16 STORY OFFICE BUILDING IN CONCRETE

1. Building Description and Loading

This sixteen storey office building typical floor consists of flat plates and a number of beams near the core walls. On the perimeter, the floor slab cantilevers 3 ft beyond the column lines and in the front edge of the slab the cantilever is 6.5 ft. The vertical structural elements are columns and shear wall with pilasters. In the X-direction much of the seismic forces are resisted by shear walls, while in Y-direction they are resisted by rigid frames formed by flat plates and columns. For typical floor layout see figure A..

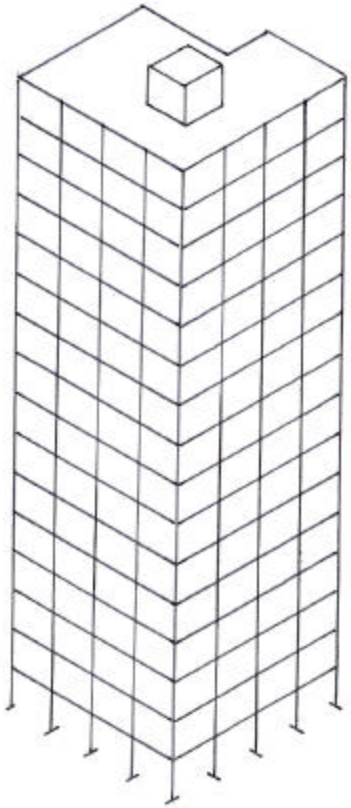
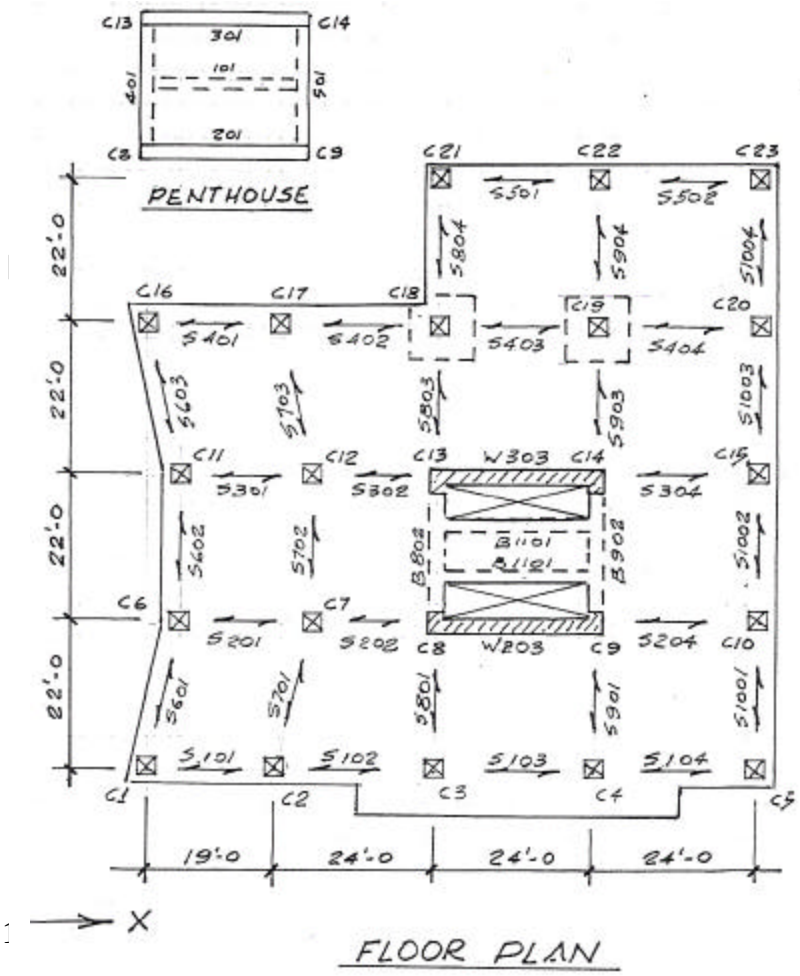


Fig. A



The floor live load is 80 psf, floor dead load 11 psf, plus the slab. The structure is to be designed by the American Concrete Institute “Building Code Requirements for Structural Concrete” (ACI) and the seismic forces to be computed by the Uniform Building Code.

The design of flat plate floors is often governed by punching shear around columns. This problem can be resolved by investigating different slab thickness, columns sizes, or by introducing drop panels, column capitals, shear heads or change concrete strength. With AMECO the **optimum solution** was found **in one hour** by redesigning the structure some seven or eight times with different slab thickness, different minimum column sizes and with drop panels over selected columns, etc.. Since for each design AMECO calculates for the whole structure the exact construction costs, it was simple to select the least cost design. Each AMECO-17 design execution took nine seconds.

The input commands for the **optimum design solution** of the structure are shown in Fig. B. No member sizes were input, no loads manually calculated, no loading cases or combinations selected. Basically only loading parameters and member connectivitiies, and their spans were input, plus the trial minimum dimensions for columns and slabs.

If you wish to learn about the basics of the AMECO input language for designing concrete structures, you may read the next section. Otherwise proceed to section 3.

2. Input Commands

The command USE ACI-99 calls for the American Concrete Institute Building code using the USD method for designing members. No other criteria is given, therefore AMECO-17 standard criteria values will be used for concrete and steel strength, for unit prices of materials, etc. The values used can be later seen in the output result file. The LIST and SUPPRESS are entered to select desired results

LEVEL 17 defines the penthouse framing. A very simple structure – let us proceed to the main floor input.

LEVELS 16 TO 1 implies that the subsequent data given is the same for all 16 levels. That does not mean that the member sizes selected by AMECO-17 will be the same on all levels.

```
PROJECT- OAK PLAZA
STRUCTURE- 16 STOREY OFFICE BUILDING
CLIENT- NORK ENTERPRIZES LTD.
REVISION- D
FILE OAK
INPUT- FB
$
USE CODE ACI-99, USD
CYCLE MAX 2
LIST ALL
SUPPR ENVELOPES FOR LEVELS 17 TO15 13 to 9, 7 TO 1
LIST FRAME FORCES EQ LEVEL 15 2 1
$
LEVEL 17  $ PENTHOUSE
DESIGN BEAMS
USE SPANS 24 SLAB 8 FLL 65
B101 WALL201 TO 301
B401 TO 501 12 101
DESIGN COLS SQ 14, L 11-0
C8 TO 9 201 401 C13 TO 14 301 401R
$
LEVELS 16 TO 1
   DESIGN TWO WAY SYSTEM
USE SLAB 8, FDL 11, FLL 80 SPANS 24
USE FL PROJ 36, CANTILEVERS 3.
S101 19  S102  S103 FL NS 6-6  S104
S201 TO 202 19  WALL203  S204 TO 304
S401 19  S402 TO 404  S501 TO 502
   USE SPANS 22
S601 OFFS -5 S602 S603 TO 703 OFFS 5
S801 23-6 LCANT 6.5  B802 2(6 1101) 22 FLL100
S803 23-6  S804 TO 904
S1001 TO 1004 DL W .4
B1101 24 REQ 2 OP FS FLL 100
$
   DESIGN COLS SQUARE, L 11-6
RESTRICT XDIM TO MIN 16
EQUATE COLS 1 5 16 21 23
EQUATE COLS 7 12
EQUATE COLS 10 15 20
C1 TO 5 101 601  C6 TO 10 201 602
C11 TO 15 301 603 C16 TO 20 401 603R
C21 TO 23 501 804R
C8 TO 9 RECT 16 30, C13 TO 14 RECT 16 30
C18 TO 19 DROP 8-0 8-0 12
$
COMPUTE TORSION UBC
COMPUTE EQ FORCES UBC Z .15
EXECUTE
```

Fig. B

USE SLAB 8, FDL 11 (floor dead load 11 psf), FLL 80 (floor live load 80 psf) SPANS 24 (24 ft span will be applied to all subsequent slabs unless other value is entered). The subsequent lines lists the slabs and beams with their spans. Slab marks are prefixed with letter S and beam marks with B. An exterior wall load is applied on slabs S1001 to 1004; DL W .04 (0.4 kips/ft.).

DESIGN COLS SQUARE 16, L 11-6 requests column size selections, starting with 16 in. EQUATE COLS 1 5 16 21 23 requests that all five column to be the same. C1 to 5 101 601 connects 101 to 104 to the columns in X-direction and members 601 701 801 901 1001 in Y-direction. This is a typical statement for connecting slabs and beams to columns.

C8 to 9 RECT 18 30 enters the pilaster size. C18 TO 19 DROP 8-0 8-0 12 enters 8 ft. square drop panel with total thickness of 12 in

COMPUTE TORSION UBC invokes mass eccentricity amplification & COMPUTE EQ FORCES .. requests static earthquake computations as per UBC code with Z= 0.15

3. Analysis and Design Process

Based on the input commands of Fig. B, AMECO-17 generates the geometry in 3D, initializes member sizes, models joints, calculates floor dead and live loads on each member, calculates seismic forces, sets up loading cases and combinations and through an iterative cyclic analysis/design process designs the whole structure

.

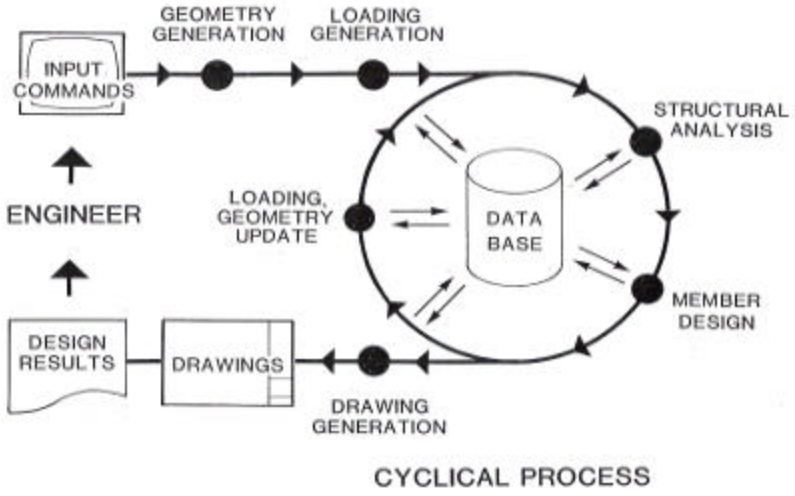


Fig. C
AMECO-17 cyclical process

4. Analysis and Design Execution Time

This structure has 512 slabs, 67 beams, 384 columns and 34 walls or total of 981 members. Nonlinear analysis was executed for 17 dead load cases (produced by construction simulation), 576 live load cases (number of beams and slabs) and two seismic load cases. **This structure was designed and optimized in 12 man-hours** – from the input preparation to the review of the design results. The AMECO-17 design execution per design run was 9 seconds.

5. Analysis and Design Results

In this section representative pages are displayed out of the total of 354 Design Result pages. This design was done in English units, therefore all member forces and moments are ft –kip units; member dimensions and displacements in inches; floor and formwork areas in sq.ft.; ASTM standard reinforcing bars invoked by the ACI code.

The following results are listed level by level.

Principal Design Parameters

Frame Analysis results for earthquake

Column Design Tables

Column Reinforcing Schedules

Column Quantities and Costs

Beam Moment, Shear and Steel Envelopes

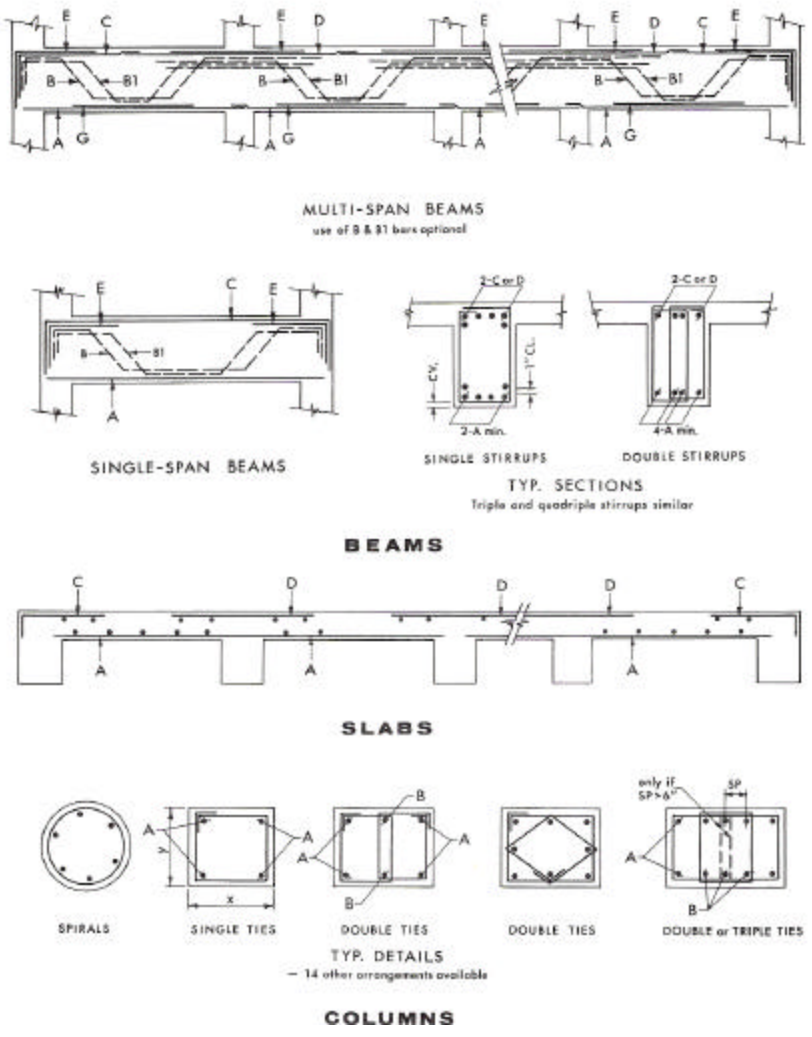
Beam Reinforcing Schedules

Beam Quantities and Costs

Construction Costs Summary

Dayfile – execution time.

Use the diagrams on the right to interpret the reinforcing schedules for the members listed in the Design Results tables



```
*****************************************************************

   P R I N C I P A L   D E S I G N   P A R A M E T E R S

*****************************************************************

   DESIGN  CODE ....................... ACI -99

   MEMBER  DESIGN  METHOD ............. USD

   NONLINEAR  ANALYSIS ................ PERFORMED

   CONSTRUCTION SIMULATION ............. PERFORMED

   FINITE  JOINTS ..................... CONSIDERED

   MEMBER  CRACKING ................... CONSIDERED

   LIVE  LOAD  REDUCTION .............. NBC - HUMAN

   LOAD  FACTORS ...................... 1.40 1.70 1.27 0.90 1.30

*****************************************************

***** MESSAGE D-83  ENTERING CONTRUCTION  SIMULATION

***** LEVELS ADDED DURING EACH CONSTRUCTION STAGE = 1

*************************************************
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F R A M E A N A L Y S I S R E S U L T S - DESIGN CYCLE 2

B A S E S H E A R COMPUTATIONS BY 'UBC' CODE FOR LOAD CASE 'EQ-Y'

Z = 0.1500
C = 1.0000
I = 1.0000
R = 8.0000
ZIC/R = 0.0188

W = 10075.4 TONS
V = 377.8 KIPS

F R A M E A N A L Y S I S R E S U L T S - DESIGN CYCLE 2

FRAME Y- 1 LOADING CASE - LATERAL EQ-Y IN Y DIRECTION

LEVEL 15 MASS= 66.9 TONS

BEAM/SLAB	MOMENTS		FORCES	
	LEFT	RIGHT	SHEAR	AXIAL
601	28.43	-25.18	2.38	-0.03
602	29.41	-29.45	2.68	0.01
603	24.70	-27.97	2.33	0.04

COLUMN	MOMENTS		FORCES		VERTICAL	HORIZONTAL	JOINT
	TOP	BOT	SHEAR	AXIAL	DISPL	JOINT LOADS	ROTATIONS
1	14.04	-12.79	2.33	-3.63	-0.067	-0.43	0.12
6	27.03	-26.22	4.63	0.07	0.001	-0.43	0.09
11	26.86	-26.04	4.60	-0.02	0.000	-0.43	0.09
16	13.87	-12.59	2.30	3.46	0.076	-0.43	0.12

TOTAL SHEAR = 13.86

LEVEL 2 MASS= 71.6 TONS

BEAM/SLAB	MOMENTS		FORCES	
	LEFT	RIGHT	SHEAR	AXIAL
601	60.67	-59.36	5.32	-0.61
602	62.88	-62.94	5.72	-0.54
603	57.29	-56.88	5.06	-0.42

COLUMN	MOMENTS		FORCES		VERTICAL	HORIZONTAL	JOINT
	TOP	BOT	SHEAR	AXIAL	DISPL	JOINT LOADS	ROTATIONS
1	28.67	-46.26	6.51	-54.97	-0.013	0.79	0.20
6	56.15	-77.22	11.60	-0.45	0.000	0.79	0.19
11	55.03	-75.99	11.39	2.22	0.001	0.79	0.19
16	26.08	-35.07	5.32	51.57	0.018	0.79	0.18

TOTAL SHEAR = 34.82

LEVEL 1

MASS= 71.6 TONS

BEAM/SLAB	MOMENTS		FORCES	
	LEFT	RIGHT	SHEAR	AXIAL
601	50.68	-49.10	4.42	-0.85
602	50.99	-51.08	4.64	-0.63
603	46.87	-46.49	4.14	-0.50

COLUMN	MOMENTS		FORCES		VERTICAL	HORIZONTAL	JOINT
	TOP	BOT	SHEAR	AXIAL	DISPL	JOINT LOADS	ROTATIONS
1	3.19	-84.12	7.59	-59.24	-0.007	0.23	0.16

F R A M E A N A L Y S I S R E S U L T S - DESIGN CYCLE 2

FRAME Y- 1 LOADING CASE - LATERAL EQ-Y IN Y DIRECTION

6	21.74	-111.75	11.61	-0.46	0.000	0.23	0.15
11	20.85	-111.31	11.49	2.52	0.000	0.23	0.15
16	10.25	-47.73	5.04	55.45	0.009	0.23	0.15

TOTAL SHEAR = 35.73

FRAME Y- 3 LOADING CASE - LATERAL EQ-Y IN Y DIRECTION

LEVEL 15

MASS= 145.8 TONS

BEAM/SLAB	MOMENTS		FORCES	
	LEFT	RIGHT	SHEAR	AXIAL
801	54.08	-60.87	4.89	4.86
802	143.56	-143.34	13.04	-2.09
803	73.18	-55.80	5.49	-8.31
804	30.42	-41.64	3.28	-3.99

COLUMN	MOMENTS		FORCES		VERTICAL	HORIZONTAL	JOINT
	TOP	BOT	SHEAR	AXIAL	DISPL	JOINT LOADS	ROTATIONS

3	26.12	-25.83	4.52	-8.69	-0.101	3.88	0.09
8	136.64	-108.55	21.32	-26.48	-0.067	3.88	0.13
13	140.89	-114.01	22.17	25.53	0.065	3.88	0.13
18	42.94	-42.66	7.44	6.00	0.036	3.88	0.05
21	21.66	-20.47	3.66	4.63	0.117	3.88	0.10

TOTAL SHEAR = 59.11

LEVEL 2

MASS= 154.3 TONS

BEAM/SLAB	MOMENTS		FORCES	
	LEFT	RIGHT	SHEAR	AXIAL
801	112.23	-105.41	9.26	-1.83
802	551.93	-550.81	50.12	1.04
803	121.10	-126.57	10.54	3.97
804	123.77	-120.61	11.11	2.26

COLUMN	MOMENTS		FORCES		VERTICAL	HORIZONTAL	JOINT
	TOP	BOT	SHEAR	AXIAL	DISPL	JOINT LOADS	ROTATIONS
3	46.19	-91.66	11.99	-117.22	-0.018	-0.70	0.20
8	295.49	-361.70	57.15	-412.26	-0.019	-0.70	0.17
13	303.50	-369.78	58.55	399.59	0.019	-0.70	0.17
18	112.23	-167.79	24.35	32.03	0.004	-0.70	0.19
21	60.09	-77.55	11.97	105.85	0.025	-0.70	0.18

TOTAL SHEAR = 164.00

LEVEL 1

MASS= 155.3 TONS

F R A M E A N A L Y S I S R E S U L T S - DESIGN CYCLE 2

FRAME Y- 3 LOADING CASE - LATERAL EQ-Y IN Y DIRECTION

BEAM/SLAB	MOMENTS		FORCES	
	LEFT	RIGHT	SHEAR	AXIAL
801	91.35	-85.73	7.54	-13.95
802	370.01	-369.08	33.60	0.77
803	98.35	-102.61	8.55	16.38
804	101.99	-99.71	9.17	5.48

COLUMN	MOMENTS		FORCES		VERTICAL	HORIZONTAL	JOINT
	TOP	BOT	SHEAR	AXIAL	DISPL	JOINT LOADS	ROTATIONS
3	0.50	-213.53	18.61	-123.78	-0.009	-7.33	0.17
8	92.79	-310.74	35.09	-438.16	-0.010	-7.33	0.14
13	96.78	-312.68	35.61	424.58	0.010	-7.33	0.14

18	37.42	-283.63	27.92	31.52	0.002	-7.33	0.16
21	21.86	-94.55	10.12	115.12	0.013	-7.33	0.15

D R I F T TABLE FOR LOADING CASE EQ-Y

LEVEL	FORCE APPLIED	STOREY HEIGHT	D R I F T TOTAL	D R I F T INTERSTORY	MAX. AMPLIF. DUE TO TORQUE
17	98.32	11.00	7.635	1.119*	1.000 AT C 9
16	36.02	11.50	6.516	0.289	1.035 AT C 9
15	29.96	11.50	6.227	0.318	1.022 AT C 9
14	27.98	11.50	5.909	0.359	1.023 AT C 9
13	26.01	11.50	5.550	0.399	1.021 AT C 9
12	24.04	11.50	5.151	0.419	1.020 AT C 9
11	22.15	11.50	4.732	0.425	1.021 AT C 9
10	20.21	11.50	4.307	0.444	1.020 AT C 9
9	18.30	11.50	3.863	0.457	1.020 AT C 9
8	16.35	11.50	3.406	0.462	1.024 AT C 4
7	14.43	11.50	2.944	0.458	1.029 AT C 4
6	12.45	11.50	2.486	0.459	1.033 AT C 4
5	10.43	11.50	2.027	0.466	1.037 AT C 4
4	8.42	11.50	1.561	0.467	1.041 AT C 4
3	6.36	11.50	1.093	0.458	1.042 AT C 4
2	4.27	11.50	0.636	0.411	1.042 AT C 4
1	2.14	11.50	0.225	0.225	1.034 AT C 20

TOTAL HORIZONTAL FORCES APPLIED = 377.83

TOTAL BASE SHEAR DEVELOPED = 439.33

ALLOWABLE DRIFT H/ 250

***** MESSAGE D-77 ALOWABLE DRIFT EXCEEDED AT LEVELS MARKED WITH AN ASTERISK (*).

********** NATURAL PERIOD OF VIBRATION IN Y DIRECTION 4.10 SECONDS

EQ-Y FRAME ANALYSIS COMPUTATION TIMES IN CPU-SEC

FRAME CONSTANTS	0.000
JOINT DISPLACEMENTS (RELAXATION)	0.000
MEMBER FORCES AND MOMENTS	0.000

ITERATION COUNTS

ROTATION	186
VERTICAL DISPLACEMENT	49
HORIZONTAL DISPLACEMENT	116
X-Y PLANE SWAPPING	3

****

***** MESSAGE D-81 FRAME ANALYSIS COMPLETED FOR DESIGN CYCLE 2

1

C O L U M N D E S I G N T A B L E - LEVEL 1

COL MK	LOAD CASE	FORCES AND MOMENTS P	TOP MOMENT X-DIR	TOP MOMENT Y-DIR	BOT MOMENT X-DIR	BOT MOMENT Y-DIR	LLR	EFFECTIVE ACTUAL LENGTH	EFFECTIVE LENGTH LX	EFFECTIVE LENGTH LY	EFFECTIVE ALFA	COL X	COL Y	F'C	FY	AS	PG	UTIL. RATIO
1	DL	14.3	-4.8	-2.9	2.3	1.3	1.00	12.33	10.33	10.33		16	16	4000	60000	3.10	1.21	0.58
	LL	28.7	-15.0	-14.6	7.4	6.9										4-*25		
	EQ-X	-5.2	45.6	0.1	-50.6	0.0												
	EQ-Y	-5.4	0.0	49.0	0.0	-55.2												
	COMB 15	12.5			2.9	53.6												
2	DL	33.1	-3.4	-6.1	1.6	2.8	1.00	12.33	10.17	10.17		16	16	4000	60000	3.10	1.21	0.59
	LL	66.3	-20.7	-20.1	10.1	9.5										4-*25		
	EQ-X	2.6	52.5	0.1	-53.6	-0.1												
	EQ-Y	-7.1	0.1	62.2	-0.1	-66.6												
	COMB 17	48.4			0.0	70.1												
3	DL	58.0	-2.2	-3.9	1.1	1.7	0.93	12.33	10.17	10.17		16	16	4000	60000	3.10	1.21	0.61
	LL	119.8	-22.5	-14.4	11.1	6.7										4-*25		
	EQ-X	-6.2	46.9	-0.1	-51.2	0.0												
	EQ-Y	-18.7	0.1	65.7	0.0	-75.6												
	COMB 15	53.8			0.0	73.4												
4	DL	39.9	14.7	-3.0	-7.4	1.3	0.85	12.33	10.33	10.33		16	16	4000	60000	3.10	1.21	0.80
	LL	80.8	30.4	-11.7	-15.3	5.4										4-*25		
	EQ-X	9.0	38.7	0.0	-47.6	0.0												
	EQ-Y	-15.5	-0.1	67.6	0.0	-83.2												
	COMB 15	34.4			9.2	81.5												
5	DL	35.0	-2.1	-8.9	0.8	4.4	1.00	12.33	9.67	9.67		16	16	4000	60000	3.10	1.21	0.57
	LL	73.0	-14.5	-26.2	6.8	12.8										4-*25		
	EQ-X	-8.0	57.9	0.0	-59.9	0.0												
	EQ-Y	1.7	0.2	54.8	-0.1	-55.6												
	COMB 17	42.0	0.0	66.0														
6	DL	115.7	-9.0	-6.4	4.4	3.0	0.76	12.33	9.67	9.67		16	16	4000	60000	3.10	1.21	0.87
	LL	208.0	-30.7	-22.3	15.0	10.7										4-*25		
	EQ-X	-2.0	57.1	0.0	-59.6	0.0												
	EQ-Y	-3.0	0.0	59.9	0.0	-63.0												
	COMB 1	454.4	57.0	41.2														

7	DL	184.8	10.4	-13.3	-5.2	6.3	0.74	12.33	9.67	9.67		18	18	4000	60000	6.20	1.91	0.99
	LL	348.1	50.1	-37.8	-25.2	18.1										8-*25		
	EQ-X	-3.4	107.0	0.0	-114.3	0.0												
	EQ-Y	7.7	-0.2	128.9	0.1	-140.6												
	COMB 1	749.3	87.7	72.8														
				1														

C O L U M N D E S I G N T A B L E - LEVEL 1

COL MK	I LOAD CASE	I	F O R C E S AND M O M E N T S P	TOP MOMENT X-DIR	BOT MOMENT Y-DIR	BOT MOMENT X-DIR	TOP MOMENT Y-DIR	LLR	I ACTUAL LENGTH	EFFECTIVE LENGTH LX	LY	ALFA	I COL X	SIZE Y	F'C	FY	AS	PG	UTIL. RATIO
8	DL		86.6	7.7	-7.9	-3.8	3.8	0.89	12.33	9.67	9.67		16	16	4000	60000	3.10	1.21	0.78
	LL		182.6	23.0	-22.4	-11.5	10.9										4-*25		
	EQ-X		12.9	53.2	-0.1	-58.1	0.0												
	EQ-Y		6.8	0.0	76.8	0.0	-81.0												
	COMB	31	295.2	33.7	87.2														
9	DL		19.9	-2.3	21.9	1.0	-11.0	1.00	12.33	10.17	10.17		16	16	4000	60000	3.10	1.21	0.90
	LL		38.5	-13.2	42.0	6.3	-21.3										4-*25		
	EQ-X		-7.4	57.7	0.0	-60.8	0.0												
	EQ-Y		3.6	-0.2	45.1	0.1	-53.1												
	COMB	25	67.7	16.9	103.1														
10	DL		80.7	-9.3	17.4	4.5	-8.8	0.88	12.33	10.17	10.17		18	18	4000	60000	6.20	1.91	0.54
	LL		153.5	-27.2	33.9	13.4	-17.2										8-*25		
	EQ-X		-0.2	54.7	0.0	-59.7	0.0												
	EQ-Y		10.4	-0.1	50.6	0.0	-61.7												
	COMB	1	329.4	52.1	72.3														
11	DL		102.9	9.5	19.9	-4.8	-10.0	0.86	12.33	10.17	10.17		16	16	4000	60000	3.10	1.21	0.94
	LL		201.6	25.0	37.9	-12.5	-19.2										4-*25		
	EQ-X		-8.1	58.1	0.1	-60.9	0.0												
	EQ-Y		10.5	0.0	61.5	0.0	-73.6												
	COMB	1	428.8	49.1	81.3														
12	DL		38.5	1.0	18.1	-0.5	-9.1	0.85	12.33	10.17	10.17		16	16	4000	60000	3.10	1.21	0.82
	LL		81.8	8.9	34.2	-4.4	-17.3										4-*25		
	EQ-X		15.6	51.2	0.0	-58.4	0.0												
	EQ-Y		8.7	0.0	63.0	0.0	-81.4												
	COMB	15	56.8			0.0	92.8												

FORCES AND MOMENTS MULTIPLIED BY LOAD FACTORS FOR LOAD CASE COMBINATIONS ONLY

L O A D S U M M A R Y LEVEL 1

TOTAL MASS THIS LEVEL = 254.3 TONS

TOTAL MASS ALL LEVELS = 404.6 TONS

TOTAL FLOOR AREA THIS LEVEL = 3365.8 SQ.FT.

TOTAL V E R T I C A L LOADS	DL	LL (KIPS)
COLUMNS	809.2	1582.7
WALLS	0.0	0.0
TOTAL DOWN TO THIS LEVEL	809.2	1582.7

C O L U M N R E I N F O R C I N G S C H E D U L E PAGE 3

LEVEL 9	COL 1	COL 2	COL 3	COL 4	COL 5	COL 6	COL 7	COL 8
SIZE	16 X 16	18 X 18	20 X 20	20 X 20	16 X 16	16 X 16	18 X 18	
VERT.	4-* 8	8-* 7	8-* 8	8-* 9	4-* 9	8-* 8	12-* 7	
STEEL	2-A,	3-A,1-B	3-A,1-B	3-A,1-B	2-A,	3-A,1-B	4-A,2-B	
TIES	* 3 AT 16 S	* 3 AT 14 D	* 3 AT 16 D	* 3 AT 18 D	* 3 AT 16 S	* 3 AT 16 D	* 3 AT 14 D	
DWLS								

LEVEL 8	COL 1	COL 2	COL 3	COL 4	COL 5	COL 6	COL 7	COL 8
SIZE	16 X 16	18 X 18	20 X 20	22 X 22	16 X 16	18 X 18	20 X 20	
VERT.	4-* 8	12-* 7	12-* 8	8-* 9	8-* 8	8-* 7	8-* 8	
STEEL	2-A,	4-A,2-B	4-A,2-B	3-A,1-B	3-A,1-B	3-A,1-B	3-A,1-B	
TIES	* 3 AT 16 S	* 3 AT 14 D	* 3 AT 16 D	* 3 AT 18 D	* 3 AT 16 D	* 3 AT 14 D	* 3 AT 16 D	
DWLS								

LEVEL 7	COL 1	COL 2	COL 3	COL 4	COL 5	COL 6	COL 7	COL 8
SIZE	18 X 18	20 X 20	22 X 22	22 X 22	18 X 18	18 X 18	20 X 20	
VERT.	8-* 7	8-* 8	8-* 9	8-*10	8-* 7	12-* 7	12-* 8	
STEEL	3-A,1-B	3-A,1-B	3-A,1-B	3-A,1-B	3-A,1-B	4-A,2-B	4-A,2-B	
TIES	* 3 AT 14 D	* 3 AT 16 D	* 3 AT 18 D	* 4 AT 20 D	* 3 AT 14 D	* 3 AT 14 D	* 3 AT 16 D	
DWLS								

LEVEL 6	COL 1	COL 2	COL 3	COL 4	COL 5	COL 6	COL 7	COL 8
SIZE	18 X 18	20 X 20	22 X 22	24 X 24	18 X 18	20 X 20	22 X 22	
VERT.	8-* 7	8-* 9	12-* 9	8-* 9	8-* 8	8-* 8	8-* 9	
STEEL	3-A,1-B	3-A,1-B	4-A,2-B	3-A,1-B	3-A,1-B	3-A,1-B	3-A,1-B	
TIES	* 3 AT 14 D	* 3 AT 18 D	* 3 AT 18 D	* 3 AT 18 D	* 3 AT 16 D	* 3 AT 16 D	* 3 AT 18 D	

C O L U M N Q U A N T I T I E S

L E V E L 1 NUMBER OF C O L U M N S = 12

REINFORCING STEEL SIZE	MAIN BARS	TIES + SPIRALS	SUBTOTAL				
*10		0.174	0.174				
*15							
*20							
*25	1.093		1.093				
*30							
*35							
*45							
*55							
	1.093	0.174	1.267	TONS	AT $1200.00	$	1520.13
CONCRETE			10.18	CYD	AT $ 160.00	$	1628.20
FORMWORK			806.	SF	AT $ 11.00	$	8863.56
					T O T A L	$	12011.89

S U M M A R Y ALL LEVELS NUMBER OF C O L U M N S= 20

REINFORCING STEEL SIZE	MAIN BARS	TIES + SPIRALS	SUBTOTAL				
*10		0.272	0.272				
*15		0.024	0.024				
*20							
*25	1.418		1.418				
*30	0.273		0.273				
*35	0.130		0.130				
*45							
*55							
	1.821	0.295	2.116	TONS	AT $1200.00	$	2538.74
CONCRETE			16.89	CYD	AT $ 160.00	$	2702.17
FORMWORK			1340.	SF	AT $ 11.00	$	14742.44
					T O T A L	$	19983.35

```
LEVEL NO. -    8
                                                                                           PAGE  72
                                                                                                 FOR 1173 BEAM / SLAB TYPES
                    B E A M / S L A B     R E I N F O R C I N G     S C H E D U L E
------------------------------------------------------------------------------------------------------------------------
                 I    L O N G I T U D I N A L      R E I N F O R C I N G    I
B E A M / S L A BI--------------------------------------------------------------I    S T I R R UP S
                 I  A  I  B  I  B1  I  C  I  D  I  E  I  F  IG/H  LAYERSI
------------------------------------------------------------------------------------------------------------------------
    I    I   I   I      I      I      I      I      I      I      I      I     I S I    I                S - SINGLE
    I NO.I   I   INO.   INO.   INO.   INO.   INO.   INO.   INO.   INO.   ITOP  I I I    I                D - DOUBLE
MARK REQD  B I T I  SIZEI  SIZEI  SIZEI  SIZEI  SIZEI  SIZEI  SIZEI  SIZEI  BOTI Z IEND I NO. TYPE SPCG  T - TRIPLE
    I    I   I   I      I      I      I      I      I      I      I      I     I E I    I                Q - QUADRUPLE
------------------------------------------------------------------------------------------------------------------------

S 804  1  120  8.0 17-* 4                            18-* 5 12-* 5  4-* 5
               L=     273                               191    104     70

