门式刚架计算书

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**1. 设计依据**

《建筑结构荷载规范》(GB 50009-2012);

《建筑抗震设计规范》(GB 50011-2010);

《钢结构设计标准》(GB 50017-2017);

《门式刚架轻型房屋钢结构技术规范》(GB 51022-2015);

《建筑结构可靠性设计统一标准》(GB 50068-2018)

《工程结构通用规范》(GB 55001-2021)

《建筑与市政工程抗震通用规范》(GB 55002-2021)

《钢结构通用规范》(GB 55006-2021)

**2. 计算软件信息**

本工程计算软件为PKPM钢结构设计软件 2021 V1.2.0版 。

计算日期为 2025年10月 7日11时 7分35秒。

**3. 结构计算简图**



图1-1 结构简图

**4. 结构计算信息**

结构类型: 门式刚架轻型房屋钢结构

设计规范: 按《门式刚架轻型房屋钢结构技术规范》（GB 51022-2015）计算

结构重要性系数: 1.00

节点总数: 8

柱数: 5

梁数: 2

支座约束数: 3

标准截面总数: 4

荷载分项系数：

恒载: 1.30

活载: 1.50

风载: 1.50

地震: 1.40

吊车: 1.50

重力荷载分项系数: 1.30

活荷载计算信息: 考虑活荷载不利布置

考虑结构使用年限的活荷载调整系数：1.00

风荷载计算信息: 计算风荷载

钢材: Q235

梁柱自重计算信息: 柱梁自重都计算

恒载作用下柱的轴向变形: 考虑

梁柱自重计算增大系数: 1.20

梁刚度增大系数: 1.00

钢结构净截面面积与毛截面面积比: 0.90

门式刚架梁平面内的整体稳定性: 按压弯构件验算

程序自动确定允许的长细比

钢梁(恒+活)容许挠跨比: l /180

柱顶容许水平位移/柱高: l /60

地震影响系数取值依据: 10抗规(2010版)

特征周期(s):0.35

水平地震影响系数最大值αmax:0.0400

地震作用计算: 计算水平地震作用

计算振型数：3

地震烈度：6.00

场地土类别：Ⅱ类

附加重量节点数：0

设计地震分组：第一组

周期折减系数:0.80

地震力计算方法：振型分解法

结构阻尼比：0.050

按GB50011-2010 地震效应增大系数:1.050

防火设计计算信息：考虑防火设计

建筑耐火等级：二级

**5. 结构基本信息**

**节点坐标**

| 节点号 | X | Y | 节点号 | X | Y |
| --- | --- | --- | --- | --- | --- |
| 1 | 0.13 | 7.30 | 2 | 14.48 | 7.30 |
| 3 | 7.30 | 8.03 | 4 | -0.10 | 8.50 |
| 5 | 14.70 | 8.50 | 6 | 0.13 | 0.00 |
| 7 | 7.30 | 0.00 | 8 | 14.48 | 0.00 |

**柱关联号**

| 柱号 | 节点Ⅰ | 节点Ⅱ | 柱号 | 节点Ⅰ | 节点Ⅱ |
| --- | --- | --- | --- | --- | --- |
| 1 | 6 | 1 | 2 | 7 | 3 |
| 3 | 8 | 2 | 4 | 1 | 4 |
| 5 | 2 | 5 |  |  |  |

**梁关联号**

| 梁号 | 节点Ⅰ | 节点Ⅱ | 梁号 | 节点Ⅰ | 节点Ⅱ |
| --- | --- | --- | --- | --- | --- |
| 1 | 1 | 3 | 2 | 3 | 2 |

**柱节点偏心 (m)**

| 节点号 | 柱偏心值 | 节点号 | 柱偏心值 | 节点号 | 柱偏心值 |
| --- | --- | --- | --- | --- | --- |
| 1 | -0.225 | 2 | 0.225 | 3 | 0.000 |
| 4 | 0.000 | 5 | 0.000 | 6 | 0.000 |
| 7 | 0.000 | 8 | 0.000 |  |  |

**标准截面信息**

| 截面号 | 截面信息 |
| --- | --- |
| 1 | H形变截面:  (H1~H2)\*B1\*B2\*Tw\*T1\*T2=(250~500)\*200\*200\*6\*8\*8 |
| 2 | 焊接组合H形截面:  H\*B1\*B2\*Tw\*T1\*T2=250\*200\*200\*6\*8\*8 |
| 3 | 焊接组合H形截面:  H\*B1\*B2\*Tw\*T1\*T2=200\*200\*200\*6\*8\*8 |
| 4 | 焊接组合H形截面:  H\*B1\*B2\*Tw\*T1\*T2=250\*200\*200\*6\*8\*8 |

**柱布置截面号,约束信息,截面布置角度**

| 柱号 | 标准截面号 | 约束信息 | 截面布置角度 |
| --- | --- | --- | --- |
| 1 | 2 | I端铰接 | 0 |
| 2 | 2 | I端铰接 | 0 |
| 3 | 2 | I端铰接 | 0 |
| 4 | 3 | 两端刚接 | 0 |
| 5 | 3 | 两端刚接 | 0 |

**梁布置截面号,约束信息**

| 梁号 | 标准截面号 | 约束信息 |
| --- | --- | --- |
| 1 | 4 | 两端刚接 |
| 2 | 4 | 两端刚接 |

**截面特性**

| 截面号 | Xc (mm) | Yc (mm) | Ix (cm4) | Iy (cm4) | A (cm2) |
| --- | --- | --- | --- | --- | --- |
| 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 100.0 | 125.0 | 5327.5 | 1067.1 | 46.0 |
| 3 | 100.0 | 100.0 | 3262.3 | 1067.0 | 43.0 |
| 4 | 100.0 | 125.0 | 5327.5 | 1067.1 | 46.0 |

| 截面号 | ix (cm) | iy (cm) | W1x (cm3) | W2x (cm3) | W1y (cm3) | W2y (cm3) |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 10.8 | 4.8 | 426.2 | 426.2 | 106.7 | 106.7 |
| 3 | 8.7 | 5.0 | 326.2 | 326.2 | 106.7 | 106.7 |
| 4 | 10.8 | 4.8 | 426.2 | 426.2 | 106.7 | 106.7 |

**防火材料信息**

| 序号 | 名称 | 热传导系数(W/(m\*℃)) | 密度(kg/m^3) | 比热(J/(kg\*℃) | 类型 |
| --- | --- | --- | --- | --- | --- |
| 1 | 防火涂料1 | 0.100 | 680.00 | 1000.00 | 非膨胀 |
| 2 | 防火涂料2 | 0.100 | 680.00 | 1000.00 | 膨胀 |

**6. 荷载与效应组合**

## **1. 各工况荷载表**

**节点荷载**

| 工况 | 节点号 | 弯矩 | 垂直力 | 水平力 |
| --- | --- | --- | --- | --- |
| -- | -- | -- | -- | -- |

**柱荷载**

| 工况 | 柱号 | 荷载类型 | 荷载值 | 荷载参数1 | 荷载参数2 |
| --- | --- | --- | --- | --- | --- |
| 左风1 | 1 | 1 | -0.45 | 0.00 | 0.00 |
| 3 | 1 | 2.75 | 0.00 | 0.00 |
| 4 | 1 | -4.20 | 0.00 | 0.00 |
| 5 | 1 | 4.20 | 0.00 | 0.00 |
| 右风1 | 1 | 1 | -2.75 | 0.00 | 0.00 |
| 3 | 1 | 0.45 | 0.00 | 0.00 |
| 4 | 1 | -4.20 | 0.00 | 0.00 |
| 5 | 1 | 4.20 | 0.00 | 0.00 |
| 左风2 | 1 | 1 | 3.10 | 0.00 | 0.00 |
| 3 | 1 | -0.81 | 0.00 | 0.00 |
| 4 | 1 | 4.20 | 0.00 | 0.00 |
| 5 | 1 | -4.20 | 0.00 | 0.00 |
| 右风2 | 1 | 1 | 0.81 | 0.00 | 0.00 |
| 3 | 1 | -3.10 | 0.00 | 0.00 |
| 4 | 1 | 4.20 | 0.00 | 0.00 |
| 5 | 1 | -4.20 | 0.00 | 0.00 |

**梁荷载**

| 工况 | 连续数 | 荷载个数 | 荷载类型 | 荷载值1 | 荷载参数1 | 荷载值2 | 荷载参数2 |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 恒荷载 | 1 | 1 | 1 | 3.15 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.15 | 0.00 | 0.00 | 0.00 |
| 活荷载 | 1 | 1 | 1 | 3.50 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.50 | 0.00 | 0.00 | 0.00 |
| 左风1 | 1 | 1 | 1 | -4.01 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -2.98 | 0.00 | 0.00 | 0.00 |
| 右风1 | 1 | 1 | 1 | -2.98 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -4.01 | 0.00 | 0.00 | 0.00 |
| 左风2 | 1 | 1 | 1 | -0.45 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 0.58 | 0.00 | 0.00 | 0.00 |
| 右风2 | 1 | 1 | 1 | 0.58 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -0.45 | 0.00 | 0.00 | 0.00 |

## **2. 荷载效应组合表**

**(1)柱内力的组合值**

| 柱内力的组合 | |
| --- | --- |
| (1)1.3恒+1.5活1 | (2)1.3恒+1.5活2 |
| (3)1.3恒+1.5活3 | (4)1.3恒+1.5活4 |
| (5)1.0恒+1.5活1 | (6)1.0恒+1.5活2 |
| (7)1.0恒+1.5活3 | (8)1.0恒+1.5活4 |
| (9)1.3恒+1.5左风1 | (10)1.3恒+1.5右风1 |
| (11)1.3恒+1.5左风2 | (12)1.3恒+1.5右风2 |
| (13)1.0恒+1.5左风1 | (14)1.0恒+1.5右风1 |
| (15)1.0恒+1.5左风2 | (16)1.0恒+1.5右风2 |
| (17)1.3恒+1.5活1+0.9左风1 | (18)1.3恒+1.5活1+0.9右风1 |
| (19)1.3恒+1.5活1+0.9左风2 | (20)1.3恒+1.5活1+0.9右风2 |
| (21)1.3恒+1.5活2+0.9左风1 | (22)1.3恒+1.5活2+0.9右风1 |
| (23)1.3恒+1.5活2+0.9左风2 | (24)1.3恒+1.5活2+0.9右风2 |
| (25)1.3恒+1.5活3+0.9左风1 | (26)1.3恒+1.5活3+0.9右风1 |
| (27)1.3恒+1.5活3+0.9左风2 | (28)1.3恒+1.5活3+0.9右风2 |
| (29)1.3恒+1.5活4+0.9左风1 | (30)1.3恒+1.5活4+0.9右风1 |
| (31)1.3恒+1.5活4+0.9左风2 | (32)1.3恒+1.5活4+0.9右风2 |
| (33)1.0恒+1.5活1+0.9左风1 | (34)1.0恒+1.5活1+0.9右风1 |
| (35)1.0恒+1.5活1+0.9左风2 | (36)1.0恒+1.5活1+0.9右风2 |
| (37)1.0恒+1.5活2+0.9左风1 | (38)1.0恒+1.5活2+0.9右风1 |
| (39)1.0恒+1.5活2+0.9左风2 | (40)1.0恒+1.5活2+0.9右风2 |
| (41)1.0恒+1.5活3+0.9左风1 | (42)1.0恒+1.5活3+0.9右风1 |
| (43)1.0恒+1.5活3+0.9左风2 | (44)1.0恒+1.5活3+0.9右风2 |
| (45)1.0恒+1.5活4+0.9左风1 | (46)1.0恒+1.5活4+0.9右风1 |
| (47)1.0恒+1.5活4+0.9左风2 | (48)1.0恒+1.5活4+0.9右风2 |
| (49)1.3恒+1.05活1+1.5左风1 | (50)1.3恒+1.05活1+1.5右风1 |
| (51)1.3恒+1.05活1+1.5左风2 | (52)1.3恒+1.05活1+1.5右风2 |
| (53)1.3恒+1.05活2+1.5左风1 | (54)1.3恒+1.05活2+1.5右风1 |
| (55)1.3恒+1.05活2+1.5左风2 | (56)1.3恒+1.05活2+1.5右风2 |
| (57)1.3恒+1.05活3+1.5左风1 | (58)1.3恒+1.05活3+1.5右风1 |
| (59)1.3恒+1.05活3+1.5左风2 | (60)1.3恒+1.05活3+1.5右风2 |
| (61)1.3恒+1.05活4+1.5左风1 | (62)1.3恒+1.05活4+1.5右风1 |
| (63)1.3恒+1.05活4+1.5左风2 | (64)1.3恒+1.05活4+1.5右风2 |
| (65)1.0恒+1.05活1+1.5左风1 | (66)1.0恒+1.05活1+1.5右风1 |
| (67)1.0恒+1.05活1+1.5左风2 | (68)1.0恒+1.05活1+1.5右风2 |
| (69)1.0恒+1.05活2+1.5左风1 | (70)1.0恒+1.05活2+1.5右风1 |
| (71)1.0恒+1.05活2+1.5左风2 | (72)1.0恒+1.05活2+1.5右风2 |
| (73)1.0恒+1.05活3+1.5左风1 | (74)1.0恒+1.05活3+1.5右风1 |
| (75)1.0恒+1.05活3+1.5左风2 | (76)1.0恒+1.05活3+1.5右风2 |
| (77)1.0恒+1.05活4+1.5左风1 | (78)1.0恒+1.05活4+1.5右风1 |
| (79)1.0恒+1.05活4+1.5左风2 | (80)1.0恒+1.05活4+1.5右风2 |
| (81)1.3恒+0.65活1+1.4左地震 | (82)1.3恒+0.65活1+1.4右地震 |
| (83)1.3恒+0.65活2+1.4左地震 | (84)1.3恒+0.65活2+1.4右地震 |
| (85)1.3恒+0.65活3+1.4左地震 | (86)1.3恒+0.65活3+1.4右地震 |
| (87)1.3恒+0.65活4+1.4左地震 | (88)1.3恒+0.65活4+1.4右地震 |
| (89)1.0恒+0.5活1+1.4左地震 | (90)1.0恒+0.5活1+1.4右地震 |
| (91)1.0恒+0.5活2+1.4左地震 | (92)1.0恒+0.5活2+1.4右地震 |
| (93)1.0恒+0.5活3+1.4左地震 | (94)1.0恒+0.5活3+1.4右地震 |
| (95)1.0恒+0.5活4+1.4左地震 | (96)1.0恒+0.5活4+1.4右地震 |

