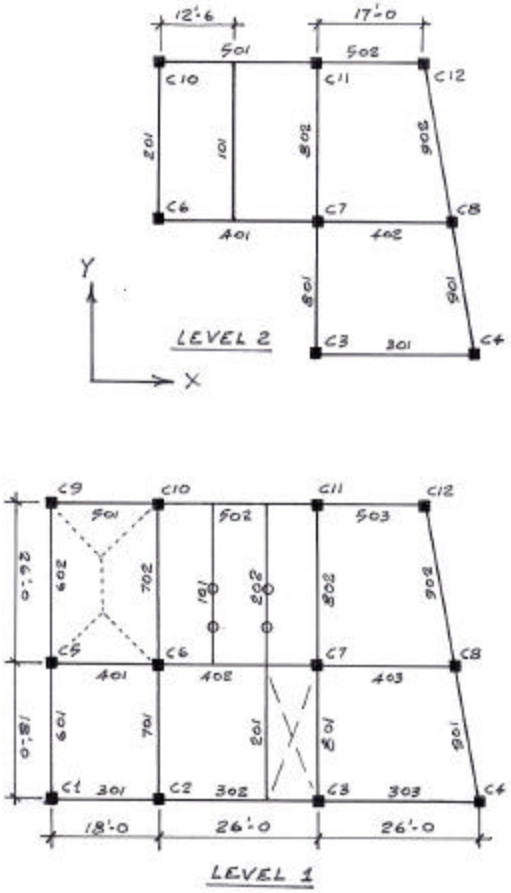
DESIGN OF A TWO-LEVEL CONCRETE STRUCTURE

1. Description of Structure and Loading Parameters

This two level concrete structure is located at the feed end of a kiln in a cement manufacturing plant. The nominal measurements were: 70’ by 45’ and 25’ in height, comprising of slabs, beams and columns – for a visual reference of the framing see to Fig. A. below:



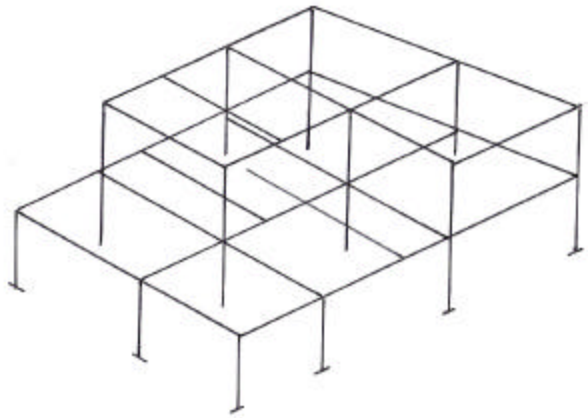


Fig. A

The live loads on both floors are fairly heavy: on the second level they are 350 psf and on the first, 275 psf. In addition, on the first-level beams 101 and 202 there are four point loads of 12 kips each, indicated by (o). On the LEVEL 1 floor plan, the dotted lines on the left side illustrate typical floor load distribution to the beams. The structure is also subjected to earthquake forces in accordance with the National Building Code of Canada, for V= .15, R=5 and 50% of the live load to be included in the mass for seismic consideration.

The simple input commands for AMECO to design the structure are shown in Fig. B. It took two hours to prepare this input. Member sizes did not have to be given, loads did not have to be manually calculated; nor did any load cases or combinations have to be specified. To enable AMECO-17 to design the structure, only loading parameters, member connectivities and member spans were required to be entered.

If you wish to familiarize yourself with the basics of the AMECO input language, it would be helpful to read the next section. Otherwise, proceed to section 3.

2. Input Commands – see Fig. B

The fifth line: USE CODE NBC-95 LSD invokes the National Building of Canada and the LSD design method. LIST ALL requests the listing of all design result tables. The next command serves to suppress the listing of envelopes – see also level 1 input, where they are actually required. Then the input for level 2 is entered, followed by level 1. All data is given in English units.

LEVEL 2 **Fig. B**

DESIGN BEAMS requests beam size selection. USE SLAB 9, FLL 350, SPAN 26 specifies slab 9" thick, floor live load 350 psf and beam spans 26'. Beam marks are prefixed with the letter B, columns with a C. Thus, B401 12-6 101 means that beam 401 supports at 12'-6" the left end of beam 101.

DESIGN COLS SQ 16 requests size selection starting with 16"; the length of the column is indicated by L 12-4 and defines the storey height. Unless indicated otherwise, this value will be used automatically for LEVEL 1 as well. ANALYSE COLS requires the input of column sizes. C3 to 4 301 801 means that columns 3 to 4 support in X-direction B301 and in Y-direction left ends of B801, B901.

