# STEEL STRUCTUR ENGINEERING

## STEEL STRUCTURE DESIGN-H-BEAM COLUMN

***INPUT DATA*** PGM RUN *V1.0 Developed by Ryu ChangMyong/P.E*

| | | | | | |
|---|---|---|---|---|---|
| * Item Name | E-1004 | | * Description | PES21 | |
| **DESIGN DATA** | | | | | |
| **MATERIAL FOR COLUMN SUPPORT** | | | | | |
| * Material | SS400 | | * Max. tensile strength, Ts | 4100 | kgf/cm^2 |
| * Allowable stress, Sat-Tensile | 683 | kgf/cm^2 | * Min. Yield strength, Ys | 2100 | kgf/cm^2 |
| * Allowable stress, Sas-Shear | 395 | kgf/cm^2 | | | |
| * Elastic Modulus, E | 2076000 | kgf/cm^2 | * Support column Q'ty | 4 | EA |
| **LOADING DATA** | | | | | |
| * Structure Total Weight, Sw1 | 2500 | Kgf | * Empty Weight of Equipment, We | 3000 | Kgf |
| | | | * Solid Weight of Equipment, Wo | 20000 | Kgf |
| **SEISMIC LOAD DATA** | | | | | |
| * Seismic Zone No ( 0,1,2,3,4 ) | ZONE 4 | | * Soil Profile Type | S1 | |
| * Occupancy Category | CAT-1 | | * Value C = 1/15√(Period) ; Max.=0.12 | 0.12 | |
| | | | * Horizontal Force Factor (Table 24) | 2.0 | |
| **WIND LOAD DATA** | | | | | |
| * Effective Height,H | 5 | m | | | |
| * Effective Width, W | 3 | m | * Structure Height Above GL. (Lever Arm), H | 5 | m |
| * Exposure Coefficient (From Table 6-3 , C ), Kz | 1.64 | | * Topographic Factor, Kzl | 1.0 | |
| * Wind Velocity, V | 35 | m/s | * Importance Factor, I | 1.15 | |
| * Gust Effect Factor, G | 0.85 | | * Force Coefficient, Cf | 0.5 | |
| **EQUIPMENT BOTTOM MEMBER** | | | | | |
| * H-beam thickness, t | 8 | mm | * H-beam thickness, s | 8 | mm |
| * H-beam length, b | 100 | mm | * H-beam length, d | 150 | mm |
| * Bottom Support Q'ty | 4 | EA | * Support Length,L | 2000 | mm |
| **SUPPORT COLUMN** | | | | | |
| * H-beam thickness, t | 8 | mm | * H-beam thickness, s | 8 | mm |
| * H-beam length, b | 100 | mm | * H-beam length, d | 150 | mm |
| * Column Height, Hi | 2500 | mm | | | |

## BASE PLATE

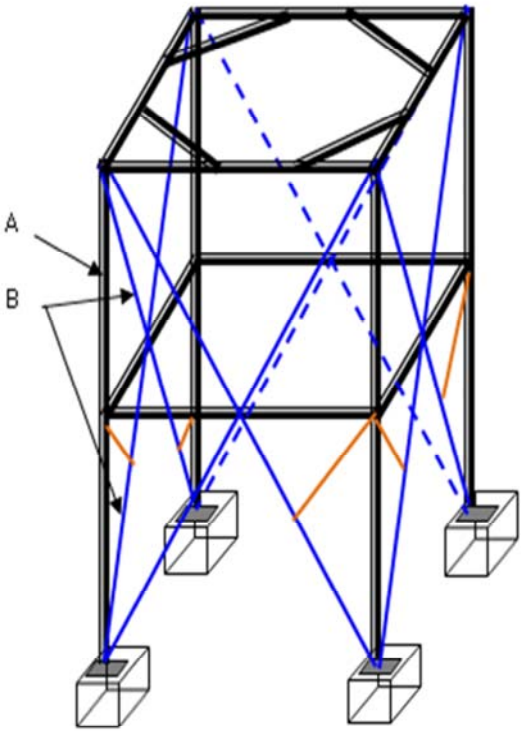
| | | | | | |
|---|---|---|---|---|---|
| * Plate Width | 150 | mm | * Plate Length | 150 | mm |
| * Outward Length | 25 | mm | | | |

## DIAGONAL BRACING MEMBER

| | | | | | |
|---|---|---|---|---|---|
| * Angle size | 150 | mm | * Angle Thickness,t | 13 | mm |
| | | | * Bracing Angle,β | 45 | o |

## ANCHOR BOLT

| | | | | | |
|---|---|---|---|---|---|
| * Allowable tension Stress, Sat | 1106 | kg/cm^2 | * Allowable Shear Stress, Sas | 592 | kgf/cm^2 |
| * Anchor bolt size, | M20 | | * Bolt Q'ty per Base Plate, Nb | 4 | EA |




*RESULT OF CALCULATION*

## 1. SEISMIC LOAD

| | | | | | |
|---|---|---|---|---|---|
| * Soil Profile Coefficient (Table 25) | 1.0 | | * Seismic Zone Coefficient (Table 22) | 0.125 | |
| * Occupancy Importance Factor (Table 23) | 1.0 | | * Limitation for KCS | 0.24 | |
| * Fs1 = Z*I*KCS*We @ Empty | 90.0 | Kgf | * Seismic Load, F = Max. (Fs1 or Fs2) | 600.0 | Kgf |
| * Fs2 = Z*I*KCS*Wo @ Operating | 600.0 | Kgf | * Seismic Moment, Ms | 3,000.0 | Kgf-m |
| * Limitation for CS | 0.12 | Kgf-m | * Moment at Base Plate, Ms | 3,000.0 | Kgf-m |

