










Table 4.5 Ratio of load  $w$  in  $L$  and  $B$  directions for shear in slab and load on supports\*

| Ratio<br>$m = \frac{A}{B}$ | Case 1  | Case 2  | Case 3  | Case 4  | Case 5  | Case 6  | Case 7  | Case 8  | Case 9  |
|----------------------------|---|---|---|---|---|---|---|---|---|
|                            |  |  |  |  |  |  |  |  |  |
| 1.00                       | $W_x$ 0.50  | 0.50  | 0.17  | 0.50  | 0.83  | 0.71  | 0.29  | 0.33  | 0.67  |
|                            | $W_y$ 0.50  | 0.50  | 0.83  | 0.50  | 0.17  | 0.29  | 0.71  | 0.67  | 0.33  |
| 0.95                       | $W_x$ 0.55  | 0.55  | 0.20  | 0.55  | 0.86  | 0.75  | 0.33  | 0.38  | 0.71  |
|                            | $W_y$ 0.45  | 0.45  | 0.80  | 0.45  | 0.14  | 0.25  | 0.67  | 0.62  | 0.29  |
| 0.90                       | $W_x$ 0.60  | 0.60  | 0.23  | 0.60  | 0.88  | 0.79  | 0.38  | 0.43  | 0.75  |
|                            | $W_y$ 0.40  | 0.40  | 0.77  | 0.40  | 0.12  | 0.21  | 0.62  | 0.57  | 0.25  |
| 0.85                       | $W_x$ 0.66  | 0.66  | 0.28  | 0.66  | 0.90  | 0.83  | 0.43  | 0.49  | 0.79  |
|                            | $W_y$ 0.34  | 0.34  | 0.72  | 0.34  | 0.10  | 0.17  | 0.57  | 0.51  | 0.21  |
| 0.80                       | $W_x$ 0.71  | 0.71  | 0.33  | 0.71  | 0.92  | 0.86  | 0.49  | 0.55  | 0.83  |
|                            | $W_y$ 0.29  | 0.29  | 0.67  | 0.29  | 0.08  | 0.14  | 0.51  | 0.45  | 0.17  |
| 0.75                       | $W_x$ 0.76  | 0.76  | 0.39  | 0.76  | 0.94  | 0.88  | 0.56  | 0.61  | 0.86  |
|                            | $W_y$ 0.24  | 0.24  | 0.61  | 0.24  | 0.06  | 0.12  | 0.44  | 0.39  | 0.14  |
| 0.70                       | $W_x$ 0.81  | 0.81  | 0.45  | 0.81  | 0.95  | 0.91  | 0.62  | 0.68  | 0.89  |
|                            | $W_y$ 0.19  | 0.19  | 0.55  | 0.19  | 0.05  | 0.09  | 0.38  | 0.32  | 0.11  |
| 0.65                       | $W_x$ 0.85  | 0.85  | 0.53  | 0.85  | 0.96  | 0.93  | 0.69  | 0.74  | 0.92  |
|                            | $W_y$ 0.15  | 0.15  | 0.47  | 0.15  | 0.04  | 0.07  | 0.31  | 0.26  | 0.08  |
| 0.60                       | $W_x$ 0.89  | 0.89  | 0.61  | 0.89  | 0.97  | 0.95  | 0.76  | 0.80  | 0.94  |
|                            | $W_y$ 0.11  | 0.11  | 0.39  | 0.11  | 0.03  | 0.05  | 0.24  | 0.20  | 0.06  |
| 0.55                       | $W_x$ 0.92  | 0.92  | 0.69  | 0.92  | 0.98  | 0.96  | 0.81  | 0.85  | 0.95  |
|                            | $W_y$ 0.08  | 0.08  | 0.31  | 0.08  | 0.02  | 0.04  | 0.19  | 0.15  | 0.05  |
| 0.50                       | $W_x$ 0.94  | 0.94  | 0.76  | 0.94  | 0.99  | 0.97  | 0.86  | 0.89  | 0.97  |
|                            | $W_y$ 0.06  | 0.06  | 0.24  | 0.06  | 0.01  | 0.03  | 0.14  | 0.11  | 0.03  |

\*A cross-hatched edge indicates that the slab continues across or is fixed at the support; unmarked edge indicates a support at which torsional resistance is negligible.

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Table 4.1 Coefficients for live-load positive moments in slabs\*

$$\left. \begin{aligned} M_{A \text{ pos LL}} &= C_{A \text{ LL}} \times w \times A^2 \\ M_{B \text{ pos LL}} &= C_{B \text{ LL}} \times w \times B^2 \end{aligned} \right\} \text{ where } w = \text{total uniform live load}$$

