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48分46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: 22

柱数: 10

梁数: 12

支座约束数: 6

标准截面总数: 12

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 | 31.40 | 9.41 | 10 | -0.45 | 9.50 |
| 11 | 63.25 | 9.50 | 12 | 28.60 | 10.69 |
| 13 | 34.20 | 10.69 | 14 | 29.55 | 10.81 |
| 15 | 33.25 | 10.81 | 16 | 31.40 | 11.11 |
| 17 | -0.17 | 0.00 | 18 | 16.55 | 0.00 |
| 19 | 29.55 | 0.00 | 20 | 33.25 | 0.00 |
| 21 | 46.25 | 0.00 | 22 | 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 | 17 | 1 | 2 | 18 | 5 |
| 3 | 19 | 7 | 4 | 20 | 8 |
| 5 | 21 | 6 | 6 | 22 | 2 |
| 7 | 1 | 10 | 8 | 2 | 11 |
| 9 | 7 | 14 | 10 | 8 | 15 |

**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 | 7 | 9 |
| 7 | 8 | 6 | 8 | 9 | 8 |
| 9 | 12 | 14 | 10 | 14 | 16 |
| 11 | 15 | 13 | 12 | 16 | 15 |

**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 |
| 22 | 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 | 焊接组合H形截面:  H\*B1\*B2\*Tw\*T1\*T2=300\*200\*200\*6\*10\*10 |
| 6 | H形变截面:  (H1~H2)\*B1\*B2\*Tw\*T1\*T2=(500~400)\*220\*220\*6\*10\*10 |
| 7 | H形变截面:  (H1~H2)\*B1\*B2\*Tw\*T1\*T2=(400~450)\*240\*240\*6\*10\*10 |
| 8 | 焊接组合H形截面:  H\*B1\*B2\*Tw\*T1\*T2=400\*220\*220\*6\*10\*10 |
| 9 | 焊接组合H形截面:  H\*B1\*B2\*Tw\*T1\*T2=200\*200\*200\*6\*8\*8 |
| 10 | H形变截面:  (H1~H2)\*B1\*B2\*Tw\*T1\*T2=(450~400)\*240\*240\*6\*10\*10 |
| 11 | H形变截面:  (H1~H2)\*B1\*B2\*Tw\*T1\*T2=(400~500)\*220\*220\*6\*10\*10 |
| 12 | 焊接组合H形截面:  H\*B1\*B2\*Tw\*T1\*T2=200\*180\*180\*6\*8\*8 |

**柱布置截面号,约束信息,截面布置角度**

| 柱号 | 标准截面号 | 约束信息 | 截面布置角度 |
| --- | --- | --- | --- |
| 1 | 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 | 5 | 两端刚接 | 0 |
| 10 | 5 | 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 | 6 | 两端刚接 |
| 2 | 7 | 两端刚接 |
| 3 | 11 | 两端刚接 |
| 4 | 8 | 两端刚接 |
| 5 | 10 | 两端刚接 |
| 6 | 12 | 两端刚接 |
| 7 | 8 | 两端刚接 |
| 8 | 12 | 两端刚接 |
| 9 | 12 | 两端刚接 |
| 10 | 12 | 两端刚接 |
| 11 | 12 | 两端刚接 |
| 12 | 12 | 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 | 100.0 | 150.0 | 9510.9 | 1333.8 | 56.8 |
| 6 | 110.0 | 225.0 | 25275.0 | 1775.4 | 69.8 |
| 7 | 120.0 | 212.5 | 23992.5 | 2304.7 | 72.3 |
| 8 | 110.0 | 200.0 | 19478.3 | 1775.4 | 66.8 |
| 9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 | 120.0 | 212.5 | 23992.5 | 2304.7 | 72.3 |
| 11 | 110.0 | 225.0 | 25275.0 | 1775.4 | 69.8 |
| 12 | 90.0 | 100.0 | 2967.2 | 777.9 | 39.8 |

| 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 | 12.9 | 4.8 | 634.1 | 634.1 | 133.4 | 133.4 |
| 6 | 19.0 | 5.0 | 1123.3 | 1123.3 | 161.4 | 161.4 |
| 7 | 18.2 | 5.6 | 1129.1 | 1129.1 | 192.1 | 192.1 |
| 8 | 17.1 | 5.2 | 973.9 | 973.9 | 161.4 | 161.4 |
| 9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 | 18.2 | 5.6 | 1129.1 | 1129.1 | 192.1 | 192.1 |
| 11 | 19.0 | 5.0 | 1123.3 | 1123.3 | 161.4 | 161.4 |
| 12 | 8.6 | 4.4 | 296.7 | 296.7 | 86.4 | 86.4 |

**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 | 2.13 | 0.00 | 0.00 |
| 6 | 1 | 1.33 | 0.00 | 0.00 |
| 7 | 1 | 3.45 | 0.00 | 0.00 |
| 8 | 1 | 3.45 | 0.00 | 0.00 |
| 9 | 1 | 1.64 | 0.00 | 0.00 |
| 10 | 1 | 1.64 | 0.00 | 0.00 |
| 右风1 | 1 | 1 | -1.33 | 0.00 | 0.00 |
| 6 | 1 | -2.13 | 0.00 | 0.00 |
| 7 | 1 | -3.45 | 0.00 | 0.00 |
| 8 | 1 | -3.45 | 0.00 | 0.00 |
| 9 | 1 | -1.64 | 0.00 | 0.00 |
| 10 | 1 | -1.64 | 0.00 | 0.00 |

**梁荷载**

| 工况 | 连续数 | 荷载个数 | 荷载类型 | 荷载值1 | 荷载参数1 | 荷载值2 | 荷载参数2 |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 恒荷载 | 1 | 1 | 1 | 3.74 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.74 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.74 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.74 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.74 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.74 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.74 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 3.74 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 2.24 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 2.24 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 2.24 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 2.24 | 0.00 | 0.00 | 0.00 |
| 活荷载 | 1 | 1 | 1 | 2.88 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 2.88 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 2.88 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 2.88 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 2.88 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 2.88 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 2.88 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 2.88 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 1.73 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 1.73 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 1.73 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | 1.73 | 0.00 | 0.00 | 0.00 |
| 左风1 | 1 | 1 | 1 | -0.53 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -0.53 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.59 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -0.53 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.59 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.59 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.92 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.92 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.92 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.92 | 0.00 | 0.00 | 0.00 |
| 右风1 | 1 | 1 | 1 | -1.59 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.59 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -0.53 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.59 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -0.53 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -0.53 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.92 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.92 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.92 | 0.00 | 0.00 | 0.00 |
| 1 | 1 | 1 | -1.92 | 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 | 384.867 |
| 10 | 0.380 |
| 11 | 0.380 |
| 12 | 20.515 |

水平地震标准值作用底层剪力： 8.807

底层最小地震剪力(抗震规范5.2.5条): 3.249

各质点地震力调整系数: 1.000

地震力调整后剪重比： 0.022

**周期(已乘折减系数)**

| 振型号 | 周期(s) |
| --- | --- |
| 1 | 0.691 |
| 2 | 0.055 |
| 3 | 0.019 |

## **2. 右地震**

**地震力计算质量集中信息**

| 质量集中节点号 | 质量重量(KN) |
| --- | --- |
| 2 | 384.867 |
| 10 | 0.380 |
| 11 | 0.380 |
| 13 | 20.515 |

水平地震标准值作用底层剪力： 8.807

底层最小地震剪力(抗震规范5.2.5条): 3.249

各质点地震力调整系数: 1.000

地震力调整后剪重比： 0.022

**周期(已乘折减系数)**

| 振型号 | 周期(s) |
| --- | --- |
| 1 | 0.691 |
| 2 | 0.055 |
| 3 | 0.019 |

**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 | 40.9 | -13.2 | -33.9 | -36.0 | 13.2 | -69.0 |
| 2 | 76.7 | 3.5 | 10.1 | -71.4 | -3.5 | 19.9 |
| 3 | 45.3 | 1.3 | 4.0 | -40.0 | -1.3 | 7.9 |
| 4 | 45.3 | -1.3 | -4.0 | -40.0 | 1.3 | -7.9 |
| 5 | 76.7 | -3.5 | -10.1 | -71.4 | 3.5 | -19.9 |
| 6 | 40.9 | 13.2 | 33.9 | -36.0 | -13.2 | 69.0 |
| 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 | 8.2 | 15.0 | 25.8 | -7.4 | -15.0 | -3.2 |
| 10 | 8.2 | -15.0 | -25.8 | -7.4 | 15.0 | 3.2 |
| 左风1 | 1 | -5.9 | 17.7 | 50.6 | 5.9 | -1.1 | 22.6 |
| 2 | -8.3 | 5.0 | 23.4 | 8.3 | -5.0 | 20.0 |
| 3 | -10.4 | 3.7 | 18.6 | 10.4 | -3.7 | 15.7 |
| 4 | -12.0 | 4.4 | 20.8 | 12.0 | -4.4 | 20.2 |
| 5 | -26.5 | 6.7 | 28.3 | 26.5 | -6.7 | 29.7 |
| 6 | -10.8 | 7.7 | 29.0 | 10.8 | 2.6 | -9.0 |
| 7 | 0.0 | 5.9 | 5.0 | -0.0 | -0.0 | 0.0 |
| 8 | -0.0 | 5.9 | 5.0 | 0.0 | 0.0 | 0.0 |
| 9 | -6.7 | -0.9 | -7.2 | 6.7 | 3.4 | 3.9 |
| 10 | -4.0 | 5.9 | 6.1 | 4.0 | -3.4 | 0.9 |
| 右风1 | 1 | -10.8 | -7.8 | -29.1 | 10.8 | -2.6 | 9.0 |
| 2 | -26.5 | -6.7 | -28.3 | 26.5 | 6.7 | -29.7 |
| 3 | -12.0 | -4.4 | -20.8 | 12.0 | 4.4 | -20.1 |
| 4 | -10.4 | -3.7 | -18.6 | 10.4 | 3.7 | -15.7 |
| 5 | -8.2 | -5.0 | -23.4 | 8.2 | 5.0 | -20.0 |
| 6 | -5.9 | -17.7 | -50.7 | 5.9 | 1.1 | -22.5 |
| 7 | -0.0 | -5.9 | -5.0 | 0.0 | -0.0 | 0.0 |
| 8 | -0.0 | -5.9 | -5.0 | 0.0 | -0.0 | -0.0 |
| 9 | -4.1 | -5.9 | -6.0 | 4.1 | 3.4 | -0.9 |
| 10 | -6.7 | 0.9 | 7.2 | 6.7 | -3.4 | -4.0 |
| 左地震 | 1 | -0.6 | 2.0 | 9.5 | 0.6 | -2.0 | 6.0 |
| 2 | 0.2 | 1.6 | 7.0 | -0.2 | -1.6 | 6.5 |
| 3 | -0.9 | 1.1 | 5.4 | 0.9 | -1.1 | 4.6 |
| 4 | 0.9 | 1.1 | 5.4 | -0.9 | -1.1 | 4.6 |
| 5 | -0.2 | 1.6 | 7.0 | 0.2 | -1.6 | 6.5 |
| 6 | 0.6 | 2.0 | 9.5 | -0.6 | -2.0 | 6.0 |
| 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 | -0.5 | 0.2 | -0.6 | 0.5 | -0.2 | 0.9 |
| 10 | 0.5 | 0.2 | -0.6 | -0.5 | -0.2 | 0.9 |
| 右地震 | 1 | 0.6 | -2.0 | -9.5 | -0.6 | 2.0 | -6.0 |
| 2 | -0.2 | -1.6 | -7.0 | 0.2 | 1.6 | -6.5 |
| 3 | 0.9 | -1.1 | -5.4 | -0.9 | 1.1 | -4.6 |
| 4 | -0.9 | -1.1 | -5.4 | 0.9 | 1.1 | -4.6 |
| 5 | 0.2 | -1.6 | -7.0 | -0.2 | 1.6 | -6.5 |
| 6 | -0.6 | -2.0 | -9.5 | 0.6 | 2.0 | -6.0 |
| 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 | 0.5 | -0.2 | 0.6 | -0.5 | 0.2 | -0.9 |
| 10 | -0.5 | -0.2 | 0.6 | 0.5 | 0.2 | -0.9 |

**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 | 14.9 | 34.5 | 69.2 | -13.7 | -9.2 | 56.5 |
| 2 | 13.7 | 9.2 | -56.5 | -11.2 | 39.3 | -109.1 |
| 3 | 13.7 | -9.2 | -56.5 | -14.9 | 34.5 | -69.2 |
| 4 | 11.4 | 32.2 | 89.2 | -8.5 | 24.6 | -40.0 |
| 5 | 11.2 | 39.3 | 109.1 | -13.7 | 9.2 | 56.5 |
| 6 | 23.8 | 6.3 | 6.3 | -23.4 | 1.3 | -1.7 |
| 7 | 8.5 | 24.6 | 40.0 | -11.4 | 32.2 | -89.2 |
| 8 | 23.4 | 1.3 | 1.7 | -23.8 | 6.3 | -6.3 |
| 9 | 0.0 | -0.0 | -0.0 | 0.3 | 2.5 | -1.2 |
| 10 | -14.0 | 7.2 | 4.4 | 14.8 | -2.4 | 4.6 |
| 11 | -0.3 | 2.5 | 1.2 | 0.0 | 0.0 | -0.0 |
| 12 | -14.8 | -2.4 | -4.6 | 14.0 | 7.2 | -4.4 |
| 左风1 | 1 | 4.5 | -6.1 | -27.6 | -4.5 | 3.1 | 1.1 |
| 2 | 4.5 | -3.1 | -1.1 | -4.5 | -2.7 | -0.9 |
| 3 | -9.0 | 1.2 | 29.2 | 9.0 | -10.4 | 4.0 |
| 4 | -1.0 | -5.2 | -19.2 | 1.0 | -1.7 | -4.1 |
| 5 | -9.0 | -16.4 | -54.3 | 9.0 | -1.2 | -29.2 |
| 6 | -5.8 | -1.8 | -4.3 | 5.8 | 1.8 | 1.1 |
| 7 | -3.7 | -10.2 | -22.9 | 3.7 | -10.5 | 24.6 |
| 8 | -5.5 | -2.4 | -1.1 | 5.5 | 2.4 | -3.4 |
| 9 | -0.0 | 0.0 | 0.0 | 0.0 | -1.8 | 0.9 |
| 10 | 2.4 | -5.3 | -4.8 | -2.4 | 1.7 | -1.8 |
| 11 | -0.0 | -1.8 | -0.9 | 0.0 | -0.0 | -0.0 |
| 12 | 2.8 | -0.9 | 1.8 | -2.8 | -2.7 | -0.0 |
| 右风1 | 1 | -9.0 | -10.3 | -4.0 | 9.0 | 1.2 | -29.1 |
| 2 | -9.0 | -1.2 | 29.1 | 9.0 | -16.3 | 54.2 |
| 3 | 4.5 | 3.1 | -1.1 | -4.5 | -6.1 | 27.5 |
| 4 | -3.7 | -10.5 | -24.6 | 3.7 | -10.2 | 22.8 |
| 5 | 4.5 | -2.7 | 0.9 | -4.5 | -3.1 | 1.1 |
| 6 | -5.5 | 2.4 | 3.4 | 5.5 | -2.4 | 1.1 |
| 7 | -0.9 | -1.7 | 4.1 | 0.9 | -5.2 | 19.2 |
| 8 | -5.7 | 1.8 | -1.1 | 5.7 | -1.8 | 4.4 |
| 9 | -0.0 | -0.0 | 0.0 | 0.0 | -1.8 | 0.9 |
| 10 | 2.8 | -2.7 | 0.0 | -2.8 | -0.9 | -1.8 |
| 11 | 0.0 | -1.8 | -0.9 | -0.0 | 0.0 | -0.0 |
| 12 | 2.3 | 1.7 | 1.8 | -2.3 | -5.3 | 4.8 |
| 左地震 | 1 | -1.0 | -0.6 | -6.0 | 1.0 | 0.6 | 2.7 |
| 2 | -0.1 | -0.6 | -2.7 | 0.1 | 0.6 | -4.3 |
| 3 | 1.0 | -0.6 | 2.7 | -1.0 | 0.6 | -6.0 |
| 4 | -0.6 | -0.4 | -2.2 | 0.6 | 0.4 | -2.6 |
| 5 | 0.1 | -0.6 | -4.3 | -0.1 | 0.6 | -2.7 |
| 6 | -0.5 | -0.8 | -1.5 | 0.5 | 0.8 | -0.0 |
| 7 | 0.6 | -0.4 | -2.6 | -0.6 | 0.4 | -2.2 |
| 8 | 0.5 | -0.8 | 0.0 | -0.5 | 0.8 | -1.5 |
| 9 | 0.1 | -0.0 | 0.0 | -0.1 | 0.0 | -0.0 |
| 10 | -0.1 | -0.5 | -0.9 | 0.1 | 0.5 | -0.0 |
| 11 | -0.1 | -0.0 | -0.0 | 0.1 | 0.0 | -0.0 |
| 12 | 0.1 | -0.5 | 0.0 | -0.1 | 0.5 | -0.9 |
| 右地震 | 1 | 1.0 | 0.6 | 6.0 | -1.0 | -0.6 | -2.7 |
| 2 | 0.1 | 0.6 | 2.7 | -0.1 | -0.6 | 4.3 |
| 3 | -1.0 | 0.6 | -2.7 | 1.0 | -0.6 | 6.0 |
| 4 | 0.6 | 0.4 | 2.2 | -0.6 | -0.4 | 2.6 |
| 5 | -0.1 | 0.6 | 4.3 | 0.1 | -0.6 | 2.7 |
| 6 | 0.5 | 0.8 | 1.5 | -0.5 | -0.8 | -0.0 |
| 7 | -0.6 | 0.4 | 2.6 | 0.6 | -0.4 | 2.2 |
| 8 | -0.5 | 0.8 | 0.0 | 0.5 | -0.8 | 1.5 |
| 9 | -0.1 | 0.0 | 0.0 | 0.1 | -0.0 | 0.0 |
| 10 | 0.1 | 0.5 | 0.9 | -0.1 | -0.5 | -0.0 |
| 11 | 0.1 | 0.0 | 0.0 | -0.1 | -0.0 | 0.0 |
| 12 | -0.1 | 0.5 | 0.0 | 0.1 | -0.5 | 0.9 |

**9. 节点位移**

**恒荷载工况下节点位移（mm）**

| 节点号 | X向位移 | Y向位移 |
| --- | --- | --- |
| 1 | 0.39 | 0.21 |
| 2 | -0.39 | 0.21 |
| 3 | 1.71 | 27.90 |
| 4 | -1.71 | 27.90 |
| 5 | 0.19 | 0.48 |
| 6 | -0.19 | 0.48 |
| 7 | 0.09 | 0.32 |
| 8 | -0.08 | 0.32 |
| 9 | 0.00 | -0.25 |
| 10 | 7.59 | 0.22 |
| 11 | -7.59 | 0.22 |
| 12 | -0.17 | 0.12 |
| 13 | 0.17 | 0.12 |
| 14 | -0.14 | 0.33 |
| 15 | 0.14 | 0.33 |
| 16 | 0.00 | 0.99 |

**活荷载工况下节点位移（mm）**

| 节点号 | X向位移 | Y向位移 |
| --- | --- | --- |
| 1 | 0.25 | 0.14 |
| 2 | -0.25 | 0.14 |
| 3 | 1.11 | 21.44 |
| 4 | -1.11 | 21.44 |
| 5 | 0.12 | 0.31 |
| 6 | -0.12 | 0.31 |
| 7 | 0.06 | 0.27 |
| 8 | -0.06 | 0.27 |
| 9 | 0.00 | 0.58 |
| 10 | 4.95 | 0.14 |
| 11 | -4.95 | 0.14 |
| 12 | -0.11 | 0.83 |
| 13 | 0.11 | 0.83 |
| 14 | -0.09 | 0.28 |
| 15 | 0.09 | 0.28 |
| 16 | 0.00 | 0.82 |

**节点侧向（水平向）位移(mm)**

| 工况 | 节点 | δx | 节点 | δx |
| --- | --- | --- | --- | --- |
| 左风1 | 1 | 14.56 | 2 | 14.74 |
| 3 | 14.53 | 4 | 15.37 |
| 5 | 14.51 | 6 | 14.61 |
| 7 | 14.52 | 8 | 14.57 |
| 9 | 14.55 | 10 | 16.39 |
| 11 | 20.29 | 12 | 15.06 |
| 13 | 14.96 | 14 | 15.09 |
| 15 | 14.99 | 16 | 15.04 |
| 17 | 0.00 | 18 | 0.00 |
| 19 | 0.00 | 20 | 0.00 |
| 21 | 0.00 | 22 | 0.00 |
| 右风1 | 1 | -14.74 | 2 | -14.56 |
| 3 | -15.37 | 4 | -14.53 |
| 5 | -14.61 | 6 | -14.51 |
| 7 | -14.57 | 8 | -14.52 |
| 9 | -14.54 | 10 | -20.28 |
| 11 | -16.39 | 12 | -14.95 |
| 13 | -15.06 | 14 | -14.99 |
| 15 | -15.09 | 16 | -15.04 |
| 17 | 0.00 | 18 | 0.00 |
| 19 | 0.00 | 20 | 0.00 |
| 21 | 0.00 | 22 | 0.00 |
| 左地震 | 1 | 4.11 | 2 | 4.11 |
| 3 | 4.16 | 4 | 4.16 |
| 5 | 4.11 | 6 | 4.11 |
| 7 | 4.11 | 8 | 4.11 |
| 9 | 4.11 | 10 | 4.84 |
| 11 | 4.84 | 12 | 4.30 |
| 13 | 4.30 | 14 | 4.31 |
| 15 | 4.31 | 16 | 4.31 |
| 17 | 0.00 | 18 | 0.00 |
| 19 | 0.00 | 20 | 0.00 |
| 21 | 0.00 | 22 | 0.00 |
| 右地震 | 1 | -4.11 | 2 | -4.11 |
| 3 | -4.16 | 4 | -4.16 |
| 5 | -4.11 | 6 | -4.11 |
| 7 | -4.11 | 8 | -4.11 |
| 9 | -4.11 | 10 | -4.84 |
| 11 | -4.84 | 12 | -4.30 |
| 13 | -4.30 | 14 | -4.31 |
| 15 | -4.31 | 16 | -4.31 |
| 17 | 0.00 | 18 | 0.00 |
| 19 | 0.00 | 20 | 0.00 |
| 21 | 0.00 | 22 | 0.00 |

