

AISC Steel Office Building Design Case Study

DESIGN CALCULATIONS FOR 3-STORY OFFICE BUILDING

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CALCULATIONS FOR PRIMARY STRUCTURAL FRAME

3 STORY OFFICE BUILDING
3100 SOUTH WEST STREET
LAWRENCE, KANSAS

DESIGN TEAM:

ARCHITECT:	ARCHITECTS R' US ^a
STRUC. ENGR.:	AISC DESIGN ENGINEERS ^a
MECH/ELEC/LIGHTING & ARCHITECTURAL SYSTEMS:	B. SELF, INC. ^a
GEOTECHNICAL:	SOILS GUYS ^a

INFO INDICATES SPREAD FOOTINGS WILL BE REASONABLE

GOVERNING CODES:

ASCE 7-02
STRUCT. STEEL PER AISC & LRFD

FIRE REQUIREMENTS:

INTERNATIONAL BUILDING CODE - TYPE OF CONSTRUCTION IS I (NON-COMBUSTIBLE MATERIALS)
TABLE 503 - ALLOWABLE HEIGHT AND BUILDING AREAS - P.5.7
BUILDING UP TO 160 AND 11 STORIES - TYPE IB CONSTRUCTION
TABLE 601 FIRE RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HRS)
USING TYPE IB - 2 HOUR FIRE RATING FOR STRUCTURAL FRAME INCLUDING GIRDERS IN FLOOR
REDUCED TO ONE HOUR FOR THE FLOOR

(PER ARCHITECT - BASED ON ZONE USE & OCCUPIED AREA)
STRUCT. FRAME - 2 HRS
FLOORS - 2 HRS
ROOF - 1 HR

ARCHITECTS' SCHEMATIC DRAWINGS SET DESIRED COLUMN ARRANGEMENT,
STORY HEIGHTS, NEED CHECKS (STRUCTURAL) ON:

FRAMING MATERIAL
TYPE OF VERTICAL & LATERAL RESISTING SYSTEM
SIZE OF COLUMNS & COLUMN BASE PLATES
DEPTH REQUIREMENTS FOR BEAMS, GIRDERS, & STRUCTURAL FLRS
PRELIMINARY BUDGET - STRUCTURAL FRAME

FLOOR VIBRATION:

A 3 ½" thick slab of lightweight concrete on spans in the range of 30-36 feet is not expected to exhibit floor vibrations severe enough to be considered objectionable. Furthermore, partitions eliminate vibration problems since they introduce damping to the structural system.

ARRANGEMENT - BY ARCHITECT COORDINATING WITH DESIGN TEAM

FUNCTION: SPECULATIVE (RENTAL) OFFICE BUILDING
LEASABLE SPACE - 21,000 SQ FT.
ENTRANCE LOBBY: FRONT CENTER, ALLOWS LEASING FLEXIBILITY
EACH FLOOR TO 1, 2, OR 3 CLIENTS
PENTHOUSE: SINGLE BAY OVER ELEVATORS
(Hydraulic elevator, piston at ground and sheave beams at penthouse level)
FIRE EGRESS: SEPARATE SMOKE ENCLOSURE EXITS FRONT & REAR

LAYOUT: BUILDING FOOT PRINT:
BAY SIZES: 36' X 30' (RECOMMENDED BY STRUCT. ENGR. SHEET 5)
STORIES: 3
CEILING HEIGHT: 10'-9"
MECH PLENUM DEPTH: ~16"

FACADE: BRICK
WINDOWS: PUNCHED

ROOF: BUILT UP ASPHALT & GRAVEL
HEIGHT OF SECONDARY DRAINAGE SYSTEM - 2"

INTERIOR FINISHES: CEILING: SUSPENDED ACOUSTIC TILE
WALLS: GYPSUM BOARD, PARTITION ALLOWANCE IN LEASABLE SPACE
FLOORS: VINYL TILE / CARPET

ARCHITECTURAL DRAWINGS LIST:
A-1 - 1ST FLOOR PLAN
A-2 - 2ND AND 3RD FLOOR PLAN
A-3 - PENTHOUSE, ROOF PLAN
A-4 - WALL SECTIONS

CHOICE OF FRAMING SYSTEM

SHORT DELIVERY SCHEDULE MEANS CONSTRUCTION TIME MUST BE MINIMIZED, AVOID SHEAR WALLS

LOBBY LAYOUT ALLOWS BRACED FRAMES

BUILDING CLASSIFIED AS LOW-RISE (1-4 STORIES)

BRICK FACADE TO USE STEEL STUD BACKUP FOR LATERAL SUPPORT

PUNCHED WINDOWS ALLOW LOOSE LINTELS

LOW TOTAL BUILDING HEIGHT ALLOWS BRICK TO BEAR VERTICALLY ON BRICK SHELF AT FOUNDATION WITHOUT RELIEVING ANGLES
THE BUILDING HEIGHT OF 39' IS ON THE UPPER END FOR THIS METHOD OF BRICK SUPPORT. AT THE PENTHOUSE WHERE THE BRICK HEIGHT IS 52' A SHELF ANGLE SHOULD BE ADDED TO LIMIT THE BRICK HEIGHT TO 39'. THIS DETAIL HAS BEEN OMITTED HERE FOR SIMPLICITY. SEE THE AISC PUBLICATION "DESIGNING WITH STRUCTURAL STEEL. A GUIDE FOR ARCHITECTS" FOR INFORMATION ABOUT WALL DETAILS.

☆ FRAME TO BE STRUCTURAL STEEL, CONCENTRICALLY BRACED, SIMPLE CONNECTIONS

FRAMING PLAN:

BAY SIZES: 30 X 36, FOR INFORMATION ON PRELIMINARY FRAMING LAYOUT, SEE ESSENTIALS OF STEEL DESIGN ECONOMY, LECTURE 2, DECISION MAKING IN SYSTEM SELECTION LAYOUT, AISC, CHICAGO 1999

FRAMING DIRECTION: JOISTS SPANNING LONGER BAY DIRECTION
A BAY STUDY IS DONE ON SHEET 34 TO VERIFY JOISTS SPANNING LONGER BAY DIRECTION IS MOST ECONOMICAL

FOR MANY POINTERS CONCERNING STEEL DESIGN ECONOMY, SEE MODERN STEEL CONSTRUCTION, VOLUME 40, NO. 4, AISC, APRIL 2000

FILL BEAMS ARE USED INSTEAD OF JOISTS ON COLUMN LINES
(EASIER TO PLUMB FRAME)

COMPOSITE SECTIONS ARE NOT USED FOR PEDAGOGICAL PURPOSES

MATERIALS:

STRUCTURAL STEEL - A992

JOISTS- STEEL JOIST INSTITUTE: MAX ALLOWABLE TENSILE STRESS 30,000 PSI

CONNECTION MATERIAL - A36

BOLTS - 3/4" ϕ A325 N

SITE:

SUBURBAN

RELATIVELY SMOOTH TYPOGRAPHY

DEFLECTION CRITERIA: