APPENDIX G. STRAIN GAUGE DATA

This Appendix will graphically outline the strain gauge data collected for all specimens in the final test to failure. No plots are presented for the elastic scenarios investigated for each specimen. Interested reader can contact the PI for raw data files if they need more detailed information about strains during the elastic loading.

DESCRIPTION OF GAUGE LOCATIONS

In total there were approximately 200 strain gauges used during every gusset plate test. All the strain gauges used in the project were manufactured by Tokyo Sokki Kenkyujo Co. Ltd. and purchased from Texas Measurement, Inc. (TML). All the uniaxial strain gauges had 6 mm grids (FLA-6) and the rosettes were 3-element 45º/90º stacked rosettes with 6 mm grids (FRA-6).

The interior surface of every gusset plate had nine rosettes applied according to the dimensions shown in Figure G1 and Table G1. All rosettes applied to both the north and south plates used the same orientation as shown in the figure, from an observer's standpoint outside the connection looking from south to north. In other words, the 90 degree gauge on the rosette was vertical, the 45 degree gauge was inclined to the east, and the 135 degree gauge was inclined to the west on both plates. In addition, five uniaxial strain gauges were affixed near the end of each of the diagonal members as shown in Figure G2.

Figures G3 through G7 outline the strain gauge placement on the five reusable members of the connection. One cross-section, approximately at the mid length of the member, was heavily gauged so the internal axial and bending moments could be determined. In addition, the two chord members also got a line of gauges near the top and bottom corners to try to deduce how load may shed from the member into the gusset plate.

Figure G8 shows the locations of all the uniaxial gauges applied to the chord splice plates.

DESCRIPTION OF PLOTS

For each specimen a series of 25 plots is presented that should outline the data collected from most strain gauges affixed to each specimen. For some specimens, there may be more plots as in some special circumstance there were extra gauges applied.

No data is presented from the gauges affixed to the splice plates. The data from these gauges was judged not to be worthy as the strain gradient were very sharp throughout the plate as a consequence of the tight the hole spacing. Attempts were made to analyze the data from the splice plate gauges but it proved to be futile.

In the sections entitled "Maximum Shear Strain Plots," are two graphs of the maximum shear strains for the five collinear rosettes along the horizontal plane above the chord. One plot is from the five rosettes on the north plate, the other from the five rosettes on the south plate. They are plotted versus the distance along the width of the plate where the west edge of the plate is considered the origin. As a reference, the compression diagonal framed into the connection from

the west. Four plots are presented within each graph corresponding to the strain readings at approximately the ¼. ½, ¾ and maximum applied load fractions (ALF). The ALF is the proportion of the applied reference load combination. Also shown in each of these graphs is dashed line which corresponds to the maximum shear strain calculated using the yield strength of a uniaxial specimen.

In the section entitled "Variations in Principal Strain" are 10 graphs, where each graph shows the data from each individual rosette affixed along the horizontal plane just above the chord. Four plots are presented for each rosette, "ε1" is the first principle strain, "ε2" is the second principle strain, "γmax" is the maximum shear strain, and "θ1" is the angle to the first principle strain direction. As a note, the 45, 90, and 135 degree gauges within the rosettes were always oriented in the same manner. That is, from a prospective outside of the assembled connection, looking from south to north, the 90 degree orientation was straight up, the 45 degree orientation was to the right, and the 135 degree to the left. This orientation was used for both the north and south plates. This is also shown in Figure G1. All data are plotted against the ALF along the horizontal axis. As a reference, the maximum shear strain for the measured yield stress is shown as a dashed line.

In the sections entitled "Member Cross-Sectional Plots" are five graph that outline the post-processed strain data from the five members. A least-squares fit strain plane was fit to all the individual strain gauges readings. Then using the member cross-sectional properties, this strain plane was integrated to get the measured axial load, strong axis moment, and weak axis moment internal to the member. Also shown is the combined axial load coming from the two jacks, or in the case of the west chord, the resolved reaction force based on equilibrium. Each plot within the graphs is plotted versus the ALF throughout the test.

In the sections titled "Chord Load Shedding Plots" represents the data collected from the lines of uniaxial gauges affixed to the four corners of the chord members. The intent of the gauges was to try and capture how the load transfers between the chord and the gusset by seeing over what distance it takes for the strain to decrease to zero, or how the load sheds from the chord into the gusset. Four graphs are presented, each plots the four gauge lines against the distance away from the theoretical chord splice location. Each graph is made at point in the load approximately representing the ¼. ½, ¾ and maximum ALFs.

In the section entitled "Uniaxial Gauge Plots" are the data from the five strain gauges affixed to each gusset at the base of the tension and compression diagonals. Each graph contains four plots representing the strain readings taken at approximately the ¼. ½, ¾ and maximum ALFs. The strain readings are plotted again the distance along the member width on the horizontal axis.

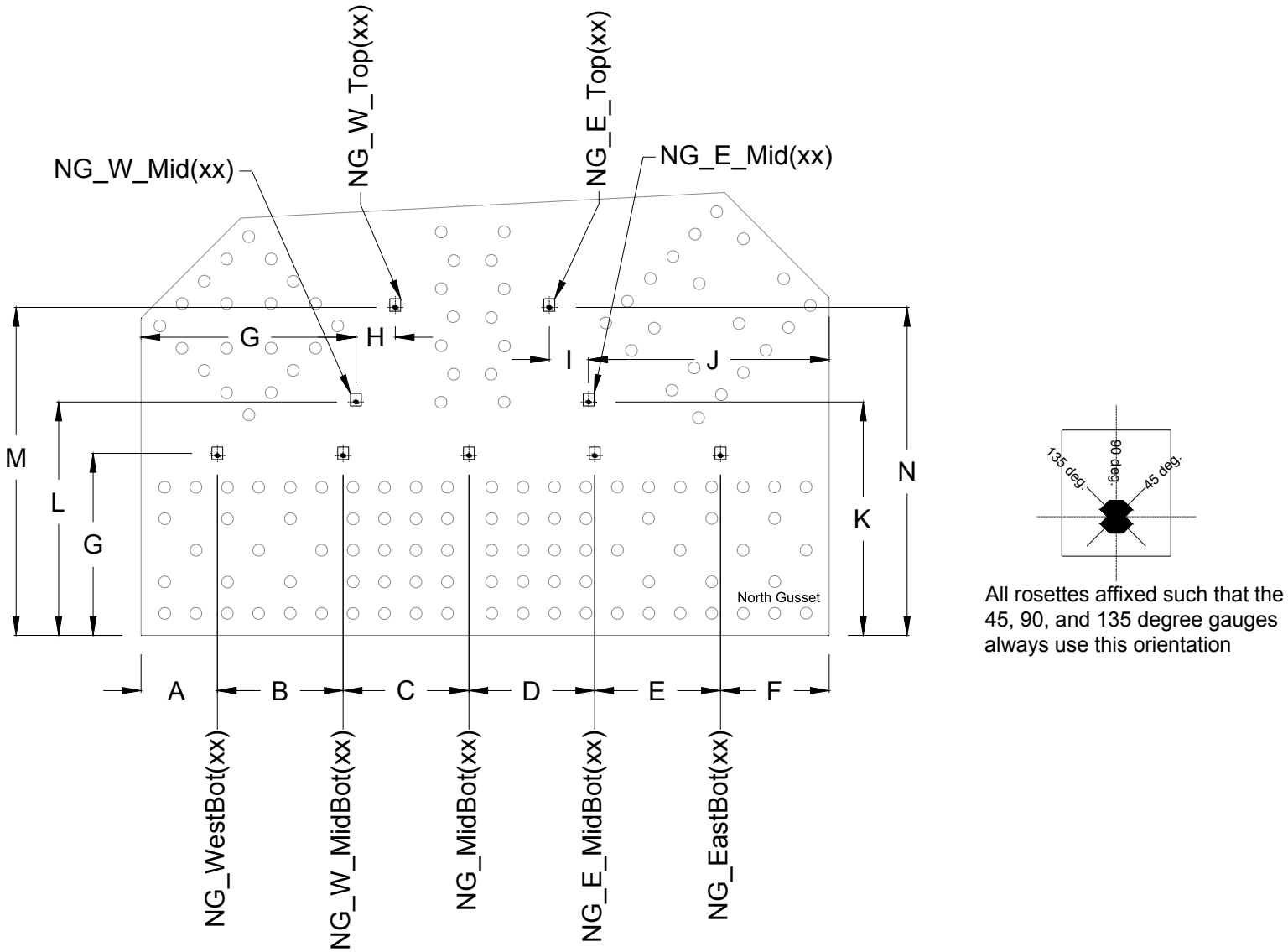

Figure G1. Placement and labeling (of north plate) of nine strain rosettes on the interior surface of each gusset plate.

Table G1. Dimension Cross Reference to Figure G1 Rosette Gauge Location

Specimen	Dimension in inches														
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
307SS3	4.50	12.00	12.00	12.00	12.00	6.50	19.25	3.00	3.25	21.25	18.50	18.50	26.00	26.00	14.00
307SS3-1	5.50	11.50	11.50	11.50	11.50	7.50	21.5	1.75	1.75	23.50	19.00	19.00	26.50	26.50	14.50
307SS3-2	5.50	11.50	11.50	11.50	11.50	7.50	21.5	1.75	1.75	23.50	19.00	19.00	26.50	26.50	14.50
307SS3-3	5.50	11.50	11.50	11.50	11.50	7.50	21.5	1.75	1.75	23.50	19.00	19.00	26.50	26.50	14.00
307SS3-4	5.50	11.50	11.50	11.50	11.50	7.50	21.5	1.75	1.75	23.50	19.00	19.00	26.50	26.50	14.00
307LS3	11.25	11.00	11.00	11.00	11.00	11.25	23.25	2.50	3.75	21.25	18.75	18.75	26.25	26.25	14.50
307SL3	11.25	11.00	11.00	11.00	11.00	11.25	23.25	2.50	2.50	24.75	18.75	18.75	26.25	26.25	14.50
307SL4	11.25	11.00	11.00	11.00	11.00	11.25	24.75	2.50	2.50	23.25	18.75	18.75	26.25	26.25	14.50
490SS3	6.00	10.00	10.00	10.00	10.00	8.75	17.00	3.50	18.75	18.50	18.50	18.50	26.00	26.00	14.25
490SS3-1	6.00	10.00	10.00	10.00	10.00	8.75	17.00	3.00	3.00	19.00	18.50	18.50	26.00	26.00	14.25
490LS3	8.25	10.00	10.00	10.00	10.00	10.75	19.50	2.75	3.75	17.25	18.50	18.50	26.00	26.00	14.50
490LS3-1	8.25	10.00	10.00	10.00	10.00	10.75	19.50	2.75	3.75	17.25	18.50	18.50	26.00	26.00	14.50
490LS3-2	8.25	10.00	10.00	10.00	10.00	10.75	19.50	2.75	3.75	17.25	18.50	18.50	26.00	26.00	14.50

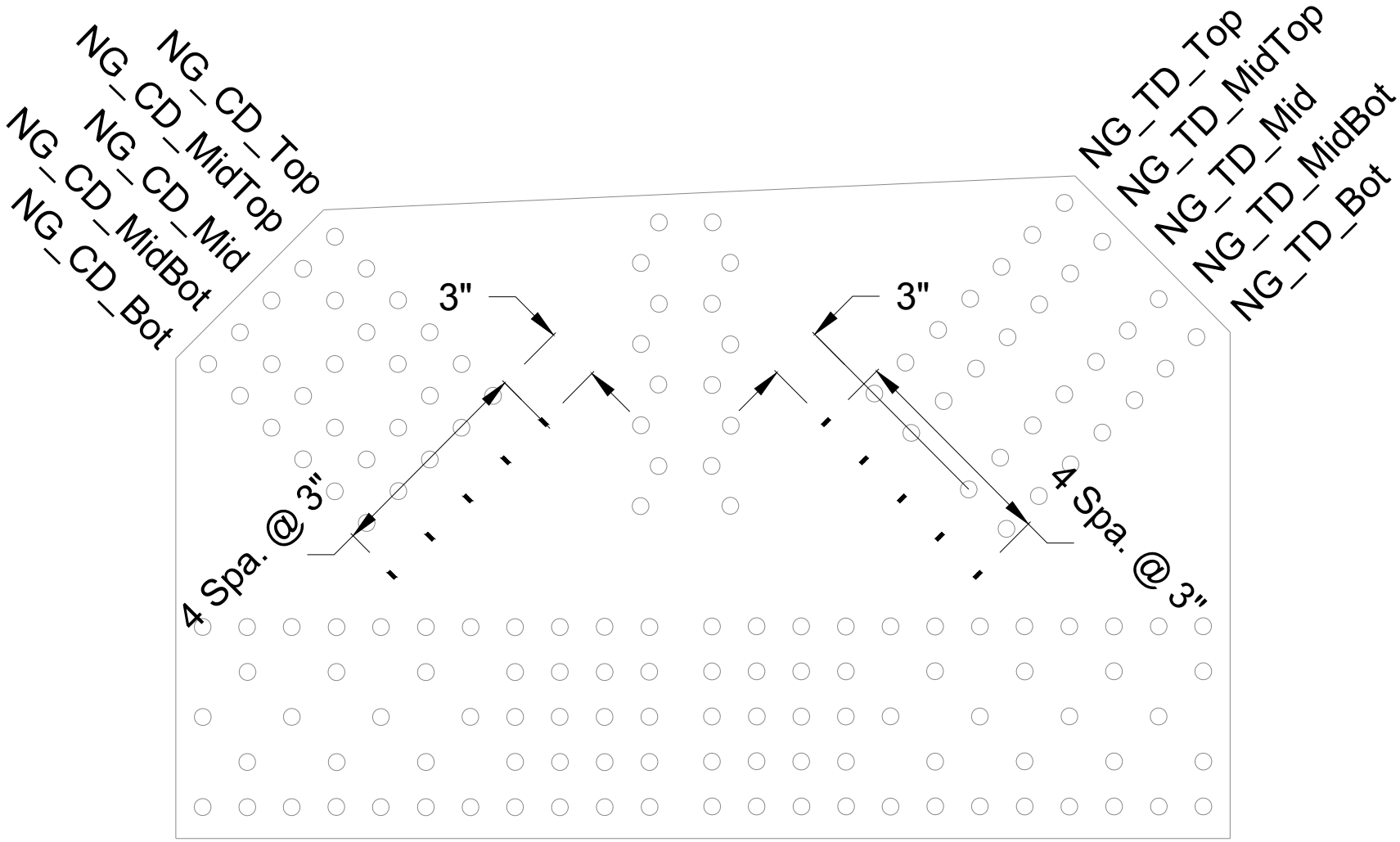

Figure G2. Location and labeling (for north plate) of ten uniaxial strain gauges on interior of each gusset plate.

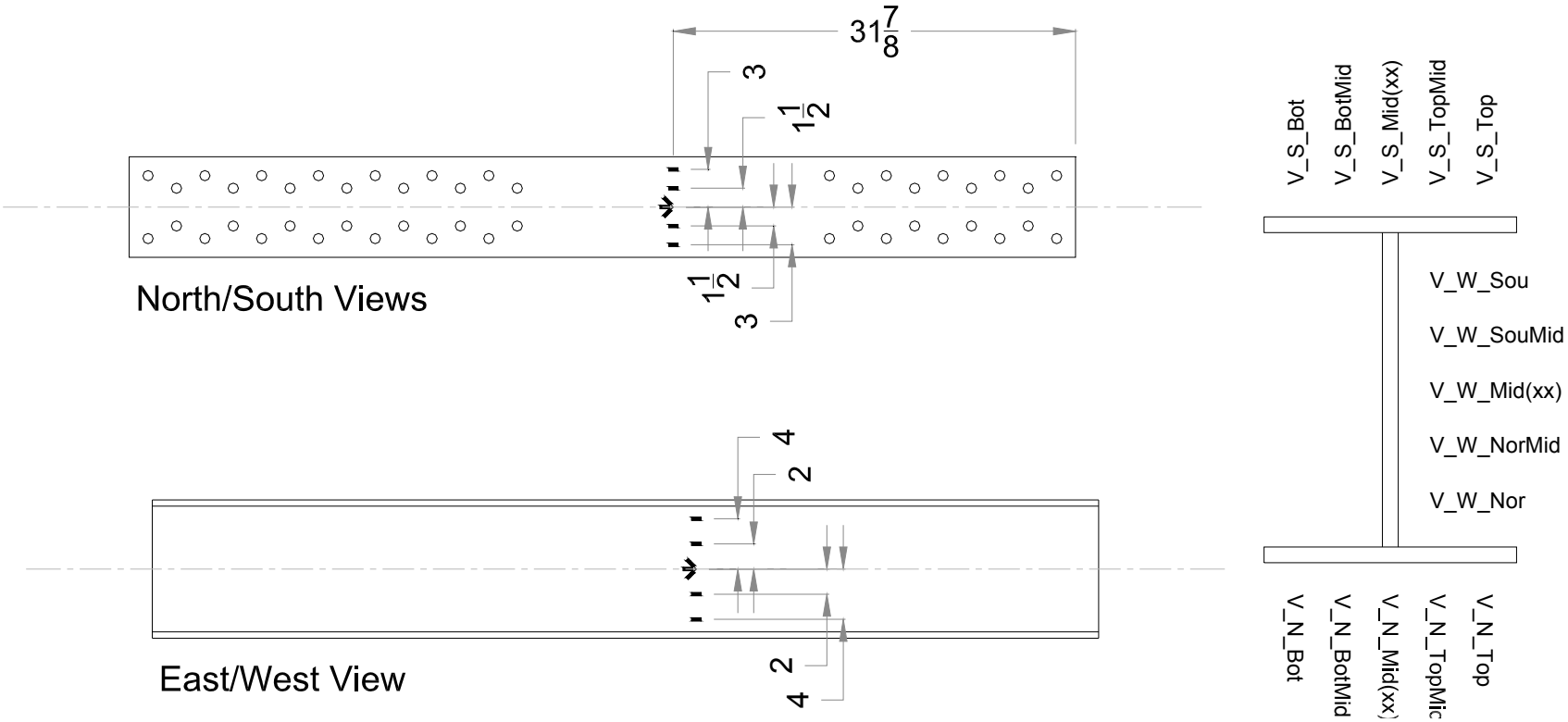

Figure G3. Location and labeling of uniaxial and rosette strain gauge applied to vertical member.

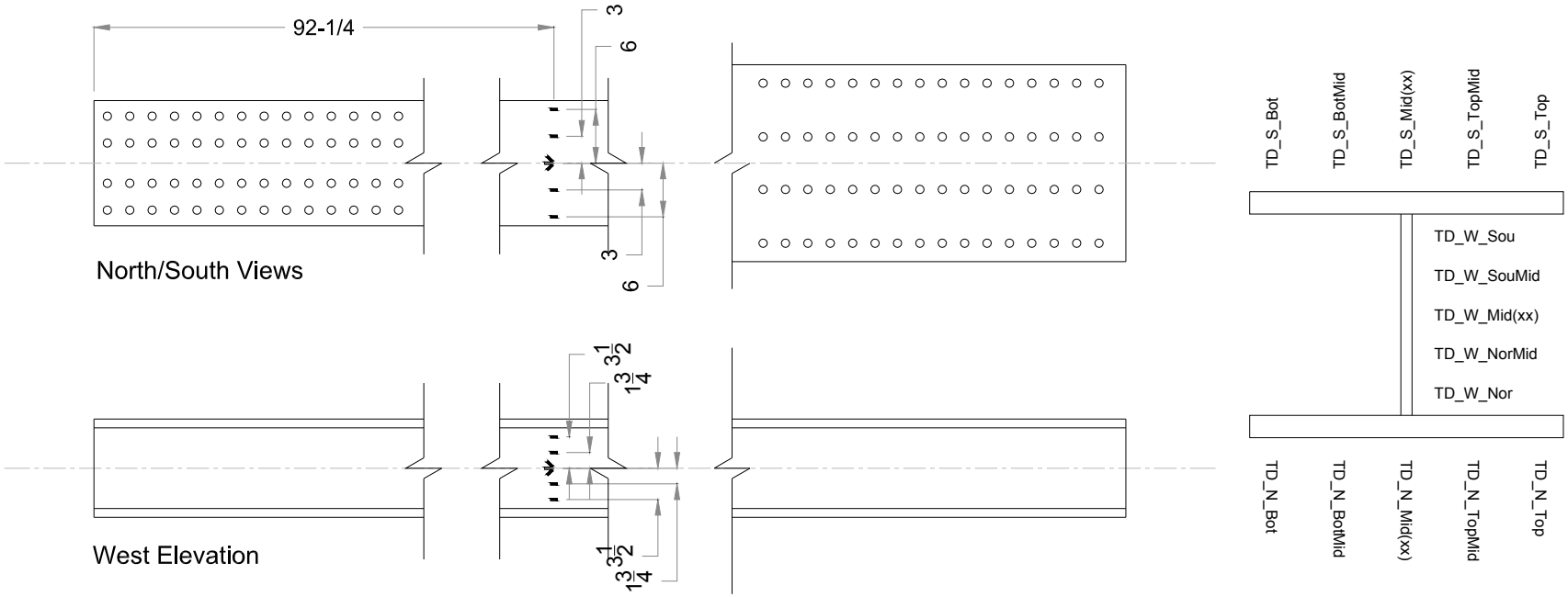

Figure G4. Location and labeling of uniaxial and rosette strain gauge applied to tension diagonal.

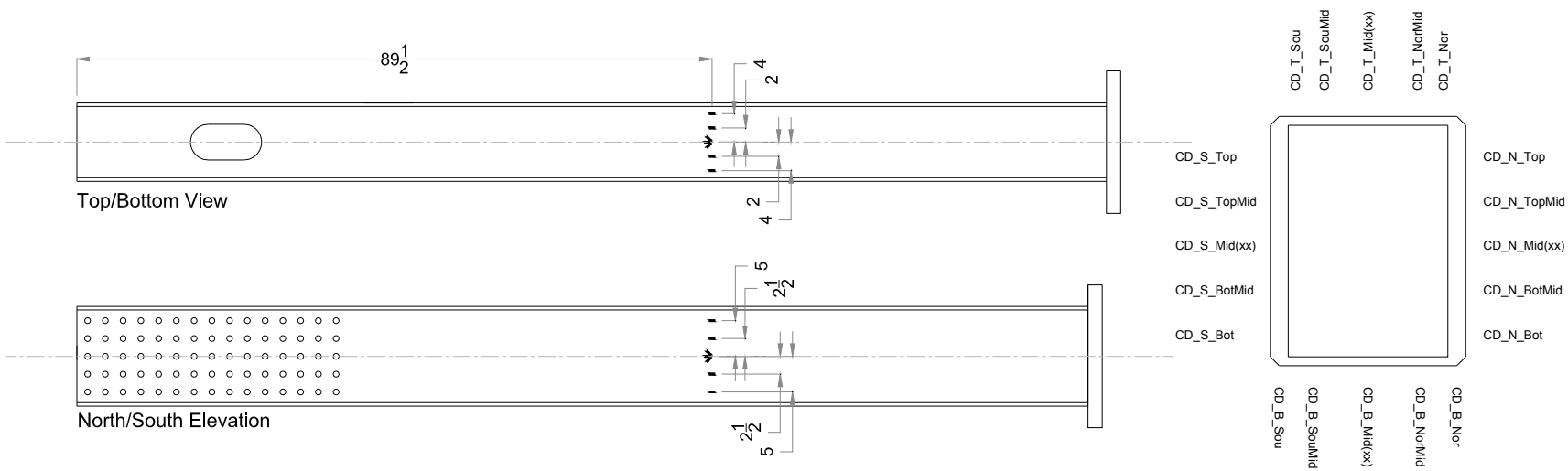

Figure G5. Location and labeling of uniaxial and rosette strain gauge applied to compression diagonal.

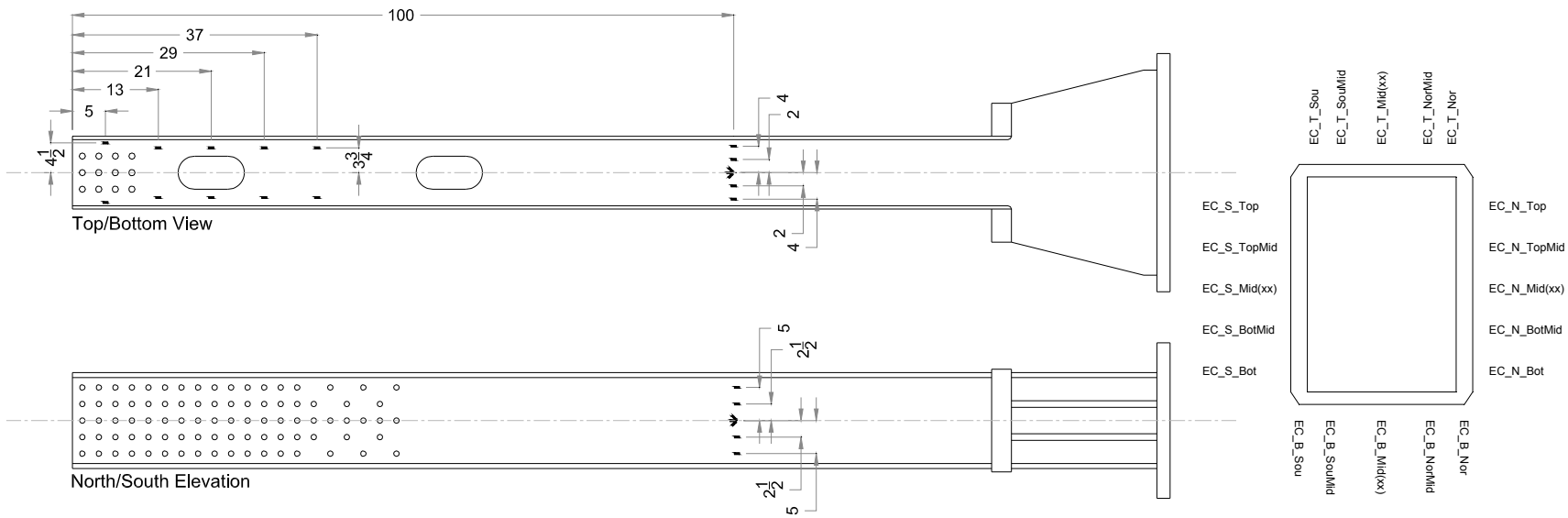

Figure G6. Location and labeling of uniaxial and rosette strain gauge applied to east chord.

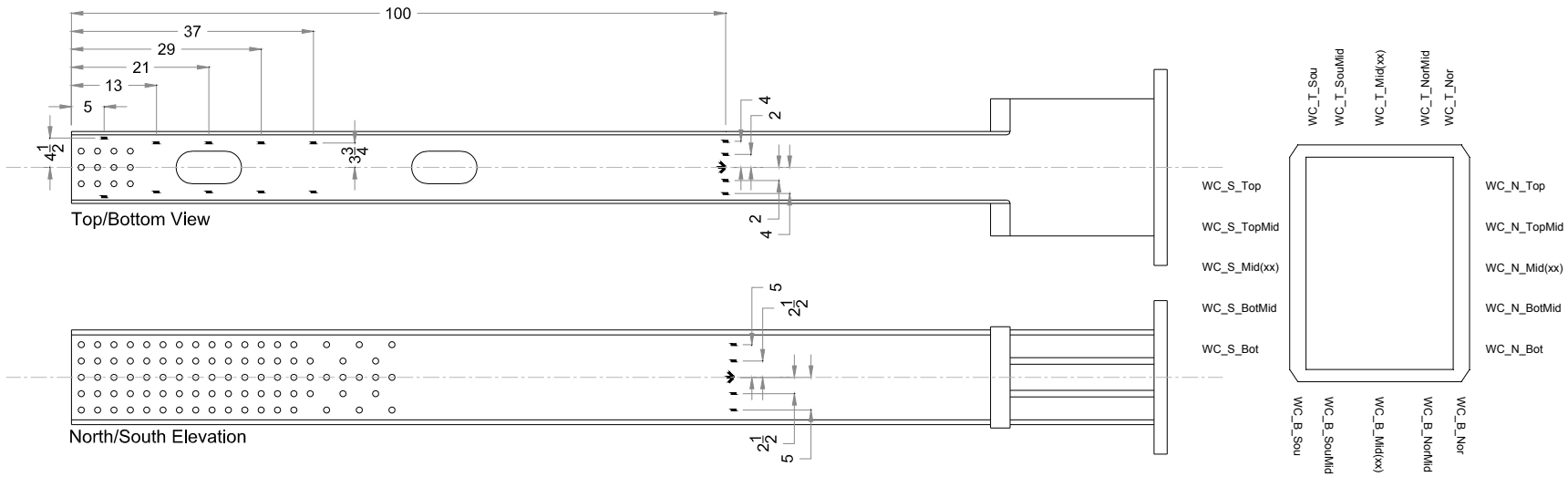

Figure G7. Location and labeling of uniaxial and rosette strain gauge applied to west chord.

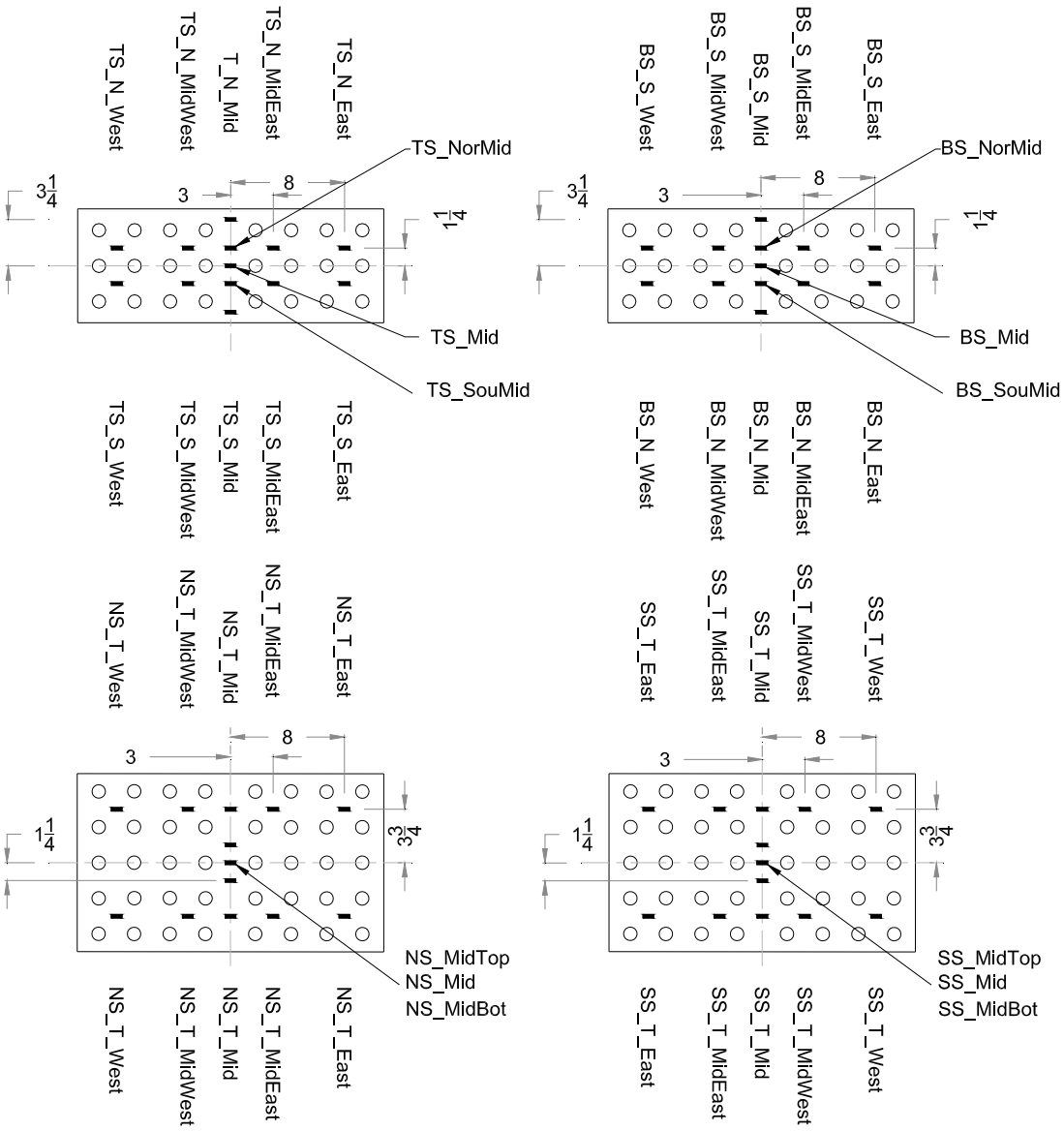

Figure G8. Location and labeling of uniaxial strain gauges applied to splice plates.

SPECIMEN 307SS3

Maximum Shear Strain Plots

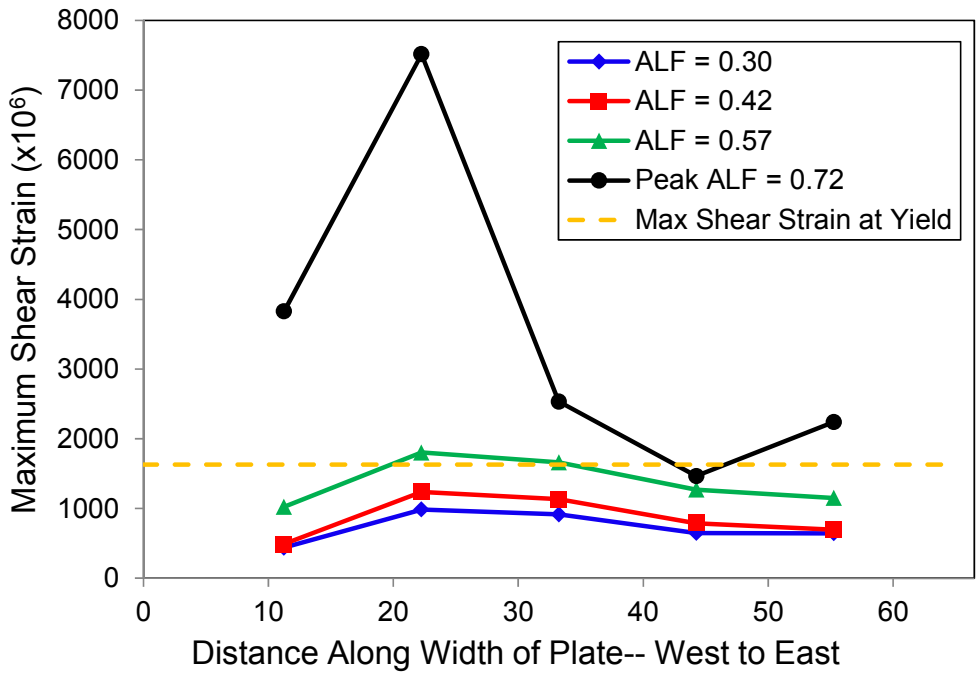

Figure G9. Horizontal line of rosettes above chord; south gusset plate

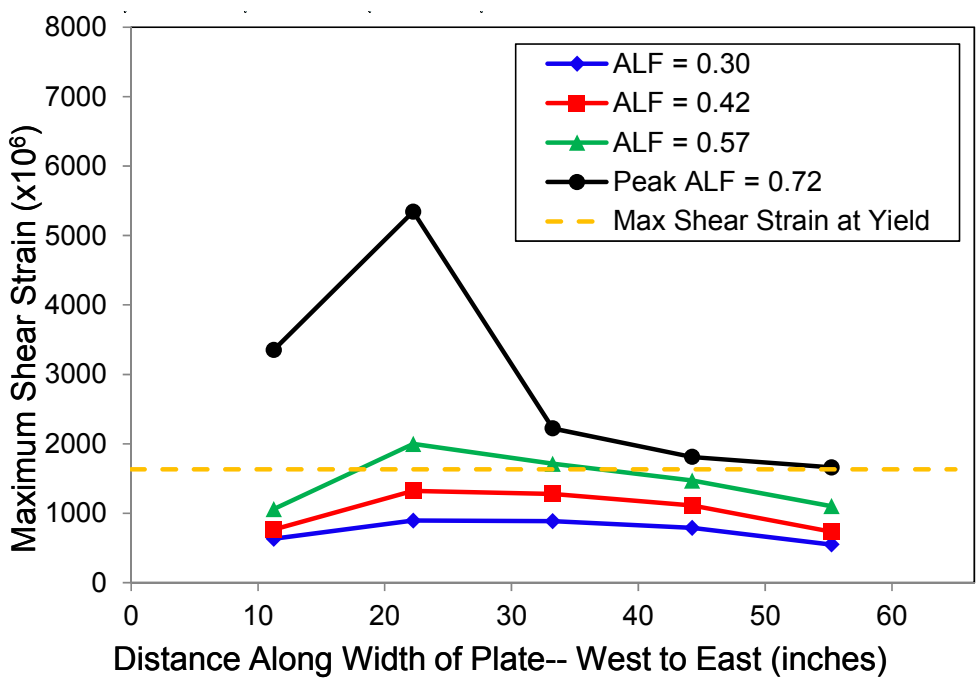

Figure G10. Horizontal line of rosettes above chord; north gusset plate

Variations in Principal Strain

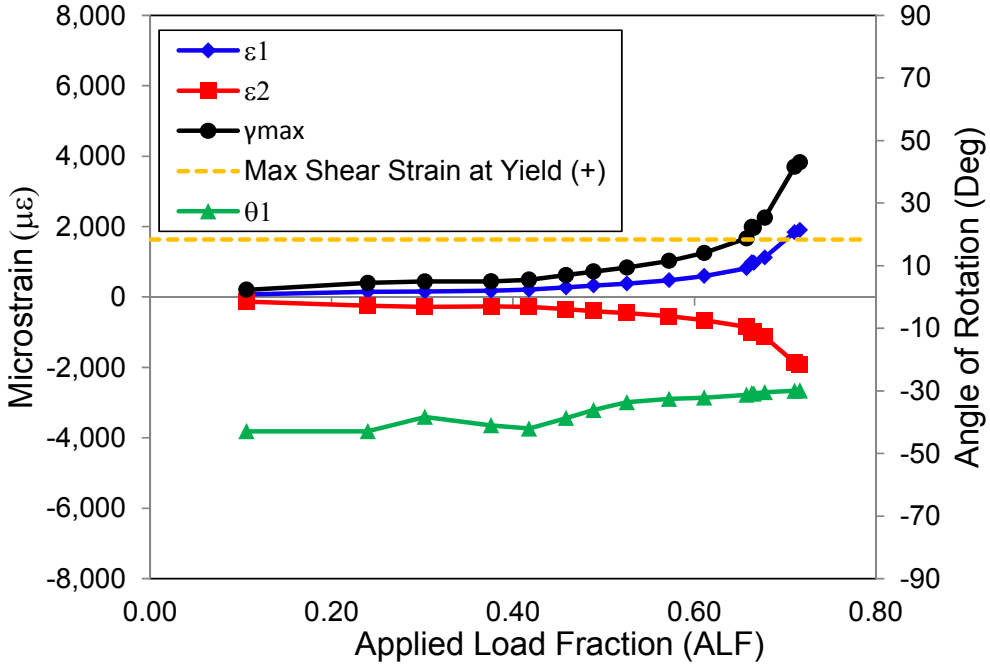

Figure G11. South gusset west bottom

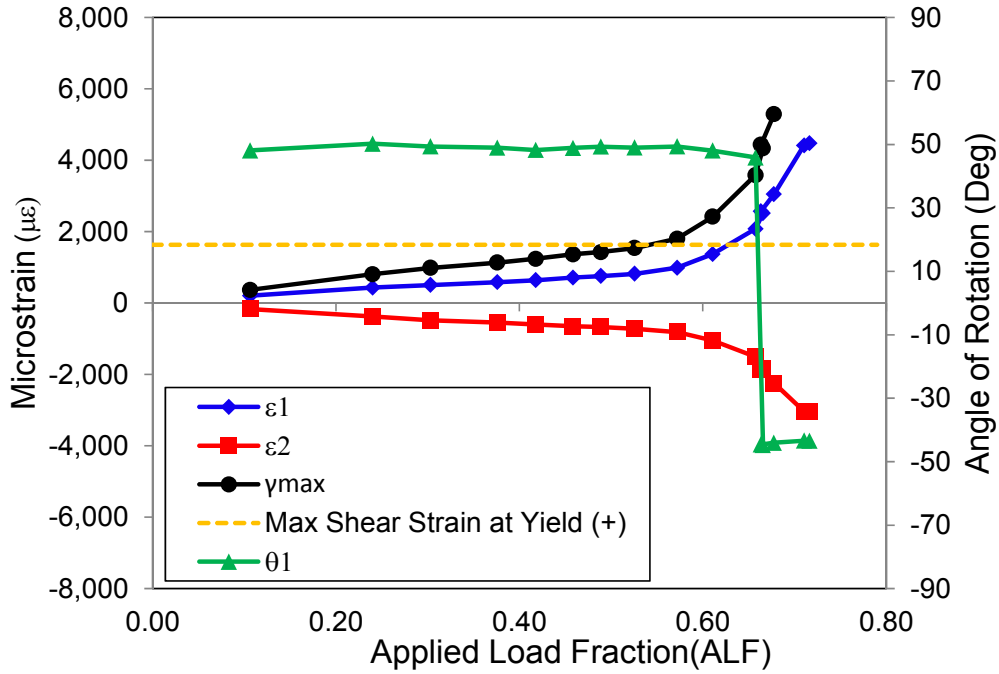

Figure G12. South gusset west mid bottom

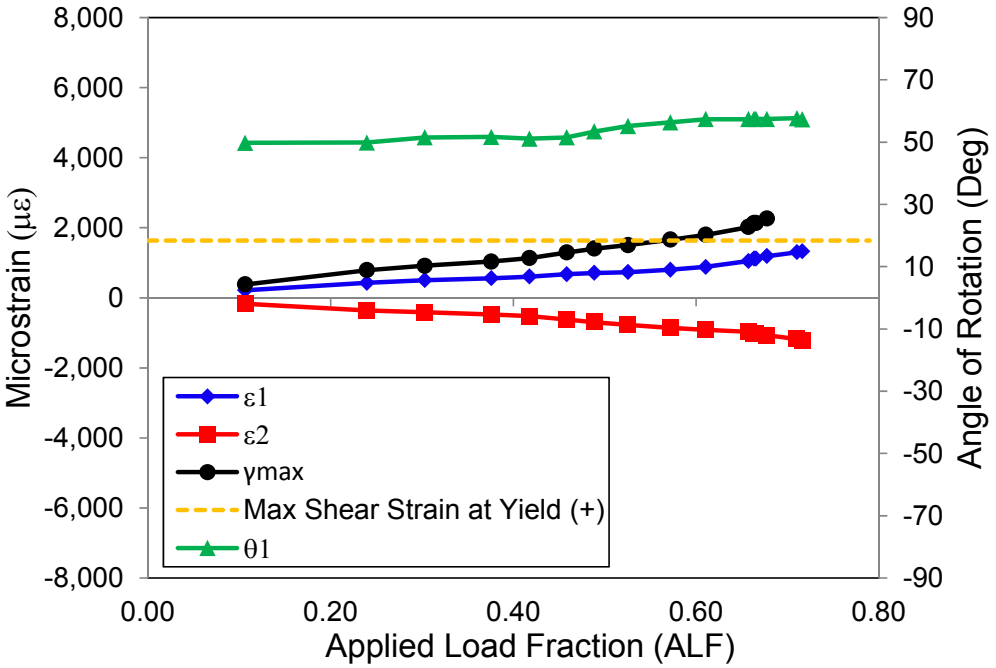

Figure G13. South gusset mid bottom

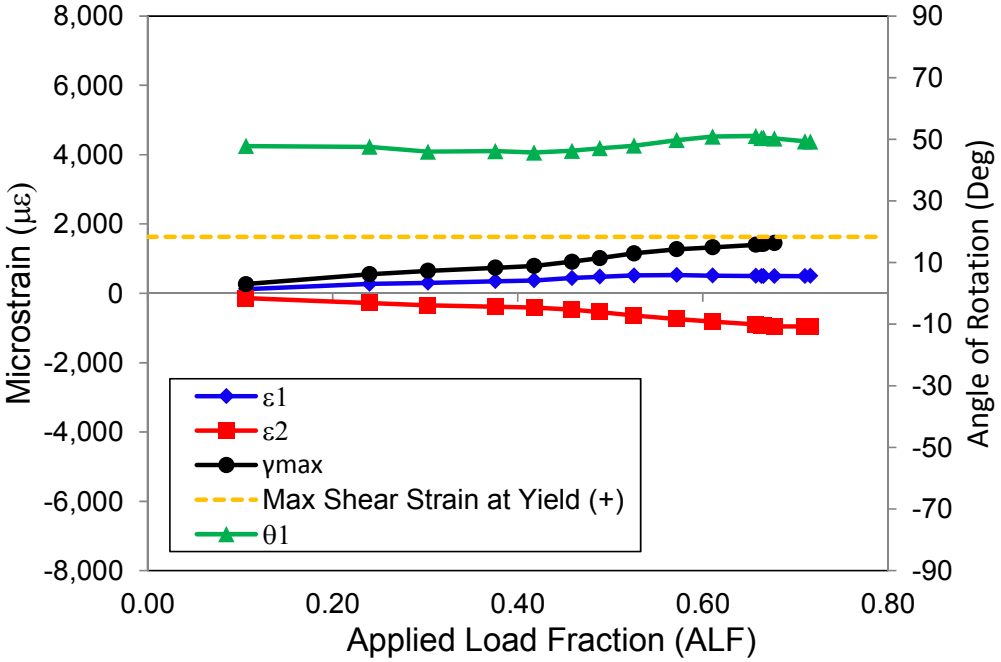

Figure G14. South gusset east mid bottom

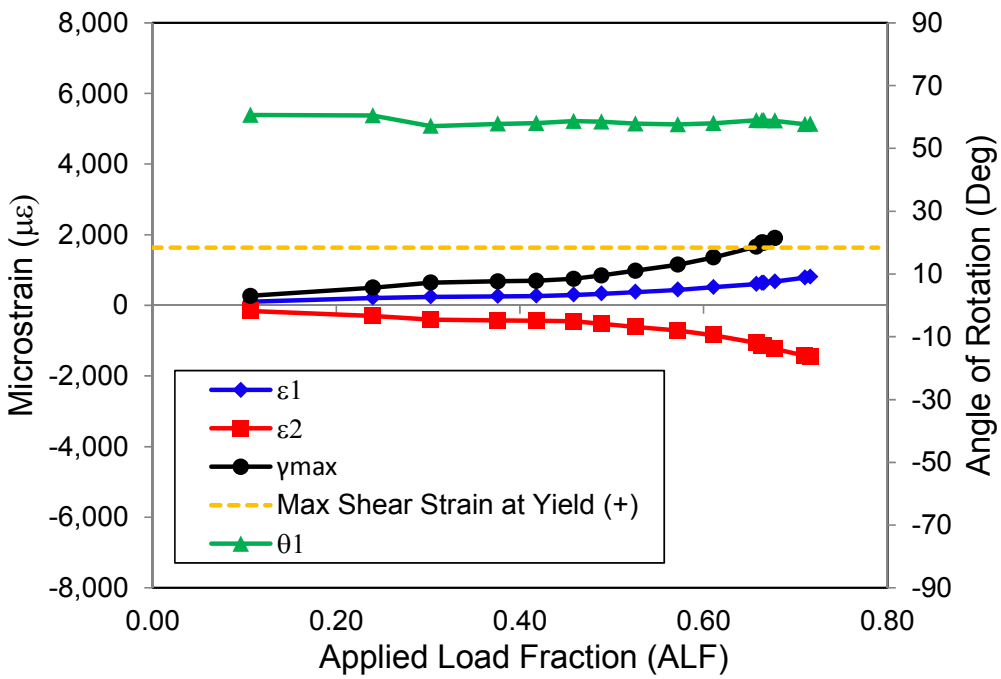

Figure G15. South gusset east bottom

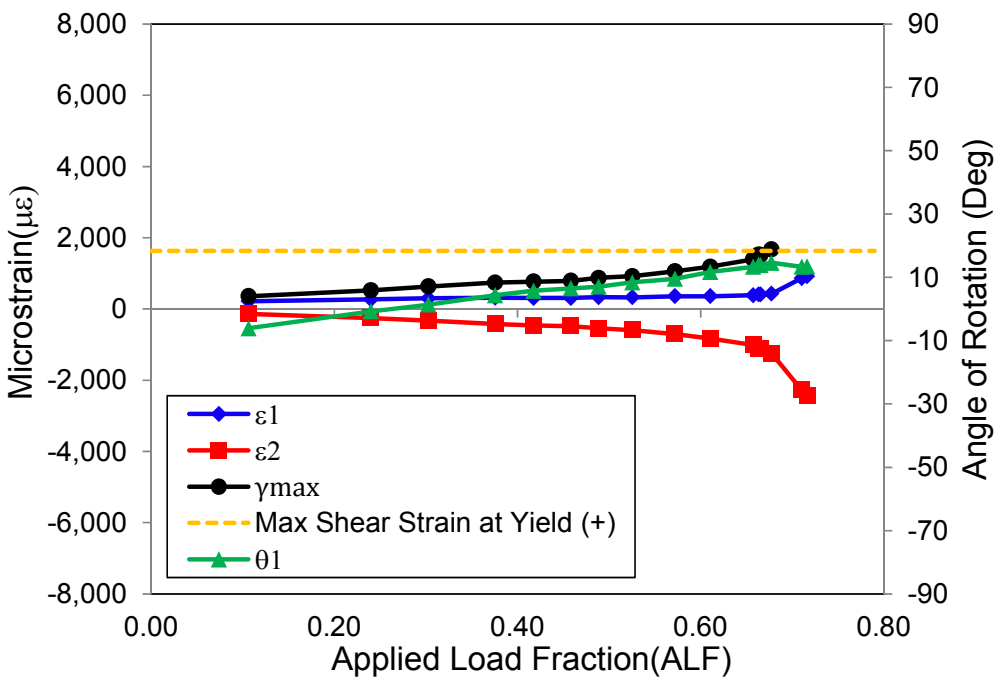

Figure G16. North gusset west bottom

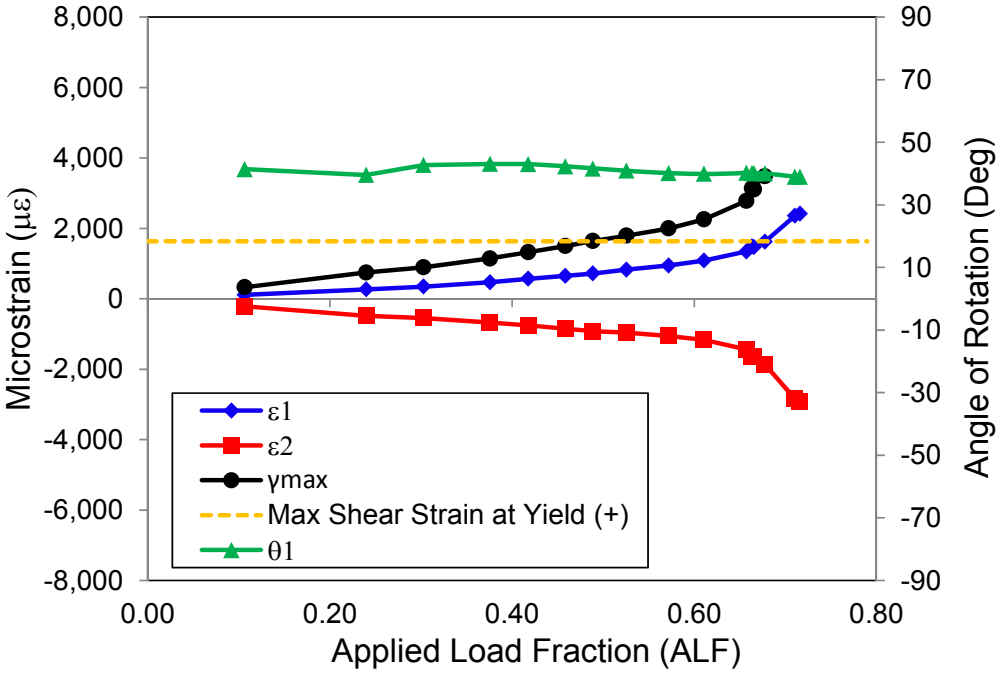

Figure G17. North gusset west mid bottom

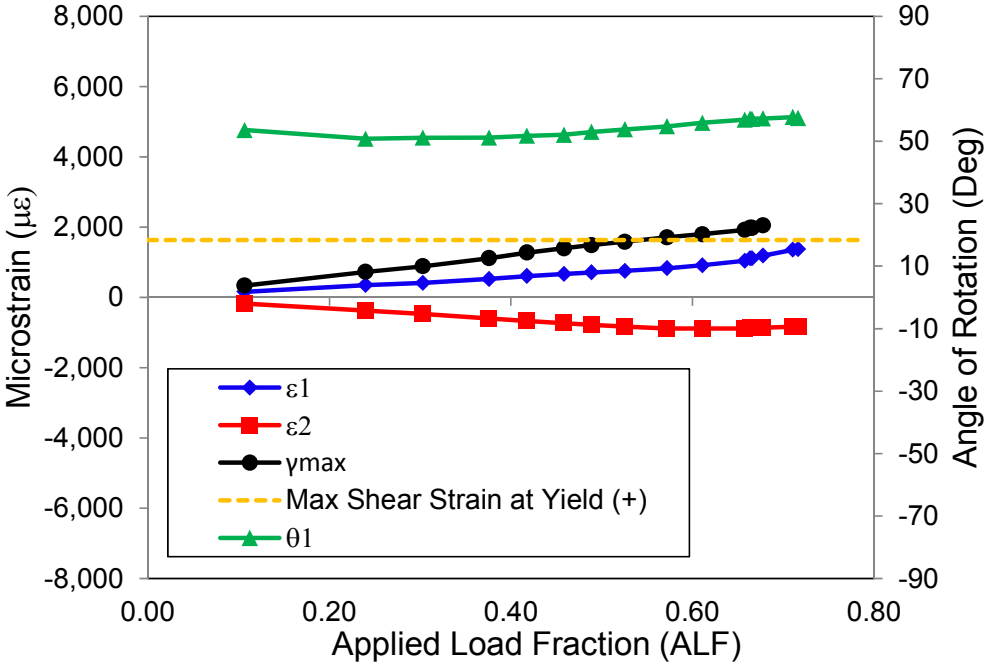

Figure G18. North gusset mid bottom

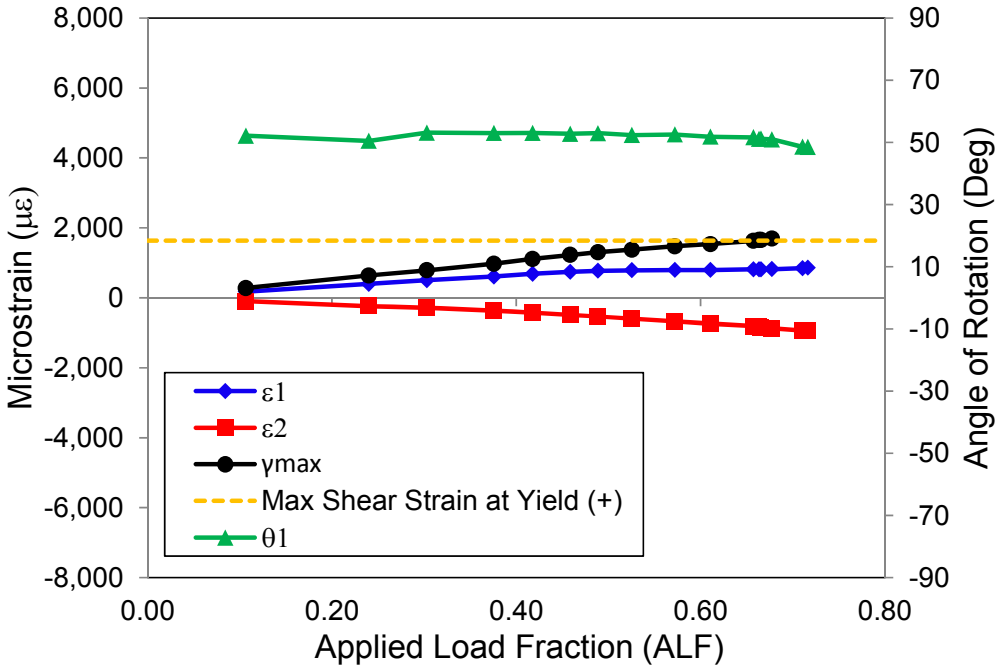

Figure G19. North gusset mid east bottom

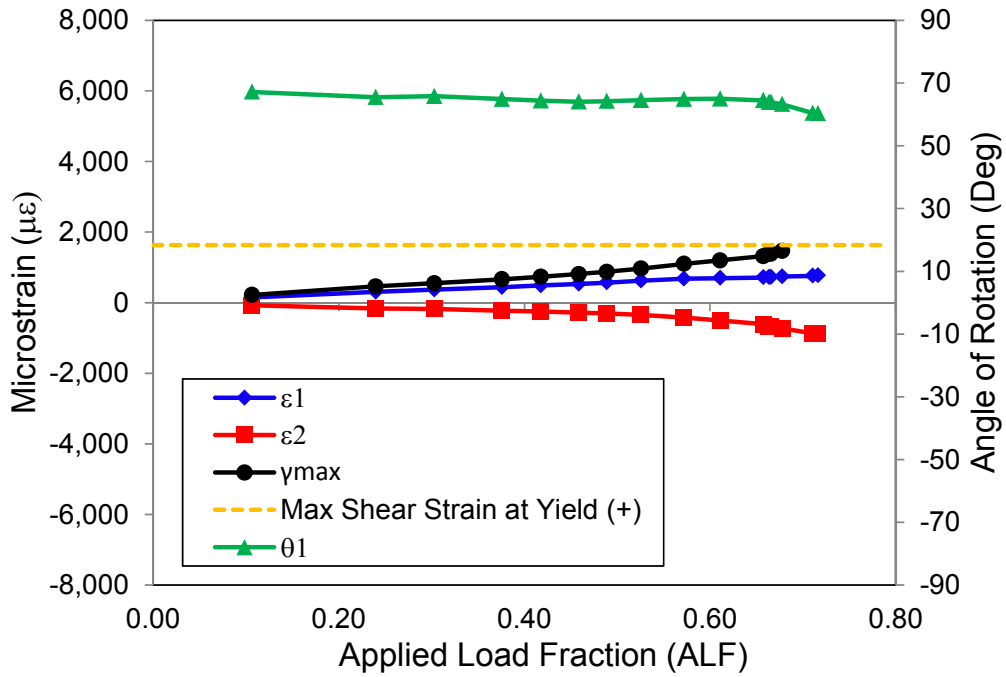

Figure G20. North gusset east bottom

Member Cross-Sectional Plots

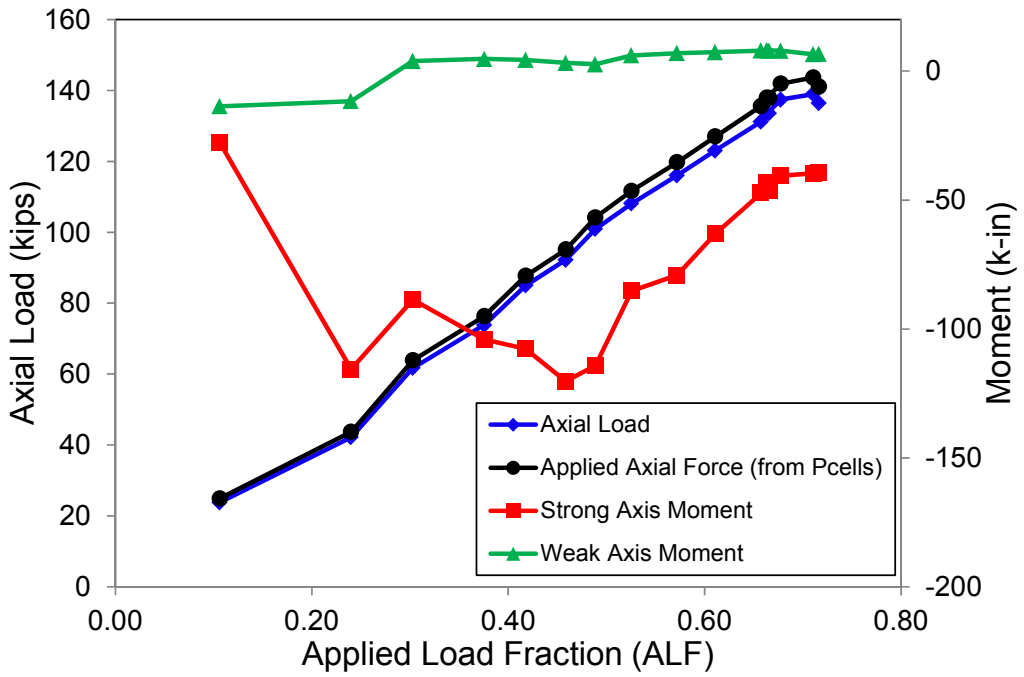

Figure G21. Vertical

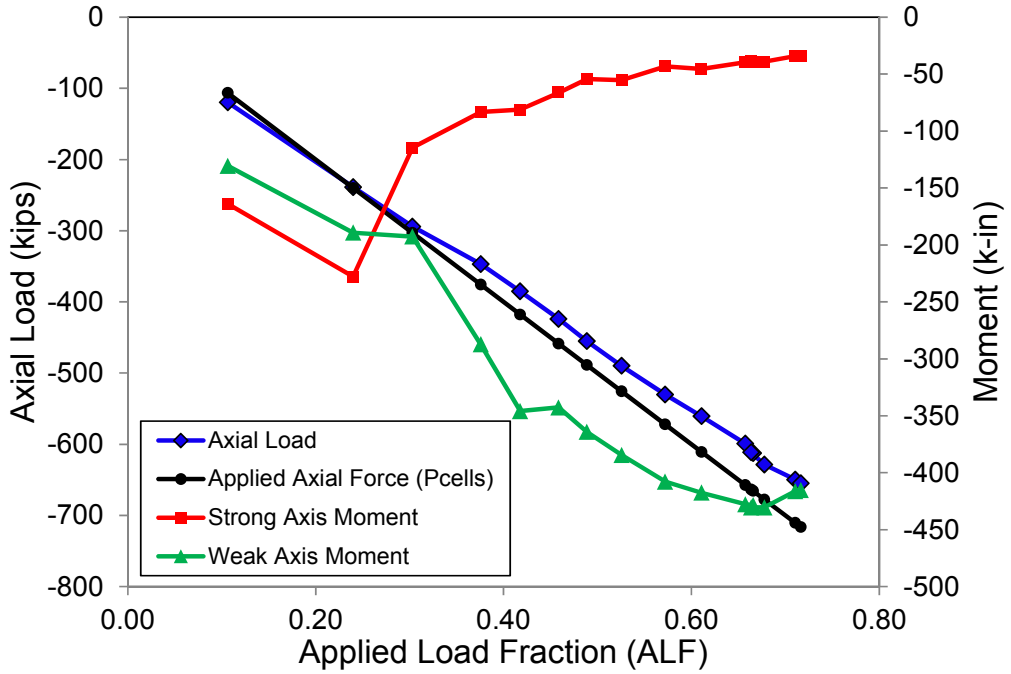

Figure G22. Compression Diagonal

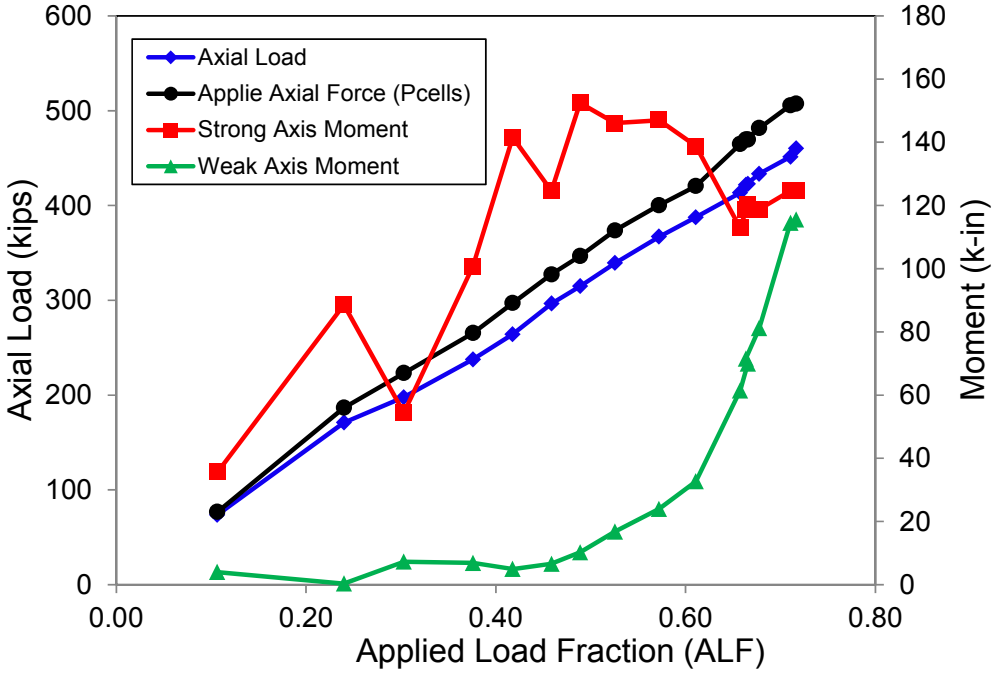

Figure G23. Tension Diagonal

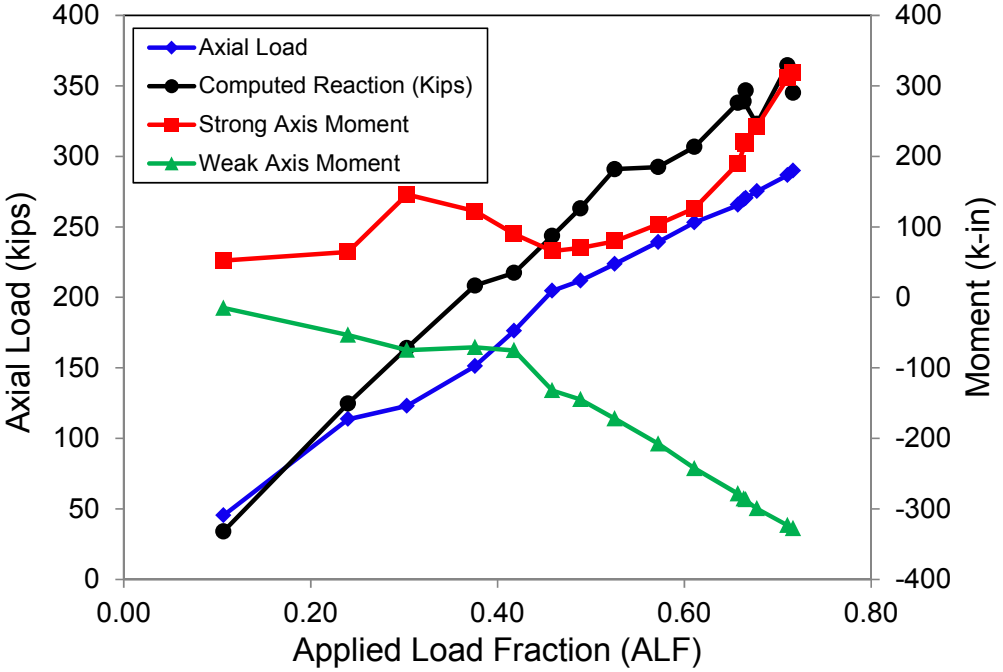

Figure G24. West Chord

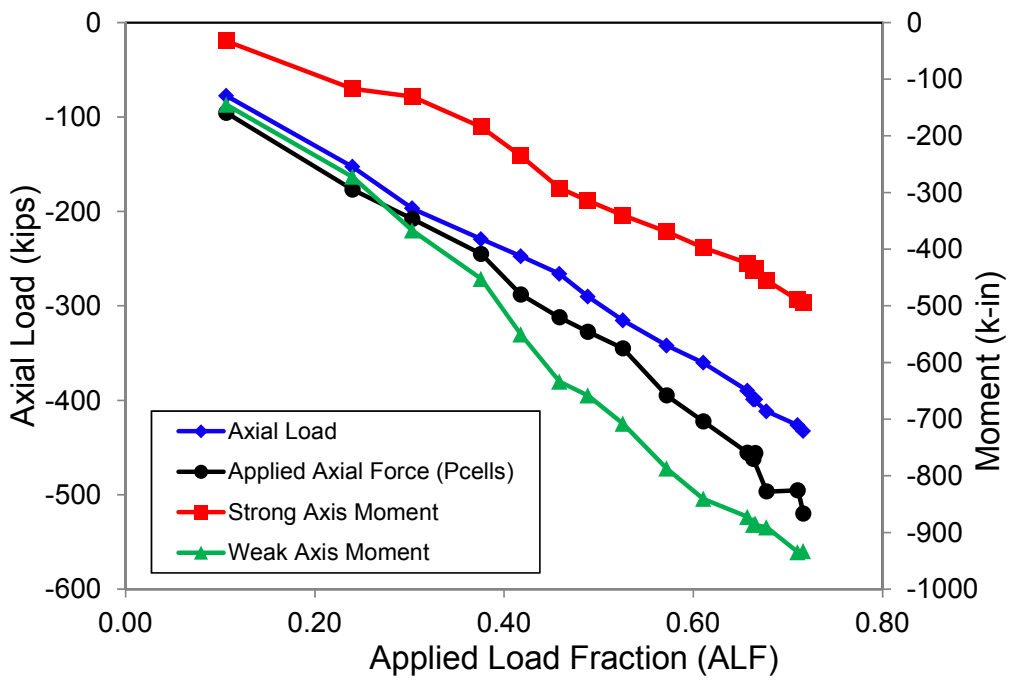

Figure G25. East Chord

Chord Load Shedding Plots

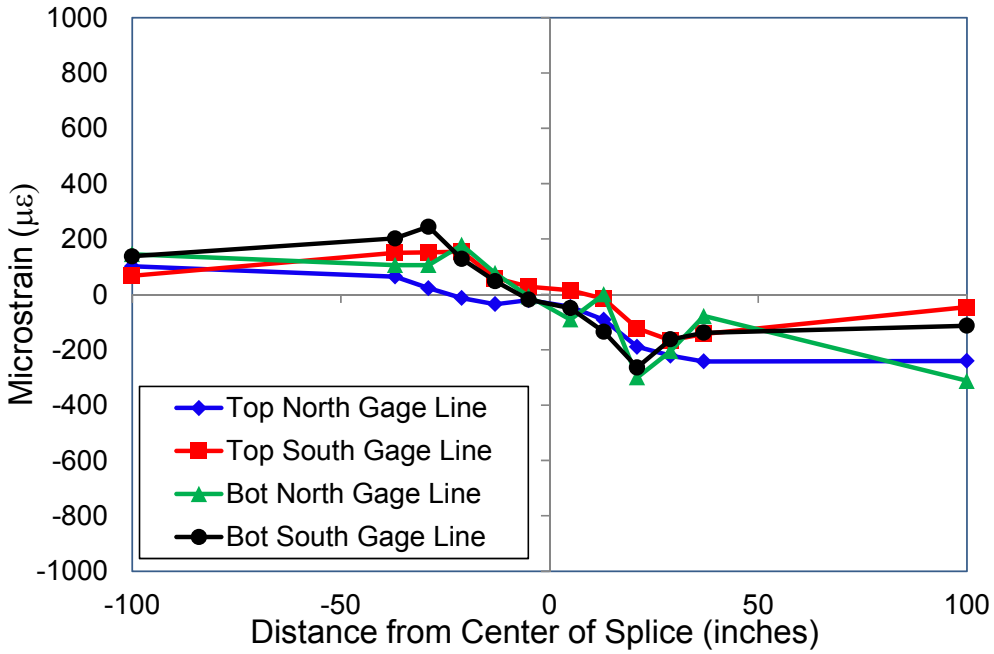

Figure G26. ALF=0.30.

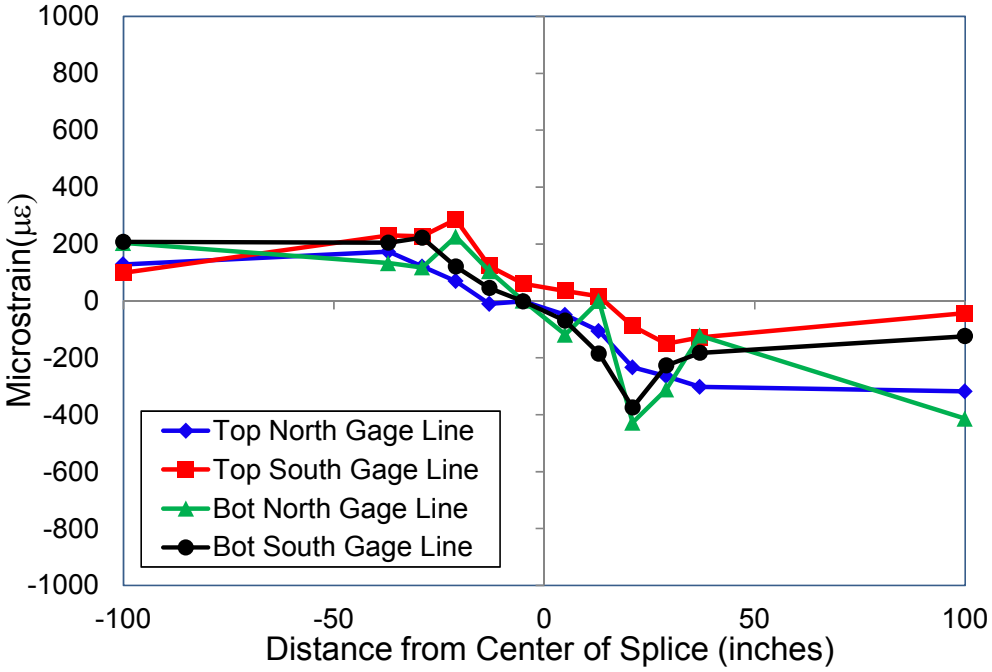

Figure G27. ALF=0.42.

