

OGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OJECT : National Museum - Amman  
 FRAME : Stair on AxisLines X7-X8/Y05-Y06 (Flight 1)  
 DATE : February 23, 2000

Page 388

# BEAM DESIGN FOR FLEXURE

fcu= 25MPa fy= 420MPa

CODE: BS8110

|          |         | b<br>(mm) | h<br>(mm)  | c<br>(mm)   | d'<br>(mm) |      |          |           |                          |                           | hf= 0 mm(Rectangular) |   |
|----------|---------|-----------|------------|-------------|------------|------|----------|-----------|--------------------------|---------------------------|-----------------------|---|
| (1) Str1 |         | 1000      | 300        | 35          | 40         | mm   |          |           |                          |                           |                       |   |
| MARK     | pos.    | d<br>(mm) | bf<br>(mm) | M<br>(kN.m) | R<br>(MPa) | x/d  | p<br>(%) | p'<br>(%) | As<br>(mm <sup>2</sup> ) | As'<br>(mm <sup>2</sup> ) |                       |   |
|          | L supp  | 260       | 1000       | 0.0         | 0.00       | 0.00 | 0.16     | 0.00      | *                        | 429                       |                       | 0 |
|          | L sup F | 260       | 1000       | +5.3        | 0.08       | 0.01 | 0.16     | 0.00      | *                        | 429                       |                       | 0 |
| (1) Str1 | span    | 265       | 1000       | +214.1      | 3.05       | 0.36 | 1.00     | 0.00      |                          | 2643                      |                       | 0 |
|          | R sup F | 260       | 1000       | +5.3        | 0.08       | 0.01 | 0.16     | 0.00      | *                        | 429                       |                       | 0 |
|          | R supp  | 260       | 1000       | 0.0         | 0.00       | 0.00 | 0.16     | 0.00      | *                        | 429                       |                       | 0 |

\* = Nominal Reinforcement

## CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at: SUPPORT CENTERLINES

| MARK     | pos.   | As_B | As_T | Bottom Bars                                                              | Top Bars                         |
|----------|--------|------|------|--------------------------------------------------------------------------|----------------------------------|
|          | L supp | 0    | 429  | - - -                                                                    | 1Y10 @200( 97%)                  |
| (1) Str1 | span   | 2643 | 0    | 1Y25 @215( 98%)<br>1Y22 @172( 96%)<br>1Y20 @140( 99%)<br>1Y18 @118( 96%) | - - -<br>- - -<br>- - -<br>- - - |
|          | R supp | 0    | 429  | - - -                                                                    | 1Y10 @200( 97%)                  |

## BEAM DESIGN FOR SHEAR

Value of vc Near Supports Based on Tension Steel Calculated at:  
SUPPORT CENTERLINES.

fcu= 25MPa fyv= 420MPa

CODE: BS8110

| MARK    | X1 - X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | vc<br>(MPa) | Asv/Sv<br>(mm) | Stirrups |
|---------|---------------------|------------|------------|-------------|----------------|----------|
| 1) Str1 | L 0.10- 0.37        | 97.27      | 0.367      | 0.386       | 0.000          | -- -- -- |
|         | 0.10- 7.90          |            |            |             | 0.000 *        | -- -- -- |
|         | R 7.64- 7.90        | 97.27      | 0.367      | 0.386       | 0.000          | -- -- -- |

\* = Nominal Stirrups

GRAM : SFRM - R.C. SubFrame Analysis and Design  
 JECT : National Museum - Amman  
 FRAME : Stair on AxisLines X7-X8/Y05-Y06 (Flight 2)  
 DATE : February 23, 2000

Page 389

Design Code: BS8110

Frame Type: Solid Slab

Load Pattern for Span Mom: Alternate Spans Loaded.

Load Pattern for Supp Mom: All Spans Loaded.

Load Factors: Code Standard

#### BEAMS

| MARK     | PROPERTIES |       |      | UNIFORM LOADS |      |      |      |
|----------|------------|-------|------|---------------|------|------|------|
|          | Span       | b (I) | h    | DEAD          | LIVE | X1   | X2   |
| (1) Str2 | 5.20       | 1.00  | 0.30 | 13.40         | 5.00 | 0.00 | 5.20 |
| (2) Str2 | 8.00       | 1.00  | 0.30 | 13.40         | 5.00 | 0.00 | 8.00 |

#### SUPPORTS

| Support # | BREADTH |
|-----------|---------|
| 1         | 0.20    |
| 2         | 0.20    |
| 3         | 0.20    |

#### ELASTIC BEAM SUPPORT MOMENTS

| MARK     | ODD SPANS LOADED |         | EVEN SPANS LOADED |         | ALL SPANS LOADED |         |
|----------|------------------|---------|-------------------|---------|------------------|---------|
|          | Left             | Right   | Left              | Right   | Left             | Right   |
| (1) Str2 | 0.00             | -100.60 | 0.00              | -147.59 | 0.00             | -165.38 |
| (2) Str2 | -100.60          | 0.00    | -147.59           | 0.00    | -165.38          | 0.00    |

#### MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

| MARK     | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|----------|------------------|------|-------------------|------|------------------|------|
|          | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) Str2 | +47.14           | 1.87 | +1.55             | 0.47 | +26.66           | 1.40 |
| (2) Str2 | +62.80           | 4.96 | +146.63           | 4.72 | +139.37          | 4.80 |

#### ELASTIC BEAM SHEARS

| MARK     | AT LEFT SUPPORT | AT 0.10 OF SPAN | AT 0.20 OF SPAN | AT 0.80 OF SPAN | AT 0.90 OF SPAN | AT RIGHT SUPPORT |
|----------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| (1) Str2 | +50.23          | +36.31          | +22.40          | -73.55          | -87.46          | -101.38          |
| (2) Str2 | +127.71         | +106.30         | +84.90          | -45.78          | -67.18          | -88.59           |

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 SUBJECT : National Museum - Amman  
 FRAME : Stair on AxisLines X7-X8/Y05-Y06 (Flight 2)  
 DATE : February 23, 2000

Page 390

# ELASTIC SUPPORT REACTIONS

| MARK    | ODD SPANS L'D | EVEN SPANS L'D | ALL SPANS LOADED |           |             |
|---------|---------------|----------------|------------------|-----------|-------------|
| SUPPORT | Design Load   | Design Load    | Dead Load        | Live Load | Design Load |
| #1      | 50.23         | 6.46           | 18.91            | 7.06      | 37.77       |
| #2      | 155.10        | 188.71         | 114.72           | 42.80     | 229.09      |
| #3      | 41.02         | 88.59          | 43.25            | 16.14     | 86.37       |

# REDISTRIBUTED BEAM SUPPORT MOMENTS

| MARK     | ODD SPANS LOADED |         | EVEN SPANS LOADED |         | ALL SPANS LOADED |         |
|----------|------------------|---------|-------------------|---------|------------------|---------|
|          | Left             | Right   | Left              | Right   | Left             | Right   |
| (1) Str2 | 0.00             | -100.60 | 0.00              | -132.30 | 0.00             | -132.30 |
| (2) Str2 | -100.60          | 0.00    | -132.30           | 0.00    | -132.30          | 0.00    |

# MAXIMUM REDISTRIBUTED BEAM SPAN MOMENTS (X to nearest 0.01 L)

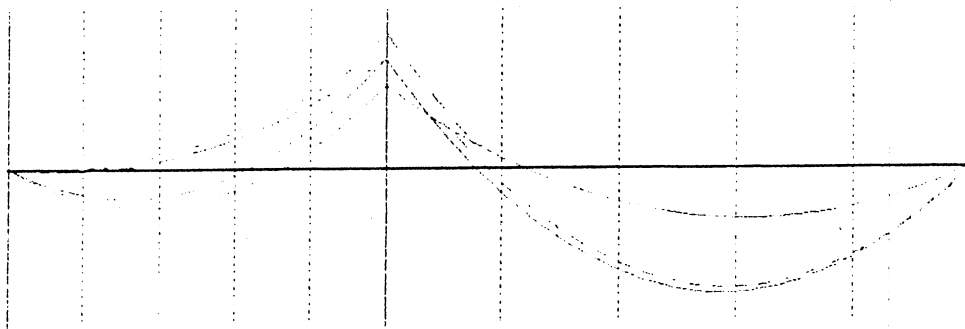
| MARK     | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|----------|------------------|------|-------------------|------|------------------|------|
|          | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) Str2 | +47.14           | 1.87 | +3.29             | 0.68 | +36.39           | 1.66 |
| (2) Str2 | +62.80           | 4.96 | +153.03           | 4.64 | +153.03          | 4.64 |

# REDISTRIBUTED BEAM SHEARS

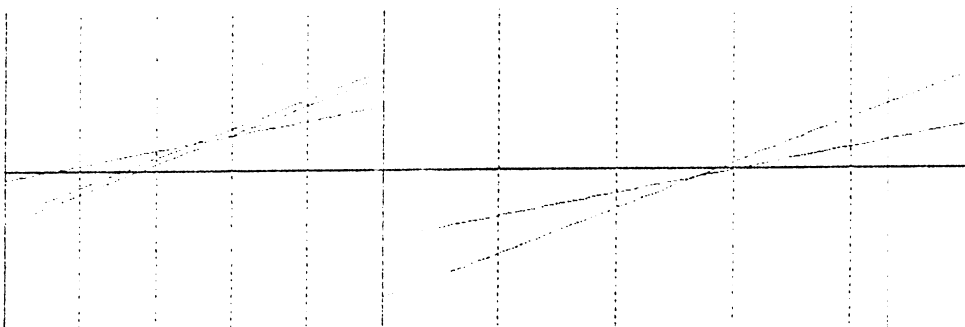
| MARK     | AT LEFT SUPPORT | AT 0.10 OF SPAN | AT 0.20 OF SPAN | AT 0.80 OF SPAN | AT 0.90 OF SPAN | AT RIGHT SUPPORT |
|----------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| (1) Str2 | +50.23          | +36.31          | +22.40          | -67.19          | -81.10          | -95.02           |
| (2) Str2 | +123.58         | +102.17         | +80.76          | -47.69          | -69.09          | -90.50           |

# REDISTRIBUTED SUPPORT REACTIONS

| MARK    | ODD SPANS L'D | EVEN SPANS L'D | ALL SPANS LOADED |           |             |
|---------|---------------|----------------|------------------|-----------|-------------|
| SUPPORT | Design Load   | Design Load    | Dead Load        | Live Load | Design Load |
| #1      | 50.23         | 9.40           | 18.91            | 7.06      | 44.13       |
| #2      | 155.10        | 188.86         | 114.72           | 42.80     | 218.60      |
| #3      | 41.02         | 90.50          | 43.25            | 16.14     | 90.50       |



Bending Moment Diagram



Shear Diagram

=====

BEAM DESIGN FOR FLEXURE

$f_{cu} = 25\text{MPa}$   $f_y = 420\text{MPa}$

CODE: BS8110

$h_f = 0\text{ mm (Rectangular)}$

|           |      | b<br>( mm) | h<br>( mm)  | c<br>(mm)    | d'<br>(mm)  | hf= 0 mm(Rectangular) |            |             |              |               |      |   |
|-----------|------|------------|-------------|--------------|-------------|-----------------------|------------|-------------|--------------|---------------|------|---|
| ALL SPANS |      | 1000       | 300         | 35           | 40          | mm                    |            |             |              |               |      |   |
| MARK      | pos. | d<br>( mm) | bf<br>( mm) | M<br>( kN.m) | R<br>( MPa) | x/d                   | p<br>( % ) | p'<br>( % ) | As<br>(mm^2) | As'<br>(mm^2) |      |   |
| (1)       | Str2 | L supp     | 260         | 1000         | 0.0         | 0.00                  | 0.00       | 0.16        | 0.00         | *             | 429  | 0 |
|           |      | L sup F    | 260         | 1000         | +0.9        | 0.01                  | 0.00       | 0.16        | 0.00         | *             | 429  | 0 |
|           |      | span       | 265         | 1000         | +47.1       | 0.67                  | 0.07       | 0.19        | 0.00         |               | 503  | 0 |
|           |      | R sup F    | 260         | 1000         | -126.3      | 1.87                  | 0.20       | 0.56        | 0.00         |               | 1466 | 0 |
|           |      | R supp     | 260         | 1000         | -132.3      | 1.96                  | 0.22       | 0.59        | 0.00         |               | 1543 | 0 |
| (2)       | Str2 | L supp     | 260         | 1000         | -132.3      | 1.96                  | 0.22       | 0.59        | 0.00         |               | 1543 | 0 |
|           |      | L sup F    | 260         | 1000         | -120.1      | 1.78                  | 0.19       | 0.53        | 0.00         |               | 1385 | 0 |
|           |      | span       | 265         | 1000         | +153.0      | 2.18                  | 0.24       | 0.67        | 0.00         |               | 1776 | 0 |
|           |      | R sup F    | 260         | 1000         | +4.0        | 0.06                  | 0.01       | 0.16        | 0.00         | *             | 429  | 0 |
|           |      | R supp     | 260         | 1000         | 0.0         | 0.00                  | 0.00       | 0.16        | 0.00         | *             | 429  | 0 |

\* = Nominal Reinforcement

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : Stair on AxisLines X7-X8/Y05-Y06 (Flight 2)  
 DATE : February 23, 2000

Page 392

# CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at:  
 MEDIAN BETWEEN SUPPORT FACES AND CETERLINES

| MARK | pos.      | As_B | As_T | Bottom Bars     | Top Bars        |
|------|-----------|------|------|-----------------|-----------------|
|      | L supp    | 0    | 429  | - - -           | 1Y10 @200( 97%) |
| (1)  | Str2 span | 503  | 0    | 1Y10 @170( 98%) | - - -           |
|      | supp      | 0    | 1504 | - - -           | 1Y20 @230( 99%) |
|      |           |      |      | - - -           | 1Y18 @188( 99%) |
|      |           |      |      | - - -           | 1Y16 @156( 95%) |
|      |           |      |      | - - -           | 1Y14 @114(102%) |
| (2)  | Str2 span | 1776 | 0    | 1Y22 @242( 97%) | - - -           |
|      |           |      |      | 1Y20 @200( 98%) | - - -           |
|      |           |      |      | 1Y18 @168( 95%) | - - -           |
|      |           |      |      | 1Y14 @104( 96%) | - - -           |
|      | R supp    | 0    | 429  | - - -           | 1Y10 @200( 97%) |

## BFAM DESIGN FOR SHEAR

Value of vc Near Supports Based on Tension Steel Calculated at:  
 MEDIAN BETWEEN SUPPORT FACES AND CETERLINES.

fcu= 25MPa fyv= 420MPa

CODE: BS8110

| MARK | X1 - X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | vc<br>(MPa) | Asv/Sv<br>(mm) | Stirrups |
|------|---------------------|------------|------------|-------------|----------------|----------|
| (1)  | L 0.10- 0.37        | 40.46      | 0.153      | 0.386       | 0.000          | -- -- -- |
|      | Str2 0.10- 5.10     |            |            |             | 0.000 *        | -- -- -- |
|      | R 4.84- 5.10        | 85.25      | 0.322      | 0.587       | 0.000          | -- -- -- |
| (2)  | L 0.10- 0.37        | 113.81     | 0.429      | 0.581       | 0.000          | -- -- -- |
|      | Str2 0.10- 7.90     |            |            |             | 0.000 *        | -- -- -- |
|      | R 7.64- 7.90        | 80.73      | 0.305      | 0.386       | 0.000          | -- -- -- |

\* = Nominal Stirrups

OGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : Stair on AxisLines Y03-Y02/X3-X4 (Landing)  
 DATE : February 23, 2000

Page 393

Design Code: BS8110  
 Frame Type: Solid Slab  
 Load Pattern for Span Mom: Alternate Spans Loaded.  
 Load Pattern for Supp Mom: All Spans Loaded.  
 Load Factors: Code Standard

## BEAMS

| MARK     | PROPERTIES |       |      | UNIFORM LOADS |      |      |      |
|----------|------------|-------|------|---------------|------|------|------|
|          | Span       | b (I) | h    | DEAD          | LIVE | X1   | X2   |
| (1) Str1 | 8.00       | 1.00  | 0.40 | 11.60         | 5.00 | 0.00 | 8.00 |

## SUPPORTS

| Support # | BREADTH |
|-----------|---------|
| 1         | 1.00    |
| 2         | 1.00    |

## ELASTIC BEAM SUPPORT MOMENTS

| MARK     | ODD SPANS LOADED |       | EVEN SPANS LOADED |       | ALL SPANS LOADED |       |
|----------|------------------|-------|-------------------|-------|------------------|-------|
|          | Left             | Right | Left              | Right | Left             | Right |
| (1) Str1 | 0.00             | 0.00  | 0.00              | 0.00  | 0.00             | 0.00  |

## MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

| MARK     | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|----------|------------------|------|-------------------|------|------------------|------|
|          | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) Str1 | +193.92          | 4.00 | +92.80            | 4.00 | +193.92          | 4.00 |

## ELASTIC BEAM SHEARS

| MARK     | AT LEFT SUPPORT | AT 0.10 OF SPAN | AT 0.20 OF SPAN | AT 0.80 OF SPAN | AT 0.90 OF SPAN | AT RIGHT SUPPORT |
|----------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| (1) Str1 | +96.96          | +77.57          | +58.18          | -58.18          | -77.57          | -96.96           |

## ELASTIC SUPPORT REACTIONS

| MARK | ODD SPANS L'D |  | EVEN SPANS L'D |  | ALL SPANS LOADED |           |
|------|---------------|--|----------------|--|------------------|-----------|
|      | Design Load   |  | Design Load    |  | Dead Load        | Live Load |
| #1   | 96.96         |  | 46.40          |  | 46.40            | 20.00     |
| #2   | 96.96         |  | 46.40          |  | 46.40            | 20.00     |

# BEAM DESIGN FOR FLEXURE

fcu= 25MPa fy= 420MPa

CODE: BS8110

|          |         | b<br>( mm ) | h<br>( mm )  | c<br>( mm )   | d'<br>( mm ) |      |            |             |                           |                            | hf= 0 mm(Rectangular) |   |
|----------|---------|-------------|--------------|---------------|--------------|------|------------|-------------|---------------------------|----------------------------|-----------------------|---|
| (1) Str1 |         | 1000        | 400          | 35            | 40           | mm   |            |             |                           |                            |                       |   |
| MARK     | pos.    | d<br>( mm ) | bf<br>( mm ) | M<br>( kN.m ) | R<br>( MPa ) | x/d  | p<br>( % ) | p'<br>( % ) | As<br>( mm <sup>2</sup> ) | As'<br>( mm <sup>2</sup> ) |                       |   |
| (1) Str1 | L supp  | 360         | 1000         | 0.0           | 0.00         | 0.00 | 0.16       | 0.00        | *                         | 571                        | 0                     | 0 |
|          | L sup F | 360         | 1000         | +21.7         | 0.17         | 0.02 | 0.16       | 0.00        | *                         | 571                        | 0                     | 0 |
|          | span    | 365         | 1000         | +193.9        | 1.46         | 0.16 | 0.43       | 0.00        |                           | 1564                       | 0                     | 0 |
|          | R sup F | 360         | 1000         | +21.7         | 0.17         | 0.02 | 0.16       | 0.00        | *                         | 571                        | 0                     | 0 |
|          | R supp  | 360         | 1000         | 0.0           | 0.00         | 0.00 | 0.16       | 0.00        | *                         | 571                        | 0                     | 0 |

\* = Nominal Reinforcement

## CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at: SUPPORT CENTERLINES

| MARK     | pos.   | As_B | As_T | Bottom Bars     |   | Top Bars        |   |
|----------|--------|------|------|-----------------|---|-----------------|---|
| (1) Str1 | L supp | 0    | 571  | -               | - | 1Y12 @212( 99%) |   |
|          |        |      |      | -               | - | 1Y10 @150( 99%) |   |
|          | span   | 1564 | 0    | 1Y20 @230( 96%) |   | -               | - |
|          |        |      |      | 1Y18 @188( 96%) |   | -               | - |
|          |        |      |      | 1Y16 @146( 99%) |   | -               | - |
|          | R supp | 0    | 571  | -               | - | 1Y12 @212( 99%) |   |
|          |        |      |      | -               | - | 1Y10 @150( 99%) |   |

## BEAM DESIGN FOR SHEAR

Value of vc Near Supports Based on Tension Steel Calculated at:  
SUPPORT CENTERLINES.

fcu= 25MPa fyv= 420MPa

CODE: BS8110

| MARK     | X1 - X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | vc<br>(MPa) | Asv/Sv<br>(mm) | Stirrups |    |
|----------|---------------------|------------|------------|-------------|----------------|----------|----|
| (1) Str1 | L 0.50- 0.87        | 75.99      | 0.208      | 0.351       | 0.000          | --       | -- |
|          | 0.50- 7.50          |            |            |             | 0.000 *        | --       | -- |
|          | R 7.14- 7.50        | 75.99      | 0.208      | 0.351       | 0.000          | --       | -- |

\* = Nominal Stirrups

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : Stair on AxisLines Y04-Y05/X4-X5  
 DATE : February 23, 2000

Page 395

Design Code: BS8110  
 Frame Type: Solid Slab  
 Load Pattern for Span Mom: Alternate Spans Loaded.  
 Load Pattern for Supp Mom: All Spans Loaded.  
 Load Factors: Code Standard

# BEAMS

| MARK     | PROPERTIES |       |      | UNIFORM LOADS |       |      |       |
|----------|------------|-------|------|---------------|-------|------|-------|
|          | Span       | b (I) | h    | DEAD          | LIVE  | X1   | X2    |
| L. Cant. |            |       |      | 37.18         | 11.50 | 0.00 | 2.20  |
| (1) Str4 | 10.60      | 2.30  | 0.40 | 37.18         | 11.50 | 0.00 | 10.60 |

# SUPPORTS

| Support # | BREADTH |
|-----------|---------|
| 1         | 0.60    |
| 2         | 0.30    |

# ELASTIC BEAM SUPPORT MOMENTS

| MARK     | ODD SPANS LOADED |         | EVEN SPANS LOADED |         | ALL SPANS LOADED |         |
|----------|------------------|---------|-------------------|---------|------------------|---------|
|          | Left             | Right   | Left              | Right   | Left             | Right   |
| L. Cant. |                  | -202.26 |                   | -405.14 |                  | -405.14 |
| (1) Str4 | -202.26          | 0.00    | -405.14           | 0.00    | -405.14          | 0.00    |

# MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

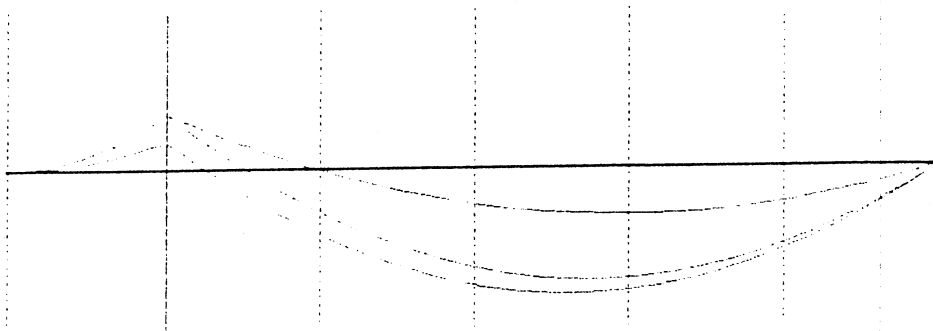
| MARK     | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|----------|------------------|------|-------------------|------|------------------|------|
|          | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) Str4 | +890.87          | 5.62 | +339.25           | 6.36 | +797.29          | 5.83 |

# ELASTIC BEAM SHEARS

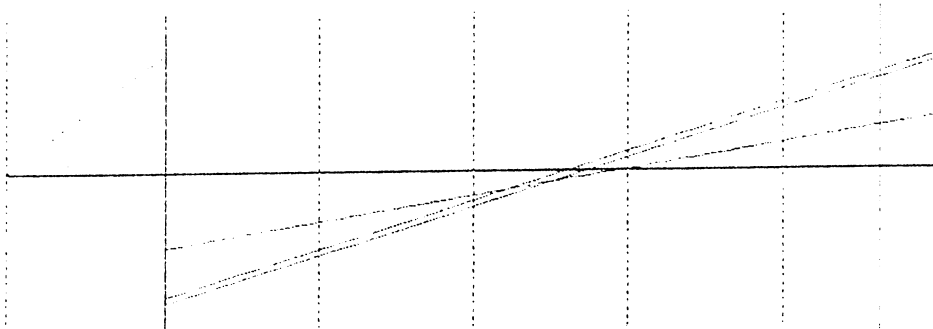
| MARK     | AT LEFT SUPPORT | AT 0.10 OF SPAN | AT 0.20 OF SPAN | AT 0.80 OF SPAN | AT 0.90 OF SPAN | AT RIGHT SUPPORT |
|----------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| L. Cant. |                 |                 |                 |                 |                 | -368.31          |
| (1) Str4 | +411.62         | +336.94         | +262.26         | -204.96         | -279.64         | -354.31          |

# ELASTIC SUPPORT REACTIONS

| MARK | ODD SPANS L'D | EVEN SPANS L'D | ALL SPANS LOADED |           |             |
|------|---------------|----------------|------------------|-----------|-------------|
|      | Design Load   | Design Load    | Dead Load        | Live Load | Design Load |
| #1   | 576.35        | 603.58         | 400.01           | 137.44    | 779.92      |
| #2   | 354.31        | 158.83         | 177.97           | 53.76     | 335.18      |



Bending Moment Diagram



Shear Diagram

=====

BEAM DESIGN FOR FLEXURE

fcu= 25MPa fy= 420MPa

CODE: BS8110

hf= 0 mm(Rectangular)

|           |         | b<br>( mm ) | h<br>( mm )  | c<br>( mm )   | d'<br>( mm ) |      |            |             |                |                 |
|-----------|---------|-------------|--------------|---------------|--------------|------|------------|-------------|----------------|-----------------|
| ALL SPANS |         | 2300        | 400          | 35            | 40           | mm   |            |             |                |                 |
| MARK      | pos.    | d<br>( mm ) | bf<br>( mm ) | M<br>( kN.m ) | R<br>( MPa ) | x/d  | p<br>( % ) | p'<br>( % ) | As<br>( mm^2 ) | As'<br>( mm^2 ) |
| L. Cant.  | sup F   | 360         | 2300         | -302.2        | 1.01         | 0.11 | 0.29       | 0.00        | 2413           | 0               |
|           | supp    | 360         | 2300         | -405.1        | 1.36         | 0.14 | 0.40       | 0.00        | 3296           | 0               |
| (1) Str4  | L supp  | 360         | 2300         | -405.1        | 1.36         | 0.14 | 0.40       | 0.00        | 3296           | 0               |
|           | L sup F | 360         | 2300         | -336.3        | 1.13         | 0.12 | 0.33       | 0.00        | 2702           | 0               |
|           | span    | 365         | 2300         | +890.9        | 2.91         | 0.34 | 0.94       | 0.00        | 7898           | 0               |
|           | R sup F | 360         | 2300         | +23.4         | 0.08         | 0.01 | 0.16       | 0.00        | * 1314         | 0               |
|           | R supp  | 360         | 2300         | 0.0           | 0.00         | 0.00 | 0.16       | 0.00        | * 1314         | 0               |

\* = Nominal Reinforcement

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 PROJECT : National Museum - Amman  
 FRAME : Stair on AxisLines Y04-Y05/X4-X5  
 DATE : February 23, 2000

Page 397

# CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at:  
 MEDIAN BETWEEN SUPPORT FACES AND CETERLINES

| MARK     | pos.   | As_B | As_T | Bottom Bars     | Top Bars        |
|----------|--------|------|------|-----------------|-----------------|
|          | supp   | 0    | 2999 | - - -           | 1Y18 @218( 97%) |
|          |        |      |      | - - -           | 1Y16 @176( 96%) |
|          |        |      |      | - - -           | 1Y14 @134( 98%) |
|          |        |      |      | - - -           | 1Y12 @102( 96%) |
| <hr/>    |        |      |      |                 |                 |
| (1) Str4 | span   | 7898 | 0    | 1Y25 @175( 95%) | - - -           |
|          |        |      |      | 1Y32 @272( 98%) | - - -           |
|          |        |      |      | 1Y22 @132(101%) | - - -           |
|          |        |      |      | 1Y20 @110(102%) | - - -           |
| <hr/>    |        |      |      |                 |                 |
|          | R supp | 0    | 1314 | - - -           | 1Y12 @212( 99%) |
|          |        |      |      | - - -           | 1Y10 @150( 99%) |

# BEAM DESIGN FOR SHEAR

Value of vc Near Supports Based on Tension Steel Calculated at:  
 - Beam Spans : MEDIAN BETWEEN SUPPORT FACES AND CETERLINES.  
 For Cantilevers: MEDIAN BETWEEN SUPPORT FACES AND CETERLINES.

fcu= 25MPa fyv= 420MPa

CODE: BS8110

| MARK    | X1 - X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | vc<br>(MPa) | Asv/Sv<br>(mm) | Stirrups |
|---------|---------------------|------------|------------|-------------|----------------|----------|
| Cant.   | 0.00- 1.90          |            |            |             | 0.000 *        |          |
| R       | 1.54- 1.90          | 256.98     | 0.306      | 0.455       | 0.000          | -- -- -- |
| L       | 0.30- 0.67          | 364.77     | 0.435      | 0.463       | 0.000          | -- -- -- |
| 1) Str4 | 0.30-10.45          |            |            |             | 0.000 *        |          |
| R       | 10.09-10.45         | 318.03     | 0.379      | 0.351       | 0.000          | -- -- -- |

\* = Nominal Stirrups

GRAM : SFRM - R.C. SubFrame Analysis and Design  
 UJECT : National Museum - Amman  
 FRAME : Beam B44+B45+B44  
 DATE : February 23, 2000

Page 398

Design Code: BS8110  
 Frame Type: Plane Subframe  
 Load Pattern for Span Mom: Alternate Spans Loaded.  
 Load Pattern for Supp Mom: All Spans Loaded.  
 Load Factors: Code Standard

#### BEAMS

| MARK    | PROPERTIES |       |      | UNIFORM LOADS |       |      |      | POINT LOADS |       |      |
|---------|------------|-------|------|---------------|-------|------|------|-------------|-------|------|
|         | Span       | b (I) | h    | DEAD          | LIVE  | X1   | X2   | DEAD        | LIVE  | X    |
| (1) B44 | 3.00       | 0.60  | 0.40 | 121.25        | 37.50 | 0.00 | 3.00 | 106.72      | 46.00 | 1.50 |
| (2) B45 | 5.60       | 0.60  | 0.40 | 10.44         | 4.50  | 0.00 | 5.60 | 0.00        | 0.00  | 0.00 |
| (3) B44 | 3.00       | 0.60  | 0.40 | 121.25        | 37.50 | 0.00 | 3.00 | 106.72      | 46.00 | 1.50 |

#### COLUMNS AND SUPPORTS

| SUPPORT<br>No.<br>L-->R | COLUMNS ABOVE |       |     | COLUMNS BELOW |       |      | SUPPORT<br>BREADTH<br>h |
|-------------------------|---------------|-------|-----|---------------|-------|------|-------------------------|
|                         | Height        | b (I) | h   | Height        | b (I) | h    |                         |
| 1                       | 0.00          | ---   | --- | 0.00          | ---   | ---  | 0.20                    |
| 2                       | 0.00          | ---   | --- | 4.00          | 0.30  | 0.60 | 0.60                    |
| 3                       | 0.00          | ---   | --- | 4.00          | 0.30  | 0.60 | 0.60                    |
| 4                       | 0.00          | ---   | --- | 0.00          | ---   | ---  | 0.20                    |

#### ELASTIC BEAM SUPPORT MOMENTS

| MARK    | ODD SPANS LOADED |         | EVEN SPANS LOADED |         | ALL SPANS LOADED |         |
|---------|------------------|---------|-------------------|---------|------------------|---------|
|         | Left             | Right   | Left              | Right   | Left             | Right   |
| (1) B44 | 0.00             | -266.78 | 0.00              | -150.64 | 0.00             | -276.54 |
| (2) B45 | -69.12           | -69.12  | -73.37            | -73.37  | -95.36           | -95.36  |
| (3) B44 | -266.78          | 0.00    | -150.64           | 0.00    | -276.54          | 0.00    |

#### MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

| MARK    | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|---------|------------------|------|-------------------|------|------------------|------|
|         | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) B44 | +292.34          | 1.50 | +141.12           | 1.50 | +287.45          | 1.50 |
| (2) B45 | -28.19           | 2.80 | +12.15            | 2.80 | -9.84            | 2.80 |
| (3) B44 | +292.34          | 1.50 | +141.12           | 1.50 | +287.45          | 1.50 |

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : Beam B44+B45+B44  
 DATE : February 23, 2000

Page 399

### ELASTIC BEAM SHEARS

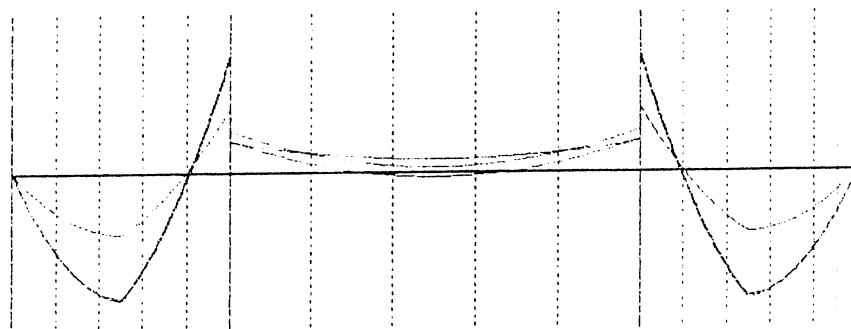
| MARK    | AT LEFT<br>SUPPORT | AT 0.10<br>OF SPAN | AT 0.20<br>OF SPAN | AT 0.80<br>OF SPAN | AT 0.90<br>OF SPAN | AT RIGHT<br>SUPPORT |
|---------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|
| (1) B44 | +367.20            | +298.28            | +229.35            | -410.46            | -479.38            | -548.31             |
| (2) B45 | +61.08             | +48.87             | +36.65             | -36.65             | -48.87             | -61.08              |
| (3) B44 | +548.31            | +479.38            | +410.46            | -229.35            | -298.28            | -367.20             |

### ELASTIC SUPPORT REACTIONS

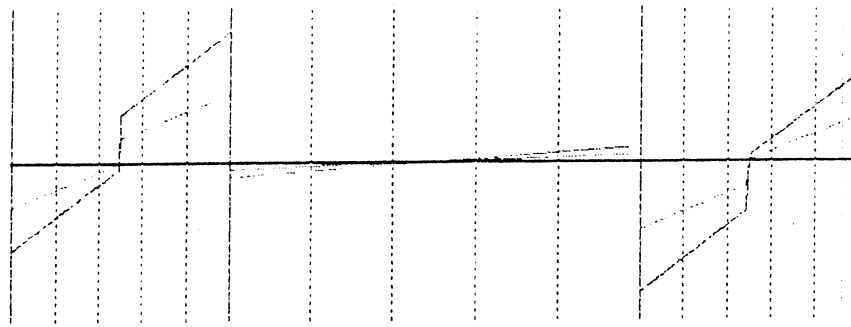
| MARK<br>SUPPORT | ODD SPANS L'D | EVEN SPANS L'D | ALL SPANS LOADED |           |             |
|-----------------|---------------|----------------|------------------|-----------|-------------|
|                 | Design Load   | Design Load    | Dead Load        | Live Load | Design Load |
| #1              | 367.20        | 185.02         | 188.28           | 62.73     | 363.95      |
| #2              | 574.29        | 346.53         | 311.43           | 108.37    | 609.39      |
| #3              | 574.29        | 346.53         | 311.43           | 108.37    | 609.39      |
| #4              | 367.20        | 185.02         | 188.28           | 62.73     | 363.95      |

### ELASTIC COLUMN MOMENTS (CCW +ve)

| MARK<br>COLUMN | ODD SPANS LOADED |         | EVEN SPANS LOADED |        | ALL SPANS LOADED |         |
|----------------|------------------|---------|-------------------|--------|------------------|---------|
|                | ABOVE            | BELOW   | ABOVE             | BELOW  | ABOVE            | BELOW   |
| #1             | 0.00             | 0.00    | 0.00              | 0.00   | 0.00             | 0.00    |
| #2             | 0.00             | +197.66 | 0.00              | +77.28 | 0.00             | +181.18 |
| #3             | 0.00             | -197.66 | 0.00              | -77.28 | 0.00             | -181.18 |
| #4             | 0.00             | 0.00    | 0.00              | 0.00   | 0.00             | 0.00    |



Bending Moment Diagram



Shear Diagram

=====

BEAM DESIGN FOR FLEXURE

$f_{cu} = 25\text{MPa}$   $f_y = 420\text{MPa}$

CODE: BS8110

|           |         | b<br>(mm) | h<br>(mm)  | c<br>(mm)   | d'<br>(mm) |      |          |           |                          |                           |    |
|-----------|---------|-----------|------------|-------------|------------|------|----------|-----------|--------------------------|---------------------------|----|
| ALL SPANS |         | 600       | 400        | 50          | 50         | mm   |          |           |                          |                           |    |
| MARK      | pos.    | d<br>(mm) | bf<br>(mm) | M<br>(kN.m) | R<br>(MPa) | x/d  | p<br>(%) | p'<br>(%) | As<br>(mm <sup>2</sup> ) | As'<br>(mm <sup>2</sup> ) |    |
| (1) B44   | L supp  | 350       | 600        | 0.0         | 0.00       | 0.00 | 0.16     | 0.00      | *                        | 343                       | 0  |
|           | L sup F | 350       | 600        | +17.9       | 0.24       | 0.02 | 0.16     | 0.00      | *                        | 343                       | 0  |
|           | span    | 350       | 600        | +292.3      | 3.98       | 0.50 | 1.40     | 0.03      |                          | 2945                      | 56 |
|           | R sup F | 350       | 600        | -122.4      | 1.67       | 0.18 | 0.50     | 0.00      |                          | 1042                      | 0  |
|           | R supp  | 350       | 600        | -276.5      | 3.76       | 0.48 | 1.31     | 0.00      |                          | 2754                      | 0  |
| (2) B45   | L supp  | 350       | 600        | -95.4       | 1.30       | 0.14 | 0.38     | 0.00      |                          | 795                       | 0  |
|           | L sup F | 350       | 600        | -78.0       | 1.06       | 0.11 | 0.31     | 0.00      |                          | 643                       | 0  |
|           | span    | 350       | 600        | +12.2       | 0.17       | 0.02 | 0.16     | 0.00      | *                        | 343                       | 0  |
|           | R sup F | 350       | 600        | -78.0       | 1.06       | 0.11 | 0.31     | 0.00      |                          | 643                       | 0  |
|           | R supp  | 350       | 600        | -95.4       | 1.30       | 0.14 | 0.38     | 0.00      |                          | 795                       | 0  |
| (3) B44   | L supp  | 350       | 600        | -276.5      | 3.76       | 0.48 | 1.31     | 0.00      |                          | 2754                      | 0  |
|           | L sup F | 350       | 600        | -122.4      | 1.67       | 0.18 | 0.50     | 0.00      |                          | 1042                      | 0  |
|           | span    | 350       | 600        | +292.3      | 3.98       | 0.50 | 1.40     | 0.03      |                          | 2945                      | 56 |
|           | R sup F | 350       | 600        | +17.9       | 0.24       | 0.02 | 0.16     | 0.00      | *                        | 343                       | 0  |
|           | R supp  | 350       | 600        | 0.0         | 0.00       | 0.00 | 0.16     | 0.00      | *                        | 343                       | 0  |

