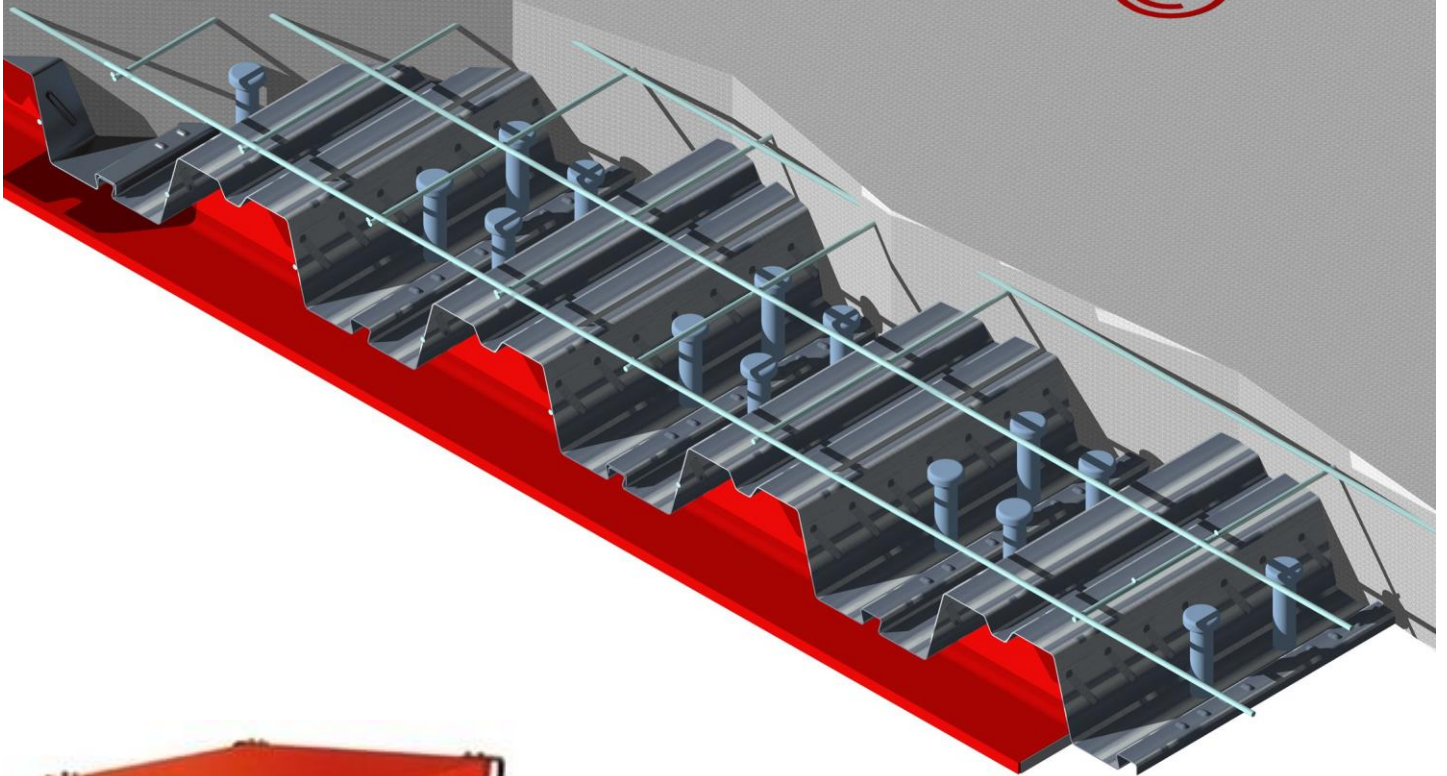


# ***Stud Welding applications***

## *Concrete Connections*

**NELSON**  
STUD WELDING



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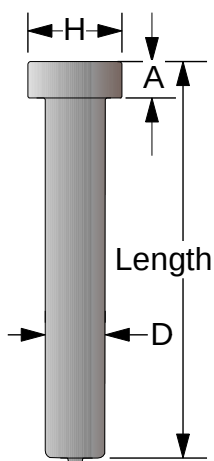
*Email: [ian@nelsonstud.co.nz](mailto:ian@nelsonstud.co.nz)*

# The Nelson System Product and embedment data

## ▣ Headed anchors

### Stock sizes

| H4L | B<br>Stud Dia | L<br>Length | A              | H     | Part No     |
|-----|---------------|-------------|----------------|-------|-------------|
| S3L | 6.35 H4L      | 68          | 4.75           | 12.70 | 101-053-031 |
|     | 6.35 H4L      | 104         |                |       | 101-053-033 |
|     | 9.5H4L        | 104         | 71.37          | 19.05 | 101-053-043 |
|     | 9.5H4L        | 68          |                |       | 101-053-045 |
|     | 12.7 H4L      | 54          | 71.37          | 25.40 | 101-053-047 |
|     | 12.7 H4L      | 79          |                |       | 101-053-002 |
|     | 12.7 H4L      | 104         |                |       | 101-053-003 |
|     | 12.7 H4L      | 134         |                |       | 101-053-005 |
|     | 12.7 H4L      | 154         |                |       | 101-053-008 |
|     | 12.7 H4L      | 205         |                |       | 101-053-010 |
|     | 15.88 H4L     | 68          | 71.37          | 31.75 | 101-053-012 |
|     | 15.88 H4L     | 106         |                |       | 101-053-015 |
|     | 15.88 H4L     | 165         |                |       | 101-053-019 |
|     | 15.88 H4L     | 206         |                |       | 101-053-023 |
|     | 19.05 S3L     | 80          | 9.53<br>(min.) | 31.75 | 101-098-003 |
|     | 19.05 S3L     | 85          |                |       | 101-098-132 |
|     | 19.05 S3L     | 87          |                |       | 101-098-127 |
|     | 19.05 S3L     | 106         |                |       | 101-098-007 |
|     | 19.05 S3L     | 123         |                |       | 101-098-131 |
|     | 19.05 S3L     | 131         |                |       | 101-098-011 |
|     | 19.05 S3L     | 135         |                |       | 101-098-143 |
|     | 19.05 S3L     | 148         |                |       | 101-098-138 |
|     | 19.05 S3L     | 156         |                |       | 101-098-015 |
|     | 19.05 S3L     | 181         |                |       | 101-098-019 |
|     | 19.05 S3L     | 206         |                |       | 101-098-023 |
|     | 22.23 S3L     | 93          | 9.53<br>(min.) | 34.93 | 101-098-029 |
|     | 22.23 S3L     | 106         |                |       | 101-098-031 |
|     | 22.23 S3L     | 131         |                |       | 101-098-035 |
|     | 22.23 S3L     | 156         |                |       | 101-098-039 |
|     | 22.23 S3L     | 181         |                |       | 101-098-043 |
|     | 22.23 S3L     | 206         |                |       | 101-098-047 |



### ▣ Tension capacity

The following data is presented as guidelines only and are based on embedded studs and adequate spacing for full capacity development. Appropriate safety factors should be applied based on actual use. For further information consult Nelson Design Data 10

### ▣ Shear capacity

Headed anchors embedded in concrete with an embedment length more than four times their diameter are capable of developing full shear capacity. Spacing is not as sensitive in shear as in tension. Spacing four times diameter between studs in a plane perpendicular to the shear force and six times diameter in the direction of the shear force is generally adequate to develop full stud capacity. Free edges in the direction of the shear force and some spacing restrictions along a free edge apply. Consult Nelson Design Data 10, and use proper safety factors and edge reinforcement. An upper bound limit for headed studs is approached at 0.9 AsFs when concrete strength exceeds 35 Mpa

Headed studs used as inserts have different values than those employed in composite design. For shear capacity of studs in composite design with and without metal deck, see the AISC code and commentary dated November 1978

### ▣ Short form specification

To insure that certified Nelson products are used, the following specification is suggested. "Headed anchors shall be Nelson type H4L or S3L, flux filled welded to plates as shown on the drawings. Stud shall be made from cold drawn steel Grades To I C-1010 through C-1020 per ASTM A-108 and shall be welded per the manufactures recommendation.

