

**Table 4-22**  
**Available Critical Stress for**  
**Compression Members**

| $F_y = 35$ ksi |                   |                 | $F_y = 36$ ksi |                   |                 | $F_y = 42$ ksi |                   |                 | $F_y = 46$ ksi |                   |                 | $F_y = 50$ ksi |                   |                 |
|----------------|-------------------|-----------------|----------------|-------------------|-----------------|----------------|-------------------|-----------------|----------------|-------------------|-----------------|----------------|-------------------|-----------------|
| $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ |
|                | ksi               | ksi             |                | ksi               | ksi             |                | ksi               | ksi             |                | ksi               | ksi             |                | ksi               | ksi             |
|                | ASD               | LRFD            |                | ASD               | LRFD            |                | ASD               | LRFD            |                | ASD               | LRFD            |                | ASD               | LRFD            |
| 1              | 21.0              | 31.5            | 1              | 21.6              | 32.4            | 1              | 25.1              | 37.8            | 1              | 27.5              | 41.4            | 1              | 29.9              | 45.0            |
| 2              | 21.0              | 31.5            | 2              | 21.6              | 32.4            | 2              | 25.1              | 37.8            | 2              | 27.5              | 41.4            | 2              | 29.9              | 45.0            |
| 3              | 20.9              | 31.5            | 3              | 21.5              | 32.4            | 3              | 25.1              | 37.8            | 3              | 27.5              | 41.4            | 3              | 29.9              | 45.0            |
| 4              | 20.9              | 31.5            | 4              | 21.5              | 32.4            | 4              | 25.1              | 37.8            | 4              | 27.5              | 41.4            | 4              | 29.9              | 44.9            |
| 5              | 20.9              | 31.5            | 5              | 21.5              | 32.4            | 5              | 25.1              | 37.7            | 5              | 27.5              | 41.3            | 5              | 29.9              | 44.9            |
| 6              | 20.9              | 31.4            | 6              | 21.5              | 32.3            | 6              | 25.1              | 37.7            | 6              | 27.5              | 41.3            | 6              | 29.9              | 44.9            |
| 7              | 20.9              | 31.4            | 7              | 21.5              | 32.3            | 7              | 25.1              | 37.7            | 7              | 27.5              | 41.3            | 7              | 29.8              | 44.8            |
| 8              | 20.9              | 31.4            | 8              | 21.5              | 32.3            | 8              | 25.1              | 37.7            | 8              | 27.4              | 41.2            | 8              | 29.8              | 44.8            |
| 9              | 20.9              | 31.4            | 9              | 21.5              | 32.3            | 9              | 25.0              | 37.6            | 9              | 27.4              | 41.2            | 9              | 29.8              | 44.7            |
| 10             | 20.9              | 31.3            | 10             | 21.4              | 32.2            | 10             | 25.0              | 37.6            | 10             | 27.4              | 41.1            | 10             | 29.7              | 44.7            |
| 11             | 20.8              | 31.3            | 11             | 21.4              | 32.2            | 11             | 25.0              | 37.5            | 11             | 27.3              | 41.1            | 11             | 29.7              | 44.6            |
| 12             | 20.8              | 31.3            | 12             | 21.4              | 32.2            | 12             | 24.9              | 37.5            | 12             | 27.3              | 41.0            | 12             | 29.6              | 44.5            |
| 13             | 20.8              | 31.2            | 13             | 21.4              | 32.1            | 13             | 24.9              | 37.4            | 13             | 27.2              | 40.9            | 13             | 29.6              | 44.4            |
| 14             | 20.7              | 31.2            | 14             | 21.3              | 32.1            | 14             | 24.8              | 37.3            | 14             | 27.2              | 40.9            | 14             | 29.5              | 44.4            |
| 15             | 20.7              | 31.1            | 15             | 21.3              | 32.0            | 15             | 24.8              | 37.3            | 15             | 27.1              | 40.8            | 15             | 29.5              | 44.3            |
| 16             | 20.7              | 31.1            | 16             | 21.3              | 32.0            | 16             | 24.8              | 37.2            | 16             | 27.1              | 40.7            | 16             | 29.4              | 44.2            |
| 17             | 20.7              | 31.0            | 17             | 21.2              | 31.9            | 17             | 24.7              | 37.1            | 17             | 27.0              | 40.6            | 17             | 29.3              | 44.1            |
| 18             | 20.6              | 31.0            | 18             | 21.2              | 31.9            | 18             | 24.7              | 37.1            | 18             | 27.0              | 40.5            | 18             | 29.2              | 43.9            |
| 19             | 20.6              | 30.9            | 19             | 21.2              | 31.8            | 19             | 24.6              | 37.0            | 19             | 26.9              | 40.4            | 19             | 29.2              | 43.8            |
| 20             | 20.5              | 30.9            | 20             | 21.1              | 31.7            | 20             | 24.5              | 36.9            | 20             | 26.8              | 40.3            | 20             | 29.1              | 43.7            |
| 21             | 20.5              | 30.8            | 21             | 21.1              | 31.7            | 21             | 24.5              | 36.8            | 21             | 26.7              | 40.2            | 21             | 29.0              | 43.6            |
| 22             | 20.4              | 30.7            | 22             | 21.0              | 31.6            | 22             | 24.4              | 36.7            | 22             | 26.7              | 40.1            | 22             | 28.9              | 43.4            |
| 23             | 20.4              | 30.7            | 23             | 21.0              | 31.5            | 23             | 24.3              | 36.6            | 23             | 26.6              | 40.0            | 23             | 28.8              | 43.3            |
| 24             | 20.3              | 30.6            | 24             | 20.9              | 31.4            | 24             | 24.3              | 36.5            | 24             | 26.5              | 39.8            | 24             | 28.7              | 43.1            |
| 25             | 20.3              | 30.5            | 25             | 20.9              | 31.4            | 25             | 24.2              | 36.4            | 25             | 26.4              | 39.7            | 25             | 28.6              | 43.0            |