\* = Nominal Reinforcement

=====

CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at:  
 MEDIAN BETWEEN SUPPORT FACES AND CETERLINES

| MARK    | pos.   | As_B | As_T | Bottom Bars                                                              | Top Bars                           |
|---------|--------|------|------|--------------------------------------------------------------------------|------------------------------------|
|         | L supp | 0    | 343  | - - -                                                                    | 5Y10 @130(115%)<br>7Y 8 @ 87(102%) |
| (1) B44 | span   | 2945 | 56   | 6Y25 @101(100%)<br>9Y20 @ 64( 96%)<br>4Y32 @166(109%)<br>8Y22 @ 73(103%) | - - -<br>- - -<br>- - -<br>- - -   |

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 PROJECT : National Museum - Amman  
 FRAME : Beam B44+B45+B44  
 DATE : February 23, 2000

Page 401

# CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at:  
 MEDIAN BETWEEN SUPPORT FACES AND CETERLINES

| MARK   | pos.   | As_B | As_T | Bottom Bars     | Top Bars        |
|--------|--------|------|------|-----------------|-----------------|
|        | supp   | 0    | 1898 | - - -           | 4Y25 @168(103%) |
|        |        |      |      | - - -           | 5Y22 @127(100%) |
|        |        |      |      | - - -           | 6Y20 @102( 99%) |
|        |        |      |      | - - -           | 9Y16 @ 64( 95%) |
| 2) B45 | span   | 343  | 0    | 5Y10 @130(115%) | - - -           |
|        |        |      |      | 7Y 8 @ 87(102%) | - - -           |
|        | supp   | 0    | 1898 | - - -           | 4Y25 @168(103%) |
|        |        |      |      | - - -           | 5Y22 @127(100%) |
|        |        |      |      | - - -           | 6Y20 @102( 99%) |
|        |        |      |      | - - -           | 9Y16 @ 64( 95%) |
| 3) B44 | span   | 2945 | 56   | 6Y25 @101(100%) | - - -           |
|        |        |      |      | 9Y20 @ 64( 96%) | - - -           |
|        |        |      |      | 4Y32 @166(109%) | - - -           |
|        |        |      |      | 8Y22 @ 73(103%) | - - -           |
|        | R supp | 0    | 343  | - - -           | 5Y10 @130(115%) |
|        |        |      |      | - - -           | 7Y 8 @ 87(102%) |

# EAM DESIGN FOR SHIAR

Value of vc Near Supports Based on Tension Steel Calculated at:  
 MEDIAN BETWEEN SUPPORT FACES AND CETERLINES.

f<sub>cu</sub>= 25MPa f<sub>yv</sub>= 420MPa

CODE: BS8110

| MARK   | X1 - X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | vc<br>(MPa) | Asv/Sv<br>(mm) | Stirrups                   |
|--------|---------------------|------------|------------|-------------|----------------|----------------------------|
| 1) B44 | L 0.10- 0.45        | 263.82     | 1.256      | 0.731       | 0.862          | 2Y10@262 3Y10@262 4Y10@262 |
|        | 0.56- 1.65          |            |            |             | 0.657 *        | 2Y10@262 3Y10@262 4Y10@262 |
|        | R 2.35- 2.70        | 398.97     | 1.900      | 0.731       | 1.919          | 3Y10@245 4Y10@262 5Y10@262 |
| 2) B45 | L 0.30- 0.65        | 46.90      | 0.223      | 0.457       | 0.657 *        | 2Y10@262 3Y10@262 4Y10@262 |
|        | 0.30- 5.30          |            |            |             | 0.657 *        | 2Y10@262 3Y10@262 4Y10@262 |
|        | R 4.95- 5.30        | 46.90      | 0.223      | 0.457       | 0.657 *        | 2Y10@262 3Y10@262 4Y10@262 |
| 3) B44 | L 0.30- 0.65        | 398.97     | 1.900      | 0.731       | 1.919          | 3Y10@245 4Y10@262 5Y10@262 |
|        | 1.35- 2.44          |            |            |             | 0.657 *        | 2Y10@262 3Y10@262 4Y10@262 |
|        | R 2.55- 2.90        | 263.82     | 1.256      | 0.731       | 0.862          | 2Y10@262 3Y10@262 4Y10@262 |

\* = Nominal Stirrups

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : Beam B46  
 DATE : February 23, 2000

Page 402

Design Code: BS8110  
 Frame Type: Simple Beam  
 Load Pattern for Span Mom: Alternate Spans Loaded.  
 Load Pattern for Supp Mom: All Spans Loaded.  
 Load Factors: Code Standard

# BEAMS

| MARK    | PROPERTIES |       |      | UNIFORM LOADS |       |      |      |
|---------|------------|-------|------|---------------|-------|------|------|
|         | Span       | b (I) | h    | DEAD          | LIVE  | X1   | X2   |
| (1) B46 | 5.20       | 1.00  | 0.40 | 25.52         | 26.00 | 0.00 | 5.20 |

# SUPPORTS

| Support # | BREADTH |
|-----------|---------|
| 1         | 1.00    |
| 2         | 1.00    |

# MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

| MARK    | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|---------|------------------|------|-------------------|------|------------------|------|
|         | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) B46 | +261.37          | 2.60 | +86.26            | 2.60 | +261.37          | 2.60 |

# ELASTIC BEAM SHEARS

| MARK    | AT LEFT SUPPORT | AT 0.10 OF SPAN | AT 0.20 OF SPAN | AT 0.80 OF SPAN | AT 0.90 OF SPAN | AT RIGHT SUPPORT |
|---------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| (1) B46 | +201.05         | +160.84         | +120.63         | -120.63         | -160.84         | -201.05          |

# ELASTIC SUPPORT REACTIONS

| MARK | ODD SPANS L'D |  | EVEN SPANS L'D |  | ALL SPANS LOADED |           |
|------|---------------|--|----------------|--|------------------|-----------|
|      | Design Load   |  | Design Load    |  | Dead Load        | Live Load |
| #1   | 201.05        |  | 66.35          |  | 66.35            | 67.60     |
| 2    | 201.05        |  | 66.35          |  | 66.35            | 67.60     |

# BEAM DESIGN FOR FLEXURE

fcu= 25MPa fy= 420MPa

CODE: BS8110

|         | b<br>(mm) | h<br>(mm) | c<br>(mm) | d'<br>(mm) |    |
|---------|-----------|-----------|-----------|------------|----|
| (1) B46 | 1000      | 400       | 50        | 50         | mm |

hf= 0 mm(Rectangular)

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : Beam B46  
 DATE : February 23, 2000

Page 403

| MARK    | pos.    | d<br>(mm) | bf<br>(mm) | M<br>(kN.m) | R<br>(MPa) | x/d  | p<br>(%) | p'<br>(%) | As<br>(mm <sup>2</sup> ) | As'<br>(mm <sup>2</sup> ) |
|---------|---------|-----------|------------|-------------|------------|------|----------|-----------|--------------------------|---------------------------|
| (1) B46 | L supp  | 350       | 1000       | 0.0         | 0.00       | 0.00 | 0.16     | 0.00      | 571                      |                           |
|         | L sup F | 350       | 1000       | +30.0       | 0.24       | 0.02 | 0.16     | 0.00      | 571                      |                           |
|         | span    | 350       | 1000       | +261.4      | 2.13       | 0.24 | 0.65     | 0.00      | 2290                     |                           |
|         | R sup F | 350       | 1000       | +30.0       | 0.24       | 0.02 | 0.16     | 0.00      | 571                      |                           |
|         | R supp  | 350       | 1000       | 0.0         | 0.00       | 0.00 | 0.16     | 0.00      | 571                      |                           |

\* = Nominal Reinforcement

#### CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at: SUPPORT CENTERLINES

| MARK    | pos.   | As_B | As_T | Bottom Bars                                                               | Top Bars                            |
|---------|--------|------|------|---------------------------------------------------------------------------|-------------------------------------|
| (1) B46 | L supp | 0    | 571  | - - -                                                                     | 7Y10 @153( 97%)<br>11Y 8 @ 92( 96%) |
|         | span   | 2290 | 0    | 6Y22 @182(100%)<br>7Y20 @152( 96%)<br>9Y18 @114(100%)<br>11Y16 @ 91( 97%) | - - -                               |
|         | R sup  | 0    | 571  | - - -                                                                     | 7Y10 @153( 97%)<br>11Y 8 @ 92( 96%) |
|         |        |      |      |                                                                           |                                     |
|         |        |      |      |                                                                           |                                     |

#### BEAM DESIGN FOR SHEAR

Value of vc Near Supports Based on Tension Steel Calculated at:  
SUPPORT CENTERLINES.

f<sub>cu</sub>= 25MPa f<sub>yv</sub>= 420MPa

CODE: BS8110

| MARK   | X1 - X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | vc<br>(MPa) | Asv/Sv<br>(mm) | Stirrups                   |
|--------|---------------------|------------|------------|-------------|----------------|----------------------------|
| 1) B46 | L 0.50- 0.85        | 135.32     | 0.387      | 0.357       | 1.095 *        | 3Y10@262 4Y10@262 5Y10@262 |
|        | 0.50- 4.70          |            |            |             | 1.095 *        | 3Y10@262 4Y10@262 5Y10@262 |
|        | R 4.35- 4.70        | 135.32     | 0.387      | 0.357       | 1.095 *        | 3Y10@262 4Y10@262 5Y10@262 |

\* = Nominal Stirrups

OGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OJECT : National Museum - Amman  
 FRAME : Beam B47  
 DATE : February 23, 2000

Page 404

Design Code: BS8110  
 Frame Type: Simple Beam  
 Load Pattern for Span Mom: Alternate Spans Loaded.  
 Load Pattern for Supp Mom: All Spans Loaded.  
 Load Factors: Code Standard

# BEAMS

| MARK    | PROPERTIES |       |      | UNIFORM LOADS |       |      |      | POINT LOADS |       |      |
|---------|------------|-------|------|---------------|-------|------|------|-------------|-------|------|
|         | Span       | b (I) | h    | DEAD          | LIVE  | X1   | X2   | DEAD        | LIVE  | X    |
| (1) B47 | 4.50       | 1.00  | 0.40 | 29.00         | 25.00 | 0.00 | 4.50 | 66.35       | 67.60 | 0.70 |

# SUPPORTS

| Support # | BREADTH |
|-----------|---------|
| 1         | 0.20    |
| 2         | 0.20    |

# MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

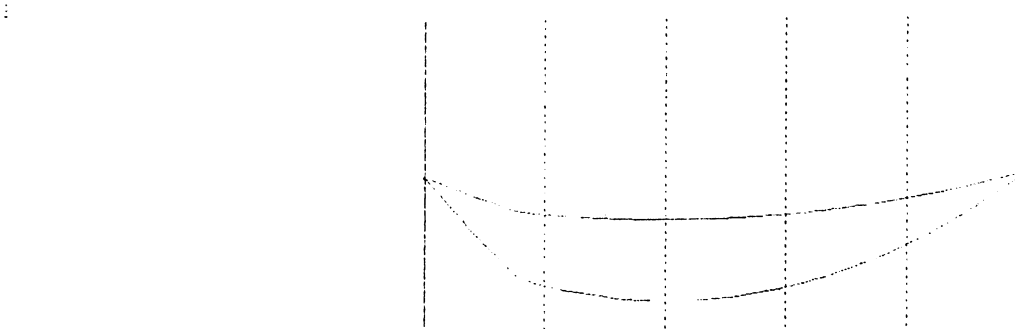
| MARK    | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|---------|------------------|------|-------------------|------|------------------|------|
|         | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) B47 | +280.44          | 1.85 | +98.47            | 1.89 | +280.44          | 1.85 |

# ELASTIC BEAM SHEARS

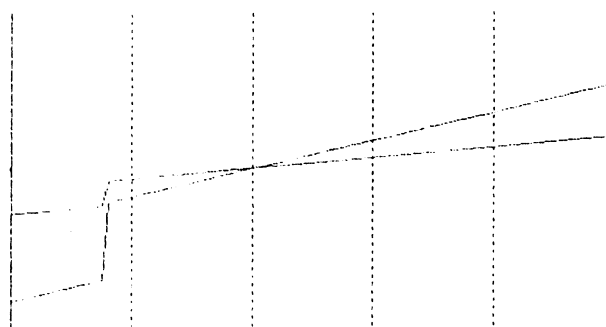
| MARK    | AT LEFT SUPPORT | AT 0.10 OF SPAN | AT 0.20 OF SPAN | AT 0.80 OF SPAN | AT 0.90 OF SPAN | AT RIGHT SUPPORT |
|---------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| (1) B47 | +351.13         | +314.86         | +77.54          | -140.08         | -176.35         | -212.62          |

# ELASTIC SUPPORT REACTIONS

| MARK | ODD SPANS L'D |  | EVEN SPANS L'D |  | ALL SPANS LOADED |           |
|------|---------------|--|----------------|--|------------------|-----------|
|      | Design Load   |  | Design Load    |  | Dead Load        | Live Load |
| #1   | 351.13        |  | 121.28         |  | 121.28           | 113.33    |
| #2   | 212.62        |  | 75.57          |  | 75.57            | 66.77     |



Bending Moment Diagram



Shear Diagram

### BEAM DESIGN FOR FLEXURE

$f_{cu} = 25\text{MPa}$   $f_y = 420\text{MPa}$

CODE: BS8110

|           |         | b<br>( mm ) | h<br>( mm )  | c<br>( mm )   | d'<br>( mm ) | hf= 0 mm(Rectangular) |            |             |                |                 |   |
|-----------|---------|-------------|--------------|---------------|--------------|-----------------------|------------|-------------|----------------|-----------------|---|
| ( 1 ) B47 |         | 1000        | 400          | 50            | 50           | mm                    |            |             |                |                 |   |
| MARK      | pos.    | d<br>( mm ) | bf<br>( mm ) | M<br>( kN.m ) | R<br>( MPa ) | x/d                   | ( p<br>% ) | ( p'<br>% ) | As<br>( mm^2 ) | As'<br>( mm^2 ) |   |
| ( 1 ) B47 | L supp  | 350         | 1000         | 0.0           | 0.00         | 0.00                  | 0.16       | 0.00        | *              | 571             | 0 |
|           | L sup F | 350         | 1000         | +12.0         | 0.10         | 0.01                  | 0.16       | 0.00        | *              | 571             | 0 |
|           | span    | 350         | 1000         | +280.4        | 2.29         | 0.26                  | 0.71       | 0.00        |                | 2482            | 0 |
|           | R sup F | 350         | 1000         | +7.4          | 0.06         | 0.01                  | 0.16       | 0.00        | *              | 571             | 0 |
|           | R supp  | 350         | 1000         | 0.0           | 0.00         | 0.00                  | 0.16       | 0.00        | *              | 571             | 0 |

\* = Nominal Reinforcement

### CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at: SUPPORT CENTERLINES

| MARK    | pos.   | As_B | As_T | Bottom Bars                                                                | Top Bars                            |
|---------|--------|------|------|----------------------------------------------------------------------------|-------------------------------------|
| (1) B47 | L supp | 0    | 571  | - - -                                                                      | 7Y10 @153( 97%)<br>11Y 8 @ 92( 96%) |
|         | span   | 2482 | 0    | 8Y20 @130(101%)<br>7Y22 @151(107%)<br>10Y18 @101(102%)<br>12Y16 @ 83( 97%) | - - -                               |
|         | R supp | 0    | 571  | - - -                                                                      | 7Y10 @153( 97%)<br>11Y 8 @ 92( 96%) |

### BEAM DESIGN FOR SHEAR

Value of  $v_c$  Near Supports Based on Tension Steel Calculated at:  
SUPPORT CENTERLINES.

$f_{cu} = 25\text{MPa}$   $f_{yv} = 420\text{MPa}$

CODE: BS8110

OGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OJECT : National Museum - Amman  
 FRAME : Beam B47  
 DATE : February 23, 2000

Page 406

| MARK   |   | X1 - X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | vc<br>(MPa) | Asv/Sv<br>(mm) | Stirrups |          |          |
|--------|---|---------------------|------------|------------|-------------|----------------|----------|----------|----------|
| 1) B47 | L | 0.10- 0.45          | 314.86     | 0.900      | 0.357       | 1.485          | 3Y10@262 | 4Y10@262 | 5Y10@262 |
|        |   | 0.09- 4.40          |            |            |             | 1.095 *        | 3Y10@262 | 4Y10@262 | 5Y10@262 |
|        | R | 4.05- 4.40          | 176.35     | 0.504      | 0.357       | 1.095 *        | 3Y10@262 | 4Y10@262 | 5Y10@262 |

\* = Nominal Stirrups

OGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : Beam B48  
 DATE : February 23, 2000

Page 407

Design Code: BS8110  
 Frame Type: Simple Beam  
 Load Pattern for Span Mom: Alternate Spans Loaded.  
 Load Pattern for Supp Mom: All Spans Loaded.  
 Load Factors: Code Standard

# BEAMS

| MARK    | PROPERTIES |       |      | UNIFORM LOADS |       |      |      | POINT LOADS |        |      |
|---------|------------|-------|------|---------------|-------|------|------|-------------|--------|------|
|         | Span       | b (I) | h    | DEAD          | LIVE  | X1   | X2   | DEAD        | LIVE   | X    |
| (1) B48 | 2.00       | 1.00  | 0.40 | 34.80         | 30.00 | 0.00 | 2.00 | 121.28      | 113.33 | 0.60 |

## SUPPORTS

Support # BREADTH

|   |      |
|---|------|
| 1 | 0.20 |
| 2 | 0.20 |

## MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

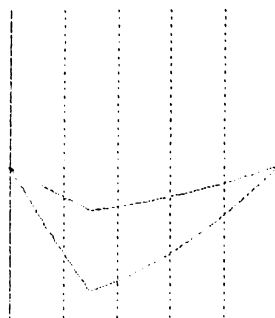
| MARK    | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|---------|------------------|------|-------------------|------|------------------|------|
|         | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) B48 | +188.10          | 0.60 | +65.55            | 0.60 | +188.10          | 0.60 |

## ELASTIC BEAM SHEARS

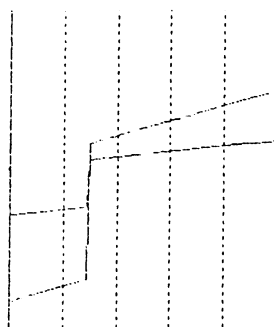
| MARK    | AT LEFT SUPPORT | AT 0.10 OF SPAN | AT 0.20 OF SPAN | AT 0.80 OF SPAN | AT 0.90 OF SPAN | AT RIGHT SUPPORT |
|---------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| (1) B48 | +342.51         | +323.17         | +303.82         | -163.37         | -182.71         | -202.06          |

## ELASTIC SUPPORT REACTIONS

| MARK<br>SUPPORT | ODD SPANS L'D<br>Design Load | EVEN SPANS L'D<br>Design Load | ALL SPANS LOADED |           |             |
|-----------------|------------------------------|-------------------------------|------------------|-----------|-------------|
|                 |                              |                               | Dead Load        | Live Load | Design Load |
| #1              | 342.51                       | 119.70                        | 119.70           | 109.33    | 342.51      |
| #2              | 202.06                       | 71.18                         | 71.18            | 64.00     | 202.06      |



Bending Moment Diagram



### Shear Diagram

### BEAM DESIGN FOR FLEXURE

$f_{cu} = 25\text{MPa}$   $f_y = 420\text{MPa}$

CODE: BS8110

|         |         | b<br>(mm) | h<br>(mm)  | c<br>(mm)   | d'<br>(mm) |                       |          |           |                          |                           |   |
|---------|---------|-----------|------------|-------------|------------|-----------------------|----------|-----------|--------------------------|---------------------------|---|
|         |         | (mm)      | (mm)       | (mm)        | (mm)       | hf= 0 mm(Rectangular) |          |           |                          |                           |   |
| (1) B48 |         | 1000      | 400        | 50          | 50         | mm                    |          |           |                          |                           |   |
| MARK    | pos.    | d<br>(mm) | bf<br>(mm) | M<br>(kN.m) | R<br>(MPa) | x/d                   | p<br>(%) | p'<br>(%) | As<br>(mm <sup>2</sup> ) | As'<br>(mm <sup>2</sup> ) |   |
| (1) B48 | L supp  | 350       | 1000       | 0.0         | 0.00       | 0.00                  | 0.16     | 0.00      | *                        | 571                       | 0 |
|         | L sup F | 350       | 1000       | +11.8       | 0.10       | 0.01                  | 0.16     | 0.00      | *                        | 571                       | 0 |
|         | span    | 350       | 1000       | +188.1      | 1.54       | 0.17                  | 0.45     | 0.00      | *                        | 1590                      | 0 |
|         | R sup F | 350       | 1000       | +6.9        | 0.06       | 0.01                  | 0.16     | 0.00      | *                        | 571                       | 0 |
|         | R supp  | 350       | 1000       | 0.0         | 0.00       | 0.00                  | 0.16     | 0.00      | *                        | 571                       | 0 |

\* = Nominal Reinforcement

### CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at: SUPPORT CENTERLINES

| MARK    | pos.   | As_B | As_T | Bottom Bars                                                                | Top Bars                            |
|---------|--------|------|------|----------------------------------------------------------------------------|-------------------------------------|
| (1) B48 | L supp | 0    | 571  | - - -                                                                      | 7Y10 @153( 97%)<br>11Y 8 @ 92( 96%) |
|         | span   | 1590 | 0    | 6Y18 @182( 96%)<br>8Y16 @131(101%)<br>10Y14 @102( 97%)<br>14Y12 @ 71(100%) | - - -                               |
|         | R supp | 0    | 571  | - - -                                                                      | 7Y10 @153( 97%)<br>11Y 8 @ 92( 96%) |
|         |        |      |      |                                                                            |                                     |
|         |        |      |      |                                                                            |                                     |

### BEAM DESIGN FOR SHEAR

Value of  $v_c$  Near Supports Based on Tension Steel Calculated at:  
SUPPORT CENTERLINES.

$f_{cu} = 25\text{MPa}$   $f_{yv} = 420\text{MPa}$

CODE: BS8110

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : Beam B48  
 DATE : February 23, 2000

Page 409

| MARK   | X1 - X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | vc<br>(MPa) | Asv/Sv<br>(mm) | Stirrups |          |          |
|--------|---------------------|------------|------------|-------------|----------------|----------|----------|----------|
| 1) B48 | L 0.10- 0.45        | 298.99     | 0.854      | 0.502       | 1.095 *        | 3Y10@262 | 4Y10@262 | 5Y10@262 |
|        | 0.28- 1.90          |            |            |             | 1.095 *        | 3Y10@262 | 4Y10@262 | 5Y10@262 |
|        | R 1.55- 1.90        | 158.53     | 0.453      | 0.502       | 1.095 *        | 3Y10@262 | 4Y10@262 | 5Y10@262 |

\* = Nominal Stirrups

=====

OGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OJECT : National Museum - Amman  
 FRAME : Beam B49  
 DATE : February 23, 2000

Page 410

Design Code: BS8110  
 Frame Type: Simple Beam  
 Load Pattern for Span Mom: Alternate Spans Loaded.  
 Load Pattern for Supp Mom: All Spans Loaded.  
 Load Factors: Code Standard

# BEAMS

| MARK    | PROPERTIES |       |      | UNIFORM LOADS |       |      |      |
|---------|------------|-------|------|---------------|-------|------|------|
|         | Span       | b (I) | h    | DEAD          | LIVE  | X1   | X2   |
| (1) B49 | 8.00       | 1.00  | 0.40 | 22.62         | 19.50 | 0.00 | 8.00 |

## SUPPORTS

| Support # | BREADTH |
|-----------|---------|
| 1         | 0.15    |
| 2         | 0.20    |

## MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

| MARK    | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|---------|------------------|------|-------------------|------|------------------|------|
|         | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) B49 | +502.94          | 4.00 | +180.96           | 4.00 | +502.94          | 4.00 |

## ELASTIC BEAM SHEARS

| MARK    | AT LEFT SUPPORT | AT 0.10 OF SPAN | AT 0.20 OF SPAN | AT 0.80 OF SPAN | AT 0.90 OF SPAN | AT RIGHT SUPPORT |
|---------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| (1) B49 | +251.47         | +201.18         | +150.88         | -150.88         | -201.18         | -251.47          |

## ELASTIC SUPPORT REACTIONS

| MARK | ODD SPANS L'D |  | EVEN SPANS L'D |  | ALL SPANS LOADED |           |
|------|---------------|--|----------------|--|------------------|-----------|
|      | Design Load   |  | Design Load    |  | Dead Load        | Live Load |
| #1   | 251.47        |  | 90.48          |  | 90.48            | 78.00     |
| #2   | 251.47        |  | 90.48          |  | 90.48            | 78.00     |

## BEAM DESIGN FOR FLEXURE

fcu= 25MPa fy= 420MPa

CODE: BS8110

|         | b<br>( mm ) | h<br>( mm ) | c<br>( mm ) | d'<br>( mm ) |    |
|---------|-------------|-------------|-------------|--------------|----|
| (1) B49 | 1000        | 400         | 50          | 50           | mm |

hf= 0 mm(Rectangular)

OGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OJECT : National Museum - Amman  
 FRAME : Beam B49  
 DATE : February 23, 2000

Page 411

| MARK    | pos.    | d<br>(mm) | bf<br>(mm) | M<br>(kN.m) | R<br>(MPa) | x/d  | p<br>(%) | p'<br>(%) | As<br>(mm <sup>2</sup> ) | As'<br>(mm <sup>2</sup> ) |
|---------|---------|-----------|------------|-------------|------------|------|----------|-----------|--------------------------|---------------------------|
| (1) B49 | L supp  | 350       | 1000       | 0.0         | 0.00       | 0.00 | 0.16     | 0.00      | * 571                    | 0                         |
|         | L sup F | 350       | 1000       | +6.7        | 0.05       | 0.01 | 0.16     | 0.00      | * 571                    | 0                         |
|         | span    | 350       | 1000       | +502.9      | 4.11       | 0.50 | 1.44     | 0.07      | 5052                     | 236                       |
|         | R sup F | 350       | 1000       | +8.9        | 0.07       | 0.01 | 0.16     | 0.00      | * 571                    | 0                         |
|         | R supp  | 350       | 1000       | 0.0         | 0.00       | 0.00 | 0.16     | 0.00      | * 571                    | 0                         |

\* = Nominal Reinforcement

#### CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at: SUPPORT CENTERLINES

| MARK    | pos.   | As_B | As_T | Bottom Bars                                                                 | Top Bars                                   |
|---------|--------|------|------|-----------------------------------------------------------------------------|--------------------------------------------|
| (1) B49 | L supp | 0    | 571  | - - -                                                                       | 7Y10 @153( 97%)<br>11Y 8 @ 92( 96%)        |
|         | span   | 5052 | 236  | 6Y32 @180( 95%)<br>10Y25 @101( 97%)<br>19Y18 @ 51( 96%)<br>13Y22 @ 76( 98%) | 6Y 8 @184(127%)<br>- - -<br>- - -<br>- - - |
|         | R supp | 0    | 571  | - - -                                                                       | 7Y10 @153( 97%)<br>11Y 8 @ 92( 96%)        |

#### BEAM DESIGN FOR SHEAR

Value of vc Near Supports Based on Tension Steel Calculated at:  
SUPPORT CENTERLINES.

fcu= 25MPa fyv= 420MPa

CODE: BS8110

| MARK   | X1 - X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | vc<br>(MPa) | Asv/Sv<br>(mm) | Stirrups                   |
|--------|---------------------|------------|------------|-------------|----------------|----------------------------|
| 1) B49 | L 0.08- 0.43        | 224.75     | 0.642      | 0.357       | 1.095 *        | 3Y10@262 4Y10@262 5Y10@262 |
|        | 0.08- 7.90          |            |            |             | 1.095 *        | 3Y10@262 4Y10@262 5Y10@262 |
|        | R 7.55- 7.90        | 223.18     | 0.638      | 0.357       | 1.095 *        | 3Y10@262 4Y10@262 5Y10@262 |

\* = Nominal Stirrups

OGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : Beam B50  
 DATE : February 23, 2000

Page 412

Design Code: BS8110  
 Frame Type: Plane Subframe  
 Load Pattern for Span Mom: Alternate Spans Loaded.  
 Load Pattern for Supp Mom: All Spans Loaded.  
 Load Factors: Code Standard

# BEAMS

| MARK    | PROPERTIES |       |      | UNIFORM LOADS |       |      |      | POINT LOADS |       |      |
|---------|------------|-------|------|---------------|-------|------|------|-------------|-------|------|
|         | Span       | b (I) | h    | DEAD          | LIVE  | X1   | X2   | DEAD        | LIVE  | X    |
| (1) B50 | 8.00       | 1.20  | 0.40 | 29.00         | 25.00 | 0.00 | 3.00 | 90.48       | 78.00 | 3.00 |
|         |            |       |      | 42.92         | 37.00 | 3.00 | 8.00 | 0.00        | 0.00  | 0.00 |

# COLUMNS AND SUPPORTS

| SUPPORT<br>No.<br>L-->R | COLUMNS ABOVE |       |      | COLUMNS BELOW |       |      | SUPPORT<br>BREADTH<br>h |
|-------------------------|---------------|-------|------|---------------|-------|------|-------------------------|
|                         | Height        | b (I) | h    | Height        | b (I) | h    |                         |
| 1                       | 8.00          | 1.00  | 0.30 | 7.50          | 1.00  | 0.30 | 0.30                    |
| 2                       | 8.00          | 0.60  | 0.60 | 7.50          | 0.60  | 0.60 | 0.60                    |

# ELASTIC BEAM SUPPORT MOMENTS

| MARK    | ODD SPANS LOADED |         | EVEN SPANS LOADED |         | ALL SPANS LOADED |         |
|---------|------------------|---------|-------------------|---------|------------------|---------|
|         | Left             | Right   | Left              | Right   | Left             | Right   |
| (1) B50 | -399.50          | -821.19 | -143.74           | -295.47 | -399.50          | -821.19 |

# MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

| MARK    | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|---------|------------------|------|-------------------|------|------------------|------|
|         | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) B50 | +699.39          | 3.04 | +251.64           | 3.04 | +699.39          | 3.04 |

# ELASTIC BEAM SHEARS

| MARK    | AT LEFT<br>SUPPORT | AT 0.10<br>OF SPAN | AT 0.20<br>OF SPAN | AT 0.80<br>OF SPAN | AT 0.90<br>OF SPAN | AT RIGHT<br>SUPPORT |
|---------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|
| (1) B50 | +487.31            | +422.83            | +358.35            | -411.54            | -506.97            | -602.40             |

# ELASTIC SUPPORT REACTIONS

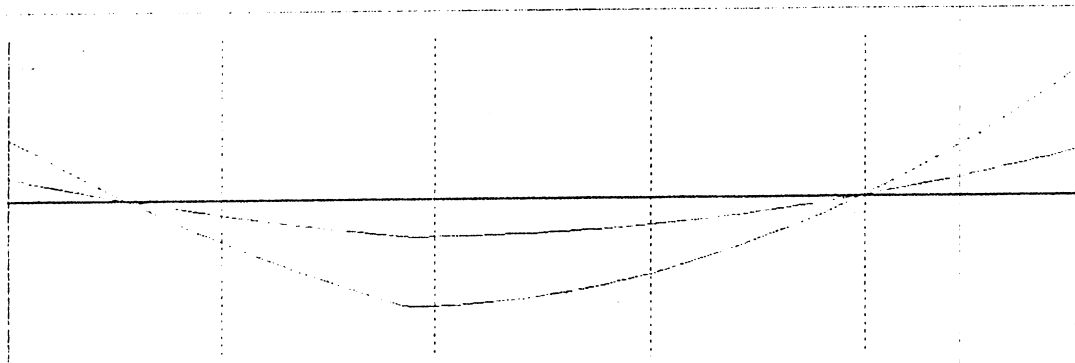
| MARK | ODD SPANS L'D |  | EVEN SPANS L'D |  | ALL SPANS LOADED |           |
|------|---------------|--|----------------|--|------------------|-----------|
|      | Design Load   |  | Design Load    |  | Dead Load        | Live Load |
| #1   | 487.31        |  | 175.33         |  | 175.33           | 151.15    |
| #2   | 602.40        |  | 216.75         |  | 216.75           | 186.85    |

GRAM : SFRM - R.C. SubFrame Analysis and Design  
 JECT : National Museum - Amman  
 FRAME : Beam B50  
 DATE : February 23, 2000

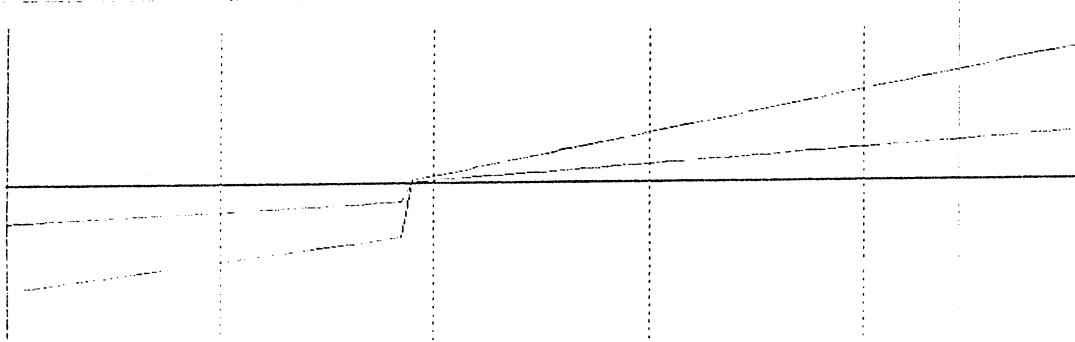
Page 413

ELASTIC COLUMN MOMENTS (CCW +ve)

| MARK   | ODD SPANS LOADED |         | EVEN SPANS LOADED |         | ALL SPANS LOADED |         |
|--------|------------------|---------|-------------------|---------|------------------|---------|
| COLUMN | ABOVE            | BELOW   | ABOVE             | BELOW   | ABOVE            | BELOW   |
| #1     | -193.30          | -206.19 | -69.55            | -74.19  | -193.30          | -206.19 |
| #2     | +397.35          | +423.84 | +142.97           | +152.50 | +397.35          | +423.84 |



ending Moment Diagram



Shear Diagram

REDISTRIBUTED BEAM SUPPORT MOMENTS

| MARK    | ODD SPANS LOADED |         | EVEN SPANS LOADED |         | ALL SPANS LOADED |         |
|---------|------------------|---------|-------------------|---------|------------------|---------|
|         | Left             | Right   | Left              | Right   | Left             | Right   |
| (1) B50 | -319.60          | -656.95 | -143.74           | -295.47 | -319.60          | -656.95 |

MAXIMUM REDISTRIBUTED BEAM SPAN MOMENTS (X to nearest 0.01 L)

| MARK    | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|---------|------------------|------|-------------------|------|------------------|------|
|         | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) B50 | +811.34          | 3.04 | +251.64           | 3.04 | +811.34          | 3.04 |

OGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OJECT : National Museum - Amman  
 FRAME : Beam B50  
 DATE : February 23, 2000

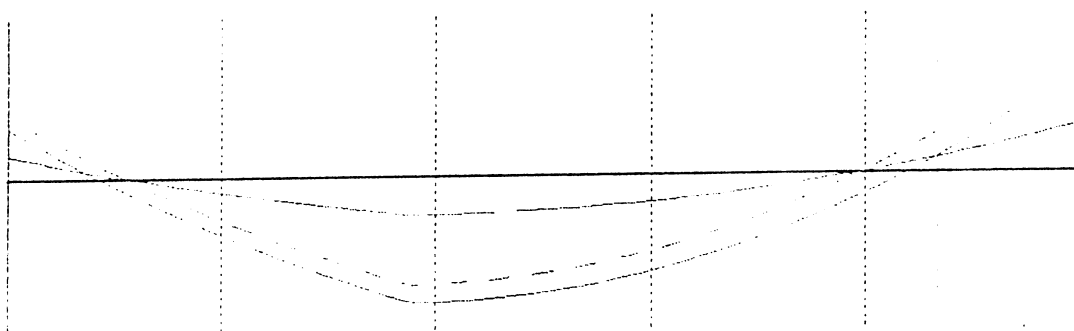
Page 414

# REDISTRIBUTED BEAM SHEARS

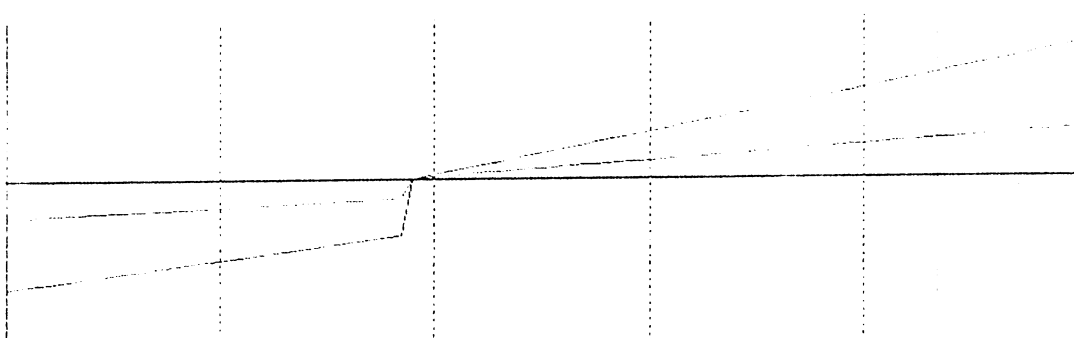
| MARK    | AT LEFT<br>SUPPORT | AT 0.10<br>OF SPAN | AT 0.20<br>OF SPAN | AT 0.80<br>OF SPAN | AT 0.90<br>OF SPAN | AT RIGHT<br>SUPPORT |
|---------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|
| (1) B50 | +497.85            | +433.37            | +368.89            | -401.00            | -496.43            | -591.86             |

# REDISTRIBUTED SUPPORT REACTIONS

| MARK    | ODD SPANS L'D | EVEN SPANS L'D | ALL SPANS LOADED |           |             |
|---------|---------------|----------------|------------------|-----------|-------------|
| SUPPORT | Design Load   | Design Load    | Dead Load        | Live Load | Design Load |
| #1      | 497.85        | 175.33         | 175.33           | 151.15    | 497.85      |
| #2      | 591.86        | 216.75         | 216.75           | 186.85    | 591.86      |



Bending Moment Diagram



Shear Diagram

# BEAM DESIGN FOR FLEXURE

$f_{cu} = 25\text{MPa}$   $f_y = 420\text{MPa}$

CODE: BS8110

$b$  (mm)  $h$  (mm)  $c$  (mm)  $d'$  (mm)

$h_f = 0$  mm(Rectangular)

(1) B50 1200 400 50 50 mm

OGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OJECT : National Museum - Amman  
 FRAME : Beam B50  
 DATE : February 23, 2000

Page 415

| MARK    | pos.    | d<br>(mm) | bf<br>(mm) | M<br>(kN.m) | R<br>(MPa) | x/d  | p<br>(%) | p'<br>(%) | As<br>(mm <sup>2</sup> ) | As'<br>(mm <sup>2</sup> ) |
|---------|---------|-----------|------------|-------------|------------|------|----------|-----------|--------------------------|---------------------------|
| (1) B50 | L supp  | 350       | 1200       | -319.6      | 2.17       | 0.24 | 0.67     | 0.00      | 2807                     |                           |
|         | L sup F | 350       | 1200       | -245.9      | 1.67       | 0.18 | 0.50     | 0.00      | 2094                     |                           |
|         | span    | 350       | 1200       | +811.3      | 5.52       | 0.50 | 1.89     | 0.52      | 7959                     | 2180                      |
|         | R sup F | 350       | 1200       | -484.8      | 3.30       | 0.40 | 1.10     | 0.00      | 4625                     |                           |
|         | R supp  | 350       | 1200       | -657.0      | 4.47       | 0.40 | 1.48     | 0.37      | 6196                     | 1570                      |

#### CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at:  
MEDIAN BETWEEN SUPPORT FACES AND CETERLINES

| MARK    | pos.   | As_B | As_T | Bottom Bars                                                                  | Top Bars                                                                    |
|---------|--------|------|------|------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| (1) B50 | L supp | 0    | 2451 | - - -                                                                        | 8Y20 @159(103%)<br>7Y22 @185(109%)<br>10Y18 @124(104%)<br>12Y16 @101( 98%)  |
|         | span   | 7959 | 2180 | 16Y25 @ 74( 99%)<br>20Y22 @ 58( 95%)<br>25Y20 @ 46( 99%)<br>10Y32 @122(101%) | 7Y20 @185(101%)<br>9Y18 @139(105%)<br>11Y16 @111(101%)<br>14Y14 @ 86( 99%)  |
|         | R supp | 788  | 5411 | 7Y12 @186(100%)<br>10Y10 @124(100%)<br>15Y 8 @ 80( 95%)                      | 11Y25 @111(100%)<br>7Y32 @183(104%)<br>17Y20 @ 69( 99%)<br>14Y22 @ 85( 98%) |
|         |        |      |      | - - -                                                                        |                                                                             |
|         |        |      |      |                                                                              |                                                                             |

#### BEAM DESIGN FOR SHEAR

Value of vc Near Supports Based on Tension Steel Calculated at:  
MEDIAN BETWEEN SUPPORT FACES AND CETERLINES.

f<sub>cu</sub>= 25MPa f<sub>yv</sub>= 420MPa

CODE: BS8110

| MARK    | X1 - X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | vc<br>(MPa) | Asv/Sv<br>(mm) | Stirrups                   |
|---------|---------------------|------------|------------|-------------|----------------|----------------------------|
| (1) B50 | L 0.15- 0.50        | 457.55     | 1.089      | 0.546       | 1.784          | 3Y10@262 4Y10@262 5Y10@262 |
|         | 0.15- 7.29          |            |            |             | 1.314 *        | 3Y10@262 4Y10@262 5Y10@262 |
|         | R 7.35- 7.70        | 514.32     | 1.225      | 0.711       | 1.687          | 3Y10@262 4Y10@262 5Y10@262 |

Nominal Stirrups

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 PROJECT : National Museum - Amman  
 MEMBER : Beam B51  
 DATE : February 23, 2000

Page 416

Design Code: BS8110  
 Frame Type: Simple Beam  
 Load Pattern for Span Mom: Alternate Spans Loaded.  
 Load Pattern for Supp Mom: All Spans Loaded.  
 Load Factors: Code Standard

# BEAMS

| MARK    | PROPERTIES |       |      | UNIFORM LOADS |       |      |      |
|---------|------------|-------|------|---------------|-------|------|------|
|         | Span       | b (I) | h    | DEAD          | LIVE  | X1   | X2   |
| (1) B51 | 5.20       | 1.00  | 0.40 | 32.48         | 28.00 | 0.00 | 5.20 |

| SUPPORTS | Support # |   | BREADTH |      |
|----------|-----------|---|---------|------|
|          | 1         | 2 | 0.20    | 0.60 |
|          |           |   |         |      |

# MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

| MARK    | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|---------|------------------|------|-------------------|------|------------------|------|
|         | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) B51 | +305.12          | 2.60 | +109.78           | 2.60 | +305.12          | 2.60 |

# ELASTIC BEAM SHEARS

| MARK    | AT LEFT SUPPORT | AT 0.10 OF SPAN | AT 0.20 OF SPAN | AT 0.80 OF SPAN | AT 0.90 OF SPAN | AT RIGHT SUPPORT |
|---------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| (1) B51 | +234.71         | +187.77         | +140.82         | -140.82         | -187.77         | -234.71          |

# ELASTIC SUPPORT REACTIONS

| RK<br>SUPPORT | ODD SPANS L'D | EVEN SPANS L'D | ALL SPANS LOADED |           |             |
|---------------|---------------|----------------|------------------|-----------|-------------|
|               | Design Load   | Design Load    | Dead Load        | Live Load | Design Load |
| #1            | 234.71        | 84.45          | 84.45            | 72.80     | 234.71      |
| #2            | 234.71        | 84.45          | 84.45            | 72.80     | 234.71      |

# BEAM DESIGN FOR FLEXURE

fcu= 25MPa fy= 420MPa

CODE: BS8110

|         | b<br>(mm) | h<br>(mm) | c<br>(mm) | d'<br>(mm) |    |
|---------|-----------|-----------|-----------|------------|----|
| (1) B51 | 1000      | 400       | 50        | 50         | mm |

hf= 0 mm(Rectangular)

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 PROJECT : National Museum - Amman  
 NAME : Beam B51  
 DATE : February 23, 2000

Page 417

| MARK  | pos.    | d<br>( mm ) | bf<br>( mm ) | M<br>( kN.m ) | R<br>( MPa ) | x/d  | p<br>( % ) | p'<br>( % ) | As<br>( mm^2 ) | As'<br>( mm^2 ) |   |
|-------|---------|-------------|--------------|---------------|--------------|------|------------|-------------|----------------|-----------------|---|
| ) B51 | L supp  | 350         | 1000         | 0.0           | 0.00         | 0.00 | 0.16       | 0.00        | *              | 571             | 0 |
|       | L sup F | 350         | 1000         | +8.3          | 0.07         | 0.01 | 0.16       | 0.00        | *              | 571             | 0 |
|       | span    | 350         | 1000         | +305.1        | 2.49         | 0.28 | 0.78       | 0.00        |                | 2737            | 0 |
|       | R sup F | 350         | 1000         | +23.9         | 0.19         | 0.02 | 0.16       | 0.00        | *              | 571             | 0 |
|       | R supp  | 350         | 1000         | 0.0           | 0.00         | 0.00 | 0.16       | 0.00        | *              | 571             | 0 |

\* = Nominal Reinforcement

#### CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at: SUPPORT CENTERLINES

| MARK  | pos.   | As_B | As_T | Bottom Bars                                                               | Top Bars                            |
|-------|--------|------|------|---------------------------------------------------------------------------|-------------------------------------|
| ) B51 | L supp | 0    | 571  | - - -                                                                     | 7Y10 @153( 97%)<br>11Y 8 @ 92( 96%) |
|       | span   | 2737 | 0    | 6Y25 @181(108%)<br>7Y22 @151( 97%)<br>9Y20 @114(103%)<br>13Y16 @ 76( 95%) | - - -                               |
|       | R sup  | 0    | 571  | - - -                                                                     | 7Y10 @153( 97%)<br>11Y 8 @ 92( 96%) |
|       |        |      |      |                                                                           |                                     |
|       |        |      |      |                                                                           |                                     |

#### BEAM DESIGN FOR SHEAR

Value of vc Near Supports Based on Tension Steel Calculated at:  
SUPPORT CENTERLINES.

fcu= 25MPa fyv= 420MPa

CODE: BS8110

| MARK  | X1 - X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | vc<br>(MPa) | Asv/Sv<br>(mm) | Stirrups                   |
|-------|---------------------|------------|------------|-------------|----------------|----------------------------|
| ) B51 | L 0.10- 0.45        | 194.08     | 0.555      | 0.357       | 1.095 *        | 3Y10@262 4Y10@262 5Y10@262 |
|       | 0.10- 4.90          |            |            |             | 1.095 *        | 3Y10@262 4Y10@262 5Y10@262 |
|       | R 4.55- 4.90        | 176.03     | 0.503      | 0.357       | 1.095 *        | 3Y10@262 4Y10@262 5Y10@262 |

= Nominal Stirrups

OGRAM : COLM - Reinforced Concrete Column Design  
 OBJECT : National Museum - Amman  
 COLUMN : Column on AxisLines X9/Y02  
 DATE : February 23, 2000

Page 418

fcu = 30 MPa  
 fy = 420 MPa

Factor for Dead Load = 1.40  
 Factor for Live Load = 1.60

REDUCTION IN LIVE LOADING CONSIDERED

DESIGN LOADING FROM MAIN FRAME (in X-Direction).

| No. | Level  | Subframe | Sup | Case | Nu    | M above | M below |
|-----|--------|----------|-----|------|-------|---------|---------|
| 1   | T Roof | ----     |     | 1    | 0.0   | 0.0     | 0.0     |
|     |        |          |     | 2    | 0.0   | 0.0     | 0.0     |
|     |        |          |     | 3    | 0.0   | 0.0     | 0.0     |
| 2   | Roof   | Beam H8  | 1   | 1    | 128.1 | -3.4    | -3.2    |
|     |        |          | 1   | 2    | 128.1 | -3.4    | -3.2    |
|     |        |          | 1   | 3    | 64.3  | -1.7    | -1.6    |
| 3   | 2nd    | ----     |     | 1    | 0.0   | 0.0     | 0.0     |
|     |        |          |     | 2    | 0.0   | 0.0     | 0.0     |
|     |        |          |     | 3    | 0.0   | 0.0     | 0.0     |
| 4   | 1st    | ----     |     | 1    | 0.0   | 0.0     | 0.0     |
|     |        |          |     | 2    | 0.0   | 0.0     | 0.0     |
|     |        |          |     | 3    | 0.0   | 0.0     | 0.0     |
| 5   | Grd    | ----     |     | 1    | 0.0   | 0.0     | 0.0     |
|     |        |          |     | 2    | 0.0   | 0.0     | 0.0     |
|     |        |          |     | 3    | 0.0   | 0.0     | 0.0     |

DESIGN LOADING FROM CROSS FRAME (in Y-Direction).

| No. | Level | Subframe     | Sup | Case | Nu     | M above | M below |
|-----|-------|--------------|-----|------|--------|---------|---------|
| 3   | 2nd   | Beam H10     | 1   | 1    | 1044.7 | -351.0  | -351.0  |
|     |       |              | 1   | 2    | 1044.7 | -351.0  | -351.0  |
|     |       |              | 1   | 3    | 508.2  | -166.8  | -166.8  |
| 5   | Grd   | Wall Beam W8 | 2   | 1    | 1343.0 | 0.0     | 2.6     |
|     |       |              | 2   | 2    | 1343.0 | 0.0     | 2.6     |
|     |       |              | 2   | 3    | 635.4  | 0.0     | 1.2     |

ADDITIONAL SERVICE LOADING

| No. | Storey | G     | Q     | Mxu  | Myu  |
|-----|--------|-------|-------|------|------|
| 1   | Roof   | 935.0 | 152.0 | 20.0 | 20.0 |
| 2   | 2nd    | 35.0  | 0.0   | 0.0  | 0.0  |
| 3   | 1st    | 35.0  | 0.0   | 0.0  | 0.0  |
| 4   | Grd    | 35.0  | 0.0   | 0.0  | 0.0  |
| 5   | Bas    | 221.8 | 140.0 | 20.0 | 20.0 |

TOTAL DESIGN LOADING

| No. | Storey | Case | Nu     | Red. | MxT    | MxB    | MyT  | MyB  |
|-----|--------|------|--------|------|--------|--------|------|------|
| 1   | Roof   | 1    | 1552.3 | 0    | 0.0    | 0.0    | 0.0  | -3.4 |
|     |        | 2    | 1552.3 | 0    | 0.0    | 0.0    | 0.0  | -3.4 |
|     |        | 3    | 1552.3 | 0    | 0.0    | 0.0    | 0.0  | -1.7 |
| 2   | 2nd    | 1    | 1705.0 | 10   | 0.0    | -351.0 | -3.2 | 0.0  |
|     |        | 2    | 1705.0 | 10   | 0.0    | -351.0 | -3.2 | 0.0  |
|     |        | 3    | 1641.3 | 10   | 0.0    | -166.8 | -1.6 | 0.0  |
| 3   | 1st    | 1    | 2774.4 | 20   | -351.0 | 0.0    | 0.0  | 0.0  |
|     |        | 2    | 2774.4 | 20   | -351.0 | 0.0    | 0.0  | 0.0  |
|     |        | 3    | 2237.9 | 20   | -166.8 | 0.0    | 0.0  | 0.0  |
| 4   | Grd    | 1    | 2799.1 | 30   | 0.0    | 0.0    | 0.0  | 0.0  |
|     |        | 2    | 2799.1 | 30   | 0.0    | 0.0    | 0.0  | 0.0  |
|     |        | 3    | 2799.1 | 30   | 0.0    | 0.0    | 0.0  | 0.0  |

TOTAL DESIGN LOADING

| No. | Storey | Case | Nu     | Red. | MxT | MxB  | MyT | MyB |
|-----|--------|------|--------|------|-----|------|-----|-----|
| 5   | Bas    | 1    | 4562.6 | 40   | 2.6 | -2.6 | 0.0 | 0.0 |
|     |        | 2    | 4562.6 | 40   | 2.6 | -2.6 | 0.0 | 0.0 |
|     |        | 3    | 3855.0 | 40   | 1.2 | -1.2 | 0.0 | 0.0 |

|               |        |        |        |              |     |              |    |  |
|---------------|--------|--------|--------|--------------|-----|--------------|----|--|
| Storey : Roof |        |        |        |              |     |              |    |  |
|               | Case1  | Case2  | Case3  | Section      |     |              |    |  |
| N =           | 1552.3 | 1552.3 | 1552.3 | Breadth, b = | 600 | b Bars =     | 2  |  |
| L =           | 20.0   | 0.0    | 0.0    | Depth, h =   | 425 | h Bars =     | 2  |  |
| V =           | 23.4   | 3.4    | 1.7    | Cover, c =   | 50  | Total Bars = | 12 |  |

|                |           |      |         |           |       |       |       |  |
|----------------|-----------|------|---------|-----------|-------|-------|-------|--|
| UNIAXIAL Short |           |      | NOMINAL |           |       |       |       |  |
| Nominal My =   | 31.0      | kN.m |         | Bar Dia = | Case1 | Case2 | Case3 |  |
| Nominal Bar =  | 12.74     | mm   |         | % =       | 0.00  | 0.00  | 0.00  |  |
| ---> p =       | 0.60      | %    |         |           | 0.00  | 0.00  | 0.00  |  |
| USE: Bar Dia = | 14        | mm   |         |           |       |       |       |  |
| ---> p =       | 0.72      | %    |         |           |       |       |       |  |
| Ratio =        | (120.74%) |      |         |           |       |       |       |  |

|              |        |        |        |              |     |              |    |  |
|--------------|--------|--------|--------|--------------|-----|--------------|----|--|
| Storey : 2nd |        |        |        |              |     |              |    |  |
|              | Case1  | Case2  | Case3  | Section      |     |              |    |  |
| N =          | 1705.0 | 1705.0 | 1641.3 | Breadth, b = | 600 | b Bars =     | 2  |  |
| L =          | 351.0  | 351.0  | 166.8  | Depth, h =   | 425 | h Bars =     | 2  |  |
| V =          | 3.2    | 3.2    | 1.6    | Cover, c =   | 50  | Total Bars = | 12 |  |

|                |          |    |  |           |       |       |       |  |
|----------------|----------|----|--|-----------|-------|-------|-------|--|
| UNIAXIAL Short |          |    |  |           |       |       |       |  |
|                |          |    |  | Bar Dia = | Case1 | Case2 | Case3 |  |
|                |          |    |  | % =       | 20.48 | 20.48 | 0.00  |  |
|                |          |    |  |           | 1.55  | 1.55  | 0.00  |  |
| USE: Bar Dia = | 20       | mm |  |           |       |       |       |  |
| ---> p =       | 1.48     | %  |  |           |       |       |       |  |
| Ratio =        | (95.35%) |    |  |           |       |       |       |  |

|              |        |        |        |              |     |              |    |  |
|--------------|--------|--------|--------|--------------|-----|--------------|----|--|
| Storey : 1st |        |        |        |              |     |              |    |  |
|              | Case1  | Case2  | Case3  | Section      |     |              |    |  |
| N =          | 2774.4 | 2774.4 | 2237.9 | Breadth, b = | 600 | b Bars =     | 2  |  |
| L =          | 351.0  | 351.0  | 166.8  | Depth, h =   | 425 | h Bars =     | 2  |  |
| V =          | 0.0    | 0.0    | 0.0    | Cover, c =   | 50  | Total Bars = | 12 |  |

|                |           |    |  |           |       |       |       |  |
|----------------|-----------|----|--|-----------|-------|-------|-------|--|
| UNIAXIAL Short |           |    |  |           |       |       |       |  |
|                |           |    |  | Bar Dia = | Case1 | Case2 | Case3 |  |
|                |           |    |  | % =       | 24.09 | 24.09 | 2.62  |  |
|                |           |    |  |           | 2.15  | 2.15  | 0.03  |  |
| USE: Bar Dia = | 25        | mm |  |           |       |       |       |  |
| ---> p =       | 2.31      | %  |  |           |       |       |       |  |
| Ratio =        | (107.69%) |    |  |           |       |       |       |  |

PROGRAM : COLM - Reinforced Concrete Column Design  
 PROJECT : National Museum - Amman  
 COLUMN : Column on AxisLines X9/Y02  
 DATE : February 23, 2000

Page 420

|                        |           |        |  |                   |       |              |       |
|------------------------|-----------|--------|--|-------------------|-------|--------------|-------|
| Storey : Grd           |           |        |  | Section           |       |              |       |
| Case1                  | Case2     | Case3  |  | Breadth, b =      | 600   | b Bars =     | 2     |
| 2799.1                 | 2799.1    | 2799.1 |  | Depth, h =        | 425   | h Bars =     | 2     |
| 0.0                    | 0.0       | 0.0    |  | Cover, c =        | 50    | Total Bars = | 12    |
| 0.0                    | 0.0       | 0.0    |  |                   |       |              |       |
| UNIAXIAL Short NOMINAL |           |        |  | Case1 Case2 Case3 |       |              |       |
| Nominal My =           | 56.0 kN.m |        |  | Bar Dia =         | 0.00  | 0.00         | 0.00  |
| Nominal Bar =          | 12.74 mm  |        |  | % =               | 0.00  | 0.00         | 0.00  |
| ---> p =               | 0.60 %    |        |  |                   |       |              |       |
| USE: Bar Dia = 14 mm   |           |        |  |                   |       |              |       |
| ---> p =               | 0.72 %    |        |  |                   |       |              |       |
| Ratio = (120.74%)      |           |        |  |                   |       |              |       |
| Storey : Bas           |           |        |  | Section           |       |              |       |
| Case1                  | Case2     | Case3  |  | Breadth, b =      | 600   | b Bars =     | 2     |
| 4562.6                 | 4562.6    | 3855.0 |  | Depth, h =        | 425   | h Bars =     | 2     |
| 22.6                   | 2.6       | 1.2    |  | Cover, c =        | 50    | Total Bars = | 12    |
| 20.0                   | 0.0       | 0.0    |  |                   |       |              |       |
| UNIAXIAL Short         |           |        |  | Case1 Case2 Case3 |       |              |       |
| Nominal My =           | 77.1 kN.m |        |  | Bar Dia =         | 21.00 | 21.00        | 14.48 |
|                        |           |        |  | % =               | 1.63  | 1.63         | 0.77  |
| USE: Bar Dia = 22 mm   |           |        |  |                   |       |              |       |
| ---> p =               | 1.79 %    |        |  |                   |       |              |       |
| Ratio = (109.78%)      |           |        |  |                   |       |              |       |

#### DESIGN SUMMARY

| Storey | Nu<br>(kN) | Breadth<br>(mm) | Depth<br>(mm) | Reinf.<br>(%) | Bars |   |     |      |
|--------|------------|-----------------|---------------|---------------|------|---|-----|------|
|        |            |                 |               |               | b    | h | Tot | Dia. |
| Roof   | 1552.3     | 600             | 425           | 0.724         | 2    | 2 | 12  | 14   |
| 2nd    | 1705.0     | 600             | 425           | 1.478         | 2    | 2 | 12  | 20   |
| 1st    | 2774.4     | 600             | 425           | 2.310         | 2    | 2 | 12  | 25   |
| Grd    | 2799.1     | 600             | 425           | 0.724         | 2    | 2 | 12  | 14   |
| Bas    | 4562.6     | 600             | 425           | 1.789         | 2    | 2 | 12  | 22   |

PROGRAM : COLM - Reinforced Concrete Column Design  
 OBJECT : National Museum - Amman  
 COLUMN : Column on AxisLines X8/Y02  
 DATE : February 23, 2000

Page 421

f<sub>cu</sub> = 30 MPa  
 f<sub>y</sub> = 420 MPa

Factor for Dead Load = 1.40  
 Factor for Live Load = 1.60

REDUCTION IN LIVE LOADING CONSIDERED

DESIGN LOADING FROM MAIN FRAME (in X-Direction).

| No. | Level  | Subframe | Sup | Case | Nu    | M above | M below |
|-----|--------|----------|-----|------|-------|---------|---------|
| 1   | T Roof | ----     |     | 1    | 0.0   | 0.0     | 0.0     |
|     |        |          |     | 2    | 0.0   | 0.0     | 0.0     |
|     |        |          |     | 3    | 0.0   | 0.0     | 0.0     |
| 2   | Roof   | Beam B13 | 2   | 1    | 280.5 | 133.1   | 123.5   |
|     |        |          | 2   | 2    | 280.5 | 133.1   | 123.5   |
|     |        |          | 2   | 3    | 146.3 | 69.6    | 64.6    |
| 3   | 2nd    | Beam B30 | 2   | 1    | 417.7 | 202.6   | 175.6   |
|     |        |          | 2   | 2    | 417.7 | 202.6   | 175.6   |
|     |        |          | 2   | 3    | 154.5 | 74.9    | 64.9    |
| 4   | 1st    | -----    |     | 1    | 0.0   | 0.0     | 0.0     |
|     |        |          |     | 2    | 0.0   | 0.0     | 0.0     |
|     |        |          |     | 3    | 0.0   | 0.0     | 0.0     |
| 5   | Grd    | -----    |     | 1    | 0.0   | 0.0     | 0.0     |
|     |        |          |     | 2    | 0.0   | 0.0     | 0.0     |
|     |        |          |     | 3    | 0.0   | 0.0     | 0.0     |

DESIGN LOADING FROM CROSS FRAME (in Y-Direction).

| No. | Level | Subframe     | Sup | Case | Nu     | M above | M below |
|-----|-------|--------------|-----|------|--------|---------|---------|
| 3   | 2nd   | Beam H10     | 1   | 1    | 1044.7 | -351.0  | -351.0  |
|     |       |              | 1   | 2    | 1044.7 | -351.0  | -351.0  |
|     |       |              | 1   | 3    | 508.2  | -166.8  | -166.8  |
| 5   | Grd   | Wall Beam W9 | 2   | 1    | 2068.1 | 0.0     | 8.6     |
|     |       |              | 2   | 2    | 2068.1 | 0.0     | 8.6     |
|     |       |              | 2   | 3    | 991.3  | 0.0     | 4.1     |

ADDITIONAL SERVICE LOADING

| No. | Storey | G     | Q     | M <sub>xu</sub> | M <sub>yu</sub> |
|-----|--------|-------|-------|-----------------|-----------------|
| 1   | Roof   | 935.0 | 152.0 | 20.0            | 20.0            |
| 2   | 2nd    | 35.0  | 0.0   | 0.0             | 0.0             |
| 3   | 1st    | 35.0  | 0.0   | 0.0             | 0.0             |
| 4   | Grd    | 35.0  | 0.0   | 0.0             | 0.0             |
| 5   | Bas    | 186.8 | 140.0 | 100.0           | 20.0            |

TOTAL DESIGN LOADING

| No. | Storey | Case | Nu     | Red. | M <sub>xT</sub> | M <sub>xB</sub> | M <sub>yT</sub> | M <sub>yB</sub> |
|-----|--------|------|--------|------|-----------------|-----------------|-----------------|-----------------|
| 1   | Roof   | 1    | 1552.3 | 0    | 0.0             | 0.0             | 0.0             | 133.1           |
|     |        | 2    | 1552.3 | 0    | 0.0             | 0.0             | 0.0             | 133.1           |
|     |        | 3    | 1552.3 | 0    | 0.0             | 0.0             | 0.0             | 69.6            |
| 2   | 2nd    | 1    | 1857.5 | 10   | 0.0             | -351.0          | 123.5           | 202.6           |
|     |        | 2    | 1857.5 | 10   | 0.0             | -351.0          | 123.5           | 202.6           |
|     |        | 3    | 1723.3 | 10   | 0.0             | -166.8          | 64.6            | 74.9            |
| 3   | 1st    | 1    | 3344.6 | 20   | -351.0          | 0.0             | 175.6           | 0.0             |
|     |        | 2    | 3344.6 | 20   | -351.0          | 0.0             | 175.6           | 0.0             |
|     |        | 3    | 2544.8 | 20   | -166.8          | 0.0             | 64.9            | 0.0             |
| 4   | Grd    | 1    | 3369.3 | 30   | 0.0             | 0.0             | 0.0             | 0.0             |
|     |        | 2    | 3369.3 | 30   | 0.0             | 0.0             | 0.0             | 0.0             |
|     |        | 3    | 3369.3 | 30   | 0.0             | 0.0             | 0.0             | 0.0             |

OGRAM : COLM - Reinforced Concrete Column Design  
 OBJECT : National Museum - Amman  
 COLUMN : Column on AxisLines X8/Y02  
 DATE : February 23, 2000

Page 422

# TOTAL DESIGN LOADING

| No. | Storey | Case | Nu     | Red. | MxT | MxB  | MyT | MyB |
|-----|--------|------|--------|------|-----|------|-----|-----|
| 5   | Bas    | 1    | 5808.9 | 40   | 8.6 | -8.6 | 0.0 | 0.0 |
|     |        | 2    | 5808.9 | 40   | 8.6 | -8.6 | 0.0 | 0.0 |
|     |        | 3    | 4732.1 | 40   | 4.1 | -4.1 | 0.0 | 0.0 |

|               |        |        |         |              |     |              |    |  |
|---------------|--------|--------|---------|--------------|-----|--------------|----|--|
| Storey : Roof |        |        | Section |              |     |              |    |  |
| N =           | Case1  | Case2  | Case3   | Breadth, b = | 600 | b Bars =     | 2  |  |
| M =           | 1552.3 | 1552.3 | 1552.3  | Depth, h =   | 425 | h Bars =     | 2  |  |
| V =           | 20.0   | 0.0    | 0.0     | Cover, c =   | 50  | Total Bars = | 12 |  |
|               | 153.1  | 133.1  | 69.6    |              |     |              |    |  |

|                        |  |  |           |  |  |  |       |       |       |
|------------------------|--|--|-----------|--|--|--|-------|-------|-------|
| UNIAXIAL Short NOMINAL |  |  | Bar Dia = |  |  |  | Case1 | Case2 | Case3 |
| Nominal Bar = 12.74 mm |  |  | % =       |  |  |  | 0.00  | 0.00  | 0.00  |
| ---> p = 0.60 %        |  |  |           |  |  |  | 0.00  | 0.00  | 0.00  |
| USE: Bar Dia = 14 mm   |  |  |           |  |  |  |       |       |       |
| ---> p = 0.72 %        |  |  |           |  |  |  |       |       |       |
| Ratio = (120.74%)      |  |  |           |  |  |  |       |       |       |

|              |        |        |         |              |     |              |    |  |
|--------------|--------|--------|---------|--------------|-----|--------------|----|--|
| Storey : 2nd |        |        | Section |              |     |              |    |  |
| N =          | Case1  | Case2  | Case3   | Breadth, b = | 600 | b Bars =     | 2  |  |
| M =          | 1857.5 | 1857.5 | 1723.3  | Depth, h =   | 425 | h Bars =     | 2  |  |
| V =          | 351.0  | 351.0  | 166.8   | Cover, c =   | 50  | Total Bars = | 12 |  |
|              | 202.6  | 202.6  | 74.9    |              |     |              |    |  |

|                      |  |  |                |  |  |  |        |        |        |
|----------------------|--|--|----------------|--|--|--|--------|--------|--------|
| BIAXIAL Short        |  |  | Bar Dia =      |  |  |  | Case1  | Case2  | Case3  |
|                      |  |  | % =            |  |  |  | 25.86  | 25.86  | 3.29   |
|                      |  |  | Mux =          |  |  |  | 2.47   | 2.47   | 0.04   |
|                      |  |  | Muy =          |  |  |  | 450.53 | 450.53 | 187.21 |
|                      |  |  | Stress Ratio = |  |  |  | 672.48 | 672.48 | 264.89 |
| USE: Bar Dia = 32 mm |  |  | ALPHA =        |  |  |  | 0.9755 | 0.9755 | 0.9935 |
| ---> p = 3.78 %      |  |  |                |  |  |  | 1.2057 | 1.2057 | 1.4921 |
| Ratio = (153.16%)    |  |  |                |  |  |  |        |        |        |

|              |        |        |         |              |     |              |    |  |
|--------------|--------|--------|---------|--------------|-----|--------------|----|--|
| Storey : 1st |        |        | Section |              |     |              |    |  |
| N =          | Case1  | Case2  | Case3   | Breadth, b = | 600 | b Bars =     | 2  |  |
| M =          | 3344.6 | 3344.6 | 2544.8  | Depth, h =   | 425 | h Bars =     | 2  |  |
| V =          | 351.0  | 351.0  | 166.8   | Cover, c =   | 50  | Total Bars = | 12 |  |
|              | 175.6  | 175.6  | 64.9    |              |     |              |    |  |

|                      |  |  |                |  |  |  |        |        |        |
|----------------------|--|--|----------------|--|--|--|--------|--------|--------|
| BIAXIAL Short        |  |  | Bar Dia =      |  |  |  | Case1  | Case2  | Case3  |
|                      |  |  | % =            |  |  |  | 28.26  | 28.26  | 9.30   |
|                      |  |  | Mux =          |  |  |  | 2.95   | 2.95   | 0.32   |
|                      |  |  | Muy =          |  |  |  | 392.38 | 392.38 | 176.31 |
|                      |  |  | Stress Ratio = |  |  |  | 593.75 | 593.75 | 252.57 |
| USE: Bar Dia = 32 mm |  |  | ALPHA =        |  |  |  | 0.9879 | 0.9879 | 0.9915 |
| ---> p = 3.78 %      |  |  |                |  |  |  | 1.5670 | 1.5670 | 1.8006 |
| Ratio = (128.21%)    |  |  |                |  |  |  |        |        |        |

PROGRAM : COLM - Reinforced Concrete Column Design  
 SUBJECT : National Museum - Amman  
 COLUMN : Column on AxisLines X8/Y02  
 DATE : February 23, 2000

Page 423

|              |        |        |              |     |                 |
|--------------|--------|--------|--------------|-----|-----------------|
| Storey : Grd |        |        | Section      |     |                 |
| Case1        | Case2  | Case3  | Breadth, b = | 600 | b Bars = 2      |
| 3369.3       | 3369.3 | 3369.3 | Depth, h =   | 425 | h Bars = 2      |
| 0.0          | 0.0    | 0.0    | Cover, c =   | 50  | Total Bars = 12 |
| 0.0          | 0.0    | 0.0    |              |     |                 |

|                        |           |       |       |
|------------------------|-----------|-------|-------|
| UNIAXIAL Short NOMINAL | Case1     | Case2 | Case3 |
| Nominal My =           | 67.4 kN.m |       |       |
| Nominal Bar =          | 12.74 mm  |       |       |
| ---> p =               | 0.60 %    |       |       |
| USE: Bar Dia =         | 14 mm     |       |       |
| ---> p =               | 0.72 %    |       |       |
| Ratio =                | (120.74%) |       |       |

|              |        |        |              |     |                 |
|--------------|--------|--------|--------------|-----|-----------------|
| Storey : Bas |        |        | Section      |     |                 |
| Case1        | Case2  | Case3  | Breadth, b = | 700 | b Bars = 3      |
| 5808.9       | 5808.9 | 4732.1 | Depth, h =   | 700 | h Bars = 3      |
| 108.6        | 8.6    | 4.1    | Cover, c =   | 50  | Total Bars = 16 |
| 20.0         | 0.0    | 0.0    |              |     |                 |

|                        |           |       |       |
|------------------------|-----------|-------|-------|
| UNIAXIAL Short NOMINAL | Case1     | Case2 | Case3 |
| Nominal Mx =           | 94.6 kN.m |       |       |
| Nominal Bar =          | 15.30 mm  |       |       |
| ---> p =               | 0.60 %    |       |       |
| USE: Bar Dia =         | 16 mm     |       |       |
| ---> p =               | 0.66 %    |       |       |
| Ratio =                | (109.42%) |       |       |

#### DESIGN SUMMARY

| Storey | Nu<br>(kN) | Breadth<br>(mm) | Depth<br>(mm) | Reinf.<br>(%) | Bars |   |     | Dia. |
|--------|------------|-----------------|---------------|---------------|------|---|-----|------|
|        |            |                 |               |               | b    | h | Tot |      |
| Roof   | 1552.3     | 600             | 425           | 0.724         | 2    | 2 | 12  | 14   |
| 2nd    | 1857.5     | 600             | 425           | 3.785         | 2    | 2 | 12  | 32   |
| 1st    | 3344.6     | 600             | 425           | 3.785         | 2    | 2 | 12  | 32   |
| Grd    | 3369.3     | 600             | 425           | 0.724         | 2    | 2 | 12  | 14   |
| Bas    | 5808.9     | 700             | 700           | 0.657         | 3    | 3 | 16  | 16   |

PROGRAM : COLM - Reinforced Concrete Column Design  
 SUBJECT : National Museum - Amman  
 COLUMN : Column on AxisLines X8/Y05  
 DATE : February 23, 2000

Page 424

fcu = 30 MPa  
 fy = 420 MPa

Factor for Dead Load = 1.40  
 Factor for Live Load = 1.60

REDUCTION IN LIVE LOADING CONSIDERED

DESIGN LOADING FROM MAIN FRAME (in X-Direction).

| No. | Level  | Subframe                          | Sup | Case | Nu    | M above | M below |
|-----|--------|-----------------------------------|-----|------|-------|---------|---------|
| 1   | T Roof | ----                              |     | 1    | 0.0   | 0.0     | 0.0     |
|     |        |                                   |     | 2    | 0.0   | 0.0     | 0.0     |
|     |        |                                   |     | 3    | 0.0   | 0.0     | 0.0     |
| 2   | Roof   | Beams B14+B15+B16+B17+B18+B19+B20 | 8   | 1    | 683.9 | 0.0     | 175.8   |
|     |        |                                   | 8   | 2    | 731.6 | 0.0     | 203.1   |
|     |        |                                   | 8   | 3    | 325.1 | 0.0     | 68.2    |
| 3   | 2nd    | Beam H11                          | 1   | 1    | 291.6 | -107.7  | -86.2   |
|     |        |                                   | 1   | 2    | 291.6 | -107.7  | -86.2   |
|     |        |                                   | 1   | 3    | 162.6 | -60.1   | -48.0   |
| 4   | 1st    | ----                              |     | 1    | 0.0   | 0.0     | 0.0     |
|     |        |                                   |     | 2    | 0.0   | 0.0     | 0.0     |
|     |        |                                   |     | 3    | 0.0   | 0.0     | 0.0     |
| 5   | Grd    | Beam H13                          | 2   | 1    | 978.4 | 283.7   | 825.4   |
|     |        |                                   | 2   | 2    | 978.4 | 283.7   | 825.4   |
|     |        |                                   | 2   | 3    | 407.7 | 119.0   | 346.2   |

DESIGN LOADING FROM CROSS FRAME (in Y-Direction).

| No. | Level | Subframe      | Sup | Case | Nu     | M above | M below |
|-----|-------|---------------|-----|------|--------|---------|---------|
| 3   | 2nd   | Beam H10      | 2   | 1    | 1134.7 | 365.5   | 365.5   |
|     |       |               | 2   | 2    | 1134.7 | 365.5   | 365.5   |
|     |       |               | 2   | 3    | 545.8  | 172.8   | 172.8   |
| 5   | Grd   | Wall Beam W10 | 1   | 1    | 2012.0 | 0.0     | -8.4    |
|     |       |               | 1   | 2    | 2012.0 | 0.0     | -8.4    |
|     |       |               | 1   | 3    | 979.8  | 0.0     | -4.1    |

ADDITIONAL SERVICE LOADING

| No. | Storey | G     | Q     | Mxu   | Myu  |
|-----|--------|-------|-------|-------|------|
| 1   | Roof   | 935.0 | 152.0 | 20.0  | 20.0 |
| 2   | 2nd    | 35.0  | 0.0   | 0.0   | 0.0  |
| 3   | 1st    | 95.2  | 45.0  | 0.0   | 0.0  |
| 4   | Grd    | 45.0  | 0.0   | 0.0   | 0.0  |
| 5   | Bas    | 568.6 | 400.0 | 150.0 | 50.0 |

TOTAL DESIGN LOADING

| No. | Storey | Case | Nu     | Red. | MxT   | MxB   | MyT   | MyB    |
|-----|--------|------|--------|------|-------|-------|-------|--------|
| 1   | Roof   | 1    | 1552.3 | 0    | 0.0   | 0.0   | 0.0   | 0.0    |
|     |        | 2    | 1552.3 | 0    | 0.0   | 0.0   | 0.0   | 0.0    |
|     |        | 3    | 1552.3 | 0    | 0.0   | 0.0   | 0.0   | 0.0    |
| 2   | 2nd    | 1    | 2260.9 | 10   | 0.0   | 365.5 | 175.8 | -107.7 |
|     |        | 2    | 2308.6 | 10   | 0.0   | 365.5 | 203.1 | -107.7 |
|     |        | 3    | 1902.1 | 10   | 0.0   | 172.8 | 68.2  | -60.1  |
| 3   | 1st    | 1    | 3853.8 | 20   | 365.5 | 0.0   | -86.2 | 0.0    |
|     |        | 2    | 3853.8 | 20   | 365.5 | 0.0   | -86.2 | 0.0    |
|     |        | 3    | 3135.9 | 20   | 172.8 | 0.0   | -48.0 | 0.0    |
| 4   | Grd    | 1    | 3885.3 | 30   | 0.0   | 0.0   | 0.0   | 283.7  |
|     |        | 2    | 3885.3 | 30   | 0.0   | 0.0   | 0.0   | 283.7  |
|     |        | 3    | 3885.3 | 30   | 0.0   | 0.0   | 0.0   | 119.0  |

GRAM : COLM - Reinforced Concrete Column Design  
 JECT : National Museum - Amman  
 COLUMN : Column on AxisLines X8/Y05  
 DATE : February 23, 2000

