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30日15时 1分 5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: 6

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: Q355

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 /240

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 | -0.15 | 7.10 | 2 | 18.15 | 7.10 |
| 3 | 9.00 | 8.00 | 4 | -0.40 | 8.60 |
| 5 | 18.40 | 8.60 | 6 | -0.15 | 0.00 |
| 7 | 9.00 | 0.00 | 8 | 18.15 | 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 | -0.250 | 2 | 0.250 | 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=200\*180\*180\*6\*8\*8 |
| 3 | 焊接组合H形截面:  H\*B1\*B2\*Tw\*T1\*T2=300\*200\*200\*6\*10\*10 |
| 4 | 焊接组合H形截面:  H\*B1\*B2\*Tw\*T1\*T2=300\*180\*180\*6\*10\*10 |
| 5 | H形变截面:  (H1~H2)\*B1\*B2\*Tw\*T1\*T2=(600~400)\*220\*220\*6\*10\*10 |
| 6 | H形变截面:  (H1~H2)\*B1\*B2\*Tw\*T1\*T2=(400~600)\*220\*220\*6\*10\*10 |

**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 | 3 | I端铰接 | 0 |
| 2 | 3 | I端铰接 | 0 |
| 3 | 3 | I端铰接 | 0 |
| 4 | 2 | 两端刚接 | 0 |
| 5 | 2 | 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 | 90.0 | 100.0 | 2967.2 | 777.9 | 39.8 |
| 3 | 100.0 | 150.0 | 9510.9 | 1333.8 | 56.8 |
| 4 | 90.0 | 150.0 | 8669.6 | 972.5 | 52.8 |
| 5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

| 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 | 8.6 | 4.4 | 296.7 | 296.7 | 86.4 | 86.4 |
| 3 | 12.9 | 4.8 | 634.1 | 634.1 | 133.4 | 133.4 |
| 4 | 12.8 | 4.3 | 578.0 | 578.0 | 108.1 | 108.1 |
| 5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

**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 | 0.49 | 0.00 | 0.00 |
| 3 | 1 | 1.02 | 0.00 | 0.00 |
| 4 | 1 | 2.76 | 0.00 | 0.00 |
| 5 | 1 | 2.76 | 0.00 | 0.00 |
| 右风1 | 1 | 1 | -1.02 | 0.00 | 0.00 |
| 3 | 1 | -0.49 | 0.00 | 0.00 |
| 4 | 1 | -2.76 | 0.00 | 0.00 |
| 5 | 1 | -2.76 | 0.00 | 0.00 |
| 左风2 | 1 | 1 | 1.25 | 0.00 | 0.00 |
| 3 | 1 | 0.26 | 0.00 | 0.00 |
| 4 | 1 | 2.76 | 0.00 | 0.00 |
| 5 | 1 | 2.76 | 0.00 | 0.00 |
| 右风2 | 1 | 1 | -0.26 | 0.00 | 0.00 |
| 3 | 1 | -1.25 | 0.00 | 0.00 |
| 4 | 1 | -2.76 | 0.00 | 0.00 |
| 5 | 1 | -2.76 | 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 | 2.07 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 2.07 | 0.00 | 0.00 | 0.00 |
| 活荷载 | 1 | 1 | 1 | 2.30 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 2.30 | 0.00 | 0.00 | 0.00 |
| 左风1 | 1 | 1 | 1 | -1.85 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.17 | 0.00 | 0.00 | 0.00 |
| 右风1 | 1 | 1 | 1 | -1.17 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.85 | 0.00 | 0.00 | 0.00 |
| 左风2 | 1 | 1 | 1 | -1.08 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -0.40 | 0.00 | 0.00 | 0.00 |
| 右风2 | 1 | 1 | 1 | -0.40 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.08 | 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 | 74.868 |
| 4 | 0.285 |
| 5 | 0.285 |

水平地震标准值作用底层剪力： 1.353

底层最小地震剪力(抗震规范5.2.5条): 0.604

各质点地震力调整系数: 1.000

地震力调整后剪重比： 0.018

**周期(已乘折减系数)**

| 振型号 | 周期(s) |
| --- | --- |
| 1 | 0.853 |
| 2 | 0.016 |
| 3 | 0.016 |

## **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 | 74.868 |
| 4 | 0.285 |
| 5 | 0.285 |

水平地震标准值作用底层剪力： 1.353

底层最小地震剪力(抗震规范5.2.5条): 0.604

各质点地震力调整系数: 1.000

地震力调整后剪重比： 0.018

**周期(已乘折减系数)**

| 振型号 | 周期(s) |
| --- | --- |
| 1 | 0.853 |
| 2 | 0.016 |
| 3 | 0.016 |

**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 | -1.3 | 0.0 | -11.1 | 1.3 | -9.3 |
| 2 | 30.4 | 0.0 | 0.0 | -26.1 | -0.0 | 0.0 |
| 3 | 14.9 | 1.3 | 0.0 | -11.1 | -1.3 | 9.3 |
| 4 | 0.6 | -0.0 | -0.0 | -0.0 | 0.0 | -0.0 |
| 5 | 0.6 | 0.0 | 0.0 | 0.0 | -0.0 | -0.0 |
| 左风1 | 1 | -13.4 | 6.7 | 0.0 | 13.4 | -3.2 | 35.3 |
| 2 | -14.7 | 4.9 | 0.0 | 14.7 | -4.9 | 38.9 |
| 3 | 0.5 | 6.8 | 0.0 | -0.5 | 0.4 | 22.7 |
| 4 | 0.0 | 4.1 | 3.1 | -0.0 | 0.0 | -0.0 |
| 5 | -0.0 | 4.1 | 3.1 | 0.0 | -0.0 | 0.0 |
| 右风1 | 1 | 0.5 | -6.8 | 0.0 | -0.5 | -0.4 | -22.7 |
| 2 | -14.7 | -4.9 | 0.0 | 14.7 | 4.9 | -38.8 |
| 3 | -13.4 | -6.7 | 0.0 | 13.4 | 3.2 | -35.3 |
| 4 | -0.0 | -4.1 | -3.1 | 0.0 | 0.0 | 0.0 |
| 5 | 0.0 | -4.1 | -3.1 | -0.0 | 0.0 | -0.0 |
| 左风2 | 1 | -9.6 | 8.7 | 0.0 | 9.6 | 0.2 | 30.2 |
| 2 | -8.4 | 4.9 | 0.0 | 8.4 | -4.9 | 38.9 |
| 3 | 4.3 | 4.8 | 0.0 | -4.3 | -3.0 | 27.8 |
| 4 | 0.0 | 4.1 | 3.1 | -0.0 | 0.0 | -0.0 |
| 5 | -0.0 | 4.1 | 3.1 | 0.0 | 0.0 | -0.0 |
| 右风2 | 1 | 4.3 | -4.8 | 0.0 | -4.3 | 3.0 | -27.8 |
| 2 | -8.4 | -4.9 | 0.0 | 8.4 | 4.9 | -38.9 |
| 3 | -9.6 | -8.7 | 0.0 | 9.6 | -0.2 | -30.2 |
| 4 | -0.0 | -4.1 | -3.1 | 0.0 | -0.0 | 0.0 |
| 5 | 0.0 | -4.1 | -3.1 | -0.0 | -0.0 | -0.0 |
| 左地震 | 1 | -0.6 | 0.4 | -0.0 | 0.6 | -0.4 | 3.2 |
| 2 | 0.0 | 0.5 | -0.0 | -0.0 | -0.5 | 4.2 |
| 3 | 0.6 | 0.4 | -0.0 | -0.6 | -0.4 | 3.2 |
| 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 | -3.2 |
| 2 | -0.0 | -0.5 | -0.0 | 0.0 | 0.5 | -4.2 |
| 3 | -0.6 | -0.4 | -0.0 | 0.6 | 0.4 | -3.2 |
| 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 | 2.3 | 10.4 | 9.4 | -0.0 | 13.1 | -22.2 |
| 2 | 0.0 | 13.1 | 22.2 | -2.3 | 10.4 | -9.4 |
| 左风1 | 1 | -0.4 | -13.4 | -38.4 | 0.4 | -3.6 | -6.7 |
| 2 | -4.5 | -11.7 | -32.2 | 4.5 | 0.9 | -25.8 |
| 右风1 | 1 | -4.5 | 0.9 | 25.8 | 4.5 | -11.7 | 32.2 |
| 2 | -0.4 | -3.6 | 6.7 | 0.4 | -13.4 | 38.4 |
| 左风2 | 1 | 3.4 | -9.9 | -33.3 | -3.4 | -0.0 | -12.2 |
| 2 | -0.7 | -8.1 | -26.7 | 0.7 | 4.4 | -30.9 |
| 右风2 | 1 | -0.7 | 4.4 | 30.9 | 0.7 | -8.1 | 26.7 |
| 2 | 3.4 | -0.0 | 12.2 | -3.4 | -9.9 | 33.3 |
| 左地震 | 1 | -0.0 | -0.6 | -3.2 | 0.0 | 0.6 | -2.1 |
| 2 | 0.0 | -0.6 | -2.1 | -0.0 | 0.6 | -3.2 |
| 右地震 | 1 | 0.0 | 0.6 | 3.2 | -0.0 | -0.6 | 2.1 |
| 2 | -0.0 | 0.6 | 2.1 | 0.0 | -0.6 | 3.2 |

**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 | -0.00 | 0.08 |
| 2 | 0.00 | 0.08 |
| 3 | 0.00 | 0.19 |
| 4 | 1.68 | 0.08 |
| 5 | -1.68 | 0.08 |

**活荷载工况下节点位移（mm）**

| 节点号 | X向位移 | Y向位移 |
| --- | --- | --- |
| 1 | -0.00 | 0.06 |
| 2 | 0.00 | 0.06 |
| 3 | 0.00 | 0.16 |
| 4 | 1.52 | 0.06 |
| 5 | -1.52 | 0.06 |

**节点侧向（水平向）位移(mm)**

| 工况 | 节点 | δx | 节点 | δx |
| --- | --- | --- | --- | --- |
| 左风1 | 1 | 51.91 | 2 | 51.93 |
| 3 | 51.91 | 4 | 56.20 |
| 5 | 57.92 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |
| 右风1 | 1 | -51.92 | 2 | -51.89 |
| 3 | -51.89 | 4 | -57.90 |
| 5 | -56.18 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |
| 左风2 | 1 | 51.94 | 2 | 51.90 |
| 3 | 51.91 | 4 | 56.28 |
| 5 | 57.83 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |
| 右风2 | 1 | -51.90 | 2 | -51.94 |
| 3 | -51.91 | 4 | -57.83 |
| 5 | -56.28 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |
| 左地震 | 1 | 5.31 | 2 | 5.31 |
| 3 | 5.31 | 4 | 5.86 |
| 5 | 5.86 | 6 | 0.00 |
| 7 | 0.00 | 8 | 0.00 |
| 右地震 | 1 | -5.31 | 2 | -5.31 |
| 3 | -5.31 | 4 | -5.86 |
| 5 | -5.86 | 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 | 0.37 | 0.04 | 0.41 | 0.52 | 46.67 | 9.70 | 134.51 | 146.51 | 316.8 | 通过 |
| 2 | 0.40 | 0.03 | 0.44 | 0.68 | 46.67 | 9.70 | 127.82 | 165.09 | 356.7 | 通过 |
| 3 | 0.37 | 0.04 | 0.41 | 0.52 | 46.67 | 9.70 | 134.51 | 146.51 | 316.8 | 通过 |
| 4 | 0.06 | 0.03 | 0.05 | 0.02 | 30.67 | 10.88 | 35.24 | 33.95 | 47.6 | 通过 |
| 5 | 0.06 | 0.03 | 0.05 | 0.02 | 30.67 | 10.88 | 35.24 | 33.95 | 47.6 | 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 | 0.44 | 0.12 | 0.40 | 0.93 | 46.67 | 8.70 | 381.1 | 通过 |
| 2 | 0.44 | 0.12 | 0.40 | 0.93 | 46.67 | 8.70 | 381.1 | 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=17.41, Ly=7.10; 长细比：λx=134.5,λy=146.5

