Steel Design (Track 2) Beam 170 Check 1

```
|--------------------------------------------------------------------------|
|                                                   Y        PROPERTIES    |
|*************                                      |        IN INCH UNIT  |
|           *  |=============================|               ------------  |
|MEMBER 170  *  |  AISC SECTIONS              |              AX =   2.24  |
|           *  | ST  HSST3.5X3.5X0.188       |          --Z  AY =   0.98  |
|DESIGN CODE *  |                             |              AZ =   0.98  |
| AISC-1989  *  ===============================              SY =   2.31  |
|           *                                               SZ =   2.31  |
|           *  |<---LENGTH (FT)=    1.00 --->|              RY =   1.34  |
|*************                                             RZ =   1.34  |
|                                                                          |
|                 1.0 (KIP-FEET)                                           |
|PARAMETER        |                                    L8  STRESSES     |
|IN KIP  INCH     |                                L8      IN KIP  INCH |
|---------------  +                            L8          -------------|
| KL/R-Y=   8.92  |                        L8              FA  =  21.60 |
| KL/R-Z=   8.92  +                    L8                  fa  =   2.21 |
| UNL   =  12.00  |                                        FCZ =  23.76 |
| CB    =   1.00  +                L8                      FTZ =  23.76 |
| CMY   =   0.85  |L8          L8                          FCY =  23.76 |
| CMZ   =   0.85  +   L8                                   FTY =  23.76 |
| FYLD  =  36.00  |       L8  L8                           fbz =   5.36 |
| NSF   =   1.00  +---+---+---+---+---+---+---+---+---+---|  fby =  12.39 |
| DFF   =   0.00  -0.0                                     Fey =1874.98 |
| dff=      0.00            ABSOLUTE MZ ENVELOPE           Fez =1874.98 |
|                              (WITH LOAD NO.)              FV  =  14.40 |
|                                                          fv  =   3.05 |
|                                                                          |
|                     MAX FORCE/ MOMENT SUMMARY  (KIP-FEET)                |
|                     -------------------------                            |
|                                                                          |
|               AXIAL      SHEAR-Y    SHEAR-Z    MOMENT-Y    MOMENT-Z      |
|                                                                          |
|      VALUE     -5.0         1.3        3.0         2.4         1.0       |
|   LOCATION      1.0         0.0        0.0         1.0         1.0       |
|    LOADING        8           8          8           8           8       |
|                                                                          |
|**************************************************************************|
|*                                                                        *|
|*                         DESIGN SUMMARY  (KIP-FEET)                     *|
|*                         --------------                                 *|
|*                                                                        *|
|*       RESULT/     CRITICAL COND/     RATIO/         LOADING/           *|
|          FX             MY             MZ           LOCATION            |
|        ======================================================           |
|          PASS        AISC- H2-1      8.496E-01          8               |
|          4.95 T         -2.39          1.03            1.00             |
|*                                                                        *|
|**************************************************************************|
|                                                                          |
|--------------------------------------------------------------------------|
```

Steel Design (Track 2) Beam 190 Check 1

```
|-----------------------------------------------------------------------------|
|                                                    Y         PROPERTIES     |
|*************                                      |         IN INCH UNIT   |
|            *  |=============================|                ------------   |
|MEMBER 190  *  |  AISC SECTIONS              |                AX =    2.24   |
|            *  | ST  HSST3.5X3.5X0.188       |            --Z AY =    0.98   |
|DESIGN CODE *  |                             |                AZ =    0.98   |
| AISC-1989  *  ===============================                SY =    2.31   |
|            *                                                 SZ =    2.31   |
|            *  |<---LENGTH (FT)=    1.00 --->|                RY =    1.34   |
|*************                                                 RZ =    1.34   |
|                                                                             |
|                  1.0 (KIP-FEET)                                             |
|PARAMETER        |                                       L8  STRESSES       |
|IN KIP  INCH     |                                   L8      IN KIP  INCH   |
|---------------  +                               L8          -------------|
| KL/R-Y=   8.92  |                           L8              FA  =  21.60   |
| KL/R-Z=   8.92  +                       L8                  fa  =   2.21   |
| UNL   =  12.00  |                                           FCZ =  23.76   |
| CB    =   1.00  +                   L8                      FTZ =  23.76   |
| CMY   =   0.85  |L8             L8                          FCY =  23.76   |
| CMZ   =   0.85  +   L8                                      FTY =  23.76   |
| FYLD  =  36.00  |       L8  L8                              fbz =   5.36   |
| NSF   =   1.00  +---+---+---+---+---+---+---+---+---+---|   fby =  12.40   |
| DFF   =   0.00  -0.0                                        Fey =1874.98   |
| dff=      0.00           ABSOLUTE MZ ENVELOPE               Fez =1874.98   |
|                             (WITH LOAD NO.)                 FV  =  14.40   |
|                                                             fv  =   3.05   |
|                                                                             |
|                     MAX FORCE/ MOMENT SUMMARY  (KIP-FEET)                   |
|                     -------------------------                               |
|                                                                             |
|               AXIAL      SHEAR-Y    SHEAR-Z    MOMENT-Y    MOMENT-Z         |
|                                                                             |
|      VALUE     -4.9         1.3        3.0         2.4         1.0          |
|   LOCATION      1.0         0.0        0.0         1.0         1.0          |
|    LOADING        8           8          8           8           8          |
|                                                                             |
|*****************************************************************************|
|*                                                                           *|
|*                         DESIGN SUMMARY  (KIP-FEET)                        *|
|*                         --------------                                    *|
|*                                                                           *|
|*       RESULT/     CRITICAL COND/     RATIO/         LOADING/              *|
|         FX             MY             MZ           LOCATION                |
|        ======================================================              |
|          PASS       AISC- H2-1      8.496E-01           8                   |
|          4.95 T        -2.39        -1.03             1.00                  |
|*                                                                           *|
|*****************************************************************************|
|                                                                             |
|-----------------------------------------------------------------------------|
```

Steel Design (Track 2) Beam 208 Check 1

```
|-----------------------------------------------------------------------------|
|                                                    Y         PROPERTIES    |
|*************                                       |         IN INCH UNIT |
|            *  |=============================|                 ------------ |
|MEMBER 208  *  |  AISC SECTIONS              |                AX =    1.07  |
|            *  | ST  HSST2.5X2.5X0.125       |             --Z AY =    0.47  |
|DESIGN CODE *  |                             |                AZ =    0.47  |
| AISC-1989  *  ===============================                SY =    0.80  |
|            *                                                 SZ =    0.80  |
|            *  |<---LENGTH (FT)=    1.00 --->|                RY =    0.97  |
|*************                                                 RZ =    0.97  |
|                                                                             |
|                 0.0 (KIP-FEET)                                              |
|PARAMETER       |L8                                           STRESSES      |
|IN KIP  INCH    |   L8  L8                                    IN KIP  INCH |
|--------------- +           L8                                -------------|
| KL/R-Y=  12.43 |               L8                            FA  =  21.03 |
| KL/R-Z=  12.43 +                   L8                        fa  =   0.58 |
| UNL   =  12.00 |                       L8                    FCZ =  23.76 |
| CB    =   1.00 +                                             FTZ =  23.76 |
| CMY   =   0.85 |                           L8  L8            FCY =  23.76 |
| CMZ   =   0.85 +                                   L24       FTY =  23.76 |
| FYLD  =  36.00 |                                       L14 fbz =   0.10 |
| NSF   =   1.00 +---+---+---+---+---+---+---+---+---+---|  fby =   0.07 |
| DFF   =   0.00  0.0                                        Fey = 967.24 |
| dff=      0.00             ABSOLUTE MZ ENVELOPE            Fez = 967.24 |
|                               (WITH LOAD NO.)               FV  =  14.40 |
|                                                             fv  =   0.01 |
|                                                                             |
|                     MAX FORCE/ MOMENT SUMMARY  (KIP-FEET)                   |
|                     -------------------------                               |
|                                                                             |
|               AXIAL      SHEAR-Y    SHEAR-Z    MOMENT-Y    MOMENT-Z         |
|                                                                             |
|      VALUE       0.6         0.0        0.0         0.0         0.0         |
|   LOCATION       0.0         1.0        0.0         0.0         0.0         |
|    LOADING         8           8          8           8           8         |
|                                                                             |
|*****************************************************************************|
|*                                                                           *|
|*                         DESIGN SUMMARY  (KIP-FEET)                        *|
|*                         --------------                                    *|
|*                                                                           *|
|*       RESULT/     CRITICAL COND/     RATIO/         LOADING/              *|
|          FX              MY             MZ           LOCATION               |
|         ======================================================              |
|           PASS        AISC- H1-3      3.423E-02           8                 |
|           0.62 C          -0.00       -0.01            0.00                 |
|*                                                                           *|
|*****************************************************************************|
|                                                                             |
|-----------------------------------------------------------------------------|
```