| Ratio<br>$m = \frac{A}{B}$ |                    | Case 1 | Case 2 | Case 3 | Case 4 | Case 5 | Case 6 | Case 7 | Case 8 | Case 9 |
|----------------------------|--------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|                            |                    |        |        |        |        |        |        |        |        |        |
| 1.00                       | $C_{A \text{ LL}}$ | 0.036  | 0.027  | 0.027  | 0.032  | 0.032  | 0.035  | 0.032  | 0.028  | 0.030  |
|                            | $C_{B \text{ LL}}$ | 0.036  | 0.027  | 0.032  | 0.032  | 0.027  | 0.032  | 0.035  | 0.030  | 0.028  |
| 0.95                       | $C_{A \text{ LL}}$ | 0.040  | 0.030  | 0.031  | 0.035  | 0.034  | 0.038  | 0.036  | 0.031  | 0.032  |
|                            | $C_{B \text{ LL}}$ | 0.033  | 0.025  | 0.029  | 0.029  | 0.024  | 0.029  | 0.032  | 0.027  | 0.025  |
| 0.90                       | $C_{A \text{ LL}}$ | 0.045  | 0.034  | 0.035  | 0.039  | 0.037  | 0.042  | 0.040  | 0.035  | 0.036  |
|                            | $C_{B \text{ LL}}$ | 0.029  | 0.023  | 0.027  | 0.026  | 0.021  | 0.025  | 0.029  | 0.024  | 0.022  |
| 0.85                       | $C_{A \text{ LL}}$ | 0.050  | 0.037  | 0.040  | 0.043  | 0.041  | 0.046  | 0.045  | 0.040  | 0.039  |
|                            | $C_{B \text{ LL}}$ | 0.026  | 0.019  | 0.024  | 0.023  | 0.019  | 0.022  | 0.026  | 0.022  | 0.020  |
| 0.80                       | $C_{A \text{ LL}}$ | 0.056  | 0.041  | 0.045  | 0.048  | 0.044  | 0.051  | 0.051  | 0.044  | 0.042  |
|                            | $C_{B \text{ LL}}$ | 0.023  | 0.017  | 0.022  | 0.020  | 0.016  | 0.019  | 0.023  | 0.019  | 0.017  |
| 0.75                       | $C_{A \text{ LL}}$ | 0.061  | 0.045  | 0.051  | 0.052  | 0.047  | 0.055  | 0.056  | 0.049  | 0.046  |
|                            | $C_{B \text{ LL}}$ | 0.019  | 0.014  | 0.019  | 0.016  | 0.013  | 0.016  | 0.020  | 0.016  | 0.013  |
| 0.70                       | $C_{A \text{ LL}}$ | 0.068  | 0.049  | 0.057  | 0.057  | 0.051  | 0.060  | 0.063  | 0.054  | 0.050  |
|                            | $C_{B \text{ LL}}$ | 0.016  | 0.012  | 0.016  | 0.014  | 0.011  | 0.013  | 0.017  | 0.014  | 0.011  |
| 0.65                       | $C_{A \text{ LL}}$ | 0.074  | 0.053  | 0.064  | 0.062  | 0.055  | 0.064  | 0.070  | 0.059  | 0.054  |
|                            | $C_{B \text{ LL}}$ | 0.013  | 0.010  | 0.014  | 0.011  | 0.009  | 0.010  | 0.014  | 0.011  | 0.009  |
| 0.60                       | $C_{A \text{ LL}}$ | 0.081  | 0.058  | 0.071  | 0.067  | 0.059  | 0.068  | 0.077  | 0.065  | 0.059  |
|                            | $C_{B \text{ LL}}$ | 0.010  | 0.007  | 0.011  | 0.009  | 0.007  | 0.008  | 0.011  | 0.009  | 0.007  |
| 0.55                       | $C_{A \text{ LL}}$ | 0.088  | 0.062  | 0.080  | 0.072  | 0.063  | 0.073  | 0.085  | 0.070  | 0.063  |
|                            | $C_{B \text{ LL}}$ | 0.008  | 0.006  | 0.009  | 0.007  | 0.005  | 0.006  | 0.009  | 0.007  | 0.006  |
| 0.50                       | $C_{A \text{ LL}}$ | 0.095  | 0.066  | 0.088  | 0.077  | 0.067  | 0.078  | 0.092  | 0.076  | 0.067  |
|                            | $C_{B \text{ LL}}$ | 0.006  | 0.004  | 0.007  | 0.005  | 0.004  | 0.005  | 0.007  | 0.005  | 0.004  |

\*A cross-hatched edge indicates that the slab continues across or is fixed at the support; an unmarked edge indicates a support at which torsional resistance is negligible.

Table 4.3 Coefficients for dead-load positive moments in slabs\*

$$\left. \begin{aligned} M_{A, pos, DL} &= C_{A, DL} \times w \times A^2 \\ M_{B, pos, DL} &= C_{B, DL} \times w \times B^2 \end{aligned} \right\} \text{where } w = \text{total uniform dead load}$$










