-Point Deflections of EGL

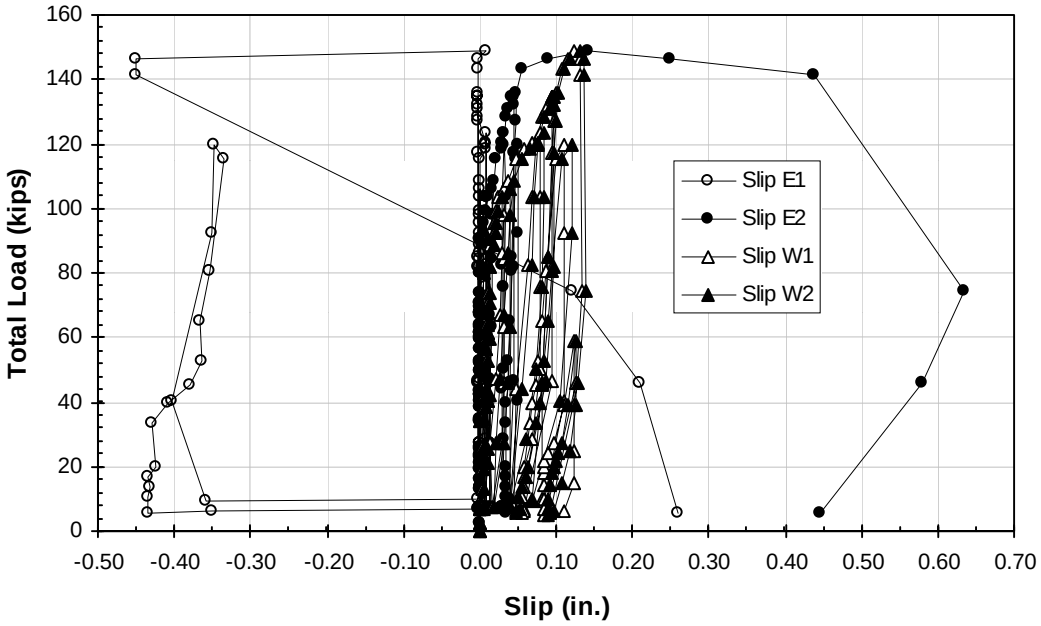


Figure B.4.3 Total Load vs. Slip of EGL

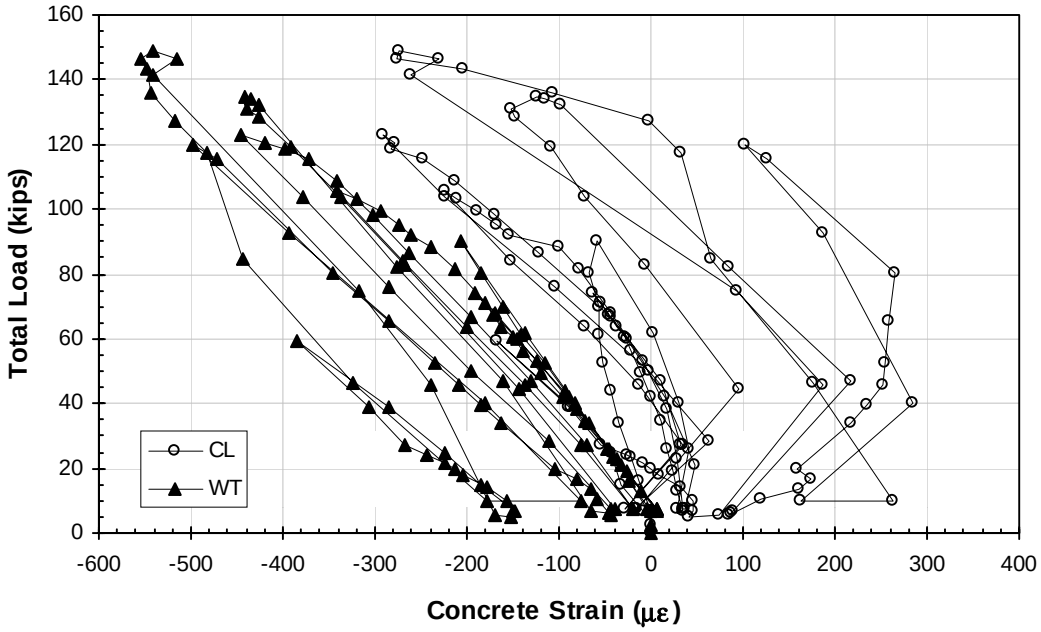


Figure B.4.4 Total Load vs. Concrete Strain of EGL

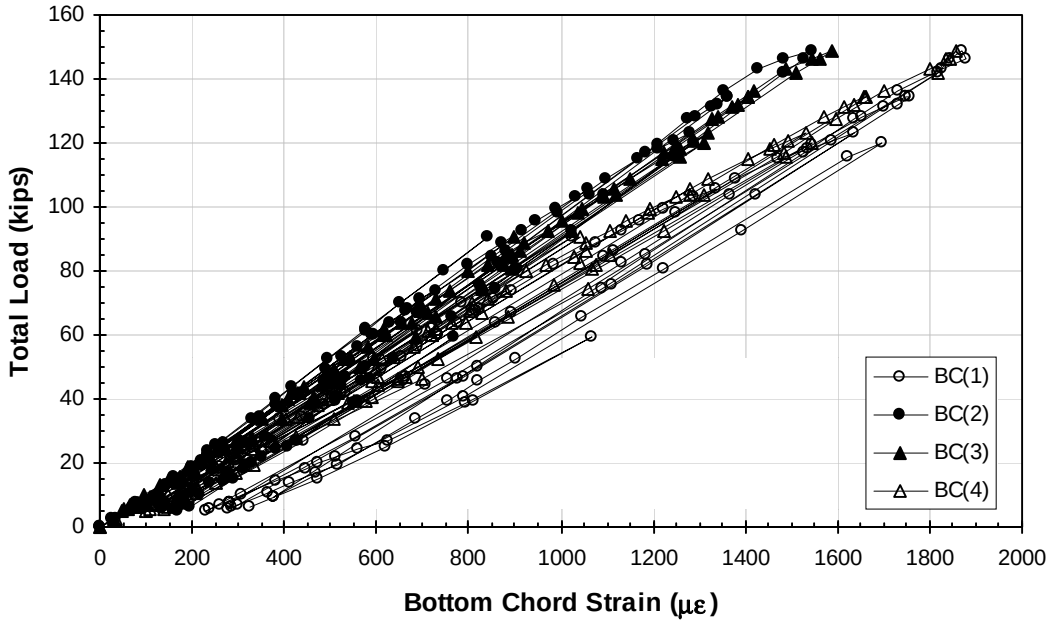


Figure B.4.5 Total Load vs. Bottom Chord Strain of EGL

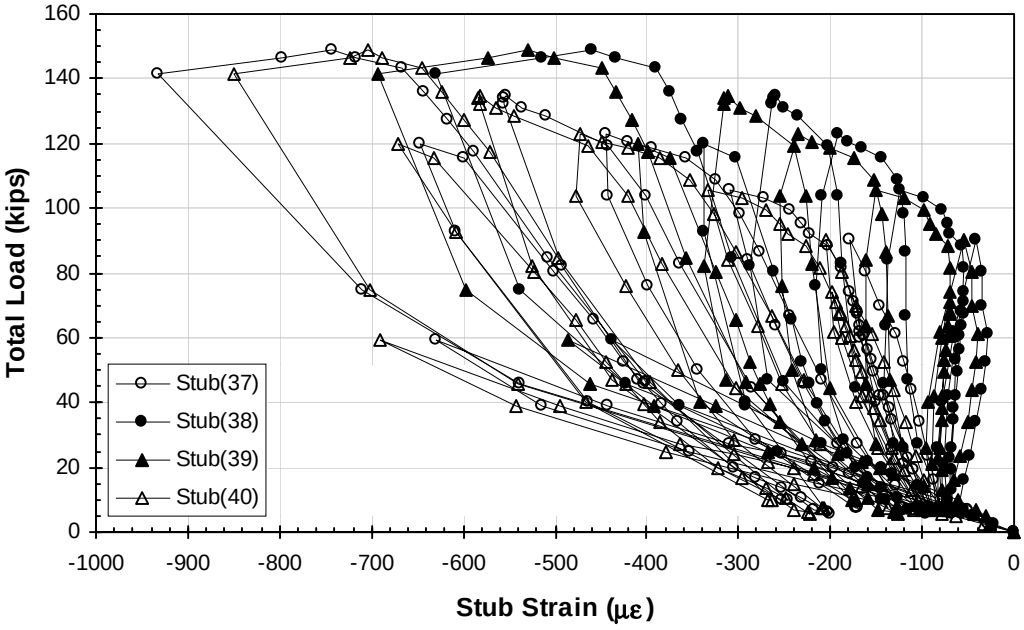


Figure B.4.6 Total Load vs. Stub Strain of EGL

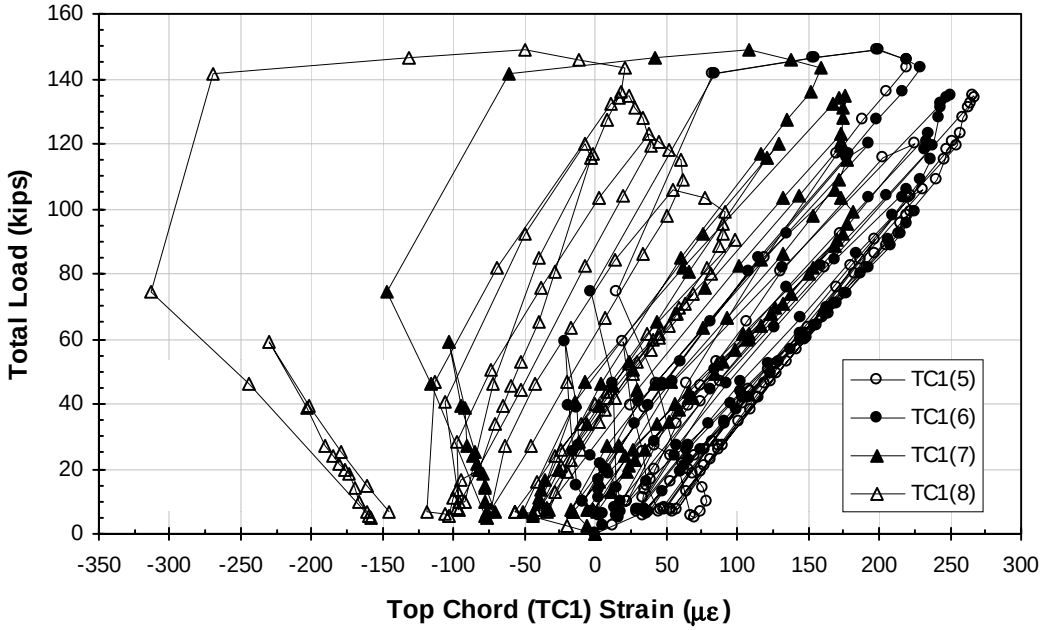


Figure B.4.7 Total Load vs. Top Chord (TC1) Strain of EGL

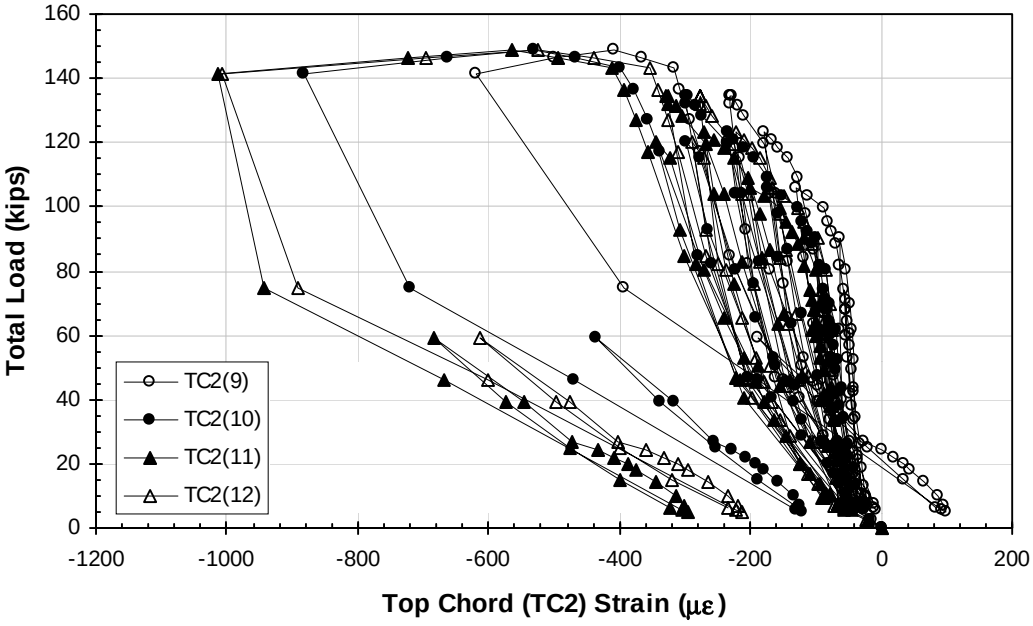


Figure B.4.8 Total Load vs. Top Chord (TC2) Strain of EGL

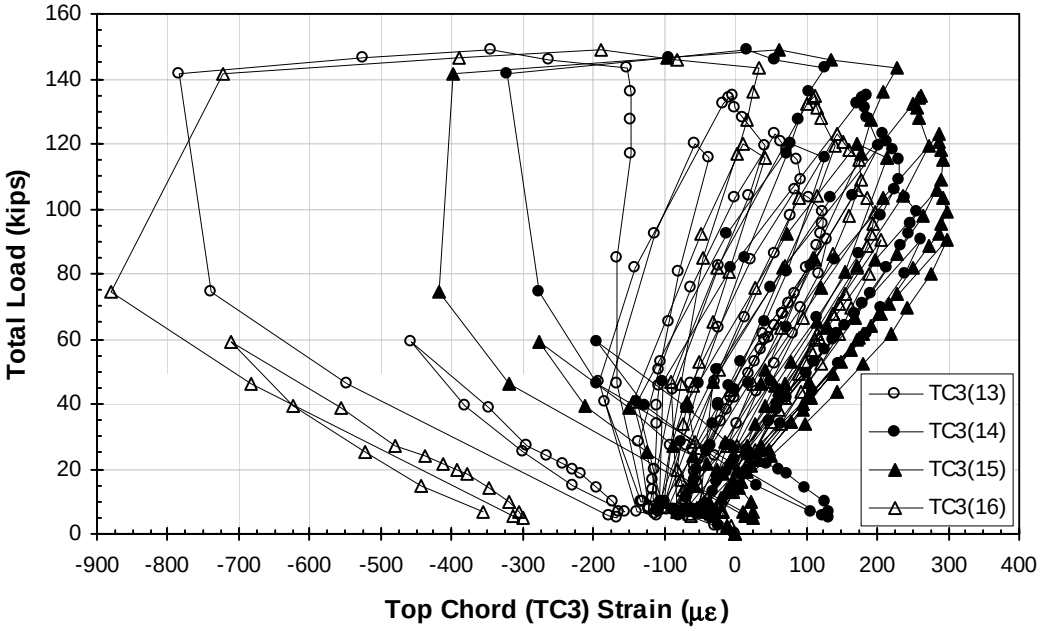


Figure B.4.9 Total Load vs. Top Chord (TC3) Strain of EGL

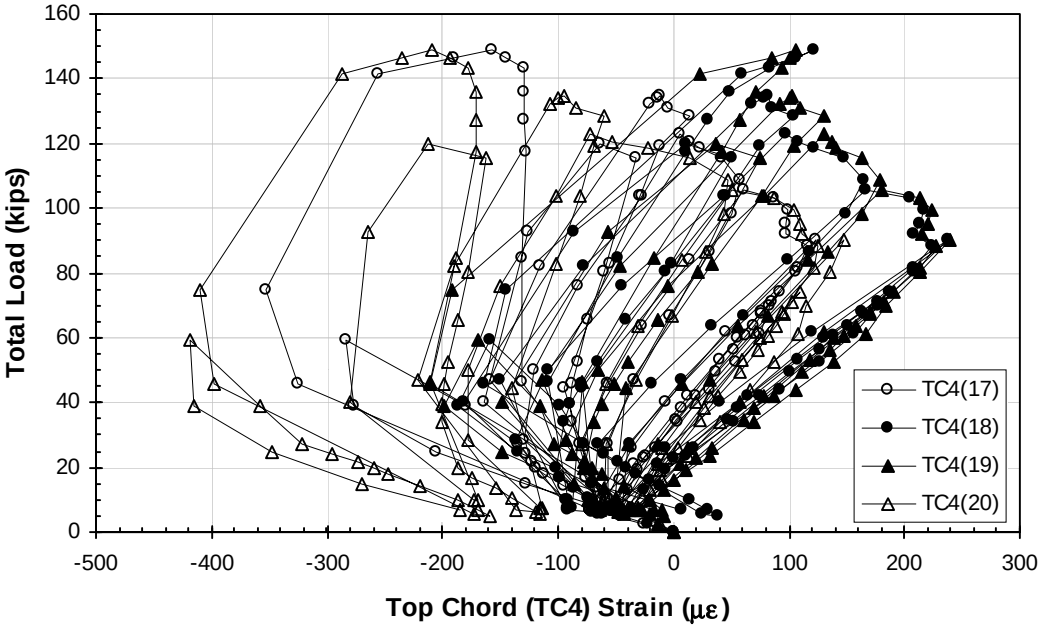


Figure B.4.10 Total Load vs. Top Chord (TC4) Strain of EGL

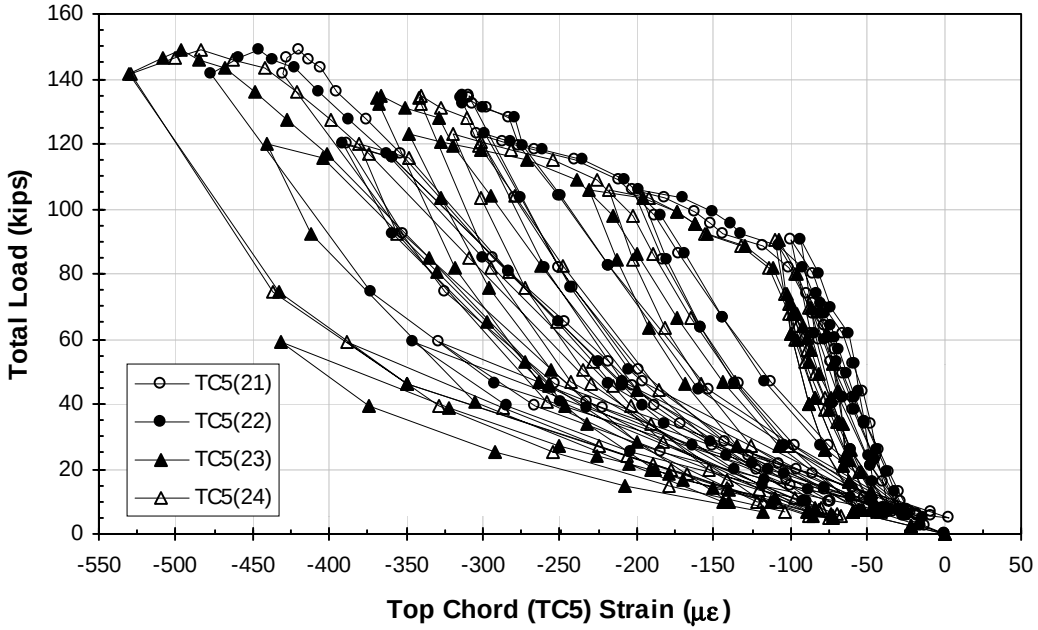


Figure B.4.11 Total Load vs. Top Chord (TC5) Strain of EGL

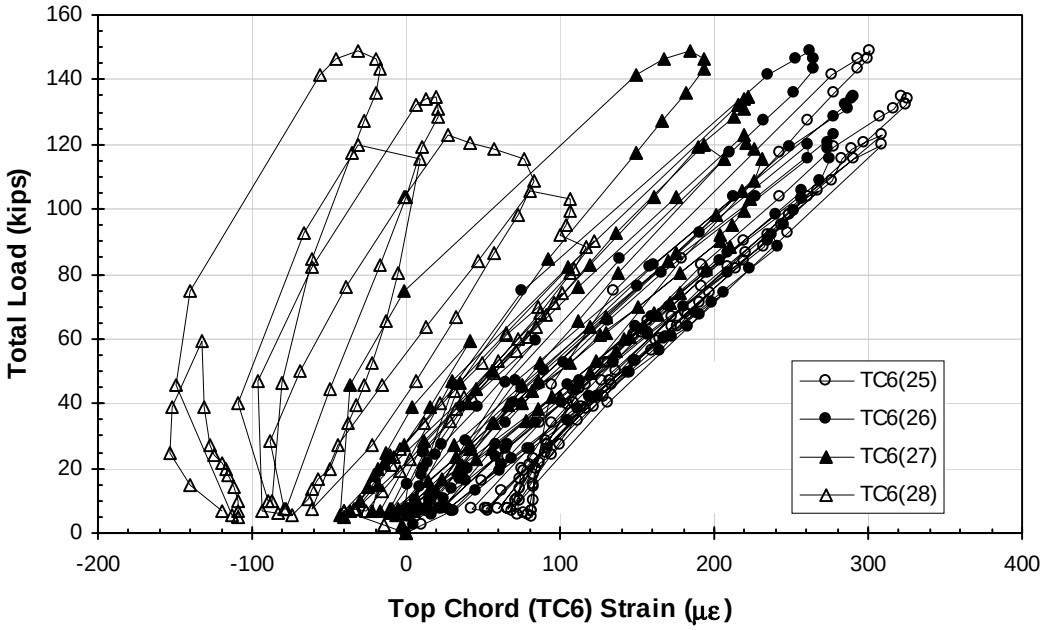


Figure B.4.12 Total Load vs. Top Chord (TC6) Strain of EGL

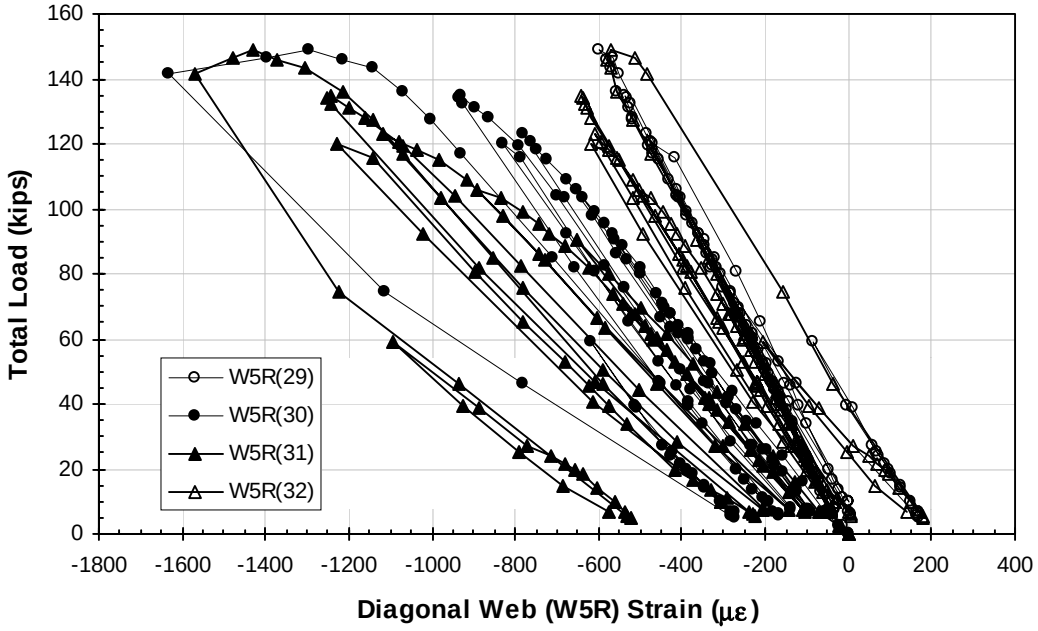


Figure B.4.13 Total Load vs. Diagonal Web (W5R) Strain of EGL

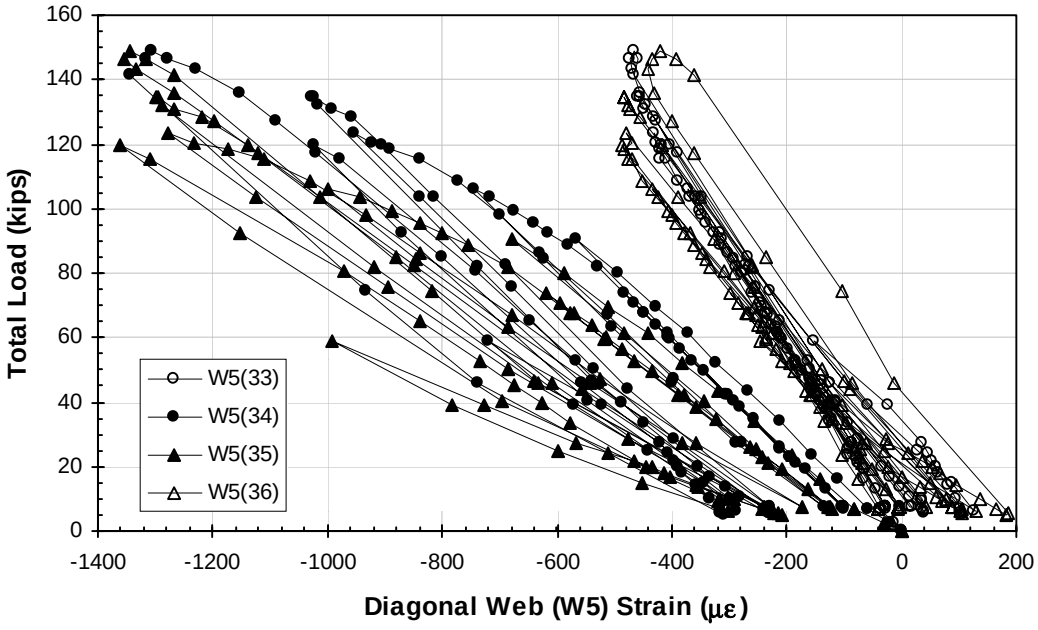


Figure B.4.14 Total Load vs. Diagonal Web (W5) Strain of EGL

COMPOSITE STUB JOIST-GIRDER TEST SUMMARY SHEET

GIRDER DESIGNATION: IG TEST DATES: 4-6 June 1996

TEST DESCRIPTION

Joist-Girder:	Span:	30'-0"	Weight:	94.4 plf
	Depth:	25 in.	Spacing:	7 ft
	Top Chord:	2L-4.00x4.00x0.375		
	Bottom Chord:	2L-5.00x5.00x0.625	Yield Stress:	59.4 ksi
	Stub:	S5x10		
Deck:	Type:	2 VL	Gage:	18 ga
Slab:	Total Depth:	5 in.	Compressive Strength:	3000 psi
Shear Connector:	Type:	3/4 in. x 4 1/2 in. Welded Headed Shear Studs		
	Quantity:	28 per half-span, 56 total		

THEORETICAL CALCULATIONS

Theoretical Max. Total Load on Joist-Girder: 370.6 kips

Theoretical Moment of Inertia: 5930 $in.^4$

TEST RESULTS

Total Load on Joist-Girder at Failure: 299.0 kips

Maximum Total Load on Joist-Girder: 299.0 kips

Midspan Deflection at Failure: 3.87 in.

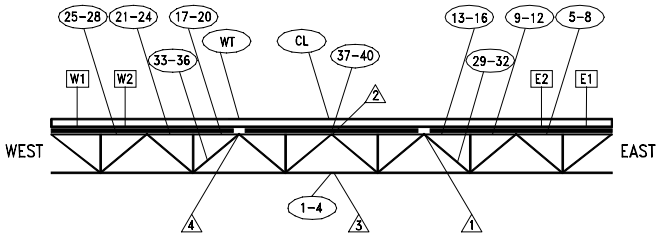
Experimental Moment of Inertia: 5709 $in.^4$

Mode of Failure: Crushing of concrete at load points

COMPARISON OF ACTUAL TO THEORETICAL

$$\frac{\text{Maximum Total Load on Joist-Girder}}{\text{Theoretical Max. Total Load on Joist-Girder}} = 0.81$$

INSTRUMENTATION LOCATIONS



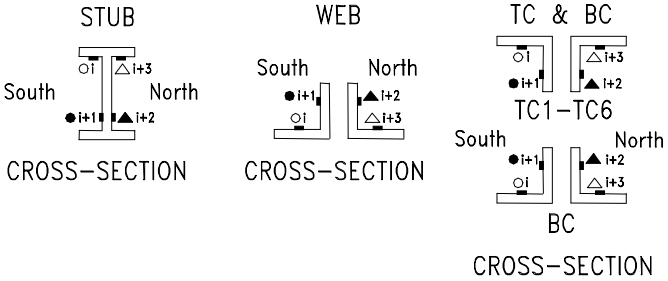
Strain Gages:

1-4	BC	25-28	TC6
5-8	TC1		
9-12	TC2	29-32	W5R
13-16	TC3	33-36	W5
17-20	TC4		
21-24	TC5	37-40	STUB

CL CONCRETE CL

WT CONCRETE WT

Location of Strain Gages on Cross-Section:



Slips:

E1	SLIP-E1
E2	SLIP-E2
W1	SLIP-W1
W2	SLIP-W2

Vert. Defl.:

1	ET TOP
2	CL TOP
3	CL BOTTOM
4	WT TOP

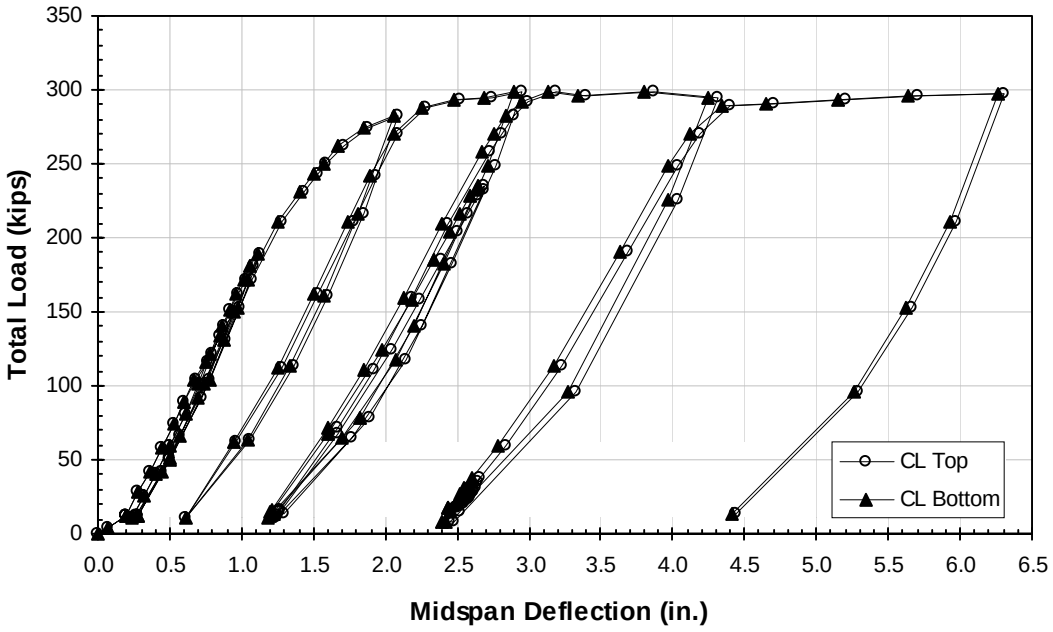


Figure B.5.1 Total Load vs. Midspan Deflections of IG

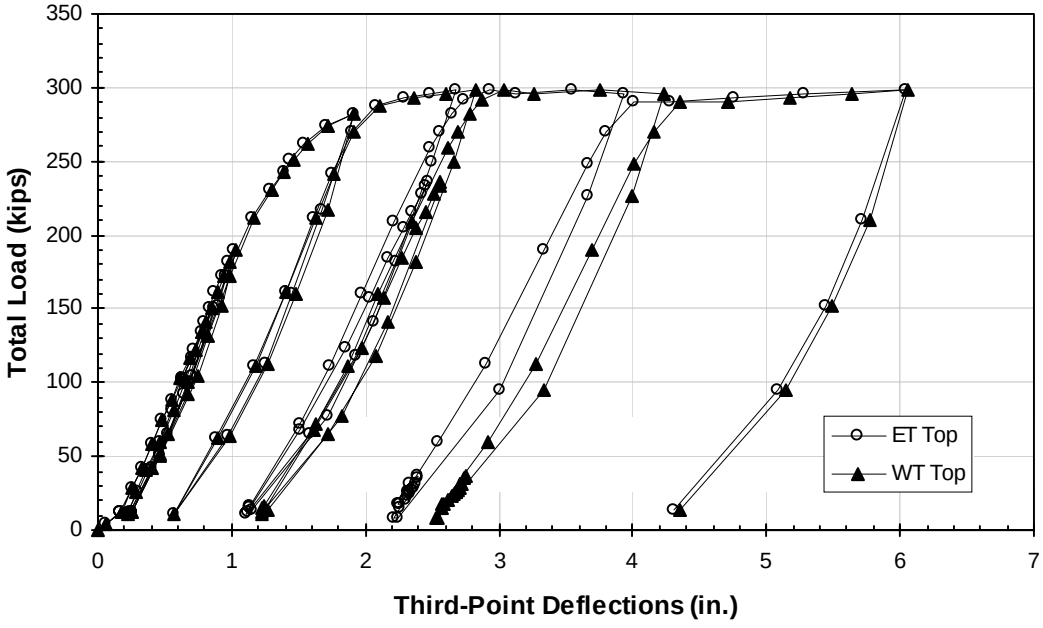


Figure B.5.2 Total Load vs. Third-Point Deflections of IG

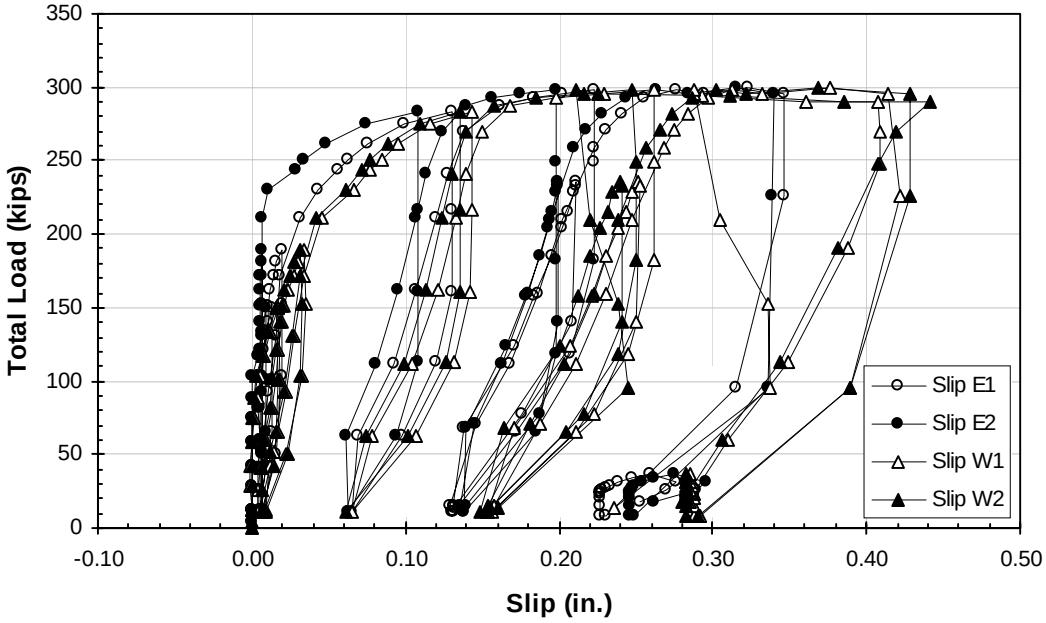


Figure B.5.3 Total Load vs. Slip of IG

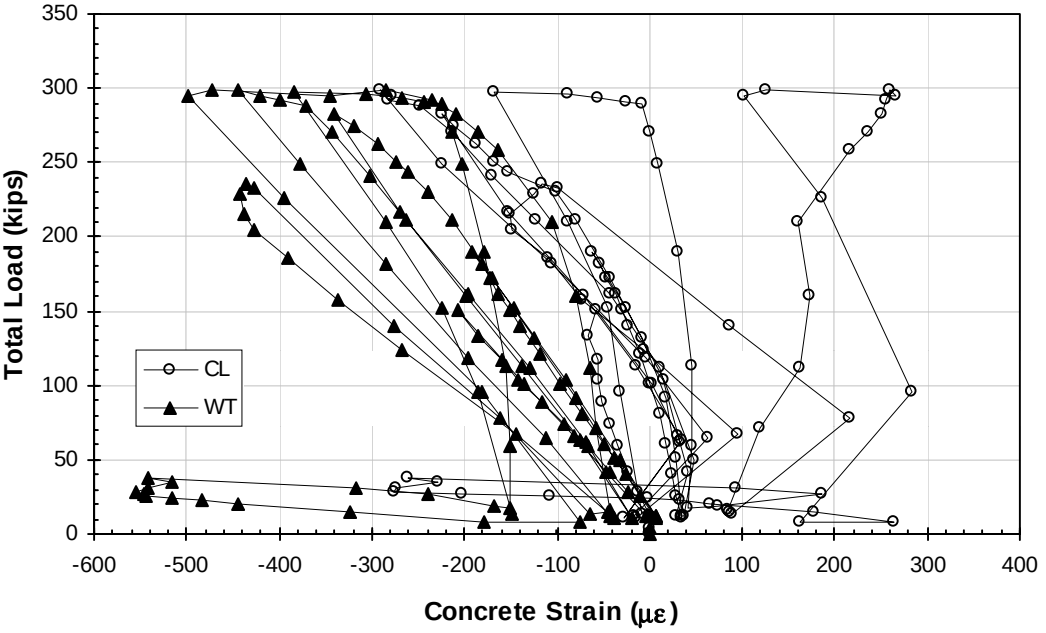


Figure B.5.4 Total Load vs. Concrete Strain of IG

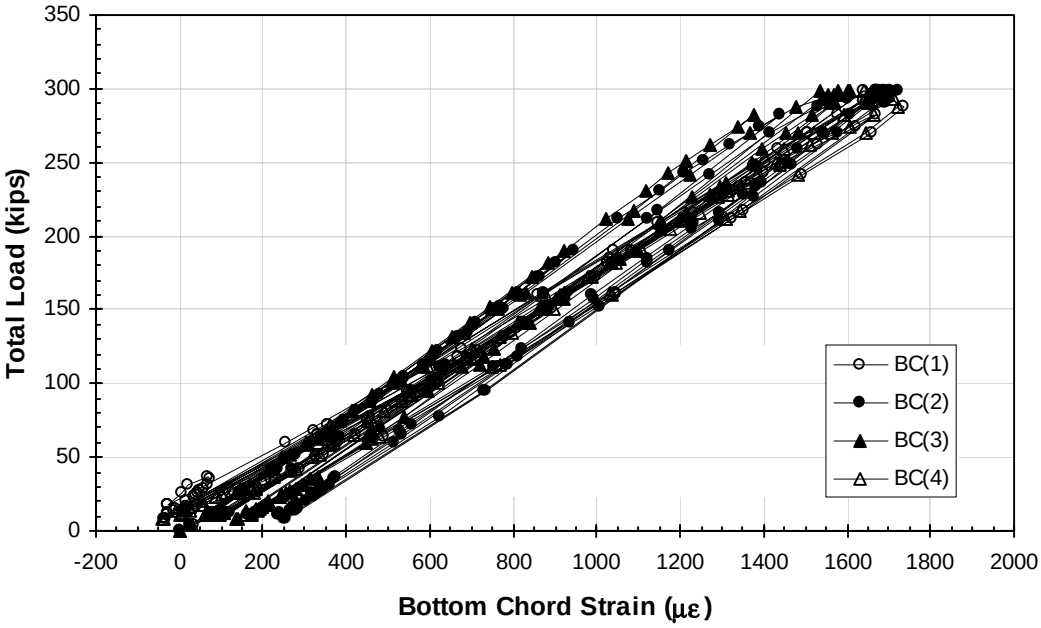


Figure B.5.5 Total Load vs. Bottom Chord Strain of IG

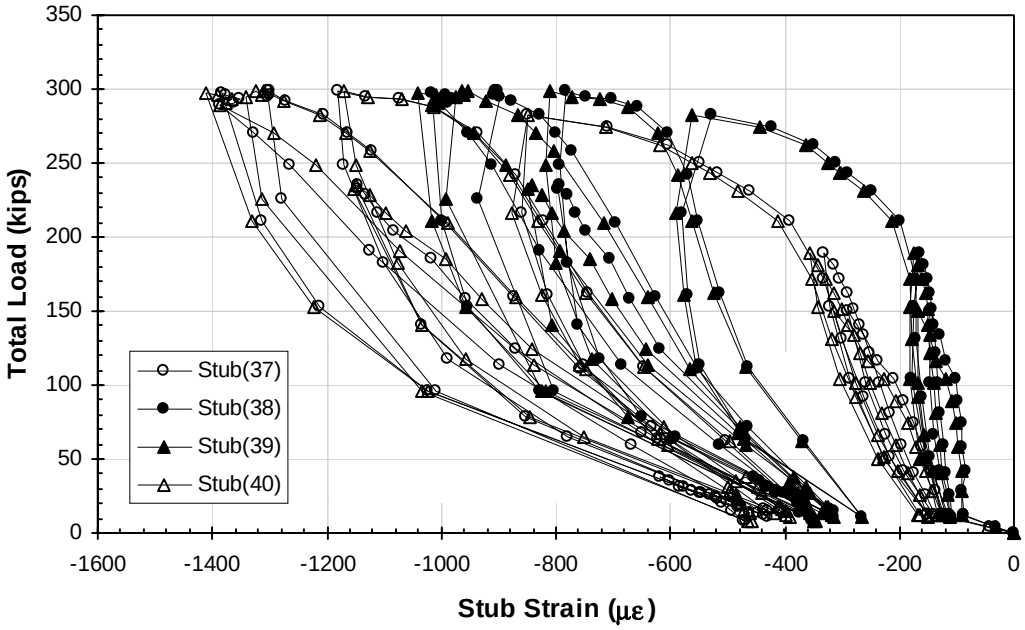


Figure B.5.6 Total Load vs. Stub Strain of IG

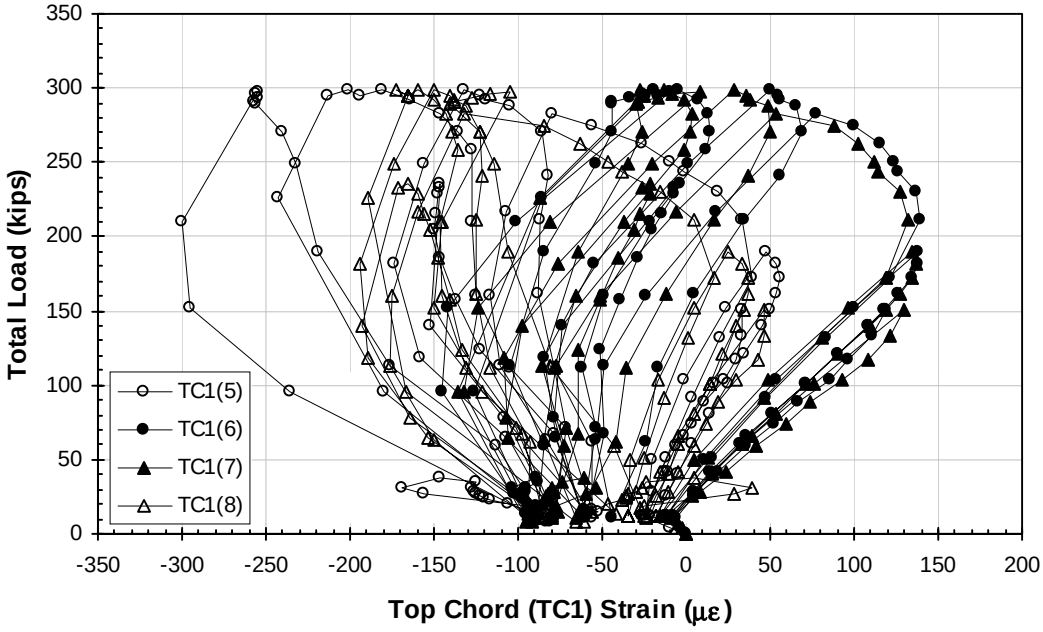


Figure B.5.7 Total Load vs. Top Chord (TC1) Strain of IG

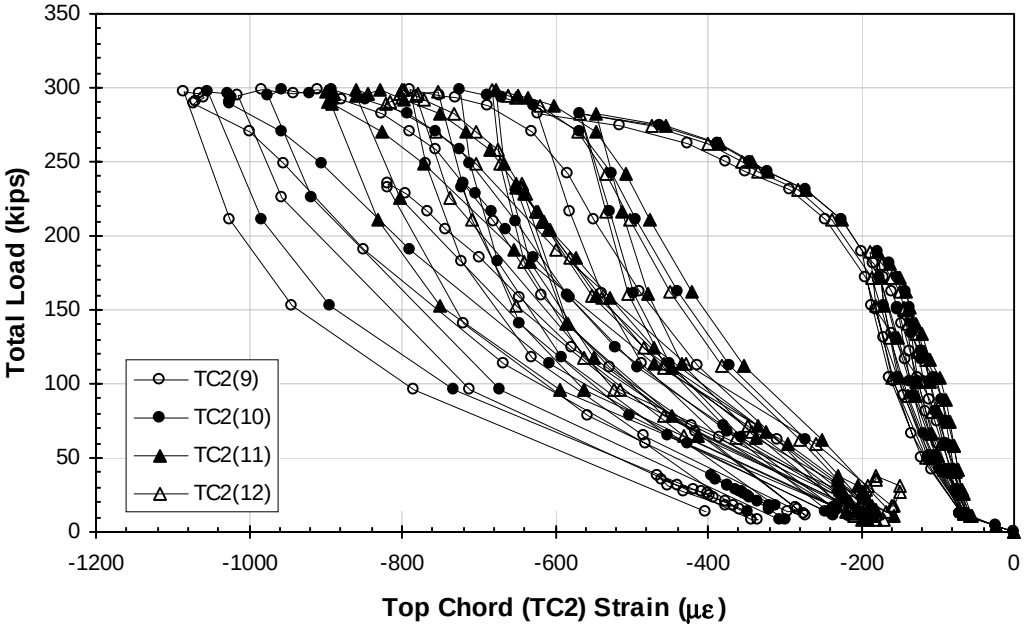


Figure B.5.8 Total Load vs. Top Chord (TC2) Strain of IG

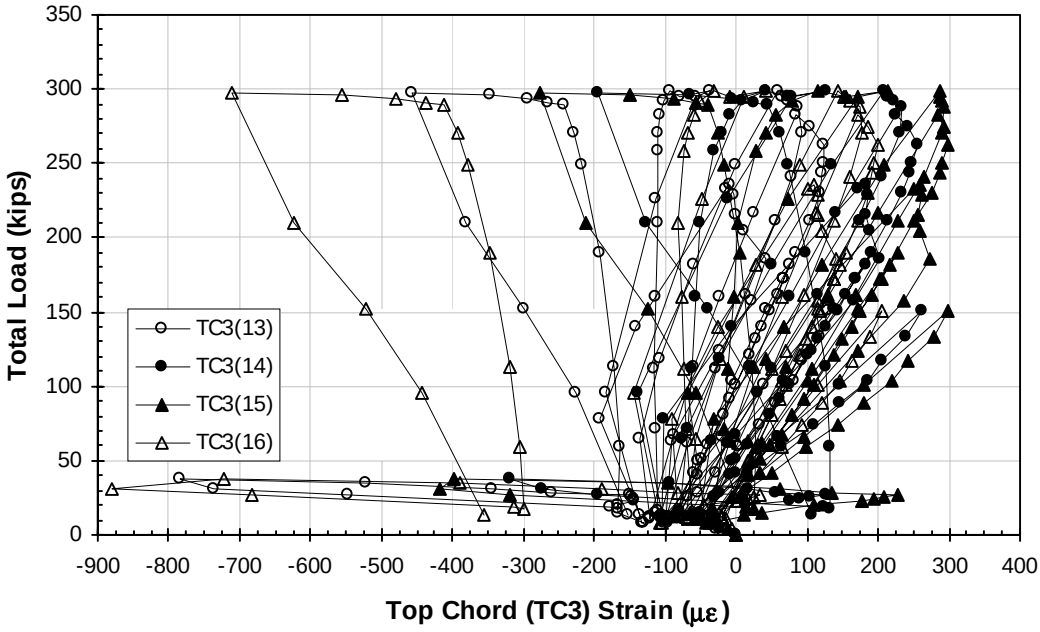


Figure B.5.9 Total Load vs. Top Chord (TC3) Strain of IG

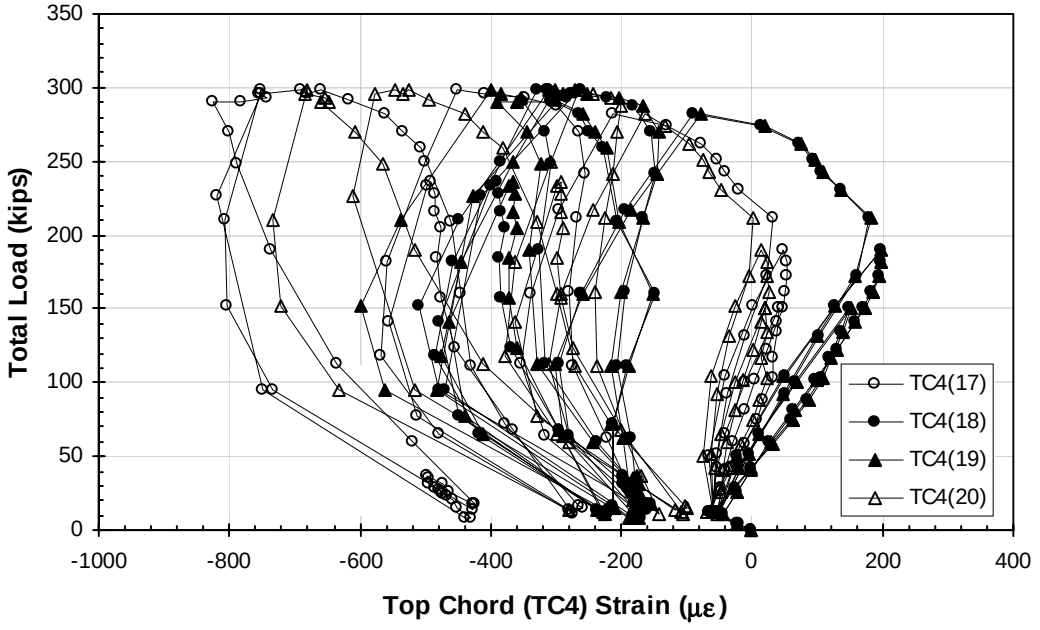


Figure B.5.10 Total Load vs. Top Chord (TC4) Strain of IG

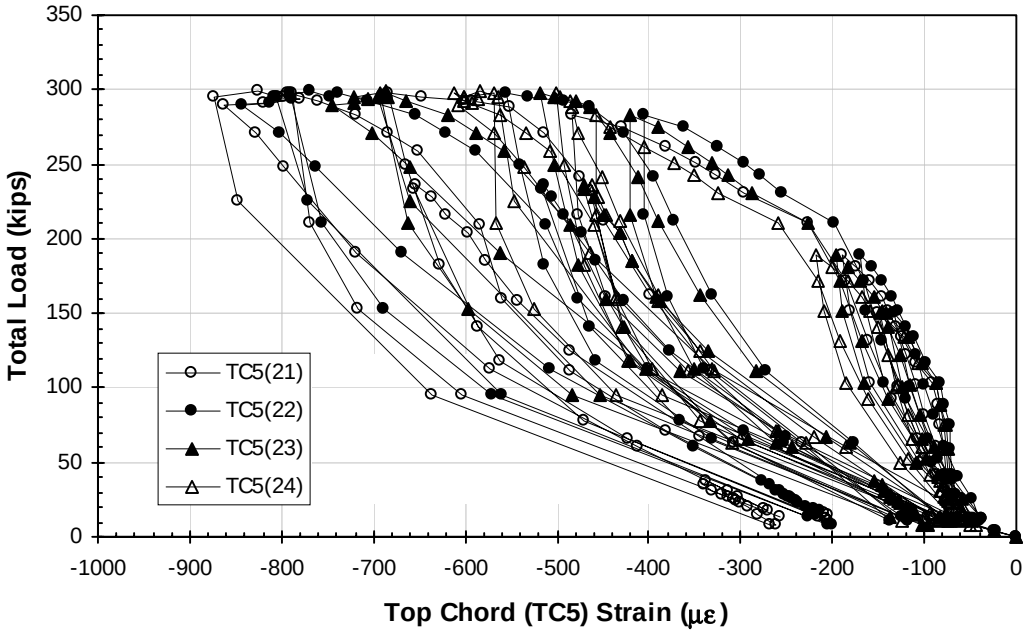


Figure B.5.11 Total Load vs. Top Chord (TC5) Strain of IG

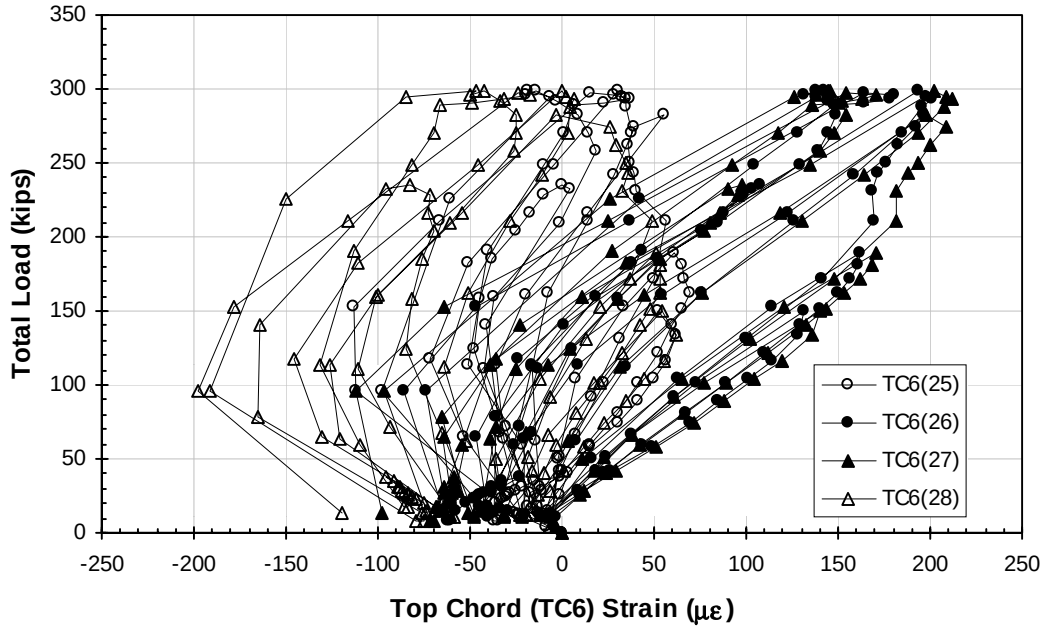


Figure B.5.12 Total Load vs. Top Chord (TC6) Strain of IG

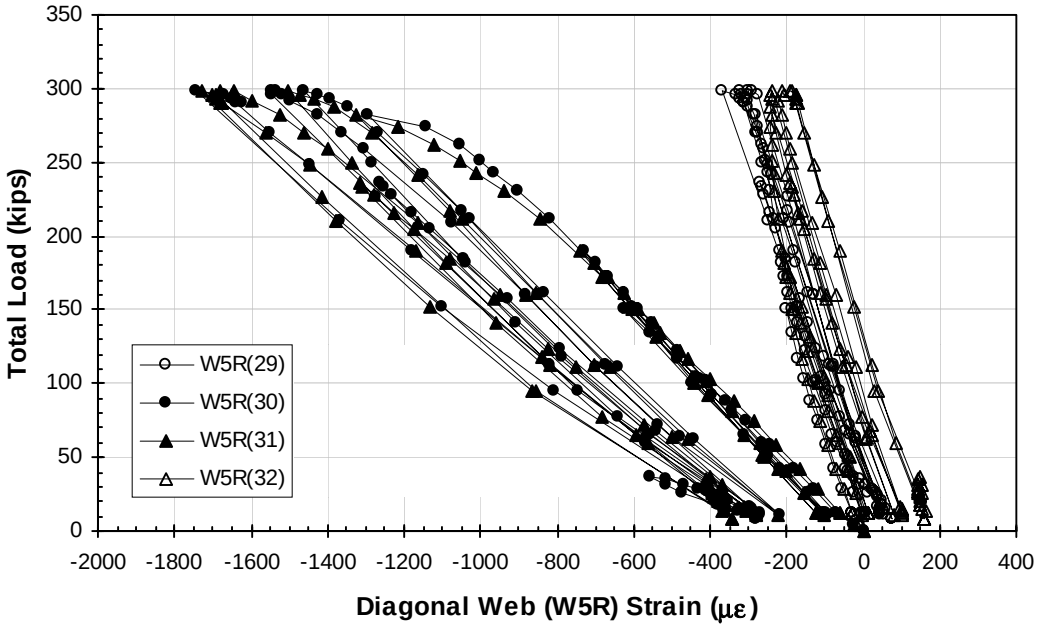


Figure B.5.13 Total Load vs. Diagonal Web (W5R) Strain of IG

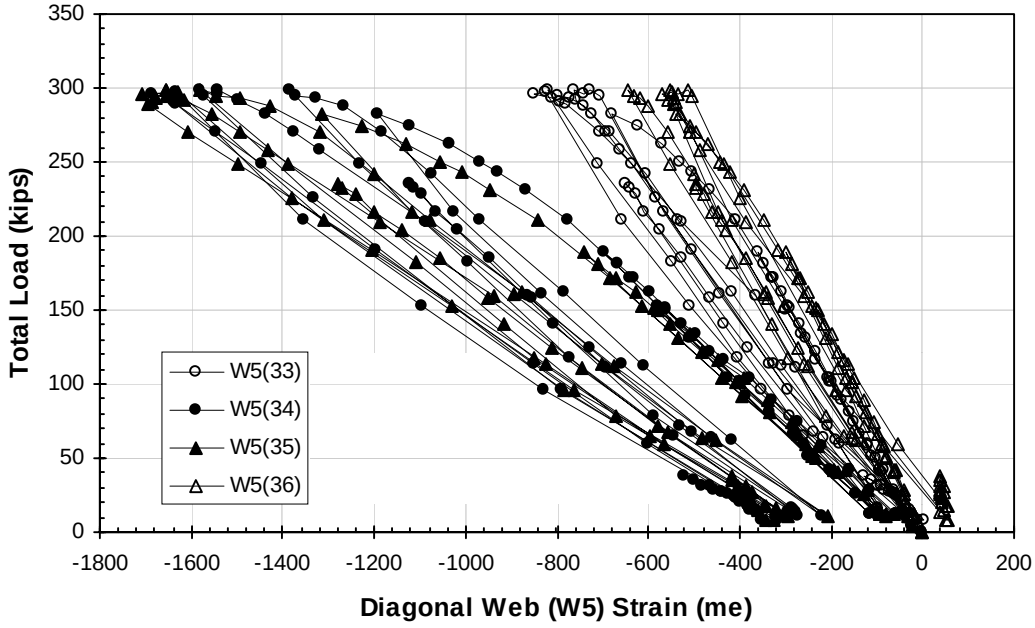


Figure B.5.14 Total Load vs. Diagonal Web (W5) Strain of IG

COMPOSITE STUB JOIST-GIRDER TEST SUMMARY SHEET

GIRDER DESIGNATION: EGR TEST DATES: 4-6 June 1996

TEST DESCRIPTION

Joist-Girder:	Span:	30'-0"	Weight:	52.8 plf
	Depth:	25 in.	Spacing:	7 ft
	Top Chord:	2L-3.00x3.00x0.250		
	Bottom Chord:	2L-4.00x4.00x0.375	Yield Stress:	53.5 ksi
	Stub:	S5x10		
Deck:	Type:	2 VL	Gage:	18 ga
Slab:	Total Depth:	5 in.	Compressive Strength:	3000 psi
Shear Connector:	Type:	3/4 in. x 4 1/2 in. Welded Headed Shear Studs		
	Quantity:	14 per half-span, 28 total		

THEORETICAL CALCULATIONS

Theoretical Max. Total Load on Joist-Girder: 166.4 kips

Theoretical Moment of Inertia: 3077 $in.^4$

TEST RESULTS

Total Load on Joist-Girder at Failure: 141.3 kips

Maximum Total Load on Joist-Girder: 141.3 kips

Midspan Deflection at Failure: 2.62 in.

