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 9分41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 | 0.11 | 0.00 | 0.00 |
| 3 | 1 | 1.60 | 0.00 | 0.00 |
| 4 | 1 | 2.10 | 0.00 | 0.00 |
| 5 | 1 | 2.10 | 0.00 | 0.00 |
| 右风1 | 1 | 1 | -1.60 | 0.00 | 0.00 |
| 3 | 1 | -0.11 | 0.00 | 0.00 |
| 4 | 1 | -2.10 | 0.00 | 0.00 |
| 5 | 1 | -2.10 | 0.00 | 0.00 |
| 左风2 | 1 | 1 | 1.89 | 0.00 | 0.00 |
| 3 | 1 | -0.18 | 0.00 | 0.00 |
| 4 | 1 | 2.10 | 0.00 | 0.00 |
| 5 | 1 | -2.10 | 0.00 | 0.00 |
| 右风2 | 1 | 1 | 0.18 | 0.00 | 0.00 |
| 3 | 1 | -1.89 | 0.00 | 0.00 |
| 4 | 1 | 2.10 | 0.00 | 0.00 |
| 5 | 1 | -2.10 | 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 | 1.58 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 1.58 | 0.00 | 0.00 | 0.00 |
| 活荷载 | 1 | 1 | 1 | 1.75 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 1.75 | 0.00 | 0.00 | 0.00 |
| 左风1 | 1 | 1 | 1 | -2.62 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.76 | 0.00 | 0.00 | 0.00 |
| 右风1 | 1 | 1 | 1 | -1.76 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -2.62 | 0.00 | 0.00 | 0.00 |
| 左风2 | 1 | 1 | 1 | -0.84 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 0.02 | 0.00 | 0.00 | 0.00 |
| 右风2 | 1 | 1 | 1 | 0.02 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -0.84 | 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 | 46.998 |
| 4 | 0.248 |
| 5 | 0.248 |

水平地震标准值作用底层剪力： 0.830

底层最小地震剪力(抗震规范5.2.5条): 0.380

各质点地震力调整系数: 1.000

地震力调整后剪重比： 0.017

**周期(已乘折减系数)**

| 振型号 | 周期(s) |
| --- | --- |
| 1 | 0.878 |
| 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 | 46.998 |
| 4 | 0.248 |
| 5 | 0.248 |

水平地震标准值作用底层剪力： 0.830

底层最小地震剪力(抗震规范5.2.5条): 0.380

各质点地震力调整系数: 1.000

地震力调整后剪重比： 0.017

**周期(已乘折减系数)**

| 振型号 | 周期(s) |
| --- | --- |
| 1 | 0.878 |
| 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 | 9.9 | -0.5 | 0.0 | -6.8 | 0.5 | -3.7 |
| 2 | 19.9 | 0.0 | 0.0 | -16.4 | -0.0 | 0.0 |
| 3 | 9.9 | 0.5 | 0.0 | -6.8 | -0.5 | 3.7 |
| 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 | -14.9 | 4.7 | 0.0 | 14.9 | -3.9 | 31.3 |
| 2 | -15.9 | 4.0 | 0.0 | 15.9 | -4.0 | 32.0 |
| 3 | -0.6 | 8.2 | 0.0 | 0.6 | 3.4 | 17.5 |
| 4 | 0.0 | 2.5 | 1.5 | -0.0 | -0.0 | -0.0 |
| 5 | 0.0 | 2.5 | 1.5 | -0.0 | -0.0 | -0.0 |
| 右风1 | 1 | -0.6 | -8.2 | 0.0 | 0.6 | -3.4 | -17.5 |
| 2 | -15.9 | -4.0 | 0.0 | 15.9 | 4.0 | -31.9 |
| 3 | -14.9 | -4.7 | 0.0 | 14.9 | 3.9 | -31.3 |
| 4 | 0.0 | -2.5 | -1.5 | -0.0 | 0.0 | 0.0 |
| 5 | -0.0 | -2.5 | -1.5 | 0.0 | -0.0 | 0.0 |
| 左风2 | 1 | -4.3 | 8.2 | 0.0 | 4.3 | 5.6 | 9.3 |
| 2 | -6.0 | 2.1 | 0.0 | 6.0 | -2.1 | 16.5 |
| 3 | 4.4 | 1.7 | 0.0 | -4.4 | -3.0 | 16.9 |
| 4 | -0.0 | 2.5 | 1.5 | 0.0 | -0.0 | -0.0 |
| 5 | -0.0 | -2.5 | -1.5 | 0.0 | 0.0 | -0.0 |
| 右风2 | 1 | 4.4 | -1.7 | 0.0 | -4.4 | 3.0 | -16.9 |
| 2 | -6.0 | -2.1 | 0.0 | 6.0 | 2.1 | -16.5 |
| 3 | -4.3 | -8.2 | 0.0 | 4.3 | -5.6 | -9.3 |
| 4 | -0.0 | 2.5 | 1.5 | 0.0 | 0.0 | -0.0 |
| 5 | 0.0 | -2.5 | -1.5 | -0.0 | -0.0 | -0.0 |
| 左地震 | 1 | -0.5 | 0.3 | -0.0 | 0.5 | -0.3 | 2.0 |
| 2 | 0.0 | 0.3 | -0.0 | -0.0 | -0.3 | 2.6 |
| 3 | 0.5 | 0.3 | -0.0 | -0.5 | -0.3 | 2.0 |
| 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 | 0.5 | -0.3 | -0.0 | -0.5 | 0.3 | -2.0 |
| 2 | -0.0 | -0.3 | -0.0 | 0.0 | 0.3 | -2.6 |
| 3 | -0.5 | -0.3 | -0.0 | 0.5 | 0.3 | -2.0 |
| 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 | 1.1 | 6.2 | 3.8 | 0.3 | 8.2 | -11.0 |
| 2 | -0.3 | 8.2 | 11.0 | -1.1 | 6.2 | -3.8 |
| 左风1 | 1 | -2.9 | -14.7 | -32.8 | 2.9 | -4.2 | -5.3 |
| 2 | -6.0 | -12.7 | -26.7 | 6.0 | -0.0 | -19.0 |
| 右风1 | 1 | -6.0 | -0.0 | 19.0 | 6.0 | -12.7 | 26.7 |
| 2 | -2.9 | -4.2 | 5.2 | 2.9 | -14.7 | 32.8 |
| 左风2 | 1 | 7.7 | -5.1 | -10.8 | -7.7 | -0.9 | -4.5 |
| 2 | 5.9 | -3.7 | -12.0 | -5.9 | 3.9 | -15.3 |
| 右风2 | 1 | 5.9 | 3.9 | 15.3 | -5.9 | -3.7 | 12.0 |
| 2 | 7.7 | -0.9 | 4.5 | -7.7 | -5.1 | 10.8 |
| 左地震 | 1 | -0.0 | -0.5 | -2.0 | 0.0 | 0.5 | -1.3 |
| 2 | 0.0 | -0.5 | -1.3 | -0.0 | 0.5 | -2.0 |
| 右地震 | 1 | 0.0 | 0.5 | 2.0 | -0.0 | -0.5 | 1.3 |
| 2 | -0.0 | 0.5 | 1.3 | 0.0 | -0.5 | 2.0 |

**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 | 0.06 |
| 2 | 0.01 | 0.06 |
| 3 | 0.00 | 0.15 |
| 4 | 0.97 | 0.06 |
| 5 | -0.97 | 0.06 |

**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 | 0.05 |
| 2 | 0.01 | 0.05 |
| 3 | 0.00 | 0.12 |
| 4 | 0.86 | 0.05 |
| 5 | -0.86 | 0.05 |

**节点侧向（水平向）位移(mm)**

| 工况 | 节点 | δx | 节点 | δx |
| --- | --- | --- | --- | --- |
| 左风1 | 1 | 73.00 | 2 | 73.05 |
| 3 | 73.02 | 4 | 76.54 |
| 5 | 77.64 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |
| 右风1 | 1 | -72.89 | 2 | -72.84 |
| 3 | -72.86 | 4 | -77.48 |
| 5 | -76.37 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |
| 左风2 | 1 | 40.30 | 2 | 40.19 |
| 3 | 40.24 | 4 | 41.19 |
| 5 | 42.55 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |
| 右风2 | 1 | -40.19 | 2 | -40.30 |
| 3 | -40.24 | 4 | -42.55 |
| 5 | -41.19 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |
| 左地震 | 1 | 5.49 | 2 | 5.49 |
| 3 | 5.49 | 4 | 5.85 |
| 5 | 5.85 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |
| 右地震 | 1 | -5.49 | 2 | -5.49 |
| 3 | -5.49 | 4 | -5.85 |
| 5 | -5.85 | 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 | 0.52 | 0.08 | 0.46 | 0.47 | 39.00 | 12.13 | 152.65 | 151.63 | 264.0 | 通过 |
| 2 | 0.63 | 0.04 | 0.59 | 0.76 | 39.00 | 12.13 | 146.97 | 166.80 | 290.2 | 通过 |
| 3 | 0.52 | 0.08 | 0.46 | 0.47 | 39.00 | 12.13 | 152.65 | 151.63 | 264.0 | 通过 |
| 4 | 0.04 | 0.03 | 0.03 | 0.01 | 30.67 | 12.13 | 28.05 | 24.10 | 41.3 | 通过 |
| 5 | 0.04 | 0.03 | 0.03 | 0.01 | 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 | 0.56 | 0.12 | 0.50 | 0.42 | 39.00 | 12.13 | 260.7 | 通过 |
| 2 | 0.56 | 0.12 | 0.50 | 0.42 | 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 | 12.30 | -0.64 | -4.70 | -8.18 | 0.64 |
| 2 | 0.00 | 21.77 | -1.34 | -9.78 | -17.65 | 1.34 |
| 3 | 0.00 | 21.77 | -1.34 | -9.78 | -17.65 | 1.34 |
| 4 | 0.00 | 12.30 | -0.64 | -4.70 | -8.18 | 0.64 |
| 5 | 0.00 | 9.32 | -0.49 | -3.59 | -6.15 | 0.49 |
| 6 | 0.00 | 18.78 | -1.19 | -8.67 | -15.61 | 1.19 |
| 7 | 0.00 | 18.78 | -1.19 | -8.67 | -15.61 | 1.19 |
| 8 | 0.00 | 9.32 | -0.49 | -3.59 | -6.15 | 0.49 |
| 9 | 0.00 | -9.48 | 6.40 | 42.20 | 13.60 | -5.16 |
| 10 | 0.00 | 12.00 | -13.00 | -30.97 | -7.88 | -4.52 |
| 11 | 0.00 | 6.42 | 11.61 | 9.10 | -2.30 | 9.11 |
| 12 | 0.00 | 19.58 | -3.15 | -30.07 | -15.46 | 5.09 |
| 13 | 0.00 | -12.47 | 6.55 | 43.31 | 15.64 | -5.31 |
| 14 | 0.00 | 9.02 | -12.85 | -29.86 | -5.85 | -4.67 |
| 15 | 0.00 | 3.44 | 11.76 | 10.21 | -0.27 | 8.96 |
| 16 | 0.00 | 16.59 | -2.99 | -28.97 | -13.43 | 4.94 |
| 17 | 0.00 | -1.15 | 3.59 | 23.50 | 5.27 | -2.85 |
| 18 | 0.00 | 11.74 | -8.05 | -20.40 | -7.62 | -2.46 |
| 19 | 0.00 | 8.39 | 6.71 | 3.64 | -4.28 | 5.72 |
| 20 | 0.00 | 16.29 | -2.14 | -19.86 | -12.17 | 3.31 |
| 21 | 0.00 | 8.32 | 2.90 | 18.42 | -4.20 | -2.15 |
| 22 | 0.00 | 21.21 | -8.75 | -25.48 | -17.09 | -1.77 |
| 23 | 0.00 | 17.86 | 6.02 | -1.44 | -13.74 | 6.41 |
| 24 | 0.00 | 25.75 | -2.83 | -24.94 | -21.64 | 4.00 |
| 25 | 0.00 | 8.32 | 2.90 | 18.42 | -4.20 | -2.15 |
| 26 | 0.00 | 21.21 | -8.75 | -25.48 | -17.09 | -1.77 |
| 27 | 0.00 | 17.86 | 6.02 | -1.44 | -13.74 | 6.41 |
| 28 | 0.00 | 25.75 | -2.83 | -24.94 | -21.64 | 4.00 |
| 29 | 0.00 | -1.15 | 3.59 | 23.50 | 5.27 | -2.85 |
| 30 | 0.00 | 11.74 | -8.05 | -20.40 | -7.62 | -2.46 |
| 31 | 0.00 | 8.39 | 6.71 | 3.64 | -4.28 | 5.72 |
| 32 | 0.00 | 16.29 | -2.14 | -19.86 | -12.17 | 3.31 |
| 33 | 0.00 | -4.13 | 3.74 | 24.61 | 7.30 | -3.00 |
| 34 | 0.00 | 8.76 | -7.90 | -19.30 | -5.59 | -2.61 |
| 35 | 0.00 | 5.41 | 6.87 | 4.75 | -2.24 | 5.56 |
| 36 | 0.00 | 13.30 | -1.99 | -18.76 | -10.14 | 3.15 |
| 37 | 0.00 | 5.33 | 3.05 | 19.53 | -2.16 | -2.30 |
| 38 | 0.00 | 18.22 | -8.60 | -24.38 | -15.05 | -1.92 |
| 39 | 0.00 | 14.87 | 6.17 | -0.33 | -11.71 | 6.26 |
| 40 | 0.00 | 22.77 | -2.68 | -23.84 | -19.60 | 3.85 |
| 41 | 0.00 | 5.33 | 3.05 | 19.53 | -2.16 | -2.30 |
| 42 | 0.00 | 18.22 | -8.60 | -24.38 | -15.05 | -1.92 |
| 43 | 0.00 | 14.87 | 6.17 | -0.33 | -11.71 | 6.26 |
| 44 | 0.00 | 22.77 | -2.68 | -23.84 | -19.60 | 3.85 |
| 45 | 0.00 | -4.13 | 3.74 | 24.61 | 7.30 | -3.00 |
| 46 | 0.00 | 8.76 | -7.90 | -19.30 | -5.59 | -2.61 |
| 47 | 0.00 | 5.41 | 6.87 | 4.75 | -2.24 | 5.56 |
| 48 | 0.00 | 13.30 | -1.99 | -18.76 | -10.14 | 3.15 |
| 49 | 0.00 | -9.93 | 6.41 | 42.27 | 14.04 | -5.17 |
| 50 | 0.00 | 11.56 | -12.99 | -30.90 | -7.44 | -4.53 |
| 51 | 0.00 | 5.98 | 11.61 | 9.17 | -1.86 | 9.10 |
| 52 | 0.00 | 19.14 | -3.14 | -30.00 | -15.02 | 5.08 |
| 53 | 0.00 | -3.30 | 5.92 | 38.71 | 7.42 | -4.68 |
| 54 | 0.00 | 18.18 | -13.48 | -34.46 | -14.07 | -4.04 |
| 55 | 0.00 | 12.60 | 11.13 | 5.62 | -8.49 | 9.59 |
| 56 | 0.00 | 25.76 | -3.62 | -33.56 | -21.64 | 5.57 |
| 57 | 0.00 | -3.30 | 5.92 | 38.71 | 7.42 | -4.68 |
| 58 | 0.00 | 18.18 | -13.48 | -34.46 | -14.07 | -4.04 |
| 59 | 0.00 | 12.60 | 11.13 | 5.62 | -8.49 | 9.59 |
| 60 | 0.00 | 25.76 | -3.62 | -33.56 | -21.64 | 5.57 |
| 61 | 0.00 | -9.93 | 6.41 | 42.27 | 14.04 | -5.17 |
| 62 | 0.00 | 11.56 | -12.99 | -30.90 | -7.44 | -4.53 |
| 63 | 0.00 | 5.98 | 11.61 | 9.17 | -1.86 | 9.10 |
| 64 | 0.00 | 19.14 | -3.14 | -30.00 | -15.02 | 5.08 |
| 65 | 0.00 | -12.91 | 6.56 | 43.38 | 16.08 | -5.32 |
| 66 | 0.00 | 8.57 | -12.84 | -29.80 | -5.40 | -4.68 |
| 67 | 0.00 | 2.99 | 11.77 | 10.28 | 0.17 | 8.95 |
| 68 | 0.00 | 16.15 | -2.98 | -28.90 | -12.98 | 4.93 |
| 69 | 0.00 | -6.29 | 6.07 | 39.82 | 9.45 | -4.84 |
| 70 | 0.00 | 15.20 | -13.33 | -33.35 | -12.03 | -4.19 |
| 71 | 0.00 | 9.62 | 11.28 | 6.72 | -6.45 | 9.44 |
| 72 | 0.00 | 22.78 | -3.47 | -32.45 | -19.61 | 5.42 |
| 73 | 0.00 | -6.29 | 6.07 | 39.82 | 9.45 | -4.84 |
| 74 | 0.00 | 15.20 | -13.33 | -33.35 | -12.03 | -4.19 |
| 75 | 0.00 | 9.62 | 11.28 | 6.72 | -6.45 | 9.44 |
| 76 | 0.00 | 22.78 | -3.47 | -32.45 | -19.61 | 5.42 |
| 77 | 0.00 | -12.91 | 6.56 | 43.38 | 16.08 | -5.32 |
| 78 | 0.00 | 8.57 | -12.84 | -29.80 | -5.40 | -4.68 |
| 79 | 0.00 | 2.99 | 11.77 | 10.28 | 0.17 | 8.95 |
| 80 | 0.00 | 16.15 | -2.98 | -28.90 | -12.98 | 4.93 |
| 81 | 0.00 | 12.02 | -0.26 | -1.93 | -7.90 | 0.26 |
| 82 | 0.00 | 13.30 | -1.04 | -7.58 | -9.18 | 1.04 |
| 83 | 0.00 | 16.12 | -0.57 | -4.13 | -12.00 | 0.57 |
| 84 | 0.00 | 17.40 | -1.34 | -9.78 | -13.29 | 1.34 |
| 85 | 0.00 | 16.12 | -0.57 | -4.13 | -12.00 | 0.57 |
| 86 | 0.00 | 17.40 | -1.34 | -9.78 | -13.29 | 1.34 |
| 87 | 0.00 | 12.02 | -0.26 | -1.93 | -7.90 | 0.26 |
| 88 | 0.00 | 13.30 | -1.04 | -7.58 | -9.18 | 1.04 |
| 89 | 0.00 | 9.10 | -0.11 | -0.83 | -5.93 | 0.11 |
| 90 | 0.00 | 10.38 | -0.89 | -6.48 | -7.21 | 0.89 |
| 91 | 0.00 | 12.25 | -0.35 | -2.52 | -9.08 | 0.35 |
| 92 | 0.00 | 13.54 | -1.12 | -8.18 | -10.37 | 1.12 |
| 93 | 0.00 | 12.25 | -0.35 | -2.52 | -9.08 | 0.35 |
| 94 | 0.00 | 13.54 | -1.12 | -8.18 | -10.37 | 1.12 |
| 95 | 0.00 | 9.10 | -0.11 | -0.83 | -5.93 | 0.11 |
| 96 | 0.00 | 10.38 | -0.89 | -6.48 | -7.21 | 0.89 |

强度计算控制组合号: 65, M=0.00, N=-12.91, M=43.38, N=16.08

强度计算应力比 =0.518

抗剪强度计算控制组合号: 54, V=-13.48

抗剪强度计算应力比 =0.077

平面内稳定计算最大应力对应组合号: 56, M=0.00, N=25.76, M=-33.56, N=-21.64

平面内稳定计算最大应力 (N/mm\*mm) =98.96

平面内稳定计算最大应力比 =0.460

临界弯矩Mcr(kN\*m) =133.55

平面外稳定计算最大应力比 =0.468

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 =0.518 < 1.0

抗剪强度计算应力比 =0.077 < 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 | 9.74 | -0.50 | -3.66 | -6.57 | 0.50 |
| 2 | 0.00 | 12.89 | -0.73 | -5.35 | -9.73 | 0.73 |
| 3 | 0.00 | 12.89 | -0.73 | -5.35 | -9.73 | 0.73 |
| 4 | 0.00 | 9.74 | -0.50 | -3.66 | -6.57 | 0.50 |
| 5 | 0.00 | 8.74 | -0.45 | -3.29 | -5.89 | 0.45 |
| 6 | 0.00 | 11.90 | -0.68 | -4.98 | -9.05 | 0.68 |
| 7 | 0.00 | 11.90 | -0.68 | -4.98 | -9.05 | 0.68 |
| 8 | 0.00 | 8.74 | -0.45 | -3.29 | -5.89 | 0.45 |
| 9 | 0.00 | 3.97 | 1.38 | 8.84 | -0.80 | -1.05 |
| 10 | 0.00 | 9.70 | -3.80 | -10.67 | -6.53 | -0.87 |
| 11 | 0.00 | 8.21 | 2.76 | 0.02 | -5.04 | 2.76 |
| 12 | 0.00 | 11.72 | -1.17 | -10.43 | -8.55 | 1.69 |
| 13 | 0.00 | 2.98 | 1.43 | 9.21 | -0.13 | -1.10 |
| 14 | 0.00 | 8.71 | -3.75 | -10.30 | -5.85 | -0.92 |
| 15 | 0.00 | 7.22 | 2.82 | 0.39 | -4.37 | 2.71 |
| 16 | 0.00 | 10.73 | -1.12 | -10.06 | -7.88 | 1.64 |

防火设计控制的偶然组合号: 10, M=0.00, N=9.70, M=-10.67, N=-6.53

强度计算荷载比 =0.13

平面内稳定计算荷载比 =0.14

平面外稳定计算荷载比 =0.12

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 | 36.58 | 0.70 | 5.59 | -32.05 | -0.70 |
| 2 | 0.00 | 36.58 | -0.70 | -5.59 | -32.05 | 0.70 |
| 3 | 0.00 | 47.31 | 0.00 | 0.00 | -42.79 | -0.00 |
| 4 | 0.00 | 25.85 | 0.00 | 0.00 | -21.32 | -0.00 |
| 5 | 0.00 | 30.62 | 0.70 | 5.59 | -27.13 | -0.70 |
| 6 | 0.00 | 30.62 | -0.70 | -5.59 | -27.13 | 0.70 |
| 7 | 0.00 | 41.35 | 0.00 | 0.00 | -37.87 | -0.00 |
| 8 | 0.00 | 19.88 | 0.00 | 0.00 | -16.40 | -0.00 |
| 9 | 0.00 | 2.03 | 5.98 | 48.02 | 2.50 | -5.98 |
| 10 | 0.00 | 2.05 | -5.97 | -47.91 | 2.48 | 5.97 |
| 11 | 0.00 | 16.84 | 3.08 | 24.73 | -12.31 | -3.08 |
| 12 | 0.00 | 16.84 | -3.08 | -24.73 | -12.31 | 3.08 |
| 13 | 0.00 | -3.93 | 5.98 | 48.02 | 7.42 | -5.98 |
| 14 | 0.00 | -3.92 | -5.97 | -47.91 | 7.40 | 5.97 |
| 15 | 0.00 | 10.87 | 3.08 | 24.73 | -7.39 | -3.08 |
| 16 | 0.00 | 10.87 | -3.08 | -24.73 | -7.39 | 3.08 |
| 17 | 0.00 | 22.29 | 4.28 | 34.40 | -17.76 | -4.28 |
| 18 | 0.00 | 22.30 | -2.88 | -23.16 | -17.77 | 2.88 |
| 19 | 0.00 | 31.18 | 2.54 | 20.43 | -26.65 | -2.54 |
| 20 | 0.00 | 31.18 | -1.15 | -9.25 | -26.65 | 1.15 |
| 21 | 0.00 | 22.29 | 2.89 | 23.22 | -17.76 | -2.89 |
| 22 | 0.00 | 22.30 | -4.28 | -34.34 | -17.77 | 4.28 |
| 23 | 0.00 | 31.18 | 1.15 | 9.25 | -26.65 | -1.15 |
| 24 | 0.00 | 31.18 | -2.54 | -20.43 | -26.65 | 2.54 |
| 25 | 0.00 | 33.02 | 3.59 | 28.81 | -28.50 | -3.59 |
| 26 | 0.00 | 33.03 | -3.58 | -28.75 | -28.51 | 3.58 |
| 27 | 0.00 | 41.91 | 1.85 | 14.84 | -37.38 | -1.85 |
| 28 | 0.00 | 41.91 | -1.85 | -14.84 | -37.38 | 1.85 |
| 29 | 0.00 | 11.56 | 3.59 | 28.81 | -7.03 | -3.59 |
| 30 | 0.00 | 11.57 | -3.58 | -28.75 | -7.04 | 3.58 |
| 31 | 0.00 | 20.44 | 1.85 | 14.84 | -15.92 | -1.85 |
| 32 | 0.00 | 20.44 | -1.85 | -14.84 | -15.92 | 1.85 |
| 33 | 0.00 | 16.33 | 4.28 | 34.40 | -12.84 | -4.28 |
| 34 | 0.00 | 16.34 | -2.88 | -23.16 | -12.85 | 2.88 |
| 35 | 0.00 | 25.21 | 2.54 | 20.43 | -21.73 | -2.54 |
| 36 | 0.00 | 25.21 | -1.15 | -9.25 | -21.73 | 1.15 |
| 37 | 0.00 | 16.33 | 2.89 | 23.22 | -12.84 | -2.89 |
| 38 | 0.00 | 16.34 | -4.28 | -34.34 | -12.85 | 4.28 |
| 39 | 0.00 | 25.21 | 1.15 | 9.25 | -21.73 | -1.15 |
| 40 | 0.00 | 25.21 | -2.54 | -20.43 | -21.73 | 2.54 |
| 41 | 0.00 | 27.06 | 3.59 | 28.81 | -23.57 | -3.59 |
| 42 | 0.00 | 27.07 | -3.58 | -28.75 | -23.58 | 3.58 |
| 43 | 0.00 | 35.94 | 1.85 | 14.84 | -32.46 | -1.85 |
| 44 | 0.00 | 35.94 | -1.85 | -14.84 | -32.46 | 1.85 |
| 45 | 0.00 | 5.59 | 3.59 | 28.81 | -2.11 | -3.59 |
| 46 | 0.00 | 5.60 | -3.58 | -28.75 | -2.12 | 3.58 |
| 47 | 0.00 | 14.48 | 1.85 | 14.84 | -11.00 | -1.85 |
| 48 | 0.00 | 14.48 | -1.85 | -14.84 | -11.00 | 1.85 |
| 49 | 0.00 | 9.54 | 6.47 | 51.94 | -5.02 | -6.47 |
| 50 | 0.00 | 9.56 | -5.48 | -44.00 | -5.03 | 5.48 |
| 51 | 0.00 | 24.35 | 3.57 | 28.64 | -19.83 | -3.57 |
| 52 | 0.00 | 24.35 | -2.59 | -20.82 | -19.83 | 2.59 |
| 53 | 0.00 | 9.54 | 5.49 | 44.11 | -5.02 | -5.49 |
| 54 | 0.00 | 9.56 | -6.45 | -51.82 | -5.03 | 6.45 |
| 55 | 0.00 | 24.35 | 2.59 | 20.82 | -19.83 | -2.59 |
| 56 | 0.00 | 24.35 | -3.57 | -28.64 | -19.83 | 3.57 |
| 57 | 0.00 | 17.06 | 5.98 | 48.02 | -12.53 | -5.98 |
| 58 | 0.00 | 17.07 | -5.97 | -47.91 | -12.55 | 5.97 |
| 59 | 0.00 | 31.87 | 3.08 | 24.73 | -27.34 | -3.08 |
| 60 | 0.00 | 31.87 | -3.08 | -24.73 | -27.34 | 3.08 |
| 61 | 0.00 | 2.03 | 5.98 | 48.02 | 2.50 | -5.98 |
| 62 | 0.00 | 2.05 | -5.97 | -47.91 | 2.48 | 5.97 |
| 63 | 0.00 | 16.84 | 3.08 | 24.73 | -12.31 | -3.08 |
| 64 | 0.00 | 16.84 | -3.08 | -24.73 | -12.31 | 3.08 |
| 65 | 0.00 | 3.58 | 6.47 | 51.94 | -0.10 | -6.47 |
| 66 | 0.00 | 3.59 | -5.48 | -44.00 | -0.11 | 5.48 |
| 67 | 0.00 | 18.39 | 3.57 | 28.64 | -14.91 | -3.57 |
| 68 | 0.00 | 18.39 | -2.59 | -20.82 | -14.91 | 2.59 |
| 69 | 0.00 | 3.58 | 5.49 | 44.11 | -0.10 | -5.49 |
| 70 | 0.00 | 3.59 | -6.45 | -51.82 | -0.11 | 6.45 |
| 71 | 0.00 | 18.39 | 2.59 | 20.82 | -14.91 | -2.59 |
| 72 | 0.00 | 18.39 | -3.57 | -28.64 | -14.91 | 3.57 |
| 73 | 0.00 | 11.09 | 5.98 | 48.02 | -7.61 | -5.98 |
| 74 | 0.00 | 11.11 | -5.97 | -47.91 | -7.62 | 5.97 |
| 75 | 0.00 | 25.90 | 3.08 | 24.73 | -22.42 | -3.08 |
| 76 | 0.00 | 25.90 | -3.08 | -24.73 | -22.42 | 3.08 |
| 77 | 0.00 | -3.93 | 5.98 | 48.02 | 7.42 | -5.98 |
| 78 | 0.00 | -3.92 | -5.97 | -47.91 | 7.40 | 5.97 |
| 79 | 0.00 | 10.87 | 3.08 | 24.73 | -7.39 | -3.08 |
| 80 | 0.00 | 10.87 | -3.08 | -24.73 | -7.39 | 3.08 |
| 81 | 0.00 | 30.50 | 0.75 | 6.01 | -25.97 | -0.75 |
| 82 | 0.00 | 30.50 | -0.14 | -1.16 | -25.97 | 0.14 |
| 83 | 0.00 | 30.50 | 0.14 | 1.16 | -25.97 | -0.14 |
| 84 | 0.00 | 30.50 | -0.75 | -6.01 | -25.97 | 0.75 |
| 85 | 0.00 | 35.15 | 0.45 | 3.58 | -30.62 | -0.45 |
| 86 | 0.00 | 35.15 | -0.45 | -3.58 | -30.62 | 0.45 |
| 87 | 0.00 | 25.85 | 0.45 | 3.58 | -21.32 | -0.45 |
| 88 | 0.00 | 25.85 | -0.45 | -3.58 | -21.32 | 0.45 |
| 89 | 0.00 | 23.46 | 0.68 | 5.45 | -19.98 | -0.68 |
| 90 | 0.00 | 23.46 | -0.21 | -1.72 | -19.98 | 0.21 |
| 91 | 0.00 | 23.46 | 0.21 | 1.72 | -19.98 | -0.21 |
| 92 | 0.00 | 23.46 | -0.68 | -5.45 | -19.98 | 0.68 |
| 93 | 0.00 | 27.04 | 0.45 | 3.58 | -23.56 | -0.45 |
| 94 | 0.00 | 27.04 | -0.45 | -3.58 | -23.56 | 0.45 |
| 95 | 0.00 | 19.88 | 0.45 | 3.58 | -16.40 | -0.45 |
| 96 | 0.00 | 19.88 | -0.45 | -3.58 | -16.40 | 0.45 |

强度计算控制组合号: 49, M=0.00, N=9.54, M=51.94, N=-5.02

强度计算应力比 =0.633

抗剪强度计算控制组合号: 49, V=6.47

抗剪强度计算应力比 =0.037

平面内稳定计算最大应力对应组合号: 49, M=0.00, N=9.54, M=51.94, N=-5.02

平面内稳定计算最大应力 (N/mm\*mm) =126.71

平面内稳定计算最大应力比 =0.589

临界弯矩Mcr(kN\*m) =116.36

平面外稳定计算最大应力比 =0.762

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 =0.633 < 1.0

抗剪强度计算应力比 =0.037 < 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 | 23.46 | 0.23 | 1.86 | -19.98 | -0.23 |
| 2 | 0.00 | 23.46 | -0.23 | -1.86 | -19.98 | 0.23 |
| 3 | 0.00 | 27.04 | 0.00 | 0.00 | -23.56 | -0.00 |
| 4 | 0.00 | 19.88 | 0.00 | 0.00 | -16.40 | -0.00 |
| 5 | 0.00 | 21.47 | 0.23 | 1.86 | -18.34 | -0.23 |
| 6 | 0.00 | 21.47 | -0.23 | -1.86 | -18.34 | 0.23 |
| 7 | 0.00 | 25.05 | 0.00 | 0.00 | -21.92 | -0.00 |
| 8 | 0.00 | 17.89 | 0.00 | 0.00 | -14.76 | -0.00 |
| 9 | 0.00 | 13.53 | 1.59 | 12.81 | -10.05 | -1.59 |
| 10 | 0.00 | 13.54 | -1.59 | -12.78 | -10.05 | 1.59 |
| 11 | 0.00 | 17.48 | 0.82 | 6.59 | -14.00 | -0.82 |
| 12 | 0.00 | 17.48 | -0.82 | -6.59 | -14.00 | 0.82 |
| 13 | 0.00 | 11.54 | 1.59 | 12.81 | -8.41 | -1.59 |
| 14 | 0.00 | 11.55 | -1.59 | -12.78 | -8.41 | 1.59 |
| 15 | 0.00 | 15.49 | 0.82 | 6.59 | -12.36 | -0.82 |
| 16 | 0.00 | 15.49 | -0.82 | -6.59 | -12.36 | 0.82 |

防火设计控制的偶然组合号: 9, M=0.00, N=13.53, M=12.81, N=-10.05

强度计算荷载比 =0.16

平面内稳定计算荷载比 =0.17

平面外稳定计算荷载比 =0.17

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 | 21.77 | 1.34 | 9.78 | -17.65 | -1.34 |
| 2 | 0.00 | 12.30 | 0.64 | 4.70 | -8.18 | -0.64 |
| 3 | 0.00 | 21.77 | 1.34 | 9.78 | -17.65 | -1.34 |
| 4 | 0.00 | 12.30 | 0.64 | 4.70 | -8.18 | -0.64 |
| 5 | 0.00 | 18.78 | 1.19 | 8.67 | -15.61 | -1.19 |
| 6 | 0.00 | 9.32 | 0.49 | 3.59 | -6.15 | -0.49 |
| 7 | 0.00 | 18.78 | 1.19 | 8.67 | -15.61 | -1.19 |
| 8 | 0.00 | 9.32 | 0.49 | 3.59 | -6.15 | -0.49 |
| 9 | 0.00 | 12.01 | 13.02 | 31.04 | -7.89 | 4.51 |
| 10 | 0.00 | -9.47 | -6.37 | -42.14 | 13.59 | 5.17 |
| 11 | 0.00 | 19.58 | 3.15 | 30.07 | -15.46 | -5.09 |
| 12 | 0.00 | 6.42 | -11.61 | -9.10 | -2.30 | -9.11 |
| 13 | 0.00 | 9.02 | 12.87 | 29.94 | -5.85 | 4.66 |
| 14 | 0.00 | -12.46 | -6.53 | -43.24 | 15.62 | 5.32 |
| 15 | 0.00 | 16.59 | 2.99 | 28.97 | -13.43 | -4.94 |
| 16 | 0.00 | 3.44 | -11.76 | -10.21 | -0.27 | -8.96 |
| 17 | 0.00 | 21.21 | 8.76 | 25.53 | -17.09 | 1.76 |
| 18 | 0.00 | 8.32 | -2.88 | -18.38 | -4.21 | 2.16 |
| 19 | 0.00 | 25.75 | 2.83 | 24.94 | -21.64 | -4.00 |
| 20 | 0.00 | 17.86 | -6.02 | 1.44 | -13.74 | -6.41 |
| 21 | 0.00 | 11.74 | 8.06 | 20.45 | -7.63 | 2.46 |
| 22 | 0.00 | -1.14 | -3.58 | -23.46 | 5.26 | 2.85 |
| 23 | 0.00 | 16.29 | 2.14 | 19.86 | -12.17 | -3.31 |
| 24 | 0.00 | 8.39 | -6.71 | -3.64 | -4.28 | -5.72 |
| 25 | 0.00 | 21.21 | 8.76 | 25.53 | -17.09 | 1.76 |
| 26 | 0.00 | 8.32 | -2.88 | -18.38 | -4.21 | 2.16 |
| 27 | 0.00 | 25.75 | 2.83 | 24.94 | -21.64 | -4.00 |
| 28 | 0.00 | 17.86 | -6.02 | 1.44 | -13.74 | -6.41 |
| 29 | 0.00 | 11.74 | 8.06 | 20.45 | -7.63 | 2.46 |
| 30 | 0.00 | -1.14 | -3.58 | -23.46 | 5.26 | 2.85 |
| 31 | 0.00 | 16.29 | 2.14 | 19.86 | -12.17 | -3.31 |
| 32 | 0.00 | 8.39 | -6.71 | -3.64 | -4.28 | -5.72 |
| 33 | 0.00 | 18.23 | 8.60 | 24.42 | -15.06 | 1.91 |
| 34 | 0.00 | 5.34 | -3.03 | -19.49 | -2.17 | 2.31 |
| 35 | 0.00 | 22.77 | 2.68 | 23.84 | -19.60 | -3.85 |
| 36 | 0.00 | 14.87 | -6.17 | 0.33 | -11.71 | -6.26 |
| 37 | 0.00 | 8.76 | 7.91 | 19.34 | -5.59 | 2.61 |
| 38 | 0.00 | -4.13 | -3.73 | -24.57 | 7.30 | 3.00 |
| 39 | 0.00 | 13.30 | 1.99 | 18.76 | -10.14 | -3.15 |
| 40 | 0.00 | 5.41 | -6.87 | -4.75 | -2.24 | -5.56 |
| 41 | 0.00 | 18.23 | 8.60 | 24.42 | -15.06 | 1.91 |
| 42 | 0.00 | 5.34 | -3.03 | -19.49 | -2.17 | 2.31 |
| 43 | 0.00 | 22.77 | 2.68 | 23.84 | -19.60 | -3.85 |
| 44 | 0.00 | 14.87 | -6.17 | 0.33 | -11.71 | -6.26 |
| 45 | 0.00 | 8.76 | 7.91 | 19.34 | -5.59 | 2.61 |
| 46 | 0.00 | -4.13 | -3.73 | -24.57 | 7.30 | 3.00 |
| 47 | 0.00 | 13.30 | 1.99 | 18.76 | -10.14 | -3.15 |
| 48 | 0.00 | 5.41 | -6.87 | -4.75 | -2.24 | -5.56 |
| 49 | 0.00 | 18.19 | 13.49 | 34.53 | -14.07 | 4.03 |
| 50 | 0.00 | -3.29 | -5.90 | -38.65 | 7.41 | 4.69 |
| 51 | 0.00 | 25.76 | 3.62 | 33.56 | -21.64 | -5.57 |
| 52 | 0.00 | 12.60 | -11.13 | -5.62 | -8.49 | -9.59 |
| 53 | 0.00 | 11.56 | 13.01 | 30.97 | -7.45 | 4.52 |
| 54 | 0.00 | -9.91 | -6.38 | -42.21 | 14.03 | 5.18 |
| 55 | 0.00 | 19.14 | 3.14 | 30.00 | -15.02 | -5.08 |
| 56 | 0.00 | 5.98 | -11.61 | -9.17 | -1.86 | -9.10 |
| 57 | 0.00 | 18.19 | 13.49 | 34.53 | -14.07 | 4.03 |
| 58 | 0.00 | -3.29 | -5.90 | -38.65 | 7.41 | 4.69 |
| 59 | 0.00 | 25.76 | 3.62 | 33.56 | -21.64 | -5.57 |
| 60 | 0.00 | 12.60 | -11.13 | -5.62 | -8.49 | -9.59 |
| 61 | 0.00 | 11.56 | 13.01 | 30.97 | -7.45 | 4.52 |
| 62 | 0.00 | -9.91 | -6.38 | -42.21 | 14.03 | 5.18 |
| 63 | 0.00 | 19.14 | 3.14 | 30.00 | -15.02 | -5.08 |
| 64 | 0.00 | 5.98 | -11.61 | -9.17 | -1.86 | -9.10 |
| 65 | 0.00 | 15.20 | 13.34 | 33.42 | -12.04 | 4.19 |
| 66 | 0.00 | -6.27 | -6.05 | -39.76 | 9.44 | 4.84 |
| 67 | 0.00 | 22.78 | 3.47 | 32.45 | -19.61 | -5.42 |
| 68 | 0.00 | 9.62 | -11.28 | -6.72 | -6.45 | -9.44 |
| 69 | 0.00 | 8.58 | 12.86 | 29.87 | -5.41 | 4.67 |
| 70 | 0.00 | -12.90 | -6.54 | -43.31 | 16.07 | 5.33 |
| 71 | 0.00 | 16.15 | 2.98 | 28.90 | -12.98 | -4.93 |
| 72 | 0.00 | 2.99 | -11.77 | -10.28 | 0.17 | -8.95 |
| 73 | 0.00 | 15.20 | 13.34 | 33.42 | -12.04 | 4.19 |
| 74 | 0.00 | -6.27 | -6.05 | -39.76 | 9.44 | 4.84 |
| 75 | 0.00 | 22.78 | 3.47 | 32.45 | -19.61 | -5.42 |
| 76 | 0.00 | 9.62 | -11.28 | -6.72 | -6.45 | -9.44 |
| 77 | 0.00 | 8.58 | 12.86 | 29.87 | -5.41 | 4.67 |
| 78 | 0.00 | -12.90 | -6.54 | -43.31 | 16.07 | 5.33 |
| 79 | 0.00 | 16.15 | 2.98 | 28.90 | -12.98 | -4.93 |
| 80 | 0.00 | 2.99 | -11.77 | -10.28 | 0.17 | -8.95 |
| 81 | 0.00 | 17.40 | 1.34 | 9.78 | -13.29 | -1.34 |
| 82 | 0.00 | 16.12 | 0.57 | 4.13 | -12.00 | -0.57 |
| 83 | 0.00 | 13.30 | 1.04 | 7.58 | -9.18 | -1.04 |
| 84 | 0.00 | 12.02 | 0.26 | 1.93 | -7.90 | -0.26 |
| 85 | 0.00 | 17.40 | 1.34 | 9.78 | -13.29 | -1.34 |
| 86 | 0.00 | 16.12 | 0.57 | 4.13 | -12.00 | -0.57 |
| 87 | 0.00 | 13.30 | 1.04 | 7.58 | -9.18 | -1.04 |
| 88 | 0.00 | 12.02 | 0.26 | 1.93 | -7.90 | -0.26 |
| 89 | 0.00 | 13.54 | 1.12 | 8.18 | -10.37 | -1.12 |
| 90 | 0.00 | 12.25 | 0.35 | 2.52 | -9.08 | -0.35 |
| 91 | 0.00 | 10.38 | 0.89 | 6.48 | -7.21 | -0.89 |
| 92 | 0.00 | 9.10 | 0.11 | 0.83 | -5.93 | -0.11 |
| 93 | 0.00 | 13.54 | 1.12 | 8.18 | -10.37 | -1.12 |
| 94 | 0.00 | 12.25 | 0.35 | 2.52 | -9.08 | -0.35 |
| 95 | 0.00 | 10.38 | 0.89 | 6.48 | -7.21 | -0.89 |
| 96 | 0.00 | 9.10 | 0.11 | 0.83 | -5.93 | -0.11 |

强度计算控制组合号: 70, M=0.00, N=-12.90, M=-43.31, N=16.07

强度计算应力比 =0.517

抗剪强度计算控制组合号: 49, V=13.49

抗剪强度计算应力比 =0.077

平面内稳定计算最大应力对应组合号: 51, M=0.00, N=25.76, M=33.56, N=-21.64

平面内稳定计算最大应力 (N/mm\*mm) =98.96

平面内稳定计算最大应力比 =0.460

临界弯矩Mcr(kN\*m) =133.55

平面外稳定计算最大应力比 =0.468

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 =0.517 < 1.0

抗剪强度计算应力比 =0.077 < 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 | 12.89 | 0.73 | 5.35 | -9.73 | -0.73 |
| 2 | 0.00 | 9.74 | 0.50 | 3.66 | -6.57 | -0.50 |
| 3 | 0.00 | 12.89 | 0.73 | 5.35 | -9.73 | -0.73 |
| 4 | 0.00 | 9.74 | 0.50 | 3.66 | -6.57 | -0.50 |
| 5 | 0.00 | 11.90 | 0.68 | 4.98 | -9.05 | -0.68 |
| 6 | 0.00 | 8.74 | 0.45 | 3.29 | -5.89 | -0.45 |
| 7 | 0.00 | 11.90 | 0.68 | 4.98 | -9.05 | -0.68 |
| 8 | 0.00 | 8.74 | 0.45 | 3.29 | -5.89 | -0.45 |
| 9 | 0.00 | 9.70 | 3.80 | 10.69 | -6.53 | 0.87 |
| 10 | 0.00 | 3.97 | -1.37 | -8.83 | -0.81 | 1.05 |
| 11 | 0.00 | 11.72 | 1.17 | 10.43 | -8.55 | -1.69 |
| 12 | 0.00 | 8.21 | -2.76 | -0.02 | -5.04 | -2.76 |
| 13 | 0.00 | 8.71 | 3.75 | 10.32 | -5.86 | 0.92 |
| 14 | 0.00 | 2.98 | -1.42 | -9.20 | -0.13 | 1.10 |
| 15 | 0.00 | 10.73 | 1.12 | 10.06 | -7.88 | -1.64 |
| 16 | 0.00 | 7.22 | -2.82 | -0.39 | -4.37 | -2.71 |

防火设计控制的偶然组合号: 9, M=0.00, N=9.70, M=10.69, N=-6.53

强度计算荷载比 =0.13

平面内稳定计算荷载比 =0.14

平面外稳定计算荷载比 =0.12

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 | 0.50 | 0.00 | -0.00 | 0.00 | -0.00 |
| 7 | -0.00 | 0.50 | 0.00 | 0.00 | 0.00 | -0.00 |
| 8 | 0.00 | 0.49 | 0.00 | -0.00 | 0.00 | -0.00 |
| 9 | 2.27 | 0.64 | 3.78 | -0.00 | -0.00 | -0.00 |
| 10 | -2.27 | 0.64 | -3.78 | 0.00 | -0.00 | 0.00 |
| 11 | 2.27 | 0.64 | 3.78 | -0.00 | 0.00 | -0.00 |
| 12 | 2.27 | 0.64 | 3.78 | -0.00 | 0.00 | 0.00 |
| 13 | 2.27 | 0.50 | 3.78 | -0.00 | -0.00 | -0.00 |
| 14 | -2.27 | 0.50 | -3.78 | 0.00 | -0.00 | 0.00 |
| 15 | 2.27 | 0.49 | 3.78 | -0.00 | 0.00 | -0.00 |
| 16 | 2.27 | 0.50 | 3.78 | -0.00 | 0.00 | 0.00 |
| 17 | 1.36 | 0.64 | 2.27 | -0.00 | 0.00 | -0.00 |
| 18 | -1.36 | 0.64 | -2.27 | 0.00 | 0.00 | 0.00 |
| 19 | 1.36 | 0.64 | 2.27 | -0.00 | 0.00 | -0.00 |
| 20 | 1.36 | 0.64 | 2.27 | -0.00 | 0.00 | 0.00 |
| 21 | 1.36 | 0.64 | 2.27 | -0.00 | -0.00 | -0.00 |
| 22 | -1.36 | 0.64 | -2.27 | 0.00 | 0.00 | 0.00 |
| 23 | 1.36 | 0.64 | 2.27 | -0.00 | 0.00 | -0.00 |
| 24 | 1.36 | 0.64 | 2.27 | -0.00 | 0.00 | 0.00 |
| 25 | 1.36 | 0.64 | 2.27 | -0.00 | -0.00 | -0.00 |
| 26 | -1.36 | 0.64 | -2.27 | 0.00 | 0.00 | 0.00 |
| 27 | 1.36 | 0.64 | 2.27 | -0.00 | 0.00 | -0.00 |
| 28 | 1.36 | 0.64 | 2.27 | -0.00 | 0.00 | 0.00 |
| 29 | 1.36 | 0.64 | 2.27 | -0.00 | 0.00 | -0.00 |
| 30 | -1.36 | 0.64 | -2.27 | 0.00 | 0.00 | 0.00 |
| 31 | 1.36 | 0.64 | 2.27 | -0.00 | 0.00 | -0.00 |
| 32 | 1.36 | 0.64 | 2.27 | -0.00 | 0.00 | 0.00 |
| 33 | 1.36 | 0.49 | 2.27 | -0.00 | 0.00 | -0.00 |
| 34 | -1.36 | 0.49 | -2.27 | 0.00 | 0.00 | 0.00 |
| 35 | 1.36 | 0.49 | 2.27 | -0.00 | 0.00 | -0.00 |
| 36 | 1.36 | 0.49 | 2.27 | -0.00 | 0.00 | 0.00 |
| 37 | 1.36 | 0.50 | 2.27 | -0.00 | -0.00 | -0.00 |
| 38 | -1.36 | 0.50 | -2.27 | 0.00 | 0.00 | 0.00 |
| 39 | 1.36 | 0.49 | 2.27 | -0.00 | 0.00 | -0.00 |
| 40 | 1.36 | 0.50 | 2.27 | -0.00 | 0.00 | 0.00 |
| 41 | 1.36 | 0.50 | 2.27 | -0.00 | -0.00 | -0.00 |
| 42 | -1.36 | 0.50 | -2.27 | 0.00 | -0.00 | 0.00 |
| 43 | 1.36 | 0.49 | 2.27 | -0.00 | 0.00 | -0.00 |
| 44 | 1.36 | 0.50 | 2.27 | -0.00 | 0.00 | 0.00 |
| 45 | 1.36 | 0.49 | 2.27 | -0.00 | 0.00 | -0.00 |
| 46 | -1.36 | 0.49 | -2.27 | 0.00 | 0.00 | 0.00 |
| 47 | 1.36 | 0.49 | 2.27 | -0.00 | 0.00 | -0.00 |
| 48 | 1.36 | 0.49 | 2.27 | -0.00 | 0.00 | 0.00 |
| 49 | 2.27 | 0.64 | 3.78 | -0.00 | 0.00 | -0.00 |
| 50 | -2.27 | 0.64 | -3.78 | 0.00 | 0.00 | 0.00 |
| 51 | 2.27 | 0.64 | 3.78 | -0.00 | 0.00 | -0.00 |
| 52 | 2.27 | 0.64 | 3.78 | -0.00 | 0.00 | 0.00 |
| 53 | 2.27 | 0.64 | 3.78 | -0.00 | -0.00 | -0.00 |
| 54 | -2.27 | 0.64 | -3.78 | 0.00 | -0.00 | 0.00 |
| 55 | 2.27 | 0.64 | 3.78 | -0.00 | 0.00 | -0.00 |
| 56 | 2.27 | 0.64 | 3.78 | -0.00 | 0.00 | 0.00 |
| 57 | 2.27 | 0.64 | 3.78 | -0.00 | -0.00 | -0.00 |
| 58 | -2.27 | 0.64 | -3.78 | 0.00 | -0.00 | 0.00 |
| 59 | 2.27 | 0.64 | 3.78 | -0.00 | 0.00 | -0.00 |
| 60 | 2.27 | 0.64 | 3.78 | -0.00 | 0.00 | 0.00 |
| 61 | 2.27 | 0.64 | 3.78 | -0.00 | 0.00 | -0.00 |
| 62 | -2.27 | 0.64 | -3.78 | 0.00 | 0.00 | 0.00 |
| 63 | 2.27 | 0.64 | 3.78 | -0.00 | 0.00 | -0.00 |
| 64 | 2.27 | 0.64 | 3.78 | -0.00 | 0.00 | 0.00 |
| 65 | 2.27 | 0.50 | 3.78 | -0.00 | 0.00 | -0.00 |
| 66 | -2.27 | 0.49 | -3.78 | 0.00 | 0.00 | 0.00 |
| 67 | 2.27 | 0.49 | 3.78 | -0.00 | 0.00 | -0.00 |
| 68 | 2.27 | 0.49 | 3.78 | -0.00 | 0.00 | 0.00 |
| 69 | 2.27 | 0.50 | 3.78 | -0.00 | -0.00 | -0.00 |
| 70 | -2.27 | 0.50 | -3.78 | 0.00 | -0.00 | 0.00 |
| 71 | 2.27 | 0.49 | 3.78 | -0.00 | 0.00 | -0.00 |
| 72 | 2.27 | 0.50 | 3.78 | -0.00 | 0.00 | 0.00 |
| 73 | 2.27 | 0.50 | 3.78 | -0.00 | -0.00 | -0.00 |
| 74 | -2.27 | 0.50 | -3.78 | 0.00 | -0.00 | 0.00 |
| 75 | 2.27 | 0.49 | 3.78 | -0.00 | 0.00 | -0.00 |
| 76 | 2.27 | 0.50 | 3.78 | -0.00 | 0.00 | 0.00 |
| 77 | 2.27 | 0.50 | 3.78 | -0.00 | 0.00 | -0.00 |
| 78 | -2.27 | 0.49 | -3.78 | 0.00 | 0.00 | 0.00 |
| 79 | 2.27 | 0.49 | 3.78 | -0.00 | 0.00 | -0.00 |
| 80 | 2.27 | 0.49 | 3.78 | -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 | 0.50 | 0.01 | -0.00 | 0.00 | -0.01 |
| 92 | -0.01 | 0.50 | -0.01 | 0.00 | 0.00 | 0.01 |
| 93 | 0.01 | 0.50 | 0.01 | -0.00 | 0.00 | -0.01 |
| 94 | -0.01 | 0.50 | -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: 49, M=2.27, N=0.64, M=-0.00, N=0.00

强度计算应力比 =0.036

抗剪强度计算控制组合号: 49, V=3.78

抗剪强度计算应力比 =0.027

平面内稳定计算最大应力对应组合号: 49, M=2.27, N=0.64, M=-0.00, N=0.00

平面内稳定计算最大应力 (N/mm\*mm) =7.12

平面内稳定计算最大应力比 =0.033

临界弯矩Mcr(kN\*m) =2748.54

平面外稳定计算最大应力比 =0.012

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 =0.036 < 1.0

抗剪强度计算应力比 =0.027 < 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 | 0.50 | 0.00 | -0.00 | 0.00 | -0.00 |
| 3 | 0.00 | 0.50 | 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 | 0.61 | 0.50 | 1.01 | -0.00 | -0.00 | -0.00 |
| 10 | -0.60 | 0.50 | -1.01 | 0.00 | 0.00 | 0.00 |
| 11 | 0.61 | 0.49 | 1.01 | -0.00 | 0.00 | -0.00 |
| 12 | 0.61 | 0.50 | 1.01 | -0.00 | 0.00 | 0.00 |
| 13 | 0.61 | 0.45 | 1.01 | -0.00 | -0.00 | -0.00 |
| 14 | -0.60 | 0.45 | -1.01 | 0.00 | 0.00 | 0.00 |
| 15 | 0.61 | 0.45 | 1.01 | -0.00 | 0.00 | -0.00 |
| 16 | 0.61 | 0.45 | 1.01 | -0.00 | 0.00 | 0.00 |