构件长度=7.10; 计算长度系数: Ux=2.45 Uy=1.00

抗震等级: 四级

截面参数: B1=200, B2=200, H=300, Tw=6, T1=10, T2=10

轴压截面分类:X轴:b类 , Y轴:c类

构件钢号：Q355

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: 244.366196(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.00 | 18.52 | -1.70 | -12.05 | -13.58 | 1.70 |
| 2 | 0.00 | 34.38 | -3.47 | -24.67 | -29.44 | 3.47 |
| 3 | 0.00 | 34.38 | -3.47 | -24.67 | -29.44 | 3.47 |
| 4 | 0.00 | 18.52 | -1.70 | -12.05 | -13.58 | 1.70 |
| 5 | 0.00 | 14.05 | -1.31 | -9.27 | -10.25 | 1.31 |
| 6 | 0.00 | 29.91 | -3.08 | -21.88 | -26.11 | 3.08 |
| 7 | 0.00 | 29.91 | -3.08 | -21.88 | -26.11 | 3.08 |
| 8 | 0.00 | 14.05 | -1.31 | -9.27 | -10.25 | 1.31 |
| 9 | 0.00 | -0.70 | 8.37 | 40.94 | 5.64 | -3.16 |
| 10 | 0.00 | 20.10 | -11.92 | -46.09 | -15.16 | 1.06 |
| 11 | 0.00 | 5.04 | 11.36 | 33.28 | -0.10 | 1.99 |
| 12 | 0.00 | 25.85 | -8.93 | -53.77 | -20.91 | 6.22 |
| 13 | 0.00 | -5.17 | 8.76 | 43.72 | 8.97 | -3.56 |
| 14 | 0.00 | 15.63 | -11.53 | -43.31 | -11.83 | 0.67 |
| 15 | 0.00 | 0.57 | 11.76 | 36.06 | 3.23 | 1.60 |
| 16 | 0.00 | 21.38 | -8.54 | -50.99 | -17.58 | 5.82 |
| 17 | 0.00 | 6.47 | 4.34 | 19.75 | -1.53 | -1.22 |
| 18 | 0.00 | 18.95 | -7.83 | -32.47 | -14.01 | 1.31 |
| 19 | 0.00 | 9.92 | 6.14 | 15.16 | -4.98 | 1.87 |
| 20 | 0.00 | 22.40 | -6.04 | -37.07 | -17.46 | 4.41 |
| 21 | 0.00 | 22.33 | 2.57 | 7.14 | -17.39 | 0.56 |
| 22 | 0.00 | 34.81 | -9.61 | -45.08 | -29.87 | 3.09 |
| 23 | 0.00 | 25.78 | 4.36 | 2.54 | -20.84 | 3.65 |
| 24 | 0.00 | 38.26 | -7.81 | -49.69 | -33.32 | 6.18 |
| 25 | 0.00 | 22.33 | 2.57 | 7.14 | -17.39 | 0.56 |
| 26 | 0.00 | 34.81 | -9.61 | -45.08 | -29.87 | 3.09 |
| 27 | 0.00 | 25.78 | 4.36 | 2.54 | -20.84 | 3.65 |
| 28 | 0.00 | 38.26 | -7.81 | -49.69 | -33.32 | 6.18 |
| 29 | 0.00 | 6.47 | 4.34 | 19.75 | -1.53 | -1.22 |
| 30 | 0.00 | 18.95 | -7.83 | -32.47 | -14.01 | 1.31 |
| 31 | 0.00 | 9.92 | 6.14 | 15.16 | -4.98 | 1.87 |
| 32 | 0.00 | 22.40 | -6.04 | -37.07 | -17.46 | 4.41 |
| 33 | 0.00 | 2.00 | 4.74 | 22.54 | 1.80 | -1.61 |
| 34 | 0.00 | 14.48 | -7.44 | -29.68 | -10.68 | 0.92 |
| 35 | 0.00 | 5.44 | 6.53 | 17.94 | -1.64 | 1.48 |
| 36 | 0.00 | 17.93 | -5.64 | -34.29 | -14.13 | 4.01 |
| 37 | 0.00 | 17.86 | 2.96 | 9.92 | -14.06 | 0.16 |
| 38 | 0.00 | 30.34 | -9.22 | -42.30 | -26.54 | 2.70 |
| 39 | 0.00 | 21.30 | 4.76 | 5.32 | -17.50 | 3.26 |
| 40 | 0.00 | 33.79 | -7.42 | -46.90 | -29.99 | 5.79 |
| 41 | 0.00 | 17.86 | 2.96 | 9.92 | -14.06 | 0.16 |
| 42 | 0.00 | 30.34 | -9.22 | -42.30 | -26.54 | 2.70 |
| 43 | 0.00 | 21.30 | 4.76 | 5.32 | -17.50 | 3.26 |
| 44 | 0.00 | 33.79 | -7.42 | -46.90 | -29.99 | 5.79 |
| 45 | 0.00 | 2.00 | 4.74 | 22.54 | 1.80 | -1.61 |
| 46 | 0.00 | 14.48 | -7.44 | -29.68 | -10.68 | 0.92 |
| 47 | 0.00 | 5.44 | 6.53 | 17.94 | -1.64 | 1.48 |
| 48 | 0.00 | 17.93 | -5.64 | -34.29 | -14.13 | 4.01 |
| 49 | 0.00 | -1.30 | 8.37 | 40.95 | 6.24 | -3.17 |
| 50 | 0.00 | 19.50 | -11.92 | -46.08 | -14.56 | 1.06 |
| 51 | 0.00 | 4.44 | 11.37 | 33.29 | 0.50 | 1.99 |
| 52 | 0.00 | 25.25 | -8.93 | -53.76 | -20.31 | 6.21 |
| 53 | 0.00 | 9.80 | 7.13 | 32.12 | -4.86 | -1.92 |
| 54 | 0.00 | 30.60 | -13.17 | -54.91 | -25.66 | 2.30 |
| 55 | 0.00 | 15.54 | 10.12 | 24.46 | -10.60 | 3.23 |
| 56 | 0.00 | 36.35 | -10.17 | -62.59 | -31.41 | 7.46 |
| 57 | 0.00 | 9.80 | 7.13 | 32.12 | -4.86 | -1.92 |
| 58 | 0.00 | 30.60 | -13.17 | -54.91 | -25.66 | 2.30 |
| 59 | 0.00 | 15.54 | 10.12 | 24.46 | -10.60 | 3.23 |
| 60 | 0.00 | 36.35 | -10.17 | -62.59 | -31.41 | 7.46 |
| 61 | 0.00 | -1.30 | 8.37 | 40.95 | 6.24 | -3.17 |
| 62 | 0.00 | 19.50 | -11.92 | -46.08 | -14.56 | 1.06 |
| 63 | 0.00 | 4.44 | 11.37 | 33.29 | 0.50 | 1.99 |
| 64 | 0.00 | 25.25 | -8.93 | -53.76 | -20.31 | 6.21 |
| 65 | 0.00 | -5.77 | 8.76 | 43.74 | 9.57 | -3.56 |
| 66 | 0.00 | 15.03 | -11.53 | -43.29 | -11.23 | 0.67 |
| 67 | 0.00 | -0.03 | 11.76 | 36.08 | 3.83 | 1.60 |
| 68 | 0.00 | 20.78 | -8.54 | -50.97 | -16.98 | 5.82 |
| 69 | 0.00 | 5.33 | 7.52 | 34.91 | -1.53 | -2.31 |
| 70 | 0.00 | 26.13 | -12.77 | -52.13 | -22.33 | 1.91 |
| 71 | 0.00 | 11.07 | 10.51 | 27.24 | -7.27 | 2.84 |
| 72 | 0.00 | 31.88 | -9.78 | -59.81 | -28.08 | 7.07 |
| 73 | 0.00 | 5.33 | 7.52 | 34.91 | -1.53 | -2.31 |
| 74 | 0.00 | 26.13 | -12.77 | -52.13 | -22.33 | 1.91 |
| 75 | 0.00 | 11.07 | 10.51 | 27.24 | -7.27 | 2.84 |
| 76 | 0.00 | 31.88 | -9.78 | -59.81 | -28.08 | 7.07 |
| 77 | 0.00 | -5.77 | 8.76 | 43.74 | 9.57 | -3.56 |
| 78 | 0.00 | 15.03 | -11.53 | -43.29 | -11.23 | 0.67 |
| 79 | 0.00 | -0.03 | 11.76 | 36.08 | 3.83 | 1.60 |
| 80 | 0.00 | 20.78 | -8.54 | -50.97 | -16.98 | 5.82 |
| 81 | 0.00 | 18.20 | -1.07 | -7.62 | -13.26 | 1.07 |
| 82 | 0.00 | 19.81 | -2.32 | -16.50 | -14.87 | 2.32 |
| 83 | 0.00 | 25.07 | -1.84 | -13.09 | -20.13 | 1.84 |
| 84 | 0.00 | 26.68 | -3.09 | -21.97 | -21.74 | 3.09 |
| 85 | 0.00 | 25.07 | -1.84 | -13.09 | -20.13 | 1.84 |
| 86 | 0.00 | 26.68 | -3.09 | -21.97 | -21.74 | 3.09 |
| 87 | 0.00 | 18.20 | -1.07 | -7.62 | -13.26 | 1.07 |
| 88 | 0.00 | 19.81 | -2.32 | -16.50 | -14.87 | 2.32 |
| 89 | 0.00 | 13.81 | -0.68 | -4.84 | -10.01 | 0.68 |
| 90 | 0.00 | 15.43 | -1.93 | -13.72 | -11.62 | 1.93 |
| 91 | 0.00 | 19.10 | -1.27 | -9.05 | -15.30 | 1.27 |
| 92 | 0.00 | 20.71 | -2.52 | -17.93 | -16.91 | 2.52 |
| 93 | 0.00 | 19.10 | -1.27 | -9.05 | -15.30 | 1.27 |
| 94 | 0.00 | 20.71 | -2.52 | -17.93 | -16.91 | 2.52 |
| 95 | 0.00 | 13.81 | -0.68 | -4.84 | -10.01 | 0.68 |
| 96 | 0.00 | 15.43 | -1.93 | -13.72 | -11.62 | 1.93 |

强度计算控制组合号: 56, M=0.00, N=36.35, M=-62.59, N=-31.41

强度计算应力比 =0.366

抗剪强度计算控制组合号: 54, V=-13.17

抗剪强度计算应力比 =0.045

平面内稳定计算最大应力对应组合号: 56, M=0.00, N=36.35, M=-62.59, N=-31.41

平面内稳定计算最大应力 (N/mm\*mm) =125.02

平面内稳定计算最大应力比 =0.410

临界弯矩Mcr(kN\*m) =208.68

平面外稳定计算最大应力比 =0.522

门规GB51022-2015腹板容许高厚比 [H0/TW] =250.00

翼缘容许宽厚比 [B/T] =12.20

强度计算应力比 =0.366 < 1.0

抗剪强度计算应力比 =0.045 < 1.0

平面内稳定计算最大应力 < f=305.00

平面外稳定计算最大应力比 < 1.0

腹板高厚比 H0/TW=46.67 < [H0/TW]=250.00

翼缘宽厚比 B/T =9.70 < [B/T]=12.20

压杆,平面内长细比 λ=135. ≤ [λ]=180

压杆,平面外长细比 λ=147. ≤ [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 | 14.62 | -1.31 | -9.28 | -10.82 | 1.31 |
| 2 | 0.00 | 19.91 | -1.90 | -13.49 | -16.11 | 1.90 |
| 3 | 0.00 | 19.91 | -1.90 | -13.49 | -16.11 | 1.90 |
| 4 | 0.00 | 14.62 | -1.31 | -9.28 | -10.82 | 1.31 |
| 5 | 0.00 | 13.13 | -1.18 | -8.35 | -9.71 | 1.18 |
| 6 | 0.00 | 18.42 | -1.77 | -12.56 | -14.99 | 1.77 |
| 7 | 0.00 | 18.42 | -1.77 | -12.56 | -14.99 | 1.77 |
| 8 | 0.00 | 13.13 | -1.18 | -8.35 | -9.71 | 1.18 |
| 9 | 0.00 | 9.55 | 1.38 | 4.85 | -5.75 | 0.01 |
| 10 | 0.00 | 15.10 | -4.03 | -18.36 | -11.30 | 1.14 |
| 11 | 0.00 | 11.08 | 2.18 | 2.81 | -7.28 | 1.39 |
| 12 | 0.00 | 16.63 | -3.24 | -20.41 | -12.83 | 2.51 |
| 13 | 0.00 | 8.06 | 1.51 | 5.78 | -4.64 | -0.12 |
| 14 | 0.00 | 13.61 | -3.90 | -17.43 | -10.19 | 1.01 |
| 15 | 0.00 | 9.59 | 2.31 | 3.74 | -6.17 | 1.25 |
| 16 | 0.00 | 15.14 | -3.11 | -19.48 | -11.72 | 2.38 |

防火设计控制的偶然组合号: 12, M=0.00, N=16.63, M=-20.41, N=-12.83

强度计算荷载比 =0.12

平面内稳定计算荷载比 =0.14

平面外稳定计算荷载比 =0.14

无防护下钢构件最大升温(Ts): 1081.77℃ ,按临界温度法求得临界温度(Td): 644.39℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4378(m^2\*℃/w) ,计算所需保护层厚度(di) =43.78(mm)

