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14日 8时45分27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: 21

柱数: 10

梁数: 10

支座约束数: 6

标准截面总数: 10

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 | -0.17 | 7.80 | 2 | 62.97 | 7.80 |
| 3 | 5.57 | 8.09 | 4 | 57.23 | 8.09 |
| 5 | 16.55 | 8.66 | 6 | 46.25 | 8.66 |
| 7 | 29.55 | 9.31 | 8 | 33.25 | 9.31 |
| 9 | -0.45 | 9.50 | 10 | 63.25 | 9.50 |
| 11 | 28.60 | 10.69 | 12 | 34.20 | 10.69 |
| 13 | 29.55 | 10.81 | 14 | 33.25 | 10.81 |
| 15 | 31.40 | 11.11 | 16 | -0.17 | 0.00 |
| 17 | 16.55 | 0.00 | 18 | 29.55 | 0.00 |
| 19 | 33.25 | 0.00 | 20 | 46.25 | 0.00 |
| 21 | 62.97 | 0.00 |  |  |  |

**柱关联号**

| 柱号 | 节点Ⅰ | 节点Ⅱ | 柱号 | 节点Ⅰ | 节点Ⅱ |
| --- | --- | --- | --- | --- | --- |
| 1 | 16 | 1 | 2 | 17 | 5 |
| 3 | 18 | 7 | 4 | 19 | 8 |
| 5 | 20 | 6 | 6 | 21 | 2 |
| 7 | 1 | 9 | 8 | 2 | 10 |
| 9 | 7 | 13 | 10 | 8 | 14 |

**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 | 5 |
| 3 | 4 | 2 | 4 | 5 | 7 |
| 5 | 6 | 4 | 6 | 8 | 6 |
| 7 | 11 | 13 | 8 | 13 | 15 |
| 9 | 14 | 12 | 10 | 15 | 14 |

**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 | -0.275 | 2 | 0.275 | 3 | 0.000 |
| 4 | 0.000 | 5 | 0.000 | 6 | 0.000 |
| 7 | 0.000 | 8 | 0.000 | 9 | 0.000 |
| 10 | 0.000 | 11 | 0.000 | 12 | 0.000 |
| 13 | 0.000 | 14 | 0.000 | 15 | 0.000 |
| 16 | 0.000 | 17 | 0.000 | 18 | 0.000 |
| 19 | 0.000 | 20 | 0.000 | 21 | 0.000 |

**标准截面信息**

| 截面号 | 截面信息 |
| --- | --- |
| 1 | 焊接组合H形截面:  H\*B1\*B2\*Tw\*T1\*T2=350\*240\*240\*6\*10\*10 |
| 2 | 焊接组合H形截面:  H\*B1\*B2\*Tw\*T1\*T2=300\*240\*240\*6\*10\*10 |
| 3 | 焊接组合H形截面:  H\*B1\*B2\*Tw\*T1\*T2=300\*220\*220\*6\*10\*10 |
| 4 | 焊接组合H形截面:  H\*B1\*B2\*Tw\*T1\*T2=200\*180\*180\*6\*10\*10 |
| 5 | H形变截面:  (H1~H2)\*B1\*B2\*Tw\*T1\*T2=(500~400)\*220\*220\*6\*10\*10 |
| 6 | H形变截面:  (H1~H2)\*B1\*B2\*Tw\*T1\*T2=(400~450)\*240\*240\*6\*10\*10 |
| 7 | 焊接组合H形截面:  H\*B1\*B2\*Tw\*T1\*T2=400\*220\*220\*6\*10\*10 |
| 8 | 焊接组合H形截面:  H\*B1\*B2\*Tw\*T1\*T2=200\*180\*180\*6\*8\*8 |
| 9 | H形变截面:  (H1~H2)\*B1\*B2\*Tw\*T1\*T2=(450~400)\*240\*240\*6\*10\*10 |
| 10 | H形变截面:  (H1~H2)\*B1\*B2\*Tw\*T1\*T2=(400~500)\*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 | 1 | 两端刚接 | 0 |
| 2 | 2 | 两端刚接 | 0 |
| 3 | 3 | 两端刚接 | 0 |
| 4 | 3 | 两端刚接 | 0 |
| 5 | 2 | 两端刚接 | 0 |
| 6 | 1 | 两端刚接 | 0 |
| 7 | 4 | 两端刚接 | 0 |
| 8 | 4 | 两端刚接 | 0 |
| 9 | 3 | 两端刚接 | 0 |
| 10 | 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 | 5 | 两端刚接 |
| 2 | 6 | 两端刚接 |
| 3 | 10 | 两端刚接 |
| 4 | 7 | 两端刚接 |
| 5 | 9 | 两端刚接 |
| 6 | 7 | 两端刚接 |
| 7 | 8 | 两端刚接 |
| 8 | 8 | 两端刚接 |
| 9 | 8 | 两端刚接 |
| 10 | 8 | 两端刚接 |

**截面特性**

| 截面号 | Xc (mm) | Yc (mm) | Ix (cm4) | Iy (cm4) | A (cm2) |
| --- | --- | --- | --- | --- | --- |
| 1 | 120.0 | 175.0 | 15672.9 | 2304.6 | 67.8 |
| 2 | 120.0 | 150.0 | 11193.6 | 2304.5 | 64.8 |
| 3 | 110.0 | 150.0 | 10352.3 | 1775.2 | 60.8 |
| 4 | 90.0 | 100.0 | 3543.6 | 972.3 | 46.8 |
| 5 | 110.0 | 225.0 | 25275.0 | 1775.4 | 69.8 |
| 6 | 120.0 | 212.5 | 23992.5 | 2304.7 | 72.3 |
| 7 | 110.0 | 200.0 | 19478.3 | 1775.4 | 66.8 |
| 8 | 90.0 | 100.0 | 2967.2 | 777.9 | 39.8 |
| 9 | 120.0 | 212.5 | 23992.5 | 2304.7 | 72.3 |
| 10 | 110.0 | 225.0 | 25275.0 | 1775.4 | 69.8 |

| 截面号 | ix (cm) | iy (cm) | W1x (cm3) | W2x (cm3) | W1y (cm3) | W2y (cm3) |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 15.2 | 5.8 | 895.6 | 895.6 | 192.0 | 192.0 |
| 2 | 13.1 | 6.0 | 746.2 | 746.2 | 192.0 | 192.0 |
| 3 | 13.0 | 5.4 | 690.2 | 690.2 | 161.4 | 161.4 |
| 4 | 8.7 | 4.6 | 354.4 | 354.4 | 108.0 | 108.0 |
| 5 | 19.0 | 5.0 | 1123.3 | 1123.3 | 161.4 | 161.4 |
| 6 | 18.2 | 5.6 | 1129.1 | 1129.1 | 192.1 | 192.1 |
| 7 | 17.1 | 5.2 | 973.9 | 973.9 | 161.4 | 161.4 |
| 8 | 8.6 | 4.4 | 296.7 | 296.7 | 86.4 | 86.4 |
| 9 | 18.2 | 5.6 | 1129.1 | 1129.1 | 192.1 | 192.1 |
| 10 | 19.0 | 5.0 | 1123.3 | 1123.3 | 161.4 | 161.4 |

**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 | 2.60 | 0.00 | 0.00 |
| 6 | 1 | 1.62 | 0.00 | 0.00 |
| 7 | 1 | 4.22 | 0.00 | 0.00 |
| 8 | 1 | 4.22 | 0.00 | 0.00 |
| 9 | 1 | 2.01 | 0.00 | 0.00 |
| 10 | 1 | 2.01 | 0.00 | 0.00 |
| 右风1 | 1 | 1 | -1.62 | 0.00 | 0.00 |
| 6 | 1 | -2.60 | 0.00 | 0.00 |
| 7 | 1 | -4.22 | 0.00 | 0.00 |
| 8 | 1 | -4.22 | 0.00 | 0.00 |
| 9 | 1 | -2.01 | 0.00 | 0.00 |
| 10 | 1 | -2.01 | 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 | 4.57 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 4.57 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 4.57 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 4.57 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 4.57 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 4.57 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 4.57 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 4.57 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 4.57 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 4.57 | 0.00 | 0.00 | 0.00 |
| 活荷载 | 1 | 1 | 1 | 3.51 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.51 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.51 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.51 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.51 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.51 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.51 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.51 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.51 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.51 | 0.00 | 0.00 | 0.00 |
| 左风1 | 1 | 1 | 1 | -0.65 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -0.65 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.95 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -0.65 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.95 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.95 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -2.34 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -2.34 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -2.34 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -2.34 | 0.00 | 0.00 | 0.00 |
| 右风1 | 1 | 1 | 1 | -1.95 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.95 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -0.65 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.95 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -0.65 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -0.65 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -2.34 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -2.34 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -2.34 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -2.34 | 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)1.0恒+1.5左风1 | (12)1.0恒+1.5右风1 |
| (13)1.3恒+1.5活1+0.9左风1 | (14)1.3恒+1.5活1+0.9右风1 |
| (15)1.3恒+1.5活2+0.9左风1 | (16)1.3恒+1.5活2+0.9右风1 |
| (17)1.3恒+1.5活3+0.9左风1 | (18)1.3恒+1.5活3+0.9右风1 |
| (19)1.3恒+1.5活4+0.9左风1 | (20)1.3恒+1.5活4+0.9右风1 |
| (21)1.0恒+1.5活1+0.9左风1 | (22)1.0恒+1.5活1+0.9右风1 |
| (23)1.0恒+1.5活2+0.9左风1 | (24)1.0恒+1.5活2+0.9右风1 |
| (25)1.0恒+1.5活3+0.9左风1 | (26)1.0恒+1.5活3+0.9右风1 |
| (27)1.0恒+1.5活4+0.9左风1 | (28)1.0恒+1.5活4+0.9右风1 |
| (29)1.3恒+1.05活1+1.5左风1 | (30)1.3恒+1.05活1+1.5右风1 |
| (31)1.3恒+1.05活2+1.5左风1 | (32)1.3恒+1.05活2+1.5右风1 |
| (33)1.3恒+1.05活3+1.5左风1 | (34)1.3恒+1.05活3+1.5右风1 |
| (35)1.3恒+1.05活4+1.5左风1 | (36)1.3恒+1.05活4+1.5右风1 |
| (37)1.0恒+1.05活1+1.5左风1 | (38)1.0恒+1.05活1+1.5右风1 |
| (39)1.0恒+1.05活2+1.5左风1 | (40)1.0恒+1.05活2+1.5右风1 |
| (41)1.0恒+1.05活3+1.5左风1 | (42)1.0恒+1.05活3+1.5右风1 |
| (43)1.0恒+1.05活4+1.5左风1 | (44)1.0恒+1.05活4+1.5右风1 |
| (45)1.3恒+0.65活1+1.4左地震 | (46)1.3恒+0.65活1+1.4右地震 |
| (47)1.3恒+0.65活2+1.4左地震 | (48)1.3恒+0.65活2+1.4右地震 |
| (49)1.3恒+0.65活3+1.4左地震 | (50)1.3恒+0.65活3+1.4右地震 |
| (51)1.3恒+0.65活4+1.4左地震 | (52)1.3恒+0.65活4+1.4右地震 |
| (53)1.0恒+0.5活1+1.4左地震 | (54)1.0恒+0.5活1+1.4右地震 |
| (55)1.0恒+0.5活2+1.4左地震 | (56)1.0恒+0.5活2+1.4右地震 |
| (57)1.0恒+0.5活3+1.4左地震 | (58)1.0恒+0.5活3+1.4右地震 |
| (59)1.0恒+0.5活4+1.4左地震 | (60)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)1.0恒+1.5左风1 | (12)1.0恒+1.5右风1 |
| (13)1.3恒+1.5活1+0.9左风1 | (14)1.3恒+1.5活1+0.9右风1 |
| (15)1.3恒+1.5活2+0.9左风1 | (16)1.3恒+1.5活2+0.9右风1 |
| (17)1.3恒+1.5活3+0.9左风1 | (18)1.3恒+1.5活3+0.9右风1 |
| (19)1.3恒+1.5活4+0.9左风1 | (20)1.3恒+1.5活4+0.9右风1 |
| (21)1.0恒+1.5活1+0.9左风1 | (22)1.0恒+1.5活1+0.9右风1 |
| (23)1.0恒+1.5活2+0.9左风1 | (24)1.0恒+1.5活2+0.9右风1 |
| (25)1.0恒+1.5活3+0.9左风1 | (26)1.0恒+1.5活3+0.9右风1 |
| (27)1.0恒+1.5活4+0.9左风1 | (28)1.0恒+1.5活4+0.9右风1 |
| (29)1.3恒+1.05活1+1.5左风1 | (30)1.3恒+1.05活1+1.5右风1 |
| (31)1.3恒+1.05活2+1.5左风1 | (32)1.3恒+1.05活2+1.5右风1 |
| (33)1.3恒+1.05活3+1.5左风1 | (34)1.3恒+1.05活3+1.5右风1 |
| (35)1.3恒+1.05活4+1.5左风1 | (36)1.3恒+1.05活4+1.5右风1 |
| (37)1.0恒+1.05活1+1.5左风1 | (38)1.0恒+1.05活1+1.5右风1 |
| (39)1.0恒+1.05活2+1.5左风1 | (40)1.0恒+1.05活2+1.5右风1 |
| (41)1.0恒+1.05活3+1.5左风1 | (42)1.0恒+1.05活3+1.5右风1 |
| (43)1.0恒+1.05活4+1.5左风1 | (44)1.0恒+1.05活4+1.5右风1 |
| (45)1.3恒+0.65活1+1.4左地震 | (46)1.3恒+0.65活1+1.4右地震 |
| (47)1.3恒+0.65活2+1.4左地震 | (48)1.3恒+0.65活2+1.4右地震 |
| (49)1.3恒+0.65活3+1.4左地震 | (50)1.3恒+0.65活3+1.4右地震 |
| (51)1.3恒+0.65活4+1.4左地震 | (52)1.3恒+0.65活4+1.4右地震 |
| (53)1.0恒+0.5活1+1.4左地震 | (54)1.0恒+0.5活1+1.4右地震 |
| (55)1.0恒+0.5活2+1.4左地震 | (56)1.0恒+0.5活2+1.4右地震 |
| (57)1.0恒+0.5活3+1.4左地震 | (58)1.0恒+0.5活3+1.4右地震 |
| (59)1.0恒+0.5活4+1.4左地震 | (60)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)0.9恒+0.4左风1 | (12)0.9恒+0.4右风1 |

**(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)0.9恒+0.4左风1 | (12)0.9恒+0.4右风1 |

**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 | 216.252 |
| 8 | 216.252 |
| 9 | 0.380 |
| 10 | 0.380 |
| 11 | 38.798 |

水平地震标准值作用底层剪力： 9.569

底层最小地震剪力(抗震规范5.2.5条): 3.776

各质点地震力调整系数: 1.000

地震力调整后剪重比： 0.020

**周期(已乘折减系数)**

| 振型号 | 周期(s) |
| --- | --- |
| 1 | 0.745 |
| 2 | 0.267 |
| 3 | 0.068 |

## **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) |
| --- | --- |
| 7 | 216.252 |
| 2 | 216.252 |
| 9 | 0.380 |
| 10 | 0.380 |
| 12 | 38.798 |

水平地震标准值作用底层剪力： 9.569

底层最小地震剪力(抗震规范5.2.5条): 3.776

各质点地震力调整系数: 1.000

地震力调整后剪重比： 0.020

**周期(已乘折减系数)**

| 振型号 | 周期(s) |
| --- | --- |
| 1 | 0.745 |
| 2 | 0.267 |
| 3 | 0.068 |

**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 | 46.6 | -13.7 | -31.4 | -41.7 | 13.7 | -75.5 |
| 2 | 92.4 | 4.9 | 16.6 | -87.1 | -4.9 | 26.1 |
| 3 | 47.5 | 4.8 | 16.9 | -42.2 | -4.8 | 28.3 |
| 4 | 47.5 | -4.8 | -16.9 | -42.2 | 4.8 | -28.3 |
| 5 | 92.4 | -4.9 | -16.6 | -87.1 | 4.9 | -26.1 |
| 6 | 46.6 | 13.7 | 31.4 | -41.7 | -13.7 | 75.5 |
| 7 | 0.8 | 0.0 | 0.0 | 0.0 | -0.0 | -0.0 |
| 8 | 0.8 | 0.0 | -0.0 | 0.0 | -0.0 | -0.0 |
| 9 | 14.9 | -3.9 | 3.6 | -14.0 | 3.9 | -9.5 |
| 10 | 14.9 | 3.9 | -3.6 | -14.0 | -3.9 | 9.5 |
| 左风1 | 1 | -7.0 | 21.2 | 60.2 | 7.0 | -0.9 | 26.3 |
| 2 | -10.9 | 6.1 | 28.0 | 10.9 | -6.1 | 24.5 |
| 3 | -10.2 | 3.5 | 19.4 | 10.2 | -3.5 | 13.5 |
| 4 | -16.5 | 5.9 | 27.7 | 16.5 | -5.9 | 27.5 |
| 5 | -32.7 | 8.5 | 36.3 | 32.7 | -8.5 | 37.6 |
| 6 | -13.0 | 10.0 | 38.1 | 13.0 | 2.7 | -9.3 |
| 7 | -0.0 | 7.2 | 6.1 | 0.0 | 0.0 | -0.0 |
| 8 | 0.0 | 7.2 | 6.1 | -0.0 | 0.0 | -0.0 |
| 9 | -8.8 | 4.3 | -2.8 | 8.8 | -1.3 | 7.1 |
| 10 | -4.3 | 1.7 | -1.0 | 4.3 | 1.3 | 1.3 |
| 右风1 | 1 | -13.0 | -10.0 | -38.0 | 13.0 | -2.6 | 9.4 |
| 2 | -32.8 | -8.5 | -36.3 | 32.8 | 8.5 | -37.6 |
| 3 | -16.5 | -5.9 | -27.7 | 16.5 | 5.9 | -27.5 |
| 4 | -10.2 | -3.5 | -19.4 | 10.2 | 3.5 | -13.5 |
| 5 | -10.9 | -6.1 | -28.0 | 10.9 | 6.1 | -24.5 |
| 6 | -7.0 | -21.2 | -60.2 | 7.0 | 0.9 | -26.3 |
| 7 | 0.0 | -7.2 | -6.1 | -0.0 | -0.0 | 0.0 |
| 8 | 0.0 | -7.2 | -6.1 | -0.0 | -0.0 | 0.0 |
| 9 | -4.3 | -1.7 | 1.0 | 4.3 | -1.3 | -1.3 |
| 10 | -8.8 | -4.3 | 2.8 | 8.8 | 1.3 | -7.1 |
| 左地震 | 1 | -0.7 | 2.2 | 10.5 | 0.7 | -2.2 | 6.6 |
| 2 | 0.2 | 1.8 | 7.8 | -0.2 | -1.8 | 7.3 |
| 3 | -0.3 | 1.1 | 5.6 | 0.3 | -1.1 | 4.5 |
| 4 | 0.3 | 1.1 | 5.6 | -0.3 | -1.1 | 4.5 |
| 5 | -0.2 | 1.7 | 7.8 | 0.2 | -1.7 | 7.3 |
| 6 | 0.7 | 2.2 | 10.5 | -0.7 | -2.2 | 6.6 |
| 7 | -0.0 | 0.0 | 0.0 | 0.0 | -0.0 | -0.0 |
| 8 | -0.0 | 0.0 | 0.0 | 0.0 | -0.0 | -0.0 |
| 9 | -0.8 | 0.4 | -0.9 | 0.8 | -0.4 | 1.5 |
| 10 | 0.8 | 0.5 | -0.9 | -0.8 | -0.5 | 1.5 |
| 右地震 | 1 | 0.7 | -2.2 | -10.5 | -0.7 | 2.2 | -6.6 |
| 2 | -0.2 | -1.7 | -7.8 | 0.2 | 1.7 | -7.3 |
| 3 | 0.3 | -1.1 | -5.6 | -0.3 | 1.1 | -4.5 |
| 4 | -0.3 | -1.1 | -5.6 | 0.3 | 1.1 | -4.5 |
| 5 | 0.2 | -1.8 | -7.8 | -0.2 | 1.8 | -7.3 |
| 6 | -0.7 | -2.2 | -10.5 | 0.7 | 2.2 | -6.6 |
| 7 | -0.0 | -0.0 | -0.0 | 0.0 | 0.0 | 0.0 |
| 8 | -0.0 | -0.0 | -0.0 | 0.0 | 0.0 | 0.0 |
| 9 | 0.8 | -0.5 | 0.9 | -0.8 | 0.5 | -1.5 |
| 10 | -0.8 | -0.4 | 0.9 | 0.8 | 0.4 | -1.5 |

**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 | 15.7 | 40.2 | 75.8 | -14.2 | -10.2 | 68.9 |
| 2 | 14.3 | 10.1 | -68.9 | -11.2 | 47.5 | -136.5 |
| 3 | 14.2 | -10.2 | -68.9 | -15.7 | 40.2 | -75.8 |
| 4 | 10.8 | 39.8 | 110.3 | -7.4 | 27.7 | -31.9 |
| 5 | 11.2 | 47.5 | 136.5 | -14.3 | 10.1 | 68.9 |
| 6 | 7.4 | 27.7 | 31.9 | -10.8 | 39.8 | -110.3 |
| 7 | -0.0 | -0.0 | 0.0 | 0.6 | 4.7 | -2.2 |
| 8 | 5.4 | 8.5 | 11.7 | -3.9 | 0.6 | -4.4 |
| 9 | -0.6 | 4.7 | 2.2 | -0.0 | 0.0 | -0.0 |
| 10 | 3.9 | 0.6 | 4.4 | -5.4 | 8.5 | -11.7 |
| 左风1 | 1 | 5.9 | -7.3 | -32.4 | -5.9 | 3.6 | 1.0 |
| 2 | 5.9 | -3.6 | -1.0 | -5.9 | -3.5 | 0.7 |
| 3 | -10.5 | 1.3 | 36.3 | 10.5 | -12.5 | 3.2 |
| 4 | -0.7 | -7.0 | -25.2 | 0.7 | -1.5 | -10.7 |
| 5 | -10.5 | -20.2 | -67.9 | 10.5 | -1.2 | -36.3 |
| 6 | -3.6 | -12.4 | -26.5 | 3.6 | -13.0 | 30.3 |
| 7 | -0.0 | 0.0 | 0.0 | 0.0 | -2.2 | 1.1 |
| 8 | -2.6 | -6.2 | -8.2 | 2.6 | 1.9 | 0.6 |
| 9 | 0.0 | -2.2 | -1.1 | -0.0 | -0.0 | -0.0 |
| 10 | -1.9 | -2.6 | -0.6 | 1.9 | -1.8 | -0.2 |
| 右风1 | 1 | -10.5 | -12.5 | -3.3 | 10.5 | 1.3 | -36.3 |
| 2 | -10.5 | -1.3 | 36.3 | 10.5 | -20.2 | 67.9 |
| 3 | 5.9 | 3.6 | -1.0 | -5.9 | -7.3 | 32.4 |
| 4 | -3.6 | -13.0 | -30.3 | 3.6 | -12.4 | 26.6 |
| 5 | 5.9 | -3.5 | -0.7 | -5.9 | -3.6 | 1.0 |
| 6 | -0.7 | -1.5 | 10.7 | 0.7 | -7.0 | 25.2 |
| 7 | -0.0 | -0.0 | 0.0 | 0.0 | -2.2 | 1.1 |
| 8 | -1.9 | -1.8 | 0.2 | 1.9 | -2.6 | 0.6 |
| 9 | -0.0 | -2.2 | -1.1 | 0.0 | 0.0 | 0.0 |
| 10 | -2.6 | 1.9 | -0.6 | 2.6 | -6.2 | 8.2 |
| 左地震 | 1 | -1.1 | -0.6 | -6.6 | 1.1 | 0.6 | 3.0 |
| 2 | 0.1 | -0.7 | -3.0 | -0.1 | 0.7 | -4.6 |
| 3 | 1.1 | -0.6 | 3.0 | -1.1 | 0.6 | -6.6 |
| 4 | -0.5 | -0.5 | -2.7 | 0.5 | 0.5 | -3.6 |
| 5 | -0.1 | -0.7 | -4.6 | 0.1 | 0.7 | -3.0 |
| 6 | 0.5 | -0.5 | -3.6 | -0.5 | 0.5 | -2.7 |
| 7 | 0.2 | -0.0 | -0.0 | -0.2 | 0.0 | -0.0 |
| 8 | -0.2 | -0.8 | -1.5 | 0.2 | 0.8 | -0.0 |
| 9 | -0.2 | -0.0 | -0.0 | 0.2 | 0.0 | 0.0 |
| 10 | 0.2 | -0.8 | 0.0 | -0.2 | 0.8 | -1.5 |
| 右地震 | 1 | 1.1 | 0.6 | 6.6 | -1.1 | -0.6 | -3.0 |
| 2 | -0.1 | 0.7 | 3.0 | 0.1 | -0.7 | 4.6 |
| 3 | -1.1 | 0.6 | -3.0 | 1.1 | -0.6 | 6.6 |
| 4 | 0.5 | 0.5 | 2.7 | -0.5 | -0.5 | 3.6 |
| 5 | 0.1 | 0.7 | 4.6 | -0.1 | -0.7 | 3.0 |
| 6 | -0.5 | 0.5 | 3.6 | 0.5 | -0.5 | 2.7 |
| 7 | -0.2 | 0.0 | 0.0 | 0.2 | -0.0 | 0.0 |
| 8 | 0.2 | 0.8 | 1.5 | -0.2 | -0.8 | -0.0 |
| 9 | 0.2 | 0.0 | 0.0 | -0.2 | -0.0 | 0.0 |
| 10 | -0.2 | 0.8 | 0.0 | 0.2 | -0.8 | 1.5 |

**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 | 4.02 | 0.25 |
| 2 | -4.02 | 0.25 |
| 3 | 5.61 | 33.44 |
| 4 | -5.61 | 33.44 |
| 5 | 3.81 | 0.58 |
| 6 | -3.81 | 0.58 |
| 7 | 3.71 | 0.33 |
| 8 | -3.71 | 0.33 |
| 9 | 13.09 | 0.25 |
| 10 | -13.09 | 0.25 |
| 11 | 0.51 | 2.36 |
| 12 | -0.51 | 2.36 |
| 13 | 0.26 | 0.35 |
| 14 | -0.26 | 0.35 |
| 15 | 0.00 | -1.18 |

**活荷载工况下节点位移（mm）**

| 节点号 | X向位移 | Y向位移 |
| --- | --- | --- |
| 1 | 2.71 | 0.17 |
| 2 | -2.71 | 0.17 |
| 3 | 3.78 | 26.58 |
| 4 | -3.78 | 26.58 |
| 5 | 2.57 | 0.38 |
| 6 | -2.57 | 0.38 |
| 7 | 2.50 | 0.27 |
| 8 | -2.50 | 0.27 |
| 9 | 8.79 | 0.17 |
| 10 | -8.79 | 0.17 |
| 11 | 0.34 | 2.10 |
| 12 | -0.34 | 2.10 |
| 13 | 0.17 | 0.29 |
| 14 | -0.17 | 0.29 |
| 15 | 0.00 | 0.65 |