防火设计控制的偶然组合号: 9, M=0.61, N=0.50, M=-0.00, N=-0.00

强度计算荷载比 =0.01

平面内稳定计算荷载比 =0.01

平面外稳定计算荷载比 =0.00

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 | 2.27 | 0.64 | 3.78 | -0.00 | -0.00 | -0.00 |
| 10 | -2.27 | 0.64 | -3.78 | 0.00 | 0.00 | -0.00 |
| 11 | -2.27 | 0.64 | -3.78 | -0.00 | 0.00 | 0.00 |
| 12 | -2.27 | 0.64 | -3.78 | -0.00 | 0.00 | -0.00 |
| 13 | 2.27 | 0.50 | 3.78 | -0.00 | -0.00 | -0.00 |
| 14 | -2.27 | 0.49 | -3.78 | 0.00 | 0.00 | -0.00 |
| 15 | -2.27 | 0.49 | -3.78 | -0.00 | 0.00 | 0.00 |
| 16 | -2.27 | 0.49 | -3.78 | -0.00 | 0.00 | -0.00 |
| 17 | 1.36 | 0.64 | 2.27 | -0.00 | 0.00 | -0.00 |
| 18 | -1.36 | 0.64 | -2.27 | 0.00 | 0.00 | -0.00 |
| 19 | -1.36 | 0.64 | -2.27 | -0.00 | 0.00 | -0.00 |
| 20 | -1.36 | 0.64 | -2.27 | -0.00 | 0.00 | -0.00 |
| 21 | 1.36 | 0.64 | 2.27 | -0.00 | 0.00 | -0.00 |
| 22 | -1.36 | 0.64 | -2.27 | 0.00 | 0.00 | -0.00 |
| 23 | -1.36 | 0.64 | -2.27 | -0.00 | 0.00 | 0.00 |
| 24 | -1.36 | 0.64 | -2.27 | -0.00 | 0.00 | -0.00 |
| 25 | 1.36 | 0.64 | 2.27 | -0.00 | 0.00 | -0.00 |
| 26 | -1.36 | 0.64 | -2.27 | 0.00 | 0.00 | -0.00 |
| 27 | -1.36 | 0.64 | -2.27 | -0.00 | 0.00 | 0.00 |
| 28 | -1.36 | 0.64 | -2.27 | -0.00 | 0.00 | -0.00 |
| 29 | 1.36 | 0.64 | 2.27 | -0.00 | 0.00 | -0.00 |
| 30 | -1.36 | 0.64 | -2.27 | 0.00 | 0.00 | -0.00 |
| 31 | -1.36 | 0.64 | -2.27 | -0.00 | 0.00 | 0.00 |
| 32 | -1.36 | 0.64 | -2.27 | -0.00 | 0.00 | -0.00 |
| 33 | 1.36 | 0.50 | 2.27 | -0.00 | 0.00 | -0.00 |
| 34 | -1.36 | 0.49 | -2.27 | 0.00 | 0.00 | -0.00 |
| 35 | -1.36 | 0.49 | -2.27 | -0.00 | 0.00 | -0.00 |
| 36 | -1.36 | 0.49 | -2.27 | -0.00 | 0.00 | -0.00 |
| 37 | 1.36 | 0.49 | 2.27 | -0.00 | -0.00 | -0.00 |
| 38 | -1.36 | 0.49 | -2.27 | 0.00 | 0.00 | -0.00 |
| 39 | -1.36 | 0.49 | -2.27 | -0.00 | 0.00 | 0.00 |
| 40 | -1.36 | 0.49 | -2.27 | -0.00 | 0.00 | -0.00 |
| 41 | 1.36 | 0.50 | 2.27 | -0.00 | -0.00 | -0.00 |
| 42 | -1.36 | 0.49 | -2.27 | 0.00 | 0.00 | -0.00 |
| 43 | -1.36 | 0.49 | -2.27 | -0.00 | 0.00 | 0.00 |
| 44 | -1.36 | 0.49 | -2.27 | -0.00 | 0.00 | -0.00 |
| 45 | 1.36 | 0.49 | 2.27 | -0.00 | 0.00 | -0.00 |
| 46 | -1.36 | 0.49 | -2.27 | 0.00 | 0.00 | -0.00 |
| 47 | -1.36 | 0.49 | -2.27 | -0.00 | 0.00 | 0.00 |
| 48 | -1.36 | 0.49 | -2.27 | -0.00 | 0.00 | -0.00 |
| 49 | 2.27 | 0.64 | 3.78 | -0.00 | 0.00 | -0.00 |
| 50 | -2.27 | 0.64 | -3.78 | 0.00 | 0.00 | -0.00 |
| 51 | -2.27 | 0.64 | -3.78 | -0.00 | 0.00 | 0.00 |
| 52 | -2.27 | 0.64 | -3.78 | -0.00 | 0.00 | -0.00 |
| 53 | 2.27 | 0.64 | 3.78 | -0.00 | -0.00 | -0.00 |
| 54 | -2.27 | 0.64 | -3.78 | 0.00 | 0.00 | -0.00 |
| 55 | -2.27 | 0.64 | -3.78 | -0.00 | 0.00 | 0.00 |
| 56 | -2.27 | 0.64 | -3.78 | -0.00 | 0.00 | -0.00 |
| 57 | 2.27 | 0.64 | 3.78 | -0.00 | -0.00 | -0.00 |
| 58 | -2.27 | 0.64 | -3.78 | 0.00 | 0.00 | -0.00 |
| 59 | -2.27 | 0.64 | -3.78 | -0.00 | 0.00 | 0.00 |
| 60 | -2.27 | 0.64 | -3.78 | -0.00 | 0.00 | -0.00 |
| 61 | 2.27 | 0.64 | 3.78 | -0.00 | 0.00 | -0.00 |
| 62 | -2.27 | 0.64 | -3.78 | 0.00 | 0.00 | -0.00 |
| 63 | -2.27 | 0.64 | -3.78 | -0.00 | 0.00 | 0.00 |
| 64 | -2.27 | 0.64 | -3.78 | -0.00 | 0.00 | -0.00 |
| 65 | 2.27 | 0.50 | 3.78 | -0.00 | -0.00 | -0.00 |
| 66 | -2.27 | 0.49 | -3.78 | 0.00 | 0.00 | -0.00 |
| 67 | -2.27 | 0.49 | -3.78 | -0.00 | 0.00 | 0.00 |
| 68 | -2.27 | 0.49 | -3.78 | -0.00 | 0.00 | -0.00 |
| 69 | 2.27 | 0.50 | 3.78 | -0.00 | -0.00 | -0.00 |
| 70 | -2.27 | 0.49 | -3.78 | 0.00 | 0.00 | -0.00 |
| 71 | -2.27 | 0.49 | -3.78 | -0.00 | 0.00 | 0.00 |
| 72 | -2.27 | 0.49 | -3.78 | -0.00 | 0.00 | -0.00 |
| 73 | 2.27 | 0.50 | 3.78 | -0.00 | -0.00 | -0.00 |
| 74 | -2.27 | 0.49 | -3.78 | 0.00 | 0.00 | -0.00 |
| 75 | -2.27 | 0.49 | -3.78 | -0.00 | 0.00 | 0.00 |
| 76 | -2.27 | 0.49 | -3.78 | -0.00 | 0.00 | -0.00 |
| 77 | 2.27 | 0.50 | 3.78 | -0.00 | -0.00 | -0.00 |
| 78 | -2.27 | 0.49 | -3.78 | 0.00 | 0.00 | -0.00 |
| 79 | -2.27 | 0.49 | -3.78 | -0.00 | 0.00 | 0.00 |
| 80 | -2.27 | 0.49 | -3.78 | -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: 49, M=2.27, N=0.64, M=-0.00, N=0.00

强度计算应力比 =0.036

抗剪强度计算控制组合号: 49, V=3.78

抗剪强度计算应力比 =0.027

平面内稳定计算最大应力对应组合号: 49, M=2.27, N=0.64, M=-0.00, N=0.00

平面内稳定计算最大应力 (N/mm\*mm) =7.12

平面内稳定计算最大应力比 =0.033

临界弯矩Mcr(kN\*m) =2748.54

平面外稳定计算最大应力比 =0.012

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 =0.036 < 1.0

抗剪强度计算应力比 =0.027 < 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 | 0.61 | 0.49 | 1.01 | -0.00 | 0.00 | -0.00 |
| 10 | -0.60 | 0.49 | -1.01 | 0.00 | 0.00 | -0.00 |
| 11 | -0.61 | 0.49 | -1.01 | -0.00 | 0.00 | 0.00 |
| 12 | -0.61 | 0.49 | -1.01 | -0.00 | 0.00 | -0.00 |
| 13 | 0.61 | 0.45 | 1.01 | -0.00 | 0.00 | -0.00 |
| 14 | -0.60 | 0.45 | -1.01 | 0.00 | 0.00 | -0.00 |
| 15 | -0.61 | 0.45 | -1.01 | -0.00 | 0.00 | 0.00 |
| 16 | -0.61 | 0.45 | -1.01 | -0.00 | 0.00 | -0.00 |

防火设计控制的偶然组合号: 9, M=0.61, N=0.49, M=-0.00, N=0.00

强度计算荷载比 =0.01

平面内稳定计算荷载比 =0.01

平面外稳定计算荷载比 =0.00

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 | 9.92 | 3.05 | 16.78 | -14.35 | 0.43 | 10.67 |
| 2 | 4.84 | 1.40 | 7.44 | -28.81 | 0.85 | 21.42 |
| 3 | 9.92 | 3.05 | 16.78 | -24.37 | 0.77 | 20.79 |
| 4 | 4.84 | 1.40 | 7.44 | -18.78 | 0.50 | 11.30 |
| 5 | 8.78 | 2.71 | 14.92 | -11.04 | 0.33 | 8.21 |
| 6 | 3.70 | 1.06 | 5.57 | -25.50 | 0.75 | 18.95 |
| 7 | 8.78 | 2.71 | 14.92 | -21.06 | 0.67 | 18.33 |
| 8 | 3.70 | 1.06 | 5.57 | -15.47 | 0.40 | 8.84 |
| 9 | -44.33 | -2.81 | -14.03 | -22.25 | 4.72 | 4.43 |
| 10 | 33.38 | -7.52 | 8.04 | 25.71 | 9.43 | -8.35 |
| 11 | -11.23 | 13.00 | 0.35 | -21.04 | -11.09 | 9.29 |
| 12 | 27.95 | 10.33 | 13.84 | 3.70 | -8.43 | 5.07 |
| 13 | -45.47 | -3.15 | -15.89 | -18.94 | 4.62 | 1.97 |
| 14 | 32.24 | -7.86 | 6.18 | 29.02 | 9.33 | -10.81 |
| 15 | -12.37 | 12.66 | -1.51 | -17.72 | -11.19 | 6.83 |
| 16 | 26.81 | 9.99 | 11.98 | 7.01 | -8.52 | 2.61 |
| 17 | -19.64 | 0.48 | 3.52 | -19.09 | 3.00 | 6.93 |
| 18 | 26.99 | -2.35 | 16.77 | 9.69 | 5.83 | -0.74 |
| 19 | 0.22 | 9.96 | 12.15 | -18.36 | -6.48 | 9.85 |
| 20 | 23.73 | 8.36 | 20.25 | -3.52 | -4.89 | 7.31 |
| 21 | -24.72 | -1.17 | -5.82 | -33.55 | 3.42 | 17.67 |
| 22 | 21.91 | -4.00 | 7.42 | -4.78 | 6.25 | 10.01 |
| 23 | -4.86 | 8.31 | 2.80 | -32.82 | -6.06 | 20.59 |
| 24 | 18.65 | 6.71 | 10.90 | -17.98 | -4.46 | 18.05 |
| 25 | -19.64 | 0.48 | 3.52 | -29.11 | 3.34 | 17.04 |
| 26 | 26.99 | -2.35 | 16.77 | -0.34 | 6.17 | 9.38 |
| 27 | 0.22 | 9.96 | 12.15 | -28.39 | -6.14 | 19.96 |
| 28 | 23.73 | 8.36 | 20.25 | -13.55 | -4.54 | 17.43 |
| 29 | -24.72 | -1.17 | -5.82 | -23.52 | 3.08 | 7.56 |
| 30 | 21.91 | -4.00 | 7.42 | 5.25 | 5.90 | -0.11 |
| 31 | -4.86 | 8.31 | 2.80 | -22.80 | -6.41 | 10.47 |
| 32 | 18.65 | 6.71 | 10.90 | -7.96 | -4.81 | 7.94 |
| 33 | -20.78 | 0.14 | 1.66 | -15.78 | 2.90 | 4.46 |
| 34 | 25.85 | -2.69 | 14.91 | 13.00 | 5.73 | -3.20 |
| 35 | -0.92 | 9.62 | 10.29 | -15.05 | -6.58 | 7.38 |
| 36 | 22.59 | 8.02 | 18.39 | -0.21 | -4.98 | 4.85 |
| 37 | -25.86 | -1.51 | -7.68 | -30.24 | 3.32 | 15.21 |
| 38 | 20.77 | -4.34 | 5.56 | -1.46 | 6.15 | 7.54 |
| 39 | -6.00 | 7.97 | 0.94 | -29.51 | -6.16 | 18.13 |
| 40 | 17.51 | 6.37 | 9.04 | -14.67 | -4.56 | 15.59 |
| 41 | -20.78 | 0.14 | 1.66 | -25.80 | 3.24 | 14.58 |
| 42 | 25.85 | -2.69 | 14.91 | 2.97 | 6.07 | 6.92 |
| 43 | -0.92 | 9.62 | 10.29 | -25.07 | -6.24 | 17.50 |
| 44 | 22.59 | 8.02 | 18.39 | -10.24 | -4.64 | 14.96 |
| 45 | -25.86 | -1.51 | -7.68 | -20.21 | 2.98 | 5.09 |
| 46 | 20.77 | -4.34 | 5.56 | 8.56 | 5.81 | -2.57 |
| 47 | -6.00 | 7.97 | 0.94 | -19.49 | -6.51 | 8.01 |
| 48 | 17.51 | 6.37 | 9.04 | -4.65 | -4.91 | 5.48 |
| 49 | -40.84 | -1.71 | -7.93 | -22.25 | 4.72 | 4.43 |
| 50 | 36.87 | -6.42 | 14.14 | 25.71 | 9.43 | -8.35 |
| 51 | -7.74 | 14.10 | 6.45 | -21.04 | -11.09 | 9.29 |
| 52 | 31.44 | 11.43 | 19.95 | 3.70 | -8.43 | 5.07 |
| 53 | -44.40 | -2.86 | -14.47 | -32.37 | 5.01 | 11.95 |
| 54 | 33.32 | -7.58 | 7.60 | 15.59 | 9.72 | -0.82 |
| 55 | -11.30 | 12.94 | -0.09 | -31.16 | -10.80 | 16.82 |
| 56 | 27.88 | 10.28 | 13.40 | -6.43 | -8.13 | 12.59 |
| 57 | -40.84 | -1.71 | -7.93 | -29.26 | 4.96 | 11.51 |
| 58 | 36.87 | -6.42 | 14.14 | 18.69 | 9.67 | -1.26 |
| 59 | -7.74 | 14.10 | 6.45 | -28.05 | -10.85 | 16.38 |
| 60 | 31.44 | 11.43 | 19.95 | -3.32 | -8.19 | 12.15 |
| 61 | -44.40 | -2.86 | -14.47 | -25.35 | 4.77 | 4.87 |
| 62 | 33.32 | -7.58 | 7.60 | 22.60 | 9.48 | -7.91 |
| 63 | -11.30 | 12.94 | -0.09 | -24.14 | -11.04 | 9.73 |
| 64 | 27.88 | 10.28 | 13.40 | 0.59 | -8.37 | 5.51 |
| 65 | -41.98 | -2.05 | -9.79 | -18.94 | 4.62 | 1.97 |
| 66 | 35.73 | -6.76 | 12.28 | 29.02 | 9.33 | -10.81 |
| 67 | -8.88 | 13.76 | 4.59 | -17.72 | -11.19 | 6.83 |
| 68 | 30.30 | 11.09 | 18.08 | 7.01 | -8.52 | 2.61 |
| 69 | -45.54 | -3.21 | -16.33 | -29.06 | 4.91 | 9.49 |
| 70 | 32.18 | -7.92 | 5.74 | 18.90 | 9.62 | -3.29 |
| 71 | -12.44 | 12.60 | -1.95 | -27.85 | -10.89 | 14.35 |
| 72 | 26.74 | 9.94 | 11.54 | -3.12 | -8.23 | 10.13 |
| 73 | -41.98 | -2.05 | -9.79 | -25.95 | 4.86 | 9.05 |
| 74 | 35.73 | -6.76 | 12.28 | 22.00 | 9.57 | -3.73 |
| 75 | -8.88 | 13.76 | 4.59 | -24.74 | -10.95 | 13.91 |
| 76 | 30.30 | 11.09 | 18.08 | -0.01 | -8.28 | 9.69 |
| 77 | -45.54 | -3.21 | -16.33 | -22.04 | 4.67 | 2.41 |
| 78 | 32.18 | -7.92 | 5.74 | 25.91 | 9.38 | -10.37 |
| 79 | -12.44 | 12.60 | -1.95 | -20.83 | -11.13 | 7.27 |
| 80 | 26.74 | 9.94 | 11.54 | 3.90 | -8.47 | 3.05 |
| 81 | 4.27 | 2.12 | 11.20 | -16.14 | 0.47 | 11.31 |
| 82 | 9.93 | 2.21 | 12.48 | -12.56 | 0.38 | 10.03 |
| 83 | 2.06 | 1.40 | 7.15 | -22.40 | 0.65 | 15.97 |
| 84 | 7.73 | 1.49 | 8.43 | -18.82 | 0.56 | 14.69 |
| 85 | 4.27 | 2.12 | 11.20 | -20.48 | 0.62 | 15.70 |
| 86 | 9.93 | 2.21 | 12.48 | -16.90 | 0.53 | 14.41 |
| 87 | 2.06 | 1.40 | 7.15 | -18.06 | 0.50 | 11.59 |
| 88 | 7.73 | 1.49 | 8.43 | -14.48 | 0.42 | 10.30 |
| 89 | 2.63 | 1.62 | 8.47 | -12.83 | 0.37 | 8.85 |
| 90 | 8.30 | 1.71 | 9.75 | -9.24 | 0.28 | 7.57 |
| 91 | 0.93 | 1.07 | 5.35 | -17.65 | 0.51 | 12.43 |
| 92 | 6.60 | 1.16 | 6.63 | -14.07 | 0.42 | 11.15 |
| 93 | 2.63 | 1.62 | 8.47 | -16.17 | 0.48 | 12.22 |
| 94 | 8.30 | 1.71 | 9.75 | -12.59 | 0.40 | 10.94 |
| 95 | 0.93 | 1.07 | 5.35 | -14.31 | 0.40 | 9.06 |
| 96 | 6.60 | 1.16 | 6.63 | -10.72 | 0.31 | 7.78 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -45.54 | -30.95 | -20.34 | -16.72 | -11.73 | -16.66 | -29.02 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 36.87 | 24.35 | 15.53 | 5.78 | 8.63 | 15.96 | 33.55 |

强度计算应力比 =0.560

抗剪强度计算应力比 =0.122

平面内稳定计算最大应力对应组合号: 1, M=9.92, N=3.05, M=-14.35, N=0.43

平面内稳定最大应力 (N/mm\*mm) =108.49

平面内稳定计算最大应力比 =0.505

临界弯矩Mcr(kN\*m) =83.19

平面外稳定计算最大应力比 =0.420

强度计算应力比 =0.560 < 1.0

抗剪强度计算应力比 =0.122 < 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 =0.420 < 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 | 2.34 | 4.14 | 4.58 | 3.52 | 1.56 | 0.00 |

最大挠度值 =4.58 最大挠度/梁跨度 =1/1567.

斜梁坡度初始值: 1/9.83

变形后斜梁坡度最小值: 1/10.02

变形后斜梁坡度改变率 =0.019 < 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 | 5.46 | 1.66 | 9.11 | -11.04 | 0.33 | 8.21 |
| 2 | 3.77 | 1.11 | 5.99 | -15.86 | 0.47 | 11.79 |
| 3 | 5.46 | 1.66 | 9.11 | -14.38 | 0.44 | 11.58 |
| 4 | 3.77 | 1.11 | 5.99 | -12.51 | 0.35 | 8.42 |
| 5 | 5.08 | 1.55 | 8.49 | -9.93 | 0.29 | 7.39 |
| 6 | 3.39 | 1.00 | 5.37 | -14.75 | 0.43 | 10.97 |
| 7 | 5.08 | 1.55 | 8.49 | -13.27 | 0.41 | 10.76 |
| 8 | 3.39 | 1.00 | 5.37 | -11.41 | 0.32 | 7.60 |
| 9 | -9.34 | -0.01 | 0.31 | -13.14 | 1.47 | 6.54 |
| 10 | 11.39 | -1.26 | 6.20 | -0.35 | 2.73 | 3.14 |
| 11 | -0.51 | 4.21 | 4.14 | -12.82 | -2.74 | 7.84 |
| 12 | 9.94 | 3.50 | 7.74 | -6.22 | -2.03 | 6.71 |
| 13 | -9.72 | -0.12 | -0.31 | -12.04 | 1.44 | 5.72 |
| 14 | 11.01 | -1.38 | 5.58 | 0.75 | 2.70 | 2.32 |
| 15 | -0.89 | 4.10 | 3.52 | -11.72 | -2.78 | 7.02 |
| 16 | 9.56 | 3.39 | 7.12 | -5.12 | -2.07 | 5.89 |

--- 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 -9.72 -9.02 -8.15 -8.73 -5.17 -2.74 -0.75

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 11.39 5.09 0.76 0.00 0.45 5.96 15.86