Utilization Ratio

Beam	Analysis Property	Design Property	Actual Ratio	Allowable Ratio	Ratio (Act./Allow.)	Clause	L/C	Ax (in^2)	Iz (in^4)	Iy (in^4)	Ix (in^4)
1	HSST3.5X3.	HSST3.5X3.	0.269	1.050	0.256	AISC- H2-1	28	2.240	4.050	4.050	6.560
2	HSST3.5X3.	HSST3.5X3.	0.275	1.050	0.262	AISC- H2-1	28	2.240	4.050	4.050	6.560
3	HSST3.5X3.	HSST3.5X3.	0.824	1.050	0.785	AISC- H1-3	29	2.240	4.050	4.050	6.560
4	HSST3.5X3.	HSST3.5X3.	0.655	1.050	0.624	AISC- H1-3	11	2.240	4.050	4.050	6.560
5	HSST3.5X3.	HSST3.5X3.	0.533	1.050	0.508	AISC- H2-1	29	2.240	4.050	4.050	6.560
6	HSST3.5X3.	HSST3.5X3.	0.599	1.050	0.570	AISC- H1-3	11	2.240	4.050	4.050	6.560
7	HSST3.5X3.	HSST3.5X3.	0.640	1.050	0.609	AISC- H1-3	8	2.240	4.050	4.050	6.560
8	HSST3.5X3.	HSST3.5X3.	0.222	1.050	0.211	AISC- H1-3	8	2.240	4.050	4.050	6.560
9	HSST3.5X3.	HSST3.5X3.	0.640	1.050	0.609	AISC- H1-3	8	2.240	4.050	4.050	6.560
10	HSST3.5X3.	HSST3.5X3.	0.222	1.050	0.211	AISC- H1-3	8	2.240	4.050	4.050	6.560
11	HSST2.5X2.	HSST2.5X2.	0.729	1.050	0.694	AISC- H1-3	11	1.070	0.998	0.998	1.610
12	HSST3.5X3.	HSST3.5X3.	0.639	1.050	0.609	AISC- H2-1	29	2.240	4.050	4.050	6.560
36	HSST2.5X2.	HSST2.5X2.	0.029	1.050	0.027	AISC- H2-1	8	1.070	0.998	0.998	1.610
56	HSST3.5X3.	HSST3.5X3.	0.325	1.050	0.310	AISC- H1-3	10	2.240	4.050	4.050	6.560
102	HSST2.5X2.	HSST2.5X2.	0.047	1.050	0.045	AISC- H1-3	17	1.070	0.998	0.998	1.610
170	HSST3.5X3.	HSST3.5X3.	0.850	1.050	0.809	AISC- H2-1	8	2.240	4.050	4.050	6.560
190	HSST3.5X3.	HSST3.5X3.	0.850	1.050	0.809	AISC- H2-1	8	2.240	4.050	4.050	6.560
208	HSST2.5X2.	HSST2.5X2.	0.034	1.050	0.033	AISC- H1-3	8	1.070	0.998	0.998	1.610