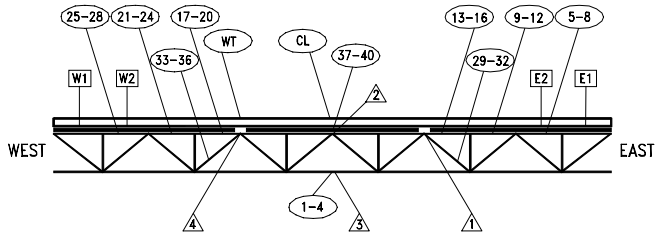
Experimental Moment of Inertia: 3137 $in.^4$

Mode of Failure: Loss of shear connection along west third of span

COMPARISON OF ACTUAL TO THEORETICAL

$$\frac{\text{Maximum Total Load on Joist-Girder}}{\text{Theoretical Max. Total Load on Joist-Girder}} = 0.85$$

INSTRUMENTATION LOCATIONS



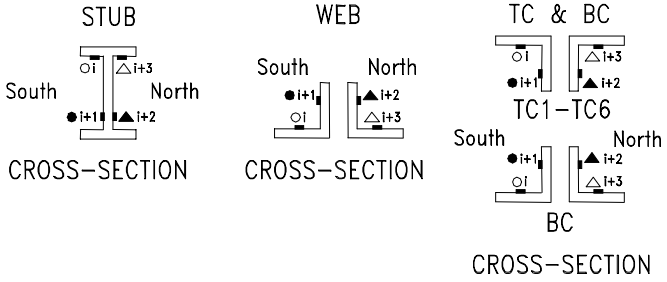
Strain Gages:

1-4	BC	25-28	TC6
5-8	TC1		
9-12	TC2	29-32	W5R
13-16	TC3	33-36	W5
17-20	TC4		
21-24	TC5	37-40	STUB

CL CONCRETE CL

WT CONCRETE WT

Location of Strain Gages on Cross-Section:



Slips:

E1	SLIP-E1
E2	SLIP-E2
W1	SLIP-W1
W2	SLIP-W2

Vert. Defl.:

1	ET TOP
2	CL TOP
3	CL BOTTOM
4	WT TOP

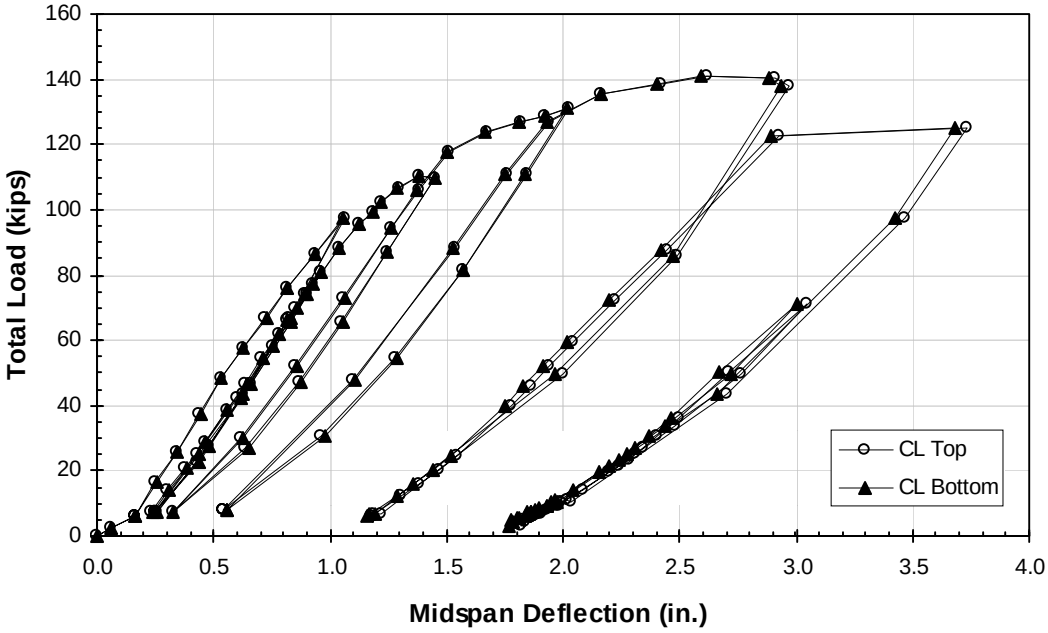


Figure B.6.1 Total Load vs. Midspan Deflections of EGR

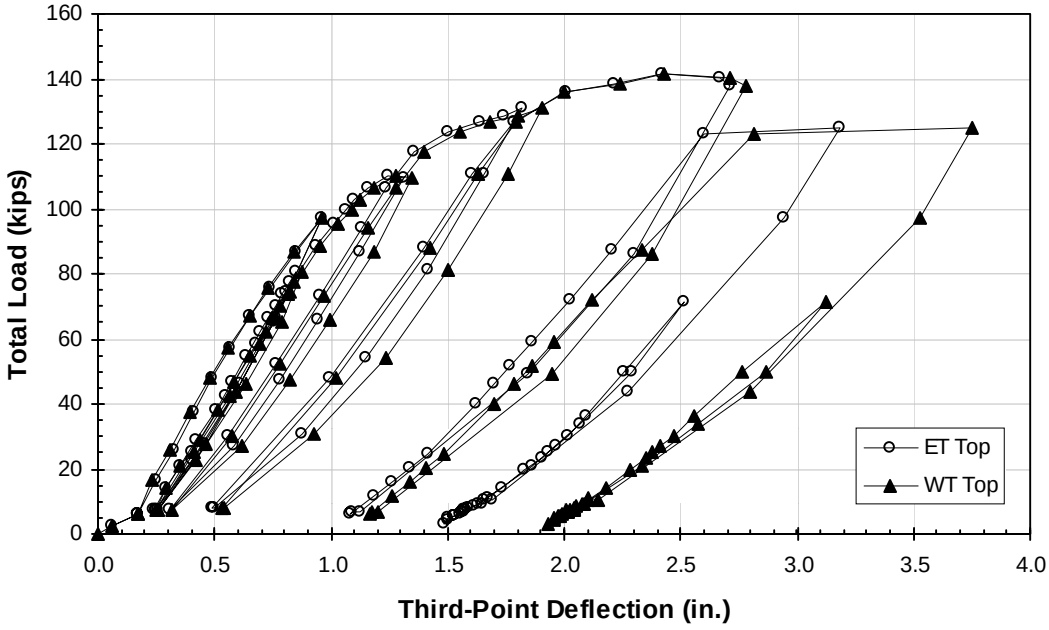


Figure B.6.2 Total Load vs. Third-Point Deflections of EGR

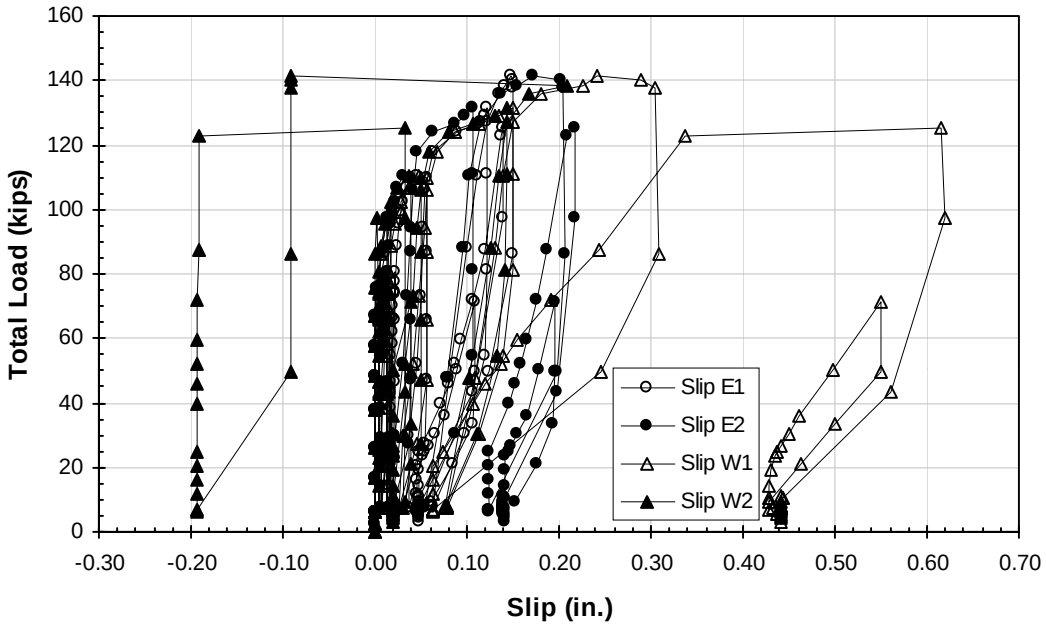


Figure B.6.3 Total Load vs. Slip of EGR

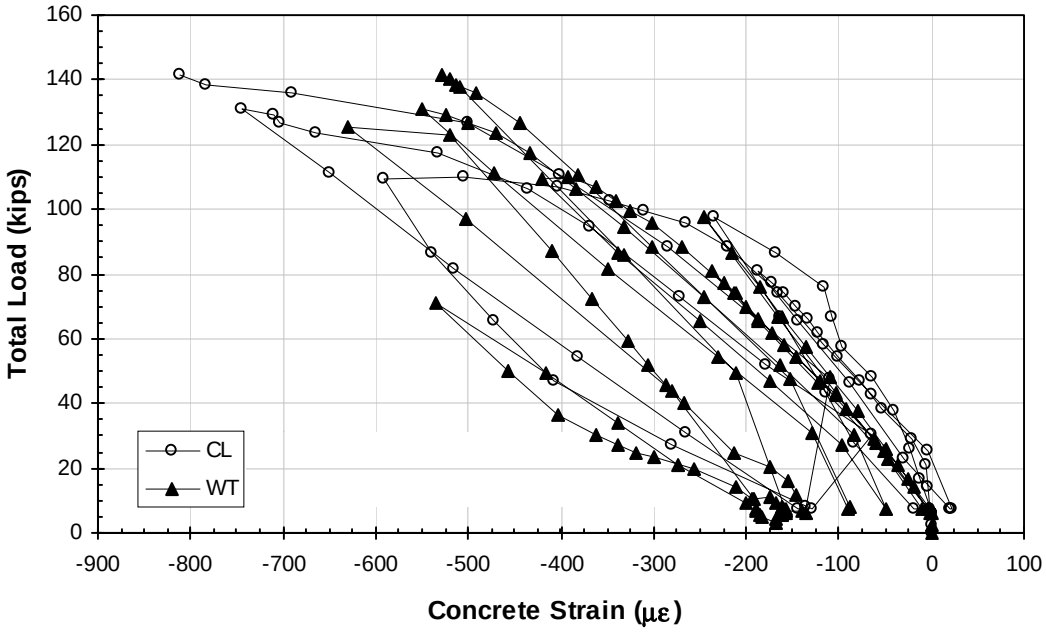


Figure B.6.4 Total Load vs. Concrete Strain of EGR

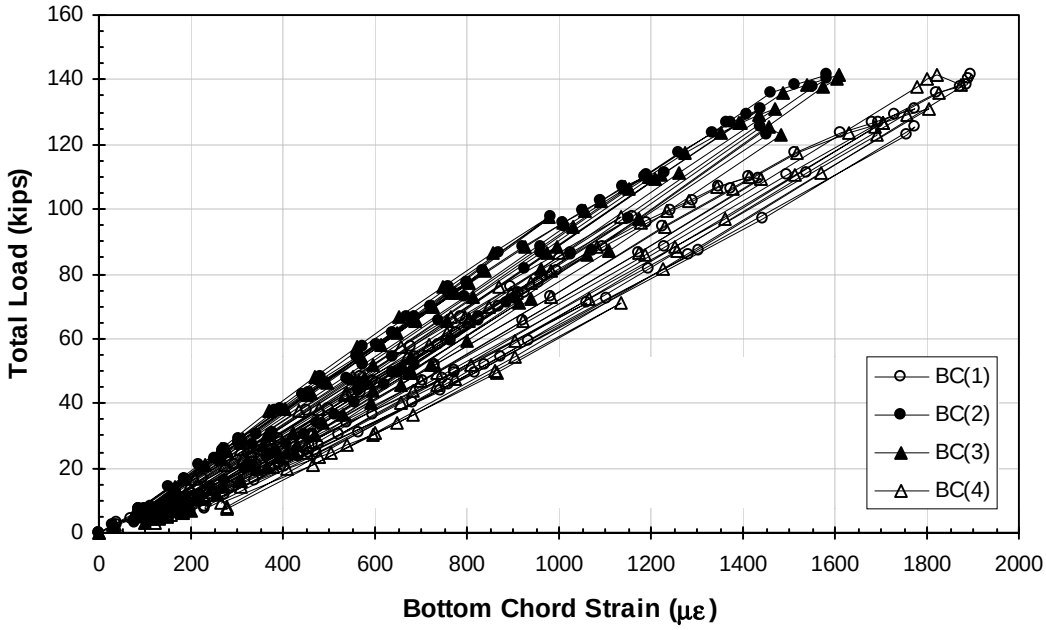


Figure B.6.5 Total Load vs. Bottom Chord Strain of EGR

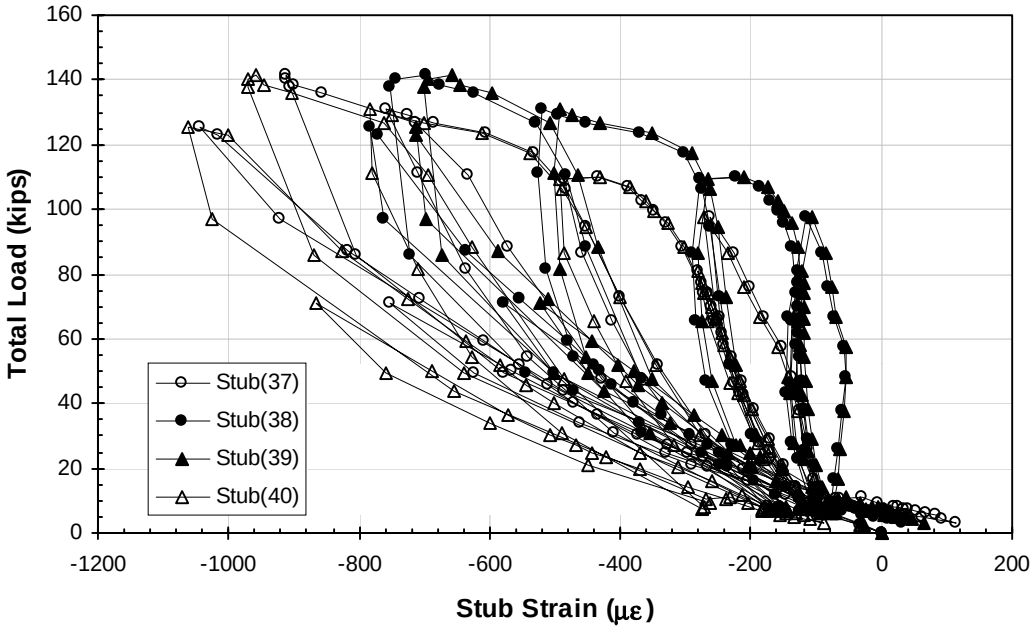


Figure B.6.6 Total Load vs. Stub Strain of EGR

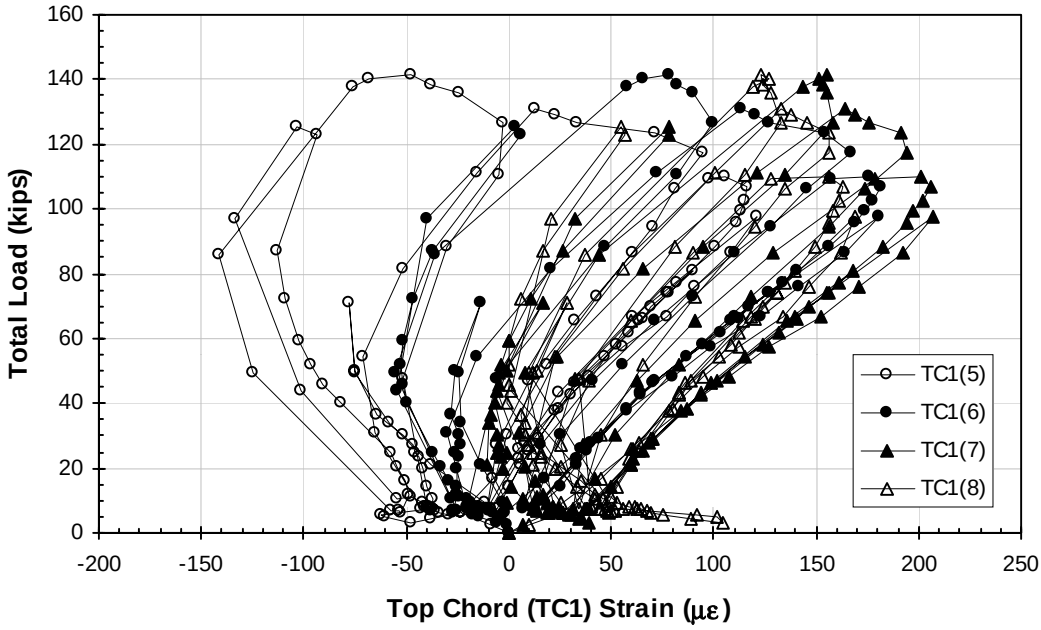


Figure B.6.7 Total Load vs. Top Chord (TC1) Strain of EGR

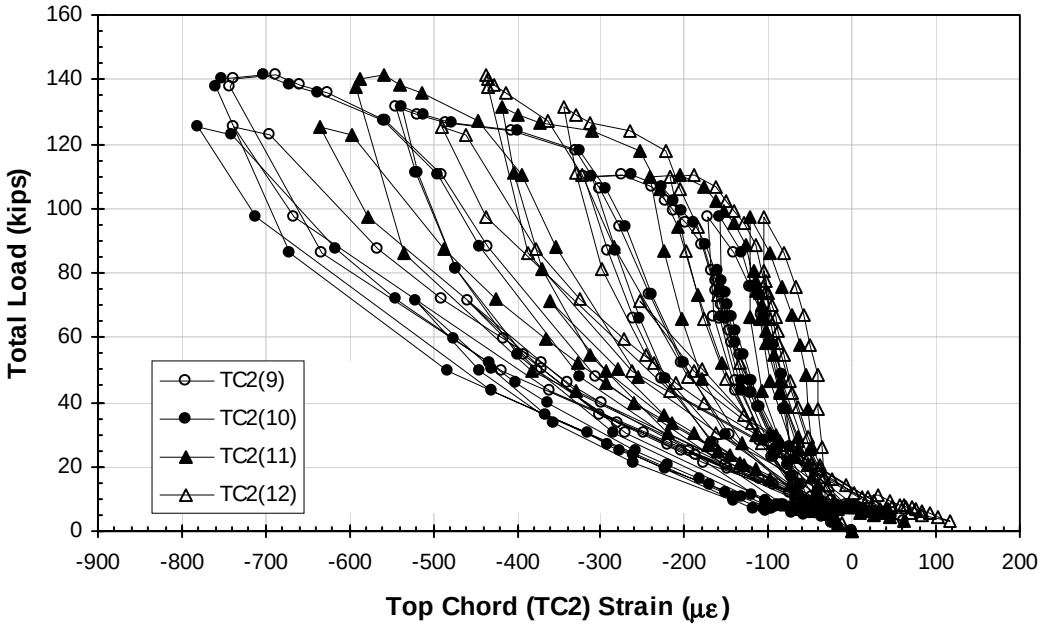


Figure B.6.8 Total Load vs. Top Chord (TC2) Strain of EGR

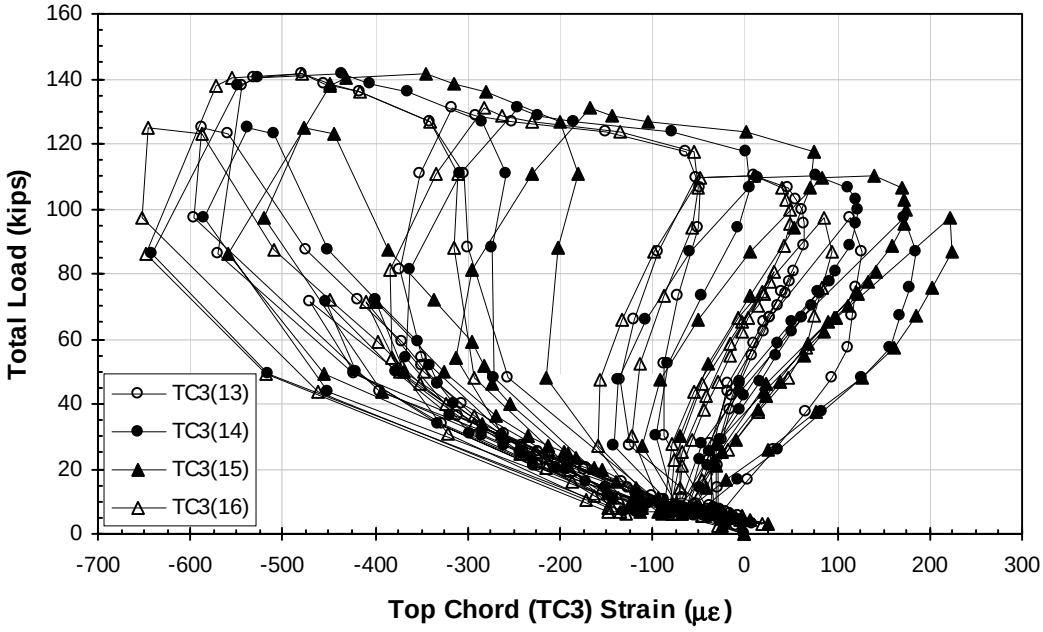


Figure B.6.9 Total Load vs. Top Chord (TC3) Strain of EGR

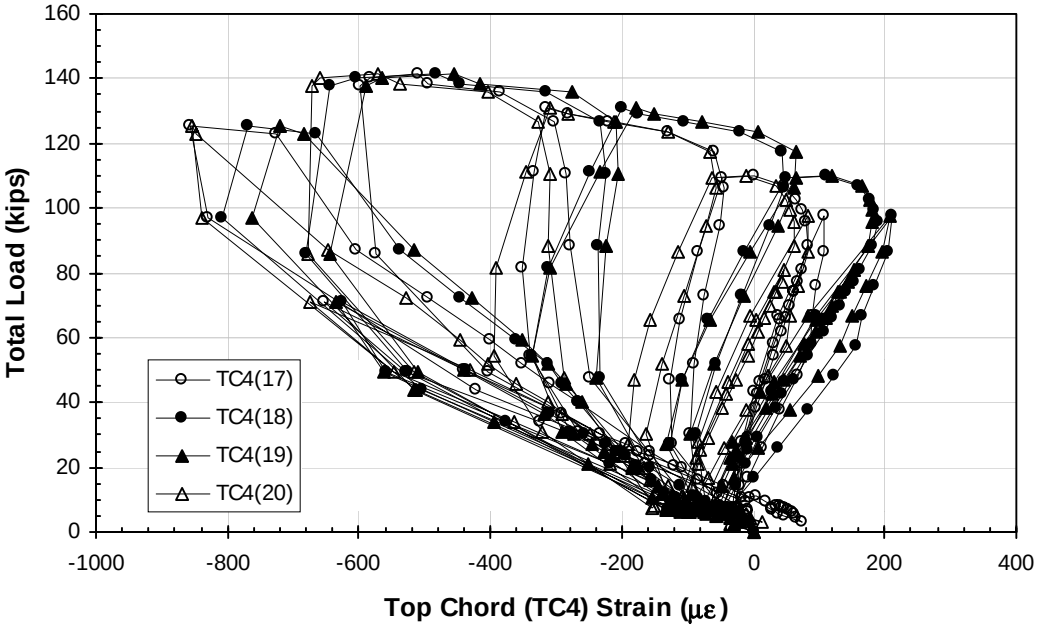


Figure B.6.10 Total Load vs. Top Chord (TC4) Strain of EGR

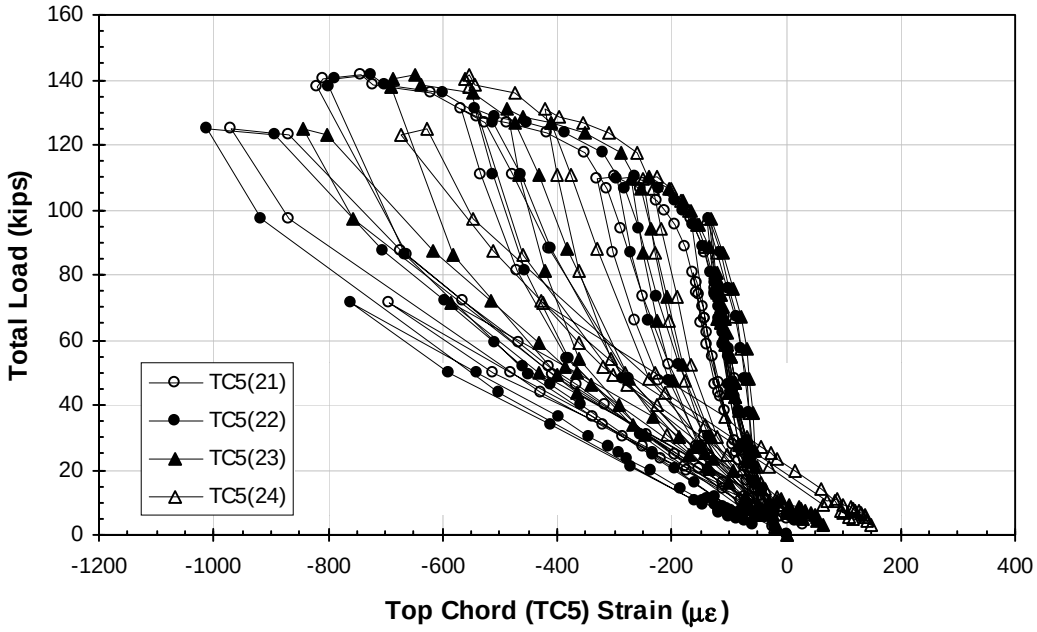


Figure B.6.11 Total Load vs. Top Chord (TC5) Strain of EGR

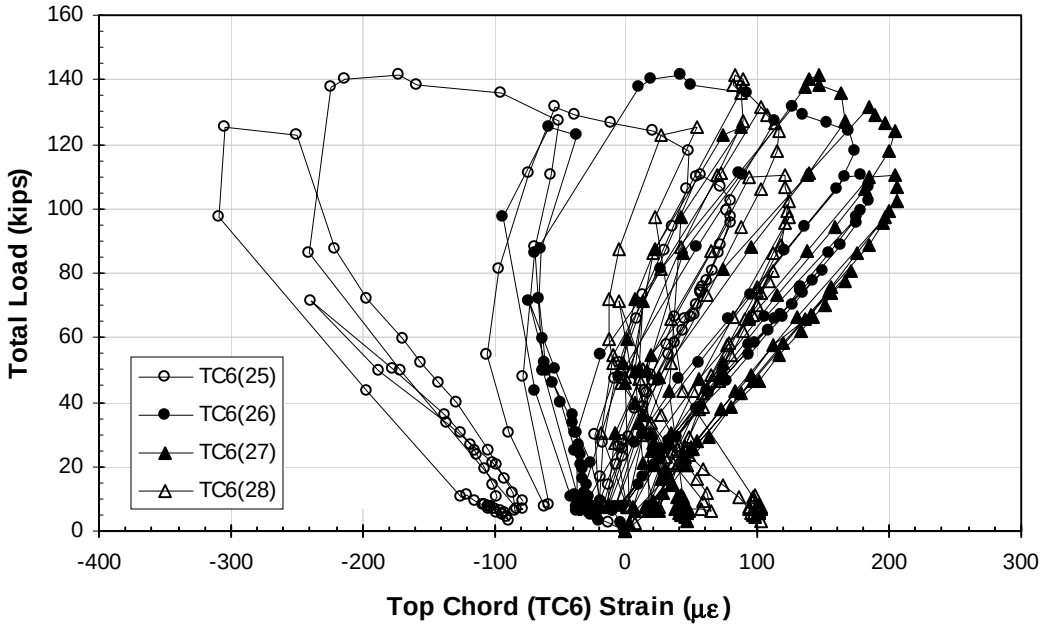


Figure B.6.12 Total Load vs. Top Chord (TC6) Strain of EGR

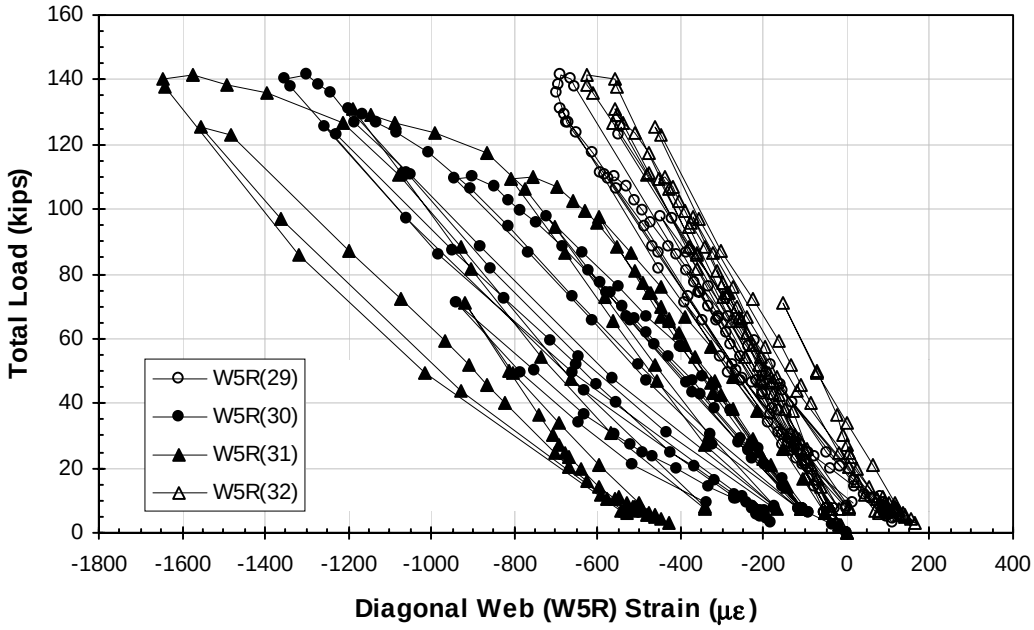


Figure B.6.13 Total Load vs. Diagonal Web (W5R) Strain of EGR

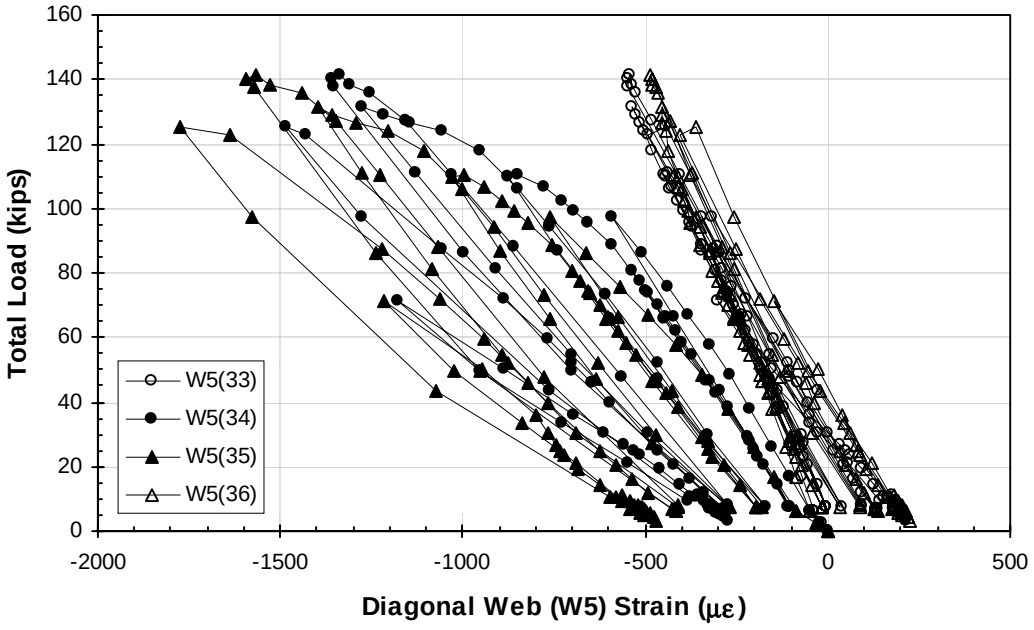


Figure B.6.14 Total Load vs. Diagonal Web (W5) Strain of EGR