| 26             | 20.2              | 30.4            | 26             | 20.8              | 31.3            | 26             | 24.1              | 36.3            | 26             | 26.3              | 39.6            | 26             | 28.5              | 42.8            |
| 27             | 20.2              | 30.3            | 27             | 20.7              | 31.2            | 27             | 24.0              | 36.1            | 27             | 26.2              | 39.4            | 27             | 28.4              | 42.7            |
| 28             | 20.1              | 30.3            | 28             | 20.7              | 31.1            | 28             | 24.0              | 36.0            | 28             | 26.1              | 39.3            | 28             | 28.3              | 42.5            |
| 29             | 20.1              | 30.2            | 29             | 20.6              | 31.0            | 29             | 23.9              | 35.9            | 29             | 26.0              | 39.1            | 29             | 28.2              | 42.3            |
| 30             | 20.0              | 30.1            | 30             | 20.6              | 30.9            | 30             | 23.8              | 35.8            | 30             | 25.9              | 39.0            | 30             | 28.0              | 42.1            |
| 31             | 20.0              | 30.0            | 31             | 20.5              | 30.8            | 31             | 23.7              | 35.6            | 31             | 25.8              | 38.8            | 31             | 27.9              | 41.9            |
| 32             | 19.9              | 29.9            | 32             | 20.4              | 30.7            | 32             | 23.6              | 35.5            | 32             | 25.7              | 38.6            | 32             | 27.8              | 41.8            |
| 33             | 19.8              | 29.8            | 33             | 20.4              | 30.6            | 33             | 23.5              | 35.4            | 33             | 25.6              | 38.5            | 33             | 27.7              | 41.6            |
| 34             | 19.8              | 29.7            | 34             | 20.3              | 30.5            | 34             | 23.4              | 35.2            | 34             | 25.5              | 38.3            | 34             | 27.5              | 41.4            |
| 35             | 19.7              | 29.6            | 35             | 20.2              | 30.4            | 35             | 23.3              | 35.1            | 35             | 25.4              | 38.1            | 35             | 27.4              | 41.2            |
| 36             | 19.6              | 29.5            | 36             | 20.1              | 30.3            | 36             | 23.2              | 34.9            | 36             | 25.2              | 37.9            | 36             | 27.2              | 40.9            |
| 37             | 19.5              | 29.4            | 37             | 20.1              | 30.1            | 37             | 23.1              | 34.8            | 37             | 25.1              | 37.8            | 37             | 27.1              | 40.7            |
| 38             | 19.5              | 29.3            | 38             | 20.0              | 30.0            | 38             | 23.0              | 34.6            | 38             | 25.0              | 37.6            | 38             | 26.9              | 40.5            |
| 39             | 19.4              | 29.1            | 39             | 19.9              | 29.9            | 39             | 22.9              | 34.4            | 39             | 24.9              | 37.4            | 39             | 26.8              | 40.3            |
| 40             | 19.3              | 29.0            | 40             | 19.8              | 29.8            | 40             | 22.8              | 34.3            | 40             | 24.7              | 37.2            | 40             | 26.6              | 40.0            |

**ASD**
**LRFD**

$\Omega_c = 1.67$ 
 $\phi_c = 0.90$

**Table 4-22 (continued)**  
**Available Critical Stress for**  
**Compression Members**

| $F_y = 35$ ksi    |                   |                 | $F_y = 36$ ksi |                   |                 | $F_y = 42$ ksi |                   |                 | $F_y = 46$ ksi |                   |                 | $F_y = 50$ ksi |                   |                 |
|-------------------|-------------------|-----------------|----------------|-------------------|-----------------|----------------|-------------------|-----------------|----------------|-------------------|-----------------|----------------|-------------------|-----------------|
| $\frac{KL}{r}$    | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ |
|                   | ksi               | ksi             |                | ksi               | ksi             |                | ksi               | ksi             |                | ksi               | ksi             |                | ksi               | ksi             |
|                   | ASD               | LRFD            |                | ASD               | LRFD            |                | ASD               | LRFD            |                | ASD               | LRFD            |                | ASD               | LRFD            |
| 41                | 19.2              | 28.9            | 41             | 19.7              | 29.7            | 41             | 22.7              | 34.1            | 41             | 24.6              | 37.0            | 41             | 26.5              | 39.8            |
| 42                | 19.2              | 28.8            | 42             | 19.6              | 29.5            | 42             | 22.6              | 33.9            | 42             | 24.5              | 36.8            | 42             | 26.3              | 39.5            |
| 43                | 19.1              | 28.7            | 43             | 19.6              | 29.4            | 43             | 22.5              | 33.7            | 43             | 24.3              | 36.6            | 43             | 26.2              | 39.3            |
| 44                | 19.0              | 28.5            | 44             | 19.5              | 29.3            | 44             | 22.3              | 33.6            | 44             | 24.2              | 36.3            | 44             | 26.0              | 39.1            |
| 45                | 18.9              | 28.4            | 45             | 19.4              | 29.1            | 45             | 22.2              | 33.4            | 45             | 24.0              | 36.1            | 45             | 25.8              | 38.8            |
| 46                | 18.8              | 28.3            | 46             | 19.3              | 29.0            | 46             | 22.1              | 33.2            | 46             | 23.9              | 35.9            | 46             | 25.6              | 38.5            |
| 47                | 18.7              | 28.1            | 47             | 19.2              | 28.9            | 47             | 22.0              | 33.0            | 47             | 23.8              | 35.7            | 47             | 25.5              | 38.3            |
| 48                | 18.6              | 28.0            | 48             | 19.1              | 28.7            | 48             | 21.8              | 32.8            | 48             | 23.6              | 35.4            | 48             | 25.3              | 38.0            |
| 49                | 18.5              | 27.9            | 49             | 19.0              | 28.5            | 49             | 21.7              | 32.6            | 49             | 23.4              | 35.2            | 49             | 25.1              | 37.7            |