### Physical properties of H4L and S3L anchors

|                                            |             | A <sub>s</sub><br>Nominal | A <sub>s</sub> f <sub>y</sub><br>Yield | A <sub>s</sub> f <sub>s</sub><br>Tensile |
|--------------------------------------------|-------------|---------------------------|----------------------------------------|------------------------------------------|
| f <sub>s</sub> Ultimate strength (tensile) |             | Area                      | kg (min.)                              | kg (min.)                                |
| 6.35 and 9.53 H4L ~                        | 380 Mpa min | 6.35                      | 31.7                                   | 1,111                                    |
| 12.7 and 15.88 H4L ~                       | 420 Mpa min | 9.53                      | 71.3                                   | 2,495                                    |
| 19.05 and 22.23 H4L ~                      | 420 Mpa min | 12.70                     | 126.7                                  | 4,445                                    |
| yield strength ~                           | 345 Mpa min | 15.88                     | 198.0                                  | 6,963                                    |
| Elongation ~                               | 20% min     | 19.05                     | 285.0                                  | 10,024                                   |
| Reduction Area                             | 50% min     | 22.23                     | 388.0                                  | 13,630                                   |
|                                            |             |                           |                                        | 16,356                                   |

Cold Finished low carbon steel

C ~ 0.23 max

Mn ~ 0.90 max

P ~ 0.04 max f

S ~ 0.05 max

A<sub>s</sub> Area of stud shank

### H4L and S3L tension capacity in concrete

| Anchor<br>Size | [1.]<br>A.W.<br>Length | Dh<br>Head<br>Dia | [2.]<br>Le<br>[mm] | Ultimate[3.0]<br>Embedded<br>Strength of<br>Anchor<br>[Pue] kN | Tension Capacity(Puc) kN(4.) |                             |                                 |                                     |                                     |                                     |                                     |                                     |                                     |
|----------------|------------------------|-------------------|--------------------|----------------------------------------------------------------|------------------------------|-----------------------------|---------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
|                |                        |                   |                    |                                                                | [5.]                         |                             |                                 | [6.0]                               |                                     |                                     | [7.0]                               |                                     |                                     |
|                |                        |                   |                    |                                                                | f <sub>c</sub> =3000<br>kPa  | f <sub>c</sub> =4000<br>kPa | f <sub>c</sub> =5000<br>kPa NWT | f <sub>c</sub> =3000<br>kPa<br>SLWT | f <sub>c</sub> =4000<br>kPa<br>SLWT | f <sub>c</sub> =5000<br>kPa<br>SLWT | f <sub>c</sub> =3000<br>kPa<br>ALWT | f <sub>c</sub> =4000<br>kPa<br>ALWT | f <sub>c</sub> =5000<br>kPa<br>ALWT |
| 6.35 x 68      | 65                     | 12.7              | 60                 | 10.81                                                          | 16.75                        | 16.75                       | 16.75                           | 16.75                               | 16.75                               | 16.75                               | 16.75                               | 16.75                               | 16.75                               |
| 6.35 x 104     | 101                    | 12.7              | 96                 | 10.81                                                          | 16.75                        | 16.75                       | 16.75                           | 16.75                               | 16.75                               | 16.75                               | 16.75                               | 16.75                               | 16.75                               |
| 9.5 x 104      | 101                    | 9.05              | 94                 | 24.24                                                          | 37.58                        | 37.58                       | 37.58                           | 37.58                               | 37.58                               | 37.58                               | 37.58                               | 37.58                               | 37.58                               |
| 9.5 x 154      | 151                    | 9.05              | 144                | 24.24                                                          | 37.58                        | 37.58                       | 37.58                           | 37.58                               | 37.58                               | 37.58                               | 37.58                               | 37.58                               | 37.58                               |
| 12.7 x 54      | 50                     | 25.4              | 43                 | 47.15                                                          | 25.86                        | 29.85                       | 33.37                           | 21.58                               | 25.37                               | 28.34                               | 19.37                               | 22.41                               | 25.03                               |
| 12.7 x 79      | 76                     | 25.4              | 68                 | 47.15                                                          | 56.54                        | 65.22                       | 72.95                           | 48.06                               | 55.43                               | 61.98                               | 42.40                               | 48.95                               | 54.74                               |
| 12.7 x 104     | 101                    | 25.4              | 93                 | 47.15                                                          | 73.08                        | 73.08                       | 73.08                           | 73.08                               | 73.08                               | 73.08                               | 73.08                               | 73.08                               | 73.08                               |
| 12.7 x 134     | 131                    | 25.4              | 123                | 47.15                                                          | 73.08                        | 73.08                       | 73.08                           | 73.08                               | 73.08                               | 73.08                               | 73.08                               | 73.08                               | 73.08                               |
| 12.7 x 154     | 151                    | 25.4              | 143                | 47.15                                                          | 73.08                        | 73.08                       | 73.08                           | 73.08                               | 73.08                               | 73.08                               | 73.08                               | 73.08                               | 73.08                               |
| 12.7 x 205     | 202                    | 25.4              | 194                | 47.15                                                          | 73.08                        | 73.08                       | 73.08                           | 73.08                               | 73.08                               | 73.08                               | 73.08                               | 73.08                               | 73.08                               |
| 15.9 x 68      | 63                     | 31.75             | 55                 | 73.66                                                          | 42.89                        | 49.5                        | 55.16                           | 36.47                               | 42.06                               | 46.88                               | 32.13                               | 37.16                               | 41.37                               |
| 15.9 x 106     | 101                    | 31.75             | 93                 | 73.66                                                          | 103.84                       | 114.18                      | 114.18                          | 88.25                               | 101.90                              | 113.97                              | 77.91                               | 89.91                               | 100.59                              |
| 15.9 x 165     | 161                    | 31.75             | 153                | 73.66                                                          | 114.18                       | 114.18                      | 114.18                          | 114.18                              | 114.18                              | 114.18                              | 114.18                              | 114.18                              | 114.18                              |
| 15.9 x 206     | 202                    | 31.75             | 194                | 73.66                                                          | 114.18                       | 114.18                      | 114.18                          | 114.18                              | 114.18                              | 114.18                              | 114.18                              | 114.18                              | 114.18                              |
| 19.05 x 80     | 76                     | 31.75             | 66                 | 106.13                                                         | 57.98                        | 66.95                       | 74.88                           | 49.30                               | 56.88                               | 63.64                               | 43.51                               | 50.19                               | 56.19                               |
| 19.05 x 85     | 80                     | 31.75             | 71                 | 106.13                                                         | 65.16                        | 75.29                       | 84.12                           | 55.36                               | 63.98                               | 71.50                               | 48.88                               | 56.47                               | 63.09                               |
| 19.05 x 98     | 93                     | 31.75             | 83                 | 106.13                                                         | 86.18                        | 99.56                       | 111.28                          | 73.29                               | 84.60                               | 94.80                               | 64.67                               | 74.67                               | 83.70                               |
| 19.05 x 106    | 101                    | 31.75             | 91                 | 106.13                                                         | 100.8                        | 116.31                      | 130.1                           | 85.70                               | 98.87                               | 110.59                              | 75.64                               | 87.22                               | 97.56                               |
| 19.05 x 123    | 118                    | 31.75             | 109                | 106.13                                                         | 136.79                       | 158.03                      | 164.51                          | 116.25                              | 134.31                              | 150.10                              | 102.59                              | 118.52                              | 150.03                              |
| 19.05 x 131    | 126                    | 31.75             | 117                | 106.13                                                         | 164.51                       | 164.51                      | 164.51                          | 131.76                              | 152.03                              | 164.51                              | 116.25                              | 134.17                              | 164.51                              |
| 19.05 x 135    | 131                    | 31.75             | 121                | 106.13                                                         | 164.51                       | 164.51                      | 164.51                          | 141.48                              | 164.51                              | 164.51                              | 124.79                              | 144.10                              | 164.51                              |
| 19.05 x 148    | 143                    | 31.75             | 134                | 106.13                                                         | 164.51                       | 164.51                      | 164.51                          | 164.51                              | 164.51                              | 164.51                              | 149.13                              | 164.51                              | 164.51                              |
| 19.05 x 156    | 151                    | 31.75             | 142                | 106.13                                                         | 164.51                       | 164.51                      | 164.51                          | 164.51                              | 164.51                              | 164.51                              | 164.51                              | 164.51                              | 164.51                              |
| 19.05 x 181    | 176                    | 31.75             | 167                | 106.13                                                         | 164.51                       | 164.51                      | 164.51                          | 164.51                              | 164.51                              | 164.51                              | 164.51                              | 164.51                              | 164.51                              |
| 19.05 x 26     | 202                    | 31.75             | 192                | 106.13                                                         | 164.51                       | 164.51                      | 164.51                          | 164.51                              | 164.51                              | 164.51                              | 164.51                              | 164.51                              | 164.51                              |
| 22.23 x 93     | 88                     | 34.93             | 79                 | 144.43                                                         | 80.19                        | 92.6                        | 103.49                          | 68.19                               | 78.74                               | 87.98                               | 60.12                               | 69.43                               | 77.63                               |
| 22.23 x 106    | 101                    | 34.93             | 91                 | 144.43                                                         | 103.42                       | 119.28                      | 133.41                          | 87.91                               | 101.42                              | 113.42                              | 77.57                               | 89.49                               | 100.04                              |
| 22.23 x 131    | 126                    | 34.93             | 117                | 144.43                                                         | 158.3                        | 182.64                      | 204.29                          | 134.59                              | 155.27                              | 173.68                              | 118.72                              | 137.00                              | 153.20                              |
| 22.23 x 156    | 151                    | 34.93             | 142                | 144.43                                                         | 223.87                       | 223.87                      | 223.87                          | 190.85                              | 220.29                              | 223.87                              | 168.44                              | 194.36                              | 217.39                              |
| 22.23 x 181    | 176                    | 34.93             | 167                | 144.43                                                         | 223.87                       | 223.87                      | 223.87                          | 223.87                              | 223.87                              | 223.87                              | 223.87                              | 223.87                              | 223.87                              |
| 22.23 x 206    | 202                    | 34.93             | 192                | 144.43                                                         | 223.87                       | 223.87                      | 223.87                          | 223.87                              | 223.87                              | 223.87                              | 223.87                              | 223.87                              | 223.87                              |