**10. 构件设计结果汇总**

**钢柱验算结果**

| 柱号 | 应力比 | 剪应力比 | 平面内稳定 | 平面外稳定 | 腹板高厚比 | 翼缘宽厚比 | 平面内长细比 | 平面外长细比 | 质量(kg) | 状态 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 0.70 | 0.11 | 0.68 | 0.80 | 55.00 | 11.70 | 70.00 | 133.79 | 415.4 | 通过 |
| 2 | 0.48 | 0.06 | 0.54 | 0.63 | 46.67 | 11.70 | 76.82 | 145.20 | 440.5 | 通过 |
| 3 | 0.25 | 0.03 | 0.29 | 0.46 | 46.67 | 10.70 | 82.05 | 172.34 | 444.4 | 通过 |
| 4 | 0.25 | 0.03 | 0.29 | 0.46 | 46.67 | 10.70 | 82.05 | 172.34 | 444.4 | 通过 |
| 5 | 0.48 | 0.06 | 0.54 | 0.63 | 46.67 | 11.70 | 76.82 | 145.20 | 440.5 | 通过 |
| 6 | 0.70 | 0.11 | 0.68 | 0.80 | 55.00 | 11.70 | 70.00 | 133.79 | 415.4 | 通过 |
| 7 | 0.08 | 0.05 | 0.07 | 0.03 | 30.00 | 8.70 | 39.58 | 37.30 | 63.3 | 通过 |
| 8 | 0.08 | 0.05 | 0.07 | 0.03 | 30.00 | 8.70 | 39.58 | 37.30 | 63.3 | 通过 |
| 9 | 0.44 | 0.16 | 0.44 | 0.28 | 46.67 | 9.70 | 178.67 | 31.02 | 67.0 | 通过 |
| 10 | 0.44 | 0.16 | 0.44 | 0.28 | 46.67 | 9.70 | 178.67 | 31.02 | 67.0 | 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 | 0.52 | 0.23 | 0.46 | 0.28 | 71.67 | 10.70 | 315.0 | 通过 |
| 2 | 0.78 | 0.25 | 0.73 | 0.57 | 67.50 | 11.70 | 624.2 | 通过 |
| 3 | 0.52 | 0.23 | 0.46 | 0.28 | 71.67 | 10.70 | 315.0 | 通过 |
| 4 | 0.78 | 0.20 | 0.72 | 0.72 | 63.33 | 10.70 | 682.6 | 通过 |
| 5 | 0.78 | 0.25 | 0.73 | 0.57 | 67.50 | 11.70 | 624.2 | 通过 |
| 6 | 0.40 | 0.13 | 0.38 | 0.27 | 30.67 | 10.88 | 57.9 | 通过 |
| 7 | 0.78 | 0.20 | 0.72 | 0.72 | 63.33 | 10.70 | 682.6 | 通过 |
| 8 | 0.40 | 0.13 | 0.38 | 0.27 | 30.67 | 10.88 | 57.9 | 通过 |
| 9 | 0.03 | 0.03 | 0.03 | 0.01 | 30.67 | 10.88 | 29.9 | 通过 |
| 10 | 0.21 | 0.10 | 0.24 | 0.13 | 30.67 | 10.88 | 58.6 | 通过 |
| 11 | 0.03 | 0.03 | 0.03 | 0.01 | 30.67 | 10.88 | 29.9 | 通过 |
| 12 | 0.21 | 0.10 | 0.24 | 0.13 | 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 | -39.92 | 51.34 | -15.62 | -81.87 | -44.85 | 15.62 |
| 2 | -81.31 | 89.53 | -31.57 | -164.98 | -83.06 | 31.58 |
| 3 | -80.59 | 89.55 | -31.45 | -164.73 | -83.07 | 31.45 |
| 4 | -40.64 | 51.32 | -15.74 | -82.13 | -44.84 | 15.74 |
| 5 | -29.76 | 39.05 | -11.66 | -61.18 | -34.06 | 11.66 |
| 6 | -71.14 | 77.25 | -27.62 | -144.28 | -72.27 | 27.62 |
| 7 | -70.43 | 77.26 | -27.50 | -144.03 | -72.28 | 27.50 |
| 8 | -30.47 | 39.04 | -11.78 | -61.43 | -34.05 | 11.78 |
| 9 | 31.90 | 44.36 | 9.37 | -55.82 | -37.88 | 15.50 |
| 10 | -87.68 | 37.08 | -28.79 | -76.23 | -30.60 | 13.23 |
| 11 | 42.07 | 32.08 | 13.32 | -35.13 | -27.09 | 11.54 |
| 12 | -77.51 | 24.80 | -24.84 | -55.53 | -19.81 | 9.28 |
| 13 | 5.65 | 46.02 | 0.29 | -61.56 | -39.53 | 14.63 |
| 14 | -66.10 | 41.65 | -22.61 | -73.80 | -35.16 | 13.27 |
| 15 | -35.74 | 84.21 | -15.67 | -144.66 | -77.74 | 30.59 |
| 16 | -107.49 | 79.84 | -38.56 | -156.91 | -73.37 | 29.23 |
| 17 | -35.02 | 84.23 | -15.55 | -144.41 | -77.75 | 30.46 |
| 18 | -106.77 | 79.86 | -38.44 | -156.65 | -73.38 | 29.10 |
| 19 | 4.93 | 46.00 | 0.17 | -61.81 | -39.52 | 14.75 |
| 20 | -66.82 | 41.63 | -22.73 | -74.05 | -35.15 | 13.39 |
| 21 | 15.81 | 33.74 | 4.24 | -40.86 | -28.74 | 10.67 |
| 22 | -55.94 | 29.37 | -18.65 | -53.10 | -24.37 | 9.31 |
| 23 | -25.57 | 71.93 | -11.71 | -123.97 | -66.95 | 26.63 |
| 24 | -97.32 | 67.56 | -34.60 | -136.21 | -62.58 | 25.27 |
| 25 | -24.86 | 71.95 | -11.59 | -123.71 | -66.96 | 26.51 |
| 26 | -96.61 | 67.58 | -34.48 | -135.96 | -62.59 | 25.15 |
| 27 | 15.10 | 33.72 | 4.12 | -41.11 | -28.74 | 10.79 |
| 28 | -56.65 | 29.35 | -18.77 | -53.35 | -24.37 | 9.44 |
| 29 | 34.79 | 43.04 | 10.43 | -50.35 | -36.55 | 14.43 |
| 30 | -84.79 | 35.76 | -27.73 | -70.76 | -29.27 | 12.16 |
| 31 | 5.82 | 69.77 | -0.73 | -108.53 | -63.30 | 25.60 |
| 32 | -113.76 | 62.49 | -38.89 | -128.93 | -56.02 | 23.33 |
| 33 | 6.32 | 69.79 | -0.65 | -108.35 | -63.31 | 25.51 |
| 34 | -113.26 | 62.50 | -38.81 | -128.76 | -56.02 | 23.25 |
| 35 | 34.29 | 43.03 | 10.35 | -50.53 | -36.55 | 14.51 |
| 36 | -85.29 | 35.75 | -27.81 | -70.93 | -29.27 | 12.25 |
| 37 | 44.95 | 30.76 | 14.39 | -29.66 | -25.77 | 10.47 |
| 38 | -74.63 | 23.47 | -23.77 | -50.06 | -18.48 | 8.21 |
| 39 | 15.98 | 57.49 | 3.22 | -87.83 | -52.51 | 21.64 |
| 40 | -103.60 | 50.21 | -34.94 | -108.24 | -45.23 | 19.38 |
| 41 | 16.48 | 57.50 | 3.31 | -87.66 | -52.52 | 21.56 |
| 42 | -103.10 | 50.22 | -34.85 | -108.06 | -45.24 | 19.29 |
| 43 | 44.45 | 30.75 | 14.31 | -29.83 | -25.76 | 10.56 |
| 44 | -75.13 | 23.46 | -23.85 | -50.24 | -18.48 | 8.29 |
| 45 | -28.92 | 51.52 | -13.70 | -77.93 | -45.04 | 13.70 |
| 46 | -55.60 | 53.29 | -19.27 | -94.68 | -46.80 | 19.27 |
| 47 | -46.86 | 68.07 | -20.61 | -113.94 | -61.60 | 20.61 |
| 48 | -73.53 | 69.84 | -26.18 | -130.69 | -63.36 | 26.18 |
| 49 | -46.55 | 68.08 | -20.56 | -113.83 | -61.60 | 20.56 |
| 50 | -73.22 | 69.85 | -26.13 | -130.58 | -63.37 | 26.13 |
| 51 | -29.23 | 51.51 | -13.75 | -78.04 | -45.03 | 13.75 |
| 52 | -55.91 | 53.28 | -19.32 | -94.78 | -46.80 | 19.32 |
| 53 | -19.17 | 39.43 | -9.90 | -58.01 | -34.44 | 9.90 |
| 54 | -45.84 | 41.20 | -15.46 | -74.76 | -36.21 | 15.46 |
| 55 | -32.97 | 52.16 | -15.21 | -85.71 | -47.18 | 15.22 |
| 56 | -59.64 | 53.93 | -20.78 | -102.46 | -48.94 | 20.78 |
| 57 | -32.73 | 52.16 | -15.17 | -85.63 | -47.18 | 15.17 |
| 58 | -59.40 | 53.93 | -20.74 | -102.38 | -48.95 | 20.74 |
| 59 | -19.41 | 39.42 | -9.94 | -58.10 | -34.44 | 9.94 |
| 60 | -46.08 | 41.19 | -15.50 | -74.84 | -36.21 | 15.50 |

强度计算控制组合号: 2, M=-81.31, N=89.53, M=-164.98, N=-83.06

强度计算应力比 =0.699

抗剪强度计算控制组合号: 32, V=-38.89

抗剪强度计算应力比 =0.112

平面内稳定计算最大应力对应组合号: 2, M=-81.31, N=89.53, M=-164.98, N=-83.06

平面内稳定计算最大应力 (N/mm\*mm) =208.73

平面内稳定计算最大应力比 =0.684

平面外稳定计算最大应力对应组合号: 17, M=-35.02, N=84.23, M=-144.41, N=-77.75

临界弯矩Mcr(kN\*m) =371.12

平面外稳定计算最大应力比 =0.797

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 =0.699 < 1.0

抗剪强度计算应力比 =0.112 < 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 | -32.51 | 40.31 | -12.68 | -66.39 | -35.32 | 12.68 |
| 2 | -46.30 | 53.04 | -18.00 | -94.09 | -48.06 | 18.00 |
| 3 | -46.06 | 53.05 | -17.96 | -94.00 | -48.06 | 17.96 |
| 4 | -32.75 | 40.31 | -12.72 | -66.47 | -35.32 | 12.72 |
| 5 | -29.12 | 36.22 | -11.36 | -59.49 | -31.73 | 11.36 |
| 6 | -42.91 | 48.95 | -16.68 | -87.19 | -44.47 | 16.68 |
| 7 | -42.68 | 48.95 | -16.64 | -87.10 | -44.47 | 16.64 |
| 8 | -29.36 | 36.21 | -11.40 | -59.57 | -31.73 | 11.40 |
| 9 | -13.63 | 38.58 | -6.12 | -59.96 | -33.59 | 12.75 |
| 10 | -45.52 | 36.64 | -16.29 | -65.40 | -31.65 | 12.15 |
| 11 | -10.24 | 34.48 | -4.80 | -53.06 | -30.00 | 11.43 |
| 12 | -42.13 | 32.54 | -14.98 | -58.50 | -28.05 | 10.83 |

防火设计控制的偶然组合号: 2, M=-46.30, N=53.04, M=-94.09, N=-48.06

强度计算荷载比 =0.39

平面内稳定计算荷载比 =0.39

平面外稳定计算荷载比 =0.38

无防护下钢构件最大升温(Ts): 1081.77℃ ,按临界温度法求得临界温度(Td): 616.75℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4715(m^2\*℃/w) ,计算所需保护层厚度(di) =47.15(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 | 40.91 | 140.14 | 13.25 | 73.82 | -133.27 | -13.25 |
| 2 | -4.83 | 129.31 | -0.89 | -2.90 | -122.44 | 0.89 |
| 3 | 25.16 | 170.43 | 8.29 | 46.63 | -163.56 | -8.29 |
| 4 | 10.92 | 99.02 | 4.07 | 24.29 | -92.15 | -4.07 |
| 5 | 37.88 | 117.13 | 12.21 | 67.86 | -111.85 | -12.21 |
| 6 | -7.87 | 106.30 | -1.93 | -8.87 | -101.01 | 1.93 |
| 7 | 22.13 | 147.42 | 7.25 | 40.67 | -142.14 | -7.25 |
| 8 | 7.88 | 76.01 | 3.03 | 18.32 | -70.72 | -3.03 |
| 9 | 48.26 | 87.31 | 12.03 | 55.91 | -80.44 | -12.03 |
| 10 | -29.31 | 59.99 | -5.54 | -18.64 | -53.12 | 5.54 |
| 11 | 45.23 | 64.30 | 10.99 | 49.95 | -59.01 | -10.99 |
| 12 | -32.35 | 36.98 | -6.58 | -24.61 | -31.70 | 6.58 |
| 13 | 61.98 | 132.70 | 17.77 | 91.86 | -125.83 | -17.77 |
| 14 | 15.43 | 116.31 | 7.22 | 47.12 | -109.44 | -7.22 |
| 15 | 16.23 | 121.87 | 3.62 | 15.13 | -115.00 | -3.62 |
| 16 | -30.31 | 105.48 | -6.92 | -29.60 | -98.60 | 6.92 |
| 17 | 46.23 | 162.99 | 12.81 | 64.67 | -156.12 | -12.81 |
| 18 | -0.32 | 146.60 | 2.27 | 19.93 | -139.73 | -2.27 |
| 19 | 31.98 | 91.58 | 8.58 | 42.32 | -84.71 | -8.58 |
| 20 | -14.56 | 75.19 | -1.96 | -2.41 | -68.32 | 1.96 |
| 21 | 58.94 | 109.69 | 16.73 | 85.89 | -104.41 | -16.73 |
| 22 | 12.40 | 93.30 | 6.18 | 41.16 | -88.01 | -6.18 |
| 23 | 13.20 | 98.86 | 2.58 | 9.17 | -93.57 | -2.58 |
| 24 | -33.35 | 82.47 | -7.96 | -35.57 | -77.18 | 7.96 |
| 25 | 43.19 | 139.98 | 11.77 | 58.70 | -134.69 | -11.77 |
| 26 | -3.35 | 123.59 | 1.23 | 13.97 | -118.30 | -1.23 |
| 27 | 28.95 | 68.57 | 7.54 | 36.36 | -63.28 | -7.54 |
| 28 | -17.60 | 52.18 | -3.00 | -8.38 | -46.89 | 3.00 |
| 29 | 67.69 | 115.61 | 18.15 | 89.49 | -108.74 | -18.15 |
| 30 | -9.88 | 88.29 | 0.58 | 14.94 | -81.42 | -0.58 |
| 31 | 35.67 | 108.03 | 8.25 | 35.78 | -101.16 | -8.25 |
| 32 | -41.90 | 80.71 | -9.32 | -38.77 | -73.84 | 9.32 |
| 33 | 56.67 | 136.81 | 14.68 | 70.46 | -129.94 | -14.68 |
| 34 | -20.91 | 109.49 | -2.89 | -4.10 | -102.62 | 2.89 |
| 35 | 46.70 | 86.83 | 11.72 | 54.82 | -79.96 | -11.72 |
| 36 | -30.88 | 59.51 | -5.85 | -19.74 | -52.64 | 5.85 |
| 37 | 64.66 | 92.60 | 17.11 | 83.52 | -87.32 | -17.11 |
| 38 | -12.92 | 65.28 | -0.46 | 8.97 | -60.00 | 0.46 |
| 39 | 32.64 | 85.02 | 7.21 | 29.82 | -79.73 | -7.21 |
| 40 | -44.94 | 57.70 | -10.36 | -44.74 | -52.41 | 10.36 |
| 41 | 53.63 | 113.80 | 13.64 | 64.49 | -108.52 | -13.64 |
| 42 | -23.94 | 86.48 | -3.93 | -10.06 | -81.20 | 3.93 |
| 43 | 43.66 | 63.82 | 10.68 | 48.85 | -58.53 | -10.68 |
| 44 | -33.91 | 36.50 | -6.89 | -25.70 | -31.21 | 6.89 |
| 45 | 35.03 | 117.56 | 10.48 | 55.72 | -110.69 | -10.48 |
| 46 | 15.33 | 116.91 | 6.11 | 37.56 | -110.04 | -6.11 |
| 47 | 15.20 | 112.86 | 4.35 | 22.47 | -105.99 | -4.35 |
| 48 | -4.49 | 112.22 | -0.02 | 4.31 | -105.34 | 0.02 |
| 49 | 28.20 | 130.68 | 8.33 | 43.94 | -123.81 | -8.33 |
| 50 | 8.51 | 130.04 | 3.96 | 25.78 | -123.16 | -3.96 |
| 51 | 22.03 | 99.74 | 6.50 | 34.26 | -92.87 | -6.50 |
| 52 | 2.34 | 99.09 | 2.13 | 16.09 | -92.22 | -2.13 |
| 53 | 29.22 | 90.50 | 8.57 | 44.96 | -85.22 | -8.57 |
| 54 | 9.52 | 89.86 | 4.19 | 26.79 | -84.57 | -4.19 |
| 55 | 13.97 | 86.89 | 3.85 | 19.38 | -81.61 | -3.85 |
| 56 | -5.73 | 86.25 | -0.52 | 1.22 | -80.96 | 0.52 |
| 57 | 23.97 | 100.60 | 6.91 | 35.90 | -95.31 | -6.91 |
| 58 | 4.27 | 99.95 | 2.54 | 17.73 | -94.67 | -2.54 |
| 59 | 19.22 | 76.80 | 5.50 | 28.45 | -71.51 | -5.50 |
| 60 | -0.47 | 76.15 | 1.13 | 10.28 | -70.86 | -1.13 |

强度计算控制组合号: 13, M=61.98, N=132.70, M=91.86, N=-125.83

强度计算应力比 =0.479

抗剪强度计算控制组合号: 29, V=18.15

抗剪强度计算应力比 =0.062

平面内稳定计算最大应力对应组合号: 13, M=61.98, N=132.70, M=91.86, N=-125.83

平面内稳定计算最大应力 (N/mm\*mm) =163.27

平面内稳定计算最大应力比 =0.535

临界弯矩Mcr(kN\*m) =359.36

平面外稳定计算最大应力比 =0.629

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 =0.479 < 1.0

抗剪强度计算应力比 =0.062 < 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 | 19.37 | 90.18 | 6.38 | 35.88 | -84.89 | -6.38 |
| 2 | 4.12 | 86.57 | 1.67 | 10.30 | -81.28 | -1.67 |
| 3 | 14.12 | 100.28 | 4.73 | 26.81 | -94.99 | -4.73 |
| 4 | 9.37 | 76.47 | 3.32 | 19.37 | -71.19 | -3.32 |
| 5 | 18.36 | 82.51 | 6.03 | 33.89 | -77.75 | -6.03 |
| 6 | 3.11 | 78.90 | 1.32 | 8.31 | -74.14 | -1.32 |
| 7 | 13.11 | 92.61 | 4.38 | 24.82 | -87.85 | -4.38 |
| 8 | 8.36 | 68.80 | 2.97 | 17.38 | -64.04 | -2.97 |
| 9 | 19.48 | 73.40 | 5.47 | 27.90 | -68.11 | -5.47 |
| 10 | -1.21 | 66.11 | 0.79 | 8.02 | -60.82 | -0.79 |
| 11 | 18.47 | 65.73 | 5.13 | 25.91 | -60.97 | -5.13 |
| 12 | -2.22 | 58.44 | 0.44 | 6.03 | -53.68 | -0.44 |

防火设计控制的偶然组合号: 1, M=19.37, N=90.18, M=35.88, N=-84.89

强度计算荷载比 =0.18

平面内稳定计算荷载比 =0.24

平面外稳定计算荷载比 =0.30

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): 648.88℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4243(m^2\*℃/w) ,计算所需保护层厚度(di) =42.43(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=10.71, Ly=9.31; 长细比：λx=82.0,λy=172.3

构件长度=9.31; 计算长度系数: Ux=1.15 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 | 15.30 | 94.79 | 4.37 | 27.30 | -94.18 | -4.54 |
| 2 | -0.86 | 62.31 | 0.24 | 1.12 | -49.05 | -0.06 |
| 3 | 8.11 | 113.97 | 3.22 | 21.88 | -107.03 | -3.22 |
| 4 | 6.32 | 43.14 | 1.38 | 6.54 | -36.20 | -1.38 |
| 5 | 14.09 | 81.19 | 3.98 | 24.92 | -82.18 | -4.15 |
| 6 | -2.07 | 48.71 | -0.15 | -1.25 | -37.05 | 0.32 |
| 7 | 6.90 | 100.36 | 2.84 | 19.50 | -95.03 | -2.84 |
| 8 | 5.12 | 29.54 | 1.00 | 4.17 | -24.20 | -1.00 |
| 9 | 33.08 | 43.38 | 7.19 | 33.85 | -36.44 | -7.19 |
| 10 | -26.00 | 40.95 | -4.93 | -19.91 | -34.01 | 4.93 |
| 11 | 31.87 | 29.77 | 6.80 | 31.48 | -24.44 | -6.80 |
| 12 | -27.21 | 27.35 | -5.32 | -22.29 | -22.01 | 5.32 |
| 13 | 32.00 | 85.45 | 7.68 | 41.43 | -84.85 | -7.85 |
| 14 | -3.44 | 83.99 | 0.41 | 9.17 | -83.39 | -0.58 |
| 15 | 15.85 | 52.98 | 3.55 | 15.25 | -39.71 | -3.37 |
| 16 | -19.60 | 51.52 | -3.72 | -17.01 | -38.26 | 3.90 |
| 17 | 24.82 | 104.63 | 6.53 | 36.01 | -97.69 | -6.53 |
| 18 | -10.63 | 103.17 | -0.74 | 3.75 | -96.24 | 0.74 |
| 19 | 23.03 | 33.80 | 4.69 | 20.67 | -26.87 | -4.69 |
| 20 | -12.42 | 32.34 | -2.58 | -11.59 | -25.41 | 2.58 |
| 21 | 30.79 | 71.85 | 7.29 | 39.05 | -72.84 | -7.47 |
| 22 | -4.65 | 70.39 | 0.02 | 6.79 | -71.39 | -0.20 |
| 23 | 14.64 | 39.38 | 3.16 | 12.88 | -27.71 | -2.99 |
| 24 | -20.81 | 37.92 | -4.11 | -19.39 | -26.26 | 4.28 |
| 25 | 23.61 | 91.03 | 6.15 | 33.63 | -85.69 | -6.15 |
| 26 | -11.84 | 89.57 | -1.12 | 1.37 | -84.24 | 1.12 |
| 27 | 21.82 | 20.20 | 4.31 | 18.30 | -14.86 | -4.31 |
| 28 | -13.63 | 18.74 | -2.96 | -13.97 | -13.41 | 2.96 |
| 29 | 40.12 | 68.47 | 9.08 | 45.75 | -65.97 | -9.20 |
| 30 | -18.96 | 66.04 | -3.04 | -8.02 | -63.54 | 2.92 |
| 31 | 28.81 | 45.74 | 6.19 | 27.43 | -34.37 | -6.06 |
| 32 | -30.27 | 43.31 | -5.93 | -26.34 | -31.95 | 6.06 |
| 33 | 35.09 | 81.89 | 8.27 | 41.96 | -74.96 | -8.27 |
| 34 | -23.99 | 79.47 | -3.84 | -11.81 | -72.53 | 3.84 |
| 35 | 33.84 | 32.31 | 6.99 | 31.22 | -25.38 | -6.99 |
| 36 | -25.24 | 29.89 | -5.13 | -22.55 | -22.95 | 5.13 |
| 37 | 38.91 | 54.87 | 8.69 | 43.37 | -53.97 | -8.81 |
| 38 | -20.17 | 52.44 | -3.43 | -10.40 | -51.54 | 3.31 |
| 39 | 27.60 | 32.14 | 5.80 | 25.05 | -22.37 | -5.68 |
| 40 | -31.47 | 29.71 | -6.32 | -28.72 | -19.95 | 6.44 |
| 41 | 33.88 | 68.29 | 7.89 | 39.58 | -62.96 | -7.89 |
| 42 | -25.19 | 65.86 | -4.23 | -14.19 | -60.53 | 4.23 |
| 43 | 32.63 | 18.71 | 6.60 | 28.84 | -13.38 | -6.60 |
| 44 | -26.45 | 16.29 | -5.52 | -24.93 | -10.95 | 5.52 |
| 45 | 17.09 | 73.15 | 4.34 | 24.17 | -68.96 | -4.42 |
| 46 | 2.10 | 75.79 | 1.33 | 11.17 | -71.60 | -1.41 |
| 47 | 10.09 | 59.08 | 2.55 | 12.83 | -49.41 | -2.48 |
| 48 | -4.91 | 61.72 | -0.45 | -0.17 | -52.05 | 0.53 |
| 49 | 13.98 | 81.46 | 3.84 | 21.82 | -74.53 | -3.84 |
| 50 | -1.02 | 84.10 | 0.84 | 8.82 | -77.17 | -0.84 |
| 51 | 13.20 | 50.77 | 3.05 | 15.18 | -43.84 | -3.05 |
| 52 | -1.79 | 53.41 | 0.04 | 2.18 | -46.48 | -0.04 |
| 53 | 14.88 | 55.97 | 3.69 | 20.09 | -52.74 | -3.74 |
| 54 | -0.12 | 58.61 | 0.68 | 7.09 | -55.38 | -0.74 |
| 55 | 9.49 | 45.14 | 2.31 | 11.37 | -37.70 | -2.25 |
| 56 | -5.50 | 47.78 | -0.70 | -1.63 | -40.34 | 0.76 |
| 57 | 12.48 | 62.36 | 3.30 | 18.29 | -57.03 | -3.30 |
| 58 | -2.51 | 65.00 | 0.30 | 5.28 | -59.67 | -0.30 |
| 59 | 11.89 | 38.75 | 2.69 | 13.17 | -33.42 | -2.69 |
| 60 | -3.11 | 41.39 | -0.32 | 0.17 | -36.06 | 0.32 |

强度计算控制组合号: 29, M=40.12, N=68.47, M=45.75, N=-65.97

强度计算应力比 =0.250

抗剪强度计算控制组合号: 29, V=-9.20

抗剪强度计算应力比 =0.031

平面内稳定计算最大应力对应组合号: 29, M=40.12, N=68.47, M=45.75, N=-65.97

平面内稳定计算最大应力 (N/mm\*mm) =88.50

平面内稳定计算最大应力比 =0.290

平面外稳定计算最大应力对应组合号: 17, M=24.82, N=104.63, M=36.01, N=-97.69

临界弯矩Mcr(kN\*m) =262.53

平面外稳定计算最大应力比 =0.459

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 =0.250 < 1.0

抗剪强度计算应力比 =0.031 < 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=82. ≤ [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 | 7.38 | 57.29 | 2.18 | 13.59 | -54.06 | -2.24 |
| 2 | 1.99 | 46.46 | 0.81 | 4.87 | -39.02 | -0.75 |
| 3 | 4.99 | 63.68 | 1.80 | 11.78 | -58.35 | -1.80 |
| 4 | 4.39 | 40.07 | 1.19 | 6.67 | -34.74 | -1.19 |
| 5 | 6.98 | 52.75 | 2.05 | 12.80 | -50.06 | -2.11 |
| 6 | 1.59 | 41.93 | 0.68 | 4.07 | -35.02 | -0.62 |
| 7 | 4.58 | 59.15 | 1.67 | 10.99 | -54.35 | -1.67 |
| 8 | 3.99 | 35.54 | 1.06 | 5.88 | -30.74 | -1.06 |
| 9 | 11.45 | 41.19 | 2.76 | 14.21 | -35.85 | -2.76 |
| 10 | -4.30 | 40.54 | -0.48 | -0.13 | -35.21 | 0.48 |
| 11 | 11.05 | 36.65 | 2.63 | 13.41 | -31.85 | -2.63 |
| 12 | -4.71 | 36.01 | -0.60 | -0.92 | -31.21 | 0.60 |

防火设计控制的偶然组合号: 9, M=11.45, N=41.19, M=14.21, N=-35.85

强度计算荷载比 =0.08

平面内稳定计算荷载比 =0.10

平面外稳定计算荷载比 =0.16

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): 647.95℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4295(m^2\*℃/w) ,计算所需保护层厚度(di) =42.95(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=10.71, Ly=9.31; 长细比：λx=82.0,λy=172.3

