The **NMB SPLICE-SLEEVE®** is an efficient coupler for splicing reinforcing bars which uses a cylindrical-shaped steel sleeve interior of which is filled with **SS MORTAR®** grout a cementicious, non-metallic, non-shrink, high-early-strength grout. Reinforcing bars to be spliced are inserted into the sleeve to meet approximately at the center of the sleeve. The resulting splices will develop tensile and compressive strengths in excess of the specified minimum for ASTM Grade 60 bars conforming to the ACI Building Code Requirements for both Type 1 and Type 2 conditions.

The **NMB SPLICE-SLEEVE® SYSTEM** is a proven method for connecting precast reinforced concrete structural members. At the precast plant, the sleeves are embedded precast element on one end of the main reinforcing bars to be connected. The bars protrude from the other end of the precast member. At the building site, the precast members are joined by inserting the protruding bars from the end of one precast member into the sleeves of the adjacent member. The sleeves are then grouted, in effect making the reinforcing bars continuous through the connection.

This is called "Emulation" and the NMB is categorized as an emulative connection for precast systems. (Refer to ACI 550.1R-09 for more information).

Patented Worldwide
The NMB SPLICE-SLEEVE® is particularly appropriate for use in joining vertical precast concrete structural elements (columns and shear walls). This is because the sleeve can be embedded completely in the precast elements at the manufacturing yard and when the elements are joined in the erection process, there is no need to make a closure pour or to perform other cosmetic patching after the bars are joined. This is sometimes referred to as a "blind" connection. When used in cast-in-place situations, the NMB SPLICE-SLEEVE performs the same function as other mechanical rebar splicing devices, basically that of extending the rebar length.

APPLIEDS

NMB SPLICE-SLEEVES have been used in a number of different applications both in cast-in-place and precast concrete structures.

**Precast Concrete Connections:**
- Column-to-column
- Column-to-beam
- Column-to-foundation
- Beam-to-beam
- Shear wall to shear wall
- Shear wall to foundation
- Elevator and stair cores
- Airport control towers
- Bridge piers and Pier caps
- Caissons
- Large diameter hollow columns

**Cast-in-place Concrete Structures:**
- Connections of prefabricated column reinforcing cages
- Connections of new bars to old in vertical and horizontal rehabilitation work
- Stress relief joints in post-tensioned cast in place slabs
NMB SPLICE-SLEEVES are installed and held firmly in place in the forms during concrete pouring by means of a Sleeve Setter featuring a fast-acting cam operated locking device.

The NMB SPLICE-SLEEVE has an integral Rebar Stop in the mid-portion which assures the specified embedment of the rebar into the sleeve and an optional setscrew to hold the bar in the narrow end.

The uniform exterior dimension of the sleeve permits use of stirrups or hoops of the same size throughout the length of the sleeve.

No special treatment such as threading of rebar ends is required.

NMB SPLICE-SLEEVE can connect bars of the same size or any size smaller than the sleeve size.

The NMB can be epoxy coated and used to connect epoxy coated bars without removing the coating.
ERECTION

During erection, precast concrete elements are set into position one of three ways (see diagrams). The rebar dowels projecting from either the foundation or opposite piece are inserted into NMB Splice-Sleeves embedded in the precast element. The wide (field) end of the sleeves is designed larger than the rebar to provide tolerance to accommodate bar misalignment. The sleeve also allows tolerance with inserted rebar length (See Chart on Page 5).

If needed additional tolerance can be gained by “Upsizing” to a bigger sleeve. This can be any bigger size but usually one or two. Similar to Upsizing, different rebar sizes can be “Transition Spliced” in the NMB Splice-Sleeve (for details see User’s Manual). These abilities allow all bars to be quickly mated and grouted simultaneously, saving crane time and speeding erection.

The precast elements are temporarily braced while the grout cures sufficiently in the sleeves. Typically EORs specify 4,000 psi which is comfortably above the yield strength connection. This is achieved in less than 24 hours at 68°F (see chart above), contributing to rapid construction.

GROUTING

For PRE-GROUT applications, the SS MORTAR grout is simply poured into the sleeve and consolidated before the next precast member is set in position.

For POST-GROUT and HORIZONTAL applications, the grout is pumped into the sleeve by means of a hand-operated pump. With both these systems, grouting operations can be performed after bracing and do not interfere with erection progress.

In total, NMB SPLICE-SLEEVE contributes to speed of construction.
### NMB SPLICE-SLEEVE

**Steel Specification:** The material properties of the NMB Splice-Sleeve® iron castings conform to proprietary specification based on ASTM A536-84. The Models 5U-X and 6U-X satisfy the ASTM A536 Grade 65-45-12 [minimum yield and tensile strength of 65,000 and 45,000 psi respectively]. Models 7U-X through Model 14U-X, Model A11W, and Model SNX 11 satisfy ASTM A536 [Grade 80-55-06] with a Grade of 85-60-06 [minimum yield and tensile strength of 85,000 and 60,000 psi respectively].