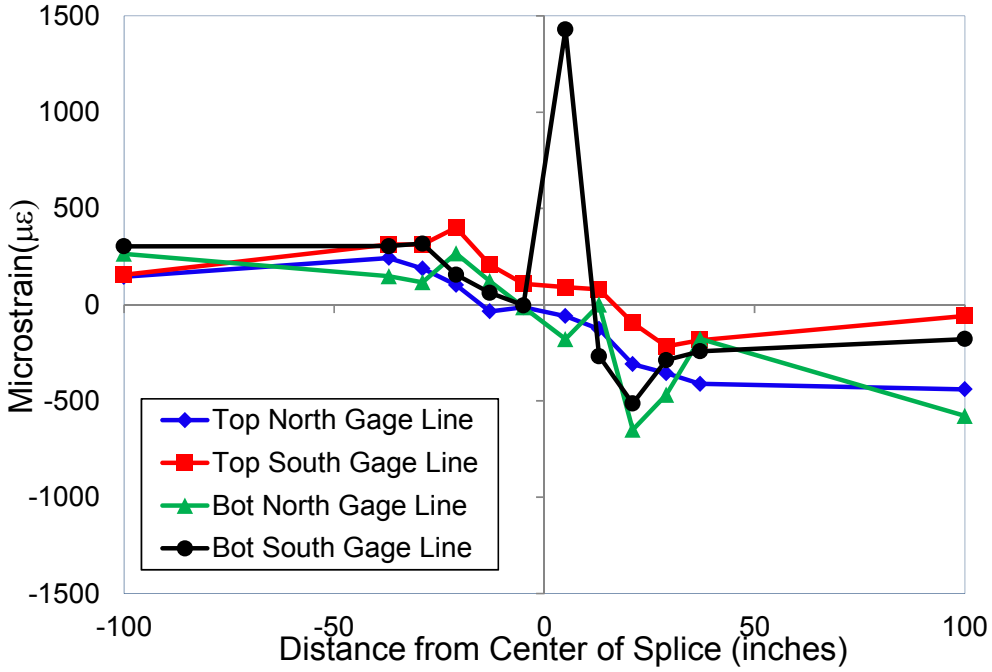

Figure G28. ALF=0.57

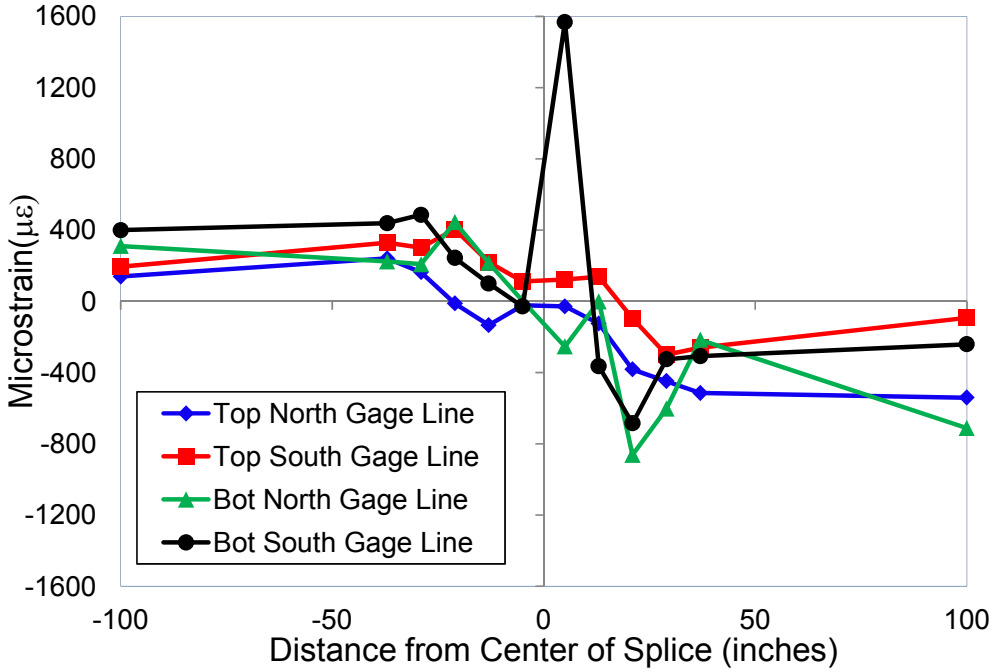

Figure G29. Max ALF

Uniaxial Gauge Plots

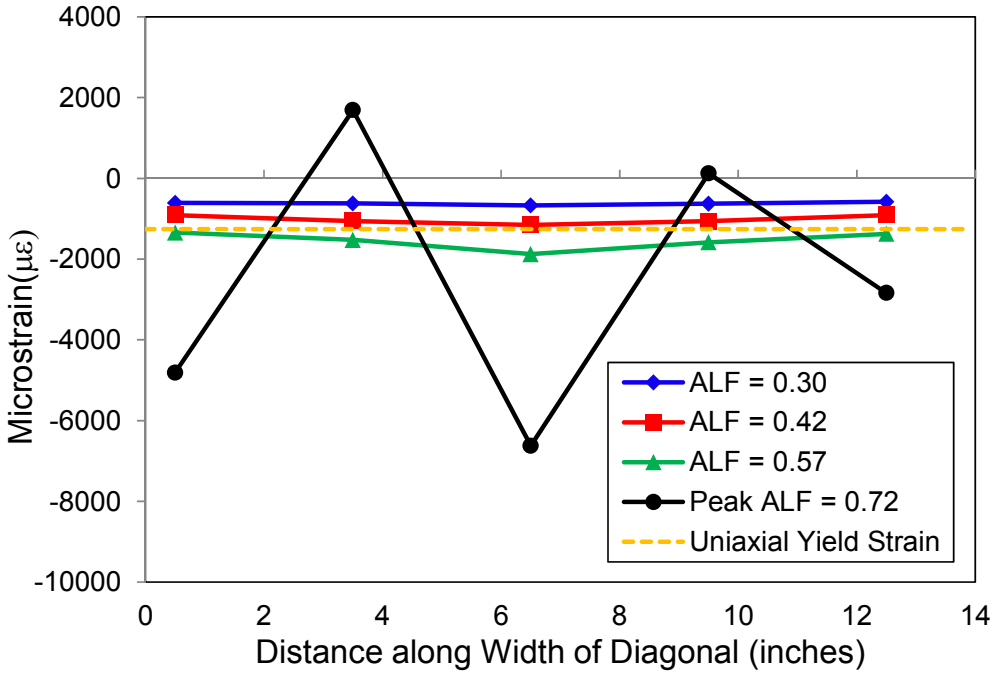

Figure G30. North Compression Diagonal

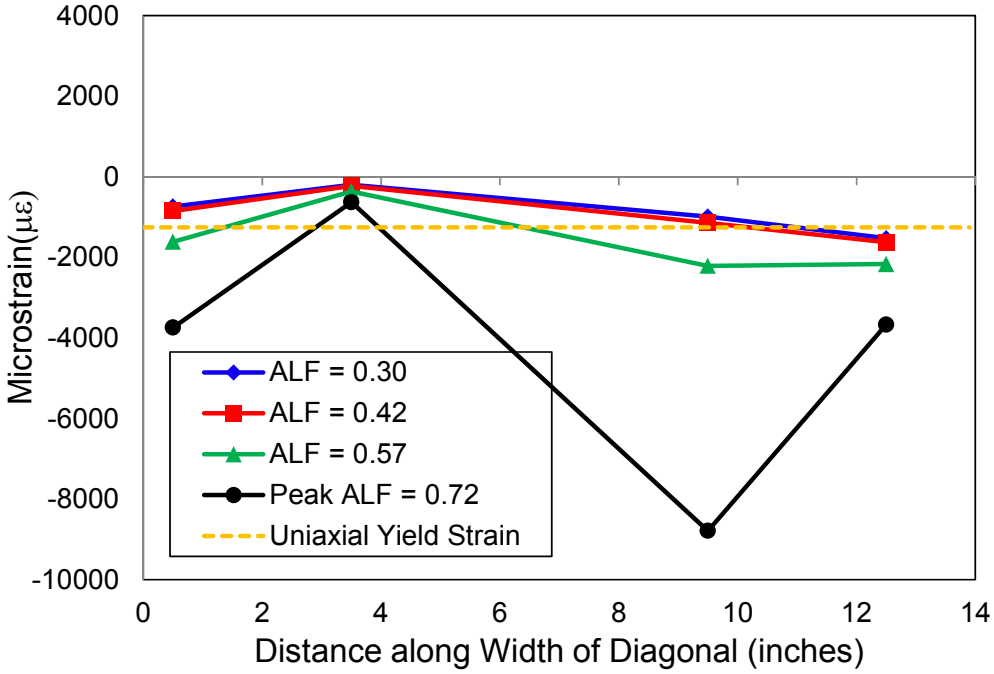

Figure G31. South Compression Diagonal

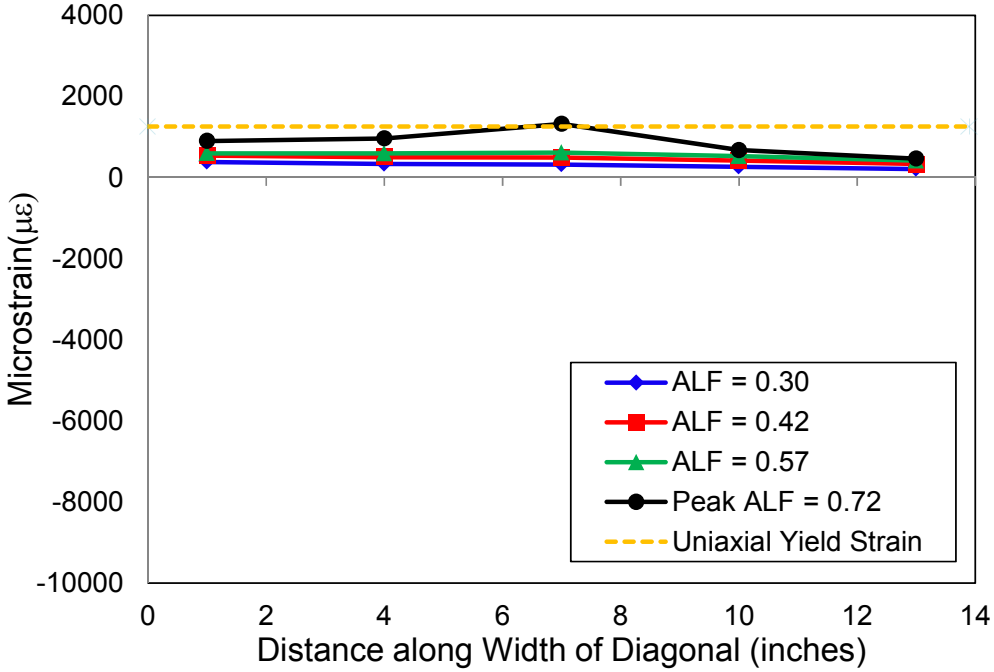

Figure G32. North Tension Diagonal

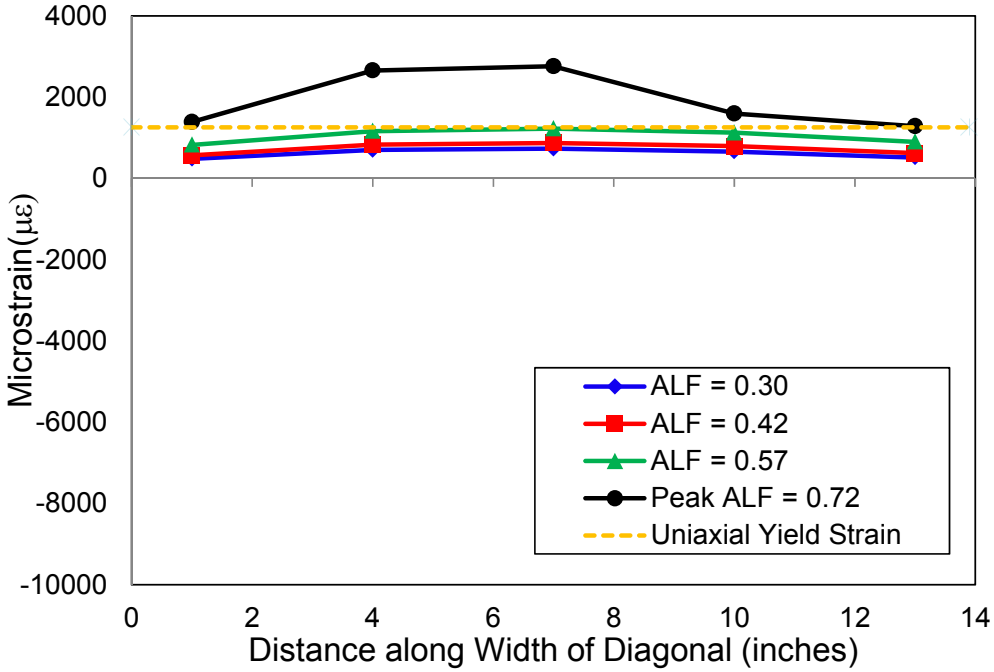

Figure G33. South Tension Diagonal

SPECIMEN 490SS3

Maximum Shear Strain Plots

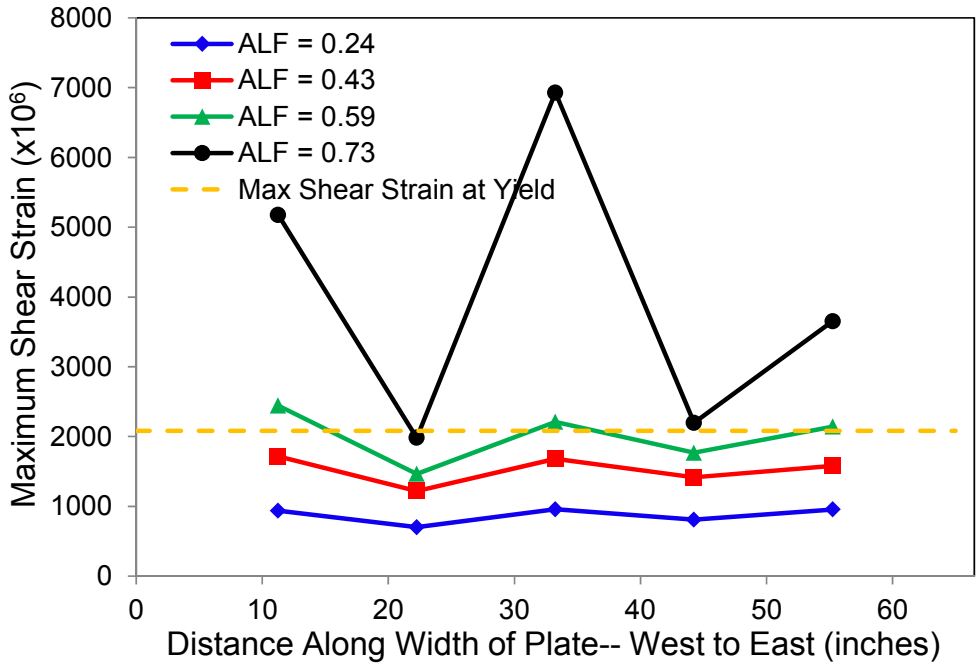

Figure G34. Horizontal line of rosettes above chord; south gusset plate

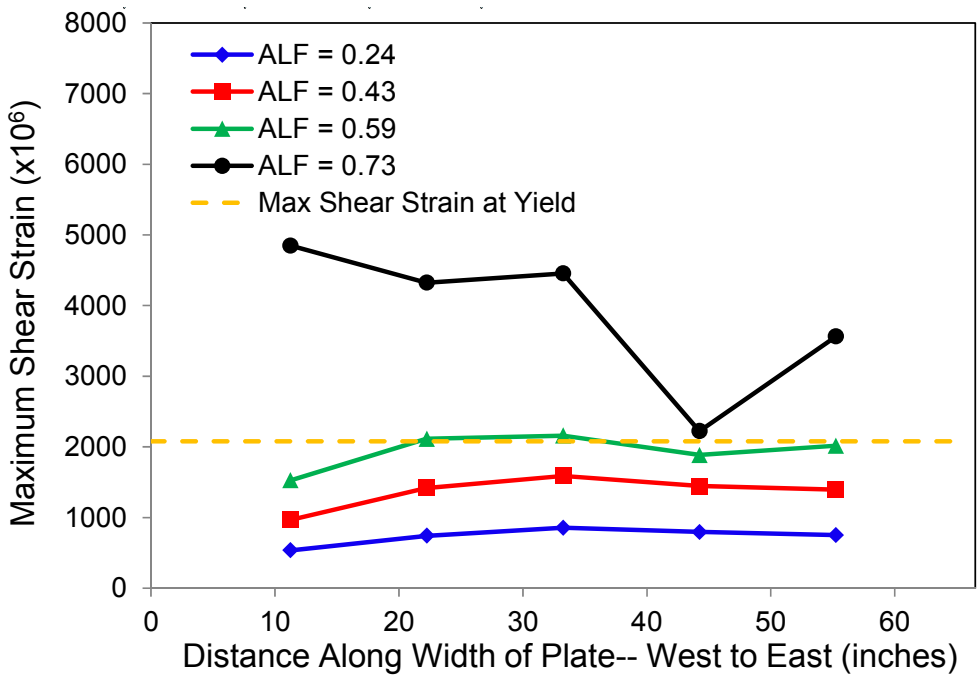

Figure G35. Horizontal line of rosettes above chord; north gusset plate

Variations in Principal Strain

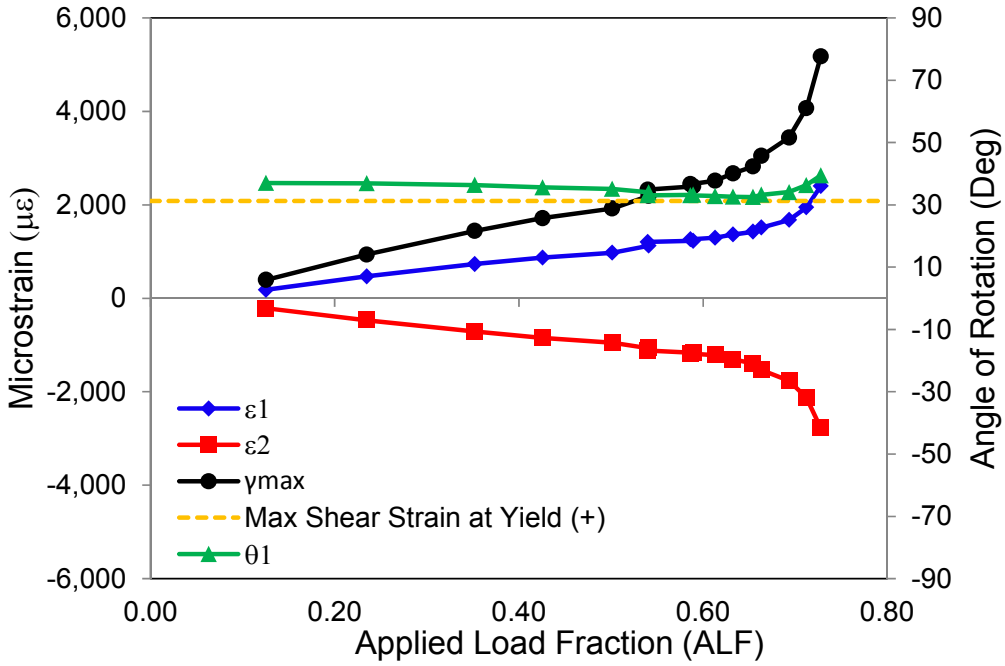

Figure G36. South gusset west bottom

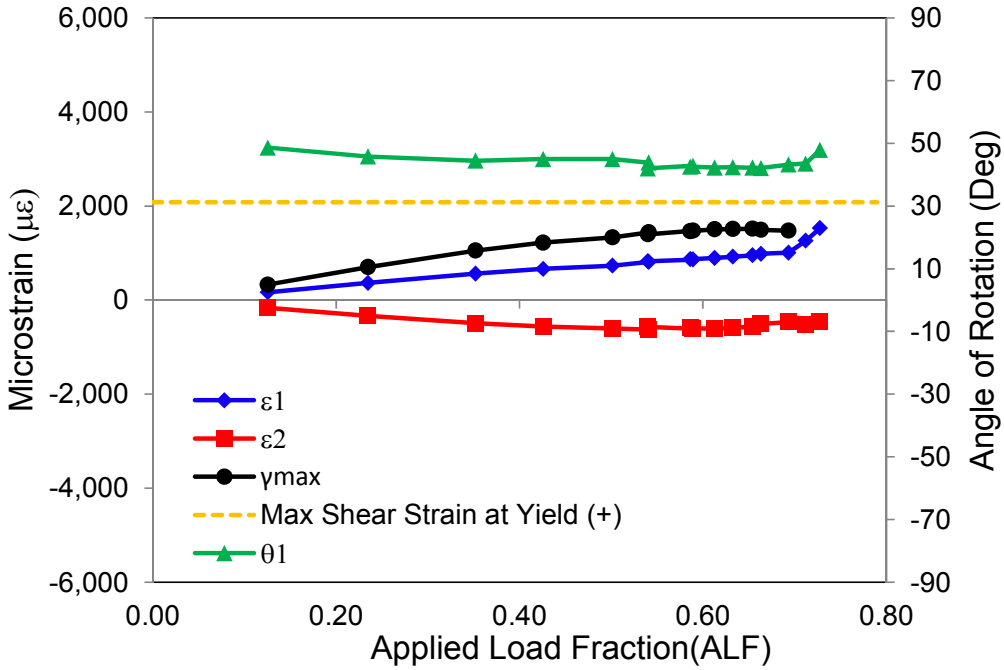

Figure G37. South gusset west mid bottom

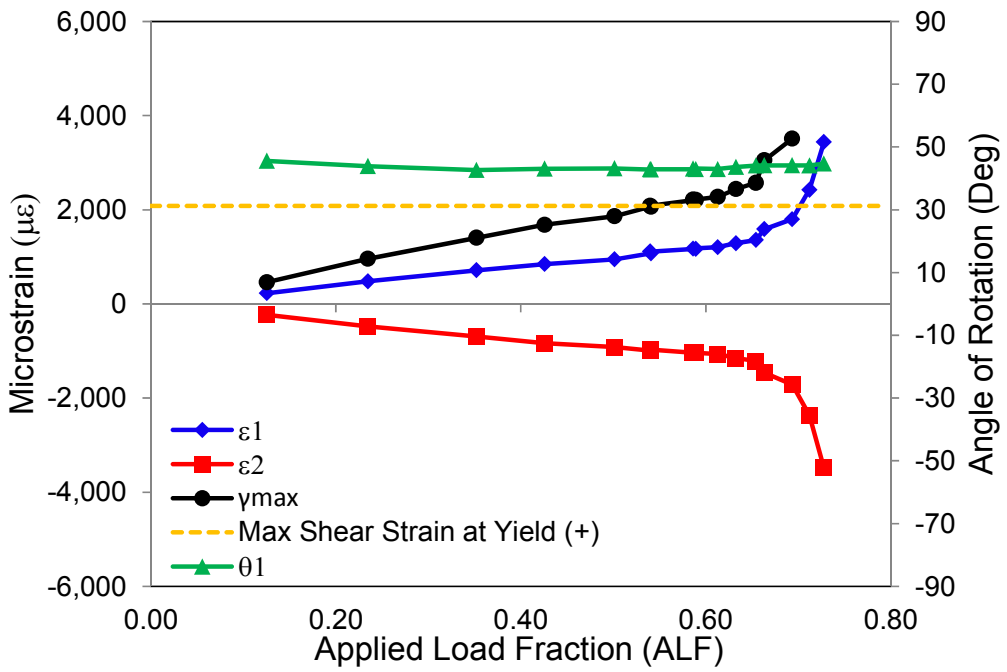

Figure G38. South gusset mid bottom

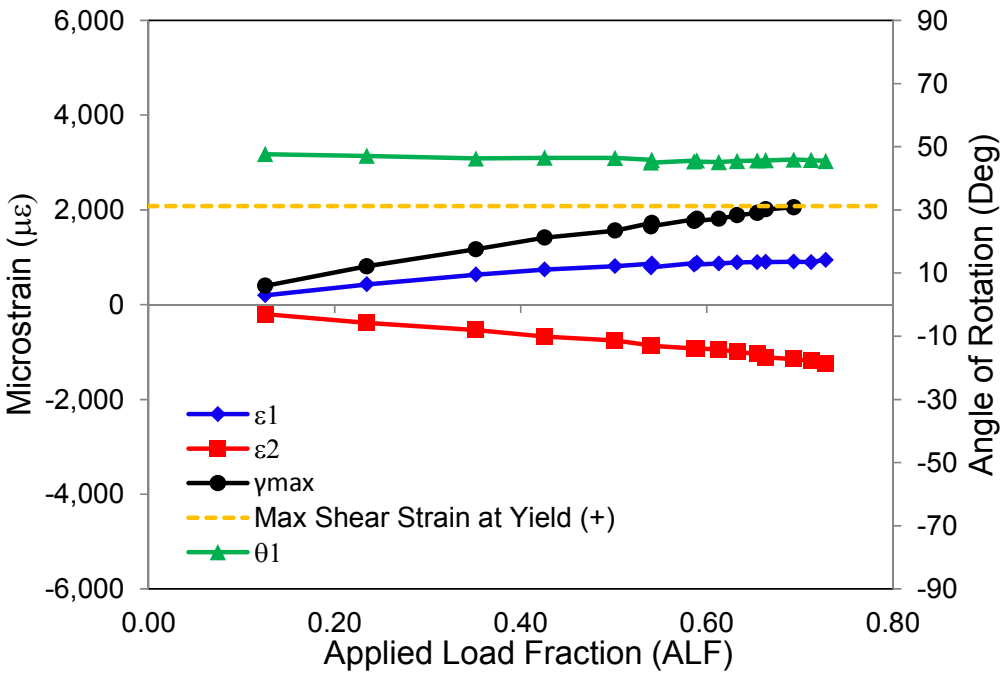

Figure G39. South gusset east mid bottom

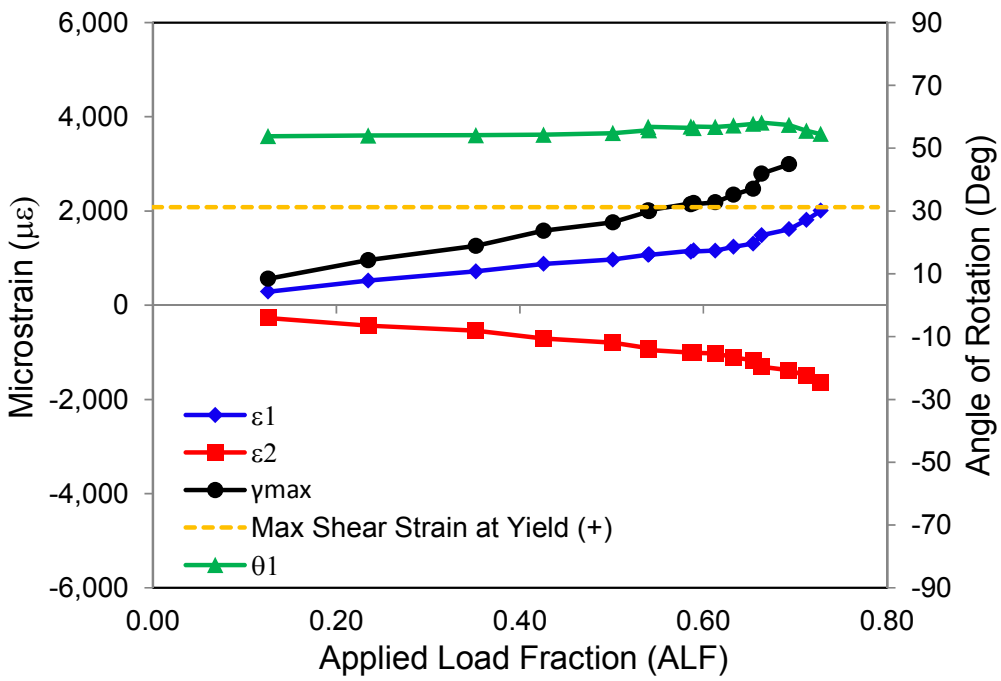

Figure G40. South gusset east bottom

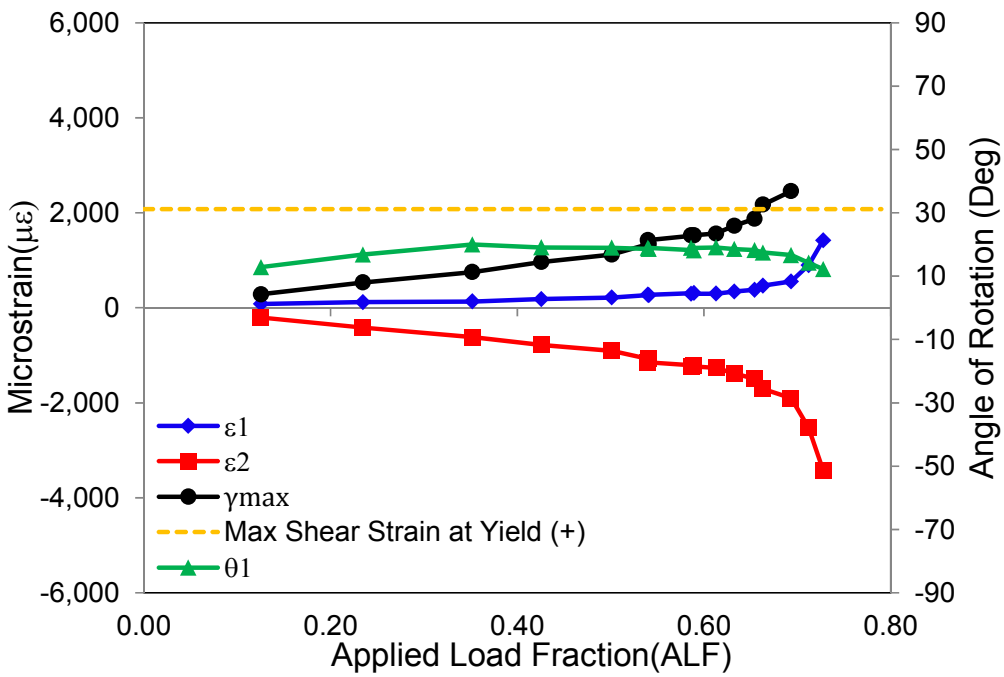

Figure G41. North gusset west bottom

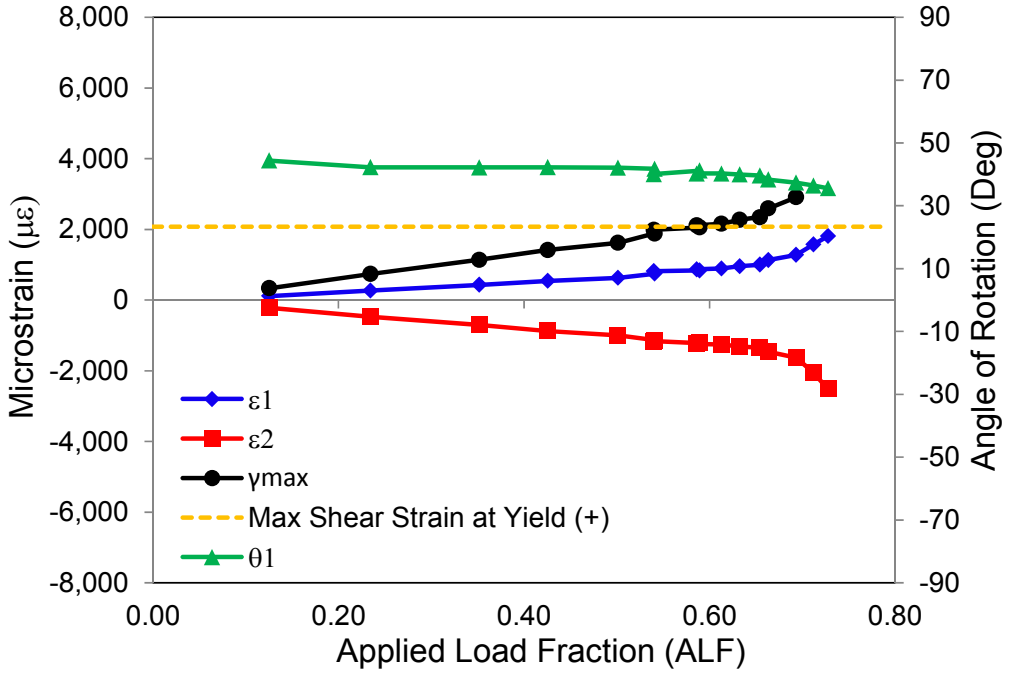

Figure G42. North gusset west mid bottom

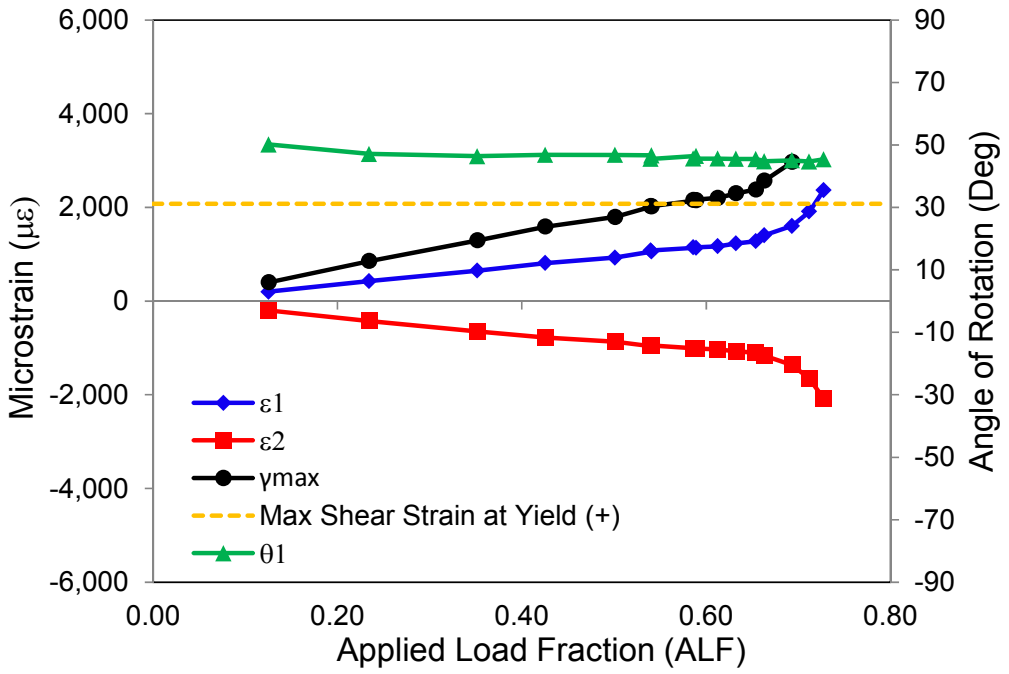

Figure G43. North gusset mid bottom

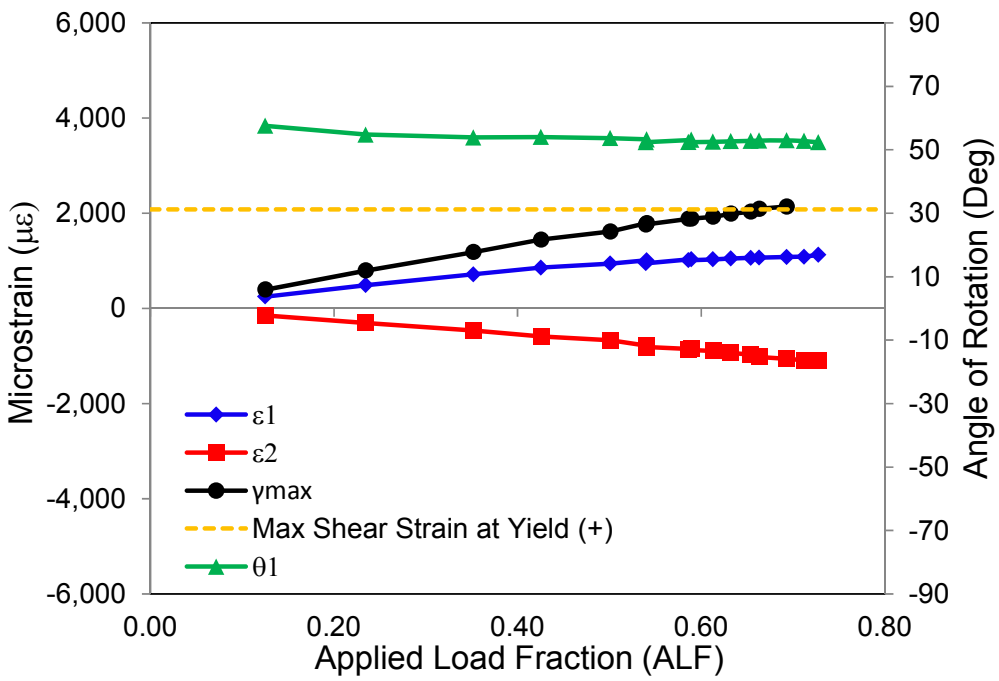

Figure G44. North gusset mid east bottom

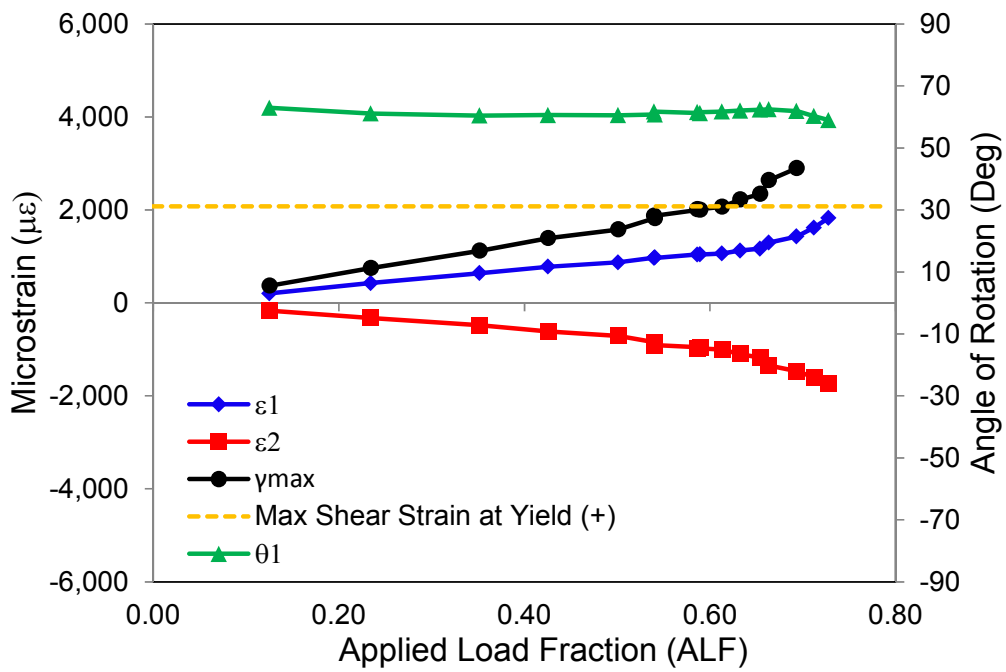

Figure G45. North gusset east bottom

Member Cross-Sectional Plots

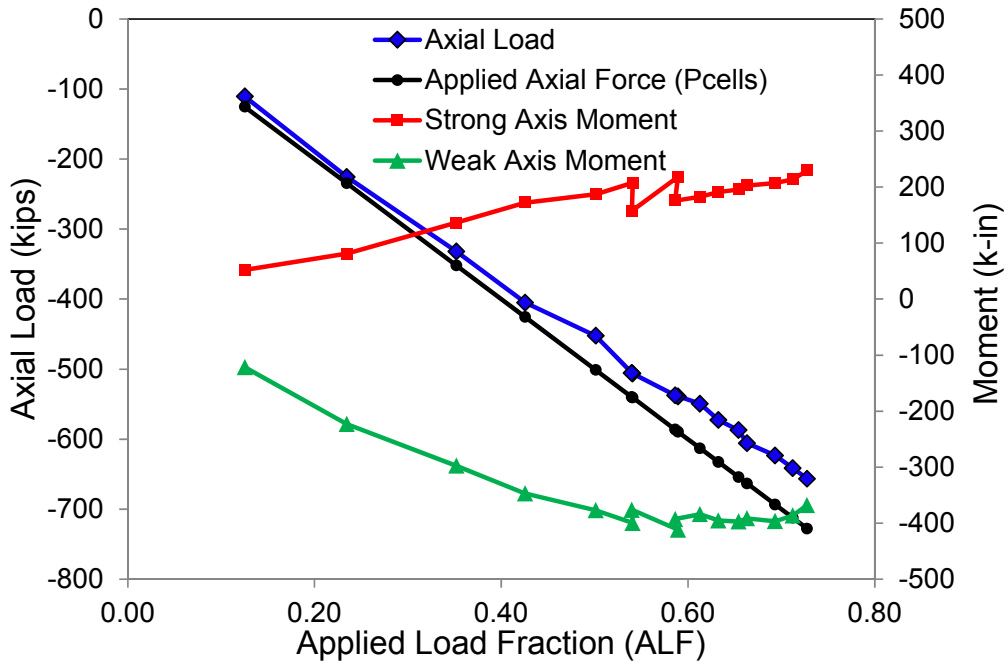

Figure G46. Compression Diagonal

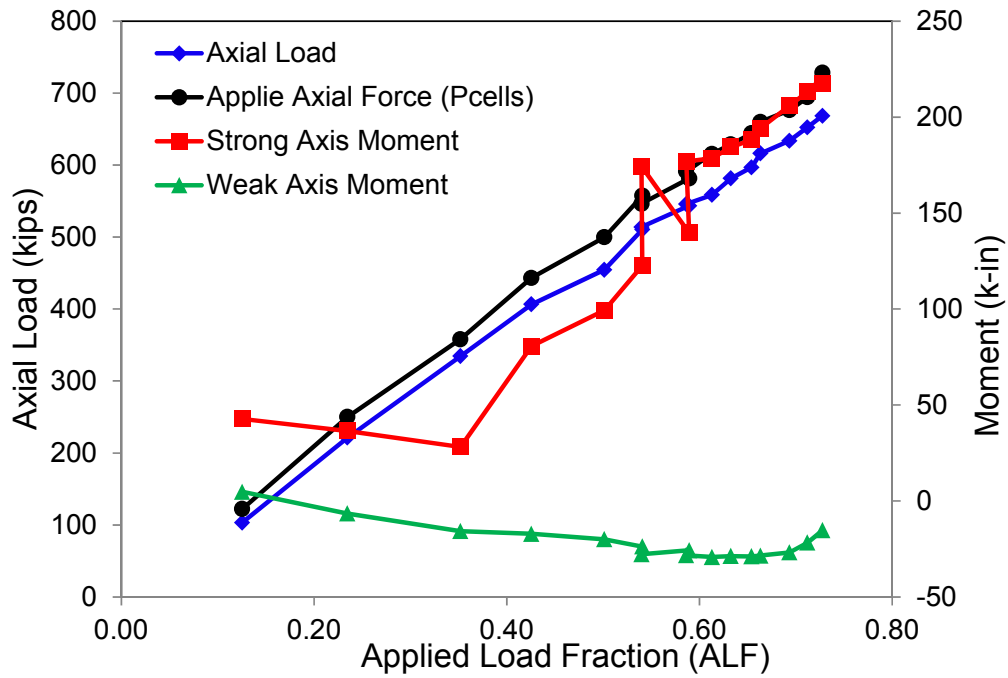

Figure G47. Tension Diagonal

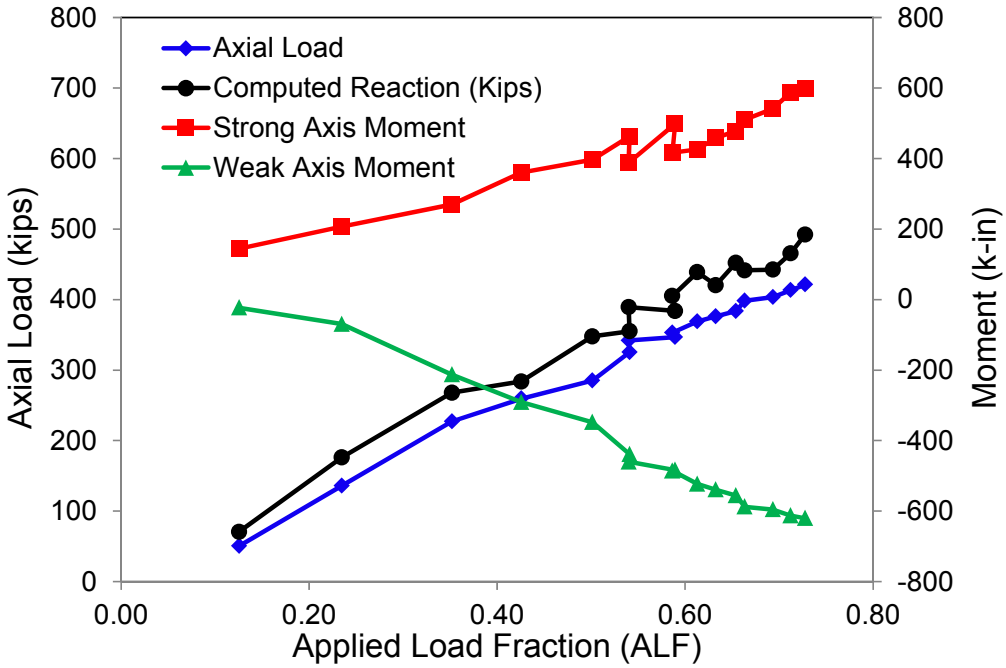

Figure G48. West Chord

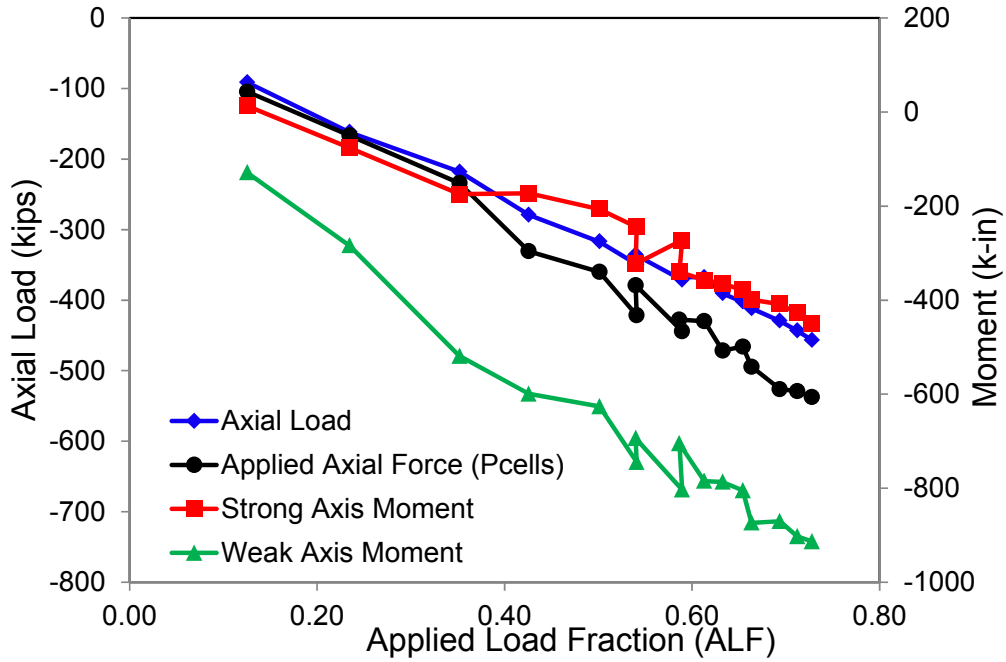

Figure G49. East Chord

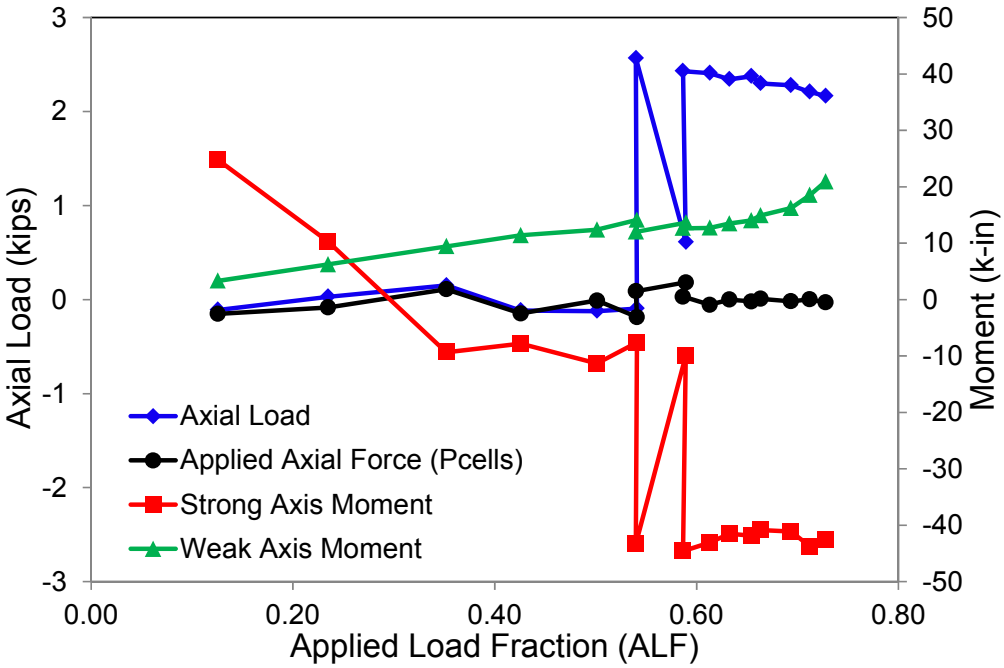

Figure G50. Vertical.

Chord Load Shedding Plots

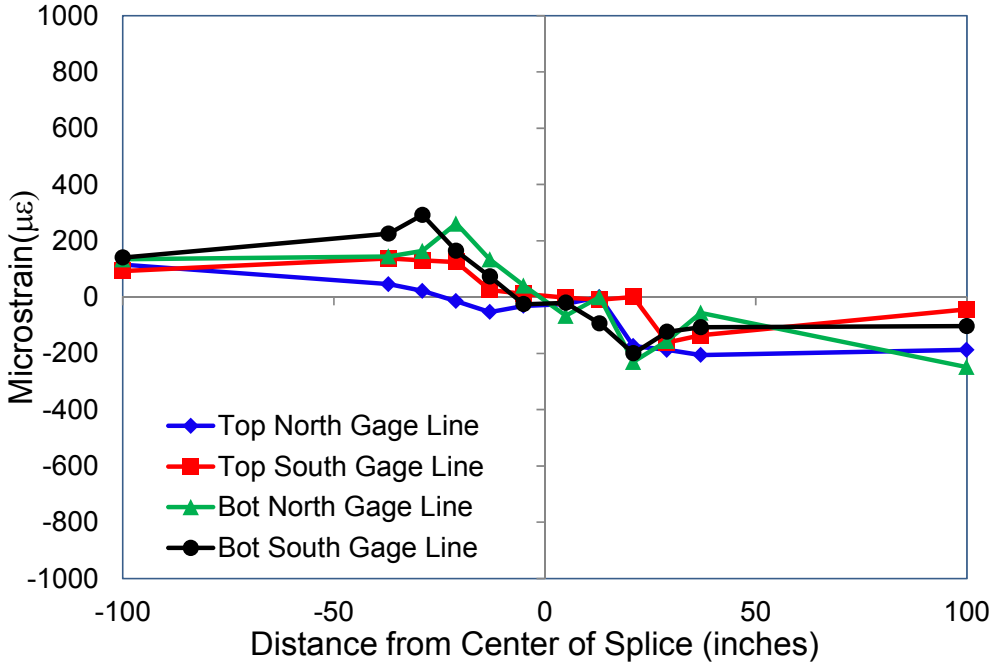

Figure G51. ALF=0.24

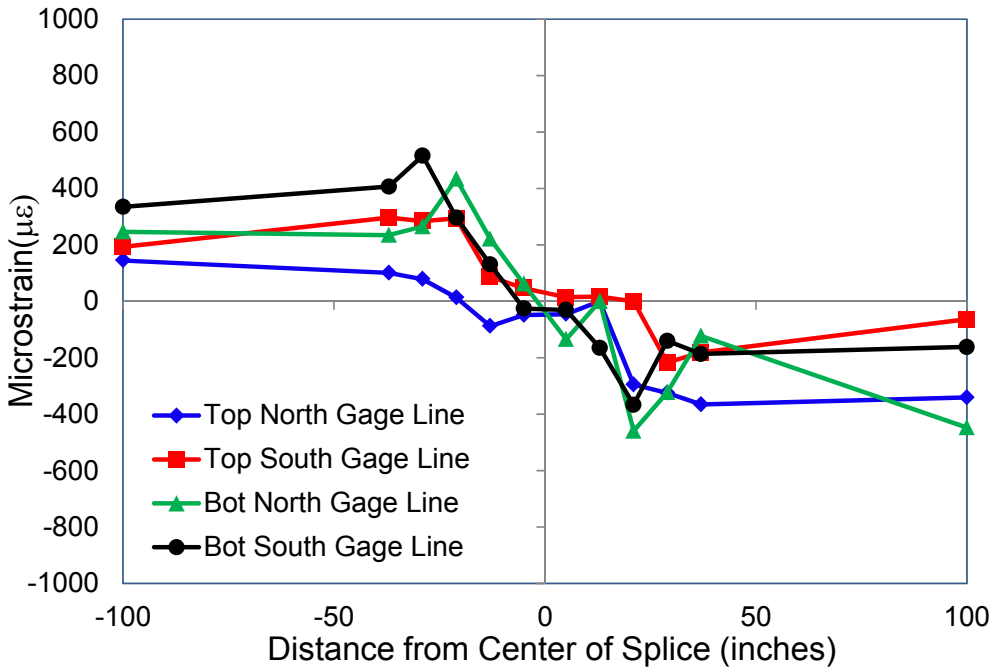

Figure G52. ALF=0.43

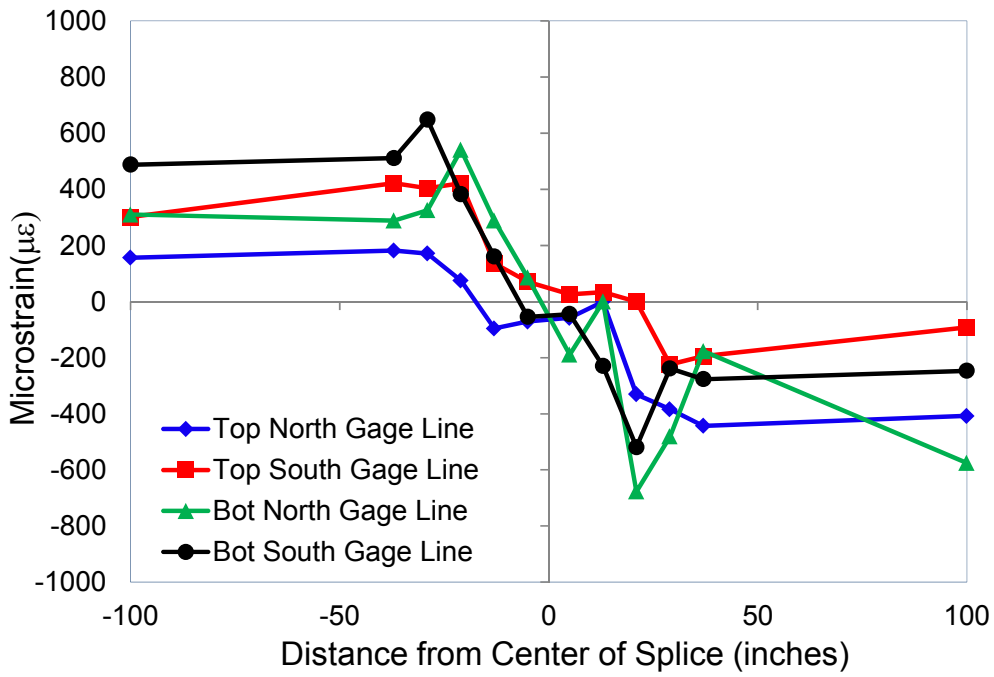

Figure G53. ALF=0.59

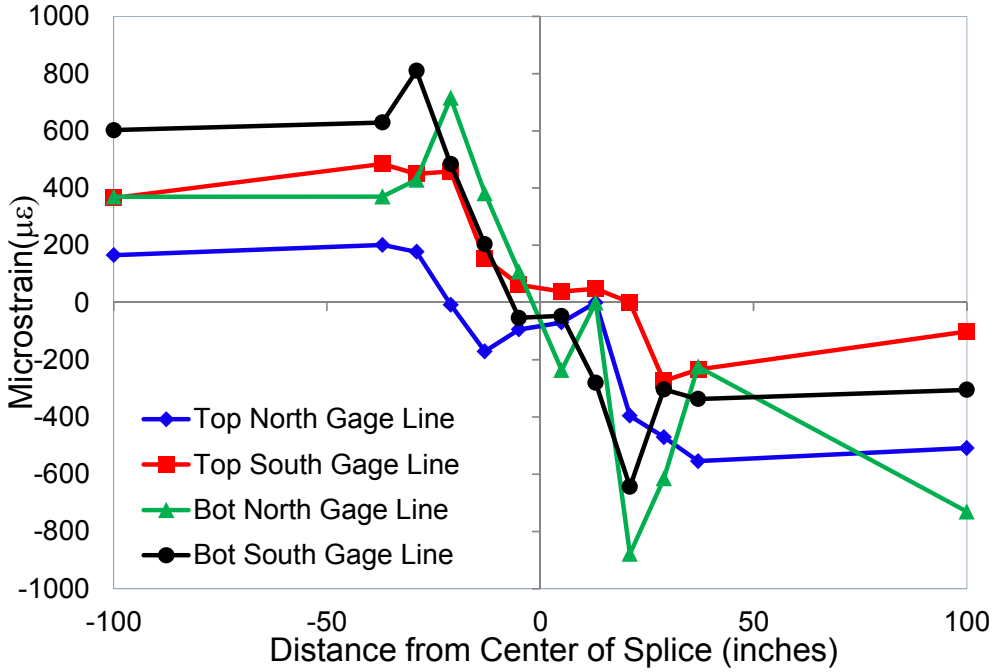

Figure G54. Max ALF=0.73

Uniaxial Gauge Plots

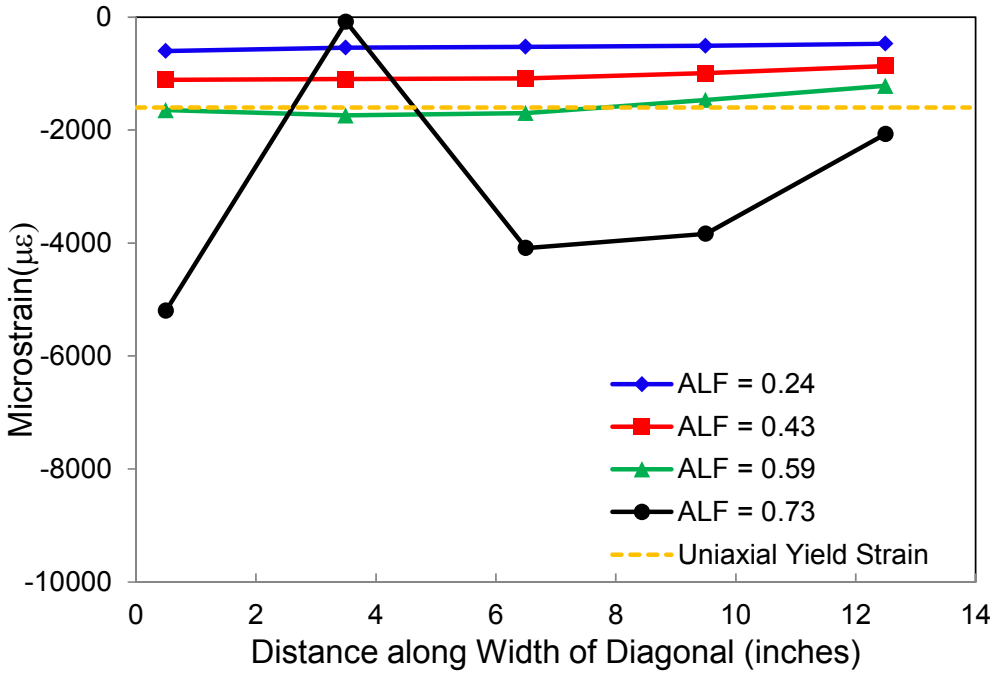

Figure G55. North Compression Diagonal

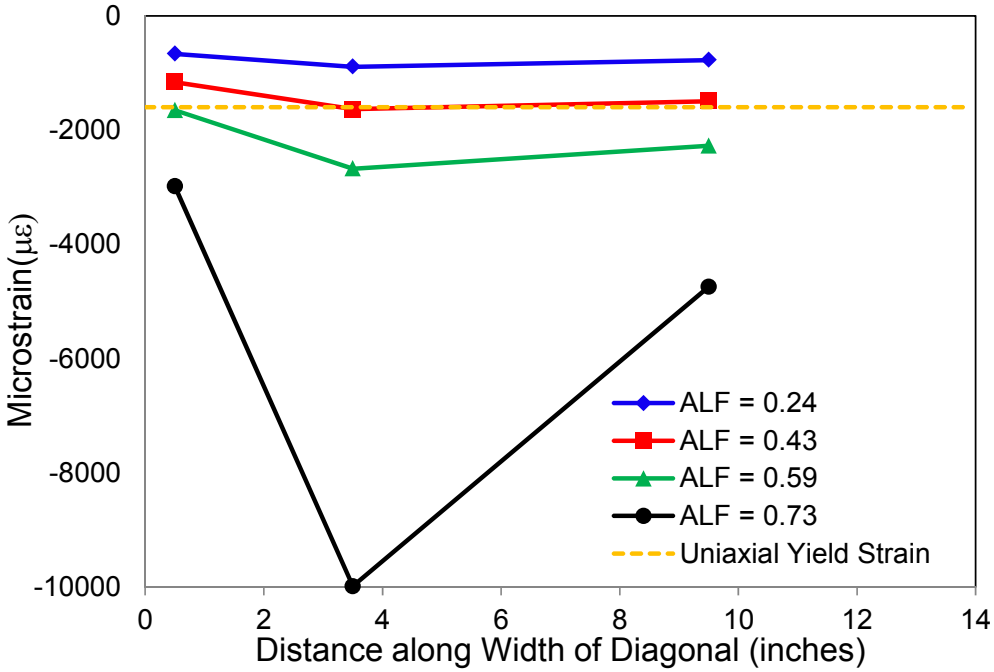

Figure G56. South Compression Diagonal

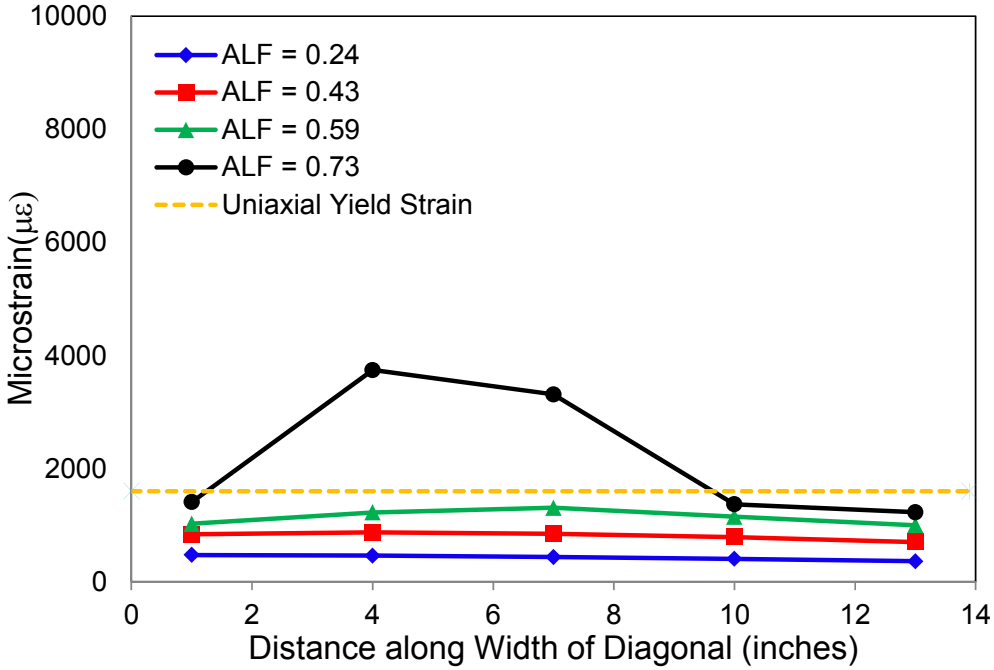

Figure G57. North Tension Diagonal

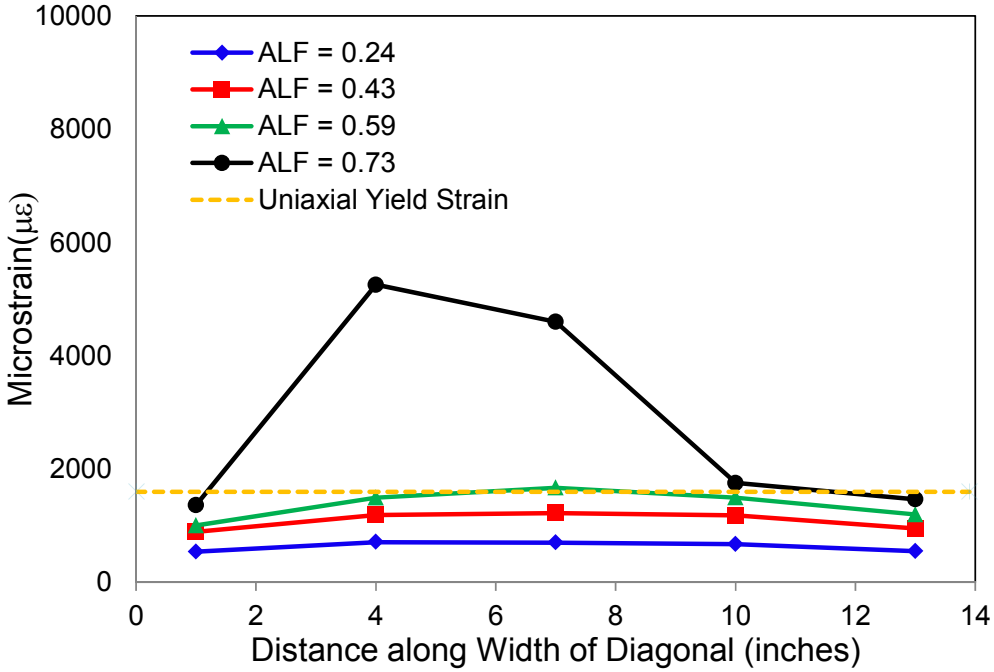

Figure G58. South Tension Diagonal

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Maximum Shear Strain Plots

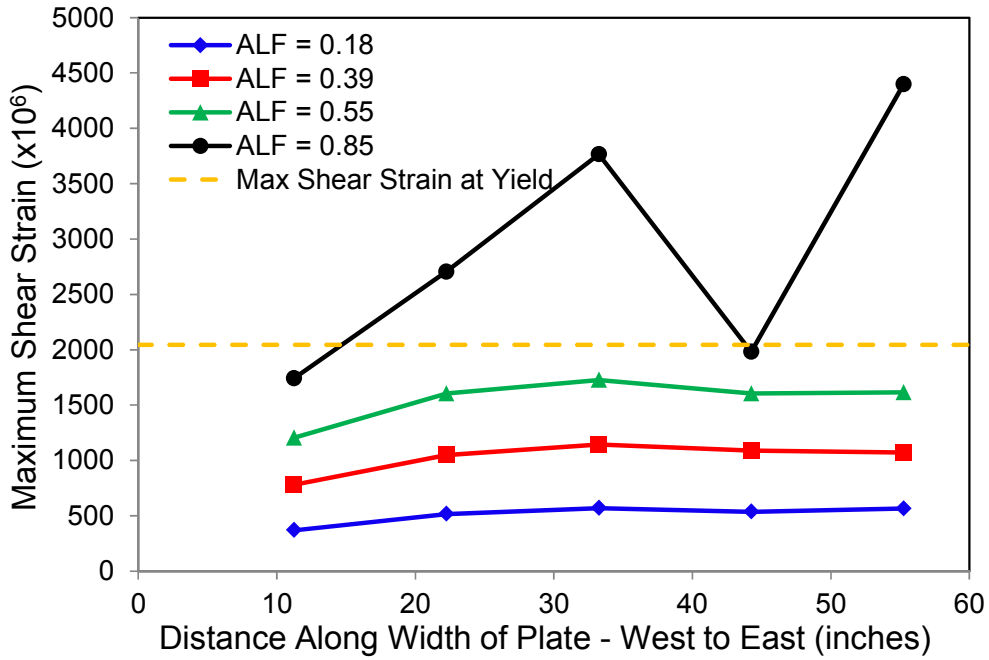

Figure G59. Horizontal line of rosettes above chord; south gusset plate

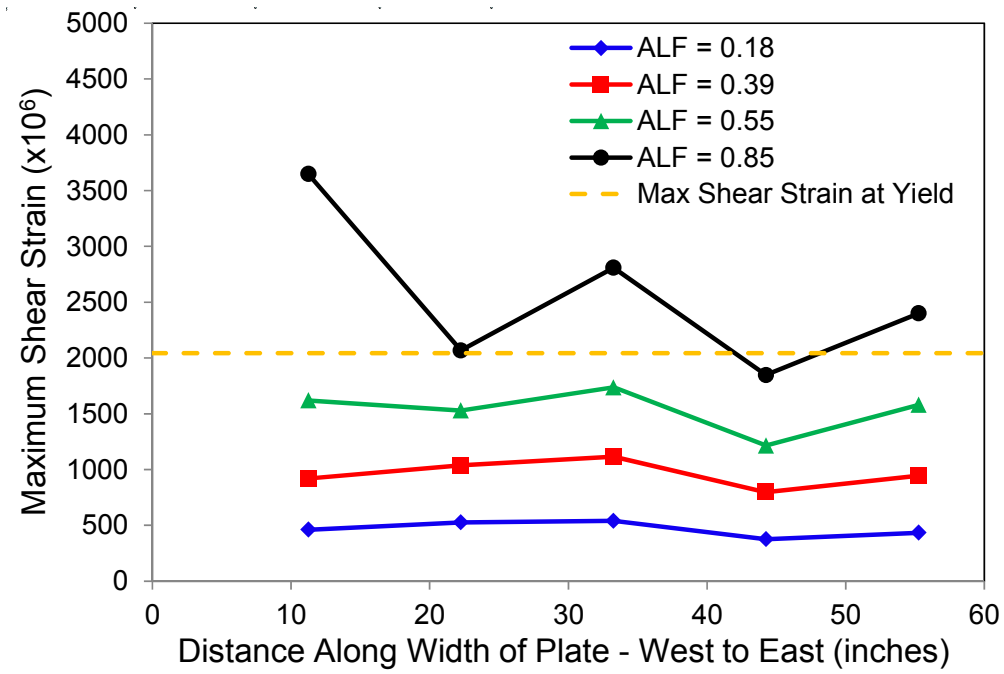

Figure G60. Horizontal line of rosettes above chord; north gusset plate

Variations in Principal Strain

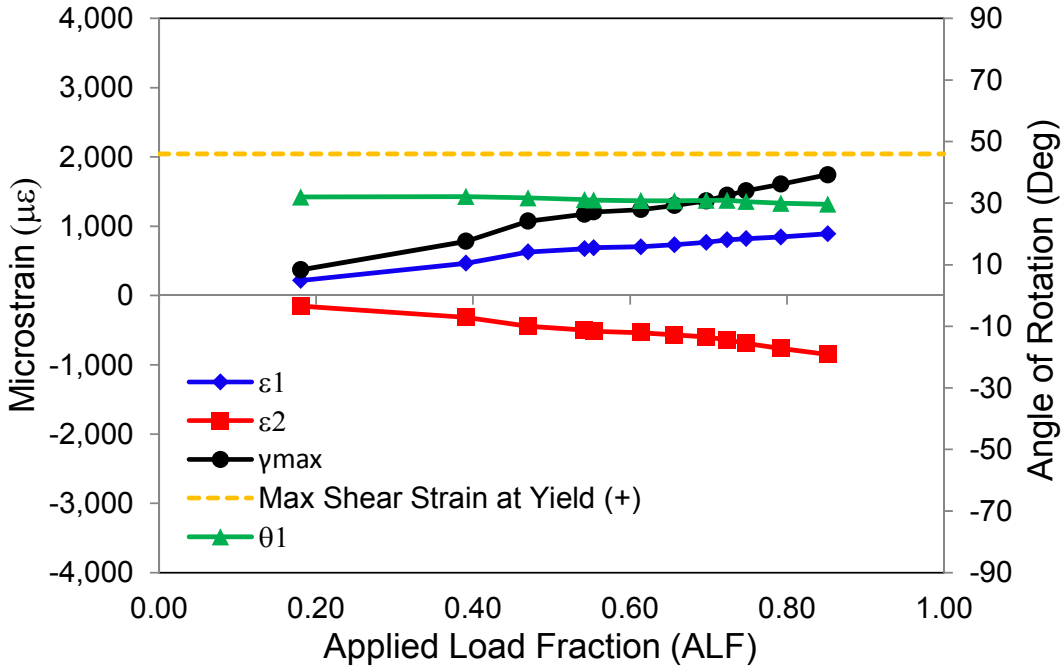

Figure G61. South gusset west bottom

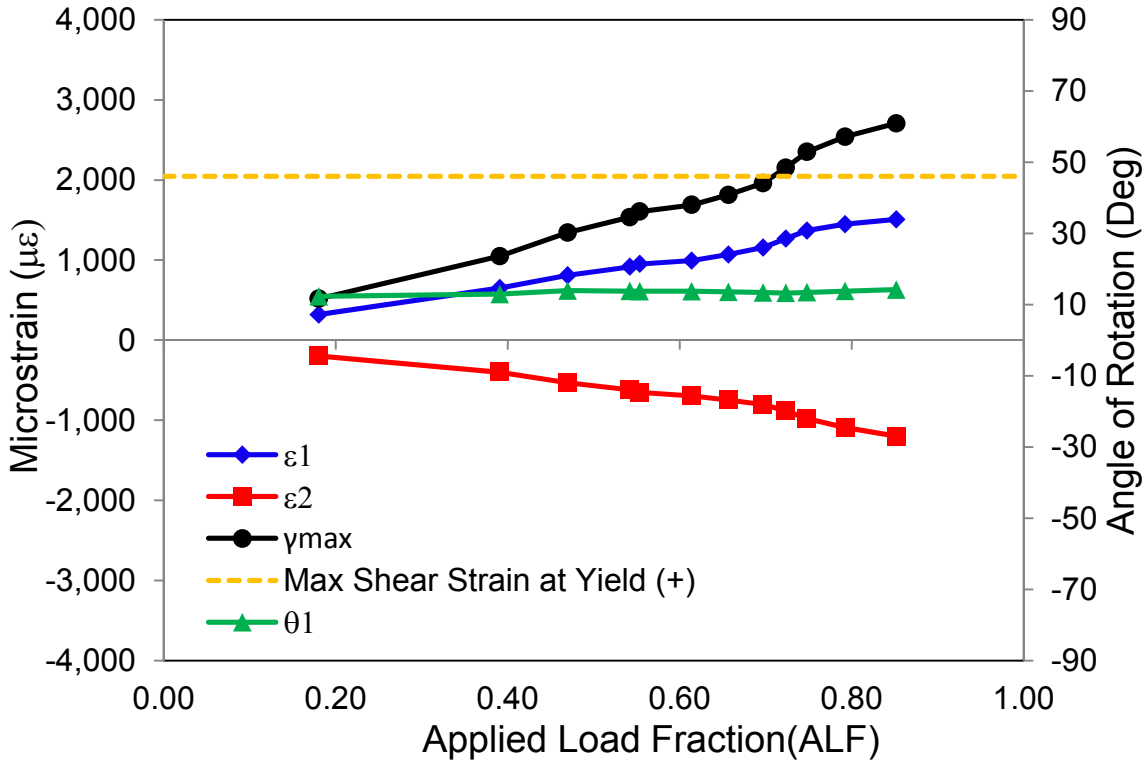

Figure G62. South gusset west mid bottom

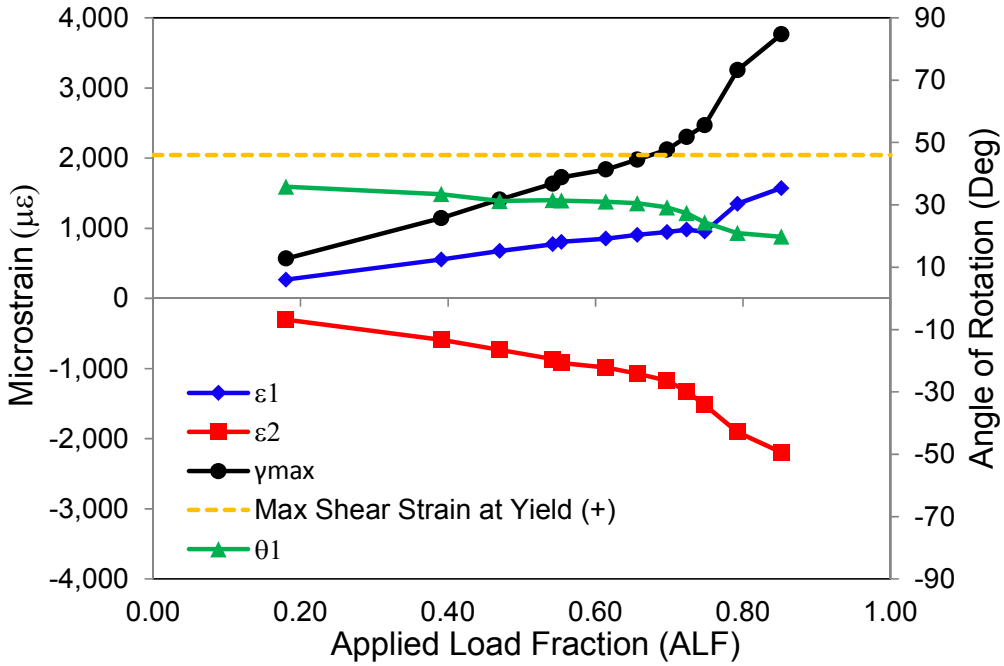

Figure G63. South gusset mid bottom

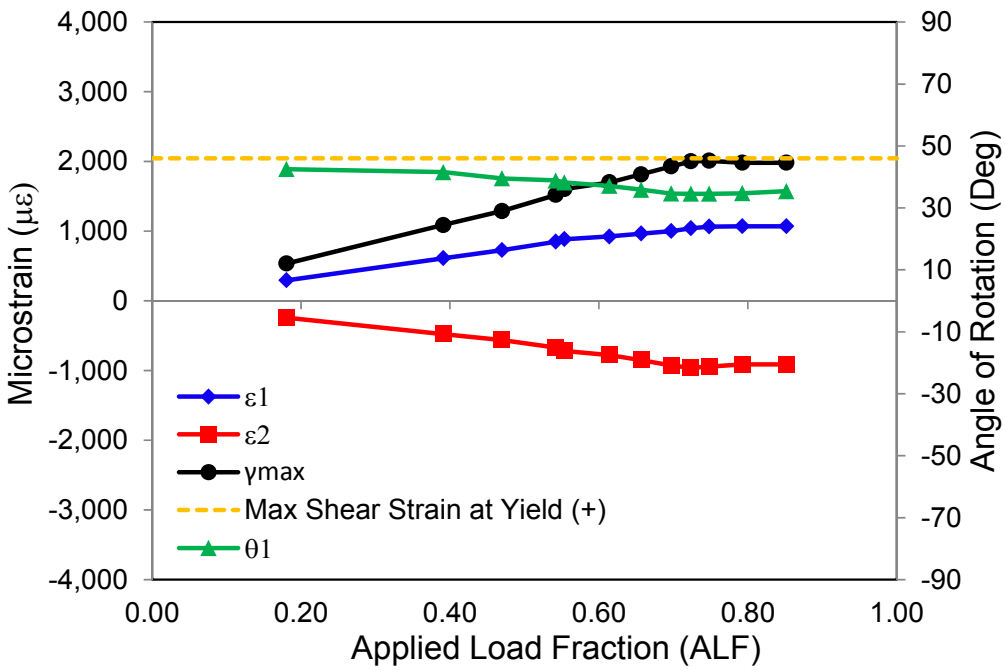

Figure G64. South gusset east mid bottom

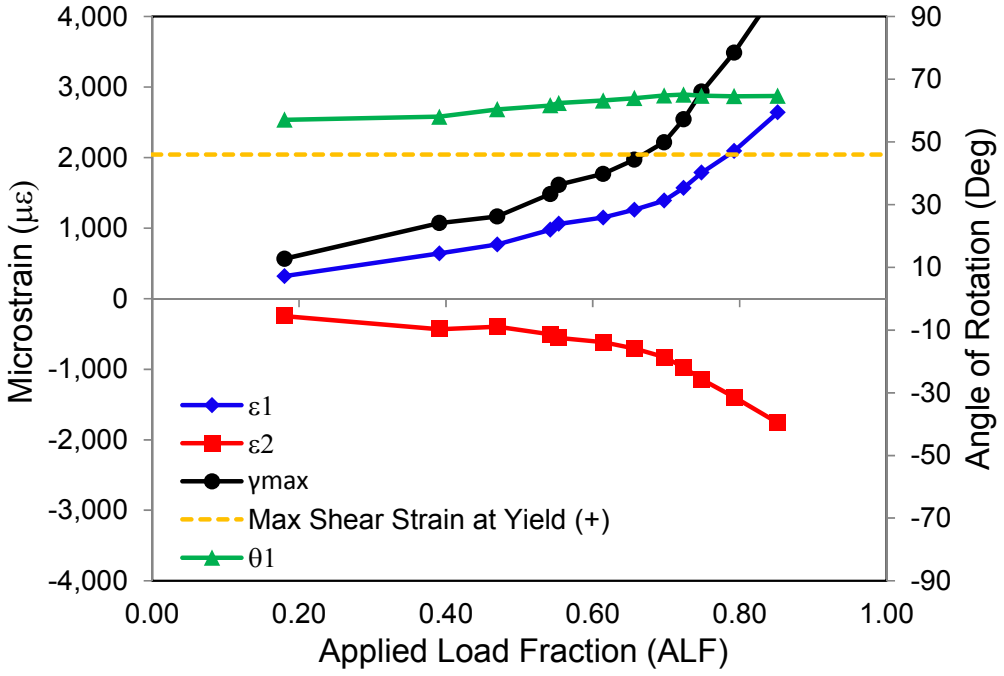

Figure G65. South gusset east bottom

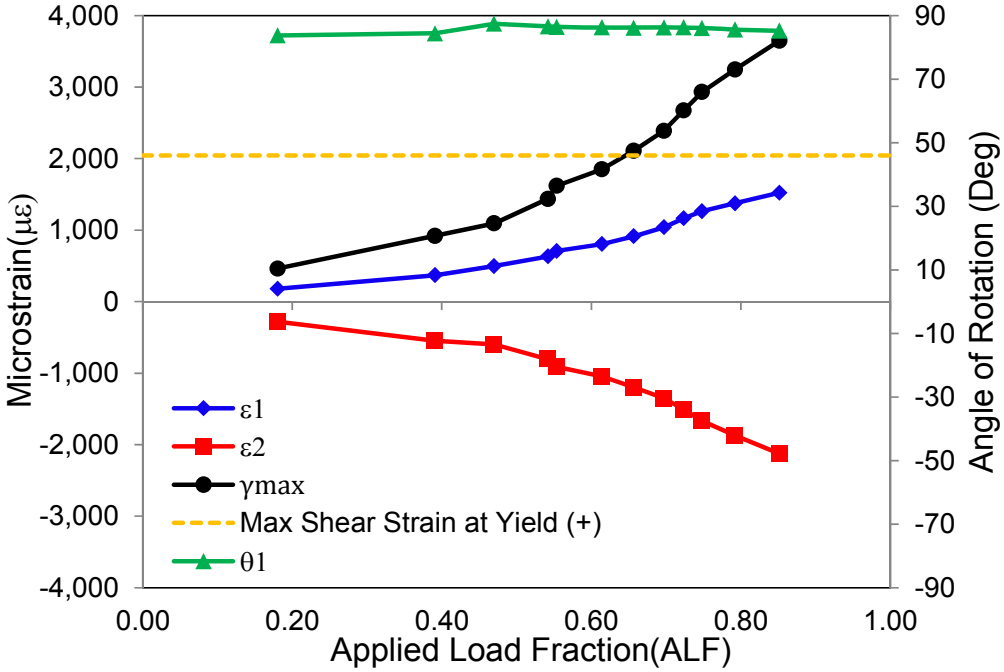

Figure G66. North gusset west bottom

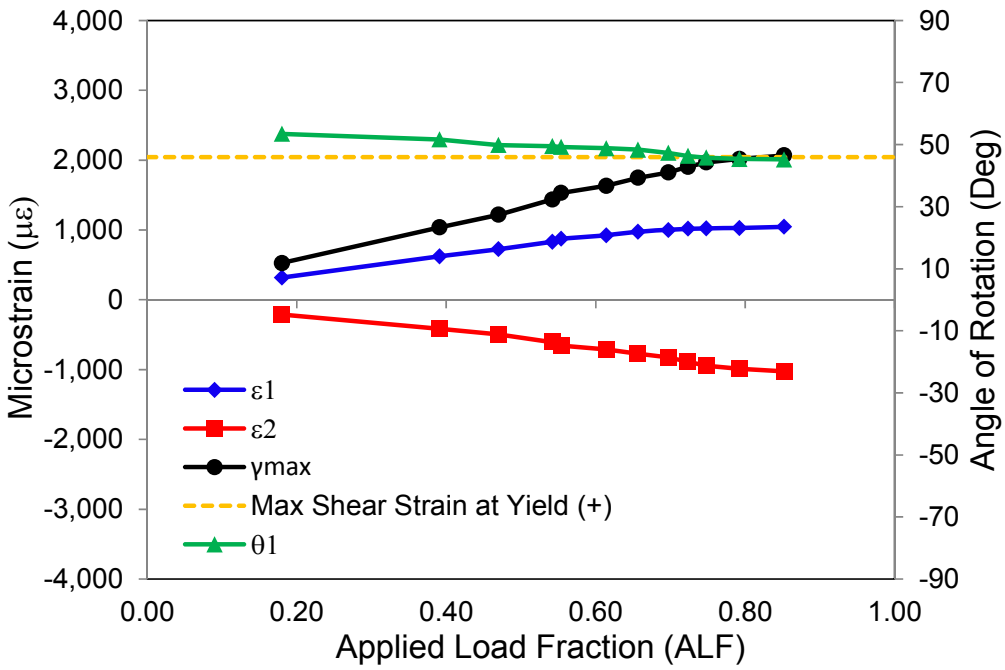

Figure G67. North gusset west mid bottom

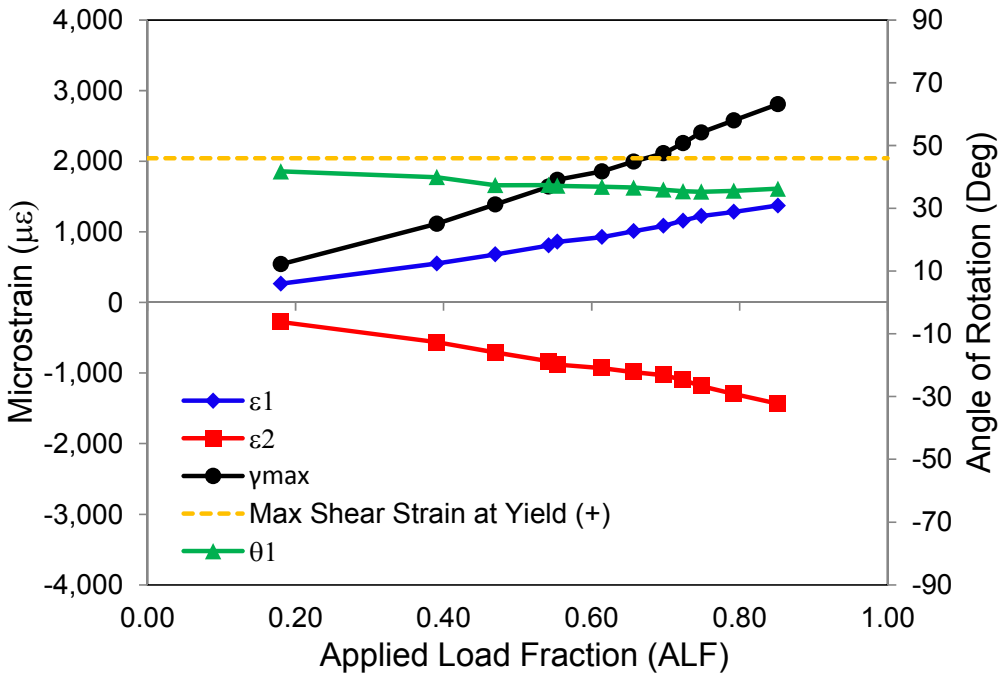

Figure G68. North gusset mid bottom

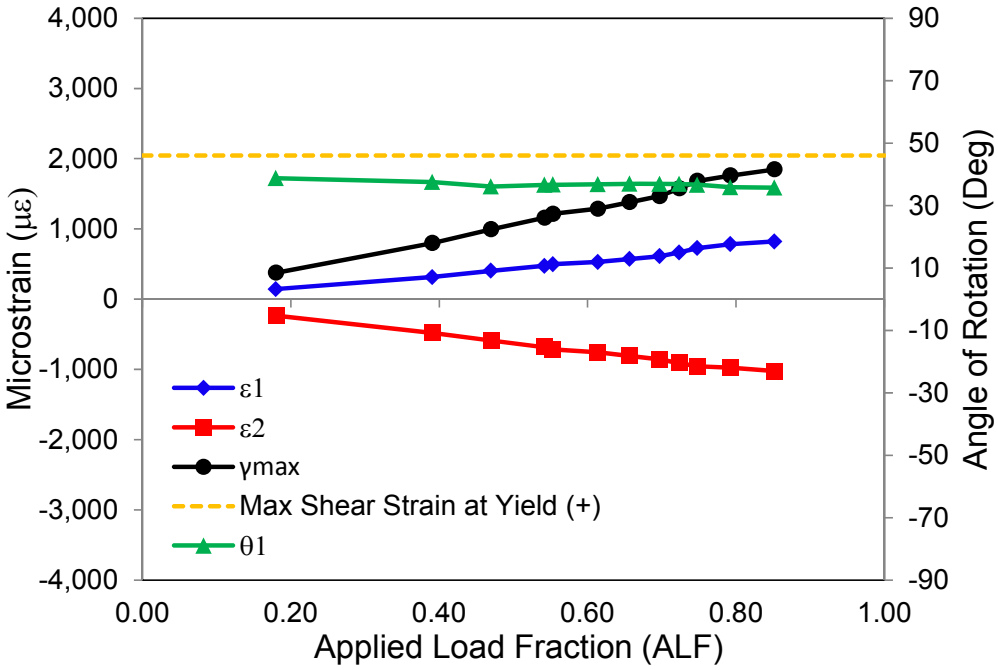

Figure G69. North gusset mid east bottom

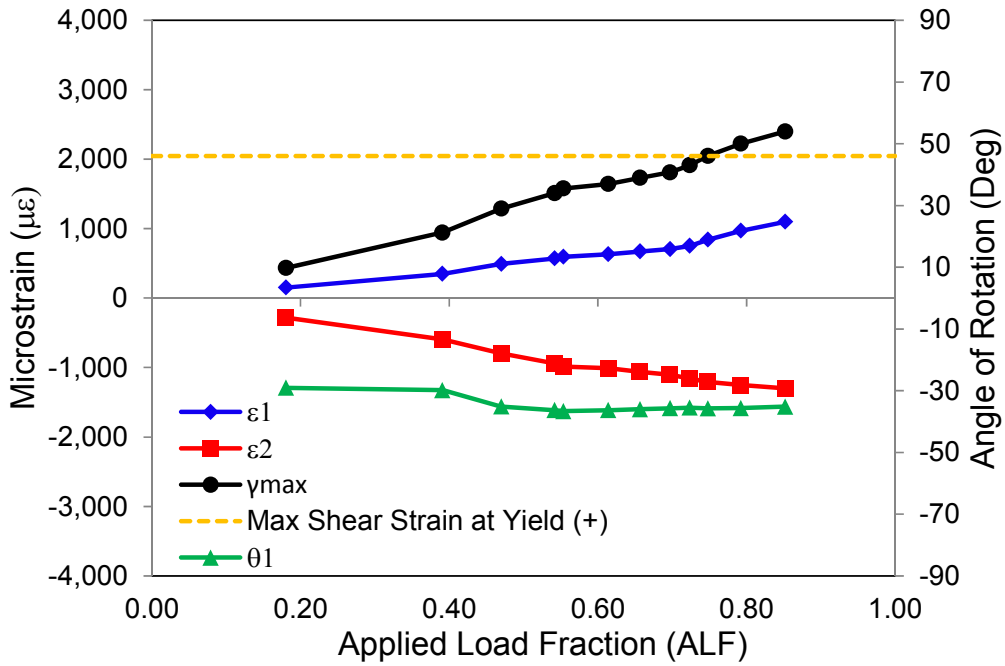

Figure G70. North gusset east bottom

Member Cross-Sectional Plots

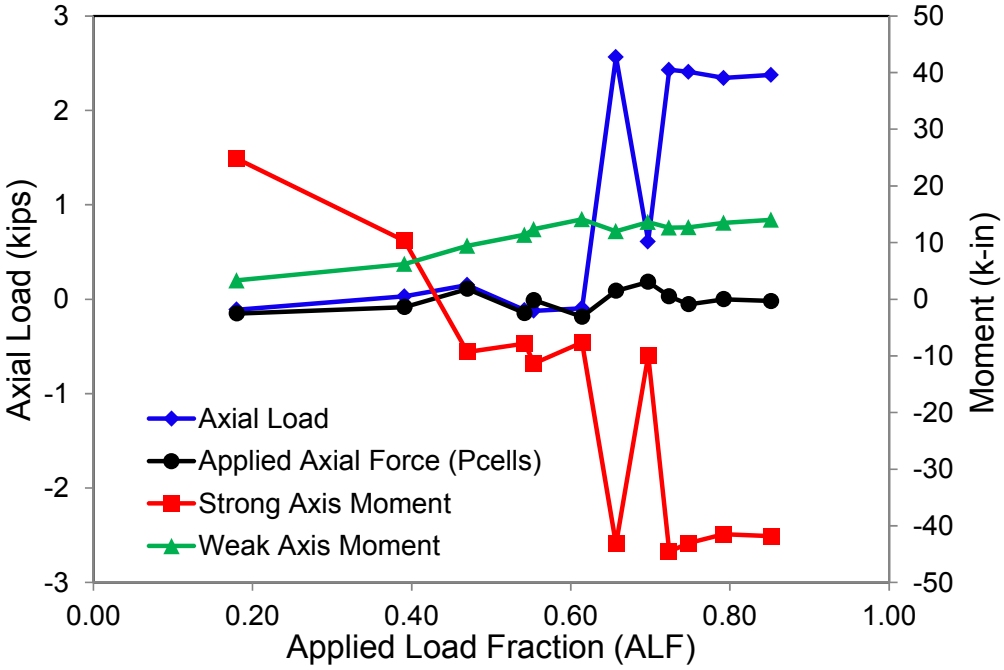

Figure G71. Vertical

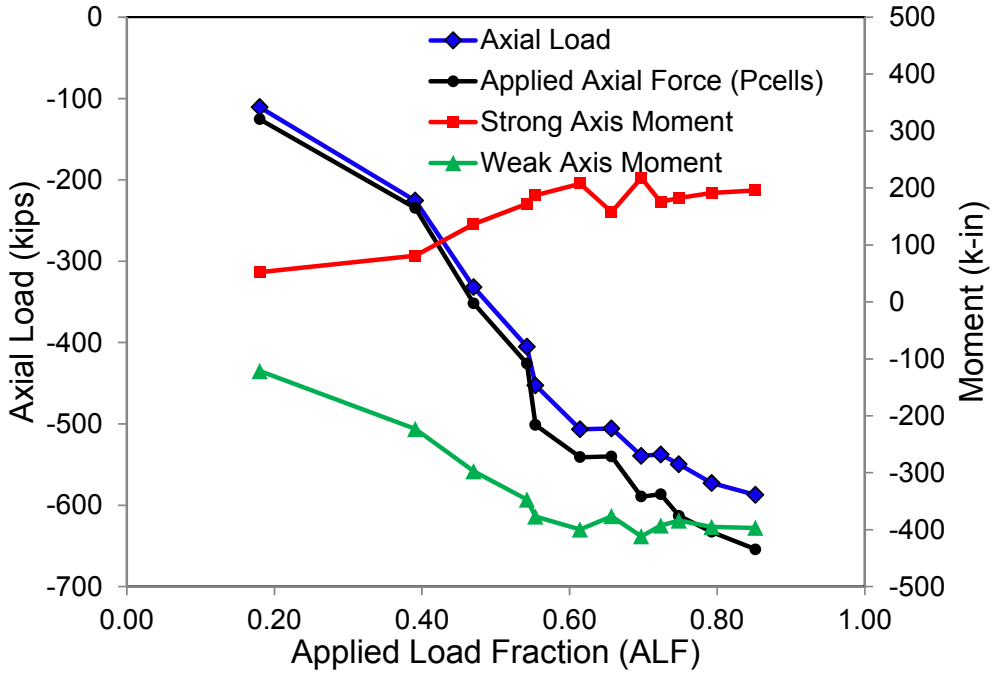

Figure G72. Compression Diagonal

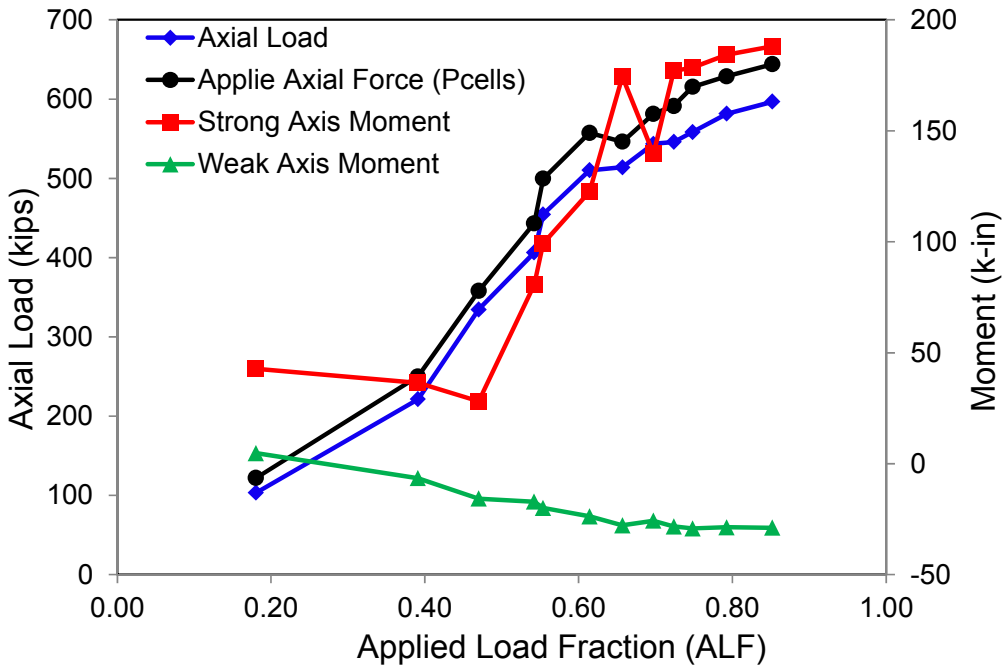

Figure G73. Tension Diagonal

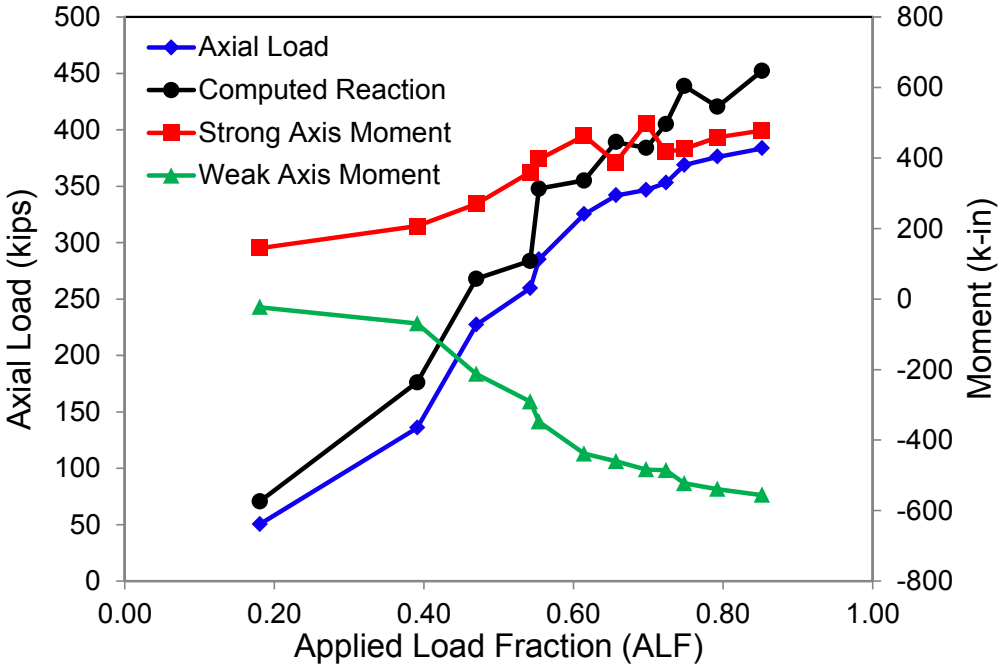

Figure G74. West Chord

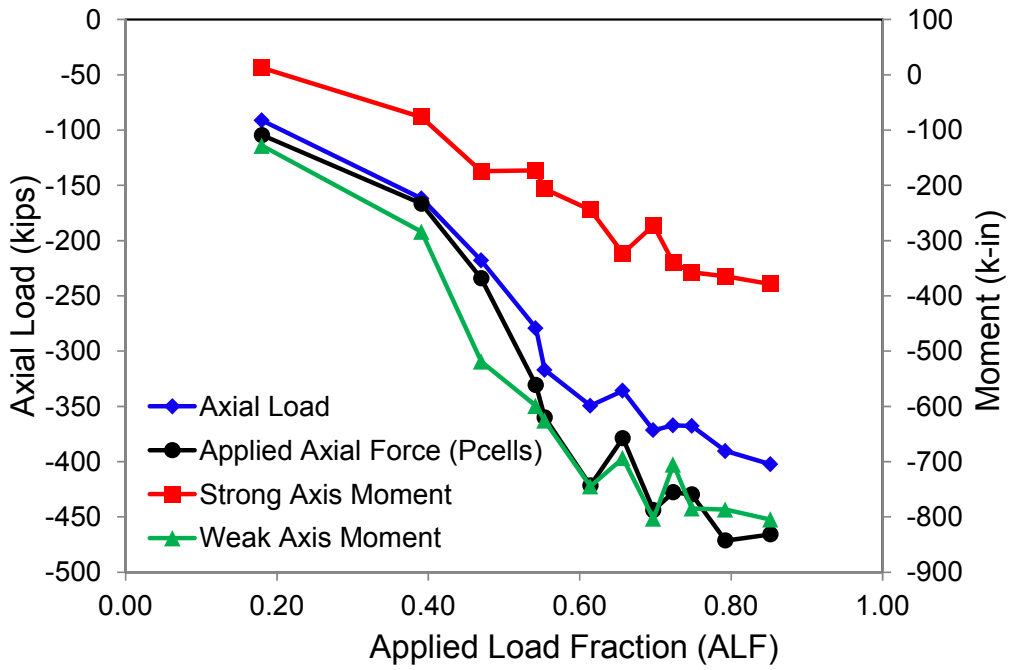

Figure G75. East Chord

Chord Load Shedding Plots

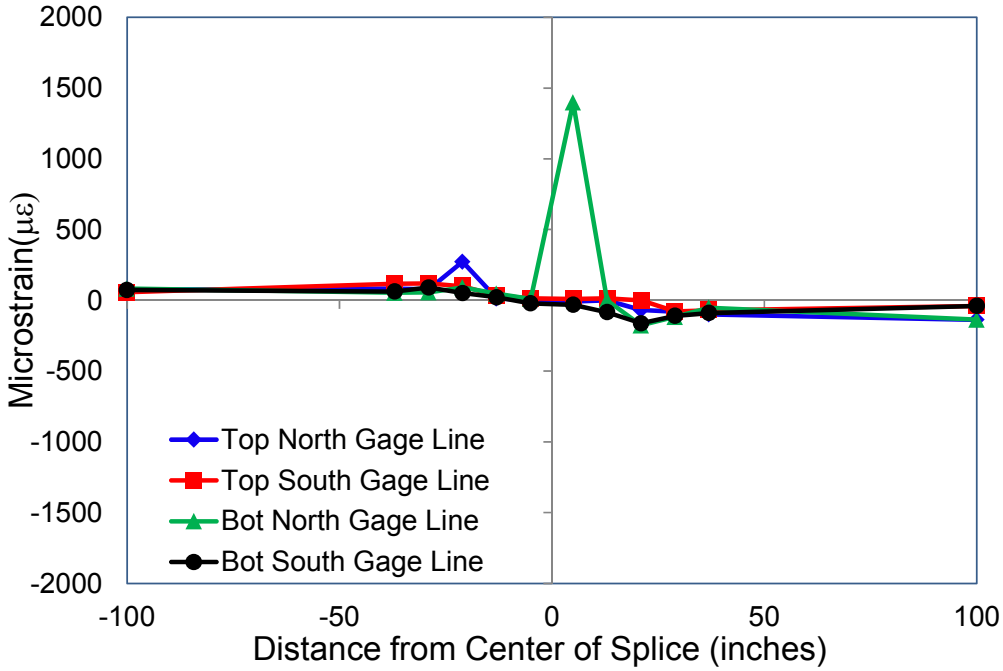

Figure G76. ALF = 0.18

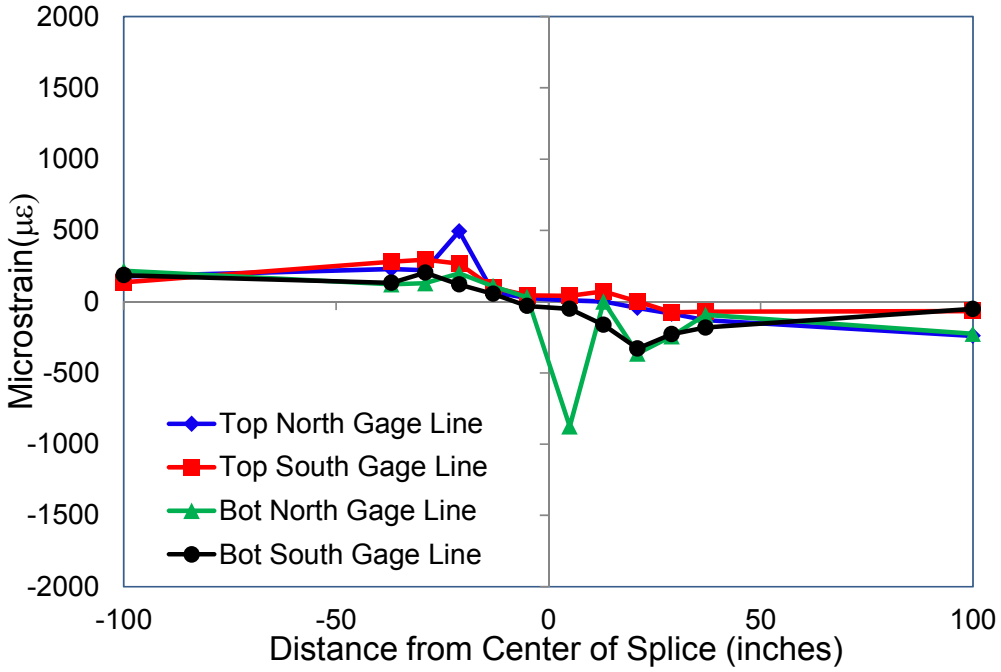

Figure G77. ALF = 0.39

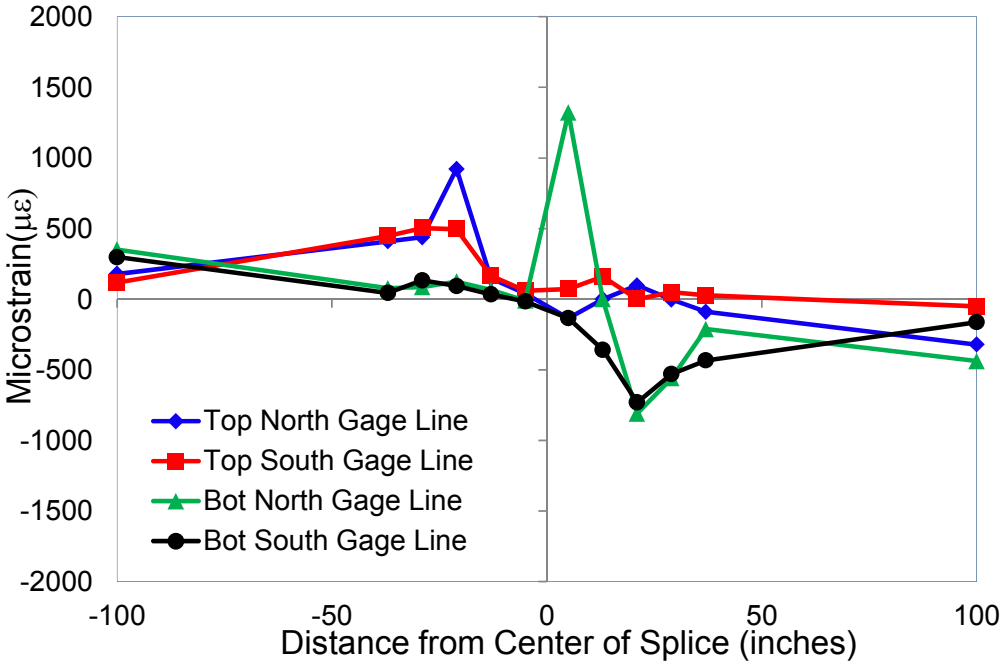

Figure G78. ALF = 0.55

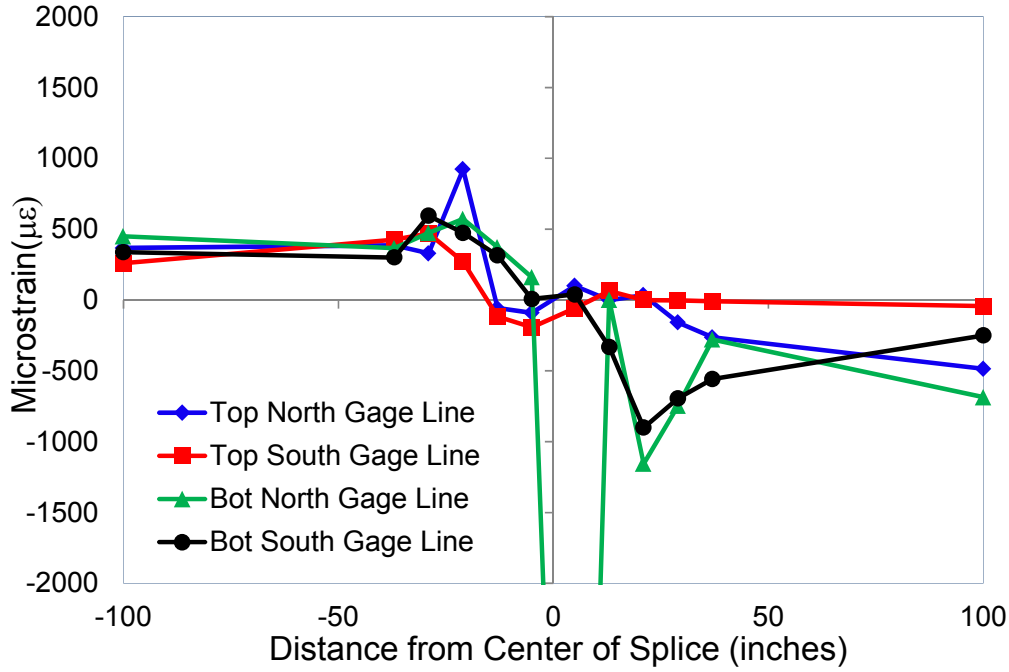

Figure G79. Max ALF = 0.85

Uniaxial Gauge Plots

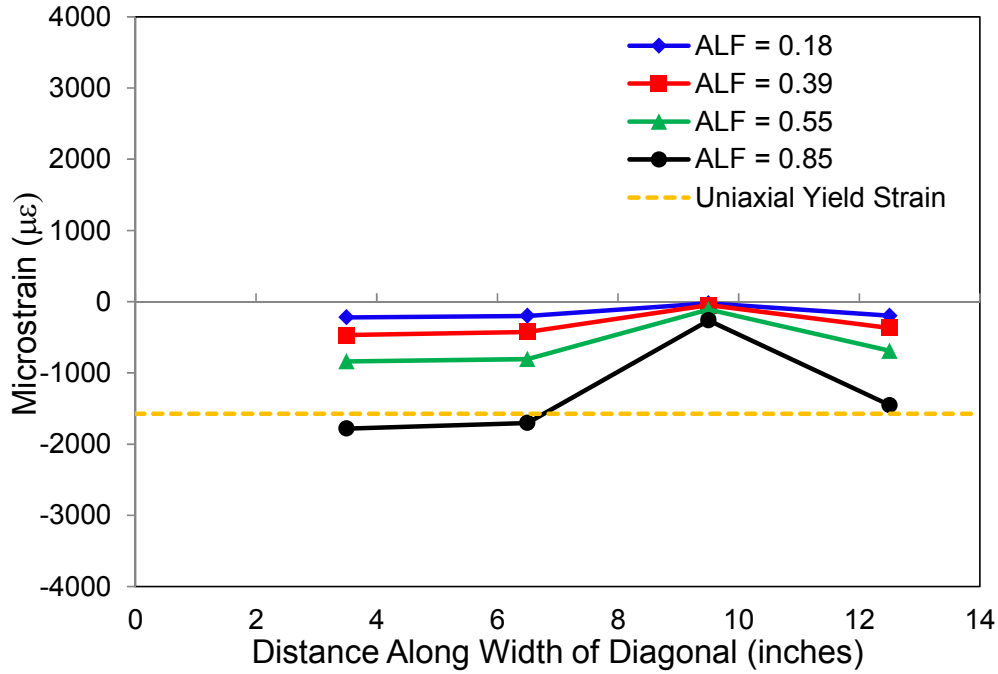

Figure G80. North Compression Diagonal

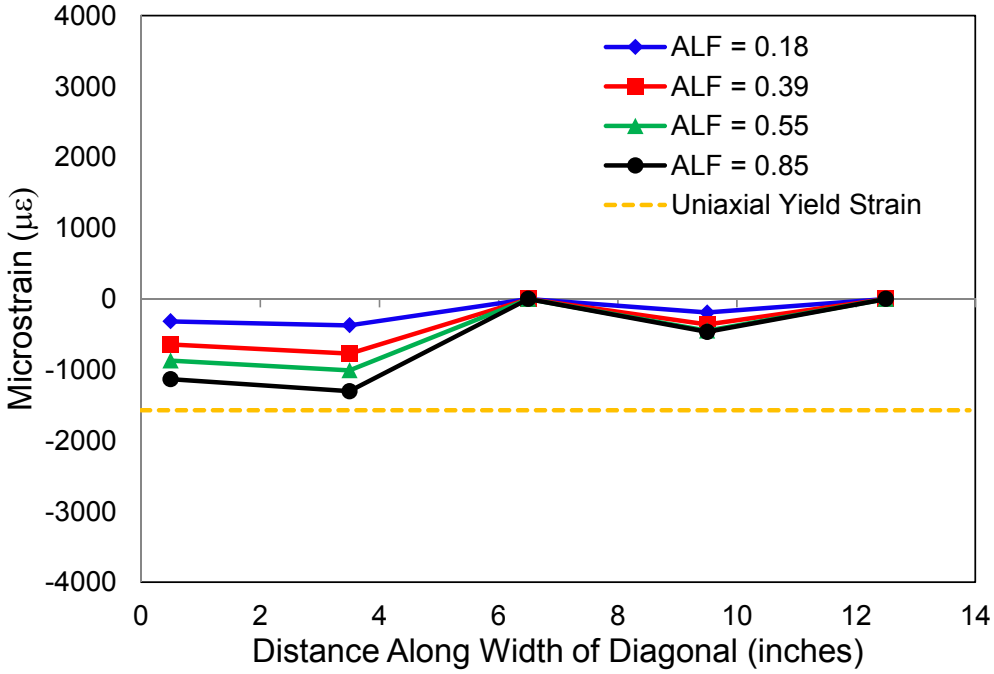

Figure G81. South Compression Diagonal

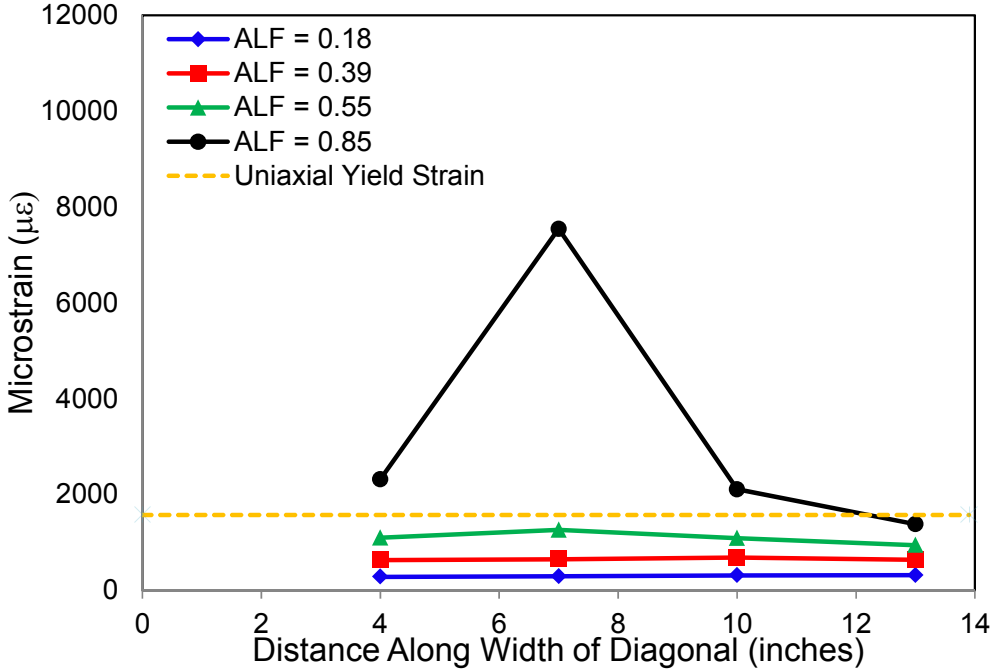

Figure G82. North Tension Diagonal

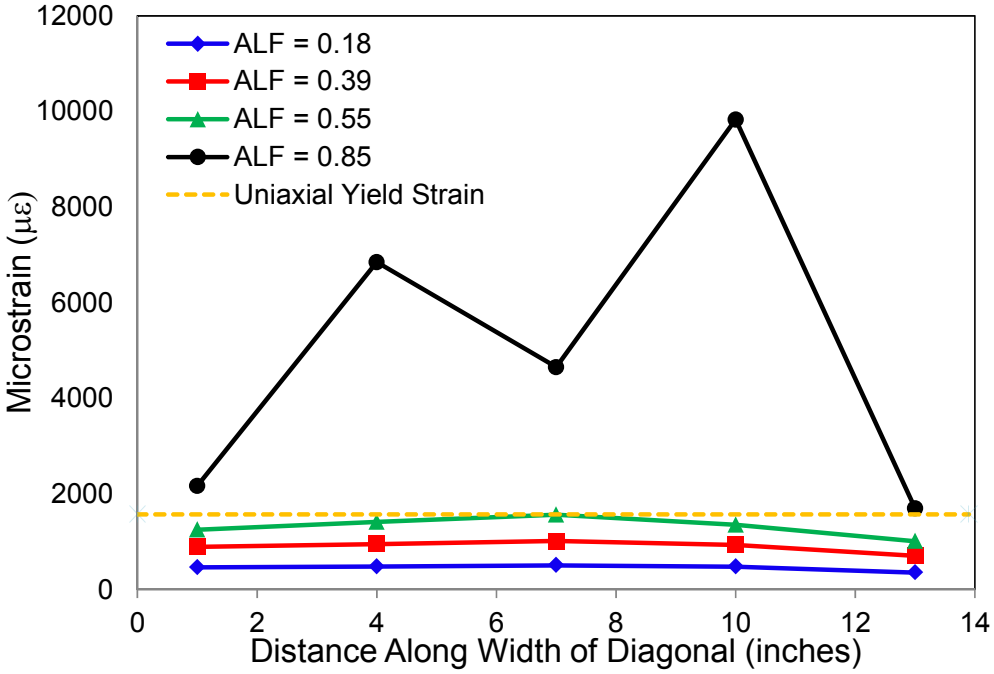

Figure G83. South Tension Diagonal

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Maximum Shear Strain Plots

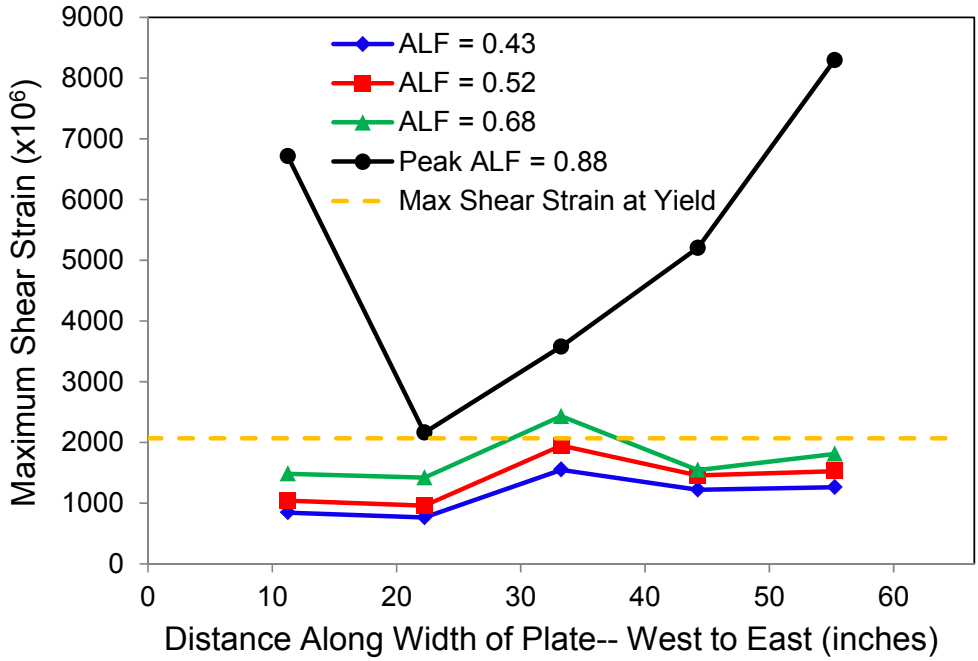

Figure G84. Horizontal line of rosettes above chord; south gusset plate

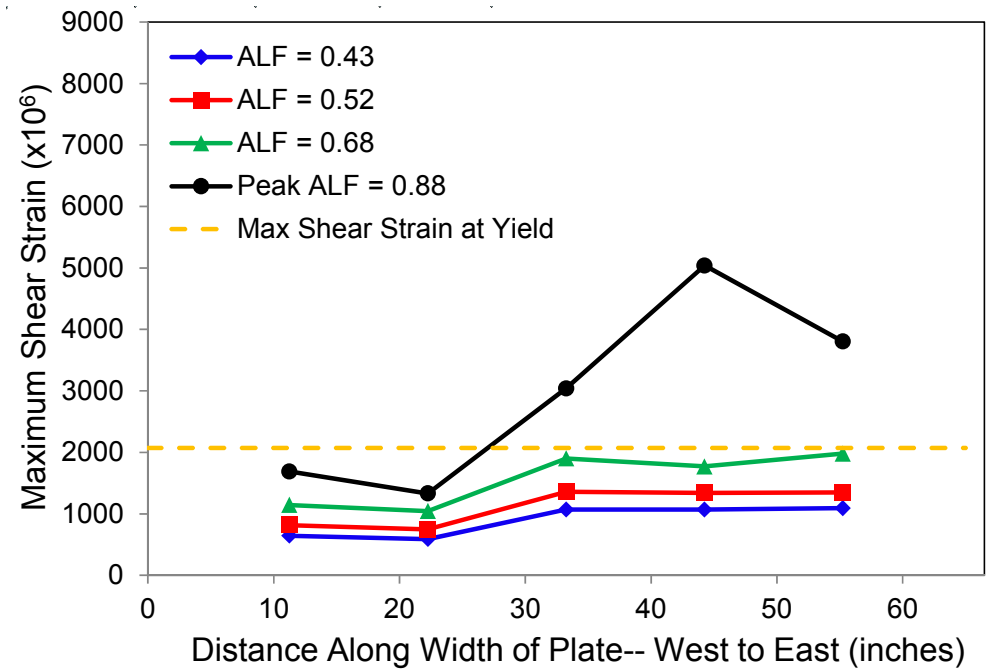

Figure G85. Horizontal line of rosettes above chord; north gusset plate

Variations in Principal Strain

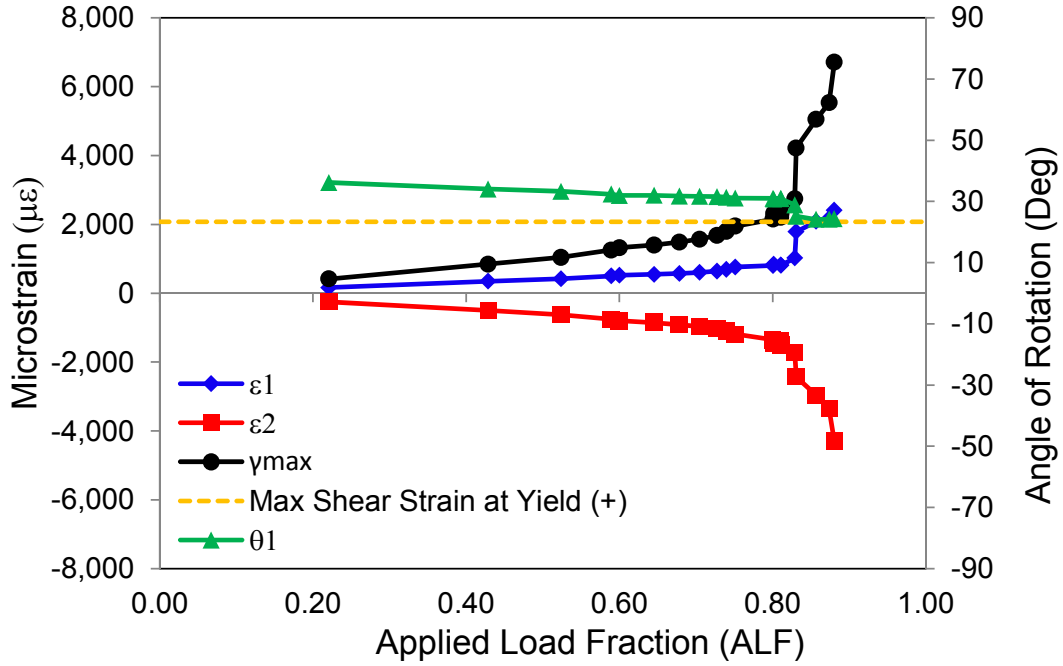

Figure G86. South gusset west bottom

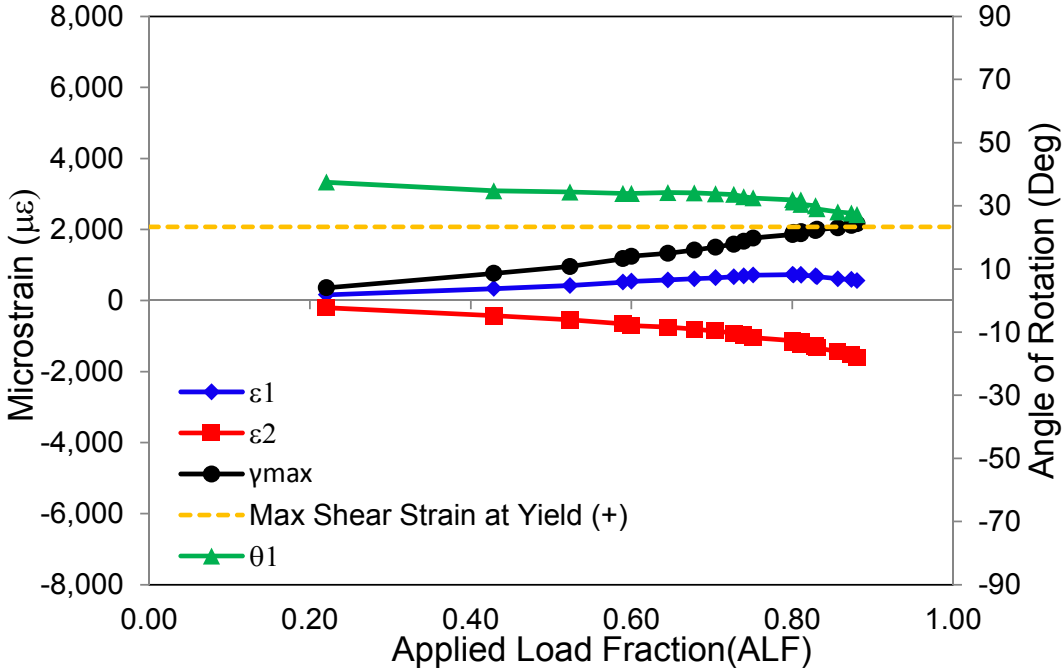

Figure G87. South gusset west mid bottom

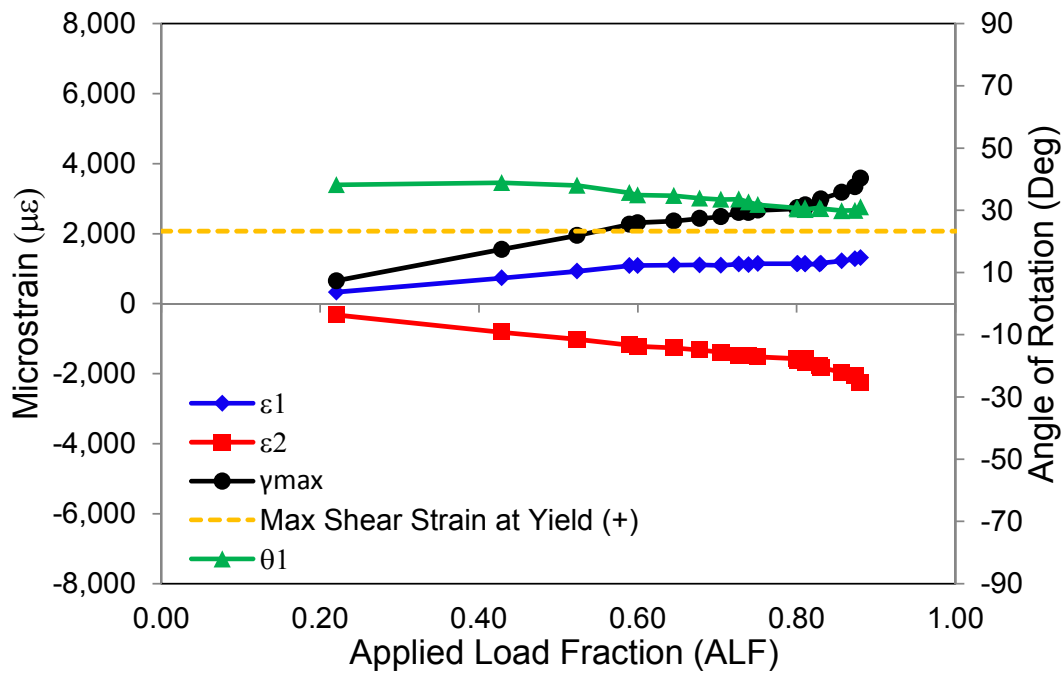

Figure G88. South gusset mid bottom

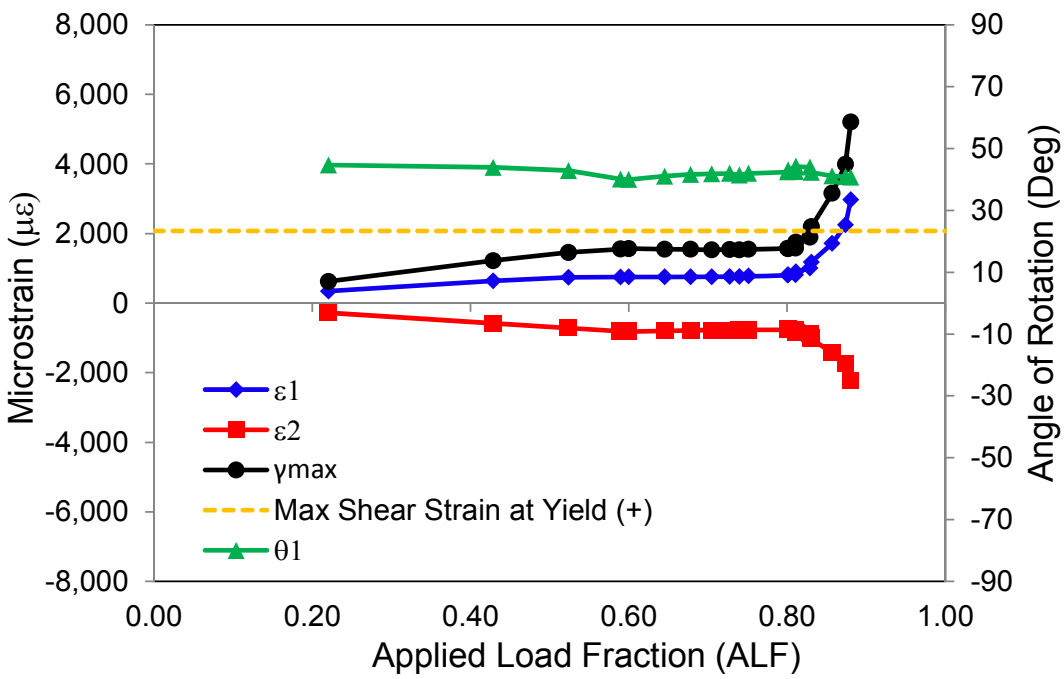

Figure G89. South gusset east mid bottom

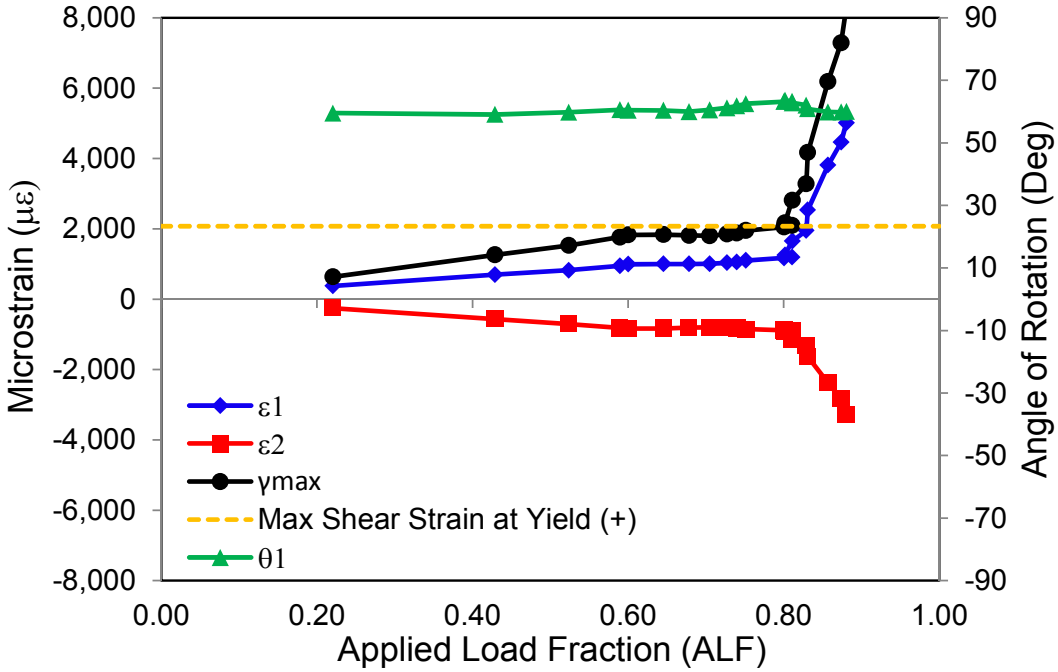

Figure G90. South gusset east bottom

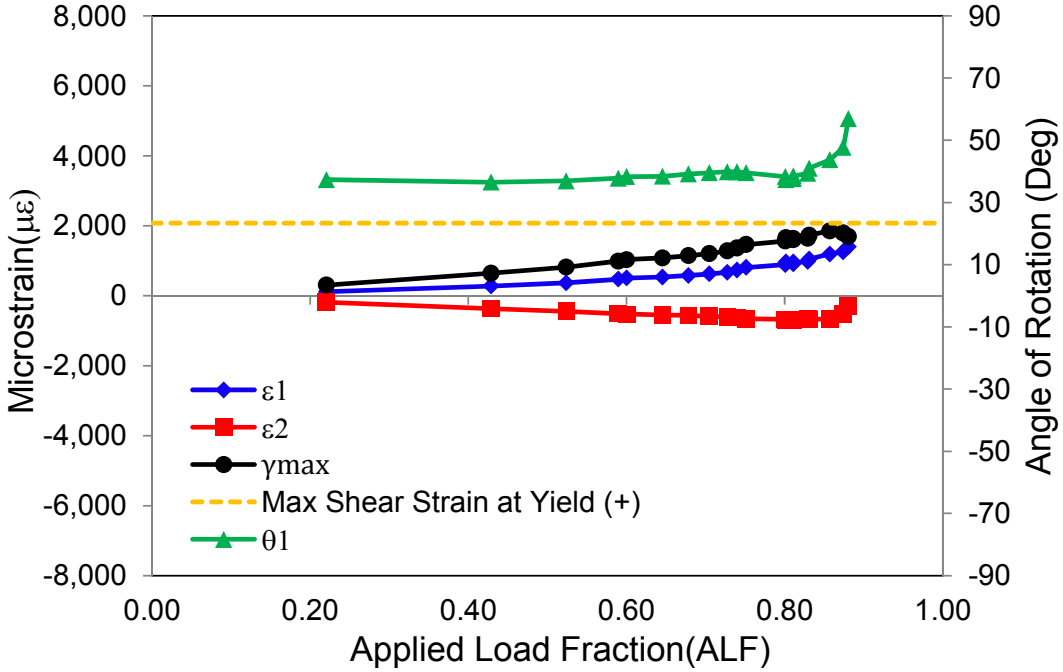

Figure G91. North gusset west bottom

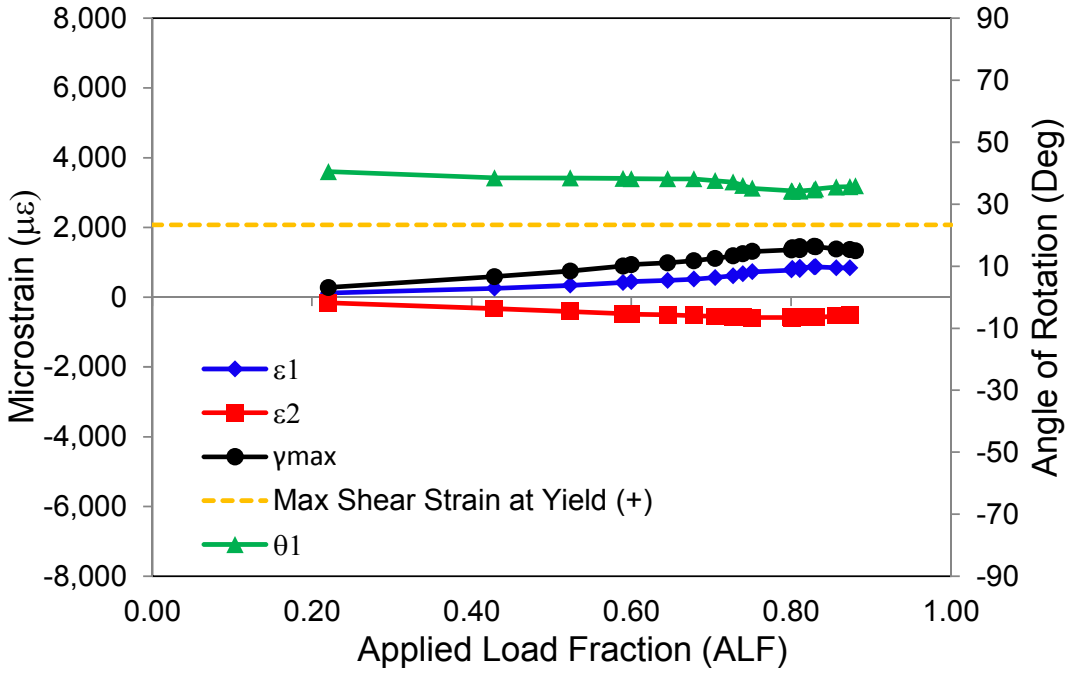

Figure G92. North gusset west mid bottom

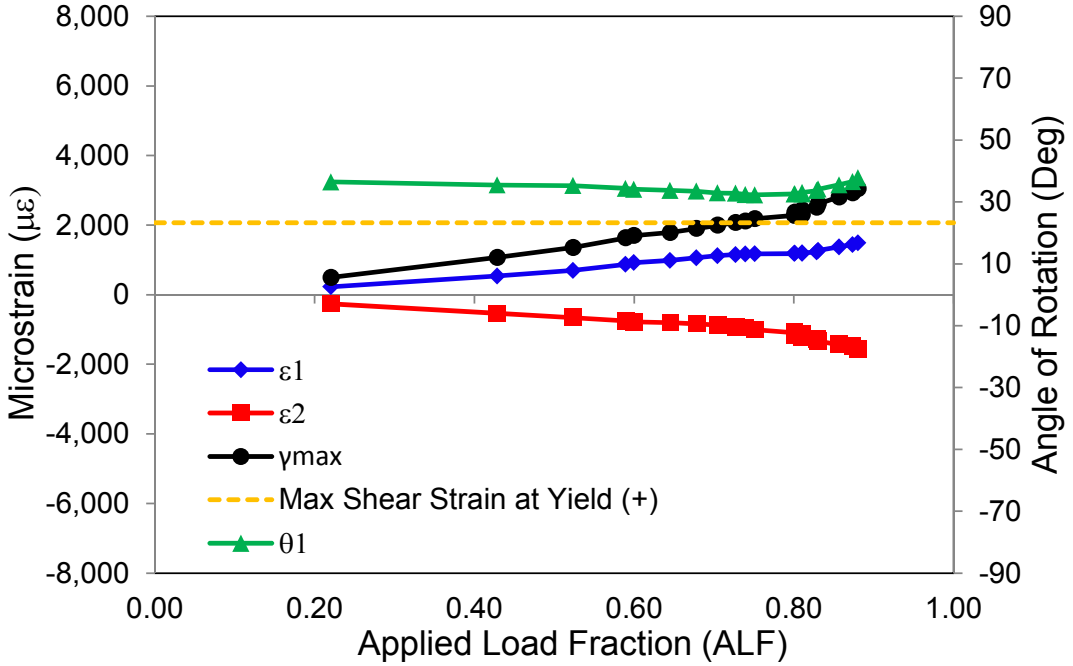

Figure G93. North gusset mid bottom

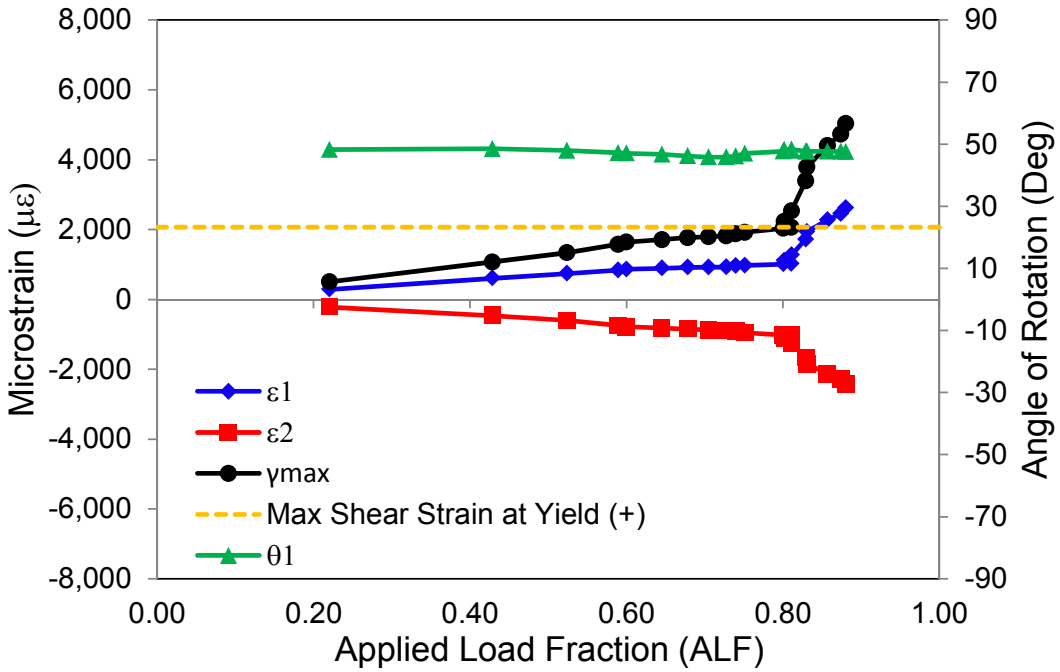

Figure G94. North gusset mid east bottom

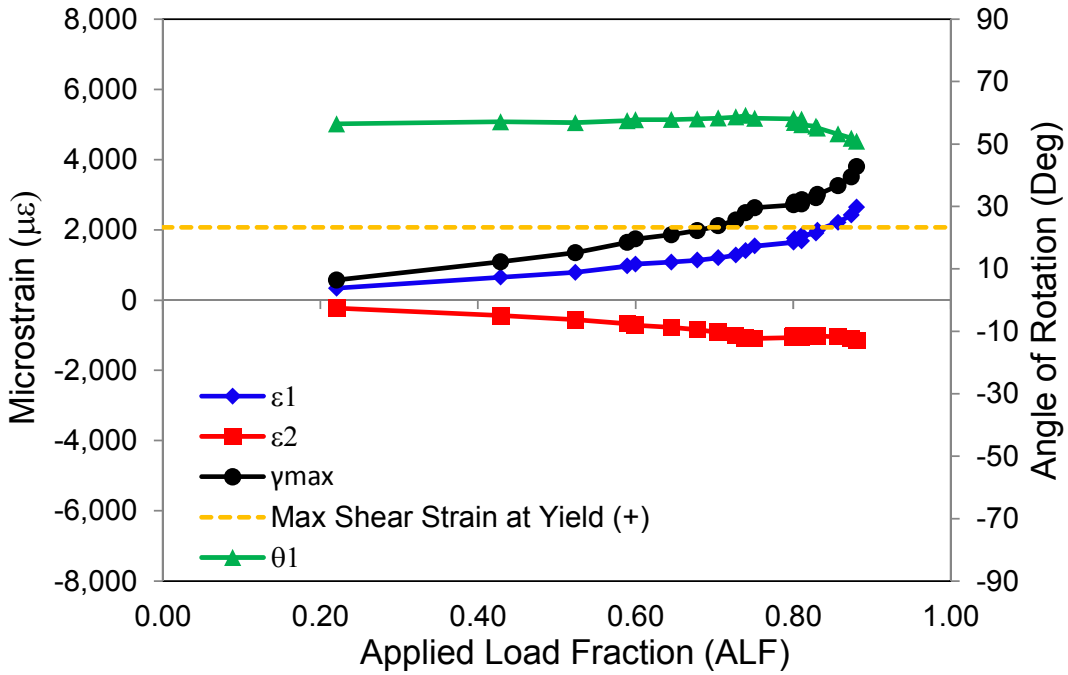

Figure G95. North gusset east bottom

Member Cross-Sectional Plots

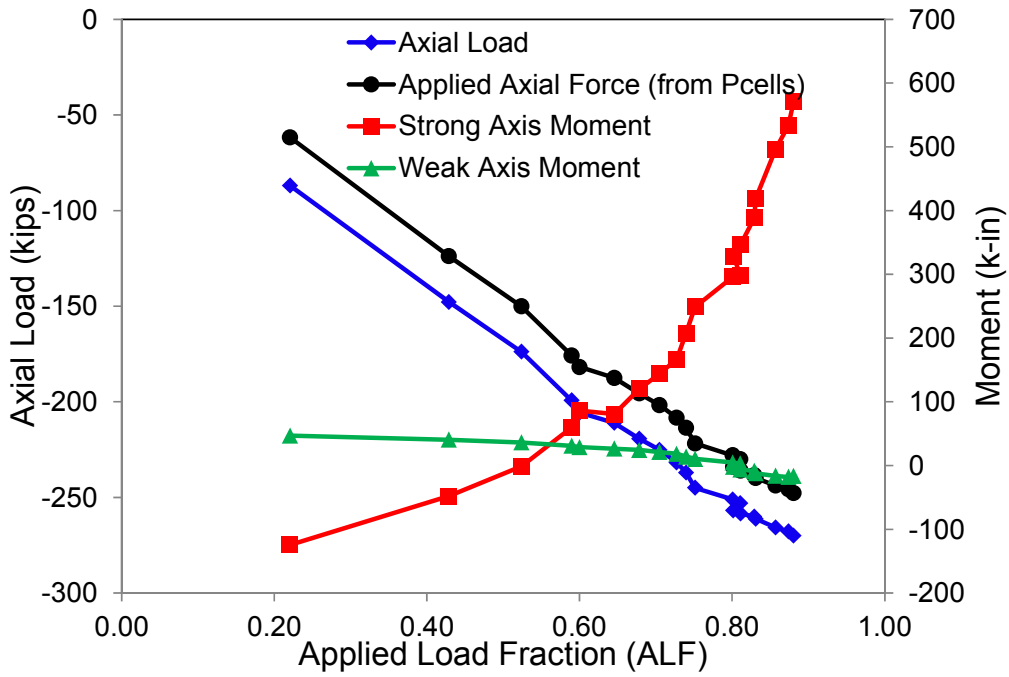

Figure G96. Vertical

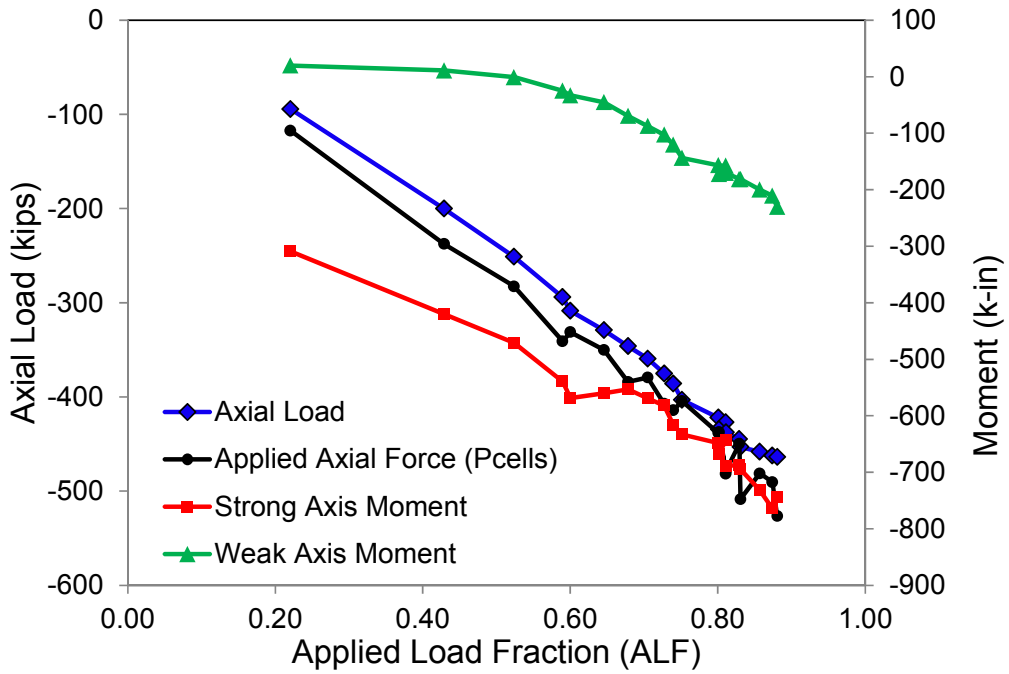

Figure G97. Compression Diagonal

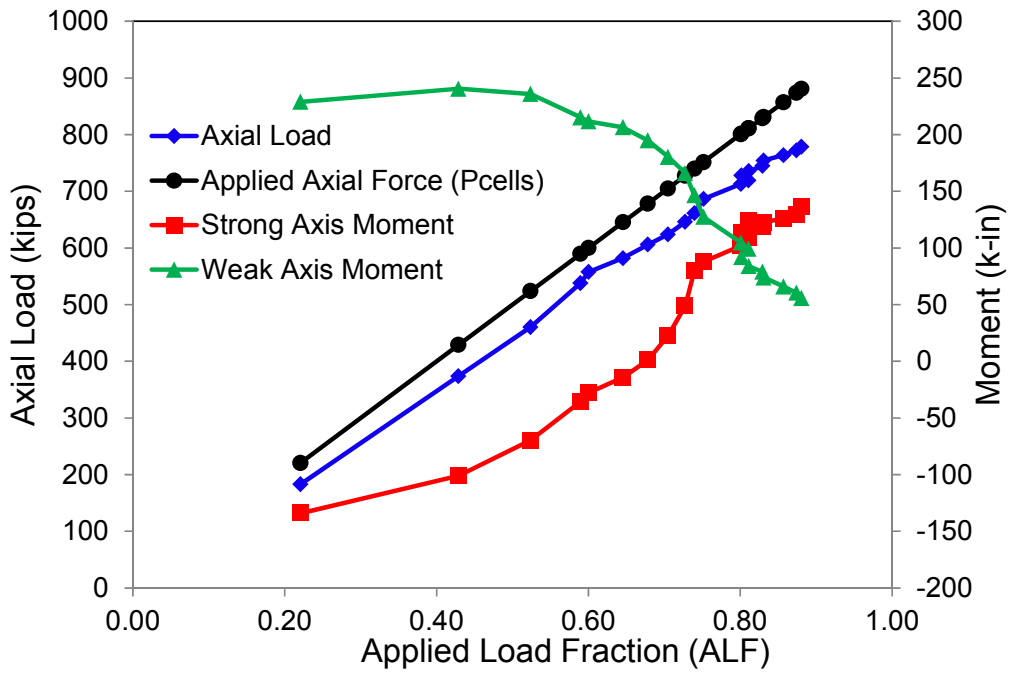

Figure G98. Tension Diagonal

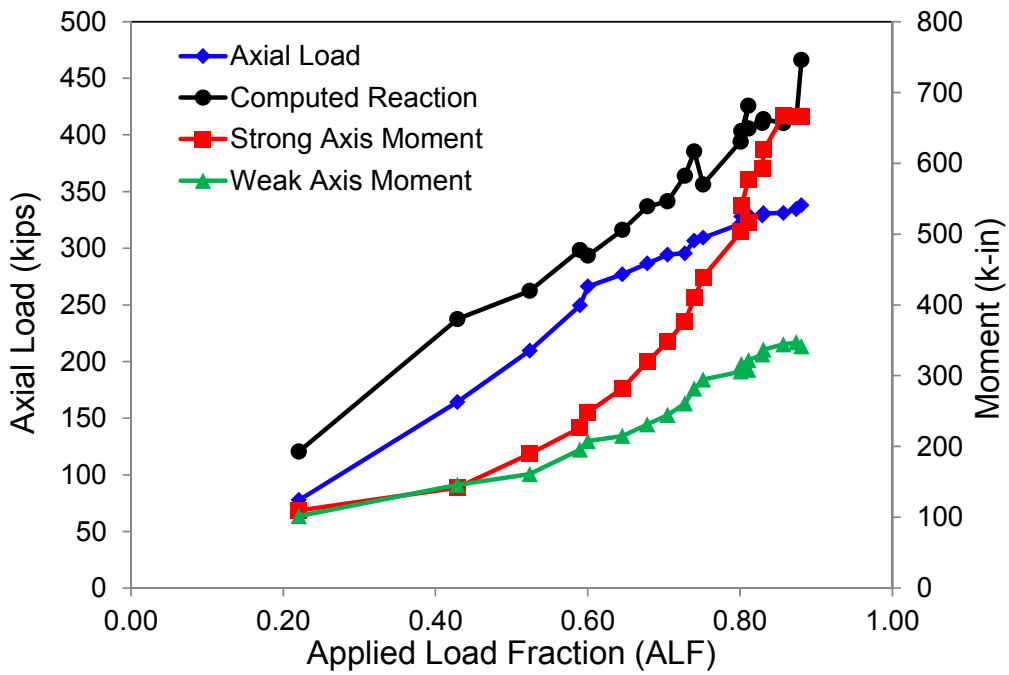

Figure G99. West Chord

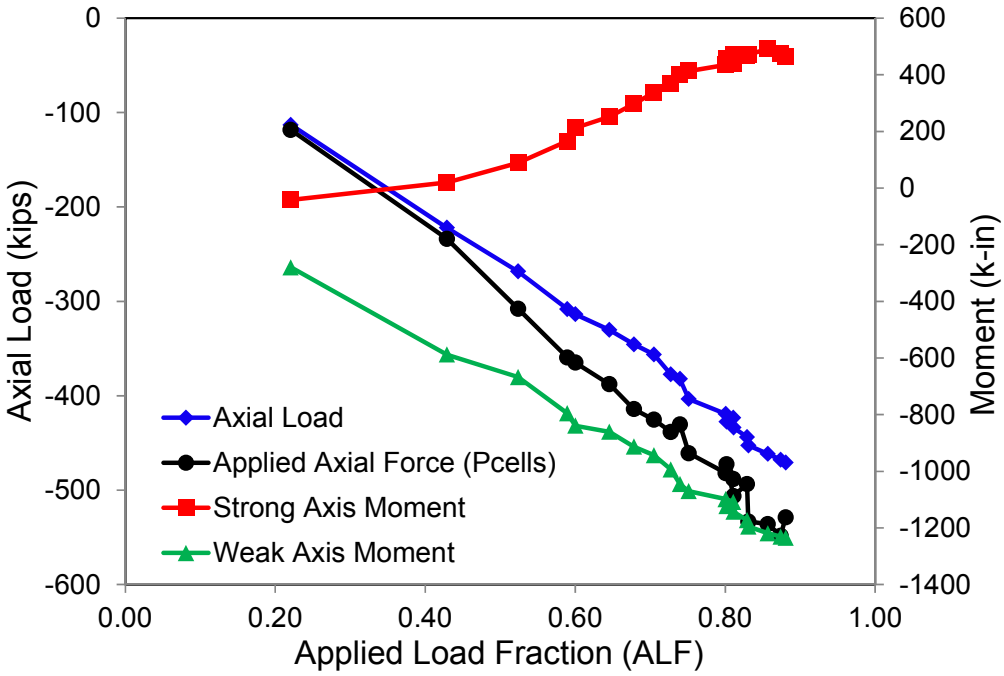

Figure G100. East Chord

Chord Load Shedding Plots

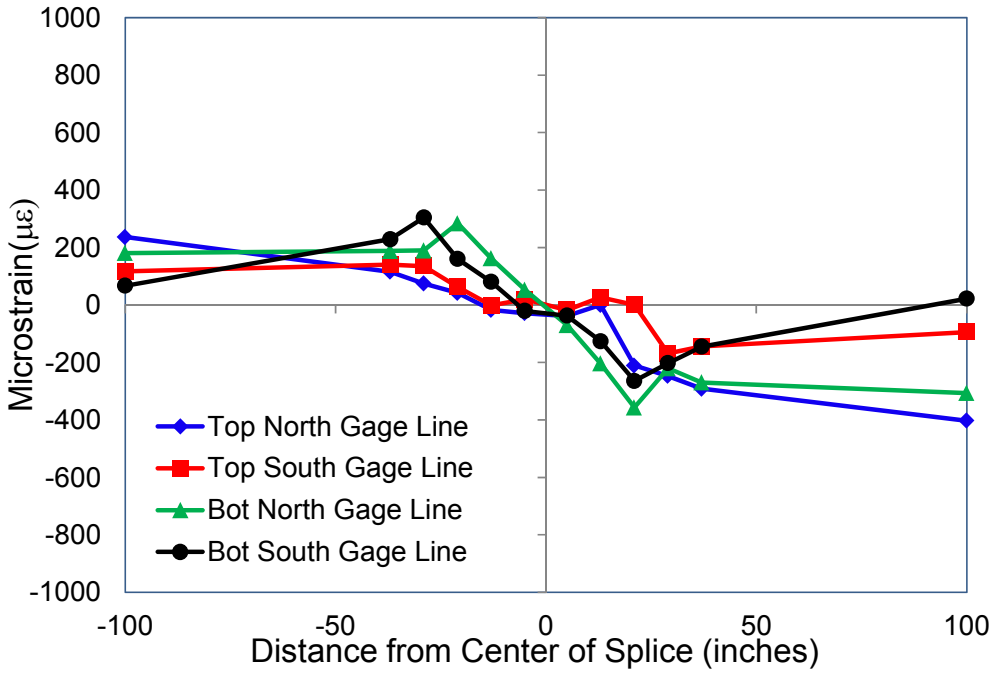

Figure G101. ALF=0.43

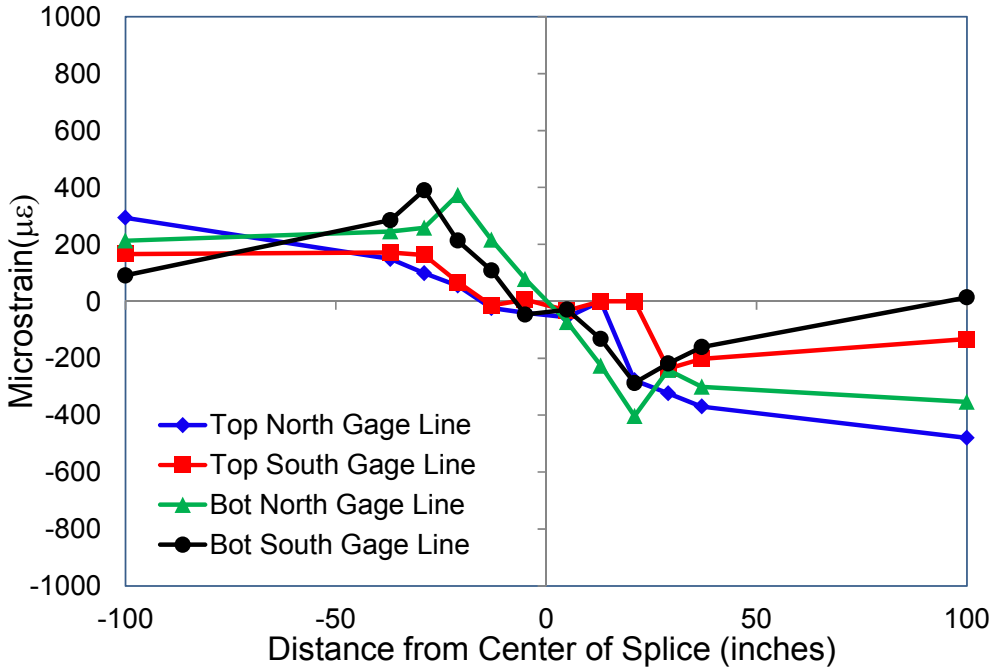

Figure G102. ALF=0.52

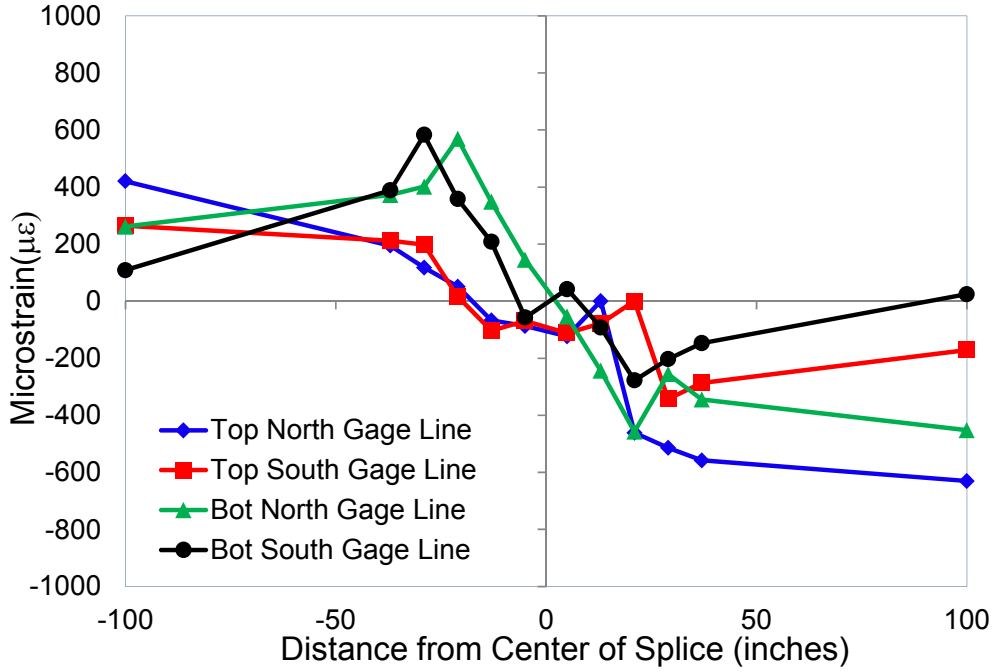

Figure G103. ALF=0.68

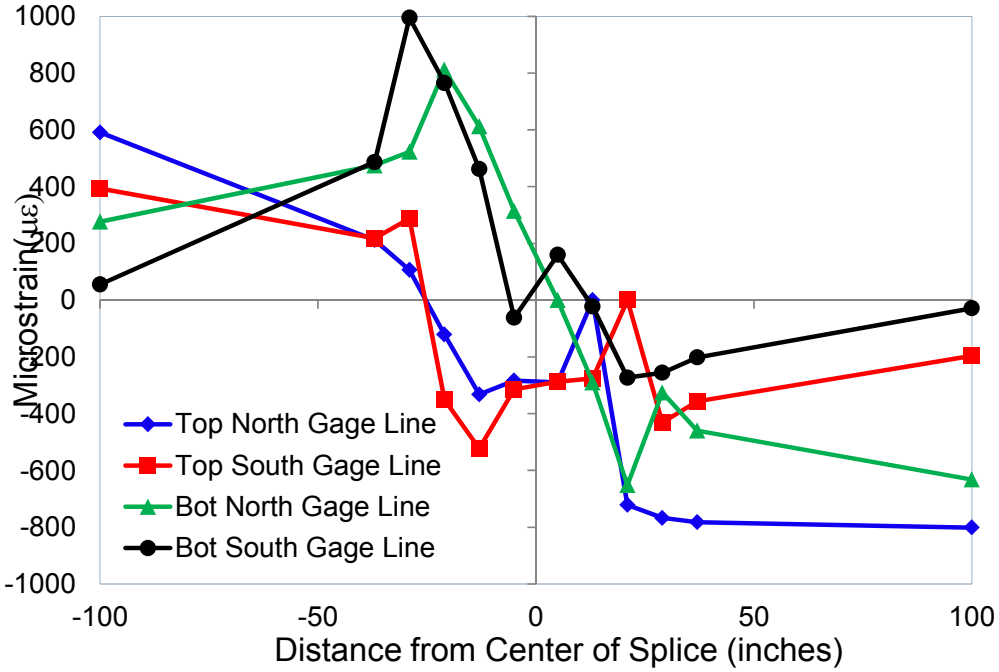

Figure G104. Max ALF=0.88

Uniaxial Gauge Plots

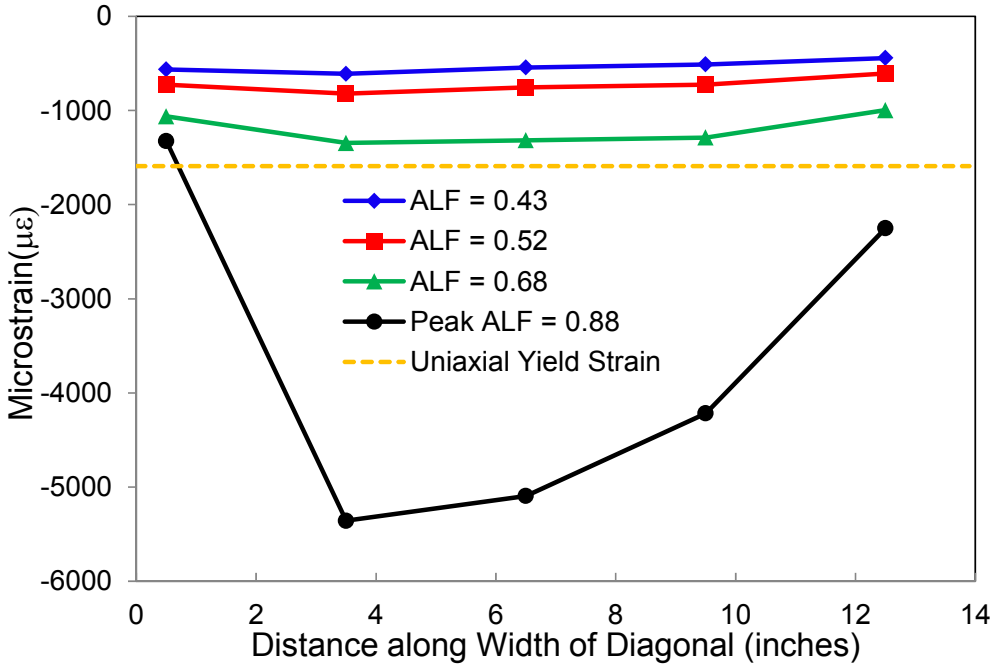

Figure G105. North Compression Diagonal

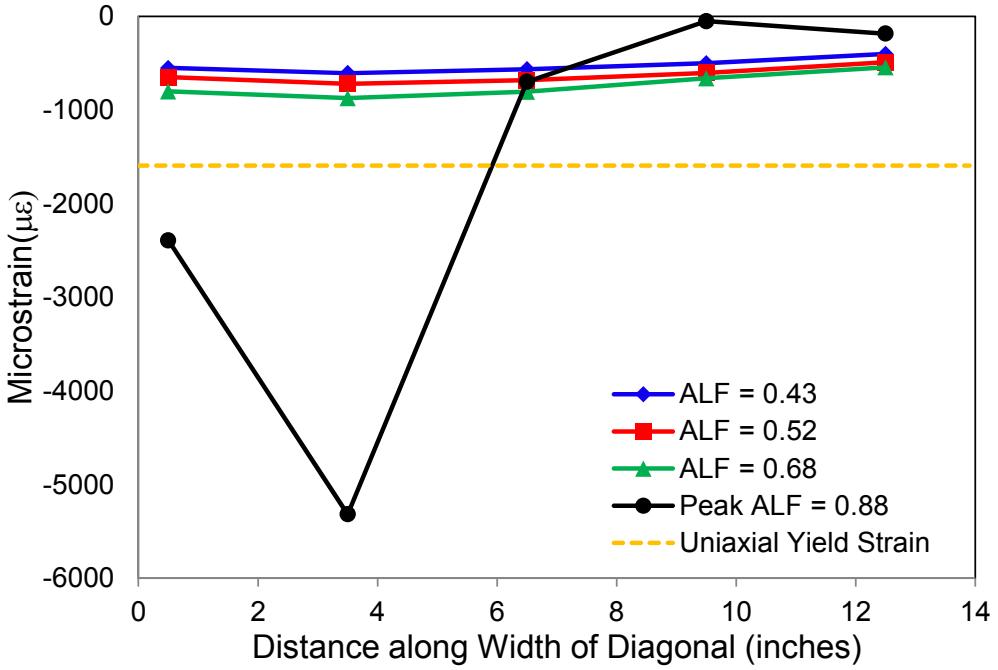

Figure G106. South Compression Diagonal

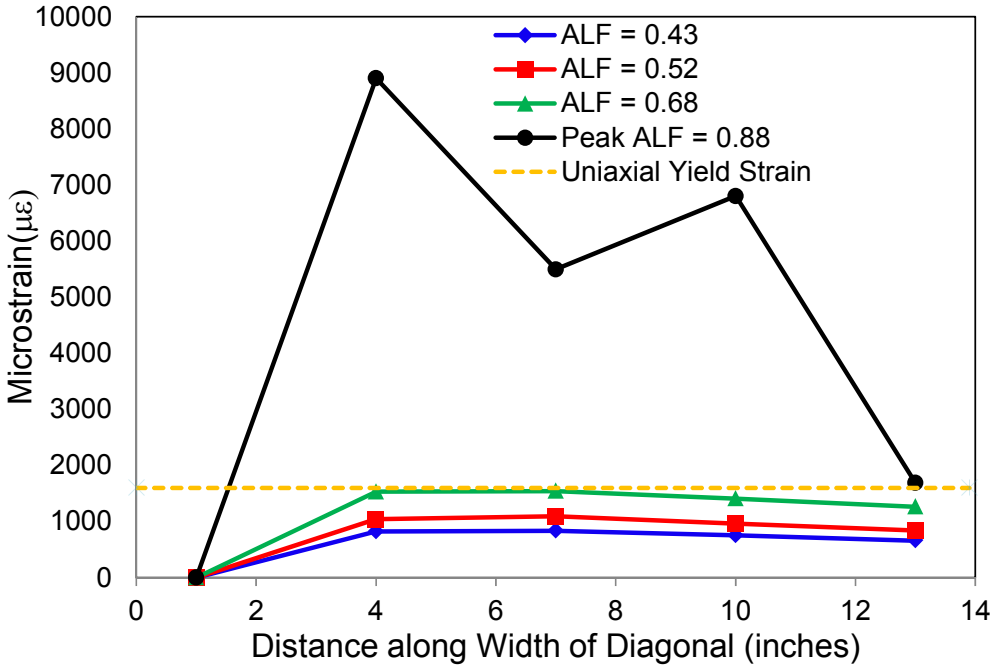

Figure G107. North Tension Diagonal

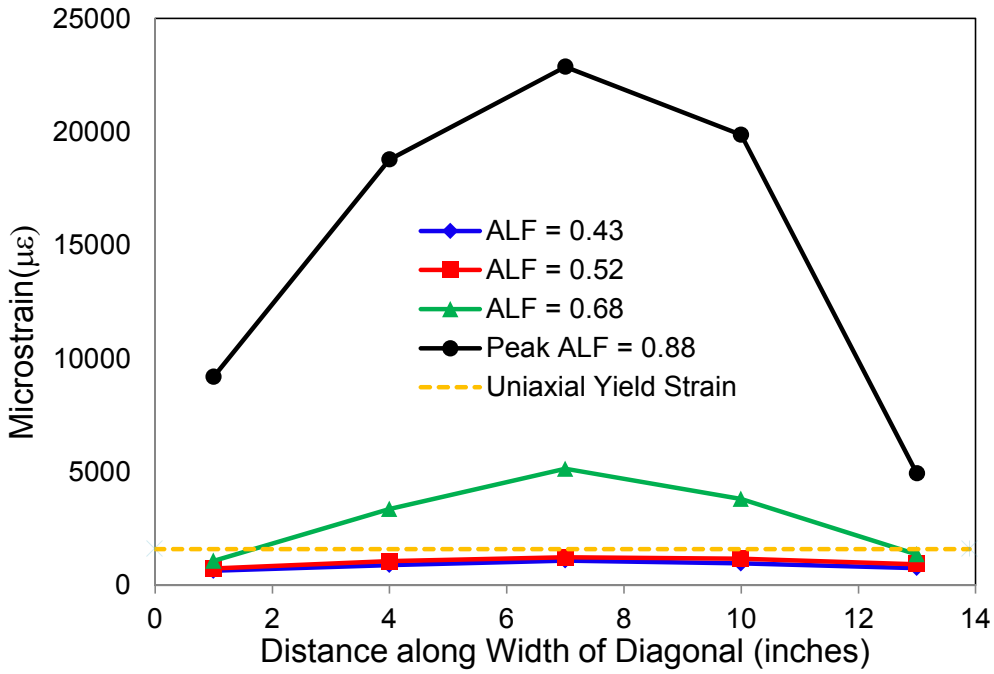

Figure G108. South Tension Diagonal

SPECIMEN 307LS3

Maximum Shear Strain Plots

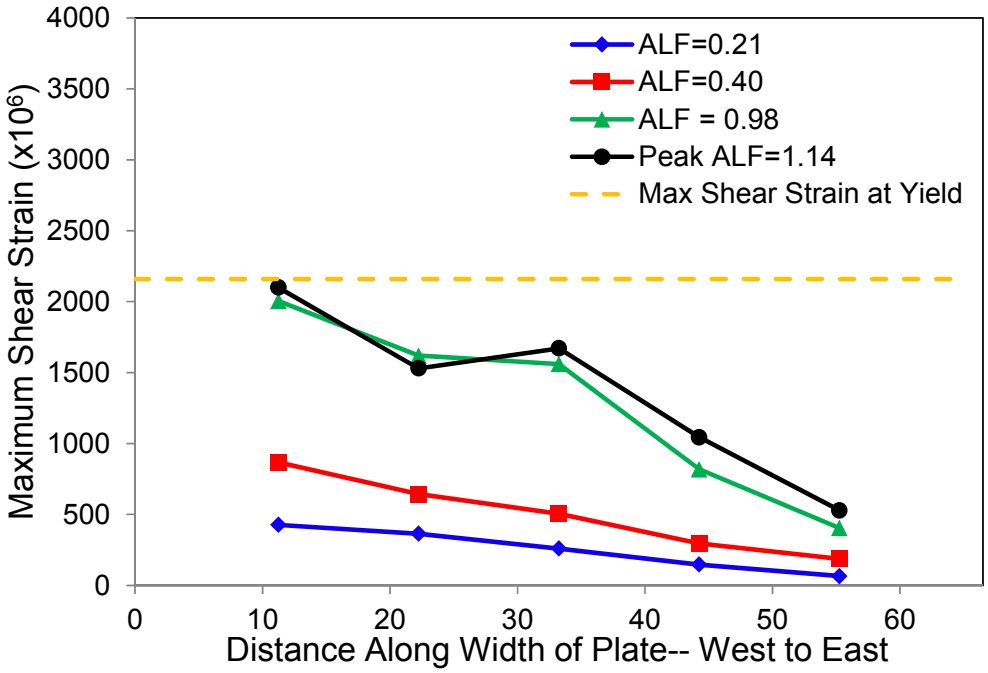

Figure G109. Horizontal line of rosettes above chord; south gusset plate

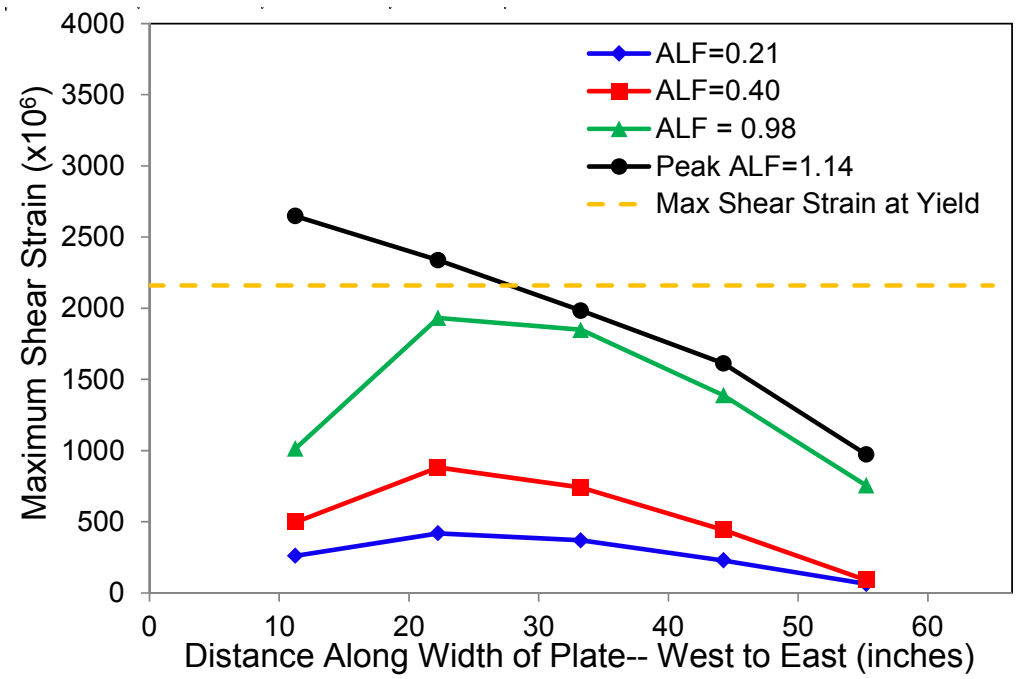

Figure G110. Horizontal line of rosettes above chord; north gusset plate

Variations in Principal Strain

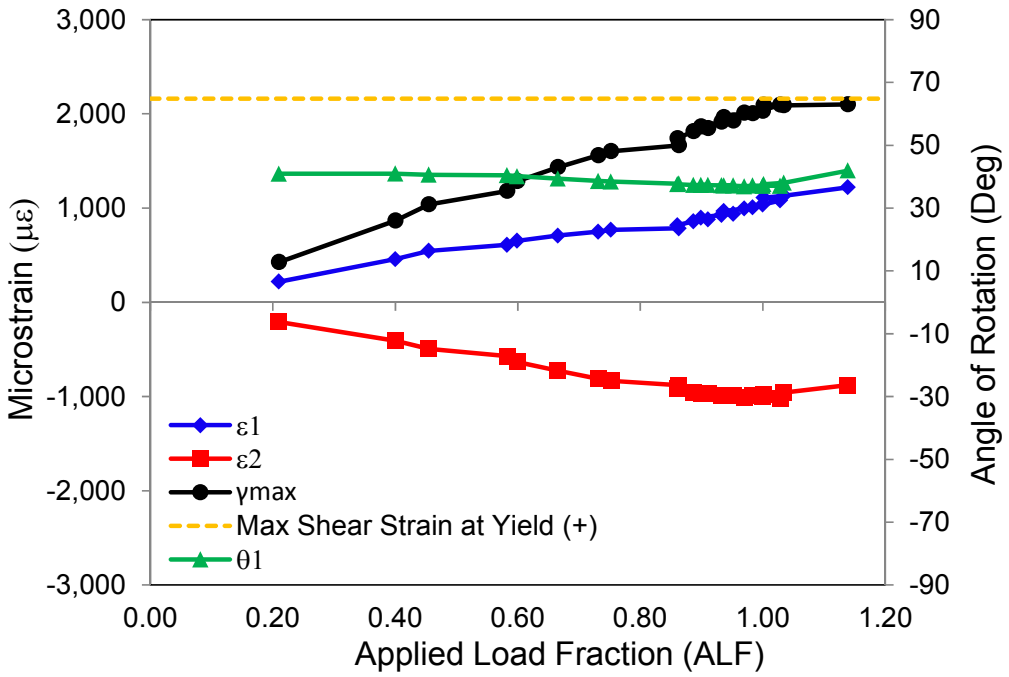

Figure G111. South gusset west bottom

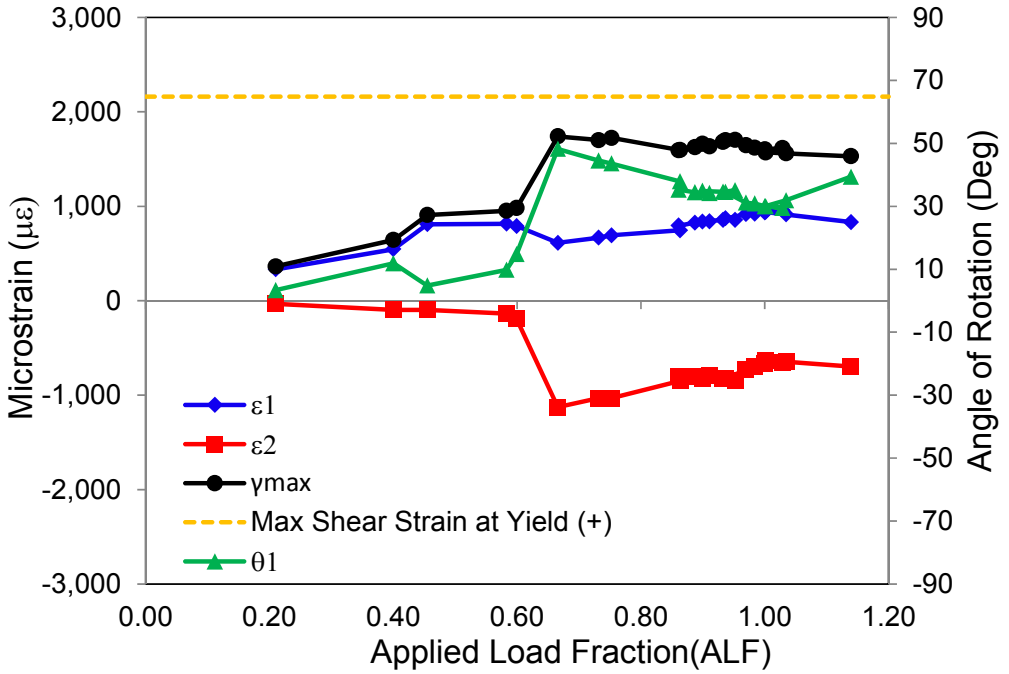

Figure G112. South gusset west mid bottom

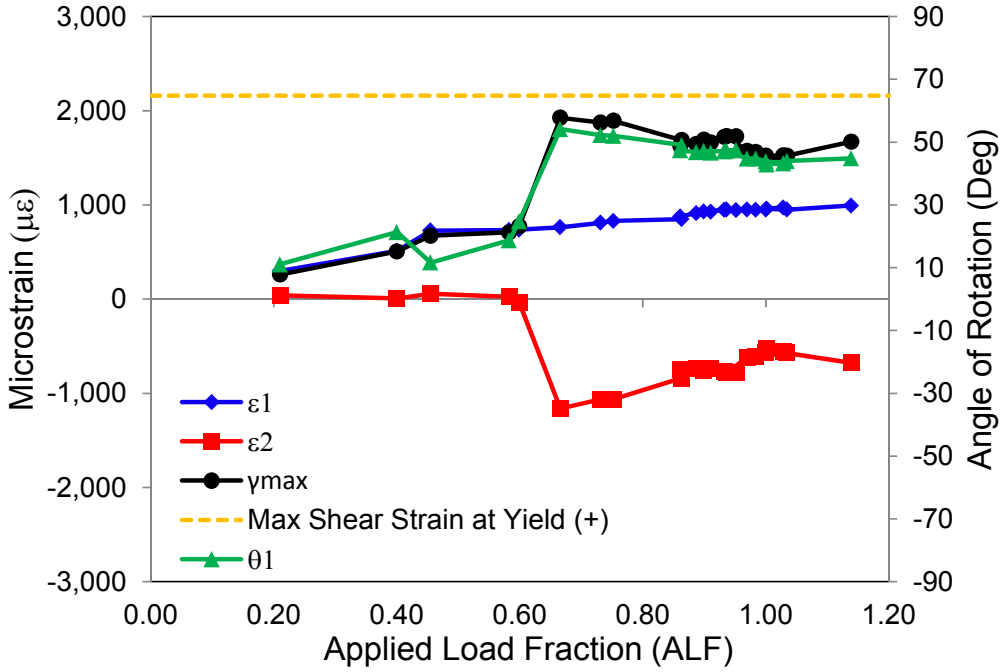

Figure G113. South gusset mid bottom

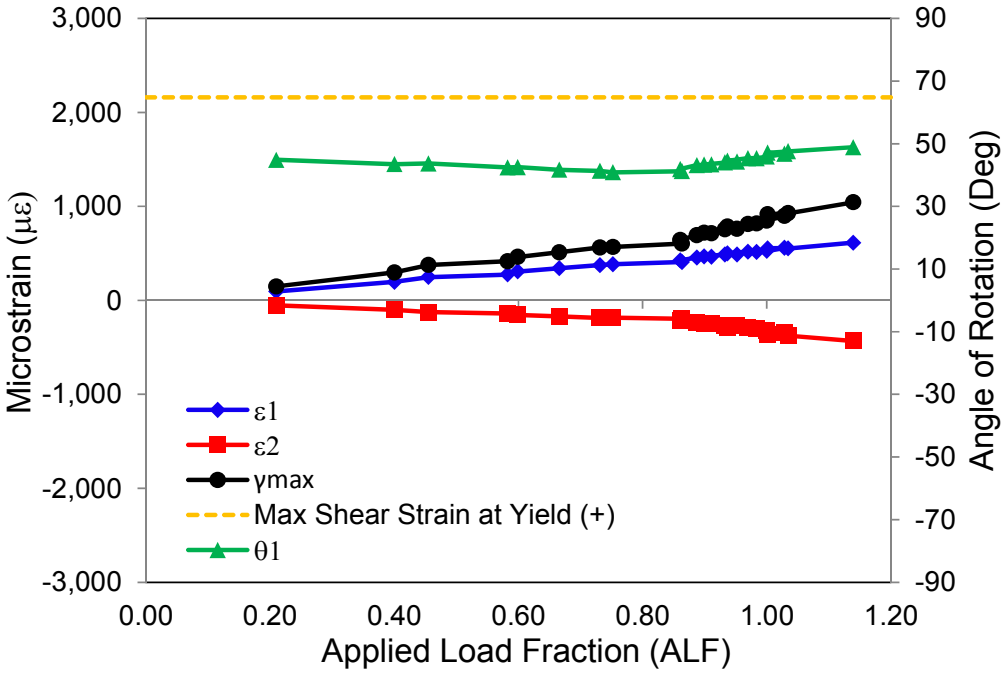

Figure G114. South gusset east mid bottom

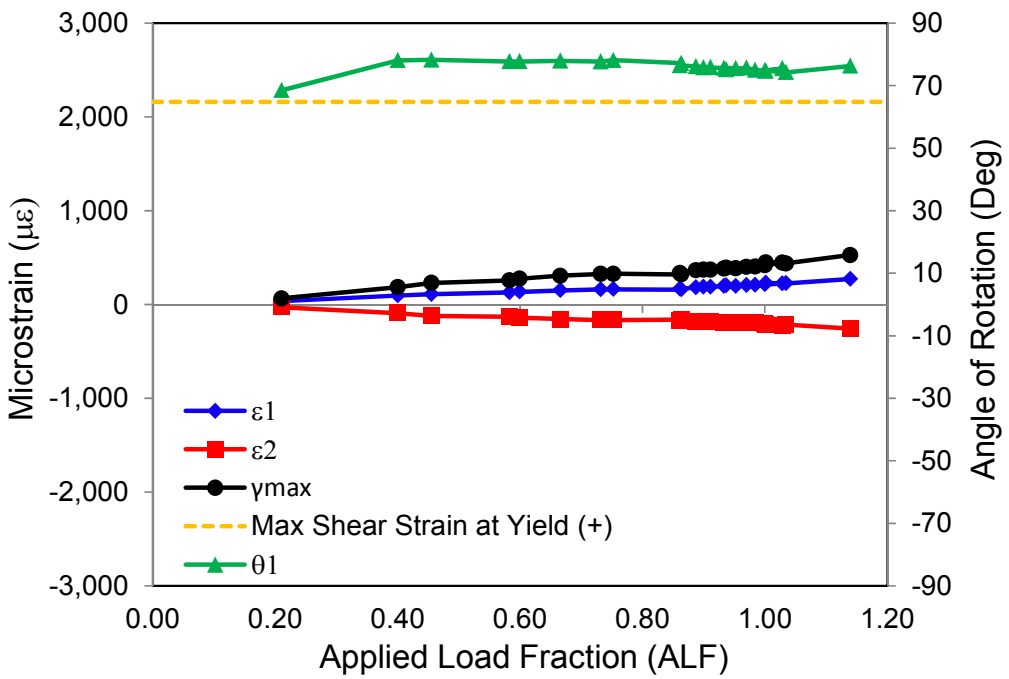

Figure G115. South gusset east bottom

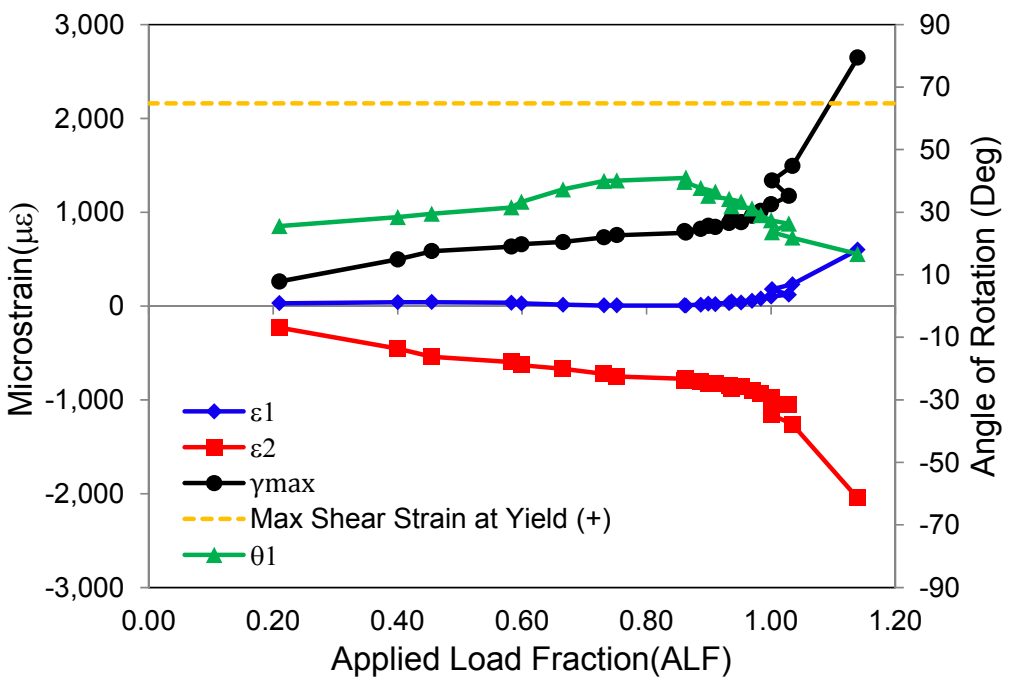

Figure G116. North gusset west bottom

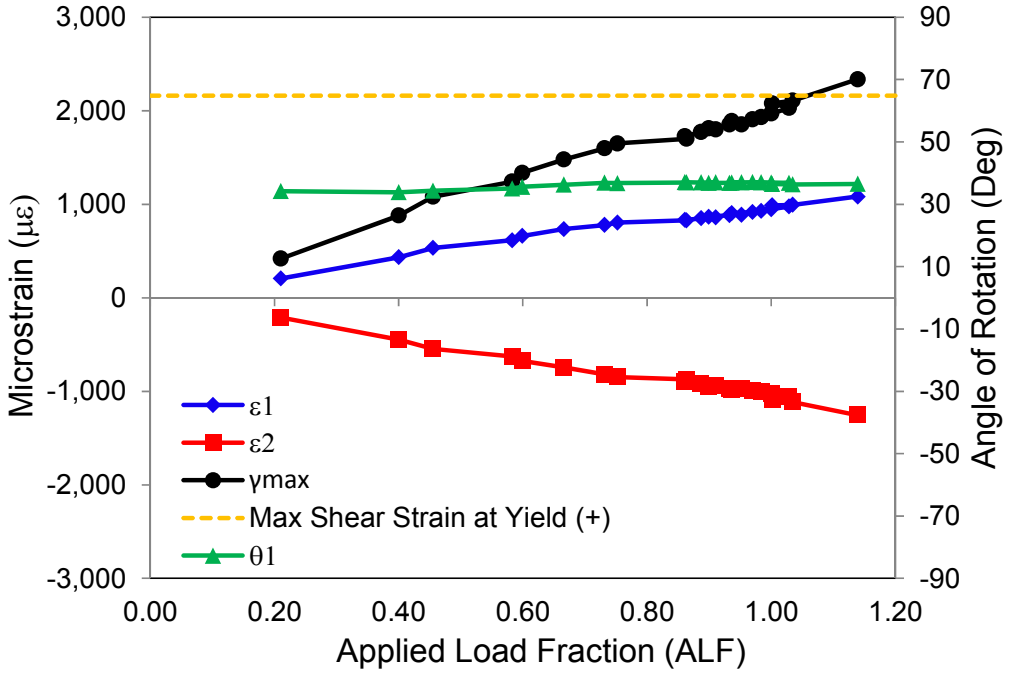

Figure G117. North gusset west mid bottom

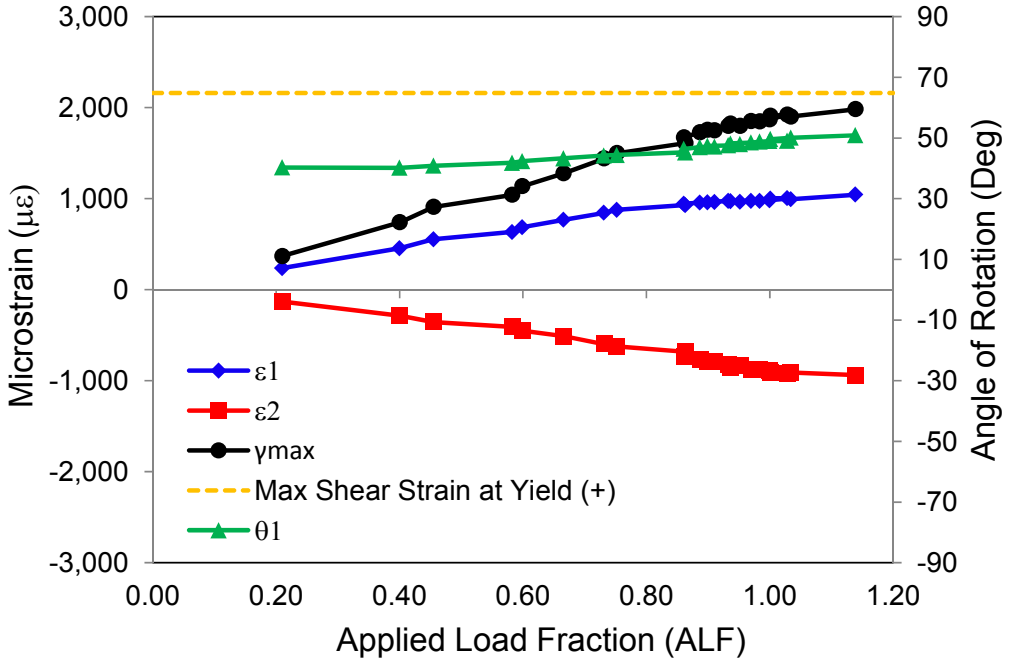

Figure G118. North gusset mid bottom

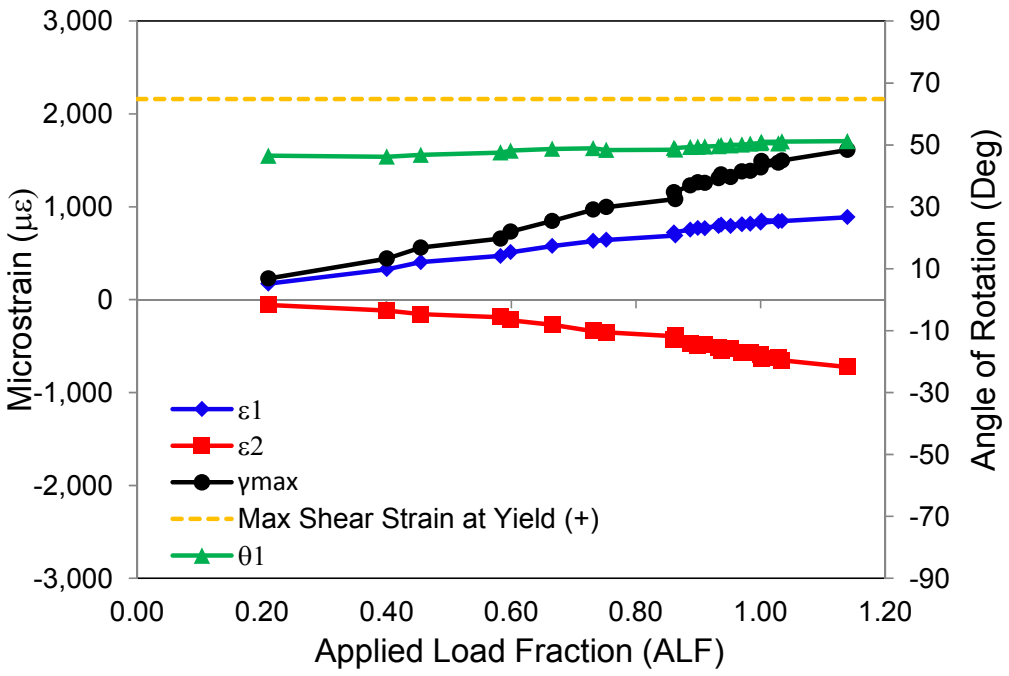

Figure G119. North gusset mid east bottom

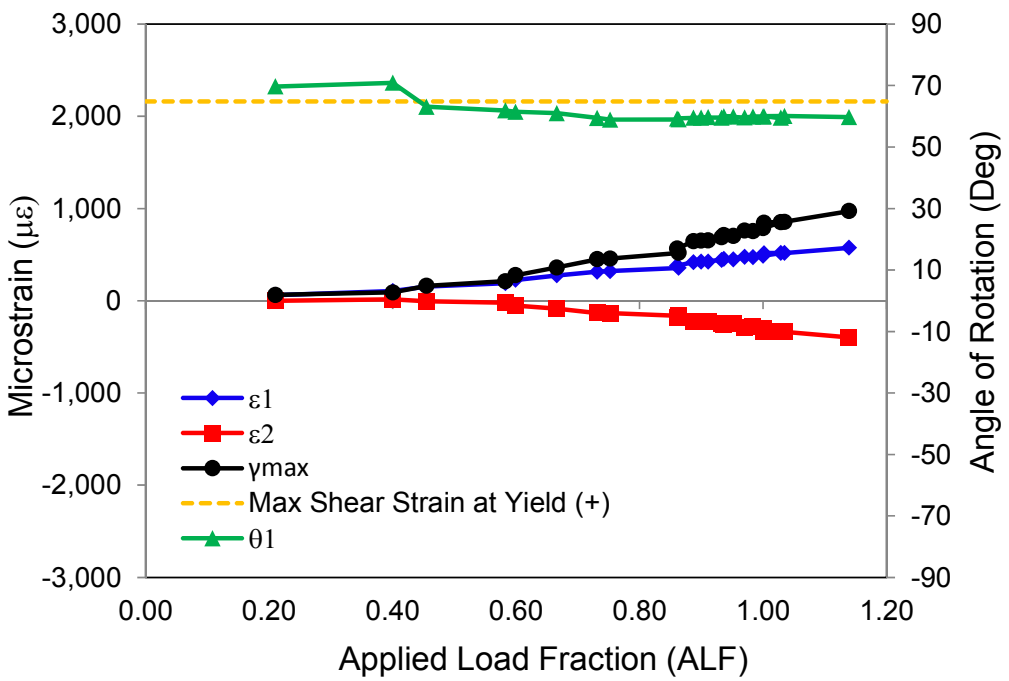

Figure G120. North gusset east bottom

Member Cross-Sectional Plots

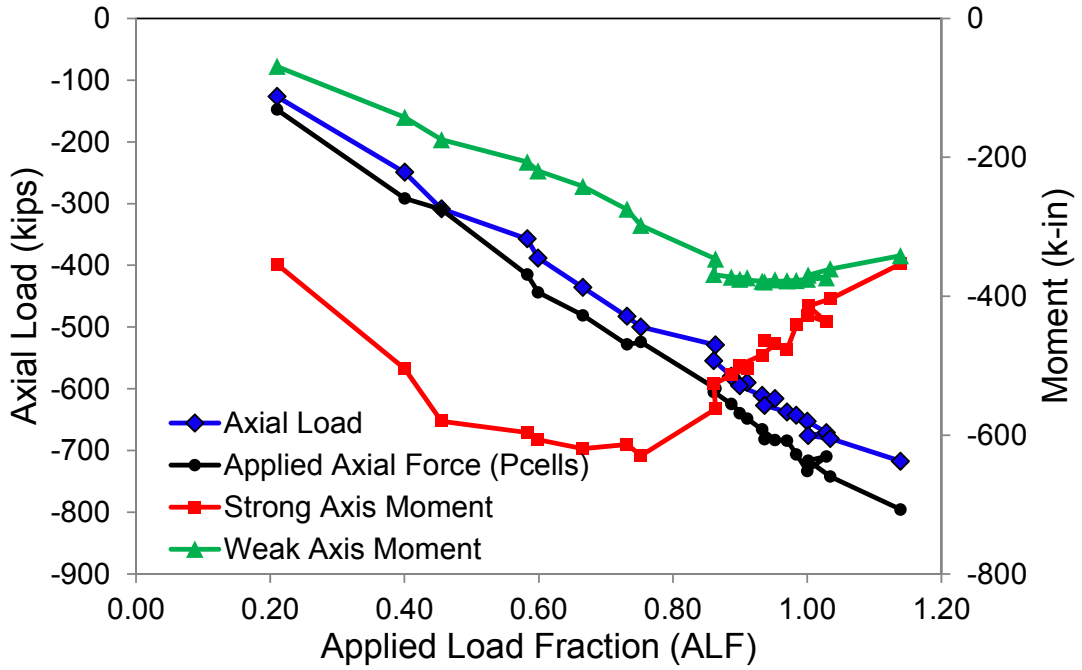

Figure G121. Compression Diagonal

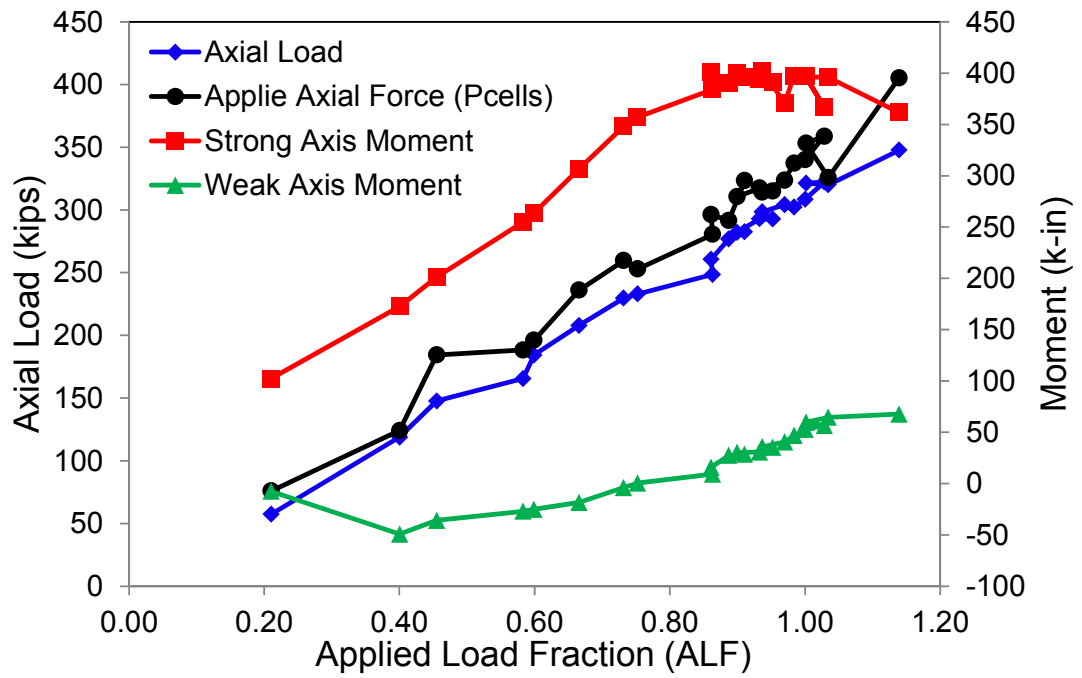

Figure G122. Tension Diagonal

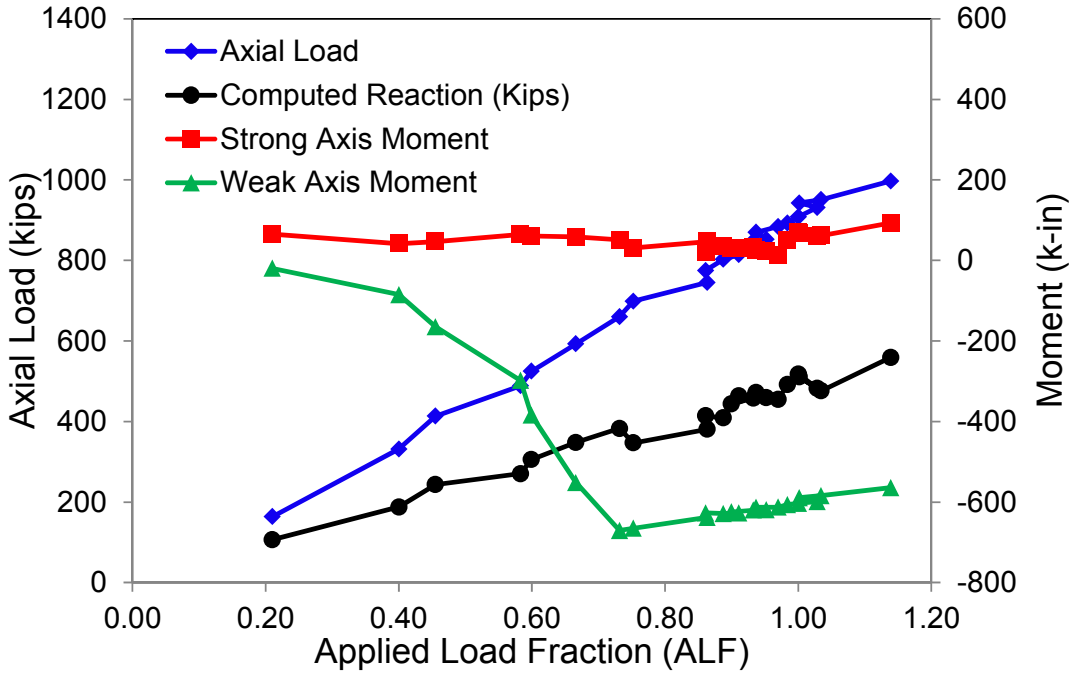

Figure G123. West Chord

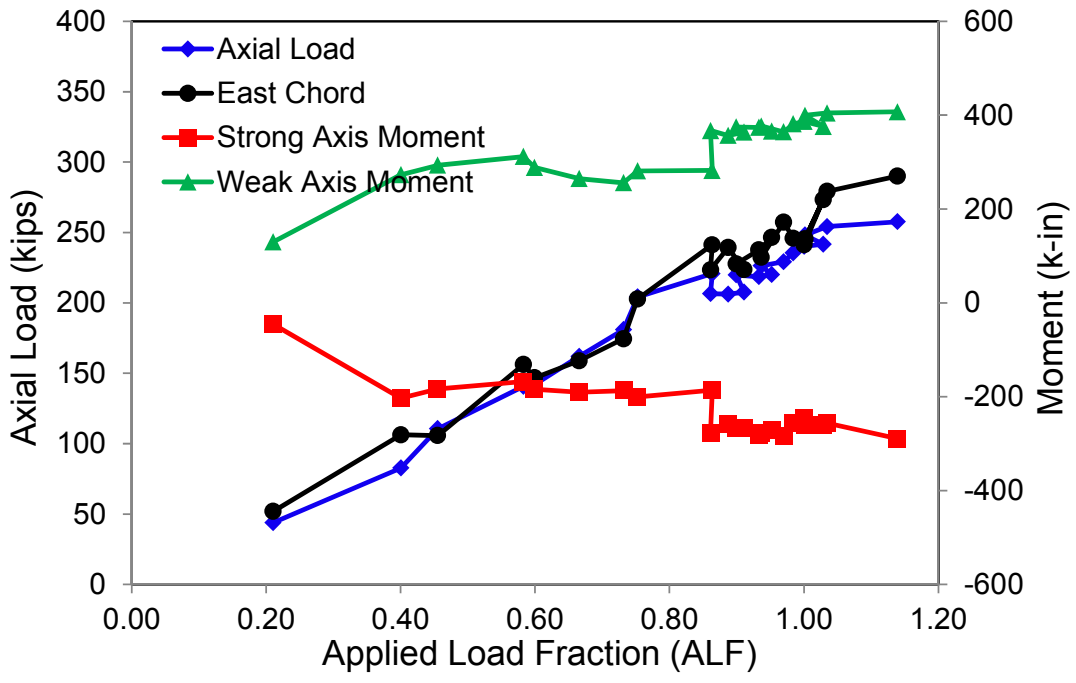

Figure G124. East Chord.

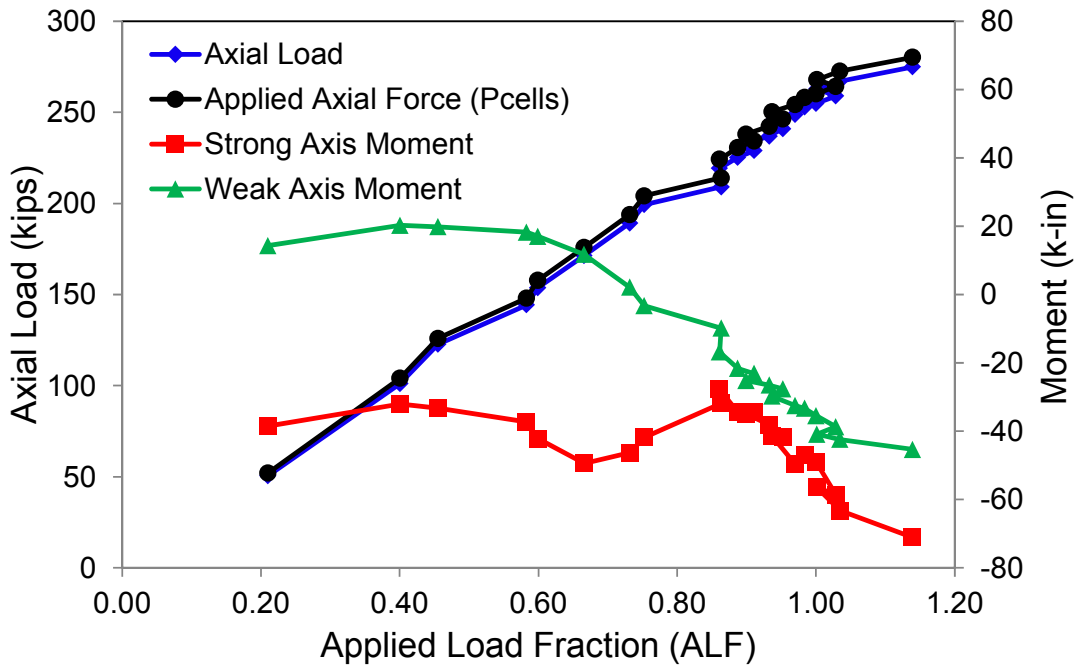

Figure G125. Vertical.

Chord Load Shedding Plots

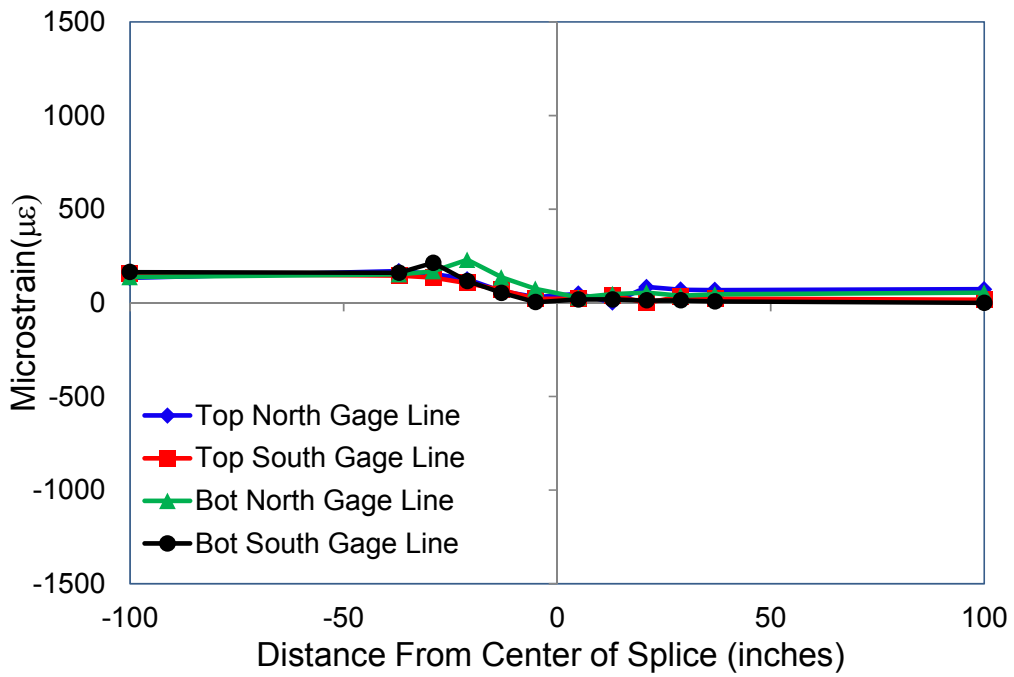

Figure G126. ALF=0.21

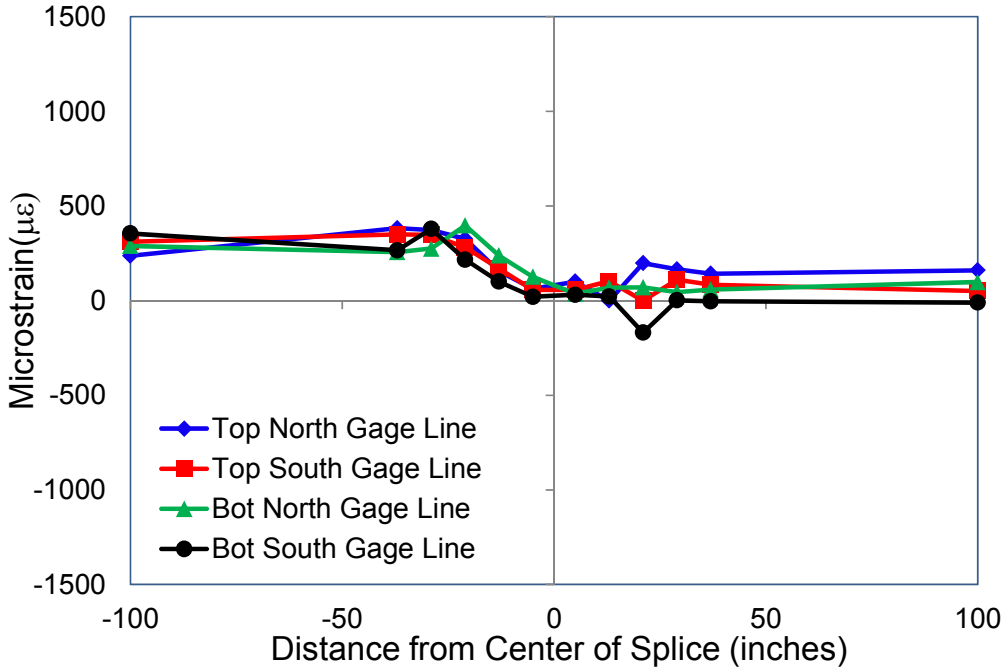

Figure G127. ALF=0.40

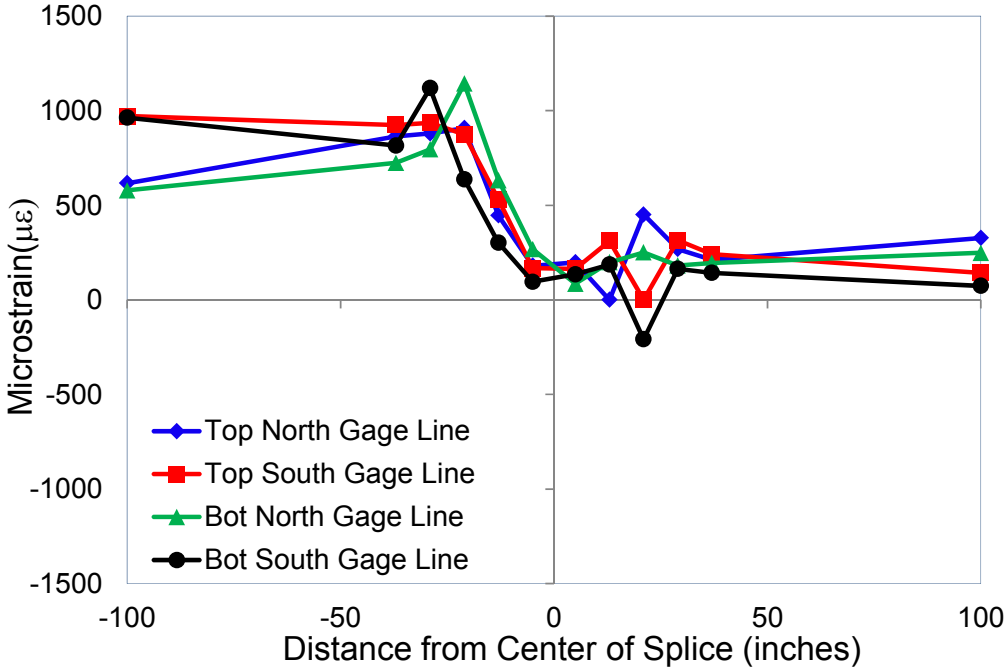

Figure G128. ALF=0.98

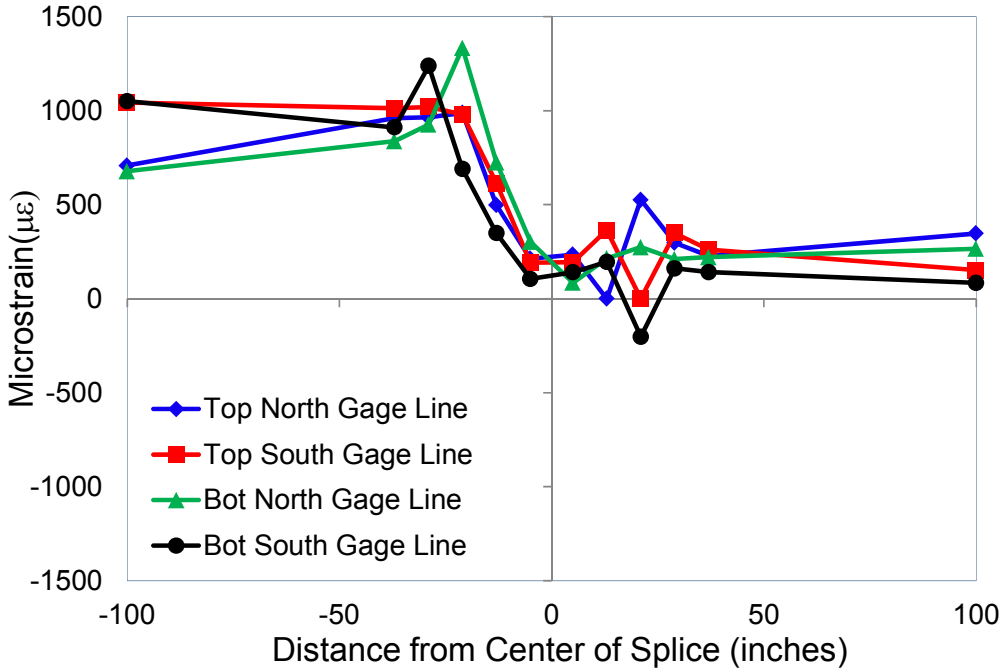

Figure G129. Max ALF=1.14

Uniaxial Gauge Plots

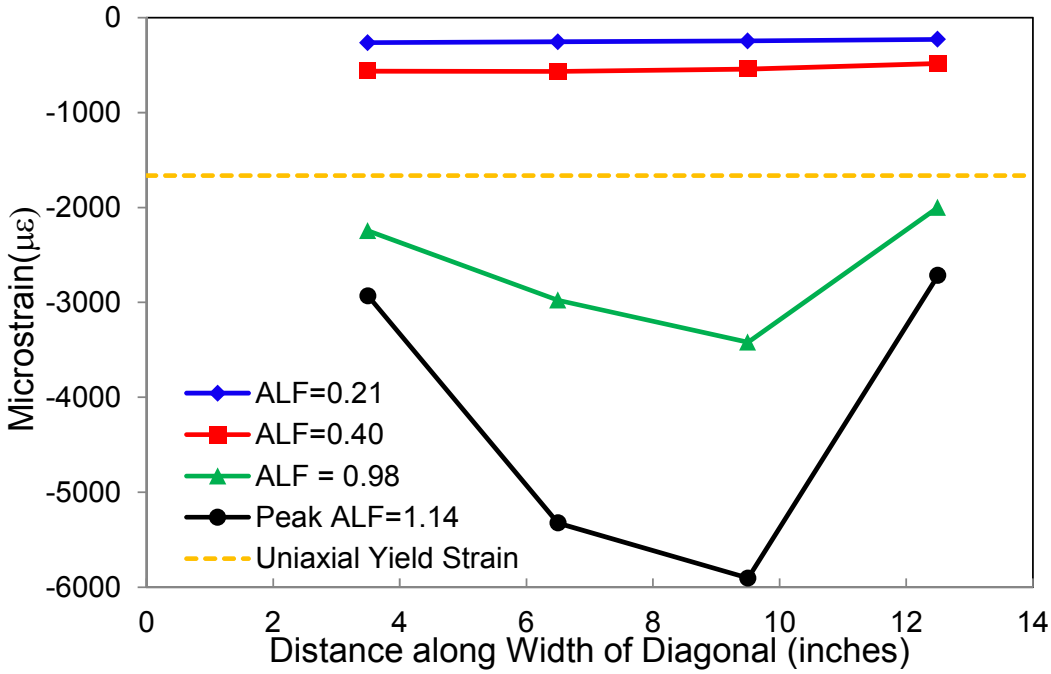

Figure G130. North Compression Diagonal

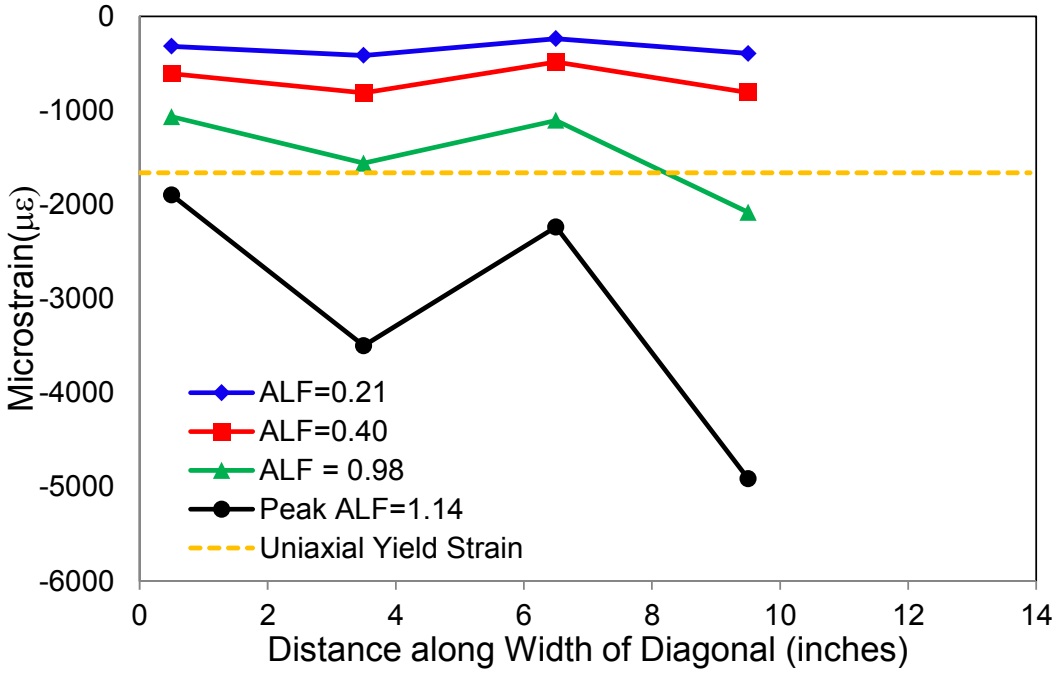

Figure G131. South Compression Diagonal

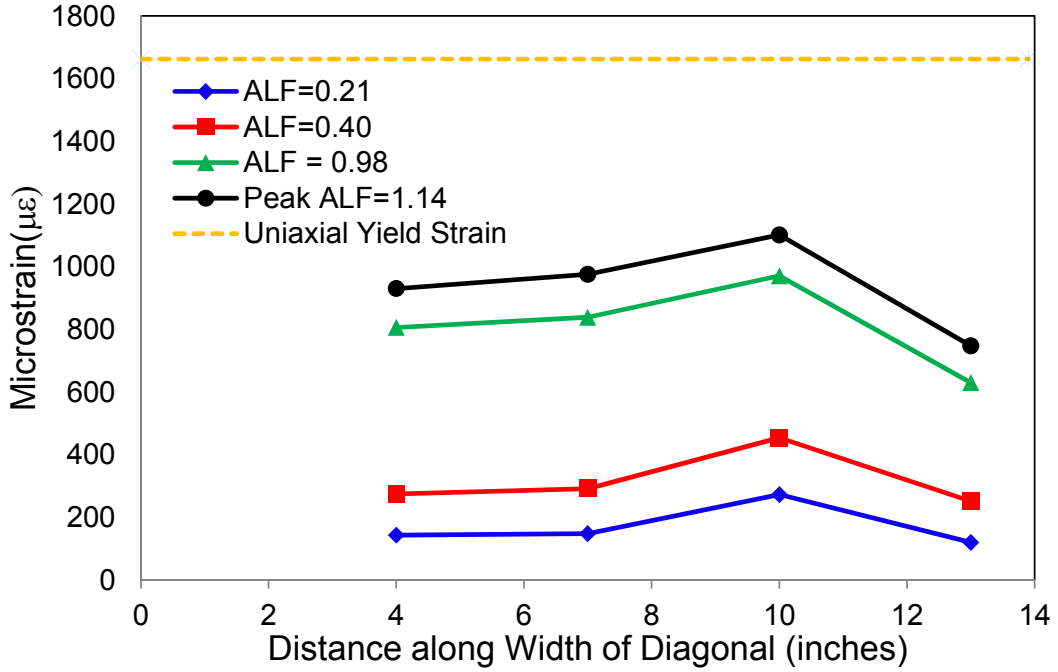

Figure G132. North Tension Diagonal

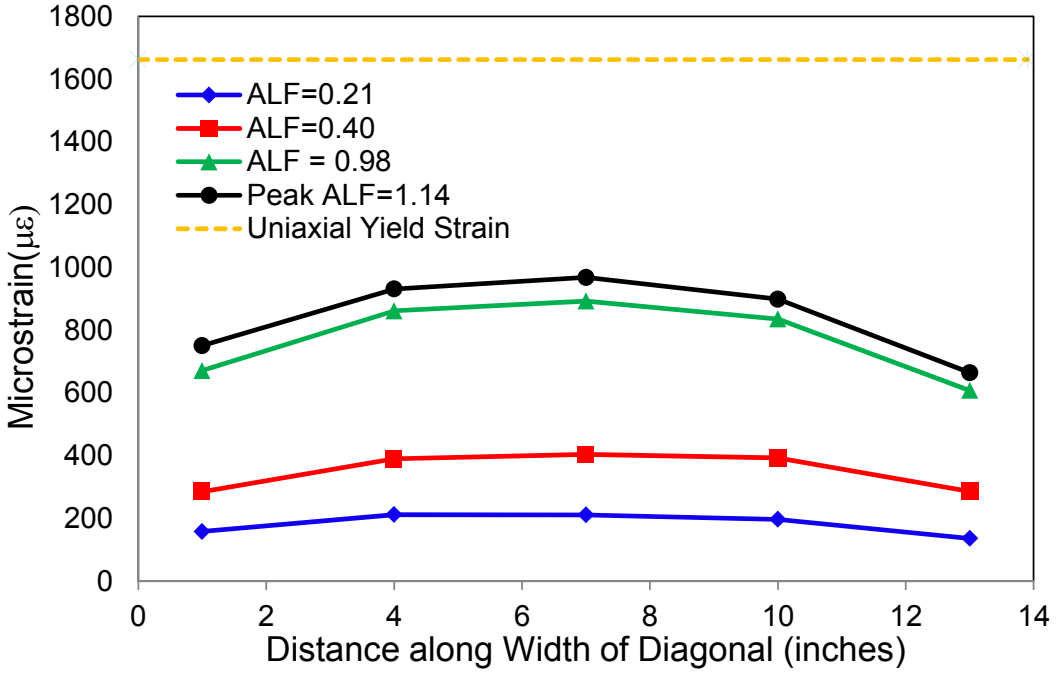

Figure G133. South Tension Diagonal

SPECIMEN 307SL3

Maximum Shear Strain Plots

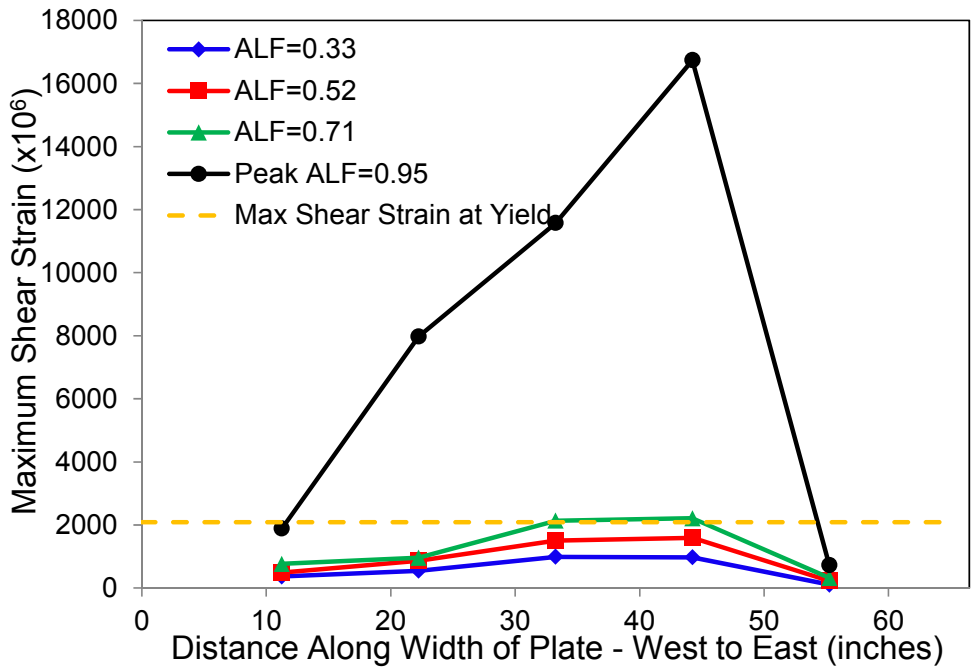

Figure G134. Horizontal line of rosettes above chord; south gusset plate

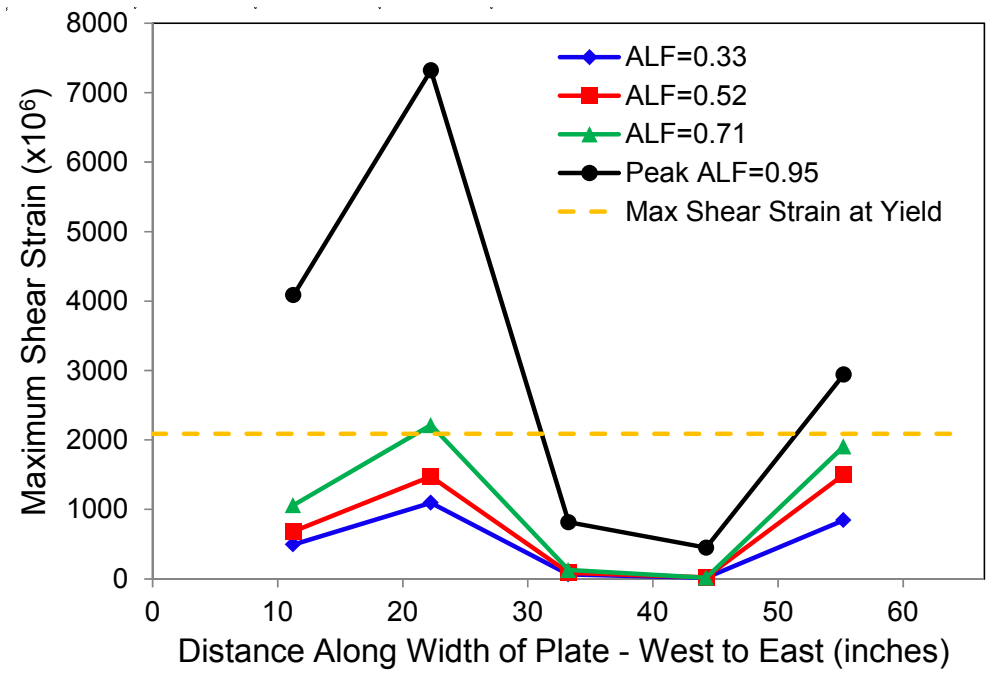

Figure G135. Horizontal line of rosettes above chord; north gusset plate

Variations in Principal Strain

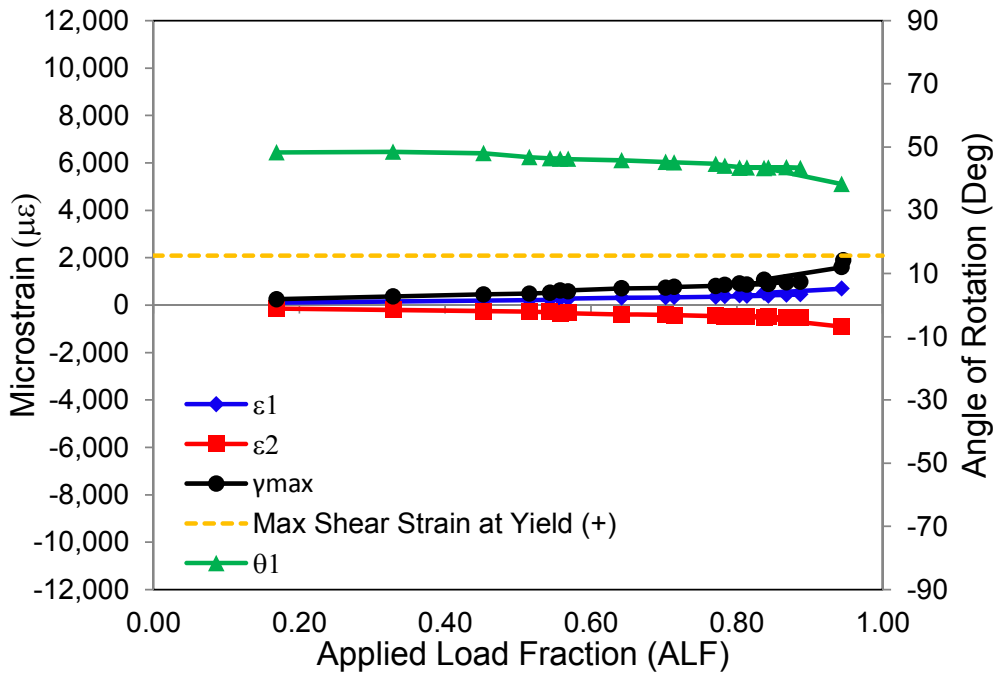

Figure G136. South gusset west bottom

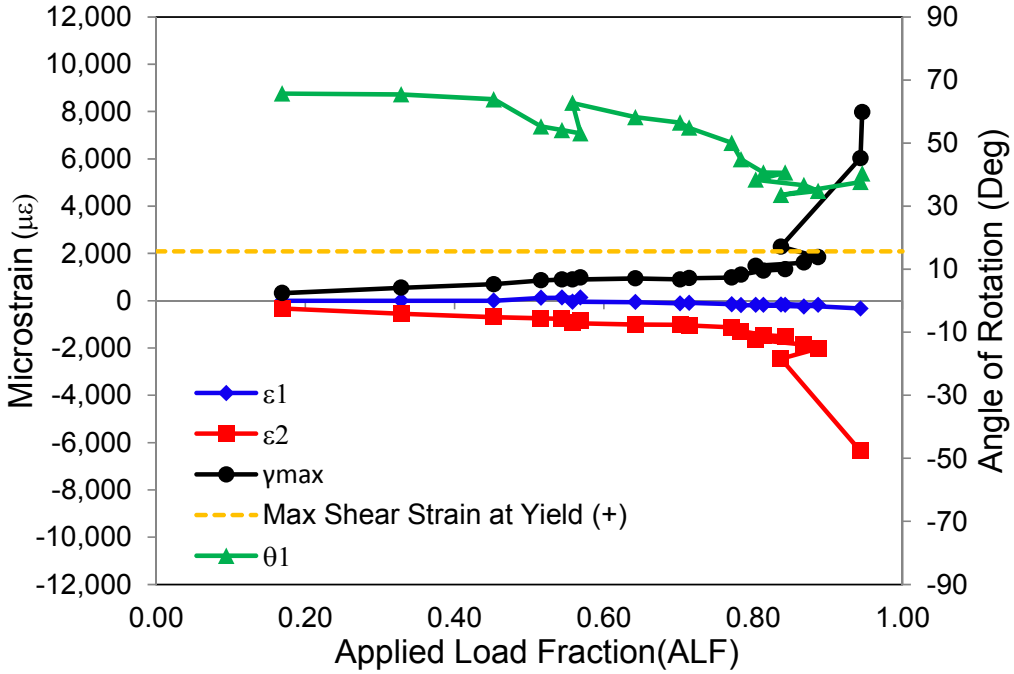

Figure G137. South gusset west mid bottom

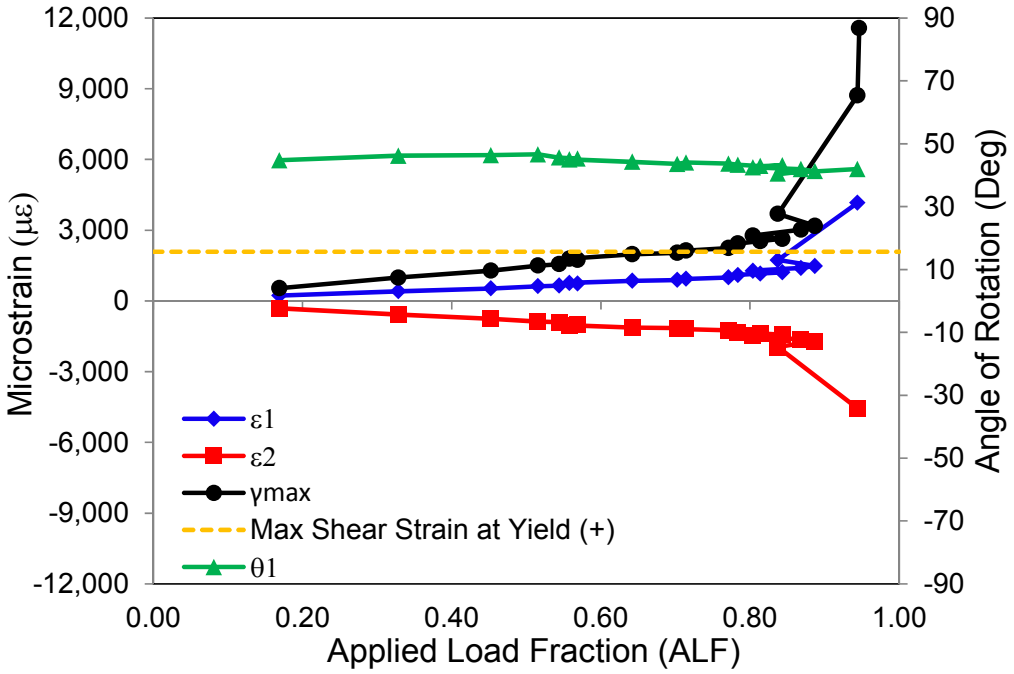

Figure G138. South gusset mid bottom

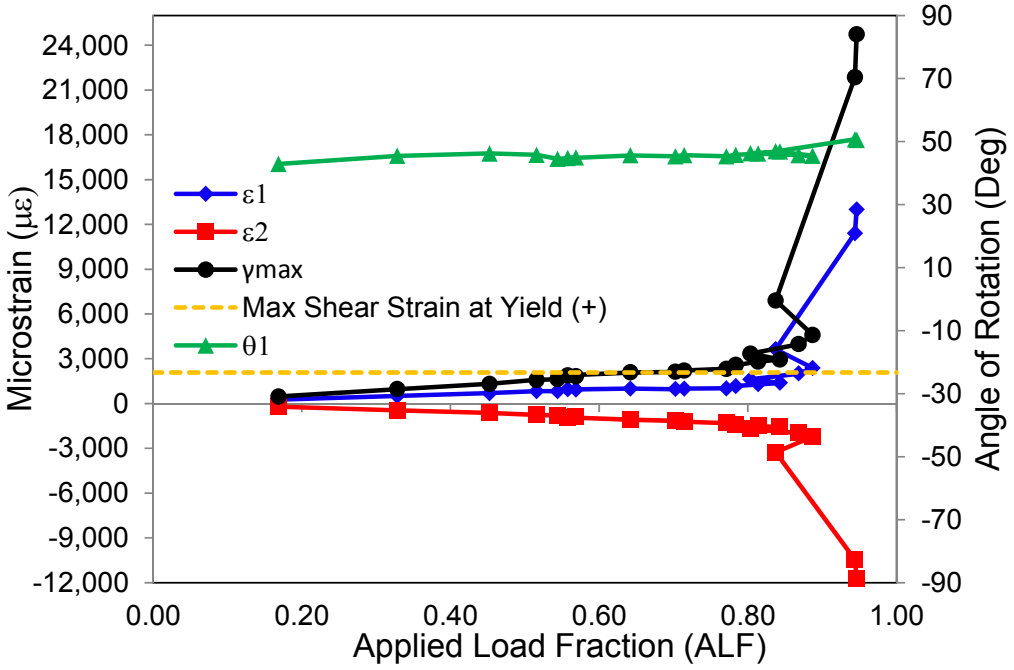

Figure G139. South gusset east mid bottom

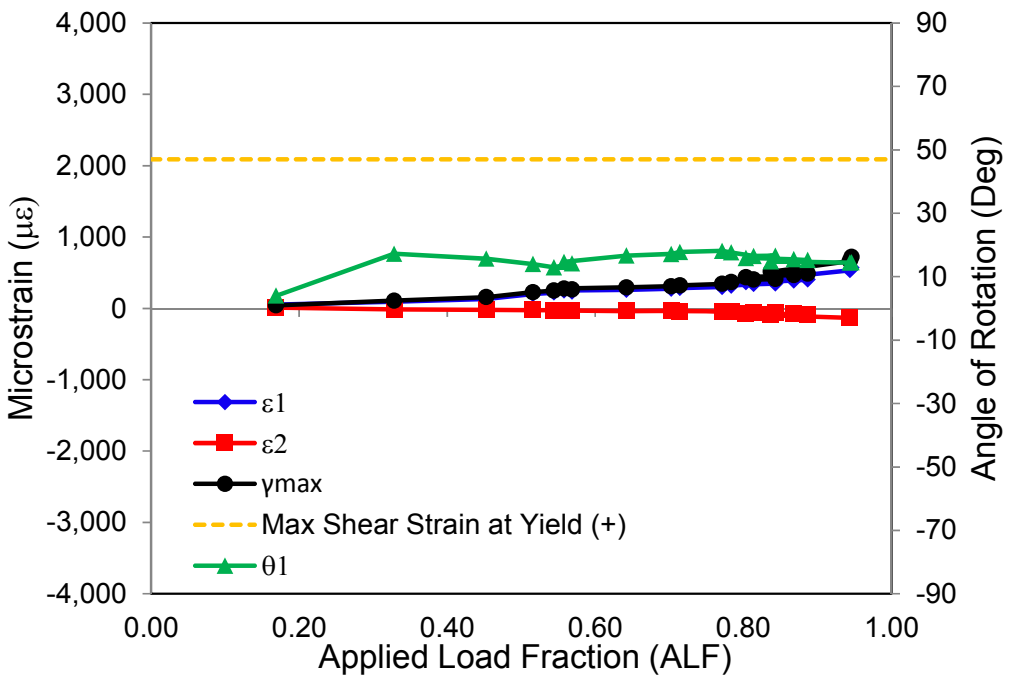

Figure G140. South gusset east bottom

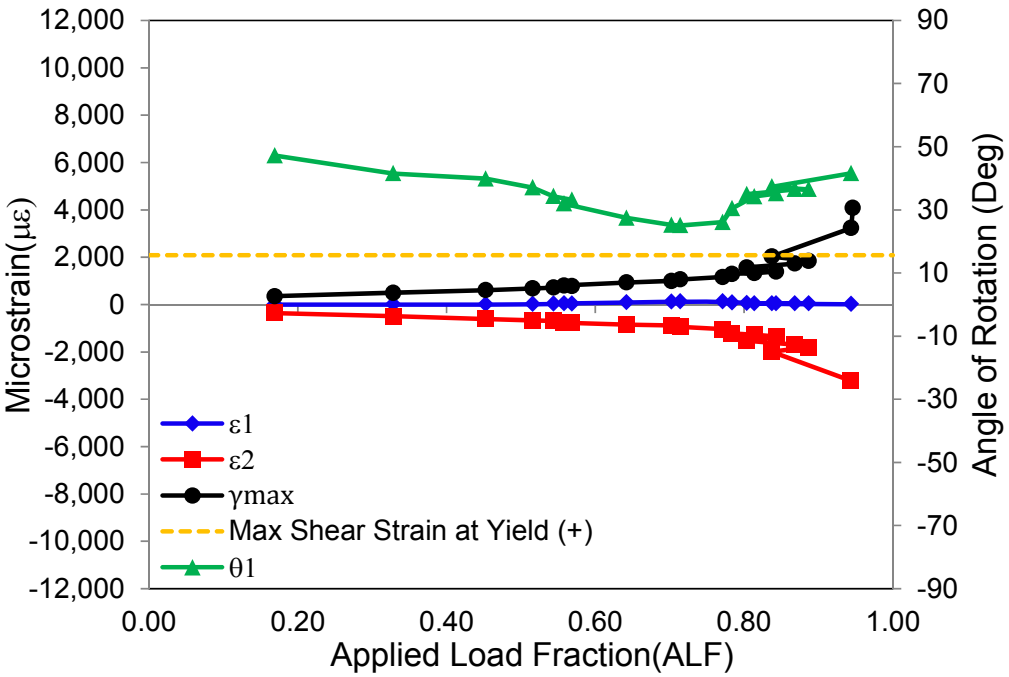

Figure G141. North gusset west bottom

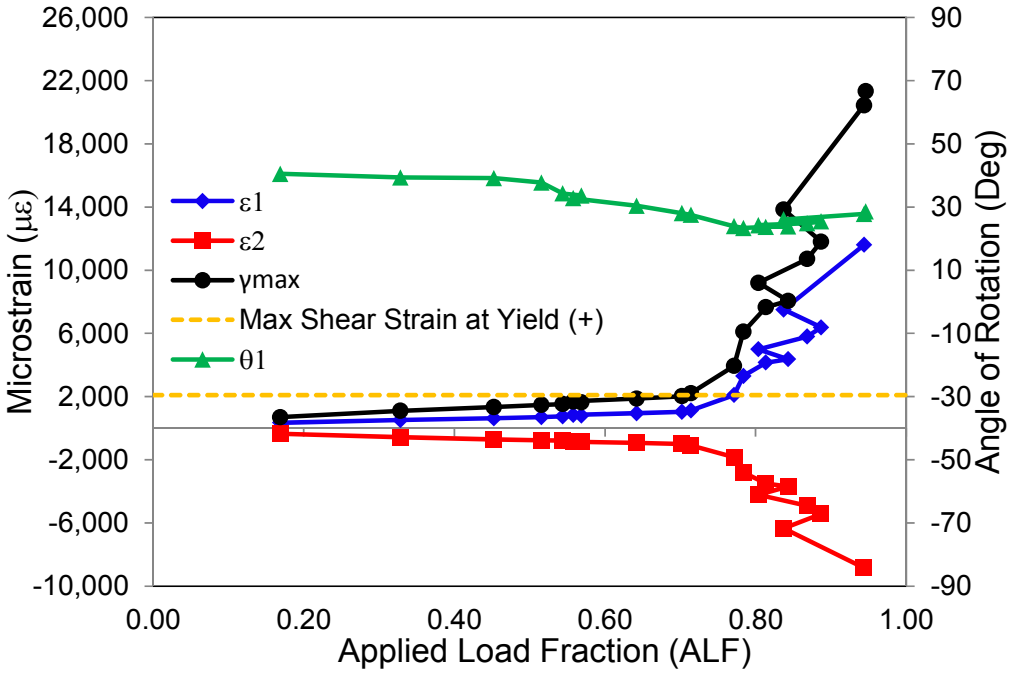

Figure G142. North gusset west mid bottom

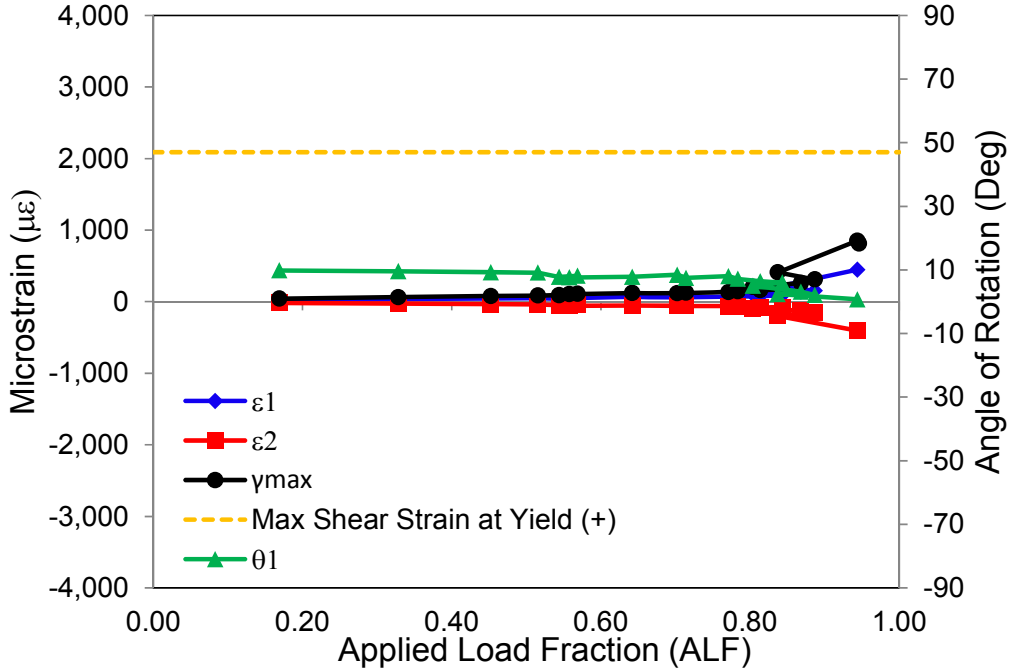

Figure G143. North gusset mid bottom

DEAD GAUGE

Figure G144. North gusset mid east bottom

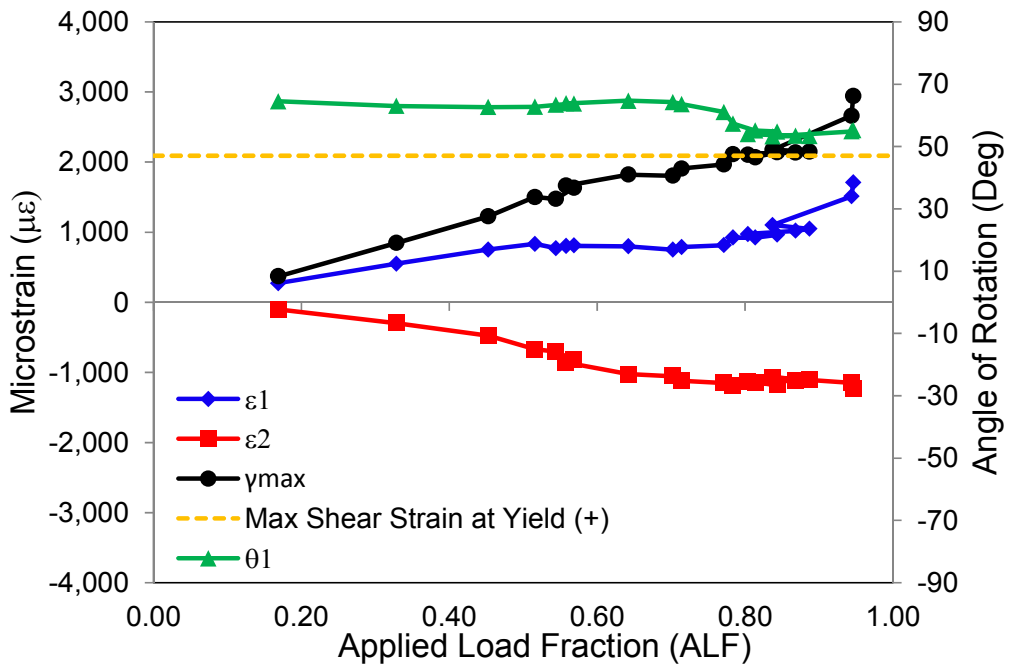

Figure G145. North gusset east bottom

Member Cross-Sectional Plots

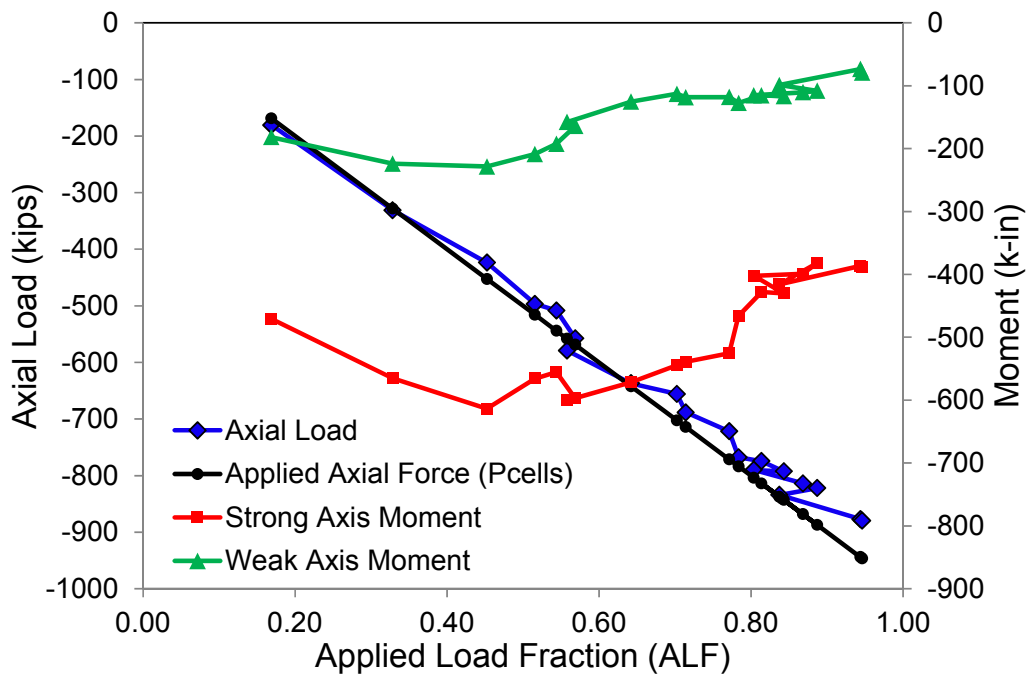

Figure G146. Compression Diagonal

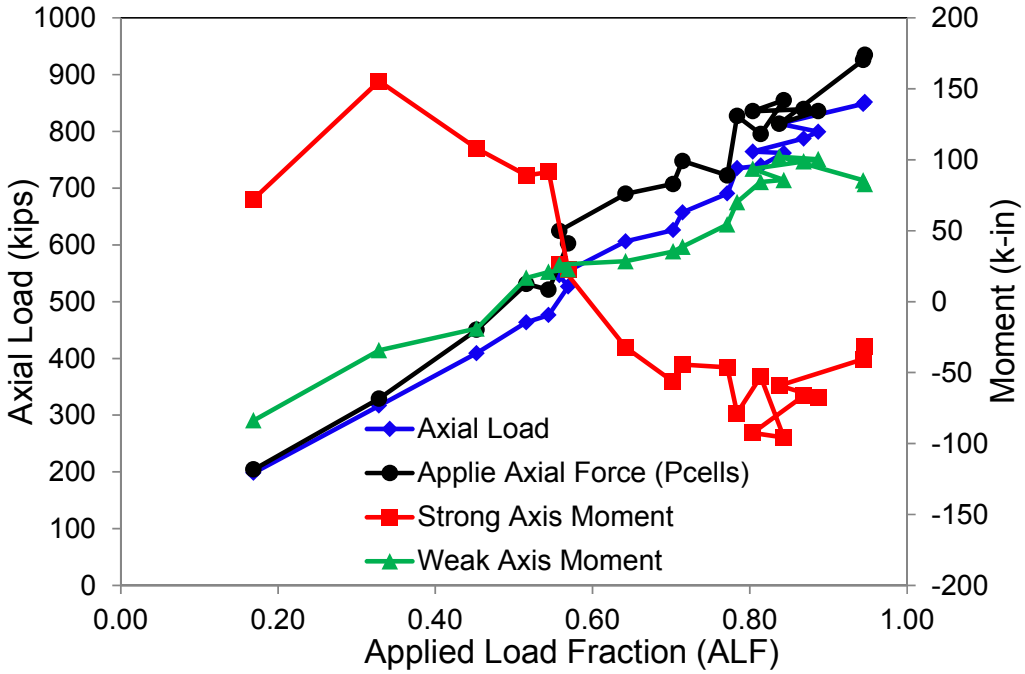

Figure G147. Tension Diagonal

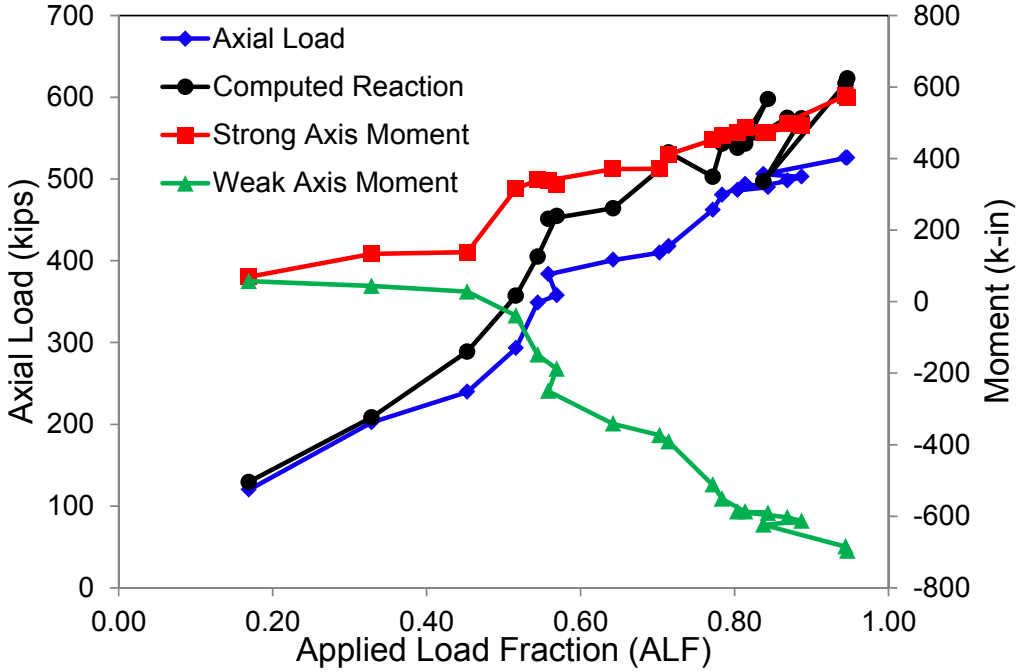

Figure G148. West Chord

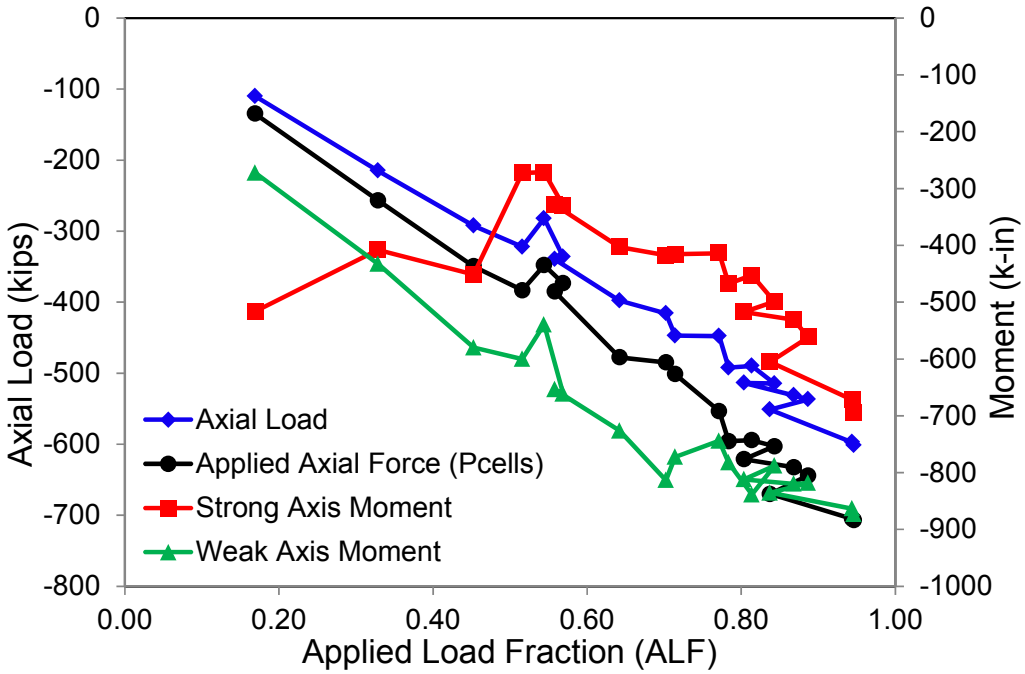

Figure G149. East Chord.

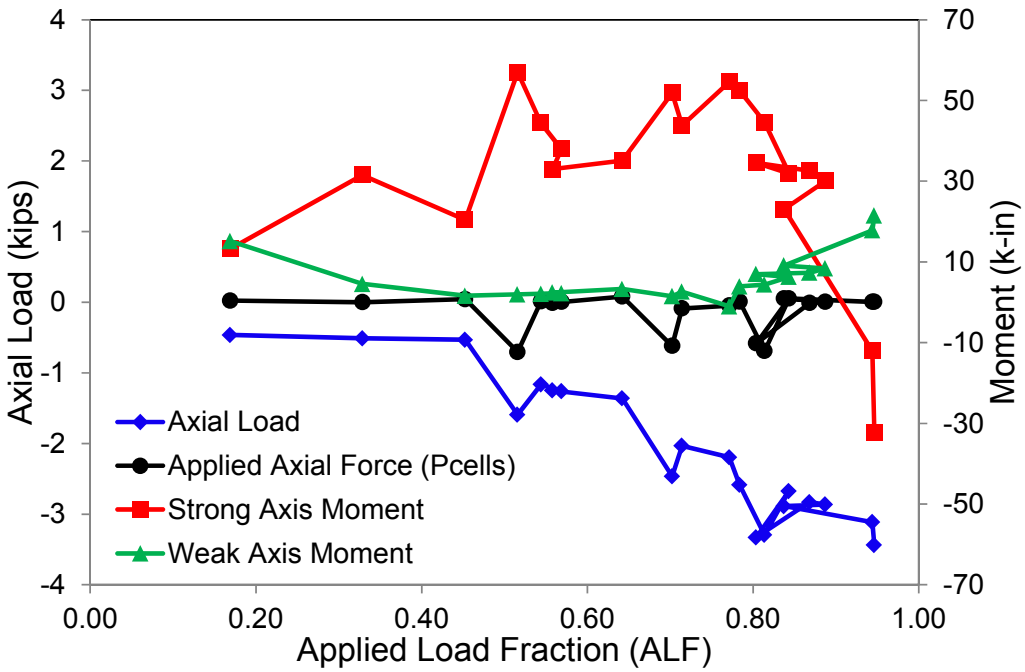

Figure G150. Vertical.

Chord Load Shedding Plots

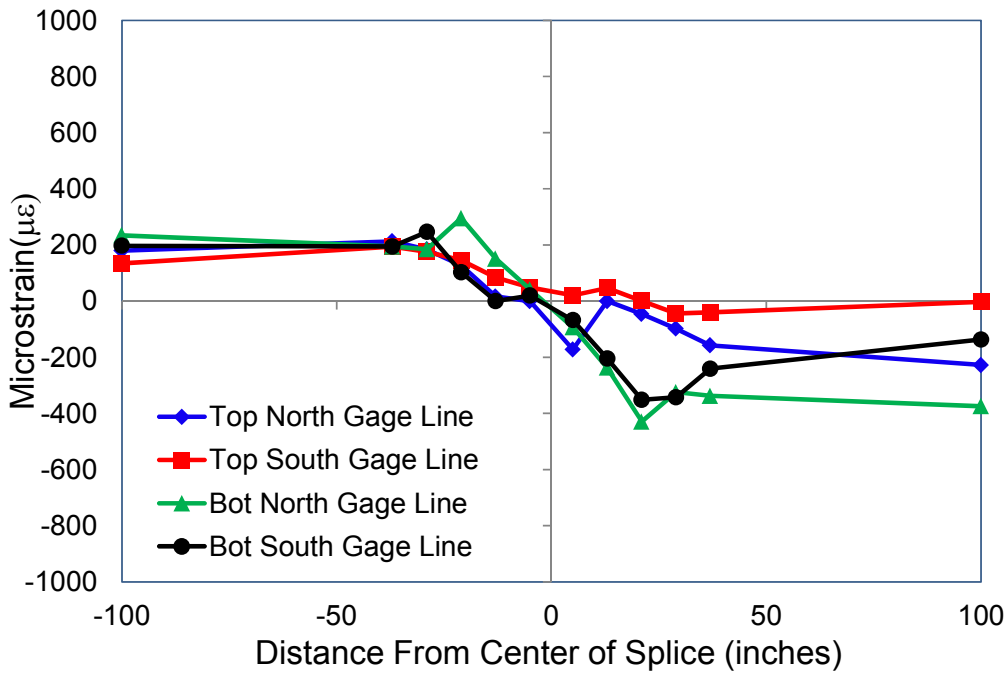

Figure G151. ALF=0.33

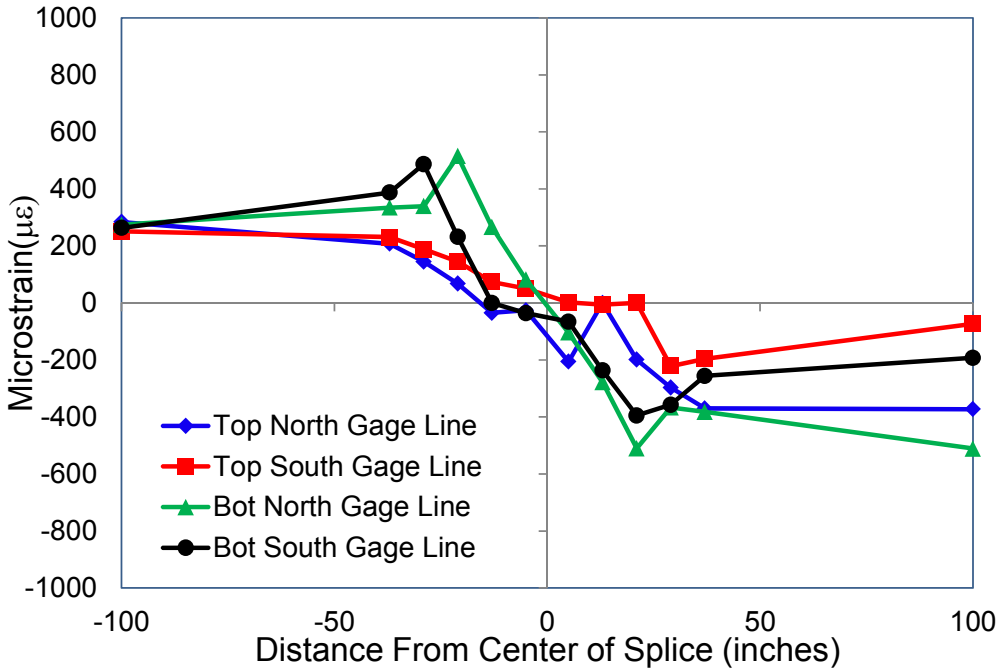

Figure G152. ALF=0.52

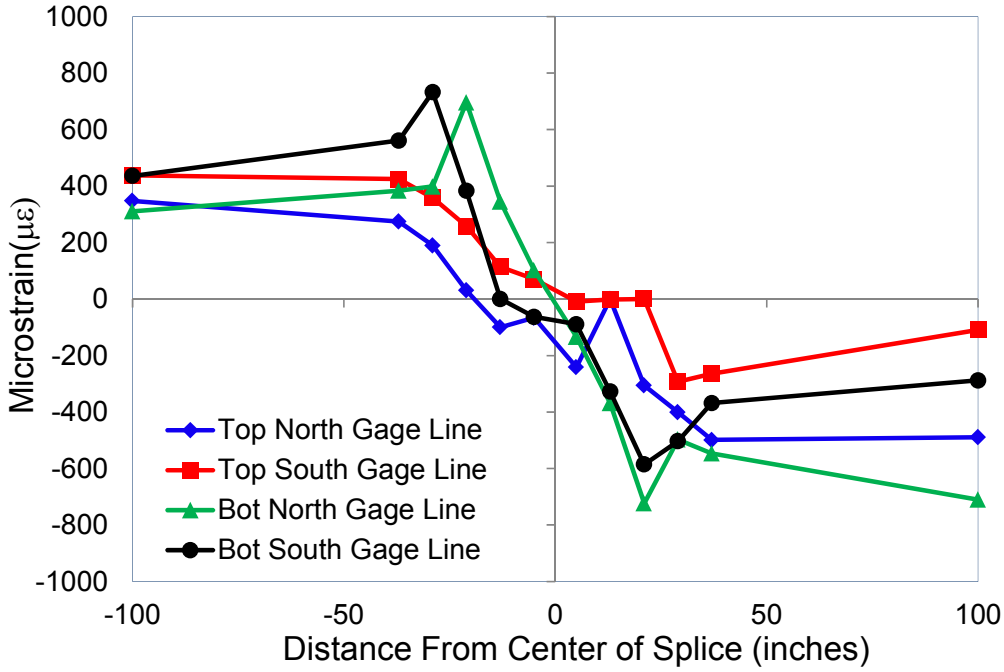

Figure G153. ALF=0.71

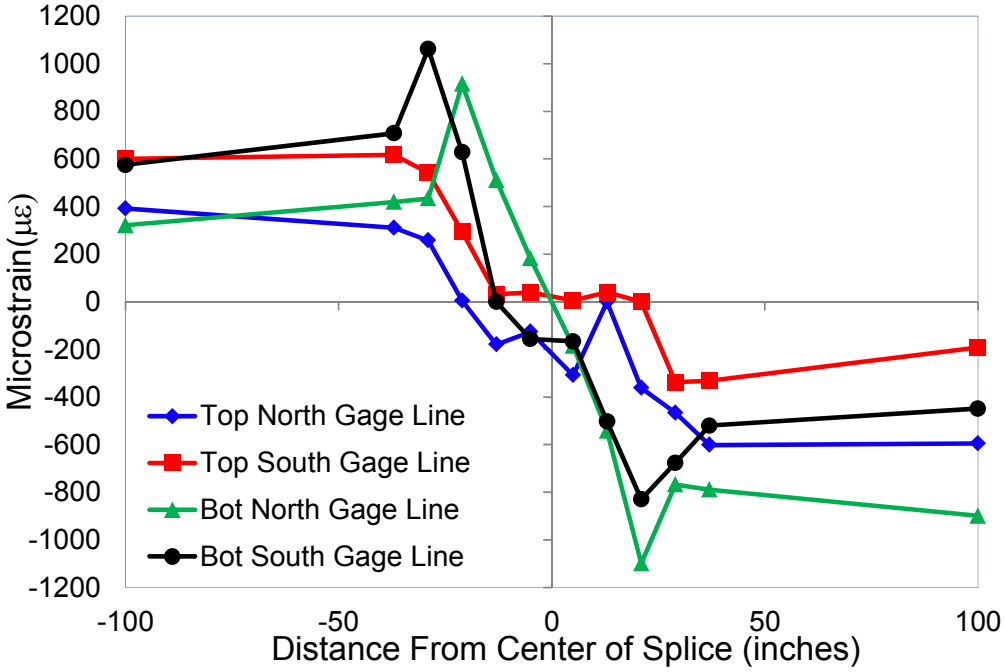

Figure G154. Max ALF=0.95

Uniaxial Gauge Plots

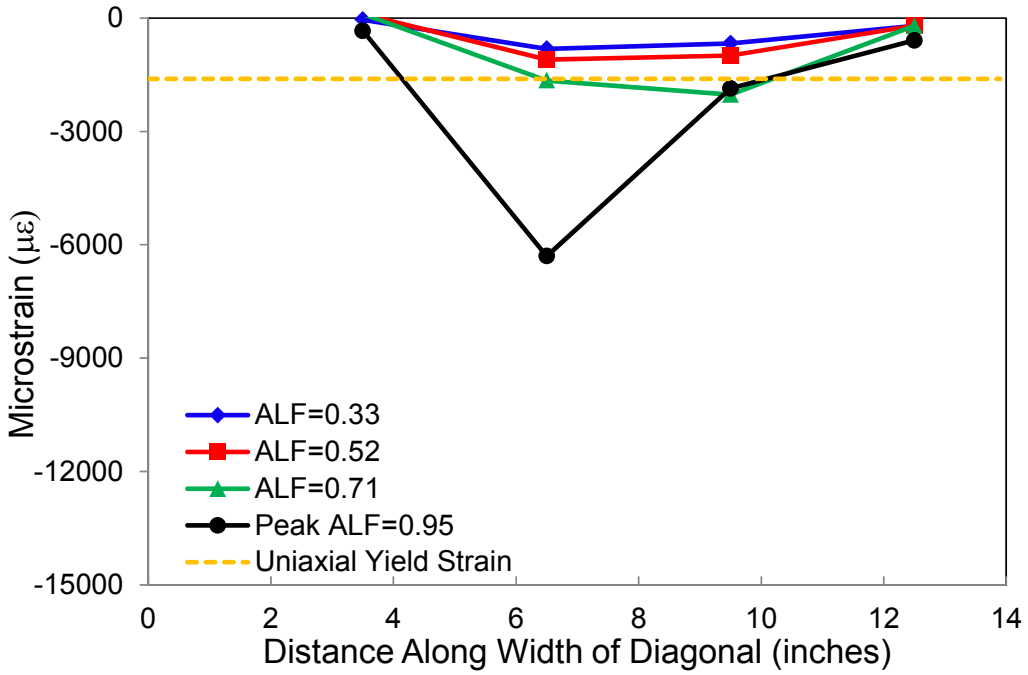

Figure G155. North Compression Diagonal

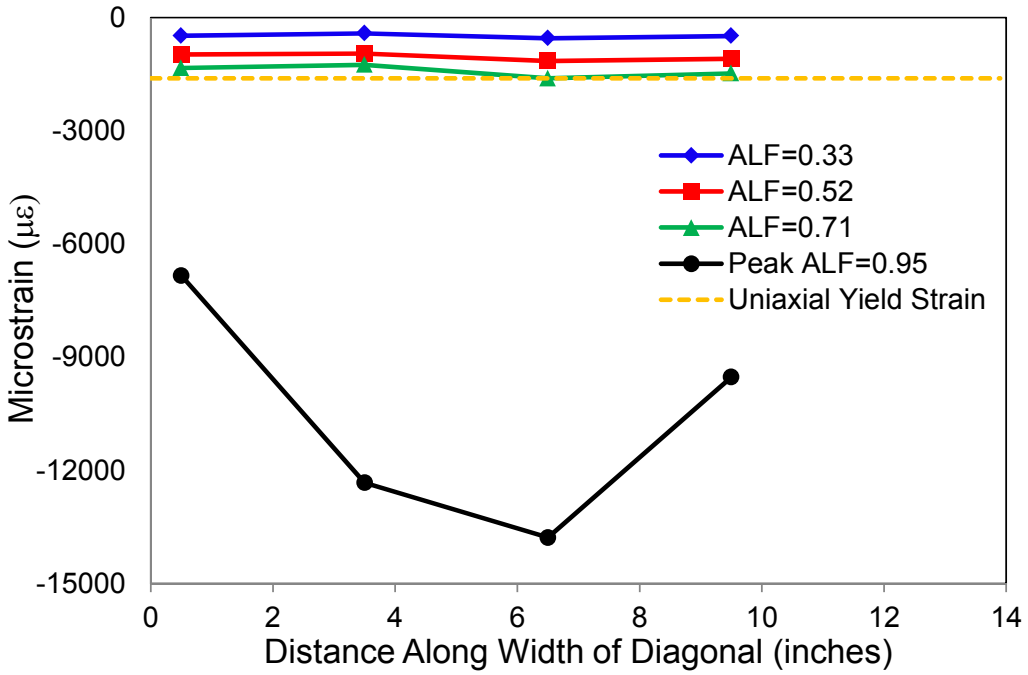

Figure G156. South Compression Diagonal

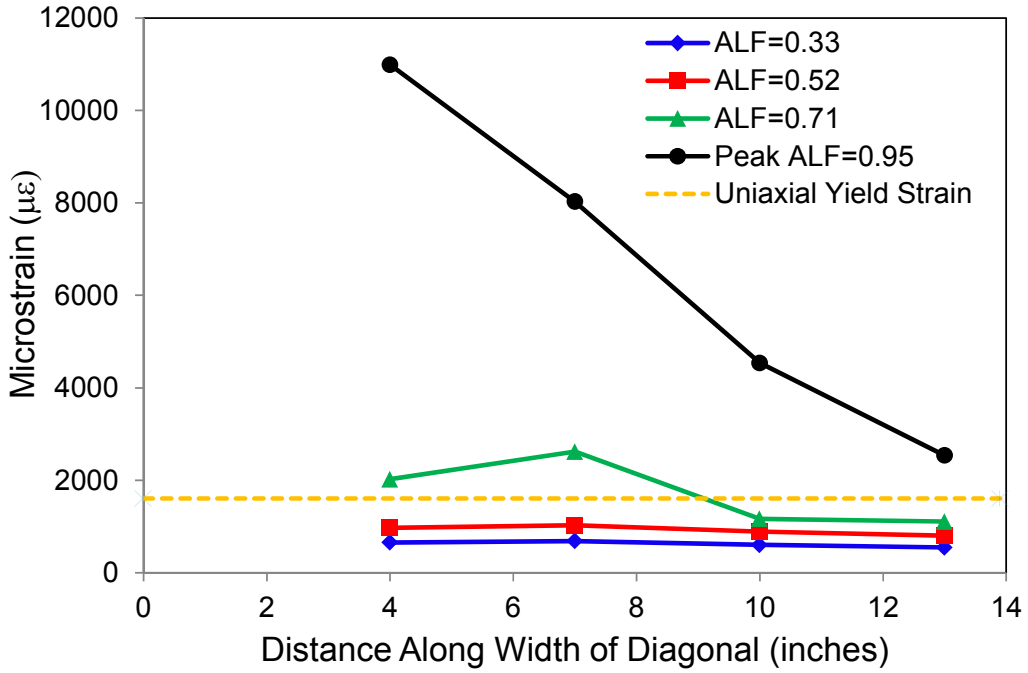

Figure G157. North Tension Diagonal

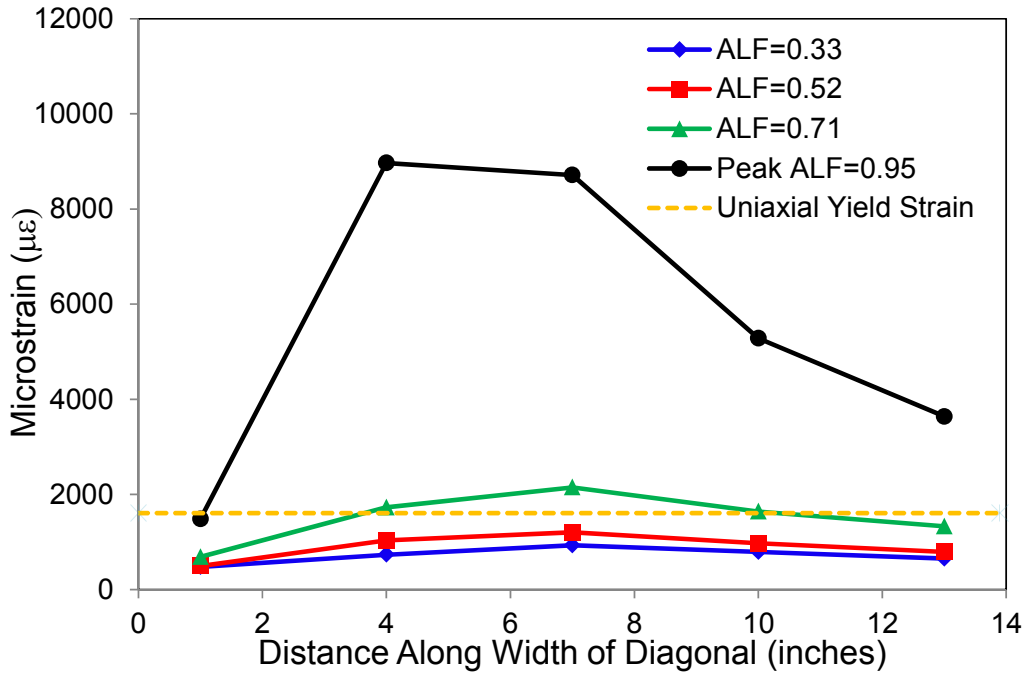

Figure G158. South Tension Diagonal

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Maximum Shear Strain Plots

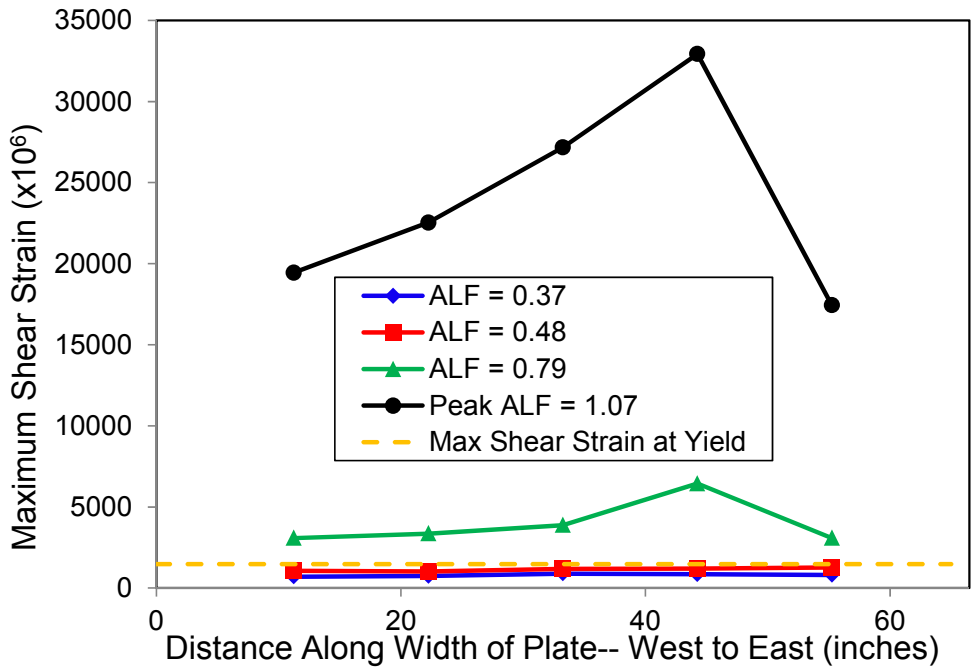

Figure G159. Horizontal line of rosettes above chord; south gusset plate

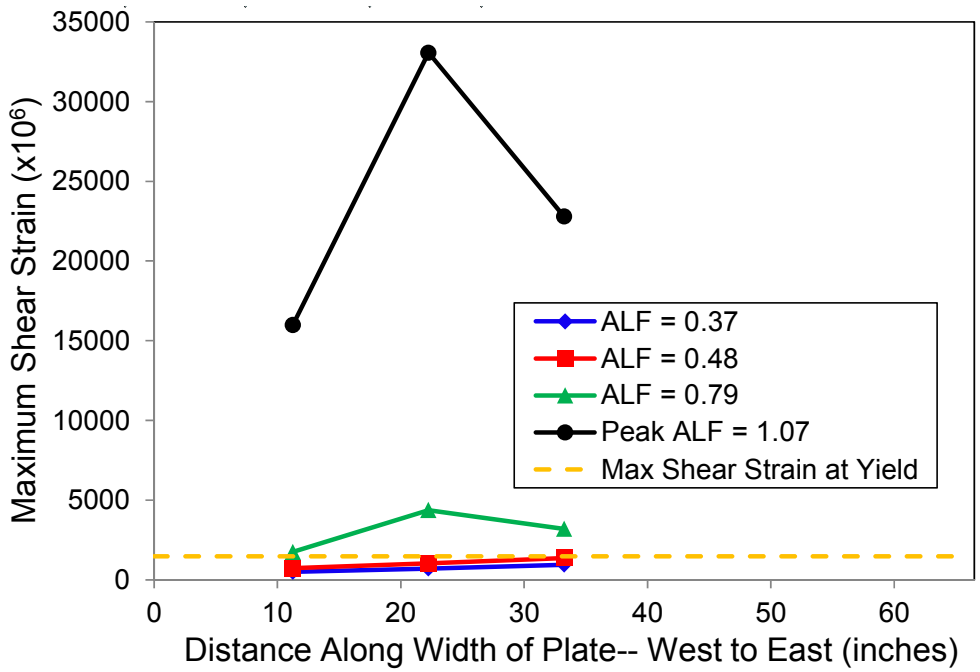

Figure G160. Horizontal line of rosettes above chord; north gusset plate

Variations in Principal Strain

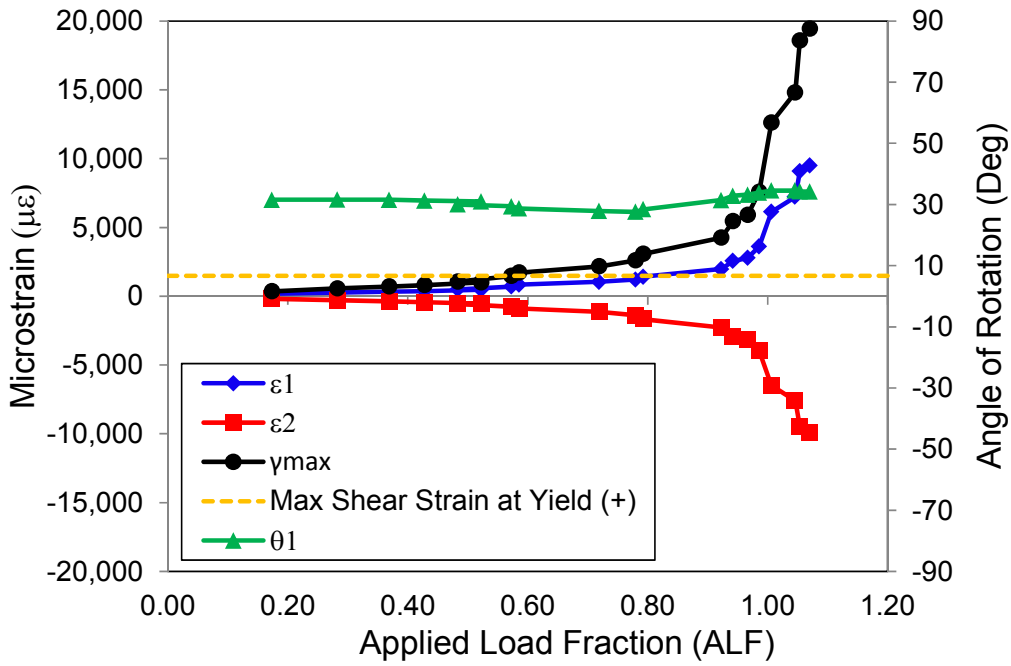

Figure G161. South gusset west bottom

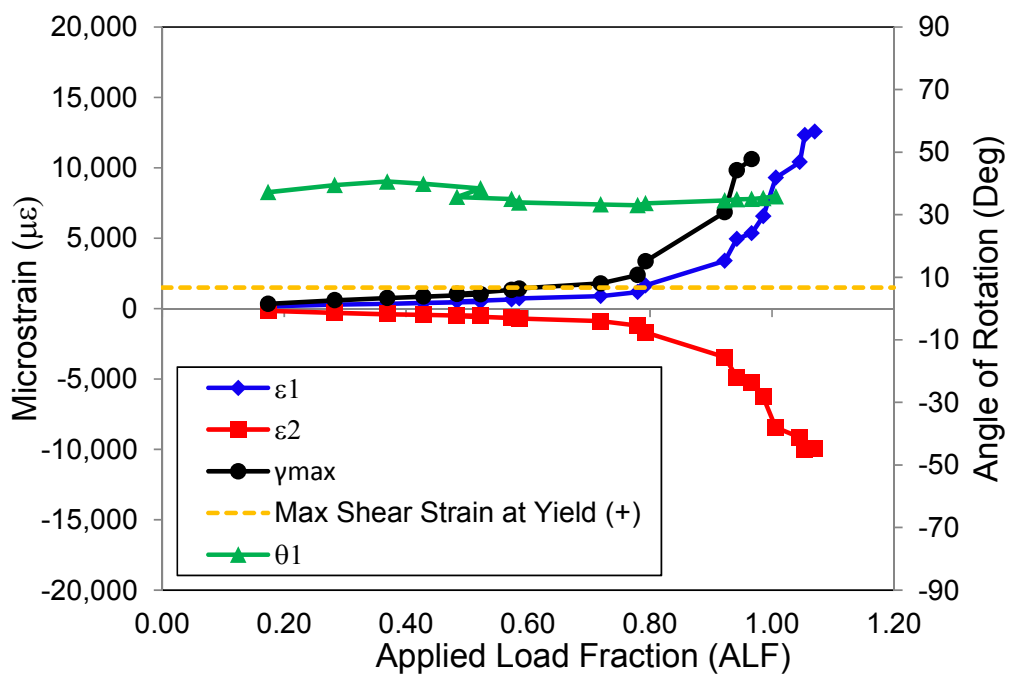

Figure G162. South gusset west mid bottom

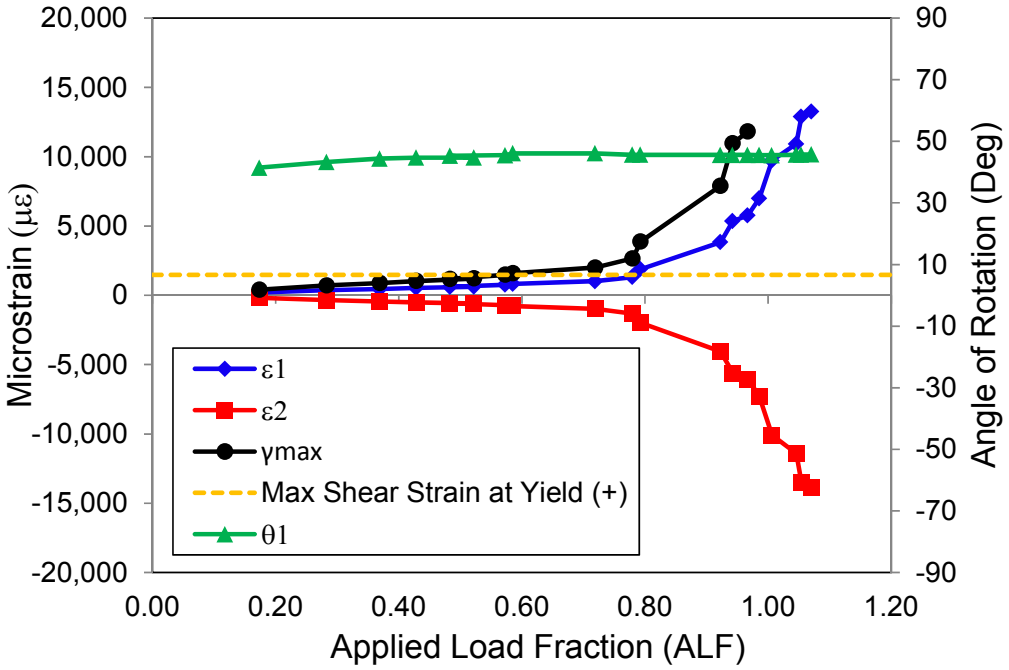

Figure G163. South gusset mid bottom

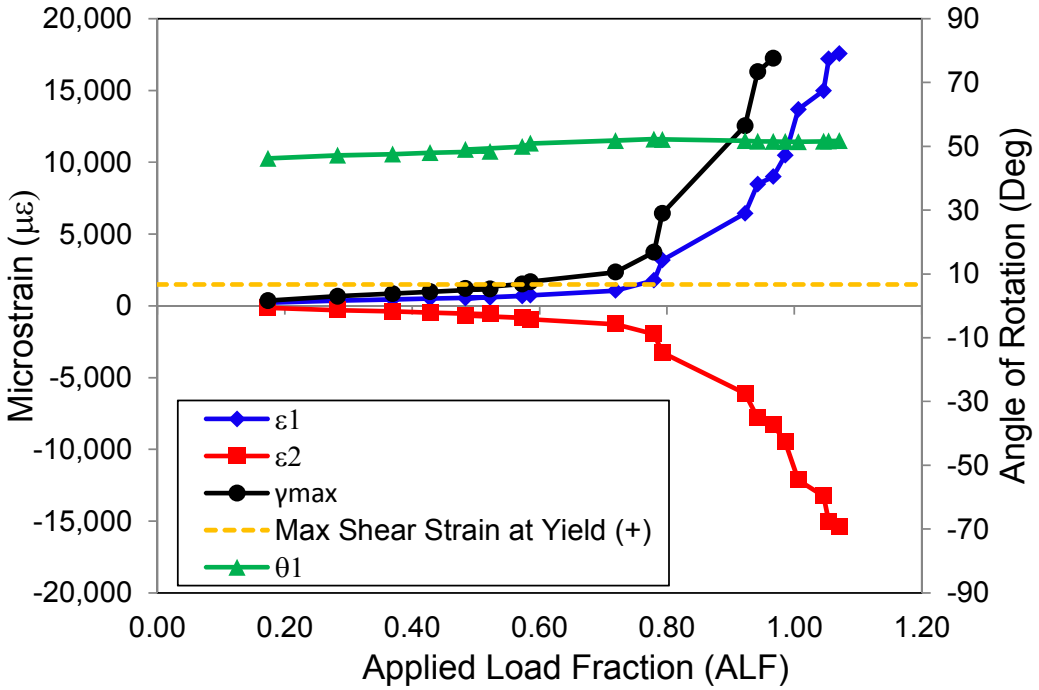

Figure G164. South gusset east mid bottom

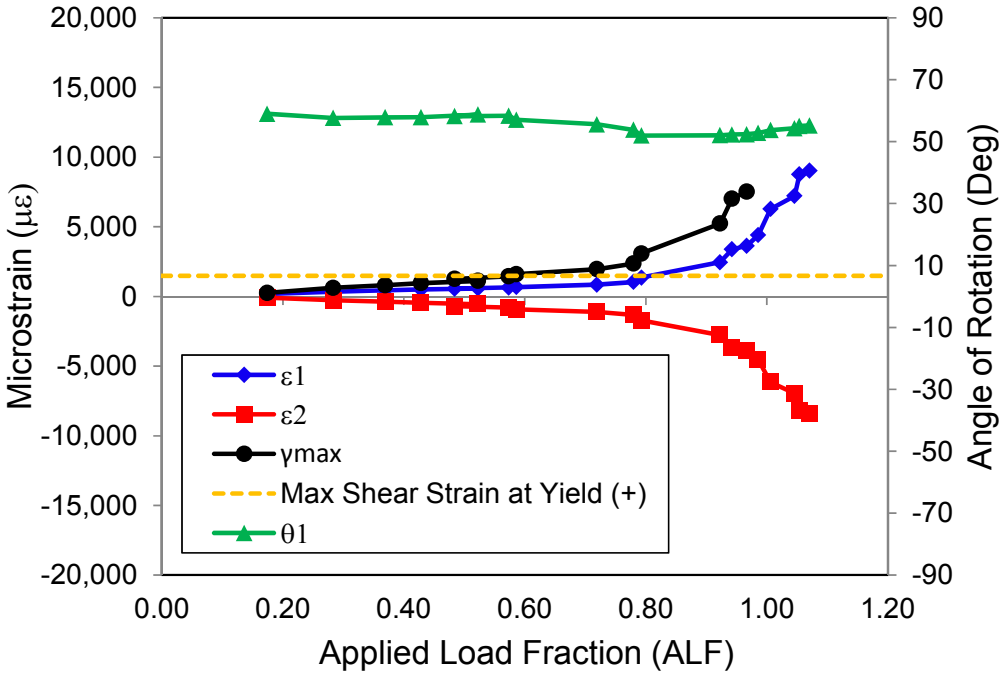

Figure G165. South gusset east bottom

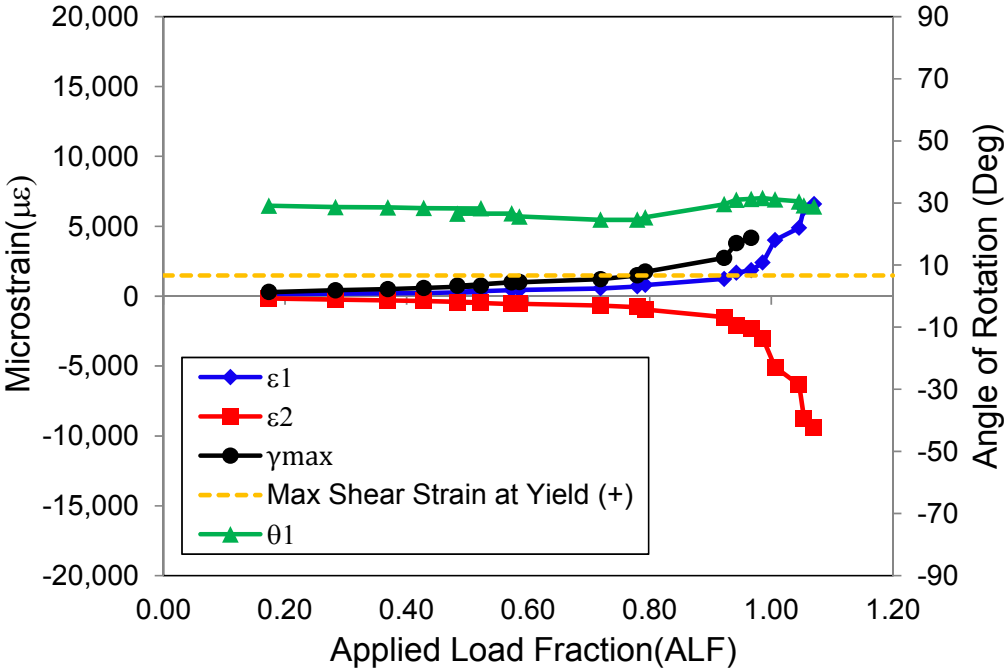

Figure G166. North gusset west bottom

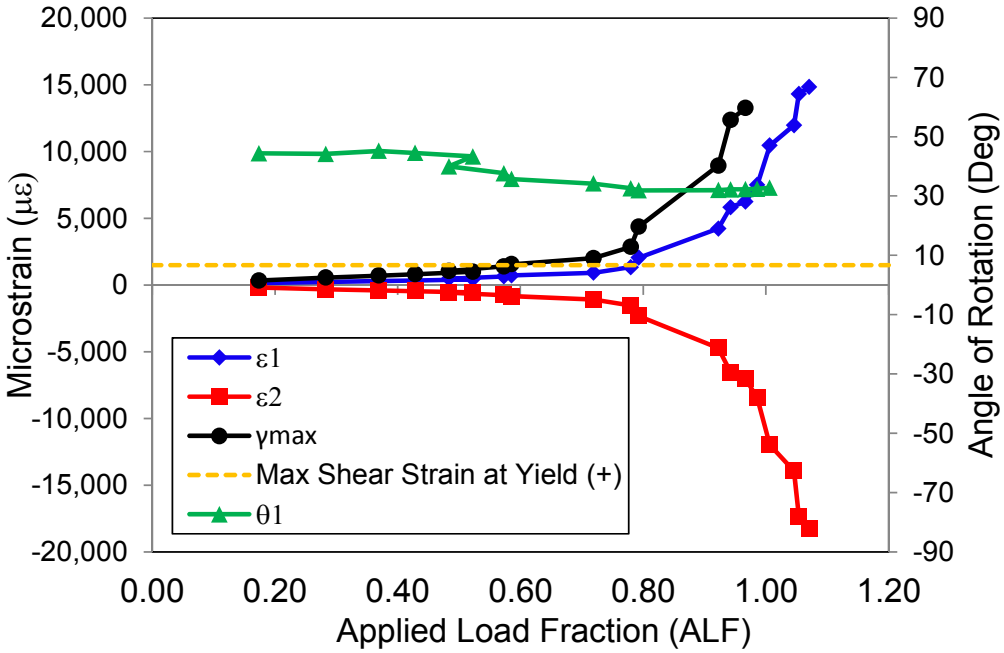

Figure G167. North gusset west mid bottom

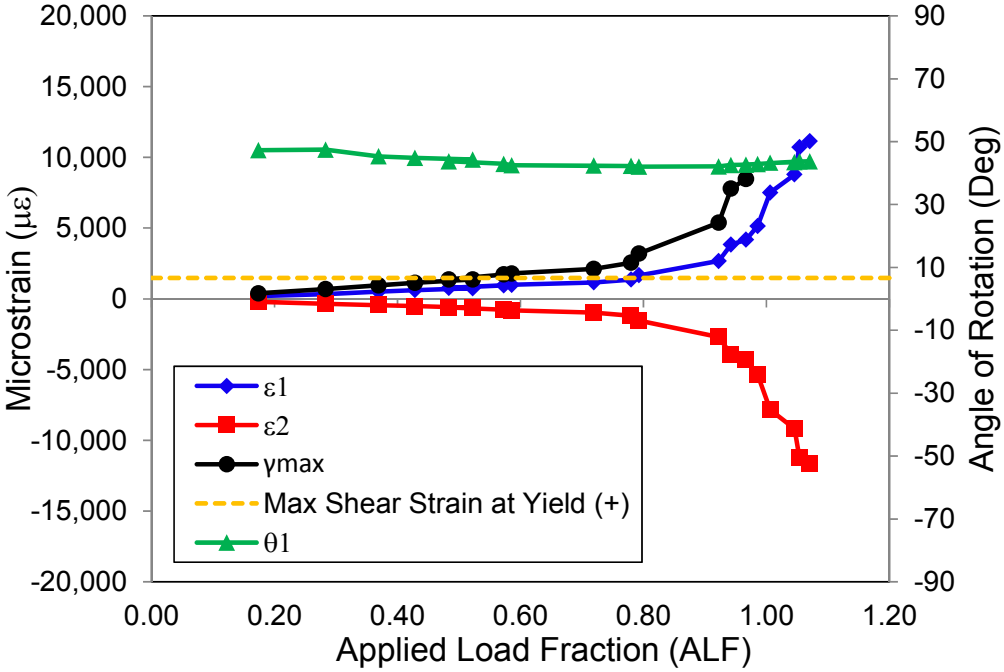

Figure G168. North gusset mid bottom

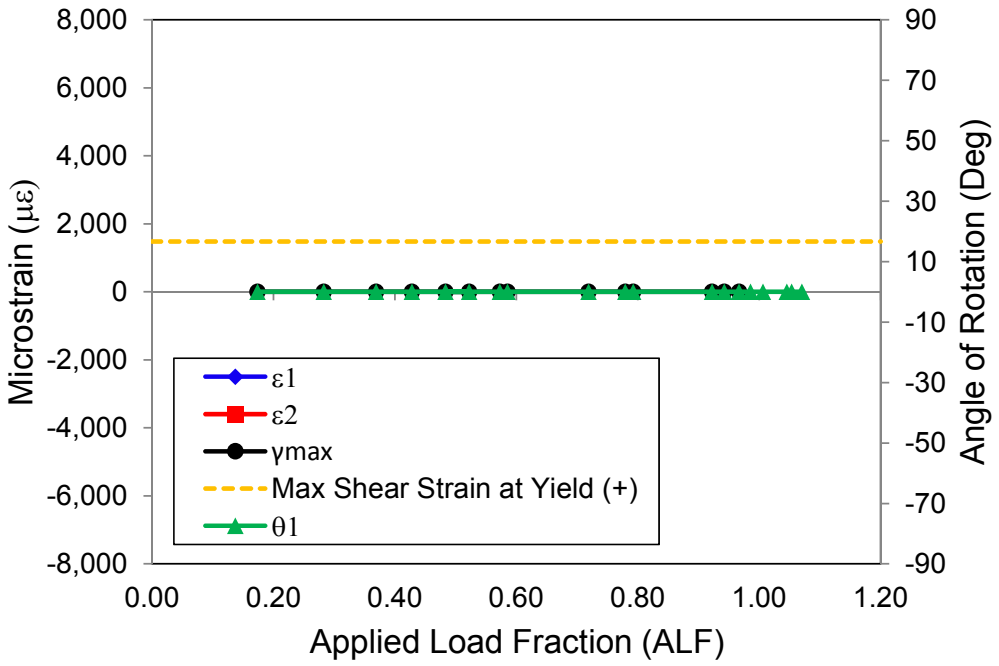

Figure G169. North gusset mid east bottom (DEAD GUAGE).

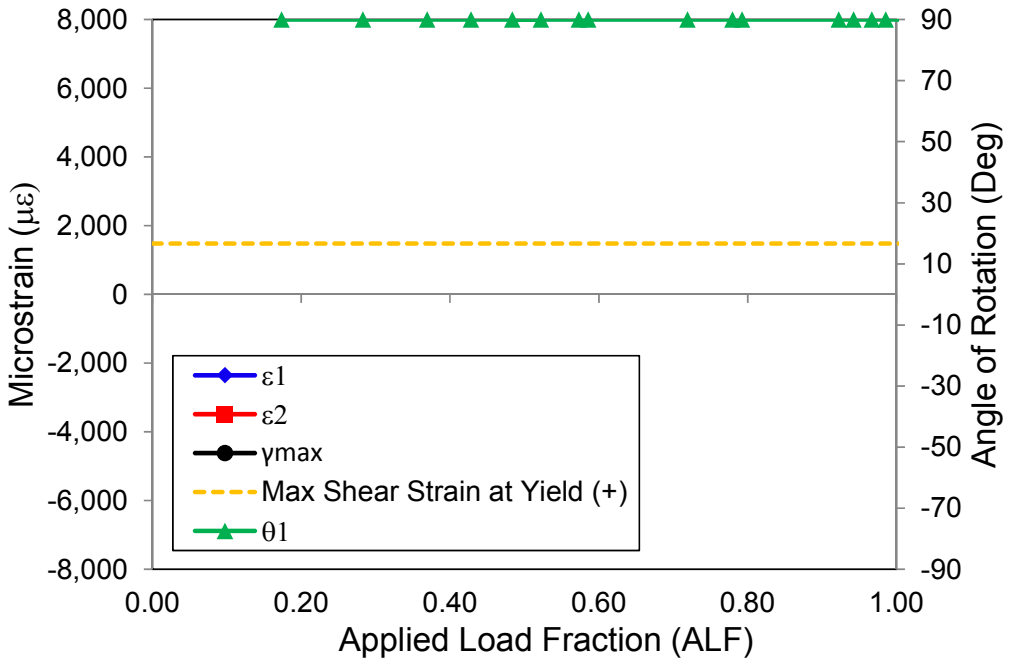

Figure G170. North gusset east bottom (DEAD GUAGE).

Member Cross-Sectional Plots

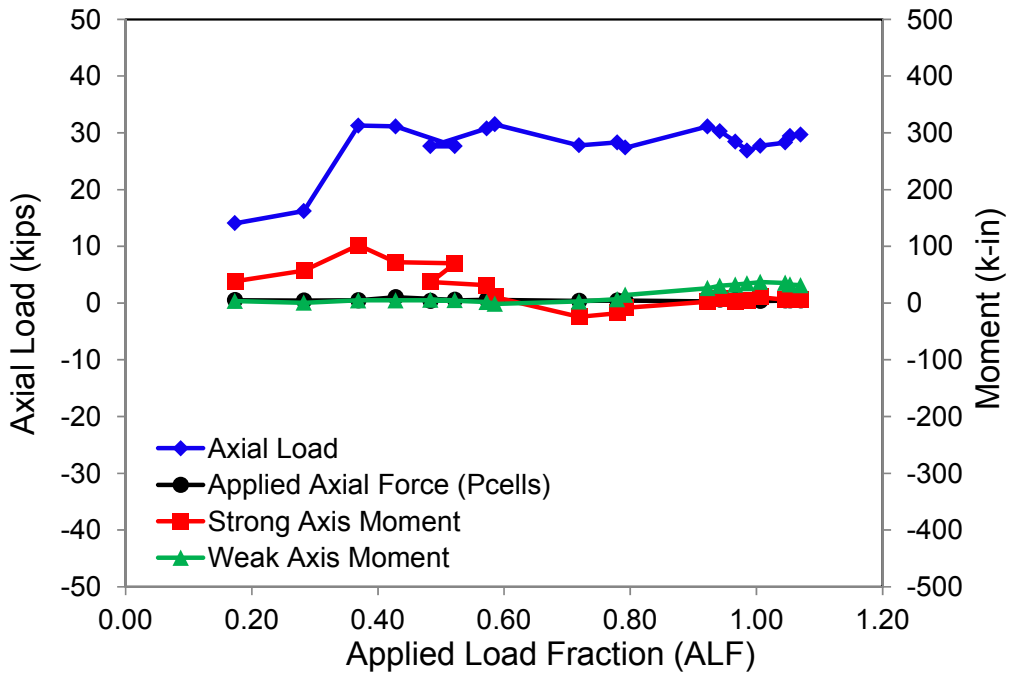

Figure G171. Vertical

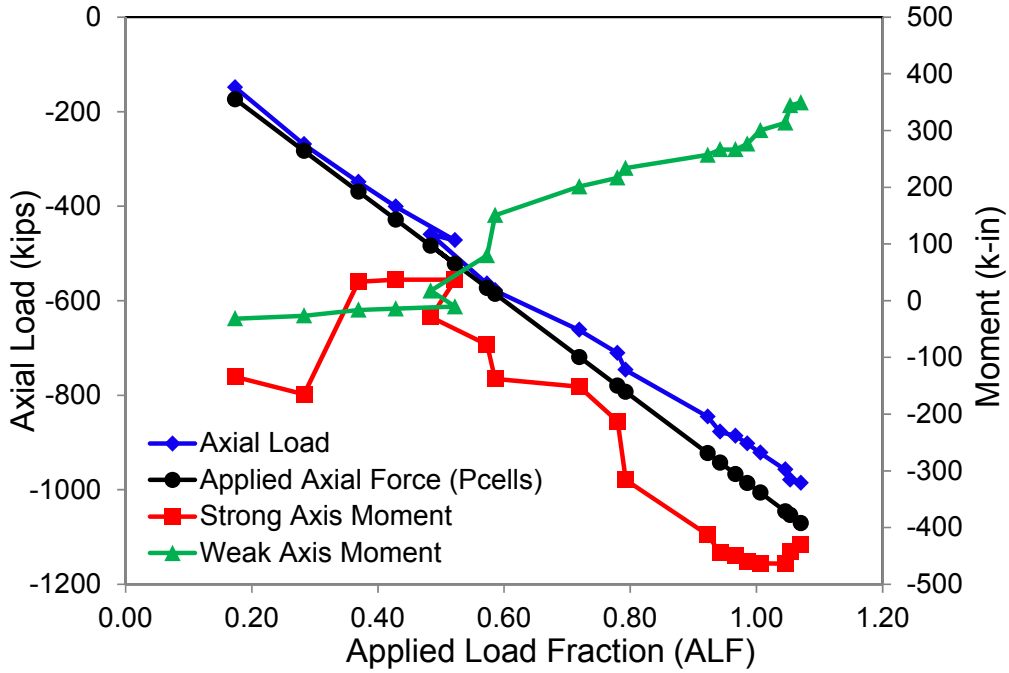

Figure G172. Compression Diagonal

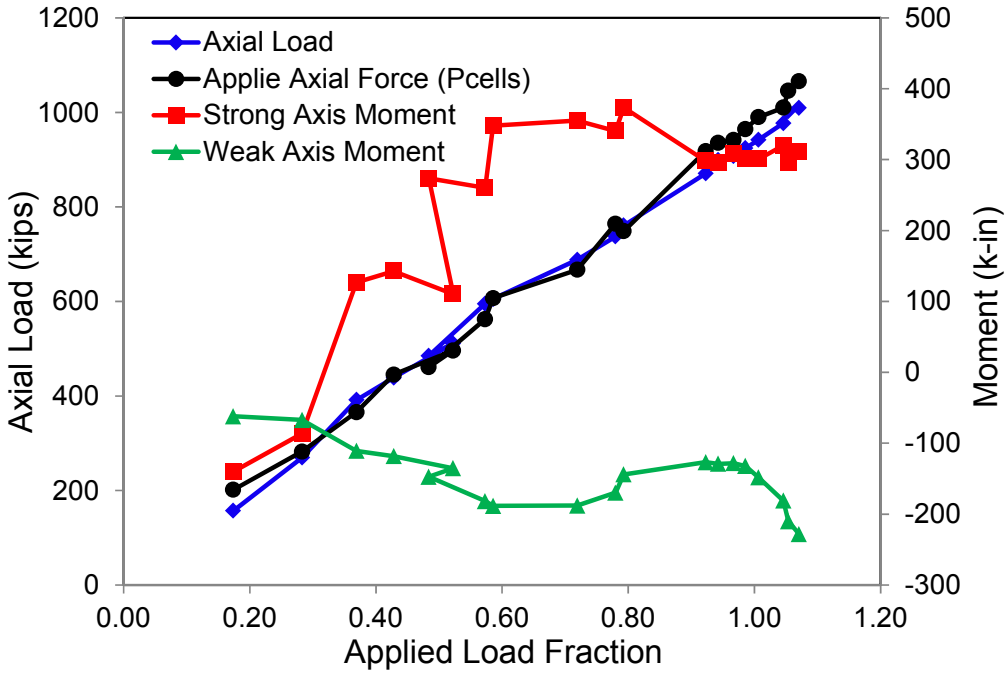

Figure G173. Tension Diagonal

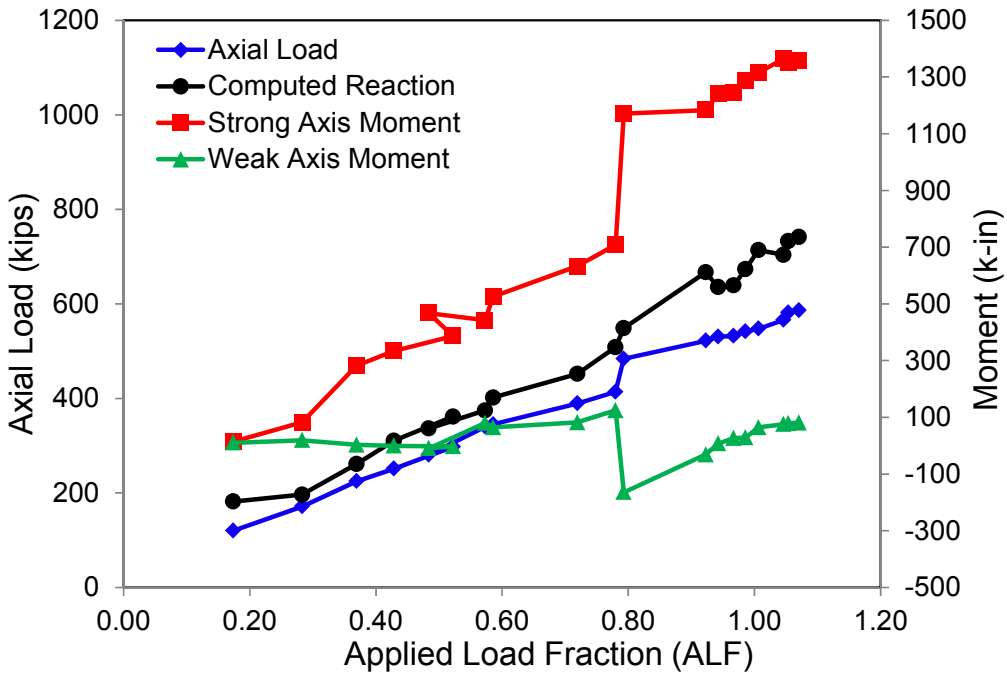

Figure G174. West Chord

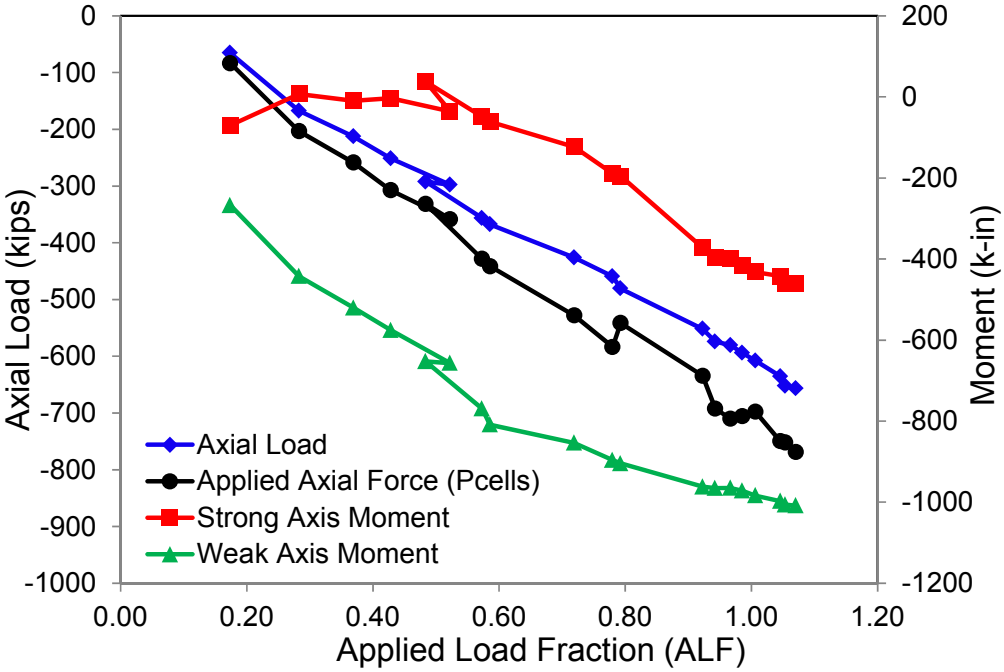

Figure G175. East Chord

Chord Load Shedding Plots

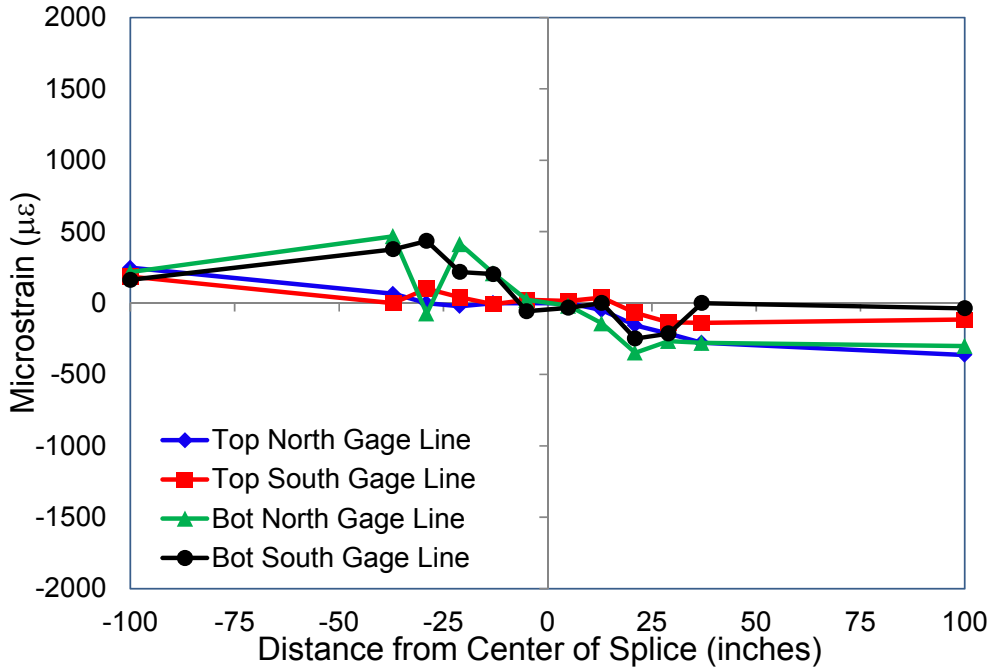

Figure G176. ALF = 0.37

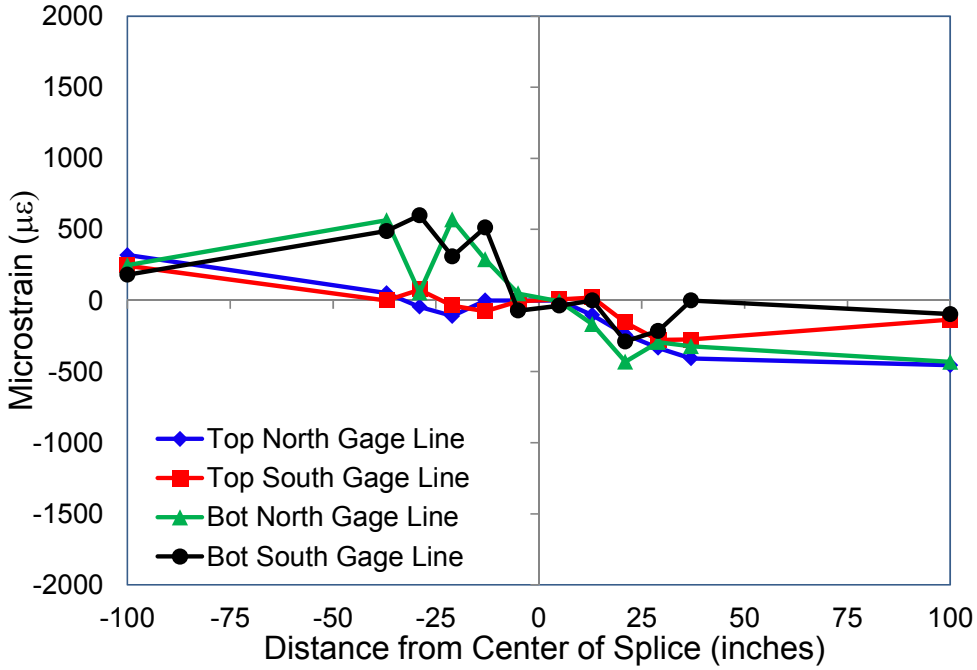

Figure G177. ALF = 0.48

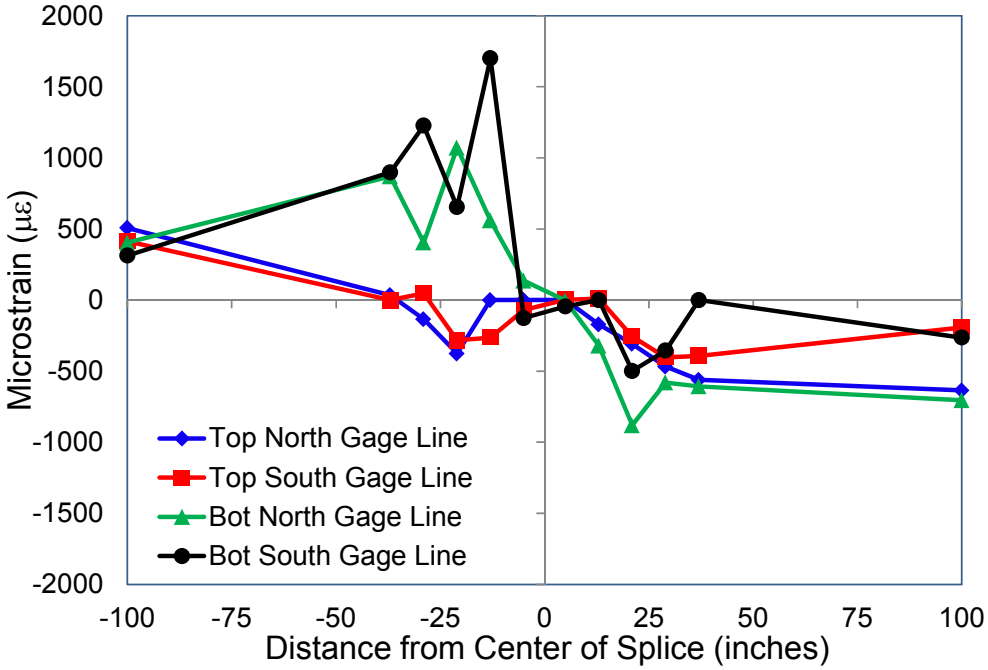

Figure G178. ALF = 0.79

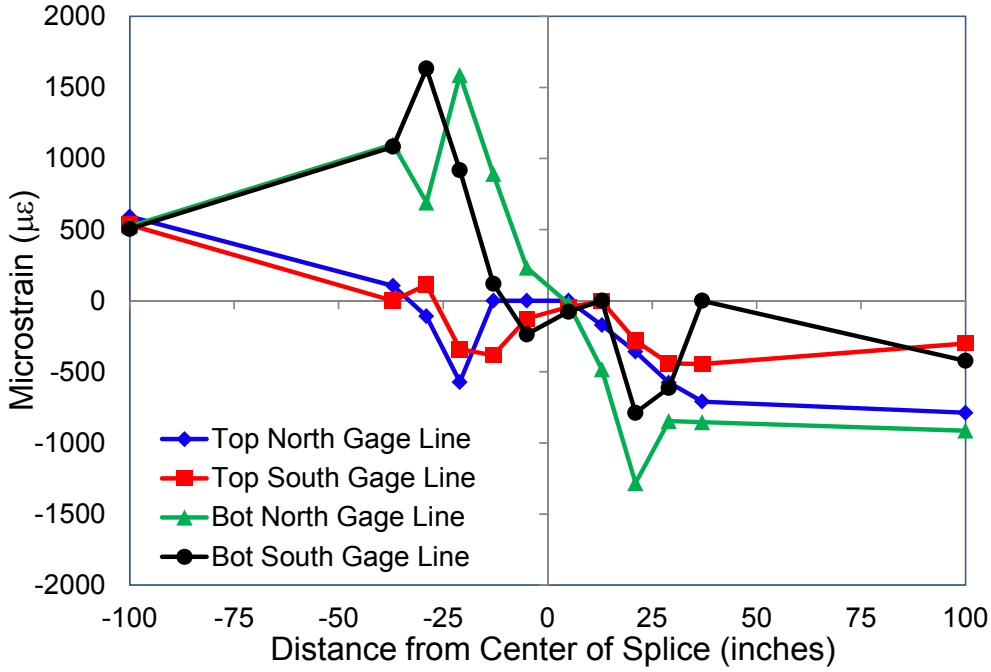

Figure G179. Peak ALF

Uniaxial Gauge Plots

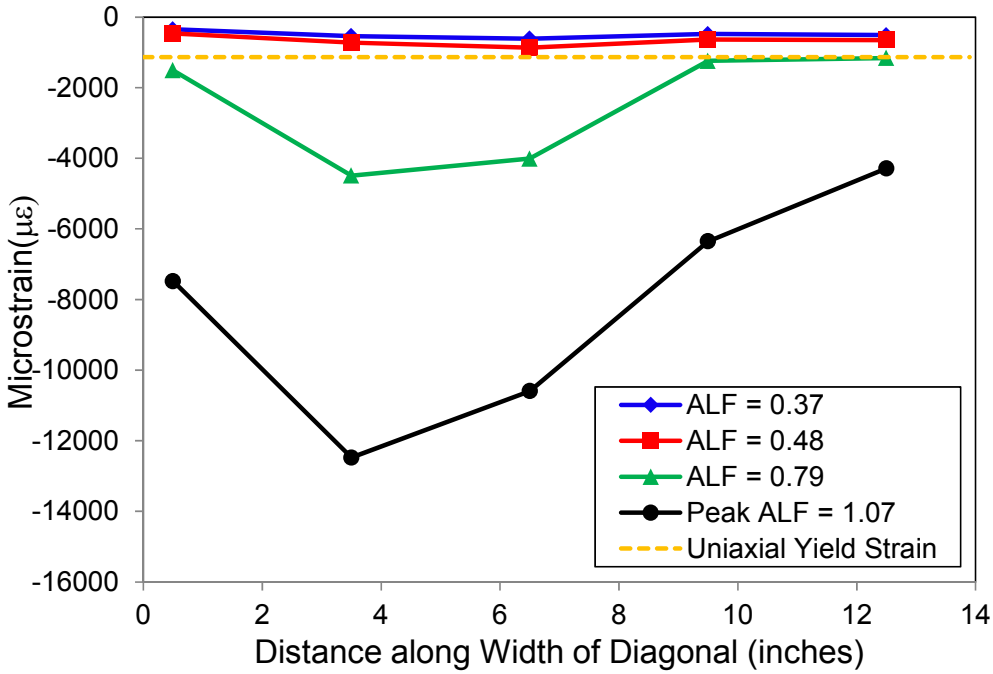

Figure G180. North Gusset Compression Diagonal

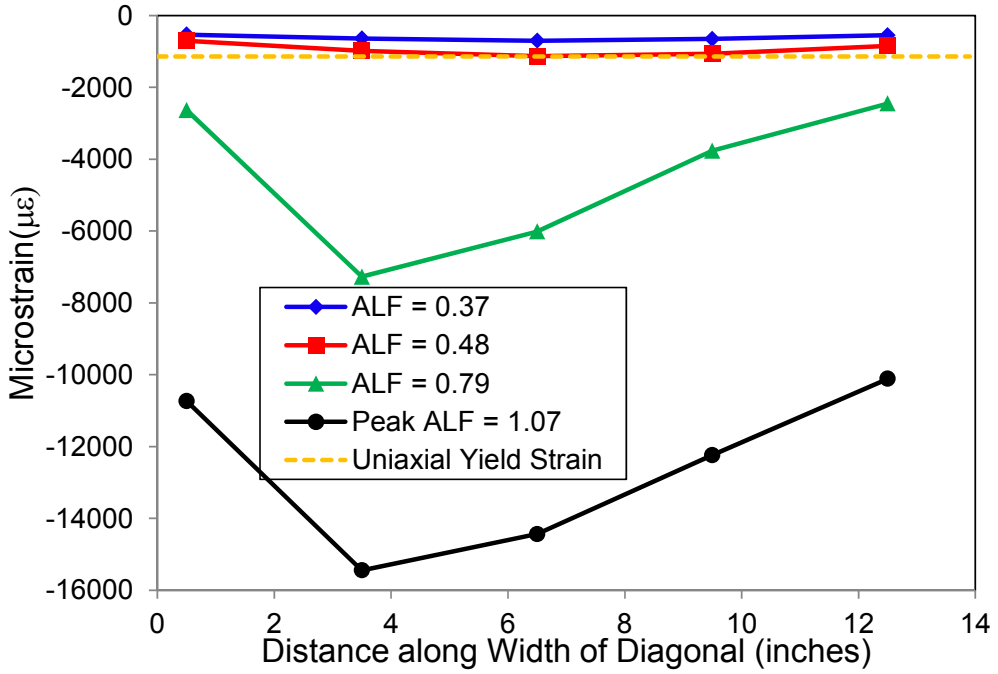

Figure G181. South Gusset Compression Diagonal

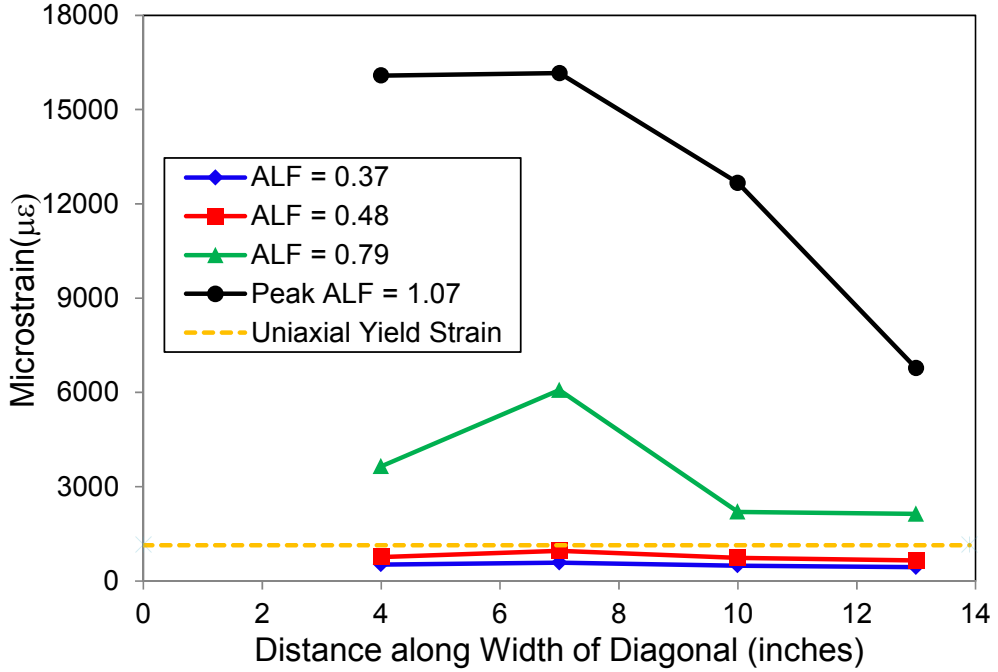

Figure G182. North Gusset Tension Diagonal

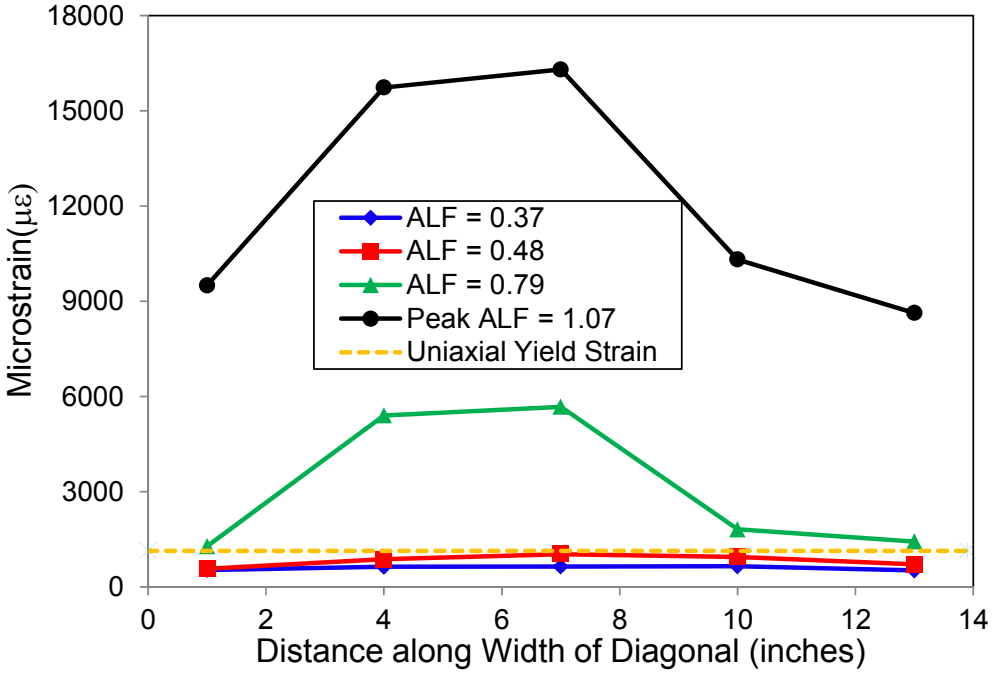

Figure G183. South Tension Diagonal

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Maximum Shear Strain Plots

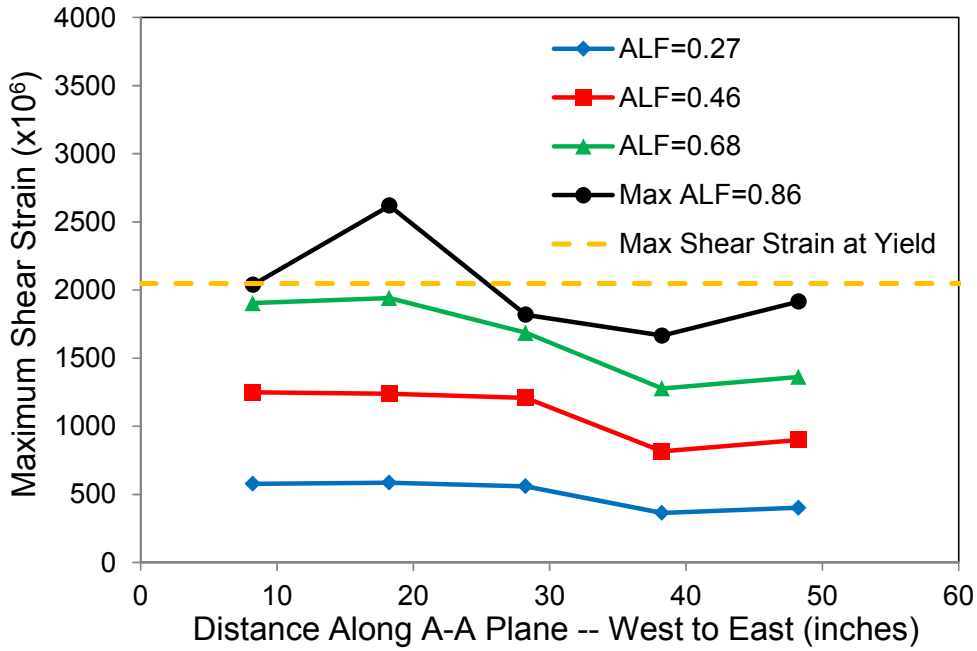

Figure G184. Horizontal line of rosettes above chord; south gusset plate

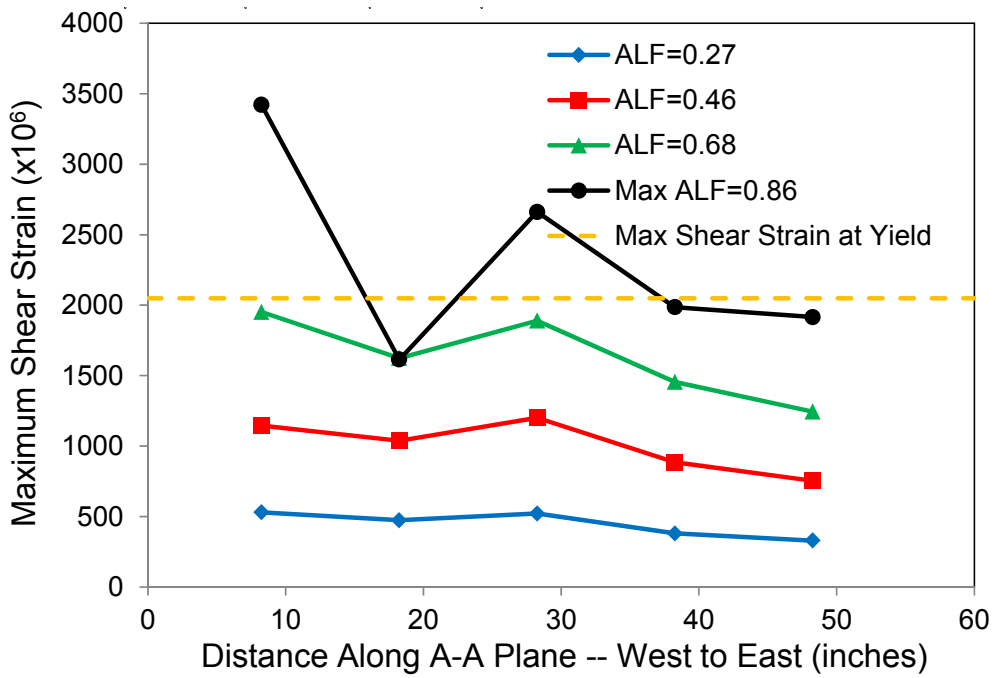

Figure G185. Horizontal line of rosettes above chord; north gusset plate

Variations in Principal Strain

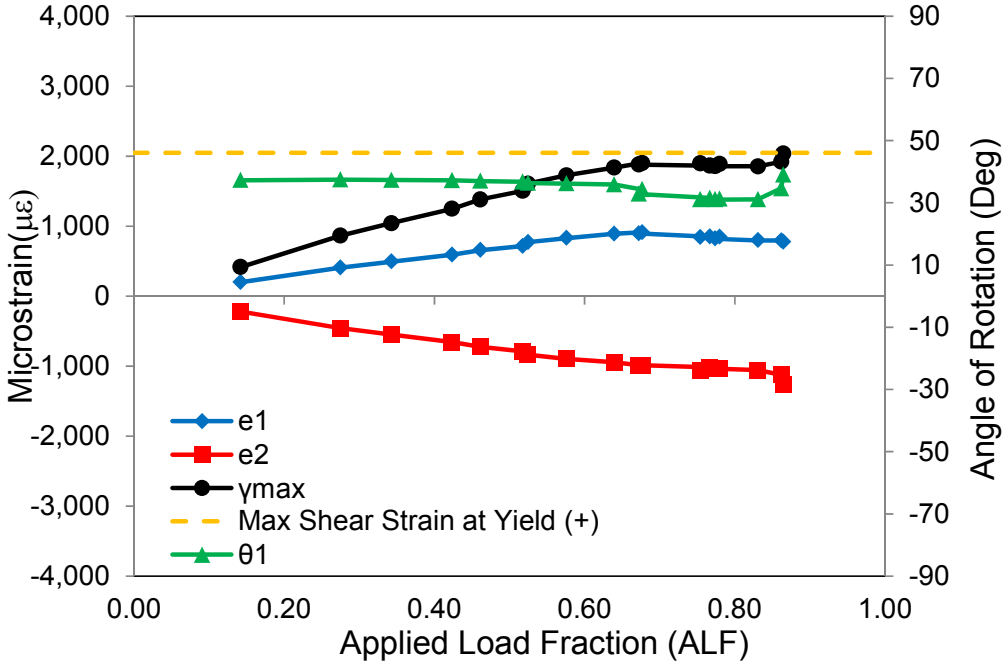

Figure G186. South gusset west bottom

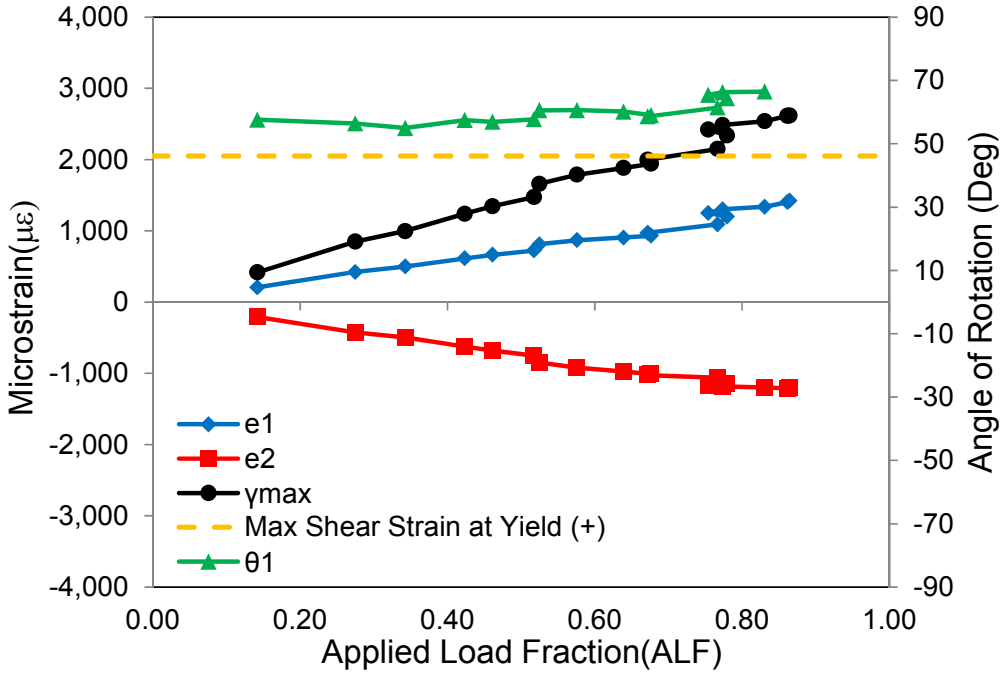

Figure G187. South gusset west mid bottom

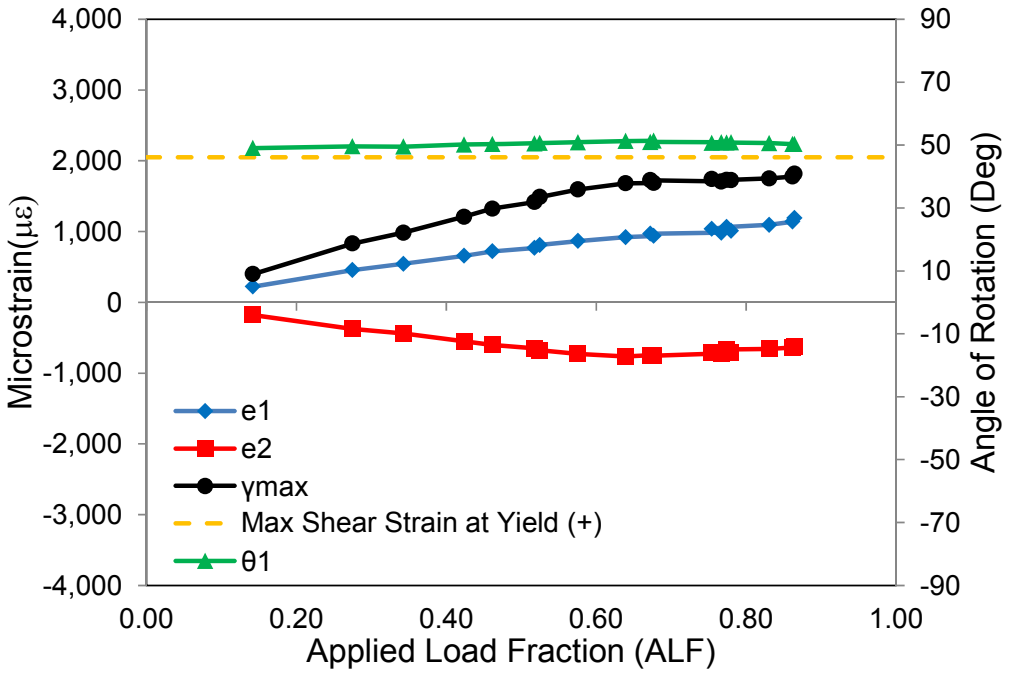

Figure G188. South gusset mid bottom

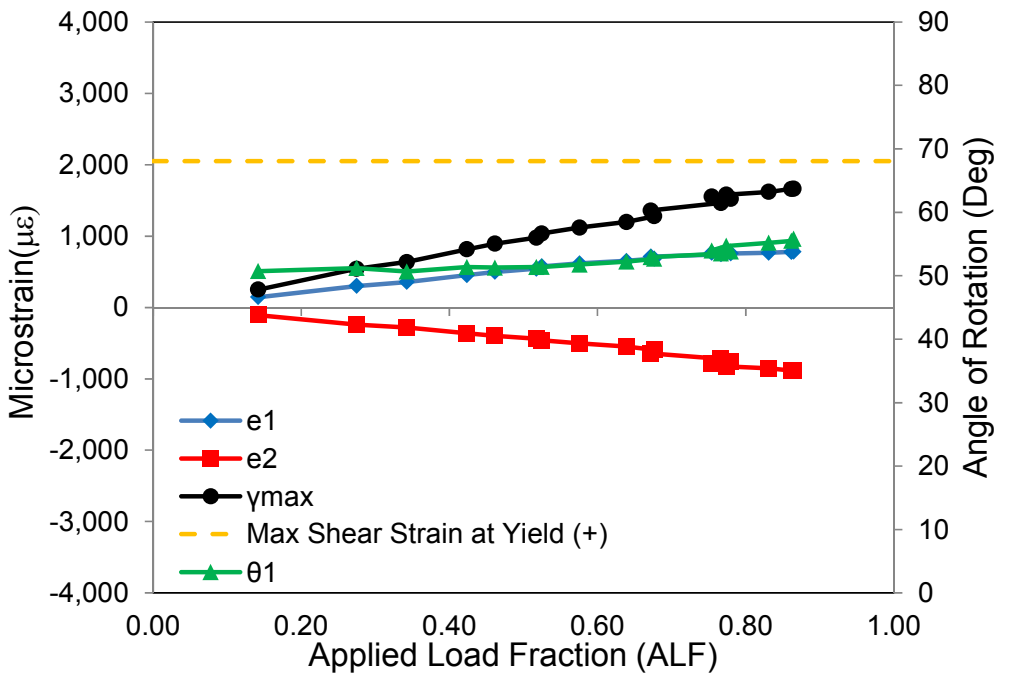

Figure G189. South gusset east mid bottom

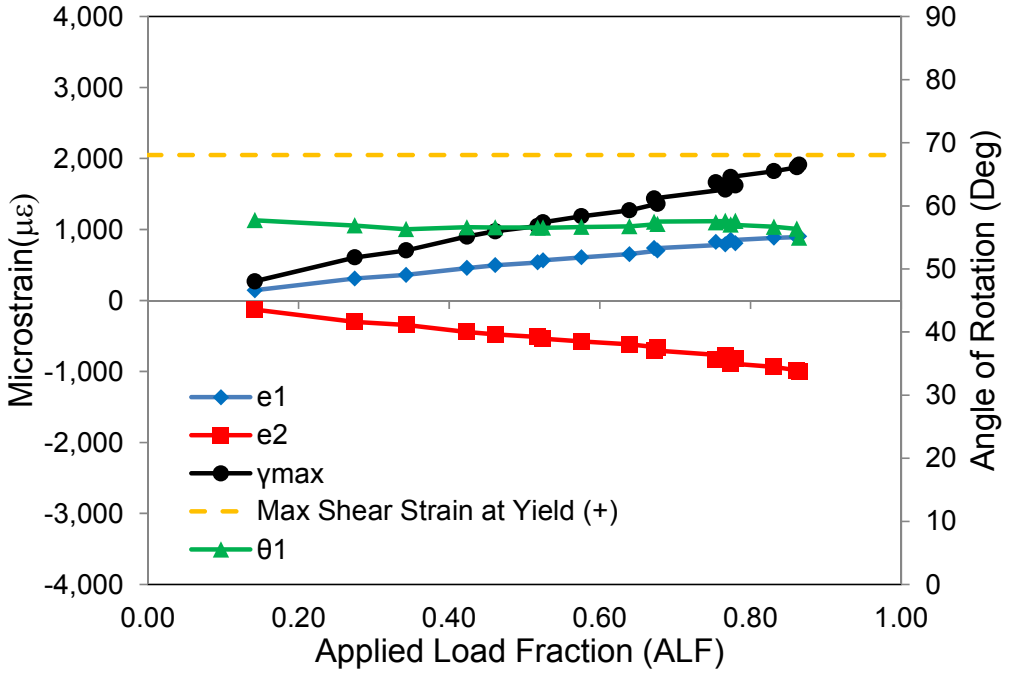

Figure G190. South gusset east bottom

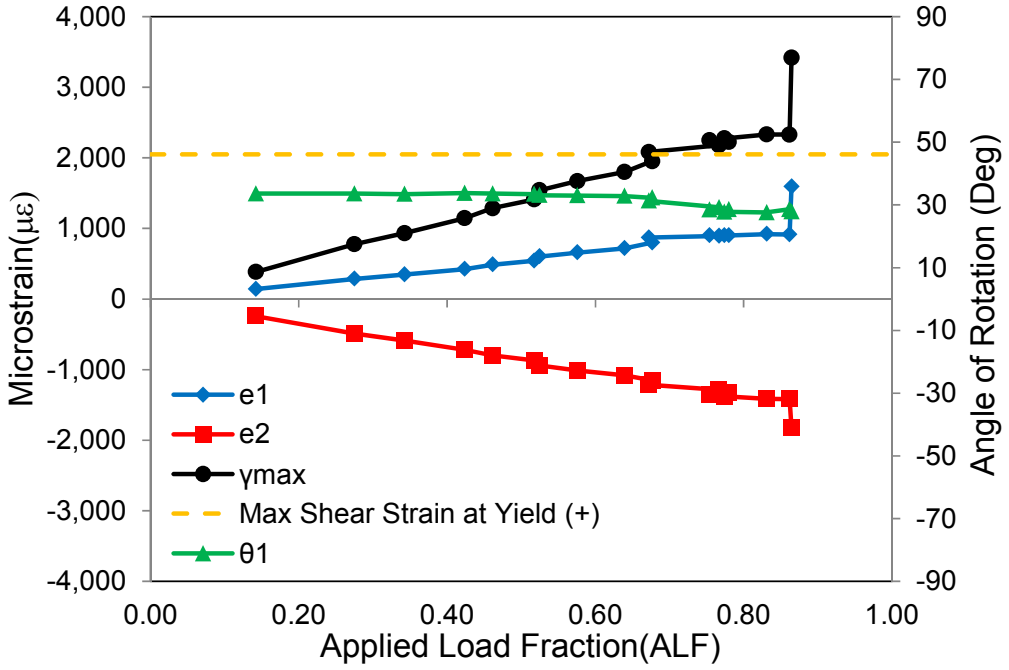

Figure G191. North gusset west bottom

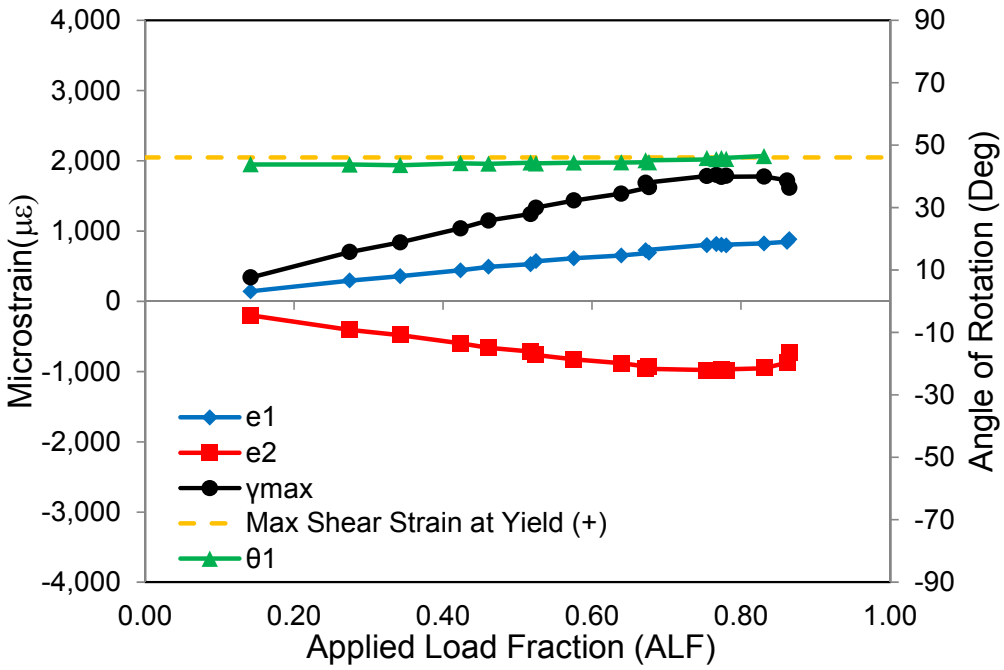

Figure G192. North gusset west mid bottom

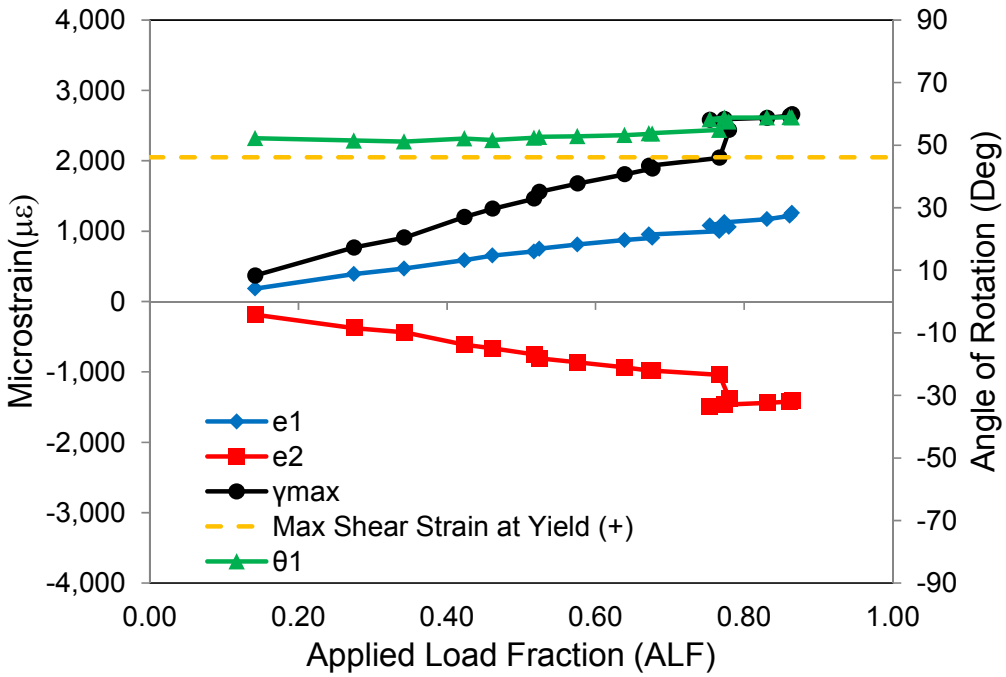

Figure G193. North gusset mid bottom

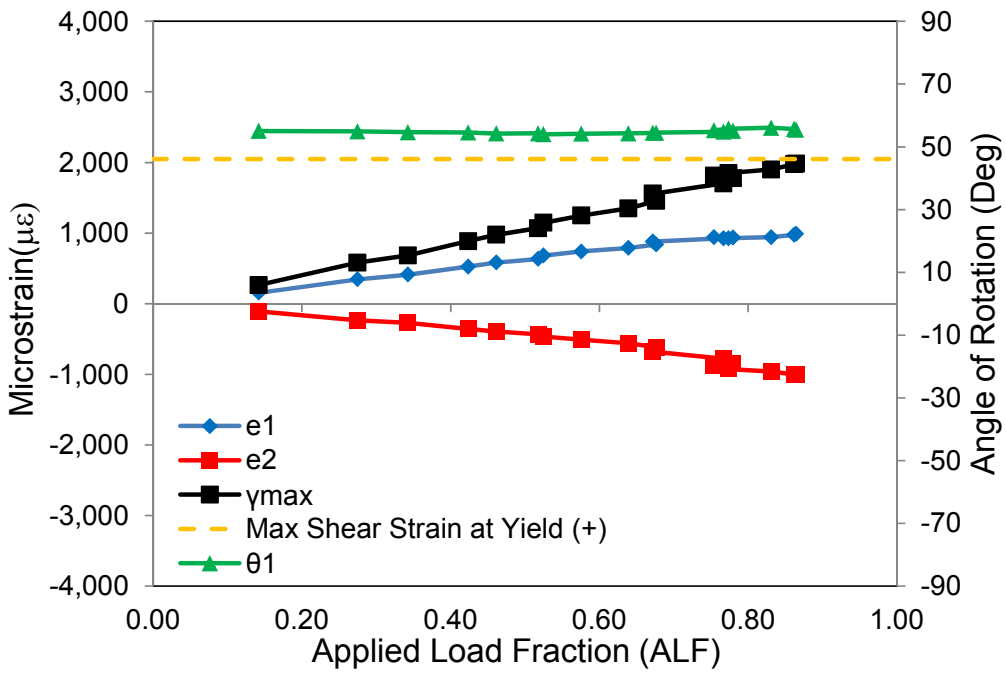

Figure G194. North gusset mid east bottom

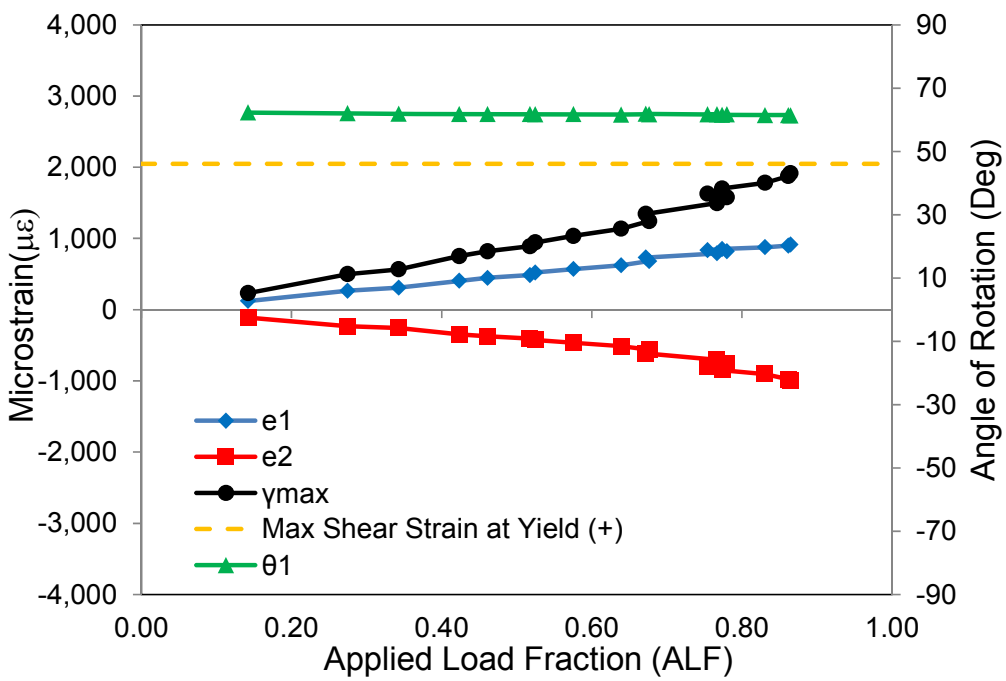

Figure G195. North gusset east bottom

Member Cross-Sectional Plots

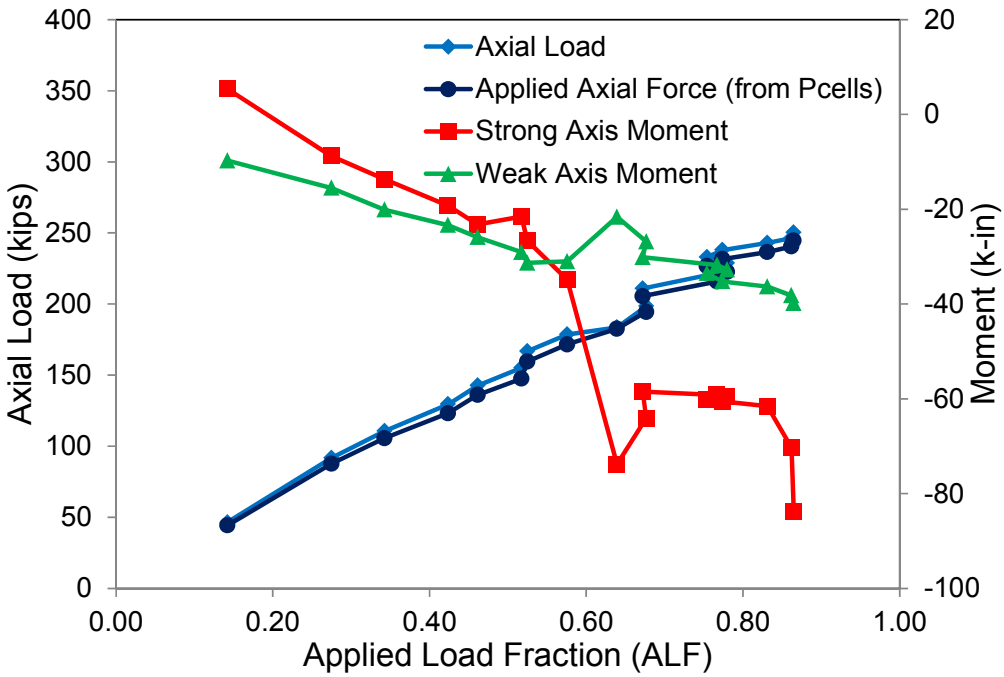

Figure G196. Vertical

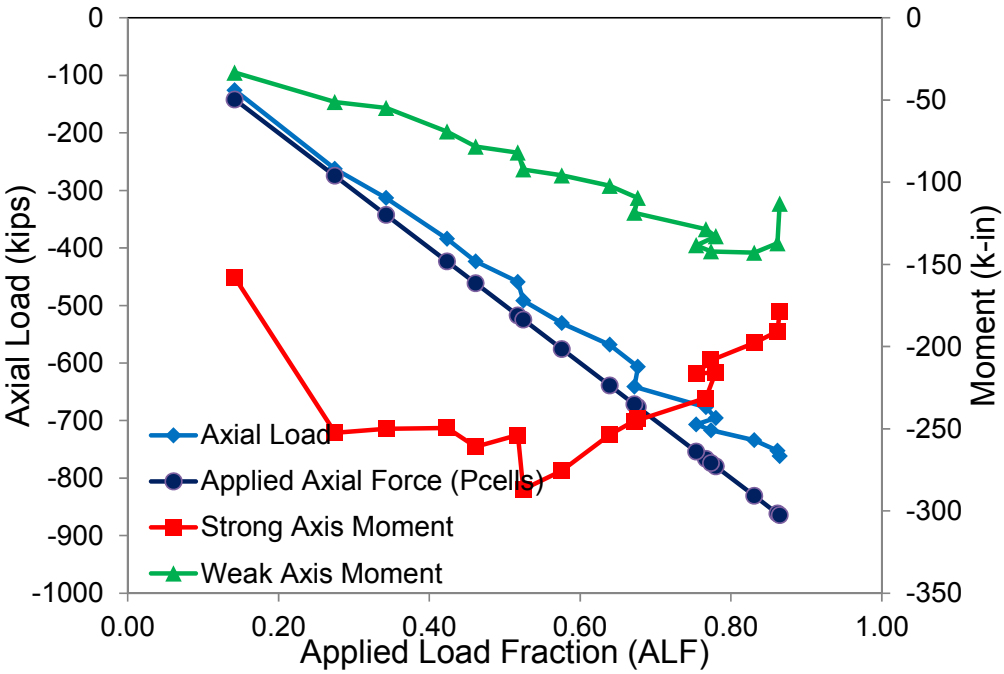

Figure G197. Compression Diagonal

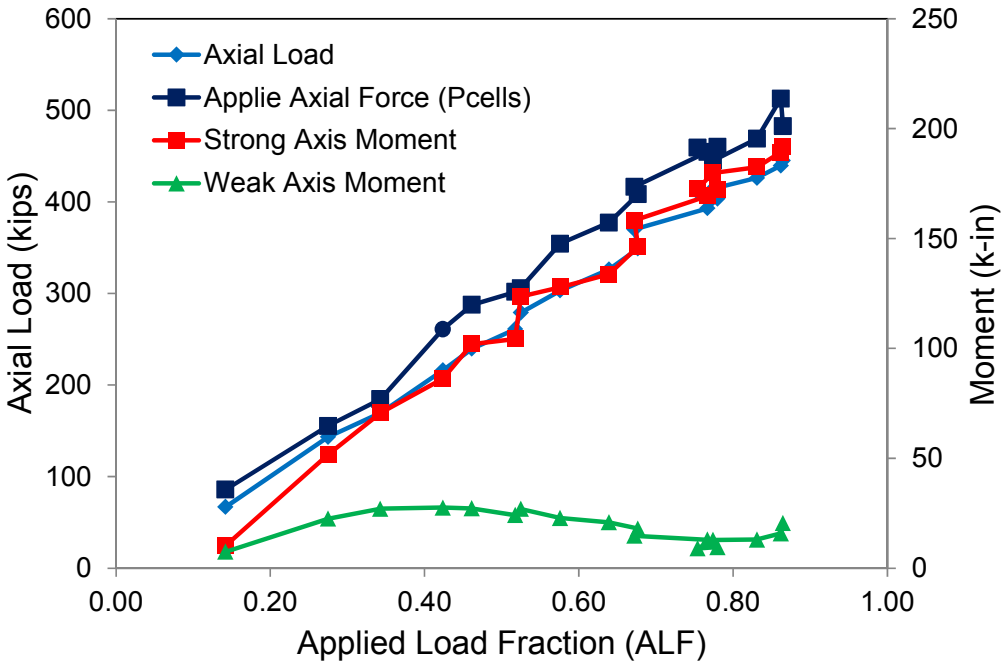

Figure G198. Tension Diagonal

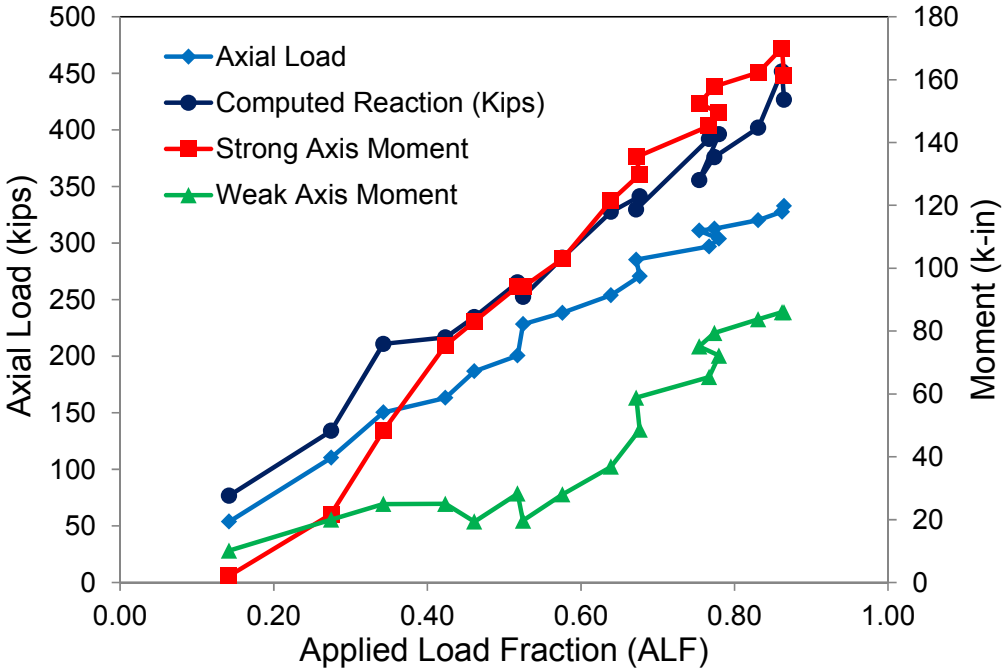

Figure G199. West Chord

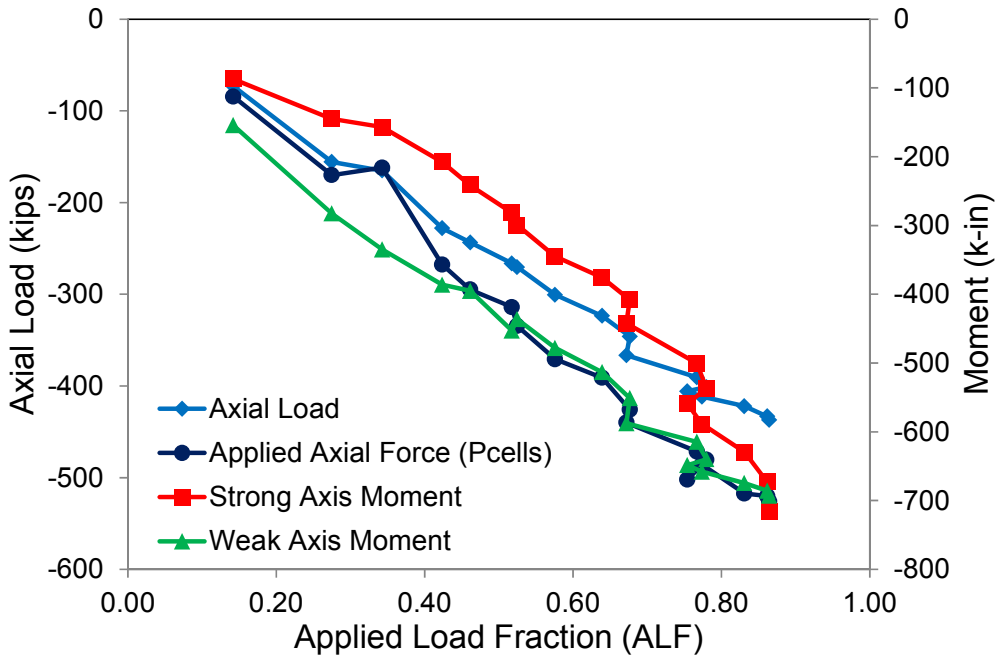

Figure G200. East Chord

Chord Load Shedding Plots

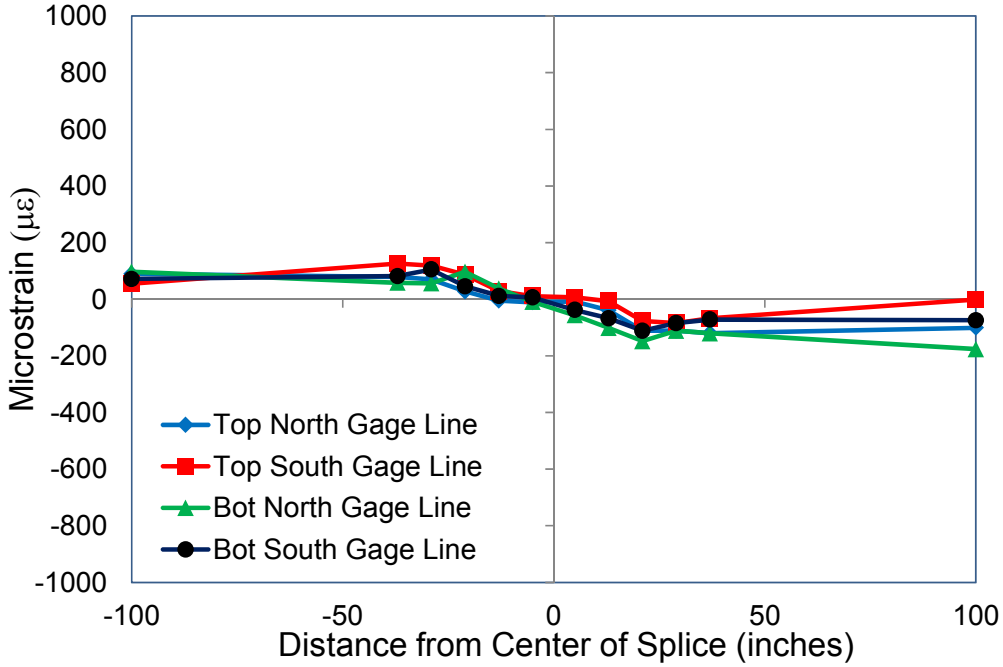

Figure G201. ALF=0.27

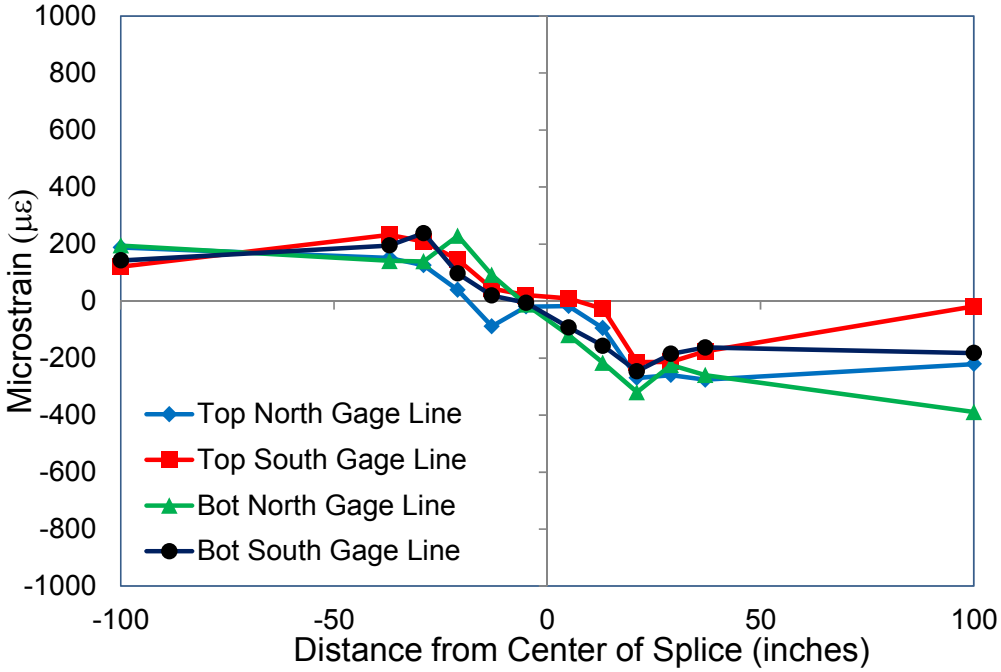

Figure G202. ALF=0.46

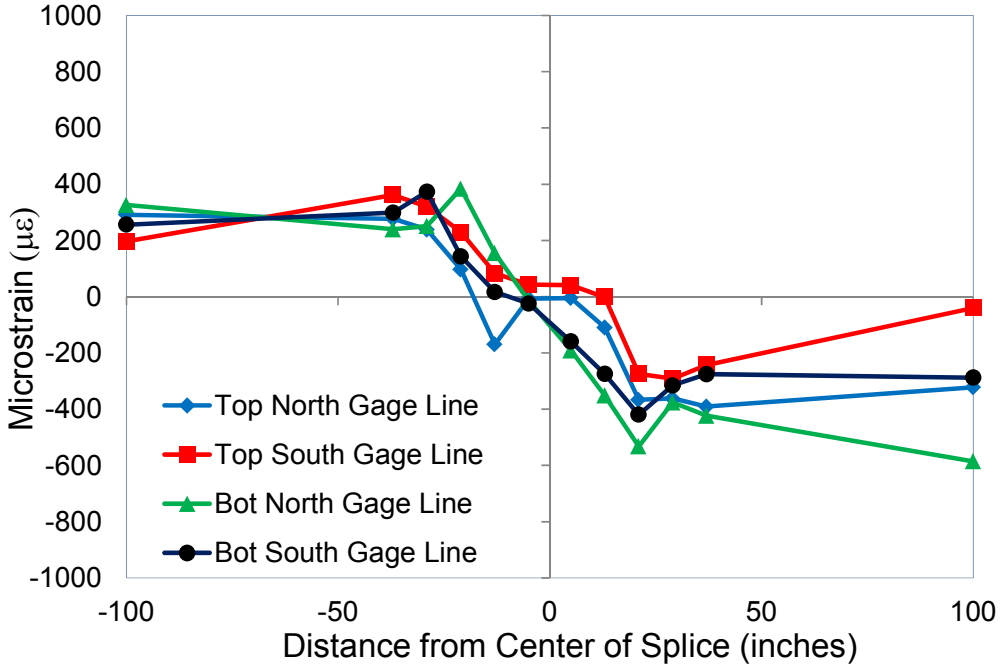

Figure G203. ALF=0.68

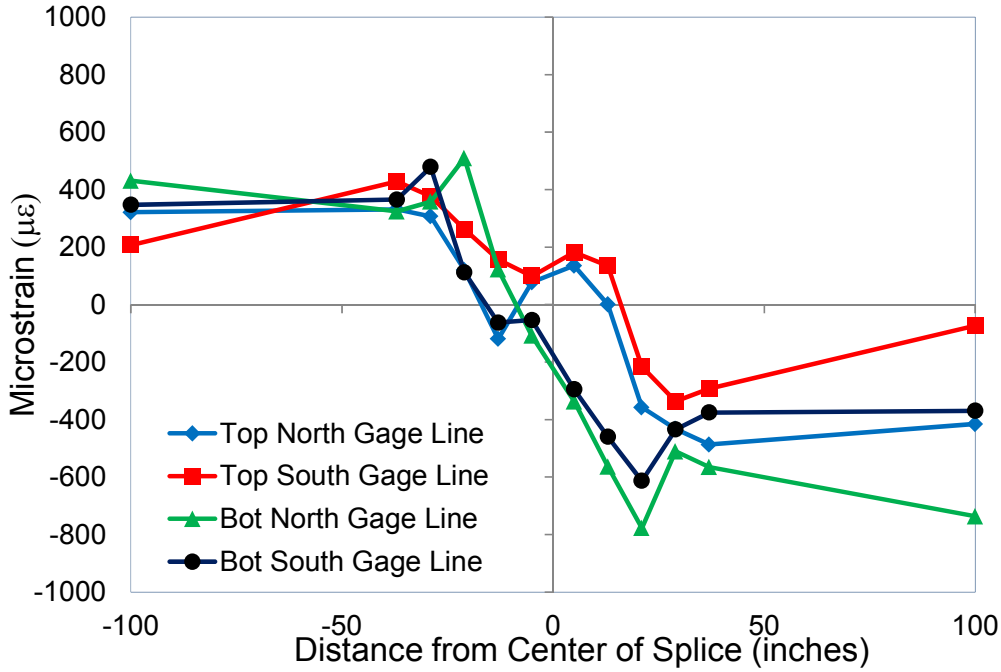

Figure G204. Max ALF=0.86

Uniaxial Gauge Plots

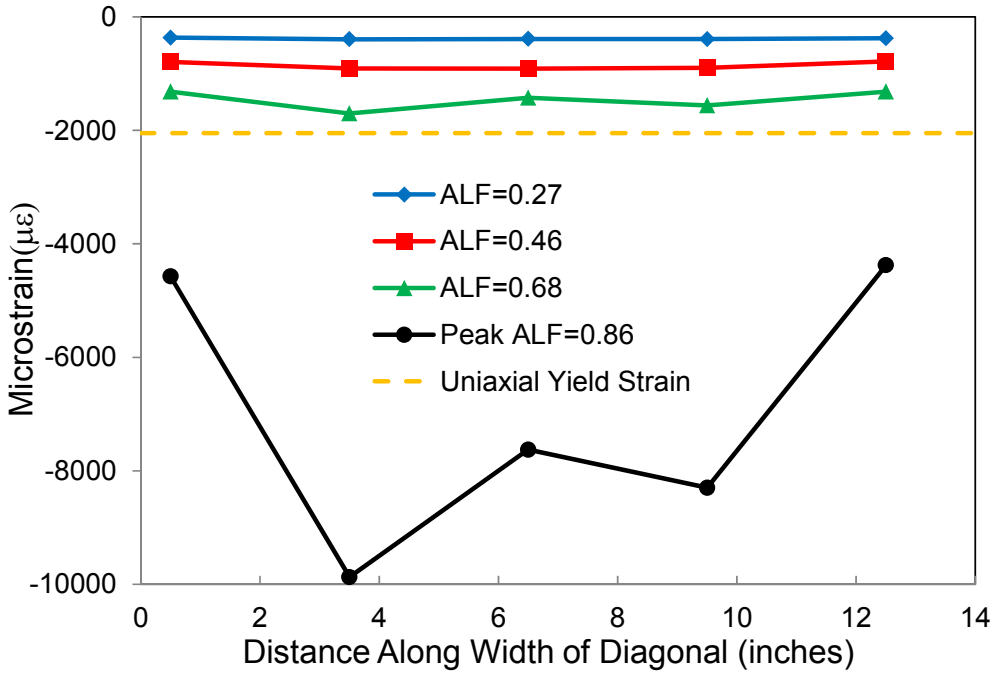

Figure G205. North Compression Diagonal

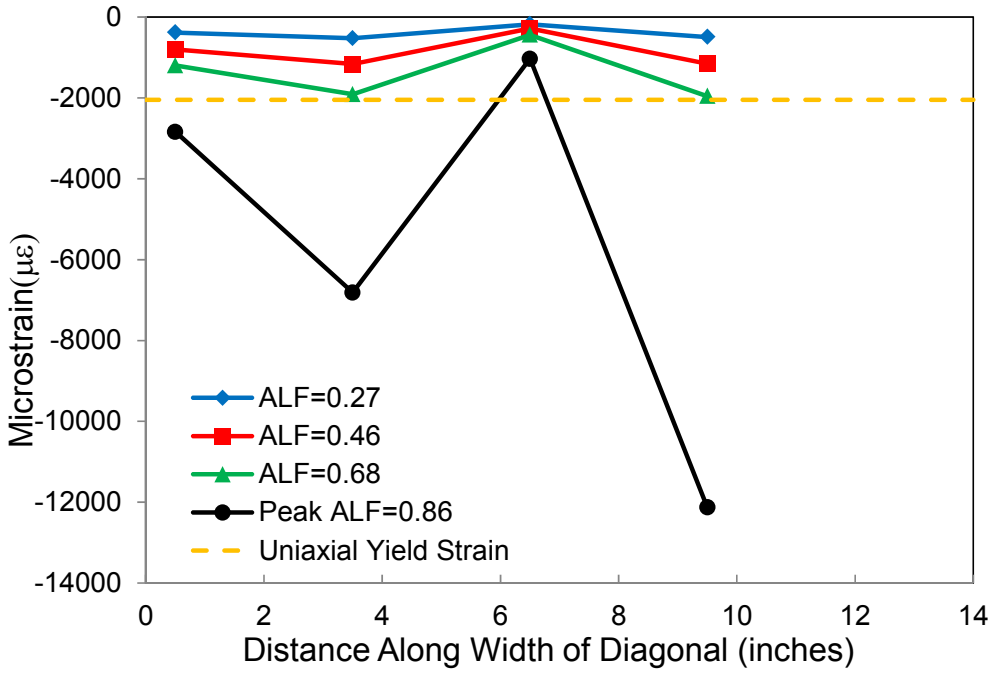

Figure G206. South Compression Diagonal

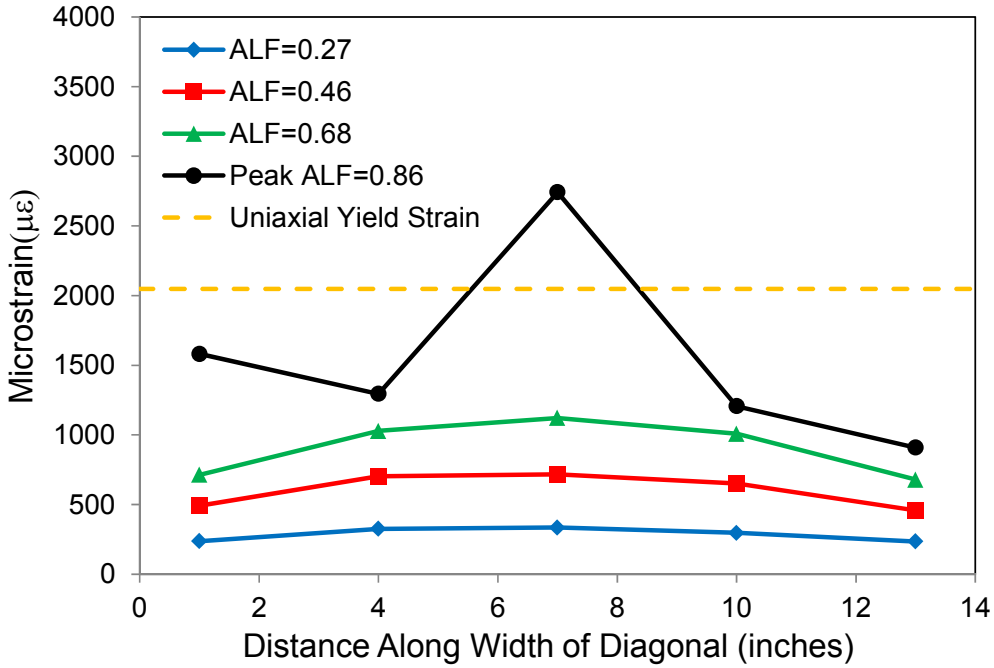

Figure G207. North Tension Diagonal

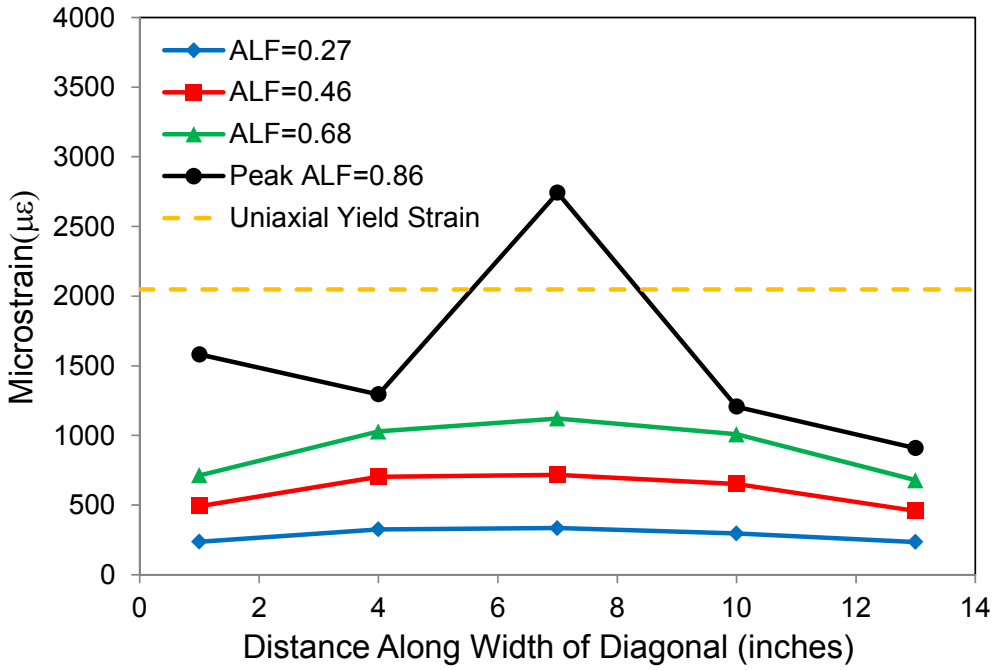

Figure G208. South Tension Diagonal

Angle Plots

Theses four graphs in this section represent the gauges that were affixed to the stiffening angles.