LEVEL 1

Similarly, specific commands are used to incorporate design criteria; on the second line: B101 LL 2(L 6 p12) applies Live Load and two Point loads of 12 kips at 6' spacing.

```
PROJECT LTZK
STRUCTURE- KILN FEED
CLIENT-  MIRON FRERE LTD
$
USE CODE NBC-95, LSD
LIST ALL
SUPPRESS LIST ENVELOPES
$
LEVEL 2
DESIGN BEAMS
USE SLAB 9,FLL 350,FL PROJ 18,SPAN 26
B101, B201 B301
B401 12-6 101 B402 23-6
B501 12-6 101R  B502 16
B801 16 B802 TO 902
DESIGN COLS SQ 16, L 12-4
C3 TO 4 301 801
C6 TO 8 401 201 802
C10 TO 12 501 201R 802R
$
LEVEL 1
DESIGN BEAMS, FLL 275
B101 LL 2(L 6 P 12)
B201 18 OP NS, B202 LL 2(L 6 P 12)
B301 18 B302 16-0 201 B303
LIST ENVELOPES AT 10 SECTIONS
B401 18 B402 8 101 8 202 B403 23-6
B501 18 B502 8 101R 8 202R B503 16
B601 18 B602 TO 902
DESIGN COLUMNS
C1 TO 4 301 601 C5 TO 8 401 602
C9 TO 12 501 602R
COMPUTE TORSION NBC
COMPUTE EQ FORCES NBC V.15 R 5 MF.5
EXECUTE
```

LIST ENVELOPES AT 10 SECTIONS for beams requests: dead, live and critical moment, shear and steel area listing at 10 sections per span.
COMPUTE EQ FORCES NBC V 0.15 R 5 MF 0.5 invokes seismic force application in X and Y directions.

3. Analysis and Design Process

Based on the input commands of Fig. B, AMECO-17 generates the geometry in 3-D, initializes member sizes, models finite joints, calculates floor dead and live loads on each member, calculates seismic forces, sets up loading cases and combinations and through a cyclical analysis/design process determines an optimal design for the complete structure - see Fig. C. This structure was designed in six man-hours - from the input preparation to the review of design results. The AMECO-17 design execution time was a fraction of a second.

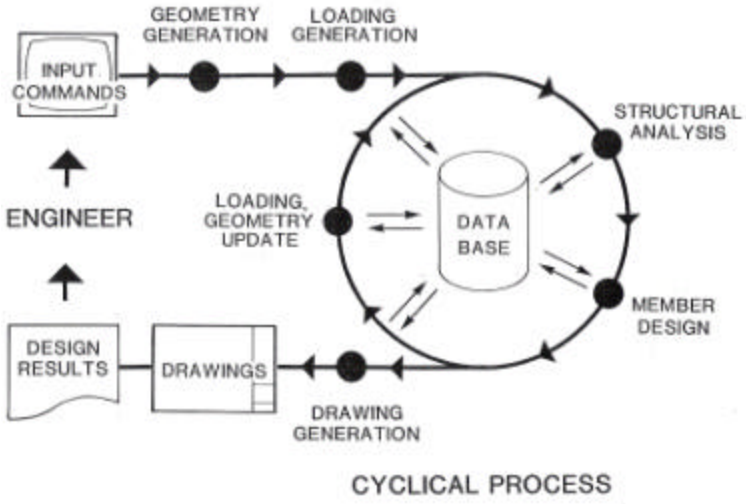


Fig. C
AMECO-17 cyclical process

4. Analysis and Design Results

In this section representative pages are displayed out of the total of 76 Design Result pages. This design was done in English units, therefore all member forces and moments are ft–kip units; member cross-section dimensions and displacements in inches; SI series reinforcing bars made in Canada are used, as per the NBC code.

The following results are listed level by level, starting from the top level.

Principal Design Parameters

Frame Analysis results for earthquake in X- direction

Column Design Tables

Column Reinforcing Schedules

Column Quantities and Costs

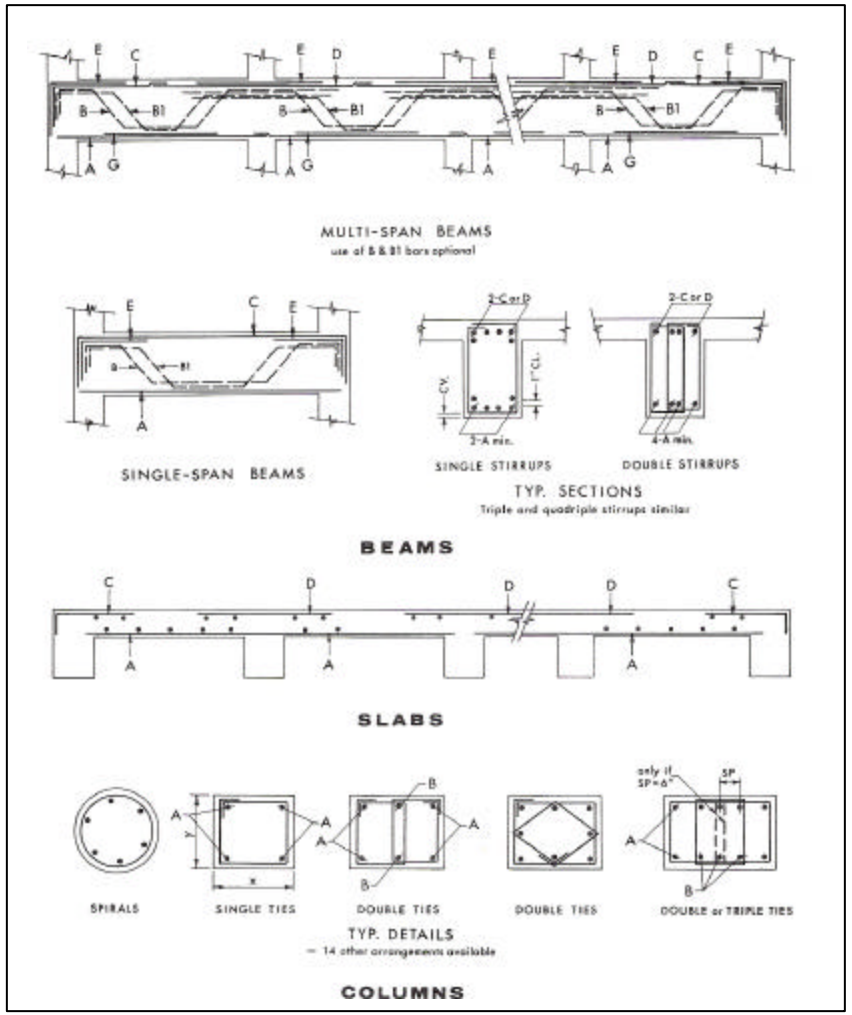
Beam Moment, Shear and Steel Envelopes

Beam Reinforcing Schedules

Construction Costs Summary

Dayfile – execution time.

Use the diagrams on the right to interpret the reinforcing schedules for beams and columns listed in the Design Results tables



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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 ..... NBC -95

MEMBER DESIGN METHOD ..... LSD

NONLINEAR ANALYSIS ..... PERFORMED

CONSTRUCTION SIMULATION ..... PERFORMED

FINITE JOINTS ..... CONSIDERED

MEMBER CRACKING ..... CONSIDERED

LIVE LOAD REDUCTION ..... NBC - HUMAN

LOAD FACTORS 1.25 1.50 1.05 1.25 1.50

****

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

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

****

F R A M E A N A L Y S I S R E S U L T S - DESIGN CYCLE 3

B A S E S H E A R COMPUTATIONS BY 'NBC' CODE FOR LOAD CASE 'EQ-X'

V = 0.2000
S = 1.1055
F = 1.0000
I = 1.0000
R = 4.0000
T = 1.8411
U = .6000
V/RUSIF = 0.0332

W = 595.6 TONS
FORCE V = 39.5 KIPS

F R A M E A N A L Y S I S R E S U L T S - DESIGN CYCLE 3

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

LEVEL 4 MASS= 11.8 TONS

BEAM/SLAB	MOMENTS		FORCES	
	LEFT	RIGHT	SHEAR	AXIAL
101	7.15	-7.44	0.81	0.23

COLUMN	MOMENTS		FORCES		VERTICAL	HORIZONTAL	JOINT
	TOP	BOT	SHEAR	AXIAL	DISPL	JOINT LOADS	ROTATIONS
1	7.14	-6.54	1.09	-1.11	-0.016	1.32	0.14
2	7.45	-11.92	1.55	1.12	0.004	1.32	0.16

TOTAL SHEAR = 2.64

LEVEL 3 MASS= 77.0 TONS

BEAM/SLAB	MOMENTS		FORCES	
	LEFT	RIGHT	SHEAR	AXIAL
101	21.21	-19.12	2.24	1.31
102	16.78	-15.46	1.79	1.83
103	16.12	-18.87	1.94	0.14

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

1	14.59	-10.88	1.70	-3.73	-0.015	1.91	0.15
2	23.90	-20.21	2.94	1.97	0.004	1.91	0.11
3	31.65	-22.38	3.60	-0.16	-0.001	1.91	0.08
4	19.01	-11.84	2.06	1.87	0.010	1.91	0.13

TOTAL SHEAR = 10.30

LEVEL 2

MASS= 77.1 TONS

BEAM/SLAB	MOMENTS		FORCES	
	LEFT	RIGHT	SHEAR	AXIAL
101	29.57	-27.43	3.17	0.46
102	27.75	-29.42	3.18	-0.03
103	32.44	-34.01	3.69	-0.41

COLUMN	MOMENTS		FORCES		VERTICAL	HORIZONTAL	JOINT
	TOP	BOT	SHEAR	AXIAL	DISPL	JOINT LOADS	ROTATIONS
1	18.63	-17.63	2.42	-7.39	-0.013	1.18	0.19
2	34.93	-34.11	4.60	1.96	0.002	1.18	0.15
3	39.49	-37.94	5.16	-0.68	-0.001	1.18	0.18
4	22.23	-20.05	2.82	5.46	0.009	1.18	0.21

F R A M E A N A L Y S I S R E S U L T S - DESIGN CYCLE 3

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

TOTAL SHEAR = 15.00

LEVEL 1

MASS= 77.1 TONS

BEAM/SLAB	MOMENTS		FORCES	
	LEFT	RIGHT	SHEAR	AXIAL
101	31.17	-28.92	3.34	-0.10
102	28.92	-30.68	3.31	0.85
103	34.21	-35.97	3.90	1.05

COLUMN	MOMENTS		FORCES		VERTICAL	HORIZONTAL	JOINT
	TOP	BOT	SHEAR	AXIAL	DISPL	JOINT LOADS	ROTATIONS
1	13.49	-33.64	3.14	-11.31	-0.009	0.63	0.20
2	23.67	-40.53	4.28	1.99	0.002	0.63	0.16
3	26.91	-56.84	5.58	-1.28	-0.001	0.63	0.19
4	15.89	-51.59	4.50	9.11	0.007	0.63	0.22

TOTAL SHEAR = 17.50

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

LEVEL	FORCE APPLIED	STOREY HEIGHT	DRIFT TOTAL	DRIFT INTERSTORY	MAX. AMPLIF. DUE TO TORQUE
4	9.10	12.50	2.101	0.370	1.058 AT C 9
3	15.19	15.00	1.730	0.591	1.010 AT C 9
2	10.14	15.00	1.139	0.662	1.012 AT C 8
1	5.07	15.00	0.477	0.477	1.009 AT C 10

TOTAL HORIZONTAL FORCES APPLIED = 39.51
TOTAL BASE SHEAR DEVELOPED = 44.91

ALLOWABLE DRIFT H/ 250

********** NATURAL PERIOD OF VIBRATION IN X DIRECTION 1.863 SECONDS

EQ-X FRAME ANALYSIS COMPUTATION TIMES IN CPU-SEC

FRAME CONSTANTS	0.00
JOINT DISPLACEMENTS (RELAXATION)	0.00
MEMBER FORCES AND MOMENTS	0.00

ITERATION COUNTS

ROTATION	26
VERTICAL DISPLACEMENT	4
HORIZONTAL DISPLACEMENT	19
X-Y PLANE SWAPPING	1

F R A M E A N A L Y S I S R E S U L T S - DESIGN CYCLE 3

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

V = 0.2000
S = 2.0874
F = 1.0000

I = 1.0000
R = 2.0000
T = 0.5164
U = .6000
V/RUSIF = 0.1252

W = 595.6 TONS
FORCE V = 149.2 KIPS

FRAME Y- 4 LOADING CASE - LATERAL EQ-Y IN Y DIRECTION

LEVEL 3 MASS= 27.5 TONS

BEAM/SLAB	MOMENTS		FORCES	
	LEFT	RIGHT	SHEAR	AXIAL
701	0.00	0.00	0.00	0.00

BRACING	FORCES		HORIZONTAL	LENGTH	
	LEFT BR	RIGHT BR	SHEAR	LEFT BR	RIGHT BR
701	26.89	-26.88	44.43	26.63	26.63

COLUMN	MOMENTS		FORCES		VERTICAL	HORIZONTAL	JOINT
	TOP	BOT	SHEAR	AXIAL	DISPL	JOINT LOADS	ROTATIONS
4	0.01	-0.20	0.01	-14.38	-0.099	22.23	0.08
8	0.01	-0.20	0.01	14.45	0.100	22.23	0.08