| Ratio<br>$\lambda = \frac{A}{B}$ | Case 1      | Case 2 | Case 3 | Case 4 | Case 5 | Case 6 | Case 7 | Case 8 | Case 9 |       |
|----------------------------------|-------------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
|                                  |             |        |        |        |        |        |        |        |        |       |
| .00                              | $C_{A, DL}$ | 0.036  | 0.018  | 0.018  | 0.027  | 0.027  | 0.033  | 0.027  | 0.020  | 0.023 |
|                                  | $C_{B, DL}$ | 0.036  | 0.018  | 0.027  | 0.027  | 0.018  | 0.027  | 0.033  | 0.023  | 0.020 |
| .95                              | $C_{A, DL}$ | 0.040  | 0.020  | 0.021  | 0.030  | 0.028  | 0.036  | 0.031  | 0.022  | 0.024 |
|                                  | $C_{B, DL}$ | 0.033  | 0.016  | 0.025  | 0.024  | 0.015  | 0.024  | 0.031  | 0.021  | 0.017 |
| .90                              | $C_{A, DL}$ | 0.045  | 0.022  | 0.025  | 0.033  | 0.029  | 0.039  | 0.035  | 0.025  | 0.026 |
|                                  | $C_{B, DL}$ | 0.029  | 0.014  | 0.024  | 0.022  | 0.013  | 0.021  | 0.028  | 0.019  | 0.015 |
| .85                              | $C_{A, DL}$ | 0.050  | 0.024  | 0.029  | 0.036  | 0.031  | 0.042  | 0.040  | 0.029  | 0.028 |
|                                  | $C_{B, DL}$ | 0.026  | 0.012  | 0.022  | 0.019  | 0.011  | 0.017  | 0.025  | 0.017  | 0.013 |
| .80                              | $C_{A, DL}$ | 0.056  | 0.026  | 0.034  | 0.039  | 0.032  | 0.045  | 0.045  | 0.032  | 0.029 |
|                                  | $C_{B, DL}$ | 0.023  | 0.011  | 0.020  | 0.016  | 0.009  | 0.015  | 0.022  | 0.015  | 0.010 |
| .75                              | $C_{A, DL}$ | 0.061  | 0.028  | 0.040  | 0.043  | 0.033  | 0.048  | 0.051  | 0.036  | 0.031 |
|                                  | $C_{B, DL}$ | 0.019  | 0.009  | 0.018  | 0.013  | 0.007  | 0.012  | 0.020  | 0.013  | 0.007 |
| .70                              | $C_{A, DL}$ | 0.068  | 0.030  | 0.046  | 0.046  | 0.035  | 0.051  | 0.058  | 0.040  | 0.033 |
|                                  | $C_{B, DL}$ | 0.016  | 0.007  | 0.016  | 0.011  | 0.005  | 0.009  | 0.017  | 0.011  | 0.006 |
| .65                              | $C_{A, DL}$ | 0.074  | 0.032  | 0.054  | 0.050  | 0.036  | 0.054  | 0.065  | 0.044  | 0.034 |
|                                  | $C_{B, DL}$ | 0.013  | 0.006  | 0.014  | 0.009  | 0.004  | 0.007  | 0.014  | 0.009  | 0.005 |
| .60                              | $C_{A, DL}$ | 0.081  | 0.034  | 0.062  | 0.053  | 0.037  | 0.056  | 0.073  | 0.048  | 0.038 |
|                                  | $C_{B, DL}$ | 0.010  | 0.004  | 0.011  | 0.007  | 0.003  | 0.006  | 0.012  | 0.007  | 0.004 |
| .55                              | $C_{A, DL}$ | 0.088  | 0.035  | 0.071  | 0.056  | 0.038  | 0.058  | 0.081  | 0.052  | 0.037 |
|                                  | $C_{B, DL}$ | 0.008  | 0.003  | 0.009  | 0.005  | 0.002  | 0.004  | 0.009  | 0.005  | 0.003 |
| .50                              | $C_{A, DL}$ | 0.095  | 0.037  | 0.080  | 0.059  | 0.039  | 0.061  | 0.089  | 0.056  | 0.038 |
|                                  | $C_{B, DL}$ | 0.006  | 0.002  | 0.007  | 0.004  | 0.001  | 0.003  | 0.007  | 0.004  | 0.002 |

\* A cross-hatched edge indicates that the slab continues across or is fixed at the support; unmarked edge indicates a support at which torsional resistance is negligible.

## آیین نامه بتن ایران

Table 4.2 Coefficients for negative moments in slabs\*

$$\left. \begin{aligned} M_{A \text{ neg}} &= C_{A \text{ neg}} \times w \times A^2 \\ M_{B \text{ neg}} &= C_{B \text{ neg}} \times w \times B^2 \end{aligned} \right\} \text{ where } w = \text{total uniform dead plus live load}$$

| Ratio<br>$m = \frac{A}{B}$ | Case 1  | Case 2  | Case 3  | Case 4  | Case 5  | Case 6   | Case 7  | Case 8  | Case 9  |
|----------------------------|---|---|---|---|---|--|---|---|---|
|                            |  |  |  |  |  |  |  |  |  |
| 1.00                       |   | 0.045   |   | 0.050   | 0.075   | 0.071  |   | 0.033   | 0.061   |
|                            |   | 0.045   | 0.076   | 0.050   |   |  | 0.071   | 0.061   | 0.033   |
| 0.95                       |   | 0.050   |   | 0.055   | 0.079   | 0.075  |   | 0.038   | 0.065   |
|                            |   | 0.041   | 0.072   | 0.045   |   |  | 0.067   | 0.058   | 0.029   |
| 0.90                       |   | 0.055   |   | 0.060   | 0.080   | 0.079  |   | 0.043   | 0.068   |
|                            |   | 0.037   | 0.070   | 0.040   |   |  | 0.062   | 0.052   | 0.025   |
| 0.85                       |   | 0.060   |   | 0.066   | 0.082   | 0.083  |   | 0.049   | 0.072   |
|                            |   | 0.031   | 0.065   | 0.034   |   |  | 0.057   | 0.046   | 0.021   |
| 0.80                       |   | 0.065   |   | 0.071   | 0.083   | 0.086  |   | 0.055   | 0.075   |
|                            |   | 0.027   | 0.061   | 0.029   |   |  | 0.051   | 0.041   | 0.017   |
| 0.75                       |   | 0.069   |   | 0.076   | 0.085   | 0.088  |   | 0.061   | 0.078   |
|                            |   | 0.022   | 0.056   | 0.024   |   |  | 0.044   | 0.036   | 0.014   |
| 0.70                       |   | 0.074   |   | 0.081   | 0.086   | 0.091  |   | 0.068   | 0.081   |
|                            |   | 0.017   | 0.050   | 0.019   |   |  | 0.038   | 0.029   | 0.011   |
| 0.65                       |   | 0.077   |   | 0.085   | 0.087   | 0.093  |   | 0.074   | 0.083   |
|                            |   | 0.014   | 0.043   | 0.015   |   |  | 0.031   | 0.024   | 0.008   |
| 0.60                       |   | 0.081   |   | 0.089   | 0.088   | 0.095  |   | 0.080   | 0.085   |
|                            |   | 0.010   | 0.035   | 0.011   |   |  | 0.024   | 0.018   | 0.006   |
| 0.55                       |   | 0.084   |   | 0.092   | 0.089   | 0.096  |   | 0.085   | 0.086   |
|                            |   | 0.007   | 0.028   | 0.008   |   |  | 0.019   | 0.014   | 0.005   |
| 0.50                       |   | 0.086   |   | 0.094   | 0.090   | 0.097  |   | 0.089   | 0.088   |
|                            |   | 0.006   | 0.022   | 0.006   |   |  | 0.014   | 0.010   | 0.003   |