### H4L and S3L shear capacity in concrete

| Anchor<br>Size | A.W.(b.)<br>Length<br>[mm] | H/Ds<br>[No of Dia] | Sue (c.)<br>[kN] | Concrete shear capacity(Suc) kPa |                             |                             |                              |                             |                             |  |  |  |
|----------------|----------------------------|---------------------|------------------|----------------------------------|-----------------------------|-----------------------------|------------------------------|-----------------------------|-----------------------------|--|--|--|
|                |                            |                     |                  | Normal Concrete(145 pcf)         |                             |                             | Lightweight Concrete(110pcf) |                             |                             |  |  |  |
|                |                            |                     |                  | f <sub>c</sub> =3000<br>kPa      | f <sub>c</sub> =4000<br>kPa | f <sub>c</sub> =5000<br>kPa | f <sub>c</sub> =3000<br>kPa  | f <sub>c</sub> =4000<br>kPa | f <sub>c</sub> =5000<br>kPa |  |  |  |
| 6.35 x 68      | 65                         | 260.35              | 10.81            | 15.31                            | 16.75                       | 16.75                       | 12.76                        | 14.89                       | 16.61                       |  |  |  |
| 6.35 x 104     | 101                        | 406.40              | 10.81            | 15.31                            | 16.75                       | 16.75                       | 12.76                        | 14.89                       | 16.61                       |  |  |  |
| 9.5 x 104      | 101                        | 271.00              | 24.24            | 34.34                            | 37.58                       | 37.58                       | 28.54                        | 33.3                        | 37.3                        |  |  |  |
| 9.5 x 154      | 151                        | 406.40              | 24.24            | 34.34                            | 37.58                       | 37.58                       | 28.54                        | 33.3                        | 37.3                        |  |  |  |
| 12.7 x 54      | 50                         | 101.60              | 47.15            | 61.16                            | 71.22                       | 73.08                       | 50.95                        | 59.36                       | 66.47                       |  |  |  |
| 12.7 x 79      | 76                         | 152.4               | 47.15            | 61.16                            | 71.22                       | 73.08                       | 50.95                        | 59.36                       | 66.47                       |  |  |  |
| 12.7 x 104     | 101                        | 203.20              | 47.15            | 61.16                            | 71.22                       | 73.08                       | 50.95                        | 59.36                       | 66.47                       |  |  |  |
| 12.7 x 134     | 131                        | 263.40              | 47.15            | 61.16                            | 71.22                       | 73.08                       | 50.95                        | 59.36                       | 66.47                       |  |  |  |
| 12.7 x 154     | 151                        | 304.80              | 47.15            | 61.16                            | 71.22                       | 73.08                       | 50.95                        | 59.36                       | 66.47                       |  |  |  |
| 12.7 x 205     | 202                        | 406.40              | 47.15            | 61.16                            | 71.22                       | 73.08                       | 50.95                        | 59.36                       | 66.47                       |  |  |  |
| 15.9 x 68      | 63                         | 101.60              | 73.66            | 95.77                            | 111.63                      | 114.18                      | 79.77                        | 93.00                       | 104.11                      |  |  |  |
| 15.9 x 106     | 101                        | 162.56              | 73.66            | 95.77                            | 111.63                      | 114.18                      | 79.77                        | 93.00                       | 104.11                      |  |  |  |
| 15.9 x 165     | 161                        | 259.10              | 73.66            | 95.77                            | 111.63                      | 114.18                      | 79.77                        | 93.00                       | 104.11                      |  |  |  |
| 15.9 x 206     | 202                        | 325.12              | 73.66            | 95.77                            | 111.63                      | 114.18                      | 79.77                        | 93.00                       | 104.11                      |  |  |  |
| 19.05 x 80     | 76                         | 101.60              | 106.13           | 137.83                           | 160.65                      | 164.51                      | 114.94                       | 133.90                      | 149.82                      |  |  |  |
| 19.05 x 85     | 80                         | 114.30              | 106.13           | 137.83                           | 160.65                      | 164.51                      | 114.94                       | 133.90                      | 149.82                      |  |  |  |
| 19.05 x 98     | 93                         | 124.97              | 106.13           | 137.83                           | 160.65                      | 164.51                      | 114.94                       | 133.90                      | 149.82                      |  |  |  |
| 19.05 x 106    | 101                        | 135.38              | 106.13           | 137.83                           | 160.65                      | 164.51                      | 114.94                       | 133.90                      | 149.82                      |  |  |  |
| 19.05 x 123    | 118                        | 158.75              | 106.13           | 137.83                           | 160.65                      | 164.51                      | 114.94                       | 133.90                      | 149.82                      |  |  |  |
| 19.05 x 131    | 126                        | 169.42              | 106.13           | 137.83                           | 160.65                      | 164.51                      | 114.94                       | 133.90                      | 149.82                      |  |  |  |
| 19.05 x 135    | 131                        | 179.83              | 106.13           | 137.83                           | 160.65                      | 164.51                      | 114.94                       | 133.90                      | 149.82                      |  |  |  |
| 19.05 x 148    | 143                        | 192.53              | 106.13           | 137.83                           | 160.65                      | 164.51                      | 114.94                       | 133.90                      | 149.82                      |  |  |  |
| 19.05 x 156    | 151                        | 203.20              | 106.13           | 137.83                           | 160.65                      | 164.51                      | 114.94                       | 133.90                      | 149.82                      |  |  |  |
| 19.05 x 181    | 176                        | 236.98              | 106.13           | 137.83                           | 160.65                      | 164.51                      | 114.94                       | 133.90                      | 149.82                      |  |  |  |
| 19.05 x 26     | 202                        | 271.00              | 106.13           | 137.83                           | 160.65                      | 164.51                      | 114.94                       | 133.90                      | 149.82                      |  |  |  |
| 22.23 x 93     | 88                         | 101.60              | 144.43           | 187.47                           | 218.49                      | 223.87                      | 156.24                       | 182.10                      | 203.74                      |  |  |  |
| 22.23 x 106    | 101                        | 116.01              | 144.43           | 187.47                           | 218.49                      | 223.87                      | 156.24                       | 182.10                      | 203.74                      |  |  |  |
| 22.23 x 131    | 126                        | 145.03              | 144.43           | 187.47                           | 218.49                      | 223.87                      | 156.24                       | 182.10                      | 203.74                      |  |  |  |
| 22.23 x 156    | 151                        | 172.24              | 144.43           | 187.47                           | 218.49                      | 223.87                      | 156.24                       | 182.10                      | 203.74                      |  |  |  |
| 22.23 x 181    | 176                        | 203.20              | 144.43           | 187.47                           | 218.49                      | 223.87                      | 156.24                       | 182.10                      | 203.74                      |  |  |  |
| 22.23 x 206    | 202                        | 232.16              | 144.43           | 187.47                           | 218.49                      | 223.87                      | 156.24                       | 182.10                      | 203.74                      |  |  |  |

#### NOTES

[1.] A.W. - length overall after welding to plate

[2.] L<sub>e</sub> - Length of embedment under head of anchor

$$[3.] \text{Pue} \leq 0.9A_s F_s$$

[4.] Puc: Ultimate concrete tension capacity from the formulae where  $Puc \geq Pue$ .