构件长度=9.31; 计算长度系数: Ux=1.15 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 | 0.86 | 62.32 | -0.24 | -1.12 | -49.05 | 0.06 |
| 2 | -15.30 | 94.79 | -4.37 | -27.30 | -94.18 | 4.54 |
| 3 | -8.11 | 113.97 | -3.22 | -21.88 | -107.03 | 3.22 |
| 4 | -6.32 | 43.14 | -1.38 | -6.54 | -36.20 | 1.38 |
| 5 | 2.07 | 48.71 | 0.15 | 1.25 | -37.05 | -0.32 |
| 6 | -14.09 | 81.19 | -3.98 | -24.92 | -82.18 | 4.15 |
| 7 | -6.90 | 100.36 | -2.84 | -19.50 | -95.03 | 2.84 |
| 8 | -5.12 | 29.54 | -1.00 | -4.17 | -24.20 | 1.00 |
| 9 | 26.01 | 40.93 | 4.93 | 19.93 | -34.00 | -4.93 |
| 10 | -33.07 | 43.36 | -7.19 | -33.85 | -36.43 | 7.19 |
| 11 | 27.22 | 27.33 | 5.32 | 22.31 | -22.00 | -5.32 |
| 12 | -31.87 | 29.76 | -6.80 | -31.48 | -24.43 | 6.80 |
| 13 | 19.61 | 51.51 | 3.72 | 17.02 | -38.25 | -3.90 |
| 14 | -15.84 | 52.97 | -3.55 | -15.25 | -39.71 | 3.37 |
| 15 | 3.45 | 83.98 | -0.40 | -9.16 | -83.38 | 0.58 |
| 16 | -32.00 | 85.44 | -7.68 | -41.43 | -84.84 | 7.85 |
| 17 | 10.63 | 103.16 | 0.74 | -3.74 | -96.23 | -0.74 |
| 18 | -24.82 | 104.62 | -6.53 | -36.01 | -97.69 | 6.53 |
| 19 | 12.42 | 32.33 | 2.58 | 11.60 | -25.40 | -2.58 |
| 20 | -23.03 | 33.79 | -4.69 | -20.67 | -26.86 | 4.69 |
| 21 | 20.82 | 37.91 | 4.11 | 19.40 | -26.25 | -4.28 |
| 22 | -14.64 | 39.37 | -3.16 | -12.87 | -27.71 | 2.99 |
| 23 | 4.66 | 70.38 | -0.02 | -6.78 | -71.38 | 0.19 |
| 24 | -30.79 | 71.84 | -7.29 | -39.05 | -72.84 | 7.47 |
| 25 | 11.84 | 89.56 | 1.13 | -1.36 | -84.23 | -1.13 |
| 26 | -23.61 | 91.02 | -6.15 | -33.63 | -85.69 | 6.15 |
| 27 | 13.63 | 18.73 | 2.96 | 13.98 | -13.40 | -2.96 |
| 28 | -21.82 | 20.19 | -4.31 | -18.29 | -14.86 | 4.31 |
| 29 | 30.28 | 43.30 | 5.94 | 26.36 | -31.93 | -6.06 |
| 30 | -28.81 | 45.73 | -6.19 | -27.43 | -34.36 | 6.06 |
| 31 | 18.97 | 66.03 | 3.05 | 8.04 | -63.52 | -2.92 |
| 32 | -40.12 | 68.46 | -9.07 | -45.75 | -65.95 | 9.20 |
| 33 | 24.00 | 79.45 | 3.85 | 11.83 | -72.52 | -3.85 |
| 34 | -35.09 | 81.88 | -8.27 | -41.96 | -74.95 | 8.27 |
| 35 | 25.25 | 29.87 | 5.13 | 22.56 | -22.94 | -5.13 |
| 36 | -33.84 | 32.30 | -6.99 | -31.22 | -25.37 | 6.99 |
| 37 | 31.48 | 29.69 | 6.32 | 28.74 | -19.93 | -6.44 |
| 38 | -27.60 | 32.12 | -5.80 | -25.05 | -22.36 | 5.68 |
| 39 | 20.18 | 52.43 | 3.43 | 10.41 | -51.52 | -3.31 |
| 40 | -38.91 | 54.86 | -8.69 | -43.37 | -53.95 | 8.81 |
| 41 | 25.20 | 65.85 | 4.23 | 14.21 | -60.52 | -4.23 |
| 42 | -33.88 | 68.28 | -7.89 | -39.58 | -62.95 | 7.89 |
| 43 | 26.46 | 16.27 | 5.52 | 24.94 | -10.94 | -5.52 |
| 44 | -32.63 | 18.70 | -6.60 | -28.84 | -13.37 | 6.60 |
| 45 | 4.91 | 61.72 | 0.46 | 0.17 | -52.05 | -0.53 |
| 46 | -10.09 | 59.08 | -2.55 | -12.83 | -49.41 | 2.48 |
| 47 | -2.10 | 75.79 | -1.33 | -11.17 | -71.60 | 1.41 |
| 48 | -17.09 | 73.15 | -4.34 | -24.17 | -68.96 | 4.42 |
| 49 | 1.02 | 84.10 | -0.84 | -8.82 | -77.17 | 0.84 |
| 50 | -13.98 | 81.46 | -3.84 | -21.82 | -74.53 | 3.84 |
| 51 | 1.79 | 53.41 | -0.04 | -2.18 | -46.48 | 0.04 |
| 52 | -13.20 | 50.77 | -3.05 | -15.18 | -43.84 | 3.05 |
| 53 | 5.50 | 47.78 | 0.70 | 1.63 | -40.34 | -0.76 |
| 54 | -9.49 | 45.14 | -2.31 | -11.37 | -37.70 | 2.25 |
| 55 | 0.12 | 58.61 | -0.68 | -7.09 | -55.38 | 0.74 |
| 56 | -14.88 | 55.97 | -3.69 | -20.09 | -52.74 | 3.74 |
| 57 | 2.51 | 65.00 | -0.30 | -5.28 | -59.67 | 0.30 |
| 58 | -12.48 | 62.36 | -3.30 | -18.29 | -57.03 | 3.30 |
| 59 | 3.11 | 41.39 | 0.32 | -0.17 | -36.06 | -0.32 |
| 60 | -11.89 | 38.75 | -2.69 | -13.17 | -33.42 | 2.69 |

强度计算控制组合号: 32, M=-40.12, N=68.46, M=-45.75, N=-65.95

强度计算应力比 =0.250

抗剪强度计算控制组合号: 32, V=9.20

抗剪强度计算应力比 =0.031

平面内稳定计算最大应力对应组合号: 32, M=-40.12, N=68.46, M=-45.75, N=-65.95

平面内稳定计算最大应力 (N/mm\*mm) =88.50

平面内稳定计算最大应力比 =0.290

平面外稳定计算最大应力对应组合号: 18, M=-24.82, N=104.62, M=-36.01, N=-97.69

临界弯矩Mcr(kN\*m) =262.53

平面外稳定计算最大应力比 =0.459

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 =0.250 < 1.0

抗剪强度计算应力比 =0.031 < 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=82. ≤ [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 | -1.99 | 46.46 | -0.81 | -4.87 | -39.02 | 0.75 |
| 2 | -7.38 | 57.29 | -2.18 | -13.59 | -54.06 | 2.24 |
| 3 | -4.99 | 63.68 | -1.80 | -11.78 | -58.35 | 1.80 |
| 4 | -4.39 | 40.07 | -1.19 | -6.67 | -34.74 | 1.19 |
| 5 | -1.59 | 41.93 | -0.68 | -4.07 | -35.02 | 0.62 |
| 6 | -6.98 | 52.75 | -2.05 | -12.80 | -50.06 | 2.11 |
| 7 | -4.58 | 59.15 | -1.67 | -10.99 | -54.35 | 1.67 |
| 8 | -3.99 | 35.54 | -1.06 | -5.88 | -30.74 | 1.06 |
| 9 | 4.31 | 40.54 | 0.48 | 0.14 | -35.20 | -0.48 |
| 10 | -11.45 | 41.18 | -2.76 | -14.21 | -35.85 | 2.76 |
| 11 | 4.71 | 36.00 | 0.61 | 0.93 | -31.20 | -0.61 |
| 12 | -11.05 | 36.65 | -2.63 | -13.41 | -31.85 | 2.63 |

防火设计控制的偶然组合号: 10, M=-11.45, N=41.18, M=-14.21, N=-35.85

强度计算荷载比 =0.08

平面内稳定计算荷载比 =0.10

平面外稳定计算荷载比 =0.16

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): 647.95℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4295(m^2\*℃/w) ,计算所需保护层厚度(di) =42.95(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 | 4.83 | 129.31 | 0.89 | 2.90 | -122.44 | -0.89 |
| 2 | -40.91 | 140.14 | -13.25 | -73.82 | -133.27 | 13.25 |
| 3 | -25.16 | 170.43 | -8.29 | -46.63 | -163.56 | 8.29 |
| 4 | -10.92 | 99.02 | -4.07 | -24.29 | -92.15 | 4.07 |
| 5 | 7.87 | 106.30 | 1.93 | 8.87 | -101.01 | -1.93 |
| 6 | -37.88 | 117.13 | -12.21 | -67.86 | -111.85 | 12.21 |
| 7 | -22.13 | 147.42 | -7.25 | -40.67 | -142.14 | 7.25 |
| 8 | -7.88 | 76.01 | -3.03 | -18.32 | -70.72 | 3.03 |
| 9 | 29.33 | 59.90 | 5.54 | 18.68 | -53.02 | -5.54 |
| 10 | -48.26 | 87.34 | -12.03 | -55.91 | -80.47 | 12.03 |
| 11 | 32.37 | 36.88 | 6.58 | 24.64 | -31.60 | -6.58 |
| 12 | -45.23 | 64.33 | -10.99 | -49.95 | -59.04 | 10.99 |
| 13 | 30.32 | 105.42 | 6.92 | 29.62 | -98.55 | -6.92 |
| 14 | -16.23 | 121.89 | -3.62 | -15.13 | -115.01 | 3.62 |
| 15 | -15.42 | 116.25 | -7.22 | -47.10 | -109.38 | 7.22 |
| 16 | -61.98 | 132.72 | -17.77 | -91.86 | -125.85 | 17.77 |
| 17 | 0.33 | 146.54 | -2.26 | -19.91 | -139.67 | 2.26 |
| 18 | -46.23 | 163.01 | -12.81 | -64.67 | -156.14 | 12.81 |
| 19 | 14.57 | 75.13 | 1.96 | 2.43 | -68.26 | -1.96 |
| 20 | -31.98 | 91.60 | -8.58 | -42.32 | -84.73 | 8.58 |
| 21 | 33.36 | 82.41 | 7.96 | 35.59 | -77.12 | -7.96 |
| 22 | -13.20 | 98.87 | -2.58 | -9.17 | -93.59 | 2.58 |
| 23 | -12.39 | 93.24 | -6.18 | -41.14 | -87.96 | 6.18 |
| 24 | -58.94 | 109.71 | -16.73 | -85.89 | -104.42 | 16.73 |
| 25 | 3.37 | 123.53 | -1.22 | -13.95 | -118.24 | 1.22 |
| 26 | -43.19 | 140.00 | -11.77 | -58.70 | -134.71 | 11.77 |
| 27 | 17.61 | 52.12 | 3.00 | 8.40 | -46.83 | -3.00 |
| 28 | -28.95 | 68.59 | -7.54 | -36.36 | -63.30 | 7.54 |
| 29 | 41.92 | 80.61 | 9.32 | 38.80 | -73.74 | -9.32 |
| 30 | -35.67 | 108.06 | -8.25 | -35.78 | -101.19 | 8.25 |
| 31 | 9.90 | 88.20 | -0.58 | -14.90 | -81.33 | 0.58 |
| 32 | -67.69 | 115.64 | -18.15 | -89.49 | -108.77 | 18.15 |
| 33 | 20.93 | 109.40 | 2.89 | 4.13 | -102.53 | -2.89 |
| 34 | -56.67 | 136.84 | -14.68 | -70.46 | -129.97 | 14.68 |
| 35 | 30.90 | 59.41 | 5.85 | 19.77 | -52.54 | -5.85 |
| 36 | -46.70 | 86.86 | -11.72 | -54.82 | -79.98 | 11.72 |
| 37 | 44.96 | 57.60 | 10.36 | 44.77 | -52.32 | -10.36 |
| 38 | -32.64 | 85.05 | -7.21 | -29.82 | -79.76 | 7.21 |
| 39 | 12.94 | 65.19 | 0.46 | -8.94 | -59.90 | -0.46 |
| 40 | -64.66 | 92.63 | -17.11 | -83.53 | -87.35 | 17.11 |
| 41 | 23.96 | 86.39 | 3.93 | 10.10 | -81.10 | -3.93 |
| 42 | -53.63 | 113.83 | -13.64 | -64.49 | -108.55 | 13.64 |
| 43 | 33.93 | 36.40 | 6.89 | 25.74 | -31.11 | -6.89 |
| 44 | -43.66 | 63.85 | -10.68 | -48.85 | -58.56 | 10.68 |
| 45 | 4.49 | 112.22 | 0.02 | -4.31 | -105.34 | -0.02 |
| 46 | -15.20 | 112.86 | -4.35 | -22.47 | -105.99 | 4.35 |
| 47 | -15.33 | 116.91 | -6.11 | -37.56 | -110.04 | 6.11 |
| 48 | -35.03 | 117.56 | -10.48 | -55.72 | -110.69 | 10.48 |
| 49 | -8.51 | 130.04 | -3.96 | -25.78 | -123.16 | 3.96 |
| 50 | -28.20 | 130.68 | -8.33 | -43.94 | -123.81 | 8.33 |
| 51 | -2.34 | 99.09 | -2.13 | -16.09 | -92.22 | 2.13 |
| 52 | -22.03 | 99.74 | -6.50 | -34.26 | -92.87 | 6.50 |
| 53 | 5.73 | 86.25 | 0.52 | -1.22 | -80.96 | -0.52 |
| 54 | -13.97 | 86.89 | -3.85 | -19.38 | -81.61 | 3.85 |
| 55 | -9.52 | 89.86 | -4.19 | -26.79 | -84.57 | 4.19 |
| 56 | -29.22 | 90.50 | -8.57 | -44.96 | -85.22 | 8.57 |
| 57 | -4.27 | 99.95 | -2.54 | -17.73 | -94.67 | 2.54 |
| 58 | -23.97 | 100.60 | -6.91 | -35.90 | -95.31 | 6.91 |
| 59 | 0.47 | 76.15 | -1.13 | -10.28 | -70.86 | 1.13 |
| 60 | -19.22 | 76.80 | -5.50 | -28.45 | -71.51 | 5.50 |

强度计算控制组合号: 16, M=-61.98, N=132.72, M=-91.86, N=-125.85

强度计算应力比 =0.479

抗剪强度计算控制组合号: 32, V=-18.15

抗剪强度计算应力比 =0.062

平面内稳定计算最大应力对应组合号: 16, M=-61.98, N=132.72, M=-91.86, N=-125.85

平面内稳定计算最大应力 (N/mm\*mm) =163.28

平面内稳定计算最大应力比 =0.535

临界弯矩Mcr(kN\*m) =359.36

平面外稳定计算最大应力比 =0.629

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 =0.479 < 1.0

抗剪强度计算应力比 =0.062 < 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 | -4.12 | 86.57 | -1.67 | -10.30 | -81.28 | 1.67 |
| 2 | -19.37 | 90.18 | -6.38 | -35.88 | -84.89 | 6.38 |
| 3 | -14.12 | 100.28 | -4.73 | -26.81 | -94.99 | 4.73 |
| 4 | -9.37 | 76.47 | -3.32 | -19.37 | -71.19 | 3.32 |
| 5 | -3.11 | 78.90 | -1.32 | -8.31 | -74.14 | 1.32 |
| 6 | -18.36 | 82.51 | -6.03 | -33.89 | -77.75 | 6.03 |
| 7 | -13.11 | 92.61 | -4.38 | -24.82 | -87.85 | 4.38 |
| 8 | -8.36 | 68.80 | -2.97 | -17.38 | -64.04 | 2.97 |
| 9 | 1.21 | 66.08 | -0.79 | -8.01 | -60.80 | 0.79 |
| 10 | -19.48 | 73.40 | -5.47 | -27.90 | -68.12 | 5.47 |
| 11 | 2.22 | 58.41 | -0.44 | -6.02 | -53.66 | 0.44 |
| 12 | -18.47 | 65.73 | -5.13 | -25.91 | -60.98 | 5.13 |

防火设计控制的偶然组合号: 2, M=-19.37, N=90.18, M=-35.88, N=-84.89

强度计算荷载比 =0.18

平面内稳定计算荷载比 =0.24

平面外稳定计算荷载比 =0.30

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): 648.88℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4243(m^2\*℃/w) ,计算所需保护层厚度(di) =42.43(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 | 81.31 | 89.53 | 31.57 | 164.98 | -83.06 | -31.58 |
| 2 | 39.92 | 51.34 | 15.62 | 81.87 | -44.85 | -15.62 |
| 3 | 80.59 | 89.55 | 31.45 | 164.73 | -83.07 | -31.45 |
| 4 | 40.64 | 51.32 | 15.74 | 82.13 | -44.84 | -15.74 |
| 5 | 71.14 | 77.25 | 27.62 | 144.28 | -72.27 | -27.62 |
| 6 | 29.76 | 39.05 | 11.66 | 61.18 | -34.06 | -11.66 |
| 7 | 70.43 | 77.26 | 27.50 | 144.03 | -72.28 | -27.50 |
| 8 | 30.47 | 39.04 | 11.78 | 61.43 | -34.05 | -11.78 |
| 9 | 87.62 | 37.03 | 28.77 | 76.14 | -30.55 | -13.22 |
| 10 | -31.93 | 44.38 | -9.39 | 55.87 | -37.90 | -15.53 |
| 11 | 77.46 | 24.75 | 24.81 | 55.44 | -19.77 | -9.27 |
| 12 | -42.10 | 32.10 | -13.35 | 35.17 | -27.11 | -11.57 |
| 13 | 107.45 | 79.82 | 38.54 | 156.85 | -73.34 | -29.22 |
| 14 | 35.72 | 84.22 | 15.65 | 144.69 | -77.75 | -30.61 |
| 15 | 66.07 | 41.62 | 22.59 | 73.75 | -35.13 | -13.26 |
| 16 | -5.66 | 46.03 | -0.30 | 61.58 | -39.54 | -14.65 |
| 17 | 106.74 | 79.83 | 38.42 | 156.60 | -73.35 | -29.10 |
| 18 | 35.01 | 84.24 | 15.53 | 144.44 | -77.76 | -30.48 |
| 19 | 66.78 | 41.61 | 22.71 | 74.00 | -35.13 | -13.39 |
| 20 | -4.95 | 46.01 | -0.18 | 61.83 | -39.53 | -14.77 |
| 21 | 97.29 | 67.53 | 34.59 | 136.16 | -62.56 | -25.27 |
| 22 | 25.56 | 71.94 | 11.69 | 123.99 | -66.96 | -26.65 |
| 23 | 55.90 | 29.34 | 18.63 | 53.05 | -24.35 | -9.31 |
| 24 | -15.83 | 33.75 | -4.26 | 40.89 | -28.75 | -10.69 |
| 25 | 96.57 | 67.55 | 34.47 | 135.91 | -62.57 | -25.14 |
| 26 | 24.84 | 71.96 | 11.57 | 123.74 | -66.97 | -26.53 |
| 27 | 56.62 | 29.32 | 18.75 | 53.30 | -24.34 | -9.43 |
| 28 | -15.11 | 33.73 | -4.14 | 41.14 | -28.75 | -10.81 |
| 29 | 113.71 | 62.45 | 38.86 | 128.85 | -55.97 | -23.33 |
| 30 | -5.85 | 69.79 | 0.71 | 108.57 | -63.32 | -25.63 |
| 31 | 84.74 | 35.71 | 27.70 | 70.67 | -29.23 | -12.15 |
| 32 | -34.82 | 43.06 | -10.46 | 50.40 | -36.57 | -14.46 |
| 33 | 113.20 | 62.46 | 38.78 | 128.67 | -55.98 | -23.24 |
| 34 | -6.35 | 69.80 | 0.62 | 108.40 | -63.32 | -25.54 |
| 35 | 85.24 | 35.70 | 27.78 | 70.85 | -29.22 | -12.24 |
| 36 | -34.32 | 43.05 | -10.38 | 50.58 | -36.57 | -14.54 |
| 37 | 103.54 | 50.17 | 34.91 | 108.15 | -45.19 | -19.37 |
| 38 | -16.01 | 57.51 | -3.25 | 87.88 | -52.53 | -21.67 |
| 39 | 74.57 | 23.43 | 23.74 | 49.98 | -18.44 | -8.20 |
| 40 | -44.98 | 30.77 | -14.42 | 29.70 | -25.78 | -10.50 |
| 41 | 103.04 | 50.18 | 34.82 | 107.97 | -45.19 | -19.28 |
| 42 | -16.51 | 57.52 | -3.33 | 87.70 | -52.54 | -21.59 |
| 43 | 75.07 | 23.42 | 23.82 | 50.15 | -18.43 | -8.28 |
| 44 | -44.48 | 30.76 | -14.33 | 29.88 | -25.78 | -10.59 |
| 45 | 73.53 | 69.84 | 26.18 | 130.69 | -63.36 | -26.18 |
| 46 | 46.86 | 68.07 | 20.61 | 113.94 | -61.60 | -20.61 |
| 47 | 55.60 | 53.29 | 19.27 | 94.68 | -46.80 | -19.27 |
| 48 | 28.92 | 51.52 | 13.70 | 77.93 | -45.04 | -13.70 |
| 49 | 73.22 | 69.85 | 26.13 | 130.58 | -63.37 | -26.13 |
| 50 | 46.55 | 68.08 | 20.56 | 113.83 | -61.60 | -20.56 |
| 51 | 55.91 | 53.28 | 19.32 | 94.78 | -46.80 | -19.32 |
| 52 | 29.23 | 51.51 | 13.75 | 78.04 | -45.03 | -13.75 |
| 53 | 59.64 | 53.93 | 20.78 | 102.46 | -48.94 | -20.78 |
| 54 | 32.97 | 52.16 | 15.21 | 85.71 | -47.18 | -15.22 |
| 55 | 45.84 | 41.20 | 15.46 | 74.76 | -36.21 | -15.46 |
| 56 | 19.17 | 39.43 | 9.90 | 58.01 | -34.44 | -9.90 |
| 57 | 59.40 | 53.93 | 20.74 | 102.38 | -48.95 | -20.74 |
| 58 | 32.73 | 52.16 | 15.17 | 85.63 | -47.18 | -15.17 |
| 59 | 46.08 | 41.19 | 15.50 | 74.84 | -36.20 | -15.50 |
| 60 | 19.41 | 39.42 | 9.94 | 58.10 | -34.44 | -9.94 |

强度计算控制组合号: 1, M=81.31, N=89.53, M=164.98, N=-83.06

强度计算应力比 =0.699

抗剪强度计算控制组合号: 29, V=38.86

抗剪强度计算应力比 =0.112

平面内稳定计算最大应力对应组合号: 1, M=81.31, N=89.53, M=164.98, N=-83.06

平面内稳定计算最大应力 (N/mm\*mm) =208.73

平面内稳定计算最大应力比 =0.684

平面外稳定计算最大应力对应组合号: 18, M=35.01, N=84.24, M=144.44, N=-77.76

临界弯矩Mcr(kN\*m) =371.08

平面外稳定计算最大应力比 =0.798

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 =0.699 < 1.0

抗剪强度计算应力比 =0.112 < 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 | 46.30 | 53.04 | 18.00 | 94.09 | -48.06 | -18.00 |
| 2 | 32.51 | 40.31 | 12.68 | 66.39 | -35.32 | -12.68 |
| 3 | 46.06 | 53.05 | 17.96 | 94.00 | -48.06 | -17.96 |
| 4 | 32.75 | 40.31 | 12.72 | 66.47 | -35.32 | -12.72 |
| 5 | 42.91 | 48.95 | 16.68 | 87.19 | -44.47 | -16.68 |
| 6 | 29.12 | 36.22 | 11.36 | 59.49 | -31.73 | -11.36 |
| 7 | 42.68 | 48.95 | 16.64 | 87.10 | -44.47 | -16.64 |
| 8 | 29.36 | 36.21 | 11.40 | 59.57 | -31.73 | -11.40 |
| 9 | 45.50 | 36.62 | 16.29 | 65.38 | -31.64 | -12.14 |
| 10 | 13.62 | 38.58 | 6.11 | 59.97 | -33.60 | -12.76 |
| 11 | 42.11 | 32.53 | 14.97 | 58.48 | -28.04 | -10.82 |
| 12 | 10.23 | 34.49 | 4.79 | 53.07 | -30.00 | -11.44 |

防火设计控制的偶然组合号: 1, M=46.30, N=53.04, M=94.09, N=-48.06

强度计算荷载比 =0.39

平面内稳定计算荷载比 =0.39

平面外稳定计算荷载比 =0.38

无防护下钢构件最大升温(Ts): 1081.77℃ ,按临界温度法求得临界温度(Td): 616.75℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4715(m^2\*℃/w) ,计算所需保护层厚度(di) =47.15(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 | 7.49 | 0.99 | 8.81 | 0.00 | 0.00 | -0.00 |
| 10 | -7.48 | 0.99 | -8.80 | 0.00 | 0.00 | -0.00 |
| 11 | 7.49 | 0.76 | 8.81 | 0.00 | 0.00 | -0.00 |
| 12 | -7.48 | 0.76 | -8.80 | 0.00 | 0.00 | -0.00 |
| 13 | 4.49 | 0.99 | 5.28 | 0.00 | 0.00 | -0.00 |
| 14 | -4.49 | 0.99 | -5.28 | 0.00 | 0.00 | -0.00 |
| 15 | 4.49 | 0.99 | 5.28 | 0.00 | 0.00 | 0.00 |
| 16 | -4.49 | 0.99 | -5.28 | 0.00 | 0.00 | -0.00 |
| 17 | 4.49 | 0.99 | 5.28 | 0.00 | 0.00 | -0.00 |
| 18 | -4.49 | 0.99 | -5.28 | 0.00 | 0.00 | -0.00 |
| 19 | 4.49 | 0.99 | 5.28 | 0.00 | 0.00 | 0.00 |
| 20 | -4.49 | 0.99 | -5.28 | 0.00 | 0.00 | -0.00 |
| 21 | 4.49 | 0.76 | 5.28 | 0.00 | 0.00 | -0.00 |
| 22 | -4.49 | 0.76 | -5.28 | 0.00 | 0.00 | -0.00 |
| 23 | 4.49 | 0.76 | 5.28 | 0.00 | 0.00 | 0.00 |
| 24 | -4.49 | 0.76 | -5.28 | 0.00 | 0.00 | -0.00 |
| 25 | 4.49 | 0.76 | 5.28 | 0.00 | 0.00 | -0.00 |
| 26 | -4.49 | 0.76 | -5.28 | 0.00 | 0.00 | -0.00 |
| 27 | 4.49 | 0.76 | 5.28 | 0.00 | 0.00 | -0.00 |
| 28 | -4.49 | 0.76 | -5.28 | 0.00 | 0.00 | -0.00 |
| 29 | 7.49 | 0.99 | 8.81 | 0.00 | 0.00 | -0.00 |
| 30 | -7.48 | 0.99 | -8.80 | 0.00 | 0.00 | -0.00 |
| 31 | 7.49 | 0.99 | 8.81 | 0.00 | 0.00 | 0.00 |
| 32 | -7.48 | 0.99 | -8.80 | 0.00 | 0.00 | -0.00 |
| 33 | 7.49 | 0.99 | 8.81 | 0.00 | 0.00 | -0.00 |
| 34 | -7.48 | 0.99 | -8.80 | 0.00 | 0.00 | -0.00 |
| 35 | 7.49 | 0.99 | 8.81 | 0.00 | 0.00 | -0.00 |
| 36 | -7.48 | 0.99 | -8.80 | 0.00 | 0.00 | -0.00 |
| 37 | 7.49 | 0.76 | 8.81 | 0.00 | 0.00 | -0.00 |
| 38 | -7.48 | 0.76 | -8.80 | 0.00 | 0.00 | -0.00 |
| 39 | 7.49 | 0.76 | 8.81 | 0.00 | 0.00 | 0.00 |
| 40 | -7.48 | 0.76 | -8.80 | 0.00 | 0.00 | -0.00 |
| 41 | 7.49 | 0.76 | 8.81 | 0.00 | 0.00 | -0.00 |
| 42 | -7.48 | 0.76 | -8.80 | 0.00 | 0.00 | -0.00 |
| 43 | 7.49 | 0.76 | 8.81 | 0.00 | 0.00 | -0.00 |
| 44 | -7.48 | 0.76 | -8.80 | 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=7.49, N=0.99, M=0.00, N=0.00