| 50                | 18.4              | 27.7            | 50             | 18.9              | 28.4            | 50             | 21.6              | 32.4            | 50             | 23.3              | 35.0            | 50             | 24.9              | 37.5            |
| 51                | 18.3              | 27.6            | 51             | 18.8              | 28.3            | 51             | 21.4              | 32.2            | 51             | 23.1              | 34.8            | 51             | 24.8              | 37.2            |
| 52                | 18.3              | 27.4            | 52             | 18.7              | 28.1            | 52             | 21.3              | 32.0            | 52             | 23.0              | 34.5            | 52             | 24.6              | 36.9            |
| 53                | 18.2              | 27.3            | 53             | 18.6              | 28.0            | 53             | 21.2              | 31.8            | 53             | 22.8              | 34.3            | 53             | 24.4              | 36.7            |
| 54                | 18.1              | 27.1            | 54             | 18.5              | 27.8            | 54             | 21.0              | 31.6            | 54             | 22.6              | 34.0            | 54             | 24.2              | 36.4            |
| 55                | 18.0              | 27.0            | 55             | 18.4              | 27.6            | 55             | 20.9              | 31.4            | 55             | 22.5              | 33.8            | 55             | 24.0              | 36.1            |
| 56                | 17.9              | 26.8            | 56             | 18.3              | 27.5            | 56             | 20.7              | 31.2            | 56             | 22.3              | 33.5            | 56             | 23.8              | 35.8            |
| 57                | 17.7              | 26.7            | 57             | 18.2              | 27.3            | 57             | 20.6              | 31.0            | 57             | 22.1              | 33.3            | 57             | 23.6              | 35.5            |
| 58                | 17.6              | 26.5            | 58             | 18.1              | 27.1            | 58             | 20.5              | 30.7            | 58             | 22.0              | 33.0            | 58             | 23.4              | 35.2            |
| 59                | 17.5              | 26.4            | 59             | 17.9              | 27.0            | 59             | 20.3              | 30.5            | 59             | 21.8              | 32.8            | 59             | 23.2              | 34.9            |
| 60                | 17.4              | 26.2            | 60             | 17.8              | 26.8            | 60             | 20.2              | 30.3            | 60             | 21.6              | 32.5            | 60             | 23.0              | 34.6            |
| 61                | 17.3              | 26.0            | 61             | 17.7              | 26.6            | 61             | 20.0              | 30.1            | 61             | 21.4              | 32.2            | 61             | 22.8              | 34.3            |
| 62                | 17.2              | 25.9            | 62             | 17.6              | 26.5            | 62             | 19.9              | 29.9            | 62             | 21.3              | 32.0            | 62             | 22.6              | 34.0            |
| 63                | 17.1              | 25.7            | 63             | 17.5              | 26.3            | 63             | 19.7              | 29.6            | 63             | 21.1              | 31.7            | 63             | 22.4              | 33.7            |
| 64                | 17.0              | 25.5            | 64             | 17.4              | 26.1            | 64             | 19.6              | 29.4            | 64             | 20.9              | 31.4            | 64             | 22.2              | 33.4            |
| 65                | 16.9              | 25.4            | 65             | 17.3              | 25.9            | 65             | 19.4              | 29.2            | 65             | 20.7              | 31.2            | 65             | 22.0              | 33.0            |
| 66                | 16.8              | 25.2            | 66             | 17.1              | 25.8            | 66             | 19.2              | 28.9            | 66             | 20.5              | 30.9            | 66             | 21.8              | 32.7            |
| 67                | 16.7              | 25.0            | 67             | 17.0              | 25.6            | 67             | 19.1              | 28.7            | 67             | 20.4              | 30.6            | 67             | 21.6              | 32.4            |
| 68                | 16.5              | 24.9            | 68             | 16.9              | 25.4            | 68             | 18.9              | 28.5            | 68             | 20.2              | 30.3            | 68             | 21.4              | 32.1            |
| 69                | 16.4              | 24.7            | 69             | 16.8              | 25.2            | 69             | 18.8              | 28.2            | 69             | 20.0              | 30.1            | 69             | 21.1              | 31.8            |
| 70                | 16.3              | 24.5            | 70             | 16.7              | 25.0            | 70             | 18.6              | 28.0            | 70             | 19.8              | 29.8            | 70             | 20.9              | 31.4            |
| 71                | 16.2              | 24.3            | 71             | 16.5              | 24.8            | 71             | 18.5              | 27.7            | 71             | 19.6              | 29.5            | 71             | 20.7              | 31.1            |
| 72                | 16.1              | 24.2            | 72             | 16.4              | 24.7            | 72             | 18.3              | 27.5            | 72             | 19.4              | 29.2            | 72             | 20.5              | 30.8            |
| 73                | 16.0              | 24.0            | 73             | 16.3              | 24.5            | 73             | 18.1              | 27.2            | 73             | 19.2              | 28.9            | 73             | 20.3              | 30.5            |
| 74                | 15.8              | 23.8            | 74             | 16.2              | 24.3            | 74             | 18.0              | 27.0            | 74             | 19.1              | 28.6            | 74             | 20.1              | 30.2            |
| 75                | 15.7              | 23.6            | 75             | 16.0              | 24.1            | 75             | 17.8              | 26.8            | 75             | 18.9              | 28.4            | 75             | 19.8              | 29.8            |
| 76                | 15.6              | 23.4            | 76             | 15.9              | 23.9            | 76             | 17.6              | 26.5            | 76             | 18.7              | 28.1            | 76             | 19.6              | 29.5            |
| 77                | 15.5              | 23.3            | 77             | 15.8              | 23.7            | 77             | 17.5              | 26.3            | 77             | 18.5              | 27.8            | 77             | 19.4              | 29.2            |
| 78                | 15.4              | 23.1            | 78             | 15.6              | 23.5            | 78             | 17.3              | 26.0            | 78             | 18.3              | 27.5            | 78             | 19.2              | 28.8            |
