Columns – 3/7.5
moment frame – 5/15
braced frame – ?
↑
missing.

Dear Professor. Sorry about my late submission it is because I got too low points in the first part and I had to redo the whole project again so I can get the data from the first part.

I do attach importance to this course and the project So I am really trying my best to finish it. I know there are really many mistakes, so I hope to correct them after you grade it and present the final edition both of us will be satisfied.

Sorry about being late again.

With respect

Tianmi Hua

I really really really want to do better in this course!

CAE 521

Project 2017 Fall

Tianmin Hua

C11957230

Assumptions made for the design of steel structure

1. All loading conditions are taken in accordance with ASCE 7-10 specifications.
2. The density of the concrete used is taken as 145psf.
3. The steel designed is A-36 steel with 250MPa strength.

$F_y = 50$ KSI

Comparison of cost effectiveness between option 1 and option 2 column framing.

Option 1:

Option 1 framing system contains 5 series of steel frames which makes the construction more time taking and spans of the beams shorter. This will result in an increased cost due to the installation of frame and base plates. However, it is more stable than option 2.

Option 2:

Option 2 contains only 3 series of columns in a frame, equally spaced, which will result in the lesser material usage and more clear space in the building to be designed. This might result in heavy cross sections of beams but ultimately it is a better and more cost-efficient option. Base plates and foundation will be costlier, as the load transfer is being made by lesser members which will result in the concentration of loading on certain points.

```
****************************************************
*                                                  *
*           STAAD.Pro V8i SELECTseries6            *
*           Version  20.07.11.33                   *
*           Proprietary Program of                 *
*           Bentley Systems, Inc.                  *
*           Date=    DEC  4, 2017                  *
*           Time=    17:40:45                      *
*                                                  *
*      USER ID: Microsoft                          *
****************************************************


     1. STAAD SPACE
INPUT FILE: D:\Downloads\steel\frame (1).STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 03-DEC-17
     4. END JOB INFORMATION
     5. INPUT WIDTH 79
     6. UNIT FEET KIP
     7. JOINT COORDINATES
     8. 1 0 0 0; 2 35 0 0; 3 70 0 0; 4 0 15 0; 5 35 15 0; 6 70 15 0; 7 0 27 0
     9. 8 35 27 0; 9 70 27 0; 10 0 39 0; 11 35 39 0; 12 70 39 0; 13 0 51 0
    10. 14 35 51 0; 15 70 51 0
    11. MEMBER INCIDENCES
    12. 1 1 4; 2 13 14; 3 15 12; 4 2 5; 5 10 11; 6 7 8; 7 4 5; 8 7 10; 9 4 7
    13. 10 14 15; 11 6 3; 12 9 6; 13 12 9; 14 8 11; 15 5 8; 16 11 12; 17 8 9
    14. 18 5 6; 19 10 13; 20 11 14
    15. DEFINE MATERIAL START
    16. ISOTROPIC STEEL
    17. E 4.176E+006
    18. POISSON 0.3
    19. DENSITY 0.489024
    20. ALPHA 6.5E-006
    21. DAMP 0.03
    22. TYPE STEEL
    23. STRENGTH FY 5184 FU 8352 RY 1.5 RT 1.2
    24. END DEFINE MATERIAL
    25. MEMBER PROPERTY
    26. 1 4 9 11 12 15 PRIS YD 24 ZD 24
    27. MEMBER PROPERTY AMERICAN
    28. 2 5 TO 7 10 16 TO 18 ASSIGN BEAM
    29. MEMBER PROPERTY
    30. 8 13 14 PRIS YD 18 ZD 18
    31. 3 19 20 PRIS YD 12 ZD 12
    32. CONSTANTS
    33. MATERIAL STEEL ALL
    34. SUPPORTS
    35. 1 TO 3 FIXED
    36. LOAD 1 LOADTYPE DEAD  TITLE LOAD CASE 1
    37. MEMBER LOAD
    38. 7 18 UNI GY -83.008
```

high!

```
39. 6 17 UNI GY -62.256
40. 5 16 UNI GY -41.504
41. 2 10 UNI GY -20.752
42. PERFORM ANALYSIS PRINT ALL
```

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

```
 NUMBER OF JOINTS           15  NUMBER OF MEMBERS       20
 NUMBER OF PLATES            0  NUMBER OF SOLIDS         0
 NUMBER OF SURFACES          0  NUMBER OF SUPPORTS       3

       SOLVER USED IS THE OUT-OF-CORE BASIC SOLVER

 ORIGINAL/FINAL BAND-WIDTH=      3/      3/      24 DOF
TOTAL      PRIMARY LOAD CASES =       1, TOTAL DEGREES OF FREEDOM =        72
TOTAL LOAD COMBINATION  CASES =       0  SO FAR.
 SIZE OF STIFFNESS MATRIX =           2 DOUBLE  KILO-WORDS
 REQRD/AVAIL. DISK SPACE  =      12.0/  22787.9 MB
```

LOADING 1 LOADTYPE DEAD TITLE LOAD CASE 1

MEMBER LOAD - UNIT KIP FEET

MEMBER	UDL		L1	L2	CON	L	LIN1	LIN2
7	-83.0080	GY	0.00	35.00				
18	-83.0080	GY	0.00	35.00				
6	-62.2560	GY	0.00	35.00				
17	-62.2560	GY	0.00	35.00				
5	-41.5040	GY	0.00	35.00				
16	-41.5040	GY	0.00	35.00				
2	-20.7520	GY	0.00	35.00				
10	-20.7520	GY	0.00	35.00				

FOR LOADING - 1
APPLIED JOINT EQUIVALENT LOADS

JOINT	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM-Z
4	0.00000E+00	-1.45264E+03	0.00000E+00	0.00000E+00	0.00000E+00	-8.47373E+03
5	0.00000E+00	-2.90528E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.00000E+00	-1.45264E+03	0.00000E+00	0.00000E+00	0.00000E+00	8.47373E+03
7	0.00000E+00	-1.08948E+03	0.00000E+00	0.00000E+00	0.00000E+00	-6.35530E+03
8	0.00000E+00	-2.17896E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
9	0.00000E+00	-1.08948E+03	0.00000E+00	0.00000E+00	0.00000E+00	6.35530E+03
10	0.00000E+00	-7.26320E+02	0.00000E+00	0.00000E+00	0.00000E+00	-4.23687E+03
11	0.00000E+00	-1.45264E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
12	0.00000E+00	-7.26320E+02	0.00000E+00	0.00000E+00	0.00000E+00	4.23687E+03
13	0.00000E+00	-3.63160E+02	0.00000E+00	0.00000E+00	0.00000E+00	-2.11843E+03
14	0.00000E+00	-7.26320E+02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
15	0.00000E+00	-3.63160E+02	0.00000E+00	0.00000E+00	0.00000E+00	2.11843E+03