强度计算应力比 =0.077

抗剪强度计算控制组合号: 37, V=8.81

抗剪强度计算应力比 =0.047

平面内稳定计算最大应力对应组合号: 29, M=7.49, N=0.99, M=0.00, N=0.00

平面内稳定计算最大应力 (N/mm\*mm) =21.37

平面内稳定计算最大应力比 =0.070

临界弯矩Mcr(kN\*m) =1306.07

平面外稳定计算最大应力比 =0.030

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 =0.077 < 1.0

抗剪强度计算应力比 =0.047 < 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 | 2.00 | 0.76 | 2.35 | 0.00 | 0.00 | 0.00 |
| 10 | -1.99 | 0.76 | -2.35 | 0.00 | 0.00 | -0.00 |
| 11 | 2.00 | 0.68 | 2.35 | 0.00 | 0.00 | 0.00 |
| 12 | -1.99 | 0.68 | -2.35 | 0.00 | 0.00 | -0.00 |

防火设计控制的偶然组合号: 9, M=2.00, N=0.76, M=0.00, N=0.00

强度计算荷载比 =0.02

平面内稳定计算荷载比 =0.02

平面外稳定计算荷载比 =0.01

无防护下钢构件最大升温(Ts): 1081.75℃ ,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 | 7.49 | 0.99 | 8.81 | -0.00 | -0.00 | -0.00 |
| 10 | -7.48 | 0.99 | -8.80 | -0.00 | -0.00 | -0.00 |
| 11 | 7.49 | 0.76 | 8.81 | 0.00 | -0.00 | 0.00 |
| 12 | -7.48 | 0.76 | -8.80 | -0.00 | -0.00 | -0.00 |
| 13 | 4.49 | 0.99 | 5.28 | -0.00 | -0.00 | -0.00 |
| 14 | -4.49 | 0.99 | -5.28 | -0.00 | -0.00 | -0.00 |
| 15 | 4.49 | 0.99 | 5.28 | -0.00 | 0.00 | -0.00 |
| 16 | -4.49 | 0.99 | -5.28 | -0.00 | 0.00 | -0.00 |
| 17 | 4.49 | 0.99 | 5.28 | -0.00 | -0.00 | -0.00 |
| 18 | -4.49 | 0.99 | -5.28 | -0.00 | -0.00 | -0.00 |
| 19 | 4.49 | 0.99 | 5.28 | -0.00 | 0.00 | -0.00 |
| 20 | -4.49 | 0.99 | -5.28 | -0.00 | 0.00 | -0.00 |
| 21 | 4.49 | 0.76 | 5.28 | 0.00 | -0.00 | -0.00 |
| 22 | -4.49 | 0.76 | -5.28 | -0.00 | -0.00 | -0.00 |
| 23 | 4.49 | 0.76 | 5.28 | -0.00 | 0.00 | -0.00 |
| 24 | -4.49 | 0.76 | -5.28 | -0.00 | 0.00 | -0.00 |
| 25 | 4.49 | 0.76 | 5.28 | 0.00 | -0.00 | 0.00 |
| 26 | -4.49 | 0.76 | -5.28 | -0.00 | -0.00 | -0.00 |
| 27 | 4.49 | 0.76 | 5.28 | -0.00 | 0.00 | -0.00 |
| 28 | -4.49 | 0.76 | -5.28 | -0.00 | 0.00 | -0.00 |
| 29 | 7.49 | 0.99 | 8.81 | 0.00 | -0.00 | -0.00 |
| 30 | -7.48 | 0.99 | -8.80 | -0.00 | -0.00 | -0.00 |
| 31 | 7.49 | 0.99 | 8.81 | -0.00 | -0.00 | -0.00 |
| 32 | -7.48 | 0.99 | -8.80 | -0.00 | -0.00 | -0.00 |
| 33 | 7.49 | 0.99 | 8.81 | 0.00 | -0.00 | 0.00 |
| 34 | -7.48 | 0.99 | -8.80 | -0.00 | -0.00 | -0.00 |
| 35 | 7.49 | 0.99 | 8.81 | -0.00 | 0.00 | -0.00 |
| 36 | -7.48 | 0.99 | -8.80 | -0.00 | -0.00 | -0.00 |
| 37 | 7.49 | 0.76 | 8.81 | 0.00 | -0.00 | 0.00 |
| 38 | -7.48 | 0.76 | -8.80 | -0.00 | -0.00 | -0.00 |
| 39 | 7.49 | 0.76 | 8.81 | -0.00 | 0.00 | -0.00 |
| 40 | -7.48 | 0.76 | -8.80 | -0.00 | 0.00 | -0.00 |
| 41 | 7.49 | 0.76 | 8.81 | 0.00 | -0.00 | 0.00 |
| 42 | -7.48 | 0.76 | -8.80 | -0.00 | -0.00 | -0.00 |
| 43 | 7.49 | 0.76 | 8.81 | -0.00 | 0.00 | -0.00 |
| 44 | -7.48 | 0.76 | -8.80 | -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: 35, M=7.49, N=0.99, M=-0.00, N=0.00

强度计算应力比 =0.077

抗剪强度计算控制组合号: 29, V=8.81

抗剪强度计算应力比 =0.047

平面内稳定计算最大应力对应组合号: 35, M=7.49, N=0.99, M=-0.00, N=0.00

平面内稳定计算最大应力 (N/mm\*mm) =21.37

平面内稳定计算最大应力比 =0.070

临界弯矩Mcr(kN\*m) =1306.07

平面外稳定计算最大应力比 =0.030

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 =0.077 < 1.0

抗剪强度计算应力比 =0.047 < 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 | 2.00 | 0.76 | 2.35 | -0.00 | -0.00 | -0.00 |
| 10 | -1.99 | 0.76 | -2.35 | -0.00 | -0.00 | -0.00 |
| 11 | 2.00 | 0.68 | 2.35 | -0.00 | -0.00 | -0.00 |
| 12 | -1.99 | 0.68 | -2.35 | -0.00 | -0.00 | -0.00 |

防火设计控制的偶然组合号: 9, M=2.00, N=0.76, M=-0.00, N=-0.00

强度计算荷载比 =0.02

平面内稳定计算荷载比 =0.02

平面外稳定计算荷载比 =0.01

无防护下钢构件最大升温(Ts): 1081.75℃ ,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=23.12, Ly=1.50; 长细比：λx=178.7,λy=31.0

构件长度=1.50; 计算长度系数: Ux=15.38 Uy=1.00

抗震等级: 四级

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

轴压截面分类:X轴:b类 , Y轴:c类

构件钢号：Q355

宽厚比等级:S4

验算规范: 门规GB51022-2015

构件耐火等级: 二级

是否耐火钢: 否; 采用防火材料: 防火涂料1( 1); 形状系数: 244.366196(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | 75.85 | 10.53 | 46.05 | 3.90 | -7.82 | -28.43 |
| 2 | 16.69 | 18.16 | 7.81 | -15.49 | -18.78 | -25.43 |
| 3 | 53.50 | 22.45 | 25.82 | -14.69 | -21.41 | -25.82 |
| 4 | 39.05 | 6.24 | 28.04 | 3.10 | -5.19 | -28.04 |
| 5 | 68.11 | 8.06 | 41.54 | 4.87 | -5.60 | -23.93 |
| 6 | 8.95 | 15.70 | 3.31 | -14.52 | -16.55 | -20.92 |
| 7 | 45.75 | 19.99 | 21.31 | -13.72 | -19.18 | -21.31 |
| 8 | 31.31 | 3.77 | 23.54 | 4.07 | -2.97 | -23.54 |
| 9 | 22.72 | 0.66 | 18.11 | 1.72 | 0.38 | -14.41 |
| 10 | 24.50 | 4.59 | 10.74 | -5.58 | -3.55 | -14.43 |
| 11 | 14.98 | -1.80 | 13.61 | 2.69 | 2.61 | -9.91 |
| 12 | 16.76 | 2.13 | 6.23 | -4.61 | -1.32 | -9.93 |
| 13 | 69.36 | 4.52 | 45.20 | 7.45 | -1.81 | -25.36 |
| 14 | 70.42 | 6.88 | 40.77 | 3.07 | -4.17 | -25.38 |
| 15 | 10.20 | 12.15 | 6.97 | -11.94 | -12.76 | -22.36 |
| 16 | 11.26 | 14.51 | 2.54 | -16.32 | -15.12 | -22.38 |
| 17 | 47.00 | 16.44 | 24.97 | -11.14 | -15.40 | -22.75 |
| 18 | 48.07 | 18.80 | 20.54 | -15.52 | -17.75 | -22.76 |
| 19 | 32.56 | 0.23 | 27.20 | 6.65 | 0.82 | -24.98 |
| 20 | 33.62 | 2.59 | 22.77 | 2.27 | -1.54 | -24.99 |
| 21 | 61.62 | 2.05 | 40.70 | 8.42 | 0.41 | -20.86 |
| 22 | 62.68 | 4.41 | 36.27 | 4.04 | -1.95 | -20.87 |
| 23 | 2.46 | 9.69 | 2.46 | -10.97 | -10.54 | -17.86 |
| 24 | 3.52 | 12.04 | -1.96 | -15.35 | -12.90 | -17.87 |
| 25 | 39.26 | 13.98 | 20.47 | -10.17 | -13.17 | -18.24 |
| 26 | 40.32 | 16.33 | 16.04 | -14.55 | -15.53 | -18.26 |
| 27 | 24.82 | -2.24 | 22.69 | 7.62 | 3.04 | -20.47 |
| 28 | 25.88 | 0.12 | 18.27 | 3.24 | 0.68 | -20.48 |
| 29 | 52.34 | 0.56 | 36.68 | 7.39 | 1.65 | -20.65 |
| 30 | 54.11 | 4.49 | 29.30 | 0.09 | -2.28 | -20.67 |
| 31 | 10.93 | 5.90 | 9.92 | -6.18 | -6.02 | -18.55 |
| 32 | 12.70 | 9.83 | 2.54 | -13.48 | -9.94 | -18.57 |
| 33 | 36.69 | 8.90 | 22.52 | -5.62 | -7.86 | -18.82 |
| 34 | 38.46 | 12.83 | 15.14 | -12.93 | -11.79 | -18.84 |
| 35 | 26.58 | -2.45 | 24.08 | 6.83 | 3.49 | -20.38 |
| 36 | 28.35 | 1.48 | 16.70 | -0.47 | -0.44 | -20.40 |
| 37 | 44.60 | -1.91 | 32.18 | 8.36 | 3.87 | -16.14 |
| 38 | 46.37 | 2.02 | 24.80 | 1.06 | -0.06 | -16.16 |
| 39 | 3.18 | 3.43 | 5.41 | -5.21 | -3.79 | -14.04 |
| 40 | 4.96 | 7.36 | -1.97 | -12.51 | -7.72 | -14.06 |
| 41 | 28.95 | 6.44 | 18.01 | -4.65 | -5.63 | -14.31 |
| 42 | 30.72 | 10.37 | 10.64 | -11.96 | -9.56 | -14.33 |
| 43 | 18.83 | -4.91 | 19.57 | 7.80 | 5.71 | -15.87 |
| 44 | 20.61 | -0.98 | 12.20 | 0.50 | 1.79 | -15.89 |
| 45 | 51.07 | 9.91 | 31.35 | 0.61 | -8.15 | -23.71 |
| 46 | 52.68 | 11.32 | 30.69 | -1.99 | -9.56 | -23.05 |
| 47 | 25.44 | 13.22 | 14.78 | -7.79 | -12.89 | -22.41 |
| 48 | 27.05 | 14.63 | 14.12 | -10.40 | -14.30 | -21.75 |
| 49 | 41.39 | 15.08 | 22.58 | -7.45 | -14.03 | -22.58 |
| 50 | 43.00 | 16.49 | 21.92 | -10.05 | -15.44 | -21.92 |
| 51 | 35.13 | 8.05 | 23.55 | 0.26 | -7.01 | -23.55 |
| 52 | 36.74 | 9.46 | 22.89 | -2.34 | -8.42 | -22.89 |
| 53 | 39.10 | 7.46 | 24.19 | 0.77 | -6.10 | -18.32 |
| 54 | 40.71 | 8.87 | 23.53 | -1.83 | -7.51 | -17.66 |
| 55 | 19.38 | 10.00 | 11.44 | -5.69 | -9.75 | -17.32 |
| 56 | 20.99 | 11.42 | 10.78 | -8.30 | -11.16 | -16.66 |
| 57 | 31.65 | 11.43 | 17.45 | -5.43 | -10.63 | -17.45 |
| 58 | 33.26 | 12.85 | 16.79 | -8.03 | -12.04 | -16.79 |
| 59 | 26.83 | 6.03 | 18.19 | 0.50 | -5.23 | -18.19 |
| 60 | 28.45 | 7.44 | 17.53 | -2.10 | -6.64 | -17.53 |

强度计算控制组合号: 1, M=75.85, N=10.53, M=3.90, N=-7.82

强度计算应力比 =0.438

抗剪强度计算控制组合号: 1, V=46.05

抗剪强度计算应力比 =0.157

平面内稳定计算最大应力对应组合号: 1, M=75.85, N=10.53, M=3.90, N=-7.82

平面内稳定计算最大应力 (N/mm\*mm) =135.03

平面内稳定计算最大应力比 =0.443

临界弯矩Mcr(kN\*m) =3279.41

平面外稳定计算最大应力比 =0.281

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 =0.438 < 1.0

抗剪强度计算应力比 =0.157 < 1.0

平面内稳定计算最大应力 < f=305.00

平面外稳定计算最大应力比 < 1.0

腹板高厚比 H0/TW=46.67 < [H0/TW]=250.00

翼缘宽厚比 B/T =9.70 < [B/T]=12.20

压杆,平面内长细比 λ=179. ≤ [λ]=180

压杆,平面外长细比 λ=31. ≤ [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 | 39.91 | 8.17 | 23.86 | -0.53 | -6.81 | -17.99 |
| 2 | 20.19 | 10.71 | 11.11 | -7.00 | -10.46 | -16.99 |
| 3 | 32.45 | 12.14 | 17.12 | -6.73 | -11.34 | -17.12 |
| 4 | 27.64 | 6.74 | 17.86 | -0.80 | -5.93 | -17.86 |
| 5 | 37.33 | 7.34 | 22.36 | -0.21 | -6.07 | -16.49 |
| 6 | 17.61 | 9.89 | 9.61 | -6.67 | -9.72 | -15.48 |
| 7 | 29.87 | 11.32 | 15.61 | -6.41 | -10.59 | -15.61 |
| 8 | 25.06 | 5.91 | 16.36 | -0.48 | -5.19 | -16.36 |
| 9 | 22.92 | 5.55 | 14.64 | -1.65 | -4.74 | -13.66 |
| 10 | 23.39 | 6.59 | 12.67 | -3.60 | -5.79 | -13.66 |
| 11 | 20.34 | 4.72 | 13.14 | -1.33 | -4.00 | -12.15 |
| 12 | 20.81 | 5.77 | 11.17 | -3.28 | -5.05 | -12.16 |

防火设计控制的偶然组合号: 1, M=39.91, N=8.17, M=-0.53, N=-6.81

强度计算荷载比 =0.23

平面内稳定计算荷载比 =0.24

平面外稳定计算荷载比 =0.13

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): 643.00℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4390(m^2\*℃/w) ,计算所需保护层厚度(di) =43.90(mm)

构件重量 (Kg)=67.02

**10. 钢 柱 10
设计结果**

截面类型=16; 布置角度=0; 计算长度：Lx=23.12, Ly=1.50; 长细比：λx=178.7,λy=31.0

构件长度=1.50; 计算长度系数: Ux=15.38 Uy=1.00

抗震等级: 四级

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

轴压截面分类:X轴:b类 , Y轴:c类

构件钢号：Q355

宽厚比等级:S4

验算规范: 门规GB51022-2015

构件耐火等级: 二级

是否耐火钢: 否; 采用防火材料: 防火涂料1( 1); 形状系数: 244.366196(1/m)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| \ | I端 | | | II端 | | |
| 组合 | M | N | V | M | N | V |
| 1 | -16.69 | 18.16 | -7.81 | 15.49 | -18.78 | 25.43 |
| 2 | -75.85 | 10.53 | -46.05 | -3.90 | -7.82 | 28.43 |
| 3 | -53.50 | 22.45 | -25.82 | 14.69 | -21.41 | 25.82 |
| 4 | -39.05 | 6.24 | -28.04 | -3.10 | -5.19 | 28.04 |
| 5 | -8.95 | 15.70 | -3.31 | 14.52 | -16.55 | 20.92 |
| 6 | -68.11 | 8.06 | -41.54 | -4.87 | -5.60 | 23.93 |
| 7 | -45.75 | 19.99 | -21.31 | 13.72 | -19.18 | 21.31 |
| 8 | -31.31 | 3.77 | -23.54 | -4.07 | -2.97 | 23.54 |
| 9 | -24.46 | 4.61 | -10.71 | 5.58 | -3.57 | 14.41 |
| 10 | -22.75 | 0.64 | -18.13 | -1.73 | 0.40 | 14.43 |
| 11 | -16.72 | 2.15 | -6.21 | 4.61 | -1.34 | 9.91 |
| 12 | -15.01 | -1.82 | -13.63 | -2.70 | 2.63 | 9.93 |
| 13 | -11.24 | 14.52 | -2.53 | 16.32 | -15.13 | 22.36 |
| 14 | -10.21 | 12.14 | -6.98 | 11.93 | -12.75 | 22.37 |
| 15 | -70.40 | 6.89 | -40.76 | -3.07 | -4.18 | 25.37 |
| 16 | -69.37 | 4.51 | -45.21 | -7.45 | -1.80 | 25.38 |
| 17 | -48.05 | 18.81 | -20.53 | 15.52 | -17.76 | 22.75 |
| 18 | -47.02 | 16.43 | -24.98 | 11.14 | -15.38 | 22.76 |
| 19 | -33.60 | 2.60 | -22.76 | -2.27 | -1.55 | 24.98 |
| 20 | -32.57 | 0.22 | -27.21 | -6.66 | 0.83 | 24.99 |
| 21 | -3.50 | 12.05 | 1.98 | 15.35 | -12.91 | 17.86 |
| 22 | -2.47 | 9.67 | -2.47 | 10.96 | -10.53 | 17.87 |
| 23 | -62.66 | 4.42 | -36.25 | -4.04 | -1.96 | 20.86 |
| 24 | -61.63 | 2.04 | -40.71 | -8.42 | 0.42 | 20.87 |
| 25 | -40.31 | 16.34 | -16.02 | 14.55 | -15.54 | 18.24 |
| 26 | -39.27 | 13.96 | -20.47 | 10.17 | -13.16 | 18.26 |
| 27 | -25.86 | 0.13 | -18.25 | -3.24 | 0.67 | 20.47 |
| 28 | -24.83 | -2.25 | -22.70 | -7.63 | 3.05 | 20.48 |
| 29 | -12.67 | 9.85 | -2.52 | 13.48 | -9.96 | 18.55 |
| 30 | -10.95 | 5.88 | -9.93 | 6.18 | -6.00 | 18.57 |
| 31 | -54.08 | 4.50 | -29.28 | -0.09 | -2.30 | 20.65 |
| 32 | -52.36 | 0.54 | -36.70 | -7.39 | 1.67 | 20.67 |
| 33 | -38.43 | 12.85 | -15.12 | 12.93 | -11.81 | 18.82 |
| 34 | -36.71 | 8.88 | -22.54 | 5.62 | -7.84 | 18.84 |
| 35 | -28.32 | 1.50 | -16.68 | 0.47 | -0.46 | 20.38 |
| 36 | -26.60 | -2.47 | -24.10 | -6.84 | 3.51 | 20.40 |
| 37 | -4.93 | 7.38 | 1.99 | 12.51 | -7.74 | 14.04 |
| 38 | -3.21 | 3.41 | -5.43 | 5.21 | -3.77 | 14.06 |
| 39 | -46.34 | 2.04 | -24.77 | -1.06 | -0.07 | 16.14 |
| 40 | -44.62 | -1.93 | -32.19 | -8.36 | 3.89 | 16.16 |
| 41 | -30.69 | 10.39 | -10.61 | 11.96 | -9.58 | 14.31 |
| 42 | -28.97 | 6.42 | -18.03 | 4.65 | -5.61 | 14.33 |
| 43 | -20.58 | -0.96 | -12.17 | -0.50 | 1.77 | 15.87 |
| 44 | -18.86 | -4.93 | -19.59 | -7.81 | 5.74 | 15.89 |
| 45 | -27.05 | 14.63 | -14.12 | 10.40 | -14.30 | 21.75 |
| 46 | -25.44 | 13.22 | -14.78 | 7.79 | -12.89 | 22.41 |
| 47 | -52.68 | 11.32 | -30.69 | 1.99 | -9.56 | 23.05 |
| 48 | -51.07 | 9.91 | -31.35 | -0.61 | -8.15 | 23.71 |
| 49 | -43.00 | 16.49 | -21.92 | 10.05 | -15.44 | 21.92 |
| 50 | -41.39 | 15.08 | -22.58 | 7.45 | -14.03 | 22.58 |
| 51 | -36.74 | 9.46 | -22.89 | 2.34 | -8.42 | 22.89 |
| 52 | -35.13 | 8.05 | -23.55 | -0.26 | -7.01 | 23.55 |
| 53 | -20.99 | 11.42 | -10.78 | 8.30 | -11.16 | 16.66 |
| 54 | -19.38 | 10.00 | -11.44 | 5.69 | -9.75 | 17.32 |
| 55 | -40.71 | 8.87 | -23.53 | 1.83 | -7.51 | 17.66 |
| 56 | -39.10 | 7.46 | -24.19 | -0.77 | -6.10 | 18.32 |
| 57 | -33.26 | 12.85 | -16.79 | 8.03 | -12.04 | 16.79 |
| 58 | -31.65 | 11.43 | -17.45 | 5.43 | -10.63 | 17.45 |
| 59 | -28.45 | 7.44 | -17.53 | 2.10 | -6.64 | 17.53 |
| 60 | -26.83 | 6.03 | -18.19 | -0.50 | -5.23 | 18.19 |

强度计算控制组合号: 2, M=-75.85, N=10.53, M=-3.90, N=-7.82

强度计算应力比 =0.438

抗剪强度计算控制组合号: 2, V=-46.05

抗剪强度计算应力比 =0.157

平面内稳定计算最大应力对应组合号: 2, M=-75.85, N=10.53, M=-3.90, N=-7.82

平面内稳定计算最大应力 (N/mm\*mm) =135.03

平面内稳定计算最大应力比 =0.443

临界弯矩Mcr(kN\*m) =3279.41

平面外稳定计算最大应力比 =0.281

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 =0.438 < 1.0

抗剪强度计算应力比 =0.157 < 1.0

平面内稳定计算最大应力 < f=305.00

平面外稳定计算最大应力比 < 1.0

腹板高厚比 H0/TW=46.67 < [H0/TW]=250.00

翼缘宽厚比 B/T =9.70 < [B/T]=12.20

压杆,平面内长细比 λ=179. ≤ [λ]=180

压杆,平面外长细比 λ=31. ≤ [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 | -20.19 | 10.71 | -11.11 | 7.00 | -10.46 | 16.99 |
| 2 | -39.91 | 8.17 | -23.86 | 0.53 | -6.81 | 17.99 |
| 3 | -32.45 | 12.14 | -17.12 | 6.73 | -11.34 | 17.12 |
| 4 | -27.64 | 6.74 | -17.86 | 0.80 | -5.93 | 17.86 |
| 5 | -17.61 | 9.89 | -9.61 | 6.67 | -9.72 | 15.48 |
| 6 | -37.33 | 7.34 | -22.36 | 0.21 | -6.07 | 16.49 |
| 7 | -29.87 | 11.32 | -15.61 | 6.41 | -10.59 | 15.61 |
| 8 | -25.06 | 5.91 | -16.36 | 0.48 | -5.19 | 16.36 |
| 9 | -23.38 | 6.60 | -12.67 | 3.60 | -5.79 | 13.66 |
| 10 | -22.92 | 5.54 | -14.65 | 1.65 | -4.74 | 13.66 |
| 11 | -20.80 | 5.78 | -11.17 | 3.28 | -5.05 | 12.15 |
| 12 | -20.34 | 4.72 | -13.14 | 1.33 | -3.99 | 12.16 |

防火设计控制的偶然组合号: 2, M=-39.91, N=8.17, M=0.53, N=-6.81

强度计算荷载比 =0.23

平面内稳定计算荷载比 =0.24

平面外稳定计算荷载比 =0.13

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): 643.00℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.4390(m^2\*℃/w) ,计算所需保护层厚度(di) =43.90(mm)