TOTAL SHEAR = 44.46

LEVEL 2 MASS= 28.1 TONS

BEAM/SLAB	MOMENTS		FORCES	
	LEFT	RIGHT	SHEAR	AXIAL
701	0.00	0.00	0.00	-0.02

BRACING	FORCES		HORIZONTAL	LENGTH	
	LEFT BR	RIGHT BR	SHEAR	LEFT BR	RIGHT BR
701	37.20	-37.17	61.44	26.63	26.63

COLUMN	MOMENTS		FORCES		VERTICAL	HORIZONTAL	JOINT
	TOP	BOT	SHEAR	AXIAL	DISPL	JOINT LOADS	ROTATIONS
4	-0.21	0.49	-0.05	-51.14	-0.092	8.45	0.07
8	-0.21	0.49	-0.05	51.37	0.092	8.45	0.07

TOTAL SHEAR = 61.35

LEVEL 1

MASS= 28.2 TONS

BEAM/SLAB	MOMENTS		FORCES	
	LEFT	RIGHT	SHEAR	AXIAL
701	0.00	0.00	0.00	-0.03

BRACING	FORCES		HORIZONTAL	LENGTH	
	LEFT BR	RIGHT BR	SHEAR	LEFT BR	RIGHT BR
701	40.42	-40.37	66.75	26.63	26.63

COLUMN	MOMENTS		FORCES		VERTICAL	HORIZONTAL	JOINT
	TOP	BOT	SHEAR	AXIAL	DISPL	JOINT LOADS	ROTATIONS
4	0.50	-3.48	0.27	-94.90	-0.073	2.97	0.08
8	0.50	-3.48	0.27	95.22	0.073	2.97	0.08

TOTAL SHEAR = 67.28

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

LEVEL	FORCE APPLIED	STOREY HEIGHT	DRIFT TOTAL	DRIFT INTERSTORY	MAX. AMPLIF. DUE TO TORQUE
4	22.16	12.50	0.611	0.084	1.017 AT C 2
3	63.47	15.00	0.527	0.200	1.013 AT C 4
2	42.38	15.00	0.327	0.182	1.070 AT C 4
1	21.18	15.00	0.145	0.145	1.082 AT C 4

TOTAL HORIZONTAL FORCES APPLIED = 149.19
TOTAL BASE SHEAR DEVELOPED = 150.90

ALLOWABLE DRIFT H/ 250

********** NATURAL PERIOD OF VIBRATION IN Y DIRECTION 0.535 SECONDS

EQ-Y FRAME ANALYSIS COMPUTATION TIMES IN CPU-SEC

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 1

LEVEL	2	COL 1	COL 2	COL 3	COL 4	COL 5	COL 6	COL 7	COL 8
SIZE				16 X 16	16 X 16		16 X 16	16 X 16	16 X 16
VERT. STEEL				4-*30 2-A,	4-*30 2-A,		4-*35 2-A,	4-*25 2-A,	4-*25 2-A,
TIES DWLS				*10 AT 16 S	*10 AT 16 S		*15 AT 16 S	*10 AT 15 S	*10 AT 15 S
LEVEL	1								
SIZE		16 X 16	16 X 16	16 X 16	16 X 16	16 X 16	16 X 16	18 X 18	16 X 16
VERT. STEEL		4-*25 2-A,	4-*25 2-A,	4-*25 2-A,	4-*25 2-A,	4-*25 2-A,	4-*25 2-A,	8-*25 3-A,1-B	4-*25 2-A,
TIES DWLS		*10 AT 15 S	*10 AT 15 S	*10 AT 15 S	*10 AT 15 S	*10 AT 15 S	*10 AT 15 S	*10 AT 15 D	*10 AT 15 S
FNDN"S	0								

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 2

LEVEL	2	COL 9	COL 10	COL 11	COL 12
SIZE			18 X 18	16 X 16	16 X 16
VERT. STEEL			8-*25 3-A,1-B	4-*30 2-A,	4-*25 2-A,
TIES DWLS			*10 AT 15 D	*10 AT 16 S	*10 AT 15 S
LEVEL	1				