\*A cross-hatched edge indicates that the slab continues across or is fixed at the support an unmarked edge indicates a support at which torsional resistance is negligible.

## آیین نامه بتن ایران

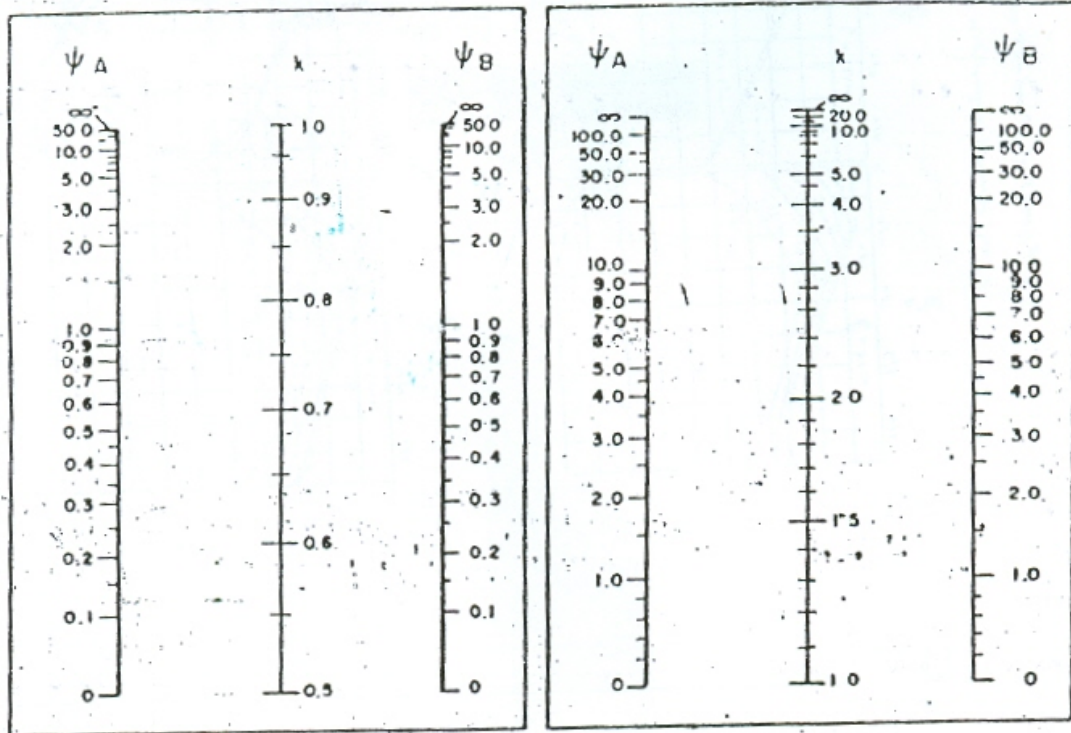
سطح مقطع آرماتورهای با الگای مختلف بر حسب سازه‌های بتنی

| φ (mm) | سازه‌های بتنی |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | φ (mm) | شکل    | معمق (mm) |
|--------|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|
|        | 1             | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     | 16     |        |        |           |
| 4      | 0.13          | 0.25   | 0.38   | 0.50   | 0.63   | 0.75   | 0.88   | 1.01   | 1.13   | 1.26   | 1.38   | 1.51   | 1.63   | 1.76   | 1.88   | 2.01   | 4      | 0.099  | 1.26      |
| 5      | 0.20          | 0.39   | 0.59   | 0.79   | 0.98   | 1.18   | 1.37   | 1.57   | 1.77   | 1.96   | 2.16   | 2.36   | 2.55   | 2.75   | 2.95   | 3.14   | 5      | 0.154  | 1.57      |
| 6      | 0.28          | 0.57   | 0.85   | 1.13   | 1.41   | 1.70   | 1.98   | 2.26   | 2.54   | 2.83   | 3.11   | 3.39   | 3.68   | 3.96   | 4.24   | 4.52   | 6      | 0.222  | 1.88      |
| 7      | 0.38          | 0.77   | 1.15   | 1.54   | 1.92   | 2.31   | 2.69   | 3.08   | 3.46   | 3.85   | 4.23   | 4.62   | 5.00   | 5.39   | 5.77   | 6.16   | 7      | 0.302  | 2.20      |
| 8      | 0.50          | 1.01   | 1.51   | 2.01   | 2.51   | 3.02   | 3.52   | 4.02   | 4.52   | 5.03   | 5.53   | 6.03   | 6.53   | 7.04   | 7.54   | 8.04   | 8      | 0.395  | 2.51      |
| 10     | 0.79          | 1.57   | 2.36   | 3.14   | 3.93   | 4.71   | 5.50   | 6.28   | 7.07   | 7.85   | 8.64   | 9.42   | 10.21  | 11.00  | 11.78  | 12.57  | 10     | 0.617  | 3.14      |
| 12     | 1.13          | 2.26   | 3.39   | 4.52   | 5.65   | 6.79   | 7.92   | 9.05   | 10.18  | 11.31  | 12.44  | 13.57  | 14.70  | 15.83  | 16.96  | 18.10  | 12     | 0.888  | 3.77      |
| 14     | 1.54          | 3.08   | 4.62   | 6.16   | 7.70   | 9.24   | 10.78  | 12.32  | 13.85  | 15.39  | 16.93  | 18.47  | 20.01  | 21.55  | 23.09  | 24.63  | 14     | 1.208  | 4.40      |
| 16     | 2.01          | 4.02   | 6.03   | 8.04   | 10.05  | 12.06  | 14.07  | 16.08  | 18.10  | 20.11  | 22.12  | 24.13  | 26.14  | 28.15  | 30.16  | 32.17  | 16     | 1.578  | 5.03      |
| 18     | 2.54          | 5.09   | 7.63   | 10.18  | 12.72  | 15.27  | 17.81  | 20.36  | 22.90  | 25.45  | 27.99  | 30.54  | 33.08  | 35.63  | 38.17  | 40.72  | 18     | 1.998  | 5.65      |
| 20     | 3.14          | 6.28   | 9.42   | 12.57  | 15.71  | 18.85  | 21.99  | 25.13  | 28.27  | 31.42  | 34.56  | 37.70  | 40.84  | 43.98  | 47.12  | 50.27  | 20     | 2.466  | 6.28      |
| 22     | 3.80          | 7.60   | 11.40  | 15.21  | 19.01  | 22.81  | 26.61  | 30.41  | 34.21  | 38.01  | 41.81  | 45.62  | 49.42  | 53.22  | 57.02  | 60.82  | 22     | 2.984  | 6.91      |
| 24     | 4.52          | 9.05   | 13.57  | 18.10  | 22.62  | 27.14  | 31.67  | 36.19  | 40.72  | 45.24  | 49.76  | 54.29  | 58.81  | 63.33  | 67.86  | 72.38  | 24     | 3.551  | 7.54      |
| 26     | 5.31          | 10.62  | 15.93  | 21.24  | 26.55  | 31.86  | 37.17  | 42.47  | 47.78  | 53.09  | 58.40  | 63.71  | 69.02  | 74.33  | 79.64  | 84.95  | 26     | 4.168  | 8.17      |
| 28     | 6.16          | 12.32  | 18.47  | 24.63  | 30.79  | 36.95  | 43.10  | 49.26  | 55.42  | 61.58  | 67.73  | 73.89  | 80.05  | 86.21  | 92.36  | 98.52  | 28     | 4.834  | 8.80      |