构件重量 (Kg)=316.77

**2. 钢 柱 2
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=16.54, Ly=8.00; 长细比：λx=127.8,λy=165.1

构件长度=8.00; 计算长度系数: Ux=2.07 Uy=1.00

抗震等级: 四级

截面参数: B1=200, B2=200, H=300, Tw=6, T1=10, T2=10

轴压截面分类:X轴:b类 , Y轴:c类

构件钢号：Q355

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: 244.366196(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.00 | 57.13 | 1.78 | 14.22 | -51.56 | -1.78 |
| 2 | 0.00 | 57.13 | -1.78 | -14.22 | -51.56 | 1.78 |
| 3 | 0.00 | 74.70 | 0.00 | 0.00 | -69.14 | -0.00 |
| 4 | 0.00 | 39.55 | 0.00 | 0.00 | -33.98 | -0.00 |
| 5 | 0.00 | 48.00 | 1.78 | 14.22 | -43.72 | -1.78 |
| 6 | 0.00 | 48.00 | -1.78 | -14.22 | -43.72 | 1.78 |
| 7 | 0.00 | 65.58 | 0.00 | 0.00 | -61.30 | -0.00 |
| 8 | 0.00 | 30.42 | 0.00 | 0.00 | -26.14 | -0.00 |
| 9 | 0.00 | 17.48 | 7.29 | 58.29 | -11.91 | -7.29 |
| 10 | 0.00 | 17.46 | -7.28 | -58.27 | -11.89 | 7.28 |
| 11 | 0.00 | 27.00 | 7.29 | 58.29 | -21.43 | -7.29 |
| 12 | 0.00 | 27.00 | -7.29 | -58.29 | -21.43 | 7.29 |
| 13 | 0.00 | 8.35 | 7.29 | 58.29 | -4.07 | -7.29 |
| 14 | 0.00 | 8.33 | -7.28 | -58.27 | -4.05 | 7.28 |
| 15 | 0.00 | 17.87 | 7.29 | 58.29 | -13.59 | -7.29 |
| 16 | 0.00 | 17.87 | -7.29 | -58.29 | -13.59 | 7.29 |
| 17 | 0.00 | 43.88 | 6.15 | 49.19 | -38.32 | -6.15 |
| 18 | 0.00 | 43.87 | -2.59 | -20.75 | -38.31 | 2.59 |
| 19 | 0.00 | 49.59 | 6.15 | 49.19 | -44.03 | -6.15 |
| 20 | 0.00 | 49.59 | -2.59 | -20.76 | -44.03 | 2.59 |
| 21 | 0.00 | 43.88 | 2.59 | 20.76 | -38.32 | -2.59 |
| 22 | 0.00 | 43.87 | -6.15 | -49.18 | -38.31 | 6.15 |
| 23 | 0.00 | 49.59 | 2.59 | 20.76 | -44.03 | -2.59 |
| 24 | 0.00 | 49.59 | -6.15 | -49.19 | -44.03 | 6.15 |
| 25 | 0.00 | 61.46 | 4.37 | 34.98 | -55.90 | -4.37 |
| 26 | 0.00 | 61.45 | -4.37 | -34.96 | -55.89 | 4.37 |
| 27 | 0.00 | 67.17 | 4.37 | 34.98 | -61.61 | -4.37 |
| 28 | 0.00 | 67.17 | -4.37 | -34.98 | -61.61 | 4.37 |
| 29 | 0.00 | 26.30 | 4.37 | 34.98 | -20.74 | -4.37 |
| 30 | 0.00 | 26.29 | -4.37 | -34.96 | -20.73 | 4.37 |
| 31 | 0.00 | 32.02 | 4.37 | 34.98 | -26.45 | -4.37 |
| 32 | 0.00 | 32.02 | -4.37 | -34.98 | -26.45 | 4.37 |
| 33 | 0.00 | 34.76 | 6.15 | 49.19 | -30.48 | -6.15 |
| 34 | 0.00 | 34.75 | -2.59 | -20.75 | -30.46 | 2.59 |
| 35 | 0.00 | 40.47 | 6.15 | 49.19 | -36.19 | -6.15 |
| 36 | 0.00 | 40.47 | -2.59 | -20.76 | -36.19 | 2.59 |
| 37 | 0.00 | 34.76 | 2.59 | 20.76 | -30.48 | -2.59 |
| 38 | 0.00 | 34.75 | -6.15 | -49.18 | -30.46 | 6.15 |
| 39 | 0.00 | 40.47 | 2.59 | 20.76 | -36.19 | -2.59 |
| 40 | 0.00 | 40.47 | -6.15 | -49.19 | -36.19 | 6.15 |
| 41 | 0.00 | 52.33 | 4.37 | 34.98 | -48.05 | -4.37 |
| 42 | 0.00 | 52.32 | -4.37 | -34.96 | -48.04 | 4.37 |
| 43 | 0.00 | 58.05 | 4.37 | 34.98 | -53.77 | -4.37 |
| 44 | 0.00 | 58.05 | -4.37 | -34.98 | -53.77 | 4.37 |
| 45 | 0.00 | 17.18 | 4.37 | 34.98 | -12.90 | -4.37 |
| 46 | 0.00 | 17.17 | -4.37 | -34.96 | -12.89 | 4.37 |
| 47 | 0.00 | 22.89 | 4.37 | 34.98 | -18.61 | -4.37 |
| 48 | 0.00 | 22.89 | -4.37 | -34.98 | -18.61 | 4.37 |
| 49 | 0.00 | 29.78 | 8.53 | 68.24 | -24.22 | -8.53 |
| 50 | 0.00 | 29.76 | -6.04 | -48.32 | -24.20 | 6.04 |
| 51 | 0.00 | 39.30 | 8.53 | 68.24 | -33.74 | -8.53 |
| 52 | 0.00 | 39.30 | -6.04 | -48.34 | -33.74 | 6.04 |
| 53 | 0.00 | 29.78 | 6.04 | 48.34 | -24.22 | -6.04 |
| 54 | 0.00 | 29.76 | -8.53 | -68.22 | -24.20 | 8.53 |
| 55 | 0.00 | 39.30 | 6.04 | 48.34 | -33.74 | -6.04 |
| 56 | 0.00 | 39.30 | -8.53 | -68.24 | -33.74 | 8.53 |
| 57 | 0.00 | 42.08 | 7.29 | 58.29 | -36.52 | -7.29 |
| 58 | 0.00 | 42.07 | -7.28 | -58.27 | -36.50 | 7.28 |
| 59 | 0.00 | 51.60 | 7.29 | 58.29 | -46.04 | -7.29 |
| 60 | 0.00 | 51.60 | -7.29 | -58.29 | -46.04 | 7.29 |
| 61 | 0.00 | 17.48 | 7.29 | 58.29 | -11.91 | -7.29 |
| 62 | 0.00 | 17.46 | -7.28 | -58.27 | -11.89 | 7.28 |
| 63 | 0.00 | 27.00 | 7.29 | 58.29 | -21.43 | -7.29 |
| 64 | 0.00 | 27.00 | -7.29 | -58.29 | -21.43 | 7.29 |
| 65 | 0.00 | 20.65 | 8.53 | 68.24 | -16.37 | -8.53 |
| 66 | 0.00 | 20.64 | -6.04 | -48.32 | -16.35 | 6.04 |
| 67 | 0.00 | 30.17 | 8.53 | 68.24 | -25.89 | -8.53 |
| 68 | 0.00 | 30.17 | -6.04 | -48.34 | -25.89 | 6.04 |
| 69 | 0.00 | 20.65 | 6.04 | 48.34 | -16.37 | -6.04 |
| 70 | 0.00 | 20.64 | -8.53 | -68.22 | -16.35 | 8.53 |
| 71 | 0.00 | 30.17 | 6.04 | 48.34 | -25.89 | -6.04 |
| 72 | 0.00 | 30.17 | -8.53 | -68.24 | -25.89 | 8.53 |
| 73 | 0.00 | 32.96 | 7.29 | 58.29 | -28.68 | -7.29 |
| 74 | 0.00 | 32.94 | -7.28 | -58.27 | -28.66 | 7.28 |
| 75 | 0.00 | 42.48 | 7.29 | 58.29 | -38.20 | -7.29 |
| 76 | 0.00 | 42.48 | -7.29 | -58.29 | -38.20 | 7.29 |
| 77 | 0.00 | 8.35 | 7.29 | 58.29 | -4.07 | -7.29 |
| 78 | 0.00 | 8.33 | -7.28 | -58.27 | -4.05 | 7.28 |
| 79 | 0.00 | 17.87 | 7.29 | 58.29 | -13.59 | -7.29 |
| 80 | 0.00 | 17.87 | -7.29 | -58.29 | -13.59 | 7.29 |
| 81 | 0.00 | 47.17 | 1.51 | 12.07 | -41.60 | -1.51 |
| 82 | 0.00 | 47.17 | 0.03 | 0.25 | -41.60 | -0.03 |
| 83 | 0.00 | 47.17 | -0.03 | -0.25 | -41.60 | 0.03 |
| 84 | 0.00 | 47.17 | -1.51 | -12.07 | -41.60 | 1.51 |
| 85 | 0.00 | 54.78 | 0.74 | 5.91 | -49.22 | -0.74 |
| 86 | 0.00 | 54.78 | -0.74 | -5.91 | -49.22 | 0.74 |
| 87 | 0.00 | 39.55 | 0.74 | 5.91 | -33.98 | -0.74 |
| 88 | 0.00 | 39.55 | -0.74 | -5.91 | -33.98 | 0.74 |
| 89 | 0.00 | 36.28 | 1.33 | 10.65 | -32.00 | -1.33 |
| 90 | 0.00 | 36.28 | -0.15 | -1.17 | -32.00 | 0.15 |
| 91 | 0.00 | 36.28 | 0.15 | 1.17 | -32.00 | -0.15 |
| 92 | 0.00 | 36.28 | -1.33 | -10.65 | -32.00 | 1.33 |
| 93 | 0.00 | 42.14 | 0.74 | 5.91 | -37.86 | -0.74 |
| 94 | 0.00 | 42.14 | -0.74 | -5.91 | -37.86 | 0.74 |
| 95 | 0.00 | 30.42 | 0.74 | 5.91 | -26.14 | -0.74 |
| 96 | 0.00 | 30.42 | -0.74 | -5.91 | -26.14 | 0.74 |

强度计算控制组合号: 51, M=0.00, N=39.30, M=68.24, N=-33.74

强度计算应力比 =0.400

抗剪强度计算控制组合号: 49, V=8.53

抗剪强度计算应力比 =0.029

平面内稳定计算最大应力对应组合号: 51, M=0.00, N=39.30, M=68.24, N=-33.74

平面内稳定计算最大应力 (N/mm\*mm) =133.88

平面内稳定计算最大应力比 =0.439

临界弯矩Mcr(kN\*m) =175.46

平面外稳定计算最大应力比 =0.677

门规GB51022-2015腹板容许高厚比 [H0/TW] =250.00

翼缘容许宽厚比 [B/T] =12.20

强度计算应力比 =0.400 < 1.0

抗剪强度计算应力比 =0.029 < 1.0

平面内稳定计算最大应力 < f=305.00

平面外稳定计算最大应力比 < 1.0

腹板高厚比 H0/TW=46.67 < [H0/TW]=250.00

翼缘宽厚比 B/T =9.70 < [B/T]=12.20

压杆,平面内长细比 λ=128. ≤ [λ]=180

压杆,平面外长细比 λ=165. ≤ [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 | 36.28 | 0.59 | 4.74 | -32.00 | -0.59 |
| 2 | 0.00 | 36.28 | -0.59 | -4.74 | -32.00 | 0.59 |
| 3 | 0.00 | 42.14 | 0.00 | 0.00 | -37.86 | -0.00 |
| 4 | 0.00 | 30.42 | 0.00 | 0.00 | -26.14 | -0.00 |
| 5 | 0.00 | 33.24 | 0.59 | 4.74 | -29.39 | -0.59 |
| 6 | 0.00 | 33.24 | -0.59 | -4.74 | -29.39 | 0.59 |
| 7 | 0.00 | 39.10 | 0.00 | 0.00 | -35.25 | -0.00 |
| 8 | 0.00 | 27.38 | 0.00 | 0.00 | -23.53 | -0.00 |
| 9 | 0.00 | 24.54 | 1.94 | 15.54 | -20.26 | -1.94 |
| 10 | 0.00 | 24.53 | -1.94 | -15.54 | -20.25 | 1.94 |
| 11 | 0.00 | 27.07 | 1.94 | 15.54 | -22.79 | -1.94 |
| 12 | 0.00 | 27.07 | -1.94 | -15.54 | -22.79 | 1.94 |
| 13 | 0.00 | 21.49 | 1.94 | 15.54 | -17.64 | -1.94 |
| 14 | 0.00 | 21.49 | -1.94 | -15.54 | -17.64 | 1.94 |
| 15 | 0.00 | 24.03 | 1.94 | 15.54 | -20.18 | -1.94 |
| 16 | 0.00 | 24.03 | -1.94 | -15.54 | -20.18 | 1.94 |

防火设计控制的偶然组合号: 11, M=0.00, N=27.07, M=15.54, N=-22.79

强度计算荷载比 =0.09

平面内稳定计算荷载比 =0.13

平面外稳定计算荷载比 =0.17

无防护下钢构件最大升温(Ts): 1081.77℃ ,按临界温度法求得临界温度(Td): 644.72℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4375(m^2\*℃/w) ,计算所需保护层厚度(di) =43.75(mm)