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

B E A M / S L A B E N V E L O P E S

LEVEL NO. - 1

G E N E R A L N O T E S

1. ALL MOMENTS AND FORCES ARE MULTIPLIED BY LOAD FACTORS

2. DEFLECTIONS ARE COMPUTED FOR SERVICE LOADS
   AND INCLUDE CONCRETE CRACKING EFFECTS

3. DEAD LOAD DEFLECTIONS INCLUDE LONG TIME EFFECTS

4. FOR EXPLANATION OF CRITICAL LOADING COMBINATION NUMBERS
   SEE NOTES AT END OF ENVELOPE LISTING.

MEMBER DIMENSIONS	SEC.	DEAD LOAD MOMENT	DEAD LOAD SHEAR	DEAD + LIVE LOAD MOMENT NEG.	DEAD + LIVE LOAD MOMENT POS.	DEAD + LIVE LOAD SHEAR	CRITICAL LOADING COMBINATION MOMENT NEG.		MOMENT POS.		SHEAR		STEEL TOP	STEEL BOT	STIR SPCG	SHEAR STRESS
		FORCE									FORCE					
BEAM 401	LEFT	-4.9	-2.8	-30.8	-30.8	8.8	-79.2	5	69.3	4	-11.3	4	1.57	1.57	18.00	24.0
	0.10	8.0	-2.8	-13.8	37.4	8.8	-50.9	5	69.8	6	-11.3	4	1.57	1.57	18.00	24.0
	0.20	17.8	-2.8	-41.5	100.6	8.8	-54.2	7	106.3	6	-11.3	4	1.57	1.57	18.00	24.0
SPAN 18.00	0.30	22.7	-2.8	-74.2	149.3	8.8	-74.2	1	149.3	1	-11.3	4	1.57	1.57	18.00	24.0
WIDTH 16.0	0.40	21.1	-2.8	-113.5	177.0	8.8	-113.5	1	177.0	1	-11.3	4	1.57	1.57	18.00	24.0
DEPTH 32.0	0.50	11.3	-7.8	-161.0	177.2	-32.6	-161.0	1	177.2	1	-32.6	1	1.57	1.57	18.00	69.1
FLG W 54.0	0.60	-7.8	-12.7	-217.9	145.7	-49.6	-217.9	1	145.7	1	-49.6	1	1.83	1.57	14.00	105.1
FLG T 9.0	0.70	-35.0	-15.0	-283.1	86.7	-52.9	-283.1	1	86.7	1	-52.9	1	2.42	1.57	14.00	112.1
	0.80	-68.8	-15.0	-354.8	6.8	-52.9	-354.8	1	18.1	7	-52.9	1	3.10	1.57	14.00	112.1
	0.90	-107.4	-15.0	-462.2	-87.7	-52.9	-462.2	1	0.0	0	-52.9	1	4.17		14.00	112.1
	RITE	-136.5	-15.0	-564.0	-162.1	-52.9	-564.0	1	0.0	0	-52.9	1	5.27		14.00	112.1

LLR=1.00 LTDF=1.65 DEFL=-0.01 (L/9999) DEFL= 0.10 (L/2229) LL DEFL= 0.11 (L/1990)

****** MESSAGE D-8 PROVIDE ANCHORAGE OF BOTTOM STEEL INTO SUPPORTS. ******

BEAM 402	LEFT	-163.6	34.2	-576.6	-520.0	125.7	-576.6	1	0.0	0	125.7	1	5.41		5.64	266.3
	0.10	-79.0	34.2	-280.6	-225.6	125.7	-280.6	1	0.0	0	125.7	1	2.40		5.64	266.3
	0.20	14.4	34.0	-33.3	105.4	125.1	-49.7	7	108.7	6	125.1	1	1.57	1.57	5.68	265.1
SPAN 26.00	0.30	95.0	24.2	38.3	398.5	89.6	0.0	0	398.5	1	89.6	1		3.24	10.01	189.8
WIDTH 16.0	0.40	134.0	11.1	68.4	530.0	39.8	0.0	0	530.0	1	39.8	1		4.33	14.00	84.4
DEPTH 32.0	0.50	157.2	7.1	82.7	610.8	19.6	0.0	0	610.8	1	20.3	7		5.02	18.00	42.9

I FLG W	78.0	I 0.60	168.0	-6.7	84.5	656.7	-25.8	0.0	0	656.7	1	-25.8	1		5.40	6.59	54.7	
I FLG T	9.0	I 0.70	96.2	-36.0	3.8	419.8	-125.7	0.0	0	419.8	1	-125.7	1		3.42	5.64	266.3	
I		I 0.80	-2.2	-39.7	-103.6	98.0	-135.4	-111.1	6	105.8	7	-135.4	1	1.57	1.57	5.05	286.9	
I		I 0.90	-111.7	-39.7	-370.0	-253.6	-135.4	-370.0	1	0.0	0	-135.4	1	3.24		5.05	286.9	
I		I RITE	-203.3	-39.7	-672.7	-554.0	-135.4	-672.7	1	0.0	0	-135.4	1	6.57		5.05	286.9	

LLR=0.81 LTDF=1.71 DEFL= 0.22 (L/1428) DEFL= 0.66 (L/ 470) LL DEFL= 0.44 (L/ 701)