Appendix A - STAAD Input and Design Output

```
  1. STAAD SPACE
  INPUT FILE:\Container House\Staad\Container House.STD
  2. START JOB INFORMATION
  3. ENGINEER DATE 10-FEB-18
  4. END JOB INFORMATION
  5. INPUT WIDTH 79
  6. UNIT FEET KIP
  7. JOINT COORDINATES
  8. 1 0 0 0; 2 0 0 8; 3 20 0 0; 4 20 0 8; 5 0 8 0; 6 0 8 8; 7 20 8 0; 8 20 8 8
  9. 9 1 0 8; 10 1 1 8; 11 0 1 8; 12 2 0 8; 13 2 1 8; 14 3 0 8; 15 3 1 8; 16 4 0 8
 10. 17 4 1 8; 18 5 0 8; 19 5 1 8; 20 6 0 8; 21 6 1 8; 22 7 0 8; 23 7 1 8; 24 8 0 8
 11. 25 8 1 8; 26 9 0 8; 27 9 1 8; 28 10 0 8; 29 10 1 8; 30 11 0 8; 31 11 1 8
 12. 32 12 0 8; 33 12 1 8; 34 13 0 8; 35 13 1 8; 36 14 0 8; 37 14 1 8; 38 15 0 8
 13. 39 15 1 8; 40 16 0 8; 41 16 1 8; 42 17 0 8; 43 17 1 8; 44 18 0 8; 45 18 1 8
 14. 46 19 0 8; 47 19 1 8; 48 20 1 8; 49 1 2 8; 50 0 2 8; 51 2 2 8; 52 3 2 8
 15. 53 4 2 8; 54 5 2 8; 55 6 2 8; 56 7 2 8; 57 8 2 8; 58 9 2 8; 59 10 2 8
 16. 60 11 2 8; 61 12 2 8; 62 13 2 8; 63 14 2 8; 64 15 2 8; 65 16 2 8; 66 17 2 8
 17. 67 18 2 8; 68 19 2 8; 69 20 2 8; 70 1 3 8; 71 0 3 8; 72 2 3 8; 73 3 3 8
 18. 74 4 3 8; 75 5 3 8; 76 6 3 8; 77 7 3 8; 78 8 3 8; 79 9 3 8; 80 10 3 8
 19. 81 11 3 8; 82 12 3 8; 83 13 3 8; 84 14 3 8; 85 15 3 8; 86 16 3 8; 87 17 3 8
 20. 88 18 3 8; 89 19 3 8; 90 20 3 8; 91 1 4 8; 92 0 4 8; 93 2 4 8; 94 3 4 8
 21. 95 4 4 8; 96 5 4 8; 97 6 4 8; 98 7 4 8; 99 8 4 8; 100 9 4 8; 101 10 4 8
 22. 102 11 4 8; 103 12 4 8; 104 13 4 8; 105 14 4 8; 106 15 4 8; 107 16 4 8
 23. 108 17 4 8; 109 18 4 8; 110 19 4 8; 111 20 4 8; 112 1 5 8; 113 0 5 8
 24. 114 2 5 8; 115 3 5 8; 116 4 5 8; 117 5 5 8; 118 6 5 8; 119 7 5 8; 120 8 5 8
 25. 121 9 5 8; 122 10 5 8; 123 11 5 8; 124 12 5 8; 125 13 5 8; 126 14 5 8
 26. 127 15 5 8; 128 16 5 8; 129 17 5 8; 130 18 5 8; 131 19 5 8; 132 20 5 8
 27. 133 1 6 8; 134 0 6 8; 135 2 6 8; 136 3 6 8; 137 4 6 8; 138 5 6 8; 139 6 6 8
 28. 140 7 6 8; 141 8 6 8; 142 9 6 8; 143 10 6 8; 144 11 6 8; 145 12 6 8
 29. 146 13 6 8; 147 14 6 8; 148 15 6 8; 149 16 6 8; 150 17 6 8; 151 18 6 8
 30. 152 19 6 8; 153 20 6 8; 154 1 7 8; 155 0 7 8; 156 2 7 8; 157 3 7 8; 158 4 7 8
 31. 159 5 7 8; 160 6 7 8; 161 7 7 8; 162 8 7 8; 163 9 7 8; 164 10 7 8; 165 11 7 8
 32. 166 12 7 8; 167 13 7 8; 168 14 7 8; 169 15 7 8; 170 16 7 8; 171 17 7 8
 33. 172 18 7 8; 173 19 7 8; 174 20 7 8; 175 1 8 8; 176 2 8 8; 177 3 8 8; 178 4 8 8
 34. 179 5 8 8; 180 6 8 8; 181 7 8 8; 182 8 8 8; 183 9 8 8; 184 10 8 8; 185 11 8 8
 35. 186 12 8 8; 187 13 8 8; 188 14 8 8; 189 15 8 8; 190 16 8 8; 191 17 8 8
 36. 192 18 8 8; 193 19 8 8; 194 19 0 0; 195 19 1 0; 196 20 1 0; 197 18 0 0
 37. 198 18 1 0; 199 17 0 0; 200 17 1 0; 201 16 0 0; 202 16 1 0; 203 15 0 0
 38. 204 15 1 0; 205 14 0 0; 206 14 1 0; 207 13 0 0; 208 13 1 0; 209 12 0 0
   STAAD SPACE                                              -- PAGE NO.    2

 39. 210 12 1 0; 211 11 0 0; 212 11 1 0; 213 10 0 0; 214 10 1 0; 215 9 0 0
 40. 216 9 1 0; 217 8 0 0; 218 8 1 0; 219 7 0 0; 220 7 1 0; 221 6 0 0; 222 6 1 0
 41. 223 5 0 0; 224 5 1 0; 225 4 0 0; 226 4 1 0; 227 3 0 0; 228 3 1 0; 229 2 0 0
 42. 230 2 1 0; 231 1 0 0; 232 1 1 0; 233 0 1 0; 234 19 2 0; 235 20 2 0; 236 18 2 0
 43. 237 17 2 0; 238 16 2 0; 239 15 2 0; 240 14 2 0; 241 13 2 0; 242 12 2 0
 44. 243 11 2 0; 244 10 2 0; 245 9 2 0; 246 8 2 0; 247 7 2 0; 248 6 2 0; 249 5 2 0
 45. 250 4 2 0; 251 3 2 0; 252 2 2 0; 253 1 2 0; 254 0 2 0; 255 19 3 0; 256 20 3 0
 46. 257 18 3 0; 258 17 3 0; 259 16 3 0; 260 15 3 0; 261 14 3 0; 262 13 3 0
 47. 263 12 3 0; 264 11 3 0; 265 10 3 0; 266 9 3 0; 267 8 3 0; 268 7 3 0; 269 6 3 0
 48. 270 5 3 0; 271 4 3 0; 272 3 3 0; 273 2 3 0; 274 1 3 0; 275 0 3 0; 276 19 4 0
 49. 277 20 4 0; 278 18 4 0; 279 17 4 0; 280 16 4 0; 281 15 4 0; 282 14 4 0
 50. 283 13 4 0; 284 12 4 0; 285 11 4 0; 286 10 4 0; 287 9 4 0; 288 8 4 0
 51. 289 7 4 0; 290 6 4 0; 291 5 4 0; 292 4 4 0; 293 3 4 0; 294 2 4 0; 295 1 4 0
 52. 296 0 4 0; 297 19 5 0; 298 20 5 0; 299 18 5 0; 300 17 5 0; 301 16 5 0
 53. 302 15 5 0; 303 14 5 0; 304 13 5 0; 305 12 5 0; 306 11 5 0; 307 10 5 0
 54. 308 9 5 0; 309 8 5 0; 310 7 5 0; 311 6 5 0; 312 5 5 0; 313 4 5 0; 314 3 5 0
 55. 315 2 5 0; 316 1 5 0; 317 0 5 0; 318 19 6 0; 319 20 6 0; 320 18 6 0
 56. 321 17 6 0; 322 16 6 0; 323 15 6 0; 324 14 6 0; 325 13 6 0; 326 12 6 0
 57. 327 11 6 0; 328 10 6 0; 329 9 6 0; 330 8 6 0; 331 7 6 0; 332 6 6 0; 333 5 6 0
 58. 334 4 6 0; 335 3 6 0; 336 2 6 0; 337 1 6 0; 338 0 6 0; 339 19 7 0; 340 20 7 0
 59. 341 18 7 0; 342 17 7 0; 343 16 7 0; 344 15 7 0; 345 14 7 0; 346 13 7 0
 60. 347 12 7 0; 348 11 7 0; 349 10 7 0; 350 9 7 0; 351 8 7 0; 352 7 7 0; 353 6 7 0
 61. 354 5 7 0; 355 4 7 0; 356 3 7 0; 357 2 7 0; 358 1 7 0; 359 0 7 0; 360 19 8 0
 62. 361 18 8 0; 362 17 8 0; 363 16 8 0; 364 15 8 0; 365 14 8 0; 366 13 8 0
 63. 367 12 8 0; 368 11 8 0; 369 10 8 0; 370 9 8 0; 371 8 8 0; 372 7 8 0; 373 6 8 0
 64. 374 5 8 0; 375 4 8 0; 376 3 8 0; 377 2 8 0; 378 1 8 0; 379 0 0 1; 380 0 1 1
```

```
 65. 381 0 0 2; 382 0 1 2; 383 0 0 3; 384 0 1 3; 385 0 0 4; 386 0 1 4; 387 0 0 5
 66. 388 0 1 5; 389 0 0 6; 390 0 1 6; 391 0 0 7; 392 0 1 7; 393 0 2 1; 394 0 2 2
 67. 395 0 2 3; 396 0 2 4; 397 0 2 5; 398 0 2 6; 399 0 2 7; 400 0 3 1; 401 0 3 2
 68. 402 0 3 3; 403 0 3 4; 404 0 3 5; 405 0 3 6; 406 0 3 7; 407 0 4 1; 408 0 4 2
 69. 409 0 4 3; 410 0 4 4; 411 0 4 5; 412 0 4 6; 413 0 4 7; 414 0 5 1; 415 0 5 2
 70. 416 0 5 3; 417 0 5 4; 418 0 5 5; 419 0 5 6; 420 0 5 7; 421 0 6 1; 422 0 6 2
 71. 423 0 6 3; 424 0 6 4; 425 0 6 5; 426 0 6 6; 427 0 6 7; 428 0 7 1; 429 0 7 2
 72. 430 0 7 3; 431 0 7 4; 432 0 7 5; 433 0 7 6; 434 0 7 7; 435 0 8 1; 436 0 8 2
 73. 437 0 8 3; 438 0 8 4; 439 0 8 5; 440 0 8 6; 441 0 8 7; 442 20 0 7; 443 20 1 7
 74. 444 20 0 6; 445 20 1 6; 446 20 0 5; 447 20 1 5; 448 20 0 4; 449 20 1 4
 75. 450 20 0 3; 451 20 1 3; 452 20 0 2; 453 20 1 2; 454 20 0 1; 455 20 1 1
 76. 456 20 2 7; 457 20 2 6; 458 20 2 5; 459 20 2 4; 460 20 2 3; 461 20 2 2
 77. 462 20 2 1; 463 20 3 7; 464 20 3 6; 465 20 3 5; 466 20 3 4; 467 20 3 3
 78. 468 20 3 2; 469 20 3 1; 470 20 4 7; 471 20 4 6; 472 20 4 5; 473 20 4 4
 79. 474 20 4 3; 475 20 4 2; 476 20 4 1; 477 20 5 7; 478 20 5 6; 479 20 5 5
 80. 480 20 5 4; 481 20 5 3; 482 20 5 2; 483 20 5 1; 484 20 6 7; 485 20 6 6
 81. 486 20 6 5; 487 20 6 4; 488 20 6 3; 489 20 6 2; 490 20 6 1; 491 20 7 7
 82. 492 20 7 6; 493 20 7 5; 494 20 7 4; 495 20 7 3; 496 20 7 2; 497 20 7 1
 83. 498 20 8 7; 499 20 8 6; 500 20 8 5; 501 20 8 4; 502 20 8 3; 503 20 8 2
 84. 504 20 8 1; 505 1 8 7; 506 2 8 7; 507 3 8 7; 508 4 8 7; 509 5 8 7; 510 6 8 7
 85. 511 7 8 7; 512 8 8 7; 513 9 8 7; 514 10 8 7; 515 11 8 7; 516 12 8 7
 86. 517 13 8 7; 518 14 8 7; 519 15 8 7; 520 16 8 7; 521 17 8 7; 522 18 8 7
 87. 523 19 8 7; 524 1 8 6; 525 2 8 6; 526 3 8 6; 527 4 8 6; 528 5 8 6; 529 6 8 6
 88. 530 7 8 6; 531 8 8 6; 532 9 8 6; 533 10 8 6; 534 11 8 6; 535 12 8 6
 89. 536 13 8 6; 537 14 8 6; 538 15 8 6; 539 16 8 6; 540 17 8 6; 541 18 8 6
 90. 542 19 8 6; 543 1 8 5; 544 2 8 5; 545 3 8 5; 546 4 8 5; 547 5 8 5; 548 6 8 5
 91. 549 7 8 5; 550 8 8 5; 551 9 8 5; 552 10 8 5; 553 11 8 5; 554 12 8 5
 92. 555 13 8 5; 556 14 8 5; 557 15 8 5; 558 16 8 5; 559 17 8 5; 560 18 8 5
 93. 561 19 8 5; 562 1 8 4; 563 2 8 4; 564 3 8 4; 565 4 8 4; 566 5 8 4; 567 6 8 4