STATIC LOAD/REACTION/EQUILIBRIUM SUMMARY FOR CASE NO. 1
LOADTYPE DEAD TITLE LOAD CASE 1

CENTER OF FORCE BASED ON Y FORCES ONLY (FEET).
(FORCES IN NON-GLOBAL DIRECTIONS WILL INVALIDATE RESULTS)

X = 0.350000010E+02
Y = 0.270000008E+02
Z = 0.000000000E+00

***TOTAL APPLIED LOAD (KIP FEET) SUMMARY (LOADING 1)
SUMMATION FORCE-X = 0.00
SUMMATION FORCE-Y = -14526.40
SUMMATION FORCE-Z = 0.00

SUMMATION OF MOMENTS AROUND THE ORIGIN-
MX= 0.00 MY= 0.00 MZ= -508424.03

```
***TOTAL REACTION LOAD( KIP  FEET ) SUMMARY (LOADING     1 )
    SUMMATION FORCE-X =          0.00
    SUMMATION FORCE-Y =      14526.40
    SUMMATION FORCE-Z =          0.00

   SUMMATION OF MOMENTS AROUND THE ORIGIN-
   MX=           0.00  MY=           0.00  MZ=      508424.03

MAXIMUM DISPLACEMENTS ( INCH /RADIANS) (LOADING      1)
          MAXIMUMS    AT NODE
   X =  2.59393E-03      13
   Y = -1.21025E-03      14
   Z =  0.00000E+00       0
   RX=  0.00000E+00       0
   RY=  0.00000E+00       0
   RZ=  9.61978E-06      15

EXTERNAL AND INTERNAL JOINT LOAD SUMMARY ( KIP  FEET )-

JT     EXT FX/   EXT FY/   EXT FZ/    EXT MX/    EXT MY/    EXT MZ/
       INT FX    INT FY    INT FZ     INT MX     INT MY     INT MZ

                                                                    SUPPORT=1
  1       0.00      0.00      0.00       0.00       0.00       0.00
         -4.10  -3631.59      0.00       0.00       0.00  -21010.74  111111

  2       0.00      0.00      0.00       0.00       0.00       0.00
         -0.00  -7263.22      0.00       0.00       0.00       0.00  111111

  3       0.00      0.00      0.00       0.00       0.00       0.00
          4.10  -3631.59      0.00       0.00       0.00   21010.74  111111

************ END OF DATA FROM INTERNAL STORAGE ************

 43. DEFINE ENVELOPE
 44. 1 ENVELOPE 1 TYPE COLUMN
 45. 1 ENVELOPE 2 TYPE CONNECTION
 46. END DEFINE ENVELOPE
 47. PERFORM ANALYSIS PRINT ALL
```

LOADING 1 LOADTYPE DEAD TITLE LOAD CASE 1

MEMBER LOAD - UNIT KIP FEET

MEMBER	UDL		L1	L2	CON	L	LIN1	LIN2
7	-83.0080	GY	0.00	35.00				
18	-83.0080	GY	0.00	35.00				
6	-62.2560	GY	0.00	35.00				
17	-62.2560	GY	0.00	35.00				
5	-41.5040	GY	0.00	35.00				
16	-41.5040	GY	0.00	35.00				
2	-20.7520	GY	0.00	35.00				
10	-20.7520	GY	0.00	35.00				

FOR LOADING - 1
APPLIED JOINT EQUIVALENT LOADS

JOINT	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM-Z
4	0.00000E+00	-1.45264E+03	0.00000E+00	0.00000E+00	0.00000E+00	-8.47373E+03
5	0.00000E+00	-2.90528E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.00000E+00	-1.45264E+03	0.00000E+00	0.00000E+00	0.00000E+00	8.47373E+03
7	0.00000E+00	-1.08948E+03	0.00000E+00	0.00000E+00	0.00000E+00	-6.35530E+03
8	0.00000E+00	-2.17896E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
9	0.00000E+00	-1.08948E+03	0.00000E+00	0.00000E+00	0.00000E+00	6.35530E+03
10	0.00000E+00	-7.26320E+02	0.00000E+00	0.00000E+00	0.00000E+00	-4.23687E+03
11	0.00000E+00	-1.45264E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
12	0.00000E+00	-7.26320E+02	0.00000E+00	0.00000E+00	0.00000E+00	4.23687E+03
13	0.00000E+00	-3.63160E+02	0.00000E+00	0.00000E+00	0.00000E+00	-2.11843E+03
14	0.00000E+00	-7.26320E+02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
15	0.00000E+00	-3.63160E+02	0.00000E+00	0.00000E+00	0.00000E+00	2.11843E+03

STATIC LOAD/REACTION/EQUILIBRIUM SUMMARY FOR CASE NO. 1
LOADTYPE DEAD TITLE LOAD CASE 1

CENTER OF FORCE BASED ON Y FORCES ONLY (FEET).
(FORCES IN NON-GLOBAL DIRECTIONS WILL INVALIDATE RESULTS)

X = 0.350000010E+02
Y = 0.270000008E+02
Z = 0.000000000E+00

***TOTAL APPLIED LOAD (KIP FEET) SUMMARY (LOADING 1)
SUMMATION FORCE-X = 0.00
SUMMATION FORCE-Y = -14526.40
SUMMATION FORCE-Z = 0.00

SUMMATION OF MOMENTS AROUND THE ORIGIN-
MX= 0.00 MY= 0.00 MZ= -508424.03

```
***TOTAL REACTION LOAD( KIP  FEET ) SUMMARY (LOADING      1 )
    SUMMATION FORCE-X =           0.00
    SUMMATION FORCE-Y =       14526.40
    SUMMATION FORCE-Z =           0.00

   SUMMATION OF MOMENTS AROUND THE ORIGIN-
   MX=          0.00  MY=          0.00  MZ=      508424.03


MAXIMUM DISPLACEMENTS ( INCH /RADIANS) (LOADING      1)
            MAXIMUMS    AT NODE
   X =  2.59393E-03      13
   Y = -1.21025E-03      14
   Z =  0.00000E+00       0
   RX=  0.00000E+00       0
   RY=  0.00000E+00       0
   RZ=  9.61978E-06      15


EXTERNAL AND INTERNAL JOINT LOAD SUMMARY ( KIP  FEET )-

JT     EXT FX/   EXT FY/   EXT FZ/    EXT MX/    EXT MY/    EXT MZ/
       INT FX    INT FY    INT FZ     INT MX     INT MY     INT MZ

                                                                   SUPPORT=1
 1       0.00      0.00      0.00       0.00       0.00       0.00
        -4.10  -3631.59      0.00       0.00       0.00  -21010.74  111111

 2       0.00      0.00      0.00       0.00       0.00       0.00
        -0.00  -7263.22      0.00       0.00       0.00       0.00  111111

 3       0.00      0.00      0.00       0.00       0.00       0.00
         4.10  -3631.59      0.00       0.00       0.00   21010.74  111111


************ END OF DATA FROM INTERNAL STORAGE ************

 48. FINISH

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

            **** DATE= DEC  4,2017   TIME= 17:40:45 ****
```