| 30     | 7.07          | 14.14  | 21.21  | 28.27  | 35.34  | 42.41  | 49.48  | 56.55  | 63.62  | 70.69  | 77.75  | 84.82  | 91.89  | 98.96  | 106.03 | 113.10 | 30     | 5.549  | 9.42      |
| 32     | 8.04          | 16.08  | 24.13  | 32.17  | 40.21  | 48.25  | 56.30  | 64.34  | 72.38  | 80.42  | 88.47  | 96.51  | 104.55 | 112.59 | 120.64 | 128.68 | 32     | 6.313  | 10.05     |
| 34     | 9.08          | 18.16  | 27.24  | 36.32  | 45.40  | 54.48  | 63.55  | 72.63  | 81.71  | 90.79  | 99.87  | 108.95 | 118.03 | 127.11 | 136.19 | 145.27 | 34     | 7.127  | 10.68     |
| 35     | 9.62          | 19.24  | 28.86  | 38.48  | 48.11  | 57.73  | 67.35  | 76.97  | 86.59  | 96.21  | 105.83 | 115.45 | 125.07 | 134.70 | 144.32 | 153.94 | 35     | 7.553  | 11.00     |
| 36     | 10.18         | 20.36  | 30.54  | 40.72  | 50.89  | 61.07  | 71.25  | 81.43  | 91.61  | 101.79 | 111.97 | 122.15 | 132.32 | 142.50 | 152.68 | 162.86 | 36     | 7.990  | 11.31     |
| 38     | 11.34         | 22.68  | 34.02  | 45.36  | 56.71  | 68.05  | 79.39  | 90.73  | 102.07 | 113.41 | 124.75 | 136.08 | 147.44 | 158.78 | 170.12 | 181.46 | 38     | 8.903  | 11.94     |
| 40     | 12.57         | 25.13  | 37.70  | 50.27  | 62.83  | 75.40  | 87.96  | 100.53 | 113.10 | 125.66 | 138.23 | 150.80 | 163.36 | 175.93 | 188.50 | 201.06 | 40     | 9.865  | 12.57     |
| 42     | 13.85         | 27.71  | 41.56  | 55.42  | 69.27  | 83.13  | 96.98  | 110.84 | 124.69 | 138.54 | 152.40 | 166.25 | 180.11 | 193.96 | 207.82 | 221.67 | 42     | 10.876 | 13.19     |
| 44     | 15.21         | 30.41  | 45.62  | 60.82  | 76.03  | 91.23  | 106.44 | 121.64 | 136.85 | 152.05 | 167.26 | 182.46 | 197.67 | 212.87 | 228.08 | 243.29 | 44     | 11.936 | 13.82     |
| 45     | 15.90         | 31.81  | 47.71  | 63.62  | 79.52  | 95.43  | 111.33 | 127.23 | 143.14 | 159.04 | 174.95 | 190.85 | 206.76 | 222.66 | 238.57 | 254.47 | 45     | 12.485 | 14.14     |
| 46     | 16.62         | 33.24  | 49.86  | 66.48  | 83.10  | 99.71  | 116.33 | 132.95 | 149.57 | 166.19 | 182.81 | 199.43 | 216.05 | 232.67 | 249.29 | 265.91 | 46     | 13.046 | 14.45     |
| 48     | 18.10         | 36.19  | 54.29  | 72.38  | 90.48  | 108.57 | 126.67 | 144.76 | 162.86 | 180.96 | 199.05 | 217.15 | 235.24 | 253.34 | 271.43 | 289.53 | 48     | 14.205 | 15.08     |
| 50     | 19.64         | 39.27  | 58.91  | 78.54  | 98.19  | 117.81 | 137.45 | 157.08 | 176.72 | 196.35 | 215.99 | 235.62 | 255.26 | 274.89 | 294.53 | 314.16 | 50     | 15.413 | 15.71     |
| 60     | 28.27         | 56.55  | 84.82  | 113.10 | 141.37 | 169.65 | 197.92 | 226.20 | 254.47 | 282.74 | 311.02 | 339.29 | 367.57 | 395.84 | 424.12 | 452.39 | 60     | 22.195 | 18.85     |
| 70     | 38.48         | 76.97  | 115.45 | 153.94 | 192.42 | 230.91 | 269.39 | 307.88 | 346.36 | 384.85 | 423.33 | 461.82 | 500.30 | 538.78 | 577.27 | 615.75 | 70     | 30.210 | 21.99     |
| 80     | 50.27         | 100.53 | 150.80 | 201.06 | 251.33 | 301.59 | 351.86 | 402.12 | 452.39 | 502.66 | 552.92 | 603.19 | 653.45 | 703.72 | 753.98 | 804.25 | 80     | 39.458 | 25.13     |