 94. 568 7 8 4; 569 8 8 4; 570 9 8 4; 571 10 8 4; 572 11 8 4; 573 12 8 4
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 95. 574 13 8 4; 575 14 8 4; 576 15 8 4; 577 16 8 4; 578 17 8 4; 579 18 8 4
 96. 580 19 8 4; 581 1 8 3; 582 2 8 3; 583 3 8 3; 584 4 8 3; 585 5 8 3; 586 6 8 3
 97. 587 7 8 3; 588 8 8 3; 589 9 8 3; 590 10 8 3; 591 11 8 3; 592 12 8 3
 98. 593 13 8 3; 594 14 8 3; 595 15 8 3; 596 16 8 3; 597 17 8 3; 598 18 8 3
 99. 599 19 8 3; 600 1 8 2; 601 2 8 2; 602 3 8 2; 603 4 8 2; 604 5 8 2; 605 6 8 2
100. 606 7 8 2; 607 8 8 2; 608 9 8 2; 609 10 8 2; 610 11 8 2; 611 12 8 2
101. 612 13 8 2; 613 14 8 2; 614 15 8 2; 615 16 8 2; 616 17 8 2; 617 18 8 2
102. 618 19 8 2; 619 1 8 1; 620 2 8 1; 621 3 8 1; 622 4 8 1; 623 5 8 1; 624 6 8 1
103. 625 7 8 1; 626 8 8 1; 627 9 8 1; 628 10 8 1; 629 11 8 1; 630 12 8 1
104. 631 13 8 1; 632 14 8 1; 633 15 8 1; 634 16 8 1; 635 17 8 1; 636 18 8 1
105. 637 19 8 1; 638 1 0 7; 639 2 0 7; 640 3 0 7; 641 4 0 7; 642 5 0 7; 643 6 0 7
106. 644 7 0 7; 645 8 0 7; 646 9 0 7; 647 10 0 7; 648 11 0 7; 649 12 0 7
107. 650 13 0 7; 651 14 0 7; 652 15 0 7; 653 16 0 7; 654 17 0 7; 655 18 0 7
108. 656 19 0 7; 657 1 0 6; 658 2 0 6; 659 3 0 6; 660 4 0 6; 661 5 0 6; 662 6 0 6
109. 663 7 0 6; 664 8 0 6; 665 9 0 6; 666 10 0 6; 667 11 0 6; 668 12 0 6
110. 669 13 0 6; 670 14 0 6; 671 15 0 6; 672 16 0 6; 673 17 0 6; 674 18 0 6
111. 675 19 0 6; 676 1 0 5; 677 2 0 5; 678 3 0 5; 679 4 0 5; 680 5 0 5; 681 6 0 5
112. 682 7 0 5; 683 8 0 5; 684 9 0 5; 685 10 0 5; 686 11 0 5; 687 12 0 5
113. 688 13 0 5; 689 14 0 5; 690 15 0 5; 691 16 0 5; 692 17 0 5; 693 18 0 5
114. 694 19 0 5; 695 1 0 4; 696 2 0 4; 697 3 0 4; 698 4 0 4; 699 5 0 4; 700 6 0 4
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12 58 80 102 124 146 168 190 PMEMBER 11
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DENSITY 0.489024
ALPHA 6E-006
DAMP 0.03
TYPE STEEL
STRENGTH FY 5184 FU 8352 RY 1.5 RT 1.2
ISOTROPIC CONCRETE
E 453600
POISSON 0.17
DENSITY 0.150336
ALPHA 5E-006
DAMP 0.05
TYPE CONCRETE
STRENGTH FCU 576
END DEFINE MATERIAL
MEMBER PROPERTY AMERICAN
_SCB TABLE ST HSST2.5X2.5X0.125
_EB TABLE ST HSST3.5X3.5X0.188
MEMBER PROPERTY AMERICAN
_CC PRIS YD 1 ZD 1
CONSTANTS
MATERIAL STEEL MEMB 1 TO 12 19 TO 918
MATERIAL CONCRETE MEMB 919 TO 922
SUPPORTS
771 TO 774 PINNED
DEFINE IBC 2012
ZIP 94116 I 1 RX 8 RZ 8 SCLASS 4 TL 8 FA 1 FV 1.5

*****************************************************************************
* EQUIV. SEISMIC LOADS AS PER IBC 2012                                      *
* PARAMETERS CONSIDERED FOR SUBSEQUENT LOAD GENERATION                      *
*  SS =  2.071 S1 =  0.980 FA =  1.000 FV =  1.500                          *
*  SDS =  1.381 SD1 =  0.980                                                *
*****************************************************************************
```

```
463. SELFWEIGHT 1
464. ELEMENT WEIGHT
465. 759 TO 918 PRESSURE 0.05
466. DEFINE WIND LOAD

*** NOTE: If any floor diaphragm is present in the model Wind Load definition
          should be defined after Floor Diaphragm definition. Otherwise wind
          load generation may be unsuccessful during analysis.

467. TYPE 1 WIND 1
468. <! STAAD PRO GENERATED DATA DO NOT MODIFY !!!
469. ASCE-7-2010:PARAMS 180.000 MPH 0 3 1 0 0.000 FT 0.000 FT 0.000 FT 1 -
470. 1 8.000 FT 20.000 FT 8.000 FT 2.000 0.010 0 -
471. 0 0 0 0 1.030 1.000 1.000 0.850 0 -
472. 0 0 0 0.907 0.800 -0.550
```



```
473. !> END GENERATED DATA BLOCK
474. INT 0.0926768 0.0926768 HEIG  0  15
475. EXP 0.85 JOINT 1 TO 774
476. TYPE 2 WIND 2
477. <! STAAD PRO GENERATED DATA DO NOT MODIFY !!!
478. ASCE-7-2010:PARAMS 180.000 MPH 0 3 1 0 0.000 FT 0.000 FT 0.000 FT 1 -
479. 1 8.000 FT 20.000 FT 8.000 FT 2.000 0.010 0 -
480. 0 0 0 0 1.030 1.000 1.000 0.850 0 -
481. 0 0 0 0.907 0.800 -0.550
482. !> END GENERATED DATA BLOCK
483. INT 0.0926768 0.0926768 HEIG  0  15
484. EXP 0.85 JOINT 1 TO 774
485. DEFINE REFERENCE LOADS
486. LOAD R1 LOADTYPE DEAD  TITLE REF LOAD CASE 1
487. SELFWEIGHT Y -1
488. END DEFINE REFERENCE LOADS
489. LOAD 1 LOADTYPE SEISMIC  TITLE EQX
490. IBC LOAD X 1
491. PERFORM ANALYSIS


        P R O B L E M   S T A T I S T I C S
        -----------------------------------

  NUMBER OF JOINTS        774  NUMBER OF MEMBERS     148
  NUMBER OF PLATES        768  NUMBER OF SOLIDS        0
  NUMBER OF SURFACES        0  NUMBER OF SUPPORTS      4


       SOLVER USED IS THE IN-CORE ADVANCED MATH SOLVER

TOTAL      PRIMARY LOAD CASES =     1, TOTAL DEGREES OF FREEDOM =    4632
TOTAL LOAD COMBINATION  CASES =     0  SO FAR.
```



```
************************************************************
*  IBC 2012 SEISMIC LOAD ALONG X  :                        *
*     CT =  0.028 Cu =  1.400 x =  0.8000                  *
*  TIME PERIODS :                                          *
*     Ta =  0.177 T =  0.082 Tuser = 0.000                 *
*  TIME PERIOD USED (T) =  0.082                           *
*  Cs LIMITS : LOWER =  0.061 UPPER =  1.486               *
*  LOAD FACTOR          =  1.000                           *
*  DESIGN BASE SHEAR    =  1.000 X  0.173 X       17.70    *
*                       =        3.05  KIP                 *
************************************************************
```

```
 492. CHANGE
 493. LOAD 2 LOADTYPE SEISMIC  TITLE EQZ
 494. IBC LOAD Z 1
 495. PERFORM ANALYSIS


 ************************************************************
 *  IBC 2012 SEISMIC LOAD ALONG Z  :                        *
 *     CT =  0.028 Cu =  1.400 x =  0.8000                  *
 *  TIME PERIODS :                                          *
 *     Ta =  0.177 T =  0.155 Tuser = 0.000                 *
 *  TIME PERIOD USED (T) =  0.155                           *
 *  Cs LIMITS : LOWER =  0.061 UPPER =  0.792               *
 *  LOAD FACTOR          =  1.000                           *
 *  DESIGN BASE SHEAR    =  1.000 X  0.173 X        17.70   *
 *                       =         3.05  KIP                *
 ************************************************************


 496. CHANGE
 497. LOAD 3 LOADTYPE DEAD  TITLE DEAD LOAD
 498. ELEMENT LOAD
 499. 759 TO 918 PR GY -0.05
 500. SELFWEIGHT Y -1
 501. LOAD 4 LOADTYPE ROOF LIVE  TITLE ROOF LIVE
 502. ELEMENT LOAD
 503. 599 TO 758 PR GY -0.3
 504. LOAD 5 LOADTYPE WIND  TITLE WIND_X
 505. WIND LOAD X 1 TYPE 1 YR 0 8 ZR 0 8
    STAAD SPACE                                             -- PAGE NO.   12

 506. LOAD 6 LOADTYPE WIND  TITLE WIND_Z
 507. WIND LOAD Z 1 TYPE 2 YR 0 8 ZR 0 20
 508. LOAD COMB 7 GENERATED AISC GENERAL 1
 509. 3 1.0
 510. LOAD COMB 8 GENERATED AISC GENERAL 2
 511. 3 1.0 4 1.0
 512. LOAD COMB 9 GENERATED AISC GENERAL 3
 513. 3 1.0 4 0.75
 514. LOAD COMB 10 GENERATED AISC GENERAL 4
 515. 3 1.0 5 1.0
 516. LOAD COMB 11 GENERATED AISC GENERAL 5
 517. 3 1.0 6 1.0
 518. LOAD COMB 12 GENERATED AISC GENERAL 6
 519. 3 1.0 1 0.7
 520. LOAD COMB 13 GENERATED AISC GENERAL 7
 521. 3 1.0 2 0.7
 522. LOAD COMB 14 GENERATED AISC GENERAL 8
 523. 3 1.0 1 -0.7
 524. LOAD COMB 15 GENERATED AISC GENERAL 9
 525. 3 1.0 2 -0.7
 526. LOAD COMB 16 GENERATED AISC GENERAL 10
 527. 3 1.0 4 0.75 5 0.75