Page 425

# TOTAL DESIGN LOADING

| No.                    | Storey | Case   | Nu     | Red.                                | MxT  | MxB          | MyT   | MyB    |
|------------------------|--------|--------|--------|-------------------------------------|------|--------------|-------|--------|
| 5                      | Bas    | 1      | 8024.2 | 40                                  | -8.4 | 8.4          | 825.4 | -825.4 |
|                        |        | 2      | 8024.2 | 40                                  | -8.4 | 8.4          | 825.4 | -825.4 |
|                        |        | 3      | 6421.3 | 40                                  | -4.1 | 4.1          | 346.2 | -346.2 |
| =====                  |        |        |        |                                     |      |              |       |        |
| Storey : Roof          |        |        |        |                                     |      |              |       |        |
|                        | Case1  | Case2  | Case3  | Section                             |      |              |       |        |
| =                      | 1552.3 | 1552.3 | 1552.3 | Breadth, b =                        | 600  | b Bars =     | 2     |        |
| =                      | 20.0   | 0.0    | 0.0    | Depth, h =                          | 425  | h Bars =     | 2     |        |
| =                      | 20.0   | 0.0    | 0.0    | Cover, c =                          | 50   | Total Bars = | 12    |        |
| =====                  |        |        |        |                                     |      |              |       |        |
| UNIAXIAL Short NOMINAL |        |        |        | Case1 Case2 Case3                   |      |              |       |        |
| Nominal My = 31.0 kN.m |        |        |        | Bar Dia = 0.00 0.00 0.00            |      |              |       |        |
| Nominal Bar = 12.74 mm |        |        |        | % = 0.00 0.00 0.00                  |      |              |       |        |
| ----> p = 0.60 %       |        |        |        |                                     |      |              |       |        |
| USE: Bar Dia = 14 mm   |        |        |        |                                     |      |              |       |        |
| ----> p = 0.72 %       |        |        |        |                                     |      |              |       |        |
| Ratio = (120.74%)      |        |        |        |                                     |      |              |       |        |
| =====                  |        |        |        |                                     |      |              |       |        |
| Storey : 2nd           |        |        |        |                                     |      |              |       |        |
|                        | Case1  | Case2  | Case3  | Section                             |      |              |       |        |
| =                      | 2260.9 | 2308.6 | 1902.1 | Breadth, b =                        | 600  | b Bars =     | 2     |        |
| =                      | 365.5  | 365.5  | 172.8  | Depth, h =                          | 425  | h Bars =     | 2     |        |
| =                      | 175.8  | 203.1  | 68.2   | Cover, c =                          | 50   | Total Bars = | 12    |        |
| =====                  |        |        |        |                                     |      |              |       |        |
| BIAXIAL Short          |        |        |        | Case1 Case2 Case3                   |      |              |       |        |
|                        |        |        |        | Bar Dia = 25.91 26.65 4.65          |      |              |       |        |
|                        |        |        |        | % = 2.48 2.62 0.08                  |      |              |       |        |
|                        |        |        |        | Mux = 431.03 443.48 189.28          |      |              |       |        |
|                        |        |        |        | Muy = 652.81 672.71 268.97          |      |              |       |        |
| USE: Bar Dia = 32 mm   |        |        |        | Stress Ratio = 0.9809 0.9805 0.9835 |      |              |       |        |
| ----> p = 3.78 %       |        |        |        | ALPHA = 1.3217 1.3202 1.5680        |      |              |       |        |
| Ratio = (144.18%)      |        |        |        |                                     |      |              |       |        |
| =====                  |        |        |        |                                     |      |              |       |        |
| Storey : 1st           |        |        |        |                                     |      |              |       |        |
|                        | Case1  | Case2  | Case3  | Section                             |      |              |       |        |
| =                      | 3853.8 | 3853.8 | 3135.9 | Breadth, b =                        | 600  | b Bars =     | 2     |        |
| =                      | 365.5  | 365.5  | 172.8  | Depth, h =                          | 425  | h Bars =     | 2     |        |
| =                      | 86.2   | 86.2   | 48.0   | Cover, c =                          | 50   | Total Bars = | 12    |        |
| =====                  |        |        |        |                                     |      |              |       |        |
| UNIAXIAL Short         |        |        |        | Case1 Case2 Case3                   |      |              |       |        |
|                        |        |        |        | Bar Dia = 29.76 29.76 15.14         |      |              |       |        |
|                        |        |        |        | % = 3.27 3.27 0.85                  |      |              |       |        |
|                        |        |        |        | Mux = 379.53 379.53                 |      |              |       |        |
|                        |        |        |        | Muy = 572.83 572.83                 |      |              |       |        |
| USE: Bar Dia = 32 mm   |        |        |        | Stress Ratio = 0.9831 0.9831        |      |              |       |        |
| ----> p = 3.78 %       |        |        |        | ALPHA = 1.6562 1.6562               |      |              |       |        |
| Ratio = (115.62%)      |        |        |        |                                     |      |              |       |        |

GRAM : COLM - Reinforced Concrete Column Design  
 JECT : National Museum - Amman  
 COLUMN : Column on AxisLines X8/Y05  
 DATE : February 23, 2000

Page 426

|              |        |        |              |     |                 |
|--------------|--------|--------|--------------|-----|-----------------|
| Storey : Grd |        |        | Section      |     |                 |
| Case1        | Case2  | Case3  | Breadth, b = | 600 | b Bars = 2      |
| 3885.3       | 3885.3 | 3885.3 | Depth, h =   | 425 | h Bars = 2      |
| 0.0          | 0.0    | 0.0    | Cover, c =   | 50  | Total Bars = 12 |
| 283.7        | 283.7  | 119.0  |              |     |                 |

|          |       |           |                |                |                |
|----------|-------|-----------|----------------|----------------|----------------|
| UNIAXIAL | Short | Bar Dia = | Case1<br>21.95 | Case2<br>21.95 | Case3<br>16.34 |
|          |       | % =       | 1.78           | 1.78           | 0.99           |

USE: Bar Dia = 22 mm  
 ---> p = 1.79 %  
 Ratio = (100.43%)

|              |        |        |              |     |                 |
|--------------|--------|--------|--------------|-----|-----------------|
| Storey : Bas |        |        | Section      |     |                 |
| Case1        | Case2  | Case3  | Breadth, b = | 700 | b Bars = 3      |
| 8024.2       | 8024.2 | 6421.3 | Depth, h =   | 700 | h Bars = 3      |
| 158.4        | 8.4    | 4.1    | Cover, c =   | 50  | Total Bars = 16 |
| 875.4        | 825.4  | 346.2  |              |     |                 |

|          |       |           |                |                |                |
|----------|-------|-----------|----------------|----------------|----------------|
| UNIAXIAL | Short | Bar Dia = | Case1<br>32.04 | Case2<br>31.21 | Case3<br>14.70 |
|          |       | % =       | 2.63           | 2.50           | 0.55           |

USE: Bar Dia = 32 mm  
 ---> p = 2.63 %  
 Ratio = (99.77%)

#### DESIGN SUMMARY

| Storey | Nu<br>(kN) | Breadth<br>(mm) | Depth<br>(mm) | Reinf.<br>(%) | Bars |   |     | Dia. |
|--------|------------|-----------------|---------------|---------------|------|---|-----|------|
|        |            |                 |               |               | b    | h | Tot |      |
| Roof   | 1552.3     | 600             | 425           | 0.724         | 2    | 2 | 12  | 14   |
| 2nd    | 2260.9     | 600             | 425           | 3.785         | 2    | 2 | 12  | 32   |
| 1st    | 3853.8     | 600             | 425           | 3.785         | 2    | 2 | 12  | 32   |
| Grd    | 3885.3     | 600             | 425           | 1.789         | 2    | 2 | 12  | 22   |
| Bas    | 8024.2     | 700             | 700           | 2.626         | 3    | 3 | 16  | 32   |

PROGRAM : COLM - Reinforced Concrete Column Design  
 SUBJECT : National Museum - Amman  
 COLUMN : Column on AxisLines X7/Y05  
 DATE : February 23, 2000

Page 427

fcu = 30 MPa  
 fy = 420 MPa

Factor for Dead Load = 1.40  
 Factor for Live Load = 1.60

REDUCTION IN LIVE LOADING CONSIDERED

DESIGN LOADING FROM MAIN FRAME (in X-Direction).

| No. | Level | Subframe                          | Sup | Case | Nu     | M above | M below |
|-----|-------|-----------------------------------|-----|------|--------|---------|---------|
| 1   | Roof  | Beams B14+B15+B16+B17+B18+B19+B20 | 7   | 1    | 2502.2 | 0.0     | -36.3   |
|     |       |                                   | 7   | 2    | 1835.4 | 0.0     | -129.1  |
|     |       |                                   | 7   | 3    | 1928.9 | 0.0     | 69.1    |
| 2   | 2nd   | Beams B32+B33+B34+B35+B36+B37     | 7   | 1    | 2178.9 | 158.2   | 128.5   |
|     |       |                                   | 7   | 2    | 1127.0 | -31.9   | -25.9   |
|     |       |                                   | 7   | 3    | 1982.7 | 198.3   | 161.1   |
| 3   | 1st   | Beam H12                          | 1   | 1    | 160.9  | 0.0     | -183.8  |
|     |       |                                   | 1   | 2    | 160.9  | 0.0     | -183.8  |
|     |       |                                   | 1   | 3    | 71.1   | 0.0     | -85.5   |
| 4   | Grd   | Beam H13                          | 1   | 1    | 891.1  | -460.3  | -669.6  |
|     |       |                                   | 1   | 2    | 891.1  | -460.3  | -669.6  |
|     |       |                                   | 1   | 3    | 353.6  | -186.8  | -271.6  |

DESIGN LOADING FROM CROSS FRAME (in Y-Direction).

| No. | Level | Subframe    | Sup | Case | Nu    | M above | M below |
|-----|-------|-------------|-----|------|-------|---------|---------|
| 1   | Roof  | Beams H6+H7 | 3   | 1    | 146.2 | 0.0     | 21.0    |
|     |       |             | 3   | 2    | 49.7  | 0.0     | 3.1     |
|     |       |             | 3   | 3    | 161.2 | 0.0     | 27.2    |

ADDITIONAL SERVICE LOADING

| No. | Storey | G     | Q     | Mxu | Myu |
|-----|--------|-------|-------|-----|-----|
| 1   | 2nd    | 35.0  | 0.0   | 0.0 | 0.0 |
| 2   | 1st    | 35.0  | 0.0   | 0.0 | 0.0 |
| 3   | Grd    | 35.0  | 0.0   | 0.0 | 0.0 |
| 4   | Bas    | 435.2 | 300.0 | 0.0 | 0.0 |

TOTAL DESIGN LOADING

| No. | Storey | Case | Nu     | Red. | MxT  | MxB | MyT    | MyB    |
|-----|--------|------|--------|------|------|-----|--------|--------|
| 1   | 2nd    | 1    | 2697.5 | 0    | 21.0 | 0.0 | -36.3  | 158.2  |
|     |        | 2    | 1934.0 | 0    | 3.1  | 0.0 | -129.1 | -31.9  |
|     |        | 3    | 2139.2 | 0    | 27.2 | 0.0 | 69.1   | 198.3  |
| 2   | 1st    | 1    | 4925.4 | 10   | 0.0  | 0.0 | 128.5  | 0.0    |
|     |        | 2    | 3873.5 | 10   | 0.0  | 0.0 | -25.9  | 0.0    |
|     |        | 3    | 4729.2 | 10   | 0.0  | 0.0 | 161.1  | 0.0    |
| 3   | Grd    | 1    | 5135.3 | 20   | 0.0  | 0.0 | -183.8 | -460.3 |
|     |        | 2    | 5135.3 | 20   | 0.0  | 0.0 | -183.8 | -460.3 |
|     |        | 3    | 5045.5 | 20   | 0.0  | 0.0 | -85.5  | -186.8 |
| 4   | Bas    | 1    | 6971.7 | 30   | 0.0  | 0.0 | -669.6 | 669.6  |
|     |        | 2    | 6971.7 | 30   | 0.0  | 0.0 | -669.6 | 669.6  |
|     |        | 3    | 6434.1 | 30   | 0.0  | 0.0 | -271.6 | 271.6  |

PROGRAM : COLM - Reinforced Concrete Column Design  
 SUBJECT : National Museum - Amman  
 COLUMN : Column on AxisLines X7/Y05  
 DATE : February 23, 2000

Page 428

|              |        |        |              |     |                 |
|--------------|--------|--------|--------------|-----|-----------------|
| Storey : 2nd |        |        | Section      |     |                 |
| Case1        | Case2  | Case3  | Breadth, b = | 600 | b Bars = 2      |
| N = 2697.5   | 1934.0 | 2139.2 | Depth, h =   | 600 | h Bars = 2      |
| = 21.0       | 3.1    | 27.2   | Cover, c =   | 50  | Total Bars = 12 |
| = 158.2      | 129.1  | 198.3  |              |     |                 |

|                        |           |       |       |       |
|------------------------|-----------|-------|-------|-------|
| UNIAXIAL Short NOMINAL | Bar Dia = | Case1 | Case2 | Case3 |
| Nominal Bar = 15.14 mm | % =       | 0.00  | 0.00  | 0.00  |
| ---> p = 0.60 %        |           |       |       |       |
| USE: Bar Dia = 16 mm   |           |       |       |       |
| ---> p = 0.67 %        |           |       |       |       |
| Ratio = (111.70%)      |           |       |       |       |

|              |        |        |              |     |                 |
|--------------|--------|--------|--------------|-----|-----------------|
| Storey : 1st |        |        | Section      |     |                 |
| Case1        | Case2  | Case3  | Breadth, b = | 600 | b Bars = 2      |
| N = 4925.4   | 3873.5 | 4729.2 | Depth, h =   | 600 | h Bars = 2      |
| = 0.0        | 0.0    | 0.0    | Cover, c =   | 50  | Total Bars = 12 |
| = 128.5      | 25.9   | 161.1  |              |     |                 |

|                        |           |       |       |       |
|------------------------|-----------|-------|-------|-------|
| UNIAXIAL Short NOMINAL | Bar Dia = | Case1 | Case2 | Case3 |
| Nominal Mx = 77.5 kN.m | % =       | 12.78 | 0.00  | 11.95 |
| Nominal Bar = 15.14 mm |           | 0.43  | 0.00  | 0.37  |
| ---> p = 0.60 %        |           |       |       |       |
| USE: Bar Dia = 16 mm   |           |       |       |       |
| ---> p = 0.67 %        |           |       |       |       |
| Ratio = (111.70%)      |           |       |       |       |

|              |        |        |              |     |                 |
|--------------|--------|--------|--------------|-----|-----------------|
| Storey : Grd |        |        | Section      |     |                 |
| Case1        | Case2  | Case3  | Breadth, b = | 600 | b Bars = 2      |
| N = 5135.3   | 5135.3 | 5045.5 | Depth, h =   | 600 | h Bars = 2      |
| = 0.0        | 0.0    | 0.0    | Cover, c =   | 50  | Total Bars = 12 |
| = 460.3      | 460.3  | 186.8  |              |     |                 |

|                      |           |       |       |       |
|----------------------|-----------|-------|-------|-------|
| UNIAXIAL Short       | Bar Dia = | Case1 | Case2 | Case3 |
|                      | % =       | 25.91 | 25.91 | 16.38 |
|                      |           | 1.76  | 1.76  | 0.70  |
| USE: Bar Dia = 32 mm |           |       |       |       |
| ---> p = 2.68 %      |           |       |       |       |
| Ratio = (152.58%)    |           |       |       |       |

|              |        |        |              |     |                 |
|--------------|--------|--------|--------------|-----|-----------------|
| Storey : Bas |        |        | Section      |     |                 |
| Case1        | Case2  | Case3  | Breadth, b = | 700 | b Bars = 3      |
| N = 6971.7   | 6971.7 | 6434.1 | Depth, h =   | 700 | h Bars = 3      |
| = 0.0        | 0.0    | 0.0    | Cover, c =   | 50  | Total Bars = 16 |
| = 669.6      | 669.6  | 271.6  |              |     |                 |

|                      |           |       |       |       |
|----------------------|-----------|-------|-------|-------|
| UNIAXIAL Short       | Bar Dia = | Case1 | Case2 | Case3 |
|                      | % =       | 24.99 | 24.99 | 12.49 |
|                      |           | 1.60  | 1.60  | 0.40  |
| USE: Bar Dia = 25 mm |           |       |       |       |
| ---> p = 1.60 %      |           |       |       |       |
| Ratio = (100.09%)    |           |       |       |       |

PROGRAM : COLM - Reinforced Concrete Column Design  
 PROJECT : National Museum - Amman  
 COLUMN : Column on AxisLines X7/Y05  
 DATE : February 23, 2000

Page 429

# DESIGN SUMMARY

| Storey | Nu<br>(kN) | Breadth<br>(mm) | Depth<br>(mm) | Reinf.<br>(%) | b | h | Bars<br>Tot | Dia. |
|--------|------------|-----------------|---------------|---------------|---|---|-------------|------|
| 2nd    | 2697.5     | 600             | 600           | 0.670         | 2 | 2 | 12          | 16   |
| 1st    | 4925.4     | 600             | 600           | 0.670         | 2 | 2 | 12          | 16   |
| Grd    | 5135.3     | 600             | 600           | 2.681         | 2 | 2 | 12          | 32   |
| Bas    | 6971.7     | 700             | 700           | 1.603         | 3 | 3 | 16          | 25   |

OGRAM : FOOT - Reinforced Concrete Footing Design  
 OJECT : National Museum - Amman  
 OOTING : Strip Footing on AxisLines Y06/X11-X12  
 DATE : February 26, 2000

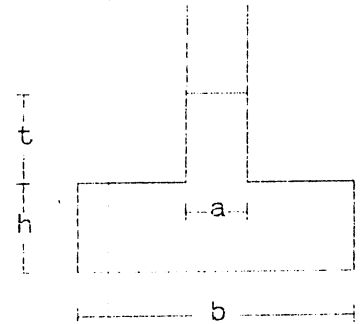
Page 430

ODE: BS8110  
 NPUT

Design Bearing Capacity,  $Q_u = 290.00$  kPa  
 Surcharge Design Load,  $W_u = 10.00$  kPa  
 Wall Design Axial Load,  $N_u = 445.50$  kN/m  
 Design Transverse Moment,  $M_x = 0.00$  kN.m/m  
 Max. Wall Opening Length,  $L_y = 2.00$  m

Wall Breadth,  $a = 300$  mm  
 Wall Stem Height,  $t = 600$  mm  
 Footing Depth,  $h = 400$  mm

Concrete Grade,  $f_{cu} = 25$  MPa  
 Steel Grade,  $f_y = 420$  MPa  
 Max. Cover to center of Bars,  $c = 60$  mm



# ANALYSIS

Footing Breadth,  $b = 1.70$  m

Total Design Load,  $\sim N = 482.35$  kN

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 283.73 kPa          | 262.06 kPa        |
| S2 | 283.73 kPa          | 262.06 kPa        |

# EXURE

| Transverse              |                  | Longitudinal            |  |
|-------------------------|------------------|-------------------------|--|
| $M_x = 64.20$ kN.m      |                  | $M_y = 178.20$ kN.m     |  |
| $R_x = 0.56$ MPa        |                  | $R_y = 0.67$ MPa        |  |
| $As_x = 0.17$ %         |                  | $As_y = 0.19$ %         |  |
| $= 571$ mm <sup>2</sup> |                  | $= 536$ mm <sup>2</sup> |  |
| Nominal                 |                  |                         |  |
| 4Y14@289(108%)          | T 2Y20@230(117%) | B 7Y14@261(106%)        |  |
| 5Y12@217( 99%)          | T 3Y16@117(113%) | B 9Y12@196(100%)        |  |
| 7Y10@145( 97%)          | T 5Y12@ 60(105%) | B 13Y10@131(101%)       |  |
| 7Y10@145( 97%)          | T 7Y10@ 40(103%) | B 13Y10@131(101%)       |  |

# EAR

Design Concrete Shear Stress = 2.04 MPa  
 Shear Stress at  $d$  from Wall Face = 0.28 MPa O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 PROJECT : National Museum - Amman  
 FOOTING : Strip Footing on AxisLine X12-U3  
 DATE : February 26, 2000

Page 431

CODE: BS8110

# INPUT

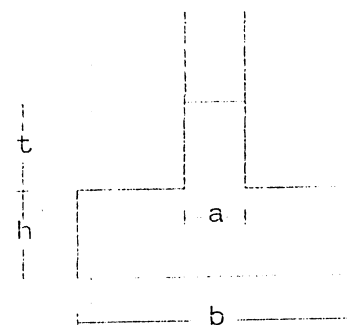
Design Bearing Capacity,  $Q_u = 290.00$  kPa  
 Surcharge Design Load,  $W_u = 10.00$  kPa  
 Wall Design Axial Load,  $N_u = 374.63$  kN/m  
 Design Transverse Moment,  $M_x = 0.00$  kN.m/m  
 Max. Wall Opening Length,  $L_y = 2.00$  m

Wall Breadth,  $a = 300$  mm  
 Wall Stem Height,  $t = 600$  mm  
 Footing Depth,  $h = 400$  mm

Concrete Grade,  $f_{cu} = 25$  MPa

Steel Grade,  $f_y = 420$  MPa

Max. Cover to center of Bars,  $c = 60$  mm



# ANALYSIS

Footing Breadth,  $b = 1.40$  m

Total Design Load,  $\sim N = 404.45$  kN

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 288.89 kPa          | 267.59 kPa        |
| S2 | 288.89 kPa          | 267.59 kPa        |

# LEXURE

| Transverse              |   | Longitudinal            |                 |
|-------------------------|---|-------------------------|-----------------|
| $M_x = 40.47$ kN.m      |   | $M_y = 149.85$ kN.m     |                 |
| $R_x = 0.35$ MPa        |   | $R_y = 0.57$ MPa        |                 |
| $As_x = 0.17$ %         |   | $As_y = 0.16$ %         |                 |
| $= 571$ mm <sup>2</sup> |   | $= 448$ mm <sup>2</sup> |                 |
| Nominal                 |   |                         |                 |
| 4Y14@289(108%)          | T | 2Y18@232(113%)          | B               |
| 5Y12@217( 99%)          | T | 3Y14@118(103%)          | B               |
| 7Y10@145( 97%)          | T | 4Y12@ 79(101%)          | B               |
| 7Y10@145( 97%)          | T | 6Y10@ 48(106%)          | B               |
|                         |   |                         | 11Y10@127(103%) |

# SHEAR

Design Concrete Shear Stress = 2.04 MPa

Shear Stress at d from Wall Face = 0.17 MPa O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 OBJECT : National Museum - Amman  
 FOOTING : Strip Footing on AxisLine X12/Y05-Y06  
 DATE : February 26, 2000

Page 432

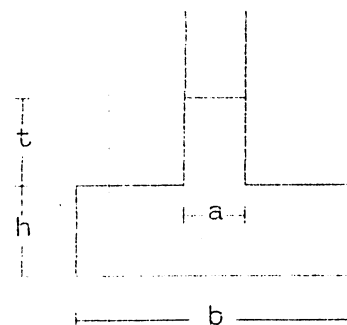
CODE: BS8110

#### INPUT

Design Bearing Capacity,  $Q_u = 290.00$  kPa  
 Surcharge Design Load,  $W_u = 10.00$  kPa  
 Wall Design Axial Load,  $N_u = 459.79$  kN/m  
 Design Transverse Moment,  $M_x = 0.00$  kN.m/m  
 Max. Wall Opening Length,  $L_y = 2.00$  m

Wall Breadth,  $a = 300$  mm  
 Wall Stem Height,  $t = 600$  mm  
 Footing Depth,  $h = 400$  mm

Concrete Grade,  $f_{cu} = 25$  MPa  
 Steel Grade,  $f_y = 420$  MPa  
 Max. Cover to center of Bars,  $c = 60$  mm



#### ANALYSIS

Footing Breadth,  $b = 1.80$  m

Total Design Load,  $\sim N = 498.98$  kN

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 277.21 kPa          | 255.44 kPa        |
| S2 | 277.21 kPa          | 255.44 kPa        |

#### STRESS

| Transverse              |   | Longitudinal            |                 |
|-------------------------|---|-------------------------|-----------------|
| $M_x = 71.84$ kN.m      |   | $M_y = 183.92$ kN.m     |                 |
| $R_x = 0.62$ MPa        |   | $R_y = 0.69$ MPa        |                 |
| $As_x = 0.18$ %         |   | $As_y = 0.20$ %         |                 |
| $= 596$ mm <sup>2</sup> |   | $= 553$ mm <sup>2</sup> |                 |
| 4Y14@289(103%)          | T | 2Y20@230(113%)          | B               |
| 8Y10@124(106%)          | T | 3Y16@117(109%)          | B               |
| 6Y12@174(114%)          | T | 5Y12@ 60(102%)          | B               |
| 6Y12@174(114%)          | T | 7Y10@ 40(100%)          | B               |
|                         |   |                         | 7Y14@278(100%)  |
|                         |   |                         | 6Y16@333(112%)  |
|                         |   |                         | 10Y12@185(105%) |
|                         |   |                         | 14Y10@128(102%) |

#### SHEAR

Design Concrete Shear Stress = 2.07 MPa  
 Shear Stress at  $d$  from Wall Face = 0.31 MPa O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 SUBJECT : National Museum - Amman  
 NOTING : Strip Footing on AxisLine Y01/X1-X7  
 DATE : February 26, 2000

Page 433

CODE: BS8110

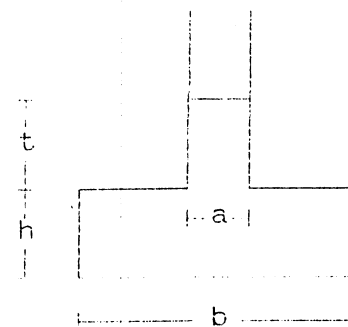
INPUT

Design Bearing Capacity,  $Q_u = 290.00$  kPa  
 Surcharge Design Load,  $W_u = 10.00$  kPa  
 Wall Design Axial Load,  $N_u = 555.83$  kN/m  
 Design Transverse Moment,  $M_x = 0.00$  kN.m/m  
 Max. Wall Opening Length,  $L_y = 2.00$  m

Wall Breadth,  $a = 300$  mm  
 Wall Stem Height,  $t = 600$  mm  
 Footing Depth,  $h = 400$  mm

Concrete Grade,  $f_{cu} = 25$  MPa  
 Steel Grade,  $f_y = 420$  MPa

Max. Cover to center of Bars,  $c = 60$  mm



ANALYSIS

Footing Breadth,  $b = 2.10$  m

Total Design Load,  $\sim N = 602.05$  kN

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 286.69 kPa          | 264.68 kPa        |
| S2 | 286.69 kPa          | 264.68 kPa        |

EXHIBIT

| Transverse              |   | Longitudinal            |   |
|-------------------------|---|-------------------------|---|
| $M_x = 107.20$ kN.m     |   | $M_y = 222.33$ kN.m     |   |
| $R_x = 0.93$ MPa        |   | $R_y = 0.84$ MPa        |   |
| $As_x = 0.27$ %         |   | $As_y = 0.24$ %         |   |
| $= 902$ mm <sup>2</sup> |   | $= 674$ mm <sup>2</sup> |   |
| 4Y18@287(113%)          | T | 2Y22@228(113%)          | B |
| 6Y14@173(102%)          | T | 6Y12@48(101%)           | B |
| 5Y16@216(111%)          | T | 3Y18@116(113%)          | B |
| 8Y12@124(100%)          | T | 5Y14@59(114%)           | B |
|                         |   | 8Y14@281(98%)           |   |
|                         |   | 11Y12@197(99%)          |   |
|                         |   | 16Y10@131(100%)         |   |
|                         |   | 16Y10@131(100%)         |   |

BAR

Design Concrete Shear Stress = 2.38 MPa  
 Shear Stress at  $d$  from Wall Face = 0.44 MPa O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 SUBJECT : National Museum - Amman  
 NOTING : Strip Footing on AxisLine u2/Y01-Y05  
 DATE : February 26, 2000

Page 434

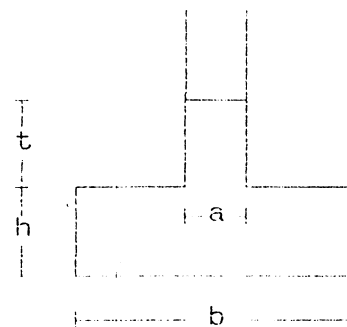
CODE: BS8110

INPUT

Design Bearing Capacity,  $Q_u = 290.00$  kPa  
 Surcharge Design Load,  $W_u = 10.00$  kPa  
 Wall Design Axial Load,  $N_u = 415.80$  kN/m  
 Design Transverse Moment,  $M_x = 0.00$  kN.m/m  
 Max. Wall Opening Length,  $L_y = 2.00$  m

Wall Breadth,  $a = 300$  mm  
 Wall Stem Height,  $t = 600$  mm  
 Footing Depth,  $h = 400$  mm

Concrete Grade,  $f_{cu} = 25$  MPa  
 Steel Grade,  $f_y = 420$  MPa  
 Max. Cover to center of Bars,  $c = 60$  mm



## ANALYSIS

Footing Breadth,  $b = 1.60$  m

Total Design Load,  $\sim N = 450.30$  kN

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 281.44 kPa          | 259.87 kPa        |
| S2 | 281.44 kPa          | 259.87 kPa        |

## REINFORCE

| Transverse              |   | Longitudinal            |                 |
|-------------------------|---|-------------------------|-----------------|
| $M_x = 54.90$ kN.m      |   | $M_y = 166.32$ kN.m     |                 |
| $R_x = 0.47$ MPa        |   | $R_y = 0.63$ MPa        |                 |
| $As_x = 0.17$ %         |   | $As_y = 0.18$ %         |                 |
| $= 571$ mm <sup>2</sup> |   | $= 499$ mm <sup>2</sup> |                 |
| Nominal                 |   |                         |                 |
| 4Y14@289(108%)          | T | 2Y18@232(102%)          | B               |
| 5Y12@217( 99%)          | T | 5Y12@ 60(113%)          | B               |
| 7Y10@145( 97%)          | T | 7Y10@ 40(111%)          | B               |
| 7Y10@145( 97%)          | T | 4Y14@ 79(123%)          | B               |
|                         |   |                         | 12Y10@134( 99%) |

## BEAR

Design Concrete Shear Stress = 2.04 MPa

Shear Stress at d from Wall Face = 0.24 MPa O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 PROJECT : National Museum - Amman  
 FOOTING : Strip Footing on AxisLine Y06/X8-X9  
 DATE : February 26, 2000

Page 435

CODE: BS8110

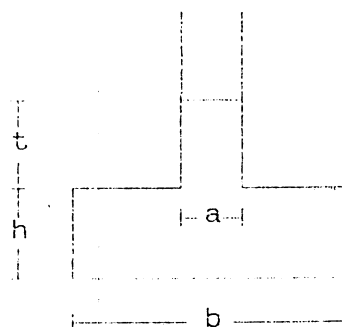
# INPUT

Design Bearing Capacity,  $Q_u = 290.00$  kPa  
 Surcharge Design Load,  $W_u = 10.00$  kPa  
 Wall Design Axial Load,  $N_u = 189.44$  kN/m  
 Design Transverse Moment,  $M_x = 0.00$  kN.m/m  
 Max. Wall Opening Length,  $L_y = 2.00$  m

Wall Breadth,  $a = 300$  mm  
 Wall Stem Height,  $t = 600$  mm  
 Footing Depth,  $h = 400$  mm

Concrete Grade,  $f_{cu} = 25$  MPa  
 Steel Grade,  $f_y = 420$  MPa

Max. Cover to center of Bars,  $c = 60$  mm



# ANALYSIS

Footing Breadth,  $b = 0.70$  m

Total Design Load,  $\sim N = 202.85$  kN

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 289.78 kPa          | 270.63 kPa        |
| S2 | 289.78 kPa          | 270.63 kPa        |

# FLEXURE

| Transverse              |   | Longitudinal            |   |
|-------------------------|---|-------------------------|---|
| $M_x = 5.41$ kN.m       |   | $M_y = 75.78$ kN.m      |   |
| $R_x = 0.05$ MPa        |   | $R_y = 0.29$ MPa        |   |
| $As_x = 0.17\%$         |   | $As_y = 0.15\%$         |   |
| $= 571$ mm <sup>2</sup> |   | $= 429$ mm <sup>2</sup> |   |
| Nominal                 |   | Nominal                 |   |
| 4Y14@289(108%)          | T | 2Y18@232(119%)          | B |
| 5Y12@217(99%)           | T | 3Y14@118(108%)          | B |
| 7Y10@145(97%)           | T | 4Y12@79(105%)           | B |
| 7Y10@145(97%)           | T | 6Y10@48(111%)           | B |
|                         |   | 3Y14@283(110%)          | B |
|                         |   | 4Y12@189(108%)          | B |
|                         |   | 6Y10@114(113%)          | B |
|                         |   | 6Y10@114(113%)          | B |

# FEAR

Design Concrete Shear Stress = 2.04 MPa

\*\*\*\*\* Critical Shear Section Outside Footing \*\*\*\*\*

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 SUBJECT : National Museum - Amman  
 FOOTING : Strip Footing on AxisLine Y01-Y02/X9-X11  
 DATE : February 26, 2000

Page 436

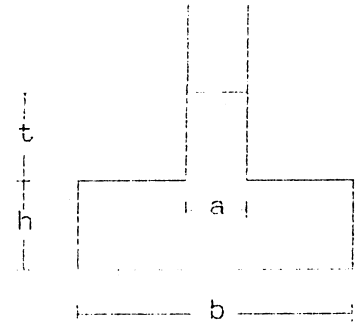
CODE: BS8110

#### INPUT

Design Bearing Capacity,  $Q_u = 290.00$  kPa  
 Surcharge Design Load,  $W_u = 10.00$  kPa  
 Wall Design Axial Load,  $N_u = 454.03$  kN/m  
 Design Transverse Moment,  $M_x = 0.00$  kN.m/m  
 Max. Wall Opening Length,  $L_y = 2.00$  m

Wall Breadth,  $a = 300$  mm  
 Wall Stem Height,  $t = 600$  mm  
 Footing Depth,  $h = 400$  mm

Concrete Grade,  $f_{cu} = 25$  MPa  
 Steel Grade,  $f_y = 420$  MPa  
 Max. Cover to center of Bars,  $c = 60$  mm



#### ANALYSIS

Footing Breadth,  $b = 1.70$  m

Total Design Load,  $\sim N = 490.88$  kN

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 288.75 kPa          | 267.08 kPa        |
| S2 | 288.75 kPa          | 267.08 kPa        |

#### LEXURE

| Transverse              |   | Longitudinal            |   |
|-------------------------|---|-------------------------|---|
| $M_x = 65.43$ kN.m      |   | $M_y = 181.61$ kN.m     |   |
| $R_x = 0.57$ MPa        |   | $R_y = 0.69$ MPa        |   |
| $As_x = 0.17$ %         |   | $As_y = 0.19$ %         |   |
| $= 571$ mm <sup>2</sup> |   | $= 546$ mm <sup>2</sup> |   |
| Nominal                 |   |                         |   |
| 4Y14@289(108%)          | T | 2Y20@230(115%)          | B |
| 5Y12@217( 99%)          | T | 3Y16@117(110%)          | B |
| 7Y10@145( 97%)          | T | 5Y12@ 60(103%)          | B |
| 7Y10@145( 97%)          | T | 7Y10@ 40(101%)          | B |

#### FEAR

Design Concrete Shear Stress = 2.04 MPa  
 Shear Stress at  $d$  from Wall Face = 0.28 MPa O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 SUBJECT : National Museum - Amman  
 FOOTING : Strip Footing on AxisLine X1/Y05-Y06  
 DATE : February 26, 2000

Page 437

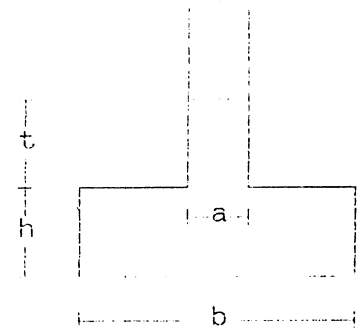
CODE: BS8110

INPUT

Design Bearing Capacity,  $Q_u = 290.00$  kPa  
 Surcharge Design Load,  $W_u = 10.00$  kPa  
 Wall Design Axial Load,  $N_u = 316.62$  kN/m  
 Design Transverse Moment,  $M_x = 0.00$  kN.m/m  
 Max. Wall Opening Length,  $L_y = 2.00$  m

Wall Breadth,  $a = 300$  mm  
 Wall Stem Height,  $t = 600$  mm  
 Footing Depth,  $h = 400$  mm

Concrete Grade,  $f_{cu} = 25$  MPa  
 Steel Grade,  $f_y = 420$  MPa  
 Max. Cover to center of Bars,  $c = 60$  mm



ANALYSIS

Footing Breadth,  $b = 1.20$  m

Total Design Load,  $\sim N = 341.75$  kN

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 284.79 kPa          | 263.85 kPa        |
| S2 | 284.79 kPa          | 263.85 kPa        |

REINFORCEMENT

| Transverse              |   | Longitudinal            |   |
|-------------------------|---|-------------------------|---|
| $M_x = 26.71$ kN.m      |   | $M_y = 126.65$ kN.m     |   |
| $R_x = 0.23$ MPa        |   | $R_y = 0.48$ MPa        |   |
| $As_x = 0.17$ %         |   | $As_y = 0.15$ %         |   |
| $= 571$ mm <sup>2</sup> |   | $= 429$ mm <sup>2</sup> |   |
| Nominal                 |   | Nominal                 |   |
| 4Y14@280(108%)          | T | 2Y18@232(119%)          | B |
| 5Y12@217( 99%)          | T | 3Y14@118(108%)          | B |
| 7Y10@145( 97%)          | T | 4Y12@ 79(105%)          | B |
| 7Y10@145( 97%)          | T | 6Y10@ 48(111%)          | B |
|                         |   | 4Y16@355(112%)          | B |
|                         |   | 5Y14@267(107%)          | B |
|                         |   | 9Y10@134( 99%)          | B |
|                         |   | 7Y12@178(110%)          | B |

CHECK

Design Concrete Shear Stress = 2.04 MPa  
 Shear Stress at  $d$  from Wall Face = 0.09 MPa O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 OBJECT : National Museum - Amman  
 FOOTING : Column on AxisLines X1/Y02  
 DATE : February 26, 2000

Page 438

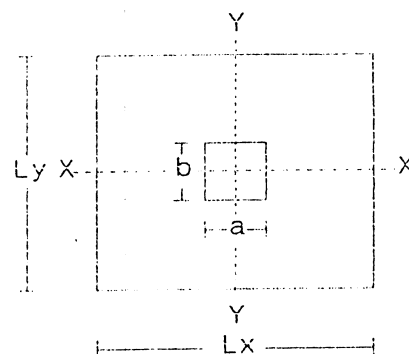
# PUT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 6961.41 \text{ kN}$   
 Column Design Moment,  $M_x = 0.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 0.00 \text{ kN.m}$

Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 1000 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$

Max Cover to center of Bars,  $c = 60 \text{ mm}$



# ANALYSIS

Total Design Load,  $\sim N = 8204.46 \text{ kN}$   
 Footing X Dimension,  $L_x = 5.35 \text{ m}$   
 Footing Y Dimension,  $L_y = 5.35 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 286.64 kPa          | 243.21 kPa        |
| S2 | 286.64 kPa          | 243.21 kPa        |
| S3 | 286.64 kPa          | 243.21 kPa        |
| S4 | 286.64 kPa          | 243.21 kPa        |

# EXCURE

| Y - Direction                | X - Direction                |
|------------------------------|------------------------------|
| $M_x = 3516.90 \text{ kN.m}$ | $M_y = 3516.90 \text{ kN.m}$ |
| $R_x = 0.74 \text{ MPa}$     | $R_y = 0.74 \text{ MPa}$     |
| $As_x = 0.21 \%$             | $As_y = 0.21 \%$             |
| $= 10610 \text{ mm}^2$       | $= 10610 \text{ mm}^2$       |
| 21Y25@260( 97%)              | 21Y25@260( 97%)              |
| 27Y22@200( 97%)              | 27Y22@200( 97%)              |
| 33Y20@163( 98%)              | 33Y20@163( 98%)              |
| 40Y18@134( 96%)              | 40Y18@134( 96%)              |

CODE: BS8110

# SHEAR AND PUNCHING

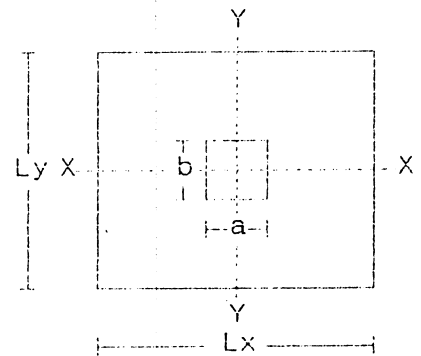
Max Permissible Shear Stress = 4.00 MPa  
 Shear Stress Across X at Column Face = 0.60 MPa O.K.  
 Shear Stress Across Y at Column Face = 0.60 MPa O.K.  
 Design Concrete Shear Stress Across X = 0.38 MPa  
 Design Concrete Shear Stress Across Y = 0.38 MPa  
 Shear Stress Across X at d from Column Face = 0.36 MPa O.K.  
 Shear Stress Across Y at d from Column Face = 0.36 MPa O.K.  
 Length of Punching Perimeter = 14080 mm  
 Design Concrete Punching Shear Stress = 0.38 MPa  
 Vertical Force Inside Perimeter = 3013.53 kN  
 Punching Shear Force = 3947.89 kN  
 Punching Shear Stress = 0.30 MPa O.K.