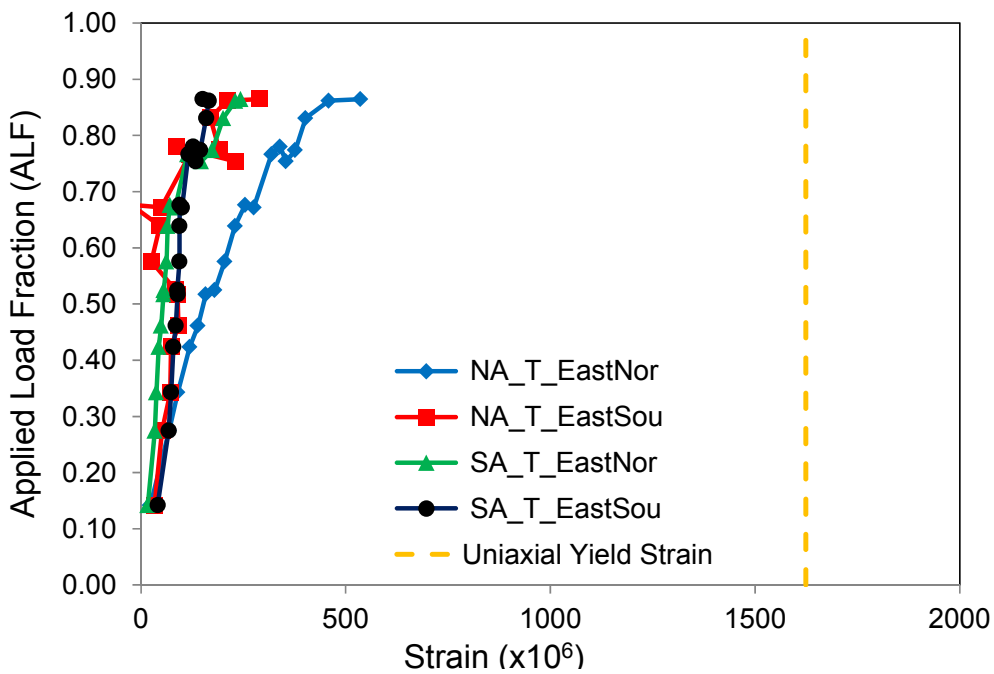

Figure G209. East gage pairs

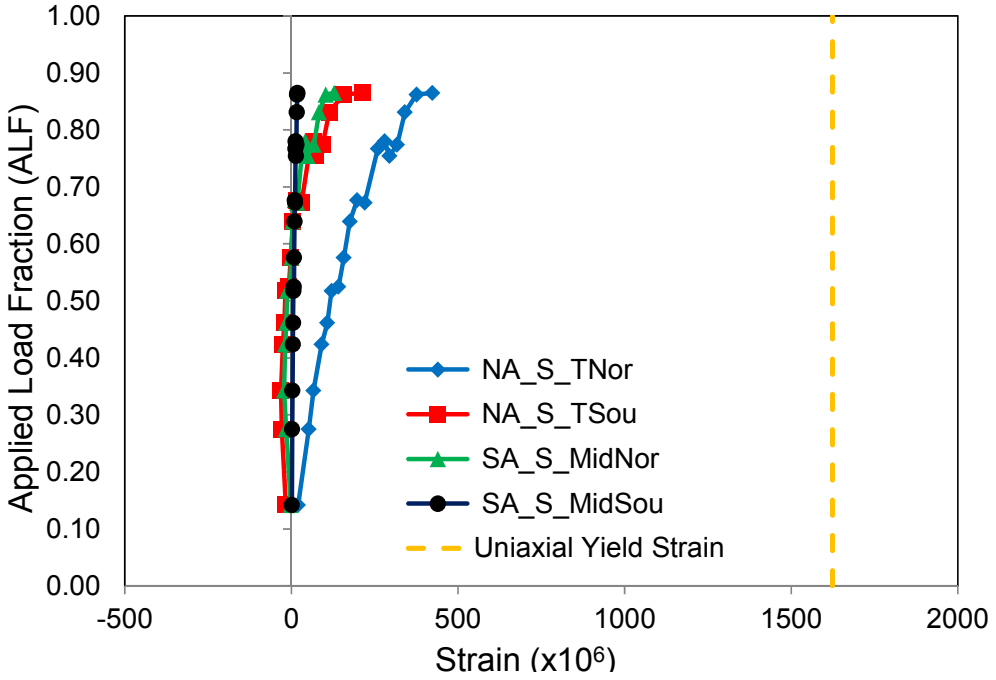

Figure G210. Top gage pairs

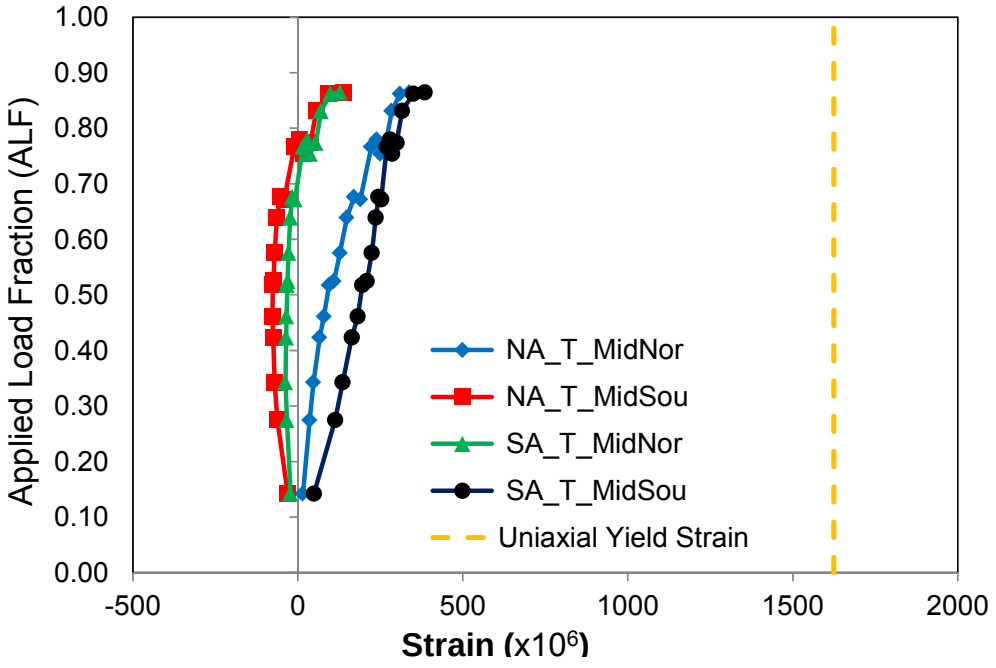

Figure G211. Middle gage pairs.

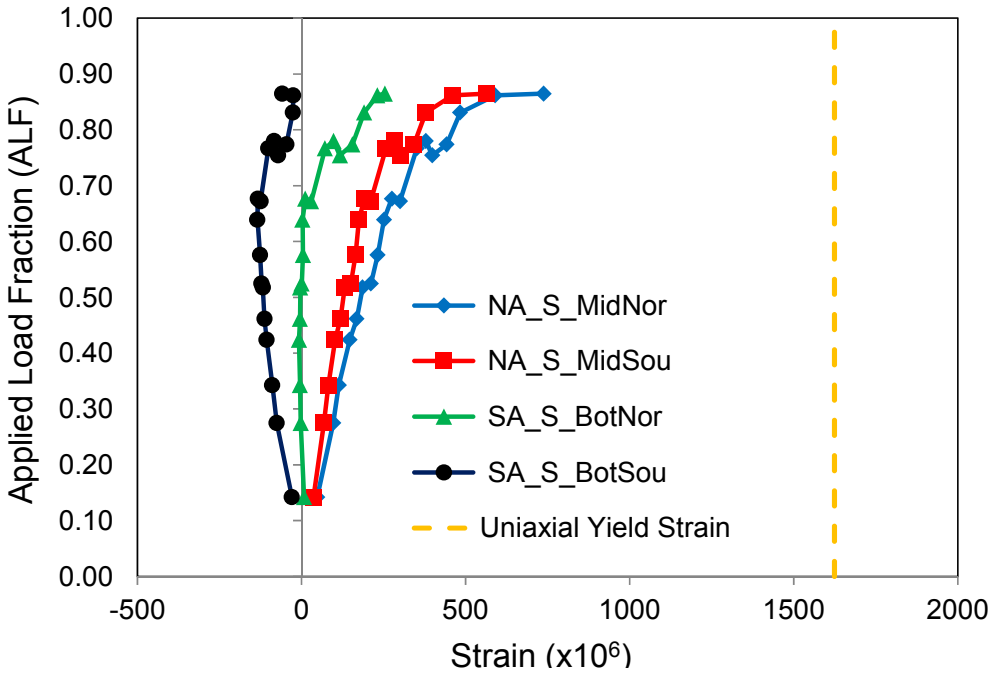

Figure G212. Bottom gage pairs.