COMPOSITE HAUNCHED JOIST-GIRDER TEST SUMMARY SHEET

GIRDER DESIGNATION: EGL TEST DATES: 17-19 December 1996

TEST DESCRIPTION

Joist-Girder:	Span:	30'-0"	Weight:	46.1 plf
	Depth:	25 in.	Spacing:	6 ft - 9 in.
	Top Chord:	2L-3.00x3.00x0.250	Yield Stress:	58.0 ksi
	Bottom Chord:	2L-4.00x4.00x0.375	Yield Stress:	55.3 ksi
Deck:	Type:	2 VL	Gage:	18 ga
Slab:	Total Depth:	5 in.	Compressive Strength:	4500 psi
	Haunch:	5 in.		
Shear Connector:	Type:	3/4 in. x 8.0 in. Welded Headed Shear Studs		
	Quantity:	27 per half-span, one at midspan, 55 total		

THEORETICAL CALCULATIONS

Theoretical Max. Total Load on Joist-Girder: 181.7 kips

Theoretical Moment of Inertia: 3323 in.^{4}

TEST RESULTS

Total Load on Joist-Girder at Failure: 176.6 kips

Maximum Total Load on Joist-Girder: 176.6 kips

Midspan Deflection at Failure: 3.36 in.

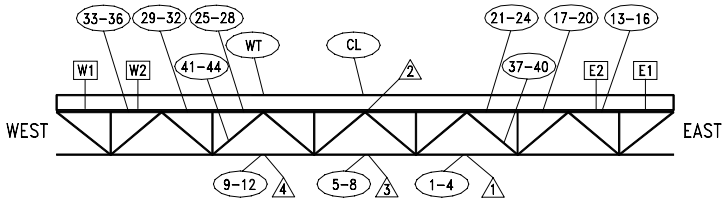
Experimental Moment of Inertia: 3694 in.^{4}

Mode of Failure: Yielding of bottom chord

COMPARISON OF ACTUAL TO THEORETICAL

$$\frac{\text{Maximum Total Load on Joist-Girder}}{\text{Theoretical Max. Total Load on Joist-Girder}} = 0.97$$

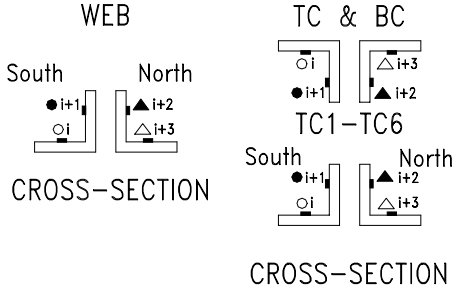
LOCATION OF INSTRUMENTATION ON JOIST-GIRDER



Strain Gages:

1-4	BC1	21-24	TC3
5-8	BC2	25-28	TC4
9-12	BC3	29-32	TC5
13-16	TC1	33-36	TC6
17-20	TC2		
37-40	W5R	41-44	W5
CL	CONCRETE CL		
WT	CONCRETE WT		

Location of Strain Gages on Cross-Section:



Slips:

E1	SLIP-E1
E2	SLIP-E2
W1	SLIP-W1
W2	SLIP-W2

Vert. Defl.:

1	ET BOTTOM
2	CL TOP
3	CL BOTTOM
4	WT BOTTOM

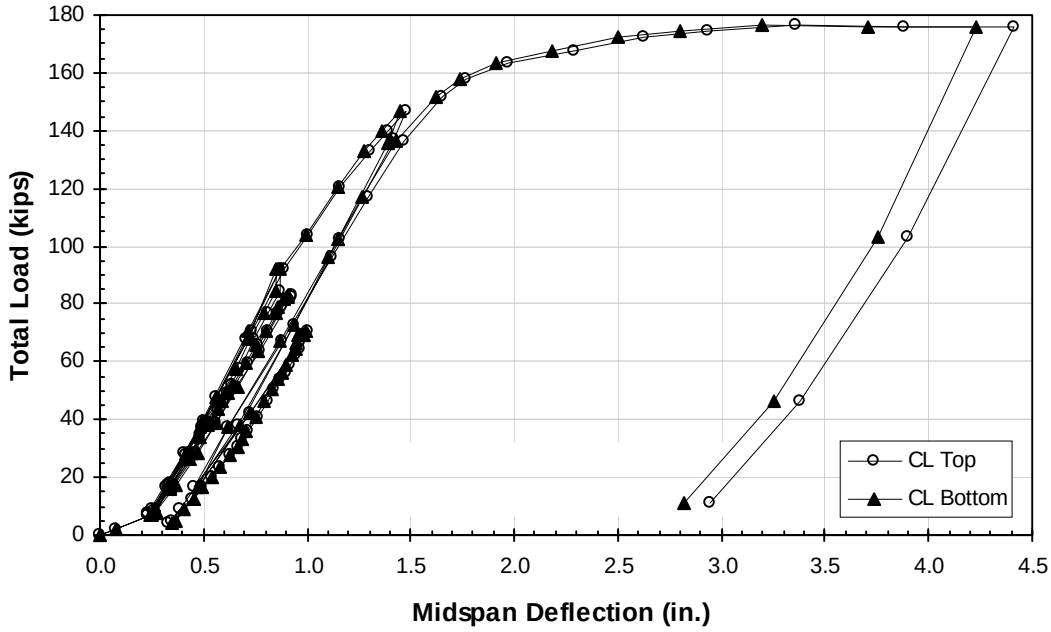


Figure B.7.1 Total Load vs. Midspan Deflections of EGL

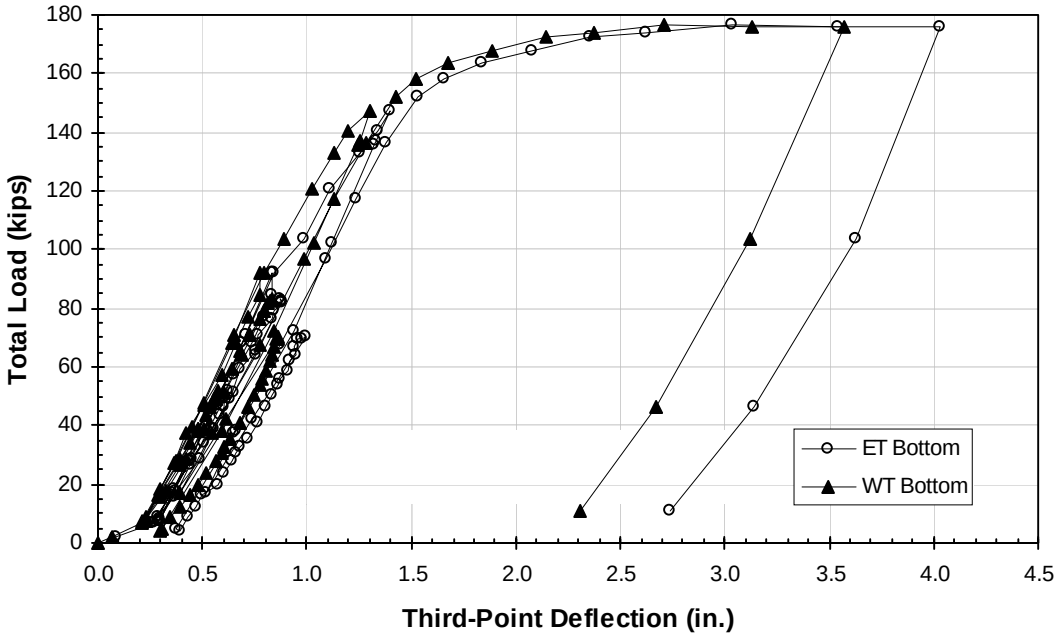


Figure B.7.2 Total Load vs. Third-Point Deflections of EGL

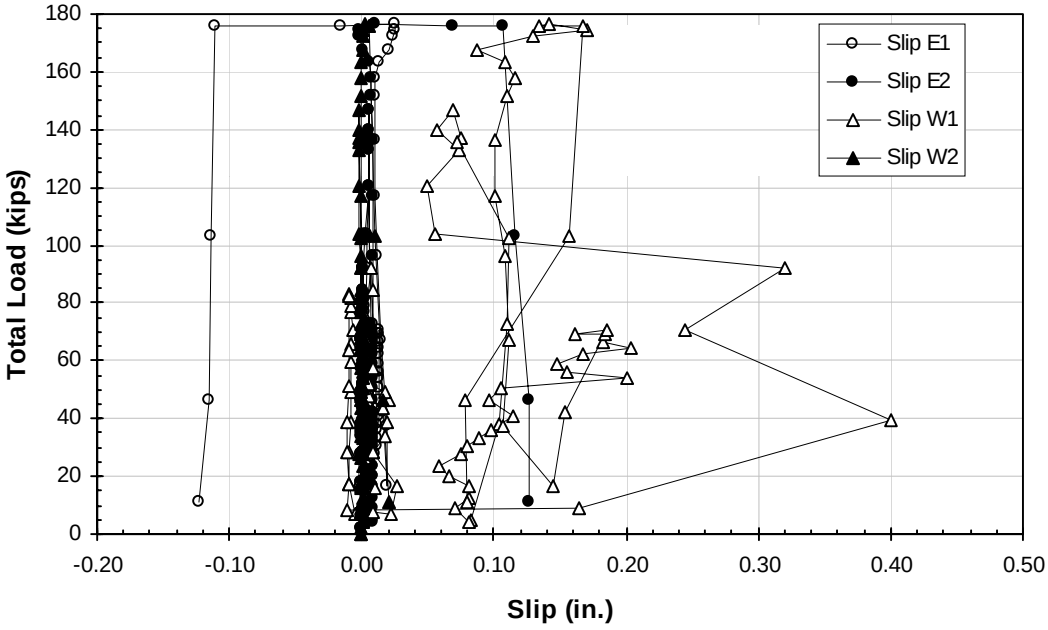


Figure B.7.3 Total Load vs. Slip of EGL

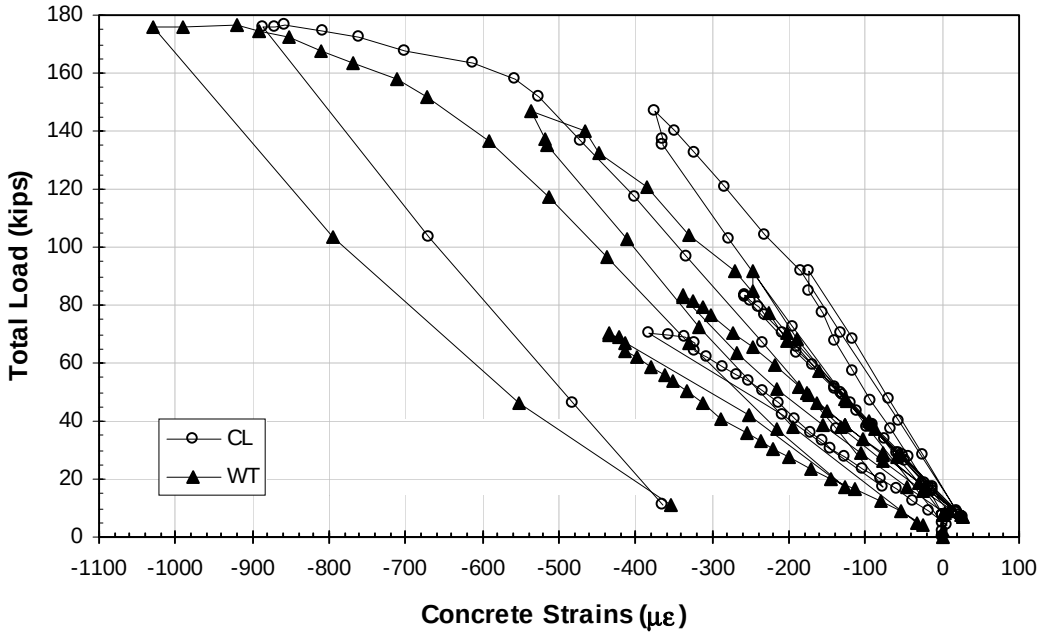


Figure B.7.4 Total Load vs. Concrete Strain of EGL

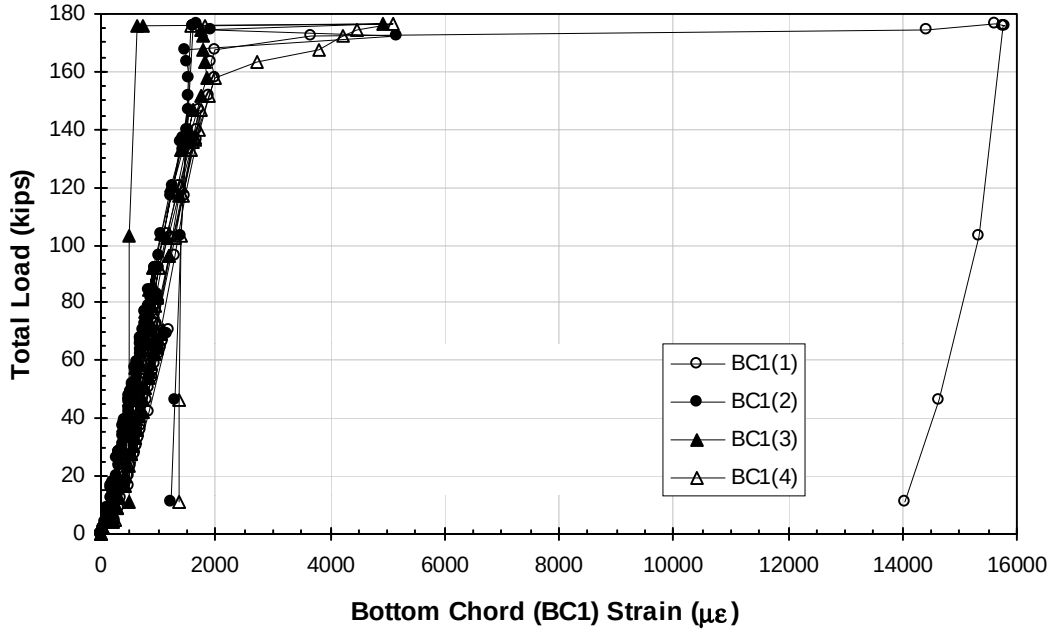


Figure B.7.5 Total Load vs. Bottom Chord (BC1) Strain of EGL

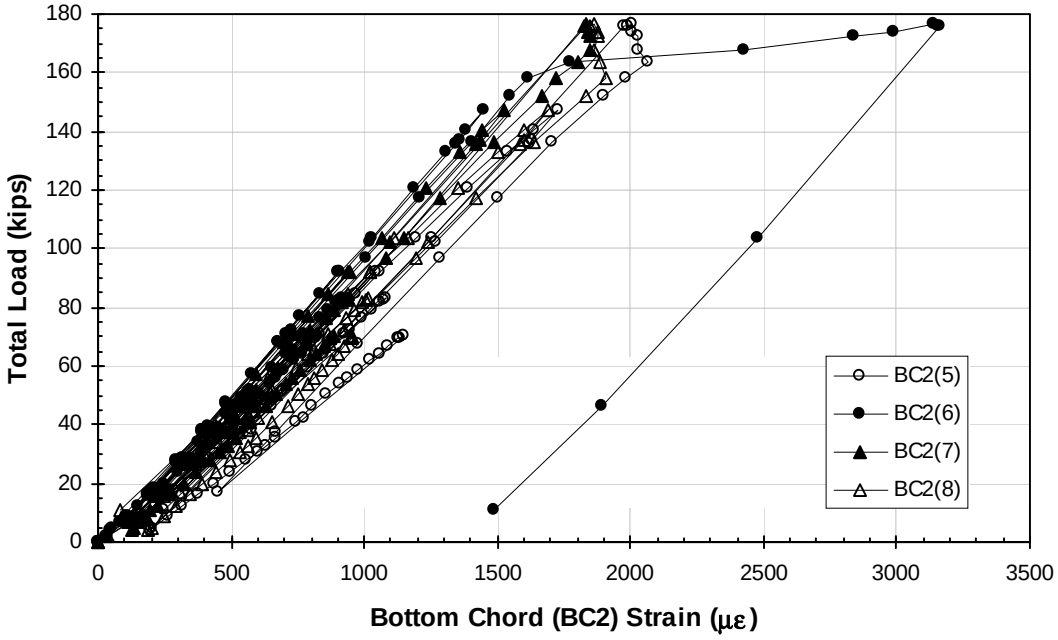


Figure B.4.6 Total Load vs. Bottom Chord (BC2) Strain of EGL

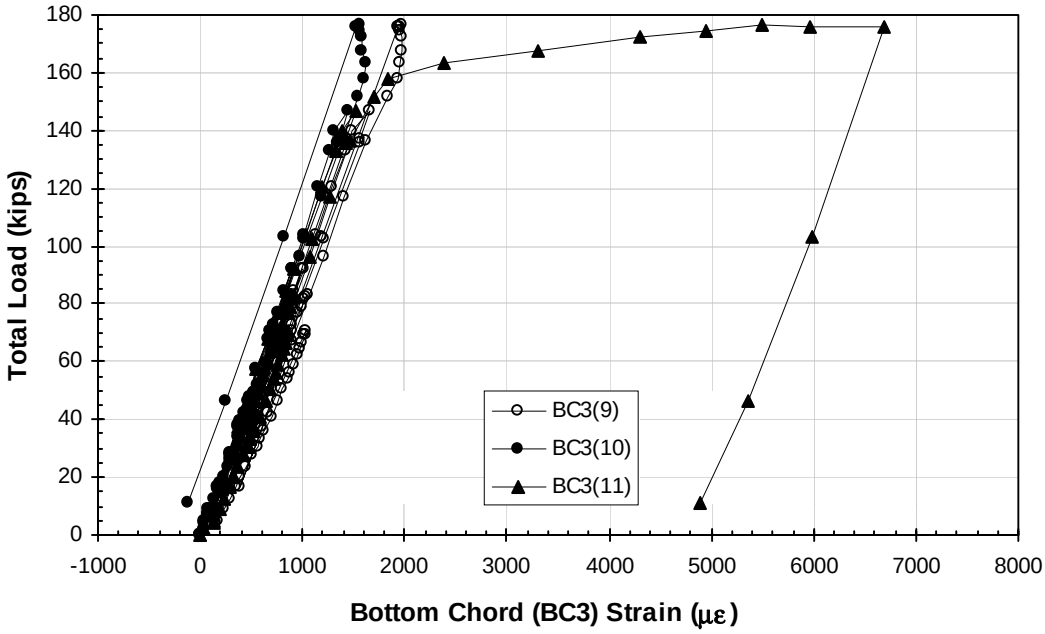


Figure B.7.7 Total Load vs. Bottom Chord (BC3) Strain of EGL

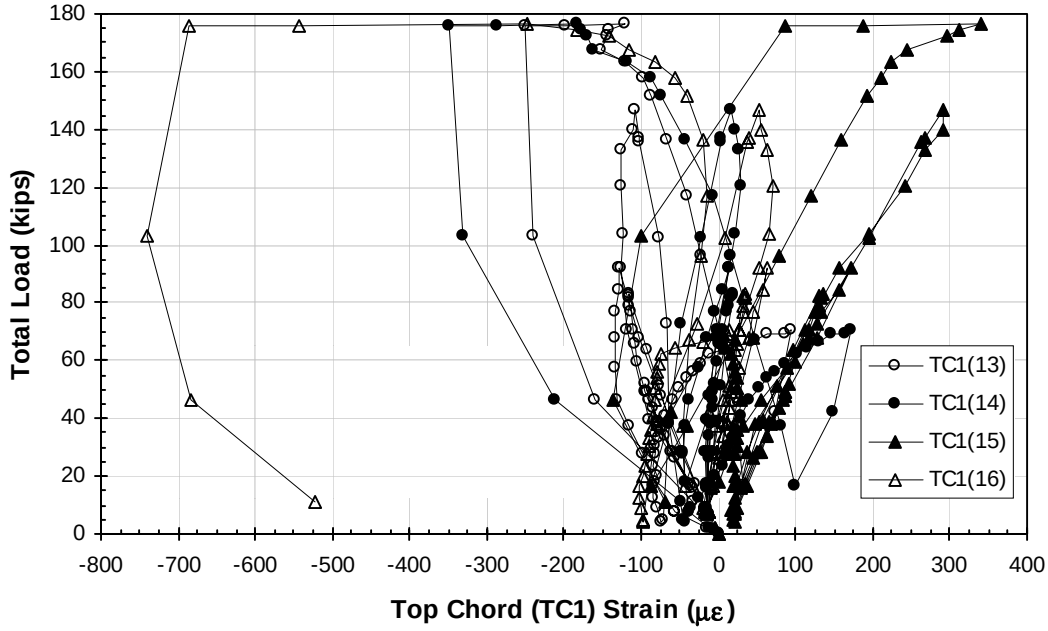


Figure B.7.8 Total Load vs. Top Chord (TC1) Strain of EGL

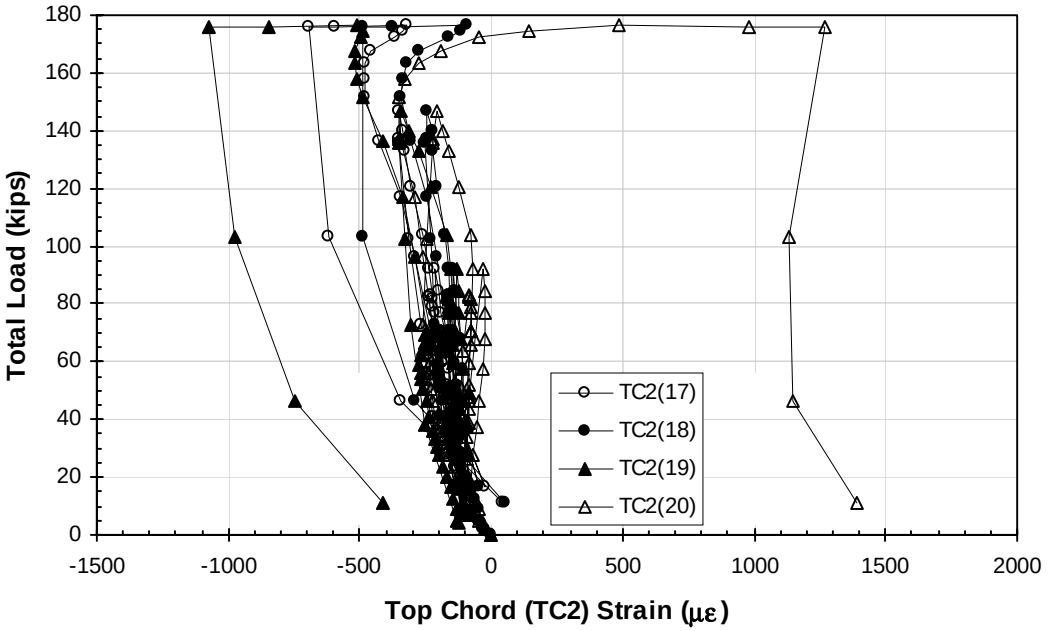


Figure B.7.9 Total Load vs. Top Chord (TC2) Strain of EGL

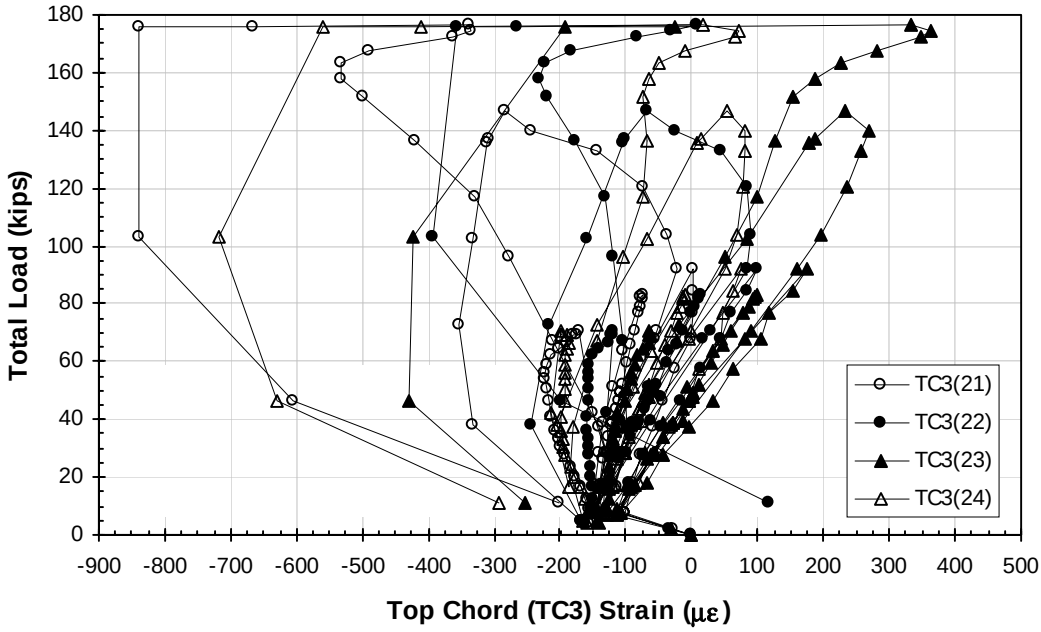


Figure B.7.10 Total Load vs. Top Chord (TC3) Strain of EGL

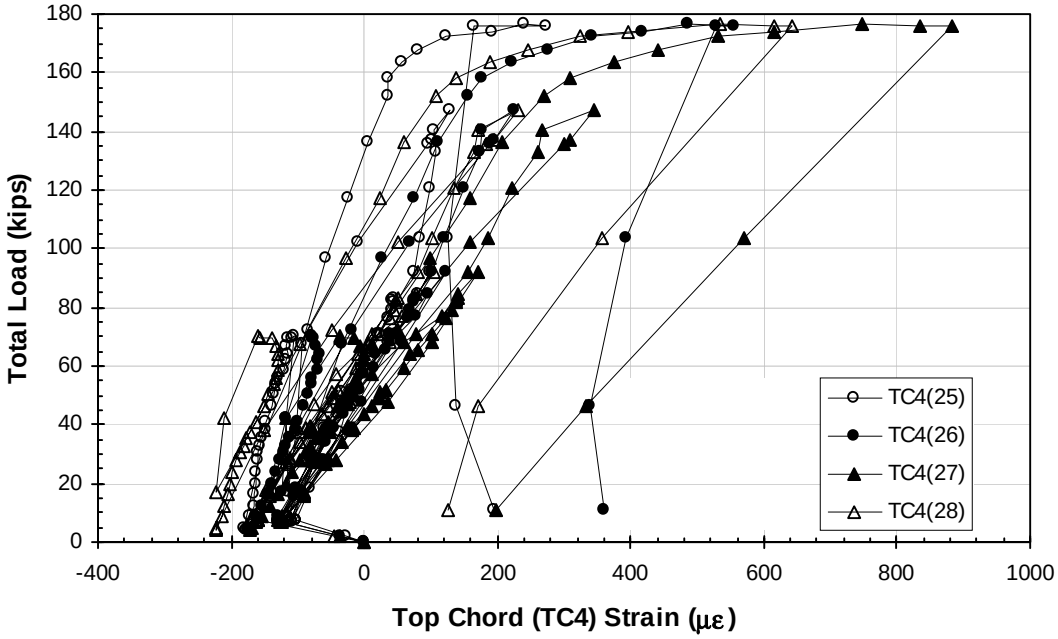


Figure B.7.11 Total Load vs. Top Chord (TC4) Strain of EGL

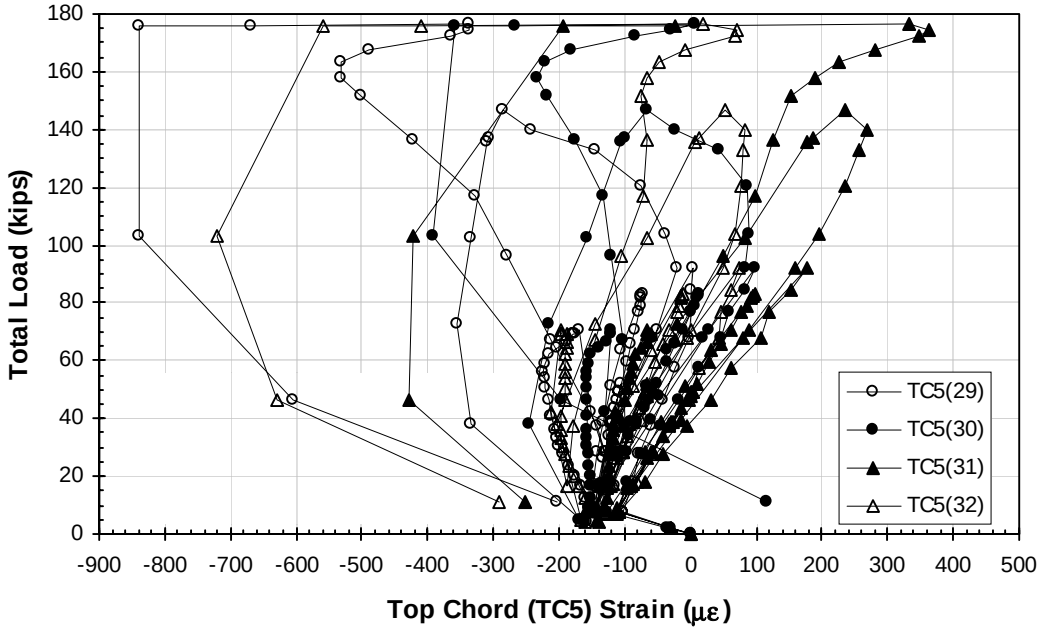


Figure B.7.12 Total Load vs. Top Chord (TC5) Strain of EGL

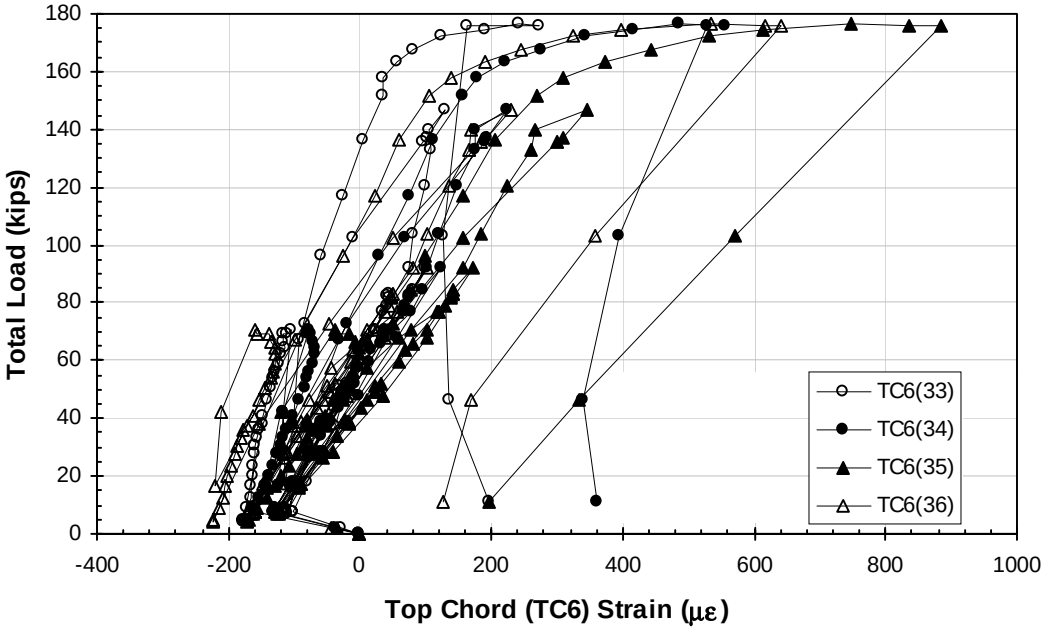


Figure B.7.13 Total Load vs. Top Chord (TC6) Strain of EGL

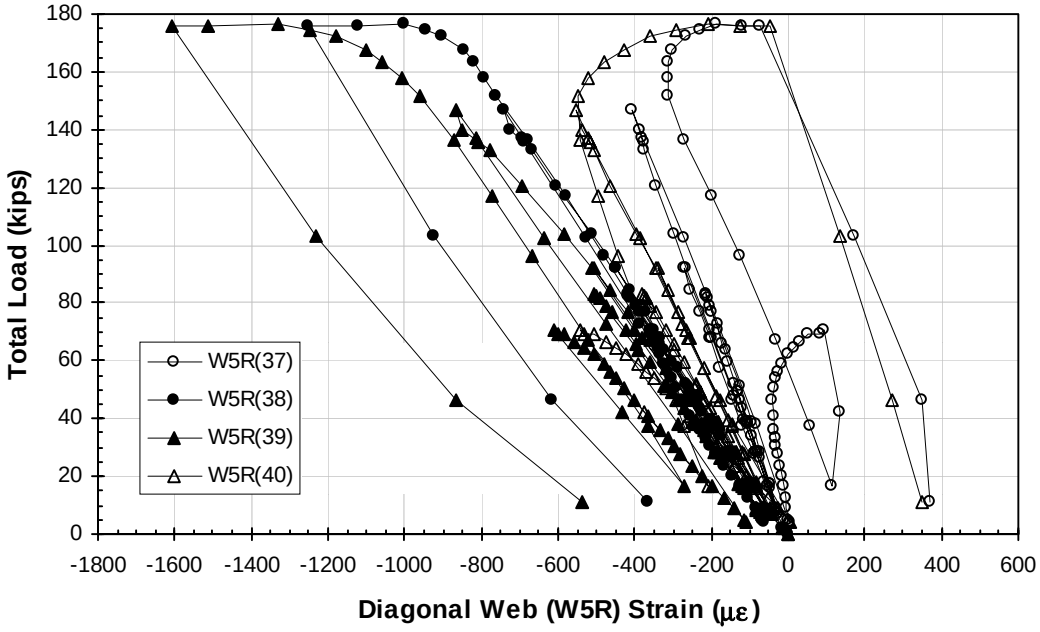


Figure B.7.14 Total Load vs. Diagonal Web (W5R) Strain of EGL

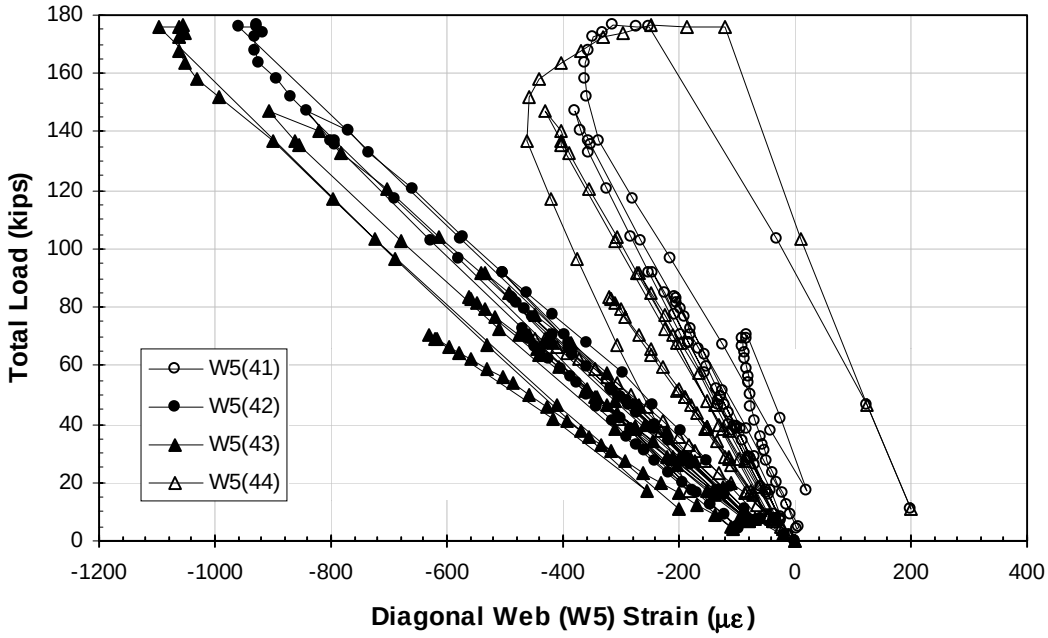