GRAM : FOOT Reinforced Concrete Footing Design  
 JECT : National Museum - Amman  
 OTING : Column on AxisLines X10/Y04 & X10/Y03  
 DATE : February 26, 2000

Page 439

II

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 2918.92 \text{ kN}$   
 Column Design Moment,  $M_x = 0.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 0.00 \text{ kN.m}$   
 Column Size in X,  $a = 600 \text{ mm}$   
 Column Size in Y,  $b = 600 \text{ mm}$   
 Footing Depth,  $h = 700 \text{ mm}$   
 Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$



ALYSIS

Total Design Load,  $\sim N = 3302.81 \text{ kN}$   
 Footing X Dimension,  $L_x = 3.40 \text{ m}$   
 Footing Y Dimension,  $L_y = 3.40 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 285.71 kPa          | 252.50 kPa        |
| S2 | 285.71 kPa          | 252.50 kPa        |
| S3 | 285.71 kPa          | 252.50 kPa        |
| S4 | 285.71 kPa          | 252.50 kPa        |

URE

| Y - Direction               | X - Direction               |
|-----------------------------|-----------------------------|
| $M_x = 841.33 \text{ kN.m}$ | $M_y = 841.33 \text{ kN.m}$ |
| $R_x = 0.60 \text{ MPa}$    | $R_y = 0.60 \text{ MPa}$    |
| $As_x = 0.17 \%$            | $As_y = 0.17 \%$            |
| $= 3702 \text{ mm}^2$       | $= 3702 \text{ mm}^2$       |
| 10Y22@362(103%)             | 10Y22@362(103%)             |
| 12Y20@296(102%)             | 12Y20@296(102%)             |
| 14Y18@251( 96%)             | 14Y18@251( 96%)             |
| 18Y16@192( 98%)             | 18Y16@192( 98%)             |

CODE: BS8110

EAR AND PUNCHING

Max Permissible Shear Stress = 4.00 MPa  
 Shear Stress Across X at Column Face = 0.55 MPa O.K.  
 Shear Stress Across Y at Column Face = 0.55 MPa O.K.  
 Design Concrete Shear Stress Across X = 0.35 MPa  
 Design Concrete Shear Stress Across Y = 0.35 MPa  
 Shear Stress Across X at d from Column Face = 0.30 MPa O.K.  
 Shear Stress Across Y at d from Column Face = 0.30 MPa O.K.  
 Length of Punching Perimeter = 10080 mm  
 Design Concrete Punching Shear Stress = 0.35 MPa  
 Vertical Force Inside Perimeter = 1603.49 kN  
 Punching Shear Force = 1315.43 kN  
 Punching Shear Stress = 0.20 MPa O.K.

GRAM : FOOT - Reinforced Concrete Footing Design  
 JECT : National Museum - Amman  
 OTING : Column on AxisLines X10/Y05 & X10/Y02  
 DATE : February 26, 2000

Page 440

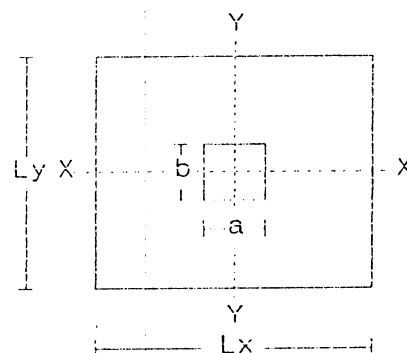
# UT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 3145.55 \text{ kN}$   
 Column Design Moment,  $M_x = 0.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 0.00 \text{ kN.m}$

Column Size in X,  $a = 600 \text{ mm}$   
 Column Size in Y,  $b = 600 \text{ mm}$   
 Footing Depth,  $h = 700 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$

Max Cover to center of Bars,  $c = 60 \text{ mm}$



# ALYSIS

Total Design Load,  $\tilde{N} = 3552.57 \text{ kN}$   
 Footing X Dimension,  $L_x = 3.50 \text{ m}$   
 Footing Y Dimension,  $L_y = 3.50 \text{ m}$

| TOTAL SOIL STRESSES |            | NET SOIL STRESSES |  |
|---------------------|------------|-------------------|--|
| S1                  | 290.01 kPa | 256.78 kPa        |  |
| S2                  | 290.01 kPa | 256.78 kPa        |  |
| S3                  | 290.01 kPa | 256.78 kPa        |  |
| S4                  | 290.01 kPa | 256.78 kPa        |  |

# URE

| Y - Direction               |  | X - Direction               |  |
|-----------------------------|--|-----------------------------|--|
| $M_x = 944.79 \text{ kN.m}$ |  | $M_y = 944.79 \text{ kN.m}$ |  |
| $R_x = 0.66 \text{ MPa}$    |  | $R_y = 0.66 \text{ MPa}$    |  |
| $As_x = 0.19 \%$            |  | $As_y = 0.19 \%$            |  |
| $= 4169 \text{ mm}^2$       |  | $= 4169 \text{ mm}^2$       |  |
| 11Y22@336(100%)             |  | 11Y22@336(100%)             |  |
| 13Y20@280( 98%)             |  | 13Y20@280( 98%)             |  |
| 16Y18@224( 97%)             |  | 16Y18@224( 97%)             |  |
| 20Y16@177( 96%)             |  | 20Y16@177( 96%)             |  |

CODE: BS8110

# EAR AND PUNCHING

Max Permissible Shear Stress =  $4.00 \text{ MPa}$   
 Shear Stress Across X at Column Face =  $0.58 \text{ MPa}$  O.K.  
 Shear Stress Across Y at Column Face =  $0.58 \text{ MPa}$  O.K.

Design Concrete Shear Stress Across X =  $0.36 \text{ MPa}$   
 Design Concrete Shear Stress Across Y =  $0.36 \text{ MPa}$   
 Stress Across X at  $d$  from Column Face =  $0.32 \text{ MPa}$  O.K.  
 Stress Across Y at  $d$  from Column Face =  $0.32 \text{ MPa}$  O.K.

Length of Punching Perimeter =  $10080 \text{ mm}$   
 Design Concrete Punching Shear Stress =  $0.36 \text{ MPa}$   
 Vertical Force Inside Perimeter =  $1630.66 \text{ kN}$   
 Punching Shear Force =  $1514.90 \text{ kN}$   
 Punching Shear Stress =  $0.23 \text{ MPa}$  O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 SUBJECT : National Museum - Amman  
 NOTING : Column on Axis Lines X11/Y02  
 DATE : February 26, 2000

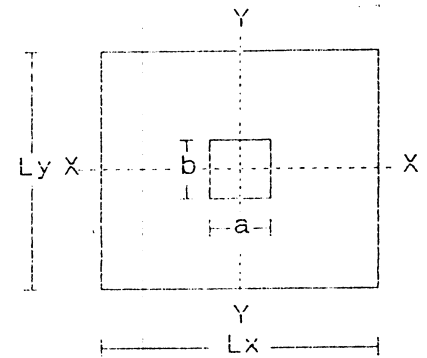
Page 441

# INPUT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 1521.79 \text{ kN}$   
 Column Design Moment,  $M_x = 0.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 0.00 \text{ kN.m}$

Column Size in X,  $a = 600 \text{ mm}$   
 Column Size in Y,  $b = 600 \text{ mm}$   
 Footing Depth,  $h = 500 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$



# ANALYSIS

Total Design Load,  $\sim N = 1685.69 \text{ kN}$   
 Footing X Dimension,  $L_x = 2.50 \text{ m}$   
 Footing Y Dimension,  $L_y = 2.50 \text{ m}$

| TOTAL SOIL STRESSES |            | NET SOIL STRESSES |  |
|---------------------|------------|-------------------|--|
| S1                  | 269.71 kPa | 243.49 kPa        |  |
| S2                  | 269.71 kPa | 243.49 kPa        |  |
| S3                  | 269.71 kPa | 243.49 kPa        |  |
| S4                  | 269.71 kPa | 243.49 kPa        |  |

# EXCURE

| Y - Direction               |  | X - Direction               |  |
|-----------------------------|--|-----------------------------|--|
| $M_x = 274.68 \text{ kN.m}$ |  | $M_y = 274.68 \text{ kN.m}$ |  |
| $R_x = 0.57 \text{ MPa}$    |  | $R_y = 0.57 \text{ MPa}$    |  |
| $As_x = 0.16 \%$            |  | $As_y = 0.16 \%$            |  |
| $= 1786 \text{ mm}^2$       |  | $= 1786 \text{ mm}^2$       |  |
| Nominal                     |  | Nominal                     |  |
| 9Y16@295(101%)              |  | 9Y16@295(101%)              |  |
| 12Y14@215(103%)             |  | 12Y14@215(103%)             |  |
| 16Y12@158(101%)             |  | 16Y12@158(101%)             |  |
| 22Y10@113( 97%)             |  | 22Y10@113( 97%)             |  |

CODE: BS8110

# SHEAR AND PUNCHING

Max Permissible Shear Stress =  $4.00 \text{ MPa}$   
 Shear Stress Across X at Column Face =  $0.53 \text{ MPa}$  O.K.  
 Shear Stress Across Y at Column Face =  $0.53 \text{ MPa}$  O.K.

Design Concrete Shear Stress Across X =  $0.34 \text{ MPa}$   
 Design Concrete Shear Stress Across Y =  $0.34 \text{ MPa}$   
 Shear Stress Across X at d from Column Face =  $0.28 \text{ MPa}$  O.K.  
 Shear Stress Across Y at d from Column Face =  $0.28 \text{ MPa}$  O.K.

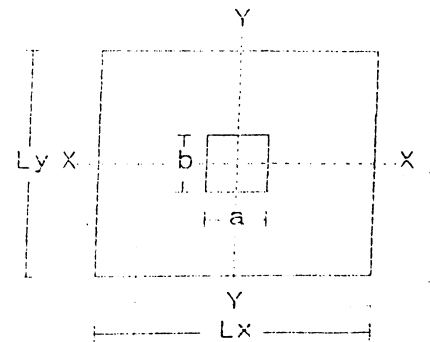
Length of Punching Perimeter =  $7680 \text{ mm}$   
 Design Concrete Punching Shear Stress =  $0.34 \text{ MPa}$   
 Vertical Force Inside Perimeter =  $897.59 \text{ kN}$   
 Punching Shear Force =  $624.20 \text{ kN}$   
 Punching Shear Stress =  $0.13 \text{ MPa}$  O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 SUBJECT : National Museum Amman  
 FOOTING : Column on AxisLines X11/Y05  
 DATE : February 26, 2000

Page 442

# PUT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 3539.64 \text{ kN}$   
 Column Design Moment,  $M_x = 0.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 0.00 \text{ kN.m}$



Column Size in X,  $a = 600 \text{ mm}$   
 Column Size in Y,  $b = 600 \text{ mm}$   
 Footing Depth,  $h = 700 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$

# ANALYSIS

Total Design Load,  $\sim N = 4020.07 \text{ kN}$   
 Footing X Dimension,  $L_x = 3.80 \text{ m}$   
 Footing Y Dimension,  $L_y = 3.80 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 278.40 kPa          | 245.13 kPa        |
| S2 | 278.40 kPa          | 245.13 kPa        |
| S3 | 278.40 kPa          | 245.13 kPa        |
| S4 | 278.40 kPa          | 245.13 kPa        |

# REINFORCEMENT

| Y - Direction                | X - Direction                |
|------------------------------|------------------------------|
| $M_x = 1192.30 \text{ kN.m}$ | $M_y = 1192.30 \text{ kN.m}$ |
| $R_x = 0.77 \text{ MPa}$     | $R_y = 0.77 \text{ MPa}$     |
| $As_x = 0.22 \%$             | $As_y = 0.22 \%$             |
| $= 5289 \text{ mm}^2$        | $= 5289 \text{ mm}^2$        |
| 11Y25@365(102%)              | 11Y25@365(102%)              |
| 14Y22@281(101%)              | 14Y22@281(101%)              |
| 17Y20@229(101%)              | 17Y20@229(101%)              |
| 20Y18@193(96%)               | 20Y18@193(96%)               |

CODE: BS8110

# BEAR AND PUNCHING

Max Permissible Shear Stress = 4.00 MPa  
 Shear Stress Across X at Column Face = 0.61 MPa O.K.  
 Shear Stress Across Y at Column Face = 0.61 MPa O.K.  
 Design Concrete Shear Stress Across X = 0.38 MPa  
 Design Concrete Shear Stress Across Y = 0.38 MPa  
 Shear Stress Across X at d from Column Face = 0.37 MPa O.K.  
 Shear Stress Across Y at d from Column Face = 0.37 MPa O.K.  
 Length of Punching Perimeter = 10080 mm  
 Design Concrete Punching Shear Stress = 0.38 MPa  
 Vertical Force Inside Perimeter = 1556.66 kN  
 Punching Shear Force = 1982.98 kN  
 Punching Shear Stress = 0.31 MPa O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 OBJECT : National Museum - Amman  
 FOOTING : Column on Axis Lines X12/Y02  
 DATE : February 26, 2000

Page 443

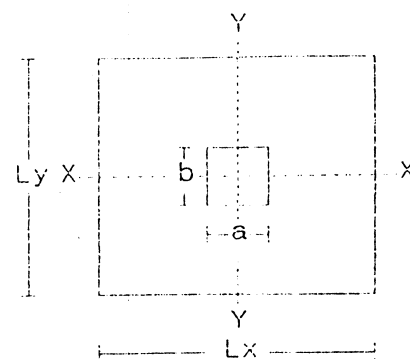
# PUT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 5857.96 \text{ kN}$   
 Column Design Moment,  $M_x = 0.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 0.00 \text{ kN.m}$

Column Size in X,  $a = 600 \text{ mm}$   
 Column Size in Y,  $b = 600 \text{ mm}$   
 Footing Depth,  $h = 1000 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$

Max Cover to center of Bars,  $c = 60 \text{ mm}$



# ANALYSIS

Total Design Load,  $\sim N = 6901.20 \text{ kN}$   
 Footing X Dimension,  $L_x = 4.90 \text{ m}$   
 Footing Y Dimension,  $L_y = 4.90 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 287.43 kPa          | 243.98 kPa        |
| S2 | 287.43 kPa          | 243.98 kPa        |
| S3 | 287.43 kPa          | 243.98 kPa        |
| S4 | 287.43 kPa          | 243.98 kPa        |

# EXURE

| Y - Direction                | X - Direction                |
|------------------------------|------------------------------|
| $M_x = 2763.10 \text{ kN.m}$ | $M_y = 2763.10 \text{ kN.m}$ |
| $R_x = 0.64 \text{ MPa}$     | $R_y = 0.64 \text{ MPa}$     |
| $A_{sx} = 0.18 \%$           | $A_{sy} = 0.18 \%$           |
| $= 8293 \text{ mm}^2$        | $= 8293 \text{ mm}^2$        |
| 17Y25@297(101%)              | 17Y25@297(101%)              |
| 21Y22@238( 96%)              | 21Y22@238( 96%)              |
| 26Y20@190( 98%)              | 26Y20@190( 98%)              |
| 32Y18@154( 98%)              | 32Y18@154( 98%)              |

CODE: BS8110

# SHEAR AND PUNCHING

Max Permissible Shear Stress =  $4.00 \text{ MPa}$   
 Shear Stress Across X at Column Face =  $0.56 \text{ MPa}$  O.K.  
 Shear Stress Across Y at Column Face =  $0.56 \text{ MPa}$  O.K.

Design Concrete Shear Stress Across X =  $0.36 \text{ MPa}$   
 Design Concrete Shear Stress Across Y =  $0.36 \text{ MPa}$   
 Shear Stress Across X at  $d$  from Column Face =  $0.31 \text{ MPa}$  O.K.  
 Shear Stress Across Y at  $d$  from Column Face =  $0.31 \text{ MPa}$  O.K.

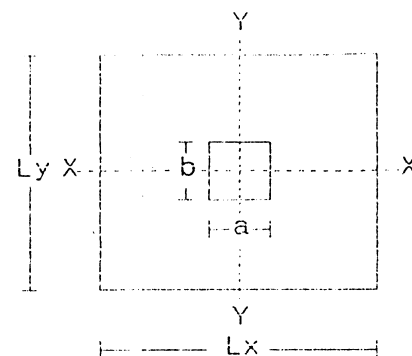
Length of Punching Perimeter =  $13680 \text{ mm}$   
 Design Concrete Punching Shear Stress =  $0.36 \text{ MPa}$   
 Vertical Force Inside Perimeter =  $2853.69 \text{ kN}$   
 Punching Shear Force =  $3004.27 \text{ kN}$   
 Punching Shear Stress =  $0.23 \text{ MPa}$  O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 SUBJECT : National Museum - Amman  
 NOTING : Column on Axis Lines X12/Y04  
 DATE : February 26, 2000

Page 444

# PUT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 4400.11 \text{ kN}$   
 Column Design Moment,  $M_x = 0.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 0.00 \text{ kN.m}$



27

Column Size in X,  $a = 600 \text{ mm}$   
 Column Size in Y,  $b = 600 \text{ mm}$   
 Footing Depth,  $h = 900 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$

# ANALYSIS

Total Design Load,  $\sim N = 5106.34 \text{ kN}$   
 Footing X Dimension,  $L_x = 4.20 \text{ m}$   
 Footing Y Dimension,  $L_y = 4.20 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 289.48 kPa          | 249.44 kPa        |
| S2 | 289.48 kPa          | 249.44 kPa        |
| S3 | 289.48 kPa          | 249.44 kPa        |
| S4 | 289.48 kPa          | 249.44 kPa        |

# REINFORCE

| Y - Direction                | X - Direction                |
|------------------------------|------------------------------|
| $M_x = 1697.18 \text{ kN.m}$ | $M_y = 1697.18 \text{ kN.m}$ |
| $R_x = 0.57 \text{ MPa}$     | $R_y = 0.57 \text{ MPa}$     |
| $A_{sx} = 0.16 \%$           | $A_{sy} = 0.16 \%$           |
| $= 5682 \text{ mm}^2$        | $= 5682 \text{ mm}^2$        |
| 12Y25@369(104%)              | 12Y25@369(104%)              |
| 15Y22@290(100%)              | 15Y22@290(100%)              |
| 18Y20@239(99%)               | 18Y20@239(99%)               |
| 22Y18@193(98%)               | 22Y18@193(98%)               |

CODE: BS8110

# SHEAR AND PUNCHING

Max Permissible Shear Stress = 4.00 MPa  
 Shear Stress Across X at Column Face = 0.53 MPa O.K.  
 Shear Stress Across Y at Column Face = 0.53 MPa O.K.  
 Design Concrete Shear Stress Across X = 0.34 MPa  
 Design Concrete Shear Stress Across Y = 0.34 MPa  
 Shear Stress Across X at d from Column Face = 0.29 MPa O.K.  
 Shear Stress Across Y at d from Column Face = 0.29 MPa O.K.  
 Length of Punching Perimeter = 12480 mm  
 Design Concrete Punching Shear Stress = 0.34 MPa  
 Vertical Force Inside Perimeter = 2428.14 kN  
 Punching Shear Force = 1971.96 kN  
 Punching Shear Stress = 0.19 MPa O.K.

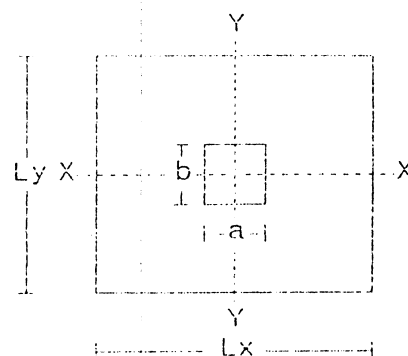
PROGRAM : FOOT - Reinforced Concrete Footing Design  
 SUBJECT : National Museum - Amman  
 FOOTING : Column on AxisLines X12/Y05  
 DATE : February 26, 2000

Page 445

# PUT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 4978.93 \text{ kN}$   
 Column Design Moment,  $M_x = 0.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 0.00 \text{ kN.m}$

Column Size in X,  $a = 600 \text{ mm}$   
 Column Size in Y,  $b = 600 \text{ mm}$   
 Footing Depth,  $h = 900 \text{ mm}$



Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$

# ANALYSIS

Total Design Load,  $\sim N = 5790.19 \text{ kN}$   
 Footing X Dimension,  $L_x = 4.50 \text{ m}$   
 Footing Y Dimension,  $L_y = 4.50 \text{ m}$

| TOTAL SOIL STRESSES |            | NET SOIL STRESSES |            |
|---------------------|------------|-------------------|------------|
| S1                  | 285.94 kPa |                   | 245.87 kPa |
| S2                  | 285.94 kPa |                   | 245.87 kPa |
| S3                  | 285.94 kPa |                   | 245.87 kPa |
| S4                  | 285.94 kPa |                   | 245.87 kPa |

# REINFORCE

| Y - Direction                |  | X - Direction                |  |
|------------------------------|--|------------------------------|--|
| $M_x = 2103.60 \text{ kN.m}$ |  | $M_y = 2103.60 \text{ kN.m}$ |  |
| $R_x = 0.66 \text{ MPa}$     |  | $R_y = 0.66 \text{ MPa}$     |  |
| $As_x = 0.19 \%$             |  | $As_y = 0.19 \%$             |  |
| $= 7073 \text{ mm}^2$        |  | $= 7073 \text{ mm}^2$        |  |
| 14Y25@335( 97%)              |  | 14Y25@335( 97%)              |  |
| 18Y22@256( 97%)              |  | 18Y22@256( 97%)              |  |
| 22Y20@208( 98%)              |  | 22Y20@208( 98%)              |  |
| 27Y18@168( 97%)              |  | 27Y18@168( 97%)              |  |

CODE: BS8110

# SHEAR AND PUNCHING

Max Permissible Shear Stress = 4.00 MPa  
 Shear Stress Across X at Column Face = 0.57 MPa O.K.  
 Shear Stress Across Y at Column Face = 0.57 MPa O.K.  
 Design Concrete Shear Stress Across X = 0.36 MPa  
 Design Concrete Shear Stress Across Y = 0.36 MPa  
 Shear Stress Across X at d from Column Face = 0.32 MPa O.K.  
 Shear Stress Across Y at d from Column Face = 0.32 MPa O.K.  
 Length of Punching Perimeter = 12480 mm  
 Design Concrete Punching Shear Stress = 0.36 MPa  
 Vertical Force Inside Perimeter = 2393.43 kN  
 Punching Shear Force = 2585.50 kN  
 Punching Shear Stress = 0.25 MPa O.K.

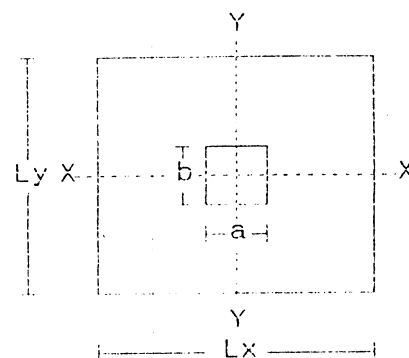
PROGRAM : FOOT - Reinforced Concrete Footing Design  
 PROJECT : National Museum - Amman  
 DRAWING : Column on Axis Lines X2/Y02  
 DATE : February 26, 2000

Page 446

JT  
 Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 7686.28 \text{ kN}$   
 Column Design Moment,  $M_x = 0.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 0.00 \text{ kN.m}$

Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 1100 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$



# ANALYSIS

Total Design Load,  $\sim N = 9207.10 \text{ kN}$   
 Footing X Dimension,  $L_x = 5.70 \text{ m}$   
 Footing Y Dimension,  $L_y = 5.70 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 283.38 kPa          | 236.57 kPa        |
| S2 | 283.38 kPa          | 236.57 kPa        |
| S3 | 283.38 kPa          | 236.57 kPa        |
| S4 | 283.38 kPa          | 236.57 kPa        |

# REQUIRE

| Y - Direction                | X - Direction                |
|------------------------------|------------------------------|
| $M_x = 4213.96 \text{ kN.m}$ | $M_y = 4213.96 \text{ kN.m}$ |
| $R_x = 0.68 \text{ MPa}$     | $R_y = 0.68 \text{ MPa}$     |
| $As_x = 0.19 \%$             | $As_y = 0.19 \%$             |
| $= 11457 \text{ mm}^2$       | $= 11457 \text{ mm}^2$       |
| 23Y25@252( 99%)              | 23Y25@252( 99%)              |
| 35Y20@164( 96%)              | 35Y20@164( 96%)              |
| 29Y22@198( 96%)              | 29Y22@198( 96%)              |
| 43Y18@132( 95%)              | 43Y18@132( 95%)              |

CODE: BS8110

# BEAR AND PUNCHING

Max Permissible Shear Stress =  $4.00 \text{ MPa}$   
 Shear Stress Across X at Column Face =  $0.57 \text{ MPa}$  O.K.  
 Shear Stress Across Y at Column Face =  $0.57 \text{ MPa}$  O.K.

Design Concrete Shear Stress Across X =  $0.37 \text{ MPa}$   
 Design Concrete Shear Stress Across Y =  $0.37 \text{ MPa}$   
 Shear Stress Across X at d from Column Face =  $0.33 \text{ MPa}$  O.K.  
 Shear Stress Across Y at d from Column Face =  $0.33 \text{ MPa}$  O.K.

Length of Punching Perimeter =  $15280 \text{ mm}$   
 Design Concrete Punching Shear Stress =  $0.37 \text{ MPa}$   
 Vertical Force Inside Perimeter =  $3452.18 \text{ kN}$   
 Punching Shear Force =  $4234.10 \text{ kN}$   
 Punching Shear Stress =  $0.27 \text{ MPa}$  O.K.

OGRAM : FOOT - Reinforced Concrete Footing Design  
 OBJECT : National Museum - Amman  
 FOOTING : Column on Axis Lines X3/Y05 /  
 DATE : February 26, 2000

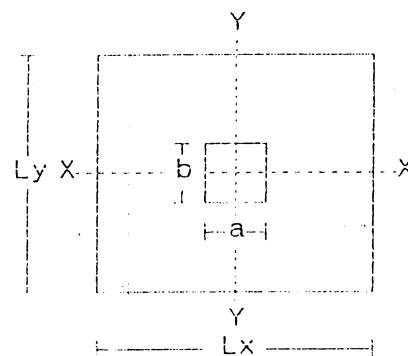
Page 447

# PUT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 7209.49 \text{ kN}$   
 Column Design Moment,  $M_x = 50.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 15.00 \text{ kN.m}$

Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 1000 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$



# ANALYSIS

Total Design Load,  $\sim N = 8523.48 \text{ kN}$   
 Footing X Dimension,  $L_x = 5.50 \text{ m}$   
 Footing Y Dimension,  $L_y = 5.50 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 284.11 kPa          | 240.67 kPa        |
| S2 | 283.03 kPa          | 239.59 kPa        |
| S3 | 279.42 kPa          | 235.99 kPa        |
| S4 | 280.51 kPa          | 237.07 kPa        |

# EXURE

| Y - Direction                | X - Direction                |
|------------------------------|------------------------------|
| $M_x = 3795.40 \text{ kN.m}$ | $M_y = 3775.15 \text{ kN.m}$ |
| $R_x = 0.78 \text{ MPa}$     | $R_y = 0.78 \text{ MPa}$     |
| $As_x = 0.22 \%$             | $As_y = 0.22 \%$             |
| $= 11472 \text{ mm}^2$       | $= 11408 \text{ mm}^2$       |
| 23Y25@243( 98%)              | 23Y25@243( 99%)              |
| 35Y20@158( 96%)              | 35Y20@158( 96%)              |
| 29Y22@191( 96%)              | 29Y22@191( 97%)              |
| 43Y18@128( 95%)              | 43Y18@128( 96%)              |

CODE: BS8110

# HEAR AND PUNCHING

Max Permissible Shear Stress = 4.00 MPa  
 Shear Stress Across X at Column Face = 0.61 MPa O.K.  
 Shear Stress Across Y at Column Face = 0.61 MPa O.K.  
 Design Concrete Shear Stress Across X = 0.38 MPa  
 Design Concrete Shear Stress Across Y = 0.38 MPa  
 Shear Stress Across X at d from Column Face = 0.37 MPa O.K.  
 Shear Stress Across Y at d from Column Face = 0.37 MPa O.K.  
 Length of Punching Perimeter = 14080 mm  
 Design Concrete Punching Shear Stress = 0.38 MPa  
 Vertical Force Inside Perimeter = 2953.01 kN  
 Punching Shear Force = 4256.48 kN  
 Punching Shear Stress = 0.32 MPa O.K.

GRAM : FOOT - Reinforced Concrete Footing Design  
 JEOT : National Museum - Amman  
 OTING : Column on AxisLines X4/Y02  
 DATE : February 26, 2000

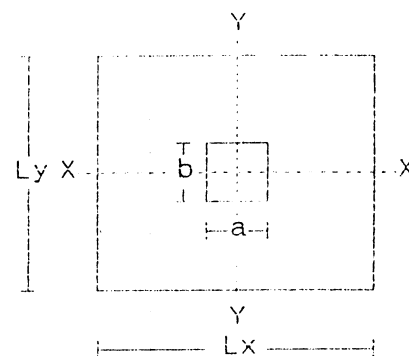
Page 448

JT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 6882.93 \text{ kN}$   
 Column Design Moment,  $M_x = 50.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 15.00 \text{ kN.m}$

Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 1000 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$



ALYSIS

Total Design Load,  $\sim N = 8149.41 \text{ kN}$   
 Footing X Dimension,  $L_x = 5.40 \text{ m}$   
 Footing Y Dimension,  $L_y = 5.40 \text{ m}$

| TOTAL SOIL STRESSES |            | NET SOIL STRESSES |            |
|---------------------|------------|-------------------|------------|
| S1                  | 281.95 kPa |                   | 238.52 kPa |
| S2                  | 280.81 kPa |                   | 237.37 kPa |
| S3                  | 277.00 kPa |                   | 233.56 kPa |
| S4                  | 278.14 kPa |                   | 234.71 kPa |

XURE

| Y - Direction                |  | X - Direction                |  |
|------------------------------|--|------------------------------|--|
| $M_x = 3539.70 \text{ kN.m}$ |  | $M_y = 3519.54 \text{ kN.m}$ |  |
| $R_x = 0.74 \text{ MPa}$     |  | $R_y = 0.74 \text{ MPa}$     |  |
| $As_x = 0.21 \%$             |  | $As_y = 0.21 \%$             |  |
| $= 10678 \text{ mm}^2$       |  | $= 10615 \text{ mm}^2$       |  |
| 21Y25@263( 97%)              |  | 21Y25@263( 97%)              |  |
| 27Y22@202( 96%)              |  | 27Y22@202( 97%)              |  |
| 33Y20@164( 97%)              |  | 33Y20@164( 98%)              |  |
| 40Y18@135( 95%)              |  | 40Y18@135( 96%)              |  |

CODE: BS8110

EAR AND PUNCHING

Max Permissible Shear Stress = 4.00 MPa  
 Shear Stress Across X at Column Face = 0.59 MPa O.K.  
 Shear Stress Across Y at Column Face = 0.59 MPa O.K.

Design Concrete Shear Stress Across X = 0.38 MPa  
 Design Concrete Shear Stress Across Y = 0.38 MPa  
 Stress Across X at d from Column Face = 0.36 MPa O.K.  
 Stress Across Y at d from Column Face = 0.35 MPa O.K.

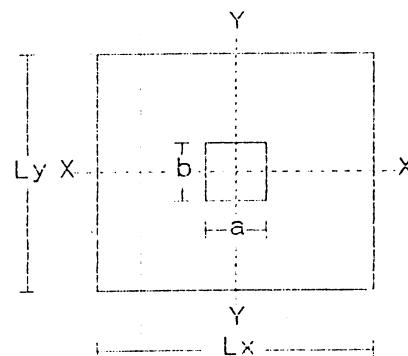
Length of Punching Perimeter = 14080 mm  
 Design Concrete Punching Shear Stress = 0.38 MPa  
 Vertical Force Inside Perimeter = 2924.64 kN  
 Punching Shear Force = 3958.30 kN  
 Punching Shear Stress = 0.30 MPa O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 SUBJECT : National Museum - Amman  
 FOOTING : Column on Axis Lines X4/Y04 & X4/Y03  
 DATE : February 26, 2000

Page 449

#### INPUT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 2525.45 \text{ kN}$   
 Column Design Moment,  $M_x = 25.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 25.00 \text{ kN.m}$   
 Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 600 \text{ mm}$   
 Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$



#### ANALYSIS

Total Design Load,  $\sim N = 2829.39 \text{ kN}$   
 Footing X Dimension,  $L_x = 3.20 \text{ m}$   
 Footing Y Dimension,  $L_y = 3.20 \text{ m}$

| TOTAL SOIL STRESSES |            | NET SOIL STRESSES |            |
|---------------------|------------|-------------------|------------|
| S1                  | 285.46 kPa |                   | 255.78 kPa |
| S2                  | 276.31 kPa |                   | 246.63 kPa |
| S3                  | 267.15 kPa |                   | 237.47 kPa |
| S4                  | 276.31 kPa |                   | 246.63 kPa |

#### REINFORCE

| Y - Direction               |  | X - Direction               |  |
|-----------------------------|--|-----------------------------|--|
| $M_x = 625.03 \text{ kN.m}$ |  | $M_y = 616.56 \text{ kN.m}$ |  |
| $R_x = 0.67 \text{ MPa}$    |  | $R_y = 0.66 \text{ MPa}$    |  |
| $As_x = 0.19 \%$            |  | $As_y = 0.19 \%$            |  |
| $= 3270 \text{ mm}^2$       |  | $= 3225 \text{ mm}^2$       |  |
| 10Y20@340( 96%)             |  | 10Y20@340( 97%)             |  |
| 13Y18@255(101%)             |  | 13Y18@255(102%)             |  |
| 16Y16@204( 98%)             |  | 16Y16@204(100%)             |  |
| 21Y14@153( 99%)             |  | 20Y14@161( 96%)             |  |

CODE: BS8110

#### BEAR AND PUNCHING

Max Permissible Shear Stress = 4.00 MPa  
 Shear Stress Across X at Column Face = 0.58 MPa O.K.  
 Shear Stress Across Y at Column Face = 0.57 MPa O.K.  
 Design Concrete Shear Stress Across X = 0.36 MPa  
 Design Concrete Shear Stress Across Y = 0.36 MPa  
 Shear Stress Across X at d from Column Face = 0.33 MPa O.K.  
 Shear Stress Across Y at d from Column Face = 0.32 MPa O.K.  
 Length of Punching Perimeter = 9280 mm  
 Design Concrete Punching Shear Stress = 0.36 MPa  
 Vertical Force Inside Perimeter = 1327.44 kN  
 Punching Shear Force = 1198.01 kN  
 Punching Shear Stress = 0.24 MPa O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 SUBJECT : National Museum - Amman  
 FOOTING : Column on Axis Lines X5/Y02  
 DATE : February 26, 2000

Page 450

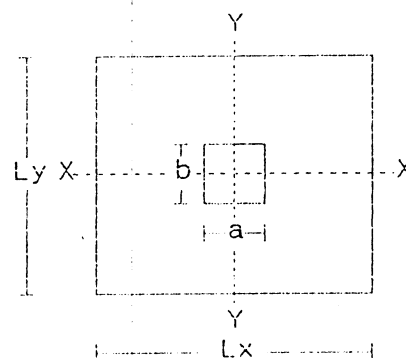
# PUT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 6805.77 \text{ kN}$   
 Column Design Moment,  $M_x = 50.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 15.00 \text{ kN.m}$

Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 1000 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$

Max Cover to center of Bars,  $c = 60 \text{ mm}$



# ANALYSIS

Total Design Load,  $\tilde{N} = 8025.59 \text{ kN}$   
 Footing X Dimension,  $L_x = 5.30 \text{ m}$   
 Footing Y Dimension,  $L_y = 5.30 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 288.33 kPa          | 244.90 kPa        |
| S2 | 287.12 kPa          | 243.70 kPa        |
| S3 | 283.09 kPa          | 239.67 kPa        |
| S4 | 284.30 kPa          | 240.87 kPa        |

# EXCURE

| Y - Direction                | X - Direction                |
|------------------------------|------------------------------|
| $M_x = 3416.54 \text{ kN.m}$ | $M_y = 3396.46 \text{ kN.m}$ |
| $R_x = 0.73 \text{ MPa}$     | $R_y = 0.73 \text{ MPa}$     |
| $As_x = 0.21 \%$             | $As_y = 0.21 \%$             |
| $= 10300 \text{ mm}^2$       | $= 10237 \text{ mm}^2$       |
| 20Y25@271( 95%)              | 20Y25@271( 96%)              |
| 26Y22@206( 96%)              | 26Y22@206( 97%)              |
| 32Y20@166( 98%)              | 32Y20@166( 98%)              |
| 39Y18@136( 96%)              | 39Y18@136( 97%)              |

CODE: BS8110

# HEAR AND PUNCHING

Max Permissible Shear Stress =  $4.00 \text{ MPa}$   
 Shear Stress Across X at Column Face =  $0.60 \text{ MPa}$  O.K.  
 Shear Stress Across Y at Column Face =  $0.59 \text{ MPa}$  O.K.

Design Concrete Shear Stress Across X =  $0.37 \text{ MPa}$   
 Design Concrete Shear Stress Across Y =  $0.37 \text{ MPa}$   
 Shear Stress Across X at  $d$  from Column Face =  $0.35 \text{ MPa}$  O.K.  
 Shear Stress Across Y at  $d$  from Column Face =  $0.35 \text{ MPa}$  O.K.

Length of Punching Perimeter =  $14080 \text{ mm}$   
 Design Concrete Punching Shear Stress =  $0.37 \text{ MPa}$   
 Vertical Force Inside Perimeter =  $3002.00 \text{ kN}$   
 Punching Shear Force =  $3803.77 \text{ kN}$   
 Punching Shear Stress =  $0.29 \text{ MPa}$  O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 SUBJECT : National Museum - Amman  
 FOOTING : Column on AxisLines X5/Y04  
 DATE : February 26, 2000

Page 451

#### INPUT

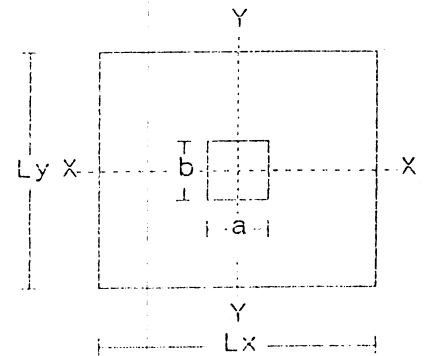
Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 1922.82 \text{ kN}$   
 Column Design Moment,  $M_x = 25.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 25.00 \text{ kN.m}$

Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 500 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$

Steel Grade,  $f_y = 420 \text{ MPa}$

Max Cover to center of Bars,  $c = 60 \text{ mm}$



#### ANALYSIS

Total Design Load,  $\sim N = 2128.03 \text{ kN}$   
 Footing X Dimension,  $L_x = 2.80 \text{ m}$   
 Footing Y Dimension,  $L_y = 2.80 \text{ m}$

| TOTAL SOIL STRESSES |            | NET SOIL STRESSES |            |
|---------------------|------------|-------------------|------------|
| S1                  | 285.10 kPa |                   | 258.92 kPa |
| S2                  | 271.43 kPa |                   | 245.26 kPa |
| S3                  | 257.77 kPa |                   | 231.59 kPa |
| S4                  | 271.43 kPa |                   | 245.26 kPa |

#### REINFORCEMENT

| Y - Direction               |  | X - Direction               |  |
|-----------------------------|--|-----------------------------|--|
| $M_x = 386.47 \text{ kN.m}$ |  | $M_y = 378.56 \text{ kN.m}$ |  |
| $R_x = 0.71 \text{ MPa}$    |  | $R_y = 0.70 \text{ MPa}$    |  |
| $As_x = 0.20 \%$            |  | $As_y = 0.20 \%$            |  |
| $= 2487 \text{ mm}^2$       |  | $= 2434 \text{ mm}^2$       |  |
| 10Y18@296(102%)             |  | 10Y18@296(104%)             |  |
| 12Y16@242( 97%)             |  | 12Y16@242( 99%)             |  |
| 16Y14@178( 99%)             |  | 16Y14@178(101%)             |  |
| 21Y12@133( 95%)             |  | 21Y12@133( 97%)             |  |

CODE: BS8110

#### BEAR AND PUNCHING

Max Permissible Shear Stress = 4.00 MPa  
 Shear Stress Across X at Column Face = 0.60 MPa O.K.  
 Shear Stress Across Y at Column Face = 0.59 MPa O.K.