where is the design check
check drift !

```
************************************************************
*   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                    *
************************************************************
```

```
****************************************************
*                                                  *
*           STAAD.Pro V8i SELECTseries6            *
*           Version  20.07.11.33                   *
*           Proprietary Program of                 *
*           Bentley Systems, Inc.                  *
*           Date=    DEC  4, 2017                  *
*           Time=    17:41:33                      *
*                                                  *
*      USER ID: Microsoft                          *
****************************************************
```

```
     1. STAAD SPACE
INPUT FILE: D:\Downloads\steel\Completestructure.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 04-DEC-17
     4. END JOB INFORMATION
     5. INPUT WIDTH 79
     6. UNIT FEET KIP
     7. JOINT COORDINATES
     8. 1 0 0 0; 2 22.5 0 0; 3 45 0 0; 4 67.5 0 0; 5 90 0 0; 6 0 0 17.5; 7 22.5 0 17.5
     9. 8 45 0 17.5; 9 67.5 0 17.5; 10 90 0 17.5; 11 0 0 35; 12 22.5 0 35; 13 45 0 35
    10. 14 67.5 0 35; 15 90 0 35; 16 0 0 52.5; 17 22.5 0 52.5; 18 45 0 52.5
    11. 19 67.5 0 52.5; 20 90 0 52.5; 21 0 0 70; 22 22.5 0 70; 23 45 0 70
    12. 24 67.5 0 70; 25 90 0 70; 26 0 15 0; 27 22.5 15 0; 28 45 15 0; 29 67.5 15 0
    13. 30 90 15 0; 31 0 15 17.5; 32 22.5 15 17.5; 33 45 15 17.5; 34 67.5 15 17.5
    14. 35 90 15 17.5; 36 0 15 35; 37 22.5 15 35; 38 45 15 35; 39 67.5 15 35
    15. 40 90 15 35; 41 0 15 52.5; 42 22.5 15 52.5; 43 45 15 52.5; 44 67.5 15 52.5
    16. 45 90 15 52.5; 46 0 15 70; 47 22.5 15 70; 48 45 15 70; 49 67.5 15 70
    17. 50 90 15 70; 51 0 27 0; 52 22.5 27 0; 53 45 27 0; 54 67.5 27 0; 55 90 27 0
    18. 56 0 27 17.5; 57 22.5 27 17.5; 58 45 27 17.5; 59 67.5 27 17.5; 60 90 27 17.5
    19. 61 0 27 35; 62 22.5 27 35; 63 45 27 35; 64 67.5 27 35; 65 90 27 35
    20. 66 0 27 52.5; 67 22.5 27 52.5; 68 45 27 52.5; 69 67.5 27 52.5; 70 90 27 52.5
    21. 71 0 27 70; 72 22.5 27 70; 73 45 27 70; 74 67.5 27 70; 75 90 27 70; 76 0 39 0
    22. 77 22.5 39 0; 78 45 39 0; 79 67.5 39 0; 80 90 39 0; 81 0 39 17.5
    23. 82 22.5 39 17.5; 83 45 39 17.5; 84 67.5 39 17.5; 85 90 39 17.5; 86 0 39 35
    24. 87 22.5 39 35; 88 45 39 35; 89 67.5 39 35; 90 90 39 35; 91 0 39 52.5
    25. 92 22.5 39 52.5; 93 45 39 52.5; 94 67.5 39 52.5; 95 90 39 52.5; 96 0 39 70
    26. 97 22.5 39 70; 98 45 39 70; 99 67.5 39 70; 100 90 39 70; 101 0 51 0
    27. 102 22.5 51 0; 103 45 51 0; 104 67.5 51 0; 105 90 51 0; 106 0 51 17.5
    28. 107 22.5 51 17.5; 108 45 51 17.5; 109 67.5 51 17.5; 110 90 51 17.5
    29. 111 0 51 35; 112 22.5 51 35; 113 45 51 35; 114 67.5 51 35; 115 90 51 35
    30. 116 0 51 52.5; 117 22.5 51 52.5; 118 45 51 52.5; 119 67.5 51 52.5
    31. 120 90 51 52.5; 121 0 51 70; 122 22.5 51 70; 123 45 51 70; 124 67.5 51 70
    32. 125 90 51 70
    33. MEMBER INCIDENCES
    34. 1 1 2; 2 2 3; 3 3 4; 4 4 5; 5 6 7; 6 7 8; 7 8 9; 8 9 10; 9 11 12; 10 12 13
    35. 11 13 14; 12 14 15; 13 16 17; 14 17 18; 15 18 19; 16 19 20; 17 21 22; 18 22 23
    36. 19 23 24; 20 24 25; 21 1 6; 22 2 7; 23 3 8; 24 4 9; 25 5 10; 26 6 11; 27 7 12
    37. 28 8 13; 29 9 14; 30 10 15; 31 11 16; 32 12 17; 33 13 18; 34 14 19; 35 15 20
    38. 36 16 21; 37 17 22; 38 18 23; 39 19 24; 40 20 25; 41 26 27; 42 27 28; 43 28 29
```

```
39. 44 29 30; 45 31 32; 46 32 33; 47 33 34; 48 34 35; 49 36 37; 50 37 38; 51 38 39
40. 52 39 40; 53 41 42; 54 42 43; 55 43 44; 56 44 45; 57 46 47; 58 47 48; 59 48 49
41. 60 49 50; 61 26 31; 62 27 32; 63 28 33; 64 29 34; 65 30 35; 66 31 36; 67 32 37
42. 68 33 38; 69 34 39; 70 35 40; 71 36 41; 72 37 42; 73 38 43; 74 39 44; 75 40 45
43. 76 41 46; 77 42 47; 78 43 48; 79 44 49; 80 45 50; 81 51 52; 82 52 53; 83 53 54
44. 84 54 55; 85 56 57; 86 57 58; 87 58 59; 88 59 60; 89 61 62; 90 62 63; 91 63 64
45. 92 64 65; 93 66 67; 94 67 68; 95 68 69; 96 69 70; 97 71 72; 98 72 73; 99 73 74
46. 100 74 75; 101 51 56; 102 52 57; 103 53 58; 104 54 59; 105 55 60; 106 56 61
47. 107 57 62; 108 58 63; 109 59 64; 110 60 65; 111 61 66; 112 62 67; 113 63 68
48. 114 64 69; 115 65 70; 116 66 71; 117 67 72; 118 68 73; 119 69 74; 120 70 75
49. 121 76 77; 122 77 78; 123 78 79; 124 79 80; 125 81 82; 126 82 83; 127 83 84
50. 128 84 85; 129 86 87; 130 87 88; 131 88 89; 132 89 90; 133 91 92; 134 92 93
51. 135 93 94; 136 94 95; 137 96 97; 138 97 98; 139 98 99; 140 99 100; 141 76 81
52. 142 77 82; 143 78 83; 144 79 84; 145 80 85; 146 81 86; 147 82 87; 148 83 88
53. 149 84 89; 150 85 90; 151 86 91; 152 87 92; 153 88 93; 154 89 94; 155 90 95
54. 156 91 96; 157 92 97; 158 93 98; 159 94 99; 160 95 100; 161 101 102
55. 162 102 103; 163 103 104; 164 104 105; 165 106 107; 166 107 108; 167 108 109
56. 168 109 110; 169 111 112; 170 112 113; 171 113 114; 172 114 115; 173 116 117
57. 174 117 118; 175 118 119; 176 119 120; 177 121 122; 178 122 123; 179 123 124
58. 180 124 125; 181 101 106; 182 102 107; 183 103 108; 184 104 109; 185 105 110
59. 186 106 111; 187 107 112; 188 108 113; 189 109 114; 190 110 115; 191 111 116
60. 192 112 117; 193 113 118; 194 114 119; 195 115 120; 196 116 121; 197 117 122
61. 198 118 123; 199 119 124; 200 120 125; 201 1 26; 202 2 27; 203 3 28; 204 4 29
62. 205 5 30; 206 6 31; 207 7 32; 208 8 33; 209 9 34; 210 10 35; 211 11 36
63. 212 12 37; 213 13 38; 214 14 39; 215 15 40; 216 16 41; 217 17 42; 218 18 43
64. 219 19 44; 220 20 45; 221 21 46; 222 22 47; 223 23 48; 224 24 49; 225 25 50
65. 226 26 51; 227 27 52; 228 28 53; 229 29 54; 230 30 55; 231 31 56; 232 32 57
66. 233 33 58; 234 34 59; 235 35 60; 236 36 61; 237 37 62; 238 38 63; 239 39 64
67. 240 40 65; 241 41 66; 242 42 67; 243 43 68; 244 44 69; 245 45 70; 246 46 71
68. 247 47 72; 248 48 73; 249 49 74; 250 50 75; 251 51 76; 252 52 77; 253 53 78
69. 254 54 79; 255 55 80; 256 56 81; 257 57 82; 258 58 83; 259 59 84; 260 60 85
70. 261 61 86; 262 62 87; 263 63 88; 264 64 89; 265 65 90; 266 66 91; 267 67 92
71. 268 68 93; 269 69 94; 270 70 95; 271 71 96; 272 72 97; 273 73 98; 274 74 99
72. 275 75 100; 276 76 101; 277 77 102; 278 78 103; 279 79 104; 280 80 105
73. 281 81 106; 282 82 107; 283 83 108; 284 84 109; 285 85 110; 286 86 111
74. 287 87 112; 288 88 113; 289 89 114; 290 90 115; 291 91 116; 292 92 117
75. 293 93 118; 294 94 119; 295 95 120; 296 96 121; 297 97 122; 298 98 123
76. 299 99 124; 300 100 125
77. DEFINE MATERIAL START
78. ISOTROPIC STEEL
79. E 4.176E+006
80. POISSON 0.3
81. DENSITY 0.489024
82. ALPHA 6E-006
83. DAMP 0.03
84. G 1.60615E+006
85. TYPE STEEL
86. STRENGTH FY 5184 FU 8352 RY 1.5 RT 1.2
87. END DEFINE MATERIAL
88. CONSTANTS
89. MATERIAL STEEL ALL
90. SUPPORTS
91. 1 TO 25 FIXED
92. PERFORM ANALYSIS PRINT ALL
```

```
**ERROR: ANALYSIS CANNOT BE PERFORMED SINCE NO LOAD CASES
            HAVE BEEN SPECIFIED.


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

            **** DATE= DEC  4,2017   TIME= 17:41:33 ****

      ************************************************************
      *   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                    *
      ************************************************************
```