 528. LOAD COMB 17 GENERATED AISC GENERAL 11
 529. 3 1.0 4 0.75 6 0.75
 530. LOAD COMB 18 GENERATED AISC GENERAL 12
 531. 3 1.0 5 0.75
 532. LOAD COMB 19 GENERATED AISC GENERAL 13
 533. 3 1.0 6 0.75
 534. LOAD COMB 20 GENERATED AISC GENERAL 14
 535. 3 1.0 4 0.75 1 0.525
 536. LOAD COMB 21 GENERATED AISC GENERAL 15
 537. 3 1.0 4 0.75 2 0.525
 538. LOAD COMB 22 GENERATED AISC GENERAL 16
```

```
 539. 3 1.0 1 0.525
 540. LOAD COMB 23 GENERATED AISC GENERAL 17
 541. 3 1.0 2 0.525
 542. LOAD COMB 24 GENERATED AISC GENERAL 18
 543. 3 1.0 4 0.75 1 -0.525
 544. LOAD COMB 25 GENERATED AISC GENERAL 19
 545. 3 1.0 4 0.75 2 -0.525
 546. LOAD COMB 26 GENERATED AISC GENERAL 20
 547. 3 1.0 1 -0.525
 548. LOAD COMB 27 GENERATED AISC GENERAL 21
 549. 3 1.0 2 -0.525
 550. LOAD COMB 28 GENERATED AISC GENERAL 22
 551. 3 0.6 5 1.0
 552. LOAD COMB 29 GENERATED AISC GENERAL 23
 553. 3 0.6 6 1.0
 554. LOAD COMB 30 GENERATED AISC GENERAL 24
 555. 3 0.6 1 0.7
↑   STAAD SPACE                                           -- PAGE NO.   13

 556. LOAD COMB 31 GENERATED AISC GENERAL 25
 557. 3 0.6 2 0.7
 558. LOAD COMB 32 GENERATED AISC GENERAL 26
 559. 3 0.6 1 -0.7
 560. LOAD COMB 33 GENERATED AISC GENERAL 27
 561. 3 0.6 2 -0.7
 562. LOAD COMB 34 GENERATED ACI TABLE1 1
 563. 3 1.4
 564. LOAD COMB 35 GENERATED ACI TABLE1 2
 565. 3 1.2 4 0.5
 566. LOAD COMB 36 GENERATED ACI TABLE1 3
 567. 3 1.2
 568. LOAD COMB 37 GENERATED ACI TABLE1 4
 569. 3 1.2 4 1.6
 570. LOAD COMB 38 GENERATED ACI TABLE1 5
 571. 3 1.2 4 1.6 5 0.8
 572. LOAD COMB 39 GENERATED ACI TABLE1 6
 573. 3 1.2 4 1.6 6 0.8
 574. LOAD COMB 40 GENERATED ACI TABLE1 7
 575. 3 1.2 5 0.8
 576. LOAD COMB 41 GENERATED ACI TABLE1 8
 577. 3 1.2 6 0.8
 578. LOAD COMB 42 GENERATED ACI TABLE1 9
 579. 3 1.2 4 0.5 5 1.6
 580. LOAD COMB 43 GENERATED ACI TABLE1 10
 581. 3 1.2 4 0.5 6 1.6
 582. LOAD COMB 44 GENERATED ACI TABLE1 11
 583. 3 1.2 5 1.6
 584. LOAD COMB 45 GENERATED ACI TABLE1 12
 585. 3 1.2 6 1.6
 586. LOAD COMB 46 GENERATED ACI TABLE1 13
 587. 3 1.2 1 1.0
 588. LOAD COMB 47 GENERATED ACI TABLE1 14
 589. 3 1.2 2 1.0
 590. LOAD COMB 48 GENERATED ACI TABLE1 15
 591. 3 0.9 5 1.6
 592. LOAD COMB 49 GENERATED ACI TABLE1 16
 593. 3 0.9 6 1.6
 594. LOAD COMB 50 GENERATED ACI TABLE1 17
 595. 3 0.9 1 1.0
 596. LOAD COMB 51 GENERATED ACI TABLE1 18
 597. 3 0.9 2 1.0
 598. PERFORM ANALYSIS


 599. LOAD LIST 7 TO 33
 600. PARAMETER 1
 601. CODE AISC
 602. TRACK 2 MEMB 1 TO 12 19 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 -
 603. 54 56 58 60 80 82 102 104 124 126 146 148 168 170 190 192 194 196 198 200 -
 604. 202 204 206 208 210 212 214 216 218 220 222 224 226 228 231 232 234 236 238 -
```

```
   605. 240 242 244 246 248 250 252 254 256 258 260 262 264 266 268 270 272 292 294 -
   606. 314 316 336 338 358 360 380 382 402 404 406 408 410 412 414 416 418 420 422 -
      STAAD SPACE                                              -- PAGE NO.   14

   607. 424 426 428 430 432 434 436 438 440 443 445 447 449 451 453 455 506 508 510 -
   608. 512 514 516 518 521 523 525 527 529 531 533 584 586 588 590 592 594 596
   609. RATIO 1.05 ALL
   610. CHECK CODE MEMB 1 TO 12 19 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 -
   611. 52 54 56 58 60 80 82 102 104 124 126 146 148 168 170 190 192 194 196 198 -
   612. 200 202 204 206 208 210 212 214 216 218 220 222 224 226 228 231 232 234 236 -
   613. 238 240 242 244 246 248 250 252 254 256 258 260 262 264 266 268 270 272 292 -
   614. 294 314 316 336 338 358 360 380 382 402 404 406 408 410 412 414 416 418 420 -
   615. 422 424 426 428 430 432 434 436 438 440 443 445 447 449 451 453 455 506 508 -
   616. 510 512 514 516 518 521 523 525 527 529 531 533 584 586 588 590 592 594 596

      STAAD SPACE                                              -- PAGE NO.  303

   617. LOAD LIST 34 TO 51
   618. START CONCRETE DESIGN
      STAAD SPACE                                              -- PAGE NO.  304

CONCRETE DESIGN
   619. CODE ACI
   620. TRACK 2 MEMB 919 TO 922
   621. DESIGN COLUMN 919 TO 922
      STAAD SPACE                                              -- PAGE NO.  305



        ACI 318-11   COLUMN  NO.   919   DESIGN RESULTS
        ===============================================


   FY - 60000  FC - 4000 PSI,  SQRE SIZE - 12.00 X 12.00 INCHES, TIED
           ONLY MINIMUM STEEL IS REQUIRED.
           AREA OF STEEL REQUIRED =   1.440  SQ. IN.

   BAR CONFIGURATION       REINF PCT.   LOAD   LOCATION   PHI
   ----------------------------------------------------------

     8 - NUMBER  4           1.111       34      END     0.650
   (PROVIDE EQUAL NUMBER OF BARS ON EACH FACE)
   TIE BAR NUMBER    4 SPACING   8.00 IN

       COLUMN INTERACTION: MOMENT ABOUT Z -AXIS (KIP-FT)

    --------------------------------------------------------
      P0        Pn max    P-bal.    M-bal.   e-bal.(inch)
     580.16    464.13    207.36     84.77    4.91
       M0       P-tens.   Des.Pn    Des.Mn     e/h
      39.08    -96.00      8.75      1.60    0.09164
    --------------------------------------------------------

       COLUMN INTERACTION: MOMENT ABOUT Y -AXIS (KIP-FT)

    --------------------------------------------------------
      P0        Pn max    P-bal.    M-bal.   e-bal.(inch)
     580.16    464.13    207.36     84.77    4.91
       M0       P-tens.   Des.Pn    Des.Mn     e/h
      39.08    -96.00      8.75      2.82    0.16101
    --------------------------------------------------------
                            Pn       Mn       Pn       Mn    (@ Z )
            |              428.43    54.43   214.21    84.42
        P0  |*             392.72    62.91   178.51    82.09
            | *            357.02    69.84   142.81    77.19
      Pn,max|__*           321.32    75.23   107.11    71.14
            |   *          285.62    79.28    71.40    62.97
      Pn    |    *         249.92    82.26    35.70    51.70
     NOMINAL|     *         Pn       Mn       Pn       Mn    (@ Y )
```

```
      AXIAL|      *       428.43    54.43   214.21    84.42
 COMPRESSION|       *      392.72    62.91   178.51    82.09
         Pb|-------*Mb    357.02    69.84   142.81    77.19
           |      *       321.32    75.23   107.11    71.14
___________|____*_______  285.62    79.28    71.40    62.97
           |  * M0   Mn,  249.92    82.26    35.70    51.70
           | *   BENDING
     P-tens|*     MONENT
           |
```



```
       ACI 318-11   COLUMN  NO.   920   DESIGN RESULTS
       ===============================================


  FY - 60000  FC - 4000 PSI,  SQRE SIZE - 12.00 X 12.00 INCHES, TIED
          ONLY MINIMUM STEEL IS REQUIRED.
          AREA OF STEEL REQUIRED =   1.440  SQ. IN.

  BAR CONFIGURATION       REINF PCT.   LOAD   LOCATION   PHI
  ----------------------------------------------------------

    8 - NUMBER  4           1.111       34      END     0.650
  (PROVIDE EQUAL NUMBER OF BARS ON EACH FACE)
  TIE BAR NUMBER    4 SPACING   8.00 IN

      COLUMN INTERACTION: MOMENT ABOUT Z -AXIS (KIP-FT)

   --------------------------------------------------------
     P0        Pn max    P-bal.    M-bal.   e-bal.(inch)