构件重量 (Kg)=356.70

**3. 钢 柱 3
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=17.41, Ly=7.10; 长细比：λx=134.5,λy=146.5

构件长度=7.10; 计算长度系数: Ux=2.45 Uy=1.00

抗震等级: 四级

截面参数: B1=200, B2=200, H=300, Tw=6, T1=10, T2=10

轴压截面分类:X轴:b类 , Y轴:c类

构件钢号：Q355

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: 244.366196(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.00 | 34.38 | 3.47 | 24.67 | -29.44 | -3.47 |
| 2 | 0.00 | 18.52 | 1.70 | 12.05 | -13.58 | -1.70 |
| 3 | 0.00 | 34.38 | 3.47 | 24.67 | -29.44 | -3.47 |
| 4 | 0.00 | 18.52 | 1.70 | 12.05 | -13.58 | -1.70 |
| 5 | 0.00 | 29.91 | 3.08 | 21.88 | -26.11 | -3.08 |
| 6 | 0.00 | 14.05 | 1.31 | 9.27 | -10.25 | -1.31 |
| 7 | 0.00 | 29.91 | 3.08 | 21.88 | -26.11 | -3.08 |
| 8 | 0.00 | 14.05 | 1.31 | 9.27 | -10.25 | -1.31 |
| 9 | 0.00 | 20.11 | 11.93 | 46.11 | -15.17 | -1.06 |
| 10 | 0.00 | -0.70 | -8.37 | -40.93 | 5.64 | 3.16 |
| 11 | 0.00 | 25.85 | 8.93 | 53.77 | -20.91 | -6.22 |
| 12 | 0.00 | 5.04 | -11.36 | -33.28 | -0.10 | -1.99 |
| 13 | 0.00 | 15.64 | 11.53 | 43.32 | -11.84 | -0.67 |
| 14 | 0.00 | -5.17 | -8.77 | -43.71 | 8.98 | 3.55 |
| 15 | 0.00 | 21.38 | 8.54 | 50.99 | -17.58 | -5.82 |
| 16 | 0.00 | 0.57 | -11.76 | -36.06 | 3.23 | -1.60 |
| 17 | 0.00 | 34.82 | 9.61 | 45.09 | -29.88 | -3.09 |
| 18 | 0.00 | 22.33 | -2.57 | -7.13 | -17.39 | -0.56 |
| 19 | 0.00 | 38.26 | 7.81 | 49.69 | -33.32 | -6.18 |
| 20 | 0.00 | 25.78 | -4.36 | -2.54 | -20.84 | -3.65 |
| 21 | 0.00 | 18.96 | 7.83 | 32.48 | -14.02 | -1.31 |
| 22 | 0.00 | 6.47 | -4.35 | -19.75 | -1.53 | 1.22 |
| 23 | 0.00 | 22.40 | 6.04 | 37.07 | -17.46 | -4.41 |
| 24 | 0.00 | 9.92 | -6.14 | -15.16 | -4.98 | -1.87 |
| 25 | 0.00 | 34.82 | 9.61 | 45.09 | -29.88 | -3.09 |
| 26 | 0.00 | 22.33 | -2.57 | -7.13 | -17.39 | -0.56 |
| 27 | 0.00 | 38.26 | 7.81 | 49.69 | -33.32 | -6.18 |
| 28 | 0.00 | 25.78 | -4.36 | -2.54 | -20.84 | -3.65 |
| 29 | 0.00 | 18.96 | 7.83 | 32.48 | -14.02 | -1.31 |
| 30 | 0.00 | 6.47 | -4.35 | -19.75 | -1.53 | 1.22 |
| 31 | 0.00 | 22.40 | 6.04 | 37.07 | -17.46 | -4.41 |
| 32 | 0.00 | 9.92 | -6.14 | -15.16 | -4.98 | -1.87 |
| 33 | 0.00 | 30.35 | 9.22 | 42.31 | -26.54 | -2.70 |
| 34 | 0.00 | 17.86 | -2.96 | -9.92 | -14.06 | -0.17 |
| 35 | 0.00 | 33.79 | 7.42 | 46.90 | -29.99 | -5.79 |
| 36 | 0.00 | 21.30 | -4.76 | -5.32 | -17.50 | -3.26 |
| 37 | 0.00 | 14.49 | 7.44 | 29.69 | -10.68 | -0.92 |
| 38 | 0.00 | 2.00 | -4.74 | -22.53 | 1.80 | 1.61 |
| 39 | 0.00 | 17.93 | 5.64 | 34.29 | -14.13 | -4.01 |
| 40 | 0.00 | 5.44 | -6.53 | -17.94 | -1.64 | -1.48 |
| 41 | 0.00 | 30.35 | 9.22 | 42.31 | -26.54 | -2.70 |
| 42 | 0.00 | 17.86 | -2.96 | -9.92 | -14.06 | -0.17 |
| 43 | 0.00 | 33.79 | 7.42 | 46.90 | -29.99 | -5.79 |
| 44 | 0.00 | 21.30 | -4.76 | -5.32 | -17.50 | -3.26 |
| 45 | 0.00 | 14.49 | 7.44 | 29.69 | -10.68 | -0.92 |
| 46 | 0.00 | 2.00 | -4.74 | -22.53 | 1.80 | 1.61 |
| 47 | 0.00 | 17.93 | 5.64 | 34.29 | -14.13 | -4.01 |
| 48 | 0.00 | 5.44 | -6.53 | -17.94 | -1.64 | -1.48 |
| 49 | 0.00 | 30.61 | 13.17 | 54.93 | -25.67 | -2.30 |
| 50 | 0.00 | 9.80 | -7.13 | -32.11 | -4.86 | 1.91 |
| 51 | 0.00 | 36.35 | 10.17 | 62.59 | -31.41 | -7.46 |
| 52 | 0.00 | 15.54 | -10.12 | -24.46 | -10.60 | -3.23 |
| 53 | 0.00 | 19.51 | 11.92 | 46.10 | -14.57 | -1.06 |
| 54 | 0.00 | -1.30 | -8.38 | -40.94 | 6.25 | 3.16 |
| 55 | 0.00 | 25.25 | 8.93 | 53.76 | -20.31 | -6.21 |
| 56 | 0.00 | 4.44 | -11.37 | -33.29 | 0.50 | -1.99 |
| 57 | 0.00 | 30.61 | 13.17 | 54.93 | -25.67 | -2.30 |
| 58 | 0.00 | 9.80 | -7.13 | -32.11 | -4.86 | 1.91 |
| 59 | 0.00 | 36.35 | 10.17 | 62.59 | -31.41 | -7.46 |
| 60 | 0.00 | 15.54 | -10.12 | -24.46 | -10.60 | -3.23 |
| 61 | 0.00 | 19.51 | 11.92 | 46.10 | -14.57 | -1.06 |
| 62 | 0.00 | -1.30 | -8.38 | -40.94 | 6.25 | 3.16 |
| 63 | 0.00 | 25.25 | 8.93 | 53.76 | -20.31 | -6.21 |
| 64 | 0.00 | 4.44 | -11.37 | -33.29 | 0.50 | -1.99 |
| 65 | 0.00 | 26.14 | 12.78 | 52.14 | -22.34 | -1.91 |
| 66 | 0.00 | 5.33 | -7.52 | -34.90 | -1.53 | 2.31 |
| 67 | 0.00 | 31.88 | 9.78 | 59.81 | -28.08 | -7.07 |
| 68 | 0.00 | 11.07 | -10.51 | -27.24 | -7.27 | -2.84 |
| 69 | 0.00 | 15.04 | 11.53 | 43.31 | -11.23 | -0.67 |
| 70 | 0.00 | -5.78 | -8.77 | -43.73 | 9.58 | 3.55 |
| 71 | 0.00 | 20.78 | 8.54 | 50.97 | -16.98 | -5.82 |
| 72 | 0.00 | -0.03 | -11.76 | -36.08 | 3.83 | -1.60 |
| 73 | 0.00 | 26.14 | 12.78 | 52.14 | -22.34 | -1.91 |
| 74 | 0.00 | 5.33 | -7.52 | -34.90 | -1.53 | 2.31 |
| 75 | 0.00 | 31.88 | 9.78 | 59.81 | -28.08 | -7.07 |
| 76 | 0.00 | 11.07 | -10.51 | -27.24 | -7.27 | -2.84 |
| 77 | 0.00 | 15.04 | 11.53 | 43.31 | -11.23 | -0.67 |
| 78 | 0.00 | -5.78 | -8.77 | -43.73 | 9.58 | 3.55 |
| 79 | 0.00 | 20.78 | 8.54 | 50.97 | -16.98 | -5.82 |
| 80 | 0.00 | -0.03 | -11.76 | -36.08 | 3.83 | -1.60 |
| 81 | 0.00 | 26.68 | 3.09 | 21.97 | -21.74 | -3.09 |
| 82 | 0.00 | 25.07 | 1.84 | 13.09 | -20.13 | -1.84 |
| 83 | 0.00 | 19.81 | 2.32 | 16.50 | -14.87 | -2.32 |
| 84 | 0.00 | 18.20 | 1.07 | 7.62 | -13.26 | -1.07 |
| 85 | 0.00 | 26.68 | 3.09 | 21.97 | -21.74 | -3.09 |
| 86 | 0.00 | 25.07 | 1.84 | 13.09 | -20.13 | -1.84 |
| 87 | 0.00 | 19.81 | 2.32 | 16.50 | -14.87 | -2.32 |
| 88 | 0.00 | 18.20 | 1.07 | 7.62 | -13.26 | -1.07 |
| 89 | 0.00 | 20.71 | 2.52 | 17.93 | -16.91 | -2.52 |
| 90 | 0.00 | 19.10 | 1.27 | 9.05 | -15.30 | -1.27 |
| 91 | 0.00 | 15.43 | 1.93 | 13.72 | -11.62 | -1.93 |
| 92 | 0.00 | 13.81 | 0.68 | 4.84 | -10.01 | -0.68 |
| 93 | 0.00 | 20.71 | 2.52 | 17.93 | -16.91 | -2.52 |
| 94 | 0.00 | 19.10 | 1.27 | 9.05 | -15.30 | -1.27 |
| 95 | 0.00 | 15.43 | 1.93 | 13.72 | -11.62 | -1.93 |
| 96 | 0.00 | 13.81 | 0.68 | 4.84 | -10.01 | -0.68 |

强度计算控制组合号: 51, M=0.00, N=36.35, M=62.59, N=-31.41

强度计算应力比 =0.366

抗剪强度计算控制组合号: 49, V=13.17

抗剪强度计算应力比 =0.045

平面内稳定计算最大应力对应组合号: 51, M=0.00, N=36.35, M=62.59, N=-31.41

平面内稳定计算最大应力 (N/mm\*mm) =125.02

平面内稳定计算最大应力比 =0.410

临界弯矩Mcr(kN\*m) =208.68

平面外稳定计算最大应力比 =0.522

门规GB51022-2015腹板容许高厚比 [H0/TW] =250.00

翼缘容许宽厚比 [B/T] =12.20

强度计算应力比 =0.366 < 1.0

抗剪强度计算应力比 =0.045 < 1.0

平面内稳定计算最大应力 < f=305.00

平面外稳定计算最大应力比 < 1.0

腹板高厚比 H0/TW=46.67 < [H0/TW]=250.00

翼缘宽厚比 B/T =9.70 < [B/T]=12.20

压杆,平面内长细比 λ=135. ≤ [λ]=180

压杆,平面外长细比 λ=147. ≤ [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 | 19.91 | 1.90 | 13.49 | -16.11 | -1.90 |
| 2 | 0.00 | 14.62 | 1.31 | 9.28 | -10.82 | -1.31 |
| 3 | 0.00 | 19.91 | 1.90 | 13.49 | -16.11 | -1.90 |
| 4 | 0.00 | 14.62 | 1.31 | 9.28 | -10.82 | -1.31 |
| 5 | 0.00 | 18.42 | 1.77 | 12.56 | -14.99 | -1.77 |
| 6 | 0.00 | 13.13 | 1.18 | 8.35 | -9.71 | -1.18 |
| 7 | 0.00 | 18.42 | 1.77 | 12.56 | -14.99 | -1.77 |
| 8 | 0.00 | 13.13 | 1.18 | 8.35 | -9.71 | -1.18 |
| 9 | 0.00 | 15.10 | 4.03 | 18.36 | -11.30 | -1.14 |
| 10 | 0.00 | 9.55 | -1.38 | -4.85 | -5.75 | -0.01 |
| 11 | 0.00 | 16.63 | 3.24 | 20.41 | -12.83 | -2.51 |
| 12 | 0.00 | 11.08 | -2.18 | -2.81 | -7.28 | -1.39 |
| 13 | 0.00 | 13.61 | 3.90 | 17.43 | -10.19 | -1.01 |
| 14 | 0.00 | 8.06 | -1.51 | -5.78 | -4.64 | 0.12 |
| 15 | 0.00 | 15.14 | 3.11 | 19.48 | -11.72 | -2.38 |
| 16 | 0.00 | 9.59 | -2.31 | -3.74 | -6.17 | -1.25 |

防火设计控制的偶然组合号: 11, M=0.00, N=16.63, M=20.41, N=-12.83

强度计算荷载比 =0.12

平面内稳定计算荷载比 =0.14

平面外稳定计算荷载比 =0.14

无防护下钢构件最大升温(Ts): 1081.77℃ ,按临界温度法求得临界温度(Td): 644.39℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4378(m^2\*℃/w) ,计算所需保护层厚度(di) =43.78(mm)