Puc controls

$$Puc = \emptyset 17.77C(L_e) (L_e + D_h)^{1/4} f_c.$$

[5.] NWT: Normal weight concrete (C = 1)

[6.] SLWT:Sand lightweight concrete (C = 0.85)

[7.] ALWT:All light weight concrete (C = 0.75)

(a.) Stock anchor sizes

(b.) A.W. Length, length after welding

(c.) Sue=Ultimate stud embedded Shear Strength  
Sue = 9 As<sub>s</sub>. Where Sue > Sue controls



## Recommended Weld Setup

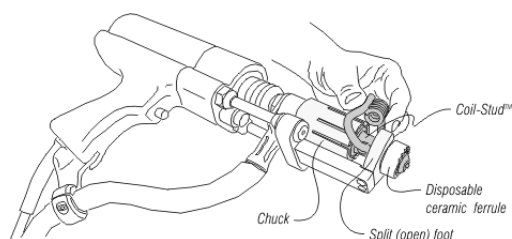
This basic welding setup is suitable for all types of deck materials, i.e. black iron, phos./ptd. 150g galvanized, 390 g. galvanized and cellular deck

When welding through single thickness of thin (22 ga. or lighter), lightly coated (150g. galvanized or phos./ptd.) or black iron deck materials, use the lower weld time and plunge settings shown.

As the deck thickness and galvanized coatings thickness increases, time, current and plunge settings will normally be adjusted up through the range of settings listed. Cellular decks will require settings in the higher range of those listed. Best results are obtained when the combined galvanized coating thickness of both sheets of cellular deck is limited to 390g per sq.meter

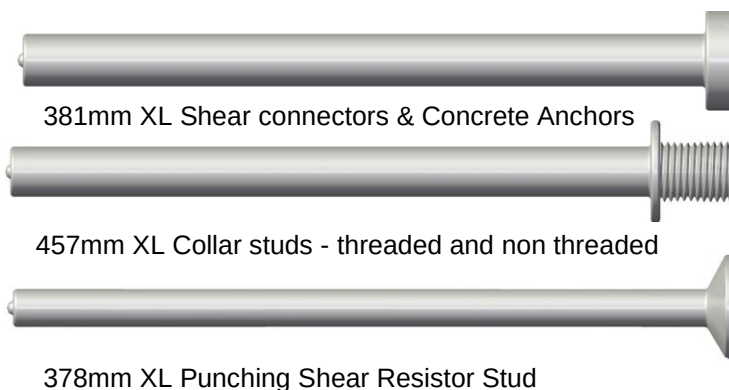
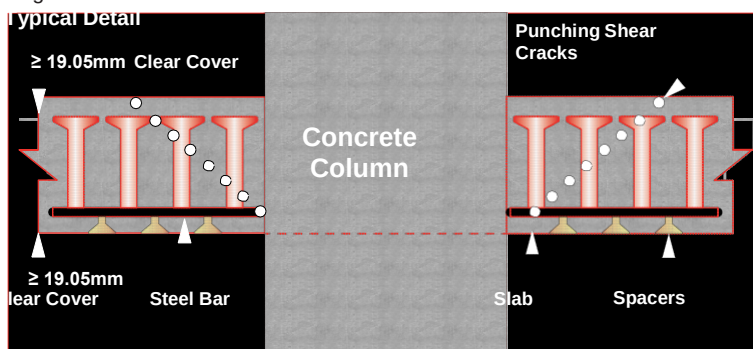
Typical weld setup: adjust as needed to meet job

|                         |                            |
|-------------------------|----------------------------|
| Weld time:              | 0.8 to 1.4 seconds         |
| Weld current (actual)*: | 1650 to 1850 amperes       |
| Lift:                   | 0.81 to 3.75 mm            |
| Plunge:                 | 9.05 to 12.7 mm            |
| Free Travel*            | 3.75 mm                    |
| Polarity:               | Straight                   |
| Ferrule:                | 100-101-175 or 100-101-177 |