Design loads for the structure

Dead load

Self weight of the structure

4th floor density of concrete = 145

Dimensions of roof slab 90' × 70' × 0.5'

=> Load = 145 × 90 × 0.5 × 32.2 use loads from steel deck catalog.

= 210.105 kips/ft

Dead load adjustment = 28.98 kips ft

TL = 239 kips/ft — why are you calculating a total D.L.?

Liveload, according to the ASCE 7-10

Office + Lobbies => 143 kips / ft

3rd floor

Dead floor = 239 + 239 = 478 kips / ft

Live load = 290 kips / ft

2nd floor

Dead load = 478 + 239 = 717 kips / ft

Live load = 433 kips / ft

1st floor

Dead Load = 717 + 239 = 956 kips / ft

Live Load = 580 kips / ft

wind load (Tampa, Florida)

= 97.4 48.8 (walls)

Factored Loads

① 1.2DL + 1.6LL

=> Loads on first floor

= 1.2 × 956 + 1.6 × 580

= 2075.2 kips / ft

=> Loads on second floor

= 1.2 × 717 + 1.6 × 435

= 1556.4 kips / ft

=> Loads on third floor

= 1.2 × 478 + 1.6 × 435

= 1556.4 kips / ft

=> Loads on fourth floor

= 1.2 × 239 + 1.6 × 145

= 518.8 kips / ft

As there are 5 70' spans over the 90' length of the structure, the loads on joists are

1st floor $= \frac{2075.2}{5} = 415.04$ kips/ft

2nd floor $= \frac{1556.4}{5} = 311.28$ kips/ft

3rd floor $= \frac{1037.6}{5} = 207.52$ kips/ft

4th floor $= \frac{518.8}{5} = 103.76$ kips/ft

These are too high!

Wind Load: ASCE Category C

$K_d = 0.85 \rightarrow$ Building

$K_g = 0$ — Assuming building lies on a flat plain

$n = \frac{75}{h} = 1.415$ Hz

Rigid building => factor $= 0.85$

$\alpha = 9.5$ $z_g = 900$ ft $\hat{a} = \frac{1}{9.5}$ $\hat{b} = 1.0$

$l = 500$ ft $\bar{a} = \frac{1}{6.5}$ $\bar{b} = 0.65$ $c = 0.2$

Wind speed - 140 mph

Velocity pressure

$q_z = 0.00256\, K_d K_z V^2$

$= 42.64$

Main Wall $42.64 \times 90 \times 53 = 203.438$ kips/ft

bending wall $= 42.64 \times 70 \times 53 = 158.19$ kips/ft

Design loads

Floor	1st floor	2nd floor	3rd floor	4th floor
Loads	kip/ft	kip/ft	kip/ft	kip/ft
Dead load	956	717	478	239
Live load	580	435	290	145
Wind load	50.86	67.813	101.719	203.438

Factored loads	415.04	311.28	207.52	103.76

The length to width ratio $\frac{90}{70} = 1.29 \leq 3$

So it will accept maximum for diaphragms

Assume that a deck spanning 70 ft is used to support the gravity loads. Steel joists span in the north-side direction.