构件重量 (Kg)=316.77

**4. 钢 柱 4
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=3.00, Ly=1.50; 长细比：λx=35.2,λy=33.9

构件长度=1.52; 计算长度系数: Ux=1.97 Uy=0.99

抗震等级: 四级

截面参数: B1=180, B2=180, 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：Q355

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: 278.112457(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | -0.00 | 0.74 | -0.00 | -0.00 | -0.00 | 0.00 |
| 2 | -0.00 | 0.74 | -0.00 | -0.00 | -0.00 | 0.00 |
| 3 | -0.00 | 0.74 | -0.00 | -0.00 | -0.00 | 0.00 |
| 4 | -0.00 | 0.74 | -0.00 | -0.00 | -0.00 | 0.00 |
| 5 | -0.00 | 0.57 | -0.00 | -0.00 | -0.00 | 0.00 |
| 6 | -0.00 | 0.57 | -0.00 | -0.00 | -0.00 | 0.00 |
| 7 | -0.00 | 0.57 | -0.00 | -0.00 | -0.00 | 0.00 |
| 8 | -0.00 | 0.57 | -0.00 | -0.00 | -0.00 | 0.00 |
| 9 | 4.66 | 0.74 | 6.22 | -0.00 | -0.00 | 0.00 |
| 10 | -4.66 | 0.74 | -6.21 | 0.00 | 0.00 | 0.00 |
| 11 | 4.66 | 0.74 | 6.22 | -0.00 | -0.00 | 0.00 |
| 12 | -4.66 | 0.74 | -6.22 | 0.00 | -0.00 | -0.00 |
| 13 | 4.66 | 0.57 | 6.22 | -0.00 | -0.00 | 0.00 |
| 14 | -4.66 | 0.57 | -6.21 | 0.00 | 0.00 | 0.00 |
| 15 | 4.66 | 0.57 | 6.22 | -0.00 | -0.00 | 0.00 |
| 16 | -4.66 | 0.57 | -6.22 | 0.00 | -0.00 | -0.00 |
| 17 | 2.80 | 0.74 | 3.73 | -0.00 | -0.00 | 0.00 |
| 18 | -2.79 | 0.74 | -3.73 | 0.00 | 0.00 | 0.00 |
| 19 | 2.80 | 0.74 | 3.73 | -0.00 | -0.00 | 0.00 |
| 20 | -2.80 | 0.74 | -3.73 | 0.00 | -0.00 | -0.00 |
| 21 | 2.80 | 0.74 | 3.73 | -0.00 | -0.00 | 0.00 |
| 22 | -2.79 | 0.74 | -3.73 | 0.00 | 0.00 | 0.00 |
| 23 | 2.80 | 0.74 | 3.73 | -0.00 | -0.00 | 0.00 |
| 24 | -2.80 | 0.74 | -3.73 | 0.00 | -0.00 | -0.00 |
| 25 | 2.80 | 0.74 | 3.73 | -0.00 | -0.00 | 0.00 |
| 26 | -2.79 | 0.74 | -3.73 | 0.00 | 0.00 | 0.00 |
| 27 | 2.80 | 0.74 | 3.73 | -0.00 | -0.00 | 0.00 |
| 28 | -2.80 | 0.74 | -3.73 | 0.00 | -0.00 | -0.00 |
| 29 | 2.80 | 0.74 | 3.73 | -0.00 | -0.00 | 0.00 |
| 30 | -2.79 | 0.74 | -3.73 | 0.00 | 0.00 | 0.00 |
| 31 | 2.80 | 0.74 | 3.73 | -0.00 | -0.00 | 0.00 |
| 32 | -2.80 | 0.74 | -3.73 | 0.00 | -0.00 | -0.00 |
| 33 | 2.80 | 0.57 | 3.73 | -0.00 | -0.00 | 0.00 |
| 34 | -2.79 | 0.57 | -3.73 | 0.00 | 0.00 | 0.00 |
| 35 | 2.80 | 0.57 | 3.73 | -0.00 | -0.00 | 0.00 |
| 36 | -2.80 | 0.57 | -3.73 | 0.00 | -0.00 | -0.00 |
| 37 | 2.80 | 0.57 | 3.73 | -0.00 | -0.00 | 0.00 |
| 38 | -2.79 | 0.57 | -3.73 | 0.00 | 0.00 | 0.00 |
| 39 | 2.80 | 0.57 | 3.73 | -0.00 | -0.00 | 0.00 |
| 40 | -2.80 | 0.57 | -3.73 | 0.00 | -0.00 | -0.00 |
| 41 | 2.80 | 0.57 | 3.73 | -0.00 | -0.00 | 0.00 |
| 42 | -2.79 | 0.57 | -3.73 | 0.00 | 0.00 | 0.00 |
| 43 | 2.80 | 0.57 | 3.73 | -0.00 | -0.00 | 0.00 |
| 44 | -2.80 | 0.57 | -3.73 | 0.00 | -0.00 | -0.00 |
| 45 | 2.80 | 0.57 | 3.73 | -0.00 | -0.00 | 0.00 |
| 46 | -2.79 | 0.57 | -3.73 | 0.00 | 0.00 | 0.00 |
| 47 | 2.80 | 0.57 | 3.73 | -0.00 | -0.00 | 0.00 |
| 48 | -2.80 | 0.57 | -3.73 | 0.00 | -0.00 | -0.00 |
| 49 | 4.66 | 0.74 | 6.22 | -0.00 | -0.00 | 0.00 |
| 50 | -4.66 | 0.74 | -6.21 | 0.00 | 0.00 | 0.00 |
| 51 | 4.66 | 0.74 | 6.22 | -0.00 | -0.00 | 0.00 |
| 52 | -4.66 | 0.74 | -6.22 | 0.00 | -0.00 | -0.00 |
| 53 | 4.66 | 0.74 | 6.22 | -0.00 | -0.00 | 0.00 |
| 54 | -4.66 | 0.74 | -6.21 | 0.00 | 0.00 | 0.00 |
| 55 | 4.66 | 0.74 | 6.22 | -0.00 | -0.00 | 0.00 |
| 56 | -4.66 | 0.74 | -6.22 | 0.00 | -0.00 | -0.00 |
| 57 | 4.66 | 0.74 | 6.22 | -0.00 | -0.00 | 0.00 |
| 58 | -4.66 | 0.74 | -6.21 | 0.00 | 0.00 | 0.00 |
| 59 | 4.66 | 0.74 | 6.22 | -0.00 | -0.00 | 0.00 |
| 60 | -4.66 | 0.74 | -6.22 | 0.00 | -0.00 | -0.00 |
| 61 | 4.66 | 0.74 | 6.22 | -0.00 | -0.00 | 0.00 |
| 62 | -4.66 | 0.74 | -6.21 | 0.00 | 0.00 | 0.00 |
| 63 | 4.66 | 0.74 | 6.22 | -0.00 | -0.00 | 0.00 |
| 64 | -4.66 | 0.74 | -6.22 | 0.00 | -0.00 | -0.00 |
| 65 | 4.66 | 0.57 | 6.22 | -0.00 | -0.00 | 0.00 |
| 66 | -4.66 | 0.57 | -6.21 | 0.00 | 0.00 | 0.00 |
| 67 | 4.66 | 0.57 | 6.22 | -0.00 | -0.00 | 0.00 |
| 68 | -4.66 | 0.57 | -6.22 | 0.00 | -0.00 | -0.00 |
| 69 | 4.66 | 0.57 | 6.22 | -0.00 | -0.00 | 0.00 |
| 70 | -4.66 | 0.57 | -6.21 | 0.00 | 0.00 | 0.00 |
| 71 | 4.66 | 0.57 | 6.22 | -0.00 | -0.00 | 0.00 |
| 72 | -4.66 | 0.57 | -6.22 | 0.00 | -0.00 | -0.00 |
| 73 | 4.66 | 0.57 | 6.22 | -0.00 | -0.00 | 0.00 |
| 74 | -4.66 | 0.57 | -6.21 | 0.00 | 0.00 | 0.00 |
| 75 | 4.66 | 0.57 | 6.22 | -0.00 | -0.00 | 0.00 |
| 76 | -4.66 | 0.57 | -6.22 | 0.00 | -0.00 | -0.00 |
| 77 | 4.66 | 0.57 | 6.22 | -0.00 | -0.00 | 0.00 |
| 78 | -4.66 | 0.57 | -6.21 | 0.00 | 0.00 | 0.00 |
| 79 | 4.66 | 0.57 | 6.22 | -0.00 | -0.00 | 0.00 |
| 80 | -4.66 | 0.57 | -6.22 | 0.00 | -0.00 | -0.00 |
| 81 | 0.01 | 0.74 | 0.01 | -0.00 | -0.00 | -0.01 |
| 82 | -0.01 | 0.74 | -0.01 | 0.00 | -0.00 | 0.01 |
| 83 | 0.01 | 0.74 | 0.01 | -0.00 | -0.00 | -0.01 |
| 84 | -0.01 | 0.74 | -0.01 | 0.00 | -0.00 | 0.01 |
| 85 | 0.01 | 0.74 | 0.01 | -0.00 | -0.00 | -0.01 |
| 86 | -0.01 | 0.74 | -0.01 | 0.00 | -0.00 | 0.01 |
| 87 | 0.01 | 0.74 | 0.01 | -0.00 | -0.00 | -0.01 |
| 88 | -0.01 | 0.74 | -0.01 | 0.00 | -0.00 | 0.01 |
| 89 | 0.01 | 0.57 | 0.01 | -0.00 | -0.00 | -0.01 |
| 90 | -0.01 | 0.57 | -0.01 | 0.00 | -0.00 | 0.01 |
| 91 | 0.01 | 0.57 | 0.01 | -0.00 | -0.00 | -0.01 |
| 92 | -0.01 | 0.57 | -0.01 | 0.00 | -0.00 | 0.01 |
| 93 | 0.01 | 0.57 | 0.01 | -0.00 | -0.00 | -0.01 |
| 94 | -0.01 | 0.57 | -0.01 | 0.00 | -0.00 | 0.01 |
| 95 | 0.01 | 0.57 | 0.01 | -0.00 | -0.00 | -0.01 |
| 96 | -0.01 | 0.57 | -0.01 | 0.00 | -0.00 | 0.01 |

强度计算控制组合号: 49, M=4.66, N=0.74, M=-0.00, N=-0.00

强度计算应力比 =0.057

抗剪强度计算控制组合号: 67, V=6.22

抗剪强度计算应力比 =0.032

平面内稳定计算最大应力对应组合号: 49, M=4.66, N=0.74, M=-0.00, N=-0.00

平面内稳定计算最大应力 (N/mm\*mm) =15.92

平面内稳定计算最大应力比 =0.052

临界弯矩Mcr(kN\*m) =1309.58

平面外稳定计算最大应力比 =0.021

门规GB51022-2015腹板容许高厚比 [H0/TW] =250.00

翼缘容许宽厚比 [B/T] =12.20

强度计算应力比 =0.057 < 1.0

抗剪强度计算应力比 =0.032 < 1.0

平面内稳定计算最大应力 < f=305.00

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 =10.88 < [B/T]=12.20

压杆,平面内长细比 λ=35. ≤ [λ]=180

压杆,平面外长细比 λ=34. ≤ [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 | 0.57 | -0.00 | -0.00 | -0.00 | 0.00 |
| 2 | -0.00 | 0.57 | -0.00 | -0.00 | -0.00 | 0.00 |
| 3 | -0.00 | 0.57 | -0.00 | -0.00 | -0.00 | 0.00 |
| 4 | -0.00 | 0.57 | -0.00 | -0.00 | -0.00 | 0.00 |
| 5 | -0.00 | 0.51 | -0.00 | -0.00 | -0.00 | 0.00 |
| 6 | -0.00 | 0.51 | -0.00 | -0.00 | -0.00 | 0.00 |
| 7 | -0.00 | 0.51 | -0.00 | -0.00 | -0.00 | 0.00 |
| 8 | -0.00 | 0.51 | -0.00 | -0.00 | -0.00 | 0.00 |
| 9 | 1.24 | 0.57 | 1.66 | -0.00 | -0.00 | 0.00 |
| 10 | -1.24 | 0.57 | -1.66 | 0.00 | -0.00 | 0.00 |
| 11 | 1.24 | 0.57 | 1.66 | -0.00 | -0.00 | 0.00 |
| 12 | -1.24 | 0.57 | -1.66 | 0.00 | -0.00 | -0.00 |
| 13 | 1.24 | 0.51 | 1.66 | -0.00 | -0.00 | 0.00 |
| 14 | -1.24 | 0.51 | -1.66 | 0.00 | -0.00 | 0.00 |
| 15 | 1.24 | 0.51 | 1.66 | -0.00 | -0.00 | 0.00 |
| 16 | -1.24 | 0.51 | -1.66 | 0.00 | -0.00 | -0.00 |

防火设计控制的偶然组合号: 9, M=1.24, N=0.57, 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 =0.01

平面外稳定计算荷载比 =0.00

无防护下钢构件最大升温(Ts): 1081.87℃ ,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) =0.4843(m^2\*℃/w) ,计算所需保护层厚度(di) =48.43(mm)