**(2)梁内力的组合值**

| 梁内力组合 | |
| --- | --- |
| (1)1.3恒+1.5活1 | (2)1.3恒+1.5活2 |
| (3)1.3恒+1.5活3 | (4)1.3恒+1.5活4 |
| (5)1.0恒+1.5活1 | (6)1.0恒+1.5活2 |
| (7)1.0恒+1.5活3 | (8)1.0恒+1.5活4 |
| (9)1.3恒+1.5左风1 | (10)1.3恒+1.5右风1 |
| (11)1.3恒+1.5左风2 | (12)1.3恒+1.5右风2 |
| (13)1.0恒+1.5左风1 | (14)1.0恒+1.5右风1 |
| (15)1.0恒+1.5左风2 | (16)1.0恒+1.5右风2 |
| (17)1.3恒+1.5活1+0.9左风1 | (18)1.3恒+1.5活1+0.9右风1 |
| (19)1.3恒+1.5活1+0.9左风2 | (20)1.3恒+1.5活1+0.9右风2 |
| (21)1.3恒+1.5活2+0.9左风1 | (22)1.3恒+1.5活2+0.9右风1 |
| (23)1.3恒+1.5活2+0.9左风2 | (24)1.3恒+1.5活2+0.9右风2 |
| (25)1.3恒+1.5活3+0.9左风1 | (26)1.3恒+1.5活3+0.9右风1 |
| (27)1.3恒+1.5活3+0.9左风2 | (28)1.3恒+1.5活3+0.9右风2 |
| (29)1.3恒+1.5活4+0.9左风1 | (30)1.3恒+1.5活4+0.9右风1 |
| (31)1.3恒+1.5活4+0.9左风2 | (32)1.3恒+1.5活4+0.9右风2 |
| (33)1.0恒+1.5活1+0.9左风1 | (34)1.0恒+1.5活1+0.9右风1 |
| (35)1.0恒+1.5活1+0.9左风2 | (36)1.0恒+1.5活1+0.9右风2 |
| (37)1.0恒+1.5活2+0.9左风1 | (38)1.0恒+1.5活2+0.9右风1 |
| (39)1.0恒+1.5活2+0.9左风2 | (40)1.0恒+1.5活2+0.9右风2 |
| (41)1.0恒+1.5活3+0.9左风1 | (42)1.0恒+1.5活3+0.9右风1 |
| (43)1.0恒+1.5活3+0.9左风2 | (44)1.0恒+1.5活3+0.9右风2 |
| (45)1.0恒+1.5活4+0.9左风1 | (46)1.0恒+1.5活4+0.9右风1 |
| (47)1.0恒+1.5活4+0.9左风2 | (48)1.0恒+1.5活4+0.9右风2 |
| (49)1.3恒+1.05活1+1.5左风1 | (50)1.3恒+1.05活1+1.5右风1 |
| (51)1.3恒+1.05活1+1.5左风2 | (52)1.3恒+1.05活1+1.5右风2 |
| (53)1.3恒+1.05活2+1.5左风1 | (54)1.3恒+1.05活2+1.5右风1 |
| (55)1.3恒+1.05活2+1.5左风2 | (56)1.3恒+1.05活2+1.5右风2 |
| (57)1.3恒+1.05活3+1.5左风1 | (58)1.3恒+1.05活3+1.5右风1 |
| (59)1.3恒+1.05活3+1.5左风2 | (60)1.3恒+1.05活3+1.5右风2 |
| (61)1.3恒+1.05活4+1.5左风1 | (62)1.3恒+1.05活4+1.5右风1 |
| (63)1.3恒+1.05活4+1.5左风2 | (64)1.3恒+1.05活4+1.5右风2 |
| (65)1.0恒+1.05活1+1.5左风1 | (66)1.0恒+1.05活1+1.5右风1 |
| (67)1.0恒+1.05活1+1.5左风2 | (68)1.0恒+1.05活1+1.5右风2 |
| (69)1.0恒+1.05活2+1.5左风1 | (70)1.0恒+1.05活2+1.5右风1 |
| (71)1.0恒+1.05活2+1.5左风2 | (72)1.0恒+1.05活2+1.5右风2 |
| (73)1.0恒+1.05活3+1.5左风1 | (74)1.0恒+1.05活3+1.5右风1 |
| (75)1.0恒+1.05活3+1.5左风2 | (76)1.0恒+1.05活3+1.5右风2 |
| (77)1.0恒+1.05活4+1.5左风1 | (78)1.0恒+1.05活4+1.5右风1 |
| (79)1.0恒+1.05活4+1.5左风2 | (80)1.0恒+1.05活4+1.5右风2 |
| (81)1.3恒+0.65活1+1.4左地震 | (82)1.3恒+0.65活1+1.4右地震 |
| (83)1.3恒+0.65活2+1.4左地震 | (84)1.3恒+0.65活2+1.4右地震 |
| (85)1.3恒+0.65活3+1.4左地震 | (86)1.3恒+0.65活3+1.4右地震 |
| (87)1.3恒+0.65活4+1.4左地震 | (88)1.3恒+0.65活4+1.4右地震 |
| (89)1.0恒+0.5活1+1.4左地震 | (90)1.0恒+0.5活1+1.4右地震 |
| (91)1.0恒+0.5活2+1.4左地震 | (92)1.0恒+0.5活2+1.4右地震 |
| (93)1.0恒+0.5活3+1.4左地震 | (94)1.0恒+0.5活3+1.4右地震 |
| (95)1.0恒+0.5活4+1.4左地震 | (96)1.0恒+0.5活4+1.4右地震 |

**(3)柱偶然组合值**

| 柱偶然组合 | |
| --- | --- |
| (1)1.0恒+0.5活1 | (2)1.0恒+0.5活2 |
| (3)1.0恒+0.5活3 | (4)1.0恒+0.5活4 |
| (5)0.9恒+0.5活1 | (6)0.9恒+0.5活2 |
| (7)0.9恒+0.5活3 | (8)0.9恒+0.5活4 |
| (9)1.0恒+0.4左风1 | (10)1.0恒+0.4右风1 |
| (11)1.0恒+0.4左风2 | (12)1.0恒+0.4右风2 |
| (13)0.9恒+0.4左风1 | (14)0.9恒+0.4右风1 |
| (15)0.9恒+0.4左风2 | (16)0.9恒+0.4右风2 |

**(4)梁偶然组合值**

| 梁偶然组合 | |
| --- | --- |
| (1)1.0恒+0.5活1 | (2)1.0恒+0.5活2 |
| (3)1.0恒+0.5活3 | (4)1.0恒+0.5活4 |
| (5)0.9恒+0.5活1 | (6)0.9恒+0.5活2 |
| (7)0.9恒+0.5活3 | (8)0.9恒+0.5活4 |
| (9)1.0恒+0.4左风1 | (10)1.0恒+0.4右风1 |
| (11)1.0恒+0.4左风2 | (12)1.0恒+0.4右风2 |
| (13)0.9恒+0.4左风1 | (14)0.9恒+0.4右风1 |
| (15)0.9恒+0.4左风2 | (16)0.9恒+0.4右风2 |

**7. 地震计算信息**

## **1. 左地震**

**地震力计算质量集中信息**

| 质量集中节点号 | 质量重量(KN) |
| --- | --- |
| 1 | 82.337 |
| 4 | 0.248 |
| 5 | 0.248 |

水平地震标准值作用底层剪力： 1.128

底层最小地震剪力(抗震规范5.2.5条): 0.663

各质点地震力调整系数: 1.000

地震力调整后剪重比： 0.014

**周期(已乘折减系数)**

| 振型号 | 周期(s) |
| --- | --- |
| 1 | 1.159 |
| 2 | 0.013 |
| 3 | 0.012 |

## **2. 右地震**

**地震力计算质量集中信息**

| 质量集中节点号 | 质量重量(KN) |
| --- | --- |
| 2 | 82.337 |
| 4 | 0.248 |
| 5 | 0.248 |

水平地震标准值作用底层剪力： 1.128

底层最小地震剪力(抗震规范5.2.5条): 0.663

各质点地震力调整系数: 1.000

地震力调整后剪重比： 0.014

**周期(已乘折减系数)**

| 振型号 | 周期(s) |
| --- | --- |
| 1 | 1.159 |
| 2 | 0.013 |
| 3 | 0.012 |

**8. 内力计算结果**

## **1. 单工况内力**

**柱内力**

| 工况 | 单元 | I端N(kN) | I端V(kN) | I端M(kN.m) | II端N(kN) | II端V(kN) | II端M(kN.m) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 恒荷载 | 1 | 14.9 | -0.9 | 0.0 | -11.7 | 0.9 | -6.6 |
| 2 | 32.8 | 0.0 | 0.0 | -29.3 | -0.0 | 0.0 |
| 3 | 14.9 | 0.9 | 0.0 | -11.7 | -0.9 | 6.6 |
| 4 | 0.5 | 0.0 | 0.0 | 0.0 | -0.0 | -0.0 |
| 5 | 0.5 | -0.0 | -0.0 | 0.0 | 0.0 | -0.0 |
| 左风1 | 1 | -18.8 | 2.7 | 0.0 | 18.8 | -6.0 | 31.4 |
| 2 | -24.0 | 2.8 | 0.0 | 24.0 | -2.8 | 22.6 |
| 3 | -7.4 | 10.5 | 0.0 | 7.4 | 9.5 | 3.7 |
| 4 | 0.0 | -5.0 | -3.0 | -0.0 | -0.0 | -0.0 |
| 5 | 0.0 | 5.0 | 3.0 | -0.0 | -0.0 | -0.0 |
| 右风1 | 1 | -7.4 | -10.5 | 0.0 | 7.4 | -9.5 | -3.7 |
| 2 | -24.0 | -2.8 | 0.0 | 24.0 | 2.8 | -22.6 |
| 3 | -18.8 | -2.7 | 0.0 | 18.8 | 6.0 | -31.4 |
| 4 | 0.0 | -5.0 | -3.0 | -0.0 | 0.0 | 0.0 |
| 5 | 0.0 | 5.0 | 3.0 | -0.0 | -0.0 | 0.0 |
| 左风2 | 1 | -3.0 | 12.5 | 0.0 | 3.0 | 10.1 | 8.8 |
| 2 | -4.6 | 2.8 | 0.0 | 4.6 | -2.8 | 22.6 |
| 3 | 8.5 | 0.7 | 0.0 | -8.5 | -6.6 | 26.4 |
| 4 | 0.0 | 5.0 | 3.0 | -0.0 | -0.0 | -0.0 |
| 5 | -0.0 | -5.0 | -3.0 | 0.0 | -0.0 | -0.0 |
| 右风2 | 1 | 8.5 | -0.7 | 0.0 | -8.5 | 6.6 | -26.4 |
| 2 | -4.6 | -2.8 | 0.0 | 4.6 | 2.8 | -22.6 |
| 3 | -3.0 | -12.5 | 0.0 | 3.0 | -10.1 | -8.8 |
| 4 | 0.0 | 5.0 | 3.0 | -0.0 | 0.0 | 0.0 |
| 5 | 0.0 | -5.0 | -3.0 | -0.0 | 0.0 | 0.0 |
| 左地震 | 1 | -0.6 | 0.4 | -0.0 | 0.6 | -0.4 | 2.7 |
| 2 | 0.0 | 0.4 | -0.0 | -0.0 | -0.4 | 3.5 |
| 3 | 0.6 | 0.4 | -0.0 | -0.6 | -0.4 | 2.7 |
| 4 | 0.0 | 0.0 | 0.0 | -0.0 | -0.0 | -0.0 |
| 5 | -0.0 | 0.0 | 0.0 | 0.0 | -0.0 | 0.0 |
| 右地震 | 1 | 0.6 | -0.4 | -0.0 | -0.6 | 0.4 | -2.7 |
| 2 | -0.0 | -0.4 | -0.0 | 0.0 | 0.4 | -3.5 |
| 3 | -0.6 | -0.4 | -0.0 | 0.6 | 0.4 | -2.7 |
| 4 | -0.0 | -0.0 | -0.0 | 0.0 | 0.0 | 0.0 |
| 5 | 0.0 | -0.0 | -0.0 | -0.0 | 0.0 | 0.0 |

**梁内力**

| 工况号 | 单元号 | I端N(kN) | I端V(kN) | I端M(kN.m) | II端N(kN) | II端V(kN) | II端M(kN.m) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 恒荷载 | 1 | 2.0 | 11.1 | 6.7 | 0.6 | 14.7 | -19.7 |
| 2 | -0.6 | 14.7 | 19.7 | -2.0 | 11.1 | -6.7 |
| 左风1 | 1 | -12.9 | -17.6 | -28.4 | 12.9 | -11.3 | 5.9 |
| 2 | -15.2 | -15.6 | -28.5 | 15.2 | -5.8 | -6.7 |
| 右风1 | 1 | -15.2 | -5.8 | 6.7 | 15.2 | -15.6 | 28.5 |
| 2 | -12.9 | -11.3 | -5.9 | 12.9 | -17.6 | 28.4 |
| 左风2 | 1 | 14.8 | -4.5 | -11.8 | -14.8 | 1.2 | -8.9 |
| 2 | 12.4 | -3.0 | -13.7 | -12.4 | 7.2 | -23.4 |
| 右风2 | 1 | 12.4 | 7.2 | 23.4 | -12.4 | -3.0 | 13.7 |
| 2 | 14.8 | 1.2 | 8.9 | -14.8 | -4.5 | 11.8 |
| 左地震 | 1 | -0.0 | -0.6 | -2.7 | 0.0 | 0.6 | -1.7 |
| 2 | 0.0 | -0.6 | -1.7 | -0.0 | 0.6 | -2.7 |
| 右地震 | 1 | 0.0 | 0.6 | 2.7 | -0.0 | -0.6 | 1.7 |
| 2 | -0.0 | 0.6 | 1.7 | 0.0 | -0.6 | 2.7 |

**9. 节点位移**

**恒荷载工况下节点位移（mm）**

| 节点号 | X向位移 | Y向位移 |
| --- | --- | --- |
| 1 | -0.01 | 0.10 |
| 2 | 0.01 | 0.10 |
| 3 | 0.00 | 0.26 |
| 4 | 1.75 | 0.10 |
| 5 | -1.75 | 0.10 |

**活荷载工况下节点位移（mm）**

| 节点号 | X向位移 | Y向位移 |
| --- | --- | --- |
| 1 | -0.01 | 0.09 |
| 2 | 0.01 | 0.09 |
| 3 | 0.00 | 0.24 |
| 4 | 1.72 | 0.09 |
| 5 | -1.72 | 0.09 |

**节点侧向（水平向）位移(mm)**

| 工况 | 节点 | δx | 节点 | δx |
| --- | --- | --- | --- | --- |
| 左风1 | 1 | 54.47 | 2 | 54.67 |
| 3 | 54.56 | 4 | 55.70 |
| 5 | 57.96 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |
| 右风1 | 1 | -54.67 | 2 | -54.47 |
| 3 | -54.56 | 4 | -57.96 |
| 5 | -55.70 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |
| 左风2 | 1 | 54.68 | 2 | 54.46 |
| 3 | 54.56 | 4 | 56.00 |
| 5 | 57.66 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |
| 右风2 | 1 | -54.46 | 2 | -54.68 |
| 3 | -54.56 | 4 | -57.66 |
| 5 | -56.00 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |
| 左地震 | 1 | 7.45 | 2 | 7.45 |
| 3 | 7.45 | 4 | 7.94 |
| 5 | 7.94 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |
| 右地震 | 1 | -7.45 | 2 | -7.45 |
| 3 | -7.45 | 4 | -7.94 |
| 5 | -7.94 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |

**10. 构件设计结果汇总**

**钢柱验算结果**

| 柱号 | 应力比 | 剪应力比 | 平面内稳定 | 平面外稳定 | 腹板高厚比 | 翼缘宽厚比 | 平面内长细比 | 平面外长细比 | 质量(kg) | 状态 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 0.70 | 0.10 | 0.81 | 0.88 | 39.00 | 12.13 | 152.65 | 151.63 | 264.0 | 通过 |
| 2 | 0.53 | 0.03 | 0.66 | 0.76 | 39.00 | 12.13 | 146.97 | 166.80 | 290.2 | 通过 |
| 3 | 0.70 | 0.10 | 0.81 | 0.88 | 39.00 | 12.13 | 152.65 | 151.63 | 264.0 | 通过 |
| 4 | 0.07 | 0.05 | 0.07 | 0.03 | 30.67 | 12.13 | 28.05 | 24.10 | 41.3 | 通过 |
| 5 | 0.07 | 0.05 | 0.07 | 0.03 | 30.67 | 12.13 | 28.05 | 24.10 | 41.3 | 通过 |

**钢梁验算结果**

| 梁号 | 应力比 | 剪应力比 | 平面内(上端)稳定 | 平面外(下端)稳定 | 腹板高厚比 | 翼缘宽厚比 | 质量(kg) | 状态 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 0.78 | 0.24 | 0.71 | 0.90 | 39.00 | 12.13 | 260.7 | 通过 |
| 2 | 0.78 | 0.24 | 0.71 | 0.90 | 39.00 | 12.13 | 260.7 | 通过 |