The total deflection:

for bending $\Delta_b = \frac{5wL^4}{384EI}$

for shear $\Delta_s = \frac{wL^2}{8PG'}$

$$G' = \frac{K_2}{3.78 + \frac{3D_{xx}}{span} + 3K_1}$$

$K_2 = 1056$

$D_{xx} = D_2 = 909$

$K_1 = 0.561 \quad K_2 = 539 \Rightarrow 22ga$ Deck

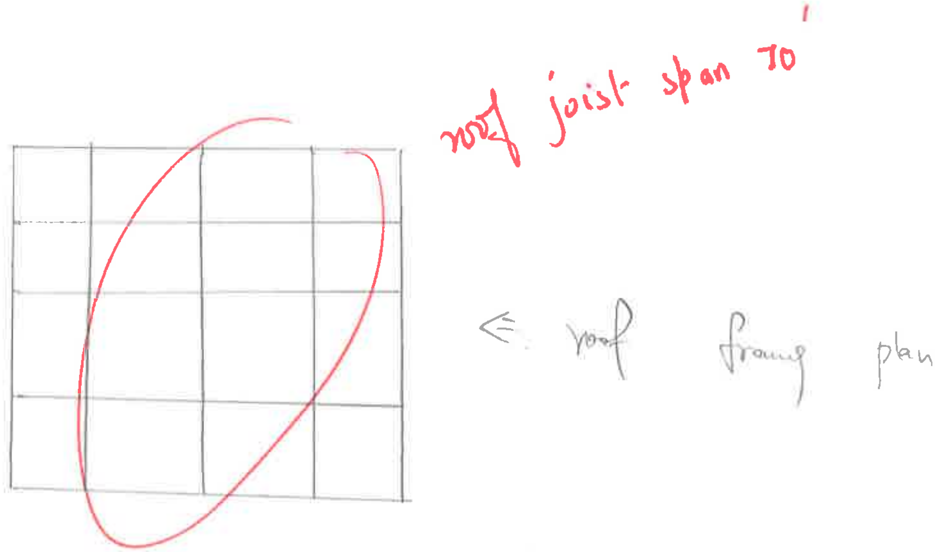
$\Rightarrow G = 16.9$

Assuming the edge member has an area of $3 in^2$

$I = 2Ad^2 = 1.99 \times 10^6 \, in^4$

Hence the bending deflection $= 0.18$ in shear is 0.83

$\Rightarrow 1.01$ in



Thus we can get the roof framing like this

The deck I choose is 1.5 B with gage 22 or 24

For joists, there is no joist designation with gage 22

So I choose 24K7

⇒ with span 30ft

we can get 5.0 kips for each joist

Roof framing detail

Floor	Load	Joist	Span	depth	wt
	Kip/ft		ft	ft	lb/ft
1	83.008	24K1	35	2	8.4
2	62.256	24K2	35	2	8.4
3	41.504	24K3	35	2	8.4
4	103.76	24K4	35	2	8.4

Column design under gravity loads

Floor	Column #	Position	Axial factored loa	Axial factored loa	Height
			kips	kN	ft
1	1	Extreme	3631.592	16514.1259	15
1	2	Mid	7263.217	32308.3987	15
2	3	Extreme	2178.953	9692.465	12
2	4	Mid	4357.935	19385.061	12
3	5	Extreme	1089.47	4846.221	12
3	6	Mid	2178.972	9692.55	12
4	7	Extreme	363.156	1615.398	12
4	8	Extreme	723.156	3216.758	12

these are too high!

Height	Condition	Rass	ϕcFcr	Area requi	Bracing	KyLuy	KxLux	KxLx/KyLy
m			Mpa	mm2		m	m	
4.572	F-P	90	146.46	112648	Mid	2.286	4.572	2
4.572	F-P	90	146.46	220595	Mid	2.286	4.572	2
3.658	F-P	90	146.46	66718.2	Mid	1.829	3.658	2
3.658	F-P	90	146.46	132357	Mid	1.829	3.658	2
3.658	F-P	90	146.46	33089	Mid	1.829	3.658	2
3.658	F-P	90	146.46	66178.8	Mid	1.829	3.658	2
3.658	F-P	90	146.46	11029.6	Mid	1.829	3.658	2
3.658	F-P	90	146.46	21963.4	Mid	1.829	3.658	2

we cannot have
bracing at mid point!

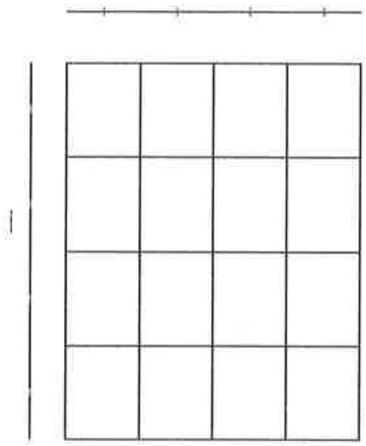
Trial Member	Area	Rx	Ry	Rx/Ry	bf/2tf	h/tw	λr Stiffened	λ r Unstiffen
	mm2	mm	mm					
W360x990	126000	202. 41	117	1. 73	2	4	15. 8	42. 1
W360x1202	153000	207. 4	122	1. 7	1. 8	3. 4	15. 8	42. 1
W360x551	70300	179. 28	108	1. 66	3. 1	6. 9	15. 8	42. 1
W360x1086	139000	207. 06	119	1. 74	1. 8	3. 7	15. 8	42. 1
W360x262	33400	163. 2	102	1. 6	6	13. 7	15. 8	42. 1
W360x551	70300	179. 28	108	1. 66	3. 1	6. 9	15. 8	42. 1
W360x91	11500	151. 28	62	2. 44	7. 7	30. 8	15. 8	42. 1
W360x179	22800	158. 65	95	1. 67	7. 8	19. 3	15. 8	42. 1

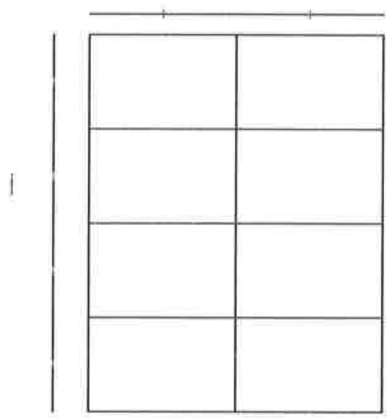
KyLy/Ry	KxLx/Rx	R critica	ϕcFcr	ϕPn	Status	Selected Member
			Mpa	kN		
24. 15	22. 58	24. 15	218. 23	27497	OK	W360x990
23. 16	22. 04	23. 16	218. 78	33473. 3	OK	W360x1202
16. 93	20. 4	20. 4	220. 28	15480. 1	OK	W360x551
15. 369	17. 667	17. 66	221. 17	30742	OK	W360x1086
17. 93	22. 4	23	218. 78	7307. 25	OK	W360x262
16. 963	20. 404	20. 404	219. 8	15451. 9	OK	W360x551
29. 5	24. 81	29. 5	214. 52	2466. 98	OK	W360x91
19. 252	23. 057	23	218. 78	4988. 18	OK	W360x179

too large !