| 79                | 15.2              | 22.9            | 79             | 15.5              | 23.3            | 79             | 17.1              | 25.8            | 79             | 18.1              | 27.2            | 79             | 19.0              | 28.5            |
| 80                | 15.1              | 22.7            | 80             | 15.4              | 23.1            | 80             | 17.0              | 25.5            | 80             | 17.9              | 26.9            | 80             | 18.8              | 28.2            |
| <b>ASD</b>        |                   | <b>LRFD</b>     |                |                   |                 |                |                   |                 |                |                   |                 |                |                   |                 |
| $\Omega_c = 1.67$ |                   | $\phi_c = 0.90$ |                |                   |                 |                |                   |                 |                |                   |                 |                |                   |                 |

**Table 4-22 (continued)**  
**Available Critical Stress for**  
**Compression Members**

| $F_y = 35$ ksi    |                   |                 | $F_y = 36$ ksi |                   |                 | $F_y = 42$ ksi |                   |                 | $F_y = 46$ ksi |                   |                 | $F_y = 50$ ksi |                   |                 |
|-------------------|-------------------|-----------------|----------------|-------------------|-----------------|----------------|-------------------|-----------------|----------------|-------------------|-----------------|----------------|-------------------|-----------------|
| $\frac{KL}{r}$    | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ |
|                   | ksi               | ksi             |                | ksi               | ksi             |                | ksi               | ksi             |                | ksi               | ksi             |                | ksi               | ksi             |
|                   | ASD               | LRFD            |                | ASD               | LRFD            |                | ASD               | LRFD            |                | ASD               | LRFD            |                | ASD               | LRFD            |
| 81                | 15.0              | 22.5            | 81             | 15.3              | 22.9            | 81             | 16.8              | 25.3            | 81             | 17.7              | 26.6            | 81             | 18.5              | 27.9            |
| 82                | 14.9              | 22.3            | 82             | 15.1              | 22.7            | 82             | 16.6              | 25.0            | 82             | 17.5              | 26.3            | 82             | 18.3              | 27.5            |
| 83                | 14.7              | 22.1            | 83             | 15.0              | 22.5            | 83             | 16.5              | 24.8            | 83             | 17.3              | 26.0            | 83             | 18.1              | 27.2            |
| 84                | 14.6              | 22.0            | 84             | 14.9              | 22.3            | 84             | 16.3              | 24.5            | 84             | 17.1              | 25.8            | 84             | 17.9              | 26.9            |
| 85                | 14.5              | 21.8            | 85             | 14.7              | 22.1            | 85             | 16.1              | 24.3            | 85             | 16.9              | 25.5            | 85             | 17.7              | 26.5            |
| 86                | 14.4              | 21.6            | 86             | 14.6              | 22.0            | 86             | 16.0              | 24.0            | 86             | 16.7              | 25.2            | 86             | 17.4              | 26.2            |
| 87                | 14.2              | 21.4            | 87             | 14.5              | 21.8            | 87             | 15.8              | 23.7            | 87             | 16.6              | 24.9            | 87             | 17.2              | 25.9            |
| 88                | 14.1              | 21.2            | 88             | 14.3              | 21.6            | 88             | 15.6              | 23.5            | 88             | 16.4              | 24.6            | 88             | 17.0              | 25.5            |
| 89                | 14.0              | 21.0            | 89             | 14.2              | 21.4            | 89             | 15.5              | 23.2            | 89             | 16.2              | 24.3            | 89             | 16.8              | 25.2            |
| 90                | 13.8              | 20.8            | 90             | 14.1              | 21.2            | 90             | 15.3              | 23.0            | 90             | 16.0              | 24.0            | 90             | 16.6              | 24.9            |
| 91                | 13.7              | 20.6            | 91             | 13.9              | 21.0            | 91             | 15.1              | 22.7            | 91             | 15.8              | 23.7            | 91             | 16.3              | 24.6            |
| 92                | 13.6              | 20.4            | 92             | 13.8              | 20.8            | 92             | 15.0              | 22.5            | 92             | 15.6              | 23.4            | 92             | 16.1              | 24.2            |
| 93                | 13.5              | 20.2            | 93             | 13.7              | 20.5            | 93             | 14.8              | 22.2            | 93             | 15.4              | 23.1            | 93             | 15.9              | 23.9            |
| 94                | 13.3              | 20.0            | 94             | 13.5              | 20.3            | 94             | 14.6              | 22.0            | 94             | 15.2              | 22.8            | 94             | 15.7              | 23.6            |
| 95                | 13.2              | 19.9            | 95             | 13.4              | 20.1            | 95             | 14.4              | 21.7            | 95             | 15.0              | 22.6            | 95             | 15.5              | 23.3            |
| 96                | 13.1              | 19.7            | 96             | 13.3              | 19.9            | 96             | 14.3              | 21.5            | 96             | 14.8              | 22.3            | 96             | 15.3              | 22.9            |
| 97                | 13.0              | 19.5            | 97             | 13.1              | 19.7            | 97             | 14.1              | 21.2            | 97             | 14.6              | 22.0            | 97             | 15.0              | 22.6            |
| 98                | 12.8              | 19.3            | 98             | 13.0              | 19.5            | 98             | 13.9              | 21.0            | 98             | 14.4              | 21.7            | 98             | 14.8              | 22.3            |
| 99                | 12.7              | 19.1            | 99             | 12.9              | 19.3            | 99             | 13.8              | 20.7            | 99             | 14.2              | 21.4            | 99             | 14.6              | 22.0            |
| 100               | 12.6              | 18.9            | 100            | 12.7              | 19.1            | 100            | 13.6              | 20.5            | 100            | 14.1              | 21.1            | 100            | 14.4              | 21.7            |
| 101               | 12.4              | 18.7            | 101            | 12.6              | 18.9            | 101            | 13.4              | 20.2            | 101            | 13.9              | 20.8            | 101            | 14.2              | 21.3            |
| 102               | 12.3              | 18.5            | 102            | 12.5              | 18.7            | 102            | 13.3              | 20.0            | 102            | 13.7              | 20.6            | 102            | 14.0              | 21.0            |
| 103               | 12.2              | 18.3            | 103            | 12.3              | 18.5            | 103            | 13.1              | 19.7            | 103            | 13.5              | 20.3            | 103            | 13.8              | 20.7            |
| 104               | 12.1              | 18.1            | 104            | 12.2              | 18.3            | 104            | 12.9              | 19.5            | 104            | 13.3              | 20.0            | 104            | 13.6              | 20.4            |
| 105               | 11.9              | 17.9            | 105            | 12.1              | 18.1            | 105            | 12.8              | 19.2            | 105            | 13.1              | 19.7            | 105            | 13.4              | 20.1            |
| 106               | 11.8              | 17.7            | 106            | 11.9              | 17.9            | 106            | 12.6              | 19.0            | 106            | 12.9              | 19.4            | 106            | 13.2              | 19.8            |
| 107               | 11.7              | 17.5            | 107            | 11.8              | 17.7            | 107            | 12.4              | 18.7            | 107            | 12.8              | 19.2            | 107            | 13.0              | 19.5            |
| 108               | 11.5              | 17.3            | 108            | 11.7              | 17.5            | 108            | 12.3              | 18.5            | 108            | 12.6              | 18.9            | 108            | 12.8              | 19.2            |
| 109               | 11.4              | 17.2            | 109            | 11.5              | 17.3            | 109            | 12.1              | 18.2            | 109            | 12.4              | 18.6            | 109            | 12.6              | 18.9            |
| 110               | 11.3              | 17.0            | 110            | 11.4              | 17.1            | 110            | 12.0              | 18.0            | 110            | 12.2              | 18.3            | 110            | 12.4              | 18.6            |
| 111               | 11.2              | 16.8            | 111            | 11.3              | 16.9            | 111            | 11.8              | 17.7            | 111            | 12.0              | 18.1            | 111            | 12.2              | 18.3            |
| 112               | 11.0              | 16.6            | 112            | 11.1              | 16.7            | 112            | 11.6              | 17.5            | 112            | 11.8              | 17.8            | 112            | 12.0              | 18.0            |
| 113               | 10.9              | 16.4            | 113            | 11.0              | 16.5            | 113            | 11.5              | 17.3            | 113            | 11.7              | 17.5            | 113            | 11.8              | 17.7            |
| 114               | 10.8              | 16.2            | 114            | 10.9              | 16.3            | 114            | 11.3              | 17.0            | 114            | 11.5              | 17.3            | 114            | 11.6              | 17.4            |
| 115               | 10.7              | 16.0            | 115            | 10.7              | 16.2            | 115            | 11.2              | 16.8            | 115            | 11.3              | 17.0            | 115            | 11.4              | 17.1            |
| 116               | 10.5              | 15.8            | 116            | 10.6              | 16.0            | 116            | 11.0              | 16.5            | 116            | 11.1              | 16.7            | 116            | 11.2              | 16.8            |
| 117               | 10.4              | 15.6            | 117            | 10.5              | 15.8            | 117            | 10.8              | 16.3            | 117            | 11.0              | 16.5            | 117            | 11.0              | 16.5            |
| 118               | 10.3              | 15.5            | 118            | 10.4              | 15.6            | 118            | 10.7              | 16.1            | 118            | 10.8              | 16.2            | 118            | 10.8              | 16.2            |
| 119               | 10.2              | 15.3            | 119            | 10.2              | 15.4            | 119            | 10.5              | 15.8            | 119            | 10.6              | 16.0            | 119            | 10.6              | 16.0            |
| 120               | 10.0              | 15.1            | 120            | 10.1              | 15.2            | 120            | 10.4              | 15.6            | 120            | 10.4              | 15.7            | 120            | 10.4              | 15.7            |
| <b>ASD</b>        |                   | <b>LRFD</b>     |                |                   |                 |                |                   |                 |                |                   |                 |                |                   |                 |
| $\Omega_c = 1.67$ |                   | $\phi_c = 0.90$ |                |                   |                 |                |                   |                 |                |                   |                 |                |                   |                 |

**Table 4-22 (continued)**  
**Available Critical Stress for**  
**Compression Members**

| $F_y = 35$ ksi    |                   |                 | $F_y = 36$ ksi |                   |                 | $F_y = 42$ ksi |                   |                 | $F_y = 46$ ksi |                   |                 | $F_y = 50$ ksi |                   |                 |
|-------------------|-------------------|-----------------|----------------|-------------------|-----------------|----------------|-------------------|-----------------|----------------|-------------------|-----------------|----------------|-------------------|-----------------|
| $\frac{KL}{r}$    | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ |
|                   | ksi               | ksi             |                | ksi               | ksi             |                | ksi               | ksi             |                | ksi               | ksi             |                | ksi               | ksi             |
|                   | ASD               | LRFD            |                | ASD               | LRFD            |                | ASD               | LRFD            |                | ASD               | LRFD            |                | ASD               | LRFD            |
| 121               | 9.91              | 14.9            | 121            | 10.0              | 15.0            | 121            | 10.2              | 15.4            | 121            | 10.3              | 15.4            | 121            | 10.3              | 15.4            |
| 122               | 9.79              | 14.7            | 122            | 9.85              | 14.8            | 122            | 10.1              | 15.2            | 122            | 10.1              | 15.2            | 122            | 10.1              | 15.2            |