    580.16    464.13    207.36     84.77    4.91
      M0       P-tens.   Des.Pn    Des.Mn     e/h
     39.08    -96.00      9.03      1.69    0.09362
   --------------------------------------------------------

      COLUMN INTERACTION: MOMENT ABOUT Y -AXIS (KIP-FT)

   --------------------------------------------------------
     P0        Pn max    P-bal.    M-bal.   e-bal.(inch)
    580.16    464.13    207.36     84.77    4.91
      M0       P-tens.   Des.Pn    Des.Mn     e/h
     39.08    -96.00      9.03      2.93    0.16245
   --------------------------------------------------------
                           Pn        Mn       Pn        Mn    (@ Z )
           |              428.43    54.43   214.21    84.42
        P0 |*             392.72    62.91   178.51    82.09
           | *            357.02    69.84   142.81    77.19
     Pn,max|__*           321.32    75.23   107.11    71.14
           |   *          285.62    79.28    71.40    62.97
     Pn    |    *         249.92    82.26    35.70    51.70
    NOMINAL|     *         Pn        Mn       Pn        Mn    (@ Y )
      AXIAL|      *       428.43    54.43   214.21    84.42
 COMPRESSION|       *      392.72    62.91   178.51    82.09
         Pb|-------*Mb    357.02    69.84   142.81    77.19
           |      *       321.32    75.23   107.11    71.14
___________|____*_______  285.62    79.28    71.40    62.97
           |  * M0   Mn,  249.92    82.26    35.70    51.70
           | *   BENDING
     P-tens|*     MOMENT
           |
```



```
       ACI 318-11   COLUMN  NO.   921   DESIGN RESULTS
       ===============================================
```

```
 
  FY - 60000  FC - 4000 PSI,  SQRE SIZE - 12.00 X 12.00 INCHES, TIED
          ONLY MINIMUM STEEL IS REQUIRED.
          AREA OF STEEL REQUIRED =   1.440  SQ. IN.

  BAR CONFIGURATION       REINF PCT.   LOAD   LOCATION   PHI
  ----------------------------------------------------------

    8 - NUMBER  4           1.111       34      END     0.650
  (PROVIDE EQUAL NUMBER OF BARS ON EACH FACE)
  TIE BAR NUMBER    4 SPACING   8.00 IN

      COLUMN INTERACTION: MOMENT ABOUT Z -AXIS (KIP-FT)

   --------------------------------------------------------
     P0        Pn max    P-bal.    M-bal.   e-bal.(inch)
    580.16    464.13    207.36     84.77    4.91
      M0       P-tens.   Des.Pn    Des.Mn     e/h
     39.08    -96.00      9.03      1.89    0.10479
   --------------------------------------------------------

      COLUMN INTERACTION: MOMENT ABOUT Y -AXIS (KIP-FT)

   --------------------------------------------------------
     P0        Pn max    P-bal.    M-bal.   e-bal.(inch)
    580.16    464.13    207.36     84.77    4.91
      M0       P-tens.   Des.Pn    Des.Mn     e/h
     39.08    -96.00      9.03      2.68    0.14867
   --------------------------------------------------------
                             Pn       Mn       Pn       Mn    (@ Z )
             |              428.43    54.43   214.21    84.42
         P0  |*             392.72    62.91   178.51    82.09
             | *            357.02    69.84   142.81    77.19
     Pn,max|__*             321.32    75.23   107.11    71.14
             |   *          285.62    79.28    71.40    62.97
     Pn      |    *         249.92    82.26    35.70    51.70
    NOMINAL|     *           Pn       Mn       Pn       Mn    (@ Y )
      AXIAL|      *         428.43    54.43   214.21    84.42
COMPRESSION|       *        392.72    62.91   178.51    82.09
         Pb|-------*Mb      357.02    69.84   142.81    77.19
             |      *       321.32    75.23   107.11    71.14
___________|____*_______    285.62    79.28    71.40    62.97
             |  * M0   Mn,  249.92    82.26    35.70    51.70
             | *   BENDING
     P-tens|*     MOMENT
             |
```



```
      ACI 318-11   COLUMN  NO.   922   DESIGN RESULTS
      ===============================================

  FY - 60000  FC - 4000 PSI,  SQRE SIZE - 12.00 X 12.00 INCHES, TIED
          ONLY MINIMUM STEEL IS REQUIRED.
          AREA OF STEEL REQUIRED =   1.440  SQ. IN.

  BAR CONFIGURATION       REINF PCT.   LOAD   LOCATION   PHI
  ----------------------------------------------------------

    8 - NUMBER  4           1.111       34      END     0.650
  (PROVIDE EQUAL NUMBER OF BARS ON EACH FACE)
  TIE BAR NUMBER    4 SPACING   8.00 IN

      COLUMN INTERACTION: MOMENT ABOUT Z -AXIS (KIP-FT)

   --------------------------------------------------------
```

```
    P0        Pn max    P-bal.    M-bal.   e-bal.(inch)
   580.16    464.13    207.36     84.77    4.91
    M0        P-tens.   Des.Pn    Des.Mn     e/h
    39.08    -96.00      8.72      1.40    0.08035
   --------------------------------------------------------

      COLUMN INTERACTION: MOMENT ABOUT Y -AXIS (KIP-FT)

   --------------------------------------------------------
    P0        Pn max    P-bal.    M-bal.   e-bal.(inch)
   580.16    464.13    207.36     84.77    4.91
    M0        P-tens.   Des.Pn    Des.Mn     e/h
    39.08    -96.00      8.72      2.57    0.14720
   --------------------------------------------------------
                        Pn        Mn        Pn        Mn    (@ Z )
           |           428.43    54.43    214.21    84.42
       P0  |*          392.72    62.91    178.51    82.09
           | *         357.02    69.84    142.81    77.19
    Pn,max|__*         321.32    75.23    107.11    71.14
           |   *       285.62    79.28     71.40    62.97
    Pn     |    *      249.92    82.26     35.70    51.70
   NOMINAL|      *      Pn        Mn        Pn        Mn    (@ Y )
     AXIAL|       *    428.43    54.43    214.21    84.42
COMPRESSION|       *   392.72    62.91    178.51    82.09
        Pb|-------*Mb  357.02    69.84    142.81    77.19
           |       *   321.32    75.23    107.11    71.14
___________|____*______ 285.62    79.28     71.40    62.97
           |  * M0   Mn, 249.92    82.26     35.70    51.70
           | *   BENDING
     P-tens|*     MOMENT
           |


  ********************END OF COLUMN DESIGN RESULTS********************


     STAAD SPACE                                         -- PAGE NO.  309

  622. END CONCRETE DESIGN
  623. FINISH


            *********** END OF THE STAAD.Pro RUN ***********

              **** DATE= FEB 12,2018   TIME= 15: 9:35 ****

        ************************************************************
        *   For technical assistance on STAAD.Pro, please visit    *
        *   http://selectservices.bentley.com/en-US/               *
        *                                                          *
        *   Details about additional assistance from               *
        *   Bentley and Partners can be found at program menu      *
        *   Help->Technical Support                                *
        *                                                          *
        *      Copyright (c) 1997-2015 Bentley Systems, Inc.
        *                http://www.bentley.com                    *
        ************************************************************
```

