xx大学

**毕业设计（论文）**

题 目 xxx

学 院 xxx

专业班级 xxx

学生姓名 xxx 学号 xxx

指导教师 xxx 职称 xxx

评阅教师 xxx 职称 xxx

xx年 x 月 xx 日

**学生毕业设计（论文）原创性声明**

本人以信誉声明：所呈交的毕业设计（论文）是在导师的指导下进行的设计（研究）工作及取得的成果，设计（论文）中引用他（她）人的文献、数据、图件、资料均已明确标注出，论文中的结论和结果为本人独立完成，不包含他人成果及为学位或证书而使用其材料。与我一同工作的同志对本设计（研究）所做的任何贡献均已在论文中作了明确的说明并表示了谢意。

毕业设计（论文）作者（签字）：

年 月 日

# 摘 要

该建筑共3层，高度为11.25m，室内外高差为450mm。在设计时，混凝土采用的型号为C30，钢筋采用的型号为HRB400。

根据要求确定合理的结构布置、构件尺寸以及基础类型，同时按要求选取结构中的某一榀主框架，按照现行规范进行计算，计算内容主要包括建筑设计以及结构设计两部分。在满足建筑物功能要求的前提下对其平面布置以及立面布置进行合理的设计。

建筑设计主要包括建筑总体布置设计、平面布置方案以及立面布置方案；结构设计主要包括框架结构尺寸计算、重力荷载计算、框架抗侧移刚度计算、水平荷载作用下框架内力计算、竖向荷载作用下框架内力计算、内力组合、截面设计、基础设计、楼梯设计以及楼板设计

**关键词**：钢筋混凝土框架结构；建筑设计；结构设计；荷载计算；内力计算

# ABSTRACT

The building type is reinforced concrete frame structure. The total of 3 floors, height 11.25m, indoor and outdoor height difference 450mm. In the design, the type used for concrete is C30, and the type used for steel is HRB400.

According to the requirements to determine the reasonable structure layout, component size and foundation type, at the same time according to the requirements to select a pin of the structure of the main frame, in accordance with the current specifications for calculation, calculation content mainly includes architectural design and structural design two parts. On the premise of meeting the functional requirements of the building, the plane layout and elevation layout are reasonably designed.

The architectural design mainly includes the overall layout design of the building, the plane layout scheme and the elevation layout scheme; Structural design mainly includes the frame structure size calculation, gravity load calculation, frame anti-lateral stiffness calculation, internal force calculation under horizontal load, internal force calculation under vertical load, internal force combination, section design, foundation design, stair design and floor design

**Keywords**: reinforced concrete frame structure; Architectural design; Structural design; Load calculation; The internal force calculation

**目录**

[摘 要 I](#_Toc127133968)

[ABSTRACT II](#_Toc127133969)

[1 建筑设计说明 1](#_Toc127133970)

[1.1 建筑基本信息 1](#_Toc127133971)

[1.2 工程概况 1](#_Toc127133972)

[2 框架构件尺寸计算 2](#_Toc127133973)

[2.1 屋面板及楼面板厚度计算 2](#_Toc127133974)

[2.2 框架梁截面尺寸计算 2](#_Toc127133975)

[2.3 框架柱截面尺寸计算 2](#_Toc127133976)

[2.4线刚度计算 3](#_Toc127133977)

[3 重力荷载计算 5](#_Toc127133978)

[3.1 屋面荷载 5](#_Toc127133979)

[3.2 楼面荷载 5](#_Toc127133980)

[3.3 墙体线荷载 5](#_Toc127133981)

[3.4 活荷载取值 6](#_Toc127133982)

[3.5重力荷载代表值计算 6](#_Toc127133983)

[3.5.1墙体计算 6](#_Toc127133984)

[3.5.2梁柱计算 6](#_Toc127133985)

[3.5.3各层重力荷载代表值汇总 7](#_Toc127133986)

[4 框架侧移刚度计算 8](#_Toc127133987)

[5 水平荷载作用计算 10](#_Toc127133988)

[5.1风荷载 10](#_Toc127133989)

[5.1.1 荷载计算 10](#_Toc127133990)

[5.1.2 位移验算 10](#_Toc127133991)

[5.1.3 内力计算 11](#_Toc127133992)

[5.2水平地震作用 14](#_Toc127133993)

[5.2.1结构基本自振周期 14](#_Toc127133994)

[5.2.2层间剪力计算 15](#_Toc127133995)

[5.2.3层间位移验算 15](#_Toc127133996)

[5.2.4框架内力计算 16](#_Toc127133997)

[6 竖向荷载作用下框架内力计算 19](#_Toc127133998)

[6.1 竖向荷载计算 19](#_Toc127133999)

[6.1.1梁荷载 20](#_Toc127134000)

[6.1.2集中荷载 22](#_Toc127134001)

[6.2 分配系数 24](#_Toc127134002)

[6.3 恒载固端弯矩 25](#_Toc127134003)

[6.4 恒载弯矩分配 25](#_Toc127134004)

[6.5 恒载跨中弯矩 26](#_Toc127134005)

[6.6 恒载柱端剪力 27](#_Toc127134006)

[6.7 恒载内力计算 27](#_Toc127134007)

[6.8 活载固端弯矩 30](#_Toc127134008)

[6.9 活载弯矩分配 30](#_Toc127134009)

[6.10 活载跨中弯矩 31](#_Toc127134010)

[6.11 活载柱端剪力 32](#_Toc127134011)

[6.12 活载内力计算 32](#_Toc127134012)

[7 内力组合 36](#_Toc127134013)

[7.1 内力调幅 36](#_Toc127134014)

[7.2 梁内力组合 37](#_Toc127134015)

[7.3 柱内力组合 40](#_Toc127134016)

[8 截面设计 47](#_Toc127134017)

[8.1 梁截面 47](#_Toc127134018)

[8.1.1 正截面配筋 47](#_Toc127134019)

[8.1.2 斜截面配筋 52](#_Toc127134020)

[8.2 柱截面 53](#_Toc127134021)

[8.2.1 正截面配筋 53](#_Toc127134022)

[8.2.2 斜截面配筋 61](#_Toc127134023)

[9 独立基础设计 63](#_Toc127134024)

[9.1设计信息 63](#_Toc127134025)

[9.2截面尺寸计算 63](#_Toc127134026)

[9.3承载力验算 64](#_Toc127134027)

[9.4受冲切验算 67](#_Toc127134028)

[9.5底面配筋 71](#_Toc127134029)

[9.6联合基础计算 75](#_Toc127134030)

[9.6.1受冲切验算 76](#_Toc127134031)

[9.6.2受剪切验算 76](#_Toc127134032)

[9.6.3配筋计算 77](#_Toc127134033)

[10楼梯设计 79](#_Toc127134034)

[10.1设计资料 79](#_Toc127134035)

[10.2 梯段板设计 79](#_Toc127134036)

[10.4 平台板设计 80](#_Toc127134037)

[10.5 平台梁设计 80](#_Toc127134038)

[11 双向板设计 82](#_Toc127134039)

[11.1 B1板计算 82](#_Toc127134040)

[11.1.1 荷载统计 82](#_Toc127134041)

[11.1.2 板配筋计算 82](#_Toc127134042)

[11.2 B2板计算 83](#_Toc127134043)

[11.2.1 荷载统计 83](#_Toc127134044)

[11.2.2 板配筋计算 83](#_Toc127134045)

[参考文献 85](#_Toc127134046)

# 建筑设计说明

## 1.1 建筑基本信息

本建筑选用钢混框架结构，建筑楼层层数为3层， 室内地面距离室外地坪的高度为450mm， 底层层高为3600mm，标准层层高为3600mm，计算框架为10号轴线对应框架。

## 1.2 工程概况

1、风荷载计算参数：基本风压为0.452， B类地面粗糙度；

2、雪荷载计算参数：基本雪压为0.3；

3、地震荷载计算参数：抗震等级为三级，第二组地震分组，7度抗震，基本地震加速度为0.15g，场地类型为Ⅱ类。

4、土层信息

第一层：杂填土厚1m，容重17 3；

第二层：黏土 层、黄褐色、含铁矿结核，质较硬，粘状结构，厚6.5m左右，容重18.5 3，*f*ak=280kPa；

第三层：微风化杂质花岗岩，已风化*f*ak=4000kPa。

5、混凝土型号：C30，纵筋型号：HRB400，箍筋型号：HRB400。

# 2 框架构件尺寸计算

## 2.1 屋面板及楼面板厚度计算

屋面板及楼面板均采用钢筋混凝土现浇板，根据规定，对于单向板，板的跨厚比不超过30；对于双向板，板的跨厚比不超过40。故楼板厚度可设定为120mm。

## 2.2 框架梁截面尺寸计算

框架梁的截面尺寸计算如下表所示：

表2.1 框架梁尺寸计算

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 类型 | 跨度l/mm | 梁高范围 | 梁宽范围 | 实取h/mm | 实取/bmm |
| AB梁 | 6000 | 1/18~1/10l | 1/2~1/4h | 600 | 250 |
| BC梁 | 2100 | 1/18~1/10l | 1/2~1/4h | 400 | 250 |
| CD梁 | 6000 | 1/18~1/10l | 1/2~1/4h | 600 | 250 |
| 纵梁 | 7500 | 1/18~1/10l | 1/2~1/4h | 600 | 250 |
| 次梁 | 6000 | 1/18~1/12l | 1/2~1/4h | 450 | 250 |

## 2.3 框架柱截面尺寸计算

利用轴压比公式对框架柱截面尺寸进行估算，根据规范，抗震等级为三级时对应的轴压比上限为0.85，按照下式对柱截面尺寸进行计算：



计算结果如下表所示

表2.2 框架柱尺寸计算

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 类型 | β | F/ kN | g/ kN/m2 | n | N/ kN | A/mm2 |
| A柱 | 1.3 | 22.5 | 14 | 3 | 1228.5 | 101069.52 |
| B柱 | 1.25 | 30.38 | 14 | 3 | 1594.688 | 131196.01 |
| C柱 | 1.25 | 30.38 | 14 | 3 | 1594.688 | 131196.01 |
| D柱 | 1.3 | 22.50 | 14 | 3 | 1228.5 | 101069.52 |

采用方形柱截面，因此，按照规范要求，柱截面尺寸具体为：

首层框架柱截面尺寸可确定为*b*×*h*=600mm×600mm，标准层框架柱截面尺寸可确定为*b*×*h*=600mm×600mm。

计算框架为10号轴线。

|  |
| --- |
|  |
| 图2.1 一榀框架图（单位：mm） |

底层框架柱高度=底层层高3600mm+室内地面距离室外地坪的高度450mm+基础顶面到室外地坪高度1000mm=5050mm。

## 2.4线刚度计算

截面惯性矩计算时，应考虑放大系数，其中，中间框架梁放大系数2.0，边框架梁放大系数1.5。

框架梁及框架柱的按照下式对线刚度进行计算：



具体计算如下所示：

表2.3 框架梁线刚度计算

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 类别 | *Ec*(N/mm2) | 梁宽b (mm×mm) | 梁高h (mm×mm) | *I*(mm4) | *l*(mm) | 梁线刚度ib\*10^10(N·mm) |
| AB跨 | 30000 | 250 | 600 | 4.5E+09 | 6000 | 4.50 |
| BC跨 | 30000 | 250 | 400 | 1.333E+09 | 2100 | 3.81 |
| CD跨 | 30000 | 250 | 600 | 4.5E+09 | 6000 | 4.50 |

表2.4 框架柱线刚度计算

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 层数 | 类别 | *Ec*(N/mm2) | b/mm | h/mm | *I*(mm4) | *hc*(mm) | *EcIc*/ *l\**10^10 (N·mm*)* |
| 底层 | A柱 | 30000 | 600 | 600 | 1.08E+10 | 5050 | 6.42 |
| B柱 | 30000 | 600 | 600 | 1.08E+10 | 5050 | 6.42 |
| C柱 | 30000 | 600 | 600 | 1.08E+10 | 5050 | 6.42 |
| D柱 | 30000 | 600 | 600 | 1.08E+10 | 5050 | 6.42 |
| 标准层 | A柱 | 30000 | 600 | 600 | 1.08E+10 | 3600 | 9.00 |
| B柱 | 30000 | 600 | 600 | 1.08E+10 | 3600 | 9.00 |
| C柱 | 30000 | 600 | 600 | 1.08E+10 | 3600 | 9.00 |
| D柱 | 30000 | 600 | 600 | 1.08E+10 | 3600 | 9.00 |

# 3 重力荷载计算

## 3.1 屋面荷载

表3.1 屋面恒载

|  |  |  |  |
| --- | --- | --- | --- |
| 做法 | 厚度(mm) | 容重(kN/m3) | 荷载(kN/m2) |
| 20mm厚 1:3 水凝砂浆找平层 | 20 | 20 | 0.4 |
| 12+12双层聚氯乙烯防水卷材 | 24 | 14 | 0.336 |
| 30mm厚1:8 水泥砂浆找坡层 | 30 | 20 | 0.6 |
| 保温层(泡沫混凝土)30mm | 30 | 4 | 0.12 |
| 现浇钢筋混凝土板 | 120 | 25 | 3 |
| 10mm厚混合砂浆抹灰 | 10 | 17 | 0.17 |
| 合计 |  |  | 4.626 |

## 3.2 楼面荷载

表3.2 楼面恒载

|  |  |  |  |
| --- | --- | --- | --- |
| 做法 | 厚度(mm) | 容重(kN/m3) | 荷载(kN/m2) |
| 铺8-10厚防滑地砖，用1:1水泥砂浆勾缝 | 8 | 20 | 0.16 |
| 20厚1:2干硬性水泥砂浆结合层，上洒2厚干水泥并洒适量清水 | 22 | 20 | 0.44 |
| 5厚水泥砂浆结合层一道 | 5 | 20 | 0.1 |
| 50厚C10混凝土找坡抹平 | 50 | 24 | 1.2 |
| 现浇钢筋混凝土板 | 120 | 25 | 3 |
| 合计 |  |  | 4.9 |

## 3.3 墙体线荷载

外墙、女儿墙的厚度为240mm，内墙厚度为240mm，墙体采用的砌块容重为5.53，外侧粉刷20mm厚混合砂浆；考虑门窗洞口及门窗自重，按照整墙0.8系数进行折减，墙体线荷载计算如下：

表3.3 内外墙体线荷载

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 类型 | | 砌块容重/ 3 | 层高/m | 梁高/m | 墙体线荷载/ |
| 外墙 | 底层 | 5.5 | 3.6 | 0.6 | 6.360 |
| 标准层 | 5.5 | 3.6 | 0.6 | 6.360 |
| 内墙 | 底层 | 5.5 | 3.6 | 0.6 | 6.360 |
| 标准层 | 5.5 | 3.6 | 0.6 | 6.360 |
| 女儿墙 | | 5.5 | 1.2 | / | 2.54 |

## 3.4 活荷载取值

屋面活载取值为0.52，楼面活载为2.52，走廊活荷载32。

## 3.5重力荷载代表值计算

### 3.5.1墙体计算

由于前文对墙体的线荷载进行了计算，故墙体重力荷载计算值如下表所示：

表3.4 墙体荷载汇总

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | 外墙长度(m) | 外墙线荷载 (kN/m**)** | 外墙重力荷载 (kN) | 内墙长度(m) | 内墙线荷载 (kN/m**)** | 内墙重力荷载 (kN) | 汇总 |
| 1 | 15.00 | 6.360 | 95.40 | 66.00 | 6.360 | 419.76 | 412.13 |
| 2 | 15.00 | 6.360 | 95.40 | 66.00 | 6.360 | 419.76 | 412.13 |
| 3 | 15.00 | 6.360 | 95.40 | 66.00 | 6.360 | 419.76 | 412.13 |
| 女儿墙 | 15.00 | 2.54 | 38.16 | / | / | / | 38.16 |
| 汇总 |  |  |  |  |  |  | 1274.54 |

### 3.5.2梁柱计算

框架梁与框架柱的重力荷载如下表所示：

表3.5 梁柱荷载汇总

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | 类型 | 截面宽度(m) | 截面高度(m) | 线荷载(kN/m) | 长度(m) | 数量 | Gi(kN) | ΣGi(kN) |
| 1 | AB梁 | 0.25 | 0.60 | 3.484 | 6 | 1 | 20.90 | 179.80 |
| BC梁 | 0.25 | 0.40 | 2.074 | 2.1 | 1 | 4.36 |
| CD梁 | 0.25 | 0.60 | 3.484 | 6 | 1 | 20.90 |
| 纵梁 | 0.25 | 0.60 | 3.484 | 7.5 | 4 | 104.52 |
| 次梁 | 0.25 | 0.45 | 2.427 | 24 | 1 | 29.12 |
| 柱 | 0.60 | 0.60 | 9.960 | 5.05 | 4 | 201.19 | 201.19 |
| 2 | AB梁 | 0.25 | 0.60 | 3.484 | 6 | 1 | 20.90 | 179.80 |
| BC梁 | 0.25 | 0.40 | 2.074 | 2.1 | 1 | 4.36 |
| CD梁 | 0.25 | 0.60 | 3.484 | 6 | 1 | 20.90 |
| 纵梁 | 0.25 | 0.60 | 3.484 | 7.5 | 4 | 104.52 |
| 次梁 | 0.25 | 0.45 | 2.427 | 24 | 1 | 29.12 |
| 柱 | 0.60 | 0.60 | 9.960 | 3.6 | 4 | 143.42 | 143.42 |
| 3 | AB梁 | 0.25 | 0.60 | 3.484 | 6 | 1 | 20.90 | 179.80 |
| BC梁 | 0.25 | 0.40 | 2.074 | 2.1 | 1 | 4.36 |
| CD梁 | 0.25 | 0.60 | 3.484 | 6 | 1 | 20.90 |
| 纵梁 | 0.25 | 0.60 | 3.484 | 7.5 | 4 | 104.52 |
| 次梁 | 0.25 | 0.45 | 2.427 | 24 | 1 | 29.12 |
| 柱 | 0.60 | 0.60 | 9.960 | 3.6 | 4 | 143.42 | 143.42 |

### 3.5.3各层重力荷载代表值汇总

各层的重力荷载标准值应综合考虑恒载与活载大小，具体计算如下表：

表3.6 重力荷标准值汇总()

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | | 恒载 | 0.5活载 | 0.5墙体荷载 | 梁荷载 | 0.5柱荷载 | 汇总 |
| 1 | 下半部分 | 0 | 0 | 206.06 | 0 | 100.60 | 306.66 |
| 上半部分 | 518.18 | 136.13 | 206.06 | 179.80 | 100.60 | 1140.76 |
| 2 | 下半部分 | 0 | 0 | 206.06 | 0 | 71.71 | 277.78 |
| 上半部分 | 518.18 | 136.13 | 206.06 | 179.80 | 71.71 | 1111.88 |
| 3 | 下半部分 | 0 | 0 | 206.06 | 0 | 71.71 | 277.78 |
| 上半部分 | 489.20 | 15.86 | 206.06 | 179.80 | 71.71 | 962.64 |
| 顶层女儿墙 | | 0 | 0 | 38.16 | 0 | 0 | 38.16 |

各质点的重力荷载计算示意图如下所示：

|  |
| --- |
|  |
| 图3.1 质点重力荷载 |

各层质点重力荷载代表值计算如下：

表3.7 质点重力荷载计算()

|  |  |  |  |
| --- | --- | --- | --- |
| 质点 | 1 | 2 | 3 |
| *Gi* | 1418.54 | 1389.65 | 1000.80 |

# 4 框架侧移刚度计算

采用D值法对水平荷载作用下的结构内力进行计算，利用系数*α*c对反弯点位置进行修正。不同楼层*α*c计算如下：

表4.1 不同楼层节点转动影响系数*α*c计算

|  |  |  |  |
| --- | --- | --- | --- |
| 类型 | 图示 | *K* | *α*c |
| 标准层 |  |  |  |
| 底层 |  |  |  |

柱的抗侧移刚度为：



具体计算如下表所示：

表4.2 各层柱D值计算

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 层数 | 类别 | *K* | α | *D*(N/mm) |
| 1 | A柱 | 0.701 | 0.445 | 13443 |
| B柱 | 1.294 | 0.545 | 16464 |
| C柱 | 1.294 | 0.545 | 16464 |
| D柱 | 0.701 | 0.445 | 13443 |
| 2 | A柱 | 0.500 | 0.200 | 16667 |
| B柱 | 0.923 | 0.316 | 26333 |
| C柱 | 0.923 | 0.316 | 26333 |
| D柱 | 0.500 | 0.200 | 16667 |
| 3 | A柱 | 0.500 | 0.200 | 16667 |
| B柱 | 0.923 | 0.316 | 26333 |
| C柱 | 0.923 | 0.316 | 26333 |
| D柱 | 0.500 | 0.200 | 16667 |

框架D值是所有柱D值之和，计算如下：

表4.3 框架D值计算

|  |  |  |  |
| --- | --- | --- | --- |
| 楼层 | 1 | 2 | 3 |
| ΣDi(N/mm) | 59814 | 86000 | 86000 |
| *Di*/*Di+1* | 0.70 | 1.00 | / |

# 5 水平荷载作用计算

## 5.1风荷载

### 5.1.1 荷载计算

根据前文提供的数据可知，基本风压*w*0=0.452，地面粗糙度为B类。风荷载标准值可以按照下式计算：



风荷载的集中力表达形式为：



集中风荷载示意图如下所示：

|  |
| --- |
|  |
| 图5.1 集中风荷载示意图 |

具体计算见下表：

表5.1 风荷载计算

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *Hi*(m) | *μz* | *w0* | *wk* (kN/m2) | *hi*(m) | *hj*(m) | *B*(m) | *Wk*(kN) |
| 1 | 4.05 | 1.00 | 0.45 | 0.59 | 4.05 | 3.6 | 7.5 | 16.93 |
| 2 | 7.65 | 1.00 | 0.45 | 0.59 | 3.6 | 3.6 | 7.5 | 15.93 |
| 3 | 11.25 | 1.03 | 0.45 | 0.60 | 3.6 | 2.4 | 7.5 | 13.50 |

### 5.1.2 位移验算

层间位移计算公式如下所示：



表5.2 位移验算

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *Wk*(kN) | *Vi*(kN) | ΣDi(N/mm) | Δui(mm) | *ui*(mm) | *h*(mm) | *θ*=Δui*/h* | θ<1/550 |
| 1 | 16.93 | 46.36 | 59814 | 0.78 | 0.78 | 4050 | 0.00019259 | 是 |
| 2 | 15.93 | 29.43 | 86000 | 0.34 | 1.12 | 3600 | 0.00009444 | 是 |
| 3 | 13.50 | 13.50 | 86000 | 0.16 | 1.28 | 3600 | 0.00004444 | 是 |

### 5.1.3 内力计算

反弯点高度计算公式如下：



具体计算如下：

表5.3 A柱计算

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 层数 | *h*(m) | *K* | *y0* | *y1* | *y2* | *y3* | *y* | *yh*(m) |
| 1 | 5.05 | 0.701 | 0.65 | 0 | 0 | 0 | 0.65 | 3.28 |
| 2 | 3.6 | 0.5 | 0.45 | 0 | 0 | 0 | 0.45 | 1.62 |
| 3 | 3.6 | 0.5 | 0.30 | 0 | 0 | 0 | 0.3 | 1.08 |

表5.4 B柱计算

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 层数 | *h*(m) | *K* | *y0* | *y1* | *y2* | *y3* | *y* | *yh*(m) |
| 1 | 5.05 | 1.294 | 0.59 | 0 | 0 | 0 | 0.59 | 2.98 |
| 2 | 3.6 | 0.923 | 0.45 | 0 | 0 | 0 | 0.45 | 1.62 |
| 3 | 3.6 | 0.923 | 0.35 | 0 | 0 | 0 | 0.35 | 1.26 |

表5.5 C柱计算

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 层数 | *h*(m) | *K* | *y0* | *y1* | *y2* | *y3* | *y* | *yh*(m) |
| 1 | 5.05 | 1.294 | 0.59 | 0 | 0 | 0 | 0.59 | 2.98 |
| 2 | 3.6 | 0.923 | 0.45 | 0 | 0 | 0 | 0.45 | 1.62 |
| 3 | 3.6 | 0.923 | 0.35 | 0 | 0 | 0 | 0.35 | 1.26 |

表5.6 D柱计算

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 层数 | *h*(m) | *K* | *y0* | *y1* | *y2* | *y3* | *y* | *yh*(m) |
| 1 | 5.05 | 0.701 | 0.65 | 0 | 0 | 0 | 0.65 | 3.28 |
| 2 | 3.6 | 0.5 | 0.45 | 0 | 0 | 0 | 0.45 | 1.62 |
| 3 | 3.6 | 0.5 | 0.30 | 0 | 0 | 0 | 0.3 | 1.08 |

风荷载作用下的结构内力可按照下式进行计算：



表5.7 A柱计算

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 类型 | *Vi*(kN) | ΣDi(N/mm) | *Dij*(N/mm) | *Dij*/ΣDi | *vij*(kN) | *yh*(m) | (1-y)*h*(m) | MC上(kN·m) | MC下(kN·m) |
| 1 | 46.36 | 59814 | 13443 | 0.225 | 10.43 | 3.28 | 1.77 | 18.46 | 34.21 |
| 2 | 29.43 | 86000 | 16667 | 0.194 | 5.71 | 1.62 | 1.98 | 11.31 | 9.25 |
| 3 | 13.50 | 86000 | 16667 | 0.194 | 2.62 | 1.08 | 2.52 | 6.6 | 2.83 |

表5.8 B柱计算

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *Vi*(kN) | ΣDi(N/mm) | *Dij*(N/mm) | *Dij*/ΣDi | *vij*(kN) | *yh*(m) | (1-y)*h*(m) | MC上(kN·m) | MC下(kN·m) |
| 1 | 46.36 | 59814 | 16464 | 0.275 | 12.75 | 2.98 | 2.07 | 26.39 | 38 |
| 2 | 29.43 | 86000 | 26333 | 0.306 | 9.01 | 1.62 | 1.98 | 17.84 | 14.6 |
| 3 | 13.50 | 86000 | 26333 | 0.306 | 4.13 | 1.26 | 2.34 | 9.66 | 5.2 |

表5.9 C柱计算

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *Vi*(kN) | ΣDi(N/mm) | *Dij*(N/mm) | *Dij*/ΣDi | *vij*(kN) | *yh*(m) | (1-y)*h*(m) | MC上(kN·m) | MC下(kN·m) |
| 1 | 46.36 | 59814 | 16464 | 0.275 | 12.75 | 2.98 | 2.07 | 26.39 | 38 |
| 2 | 29.43 | 86000 | 26333 | 0.306 | 9.01 | 1.62 | 1.98 | 17.84 | 14.6 |
| 3 | 13.50 | 86000 | 26333 | 0.306 | 4.13 | 1.26 | 2.34 | 9.66 | 5.2 |

表5.10 D柱计算

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *Vi*(kN) | ΣDi(N/mm) | *Dij*(N/mm) | *Dij*/ΣDi | *vij*(kN) | *yh*(m) | (1-y)*h*(m) | MC上(kN·m) | MC下(kN·m) |
| 1 | 46.36 | 59814 | 13443 | 0.225 | 10.43 | 3.28 | 1.77 | 18.46 | 34.21 |
| 2 | 29.43 | 86000 | 16667 | 0.194 | 5.71 | 1.62 | 1.98 | 11.31 | 9.25 |
| 3 | 13.50 | 86000 | 16667 | 0.194 | 2.62 | 1.08 | 2.52 | 6.6 | 2.83 |

梁端内力计算公式如下：

|  |  |
| --- | --- |
|  |  |
|  |  |

表5.11 A柱计算

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *ib左*(N·mm)×10^10 | *ib右*(N·mm)×10^10 | MC上(kN·m) | MC下(kN·m) | Mb左(kN·m) | Mb右(kN·m) |
| 1 | 0 | 4.5 | 18.46 | 34.21 | 0 | 27.71 |
| 2 | 0 | 4.5 | 11.31 | 9.25 | 0 | 14.14 |
| 3 | 0 | 4.5 | 6.6 | 2.83 | 0 | 6.6 |

表5.12 B柱计算

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *ib左*(N·mm)×10^10 | *ib右*(N·mm)×10^10 | MC上(kN·m) | MC下(kN·m) | Mb左(kN·m) | Mb右(kN·m) |
| 1 | 4.5 | 3.81 | 26.39 | 38 | 22.2 | 18.79 |
| 2 | 4.5 | 3.81 | 17.84 | 14.6 | 12.48 | 10.56 |
| 3 | 4.5 | 3.81 | 9.66 | 5.2 | 5.23 | 4.43 |

表5.13 C柱计算

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *ib左*(N·mm)×10^10 | *ib右*(N·mm)×10^10 | MC上(kN·m) | MC下(kN·m) | Mb左(kN·m) | Mb右(kN·m) |
| 1 | 3.81 | 4.5 | 26.39 | 38 | 18.79 | 22.2 |
| 2 | 3.81 | 4.5 | 17.84 | 14.6 | 10.56 | 12.48 |
| 3 | 3.81 | 4.5 | 9.66 | 5.2 | 4.43 | 5.23 |

表5.14 D柱计算

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *ib左*(N·mm)×10^10 | *ib右*(N·mm)×10^10 | MC上(kN·m) | MC下(kN·m) | Mb左(kN·m) | Mb右(kN·m) |
| 1 | 4.5 | 0 | 18.46 | 34.21 | 27.71 | 0 |
| 2 | 4.5 | 0 | 11.31 | 9.25 | 14.14 | 0 |
| 3 | 4.5 | 0 | 6.6 | 2.83 | 6.6 | 0 |

表5.15 剪力及轴力计算

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *lAB*(m) | *lBC*(m) | *lCD*(m) | *VAB*(kN) | *VBC*(kN) | *VCD*(kN) | *NA*(kN) | *NB*(kN) | *NC*(kN) | *ND*(kN) |
| 1 | 6 | 2.1 | 6 | 8.32 | 17.9 | 8.32 | -14.73 | -17.45 | 17.45 | 14.73 |
| 2 | 6 | 2.1 | 6 | 4.44 | 10.06 | 4.44 | -6.41 | -7.87 | 7.87 | 6.41 |
| 3 | 6 | 2.1 | 6 | 1.97 | 4.22 | 1.97 | -1.97 | -2.25 | 2.25 | 1.97 |

内力图如下：

|  |
| --- |
|  |
| M图（单位：） |
|  |
| V图（单位：kN） |
|  |
| N图（单位：kN） |
| 图5.2 内力图 |

## 5.2水平地震作用

### 5.2.1结构基本自振周期

结构基本自振周期计算公式如下：



其中：

|  |  |  |
| --- | --- | --- |
|  |  |  |

具体如下：

表5.16 结构顶点的假想位移计算

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 楼层 | *Gi*(kN) | *Vi*(kN) | ΣDi(N/mm) | Δui(mm) | *uT*(mm) |
| 1 | 1418.54 | 3808.99 | 59814 | 63.68 | 63.68 |
| 2 | 1389.65 | 2390.45 | 86000 | 27.80 | 91.48 |
| 3 | 1000.80 | 1000.80 | 86000 | 11.64 | 103.12 |

由表可得*uT*=0.1m，故：

=0.328 s



### 5.2.2层间剪力计算

抗震设防烈度7度（0.15g），查表可知*α*max=0.12；场地为Ⅱ类，第二组设计地震分组，由此可知*T*g=0.4s。

=3237.64 



由于0.1s<T1=0.328s<Tg=0.4s，故*α*=0.12。

=0.12×3237.64 =388.51 



*T*g=0.4s，T1=0.328s≤1.4Tg=0.56s，根据规范，*δn*=0，故*δn*=0。

=0×388.51 =0



计算结果如下：

表5.17 楼层剪力计算

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *Hi*(m) | *Gi*(kN) | *GiHi*(kN·m) | *GiHi*/∑GiHi | *Fi*(kN) | *Vi*(kN) |
| 1 | 5.05 | 1418.54 | 7163.63 | 0.228 | 88.58 | 388.51 |
| 2 | 8.65 | 1389.65 | 12020.47 | 0.382 | 148.41 | 299.93 |
| 3 | 12.25 | 1000.80 | 12259.80 | 0.390 | 151.52 | 151.52 |

### 5.2.3层间位移验算

层间位移计算公式：



具体计算见下表：

表5.18 位移计算

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *Vi*(kN) | ΣDi(N/mm) | Δui(mm) | *ui*(mm) | *hi*(mm) | *θe* | *θe<*1/550 |
| 1 | 388.51 | 59814 | 6.50 | 6.50 | 5050 | 0.00128713 | 是 |
| 2 | 299.93 | 86000 | 3.49 | 9.99 | 3600 | 0.00096944 | 是 |
| 3 | 151.52 | 86000 | 1.76 | 11.75 | 3600 | 0.00048889 | 是 |

### 5.2.4框架内力计算

计算公式如下:



表5.19 A柱计算

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *Vi*(kN) | ΣDi(N/mm) | *Dij*(N/mm) | *Dij*/ΣDi | *vij*(kN) | *yh*(m) | (1-y)*h*(m) | MC上(kN·m) | MC下(kN·m) |
| 1 | 388.51 | 59814 | 13443 | 0.225 | 87.41 | 3.28 | 1.77 | 154.72 | 286.7 |
| 2 | 299.93 | 86000 | 16667 | 0.194 | 58.19 | 1.62 | 1.98 | 115.22 | 94.27 |
| 3 | 151.52 | 86000 | 16667 | 0.194 | 29.39 | 1.08 | 2.52 | 74.06 | 31.74 |

表5.20 B柱计算

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *Vi*(kN) | ΣDi(N/mm) | *Dij*(N/mm) | *Dij*/ΣDi | *vij*(kN) | *yh*(m) | (1-y)*h*(m) | MC上(kN·m) | MC下(kN·m) |
| 1 | 388.51 | 59814 | 16464 | 0.275 | 106.84 | 2.98 | 2.07 | 221.16 | 318.38 |
| 2 | 299.93 | 86000 | 26333 | 0.306 | 91.78 | 1.62 | 1.98 | 181.72 | 148.68 |
| 3 | 151.52 | 86000 | 26333 | 0.306 | 46.37 | 1.26 | 2.34 | 108.51 | 58.43 |

表5.21 C柱计算

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *Vi*(kN) | ΣDi(N/mm) | *Dij*(N/mm) | *Dij*/ΣDi | *vij*(kN) | *yh*(m) | (1-y)*h*(m) | MC上(kN·m) | MC下(kN·m) |
| 1 | 388.51 | 59814 | 16464 | 0.275 | 106.84 | 2.98 | 2.07 | 221.16 | 318.38 |
| 2 | 299.93 | 86000 | 26333 | 0.306 | 91.78 | 1.62 | 1.98 | 181.72 | 148.68 |
| 3 | 151.52 | 86000 | 26333 | 0.306 | 46.37 | 1.26 | 2.34 | 108.51 | 58.43 |

表5.22 D柱计算

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *Vi*(kN) | ΣDi(N/mm) | *Dij*(N/mm) | *Dij*/ΣDi | *vij*(kN) | *yh*(m) | (1-y)*h*(m) | MC上(kN·m) | MC下(kN·m) |
| 1 | 388.51 | 59814 | 13443 | 0.225 | 87.41 | 3.28 | 1.77 | 154.72 | 286.7 |
| 2 | 299.93 | 86000 | 16667 | 0.194 | 58.19 | 1.62 | 1.98 | 115.22 | 94.27 |
| 3 | 151.52 | 86000 | 16667 | 0.194 | 29.39 | 1.08 | 2.52 | 74.06 | 31.74 |

梁端内力计算公式如下：

|  |  |
| --- | --- |
|  |  |
|  |  |

表5.23 A柱计算

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *ib左*(N·mm)×10^10 | *ib右*(N·mm)×10^10 | MC上(kN·m) | MC下(kN·m) | Mb左(kN·m) | Mb右(kN·m) |
| 1 | 0 | 4.5 | 154.72 | 286.7 | 0 | 248.99 |
| 2 | 0 | 4.5 | 115.22 | 94.27 | 0 | 146.96 |
| 3 | 0 | 4.5 | 74.06 | 31.74 | 0 | 74.06 |

表5.24 B柱计算

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *ib左*(N·mm)×10^10 | *ib右*(N·mm)×10^10 | MC上(kN·m) | MC下(kN·m) | Mb左(kN·m) | Mb右(kN·m) |
| 1 | 4.5 | 3.81 | 221.16 | 318.38 | 200.27 | 169.57 |
| 2 | 4.5 | 3.81 | 181.72 | 148.68 | 130.05 | 110.1 |
| 3 | 4.5 | 3.81 | 108.51 | 58.43 | 58.76 | 49.75 |

表5.25 C柱计算

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *ib左*(N·mm)×10^10 | *ib右*(N·mm)×10^10 | MC上(kN·m) | MC下(kN·m) | Mb左(kN·m) | Mb右(kN·m) |
| 1 | 3.81 | 4.5 | 221.16 | 318.38 | 169.57 | 200.27 |
| 2 | 3.81 | 4.5 | 181.72 | 148.68 | 110.1 | 130.05 |
| 3 | 3.81 | 4.5 | 108.51 | 58.43 | 49.75 | 58.76 |

表5.26 D柱计算

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *ib左*(N·mm)×10^10 | *ib右*(N·mm)×10^10 | MC上(kN·m) | MC下(kN·m) | Mb左(kN·m) | Mb右(kN·m) |
| 1 | 4.5 | 0 | 154.72 | 286.7 | 248.99 | 0 |
| 2 | 4.5 | 0 | 115.22 | 94.27 | 146.96 | 0 |
| 3 | 4.5 | 0 | 74.06 | 31.74 | 74.06 | 0 |

表5.27 剪力及轴力计算

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *lAB*(m) | *lBC*(m) | *lCD*(m) | *VAB*(kN) | *VBC*(kN) | *VCD*(kN) | *NA*(kN) | *NB*(kN) | *NC*(kN) | *ND*(kN) |
| 1 | 6 | 2.1 | 6 | 74.88 | 161.5 | 74.88 | -143.19 | -170.55 | 170.55 | 143.19 |
| 2 | 6 | 2.1 | 6 | 46.17 | 104.86 | 46.17 | -68.31 | -83.93 | 83.93 | 68.31 |
| 3 | 6 | 2.1 | 6 | 22.14 | 47.38 | 22.14 | -22.14 | -25.24 | 25.24 | 22.14 |

内力图绘制：

|  |
| --- |
|  |
| M图（单位：） |
|  |
| V图（单位：kN） |
|  |
| N图（单位：kN） |
| 图5.3 内力图 |

# 6 竖向荷载作用下框架内力计算

## 6.1 竖向荷载计算

荷载传递图示如下。

|  |
| --- |
|  |
| 图6.1 荷载传递图示（单位：mm） |

所有荷载需转化为均布荷载：

三角形荷载：

|  |  |
| --- | --- |
|  |  |

梯形荷载：

|  |  |
| --- | --- |
|  |  |

其中：



AB跨楼板荷载转换系数：*α*1=0.5×3.75/6=0.31

BC跨楼板荷载转换系数：*α*1=0.5×2.1/7.5=0.14

CD跨楼板荷载转换系数：*α*1=0.5×3.75/6=0.31

由前文计算可知：

表6.1 所有荷载汇总

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 类型 | 恒载 | | 活载 | | | 墙体自重 | | 梁自重 | | |
| 屋面 | 楼面 | 屋面 | 办公室 | 走廊 | 标准层 | 女儿墙 | AB跨 | BC跨 | CD跨 |
| 荷载(kN/m2) | 4.626 | 4.9 | 0.5 | 2.5 | 3 | 6.36 | 2.544 | 3.484 | 2.074 | 3.484 |

### 6.1.1梁荷载

1. AB跨

=6/3.75=1.60 < 3，为双向板

（1）屋面板：

恒载：4.626×(1-2×0.31^2+0.31^3)×3.75/2+4.626×(1-2×0.31^2+0.31^3)×3.75/2=14.54

活载：0.5×(1-2×0.31^2+0.31^3)×3.75/2+0.5×(1-2×0.31^2+0.31^3)×3.75/2=1.57

（2）楼面板：

恒载：4.9×(1-2×0.31^2+0.31^3)×3.75/2+4.9×(1-2×0.31^2+0.31^3)×3.75/2=15.39

活载：2.5×(1-2×0.31^2+0.31^3)×3.75/2+2.5×(1-2×0.31^2+0.31^3)×3.75/2=7.85

梁自重=3.484；墙体自重=6.36

（3）屋面梁

恒载=3.484+14.54=18.02 

活载=1.57 

（4）楼面梁

恒载= 3.484+15.39+6.36=25.23

活载=7.85 

1. BC跨

=7.5/2.1=3.57 >3，为单向板

（1）屋面板：

恒载：0+0=0

活载：0.00+0.00=0

（2）楼面板：

恒载：0+0=0

活载：0+0=0

梁自重：2.074；

（3）屋面梁

恒载=2.074+0=2.07

活载=0

（4）楼面梁

恒载=2.074+0+0=2.07

活载=0 

1. CD跨

=6/3.75=1.60 <3，为双向板

（1）屋面板：

恒载：4.626×(1-2×0.31^2+0.31^3)×3.75/2+4.626×(1-2×0.31^2+0.31^3)×3.75/2=14.54

活载：0.5×(1-2×0.31^2+0.31^3)×3.75/2+0.5×(1-2×0.31^2+0.31^3)×3.75/2=1.57

（2）楼面板：

恒载：4.9×(1-2×0.31^2+0.31^3)×3.75/2+4.9×(1-2×0.31^2+0.31^3)×3.75/2=15.39

活载：2.5×(1-2×0.31^2+0.31^3)×3.75/2+2.5×(1-2×0.31^2+0.31^3)×3.75/2=7.85

梁自重=3.484；墙体自重=6.36

（3）屋面梁

恒载=3.484+14.54=18.02

活载=1.57

（4）楼面梁

恒载=3.484+15.39+6.36=25.23

活载=7.85

### 6.1.2集中荷载

A柱：

（1）顶层柱

恒载=2.544×3.75+2.544×3.75+3.484×3.75+3.484×3.75+3.484×6/2+14.54×6/2+4.626×5/8×3.75/2×3.75+4.626×5/8×3.75/2×3.75+2.4265×6/4+2.4265×6/4=147.22

活载=1.57×6/2+0.5×5/8×3.75/2×3.75+0.5×5/8×3.75/2×3.75=9.10

（2）标准层柱

恒载=6.36×3.75+6.36×3.75+3.484×3.75+3.484×3.75+3.484×6/2+15.39×6/2+4.9×5/8×3.75/2×3.75+4.9×5/8×3.75/2×3.75+2.4265×6/4+2.4265×6/4+6.36×6/2=199.88

活载=7.85×6/2+2.5×5/8×3.75/2×3.75+2.5×5/8×3.75/2×3.75=45.52

B柱：

（1）顶层柱

恒载=3.484×3.75+3.484×3.75+3.484×6/2+2.074×2.1/2+0+0+14.54×6/2+4.626×5/8×3.75/2×3.75+4.626×5/8×3.75/2×3.75+4.626/2+4.626/2+0×2.1/2+2.4265×0/4+2.4265×6/4+2.4265×0/4+2.4265×6/4=134.94

活载=1.57×6/2+0.5×5/8×3.75/2×3.75+0.5×5/8×3.75/2×3.75+0.5/2+0.5/2+0×2.1/2=9.60

（2）标准层柱

恒载=3.484×3.75+3.484×3.75+3.484×6/2+2.074×2.1/2+6.36×3.75+6.36×3.75+15.39×6/2+4.9×5/8×3.75/2×3.75+4.9×5/8×3.75/2×3.75+2.45+2.45+0×2.1/2+2.4265×0/4+2.4265×6/4+2.4265×0/4+2.4265×6/4+6.36×6/2+0×2.1/2=206.96

活载=7.85×6/2+2.5×5/8×3.75/2×3.75+2.5×5/8×3.75/2×3.75+1.5+1.5+0×2.1/2=48.52

C柱：

（1）顶层柱

恒载=3.484×3.75+3.484×3.75+3.484×6/2+2.074×2.1/2+0+0+14.54×6/2+4.626/2+4.626/2+4.626×5/8×3.75/2×3.75+4.626×5/8×3.75/2×3.75+0×2.1/2+2.4265×6/4+2.4265×0/4+2.4265×6/4+2.4265×0/4=134.94

活载=1.57×6/2+0.5/2+0.5/2+0.5×5/8×3.75/2×3.75+0.5×5/8×3.75/2×3.75+0×2.1/2=9.60

（2）标准层柱

恒载=3.484×3.75+3.484×3.75+3.484×6/2+2.074×2.1/2+6.36×6/2+6.36×3.75+6.36×3.75+15.39×6/2+2.45+2.45+4.9×5/8×3.75/2×3.75+4.9×5/8×3.75/2×3.75+0×2.1/2+2.4265×6/4+2.4265×0/4+2.4265×6/4+2.4265×0/4+0×2.1/2=206.96

活载=7.85×6/2+1.5+1.5+2.5×5/8×3.75/2×3.75+2.5×5/8×3.75/2×3.75+0×2.1/2=48.52

D柱：

（1）顶层柱

恒载=2.544×3.75+2.544×3.75+3.484×3.75+3.484×3.75+3.484×6/2+14.54×6/2+4.626×5/8×3.75/2×3.75+4.626×5/8×3.75/2×3.75+2.4265×6/4+2.4265×6/4=147.22

活载=1.57×6/2+0.5×5/8×3.75/2×3.75+0.5×5/8×3.75/2×3.75=9.10

（2）标准层柱

恒载=6.36×3.75+6.36×3.75+3.484×3.75+3.484×3.75+3.484×6/2+15.39×6/2+4.9×5/8×3.75/2×3.75+4.9×5/8×3.75/2×3.75+2.4265×6/4+2.4265×6/4+6.36×6/2=199.88

活载=7.85×6/2+2.5×5/8×3.75/2×3.75+2.5×5/8×3.75/2×3.75=45.52

荷载布置图如下：

|  |
| --- |
|  |
| 图6.2 恒载 |
|  |
| 图6.3 活载 |

## 6.2 分配系数

根据线刚度计算节点分配系数，计算公式如下：



具体见下表：

表6.2 分配系数汇总

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | 节点 | 线刚度ib×10^10(N·mm) | | | | ∑ib | 分配系数μi | | | |
| 左梁 | 右梁 | 上柱 | 下柱 | 左梁 | 右梁 | 上柱 | 下柱 |
| 3 | A柱 | 0 | 4.5 | 0 | 9 | 13.5 | 0 | 0.333 | 0 | 0.667 |
| B柱 | 4.5 | 3.81 | 0 | 9 | 17.31 | 0.26 | 0.22 | 0 | 0.52 |
| C柱 | 3.81 | 4.5 | 0 | 9 | 17.31 | 0.22 | 0.26 | 0 | 0.52 |
| D柱 | 4.5 | 0 | 0 | 9 | 13.5 | 0.333 | 0 | 0 | 0.667 |
| 2 | A柱 | 0 | 4.5 | 9 | 9 | 22.5 | 0 | 0.2 | 0.4 | 0.4 |
| B柱 | 4.5 | 3.81 | 9 | 9 | 26.31 | 0.171 | 0.145 | 0.342 | 0.342 |
| C柱 | 3.81 | 4.5 | 9 | 9 | 26.31 | 0.145 | 0.171 | 0.342 | 0.342 |
| D柱 | 4.5 | 0 | 9 | 9 | 22.5 | 0.2 | 0 | 0.4 | 0.4 |
| 1 | A柱 | 0 | 4.5 | 9 | 6.42 | 19.92 | 0 | 0.226 | 0.452 | 0.322 |
| B柱 | 4.5 | 3.81 | 9 | 6.42 | 23.73 | 0.19 | 0.161 | 0.379 | 0.271 |
| C柱 | 3.81 | 4.5 | 9 | 6.42 | 23.73 | 0.161 | 0.19 | 0.379 | 0.271 |
| D柱 | 4.5 | 0 | 9 | 6.42 | 19.92 | 0.226 | 0 | 0.452 | 0.322 |

## 6.3 恒载固端弯矩

梁端弯矩可按下式计算：（顺时针为正）



表6.3 梁端弯矩计算

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | q（kN/m） | | | l（m） | | | AB | | BC | | CD | |
| AB | BC | CD | AB | BC | CD | *Mb左* | *Mb右* | *Mb左* | *Mb右* | *Mb左* | *Mb右* |
| 3 | 18.02 | 2.07 | 18.02 | 6 | 2.1 | 6 | -54.06 | 54.06 | -0.76 | 0.76 | -54.06 | 54.06 |
| 2 | 25.23 | 2.07 | 25.23 | 6 | 2.1 | 6 | -75.69 | 75.69 | -0.76 | 0.76 | -75.69 | 75.69 |
| 1 | 25.23 | 2.07 | 25.23 | 6 | 2.1 | 6 | -75.69 | 75.69 | -0.76 | 0.76 | -75.69 | 75.69 |