强度计算荷载比 =0.20

平面内稳定计算荷载比 =0.17

平面外稳定计算荷载比 =0.19

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): 653.93℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2565(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 | 28.81 | -0.85 | 21.42 | -4.84 | -1.40 | 7.44 |
| 2 | 14.35 | -0.43 | 10.67 | -9.92 | -3.05 | 16.78 |
| 3 | 24.37 | -0.77 | 20.79 | -9.92 | -3.05 | 16.78 |
| 4 | 18.78 | -0.50 | 11.30 | -4.84 | -1.40 | 7.44 |
| 5 | 25.50 | -0.75 | 18.95 | -3.70 | -1.06 | 5.57 |
| 6 | 11.04 | -0.33 | 8.21 | -8.78 | -2.71 | 14.92 |
| 7 | 21.06 | -0.67 | 18.33 | -8.78 | -2.71 | 14.92 |
| 8 | 15.47 | -0.40 | 8.84 | -3.70 | -1.06 | 5.57 |
| 9 | -25.78 | -9.42 | -8.38 | -33.46 | 7.52 | 8.05 |
| 10 | 22.20 | -4.73 | 4.41 | 44.26 | 2.82 | -14.02 |
| 11 | -3.70 | 8.42 | 5.07 | -27.95 | -10.33 | 13.84 |
| 12 | 21.04 | 11.09 | 9.29 | 11.23 | -13.00 | 0.35 |
| 13 | -29.09 | -9.33 | -10.84 | -32.32 | 7.86 | 6.19 |
| 14 | 18.89 | -4.63 | 1.95 | 45.40 | 3.17 | -15.88 |
| 15 | -7.01 | 8.52 | 2.61 | -26.81 | -9.99 | 11.98 |
| 16 | 17.72 | 11.19 | 6.83 | 12.37 | -12.66 | -1.51 |
| 17 | 4.73 | -6.25 | 9.99 | -21.95 | 4.00 | 7.43 |
| 18 | 33.52 | -3.43 | 17.66 | 24.68 | 1.18 | -5.81 |
| 19 | 17.98 | 4.46 | 18.05 | -18.65 | -6.71 | 10.90 |
| 20 | 32.82 | 6.06 | 20.59 | 4.86 | -8.31 | 2.80 |
| 21 | -9.73 | -5.82 | -0.76 | -27.03 | 2.35 | 16.77 |
| 22 | 19.06 | -3.01 | 6.92 | 19.60 | -0.47 | 3.53 |
| 23 | 3.52 | 4.88 | 7.31 | -23.73 | -8.36 | 20.25 |
| 24 | 18.36 | 6.48 | 9.85 | -0.22 | -9.96 | 12.15 |
| 25 | 0.30 | -6.17 | 9.36 | -27.03 | 2.35 | 16.77 |
| 26 | 29.08 | -3.35 | 17.03 | 19.60 | -0.47 | 3.53 |
| 27 | 13.55 | 4.54 | 17.43 | -23.73 | -8.36 | 20.25 |
| 28 | 28.39 | 6.14 | 19.96 | -0.22 | -9.96 | 12.15 |
| 29 | -5.29 | -5.90 | -0.13 | -21.95 | 4.00 | 7.43 |
| 30 | 23.50 | -3.09 | 7.54 | 24.68 | 1.18 | -5.81 |
| 31 | 7.96 | 4.81 | 7.94 | -18.65 | -6.71 | 10.90 |
| 32 | 22.80 | 6.41 | 10.47 | 4.86 | -8.31 | 2.80 |
| 33 | 1.42 | -6.15 | 7.52 | -20.81 | 4.34 | 5.56 |
| 34 | 30.21 | -3.33 | 15.20 | 25.82 | 1.52 | -7.68 |
| 35 | 14.67 | 4.56 | 15.59 | -17.51 | -6.37 | 9.04 |
| 36 | 29.51 | 6.16 | 18.13 | 6.00 | -7.97 | 0.94 |
| 37 | -13.04 | -5.73 | -3.22 | -25.89 | 2.69 | 14.91 |
| 38 | 15.75 | -2.91 | 4.45 | 20.74 | -0.13 | 1.67 |
| 39 | 0.21 | 4.98 | 4.85 | -22.59 | -8.02 | 18.39 |
| 40 | 15.05 | 6.58 | 7.38 | 0.92 | -9.62 | 10.29 |
| 41 | -3.01 | -6.07 | 6.90 | -25.89 | 2.69 | 14.91 |
| 42 | 25.77 | -3.25 | 14.57 | 20.74 | -0.13 | 1.67 |
| 43 | 10.24 | 4.64 | 14.96 | -22.59 | -8.02 | 18.39 |
| 44 | 25.07 | 6.24 | 17.50 | 0.92 | -9.62 | 10.29 |
| 45 | -8.60 | -5.80 | -2.59 | -20.81 | 4.34 | 5.56 |
| 46 | 20.18 | -2.99 | 5.08 | 25.82 | 1.52 | -7.68 |
| 47 | 4.65 | 4.91 | 5.48 | -17.51 | -6.37 | 9.04 |
| 48 | 19.49 | 6.51 | 8.01 | 6.00 | -7.97 | 0.94 |
| 49 | -15.65 | -9.72 | -0.86 | -33.39 | 7.57 | 7.61 |
| 50 | 32.32 | -5.02 | 11.93 | 44.33 | 2.88 | -14.46 |
| 51 | 6.43 | 8.13 | 12.59 | -27.88 | -10.28 | 13.40 |
| 52 | 31.16 | 10.80 | 16.82 | 11.30 | -12.94 | -0.09 |
| 53 | -25.78 | -9.42 | -8.38 | -36.95 | 6.42 | 14.15 |
| 54 | 22.20 | -4.73 | 4.41 | 40.77 | 1.72 | -7.92 |
| 55 | -3.70 | 8.42 | 5.07 | -31.44 | -11.43 | 19.95 |
| 56 | 21.04 | 11.09 | 9.29 | 7.74 | -14.10 | 6.45 |
| 57 | -18.76 | -9.66 | -1.30 | -36.95 | 6.42 | 14.15 |
| 58 | 29.22 | -4.97 | 11.49 | 40.77 | 1.72 | -7.92 |
| 59 | 3.32 | 8.18 | 12.15 | -31.44 | -11.43 | 19.95 |
| 60 | 28.05 | 10.85 | 16.38 | 7.74 | -14.10 | 6.45 |
| 61 | -22.67 | -9.48 | -7.94 | -33.39 | 7.57 | 7.61 |
| 62 | 25.31 | -4.78 | 4.85 | 44.33 | 2.88 | -14.46 |
| 63 | -0.59 | 8.37 | 5.51 | -27.88 | -10.28 | 13.40 |
| 64 | 24.14 | 11.04 | 9.73 | 11.30 | -12.94 | -0.09 |
| 65 | -18.96 | -9.62 | -3.32 | -32.25 | 7.91 | 5.75 |
| 66 | 29.01 | -4.93 | 9.47 | 45.47 | 3.22 | -16.32 |
| 67 | 3.12 | 8.23 | 10.13 | -26.74 | -9.94 | 11.54 |
| 68 | 27.85 | 10.89 | 14.35 | 12.44 | -12.60 | -1.95 |
| 69 | -29.09 | -9.33 | -10.84 | -35.81 | 6.76 | 12.29 |
| 70 | 18.89 | -4.63 | 1.95 | 41.91 | 2.06 | -9.78 |
| 71 | -7.01 | 8.52 | 2.61 | -30.29 | -11.09 | 18.08 |
| 72 | 17.72 | 11.19 | 6.83 | 8.88 | -13.76 | 4.59 |
| 73 | -22.07 | -9.57 | -3.76 | -35.81 | 6.76 | 12.29 |
| 74 | 25.91 | -4.87 | 9.03 | 41.91 | 2.06 | -9.78 |
| 75 | 0.01 | 8.28 | 9.69 | -30.29 | -11.09 | 18.08 |
| 76 | 24.74 | 10.95 | 13.91 | 8.88 | -13.76 | 4.59 |
| 77 | -25.98 | -9.38 | -10.40 | -32.25 | 7.91 | 5.75 |
| 78 | 22.00 | -4.69 | 2.39 | 45.47 | 3.22 | -16.32 |
| 79 | -3.90 | 8.47 | 3.05 | -26.74 | -9.94 | 11.54 |
| 80 | 20.83 | 11.14 | 7.27 | 12.44 | -12.60 | -1.95 |
| 81 | 18.82 | -0.56 | 14.69 | -7.73 | -1.49 | 8.43 |
| 82 | 22.40 | -0.65 | 15.97 | -2.06 | -1.40 | 7.15 |
| 83 | 12.56 | -0.38 | 10.03 | -9.93 | -2.21 | 12.48 |
| 84 | 16.14 | -0.47 | 11.31 | -4.27 | -2.12 | 11.20 |
| 85 | 16.90 | -0.53 | 14.41 | -9.93 | -2.21 | 12.48 |
| 86 | 20.48 | -0.62 | 15.70 | -4.27 | -2.12 | 11.20 |
| 87 | 14.48 | -0.42 | 10.30 | -7.73 | -1.49 | 8.43 |
| 88 | 18.06 | -0.50 | 11.59 | -2.06 | -1.40 | 7.15 |
| 89 | 14.07 | -0.42 | 11.15 | -6.60 | -1.16 | 6.63 |
| 90 | 17.65 | -0.51 | 12.43 | -0.93 | -1.07 | 5.35 |
| 91 | 9.24 | -0.28 | 7.57 | -8.30 | -1.71 | 9.75 |
| 92 | 12.83 | -0.37 | 8.85 | -2.63 | -1.62 | 8.47 |
| 93 | 12.59 | -0.40 | 10.94 | -8.30 | -1.71 | 9.75 |
| 94 | 16.17 | -0.48 | 12.22 | -2.63 | -1.62 | 8.47 |
| 95 | 10.72 | -0.31 | 7.78 | -6.60 | -1.16 | 6.63 |
| 96 | 14.31 | -0.40 | 9.06 | -0.93 | -1.07 | 5.35 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -29.09 | -16.70 | -11.73 | -16.72 | -20.31 | -30.90 | -45.47 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 33.52 | 15.94 | 8.62 | 5.81 | 15.58 | 24.42 | 36.95 |

强度计算应力比 =0.559

抗剪强度计算应力比 =0.122

平面内稳定计算最大应力对应组合号: 1, M=28.81, N=-0.85, M=-4.84, N=-1.40

平面内稳定最大应力 (N/mm\*mm) =108.33

平面内稳定计算最大应力比 =0.504

临界弯矩Mcr(kN\*m) =117.69

平面外稳定计算最大应力比 =0.419

强度计算应力比 =0.559 < 1.0

抗剪强度计算应力比 =0.122 < 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 =0.419 < 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 | 1.56 | 3.52 | 4.58 | 4.14 | 2.34 | 0.00 |

最大挠度值 =4.58 最大挠度/梁跨度 =1/1567.

斜梁坡度初始值: 1/9.83

变形后斜梁坡度最小值: 1/10.02

变形后斜梁坡度改变率 =0.019 < 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 | 15.86 | -0.47 | 11.79 | -3.77 | -1.11 | 5.99 |
| 2 | 11.04 | -0.33 | 8.21 | -5.46 | -1.66 | 9.11 |
| 3 | 14.38 | -0.44 | 11.58 | -5.46 | -1.66 | 9.11 |
| 4 | 12.51 | -0.35 | 8.42 | -3.77 | -1.11 | 5.99 |
| 5 | 14.75 | -0.43 | 10.97 | -3.39 | -1.00 | 5.37 |
| 6 | 9.93 | -0.29 | 7.39 | -5.08 | -1.55 | 8.49 |
| 7 | 13.27 | -0.41 | 10.76 | -5.08 | -1.55 | 8.49 |
| 8 | 11.41 | -0.32 | 7.60 | -3.39 | -1.00 | 5.37 |
| 9 | 0.34 | -2.73 | 3.13 | -11.41 | 1.26 | 6.20 |
| 10 | 13.13 | -1.48 | 6.54 | 9.32 | 0.01 | 0.31 |
| 11 | 6.22 | 2.03 | 6.71 | -9.94 | -3.50 | 7.74 |
| 12 | 12.82 | 2.74 | 7.84 | 0.51 | -4.21 | 4.14 |
| 13 | -0.77 | -2.69 | 2.31 | -11.03 | 1.37 | 5.58 |
| 14 | 12.03 | -1.44 | 5.72 | 9.70 | 0.12 | -0.31 |
| 15 | 5.12 | 2.07 | 5.89 | -9.56 | -3.39 | 7.12 |
| 16 | 11.72 | 2.78 | 7.02 | 0.89 | -4.10 | 3.52 |

--- 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 -0.77 -2.75 -5.17 -8.73 -8.15 -9.01 -9.70

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 15.86 5.96 0.45 0.00 0.77 5.11 11.41

强度计算荷载比 =0.20

平面内稳定计算荷载比 =0.17

平面外稳定计算荷载比 =0.19

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): 653.93℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2565(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=73.049(mm) =H /100.

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=5.486(mm) =H /1331.

梁的(恒+活)最大挠度:

梁( 1), 挠跨比 =1 /1567.

风载作用下柱顶最大水平位移: H/100< 柱顶位移容许值: H/60

地震作用下柱顶最大水平位移: H/1331< 柱顶位移容许值: H/60

梁的(恒+活)最大挠跨比: 1/1567< 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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\CalcTemp\\平面外计算长度系数.T)