## Nelson PSR System

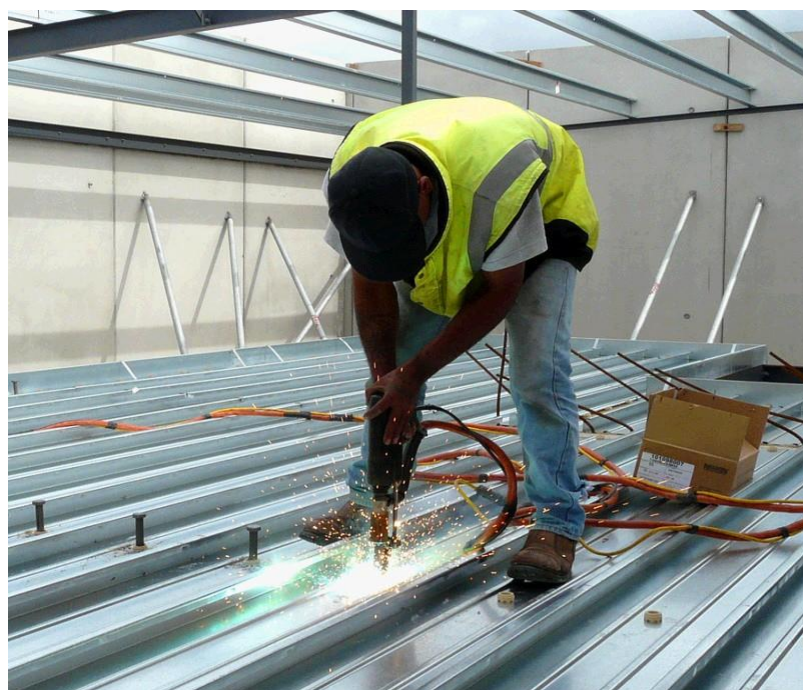
The PSR system is specifically designed to be stud welded to a flat steel rail with full steel strength in the weld to provide a strong, ductile reinforcing system that resists punching shear in concrete floor slab and foundation construction.



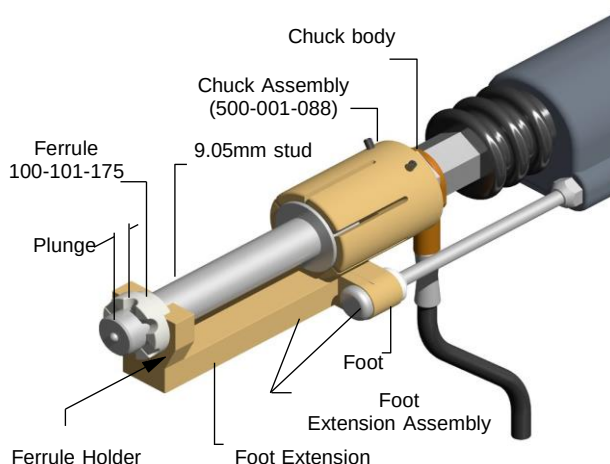
### Stud Types

We offer the largest selection of standard in-stock construction stud fasteners. In addition, Nelson is the only supplier able to produce superior quality cold formed extra

Long (CXL) headed, collar and PSR (punching shear connector resistor studs) up to 381 mm in length under the head. Stud specification sheets are available upon request.



### Gun setup for weld-thru deck application



#### Accessories:

**Chuck 500-001-008**

**Includes:**

Chuck body 500-001-117

Chuck sleeve 500-001-118

Depth Stop Screw 524-001-103

**Foot Extension Assembly**

**Includes:**

Foot 502-002-043

Foot Extension 502-002-004

**Ferrule Holder 501-006-028**

The best stud welding results are achieved through adherence to recommended job-site procedures and conditions. Factors such as painted beam flanges, water, deck fit-up to the beam, and inadequate power can seriously hamper satisfactory welding. Here are some important site requirements.

Top Flanges of beams should be unpainted. The beams should be free of heavy rust and mill scale, dirt, sand or other materials which will interfere with the welding operation. Floor sheets or deck material also should be free of dirt, sand or other foreign materials.

Water on the deck or between the deck and beams must be removed before welding.

Adequate incoming AC power must be available for power requirements of recommended power sources. (Refer to Power Sources.)

Adequate welding power must be available to provide weld current requirements as indicated in Recommended Weld Setup.

Cable length and size have a definite effect on power source current output and becomes increasingly important when dealing with high currents and high welding rates.