| 123               | 9.67              | 14.5            | 123            | 9.72              | 14.6            | 123            | 9.93              | 14.9            | 123            | 9.94              | 14.9            | 123            | 9.94              | 14.9            |
| 124               | 9.55              | 14.3            | 124            | 9.59              | 14.4            | 124            | 9.78              | 14.7            | 124            | 9.78              | 14.7            | 124            | 9.78              | 14.7            |
| 125               | 9.43              | 14.2            | 125            | 9.47              | 14.2            | 125            | 9.62              | 14.5            | 125            | 9.62              | 14.5            | 125            | 9.62              | 14.5            |
| 126               | 9.31              | 14.0            | 126            | 9.35              | 14.0            | 126            | 9.47              | 14.2            | 126            | 9.47              | 14.2            | 126            | 9.47              | 14.2            |
| 127               | 9.19              | 13.8            | 127            | 9.22              | 13.9            | 127            | 9.32              | 14.0            | 127            | 9.32              | 14.0            | 127            | 9.32              | 14.0            |
| 128               | 9.07              | 13.6            | 128            | 9.10              | 13.7            | 128            | 9.17              | 13.8            | 128            | 9.17              | 13.8            | 128            | 9.17              | 13.8            |
| 129               | 8.95              | 13.4            | 129            | 8.98              | 13.5            | 129            | 9.03              | 13.6            | 129            | 9.03              | 13.6            | 129            | 9.03              | 13.6            |
| 130               | 8.83              | 13.3            | 130            | 8.86              | 13.3            | 130            | 8.89              | 13.4            | 130            | 8.89              | 13.4            | 130            | 8.89              | 13.4            |
| 131               | 8.71              | 13.1            | 131            | 8.73              | 13.1            | 131            | 8.76              | 13.2            | 131            | 8.76              | 13.2            | 131            | 8.76              | 13.2            |
| 132               | 8.60              | 12.9            | 132            | 8.61              | 12.9            | 132            | 8.63              | 13.0            | 132            | 8.63              | 13.0            | 132            | 8.63              | 13.0            |
| 133               | 8.48              | 12.7            | 133            | 8.49              | 12.8            | 133            | 8.50              | 12.8            | 133            | 8.50              | 12.8            | 133            | 8.50              | 12.8            |
| 134               | 8.37              | 12.6            | 134            | 8.37              | 12.6            | 134            | 8.37              | 12.6            | 134            | 8.37              | 12.6            | 134            | 8.37              | 12.6            |
| 135               | 8.25              | 12.4            | 135            | 8.25              | 12.4            | 135            | 8.25              | 12.4            | 135            | 8.25              | 12.4            | 135            | 8.25              | 12.4            |
| 136               | 8.13              | 12.2            | 136            | 8.13              | 12.2            | 136            | 8.13              | 12.2            | 136            | 8.13              | 12.2            | 136            | 8.13              | 12.2            |
| 137               | 8.01              | 12.0            | 137            | 8.01              | 12.0            | 137            | 8.01              | 12.0            | 137            | 8.01              | 12.0            | 137            | 8.01              | 12.0            |
| 138               | 7.89              | 11.9            | 138            | 7.89              | 11.9            | 138            | 7.89              | 11.9            | 138            | 7.89              | 11.9            | 138            | 7.89              | 11.9            |
| 139               | 7.78              | 11.7            | 139            | 7.78              | 11.7            | 139            | 7.78              | 11.7            | 139            | 7.78              | 11.7            | 139            | 7.78              | 11.7            |
| 140               | 7.67              | 11.5            | 140            | 7.67              | 11.5            | 140            | 7.67              | 11.5            | 140            | 7.67              | 11.5            | 140            | 7.67              | 11.5            |
| 141               | 7.56              | 11.4            | 141            | 7.56              | 11.4            | 141            | 7.56              | 11.4            | 141            | 7.56              | 11.4            | 141            | 7.56              | 11.4            |
| 142               | 7.45              | 11.2            | 142            | 7.45              | 11.2            | 142            | 7.45              | 11.2            | 142            | 7.45              | 11.2            | 142            | 7.45              | 11.2            |
| 143               | 7.35              | 11.0            | 143            | 7.35              | 11.0            | 143            | 7.35              | 11.0            | 143            | 7.35              | 11.0            | 143            | 7.35              | 11.0            |
| 144               | 7.25              | 10.9            | 144            | 7.25              | 10.9            | 144            | 7.25              | 10.9            | 144            | 7.25              | 10.9            | 144            | 7.25              | 10.9            |
| 145               | 7.15              | 10.7            | 145            | 7.15              | 10.7            | 145            | 7.15              | 10.7            | 145            | 7.15              | 10.7            | 145            | 7.15              | 10.7            |
| 146               | 7.05              | 10.6            | 146            | 7.05              | 10.6            | 146            | 7.05              | 10.6            | 146            | 7.05              | 10.6            | 146            | 7.05              | 10.6            |
| 147               | 6.96              | 10.5            | 147            | 6.96              | 10.5            | 147            | 6.96              | 10.5            | 147            | 6.96              | 10.5            | 147            | 6.96              | 10.5            |
| 148               | 6.86              | 10.3            | 148            | 6.86              | 10.3            | 148            | 6.86              | 10.3            | 148            | 6.86              | 10.3            | 148            | 6.86              | 10.3            |
| 149               | 6.77              | 10.2            | 149            | 6.77              | 10.2            | 149            | 6.77              | 10.2            | 149            | 6.77              | 10.2            | 149            | 6.77              | 10.2            |
| 150               | 6.68              | 10.0            | 150            | 6.68              | 10.0            | 150            | 6.68              | 10.0            | 150            | 6.68              | 10.0            | 150            | 6.68              | 10.0            |
| 151               | 6.59              | 9.91            | 151            | 6.59              | 9.91            | 151            | 6.59              | 9.91            | 151            | 6.59              | 9.91            | 151            | 6.59              | 9.91            |