MIDDLE STRIPS

S 801  1  138  8.0 17-* 4                            12-* 5
               L=     291                                83

S 802  1  244  8.0 18-* 4                            22-* 5
               L=     273                               143

S 803  1  138  8.0 10-* 4                            21-* 5
               L=     291                               143

S 804  1  132  8.0 12-* 4                             9-* 5  9-* 5
               L=     273                               135     77

COLUMN STRIPS

S 901  1  141  8.0 18-* 4                            13-* 5         3-* 5
               L=     291                               106            70

B 902  1   16 28.0  7-* 7                            17-* 6                1  1 * 4 LEFT  6 S AT   8, 4 S AT   9, 3 S AT  12
               L=     270                               158                         RITE  5 S AT  10, 6 S AT  12,

S 903  1  141  8.0 16-* 4                            22-* 5
               L=     291                               184

S 904  1  132  8.0 20-* 4                            20-* 5 16-* 5  4-* 5
               L=     273                               191    107     70
```

B E A M / S L A B Q U A N T I T I E S AND C O S T S

L E V E L 8 NUMBER OF B E A M S / S L A B S = 36

REINFORCING STEEL

SIZE	MAIN BARS	STIRRUPS	SUBTOTAL
* 3		0.062	0.062
* 4	5.981	0.111	6.092
* 5	6.464		6.464
* 6	0.655		0.655
* 7	1.287		1.287
* 8			
* 9			
*10			
*11			
*14			
*18			
	14.387	0.173	14.559 TONS

CONCRETE 207.10 CU.YD.

FORMWORK 8582.6 SQ.FT.

Q U A N T I T I E S AND C O S T S

B E A M S

REINFORCING	1.00 TONS	AT $1200.00	$ 1203.42
CONCRETE	5.62 CU.YD.	AT $ 145.00	$ 815.25
FORMWORK	277.69 SQ.FT.	AT $ 11.00	$ 3054.64
			$ 5073.31

S L A B S

REINFORCING	13.56 TONS	AT $1200.00	$ 16267.86
CONCRETE	201.48 CU.YD.	AT $ 145.00	$ 29214.68
FORMWORK	8304.93 SQ.FT.	AT $ 9.00	$ 74744.41
			$ 120226.95

FORMWORK AND CONCRETE FOR DROP PANELS AND CANTILEVER SLABS
ARE INCLUDED IN THE ABOVE QUANTITIES

B E A M / S L A B Q U A N T I T I E S

S U M M A R Y ALL LEVELS NUMBER OF B E A M S / S L A B S = 579

REINFORCING STEEL

SIZE	MAIN BARS	STIRRUPS	SUBTOTAL	
* 3		1.290	1.290	
* 4	99.290	1.489	100.779	
* 5	97.527		97.527	
* 6	16.812		16.812	
* 7	10.587		10.587	
* 8	2.725		2.725	
* 9				
*10				
*11				
*14				
*18				
	226.941	2.779	229.719	TONS

CONCRETE 3313.26 CU.YD.

FORMWORK 137470.0 SQ.FT.

Q U A N T I T I E S AND C O S T S FOR ALL LEVELS

B E A M S

REINFORCING	16.40 TONS	AT $1200.00	$ 19684.10
CONCRETE	90.61 CU.YD.	AT $ 145.00	$ 13137.92
FORMWORK	4578.11 SQ.FT.	AT $ 11.00	$ 50359.21
			$ 83181.23

S L A B S

REINFORCING	213.32 TONS	AT $1200.00	$ 255979.06

CONCRETE	3222.65	CU.YD. AT $ 145.00	$ 467284.28
FORMWORK	132891.86	SQ.FT. AT $ 9.00	$1196026.75
			$ 1919290.12
T O T A L C O S T S FOR ALL LEVELS			$ 2002471.38

T O T A L C O N S T R U C T I O N C O S T S AND Q U A N T I T I E S

$$$

C O S T OF C O N S T R U C T I O N

$$$

B E A M S (67)

REINFORCING	16.40	TONS	AT $1200.00	$ 19,684.10
CONCRETE	90.61	CU.YD.	AT $ 145.00	$ 13,137.92
FORMWORK	4578.11	SQ.FT.	AT $ 11.00	$ 50,359.21
				$ 83,181.23

S L A B S (608)

REINFORCING	213.32	TONS	AT $1200.00	$ 255,979.06
CONCRETE	3222.65	CU.YD.	AT $ 145.00	$ 467,284.28
FORMWORK	132891.86	SQ.FT.	AT $ 9.00	$ 1,196,026.75
				$ 1,919,290.13

C O L U M N S (304)

REINFORCING	47.78	TONS	AT $1200.00	$ 57,339.90
CONCRETE	348.74	CU.YD.	AT $ 160.00	$ 55,798.19
FORMWORK	22540.00	SQ.FT.	AT $ 11.00	$ 247,940.00
				$ 361,078.09

S H E A R W A L L S (34)

REINFORCING	22.19	TONS	AT $1200.00	$ 26,628.19
CONCRETE	366.03	CU.YD.	AT $ 160.00	$ 58,565.59
FORMWORK	21187.66	SQ.FT.	AT $ 9.00	$ 190,688.95
				$ 275,882.72