## 6.4 恒载弯矩分配

弯矩分配过程如下：

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 上柱 | 下柱 | 右梁 |  | 左梁 | 上柱 | 下柱 | 右梁 |  | 左梁 | 上柱 | 下柱 | 右梁 |  | 左梁 | 上柱 | 下柱 |
|  | 0.000 | 0.667 | 0.333 |  | 0.260 | 0.000 | 0.520 | 0.220 |  | 0.220 | 0.000 | 0.520 | 0.260 |  | 0.333 | 0.000 | 0.667 |
| 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 0.00 | -54.06 |  | 54.06 |  | 0.00 | -0.76 |  | 0.76 |  | 0.00 | -54.06 |  | 54.06 |  | 0.00 |
| 0.00 | 36.06 | 18.00 |  | -13.86 | 0.00 | -27.72 | -11.73 |  | 11.73 | 0.00 | 27.72 | 13.86 |  | -18.00 | 0.00 | -36.06 |
| 0.00 | 15.14 | -6.93 |  | 9.00 | 0.00 | -12.81 | 5.86 |  | -5.86 | 0.00 | 12.81 | -9.00 |  | 6.93 | 0.00 | -15.14 |
| 0.00 | -5.48 | -2.73 |  | -0.53 | 0.00 | -1.07 | -0.45 |  | 0.45 | 0.00 | 1.07 | 0.53 |  | 2.73 | 0.00 | 5.48 |
| 0.00 | 45.72 | -45.72 |  | 48.67 | 0.00 | -41.60 | -7.07 |  | 7.07 | 0.00 | 41.60 | -48.67 |  | 45.72 | 0.00 | -45.72 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 0.400 | 0.400 | 0.200 |  | 0.171 | 0.342 | 0.342 | 0.145 |  | 0.145 | 0.342 | 0.342 | 0.171 |  | 0.200 | 0.4 | 0.400 |
| 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 0.00 | -75.69 |  | 75.69 |  | 0.00 | -0.76 |  | 0.76 |  | 0.00 | -75.69 |  | 75.69 |  | 0.00 |
| 30.28 | 30.28 | 15.14 |  | -12.81 | -25.63 | -25.63 | -10.86 |  | 10.86 | 25.63 | 25.63 | 12.81 |  | -15.14 | -30.28 | -30.28 |
| 18.03 | 17.11 | -6.41 |  | 7.57 | -13.86 | -14.20 | 5.43 |  | -5.43 | 13.86 | 14.20 | -7.57 |  | 6.41 | -18.03 | -17.11 |
| -11.49 | -11.49 | -5.75 |  | 2.57 | 5.15 | 5.15 | 2.18 |  | -2.18 | -5.15 | -5.15 | -2.57 |  | 5.75 | 11.49 | 11.49 |
| 36.81 | 35.89 | -72.70 |  | 73.02 | -34.33 | -34.68 | -4.01 |  | 4.01 | 34.33 | 34.68 | -73.02 |  | 72.70 | -36.81 | -35.89 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 0.452 | 0.322 | 0.226 |  | 0.190 | 0.379 | 0.271 | 0.161 |  | 0.161 | 0.379 | 0.271 | 0.190 |  | 0.226 | 0.452 | 0.322 |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 0.00 | -75.69 |  | 75.69 |  | 0.00 | -0.76 |  | 0.76 |  | 0.00 | -75.69 |  | 75.69 |  | 0.00 |
| 34.21 | 24.37 | 17.11 |  | -14.24 | -28.40 | -20.31 | -12.06 |  | 12.06 | 28.40 | 20.31 | 14.24 |  | -17.11 | -34.21 | -24.37 |
| 15.14 | 0.00 | -7.12 |  | 8.55 | -12.81 | 0.00 | 6.03 |  | -6.03 | 12.81 | 0.00 | -8.55 |  | 7.12 | -15.14 | 0.00 |
| -3.62 | -2.58 | -1.81 |  | -0.34 | -0.67 | -0.48 | -0.29 |  | 0.29 | 0.67 | 0.48 | 0.34 |  | 1.81 | 3.62 | 2.58 |
| 45.72 | 21.79 | -67.51 |  | 69.67 | -41.88 | -20.79 | -7.08 |  | 7.08 | 41.88 | 20.79 | -69.67 |  | 67.51 | -45.72 | -21.79 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 10.89 |  |  |  |  | -10.39 |  |  |  |  | 10.39 |  |  |  |  | -10.89 |  |

## 6.5 恒载跨中弯矩

跨中弯矩按下式计算：



表6.4 恒载作用下梁跨中弯矩

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *q（kN*/m） | | | *l（m）* | | | AB | BC | CD |
| AB | BC | CD | AB | BC | CD |
| 3 | 18.02 | 2.07 | 18.02 | 6 | 2.1 | 6 | 33.89 | -5.93 | 33.89 |
| 2 | 25.23 | 2.07 | 25.23 | 6 | 2.1 | 6 | 40.67 | -2.87 | 40.67 |
| 1 | 25.23 | 2.07 | 25.23 | 6 | 2.1 | 6 | 44.94 | -5.94 | 44.94 |

## 6.6 恒载柱端剪力

|  |
| --- |
|  |
| 图6.4 内力图示 |

柱端剪力计算公式如下：



表6.5 剪力汇总

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 楼层 | 类别 | 柱高 | 柱端弯矩 | | 柱端剪力 | |
| 上 | 下 | 上 | 下 | |
| 3 | A | 3.60 | 45.72 | 36.81 | 22.93 | 22.93 | |
| B | 3.60 | -41.60 | -34.33 | 21.09 | 21.09 | |
| C | 3.60 | 41.60 | 34.33 | 21.09 | 21.09 | |
| D | 3.60 | -45.72 | -36.81 | 22.93 | 22.93 | |
| 2 | A | 3.60 | 35.89 | 45.72 | 22.67 | 22.67 | |
| B | 3.60 | -34.68 | -41.88 | 21.27 | 21.27 | |
| C | 3.60 | 34.68 | 41.88 | 21.27 | 21.27 | |
| D | 3.60 | -35.89 | -45.72 | 22.67 | 22.67 | |
| 1 | A | 5.05 | 21.79 | 10.89 | 6.47 | 6.47 | |
| B | 5.05 | -20.79 | -10.39 | 6.17 | 6.17 | |
| C | 5.05 | 20.79 | 10.39 | 6.17 | 6.17 | |
| D | 5.05 | -21.79 | -10.89 | 6.47 | 6.47 | |

## 6.7 恒载内力计算

|  |
| --- |
|  |
| 图6.5 梁内力图示 |

梁端剪力计算公式如下：



表6.6 剪力汇总

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *q*（kN/m） | | | *l*（m） | | | AB | | BC | | CD | |
| AB | BC | CD | AB | BC | CD | *V*b左 | *V*b右 | *V*b左 | *V*b右 | *V*b左 | *V*b右 |
| 3 | 18.02 | 2.07 | 18.02 | 6.00 | 2.10 | 6.00 | 53.57 | 54.55 | 2.17 | 2.17 | 54.55 | 53.57 |
| 2 | 25.23 | 2.07 | 25.23 | 6.00 | 2.10 | 6.00 | 75.64 | 75.74 | 2.17 | 2.17 | 75.74 | 75.64 |
| 1 | 25.23 | 2.07 | 25.23 | 6.00 | 2.10 | 6.00 | 75.33 | 76.05 | 2.17 | 2.17 | 76.05 | 75.33 |

柱轴力计算公式如下：



表6.7 A柱轴力

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | | 柱高 | 柱荷载（kN/m） | P | G | *Vb左* | *Vb右* | *Nc（kN）* |
| 3 | 上部 | 3.60 | 9.96 | 147.22 | 0.00 | 0.00 | 53.57 | 200.79 |
| 下部 |  | 35.86 | 0.00 | 0.00 | 236.65 |
| 2 | 上部 | 3.60 | 9.96 | 199.88 | 0.00 | 0.00 | 75.64 | 512.17 |
| 下部 |  | 35.86 | 0.00 | 0.00 | 548.03 |
| 1 | 上部 | 5.05 | 9.96 | 199.88 | 0.00 | 0.00 | 75.33 | 823.24 |
| 下部 |  | 50.30 | 0.00 | 0.00 | 873.54 |

表6.8 B柱轴力

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | | 柱高 | 柱荷载（kN/m） | P | G | *Vb左* | *Vb右* | *Nc（kN）* |
| 3 | 上部 | 3.60 | 9.96 | 134.94 | 0.00 | 54.55 | 2.17 | 191.66 |
| 下部 |  | 35.86 | 0.00 | 0.00 | 227.52 |
| 2 | 上部 | 3.60 | 9.96 | 206.96 | 0.00 | 75.74 | 2.17 | 512.39 |
| 下部 |  | 35.86 | 0.00 | 0.00 | 548.25 |
| 1 | 上部 | 5.05 | 9.96 | 206.96 | 0.00 | 76.05 | 2.17 | 833.43 |
| 下部 |  | 50.30 | 0.00 | 0.00 | 883.73 |

表6.9 C柱轴力

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | | 柱高 | 柱荷载（kN/m） | P | G | *Vb左* | *Vb右* | *Nc（kN）* |
| 3 | 上部 | 3.60 | 9.96 | 134.94 | 0.00 | 2.17 | 54.55 | 191.66 |
| 下部 |  | 35.86 | 0.00 | 0.00 | 227.52 |
| 2 | 上部 | 3.60 | 9.96 | 206.96 | 0.00 | 2.17 | 75.74 | 512.39 |
| 下部 |  | 35.86 | 0.00 | 0.00 | 548.25 |
| 1 | 上部 | 5.05 | 9.96 | 206.96 | 0.00 | 2.17 | 76.05 | 833.43 |
| 下部 |  | 50.30 | 0.00 | 0.00 | 883.73 |

表6.10 D柱轴力

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | | 柱高 | 柱荷载（kN/m） | P | G | *Vb左* | *Vb右* | *Nc（kN）* |
| 3 | 上部 | 3.60 | 9.96 | 147.22 | 0.00 | 53.57 | 0.00 | 200.79 |
| 下部 |  | 35.86 | 0.00 | 0.00 | 236.65 |
| 2 | 上部 | 3.60 | 9.96 | 199.88 | 0.00 | 75.64 | 0.00 | 512.17 |
| 下部 |  | 35.86 | 0.00 | 0.00 | 548.03 |
| 1 | 上部 | 5.05 | 9.96 | 199.88 | 0.00 | 75.33 | 0.00 | 823.24 |
| 下部 |  | 50.30 | 0.00 | 0.00 | 873.54 |

内力图：

|  |
| --- |
|  |
| M图（单位：） |
|  |
| V图（单位：kN） |
|  |
| N图（单位：kN） |
| 图6.6 内力图 |

## 6.8 活载固端弯矩

梁端弯矩可按下式计算：（顺时针为正）



表6.11 梁端弯矩计算

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | q（kN/m） | | | l（m） | | | AB | | BC | | CD | |
| AB | BC | CD | AB | BC | CD | *Mb左* | *Mb右* | *Mb左* | *Mb右* | *Mb左* | *Mb右* |
| 3 | 1.57 | 0 | 1.57 | 6 | 2.1 | 6 | -4.71 | 4.71 | 0 | 0 | -4.71 | 4.71 |
| 2 | 7.85 | 0 | 7.85 | 6 | 2.1 | 6 | -23.55 | 23.55 | 0 | 0 | -23.55 | 23.55 |
| 1 | 7.85 | 0 | 7.85 | 6 | 2.1 | 6 | -23.55 | 23.55 | 0 | 0 | -23.55 | 23.55 |

## 6.9 活载弯矩分配

弯矩分配过程如下：

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 上柱 | 下柱 | 右梁 |  | 左梁 | 上柱 | 下柱 | 右梁 |  | 左梁 | 上柱 | 下柱 | 右梁 |  | 左梁 | 上柱 | 下柱 |
|  | 0.000 | 0.667 | 0.333 |  | 0.260 | 0 | 0.520 | 0.220 |  | 0.220 | 0 | 0.520 | 0.260 |  | 0.333 | 0 | 0.667 |
| 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 0.00 | -4.71 |  | 4.71 |  | 0.00 | 0.00 |  | 0.00 |  | 0.00 | -4.71 |  | 4.71 |  | 0.00 |
| 0.00 | 3.14 | 1.57 |  | -1.22 | 0.00 | -2.45 | -1.04 |  | 1.04 | 0.00 | 2.45 | 1.22 |  | -1.57 | 0.00 | -3.14 |
| 0.00 | 4.71 | -0.61 |  | 0.78 | 0.00 | -4.03 | 0.52 |  | -0.52 | 0.00 | 4.03 | -0.78 |  | 0.61 | 0.00 | -4.71 |
| 0.00 | -2.73 | -1.36 |  | 0.71 | 0.00 | 1.42 | 0.60 |  | -0.60 | 0.00 | -1.42 | -0.71 |  | 1.36 | 0.00 | 2.73 |
| 0.00 | 5.12 | -5.12 |  | 4.98 | 0.00 | -5.06 | 0.08 |  | -0.08 | 0.00 | 5.06 | -4.98 |  | 5.12 | 0.00 | -5.12 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 0.400 | 0.400 | 0.200 |  | 0.171 | 0.342 | 0.342 | 0.145 |  | 0.145 | 0.342 | 0.342 | 0.171 |  | 0.200 | 0.4 | 0.400 |
| 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 0.00 | -23.55 |  | 23.55 |  | 0.00 | 0.00 |  | 0.00 |  | 0.00 | -23.55 |  | 23.55 |  | 0.00 |
| 9.42 | 9.42 | 4.71 |  | -4.03 | -8.05 | -8.05 | -3.41 |  | 3.41 | 8.05 | 8.05 | 4.03 |  | -4.71 | -9.42 | -9.42 |
| 1.57 | 5.32 | -2.01 |  | 2.36 | -1.22 | -4.46 | 1.71 |  | -1.71 | 1.22 | 4.46 | -2.36 |  | 2.01 | -1.57 | -5.32 |
| -1.95 | -1.95 | -0.98 |  | 0.28 | 0.56 | 0.56 | 0.24 |  | -0.24 | -0.56 | -0.56 | -0.28 |  | 0.98 | 1.95 | 1.95 |
| 9.04 | 12.79 | -21.83 |  | 22.16 | -8.72 | -11.96 | -1.47 |  | 1.47 | 8.72 | 11.96 | -22.16 |  | 21.83 | -9.04 | -12.79 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 0.452 | 0.322 | 0.226 |  | 0.190 | 0.379 | 0.271 | 0.161 |  | 0.161 | 0.379 | 0.271 | 0.190 |  | 0.226 | 0.452 | 0.322 |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 0.00 | -23.55 |  | 23.55 |  | 0.00 | 0.00 |  | 0.00 |  | 0.00 | -23.55 |  | 23.55 |  | 0.00 |
| 10.64 | 7.58 | 5.32 |  | -4.47 | -8.93 | -6.38 | -3.79 |  | 3.79 | 8.93 | 6.38 | 4.47 |  | -5.32 | -10.64 | -7.58 |
| 4.71 | 0.00 | -2.24 |  | 2.66 | -4.03 | 0.00 | 1.90 |  | -1.90 | 4.03 | 0.00 | -2.66 |  | 2.24 | -4.71 | 0.00 |
| -1.12 | -0.80 | -0.56 |  | -0.10 | -0.20 | -0.14 | -0.09 |  | 0.09 | 0.20 | 0.14 | 0.10 |  | 0.56 | 1.12 | 0.80 |
| 14.24 | 6.79 | -21.02 |  | 21.64 | -13.15 | -6.53 | -1.98 |  | 1.98 | 13.15 | 6.53 | -21.64 |  | 21.02 | -14.24 | -6.79 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3.39 |  |  |  |  | -3.26 |  |  |  |  | 3.26 |  |  |  |  | -3.39 |  |

## 6.10 活载跨中弯矩

跨中弯矩按下式计算：



表6.12 活载作用下梁跨中弯矩

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *q（kN*/m） | | | *l（m）* | | | AB | BC | CD |
| AB | BC | CD | AB | BC | CD |
| 3 | 1.57 | 0 | 1.57 | 6 | 2.1 | 6 | 2.02 | -0.08 | 2.02 |
| 2 | 7.85 | 0 | 7.85 | 6 | 2.1 | 6 | 13.33 | -1.47 | 13.33 |
| 1 | 7.85 | 0 | 7.85 | 6 | 2.1 | 6 | 14 | -1.98 | 14 |

## 6.11 活载柱端剪力

|  |
| --- |
|  |
| 图6.7 内力图示 |

柱端剪力计算公式如下：



表6.13 剪力汇总

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 楼层 | 类别 | 柱高 | 柱端弯矩 | | 柱端剪力 | |
| 上 | 下 | 上 | 下 | |
| 3 | A | 3.60 | 5.12 | 9.04 | 3.93 | 3.93 | |
| B | 3.60 | -5.06 | -8.72 | 3.83 | 3.83 | |
| C | 3.60 | 5.06 | 8.72 | 3.83 | 3.83 | |
| D | 3.60 | -5.12 | -9.04 | 3.93 | 3.93 | |
| 2 | A | 3.60 | 12.79 | 14.24 | 7.51 | 7.51 | |
| B | 3.60 | -11.96 | -13.15 | 6.98 | 6.98 | |
| C | 3.60 | 11.96 | 13.15 | 6.98 | 6.98 | |
| D | 3.60 | -12.79 | -14.24 | 7.51 | 7.51 | |
| 1 | A | 5.05 | 6.79 | 3.39 | 2.02 | 2.02 | |
| B | 5.05 | -6.53 | -3.26 | 1.94 | 1.94 | |
| C | 5.05 | 6.53 | 3.26 | 1.94 | 1.94 | |
| D | 5.05 | -6.79 | -3.39 | 2.02 | 2.02 | |

## 6.12 活载内力计算

|  |
| --- |
|  |
| 图6.8 梁内力图示 |

梁端剪力计算公式如下：



表6.14 剪力汇总

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | *q*（kN/m） | | | *l*（m） | | | AB | | BC | | CD | |
| AB | BC | CD | AB | BC | CD | *V*b左 | *V*b右 | *V*b左 | *V*b右 | *V*b左 | *V*b右 |
| 3 | 1.57 | 0.00 | 1.57 | 6.00 | 2.10 | 6.00 | 4.73 | 4.69 | 0.00 | 0.00 | 4.69 | 4.73 |
| 2 | 7.85 | 0.00 | 7.85 | 6.00 | 2.10 | 6.00 | 23.50 | 23.60 | 0.00 | 0.00 | 23.60 | 23.50 |
| 1 | 7.85 | 0.00 | 7.85 | 6.00 | 2.10 | 6.00 | 23.45 | 23.65 | 0.00 | 0.00 | 23.65 | 23.45 |

柱轴力计算公式如下：



表6.15 A柱轴力

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 楼层 | | P | *Vb左* | *Vb右* | *Nc（kN）* |
| 3 | 上部 | 9.10 | 0.00 | 4.73 | 13.83 |
| 下部 |  | 0.00 | 0.00 | 13.83 |
| 2 | 上部 | 45.52 | 0.00 | 23.50 | 82.85 |
| 下部 |  | 0.00 | 0.00 | 82.85 |
| 1 | 上部 | 45.52 | 0.00 | 23.45 | 151.82 |
| 下部 |  | 0.00 | 0.00 | 151.82 |

表6.16 B柱轴力

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 楼层 | | P | *Vb左* | *Vb右* | *Nc（kN）* |
| 3 | 上部 | 9.60 | 4.69 | 0.00 | 14.29 |
| 下部 |  | 0.00 | 0.00 | 14.29 |
| 2 | 上部 | 48.52 | 23.60 | 0.00 | 86.41 |
| 下部 |  | 0.00 | 0.00 | 86.41 |
| 1 | 上部 | 48.52 | 23.65 | 0.00 | 158.58 |
| 下部 |  | 0.00 | 0.00 | 158.58 |

表6.17 C柱轴力

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 楼层 | | P | *Vb左* | *Vb右* | *Nc（kN）* |
| 3 | 上部 | 9.60 | 0.00 | 4.69 | 14.29 |
| 下部 |  | 0.00 | 0.00 | 14.29 |
| 2 | 上部 | 48.52 | 0.00 | 23.60 | 86.41 |
| 下部 |  | 0.00 | 0.00 | 86.41 |
| 1 | 上部 | 48.52 | 0.00 | 23.65 | 158.58 |
| 下部 |  | 0.00 | 0.00 | 158.58 |

表6.18 D柱轴力

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 楼层 | | P | *Vb左* | *Vb右* | *Nc（kN）* |
| 3 | 上部 | 9.10 | 4.73 | 0.00 | 13.83 |
| 下部 |  | 0.00 | 0.00 | 13.83 |
| 2 | 上部 | 45.52 | 23.50 | 0.00 | 82.85 |
| 下部 |  | 0.00 | 0.00 | 82.85 |
| 1 | 上部 | 45.52 | 23.45 | 0.00 | 151.82 |
| 下部 |  | 0.00 | 0.00 | 151.82 |

内力图：

|  |
| --- |
|  |
| M图（单位：） |
|  |
| V图（单位：kN） |
|  |
| N图（单位：kN） |
| 图6.9 内力图 |

# 

# 7 内力组合

## 7.1 内力调幅

支座边缘处弯矩按下式计算：



支座边缘处剪力按下式计算：



梁端弯矩调幅按如下公式计算：



跨中弯矩调幅按如下公式计算：



表7.1 内力调幅（单位：·m）

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | 截面 位置 | 内力 | 轴线处 | | | | 支座边缘处 | | | | 边缘处调幅 | | | |
| 恒 | 活 | 风 | 地震 | 恒 | 活 | 风 | 地震 | 恒 | 活 | 风 | 地震 |
| 3 | A支座 | *M* | -45.72 | -5.12 | 6.60 | 74.06 | -29.65 | -3.70 | 6.01 | 67.42 | -25.20 | -3.14 | — | — |
| *V* | 53.57 | 4.73 | -1.97 | -22.14 | 48.16 | 4.26 | -1.97 | -22.14 | — | — | — | — |
| AB跨中 | *M* | 33.89 | 2.02 | 0.69 | 7.65 | — | — | — | — | 40.97 | 2.78 | — | — |
| B支座左 | *M* | -48.67 | -4.98 | -5.23 | -58.76 | -32.30 | -3.57 | -4.64 | -52.12 | -27.46 | -3.04 | — | — |
| *V* | -54.55 | -4.69 | -1.97 | -22.14 | -49.14 | -4.22 | -1.97 | -22.14 | — | — | — | — |
| B支座右 | *M* | -7.07 | -0.08 | 4.43 | 49.75 | -6.42 | -0.08 | 3.16 | 35.54 | -5.46 | -0.07 | — | — |
| *V* | 2.17 | 0.00 | -4.22 | -47.38 | -3.24 | 0.47 | -4.22 | -47.38 | — | — | — | — |
| BC跨中 | *M* | -5.93 | -0.08 | 0.00 | 0.00 | — | — | — | — | -4.87 | -0.07 | — | — |
| C支座左 | *M* | -7.07 | -0.08 | -4.43 | -49.75 | -6.42 | -0.08 | -3.16 | -35.54 | -5.46 | -0.07 | — | — |
| *V* | -2.17 | 0.00 | -4.22 | -47.38 | 3.24 | 0.47 | -4.22 | -47.38 | — | — | — | — |
| C支座右 | *M* | -48.67 | -4.98 | 5.23 | 58.76 | -32.30 | -3.57 | 4.64 | 52.12 | -27.46 | -3.04 | — | — |
| *V* | 54.55 | 4.69 | -1.97 | -22.14 | 49.14 | 4.22 | -1.97 | -22.14 | — | — | — | — |
| CD跨中 | *M* | 33.89 | 2.02 | -0.69 | -7.65 | — | — | — | — | 40.97 | 2.78 | — | — |
| D支座 | *M* | -45.72 | -5.12 | -6.60 | -74.06 | -29.65 | -3.70 | -6.01 | -67.42 | -25.20 | -3.14 | — | — |
| *V* | -53.57 | -4.73 | -1.97 | -22.14 | -48.16 | -4.26 | -1.97 | -22.14 | — | — | — | — |
| 2 | A支座 | *M* | -72.70 | -21.83 | 14.14 | 146.96 | -50.01 | -14.78 | 12.81 | 133.11 | -42.51 | -12.56 | — | — |
| *V* | 75.64 | 23.50 | -4.44 | -46.17 | 68.07 | 21.15 | -4.44 | -46.17 | — | — | — | — |
| AB跨中 | *M* | 40.67 | 13.33 | 0.83 | 8.46 | — | — | — | — | 51.60 | 16.63 | — | — |
| B支座左 | *M* | -73.02 | -22.16 | -12.48 | -130.05 | -50.30 | -15.08 | -11.15 | -116.20 | -42.75 | -12.81 | — | — |
| *V* | -75.74 | -23.60 | -4.44 | -46.17 | -68.17 | -21.25 | -4.44 | -46.17 | — | — | — | — |
| B支座右 | *M* | -4.01 | -1.47 | 10.56 | 110.10 | -3.36 | -1.47 | 7.54 | 78.64 | -2.85 | -1.25 | — | — |
| *V* | 2.17 | 0.00 | -10.06 | -104.86 | -5.40 | 2.36 | -10.06 | -104.86 | — | — | — | — |
| BC跨中 | *M* | -2.87 | -1.47 | 0.00 | 0.00 | — | — | — | — | -2.27 | -1.25 | — | — |
| C支座左 | *M* | -4.01 | -1.47 | -10.56 | -110.10 | -3.36 | -1.47 | -7.54 | -78.64 | -2.85 | -1.25 | — | — |
| *V* | -2.17 | 0.00 | -10.06 | -104.86 | 5.40 | 2.36 | -10.06 | -104.86 | — | — | — | — |
| C支座右 | *M* | -73.02 | -22.16 | 12.48 | 130.05 | -50.30 | -15.08 | 11.15 | 116.20 | -42.75 | -12.81 | — | — |
| *V* | 75.74 | 23.60 | -4.44 | -46.17 | 68.17 | 21.25 | -4.44 | -46.17 | — | — | — | — |
| CD跨中 | *M* | 40.67 | 13.33 | -0.83 | -8.46 | — | — | — | — | 51.60 | 16.63 | — | — |
| D支座 | *M* | -72.70 | -21.83 | -14.14 | -146.96 | -50.01 | -14.78 | -12.81 | -133.11 | -42.51 | -12.56 | — | — |
| *V* | -75.64 | -23.50 | -4.44 | -46.17 | -68.07 | -21.15 | -4.44 | -46.17 | — | — | — | — |
| 1 | A支座 | *M* | -67.51 | -21.02 | 27.71 | 248.99 | -44.92 | -13.99 | 25.21 | 226.53 | -38.18 | -11.89 | — | — |
| *V* | 75.33 | 23.45 | -8.32 | -74.88 | 67.76 | 21.10 | -8.32 | -74.88 | — | — | — | — |
| AB跨中 | *M* | 44.94 | 14.00 | 2.76 | 24.36 | — | — | — | — | 55.23 | 17.20 | — | — |
| B支座左 | *M* | -69.67 | -21.64 | -22.20 | -200.27 | -46.85 | -14.54 | -19.70 | -177.81 | -39.83 | -12.36 | — | — |
| *V* | -76.05 | -23.65 | -8.32 | -74.88 | -68.48 | -21.30 | -8.32 | -74.88 | — | — | — | — |
| B支座右 | *M* | -7.08 | -1.98 | 18.79 | 169.57 | -6.43 | -1.98 | 13.42 | 121.12 | -5.46 | -1.68 | — | — |
| *V* | 2.17 | 0.00 | -17.90 | -161.50 | -5.40 | 2.36 | -17.90 | -161.50 | — | — | — | — |
| BC跨中 | *M* | -5.94 | -1.98 | 0.00 | 0.00 | — | — | — | — | -4.88 | -1.68 | — | — |
| C支座左 | *M* | -7.08 | -1.98 | -18.79 | -169.57 | -6.43 | -1.98 | -13.42 | -121.12 | -5.46 | -1.68 | — | — |
| *V* | -2.17 | 0.00 | -17.90 | -161.50 | 5.40 | 2.36 | -17.90 | -161.50 | — | — | — | — |
| C支座右 | *M* | -69.67 | -21.64 | 22.20 | 200.27 | -46.85 | -14.54 | 19.70 | 177.81 | -39.83 | -12.36 | — | — |
| *V* | 76.05 | 23.65 | -8.32 | -74.88 | 68.48 | 21.30 | -8.32 | -74.88 | — | — | — | — |
| CD跨中 | *M* | 44.94 | 14.00 | -2.76 | -24.36 | — | — | — | — | 55.23 | 17.20 | — | — |
| D支座 | *M* | -67.51 | -21.02 | -27.71 | -248.99 | -44.92 | -13.99 | -25.21 | -226.53 | -38.18 | -11.89 | — | — |
| *V* | -75.33 | -23.45 | -8.32 | -74.88 | -67.76 | -21.10 | -8.32 | -74.88 | — | — | — | — |

## 7.2 梁内力组合

内力组合形式如下：

（1）一般形式：

1. 1.3恒+1.5活
2. 1.3恒+1.5(活+0.6左风)
3. 1.3恒+1.5(活-0.6右风)
4. 1.3恒+1.5(0.7活+左风)
5. 1.3恒+1.5(0.7活-右风)

（2）考虑地震：

1. 1.3重力荷载+1.4左震
2. 1.3重力荷载-1.4右震

表7.2 一般形式内力组合（单位：·m）

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | 截面 位置 | 内力(kN·m)(kN) | 恒 | 活 | 风 | 1.3恒+1.5×活 | 1.3恒+1.5×(活+0.6风) | | 1.3恒+1.5×(0.7活+风) | | |M|max及对应V | Mmin及对应V | |V|max及对应M |
| 左风 | 右风 | 左风 | 右风 |
| 3 | A支座 | *M* | -25.20 | -3.14 | 6.01 | -37.48 | -32.07 | -42.89 | -27.05 | -45.08 | -45.08 | -45.08 | -42.89 |
| *V* | 48.16 | 4.26 | -1.97 | 69.00 | 67.23 | 70.77 | 64.13 | 70.04 | 70.04 | 70.04 | 70.77 |
| AB跨中 | *M* | 40.97 | 2.78 | 0.69 | 57.43 | 58.05 | 56.80 | 57.21 | 55.14 | 58.05 | 55.14 |  |
| B支座左 | *M* | -27.46 | -3.04 | -4.64 | -40.25 | -44.42 | -36.07 | -45.84 | -31.93 | -45.84 | -45.84 | -44.42 |
| *V* | -49.14 | -4.22 | -1.97 | -70.22 | -71.99 | -68.44 | -71.27 | -65.36 | -71.27 | -71.27 | -71.99 |
| B支座右 | *M* | -5.46 | -0.07 | 3.16 | -7.20 | -4.35 | -10.05 | -2.42 | -11.92 | -11.92 | -11.92 | -2.42 |
| *V* | -3.24 | 0.47 | -4.22 | -3.50 | -7.30 | 0.30 | -10.04 | 2.62 | 2.62 | 2.62 | -10.04 |
| BC跨中 | *M* | -4.87 | -0.07 | 0.00 | -6.43 | -6.43 | -6.43 | -6.40 | -6.40 | -6.43 | -6.43 |  |
| C支座左 | *M* | -5.46 | -0.07 | -3.16 | -7.20 | -10.05 | -4.35 | -11.92 | -2.42 | -11.92 | -11.92 | -2.42 |
| *V* | 3.24 | 0.47 | -4.22 | 4.91 | 1.12 | 8.71 | -1.63 | 11.03 | -1.63 | -1.63 | 11.03 |
| C支座右 | *M* | -27.46 | -3.04 | 4.64 | -40.25 | -36.07 | -44.42 | -31.93 | -45.84 | -45.84 | -45.84 | -44.42 |
| *V* | 49.14 | 4.22 | -1.97 | 70.22 | 68.44 | 71.99 | 65.36 | 71.27 | 71.27 | 71.27 | 71.99 |
| CD跨中 | *M* | 40.97 | 2.78 | -0.69 | 57.43 | 56.80 | 58.05 | 55.14 | 57.21 | 58.05 | 55.14 |  |
| D支座 | *M* | -25.20 | -3.14 | -6.01 | -37.48 | -42.89 | -32.07 | -45.08 | -27.05 | -45.08 | -45.08 | -42.89 |
| *V* | -48.16 | -4.26 | -1.97 | -69.00 | -70.77 | -67.23 | -70.04 | -64.13 | -70.04 | -70.04 | -70.77 |
| 2 | A支座 | *M* | -42.51 | -12.56 | 12.81 | -74.11 | -62.58 | -85.63 | -49.24 | -87.67 | -87.67 | -87.67 | -85.63 |
| *V* | 68.07 | 21.15 | -4.44 | 120.21 | 116.21 | 124.21 | 104.03 | 117.35 | 117.35 | 117.35 | 124.21 |
| AB跨中 | *M* | 51.60 | 16.63 | 0.83 | 92.02 | 92.77 | 91.28 | 85.78 | 83.29 | 92.77 | 83.29 |  |
| B支座左 | *M* | -42.75 | -12.81 | -11.15 | -74.80 | -84.83 | -64.77 | -85.76 | -52.31 | -85.76 | -85.76 | -84.83 |
| *V* | -68.17 | -21.25 | -4.44 | -120.49 | -124.49 | -116.49 | -117.59 | -104.27 | -117.59 | -117.59 | -124.49 |
| B支座右 | *M* | -2.85 | -1.25 | 7.54 | -5.59 | 1.20 | -12.38 | 6.29 | -16.34 | -16.34 | -16.34 | 6.29 |
| *V* | -5.40 | 2.36 | -10.06 | -3.49 | -12.54 | 5.57 | -19.64 | 10.54 | 10.54 | 10.54 | -19.64 |
| BC跨中 | *M* | -2.27 | -1.25 | 0.00 | -4.82 | -4.82 | -4.82 | -4.26 | -4.26 | -4.82 | -4.82 |  |
| C支座左 | *M* | -2.85 | -1.25 | -7.54 | -5.59 | -12.38 | 1.20 | -16.34 | 6.29 | -16.34 | -16.34 | 6.29 |
| *V* | 5.40 | 2.36 | -10.06 | 10.55 | 1.50 | 19.61 | -5.60 | 24.58 | -5.60 | -5.60 | 24.58 |
| C支座右 | *M* | -42.75 | -12.81 | 11.15 | -74.80 | -64.77 | -84.83 | -52.31 | -85.76 | -85.76 | -85.76 | -84.83 |
| *V* | 68.17 | 21.25 | -4.44 | 120.49 | 116.49 | 124.49 | 104.27 | 117.59 | 117.59 | 117.59 | 124.49 |
| CD跨中 | *M* | 51.60 | 16.63 | -0.83 | 92.02 | 91.28 | 92.77 | 83.29 | 85.78 | 92.77 | 83.29 |  |
| D支座 | *M* | -42.51 | -12.56 | -12.81 | -74.11 | -85.63 | -62.58 | -87.67 | -49.24 | -87.67 | -87.67 | -85.63 |
| *V* | -68.07 | -21.15 | -4.44 | -120.21 | -124.21 | -116.21 | -117.35 | -104.03 | -117.35 | -117.35 | -124.21 |
| 1 | A支座 | *M* | -38.18 | -11.89 | 25.21 | -67.47 | -44.78 | -90.16 | -24.30 | -99.94 | -99.94 | -99.94 | -90.16 |
| *V* | 67.76 | 21.10 | -8.32 | 119.73 | 112.24 | 127.22 | 97.76 | 122.72 | 122.72 | 122.72 | 127.22 |
| AB跨中 | *M* | 55.23 | 17.20 | 2.76 | 97.60 | 100.08 | 95.11 | 94.00 | 85.72 | 100.08 | 85.72 |  |
| B支座左 | *M* | -39.83 | -12.36 | -19.70 | -70.31 | -88.05 | -52.58 | -94.31 | -35.20 | -94.31 | -94.31 | -88.05 |
| *V* | -68.48 | -21.30 | -8.32 | -120.97 | -128.46 | -113.48 | -123.87 | -98.91 | -123.87 | -123.87 | -128.46 |
| B支座右 | *M* | -5.46 | -1.68 | 13.42 | -9.63 | 2.45 | -21.70 | 11.26 | -29.00 | -29.00 | -29.00 | 11.26 |
| *V* | -5.40 | 2.36 | -17.90 | -3.49 | -19.60 | 12.62 | -31.40 | 22.30 | 22.30 | 22.30 | -31.40 |
| BC跨中 | *M* | -4.88 | -1.68 | 0.00 | -8.87 | -8.87 | -8.87 | -8.11 | -8.11 | -8.87 | -8.87 |  |
| C支座左 | *M* | -5.46 | -1.68 | -13.42 | -9.63 | -21.70 | 2.45 | -29.00 | 11.26 | -29.00 | -29.00 | 11.26 |
| *V* | 5.40 | 2.36 | -17.90 | 10.55 | -5.56 | 26.66 | -17.36 | 36.34 | -17.36 | -17.36 | 36.34 |
| C支座右 | *M* | -39.83 | -12.36 | 19.70 | -70.31 | -52.58 | -88.05 | -35.20 | -94.31 | -94.31 | -94.31 | -88.05 |
| *V* | 68.48 | 21.30 | -8.32 | 120.97 | 113.48 | 128.46 | 98.91 | 123.87 | 123.87 | 123.87 | 128.46 |
| CD跨中 | *M* | 55.23 | 17.20 | -2.76 | 97.60 | 95.11 | 100.08 | 85.72 | 94.00 | 100.08 | 85.72 |  |
| D支座 | *M* | -38.18 | -11.89 | -25.21 | -67.47 | -90.16 | -44.78 | -99.94 | -24.30 | -99.94 | -99.94 | -90.16 |
| *V* | -67.76 | -21.10 | -8.32 | -119.73 | -127.22 | -112.24 | -122.72 | -97.76 | -122.72 | -122.72 | -127.22 |

重力荷载应按下式计算：



“强剪弱弯“按下式考虑：



表7.3 考虑地震内力组合（单位：·m）

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | 截面 位置 | 内力(kN·m)(kN) | 恒 | 活 | 地震 | 重力荷载 | *VGb* | 1.3重力荷载+1.4地震 | | 强剪弱弯调整 | |M|max及对应V | Mmin及对应V | |V|max及对应M |
| 左震 | 右震 |
| 3 | A支座 | *M* | -25.20 | -3.14 | 67.42 | -25.20 |  | 61.62 | -127.15 |  | -127.15 | -127.15 | -127.15 |
| *V* | 48.16 | 4.26 | -22.14 | 48.16 | 60.93 | 31.62 | 93.61 | 95.62 | 93.61 | 93.61 | 93.61 |
| AB跨中 | *M* | 40.97 | 2.78 | 7.65 | 40.97 |  | 63.97 | 42.55 |  | 63.97 | 42.55 |  |
| B支座左 | *M* | -27.46 | -3.04 | -52.12 | -27.46 |  | -108.66 | 37.27 |  | -108.66 | -108.66 | -108.66 |
| *V* | -49.14 | -4.22 | -22.14 | -49.14 | 60.93 | -94.88 | -32.89 | 95.62 | -94.88 | -94.88 | -94.88 |
| B支座右 | *M* | -5.46 | -0.07 | 35.54 | -5.46 |  | 42.65 | -56.85 |  | -56.85 | -56.85 | 42.65 |
| *V* | -3.24 | 0.47 | -47.38 | -3.24 | 1.86 | -70.54 | 62.13 | 74.83 | 62.13 | 62.13 | -70.54 |
| BC跨中 | *M* | -4.87 | -0.07 | 0.00 | -4.87 |  | -6.33 | -6.33 |  | -6.33 | -6.33 |  |
| C支座左 | *M* | -5.46 | -0.07 | -35.54 | -5.46 |  | -56.85 | 42.65 |  | -56.85 | -56.85 | 42.65 |
| *V* | 3.24 | 0.47 | -47.38 | 3.24 | 1.86 | -62.13 | 70.54 | 74.83 | -62.13 | -62.13 | 70.54 |
| C支座右 | *M* | -27.46 | -3.04 | 52.12 | -27.46 |  | 37.27 | -108.66 |  | -108.66 | -108.66 | -108.66 |
| *V* | 49.14 | 4.22 | -22.14 | 49.14 | 60.93 | 32.89 | 94.88 | 95.62 | 94.88 | 94.88 | 94.88 |
| CD跨中 | *M* | 40.97 | 2.78 | -7.65 | 40.97 |  | 42.55 | 63.97 |  | 63.97 | 42.55 |  |
| D支座 | *M* | -25.20 | -3.14 | -67.42 | -25.20 |  | -127.15 | 61.62 |  | -127.15 | -127.15 | -127.15 |
| *V* | -48.16 | -4.26 | -22.14 | -48.16 | 60.93 | -93.61 | -31.62 | 95.62 | -93.61 | -93.61 | -93.61 |
| 2 | A支座 | *M* | -42.51 | -12.56 | 133.11 | -48.79 |  | 122.92 | -249.78 |  | -249.78 | -249.78 | -249.78 |
| *V* | 68.07 | 21.15 | -46.17 | 78.64 | 94.46 | 37.60 | 166.87 | 165.66 | 166.87 | 166.87 | 166.87 |
| AB跨中 | *M* | 51.60 | 16.63 | 8.46 | 59.91 |  | 89.73 | 66.04 |  | 89.73 | 66.04 |  |
| B支座左 | *M* | -42.75 | -12.81 | -116.20 | -49.16 |  | -226.59 | 98.77 |  | -226.59 | -226.59 | -226.59 |
| *V* | -68.17 | -21.25 | -46.17 | -78.79 | 94.46 | -167.07 | -37.79 | 165.66 | -167.07 | -167.07 | -167.07 |
| B支座右 | *M* | -2.85 | -1.25 | 78.64 | -3.48 |  | 105.57 | -114.62 |  | -114.62 | -114.62 | 105.57 |
| *V* | -5.40 | 2.36 | -104.86 | -4.22 | 1.86 | -152.29 | 141.32 | 163.34 | 141.32 | 141.32 | -152.29 |
| BC跨中 | *M* | -2.27 | -1.25 | 0.00 | -2.89 |  | -3.76 | -3.76 |  | -3.76 | -3.76 |  |
| C支座左 | *M* | -2.85 | -1.25 | -78.64 | -3.48 |  | -114.62 | 105.57 |  | -114.62 | -114.62 | 105.57 |
| *V* | 5.40 | 2.36 | -104.86 | 6.58 | 1.86 | -138.25 | 155.35 | 163.34 | -138.25 | -138.25 | 155.35 |
| C支座右 | *M* | -42.75 | -12.81 | 116.20 | -49.16 |  | 98.77 | -226.59 |  | -226.59 | -226.59 | -226.59 |
| *V* | 68.17 | 21.25 | -46.17 | 78.79 | 94.46 | 37.79 | 167.07 | 165.66 | 167.07 | 167.07 | 167.07 |
| CD跨中 | *M* | 51.60 | 16.63 | -8.46 | 59.91 |  | 66.04 | 89.73 |  | 89.73 | 66.04 |  |
| D支座 | *M* | -42.51 | -12.56 | -133.11 | -48.79 |  | -249.78 | 122.92 |  | -249.78 | -249.78 | -249.78 |
| *V* | -68.07 | -21.15 | -46.17 | -78.64 | 94.46 | -166.87 | -37.60 | 165.66 | -166.87 | -166.87 | -166.87 |
| 1 | A支座 | *M* | -38.18 | -11.89 | 226.53 | -44.12 |  | 259.78 | -374.50 |  | -374.50 | -374.50 | -374.50 |
| *V* | 67.76 | 21.10 | -74.88 | 78.31 | 94.46 | -3.03 | 206.63 | 210.27 | 206.63 | 206.63 | 206.63 |
| AB跨中 | *M* | 55.23 | 17.20 | 24.36 | 63.83 |  | 117.08 | 48.87 |  | 117.08 | 48.87 |  |
| B支座左 | *M* | -39.83 | -12.36 | -177.81 | -46.01 |  | -308.74 | 189.12 |  | -308.74 | -308.74 | -308.74 |
| *V* | -68.48 | -21.30 | -74.88 | -79.13 | 94.46 | -207.70 | 1.96 | 210.27 | -207.70 | -207.70 | -207.70 |
| B支座右 | *M* | -5.46 | -1.68 | 121.12 | -6.30 |  | 161.37 | -177.76 |  | -177.76 | -177.76 | 161.37 |
| *V* | -5.40 | 2.36 | -161.50 | -4.22 | 1.86 | -231.59 | 220.61 | 250.56 | 220.61 | 220.61 | -231.59 |
| BC跨中 | *M* | -4.88 | -1.68 | 0.00 | -5.72 |  | -7.44 | -7.44 |  | -7.44 | -7.44 |  |
| C支座左 | *M* | -5.46 | -1.68 | -121.12 | -6.30 |  | -177.76 | 161.37 |  | -177.76 | -177.76 | 161.37 |
| *V* | 5.40 | 2.36 | -161.50 | 6.58 | 1.86 | -217.55 | 234.65 | 250.56 | -217.55 | -217.55 | 234.65 |
| C支座右 | *M* | -39.83 | -12.36 | 177.81 | -46.01 |  | 189.12 | -308.74 |  | -308.74 | -308.74 | -308.74 |
| *V* | 68.48 | 21.30 | -74.88 | 79.13 | 94.46 | -1.96 | 207.70 | 210.27 | 207.70 | 207.70 | 207.70 |
| CD跨中 | *M* | 55.23 | 17.20 | -24.36 | 63.83 |  | 48.87 | 117.08 |  | 117.08 | 48.87 |  |
| D支座 | *M* | -38.18 | -11.89 | -226.53 | -44.12 |  | -374.50 | 259.78 |  | -374.50 | -374.50 | -374.50 |
| *V* | -67.76 | -21.10 | -74.88 | -78.31 | 94.46 | -206.63 | 3.03 | 210.27 | -206.63 | -206.63 | -206.63 |

## 7.3 柱内力组合

“强柱弱梁“应按下式考虑：



“强剪弱弯”应按下式考虑：



框架柱的内力汇总如下：

表7.4 内力汇总（单位：·m）

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | 截面位置 | | 恒 | | | 活 | | | 风 | | | 地震 | | |
| M | N | V | M | N | V | M | N | V | M | N | V |
| 3 | A柱 | 上 | 45.72 | 200.79 | -22.93 | 5.12 | 13.83 | -3.93 | -6.60 | -1.97 | 2.62 | -74.06 | -22.14 | 29.39 |
| 下 | 36.81 | 236.65 | -22.93 | 9.04 | 13.83 | -3.93 | -2.83 | -1.97 | 2.62 | -31.74 | -22.14 | 29.39 |
| B柱 | 上 | -41.60 | 191.66 | 21.09 | -5.06 | 14.29 | 3.83 | -9.66 | -2.25 | 4.13 | -108.51 | -25.24 | 46.37 |
| 下 | -34.33 | 227.52 | 21.09 | -8.72 | 14.29 | 3.83 | -5.20 | -2.25 | 4.13 | -58.43 | -25.24 | 46.37 |
| C柱 | 上 | 41.60 | 191.66 | -21.09 | 5.06 | 14.29 | -3.83 | -9.66 | 2.25 | 4.13 | -108.51 | 25.24 | 46.37 |
| 下 | 34.33 | 227.52 | -21.09 | 8.72 | 14.29 | -3.83 | -5.20 | 2.25 | 4.13 | -58.43 | 25.24 | 46.37 |
| D柱 | 上 | -45.72 | 200.79 | 22.93 | -5.12 | 13.83 | 3.93 | -6.60 | 1.97 | 2.62 | -74.06 | 22.14 | 29.39 |
| 下 | -36.81 | 236.65 | 22.93 | -9.04 | 13.83 | 3.93 | -2.83 | 1.97 | 2.62 | -31.74 | 22.14 | 29.39 |
| 2 | A柱 | 上 | 35.89 | 512.17 | -22.67 | 12.79 | 82.85 | -7.51 | -11.31 | -6.41 | 5.71 | -115.22 | -68.31 | 58.19 |
| 下 | 45.72 | 548.03 | -22.67 | 14.24 | 82.85 | -7.51 | -9.25 | -6.41 | 5.71 | -94.27 | -68.31 | 58.19 |
| B柱 | 上 | -34.68 | 512.39 | 21.27 | -11.96 | 86.41 | 6.98 | -17.84 | -7.87 | 9.01 | -181.72 | -83.93 | 91.78 |
| 下 | -41.88 | 548.25 | 21.27 | -13.15 | 86.41 | 6.98 | -14.60 | -7.87 | 9.01 | -148.68 | -83.93 | 91.78 |
| C柱 | 上 | 34.68 | 512.39 | -21.27 | 11.96 | 86.41 | -6.98 | -17.84 | 7.87 | 9.01 | -181.72 | 83.93 | 91.78 |
| 下 | 41.88 | 548.25 | -21.27 | 13.15 | 86.41 | -6.98 | -14.60 | 7.87 | 9.01 | -148.68 | 83.93 | 91.78 |
| D柱 | 上 | -35.89 | 512.17 | 22.67 | -12.79 | 82.85 | 7.51 | -11.31 | 6.41 | 5.71 | -115.22 | 68.31 | 58.19 |
| 下 | -45.72 | 548.03 | 22.67 | -14.24 | 82.85 | 7.51 | -9.25 | 6.41 | 5.71 | -94.27 | 68.31 | 58.19 |
| 1 | A柱 | 上 | 21.79 | 823.24 | -6.47 | 6.79 | 151.82 | -2.02 | -18.46 | -14.73 | 10.43 | -154.72 | -143.19 | 87.41 |
| 下 | 10.89 | 873.54 | -6.47 | 3.39 | 151.82 | -2.02 | -34.21 | -14.73 | 10.43 | -286.70 | -143.19 | 87.41 |
| B柱 | 上 | -20.79 | 833.43 | 6.17 | -6.53 | 158.58 | 1.94 | -26.39 | -17.45 | 12.75 | -221.16 | -170.55 | 106.84 |
| 下 | -10.39 | 883.73 | 6.17 | -3.26 | 158.58 | 1.94 | -38.00 | -17.45 | 12.75 | -318.38 | -170.55 | 106.84 |
| C柱 | 上 | 20.79 | 833.43 | -6.17 | 6.53 | 158.58 | -1.94 | -26.39 | 17.45 | 12.75 | -221.16 | 170.55 | 106.84 |
| 下 | 10.39 | 883.73 | -6.17 | 3.26 | 158.58 | -1.94 | -38.00 | 17.45 | 12.75 | -318.38 | 170.55 | 106.84 |
| D柱 | 上 | -21.79 | 823.24 | 6.47 | -6.79 | 151.82 | 2.02 | -18.46 | 14.73 | 10.43 | -154.72 | 143.19 | 87.41 |
| 下 | -10.89 | 873.54 | 6.47 | -3.39 | 151.82 | 2.02 | -34.21 | 14.73 | 10.43 | -286.70 | 143.19 | 87.41 |