## 2. WIND LOAD

| | | | | | |
|---|---|---|---|---|---|
| * Effective Area, A | 15.0 | m^2 | * Wind Load at Section, F | 921.0 | Kgf |
| * Velocity Pressure, Qz | 144.5 | Kgf/m^2 | * Wind Moment, Mw | 4,604.9 | Kgf-m |

| | | | | | |
|---|---|---|---|---|---|
| * Shear Load at Base Plate, Fb | 921.0 | Kgf | * Moment at Base Plate, Mw | 4,604.9 | Kgf-m |

## 3. GOVERNING COMPRESSIVE LOAD ON EACH SUPPORT

| | | | | | |
|---|---|---|---|---|---|
| * Compressive load, Wt | 25,730 | Kgf | * Swi+We+Wo + (Bigger one of (Wind and Seismic) | | |

## 4. EQUIPMENT BOTTOM SUPPORT DESIGN

| | | | | | |
|---|---|---|---|---|---|
| * A, Sectional Area | 30.7 | cm^2 | * Za, Material Section modulus | 129.0 | cm^3 |
| * I, Moment of inertia | 967.8 | cm^4 | * y, Distance from neutral axis to extreme fiber | 7.5 | cm |
| * Moment, M = Wt*L/4 | 28,609 | Kgf.cm | * Required Section modulus, Zr = M/Sa | 209 | cm^3 |
| * Stress at the center of support beam | 1,109 | Kgf/cm^2 | * Max. deflection at center | 0.9 | mm |
| * Deflection, <1/800 | O.K | | Zr < Za | Judgement | Check ! |

## 5. SUPPORT COLUMN DESIGN

### 1) MEMBER

| | | | | | |
|---|---|---|---|---|---|
| * A, Sectional Area | 30.7 | cm^2 | * Za, Section modulus | 26.8 | cm^3 |
| * I, Moment of inertia | 133.9 | cm^4 | * L, Radius of Gyration(I/A)^0.5 | 2.1 | cm |
| * Slenderness Ration, λ | 119.7 | | | | |

### 2) MAX. COMPRESSION FORCE DUE TO WIND OR SEISMIC LOAD

| | | | | | |
|---|---|---|---|---|---|
| * Circle Diameter, Dc | 56.5 | cm | * Fmax = F*L / ((n / 2) x Dc x sin(180/n )) | 2,879.2 | Kgf |

### 3) MAX. TOTAL COMPRESSION FORCE IN THE SUPPORT

| | | | | | |
|---|---|---|---|---|---|
| | | | * G = Fmax + Wt | 28,609.4 | Kgf |

### 4) COPRESSION STRESS FOR SUPPORT (Kg/cm^2)

| | | | | | | |
|---|---|---|---|---|---|---|
| * Wind or Seismic ,sc2 | G / A = | 931.3 | < 1.5*Sat | 1,024.5 | Judgement | O.K |
| * Wind or Seismic,sc2' | Ms or Mw / Z = | 171.9 | < 1.5*Sat | 1,024.5 | Judgement | O.K |
| * Wind or Seismic,sc3 | Wt / A = | 837.6 | < 1.5*Sat | 1,024.5 | Judgement | O.K |
| * Limit Slenderness Ration, Λ | = √(π²E /( 0.6 Sa )) | 842.9 | > λ | 119.7 | Judgement | O.K |
| * Sa2 | v = 3 / 2 + 2 ( λ/ Λ)²/ 3 | 1.513 | ( 1−0.4 ( λ/ Λ)²) F / v | 45,125.5 | | |

### 5) STRENGTH EVALUATION

| | | | | | |
|---|---|---|---|---|---|
| * (Sc2' / Sat*0.5) + ( Sc2 / Sa2) | 0.52 | < | 1.0 | Judgement | O.K |

## 6. SUPPORT BASE PLATE

| | | |
|---|---|---|
| * Distributed Load on concrete foundation during test,sc=Wt/A | 114.4 | Kgf/cm^2 |
| * Required thickness, tb=√( 3 Sc lb²/ (1.25 Sab )) | 1.17 | cm |

## 7. DIAGONAL BRACING DESIGN

| | | | | | | |
|---|---|---|---|---|---|---|
| * Cross sectional Area each one,Ab | 35.6 | cm^2 | * Tension Load, T=G* ( sin β) = | 20,229.9 | Kgf | |
| * Tension Stress,st=T/Ab = | 567.9 | kgf/cm^2 | * Allowable tension Stress, sat | 683.0 | kg/cm^2 | O.K |

## 8. ANCHOR BOLT DESIGN

| | | | |
|---|---|---|---|
| * Cross sectional | cm^2 | * Applied Load per Anchor | Kgf |

| | | | | | | |
|---|---|---|---|---|---|---|
| Area each one, Ab1 | 2.17 | | bolt, Wt1=Wt/Nb | 1,608.1 | | |

9. STRESS EVALUATION (Kg/cm^2)

| | | | | | | |
|---|---|---|---|---|---|---|
| * Tensile Stress, st= | Wt1/(Nb*Ab1) = | 740.7 | < Sat = | 683.0 | Judgement | Check ! |
| * Anchor Shear Stress, Ss= | Fb /(Nb* Ab1) = | 106.1 | < Sas= | 395.0 | Judgement | O.K |

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