Figure B.7.15 Total Load vs. Diagonal Web (W5) Strain of EGL

COMPOSITE HAUNCHED JOIST-GIRDER TEST SUMMARY SHEET

GIRDER DESIGNATION: IG TEST DATES: 17-19 December 1996

TEST DESCRIPTION

Joist-Girder:	Span:	30'-0"	Weight:	89.2 plf
	Depth:	25 in.	Spacing:	6 ft - 9 in.
	Top Chord:	2L-4.00x4.00x0.375	Yield Stress:	55.7 ksi
	Bottom Chord:	2L-5.00x5.00x0.625	Yield Stress:	53.4 ksi
Deck:	Type:	2 VL	Gage:	18 ga
Slab:	Total Depth:	5 in.	Compressive Strength:	4500 psi
	Haunch:	5 in.		
Shear Connector:	Type:	3/4 in. x 8.0 in. Welded Headed Shear Studs		
	Quantity:	53 per half-span, one at midspan, 107 total		

THEORETICAL CALCULATIONS

Theoretical Max. Total Load on Joist-Girder: 353.2 kips

Theoretical Moment of Inertia: 6400 $in.^4$

TEST RESULTS

Total Load on Joist-Girder at Failure: 334.0 kips

Maximum Total Load on Joist-Girder: 409.1 kips

Midspan Deflection at Failure: 2.28 in.

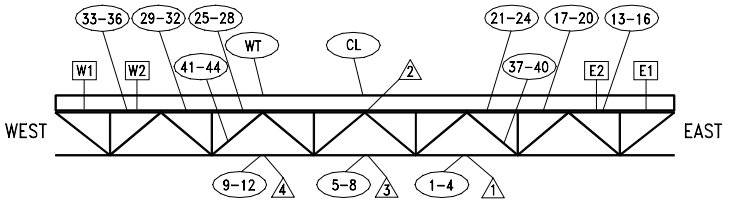
Experimental Moment of Inertia: 6152 $in.^4$

Mode of Failure: Yielding of bottom chord at the east third point

COMPARISON OF ACTUAL TO THEORETICAL

$$\frac{\text{Maximum Total Load on Joist-Girder}}{\text{Theoretical Max. Total Load on Joist-Girder}} = 1.16$$

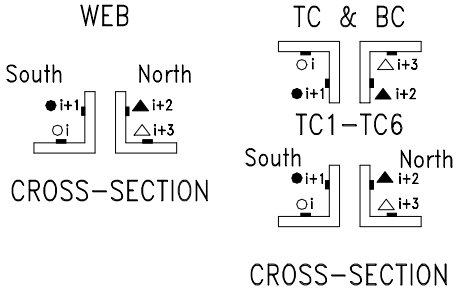
LOCATION OF INSTRUMENTATION ON JOIST-GIRDER



Strain Gages:

1-4	BC1	21-24	TC3
5-8	BC2	25-28	TC4
9-12	BC3	29-32	TC5
13-16	TC1	33-36	TC6
17-20	TC2		
37-40	W5R	41-44	W5
CL	CONCRETE CL		
WT	CONCRETE WT		

Location of Strain Gages on Cross-Section:



Slips:

E1	SLIP-E1
E2	SLIP-E2
W1	SLIP-W1
W2	SLIP-W2

Vert. Defl.:

1	ET BOTTOM
2	CL TOP
3	CL BOTTOM
4	WT BOTTOM

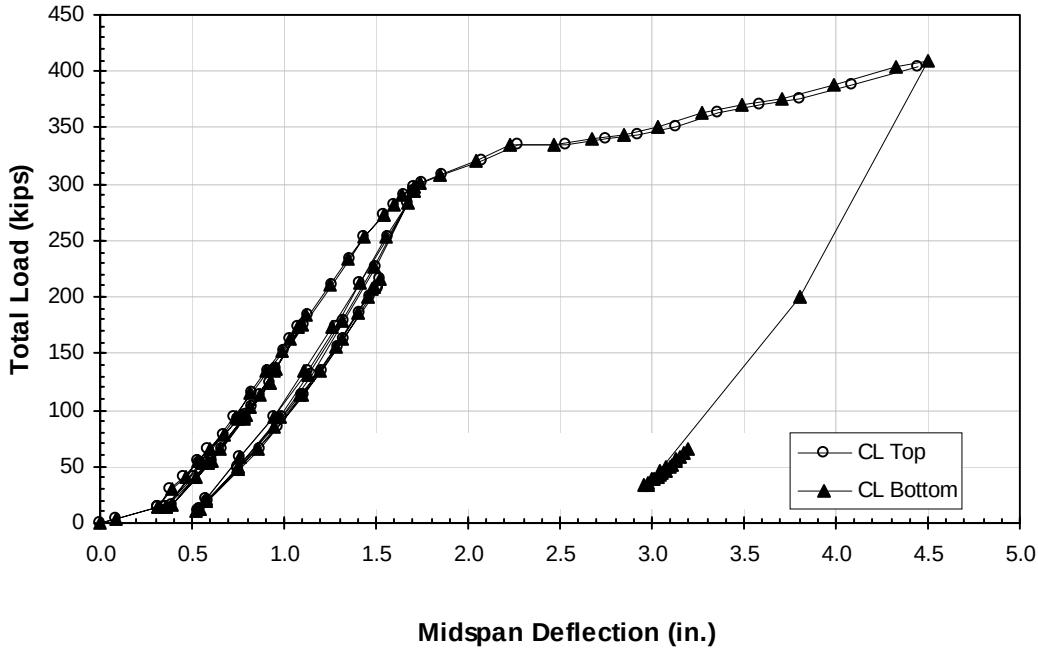


Figure B.8.1 Total Load vs. Midspan Deflections of IG

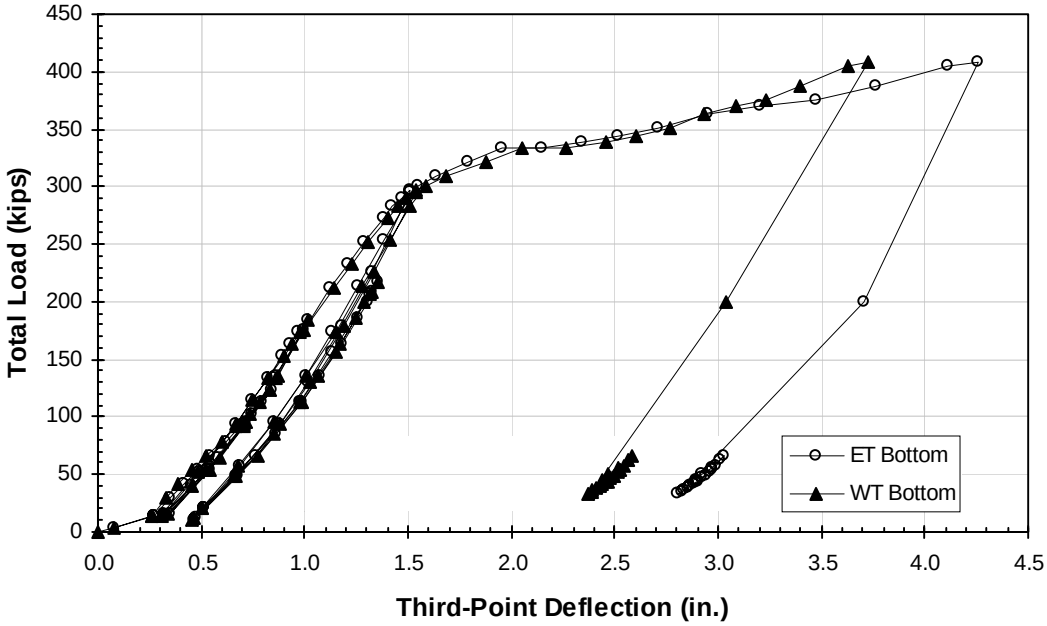


Figure B.8.2 Total Load vs. Third-Point Deflections of IG

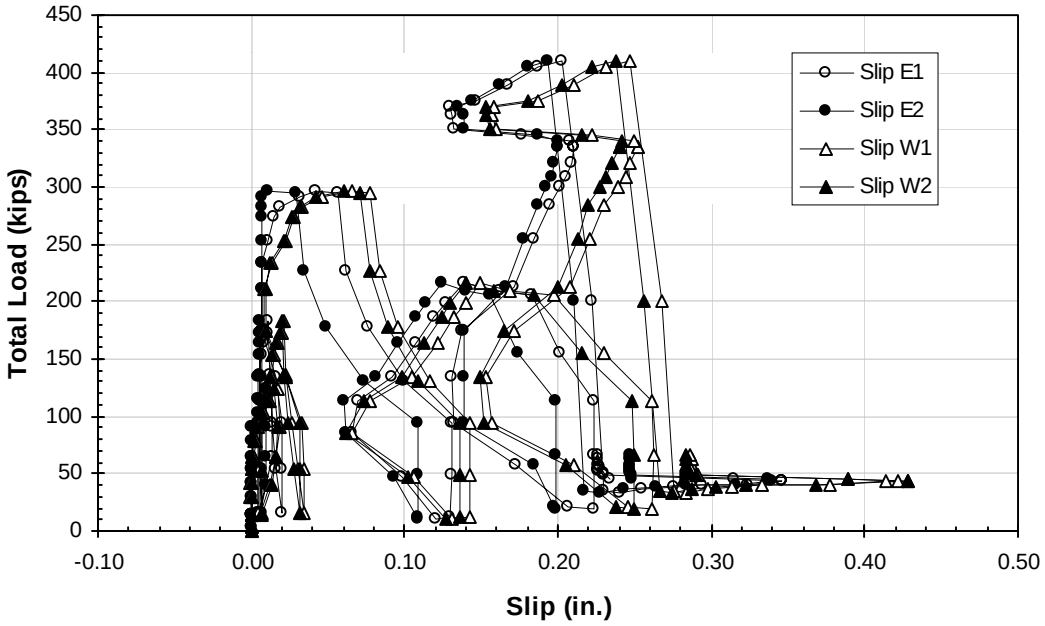


Figure B.8.3 Total Load vs. Slip of IG

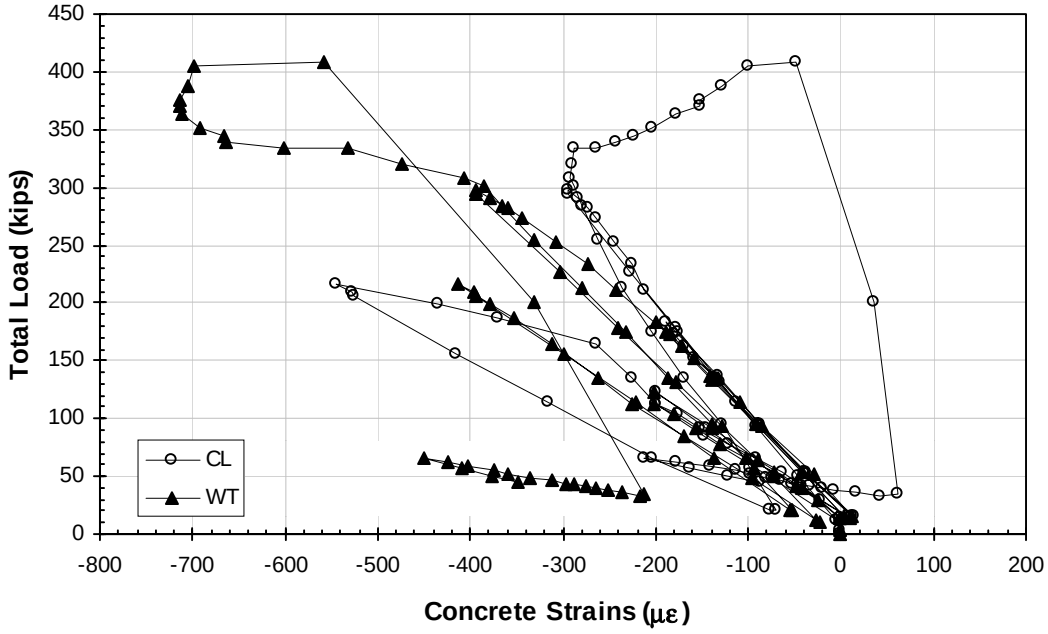


Figure B.8.4 Total Load vs. Concrete Strain of IG

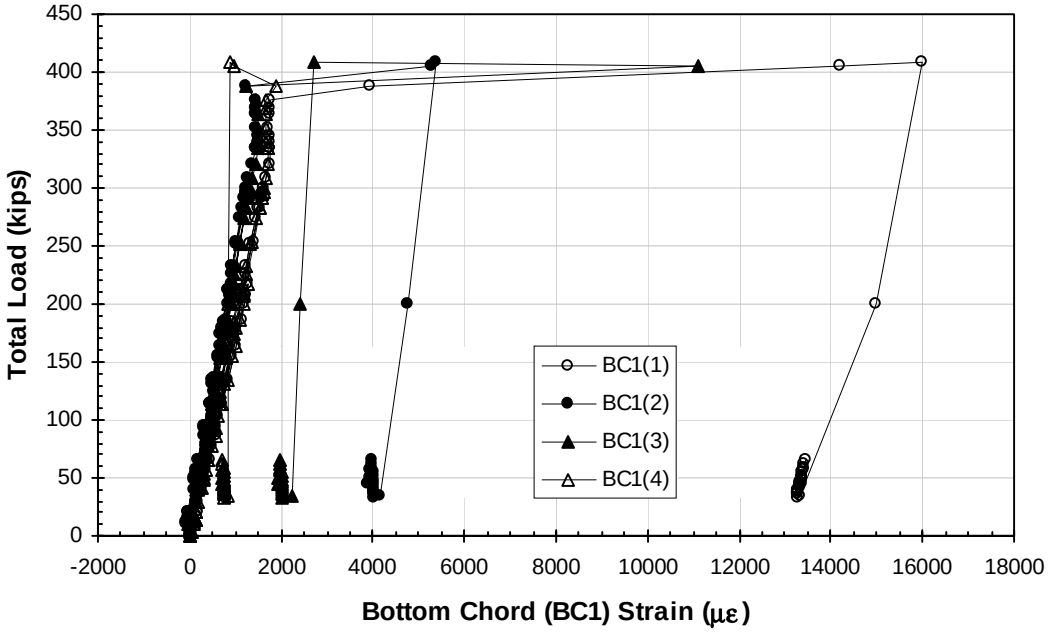


Figure B.8.5 Total Load vs. Bottom Chord (BC1) Strain of IG

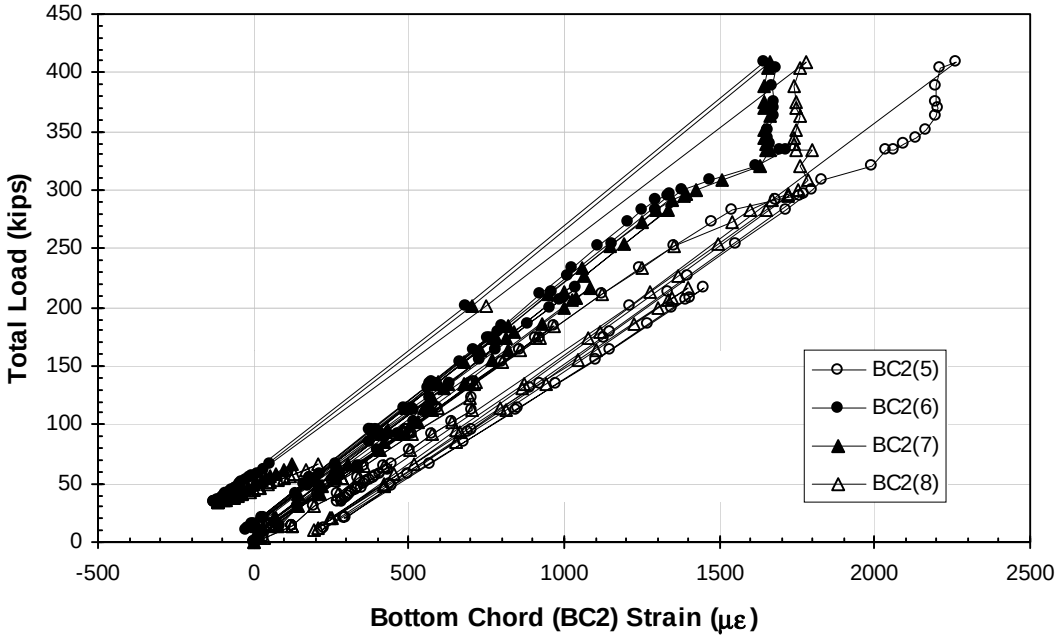


Figure B.8.6 Total Load vs. Bottom Chord (BC2) Strain of IG

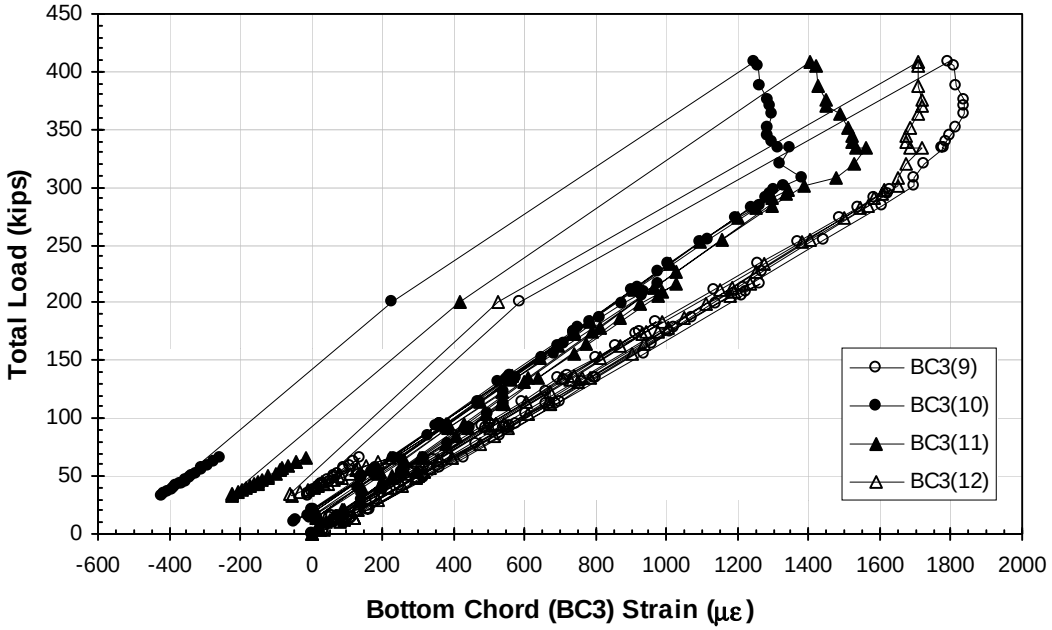


Figure B.8.7 Total Load vs. Bottom Chord (BC3) Strain of IG

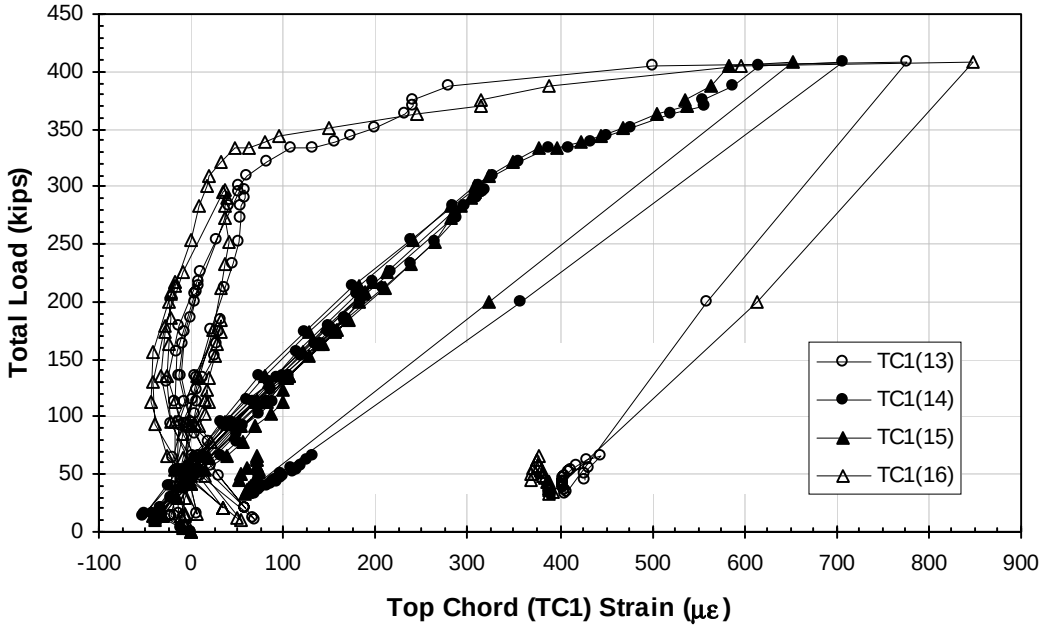


Figure B.8.8 Total Load vs. Top Chord (TC1) Strain of IG

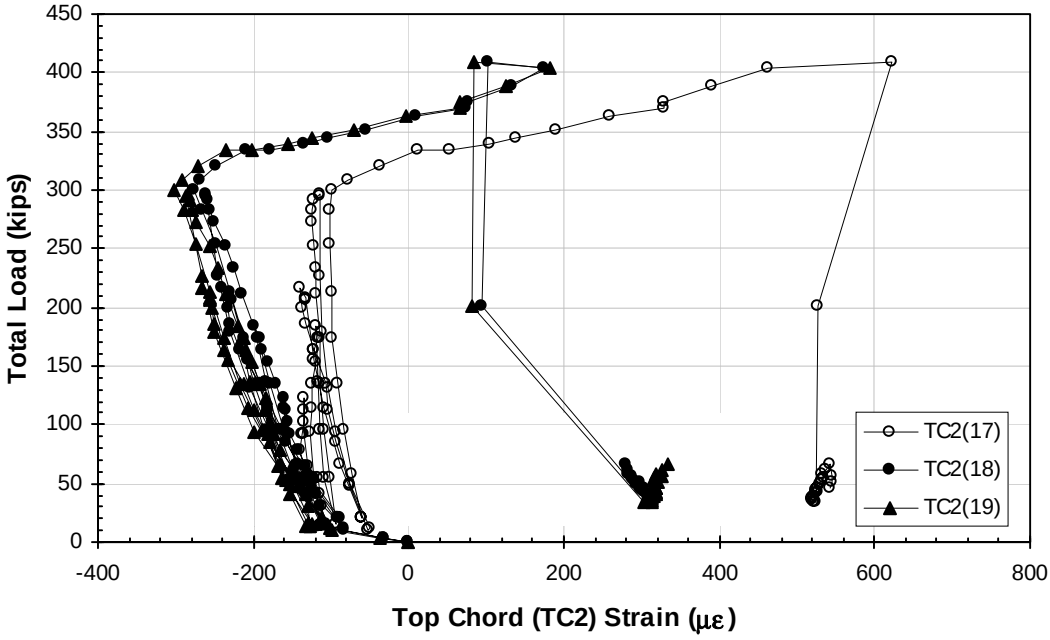


Figure B.8.9 Total Load vs. Top Chord (TC2) Strain of IG

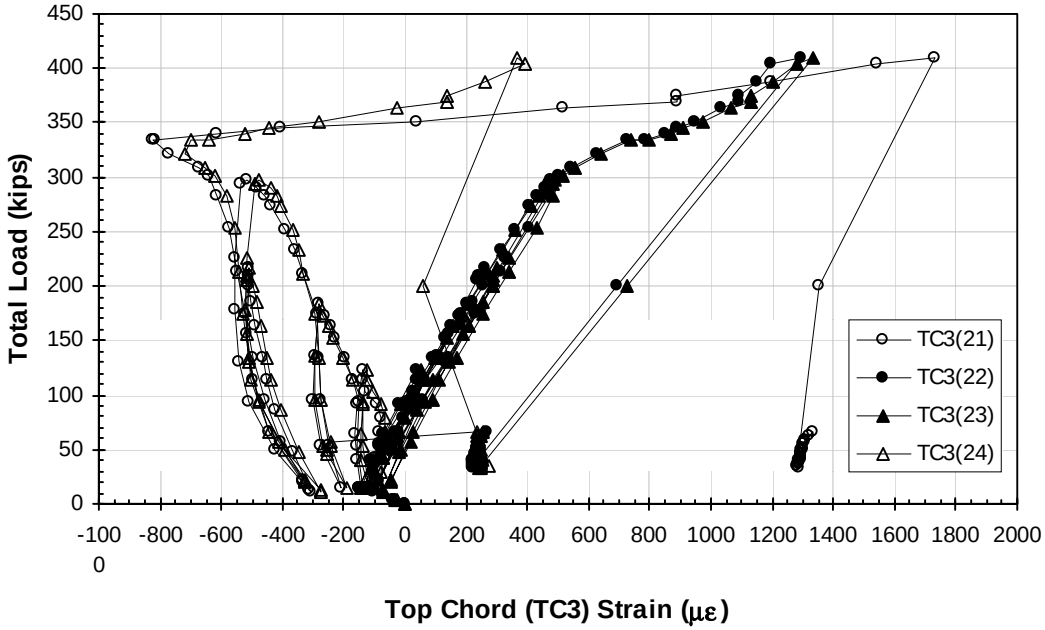


Figure B.8.10 Total Load vs. Top Chord (TC3) Strain of IG

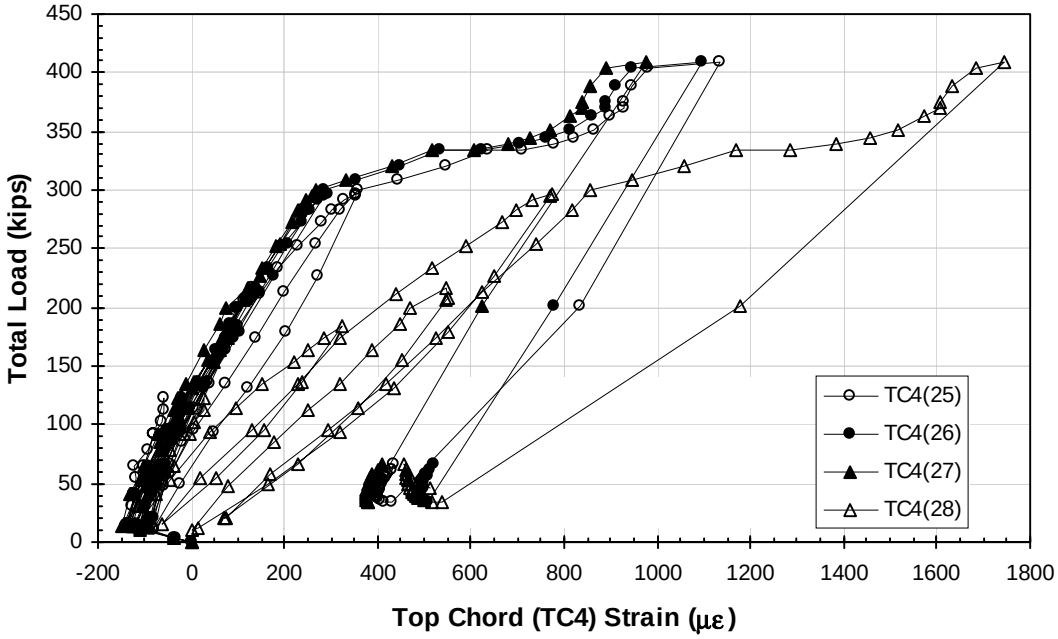


Figure B.8.11 Total Load vs. Top Chord (TC4) Strain of IG

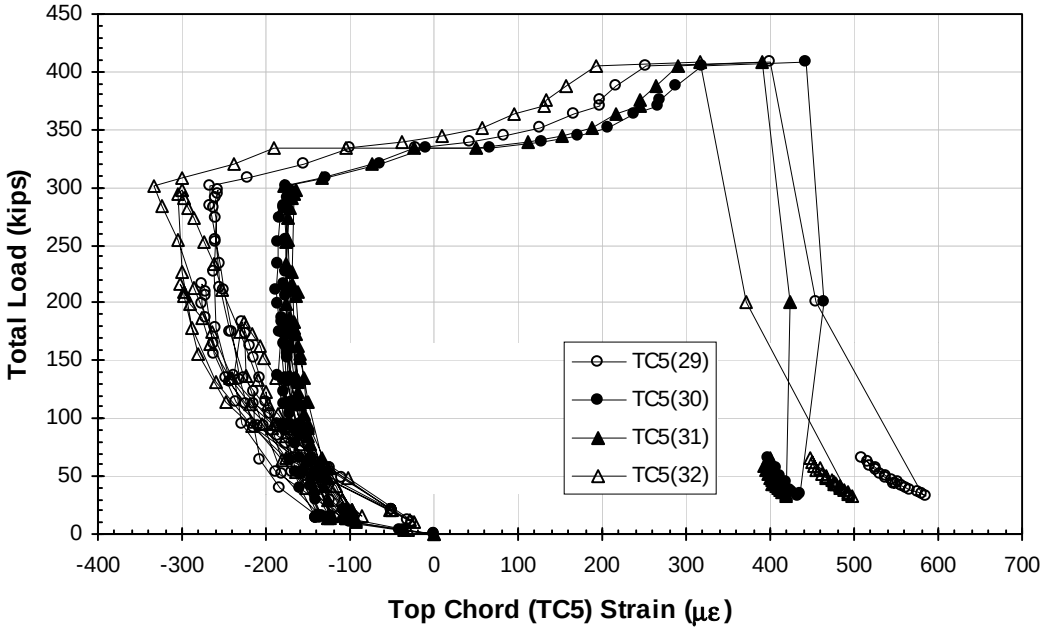


Figure B.8.12 Total Load vs. Top Chord (TC5) Strain of IG

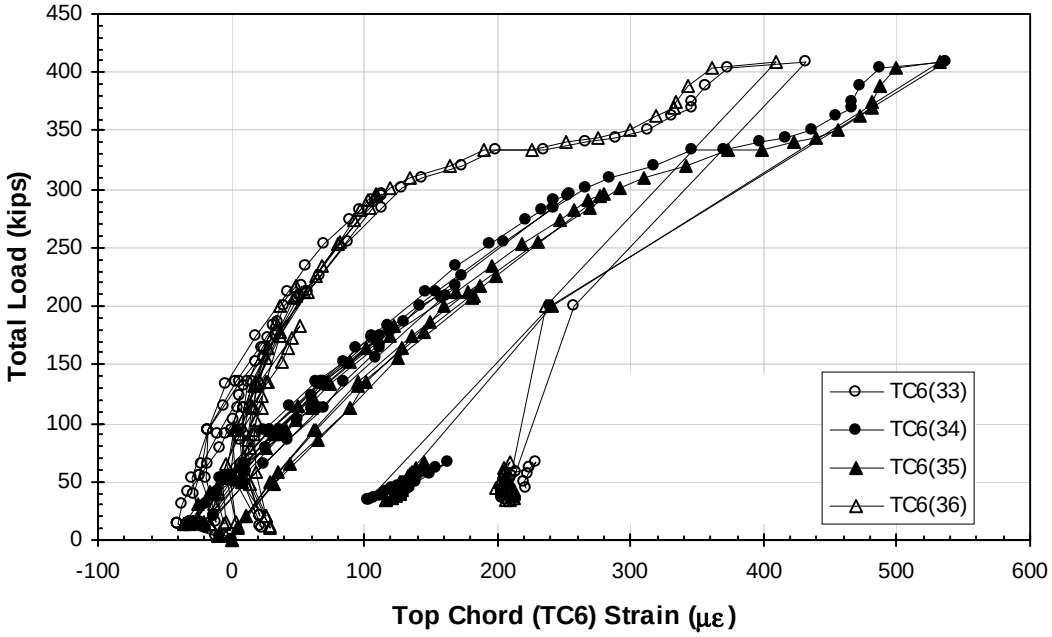


Figure B.8.13 Total Load vs. Top Chord (TC6) Strain of IG

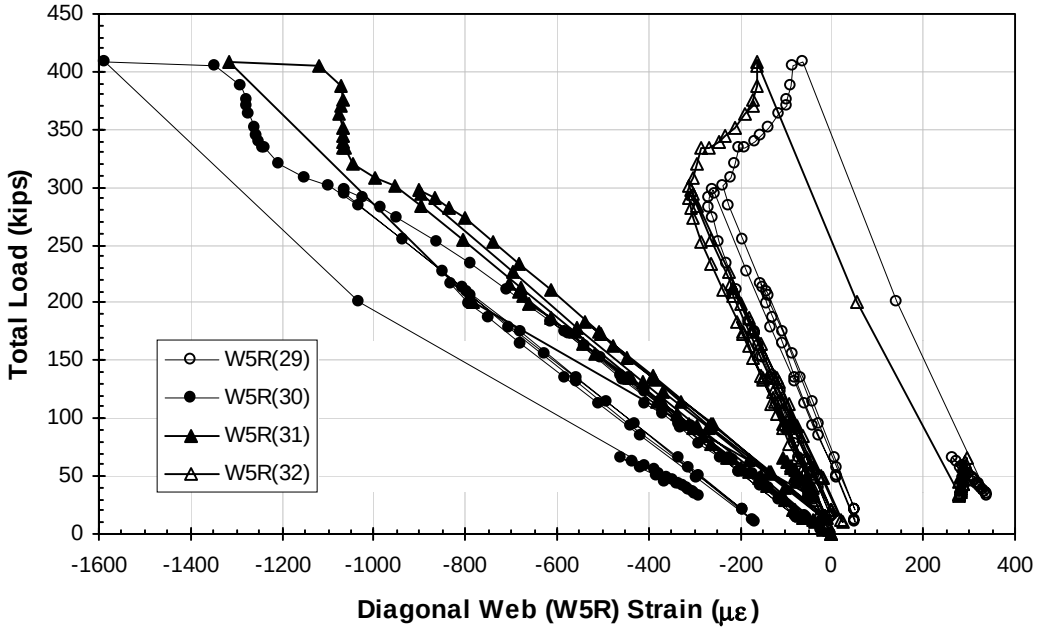


Figure B.8.14 Total Load vs. Diagonal Web (W5R) Strain of IG

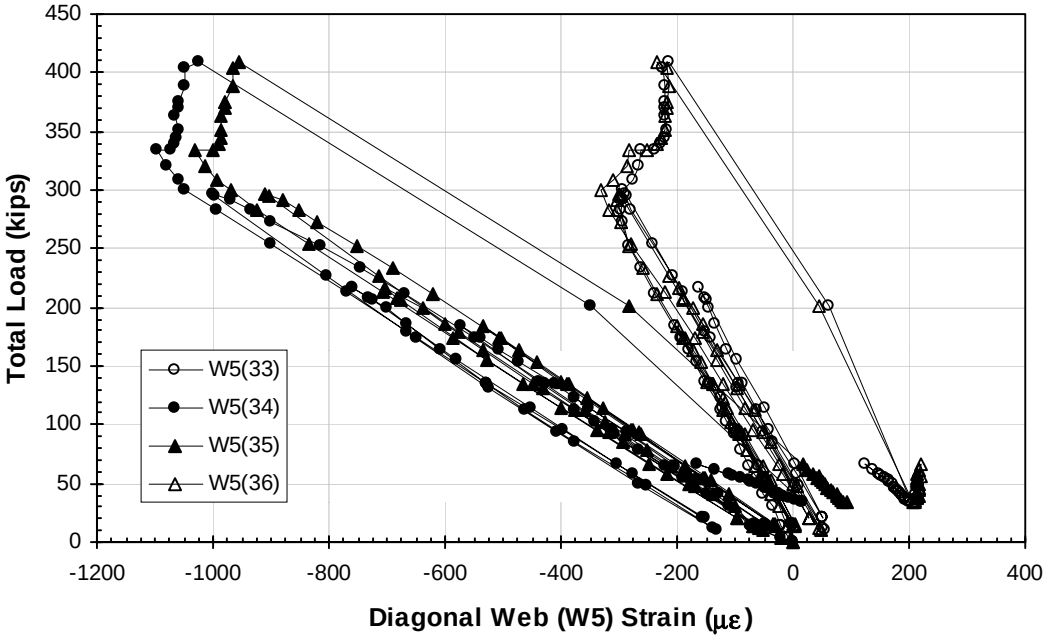


Figure B.8.15 Total Load vs. Diagonal Web (W5) Strain of IG