```
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

S U M M A R Y   O F   C O S T S
--------------------------------
       REINFORCING                299.69 TONS   AT $1200.00   $    359,631.25

       CONCRETE                  4028.03 CU.YD. AT $ 147.66   $    594,786.00

       FORMWORK                181197.62 SQ.FT. AT $   9.30   $  1,685,014.88

       FLOOR FINISH            132926.22 SQ.FT. AT $   2.00   $    265,852.44
                                                            -----------------

                                            T O T A L      $   2,905,284.50

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

U N I T   C O S T   PER  SQ.FT.  OF  FLOOR AREA             $        21.86

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

REINFORCING STEEL  4.51 LBS/SQ.FT.
```

```
**********  DAYFILE   2005-10-25  **********

   CPU-SEC  TIME
       0.0  21:53:53  10 BEGIN
       1.0  21:53:54  11 INPUT
       1.0  21:53:54  12 EDIT
       1.0  21:53:54  20 CONCRETE BEAMS
       1.0  21:53:54  40 CONCRETE COLUMNS
       2.0  21:53:55  60 FRAME CONSTANTS
       2.0  21:53:55  62 COORDINATES
       2.0  21:53:55  64 ITERATION
       2.0  21:53:55  CONSTR. SIMULATION
       2.0  21:53:55   LEVEL ADDED      1
       2.0  21:53:55   LEVEL ADDED      2
       2.0  21:53:55   LEVEL ADDED      3
       2.0  21:53:55   LEVEL ADDED      4
       2.0  21:53:55   LEVEL ADDED      5
       2.0  21:53:55   LEVEL ADDED      6
       2.0  21:53:55   LEVEL ADDED      7
       2.0  21:53:55   LEVEL ADDED      8
       2.0  21:53:55   LEVEL ADDED      9
       2.0  21:53:55   LEVEL ADDED     10
       2.0  21:53:55   LEVEL ADDED     11
       2.0  21:53:55   LEVEL ADDED     12
       2.0  21:53:55   LEVEL ADDED     13
       2.0  21:53:55   LEVEL ADDED     14
       2.0  21:53:55   LEVEL ADDED     15
       2.0  21:53:55   LEVEL ADDED     16
       2.0  21:53:55   LEVEL ADDED     17
       2.0  21:53:55    DL         0
       2.0  21:53:55    LL-Z       0
       3.0  21:53:56    EQ-X       0
       3.0  21:53:56    EQ-Y       0
       3.0  21:53:56  20 CONCRETE BEAMS
       4.0  21:53:57  40 CONCRETE COLUMNS
       5.0  21:53:58  60 FRAME CONSTANTS
       5.0  21:53:58  62 COORDINATES
       5.0  21:53:58  64 ITERATION
       5.0  21:53:58  CONSTR. SIMULATION
       5.0  21:53:58   LEVEL ADDED      1
       5.0  21:53:58   LEVEL ADDED      2
       5.0  21:53:58   LEVEL ADDED      3
       5.0  21:53:58   LEVEL ADDED      4
       5.0  21:53:58   LEVEL ADDED      5
       5.0  21:53:58   LEVEL ADDED      6
       5.0  21:53:58   LEVEL ADDED      7
```

```
5.0  21:53:58   LEVEL ADDED      8
5.0  21:53:58   LEVEL ADDED      9
5.0  21:53:58   LEVEL ADDED     10
5.0  21:53:58   LEVEL ADDED     11
5.0  21:53:58   LEVEL ADDED     12
5.0  21:53:58   LEVEL ADDED     13
6.0  21:53:59   LEVEL ADDED     14
6.0  21:53:59   LEVEL ADDED     15
6.0  21:53:59   LEVEL ADDED     16
6.0  21:53:59   LEVEL ADDED     17
6.0  21:53:59    DL         0
6.0  21:53:59    LL-Z       0
6.0  21:53:59    EQ-X       0
7.0  21:54:00    EQ-Y       0
7.0  21:54:00  20 CONCRETE BEAMS
7.0  21:54:00  40 CONCRETE COLUMNS
8.0  21:54:01  70 OUTPUT
8.0  21:54:01  71 BEAM OUTPUT
9.0  21:54:02   END OF JOB
```