| 152               | 6.51              | 9.78            | 152            | 6.51              | 9.78            | 152            | 6.51              | 9.78            | 152            | 6.51              | 9.78            | 152            | 6.51              | 9.78            |
| 153               | 6.42              | 9.65            | 153            | 6.42              | 9.65            | 153            | 6.42              | 9.65            | 153            | 6.42              | 9.65            | 153            | 6.42              | 9.65            |
| 154               | 6.34              | 9.53            | 154            | 6.34              | 9.53            | 154            | 6.34              | 9.53            | 154            | 6.34              | 9.53            | 154            | 6.34              | 9.53            |
| 155               | 6.26              | 9.40            | 155            | 6.26              | 9.40            | 155            | 6.26              | 9.40            | 155            | 6.26              | 9.40            | 155            | 6.26              | 9.40            |
| 156               | 6.18              | 9.28            | 156            | 6.18              | 9.28            | 156            | 6.18              | 9.28            | 156            | 6.18              | 9.28            | 156            | 6.18              | 9.28            |
| 157               | 6.10              | 9.17            | 157            | 6.10              | 9.17            | 157            | 6.10              | 9.17            | 157            | 6.10              | 9.17            | 157            | 6.10              | 9.17            |
| 158               | 6.02              | 9.05            | 158            | 6.02              | 9.05            | 158            | 6.02              | 9.05            | 158            | 6.02              | 9.05            | 158            | 6.02              | 9.05            |
| 159               | 5.95              | 8.94            | 159            | 5.95              | 8.94            | 159            | 5.95              | 8.94            | 159            | 5.95              | 8.94            | 159            | 5.95              | 8.94            |
| 160               | 5.87              | 8.82            | 160            | 5.87              | 8.82            | 160            | 5.87              | 8.82            | 160            | 5.87              | 8.82            | 160            | 5.87              | 8.82            |
| <b>ASD</b>        |                   | <b>LRFD</b>     |                |                   |                 |                |                   |                 |                |                   |                 |                |                   |                 |
| $\Omega_c = 1.67$ |                   | $\phi_c = 0.90$ |                |                   |                 |                |                   |                 |                |                   |                 |                |                   |                 |

**Table 4-22 (continued)**  
**Available Critical Stress for**  
**Compression Members**

| $F_y = 35$ ksi    |                   |                 | $F_y = 36$ ksi |                   |                 | $F_y = 42$ ksi |                   |                 | $F_y = 46$ ksi |                   |                 | $F_y = 50$ ksi |                   |                 |
|-------------------|-------------------|-----------------|----------------|-------------------|-----------------|----------------|-------------------|-----------------|----------------|-------------------|-----------------|----------------|-------------------|-----------------|
| $\frac{KL}{r}$    | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ | $\frac{KL}{r}$ | $F_{cr}/\Omega_c$ | $\phi_c F_{cr}$ |
|                   | ksi               | ksi             |                | ksi               | ksi             |                | ksi               | ksi             |                | ksi               | ksi             |                | ksi               | ksi             |
|                   | ASD               | LRFD            |                | ASD               | LRFD            |                | ASD               | LRFD            |                | ASD               | LRFD            |                | ASD               | LRFD            |
| 161               | 5.80              | 8.72            | 161            | 5.80              | 8.72            | 161            | 5.80              | 8.72            | 161            | 5.80              | 8.72            | 161            | 5.80              | 8.72            |
| 162               | 5.73              | 8.61            | 162            | 5.73              | 8.61            | 162            | 5.73              | 8.61            | 162            | 5.73              | 8.61            | 162            | 5.73              | 8.61            |
| 163               | 5.66              | 8.50            | 163            | 5.66              | 8.50            | 163            | 5.66              | 8.50            | 163            | 5.66              | 8.50            | 163            | 5.66              | 8.50            |
| 164               | 5.59              | 8.40            | 164            | 5.59              | 8.40            | 164            | 5.59              | 8.40            | 164            | 5.59              | 8.40            | 164            | 5.59              | 8.40            |
| 165               | 5.52              | 8.30            | 165            | 5.52              | 8.30            | 165            | 5.52              | 8.30            | 165            | 5.52              | 8.30            | 165            | 5.52              | 8.30            |
| 166               | 5.45              | 8.20            | 166            | 5.45              | 8.20            | 166            | 5.45              | 8.20            | 166            | 5.45              | 8.20            | 166            | 5.45              | 8.20            |
| 167               | 5.39              | 8.10            | 167            | 5.39              | 8.10            | 167            | 5.39              | 8.10            | 167            | 5.39              | 8.10            | 167            | 5.39              | 8.10            |
| 168               | 5.33              | 8.00            | 168            | 5.33              | 8.00            | 168            | 5.33              | 8.00            | 168            | 5.33              | 8.00            | 168            | 5.33              | 8.00            |
| 169               | 5.25              | 7.89            | 169            | 5.25              | 7.89            | 169            | 5.25              | 7.89            | 169            | 5.25              | 7.89            | 169            | 5.25              | 7.89            |
| 170               | 5.20              | 7.82            | 170            | 5.20              | 7.82            | 170            | 5.20              | 7.82            | 170            | 5.20              | 7.82            | 170            | 5.20              | 7.82            |
| 171               | 5.14              | 7.73            | 171            | 5.14              | 7.73            | 171            | 5.14              | 7.73            | 171            | 5.14              | 7.73            | 171            | 5.14              | 7.73            |
| 172               | 5.08              | 7.64            | 172            | 5.08              | 7.64            | 172            | 5.08              | 7.64            | 172            | 5.08              | 7.64            | 172            | 5.08              | 7.64            |
| 173               | 5.02              | 7.55            | 173            | 5.02              | 7.55            | 173            | 5.02              | 7.55            | 173            | 5.02              | 7.55            | 173            | 5.02              | 7.55            |