# آیین نامه بتن ایران

| انتهای بتن<br>لیتوریت (cm) | تعداد میلگرد<br>در یک متر مربع | فاصله بین میلگردها (cm) |      |       |       |       |       |       |       |       |       |        |        |      |  | انتهای بتن<br>لیتوریت (cm) |
|----------------------------|--------------------------------|-------------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|--------|--------|------|--|----------------------------|
|                            |                                | 6                       | 7    | 8     | 10    | 12    | 14    | 16    | 18    | 20    | 22    | 24     | 26     |      |  |                            |
| 4                          | 25.00                          | 7.07                    | 9.62 | 12.57 | 19.64 | 28.27 | 38.48 | 50.27 | 63.62 | 78.54 | 95.03 | 113.10 | 132.73 | 4    |  |                            |
| 5                          | 20.00                          | 5.65                    | 7.70 | 10.05 | 15.71 | 22.62 | 30.79 | 40.21 | 50.89 | 62.83 | 76.03 | 90.48  | 106.19 | 5    |  |                            |
| 6                          | 16.67                          | 4.71                    | 6.41 | 8.38  | 13.09 | 18.85 | 25.66 | 33.51 | 42.41 | 52.36 | 63.36 | 75.40  | 88.49  | 6    |  |                            |
| 7                          | 14.29                          | 4.04                    | 5.50 | 7.18  | 11.22 | 16.16 | 21.99 | 28.72 | 36.35 | 44.88 | 54.30 | 64.63  | 75.85  | 7    |  |                            |
| 7.5                        | 13.33                          | 3.77                    | 5.13 | 6.70  | 10.47 | 15.08 | 20.53 | 26.81 | 33.93 | 41.89 | 50.68 | 60.32  | 70.79  | 7.5  |  |                            |
| 8                          | 12.50                          | 3.53                    | 4.81 | 6.28  | 9.82  | 14.14 | 19.24 | 25.13 | 31.81 | 39.27 | 47.52 | 56.55  | 66.37  | 8    |  |                            |
| 8.5                        | 11.76                          | 3.33                    | 4.53 | 5.91  | 9.24  | 13.31 | 18.11 | 23.65 | 29.94 | 36.96 | 44.72 | 53.22  | 62.46  | 8.5  |  |                            |
| 9                          | 11.11                          | 3.14                    | 4.28 | 5.59  | 8.73  | 12.57 | 17.10 | 22.34 | 28.27 | 34.91 | 42.24 | 50.27  | 58.99  | 9    |  |                            |
| 9.5                        | 10.53                          | 2.98                    | 4.05 | 5.29  | 8.27  | 11.91 | 16.20 | 21.16 | 26.79 | 33.07 | 40.01 | 47.02  | 55.89  | 9.5  |  |                            |
| 10                         | 10.00                          | 2.83                    | 3.85 | 5.02  | 7.85  | 11.31 | 15.39 | 20.11 | 25.45 | 31.42 | 38.01 | 45.24  | 53.09  | 10   |  |                            |
| 10.5                       | 9.52                           | 2.69                    | 3.67 | 4.79  | 7.48  | 10.77 | 14.66 | 19.15 | 24.24 | 29.92 | 36.20 | 43.08  | 50.56  | 10.5 |  |                            |
| 11                         | 9.09                           | 2.57                    | 3.50 | 4.57  | 7.14  | 10.28 | 13.99 | 18.28 | 23.13 | 28.56 | 34.56 | 41.13  | 48.27  | 11   |  |                            |
| 11.5                       | 8.70                           | 2.46                    | 3.35 | 4.37  | 6.83  | 9.83  | 13.39 | 17.48 | 22.13 | 27.32 | 33.06 | 39.34  | 46.17  | 11.5 |  |                            |
| 12                         | 8.33                           | 2.36                    | 3.21 | 4.19  | 6.55  | 9.42  | 12.81 | 16.76 | 21.21 | 26.18 | 31.68 | 37.70  | 44.24  | 12   |  |                            |
| 12.5                       | 8.00                           | 2.26                    | 3.08 | 4.02  | 6.28  | 9.05  | 12.32 | 16.08 | 20.36 | 25.13 | 30.41 | 36.19  | 42.47  | 12.5 |  |                            |
| 13                         | 7.69                           | 2.17                    | 2.96 | 3.87  | 6.04  | 8.70  | 11.84 | 15.47 | 19.57 | 24.17 | 29.24 | 34.80  | 40.84  | 13   |  |                            |
| 13.5                       | 7.41                           | 2.09                    | 2.85 | 3.72  | 5.82  | 8.38  | 11.40 | 14.89 | 18.85 | 23.27 | 28.16 | 33.51  | 39.33  | 13.5 |  |                            |
| 14                         | 7.14                           | 2.02                    | 2.75 | 3.59  | 5.61  | 8.08  | 11.00 | 14.36 | 18.18 | 22.44 | 27.15 | 32.31  | 37.92  | 14   |  |                            |
| 14.5                       | 6.90                           | 1.95                    | 2.65 | 3.47  | 5.42  | 7.80  | 10.62 | 13.87 | 17.55 | 21.67 | 26.22 | 31.20  | 36.62  | 14.5 |  |                            |
| 15                         | 6.67                           | 1.88                    | 2.57 | 3.35  | 5.24  | 7.54  | 10.26 | 13.40 | 16.96 | 20.94 | 25.34 | 30.16  | 35.40  | 15   |  |                            |
| 15.5                       | 6.45                           | 1.82                    | 2.48 | 3.24  | 5.07  | 7.30  | 9.93  | 12.97 | 16.42 | 20.27 | 24.52 | 29.19  | 34.25  | 15.5 |  |                            |
| 16                         | 6.25                           | 1.77                    | 2.41 | 3.14  | 4.91  | 7.07  | 9.62  | 12.57 | 15.90 | 19.64 | 23.76 | 28.27  | 33.18  | 16   |  |                            |
| 16.5                       | 6.06                           | 1.71                    | 2.33 | 3.05  | 4.76  | 6.85  | 9.33  | 12.19 | 15.42 | 19.04 | 23.04 | 27.42  | 32.18  | 16.5 |  |                            |
| 17                         | 5.88                           | 1.66                    | 2.26 | 2.96  | 4.62  | 6.65  | 9.06  | 11.83 | 14.97 | 18.48 | 22.36 | 26.61  | 31.23  | 17   |  |                            |
| 17.5                       | 5.71                           | 1.62                    | 2.20 | 2.87  | 4.49  | 6.46  | 8.80  | 11.49 | 14.54 | 17.95 | 21.72 | 25.85  | 30.34  | 17.5 |  |                            |
| 18                         | 5.56                           | 1.57                    | 2.14 | 2.79  | 4.36  | 6.28  | 8.55  | 11.17 | 14.14 | 17.45 | 21.12 | 25.13  | 29.50  | 18   |  |                            |
| 18.5                       | 5.41                           | 1.53                    | 2.08 | 2.72  | 4.25  | 6.11  | 8.32  | 10.87 | 13.76 | 16.98 | 20.55 | 24.45  | 28.70  | 18.5 |  |                            |
| 19                         | 5.26                           | 1.49                    | 2.03 | 2.65  | 4.13  | 5.95  | 8.10  | 10.58 | 13.39 | 16.53 | 20.01 | 23.81  | 27.94  | 19   |  |                            |
| 19.5                       | 5.13                           | 1.45                    | 1.97 | 2.58  | 4.03  | 5.80  | 7.89  | 10.31 | 13.05 | 16.11 | 19.49 | 23.20  | 27.23  | 19.5 |  |                            |
| 20                         | 5.00                           | 1.41                    | 1.92 | 2.51  | 3.93  | 5.65  | 7.70  | 10.05 | 12.72 | 15.71 | 19.01 | 22.62  | 26.55  | 20   |  |                            |
| 25                         | 4.00                           | 1.13                    | 1.54 | 2.01  | 3.14  | 4.52  | 6.16  | 8.04  | 10.18 | 12.57 | 15.21 | 18.10  | 21.24  | 25   |  |                            |
| 30                         | 3.33                           | 0.94                    | 1.28 | 1.68  | 2.62  | 3.77  | 5.13  | 6.70  | 8.48  | 10.47 | 12.67 | 15.08  | 17.70  | 30   |  |                            |