Design Concrete Shear Stress Across X = 0.37 MPa  
 Design Concrete Shear Stress Across Y = 0.37 MPa  
 Stress Across X at  $d$  from Column Face = 0.35 MPa O.K.  
 Stress Across Y at  $d$  from Column Face = 0.34 MPa O.K.

Length of Punching Perimeter = 8080 mm  
 Design Concrete Punching Shear Stress = 0.37 MPa  
 Vertical Force Inside Perimeter = 1000.75 kN  
 Punching Shear Force = 922.07 kN  
 Punching Shear Stress = 0.26 MPa O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 PROJECT : National Museum - Amman  
 FOOTING : Column on AxisLines X6/Y02  
 DATE : February 26, 2000

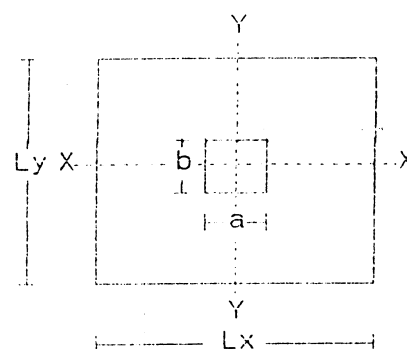
Page 452

# INPUT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 7999.06 \text{ kN}$   
 Column Design Moment,  $M_x = 50.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 15.00 \text{ kN.m}$

Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 1100 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$



# ANALYSIS

Total Design Load,  $\sim N = 9573.89 \text{ kN}$   
 Footing X Dimension,  $L_x = 5.80 \text{ m}$   
 Footing Y Dimension,  $L_y = 5.80 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 286.60 kPa          | 239.78 kPa        |
| S2 | 285.68 kPa          | 238.86 kPa        |
| S3 | 282.60 kPa          | 235.79 kPa        |
| S4 | 283.52 kPa          | 236.71 kPa        |

# REQUIRE

| Y - Direction                | X - Direction                |
|------------------------------|------------------------------|
| $M_x = 4504.45 \text{ kN.m}$ | $M_y = 4483.95 \text{ kN.m}$ |
| $R_x = 0.72 \text{ MPa}$     | $R_y = 0.71 \text{ MPa}$     |
| $As_x = 0.20 \%$             | $As_y = 0.20 \%$             |
| $= 12267 \text{ mm}^2$       | $= 12209 \text{ mm}^2$       |
| 24Y25@246( 96%)              | 24Y25@246( 97%)              |
| 31Y22@189( 96%)              | 37Y20@157( 95%)              |
| 38Y20@153( 97%)              | 31Y22@189( 96%)              |
| 46Y18@126( 95%)              | 46Y18@126( 96%)              |

CODE: BS8110

# BEAR AND PUNCHING

Max Permissible Shear Stress =  $4.00 \text{ MPa}$   
 Shear Stress Across X at Column Face =  $0.59 \text{ MPa}$  O.K.  
 Shear Stress Across Y at Column Face =  $0.58 \text{ MPa}$  O.K.

Design Concrete Shear Stress Across X =  $0.37 \text{ MPa}$   
 Design Concrete Shear Stress Across Y =  $0.37 \text{ MPa}$   
 Shear Stress Across X at d from Column Face =  $0.35 \text{ MPa}$  O.K.  
 Shear Stress Across Y at d from Column Face =  $0.35 \text{ MPa}$  O.K.

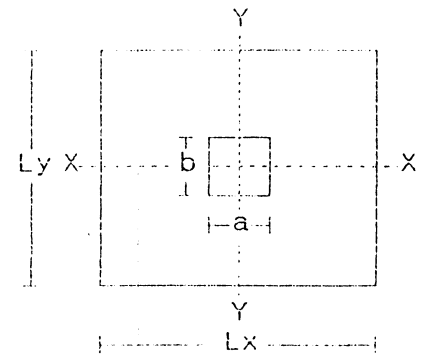
Length of Punching Perimeter =  $15280 \text{ mm}$   
 Design Concrete Punching Shear Stress =  $0.37 \text{ MPa}$   
 Vertical Force Inside Perimeter =  $3469.84 \text{ kN}$   
 Punching Shear Force =  $4529.21 \text{ kN}$   
 Punching Shear Stress =  $0.29 \text{ MPa}$  O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 PROJECT : National Museum - Amman  
 FOOTING : Column on Axis Lines X7/Y02  
 DATE : February 26, 2000

Page 453

# INPUT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 4801.65 \text{ kN}$   
 Column Design Moment,  $M_x = 25.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 25.00 \text{ kN.m}$   
 Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 800 \text{ mm}$   
 Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$



# ANALYSIS

Total Design Load,  $\sim N = 5510.74 \text{ kN}$   
 Footing X Dimension,  $L_x = 4.40 \text{ m}$   
 Footing Y Dimension,  $L_y = 4.40 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 288.17 kPa          | 251.54 kPa        |
| S2 | 284.65 kPa          | 248.02 kPa        |
| S3 | 281.12 kPa          | 244.50 kPa        |
| S4 | 284.65 kPa          | 248.02 kPa        |

# REINFORCE

| Y - Direction                | X - Direction                |
|------------------------------|------------------------------|
| $M_x = 1877.00 \text{ kN.m}$ | $M_y = 1867.46 \text{ kN.m}$ |
| $R_x = 0.78 \text{ MPa}$     | $R_y = 0.78 \text{ MPa}$     |
| $As_x = 0.22 \%$             | $As_y = 0.22 \%$             |
| $= 7206 \text{ mm}^2$        | $= 7168 \text{ mm}^2$        |
| 14Y25@327( 95%)              | 14Y25@327( 96%)              |
| 22Y20@203( 96%)              | 18Y22@250( 95%)              |
| 19Y22@237(100%)              | 22Y20@203( 96%)              |
| 27Y18@164( 95%)              | 27Y18@164( 96%)              |

CODE: BS8110

# SHEAR AND PUNCHING

Max Permissible Shear Stress = 4.00 MPa  
 Shear Stress Across X at Column Face = 0.62 MPa O.K.  
 Shear Stress Across Y at Column Face = 0.62 MPa O.K.  
 Design Concrete Shear Stress Across X = 0.38 MPa  
 Design Concrete Shear Stress Across Y = 0.38 MPa  
 Shear Stress Across X at d from Column Face = 0.37 MPa O.K.  
 Shear Stress Across Y at d from Column Face = 0.37 MPa O.K.  
 Length of Punching Perimeter = 11680 mm  
 Design Concrete Punching Shear Stress = 0.38 MPa  
 Vertical Force Inside Perimeter = 2114.71 kN  
 Punching Shear Force = 2686.94 kN  
 Punching Shear Stress = 0.31 MPa O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 PROJECT : National Museum - Amman  
 DRAWING : Column on Axis Lines X7/Y03  
 DATE : February 26, 2000

Page 454

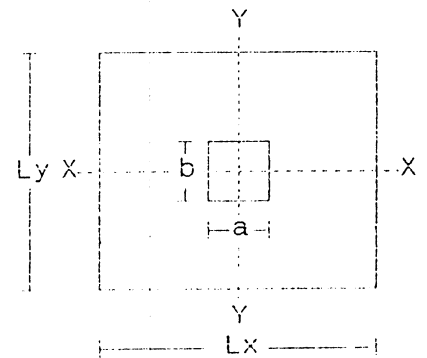
# UT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 1313.31 \text{ kN}$   
 Column Design Moment,  $M_x = 10.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 10.00 \text{ kN.m}$

Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 500 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$

Max Cover to center of Bars,  $c = 60 \text{ mm}$



# ANALYSIS

Total Design Load,  $\tilde{N} = 1450.18 \text{ kN}$   
 Footing X Dimension,  $L_x = 2.30 \text{ m}$   
 Footing Y Dimension,  $L_y = 2.30 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 284.00 kPa          | 258.13 kPa        |
| S2 | 274.14 kPa          | 248.26 kPa        |
| S3 | 264.27 kPa          | 238.40 kPa        |
| S4 | 274.14 kPa          | 248.26 kPa        |

# REQUIREMENTS

| Y - Direction               | X - Direction               |
|-----------------------------|-----------------------------|
| $M_x = 185.51 \text{ kN.m}$ | $M_y = 182.72 \text{ kN.m}$ |
| $R_x = 0.42 \text{ MPa}$    | $R_y = 0.41 \text{ MPa}$    |
| $As_x = 0.16 \%$            | $As_y = 0.16 \%$            |
| $A_s = 1643 \text{ mm}^2$   | $A_s = 1643 \text{ mm}^2$   |
| Nominal                     | Nominal                     |
| 8Y16@309 (98%)              | 8Y16@309 (98%)              |
| 7Y18@360 (108%)             | 7Y18@360 (108%)             |
| 11Y14@217 (103%)            | 11Y14@217 (103%)            |
| 14Y12@167 (96%)             | 14Y12@167 (96%)             |

CODE: BS8110

# SHEAR AND PUNCHING

Max Permissible Shear Stress = 4.00 MPa  
 Shear Stress Across X at Column Face = 0.46 MPa O.K.  
 Shear Stress Across Y at Column Face = 0.45 MPa O.K.

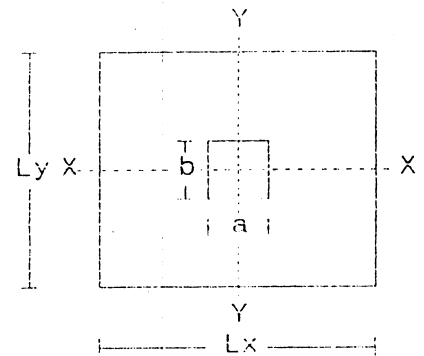
Design Concrete Shear Stress Across X = 0.34 MPa  
 Design Concrete Shear Stress Across Y = 0.34 MPa  
 Shear Stress Across X at d from Column Face = 0.21 MPa O.K.  
 Shear Stress Across Y at d from Column Face = 0.20 MPa O.K.

Length of Punching Perimeter = 8080 mm  
 Design Concrete Punching Shear Stress = 0.34 MPa  
 Vertical Force Inside Perimeter = 1013.01 kN  
 Punching Shear Force = 300.30 kN  
 Punching Shear Stress = 0.08 MPa O.K.

RAM : FOOT - Reinforced Concrete Footing Design  
 ECT : National Museum - Amman  
 OTING : Column on AxisLines X7/Y04  
 DATE : February 26, 2000

Page 455

I  
 Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 2633.93 \text{ kN}$   
 Column Design Moment,  $M_x = 0.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 0.00 \text{ kN.m}$   
 Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 600 \text{ mm}$   
 Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$



# ANALYSIS

Total Design Load,  $\sim N = 2937.87 \text{ kN}$   
 Footing X Dimension,  $L_x = 3.20 \text{ m}$   
 Footing Y Dimension,  $L_y = 3.20 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 286.90 kPa          | 257.22 kPa        |
| S2 | 286.90 kPa          | 257.22 kPa        |
| S3 | 286.90 kPa          | 257.22 kPa        |
| S4 | 286.90 kPa          | 257.22 kPa        |

# REINFORCE

| Y - Direction               | X - Direction               |
|-----------------------------|-----------------------------|
| $M_x = 643.05 \text{ kN.m}$ | $M_y = 643.05 \text{ kN.m}$ |
| $R_x = 0.69 \text{ MPa}$    | $R_y = 0.69 \text{ MPa}$    |
| $As_x = 0.19 \%$            | $As_y = 0.19 \%$            |
| $= 3368 \text{ mm}^2$       | $= 3368 \text{ mm}^2$       |
| 11Y20@306(103%)             | 11Y20@306(103%)             |
| 13Y18@255( 98%)             | 13Y18@255( 98%)             |
| 16Y16@204( 95%)             | 16Y16@204( 95%)             |
| 21Y14@153( 96%)             | 21Y14@153( 96%)             |

CODE: BS8110

# BEAR AND PUNCHING

|                                               |            |      |
|-----------------------------------------------|------------|------|
| Max Permissible Shear Stress =                | 4.00 MPa   |      |
| Shear Stress Across X at Column Face =        | 0.60 MPa   | O.K. |
| Shear Stress Across Y at Column Face =        | 0.60 MPa   | O.K. |
| Design Concrete Shear Stress Across X =       | 0.37 MPa   |      |
| Design Concrete Shear Stress Across Y =       | 0.37 MPa   |      |
| Shear Stress Across X at d from Column Face = | 0.34 MPa   | O.K. |
| Shear Stress Across Y at d from Column Face = | 0.34 MPa   | O.K. |
| Length of Punching Perimeter =                | 9280 mm    |      |
| Design Concrete Punching Shear Stress =       | 0.37 MPa   |      |
| Vertical Force Inside Perimeter =             | 1384.46 kN |      |
| Punching Shear Force =                        | 1249.47 kN |      |
| Punching Shear Stress =                       | 0.25 MPa   | O.K. |

GRAM : FOOT - Reinforced Concrete Footing Design  
 JECT : National Museum - Amman  
 UTING : Column on AxisLines X7/Y05  
 DATE : February 26, 2000

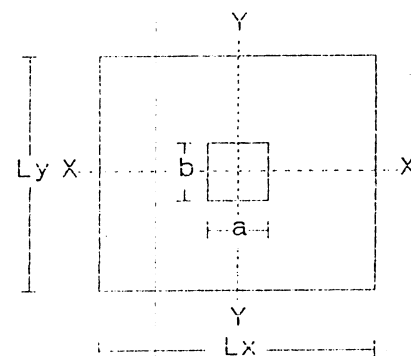
Page 456

IT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 6971.68 \text{ kN}$   
 Column Design Moment,  $M_x = 0.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 334.79 \text{ kN.m}$

Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 1000 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$



ALYSIS

Total Design Load,  $\sim N = 8285.68 \text{ kN}$   
 Footing X Dimension,  $L_x = 5.50 \text{ m}$   
 Footing Y Dimension,  $L_y = 5.50 \text{ m}$

| TOTAL SOIL STRESSES |            | NET SOIL STRESSES |  |
|---------------------|------------|-------------------|--|
| S1                  | 285.98 kPa | 242.54 kPa        |  |
| S2                  | 261.83 kPa | 218.40 kPa        |  |
| S3                  | 261.83 kPa | 218.40 kPa        |  |
| S4                  | 285.98 kPa | 242.54 kPa        |  |

URE

| Y - Direction                |  | X - Direction                |  |
|------------------------------|--|------------------------------|--|
| $M_x = 3650.62 \text{ kN.m}$ |  | $M_y = 3650.62 \text{ kN.m}$ |  |
| $R_x = 0.75 \text{ MPa}$     |  | $R_y = 0.75 \text{ MPa}$     |  |
| $As_x = 0.21 \%$             |  | $As_y = 0.21 \%$             |  |
| $= 11018 \text{ mm}^2$       |  | $= 11018 \text{ mm}^2$       |  |
| 22Y25@255( 98%)              |  | 22Y25@255( 98%)              |  |
| 28Y22@198( 97%)              |  | 28Y22@198( 97%)              |  |
| 34Y20@162( 97%)              |  | 34Y20@162( 97%)              |  |
| 42Y18@131( 97%)              |  | 42Y18@131( 97%)              |  |

CODE: BS8110

EAR AND PUNCHING

Max Permissible Shear Stress =  $4.00 \text{ MPa}$   
 Shear Stress Across X at Column Face =  $0.59 \text{ MPa}$  O.K.  
 Shear Stress Across Y at Column Face =  $0.59 \text{ MPa}$  O.K.

Design Concrete Shear Stress Across X =  $0.38 \text{ MPa}$   
 Design Concrete Shear Stress Across Y =  $0.38 \text{ MPa}$   
 Stress Across X at  $d$  from Column Face =  $0.36 \text{ MPa}$  O.K.  
 Stress Across Y at  $d$  from Column Face =  $0.36 \text{ MPa}$  O.K.

Length of Punching Perimeter =  $14080 \text{ mm}$   
 Design Concrete Punching Shear Stress =  $0.38 \text{ MPa}$   
 Vertical Force Inside Perimeter =  $2855.60 \text{ kN}$   
 Punching Shear Force =  $4116.07 \text{ kN}$   
 Punching Shear Stress =  $0.31 \text{ MPa}$  O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 SUBJECT : National Museum - Amman  
 FOOTING : Column on AxisLines X8/Y02  
 DATE : February 26, 2000

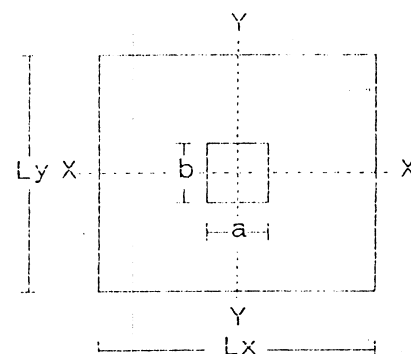
Page 457

# INPUT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 5808.91 \text{ kN}$   
 Column Design Moment,  $M_x = 54.32 \text{ kN.m}$   
 Column Design Moment,  $M_y = 10.00 \text{ kN.m}$

Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 1000 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$



# ANALYSIS

Total Design Load,  $\sim N = 6850.85 \text{ kN}$   
 Footing X Dimension,  $L_x = 4.90 \text{ m}$   
 Footing Y Dimension,  $L_y = 4.90 \text{ m}$

| TOTAL SOIL STRESSES |            | NET SOIL STRESSES |            |
|---------------------|------------|-------------------|------------|
| S1                  | 288.61 kPa |                   | 245.22 kPa |
| S2                  | 287.59 kPa |                   | 244.20 kPa |
| S3                  | 282.05 kPa |                   | 238.66 kPa |
| S4                  | 283.07 kPa |                   | 239.68 kPa |

# EXHIBIT

| Y - Direction                |  | X - Direction                |  |
|------------------------------|--|------------------------------|--|
| $M_x = 2635.39 \text{ kN.m}$ |  | $M_y = 2614.01 \text{ kN.m}$ |  |
| $R_x = 0.61 \text{ MPa}$     |  | $R_y = 0.60 \text{ MPa}$     |  |
| $As_x = 0.17 \%$             |  | $As_y = 0.17 \%$             |  |
| $= 7898 \text{ mm}^2$        |  | $= 7832 \text{ mm}^2$        |  |
| 16Y25@317( 99%)              |  | 16Y25@317(100%)              |  |
| 20Y22@250( 96%)              |  | 20Y22@250( 97%)              |  |
| 24Y20@207( 95%)              |  | 24Y20@207( 96%)              |  |
| 30Y18@164( 96%)              |  | 30Y18@164( 97%)              |  |

CODE: BS8110

# HEAR AND PUNCHING

Max Permissible Shear Stress = 4.00 MPa  
 Shear Stress Across X at Column Face = 0.54 MPa O.K.  
 Shear Stress Across Y at Column Face = 0.54 MPa O.K.  
 Design Concrete Shear Stress Across X = 0.35 MPa  
 Design Concrete Shear Stress Across Y = 0.35 MPa  
 Shear Stress Across X at d from Column Face = 0.30 MPa O.K.  
 Shear Stress Across Y at d from Column Face = 0.30 MPa O.K.  
 Length of Punching Perimeter = 14080 mm  
 Design Concrete Punching Shear Stress = 0.35 MPa  
 Vertical Force Inside Perimeter = 2997.70 kN  
 Punching Shear Force = 2811.21 kN  
 Punching Shear Stress = 0.21 MPa O.K.

GRAM : FOOT - Reinforced Concrete Footing Design  
 JECT : National Museum - Amman  
 OTING : Column on AxisLines X8/Y04  
 DATE : February 26, 2000

Page 458

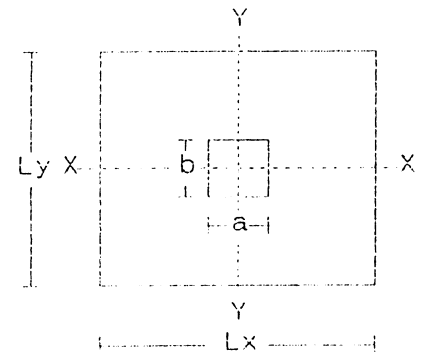
#### UT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 1765.46 \text{ kN}$   
 Column Design Moment,  $M_x = 25.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 25.00 \text{ kN.m}$

Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 500 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$

Max Cover to center of Bars,  $c = 60 \text{ mm}$



#### ANALYSIS

Total Design Load,  $\sim N = 1955.93 \text{ kN}$   
 Footing X Dimension,  $L_x = 2.70 \text{ m}$   
 Footing Y Dimension,  $L_y = 2.70 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 283.55 kPa          | 257.42 kPa        |
| S2 | 268.30 kPa          | 242.18 kPa        |
| S3 | 253.06 kPa          | 226.93 kPa        |
| S4 | 268.30 kPa          | 242.18 kPa        |

#### REINFORCE

|                             |                             |
|-----------------------------|-----------------------------|
| Y - Direction               | X - Direction               |
| $M_x = 334.69 \text{ kN.m}$ | $M_y = 326.94 \text{ kN.m}$ |
| $R_x = 0.64 \text{ MPa}$    | $R_y = 0.63 \text{ MPa}$    |
| $As_x = 0.18 \%$            | $As_y = 0.18 \%$            |
| $= 2146 \text{ mm}^2$       | $= 2095 \text{ mm}^2$       |
| 9Y18@320(107%)              | 8Y18@366( 97%)              |
| 11Y16@256(103%)             | 10Y16@285( 96%)             |
| 14Y14@197(100%)             | 13Y14@214( 96%)             |
| 19Y12@143(100%)             | 18Y12@151( 97%)             |

CODE: BS8110

#### BEAR AND PUNCHING

Max Permissible Shear Stress = 4.00 MPa  
 Shear Stress Across X at Column Face = 0.56 MPa O.K.  
 Shear Stress Across Y at Column Face = 0.55 MPa O.K.

Design Concrete Shear Stress Across X = 0.36 MPa  
 Design Concrete Shear Stress Across Y = 0.35 MPa  
 Shear Stress Across X at d from Column Face = 0.32 MPa O.K.  
 Shear Stress Across Y at d from Column Face = 0.31 MPa O.K.

Length of Punching Perimeter = 8080 mm  
 Design Concrete Punching Shear Stress = 0.36 MPa  
 Vertical Force Inside Perimeter = 988.17 kN  
 Punching Shear Force = 777.29 kN  
 Punching Shear Stress = 0.22 MPa O.K.

OGRAM : FOOT - Reinforced Concrete Footing Design  
 OBJECT : National Museum - Amman  
 FOOTING : Column on AxisLines X8/Y05  
 DATE : February 26, 2000

Page 453

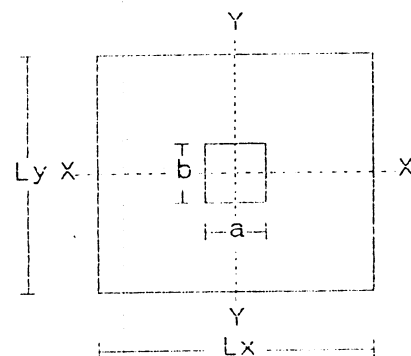
# PUT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 8024.19 \text{ kN}$   
 Column Design Moment,  $M_x = 79.20 \text{ kN.m}$   
 Column Design Moment,  $M_y = 437.72 \text{ kN.m}$

Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 1100 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$

Max Cover to center of Bars,  $c = 60 \text{ mm}$



# ANALYSIS

Total Design Load,  $\sim N = 9709.85 \text{ kN}$   
 Footing X Dimension,  $L_x = 6.00 \text{ m}$   
 Footing Y Dimension,  $L_y = 6.00 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 284.08 kPa          | 237.25 kPa        |
| S2 | 259.76 kPa          | 212.94 kPa        |
| S3 | 255.36 kPa          | 208.54 kPa        |
| S4 | 279.68 kPa          | 232.85 kPa        |

# EXCURE

| Y - Direction                | X - Direction                |
|------------------------------|------------------------------|
| $M_x = 4728.52 \text{ kN.m}$ | $M_y = 4695.82 \text{ kN.m}$ |
| $R_x = 0.73 \text{ MPa}$     | $R_y = 0.72 \text{ MPa}$     |
| $As_x = 0.21 \%$             | $As_y = 0.20 \%$             |
| $= 12884 \text{ mm}^2$       | $= 12792 \text{ mm}^2$       |
| 25Y25@244( 95%)              | 25Y25@244( 96%)              |
| 16Y32@390(100%)              | 16Y32@390(101%)              |
| 40Y20@150( 97%)              | 39Y20@154( 96%)              |
| 33Y22@183( 97%)              | 33Y22@183( 98%)              |

CODE: BS8110

# SHEAR AND PUNCHING

Max Permissible Shear Stress =  $4.00 \text{ MPa}$   
 Shear Stress Across X at Column Face =  $0.57 \text{ MPa}$  O.K.  
 Shear Stress Across Y at Column Face =  $0.57 \text{ MPa}$  O.K.

Design Concrete Shear Stress Across X =  $0.37 \text{ MPa}$   
 Design Concrete Shear Stress Across Y =  $0.37 \text{ MPa}$   
 Shear Stress Across X at d from Column Face =  $0.35 \text{ MPa}$  O.K.  
 Shear Stress Across Y at d from Column Face =  $0.35 \text{ MPa}$  O.K.

Length of Punching Perimeter =  $15280 \text{ mm}$   
 Design Concrete Punching Shear Stress =  $0.37 \text{ MPa}$   
 Vertical Force Inside Perimeter =  $3252.56 \text{ kN}$   
 Punching Shear Force =  $4771.63 \text{ kN}$   
 Punching Shear Stress =  $0.30 \text{ MPa}$  O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 SUBJECT : National Museum - Amman  
 FOOTING : Column on AxisLines X9/Y02  
 DATE : February 26, 2000

Page 460

# PUT

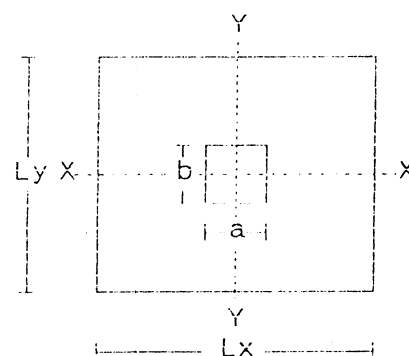
Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 4562.59 \text{ kN}$   
 Column Design Moment,  $M_x = 11.28 \text{ kN.m}$   
 Column Design Moment,  $M_y = 10.00 \text{ kN.m}$

Column Size in X,  $a = 600 \text{ mm}$   
 Column Size in Y,  $b = 425 \text{ mm}$   
 Footing Depth,  $h = 900 \text{ mm}$

Concrete Grade,  $f_{cu} = 25 \text{ MPa}$

Steel Grade,  $f_y = 420 \text{ MPa}$

Max Cover to center of Bars,  $c = 60 \text{ mm}$



# ANALYSIS

Total Design Load,  $\tilde{N} = 5308.10 \text{ kN}$   
 Footing X Dimension,  $L_x = 4.40 \text{ m}$   
 Footing Y Dimension,  $L_y = 4.22 \text{ m}$

## TOTAL SOIL STRESSES

$S_1 = 287.13 \text{ kPa}$   
 $S_2 = 285.66 \text{ kPa}$   
 $S_3 = 283.94 \text{ kPa}$   
 $S_4 = 285.41 \text{ kPa}$

## NET SOIL STRESSES

$247.03 \text{ kPa}$   
 $245.56 \text{ kPa}$   
 $243.84 \text{ kPa}$   
 $245.30 \text{ kPa}$

# FIGURE

## Short Direction

$M_x = 1954.02 \text{ kN.m}$   
 $R_x = 0.63 \text{ MPa}$   
 $A_{sx} = 0.18 \%$   
 $= 6560 \text{ mm}^2$   
 $13Y25@355 (97\%)$   
 $20Y20@224 (96\%)$   
 $17Y22@266 (98\%)$   
 $25Y18@178 (97\%)$

## Long Direction

$M_y = 1871.70 \text{ kN.m}$   
 $R_y = 0.63 \text{ MPa}$   
 $A_{sy} = 0.18 \%$   
 $= 6283 \text{ mm}^2$   
 $13Y25@340 (102\%)$   
 $16Y22@272 (97\%)$   
 $20Y20@215 (100\%)$   
 $24Y18@178 (97\%)$

CODE: BS8110

# BEAR AND PUNCHING

Max Permissible Shear Stress =  $4.00 \text{ MPa}$   
 Shear Stress Across X at Column Face =  $0.56 \text{ MPa}$  O.K.  
 Shear Stress Across Y at Column Face =  $0.56 \text{ MPa}$  O.K.

Design Concrete Shear Stress Across X =  $0.36 \text{ MPa}$   
 Design Concrete Shear Stress Across Y =  $0.35 \text{ MPa}$   
 Shear Stress Across X at  $d$  from Column Face =  $0.31 \text{ MPa}$  O.K.  
 Shear Stress Across Y at  $d$  from Column Face =  $0.31 \text{ MPa}$  O.K.

Length of Punching Perimeter =  $12130 \text{ mm}$   
 Design Concrete Punching Shear Stress =  $0.36 \text{ MPa}$   
 Vertical Force Inside Perimeter =  $2255.14 \text{ kN}$   
 Punching Shear Force =  $2307.46 \text{ kN}$   
 Punching Shear Stress =  $0.23 \text{ MPa}$  O.K.

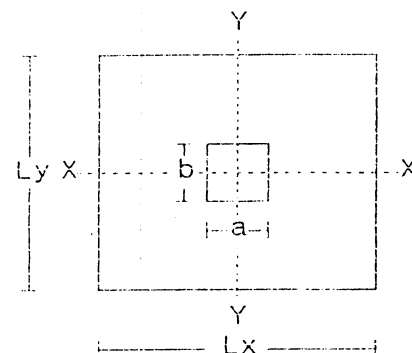
PROGRAM : FOOT - Reinforced Concrete Footing Design  
 SUBJECT : National Museum - Amman  
 FOOTING : Column on AxisLines X9/Y04 & X9/Y03  
 DATE : February 26, 2000

Page 461

#### INPUT

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 1384.03 \text{ kN}$   
 Column Design Moment,  $M_x = 25.00 \text{ kN.m}$   
 Column Design Moment,  $M_y = 25.00 \text{ kN.m}$

Column Size in X,  $a = 700 \text{ mm}$   
 Column Size in Y,  $b = 700 \text{ mm}$   
 Footing Depth,  $h = 500 \text{ mm}$



Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$

#### ANALYSIS

Total Design Load,  $\sim N = 1533.49 \text{ kN}$   
 Footing X Dimension,  $L_x = 2.40 \text{ m}$   
 Footing Y Dimension,  $L_y = 2.40 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 287.93 kPa          | 261.98 kPa        |
| S2 | 266.23 kPa          | 240.28 kPa        |
| S3 | 244.53 kPa          | 218.58 kPa        |
| S4 | 266.23 kPa          | 240.28 kPa        |

#### REINFORCE

| Y - Direction               | X - Direction               |
|-----------------------------|-----------------------------|
| $M_x = 215.51 \text{ kN.m}$ | $M_y = 208.32 \text{ kN.m}$ |
| $R_x = 0.46 \text{ MPa}$    | $R_y = 0.45 \text{ MPa}$    |
| $As_x = 0.16 \%$            | $As_y = 0.16 \%$            |
| $= 1714 \text{ mm}^2$       | $= 1714 \text{ mm}^2$       |
| Nominal                     | Nominal                     |
| 9Y16@283(106%)              | 9Y16@283(106%)              |
| 11Y14@227( 99%)             | 11Y14@227( 99%)             |
| 15Y12@162( 99%)             | 15Y12@162( 99%)             |
| 21Y10@113( 97%)             | 21Y10@113( 97%)             |

CODE: BS8110

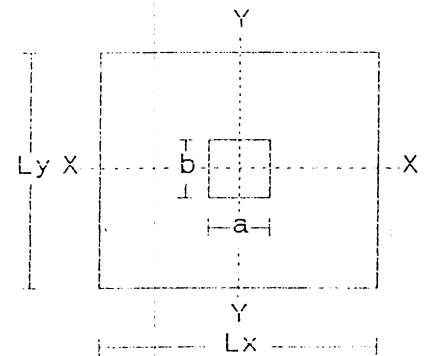
#### BEAR AND PUNCHING

Max Permissible Shear Stress = 4.00 MPa  
 Shear Stress Across X at Column Face = 0.48 MPa O.K.  
 Shear Stress Across Y at Column Face = 0.46 MPa O.K.  
 Design Concrete Shear Stress Across X = 0.34 MPa  
 Design Concrete Shear Stress Across Y = 0.34 MPa  
 Shear Stress Across X at d from Column Face = 0.23 MPa O.K.  
 Shear Stress Across Y at d from Column Face = 0.22 MPa O.K.  
 Length of Punching Perimeter = 8080 mm  
 Design Concrete Punching Shear Stress = 0.34 MPa  
 Vertical Force Inside Perimeter = 980.45 kN  
 Punching Shear Force = 403.58 kN  
 Punching Shear Stress = 0.11 MPa O.K.

PROGRAM : FOOT - Reinforced Concrete Footing Design  
 PROJECT : National Museum - Amman  
 LOCATION : Column on Axis Lines X9/Y05  
 DATE : February 26, 2000

Page 462

Design Bearing Capacity,  $Q_u = 290.00 \text{ kPa}$   
 Surcharge Design Load,  $W_u = 10.00 \text{ kPa}$   
 Column Design Load,  $N = 5595.19 \text{ kN}$   
 Column Design Moment,  $M_x = 27.46 \text{ kN.m}$   
 Column Design Moment,  $M_y = 25.00 \text{ kN.m}$   
 Column Size in X,  $a = 600 \text{ mm}$   
 Column Size in Y,  $b = 425 \text{ mm}$   
 Footing Depth,  $h = 1000 \text{ mm}$   
 Concrete Grade,  $f_{cu} = 25 \text{ MPa}$   
 Steel Grade,  $f_y = 420 \text{ MPa}$   
 Max Cover to center of Bars,  $c = 60 \text{ mm}$



# ANALYSIS

Total Design Load,  $\sim N = 6602.08 \text{ kN}$   
 Footing X Dimension,  $L_x = 4.90 \text{ m}$   
 Footing Y Dimension,  $L_y = 4.72 \text{ m}$

|    | TOTAL SOIL STRESSES | NET SOIL STRESSES |
|----|---------------------|-------------------|
| S1 | 287.99 kPa          | 244.50 kPa        |
| S2 | 285.34 kPa          | 241.85 kPa        |
| S3 | 282.33 kPa          | 238.84 kPa        |
| S4 | 284.97 kPa          | 241.48 kPa        |

# REINFORCEMENT

| Short Direction              | Long Direction               |
|------------------------------|------------------------------|
| $M_x = 2748.79 \text{ kN.m}$ | $M_y = 2639.16 \text{ kN.m}$ |
| $R_x = 0.63 \text{ MPa}$     | $R_y = 0.63 \text{ MPa}$     |
| $As_x = 0.18 \%$             | $As_y = 0.18 \%$             |
| $= 8248 \text{ mm}^2$        | $= 7918 \text{ mm}^2$        |
| 16Y25@317 ( 95%)             | 16Y25@305 ( 99%)             |
| 25Y20@198 ( 95%)             | 20Y22@241 ( 96%)             |
| 21Y22@238 ( 97%)             | 24Y20@199 ( 95%)             |
| 31Y18@159 ( 95%)             | 30Y18@158 ( 96%)             |

CODE: B38110

# BEAR AND PUNCHING

Max Permissible Shear Stress = 4.00 MPa  
 Shear Stress Across X at Column Face = 0.55 MPa O.K.  
 Shear Stress Across Y at Column Face = 0.55 MPa O.K.  
 Design Concrete Shear Stress Across X = 0.36 MPa  
 Design Concrete Shear Stress Across Y = 0.36 MPa  
 Stress Across X at d from Column Face = 0.31 MPa O.K.  
 Stress Across Y at d from Column Face = 0.31 MPa O.K.

Length of Punching Perimeter = 13330 mm  
 Design Concrete Punching Shear Stress = 0.36 MPa  
 Vertical Force Inside Perimeter = 2681.99 kN  
 Punching Shear Force = 2913.19 kN  
 Punching Shear Stress = 0.23 MPa O.K.