Appendix B - Staad Technical Reference 5.31.2.16 IBC 2012 Seismic Load Definition

5.31.2.16 IBC 2012 Seismic Load Definition

The specifications of the seismic loading chapters of the International Code Council's IBC 2012 code and the ASCE 7-10 code for seismic analysis of a building using a static equivalent approach have been implemented as described in this section. Depending on the definition, equivalent lateral loads will be generated in the horizontal direction(s).

> This feature requires STAAD.Pro 2007 (Build 11) or higher. Refer to AD.2007-11.3.7 of the What's New section for additional information on using this feature.

The seismic load generator can be used to generate lateral loads in the X & Z directions for Y up or X & Y for Z up. Y up or Z up is the vertical axis and the direction of gravity loads (See the **SET Z UP** command in Section 5.5). All vertical coordinates of the floors above the base must be positive and the vertical axis must be perpendicular to the floors.

The rules described in section 1613 of the ICC IBC-2012 code (except 1613.5.5) have been implemented. This section directs the engineer to the ASCE 7-2010 code. The specific section numbers of ASCE 7— those which are implemented, and those which are not implemented—are shown in the table below.

Table 5-22: Sections of IBC 2012 implemented and omitted in the program

Implemented sections of IBC 2012 (ASCE 7-10)	Omitted sections of IBC 2012 (ASCE 7-10)
11.4	12.8.4.1
11.5	12.8.4.3 and onwards
12.8	

Steps used to calculate and distribute the base shear are as follows:

1. The Time Period of the structure is calculated based on section 12.8.2.1 of ASCE 7-10 (IBC 2012). This is reported in the output as Ta.
2. The period is also calculated in accordance with the Rayleigh method. This is reported in the output as T.
3. You may override the Rayleigh based period by specifying a value for PX or PZ (Items f7 and f8) depending on the direction of the IBC load.
4. The governing Time Period of the structure is then chosen between the above two periods, and the additional guidance provided in section 12.8.2 of ASCE 7-10 (IBC 2012). The resulting value is reported as "Time Period used" in the output file.
5. The Design Base Shear is calculated based on equation 12.8-1 of ASCE 7-10 (IBC 2012). It is then distributed at each floor using the rules of clause 12.83, equations 12.8-11, 12.8-12 and 12.8-13 of ASCE 7-10.
6. If the **ACCIDENTAL** option is specified, the program calculates the additional torsional moment. The lever arm for calculating the torsional moment is obtained as 5% of the building dimension at each floor level perpendicular to the direction of the IBC load (section 12.8.4.2 of ASCE 7-10 for IBC 2012). At each joint where a weight is located, the lateral seismic force acting at that joint is multiplied by this lever arm to obtain the torsional moment at that joint.
7. The amplification of accidental torsional moment, as described in Section 12.8.4.3 of the ASCE 7-10 code, is not implemented.
8. The story drift determination as explained in Section 12.8.6 of the ASCE 7-10 code is not implemented in STAAD.

Methodology

The design base shear is computed in accordance with the following equation (equation 12.8-1 of ASCE 7-10):

$V = C_s W$

The seismic response coefficient, C_s, is determined in accordance with the following equation (equation 12.8-2 of ASCE 7-10):

$C_s = S_{DS}/[R/I_E]$

For IBC 2012, C_s need not exceed the following limits defined in ASCE 7-10 (equations 12.8-3 and 12.8-4):

$C_s = S_{D1}/[T\cdot(R/I)]$ for $T \le T_L$

$C_s = S_{D1} \cdot T_L/[T^2(R/I)]$ for $T > T_L$

However, C_s shall not be less than (equation 12.8-5 of ASCE 7-10):

$C_s = 0.044 \cdot S_{DS} \cdot I \geq 0.01$

In addition, per equation 12.8-6 of ASCE 7-10, for structures located where S_1 is equal to or greater than 0.6g, C_S shall not be less than

$C_s = 0.5 \cdot S_1/(R/I)$

For an explanation of the terms used in the above equations, please refer to the IBC 2012 and ASCE 7-10 codes.

General Format

There are two stages of command specification for generating lateral loads. This is the first stage and is activated through the **DEFINE IBC 2012 LOAD** command.

```
DEFINE IBC 2012 (ACCIDENTAL) LOAD
map-spec ibc12-spec
SELFWEIGHT
JOINT WEIGHT
joint-list WEIGHT w
...
```

See "UBC 1994 or 1985 Load Definition" for complete weight input definition.

Where:

map-spec = { **ZIP** f_1 | **LAT** f_2 **LONG** f_3 | **SS** f_4 **S1** f_5 }

ibc12-spec = { **RX** f_6 **RZ** f_7 **I** f_8 **TL** f_9 **SCLASS** f_{10} (**CT** f_{11}) (**PX** f_{12}) (**PZ** f_{13}) (**K** f_{14}) (**FA** f_{15}) (**FV** f_{16}) }

f_1 = The zip code of the site location to determine the latitude and longitude and consequently the Ss and S1 factors. (ASCE 7-10 Chapter 22).

f_2, f_3 = The latitude and longitude, respectively, of the site used with the longitude to determine the Ss and S1 factors. (ASCE 7-10 Chapter 22).

f_4 = The mapped MCE for 0.2s spectral response acceleration. (IBC 2012 Clause 1613.5.1, ASCE 7-10 Clause 11.4.1).

f_5 = The mapped MCE spectral response acceleration at a period of 1 second as determined in accordance with Section 11.4.1 ASCE7-10

f_6 = The response modification factor for lateral load along the X direction, (ASCE Table 12.2.1). This is the value used in "R" in the equations shown above for calculating C_S.

f_7 = The response modification factor for lateral load along the Z direction, (ASCE Table 12.2.1) This is the value used in "R" in the equations shown above for calculating C_S.

f_8 = Occupancy importance factor. (IBC 2012 Clause 1604.5, ASCE 7-10 Table 11.5-1)

f_9 = Long-Period transition period in seconds. (ASCE 7-10 Clause 11.4.5 and Chapter 22).

f_{10} = Site class. Enter 1 through 6 in place of A through F, see table below. (IBC 2012 clause 1613.3.2, ASCE 7-10 Section 20.3)

The Soil Profile Type parameter **SCLASS** can take on values from 1 to 6. These relate to the values shown in Site Class Definitions Table in the following manner:

Table 5-23: Values of IBC soil class (SCLASS) used in STAAD

IBC Class	SCLASS value
A	1
B	2
C	3
D	4
E	5
F	6

f_{11} = Optional CT value to calculate time period. (ASCE 7-10 Table 12.8-2).

f_{12} = Optional Period of structure (in sec) in X-direction to be used as fundamental period of the structure. If not entered the value is calculated from the code. (ASCE 7-10 Table 12.8-2).

f_{13} = Optional Period of structure (in sec) in Z-direction to be used as fundamental period of the structure. If not entered the value is calculated from the code. (ASCE 7-10 Table 12.8-2).

f_{14} = Exponent value, x, used in equation 12.8-7, ASCE 7. (ASCE 7-2005 table 12.8-2 page 129).

f_{15} = Optional Short-Period site coefficient at 0.2s. Value must be provided if **SCLASS** set to F (i.e., 6). (IBC 2012 Clause 1613.3.3, ASCE 7-10 Section 11.4.3).

f_{16} = Optional Long-Period site coefficient at 1.0s. Value must be provided if **SCLASS** set to F (i.e., 6). (IBC 2012 Clause 1613.3.3, ASCE 7-10 Section 11.4.3).

Appendix C - Staad Technical Reference 5.31.3 Definition of Wind load

5.31.3 Definition of Wind Load

This set of commands may be used to define some of the parameters for generation of wind loads on the structure. See **Section 5.32.12** for the definition of wind direction and the possible surfaces to be loaded. **Section 1.17.3** of this manual describes the two types of structures on which this load generation can be performed.

The wind load generator can be used to generate lateral loads in the horizontal—X and Z (or Y if Z up) —directions only.

✓ The graphical user interface can be used to automatically generate the appropriate intensity values via the **ASCE-7: Wind Load dialog**. See "Persistence of Parameters used to Generate ASCE Wind Loads"

General Format

```
DEFINE WIND LOAD
TYPE j ( optional_comment )
{ intensity-definition | code-parameters }
EXPOSURE e1 { JOINT joint-list | YRANGE f1 f2 | ZRANGE f1 f2 }
```

Repeat **EXPOSURE** command up to 98 times.

Where:

intensity-definition or *code-parameters* data is entered based on either custom or Russian code wind definitions. See "Wind Intensity Definition" or See "Russian Wind Loads"

j = wind load system type number (integer)

optional_comment = A text string comment or description used to help identify the wind load type.

$p_1, p_2, p_3 \ldots p_n$ = wind intensities (pressures) in force/area. Up to 100 different intensities can be defined in the input file per type.

$h_1, h_2, h_3 \ldots h_n$ = corresponding heights in global vertical direction, measured in terms of actual Y (or Z for Z UP) coordinates up to which the corresponding intensities occur.

$e_1, e_2 \ldots e_m$ = exposure factors. A value of 1.0 means that the wind force may be applied on the full influence area associated with the joint(s) if they are also exposed to the wind load direction. Limit: 99 factors.

joint-list = Joint list associated with Exposure Factor (joint numbers or **TO** or **BY**) or enter only a group name.

f_1 and f_2 = global coordinate values to specify Y (or Z if Z UP) vertical range for Exposure Factor. Use **YRANGE** when Y is Up and **ZRANGE** when Z is Up (See the **SET Z UP** command in **Section 5.5**).

If the command **EXPOSURE** is not specified or if a joint is not listed in an Exposure, the exposure factor for those joints is chosen as 1.0.

Wind Intensity Definition

For custom (including for ASCE 7) wind load definitions, the wind intensity at heights above ground are defined as follows:

intensity-definition = **INTENSITY** p_1 p_2 p_3 … p_n**HEIGHT** h_1 h_2 h_3 … h_n

These values are automatically generated for ASCE 7 wind loads when the ASCE-7: Wind Load dialog is used.

All intensities and heights are in current unit system. The heights specified are in terms of actual Y coordinate (or Z coordinates for Z UP) and not measured relative to the base of the structure. The first value of intensity (p_1) will be applied to any part of the structure for which the Y coordinate (or Z coordinate for Z UP) is equal to or less than h_1. The second intensity (p_2) will be applied to any part of the structure that has vertical coordinates between the first two heights (h_1 and h_2) and so on. Any part of the structure that has vertical coordinates greater than h_n will be loaded with intensity p_n.

Only exposed surfaces bounded by members (not by plates or solids) will be used. The joint influence areas are computed based on surface member selection data entered in section 5.32.12 and based on the wind direction for a load case. Only joints actually exposed to the wind and connected to members will be loaded. The individual bounded areas must be planar surfaces, to a close tolerance, or they will not be loaded.

Exposure factor (e) is the fraction of the influence area associated with the joint(s) on which the load may act if it is also exposed to the wind load. Total load on a particular joint is calculated as follows.