**11. 构件设计结果**

**1. 钢 柱 1
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=16.42, Ly=7.30; 长细比：λx=152.7,λy=151.6

构件长度=7.30; 计算长度系数: Ux=2.25 Uy=1.00

抗震等级: 四级

截面参数: B1=200, B2=200, H=250, Tw=6, T1=8, T2=8

轴压截面分类:X轴:b类 , Y轴:c类

构件钢号：Q235

宽厚比等级:S4

验算规范: 门规GB51022-2015

构件耐火等级: 二级

是否耐火钢: 否; 采用防火材料: 防火涂料1( 1); 形状系数: 279.756744(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.00 | 18.06 | -1.15 | -8.41 | -13.94 | 1.15 |
| 2 | 0.00 | 36.99 | -2.54 | -18.57 | -32.88 | 2.54 |
| 3 | 0.00 | 36.99 | -2.54 | -18.57 | -32.88 | 2.54 |
| 4 | 0.00 | 18.06 | -1.15 | -8.41 | -13.94 | 1.15 |
| 5 | 0.00 | 13.60 | -0.88 | -6.42 | -10.43 | 0.88 |
| 6 | 0.00 | 32.53 | -2.27 | -16.59 | -29.37 | 2.27 |
| 7 | 0.00 | 32.53 | -2.27 | -16.59 | -29.37 | 2.27 |
| 8 | 0.00 | 13.60 | -0.88 | -6.42 | -10.43 | 0.88 |
| 9 | 0.00 | -8.85 | 2.80 | 38.56 | 12.97 | -7.76 |
| 10 | 0.00 | 8.30 | -16.99 | -14.16 | -4.18 | -13.11 |
| 11 | 0.00 | 14.87 | 17.62 | 4.53 | -10.75 | 16.38 |
| 12 | 0.00 | 32.02 | -2.18 | -48.19 | -27.90 | 11.03 |
| 13 | 0.00 | -13.31 | 3.08 | 40.55 | 16.48 | -8.03 |
| 14 | 0.00 | 3.84 | -16.72 | -12.17 | -0.67 | -13.38 |
| 15 | 0.00 | 10.41 | 17.89 | 6.52 | -7.24 | 16.11 |
| 16 | 0.00 | 27.56 | -1.90 | -46.21 | -24.39 | 10.76 |
| 17 | 0.00 | 1.15 | 1.24 | 19.89 | 2.96 | -4.21 |
| 18 | 0.00 | 11.44 | -10.64 | -11.74 | -7.33 | -7.42 |
| 19 | 0.00 | 15.39 | 10.13 | -0.53 | -11.27 | 10.27 |
| 20 | 0.00 | 25.68 | -1.75 | -32.16 | -21.56 | 7.06 |
| 21 | 0.00 | 20.08 | -0.15 | 9.73 | -15.97 | -2.82 |
| 22 | 0.00 | 30.37 | -12.03 | -21.90 | -26.26 | -6.03 |
| 23 | 0.00 | 34.32 | 8.73 | -10.69 | -30.20 | 11.66 |
| 24 | 0.00 | 44.61 | -3.14 | -42.32 | -40.49 | 8.45 |
| 25 | 0.00 | 20.08 | -0.15 | 9.73 | -15.97 | -2.82 |
| 26 | 0.00 | 30.37 | -12.03 | -21.90 | -26.26 | -6.03 |
| 27 | 0.00 | 34.32 | 8.73 | -10.69 | -30.20 | 11.66 |
| 28 | 0.00 | 44.61 | -3.14 | -42.32 | -40.49 | 8.45 |
| 29 | 0.00 | 1.15 | 1.24 | 19.89 | 2.96 | -4.21 |
| 30 | 0.00 | 11.44 | -10.64 | -11.74 | -7.33 | -7.42 |
| 31 | 0.00 | 15.39 | 10.13 | -0.53 | -11.27 | 10.27 |
| 32 | 0.00 | 25.68 | -1.75 | -32.16 | -21.56 | 7.06 |
| 33 | 0.00 | -3.31 | 1.51 | 21.88 | 6.47 | -4.48 |
| 34 | 0.00 | 6.98 | -10.37 | -9.76 | -3.81 | -7.69 |
| 35 | 0.00 | 10.93 | 10.40 | 1.46 | -7.76 | 10.00 |
| 36 | 0.00 | 21.22 | -1.48 | -30.18 | -18.05 | 6.79 |
| 37 | 0.00 | 15.62 | 0.12 | 11.72 | -12.46 | -3.09 |
| 38 | 0.00 | 25.91 | -11.76 | -19.92 | -22.75 | -6.30 |
| 39 | 0.00 | 29.86 | 9.01 | -8.70 | -26.69 | 11.39 |
| 40 | 0.00 | 40.15 | -2.87 | -40.34 | -36.98 | 8.18 |
| 41 | 0.00 | 15.62 | 0.12 | 11.72 | -12.46 | -3.09 |
| 42 | 0.00 | 25.91 | -11.76 | -19.92 | -22.75 | -6.30 |
| 43 | 0.00 | 29.86 | 9.01 | -8.70 | -26.69 | 11.39 |
| 44 | 0.00 | 40.15 | -2.87 | -40.34 | -36.98 | 8.18 |
| 45 | 0.00 | -3.31 | 1.51 | 21.88 | 6.47 | -4.48 |
| 46 | 0.00 | 6.98 | -10.37 | -9.76 | -3.81 | -7.69 |
| 47 | 0.00 | 10.93 | 10.40 | 1.46 | -7.76 | 10.00 |
| 48 | 0.00 | 21.22 | -1.48 | -30.18 | -18.05 | 6.79 |
| 49 | 0.00 | -9.74 | 2.82 | 38.70 | 13.86 | -7.78 |
| 50 | 0.00 | 7.41 | -16.97 | -14.02 | -3.29 | -13.13 |
| 51 | 0.00 | 13.98 | 17.64 | 4.67 | -9.86 | 16.36 |
| 52 | 0.00 | 31.13 | -2.16 | -48.06 | -27.01 | 11.01 |
| 53 | 0.00 | 3.51 | 1.85 | 31.59 | 0.61 | -6.81 |
| 54 | 0.00 | 20.66 | -17.95 | -21.14 | -16.54 | -12.15 |
| 55 | 0.00 | 27.23 | 16.66 | -2.44 | -23.12 | 17.33 |
| 56 | 0.00 | 44.38 | -3.13 | -55.17 | -40.27 | 11.98 |
| 57 | 0.00 | 3.51 | 1.85 | 31.59 | 0.61 | -6.81 |
| 58 | 0.00 | 20.66 | -17.95 | -21.14 | -16.54 | -12.15 |
| 59 | 0.00 | 27.23 | 16.66 | -2.44 | -23.12 | 17.33 |
| 60 | 0.00 | 44.38 | -3.13 | -55.17 | -40.27 | 11.98 |
| 61 | 0.00 | -9.74 | 2.82 | 38.70 | 13.86 | -7.78 |
| 62 | 0.00 | 7.41 | -16.97 | -14.02 | -3.29 | -13.13 |
| 63 | 0.00 | 13.98 | 17.64 | 4.67 | -9.86 | 16.36 |
| 64 | 0.00 | 31.13 | -2.16 | -48.06 | -27.01 | 11.01 |
| 65 | 0.00 | -14.20 | 3.09 | 40.69 | 17.37 | -8.05 |
| 66 | 0.00 | 2.95 | -16.70 | -12.04 | 0.22 | -13.40 |
| 67 | 0.00 | 9.52 | 17.91 | 6.65 | -6.35 | 16.09 |
| 68 | 0.00 | 26.67 | -1.88 | -46.07 | -23.50 | 10.74 |
| 69 | 0.00 | -0.95 | 2.12 | 33.57 | 4.12 | -7.08 |
| 70 | 0.00 | 16.20 | -17.67 | -19.15 | -13.03 | -12.43 |
| 71 | 0.00 | 22.77 | 16.94 | -0.46 | -19.61 | 17.06 |
| 72 | 0.00 | 39.92 | -2.86 | -53.18 | -36.76 | 11.71 |
| 73 | 0.00 | -0.95 | 2.12 | 33.57 | 4.12 | -7.08 |
| 74 | 0.00 | 16.20 | -17.67 | -19.15 | -13.03 | -12.43 |
| 75 | 0.00 | 22.77 | 16.94 | -0.46 | -19.61 | 17.06 |
| 76 | 0.00 | 39.92 | -2.86 | -53.18 | -36.76 | 11.71 |
| 77 | 0.00 | -14.20 | 3.09 | 40.69 | 17.37 | -8.05 |
| 78 | 0.00 | 2.95 | -16.70 | -12.04 | 0.22 | -13.40 |
| 79 | 0.00 | 9.52 | 17.91 | 6.65 | -6.35 | 16.09 |
| 80 | 0.00 | 26.67 | -1.88 | -46.07 | -23.50 | 10.74 |
| 81 | 0.00 | 17.91 | -0.64 | -4.68 | -13.79 | 0.64 |
| 82 | 0.00 | 19.65 | -1.69 | -12.36 | -15.53 | 1.69 |
| 83 | 0.00 | 26.11 | -1.24 | -9.08 | -21.99 | 1.24 |
| 84 | 0.00 | 27.86 | -2.30 | -16.76 | -23.74 | 2.30 |
| 85 | 0.00 | 26.11 | -1.24 | -9.08 | -21.99 | 1.24 |
| 86 | 0.00 | 27.86 | -2.30 | -16.76 | -23.74 | 2.30 |
| 87 | 0.00 | 17.91 | -0.64 | -4.68 | -13.79 | 0.64 |
| 88 | 0.00 | 19.65 | -1.69 | -12.36 | -15.53 | 1.69 |
| 89 | 0.00 | 13.57 | -0.37 | -2.71 | -10.41 | 0.37 |
| 90 | 0.00 | 15.32 | -1.42 | -10.39 | -12.15 | 1.42 |
| 91 | 0.00 | 19.88 | -0.84 | -6.10 | -16.72 | 0.84 |
| 92 | 0.00 | 21.63 | -1.89 | -13.78 | -18.46 | 1.89 |
| 93 | 0.00 | 19.88 | -0.84 | -6.10 | -16.72 | 0.84 |
| 94 | 0.00 | 21.63 | -1.89 | -13.78 | -18.46 | 1.89 |
| 95 | 0.00 | 13.57 | -0.37 | -2.71 | -10.41 | 0.37 |
| 96 | 0.00 | 15.32 | -1.42 | -10.39 | -12.15 | 1.42 |

强度计算控制组合号: 56, M=0.00, N=44.38, M=-55.17, N=-40.27

强度计算应力比 =0.697

抗剪强度计算控制组合号: 54, V=-17.95

抗剪强度计算应力比 =0.102

平面内稳定计算最大应力对应组合号: 56, M=0.00, N=44.38, M=-55.17, N=-40.27

平面内稳定计算最大应力 (N/mm\*mm) =173.13

平面内稳定计算最大应力比 =0.805

临界弯矩Mcr(kN\*m) =133.55

平面外稳定计算最大应力比 =0.876

门规GB51022-2015腹板容许高厚比 [H0/TW] =250.00

翼缘容许宽厚比 [B/T] =15.00

强度计算应力比 =0.697 < 1.0

抗剪强度计算应力比 =0.102 < 1.0

平面内稳定计算最大应力 < f=215.00

平面外稳定计算最大应力比 < 1.0

腹板高厚比 H0/TW=39.00 < [H0/TW]=250.00

翼缘宽厚比 B/T =12.12 < [B/T]=15.00

压杆,平面内长细比 λ=153. ≤ [λ]=180

压杆,平面外长细比 λ=152. ≤ [λ]=180

钢构件防火设计结果:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 偶然组合 | | | | | | |
| \ | 柱 下 端 | | | 柱 上 端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.00 | 14.45 | -0.90 | -6.55 | -11.28 | 0.90 |
| 2 | 0.00 | 20.76 | -1.36 | -9.94 | -17.59 | 1.36 |
| 3 | 0.00 | 20.76 | -1.36 | -9.94 | -17.59 | 1.36 |
| 4 | 0.00 | 14.45 | -0.90 | -6.55 | -11.28 | 0.90 |
| 5 | 0.00 | 12.96 | -0.81 | -5.89 | -10.11 | 0.81 |
| 6 | 0.00 | 19.27 | -1.27 | -9.28 | -16.42 | 1.27 |
| 7 | 0.00 | 19.27 | -1.27 | -9.28 | -16.42 | 1.27 |
| 8 | 0.00 | 12.96 | -0.81 | -5.89 | -10.11 | 0.81 |
| 9 | 0.00 | 7.35 | 0.16 | 5.96 | -4.19 | -1.48 |
| 10 | 0.00 | 11.93 | -5.12 | -8.10 | -8.76 | -2.90 |
| 11 | 0.00 | 13.68 | 4.11 | -3.12 | -10.51 | 4.96 |
| 12 | 0.00 | 18.25 | -1.17 | -17.18 | -15.08 | 3.53 |
| 13 | 0.00 | 5.87 | 0.25 | 6.62 | -3.02 | -1.57 |
| 14 | 0.00 | 10.44 | -5.03 | -7.44 | -7.59 | -2.99 |
| 15 | 0.00 | 12.19 | 4.20 | -2.45 | -9.34 | 4.87 |
| 16 | 0.00 | 16.77 | -1.08 | -16.51 | -13.91 | 3.44 |

防火设计控制的偶然组合号: 12, M=0.00, N=18.25, M=-17.18, N=-15.08

强度计算荷载比 =0.21

平面内稳定计算荷载比 =0.25

平面外稳定计算荷载比 =0.22

无防护下钢构件最大升温(Ts): 1081.87℃ ,按临界温度法求得临界温度(Td): 644.89℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.5042(m^2\*℃/w) ,计算所需保护层厚度(di) =50.42(mm)