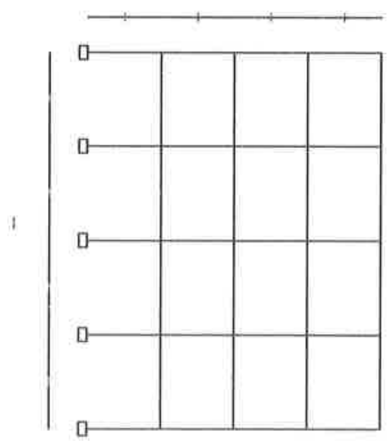
Floor Framing detail

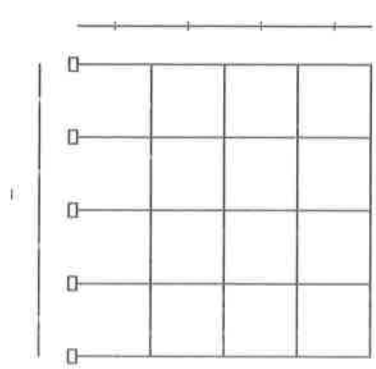
Sr#	Material	Joist	Clear span	Super imposed loads
			ft	PSF
1	N.W Concrete	2VLI19	8.5	192
			9	172
2	N.W Concrete	2VLI19	11	117
			11.5	107



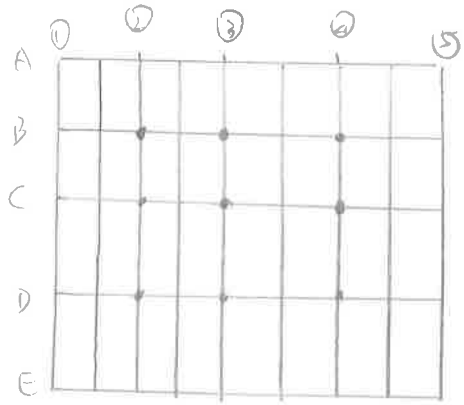


Call out all beam & column sizes





For option A



floor framing plan

Since we have gage destination of 22.5 ft, we use thickness of 0.029 in

Add more beams between columns

So we can reduce the floor pressure for each beams

First floor loads and moments

Beam 1: $F_x = 3631.592$ kips

Right $F_{y12} = 4.102$ kips

$$M_z = \frac{252.12886 \times 10^3}{12} = 21010.738 \text{ kips}\cdot\text{ft}$$

Beam 2: $F_x = 7263.217$ kips

$F_{y12} = 0$

$M_z = 0$

Beam 3: $F_x = 3631.592$ kips

$F_{y12} = 4.102$ kips

$$M_z = \frac{252.1886 \times 10^3}{12} = 21010.738 \text{ kips}\cdot\text{ft}$$

Second floor:

Beam 1 right

$F_x = 2178.955$ kips

$F_y = -3.902$ kips

$M_z = \frac{151.1326 \times 10^3}{12} = 12598.55$ kips·ft

Beam 2: $F_x = 4357.935$ kips

Mid

Beam 3: $F_x = 2178.955$ kips

$F_y = 3.902$ kips

$M_z = 12598.55$ kips·ft

1st floor

Axial factored load = 3631.592 kips

~~length~~ Height of column = 15' = 4.572m

Bottom fixed

$P_u = 3631.592$ kips = 16514.1259 kN

$R_{ag} = 90$

$A_{req} = \frac{16514.1259 \times 1000}{146.66} = 112647.5164$ mm

W 360×990 A: 12600 $\frac{r_x}{r_y} = 1.73$

$k_y = 1.0$ Buckling occurs in the middle

$\Rightarrow k_x L_{req} = 1.0 \times \frac{4.572}{2} = 2.286$

$k_x L_x = 4.572$

$\frac{k_x L_x}{k_y L_y} = 2$

$\frac{bf}{tf} = 2.0 \quad \frac{h}{tw} = 4.0$

λ_x (stiffened) = 15.8

λ_n (unstiffened) = 42.1

checks

$\frac{2826}{117} = 24.15$

$\frac{11572}{202.41} = 22.58$

Max slenderness ratio check

$k = 24.15 < 200$

critical slenderness ratio = 24.15

$f_c f_{cr} = 218.23$ MPa

$\frac{bf}{tf} = 2.0 < 15.8 \Rightarrow ok$

$\frac{h}{tw} = 4.0 < 42.1 \Rightarrow ok$

$\varnothing P_n = 218.237 \cdot \frac{12600}{1000} = 2749.6 \quad 98.71651$

$\therefore ok$

Column Design

1st floor column 20 (mid)

Axial potential load = 7263.217 kips = 32308.3987 kN

Height = 15' = 4.572 m

Rass = 90 $\phi_c f_{ce}$ assumed = 146.46

$$A_{req} = \frac{32308.3987 \times 1000}{146.46} = 220595.575 \text{ mm}^2$$

Buckling occurs in middle

$k_y = 1.0$ $k_y l_y = 2.286$ Ratio = 2

$k_x l_x = 4.572$

Members = W 360 × 1202 A = 153000 mm^2

$\frac{r_x}{r_y} = 1.7$ $r_y = 122$ $r_x = 207.4$

$\frac{b_f}{t_f} = 1.8$ $\frac{h}{t_w} = 3.4$

Checks $\frac{2826}{122} = 23.16$ $\frac{4572}{207.4} = 22.044$

R = 23.16 $\phi_c f_{cR} = 218.78$

$218.78 \times \frac{153000}{1000} = 33473.34 > 32308$ => ok

2nd floor

Internal colum

Axial load = 2178.953 kips

Height = 12' = 3.658 m

$R_{ass} = 90$ $\phi_c f_{cR} = 146.6$ MPa

$$A_{req} = \frac{9692.465 \times 1000}{146.46} = 66\,718.239 \text{ mm}^2$$

$K_x = 1.0$ $K_y L_y = 1.829$

$K_x L_x = 3.658$ Ratio = 2

Member W 360 x 551

$A = 70300 \text{ mm}^2$ $\frac{r_x}{r_y} = 1.66$

$r_y = 108$ $r_x = 179.8$ $\frac{b_f}{2t_f} = 4.1$ $\frac{h}{t_w} = 6.9$

$\frac{1829}{108} = 16.93$ $\frac{3658}{179.75} = 20.40$

$R = 20.40$ $\phi_c f_{cR} = 220.28$

$\phi P_n = 220.28 \times \frac{70300}{1000} = 15485.06 > 9692$ ok

Mid column: $P_u = 4357.935$ kips $= 19385.061$ kN

Height = 3.658 $K_y L_y = 1.829$

$K_x L_x = 3.658$ Ratio = 2

$$A_{req} = \frac{19385.06 \times 1000}{146.46} = 132357.374 \text{ mm}^2$$

Member W 360 x 1086

3rd floor

Same method

external column => W360×262

Mid => W 360 × 237

4th floor

Main => W 360 ×91

Mid => W 360 ×179

=> VL2 19 span 8'-6" and 9'-0"

Base plate foundation design

There are two kinds of column in the structure based on
Typical base-plate design is made and provided in certa
Column type 1 contains column along the bounday of the
Cloumn type 2 contains columns along the centerline of
Drawings can be seen for further elaboration.