| 174               | 4.96              | 7.46            | 174            | 4.96              | 7.46            | 174            | 4.96              | 7.46            | 174            | 4.96              | 7.46            | 174            | 4.96              | 7.46            |
| 175               | 4.91              | 7.38            | 175            | 4.91              | 7.38            | 175            | 4.91              | 7.38            | 175            | 4.91              | 7.38            | 175            | 4.91              | 7.38            |
| 176               | 4.85              | 7.29            | 176            | 4.85              | 7.29            | 176            | 4.85              | 7.29            | 176            | 4.85              | 7.29            | 176            | 4.85              | 7.29            |
| 177               | 4.80              | 7.21            | 177            | 4.80              | 7.21            | 177            | 4.80              | 7.21            | 177            | 4.80              | 7.21            | 177            | 4.80              | 7.21            |
| 178               | 4.74              | 7.13            | 178            | 4.74              | 7.13            | 178            | 4.74              | 7.13            | 178            | 4.74              | 7.13            | 178            | 4.74              | 7.13            |
| 179               | 4.69              | 7.05            | 179            | 4.69              | 7.05            | 179            | 4.69              | 7.05            | 179            | 4.69              | 7.05            | 179            | 4.69              | 7.05            |
| 180               | 4.64              | 6.97            | 180            | 4.64              | 6.97            | 180            | 4.64              | 6.97            | 180            | 4.64              | 6.97            | 180            | 4.64              | 6.97            |
| 181               | 4.59              | 6.90            | 181            | 4.59              | 6.90            | 181            | 4.59              | 6.90            | 181            | 4.59              | 6.90            | 181            | 4.59              | 6.90            |
| 182               | 4.54              | 6.82            | 182            | 4.54              | 6.82            | 182            | 4.54              | 6.82            | 182            | 4.54              | 6.82            | 182            | 4.54              | 6.82            |
| 183               | 4.49              | 6.75            | 183            | 4.49              | 6.75            | 183            | 4.49              | 6.75            | 183            | 4.49              | 6.75            | 183            | 4.49              | 6.75            |
| 184               | 4.44              | 6.67            | 184            | 4.44              | 6.67            | 184            | 4.44              | 6.67            | 184            | 4.44              | 6.67            | 184            | 4.44              | 6.67            |
| 185               | 4.39              | 6.60            | 185            | 4.39              | 6.60            | 185            | 4.39              | 6.60            | 185            | 4.39              | 6.60            | 185            | 4.39              | 6.60            |
| 186               | 4.34              | 6.53            | 186            | 4.34              | 6.53            | 186            | 4.34              | 6.53            | 186            | 4.34              | 6.53            | 186            | 4.34              | 6.53            |
| 187               | 4.30              | 6.46            | 187            | 4.30              | 6.46            | 187            | 4.30              | 6.46            | 187            | 4.30              | 6.46            | 187            | 4.30              | 6.46            |
| 188               | 4.25              | 6.39            | 188            | 4.25              | 6.39            | 188            | 4.25              | 6.39            | 188            | 4.25              | 6.39            | 188            | 4.25              | 6.39            |
| 189               | 4.21              | 6.32            | 189            | 4.21              | 6.32            | 189            | 4.21              | 6.32            | 189            | 4.21              | 6.32            | 189            | 4.21              | 6.32            |
| 190               | 4.16              | 6.26            | 190            | 4.16              | 6.26            | 190            | 4.16              | 6.26            | 190            | 4.16              | 6.26            | 190            | 4.16              | 6.26            |
| 191               | 4.12              | 6.19            | 191            | 4.12              | 6.19            | 191            | 4.12              | 6.19            | 191            | 4.12              | 6.19            | 191            | 4.12              | 6.19            |
| 192               | 4.08              | 6.13            | 192            | 4.08              | 6.13            | 192            | 4.08              | 6.13            | 192            | 4.08              | 6.13            | 192            | 4.08              | 6.13            |
| 193               | 4.04              | 6.06            | 193            | 4.04              | 6.06            | 193            | 4.04              | 6.06            | 193            | 4.04              | 6.06            | 193            | 4.04              | 6.06            |
| 194               | 3.99              | 6.00            | 194            | 3.99              | 6.00            | 194            | 3.99              | 6.00            | 194            | 3.99              | 6.00            | 194            | 3.99              | 6.00            |
| 195               | 3.95              | 5.94            | 195            | 3.95              | 5.94            | 195            | 3.95              | 5.94            | 195            | 3.95              | 5.94            | 195            | 3.95              | 5.94            |
| 196               | 3.91              | 5.88            | 196            | 3.91              | 5.88            | 196            | 3.91              | 5.88            | 196            | 3.91              | 5.88            | 196            | 3.91              | 5.88            |
| 197               | 3.87              | 5.82            | 197            | 3.87              | 5.82            | 197            | 3.87              | 5.82            | 197            | 3.87              | 5.82            | 197            | 3.87              | 5.82            |
| 198               | 3.83              | 5.76            | 198            | 3.83              | 5.76            | 198            | 3.83              | 5.76            | 198            | 3.83              | 5.76            | 198            | 3.83              | 5.76            |
| 199               | 3.80              | 5.70            | 199            | 3.80              | 5.70            | 199            | 3.80              | 5.70            | 199            | 3.80              | 5.70            | 199            | 3.80              | 5.70            |
| 200               | 3.76              | 5.65            | 200            | 3.76              | 5.65            | 200            | 3.76              | 5.65            | 200            | 3.76              | 5.65            | 200            | 3.76              | 5.65            |
| <b>ASD</b>        |                   | <b>LRFD</b>     |                |                   |                 |                |                   |                 |                |                   |                 |                |                   |                 |
| $\Omega_c = 1.67$ |                   | $\phi_c = 0.90$ |                |                   |                 |                |                   |                 |                |                   |                 |                |                   |                 |