表7.5 一般形式内力组合（单位：·m）

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | 截面 位置 | | 内力 | 恒 | 活 | 风 | 1.3恒+1.5×活 | 1.3恒+1.5×(活+0.6风) | | 1.3恒+1.5×(0.7活+风) | | |M|max及对应N,V | Nmin及对应M,V | Nmax及对应M,V |
| 左风 | 右风 | 左风 | 右风 |
| 3 | A柱 | 上 | M | 45.72 | 5.12 | -6.60 | 67.11 | 61.17 | 73.05 | 54.91 | 74.71 | 74.71 | 54.91 | 73.05 |
| N | 200.79 | 13.83 | -1.97 | 281.77 | 280.00 | 283.55 | 272.59 | 278.50 | 278.50 | 272.59 | 283.55 |
| V | -22.93 | -3.93 | 2.62 | -35.70 | -33.35 | -38.06 | -30.01 | -37.86 | -37.86 | -30.01 | -38.06 |
| 下 | M | 36.81 | 9.04 | -2.83 | 61.42 | 58.87 | 63.96 | 53.10 | 61.59 | 63.96 | 53.10 | 63.96 |
| N | 236.65 | 13.83 | -1.97 | 328.39 | 326.62 | 330.16 | 319.21 | 325.12 | 330.16 | 319.21 | 330.16 |
| V | -22.93 | -3.93 | 2.62 | -35.70 | -33.35 | -38.06 | -30.01 | -37.86 | -38.06 | -30.01 | -38.06 |
| B柱 | 上 | M | -41.60 | -5.06 | -9.66 | -61.66 | -70.36 | -52.97 | -73.88 | -44.90 | -73.88 | -73.88 | -52.97 |
| N | 191.66 | 14.29 | -2.25 | 270.59 | 268.57 | 272.62 | 260.79 | 267.54 | 260.79 | 260.79 | 272.62 |
| V | 21.09 | 3.83 | 4.13 | 33.16 | 36.88 | 29.45 | 37.63 | 25.25 | 37.63 | 37.63 | 29.45 |
| 下 | M | -34.33 | -8.72 | -5.20 | -57.72 | -62.40 | -53.04 | -61.59 | -45.99 | -62.40 | -61.59 | -53.04 |
| N | 227.52 | 14.29 | -2.25 | 317.21 | 315.19 | 319.24 | 307.41 | 314.16 | 315.19 | 307.41 | 319.24 |
| V | 21.09 | 3.83 | 4.13 | 33.16 | 36.88 | 29.45 | 37.63 | 25.25 | 36.88 | 37.63 | 29.45 |
| C柱 | 上 | M | 41.60 | 5.06 | -9.66 | 61.66 | 52.97 | 70.36 | 44.90 | 73.88 | 73.88 | 73.88 | 52.97 |
| N | 191.66 | 14.29 | 2.25 | 270.59 | 272.62 | 268.57 | 267.54 | 260.79 | 260.79 | 260.79 | 272.62 |
| V | -21.09 | -3.83 | 4.13 | -33.16 | -29.45 | -36.88 | -25.25 | -37.63 | -37.63 | -37.63 | -29.45 |
| 下 | M | 34.33 | 8.72 | -5.20 | 57.72 | 53.04 | 62.40 | 45.99 | 61.59 | 62.40 | 61.59 | 53.04 |
| N | 227.52 | 14.29 | 2.25 | 317.21 | 319.24 | 315.19 | 314.16 | 307.41 | 315.19 | 307.41 | 319.24 |
| V | -21.09 | -3.83 | 4.13 | -33.16 | -29.45 | -36.88 | -25.25 | -37.63 | -36.88 | -37.63 | -29.45 |
| D柱 | 上 | M | -45.72 | -5.12 | -6.60 | -67.11 | -73.05 | -61.17 | -74.71 | -54.91 | -74.71 | -54.91 | -73.05 |
| N | 200.79 | 13.83 | 1.97 | 281.77 | 283.55 | 280.00 | 278.50 | 272.59 | 278.50 | 272.59 | 283.55 |
| V | 22.93 | 3.93 | 2.62 | 35.70 | 38.06 | 33.35 | 37.86 | 30.01 | 37.86 | 30.01 | 38.06 |
| 下 | M | -36.81 | -9.04 | -2.83 | -61.42 | -63.96 | -58.87 | -61.59 | -53.10 | -63.96 | -53.10 | -63.96 |
| N | 236.65 | 13.83 | 1.97 | 328.39 | 330.16 | 326.62 | 325.12 | 319.21 | 330.16 | 319.21 | 330.16 |
| V | 22.93 | 3.93 | 2.62 | 35.70 | 38.06 | 33.35 | 37.86 | 30.01 | 38.06 | 30.01 | 38.06 |
| 2 | A柱 | 上 | M | 35.89 | 12.79 | -11.31 | 65.84 | 55.66 | 76.02 | 43.12 | 77.05 | 77.05 | 43.12 | 76.02 |
| N | 512.17 | 82.85 | -6.41 | 790.10 | 784.33 | 795.87 | 743.20 | 762.43 | 762.43 | 743.20 | 795.87 |
| V | -22.67 | -7.51 | 5.71 | -40.74 | -35.60 | -45.88 | -28.79 | -45.92 | -45.92 | -28.79 | -45.88 |
| 下 | M | 45.72 | 14.24 | -9.25 | 80.80 | 72.47 | 89.12 | 60.52 | 88.27 | 89.12 | 60.52 | 89.12 |
| N | 548.03 | 82.85 | -6.41 | 836.71 | 830.95 | 842.48 | 789.82 | 809.05 | 842.48 | 789.82 | 842.48 |
| V | -22.67 | -7.51 | 5.71 | -40.74 | -35.60 | -45.88 | -28.79 | -45.92 | -45.88 | -28.79 | -45.88 |
| B柱 | 上 | M | -34.68 | -11.96 | -17.84 | -63.02 | -79.08 | -46.96 | -84.40 | -30.88 | -84.40 | -84.40 | -46.96 |
| N | 512.39 | 86.41 | -7.87 | 795.72 | 788.64 | 802.81 | 745.03 | 768.64 | 745.03 | 745.03 | 802.81 |
| V | 21.27 | 6.98 | 9.01 | 38.12 | 46.23 | 30.01 | 48.50 | 21.46 | 48.50 | 48.50 | 30.01 |
| 下 | M | -41.88 | -13.15 | -14.60 | -74.18 | -87.32 | -61.04 | -90.16 | -46.36 | -90.16 | -90.16 | -61.04 |
| N | 548.25 | 86.41 | -7.87 | 842.34 | 835.26 | 849.42 | 791.65 | 815.26 | 791.65 | 791.65 | 849.42 |
| V | 21.27 | 6.98 | 9.01 | 38.12 | 46.23 | 30.01 | 48.50 | 21.46 | 48.50 | 48.50 | 30.01 |
| C柱 | 上 | M | 34.68 | 11.96 | -17.84 | 63.02 | 46.96 | 79.08 | 30.88 | 84.40 | 84.40 | 84.40 | 46.96 |
| N | 512.39 | 86.41 | 7.87 | 795.72 | 802.81 | 788.64 | 768.64 | 745.03 | 745.03 | 745.03 | 802.81 |
| V | -21.27 | -6.98 | 9.01 | -38.12 | -30.01 | -46.23 | -21.46 | -48.50 | -48.50 | -48.50 | -30.01 |
| 下 | M | 41.88 | 13.15 | -14.60 | 74.18 | 61.04 | 87.32 | 46.36 | 90.16 | 90.16 | 90.16 | 61.04 |
| N | 548.25 | 86.41 | 7.87 | 842.34 | 849.42 | 835.26 | 815.26 | 791.65 | 791.65 | 791.65 | 849.42 |
| V | -21.27 | -6.98 | 9.01 | -38.12 | -30.01 | -46.23 | -21.46 | -48.50 | -48.50 | -48.50 | -30.01 |
| D柱 | 上 | M | -35.89 | -12.79 | -11.31 | -65.84 | -76.02 | -55.66 | -77.05 | -43.12 | -77.05 | -43.12 | -76.02 |
| N | 512.17 | 82.85 | 6.41 | 790.10 | 795.87 | 784.33 | 762.43 | 743.20 | 762.43 | 743.20 | 795.87 |
| V | 22.67 | 7.51 | 5.71 | 40.74 | 45.88 | 35.60 | 45.92 | 28.79 | 45.92 | 28.79 | 45.88 |
| 下 | M | -45.72 | -14.24 | -9.25 | -80.80 | -89.12 | -72.47 | -88.27 | -60.52 | -89.12 | -60.52 | -89.12 |
| N | 548.03 | 82.85 | 6.41 | 836.71 | 842.48 | 830.95 | 809.05 | 789.82 | 842.48 | 789.82 | 842.48 |
| V | 22.67 | 7.51 | 5.71 | 40.74 | 45.88 | 35.60 | 45.92 | 28.79 | 45.88 | 28.79 | 45.88 |
| 1 | A柱 | 上 | M | 21.79 | 6.79 | -18.46 | 38.51 | 21.89 | 55.12 | 7.76 | 63.14 | 63.14 | 7.76 | 55.12 |
| N | 823.24 | 151.82 | -14.73 | 1297.94 | 1284.69 | 1311.20 | 1207.53 | 1251.72 | 1251.72 | 1207.53 | 1311.20 |
| V | -6.47 | -2.02 | 10.43 | -11.44 | -2.05 | -20.83 | 5.11 | -26.18 | -26.18 | 5.11 | -20.83 |
| 下 | M | 10.89 | 3.39 | -34.21 | 19.25 | -11.54 | 50.04 | -33.59 | 69.04 | 69.04 | -33.59 | 50.04 |
| N | 873.54 | 151.82 | -14.73 | 1363.33 | 1350.08 | 1376.59 | 1272.92 | 1317.11 | 1317.11 | 1272.92 | 1376.59 |
| V | -6.47 | -2.02 | 10.43 | -11.44 | -2.05 | -20.83 | 5.11 | -26.18 | -26.18 | 5.11 | -20.83 |
| B柱 | 上 | M | -20.79 | -6.53 | -26.39 | -36.81 | -60.56 | -13.06 | -73.46 | 5.71 | -73.46 | -73.46 | -13.06 |
| N | 833.43 | 158.58 | -17.45 | 1321.33 | 1305.62 | 1337.03 | 1223.79 | 1276.14 | 1223.79 | 1223.79 | 1337.03 |
| V | 6.17 | 1.94 | 12.75 | 10.93 | 22.41 | -0.54 | 29.18 | -9.07 | 29.18 | 29.18 | -0.54 |
| 下 | M | -10.39 | -3.26 | -38.00 | -18.41 | -52.61 | 15.79 | -73.94 | 40.06 | -73.94 | -73.94 | 15.79 |
| N | 883.73 | 158.58 | -17.45 | 1386.72 | 1371.01 | 1402.42 | 1289.18 | 1341.53 | 1289.18 | 1289.18 | 1402.42 |
| V | 6.17 | 1.94 | 12.75 | 10.93 | 22.41 | -0.54 | 29.18 | -9.07 | 29.18 | 29.18 | -0.54 |
| C柱 | 上 | M | 20.79 | 6.53 | -26.39 | 36.81 | 13.06 | 60.56 | -5.71 | 73.46 | 73.46 | 73.46 | 13.06 |
| N | 833.43 | 158.58 | 17.45 | 1321.33 | 1337.03 | 1305.62 | 1276.14 | 1223.79 | 1223.79 | 1223.79 | 1337.03 |
| V | -6.17 | -1.94 | 12.75 | -10.93 | 0.54 | -22.41 | 9.07 | -29.18 | -29.18 | -29.18 | 0.54 |
| 下 | M | 10.39 | 3.26 | -38.00 | 18.41 | -15.79 | 52.61 | -40.06 | 73.94 | 73.94 | 73.94 | -15.79 |
| N | 883.73 | 158.58 | 17.45 | 1386.72 | 1402.42 | 1371.01 | 1341.53 | 1289.18 | 1289.18 | 1289.18 | 1402.42 |
| V | -6.17 | -1.94 | 12.75 | -10.93 | 0.54 | -22.41 | 9.07 | -29.18 | -29.18 | -29.18 | 0.54 |
| D柱 | 上 | M | -21.79 | -6.79 | -18.46 | -38.51 | -55.12 | -21.89 | -63.14 | -7.76 | -63.14 | -7.76 | -55.12 |
| N | 823.24 | 151.82 | 14.73 | 1297.94 | 1311.20 | 1284.69 | 1251.72 | 1207.53 | 1251.72 | 1207.53 | 1311.20 |
| V | 6.47 | 2.02 | 10.43 | 11.44 | 20.83 | 2.05 | 26.18 | -5.11 | 26.18 | -5.11 | 20.83 |
| 下 | M | -10.89 | -3.39 | -34.21 | -19.25 | -50.04 | 11.54 | -69.04 | 33.59 | -69.04 | 33.59 | -50.04 |
| N | 873.54 | 151.82 | 14.73 | 1363.33 | 1376.59 | 1350.08 | 1317.11 | 1272.92 | 1317.11 | 1272.92 | 1376.59 |
| V | 6.47 | 2.02 | 10.43 | 11.44 | 20.83 | 2.05 | 26.18 | -5.11 | 26.18 | -5.11 | 20.83 |

表7.6 考虑地震内力组合（单位：·m）

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 楼层 | 截面 位置 | | 内力 | 恒 | 活 | 地震 | 重力荷载 | 1.3重力荷载+1.4地震 | | 强柱弱梁调整 | 强剪弱弯调整 | |M|max及对应N,V | Nmin及对应M,V | Nmax及对应M,V |
| 左震 | 右震 |
| 3 | A柱 | 上 | M | 45.72 | 5.12 | -74.06 | 45.72 | -44.25 | 163.12 | 165.29 |  | 163.12 | -44.25 | 163.12 |
| N | 200.79 | 13.83 | -22.14 | 200.79 | 230.03 | 292.02 |  |  | 292.02 | 230.03 | 292.02 |
| V | -22.93 | -3.93 | 29.39 | -22.93 | 11.34 | -70.95 |  | 102.17 | -70.95 | 11.34 | -70.95 |
| 下 | M | 36.81 | 9.04 | -31.74 | 36.81 | 3.42 | 92.29 | 97.12 |  | 92.29 | 3.42 | 92.29 |
| N | 236.65 | 13.83 | -22.14 | 236.65 | 276.65 | 338.64 |  |  | 338.64 | 276.65 | 338.64 |
| V | -22.93 | -3.93 | 29.39 | -22.93 | 11.34 | -70.95 |  | 102.17 | -70.95 | 11.34 | -70.95 |
| B柱 | 上 | M | -41.60 | -5.06 | -108.51 | -41.60 | -205.99 | 97.84 | 215.16 |  | -205.99 | -205.99 | 97.84 |
| N | 191.66 | 14.29 | -25.24 | 191.66 | 213.82 | 284.49 |  |  | 213.82 | 213.82 | 284.49 |
| V | 21.09 | 3.83 | 46.37 | 21.09 | 92.34 | -37.50 |  | 132.97 | 92.34 | 92.34 | -37.50 |
| 下 | M | -34.33 | -8.72 | -58.43 | -34.33 | -126.44 | 37.17 | 129.32 |  | -126.44 | -126.44 | 37.17 |
| N | 227.52 | 14.29 | -25.24 | 227.52 | 260.44 | 331.11 |  |  | 260.44 | 260.44 | 331.11 |
| V | 21.09 | 3.83 | 46.37 | 21.09 | 92.34 | -37.50 |  | 132.97 | 92.34 | 92.34 | -37.50 |
| C柱 | 上 | M | 41.60 | 5.06 | -108.51 | 41.60 | -97.84 | 205.99 | 215.16 |  | 205.99 | 205.99 | -97.84 |
| N | 191.66 | 14.29 | 25.24 | 191.66 | 284.49 | 213.82 |  |  | 213.82 | 213.82 | 284.49 |
| V | -21.09 | -3.83 | 46.37 | -21.09 | 37.50 | -92.34 |  | 132.97 | -92.34 | -92.34 | 37.50 |
| 下 | M | 34.33 | 8.72 | -58.43 | 34.33 | -37.17 | 126.44 | 129.32 |  | 126.44 | 126.44 | -37.17 |
| N | 227.52 | 14.29 | 25.24 | 227.52 | 331.11 | 260.44 |  |  | 260.44 | 260.44 | 331.11 |
| V | -21.09 | -3.83 | 46.37 | -21.09 | 37.50 | -92.34 |  | 132.97 | -92.34 | -92.34 | 37.50 |
| D柱 | 上 | M | -45.72 | -5.12 | -74.06 | -45.72 | -163.12 | 44.25 | 165.29 |  | -163.12 | 44.25 | -163.12 |
| N | 200.79 | 13.83 | 22.14 | 200.79 | 292.02 | 230.03 |  |  | 292.02 | 230.03 | 292.02 |
| V | 22.93 | 3.93 | 29.39 | 22.93 | 70.95 | -11.34 |  | 102.17 | 70.95 | -11.34 | 70.95 |
| 下 | M | -36.81 | -9.04 | -31.74 | -36.81 | -92.29 | -3.42 | 97.12 |  | -92.29 | -3.42 | -92.29 |
| N | 236.65 | 13.83 | 22.14 | 236.65 | 338.64 | 276.65 |  |  | 338.64 | 276.65 | 338.64 |
| V | 22.93 | 3.93 | 29.39 | 22.93 | 70.95 | -11.34 |  | 102.17 | 70.95 | -11.34 | 70.95 |
| 2 | A柱 | 上 | M | 35.89 | 12.79 | -115.22 | 42.29 | -106.34 | 216.28 | 227.59 |  | 216.28 | -106.34 | 216.28 |
| N | 512.17 | 82.85 | -68.31 | 553.60 | 624.04 | 815.31 |  |  | 815.31 | 624.04 | 815.31 |
| V | -22.67 | -7.51 | 58.19 | -26.43 | 47.12 | -115.82 |  | 166.78 | -115.82 | 47.12 | -115.82 |
| 下 | M | 45.72 | 14.24 | -94.27 | 52.84 | -63.28 | 200.67 | 217.10 |  | 200.67 | -63.28 | 200.67 |
| N | 548.03 | 82.85 | -68.31 | 589.46 | 670.66 | 861.93 |  |  | 861.93 | 670.66 | 861.93 |
| V | -22.67 | -7.51 | 58.19 | -26.43 | 47.12 | -115.82 |  | 166.78 | -115.82 | 47.12 | -115.82 |
| B柱 | 上 | M | -34.68 | -11.96 | -181.72 | -40.66 | -307.26 | 201.55 | 314.26 |  | -307.26 | -307.26 | 201.55 |
| N | 512.39 | 86.41 | -83.93 | 555.60 | 604.77 | 839.78 |  |  | 604.77 | 604.77 | 839.78 |
| V | 21.27 | 6.98 | 91.78 | 24.76 | 160.68 | -96.30 |  | 231.36 | 160.68 | 160.68 | -96.30 |
| 下 | M | -41.88 | -13.15 | -148.68 | -48.46 | -271.15 | 145.15 | 280.19 |  | -271.15 | -271.15 | 145.15 |
| N | 548.25 | 86.41 | -83.93 | 591.46 | 651.39 | 886.39 |  |  | 651.39 | 651.39 | 886.39 |
| V | 21.27 | 6.98 | 91.78 | 24.76 | 160.68 | -96.30 |  | 231.36 | 160.68 | 160.68 | -96.30 |
| C柱 | 上 | M | 34.68 | 11.96 | -181.72 | 40.66 | -201.55 | 307.26 | 314.26 |  | 307.26 | 307.26 | -201.55 |
| N | 512.39 | 86.41 | 83.93 | 555.60 | 839.78 | 604.77 |  |  | 604.77 | 604.77 | 839.78 |
| V | -21.27 | -6.98 | 91.78 | -24.76 | 96.30 | -160.68 |  | 231.36 | -160.68 | -160.68 | 96.30 |
| 下 | M | 41.88 | 13.15 | -148.68 | 48.46 | -145.15 | 271.15 | 280.19 |  | 271.15 | 271.15 | -145.15 |
| N | 548.25 | 86.41 | 83.93 | 591.46 | 886.39 | 651.39 |  |  | 651.39 | 651.39 | 886.39 |
| V | -21.27 | -6.98 | 91.78 | -24.76 | 96.30 | -160.68 |  | 231.36 | -160.68 | -160.68 | 96.30 |
| D柱 | 上 | M | -35.89 | -12.79 | -115.22 | -42.29 | -216.28 | 106.34 | 227.59 |  | -216.28 | 106.34 | -216.28 |
| N | 512.17 | 82.85 | 68.31 | 553.60 | 815.31 | 624.04 |  |  | 815.31 | 624.04 | 815.31 |
| V | 22.67 | 7.51 | 58.19 | 26.43 | 115.82 | -47.12 |  | 166.78 | 115.82 | -47.12 | 115.82 |
| 下 | M | -45.72 | -14.24 | -94.27 | -52.84 | -200.67 | 63.28 | 217.10 |  | -200.67 | 63.28 | -200.67 |
| N | 548.03 | 82.85 | 68.31 | 589.46 | 861.93 | 670.66 |  |  | 861.93 | 670.66 | 861.93 |
| V | 22.67 | 7.51 | 58.19 | 26.43 | 115.82 | -47.12 |  | 166.78 | 115.82 | -47.12 | 115.82 |
| 1 | A柱 | 上 | M | 21.79 | 6.79 | -154.72 | 25.18 | -183.87 | 249.35 | 269.75 |  | 249.35 | -183.87 | 249.35 |
| N | 823.24 | 151.82 | -143.19 | 899.15 | 968.43 | 1369.36 |  |  | 1369.36 | 968.43 | 1369.36 |
| V | -6.47 | -2.02 | 87.41 | -7.48 | 112.65 | -132.10 |  | 179.89 | -132.10 | 112.65 | -132.10 |
| 下 | M | 10.89 | 3.39 | -286.70 | 12.59 | -385.01 | 417.75 | 417.75 |  | 417.75 | -385.01 | 417.75 |
| N | 873.54 | 151.82 | -143.19 | 949.45 | 1033.82 | 1434.75 |  |  | 1434.75 | 1033.82 | 1434.75 |
| V | -6.47 | -2.02 | 87.41 | -7.48 | 112.65 | -132.10 |  | 179.89 | -132.10 | 112.65 | -132.10 |
| B柱 | 上 | M | -20.79 | -6.53 | -221.16 | -24.05 | -340.89 | 278.36 | 352.26 |  | -340.89 | -340.89 | 278.36 |
| N | 833.43 | 158.58 | -170.55 | 912.72 | 947.77 | 1425.31 |  |  | 947.77 | 947.77 | 1425.31 |
| V | 6.17 | 1.94 | 106.84 | 7.14 | 158.86 | -140.29 |  | 216.34 | 158.86 | 158.86 | -140.29 |
| 下 | M | -10.39 | -3.26 | -318.38 | -12.02 | -461.36 | 430.10 | 461.36 |  | -461.36 | -461.36 | 430.10 |
| N | 883.73 | 158.58 | -170.55 | 963.02 | 1013.16 | 1490.70 |  |  | 1013.16 | 1013.16 | 1490.70 |
| V | 6.17 | 1.94 | 106.84 | 7.14 | 158.86 | -140.29 |  | 216.34 | 158.86 | 158.86 | -140.29 |
| C柱 | 上 | M | 20.79 | 6.53 | -221.16 | 24.05 | -278.36 | 340.89 | 352.26 |  | 340.89 | 340.89 | -278.36 |
| N | 833.43 | 158.58 | 170.55 | 912.72 | 1425.31 | 947.77 |  |  | 947.77 | 947.77 | 1425.31 |
| V | -6.17 | -1.94 | 106.84 | -7.14 | 140.29 | -158.86 |  | 216.34 | -158.86 | -158.86 | 140.29 |
| 下 | M | 10.39 | 3.26 | -318.38 | 12.02 | -430.10 | 461.36 | 461.36 |  | 461.36 | 461.36 | -430.10 |
| N | 883.73 | 158.58 | 170.55 | 963.02 | 1490.70 | 1013.16 |  |  | 1013.16 | 1013.16 | 1490.70 |
| V | -6.17 | -1.94 | 106.84 | -7.14 | 140.29 | -158.86 |  | 216.34 | -158.86 | -158.86 | 140.29 |
| D柱 | 上 | M | -21.79 | -6.79 | -154.72 | -25.18 | -249.35 | 183.87 | 269.75 |  | -249.35 | 183.87 | -249.35 |
| N | 823.24 | 151.82 | 143.19 | 899.15 | 1369.36 | 968.43 |  |  | 1369.36 | 968.43 | 1369.36 |
| V | 6.47 | 2.02 | 87.41 | 7.48 | 132.10 | -112.65 |  | 179.89 | 132.10 | -112.65 | 132.10 |
| 下 | M | -10.89 | -3.39 | -286.70 | -12.59 | -417.75 | 385.01 | 417.75 |  | -417.75 | 385.01 | -417.75 |
| N | 873.54 | 151.82 | 143.19 | 949.45 | 1434.75 | 1033.82 |  |  | 1434.75 | 1033.82 | 1434.75 |
| V | 6.47 | 2.02 | 87.41 | 7.48 | 132.10 | -112.65 |  | 179.89 | 132.10 | -112.65 | 132.10 |