构件重量 (Kg)=263.96

**2. 钢 柱 2
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=15.81, Ly=8.03; 长细比：λx=147.0,λy=166.8

构件长度=8.03; 计算长度系数: Ux=1.97 Uy=1.00

抗震等级: 四级

截面参数: B1=200, B2=200, H=250, Tw=6, T1=8, T2=8

轴压截面分类:X轴:b类 , Y轴:c类

构件钢号：Q235

宽厚比等级:S4

验算规范: 门规GB51022-2015

构件耐火等级: 二级

是否耐火钢: 否; 采用防火材料: 防火涂料1( 1); 形状系数: 279.756744(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.00 | 64.06 | 1.39 | 11.18 | -59.53 | -1.39 |
| 2 | 0.00 | 64.06 | -1.39 | -11.18 | -59.53 | 1.39 |
| 3 | 0.00 | 85.52 | 0.00 | 0.00 | -80.99 | -0.00 |
| 4 | 0.00 | 42.59 | 0.00 | 0.00 | -38.06 | -0.00 |
| 5 | 0.00 | 54.23 | 1.39 | 11.18 | -50.74 | -1.39 |
| 6 | 0.00 | 54.23 | -1.39 | -11.18 | -50.74 | 1.39 |
| 7 | 0.00 | 75.69 | 0.00 | 0.00 | -72.21 | -0.00 |
| 8 | 0.00 | 32.76 | 0.00 | 0.00 | -29.28 | -0.00 |
| 9 | 0.00 | 6.62 | 4.22 | 33.86 | -2.10 | -4.22 |
| 10 | 0.00 | 6.62 | -4.22 | -33.86 | -2.10 | 4.22 |
| 11 | 0.00 | 35.76 | 4.22 | 33.86 | -31.23 | -4.22 |
| 12 | 0.00 | 35.75 | -4.22 | -33.86 | -31.23 | 4.22 |
| 13 | 0.00 | -3.20 | 4.22 | 33.86 | 6.69 | -4.22 |
| 14 | 0.00 | -3.20 | -4.22 | -33.86 | 6.69 | 4.22 |
| 15 | 0.00 | 25.93 | 4.22 | 33.86 | -22.44 | -4.22 |
| 16 | 0.00 | 25.93 | -4.22 | -33.86 | -22.44 | 4.22 |
| 17 | 0.00 | 42.48 | 3.92 | 31.49 | -37.95 | -3.92 |
| 18 | 0.00 | 42.48 | -1.14 | -9.14 | -37.95 | 1.14 |
| 19 | 0.00 | 59.95 | 3.92 | 31.49 | -55.43 | -3.92 |
| 20 | 0.00 | 59.95 | -1.14 | -9.13 | -55.43 | 1.14 |
| 21 | 0.00 | 42.48 | 1.14 | 9.14 | -37.95 | -1.14 |
| 22 | 0.00 | 42.48 | -3.92 | -31.49 | -37.95 | 3.92 |
| 23 | 0.00 | 59.95 | 1.14 | 9.14 | -55.43 | -1.14 |
| 24 | 0.00 | 59.95 | -3.92 | -31.49 | -55.43 | 3.92 |
| 25 | 0.00 | 63.94 | 2.53 | 20.31 | -59.41 | -2.53 |
| 26 | 0.00 | 63.94 | -2.53 | -20.31 | -59.41 | 2.53 |
| 27 | 0.00 | 81.42 | 2.53 | 20.31 | -76.89 | -2.53 |
| 28 | 0.00 | 81.42 | -2.53 | -20.31 | -76.89 | 2.53 |
| 29 | 0.00 | 21.01 | 2.53 | 20.31 | -16.48 | -2.53 |
| 30 | 0.00 | 21.01 | -2.53 | -20.31 | -16.48 | 2.53 |
| 31 | 0.00 | 38.49 | 2.53 | 20.31 | -33.96 | -2.53 |
| 32 | 0.00 | 38.49 | -2.53 | -20.31 | -33.96 | 2.53 |
| 33 | 0.00 | 32.65 | 3.92 | 31.49 | -29.16 | -3.92 |
| 34 | 0.00 | 32.65 | -1.14 | -9.14 | -29.16 | 1.14 |
| 35 | 0.00 | 50.13 | 3.92 | 31.49 | -46.64 | -3.92 |
| 36 | 0.00 | 50.13 | -1.14 | -9.14 | -46.64 | 1.14 |
| 37 | 0.00 | 32.65 | 1.14 | 9.14 | -29.16 | -1.14 |
| 38 | 0.00 | 32.65 | -3.92 | -31.49 | -29.16 | 3.92 |
| 39 | 0.00 | 50.13 | 1.14 | 9.14 | -46.64 | -1.14 |
| 40 | 0.00 | 50.13 | -3.92 | -31.49 | -46.64 | 3.92 |
| 41 | 0.00 | 54.11 | 2.53 | 20.31 | -50.63 | -2.53 |
| 42 | 0.00 | 54.11 | -2.53 | -20.31 | -50.63 | 2.53 |
| 43 | 0.00 | 71.59 | 2.53 | 20.31 | -68.11 | -2.53 |
| 44 | 0.00 | 71.59 | -2.53 | -20.31 | -68.11 | 2.53 |
| 45 | 0.00 | 11.18 | 2.53 | 20.31 | -7.70 | -2.53 |
| 46 | 0.00 | 11.18 | -2.53 | -20.31 | -7.70 | 2.53 |
| 47 | 0.00 | 28.66 | 2.53 | 20.31 | -25.18 | -2.53 |
| 48 | 0.00 | 28.66 | -2.53 | -20.31 | -25.18 | 2.53 |
| 49 | 0.00 | 21.65 | 5.19 | 41.68 | -17.12 | -5.19 |
| 50 | 0.00 | 21.65 | -3.24 | -26.03 | -17.12 | 3.24 |
| 51 | 0.00 | 50.78 | 5.19 | 41.68 | -46.25 | -5.19 |
| 52 | 0.00 | 50.78 | -3.24 | -26.03 | -46.25 | 3.24 |
| 53 | 0.00 | 21.65 | 3.24 | 26.03 | -17.12 | -3.24 |
| 54 | 0.00 | 21.65 | -5.19 | -41.68 | -17.12 | 5.19 |
| 55 | 0.00 | 50.78 | 3.24 | 26.03 | -46.25 | -3.24 |
| 56 | 0.00 | 50.78 | -5.19 | -41.68 | -46.25 | 5.19 |
| 57 | 0.00 | 36.68 | 4.22 | 33.86 | -32.15 | -4.22 |
| 58 | 0.00 | 36.68 | -4.22 | -33.86 | -32.15 | 4.22 |
| 59 | 0.00 | 65.81 | 4.22 | 33.86 | -61.28 | -4.22 |
| 60 | 0.00 | 65.81 | -4.22 | -33.86 | -61.28 | 4.22 |
| 61 | 0.00 | 6.62 | 4.22 | 33.86 | -2.10 | -4.22 |
| 62 | 0.00 | 6.62 | -4.22 | -33.86 | -2.10 | 4.22 |
| 63 | 0.00 | 35.76 | 4.22 | 33.86 | -31.23 | -4.22 |
| 64 | 0.00 | 35.75 | -4.22 | -33.86 | -31.23 | 4.22 |
| 65 | 0.00 | 11.82 | 5.19 | 41.68 | -8.34 | -5.19 |
| 66 | 0.00 | 11.82 | -3.24 | -26.03 | -8.34 | 3.24 |
| 67 | 0.00 | 40.95 | 5.19 | 41.68 | -37.47 | -5.19 |
| 68 | 0.00 | 40.95 | -3.24 | -26.03 | -37.47 | 3.24 |
| 69 | 0.00 | 11.82 | 3.24 | 26.03 | -8.34 | -3.24 |
| 70 | 0.00 | 11.82 | -5.19 | -41.68 | -8.34 | 5.19 |
| 71 | 0.00 | 40.95 | 3.24 | 26.03 | -37.47 | -3.24 |
| 72 | 0.00 | 40.95 | -5.19 | -41.68 | -37.47 | 5.19 |
| 73 | 0.00 | 26.85 | 4.22 | 33.86 | -23.36 | -4.22 |
| 74 | 0.00 | 26.85 | -4.22 | -33.86 | -23.36 | 4.22 |
| 75 | 0.00 | 55.98 | 4.22 | 33.86 | -52.49 | -4.22 |
| 76 | 0.00 | 55.98 | -4.22 | -33.86 | -52.49 | 4.22 |
| 77 | 0.00 | -3.20 | 4.22 | 33.86 | 6.69 | -4.22 |
| 78 | 0.00 | -3.20 | -4.22 | -33.86 | 6.69 | 4.22 |
| 79 | 0.00 | 25.93 | 4.22 | 33.86 | -22.44 | -4.22 |
| 80 | 0.00 | 25.93 | -4.22 | -33.86 | -22.44 | 4.22 |
| 81 | 0.00 | 51.89 | 1.21 | 9.71 | -47.37 | -1.21 |
| 82 | 0.00 | 51.89 | -0.00 | -0.02 | -47.37 | 0.00 |
| 83 | 0.00 | 51.89 | 0.00 | 0.02 | -47.37 | -0.00 |
| 84 | 0.00 | 51.89 | -1.21 | -9.71 | -47.37 | 1.21 |
| 85 | 0.00 | 61.19 | 0.61 | 4.86 | -56.67 | -0.61 |
| 86 | 0.00 | 61.19 | -0.61 | -4.86 | -56.67 | 0.61 |
| 87 | 0.00 | 42.59 | 0.61 | 4.86 | -38.06 | -0.61 |
| 88 | 0.00 | 42.59 | -0.61 | -4.86 | -38.06 | 0.61 |
| 89 | 0.00 | 39.92 | 1.07 | 8.59 | -36.43 | -1.07 |
| 90 | 0.00 | 39.92 | -0.14 | -1.14 | -36.43 | 0.14 |
| 91 | 0.00 | 39.92 | 0.14 | 1.14 | -36.43 | -0.14 |
| 92 | 0.00 | 39.92 | -1.07 | -8.59 | -36.43 | 1.07 |
| 93 | 0.00 | 47.07 | 0.61 | 4.86 | -43.59 | -0.61 |
| 94 | 0.00 | 47.07 | -0.61 | -4.86 | -43.59 | 0.61 |
| 95 | 0.00 | 32.76 | 0.61 | 4.86 | -29.28 | -0.61 |
| 96 | 0.00 | 32.76 | -0.61 | -4.86 | -29.28 | 0.61 |

强度计算控制组合号: 51, M=0.00, N=50.78, M=41.68, N=-46.25

强度计算应力比 =0.530

抗剪强度计算控制组合号: 49, V=5.19

抗剪强度计算应力比 =0.030

平面内稳定计算最大应力对应组合号: 51, M=0.00, N=50.78, M=41.68, N=-46.25

平面内稳定计算最大应力 (N/mm\*mm) =141.04

平面内稳定计算最大应力比 =0.656

临界弯矩Mcr(kN\*m) =116.36

平面外稳定计算最大应力比 =0.758

门规GB51022-2015腹板容许高厚比 [H0/TW] =250.00

翼缘容许宽厚比 [B/T] =15.00

强度计算应力比 =0.530 < 1.0

抗剪强度计算应力比 =0.030 < 1.0

平面内稳定计算最大应力 < f=215.00

平面外稳定计算最大应力比 < 1.0

腹板高厚比 H0/TW=39.00 < [H0/TW]=250.00

翼缘宽厚比 B/T =12.12 < [B/T]=15.00

压杆,平面内长细比 λ=147. ≤ [λ]=180

压杆,平面外长细比 λ=167. ≤ [λ]=180

钢构件防火设计结果:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 偶然组合 | | | | | | |
| \ | 柱 下 端 | | | 柱 上 端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.00 | 39.92 | 0.46 | 3.73 | -36.43 | -0.46 |
| 2 | 0.00 | 39.92 | -0.46 | -3.73 | -36.43 | 0.46 |
| 3 | 0.00 | 47.07 | 0.00 | 0.00 | -43.59 | -0.00 |
| 4 | 0.00 | 32.76 | 0.00 | 0.00 | -29.28 | -0.00 |
| 5 | 0.00 | 36.64 | 0.46 | 3.73 | -33.51 | -0.46 |
| 6 | 0.00 | 36.64 | -0.46 | -3.73 | -33.51 | 0.46 |
| 7 | 0.00 | 43.80 | 0.00 | 0.00 | -40.66 | -0.00 |
| 8 | 0.00 | 29.49 | 0.00 | 0.00 | -26.35 | -0.00 |
| 9 | 0.00 | 23.17 | 1.12 | 9.03 | -19.69 | -1.12 |
| 10 | 0.00 | 23.17 | -1.12 | -9.03 | -19.69 | 1.12 |
| 11 | 0.00 | 30.94 | 1.12 | 9.03 | -27.46 | -1.12 |
| 12 | 0.00 | 30.94 | -1.12 | -9.03 | -27.46 | 1.12 |
| 13 | 0.00 | 19.89 | 1.12 | 9.03 | -16.76 | -1.12 |
| 14 | 0.00 | 19.89 | -1.12 | -9.03 | -16.76 | 1.12 |
| 15 | 0.00 | 27.66 | 1.12 | 9.03 | -24.53 | -1.12 |
| 16 | 0.00 | 27.66 | -1.12 | -9.03 | -24.53 | 1.12 |

防火设计控制的偶然组合号: 11, M=0.00, N=30.94, M=9.03, N=-27.46

强度计算荷载比 =0.11

平面内稳定计算荷载比 =0.19

平面外稳定计算荷载比 =0.21

无防护下钢构件最大升温(Ts): 1081.87℃ ,按临界温度法求得临界温度(Td): 645.18℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4989(m^2\*℃/w) ,计算所需保护层厚度(di) =49.89(mm)

构件重量 (Kg)=290.22

**3. 钢 柱 3
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=16.42, Ly=7.30; 长细比：λx=152.7,λy=151.6

构件长度=7.30; 计算长度系数: Ux=2.25 Uy=1.00

抗震等级: 四级

截面参数: B1=200, B2=200, H=250, Tw=6, T1=8, T2=8

轴压截面分类:X轴:b类 , Y轴:c类

构件钢号：Q235

宽厚比等级:S4

验算规范: 门规GB51022-2015

构件耐火等级: 二级

是否耐火钢: 否; 采用防火材料: 防火涂料1( 1); 形状系数: 279.756744(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.00 | 36.99 | 2.54 | 18.57 | -32.88 | -2.54 |
| 2 | 0.00 | 18.06 | 1.15 | 8.41 | -13.94 | -1.15 |
| 3 | 0.00 | 36.99 | 2.54 | 18.57 | -32.88 | -2.54 |
| 4 | 0.00 | 18.06 | 1.15 | 8.41 | -13.94 | -1.15 |
| 5 | 0.00 | 32.53 | 2.27 | 16.59 | -29.37 | -2.27 |
| 6 | 0.00 | 13.60 | 0.88 | 6.42 | -10.43 | -0.88 |
| 7 | 0.00 | 32.53 | 2.27 | 16.59 | -29.37 | -2.27 |
| 8 | 0.00 | 13.60 | 0.88 | 6.42 | -10.43 | -0.88 |
| 9 | 0.00 | 8.30 | 16.99 | 14.16 | -4.18 | 13.11 |
| 10 | 0.00 | -8.85 | -2.80 | -38.56 | 12.97 | 7.76 |
| 11 | 0.00 | 32.02 | 2.18 | 48.19 | -27.90 | -11.03 |
| 12 | 0.00 | 14.87 | -17.62 | -4.53 | -10.75 | -16.38 |
| 13 | 0.00 | 3.84 | 16.72 | 12.17 | -0.67 | 13.38 |
| 14 | 0.00 | -13.31 | -3.08 | -40.55 | 16.48 | 8.03 |
| 15 | 0.00 | 27.56 | 1.90 | 46.21 | -24.39 | -10.76 |
| 16 | 0.00 | 10.41 | -17.89 | -6.52 | -7.24 | -16.11 |
| 17 | 0.00 | 30.37 | 12.03 | 21.90 | -26.26 | 6.03 |
| 18 | 0.00 | 20.08 | 0.15 | -9.73 | -15.97 | 2.82 |
| 19 | 0.00 | 44.61 | 3.14 | 42.32 | -40.49 | -8.45 |
| 20 | 0.00 | 34.32 | -8.73 | 10.69 | -30.20 | -11.66 |
| 21 | 0.00 | 11.44 | 10.64 | 11.74 | -7.33 | 7.42 |
| 22 | 0.00 | 1.15 | -1.24 | -19.89 | 2.96 | 4.21 |
| 23 | 0.00 | 25.68 | 1.75 | 32.16 | -21.56 | -7.06 |
| 24 | 0.00 | 15.39 | -10.13 | 0.53 | -11.27 | -10.27 |
| 25 | 0.00 | 30.37 | 12.03 | 21.90 | -26.26 | 6.03 |
| 26 | 0.00 | 20.08 | 0.15 | -9.73 | -15.97 | 2.82 |
| 27 | 0.00 | 44.61 | 3.14 | 42.32 | -40.49 | -8.45 |
| 28 | 0.00 | 34.32 | -8.73 | 10.69 | -30.20 | -11.66 |
| 29 | 0.00 | 11.44 | 10.64 | 11.74 | -7.33 | 7.42 |
| 30 | 0.00 | 1.15 | -1.24 | -19.89 | 2.96 | 4.21 |
| 31 | 0.00 | 25.68 | 1.75 | 32.16 | -21.56 | -7.06 |
| 32 | 0.00 | 15.39 | -10.13 | 0.53 | -11.27 | -10.27 |
| 33 | 0.00 | 25.91 | 11.76 | 19.92 | -22.75 | 6.30 |
| 34 | 0.00 | 15.62 | -0.12 | -11.72 | -12.46 | 3.09 |
| 35 | 0.00 | 40.15 | 2.87 | 40.34 | -36.98 | -8.18 |
| 36 | 0.00 | 29.86 | -9.01 | 8.70 | -26.69 | -11.39 |
| 37 | 0.00 | 6.98 | 10.37 | 9.76 | -3.81 | 7.69 |
| 38 | 0.00 | -3.31 | -1.51 | -21.88 | 6.47 | 4.48 |
| 39 | 0.00 | 21.21 | 1.48 | 30.18 | -18.05 | -6.79 |
| 40 | 0.00 | 10.93 | -10.40 | -1.46 | -7.76 | -10.00 |
| 41 | 0.00 | 25.91 | 11.76 | 19.92 | -22.75 | 6.30 |
| 42 | 0.00 | 15.62 | -0.12 | -11.72 | -12.46 | 3.09 |
| 43 | 0.00 | 40.15 | 2.87 | 40.34 | -36.98 | -8.18 |
| 44 | 0.00 | 29.86 | -9.01 | 8.70 | -26.69 | -11.39 |
| 45 | 0.00 | 6.98 | 10.37 | 9.76 | -3.81 | 7.69 |
| 46 | 0.00 | -3.31 | -1.51 | -21.88 | 6.47 | 4.48 |
| 47 | 0.00 | 21.21 | 1.48 | 30.18 | -18.05 | -6.79 |
| 48 | 0.00 | 10.93 | -10.40 | -1.46 | -7.76 | -10.00 |
| 49 | 0.00 | 20.66 | 17.95 | 21.14 | -16.54 | 12.15 |
| 50 | 0.00 | 3.51 | -1.85 | -31.59 | 0.61 | 6.81 |
| 51 | 0.00 | 44.38 | 3.13 | 55.17 | -40.27 | -11.98 |
| 52 | 0.00 | 27.23 | -16.66 | 2.44 | -23.12 | -17.33 |
| 53 | 0.00 | 7.41 | 16.97 | 14.02 | -3.29 | 13.13 |
| 54 | 0.00 | -9.74 | -2.82 | -38.70 | 13.86 | 7.78 |
| 55 | 0.00 | 31.13 | 2.16 | 48.06 | -27.01 | -11.01 |
| 56 | 0.00 | 13.98 | -17.64 | -4.67 | -9.86 | -16.36 |
| 57 | 0.00 | 20.66 | 17.95 | 21.14 | -16.54 | 12.15 |
| 58 | 0.00 | 3.51 | -1.85 | -31.59 | 0.61 | 6.81 |
| 59 | 0.00 | 44.38 | 3.13 | 55.17 | -40.27 | -11.98 |
| 60 | 0.00 | 27.23 | -16.66 | 2.44 | -23.12 | -17.33 |
| 61 | 0.00 | 7.41 | 16.97 | 14.02 | -3.29 | 13.13 |
| 62 | 0.00 | -9.74 | -2.82 | -38.70 | 13.86 | 7.78 |
| 63 | 0.00 | 31.13 | 2.16 | 48.06 | -27.01 | -11.01 |
| 64 | 0.00 | 13.98 | -17.64 | -4.67 | -9.86 | -16.36 |
| 65 | 0.00 | 16.20 | 17.67 | 19.15 | -13.03 | 12.43 |
| 66 | 0.00 | -0.95 | -2.12 | -33.57 | 4.12 | 7.08 |
| 67 | 0.00 | 39.92 | 2.86 | 53.18 | -36.76 | -11.71 |
| 68 | 0.00 | 22.77 | -16.94 | 0.46 | -19.61 | -17.06 |
| 69 | 0.00 | 2.95 | 16.70 | 12.04 | 0.22 | 13.40 |
| 70 | 0.00 | -14.20 | -3.09 | -40.69 | 17.37 | 8.05 |
| 71 | 0.00 | 26.67 | 1.88 | 46.07 | -23.50 | -10.74 |
| 72 | 0.00 | 9.52 | -17.91 | -6.65 | -6.35 | -16.09 |
| 73 | 0.00 | 16.20 | 17.67 | 19.15 | -13.03 | 12.43 |
| 74 | 0.00 | -0.95 | -2.12 | -33.57 | 4.12 | 7.08 |
| 75 | 0.00 | 39.92 | 2.86 | 53.18 | -36.76 | -11.71 |
| 76 | 0.00 | 22.77 | -16.94 | 0.46 | -19.61 | -17.06 |
| 77 | 0.00 | 2.95 | 16.70 | 12.04 | 0.22 | 13.40 |
| 78 | 0.00 | -14.20 | -3.09 | -40.69 | 17.37 | 8.05 |
| 79 | 0.00 | 26.67 | 1.88 | 46.07 | -23.50 | -10.74 |
| 80 | 0.00 | 9.52 | -17.91 | -6.65 | -6.35 | -16.09 |
| 81 | 0.00 | 27.86 | 2.30 | 16.76 | -23.74 | -2.30 |
| 82 | 0.00 | 26.11 | 1.24 | 9.08 | -21.99 | -1.24 |
| 83 | 0.00 | 19.65 | 1.69 | 12.36 | -15.53 | -1.69 |
| 84 | 0.00 | 17.91 | 0.64 | 4.68 | -13.79 | -0.64 |
| 85 | 0.00 | 27.86 | 2.30 | 16.76 | -23.74 | -2.30 |
| 86 | 0.00 | 26.11 | 1.24 | 9.08 | -21.99 | -1.24 |
| 87 | 0.00 | 19.65 | 1.69 | 12.36 | -15.53 | -1.69 |
| 88 | 0.00 | 17.91 | 0.64 | 4.68 | -13.79 | -0.64 |
| 89 | 0.00 | 21.63 | 1.89 | 13.78 | -18.46 | -1.89 |
| 90 | 0.00 | 19.88 | 0.84 | 6.10 | -16.72 | -0.84 |
| 91 | 0.00 | 15.32 | 1.42 | 10.39 | -12.15 | -1.42 |
| 92 | 0.00 | 13.57 | 0.37 | 2.71 | -10.41 | -0.37 |
| 93 | 0.00 | 21.63 | 1.89 | 13.78 | -18.46 | -1.89 |
| 94 | 0.00 | 19.88 | 0.84 | 6.10 | -16.72 | -0.84 |
| 95 | 0.00 | 15.32 | 1.42 | 10.39 | -12.15 | -1.42 |
| 96 | 0.00 | 13.57 | 0.37 | 2.71 | -10.41 | -0.37 |