Joint load = (Exposure Factor) × (Influence Area) × (Wind Intensity)

The exposure factor may be specified by a joint-list or by giving a vertical range within which all joints will have the same exposure. If an exposure factor is not entered or not specified for a joint, then it defaults to 1.0 for those joints; in which case the entire influence area associated with the joint(s) will be considered.

For load generation on a closed type structure defined as a PLANE FRAME, influence area for each joint is calculated considering unit width perpendicular to the plane of the structure. You can accommodate the actual width by incorporating it in the Exposure Factor as follows.

Exposure Factor (User Specified) = (Fraction of influence area) × (influence width for joint)

Notes

a. All intensities, heights and ranges must be provided in the current unit system.

b. If necessary, the **INTENSITY** and **EXPOSURE** command lines can be continued on to additional lines by ending all but last line with a space and hyphen (-). Use up to 11 lines for a command.

Appendix D - Staad Technical Reference 2.4.1.1 Allowable per AISC code

2.4.1.1 Allowables per AISC Code

For steel design, STAAD compares the actual stresses with the allowable stresses as defined by the American Institute of Steel Construction (AISC) Code. The ninth edition of the AISC Code, as published in 1989, is used as the basis of this design (except for tension stress). Because of the size and complexity of the AISC codes, it would not be practical to describe every aspect of the steel design in this manual. Instead, a brief description of some of the major allowable stresses are described herein.

2.4.1.1.1 Tension Stress

Allowable tensile stress on the net section is calculated as;

$$F_t = 0.60\ F_y$$

2.4.1.1.2 Shear Stress

Allowable shear stress on the gross section,

$$F_v = 0.4\ F_y$$

2.4.1.1.3 Stress Due To Compression

Allowable compressive stress on the gross section of axially loaded compression members is calculated based on the formula E-1 in the AISC Code, when the largest effective slenderness ratio (Kl/r) is less than C_c. If Kl/r exceeds C_c, allowable compressive stress is decreased as per formula 1E2-2 of the Code.

$$C_c = \sqrt{\frac{2\pi^2 E}{F_y}}$$

2.4.1.1.4 Bending Stress

Allowable bending stress for tension and compression for a symmetrical member loaded in the plane of its minor axis, as given in Section 1.5.1.4 is:

$F_b = 0.66F_y$

If meeting the requirements of this section of:

a. $b_f/2t_f \leq 65/\sqrt{(F_y)}$
b. $b_f/t_f \leq 190/\sqrt{(F_y)}$
c. $d/t \leq 640(1 - 3.74\ (f_a/F_y))/\sqrt{(F_y)}$ when $(f_a/F_y) < 0.16$, or than $257/\sqrt{(F_y)}$ if $(f_a/F_y) > 0.16$
d. The laterally unsupported length shall not exceed $76.0\ b_f/F_y$ (except for pipes or tubes), nor $20{,}000/(d\ F_y/A_f)$
e. The diameter:thickness ratio of pipes shall not exceed $3{,}300/\sqrt{(F_y)}$

If for these symmetrical members, $b_f/2t_f$ exceeds $65/\sqrt{(F_y)}$, but is less than $95/\sqrt{(F_y)}$, $F_b = F_y(0.79 - 0.002(b_f/2t_f)\sqrt{(F_y)}$

For other symmetrical members which do not meet the above, Fb is calculated as the larger value computed as per AISC formulas F1-6 or F1-7 and F1-8 as applicable, but not more than 0.60Fy. An unstiffened member subject to axial compression or compression due to bending is considered fully effective when the width-thickness ratio is not greater than the following:

- $76.0/\sqrt{(F_y)}$, for single angles or double angles with separators
- $95.0/\sqrt{(F_y)}$, for double angles in contact
- $127.0/\sqrt{(F_y)}$, for stems of tees

When the actual width-thickness ratio exceeds these values, the allowable stress is governed by B5 of the AISC code.

Tension and compression for the double symmetric (I & H) sections with $b_f/2t_f$ less than $65/\sqrt{(F_y)}$ and bent about their minor axis, $F_b = 0.75\ F_y$. If $b_f/2t_f$ exceeds $65/\sqrt{(F_y)}$, but is less than $95/\sqrt{(F_y)}$, $F_b = F_y(1.075 - 0.005(b_f/2t_f)\sqrt{(F_y)}$.

For tubes, meeting the subparagraphs b and c of this Section, bent about the minor axis, $F_b = 0.66F_y$; failing the subparagraphs B and C but with a width:thickness ration less than $238/\sqrt{(F_y)}$, $F_b = 0.6F_y$.

2.4.1.1.5 Combined Compression and Bending

Members subjected to both axial compression and bending stresses are proportioned to satisfy AISC formula H1-1 and H1-2 when fa/Fa is greater than 0.15, otherwise formula H1-3 is used. It should be noted that during code checking or member selection, if fa/Fa exceeds unity, the program does not compute the second and third part of the formula H1-1, because this would result in a misleadingly liberal ratio. The value of the coefficient Cm is taken as 0.85 for sidesway and 0.6 - 0.4 (M1/M2), but not less than 0.4 for no sidesway.

Appendix E - Staad Technical Reference 3.7 Column Design

3.7 Column Design

Columns design in STAAD per the ACI code is performed for axial force and uniaxial as well as biaxial moments. All active loadings are checked to compute reinforcement. The loading which produces the largest amount of reinforcement is called the critical load. Column design is done for square, rectangular and circular sections. For rectangular and circular sections, reinforcement is always assumed to be equally distributed on all faces. This means that the total number of bars for these sections will always be a multiple of four (4). If the MMAG parameter is specified, the column moments are multiplied by the MMAG value to arrive at the ultimate moments on the column. Since the ACI code no longer requires any minimum eccentricity conditions to be satisfied, such checks are not made.

Method used

Bresler Load Contour Method

Known Values

Pu, Muy, Muz, B, D, Clear cover, Fc, Fy

Ultimate Strain for concrete : 0.003

Steps involved

1. Assume some reinforcement. Minimum reinforcement (1%) is a good amount to start with.
2. Find an approximate arrangement of bars for the assumed reinforcement.
3. Calculate PNMAX = 0.85 Po, where Po is the maximum axial load capacity of the section. Ensure that the actual nominal load on the column does not exceed PNMAX. If PNMAX is less than Pu/PHI, (PHI is the strength reduction factor) increase the reinforcement and repeat steps 2 and 3. If the reinforcement exceeds 8%, the column cannot be designed with its current dimensions.
4. For the assumed reinforcement, bar arrangement and axial load, find the uniaxial moment capacities of the column for the Y and the Z axes, independently. These values are referred to as MYCAP and MZCAP respectively.
5. Solve the interaction equation:

   $$\left(\frac{M_{uy}}{M_{ycap}}\right)^{a} + \left(\frac{M_{uz}}{M_{zcap}}\right)^{a} \le 1.0$$

   Where a = 1.24

   If the column is subjected to a uniaxial moment, a is chosen as 1.0
6. If the Interaction equation is satisfied, find an arrangement with available bar sizes, find the uniaxial capacities and solve the interaction equation again. If the equation is satisfied now, the reinforcement details are written to the output file.
7. If the interaction equation is not satisfied, the assumed reinforcement is increased (ensuring that it is under 8%) and steps 2 to 6 are repeated.
8. The maximum spacing of reinforcement closest to the tension force, for purposes of crack control, is given by

   $$s = 15\left(40,000\frac{40,000}{f_s}\right) - 2.5cc \le 12\left(\frac{40,000}{f_s}\right)$$

with f_s in psi and is permitted to be taken equal to (2/3) f_y, rather than 60 percent of f_y, as in ACI 318-02.

9. Section 10.9.3 has been modified to permit the use of spiral reinforcement with specified yield strength of up to 100,000 psi. For spirals with fyt greater than 60,000 psi, only mechanical or welded splices may be used.

Column Interaction

The column interaction values may be obtained by using the design parameter TRACK 1.0 or TRACK 2.0 for the column member. If a value of 2.0 is used for the TRACK parameter, 12 different Pn-Mn pairs, each representing a different point on the Pn-Mn curve are printed. Each of these points represents one of the several Pn-Mn combinations that this column is capable of carrying about the given axis, for the actual reinforcement that the column has been designed for. In the case of circular columns, the values are for any of the radial axes. The values printed for the TRACK 1.0 output are:

P0 = Maximum purely axial load carrying capacity of the column (zero moment).

Pnmax = Maximum allowable axial load on the column (Section 10.3.5 of ACI 318).

P-bal = Axial load capacity at balanced strain condition.

M-bal = Uniaxial moment capacity at balanced strain condition.

e-bal = M-bal / P-bal = Eccentricity at balanced strain condition.

M0 = Moment capacity at zero axial load.

P-tens = Maximum permissible tensile load on the column.

Des. Pn = Pu/PHI where PHI is the Strength Reduction Factor and Pu is the axial load for the critical load case.

Des. Mn = Mu*MMAG/PHI where PHI is the Strength Reduction Factor and Mu is the bending moment for the appropriate axis for the critical load case. For circular columns,

$$M_u = \sqrt{M_{uy}^2 + M_{uz}^2}$$

$$e/h = (M_n/P_n)/h$$

Where:

h is the length of the column.