**节点侧向（水平向）位移(mm)**

| 工况 | 节点 | δx | 节点 | δx |
| --- | --- | --- | --- | --- |
| 左风1 | 1 | 17.15 | 2 | 19.08 |
| 3 | 17.10 | 4 | 19.86 |
| 5 | 17.08 | 6 | 18.93 |
| 7 | 17.09 | 8 | 18.89 |
| 9 | 19.31 | 10 | 26.03 |
| 11 | 18.65 | 12 | 18.88 |
| 13 | 18.76 | 14 | 18.87 |
| 15 | 18.81 | 16 | 0.00 |
| 17 | 0.00 | 18 | 0.00 |
| 19 | 0.00 | 20 | 0.00 |
| 21 | 0.00 |  |  |
| 右风1 | 1 | -19.08 | 2 | -17.14 |
| 3 | -19.86 | 4 | -17.10 |
| 5 | -18.93 | 6 | -17.08 |
| 7 | -18.89 | 8 | -17.08 |
| 9 | -26.03 | 10 | -19.30 |
| 11 | -18.88 | 12 | -18.65 |
| 13 | -18.86 | 14 | -18.76 |
| 15 | -18.81 | 16 | 0.00 |
| 17 | 0.00 | 18 | 0.00 |
| 19 | 0.00 | 20 | 0.00 |
| 21 | 0.00 |  |  |
| 左地震 | 1 | 4.54 | 2 | 4.54 |
| 3 | 4.61 | 4 | 4.60 |
| 5 | 4.55 | 6 | 4.54 |
| 7 | 4.55 | 8 | 4.54 |
| 9 | 5.36 | 10 | 5.35 |
| 11 | 4.83 | 12 | 4.83 |
| 13 | 4.85 | 14 | 4.85 |
| 15 | 4.85 | 16 | 0.00 |
| 17 | 0.00 | 18 | 0.00 |
| 19 | 0.00 | 20 | 0.00 |
| 21 | 0.00 |  |  |
| 右地震 | 1 | -4.54 | 2 | -4.54 |
| 3 | -4.60 | 4 | -4.61 |
| 5 | -4.54 | 6 | -4.55 |
| 7 | -4.54 | 8 | -4.55 |
| 9 | -5.35 | 10 | -5.36 |
| 11 | -4.83 | 12 | -4.83 |
| 13 | -4.85 | 14 | -4.85 |
| 15 | -4.85 | 16 | 0.00 |
| 17 | 0.00 | 18 | 0.00 |
| 19 | 0.00 | 20 | 0.00 |
| 21 | 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 | 0.82 | 0.13 | 0.80 | 0.99 | 55.00 | 11.70 | 70.00 | 133.79 | 415.4 | 通过 |
| 2 | 0.63 | 0.08 | 0.69 | 0.83 | 46.67 | 11.70 | 76.82 | 145.20 | 440.5 | 通过 |
| 3 | 0.48 | 0.06 | 0.52 | 0.70 | 46.67 | 10.70 | 86.75 | 172.34 | 444.4 | 通过 |
| 4 | 0.48 | 0.06 | 0.52 | 0.70 | 46.67 | 10.70 | 86.75 | 172.34 | 444.4 | 通过 |
| 5 | 0.63 | 0.08 | 0.69 | 0.83 | 46.67 | 11.70 | 76.82 | 145.20 | 440.5 | 通过 |
| 6 | 0.82 | 0.13 | 0.80 | 0.99 | 55.00 | 11.70 | 70.00 | 133.79 | 415.4 | 通过 |
| 7 | 0.09 | 0.06 | 0.09 | 0.04 | 30.00 | 8.70 | 39.58 | 37.30 | 63.3 | 通过 |
| 8 | 0.09 | 0.06 | 0.09 | 0.04 | 30.00 | 8.70 | 39.58 | 37.30 | 63.3 | 通过 |
| 9 | 0.19 | 0.04 | 0.26 | 0.15 | 46.67 | 10.70 | 144.76 | 27.82 | 71.7 | 通过 |
| 10 | 0.19 | 0.04 | 0.26 | 0.15 | 46.67 | 10.70 | 144.76 | 27.82 | 71.7 | 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 | 0.64 | 0.28 | 0.53 | 0.34 | 71.67 | 10.70 | 315.0 | 通过 |
| 2 | 0.98 | 0.30 | 0.92 | 0.79 | 67.50 | 11.70 | 624.2 | 通过 |
| 3 | 0.64 | 0.28 | 0.53 | 0.34 | 71.67 | 10.70 | 315.0 | 通过 |
| 4 | 0.97 | 0.25 | 0.90 | 0.92 | 63.33 | 10.70 | 682.6 | 通过 |
| 5 | 0.98 | 0.30 | 0.92 | 0.79 | 67.50 | 11.70 | 624.2 | 通过 |
| 6 | 0.97 | 0.25 | 0.90 | 0.92 | 63.33 | 10.70 | 682.6 | 通过 |
| 7 | 0.07 | 0.06 | 0.06 | 0.02 | 30.67 | 10.88 | 29.9 | 通过 |
| 8 | 0.47 | 0.15 | 0.43 | 0.32 | 30.67 | 10.88 | 58.6 | 通过 |
| 9 | 0.07 | 0.06 | 0.06 | 0.02 | 30.67 | 10.88 | 29.9 | 通过 |
| 10 | 0.47 | 0.15 | 0.43 | 0.32 | 30.67 | 10.88 | 58.6 | 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=10.64, Ly=7.80; 长细比：λx=70.0,λy=133.8

构件长度=7.80; 计算长度系数: Ux=1.36 Uy=1.00

抗震等级: 四级

截面参数: B1=240, B2=240, H=350, 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: 243.067841(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | -25.34 | 57.29 | -13.66 | -81.21 | -50.81 | 13.66 |
| 2 | -87.76 | 105.13 | -35.76 | -191.18 | -98.65 | 35.76 |
| 3 | -87.76 | 105.13 | -35.76 | -191.18 | -98.65 | 35.76 |
| 4 | -25.34 | 57.29 | -13.66 | -81.21 | -50.81 | 13.66 |
| 5 | -15.93 | 43.30 | -9.55 | -58.55 | -38.31 | 9.55 |
| 6 | -78.35 | 91.14 | -31.65 | -168.52 | -86.16 | 31.65 |
| 7 | -78.35 | 91.14 | -31.65 | -168.52 | -86.16 | 31.65 |
| 8 | -15.93 | 43.30 | -9.55 | -58.55 | -38.31 | 9.55 |
| 9 | 49.49 | 50.11 | 14.01 | -58.81 | -43.63 | 16.39 |
| 10 | -97.80 | 41.15 | -32.81 | -84.17 | -34.67 | 13.85 |
| 11 | 58.91 | 36.11 | 18.12 | -36.15 | -31.13 | 12.28 |
| 12 | -88.39 | 27.16 | -28.69 | -61.51 | -22.18 | 9.74 |
| 13 | 28.83 | 50.97 | 5.43 | -57.58 | -44.49 | 12.81 |
| 14 | -59.55 | 45.60 | -22.65 | -72.79 | -39.12 | 11.28 |
| 15 | -33.59 | 98.82 | -16.67 | -167.55 | -92.34 | 34.91 |
| 16 | -121.97 | 93.44 | -44.76 | -182.76 | -86.96 | 33.38 |
| 17 | -33.59 | 98.82 | -16.67 | -167.55 | -92.34 | 34.91 |
| 18 | -121.97 | 93.44 | -44.76 | -182.76 | -86.96 | 33.38 |
| 19 | 28.83 | 50.97 | 5.43 | -57.58 | -44.49 | 12.81 |
| 20 | -59.55 | 45.60 | -22.65 | -72.79 | -39.12 | 11.28 |
| 21 | 38.24 | 36.98 | 9.55 | -34.92 | -31.99 | 8.69 |
| 22 | -50.14 | 31.61 | -18.54 | -50.13 | -26.62 | 7.17 |
| 23 | -24.18 | 84.82 | -12.56 | -144.89 | -79.84 | 30.80 |
| 24 | -112.56 | 79.45 | -40.64 | -160.10 | -74.47 | 29.27 |
| 25 | -24.18 | 84.82 | -12.56 | -144.89 | -79.84 | 30.80 |
| 26 | -112.56 | 79.45 | -40.64 | -160.10 | -74.47 | 29.27 |
| 27 | 38.24 | 36.98 | 9.55 | -34.92 | -31.99 | 8.69 |
| 28 | -50.14 | 31.61 | -18.54 | -50.13 | -26.62 | 7.17 |
| 29 | 60.31 | 47.76 | 16.92 | -46.92 | -41.28 | 13.48 |
| 30 | -86.99 | 38.81 | -29.90 | -72.28 | -32.33 | 10.94 |
| 31 | 16.61 | 81.26 | 1.44 | -123.90 | -74.78 | 28.96 |
| 32 | -130.69 | 72.30 | -45.37 | -149.26 | -65.82 | 26.41 |
| 33 | 16.61 | 81.26 | 1.44 | -123.90 | -74.78 | 28.96 |
| 34 | -130.69 | 72.30 | -45.37 | -149.26 | -65.82 | 26.41 |
| 35 | 60.31 | 47.76 | 16.92 | -46.92 | -41.28 | 13.48 |
| 36 | -86.99 | 38.81 | -29.90 | -72.28 | -32.33 | 10.94 |
| 37 | 69.72 | 33.77 | 21.03 | -24.26 | -28.79 | 9.37 |
| 38 | -77.58 | 24.82 | -25.78 | -49.62 | -19.83 | 6.83 |
| 39 | 26.02 | 67.26 | 5.56 | -101.24 | -62.28 | 24.84 |
| 40 | -121.27 | 58.31 | -41.26 | -126.59 | -53.32 | 22.30 |
| 41 | 26.02 | 67.26 | 5.56 | -101.24 | -62.28 | 24.84 |
| 42 | -121.27 | 58.31 | -41.26 | -126.59 | -53.32 | 22.30 |
| 43 | 69.72 | 33.77 | 21.03 | -24.26 | -28.79 | 9.37 |
| 44 | -77.58 | 24.82 | -25.78 | -49.62 | -19.83 | 6.83 |
| 45 | -19.37 | 58.23 | -12.95 | -81.64 | -51.75 | 12.95 |
| 46 | -48.80 | 60.14 | -19.08 | -100.02 | -53.66 | 19.08 |
| 47 | -46.41 | 78.97 | -22.53 | -129.30 | -72.49 | 22.53 |
| 48 | -75.85 | 80.87 | -28.66 | -147.68 | -74.39 | 28.66 |
| 49 | -46.41 | 78.97 | -22.53 | -129.30 | -72.49 | 22.53 |
| 50 | -75.85 | 80.87 | -28.66 | -147.68 | -74.39 | 28.66 |
| 51 | -19.37 | 58.23 | -12.95 | -81.64 | -51.75 | 12.95 |
| 52 | -48.80 | 60.14 | -19.08 | -100.02 | -53.66 | 19.08 |
| 53 | -11.50 | 44.57 | -9.25 | -60.68 | -39.59 | 9.25 |
| 54 | -40.93 | 46.48 | -15.38 | -79.06 | -41.50 | 15.38 |
| 55 | -32.30 | 60.52 | -16.62 | -97.34 | -55.54 | 16.62 |
| 56 | -61.74 | 62.43 | -22.75 | -115.72 | -57.44 | 22.75 |
| 57 | -32.30 | 60.52 | -16.62 | -97.34 | -55.54 | 16.62 |
| 58 | -61.74 | 62.43 | -22.75 | -115.72 | -57.44 | 22.75 |
| 59 | -11.50 | 44.57 | -9.25 | -60.68 | -39.59 | 9.25 |
| 60 | -40.93 | 46.48 | -15.38 | -79.06 | -41.50 | 15.38 |

强度计算控制组合号: 2, M=-87.76, N=105.13, M=-191.18, N=-98.65

强度计算应力比 =0.817

抗剪强度计算控制组合号: 32, V=-45.37

抗剪强度计算应力比 =0.131

平面内稳定计算最大应力对应组合号: 2, M=-87.76, N=105.13, M=-191.18, N=-98.65

平面内稳定计算最大应力 (N/mm\*mm) =243.70

平面内稳定计算最大应力比 =0.799

平面外稳定计算最大应力对应组合号: 15, M=-33.59, N=98.82, M=-167.55, N=-92.34

临界弯矩Mcr(kN\*m) =360.35

平面外稳定计算最大应力比 =0.994

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 =0.817 < 1.0

抗剪强度计算应力比 =0.131 < 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=55.00 < [H0/TW]=250.00

翼缘宽厚比 B/T =11.70 < [B/T]=12.20

压杆,平面内长细比 λ=70. ≤ [λ]=180

压杆,平面外长细比 λ=134. ≤ [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 | -26.23 | 45.53 | -12.32 | -69.88 | -40.54 | 12.32 |
| 2 | -47.03 | 61.48 | -19.69 | -106.54 | -56.49 | 19.69 |
| 3 | -47.03 | 61.48 | -19.69 | -106.54 | -56.49 | 19.69 |
| 4 | -26.23 | 45.53 | -12.32 | -69.88 | -40.54 | 12.32 |
| 5 | -23.09 | 40.86 | -10.95 | -62.32 | -36.38 | 10.95 |
| 6 | -43.90 | 56.81 | -18.32 | -98.98 | -52.33 | 18.32 |
| 7 | -43.90 | 56.81 | -18.32 | -98.98 | -52.33 | 18.32 |
| 8 | -23.09 | 40.86 | -10.95 | -62.32 | -36.38 | 10.95 |
| 9 | -7.30 | 43.84 | -5.22 | -65.04 | -38.85 | 13.33 |
| 10 | -46.58 | 41.45 | -17.70 | -71.80 | -36.46 | 12.65 |
| 11 | -4.16 | 39.17 | -3.85 | -57.48 | -34.69 | 11.96 |
| 12 | -43.44 | 36.78 | -16.33 | -64.25 | -32.30 | 11.28 |

防火设计控制的偶然组合号: 2, M=-47.03, N=61.48, M=-106.54, N=-56.49

强度计算荷载比 =0.45

平面内稳定计算荷载比 =0.44

平面外稳定计算荷载比 =0.47

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): 587.25℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.5076(m^2\*℃/w) ,计算所需保护层厚度(di) =50.76(mm)

构件重量 (Kg)=415.40

**2. 钢 柱 2
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=10.10, Ly=8.66; 长细比：λx=76.8,λy=145.2

构件长度=8.66; 计算长度系数: Ux=1.17 Uy=1.00

抗震等级: 四级

截面参数: B1=240, B2=240, 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: 238.888885(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 59.94 | 170.13 | 18.04 | 96.34 | -163.17 | -18.04 |
| 2 | -0.31 | 158.04 | -0.31 | -2.44 | -151.26 | 0.31 |
| 3 | 38.87 | 208.25 | 11.48 | 60.53 | -201.38 | -11.48 |
| 4 | 20.76 | 119.93 | 6.25 | 33.37 | -113.06 | -6.25 |
| 5 | 54.97 | 142.41 | 16.57 | 88.51 | -137.03 | -16.57 |
| 6 | -5.28 | 130.32 | -1.79 | -10.27 | -125.12 | 1.79 |
| 7 | 33.90 | 180.53 | 10.00 | 52.70 | -175.24 | -10.00 |
| 8 | 15.79 | 92.20 | 4.77 | 25.54 | -86.92 | -4.77 |
| 9 | 63.54 | 103.86 | 15.50 | 70.67 | -96.99 | -15.50 |
| 10 | -32.87 | 70.99 | -6.39 | -22.48 | -64.12 | 6.39 |
| 11 | 58.57 | 76.13 | 14.02 | 62.84 | -70.85 | -14.02 |
| 12 | -37.84 | 43.27 | -7.87 | -30.31 | -37.98 | 7.87 |
| 13 | 85.15 | 160.36 | 23.50 | 118.38 | -153.40 | -23.50 |
| 14 | 27.30 | 140.64 | 10.37 | 62.49 | -133.68 | -10.37 |
| 15 | 24.89 | 148.27 | 5.14 | 19.60 | -141.49 | -5.14 |
| 16 | -32.95 | 128.55 | -7.99 | -36.29 | -121.77 | 7.99 |
| 17 | 64.07 | 198.48 | 16.94 | 82.57 | -191.61 | -16.94 |
| 18 | 6.23 | 178.76 | 3.80 | 26.68 | -171.89 | -3.80 |
| 19 | 45.96 | 110.16 | 11.71 | 55.41 | -103.28 | -11.71 |
| 20 | -11.88 | 90.44 | -1.43 | -0.48 | -83.56 | 1.43 |
| 21 | 80.18 | 132.64 | 22.02 | 110.55 | -127.26 | -22.02 |
| 22 | 22.33 | 112.92 | 8.89 | 54.66 | -107.54 | -8.89 |
| 23 | 19.92 | 120.55 | 3.66 | 11.77 | -115.35 | -3.66 |
| 24 | -37.92 | 100.83 | -9.47 | -44.12 | -95.63 | 9.47 |
| 25 | 59.11 | 170.75 | 15.46 | 74.74 | -165.47 | -15.46 |
| 26 | 1.26 | 151.03 | 2.32 | 18.85 | -145.75 | -2.32 |
| 27 | 40.99 | 82.43 | 10.23 | 47.58 | -77.14 | -10.23 |
| 28 | -16.85 | 62.71 | -2.91 | -8.31 | -57.42 | 2.91 |
| 29 | 90.42 | 138.85 | 23.65 | 114.35 | -131.92 | -23.65 |
| 30 | -5.98 | 105.98 | 1.75 | 21.20 | -99.05 | -1.76 |
| 31 | 48.24 | 130.39 | 10.80 | 45.21 | -123.58 | -10.80 |
| 32 | -48.16 | 97.52 | -11.10 | -47.94 | -90.71 | 11.10 |
| 33 | 75.67 | 165.53 | 19.05 | 89.29 | -158.66 | -19.05 |
| 34 | -20.73 | 132.67 | -2.84 | -3.86 | -125.80 | 2.84 |
| 35 | 62.99 | 103.71 | 15.39 | 70.28 | -96.84 | -15.39 |
| 36 | -33.41 | 70.84 | -6.50 | -22.88 | -63.97 | 6.50 |
| 37 | 85.45 | 111.13 | 22.17 | 106.52 | -105.78 | -22.17 |
| 38 | -10.95 | 78.26 | 0.28 | 13.37 | -72.91 | -0.28 |
| 39 | 43.27 | 102.66 | 9.32 | 37.38 | -97.44 | -9.32 |
| 40 | -53.13 | 69.80 | -12.57 | -55.77 | -64.57 | 12.57 |
| 41 | 70.71 | 137.81 | 17.57 | 81.46 | -132.52 | -17.57 |
| 42 | -25.70 | 104.94 | -4.32 | -11.69 | -99.66 | 4.32 |
| 43 | 58.02 | 75.98 | 13.91 | 62.44 | -70.70 | -13.91 |
| 44 | -38.38 | 43.11 | -7.98 | -30.71 | -37.83 | 7.98 |
| 45 | 49.17 | 142.04 | 13.90 | 71.21 | -135.13 | -13.90 |
| 46 | 27.20 | 141.58 | 9.00 | 50.75 | -134.66 | -9.00 |
| 47 | 23.06 | 136.81 | 5.95 | 28.41 | -129.97 | -5.95 |
| 48 | 1.09 | 136.34 | 1.05 | 7.95 | -129.50 | -1.05 |
| 49 | 40.04 | 158.56 | 11.06 | 55.70 | -151.69 | -11.06 |
| 50 | 18.07 | 158.09 | 6.16 | 35.23 | -151.22 | -6.16 |
| 51 | 32.19 | 120.29 | 8.79 | 43.93 | -113.42 | -8.79 |
| 52 | 10.22 | 119.82 | 3.89 | 23.46 | -112.95 | -3.89 |
| 53 | 40.36 | 109.32 | 11.26 | 57.14 | -104.00 | -11.26 |
| 54 | 18.39 | 108.85 | 6.36 | 36.68 | -103.54 | -6.36 |
| 55 | 20.27 | 105.29 | 5.14 | 24.22 | -100.03 | -5.14 |
| 56 | -1.69 | 104.82 | 0.24 | 3.75 | -99.57 | -0.24 |
| 57 | 33.33 | 122.03 | 9.07 | 45.21 | -116.74 | -9.07 |
| 58 | 11.37 | 121.56 | 4.17 | 24.74 | -116.27 | -4.17 |
| 59 | 27.29 | 92.58 | 7.33 | 36.15 | -87.30 | -7.33 |
| 60 | 5.33 | 92.12 | 2.43 | 15.69 | -86.83 | -2.43 |

强度计算控制组合号: 13, M=85.15, N=160.36, M=118.38, N=-153.40

强度计算应力比 =0.627

抗剪强度计算控制组合号: 29, V=-23.65

抗剪强度计算应力比 =0.080

平面内稳定计算最大应力对应组合号: 13, M=85.15, N=160.36, M=118.38, N=-153.40

平面内稳定计算最大应力 (N/mm\*mm) =210.36

平面内稳定计算最大应力比 =0.690

临界弯矩Mcr(kN\*m) =359.36

平面外稳定计算最大应力比 =0.831

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 =0.627 < 1.0

抗剪强度计算应力比 =0.080 < 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 =11.70 < [B/T]=12.20

压杆,平面内长细比 λ=77. ≤ [λ]=180

压杆,平面外长细比 λ=145. ≤ [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 | 29.37 | 109.08 | 8.81 | 46.91 | -103.77 | -8.81 |
| 2 | 9.28 | 105.05 | 2.69 | 13.98 | -99.80 | -2.69 |
| 3 | 22.34 | 121.79 | 6.62 | 34.97 | -116.50 | -6.62 |
| 4 | 16.30 | 92.35 | 4.88 | 25.92 | -87.06 | -4.88 |
| 5 | 27.71 | 99.84 | 8.31 | 44.30 | -95.05 | -8.31 |
| 6 | 7.62 | 95.81 | 2.20 | 11.37 | -91.08 | -2.19 |
| 7 | 20.69 | 112.55 | 6.13 | 32.36 | -107.79 | -6.13 |
| 8 | 14.65 | 83.10 | 4.38 | 23.31 | -78.35 | -4.38 |
| 9 | 27.77 | 88.08 | 7.35 | 35.90 | -82.79 | -7.35 |
| 10 | 2.06 | 79.31 | 1.52 | 11.06 | -74.03 | -1.52 |
| 11 | 26.11 | 78.83 | 6.86 | 33.29 | -74.08 | -6.86 |
| 12 | 0.40 | 70.07 | 1.02 | 8.45 | -65.31 | -1.02 |

防火设计控制的偶然组合号: 1, M=29.37, N=109.08, M=46.91, N=-103.77

强度计算荷载比 =0.24

平面内稳定计算荷载比 =0.30

平面外稳定计算荷载比 =0.38

无防护下钢构件最大升温(Ts): 1081.76℃ ,按临界温度法求得临界温度(Td): 618.85℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4617(m^2\*℃/w) ,计算所需保护层厚度(di) =46.17(mm)

构件重量 (Kg)=440.47

**3. 钢 柱 3
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=11.32, Ly=9.31; 长细比：λx=86.7,λy=172.3

构件长度=9.31; 计算长度系数: Ux=1.22 Uy=1.00

抗震等级: 四级

截面参数: B1=220, B2=220, 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: 241.447372(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 46.20 | 99.13 | 13.00 | 74.90 | -92.20 | -13.00 |
| 2 | 14.79 | 67.13 | 4.52 | 27.33 | -60.19 | -4.52 |
| 3 | 33.11 | 117.01 | 10.53 | 64.98 | -110.07 | -10.53 |
| 4 | 27.88 | 49.26 | 6.99 | 37.25 | -42.32 | -6.99 |
| 5 | 41.14 | 84.88 | 11.55 | 66.41 | -79.54 | -11.55 |
| 6 | 9.73 | 52.87 | 3.07 | 18.85 | -47.54 | -3.07 |
| 7 | 28.04 | 102.75 | 9.08 | 56.50 | -97.41 | -9.08 |
| 8 | 22.82 | 35.00 | 5.54 | 28.76 | -29.66 | -5.54 |
| 9 | 50.97 | 46.41 | 11.60 | 57.01 | -39.48 | -11.60 |
| 10 | -19.62 | 37.03 | -2.59 | -4.54 | -30.10 | 2.59 |
| 11 | 45.91 | 32.15 | 10.14 | 48.53 | -26.82 | -10.14 |
| 12 | -24.68 | 22.78 | -4.05 | -13.03 | -17.44 | 4.05 |
| 13 | 63.62 | 89.91 | 16.18 | 87.04 | -82.98 | -16.18 |
| 14 | 21.26 | 84.28 | 7.66 | 50.11 | -77.35 | -7.66 |
| 15 | 32.21 | 57.90 | 7.70 | 39.48 | -50.97 | -7.70 |
| 16 | -10.15 | 52.28 | -0.82 | 2.54 | -45.34 | 0.82 |
| 17 | 50.52 | 107.78 | 13.71 | 77.13 | -100.85 | -13.71 |
| 18 | 8.17 | 102.16 | 5.19 | 40.19 | -95.22 | -5.19 |
| 19 | 45.30 | 40.03 | 10.17 | 49.39 | -33.10 | -10.17 |
| 20 | 2.95 | 34.41 | 1.65 | 12.46 | -27.47 | -1.65 |
| 21 | 58.56 | 75.65 | 14.72 | 78.56 | -70.32 | -14.72 |
| 22 | 16.20 | 70.03 | 6.21 | 41.62 | -64.69 | -6.21 |
| 23 | 27.15 | 43.64 | 6.24 | 30.99 | -38.31 | -6.24 |
| 24 | -15.21 | 38.02 | -2.27 | -5.94 | -32.69 | 2.27 |
| 25 | 45.46 | 93.52 | 12.25 | 68.64 | -88.19 | -12.25 |
| 26 | 3.11 | 87.90 | 3.74 | 31.71 | -82.56 | -3.74 |
| 27 | 40.24 | 25.77 | 8.71 | 40.91 | -20.44 | -8.71 |
| 28 | -2.11 | 20.15 | 0.20 | 3.97 | -14.81 | -0.20 |
| 29 | 67.95 | 72.56 | 16.29 | 83.70 | -65.62 | -16.29 |
| 30 | -2.64 | 63.18 | 2.10 | 22.15 | -56.25 | -2.10 |
| 31 | 45.97 | 50.15 | 10.35 | 50.41 | -43.22 | -10.35 |
| 32 | -24.62 | 40.77 | -3.84 | -11.15 | -33.84 | 3.84 |
| 33 | 58.79 | 85.07 | 14.56 | 76.76 | -78.13 | -14.56 |
| 34 | -11.80 | 75.69 | 0.37 | 15.21 | -68.76 | -0.37 |
| 35 | 55.13 | 37.64 | 12.08 | 57.35 | -30.71 | -12.08 |
| 36 | -15.46 | 28.26 | -2.11 | -4.21 | -21.33 | 2.11 |
| 37 | 62.89 | 58.30 | 14.83 | 75.22 | -52.96 | -14.83 |
| 38 | -7.70 | 48.92 | 0.64 | 13.66 | -43.59 | -0.64 |
| 39 | 40.90 | 35.89 | 8.89 | 41.92 | -30.56 | -8.89 |
| 40 | -29.69 | 26.52 | -5.30 | -19.63 | -21.18 | 5.30 |
| 41 | 53.72 | 70.81 | 13.10 | 68.28 | -65.47 | -13.10 |
| 42 | -16.87 | 61.43 | -1.09 | 6.72 | -56.10 | 1.09 |
| 43 | 50.07 | 23.38 | 10.62 | 48.86 | -18.05 | -10.62 |
| 44 | -20.52 | 14.01 | -3.57 | -12.69 | -8.67 | 3.57 |
| 45 | 40.31 | 77.52 | 10.73 | 59.60 | -70.58 | -10.73 |
| 46 | 24.63 | 78.41 | 7.69 | 47.02 | -71.48 | -7.69 |
| 47 | 26.70 | 63.65 | 7.05 | 38.99 | -56.71 | -7.05 |
| 48 | 11.01 | 64.54 | 4.02 | 26.41 | -57.61 | -4.02 |
| 49 | 34.64 | 85.26 | 9.66 | 55.31 | -78.33 | -9.66 |
| 50 | 18.95 | 86.16 | 6.62 | 42.73 | -79.23 | -6.62 |
| 51 | 32.37 | 55.90 | 8.13 | 43.29 | -48.97 | -8.13 |
| 52 | 16.69 | 56.80 | 5.09 | 30.71 | -49.87 | -5.09 |
| 53 | 32.82 | 59.52 | 8.60 | 47.31 | -54.19 | -8.60 |
| 54 | 17.14 | 60.42 | 5.57 | 34.73 | -55.09 | -5.57 |
| 55 | 22.35 | 48.86 | 5.78 | 31.45 | -43.52 | -5.78 |
| 56 | 6.67 | 49.75 | 2.74 | 18.87 | -44.42 | -2.74 |
| 57 | 28.46 | 65.48 | 7.78 | 44.00 | -60.15 | -7.78 |
| 58 | 12.77 | 66.38 | 4.75 | 31.42 | -61.05 | -4.75 |
| 59 | 26.72 | 42.90 | 6.60 | 34.76 | -37.57 | -6.60 |
| 60 | 11.03 | 43.80 | 3.57 | 22.18 | -38.46 | -3.57 |