强度计算控制组合号: 51, M=0.00, N=44.38, M=55.17, N=-40.27

强度计算应力比 =0.697

抗剪强度计算控制组合号: 49, V=17.95

抗剪强度计算应力比 =0.102

平面内稳定计算最大应力对应组合号: 51, M=0.00, N=44.38, M=55.17, N=-40.27

平面内稳定计算最大应力 (N/mm\*mm) =173.13

平面内稳定计算最大应力比 =0.805

临界弯矩Mcr(kN\*m) =133.55

平面外稳定计算最大应力比 =0.876

门规GB51022-2015腹板容许高厚比 [H0/TW] =250.00

翼缘容许宽厚比 [B/T] =15.00

强度计算应力比 =0.697 < 1.0

抗剪强度计算应力比 =0.102 < 1.0

平面内稳定计算最大应力 < f=215.00

平面外稳定计算最大应力比 < 1.0

腹板高厚比 H0/TW=39.00 < [H0/TW]=250.00

翼缘宽厚比 B/T =12.12 < [B/T]=15.00

压杆,平面内长细比 λ=153. ≤ [λ]=180

压杆,平面外长细比 λ=152. ≤ [λ]=180

钢构件防火设计结果:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 偶然组合 | | | | | | |
| \ | 柱 下 端 | | | 柱 上 端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.00 | 20.76 | 1.36 | 9.94 | -17.59 | -1.36 |
| 2 | 0.00 | 14.45 | 0.90 | 6.55 | -11.28 | -0.90 |
| 3 | 0.00 | 20.76 | 1.36 | 9.94 | -17.59 | -1.36 |
| 4 | 0.00 | 14.45 | 0.90 | 6.55 | -11.28 | -0.90 |
| 5 | 0.00 | 19.27 | 1.27 | 9.28 | -16.42 | -1.27 |
| 6 | 0.00 | 12.96 | 0.81 | 5.89 | -10.11 | -0.81 |
| 7 | 0.00 | 19.27 | 1.27 | 9.28 | -16.42 | -1.27 |
| 8 | 0.00 | 12.96 | 0.81 | 5.89 | -10.11 | -0.81 |
| 9 | 0.00 | 11.93 | 5.12 | 8.10 | -8.76 | 2.90 |
| 10 | 0.00 | 7.35 | -0.16 | -5.96 | -4.19 | 1.48 |
| 11 | 0.00 | 18.25 | 1.17 | 17.18 | -15.08 | -3.53 |
| 12 | 0.00 | 13.68 | -4.11 | 3.12 | -10.51 | -4.96 |
| 13 | 0.00 | 10.44 | 5.03 | 7.44 | -7.59 | 2.99 |
| 14 | 0.00 | 5.87 | -0.25 | -6.62 | -3.02 | 1.57 |
| 15 | 0.00 | 16.77 | 1.08 | 16.51 | -13.91 | -3.44 |
| 16 | 0.00 | 12.19 | -4.20 | 2.45 | -9.34 | -4.87 |

防火设计控制的偶然组合号: 11, M=0.00, N=18.25, M=17.18, N=-15.08

强度计算荷载比 =0.21

平面内稳定计算荷载比 =0.25

平面外稳定计算荷载比 =0.22

无防护下钢构件最大升温(Ts): 1081.87℃ ,按临界温度法求得临界温度(Td): 644.89℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.5042(m^2\*℃/w) ,计算所需保护层厚度(di) =50.42(mm)

构件重量 (Kg)=263.96

**4. 钢 柱 4
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=2.40, Ly=1.20; 长细比：λx=28.0,λy=24.1

构件长度=1.22; 计算长度系数: Ux=1.97 Uy=0.98

抗震等级: 四级

截面参数: B1=200, B2=200, H=200, Tw=6, T1=8, T2=8

轴压截面分类:X轴:b类 , Y轴:c类

构件钢号：Q235

宽厚比等级:S4

验算规范: 门规GB51022-2015

构件耐火等级: 二级

是否耐火钢: 否; 采用防火材料: 防火涂料1( 1); 形状系数: 276.022308(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.00 | 0.64 | 0.00 | 0.00 | 0.00 | -0.00 |
| 2 | -0.00 | 0.64 | 0.00 | -0.00 | 0.00 | -0.00 |
| 3 | -0.00 | 0.64 | 0.00 | 0.00 | 0.00 | -0.00 |
| 4 | 0.00 | 0.64 | 0.00 | 0.00 | 0.00 | -0.00 |
| 5 | 0.00 | 0.49 | 0.00 | 0.00 | 0.00 | -0.00 |
| 6 | -0.00 | 0.49 | 0.00 | -0.00 | 0.00 | -0.00 |
| 7 | -0.00 | 0.49 | 0.00 | 0.00 | 0.00 | -0.00 |
| 8 | 0.00 | 0.49 | 0.00 | 0.00 | 0.00 | -0.00 |
| 9 | -4.54 | 0.64 | -7.57 | -0.00 | -0.00 | -0.00 |
| 10 | -4.54 | 0.64 | -7.57 | 0.00 | -0.00 | 0.00 |
| 11 | 4.54 | 0.64 | 7.57 | -0.00 | 0.00 | -0.00 |
| 12 | 4.54 | 0.64 | 7.57 | 0.00 | 0.00 | 0.00 |
| 13 | -4.54 | 0.50 | -7.57 | -0.00 | -0.00 | -0.00 |
| 14 | -4.54 | 0.50 | -7.57 | 0.00 | -0.00 | 0.00 |
| 15 | 4.54 | 0.49 | 7.57 | -0.00 | 0.00 | -0.00 |
| 16 | 4.54 | 0.49 | 7.57 | 0.00 | 0.00 | 0.00 |
| 17 | -2.72 | 0.64 | -4.54 | -0.00 | 0.00 | -0.00 |
| 18 | -2.72 | 0.64 | -4.54 | 0.00 | 0.00 | -0.00 |
| 19 | 2.72 | 0.64 | 4.54 | -0.00 | 0.00 | -0.00 |
| 20 | 2.72 | 0.64 | 4.54 | 0.00 | 0.00 | 0.00 |
| 21 | -2.72 | 0.64 | -4.54 | -0.00 | 0.00 | -0.00 |
| 22 | -2.72 | 0.64 | -4.54 | 0.00 | 0.00 | 0.00 |
| 23 | 2.72 | 0.64 | 4.54 | -0.00 | 0.00 | -0.00 |
| 24 | 2.72 | 0.64 | 4.54 | 0.00 | 0.00 | 0.00 |
| 25 | -2.72 | 0.64 | -4.54 | -0.00 | 0.00 | -0.00 |
| 26 | -2.72 | 0.64 | -4.54 | 0.00 | 0.00 | -0.00 |
| 27 | 2.72 | 0.64 | 4.54 | -0.00 | 0.00 | -0.00 |
| 28 | 2.72 | 0.64 | 4.54 | 0.00 | 0.00 | 0.00 |
| 29 | -2.72 | 0.64 | -4.54 | -0.00 | 0.00 | -0.00 |
| 30 | -2.72 | 0.64 | -4.54 | 0.00 | 0.00 | -0.00 |
| 31 | 2.72 | 0.64 | 4.54 | -0.00 | 0.00 | -0.00 |
| 32 | 2.72 | 0.64 | 4.54 | 0.00 | 0.00 | 0.00 |
| 33 | -2.72 | 0.49 | -4.54 | -0.00 | 0.00 | -0.00 |
| 34 | -2.72 | 0.49 | -4.54 | 0.00 | 0.00 | -0.00 |
| 35 | 2.72 | 0.49 | 4.54 | -0.00 | 0.00 | -0.00 |
| 36 | 2.72 | 0.49 | 4.54 | 0.00 | 0.00 | 0.00 |
| 37 | -2.72 | 0.49 | -4.54 | -0.00 | 0.00 | -0.00 |
| 38 | -2.72 | 0.50 | -4.54 | 0.00 | 0.00 | 0.00 |
| 39 | 2.72 | 0.49 | 4.54 | -0.00 | 0.00 | -0.00 |
| 40 | 2.72 | 0.49 | 4.54 | 0.00 | 0.00 | 0.00 |
| 41 | -2.72 | 0.49 | -4.54 | -0.00 | 0.00 | -0.00 |
| 42 | -2.72 | 0.50 | -4.54 | 0.00 | 0.00 | -0.00 |
| 43 | 2.72 | 0.49 | 4.54 | -0.00 | 0.00 | -0.00 |
| 44 | 2.72 | 0.49 | 4.54 | 0.00 | 0.00 | 0.00 |
| 45 | -2.72 | 0.49 | -4.54 | -0.00 | 0.00 | -0.00 |
| 46 | -2.72 | 0.49 | -4.54 | 0.00 | 0.00 | -0.00 |
| 47 | 2.72 | 0.49 | 4.54 | -0.00 | 0.00 | -0.00 |
| 48 | 2.72 | 0.49 | 4.54 | 0.00 | 0.00 | 0.00 |
| 49 | -4.54 | 0.64 | -7.57 | -0.00 | 0.00 | -0.00 |
| 50 | -4.54 | 0.64 | -7.57 | 0.00 | 0.00 | -0.00 |
| 51 | 4.54 | 0.64 | 7.57 | -0.00 | 0.00 | -0.00 |
| 52 | 4.54 | 0.64 | 7.57 | 0.00 | 0.00 | 0.00 |
| 53 | -4.54 | 0.64 | -7.57 | -0.00 | -0.00 | -0.00 |
| 54 | -4.54 | 0.64 | -7.57 | 0.00 | -0.00 | 0.00 |
| 55 | 4.54 | 0.64 | 7.57 | -0.00 | 0.00 | -0.00 |
| 56 | 4.54 | 0.64 | 7.57 | 0.00 | 0.00 | 0.00 |
| 57 | -4.54 | 0.64 | -7.57 | -0.00 | -0.00 | -0.00 |
| 58 | -4.54 | 0.64 | -7.57 | 0.00 | -0.00 | 0.00 |
| 59 | 4.54 | 0.64 | 7.57 | -0.00 | 0.00 | -0.00 |
| 60 | 4.54 | 0.64 | 7.57 | 0.00 | 0.00 | 0.00 |
| 61 | -4.54 | 0.64 | -7.57 | -0.00 | 0.00 | -0.00 |
| 62 | -4.54 | 0.64 | -7.57 | 0.00 | 0.00 | -0.00 |
| 63 | 4.54 | 0.64 | 7.57 | -0.00 | 0.00 | -0.00 |
| 64 | 4.54 | 0.64 | 7.57 | 0.00 | 0.00 | 0.00 |
| 65 | -4.54 | 0.49 | -7.57 | -0.00 | 0.00 | -0.00 |
| 66 | -4.54 | 0.49 | -7.57 | 0.00 | 0.00 | -0.00 |
| 67 | 4.54 | 0.49 | 7.57 | -0.00 | 0.00 | -0.00 |
| 68 | 4.54 | 0.49 | 7.57 | 0.00 | 0.00 | 0.00 |
| 69 | -4.54 | 0.50 | -7.57 | -0.00 | -0.00 | -0.00 |
| 70 | -4.54 | 0.50 | -7.57 | 0.00 | -0.00 | 0.00 |
| 71 | 4.54 | 0.49 | 7.57 | -0.00 | 0.00 | -0.00 |
| 72 | 4.54 | 0.49 | 7.57 | 0.00 | 0.00 | 0.00 |
| 73 | -4.54 | 0.50 | -7.57 | -0.00 | -0.00 | -0.00 |
| 74 | -4.54 | 0.50 | -7.57 | 0.00 | -0.00 | 0.00 |
| 75 | 4.54 | 0.49 | 7.57 | -0.00 | 0.00 | -0.00 |
| 76 | 4.54 | 0.49 | 7.57 | 0.00 | 0.00 | 0.00 |
| 77 | -4.54 | 0.49 | -7.57 | -0.00 | 0.00 | -0.00 |
| 78 | -4.54 | 0.49 | -7.57 | 0.00 | 0.00 | -0.00 |
| 79 | 4.54 | 0.49 | 7.57 | -0.00 | 0.00 | -0.00 |
| 80 | 4.54 | 0.49 | 7.57 | 0.00 | 0.00 | 0.00 |
| 81 | 0.01 | 0.64 | 0.01 | -0.00 | 0.00 | -0.01 |
| 82 | -0.01 | 0.64 | -0.01 | 0.00 | 0.00 | 0.01 |
| 83 | 0.01 | 0.64 | 0.01 | -0.00 | 0.00 | -0.01 |
| 84 | -0.01 | 0.64 | -0.01 | 0.00 | 0.00 | 0.01 |
| 85 | 0.01 | 0.64 | 0.01 | -0.00 | 0.00 | -0.01 |
| 86 | -0.01 | 0.64 | -0.01 | 0.00 | 0.00 | 0.01 |
| 87 | 0.01 | 0.64 | 0.01 | -0.00 | 0.00 | -0.01 |
| 88 | -0.01 | 0.64 | -0.01 | 0.00 | 0.00 | 0.01 |
| 89 | 0.01 | 0.49 | 0.01 | -0.00 | 0.00 | -0.01 |
| 90 | -0.01 | 0.49 | -0.01 | 0.00 | 0.00 | 0.01 |
| 91 | 0.01 | 0.49 | 0.01 | -0.00 | 0.00 | -0.01 |
| 92 | -0.01 | 0.49 | -0.01 | 0.00 | 0.00 | 0.01 |
| 93 | 0.01 | 0.49 | 0.01 | -0.00 | 0.00 | -0.01 |
| 94 | -0.01 | 0.49 | -0.01 | 0.00 | 0.00 | 0.01 |
| 95 | 0.01 | 0.49 | 0.01 | -0.00 | 0.00 | -0.01 |
| 96 | -0.01 | 0.49 | -0.01 | 0.00 | 0.00 | 0.01 |