构件重量 (Kg)=67.02

**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 | 165.25 | 35.62 | 80.40 | 134.06 | -30.81 | -22.29 |
| 2 | 82.15 | 17.78 | 43.03 | 68.22 | -18.09 | -10.73 |
| 3 | 107.50 | 23.30 | 64.06 | 95.23 | -20.43 | -6.47 |
| 4 | 139.89 | 30.11 | 59.37 | 107.05 | -28.47 | -26.54 |
| 5 | 144.49 | 31.15 | 70.05 | 117.09 | -26.71 | -19.51 |
| 6 | 61.39 | 13.30 | 32.68 | 51.26 | -13.99 | -7.95 |
| 7 | 86.74 | 18.82 | 53.71 | 78.27 | -16.33 | -3.70 |
| 8 | 119.13 | 25.63 | 49.02 | 90.09 | -24.37 | -23.77 |
| 9 | 48.61 | 26.11 | 35.64 | 75.08 | -24.48 | -7.39 |
| 10 | 83.98 | 5.90 | 29.35 | 29.83 | -4.27 | -10.24 |
| 11 | 27.85 | 21.63 | 25.29 | 58.11 | -20.38 | -4.62 |
| 12 | 63.22 | 1.43 | 19.00 | 12.87 | -0.17 | -7.47 |
| 13 | 140.44 | 39.65 | 74.87 | 135.00 | -34.83 | -19.51 |
| 14 | 161.66 | 27.52 | 71.10 | 107.85 | -22.71 | -21.22 |
| 15 | 57.34 | 21.81 | 37.50 | 69.17 | -22.11 | -7.95 |
| 16 | 78.56 | 9.68 | 33.73 | 42.02 | -9.99 | -9.66 |
| 17 | 82.69 | 27.32 | 58.53 | 96.18 | -24.45 | -3.70 |
| 18 | 103.91 | 15.20 | 54.76 | 69.03 | -12.33 | -5.40 |
| 19 | 115.08 | 34.13 | 53.84 | 108.00 | -32.49 | -23.77 |
| 20 | 136.31 | 22.01 | 50.07 | 80.85 | -20.37 | -25.48 |
| 21 | 119.68 | 35.17 | 64.52 | 118.04 | -30.73 | -16.74 |
| 22 | 140.90 | 23.05 | 60.75 | 90.89 | -18.61 | -18.45 |
| 23 | 36.58 | 17.33 | 27.15 | 52.21 | -18.01 | -5.18 |
| 24 | 57.80 | 5.20 | 23.38 | 25.06 | -5.89 | -6.89 |
| 25 | 61.93 | 22.85 | 48.18 | 79.21 | -20.35 | -0.92 |
| 26 | 83.16 | 10.72 | 44.41 | 52.07 | -8.23 | -2.63 |
| 27 | 94.33 | 29.65 | 43.49 | 91.04 | -28.39 | -20.99 |
| 28 | 115.55 | 17.53 | 39.72 | 63.89 | -16.27 | -22.70 |
| 29 | 101.31 | 37.47 | 60.52 | 117.47 | -33.60 | -14.58 |
| 30 | 136.68 | 17.26 | 54.24 | 72.22 | -13.40 | -17.43 |
| 31 | 43.14 | 24.98 | 34.36 | 71.38 | -24.70 | -6.49 |
| 32 | 78.51 | 4.77 | 28.08 | 26.14 | -4.49 | -9.33 |
| 33 | 60.89 | 28.84 | 49.08 | 90.29 | -26.34 | -3.51 |
| 34 | 96.26 | 8.63 | 42.80 | 45.04 | -6.13 | -6.36 |
| 35 | 83.56 | 33.60 | 45.80 | 98.56 | -31.97 | -17.56 |
| 36 | 118.93 | 13.40 | 39.52 | 53.32 | -11.76 | -20.41 |
| 37 | 80.56 | 32.99 | 50.17 | 100.51 | -29.50 | -11.81 |
| 38 | 115.92 | 12.78 | 43.89 | 55.26 | -9.30 | -14.65 |
| 39 | 22.38 | 20.50 | 24.02 | 54.42 | -20.60 | -3.71 |
| 40 | 57.75 | 0.29 | 17.73 | 9.18 | -0.39 | -6.56 |
| 41 | 40.13 | 24.36 | 38.74 | 73.33 | -22.24 | -0.74 |
| 42 | 75.50 | 4.15 | 32.45 | 28.08 | -2.03 | -3.58 |
| 43 | 62.80 | 29.13 | 35.45 | 81.60 | -27.87 | -14.79 |
| 44 | 98.17 | 8.92 | 29.17 | 36.35 | -7.66 | -17.63 |
| 45 | 114.19 | 24.98 | 59.44 | 103.47 | -21.97 | -15.66 |
| 46 | 130.98 | 27.88 | 61.06 | 96.01 | -24.87 | -17.28 |
| 47 | 78.18 | 17.25 | 43.25 | 74.94 | -16.46 | -10.65 |
| 48 | 94.97 | 20.15 | 44.87 | 67.48 | -19.36 | -12.27 |
| 49 | 89.16 | 19.64 | 52.36 | 86.64 | -17.47 | -8.80 |
| 50 | 105.96 | 22.54 | 53.98 | 79.19 | -20.37 | -10.43 |
| 51 | 103.20 | 22.59 | 50.33 | 91.76 | -20.95 | -17.50 |
| 52 | 119.99 | 25.49 | 51.95 | 84.31 | -23.85 | -19.13 |
| 53 | 85.90 | 18.88 | 45.53 | 80.45 | -16.56 | -11.86 |
| 54 | 102.69 | 21.78 | 47.16 | 72.99 | -19.46 | -13.48 |
| 55 | 58.20 | 12.94 | 33.08 | 58.51 | -12.32 | -8.00 |
| 56 | 74.99 | 15.83 | 34.70 | 51.05 | -15.22 | -9.63 |
| 57 | 66.65 | 14.77 | 40.09 | 67.51 | -13.10 | -6.59 |
| 58 | 83.44 | 17.67 | 41.71 | 60.05 | -16.00 | -8.21 |
| 59 | 77.45 | 17.04 | 38.52 | 71.45 | -15.78 | -13.28 |
| 60 | 94.24 | 19.94 | 40.15 | 63.99 | -18.68 | -14.90 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 0.00 | 0.00 | -21.96 | -47.45 | -71.58 | -88.26 | -135.00 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 165.25 | 58.16 | 33.83 | 16.88 | 5.12 | 0.00 | 0.00 |

强度计算应力比 =0.515

抗剪强度计算应力比 =0.231

平面内稳定计算最大应力对应组合号: 1, M=165.25, N=35.62, M=134.06, N=-30.81

平面内稳定最大应力 (N/mm\*mm) =140.15

平面内稳定计算最大应力比 =0.460

临界弯矩Mcr(kN\*m) =864.43

平面外稳定计算最大应力比 =0.277

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 =0.515 < 1.0

抗剪强度计算应力比 =0.231 < 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 =0.277 < 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 | 8.42 | 17.44 | 26.51 | 35.15 | 42.90 | 49.35 |

最大挠度值 =49.35 最大挠度/梁跨度 =1/339.

斜梁坡度初始值: 1/20.05

变形后斜梁坡度最小值: 1/24.79

变形后斜梁坡度改变率 =0.191 < 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 | 94.30 | 20.33 | 46.35 | 76.72 | -18.01 | -12.67 |
| 2 | 66.59 | 14.38 | 33.89 | 54.78 | -13.77 | -8.82 |
| 3 | 75.05 | 16.22 | 40.90 | 63.78 | -14.55 | -7.40 |
| 4 | 85.84 | 18.49 | 39.34 | 67.72 | -17.23 | -14.09 |
| 5 | 87.38 | 18.84 | 42.90 | 71.07 | -16.65 | -11.74 |
| 6 | 59.67 | 12.89 | 30.44 | 49.12 | -12.41 | -7.89 |
| 7 | 68.13 | 14.73 | 37.45 | 58.13 | -13.19 | -6.47 |
| 8 | 78.92 | 17.00 | 35.89 | 62.07 | -15.87 | -13.16 |
| 9 | 58.17 | 16.71 | 32.04 | 56.96 | -15.46 | -8.01 |
| 10 | 67.60 | 11.33 | 30.36 | 44.89 | -10.07 | -8.77 |
| 11 | 51.25 | 15.22 | 28.59 | 51.30 | -14.09 | -7.09 |
| 12 | 60.68 | 9.83 | 26.92 | 39.24 | -8.70 | -7.85 |

--- 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 -18.44 -38.90 -54.02 -76.72

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 94.30 40.23 16.31 0.00 0.00 0.00 0.00

强度计算荷载比 =0.30

平面内稳定计算荷载比 =0.26

平面外稳定计算荷载比 =0.12

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): 648.31℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2370(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 | -68.22 | 18.11 | 10.69 | -137.75 | -16.20 | 50.59 |
| 2 | -134.06 | 30.86 | 22.22 | -252.81 | -23.72 | 90.12 |
| 3 | -131.75 | 32.68 | 22.75 | -225.61 | -26.92 | 87.74 |
| 4 | -70.52 | 16.29 | 10.15 | -164.94 | -13.00 | 52.97 |
| 5 | -51.26 | 14.01 | 7.92 | -105.01 | -12.86 | 38.79 |
| 6 | -117.09 | 26.75 | 19.45 | -220.07 | -20.37 | 78.32 |
| 7 | -114.79 | 28.57 | 19.99 | -192.88 | -23.57 | 75.94 |
| 8 | -53.56 | 12.19 | 7.39 | -132.20 | -9.66 | 41.17 |
| 9 | -75.08 | 24.49 | 7.34 | -143.15 | -21.20 | 47.02 |
| 10 | -29.83 | 4.29 | 10.23 | -60.55 | -1.00 | 26.66 |
| 11 | -58.11 | 20.39 | 4.57 | -110.41 | -17.85 | 35.22 |
| 12 | -12.87 | 0.19 | 7.47 | -27.81 | 2.35 | 14.86 |
| 13 | -69.17 | 22.13 | 7.90 | -138.51 | -20.22 | 48.12 |
| 14 | -42.02 | 10.01 | 9.64 | -88.95 | -8.10 | 35.90 |
| 15 | -135.00 | 34.88 | 19.43 | -253.58 | -27.74 | 87.65 |
| 16 | -107.85 | 22.76 | 21.17 | -204.01 | -15.61 | 75.43 |
| 17 | -132.70 | 36.70 | 19.97 | -226.38 | -30.93 | 85.27 |
| 18 | -105.55 | 24.58 | 21.70 | -176.82 | -18.81 | 73.05 |
| 19 | -71.47 | 20.31 | 7.37 | -165.71 | -17.02 | 50.50 |
| 20 | -44.32 | 8.19 | 9.10 | -116.14 | -4.90 | 38.28 |
| 21 | -52.21 | 18.03 | 5.14 | -105.77 | -16.88 | 36.32 |
| 22 | -25.06 | 5.91 | 6.87 | -56.21 | -4.75 | 24.10 |
| 23 | -118.04 | 30.77 | 16.67 | -220.84 | -24.39 | 75.84 |
| 24 | -90.89 | 18.65 | 18.40 | -171.27 | -12.27 | 63.63 |
| 25 | -115.74 | 32.59 | 17.20 | -193.64 | -27.59 | 73.46 |
| 26 | -88.59 | 20.47 | 18.94 | -144.08 | -15.47 | 61.25 |
| 27 | -54.51 | 16.21 | 4.60 | -132.97 | -13.68 | 38.70 |
| 28 | -27.36 | 4.09 | 6.34 | -83.40 | -1.56 | 26.48 |
| 29 | -71.38 | 24.72 | 6.43 | -140.26 | -22.39 | 46.63 |
| 30 | -26.14 | 4.51 | 9.32 | -57.66 | -2.19 | 26.28 |
| 31 | -117.47 | 33.64 | 14.51 | -220.81 | -27.65 | 74.30 |
| 32 | -72.22 | 13.44 | 17.40 | -138.20 | -7.45 | 53.95 |
| 33 | -115.86 | 34.91 | 14.88 | -201.77 | -29.89 | 72.64 |
| 34 | -70.61 | 14.71 | 17.77 | -119.17 | -9.69 | 52.28 |
| 35 | -72.99 | 23.44 | 6.06 | -159.30 | -20.15 | 48.30 |
| 36 | -27.75 | 3.24 | 8.95 | -76.69 | 0.05 | 27.94 |
| 37 | -54.42 | 20.61 | 3.67 | -107.52 | -19.04 | 34.83 |
| 38 | -9.18 | 0.41 | 6.56 | -24.92 | 1.16 | 14.47 |
| 39 | -100.51 | 29.53 | 11.74 | -188.07 | -24.30 | 62.50 |
| 40 | -55.26 | 9.33 | 14.63 | -105.46 | -4.10 | 42.14 |
| 41 | -98.89 | 30.80 | 12.11 | -169.03 | -26.54 | 60.84 |
| 42 | -53.65 | 10.60 | 15.01 | -86.43 | -6.34 | 40.48 |
| 43 | -56.03 | 19.34 | 3.29 | -126.56 | -16.80 | 36.50 |
| 44 | -10.79 | -0.86 | 6.19 | -43.95 | 3.40 | 16.14 |
| 45 | -74.94 | 17.84 | 10.54 | -146.03 | -15.15 | 51.78 |
| 46 | -67.48 | 18.02 | 12.30 | -134.13 | -15.33 | 50.02 |
| 47 | -103.47 | 23.36 | 15.54 | -195.89 | -18.40 | 68.91 |
| 48 | -96.01 | 23.55 | 17.30 | -183.99 | -18.59 | 67.15 |
| 49 | -102.47 | 24.15 | 15.77 | -184.11 | -19.79 | 67.88 |
| 50 | -95.01 | 24.33 | 17.53 | -172.21 | -19.97 | 66.12 |
| 51 | -75.94 | 17.05 | 10.31 | -157.82 | -13.76 | 52.82 |
| 52 | -68.48 | 17.24 | 12.07 | -145.92 | -13.94 | 51.06 |
| 53 | -58.51 | 13.70 | 7.90 | -113.71 | -11.63 | 40.04 |
| 54 | -51.05 | 13.89 | 9.66 | -101.81 | -11.81 | 38.28 |
| 55 | -80.45 | 17.95 | 11.75 | -152.06 | -14.14 | 53.21 |
| 56 | -72.99 | 18.13 | 13.51 | -140.16 | -14.32 | 51.45 |
| 57 | -79.68 | 18.56 | 11.93 | -143.00 | -15.20 | 52.42 |
| 58 | -72.23 | 18.74 | 13.69 | -131.10 | -15.38 | 50.66 |
| 59 | -59.27 | 13.10 | 7.73 | -122.77 | -10.56 | 40.83 |
| 60 | -51.82 | 13.28 | 9.49 | -110.87 | -10.75 | 39.07 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -135.00 | -156.58 | -147.65 | -104.97 | -33.09 | 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 | 5.61 | 86.16 | 253.58 |

强度计算应力比 =0.776

抗剪强度计算应力比 =0.249

平面内稳定计算最大应力对应组合号: 1, M=-68.22, N=18.11, M=-137.75, N=-16.20

平面内稳定最大应力 (N/mm\*mm) =222.75

平面内稳定计算最大应力比 =0.730

临界弯矩Mcr(kN\*m) =975.64

平面外稳定计算最大应力比 =0.569

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 =0.776 < 1.0

抗剪强度计算应力比 =0.249 < 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 =0.569 < 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 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 49.35 | 55.12 | 52.68 | 42.84 | 28.03 | 12.07 | 0.00 |

最大挠度值 =55.12 最大挠度/梁跨度 =1/303.

斜梁坡度初始值: 1/19.18

变形后斜梁坡度最小值: 1/16.39

变形后斜梁坡度改变率 =0.170 < 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 | -54.78 | 13.79 | 8.78 | -107.76 | -11.72 | 39.16 |
| 2 | -76.72 | 18.04 | 12.63 | -146.11 | -14.23 | 52.33 |
| 3 | -75.96 | 18.65 | 12.81 | -137.05 | -15.29 | 51.54 |
| 4 | -55.55 | 13.19 | 8.61 | -116.82 | -10.66 | 39.95 |
| 5 | -49.12 | 12.42 | 7.86 | -96.84 | -10.61 | 35.22 |
| 6 | -71.07 | 16.67 | 11.71 | -135.20 | -13.11 | 48.40 |
| 7 | -70.30 | 17.28 | 11.88 | -126.13 | -14.18 | 47.61 |
| 8 | -49.89 | 11.82 | 7.69 | -105.91 | -9.54 | 36.02 |
| 9 | -56.96 | 15.47 | 7.98 | -109.47 | -12.94 | 38.24 |
| 10 | -44.89 | 10.09 | 8.75 | -87.45 | -7.55 | 32.81 |
| 11 | -51.30 | 14.10 | 7.06 | -98.56 | -11.83 | 34.31 |
| 12 | -39.24 | 8.72 | 7.83 | -76.53 | -6.44 | 28.88 |

--- 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 -76.72 -89.60 -83.59 -57.92 -12.59 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 0.00 52.40 146.11

强度计算荷载比 =0.45

平面内稳定计算荷载比 =0.42

平面外稳定计算荷载比 =0.25

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): 601.00℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2670(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 | -68.22 | 18.09 | -10.73 | -82.15 | -17.78 | 43.03 |
| 2 | -134.06 | 30.81 | -22.29 | -165.25 | -35.62 | 80.40 |
| 3 | -95.23 | 20.43 | -6.47 | -107.50 | -23.30 | 64.06 |
| 4 | -107.05 | 28.47 | -26.54 | -139.89 | -30.11 | 59.37 |
| 5 | -51.26 | 13.99 | -7.95 | -61.39 | -13.30 | 32.68 |
| 6 | -117.09 | 26.71 | -19.51 | -144.49 | -31.15 | 70.05 |
| 7 | -78.27 | 16.33 | -3.70 | -86.74 | -18.82 | 53.71 |
| 8 | -90.09 | 24.37 | -23.77 | -119.14 | -25.63 | 49.02 |
| 9 | -29.75 | 4.25 | -10.23 | -83.90 | -5.89 | 29.31 |
| 10 | -75.09 | 24.50 | -7.40 | -48.66 | -26.13 | 35.65 |
| 11 | -12.79 | 0.15 | -7.45 | -63.14 | -1.41 | 18.96 |
| 12 | -58.13 | 20.40 | -4.63 | -27.90 | -21.66 | 25.30 |
| 13 | -41.97 | 9.98 | -9.65 | -78.51 | -9.67 | 33.71 |
| 14 | -69.18 | 22.13 | -7.95 | -57.37 | -21.82 | 37.51 |
| 15 | -107.81 | 22.70 | -21.21 | -161.62 | -27.51 | 71.07 |
| 16 | -135.01 | 34.85 | -19.52 | -140.47 | -39.66 | 74.88 |
| 17 | -68.98 | 12.32 | -5.40 | -103.87 | -15.19 | 54.74 |
| 18 | -96.18 | 24.47 | -3.70 | -82.73 | -27.34 | 58.54 |
| 19 | -80.80 | 20.36 | -25.47 | -136.26 | -22.00 | 50.05 |
| 20 | -108.01 | 32.51 | -23.77 | -115.12 | -34.14 | 53.85 |
| 21 | -25.01 | 5.88 | -6.88 | -57.75 | -5.19 | 23.36 |
| 22 | -52.22 | 18.03 | -5.18 | -36.61 | -17.34 | 27.16 |
| 23 | -90.84 | 18.60 | -18.44 | -140.86 | -23.04 | 60.73 |
| 24 | -118.05 | 30.75 | -16.74 | -119.71 | -35.19 | 64.53 |
| 25 | -52.02 | 8.22 | -2.62 | -83.11 | -10.71 | 44.39 |
| 26 | -79.22 | 20.37 | -0.93 | -61.97 | -22.86 | 48.19 |
| 27 | -63.84 | 16.26 | -22.69 | -115.50 | -17.52 | 39.70 |
| 28 | -91.04 | 28.41 | -21.00 | -94.36 | -29.67 | 43.50 |
| 29 | -26.06 | 4.47 | -9.32 | -78.43 | -4.75 | 28.04 |
| 30 | -71.40 | 24.72 | -6.49 | -43.19 | -25.00 | 34.38 |
| 31 | -72.14 | 13.38 | -17.42 | -136.60 | -17.24 | 54.19 |
| 32 | -117.48 | 33.63 | -14.59 | -101.37 | -37.49 | 60.54 |
| 33 | -44.96 | 6.11 | -6.35 | -96.18 | -8.61 | 42.76 |
| 34 | -90.30 | 26.36 | -3.52 | -60.94 | -28.86 | 49.10 |
| 35 | -53.23 | 11.74 | -20.39 | -118.85 | -13.38 | 39.47 |
| 36 | -98.58 | 31.99 | -17.57 | -83.62 | -33.63 | 45.82 |
| 37 | -9.09 | 0.37 | -6.55 | -57.67 | -0.27 | 17.69 |
| 38 | -54.44 | 20.62 | -3.72 | -22.43 | -20.52 | 24.03 |
| 39 | -55.18 | 9.28 | -14.64 | -115.84 | -12.76 | 43.85 |
| 40 | -100.52 | 29.53 | -11.81 | -80.61 | -33.01 | 50.19 |
| 41 | -28.00 | 2.01 | -3.57 | -75.42 | -4.14 | 32.41 |
| 42 | -73.34 | 22.26 | -0.74 | -40.18 | -24.38 | 38.75 |
| 43 | -36.27 | 7.64 | -17.62 | -98.09 | -8.90 | 29.13 |
| 44 | -81.62 | 27.89 | -14.79 | -62.86 | -29.15 | 35.47 |
| 45 | -67.48 | 19.36 | -12.27 | -94.97 | -20.15 | 44.87 |
| 46 | -74.94 | 16.46 | -10.65 | -78.18 | -17.25 | 43.25 |
| 47 | -96.01 | 24.87 | -17.28 | -130.98 | -27.88 | 61.06 |
| 48 | -103.47 | 21.97 | -15.66 | -114.19 | -24.98 | 59.44 |
| 49 | -79.19 | 20.37 | -10.43 | -105.96 | -22.54 | 53.98 |
| 50 | -86.64 | 17.47 | -8.80 | -89.16 | -19.64 | 52.36 |
| 51 | -84.31 | 23.85 | -19.13 | -119.99 | -25.49 | 51.95 |
| 52 | -91.76 | 20.95 | -17.50 | -103.20 | -22.59 | 50.33 |
| 53 | -51.05 | 15.22 | -9.63 | -74.99 | -15.83 | 34.70 |
| 54 | -58.51 | 12.32 | -8.00 | -58.20 | -12.94 | 33.08 |
| 55 | -72.99 | 19.46 | -13.48 | -102.69 | -21.78 | 47.16 |
| 56 | -80.45 | 16.56 | -11.86 | -85.90 | -18.88 | 45.53 |
| 57 | -60.05 | 16.00 | -8.21 | -83.44 | -17.67 | 41.71 |
| 58 | -67.51 | 13.10 | -6.59 | -66.65 | -14.77 | 40.09 |
| 59 | -63.99 | 18.68 | -14.90 | -94.24 | -19.94 | 40.15 |
| 60 | -71.45 | 15.78 | -13.28 | -77.45 | -17.04 | 38.52 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -135.01 | -88.26 | -71.58 | -47.44 | -21.94 | 0.00 | 0.00 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 0.00 | 0.00 | 5.17 | 16.91 | 33.83 | 58.12 | 165.25 |

强度计算应力比 =0.515

抗剪强度计算应力比 =0.231

平面内稳定计算最大应力对应组合号: 1, M=-68.22, N=18.09, M=-82.15, N=-17.78

平面内稳定最大应力 (N/mm\*mm) =140.15

平面内稳定计算最大应力比 =0.460

临界弯矩Mcr(kN\*m) =864.43

平面外稳定计算最大应力比 =0.277

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 =0.515 < 1.0

抗剪强度计算应力比 =0.231 < 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 =0.277 < 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 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 49.35 | 42.90 | 35.15 | 26.51 | 17.44 | 8.42 | 0.00 |

最大挠度值 =49.35 最大挠度/梁跨度 =1/339.