强度计算控制组合号: 13, M=63.62, N=89.91, M=87.04, N=-82.98

强度计算应力比 =0.481

抗剪强度计算控制组合号: 29, V=16.29

抗剪强度计算应力比 =0.055

平面内稳定计算最大应力对应组合号: 13, M=63.62, N=89.91, M=87.04, N=-82.98

平面内稳定计算最大应力 (N/mm\*mm) =159.42

平面内稳定计算最大应力比 =0.523

平面外稳定计算最大应力对应组合号: 17, M=50.52, N=107.78, M=77.13, N=-100.85

临界弯矩Mcr(kN\*m) =262.53

平面外稳定计算最大应力比 =0.703

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 =0.481 < 1.0

抗剪强度计算应力比 =0.055 < 1.0

平面内稳定计算最大应力 < f=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 =10.70 < [B/T]=12.20

压杆,平面内长细比 λ=87. ≤ [λ]=180

压杆,平面外长细比 λ=172. ≤ [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 | 24.96 | 59.98 | 7.08 | 40.99 | -54.64 | -7.08 |
| 2 | 14.49 | 49.31 | 4.26 | 25.14 | -43.97 | -4.26 |
| 3 | 20.60 | 65.93 | 6.26 | 37.69 | -60.60 | -6.26 |
| 4 | 18.86 | 43.35 | 5.08 | 28.44 | -38.02 | -5.08 |
| 5 | 23.28 | 55.22 | 6.60 | 38.16 | -50.42 | -6.60 |
| 6 | 12.81 | 44.55 | 3.77 | 22.31 | -39.75 | -3.77 |
| 7 | 18.91 | 61.18 | 5.77 | 34.86 | -56.38 | -5.77 |
| 8 | 17.17 | 38.60 | 4.59 | 25.61 | -33.80 | -4.59 |
| 9 | 24.62 | 43.43 | 6.26 | 33.68 | -38.09 | -6.26 |
| 10 | 5.79 | 40.93 | 2.48 | 17.27 | -35.59 | -2.48 |
| 11 | 22.93 | 38.67 | 5.78 | 30.85 | -33.87 | -5.78 |
| 12 | 4.11 | 36.17 | 1.99 | 14.44 | -31.37 | -1.99 |

防火设计控制的偶然组合号: 3, M=20.60, N=65.93, M=37.69, N=-60.60

强度计算荷载比 =0.21

平面内稳定计算荷载比 =0.25

平面外稳定计算荷载比 =0.35

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): 628.01℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4526(m^2\*℃/w) ,计算所需保护层厚度(di) =45.26(mm)

构件重量 (Kg)=444.44

**4. 钢 柱 4
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=11.32, Ly=9.31; 长细比：λx=86.7,λy=172.3

构件长度=9.31; 计算长度系数: Ux=1.22 Uy=1.00

抗震等级: 四级

截面参数: B1=220, B2=220, 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: 241.447372(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | -14.79 | 67.13 | -4.52 | -27.33 | -60.19 | 4.52 |
| 2 | -46.20 | 99.13 | -13.00 | -74.90 | -92.20 | 13.00 |
| 3 | -33.11 | 117.01 | -10.53 | -64.98 | -110.07 | 10.53 |
| 4 | -27.88 | 49.26 | -6.99 | -37.25 | -42.32 | 6.99 |
| 5 | -9.73 | 52.87 | -3.07 | -18.85 | -47.54 | 3.07 |
| 6 | -41.14 | 84.88 | -11.55 | -66.41 | -79.54 | 11.55 |
| 7 | -28.04 | 102.75 | -9.08 | -56.50 | -97.41 | 9.08 |
| 8 | -22.82 | 35.00 | -5.54 | -28.76 | -29.66 | 5.54 |
| 9 | 19.62 | 37.04 | 2.60 | 4.54 | -30.11 | -2.60 |
| 10 | -50.97 | 46.41 | -11.60 | -57.01 | -39.48 | 11.60 |
| 11 | 24.68 | 22.78 | 4.05 | 13.03 | -17.45 | -4.05 |
| 12 | -45.90 | 32.16 | -10.14 | -48.53 | -26.82 | 10.14 |
| 13 | 10.15 | 52.28 | 0.82 | -2.54 | -45.35 | -0.82 |
| 14 | -32.21 | 57.90 | -7.70 | -39.48 | -50.97 | 7.70 |
| 15 | -21.26 | 84.29 | -7.66 | -50.11 | -77.35 | 7.66 |
| 16 | -63.62 | 89.91 | -16.18 | -87.04 | -82.98 | 16.18 |
| 17 | -8.17 | 102.16 | -5.19 | -40.19 | -95.23 | 5.19 |
| 18 | -50.52 | 107.78 | -13.71 | -77.13 | -100.85 | 13.71 |
| 19 | -2.95 | 34.41 | -1.65 | -12.46 | -27.48 | 1.65 |
| 20 | -45.30 | 40.03 | -10.17 | -49.39 | -33.10 | 10.17 |
| 21 | 15.21 | 38.02 | 2.27 | 5.94 | -32.69 | -2.27 |
| 22 | -27.14 | 43.65 | -6.24 | -30.99 | -38.31 | 6.24 |
| 23 | -16.20 | 70.03 | -6.21 | -41.62 | -64.70 | 6.21 |
| 24 | -58.55 | 75.65 | -14.72 | -78.56 | -70.32 | 14.72 |
| 25 | -3.11 | 87.90 | -3.74 | -31.71 | -82.57 | 3.74 |
| 26 | -45.46 | 93.53 | -12.25 | -68.64 | -88.19 | 12.25 |
| 27 | 2.12 | 20.15 | -0.20 | -3.97 | -14.82 | 0.20 |
| 28 | -40.24 | 25.78 | -8.71 | -40.91 | -20.44 | 8.71 |
| 29 | 24.63 | 40.78 | 3.84 | 11.15 | -33.85 | -3.84 |
| 30 | -45.96 | 50.15 | -10.35 | -50.40 | -43.22 | 10.35 |
| 31 | 2.64 | 63.18 | -2.09 | -22.14 | -56.25 | 2.09 |
| 32 | -67.95 | 72.56 | -16.29 | -83.70 | -65.63 | 16.29 |
| 33 | 11.81 | 75.69 | -0.37 | -15.20 | -68.76 | 0.37 |
| 34 | -58.78 | 85.07 | -14.56 | -76.76 | -78.14 | 14.56 |
| 35 | 15.46 | 28.27 | 2.11 | 4.21 | -21.34 | -2.11 |
| 36 | -55.13 | 37.64 | -12.08 | -57.35 | -30.71 | 12.08 |
| 37 | 29.69 | 26.52 | 5.30 | 19.64 | -21.19 | -5.30 |
| 38 | -40.90 | 35.90 | -8.89 | -41.92 | -30.56 | 8.89 |
| 39 | 7.70 | 48.93 | -0.64 | -13.66 | -43.59 | 0.64 |
| 40 | -62.89 | 58.30 | -14.83 | -75.21 | -52.97 | 14.83 |
| 41 | 16.87 | 61.44 | 1.09 | -6.72 | -56.10 | -1.09 |
| 42 | -53.72 | 70.81 | -13.10 | -68.27 | -65.48 | 13.10 |
| 43 | 20.52 | 14.01 | 3.57 | 12.69 | -8.68 | -3.57 |
| 44 | -50.06 | 23.39 | -10.62 | -48.86 | -18.05 | 10.62 |
| 45 | -11.01 | 64.54 | -4.02 | -26.41 | -57.61 | 4.02 |
| 46 | -26.70 | 63.65 | -7.05 | -38.99 | -56.71 | 7.05 |
| 47 | -24.63 | 78.41 | -7.69 | -47.02 | -71.48 | 7.69 |
| 48 | -40.31 | 77.52 | -10.73 | -59.60 | -70.58 | 10.73 |
| 49 | -18.95 | 86.16 | -6.62 | -42.73 | -79.23 | 6.62 |
| 50 | -34.64 | 85.26 | -9.66 | -55.31 | -78.33 | 9.66 |
| 51 | -16.69 | 56.80 | -5.09 | -30.71 | -49.87 | 5.09 |
| 52 | -32.37 | 55.90 | -8.13 | -43.29 | -48.97 | 8.13 |
| 53 | -6.67 | 49.75 | -2.74 | -18.87 | -44.42 | 2.74 |
| 54 | -22.35 | 48.86 | -5.78 | -31.45 | -43.52 | 5.78 |
| 55 | -17.14 | 60.42 | -5.57 | -34.73 | -55.09 | 5.57 |
| 56 | -32.82 | 59.52 | -8.60 | -47.31 | -54.19 | 8.60 |
| 57 | -12.77 | 66.38 | -4.75 | -31.42 | -61.05 | 4.75 |
| 58 | -28.46 | 65.48 | -7.78 | -44.00 | -60.15 | 7.78 |
| 59 | -11.03 | 43.80 | -3.57 | -22.18 | -38.46 | 3.57 |
| 60 | -26.72 | 42.90 | -6.60 | -34.76 | -37.57 | 6.60 |

强度计算控制组合号: 16, M=-63.62, N=89.91, M=-87.04, N=-82.98

强度计算应力比 =0.481

抗剪强度计算控制组合号: 32, V=-16.29

抗剪强度计算应力比 =0.055

平面内稳定计算最大应力对应组合号: 16, M=-63.62, N=89.91, M=-87.04, N=-82.98

平面内稳定计算最大应力 (N/mm\*mm) =159.42

平面内稳定计算最大应力比 =0.523

平面外稳定计算最大应力对应组合号: 18, M=-50.52, N=107.78, M=-77.13, N=-100.85

临界弯矩Mcr(kN\*m) =262.53

平面外稳定计算最大应力比 =0.703

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 =0.481 < 1.0

抗剪强度计算应力比 =0.055 < 1.0

平面内稳定计算最大应力 < f=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 =10.70 < [B/T]=12.20

压杆,平面内长细比 λ=87. ≤ [λ]=180

压杆,平面外长细比 λ=172. ≤ [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 | -14.49 | 49.31 | -4.26 | -25.14 | -43.97 | 4.26 |
| 2 | -24.96 | 59.98 | -7.08 | -40.99 | -54.64 | 7.08 |
| 3 | -20.60 | 65.93 | -6.26 | -37.69 | -60.60 | 6.26 |
| 4 | -18.86 | 43.35 | -5.08 | -28.44 | -38.02 | 5.08 |
| 5 | -12.81 | 44.55 | -3.77 | -22.31 | -39.75 | 3.77 |
| 6 | -23.28 | 55.22 | -6.60 | -38.16 | -50.42 | 6.60 |
| 7 | -18.91 | 61.18 | -5.77 | -34.86 | -56.38 | 5.77 |
| 8 | -17.17 | 38.60 | -4.59 | -25.61 | -33.80 | 4.59 |
| 9 | -5.79 | 40.93 | -2.48 | -17.27 | -35.59 | 2.48 |
| 10 | -24.62 | 43.43 | -6.26 | -33.68 | -38.09 | 6.26 |
| 11 | -4.11 | 36.18 | -1.99 | -14.44 | -31.38 | 1.99 |
| 12 | -22.93 | 38.67 | -5.78 | -30.85 | -33.87 | 5.78 |

防火设计控制的偶然组合号: 3, M=-20.60, N=65.93, M=-37.69, N=-60.60

强度计算荷载比 =0.21

平面内稳定计算荷载比 =0.25

平面外稳定计算荷载比 =0.35

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): 628.01℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4526(m^2\*℃/w) ,计算所需保护层厚度(di) =45.26(mm)

构件重量 (Kg)=444.44

**5. 钢 柱 5
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=10.10, Ly=8.66; 长细比：λx=76.8,λy=145.2

构件长度=8.66; 计算长度系数: Ux=1.17 Uy=1.00

抗震等级: 四级

截面参数: B1=240, B2=240, 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: 238.888885(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.31 | 158.04 | 0.31 | 2.44 | -151.26 | -0.31 |
| 2 | -59.94 | 170.13 | -18.04 | -96.34 | -163.17 | 18.04 |
| 3 | -38.87 | 208.25 | -11.48 | -60.53 | -201.38 | 11.48 |
| 4 | -20.76 | 119.93 | -6.25 | -33.37 | -113.06 | 6.25 |
| 5 | 5.28 | 130.32 | 1.79 | 10.27 | -125.12 | -1.79 |
| 6 | -54.97 | 142.41 | -16.57 | -88.51 | -137.03 | 16.57 |
| 7 | -33.90 | 180.53 | -10.00 | -52.70 | -175.24 | 10.00 |
| 8 | -15.79 | 92.20 | -4.77 | -25.54 | -86.92 | 4.77 |
| 9 | 32.87 | 71.02 | 6.39 | 22.47 | -64.15 | -6.39 |
| 10 | -63.53 | 103.85 | -15.50 | -70.67 | -96.98 | 15.50 |
| 11 | 37.84 | 43.30 | 7.87 | 30.30 | -38.01 | -7.87 |
| 12 | -58.56 | 76.12 | -14.02 | -62.83 | -70.84 | 14.02 |
| 13 | 32.96 | 128.57 | 7.99 | 36.29 | -121.79 | -7.99 |
| 14 | -24.88 | 148.27 | -5.14 | -19.60 | -141.49 | 5.14 |
| 15 | -27.30 | 140.66 | -10.37 | -62.49 | -133.70 | 10.37 |
| 16 | -85.14 | 160.36 | -23.50 | -118.37 | -153.39 | 23.50 |
| 17 | -6.23 | 178.78 | -3.80 | -26.68 | -171.91 | 3.80 |
| 18 | -64.07 | 198.47 | -16.93 | -82.57 | -191.60 | 16.93 |
| 19 | 11.88 | 90.45 | 1.43 | 0.48 | -83.58 | -1.43 |
| 20 | -45.95 | 110.15 | -11.71 | -55.41 | -103.28 | 11.71 |
| 21 | 37.92 | 100.85 | 9.47 | 44.12 | -95.65 | -9.47 |
| 22 | -19.91 | 120.54 | -3.66 | -11.76 | -115.35 | 3.66 |
| 23 | -22.33 | 112.94 | -8.89 | -54.66 | -107.56 | 8.89 |
| 24 | -80.17 | 132.63 | -22.02 | -110.54 | -127.25 | 22.02 |
| 25 | -1.26 | 151.05 | -2.32 | -18.85 | -145.77 | 2.32 |
| 26 | -59.10 | 170.75 | -15.46 | -74.73 | -165.46 | 15.46 |
| 27 | 16.85 | 62.73 | 2.91 | 8.31 | -57.44 | -2.91 |
| 28 | -40.98 | 82.42 | -10.23 | -47.57 | -77.14 | 10.23 |
| 29 | 48.16 | 97.55 | 11.09 | 47.94 | -90.75 | -11.10 |
| 30 | -48.24 | 130.38 | -10.79 | -45.20 | -123.57 | 10.79 |
| 31 | 5.98 | 106.02 | -1.76 | -21.21 | -99.08 | 1.76 |
| 32 | -90.42 | 138.84 | -23.64 | -114.35 | -131.91 | 23.64 |
| 33 | 20.73 | 132.70 | 2.84 | 3.86 | -125.83 | -2.84 |
| 34 | -75.67 | 165.52 | -19.05 | -89.28 | -158.65 | 19.05 |
| 35 | 33.41 | 70.87 | 6.50 | 22.87 | -64.00 | -6.50 |
| 36 | -62.99 | 103.70 | -15.39 | -70.27 | -96.83 | 15.39 |
| 37 | 53.13 | 69.83 | 12.57 | 55.77 | -64.61 | -12.57 |
| 38 | -43.27 | 102.65 | -9.32 | -37.37 | -97.43 | 9.32 |
| 39 | 10.95 | 78.29 | -0.28 | -13.38 | -72.94 | 0.28 |
| 40 | -85.45 | 111.12 | -22.17 | -106.51 | -105.77 | 22.17 |
| 41 | 25.70 | 104.97 | 4.32 | 11.69 | -99.69 | -4.32 |
| 42 | -70.70 | 137.80 | -17.57 | -81.45 | -132.51 | 17.57 |
| 43 | 38.38 | 43.15 | 7.98 | 30.70 | -37.86 | -7.98 |
| 44 | -58.02 | 75.97 | -13.91 | -62.44 | -70.69 | 13.91 |
| 45 | -1.09 | 136.34 | -1.05 | -7.95 | -129.50 | 1.05 |
| 46 | -23.06 | 136.81 | -5.95 | -28.41 | -129.97 | 5.95 |
| 47 | -27.20 | 141.58 | -9.00 | -50.75 | -134.66 | 9.00 |
| 48 | -49.17 | 142.04 | -13.90 | -71.21 | -135.13 | 13.90 |
| 49 | -18.07 | 158.09 | -6.16 | -35.23 | -151.22 | 6.16 |
| 50 | -40.04 | 158.56 | -11.06 | -55.70 | -151.69 | 11.06 |
| 51 | -10.22 | 119.82 | -3.89 | -23.46 | -112.95 | 3.89 |
| 52 | -32.19 | 120.29 | -8.79 | -43.93 | -113.42 | 8.79 |
| 53 | 1.70 | 104.82 | -0.24 | -3.75 | -99.57 | 0.24 |
| 54 | -20.27 | 105.29 | -5.14 | -24.22 | -100.03 | 5.14 |
| 55 | -18.39 | 108.85 | -6.36 | -36.68 | -103.54 | 6.36 |
| 56 | -40.36 | 109.32 | -11.26 | -57.14 | -104.00 | 11.26 |
| 57 | -11.37 | 121.56 | -4.17 | -24.74 | -116.27 | 4.17 |
| 58 | -33.33 | 122.03 | -9.07 | -45.20 | -116.74 | 9.07 |
| 59 | -5.33 | 92.12 | -2.43 | -15.69 | -86.83 | 2.43 |
| 60 | -27.29 | 92.58 | -7.33 | -36.15 | -87.30 | 7.33 |

强度计算控制组合号: 16, M=-85.14, N=160.36, M=-118.37, N=-153.39

强度计算应力比 =0.627

抗剪强度计算控制组合号: 32, V=23.64

抗剪强度计算应力比 =0.080

平面内稳定计算最大应力对应组合号: 16, M=-85.14, N=160.36, M=-118.37, N=-153.39

平面内稳定计算最大应力 (N/mm\*mm) =210.35

平面内稳定计算最大应力比 =0.690

临界弯矩Mcr(kN\*m) =359.36

平面外稳定计算最大应力比 =0.831

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 =0.627 < 1.0

抗剪强度计算应力比 =0.080 < 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 =11.70 < [B/T]=12.20

压杆,平面内长细比 λ=77. ≤ [λ]=180

压杆,平面外长细比 λ=145. ≤ [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 | -9.28 | 105.05 | -2.69 | -13.98 | -99.80 | 2.69 |
| 2 | -29.37 | 109.08 | -8.81 | -46.91 | -103.77 | 8.81 |
| 3 | -22.34 | 121.79 | -6.62 | -34.97 | -116.50 | 6.62 |
| 4 | -16.30 | 92.35 | -4.88 | -25.92 | -87.06 | 4.88 |
| 5 | -7.62 | 95.81 | -2.20 | -11.37 | -91.08 | 2.19 |
| 6 | -27.71 | 99.84 | -8.31 | -44.30 | -95.05 | 8.31 |
| 7 | -20.69 | 112.55 | -6.13 | -32.36 | -107.79 | 6.13 |
| 8 | -14.65 | 83.10 | -4.38 | -23.31 | -78.35 | 4.38 |
| 9 | -2.06 | 79.32 | -1.52 | -11.06 | -74.03 | 1.52 |
| 10 | -27.76 | 88.07 | -7.35 | -35.90 | -82.79 | 7.35 |
| 11 | -0.40 | 70.08 | -1.02 | -8.45 | -65.32 | 1.02 |
| 12 | -26.11 | 78.83 | -6.86 | -33.29 | -74.07 | 6.86 |

防火设计控制的偶然组合号: 2, M=-29.37, N=109.08, M=-46.91, N=-103.77

强度计算荷载比 =0.24

平面内稳定计算荷载比 =0.30

平面外稳定计算荷载比 =0.38

无防护下钢构件最大升温(Ts): 1081.76℃ ,按临界温度法求得临界温度(Td): 618.85℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4617(m^2\*℃/w) ,计算所需保护层厚度(di) =46.17(mm)

构件重量 (Kg)=440.47

**6. 钢 柱 6
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=10.64, Ly=7.80; 长细比：λx=70.0,λy=133.8

构件长度=7.80; 计算长度系数: Ux=1.36 Uy=1.00

抗震等级: 四级

截面参数: B1=240, B2=240, H=350, 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: 243.067841(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 87.76 | 105.13 | 35.76 | 191.19 | -98.65 | -35.76 |
| 2 | 25.34 | 57.29 | 13.66 | 81.22 | -50.81 | -13.66 |
| 3 | 87.76 | 105.13 | 35.76 | 191.19 | -98.65 | -35.76 |
| 4 | 25.34 | 57.29 | 13.66 | 81.22 | -50.81 | -13.66 |
| 5 | 78.35 | 91.14 | 31.65 | 168.52 | -86.16 | -31.65 |
| 6 | 15.93 | 43.30 | 9.55 | 58.55 | -38.31 | -9.55 |
| 7 | 78.35 | 91.14 | 31.65 | 168.52 | -86.16 | -31.65 |
| 8 | 15.93 | 43.30 | 9.55 | 58.55 | -38.31 | -9.55 |
| 9 | 97.86 | 41.17 | 32.84 | 84.19 | -34.69 | -13.84 |
| 10 | -49.51 | 50.10 | -14.02 | 58.81 | -43.62 | -16.40 |
| 11 | 88.45 | 27.17 | 28.73 | 61.53 | -22.19 | -9.73 |
| 12 | -58.92 | 36.11 | -18.13 | 36.15 | -31.13 | -12.29 |
| 13 | 122.01 | 93.45 | 44.78 | 182.78 | -86.97 | -33.38 |
| 14 | 33.58 | 98.81 | 16.66 | 167.55 | -92.33 | -34.91 |
| 15 | 59.59 | 45.61 | 22.67 | 72.81 | -39.13 | -11.27 |
| 16 | -28.84 | 50.97 | -5.44 | 57.58 | -44.49 | -12.81 |
| 17 | 122.01 | 93.45 | 44.78 | 182.78 | -86.97 | -33.38 |
| 18 | 33.58 | 98.81 | 16.66 | 167.55 | -92.33 | -34.91 |
| 19 | 59.59 | 45.61 | 22.67 | 72.81 | -39.13 | -11.27 |
| 20 | -28.84 | 50.97 | -5.44 | 57.58 | -44.49 | -12.81 |
| 21 | 112.60 | 79.46 | 40.66 | 160.11 | -74.47 | -29.26 |
| 22 | 24.17 | 84.82 | 12.55 | 144.89 | -79.84 | -30.80 |
| 23 | 50.18 | 31.61 | 18.56 | 50.14 | -26.63 | -7.16 |
| 24 | -38.25 | 36.98 | -9.55 | 34.92 | -31.99 | -8.70 |
| 25 | 112.60 | 79.46 | 40.66 | 160.11 | -74.47 | -29.26 |
| 26 | 24.17 | 84.82 | 12.55 | 144.89 | -79.84 | -30.80 |
| 27 | 50.18 | 31.61 | 18.56 | 50.14 | -26.63 | -7.16 |
| 28 | -38.25 | 36.98 | -9.55 | 34.92 | -31.99 | -8.70 |
| 29 | 130.75 | 72.32 | 45.40 | 149.28 | -65.84 | -26.40 |
| 30 | -16.63 | 81.25 | -1.46 | 123.90 | -74.77 | -28.96 |
| 31 | 87.05 | 38.82 | 29.93 | 72.30 | -32.34 | -10.93 |
| 32 | -60.32 | 47.76 | -16.93 | 46.92 | -41.28 | -13.49 |
| 33 | 130.75 | 72.32 | 45.40 | 149.28 | -65.84 | -26.40 |
| 34 | -16.63 | 81.25 | -1.46 | 123.90 | -74.77 | -28.96 |
| 35 | 87.05 | 38.82 | 29.93 | 72.30 | -32.34 | -10.93 |
| 36 | -60.32 | 47.76 | -16.93 | 46.92 | -41.28 | -13.49 |
| 37 | 121.33 | 58.32 | 41.29 | 126.61 | -53.34 | -22.29 |
| 38 | -26.04 | 67.26 | -5.57 | 101.23 | -62.27 | -24.85 |
| 39 | 77.64 | 24.83 | 25.82 | 49.64 | -19.85 | -6.82 |
| 40 | -69.73 | 33.77 | -21.04 | 24.25 | -28.78 | -9.38 |
| 41 | 121.33 | 58.32 | 41.29 | 126.61 | -53.34 | -22.29 |
| 42 | -26.04 | 67.26 | -5.57 | 101.23 | -62.27 | -24.85 |
| 43 | 77.64 | 24.83 | 25.82 | 49.64 | -19.85 | -6.82 |
| 44 | -69.73 | 33.77 | -21.04 | 24.25 | -28.78 | -9.38 |
| 45 | 75.85 | 80.87 | 28.66 | 147.68 | -74.39 | -28.66 |
| 46 | 46.41 | 78.97 | 22.53 | 129.30 | -72.49 | -22.53 |
| 47 | 48.80 | 60.14 | 19.08 | 100.02 | -53.66 | -19.08 |
| 48 | 19.37 | 58.23 | 12.95 | 81.64 | -51.75 | -12.95 |
| 49 | 75.85 | 80.87 | 28.66 | 147.68 | -74.39 | -28.66 |
| 50 | 46.41 | 78.97 | 22.53 | 129.30 | -72.49 | -22.53 |
| 51 | 48.80 | 60.14 | 19.08 | 100.02 | -53.66 | -19.08 |
| 52 | 19.37 | 58.23 | 12.95 | 81.64 | -51.75 | -12.95 |
| 53 | 61.74 | 62.43 | 22.75 | 115.72 | -57.44 | -22.75 |
| 54 | 32.30 | 60.52 | 16.62 | 97.34 | -55.54 | -16.62 |
| 55 | 40.93 | 46.48 | 15.38 | 79.06 | -41.50 | -15.38 |
| 56 | 11.50 | 44.57 | 9.25 | 60.68 | -39.59 | -9.25 |
| 57 | 61.74 | 62.43 | 22.75 | 115.72 | -57.44 | -22.75 |
| 58 | 32.30 | 60.52 | 16.62 | 97.34 | -55.54 | -16.62 |
| 59 | 40.93 | 46.48 | 15.38 | 79.06 | -41.50 | -15.38 |
| 60 | 11.50 | 44.57 | 9.25 | 60.68 | -39.59 | -9.25 |