强度计算控制组合号: 51, M=4.54, N=0.64, M=-0.00, N=0.00

强度计算应力比 =0.072

抗剪强度计算控制组合号: 51, V=7.57

抗剪强度计算应力比 =0.055

平面内稳定计算最大应力对应组合号: 51, M=4.54, N=0.64, M=-0.00, N=0.00

平面内稳定计算最大应力 (N/mm\*mm) =14.08

平面内稳定计算最大应力比 =0.065

临界弯矩Mcr(kN\*m) =2748.54

平面外稳定计算最大应力比 =0.027

门规GB51022-2015腹板容许高厚比 [H0/TW] =250.00

翼缘容许宽厚比 [B/T] =15.00

强度计算应力比 =0.072 < 1.0

抗剪强度计算应力比 =0.055 < 1.0

平面内稳定计算最大应力 < f=215.00

平面外稳定计算最大应力比 < 1.0

腹板高厚比 H0/TW=30.67 < [H0/TW]=250.00

翼缘宽厚比 B/T =12.12 < [B/T]=15.00

压杆,平面内长细比 λ=28. ≤ [λ]=180

压杆,平面外长细比 λ=24. ≤ [λ]=180

钢构件防火设计结果:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 偶然组合 | | | | | | |
| \ | 柱 下 端 | | | 柱 上 端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.00 | 0.49 | 0.00 | 0.00 | 0.00 | -0.00 |
| 2 | 0.00 | 0.49 | 0.00 | -0.00 | 0.00 | -0.00 |
| 3 | 0.00 | 0.49 | 0.00 | 0.00 | 0.00 | -0.00 |
| 4 | 0.00 | 0.49 | 0.00 | -0.00 | 0.00 | -0.00 |
| 5 | 0.00 | 0.45 | 0.00 | 0.00 | 0.00 | -0.00 |
| 6 | 0.00 | 0.45 | 0.00 | -0.00 | 0.00 | -0.00 |
| 7 | 0.00 | 0.45 | 0.00 | 0.00 | 0.00 | -0.00 |
| 8 | 0.00 | 0.45 | 0.00 | -0.00 | 0.00 | -0.00 |
| 9 | -1.21 | 0.49 | -2.02 | -0.00 | 0.00 | -0.00 |
| 10 | -1.21 | 0.49 | -2.02 | 0.00 | 0.00 | 0.00 |
| 11 | 1.21 | 0.49 | 2.02 | -0.00 | 0.00 | -0.00 |
| 12 | 1.21 | 0.49 | 2.02 | 0.00 | 0.00 | 0.00 |
| 13 | -1.21 | 0.45 | -2.02 | -0.00 | 0.00 | -0.00 |
| 14 | -1.21 | 0.45 | -2.02 | 0.00 | 0.00 | 0.00 |
| 15 | 1.21 | 0.45 | 2.02 | -0.00 | 0.00 | -0.00 |
| 16 | 1.21 | 0.45 | 2.02 | 0.00 | 0.00 | 0.00 |

防火设计控制的偶然组合号: 11, M=1.21, N=0.49, M=-0.00, N=0.00

强度计算荷载比 =0.02

平面内稳定计算荷载比 =0.02

平面外稳定计算荷载比 =0.01

无防护下钢构件最大升温(Ts): 1081.86℃ ,按临界温度法求得临界温度(Td): 657.00℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4807(m^2\*℃/w) ,计算所需保护层厚度(di) =48.07(mm)

构件重量 (Kg)=41.25

**5. 钢 柱 5
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=2.40, Ly=1.20; 长细比：λx=28.0,λy=24.1

构件长度=1.22; 计算长度系数: Ux=1.97 Uy=0.98

抗震等级: 四级

截面参数: B1=200, B2=200, H=200, Tw=6, T1=8, T2=8

轴压截面分类:X轴:b类 , Y轴:c类

构件钢号：Q235

宽厚比等级:S4

验算规范: 门规GB51022-2015

构件耐火等级: 二级

是否耐火钢: 否; 采用防火材料: 防火涂料1( 1); 形状系数: 276.022308(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.00 | 0.64 | 0.00 | -0.00 | 0.00 | -0.00 |
| 2 | -0.00 | 0.64 | 0.00 | -0.00 | 0.00 | 0.00 |
| 3 | 0.00 | 0.64 | 0.00 | -0.00 | 0.00 | -0.00 |
| 4 | -0.00 | 0.64 | 0.00 | -0.00 | 0.00 | -0.00 |
| 5 | 0.00 | 0.49 | 0.00 | 0.00 | 0.00 | -0.00 |
| 6 | -0.00 | 0.49 | 0.00 | -0.00 | 0.00 | 0.00 |
| 7 | 0.00 | 0.49 | 0.00 | -0.00 | 0.00 | -0.00 |
| 8 | -0.00 | 0.49 | 0.00 | -0.00 | 0.00 | -0.00 |
| 9 | 4.54 | 0.64 | 7.57 | -0.00 | 0.00 | -0.00 |
| 10 | 4.54 | 0.64 | 7.57 | 0.00 | -0.00 | -0.00 |
| 11 | -4.54 | 0.64 | -7.57 | -0.00 | 0.00 | -0.00 |
| 12 | -4.54 | 0.64 | -7.57 | 0.00 | 0.00 | 0.00 |
| 13 | 4.54 | 0.50 | 7.57 | -0.00 | -0.00 | -0.00 |
| 14 | 4.54 | 0.50 | 7.57 | 0.00 | -0.00 | -0.00 |
| 15 | -4.54 | 0.49 | -7.57 | -0.00 | 0.00 | -0.00 |
| 16 | -4.54 | 0.50 | -7.57 | 0.00 | 0.00 | 0.00 |
| 17 | 2.72 | 0.64 | 4.54 | -0.00 | 0.00 | -0.00 |
| 18 | 2.72 | 0.64 | 4.54 | 0.00 | 0.00 | -0.00 |
| 19 | -2.72 | 0.64 | -4.54 | -0.00 | 0.00 | -0.00 |
| 20 | -2.72 | 0.64 | -4.54 | 0.00 | 0.00 | -0.00 |
| 21 | 2.72 | 0.64 | 4.54 | -0.00 | 0.00 | -0.00 |
| 22 | 2.72 | 0.64 | 4.54 | 0.00 | 0.00 | -0.00 |
| 23 | -2.72 | 0.64 | -4.54 | -0.00 | 0.00 | -0.00 |
| 24 | -2.72 | 0.64 | -4.54 | 0.00 | 0.00 | 0.00 |
| 25 | 2.72 | 0.64 | 4.54 | -0.00 | 0.00 | -0.00 |
| 26 | 2.72 | 0.64 | 4.54 | 0.00 | 0.00 | -0.00 |
| 27 | -2.72 | 0.64 | -4.54 | -0.00 | 0.00 | -0.00 |
| 28 | -2.72 | 0.64 | -4.54 | 0.00 | 0.00 | 0.00 |
| 29 | 2.72 | 0.64 | 4.54 | -0.00 | 0.00 | -0.00 |
| 30 | 2.72 | 0.64 | 4.54 | 0.00 | 0.00 | -0.00 |
| 31 | -2.72 | 0.64 | -4.54 | -0.00 | 0.00 | -0.00 |
| 32 | -2.72 | 0.64 | -4.54 | 0.00 | 0.00 | 0.00 |
| 33 | 2.72 | 0.50 | 4.54 | -0.00 | 0.00 | -0.00 |
| 34 | 2.72 | 0.50 | 4.54 | 0.00 | 0.00 | -0.00 |
| 35 | -2.72 | 0.49 | -4.54 | -0.00 | 0.00 | -0.00 |
| 36 | -2.72 | 0.49 | -4.54 | 0.00 | 0.00 | -0.00 |
| 37 | 2.72 | 0.49 | 4.54 | -0.00 | 0.00 | -0.00 |
| 38 | 2.72 | 0.49 | 4.54 | 0.00 | 0.00 | -0.00 |
| 39 | -2.72 | 0.49 | -4.54 | -0.00 | 0.00 | -0.00 |
| 40 | -2.72 | 0.49 | -4.54 | 0.00 | 0.00 | 0.00 |
| 41 | 2.72 | 0.50 | 4.54 | -0.00 | 0.00 | -0.00 |
| 42 | 2.72 | 0.50 | 4.54 | 0.00 | 0.00 | -0.00 |
| 43 | -2.72 | 0.49 | -4.54 | -0.00 | 0.00 | -0.00 |
| 44 | -2.72 | 0.49 | -4.54 | 0.00 | 0.00 | 0.00 |
| 45 | 2.72 | 0.49 | 4.54 | -0.00 | 0.00 | -0.00 |
| 46 | 2.72 | 0.49 | 4.54 | 0.00 | 0.00 | -0.00 |
| 47 | -2.72 | 0.49 | -4.54 | -0.00 | 0.00 | -0.00 |
| 48 | -2.72 | 0.49 | -4.54 | 0.00 | 0.00 | 0.00 |
| 49 | 4.54 | 0.64 | 7.57 | -0.00 | 0.00 | -0.00 |
| 50 | 4.54 | 0.64 | 7.57 | 0.00 | 0.00 | -0.00 |
| 51 | -4.54 | 0.64 | -7.57 | -0.00 | 0.00 | -0.00 |
| 52 | -4.54 | 0.64 | -7.57 | 0.00 | 0.00 | 0.00 |
| 53 | 4.54 | 0.64 | 7.57 | -0.00 | 0.00 | -0.00 |
| 54 | 4.54 | 0.64 | 7.57 | 0.00 | -0.00 | -0.00 |
| 55 | -4.54 | 0.64 | -7.57 | -0.00 | 0.00 | -0.00 |
| 56 | -4.54 | 0.64 | -7.57 | 0.00 | 0.00 | 0.00 |
| 57 | 4.54 | 0.64 | 7.57 | -0.00 | 0.00 | -0.00 |
| 58 | 4.54 | 0.64 | 7.57 | 0.00 | -0.00 | -0.00 |
| 59 | -4.54 | 0.64 | -7.57 | -0.00 | 0.00 | -0.00 |
| 60 | -4.54 | 0.64 | -7.57 | 0.00 | 0.00 | 0.00 |
| 61 | 4.54 | 0.64 | 7.57 | -0.00 | 0.00 | -0.00 |
| 62 | 4.54 | 0.64 | 7.57 | 0.00 | 0.00 | -0.00 |
| 63 | -4.54 | 0.64 | -7.57 | -0.00 | 0.00 | -0.00 |
| 64 | -4.54 | 0.64 | -7.57 | 0.00 | 0.00 | 0.00 |
| 65 | 4.54 | 0.50 | 7.57 | -0.00 | 0.00 | -0.00 |
| 66 | 4.54 | 0.50 | 7.57 | 0.00 | 0.00 | -0.00 |
| 67 | -4.54 | 0.49 | -7.57 | -0.00 | 0.00 | -0.00 |
| 68 | -4.54 | 0.50 | -7.57 | 0.00 | 0.00 | 0.00 |
| 69 | 4.54 | 0.49 | 7.57 | -0.00 | -0.00 | -0.00 |
| 70 | 4.54 | 0.49 | 7.57 | 0.00 | -0.00 | -0.00 |
| 71 | -4.54 | 0.49 | -7.57 | -0.00 | 0.00 | -0.00 |
| 72 | -4.54 | 0.49 | -7.57 | 0.00 | 0.00 | 0.00 |
| 73 | 4.54 | 0.50 | 7.57 | -0.00 | -0.00 | -0.00 |
| 74 | 4.54 | 0.50 | 7.57 | 0.00 | -0.00 | -0.00 |
| 75 | -4.54 | 0.49 | -7.57 | -0.00 | 0.00 | -0.00 |
| 76 | -4.54 | 0.50 | -7.57 | 0.00 | 0.00 | 0.00 |
| 77 | 4.54 | 0.49 | 7.57 | -0.00 | 0.00 | -0.00 |
| 78 | 4.54 | 0.49 | 7.57 | 0.00 | 0.00 | -0.00 |
| 79 | -4.54 | 0.49 | -7.57 | -0.00 | 0.00 | -0.00 |
| 80 | -4.54 | 0.49 | -7.57 | 0.00 | 0.00 | 0.00 |
| 81 | 0.01 | 0.64 | 0.01 | 0.00 | 0.00 | -0.01 |
| 82 | -0.01 | 0.64 | -0.01 | 0.00 | 0.00 | 0.01 |
| 83 | 0.01 | 0.64 | 0.01 | -0.00 | 0.00 | -0.01 |
| 84 | -0.01 | 0.64 | -0.01 | 0.00 | 0.00 | 0.01 |
| 85 | 0.01 | 0.64 | 0.01 | -0.00 | 0.00 | -0.01 |
| 86 | -0.01 | 0.64 | -0.01 | 0.00 | 0.00 | 0.01 |
| 87 | 0.01 | 0.64 | 0.01 | -0.00 | 0.00 | -0.01 |
| 88 | -0.01 | 0.64 | -0.01 | 0.00 | 0.00 | 0.01 |
| 89 | 0.01 | 0.49 | 0.01 | 0.00 | 0.00 | -0.01 |
| 90 | -0.01 | 0.49 | -0.01 | 0.00 | 0.00 | 0.01 |
| 91 | 0.01 | 0.49 | 0.01 | -0.00 | 0.00 | -0.01 |
| 92 | -0.01 | 0.49 | -0.01 | 0.00 | 0.00 | 0.01 |
| 93 | 0.01 | 0.49 | 0.01 | 0.00 | 0.00 | -0.01 |
| 94 | -0.01 | 0.49 | -0.01 | 0.00 | 0.00 | 0.01 |
| 95 | 0.01 | 0.49 | 0.01 | 0.00 | 0.00 | -0.01 |
| 96 | -0.01 | 0.49 | -0.01 | 0.00 | 0.00 | 0.01 |

强度计算控制组合号: 56, M=-4.54, N=0.64, M=0.00, N=0.00

强度计算应力比 =0.072

抗剪强度计算控制组合号: 65, V=7.57

抗剪强度计算应力比 =0.055

平面内稳定计算最大应力对应组合号: 56, M=-4.54, N=0.64, M=0.00, N=0.00

平面内稳定计算最大应力 (N/mm\*mm) =14.08

平面内稳定计算最大应力比 =0.065

临界弯矩Mcr(kN\*m) =2748.54

平面外稳定计算最大应力比 =0.027

门规GB51022-2015腹板容许高厚比 [H0/TW] =250.00

翼缘容许宽厚比 [B/T] =15.00

强度计算应力比 =0.072 < 1.0

抗剪强度计算应力比 =0.055 < 1.0

平面内稳定计算最大应力 < f=215.00

平面外稳定计算最大应力比 < 1.0

腹板高厚比 H0/TW=30.67 < [H0/TW]=250.00

翼缘宽厚比 B/T =12.12 < [B/T]=15.00

压杆,平面内长细比 λ=28. ≤ [λ]=180

压杆,平面外长细比 λ=24. ≤ [λ]=180

钢构件防火设计结果:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 偶然组合 | | | | | | |
| \ | 柱 下 端 | | | 柱 上 端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | -0.00 | 0.49 | 0.00 | -0.00 | 0.00 | -0.00 |
| 2 | -0.00 | 0.49 | -0.00 | -0.00 | 0.00 | 0.00 |
| 3 | -0.00 | 0.49 | 0.00 | -0.00 | 0.00 | -0.00 |
| 4 | -0.00 | 0.49 | -0.00 | -0.00 | 0.00 | 0.00 |
| 5 | -0.00 | 0.45 | 0.00 | -0.00 | 0.00 | -0.00 |
| 6 | -0.00 | 0.45 | -0.00 | -0.00 | 0.00 | 0.00 |
| 7 | -0.00 | 0.45 | 0.00 | -0.00 | 0.00 | -0.00 |
| 8 | -0.00 | 0.45 | -0.00 | -0.00 | 0.00 | 0.00 |
| 9 | 1.21 | 0.49 | 2.02 | -0.00 | 0.00 | -0.00 |
| 10 | 1.21 | 0.49 | 2.02 | 0.00 | 0.00 | -0.00 |
| 11 | -1.21 | 0.49 | -2.02 | -0.00 | 0.00 | -0.00 |
| 12 | -1.21 | 0.49 | -2.02 | 0.00 | 0.00 | 0.00 |
| 13 | 1.21 | 0.45 | 2.02 | -0.00 | 0.00 | -0.00 |
| 14 | 1.21 | 0.45 | 2.02 | 0.00 | 0.00 | -0.00 |
| 15 | -1.21 | 0.45 | -2.02 | -0.00 | 0.00 | -0.00 |
| 16 | -1.21 | 0.45 | -2.02 | 0.00 | 0.00 | 0.00 |