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Maximum Shear Strain Plots

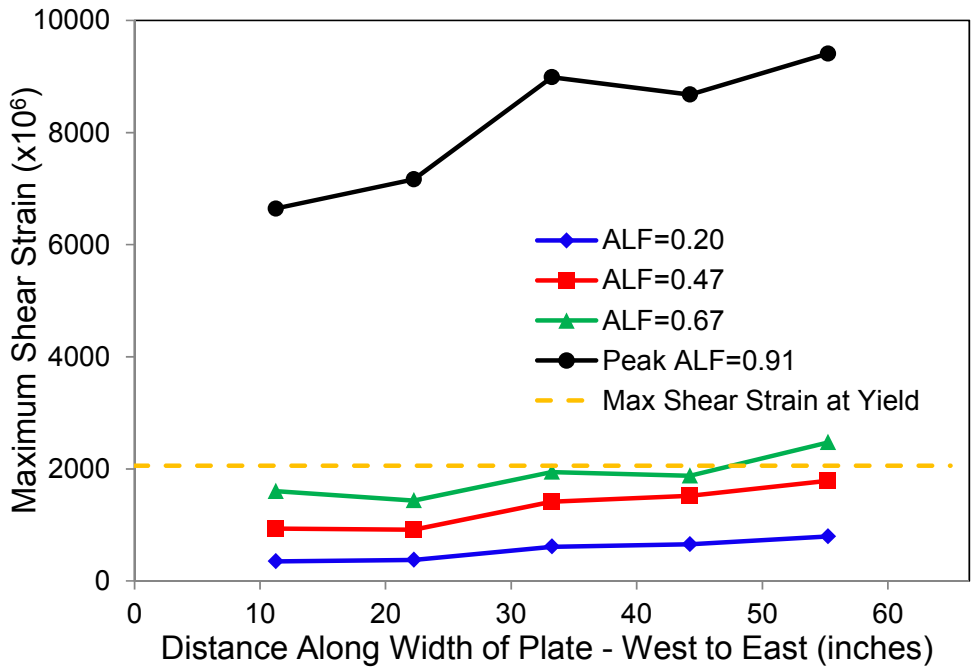

Figure G213. Horizontal line of rosettes above chord; south gusset plate

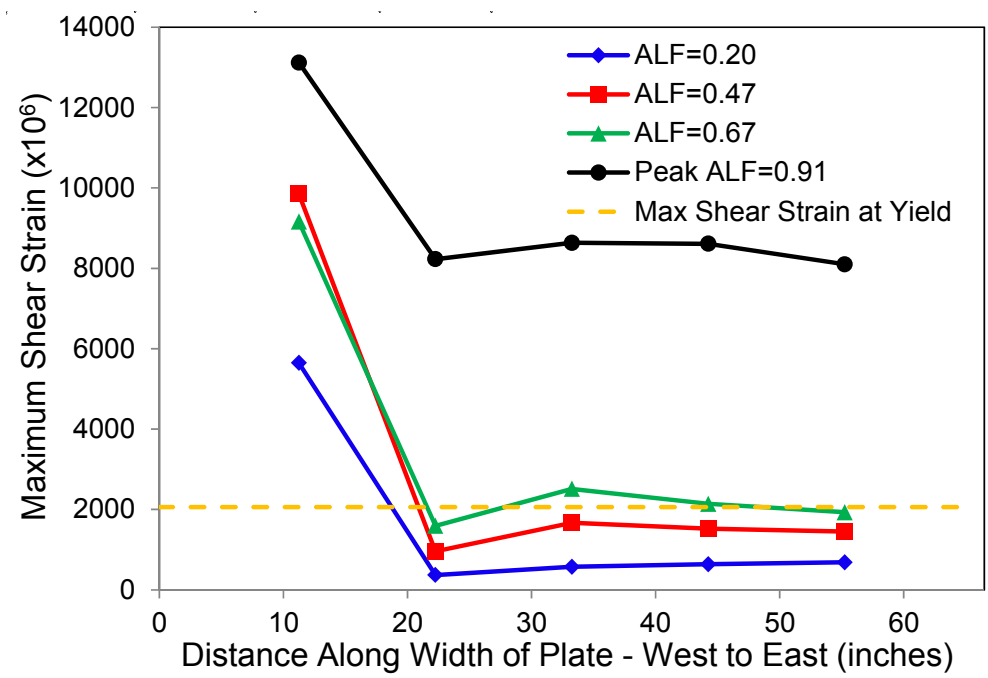

Figure G214. Horizontal line of rosettes above chord; north gusset plate

Variations in Principal Strain

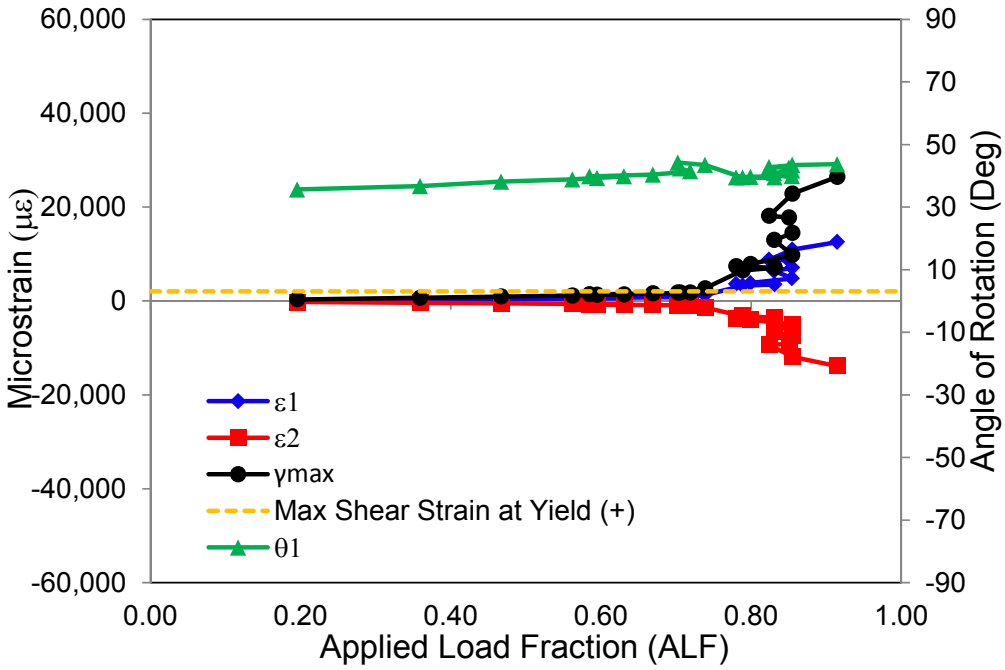

Figure G215. South gusset west bottom

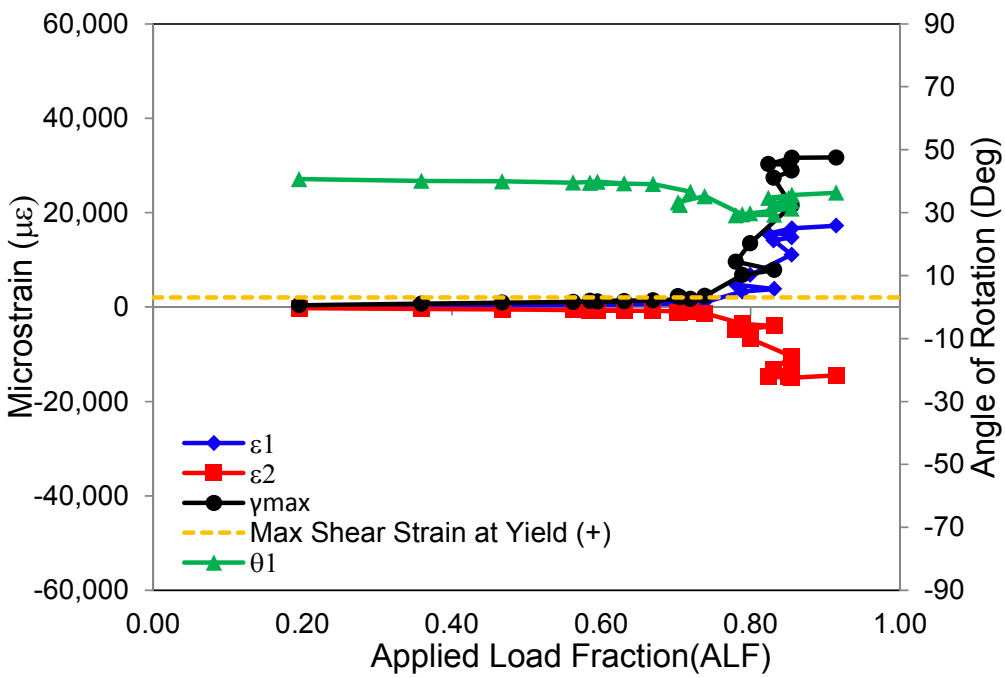

Figure G216. South gusset west mid bottom

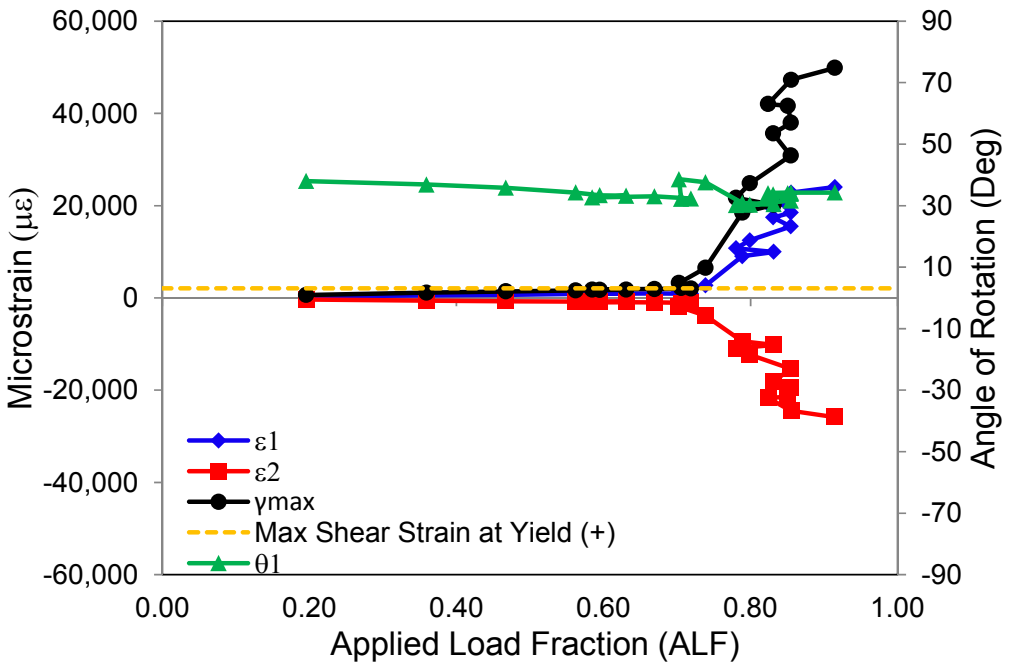

Figure G217. South gusset mid bottom

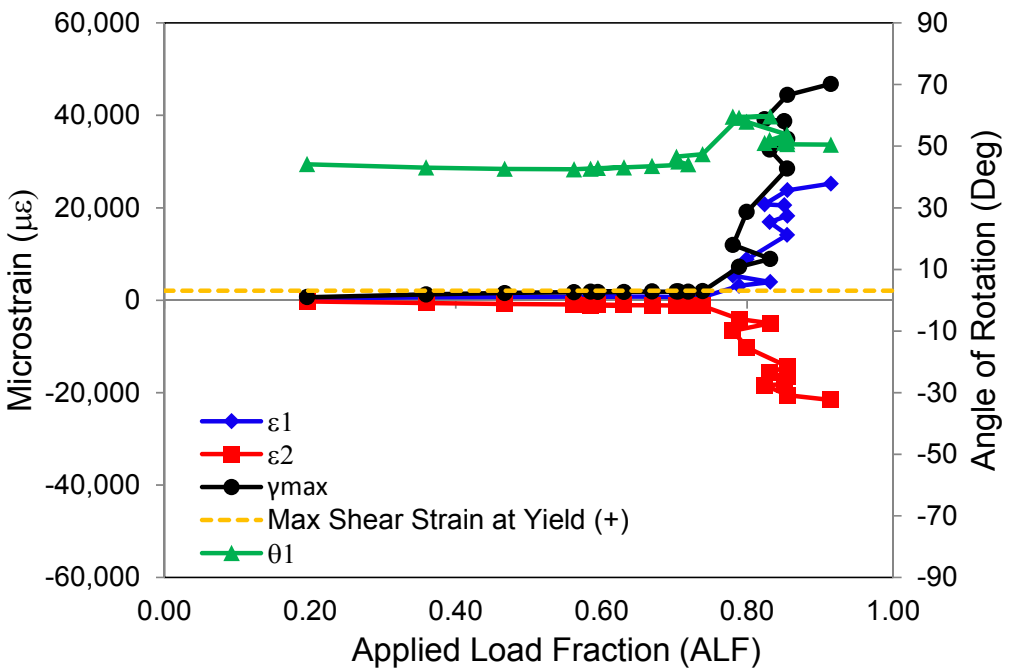

Figure G218. South gusset east mid bottom

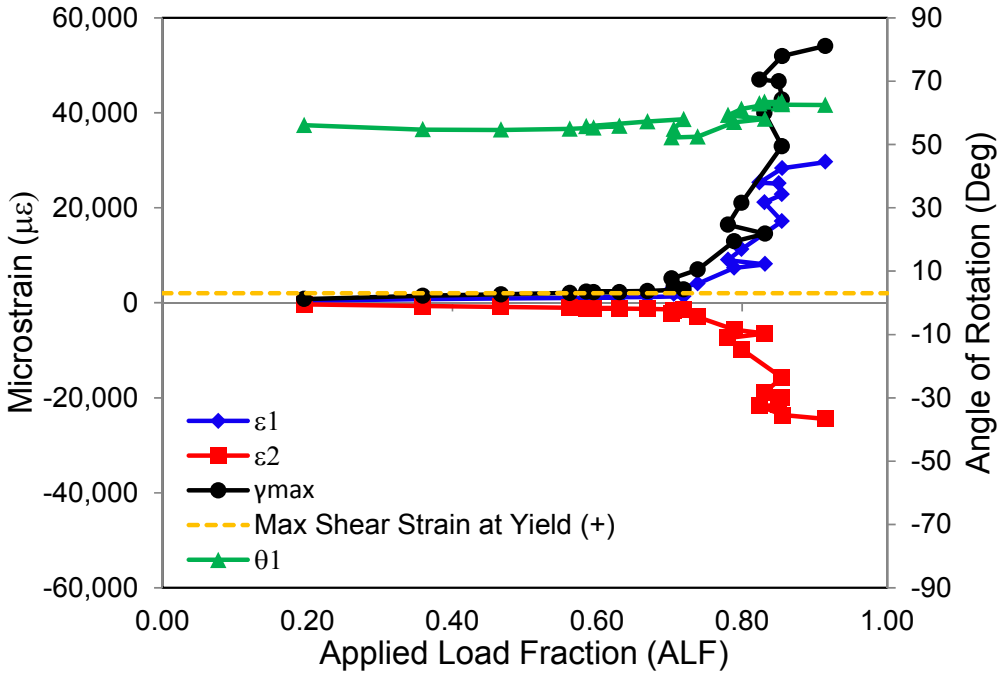

Figure G219. South gusset east bottom

DEAD GAUGE

Figure G220. North gusset west bottom

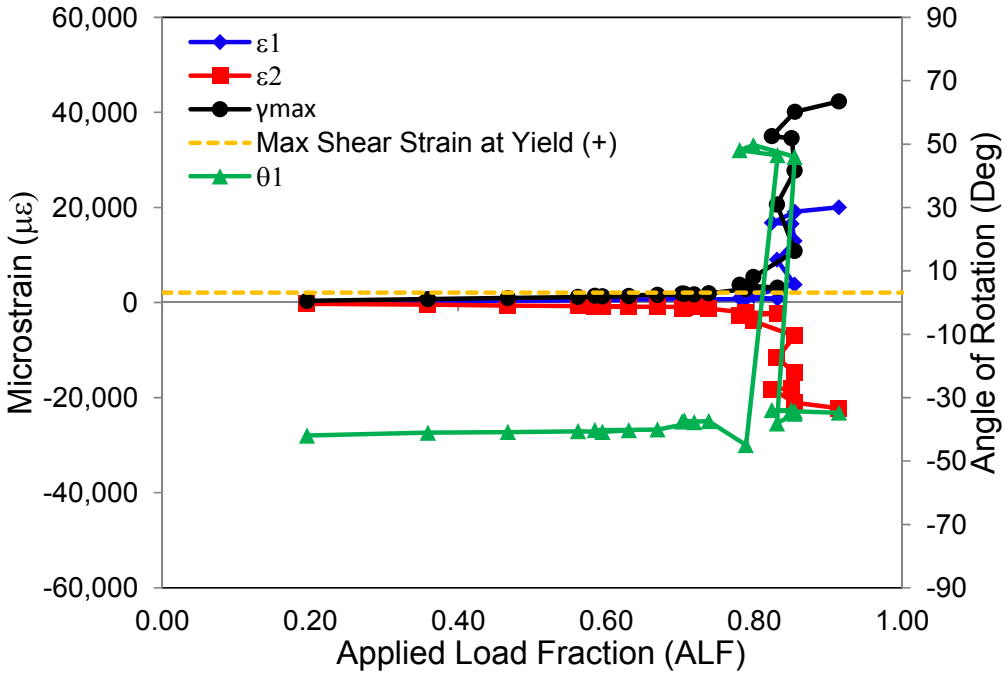

Figure G221. North gusset west mid bottom

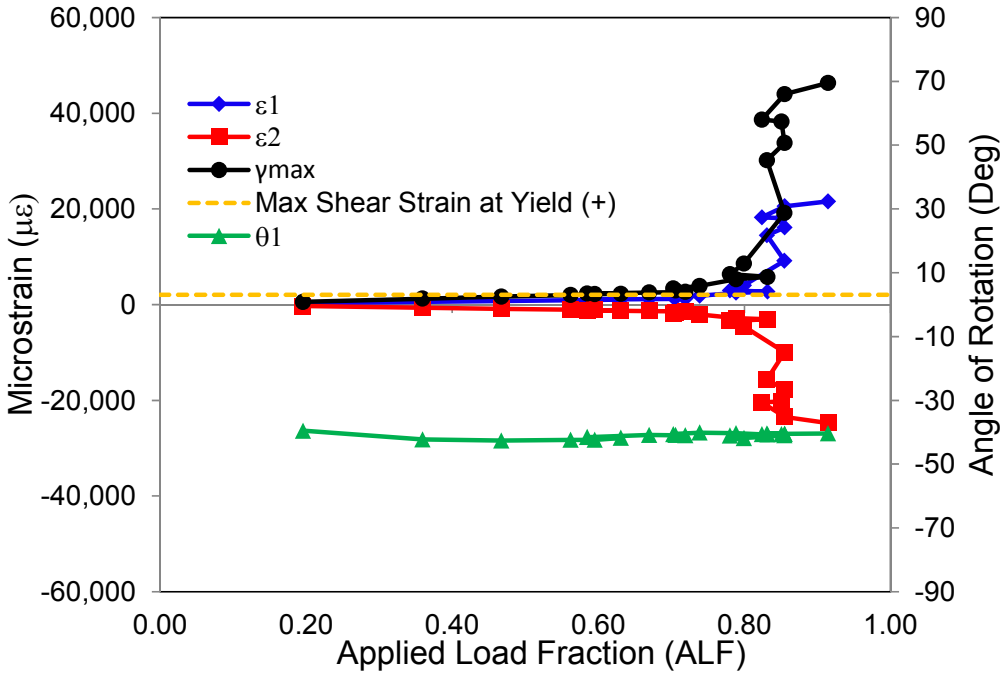

Figure G222. North gusset mid bottom

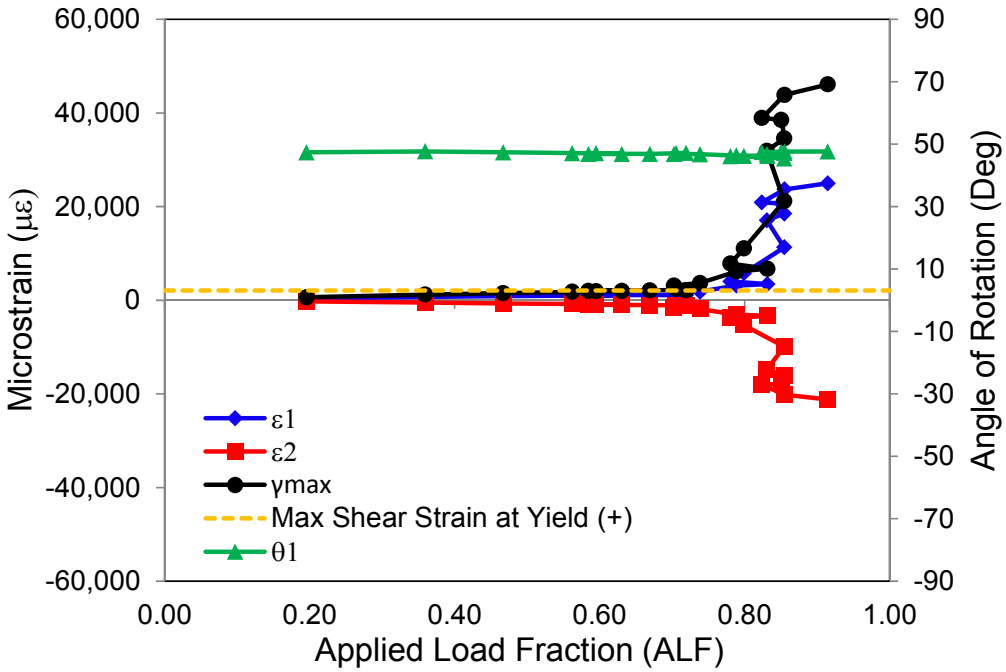

Figure G223. North gusset mid east bottom

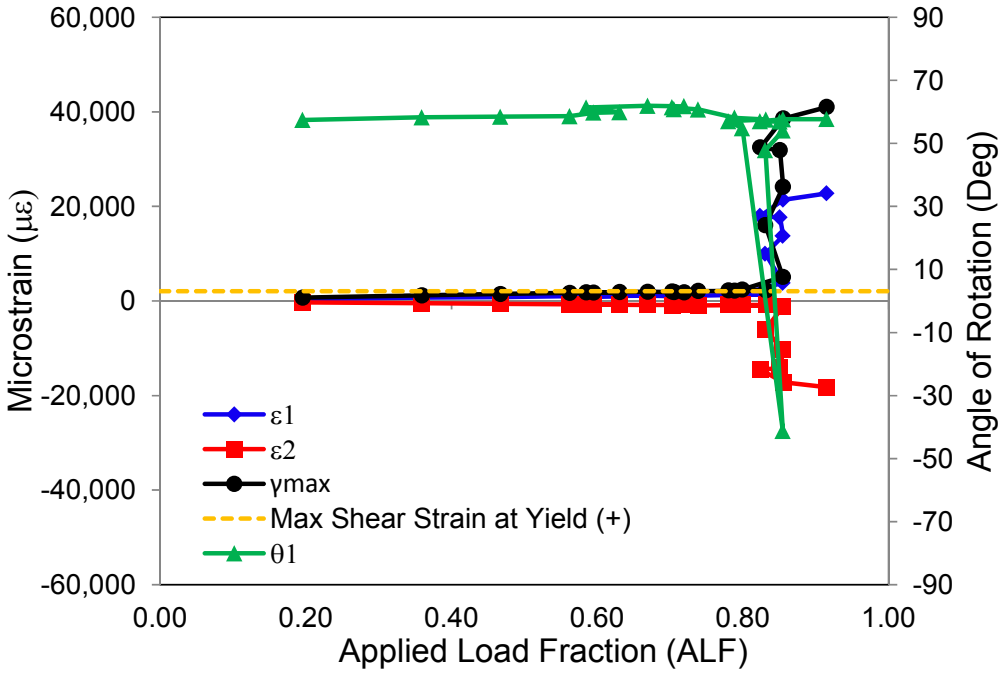

Figure G224. North gusset east bottom

Member Cross-Sectional Plots

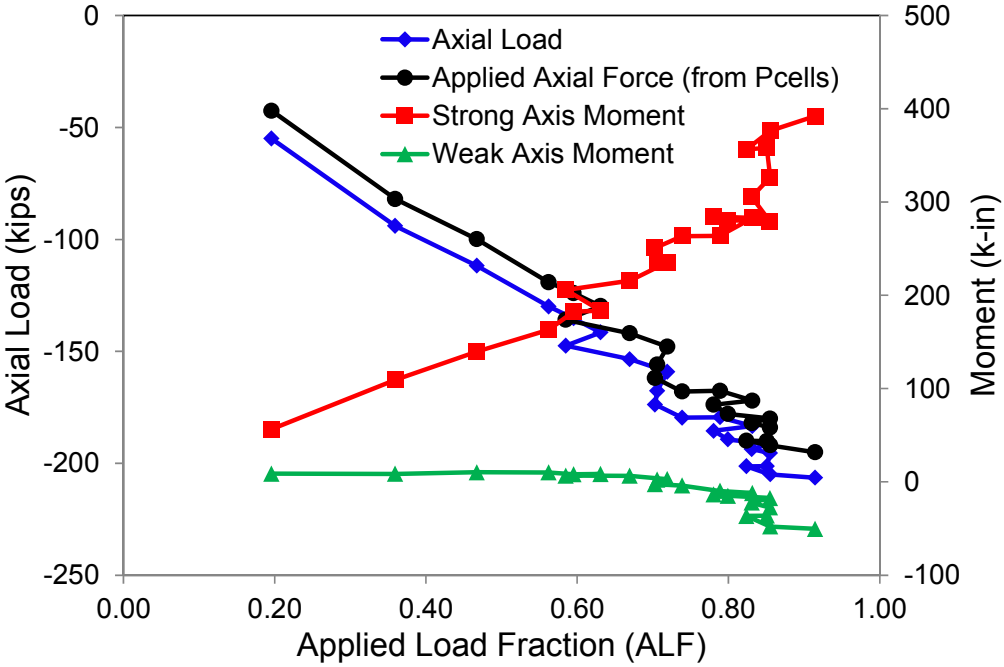

Figure G225. Vertical

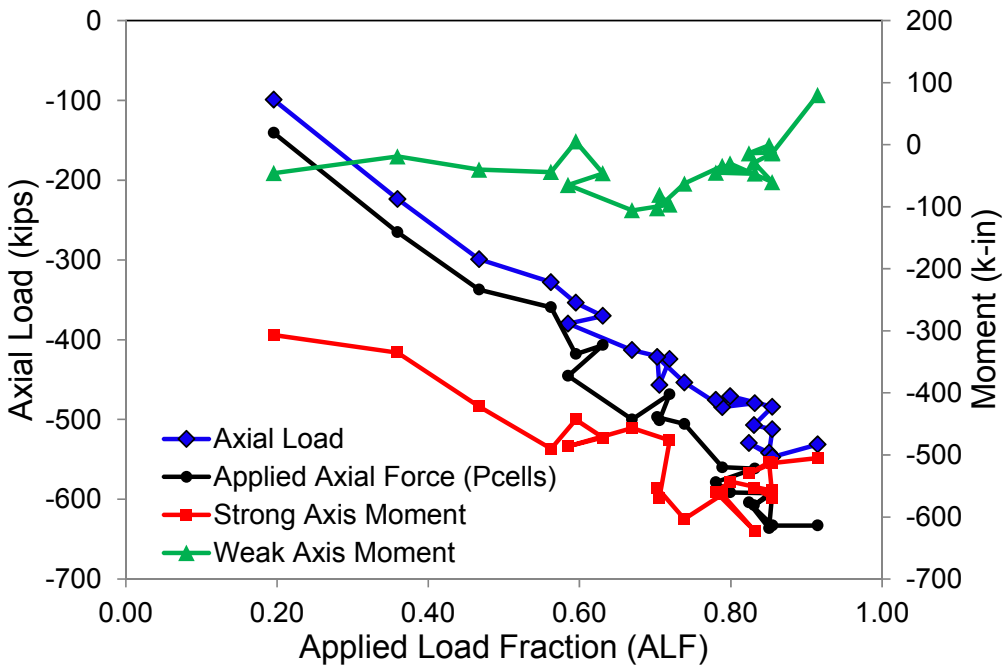

Figure G226. Compression Diagonal

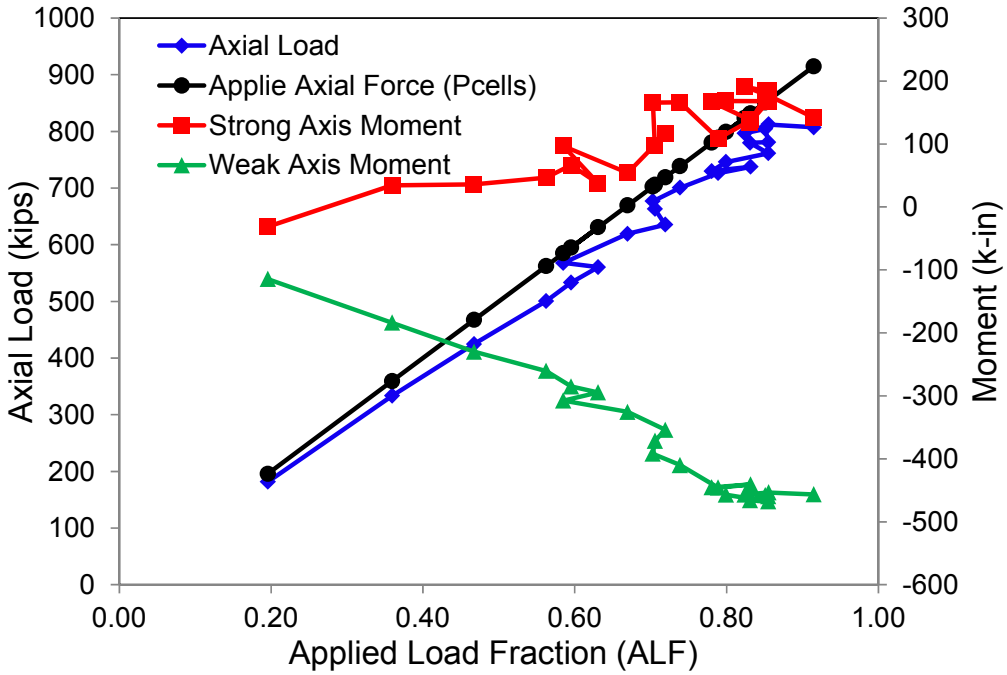

Figure G227. Tension Diagonal

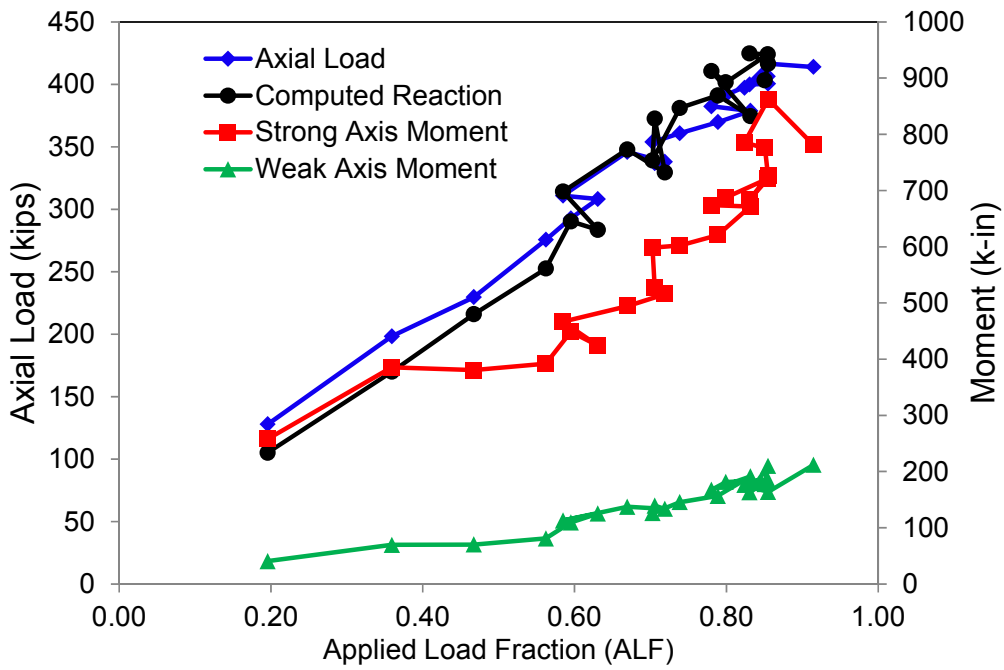

Figure G228. West Chord

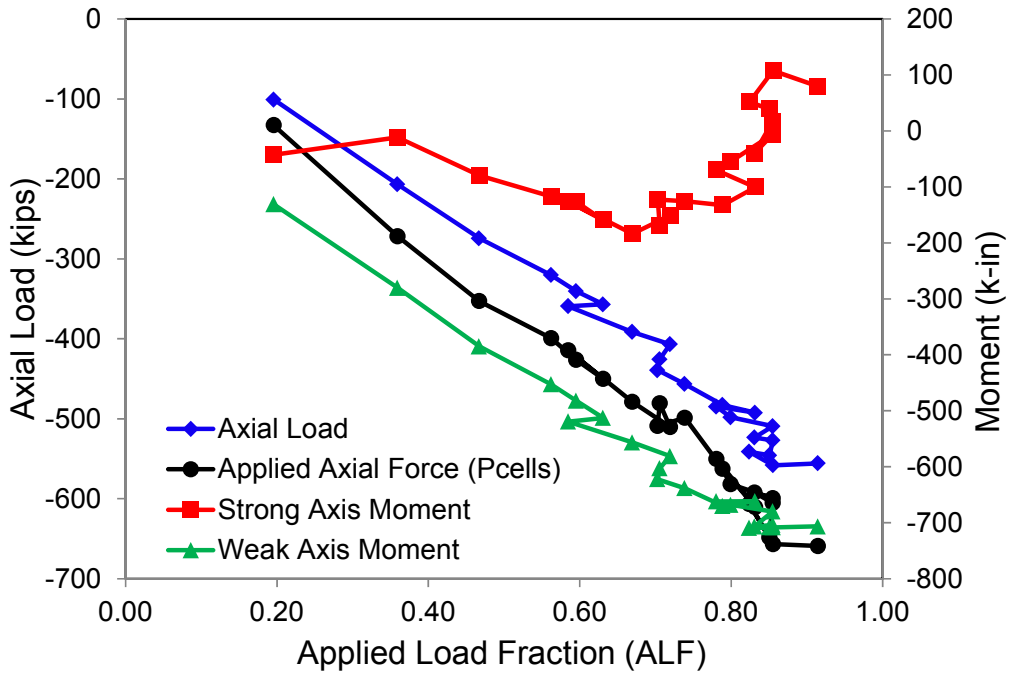

Figure G229. East Chord

Chord Load Shedding Plots

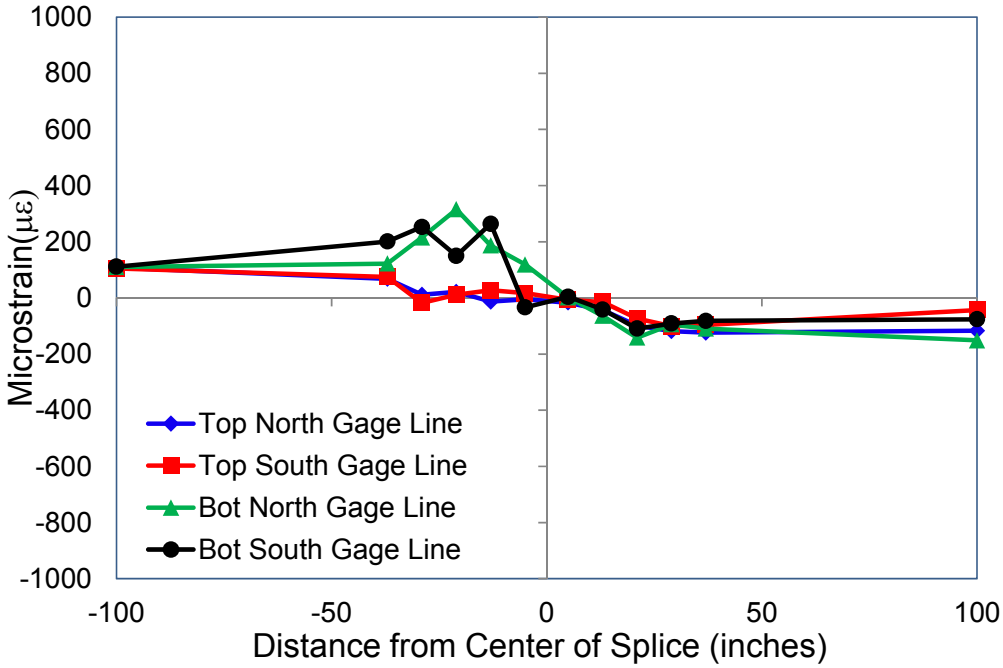

Figure G230. ALF=0.20

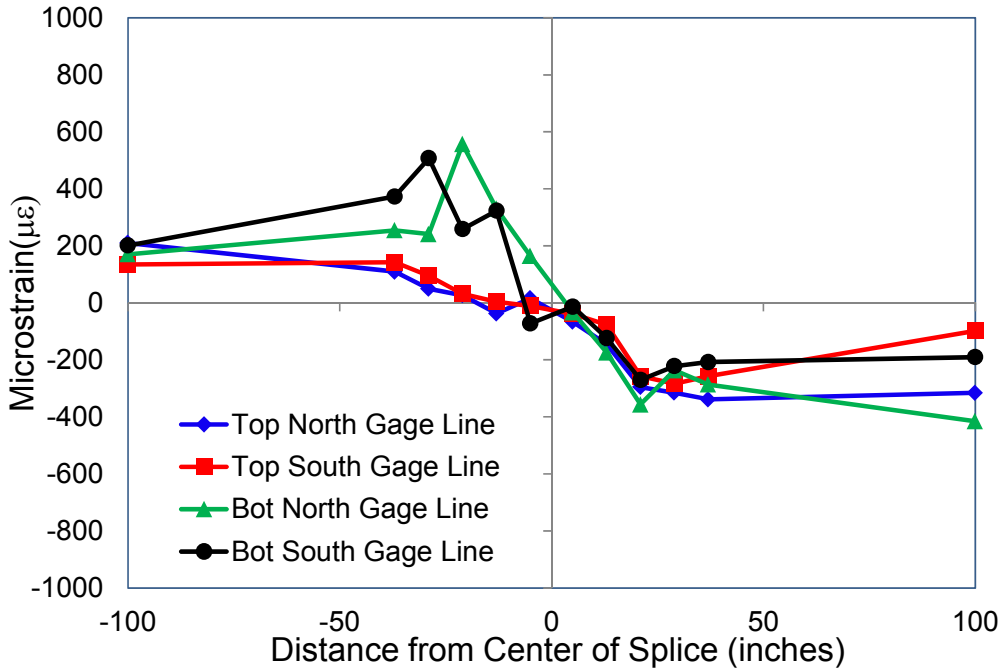

Figure G231. ALF=0.47

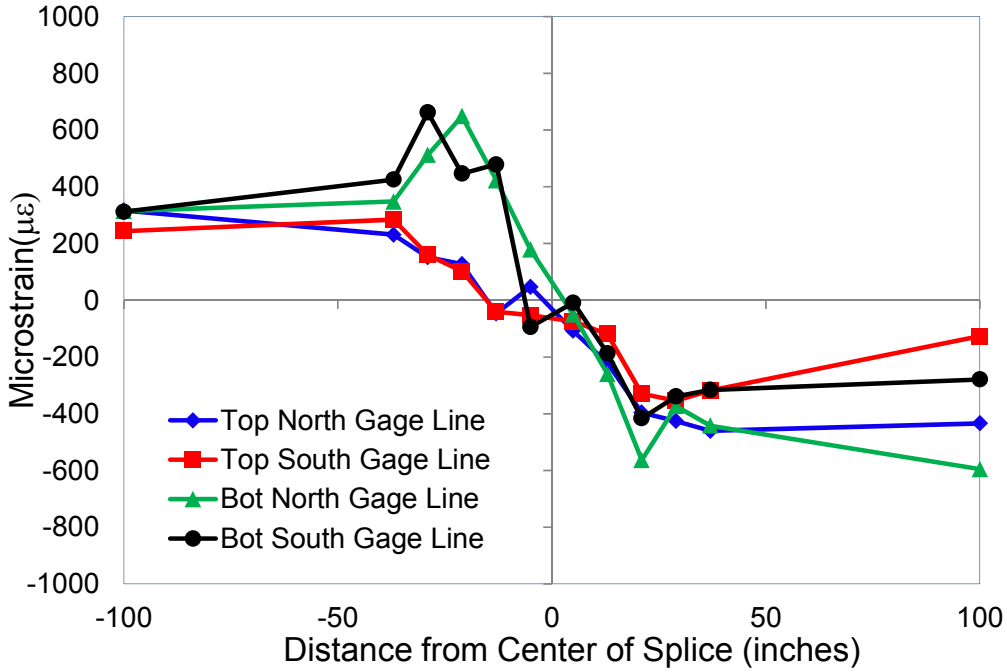

Figure G232. ALF=0.67

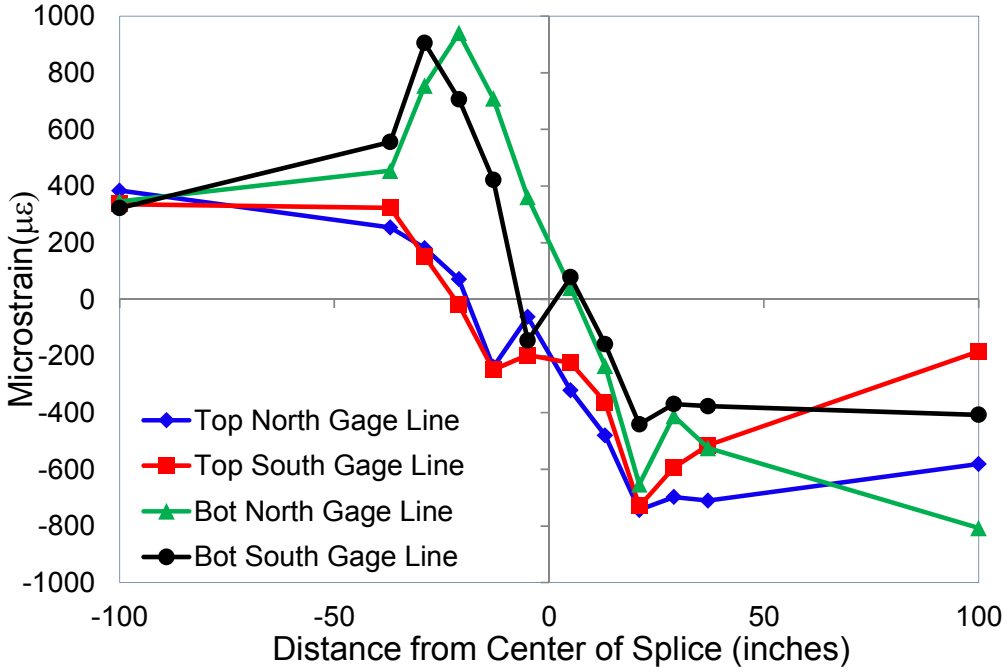

Figure G233. Max ALF=0.91

Uniaxial Gauge Plots

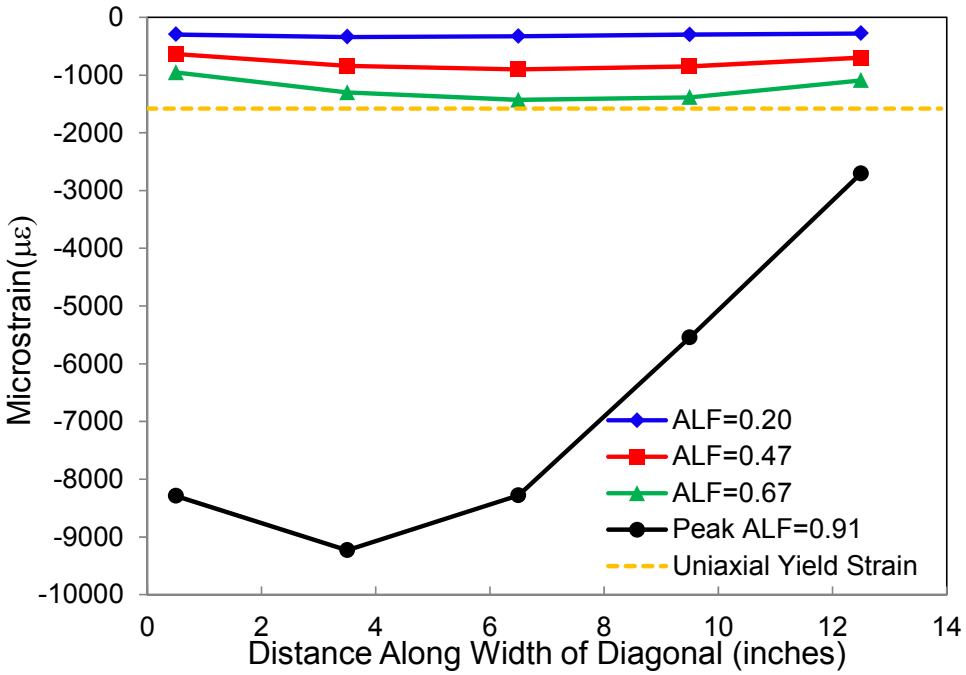

Figure G234. North Compression Diagonal

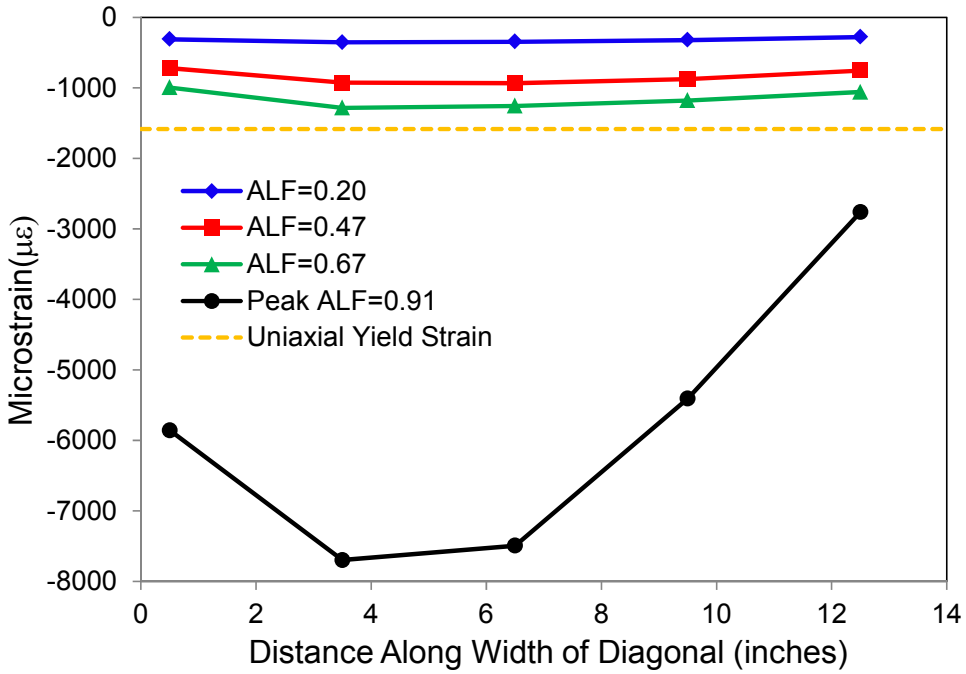

Figure G235. South Compression Diagonal

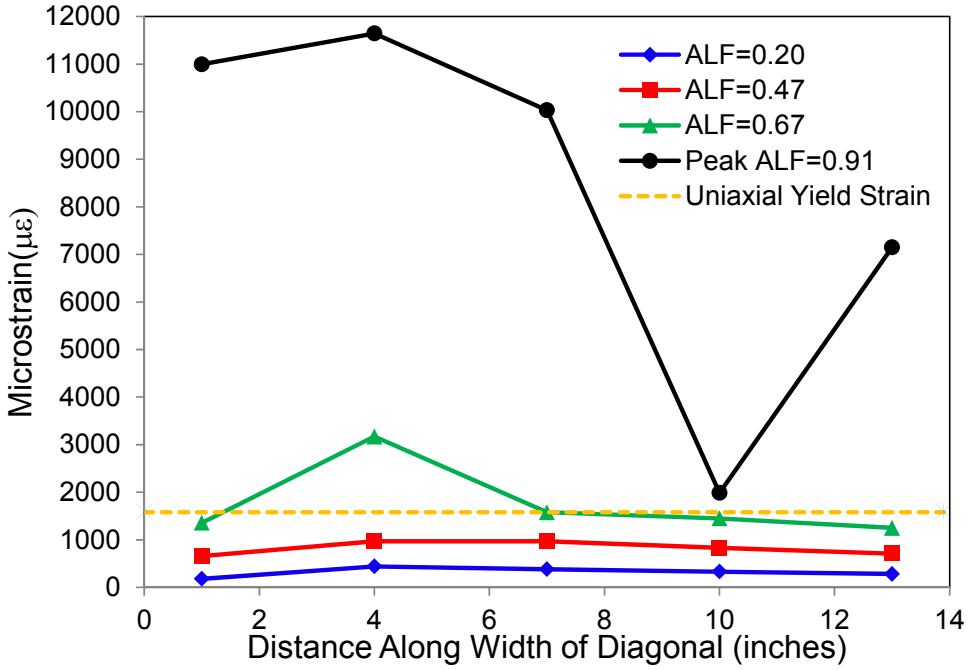

Figure G236. North Tension Diagonal

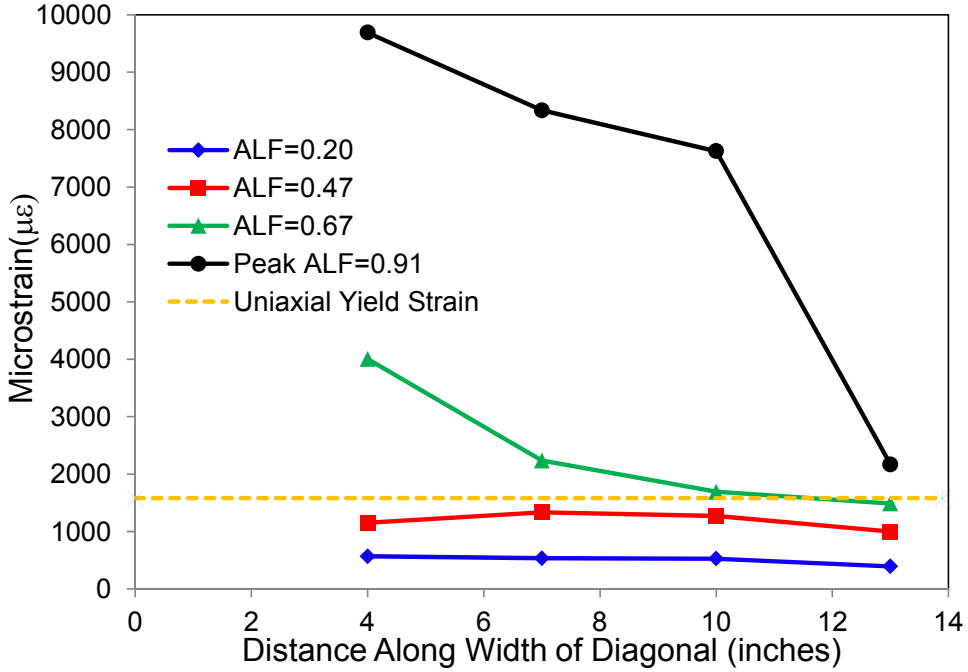

Figure G237. South Tension Diagonal

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Maximum Shear Strain Plots

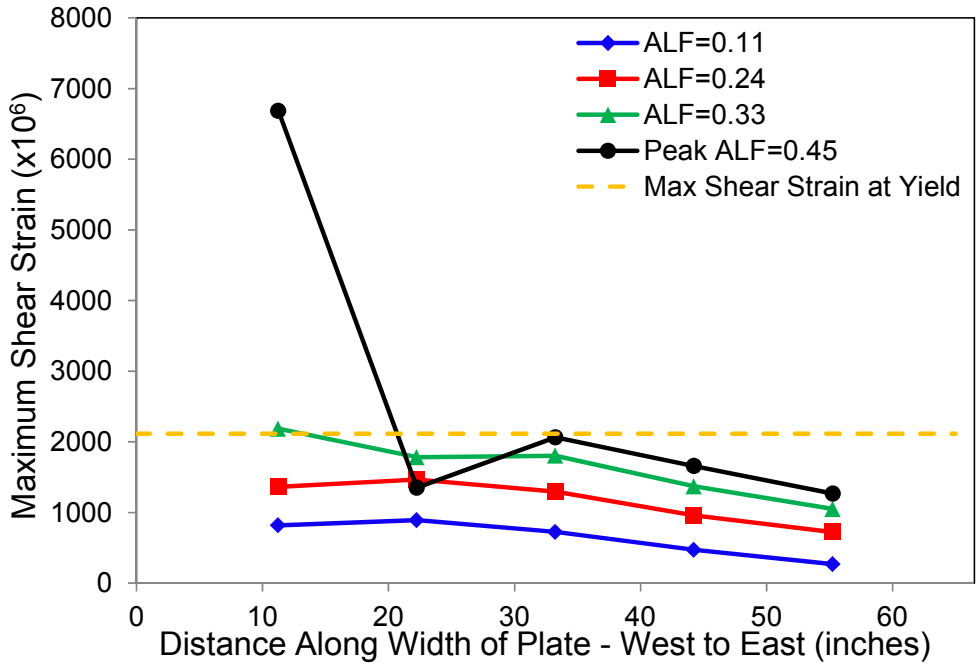

Figure G238. Horizontal line of rosettes above chord; south gusset plate

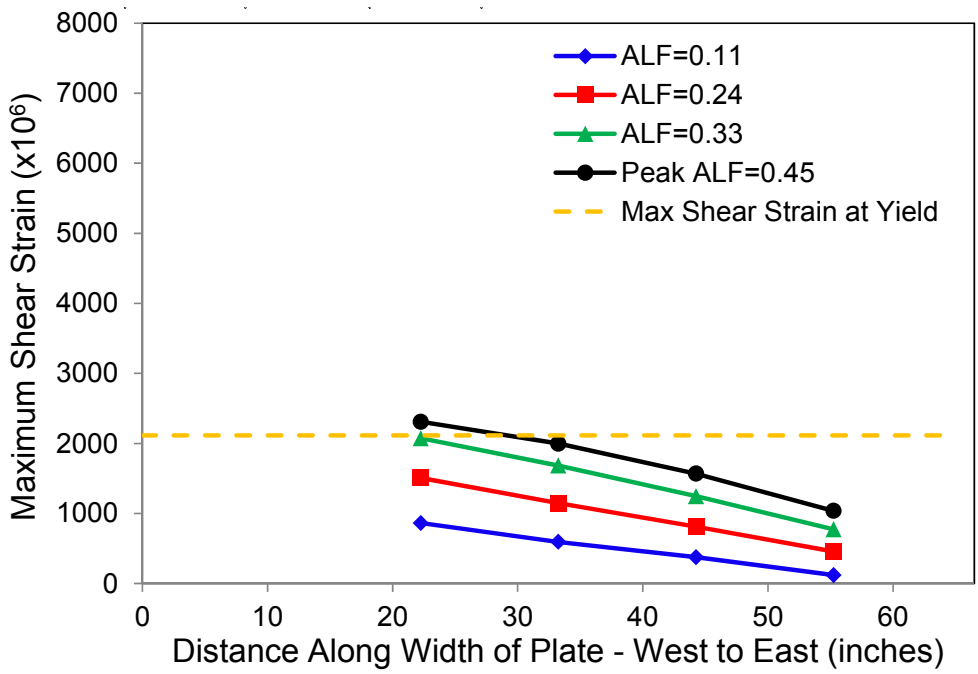

Figure G239. Horizontal line of rosettes above chord; north gusset plate

Variations in Principal Strain

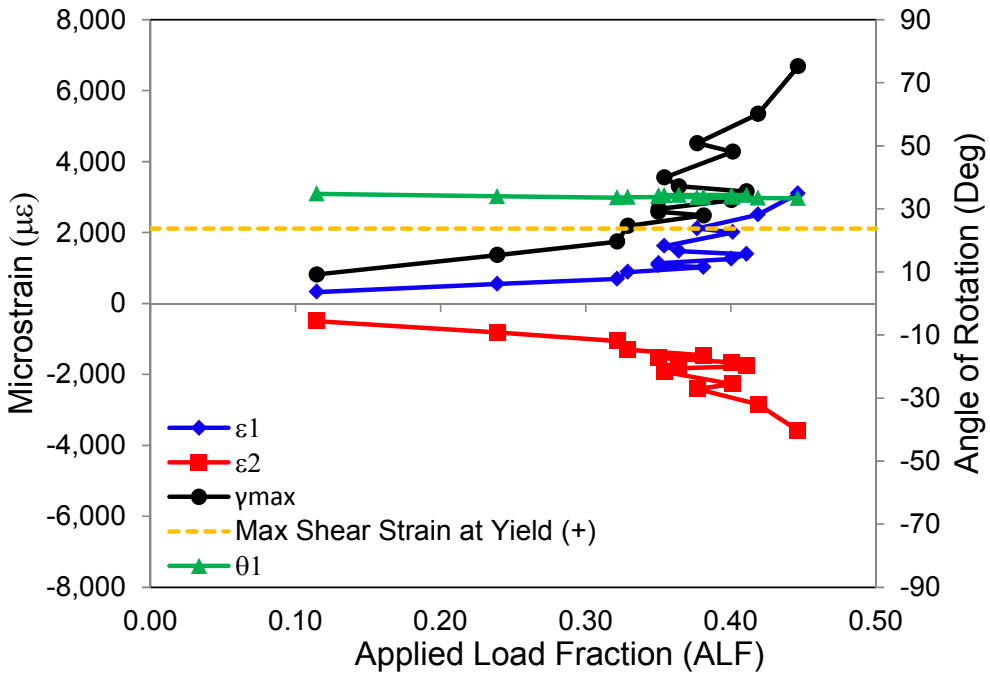

Figure G240. South gusset west bottom

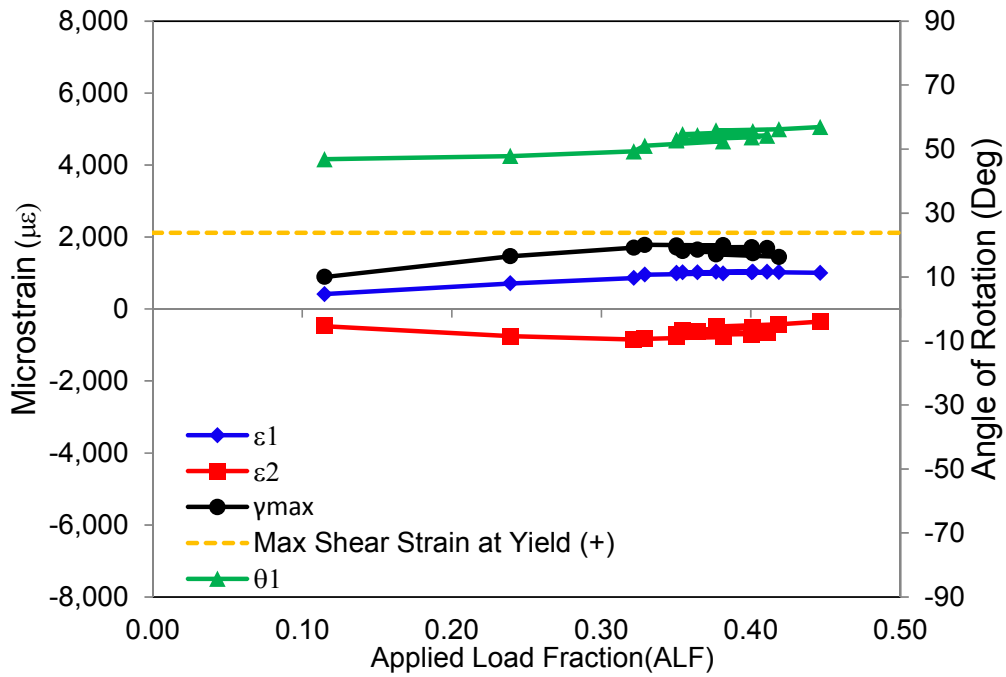

Figure G241. South gusset west mid bottom

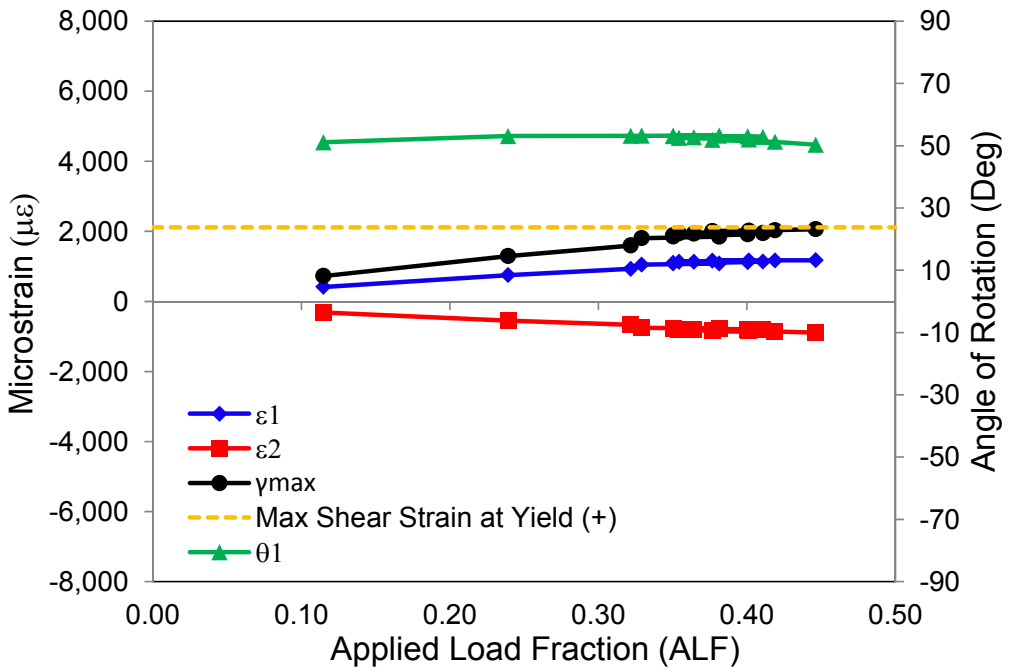

Figure G242. South gusset mid bottom

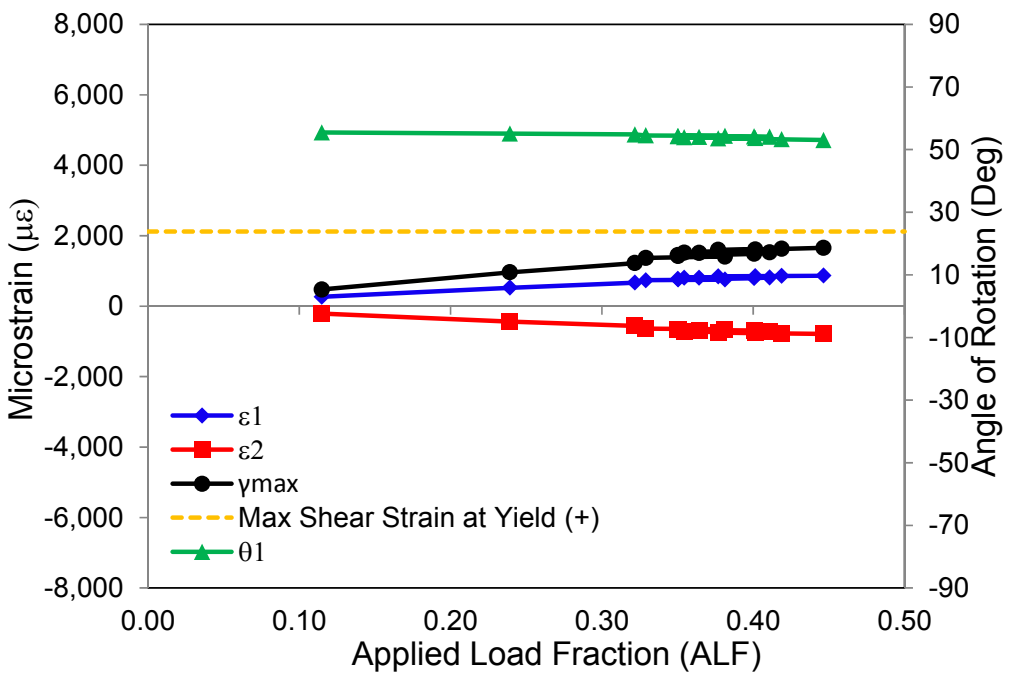

Figure G243. South gusset east mid bottom

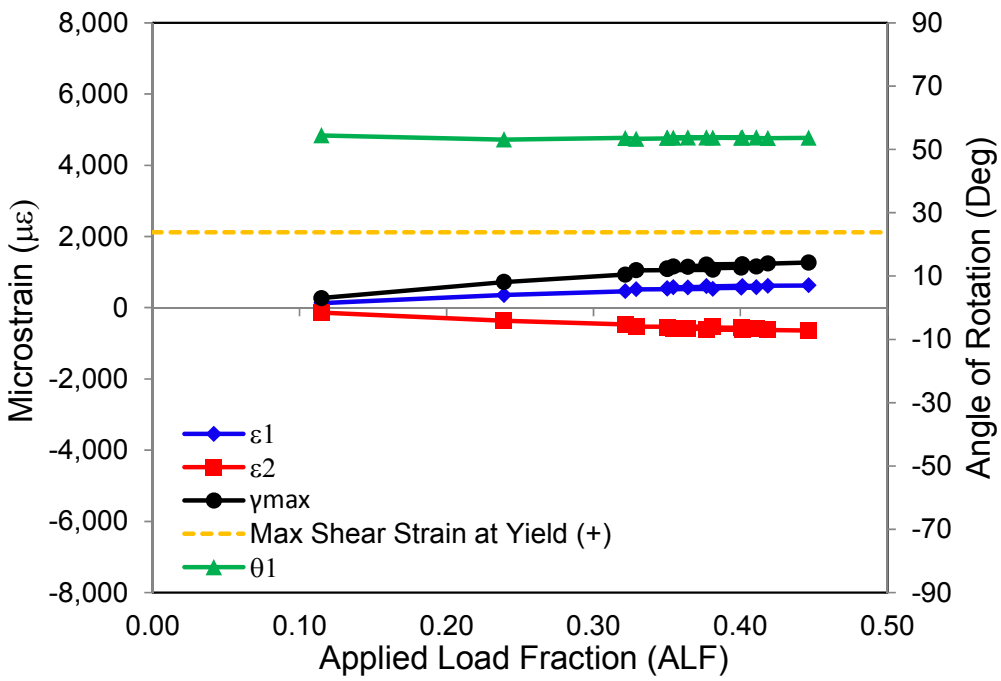

Figure G244. South gusset east bottom

DEAD GAUGE

Figure G245. North gusset west bottom

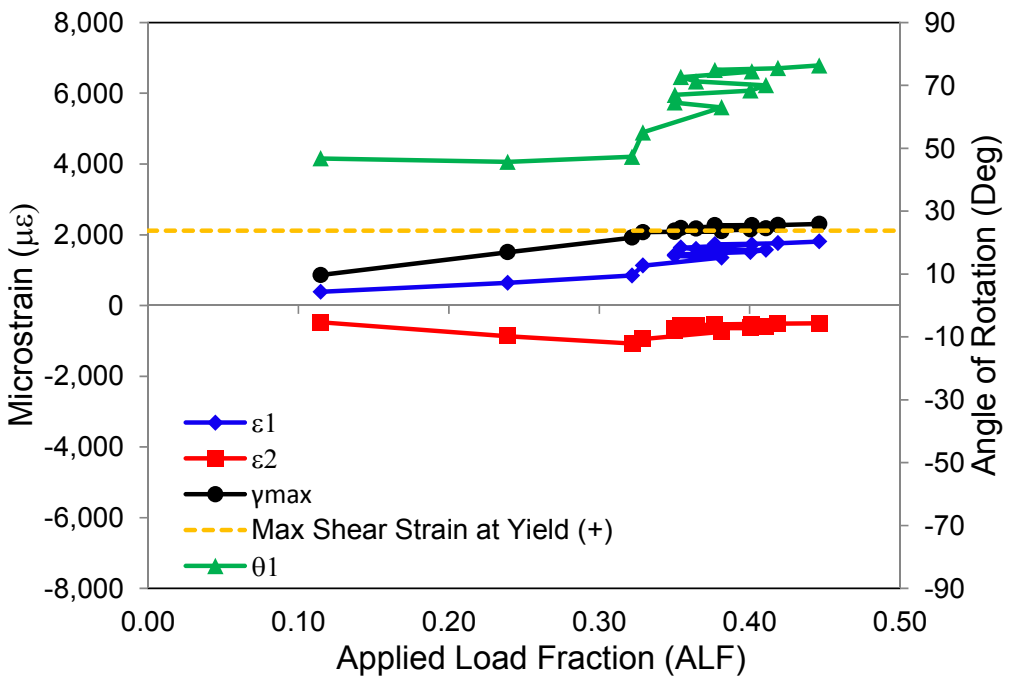

Figure G246. North gusset west mid bottom

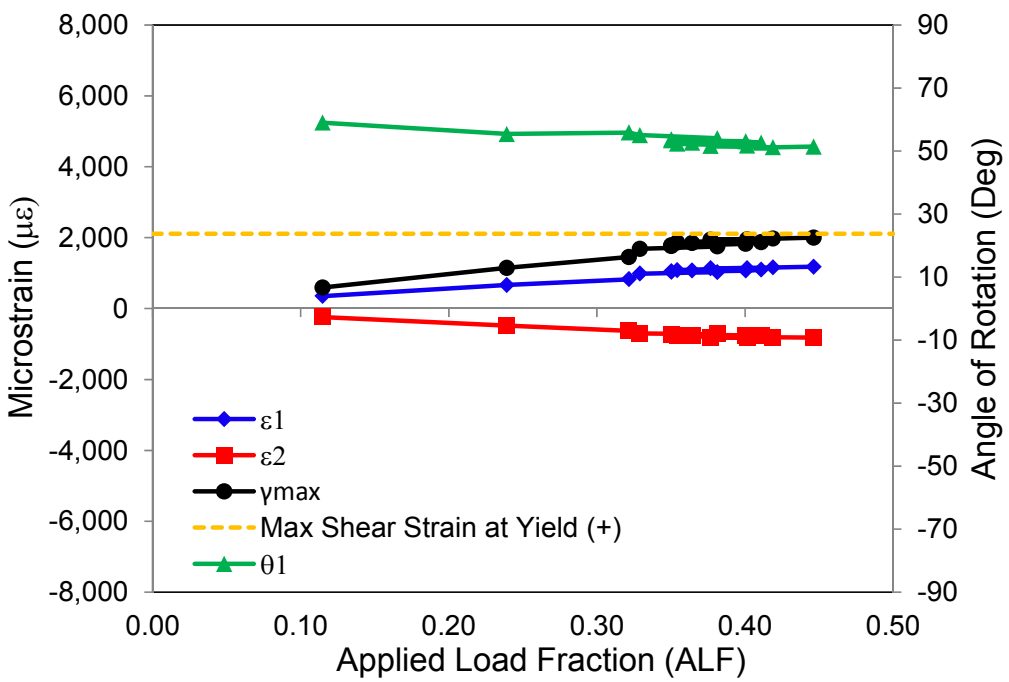

Figure G247. North gusset mid bottom

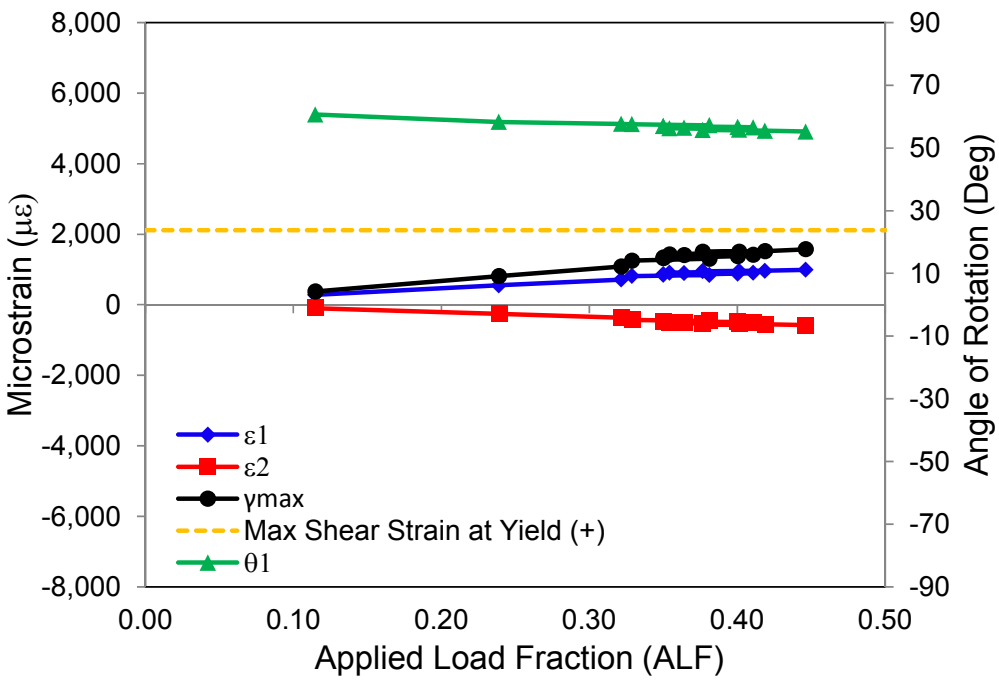

Figure G248. North gusset mid east bottom

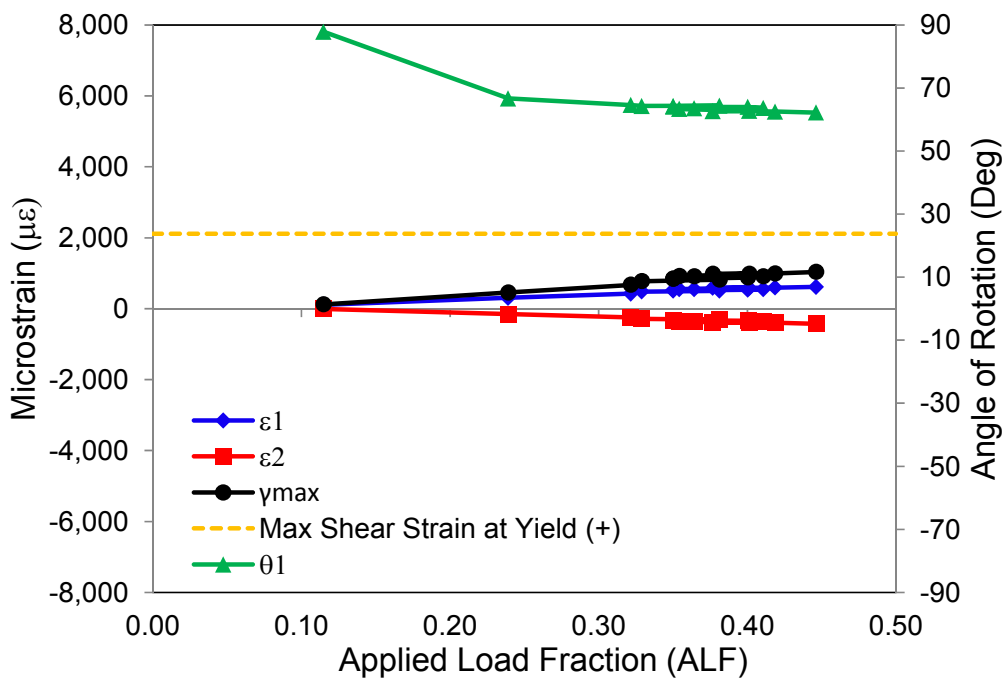

Figure G249. North gusset east bottom

Member Cross-Sectional Plots

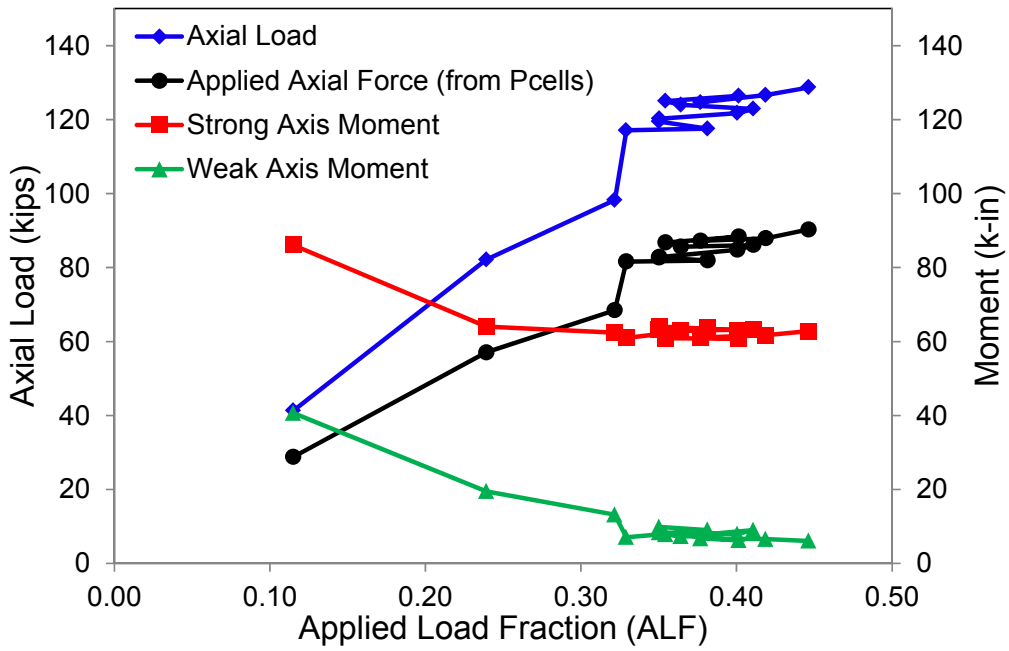

Figure G250. Vertical

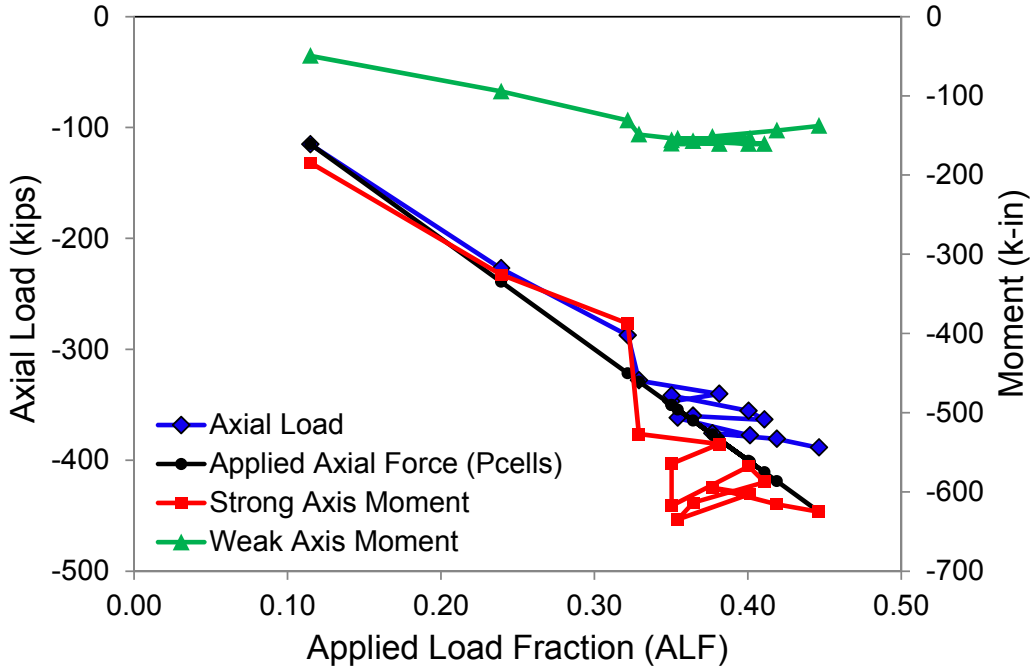

Figure G251. Compression Diagonal

DEAD GAUGES

Figure G252. Tension Diagonal

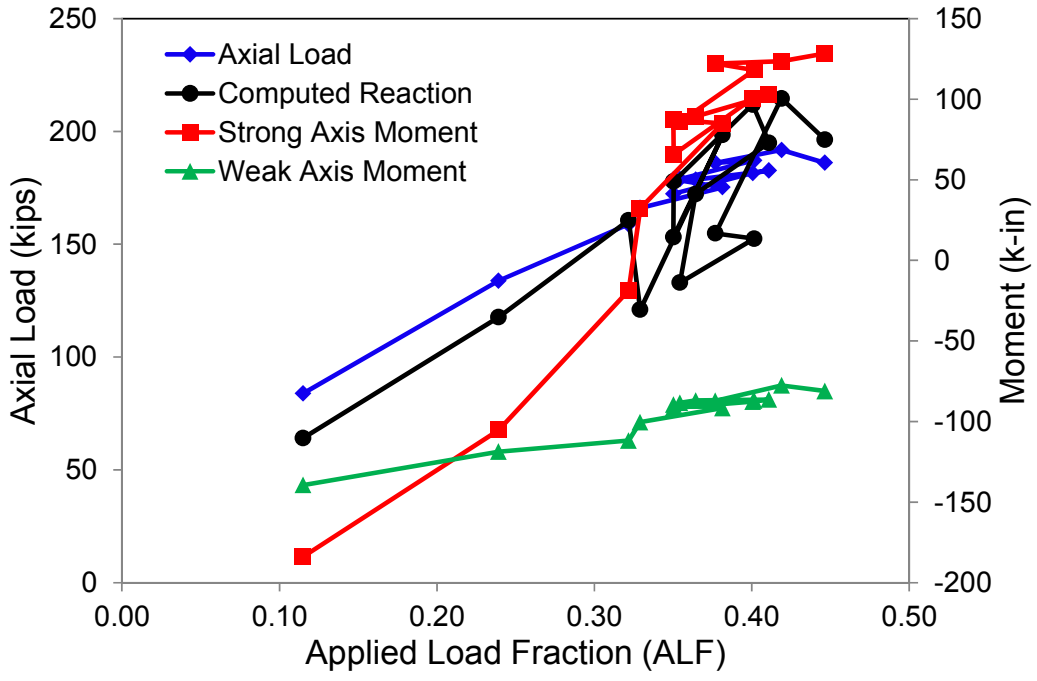

Figure G253. West Chord

DEAD GAUGES

Figure G254. East Chord

Chord Load Shedding Plots

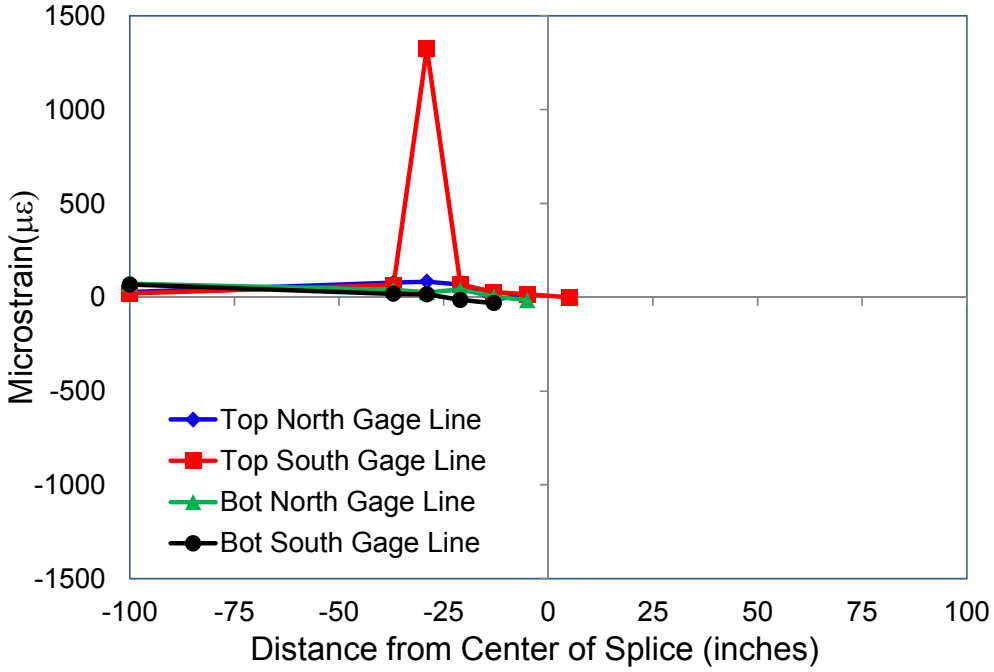

Figure G255. ALF=0.11

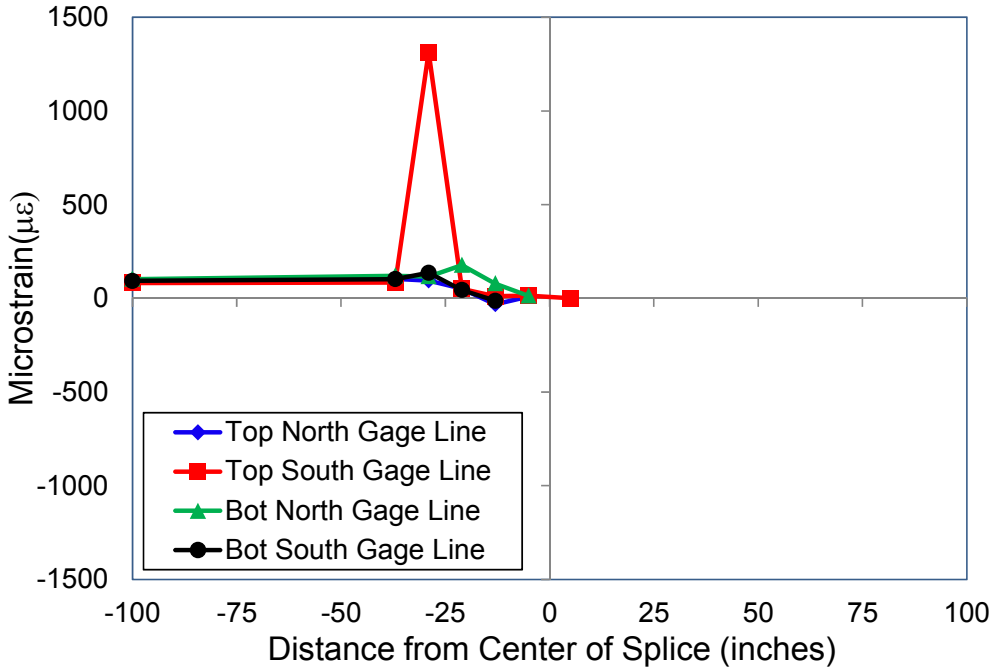

Figure G256. ALF=0.24

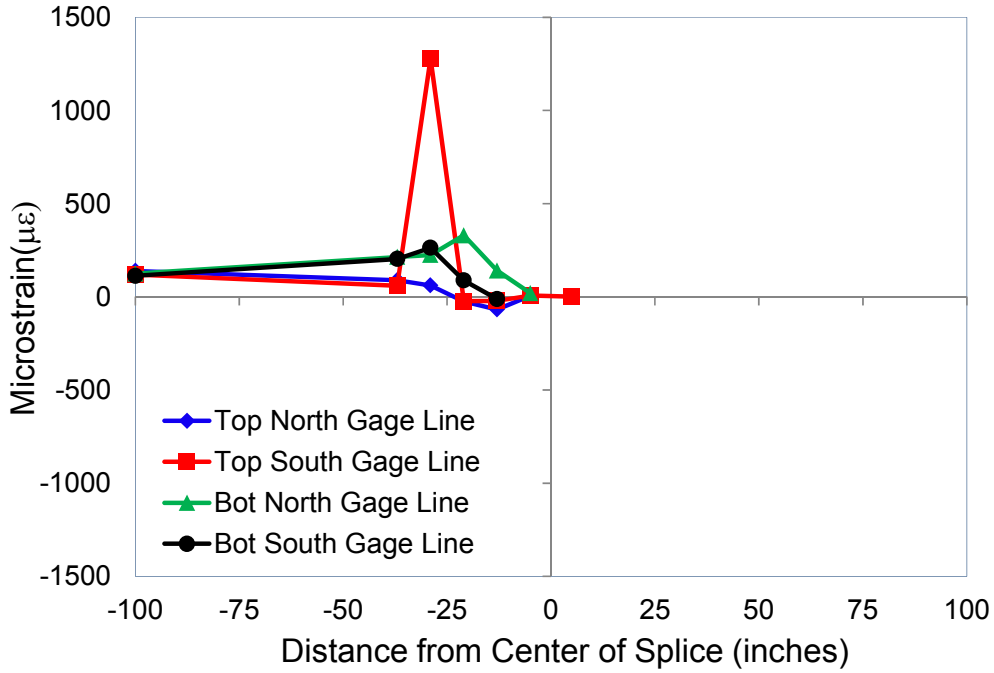

Figure G257. ALF=0.33

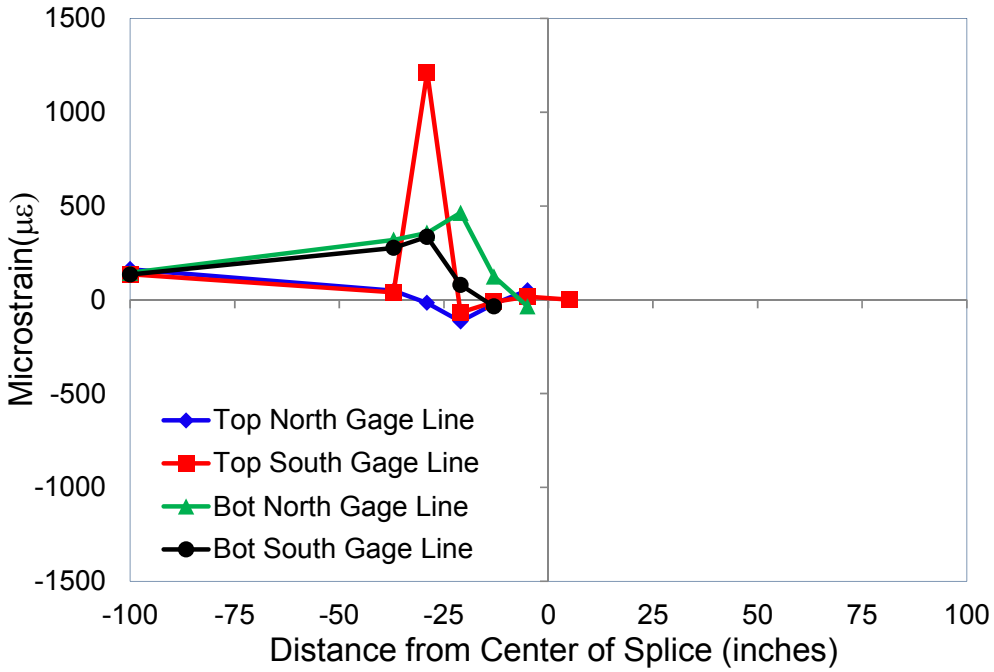

Figure G258. Max ALF=0.45

Uniaxial Gauge Plots

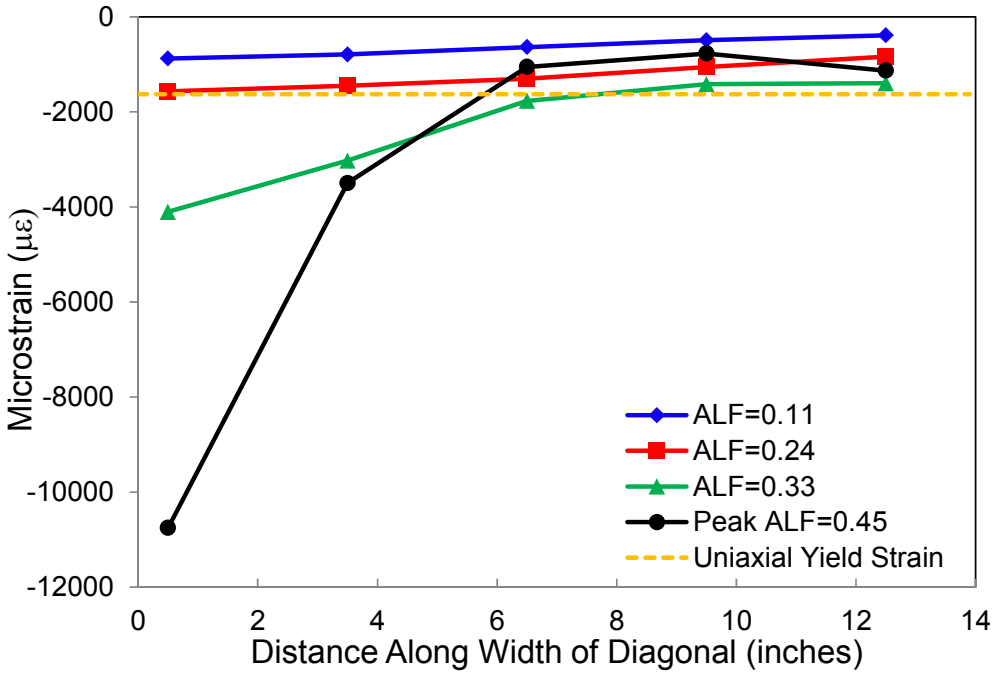

Figure G259. North Compression Diagonal

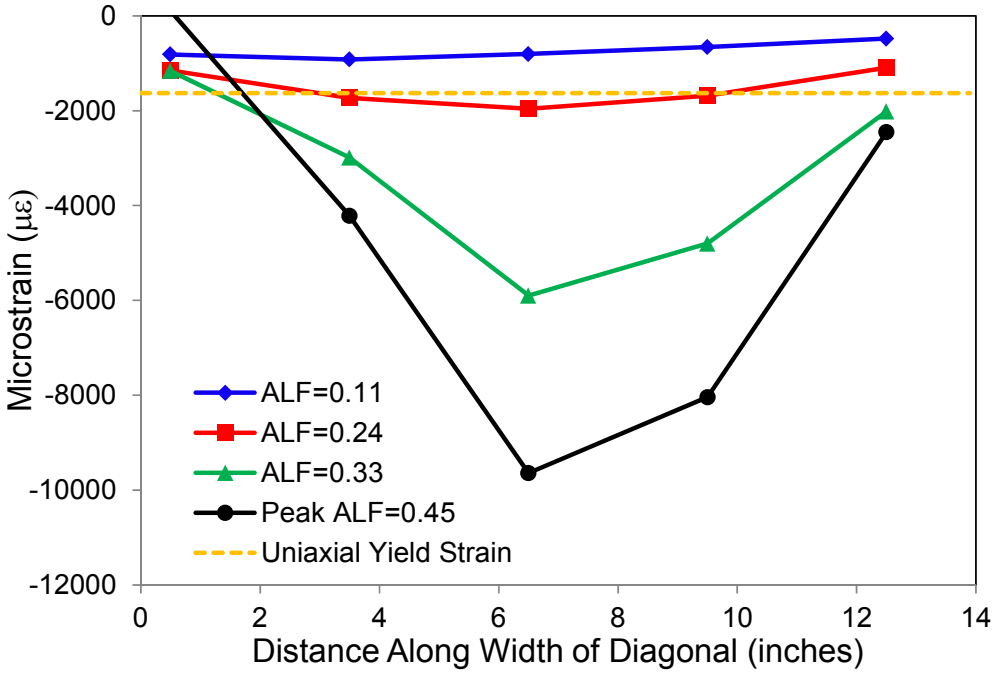

Figure G260. South Compression Diagonal

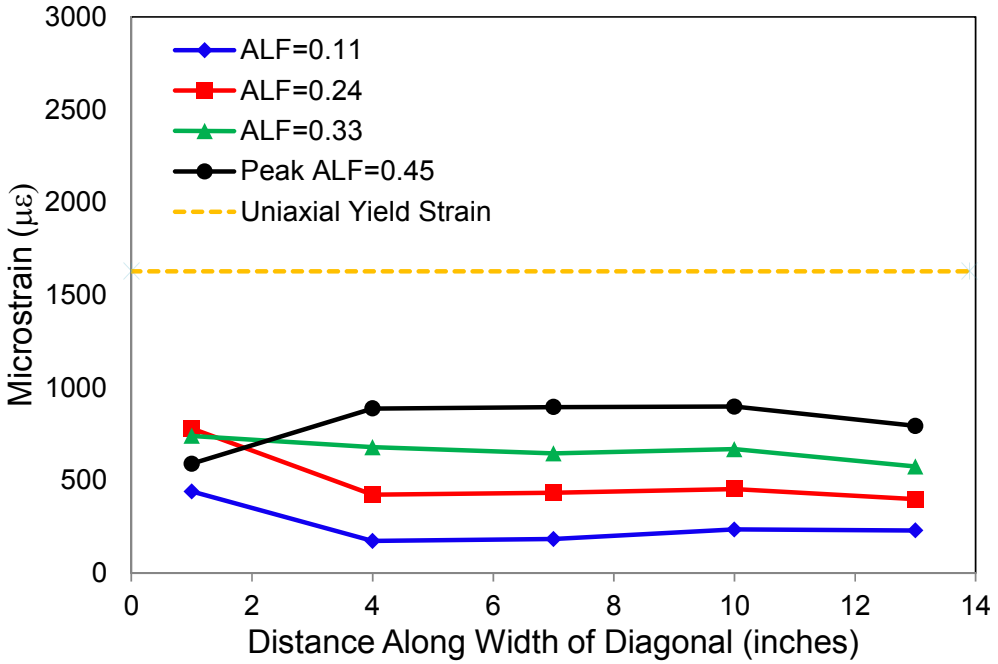

Figure G261. North Tension Diagonal

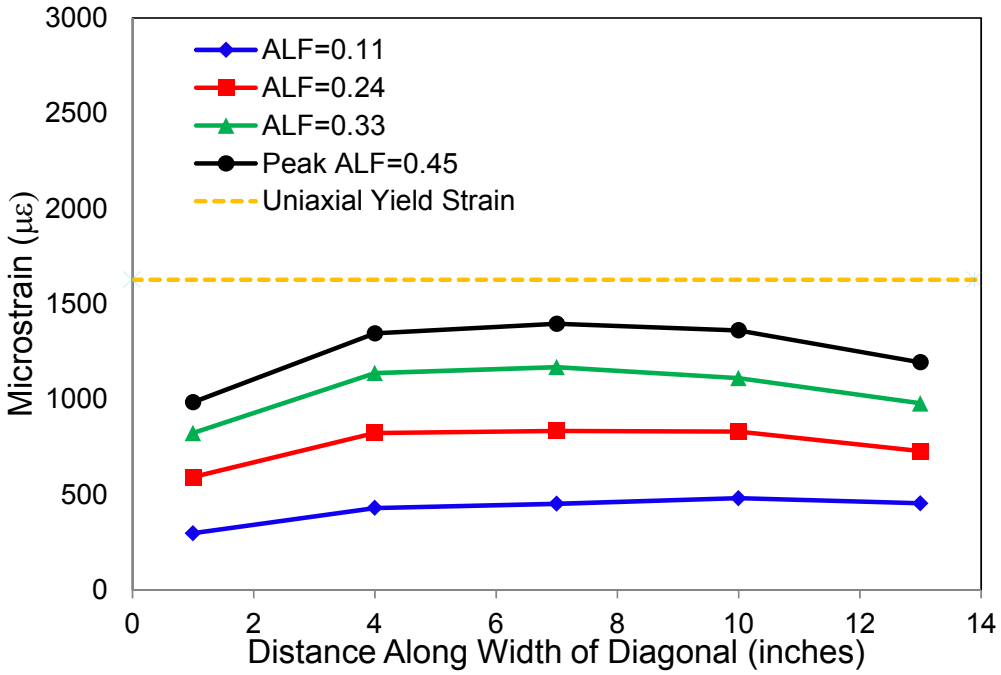

Figure G262. South Tension Diagonal

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Maximum Shear Strain Plots

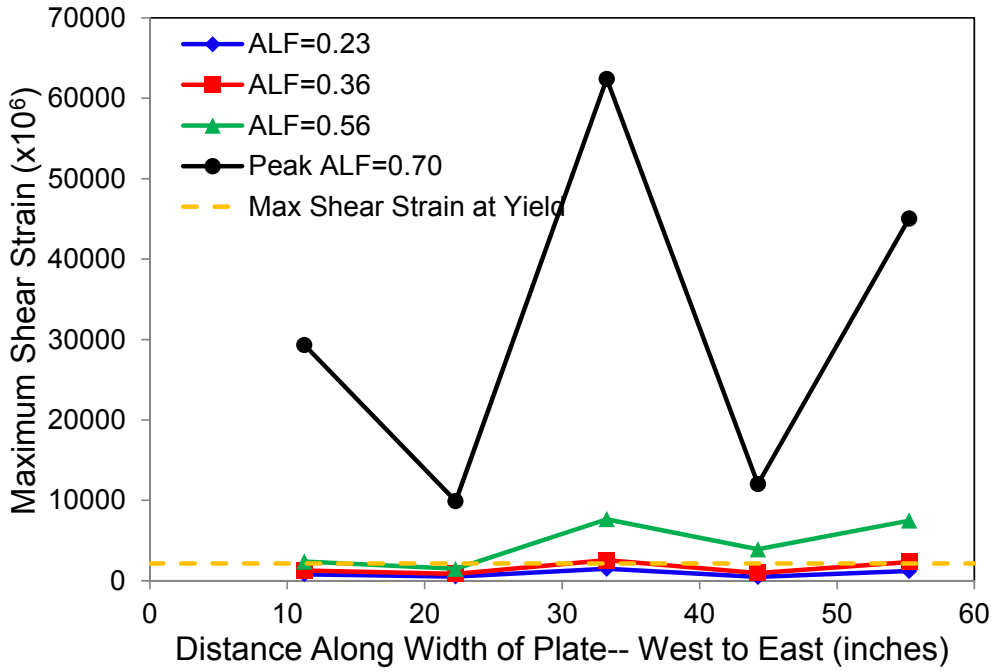

Figure G263. Horizontal line of rosettes above chord; south gusset plate

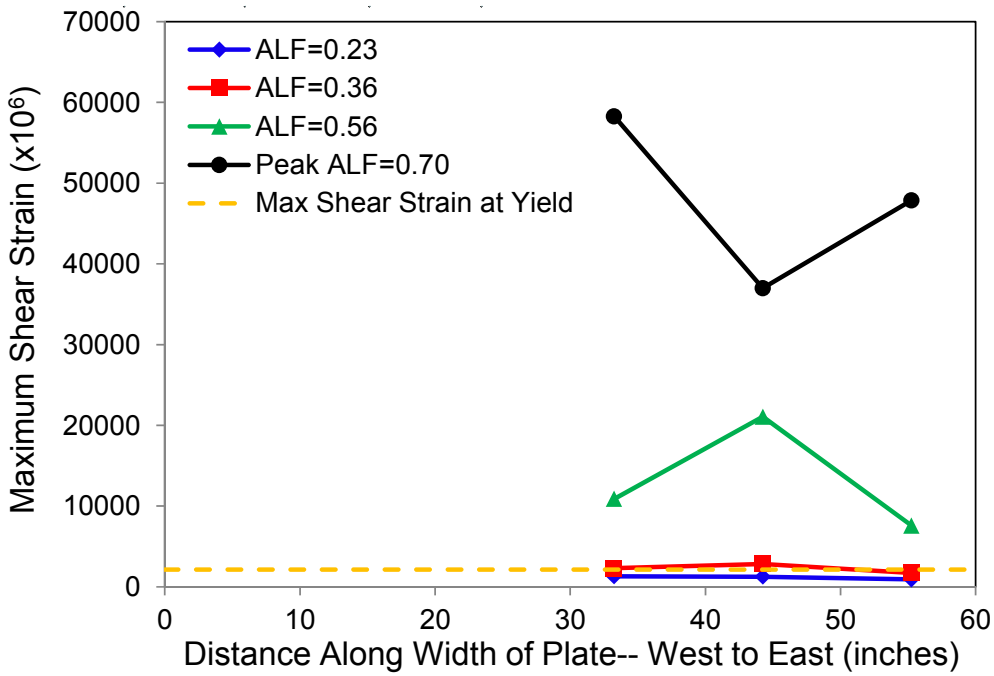

Figure G264. Horizontal line of rosettes above chord; north gusset plate

Variations in Principal Strain

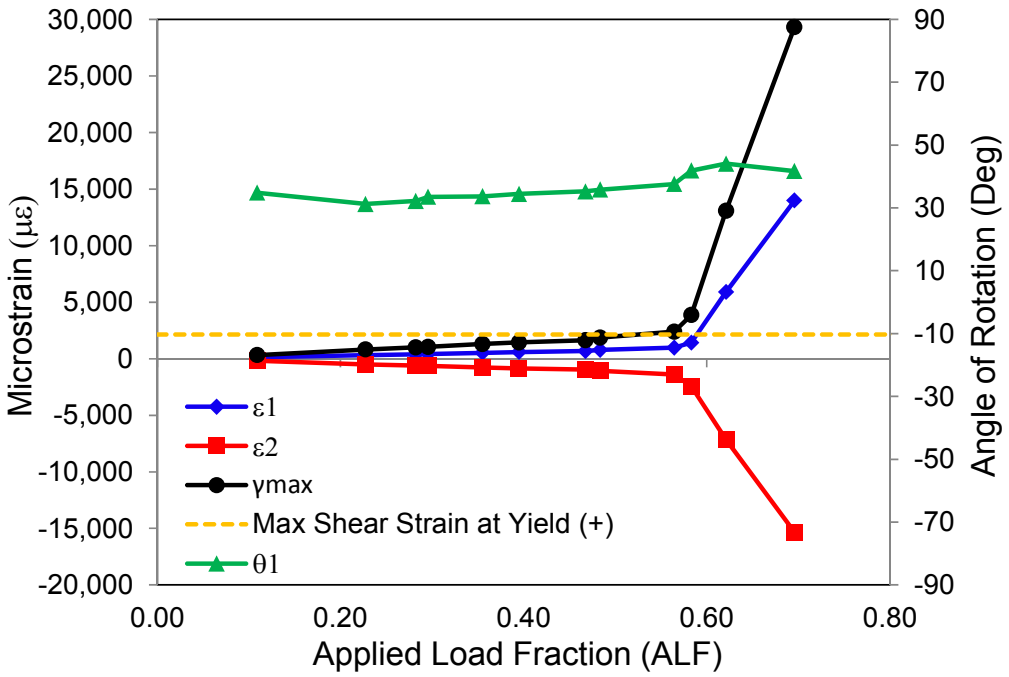

Figure G265. South gusset west bottom

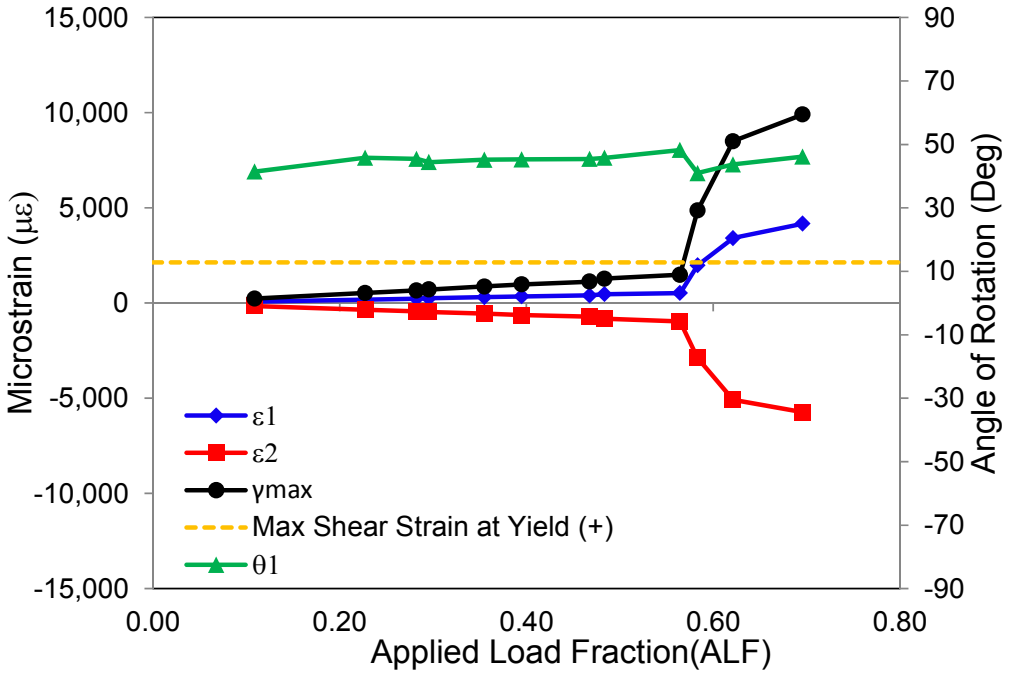

Figure G266. South gusset west mid bottom

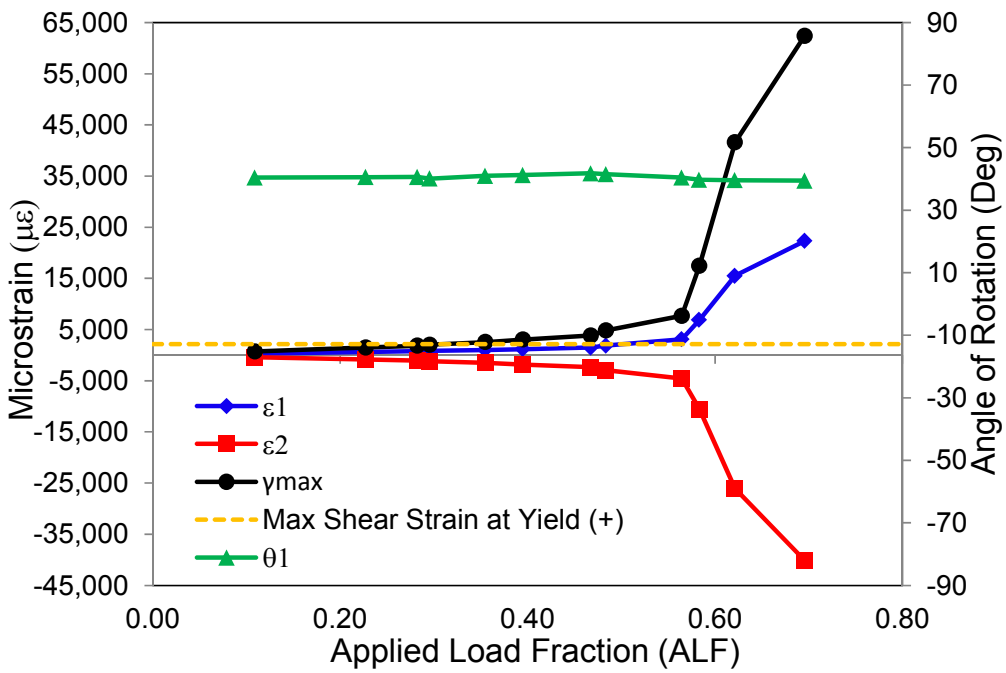

Figure G267. South gusset mid bottom

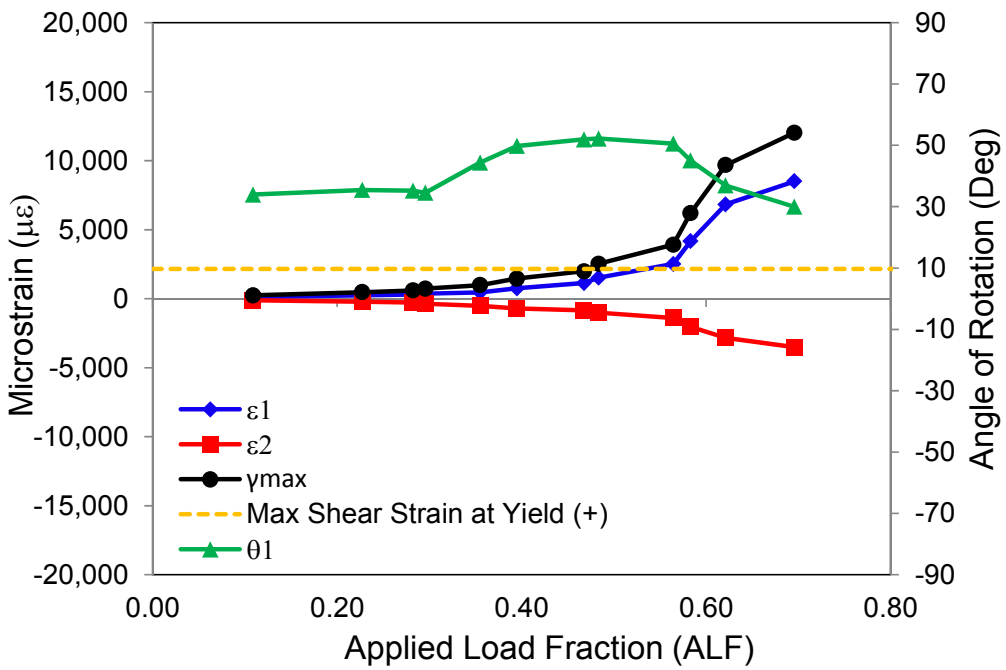

Figure G268. South gusset east mid bottom

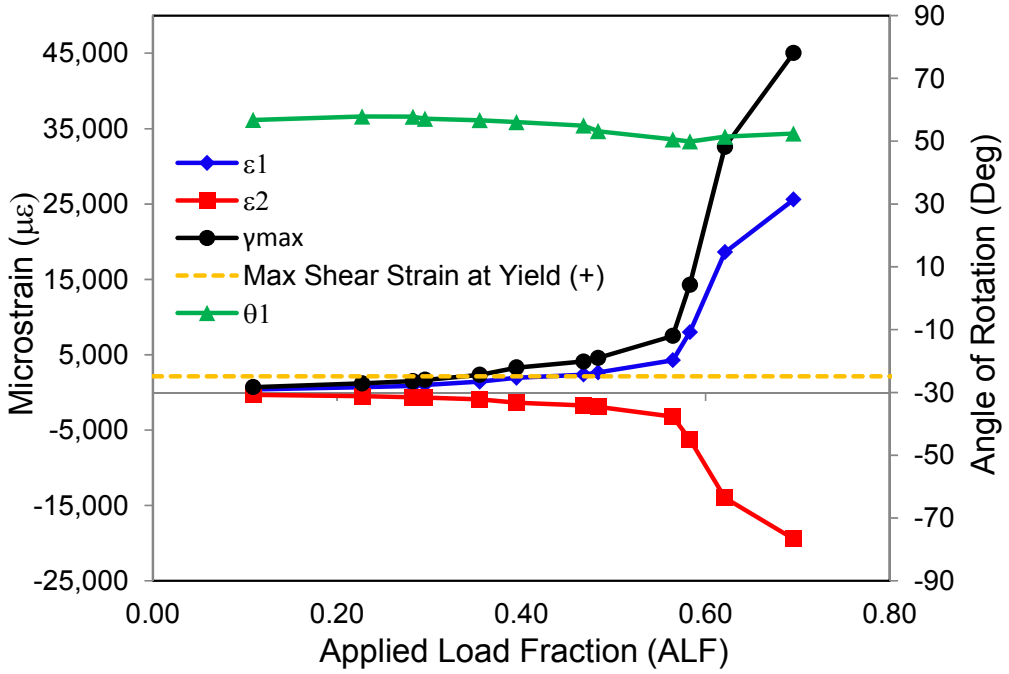

Figure G269. South gusset east bottom

DEAD GAUGE

Figure G270. North gusset west bottom

DEAD GUAGE

Figure G271. North gusset west mid bottom

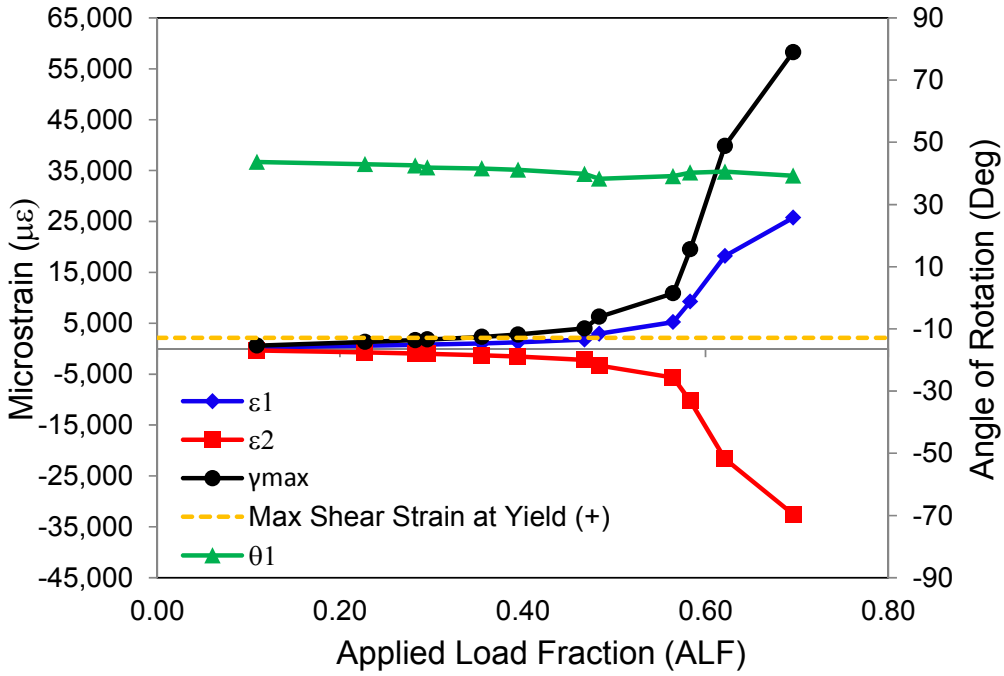

Figure G272. North gusset mid bottom

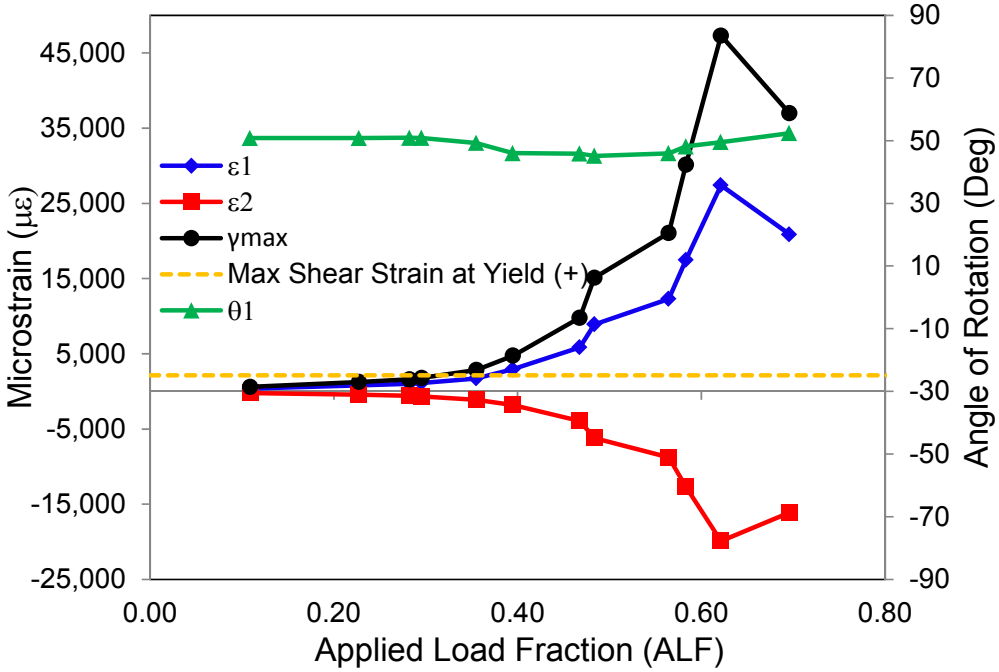

Figure G273. North gusset mid east bottom

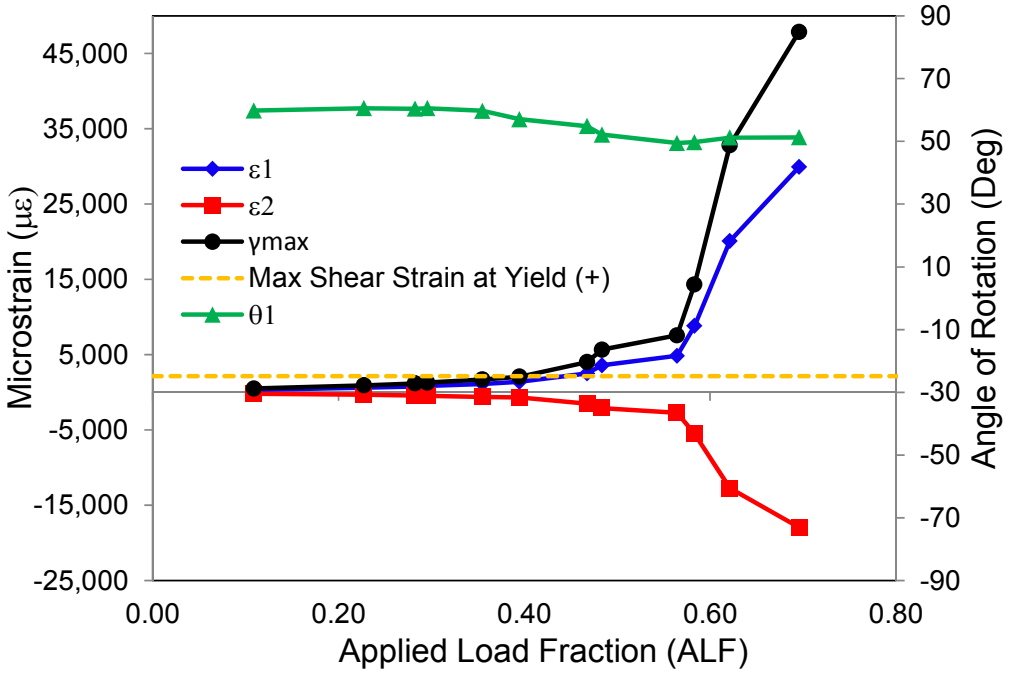

Figure G274. North gusset east bottom