强度计算控制组合号: 1, M=87.76, N=105.13, M=191.19, N=-98.65

强度计算应力比 =0.817

抗剪强度计算控制组合号: 29, V=45.40

抗剪强度计算应力比 =0.131

平面内稳定计算最大应力对应组合号: 1, M=87.76, N=105.13, M=191.19, N=-98.65

平面内稳定计算最大应力 (N/mm\*mm) =243.70

平面内稳定计算最大应力比 =0.799

平面外稳定计算最大应力对应组合号: 14, M=33.58, N=98.81, M=167.55, N=-92.33

临界弯矩Mcr(kN\*m) =360.33

平面外稳定计算最大应力比 =0.994

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 =0.817 < 1.0

抗剪强度计算应力比 =0.131 < 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=55.00 < [H0/TW]=250.00

翼缘宽厚比 B/T =11.70 < [B/T]=12.20

压杆,平面内长细比 λ=70. ≤ [λ]=180

压杆,平面外长细比 λ=134. ≤ [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 | 47.03 | 61.48 | 19.69 | 106.54 | -56.49 | -19.69 |
| 2 | 26.23 | 45.53 | 12.32 | 69.88 | -40.54 | -12.32 |
| 3 | 47.03 | 61.48 | 19.69 | 106.54 | -56.49 | -19.69 |
| 4 | 26.23 | 45.53 | 12.32 | 69.88 | -40.54 | -12.32 |
| 5 | 43.90 | 56.81 | 18.32 | 98.98 | -52.33 | -18.32 |
| 6 | 23.09 | 40.86 | 10.95 | 62.32 | -36.38 | -10.95 |
| 7 | 43.90 | 56.81 | 18.32 | 98.98 | -52.33 | -18.32 |
| 8 | 23.09 | 40.86 | 10.95 | 62.32 | -36.38 | -10.95 |
| 9 | 46.60 | 41.45 | 17.71 | 71.81 | -36.47 | -12.65 |
| 10 | 7.29 | 43.83 | 5.22 | 65.04 | -38.85 | -13.33 |
| 11 | 43.46 | 36.79 | 16.34 | 64.25 | -32.30 | -11.28 |
| 12 | 4.16 | 39.17 | 3.85 | 57.48 | -34.68 | -11.96 |

防火设计控制的偶然组合号: 1, M=47.03, N=61.48, M=106.54, N=-56.49

强度计算荷载比 =0.45

平面内稳定计算荷载比 =0.44

平面外稳定计算荷载比 =0.47

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): 587.25℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.5076(m^2\*℃/w) ,计算所需保护层厚度(di) =50.76(mm)

构件重量 (Kg)=415.40

**7. 钢 柱 7
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=3.40, Ly=1.70; 长细比：λx=39.6,λy=37.3

构件长度=1.72; 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=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: 236.752136(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.00 | 0.99 | 0.00 | -0.00 | 0.00 | -0.00 |
| 2 | 0.00 | 0.99 | -0.00 | -0.00 | 0.00 | 0.00 |
| 3 | 0.00 | 0.99 | -0.00 | -0.00 | 0.00 | 0.00 |
| 4 | 0.00 | 0.99 | 0.00 | -0.00 | 0.00 | -0.00 |
| 5 | 0.00 | 0.76 | 0.00 | 0.00 | 0.00 | -0.00 |
| 6 | 0.00 | 0.76 | -0.00 | -0.00 | 0.00 | 0.00 |
| 7 | 0.00 | 0.76 | -0.00 | -0.00 | 0.00 | 0.00 |
| 8 | 0.00 | 0.76 | 0.00 | -0.00 | 0.00 | -0.00 |
| 9 | 9.15 | 0.99 | 10.77 | -0.00 | 0.00 | 0.00 |
| 10 | -9.15 | 0.99 | -10.76 | -0.00 | 0.00 | -0.00 |
| 11 | 9.15 | 0.76 | 10.77 | -0.00 | 0.00 | 0.00 |
| 12 | -9.15 | 0.76 | -10.76 | -0.00 | 0.00 | -0.00 |
| 13 | 5.49 | 0.99 | 6.46 | -0.00 | 0.00 | -0.00 |
| 14 | -5.49 | 0.99 | -6.46 | -0.00 | 0.00 | -0.00 |
| 15 | 5.49 | 0.99 | 6.46 | -0.00 | 0.00 | 0.00 |
| 16 | -5.49 | 0.99 | -6.46 | -0.00 | 0.00 | 0.00 |
| 17 | 5.49 | 0.99 | 6.46 | -0.00 | 0.00 | 0.00 |
| 18 | -5.49 | 0.99 | -6.46 | -0.00 | 0.00 | 0.00 |
| 19 | 5.49 | 0.99 | 6.46 | -0.00 | 0.00 | 0.00 |
| 20 | -5.49 | 0.99 | -6.46 | -0.00 | 0.00 | -0.00 |
| 21 | 5.49 | 0.76 | 6.46 | -0.00 | 0.00 | -0.00 |
| 22 | -5.49 | 0.76 | -6.46 | 0.00 | 0.00 | -0.00 |
| 23 | 5.49 | 0.76 | 6.46 | -0.00 | 0.00 | 0.00 |
| 24 | -5.49 | 0.76 | -6.46 | -0.00 | 0.00 | 0.00 |
| 25 | 5.49 | 0.76 | 6.46 | -0.00 | 0.00 | 0.00 |
| 26 | -5.49 | 0.76 | -6.46 | -0.00 | 0.00 | 0.00 |
| 27 | 5.49 | 0.76 | 6.46 | -0.00 | 0.00 | 0.00 |
| 28 | -5.49 | 0.76 | -6.46 | -0.00 | 0.00 | -0.00 |
| 29 | 9.15 | 0.99 | 10.77 | -0.00 | 0.00 | 0.00 |
| 30 | -9.15 | 0.99 | -10.76 | -0.00 | 0.00 | -0.00 |
| 31 | 9.15 | 0.99 | 10.77 | -0.00 | 0.00 | 0.00 |
| 32 | -9.15 | 0.99 | -10.76 | -0.00 | 0.00 | 0.00 |
| 33 | 9.15 | 0.99 | 10.77 | -0.00 | 0.00 | 0.00 |
| 34 | -9.15 | 0.99 | -10.76 | -0.00 | 0.00 | -0.00 |
| 35 | 9.15 | 0.99 | 10.77 | -0.00 | 0.00 | 0.00 |
| 36 | -9.15 | 0.99 | -10.76 | -0.00 | 0.00 | -0.00 |
| 37 | 9.15 | 0.76 | 10.77 | -0.00 | 0.00 | 0.00 |
| 38 | -9.15 | 0.76 | -10.76 | -0.00 | 0.00 | -0.00 |
| 39 | 9.15 | 0.76 | 10.77 | -0.00 | 0.00 | 0.00 |
| 40 | -9.15 | 0.76 | -10.76 | -0.00 | 0.00 | 0.00 |
| 41 | 9.15 | 0.76 | 10.77 | -0.00 | 0.00 | 0.00 |
| 42 | -9.15 | 0.76 | -10.76 | -0.00 | 0.00 | -0.00 |
| 43 | 9.15 | 0.76 | 10.77 | -0.00 | 0.00 | 0.00 |
| 44 | -9.15 | 0.76 | -10.76 | -0.00 | 0.00 | -0.00 |
| 45 | 0.02 | 0.99 | 0.01 | -0.00 | 0.00 | -0.01 |
| 46 | -0.02 | 0.99 | -0.01 | 0.00 | 0.00 | 0.01 |
| 47 | 0.02 | 0.99 | 0.01 | -0.00 | 0.00 | -0.01 |
| 48 | -0.02 | 0.99 | -0.01 | -0.00 | 0.00 | 0.01 |
| 49 | 0.02 | 0.99 | 0.01 | -0.00 | 0.00 | -0.01 |
| 50 | -0.02 | 0.99 | -0.01 | -0.00 | 0.00 | 0.01 |
| 51 | 0.02 | 0.99 | 0.01 | -0.00 | 0.00 | -0.01 |
| 52 | -0.02 | 0.99 | -0.01 | 0.00 | 0.00 | 0.01 |
| 53 | 0.02 | 0.76 | 0.01 | -0.00 | 0.00 | -0.01 |
| 54 | -0.02 | 0.76 | -0.01 | 0.00 | 0.00 | 0.01 |
| 55 | 0.02 | 0.76 | 0.01 | -0.00 | 0.00 | -0.01 |
| 56 | -0.02 | 0.76 | -0.01 | -0.00 | 0.00 | 0.01 |
| 57 | 0.02 | 0.76 | 0.01 | -0.00 | 0.00 | -0.01 |
| 58 | -0.02 | 0.76 | -0.01 | -0.00 | 0.00 | 0.01 |
| 59 | 0.02 | 0.76 | 0.01 | -0.00 | 0.00 | -0.01 |
| 60 | -0.02 | 0.76 | -0.01 | 0.00 | 0.00 | 0.01 |

强度计算控制组合号: 29, M=9.15, N=0.99, M=-0.00, N=0.00

强度计算应力比 =0.094

抗剪强度计算控制组合号: 29, V=10.77

抗剪强度计算应力比 =0.057

平面内稳定计算最大应力对应组合号: 29, M=9.15, N=0.99, M=-0.00, N=0.00

平面内稳定计算最大应力 (N/mm\*mm) =26.07

平面内稳定计算最大应力比 =0.085

临界弯矩Mcr(kN\*m) =1306.07

平面外稳定计算最大应力比 =0.039

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 =0.094 < 1.0

抗剪强度计算应力比 =0.057 < 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=30.00 < [H0/TW]=250.00

翼缘宽厚比 B/T =8.70 < [B/T]=12.20

压杆,平面内长细比 λ=40. ≤ [λ]=180

压杆,平面外长细比 λ=37. ≤ [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 | 0.76 | 0.00 | -0.00 | 0.00 | -0.00 |
| 2 | 0.00 | 0.76 | -0.00 | -0.00 | 0.00 | 0.00 |
| 3 | 0.00 | 0.76 | 0.00 | -0.00 | 0.00 | -0.00 |
| 4 | 0.00 | 0.76 | 0.00 | -0.00 | 0.00 | -0.00 |
| 5 | 0.00 | 0.68 | 0.00 | -0.00 | 0.00 | -0.00 |
| 6 | 0.00 | 0.68 | -0.00 | -0.00 | 0.00 | 0.00 |
| 7 | 0.00 | 0.68 | 0.00 | -0.00 | 0.00 | -0.00 |
| 8 | 0.00 | 0.68 | 0.00 | -0.00 | 0.00 | -0.00 |
| 9 | 2.44 | 0.76 | 2.87 | -0.00 | 0.00 | 0.00 |
| 10 | -2.44 | 0.76 | -2.87 | -0.00 | 0.00 | -0.00 |
| 11 | 2.44 | 0.68 | 2.87 | -0.00 | 0.00 | 0.00 |
| 12 | -2.44 | 0.68 | -2.87 | -0.00 | 0.00 | -0.00 |

防火设计控制的偶然组合号: 9, M=2.44, N=0.76, M=-0.00, N=0.00

强度计算荷载比 =0.03

平面内稳定计算荷载比 =0.02

平面外稳定计算荷载比 =0.01

无防护下钢构件最大升温(Ts): 1081.75℃ ,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) =0.4137(m^2\*℃/w) ,计算所需保护层厚度(di) =41.37(mm)

构件重量 (Kg)=63.27

**8. 钢 柱 8
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=3.40, Ly=1.70; 长细比：λx=39.6,λy=37.3

构件长度=1.72; 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=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: 236.752136(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | -0.00 | 0.99 | 0.00 | 0.00 | 0.00 | -0.00 |
| 2 | -0.00 | 0.99 | -0.00 | -0.00 | 0.00 | 0.00 |
| 3 | -0.00 | 0.99 | 0.00 | -0.00 | 0.00 | -0.00 |
| 4 | -0.00 | 0.99 | -0.00 | -0.00 | 0.00 | 0.00 |
| 5 | -0.00 | 0.76 | 0.00 | 0.00 | 0.00 | -0.00 |
| 6 | -0.00 | 0.76 | -0.00 | -0.00 | 0.00 | 0.00 |
| 7 | -0.00 | 0.76 | 0.00 | -0.00 | 0.00 | -0.00 |
| 8 | -0.00 | 0.76 | -0.00 | -0.00 | 0.00 | 0.00 |
| 9 | 9.15 | 0.99 | 10.77 | -0.00 | 0.00 | -0.00 |
| 10 | -9.15 | 0.99 | -10.76 | 0.00 | 0.00 | -0.00 |
| 11 | 9.15 | 0.76 | 10.77 | -0.00 | 0.00 | -0.00 |
| 12 | -9.15 | 0.76 | -10.76 | 0.00 | 0.00 | -0.00 |
| 13 | 5.49 | 0.99 | 6.46 | -0.00 | 0.00 | -0.00 |
| 14 | -5.49 | 0.99 | -6.46 | 0.00 | 0.00 | -0.00 |
| 15 | 5.49 | 0.99 | 6.46 | -0.00 | 0.00 | 0.00 |
| 16 | -5.49 | 0.99 | -6.46 | -0.00 | 0.00 | 0.00 |
| 17 | 5.49 | 0.99 | 6.46 | -0.00 | 0.00 | -0.00 |
| 18 | -5.49 | 0.99 | -6.46 | 0.00 | 0.00 | -0.00 |
| 19 | 5.49 | 0.99 | 6.46 | -0.00 | 0.00 | 0.00 |
| 20 | -5.49 | 0.99 | -6.46 | 0.00 | 0.00 | 0.00 |
| 21 | 5.49 | 0.76 | 6.46 | -0.00 | 0.00 | -0.00 |
| 22 | -5.49 | 0.76 | -6.46 | 0.00 | 0.00 | -0.00 |
| 23 | 5.49 | 0.76 | 6.46 | -0.00 | 0.00 | 0.00 |
| 24 | -5.49 | 0.76 | -6.46 | -0.00 | 0.00 | 0.00 |
| 25 | 5.49 | 0.76 | 6.46 | -0.00 | 0.00 | 0.00 |
| 26 | -5.49 | 0.76 | -6.46 | 0.00 | 0.00 | -0.00 |
| 27 | 5.49 | 0.76 | 6.46 | -0.00 | 0.00 | 0.00 |
| 28 | -5.49 | 0.76 | -6.46 | 0.00 | 0.00 | 0.00 |
| 29 | 9.15 | 0.99 | 10.77 | -0.00 | 0.00 | -0.00 |
| 30 | -9.15 | 0.99 | -10.76 | 0.00 | 0.00 | -0.00 |
| 31 | 9.15 | 0.99 | 10.77 | -0.00 | 0.00 | 0.00 |
| 32 | -9.15 | 0.99 | -10.76 | 0.00 | 0.00 | 0.00 |
| 33 | 9.15 | 0.99 | 10.77 | -0.00 | 0.00 | -0.00 |
| 34 | -9.15 | 0.99 | -10.76 | 0.00 | 0.00 | -0.00 |
| 35 | 9.15 | 0.99 | 10.77 | -0.00 | 0.00 | 0.00 |
| 36 | -9.15 | 0.99 | -10.76 | 0.00 | 0.00 | 0.00 |
| 37 | 9.15 | 0.76 | 10.77 | -0.00 | 0.00 | -0.00 |
| 38 | -9.15 | 0.76 | -10.76 | 0.00 | 0.00 | -0.00 |
| 39 | 9.15 | 0.76 | 10.77 | -0.00 | 0.00 | 0.00 |
| 40 | -9.15 | 0.76 | -10.76 | 0.00 | 0.00 | 0.00 |
| 41 | 9.15 | 0.76 | 10.77 | -0.00 | 0.00 | 0.00 |
| 42 | -9.15 | 0.76 | -10.76 | 0.00 | 0.00 | -0.00 |
| 43 | 9.15 | 0.76 | 10.77 | -0.00 | 0.00 | 0.00 |
| 44 | -9.15 | 0.76 | -10.76 | 0.00 | 0.00 | 0.00 |
| 45 | 0.02 | 0.99 | 0.01 | -0.00 | 0.00 | -0.01 |
| 46 | -0.02 | 0.99 | -0.01 | 0.00 | 0.00 | 0.01 |
| 47 | 0.02 | 0.99 | 0.01 | -0.00 | 0.00 | -0.01 |
| 48 | -0.02 | 0.99 | -0.01 | -0.00 | 0.00 | 0.01 |
| 49 | 0.02 | 0.99 | 0.01 | -0.00 | 0.00 | -0.01 |
| 50 | -0.02 | 0.99 | -0.01 | 0.00 | 0.00 | 0.01 |
| 51 | 0.02 | 0.99 | 0.01 | -0.00 | 0.00 | -0.01 |
| 52 | -0.02 | 0.99 | -0.01 | -0.00 | 0.00 | 0.01 |
| 53 | 0.02 | 0.76 | 0.01 | -0.00 | 0.00 | -0.01 |
| 54 | -0.02 | 0.76 | -0.01 | 0.00 | 0.00 | 0.01 |
| 55 | 0.02 | 0.76 | 0.01 | -0.00 | 0.00 | -0.01 |
| 56 | -0.02 | 0.76 | -0.01 | -0.00 | 0.00 | 0.01 |
| 57 | 0.02 | 0.76 | 0.01 | -0.00 | 0.00 | -0.01 |
| 58 | -0.02 | 0.76 | -0.01 | 0.00 | 0.00 | 0.01 |
| 59 | 0.02 | 0.76 | 0.01 | -0.00 | 0.00 | -0.01 |
| 60 | -0.02 | 0.76 | -0.01 | -0.00 | 0.00 | 0.01 |

强度计算控制组合号: 29, M=9.15, N=0.99, M=-0.00, N=0.00

强度计算应力比 =0.094

抗剪强度计算控制组合号: 29, V=10.77

抗剪强度计算应力比 =0.057

平面内稳定计算最大应力对应组合号: 29, M=9.15, N=0.99, M=-0.00, N=0.00

平面内稳定计算最大应力 (N/mm\*mm) =26.07

平面内稳定计算最大应力比 =0.085

临界弯矩Mcr(kN\*m) =1306.07

平面外稳定计算最大应力比 =0.039

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 =0.094 < 1.0

抗剪强度计算应力比 =0.057 < 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=30.00 < [H0/TW]=250.00

翼缘宽厚比 B/T =8.70 < [B/T]=12.20

压杆,平面内长细比 λ=40. ≤ [λ]=180

压杆,平面外长细比 λ=37. ≤ [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 | 0.76 | 0.00 | 0.00 | 0.00 | -0.00 |
| 2 | -0.00 | 0.76 | -0.00 | -0.00 | 0.00 | 0.00 |
| 3 | -0.00 | 0.76 | 0.00 | -0.00 | 0.00 | -0.00 |
| 4 | -0.00 | 0.76 | -0.00 | -0.00 | 0.00 | 0.00 |
| 5 | -0.00 | 0.68 | 0.00 | 0.00 | 0.00 | -0.00 |
| 6 | -0.00 | 0.68 | -0.00 | -0.00 | 0.00 | 0.00 |
| 7 | -0.00 | 0.68 | 0.00 | -0.00 | 0.00 | -0.00 |
| 8 | -0.00 | 0.68 | -0.00 | -0.00 | 0.00 | 0.00 |
| 9 | 2.44 | 0.76 | 2.87 | -0.00 | 0.00 | -0.00 |
| 10 | -2.44 | 0.76 | -2.87 | 0.00 | 0.00 | -0.00 |
| 11 | 2.44 | 0.68 | 2.87 | -0.00 | 0.00 | -0.00 |
| 12 | -2.44 | 0.68 | -2.87 | 0.00 | 0.00 | -0.00 |

防火设计控制的偶然组合号: 9, M=2.44, N=0.76, M=-0.00, N=0.00

强度计算荷载比 =0.03

平面内稳定计算荷载比 =0.02

平面外稳定计算荷载比 =0.01

无防护下钢构件最大升温(Ts): 1081.75℃ ,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) =0.4137(m^2\*℃/w) ,计算所需保护层厚度(di) =41.37(mm)

构件重量 (Kg)=63.27

**9. 钢 柱 9
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=18.89, Ly=1.50; 长细比：λx=144.8,λy=27.8

构件长度=1.50; 计算长度系数: Ux=12.57 Uy=1.00

抗震等级: 四级

截面参数: B1=220, B2=220, 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: 241.447372(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 26.62 | 34.34 | -2.65 | -0.21 | -15.77 | 6.54 |
| 2 | -13.45 | 19.20 | -11.52 | -34.25 | -35.54 | 7.63 |
| 3 | 21.49 | 42.02 | -7.49 | -32.74 | -40.90 | 7.49 |
| 4 | -8.32 | 11.53 | -6.68 | -1.72 | -10.41 | 6.68 |
| 5 | 25.54 | 29.88 | -1.47 | 2.64 | -11.57 | 5.36 |
| 6 | -14.52 | 14.75 | -10.34 | -31.40 | -31.34 | 6.45 |
| 7 | 20.41 | 37.56 | -6.31 | -29.89 | -36.70 | 6.31 |
| 8 | -9.39 | 7.07 | -5.50 | 1.13 | -6.21 | 5.50 |
| 9 | 0.42 | 6.09 | 1.41 | -1.71 | -4.97 | 3.12 |
| 10 | 6.15 | 12.88 | -7.66 | -14.25 | -11.76 | 3.12 |
| 11 | -0.65 | 1.63 | 2.59 | 1.14 | -0.77 | 1.94 |
| 12 | 5.07 | 8.42 | -6.48 | -11.40 | -7.56 | 1.95 |
| 13 | 24.07 | 26.41 | 1.26 | 6.17 | -7.84 | 5.34 |
| 14 | 27.51 | 30.48 | -4.17 | -1.35 | -11.91 | 5.35 |
| 15 | -15.99 | 11.27 | -7.61 | -27.87 | -27.60 | 6.43 |
| 16 | -12.56 | 15.34 | -13.05 | -35.39 | -31.67 | 6.44 |
| 17 | 18.94 | 34.08 | -3.58 | -26.36 | -32.96 | 6.29 |
| 18 | 22.38 | 38.15 | -9.01 | -33.88 | -37.03 | 6.29 |
| 19 | -10.86 | 3.59 | -2.77 | 4.66 | -2.47 | 5.49 |
| 20 | -7.43 | 7.66 | -8.21 | -2.87 | -6.55 | 5.49 |
| 21 | 23.00 | 21.95 | 2.44 | 9.02 | -3.64 | 4.17 |
| 22 | 26.43 | 26.02 | -2.99 | 1.49 | -7.71 | 4.17 |
| 23 | -17.07 | 6.81 | -6.43 | -25.02 | -23.40 | 5.25 |
| 24 | -13.63 | 10.88 | -11.87 | -32.55 | -27.47 | 5.26 |
| 25 | 17.87 | 29.63 | -2.40 | -23.51 | -28.76 | 5.11 |
| 26 | 21.30 | 33.70 | -7.83 | -31.03 | -32.84 | 5.12 |
| 27 | -11.94 | -0.86 | -1.59 | 7.51 | 1.72 | 4.31 |
| 28 | -8.50 | 3.21 | -7.03 | -0.02 | -2.35 | 4.31 |
| 29 | 15.79 | 16.61 | 3.13 | 6.78 | -3.27 | 4.12 |
| 30 | 21.51 | 23.39 | -5.93 | -5.76 | -10.06 | 4.13 |
| 31 | -12.25 | 6.01 | -3.08 | -17.04 | -17.11 | 4.88 |
| 32 | -6.53 | 12.80 | -12.14 | -29.58 | -23.90 | 4.89 |
| 33 | 12.20 | 21.98 | -0.26 | -15.99 | -20.86 | 4.78 |
| 34 | 17.92 | 28.77 | -9.32 | -28.53 | -27.65 | 4.79 |
| 35 | -8.66 | 0.64 | 0.31 | 5.73 | 0.48 | 4.22 |
| 36 | -2.94 | 7.42 | -8.76 | -6.81 | -6.31 | 4.22 |
| 37 | 14.72 | 12.15 | 4.31 | 9.63 | 0.93 | 2.94 |
| 38 | 20.44 | 18.94 | -4.75 | -2.91 | -5.86 | 2.95 |
| 39 | -13.33 | 1.56 | -1.90 | -14.20 | -12.91 | 3.70 |
| 40 | -7.61 | 8.34 | -10.96 | -26.74 | -19.70 | 3.71 |
| 41 | 11.12 | 17.52 | 0.92 | -13.14 | -16.66 | 3.60 |
| 42 | 16.85 | 24.31 | -8.14 | -25.68 | -23.45 | 3.61 |
| 43 | -9.74 | -3.82 | 1.49 | 8.57 | 4.68 | 3.04 |
| 44 | -4.02 | 2.97 | -7.58 | -3.97 | -2.11 | 3.05 |
| 45 | 12.89 | 24.66 | -3.46 | -4.94 | -15.98 | 5.14 |
| 46 | 15.37 | 26.99 | -4.69 | -9.24 | -18.31 | 6.37 |
| 47 | -4.47 | 18.10 | -7.30 | -19.69 | -24.54 | 5.62 |
| 48 | -1.99 | 20.43 | -8.53 | -23.99 | -26.88 | 6.85 |
| 49 | 10.67 | 27.99 | -5.55 | -19.03 | -26.87 | 5.55 |
| 50 | 13.15 | 30.32 | -6.78 | -23.34 | -29.20 | 6.78 |
| 51 | -2.25 | 14.77 | -5.21 | -5.59 | -13.65 | 5.21 |
| 52 | 0.23 | 17.11 | -6.44 | -9.89 | -15.99 | 6.44 |
| 53 | 9.62 | 18.70 | -2.52 | -3.30 | -12.02 | 3.82 |
| 54 | 12.10 | 21.03 | -3.75 | -7.61 | -14.35 | 5.05 |
| 55 | -3.73 | 13.65 | -5.48 | -14.65 | -18.61 | 4.19 |
| 56 | -1.25 | 15.99 | -6.71 | -18.95 | -20.94 | 5.42 |
| 57 | 7.91 | 21.26 | -4.14 | -14.15 | -20.40 | 4.14 |
| 58 | 10.39 | 23.59 | -5.37 | -18.45 | -22.73 | 5.37 |
| 59 | -2.02 | 11.10 | -3.87 | -3.81 | -10.23 | 3.87 |
| 60 | 0.46 | 13.43 | -5.10 | -8.11 | -12.57 | 5.10 |

强度计算控制组合号: 16, M=-12.56, N=15.34, M=-35.39, N=-31.67

强度计算应力比 =0.190

抗剪强度计算控制组合号: 16, V=-13.05

抗剪强度计算应力比 =0.044

平面内稳定计算最大应力对应组合号: 3, M=21.49, N=42.02, M=-32.74, N=-40.90

平面内稳定计算最大应力 (N/mm\*mm) =80.29

平面内稳定计算最大应力比 =0.263

平面外稳定计算最大应力对应组合号: 18, M=22.38, N=38.15, M=-33.88, N=-37.03

临界弯矩Mcr(kN\*m) =2804.46

平面外稳定计算最大应力比 =0.150

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 =0.190 < 1.0

抗剪强度计算应力比 =0.044 < 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 =10.70 < [B/T]=12.20