防火设计控制的偶然组合号: 12, M=-1.21, N=0.49, M=0.00, N=0.00

强度计算荷载比 =0.02

平面内稳定计算荷载比 =0.02

平面外稳定计算荷载比 =0.01

无防护下钢构件最大升温(Ts): 1081.86℃ ,按临界温度法求得临界温度(Td): 657.00℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4807(m^2\*℃/w) ,计算所需保护层厚度(di) =48.07(mm)

构件重量 (Kg)=41.25

**6、 钢 梁 1
设计结果**

截面类型=16; 布置角度=0; 计算长度： Lx=7.21, Ly=7.34

构件长度=7.21; 计算长度系数: Ux=1.00 Uy=1.02

支撑长度=7.34

抗震等级: 四级

截面参数: B1=200, B2=200, H=250, Tw=6, T1=8, T2=8

轴压截面分类:X轴:b类 , Y轴:c类

构件钢号：Q235

宽厚比等级:S4

验算规范: 门规GB51022-2015

构件耐火等级: 二级

是否耐火钢: 否; 采用防火材料: 防火涂料2( 2); 形状系数: 279.756744(1/m)

梁刚度放大系数: 1.0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 18.72 | 5.79 | 31.81 | -25.63 | 0.75 | 19.05 |
| 2 | 8.55 | 2.49 | 13.12 | -54.55 | 1.59 | 40.54 |
| 3 | 18.72 | 5.79 | 31.81 | -45.68 | 1.44 | 39.29 |
| 4 | 8.55 | 2.49 | 13.12 | -34.50 | 0.91 | 20.31 |
| 5 | 16.70 | 5.18 | 28.49 | -19.71 | 0.58 | 14.66 |
| 6 | 6.53 | 1.88 | 9.80 | -48.64 | 1.42 | 36.15 |
| 7 | 16.70 | 5.18 | 28.49 | -39.76 | 1.27 | 34.89 |
| 8 | 6.53 | 1.88 | 9.80 | -28.59 | 0.73 | 15.91 |
| 9 | -33.88 | -16.63 | -11.99 | -16.71 | 20.03 | 2.04 |
| 10 | 18.85 | -20.21 | 5.61 | 17.14 | 23.62 | -4.37 |
| 11 | -8.93 | 24.84 | 7.63 | -38.91 | -21.44 | 20.90 |
| 12 | 43.80 | 21.26 | 25.23 | -5.05 | -17.86 | 14.49 |
| 13 | -35.90 | -17.24 | -15.31 | -10.80 | 19.86 | -2.36 |
| 14 | 16.83 | -20.83 | 2.29 | 23.06 | 23.44 | -8.77 |
| 15 | -10.95 | 24.23 | 4.31 | -33.00 | -21.62 | 16.50 |
| 16 | 41.78 | 20.65 | 21.92 | 0.86 | -18.03 | 10.09 |
| 17 | -6.86 | -5.77 | 15.99 | -20.28 | 12.32 | 8.84 |
| 18 | 24.77 | -7.92 | 26.55 | 0.04 | 14.47 | 5.00 |
| 19 | 8.11 | 19.11 | 27.76 | -33.60 | -12.56 | 20.16 |
| 20 | 39.74 | 16.96 | 38.33 | -13.28 | -10.41 | 16.32 |
| 21 | -17.02 | -9.07 | -2.70 | -49.20 | 13.16 | 30.33 |
| 22 | 14.61 | -11.22 | 7.86 | -28.89 | 15.31 | 26.49 |
| 23 | -2.05 | 15.81 | 9.07 | -62.52 | -11.72 | 41.65 |
| 24 | 29.58 | 13.66 | 19.63 | -42.21 | -9.57 | 37.81 |
| 25 | -6.86 | -5.77 | 15.99 | -40.33 | 13.01 | 29.08 |
| 26 | 24.77 | -7.92 | 26.55 | -20.02 | 15.16 | 25.23 |
| 27 | 8.11 | 19.11 | 27.76 | -53.65 | -11.88 | 40.39 |
| 28 | 39.74 | 16.96 | 38.33 | -33.33 | -9.73 | 36.55 |
| 29 | -17.02 | -9.07 | -2.70 | -29.15 | 12.47 | 10.10 |
| 30 | 14.61 | -11.22 | 7.86 | -8.84 | 14.63 | 6.26 |
| 31 | -2.05 | 15.81 | 9.07 | -42.47 | -12.41 | 21.42 |
| 32 | 29.58 | 13.66 | 19.63 | -22.16 | -10.26 | 17.57 |
| 33 | -8.88 | -6.38 | 12.67 | -14.36 | 12.15 | 4.45 |
| 34 | 22.75 | -8.53 | 23.23 | 5.95 | 14.30 | 0.60 |
| 35 | 6.09 | 18.50 | 24.45 | -27.68 | -12.74 | 15.76 |
| 36 | 37.73 | 16.35 | 35.01 | -7.37 | -10.59 | 11.92 |
| 37 | -19.04 | -9.68 | -6.02 | -43.29 | 12.99 | 25.94 |
| 38 | 12.59 | -11.84 | 4.54 | -22.97 | 15.14 | 22.09 |
| 39 | -4.07 | 15.20 | 5.75 | -56.61 | -11.90 | 37.25 |
| 40 | 27.56 | 13.05 | 16.32 | -36.29 | -9.75 | 33.41 |
| 41 | -8.88 | -6.38 | 12.67 | -34.42 | 12.83 | 24.68 |
| 42 | 22.75 | -8.53 | 23.23 | -14.10 | 14.98 | 20.84 |
| 43 | 6.09 | 18.50 | 24.45 | -47.73 | -12.05 | 36.00 |
| 44 | 37.73 | 16.35 | 35.01 | -27.42 | -9.90 | 32.15 |
| 45 | -19.04 | -9.68 | -6.02 | -23.24 | 12.30 | 5.70 |
| 46 | 12.59 | -11.84 | 4.54 | -2.92 | 14.45 | 1.86 |
| 47 | -4.07 | 15.20 | 5.75 | -36.56 | -12.58 | 17.02 |
| 48 | 27.56 | 13.05 | 16.32 | -16.24 | -10.43 | 13.18 |
| 49 | -26.90 | -14.43 | 0.21 | -16.71 | 20.03 | 2.04 |
| 50 | 25.82 | -18.01 | 17.82 | 17.14 | 23.62 | -4.37 |
| 51 | -1.95 | 27.05 | 19.84 | -38.91 | -21.44 | 20.90 |
| 52 | 50.77 | 23.46 | 37.44 | -5.05 | -17.86 | 14.49 |
| 53 | -34.02 | -16.74 | -12.87 | -36.96 | 20.62 | 17.08 |
| 54 | 18.71 | -20.32 | 4.73 | -3.10 | 24.20 | 10.67 |
| 55 | -9.06 | 24.74 | 6.75 | -59.16 | -20.85 | 35.94 |
| 56 | 43.66 | 21.15 | 24.35 | -25.30 | -17.27 | 29.53 |
| 57 | -26.90 | -14.43 | 0.21 | -30.75 | 20.51 | 16.20 |
| 58 | 25.82 | -18.01 | 17.82 | 3.11 | 24.10 | 9.79 |
| 59 | -1.95 | 27.05 | 19.84 | -52.95 | -20.96 | 35.06 |
| 60 | 50.77 | 23.46 | 37.44 | -19.09 | -17.38 | 28.65 |
| 61 | -34.02 | -16.74 | -12.87 | -22.92 | 20.14 | 2.92 |
| 62 | 18.71 | -20.32 | 4.73 | 10.93 | 23.72 | -3.49 |
| 63 | -9.06 | 24.74 | 6.75 | -45.12 | -21.34 | 21.78 |
| 64 | 43.66 | 21.15 | 24.35 | -11.26 | -17.75 | 15.37 |
| 65 | -28.92 | -15.04 | -3.10 | -10.80 | 19.86 | -2.36 |
| 66 | 23.80 | -18.62 | 14.50 | 23.06 | 23.44 | -8.77 |
| 67 | -3.97 | 26.44 | 16.52 | -33.00 | -21.62 | 16.50 |
| 68 | 48.75 | 22.85 | 34.12 | 0.86 | -18.03 | 10.09 |
| 69 | -36.04 | -17.35 | -16.19 | -31.05 | 20.45 | 12.68 |
| 70 | 16.69 | -20.93 | 1.41 | 2.81 | 24.03 | 6.28 |
| 71 | -11.08 | 24.13 | 3.43 | -53.24 | -21.03 | 31.54 |
| 72 | 41.64 | 20.54 | 21.04 | -19.39 | -17.44 | 25.14 |
| 73 | -28.92 | -15.04 | -3.10 | -24.84 | 20.34 | 11.80 |
| 74 | 23.80 | -18.62 | 14.50 | 9.02 | 23.92 | 5.40 |
| 75 | -3.97 | 26.44 | 16.52 | -47.03 | -21.14 | 30.66 |
| 76 | 48.75 | 22.85 | 34.12 | -13.18 | -17.55 | 24.26 |
| 77 | -36.04 | -17.35 | -16.19 | -17.01 | 19.96 | -1.48 |
| 78 | 16.69 | -20.93 | 1.41 | 16.85 | 23.55 | -7.89 |
| 79 | -11.08 | 24.13 | 3.43 | -39.21 | -21.51 | 17.38 |
| 80 | 41.64 | 20.54 | 21.04 | -5.35 | -17.92 | 10.97 |
| 81 | 9.22 | 3.95 | 21.06 | -28.06 | 0.81 | 19.92 |
| 82 | 16.92 | 4.07 | 22.80 | -23.19 | 0.69 | 18.18 |
| 83 | 4.82 | 2.52 | 12.96 | -40.59 | 1.18 | 29.24 |
| 84 | 12.51 | 2.64 | 14.70 | -35.73 | 1.06 | 27.50 |
| 85 | 9.22 | 3.95 | 21.06 | -36.75 | 1.11 | 28.69 |
| 86 | 16.92 | 4.07 | 22.80 | -31.88 | 0.99 | 26.95 |
| 87 | 4.82 | 2.52 | 12.96 | -31.90 | 0.88 | 20.47 |
| 88 | 12.51 | 2.64 | 14.70 | -27.04 | 0.76 | 18.73 |
| 89 | 6.21 | 3.03 | 16.00 | -22.15 | 0.64 | 15.53 |
| 90 | 13.90 | 3.15 | 17.74 | -17.28 | 0.52 | 13.79 |
| 91 | 2.82 | 1.92 | 9.77 | -31.79 | 0.92 | 22.69 |
| 92 | 10.51 | 2.04 | 11.51 | -26.92 | 0.80 | 20.95 |
| 93 | 6.21 | 3.03 | 16.00 | -28.83 | 0.87 | 22.27 |
| 94 | 13.90 | 3.15 | 17.74 | -23.96 | 0.75 | 20.53 |
| 95 | 2.82 | 1.92 | 9.77 | -25.10 | 0.69 | 15.95 |
| 96 | 10.51 | 2.04 | 11.51 | -20.24 | 0.57 | 14.21 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -36.04 | -25.51 | -29.27 | -31.90 | -20.28 | -13.51 | -23.06 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 50.77 | 13.42 | 8.72 | 3.38 | 9.39 | 13.27 | 62.52 |

强度计算应力比 =0.779

抗剪强度计算应力比 =0.237

平面内稳定计算最大应力对应组合号: 1, M=18.72, N=5.79, M=-25.63, N=0.75

平面内稳定最大应力 (N/mm\*mm) =152.29

平面内稳定计算最大应力比 =0.708

临界弯矩Mcr(kN\*m) =81.35

平面外稳定计算最大应力比 =0.903

强度计算应力比 =0.779 < 1.0

抗剪强度计算应力比 =0.237 < 1.0

平面内稳定最大应力 < f=215.00

平面外稳定计算最大应力比 =0.903 < 1.0

腹板高厚比 H0/TW=39.00 < [H0/TW]=250.00 (GB51022-2015)

翼缘宽厚比 B/T =12.12 < [B/T] =15.00

**(恒+活)梁的挠度 mm**

| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0.00 | 4.46 | 7.89 | 8.73 | 6.74 | 3.01 | 0.00 |

最大挠度值 =8.73 最大挠度/梁跨度 =1/821.

斜梁坡度初始值: 1/9.83

变形后斜梁坡度最小值: 1/10.21

变形后斜梁坡度改变率 =0.037 < 1/3

钢构件防火设计结果:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 偶然组合 | | | | | | |
| \ | I端 |  |  | II端 |  |  |
| 组合 | M | N | V | M | N | V |
| 1 | 10.05 | 3.09 | 16.87 | -19.71 | 0.58 | 14.66 |
| 2 | 6.67 | 1.98 | 10.64 | -29.35 | 0.86 | 21.82 |
| 3 | 10.05 | 3.09 | 16.87 | -26.40 | 0.81 | 21.40 |
| 4 | 6.67 | 1.98 | 10.64 | -22.67 | 0.63 | 15.08 |
| 5 | 9.38 | 2.88 | 15.76 | -17.74 | 0.52 | 13.19 |
| 6 | 5.99 | 1.78 | 9.53 | -27.38 | 0.80 | 20.35 |
| 7 | 9.38 | 2.88 | 15.76 | -24.43 | 0.75 | 19.94 |
| 8 | 5.99 | 1.78 | 9.53 | -20.70 | 0.57 | 13.61 |
| 9 | -4.64 | -3.10 | 4.03 | -17.34 | 5.72 | 10.12 |
| 10 | 9.42 | -4.06 | 8.72 | -8.31 | 6.68 | 8.41 |
| 11 | 2.02 | 7.96 | 9.26 | -23.26 | -5.34 | 15.15 |
| 12 | 16.08 | 7.00 | 13.95 | -14.23 | -4.38 | 13.44 |
| 13 | -5.31 | -3.31 | 2.92 | -15.36 | 5.66 | 8.65 |
| 14 | 8.75 | -4.26 | 7.61 | -6.34 | 6.62 | 6.94 |
| 15 | 1.34 | 7.75 | 8.15 | -21.28 | -5.40 | 13.68 |
| 16 | 15.40 | 6.80 | 12.85 | -12.26 | -4.44 | 11.97 |

--- 梁的弯矩包络(偶然组合) ---

梁下部受拉:

截面 1 2 3 4 5 6 7

弯矩 -5.31 -8.06 -15.17 -16.27 -9.72 -0.55 0.00

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 16.08 1.06 0.00 0.00 0.00 6.59 29.35

强度计算荷载比 =0.36

平面内稳定计算荷载比 =0.32

平面外稳定计算荷载比 =0.39

无防护下钢构件最大升温(Ts): 1004.35℃ ,按临界温度法求得临界温度(Td): 618.56℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2858(m^2\*℃/w)

构件重量 (Kg)=260.65

**7、 钢 梁 2
设计结果**

截面类型=16; 布置角度=0; 计算长度： Lx=7.21, Ly=7.34

构件长度=7.21; 计算长度系数: Ux=1.00 Uy=1.02

支撑长度=7.34

抗震等级: 四级

截面参数: B1=200, B2=200, H=250, Tw=6, T1=8, T2=8

轴压截面分类:X轴:b类 , Y轴:c类

构件钢号：Q235

宽厚比等级:S4

验算规范: 门规GB51022-2015

构件耐火等级: 二级

是否耐火钢: 否; 采用防火材料: 防火涂料2( 2); 形状系数: 279.756744(1/m)