تمام ابعاد بر اساس استاندارد بتن ایران (مطابق با استاندارد)



(a)

قابهای مهار شده

(b)

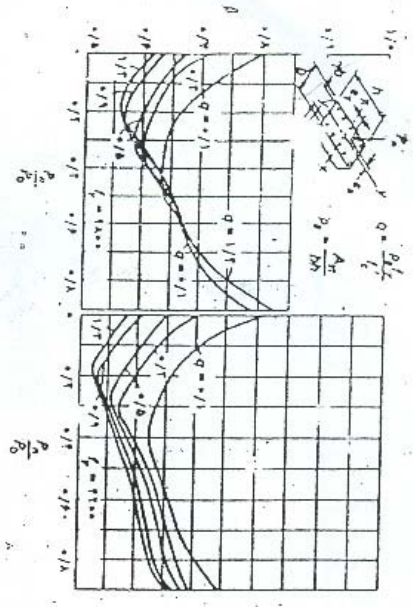
قابهای مهار نشده

$\psi$  = نسبت  $(\Sigma(E\epsilon))$  اعضای فشاری به  $(\Sigma(E\epsilon))$  اعضای خمشی در یک صفحه در یک انتهای یک منفر فشاری

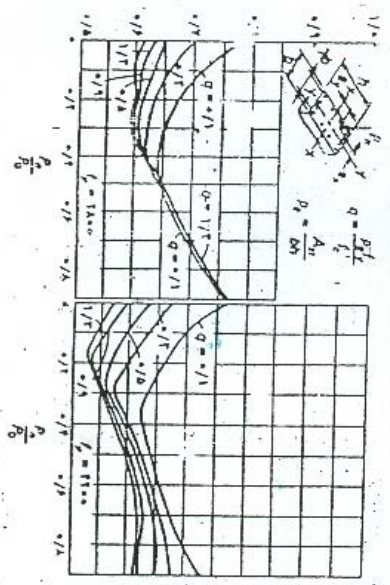
$k$  = ضریب طول مؤثر

شکل ۱۰-۱۱-۲- ضرایب طول مؤثر

آثار نیرو و طول برای مقاطع مستطیل در محورهای مختلف



شماره ۱۹-۲: با ۵ سطح در هر مرتبه از دور تا دورتر

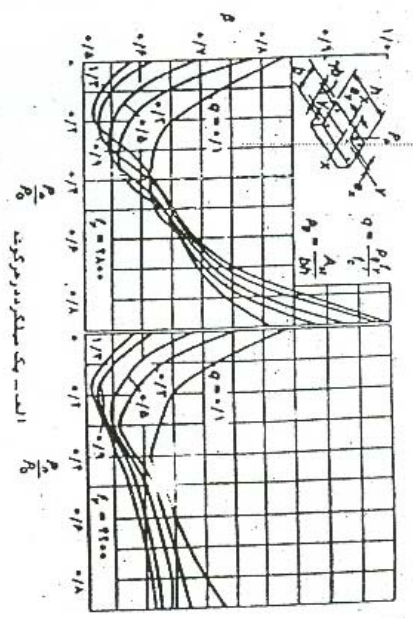


شماره ۱۹-۳: با ۵ سطح در هر مرتبه

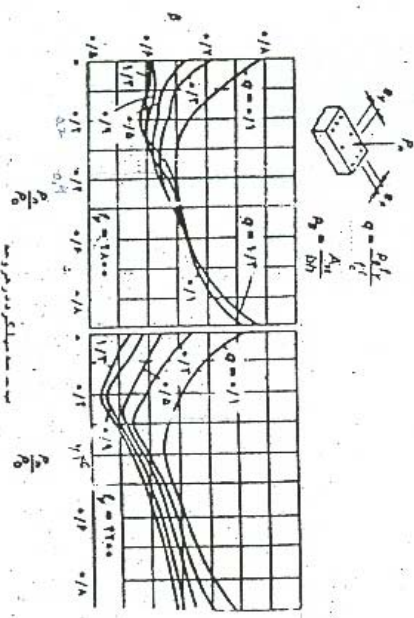
شماره ۱۹-۴: بار از میان برای طراحی ستونهای تحت فشار در محوری

توجه داشته است (این دیاگرام برای مقیاس دیر است)  $0.1 \leq q \leq 200$  تا  $0.1$  تا  $200$  کیلوگرم بر سانتیمتر مربع، و  $0.1 \leq b/h \leq 1$  تا  $1$  است

آثار نیرو و طول برای مقاطع مربعی در محوری



شماره ۱۹-۵: با ۵ سطح در هر مرتبه



شماره ۱۹-۶: با ۵ سطح در هر مرتبه

شماره ۱۹-۷: بار از میان برای طراحی ستونهای تحت فشار در محوری

توجه داشته است (این دیاگرام برای مقیاس دیر است)  $0.1 \leq q \leq 200$  تا  $0.1$  تا  $200$  کیلوگرم بر سانتیمتر مربع، و  $0.1 \leq b/h \leq 1$  تا  $1$  است