压杆,平面内长细比 λ=145. ≤ [λ]=180

压杆,平面外长细比 λ=28. ≤ [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 | 10.90 | 19.87 | -3.11 | -5.45 | -13.19 | 4.41 |
| 2 | -2.45 | 14.82 | -6.07 | -16.80 | -19.78 | 4.77 |
| 3 | 9.19 | 22.42 | -4.72 | -16.29 | -21.56 | 4.72 |
| 4 | -0.74 | 12.26 | -4.45 | -5.95 | -11.40 | 4.45 |
| 5 | 10.55 | 18.38 | -2.72 | -4.50 | -11.79 | 4.01 |
| 6 | -2.81 | 13.33 | -5.67 | -15.85 | -18.38 | 4.38 |
| 7 | 8.84 | 20.94 | -4.33 | -15.34 | -20.16 | 4.33 |
| 8 | -1.10 | 10.78 | -4.06 | -5.00 | -10.00 | 4.06 |
| 9 | 2.45 | 11.33 | -2.19 | -6.66 | -10.47 | 3.40 |
| 10 | 3.98 | 13.14 | -4.61 | -10.00 | -12.28 | 3.40 |
| 11 | 2.10 | 9.85 | -1.80 | -5.71 | -9.07 | 3.01 |
| 12 | 3.62 | 11.65 | -4.22 | -9.05 | -10.88 | 3.01 |

防火设计控制的偶然组合号: 2, M=-2.45, N=14.82, M=-16.80, N=-19.78

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 =0.04

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): 643.88℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4331(m^2\*℃/w)

构件重量 (Kg)=71.74

**10. 钢 柱 10
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=18.89, Ly=1.50; 长细比：λx=144.8,λy=27.8

构件长度=1.50; 计算长度系数: Ux=12.57 Uy=1.00

抗震等级: 四级

截面参数: B1=220, B2=220, 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: 241.447372(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 13.45 | 19.20 | 11.52 | 34.25 | -35.54 | -7.63 |
| 2 | -26.62 | 34.34 | 2.65 | 0.21 | -15.77 | -6.54 |
| 3 | -21.49 | 42.02 | 7.49 | 32.74 | -40.90 | -7.49 |
| 4 | 8.32 | 11.53 | 6.68 | 1.72 | -10.41 | -6.68 |
| 5 | 14.52 | 14.75 | 10.34 | 31.40 | -31.34 | -6.45 |
| 6 | -25.54 | 29.88 | 1.47 | -2.64 | -11.57 | -5.36 |
| 7 | -20.41 | 37.56 | 6.31 | 29.89 | -36.70 | -6.31 |
| 8 | 9.39 | 7.07 | 5.50 | -1.13 | -6.21 | -5.50 |
| 9 | -6.16 | 12.87 | 7.64 | 14.25 | -11.75 | -3.12 |
| 10 | -0.42 | 6.10 | -1.41 | 1.71 | -4.98 | -3.13 |
| 11 | -5.09 | 8.41 | 6.46 | 11.40 | -7.55 | -1.94 |
| 12 | 0.66 | 1.64 | -2.58 | -1.14 | -0.78 | -1.95 |
| 13 | 12.55 | 15.34 | 13.04 | 35.39 | -31.67 | -6.43 |
| 14 | 16.00 | 11.27 | 7.61 | 27.87 | -27.61 | -6.44 |
| 15 | -27.52 | 30.47 | 4.16 | 1.35 | -11.90 | -5.34 |
| 16 | -24.07 | 26.41 | -1.26 | -6.17 | -7.84 | -5.35 |
| 17 | -22.39 | 38.15 | 9.00 | 33.88 | -37.03 | -6.29 |
| 18 | -18.94 | 34.09 | 3.58 | 26.36 | -32.97 | -6.30 |
| 19 | 7.42 | 7.66 | 8.20 | 2.87 | -6.54 | -5.48 |
| 20 | 10.87 | 3.60 | 2.77 | -4.66 | -2.48 | -5.49 |
| 21 | 13.62 | 10.88 | 11.86 | 32.55 | -27.47 | -5.25 |
| 22 | 17.07 | 6.82 | 6.43 | 25.02 | -23.41 | -5.26 |
| 23 | -26.44 | 26.02 | 2.99 | -1.49 | -7.70 | -4.16 |
| 24 | -22.99 | 21.95 | -2.44 | -9.02 | -3.64 | -4.17 |
| 25 | -21.31 | 33.69 | 7.83 | 31.03 | -32.83 | -5.11 |
| 26 | -17.86 | 29.63 | 2.40 | 23.51 | -28.77 | -5.12 |
| 27 | 8.49 | 3.20 | 7.02 | 0.02 | -2.34 | -4.31 |
| 28 | 11.94 | -0.86 | 1.59 | -7.50 | 1.72 | -4.31 |
| 29 | 6.51 | 12.79 | 12.13 | 29.58 | -23.89 | -4.88 |
| 30 | 12.26 | 6.02 | 3.08 | 17.05 | -17.12 | -4.89 |
| 31 | -21.53 | 23.39 | 5.92 | 5.76 | -10.05 | -4.12 |
| 32 | -15.78 | 16.62 | -3.13 | -6.78 | -3.28 | -4.13 |
| 33 | -17.94 | 28.76 | 9.30 | 28.53 | -27.64 | -4.78 |
| 34 | -12.19 | 21.99 | 0.26 | 15.99 | -20.87 | -4.79 |
| 35 | 2.92 | 7.42 | 8.74 | 6.81 | -6.30 | -4.22 |
| 36 | 8.67 | 0.65 | -0.31 | -5.72 | 0.47 | -4.23 |
| 37 | 7.59 | 8.33 | 10.95 | 26.74 | -19.69 | -3.70 |
| 38 | 13.34 | 1.56 | 1.90 | 14.20 | -12.92 | -3.71 |
| 39 | -20.46 | 18.93 | 4.74 | 2.91 | -5.85 | -2.94 |
| 40 | -14.71 | 12.16 | -4.31 | -9.63 | 0.92 | -2.95 |
| 41 | -16.87 | 24.30 | 8.13 | 25.68 | -23.44 | -3.60 |
| 42 | -11.12 | 17.53 | -0.92 | 13.14 | -16.67 | -3.61 |
| 43 | 4.00 | 2.96 | 7.56 | 3.97 | -2.10 | -3.04 |
| 44 | 9.75 | -3.81 | -1.48 | -8.57 | 4.67 | -3.05 |
| 45 | 1.99 | 20.43 | 8.53 | 23.99 | -26.88 | -6.85 |
| 46 | 4.47 | 18.10 | 7.30 | 19.69 | -24.54 | -5.62 |
| 47 | -15.37 | 26.99 | 4.69 | 9.24 | -18.31 | -6.37 |
| 48 | -12.89 | 24.66 | 3.46 | 4.94 | -15.98 | -5.14 |
| 49 | -13.15 | 30.32 | 6.79 | 23.34 | -29.20 | -6.79 |
| 50 | -10.67 | 27.99 | 5.55 | 19.03 | -26.87 | -5.55 |
| 51 | -0.23 | 17.11 | 6.44 | 9.89 | -15.99 | -6.44 |
| 52 | 2.25 | 14.77 | 5.21 | 5.59 | -13.65 | -5.21 |
| 53 | 1.25 | 15.99 | 6.71 | 18.95 | -20.94 | -5.42 |
| 54 | 3.73 | 13.65 | 5.48 | 14.65 | -18.61 | -4.19 |
| 55 | -12.10 | 21.03 | 3.76 | 7.61 | -14.35 | -5.05 |
| 56 | -9.62 | 18.70 | 2.52 | 3.30 | -12.02 | -3.82 |
| 57 | -10.39 | 23.59 | 5.37 | 18.45 | -22.73 | -5.37 |
| 58 | -7.91 | 21.26 | 4.14 | 14.15 | -20.40 | -4.14 |
| 59 | -0.46 | 13.43 | 5.10 | 8.11 | -12.57 | -5.10 |
| 60 | 2.02 | 11.10 | 3.87 | 3.81 | -10.23 | -3.87 |

强度计算控制组合号: 13, M=12.55, N=15.34, M=35.39, N=-31.67

强度计算应力比 =0.190

抗剪强度计算控制组合号: 13, V=13.04

抗剪强度计算应力比 =0.044

平面内稳定计算最大应力对应组合号: 3, M=-21.49, N=42.02, M=32.74, N=-40.90

平面内稳定计算最大应力 (N/mm\*mm) =80.29

平面内稳定计算最大应力比 =0.263

平面外稳定计算最大应力对应组合号: 17, M=-22.39, N=38.15, M=33.88, N=-37.03

临界弯矩Mcr(kN\*m) =2803.95

平面外稳定计算最大应力比 =0.150

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 =0.190 < 1.0

抗剪强度计算应力比 =0.044 < 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 =10.70 < [B/T]=12.20

压杆,平面内长细比 λ=145. ≤ [λ]=180

压杆,平面外长细比 λ=28. ≤ [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 | 2.45 | 14.82 | 6.07 | 16.80 | -19.78 | -4.77 |
| 2 | -10.90 | 19.87 | 3.11 | 5.45 | -13.19 | -4.41 |
| 3 | -9.19 | 22.42 | 4.72 | 16.29 | -21.56 | -4.72 |
| 4 | 0.74 | 12.26 | 4.45 | 5.95 | -11.40 | -4.45 |
| 5 | 2.81 | 13.33 | 5.67 | 15.85 | -18.38 | -4.38 |
| 6 | -10.55 | 18.38 | 2.72 | 4.50 | -11.79 | -4.01 |
| 7 | -8.84 | 20.94 | 4.33 | 15.34 | -20.16 | -4.33 |
| 8 | 1.10 | 10.78 | 4.06 | 5.00 | -10.00 | -4.06 |
| 9 | -3.99 | 13.14 | 4.60 | 10.00 | -12.28 | -3.40 |
| 10 | -2.45 | 11.33 | 2.19 | 6.66 | -10.47 | -3.40 |
| 11 | -3.63 | 11.65 | 4.21 | 9.05 | -10.88 | -3.01 |
| 12 | -2.09 | 9.85 | 1.80 | 5.71 | -9.07 | -3.01 |

防火设计控制的偶然组合号: 1, M=2.45, N=14.82, M=16.80, N=-19.78

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 =0.04

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): 643.88℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4331(m^2\*℃/w)

构件重量 (Kg)=71.74

**11、 钢 梁 1
设计结果**

截面类型=27; 布置角度=0; 计算长度： Lx=16.75

构件长度=5.75; 计算长度系数: Ux=2.91

支撑长度=16.70

隅撑作为梁面外弹性支撑点，以下为隅撑支撑信息：

隅撑截面:L50X5 ; 布置间距: 2.40

隅撑与檩条夹角(度): 45.00; 隅撑孔距檩条下边缘距离: 0.10

檩条截面:XZ180X70X20X2.0 ; 檩条跨度: 6.88; 檩条到梁上皮距离: 0.02

抗震等级: 四级

变截面 H 形截面 H: B1=220, B2=220, H1=500, H2=400 T1=6 T2=10 T3=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: 254.647888(1/m)

梁刚度放大系数: 1.0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 191.46 | 40.58 | 95.77 | 165.28 | -32.98 | -25.29 |
| 2 | 81.49 | 16.13 | 49.08 | 83.36 | -18.33 | -11.32 |
| 3 | 112.08 | 22.74 | 74.73 | 118.50 | -19.29 | -5.49 |
| 4 | 160.86 | 33.97 | 70.11 | 130.14 | -32.02 | -31.12 |
| 5 | 168.73 | 35.86 | 83.72 | 144.59 | -28.71 | -22.24 |
| 6 | 58.76 | 11.41 | 37.03 | 62.68 | -14.06 | -8.27 |
| 7 | 89.36 | 18.02 | 62.68 | 97.82 | -15.02 | -2.44 |
| 8 | 138.14 | 29.25 | 58.06 | 109.45 | -27.75 | -28.07 |
| 9 | 49.93 | 29.25 | 41.23 | 91.14 | -27.31 | -7.85 |
| 10 | 93.59 | 4.77 | 33.49 | 35.20 | -2.82 | -11.31 |
| 11 | 27.21 | 24.53 | 29.19 | 70.46 | -23.04 | -4.79 |
| 12 | 70.86 | 0.05 | 21.44 | 14.51 | 1.45 | -8.26 |
| 13 | 162.33 | 45.87 | 89.18 | 166.18 | -38.27 | -22.06 |
| 14 | 188.52 | 31.17 | 84.53 | 132.62 | -23.57 | -24.14 |
| 15 | 52.36 | 21.41 | 42.49 | 84.27 | -23.61 | -8.10 |
| 16 | 78.55 | 6.72 | 37.84 | 50.70 | -8.92 | -10.18 |
| 17 | 82.96 | 28.02 | 68.14 | 119.41 | -24.57 | -2.26 |
| 18 | 109.15 | 13.33 | 63.50 | 85.84 | -9.88 | -4.34 |
| 19 | 131.74 | 39.25 | 63.53 | 131.04 | -37.31 | -27.90 |
| 20 | 157.93 | 24.56 | 58.88 | 97.48 | -22.62 | -29.98 |
| 21 | 139.61 | 41.15 | 77.13 | 145.50 | -34.00 | -19.01 |
| 22 | 165.80 | 26.46 | 72.48 | 111.93 | -19.30 | -21.09 |
| 23 | 29.64 | 16.69 | 30.44 | 63.59 | -19.34 | -5.04 |
| 24 | 55.83 | 2.00 | 25.79 | 30.02 | -4.65 | -7.13 |
| 25 | 60.23 | 23.31 | 56.09 | 98.73 | -20.30 | 0.79 |
| 26 | 86.42 | 8.61 | 51.45 | 65.16 | -5.61 | -1.29 |
| 27 | 109.01 | 34.53 | 51.48 | 110.36 | -33.04 | -24.84 |
| 28 | 135.20 | 19.84 | 46.83 | 76.79 | -18.35 | -26.92 |
| 29 | 115.02 | 43.35 | 71.72 | 144.09 | -37.44 | -16.29 |
| 30 | 158.68 | 18.86 | 63.97 | 88.15 | -12.96 | -19.76 |
| 31 | 38.04 | 26.23 | 39.04 | 86.76 | -27.19 | -6.51 |
| 32 | 81.70 | 1.74 | 31.29 | 30.81 | -2.70 | -9.98 |
| 33 | 59.46 | 30.86 | 57.00 | 111.35 | -27.86 | -2.43 |
| 34 | 103.11 | 6.37 | 49.25 | 55.41 | -3.37 | -5.90 |
| 35 | 93.60 | 38.72 | 53.76 | 119.50 | -36.77 | -20.37 |
| 36 | 137.26 | 14.23 | 46.02 | 63.55 | -12.29 | -23.84 |
| 37 | 92.30 | 38.63 | 59.67 | 123.41 | -33.17 | -13.24 |
| 38 | 135.95 | 14.14 | 51.92 | 67.47 | -8.69 | -16.71 |
| 39 | 15.32 | 21.51 | 26.99 | 66.07 | -22.92 | -3.46 |
| 40 | 58.97 | -2.98 | 19.24 | 10.13 | 1.57 | -6.93 |
| 41 | 36.73 | 26.14 | 44.95 | 90.67 | -23.59 | 0.62 |
| 42 | 80.39 | 1.65 | 37.20 | 34.72 | 0.90 | -2.85 |
| 43 | 70.88 | 34.00 | 41.71 | 98.81 | -32.50 | -17.32 |
| 44 | 114.53 | 9.51 | 33.97 | 42.87 | -8.02 | -20.79 |
| 45 | 129.55 | 27.68 | 70.21 | 126.57 | -23.29 | -17.57 |
| 46 | 147.97 | 30.67 | 71.97 | 118.26 | -26.28 | -19.33 |
| 47 | 81.89 | 17.09 | 49.98 | 91.08 | -16.94 | -11.52 |
| 48 | 100.32 | 20.08 | 51.74 | 82.76 | -19.93 | -13.28 |
| 49 | 95.15 | 19.95 | 61.09 | 106.30 | -17.35 | -8.99 |
| 50 | 113.58 | 22.94 | 62.85 | 97.99 | -20.34 | -10.75 |
| 51 | 116.29 | 24.82 | 59.09 | 111.34 | -22.87 | -20.10 |
| 52 | 134.71 | 27.81 | 60.85 | 103.03 | -25.86 | -21.86 |
| 53 | 97.52 | 20.95 | 53.80 | 98.32 | -17.57 | -13.31 |
| 54 | 115.95 | 23.94 | 55.56 | 90.01 | -20.56 | -15.07 |
| 55 | 60.87 | 12.80 | 38.24 | 71.02 | -12.69 | -8.66 |
| 56 | 79.29 | 15.79 | 40.00 | 62.70 | -15.68 | -10.42 |
| 57 | 71.07 | 15.00 | 46.79 | 82.73 | -13.01 | -6.71 |
| 58 | 89.49 | 17.99 | 48.55 | 74.42 | -16.00 | -8.47 |
| 59 | 87.33 | 18.75 | 45.25 | 86.61 | -17.25 | -15.26 |
| 60 | 105.75 | 21.74 | 47.01 | 78.29 | -20.24 | -17.02 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 0.00 | -2.69 | -34.84 | -65.57 | -94.04 | -111.98 | -166.18 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 191.46 | 63.27 | 36.50 | 18.71 | 5.53 | 0.00 | 0.00 |

强度计算应力比 =0.636

抗剪强度计算应力比 =0.276

平面内稳定计算最大应力对应组合号: 1, M=191.46, N=40.58, M=165.28, N=-32.98

平面内稳定最大应力 (N/mm\*mm) =162.54

平面内稳定计算最大应力比 =0.533

临界弯矩Mcr(kN\*m) =864.43

平面外稳定计算最大应力比 =0.345

梁面外稳定计算方式：梁面外稳定按隅撑间距计算。

强度计算应力比 =0.636 < 1.0

抗剪强度计算应力比 =0.276 < 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 =0.345 < 1.0

腹板高厚比 H0/TW=71.67 < [H0/TW]=250.00 (GB51022-2015)

翼缘宽厚比 B/T =10.70 < [B/T] =12.20

**(恒+活)梁的挠度 mm**

| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0.00 | 10.60 | 21.74 | 32.81 | 43.22 | 52.44 | 60.02 |

最大挠度值 =60.02 最大挠度/梁跨度 =1/279.

斜梁坡度初始值: 1/20.05

变形后斜梁坡度最小值: 1/26.20

变形后斜梁坡度改变率 =0.235 < 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 | 106.74 | 22.44 | 54.68 | 94.16 | -19.06 | -14.19 |
| 2 | 70.09 | 14.29 | 39.12 | 66.86 | -14.17 | -9.54 |
| 3 | 80.29 | 16.49 | 47.67 | 78.57 | -14.49 | -7.59 |
| 4 | 96.55 | 20.23 | 46.13 | 82.45 | -18.74 | -16.14 |
| 5 | 99.17 | 20.87 | 50.67 | 87.27 | -17.64 | -13.18 |
| 6 | 62.51 | 12.71 | 35.10 | 59.96 | -12.75 | -8.52 |
| 7 | 72.71 | 14.92 | 43.65 | 71.68 | -13.07 | -6.58 |
| 8 | 88.97 | 18.66 | 42.12 | 75.55 | -17.32 | -15.12 |
| 9 | 62.81 | 18.08 | 37.24 | 69.35 | -16.58 | -8.74 |
| 10 | 74.45 | 11.55 | 35.17 | 54.43 | -10.05 | -9.66 |
| 11 | 55.23 | 16.50 | 33.22 | 62.45 | -15.16 | -7.72 |
| 12 | 66.87 | 9.97 | 31.16 | 47.54 | -8.63 | -8.65 |

--- 梁的弯矩包络(偶然组合) ---

梁下部受拉:

截面 1 2 3 4 5 6 7

弯矩 0.00 0.00 -0.29 -27.94 -51.22 -68.09 -94.16

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 106.74 42.78 15.19 0.00 0.00 0.00 0.00

强度计算荷载比 =0.36

平面内稳定计算荷载比 =0.29

平面外稳定计算荷载比 =0.14

无防护下钢构件最大升温(Ts): 1004.70℃ ,按临界温度法求得临界温度(Td): 635.22℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2434(m^2\*℃/w)

构件重量 (Kg)=314.99

**12、 钢 梁 2
设计结果**

截面类型=27; 布置角度=0; 计算长度： Lx=16.75

构件长度=11.00; 计算长度系数: Ux=1.52

支撑长度=16.70

隅撑作为梁面外弹性支撑点，以下为隅撑支撑信息：

隅撑截面:L50X5 ; 布置间距: 2.40

隅撑与檩条夹角(度): 45.00; 隅撑孔距檩条下边缘距离: 0.10

檩条截面:XZ180X70X20X2.0 ; 檩条跨度: 6.88; 檩条到梁上皮距离: 0.02

抗震等级: 四级

变截面 H 形截面 H: B1=240, B2=240, H1=400, H2=450 T1=6 T2=10 T3=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: 250.068024(1/m)

梁刚度放大系数: 1.0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | -83.36 | 18.35 | 11.28 | -172.35 | -17.22 | 60.98 |
| 2 | -165.28 | 33.04 | 25.21 | -319.87 | -23.34 | 110.24 |
| 3 | -160.05 | 37.19 | 26.44 | -279.41 | -30.27 | 106.35 |
| 4 | -88.59 | 14.20 | 10.06 | -212.81 | -10.30 | 64.87 |
| 5 | -62.68 | 14.08 | 8.24 | -131.41 | -13.85 | 46.73 |
| 6 | -144.59 | 28.76 | 22.17 | -278.94 | -19.97 | 95.99 |
| 7 | -139.37 | 32.91 | 23.40 | -238.47 | -26.89 | 92.11 |
| 8 | -67.91 | 9.93 | 7.01 | -171.88 | -6.92 | 50.62 |
| 9 | -91.14 | 27.32 | 7.78 | -176.33 | -23.42 | 56.42 |
| 10 | -35.20 | 2.85 | 11.31 | -75.54 | 1.06 | 31.45 |
| 11 | -70.46 | 23.05 | 4.74 | -135.40 | -20.04 | 42.18 |
| 12 | -14.51 | -1.43 | 8.27 | -34.60 | 4.43 | 17.20 |
| 13 | -84.27 | 23.63 | 8.04 | -171.72 | -22.50 | 57.79 |
| 14 | -50.70 | 8.94 | 10.16 | -111.24 | -7.81 | 42.80 |
| 15 | -166.18 | 38.32 | 21.97 | -319.24 | -28.62 | 107.05 |
| 16 | -132.62 | 23.63 | 24.09 | -258.76 | -13.93 | 92.06 |
| 17 | -160.96 | 42.47 | 23.20 | -278.78 | -35.54 | 103.16 |
| 18 | -127.39 | 27.78 | 25.31 | -218.30 | -20.86 | 88.18 |
| 19 | -89.50 | 19.48 | 6.82 | -212.18 | -15.57 | 61.68 |
| 20 | -55.93 | 4.79 | 8.93 | -151.70 | -0.89 | 46.69 |
| 21 | -63.59 | 19.35 | 5.00 | -130.78 | -19.12 | 43.54 |
| 22 | -30.02 | 4.67 | 7.11 | -70.30 | -4.44 | 28.56 |
| 23 | -145.50 | 34.04 | 18.93 | -278.30 | -25.24 | 92.80 |
| 24 | -111.93 | 19.35 | 21.05 | -217.83 | -10.56 | 77.81 |
| 25 | -140.27 | 38.19 | 20.16 | -237.84 | -32.17 | 88.92 |
| 26 | -106.71 | 23.50 | 22.27 | -177.36 | -17.48 | 73.93 |
| 27 | -68.81 | 15.20 | 3.77 | -171.24 | -12.20 | 47.43 |
| 28 | -35.25 | 0.52 | 5.89 | -110.77 | 2.49 | 32.44 |
| 29 | -86.76 | 27.20 | 6.45 | -172.81 | -25.24 | 55.89 |
| 30 | -30.81 | 2.72 | 9.98 | -72.01 | -0.76 | 30.91 |
| 31 | -144.09 | 37.48 | 16.20 | -276.07 | -29.52 | 90.37 |
| 32 | -88.15 | 13.00 | 19.73 | -175.28 | -5.04 | 65.39 |
| 33 | -140.44 | 40.39 | 17.06 | -247.75 | -34.37 | 87.65 |
| 34 | -84.49 | 15.91 | 20.59 | -146.95 | -9.89 | 62.67 |
| 35 | -90.41 | 24.30 | 5.59 | -201.13 | -20.39 | 58.61 |
| 36 | -34.47 | -0.18 | 9.12 | -100.34 | 4.09 | 33.63 |
| 37 | -66.07 | 22.92 | 3.41 | -131.87 | -21.86 | 41.64 |
| 38 | -10.13 | -1.55 | 6.93 | -31.08 | 2.62 | 16.67 |
| 39 | -123.41 | 33.20 | 13.16 | -235.14 | -26.14 | 76.12 |
| 40 | -67.47 | 8.73 | 16.69 | -134.34 | -1.67 | 51.15 |
| 41 | -119.75 | 36.11 | 14.02 | -206.81 | -30.99 | 73.40 |
| 42 | -63.81 | 11.63 | 17.54 | -106.02 | -6.51 | 48.43 |
| 43 | -69.73 | 20.02 | 2.55 | -160.20 | -17.01 | 44.36 |
| 44 | -13.79 | -4.46 | 6.08 | -59.40 | 7.46 | 19.39 |
| 45 | -91.08 | 18.58 | 11.40 | -181.61 | -15.88 | 62.37 |
| 46 | -82.76 | 18.36 | 13.32 | -168.82 | -15.65 | 60.45 |
| 47 | -126.57 | 24.95 | 17.44 | -245.54 | -18.53 | 83.72 |
| 48 | -118.26 | 24.72 | 19.35 | -232.75 | -18.30 | 81.80 |
| 49 | -124.31 | 26.75 | 17.97 | -228.00 | -21.53 | 82.03 |
| 50 | -115.99 | 26.52 | 19.89 | -215.21 | -21.31 | 80.11 |
| 51 | -93.34 | 16.79 | 10.87 | -199.14 | -12.88 | 64.06 |
| 52 | -85.03 | 16.56 | 12.79 | -186.35 | -12.65 | 62.14 |
| 53 | -71.02 | 14.33 | 8.55 | -141.18 | -12.25 | 48.20 |
| 54 | -62.70 | 14.10 | 10.47 | -128.39 | -12.02 | 46.28 |
| 55 | -98.32 | 19.22 | 13.19 | -190.35 | -14.28 | 64.62 |
| 56 | -90.01 | 18.99 | 15.11 | -177.56 | -14.06 | 62.70 |
| 57 | -96.58 | 20.60 | 13.60 | -176.86 | -16.59 | 63.32 |
| 58 | -88.27 | 20.38 | 15.52 | -164.07 | -16.37 | 61.40 |
| 59 | -72.76 | 12.94 | 8.14 | -154.67 | -9.94 | 49.49 |
| 60 | -64.45 | 12.72 | 10.06 | -141.87 | -9.71 | 47.58 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -166.18 | -188.23 | -175.84 | -122.88 | -35.62 | 0.00 | 0.00 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 0.00 | 0.00 | 0.00 | 0.00 | 9.45 | 108.98 | 319.87 |

强度计算应力比 =0.982

抗剪强度计算应力比 =0.304

平面内稳定计算最大应力对应组合号: 1, M=-83.36, N=18.35, M=-172.35, N=-17.22

平面内稳定最大应力 (N/mm\*mm) =279.41

平面内稳定计算最大应力比 =0.916

临界弯矩Mcr(kN\*m) =975.64

平面外稳定计算最大应力比 =0.790

梁面外稳定计算方式：梁面外稳定按隅撑间距计算。

强度计算应力比 =0.982 < 1.0

抗剪强度计算应力比 =0.304 < 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 =0.790 < 1.0

腹板高厚比 H0/TW=67.50 < [H0/TW]=250.00 (GB51022-2015)

翼缘宽厚比 B/T =11.70 < [B/T] =12.20

**(恒+活)梁的挠度 mm**

| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 60.02 | 66.55 | 63.21 | 51.08 | 33.14 | 14.08 | 0.00 |

最大挠度值 =66.55 最大挠度/梁跨度 =1/251.