梁刚度放大系数: 1.0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 54.55 | -1.59 | 40.54 | -8.55 | -2.49 | 13.12 |
| 2 | 25.63 | -0.75 | 19.05 | -18.72 | -5.79 | 31.81 |
| 3 | 45.68 | -1.44 | 39.29 | -18.72 | -5.79 | 31.81 |
| 4 | 34.50 | -0.91 | 20.31 | -8.55 | -2.49 | 13.12 |
| 5 | 48.64 | -1.42 | 36.15 | -6.53 | -1.88 | 9.80 |
| 6 | 19.71 | -0.58 | 14.66 | -16.70 | -5.18 | 28.49 |
| 7 | 39.76 | -1.27 | 34.89 | -16.70 | -5.18 | 28.49 |
| 8 | 28.59 | -0.73 | 15.91 | -6.53 | -1.88 | 9.80 |
| 9 | -17.14 | -23.62 | -4.37 | -18.85 | 20.21 | 5.61 |
| 10 | 16.71 | -20.03 | 2.04 | 33.88 | 16.63 | -11.99 |
| 11 | 5.05 | 17.86 | 14.49 | -43.80 | -21.26 | 25.23 |
| 12 | 38.91 | 21.45 | 20.90 | 8.93 | -24.85 | 7.63 |
| 13 | -23.06 | -23.44 | -8.77 | -16.83 | 20.83 | 2.29 |
| 14 | 10.80 | -19.86 | -2.36 | 35.90 | 17.24 | -15.31 |
| 15 | -0.86 | 18.03 | 10.09 | -41.78 | -20.65 | 21.92 |
| 16 | 33.00 | 21.62 | 16.50 | 10.95 | -24.24 | 4.31 |
| 17 | 28.89 | -15.31 | 26.49 | -14.61 | 11.22 | 7.86 |
| 18 | 49.20 | -13.16 | 30.33 | 17.02 | 9.07 | -2.70 |
| 19 | 42.21 | 9.57 | 37.81 | -29.58 | -13.66 | 19.63 |
| 20 | 62.52 | 11.72 | 41.65 | 2.05 | -15.81 | 9.07 |
| 21 | -0.04 | -14.47 | 5.00 | -24.77 | 7.92 | 26.55 |
| 22 | 20.28 | -12.32 | 8.84 | 6.86 | 5.77 | 15.99 |
| 23 | 13.28 | 10.41 | 16.32 | -39.74 | -16.96 | 38.33 |
| 24 | 33.60 | 12.57 | 20.16 | -8.11 | -19.11 | 27.76 |
| 25 | 20.02 | -15.16 | 25.23 | -24.77 | 7.92 | 26.55 |
| 26 | 40.33 | -13.01 | 29.08 | 6.86 | 5.77 | 15.99 |
| 27 | 33.33 | 9.73 | 36.55 | -39.74 | -16.96 | 38.33 |
| 28 | 53.65 | 11.88 | 40.39 | -8.11 | -19.11 | 27.76 |
| 29 | 8.84 | -14.63 | 6.26 | -14.61 | 11.22 | 7.86 |
| 30 | 29.15 | -12.47 | 10.10 | 17.02 | 9.07 | -2.70 |
| 31 | 22.16 | 10.26 | 17.57 | -29.58 | -13.66 | 19.63 |
| 32 | 42.47 | 12.41 | 21.42 | 2.05 | -15.81 | 9.07 |
| 33 | 22.97 | -15.14 | 22.09 | -12.59 | 11.84 | 4.54 |
| 34 | 43.29 | -12.99 | 25.94 | 19.04 | 9.68 | -6.02 |
| 35 | 36.29 | 9.75 | 33.41 | -27.56 | -13.05 | 16.32 |
| 36 | 56.61 | 11.90 | 37.25 | 4.07 | -15.20 | 5.75 |
| 37 | -5.95 | -14.30 | 0.60 | -22.75 | 8.53 | 23.23 |
| 38 | 14.36 | -12.14 | 4.45 | 8.88 | 6.38 | 12.67 |
| 39 | 7.37 | 10.59 | 11.92 | -37.73 | -16.35 | 35.01 |
| 40 | 27.68 | 12.74 | 15.76 | -6.09 | -18.50 | 24.45 |
| 41 | 14.10 | -14.98 | 20.84 | -22.75 | 8.53 | 23.23 |
| 42 | 34.42 | -12.83 | 24.68 | 8.88 | 6.38 | 12.67 |
| 43 | 27.42 | 9.90 | 32.15 | -37.73 | -16.35 | 35.01 |
| 44 | 47.73 | 12.05 | 36.00 | -6.09 | -18.50 | 24.45 |
| 45 | 2.92 | -14.45 | 1.86 | -12.59 | 11.84 | 4.54 |
| 46 | 23.24 | -12.30 | 5.70 | 19.04 | 9.68 | -6.02 |
| 47 | 16.24 | 10.43 | 13.18 | -27.56 | -13.05 | 16.32 |
| 48 | 36.56 | 12.58 | 17.02 | 4.07 | -15.20 | 5.75 |
| 49 | 3.10 | -24.20 | 10.67 | -18.71 | 20.32 | 4.73 |
| 50 | 36.96 | -20.62 | 17.08 | 34.02 | 16.74 | -12.87 |
| 51 | 25.30 | 17.27 | 29.53 | -43.66 | -21.15 | 24.35 |
| 52 | 59.16 | 20.86 | 35.94 | 9.06 | -24.74 | 6.75 |
| 53 | -17.14 | -23.62 | -4.37 | -25.82 | 18.01 | 17.82 |
| 54 | 16.71 | -20.03 | 2.04 | 26.90 | 14.43 | 0.21 |
| 55 | 5.05 | 17.86 | 14.49 | -50.77 | -23.46 | 37.44 |
| 56 | 38.91 | 21.45 | 20.90 | 1.95 | -27.05 | 19.84 |
| 57 | -3.11 | -24.10 | 9.79 | -25.82 | 18.01 | 17.82 |
| 58 | 30.75 | -20.51 | 16.20 | 26.90 | 14.43 | 0.21 |
| 59 | 19.09 | 17.38 | 28.65 | -50.77 | -23.46 | 37.44 |
| 60 | 52.95 | 20.97 | 35.06 | 1.95 | -27.05 | 19.84 |
| 61 | -10.93 | -23.72 | -3.49 | -18.71 | 20.32 | 4.73 |
| 62 | 22.92 | -20.14 | 2.92 | 34.02 | 16.74 | -12.87 |
| 63 | 11.26 | 17.75 | 15.37 | -43.66 | -21.15 | 24.35 |
| 64 | 45.12 | 21.34 | 21.78 | 9.06 | -24.74 | 6.75 |
| 65 | -2.81 | -24.03 | 6.28 | -16.69 | 20.93 | 1.41 |
| 66 | 31.05 | -20.44 | 12.68 | 36.04 | 17.35 | -16.19 |
| 67 | 19.39 | 17.44 | 25.14 | -41.64 | -20.54 | 21.04 |
| 68 | 53.24 | 21.03 | 31.54 | 11.08 | -24.13 | 3.43 |
| 69 | -23.06 | -23.44 | -8.77 | -23.80 | 18.62 | 14.50 |
| 70 | 10.80 | -19.86 | -2.36 | 28.92 | 15.04 | -3.10 |
| 71 | -0.86 | 18.03 | 10.09 | -48.75 | -22.85 | 34.12 |
| 72 | 33.00 | 21.62 | 16.50 | 3.97 | -26.44 | 16.52 |
| 73 | -9.02 | -23.92 | 5.40 | -23.80 | 18.62 | 14.50 |
| 74 | 24.84 | -20.34 | 11.80 | 28.92 | 15.04 | -3.10 |
| 75 | 13.18 | 17.55 | 24.26 | -48.75 | -22.85 | 34.12 |
| 76 | 47.03 | 21.14 | 30.66 | 3.97 | -26.44 | 16.52 |
| 77 | -16.85 | -23.55 | -7.89 | -16.69 | 20.93 | 1.41 |
| 78 | 17.01 | -19.96 | -1.48 | 36.04 | 17.35 | -16.19 |
| 79 | 5.35 | 17.93 | 10.97 | -41.64 | -20.54 | 21.04 |
| 80 | 39.21 | 21.51 | 17.38 | 11.08 | -24.13 | 3.43 |
| 81 | 35.73 | -1.06 | 27.50 | -12.51 | -2.64 | 14.70 |
| 82 | 40.59 | -1.18 | 29.24 | -4.82 | -2.52 | 12.96 |
| 83 | 23.19 | -0.69 | 18.18 | -16.92 | -4.07 | 22.80 |
| 84 | 28.06 | -0.81 | 19.92 | -9.22 | -3.95 | 21.06 |
| 85 | 31.88 | -0.99 | 26.95 | -16.92 | -4.07 | 22.80 |
| 86 | 36.75 | -1.11 | 28.69 | -9.22 | -3.95 | 21.06 |
| 87 | 27.04 | -0.76 | 18.73 | -12.51 | -2.64 | 14.70 |
| 88 | 31.90 | -0.88 | 20.47 | -4.82 | -2.52 | 12.96 |
| 89 | 26.92 | -0.80 | 20.95 | -10.51 | -2.05 | 11.51 |
| 90 | 31.79 | -0.92 | 22.69 | -2.82 | -1.92 | 9.77 |
| 91 | 17.28 | -0.52 | 13.79 | -13.90 | -3.15 | 17.74 |
| 92 | 22.15 | -0.64 | 15.53 | -6.21 | -3.03 | 16.00 |
| 93 | 23.96 | -0.75 | 20.53 | -13.90 | -3.15 | 17.74 |
| 94 | 28.83 | -0.87 | 22.27 | -6.21 | -3.03 | 16.00 |
| 95 | 20.24 | -0.57 | 14.21 | -10.51 | -2.05 | 11.51 |
| 96 | 25.10 | -0.69 | 15.95 | -2.82 | -1.92 | 9.77 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -23.06 | -13.51 | -20.28 | -31.90 | -29.27 | -25.51 | -36.04 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 62.52 | 13.27 | 9.39 | 3.38 | 8.72 | 13.42 | 50.77 |

强度计算应力比 =0.779

抗剪强度计算应力比 =0.237

平面内稳定计算最大应力对应组合号: 1, M=54.55, N=-1.59, M=-8.55, N=-2.49

平面内稳定最大应力 (N/mm\*mm) =152.29

平面内稳定计算最大应力比 =0.708

临界弯矩Mcr(kN\*m) =118.63

平面外稳定计算最大应力比 =0.903

强度计算应力比 =0.779 < 1.0

抗剪强度计算应力比 =0.237 < 1.0

平面内稳定最大应力 < f=215.00

平面外稳定计算最大应力比 =0.903 < 1.0

腹板高厚比 H0/TW=39.00 < [H0/TW]=250.00 (GB51022-2015)

翼缘宽厚比 B/T =12.12 < [B/T] =15.00

**(恒+活)梁的挠度 mm**

| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0.00 | 3.01 | 6.74 | 8.73 | 7.89 | 4.46 | 0.00 |

最大挠度值 =8.73 最大挠度/梁跨度 =1/821.

斜梁坡度初始值: 1/9.83

变形后斜梁坡度最小值: 1/10.21

变形后斜梁坡度改变率 =0.037 < 1/3

钢构件防火设计结果:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 偶然组合 | | | | | | |
| \ | I端 |  |  | II端 |  |  |
| 组合 | M | N | V | M | N | V |
| 1 | 29.35 | -0.86 | 21.82 | -6.67 | -1.98 | 10.64 |
| 2 | 19.71 | -0.58 | 14.66 | -10.05 | -3.09 | 16.87 |
| 3 | 26.40 | -0.81 | 21.40 | -10.05 | -3.09 | 16.87 |
| 4 | 22.67 | -0.63 | 15.08 | -6.67 | -1.98 | 10.64 |
| 5 | 27.38 | -0.80 | 20.35 | -5.99 | -1.78 | 9.53 |
| 6 | 17.74 | -0.52 | 13.19 | -9.38 | -2.88 | 15.76 |
| 7 | 24.43 | -0.75 | 19.94 | -9.38 | -2.88 | 15.76 |
| 8 | 20.70 | -0.57 | 13.61 | -5.99 | -1.78 | 9.53 |
| 9 | 8.31 | -6.68 | 8.41 | -9.42 | 4.06 | 8.72 |
| 10 | 17.34 | -5.72 | 10.12 | 4.64 | 3.10 | 4.03 |
| 11 | 14.23 | 4.38 | 13.44 | -16.08 | -7.00 | 13.95 |
| 12 | 23.26 | 5.34 | 15.15 | -2.02 | -7.96 | 9.26 |
| 13 | 6.34 | -6.62 | 6.94 | -8.75 | 4.26 | 7.61 |
| 14 | 15.36 | -5.66 | 8.65 | 5.31 | 3.31 | 2.92 |
| 15 | 12.26 | 4.44 | 11.97 | -15.40 | -6.80 | 12.85 |
| 16 | 21.28 | 5.40 | 13.68 | -1.34 | -7.75 | 8.15 |

--- 梁的弯矩包络(偶然组合) ---

梁下部受拉:

截面 1 2 3 4 5 6 7

弯矩 0.00 -0.55 -9.72 -16.27 -15.17 -8.06 -5.31

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 29.35 6.59 0.00 0.00 0.00 1.06 16.08

强度计算荷载比 =0.36

平面内稳定计算荷载比 =0.32

平面外稳定计算荷载比 =0.39

无防护下钢构件最大升温(Ts): 1004.35℃ ,按临界温度法求得临界温度(Td): 618.56℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2858(m^2\*℃/w)

构件重量 (Kg)=260.65

风荷载作用下柱顶最大水平（X 向）位移:

节点( 2), 水平位移 dx=54.680(mm) =H /134.

地震荷载作用下柱顶最大水平（X 向）位移:

节点( 1), 水平位移 dx=7.449(mm) =H /980.

梁的(恒+活)最大挠度:

梁( 1), 挠跨比 =1 /821.

风载作用下柱顶最大水平位移: H/134< 柱顶位移容许值: H/60

地震作用下柱顶最大水平位移: H/980< 柱顶位移容许值: H/60

梁的(恒+活)最大挠跨比: 1/821< 梁的容许挠跨比: 1/180

所有钢柱的总重量 (Kg)=901.

所有钢梁的总重量 (Kg)=521.

钢梁与钢柱重量之和 (Kg)=1422.

**12. 荷载与计算结果简图**

## **1. 结构简图**



[图12-1 刚架简图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\刚架简图.T)

## **2. 荷载简图**



[图12-2 恒载简图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\恒载简图.T)



[图12-3 活载简图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\活载简图.T)



[图12-4 左风1简图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\左风1简图.T)



[图12-5 右风1简图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\右风1简图.T)



[图12-6 左风2简图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\左风2简图.T)



[图12-7 右风2简图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\右风2简图.T)

## **3. 应力比图**



[图12-8 应力比图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\应力比图.T)



[图12-9 荷载比图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\荷载比图.T)



[图12-10 防火图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\防火图.T)

## **4. 内力图**



[图12-11 恒载弯矩图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\恒载弯矩图.T)



[图12-12 恒载剪力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\恒载剪力图.T)



[图12-13 恒载轴力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\恒载轴力图.T)



[图12-14 活载弯矩图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\活载弯矩图.T)



[图12-15 活载剪力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\活载剪力图.T)



[图12-16 活载轴力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\活载轴力图.T)



[图12-17 左风1弯矩图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\左风1弯矩图.T)



[图12-18 右风1弯矩图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\右风1弯矩图.T)



[图12-19 左风1剪力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\左风1剪力图.T)



[图12-20 右风1剪力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\右风1剪力图.T)



[图12-21 左风1轴力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\左风1轴力图.T)



[图12-22 右风1轴力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\右风1轴力图.T)



[图12-23 左风2弯矩图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\左风2弯矩图.T)



[图12-24 右风2弯矩图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\右风2弯矩图.T)



[图12-25 左风2剪力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\左风2剪力图.T)



[图12-26 右风2剪力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\右风2剪力图.T)



[图12-27 左风2轴力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\左风2轴力图.T)



[图12-28 右风2轴力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\右风2轴力图.T)



[图12-29 左地震弯矩图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\左地震弯矩图.T)



[图12-30 右地震弯矩图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\右地震弯矩图.T)



[图12-31 左地震剪力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\左地震剪力图.T)



[图12-32 右地震剪力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\右地震剪力图.T)



[图12-33 左地震轴力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\左地震轴力图.T)



[图12-34 右地震轴力图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\右地震轴力图.T)



[图12-35 弯矩包络图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\弯矩包络图.T)



[图12-36 剪力包络图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\剪力包络图.T)



[图12-37 轴力包络图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\轴力包络图.T)

## **5. 位移图**



[图12-38 恒载位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\恒载位移图.T)



[图12-39 活载位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\活载位移图.T)



[图12-40 左风1位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\左风1位移图.T)



[图12-41 右风1位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\右风1位移图.T)



[图12-42 左风2位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\左风2位移图.T)



[图12-43 右风2位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\右风2位移图.T)



[图12-44 左地震位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\左地震位移图.T)



[图12-45 右地震位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\右地震位移图.T)



[图12-46 恒+活位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\恒+活位移图.T)

## **6. 挠度图**



[图12-47 (恒+活)挠度图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\(恒+活)挠度图.T)



[图12-48 (活)挠度图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\(活)挠度图.T)



[图12-49 斜梁计算坡度图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\斜梁计算坡度图.T)



[图12-50 抗风柱挠度图](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\抗风柱挠度图.T)

## **7. 计算长度系数图**



[图12-51 平面内计算长度系数](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\平面内计算长度系数.T)



[图12-52 平面外计算长度系数](F:\\项目人\\大兵\\2025\\食用菌项目\\破袋车间修改\\结构计算\\GJ1\\CalcTemp\\平面外计算长度系数.T)