# 8 截面设计

## 8.1 梁截面

### 8.1.1 正截面配筋

（1）翼缘宽度计算：



（2）跨中截面类型判断：



（3）配筋计算：



表8.1 正截面配筋

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 层数 | 类别 | *h* | *b* | *hf* | *bf* | 保护层厚度 | 截面 | 一般组合 | | | | | 地震效应组合 | 截面类型 | | *αs* | | | *ξ* | | *As* | | *As*.min | | 选配钢筋 | | 实选面积(mm2) |
| M | V | *γREM* | *γREV* |  | | |  | |  |  | |  | |  | |  | |
| 3 | AB | 600 | 250 | 100 | 2000.00 | 40 | 左 | -45.08 | 70.04 | -95.36 | 79.57 |  | | | 0.085 | | 0.089 | 495.06 | | 375 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 46.22 | 26.87 |  | | | 0.041 | | 0.042 | 234.18 | | 375 | | 6C20 | | 1884 | |
| 中 | 58.05 | 0.00 | 47.98 | 0.00 | 第一类T形截面 | | | 0.006 | | 0.006 | 288.87 | | 300 | | 6C20 | | 1884 | |
| 右 | -45.84 | -71.27 | -81.50 | -80.65 |  | | | 0.073 | | 0.076 | 420.12 | | 375 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 27.95 | -27.96 |  | | | 0.025 | | 0.025 | 140.42 | | 375 | | 6C20 | | 1884 | |
| BC | 400 | 250 | 700.00 | 左 | -11.92 | 2.62 | -42.64 | 52.81 |  | | | 0.092 | | 0.097 | 345.70 | | 250 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 31.99 | -59.96 |  | | | 0.069 | | 0.072 | 256.00 | | 250 | | 6C20 | | 1884 | |
| 中 | -6.43 | 0.00 | -4.75 | 0.00 | 第一类T形截面 | | | 0.005 | | 0.005 | 49.75 | | 200 | | 6C20 | | 1884 | |
| 右 | -11.92 | -1.63 | -42.64 | -52.81 |  | | | 0.092 | | 0.097 | 345.70 | | 250 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 31.99 | 59.96 |  | | | 0.069 | | 0.072 | 256.00 | | 250 | | 6C20 | | 1884 | |
| CD | 600 | 250 | 2000.00 | 左 | -45.84 | 71.27 | -81.50 | 80.65 |  | | | 0.073 | | 0.076 | 420.12 | | 375 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 27.95 | 27.96 |  | | | 0.025 | | 0.025 | 140.42 | | 375 | | 6C20 | | 1884 | |
| 中 | 58.05 | 0.00 | 47.98 | 0.00 | 第一类T形截面 | | | 0.006 | | 0.006 | 288.87 | | 300 | | 6C20 | | 1884 | |
| 右 | -45.08 | -70.04 | -95.36 | -79.57 |  | | | 0.085 | | 0.089 | 495.06 | | 375 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 46.22 | -26.87 |  | | | 0.041 | | 0.042 | 234.18 | | 375 | | 6C20 | | 1884 | |
| 2 | AB | 600 | 250 | 100 | 2000.00 | 40 | 左 | -87.67 | 117.35 | -187.34 | 141.84 |  | | | 0.167 | | 0.184 | 1023.42 | | 375 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 92.19 | 31.96 |  | | | 0.082 | | 0.086 | 477.83 | | 375 | | 6C20 | | 1884 | |
| 中 | 92.77 | 0.00 | 67.30 | 0.00 | 第一类T形截面 | | | 0.010 | | 0.010 | 462.57 | | 300 | | 6C20 | | 1884 | |
| 右 | -85.76 | -117.59 | -169.94 | -142.01 |  | | | 0.152 | | 0.165 | 918.87 | | 375 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 74.08 | -32.12 |  | | | 0.066 | | 0.068 | 380.46 | | 375 | | 6C20 | | 1884 | |
| BC | 400 | 250 | 700.00 | 左 | -16.34 | 10.54 | -85.97 | 120.12 |  | | | 0.186 | | 0.207 | 739.89 | | 250 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 79.18 | -129.45 |  | | | 0.171 | | 0.189 | 674.62 | | 250 | | 6C20 | | 1884 | |
| 中 | -4.82 | 0.00 | -2.82 | 0.00 | 第一类T形截面 | | | 0.004 | | 0.004 | 37.28 | | 200 | | 6C20 | | 1884 | |
| 右 | -16.34 | -5.60 | -85.97 | -117.52 |  | | | 0.186 | | 0.207 | 739.89 | | 250 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 79.18 | 132.05 |  | | | 0.171 | | 0.189 | 674.62 | | 250 | | 6C20 | | 1884 | |
| CD | 600 | 250 | 2000.00 | 左 | -85.76 | 117.59 | -169.94 | 142.01 |  | | | 0.152 | | 0.165 | 918.87 | | 375 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 74.08 | 32.12 |  | | | 0.066 | | 0.068 | 380.46 | | 375 | | 6C20 | | 1884 | |
| 中 | 92.77 | 0.00 | 67.30 | 0.00 | 第一类T形截面 | | | 0.010 | | 0.010 | 462.57 | | 300 | | 6C20 | | 1884 | |
| 右 | -87.67 | -117.35 | -187.34 | -141.84 |  | | | 0.167 | | 0.184 | 1023.42 | | 375 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 92.19 | -31.96 |  | | | 0.082 | | 0.086 | 477.83 | | 375 | | 6C20 | | 1884 | |
| 1 | AB | 600 | 250 | 100 | 2000.00 | 40 | 左 | -99.94 | 122.72 | -280.87 | 175.64 |  | | | 0.251 | | 0.294 | 1632.97 | | 375 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 194.83 | -2.58 |  | | | 0.174 | | 0.192 | 1069.21 | | 375 | | 6C20 | | 1884 | |
| 中 | 100.08 | 0.00 | 87.81 | 0.00 | 第一类T形截面 | | | 0.011 | | 0.011 | 499.23 | | 300 | | 6C20 | | 1884 | |
| 右 | -94.31 | -123.87 | -231.55 | -176.54 |  | | | 0.207 | | 0.234 | 1300.68 | | 375 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 141.84 | 1.67 |  | | | 0.127 | | 0.136 | 754.80 | | 375 | | 6C20 | | 1884 | |
| BC | 400 | 250 | 700.00 | 左 | -29.00 | 22.30 | -133.32 | 187.52 |  | | | 0.288 | | 0.348 | 1245.78 | | 250 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 121.03 | -196.85 |  | | | 0.261 | | 0.309 | 1104.48 | | 250 | | 6C20 | | 1884 | |
| 中 | -8.87 | 0.00 | -5.58 | 0.00 | 第一类T形截面 | | | 0.007 | | 0.007 | 68.65 | | 200 | | 6C20 | | 1884 | |
| 右 | -29.00 | -17.36 | -133.32 | -184.92 |  | | | 0.288 | | 0.348 | 1245.78 | | 250 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 121.03 | 199.45 |  | | | 0.261 | | 0.309 | 1104.48 | | 250 | | 6C20 | | 1884 | |
| CD | 600 | 250 | 2000.00 | 左 | -94.31 | 123.87 | -231.55 | 176.54 |  | | | 0.207 | | 0.234 | 1300.68 | | 375 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 141.84 | -1.67 |  | | | 0.127 | | 0.136 | 754.80 | | 375 | | 6C20 | | 1884 | |
| 中 | 100.08 | 0.00 | 87.81 | 0.00 | 第一类T形截面 | | | 0.011 | | 0.011 | 499.23 | | 300 | | 6C20 | | 1884 | |
| 右 | -99.94 | -122.72 | -280.87 | -175.64 |  | | | 0.251 | | 0.294 | 1632.97 | | 375 | | 6C20 | | 1884 | |
| 0.00 | 0.00 | 194.83 | 2.58 |  | | | 0.174 | | 0.192 | 1069.21 | | 375 | | 6C20 | | 1884 | |

### 8.1.2 斜截面配筋

（1）截面尺寸验算：

1. 跨高比大于2.5



1. 跨高比不大于2.5



（2）仅构造配筋是否满足要求：



（3）计算配件公式：



（4）最小配筋率：



表8.2 斜截面配筋

|  |  |  |  |
| --- | --- | --- | --- |
| 类型 | AB | BC | CD |
| *h/*mm | 600 | 400 | 600 |
| *b/mm* | 250 | 250 | 250 |
| *l/mm* | 6000 | 2100 | 6000 |
| 保护层/mm | 40 | 40 | 40 |
| *γREV*(kN) | 178.73 | 212.98 | 178.73 |
| *h*/*l* | 10.00 | 5.25 | 10.00 |
| 截面满足要求与否 | 满足 | 满足 | 满足 |
| 计算配筋与否 | 计算配筋 | 计算配筋 | 计算配筋 |
| *nAsv*/*S* | 0.258 | 0.258 | 0.258 |
| 直径/mm | 8 | 8 | 8 |
| 最大间距/mm | 128 | 100 | 128 |
| 实际间距/mm | 100 | 100 | 100 |
| 实配 | 2B8@100 | 2B8@100 | 2B8@100 |
| 配箍率 | 0.402 | 0.402 | 0.402 |
| 加密区长度 | 900 | 600 | 900 |
| 非加密区 | 2B8@200 | 2B8@200 | 2B8@200 |
| 配箍率 | 0.201 | 0.201 | 0.201 |
| 最小配箍率 | 0.103 | 0.103 | 0.103 |

## 8.2 柱截面

### 8.2.1 正截面配筋

为保障柱的延性，需进行轴压比验算，以底层轴力进行计算。

表8.3 轴压比验算

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 类型 | *b* | *h* | *Nmax* | 轴压比 | 限值 |
| A | 600.0 | 600.0 | 1434.75 | 0.28 | 0.85 |
| B | 1490.70 | 0.29 |
| C | 1490.70 | 0.29 |
| D | 1434.75 | 0.28 |

（1）考虑二阶效应的弯矩计算：



（2）偏心距



（3）偏心类型



（4）配筋计算

1. 大偏心



1. 小偏心



表8.4 正截面配筋

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3层 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 类型 | | A柱上 | | | A柱下 | | | B柱上 | | | | B柱下 | | | C柱上 | | | | | C柱下 | | | | D柱上 | | | | | D柱下 | | | |
| |M|max | Nmin | Nmax | |M|max | Nmin | Nmax | |M|max | | Nmin | Nmax | |M|max | Nmin | Nmax | | |M|max | | Nmin | Nmax | | |M|max | Nmin | Nmax | | |M|max | | Nmin | Nmax | | |M|max | Nmin | Nmax |
| 弯矩 | | 130.50 | 35.40 | 130.50 | 73.83 | 2.74 | 73.83 | 164.79 | | 164.79 | 78.27 | 101.15 | 101.15 | 29.73 | | 164.79 | | 164.79 | 78.27 | | 101.15 | 101.15 | 29.73 | | 130.50 | | 35.40 | 130.50 | | 73.83 | 2.74 | 73.83 |
| 轴力 | | 233.62 | 184.02 | 233.62 | 270.91 | 221.32 | 270.91 | 171.06 | | 171.06 | 227.60 | 208.35 | 208.35 | 264.89 | | 171.06 | | 171.06 | 227.60 | | 208.35 | 208.35 | 264.89 | | 233.62 | | 184.02 | 233.62 | | 270.91 | 221.32 | 270.91 |
| L | | 4500 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| b | | 600 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| h | | 600 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ea | | 20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M1/M2 | | 0.57 | 0.08 | 0.57 | 0.57 | 0.08 | 0.57 | 0.61 | | 0.61 | 0.38 | 0.61 | 0.61 | 0.38 | | 0.61 | | 0.61 | 0.38 | | 0.61 | 0.61 | 0.38 | | 0.57 | | 0.08 | 0.57 | | 0.57 | 0.08 | 0.57 |
| ζc | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Cmηns | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 |
| M | | 130.50 | 35.40 | 130.50 | 130.50 | 35.40 | 130.50 | 164.79 | | 164.79 | 78.27 | 164.79 | 164.79 | 78.27 | | 164.79 | | 164.79 | 78.27 | | 164.79 | 164.79 | 78.27 | | 130.50 | | 35.40 | 130.50 | | 130.50 | 35.40 | 130.50 |
| e0 | | 558.59 | 192.35 | 558.59 | 558.59 | 192.35 | 558.59 | 963.36 | | 963.36 | 343.91 | 963.36 | 963.36 | 343.91 | | 963.36 | | 963.36 | 343.91 | | 963.36 | 963.36 | 343.91 | | 558.59 | | 192.35 | 558.59 | | 558.59 | 192.35 | 558.59 |
| ei | | 578.59 | 212.35 | 578.59 | 578.59 | 212.35 | 578.59 | 983.36 | | 983.36 | 363.91 | 983.36 | 983.36 | 363.91 | | 983.36 | | 983.36 | 363.91 | | 983.36 | 983.36 | 363.91 | | 578.59 | | 212.35 | 578.59 | | 578.59 | 212.35 | 578.59 |
| e | | 838.59 | 472.35 | 838.59 | 838.59 | 472.35 | 838.59 | 1243.36 | | 1243.36 | 623.91 | 1243.36 | 1243.36 | 623.91 | | 1243.36 | | 1243.36 | 623.91 | | 1243.36 | 1243.36 | 623.91 | | 838.59 | | 472.35 | 838.59 | | 838.59 | 472.35 | 838.59 |
| x | | 27.23 | 21.45 | 27.23 | 27.23 | 21.45 | 27.23 | 19.94 | | 19.94 | 26.53 | 19.94 | 19.94 | 26.53 | | 19.94 | | 19.94 | 26.53 | | 19.94 | 19.94 | 26.53 | | 27.23 | | 21.45 | 27.23 | | 27.23 | 21.45 | 27.23 |
| 偏心性质 | | 大偏心 | 大偏心 | 大偏心 | 大偏心 | 大偏心 | 大偏心 | 大偏心 | | 大偏心 | 大偏心 | 大偏心 | 大偏心 | 大偏心 | | 大偏心 | | 大偏心 | 大偏心 | | 大偏心 | 大偏心 | 大偏心 | | 大偏心 | | 大偏心 | 大偏心 | | 大偏心 | 大偏心 | 大偏心 |
| 大偏心 | e | 838.59 | 472.35 | 838.59 | 838.59 | 472.35 | 838.59 | 1243.36 | | 1243.36 | 623.91 | 1243.36 | 1243.36 | 623.91 | | 1243.36 | | 1243.36 | 623.91 | | 1243.36 | 1243.36 | 623.91 | | 838.59 | | 472.35 | 838.59 | | 838.59 | 472.35 | 838.59 |
| x | 27.23 | 21.45 | 27.23 | 27.23 | 21.45 | 27.23 | 19.94 | | 19.94 | 26.53 | 19.94 | 19.94 | 26.53 | | 19.94 | | 19.94 | 26.53 | | 19.94 | 19.94 | 26.53 | | 27.23 | | 21.45 | 27.23 | | 27.23 | 21.45 | 27.23 |
| As=As＇ | 397.59 | -46.84 | 397.59 | 397.59 | -46.84 | 397.59 | 660.99 | | 660.99 | 126.33 | 660.99 | 660.99 | 126.33 | | 660.99 | | 660.99 | 126.33 | | 660.99 | 660.99 | 126.33 | | 397.59 | | -46.84 | 397.59 | | 397.59 | -46.84 | 397.59 |
| 小偏心 | e |  |  |  |  |  |  |  | |  |  |  |  |  | |  | |  |  | |  |  |  | |  | |  |  | |  |  |  |
| ζ |  |  |  |  |  |  |  | |  |  |  |  |  | |  | |  |  | |  |  |  | |  | |  |  | |  |  |  |
| As=As＇ |  |  |  |  |  |  |  | |  |  |  |  |  | |  | |  |  | |  |  |  | |  | |  |  | |  |  |  |
| 单侧 | | 5C20 | | | | | | | 5C20 | | | | | | | | 5C20 | | | | | | | | | 5C20 | | | | | | |
| 1570 | | | | | | | 1570 | | | | | | | | 1570 | | | | | | | | | 1570 | | | | | | |
| 双侧 | | 10C20 | | | | | | | 10C20 | | | | | | | | 10C20 | | | | | | | | | 10C20 | | | | | | |
| 3140 | | | | | | | 3140 | | | | | | | | 3140 | | | | | | | | | 3140 | | | | | | |
| 单侧配筋率 | | 0.44 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 双侧配筋率 | | 0.87 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 最大配筋率 | | 5.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 单侧最小面积 | | 720 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 双侧最小面积 | | 2700 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2层 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 类型 | | A柱上 | | | A柱下 | | | B柱上 | | | | B柱下 | | | C柱上 | | | | | C柱下 | | | | D柱上 | | | | | D柱下 | | | |
| |M|max | Nmin | Nmax | |M|max | Nmin | Nmax | |M|max | | Nmin | Nmax | |M|max | Nmin | Nmax | | |M|max | | Nmin | Nmax | | |M|max | Nmin | Nmax | | |M|max | | Nmin | Nmax | | |M|max | Nmin | Nmax |
| 弯矩 | | 173.02 | 85.07 | 173.02 | 160.54 | 50.63 | 160.54 | 245.81 | | 245.81 | 161.24 | 216.92 | 216.92 | 116.12 | | 245.81 | | 245.81 | 161.24 | | 216.92 | 216.92 | 116.12 | | 173.02 | | 85.07 | 173.02 | | 160.54 | 50.63 | 160.54 |
| 轴力 | | 652.25 | 499.23 | 652.25 | 689.54 | 536.53 | 689.54 | 483.82 | | 483.82 | 671.82 | 521.11 | 521.11 | 709.11 | | 483.82 | | 483.82 | 671.82 | | 521.11 | 521.11 | 709.11 | | 652.25 | | 499.23 | 652.25 | | 689.54 | 536.53 | 689.54 |
| L | | 4500 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| b | | 600 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| h | | 600 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ea | | 20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M1/M2 | | 0.93 | 0.60 | 0.93 | 0.93 | 0.60 | 0.93 | 0.88 | | 0.88 | 0.72 | 0.88 | 0.88 | 0.72 | | 0.88 | | 0.88 | 0.72 | | 0.88 | 0.88 | 0.72 | | 0.93 | | 0.60 | 0.93 | | 0.93 | 0.60 | 0.93 |
| ζc | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Cmηns | | 1.06 | 1.00 | 1.06 | 1.06 | 1.00 | 1.06 | 1.01 | | 1.01 | 1.00 | 1.01 | 1.01 | 1.00 | | 1.01 | | 1.01 | 1.00 | | 1.01 | 1.01 | 1.00 | | 1.06 | | 1.00 | 1.06 | | 1.06 | 1.00 | 1.06 |
| M | | 183.66 | 85.07 | 183.66 | 183.66 | 85.07 | 183.66 | 248.02 | | 248.02 | 161.47 | 248.02 | 248.02 | 161.47 | | 248.02 | | 248.02 | 161.47 | | 248.02 | 248.02 | 161.47 | | 183.66 | | 85.07 | 183.66 | | 183.66 | 85.07 | 183.66 |
| e0 | | 281.58 | 170.40 | 281.58 | 281.58 | 170.40 | 281.58 | 512.64 | | 512.64 | 240.35 | 512.64 | 512.64 | 240.35 | | 512.64 | | 512.64 | 240.35 | | 512.64 | 512.64 | 240.35 | | 281.58 | | 170.40 | 281.58 | | 281.58 | 170.40 | 281.58 |
| ei | | 301.58 | 190.40 | 301.58 | 301.58 | 190.40 | 301.58 | 532.64 | | 532.64 | 260.35 | 532.64 | 532.64 | 260.35 | | 532.64 | | 532.64 | 260.35 | | 532.64 | 532.64 | 260.35 | | 301.58 | | 190.40 | 301.58 | | 301.58 | 190.40 | 301.58 |
| e | | 561.58 | 450.40 | 561.58 | 561.58 | 450.40 | 561.58 | 792.64 | | 792.64 | 520.35 | 792.64 | 792.64 | 520.35 | | 792.64 | | 792.64 | 520.35 | | 792.64 | 792.64 | 520.35 | | 561.58 | | 450.40 | 561.58 | | 561.58 | 450.40 | 561.58 |
| x | | 76.02 | 58.19 | 76.02 | 76.02 | 58.19 | 76.02 | 56.39 | | 56.39 | 78.30 | 56.39 | 56.39 | 78.30 | | 56.39 | | 56.39 | 78.30 | | 56.39 | 56.39 | 78.30 | | 76.02 | | 58.19 | 76.02 | | 76.02 | 58.19 | 76.02 |
| 偏心性质 | | 大偏心 | 大偏心 | 大偏心 | 大偏心 | 大偏心 | 大偏心 | 大偏心 | | 大偏心 | 大偏心 | 大偏心 | 大偏心 | 大偏心 | | 大偏心 | | 大偏心 | 大偏心 | | 大偏心 | 大偏心 | 大偏心 | | 大偏心 | | 大偏心 | 大偏心 | | 大偏心 | 大偏心 | 大偏心 |
| 大偏心 | e | 561.58 | 450.40 | 561.58 | 561.58 | 450.40 | 561.58 | 792.64 | | 792.64 | 520.35 | 792.64 | 792.64 | 520.35 | | 792.64 | | 792.64 | 520.35 | | 792.64 | 792.64 | 520.35 | | 561.58 | | 450.40 | 561.58 | | 561.58 | 450.40 | 561.58 |
| x | 76.02 | 58.19 | 76.02 | 76.02 | 58.19 | 76.02 | 56.39 | | 56.39 | 78.30 | 56.39 | 56.39 | 78.30 | | 56.39 | | 56.39 | 78.30 | | 56.39 | 56.39 | 78.30 | | 76.02 | | 58.19 | 76.02 | | 76.02 | 58.19 | 76.02 |
| As=As＇ | 144.86 | -185.61 | 144.86 | 144.86 | -185.61 | 144.86 | 704.64 | | 704.64 | 1.26 | 704.64 | 704.64 | 1.26 | | 704.64 | | 704.64 | 1.26 | | 704.64 | 704.64 | 1.26 | | 144.86 | | -185.61 | 144.86 | | 144.86 | -185.61 | 144.86 |
| 小偏心 | e |  |  |  |  |  |  |  | |  |  |  |  |  | |  | |  |  | |  |  |  | |  | |  |  | |  |  |  |
| ζ |  |  |  |  |  |  |  | |  |  |  |  |  | |  | |  |  | |  |  |  | |  | |  |  | |  |  |  |
| As=As＇ |  |  |  |  |  |  |  | |  |  |  |  |  | |  | |  |  | |  |  |  | |  | |  |  | |  |  |  |
| 单侧 | | 5C20 | | | | | | | 5C20 | | | | | | | | 5C20 | | | | | | | | | 5C20 | | | | | | |
| 1570 | | | | | | | 1570 | | | | | | | | 1570 | | | | | | | | | 1570 | | | | | | |
| 双侧 | | 10C20 | | | | | | | 10C20 | | | | | | | | 10C20 | | | | | | | | | 10C20 | | | | | | |
| 3140 | | | | | | | 3140 | | | | | | | | 3140 | | | | | | | | | 3140 | | | | | | |
| 单侧配筋率 | | 0.44 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 双侧配筋率 | | 0.87 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 最大配筋率 | | 5.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 单侧最小面积 | | 720 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 双侧最小面积 | | 2700 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1层 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 类型 | | A柱上 | | | A柱下 | | | B柱上 | | | | B柱下 | | | C柱上 | | | | | C柱下 | | | | D柱上 | | | | | D柱下 | | | |
| |M|max | Nmin | Nmax | |M|max | Nmin | Nmax | |M|max | | Nmin | Nmax | |M|max | Nmin | Nmax | | |M|max | | Nmin | Nmax | | |M|max | Nmin | Nmax | | |M|max | | Nmin | Nmax | | |M|max | Nmin | Nmax |
| 弯矩 | | 199.48 | 147.10 | 199.48 | 334.20 | 308.01 | 334.20 | 272.71 | | 272.71 | 222.69 | 369.09 | 369.09 | 344.08 | | 272.71 | | 272.71 | 222.69 | | 369.09 | 369.09 | 344.08 | | 199.48 | | 147.10 | 199.48 | | 334.20 | 308.01 | 334.20 |
| 轴力 | | 1095.49 | 774.74 | 1095.49 | 1147.80 | 827.06 | 1147.80 | 758.21 | | 758.21 | 1140.24 | 810.52 | 810.52 | 1192.56 | | 758.21 | | 758.21 | 1140.24 | | 810.52 | 810.52 | 1192.56 | | 1095.49 | | 774.74 | 1095.49 | | 1147.80 | 827.06 | 1147.80 |
| L | | 5050 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| b | | 600 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| h | | 600 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ea | | 20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M1/M2 | | 0.60 | 0.48 | 0.60 | 0.60 | 0.48 | 0.60 | 0.74 | | 0.74 | 0.65 | 0.74 | 0.74 | 0.65 | | 0.74 | | 0.74 | 0.65 | | 0.74 | 0.74 | 0.65 | | 0.60 | | 0.48 | 0.60 | | 0.60 | 0.48 | 0.60 |
| ζc | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Cmηns | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 |
| M | | 334.20 | 308.01 | 334.20 | 334.20 | 308.01 | 334.20 | 369.09 | | 369.09 | 344.08 | 369.09 | 369.09 | 344.08 | | 369.09 | | 369.09 | 344.08 | | 369.09 | 369.09 | 344.08 | | 334.20 | | 308.01 | 334.20 | | 334.20 | 308.01 | 334.20 |
| e0 | | 291.16 | 372.42 | 291.16 | 291.16 | 372.42 | 291.16 | 455.37 | | 455.37 | 288.52 | 455.37 | 455.37 | 288.52 | | 455.37 | | 455.37 | 288.52 | | 455.37 | 455.37 | 288.52 | | 291.16 | | 372.42 | 291.16 | | 291.16 | 372.42 | 291.16 |
| ei | | 311.16 | 392.42 | 311.16 | 311.16 | 392.42 | 311.16 | 475.37 | | 475.37 | 308.52 | 475.37 | 475.37 | 308.52 | | 475.37 | | 475.37 | 308.52 | | 475.37 | 475.37 | 308.52 | | 311.16 | | 392.42 | 311.16 | | 311.16 | 392.42 | 311.16 |
| e | | 571.16 | 652.42 | 571.16 | 571.16 | 652.42 | 571.16 | 735.37 | | 735.37 | 568.52 | 735.37 | 735.37 | 568.52 | | 735.37 | | 735.37 | 568.52 | | 735.37 | 735.37 | 568.52 | | 571.16 | | 652.42 | 571.16 | | 571.16 | 652.42 | 571.16 |
| x | | 133.78 | 96.39 | 133.78 | 133.78 | 96.39 | 133.78 | 94.47 | | 94.47 | 138.99 | 94.47 | 94.47 | 138.99 | | 94.47 | | 94.47 | 138.99 | | 94.47 | 94.47 | 138.99 | | 133.78 | | 96.39 | 133.78 | | 133.78 | 96.39 | 133.78 |
| 偏心性质 | | 大偏心 | 大偏心 | 大偏心 | 大偏心 | 大偏心 | 大偏心 | 大偏心 | | 大偏心 | 大偏心 | 大偏心 | 大偏心 | 大偏心 | | 大偏心 | | 大偏心 | 大偏心 | | 大偏心 | 大偏心 | 大偏心 | | 大偏心 | | 大偏心 | 大偏心 | | 大偏心 | 大偏心 | 大偏心 |
| 大偏心 | e | 571.16 | 652.42 | 571.16 | 571.16 | 652.42 | 571.16 | 735.37 | | 735.37 | 568.52 | 735.37 | 735.37 | 568.52 | | 735.37 | | 735.37 | 568.52 | | 735.37 | 735.37 | 568.52 | | 571.16 | | 652.42 | 571.16 | | 571.16 | 652.42 | 571.16 |
| x | 133.78 | 96.39 | 133.78 | 133.78 | 96.39 | 133.78 | 94.47 | | 94.47 | 138.99 | 94.47 | 94.47 | 138.99 | | 94.47 | | 94.47 | 138.99 | | 94.47 | 94.47 | 138.99 | | 133.78 | | 96.39 | 133.78 | | 133.78 | 96.39 | 133.78 |
| As=As＇ | 478.58 | 621.23 | 478.58 | 478.58 | 621.23 | 478.58 | 963.82 | | 963.82 | 497.02 | 963.82 | 963.82 | 497.02 | | 963.82 | | 963.82 | 497.02 | | 963.82 | 963.82 | 497.02 | | 478.58 | | 621.23 | 478.58 | | 478.58 | 621.23 | 478.58 |
| 小偏心 | e |  |  |  |  |  |  |  | |  |  |  |  |  | |  | |  |  | |  |  |  | |  | |  |  | |  |  |  |
| ζ |  |  |  |  |  |  |  | |  |  |  |  |  | |  | |  |  | |  |  |  | |  | |  |  | |  |  |  |
| As=As＇ |  |  |  |  |  |  |  | |  |  |  |  |  | |  | |  |  | |  |  |  | |  | |  |  | |  |  |  |
| 单侧 | | 5C20 | | | | | | | 5C20 | | | | | | | | 5C20 | | | | | | | | | 5C20 | | | | | | |
| 1570 | | | | | | | 1570 | | | | | | | | 1570 | | | | | | | | | 1570 | | | | | | |
| 双侧 | | 10C20 | | | | | | | 10C20 | | | | | | | | 10C20 | | | | | | | | | 10C20 | | | | | | |
| 3140 | | | | | | | 3140 | | | | | | | | 3140 | | | | | | | | | 3140 | | | | | | |
| 单侧配筋率 | | 0.44 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 双侧配筋率 | | 0.87 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 最大配筋率 | | 5.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 单侧最小面积 | | 720 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 双侧最小面积 | | 2700 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