斜梁坡度初始值: 1/19.18

变形后斜梁坡度最小值: 1/15.93

变形后斜梁坡度改变率 =0.204 < 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 | -66.86 | 14.20 | 9.51 | -134.77 | -12.12 | 47.24 |
| 2 | -94.16 | 19.09 | 14.15 | -183.95 | -14.16 | 63.66 |
| 3 | -92.42 | 20.47 | 14.56 | -170.46 | -16.46 | 62.36 |
| 4 | -68.60 | 12.81 | 9.10 | -148.26 | -9.81 | 48.53 |
| 5 | -59.96 | 12.77 | 8.49 | -121.13 | -10.99 | 42.49 |
| 6 | -87.27 | 17.67 | 13.14 | -170.30 | -13.03 | 58.91 |
| 7 | -85.52 | 19.05 | 13.55 | -156.81 | -15.34 | 57.61 |
| 8 | -61.70 | 11.39 | 8.08 | -134.61 | -8.68 | 43.78 |
| 9 | -69.35 | 16.60 | 8.70 | -136.17 | -13.59 | 46.07 |
| 10 | -54.43 | 10.07 | 9.64 | -109.29 | -7.07 | 39.41 |
| 11 | -62.45 | 15.17 | 7.69 | -122.53 | -12.47 | 41.33 |
| 12 | -47.54 | 8.65 | 8.63 | -95.65 | -5.94 | 34.66 |

--- 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 -94.16 -107.36 -98.79 -66.73 -11.17 0.00 0.00

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 0.00 0.00 0.00 0.00 0.97 67.90 183.95

强度计算荷载比 =0.56

平面内稳定计算荷载比 =0.52

平面外稳定计算荷载比 =0.35

无防护下钢构件最大升温(Ts): 1004.13℃ ,按临界温度法求得临界温度(Td): 556.32℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.3042(m^2\*℃/w)

构件重量 (Kg)=624.21

**13、 钢 梁 3
设计结果**

截面类型=27; 布置角度=0; 计算长度： Lx=16.75

构件长度=5.75; 计算长度系数: Ux=2.91

支撑长度=16.70

隅撑作为梁面外弹性支撑点，以下为隅撑支撑信息：

隅撑截面:L50X5 ; 布置间距: 2.40

隅撑与檩条夹角(度): 45.00; 隅撑孔距檩条下边缘距离: 0.10

檩条截面:XZ180X70X20X2.0 ; 檩条跨度: 6.88; 檩条到梁上皮距离: 0.02

抗震等级: 四级

变截面 H 形截面 H: B1=220, B2=220, H1=400, H2=500 T1=6 T2=10 T3=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: 254.647888(1/m)

梁刚度放大系数: 1.0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | -83.36 | 18.33 | -11.32 | -81.49 | -16.13 | 49.08 |
| 2 | -165.28 | 32.98 | -25.29 | -191.46 | -40.58 | 95.77 |
| 3 | -118.50 | 19.29 | -5.49 | -112.08 | -22.74 | 74.73 |
| 4 | -130.14 | 32.02 | -31.12 | -160.86 | -33.97 | 70.11 |
| 5 | -62.68 | 14.06 | -8.27 | -58.76 | -11.41 | 37.03 |
| 6 | -144.59 | 28.71 | -22.24 | -168.73 | -35.86 | 83.72 |
| 7 | -97.82 | 15.02 | -2.44 | -89.36 | -18.02 | 62.68 |
| 8 | -109.45 | 27.75 | -28.07 | -138.14 | -29.25 | 58.06 |
| 9 | -35.22 | 2.80 | -11.32 | -93.61 | -4.75 | 33.50 |
| 10 | -91.13 | 27.31 | -7.84 | -49.93 | -29.25 | 41.23 |
| 11 | -14.54 | -1.47 | -8.27 | -70.89 | -0.03 | 21.45 |
| 12 | -70.45 | 23.04 | -4.79 | -27.21 | -24.53 | 29.18 |
| 13 | -50.72 | 8.91 | -10.18 | -78.57 | -6.71 | 37.85 |
| 14 | -84.26 | 23.61 | -8.10 | -52.36 | -21.41 | 42.49 |
| 15 | -132.63 | 23.56 | -24.14 | -188.54 | -31.16 | 84.54 |
| 16 | -166.17 | 38.27 | -22.06 | -162.33 | -45.87 | 89.17 |
| 17 | -85.86 | 9.87 | -4.34 | -109.16 | -13.32 | 63.50 |
| 18 | -119.40 | 24.57 | -2.26 | -82.96 | -28.02 | 68.14 |
| 19 | -97.49 | 22.61 | -29.98 | -157.94 | -24.55 | 58.89 |
| 20 | -131.04 | 37.31 | -27.90 | -131.74 | -39.25 | 63.52 |
| 21 | -30.04 | 4.64 | -7.13 | -55.84 | -1.99 | 25.80 |
| 22 | -63.58 | 19.34 | -5.04 | -29.64 | -16.69 | 30.44 |
| 23 | -111.95 | 19.29 | -21.09 | -165.81 | -26.45 | 72.49 |
| 24 | -145.49 | 34.00 | -19.01 | -139.61 | -41.15 | 77.12 |
| 25 | -65.18 | 5.60 | -1.29 | -86.44 | -8.60 | 51.45 |
| 26 | -98.72 | 20.30 | 0.79 | -60.23 | -23.31 | 56.09 |
| 27 | -76.81 | 18.34 | -26.93 | -135.22 | -19.83 | 46.84 |
| 28 | -110.35 | 33.04 | -24.84 | -109.01 | -34.53 | 51.47 |
| 29 | -30.84 | 2.68 | -9.99 | -81.72 | -1.72 | 31.31 |
| 30 | -86.74 | 27.19 | -6.51 | -38.04 | -26.23 | 39.04 |
| 31 | -88.18 | 12.94 | -19.76 | -158.70 | -18.84 | 63.99 |
| 32 | -144.08 | 37.44 | -16.29 | -115.02 | -43.35 | 71.72 |
| 33 | -55.44 | 3.35 | -5.90 | -103.14 | -6.35 | 49.27 |
| 34 | -111.34 | 27.86 | -2.43 | -59.46 | -30.86 | 56.99 |
| 35 | -63.58 | 12.27 | -23.85 | -137.28 | -14.21 | 46.03 |
| 36 | -119.48 | 36.77 | -20.37 | -93.60 | -38.72 | 53.76 |
| 37 | -10.15 | -1.59 | -6.94 | -59.00 | 2.99 | 19.26 |
| 38 | -66.06 | 22.92 | -3.46 | -15.32 | -21.51 | 26.99 |
| 39 | -67.49 | 8.67 | -16.71 | -135.98 | -14.13 | 51.94 |
| 40 | -123.40 | 33.18 | -13.24 | -92.30 | -38.63 | 59.67 |
| 41 | -34.75 | -0.92 | -2.85 | -80.41 | -1.64 | 37.22 |
| 42 | -90.66 | 23.59 | 0.62 | -36.73 | -26.14 | 44.94 |
| 43 | -42.90 | 8.00 | -20.79 | -114.56 | -9.50 | 33.98 |
| 44 | -98.80 | 32.50 | -17.32 | -70.88 | -34.00 | 41.71 |
| 45 | -82.76 | 19.93 | -13.28 | -100.32 | -20.08 | 51.74 |
| 46 | -91.08 | 16.94 | -11.52 | -81.89 | -17.09 | 49.98 |
| 47 | -118.26 | 26.28 | -19.33 | -147.97 | -30.67 | 71.97 |
| 48 | -126.57 | 23.29 | -17.57 | -129.55 | -27.68 | 70.21 |
| 49 | -97.99 | 20.34 | -10.75 | -113.58 | -22.94 | 62.85 |
| 50 | -106.30 | 17.35 | -8.99 | -95.15 | -19.95 | 61.09 |
| 51 | -103.03 | 25.86 | -21.86 | -134.71 | -27.81 | 60.85 |
| 52 | -111.34 | 22.87 | -20.10 | -116.29 | -24.82 | 59.09 |
| 53 | -62.70 | 15.68 | -10.42 | -79.29 | -15.79 | 40.00 |
| 54 | -71.02 | 12.69 | -8.66 | -60.87 | -12.80 | 38.24 |
| 55 | -90.01 | 20.56 | -15.07 | -115.95 | -23.94 | 55.56 |
| 56 | -98.32 | 17.57 | -13.31 | -97.52 | -20.95 | 53.80 |
| 57 | -74.42 | 16.00 | -8.47 | -89.49 | -17.99 | 48.55 |
| 58 | -82.73 | 13.01 | -6.71 | -71.07 | -15.00 | 46.79 |
| 59 | -78.29 | 20.24 | -17.02 | -105.75 | -21.74 | 47.01 |
| 60 | -86.61 | 17.25 | -15.26 | -87.33 | -18.75 | 45.25 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -166.17 | -111.98 | -94.03 | -65.56 | -34.83 | -2.69 | 0.00 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 0.00 | 0.00 | 5.51 | 18.70 | 36.50 | 63.28 | 191.46 |

强度计算应力比 =0.636

抗剪强度计算应力比 =0.276

平面内稳定计算最大应力对应组合号: 1, M=-83.36, N=18.33, M=-81.49, N=-16.13

平面内稳定最大应力 (N/mm\*mm) =162.54

平面内稳定计算最大应力比 =0.533

临界弯矩Mcr(kN\*m) =864.43

平面外稳定计算最大应力比 =0.345

梁面外稳定计算方式：梁面外稳定按隅撑间距计算。

强度计算应力比 =0.636 < 1.0

抗剪强度计算应力比 =0.276 < 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 =0.345 < 1.0

腹板高厚比 H0/TW=71.67 < [H0/TW]=250.00 (GB51022-2015)

翼缘宽厚比 B/T =10.70 < [B/T] =12.20

**(恒+活)梁的挠度 mm**

| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 60.02 | 52.44 | 43.22 | 32.81 | 21.74 | 10.60 | 0.00 |

最大挠度值 =60.02 最大挠度/梁跨度 =1/279.

斜梁坡度初始值: 1/20.05

变形后斜梁坡度最小值: 1/26.20

变形后斜梁坡度改变率 =0.235 < 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 | -66.86 | 14.17 | -9.54 | -70.09 | -14.29 | 39.12 |
| 2 | -94.16 | 19.06 | -14.19 | -106.74 | -22.44 | 54.68 |
| 3 | -78.57 | 14.49 | -7.59 | -80.29 | -16.49 | 47.67 |
| 4 | -82.45 | 18.74 | -16.14 | -96.55 | -20.23 | 46.13 |
| 5 | -59.96 | 12.75 | -8.52 | -62.51 | -12.71 | 35.10 |
| 6 | -87.27 | 17.64 | -13.18 | -99.17 | -20.87 | 50.67 |
| 7 | -71.68 | 13.07 | -6.58 | -72.71 | -14.92 | 43.65 |
| 8 | -75.55 | 17.32 | -15.12 | -88.97 | -18.66 | 42.12 |
| 9 | -54.44 | 10.05 | -9.66 | -74.45 | -11.54 | 35.18 |
| 10 | -69.35 | 16.58 | -8.74 | -62.81 | -18.08 | 37.24 |
| 11 | -47.54 | 8.62 | -8.65 | -66.88 | -9.97 | 31.16 |
| 12 | -62.45 | 15.16 | -7.72 | -55.23 | -16.50 | 33.22 |

--- 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 -94.16 -68.09 -51.22 -27.94 -0.28 0.00 0.00

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 0.00 0.00 0.00 0.00 15.19 42.79 106.74

强度计算荷载比 =0.36

平面内稳定计算荷载比 =0.29

平面外稳定计算荷载比 =0.14

无防护下钢构件最大升温(Ts): 1004.70℃ ,按临界温度法求得临界温度(Td): 635.22℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2434(m^2\*℃/w)

构件重量 (Kg)=314.99

**14、 钢 梁 4
设计结果**

截面类型=16; 布置角度=0; 计算长度： Lx=13.02

构件长度=13.02; 计算长度系数: Ux=1.00

支撑长度=12.70

隅撑作为梁面外弹性支撑点，以下为隅撑支撑信息：

隅撑截面:L50X5 ; 布置间距: 2.40

隅撑与檩条夹角(度): 45.00; 隅撑孔距檩条下边缘距离: 0.10

檩条截面:XZ180X70X20X2.0 ; 檩条跨度: 6.88; 檩条到梁上皮距离: 0.02

抗震等级: 四级

截面参数: B1=220, B2=220, H=400, 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: 249.700592(1/m)

梁刚度放大系数: 1.0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 257.04 | 27.19 | 92.51 | -19.31 | -18.99 | 30.24 |
| 2 | 141.28 | 11.76 | 51.28 | -96.08 | -7.70 | 70.07 |
| 3 | 207.46 | 22.00 | 87.55 | -85.12 | -14.15 | 68.75 |
| 4 | 190.87 | 16.95 | 56.24 | -30.27 | -12.54 | 31.56 |
| 5 | 223.94 | 23.95 | 80.57 | -9.75 | -16.78 | 21.92 |
| 6 | 108.17 | 8.53 | 39.34 | -86.52 | -5.48 | 61.75 |
| 7 | 174.35 | 18.77 | 75.61 | -75.56 | -11.93 | 60.43 |
| 8 | 157.76 | 13.71 | 44.30 | -20.71 | -10.32 | 23.24 |
| 9 | 105.66 | 12.91 | 41.27 | -57.44 | -8.50 | 33.86 |
| 10 | 98.02 | 8.60 | 32.27 | -1.60 | -4.19 | 17.46 |
| 11 | 72.56 | 9.67 | 29.33 | -47.87 | -6.28 | 25.53 |
| 12 | 64.91 | 5.36 | 20.33 | 7.96 | -1.97 | 9.14 |
| 13 | 234.37 | 26.52 | 86.22 | -28.92 | -18.33 | 28.92 |
| 14 | 229.78 | 23.94 | 80.83 | 4.58 | -15.74 | 19.08 |
| 15 | 118.60 | 11.10 | 44.99 | -105.69 | -7.03 | 68.75 |
| 16 | 114.02 | 8.51 | 39.60 | -72.19 | -4.44 | 58.91 |
| 17 | 184.78 | 21.34 | 81.26 | -94.73 | -13.48 | 67.43 |
| 18 | 180.20 | 18.75 | 75.87 | -61.23 | -10.90 | 57.59 |
| 19 | 168.19 | 16.28 | 49.96 | -39.87 | -11.87 | 30.24 |
| 20 | 163.61 | 13.70 | 44.56 | -6.38 | -9.29 | 20.40 |
| 21 | 201.27 | 23.29 | 74.28 | -19.35 | -16.11 | 20.59 |
| 22 | 196.68 | 20.70 | 68.89 | 14.14 | -13.52 | 10.76 |
| 23 | 85.50 | 7.86 | 33.05 | -96.12 | -4.81 | 60.43 |
| 24 | 80.91 | 5.27 | 27.66 | -62.63 | -2.23 | 50.59 |
| 25 | 151.68 | 18.10 | 69.32 | -85.17 | -11.27 | 59.10 |
| 26 | 147.09 | 15.51 | 63.93 | -51.67 | -8.68 | 49.26 |
| 27 | 135.09 | 13.05 | 38.02 | -30.31 | -9.65 | 21.92 |
| 28 | 130.50 | 10.46 | 32.62 | 3.19 | -7.07 | 12.08 |
| 29 | 185.18 | 22.13 | 69.80 | -41.95 | -15.07 | 29.78 |
| 30 | 177.53 | 17.82 | 60.81 | 13.88 | -10.76 | 13.38 |
| 31 | 104.14 | 11.33 | 40.94 | -95.69 | -7.16 | 57.66 |
| 32 | 96.50 | 7.02 | 31.95 | -39.86 | -2.85 | 41.26 |
| 33 | 150.46 | 18.50 | 66.33 | -88.02 | -11.68 | 56.74 |
| 34 | 142.82 | 14.19 | 57.34 | -32.19 | -7.37 | 40.34 |
| 35 | 138.85 | 14.96 | 44.42 | -49.62 | -10.55 | 30.71 |
| 36 | 131.21 | 10.65 | 35.42 | 6.21 | -6.24 | 14.31 |
| 37 | 152.07 | 18.89 | 57.86 | -32.39 | -12.85 | 21.46 |
| 38 | 144.43 | 14.58 | 48.87 | 23.44 | -8.54 | 5.06 |
| 39 | 71.04 | 8.09 | 29.00 | -86.13 | -4.94 | 49.34 |
| 40 | 63.39 | 3.78 | 20.01 | -30.30 | -0.63 | 32.94 |
| 41 | 117.36 | 15.26 | 54.39 | -78.46 | -9.46 | 48.41 |
| 42 | 109.72 | 10.95 | 45.40 | -22.63 | -5.15 | 32.02 |
| 43 | 105.75 | 11.72 | 32.48 | -40.06 | -8.33 | 22.38 |
| 44 | 98.10 | 7.41 | 23.48 | 15.77 | -4.02 | 5.99 |
| 45 | 188.84 | 19.02 | 68.73 | -36.88 | -12.97 | 34.22 |
| 46 | 196.52 | 20.49 | 70.09 | -26.77 | -14.44 | 32.86 |
| 47 | 138.68 | 12.34 | 50.86 | -70.15 | -8.08 | 51.48 |
| 48 | 146.35 | 13.80 | 52.22 | -60.04 | -9.54 | 50.12 |
| 49 | 167.36 | 16.78 | 66.58 | -65.40 | -10.88 | 50.91 |
| 50 | 175.03 | 18.24 | 67.94 | -55.29 | -12.34 | 49.54 |
| 51 | 160.17 | 14.59 | 53.01 | -41.63 | -10.18 | 34.80 |
| 52 | 167.84 | 16.05 | 54.37 | -31.52 | -11.64 | 33.43 |
| 53 | 144.38 | 14.47 | 52.71 | -29.53 | -9.82 | 26.48 |
| 54 | 152.05 | 15.94 | 54.07 | -19.42 | -11.28 | 25.12 |
| 55 | 105.79 | 9.33 | 38.96 | -55.12 | -6.05 | 39.76 |
| 56 | 113.46 | 10.79 | 40.33 | -45.01 | -7.52 | 38.39 |
| 57 | 127.85 | 12.74 | 51.05 | -51.47 | -8.20 | 39.32 |
| 58 | 135.52 | 14.21 | 52.42 | -41.36 | -9.67 | 37.95 |
| 59 | 122.32 | 11.06 | 40.62 | -33.19 | -7.67 | 26.92 |
| 60 | 129.99 | 12.52 | 41.98 | -23.08 | -9.13 | 25.56 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 0.00 | 0.00 | -60.28 | -108.01 | -100.15 | -39.58 | -23.44 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 257.04 | 49.44 | 0.00 | 0.00 | 0.00 | 2.40 | 105.69 |

强度计算应力比 =0.974

抗剪强度计算应力比 =0.254

平面内稳定计算最大应力对应组合号: 1, M=257.04, N=27.19, M=-19.31, N=-18.99

平面内稳定最大应力 (N/mm\*mm) =273.86

平面内稳定计算最大应力比 =0.898

临界弯矩Mcr(kN\*m) =850.57

平面外稳定计算最大应力比 =0.920

梁面外稳定计算方式：梁面外稳定按隅撑间距计算。

强度计算应力比 =0.974 < 1.0

抗剪强度计算应力比 =0.254 < 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 =0.920 < 1.0

腹板高厚比 H0/TW=63.33 < [H0/TW]=250.00 (GB51022-2015)

翼缘宽厚比 B/T =10.70 < [B/T] =12.20

**(恒+活)梁的挠度 mm**

| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0.00 | 6.38 | 17.41 | 24.08 | 22.21 | 12.38 | 0.00 |

最大挠度值 =24.29 最大挠度/梁跨度 =1/535.

斜梁坡度初始值: 1/19.91

变形后斜梁坡度最小值: 1/17.81

变形后斜梁坡度改变率 =0.118 < 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 | 148.21 | 15.18 | 53.39 | -24.50 | -10.52 | 25.80 |
| 2 | 109.62 | 10.04 | 39.65 | -50.09 | -6.76 | 39.08 |
| 3 | 131.68 | 13.45 | 51.74 | -46.43 | -8.91 | 38.64 |
| 4 | 126.15 | 11.76 | 41.30 | -28.15 | -8.37 | 26.24 |
| 5 | 137.18 | 14.10 | 49.41 | -21.31 | -9.78 | 23.03 |
| 6 | 98.59 | 8.96 | 35.67 | -46.90 | -6.02 | 36.30 |
| 7 | 120.65 | 12.37 | 47.76 | -43.25 | -8.17 | 35.86 |
| 8 | 115.12 | 10.69 | 37.32 | -24.96 | -7.63 | 23.47 |
| 9 | 100.27 | 10.49 | 37.01 | -36.14 | -7.10 | 27.15 |
| 10 | 98.23 | 9.34 | 34.61 | -21.25 | -5.95 | 22.78 |
| 11 | 89.23 | 9.41 | 33.03 | -32.95 | -6.36 | 24.38 |
| 12 | 87.20 | 8.26 | 30.63 | -18.06 | -5.21 | 20.01 |

--- 梁的弯矩包络(偶然组合) ---

梁下部受拉:

截面 1 2 3 4 5 6 7

弯矩 0.00 0.00 -27.44 -57.98 -55.85 -21.05 0.00

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 148.21 36.22 0.00 0.00 0.00 0.00 50.09

强度计算荷载比 =0.56

平面内稳定计算荷载比 =0.51

平面外稳定计算荷载比 =0.47

无防护下钢构件最大升温(Ts): 1004.12℃ ,按临界温度法求得临界温度(Td): 556.93℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.3034(m^2\*℃/w)

构件重量 (Kg)=682.55

**15、 钢 梁 5
设计结果**

截面类型=27; 布置角度=0; 计算长度： Lx=16.75

构件长度=11.00; 计算长度系数: Ux=1.52

支撑长度=16.70

隅撑作为梁面外弹性支撑点，以下为隅撑支撑信息：

隅撑截面:L50X5 ; 布置间距: 2.40

隅撑与檩条夹角(度): 45.00; 隅撑孔距檩条下边缘距离: 0.10

檩条截面:XZ180X70X20X2.0 ; 檩条跨度: 6.88; 檩条到梁上皮距离: 0.02

抗震等级: 四级

变截面 H 形截面 H: B1=240, B2=240, H1=450, H2=400 T1=6 T2=10 T3=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: 250.068024(1/m)

梁刚度放大系数: 1.0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 319.87 | 23.34 | 110.24 | 165.27 | -33.04 | 25.21 |
| 2 | 172.35 | 17.22 | 60.98 | 83.36 | -18.35 | 11.28 |
| 3 | 279.41 | 30.27 | 106.35 | 160.05 | -37.19 | 26.44 |
| 4 | 212.81 | 10.30 | 64.87 | 88.59 | -14.20 | 10.06 |
| 5 | 278.94 | 19.97 | 95.99 | 144.59 | -28.76 | 22.17 |
| 6 | 131.41 | 13.85 | 46.73 | 62.68 | -14.08 | 8.24 |
| 7 | 238.47 | 26.89 | 92.11 | 139.37 | -32.91 | 23.40 |
| 8 | 171.88 | 6.92 | 50.62 | 67.91 | -9.93 | 7.01 |
| 9 | 75.59 | -1.08 | 31.46 | 35.22 | -2.83 | 11.31 |
| 10 | 176.31 | 23.42 | 56.42 | 91.13 | -27.33 | 7.78 |
| 11 | 34.65 | -4.45 | 17.22 | 14.54 | 1.45 | 8.27 |
| 12 | 135.38 | 20.04 | 42.17 | 70.45 | -23.05 | 4.74 |
| 13 | 258.79 | 13.92 | 92.07 | 132.63 | -23.62 | 24.09 |
| 14 | 319.23 | 28.62 | 107.04 | 166.17 | -38.32 | 21.97 |
| 15 | 111.27 | 7.80 | 42.81 | 50.72 | -8.93 | 10.16 |
| 16 | 171.70 | 22.50 | 57.79 | 84.26 | -23.63 | 8.04 |
| 17 | 218.33 | 20.84 | 88.19 | 127.41 | -27.77 | 25.32 |
| 18 | 278.76 | 35.54 | 103.16 | 160.95 | -42.47 | 23.20 |
| 19 | 151.73 | 0.88 | 46.70 | 55.95 | -4.78 | 8.93 |
| 20 | 212.17 | 15.57 | 61.67 | 89.49 | -19.48 | 6.82 |
| 21 | 217.86 | 10.55 | 77.82 | 111.95 | -19.34 | 21.05 |
| 22 | 278.29 | 25.24 | 92.80 | 145.49 | -34.04 | 18.93 |
| 23 | 70.33 | 4.43 | 28.57 | 30.04 | -4.66 | 7.12 |
| 24 | 130.77 | 19.12 | 43.54 | 63.58 | -19.36 | 5.00 |
| 25 | 177.39 | 17.47 | 73.94 | 106.72 | -23.49 | 22.27 |
| 26 | 237.83 | 32.17 | 88.91 | 140.26 | -38.19 | 20.16 |
| 27 | 110.80 | -2.50 | 32.45 | 35.26 | -0.51 | 5.89 |
| 28 | 171.23 | 12.20 | 47.42 | 68.81 | -15.20 | 3.77 |
| 29 | 175.33 | 5.02 | 65.41 | 88.18 | -12.99 | 19.73 |
| 30 | 276.05 | 29.52 | 90.37 | 144.08 | -37.48 | 16.20 |
| 31 | 72.06 | 0.74 | 30.93 | 30.84 | -2.71 | 9.98 |
| 32 | 172.78 | 25.24 | 55.89 | 86.74 | -27.20 | 6.45 |
| 33 | 147.00 | 9.87 | 62.69 | 84.52 | -15.89 | 20.59 |
| 34 | 247.73 | 34.37 | 87.65 | 140.42 | -40.39 | 17.06 |
| 35 | 100.38 | -4.11 | 33.65 | 34.50 | 0.20 | 9.12 |
| 36 | 201.11 | 20.39 | 58.61 | 90.40 | -24.30 | 5.59 |
| 37 | 134.39 | 1.65 | 51.16 | 67.49 | -8.71 | 16.69 |
| 38 | 235.12 | 26.15 | 76.12 | 123.40 | -33.20 | 13.16 |
| 39 | 31.12 | -2.63 | 16.68 | 10.15 | 1.57 | 6.94 |
| 40 | 131.85 | 21.86 | 41.64 | 66.06 | -22.93 | 3.41 |
| 41 | 106.07 | 6.50 | 48.44 | 63.83 | -11.61 | 17.55 |
| 42 | 206.79 | 30.99 | 73.40 | 119.74 | -36.11 | 14.02 |
| 43 | 59.45 | -7.48 | 19.40 | 13.81 | 4.48 | 6.08 |
| 44 | 160.17 | 17.02 | 44.36 | 69.72 | -20.02 | 2.55 |
| 45 | 232.75 | 18.30 | 81.80 | 118.26 | -24.72 | 19.35 |
| 46 | 245.54 | 18.53 | 83.72 | 126.57 | -24.95 | 17.44 |
| 47 | 168.82 | 15.65 | 60.45 | 82.76 | -18.36 | 13.32 |
| 48 | 181.61 | 15.88 | 62.37 | 91.08 | -18.58 | 11.40 |
| 49 | 215.21 | 21.31 | 80.11 | 115.99 | -26.52 | 19.89 |
| 50 | 228.00 | 21.53 | 82.03 | 124.31 | -26.75 | 17.97 |
| 51 | 186.35 | 12.65 | 62.14 | 85.03 | -16.56 | 12.79 |
| 52 | 199.14 | 12.88 | 64.06 | 93.34 | -16.79 | 10.87 |
| 53 | 177.56 | 14.06 | 62.70 | 90.01 | -18.99 | 15.11 |
| 54 | 190.35 | 14.28 | 64.62 | 98.32 | -19.22 | 13.19 |
| 55 | 128.39 | 12.02 | 46.28 | 62.70 | -14.10 | 10.47 |
| 56 | 141.18 | 12.25 | 48.20 | 71.02 | -14.33 | 8.55 |
| 57 | 164.07 | 16.37 | 61.40 | 88.27 | -20.38 | 15.52 |
| 58 | 176.86 | 16.59 | 63.32 | 96.58 | -20.60 | 13.60 |
| 59 | 141.87 | 9.71 | 47.58 | 64.45 | -12.72 | 10.06 |
| 60 | 154.67 | 9.94 | 49.49 | 72.76 | -12.94 | 8.14 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 0.00 | 0.00 | -35.62 | -122.88 | -175.84 | -188.23 | -166.17 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 319.87 | 108.97 | 9.45 | 0.00 | 0.00 | 0.00 | 0.00 |

强度计算应力比 =0.982

抗剪强度计算应力比 =0.304

平面内稳定计算最大应力对应组合号: 1, M=319.87, N=23.34, M=165.27, N=-33.04

平面内稳定最大应力 (N/mm\*mm) =279.40

平面内稳定计算最大应力比 =0.916

临界弯矩Mcr(kN\*m) =975.64

平面外稳定计算最大应力比 =0.790

梁面外稳定计算方式：梁面外稳定按隅撑间距计算。

强度计算应力比 =0.982 < 1.0

抗剪强度计算应力比 =0.304 < 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 =0.790 < 1.0

腹板高厚比 H0/TW=67.50 < [H0/TW]=250.00 (GB51022-2015)

翼缘宽厚比 B/T =11.70 < [B/T] =12.20

**(恒+活)梁的挠度 mm**

| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0.00 | 14.08 | 33.14 | 51.08 | 63.21 | 66.55 | 60.02 |

最大挠度值 =66.55 最大挠度/梁跨度 =1/251.