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : Beams N1+N2+N3  
 DATE : February 26, 2000

Page 463

Design Code: BS8110  
 Frame Type: Plane Subframe  
 Load Pattern for Span Mom: Alternate Spans Loaded.  
 Load Pattern for Supp Mom: All Spans Loaded.  
 Load Factors: Code Standard

#### BEAMS

| MARK     | PROPERTIES |       |      | UNIFORM LOADS |       |      |      | POINT LOADS |      |      |
|----------|------------|-------|------|---------------|-------|------|------|-------------|------|------|
|          | Span       | b (I) | h    | DEAD          | LIVE  | X1   | X2   | DEAD        | LIVE | X    |
| L. Cant. |            |       |      | 41.92         | 10.00 | 0.00 | 2.80 | 94.08       | 7.00 | 2.80 |
| (1) N1   | 8.00       | 0.25  | 2.40 | 41.92         | 10.00 | 0.00 | 8.00 | 0.00        | 0.00 | 0.00 |
| (2) N2   | 8.00       | 0.25  | 2.40 | 41.92         | 10.00 | 0.00 | 8.00 | 0.00        | 0.00 | 0.00 |
| (3) N3   | 5.40       | 0.25  | 2.40 | 41.92         | 10.00 | 0.00 | 5.40 | 0.00        | 0.00 | 0.00 |
| R. Cant. |            |       |      | 41.92         | 10.00 | 0.00 | 2.70 | 94.08       | 7.00 | 2.70 |

#### COLUMNS AND SUPPORTS

| SUPPORT<br>No.<br>L-->R | COLUMNS ABOVE |       |      | COLUMNS BELOW |       |      | SUPPORT<br>BREADTH<br>h |
|-------------------------|---------------|-------|------|---------------|-------|------|-------------------------|
|                         | Height        | b (I) | h    | Height        | b (I) | h    |                         |
| 1                       | 0.00          | ----  | ---- | 4.20          | 0.25  | 0.25 | 0.25                    |
| 2                       | 0.00          | ----  | ---- | 4.20          | 0.25  | 0.25 | 0.25                    |
| 3                       | 0.00          | ----  | ---- | 4.20          | 0.25  | 0.25 | 0.25                    |
| 4                       | 0.00          | ----  | ---- | 0.00          | ----  | ---- | 0.20                    |

#### ELASTIC BEAM SUPPORT MOMENTS

| MARK     | ODD SPANS |         | EVEN SPANS |         | ALL SPANS |         |
|----------|-----------|---------|------------|---------|-----------|---------|
|          | Left      | Right   | Left       | Right   | Left      | Right   |
| L. Cant. |           | -427.75 |            | -692.93 |           | -692.93 |
| (1) N1   | -427.77   | -326.96 | -691.56    | -239.62 | -692.13   | -426.20 |
| (2) N2   | -326.80   | -130.45 | -240.34    | -214.25 | -426.32   | -257.34 |
| (3) N3   | -130.33   | -406.81 | -213.50    | -658.10 | -256.98   | -658.10 |
| R. Cant. | -406.81   |         | -658.10    |         | -658.10   |         |

#### MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

| MARK   | ODD SPANS |      | EVEN SPANS |      | ALL SPANS |      |
|--------|-----------|------|------------|------|-----------|------|
|        | Moment    | X    | Moment     | X    | Moment    | X    |
| (1) N1 | +221.20   | 4.16 | -92.17     | 5.36 | +45.69    | 4.48 |
| (2) N2 | +113.91   | 4.56 | +370.23    | 4.08 | +258.61   | 4.32 |
| (3) N3 | +21.21    | 2.00 | -202.16    | 0.76 | -148.38   | 1.73 |

GRAM : SFRM - R.C. SubFrame Analysis and Design  
 JECT : National Museum - Amman  
 FRAME : Beams N1+N2+N3  
 DATE : February 26, 2000

Page 464

# ELASTIC BEAM SHEARS

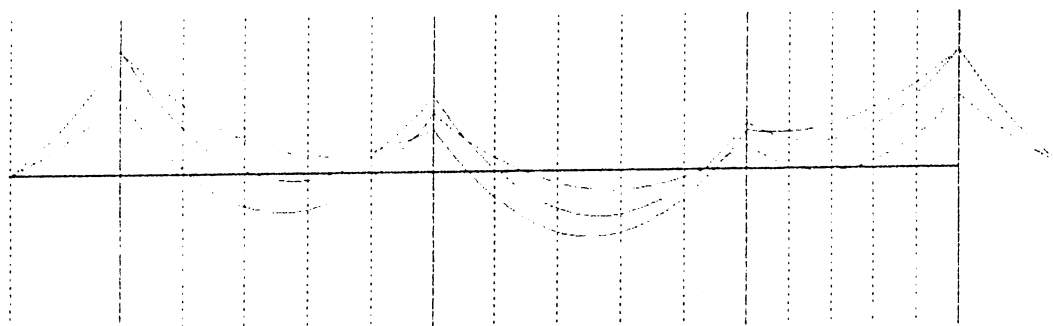
| MARK     | AT LEFT<br>SUPPORT | AT 0.10<br>OF SPAN | AT 0.20<br>OF SPAN | AT 0.80<br>OF SPAN | AT 0.90<br>OF SPAN | AT RIGHT<br>SUPPORT |
|----------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|
| L. Cant. |                    |                    |                    |                    |                    | -352.04             |
| (1) N1   | +331.99            | +272.24            | +212.49            | -166.65            | -226.40            | -286.15             |
| (2) N2   | +319.87            | +260.12            | +200.37            | -175.99            | -235.74            | -295.49             |
| (3) N3   | +150.46            | +110.13            | +69.79             | -195.28            | -235.61            | -275.94             |
| R. Cant. | +344.57            |                    |                    |                    |                    |                     |

# ELASTIC SUPPORT REACTIONS

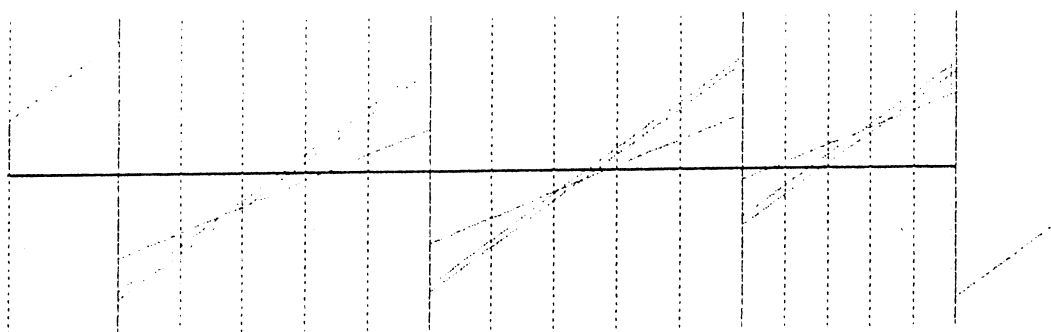
| MARK<br>SUPPORT | ODD SPANS L'D | EVEN SPANS L'D | ALL SPANS LOADED |           |             |
|-----------------|---------------|----------------|------------------|-----------|-------------|
|                 | Design Load   | Design Load    | Dead Load        | Live Load | Design Load |
| #1              | 522.81        | 576.21         | 407.75           | 75.26     | 684.03      |
| #2              | 478.37        | 413.20         | 316.47           | 82.53     | 585.39      |
| #3              | 293.59        | 326.34         | 218.09           | 60.32     | 405.01      |
| #4              | 460.12        | 540.09         | 373.49           | 64.89     | 620.51      |

# ELASTIC COLUMN MOMENTS (CCW +ve)

| MARK<br>COLUMN | ODD SPANS LOADED |       | EVEN SPANS LOADED |       | ALL SPANS LOADED |       |
|----------------|------------------|-------|-------------------|-------|------------------|-------|
|                | ABOVE            | BELOW | ABOVE             | BELOW | ABOVE            | BELOW |
| #1             | 0.00             | -0.02 | 0.00              | +1.37 | 0.00             | +0.80 |
| #2             | 0.00             | +0.16 | 0.00              | -0.72 | 0.00             | -0.34 |
| #3             | 0.00             | +0.12 | 0.00              | +0.76 | 0.00             | +0.54 |
| #4             | 0.00             | 0.00  | 0.00              | 0.00  | 0.00             | 0.00  |



Bending Moment Diagram



Shear Diagram

=====

BEAM DESIGN FOR FLEXURE

fcu= 25MPa fy= 420MPa

CODE: BS8110

|           |         | b<br>( mm ) | h<br>( mm )  | c<br>( mm )   | d'<br>( mm ) |      |            |             |                           |                            |   |
|-----------|---------|-------------|--------------|---------------|--------------|------|------------|-------------|---------------------------|----------------------------|---|
| ALL SPANS |         | 250         | 2400         | 240           | 240          | mm   |            |             |                           |                            |   |
| MARK      | pos.    | d<br>( mm ) | bf<br>( mm ) | M<br>( kN.m ) | R<br>( MPa ) | x/d  | p<br>( % ) | p'<br>( % ) | As<br>( mm <sup>2</sup> ) | As'<br>( mm <sup>2</sup> ) |   |
| . Cant.   | sup F   | 2160        | 250          | -649.5        | 0.56         | 0.06 | 0.16       | 0.00        | *                         | 857                        | 0 |
|           | supp    | 2160        | 250          | -692.9        | 0.59         | 0.06 | 0.17       | 0.00        |                           | 903                        | 0 |
| 1) N1     | L supp  | 2160        | 250          | -692.1        | 0.59         | 0.06 | 0.17       | 0.00        |                           | 902                        | 0 |
|           | L sup F | 2160        | 250          | -663.9        | 0.57         | 0.06 | 0.16       | 0.00        |                           | 864                        | 0 |
|           | span    | 2160        | 250          | +221.2        | 0.19         | 0.02 | 0.16       | 0.00        | *                         | 857                        | 0 |
|           | R sup F | 2160        | 250          | -393.7        | 0.34         | 0.03 | 0.16       | 0.00        | *                         | 857                        | 0 |
|           | R supp  | 2160        | 250          | -426.2        | 0.37         | 0.04 | 0.16       | 0.00        | *                         | 857                        | 0 |
|           |         |             |              |               |              |      |            |             |                           |                            |   |
| (2) N2    | L supp  | 2160        | 250          | -426.3        | 0.37         | 0.04 | 0.16       | 0.00        | *                         | 857                        | 0 |
|           | L sup F | 2160        | 250          | -387.0        | 0.33         | 0.03 | 0.16       | 0.00        | *                         | 857                        | 0 |
|           | span    | 2160        | 250          | +370.2        | 0.32         | 0.03 | 0.16       | 0.00        | *                         | 857                        | 0 |
|           | R sup F | 2160        | 250          | -223.3        | 0.19         | 0.02 | 0.16       | 0.00        | *                         | 857                        | 0 |
|           | R supp  | 2160        | 250          | -257.3        | 0.22         | 0.02 | 0.16       | 0.00        | *                         | 857                        | 0 |
|           |         |             |              |               |              |      |            |             |                           |                            |   |
| (3) N3    | L supp  | 2160        | 250          | -257.0        | 0.22         | 0.02 | 0.16       | 0.00        | *                         | 857                        | 0 |
|           | L sup F | 2160        | 250          | -241.7        | 0.21         | 0.02 | 0.16       | 0.00        | *                         | 857                        | 0 |
|           | span    | 2160        | 250          | +21.2         | 0.02         | 0.00 | 0.16       | 0.00        | *                         | 857                        | 0 |
|           | R sup F | 2160        | 250          | -638.8        | 0.55         | 0.06 | 0.16       | 0.00        | *                         | 857                        | 0 |
|           | R supp  | 2160        | 250          | -658.1        | 0.56         | 0.06 | 0.16       | 0.00        | *                         | 857                        | 0 |
|           |         |             |              |               |              |      |            |             |                           |                            |   |
|           | L supp  | 2160        | 250          | -658.1        | 0.56         | 0.06 | 0.16       | 0.00        | *                         | 857                        | 0 |
|           | L sup F | 2160        | 250          | -624.0        | 0.53         | 0.05 | 0.16       | 0.00        | *                         | 857                        | 0 |

\* = Nominal Reinforcement

OGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OJECT : National Museum - Amman  
 FRAME : Beams N1+N2+N3  
 DATE : February 26, 2000

Page 466

# CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at: SUPPORT CENTERLINES

| MARK   | pos. | As_B | As_T | Bottom Bars     |   | Top Bars        |   |
|--------|------|------|------|-----------------|---|-----------------|---|
|        | supp | 0    | 903  | -               | - | 2Y25 @155(109%) |   |
|        |      |      |      | -               | - | 3Y20 @ 80(104%) |   |
|        |      |      |      | -               | - | 4Y18 @ 54(113%) |   |
|        |      |      |      | -               | - | 5Y16 @ 41(111%) |   |
| (1) N1 | span | 857  | 0    | 2Y25 @155(115%) |   | -               | - |
|        |      |      |      | 3Y20 @ 80(110%) |   | -               | - |
|        |      |      |      | 4Y18 @ 54(119%) |   | -               | - |
|        |      |      |      | 5Y16 @ 41(117%) |   | -               | - |
|        | supp | 0    | 857  | -               | - | 2Y25 @155(115%) |   |
|        |      |      |      | -               | - | 3Y20 @ 80(110%) |   |
|        |      |      |      | -               | - | 4Y18 @ 54(119%) |   |
|        |      |      |      | -               | - | 5Y16 @ 41(117%) |   |
| (2) N2 | span | 857  | 0    | 2Y25 @155(115%) |   | -               | - |
|        |      |      |      | 3Y20 @ 80(110%) |   | -               | - |
|        |      |      |      | 4Y18 @ 54(119%) |   | -               | - |
|        |      |      |      | 5Y16 @ 41(117%) |   | -               | - |
|        | supp | 0    | 857  | -               | - | 2Y25 @155(115%) |   |
|        |      |      |      | -               | - | 3Y20 @ 80(110%) |   |
|        |      |      |      | -               | - | 4Y18 @ 54(119%) |   |
|        |      |      |      | -               | - | 5Y16 @ 41(117%) |   |
| (3) N3 | span | 857  | 0    | 2Y25 @155(115%) |   | -               | - |
|        |      |      |      | 3Y20 @ 80(110%) |   | -               | - |
|        |      |      |      | 4Y18 @ 54(119%) |   | -               | - |
|        |      |      |      | 5Y16 @ 41(117%) |   | -               | - |
|        | supp | 0    | 857  | -               | - | 2Y25 @155(115%) |   |
|        |      |      |      | -               | - | 3Y20 @ 80(110%) |   |
|        |      |      |      | -               | - | 4Y18 @ 54(119%) |   |
|        |      |      |      | -               | - | 5Y16 @ 41(117%) |   |

## BEAM DESIGN FOR SHEAR

Value of  $v_c$  Near Supports Based on Tension Steel Calculated at:  
 For Beam Spans : SUPPORT CENTERLINES.  
 For Cantilevers: SUPPORT CENTERLINES.

$f_{cu} = 25\text{MPa}$   $f_{yv} = 420\text{MPa}$

CODE: BS8110

| MARK    | X1 - X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | $v_c$<br>(MPa) | Asv/Sv<br>(mm) | Stirrups |          |          |
|---------|---------------------|------------|------------|----------------|----------------|----------|----------|----------|
| . Cant. | 0.00- 2.68          |            |            |                | 0.274 *        | 1Y10@500 | 2Y10@500 | 1Y12@500 |
| R       | 0.51- 2.68          | 181.38     | 0.336      | 0.348          | 0.274 *        | 1Y10@500 | 2Y10@500 | 1Y12@500 |
| 1) N1   | L 0.13- 2.29        | 161.33     | 0.299      | 0.342          | 0.274 *        | 1Y10@500 | 2Y10@500 | 1Y12@500 |
|         | R 0.13- 7.88        |            |            |                | 0.274 *        | 1Y10@500 | 2Y10@500 | 1Y12@500 |
|         | R 5.72- 7.88        | 115.49     | 0.214      | 0.342          | 0.274 *        | 1Y10@500 | 2Y10@500 | 1Y12@500 |
| 2) N2   | L 0.13- 2.29        | 149.21     | 0.276      | 0.342          | 0.274 *        | 1Y10@500 | 2Y10@500 | 1Y12@500 |
|         | R 0.13- 7.88        |            |            |                | 0.274 *        | 1Y10@500 | 2Y10@500 | 1Y12@500 |
|         | R 5.72- 7.88        | 124.83     | 0.231      | 0.342          | 0.274 *        | 1Y10@500 | 2Y10@500 | 1Y12@500 |

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : Beams N1+N2+N3  
 DATE : February 26, 2000

Page 467

| MARK  |   | X1 - X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | vc<br>(MPa) | Asv/Sv<br>(mm) | Stirrups |          |          |
|-------|---|---------------------|------------|------------|-------------|----------------|----------|----------|----------|
| N3    | L | 0.13- 2.29          | 64.94      | 0.120      | 0.342       | 0.274 *        | 1Y10@500 | 2Y10@500 | 1Y12@500 |
|       |   | 0.13- 5.30          |            |            |             | 0.274 *        | 1Y10@500 | 2Y10@500 | 1Y12@500 |
|       | R | 3.14- 5.30          | 107.14     | 0.198      | 0.342       | 0.274 *        | 1Y10@500 | 2Y10@500 | 1Y12@500 |
| Cant. | L | 0.10- 2.26          | 175.77     | 0.326      | 0.342       | 0.274 *        | 1Y10@500 | 2Y10@500 | 1Y12@500 |
|       |   | 0.10- 2.70          |            |            |             | 0.274 *        | 1Y10@500 | 2Y10@500 | 1Y12@500 |

\* = Nominal Stirrups

AM : SFRM - R.C. SubFrame Analysis and Design  
 CT : National Museum - Amman  
 AME : Beams N4 IN5  
 ATE : February 26, 2000

Page 468

Design Code: BS8110  
 Frame Type: Continuous Beam  
 Load Pattern for Span Mom: Alternate Spans Loaded.  
 Load Pattern for Supp Mom: All Spans Loaded.  
 Load Factors: Code Standard

# BEAMS

| MARK  | PROPERTIES |       |      | UNIFORM LOADS |      |      |      |
|-------|------------|-------|------|---------------|------|------|------|
|       | Span       | b (I) | h    | DEAD          | LIVE | X1   | X2   |
| 1) N4 | 7.80       | 0.20  | 0.60 | 11.38         | 6.25 | 0.00 | 7.80 |
| 2) N5 | 3.00       | 0.20  | 0.60 | 11.38         | 6.25 | 0.00 | 3.00 |

# SUPPORTS

| Support # | BREADTH |
|-----------|---------|
| 1         | 0.25    |
| 2         | 0.25    |
| 3         | 0.25    |

# ELASTIC BEAM SUPPORT MOMENTS

| MARK  | ODD SPANS LOADED |         | EVEN SPANS LOADED |        | ALL SPANS LOADED |         |
|-------|------------------|---------|-------------------|--------|------------------|---------|
|       | Left             | Right   | Left              | Right  | Left             | Right   |
| 1) N4 | 0.00             | -145.99 | 0.00              | -70.61 | 0.00             | -150.54 |
| 2) N5 | -145.99          | 0.00    | -70.61            | 0.00   | -150.54          | 0.00    |

# MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

| MARK  | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|-------|------------------|------|-------------------|------|------------------|------|
|       | Moment           | X    | Moment            | X    | Moment           | X    |
| 1) N4 | +130.97          | 3.20 | +54.84            | 3.12 | +129.11          | 3.12 |
| 2) N5 | 0.00             | 3.00 | +4.55             | 2.40 | 0.00             | 3.00 |

# ELASTIC BEAM SHEARS

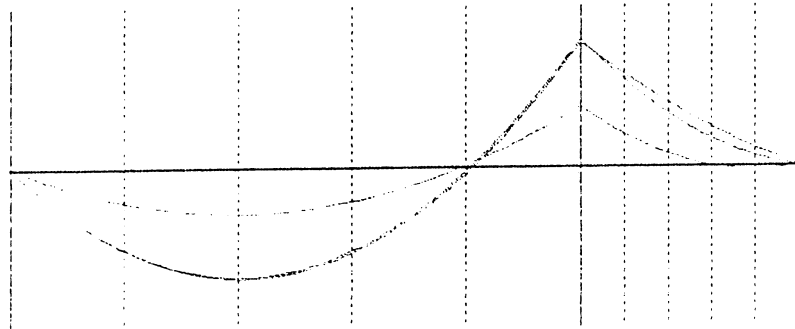
| MARK  | AT LEFT SUPPORT | AT 0.10 OF SPAN | AT 0.20 OF SPAN | AT 0.80 OF SPAN | AT 0.90 OF SPAN | AT RIGHT SUPPORT |
|-------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| 1) N4 | +82.42          | +62.19          | +41.96          | -79.98          | -100.21         | -120.43          |
| 2) N5 | +89.08          | +81.30          | +73.52          | +38.42          | +35.01          | +31.59           |

GRAM : SFRM - R.C. SubFrame Analysis and Design  
 JEOT : National Museum - Amman  
 FRAME : Beams N4IN5  
 DATE : February 26, 2000

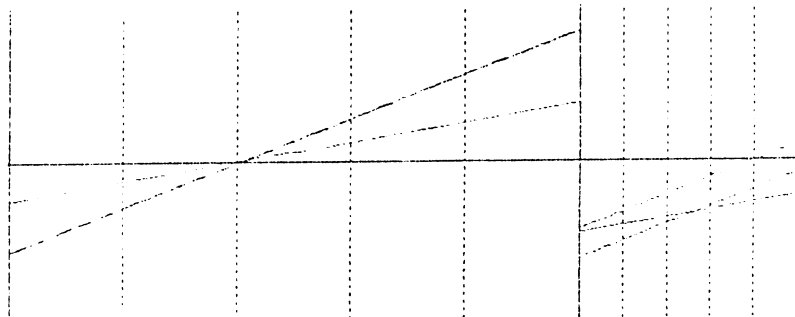
Page 469

# ELASTIC SUPPORT REACTIONS

| MARK    | ODD SPANS L'D | EVEN SPANS L'D | ALL SPANS LOADED |           |             |
|---------|---------------|----------------|------------------|-----------|-------------|
| SUPPORT | Design Load   | Design Load    | Dead Load        | Live Load | Design Load |
| #1      | 82.42         | 35.33          | 35.91            | 19.72     | 81.84       |
| #2      | 185.58        | 115.87         | 91.94            | 50.50     | 209.51      |
| #3      | -31.59        | 15.36          | -4.95            | -2.72     | -11.28      |



Bending Moment Diagram



Shear Diagram

## BEAM DESIGN FOR FLEXURE

$f_{cu} = 25\text{MPa}$   $f_y = 420\text{MPa}$

CODE: BS8110

$b$  (mm)  $h$  (mm)  $c$  (mm)  $d'$  (mm)

$h_f = 0$  mm(Rectangular)

ALL SPANS 200 600 50 50 mm

GRAM : SFRM - R.C. SubFrame Analysis and Design  
 JECT : National Museum - Amman  
 FRAME : Beams N4+N5  
 DATE : February 26, 2000

Page 470

| MARK   | pos.    | d<br>( mm ) | bf<br>( mm ) | M<br>( kN.m ) | R<br>( MPa ) | x/d  | p<br>( % ) | p'<br>( % ) | As<br>( mm^2 ) | As'<br>( mm^2 ) |   |
|--------|---------|-------------|--------------|---------------|--------------|------|------------|-------------|----------------|-----------------|---|
| (1) N4 | L supp  | 550         | 200          | 0.0           | 0.00         | 0.00 | 0.16       | 0.00        | *              | 171             | 0 |
|        | L sup F | 550         | 200          | +4.3          | 0.07         | 0.01 | 0.16       | 0.00        | *              | 171             | 0 |
|        | span    | 550         | 200          | +131.0        | 2.16         | 0.24 | 0.67       | 0.00        |                | 732             | 0 |
|        | R sup F | 550         | 200          | -135.7        | 2.24         | 0.25 | 0.69       | 0.00        |                | 762             | 0 |
|        | R supp  | 550         | 200          | -150.5        | 2.49         | 0.28 | 0.78       | 0.00        |                | 859             | 0 |
| (2) N5 | L supp  | 550         | 200          | -150.5        | 2.49         | 0.28 | 0.78       | 0.00        |                | 859             | 0 |
|        | L sup F | 550         | 200          | -139.6        | 2.31         | 0.26 | 0.72       | 0.00        |                | 787             | 0 |
|        | span    | 550         | 200          | +4.5          | 0.08         | 0.01 | 0.16       | 0.00        | *              | 171             | 0 |
|        | R sup F | 550         | 200          | -4.0          | 0.07         | 0.01 | 0.16       | 0.00        | *              | 171             | 0 |
|        | R supp  | 550         | 200          | 0.0           | 0.00         | 0.00 | 0.16       | 0.00        | *              | 171             | 0 |

\* = Nominal Reinforcement

#### CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at:  
 MEDIAN BETWEEN SUPPORT FACES AND CETERLINES

| MARK   | pos.   | As_B | As_T | Bottom Bars     | Top Bars        |
|--------|--------|------|------|-----------------|-----------------|
| (1) N4 | L supp | 0    | 171  | - - -           | 2Y12 @118(132%) |
|        |        |      |      | - - -           | 4Y 8 @ 41(117%) |
|        |        |      |      | - - -           | 3Y10 @ 60(138%) |
|        |        |      |      | - - -           | 2Y14 @116(180%) |
|        |        |      |      |                 |                 |
| (1) N4 | span   | 732  | 0    | 2Y22 @108(104%) | - - -           |
|        |        |      |      | 3Y18 @ 56(104%) | - - -           |
|        |        |      |      | 2Y25 @105(134%) | - - -           |
|        |        |      |      | 3Y20 @ 55(129%) | - - -           |
|        |        |      |      |                 |                 |
|        | supp   | 0    | 823  | - - -           | 2Y25 @105(119%) |
|        |        |      |      | - - -           | 3Y20 @ 55(114%) |
|        |        |      |      | - - -           | 3Y22 @ 54(138%) |
|        |        |      |      | - - -           | 2Y32 @ 98(195%) |
|        |        |      |      |                 |                 |
| (2) N5 | span   | 171  | 0    | 2Y12 @118(132%) | - - -           |
|        |        |      |      | 4Y 8 @ 41(117%) | - - -           |
|        |        |      |      | 3Y10 @ 60(138%) | - - -           |
|        |        |      |      | 2Y14 @116(180%) | - - -           |
|        |        |      |      |                 |                 |
|        | R supp | 0    | 171  | - - -           | 2Y12 @118(132%) |
|        |        |      |      | - - -           | 4Y 8 @ 41(117%) |
|        |        |      |      | - - -           | 3Y10 @ 60(138%) |
|        |        |      |      | - - -           | 2Y14 @116(180%) |
|        |        |      |      |                 |                 |

#### BEAM DESIGN FOR SHEAR

Value of vc Near Supports Based on Tension Steel Calculated at:  
 MEDIAN BETWEEN SUPPORT FACES AND CETERLINES.

fcu= 25MPa fyv= 420MPa

CODE: BS8110

| MARK | X1<br>(metres) | X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | vc<br>(MPa) | Asv/Sv<br>(mm) | Stirrups |          |          |
|------|----------------|----------------|------------|------------|-------------|----------------|----------|----------|----------|
| N4   | L              | 0.13- 0.68     | 64.91      | 0.590      | 0.340       | 0.219 *        | 1Y10@412 | 1Y12@412 | 1Y14@412 |
|      |                | 0.13- 7.19     |            |            |             | 0.219 *        | 1Y10@412 | 1Y12@412 | 1Y14@412 |
|      | R              | 7.13- 7.68     | 102.93     | 0.936      | 0.571       | 0.219 *        | 1Y10@412 | 1Y12@412 | 1Y14@412 |

GRAM : SFRM - R.C. SubFrame Analysis and Design  
 JECT : National Museum - Amman  
 FRAME : Beams N4+N5  
 DATE : February 26, 2000

Page 471

| MARK | X1 - X2<br>(metres) | Vu<br>(kN) | V<br>(MPa) | Vc<br>(MPa) | Asv/Sv<br>(mm) | Stirrups |          |          |
|------|---------------------|------------|------------|-------------|----------------|----------|----------|----------|
| ) N5 | L 0.13- 0.68        | 71.57      | 0.651      | 0.340       | 0.219 *        | 1Y10@412 | 1Y12@412 | 1Y14@412 |
|      | 0.30- 2.88          |            |            |             | 0.219 *        | 1Y10@412 | 1Y12@412 | 1Y14@412 |
|      | R 2.33- 2.88        | 39.27      | 0.357      | 0.340       | 0.219 *        | 1Y10@412 | 1Y12@412 | 1Y14@412 |

= Nominal Stirrups

=====

DGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : One Way Slab on 5-6/A-B  
 DATE : February 26, 2000

Page 472

Design Code: BS8110  
 Frame Type: Solid Slab  
 Load Pattern for Span Mom: Alternate Spans Loaded.  
 Load Pattern for Supp Mom: All Spans Loaded.  
 Load Factors: Code Standard

# BEAMS

| MARK     | PROPERTIES |       |      | UNIFORM LOADS |      |      |      |
|----------|------------|-------|------|---------------|------|------|------|
|          | Span       | b (I) | h    | DEAD          | LIVE | X1   | X2   |
| (1) Slab | 8.00       | 1.00  | 0.30 | 9.20          | 5.00 | 0.00 | 8.00 |

| SUPPORTS | Support # | BREADTH |
|----------|-----------|---------|
|          | 1         | 0.25    |
|          | 2         | 0.25    |

## ELASTIC BEAM SUPPORT MOMENTS

| MARK     | ODD SPANS LOADED |       | EVEN SPANS LOADED |       | ALL SPANS LOADED |       |
|----------|------------------|-------|-------------------|-------|------------------|-------|
|          | Left             | Right | Left              | Right | Left             | Right |
| (1) Slab | 0.00             | 0.00  | 0.00              | 0.00  | 0.00             | 0.00  |

## MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

| MARK     | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|----------|------------------|------|-------------------|------|------------------|------|
|          | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) Slab | 1167.04          | 4.00 | 473.60            | 4.00 | 1167.04          | 4.00 |

## ELASTIC BEAM SHEARS

| MARK     | AT LEFT SUPPORT | AT 0.10 OF SPAN | AT 0.20 OF SPAN | AT 0.80 OF SPAN | AT 0.90 OF SPAN | AT RIGHT SUPPORT |
|----------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| (1) Slab | +83.52          | +66.82          | +50.11          | -50.11          | -66.82          | -83.52           |

## ELASTIC SUPPORT REACTIONS

| MARK | ODD SPANS L'D | EVEN SPANS L'D | ALL SPANS LOADED |           |             |
|------|---------------|----------------|------------------|-----------|-------------|
|      | Design Load   | Design Load    | Dead Load        | Live Load | Design Load |
| #1   | 83.52         | 36.80          | 36.80            | 20.00     | 83.52       |
| #2   | 83.52         | 36.80          | 36.80            | 20.00     | 83.52       |

GRAM : SFRM - R.C. SubFrame Analysis and Design  
 JECT : National Museum - Amman  
 FRAME : One Way Slab on 5-6/A-B  
 DATE : February 26, 2000

Page 473

# EAM DESIGN FOR FLEXURE

$f_{cu} = 25\text{MPa}$   $f_y = 420\text{MPa}$

CODE: BS8110

|          |         |             |              |               |              | hf= 0 mm(Rectangular) |            |             |                |                 |   |
|----------|---------|-------------|--------------|---------------|--------------|-----------------------|------------|-------------|----------------|-----------------|---|
|          |         | b<br>( mm ) | h<br>( mm )  | c<br>(mm)     | d'<br>(mm)   |                       |            |             |                |                 |   |
| (1) Slab |         | 1000        | 300          | 35            | 40           | mm                    |            |             |                |                 |   |
| MARK     | pos.    | d<br>( mm ) | bf<br>( mm ) | M<br>( kN.m ) | R<br>( MPa ) | x/d                   | p<br>( % ) | p'<br>( % ) | As<br>( mm^2 ) | As'<br>( mm^2 ) |   |
| (1) Slab | L supp  | 260         | 1000         | 0.0           | 0.00         | 0.00                  | 0.16       | 0.00        | *              | 429             | 0 |
|          | L sup F | 260         | 1000         | +4.5          | 0.07         | 0.01                  | 0.16       | 0.00        | *              | 429             | 0 |
|          | span    | 265         | 1000         | +167.0        | 2.38         | 0.27                  | 0.74       | 0.00        |                | 1964            | 0 |
|          | R sup F | 260         | 1000         | +4.5          | 0.07         | 0.01                  | 0.16       | 0.00        | *              | 429             | 0 |
|          | R supp  | 260         | 1000         | 0.0           | 0.00         | 0.00                  | 0.16       | 0.00        | *              | 429             | 0 |

\* = Nominal Reinforcement

## CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at: SUPPORT CENTERLINES

| MARK     | pos.   | As_B | As_T | Bottom Bars                                                              | Top Bars        |
|----------|--------|------|------|--------------------------------------------------------------------------|-----------------|
|          | L supp | 0    | 429  | - - -                                                                    | 1Y10 @200( 97%) |
| (1) Slab | span   | 1964 | 0    | 1Y22 @222( 97%)<br>1Y20 @180(100%)<br>1Y18 @148( 99%)<br>1Y16 @116(102%) | - - -           |
|          | R supp | 0    | 429  | - - -                                                                    | 1Y10 @200( 97%) |

## EAM DESIGN FOR SHEAR

Value of  $v_c$  Near Supports Based on Tension Steel Calculated at:  
 SUPPORT CENTERLINES.

$f_{cu} = 25\text{MPa}$   $f_{yv} = 420\text{MPa}$

CODE: BS8110

| MARK     | X1 - X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | $v_c$<br>(MPa) | Asv/Sv<br>(mm) | Stirrups |
|----------|---------------------|------------|------------|----------------|----------------|----------|
|          | L 0.13- 0.39        | 75.38      | 0.284      | 0.386          | 0.000          | -- -- -- |
| (1) Slab | 0.13- 7.88          |            |            |                | 0.000 *        |          |
|          | R 7.61- 7.88        | 75.38      | 0.284      | 0.386          | 0.000          | -- -- -- |

\* = Nominal Stirrups

GRAM : SFRM - R.C. SubFrame Analysis and Design  
 JECT : National Museum - Amman  
 FRAME : One Way Slab on 4-5/B-C  
 DATE : February 26, 2000

Page 474

Design Code: BS8110  
 Frame Type: Solid Slab  
 Load Pattern for Span Mom: Alternate Spans Loaded.  
 Load Pattern for Supp Mom: All Spans Loaded.  
 Load Factors: Code Standard

# BEAMS

| MARK     | PROPERTIES |       |      | UNIFORM LOADS |      |      |      | POINT LOADS |      |      |
|----------|------------|-------|------|---------------|------|------|------|-------------|------|------|
|          | Span       | b (I) | h    | DEAD          | LIVE | X1   | X2   | DEAD        | LIVE | X    |
| (1) Slab | 5.40       | 1.00  | 0.30 | 9.20          | 5.00 | 0.00 | 5.40 | 0.00        | 0.00 | 0.00 |
| R. Cant. |            |       |      | 9.20          | 5.00 | 0.00 | 2.60 | 0.96        | 0.40 | 2.60 |

| SUPPORTS | Support # | BREADTH |
|----------|-----------|---------|
|          | 1         | 0.25    |
|          | 2         | 0.25    |

# ELASTIC BEAM SUPPORT MOMENTS

| MARK     | ODD SPANS LOADED |        | EVEN SPANS LOADED |        | ALL SPANS LOADED |        |
|----------|------------------|--------|-------------------|--------|------------------|--------|
|          | Left             | Right  | Left              | Right  | Left             | Right  |
| (1) Slab | 0.00             | -33.59 | 0.00              | -75.73 | 0.00             | -75.73 |
| R. Cant. | -33.59           |        | -75.73            |        | -75.73           |        |

# MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

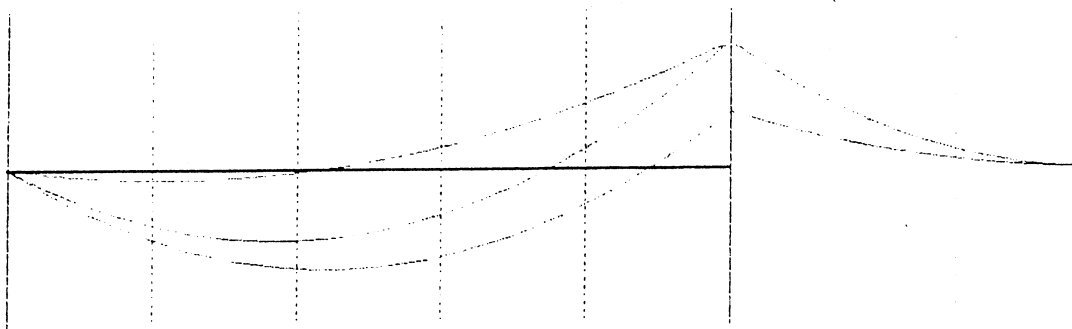
| MARK     | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|----------|------------------|------|-------------------|------|------------------|------|
|          | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) Slab | +60.23           | 2.38 | +6.36             | 1.19 | +42.95           | 2.05 |

# ELASTIC BEAM SHEARS

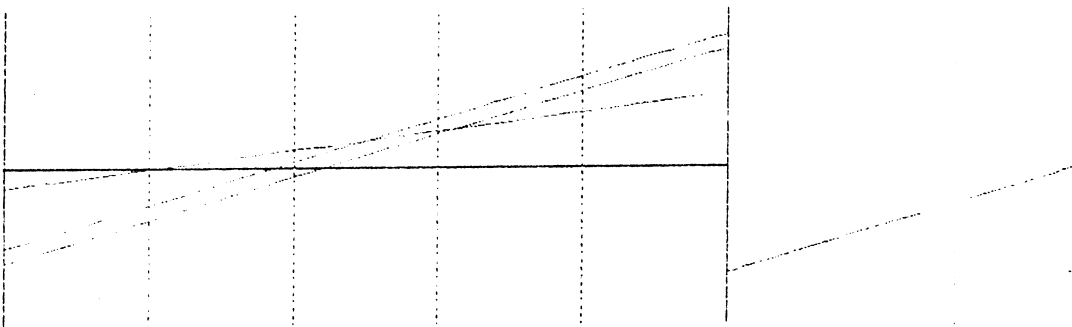
| MARK     | AT LEFT SUPPORT | AT 0.10 OF SPAN | AT 0.20 OF SPAN | AT 0.80 OF SPAN | AT 0.90 OF SPAN | AT RIGHT SUPPORT |
|----------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| (1) Slab | +50.16          | +38.88          | +27.60          | -47.85          | -59.13          | -70.40           |
| R. Cant. | +56.27          |                 |                 |                 |                 |                  |

# ELASTIC SUPPORT REACTIONS

| MARK | ODD SPANS L'D | EVEN SPANS L'D | ALL SPANS LOADED |           |
|------|---------------|----------------|------------------|-----------|
|      | Design Load   | Design Load    | Dead Load        | Live Load |
| #1   | 50.16         | 10.82          | 18.62            | 10.18     |
| #2   | 87.48         | 95.14          | 55.94            | 30.22     |



Bending Moment Diagram



Shear Diagram

=====

TEAM DESIGN FOR FLEXURE

$f_{cu} = 25\text{MPa}$   $f_y = 420\text{MPa}$

CODE: BS8110

$b$  (mm)  $h$  (mm)  $c$  (mm)  $d'$  (mm)

$h_f = 0$  mm(Rectangular)

| ALL SPANS |         | 1000        | 300          | 35            | 40           | mm   |            |             |                |                 |   |
|-----------|---------|-------------|--------------|---------------|--------------|------|------------|-------------|----------------|-----------------|---|
| MARK      | pos.    | d<br>( mm ) | bf<br>( mm ) | M<br>( kN.m ) | R<br>( MPa ) | x/d  | p<br>( % ) | p'<br>( % ) | As<br>( mm^2 ) | As'<br>( mm^2 ) |   |
| (1) Slab  | L supp  | 260         | 1000         | 0.0           | 0.00         | 0.00 | 0.16       | 0.00        | *              | 429             | 0 |
|           | L sup F | 260         | 1000         | +11.3         | 0.02         | 0.00 | 0.16       | 0.00        | *              | 429             | 0 |
|           | span    | 265         | 1000         | +60.2         | 0.86         | 0.09 | 0.24       | 0.00        |                | 648             | 0 |
|           | R sup F | 260         | 1000         | -70.9         | 1.05         | 0.11 | 0.30       | 0.00        |                | 736             | 0 |
|           | R supp  | 260         | 1000         | -75.7         | 1.12         | 0.12 | 0.32       | 0.00        |                | 842             | 0 |
|           | L supp  | 260         | 1000         | -75.7         | 1.12         | 0.12 | 0.32       | 0.00        |                | 842             | 0 |
|           | L sup F | 260         | 1000         | -68.9         | 1.02         | 0.11 | 0.29       | 0.00        |                | 762             | 0 |

\* = Nominal Reinforcement

GRAM : SFRM - R.C. SubFrame Analysis and Design  
 JECT : National Museum - Amman  
 FRAME : One Way Slab on 4-5/B-C  
 DATE : February 26, 2000

Page 476

# CHOICE OF BARS FOR FLEXURE

Support Bars Chosen for Reinforcement Calculated at: SUPPORT CENTERLINES

| MARK | pos.      | As_B | As_T | Bottom Bars                        | Top Bars                                              |
|------|-----------|------|------|------------------------------------|-------------------------------------------------------|
|      | L supp    | 0    | 429  | - - -                              | 1Y10 @200( 97%)                                       |
| 1)   | Slab span | 648  | 0    | 1Y12 @192( 97%)<br>1Y10 @130(102%) | - - -                                                 |
|      | supp      | 0    | 842  | - - -                              | 1Y14 @204( 96%)<br>1Y12 @152( 96%)<br>1Y10 @100(104%) |

# BEAM DESIGN FOR SHEAR

Value of vc Near Supports Based on Tension Steel Calculated at:  
 For Beam Spans : SUPPORT CENTERLINES.  
 For Cantilevers: SUPPORT CENTERLINES.

fcu= 25MPa fyv= 420MPa

CODE: BS8110

| MARK     | X1 - X2<br>(metres) | Vu<br>(kN) | v<br>(MPa) | vc<br>(MPa) | Asv/Sv<br>(mm) | Stirrups |
|----------|---------------------|------------|------------|-------------|----------------|----------|
| L        | 0.13- 0.39          | 42.01      | 0.159      | 0.386       | 0.000          | -- -- -- |
| ( ) Slab | 0.13- 5.28          |            |            |             | 0.000 *        | -- -- -- |
| R        | 5.01- 5.28          | 62.26      | 0.235      | 0.483       | 0.000          | -- -- -- |
| L        | 0.13- 0.39          | 48.13      | 0.182      | 0.483       | 0.000          | -- -- -- |
| Cant.    | 0.13- 2.60          |            |            |             | 0.000 *        | -- -- -- |

\* = Nominal Stirrups

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : Flat Slab Strip on B/1-6  
 DATE : February 26, 2000

Page 477

Design Code: BS8110  
 Frame Type: Flat Slab  
 Load Pattern for Span Mom: All Spans loaded (clause 3.5.2.3).  
 Load Pattern for Supp Mom: All Spans loaded (clause 3.5.2.3).  
 Load Factors: Code Standard