斜梁坡度初始值: 1/20.05

变形后斜梁坡度最小值: 1/24.79

变形后斜梁坡度改变率 =0.191 < 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 | -54.78 | 13.77 | -8.82 | -66.59 | -14.38 | 33.89 |
| 2 | -76.72 | 18.01 | -12.67 | -94.30 | -20.33 | 46.35 |
| 3 | -63.78 | 14.55 | -7.40 | -75.05 | -16.22 | 40.90 |
| 4 | -67.72 | 17.23 | -14.09 | -85.84 | -18.49 | 39.34 |
| 5 | -49.12 | 12.41 | -7.89 | -59.67 | -12.89 | 30.44 |
| 6 | -71.07 | 16.65 | -11.74 | -87.38 | -18.84 | 42.90 |
| 7 | -58.13 | 13.19 | -6.47 | -68.13 | -14.73 | 37.45 |
| 8 | -62.07 | 15.87 | -13.16 | -78.92 | -17.00 | 35.89 |
| 9 | -44.87 | 10.06 | -8.77 | -67.58 | -11.32 | 30.35 |
| 10 | -56.96 | 15.46 | -8.01 | -58.19 | -16.72 | 32.04 |
| 11 | -39.22 | 8.70 | -7.84 | -60.66 | -9.83 | 26.90 |
| 12 | -51.31 | 14.09 | -7.09 | -51.27 | -15.23 | 28.60 |

--- 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 -76.72 -54.02 -38.90 -18.44 0.00 0.00 0.00

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 0.00 0.00 0.00 0.00 16.31 40.22 94.30

强度计算荷载比 =0.30

平面内稳定计算荷载比 =0.26

平面外稳定计算荷载比 =0.12

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): 648.31℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2370(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 | 205.73 | 26.33 | 74.14 | -33.52 | -18.70 | 27.20 |
| 2 | 113.91 | 14.34 | 41.23 | -110.35 | -11.74 | 61.17 |
| 3 | 164.35 | 21.93 | 69.85 | -100.53 | -15.40 | 60.05 |
| 4 | 155.28 | 18.75 | 45.52 | -43.34 | -15.04 | 28.32 |
| 5 | 178.95 | 22.92 | 64.49 | -21.51 | -16.15 | 19.81 |
| 6 | 87.13 | 10.94 | 31.58 | -98.34 | -9.19 | 53.79 |
| 7 | 137.58 | 18.52 | 60.20 | -88.52 | -12.85 | 52.66 |
| 8 | 128.51 | 15.34 | 35.87 | -31.33 | -12.49 | 20.93 |
| 9 | 87.24 | 13.31 | 33.96 | -58.25 | -9.60 | 29.51 |
| 10 | 79.19 | 9.25 | 26.11 | -17.82 | -5.54 | 16.68 |
| 11 | 60.47 | 9.90 | 24.31 | -46.24 | -7.05 | 22.12 |
| 12 | 52.42 | 5.84 | 16.46 | -5.80 | -2.99 | 9.30 |
| 13 | 188.46 | 25.46 | 69.42 | -37.24 | -17.83 | 25.70 |
| 14 | 183.63 | 23.02 | 64.71 | -12.98 | -15.39 | 18.00 |
| 15 | 96.64 | 13.48 | 36.51 | -114.07 | -10.87 | 59.67 |
| 16 | 91.81 | 11.04 | 31.80 | -89.81 | -8.44 | 51.98 |
| 17 | 147.08 | 21.06 | 65.13 | -104.26 | -14.53 | 58.55 |
| 18 | 142.25 | 18.62 | 60.42 | -79.99 | -12.09 | 50.86 |
| 19 | 138.02 | 17.88 | 40.80 | -47.06 | -14.17 | 26.82 |
| 20 | 133.19 | 15.44 | 36.09 | -22.80 | -11.73 | 19.13 |
| 21 | 161.69 | 22.05 | 59.76 | -25.23 | -15.28 | 18.31 |
| 22 | 156.86 | 19.62 | 55.05 | -0.97 | -12.84 | 10.62 |
| 23 | 69.87 | 10.07 | 26.85 | -102.06 | -8.32 | 52.29 |
| 24 | 65.04 | 7.63 | 22.15 | -77.80 | -5.89 | 44.59 |
| 25 | 120.31 | 17.65 | 55.48 | -92.24 | -11.98 | 51.16 |
| 26 | 115.48 | 15.21 | 50.77 | -67.98 | -9.54 | 43.47 |
| 27 | 111.24 | 14.47 | 31.14 | -35.05 | -11.62 | 19.43 |
| 28 | 106.41 | 12.04 | 26.43 | -10.79 | -9.18 | 11.74 |
| 29 | 150.04 | 21.41 | 56.58 | -45.28 | -14.95 | 26.14 |
| 30 | 141.98 | 17.35 | 48.73 | -4.84 | -10.89 | 13.32 |
| 31 | 85.76 | 13.02 | 33.54 | -99.06 | -10.09 | 49.92 |
| 32 | 77.71 | 8.96 | 25.69 | -58.63 | -6.02 | 37.10 |
| 33 | 121.07 | 18.33 | 53.57 | -92.19 | -12.65 | 49.14 |
| 34 | 113.02 | 14.26 | 45.73 | -51.75 | -8.58 | 36.31 |
| 35 | 114.73 | 16.10 | 36.54 | -52.16 | -12.39 | 26.93 |
| 36 | 106.68 | 12.04 | 28.69 | -11.72 | -8.33 | 14.10 |
| 37 | 123.26 | 18.00 | 46.92 | -33.27 | -12.40 | 18.75 |
| 38 | 115.21 | 13.94 | 39.07 | 7.17 | -8.34 | 5.93 |
| 39 | 58.99 | 9.62 | 23.89 | -87.05 | -7.54 | 42.54 |
| 40 | 50.94 | 5.55 | 16.04 | -46.62 | -3.47 | 29.71 |
| 41 | 94.30 | 14.92 | 43.92 | -80.18 | -10.10 | 41.75 |
| 42 | 86.25 | 10.86 | 36.07 | -39.74 | -6.03 | 28.93 |
| 43 | 87.95 | 12.70 | 26.89 | -40.14 | -9.84 | 19.54 |
| 44 | 79.90 | 8.63 | 19.04 | 0.29 | -5.78 | 6.72 |
| 45 | 151.76 | 18.88 | 55.32 | -47.61 | -13.47 | 30.44 |
| 46 | 158.02 | 20.67 | 56.35 | -40.43 | -15.26 | 29.41 |
| 47 | 111.97 | 13.68 | 41.06 | -80.90 | -10.45 | 45.16 |
| 48 | 118.24 | 15.48 | 42.09 | -73.72 | -12.25 | 44.13 |
| 49 | 133.83 | 16.97 | 53.46 | -76.65 | -12.04 | 44.67 |
| 50 | 140.09 | 18.76 | 54.49 | -69.47 | -13.83 | 43.64 |
| 51 | 129.90 | 15.59 | 42.92 | -51.86 | -11.88 | 30.92 |
| 52 | 136.17 | 17.38 | 43.95 | -44.68 | -13.67 | 29.89 |
| 53 | 116.02 | 14.31 | 42.43 | -37.45 | -10.15 | 23.53 |
| 54 | 122.28 | 16.11 | 43.47 | -30.27 | -11.95 | 22.50 |
| 55 | 85.41 | 10.32 | 31.46 | -63.06 | -7.83 | 34.86 |
| 56 | 91.67 | 12.11 | 32.50 | -55.88 | -9.63 | 33.83 |
| 57 | 102.22 | 12.85 | 41.00 | -59.79 | -9.05 | 34.48 |
| 58 | 108.49 | 14.64 | 42.04 | -52.61 | -10.85 | 33.45 |
| 59 | 99.20 | 11.79 | 32.89 | -40.72 | -8.93 | 23.91 |
| 60 | 105.47 | 13.58 | 33.93 | -33.54 | -10.73 | 22.87 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 0.00 | 0.00 | -46.07 | -78.92 | -66.07 | -12.19 | -7.17 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 205.73 | 40.62 | 0.00 | 0.00 | 0.00 | 6.65 | 114.07 |

强度计算应力比 =0.780

抗剪强度计算应力比 =0.203

平面内稳定计算最大应力对应组合号: 1, M=205.73, N=26.33, M=-33.52, N=-18.70

平面内稳定最大应力 (N/mm\*mm) =220.25

平面内稳定计算最大应力比 =0.722

临界弯矩Mcr(kN\*m) =850.57

平面外稳定计算最大应力比 =0.716

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 =0.780 < 1.0

抗剪强度计算应力比 =0.203 < 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 =0.716 < 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 | 3.89 | 11.50 | 15.87 | 14.06 | 7.09 | 0.00 |

最大挠度值 =15.87 最大挠度/梁跨度 =1/819.

斜梁坡度初始值: 1/19.91

变形后斜梁坡度最小值: 1/18.55

变形后斜梁坡度改变率 =0.073 < 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 | 119.15 | 15.21 | 42.95 | -33.86 | -11.05 | 23.02 |
| 2 | 88.54 | 11.21 | 31.98 | -59.47 | -8.73 | 34.34 |
| 3 | 105.36 | 13.74 | 41.52 | -56.20 | -9.95 | 33.97 |
| 4 | 102.33 | 12.68 | 33.41 | -37.13 | -9.83 | 23.39 |
| 5 | 110.22 | 14.07 | 39.73 | -29.86 | -10.20 | 20.55 |
| 6 | 79.62 | 10.08 | 28.76 | -55.47 | -7.88 | 31.88 |
| 7 | 96.43 | 12.61 | 38.30 | -52.20 | -9.10 | 31.51 |
| 8 | 93.41 | 11.55 | 30.19 | -33.13 | -8.98 | 20.93 |
| 9 | 81.57 | 10.97 | 30.08 | -41.69 | -8.11 | 23.95 |
| 10 | 79.42 | 9.88 | 27.99 | -30.91 | -7.03 | 20.53 |
| 11 | 72.65 | 9.83 | 26.86 | -37.69 | -7.26 | 21.49 |
| 12 | 70.50 | 8.75 | 24.77 | -26.90 | -6.18 | 18.07 |

--- 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 -20.21 -42.05 -36.59 -4.87 0.00

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 119.15 29.70 0.00 0.00 0.00 0.00 59.47

强度计算荷载比 =0.45

平面内稳定计算荷载比 =0.42

平面外稳定计算荷载比 =0.38

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): 599.41℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2676(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 | 252.81 | 23.72 | 90.12 | 134.06 | -30.86 | 22.22 |
| 2 | 137.75 | 16.20 | 50.59 | 68.22 | -18.11 | 10.69 |
| 3 | 225.61 | 26.92 | 87.74 | 131.75 | -32.68 | 22.75 |
| 4 | 164.94 | 13.00 | 52.97 | 70.52 | -16.29 | 10.15 |
| 5 | 220.07 | 20.37 | 78.32 | 117.09 | -26.75 | 19.45 |
| 6 | 105.01 | 12.86 | 38.79 | 51.26 | -14.01 | 7.92 |
| 7 | 192.88 | 23.57 | 75.94 | 114.79 | -28.57 | 19.99 |
| 8 | 132.20 | 9.66 | 41.17 | 53.56 | -12.19 | 7.39 |
| 9 | 60.39 | 0.98 | 26.61 | 29.75 | -4.27 | 10.22 |
| 10 | 143.19 | 21.22 | 47.04 | 75.09 | -24.51 | 7.34 |
| 11 | 27.65 | -2.37 | 14.81 | 12.79 | -0.17 | 7.45 |
| 12 | 110.45 | 17.88 | 35.24 | 58.13 | -20.41 | 4.58 |
| 13 | 203.92 | 15.60 | 75.40 | 107.81 | -22.75 | 21.16 |
| 14 | 253.60 | 27.75 | 87.66 | 135.01 | -34.89 | 19.44 |
| 15 | 88.86 | 8.09 | 35.87 | 41.97 | -10.00 | 9.63 |
| 16 | 138.54 | 20.24 | 48.13 | 69.18 | -22.14 | 7.90 |
| 17 | 176.73 | 18.80 | 73.02 | 105.50 | -24.56 | 21.70 |
| 18 | 226.41 | 30.95 | 85.27 | 132.71 | -36.71 | 19.97 |
| 19 | 116.05 | 4.89 | 38.25 | 44.27 | -8.18 | 9.10 |
| 20 | 165.73 | 17.04 | 50.51 | 71.48 | -20.33 | 7.37 |
| 21 | 171.18 | 12.26 | 63.60 | 90.84 | -18.64 | 18.40 |
| 22 | 220.86 | 24.40 | 75.85 | 118.05 | -30.78 | 16.67 |
| 23 | 56.12 | 4.74 | 24.07 | 25.01 | -5.89 | 6.87 |
| 24 | 105.80 | 16.89 | 36.32 | 52.22 | -18.04 | 5.14 |
| 25 | 143.99 | 15.46 | 61.22 | 88.54 | -20.46 | 18.93 |
| 26 | 193.67 | 27.60 | 73.47 | 115.75 | -32.60 | 17.21 |
| 27 | 83.31 | 1.54 | 26.45 | 27.31 | -4.08 | 6.33 |
| 28 | 132.99 | 13.69 | 38.71 | 54.52 | -16.22 | 4.61 |
| 29 | 138.05 | 7.43 | 53.89 | 72.14 | -13.42 | 17.39 |
| 30 | 220.85 | 27.67 | 74.32 | 117.48 | -33.66 | 14.51 |
| 31 | 57.51 | 2.17 | 26.22 | 26.06 | -4.50 | 9.31 |
| 32 | 140.30 | 22.41 | 46.65 | 71.40 | -24.74 | 6.44 |
| 33 | 119.01 | 9.67 | 52.23 | 70.53 | -14.69 | 17.76 |
| 34 | 201.81 | 29.91 | 72.65 | 115.87 | -34.93 | 14.88 |
| 35 | 76.54 | -0.07 | 27.89 | 27.67 | -3.22 | 8.94 |
| 36 | 159.34 | 20.17 | 48.32 | 73.01 | -23.46 | 6.07 |
| 37 | 105.31 | 4.08 | 42.09 | 55.18 | -9.31 | 14.62 |
| 38 | 188.11 | 24.33 | 62.52 | 100.52 | -29.55 | 11.75 |
| 39 | 24.77 | -1.18 | 14.42 | 9.09 | -0.39 | 6.55 |
| 40 | 107.56 | 19.07 | 34.85 | 54.44 | -20.63 | 3.67 |
| 41 | 86.27 | 6.32 | 40.42 | 53.57 | -10.58 | 14.99 |
| 42 | 169.07 | 26.57 | 60.85 | 98.91 | -30.83 | 12.12 |
| 43 | 43.80 | -3.41 | 16.09 | 10.71 | 0.88 | 6.18 |
| 44 | 126.60 | 16.83 | 36.51 | 56.05 | -19.36 | 3.30 |
| 45 | 183.99 | 18.59 | 67.15 | 96.01 | -23.55 | 17.30 |
| 46 | 195.89 | 18.40 | 68.91 | 103.47 | -23.36 | 15.54 |
| 47 | 134.13 | 15.33 | 50.02 | 67.48 | -18.02 | 12.30 |
| 48 | 146.03 | 15.15 | 51.78 | 74.94 | -17.84 | 10.54 |
| 49 | 172.21 | 19.97 | 66.12 | 95.01 | -24.33 | 17.53 |
| 50 | 184.11 | 19.79 | 67.88 | 102.47 | -24.15 | 15.77 |
| 51 | 145.92 | 13.94 | 51.06 | 68.48 | -17.24 | 12.07 |
| 52 | 157.82 | 13.76 | 52.82 | 75.94 | -17.05 | 10.31 |
| 53 | 140.16 | 14.32 | 51.45 | 72.99 | -18.13 | 13.51 |
| 54 | 152.06 | 14.14 | 53.21 | 80.45 | -17.95 | 11.75 |
| 55 | 101.81 | 11.81 | 38.28 | 51.05 | -13.89 | 9.66 |
| 56 | 113.71 | 11.63 | 40.04 | 58.51 | -13.70 | 7.90 |
| 57 | 131.10 | 15.39 | 50.66 | 72.23 | -18.74 | 13.69 |
| 58 | 143.00 | 15.20 | 52.42 | 79.68 | -18.56 | 11.93 |
| 59 | 110.87 | 10.75 | 39.07 | 51.82 | -13.28 | 9.49 |
| 60 | 122.77 | 10.56 | 40.83 | 59.27 | -13.10 | 7.73 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 0.00 | 0.00 | -33.09 | -104.97 | -147.65 | -156.58 | -135.01 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 253.60 | 86.17 | 5.60 | 0.00 | 0.00 | 0.00 | 0.00 |

强度计算应力比 =0.777

抗剪强度计算应力比 =0.249

平面内稳定计算最大应力对应组合号: 1, M=252.81, N=23.72, M=134.06, N=-30.86

平面内稳定最大应力 (N/mm\*mm) =222.77

平面内稳定计算最大应力比 =0.730

临界弯矩Mcr(kN\*m) =975.64

平面外稳定计算最大应力比 =0.569

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 =0.777 < 1.0

抗剪强度计算应力比 =0.249 < 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 =0.569 < 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 | 12.07 | 28.03 | 42.84 | 52.68 | 55.12 | 49.35 |

最大挠度值 =55.12 最大挠度/梁跨度 =1/303.

斜梁坡度初始值: 1/19.18

变形后斜梁坡度最小值: 1/16.39

变形后斜梁坡度改变率 =0.170 < 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 | 146.11 | 14.23 | 52.33 | 76.72 | -18.04 | 12.63 |
| 2 | 107.76 | 11.72 | 39.16 | 54.78 | -13.79 | 8.78 |
| 3 | 137.05 | 15.29 | 51.54 | 75.96 | -18.65 | 12.81 |
| 4 | 116.82 | 10.66 | 39.95 | 55.55 | -13.19 | 8.61 |
| 5 | 135.20 | 13.11 | 48.40 | 71.07 | -16.67 | 11.71 |
| 6 | 96.84 | 10.61 | 35.22 | 49.12 | -12.42 | 7.86 |
| 7 | 126.13 | 14.18 | 47.61 | 70.30 | -17.28 | 11.88 |
| 8 | 105.91 | 9.54 | 36.02 | 49.89 | -11.82 | 7.69 |
| 9 | 87.40 | 7.55 | 32.80 | 44.87 | -10.08 | 8.75 |
| 10 | 109.48 | 12.95 | 38.25 | 56.96 | -15.48 | 7.98 |
| 11 | 76.49 | 6.43 | 28.87 | 39.22 | -8.71 | 7.82 |
| 12 | 98.57 | 11.83 | 34.31 | 51.31 | -14.11 | 7.06 |

--- 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 -12.59 -57.92 -83.59 -89.60 -76.72

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 146.11 52.40 0.00 0.00 0.00 0.00 0.00

强度计算荷载比 =0.45

平面内稳定计算荷载比 =0.42

平面外稳定计算荷载比 =0.25

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): 601.00℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2670(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=3.71, Ly=2.00

构件长度=1.85; 计算长度系数: Ux=2.00 Uy=1.08

支撑长度=2.00

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 | 27.74 | 42.63 | 23.11 | 2.04 | -26.45 | 1.47 |
| 2 | -4.84 | 42.87 | -0.01 | -7.86 | -57.51 | 3.20 |
| 3 | -1.89 | 42.46 | 6.35 | -2.91 | -41.47 | 11.53 |
| 4 | 24.80 | 43.04 | 16.76 | -2.91 | -42.49 | -6.86 |
| 5 | 25.85 | 35.48 | 21.22 | 2.54 | -19.43 | 1.08 |
| 6 | -6.73 | 35.72 | -1.90 | -7.37 | -50.48 | 2.81 |
| 7 | -3.78 | 35.31 | 4.45 | -2.41 | -34.44 | 11.14 |
| 8 | 22.90 | 35.89 | 14.87 | -2.41 | -35.47 | -7.25 |
| 9 | 1.67 | 22.34 | 5.56 | -0.54 | -21.79 | 4.34 |
| 10 | 13.23 | 22.72 | 11.79 | -0.55 | -22.17 | -1.90 |
| 11 | -0.22 | 15.19 | 3.67 | -0.04 | -14.76 | 3.95 |
| 12 | 11.34 | 15.57 | 9.90 | -0.05 | -15.15 | -2.29 |
| 13 | 23.83 | 37.44 | 21.52 | 3.02 | -21.26 | 3.06 |
| 14 | 30.76 | 37.67 | 25.27 | 3.01 | -21.49 | -0.68 |
| 15 | -8.75 | 37.68 | -1.59 | -6.89 | -52.31 | 4.78 |
| 16 | -1.82 | 37.91 | 2.15 | -6.90 | -52.54 | 1.04 |
| 17 | -5.81 | 37.27 | 4.76 | -1.94 | -36.27 | 13.12 |
| 18 | 1.13 | 37.50 | 8.50 | -1.94 | -36.51 | 9.38 |
| 19 | 20.88 | 37.85 | 15.17 | -1.94 | -37.30 | -5.28 |
| 20 | 27.82 | 38.08 | 18.91 | -1.94 | -37.53 | -9.02 |
| 21 | 21.94 | 30.28 | 19.63 | 3.51 | -14.23 | 2.67 |
| 22 | 28.87 | 30.51 | 23.37 | 3.51 | -14.46 | -1.07 |
| 23 | -10.64 | 30.52 | -3.49 | -6.39 | -45.28 | 4.39 |
| 24 | -3.71 | 30.76 | 0.25 | -6.40 | -45.52 | 0.65 |
| 25 | -7.70 | 30.11 | 2.86 | -1.44 | -29.25 | 12.73 |
| 26 | -0.76 | 30.35 | 6.61 | -1.44 | -29.48 | 8.99 |
| 27 | 18.99 | 30.69 | 13.28 | -1.44 | -30.27 | -5.67 |
| 28 | 25.93 | 30.92 | 17.02 | -1.44 | -30.50 | -9.41 |
| 29 | 15.36 | 30.48 | 15.99 | 2.40 | -18.99 | 4.18 |
| 30 | 26.91 | 30.87 | 22.23 | 2.40 | -19.38 | -2.05 |
| 31 | -7.45 | 30.65 | -0.19 | -4.53 | -40.73 | 5.39 |
| 32 | 4.11 | 31.04 | 6.05 | -4.54 | -41.12 | -0.84 |
| 33 | -5.39 | 30.36 | 4.26 | -1.07 | -29.50 | 11.22 |
| 34 | 6.17 | 30.75 | 10.49 | -1.07 | -29.89 | 4.99 |
| 35 | 13.29 | 30.77 | 11.55 | -1.07 | -30.22 | -1.65 |
| 36 | 24.85 | 31.16 | 17.78 | -1.07 | -30.61 | -7.89 |
| 37 | 13.46 | 23.33 | 14.10 | 2.90 | -11.97 | 3.79 |
| 38 | 25.02 | 23.72 | 20.34 | 2.90 | -12.35 | -2.44 |
| 39 | -9.34 | 23.50 | -2.08 | -4.04 | -33.70 | 5.00 |
| 40 | 2.22 | 23.88 | 4.15 | -4.04 | -34.09 | -1.23 |
| 41 | -7.28 | 23.21 | 2.36 | -0.57 | -22.48 | 10.83 |
| 42 | 4.28 | 23.60 | 8.60 | -0.57 | -22.86 | 4.60 |
| 43 | 11.40 | 23.62 | 9.65 | -0.57 | -23.19 | -2.04 |
| 44 | 22.96 | 24.00 | 15.89 | -0.57 | -23.58 | -8.28 |
| 45 | 14.56 | 35.30 | 13.53 | -0.34 | -27.97 | 2.73 |
| 46 | 18.77 | 36.79 | 15.80 | -0.34 | -29.46 | 0.46 |
| 47 | 0.44 | 35.40 | 3.51 | -4.63 | -41.43 | 3.48 |
| 48 | 4.65 | 36.89 | 5.78 | -4.63 | -42.92 | 1.21 |
| 49 | 1.72 | 35.22 | 6.26 | -2.49 | -34.48 | 7.09 |
| 50 | 5.93 | 36.71 | 8.53 | -2.49 | -35.97 | 4.82 |
| 51 | 13.29 | 35.47 | 10.78 | -2.49 | -34.92 | -0.88 |
| 52 | 17.49 | 36.96 | 13.05 | -2.49 | -36.41 | -3.15 |
| 53 | 10.72 | 26.98 | 10.14 | -0.26 | -21.35 | 2.36 |
| 54 | 14.93 | 28.47 | 12.42 | -0.26 | -22.84 | 0.09 |
| 55 | -0.14 | 27.06 | 2.44 | -3.56 | -31.70 | 2.94 |
| 56 | 4.07 | 28.55 | 4.71 | -3.56 | -33.19 | 0.67 |
| 57 | 0.84 | 26.92 | 4.56 | -1.91 | -26.35 | 5.72 |
| 58 | 5.05 | 28.41 | 6.83 | -1.91 | -27.84 | 3.45 |
| 59 | 9.73 | 27.11 | 8.03 | -1.91 | -26.69 | -0.41 |
| 60 | 13.94 | 28.61 | 10.30 | -1.91 | -28.18 | -2.69 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -10.64 | -8.18 | -7.86 | -6.74 | -4.82 | -2.44 | -3.51 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 30.76 | 9.84 | 6.97 | 4.60 | 2.84 | 2.25 | 7.86 |

强度计算应力比 =0.396

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=27.74, N=42.63, M=2.04, N=-26.45

平面内稳定最大应力 (N/mm\*mm) =115.78

平面内稳定计算最大应力比 =0.380

临界弯矩Mcr(kN\*m) =798.99

平面外稳定计算最大应力比 =0.265

强度计算应力比 =0.396 < 1.0

抗剪强度计算应力比 =0.131 < 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 =0.265 < 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 | 0.12 | 0.22 | 0.28 | 0.31 | 0.32 | 0.33 |

最大挠度值 =0.33 最大挠度/梁跨度 =1/11138.