### 8.2.2 斜截面配筋

（1）截面尺寸验算

剪跨比计算：



1. 剪跨比大于2



1. 剪跨比不大于2



（2）承载力计算



（3）最小体积配箍率计算：



（4）体积配箍率计算：



表8.5 斜截面配筋

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 类型 | A柱 | B柱 | C柱 | D柱 |
| M | 355.09 | 392.16 | 392.16 | 355.09 |
| N | 1163.96 | 805.60 | 805.60 | 1163.96 |
| V | 152.91 | 183.89 | 183.89 | 152.91 |
| b/mm | 600 | | | |
| h/mm | 600 | | | |
| λ=M/(Vh0) | 4.15 | 3.81 | 3.81 | 4.15 |
| 截面是否满足 | 满足 | 满足 | 满足 | 满足 |
| 实取λ | 3 | 3 | 3 | 3 |
| 0.3fcA | 1544.4 | | | |
| 实取N | 1369.36 | 947.77 | 947.77 | 1369.36 |
| Vc | 202.81 | 179.20 | 179.20 | 202.81 |
| 计算配筋与否 | 否 | 是 | 是 | 否 |
| Asv/s | 按构造配筋 | 0.023243956 | 0.023243956 | 按构造配筋 |
| 直径/mm | 10 | | | |
| 加密区配筋 | 4B10 | | | |
| 加密区间距/mm | 100 | | | |
| 加密区长度/mm | 600 | | | |
| 非加密区配筋 | 4B10 | | | |
| 非加密区间距/mm | 200 | | | |
| 加密区体积配箍率% | 1.31 | | | |
| 非加密区体积配箍率% | 0.65 | | | |
| λv | 0.09 | | | |
| 最小体积配箍率% | 0.36 | | | |

# 9 独立基础设计

## 9.1设计信息

本工程采用独立基础，混凝土采用C30（*f*c=14.3 N/mm2，*f*t=1.43N/mm2），钢筋选用HRB400级钢（*f*y=360N/mm2）。

土层信息如下：

第一层：杂填土厚1m，容重17 3；

第二层：黏土层、黄褐色、含铁矿结核，质较硬，粘状结构，厚6.5m左右，容重18.5 3，*f*ak=280kPa；

第三层：微风化杂质花岗岩，已风化*f*ak=4000kPa。

基础埋置深度取2.0 m，地基承载力*f*ak=270 kpa。

对底层柱内力进行统计：

表9.1 内力统计

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 内力组合 | | | *M* | *N* | *V* |
| A柱 | 一般组合 | Mmax组合 | 69.04 | 1317.11 | 26.18 |
| Nmax组合 | 50.04 | 1376.59 | 20.83 |
| 地震效应组合 | Mmax组合 | 417.75 | 1434.75 | 132.10 |
| Nmax组合 | 417.75 | 1434.75 | 132.10 |
| B柱 | 一般组合 | Mmax组合 | 73.94 | 1289.18 | 29.18 |
| Nmax组合 | 15.79 | 1402.42 | 0.54 |
| 地震效应组合 | Mmax组合 | 461.36 | 1013.16 | 158.86 |
| Nmax组合 | 430.10 | 1490.70 | 140.29 |
| C柱 | 一般组合 | Mmax组合 | 73.94 | 1289.18 | 29.18 |
| Nmax组合 | 15.79 | 1402.42 | 0.54 |
| 地震效应组合 | Mmax组合 | 461.36 | 1013.16 | 158.86 |
| Nmax组合 | 430.10 | 1490.70 | 140.29 |
| D柱 | 一般组合 | Mmax组合 | 69.04 | 1317.11 | 26.18 |
| Nmax组合 | 50.04 | 1376.59 | 20.83 |
| 地震效应组合 | Mmax组合 | 417.75 | 1434.75 | 132.10 |
| Nmax组合 | 417.75 | 1434.75 | 132.10 |

## 9.2截面尺寸计算

土体重度按照加权的方式进行计算：

=(1×17+(2-0.45-1)×18)/(2-0.45)=17.35 3



地基承载力的修正按下式进行：

=270+1×17.35×(2-0.5)=296.03 kpa



基底面积则为：

=5.60 m2



将基底面积增大1.2倍：

=6.72 m2



*b*/*l*=1.5~2，取：

=3.0 ×3.0 =9.00 m2



基础高度*h*取1.0 m。

## 9.3承载力验算

承载力验算过程见下表：

表9.2 承载力验算

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A柱地基承载力验算 | | | | | | | | | | | | |
| 荷载 | 一般组合 | | | | | | 地震效应组合 | | | | | |
| Mmax组合 | | | Nmax组合 | | | Mmax组合 | | | Nmax组合 | | |
| *M* | *N* | *V* | *M* | *N* | *V* | *M* | *N* | *V* | *M* | *N* | *V* |
| 69.04 | 1317.11 | 26.18 | 50.04 | 1376.59 | 20.83 | 417.75 | 1434.75 | 132.10 | 417.75 | 1434.75 | 132.10 |
| *b* | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| *l* | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| *h* | 1.0 | | | 1.0 | | | 1.0 | | | 1.0 | | |
| 基础埋深 | 2.0 | | | 2.0 | | | 2.0 | | | 2.0 | | |
| γG | 20.0 | | | 20.0 | | | 20.0 | | | 20.0 | | |
| 土体荷载 | 360.0 | | | 360.0 | | | 360.0 | | | 360.0 | | |
| 竖向总重 | 1677.1 | | | 1736.6 | | | 1794.8 | | | 1794.8 | | |
| 基底力矩 | 95.22 | | | 70.87 | | | 549.85 | | | 549.85 | | |
| *e* | 0.057 | | | 0.041 | | | 0.306 | | | 0.306 | | |
| *l*/6 | 0.500 | | | 0.500 | | | 0.500 | | | 0.500 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| *W* | 4.50 | | | 4.50 | | | 4.50 | | | 4.50 | | |
| *f*a | 296.03 | | | 296.03 | | | 296.03 | | | 296.03 | | |
| 1.2*f*a | 355.24 | | | 355.24 | | | 355.24 | | | 355.24 | | |
| *p*max | 207.505 | | | 208.703 | | | 321.605 | | | 321.605 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| *p*min | 165.186 | | | 177.205 | | | 77.229 | | | 77.229 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| B柱地基承载力验算 | | | | | | | | | | | | |
| 荷载 | 一般组合 | | | | | | 地震效应组合 | | | | | |
| Mmax组合 | | | Nmax组合 | | | Mmax组合 | | | Nmax组合 | | |
| *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) |
| 73.94 | 1289.18 | 29.18 | 15.79 | 1402.42 | 0.54 | 461.36 | 1013.16 | 158.86 | 430.10 | 1490.70 | 140.29 |
| 基础宽度*b*(m) | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础长度*l*(m) | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础高度*h*(m) | 1.0 | | | 1.0 | | | 1.0 | | | 1.0 | | |
| 基础埋深(m) | 2.0 | | | 2.0 | | | 2.0 | | | 2.0 | | |
| γG(kN/m3) | 20.0 | | | 20.0 | | | 20.0 | | | 20.0 | | |
| 土体自重(kN) | 360.0 | | | 360.0 | | | 360.0 | | | 360.0 | | |
| 竖向荷载总重(kN) | 1649.2 | | | 1762.4 | | | 1373.2 | | | 1850.7 | | |
| 基底力矩 | 103.12 | | | 16.34 | | | 620.22 | | | 570.39 | | |
| 偏心距*e* | 0.063 | | | 0.009 | | | 0.452 | | | 0.308 | | |
| *l*/6 | 0.500 | | | 0.500 | | | 0.500 | | | 0.500 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| 抵抗弯矩*W* | 13.50 | | | 13.50 | | | 13.50 | | | 13.50 | | |
| 地基承载力*f*a | 296.03 | | | 296.03 | | | 296.03 | | | 296.03 | | |
| 1.2*f*a | 355.24 | | | 355.24 | | | 355.24 | | | 355.24 | | |
| 基底边缘最大压力*p*max | 206.158 | | | 199.456 | | | 290.400 | | | 332.387 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| 基底边缘最小压力*p*min | 160.327 | | | 192.194 | | | 14.746 | | | 78.879 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| C柱地基承载力验算 | | | | | | | | | | | | |
| 荷载 | 一般组合 | | | | | | 地震效应组合 | | | | | |
| Mmax组合 | | | Nmax组合 | | | Mmax组合 | | | Nmax组合 | | |
| *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) |
| 73.94 | 1289.18 | 29.18 | 15.79 | 1402.42 | 0.54 | 461.36 | 1013.16 | 158.86 | 430.10 | 1490.70 | 140.29 |
| 基础宽度*b*(m) | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础长度*l*(m) | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础高度*h*(m) | 1.0 | | | 1.0 | | | 1.0 | | | 1.0 | | |
| 基础埋深(m) | 2.0 | | | 2.0 | | | 2.0 | | | 2.0 | | |
| γG(kN/m3) | 20.0 | | | 20.0 | | | 20.0 | | | 20.0 | | |
| 土体自重(kN) | 360.0 | | | 360.0 | | | 360.0 | | | 360.0 | | |
| 竖向荷载总重(kN) | 1649.2 | | | 1762.4 | | | 1373.2 | | | 1850.7 | | |
| 基底力矩 | 103.12 | | | 16.34 | | | 620.22 | | | 570.39 | | |
| 偏心距*e* | 0.063 | | | 0.009 | | | 0.452 | | | 0.308 | | |
| *l*/6 | 0.500 | | | 0.500 | | | 0.500 | | | 0.500 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| 抵抗弯矩*W* | 13.50 | | | 13.50 | | | 13.50 | | | 13.50 | | |
| 地基承载力*f*a | 296.03 | | | 296.03 | | | 296.03 | | | 296.03 | | |
| 1.2*f*a | 355.24 | | | 355.24 | | | 355.24 | | | 355.24 | | |
| 基底边缘最大压力*p*max | 206.158 | | | 199.456 | | | 290.400 | | | 332.387 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| 基底边缘最小压力*p*min | 160.327 | | | 192.194 | | | 14.746 | | | 78.879 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| D柱地基承载力验算 | | | | | | | | | | | | |
| 荷载 | 一般组合 | | | | | | 地震效应组合 | | | | | |
| Mmax组合 | | | Nmax组合 | | | Mmax组合 | | | Nmax组合 | | |
| *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) |
| 69.04 | 1317.11 | 26.18 | 50.04 | 1376.59 | 20.83 | 417.75 | 1434.75 | 132.10 | 417.75 | 1434.75 | 132.10 |
| 基础宽度*b*(m) | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础长度*l*(m) | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础高度*h*(m) | 1.0 | | | 1.0 | | | 1.0 | | | 1.0 | | |
| 基础埋深(m) | 2.0 | | | 2.0 | | | 2.0 | | | 2.0 | | |
| γG(kN/m3) | 20.0 | | | 20.0 | | | 20.0 | | | 20.0 | | |
| 土体自重(kN) | 360.0 | | | 360.0 | | | 360.0 | | | 360.0 | | |
| 竖向荷载总重(kN) | 1677.1 | | | 1736.6 | | | 1794.8 | | | 1794.8 | | |
| 基底力矩 | 95.22 | | | 70.87 | | | 549.85 | | | 549.85 | | |
| 偏心距*e* | 0.057 | | | 0.041 | | | 0.306 | | | 0.306 | | |
| *l*/6 | 0.500 | | | 0.500 | | | 0.500 | | | 0.500 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| 抵抗弯矩*W* | 13.50 | | | 13.50 | | | 13.50 | | | 13.50 | | |
| 地基承载力*f*a | 296.03 | | | 296.03 | | | 296.03 | | | 296.03 | | |
| 1.2*f*a | 355.24 | | | 355.24 | | | 355.24 | | | 355.24 | | |
| 基底边缘最大压力*p*max | 207.505 | | | 208.703 | | | 321.605 | | | 321.605 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| 基底边缘最小压力*p*min | 165.186 | | | 177.205 | | | 77.229 | | | 77.229 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |

## 9.4受冲切验算

基础高度取1.0 m，采用阶梯式基础，下阶高度取0.5 m；基础*b*×*l*=3.0 ×3.0 m，第二阶*b*1×*l*1=1.50 ×1.5 m，保护层厚度0.04m。

受冲切验算公式：



偏心距不大于*l*/6时：



表9.3 受冲切验算

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A柱受冲切承载力验算 | | | | | | | | | | | | | |
| 荷载 | | 一般组合 | | | | | | 地震效应组合 | | | | | |
| Mmax组合 | | | Nmax组合 | | | Mmax组合 | | | Nmax组合 | | |
| *M* | *N* | *V* | *M* | *N* | *V* | *M* | *N* | *V* | *M* | *N* | *V* |
| 69.04 | 1317.11 | 26.18 | 50.04 | 1376.59 | 20.83 | 417.75 | 1434.75 | 132.10 | 417.75 | 1434.75 | 132.10 |
| *b* | | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| *l* | | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| *h* | | 1.0 | | | 1.0 | | | 1.0 | | | 1.0 | | |
| *b*1 | | 1.50 | | | 1.50 | | | 1.50 | | | 1.50 | | |
| *l*1 | | 1.5 | | | 1.5 | | | 1.5 | | | 1.5 | | |
| *h*1 | | 0.5 | | | 0.5 | | | 0.5 | | | 0.5 | | |
| 保护层厚度 | | 0.04 | | | 0.04 | | | 0.04 | | | 0.04 | | |
| 净反力设计值 | | 146.35 | | | 152.95 | | | 159.42 | | | 159.42 | | |
| 基底力矩 | | 95.22 | | | 70.87 | | | 549.85 | | | 549.85 | | |
| 净偏心距 | | 0.072 | | | 0.041 | | | 0.308 | | | 0.308 | | |
| *l*/6 | | 0.500 | | | 0.500 | | | 0.500 | | | 0.500 | | |
| 是否满足 | | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| 基底净最大反力设计值 | | 167.50 | | | 165.50 | | | 257.59 | | | 257.59 | | |
| 柱与基础交界处 | *β*hp | 0.976 | | | 0.976 | | | 0.976 | | | 0.976 | | |
| *h*0 | 0.96 | | | 0.96 | | | 0.96 | | | 0.96 | | |
| *a*c | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *b*c | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *Al* | 0.662 | | | 0.662 | | | 0.662 | | | 0.662 | | |
| *Fl* | 110.96 | | | 109.63 | | | 170.63 | | | 170.63 | | |
| 0.7*β*hp*f*t*b*m*h*0 | 1463.12 | | | 1463.12 | | | 1463.12 | | | 1463.12 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| 柱与基础变阶处 | *β*hp | 0.976 | | | 0.976 | | | 0.976 | | | 0.976 | | |
| *h*01 | 0.46 | | | 0.46 | | | 0.46 | | | 0.46 | | |
| *b*1 | 1.5 | | | 1.5 | | | 1.5 | | | 1.5 | | |
| *l*1 | 1.5 | | | 1.5 | | | 1.5 | | | 1.5 | | |
| *Al* | 0.786 | | | 0.786 | | | 0.786 | | | 0.786 | | |
| *Fl* | 131.64 | | | 130.07 | | | 202.44 | | | 202.44 | | |
| 0.7*β*hp*f*t*b*m*h*0 | 880.84 | | | 880.84 | | | 880.84 | | | 880.84 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| B柱受冲切承载力验算 | | | | | | | | | | | | | |
| 荷载 | | 一般组合 | | | | | | 地震效应组合 | | | | | |
| Mmax组合 | | | Nmax组合 | | | Mmax组合 | | | Nmax组合 | | |
| *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) |
| 73.94 | 1289.18 | 29.18 | 15.79 | 1402.42 | 0.54 | 461.36 | 1013.16 | 158.86 | 430.10 | 1490.70 | 140.29 |
| 基础宽度*b*(m) | | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础长度*l*(m) | | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础高度*h*(m) | | 1.0 | | | 1.0 | | | 1.0 | | | 1.0 | | |
| 基础下阶宽度*b*1(m) | | 1.50 | | | 1.50 | | | 1.50 | | | 1.50 | | |
| 基础下阶长度*l*1(m) | | 1.5 | | | 1.5 | | | 1.5 | | | 1.5 | | |
| 基础下阶高度*h*1(m) | | 0.5 | | | 0.5 | | | 0.5 | | | 0.5 | | |
| 保护层厚度(m) | | 0.04 | | | 0.04 | | | 0.04 | | | 0.04 | | |
| 基底净反力设计值(kpa) | | 143.24 | | | 155.82 | | | 112.57 | | | 165.63 | | |
| 基底力矩 | | 103.12 | | | 16.34 | | | 620.22 | | | 570.39 | | |
| 净偏心距(m) | | 0.080 | | | 0.009 | | | 0.455 | | | 0.310 | | |
| *l*/6 | | 0.500 | | | 0.500 | | | 0.500 | | | 0.500 | | |
| 是否满足 | | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| 基底净最大反力设计值(kpa) | | 166.16 | | | 158.73 | | | 214.94 | | | 268.23 | | |
| 柱与基础交界处冲切验算 | *β*hp | 0.976 | | | 0.976 | | | 0.976 | | | 0.976 | | |
| *h*0(m) | 0.96 | | | 0.96 | | | 0.96 | | | 0.96 | | |
| *a*c(m) | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *b*c(m) | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *Al*(m2) | 0.662 | | | 0.662 | | | 0.662 | | | 0.662 | | |
| *Fl*(kN) | 110.06 | | | 105.14 | | | 142.37 | | | 177.68 | | |
| 0.7*β*hp*f*t*b*m*h*0 | 1463.12 | | | 1463.12 | | | 1463.12 | | | 1463.12 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| 柱与基础变阶处冲切验算 | *β*hp | 0.976 | | | 0.976 | | | 0.976 | | | 0.976 | | |
| *h*01(m) | 0.46 | | | 0.46 | | | 0.46 | | | 0.46 | | |
| *b*1(m) | 1.5 | | | 1.5 | | | 1.5 | | | 1.5 | | |
| *l*1(m) | 1.5 | | | 1.5 | | | 1.5 | | | 1.5 | | |
| *Al*(m2) | 0.786 | | | 0.786 | | | 0.786 | | | 0.786 | | |
| *Fl*(kN) | 130.58 | | | 124.75 | | | 168.92 | | | 210.80 | | |
| 0.7*β*hp*f*t*b*m*h*0 | 880.84 | | | 880.84 | | | 880.84 | | | 880.84 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| C柱受冲切承载力验算 | | | | | | | | | | | | | |
| 荷载 | | 一般组合 | | | | | | 地震效应组合 | | | | | |
| Mmax组合 | | | Nmax组合 | | | Mmax组合 | | | Nmax组合 | | |
| *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) |
| 73.94 | 1289.18 | 29.18 | 15.79 | 1402.42 | 0.54 | 461.36 | 1013.16 | 158.86 | 430.10 | 1490.70 | 140.29 |
| 基础宽度*b*(m) | | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础长度*l*(m) | | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础高度*h*(m) | | 1.0 | | | 1.0 | | | 1.0 | | | 1.0 | | |
| 基础下阶宽度*b*1(m) | | 1.50 | | | 1.50 | | | 1.50 | | | 1.50 | | |
| 基础下阶长度*l*1(m) | | 1.5 | | | 1.5 | | | 1.5 | | | 1.5 | | |
| 基础下阶高度*h*1(m) | | 0.5 | | | 0.5 | | | 0.5 | | | 0.5 | | |
| 保护层厚度(m) | | 0.04 | | | 0.04 | | | 0.04 | | | 0.04 | | |
| 基底净反力设计值(kpa) | | 143.24 | | | 155.82 | | | 112.57 | | | 165.63 | | |
| 基底力矩 | | 103.12 | | | 16.34 | | | 620.22 | | | 570.39 | | |
| 净偏心距(m) | | 0.080 | | | 0.009 | | | 0.455 | | | 0.310 | | |
| *l*/6 | | 0.500 | | | 0.500 | | | 0.500 | | | 0.500 | | |
| 是否满足 | | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| 基底净最大反力设计值(kpa) | | 166.16 | | | 158.73 | | | 214.94 | | | 268.23 | | |
| 柱与基础交界处冲切验算 | *β*hp | 0.976 | | | 0.976 | | | 0.976 | | | 0.976 | | |
| *h*0(m) | 0.96 | | | 0.96 | | | 0.96 | | | 0.96 | | |
| *a*c(m) | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *b*c(m) | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *Al*(m2) | 0.662 | | | 0.662 | | | 0.662 | | | 0.662 | | |
| *Fl*(kN) | 110.06 | | | 105.14 | | | 142.37 | | | 177.68 | | |
| 0.7*β*hp*f*t*b*m*h*0 | 1463.12 | | | 1463.12 | | | 1463.12 | | | 1463.12 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| 柱与基础变阶处冲切验算 | *β*hp | 0.976 | | | 0.976 | | | 0.976 | | | 0.976 | | |
| *h*01(m) | 0.46 | | | 0.46 | | | 0.46 | | | 0.46 | | |
| *b*1(m) | 1.5 | | | 1.5 | | | 1.5 | | | 1.5 | | |
| *l*1(m) | 1.5 | | | 1.5 | | | 1.5 | | | 1.5 | | |
| *Al*(m2) | 0.786 | | | 0.786 | | | 0.786 | | | 0.786 | | |
| *Fl*(kN) | 130.58 | | | 124.75 | | | 168.92 | | | 210.80 | | |
| 0.7*β*hp*f*t*b*m*h*0 | 880.84 | | | 880.84 | | | 880.84 | | | 880.84 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| D柱受冲切承载力验算 | | | | | | | | | | | | | |
| 荷载 | | 一般组合 | | | | | | 地震效应组合 | | | | | |
| Mmax组合 | | | Nmax组合 | | | Mmax组合 | | | Nmax组合 | | |
| *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) |
| 69.04 | 1317.11 | 26.18 | 50.04 | 1376.59 | 20.83 | 417.75 | 1434.75 | 132.10 | 417.75 | 1434.75 | 132.10 |
| 基础宽度*b*(m) | | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础长度*l*(m) | | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础高度*h*(m) | | 1.0 | | | 1.0 | | | 1.0 | | | 1.0 | | |
| 基础下阶宽度*b*1(m) | | 1.50 | | | 1.50 | | | 1.50 | | | 1.50 | | |
| 基础下阶长度*l*1(m) | | 1.5 | | | 1.5 | | | 1.5 | | | 1.5 | | |
| 基础下阶高度*h*1(m) | | 0.5 | | | 0.5 | | | 0.5 | | | 0.5 | | |
| 保护层厚度(m) | | 0.04 | | | 0.04 | | | 0.04 | | | 0.04 | | |
| 基底净反力设计值(kpa) | | 146.35 | | | 152.95 | | | 159.42 | | | 159.42 | | |
| 基底力矩 | | 95.22 | | | 70.87 | | | 549.85 | | | 549.85 | | |
| 净偏心距(m) | | 0.072 | | | 0.041 | | | 0.308 | | | 0.308 | | |
| *l*/6 | | 0.500 | | | 0.500 | | | 0.500 | | | 0.500 | | |
| 是否满足 | | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| 基底净最大反力设计值(kpa) | | 167.50 | | | 165.50 | | | 257.59 | | | 257.59 | | |
| 柱与基础交界处冲切验算 | *β*hp | 0.976 | | | 0.976 | | | 0.976 | | | 0.976 | | |
| *h*0(m) | 0.96 | | | 0.96 | | | 0.96 | | | 0.96 | | |
| *a*c(m) | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *b*c(m) | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *Al*(m2) | 0.662 | | | 0.662 | | | 0.662 | | | 0.662 | | |
| *Fl*(kN) | 110.96 | | | 109.63 | | | 170.63 | | | 170.63 | | |
| 0.7*β*hp*f*t*b*m*h*0 | 1463.12 | | | 1463.12 | | | 1463.12 | | | 1463.12 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |
| 柱与基础变阶处冲切验算 | *β*hp | 0.976 | | | 0.976 | | | 0.976 | | | 0.976 | | |
| *h*01(m) | 0.46 | | | 0.46 | | | 0.46 | | | 0.46 | | |
| *b*1(m) | 1.5 | | | 1.5 | | | 1.5 | | | 1.5 | | |
| *l*1(m) | 1.5 | | | 1.5 | | | 1.5 | | | 1.5 | | |
| *Al*(m2) | 0.786 | | | 0.786 | | | 0.786 | | | 0.786 | | |
| *Fl*(kN) | 131.64 | | | 130.07 | | | 202.44 | | | 202.44 | | |
| 0.7*β*hp*f*t*b*m*h*0 | 880.84 | | | 880.84 | | | 880.84 | | | 880.84 | | |
| 是否满足 | 满足 | | | 满足 | | | 满足 | | | 满足 | | |