Member Cross-Sectional Plots

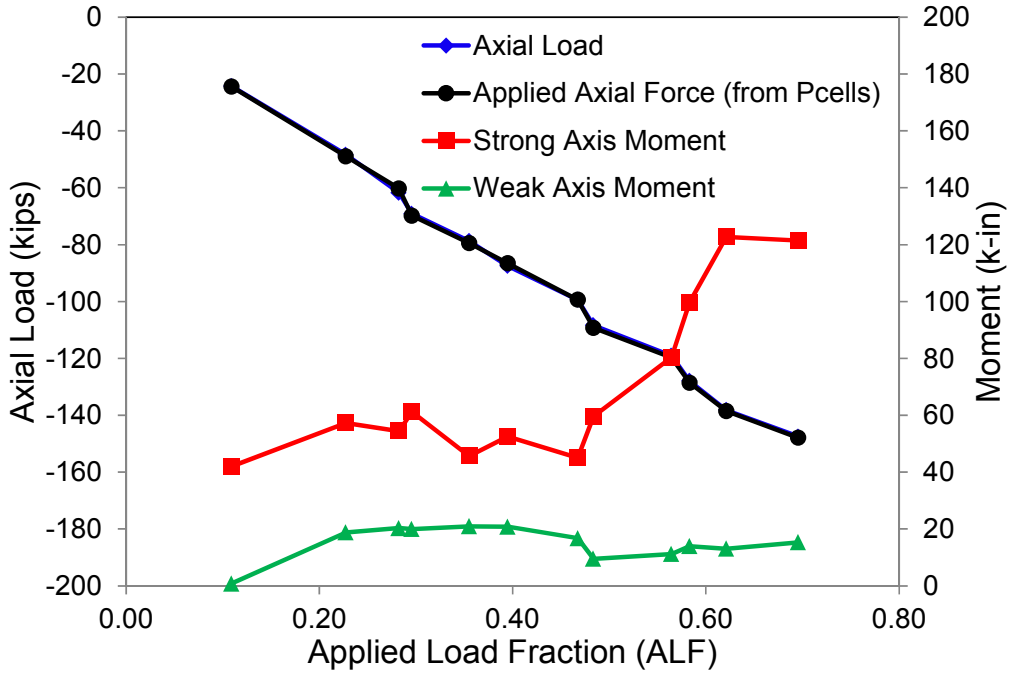

Figure G275. Vertical

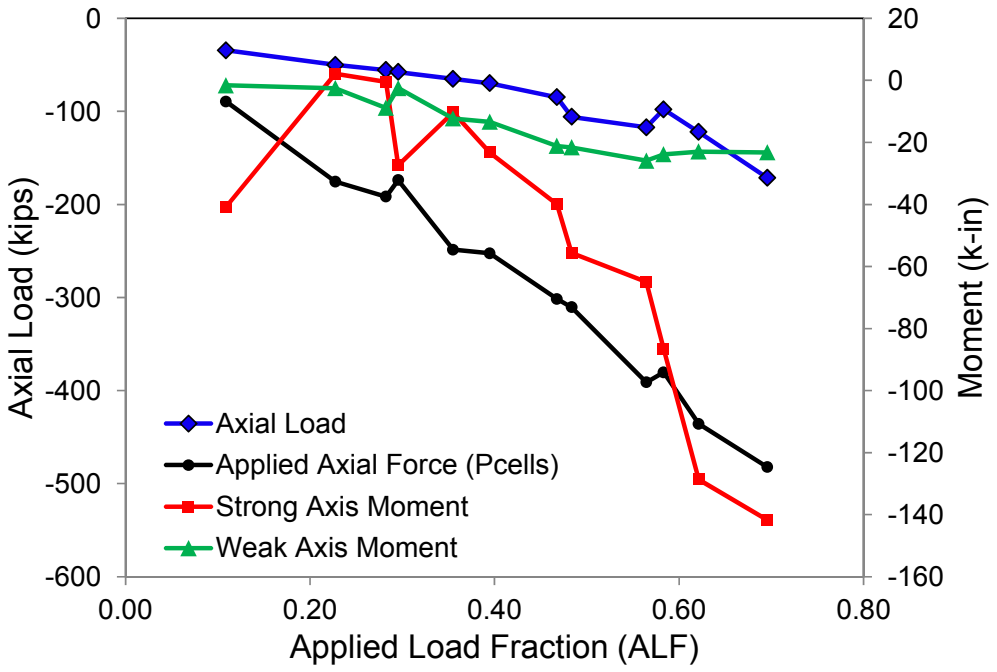

Figure G276. Compression Diagonal

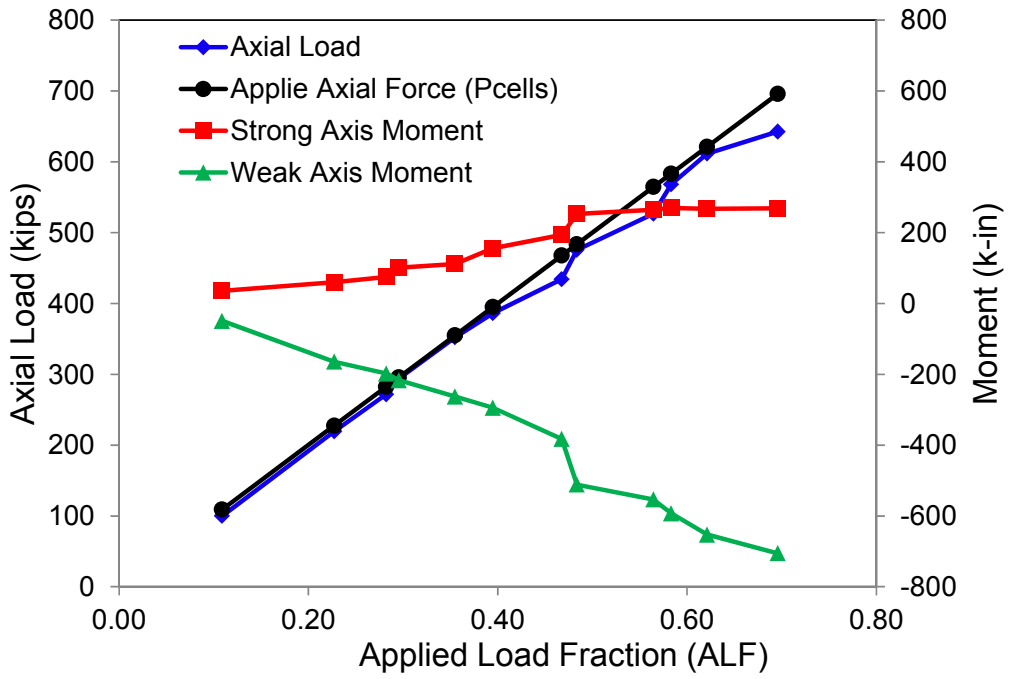

Figure G277. Tension Diagonal

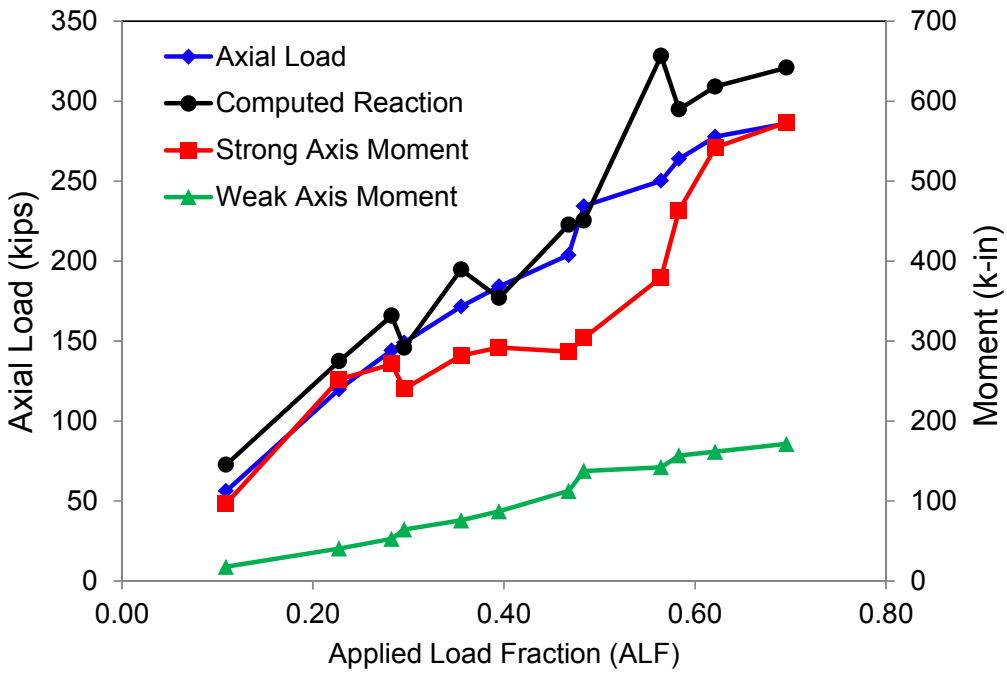

Figure G278. West Chord

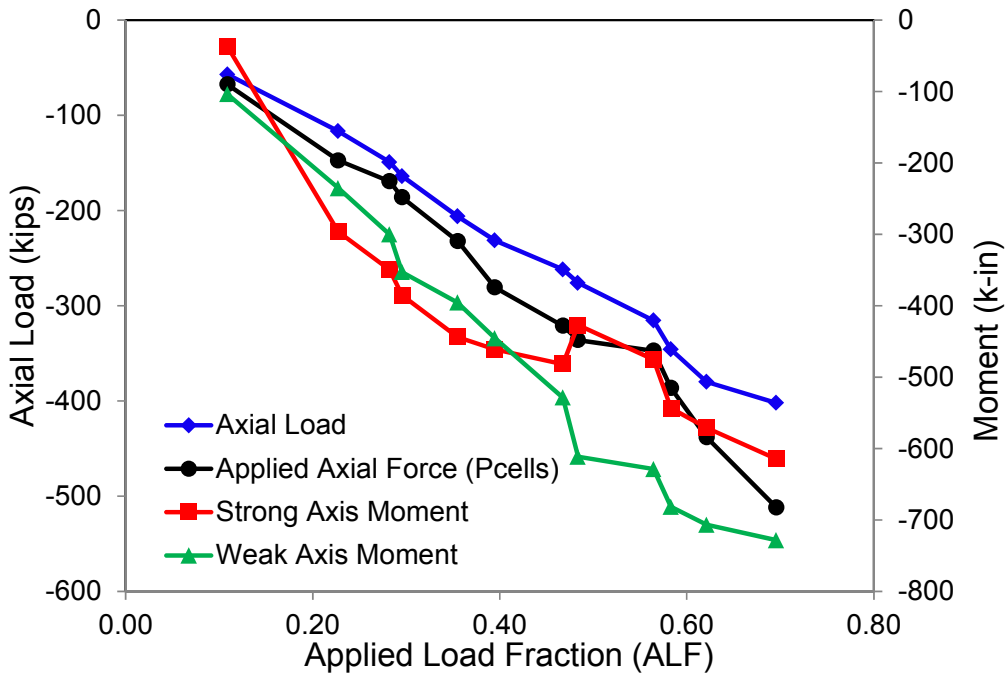

Figure G279. East Chord

Chord Load Shedding Plots

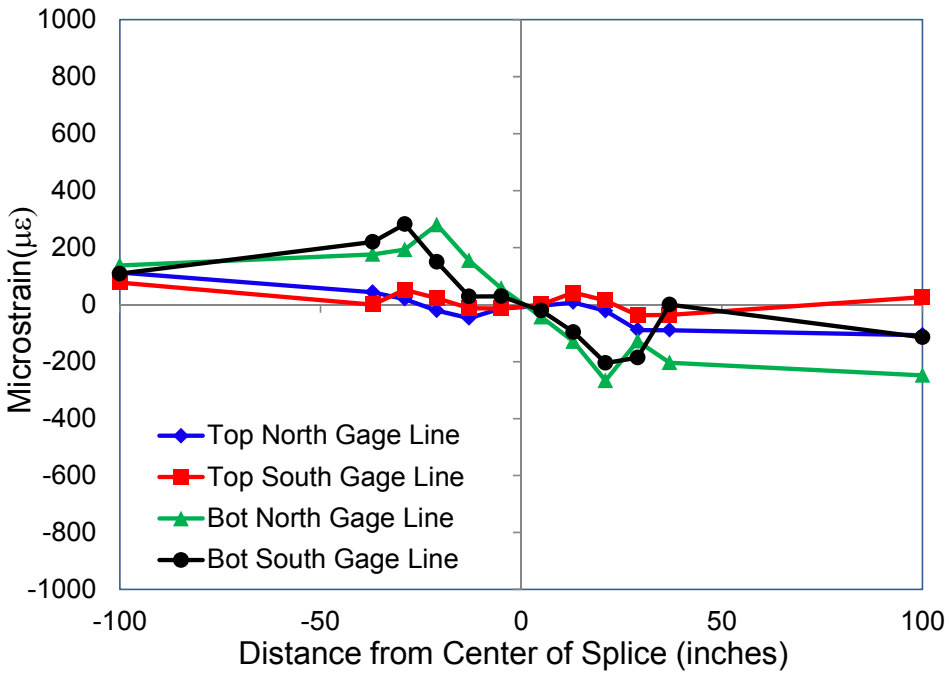

Figure G280. ALF=0.23

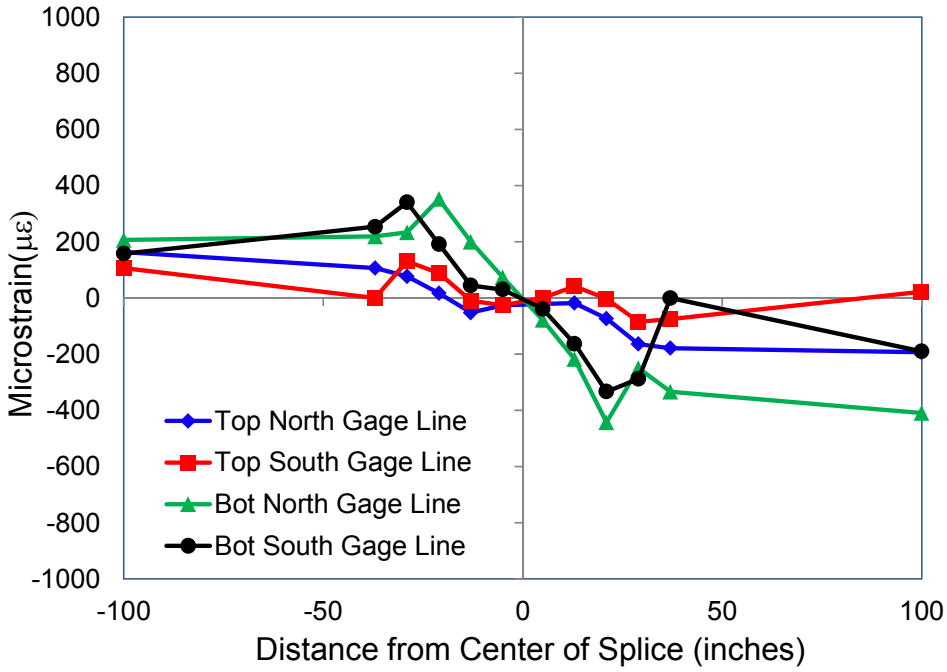

Figure G281. ALF=0.36

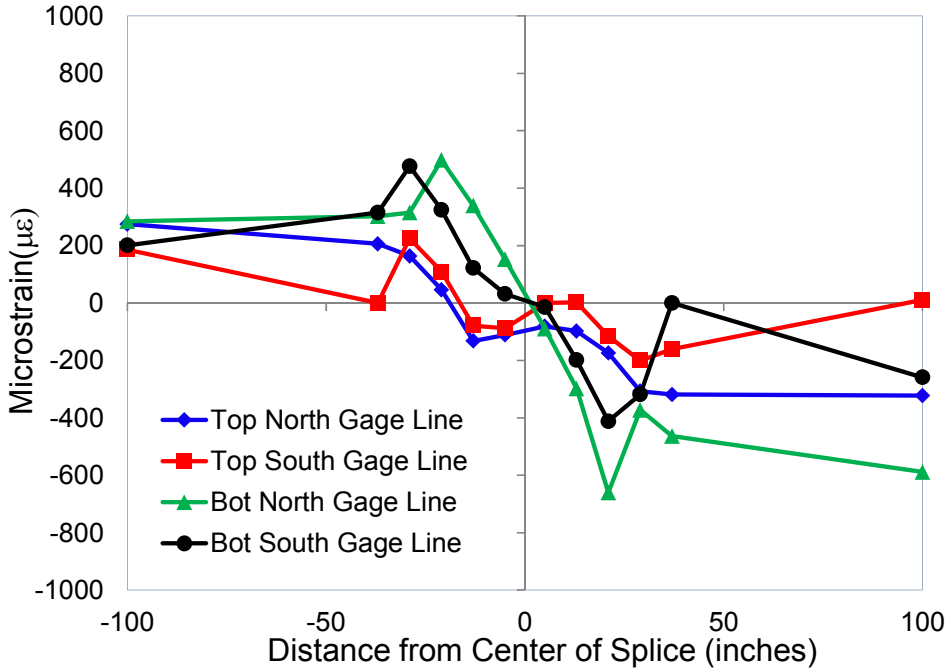

Figure G282. ALF=0.56

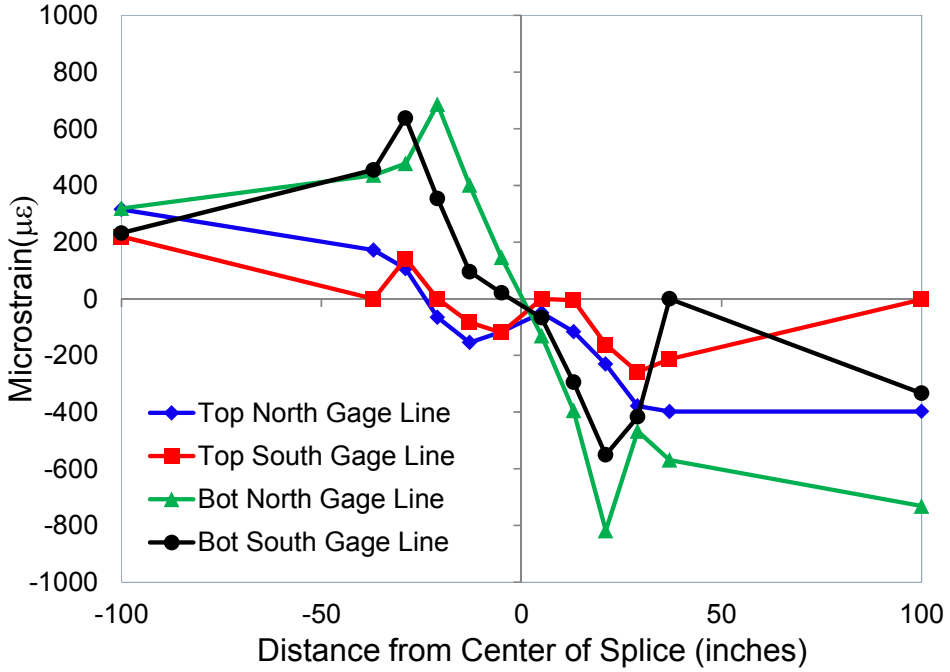

Figure G283. Max ALF=0.70

Uniaxial Gauge Plots

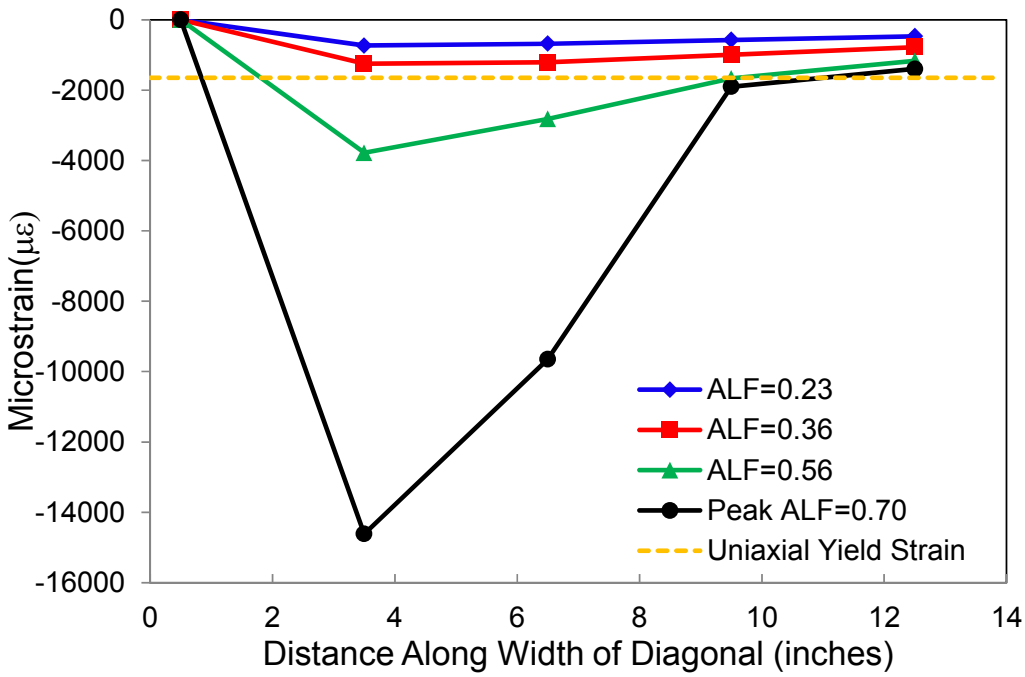

Figure G284. North Compression Diagonal

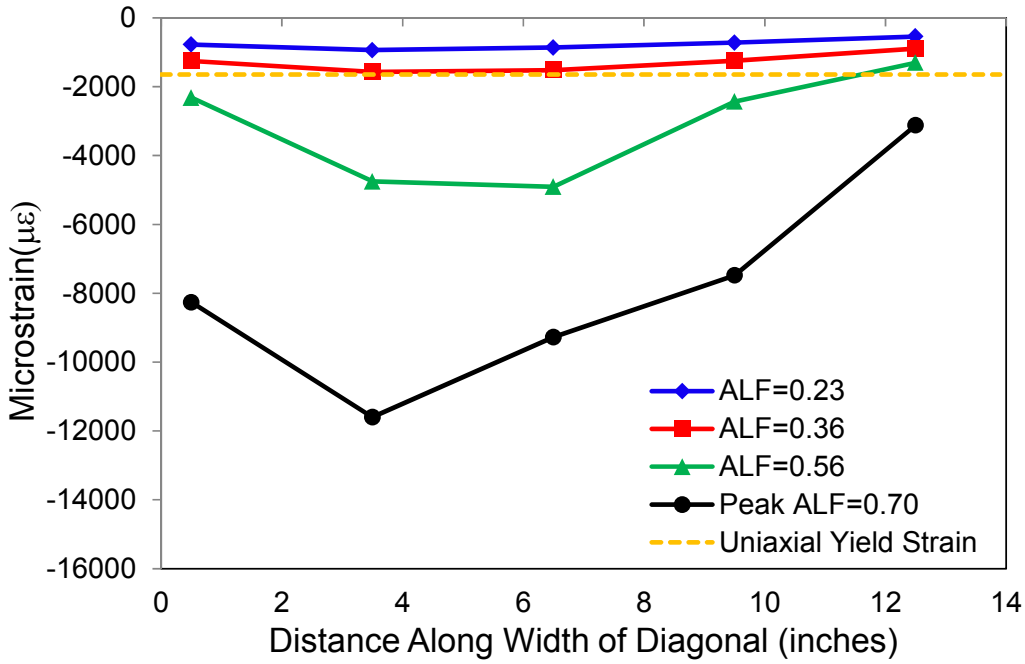

Figure G285. South Compression Diagonal

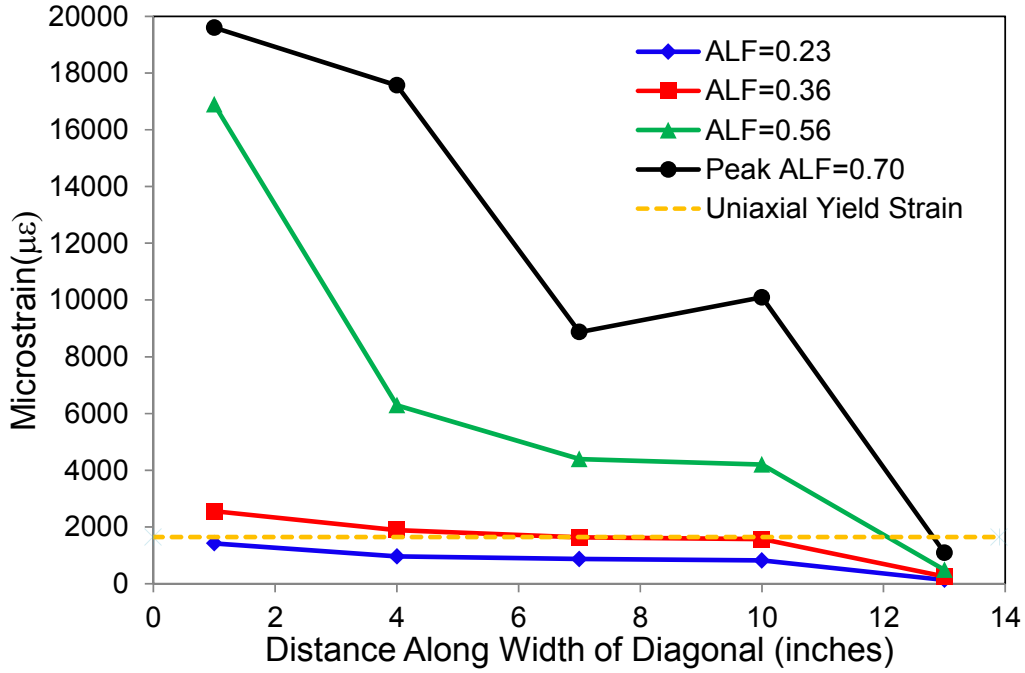

Figure G286. North Tension Diagonal

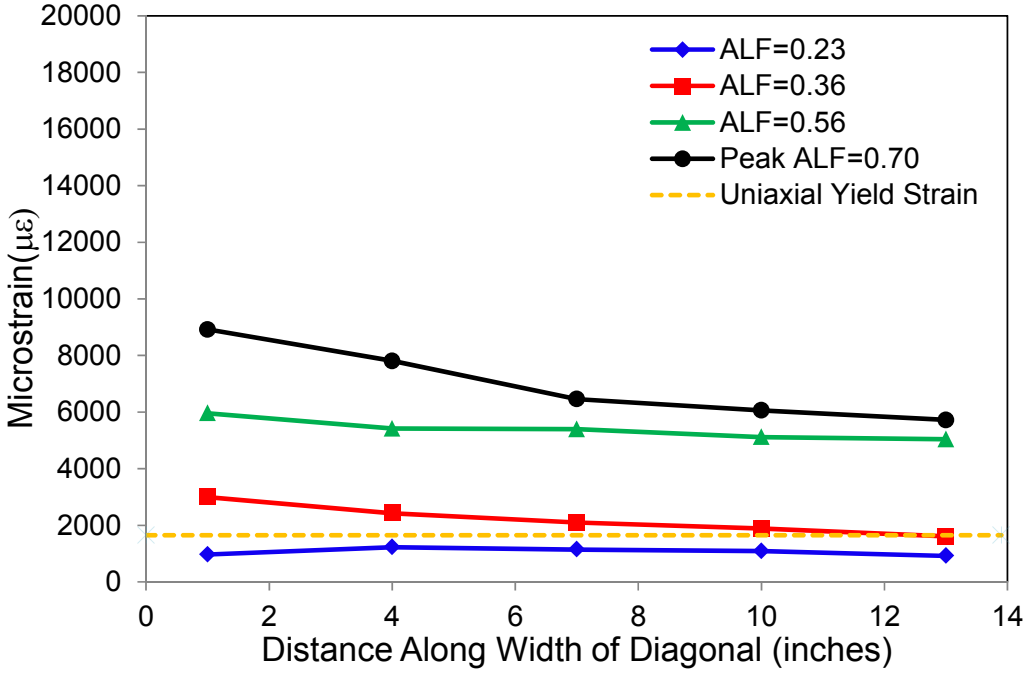

Figure G287. South Tension Diagonal

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Maximum Shear Strain Plots

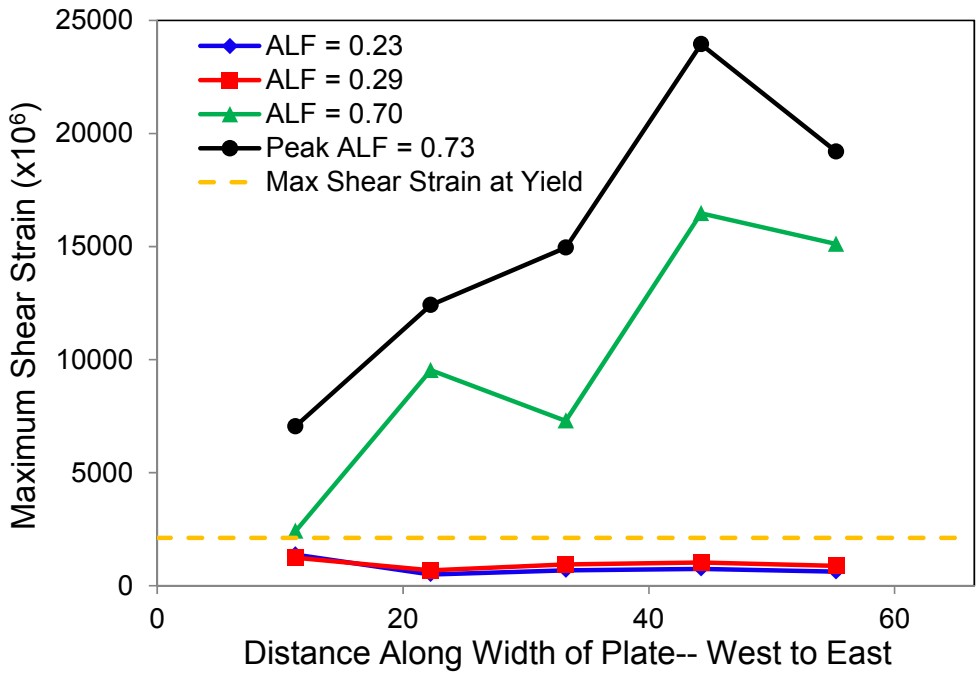

Figure G288. Horizontal line of rosettes above chord; south gusset plate

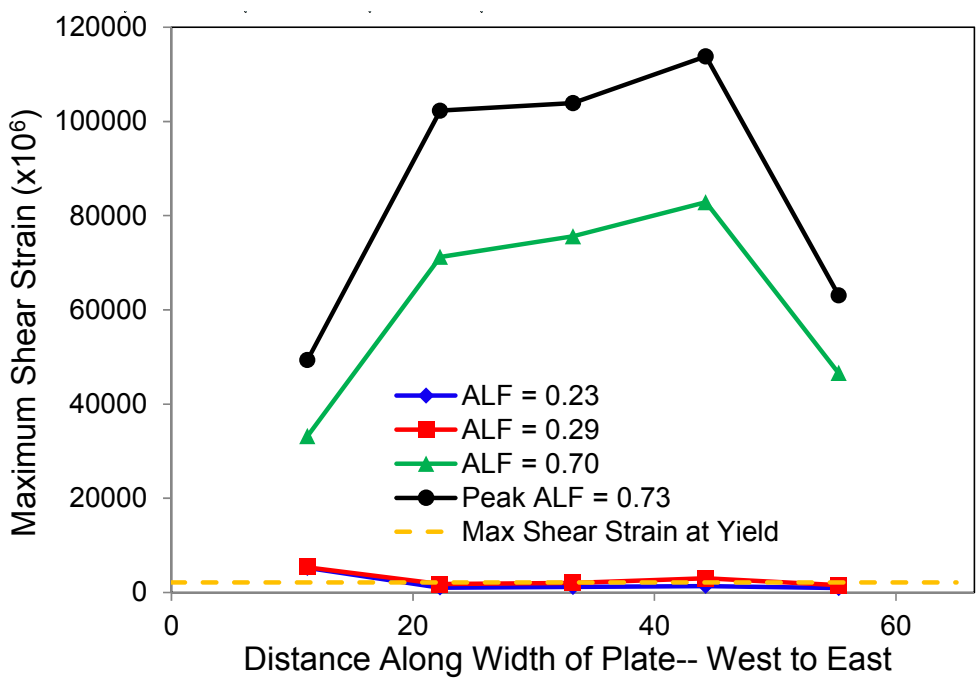

Figure G289. Horizontal line of rosettes above chord; north gusset plate

Variations in Principal Strain

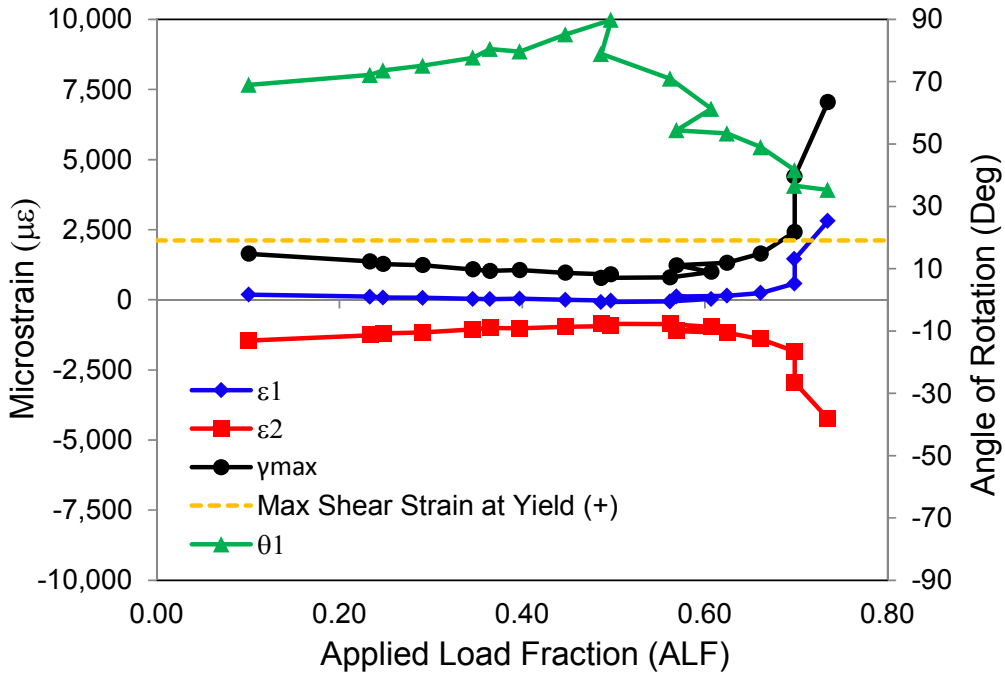

Figure G290. South gusset west bottom

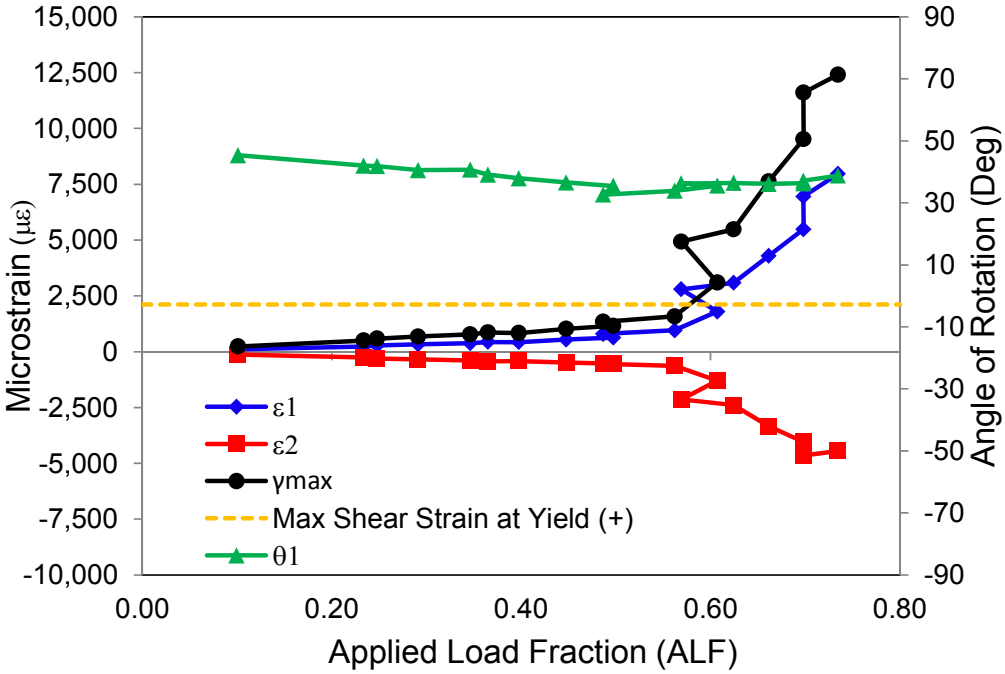

Figure G291. South gusset west mid bottom

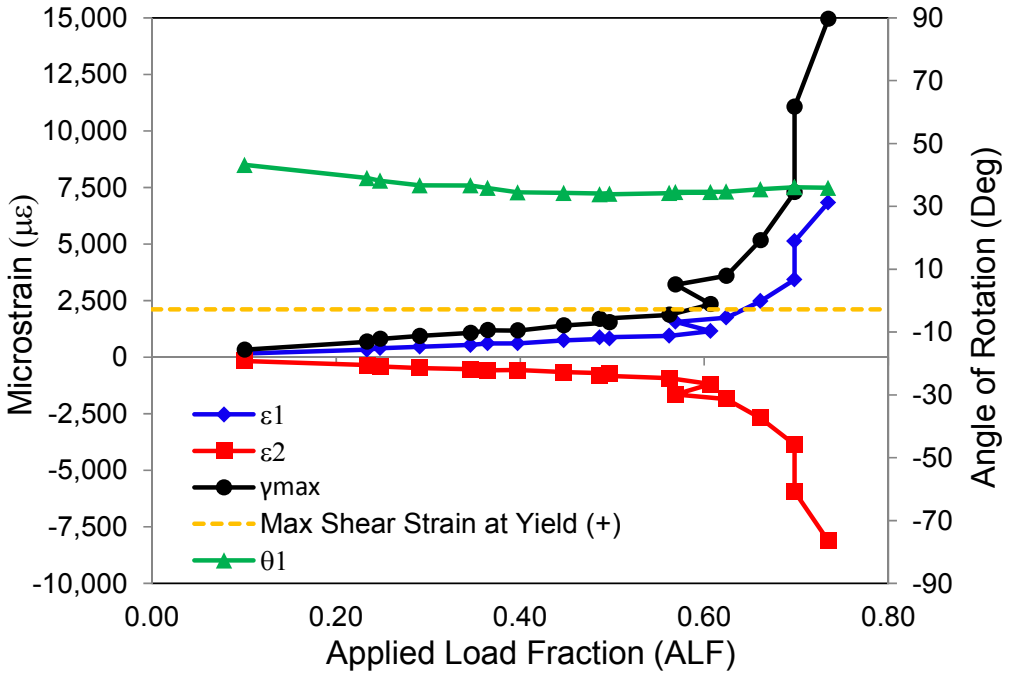

Figure G292. South gusset mid bottom

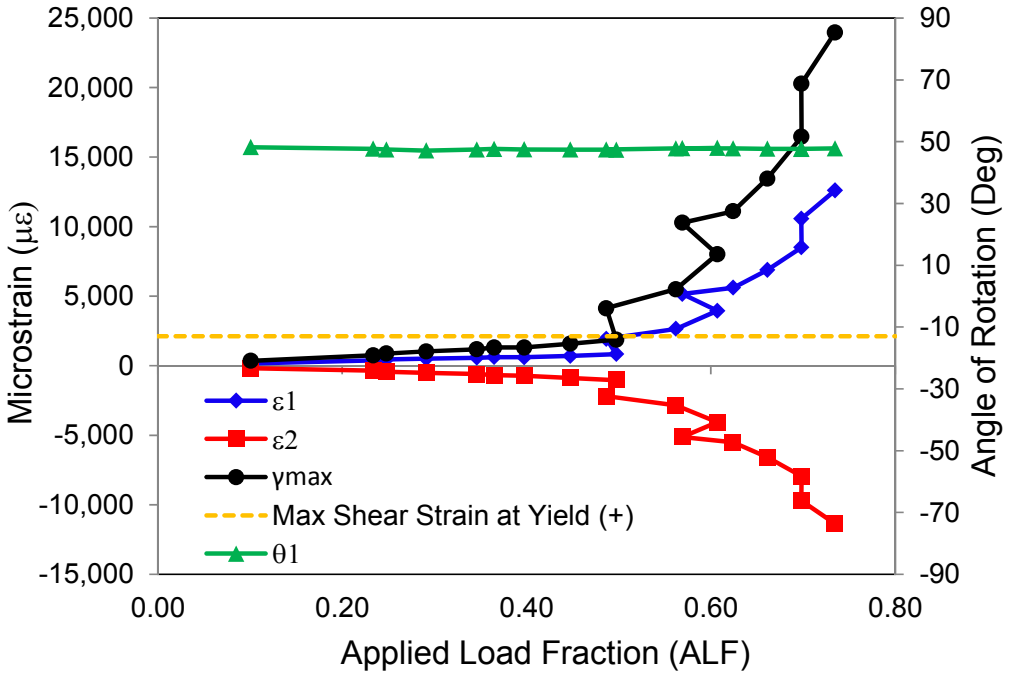

Figure G293. South gusset east mid bottom

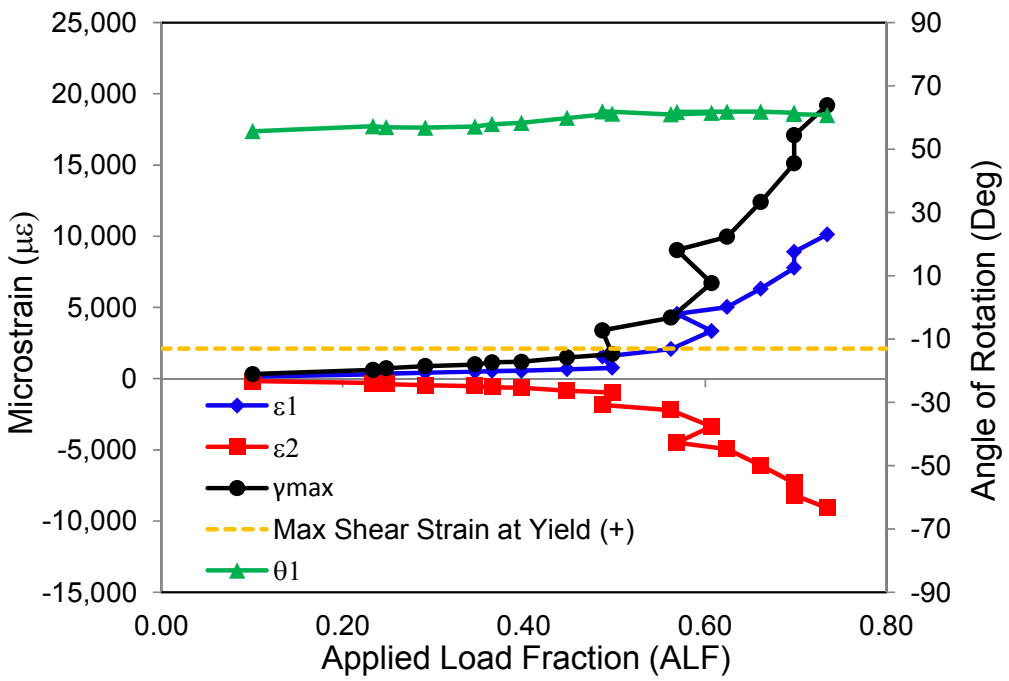

Figure G294. South gusset east bottom

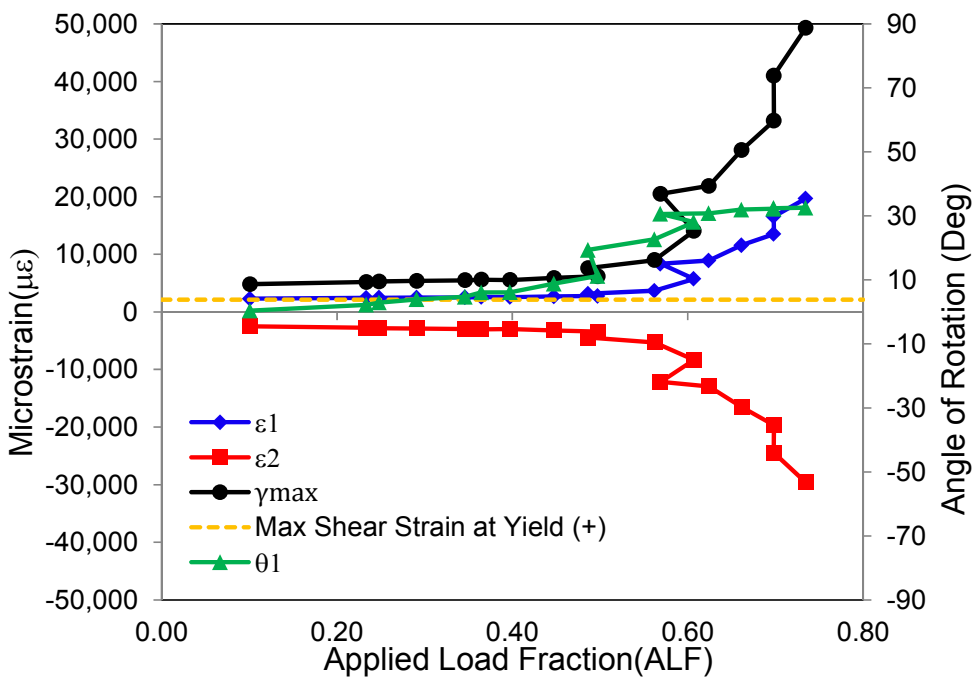

Figure G295. North gusset west bottom

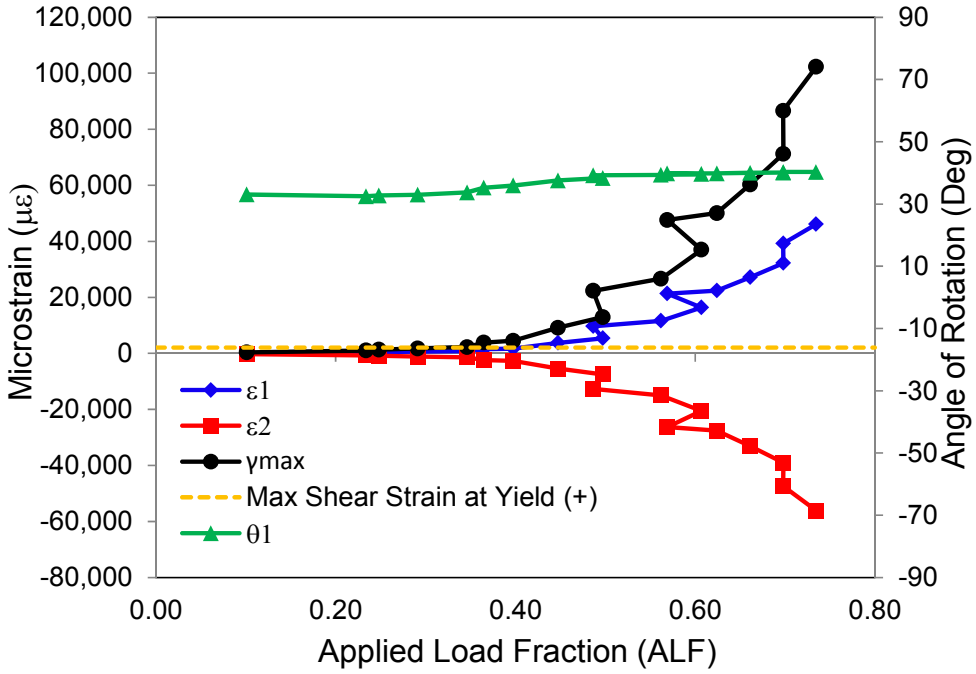

Figure G296. North gusset west mid bottom

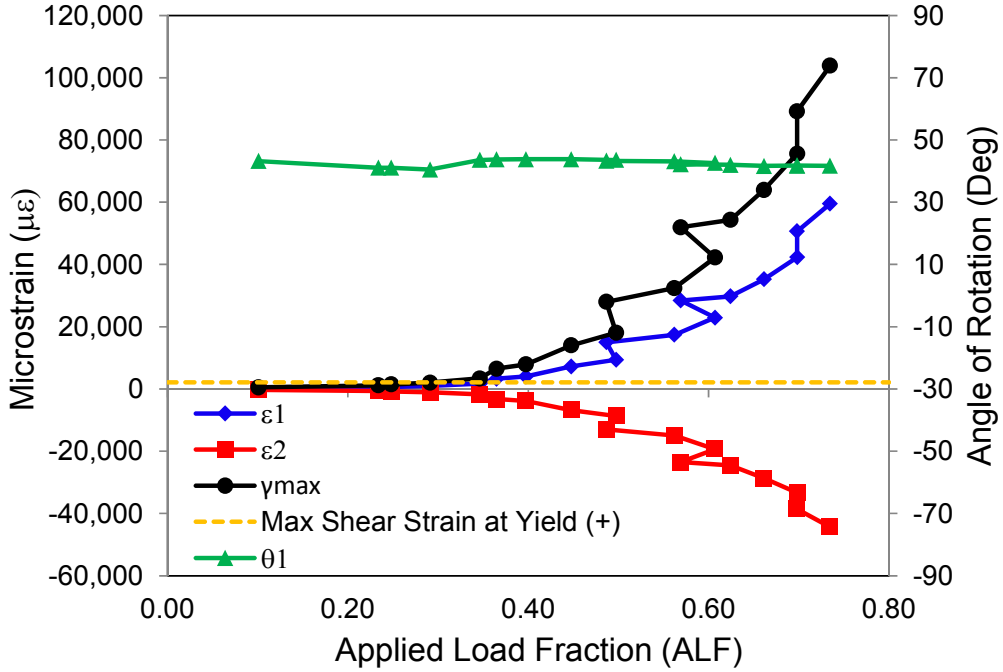

Figure G297. North gusset mid bottom

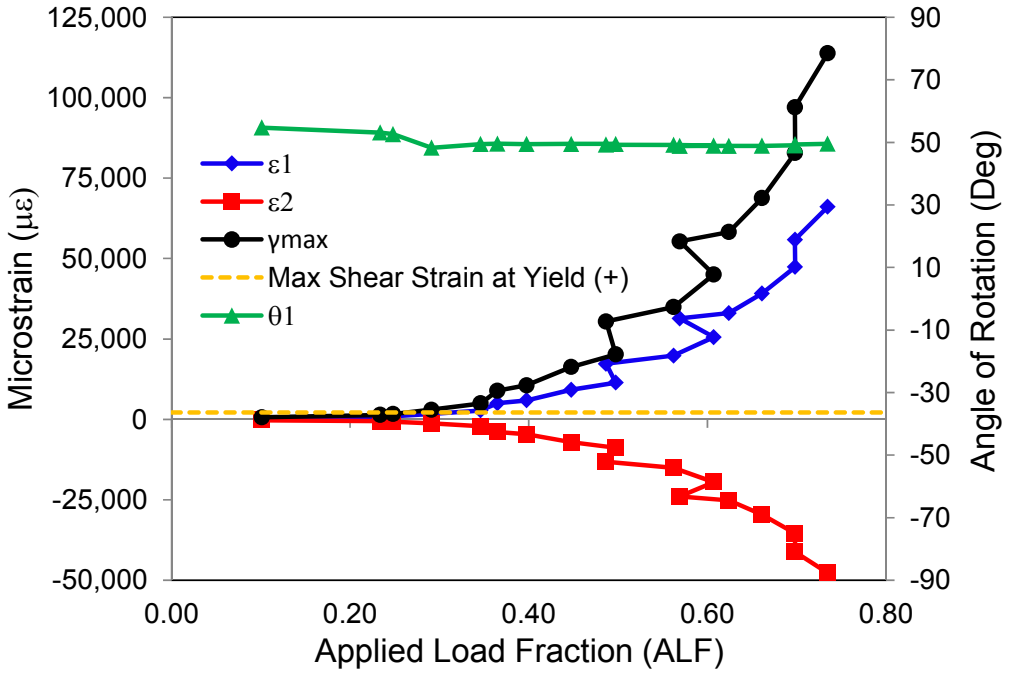

Figure G298. North gusset mid east bottom

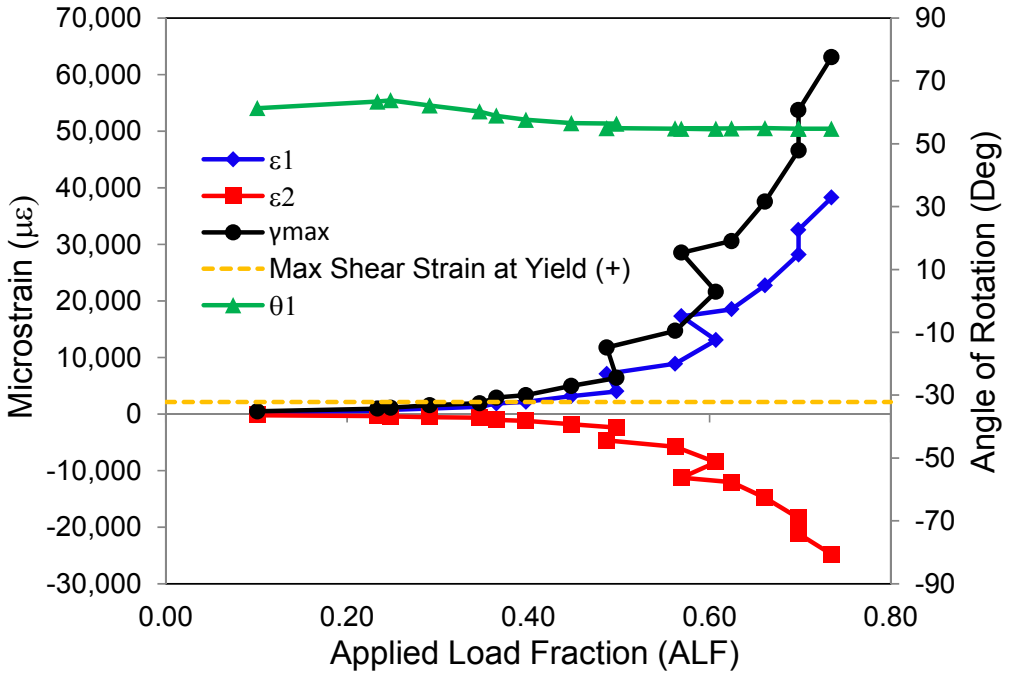

Figure G299. North gusset east bottom

Member Cross-Sectional Plots

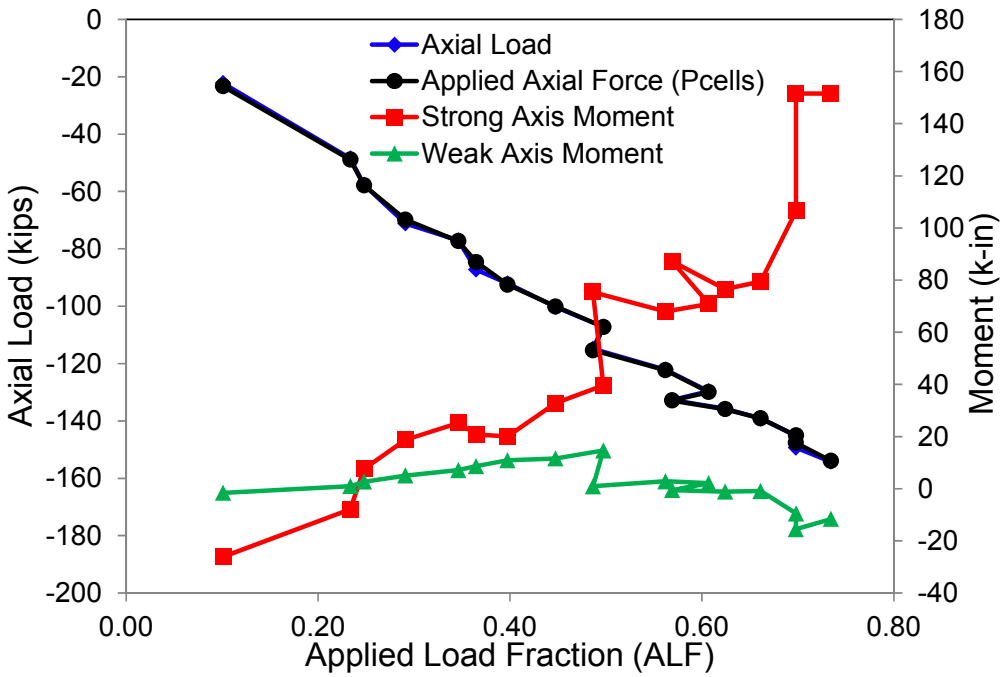

Figure G300. Vertical

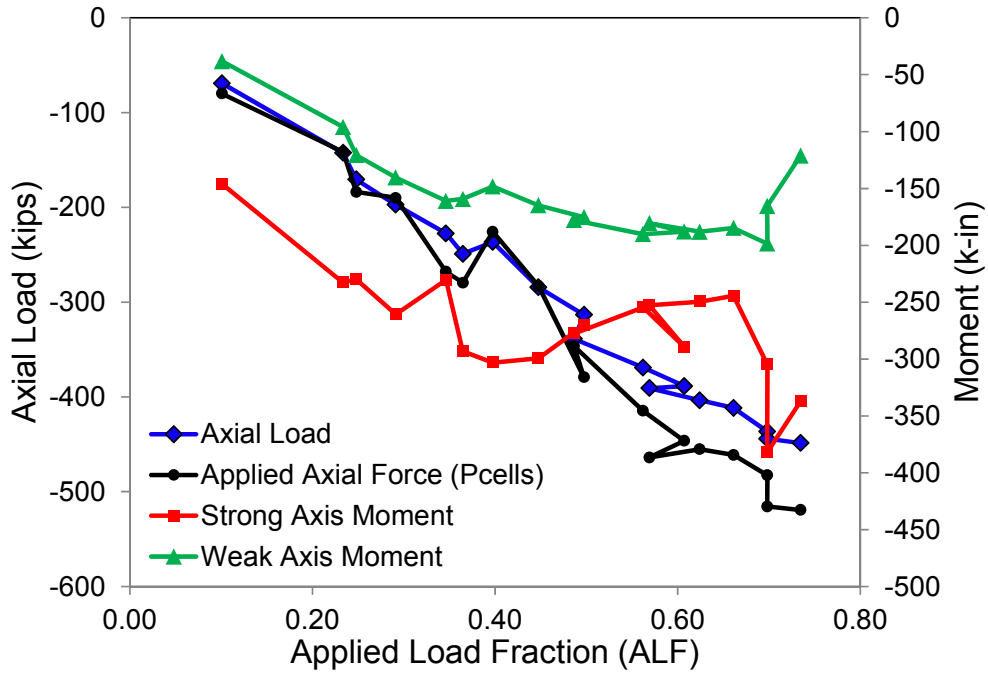

Figure G301. Compression Diagonal

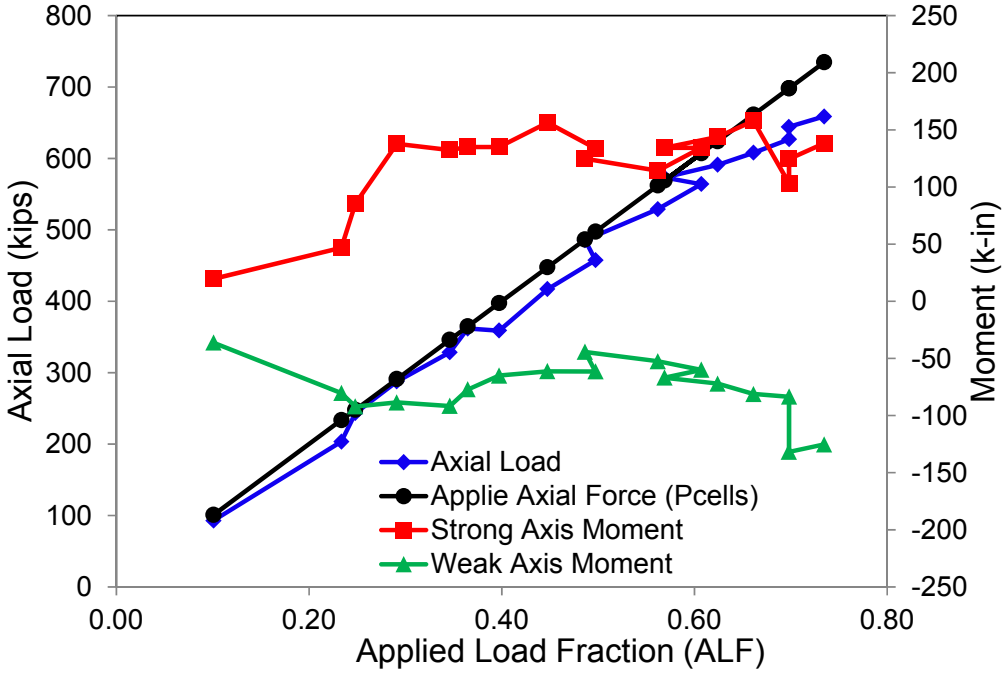

Figure G302. Tension Diagonal

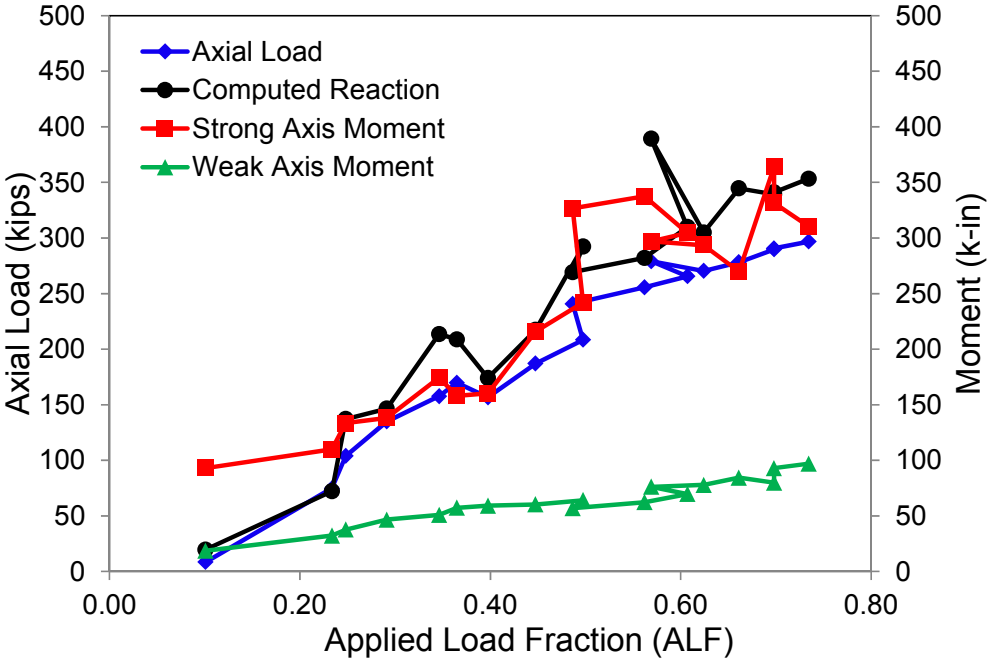

Figure G303. West Chord

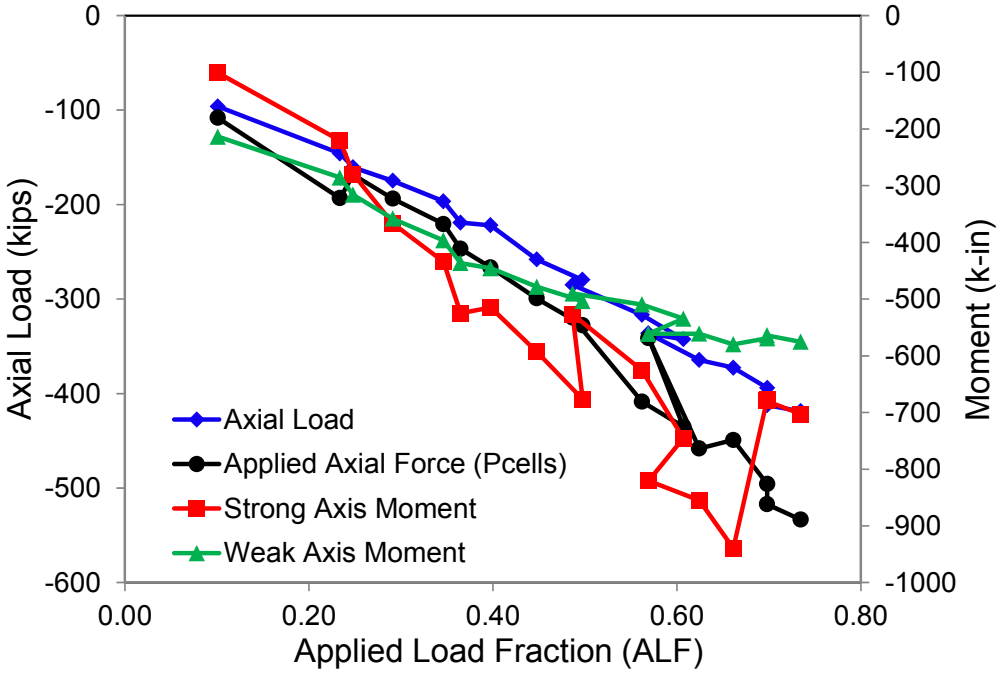

Figure G304. East Chord

Chord Load Shedding Plots

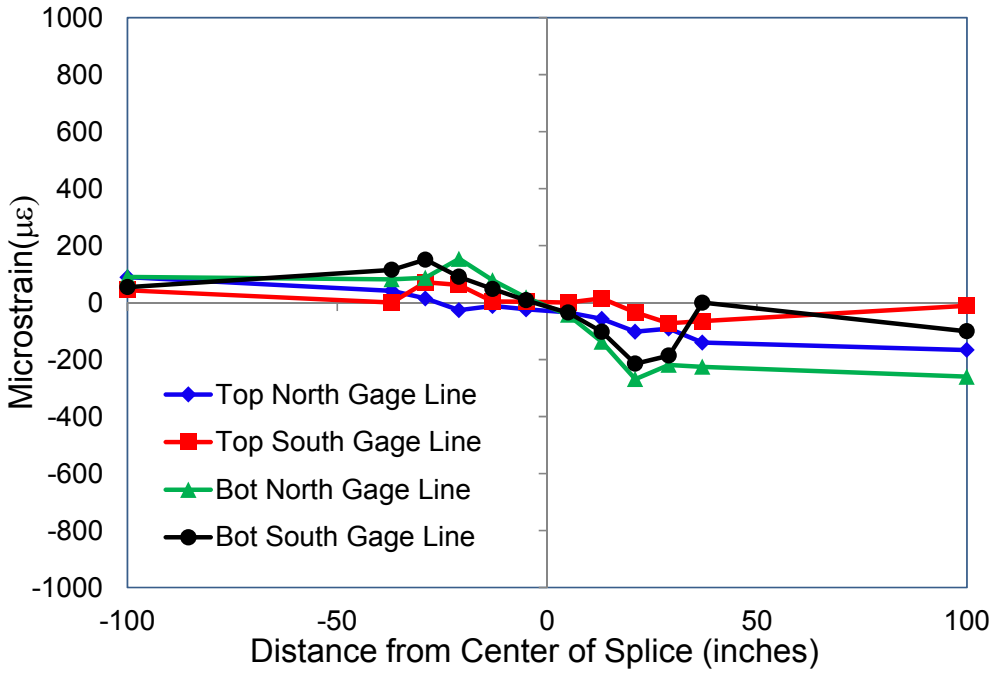

Figure G305. ALF=0.23

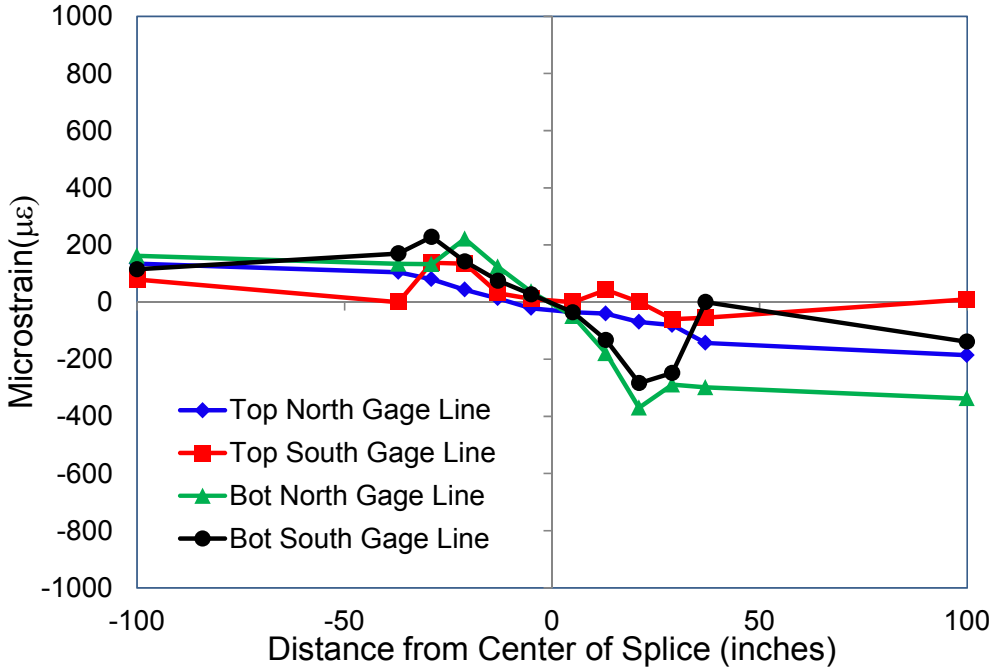

Figure G306. ALF=0.29

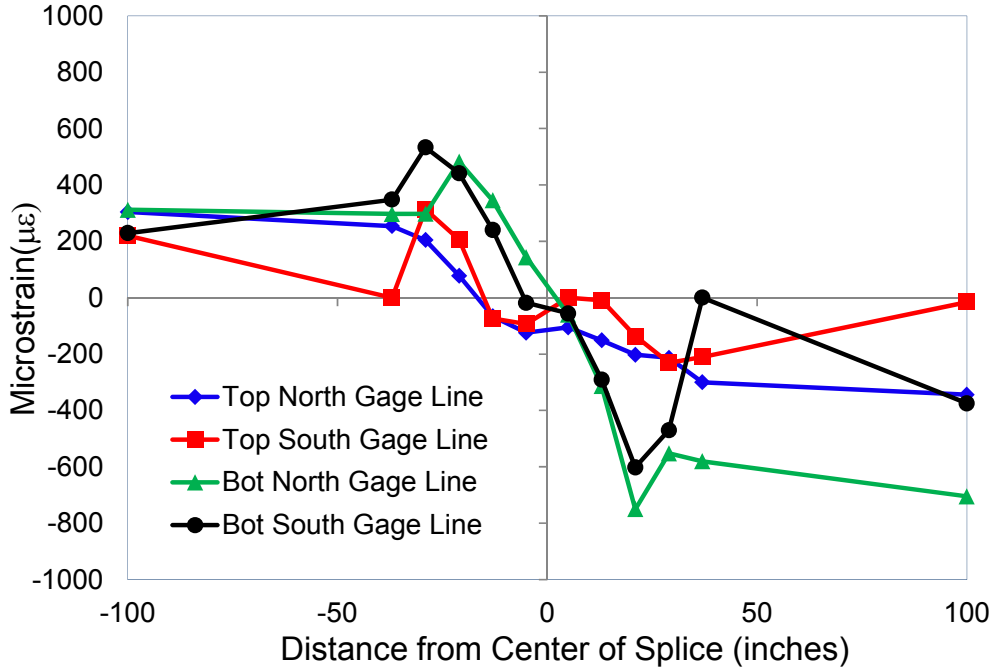

Figure G307. ALF=0.70

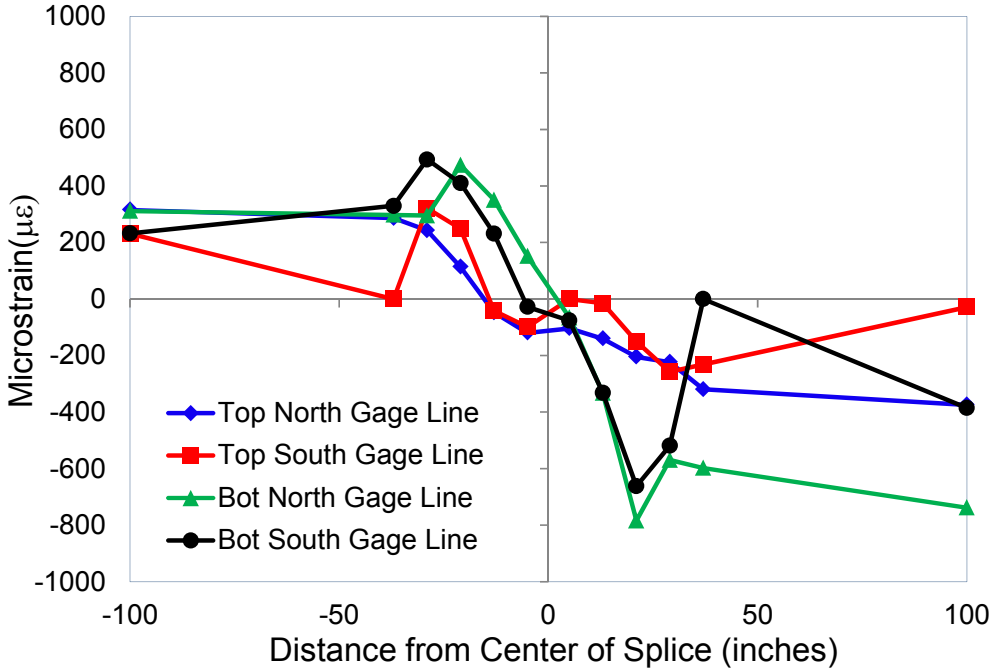

Figure G308. Max ALF=0.73

Uniaxial Gauge Plots

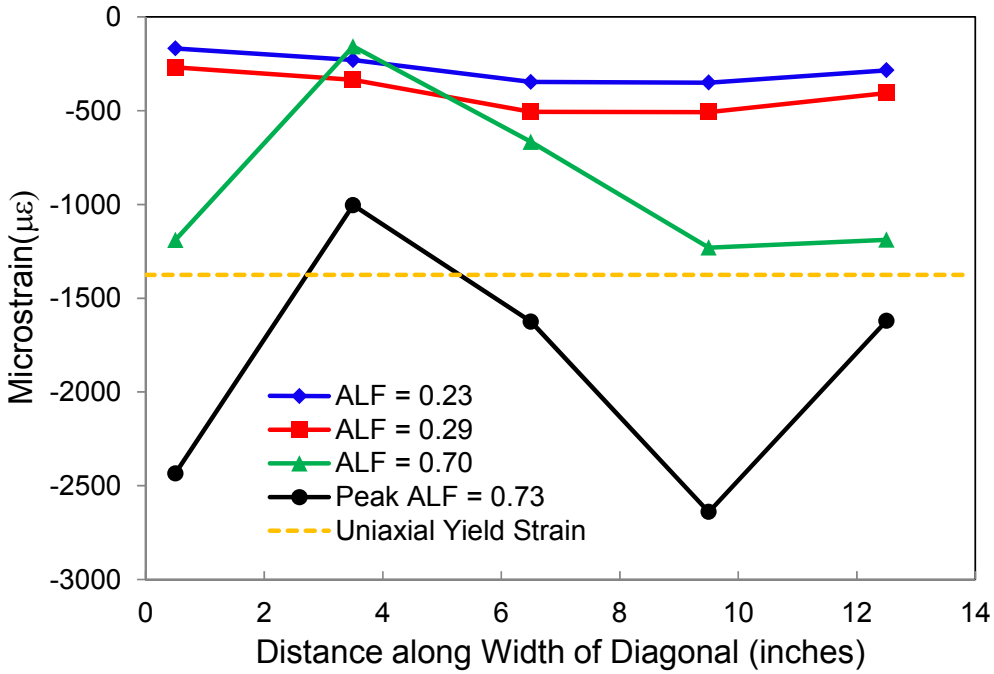

Figure G309. North Compression Diagonal

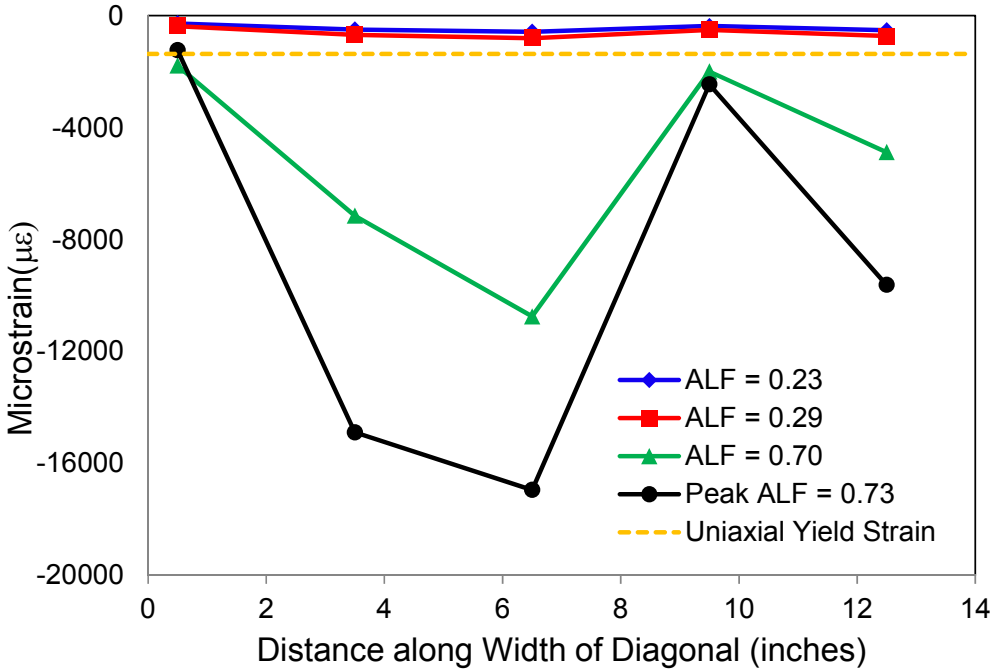

Figure G310. South Compression Diagonal

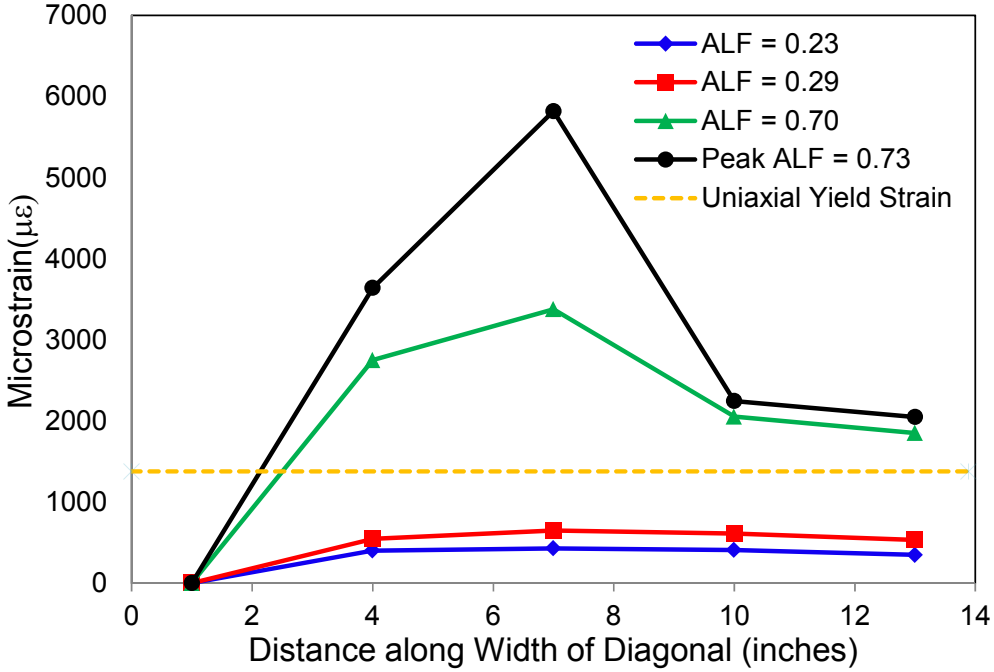

Figure G311. North Tension Diagonal

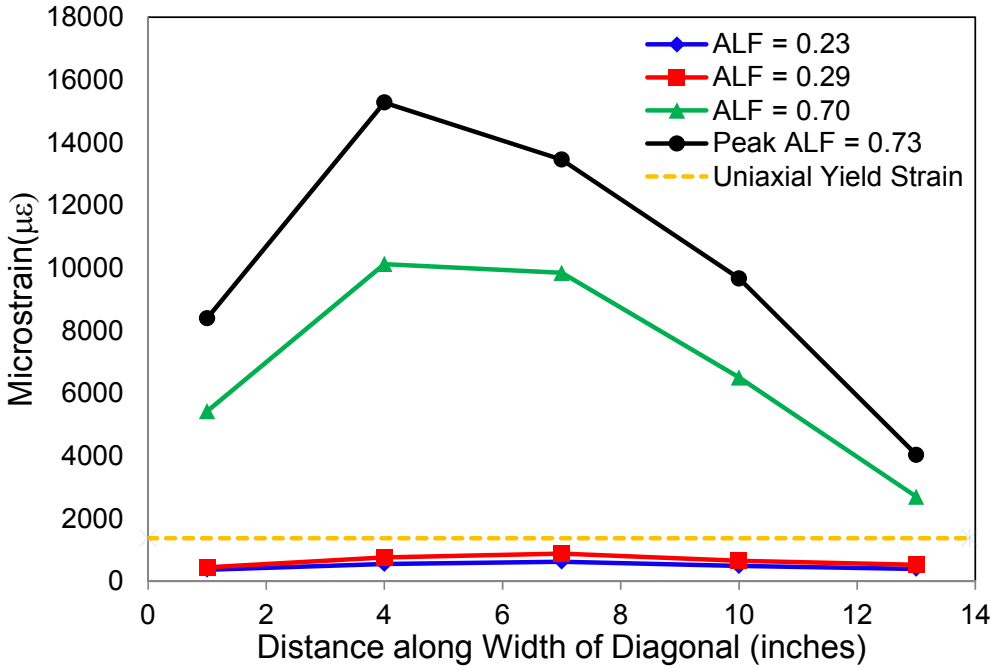

Figure G312. South Tension Diagonal

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Maximum Shear Strain Plots

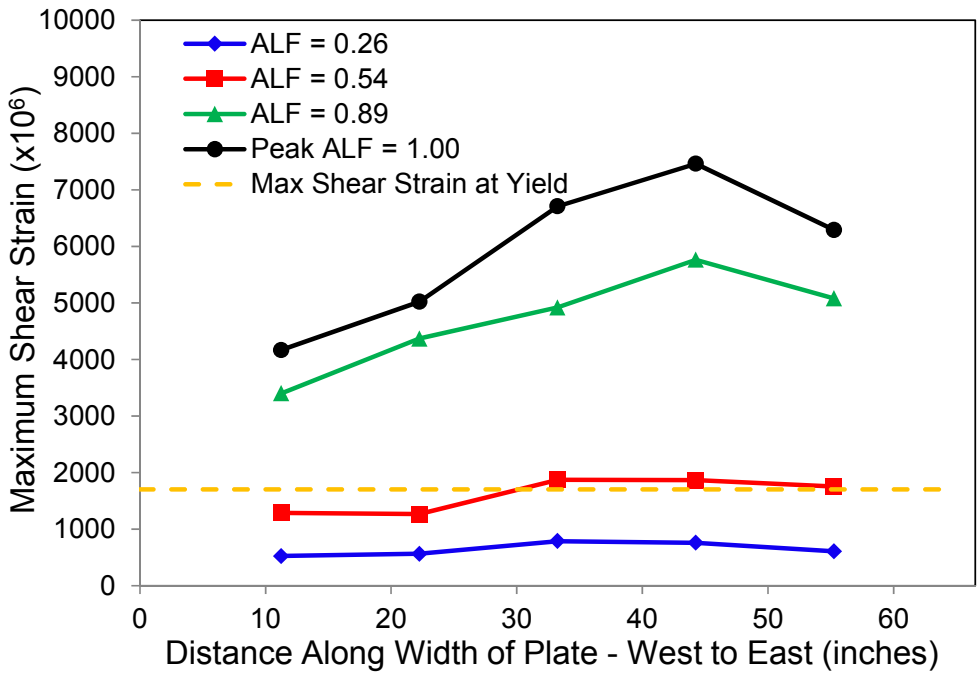

Figure G313. Horizontal line of rosettes above chord; south gusset plate.

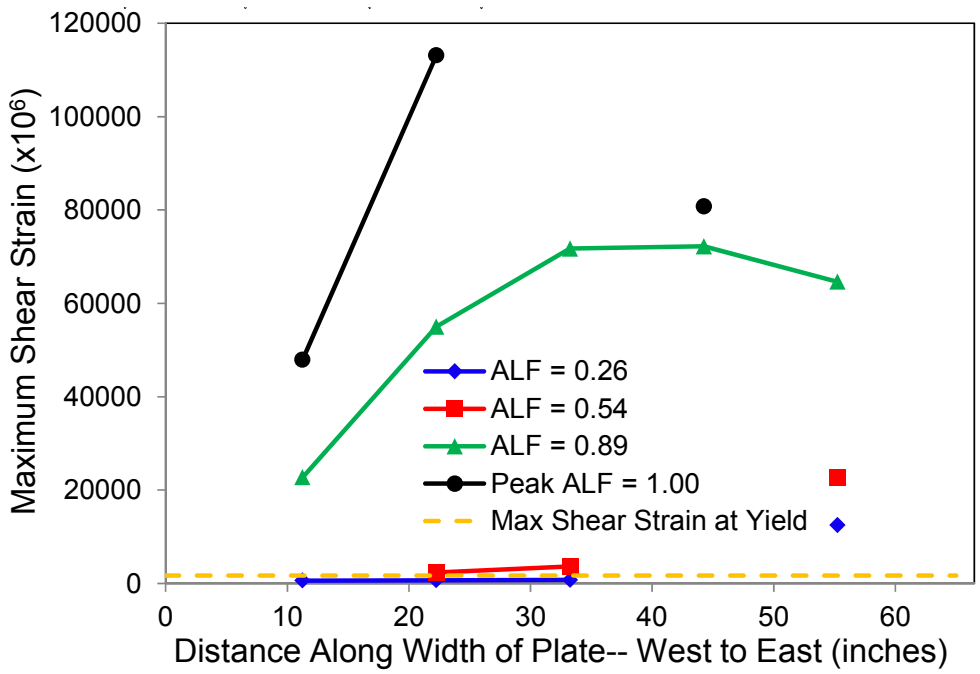

Figure G314. Horizontal line of rosettes above chord; north gusset plate.

Variations in Principal Strain

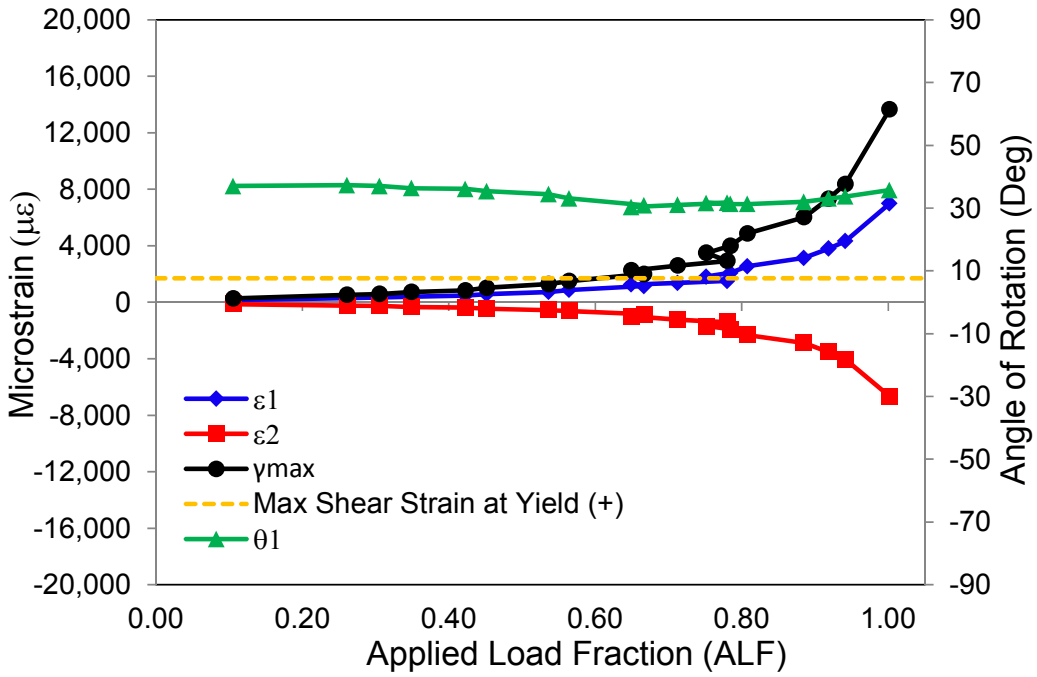

Figure G315. South gusset west bottom

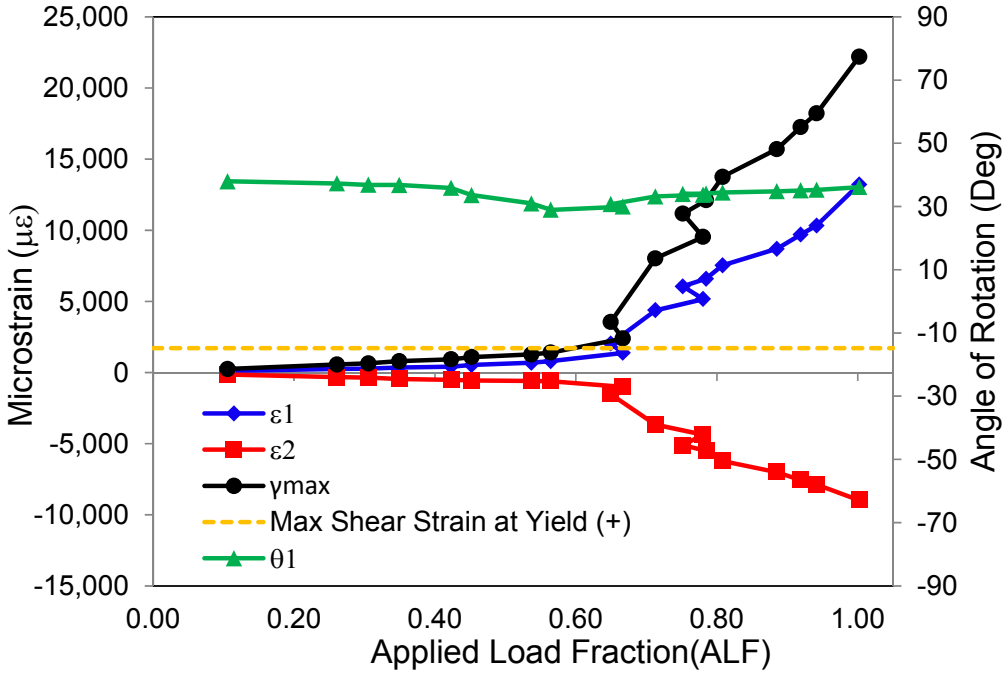

Figure G316. South gusset west mid bottom

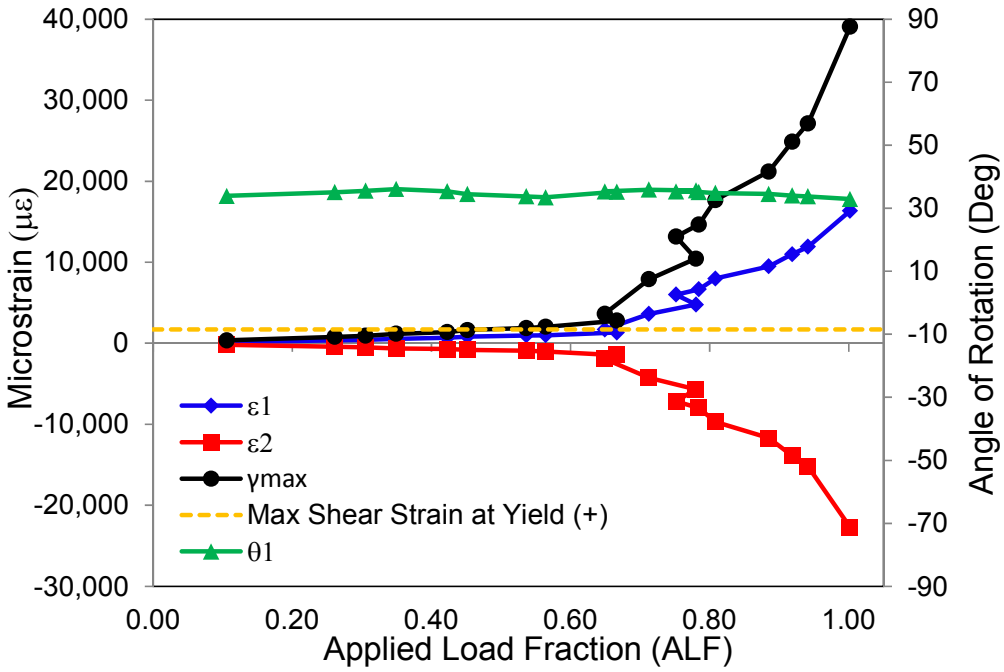

Figure G317. South gusset mid bottom

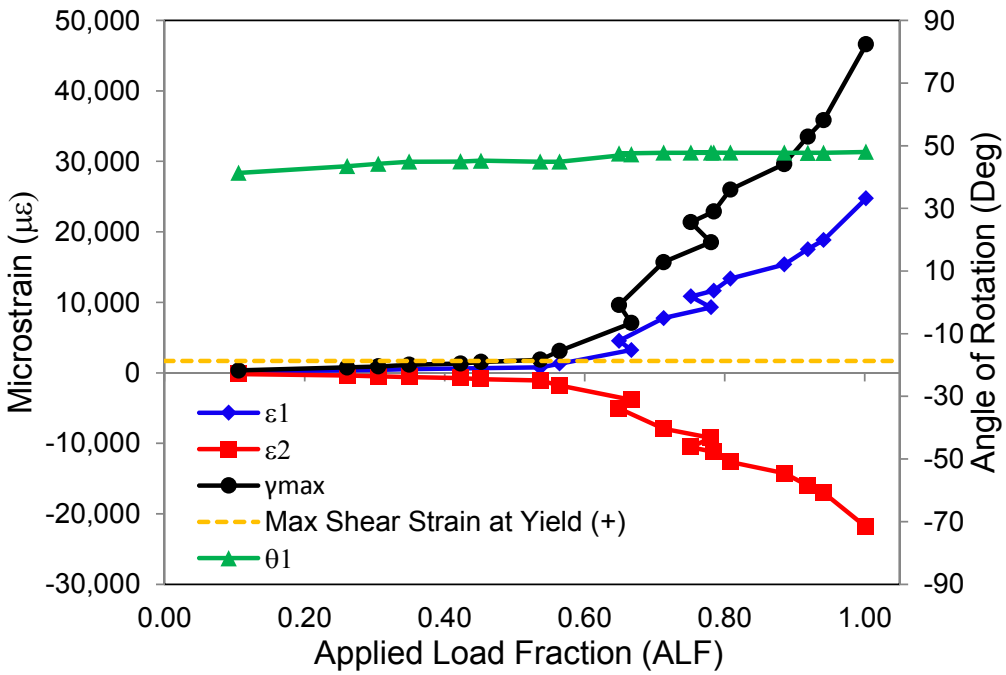

Figure G318. South gusset east mid bottom

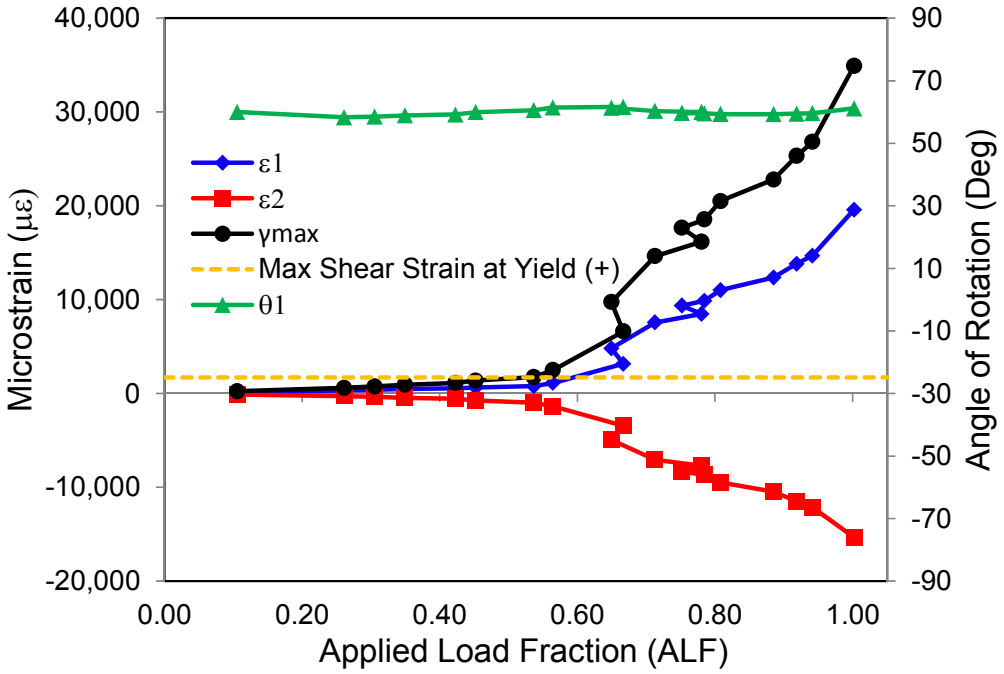

Figure G319. South gusset east bottom

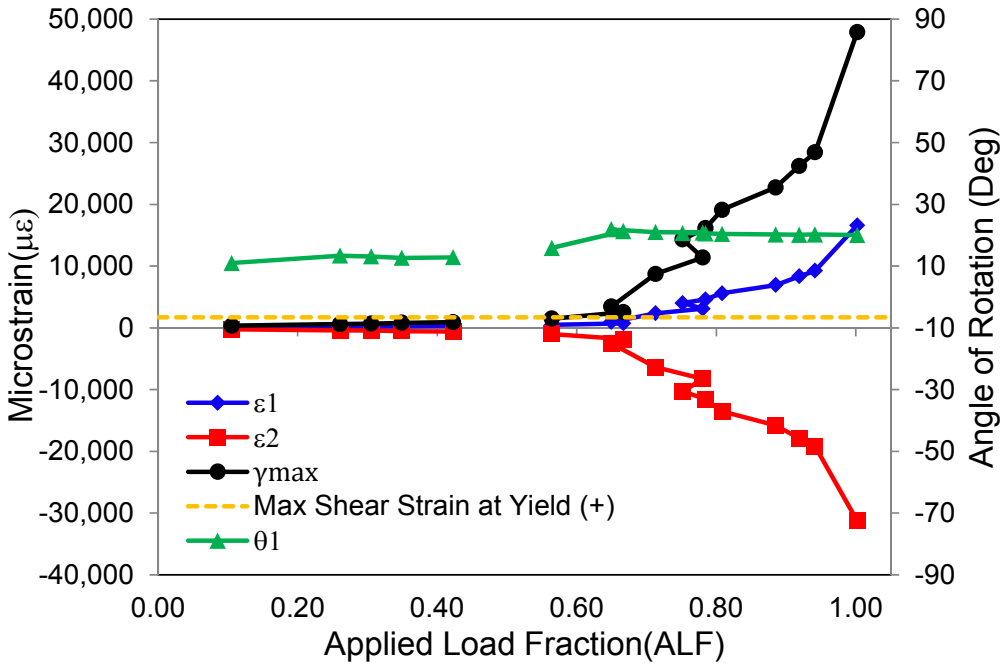

Figure G320. North gusset west bottom.

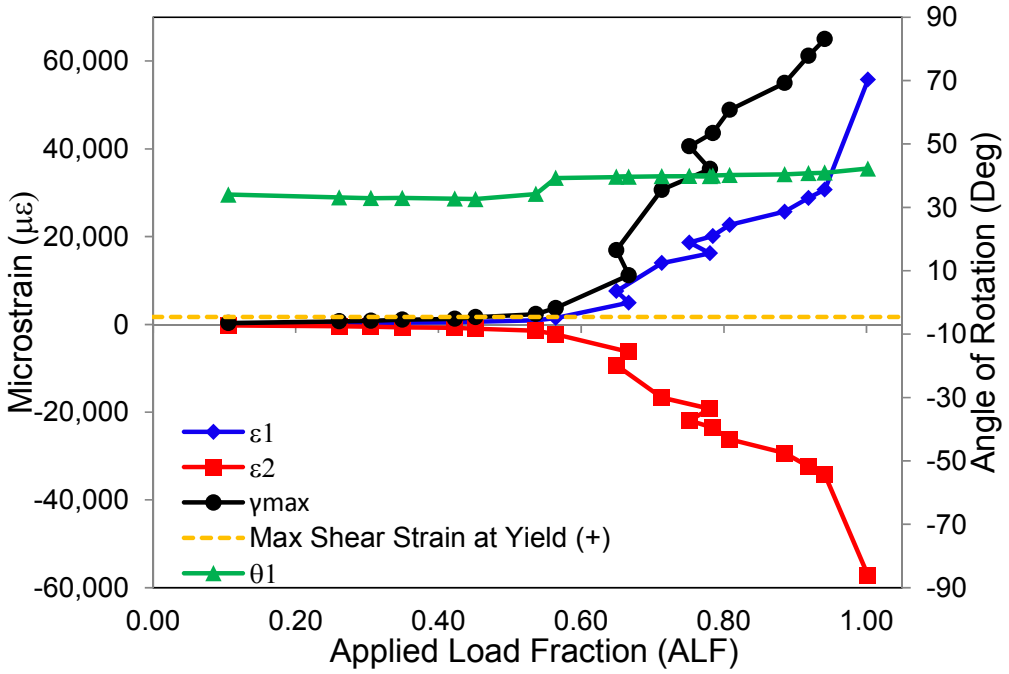

Figure G321. North gusset west mid bottom.

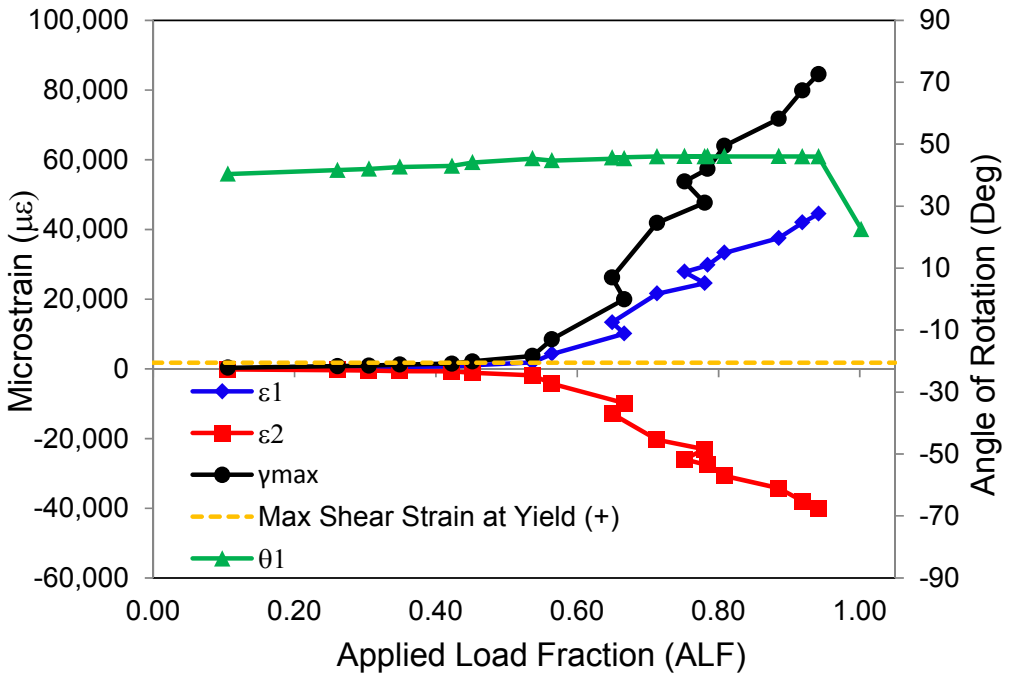

Figure G322. South gusset mid bottom.

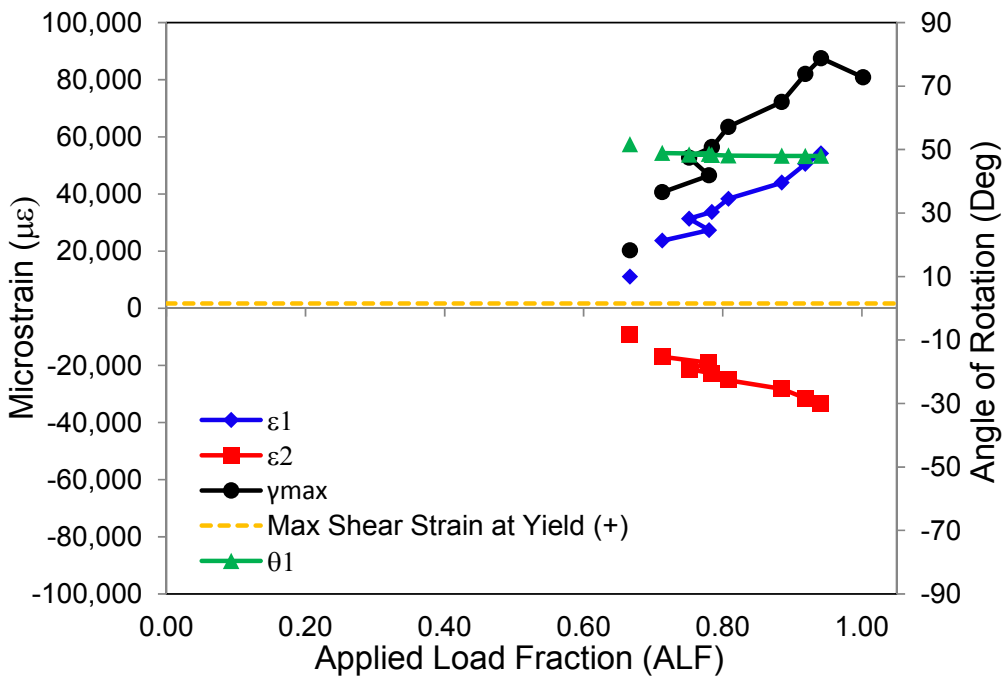

Figure G323. South gusset east mid bottom.

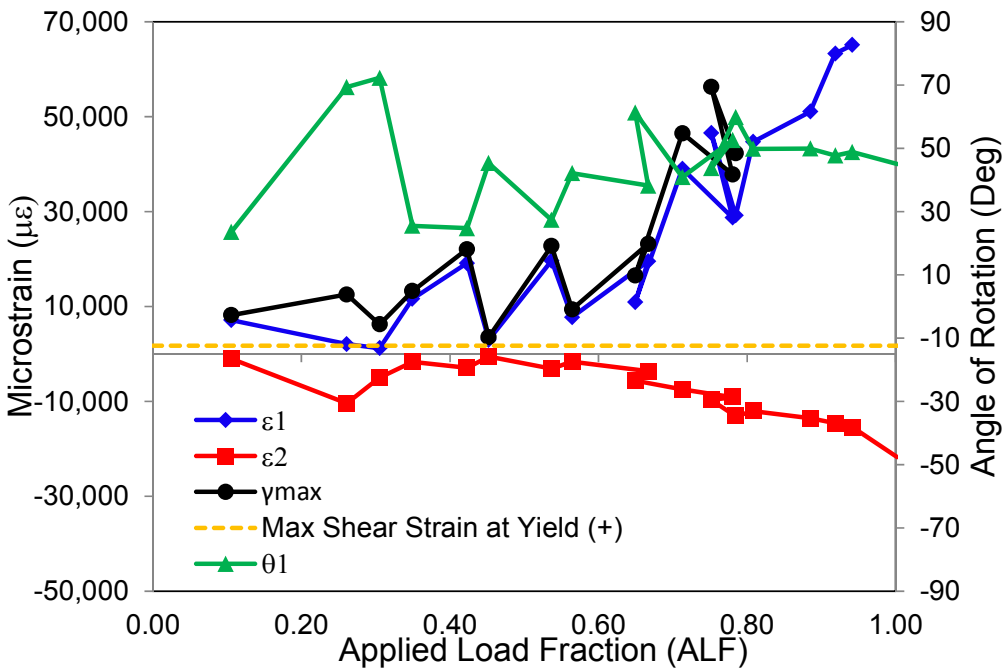

Figure G324. South gusset east bottom.

Member Cross-Sectional Plots

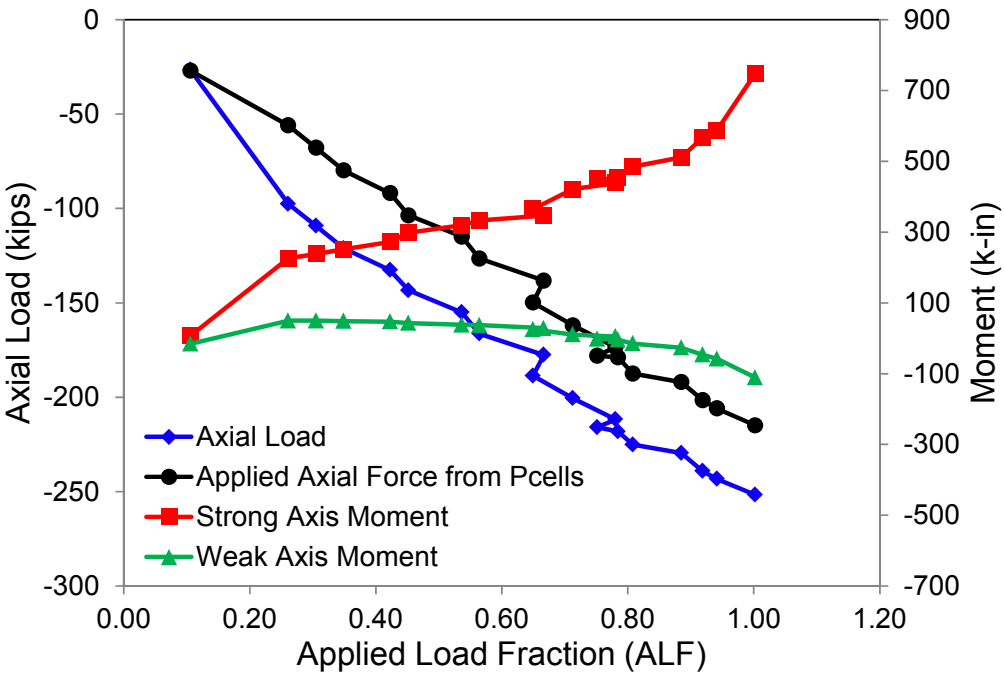

Figure G325. Vertical

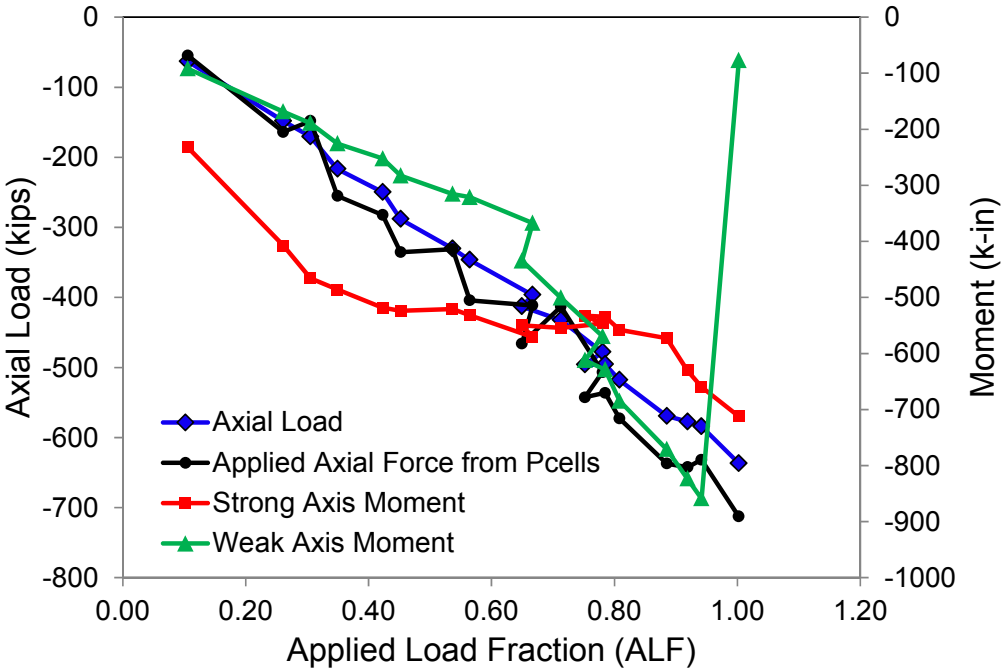

Figure G326. Compression Diagonal

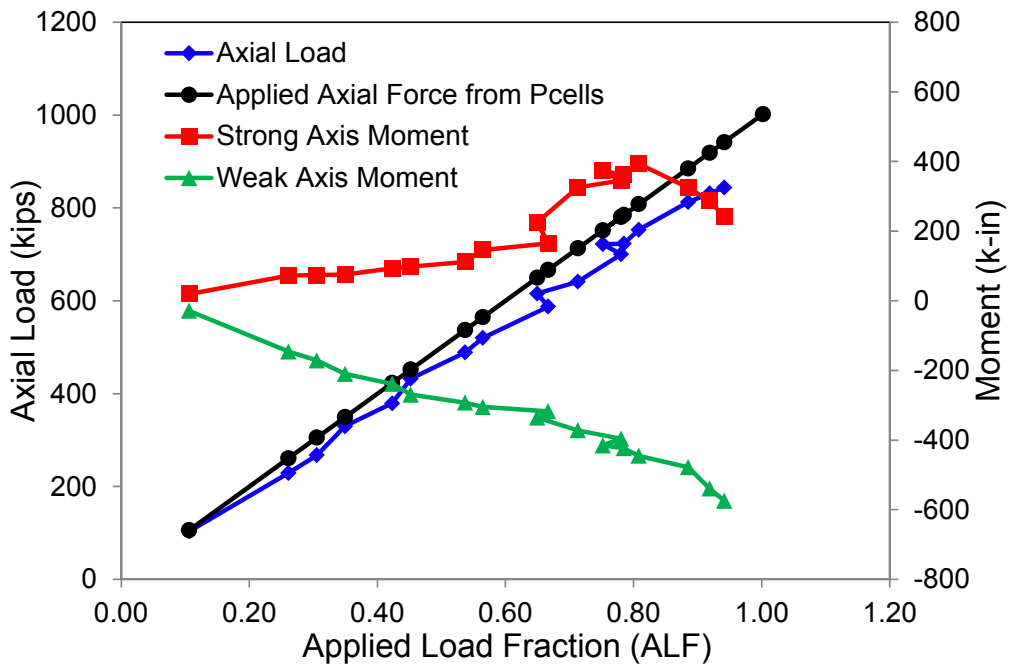

Figure G327. Tension Diagonal

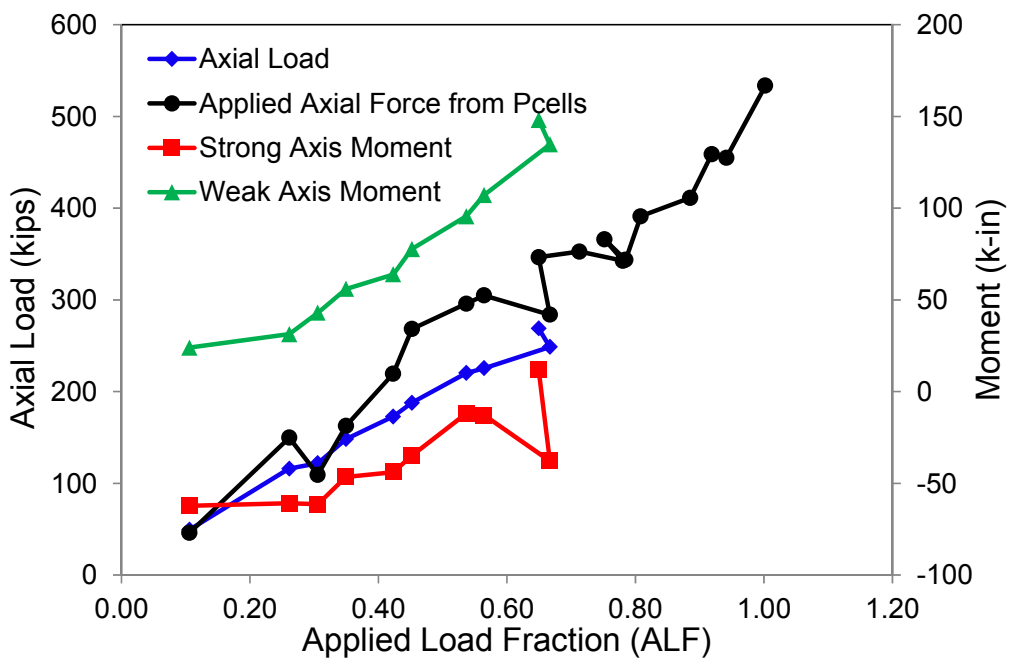

Figure G328. West Chord

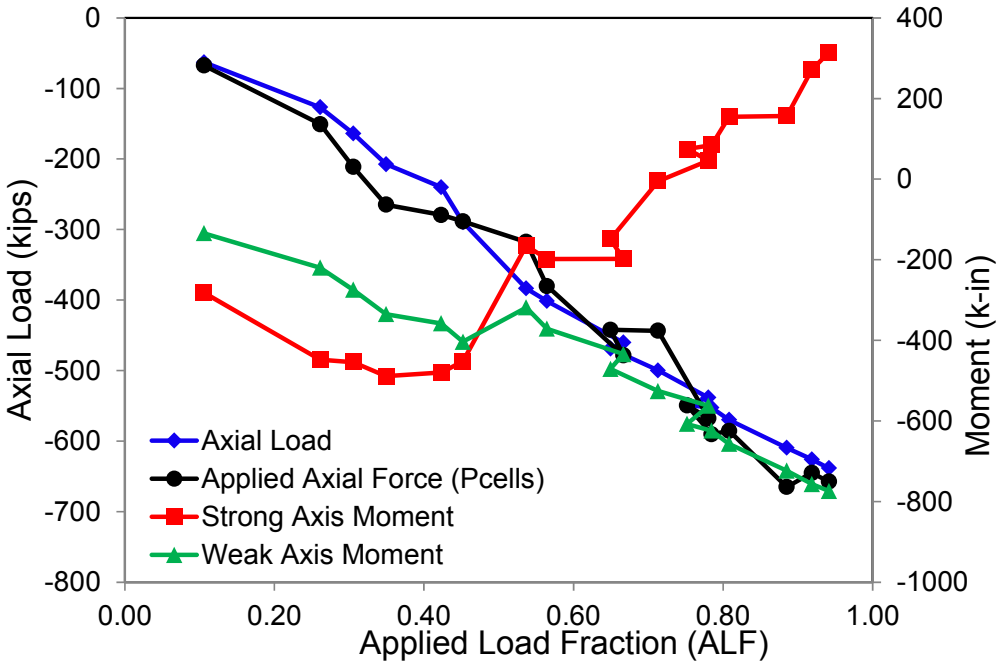

Figure G329. East Chord

Chord Load Shedding Plots

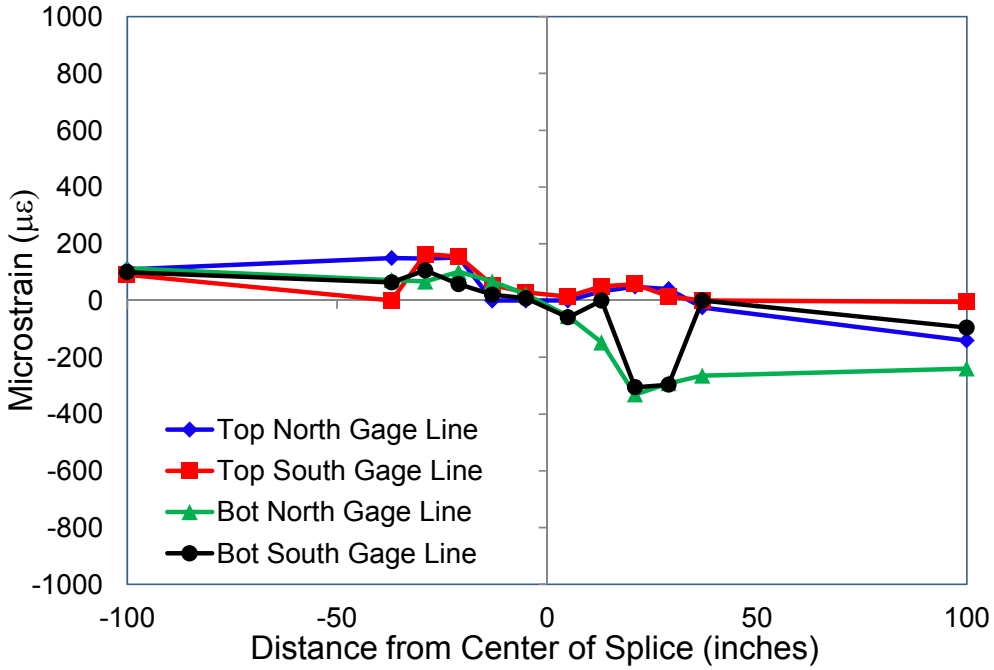

Figure G330. ALF=0.26

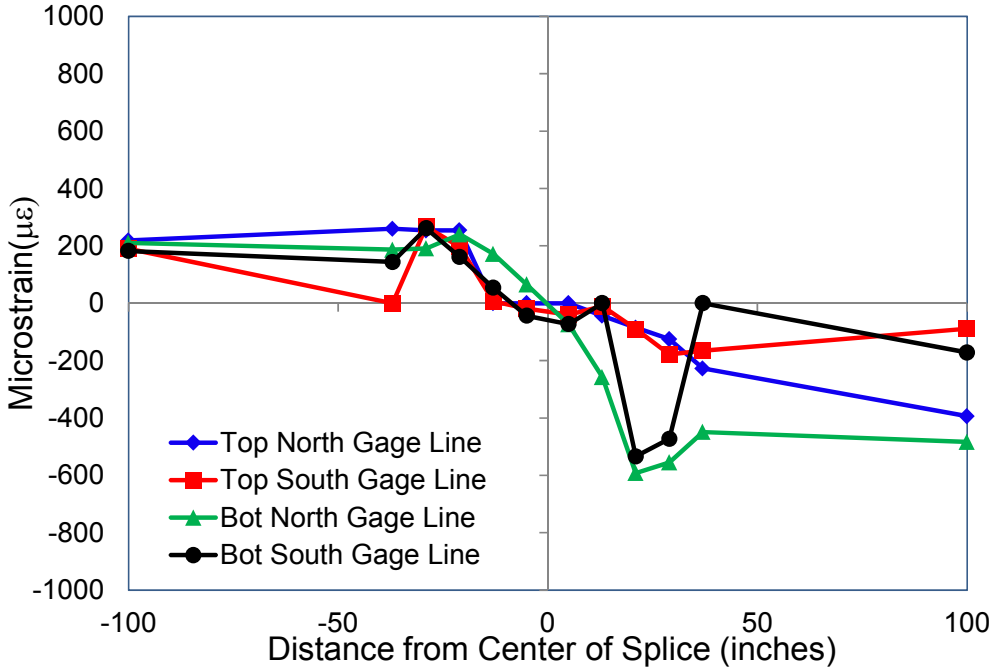

Figure G331. ALF=0.54

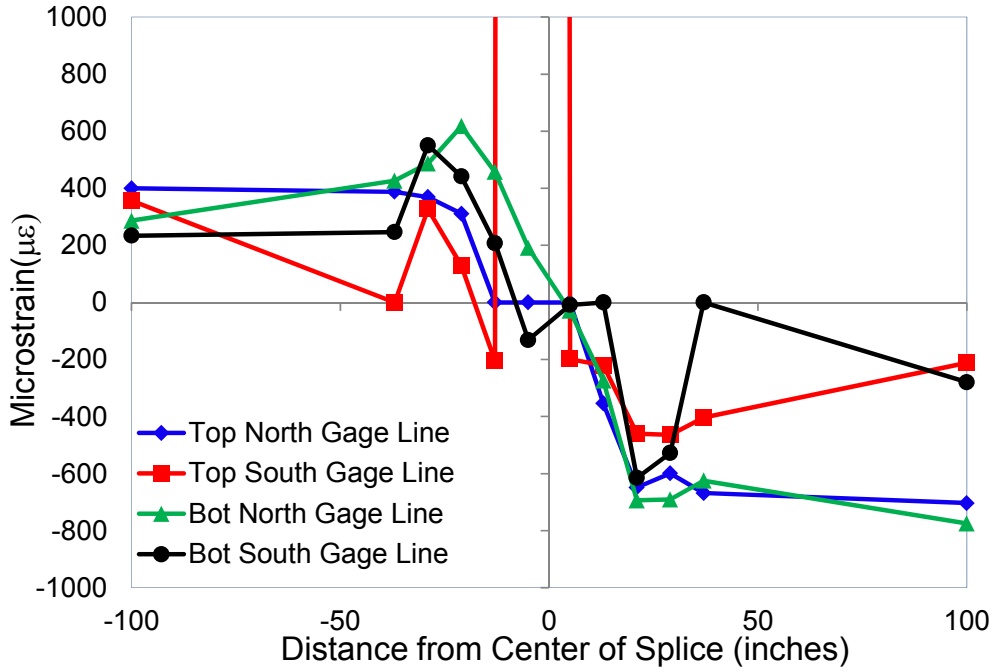

Figure G332. ALF=0.89

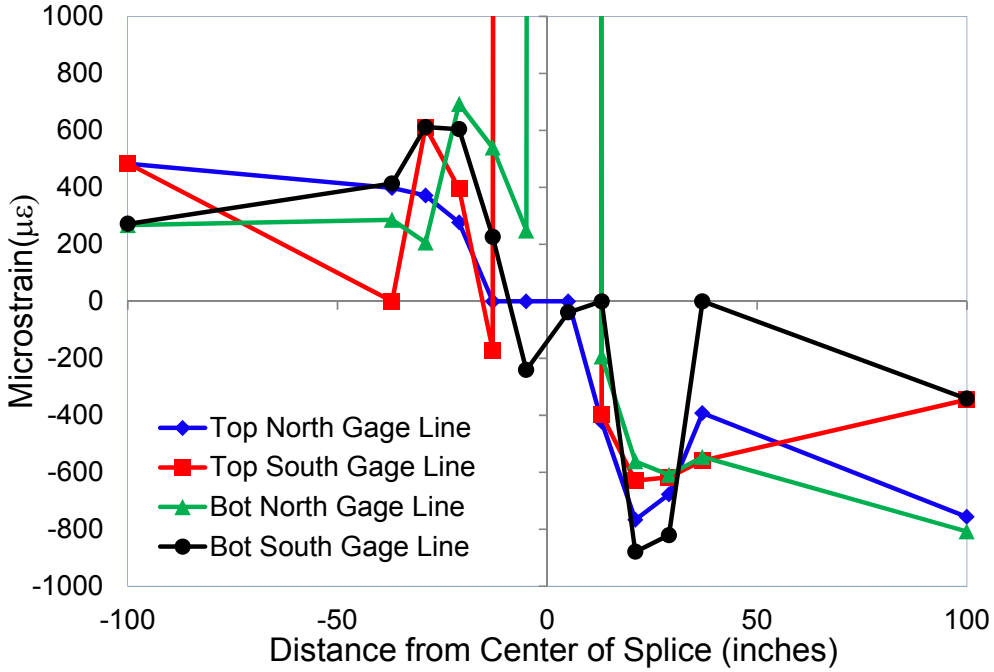

Figure G333. ALF=1.00

Uniaxial Gauge Plots

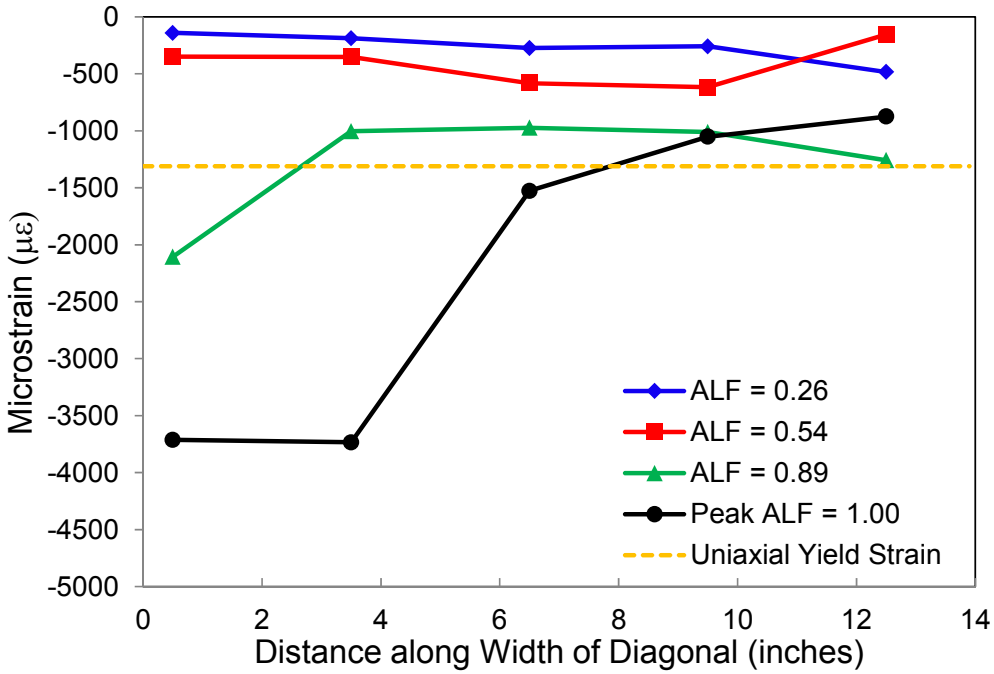

Figure G334. North Compression Diagonal

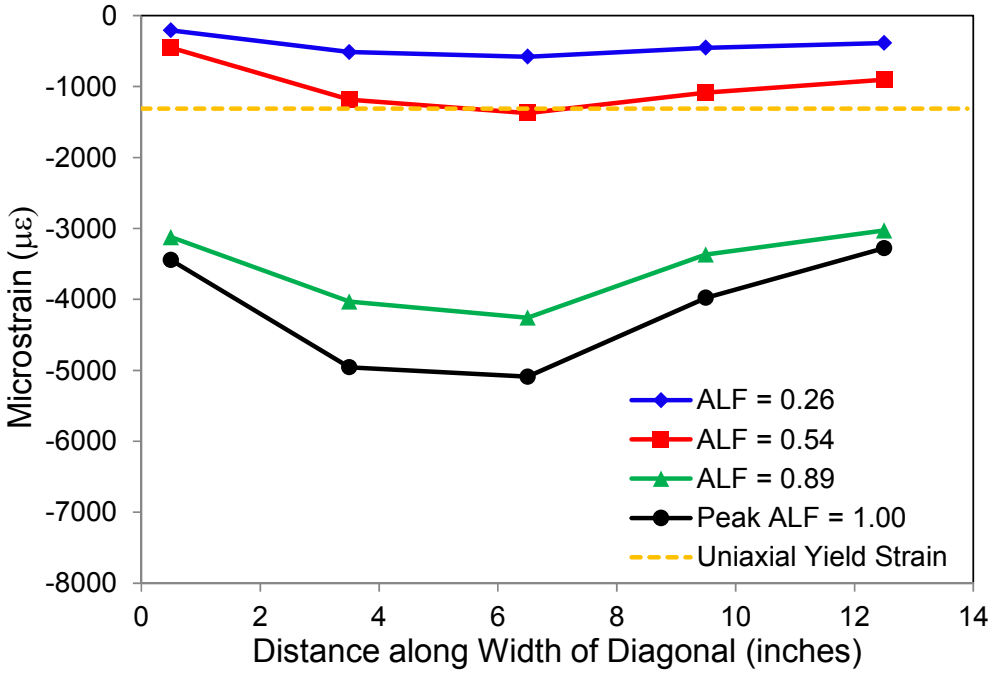

Figure G335. South Compression Diagonal

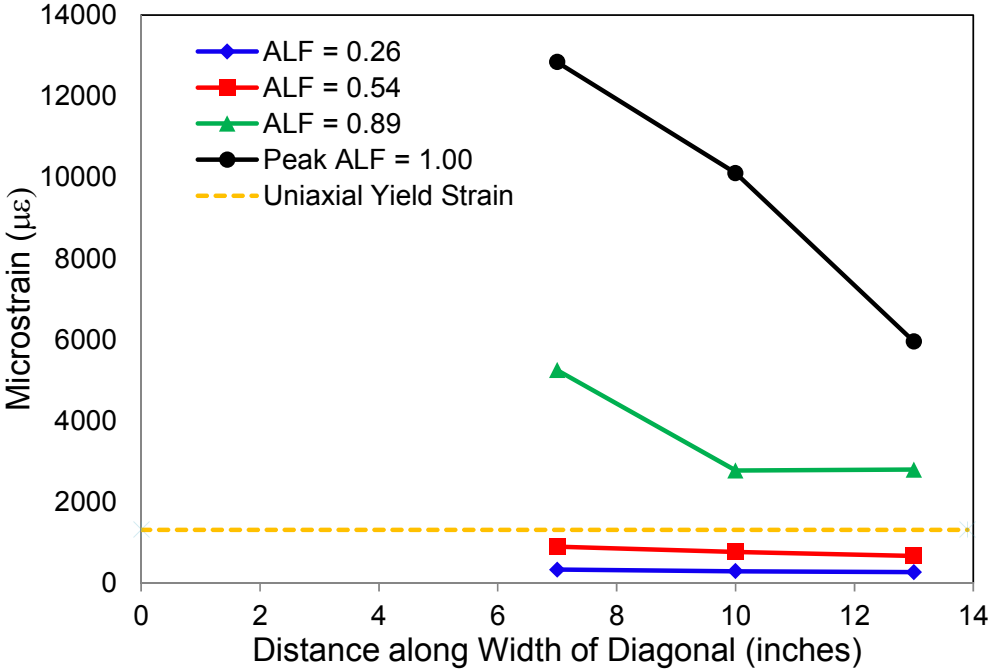

Figure G336. North Tension Diagonal

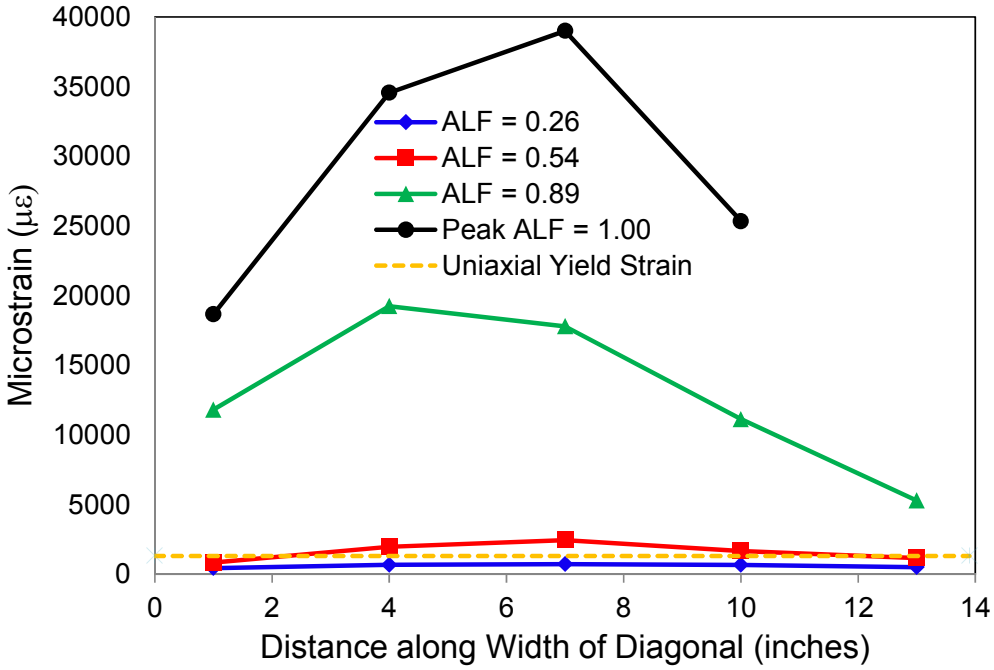

Figure G337. South Tension Diagonal