构件重量 (Kg)=47.56

**5. 钢 柱 5
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=3.00, Ly=1.50; 长细比：λx=35.2,λy=33.9

构件长度=1.52; 计算长度系数: Ux=1.97 Uy=0.99

抗震等级: 四级

截面参数: B1=180, B2=180, 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：Q355

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: 278.112457(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.00 | 0.74 | 0.00 | 0.00 | 0.00 | -0.00 |
| 2 | 0.00 | 0.74 | 0.00 | -0.00 | 0.00 | 0.00 |
| 3 | 0.00 | 0.74 | 0.00 | 0.00 | 0.00 | -0.00 |
| 4 | 0.00 | 0.74 | -0.00 | -0.00 | 0.00 | 0.00 |
| 5 | 0.00 | 0.57 | 0.00 | 0.00 | 0.00 | -0.00 |
| 6 | 0.00 | 0.57 | 0.00 | -0.00 | 0.00 | 0.00 |
| 7 | 0.00 | 0.57 | 0.00 | 0.00 | 0.00 | -0.00 |
| 8 | 0.00 | 0.57 | -0.00 | -0.00 | 0.00 | 0.00 |
| 9 | 4.66 | 0.74 | 6.22 | 0.00 | 0.00 | -0.00 |
| 10 | -4.66 | 0.74 | -6.21 | -0.00 | -0.00 | 0.00 |
| 11 | 4.66 | 0.74 | 6.22 | -0.00 | 0.00 | 0.00 |
| 12 | -4.66 | 0.74 | -6.22 | -0.00 | -0.00 | -0.00 |
| 13 | 4.66 | 0.57 | 6.22 | 0.00 | 0.00 | -0.00 |
| 14 | -4.66 | 0.57 | -6.21 | -0.00 | -0.00 | 0.00 |
| 15 | 4.66 | 0.57 | 6.22 | -0.00 | 0.00 | 0.00 |
| 16 | -4.66 | 0.57 | -6.22 | -0.00 | -0.00 | -0.00 |
| 17 | 2.80 | 0.74 | 3.73 | 0.00 | 0.00 | -0.00 |
| 18 | -2.79 | 0.74 | -3.73 | -0.00 | -0.00 | 0.00 |
| 19 | 2.80 | 0.74 | 3.73 | -0.00 | 0.00 | 0.00 |
| 20 | -2.80 | 0.74 | -3.73 | -0.00 | 0.00 | -0.00 |
| 21 | 2.80 | 0.74 | 3.73 | 0.00 | 0.00 | -0.00 |
| 22 | -2.79 | 0.74 | -3.73 | -0.00 | 0.00 | 0.00 |
| 23 | 2.80 | 0.74 | 3.73 | -0.00 | 0.00 | 0.00 |
| 24 | -2.80 | 0.74 | -3.73 | -0.00 | 0.00 | -0.00 |
| 25 | 2.80 | 0.74 | 3.73 | 0.00 | 0.00 | -0.00 |
| 26 | -2.79 | 0.74 | -3.73 | -0.00 | -0.00 | 0.00 |
| 27 | 2.80 | 0.74 | 3.73 | -0.00 | 0.00 | 0.00 |
| 28 | -2.80 | 0.74 | -3.73 | -0.00 | 0.00 | -0.00 |
| 29 | 2.80 | 0.74 | 3.73 | 0.00 | 0.00 | -0.00 |
| 30 | -2.79 | 0.74 | -3.73 | -0.00 | 0.00 | 0.00 |
| 31 | 2.80 | 0.74 | 3.73 | -0.00 | 0.00 | 0.00 |
| 32 | -2.80 | 0.74 | -3.73 | -0.00 | 0.00 | -0.00 |
| 33 | 2.80 | 0.57 | 3.73 | 0.00 | 0.00 | -0.00 |
| 34 | -2.79 | 0.57 | -3.73 | -0.00 | -0.00 | 0.00 |
| 35 | 2.80 | 0.57 | 3.73 | -0.00 | 0.00 | 0.00 |
| 36 | -2.80 | 0.57 | -3.73 | -0.00 | -0.00 | -0.00 |
| 37 | 2.80 | 0.57 | 3.73 | 0.00 | 0.00 | -0.00 |
| 38 | -2.79 | 0.57 | -3.73 | -0.00 | -0.00 | 0.00 |
| 39 | 2.80 | 0.57 | 3.73 | -0.00 | 0.00 | 0.00 |
| 40 | -2.80 | 0.57 | -3.73 | -0.00 | 0.00 | -0.00 |
| 41 | 2.80 | 0.57 | 3.73 | 0.00 | 0.00 | -0.00 |
| 42 | -2.79 | 0.57 | -3.73 | -0.00 | -0.00 | 0.00 |
| 43 | 2.80 | 0.57 | 3.73 | -0.00 | 0.00 | 0.00 |
| 44 | -2.80 | 0.57 | -3.73 | -0.00 | -0.00 | -0.00 |
| 45 | 2.80 | 0.57 | 3.73 | 0.00 | 0.00 | -0.00 |
| 46 | -2.79 | 0.57 | -3.73 | -0.00 | -0.00 | 0.00 |
| 47 | 2.80 | 0.57 | 3.73 | -0.00 | 0.00 | 0.00 |
| 48 | -2.80 | 0.57 | -3.73 | -0.00 | 0.00 | -0.00 |
| 49 | 4.66 | 0.74 | 6.22 | 0.00 | 0.00 | -0.00 |
| 50 | -4.66 | 0.74 | -6.21 | -0.00 | -0.00 | 0.00 |
| 51 | 4.66 | 0.74 | 6.22 | -0.00 | 0.00 | 0.00 |
| 52 | -4.66 | 0.74 | -6.22 | -0.00 | -0.00 | -0.00 |
| 53 | 4.66 | 0.74 | 6.22 | 0.00 | 0.00 | -0.00 |
| 54 | -4.66 | 0.74 | -6.21 | -0.00 | -0.00 | 0.00 |
| 55 | 4.66 | 0.74 | 6.22 | -0.00 | 0.00 | 0.00 |
| 56 | -4.66 | 0.74 | -6.22 | -0.00 | -0.00 | -0.00 |
| 57 | 4.66 | 0.74 | 6.22 | 0.00 | 0.00 | -0.00 |
| 58 | -4.66 | 0.74 | -6.21 | -0.00 | -0.00 | 0.00 |
| 59 | 4.66 | 0.74 | 6.22 | -0.00 | 0.00 | 0.00 |
| 60 | -4.66 | 0.74 | -6.22 | -0.00 | -0.00 | -0.00 |
| 61 | 4.66 | 0.74 | 6.22 | 0.00 | 0.00 | -0.00 |
| 62 | -4.66 | 0.74 | -6.21 | -0.00 | -0.00 | 0.00 |
| 63 | 4.66 | 0.74 | 6.22 | -0.00 | 0.00 | 0.00 |
| 64 | -4.66 | 0.74 | -6.22 | -0.00 | -0.00 | -0.00 |
| 65 | 4.66 | 0.57 | 6.22 | 0.00 | 0.00 | -0.00 |
| 66 | -4.66 | 0.57 | -6.21 | -0.00 | -0.00 | 0.00 |
| 67 | 4.66 | 0.57 | 6.22 | -0.00 | 0.00 | 0.00 |
| 68 | -4.66 | 0.57 | -6.22 | -0.00 | -0.00 | -0.00 |
| 69 | 4.66 | 0.57 | 6.22 | 0.00 | 0.00 | -0.00 |
| 70 | -4.66 | 0.57 | -6.21 | -0.00 | -0.00 | 0.00 |
| 71 | 4.66 | 0.57 | 6.22 | -0.00 | 0.00 | 0.00 |
| 72 | -4.66 | 0.57 | -6.22 | -0.00 | -0.00 | -0.00 |
| 73 | 4.66 | 0.57 | 6.22 | 0.00 | 0.00 | -0.00 |
| 74 | -4.66 | 0.57 | -6.21 | -0.00 | -0.00 | 0.00 |
| 75 | 4.66 | 0.57 | 6.22 | -0.00 | 0.00 | 0.00 |
| 76 | -4.66 | 0.57 | -6.22 | -0.00 | -0.00 | -0.00 |
| 77 | 4.66 | 0.57 | 6.22 | 0.00 | 0.00 | -0.00 |
| 78 | -4.66 | 0.57 | -6.21 | -0.00 | -0.00 | 0.00 |
| 79 | 4.66 | 0.57 | 6.22 | -0.00 | 0.00 | 0.00 |
| 80 | -4.66 | 0.57 | -6.22 | -0.00 | -0.00 | -0.00 |
| 81 | 0.01 | 0.74 | 0.01 | -0.00 | 0.00 | -0.01 |
| 82 | -0.01 | 0.74 | -0.01 | -0.00 | 0.00 | 0.01 |
| 83 | 0.01 | 0.74 | 0.01 | -0.00 | 0.00 | -0.01 |
| 84 | -0.01 | 0.74 | -0.01 | -0.00 | 0.00 | 0.01 |
| 85 | 0.01 | 0.74 | 0.01 | -0.00 | 0.00 | -0.01 |
| 86 | -0.01 | 0.74 | -0.01 | -0.00 | 0.00 | 0.01 |
| 87 | 0.01 | 0.74 | 0.01 | -0.00 | 0.00 | -0.01 |
| 88 | -0.01 | 0.74 | -0.01 | -0.00 | 0.00 | 0.01 |
| 89 | 0.01 | 0.57 | 0.01 | -0.00 | 0.00 | -0.01 |
| 90 | -0.01 | 0.57 | -0.01 | -0.00 | 0.00 | 0.01 |
| 91 | 0.01 | 0.57 | 0.01 | -0.00 | 0.00 | -0.01 |
| 92 | -0.01 | 0.57 | -0.01 | -0.00 | 0.00 | 0.01 |
| 93 | 0.01 | 0.57 | 0.01 | -0.00 | 0.00 | -0.01 |
| 94 | -0.01 | 0.57 | -0.01 | -0.00 | 0.00 | 0.01 |
| 95 | 0.01 | 0.57 | 0.01 | -0.00 | 0.00 | -0.01 |
| 96 | -0.01 | 0.57 | -0.01 | -0.00 | 0.00 | 0.01 |

强度计算控制组合号: 12, M=-4.66, N=0.74, M=-0.00, N=-0.00

强度计算应力比 =0.057

抗剪强度计算控制组合号: 57, V=6.22

抗剪强度计算应力比 =0.032

平面内稳定计算最大应力对应组合号: 12, M=-4.66, N=0.74, M=-0.00, N=-0.00

平面内稳定计算最大应力 (N/mm\*mm) =15.92

平面内稳定计算最大应力比 =0.052

临界弯矩Mcr(kN\*m) =1309.58

平面外稳定计算最大应力比 =0.021

门规GB51022-2015腹板容许高厚比 [H0/TW] =250.00

翼缘容许宽厚比 [B/T] =12.20

强度计算应力比 =0.057 < 1.0

抗剪强度计算应力比 =0.032 < 1.0

平面内稳定计算最大应力 < f=305.00

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 =10.88 < [B/T]=12.20

压杆,平面内长细比 λ=35. ≤ [λ]=180

压杆,平面外长细比 λ=34. ≤ [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 | 0.57 | 0.00 | -0.00 | 0.00 | -0.00 |
| 2 | 0.00 | 0.57 | 0.00 | -0.00 | 0.00 | -0.00 |
| 3 | 0.00 | 0.57 | 0.00 | -0.00 | 0.00 | -0.00 |
| 4 | 0.00 | 0.57 | 0.00 | -0.00 | 0.00 | -0.00 |
| 5 | 0.00 | 0.51 | 0.00 | -0.00 | 0.00 | -0.00 |
| 6 | 0.00 | 0.51 | 0.00 | -0.00 | 0.00 | -0.00 |
| 7 | 0.00 | 0.51 | 0.00 | -0.00 | 0.00 | -0.00 |
| 8 | 0.00 | 0.51 | 0.00 | -0.00 | 0.00 | -0.00 |
| 9 | 1.24 | 0.57 | 1.66 | 0.00 | 0.00 | -0.00 |
| 10 | -1.24 | 0.57 | -1.66 | -0.00 | 0.00 | 0.00 |
| 11 | 1.24 | 0.57 | 1.66 | -0.00 | 0.00 | 0.00 |
| 12 | -1.24 | 0.57 | -1.66 | -0.00 | 0.00 | -0.00 |
| 13 | 1.24 | 0.51 | 1.66 | 0.00 | 0.00 | -0.00 |
| 14 | -1.24 | 0.51 | -1.66 | -0.00 | 0.00 | 0.00 |
| 15 | 1.24 | 0.51 | 1.66 | -0.00 | 0.00 | 0.00 |
| 16 | -1.24 | 0.51 | -1.66 | -0.00 | 0.00 | -0.00 |

防火设计控制的偶然组合号: 12, M=-1.24, N=0.57, 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 =0.01

平面外稳定计算荷载比 =0.00

无防护下钢构件最大升温(Ts): 1081.87℃ ,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) =0.4843(m^2\*℃/w)

构件重量 (Kg)=47.56

**6、 钢 梁 1
设计结果**

截面类型=16; 布置角度=0; 计算长度： Lx=9.19, Ly=9.04

构件长度=9.19; 计算长度系数: Ux=1.00 Uy=0.98

支撑长度=9.04

抗震等级: 四级

截面参数: B1=180, B2=180, H=300, Tw=6, T1=10, T2=10

轴压截面分类:X轴:b类 , Y轴:c类

构件钢号：Q355

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: 247.727280(1/m)

梁刚度放大系数: 1.0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 24.86 | 6.27 | 28.22 | -28.87 | -0.03 | 17.08 |
| 2 | 12.24 | 2.95 | 12.61 | -58.77 | -0.07 | 34.74 |
| 3 | 24.86 | 6.27 | 28.22 | -50.93 | -0.16 | 33.89 |
| 4 | 12.24 | 2.95 | 12.61 | -36.71 | 0.06 | 17.93 |
| 5 | 22.03 | 5.57 | 25.11 | -22.21 | -0.02 | 13.14 |
| 6 | 9.41 | 2.25 | 9.50 | -52.10 | -0.06 | 30.80 |
| 7 | 22.03 | 5.57 | 25.11 | -44.27 | -0.15 | 29.95 |
| 8 | 9.41 | 2.25 | 9.50 | -30.05 | 0.06 | 13.99 |
| 9 | -45.42 | 2.41 | -6.65 | -38.91 | 0.59 | 11.69 |
| 10 | 50.94 | -3.71 | 14.85 | 19.39 | 6.72 | -0.45 |
| 11 | -37.75 | 8.10 | -1.44 | -47.18 | -5.10 | 17.03 |
| 12 | 58.62 | 1.97 | 20.07 | 11.11 | 1.03 | 4.90 |
| 13 | -48.24 | 1.71 | -9.76 | -32.24 | 0.60 | 7.75 |
| 14 | 48.11 | -4.41 | 11.74 | 26.06 | 6.72 | -4.39 |
| 15 | -40.58 | 7.40 | -4.55 | -40.52 | -5.09 | 13.09 |
| 16 | 55.79 | 1.27 | 16.96 | 17.77 | 1.04 | 0.96 |
| 17 | -9.75 | 5.90 | 16.15 | -34.89 | 0.34 | 13.85 |
| 18 | 48.06 | 2.22 | 29.05 | 0.09 | 4.02 | 6.56 |
| 19 | -5.15 | 9.31 | 19.27 | -39.86 | -3.07 | 17.05 |
| 20 | 52.67 | 5.63 | 32.18 | -4.88 | 0.61 | 9.77 |
| 21 | -22.37 | 2.57 | 0.54 | -64.79 | 0.30 | 31.51 |
| 22 | 35.45 | -1.10 | 13.44 | -29.81 | 3.98 | 24.23 |
| 23 | -17.77 | 5.99 | 3.66 | -69.75 | -3.11 | 34.72 |
| 24 | 40.06 | 2.31 | 16.57 | -34.78 | 0.56 | 27.44 |
| 25 | -9.75 | 5.90 | 16.15 | -56.95 | 0.21 | 30.66 |
| 26 | 48.06 | 2.22 | 29.05 | -21.97 | 3.89 | 23.37 |
| 27 | -5.15 | 9.31 | 19.27 | -61.91 | -3.20 | 33.86 |
| 28 | 52.67 | 5.63 | 32.18 | -26.94 | 0.48 | 26.58 |
| 29 | -22.37 | 2.57 | 0.54 | -42.73 | 0.43 | 14.70 |
| 30 | 35.45 | -1.10 | 13.44 | -7.75 | 4.11 | 7.42 |
| 31 | -17.77 | 5.99 | 3.66 | -47.70 | -2.98 | 17.91 |
| 32 | 40.06 | 2.31 | 16.57 | -12.72 | 0.69 | 10.63 |
| 33 | -12.58 | 5.20 | 13.04 | -28.23 | 0.35 | 9.90 |
| 34 | 45.23 | 1.52 | 25.94 | 6.75 | 4.03 | 2.62 |
| 35 | -7.98 | 8.61 | 16.17 | -33.20 | -3.06 | 13.11 |
| 36 | 49.84 | 4.93 | 29.07 | 1.78 | 0.61 | 5.83 |
| 37 | -25.20 | 1.87 | -2.57 | -58.12 | 0.31 | 27.57 |
| 38 | 32.62 | -1.80 | 10.33 | -23.14 | 3.98 | 20.29 |
| 39 | -20.60 | 5.29 | 0.56 | -63.09 | -3.11 | 30.78 |
| 40 | 37.23 | 1.61 | 13.47 | -28.11 | 0.57 | 23.50 |
| 41 | -12.58 | 5.20 | 13.04 | -50.28 | 0.22 | 26.72 |
| 42 | 45.23 | 1.52 | 25.94 | -15.31 | 3.90 | 19.43 |
| 43 | -7.98 | 8.61 | 16.17 | -55.25 | -3.19 | 29.92 |
| 44 | 49.84 | 4.93 | 29.07 | -20.28 | 0.48 | 22.64 |
| 45 | -25.20 | 1.87 | -2.57 | -36.07 | 0.44 | 10.76 |
| 46 | 32.62 | -1.80 | 10.33 | -1.09 | 4.11 | 3.48 |
| 47 | -20.60 | 5.29 | 0.56 | -41.04 | -2.98 | 13.96 |
| 48 | 37.23 | 1.61 | 13.47 | -6.06 | 0.70 | 6.69 |
| 49 | -36.60 | 4.68 | 3.68 | -38.91 | 0.59 | 11.69 |
| 50 | 59.76 | -1.45 | 25.18 | 19.39 | 6.72 | -0.45 |
| 51 | -28.93 | 10.37 | 8.89 | -47.18 | -5.10 | 17.03 |
| 52 | 67.44 | 4.24 | 30.40 | 11.11 | 1.03 | 4.90 |
| 53 | -45.43 | 2.35 | -7.25 | -59.83 | 0.56 | 24.06 |
| 54 | 50.92 | -3.77 | 14.25 | -1.53 | 6.69 | 11.92 |
| 55 | -37.77 | 8.04 | -2.04 | -68.11 | -5.13 | 29.40 |
| 56 | 58.61 | 1.91 | 19.47 | -9.82 | 1.00 | 17.27 |
| 57 | -36.60 | 4.68 | 3.68 | -54.34 | 0.50 | 23.46 |
| 58 | 59.76 | -1.45 | 25.18 | 3.95 | 6.63 | 11.32 |
| 59 | -28.93 | 10.37 | 8.89 | -62.62 | -5.19 | 28.80 |
| 60 | 67.44 | 4.24 | 30.40 | -4.33 | 0.94 | 16.67 |
| 61 | -45.43 | 2.35 | -7.25 | -44.39 | 0.65 | 12.29 |
| 62 | 50.92 | -3.77 | 14.25 | 13.91 | 6.78 | 0.15 |
| 63 | -37.77 | 8.04 | -2.04 | -52.67 | -5.04 | 17.63 |
| 64 | 58.61 | 1.91 | 19.47 | 5.62 | 1.09 | 5.50 |
| 65 | -39.43 | 3.98 | 0.57 | -32.24 | 0.60 | 7.75 |
| 66 | 56.93 | -2.15 | 22.07 | 26.06 | 6.72 | -4.39 |
| 67 | -31.76 | 9.67 | 5.78 | -40.52 | -5.09 | 13.09 |
| 68 | 64.61 | 3.54 | 27.29 | 17.77 | 1.04 | 0.96 |
| 69 | -48.26 | 1.65 | -10.36 | -53.17 | 0.57 | 20.12 |
| 70 | 48.09 | -4.47 | 11.15 | 5.13 | 6.69 | 7.98 |
| 71 | -40.60 | 7.34 | -5.15 | -61.45 | -5.12 | 25.46 |
| 72 | 55.78 | 1.21 | 16.36 | -3.15 | 1.01 | 13.33 |
| 73 | -39.43 | 3.98 | 0.57 | -47.68 | 0.51 | 19.52 |
| 74 | 56.93 | -2.15 | 22.07 | 10.62 | 6.63 | 7.38 |
| 75 | -31.76 | 9.67 | 5.78 | -55.96 | -5.18 | 24.86 |
| 76 | 64.61 | 3.54 | 27.29 | 2.33 | 0.95 | 12.73 |
| 77 | -48.26 | 1.65 | -10.36 | -37.73 | 0.66 | 8.35 |
| 78 | 48.09 | -4.47 | 11.15 | 20.57 | 6.78 | -3.79 |
| 79 | -40.60 | 7.34 | -5.15 | -46.01 | -5.03 | 13.69 |
| 80 | 55.78 | 1.21 | 16.36 | 12.29 | 1.10 | 1.56 |
| 81 | 13.26 | 4.40 | 19.05 | -31.83 | 0.01 | 17.88 |
| 82 | 22.17 | 4.47 | 20.66 | -25.92 | -0.07 | 16.27 |
| 83 | 7.80 | 2.96 | 12.29 | -44.78 | -0.01 | 25.54 |
| 84 | 16.70 | 3.03 | 13.90 | -38.87 | -0.09 | 23.93 |
| 85 | 13.26 | 4.40 | 19.05 | -41.39 | -0.05 | 25.17 |
| 86 | 22.17 | 4.47 | 20.66 | -35.48 | -0.12 | 23.56 |
| 87 | 7.80 | 2.96 | 12.29 | -35.23 | 0.05 | 18.25 |
| 88 | 16.70 | 3.03 | 13.90 | -29.32 | -0.03 | 16.64 |
| 89 | 9.18 | 3.37 | 14.47 | -25.17 | 0.02 | 13.94 |
| 90 | 18.08 | 3.45 | 16.08 | -19.26 | -0.06 | 12.33 |
| 91 | 4.97 | 2.27 | 9.27 | -35.13 | 0.00 | 19.83 |
| 92 | 13.87 | 2.34 | 10.88 | -29.22 | -0.07 | 18.22 |
| 93 | 9.18 | 3.37 | 14.47 | -32.52 | -0.03 | 19.55 |
| 94 | 18.08 | 3.45 | 16.08 | -26.61 | -0.10 | 17.93 |
| 95 | 4.97 | 2.27 | 9.27 | -27.78 | 0.05 | 14.23 |
| 96 | 13.87 | 2.34 | 10.88 | -21.87 | -0.03 | 12.62 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -48.26 | -38.77 | -35.33 | -33.48 | -22.89 | -18.39 | -26.06 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 67.44 | 31.05 | 15.87 | 2.57 | 7.46 | 21.86 | 69.75 |

强度计算应力比 =0.443

抗剪强度计算应力比 =0.118

平面内稳定计算最大应力对应组合号: 1, M=24.86, N=6.27, M=-28.87, N=-0.03

平面内稳定最大应力 (N/mm\*mm) =122.82

平面内稳定计算最大应力比 =0.403

临界弯矩Mcr(kN\*m) =66.47

平面外稳定计算最大应力比 =0.931

强度计算应力比 =0.443 < 1.0

抗剪强度计算应力比 =0.118 < 1.0

平面内稳定最大应力 < f=305.00

平面外稳定计算最大应力比 =0.931 < 1.0

腹板高厚比 H0/TW=46.67 < [H0/TW]=250.00 (GB51022-2015)

翼缘宽厚比 B/T =8.70 < [B/T] =12.20

**(恒+活)梁的挠度 mm**

| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0.00 | 4.40 | 7.97 | 8.90 | 6.86 | 3.00 | 0.00 |

最大挠度值 =8.90 最大挠度/梁跨度 =1/1028.

斜梁坡度初始值: 1/10.17

变形后斜梁坡度最小值: 1/10.48

变形后斜梁坡度改变率 =0.030 < 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 | 13.63 | 3.41 | 15.27 | -22.21 | -0.02 | 13.14 |
| 2 | 9.42 | 2.30 | 10.07 | -32.18 | -0.04 | 19.03 |
| 3 | 13.63 | 3.41 | 15.27 | -29.56 | -0.07 | 18.74 |
| 4 | 9.42 | 2.30 | 10.07 | -24.82 | 0.01 | 13.42 |
| 5 | 12.69 | 3.18 | 14.24 | -19.99 | -0.02 | 11.82 |
| 6 | 8.48 | 2.07 | 9.04 | -29.95 | -0.03 | 17.71 |
| 7 | 12.69 | 3.18 | 14.24 | -27.34 | -0.06 | 17.43 |
| 8 | 8.48 | 2.07 | 9.04 | -22.60 | 0.01 | 12.11 |
| 9 | -5.95 | 2.17 | 4.99 | -24.89 | 0.14 | 11.70 |
| 10 | 19.74 | 0.53 | 10.73 | -9.34 | 1.78 | 8.46 |
| 11 | -3.91 | 3.69 | 6.38 | -27.09 | -1.37 | 13.12 |
| 12 | 21.79 | 2.05 | 12.12 | -11.55 | 0.26 | 9.89 |
| 13 | -6.89 | 1.93 | 3.96 | -22.66 | 0.15 | 10.39 |
| 14 | 18.80 | 0.30 | 9.69 | -7.12 | 1.78 | 7.15 |
| 15 | -4.85 | 3.45 | 5.35 | -24.87 | -1.37 | 11.81 |
| 16 | 20.85 | 1.82 | 11.08 | -9.33 | 0.26 | 8.58 |

--- 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 -6.89 -11.47 -15.81 -17.50 -10.50 -1.69 0.00

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 21.79 6.10 0.00 0.00 0.00 9.09 32.18

强度计算荷载比 =0.21

平面内稳定计算荷载比 =0.18

平面外稳定计算荷载比 =0.46

无防护下钢构件最大升温(Ts): 1004.11℃ ,按临界温度法求得临界温度(Td): 588.00℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2721(m^2\*℃/w)

构件重量 (Kg)=381.08

**7、 钢 梁 2
设计结果**

截面类型=16; 布置角度=0; 计算长度： Lx=9.19, Ly=9.04

构件长度=9.19; 计算长度系数: Ux=1.00 Uy=0.98

支撑长度=9.04

抗震等级: 四级

截面参数: B1=180, B2=180, H=300, Tw=6, T1=10, T2=10

轴压截面分类:X轴:b类 , Y轴:c类

构件钢号：Q355

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: 247.727280(1/m)

梁刚度放大系数: 1.0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 58.77 | 0.07 | 34.74 | -12.24 | -2.95 | 12.61 |
| 2 | 28.87 | 0.03 | 17.08 | -24.86 | -6.27 | 28.22 |
| 3 | 50.93 | 0.16 | 33.89 | -24.86 | -6.27 | 28.22 |
| 4 | 36.71 | -0.06 | 17.93 | -12.24 | -2.95 | 12.61 |
| 5 | 52.10 | 0.06 | 30.80 | -9.41 | -2.25 | 9.50 |
| 6 | 22.21 | 0.02 | 13.14 | -22.03 | -5.57 | 25.11 |
| 7 | 44.27 | 0.15 | 29.95 | -22.03 | -5.57 | 25.11 |
| 8 | 30.05 | -0.06 | 13.99 | -9.41 | -2.25 | 9.50 |
| 9 | -19.39 | -6.72 | -0.44 | -50.96 | 3.72 | 14.86 |
| 10 | 38.88 | -0.59 | 11.68 | 45.40 | -2.41 | -6.65 |
| 11 | -11.11 | -1.03 | 4.90 | -58.62 | -1.97 | 20.07 |
| 12 | 47.18 | 5.10 | 17.03 | 37.75 | -8.10 | -1.44 |
| 13 | -26.05 | -6.73 | -4.38 | -48.13 | 4.42 | 11.75 |
| 14 | 32.22 | -0.60 | 7.74 | 48.23 | -1.72 | -9.76 |
| 15 | -17.77 | -1.04 | 0.96 | -55.79 | -1.27 | 16.96 |
| 16 | 40.52 | 5.09 | 13.09 | 40.58 | -7.40 | -4.55 |
| 17 | 29.81 | -3.98 | 24.23 | -35.46 | 1.10 | 13.45 |
| 18 | 64.77 | -0.30 | 31.51 | 22.36 | -2.58 | 0.54 |
| 19 | 34.78 | -0.56 | 27.44 | -40.06 | -2.31 | 16.57 |
| 20 | 69.75 | 3.11 | 34.72 | 17.77 | -5.99 | 3.66 |
| 21 | -0.08 | -4.02 | 6.57 | -48.08 | -2.22 | 29.06 |
| 22 | 34.88 | -0.34 | 13.84 | 9.74 | -5.90 | 16.15 |
| 23 | 4.88 | -0.61 | 9.77 | -52.67 | -5.63 | 32.18 |
| 24 | 39.86 | 3.07 | 17.05 | 5.15 | -9.31 | 19.27 |
| 25 | 21.97 | -3.89 | 23.38 | -48.08 | -2.22 | 29.06 |
| 26 | 56.93 | -0.21 | 30.65 | 9.74 | -5.90 | 16.15 |
| 27 | 26.94 | -0.48 | 26.58 | -52.67 | -5.63 | 32.18 |
| 28 | 61.91 | 3.20 | 33.86 | 5.15 | -9.31 | 19.27 |
| 29 | 7.76 | -4.11 | 7.42 | -35.46 | 1.10 | 13.45 |
| 30 | 42.72 | -0.43 | 14.69 | 22.36 | -2.58 | 0.54 |
| 31 | 12.72 | -0.69 | 10.63 | -40.06 | -2.31 | 16.57 |
| 32 | 47.70 | 2.98 | 17.91 | 17.77 | -5.99 | 3.66 |
| 33 | 23.15 | -3.99 | 20.29 | -32.63 | 1.80 | 10.34 |
| 34 | 58.11 | -0.31 | 27.56 | 25.19 | -1.88 | -2.57 |
| 35 | 28.11 | -0.57 | 23.50 | -37.23 | -1.61 | 13.47 |
| 36 | 63.09 | 3.11 | 30.78 | 20.60 | -5.29 | 0.56 |
| 37 | -6.75 | -4.03 | 2.62 | -45.25 | -1.52 | 25.95 |
| 38 | 28.21 | -0.35 | 9.90 | 12.57 | -5.20 | 13.04 |
| 39 | -1.78 | -0.61 | 5.83 | -49.84 | -4.93 | 29.07 |
| 40 | 33.20 | 3.07 | 13.11 | 7.98 | -8.61 | 16.17 |
| 41 | 15.31 | -3.90 | 19.44 | -45.25 | -1.52 | 25.95 |
| 42 | 50.27 | -0.22 | 26.71 | 12.57 | -5.20 | 13.04 |
| 43 | 20.28 | -0.48 | 22.64 | -49.84 | -4.93 | 29.07 |
| 44 | 55.25 | 3.19 | 29.92 | 7.98 | -8.61 | 16.17 |
| 45 | 1.09 | -4.11 | 3.48 | -32.63 | 1.80 | 10.34 |
| 46 | 36.05 | -0.44 | 10.75 | 25.19 | -1.88 | -2.57 |
| 47 | 6.06 | -0.70 | 6.69 | -37.23 | -1.61 | 13.47 |
| 48 | 41.04 | 2.98 | 13.96 | 20.60 | -5.29 | 0.56 |
| 49 | 1.54 | -6.69 | 11.93 | -50.94 | 3.78 | 14.26 |
| 50 | 59.80 | -0.56 | 24.05 | 45.41 | -2.35 | -7.25 |
| 51 | 9.82 | -1.00 | 17.27 | -58.61 | -1.91 | 19.47 |
| 52 | 68.11 | 5.13 | 29.40 | 37.77 | -8.04 | -2.04 |
| 53 | -19.39 | -6.72 | -0.44 | -59.78 | 1.45 | 25.19 |
| 54 | 38.88 | -0.59 | 11.68 | 36.58 | -4.68 | 3.67 |
| 55 | -11.11 | -1.03 | 4.90 | -67.44 | -4.24 | 30.40 |
| 56 | 47.18 | 5.10 | 17.03 | 28.93 | -10.37 | 8.89 |
| 57 | -3.95 | -6.63 | 11.33 | -59.78 | 1.45 | 25.19 |
| 58 | 54.32 | -0.50 | 23.45 | 36.58 | -4.68 | 3.67 |
| 59 | 4.33 | -0.94 | 16.67 | -67.44 | -4.24 | 30.40 |
| 60 | 62.62 | 5.19 | 28.80 | 28.93 | -10.37 | 8.89 |
| 61 | -13.90 | -6.78 | 0.16 | -50.94 | 3.78 | 14.26 |
| 62 | 44.37 | -0.65 | 12.28 | 45.41 | -2.35 | -7.25 |
| 63 | -5.62 | -1.09 | 5.50 | -58.61 | -1.91 | 19.47 |
| 64 | 52.67 | 5.04 | 17.63 | 37.77 | -8.04 | -2.04 |
| 65 | -5.13 | -6.70 | 7.98 | -48.12 | 4.48 | 11.16 |
| 66 | 53.14 | -0.57 | 20.11 | 48.24 | -1.65 | -10.36 |
| 67 | 3.15 | -1.01 | 13.33 | -55.78 | -1.21 | 16.36 |
| 68 | 61.45 | 5.12 | 25.46 | 40.60 | -7.34 | -5.15 |
| 69 | -26.05 | -6.73 | -4.38 | -56.95 | 2.15 | 22.08 |
| 70 | 32.22 | -0.60 | 7.74 | 39.41 | -3.98 | 0.57 |
| 71 | -17.77 | -1.04 | 0.96 | -64.61 | -3.54 | 27.29 |
| 72 | 40.52 | 5.09 | 13.09 | 31.76 | -9.67 | 5.78 |
| 73 | -10.61 | -6.64 | 7.39 | -56.95 | 2.15 | 22.08 |
| 74 | 47.65 | -0.51 | 19.51 | 39.41 | -3.98 | 0.57 |
| 75 | -2.33 | -0.95 | 12.73 | -64.61 | -3.54 | 27.29 |
| 76 | 55.96 | 5.18 | 24.86 | 31.76 | -9.67 | 5.78 |
| 77 | -20.56 | -6.79 | -3.78 | -48.12 | 4.48 | 11.16 |
| 78 | 37.70 | -0.66 | 8.34 | 48.24 | -1.65 | -10.36 |
| 79 | -12.29 | -1.10 | 1.56 | -55.78 | -1.21 | 16.36 |
| 80 | 46.01 | 5.03 | 13.69 | 40.60 | -7.34 | -5.15 |
| 81 | 38.87 | 0.09 | 23.93 | -16.70 | -3.03 | 13.90 |
| 82 | 44.78 | 0.01 | 25.54 | -7.80 | -2.96 | 12.29 |
| 83 | 25.92 | 0.07 | 16.27 | -22.17 | -4.47 | 20.66 |
| 84 | 31.83 | -0.01 | 17.88 | -13.26 | -4.40 | 19.05 |
| 85 | 35.48 | 0.12 | 23.56 | -22.17 | -4.47 | 20.66 |
| 86 | 41.39 | 0.05 | 25.17 | -13.26 | -4.40 | 19.05 |
| 87 | 29.32 | 0.03 | 16.64 | -16.70 | -3.03 | 13.90 |
| 88 | 35.23 | -0.05 | 18.25 | -7.80 | -2.96 | 12.29 |
| 89 | 29.22 | 0.07 | 18.22 | -13.87 | -2.34 | 10.88 |
| 90 | 35.13 | -0.00 | 19.83 | -4.97 | -2.27 | 9.27 |
| 91 | 19.26 | 0.06 | 12.33 | -18.08 | -3.45 | 16.08 |
| 92 | 25.17 | -0.02 | 13.94 | -9.18 | -3.37 | 14.47 |
| 93 | 26.61 | 0.10 | 17.93 | -18.08 | -3.45 | 16.08 |
| 94 | 32.52 | 0.03 | 19.55 | -9.18 | -3.37 | 14.47 |
| 95 | 21.87 | 0.03 | 12.62 | -13.87 | -2.34 | 10.88 |
| 96 | 27.78 | -0.05 | 14.23 | -4.97 | -2.27 | 9.27 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -26.05 | -18.39 | -22.89 | -33.48 | -35.32 | -38.75 | -48.24 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 69.75 | 21.85 | 7.47 | 2.57 | 15.87 | 31.06 | 67.44 |

强度计算应力比 =0.443

抗剪强度计算应力比 =0.118

平面内稳定计算最大应力对应组合号: 1, M=58.77, N=0.07, M=-12.24, N=-2.95

平面内稳定最大应力 (N/mm\*mm) =122.82

平面内稳定计算最大应力比 =0.403

临界弯矩Mcr(kN\*m) =100.22

平面外稳定计算最大应力比 =0.931

强度计算应力比 =0.443 < 1.0

抗剪强度计算应力比 =0.118 < 1.0

平面内稳定最大应力 < f=305.00

平面外稳定计算最大应力比 =0.931 < 1.0

腹板高厚比 H0/TW=46.67 < [H0/TW]=250.00 (GB51022-2015)

翼缘宽厚比 B/T =8.70 < [B/T] =12.20

**(恒+活)梁的挠度 mm**

| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0.00 | 3.00 | 6.86 | 8.90 | 7.97 | 4.40 | 0.00 |

最大挠度值 =8.90 最大挠度/梁跨度 =1/1028.

斜梁坡度初始值: 1/10.17

变形后斜梁坡度最小值: 1/10.48

变形后斜梁坡度改变率 =0.030 < 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 | 32.18 | 0.04 | 19.03 | -9.42 | -2.30 | 10.07 |
| 2 | 22.21 | 0.02 | 13.14 | -13.63 | -3.41 | 15.27 |
| 3 | 29.56 | 0.07 | 18.74 | -13.63 | -3.41 | 15.27 |
| 4 | 24.82 | -0.01 | 13.42 | -9.42 | -2.30 | 10.07 |
| 5 | 29.95 | 0.03 | 17.71 | -8.48 | -2.07 | 9.04 |
| 6 | 19.99 | 0.02 | 11.82 | -12.69 | -3.18 | 14.24 |
| 7 | 27.34 | 0.06 | 17.43 | -12.69 | -3.18 | 14.24 |
| 8 | 22.60 | -0.01 | 12.11 | -8.48 | -2.07 | 9.04 |
| 9 | 9.34 | -1.78 | 8.46 | -19.75 | -0.53 | 10.73 |
| 10 | 24.88 | -0.14 | 11.70 | 5.95 | -2.17 | 4.99 |
| 11 | 11.55 | -0.26 | 9.89 | -21.79 | -2.05 | 12.12 |
| 12 | 27.09 | 1.37 | 13.12 | 3.91 | -3.69 | 6.38 |
| 13 | 7.12 | -1.78 | 7.15 | -18.81 | -0.30 | 9.69 |
| 14 | 22.66 | -0.14 | 10.38 | 6.89 | -1.93 | 3.96 |
| 15 | 9.33 | -0.26 | 8.58 | -20.85 | -1.82 | 11.08 |
| 16 | 24.87 | 1.37 | 11.81 | 4.85 | -3.45 | 5.35 |

--- 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 -1.69 -10.50 -17.50 -15.81 -11.46 -6.89

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 32.18 9.09 0.00 0.00 0.00 6.10 21.79

强度计算荷载比 =0.21

平面内稳定计算荷载比 =0.18

平面外稳定计算荷载比 =0.46

无防护下钢构件最大升温(Ts): 1004.11℃ ,按临界温度法求得临界温度(Td): 588.00℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2721(m^2\*℃/w) ,计算所需保护层厚度(di) =27.21(mm)

构件重量 (Kg)=381.08

风荷载作用下柱顶最大水平（X 向）位移:

节点( 1), 水平位移 dx=51.935(mm) =H /137.

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=5.312(mm) =H /1337.

梁的(恒+活)最大挠度:

梁( 1), 挠跨比 =1 /1028.

风载作用下柱顶最大水平位移: H/137< 柱顶位移容许值: H/60

地震作用下柱顶最大水平位移: H/1337< 柱顶位移容许值: H/60

梁的(恒+活)最大挠跨比: 1/1028< 梁的容许挠跨比: 1/240

所有钢柱的总重量 (Kg)=1085.

所有钢梁的总重量 (Kg)=762.

钢梁与钢柱重量之和 (Kg)=1848.

**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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\恒载简图.T)



[图12-3 活载简图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\活载简图.T)



[图12-4 左风1简图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\左风1简图.T)



[图12-5 右风1简图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\右风1简图.T)



[图12-6 左风2简图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\左风2简图.T)



[图12-7 右风2简图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\应力比图.T)



[图12-9 荷载比图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\荷载比图.T)



[图12-10 防火图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\恒载弯矩图.T)



[图12-12 恒载剪力图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\恒载剪力图.T)



[图12-13 恒载轴力图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\恒载轴力图.T)



[图12-14 活载弯矩图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\活载弯矩图.T)



[图12-15 活载剪力图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\活载剪力图.T)



[图12-16 活载轴力图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\活载轴力图.T)



[图12-17 左风1弯矩图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\右地震轴力图.T)



[图12-35 弯矩包络图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\弯矩包络图.T)



[图12-36 剪力包络图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\剪力包络图.T)



[图12-37 轴力包络图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\恒载位移图.T)



[图12-39 活载位移图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\活载位移图.T)



[图12-40 左风1位移图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\右地震位移图.T)



[图12-46 恒+活位移图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\(恒+活)挠度图.T)



[图12-48 (活)挠度图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\(活)挠度图.T)



[图12-49 斜梁计算坡度图](F:\\项目人\\大兵\\2025\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\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\\10\\修改的施工图\\02包装车间\\包装车间\\GJ2\\CalcTemp\\平面外计算长度系数.T)