Column type	Load	Load	Column cross sectio
	kips	kn	
Col. Type 1	7264.18	32308.212	W360x990
Col. Type 2	14523.5	64603.532	W360x1202

the loading conditions.
in column type
structure ie. From A to E and from 1 to 5.
the structure.

Area	depth	flange widt	Area (base plate	L	B	a	b
mm2	mm	mm	mm2	mm	mm	mm	mm
126000	549	450	2602200	1000	800	225.5	175
153000	582	470	5205527.694	1050	850	234	190

Bearing stres	Ymo	Thickness	Result
kN/mm		mm	mm
0. 04039	1. 1	135	1000x800x135
0. 07238	1. 1	190	1050x850x190

Title Block Line 1
You can changes this area
using the "Settings" menu item
and then using the "Printing &
Title Block" selection.
Title Block Line 6

Title :
Dsgnr:
Project Desc.:

Project Notes :

Job #

Printed: 1 DEC 2008, 2:35PM

General Footing Design

ENERCALC, INC. 1983-2008, Ver: 6.0.19, N:67890

Lic. # : KW-06090020 - Educational Version   Licensed User : Univ. Miami, Civil-Arch-Environ Engrng

Description : --None--

General Information

Calculations per IBC 2006, CBC 2007, ACI 318-05

Material Properties

f'c : Concrete 28 day strength	=	3.0 ksi
Fy : Rebar Yield	=	60.0 ksi
Ec : Concrete Elastic Modulus	=	3,122.0 ksi
Concrete Density	=	145.0 pcf
Φ Values Flexure	=	0.90
Shear	=	0.850

Analysis Settings

Min Steel % Bending Reinf.	=	.00140
Min Allow % Temp Reinf.	=	.00180
Min. Overturning Safety Factor	=	1.50 : 1
Min. Overturning Safety Factor	=	1.50 : 1
AutoCalc Footing Weight as DL	:	No
AutoCalc Pedestal Weight as DL	:	No

Soil Design Values

Allowable Soil Bearing	=	3.0 ksf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.30

Increases based on footing Depth

Reference Depth below Surface	=	2.0 ft
Allow. Pressure Increase per foot of depth	=	0.0 ksf
when base footing is below	=	0.0 ft

Increases based on footing Width

Allow. Pressure Increase per foot of width	=	0.0 ksf
when footing is wider than	=	0.0 ft

Dimensions

Width along X-X Axis	=	5.0 ft
Length along Z-Z Axi	=	5.0 ft
Footing Thicknes	=	15.0 in

Load location offset from footing center...

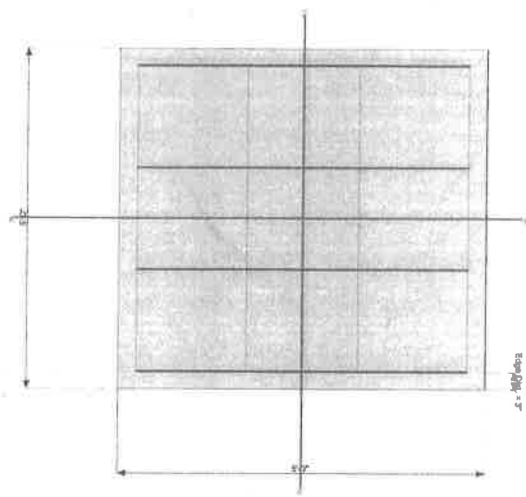
ex : Along X-X Axis	=	0.0 in
ez : Along Z-Z Axis	=	0.0 in

Pedestal dimensions...

px : Along X-X Axis	=	0.0 in
pz : Along Z-Z Axis	=	0.0 in
Height	=	0.0 in

Rebar Centerline to Edge of Concrete..

at Top of footing	=	3.0 in
at Bottom of footing	=	3.0 in



Reinforcing

Bars along X-X Axis

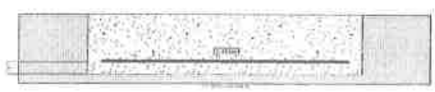
Number of Bars	=	4.0
Reinforcing Bar Size	=	# ~~5.0~~ 6

Bars along Z-Z Axis

Number of Bars	=	4.0
Reinforcing Bar Size	=	# ~~5.0~~ 6

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation		n/a
# Bars required within zone	=	n/a
# Bars required on each side of zone	=	n/a



Applied Loads

		D	Lr	L	S	W	E	H
P : Column Load	=	40.0	5.0	25.0	0.0	0.0	0.0	0.0 k
OB : Overburden	=	0.0	0.0	0.0	0.0	0.0	0.0	0.0 ksf
M-xx	=	0.0	0.0	0.0	0.0	0.0	0.0	0.0 k-ft
M-zz	=	0.0	0.0	0.0	0.0	0.0	0.0	0.0 k-ft
V-x	=	0.0	0.0	0.0	0.0	5.0	0.0	0.0 k
V-z	=	0.0	0.0	0.0	0.0	5.0	0.0	0.0 k

Title Block Line 1
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using the "Settings" menu item
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Title Block Line 6

Title :
Dsgnr:
Project Desc.:

Project Notes :

Job #

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Steel Base Plate Design

ENERCALC, INC. 1983-2008, Ver: 6.0.19, N:67890

Lic. # : KW-06090020 - Educational Version   Licensed User : Univ. Miami, Civil-Arch-Environ Engrng

Description : --None--

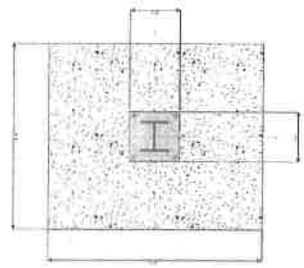
General Information

Calculations per 13th AISC & AISC Design Guide No. 1, 1990 by DeWolf & Ricker

Material Properties

AISC Design Method	Load Resistance Factor Design	Φ_c : LRFD Resistance Factor	0.60
Steel Plate Fy	= 36.0 ksi		
Concrete Support f'c	= 3.0 ksi		
Assumed Bearing Area : Full Bearing		Allowable Bearing Fp per J8	5.10 ksi

Column & Plate



Column Properties

Steel Section : W10X33

Depth	9.73 in	Area	9.71 in^2
Width	7.96 in	Ixx	171 in^4
Flange Thickness	0.435 in	Iyy	36.6 in^4
Web Thickness	0.29 in		

Plate Dimensions

N : Length	16. in
B : Width	14.0 in
Thickness	~~0.750~~ in

Column assumed welded to base plate.