#### BEAMS

| MARK     | PROPERTIES |       |      | UNIFORM LOADS |       |      |      | POINT LOADS |       |      |
|----------|------------|-------|------|---------------|-------|------|------|-------------|-------|------|
|          | Span       | b (I) | h    | DEAD          | LIVE  | X1   | X2   | DEAD        | LIVE  | X    |
| L. Cant. |            |       |      | 73.60         | 40.00 | 0.00 | 2.80 | 201.60      | 14.00 | 2.80 |
| (1) P1   | 8.00       | 8.00  | 0.30 | 73.60         | 40.00 | 0.00 | 8.00 | 0.00        | 0.00  | 0.00 |
| (2) P2   | 8.00       | 8.00  | 0.30 | 73.60         | 40.00 | 0.00 | 8.00 | 0.00        | 0.00  | 0.00 |
| (3) P3   | 5.30       | 8.00  | 0.30 | 73.60         | 40.00 | 0.00 | 5.30 | 0.00        | 0.00  | 0.00 |

#### COLUMNS AND SUPPORTS

| SUPPORT<br>No.<br>L-->R | COLUMNS ABOVE |       |     | COLUMNS BELOW |       |      | SUPPORT<br>BREADTH<br>h |
|-------------------------|---------------|-------|-----|---------------|-------|------|-------------------------|
|                         | Height        | b (I) | h   | Height        | b (I) | h    |                         |
| 1                       | 0.00          | ---   | --- | 5.30          | 0.40  | 0.40 | 0.40                    |
| 2                       | 0.00          | ---   | --- | 5.30          | 0.40  | 0.40 | 0.40                    |
| 3                       | 0.00          | ---   | --- | 5.30          | 0.40  | 0.40 | 0.40                    |
| 4                       | 0.00          | ---   | --- | 0.00          | ---   | ---  | 0.20                    |

#### ELASTIC BEAM SUPPORT MOMENTS

| MARK     | ODD SPANS LOADED |          | EVEN SPANS LOADED |          | ALL SPANS LOADED |          |
|----------|------------------|----------|-------------------|----------|------------------|----------|
|          | Left             | Right    | Left              | Right    | Left             | Right    |
| L. Cant. |                  | -1507.79 |                   | -1507.79 |                  | -1507.79 |
| (1) P1   | -1400.81         | -768.07  | -1400.81          | -768.07  | -1400.81         | -768.07  |
| (2) P2   | -799.59          | -809.16  | -799.59           | -809.16  | -799.59          | -809.16  |
| (3) P3   | -778.77          | 0.00     | -778.77           | 0.00     | -778.77          | 0.00     |

#### MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

| MARK   | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|--------|------------------|------|-------------------|------|------------------|------|
|        | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) P1 | +270.60          | 4.48 | +270.60           | 4.48 | +270.60          | 4.48 |
| (2) P2 | +531.95          | 4.00 | +531.95           | 4.00 | +531.95          | 4.00 |
| (3) P3 | +261.72          | 3.55 | +261.72           | 3.55 | +261.72          | 3.55 |

#### ELASTIC BEAM SHEARS

| MARK     | AT LEFT<br>SUPPORT | AT 0.10<br>OF SPAN | AT 0.20<br>OF SPAN | AT 0.80<br>OF SPAN | AT 0.90<br>OF SPAN | AT RIGHT<br>SUPPORT |
|----------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|
| L. Cant. |                    |                    |                    |                    |                    | -772.35             |
| (1) P1   | +747.25            | +613.62            | +479.99            | -321.80            | -455.44            | -589.07             |
| (2) P2   | +666.96            | +533.33            | +399.70            | -402.09            | -535.72            | -669.36             |
| (3) P3   | +589.59            | +501.06            | +412.53            | -118.66            | -207.19            | -295.72             |

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 PROJECT : National Museum - Amman  
 FRAME : Flat Slab Strip on B/1-6  
 DATE : February 26, 2000

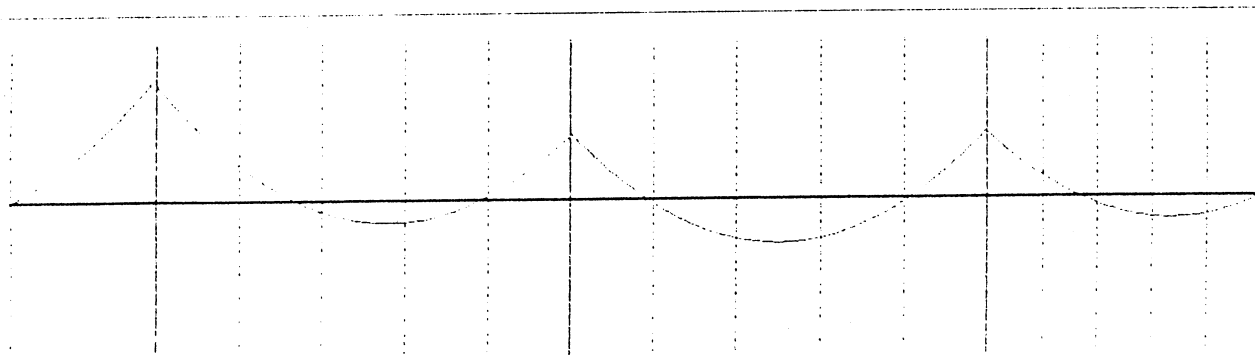
Page 478

# ELASTIC SUPPORT REACTIONS

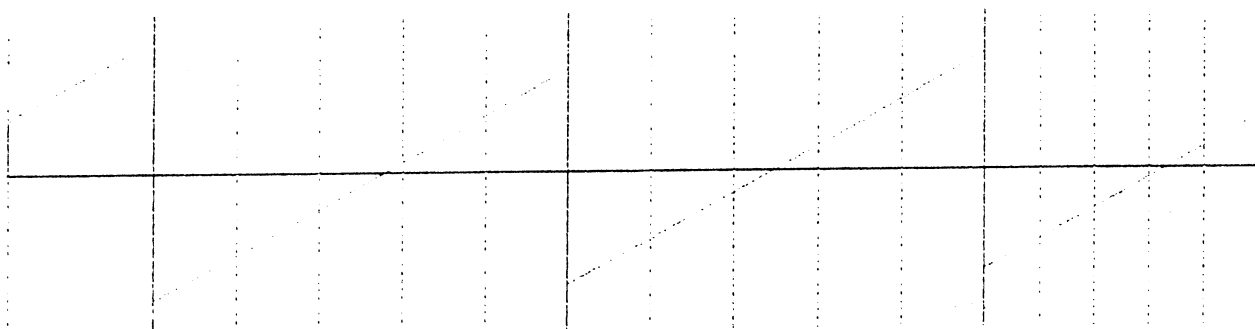
| MARK    | ODD SPANS L'D | EVEN SPANS L'D | ALL SPANS LOADED |           |             |
|---------|---------------|----------------|------------------|-----------|-------------|
| SUPPORT | Design Load   | Design Load    | Dead Load        | Live Load | Design Load |
| #1      | 1519.60       | 1519.60        | 762.28           | 282.75    | 1519.60     |
| #2      | 1256.03       | 1256.03        | 521.74           | 328.49    | 1256.03     |
| #3      | 1258.95       | 1258.95        | 563.02           | 294.20    | 1258.95     |
| #4      | 295.72        | 295.72         | 128.31           | 72.55     | 295.72      |

# ELASTIC COLUMN MOMENTS (CCW +ve)

| MARK   | ODD SPANS LOADED |         | EVEN SPANS LOADED |         | ALL SPANS LOADED |         |
|--------|------------------|---------|-------------------|---------|------------------|---------|
| COLUMN | ABOVE            | BELOW   | ABOVE             | BELOW   | ABOVE            | BELOW   |
| #1     | 0.00             | +106.98 | 0.00              | +106.98 | 0.00             | +106.98 |
| #2     | 0.00             | -31.52  | 0.00              | -31.52  | 0.00             | -31.52  |
| #3     | 0.00             | +30.38  | 0.00              | +30.38  | 0.00             | +30.38  |
| #4     | 0.00             | 0.00    | 0.00              | 0.00    | 0.00             | 0.00    |



Bending Moment Diagram



Shear Diagram

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : Flat Slab Strip on B/1-6  
 DATE : February 26, 2000

Page 479

# REDISTRIBUTED BEAM SUPPORT MOMENTS

| MARK     | ODD SPANS LOADED |          | EVEN SPANS LOADED |          | ALL SPANS LOADED |          |
|----------|------------------|----------|-------------------|----------|------------------|----------|
|          | Left             | Right    | Left              | Right    | Left             | Right    |
| L. Cant. |                  | -1507.79 |                   | -1507.79 |                  | -1507.79 |
| (1) P1   | -1400.81         | -639.67  | -1400.81          | -639.67  | -1400.81         | -639.67  |
| (2) P2   | -639.67          | -647.32  | -639.67           | -647.32  | -639.67          | -647.32  |
| (3) P3   | -647.32          | 0.00     | -647.32           | 0.00     | -647.32          | 0.00     |

# MAXIMUM REDISTRIBUTED BEAM SPAN MOMENTS (X to nearest 0.01 L)

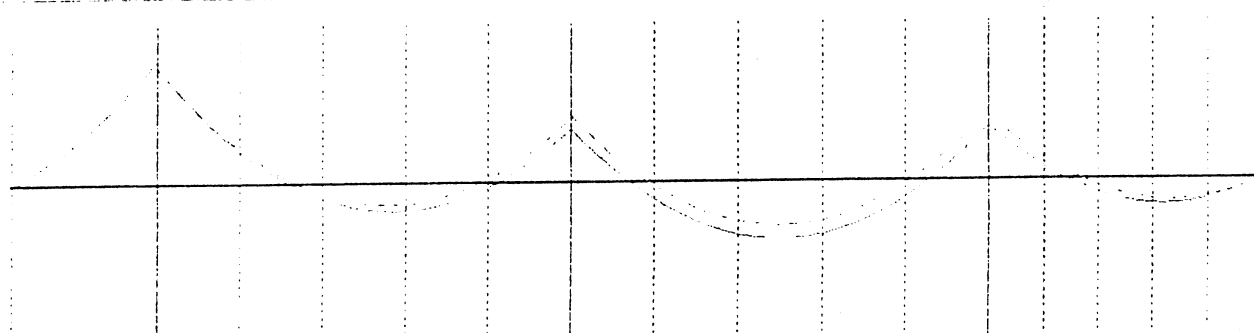
| MARK   | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|--------|------------------|------|-------------------|------|------------------|------|
|        | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) P1 | +343.17          | 4.56 | +343.17           | 4.56 | +343.17          | 4.56 |
| (2) P2 | +692.82          | 4.00 | +692.82           | 4.00 | +692.82          | 4.00 |
| (3) P3 | +307.50          | 3.39 | +307.50           | 3.39 | +307.50          | 3.39 |

# DISTRIBUTED BEAM SHEARS

| MARK     | AT LEFT SUPPORT | AT 0.10 OF SPAN | AT 0.20 OF SPAN | AT 0.80 OF SPAN | AT 0.90 OF SPAN | AT RIGHT SUPPORT |
|----------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| L. Cant. |                 |                 |                 |                 |                 | -772.35          |
| (1) P1   | +763.30         | +629.67         | +496.04         | -305.75         | -439.39         | -573.02          |
| (2) P2   | +667.20         | +533.57         | +399.94         | -401.85         | -535.48         | -669.12          |
| (3) P3   | +564.79         | +476.26         | +387.73         | -143.46         | -231.99         | -320.52          |

# REDISTRIBUTED SUPPORT REACTIONS

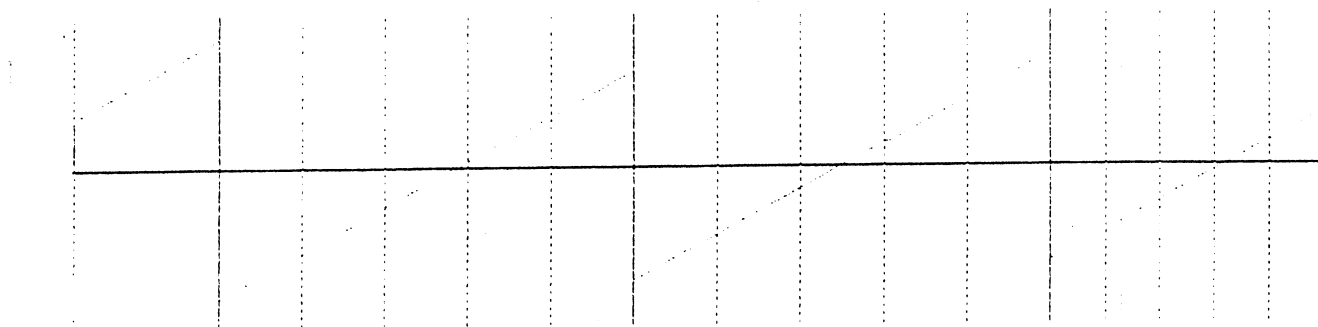
| MARK<br>SUPPORT | ODD SPANS L'D | EVEN SPANS L'D | ALL SPANS LOADED |           |             |
|-----------------|---------------|----------------|------------------|-----------|-------------|
|                 | Design Load   | Design Load    | Dead Load        | Live Load | Design Load |
| #1              | 1535.65       | 1535.65        | 762.28           | 282.75    | 1535.65     |
| #2              | 1240.22       | 1240.22        | 521.74           | 328.49    | 1240.22     |
| #3              | 1233.91       | 1233.91        | 563.02           | 294.20    | 1233.91     |
| #4              | 320.52        | 320.52         | 128.31           | 72.55     | 320.52      |



Bending Moment Diagram

GRAM : SFRM - R.C. SubFrame Analysis and Design  
 JECT : National Museum - Amman  
 FRAME : Flat Slab Strip on B/1-6  
 DATE : February 26, 2000

Page 480



hear Diagram

### FLAT SLAB PANEL DIMENSIONS

| STRIP BREADTHS            | COLUMN | MIDDLE |    |
|---------------------------|--------|--------|----|
| Effective for First Supp. | 4000   | 4000   | mm |
| Spans + Internal Supports | 4000   | 4000   | mm |
| Effective for Last Supp.  | 4000   | 4000   | mm |

Moment Transfer Between Slab & Columns: 1st Col Last Col

|                               |        |             |
|-------------------------------|--------|-------------|
| Design Moments =              | 1400.8 | 0.0 kN.m    |
| Maximum Permissible Moments = | 1014.0 | 1014.0 kN.m |

### FLAT SLAB COLUMN STRIP DESIGN FOR FLEXURE

$f_{cu} = 25\text{MPa}$   $f_y = 420\text{MPa}$

CODE: BS8110

|           |         | b<br>(mm) | h<br>(mm)  | c<br>(mm)   | d'<br>(mm) |      |          |           |                          |                           |
|-----------|---------|-----------|------------|-------------|------------|------|----------|-----------|--------------------------|---------------------------|
| ALL SPANS |         | 4000      | 300        | 40          | 40         | mm   |          |           |                          |                           |
| MARK      | pos.    | d<br>(mm) | bf<br>(mm) | M<br>(kN.m) | R<br>(MPa) | x/d  | p<br>(%) | p'<br>(%) | As<br>(mm <sup>2</sup> ) | As'<br>(mm <sup>2</sup> ) |
| Cant.     | sup F   | 260       | 4000       | -1017.5     | 3.76       | 0.48 | 1.31     | 0.00      | 13642                    | 0                         |
|           | supp    | 260       | 4000       | -1130.8     | 4.18       | 0.50 | 1.47     | 0.09      | 15278                    | 968                       |
| (1) P1    | L supp  | 260       | 4000       | -1050.6     | 3.89       | 0.50 | 1.37     | 0.00      | 14263                    | 0                         |
|           | L sup F | 260       | 4000       | -938.7      | 3.47       | 0.43 | 1.18     | 0.00      | 12242                    | 0                         |
|           | span    | 260       | 4000       | +188.7      | 0.70       | 0.07 | 0.20     | 0.00      | 2054                     | 0                         |
|           | R sup F | 260       | 4000       | -396.4      | 1.47       | 0.16 | 0.43     | 0.00      | 4492                     | 0                         |
|           | R supp  | 260       | 4000       | -479.8      | 1.77       | 0.19 | 0.53     | 0.00      | 5534                     | 0                         |

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : Flat Slab Strip on B/1-6  
 DATE : February 26, 2000

Page 481

| MARK   | pos.    | d<br>(mm) | bf<br>(mm) | M<br>(kN.m) | R<br>(MPa) | x/d  | p<br>(%) | p'<br>(%) | As<br>(mm <sup>2</sup> ) | As'<br>(mm <sup>2</sup> ) |
|--------|---------|-----------|------------|-------------|------------|------|----------|-----------|--------------------------|---------------------------|
| (2) P2 | L supp  | 260       | 4000       | -479.8      | 1.77       | 0.19 | 0.53     | 0.00      | 5534                     | 0                         |
|        | L sup F | 260       | 4000       | -382.3      | 1.41       | 0.15 | 0.42     | 0.00      | 4319                     | 0                         |
|        | span    | 260       | 4000       | +381.1      | 1.41       | 0.15 | 0.41     | 0.00      | 4304                     | 0                         |
|        | R sup F | 260       | 4000       | -387.7      | 1.43       | 0.15 | 0.42     | 0.00      | 4386                     | 0                         |
|        | R supp  | 260       | 4000       | -485.5      | 1.80       | 0.20 | 0.54     | 0.00      | 5607                     | 0                         |
| (3) P3 | L supp  | 260       | 4000       | -485.5      | 1.80       | 0.20 | 0.54     | 0.00      | 5607                     | 0                         |
|        | L sup F | 260       | 4000       | -403.3      | 1.49       | 0.16 | 0.44     | 0.00      | 4577                     | 0                         |
|        | span    | 260       | 4000       | +169.1      | 0.63       | 0.06 | 0.18     | 0.00      | 1834                     | 0                         |
|        | R sup F | 260       | 4000       | +23.4       | 0.09       | 0.01 | 0.16     | 0.00      | 1714                     | 0                         |
|        | R supp  | 260       | 4000       | 0.0         | 0.00       | 0.00 | 0.16     | 0.00      | 1714                     | 0                         |

\* = Nominal Reinforcement

### CHOICE OF BARS FOR FLEXURE (COLUMN STRIP)

Support Bars Chosen for Reinforcement Calculated at: FACES OF SUPPORTS

| MARK   | pos.    | As_B | As_T  | Bottom Bars                                                              | Top Bars                                                                 |
|--------|---------|------|-------|--------------------------------------------------------------------------|--------------------------------------------------------------------------|
| (1) P1 | sup F   | 0    | 15688 | - - -                                                                    | 1Y32 @210( 98%)<br>1Y25 @130( 96%)<br>1Y22 @100( 97%)<br>1Y20 @ 80(100%) |
|        | span    | 2054 | 0     | 1Y10 @160( 96%)                                                          | - - -                                                                    |
|        | sup F   | 0    | 4967  | - - -                                                                    | 1Y16 @170( 95%)<br>1Y14 @130( 95%)<br>1Y12 @ 90(101%)<br>1Y10 @ 60(106%) |
|        | span    | 4304 | 0     | 1Y16 @190( 98%)<br>1Y14 @150( 95%)<br>1Y12 @110( 95%)<br>1Y10 @ 70(105%) | - - -                                                                    |
|        | sup F   | 0    | 5044  | - - -                                                                    | 1Y16 @160(100%)<br>1Y14 @120(102%)<br>1Y12 @ 90(100%)<br>1Y10 @ 60(104%) |
| (2) P2 | span    | 1834 | 0     | 1Y10 @180( 96%)                                                          | - - -                                                                    |
|        | R sup F | 0    | 1714  | - - -                                                                    | 1Y10 @180(102%)                                                          |

Column Strip Negative Reinforcement Increased By 15 %

### FLAT SLAB MIDDLE STRIP DESIGN FOR FLEXURE

fcu= 25MPa fy= 420MPa

CODE: BS8110

|           | b<br>(mm) | h<br>(mm) | c<br>(mm) | d'<br>(mm) |    |
|-----------|-----------|-----------|-----------|------------|----|
| ALL SPANS | 4000      | 300       | 40        | 40         | mm |

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 PROJECT : National Museum - Amman  
 FRAME : Flat Slab Strip on D/1-6  
 DATE : February 26, 2000

Page 482

| MARK   | pos.   | d<br>(mm) | bf<br>(mm) | M<br>(kN.m) | R<br>(MPa) | x/d  | p<br>(%) | p'<br>(%) | As<br>(mm <sup>2</sup> ) | As'<br>(mm <sup>2</sup> ) |
|--------|--------|-----------|------------|-------------|------------|------|----------|-----------|--------------------------|---------------------------|
| Cant.  | supp   | 260       | 4000       | -376.9      | 1.39       | 0.15 | 0.41     | 0.00      | 4254                     | 0                         |
| (1) P1 | L supp | 260       | 4000       | -350.2      | 1.30       | 0.14 | 0.38     | 0.00      | 3931                     | 0                         |
|        | span   | 260       | 4000       | +154.4      | 0.57       | 0.06 | 0.16     | 0.00      | * 1714                   | 0                         |
|        | R supp | 260       | 4000       | -159.9      | 0.59       | 0.06 | 0.17     | 0.00      | 1731                     | 0                         |
| (2) P2 | L supp | 260       | 4000       | -159.9      | 0.59       | 0.06 | 0.17     | 0.00      | 1731                     | 0                         |
|        | span   | 260       | 4000       | +311.8      | 1.15       | 0.12 | 0.33     | 0.00      | 3473                     | 0                         |
|        | R supp | 260       | 4000       | -161.8      | 0.60       | 0.06 | 0.17     | 0.00      | 1753                     | 0                         |
| (3) P3 | L supp | 260       | 4000       | -161.8      | 0.60       | 0.06 | 0.17     | 0.00      | 1753                     | 0                         |
|        | span   | 260       | 4000       | +138.4      | 0.51       | 0.05 | 0.16     | 0.00      | * 1714                   | 0                         |
|        | R supp | 260       | 4000       | 0.0         | 0.00       | 0.00 | 0.16     | 0.00      | * 1714                   | 0                         |

\* = Nominal Reinforcement

# CHOICE OF BARS FOR FLEXURE (MIDDLE STRIP)

Support Bars Chosen for Reinforcement Calculated at: FACES OF SUPPORTS

| RK     | pos.    | As_B | As_T | Bottom Bars                                           | Top Bars                                                                 |
|--------|---------|------|------|-------------------------------------------------------|--------------------------------------------------------------------------|
|        | sup F   | 0    | 4254 | - - -                                                 | 1Y16 @190( 99%)<br>1Y14 @150( 97%)<br>1Y12 @110( 97%)<br>1Y10 @ 70(106%) |
| (1) P1 | span    | 1714 | 0    | 1Y10 @180(102%)                                       | - - -                                                                    |
|        | sup F   | 0    | 1731 | - - -                                                 | 1Y10 @180(101%)                                                          |
| (2) P2 | span    | 3473 | 0    | 1Y14 @180( 99%)<br>1Y12 @130(100%)<br>1Y10 @ 90(101%) | - - -                                                                    |
|        | sup F   | 0    | 1753 | - - -                                                 | 1Y10 @180(100%)                                                          |
| 3) P3  | span    | 1714 | 0    | 1Y10 @180(102%)                                       | - - -                                                                    |
|        | R sup F | 0    | 1714 | - - -                                                 | 1Y10 @180(102%)                                                          |

RAM : SFRM - R.C. SubFrame Analysis and Design  
 ECT : National Museum - Amman  
 RAME : Flat Slab Strip on 3/C-A \*  
 DATE : February 26, 2000

Page 483

Design Code: BS8110  
 Frame Type: Flat Slab  
 Load Pattern for Span Mom: All Spans loaded (clause 3.5.2.3).  
 Load Pattern for Supp Mom: All Spans loaded (clause 3.5.2.3).  
 Load Factors: Code Standard

# BEAMS

| MARK   | PROPERTIES |       |      | UNIFORM LOADS |       |      |      |
|--------|------------|-------|------|---------------|-------|------|------|
|        | Span       | b (I) | h    | DEAD          | LIVE  | X1   | X2   |
| 1) P1  | 8.00       | 8.00  | 0.30 | 73.60         | 40.00 | 0.00 | 8.00 |
| (2) P2 | 8.00       | 8.00  | 0.30 | 73.60         | 40.00 | 0.00 | 8.00 |

# COLUMNS AND SUPPORTS

| SUPPORT<br>No.<br>L--->R | COLUMNS ABOVE |       |     | COLUMNS BELOW |       |      | SUPPORT<br>BREADTH<br>h |
|--------------------------|---------------|-------|-----|---------------|-------|------|-------------------------|
|                          | Height        | b (I) | h   | Height        | b (I) | h    |                         |
| 1                        | 0.00          | ---   | --- | 0.00          | ---   | ---  | 0.25                    |
| 2                        | 0.00          | ---   | --- | 5.30          | 0.40  | 0.40 | 0.40                    |
| 3                        | 0.00          | ---   | --- | 0.00          | ---   | ---  | 0.25                    |

# ELASTIC BEAM SUPPORT MOMENTS

| MARK   | ODD SPANS LOADED |         | EVEN SPANS LOADED |          | ALL SPANS LOADED |          |
|--------|------------------|---------|-------------------|----------|------------------|----------|
|        | Left             | Right   | Left              | Right    | Left             | Right    |
| (1) P1 | 0.00             | 1336.32 | 0.00              | -1336.32 | 0.00             | -1336.32 |
| 2) P2  | -1336.32         | 0.00    | -1336.32          | 0.00     | -1336.32         | 0.00     |

# MAXIMUM ELASTIC BEAM SPAN MOMENTS (X to nearest 0.01 L)

| MARK   | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|--------|------------------|------|-------------------|------|------------------|------|
|        | Moment           | X    | Moment            | X    | Moment           | X    |
| 1) P1  | +751.55          | 2.96 | +751.55           | 2.96 | +751.55          | 2.96 |
| (2) P2 | +751.55          | 4.96 | +751.55           | 4.96 | +751.55          | 4.96 |

# ELASTIC BEAM SHEARS

| MARK   | AT LEFT<br>SUPPORT | AT 0.10<br>OF SPAN | AT 0.20<br>OF SPAN | AT 0.80<br>OF SPAN | AT 0.90<br>OF SPAN | AT RIGHT<br>SUPPORT |
|--------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|
|        |                    |                    |                    |                    |                    |                     |
| (1) P1 | +501.12            | +367.49            | +233.86            | -567.94            | -701.57            | -835.20             |
| 2) P2  | +835.20            | +701.57            | +567.94            | -233.86            | -367.49            | -501.12             |

RAM : SFRM - R.C. SubFrame Analysis and Design  
 ECT : National Museum - Amman  
 RAME : Flat Slab Strip on 3/C-A \*  
 DATE : February 26, 2000

Page 484

#### ELASTIC SUPPORT REACTIONS

| MARK   | ODD SPANS L'D | EVEN SPANS L'D | ALL SPANS LOADED |           |             |
|--------|---------------|----------------|------------------|-----------|-------------|
| UPPORT | Design Load   | Design Load    | Dead Load        | Live Load | Design Load |
| #1     | 501.12        | 501.12         | 220.80           | 120.00    | 501.12      |
| #2     | 1670.40       | 1670.40        | 736.00           | 400.00    | 1670.40     |
| #3     | 501.12        | 501.12         | 220.80           | 120.00    | 501.12      |

#### ELASTIC COLUMN MOMENTS (CCW +ve)

| MARK   | ODD SPANS LOADED |       | EVEN SPANS LOADED |       | ALL SPANS LOADED |       |
|--------|------------------|-------|-------------------|-------|------------------|-------|
| COLUMN | ABOVE            | BELOW | ABOVE             | BELOW | ABOVE            | BELOW |
| #1     | 0.00             | 0.00  | 0.00              | 0.00  | 0.00             | 0.00  |
| #2     | 0.00             | 0.00  | 0.00              | 0.00  | 0.00             | 0.00  |
| #3     | 0.00             | 0.00  | 0.00              | 0.00  | 0.00             | 0.00  |

#### REDISTRIBUTED BEAM SUPPORT MOMENTS

| MARK   | ODD SPANS LOADED |          | EVEN SPANS LOADED |          | ALL SPANS LOADED |          |
|--------|------------------|----------|-------------------|----------|------------------|----------|
|        | Left             | Right    | Left              | Right    | Left             | Right    |
| 1) P1  | 0.00             | -1069.06 | 0.00              | -1069.06 | 0.00             | -1069.06 |
| (2) P2 | -1069.06         | 0.00     | -1069.06          | 0.00     | -1069.06         | 0.00     |

#### MAXIMUM REDISTRIBUTED BEAM SPAN MOMENTS (X to nearest 0.01 L)

| MARK   | ODD SPANS LOADED |      | EVEN SPANS LOADED |      | ALL SPANS LOADED |      |
|--------|------------------|------|-------------------|------|------------------|------|
|        | Moment           | X    | Moment            | X    | Moment           | X    |
| (1) P1 | +855.24          | 3.20 | +855.24           | 3.20 | +855.24          | 3.20 |
| 2) P2  | +855.24          | 4.80 | +855.24           | 4.80 | +855.24          | 4.80 |

#### REDISTRIBUTED BEAM SHEARS

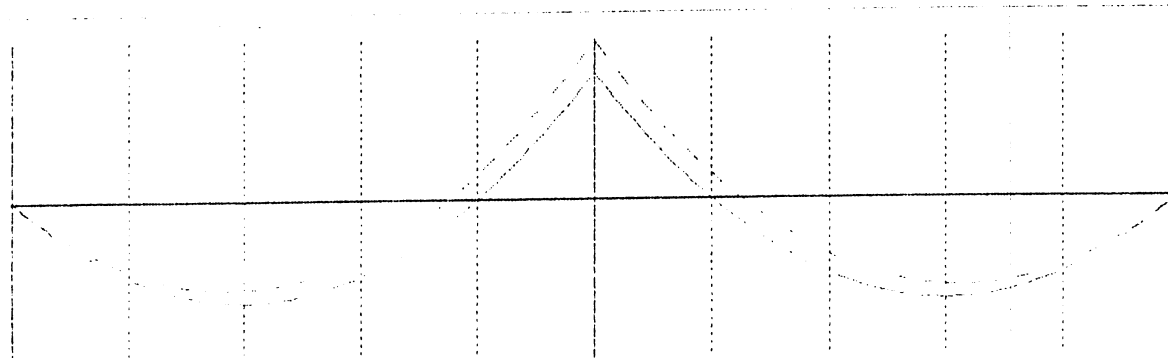
| MARK   | AT LEFT SUPPORT | AT 0.10 OF SPAN | AT 0.20 OF SPAN | AT 0.80 OF SPAN | AT 0.90 OF SPAN | AT RIGHT SUPPORT |
|--------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| 1) P1  | +534.53         | +400.90         | +267.26         | -534.53         | -668.16         | -801.79          |
| (2) P2 | +801.79         | +668.16         | +534.53         | -267.26         | -400.90         | -534.53          |

GRAM : SFRM - R.C. SubFrame Analysis and Design  
 JECT : National Museum - Amman  
 FRAME : Flat Slab Strip on 3/C-A \*  
 DATE : February 26, 2000

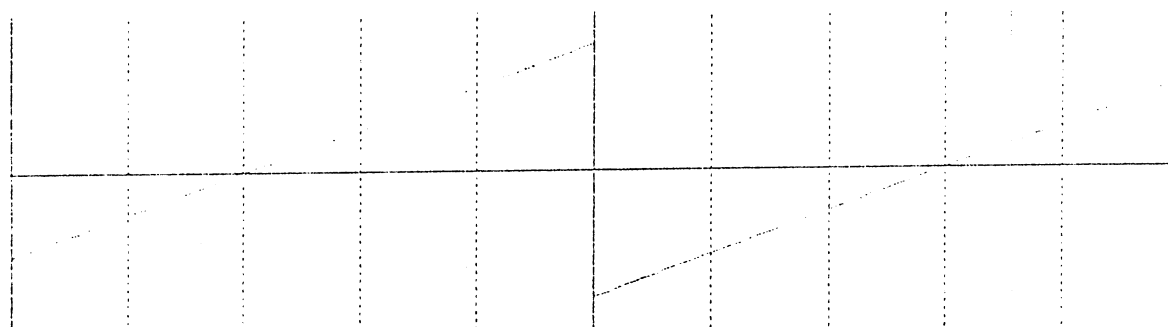
Page 485

# REDISTRIBUTED SUPPORT REACTIONS

| MARK    | ODD SPANS L'D | EVEN SPANS L'D | ALL SPANS LOADED |           |             |
|---------|---------------|----------------|------------------|-----------|-------------|
| SUPPORT | Design Load   | Design Load    | Dead Load        | Live Load | Design Load |
| #1      | 534.53        | 534.53         | 220.80           | 120.00    | 534.53      |
| #2      | 1603.58       | 1603.58        | 736.00           | 400.00    | 1603.58     |
| #3      | 534.53        | 534.53         | 220.80           | 120.00    | 534.53      |



Bending Moment Diagram



Shear Diagram

## FLAT SLAB PANEL DIMENSIONS

| STRIP BREADTHS            | COLUMN | MIDDLE  |
|---------------------------|--------|---------|
| Effective for First Supp. | 4000   | 4000 mm |
| Spans + Internal Supports | 4000   | 4000 mm |
| Effective for Last Supp.  | 4000   | 4000 mm |

Moment Transfer Between Slab & Columns: 1st Col Last Col

|                               |        |             |
|-------------------------------|--------|-------------|
| Design Moments =              | 0.0    | 0.0 kN.m    |
| Maximum Permissible Moments = | 1014.0 | 1014.0 kN.m |

PROGRAM : SFRM - R.C. SubFrame Analysis and Design  
 OBJECT : National Museum - Amman  
 FRAME : Flat Slab Strip on 3/C-A \*  
 DATE : February 26, 2000

Page 486

# FLAT SLAB COLUMN STRIP DESIGN FOR FLEXURE

fcu= 25MPa fy= 420MPa

CODE: BS8110

|           |         | b<br>( mm ) | h<br>( mm )  | c<br>( mm )   | d'<br>( mm ) |      |            |             |                           |                            |
|-----------|---------|-------------|--------------|---------------|--------------|------|------------|-------------|---------------------------|----------------------------|
| ALL SPANS |         | 4000        | 300          | 40            | 40           | mm   |            |             |                           |                            |
| MARK      | pos.    | d<br>( mm ) | bf<br>( mm ) | M<br>( kN.m ) | R<br>( MPa ) | x/d  | p<br>( % ) | p'<br>( % ) | As<br>( mm <sup>2</sup> ) | As'<br>( mm <sup>2</sup> ) |
| (1) P1    | L supp  | 260         | 4000         | 0.0           | 0.00         | 0.00 | 0.16       | 0.00        | * 1714                    | 0                          |
|           | L sup F | 260         | 4000         | +49.0         | 0.18         | 0.02 | 0.16       | 0.00        | * 1714                    | 0                          |
|           | span    | 260         | 4000         | +470.4        | 1.74         | 0.19 | 0.52       | 0.00        | 5415                      | 0                          |
|           | R sup F | 260         | 4000         | -684.1        | 2.53         | 0.29 | 0.80       | 0.00        | 8284                      | 0                          |
|           | R supp  | 260         | 4000         | -801.8        | 2.97         | 0.35 | 0.96       | 0.00        | 10024                     | 0                          |
| (2) P2    | L supp  | 260         | 4000         | -801.8        | 2.97         | 0.35 | 0.96       | 0.00        | 10024                     | 0                          |
|           | L sup F | 260         | 4000         | -684.1        | 2.53         | 0.29 | 0.80       | 0.00        | 8284                      | 0                          |
|           | span    | 260         | 4000         | +470.4        | 1.74         | 0.19 | 0.52       | 0.00        | 5415                      | 0                          |
|           | R sup F | 260         | 4000         | +49.0         | 0.18         | 0.02 | 0.16       | 0.00        | * 1714                    | 0                          |
|           | R supp  | 260         | 4000         | 0.0           | 0.00         | 0.00 | 0.16       | 0.00        | * 1714                    | 0                          |

\* = Nominal Reinforcement

## CHOICE OF BARS FOR FLEXURE (COLUMN STRIP)

Support Bars Chosen for Reinforcement Calculated at: FACES OF SUPPORTS

| MARK   | pos.    | As_B | As_T | Bottom Bars                                                              | Top Bars                                                                 |
|--------|---------|------|------|--------------------------------------------------------------------------|--------------------------------------------------------------------------|
| (1) P1 | L sup F | 0    | 1714 | - - -                                                                    | 1Y10 @180(102%)                                                          |
|        | span    | 5415 | 0    | 1Y18 @190( 99%)<br>1Y16 @150( 99%)<br>1Y14 @110(103%)<br>1Y10 @ 60( 97%) | - - -                                                                    |
|        | sup F   | 0    | 8284 | - - -                                                                    | 1Y22 @190( 97%)<br>1Y20 @150(101%)<br>1Y18 @120(102%)<br>1Y16 @100( 97%) |
|        | span    | 5415 | 0    | 1Y18 @190( 99%)<br>1Y16 @150( 99%)<br>1Y14 @110(103%)<br>1Y10 @ 60( 97%) | - - -                                                                    |
|        | R sup F | 0    | 1714 | - - -                                                                    | 1Y10 @180(102%)                                                          |

Column Strip Negative Reinforcement Increased By 15 %

## FLAT SLAB MIDDLE STRIP DESIGN FOR FLEXURE

fcu= 25MPa fy= 420MPa

CODE: BS8110

|           | b<br>( mm ) | h<br>( mm ) | c<br>( mm ) | d'<br>( mm ) |    |
|-----------|-------------|-------------|-------------|--------------|----|
| ALL SPANS | 4000        | 300         | 40          | 40           | mm |

PROGRAM : SFRM R.C. SubFrame Analysis and Design  
 SUBJECT : National Museum - Amman  
 FRAME : Flat Slab Strip on 3/C-A \*  
 DATE : February 26, 2000

Page 487

| MARK  | pos.   | d<br>( mm ) | bf<br>( mm ) | M<br>( kN.m ) | R<br>( MPa ) | x/d  | p<br>( % ) | p'<br>( % ) | As<br>( mm <sup>2</sup> ) | As'<br>( mm <sup>2</sup> ) |
|-------|--------|-------------|--------------|---------------|--------------|------|------------|-------------|---------------------------|----------------------------|
| 1) P1 | L supp | 260         | 4000         | 0.0           | 0.00         | 0.00 | 0.16       | 0.00        | * 1714                    | 0                          |
|       | span   | 260         | 4000         | +384.9        | 1.42         | 0.15 | 0.42       | 0.00        | 4351                      | 0                          |
|       | R supp | 260         | 4000         | -267.3        | 0.99         | 0.10 | 0.28       | 0.00        | 2952                      | 0                          |
| 2) P2 | L supp | 260         | 4000         | -267.3        | 0.99         | 0.10 | 0.28       | 0.00        | 2952                      | 0                          |
|       | span   | 260         | 4000         | +384.9        | 1.42         | 0.15 | 0.42       | 0.00        | 4351                      | 0                          |
|       | R supp | 260         | 4000         | 0.0           | 0.00         | 0.00 | 0.16       | 0.00        | * 1714                    | 0                          |

\* = Nominal Reinforcement

# CHOICE OF BARS FOR FLEXURE (MIDDLE STRIP)

Support Bars Chosen for Reinforcement Calculated at: FACES OF SUPPORTS

| MARK   | pos.    | As_B | As_T | Bottom Bars                                                              | Top Bars                           |
|--------|---------|------|------|--------------------------------------------------------------------------|------------------------------------|
| (1) P1 | L sup F | 0    | 1714 | - - -                                                                    | 1Y10 @180(102%)                    |
|        | span    | 4351 | 0    | 1Y16 @190( 97%)<br>1Y14 @140(101%)<br>1Y12 @100(104%)<br>1Y10 @ 70(104%) | - - -<br>- - -<br>- - -<br>- - -   |
|        | sup F   | 0    | 2952 | - - -                                                                    | 1Y12 @160( 96%)<br>1Y10 @110( 97%) |
|        | span    | 4351 | 0    | 1Y16 @190( 97%)<br>1Y14 @140(101%)<br>1Y12 @100(104%)<br>1Y10 @ 70(104%) | - - -<br>- - -<br>- - -<br>- - -   |
|        | R sup F | 0    | 1714 | - - -                                                                    | 1Y10 @180(102%)                    |