斜梁坡度初始值: 1/19.18

变形后斜梁坡度最小值: 1/15.93

变形后斜梁坡度改变率 =0.204 < 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 | 183.95 | 14.16 | 63.66 | 94.16 | -19.09 | 14.15 |
| 2 | 134.77 | 12.12 | 47.24 | 66.86 | -14.20 | 9.51 |
| 3 | 170.46 | 16.46 | 62.36 | 92.42 | -20.47 | 14.56 |
| 4 | 148.26 | 9.81 | 48.53 | 68.60 | -12.81 | 9.10 |
| 5 | 170.30 | 13.03 | 58.91 | 87.27 | -17.67 | 13.14 |
| 6 | 121.13 | 10.99 | 42.49 | 59.96 | -12.77 | 8.49 |
| 7 | 156.81 | 15.34 | 57.61 | 85.52 | -19.05 | 13.55 |
| 8 | 134.61 | 8.68 | 43.78 | 61.70 | -11.39 | 8.08 |
| 9 | 109.31 | 7.06 | 39.42 | 54.44 | -10.07 | 9.64 |
| 10 | 136.17 | 13.59 | 46.07 | 69.35 | -16.60 | 8.70 |
| 11 | 95.66 | 5.94 | 34.67 | 47.54 | -8.64 | 8.63 |
| 12 | 122.52 | 12.47 | 41.32 | 62.45 | -15.17 | 7.69 |

--- 梁的弯矩包络(偶然组合) ---

梁下部受拉:

截面 1 2 3 4 5 6 7

弯矩 0.00 0.00 -11.17 -66.73 -98.79 -107.36 -94.16

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 183.95 67.90 0.97 0.00 0.00 0.00 0.00

强度计算荷载比 =0.56

平面内稳定计算荷载比 =0.52

平面外稳定计算荷载比 =0.35

无防护下钢构件最大升温(Ts): 1004.13℃ ,按临界温度法求得临界温度(Td): 556.32℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.3042(m^2\*℃/w)

构件重量 (Kg)=624.21

**16、 钢 梁 6
设计结果**

截面类型=16; 布置角度=0; 计算长度： Lx=13.02

构件长度=13.02; 计算长度系数: Ux=1.00

支撑长度=12.70

隅撑作为梁面外弹性支撑点，以下为隅撑支撑信息：

隅撑截面:L50X5 ; 布置间距: 2.40

隅撑与檩条夹角(度): 45.00; 隅撑孔距檩条下边缘距离: 0.10

檩条截面:XZ180X70X20X2.0 ; 檩条跨度: 6.88; 檩条到梁上皮距离: 0.02

抗震等级: 四级

截面参数: B1=220, B2=220, H=400, 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: 249.700592(1/m)

梁刚度放大系数: 1.0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 96.08 | 7.70 | 70.07 | -141.28 | -11.76 | 51.28 |
| 2 | 19.31 | 18.99 | 30.24 | -257.04 | -27.19 | 92.51 |
| 3 | 85.12 | 14.15 | 68.75 | -207.46 | -22.00 | 87.55 |
| 4 | 30.27 | 12.54 | 31.56 | -190.87 | -16.95 | 56.24 |
| 5 | 86.52 | 5.48 | 61.75 | -108.17 | -8.53 | 39.34 |
| 6 | 9.75 | 16.78 | 21.92 | -223.94 | -23.95 | 80.57 |
| 7 | 75.56 | 11.93 | 60.43 | -174.35 | -18.77 | 75.61 |
| 8 | 20.71 | 10.32 | 23.24 | -157.76 | -13.71 | 44.30 |
| 9 | 1.62 | 4.17 | 17.47 | -98.06 | -8.58 | 32.29 |
| 10 | 57.43 | 8.50 | 33.85 | -105.65 | -12.91 | 41.26 |
| 11 | -7.94 | 1.96 | 9.15 | -64.96 | -5.35 | 20.35 |
| 12 | 47.87 | 6.28 | 25.53 | -72.54 | -9.68 | 29.32 |
| 13 | 72.20 | 4.43 | 58.92 | -114.04 | -8.50 | 39.61 |
| 14 | 105.68 | 7.03 | 68.75 | -118.60 | -11.10 | 44.99 |
| 15 | -4.57 | 15.73 | 19.08 | -229.81 | -23.93 | 80.84 |
| 16 | 28.91 | 18.33 | 28.91 | -234.36 | -26.52 | 86.22 |
| 17 | 61.24 | 10.89 | 57.59 | -180.22 | -18.74 | 75.88 |
| 18 | 94.72 | 13.49 | 67.42 | -184.77 | -21.34 | 81.26 |
| 19 | 6.38 | 9.28 | 20.41 | -163.63 | -13.69 | 44.57 |
| 20 | 39.87 | 11.87 | 30.24 | -168.19 | -16.28 | 49.95 |
| 21 | 62.64 | 2.22 | 50.59 | -80.94 | -5.26 | 27.67 |
| 22 | 96.12 | 4.81 | 60.42 | -85.49 | -7.86 | 33.05 |
| 23 | -14.13 | 13.51 | 10.76 | -196.71 | -20.69 | 68.90 |
| 24 | 19.35 | 16.11 | 20.59 | -201.26 | -23.29 | 74.28 |
| 25 | 51.68 | 8.67 | 49.27 | -147.12 | -15.50 | 63.94 |
| 26 | 85.16 | 11.27 | 59.10 | -151.67 | -18.10 | 69.32 |
| 27 | -3.18 | 7.06 | 12.08 | -130.53 | -10.45 | 32.63 |
| 28 | 30.31 | 9.65 | 21.91 | -135.08 | -13.05 | 38.01 |
| 29 | 39.88 | 2.83 | 41.28 | -96.54 | -7.00 | 31.96 |
| 30 | 95.68 | 7.16 | 57.66 | -104.13 | -11.33 | 40.94 |
| 31 | -13.86 | 10.74 | 13.39 | -177.58 | -17.80 | 60.83 |
| 32 | 41.94 | 15.07 | 29.78 | -185.16 | -22.13 | 69.80 |
| 33 | 32.20 | 7.35 | 40.35 | -142.86 | -14.17 | 57.35 |
| 34 | 88.01 | 11.68 | 56.73 | -150.45 | -18.50 | 66.33 |
| 35 | -6.19 | 6.22 | 14.32 | -131.25 | -10.63 | 35.44 |
| 36 | 49.62 | 10.55 | 30.70 | -138.84 | -14.96 | 44.41 |
| 37 | 30.32 | 0.61 | 32.95 | -63.44 | -3.76 | 20.02 |
| 38 | 86.12 | 4.94 | 49.34 | -71.02 | -8.09 | 29.00 |
| 39 | -23.42 | 8.52 | 5.07 | -144.47 | -14.56 | 48.89 |
| 40 | 32.38 | 12.85 | 21.45 | -152.06 | -18.89 | 57.86 |
| 41 | 22.64 | 5.13 | 32.03 | -109.76 | -10.93 | 45.41 |
| 42 | 78.45 | 9.46 | 48.41 | -117.35 | -15.26 | 54.39 |
| 43 | -15.75 | 4.00 | 6.00 | -98.15 | -7.40 | 23.50 |
| 44 | 40.05 | 8.33 | 22.38 | -105.74 | -11.72 | 32.47 |
| 45 | 60.04 | 9.54 | 50.12 | -146.35 | -13.80 | 52.22 |
| 46 | 70.15 | 8.08 | 51.48 | -138.68 | -12.34 | 50.86 |
| 47 | 26.77 | 14.44 | 32.86 | -196.52 | -20.49 | 70.09 |
| 48 | 36.88 | 12.97 | 34.22 | -188.84 | -19.02 | 68.73 |
| 49 | 55.29 | 12.34 | 49.54 | -175.03 | -18.24 | 67.94 |
| 50 | 65.40 | 10.88 | 50.91 | -167.36 | -16.78 | 66.58 |
| 51 | 31.52 | 11.64 | 33.43 | -167.84 | -16.05 | 54.37 |
| 52 | 41.63 | 10.18 | 34.80 | -160.17 | -14.59 | 53.01 |
| 53 | 45.01 | 7.52 | 38.39 | -113.46 | -10.79 | 40.33 |
| 54 | 55.12 | 6.05 | 39.76 | -105.79 | -9.33 | 38.96 |
| 55 | 19.42 | 11.28 | 25.12 | -152.05 | -15.94 | 54.07 |
| 56 | 29.53 | 9.82 | 26.48 | -144.38 | -14.47 | 52.71 |
| 57 | 41.36 | 9.67 | 37.95 | -135.52 | -14.21 | 52.42 |
| 58 | 51.47 | 8.20 | 39.32 | -127.85 | -12.74 | 51.05 |
| 59 | 23.08 | 9.13 | 25.56 | -129.99 | -12.52 | 41.98 |
| 60 | 33.19 | 7.67 | 26.92 | -122.32 | -11.06 | 40.62 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -23.42 | -39.58 | -100.15 | -108.01 | -60.28 | 0.00 | 0.00 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 105.68 | 2.40 | 0.00 | 0.00 | 0.00 | 49.44 | 257.04 |

强度计算应力比 =0.974

抗剪强度计算应力比 =0.254

平面内稳定计算最大应力对应组合号: 1, M=96.08, N=7.70, M=-141.28, N=-11.76

平面内稳定最大应力 (N/mm\*mm) =273.86

平面内稳定计算最大应力比 =0.898

临界弯矩Mcr(kN\*m) =850.57

平面外稳定计算最大应力比 =0.920

梁面外稳定计算方式：梁面外稳定按隅撑间距计算。

强度计算应力比 =0.974 < 1.0

抗剪强度计算应力比 =0.254 < 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 =0.920 < 1.0

腹板高厚比 H0/TW=63.33 < [H0/TW]=250.00 (GB51022-2015)

翼缘宽厚比 B/T =10.70 < [B/T] =12.20

**(恒+活)梁的挠度 mm**

| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0.00 | 12.38 | 22.21 | 24.08 | 17.41 | 6.38 | 0.00 |

最大挠度值 =24.29 最大挠度/梁跨度 =1/535.

斜梁坡度初始值: 1/19.91

变形后斜梁坡度最小值: 1/17.81

变形后斜梁坡度改变率 =0.118 < 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 | 50.09 | 6.76 | 39.08 | -109.62 | -10.04 | 39.65 |
| 2 | 24.50 | 10.52 | 25.80 | -148.21 | -15.18 | 53.39 |
| 3 | 46.43 | 8.91 | 38.64 | -131.68 | -13.45 | 51.74 |
| 4 | 28.15 | 8.37 | 26.24 | -126.15 | -11.76 | 41.30 |
| 5 | 46.90 | 6.02 | 36.30 | -98.59 | -8.96 | 35.67 |
| 6 | 21.31 | 9.78 | 23.03 | -137.18 | -14.10 | 49.41 |
| 7 | 43.25 | 8.17 | 35.86 | -120.65 | -12.37 | 47.76 |
| 8 | 24.96 | 7.63 | 23.47 | -115.12 | -10.69 | 37.32 |
| 9 | 21.25 | 5.95 | 22.78 | -98.24 | -9.34 | 34.61 |
| 10 | 36.13 | 7.10 | 27.15 | -100.27 | -10.49 | 37.01 |
| 11 | 18.07 | 5.21 | 20.01 | -87.21 | -8.26 | 30.63 |
| 12 | 32.95 | 6.36 | 24.38 | -89.23 | -9.41 | 33.03 |

--- 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 -21.05 -55.85 -57.98 -27.44 0.00 0.00

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 50.09 0.00 0.00 0.00 0.00 36.22 148.21

强度计算荷载比 =0.56

平面内稳定计算荷载比 =0.51

平面外稳定计算荷载比 =0.47

无防护下钢构件最大升温(Ts): 1004.12℃ ,按临界温度法求得临界温度(Td): 556.93℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.3034(m^2\*℃/w)

构件重量 (Kg)=682.55

**17、 钢 梁 7
设计结果**

截面类型=16; 布置角度=0; 计算长度： Lx=1.92, Ly=0.81

构件长度=0.96; 计算长度系数: Ux=2.00 Uy=0.84

支撑长度=0.81

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)

梁刚度放大系数: 1.0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 0.00 | -0.00 | 0.00 | -2.92 | 0.77 | 6.11 |
| 2 | -0.00 | -0.00 | -0.00 | -5.32 | 1.40 | 11.11 |
| 3 | -0.00 | -0.00 | 0.00 | -5.32 | 1.40 | 11.11 |
| 4 | -0.00 | -0.00 | -0.00 | -2.92 | 0.77 | 6.11 |
| 5 | 0.00 | -0.00 | 0.00 | -2.25 | 0.59 | 4.70 |
| 6 | -0.00 | -0.00 | -0.00 | -4.64 | 1.23 | 9.70 |
| 7 | -0.00 | -0.00 | 0.00 | -4.64 | 1.23 | 9.70 |
| 8 | -0.00 | -0.00 | -0.00 | -2.25 | 0.59 | 4.70 |
| 9 | 0.00 | -0.00 | 0.00 | -1.31 | 0.77 | 2.74 |
| 10 | 0.00 | -0.00 | -0.00 | -1.31 | 0.77 | 2.75 |
| 11 | 0.00 | -0.00 | 0.00 | -0.64 | 0.60 | 1.33 |
| 12 | 0.00 | -0.00 | -0.00 | -0.64 | 0.59 | 1.34 |
| 13 | 0.00 | -0.00 | 0.00 | -1.96 | 0.77 | 4.09 |
| 14 | 0.00 | -0.00 | -0.00 | -1.96 | 0.77 | 4.09 |
| 15 | 0.00 | -0.00 | 0.00 | -4.35 | 1.41 | 9.09 |
| 16 | -0.00 | -0.00 | -0.00 | -4.35 | 1.40 | 9.09 |
| 17 | 0.00 | -0.00 | 0.00 | -4.35 | 1.41 | 9.09 |
| 18 | 0.00 | -0.00 | -0.00 | -4.35 | 1.40 | 9.09 |
| 19 | 0.00 | -0.00 | 0.00 | -1.96 | 0.77 | 4.09 |
| 20 | -0.00 | -0.00 | -0.00 | -1.96 | 0.77 | 4.09 |
| 21 | 0.00 | -0.00 | 0.00 | -1.28 | 0.60 | 2.68 |
| 22 | 0.00 | -0.00 | -0.00 | -1.28 | 0.59 | 2.68 |
| 23 | 0.00 | -0.00 | 0.00 | -3.68 | 1.23 | 7.68 |
| 24 | -0.00 | -0.00 | -0.00 | -3.68 | 1.23 | 7.68 |
| 25 | 0.00 | -0.00 | 0.00 | -3.68 | 1.23 | 7.68 |
| 26 | 0.00 | -0.00 | -0.00 | -3.68 | 1.23 | 7.68 |
| 27 | 0.00 | -0.00 | 0.00 | -1.28 | 0.60 | 2.68 |
| 28 | -0.00 | -0.00 | -0.00 | -1.28 | 0.59 | 2.68 |
| 29 | 0.00 | -0.00 | 0.00 | -1.31 | 0.77 | 2.74 |
| 30 | 0.00 | -0.00 | -0.00 | -1.31 | 0.77 | 2.75 |
| 31 | 0.00 | -0.00 | 0.00 | -2.99 | 1.22 | 6.25 |
| 32 | 0.00 | -0.00 | -0.00 | -2.99 | 1.21 | 6.25 |
| 33 | 0.00 | -0.00 | 0.00 | -2.99 | 1.22 | 6.25 |
| 34 | 0.00 | -0.00 | -0.00 | -2.99 | 1.21 | 6.25 |
| 35 | 0.00 | -0.00 | 0.00 | -1.31 | 0.77 | 2.74 |
| 36 | 0.00 | -0.00 | -0.00 | -1.32 | 0.77 | 2.75 |
| 37 | 0.00 | -0.00 | 0.00 | -0.64 | 0.60 | 1.33 |
| 38 | 0.00 | -0.00 | -0.00 | -0.64 | 0.59 | 1.34 |
| 39 | 0.00 | -0.00 | 0.00 | -2.32 | 1.04 | 4.84 |
| 40 | -0.00 | -0.00 | -0.00 | -2.32 | 1.04 | 4.84 |
| 41 | 0.00 | -0.00 | 0.00 | -2.32 | 1.04 | 4.84 |
| 42 | 0.00 | -0.00 | -0.00 | -2.32 | 1.04 | 4.84 |
| 43 | 0.00 | -0.00 | 0.00 | -0.64 | 0.60 | 1.33 |
| 44 | 0.00 | -0.00 | -0.00 | -0.64 | 0.59 | 1.34 |
| 45 | 0.00 | 0.24 | -0.03 | -2.95 | 0.53 | 6.14 |
| 46 | 0.00 | -0.24 | 0.03 | -2.89 | 1.01 | 6.08 |
| 47 | -0.00 | 0.24 | -0.03 | -3.99 | 0.80 | 8.31 |
| 48 | 0.00 | -0.24 | 0.03 | -3.93 | 1.29 | 8.24 |
| 49 | 0.00 | 0.24 | -0.03 | -3.99 | 0.80 | 8.31 |
| 50 | 0.00 | -0.24 | 0.03 | -3.93 | 1.29 | 8.24 |
| 51 | -0.00 | 0.24 | -0.03 | -2.95 | 0.53 | 6.14 |
| 52 | 0.00 | -0.24 | 0.03 | -2.89 | 1.01 | 6.08 |
| 53 | 0.00 | 0.24 | -0.03 | -2.28 | 0.35 | 4.73 |
| 54 | 0.00 | -0.24 | 0.03 | -2.22 | 0.84 | 4.67 |
| 55 | -0.00 | 0.24 | -0.03 | -3.08 | 0.56 | 6.40 |
| 56 | 0.00 | -0.24 | 0.03 | -3.02 | 1.05 | 6.33 |
| 57 | 0.00 | 0.24 | -0.03 | -3.08 | 0.56 | 6.40 |
| 58 | 0.00 | -0.24 | 0.03 | -3.02 | 1.05 | 6.33 |
| 59 | -0.00 | 0.24 | -0.03 | -2.28 | 0.35 | 4.73 |
| 60 | 0.00 | -0.24 | 0.03 | -2.22 | 0.84 | 4.67 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 0.00 | 0.15 | 0.59 | 1.33 | 2.36 | 3.69 | 5.32 |

强度计算应力比 =0.065

抗剪强度计算应力比 =0.058

平面内稳定计算最大应力对应组合号: 1, M=0.00, N=-0.00, M=-2.92, N=0.77

平面内稳定最大应力 (N/mm\*mm) =18.30

平面内稳定计算最大应力比 =0.060

临界弯矩Mcr(kN\*m) =4367.18

平面外稳定计算最大应力比 =0.025

强度计算应力比 =0.065 < 1.0

抗剪强度计算应力比 =0.058 < 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 =0.025 < 1.0

腹板高厚比 H0/TW=30.67 < [H0/TW]=250.00 (GB51022-2015)

翼缘宽厚比 B/T =10.88 < [B/T] =12.20

**(恒+活)梁的挠度 mm**

| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 4.46 | 3.71 | 2.96 | 2.21 | 1.46 | 0.73 | 0.00 |

最大挠度值 =4.46 最大挠度/梁跨度 =1/426.

斜梁坡度初始值: 1/7.92

变形后斜梁坡度最小值: 1/7.63

变形后斜梁坡度改变率 =0.038 < 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 | 0.00 | -0.00 | -0.00 | -2.25 | 0.59 | 4.70 |
| 2 | -0.00 | -0.00 | -0.00 | -3.05 | 0.80 | 6.37 |
| 3 | 0.00 | -0.00 | 0.00 | -3.05 | 0.80 | 6.37 |
| 4 | -0.00 | -0.00 | -0.00 | -2.25 | 0.59 | 4.70 |
| 5 | 0.00 | -0.00 | -0.00 | -2.02 | 0.53 | 4.23 |
| 6 | -0.00 | -0.00 | -0.00 | -2.82 | 0.74 | 5.90 |
| 7 | 0.00 | -0.00 | 0.00 | -2.82 | 0.74 | 5.90 |
| 8 | -0.00 | -0.00 | -0.00 | -2.02 | 0.53 | 4.23 |
| 9 | 0.00 | -0.00 | 0.00 | -1.82 | 0.59 | 3.80 |
| 10 | 0.00 | -0.00 | -0.00 | -1.82 | 0.59 | 3.80 |
| 11 | 0.00 | -0.00 | 0.00 | -1.59 | 0.53 | 3.33 |
| 12 | 0.00 | -0.00 | -0.00 | -1.60 | 0.53 | 3.33 |

--- 梁的弯矩包络(偶然组合) ---

梁下部受拉:

截面 1 2 3 4 5 6 7

弯矩 -0.00 0.00 0.00 0.00 0.00 0.00 0.00

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 0.00 0.08 0.34 0.76 1.35 2.12 3.05

强度计算荷载比 =0.04

平面内稳定计算荷载比 =0.03

平面外稳定计算荷载比 =0.01

无防护下钢构件最大升温(Ts): 1004.34℃ ,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) =0.2535(m^2\*℃/w)

构件重量 (Kg)=29.95

**18、 钢 梁 8
设计结果**

截面类型=16; 布置角度=0; 计算长度： Lx=3.75, Ly=2.02

构件长度=1.87; 计算长度系数: Ux=2.00 Uy=1.08

支撑长度=2.02

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)

梁刚度放大系数: 1.0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 38.06 | 12.14 | 28.12 | -1.37 | -5.84 | 0.95 |
| 2 | 4.65 | 7.27 | 3.13 | -14.18 | -8.15 | 1.32 |
| 3 | 9.25 | 9.65 | 12.75 | -5.63 | -6.14 | 8.88 |
| 4 | 33.45 | 9.77 | 18.50 | -9.92 | -7.84 | -6.62 |
| 5 | 34.53 | 10.54 | 25.57 | -0.06 | -4.67 | 0.76 |
| 6 | 1.12 | 5.67 | 0.58 | -12.87 | -6.98 | 1.13 |
| 7 | 5.73 | 8.04 | 10.19 | -4.32 | -4.98 | 8.70 |
| 8 | 29.93 | 8.16 | 15.95 | -8.61 | -6.68 | -6.81 |
| 9 | 3.02 | 3.00 | 1.69 | -4.81 | -1.08 | 3.61 |
| 10 | 15.56 | 4.10 | 8.39 | -4.82 | -2.17 | -3.08 |
| 11 | -0.50 | 1.40 | -0.86 | -3.51 | 0.09 | 3.42 |
| 12 | 12.04 | 2.49 | 5.83 | -3.51 | -1.01 | -3.27 |
| 13 | 30.71 | 9.76 | 22.50 | -0.86 | -3.46 | 2.62 |
| 14 | 38.24 | 10.42 | 26.51 | -0.86 | -4.12 | -1.39 |
| 15 | -2.70 | 4.90 | -2.49 | -13.67 | -5.77 | 2.99 |
| 16 | 4.82 | 5.55 | 1.52 | -13.67 | -6.42 | -1.02 |
| 17 | 1.90 | 7.27 | 7.12 | -5.12 | -3.76 | 10.56 |
| 18 | 9.43 | 7.93 | 11.14 | -5.12 | -4.42 | 6.55 |
| 19 | 26.11 | 7.39 | 12.88 | -9.41 | -5.46 | -4.94 |
| 20 | 33.63 | 8.05 | 16.89 | -9.41 | -6.12 | -8.96 |
| 21 | 27.19 | 8.16 | 19.94 | 0.44 | -2.30 | 2.43 |
| 22 | 34.71 | 8.81 | 23.96 | 0.44 | -2.95 | -1.58 |
| 23 | -6.22 | 3.29 | -5.05 | -12.36 | -4.60 | 2.81 |
| 24 | 1.30 | 3.94 | -1.03 | -12.36 | -5.26 | -1.21 |
| 25 | -1.62 | 5.66 | 4.57 | -3.81 | -2.60 | 10.37 |
| 26 | 5.90 | 6.32 | 8.59 | -3.82 | -3.26 | 6.36 |
| 27 | 22.59 | 5.78 | 10.32 | -8.10 | -4.30 | -5.13 |
| 28 | 30.11 | 6.44 | 14.34 | -8.11 | -4.95 | -9.14 |
| 29 | 18.98 | 6.63 | 13.63 | -1.81 | -1.63 | 3.70 |
| 30 | 31.52 | 7.72 | 20.32 | -1.81 | -2.73 | -2.99 |
| 31 | -4.41 | 3.22 | -3.86 | -10.78 | -3.25 | 3.96 |
| 32 | 8.13 | 4.31 | 2.83 | -10.78 | -4.34 | -2.73 |
| 33 | -1.19 | 4.88 | 2.87 | -4.79 | -1.85 | 9.25 |
| 34 | 11.35 | 5.98 | 9.56 | -4.79 | -2.94 | 2.57 |
| 35 | 15.75 | 4.96 | 6.90 | -7.80 | -3.04 | -1.60 |
| 36 | 28.30 | 6.06 | 13.59 | -7.80 | -4.13 | -8.28 |
| 37 | 15.45 | 5.02 | 11.08 | -0.51 | -0.47 | 3.51 |
| 38 | 27.99 | 6.11 | 17.77 | -0.51 | -1.57 | -3.18 |
| 39 | -7.93 | 1.61 | -6.42 | -9.47 | -2.09 | 3.77 |
| 40 | 4.61 | 2.70 | 0.28 | -9.47 | -3.18 | -2.92 |
| 41 | -4.71 | 3.27 | 0.32 | -3.49 | -0.68 | 9.07 |
| 42 | 7.83 | 4.37 | 7.01 | -3.49 | -1.78 | 2.38 |
| 43 | 12.23 | 3.35 | 4.34 | -6.49 | -1.87 | -1.78 |
| 44 | 24.77 | 4.45 | 11.04 | -6.49 | -2.97 | -8.47 |
| 45 | 23.02 | 8.93 | 17.32 | -3.84 | -5.10 | 2.01 |
| 46 | 27.27 | 9.56 | 19.58 | -3.84 | -5.73 | -0.25 |
| 47 | 8.55 | 6.82 | 6.49 | -9.39 | -6.10 | 2.17 |
| 48 | 12.79 | 7.45 | 8.75 | -9.39 | -6.73 | -0.09 |
| 49 | 10.54 | 7.85 | 10.66 | -5.68 | -5.24 | 5.45 |
| 50 | 14.78 | 8.48 | 12.92 | -5.68 | -5.86 | 3.19 |
| 51 | 21.03 | 7.90 | 13.15 | -7.54 | -5.97 | -1.27 |
| 52 | 25.27 | 8.53 | 15.42 | -7.54 | -6.60 | -3.53 |
| 53 | 17.22 | 6.80 | 13.06 | -2.96 | -3.86 | 1.81 |
| 54 | 21.47 | 7.43 | 15.32 | -2.96 | -4.49 | -0.46 |
| 55 | 6.09 | 5.18 | 4.73 | -7.23 | -4.63 | 1.93 |
| 56 | 10.33 | 5.81 | 6.99 | -7.23 | -5.26 | -0.33 |
| 57 | 7.62 | 5.97 | 7.94 | -4.38 | -3.96 | 4.46 |
| 58 | 11.86 | 6.60 | 10.20 | -4.38 | -4.59 | 2.19 |
| 59 | 15.69 | 6.01 | 9.85 | -5.81 | -4.53 | -0.71 |
| 60 | 19.93 | 6.64 | 12.12 | -5.81 | -5.16 | -2.98 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -7.93 | -4.57 | -3.93 | -2.81 | -1.20 | 0.00 | -0.44 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 38.24 | 13.89 | 11.02 | 8.95 | 7.29 | 6.10 | 14.18 |

强度计算应力比 =0.474

抗剪强度计算应力比 =0.146

平面内稳定计算最大应力对应组合号: 1, M=38.06, N=12.14, M=-1.37, N=-5.84

平面内稳定最大应力 (N/mm\*mm) =132.29

平面内稳定计算最大应力比 =0.434

临界弯矩Mcr(kN\*m) =725.87

平面外稳定计算最大应力比 =0.321

强度计算应力比 =0.474 < 1.0

抗剪强度计算应力比 =0.146 < 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 =0.321 < 1.0

腹板高厚比 H0/TW=30.67 < [H0/TW]=250.00 (GB51022-2015)

翼缘宽厚比 B/T =10.88 < [B/T] =12.20

**(恒+活)梁的挠度 mm**

| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0.00 | -0.23 | -0.38 | -0.48 | -0.53 | -0.55 | -0.52 |

最大挠度值 =0.00 最大挠度/梁跨度 =1/100000.

斜梁坡度初始值: 1/6.17

变形后斜梁坡度最小值: 1/6.14

变形后斜梁坡度改变率 =0.005 < 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 | 19.34 | 7.09 | 14.20 | -2.92 | -4.14 | 0.67 |
| 2 | 8.20 | 5.46 | 5.87 | -7.19 | -4.91 | 0.80 |
| 3 | 9.74 | 6.26 | 9.07 | -4.34 | -4.25 | 3.32 |
| 4 | 17.80 | 6.29 | 10.99 | -5.77 | -4.81 | -1.85 |
| 5 | 18.16 | 6.55 | 13.35 | -2.49 | -3.76 | 0.61 |
| 6 | 7.03 | 4.93 | 5.02 | -6.76 | -4.53 | 0.73 |
| 7 | 8.56 | 5.72 | 8.22 | -3.91 | -3.86 | 3.25 |
| 8 | 16.63 | 5.76 | 10.14 | -5.34 | -4.42 | -1.91 |
| 9 | 8.48 | 4.30 | 6.01 | -4.13 | -2.82 | 1.37 |
| 10 | 11.82 | 4.60 | 7.80 | -4.13 | -3.11 | -0.41 |
| 11 | 7.30 | 3.77 | 5.16 | -3.69 | -2.43 | 1.31 |
| 12 | 10.65 | 4.06 | 6.95 | -3.69 | -2.73 | -0.47 |

--- 梁的弯矩包络(偶然组合) ---

梁下部受拉:

截面 1 2 3 4 5 6 7

弯矩 0.00 0.00 0.00 0.00 0.00 0.00 0.00

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 19.34 9.58 7.72 6.24 5.15 4.45 7.19

强度计算荷载比 =0.24

平面内稳定计算荷载比 =0.22

平面外稳定计算荷载比 =0.14

无防护下钢构件最大升温(Ts): 1004.34℃ ,按临界温度法求得临界温度(Td): 656.39℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2538(m^2\*℃/w)

构件重量 (Kg)=58.61

**19、 钢 梁 9
设计结果**

截面类型=16; 布置角度=0; 计算长度： Lx=1.92, Ly=0.81

构件长度=0.96; 计算长度系数: Ux=2.00 Uy=0.84

支撑长度=0.81

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)

梁刚度放大系数: 1.0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 5.32 | -1.40 | 11.11 | 0.00 | -0.00 | -0.00 |
| 2 | 2.92 | -0.77 | 6.11 | -0.00 | 0.00 | 0.00 |
| 3 | 5.32 | -1.40 | 11.11 | -0.00 | 0.00 | 0.00 |
| 4 | 2.92 | -0.77 | 6.11 | 0.00 | -0.00 | -0.00 |
| 5 | 4.64 | -1.23 | 9.70 | 0.00 | -0.00 | -0.00 |
| 6 | 2.25 | -0.59 | 4.70 | -0.00 | 0.00 | 0.00 |
| 7 | 4.64 | -1.23 | 9.70 | -0.00 | 0.00 | 0.00 |
| 8 | 2.25 | -0.59 | 4.70 | 0.00 | -0.00 | -0.00 |
| 9 | 1.31 | -0.77 | 2.74 | -0.00 | -0.00 | -0.00 |
| 10 | 1.31 | -0.77 | 2.75 | 0.00 | 0.00 | 0.00 |
| 11 | 0.64 | -0.59 | 1.33 | -0.00 | -0.00 | -0.00 |
| 12 | 0.64 | -0.59 | 1.34 | 0.00 | 0.00 | 0.00 |
| 13 | 4.35 | -1.40 | 9.09 | -0.00 | -0.00 | -0.00 |
| 14 | 4.35 | -1.40 | 9.09 | 0.00 | -0.00 | 0.00 |
| 15 | 1.96 | -0.77 | 4.09 | -0.00 | -0.00 | -0.00 |
| 16 | 1.96 | -0.77 | 4.09 | 0.00 | 0.00 | 0.00 |
| 17 | 4.35 | -1.40 | 9.09 | -0.00 | -0.00 | -0.00 |
| 18 | 4.35 | -1.40 | 9.09 | 0.00 | 0.00 | 0.00 |
| 19 | 1.96 | -0.77 | 4.09 | -0.00 | -0.00 | -0.00 |
| 20 | 1.96 | -0.77 | 4.09 | 0.00 | -0.00 | -0.00 |
| 21 | 3.68 | -1.22 | 7.68 | -0.00 | -0.00 | -0.00 |
| 22 | 3.68 | -1.23 | 7.68 | 0.00 | -0.00 | -0.00 |
| 23 | 1.28 | -0.59 | 2.68 | -0.00 | -0.00 | -0.00 |
| 24 | 1.28 | -0.59 | 2.68 | 0.00 | 0.00 | 0.00 |
| 25 | 3.68 | -1.22 | 7.68 | -0.00 | -0.00 | -0.00 |
| 26 | 3.68 | -1.23 | 7.68 | 0.00 | 0.00 | 0.00 |
| 27 | 1.28 | -0.59 | 2.68 | -0.00 | -0.00 | -0.00 |
| 28 | 1.28 | -0.59 | 2.68 | 0.00 | -0.00 | -0.00 |
| 29 | 2.99 | -1.21 | 6.25 | -0.00 | -0.00 | -0.00 |
| 30 | 2.99 | -1.21 | 6.25 | 0.00 | 0.00 | 0.00 |
| 31 | 1.31 | -0.77 | 2.74 | -0.00 | -0.00 | -0.00 |
| 32 | 1.31 | -0.77 | 2.75 | 0.00 | 0.00 | 0.00 |
| 33 | 2.99 | -1.21 | 6.25 | -0.00 | -0.00 | -0.00 |
| 34 | 2.99 | -1.21 | 6.25 | 0.00 | 0.00 | 0.00 |
| 35 | 1.31 | -0.77 | 2.74 | -0.00 | -0.00 | -0.00 |
| 36 | 1.31 | -0.77 | 2.75 | 0.00 | 0.00 | 0.00 |
| 37 | 2.32 | -1.03 | 4.84 | -0.00 | -0.00 | -0.00 |
| 38 | 2.32 | -1.04 | 4.84 | 0.00 | 0.00 | 0.00 |
| 39 | 0.64 | -0.59 | 1.33 | -0.00 | -0.00 | -0.00 |
| 40 | 0.64 | -0.59 | 1.34 | 0.00 | 0.00 | 0.00 |
| 41 | 2.32 | -1.03 | 4.84 | -0.00 | -0.00 | -0.00 |
| 42 | 2.32 | -1.04 | 4.84 | 0.00 | 0.00 | 0.00 |
| 43 | 0.64 | -0.59 | 1.33 | -0.00 | -0.00 | -0.00 |
| 44 | 0.64 | -0.59 | 1.34 | 0.00 | 0.00 | 0.00 |
| 45 | 3.93 | -1.29 | 8.24 | -0.00 | 0.24 | 0.03 |
| 46 | 3.99 | -0.80 | 8.31 | 0.00 | -0.24 | -0.03 |
| 47 | 2.89 | -1.01 | 6.08 | -0.00 | 0.24 | 0.03 |
| 48 | 2.95 | -0.53 | 6.14 | -0.00 | -0.24 | -0.03 |
| 49 | 3.93 | -1.29 | 8.24 | -0.00 | 0.24 | 0.03 |
| 50 | 3.99 | -0.80 | 8.31 | -0.00 | -0.24 | -0.03 |
| 51 | 2.89 | -1.01 | 6.08 | 0.00 | 0.24 | 0.03 |
| 52 | 2.95 | -0.53 | 6.14 | 0.00 | -0.24 | -0.03 |
| 53 | 3.02 | -1.05 | 6.33 | 0.00 | 0.24 | 0.03 |
| 54 | 3.08 | -0.56 | 6.40 | 0.00 | -0.24 | -0.03 |
| 55 | 2.22 | -0.84 | 4.67 | -0.00 | 0.24 | 0.03 |
| 56 | 2.28 | -0.35 | 4.73 | -0.00 | -0.24 | -0.03 |
| 57 | 3.02 | -1.05 | 6.33 | -0.00 | 0.24 | 0.03 |
| 58 | 3.08 | -0.56 | 6.40 | -0.00 | -0.24 | -0.03 |
| 59 | 2.22 | -0.84 | 4.67 | 0.00 | 0.24 | 0.03 |
| 60 | 2.28 | -0.35 | 4.73 | 0.00 | -0.24 | -0.03 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.00 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 5.32 | 3.69 | 2.36 | 1.33 | 0.59 | 0.15 | 0.00 |

强度计算应力比 =0.065

抗剪强度计算应力比 =0.058

平面内稳定计算最大应力对应组合号: 1, M=5.32, N=-1.40, M=0.00, N=-0.00

平面内稳定最大应力 (N/mm\*mm) =18.30

平面内稳定计算最大应力比 =0.060

临界弯矩Mcr(kN\*m) =4367.18

平面外稳定计算最大应力比 =0.025

强度计算应力比 =0.065 < 1.0

抗剪强度计算应力比 =0.058 < 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 =0.025 < 1.0

腹板高厚比 H0/TW=30.67 < [H0/TW]=250.00 (GB51022-2015)

翼缘宽厚比 B/T =10.88 < [B/T] =12.20

**(恒+活)梁的挠度 mm**

| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0.00 | 0.73 | 1.46 | 2.21 | 2.96 | 3.71 | 4.46 |

最大挠度值 =4.46 最大挠度/梁跨度 =1/426.

斜梁坡度初始值: 1/7.92

变形后斜梁坡度最小值: 1/7.63

变形后斜梁坡度改变率 =0.038 < 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 | 3.05 | -0.80 | 6.37 | -0.00 | -0.00 | -0.00 |
| 2 | 2.25 | -0.59 | 4.70 | -0.00 | 0.00 | 0.00 |
| 3 | 3.05 | -0.80 | 6.37 | -0.00 | 0.00 | 0.00 |
| 4 | 2.25 | -0.59 | 4.70 | -0.00 | -0.00 | -0.00 |
| 5 | 2.82 | -0.74 | 5.90 | -0.00 | -0.00 | -0.00 |
| 6 | 2.02 | -0.53 | 4.23 | -0.00 | 0.00 | 0.00 |
| 7 | 2.82 | -0.74 | 5.90 | -0.00 | 0.00 | 0.00 |
| 8 | 2.02 | -0.53 | 4.23 | -0.00 | -0.00 | -0.00 |
| 9 | 1.82 | -0.59 | 3.80 | -0.00 | -0.00 | -0.00 |
| 10 | 1.82 | -0.59 | 3.80 | 0.00 | 0.00 | 0.00 |
| 11 | 1.59 | -0.53 | 3.33 | -0.00 | -0.00 | -0.00 |
| 12 | 1.60 | -0.53 | 3.33 | 0.00 | 0.00 | 0.00 |

--- 梁的弯矩包络(偶然组合) ---

梁下部受拉:

截面 1 2 3 4 5 6 7

弯矩 0.00 0.00 0.00 0.00 0.00 0.00 -0.00

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 3.05 2.12 1.35 0.76 0.34 0.08 0.00

强度计算荷载比 =0.04

平面内稳定计算荷载比 =0.03

平面外稳定计算荷载比 =0.01

无防护下钢构件最大升温(Ts): 1004.34℃ ,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) =0.2485(m^2\*℃/w) ,计算所需保护层厚度(di) =24.85(mm)

构件重量 (Kg)=29.95

**20、 钢 梁 10
设计结果**

截面类型=16; 布置角度=0; 计算长度： Lx=3.75, Ly=2.02

构件长度=1.87; 计算长度系数: Ux=2.00 Uy=1.08

支撑长度=2.02

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)

梁刚度放大系数: 1.0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 14.18 | 8.14 | 1.32 | -4.65 | -7.27 | 3.13 |
| 2 | 1.37 | 5.84 | 0.95 | -38.06 | -12.14 | 28.12 |
| 3 | 5.63 | 6.14 | 8.88 | -9.25 | -9.65 | 12.75 |
| 4 | 9.92 | 7.84 | -6.62 | -33.45 | -9.77 | 18.50 |
| 5 | 12.87 | 6.98 | 1.13 | -1.12 | -5.67 | 0.58 |
| 6 | 0.06 | 4.67 | 0.76 | -34.53 | -10.54 | 25.57 |
| 7 | 4.32 | 4.98 | 8.70 | -5.73 | -8.04 | 10.19 |
| 8 | 8.61 | 6.68 | -6.81 | -29.93 | -8.16 | 15.95 |
| 9 | 4.81 | 2.16 | -3.08 | -15.56 | -4.09 | 8.38 |
| 10 | 4.82 | 1.09 | 3.61 | -3.02 | -3.01 | 1.70 |
| 11 | 3.51 | 1.00 | -3.27 | -12.04 | -2.48 | 5.83 |
| 12 | 3.51 | -0.08 | 3.42 | 0.50 | -1.41 | -0.86 |
| 13 | 13.67 | 6.42 | -1.02 | -4.82 | -5.55 | 1.52 |
| 14 | 13.67 | 5.77 | 3.00 | 2.70 | -4.90 | -2.49 |
| 15 | 0.86 | 4.11 | -1.39 | -38.23 | -10.42 | 26.51 |
| 16 | 0.86 | 3.46 | 2.62 | -30.71 | -9.77 | 22.50 |
| 17 | 5.12 | 4.41 | 6.54 | -9.43 | -7.92 | 11.14 |
| 18 | 5.12 | 3.77 | 10.56 | -1.90 | -7.28 | 7.13 |
| 19 | 9.41 | 6.11 | -8.96 | -33.63 | -8.04 | 16.89 |
| 20 | 9.41 | 5.47 | -4.94 | -26.11 | -7.39 | 12.88 |
| 21 | 12.36 | 5.25 | -1.21 | -1.30 | -3.94 | -1.03 |
| 22 | 12.36 | 4.61 | 2.81 | 6.22 | -3.29 | -5.05 |
| 23 | -0.44 | 2.95 | -1.58 | -34.71 | -8.81 | 23.96 |
| 24 | -0.44 | 2.30 | 2.43 | -27.19 | -8.16 | 19.94 |
| 25 | 3.81 | 3.25 | 6.36 | -5.90 | -6.31 | 8.58 |
| 26 | 3.82 | 2.61 | 10.37 | 1.62 | -5.67 | 4.57 |
| 27 | 8.10 | 4.95 | -9.15 | -30.11 | -6.43 | 14.34 |
| 28 | 8.11 | 4.30 | -5.13 | -22.59 | -5.79 | 10.33 |
| 29 | 10.78 | 4.33 | -2.73 | -8.13 | -4.30 | 2.83 |
| 30 | 10.78 | 3.26 | 3.96 | 4.41 | -3.23 | -3.86 |
| 31 | 1.81 | 2.72 | -2.99 | -31.52 | -7.71 | 20.32 |
| 32 | 1.81 | 1.64 | 3.70 | -18.98 | -6.64 | 13.63 |
| 33 | 4.79 | 2.93 | 2.56 | -11.35 | -5.97 | 9.56 |
| 34 | 4.79 | 1.86 | 9.26 | 1.19 | -4.89 | 2.87 |
| 35 | 7.80 | 4.12 | -8.29 | -28.29 | -6.05 | 13.59 |
| 36 | 7.80 | 3.05 | -1.59 | -15.76 | -4.97 | 6.90 |
| 37 | 9.47 | 3.17 | -2.92 | -4.61 | -2.69 | 0.27 |
| 38 | 9.47 | 2.09 | 3.77 | 7.93 | -1.62 | -6.41 |
| 39 | 0.51 | 1.56 | -3.18 | -27.99 | -6.10 | 17.77 |
| 40 | 0.51 | 0.48 | 3.51 | -15.46 | -5.03 | 11.08 |
| 41 | 3.49 | 1.77 | 2.38 | -7.83 | -4.36 | 7.01 |
| 42 | 3.49 | 0.69 | 9.07 | 4.71 | -3.28 | 0.32 |
| 43 | 6.49 | 2.96 | -8.48 | -24.77 | -4.44 | 11.03 |
| 44 | 6.49 | 1.88 | -1.78 | -12.24 | -3.36 | 4.35 |
| 45 | 9.39 | 6.73 | -0.09 | -12.79 | -7.45 | 8.75 |
| 46 | 9.39 | 6.10 | 2.17 | -8.55 | -6.82 | 6.49 |
| 47 | 3.84 | 5.73 | -0.25 | -27.27 | -9.56 | 19.58 |
| 48 | 3.84 | 5.10 | 2.01 | -23.02 | -8.93 | 17.32 |
| 49 | 5.68 | 5.86 | 3.19 | -14.78 | -8.48 | 12.92 |
| 50 | 5.68 | 5.23 | 5.45 | -10.54 | -7.85 | 10.66 |
| 51 | 7.54 | 6.60 | -3.53 | -25.27 | -8.53 | 15.42 |
| 52 | 7.54 | 5.97 | -1.27 | -21.03 | -7.90 | 13.15 |
| 53 | 7.23 | 5.26 | -0.33 | -10.33 | -5.81 | 6.99 |
| 54 | 7.23 | 4.63 | 1.93 | -6.09 | -5.18 | 4.73 |
| 55 | 2.96 | 4.49 | -0.46 | -21.47 | -7.43 | 15.32 |
| 56 | 2.96 | 3.86 | 1.81 | -17.22 | -6.80 | 13.06 |
| 57 | 4.38 | 4.59 | 2.19 | -11.86 | -6.60 | 10.20 |
| 58 | 4.38 | 3.96 | 4.46 | -7.62 | -5.97 | 7.94 |
| 59 | 5.81 | 5.16 | -2.98 | -19.93 | -6.64 | 12.12 |
| 60 | 5.81 | 4.53 | -0.71 | -15.69 | -6.01 | 9.85 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -0.44 | 0.00 | -1.20 | -2.81 | -3.93 | -4.57 | -7.93 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 14.18 | 6.10 | 7.29 | 8.95 | 11.02 | 13.89 | 38.23 |

强度计算应力比 =0.474

抗剪强度计算应力比 =0.146

平面内稳定计算最大应力对应组合号: 1, M=14.18, N=8.14, M=-4.65, N=-7.27

平面内稳定最大应力 (N/mm\*mm) =132.28

平面内稳定计算最大应力比 =0.434

临界弯矩Mcr(kN\*m) =591.23

平面外稳定计算最大应力比 =0.321

强度计算应力比 =0.474 < 1.0

抗剪强度计算应力比 =0.146 < 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 =0.321 < 1.0

腹板高厚比 H0/TW=30.67 < [H0/TW]=250.00 (GB51022-2015)

翼缘宽厚比 B/T =10.88 < [B/T] =12.20

**(恒+活)梁的挠度 mm**

| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | -0.52 | -0.55 | -0.53 | -0.48 | -0.38 | -0.23 | 0.00 |

最大挠度值 =0.00 最大挠度/梁跨度 =1/100000.

斜梁坡度初始值: 1/6.17

变形后斜梁坡度最小值: 1/6.14

变形后斜梁坡度改变率 =0.005 < 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 | 7.19 | 4.91 | 0.80 | -8.20 | -5.46 | 5.87 |
| 2 | 2.92 | 4.14 | 0.67 | -19.34 | -7.09 | 14.20 |
| 3 | 4.34 | 4.25 | 3.32 | -9.74 | -6.25 | 9.07 |
| 4 | 5.77 | 4.81 | -1.85 | -17.80 | -6.29 | 10.99 |
| 5 | 6.76 | 4.53 | 0.73 | -7.03 | -4.93 | 5.02 |
| 6 | 2.49 | 3.76 | 0.61 | -18.16 | -6.55 | 13.35 |
| 7 | 3.91 | 3.86 | 3.25 | -8.56 | -5.72 | 8.22 |
| 8 | 5.34 | 4.42 | -1.91 | -16.63 | -5.76 | 10.14 |
| 9 | 4.13 | 3.11 | -0.41 | -11.82 | -4.59 | 7.80 |
| 10 | 4.13 | 2.82 | 1.37 | -8.48 | -4.31 | 6.01 |
| 11 | 3.69 | 2.72 | -0.47 | -10.65 | -4.06 | 6.95 |
| 12 | 3.69 | 2.44 | 1.31 | -7.30 | -3.77 | 5.16 |

--- 梁的弯矩包络(偶然组合) ---

梁下部受拉:

截面 1 2 3 4 5 6 7

弯矩 0.00 0.00 0.00 0.00 0.00 0.00 0.00

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 7.19 4.45 5.15 6.24 7.72 9.58 19.34

强度计算荷载比 =0.24

平面内稳定计算荷载比 =0.22

平面外稳定计算荷载比 =0.14

无防护下钢构件最大升温(Ts): 1004.34℃ ,按临界温度法求得临界温度(Td): 656.39℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2538(m^2\*℃/w) ,计算所需保护层厚度(di) =25.38(mm)

构件重量 (Kg)=58.61

风荷载作用下柱顶最大水平（X 向）位移:

节点( 2), 水平位移 dx=19.078(mm) =H /409.

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=4.545(mm) =H /1716.

梁的(恒+活)最大挠度:

梁( 2), 挠跨比 =1 /251.

风载作用下柱顶最大水平位移: H/409< 柱顶位移容许值: H/60

地震作用下柱顶最大水平位移: H/1716< 柱顶位移容许值: H/60

梁的(恒+活)最大挠跨比: 1/251< 梁的容许挠跨比: 1/240

所有钢柱的总重量 (Kg)=2871.

所有钢梁的总重量 (Kg)=3421.

钢梁与钢柱重量之和 (Kg)=6291.

**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\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\刚架简图.T)

## **2. 荷载简图**



[图12-2 恒载简图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\恒载简图.T)



[图12-3 活载简图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\活载简图.T)



[图12-4 左风1简图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\左风1简图.T)



[图12-5 右风1简图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\右风1简图.T)

## **3. 应力比图**



[图12-6 应力比图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\应力比图.T)



[图12-7 荷载比图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\荷载比图.T)



[图12-8 防火图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\防火图.T)

## **4. 内力图**



[图12-9 恒载弯矩图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\恒载弯矩图.T)



[图12-10 恒载剪力图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\恒载剪力图.T)



[图12-11 恒载轴力图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\恒载轴力图.T)



[图12-12 活载弯矩图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\活载弯矩图.T)



[图12-13 活载剪力图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\活载剪力图.T)



[图12-14 活载轴力图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\活载轴力图.T)



[图12-15 左风1弯矩图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\左风1弯矩图.T)



[图12-16 右风1弯矩图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\右风1弯矩图.T)



[图12-17 左风1剪力图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\左风1剪力图.T)



[图12-18 右风1剪力图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\右风1剪力图.T)



[图12-19 左风1轴力图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\左风1轴力图.T)



[图12-20 右风1轴力图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\右风1轴力图.T)



[图12-21 左地震弯矩图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\左地震弯矩图.T)



[图12-22 右地震弯矩图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\右地震弯矩图.T)



[图12-23 左地震剪力图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\左地震剪力图.T)



[图12-24 右地震剪力图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\右地震剪力图.T)



[图12-25 左地震轴力图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\左地震轴力图.T)



[图12-26 右地震轴力图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\右地震轴力图.T)



[图12-27 弯矩包络图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\弯矩包络图.T)



[图12-28 剪力包络图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\剪力包络图.T)



[图12-29 轴力包络图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\轴力包络图.T)

## **5. 位移图**



[图12-30 恒载位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\恒载位移图.T)



[图12-31 活载位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\活载位移图.T)



[图12-32 左风1位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\左风1位移图.T)



[图12-33 右风1位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\右风1位移图.T)



[图12-34 左地震位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\左地震位移图.T)



[图12-35 右地震位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\右地震位移图.T)



[图12-36 恒+活位移图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\恒+活位移图.T)

## **6. 挠度图**



[图12-37 (恒+活)挠度图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\(恒+活)挠度图.T)



[图12-38 (活)挠度图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\(活)挠度图.T)



[图12-39 斜梁计算坡度图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\斜梁计算坡度图.T)



[图12-40 抗风柱挠度图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\抗风柱挠度图.T)

## **7. 计算长度系数图**



[图12-41 平面内计算长度系数](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\平面内计算长度系数.T)



[图12-42 平面外计算长度系数](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ1\\CalcTemp\\平面外计算长度系数.T)