0.625

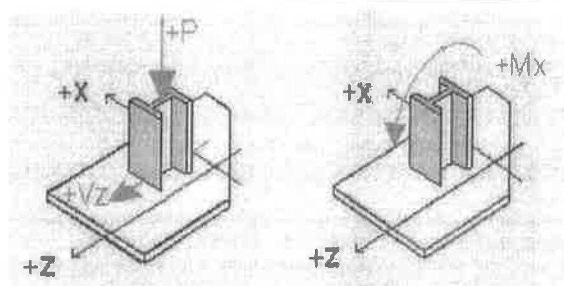
Support Dimensions

Support width along "X"	60 in
Length along "Z"	60.0 in

Applied Loads

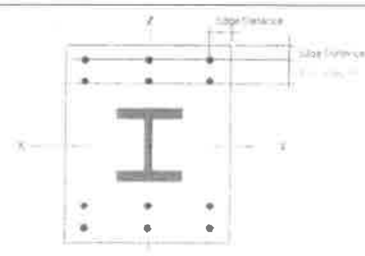
	P-Y	V-Z	M-X
D : Dead Load	40.0 k	0.0 k	0.0 k-ft
L : Live	25.0 k	0.0 k	0.0 k-ft
Lr : Roof Live	5.0 k	0.0 k	0.0 k-ft
S : Snow	0.0 k	0.0 k	0.0 k-ft
W : Wind	0.0 k	5.0 k	0.0 k-ft
E : Earthquake	0.0 k	0.0 k	0.0 k-ft
H : Lateral Earth	0.0 k	0.0 k	0.0 k-ft

" P " = Gravity load, "+" sign is downward.
"+" Moments create higher soil pressure at +Z edge.
"+" Shears push plate towards +Z edge.



Anchor Bolts

Anchor Bolt or Rod Description	3/4"
Max of Tension or Pullout Capacity..........	0.0 k
Shear Capacity..	0.0 k
Edge distance : bolt to plate..................	1.250 in
Number of Bolts in each Row..................	2.0
Number of Bolt Rows.......................	1.0
Row Spacing................................	2.50 in



GOVERNING DESIGN LOAD CASE SUMMARY

Plate Design Summary

Design Method	Load Resistance Factor Design
Governing Load Combination	+1.20D+0.50Lr+1.60L+1.60H
Governing Load Case Type	Axial Load Only
Design Plate Size	**1'-4" x 1'-2" x 0 -3/4"**
Pu : Axial	90.500 k
Mu : Moment	0.000 k-ft

fv : Actual	0.000 ksi
Fv : Allowable = 0.60 * Fy * 0.90 (per G2)	21.600 ksi
Stress Ratio	0.000

Shear Stress OK

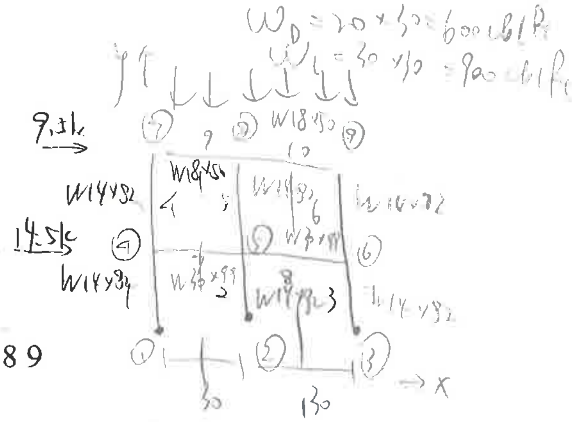
Mu : Max. Moment	2.942 k-in
fb : Max. Bending Stress	20.918 ksi
Fb : Allowable : 0.75 * Fy * Phi	21.600 ksi
Stress Ratio	0.968

Bending Stress OK

fu : Max. Plate Bearing Stress	0.404 ksi
Fp : Allowable : min(0.85*f'c*sqrt(A2/A1), 1.7* f'c)*Phi	3.060 ksi
Stress Ratio	0.132

Bearing Stress OK

注意单位统一



Symbol and label

Geometry → add beam → point → point

Diagrams → beam numbers

beam cursor → 定义型号, commands → Member property

Steel table → W14X82 → Assign

同理类似

```
STAAD PLANE
INPUT WIDTH 79
UNIT FEET KIP
JOINT COORDINATES
1 0. 0. 0.;2 30. 0. 0.;3 60. 0. 0.;4 0. 18. 0.;5 30. 18. 0.
6 60. 18. 0.; 7 0. 33. 0.;8 30. 33. 0.; 9 60. 33. 0.
MEMBER INCIDENCES
1 1 4;2 2 5;3 3 6;4 4 7;5 5 8;6 6 9;7 4 5;8 5 6;9 7 8;10 8 9
MEMBER PROPERTY AMERICAN
1 TO 6 TABLE ST W14X82
7 8 TABLE ST W30X99
9 10 TABLE ST W18X50
CONSTANTS
E STEEL ALL
POISSON STEEL ALL
DENSITY STEEL ALL
SUPPORTS
1 TO 3 PINNED
LOAD 1 DEAD LOAD(20 PSF ROOF, 30 PSF FLOOR, FRAMES @30 FT O.C.)
SELFWEIGHT Y -1
MEMBER LOAD
7 8 UNI GY -0.9
9 10 UNI GY -0.6
LOAD 2 LIVE LOAD (30 PSF ROOF, 80 PSF FLOOR, FRAMES @ 30 FT O.C.)
MEMBER LOAD
7 8 UNI GY -2.4
9 10 UNI GY -0.9
LOAD 3 WIND LOAD (AS PER ASCE 7-10)
JOINT LOAD
4 FX 14.5;6 FX 9.0;7 FX 9.5;9 FX 5.8
LOAD COMB 4 (1.2D+1.6L)
1 1.2 2 1.6
LOAD COMB 5 (1.2D+0.5L+1.0W)
1 1.2 2 0.5 3 1.0
LOAD COMB 6 (D+L+0.67W)
1 1. 2 1. 3 0.67
```

可以不写.

MEMBER LOAD → 可以不写

80×30 = 2400

Select nodes → commands → support specification

从 ① ④ 中间 到 ② ⑤ 中间 → trib = 30

WIND LOAD → 手写

JOINT LOAD → 要加

LOAD COMB → 手写

```
UNIT KIP INCH
PERFORM ANALYSIS
LOAD LIST 4 5
SECTION 0.0 0.4 0.5 0.6 1.0 ALL
PARAMETER
CODE LRFD
CB 0. ALL
DFF 240 ALL
KZ 2.0 ALL
DMIN 13 1 TO 6
```

GROUP MEMBER

Check code all → 再来一次

CB 0. ALL → 必写. 意思是求 CB, 不然默认 CB = 1

也可以 D MAX

W□×0

~~设计的话就是再修改型号~~

然后最后八行

check all code

Select all

STAAD output