I BEAM	403	I LEFT	-183.4	23.0	-658.9	-336.4	78.3	-658.9	1	0.0	0	78.3	1	6.39		13.19	166.0	
I		I 0.10	-129.1	23.0	-481.7	-186.6	78.3	-481.7	1	0.0	0	78.3	1	4.38		13.19	166.0	
I----------		I 0.20	-61.8	23.0	-305.8	0.2	78.3	-305.8	1	28.7	6	78.3	1	2.63	1.57	13.19	166.0	
I SPAN	23.50	I 0.30	-4.4	21.5	-214.0	157.1	73.6	-214.0	1	157.1	1	73.6	1	1.80	1.57	14.00	155.8	
I WIDTH	16.0	I 0.40	39.3	14.9	-136.1	270.5	52.3	-136.1	1	270.5	1	52.3	1	1.57	2.19	14.00	110.7	
I DEPTH	32.0	I 0.50	66.2	7.3	-75.0	328.7	11.3	-75.0	1	328.7	1	17.5	5	1.57	2.67	18.00	37.1	
I FLG W	70.5	I 0.60	74.8	-0.3	-32.2	326.4	-13.9	-32.2	1	326.4	1	-17.0	6	1.57	2.65	18.00	35.9	
I FLG T	9.0	I 0.70	66.7	-6.8	-6.3	268.9	-35.2	-21.3	6	268.9	1	-35.2	1	1.57	2.17	18.00	74.6	
I		I 0.80	44.9	-6.9	5.8	167.9	-35.4	-36.1	6	184.6	7	-35.4	1	1.57	1.57	18.00	75.1	
I		I 0.90	13.1	-6.9	7.8	37.0	-35.4	-87.5	4	113.6	5	-35.4	1	1.57	1.57	18.00	75.1	
I		I RITE	-23.5	-6.9	-101.3	-101.3	-35.4	-165.1	6	101.0	5	-35.4	1	1.57	1.57	18.00	75.1	

LLR=0.93 LTDF=1.65 DEFL= 0.08 (L/3459) DEFL= 0.33 (L/ 846) LL DEFL= 0.25 (L/1121)

****** MESSAGE D-8 PROVIDE ANCHORAGE OF BOTTOM STEEL INTO SUPPORTS. ******

LOAD COMBINATION 4 DL + WL/EQ

LOAD COMBINATION 5 DL - WL/EQ

LOAD COMBINATION 6 DL + LL(V) + WL/EQ

LOAD COMBINATION 7 DL + LL(V) - WL/EQ

LEVEL NO. - 2

FOR 31 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

BEAM/SLAB	I	LONGITUDINAL REINFORCING I										STIRRUPS								
	I	A I	B I	B1 I	C I	D I	E I	F	IG/H	LAYERSI										
MARK REQD	B I T I	SIZEI	SIZEI	SIZEI	SIZEI	SIZEI	SIZEI	SIZEI	SIZEI	BOTI	Z IEND I	NO.	TYPE	SPCG						
	I NO.I	INO.	INO.	INO.	INO.	INO.	INO.	INO.	INO.	ITOP	I I I									
	I I I	I	I	I	I	I	I	I	I	I	I E I									
B 101	1 12 22.0	12-*25			2-*15		1-*15	1-*15		1	3 *10	LEFT	10	S AT	5, 7	S AT	6, 7	S AT	9	
	L=	309			342		126	126				RITE	10	S AT	5, 7	S AT	6, 7	S AT	9	
B 201	1 12 20.0	5-*25			2-*15		3-*25	3-*25		1	2 *10	LEFT	17	S AT	8, 1	S AT	11,			
	L=	308			343		127	127				RITE	17	S AT	8, 1	S AT	11,			
B 301	1 12 22.0	6-*25			2-*15		2-*25	2-*25		1	2 *10	LEFT	15	S AT	9, 1	S AT	13,			
	L=	308			343		127	127				RITE	15	S AT	9, 1	S AT	13,			
B 401	1 16 30.0	3-*30			2-*25				2-*30	1	1 *10	LEFT	12	S AT	13,					
	L=	332			178				260			RITE	8	S AT	8, 5	S AT	9, 4	S AT	13	
B 402	1 16 30.0	3-*30			2-*20	2-*25	5-*30	1-*25	1-*30	1	1 *10	LEFT	11	S AT	8, 4	S AT	12,			
	L=	302			163	309	164	93	230			RITE	10	S AT	13,					
B 501	1 14 28.0	3-*30			2-*20		1-*25		2-*30	1	2 *10	LEFT	13	S AT	12,					
	L=	332			178		101		260			RITE	12	S AT	8, 5	S AT	11,			
B 502	1 14 28.0	2-*25			2-*20	2-*25	3-*30	1-*20		1	1 *10	LEFT	8	S AT	12,					
	L=	212			118	264	164	71				RITE	2	S AT	12,	4	S AT	14,		
B 801	1 16 28.0	2-*25			2-*25					1	1 *10	LEFT	5	S AT	17,					
	L=	212			118							RITE	5	S AT	17,					
B 802	1 16 28.0	4-*30			2-*20	2-*20	4-*30	1-*25	1-*30	1	1 *10	LEFT	15	S AT	6, 6	S AT	11,			
	L=	332			178	264	164	101	260			RITE	12	S AT	12,					
B 901	1 14 26.0	2-*25			2-*25					1	1 *10	LEFT	2	S AT	11,	4	S AT	14,		