斜梁坡度初始值: 1/17.99

变形后斜梁坡度最小值: 1/18.12

变形后斜梁坡度改变率 =0.007 < 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 | 12.82 | 27.72 | 11.28 | -0.26 | -22.09 | 1.23 |
| 2 | 1.96 | 27.80 | 3.57 | -3.56 | -32.44 | 1.80 |
| 3 | 2.94 | 27.67 | 5.69 | -1.91 | -27.10 | 4.58 |
| 4 | 11.84 | 27.86 | 9.16 | -1.91 | -27.44 | -1.55 |
| 5 | 12.19 | 25.34 | 10.65 | -0.10 | -19.75 | 1.10 |
| 6 | 1.33 | 25.42 | 2.94 | -3.40 | -30.10 | 1.67 |
| 7 | 2.31 | 25.28 | 5.06 | -1.75 | -24.75 | 4.45 |
| 8 | 11.21 | 25.48 | 8.53 | -1.75 | -25.09 | -1.68 |
| 9 | 4.57 | 21.54 | 5.61 | -1.23 | -21.11 | 2.01 |
| 10 | 7.65 | 21.64 | 7.27 | -1.23 | -21.22 | 0.34 |
| 11 | 3.94 | 19.15 | 4.97 | -1.07 | -18.77 | 1.88 |
| 12 | 7.02 | 19.25 | 6.64 | -1.07 | -18.87 | 0.21 |

--- 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 -0.17 -0.02 0.00 0.00

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 12.82 5.60 3.94 2.68 1.80 1.46 3.56

强度计算荷载比 =0.19

平面内稳定计算荷载比 =0.17

平面外稳定计算荷载比 =0.11

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): 656.50℃

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)=57.95

**17、 钢 梁 7
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 | 110.35 | 11.74 | 61.17 | -113.91 | -14.34 | 41.23 |
| 2 | 33.52 | 18.70 | 27.20 | -205.73 | -26.33 | 74.14 |
| 3 | 100.53 | 15.40 | 60.05 | -164.35 | -21.93 | 69.85 |
| 4 | 43.34 | 15.04 | 28.32 | -155.28 | -18.75 | 45.52 |
| 5 | 98.34 | 9.19 | 53.79 | -87.13 | -10.94 | 31.58 |
| 6 | 21.51 | 16.15 | 19.81 | -178.95 | -22.92 | 64.49 |
| 7 | 88.52 | 12.85 | 52.66 | -137.58 | -18.52 | 60.20 |
| 8 | 31.33 | 12.49 | 20.93 | -128.51 | -15.34 | 35.87 |
| 9 | 17.76 | 5.52 | 16.65 | -79.07 | -9.23 | 26.07 |
| 10 | 58.27 | 9.62 | 29.52 | -87.28 | -13.33 | 33.97 |
| 11 | 5.75 | 2.97 | 9.26 | -52.30 | -5.82 | 16.42 |
| 12 | 46.26 | 7.07 | 22.13 | -60.50 | -9.93 | 24.32 |
| 13 | 89.78 | 8.42 | 51.96 | -91.74 | -11.03 | 31.77 |
| 14 | 114.09 | 10.89 | 59.68 | -96.66 | -13.49 | 36.52 |
| 15 | 12.95 | 15.38 | 17.98 | -183.56 | -23.01 | 64.68 |
| 16 | 37.25 | 17.84 | 25.70 | -188.48 | -25.47 | 69.43 |
| 17 | 79.96 | 12.08 | 50.84 | -142.18 | -18.61 | 60.40 |
| 18 | 104.27 | 14.55 | 58.56 | -147.10 | -21.07 | 65.14 |
| 19 | 22.77 | 11.72 | 19.11 | -133.12 | -15.43 | 36.06 |
| 20 | 47.07 | 14.18 | 26.83 | -138.04 | -17.89 | 40.80 |
| 21 | 77.77 | 5.88 | 44.57 | -64.96 | -7.62 | 22.12 |
| 22 | 102.07 | 8.34 | 52.29 | -69.89 | -10.08 | 26.86 |
| 23 | 0.94 | 12.83 | 10.60 | -156.78 | -19.61 | 55.03 |
| 24 | 25.24 | 15.29 | 18.32 | -161.71 | -22.07 | 59.77 |
| 25 | 67.95 | 9.53 | 43.45 | -115.41 | -15.20 | 50.74 |
| 26 | 92.26 | 12.00 | 51.17 | -120.33 | -17.67 | 55.48 |
| 27 | 10.76 | 9.17 | 11.72 | -106.34 | -12.02 | 26.41 |
| 28 | 35.06 | 11.63 | 19.44 | -111.27 | -14.49 | 31.15 |
| 29 | 58.57 | 6.01 | 37.07 | -77.59 | -8.94 | 25.65 |
| 30 | 99.08 | 10.11 | 49.93 | -85.80 | -13.04 | 33.55 |
| 31 | 4.79 | 10.87 | 13.28 | -141.87 | -17.33 | 48.68 |
| 32 | 45.30 | 14.98 | 26.15 | -150.07 | -21.43 | 56.59 |
| 33 | 51.70 | 8.57 | 36.28 | -112.90 | -14.25 | 45.68 |
| 34 | 92.21 | 12.67 | 49.15 | -121.11 | -18.35 | 53.59 |
| 35 | 11.67 | 8.31 | 14.07 | -106.56 | -12.02 | 28.65 |
| 36 | 52.18 | 12.42 | 26.94 | -114.76 | -16.13 | 36.55 |
| 37 | 46.56 | 3.46 | 29.68 | -50.82 | -5.53 | 16.00 |
| 38 | 87.07 | 7.56 | 42.55 | -59.03 | -9.64 | 23.90 |
| 39 | -7.22 | 8.32 | 5.90 | -115.09 | -13.92 | 39.03 |
| 40 | 33.29 | 12.43 | 18.76 | -123.30 | -18.03 | 46.94 |
| 41 | 39.69 | 6.02 | 28.89 | -86.13 | -10.84 | 36.03 |
| 42 | 80.20 | 10.12 | 41.76 | -94.34 | -14.95 | 43.93 |
| 43 | -0.35 | 5.76 | 6.68 | -79.78 | -8.62 | 19.00 |
| 44 | 40.16 | 9.87 | 19.55 | -87.99 | -12.72 | 26.90 |
| 45 | 73.72 | 12.25 | 44.13 | -118.24 | -15.48 | 42.09 |
| 46 | 80.90 | 10.45 | 45.16 | -111.97 | -13.68 | 41.06 |
| 47 | 40.43 | 15.26 | 29.41 | -158.02 | -20.67 | 56.35 |
| 48 | 47.61 | 13.47 | 30.44 | -151.76 | -18.88 | 55.32 |
| 49 | 69.47 | 13.83 | 43.64 | -140.09 | -18.76 | 54.49 |
| 50 | 76.65 | 12.04 | 44.67 | -133.83 | -16.97 | 53.46 |
| 51 | 44.68 | 13.67 | 29.89 | -136.17 | -17.38 | 43.95 |
| 52 | 51.86 | 11.88 | 30.92 | -129.90 | -15.59 | 42.92 |
| 53 | 55.88 | 9.63 | 33.83 | -91.67 | -12.11 | 32.50 |
| 54 | 63.06 | 7.83 | 34.86 | -85.41 | -10.32 | 31.46 |
| 55 | 30.27 | 11.95 | 22.50 | -122.28 | -16.11 | 43.47 |
| 56 | 37.45 | 10.15 | 23.53 | -116.02 | -14.31 | 42.43 |
| 57 | 52.61 | 10.85 | 33.45 | -108.49 | -14.64 | 42.04 |
| 58 | 59.79 | 9.05 | 34.48 | -102.22 | -12.85 | 41.00 |
| 59 | 33.54 | 10.73 | 22.87 | -105.47 | -13.58 | 33.93 |
| 60 | 40.72 | 8.93 | 23.91 | -99.20 | -11.79 | 32.89 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -7.22 | -12.19 | -66.07 | -78.92 | -46.07 | 0.00 | 0.00 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 114.09 | 6.65 | 0.00 | 0.00 | 0.00 | 40.62 | 205.73 |

强度计算应力比 =0.780

抗剪强度计算应力比 =0.203

平面内稳定计算最大应力对应组合号: 1, M=110.35, N=11.74, M=-113.91, N=-14.34

平面内稳定最大应力 (N/mm\*mm) =220.25

平面内稳定计算最大应力比 =0.722

临界弯矩Mcr(kN\*m) =850.57

平面外稳定计算最大应力比 =0.716

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 =0.780 < 1.0

抗剪强度计算应力比 =0.203 < 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 =0.716 < 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 | 7.09 | 14.06 | 15.87 | 11.50 | 3.89 | 0.00 |

最大挠度值 =15.87 最大挠度/梁跨度 =1/819.

斜梁坡度初始值: 1/19.91

变形后斜梁坡度最小值: 1/18.55

变形后斜梁坡度改变率 =0.073 < 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 | 59.47 | 8.73 | 34.34 | -88.54 | -11.21 | 31.98 |
| 2 | 33.86 | 11.05 | 23.02 | -119.15 | -15.21 | 42.95 |
| 3 | 56.20 | 9.95 | 33.97 | -105.36 | -13.74 | 41.52 |
| 4 | 37.13 | 9.83 | 23.39 | -102.33 | -12.68 | 33.41 |
| 5 | 55.47 | 7.88 | 31.88 | -79.62 | -10.08 | 28.76 |
| 6 | 29.86 | 10.20 | 20.55 | -110.22 | -14.07 | 39.73 |
| 7 | 52.20 | 9.10 | 31.51 | -96.43 | -12.61 | 38.30 |
| 8 | 33.13 | 8.98 | 20.93 | -93.41 | -11.55 | 30.19 |
| 9 | 30.89 | 7.02 | 20.52 | -79.39 | -9.88 | 27.98 |
| 10 | 41.70 | 8.12 | 23.96 | -81.58 | -10.97 | 30.08 |
| 11 | 26.89 | 6.17 | 18.06 | -70.47 | -8.74 | 24.76 |
| 12 | 37.69 | 7.27 | 21.49 | -72.66 | -9.84 | 26.87 |

--- 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 -4.86 -36.59 -42.05 -20.21 0.00 0.00

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 59.47 0.00 0.00 0.00 0.00 29.70 119.15

强度计算荷载比 =0.45

平面内稳定计算荷载比 =0.42

平面外稳定计算荷载比 =0.38

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): 599.41℃

钢构件需要进行防火保护

计算所需等效热阻(Ri) =0.2676(m^2\*℃/w)

构件重量 (Kg)=682.55

**18、 钢 梁 8
设计结果**

截面类型=16; 布置角度=0; 计算长度： Lx=3.71, Ly=2.00

构件长度=1.85; 计算长度系数: Ux=2.00 Uy=1.08

支撑长度=2.00

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 | 7.86 | 57.51 | 3.20 | 4.84 | -42.87 | -0.01 |
| 2 | -2.04 | 26.46 | 1.47 | -27.74 | -42.63 | 23.11 |
| 3 | 2.91 | 41.47 | 11.53 | 1.89 | -42.46 | 6.35 |
| 4 | 2.91 | 42.49 | -6.86 | -24.80 | -43.04 | 16.76 |
| 5 | 7.37 | 50.48 | 2.81 | 6.73 | -35.72 | -1.90 |
| 6 | -2.54 | 19.43 | 1.08 | -25.85 | -35.48 | 21.22 |
| 7 | 2.41 | 34.44 | 11.14 | 3.78 | -35.31 | 4.45 |
| 8 | 2.41 | 35.47 | -7.25 | -22.90 | -35.89 | 14.87 |
| 9 | 0.54 | 22.13 | -1.90 | -13.23 | -22.68 | 11.79 |
| 10 | 0.55 | 21.83 | 4.34 | -1.67 | -22.38 | 5.55 |
| 11 | 0.04 | 15.11 | -2.29 | -11.34 | -15.53 | 9.90 |
| 12 | 0.05 | 14.80 | 3.95 | 0.22 | -15.22 | 3.66 |
| 13 | 6.89 | 52.52 | 1.04 | 1.82 | -37.88 | 2.15 |
| 14 | 6.90 | 52.33 | 4.79 | 8.75 | -37.70 | -1.60 |
| 15 | -3.02 | 21.47 | -0.68 | -30.76 | -37.64 | 25.27 |
| 16 | -3.01 | 21.28 | 3.06 | -23.83 | -37.46 | 21.52 |
| 17 | 1.94 | 36.48 | 9.38 | -1.13 | -37.48 | 8.50 |
| 18 | 1.94 | 36.30 | 13.12 | 5.81 | -37.29 | 4.76 |
| 19 | 1.94 | 37.50 | -9.02 | -27.81 | -38.05 | 18.91 |
| 20 | 1.94 | 37.32 | -5.27 | -20.88 | -37.87 | 15.17 |
| 21 | 6.39 | 45.49 | 0.65 | 3.71 | -30.73 | 0.25 |
| 22 | 6.40 | 45.31 | 4.40 | 10.64 | -30.55 | -3.49 |
| 23 | -3.51 | 14.44 | -1.07 | -28.87 | -30.49 | 23.37 |
| 24 | -3.51 | 14.26 | 2.67 | -21.93 | -30.31 | 19.63 |
| 25 | 1.44 | 29.46 | 8.99 | 0.77 | -30.32 | 6.61 |
| 26 | 1.44 | 29.27 | 12.73 | 7.70 | -30.14 | 2.86 |
| 27 | 1.44 | 30.48 | -9.41 | -25.92 | -30.90 | 17.02 |
| 28 | 1.44 | 30.29 | -5.66 | -18.99 | -30.72 | 13.28 |
| 29 | 4.53 | 41.08 | -0.84 | -4.10 | -31.00 | 6.05 |
| 30 | 4.54 | 40.77 | 5.40 | 7.45 | -30.69 | -0.19 |
| 31 | -2.40 | 19.34 | -2.05 | -26.91 | -30.83 | 22.23 |
| 32 | -2.40 | 19.03 | 4.19 | -15.35 | -30.52 | 15.99 |
| 33 | 1.07 | 29.85 | 4.99 | -6.16 | -30.71 | 10.49 |
| 34 | 1.07 | 29.54 | 11.23 | 5.39 | -30.40 | 4.25 |
| 35 | 1.07 | 30.57 | -7.89 | -24.85 | -31.12 | 17.78 |
| 36 | 1.07 | 30.26 | -1.65 | -13.29 | -30.81 | 11.54 |
| 37 | 4.04 | 34.05 | -1.23 | -2.21 | -23.84 | 4.15 |
| 38 | 4.04 | 33.74 | 5.00 | 9.34 | -23.54 | -2.09 |
| 39 | -2.90 | 12.31 | -2.44 | -25.02 | -23.68 | 20.34 |
| 40 | -2.90 | 12.01 | 3.80 | -13.46 | -23.37 | 14.10 |
| 41 | 0.57 | 22.82 | 4.60 | -4.27 | -23.56 | 8.60 |
| 42 | 0.57 | 22.52 | 10.84 | 7.28 | -23.25 | 2.36 |
| 43 | 0.57 | 23.54 | -8.28 | -22.96 | -23.96 | 15.89 |
| 44 | 0.57 | 23.23 | -2.04 | -11.40 | -23.66 | 9.65 |
| 45 | 4.63 | 42.92 | 1.21 | -4.65 | -36.89 | 5.78 |
| 46 | 4.63 | 41.43 | 3.48 | -0.44 | -35.40 | 3.51 |
| 47 | 0.34 | 29.46 | 0.46 | -18.77 | -36.79 | 15.80 |
| 48 | 0.34 | 27.97 | 2.73 | -14.56 | -35.30 | 13.53 |
| 49 | 2.49 | 35.97 | 4.82 | -5.93 | -36.71 | 8.53 |
| 50 | 2.49 | 34.48 | 7.09 | -1.72 | -35.22 | 6.26 |
| 51 | 2.49 | 36.41 | -3.15 | -17.49 | -36.96 | 13.05 |
| 52 | 2.49 | 34.92 | -0.88 | -13.29 | -35.47 | 10.78 |
| 53 | 3.56 | 33.19 | 0.67 | -4.07 | -28.55 | 4.71 |
| 54 | 3.56 | 31.70 | 2.94 | 0.14 | -27.06 | 2.44 |
| 55 | 0.26 | 22.84 | 0.09 | -14.93 | -28.47 | 12.42 |
| 56 | 0.26 | 21.35 | 2.36 | -10.72 | -26.98 | 10.14 |
| 57 | 1.91 | 27.84 | 3.45 | -5.05 | -28.41 | 6.83 |
| 58 | 1.91 | 26.35 | 5.72 | -0.84 | -26.92 | 4.56 |
| 59 | 1.91 | 28.18 | -2.69 | -13.94 | -28.60 | 10.30 |
| 60 | 1.91 | 26.69 | -0.41 | -9.73 | -27.12 | 8.03 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -3.51 | -2.44 | -4.81 | -6.74 | -7.86 | -8.18 | -10.64 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 7.86 | 2.25 | 2.84 | 4.59 | 6.96 | 9.84 | 30.76 |

强度计算应力比 =0.396

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=7.86, N=57.51, M=4.84, N=-42.87

平面内稳定最大应力 (N/mm\*mm) =115.76

平面内稳定计算最大应力比 =0.380

临界弯矩Mcr(kN\*m) =1121.20

平面外稳定计算最大应力比 =0.265

强度计算应力比 =0.396 < 1.0

抗剪强度计算应力比 =0.131 < 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 =0.265 < 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 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0.33 | 0.32 | 0.31 | 0.28 | 0.22 | 0.12 | 0.00 |

最大挠度值 =0.33 最大挠度/梁跨度 =1/11138.

斜梁坡度初始值: 1/17.99

变形后斜梁坡度最小值: 1/18.12

变形后斜梁坡度改变率 =0.007 < 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 | 3.56 | 32.44 | 1.80 | -1.96 | -27.80 | 3.57 |
| 2 | 0.26 | 22.09 | 1.23 | -12.82 | -27.72 | 11.28 |
| 3 | 1.91 | 27.10 | 4.58 | -2.94 | -27.67 | 5.69 |
| 4 | 1.91 | 27.44 | -1.55 | -11.84 | -27.86 | 9.16 |
| 5 | 3.40 | 30.10 | 1.67 | -1.33 | -25.42 | 2.94 |
| 6 | 0.10 | 19.75 | 1.10 | -12.19 | -25.34 | 10.65 |
| 7 | 1.75 | 24.75 | 4.45 | -2.31 | -25.28 | 5.06 |
| 8 | 1.75 | 25.09 | -1.68 | -11.21 | -25.48 | 8.53 |
| 9 | 1.23 | 21.20 | 0.34 | -7.65 | -21.63 | 7.27 |
| 10 | 1.23 | 21.12 | 2.01 | -4.57 | -21.55 | 5.60 |
| 11 | 1.07 | 18.86 | 0.21 | -7.02 | -19.24 | 6.64 |
| 12 | 1.07 | 18.78 | 1.88 | -3.93 | -19.16 | 4.97 |

--- 梁的弯矩包络(偶然组合) ---

梁下部受拉:

截面 1 2 3 4 5 6 7

弯矩 0.00 0.00 -0.02 -0.17 0.00 0.00 0.00

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 3.56 1.46 1.80 2.68 3.94 5.60 12.82

强度计算荷载比 =0.19

平面内稳定计算荷载比 =0.17

平面外稳定计算荷载比 =0.11

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): 656.50℃

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)=57.95

**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 | -1.55 | 0.41 | 3.23 |
| 2 | -0.00 | 0.00 | -0.00 | -2.72 | 0.72 | 5.69 |
| 3 | -0.00 | 0.00 | 0.00 | -2.72 | 0.72 | 5.69 |
| 4 | -0.00 | 0.00 | -0.00 | -1.55 | 0.41 | 3.23 |
| 5 | -0.00 | 0.00 | 0.00 | -1.19 | 0.31 | 2.49 |
| 6 | -0.00 | 0.00 | -0.00 | -2.37 | 0.62 | 4.95 |
| 7 | -0.00 | 0.00 | 0.00 | -2.37 | 0.62 | 4.95 |
| 8 | -0.00 | 0.00 | -0.00 | -1.19 | 0.31 | 2.49 |
| 9 | 0.00 | -0.00 | 0.00 | -0.23 | 0.41 | 0.48 |
| 10 | 0.00 | -0.00 | -0.00 | -0.23 | 0.41 | 0.48 |
| 11 | 0.00 | -0.00 | 0.00 | 0.13 | 0.32 | -0.26 |
| 12 | 0.00 | -0.00 | -0.00 | 0.13 | 0.32 | -0.27 |
| 13 | 0.00 | -0.00 | 0.00 | -0.76 | 0.41 | 1.58 |
| 14 | 0.00 | -0.00 | -0.00 | -0.76 | 0.41 | 1.58 |
| 15 | -0.00 | -0.00 | 0.00 | -1.93 | 0.72 | 4.04 |
| 16 | -0.00 | -0.00 | -0.00 | -1.93 | 0.72 | 4.04 |
| 17 | 0.00 | -0.00 | 0.00 | -1.93 | 0.72 | 4.04 |
| 18 | 0.00 | -0.00 | -0.00 | -1.93 | 0.72 | 4.04 |
| 19 | -0.00 | -0.00 | 0.00 | -0.76 | 0.41 | 1.58 |
| 20 | -0.00 | -0.00 | -0.00 | -0.76 | 0.41 | 1.58 |
| 21 | 0.00 | -0.00 | 0.00 | -0.40 | 0.31 | 0.84 |
| 22 | 0.00 | -0.00 | -0.00 | -0.40 | 0.31 | 0.83 |
| 23 | -0.00 | -0.00 | 0.00 | -1.58 | 0.63 | 3.29 |
| 24 | -0.00 | -0.00 | -0.00 | -1.58 | 0.63 | 3.29 |
| 25 | 0.00 | -0.00 | 0.00 | -1.58 | 0.63 | 3.29 |
| 26 | 0.00 | -0.00 | -0.00 | -1.58 | 0.63 | 3.29 |
| 27 | -0.00 | -0.00 | 0.00 | -0.40 | 0.31 | 0.84 |
| 28 | -0.00 | -0.00 | -0.00 | -0.40 | 0.31 | 0.83 |
| 29 | 0.00 | -0.00 | 0.00 | -0.23 | 0.41 | 0.48 |
| 30 | 0.00 | -0.00 | -0.00 | -0.23 | 0.41 | 0.48 |
| 31 | 0.00 | -0.00 | 0.00 | -1.05 | 0.63 | 2.20 |
| 32 | 0.00 | -0.00 | -0.00 | -1.05 | 0.63 | 2.20 |
| 33 | 0.00 | -0.00 | 0.00 | -1.05 | 0.63 | 2.20 |
| 34 | 0.00 | -0.00 | -0.00 | -1.05 | 0.63 | 2.20 |
| 35 | 0.00 | -0.00 | 0.00 | -0.23 | 0.41 | 0.48 |
| 36 | 0.00 | -0.00 | -0.00 | -0.23 | 0.41 | 0.48 |
| 37 | 0.00 | -0.00 | 0.00 | 0.13 | 0.32 | -0.26 |
| 38 | 0.00 | -0.00 | -0.00 | 0.13 | 0.32 | -0.27 |
| 39 | 0.00 | -0.00 | 0.00 | -0.70 | 0.53 | 1.46 |
| 40 | 0.00 | -0.00 | -0.00 | -0.69 | 0.53 | 1.45 |
| 41 | 0.00 | -0.00 | 0.00 | -0.70 | 0.53 | 1.46 |
| 42 | 0.00 | -0.00 | -0.00 | -0.69 | 0.53 | 1.45 |
| 43 | 0.00 | -0.00 | 0.00 | 0.13 | 0.32 | -0.26 |
| 44 | 0.00 | -0.00 | -0.00 | 0.13 | 0.32 | -0.27 |
| 45 | 0.00 | 0.13 | -0.02 | -1.56 | 0.28 | 3.25 |
| 46 | 0.00 | -0.13 | 0.02 | -1.53 | 0.54 | 3.22 |
| 47 | 0.00 | 0.13 | -0.02 | -2.07 | 0.41 | 4.31 |
| 48 | 0.00 | -0.13 | 0.02 | -2.04 | 0.67 | 4.28 |
| 49 | 0.00 | 0.13 | -0.02 | -2.07 | 0.41 | 4.31 |
| 50 | 0.00 | -0.13 | 0.02 | -2.04 | 0.67 | 4.28 |
| 51 | -0.00 | 0.13 | -0.02 | -1.56 | 0.28 | 3.25 |
| 52 | 0.00 | -0.13 | 0.02 | -1.53 | 0.54 | 3.22 |
| 53 | 0.00 | 0.13 | -0.02 | -1.21 | 0.18 | 2.50 |
| 54 | 0.00 | -0.13 | 0.02 | -1.17 | 0.45 | 2.47 |
| 55 | 0.00 | 0.13 | -0.02 | -1.60 | 0.29 | 3.32 |
| 56 | 0.00 | -0.13 | 0.02 | -1.57 | 0.55 | 3.29 |
| 57 | 0.00 | 0.13 | -0.02 | -1.60 | 0.29 | 3.32 |
| 58 | 0.00 | -0.13 | 0.02 | -1.57 | 0.55 | 3.29 |
| 59 | 0.00 | 0.13 | -0.02 | -1.21 | 0.18 | 2.50 |
| 60 | 0.00 | -0.13 | 0.02 | -1.17 | 0.45 | 2.47 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -0.00 | -0.00 | -0.01 | -0.03 | -0.06 | -0.09 | -0.13 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 0.00 | 0.08 | 0.30 | 0.68 | 1.21 | 1.89 | 2.72 |

强度计算应力比 =0.033

抗剪强度计算应力比 =0.029

平面内稳定计算最大应力对应组合号: 1, M=-0.00, N=0.00, M=-1.55, N=0.41

平面内稳定最大应力 (N/mm\*mm) =9.37

平面内稳定计算最大应力比 =0.031

临界弯矩Mcr(kN\*m) =4367.18

平面外稳定计算最大应力比 =0.011

强度计算应力比 =0.033 < 1.0

抗剪强度计算应力比 =0.029 < 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 =0.011 < 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 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0.95 | 0.79 | 0.62 | 0.46 | 0.30 | 0.15 | 0.00 |

最大挠度值 =0.95 最大挠度/梁跨度 =1/2003.

斜梁坡度初始值: 1/7.92

变形后斜梁坡度最小值: 1/7.85

变形后斜梁坡度改变率 =0.008 < 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 | -1.19 | 0.31 | 2.49 |
| 2 | -0.00 | 0.00 | -0.00 | -1.58 | 0.42 | 3.31 |
| 3 | -0.00 | 0.00 | 0.00 | -1.58 | 0.42 | 3.31 |
| 4 | -0.00 | 0.00 | -0.00 | -1.19 | 0.31 | 2.49 |
| 5 | -0.00 | 0.00 | 0.00 | -1.07 | 0.28 | 2.24 |
| 6 | -0.00 | 0.00 | -0.00 | -1.46 | 0.39 | 3.06 |
| 7 | -0.00 | 0.00 | 0.00 | -1.46 | 0.39 | 3.06 |
| 8 | -0.00 | 0.00 | -0.00 | -1.07 | 0.28 | 2.24 |
| 9 | 0.00 | -0.00 | 0.00 | -0.84 | 0.31 | 1.75 |
| 10 | 0.00 | -0.00 | -0.00 | -0.84 | 0.31 | 1.75 |
| 11 | 0.00 | -0.00 | 0.00 | -0.72 | 0.28 | 1.50 |
| 12 | 0.00 | -0.00 | -0.00 | -0.72 | 0.28 | 1.50 |

--- 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 0.04 0.18 0.40 0.70 1.10 1.58

强度计算荷载比 =0.02

平面内稳定计算荷载比 =0.02

平面外稳定计算荷载比 =0.01

无防护下钢构件最大升温(Ts): 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

**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 | 17.42 | -22.97 | 19.60 | 12.54 | 43.64 | -7.08 |
| 2 | -1.55 | -27.37 | 6.40 | 4.03 | 9.53 | -1.55 |
| 3 | -0.04 | -25.67 | 9.94 | 8.29 | 27.47 | 1.14 |
| 4 | 15.91 | -24.68 | 16.06 | 8.29 | 25.70 | -9.76 |
| 5 | 16.09 | -18.76 | 17.43 | 11.15 | 39.19 | -6.35 |
| 6 | -2.88 | -23.16 | 4.23 | 2.65 | 5.08 | -0.82 |
| 7 | -1.37 | -21.46 | 7.77 | 6.90 | 23.02 | 1.86 |
| 8 | 14.58 | -20.47 | 13.88 | 6.90 | 21.25 | -9.04 |
| 9 | -1.49 | -14.71 | 1.46 | 3.38 | 15.73 | -0.55 |
| 10 | 5.81 | -14.10 | 5.35 | 3.38 | 15.12 | -4.45 |
| 11 | -2.82 | -10.50 | -0.71 | 1.99 | 11.29 | 0.17 |
| 12 | 4.48 | -9.89 | 3.18 | 1.99 | 10.68 | -3.73 |
| 13 | 13.07 | -20.85 | 14.83 | 10.96 | 41.51 | -5.53 |
| 14 | 17.45 | -20.49 | 17.16 | 10.96 | 41.15 | -7.87 |
| 15 | -5.90 | -25.25 | 1.62 | 2.46 | 7.41 | -0.00 |
| 16 | -1.52 | -24.88 | 3.96 | 2.46 | 7.04 | -2.34 |
| 17 | -4.38 | -23.55 | 5.17 | 6.71 | 25.34 | 2.68 |
| 18 | -0.00 | -23.18 | 7.50 | 6.71 | 24.98 | 0.34 |
| 19 | 11.56 | -22.56 | 11.28 | 6.71 | 23.58 | -8.22 |
| 20 | 15.94 | -22.19 | 13.62 | 6.71 | 23.21 | -10.56 |
| 21 | 11.75 | -16.64 | 12.65 | 9.58 | 37.07 | -4.81 |
| 22 | 16.13 | -16.27 | 14.98 | 9.58 | 36.70 | -7.15 |
| 23 | -7.22 | -21.04 | -0.55 | 1.07 | 2.96 | 0.72 |
| 24 | -2.84 | -20.67 | 1.78 | 1.07 | 2.59 | -1.62 |
| 25 | -5.71 | -19.34 | 2.99 | 5.33 | 20.90 | 3.41 |
| 26 | -1.33 | -18.97 | 5.33 | 5.33 | 20.53 | 1.06 |
| 27 | 10.23 | -18.34 | 9.11 | 5.33 | 19.13 | -7.50 |
| 28 | 14.61 | -17.98 | 11.44 | 5.33 | 18.76 | -9.84 |
| 29 | 6.68 | -18.02 | 8.59 | 7.95 | 32.79 | -3.32 |
| 30 | 13.98 | -17.41 | 12.48 | 7.95 | 32.18 | -7.22 |
| 31 | -6.60 | -21.10 | -0.65 | 2.00 | 8.92 | 0.55 |
| 32 | 0.70 | -20.49 | 3.24 | 2.00 | 8.31 | -3.35 |
| 33 | -5.54 | -19.91 | 1.83 | 4.98 | 21.47 | 2.43 |
| 34 | 1.76 | -19.30 | 5.72 | 4.98 | 20.86 | -1.47 |
| 35 | 5.62 | -19.21 | 6.11 | 4.98 | 20.23 | -5.20 |
| 36 | 12.92 | -18.60 | 10.00 | 4.98 | 19.62 | -9.10 |
| 37 | 5.35 | -13.81 | 6.41 | 6.57 | 28.34 | -2.60 |
| 38 | 12.65 | -13.20 | 10.30 | 6.57 | 27.73 | -6.50 |
| 39 | -7.93 | -16.89 | -2.83 | 0.61 | 4.47 | 1.28 |
| 40 | -0.63 | -16.28 | 1.06 | 0.61 | 3.86 | -2.63 |
| 41 | -6.87 | -15.69 | -0.35 | 3.59 | 17.02 | 3.15 |
| 42 | 0.43 | -15.09 | 3.54 | 3.59 | 16.41 | -0.75 |
| 43 | 4.29 | -15.00 | 3.93 | 3.59 | 15.79 | -4.48 |
| 44 | 11.59 | -14.39 | 7.82 | 3.59 | 15.18 | -8.38 |
| 45 | 9.52 | -20.48 | 13.15 | 8.84 | 30.01 | -4.15 |
| 46 | 12.09 | -20.12 | 14.52 | 8.84 | 29.65 | -5.52 |
| 47 | 1.30 | -22.38 | 7.43 | 5.15 | 15.23 | -1.75 |
| 48 | 3.87 | -22.03 | 8.80 | 5.15 | 14.87 | -3.13 |
| 49 | 1.96 | -21.64 | 8.96 | 6.99 | 23.00 | -0.59 |
| 50 | 4.53 | -21.29 | 10.33 | 6.99 | 22.64 | -1.96 |
| 51 | 8.87 | -21.21 | 11.61 | 6.99 | 22.23 | -5.31 |
| 52 | 11.44 | -20.86 | 12.98 | 6.99 | 21.88 | -6.69 |
| 53 | 7.03 | -15.79 | 9.95 | 6.80 | 23.12 | -3.03 |
| 54 | 9.60 | -15.44 | 11.33 | 6.80 | 22.77 | -4.41 |
| 55 | 0.70 | -17.26 | 5.55 | 3.96 | 11.76 | -1.19 |
| 56 | 3.28 | -16.90 | 6.93 | 3.96 | 11.40 | -2.56 |
| 57 | 1.21 | -16.69 | 6.73 | 5.38 | 17.73 | -0.30 |
| 58 | 3.78 | -16.33 | 8.11 | 5.38 | 17.38 | -1.67 |
| 59 | 6.52 | -16.36 | 8.77 | 5.38 | 17.14 | -3.93 |
| 60 | 9.09 | -16.00 | 10.14 | 5.38 | 16.79 | -5.30 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -7.93 | -6.69 | -6.91 | -7.39 | -7.85 | -8.36 | -12.54 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 17.45 | 4.16 | 2.56 | 1.37 | 0.28 | 0.00 | 0.00 |

强度计算应力比 =0.214

抗剪强度计算应力比 =0.101

平面内稳定计算最大应力对应组合号: 1, M=17.42, N=-22.97, M=12.54, N=43.64

平面内稳定最大应力 (N/mm\*mm) =72.34

平面内稳定计算最大应力比 =0.237

临界弯矩Mcr(kN\*m) =1100.95

平面外稳定计算最大应力比 =0.126

强度计算应力比 =0.214 < 1.0

抗剪强度计算应力比 =0.101 < 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 =0.126 < 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 | 0.44 | 0.86 | 1.22 | 1.51 | 1.71 | 1.81 |

最大挠度值 =1.81 最大挠度/梁跨度 =1/2039.

斜梁坡度初始值: 1/6.17

变形后斜梁坡度最小值: 1/6.22

变形后斜梁坡度改变率 =0.009 < 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 | 8.31 | -15.61 | 10.64 | 6.80 | 22.95 | -3.72 |
| 2 | 1.99 | -17.08 | 6.24 | 3.96 | 11.58 | -1.88 |
| 3 | 2.49 | -16.51 | 7.42 | 5.38 | 17.56 | -0.98 |
| 4 | 7.81 | -16.18 | 9.46 | 5.38 | 16.97 | -4.62 |
| 5 | 7.87 | -14.21 | 9.92 | 6.34 | 21.46 | -3.48 |
| 6 | 1.55 | -15.68 | 5.52 | 3.50 | 10.09 | -1.64 |
| 7 | 2.05 | -15.11 | 6.70 | 4.92 | 16.07 | -0.74 |
| 8 | 7.37 | -14.78 | 8.73 | 4.92 | 15.48 | -4.38 |
| 9 | 2.49 | -13.10 | 5.12 | 3.92 | 13.88 | -1.72 |
| 10 | 4.44 | -12.93 | 6.16 | 3.92 | 13.72 | -2.76 |
| 11 | 2.05 | -11.69 | 4.40 | 3.46 | 12.40 | -1.48 |
| 12 | 4.00 | -11.53 | 5.44 | 3.46 | 12.24 | -2.52 |

--- 梁的弯矩包络(偶然组合) ---

梁下部受拉:

截面 1 2 3 4 5 6 7

弯矩 0.00 0.00 -1.51 -2.95 -4.10 -4.91 -6.80

梁上部受拉:

截面 1 2 3 4 5 6 7

弯矩 8.31 2.60 0.94 0.00 0.00 0.00 0.00

强度计算荷载比 =0.10

平面内稳定计算荷载比 =0.11

平面外稳定计算荷载比 =0.05

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

**21、 钢 梁 11
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 | 2.72 | -0.72 | 5.69 | -0.00 | -0.00 | -0.00 |
| 2 | 1.55 | -0.41 | 3.23 | -0.00 | 0.00 | 0.00 |
| 3 | 2.72 | -0.72 | 5.69 | -0.00 | 0.00 | 0.00 |
| 4 | 1.55 | -0.41 | 3.23 | -0.00 | -0.00 | -0.00 |
| 5 | 2.37 | -0.62 | 4.95 | -0.00 | -0.00 | -0.00 |
| 6 | 1.19 | -0.31 | 2.49 | -0.00 | 0.00 | 0.00 |
| 7 | 2.37 | -0.62 | 4.95 | -0.00 | 0.00 | 0.00 |
| 8 | 1.19 | -0.31 | 2.49 | -0.00 | -0.00 | -0.00 |
| 9 | 0.23 | -0.41 | 0.48 | -0.00 | 0.00 | -0.00 |
| 10 | 0.23 | -0.41 | 0.48 | -0.00 | -0.00 | 0.00 |
| 11 | -0.13 | -0.31 | -0.26 | -0.00 | 0.00 | -0.00 |
| 12 | -0.13 | -0.31 | -0.27 | -0.00 | -0.00 | 0.00 |
| 13 | 1.93 | -0.72 | 4.04 | -0.00 | 0.00 | -0.00 |
| 14 | 1.93 | -0.72 | 4.04 | -0.00 | -0.00 | 0.00 |
| 15 | 0.76 | -0.41 | 1.58 | -0.00 | 0.00 | -0.00 |
| 16 | 0.76 | -0.41 | 1.58 | -0.00 | -0.00 | 0.00 |
| 17 | 1.93 | -0.72 | 4.04 | -0.00 | 0.00 | -0.00 |
| 18 | 1.93 | -0.72 | 4.04 | -0.00 | -0.00 | 0.00 |
| 19 | 0.76 | -0.41 | 1.58 | -0.00 | -0.00 | -0.00 |
| 20 | 0.76 | -0.41 | 1.58 | -0.00 | -0.00 | 0.00 |
| 21 | 1.58 | -0.62 | 3.29 | -0.00 | 0.00 | -0.00 |
| 22 | 1.58 | -0.62 | 3.29 | -0.00 | -0.00 | 0.00 |
| 23 | 0.40 | -0.31 | 0.84 | -0.00 | 0.00 | -0.00 |
| 24 | 0.40 | -0.31 | 0.83 | -0.00 | -0.00 | 0.00 |
| 25 | 1.58 | -0.62 | 3.29 | -0.00 | 0.00 | -0.00 |
| 26 | 1.58 | -0.62 | 3.29 | -0.00 | -0.00 | 0.00 |
| 27 | 0.40 | -0.31 | 0.84 | -0.00 | -0.00 | -0.00 |
| 28 | 0.40 | -0.31 | 0.83 | -0.00 | -0.00 | 0.00 |
| 29 | 1.05 | -0.63 | 2.20 | -0.00 | 0.00 | -0.00 |
| 30 | 1.05 | -0.63 | 2.20 | -0.00 | -0.00 | 0.00 |
| 31 | 0.23 | -0.41 | 0.48 | -0.00 | 0.00 | -0.00 |
| 32 | 0.23 | -0.41 | 0.48 | -0.00 | -0.00 | 0.00 |
| 33 | 1.05 | -0.63 | 2.20 | -0.00 | 0.00 | -0.00 |
| 34 | 1.05 | -0.63 | 2.20 | -0.00 | -0.00 | 0.00 |
| 35 | 0.23 | -0.41 | 0.48 | -0.00 | 0.00 | -0.00 |
| 36 | 0.23 | -0.41 | 0.48 | -0.00 | -0.00 | 0.00 |
| 37 | 0.70 | -0.53 | 1.46 | -0.00 | 0.00 | -0.00 |
| 38 | 0.69 | -0.53 | 1.45 | -0.00 | -0.00 | 0.00 |
| 39 | -0.13 | -0.31 | -0.26 | -0.00 | 0.00 | -0.00 |
| 40 | -0.13 | -0.31 | -0.27 | -0.00 | -0.00 | 0.00 |
| 41 | 0.70 | -0.53 | 1.46 | -0.00 | 0.00 | -0.00 |
| 42 | 0.69 | -0.53 | 1.45 | -0.00 | -0.00 | 0.00 |
| 43 | -0.13 | -0.31 | -0.26 | -0.00 | 0.00 | -0.00 |
| 44 | -0.13 | -0.31 | -0.27 | -0.00 | -0.00 | 0.00 |
| 45 | 2.04 | -0.67 | 4.28 | -0.00 | 0.13 | 0.02 |
| 46 | 2.07 | -0.41 | 4.31 | 0.00 | -0.13 | -0.02 |
| 47 | 1.53 | -0.54 | 3.22 | -0.00 | 0.13 | 0.02 |
| 48 | 1.56 | -0.28 | 3.25 | -0.00 | -0.13 | -0.02 |
| 49 | 2.04 | -0.67 | 4.28 | -0.00 | 0.13 | 0.02 |
| 50 | 2.07 | -0.41 | 4.31 | 0.00 | -0.13 | -0.02 |
| 51 | 1.53 | -0.54 | 3.22 | -0.00 | 0.13 | 0.02 |
| 52 | 1.56 | -0.28 | 3.25 | -0.00 | -0.13 | -0.02 |
| 53 | 1.57 | -0.55 | 3.29 | -0.00 | 0.13 | 0.02 |
| 54 | 1.60 | -0.29 | 3.32 | 0.00 | -0.13 | -0.02 |
| 55 | 1.17 | -0.45 | 2.47 | -0.00 | 0.13 | 0.02 |
| 56 | 1.21 | -0.18 | 2.50 | -0.00 | -0.13 | -0.02 |
| 57 | 1.57 | -0.55 | 3.29 | -0.00 | 0.13 | 0.02 |
| 58 | 1.60 | -0.29 | 3.32 | 0.00 | -0.13 | -0.02 |
| 59 | 1.17 | -0.45 | 2.47 | -0.00 | 0.13 | 0.02 |
| 60 | 1.21 | -0.18 | 2.50 | 0.00 | -0.13 | -0.02 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -0.13 | -0.09 | -0.06 | -0.03 | -0.01 | -0.00 | -0.00 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 2.72 | 1.89 | 1.21 | 0.68 | 0.30 | 0.08 | 0.00 |

强度计算应力比 =0.033

抗剪强度计算应力比 =0.029

平面内稳定计算最大应力对应组合号: 1, M=2.72, N=-0.72, M=-0.00, N=-0.00

平面内稳定最大应力 (N/mm\*mm) =9.37

平面内稳定计算最大应力比 =0.031

临界弯矩Mcr(kN\*m) =4367.18

平面外稳定计算最大应力比 =0.011

强度计算应力比 =0.033 < 1.0

抗剪强度计算应力比 =0.029 < 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 =0.011 < 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 | 0.15 | 0.30 | 0.46 | 0.62 | 0.79 | 0.95 |

最大挠度值 =0.95 最大挠度/梁跨度 =1/2003.

斜梁坡度初始值: 1/7.92

变形后斜梁坡度最小值: 1/7.85

变形后斜梁坡度改变率 =0.008 < 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 | 1.58 | -0.42 | 3.31 | -0.00 | -0.00 | -0.00 |
| 2 | 1.19 | -0.31 | 2.49 | -0.00 | 0.00 | 0.00 |
| 3 | 1.58 | -0.42 | 3.31 | -0.00 | 0.00 | 0.00 |
| 4 | 1.19 | -0.31 | 2.49 | -0.00 | -0.00 | -0.00 |
| 5 | 1.46 | -0.39 | 3.06 | -0.00 | -0.00 | -0.00 |
| 6 | 1.07 | -0.28 | 2.24 | -0.00 | 0.00 | 0.00 |
| 7 | 1.46 | -0.39 | 3.06 | -0.00 | 0.00 | 0.00 |
| 8 | 1.07 | -0.28 | 2.24 | -0.00 | -0.00 | -0.00 |
| 9 | 0.84 | -0.31 | 1.75 | -0.00 | 0.00 | -0.00 |
| 10 | 0.84 | -0.31 | 1.75 | -0.00 | -0.00 | 0.00 |
| 11 | 0.72 | -0.28 | 1.50 | -0.00 | 0.00 | -0.00 |
| 12 | 0.72 | -0.28 | 1.50 | -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 1.58 1.10 0.70 0.40 0.18 0.04 0.00

强度计算荷载比 =0.02

平面内稳定计算荷载比 =0.02

平面外稳定计算荷载比 =0.01

无防护下钢构件最大升温(Ts): 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

**22、 钢 梁 12
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 | -4.03 | -9.53 | -1.55 | 1.55 | 27.37 | 6.40 |
| 2 | -12.54 | -43.64 | -7.08 | -17.42 | 22.97 | 19.60 |
| 3 | -8.29 | -27.47 | 1.14 | 0.04 | 25.67 | 9.94 |
| 4 | -8.29 | -25.70 | -9.76 | -15.91 | 24.68 | 16.06 |
| 5 | -2.65 | -5.08 | -0.82 | 2.88 | 23.16 | 4.23 |
| 6 | -11.15 | -39.19 | -6.35 | -16.09 | 18.76 | 17.43 |
| 7 | -6.90 | -23.02 | 1.86 | 1.37 | 21.46 | 7.77 |
| 8 | -6.90 | -21.25 | -9.04 | -14.58 | 20.47 | 13.88 |
| 9 | -3.38 | -15.10 | -4.45 | -5.81 | 14.08 | 5.36 |
| 10 | -3.38 | -15.76 | -0.55 | 1.50 | 14.74 | 1.45 |
| 11 | -1.99 | -10.66 | -3.73 | -4.49 | 9.87 | 3.19 |
| 12 | -1.99 | -11.31 | 0.17 | 2.82 | 10.52 | -0.72 |
| 13 | -2.46 | -7.03 | -2.34 | 1.51 | 24.87 | 3.96 |
| 14 | -2.46 | -7.42 | -0.00 | 5.90 | 25.26 | 1.62 |
| 15 | -10.96 | -41.13 | -7.87 | -17.46 | 20.47 | 17.16 |
| 16 | -10.96 | -41.53 | -5.53 | -13.07 | 20.87 | 14.82 |
| 17 | -6.71 | -24.97 | 0.35 | 0.00 | 23.17 | 7.51 |
| 18 | -6.71 | -25.36 | 2.68 | 4.39 | 23.56 | 5.16 |
| 19 | -6.71 | -23.20 | -10.56 | -15.94 | 22.18 | 13.62 |
| 20 | -6.71 | -23.59 | -8.22 | -11.56 | 22.57 | 11.28 |
| 21 | -1.07 | -2.58 | -1.62 | 2.84 | 20.66 | 1.79 |
| 22 | -1.07 | -2.97 | 0.72 | 7.23 | 21.05 | -0.56 |
| 23 | -9.58 | -36.69 | -7.15 | -16.13 | 16.26 | 14.99 |
| 24 | -9.58 | -37.08 | -4.81 | -11.74 | 16.65 | 12.65 |
| 25 | -5.33 | -20.52 | 1.07 | 1.33 | 18.96 | 5.33 |
| 26 | -5.33 | -20.91 | 3.40 | 5.71 | 19.35 | 2.99 |
| 27 | -5.33 | -18.75 | -9.83 | -14.62 | 17.97 | 11.45 |
| 28 | -5.33 | -19.14 | -7.50 | -10.23 | 18.36 | 9.10 |
| 29 | -2.00 | -8.28 | -3.34 | -0.70 | 20.47 | 3.25 |
| 30 | -2.00 | -8.94 | 0.55 | 6.61 | 21.12 | -0.66 |
| 31 | -7.95 | -32.16 | -7.21 | -13.98 | 17.39 | 12.49 |
| 32 | -7.95 | -32.81 | -3.32 | -6.67 | 18.04 | 8.58 |
| 33 | -4.98 | -20.84 | -1.46 | -1.76 | 19.28 | 5.73 |
| 34 | -4.98 | -21.49 | 2.43 | 5.55 | 19.93 | 1.82 |
| 35 | -4.98 | -19.60 | -9.09 | -12.92 | 18.58 | 10.01 |
| 36 | -4.98 | -20.26 | -5.20 | -5.61 | 19.24 | 6.10 |
| 37 | -0.61 | -3.84 | -2.62 | 0.63 | 16.26 | 1.07 |
| 38 | -0.61 | -4.49 | 1.27 | 7.94 | 16.91 | -2.84 |
| 39 | -6.57 | -27.71 | -6.49 | -12.65 | 13.18 | 10.31 |
| 40 | -6.57 | -28.36 | -2.60 | -5.34 | 13.83 | 6.40 |
| 41 | -3.59 | -16.39 | -0.74 | -0.43 | 15.06 | 3.55 |
| 42 | -3.59 | -17.05 | 3.15 | 6.88 | 15.72 | -0.36 |
| 43 | -3.59 | -15.15 | -8.37 | -11.59 | 14.37 | 7.83 |
| 44 | -3.59 | -15.81 | -4.48 | -4.28 | 15.02 | 3.92 |
| 45 | -5.15 | -14.87 | -3.13 | -3.87 | 22.03 | 8.80 |
| 46 | -5.15 | -15.23 | -1.75 | -1.30 | 22.38 | 7.43 |
| 47 | -8.84 | -29.65 | -5.52 | -12.09 | 20.12 | 14.52 |
| 48 | -8.84 | -30.01 | -4.15 | -9.52 | 20.48 | 13.15 |
| 49 | -6.99 | -22.64 | -1.96 | -4.53 | 21.29 | 10.33 |
| 50 | -6.99 | -23.00 | -0.59 | -1.96 | 21.64 | 8.96 |
| 51 | -6.99 | -21.88 | -6.69 | -11.44 | 20.86 | 12.98 |
| 52 | -6.99 | -22.23 | -5.31 | -8.87 | 21.21 | 11.61 |
| 53 | -3.96 | -11.40 | -2.56 | -3.28 | 16.90 | 6.93 |
| 54 | -3.96 | -11.76 | -1.19 | -0.70 | 17.26 | 5.55 |
| 55 | -6.80 | -22.77 | -4.41 | -9.60 | 15.44 | 11.33 |
| 56 | -6.80 | -23.12 | -3.03 | -7.03 | 15.79 | 9.95 |
| 57 | -5.38 | -17.38 | -1.67 | -3.78 | 16.33 | 8.11 |
| 58 | -5.38 | -17.73 | -0.30 | -1.21 | 16.69 | 6.73 |
| 59 | -5.38 | -16.79 | -5.30 | -9.09 | 16.00 | 10.14 |
| 60 | -5.38 | -17.14 | -3.93 | -6.52 | 16.36 | 8.77 |

**梁的弯矩包络**

| 梁下部受拉 | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | -12.54 | -8.36 | -7.85 | -7.39 | -6.92 | -6.69 | -7.94 |
| 梁上部受拉 | | | | | | | |
| 截面 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 0.00 | 0.00 | 0.28 | 1.37 | 2.56 | 4.16 | 17.46 |

强度计算应力比 =0.214

抗剪强度计算应力比 =0.101

平面内稳定计算最大应力对应组合号: 1, M=-4.03, N=-9.53, M=1.55, N=27.37

平面内稳定最大应力 (N/mm\*mm) =72.34

平面内稳定计算最大应力比 =0.237

临界弯矩Mcr(kN\*m) =568.69

平面外稳定计算最大应力比 =0.126

强度计算应力比 =0.214 < 1.0

抗剪强度计算应力比 =0.101 < 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 =0.126 < 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 |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1.81 | 1.71 | 1.51 | 1.22 | 0.86 | 0.44 | 0.00 |

最大挠度值 =1.81 最大挠度/梁跨度 =1/2039.

斜梁坡度初始值: 1/6.17

变形后斜梁坡度最小值: 1/6.22

变形后斜梁坡度改变率 =0.009 < 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 | -3.96 | -11.58 | -1.88 | -1.99 | 17.08 | 6.24 |
| 2 | -6.80 | -22.95 | -3.72 | -8.31 | 15.61 | 10.64 |
| 3 | -5.38 | -17.56 | -0.98 | -2.49 | 16.51 | 7.42 |
| 4 | -5.38 | -16.97 | -4.62 | -7.81 | 16.18 | 9.46 |
| 5 | -3.50 | -10.09 | -1.64 | -1.55 | 15.68 | 5.52 |
| 6 | -6.34 | -21.46 | -3.48 | -7.87 | 14.21 | 9.92 |
| 7 | -4.92 | -16.07 | -0.74 | -2.05 | 15.11 | 6.70 |
| 8 | -4.92 | -15.48 | -4.38 | -7.37 | 14.78 | 8.73 |
| 9 | -3.92 | -13.71 | -2.76 | -4.44 | 12.93 | 6.16 |
| 10 | -3.92 | -13.89 | -1.72 | -2.49 | 13.10 | 5.12 |
| 11 | -3.46 | -12.23 | -2.52 | -4.00 | 11.52 | 5.44 |
| 12 | -3.46 | -12.40 | -1.48 | -2.05 | 11.70 | 4.40 |

--- 梁的弯矩包络(偶然组合) ---

梁下部受拉:

截面 1 2 3 4 5 6 7

弯矩 -6.80 -4.91 -4.10 -2.95 -1.51 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 0.94 2.60 8.31

强度计算荷载比 =0.10

平面内稳定计算荷载比 =0.11

平面外稳定计算荷载比 =0.05

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

风荷载作用下柱顶最大水平（X 向）位移:

节点( 2), 水平位移 dx=14.738(mm) =H /529.

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=4.105(mm) =H /1900.

梁的(恒+活)最大挠度:

梁( 2), 挠跨比 =1 /303.

风载作用下柱顶最大水平位移: H/529< 柱顶位移容许值: H/60

地震作用下柱顶最大水平位移: H/1900< 柱顶位移容许值: H/60

梁的(恒+活)最大挠跨比: 1/303< 梁的容许挠跨比: 1/240

所有钢柱的总重量 (Kg)=2861.

所有钢梁的总重量 (Kg)=3537.

钢梁与钢柱重量之和 (Kg)=6398.

**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\\GJ2\\CalcTemp\\刚架简图.T)

## **2. 荷载简图**



[图12-2 恒载简图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ2\\CalcTemp\\恒载简图.T)



[图12-3 活载简图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ2\\CalcTemp\\活载简图.T)



[图12-4 左风1简图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ2\\CalcTemp\\左风1简图.T)



[图12-5 右风1简图](F:\\项目人\\大兵\\2025\\食用菌项目\\修改的施工图\\培育室-1修改\\培育室\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\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\\GJ2\\CalcTemp\\平面外计算长度系数.T)