## 9.5底面配筋

配筋截面如下所示：

|  |
| --- |
| C:\Users\Administrator\Desktop\4.PNG |
| 图9.1 配筋截面 |

1-1截面：



3-3截面：



2-2截面：



4-4截面：



计算过程见下表：

表9.4 配筋计算

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A柱基础底面配筋计算 | | | | | | | | | | | | |
| 荷载 | 一般组合 | | | | | | 地震效应组合 | | | | | |
| Nmax组合 | | | Mmax组合 | | | Nmax组合 | | | Mmax组合 | | |
| *M* | *N* | *V* | *M* | *N* | *V* | *M* | *N* | *V* | *M* | *N* | *V* |
| 69.04 | 1317.11 | 26.18 | 50.04 | 1376.59 | 20.83 | 417.75 | 1434.75 | 132.10 | 417.75 | 1434.75 | 132.10 |
| *b* | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| *l* | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| *h* | 1.0 | | | 1.0 | | | 1.0 | | | 1.0 | | |
| *h*1 | 0.5 | | | 0.5 | | | 0.5 | | | 0.5 | | |
| 保护层厚度 | 0.04 | | | 0.04 | | | 0.04 | | | 0.04 | | |
| *h*0 | 0.96 | | | 0.96 | | | 0.96 | | | 0.96 | | |
| *a*c | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *b*c | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *h*01 | 0.460 | | | 0.460 | | | 0.460 | | | 0.460 | | |
| *b*1 | 1.500 | | | 1.500 | | | 1.500 | | | 1.500 | | |
| *l*1 | 1.500 | | | 1.500 | | | 1.500 | | | 1.500 | | |
| 基底净反力设计值 | 146.35 | | | 152.95 | | | 159.42 | | | 159.42 | | |
| 基底净最大反力设计值 | 167.50 | | | 165.50 | | | 257.59 | | | 257.59 | | |
| *M*1-1 | 256.187 | | | 256.736 | | | 365.610 | | | 365.610 | | |
| *M*3-3 | 113.314 | | | 113.723 | | | 160.409 | | | 160.409 | | |
| *A*1-1 | 823.65 | | | 825.41 | | | 1175.44 | | | 1175.44 | | |
| *A*3-3 | 760.289 | | | 763.034 | | | 1076.279 | | | 1076.279 | | |
| 实配 | 10C16@150 | | | | | | 10C16@150 | | | | | |
| 面积 | 2011 | | | | | | 2011 | | | | | |
| *M*2-2 | 231.81 | | | 242.28 | | | 252.52 | | | 252.52 | | |
| *M*4-4 | 102.899 | | | 107.546 | | | 112.090 | | | 112.090 | | |
| *A*2-2 | 745.28 | | | 778.93 | | | 811.84 | | | 811.84 | | |
| *A*4-4 | 690.412 | | | 721.592 | | | 752.079 | | | 752.079 | | |
| 实配 | 10C16@150 | | | | | | 10C16@150 | | | | | |
| 面积 | 2011 | | | | | | 2011 | | | | | |
| B柱基础底面配筋计算 | | | | | | | | | | | | |
| 荷载 | 一般组合 | | | | | | 地震效应组合 | | | | | |
| Nmax组合 | | | Mmax组合 | | | Nmax组合 | | | Mmax组合 | | |
| *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) |
| 73.94 | 1289.18 | 29.18 | 15.79 | 1402.42 | 0.54 | 461.36 | 1013.16 | 158.86 | 430.10 | 1490.70 | 140.29 |
| 基础宽度*b*(m) | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础长度*l*(m) | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础高度*h*(m) | 1.0 | | | 1.0 | | | 1.0 | | | 1.0 | | |
| 基础下阶高度*h*1(m) | 0.5 | | | 0.5 | | | 0.5 | | | 0.5 | | |
| 保护层厚度(m) | 0.04 | | | 0.04 | | | 0.04 | | | 0.04 | | |
| *h*0(m) | 0.96 | | | 0.96 | | | 0.96 | | | 0.96 | | |
| *a*c(m) | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *b*c(m) | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *h*01(m) | 0.460 | | | 0.460 | | | 0.460 | | | 0.460 | | |
| *b*1(m) | 1.500 | | | 1.500 | | | 1.500 | | | 1.500 | | |
| *l*1(m) | 1.500 | | | 1.500 | | | 1.500 | | | 1.500 | | |
| 基底净反力设计值(kpa) | 143.24 | | | 155.82 | | | 112.57 | | | 165.63 | | |
| 基底净最大反力设计值(kpa) | 166.16 | | | 158.73 | | | 214.94 | | | 268.23 | | |
| *M*1-1(kN·m) | 253.295 | | | 250.172 | | | 296.239 | | | 380.554 | | |
| *M*3-3(kN·m) | 111.996 | | | 110.994 | | | 129.535 | | | 166.957 | | |
| *A*1-1(mm2) | 814.35 | | | 804.31 | | | 952.41 | | | 1223.49 | | |
| *A*3-3(mm2) | 751.451 | | | 744.724 | | | 869.129 | | | 1120.219 | | |
| 实配钢筋 | 10C16@150 | | | | | | 10C16@150 | | | | | |
| 面积(mm2) | 2011 | | | | | | 2011 | | | | | |
| *M*2-2(kN·m) | 226.90 | | | 246.83 | | | 178.32 | | | 262.36 | | |
| *M*4-4(kN·m) | 100.717 | | | 109.564 | | | 79.153 | | | 116.461 | | |
| *A*2-2(mm2) | 729.48 | | | 793.55 | | | 573.29 | | | 843.50 | | |
| *A*4-4(mm2) | 675.774 | | | 735.134 | | | 531.084 | | | 781.405 | | |
| 实配钢筋 | 10C16@150 | | | | | | 10C16@150 | | | | | |
| 面积(mm2) | 2011 | | | | | | 2011 | | | | | |
| C柱基础底面配筋计算 | | | | | | | | | | | | |
| 荷载 | 一般组合 | | | | | | 地震效应组合 | | | | | |
| Nmax组合 | | | Mmax组合 | | | Nmax组合 | | | Mmax组合 | | |
| *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) |
| 73.94 | 1289.18 | 29.18 | 15.79 | 1402.42 | 0.54 | 461.36 | 1013.16 | 158.86 | 430.10 | 1490.70 | 140.29 |
| 基础宽度*b*(m) | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础长度*l*(m) | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础高度*h*(m) | 1.0 | | | 1.0 | | | 1.0 | | | 1.0 | | |
| 基础下阶高度*h*1(m) | 0.5 | | | 0.5 | | | 0.5 | | | 0.5 | | |
| 保护层厚度(m) | 0.04 | | | 0.04 | | | 0.04 | | | 0.04 | | |
| *h*0(m) | 0.96 | | | 0.96 | | | 0.96 | | | 0.96 | | |
| *a*c(m) | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *b*c(m) | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *h*01(m) | 0.460 | | | 0.460 | | | 0.460 | | | 0.460 | | |
| *b*1(m) | 1.500 | | | 1.500 | | | 1.500 | | | 1.500 | | |
| *l*1(m) | 1.500 | | | 1.500 | | | 1.500 | | | 1.500 | | |
| 基底净反力设计值(kpa) | 143.24 | | | 155.82 | | | 112.57 | | | 165.63 | | |
| 基底净最大反力设计值(kpa) | 166.16 | | | 158.73 | | | 214.94 | | | 268.23 | | |
| *M*1-1(kN·m) | 253.295 | | | 250.172 | | | 296.239 | | | 380.554 | | |
| *M*3-3(kN·m) | 111.996 | | | 110.994 | | | 129.535 | | | 166.957 | | |
| *A*1-1(mm2) | 814.35 | | | 804.31 | | | 952.41 | | | 1223.49 | | |
| *A*3-3(mm2) | 751.451 | | | 744.724 | | | 869.129 | | | 1120.219 | | |
| 实配钢筋 | 10C16@150 | | | | | | 10C16@150 | | | | | |
| 面积(mm2) | 2011 | | | | | | 2011 | | | | | |
| *M*2-2(kN·m) | 226.90 | | | 246.83 | | | 178.32 | | | 262.36 | | |
| *M*4-4(kN·m) | 100.717 | | | 109.564 | | | 79.153 | | | 116.461 | | |
| *A*2-2(mm2) | 729.48 | | | 793.55 | | | 573.29 | | | 843.50 | | |
| *A*4-4(mm2) | 675.774 | | | 735.134 | | | 531.084 | | | 781.405 | | |
| 实配钢筋 | 10C16@150 | | | | | | 10C16@150 | | | | | |
| 面积(mm2) | 2011 | | | | | | 2011 | | | | | |
| D柱基础底面配筋计算 | | | | | | | | | | | | |
| 荷载 | 一般组合 | | | | | | 地震效应组合 | | | | | |
| Nmax组合 | | | Mmax组合 | | | Nmax组合 | | | Mmax组合 | | |
| *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) | *M*(kN·m) | *N*(kN) | *V*(kN) |
| 69.04 | 1317.11 | 26.18 | 50.04 | 1376.59 | 20.83 | 417.75 | 1434.75 | 132.10 | 417.75 | 1434.75 | 132.10 |
| 基础宽度*b*(m) | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础长度*l*(m) | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| 基础高度*h*(m) | 1.0 | | | 1.0 | | | 1.0 | | | 1.0 | | |
| 基础下阶高度*h*1(m) | 0.5 | | | 0.5 | | | 0.5 | | | 0.5 | | |
| 保护层厚度(m) | 0.04 | | | 0.04 | | | 0.04 | | | 0.04 | | |
| *h*0(m) | 0.96 | | | 0.96 | | | 0.96 | | | 0.96 | | |
| *a*c(m) | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *b*c(m) | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | | |
| *h*01(m) | 0.460 | | | 0.460 | | | 0.460 | | | 0.460 | | |
| *b*1(m) | 1.500 | | | 1.500 | | | 1.500 | | | 1.500 | | |
| *l*1(m) | 1.500 | | | 1.500 | | | 1.500 | | | 1.500 | | |
| 基底净反力设计值(kpa) | 146.35 | | | 152.95 | | | 159.42 | | | 159.42 | | |
| 基底净最大反力设计值(kpa) | 167.50 | | | 165.50 | | | 257.59 | | | 257.59 | | |
| *M*1-1(kN·m) | 256.187 | | | 256.736 | | | 365.610 | | | 365.610 | | |
| *M*3-3(kN·m) | 113.314 | | | 113.723 | | | 160.409 | | | 160.409 | | |
| *A*1-1(mm2) | 823.65 | | | 825.41 | | | 1175.44 | | | 1175.44 | | |
| *A*3-3(mm2) | 760.289 | | | 763.034 | | | 1076.279 | | | 1076.279 | | |
| 实配钢筋 | 10C16@150 | | | | | | 10C16@150 | | | | | |
| 面积(mm2) | 2011 | | | | | | 2011 | | | | | |
| *M*2-2(kN·m) | 231.81 | | | 242.28 | | | 252.52 | | | 252.52 | | |
| *M*4-4(kN·m) | 102.899 | | | 107.546 | | | 112.090 | | | 112.090 | | |
| *A*2-2(mm2) | 745.28 | | | 778.93 | | | 811.84 | | | 811.84 | | |
| *A*4-4(mm2) | 690.412 | | | 721.592 | | | 752.079 | | | 752.079 | | |
| 实配钢筋 | 10C16@150 | | | | | | 10C16@150 | | | | | |
| 面积(mm2) | 2011 | | | | | | 2011 | | | | | |

## 9.6联合基础计算

考虑到中间两柱间距过近，故采用联合基础进行设计。

内力统计见下表：

表9.5 内力统计

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 内力组合 | | | *M* | *N* | *V* |
| B柱 | 一般组合 | Mmax组合 | 73.94 | 1289.18 | 29.18 |
| Nmax组合 | 15.79 | 1402.42 | 0.54 |
| 地震效应组合 | Mmax组合 | 461.36 | 1013.16 | 158.86 |
| Nmax组合 | 430.10 | 1490.70 | 140.29 |
| C柱 | 一般组合 | Mmax组合 | 73.94 | 1289.18 | 29.18 |
| Nmax组合 | 15.79 | 1402.42 | 0.54 |
| 地震效应组合 | Mmax组合 | 461.36 | 1013.16 | 158.86 |
| Nmax组合 | 430.10 | 1490.70 | 140.29 |

联合基础高度、宽度不变，基础端部至柱边伸出1.5m。

### 9.6.1受冲切验算

对C柱左冲切面进行验算。地基净反力按下式计算：



受冲切验算按下式计算：



具体过程见下表：

表9.6 受冲切验算

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 荷载 | 一般组合 | | 地震效应组合 | |
| Mmax组合内力 | Nmax组合内力 | Mmax组合内力 | Nmax组合内力 |
| 2578.37 | 2804.85 | 2026.31 | 2981.39 |
| b(m) | 3.00 | 3.00 | 3.00 | 3.00 |
| l(m) | 5.70 | 5.70 | 5.70 | 5.70 |
| h(m) | 1.0 | 1.0 | 1.0 | 1.0 |
| 保护层厚度(m) | 0.04 | 0.04 | 0.04 | 0.04 |
| 基底净反力设计值(kpa) | 452.34 | 492.08 | 355.49 | 523.05 |
| *βhp* | 0.976 | 0.976 | 0.976 | 0.976 |
| *um* | 10.080 | 10.080 | 10.080 | 10.080 |
| *Fl*(kN) | 244.266 | 265.722 | 191.966 | 282.448 |
| 0.7βhpftumh0 | 9454.00 | 9454.00 | 9454.00 | 9454.00 |
| 是否满足 | 满足 | 满足 | 满足 | 满足 |

### 9.6.2受剪切验算

受剪切验算按下式计算：



具体过程见下表：

表9.7 受剪切验算

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 荷载 | 一般组合 | | 地震效应组合 | |
| Mmax组合内力 | Nmax组合内力 | Mmax组合内力 | Nmax组合内力 |
| 2578.37 | 2804.85 | 2026.31 | 2981.39 |
| b(m) | 3.00 | 3.00 | 3.00 | 3.00 |
| l(m) | 5.70 | 5.70 | 5.70 | 5.70 |
| h(m) | 1.0 | 1.0 | 1.0 | 1.0 |
| 保护层厚度(m) | 0.04 | 0.04 | 0.04 | 0.04 |
| 基底净反力设计值(kpa) | 452.34 | 492.08 | 355.49 | 523.05 |
| 剪力设计值 | 244.27 | 265.72 | 191.97 | 282.45 |
| *βhs* | 0.955 | 0.955 | 0.955 | 0.955 |
| 0.7βhsftbh0 | 2754.43 | 2754.43 | 2754.43 | 2754.43 |
| 是否满足 | 满足 | 满足 | 满足 | 满足 |

### 9.6.3配筋计算

配筋按下式计算：



具体过程见下表：

表9.8 配筋计算

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 荷载 | 一般组合 | | 地震效应组合 | |
| Mmax组合内力 | Nmax组合内力 | Mmax组合内力 | Nmax组合内力 |
| 2578.37 | 2804.85 | 2026.31 | 2981.39 |
| b(m) | 3.00 | 3.00 | 3.00 | 3.00 |
| l(m) | 5.70 | 5.70 | 5.70 | 5.70 |
| h(m) | 1.0 | 1.0 | 1.0 | 1.0 |
| 保护层厚度(m) | 0.04 | 0.04 | 0.04 | 0.04 |
| 基底净反力设计值(kpa) | 452.34 | 492.08 | 355.49 | 523.05 |
| 基底最大弯矩 | 806.74 | 812.96 | 1037.26 | 1277.44 |
| *As*(mm2) | 2593.67 | 2613.69 | 3334.82 | 4107.01 |
| 纵向钢筋配筋 | 14C20@150 | 14C20@150 | 14C20@150 | 14C20@150 |
| 配筋面积(mm2) | 4398.8 | 4398.8 | 4398.8 | 4398.8 |
| 横向弯矩 | 618.81 | 673.16 | 486.31 | 715.53 |
| 等效梁宽 | 2.04 | 2.04 | 2.04 | 2.04 |
| *As*(mm2) | 1989.48 | 2164.23 | 1563.51 | 2300.46 |
| 横向钢筋配筋 | 12C16@150 | 12C16@150 | 12C16@150 | 12C16@150 |
| 配筋面积(mm2) | 2413.2 | 2413.2 | 2413.2 | 2413.2 |

# 10楼梯设计

## 10.1设计资料

楼梯板共11级，每一级宽度0.27m，高度0.164m；

活荷载：3.5/m2

## 10.2 梯段板设计

*l*0=0.27×11+0.25=3.22m，*l*n=2.97m

板厚取0.11m

=0.164/0.27=0.607，=0.855。



取单位宽板进行计算

（1）恒载标准值

 (0.164×0.27/2×1×25+0.27/0.855×0.11×25)/ 0.27=5.27 

 1×(0.27+0.164) ×0.55/0.27=0.88 

 1×(0.27+0.164) ×0.018×20/0.27=0.58

 0.010×20×1/0.855=0.23

合计:*g*k=6.96



=9.05

=5.25

弯矩计算公式如下：

=14.83 ·m



=18.15



板有效高度*h*0=0.11-0.02=0.09m，配筋计算按下式进行：

=0.128



= 0.137



=0.931



=492mm2



选取C8@100，*A*s=503mm2

= 90.09>=18.15 



满足要求；

选取C8@200

## 10.4 平台板设计

计算跨度：

*l*0=1.2-0.25/2=1.075m；*l*n =1.075-0.25=0.825m

*l*x/ *l*y =3.36/1.075=3.13，取单位宽板进行计算

=4.90



=6.37 

=1.5×3.5=5.25

弯矩计算公式如下：

=1.68 ·m



配筋计算公式如下：

=0.014



= 0.015



=0.993



= 52mm2



选取C8@200，*A*s=251mm2

分布钢筋选取C8@300

## 10.5 平台梁设计

*l*=3.36m，选择设计梁尺寸0.25m×0.40m，*l*n =3.36-0.2=3.16m

3.318mm。

荷载如下：

 (9.05+5.25) ×3.22/2=23.03

 (6.37+5.25) ×1.075/2=6.25



合计: 32.52

弯矩计算公式如下：

=35.81·m



=51.39



配筋计算公式如下：

=0.077



=0.081



=0.960



=288mm2



选取3C20，*A*s=628mm2

=357.5>=51.39，满足要求；



=90.09>=51.39，满足要求；



分布钢筋选取C8@200双肢箍筋

# 

# 11 双向板设计

## 11.1 B1板计算

选择-，-板块进行计算；*l*y/*l*x=7.5/2.1=3.57 > 3，故为单向板

### 11.1.1 荷载统计

：=4.92，：==6.372

：=2.52，：==3.752

### 11.1.2 板配筋计算

取单位宽板进行计算

=2.1-0.25-0.25=1.6m



=7.5-0.25-0.25=7m



=4.375



取=0.05，=2



弯矩计算如下所示：

=7



=0.08



=14



=0.16



内力折减系数取0.8



可得：

解得：

=0.79·m/m



==0.04·m/m



=1.58·m/m



=0.08·m/m



具体计算见下表：

表11.1 配筋计算

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 板配筋计算 | | | | | | |
| 截面 | | *M* | *h0* | *AS* | 选配钢筋 | 实配面积 |
| 跨中 | *lox* | 0.79 | 100 | 23.06 | C8@200 | 251 |
| *loy* | 0.04 | 90 | 1.28 | C8@200 | 251 |
| 支座 | *lox* | 1.58 | 100 | 46.13 | C8@200 | 251 |
| *loy* | 0.08 | 90 | 2.56 | C8@200 | 251 |

## 11.2 B2板计算

选择-，-板块进行计算；*l*y/*l*x=4.5/3=1.50 < 3，故为双向板。

### 11.2.1 荷载统计

：=4.92，：==6.372

：=2.52，：==3.752

### 11.2.2 板配筋计算

取单位宽板进行计算

=3-0.25-0.25=2.5m



=4.5-0.25-0.25=4m



=1.6



取=0.39，=2



弯矩计算如下所示：

=4



=0.98



=8



=1.95



内力折减系数取0.8



可得：

解得：

=1.34·m/m



==0.52·m/m



=2.68·m/m



=1.05·m/m



具体计算见下表：

表11.2 配筋计算

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 板配筋计算 | | | | | | |
| 截面 | | *M* | *h0* | *AS* | 选配钢筋 | 实配面积 |
| 跨中 | *lox* | 1.34 | 100 | 39.24 | C8@200 | 251 |
| *loy* | 0.52 | 90 | 17.00 | C8@200 | 251 |
| 支座 | *lox* | 2.68 | 100 | 78.48 | C8@200 | 251 |
| *loy* | 1.05 | 90 | 34.01 | C8@200 | 251 |

# 参考文献

［1］邱洪兴.建筑结构设计[M].北京：高等教育出版社，2010.

［2］季韬，黄志雄.多高层钢筋混凝土结构设计[M].北京：机械工业出版社，2014.

［3］东南大学，同济大学，天津大学.混凝土结构：中册[M].3版.北京：中国建筑工业出版社，2012.

［4］李国强，李杰，苏小卒.建筑结构抗震设计.2版[M].北京：高等教育出版社，2012.

［5］姚文娟，叶志明.房屋建筑及结构设计[M].北京：高等教育出版社，2010.

［7］中华人民共和国建设部.GB50011-2010建筑抗震设计规范[S] .北京：中国建筑工业出版社，2016.

［8］中华人民共和国建设部.GB55008-2021混凝土结构通用规范[S] .北京：中国建筑工业出版社，2021.

［9］中华人民共和国建设部.GB55003-2021建筑与市政地基基础通用规范[S] .北京：中国建筑工业出版社，2021.

［10］中华人民共和国建设部.JGJ3-2010 高层建筑混凝土结构技术规程[S] .北京：中国建筑工业出版社，2010.

［11］中华人民共和国建设部.GB55001-2021工程结构通用规范[S] .北京：中国建筑工业出版社，2021

［12］中华人民共和国建设部.GB50016-2014建筑设计防火规范[S] .北京：中国建筑工业出版社，2018.

［13］中华人民共和国建设部.GB50352-2019民用建筑设计统一标准[S] .北京：中国建筑工业出版社，2019.

［14］An, X. , et al. "Effects of material of metallic frame on the penetration resistances of ceramic-metal hybrid structures." Defence Technology, 16.1(2020):11.

［15］侯贵贤. 高层建筑结构设计难点分析[J]. 建材与装饰,2019,(06):79-80.

［16］洪源. 高层建筑混凝土结构设计分析[J]. 住宅与房地产,2019,(06):88.

［17］Wang X Y , Liu H B , Ying J , et al. Two new supramolecular compounds with reversible skeleton structure changes during dehydration and rehydration: Synthesis and characterization[J]. Inorganica Chimica Acta, 2019, 493:14-19.

［18］文国治. 结构力学[M]. 重庆：重庆大学出版社，2011.

［19］舒秋华. 房屋建筑学 第六版[M]. 湖北：武汉理工大学出版社，2018.

［20］Rensheng Liao,Zheng Zhang. Second-order Effect Finite Element Analysis of Stainless Steel Frame Structure[J]. IOP Conference Series: Earth and Environmental Science,2019,267(3).

［21］沈蒲生. 高层建筑结构设计 第二版[M]. 北京：中国建筑工业出版社，2011.

［22］Vijayalakshmi K N V S K , Malathi J , Krishnaveni G . A frame work for mining huge data by non-expert users with the assistance of knowledge base[J]. Journal of Physics: Conference Series, 2019.

［23］于小娟，何山. 土力学与基础工程[M]. 北京：高等教育出版社，2018.

［24］钱稼茹，赵作周，纪晓东等.高层建筑结构设计[M]. 北京：中国建筑工业出版社，2021.

［25］T S Deng,M N Chen. Effects of the Thickness of Triangular Plates on the Stiffness and Strength of L-type Basic Structures of the Bus Body Frame[J]. IOP Conference Series: Earth and Environmental Science,2019,267(6).