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             L=     212                 118                                    RITE 10 S AT  11,

B 902  1   14 26.0  3-*30              2-*20  2-*20  3-*30  1-*20  1-*25  1  1 *10 LEFT  7 S AT   9, 5 S AT  10, 4 S AT  11
             L=     332                 178    264    164    101    260          RITE 13 S AT  11,


LEVEL NO. -    1
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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

B E A M / S L A B MARK	REQD	B	I	T	I	LONGITUDINAL REINFORCING A SIZE	B SIZE	B1 SIZE	C SIZE	D SIZE	E SIZE	F SIZE	IG/H SIZE	LAYERS BOT	I	Z	I	END I	STIRRUPS NO.	TYPE	SPCG	S - SINGLE D - DOUBLE T - TRIPLE Q - QUADRUPLE
B 101	1	12	20.0	10-*25		2-*15			1-*25	1-*15			1	2	*10	LEFT	11	S AT	5, 8	S AT	6, 6	S AT 8
	L=	309				342			126	126						RITE	19	S AT	8,			
B 201	1	14	26.0	2-*30		2-*25							1	1	*10	LEFT	2	S AT	11,	5 S AT	14,	
	L=	213				128										RITE	10	S AT	11,			
B 202	1	14	26.0	3-*30		2-*20	2-*25	4-*30	1-*20	1-*30			1	1	*10	LEFT	9	S AT	7, 6	S AT	9, 3	S AT 11
	L=	309				176	277	165	99	261						RITE	11	S AT	11, 2	S AT	14,	
B 301	1	14	24.0	2-*25		2-*25							1	1	*10	LEFT	2	S AT	10, 5	S AT	14,	
	L=	236				130										RITE	10	S AT	10,			
B 302	1	14	24.0	2-*30			2-*25	2-*25		1-*20			1	1	*10	LEFT	12	S AT	10, 2	S AT	14,	
	L=	308					276	164		260						RITE	14	S AT	10,			
B 303	1	14	24.0	2-*30		2-*20	2-*25	3-*30	1-*30	1-*25			1	1	*10	LEFT	14	S AT	10,			
	L=	332				178	324	164	101	260						RITE	11	S AT	10, 2	S AT	14,	
B 401	1	16	32.0	2-*30		2-*30							1	1	*10	LEFT	2	S AT	14, 6	S AT	12,	
	L=	236				130										RITE	8	S AT	14,			
B 402	1	16	32.0	2-*30			2-*20	5-*30		3-*30			1	1	*10	LEFT	18	S AT	5, 6	S AT	11,	
	L=	307					276	164		259						RITE	20	S AT	5, 8	S AT	6,	

LTZKSEPARVD_COSTS.RES

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

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

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

B E A M S  (  31)
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       REINFORCING                 8.81 TONS   AT $1200.00   $     10,575.65

       CONCRETE                   61.39 CU.YD. AT $ 145.00   $      8,901.17

       FORMWORK                 2606.19 SQ.FT. AT $  11.00   $     28,668.14
                                                            ----------------
                                                            $      48,144.96

C O L U M N S  (  20)
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       REINFORCING                 2.12 TONS   AT $1200.00   $      2,538.74

       CONCRETE                   16.89 CU.YD. AT $ 160.00   $      2,702.17

       FORMWORK                 1340.22 SQ.FT. AT $  11.00   $     14,742.44
                                                            ----------------
                                                            $      19,983.35

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

S U M M A R Y   O F   C O S T S
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       REINFORCING                10.93 TONS   AT $1200.00   $     13,114.40

       CONCRETE                   78.28 CU.YD. AT $ 148.24   $     11,603.33

       FORMWORK                 3946.42 SQ.FT. AT $  11.00   $     43,410.59

       FLOOR FINISH             5334.71 SQ.FT. AT $   2.00   $     10,669.42
                                                            -----------------

                                            T O T A L       $      78,797.73

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

U N I T   C O S T   PER  SQ.FT.  OF  FLOOR AREA              $         14.77

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