**Grout Specification:** The grout used in the NMB must be non-metallic, “SS Mortar®”. Minimum grout strength requirements for ASTM A615 Grade 60 rebars:

- **Type 2 (ACI)**: (100% Fu = 150% Fy = 90 ksi) 9,500 psi
- **Type 1 & AASHTO**: (125% Fy = 75 ksi) 6,500 psi
- **Yield Strength**: (100% Fu = 60 ksi) 3,000 psi

**Note:** To allow for variations in curing, typically cube breaks of 4,000-psi are specified by the EOR for removal of bracing and continued erection.

### Dimensions of NMB Splice-Sleeves

<table>
<thead>
<tr>
<th>Sleeve No.</th>
<th>Bar Diameter</th>
<th>ASTM Bar Size</th>
<th>Sleeve Length (L) inch (mm)</th>
<th>Narrow End Diameter</th>
<th>Max. Dia. (B) inch (mm)</th>
<th>Wide End Diameter</th>
<th>Factory Dowel (E1) inch (mm)</th>
<th>Field Dowel (E2) inch (mm)</th>
<th>SS Mortar lbs. per Sleeve (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5U-X</td>
<td>0.625</td>
<td>#5 16 MM</td>
<td>9.65 (245)</td>
<td>0.87 (22)</td>
<td>1.50 (38)</td>
<td>1.81 (46)</td>
<td>1.26 (32)</td>
<td>0.63 (16)</td>
<td>1.89 (48)</td>
</tr>
<tr>
<td>6U-X</td>
<td>0.750</td>
<td>#6 20 MM</td>
<td>11.22 (285)</td>
<td>1.02 (26)</td>
<td>1.65 (42)</td>
<td>1.97 (50)</td>
<td>1.42 (36)</td>
<td>0.67 (17)</td>
<td>2.05 (52)</td>
</tr>
<tr>
<td>7U-X</td>
<td>0.875</td>
<td>#7 22 MM</td>
<td>12.80 (325)</td>
<td>1.14 (29)</td>
<td>1.77 (45)</td>
<td>2.28 (58)</td>
<td>1.73 (44)</td>
<td>0.86 (22)</td>
<td>2.36 (60)</td>
</tr>
<tr>
<td>8U-X</td>
<td>1.000</td>
<td>#8 25 MM</td>
<td>14.57 (370)</td>
<td>1.30 (33)</td>
<td>1.93 (49)</td>
<td>2.48 (63)</td>
<td>1.89 (48)</td>
<td>0.89 (23)</td>
<td>2.52 (64)</td>
</tr>
<tr>
<td>9U-X</td>
<td>1.128</td>
<td>#9 28 MM</td>
<td>16.34 (415)</td>
<td>1.42 (35)</td>
<td>2.06 (52)</td>
<td>2.60 (66)</td>
<td>2.01 (51)</td>
<td>0.89 (23)</td>
<td>2.67 (68)</td>
</tr>
<tr>
<td>10U-X</td>
<td>1.270</td>
<td>#10 32 MM</td>
<td>17.91 (455)</td>
<td>1.57 (40)</td>
<td>2.28 (58)</td>
<td>2.80 (71)</td>
<td>2.16 (55)</td>
<td>0.89 (23)</td>
<td>2.87 (73)</td>
</tr>
<tr>
<td>11U-X</td>
<td>1.410</td>
<td>#11 35 MM</td>
<td>19.49 (495)</td>
<td>1.73 (44)</td>
<td>2.40 (61)</td>
<td>3.03 (77)</td>
<td>2.32 (59)</td>
<td>0.91 (23)</td>
<td>3.03 (77)</td>
</tr>
<tr>
<td>SNX11</td>
<td>1.410</td>
<td>#11 35 MM</td>
<td>19.09 (485)</td>
<td>1.69 (43)</td>
<td>3.03 (77)</td>
<td>3.03 (77)</td>
<td>2.32 (59)</td>
<td>0.91 (23)</td>
<td>3.03 (77)</td>
</tr>
<tr>
<td>A11W</td>
<td>1.410</td>
<td>#11 35 MM</td>
<td>19.49 (495)</td>
<td>1.73 (44)</td>
<td>3.31 (84)</td>
<td>3.30 (84)</td>
<td>2.60 (66)</td>
<td>1.19 (30)</td>
<td>3.30 (84)</td>
</tr>
<tr>
<td>14U-X</td>
<td>1.693</td>
<td>#14 40 MM</td>
<td>24.41 (620)</td>
<td>2.01 (51)</td>
<td>2.80 (71)</td>
<td>3.46 (88)</td>
<td>2.60 (66)</td>
<td>0.91 (23)</td>
<td>3.46 (88)</td>
</tr>
<tr>
<td>18U</td>
<td>2.257</td>
<td>#18 57 MM</td>
<td>36.22 (920)</td>
<td>2.68 (68)</td>
<td>3.66 (93)</td>
<td>4.72 (120)</td>
<td>3.27 (83)</td>
<td>1.01 (26)</td>
<td>4.25 (108)</td>
</tr>
</tbody>
</table>

**Note:** Measurements are approximate and may vary slightly due to manufacturing tolerances.
How to specify NMB SPLICE-SLEEVES:

**SPECIFIC:** Show sleeve size and grouting system.


** GENERIC:** Mechanical rebar splices by means of grout-filled steel sleeves with frusto-conical geometry into which a non-shrink, high-strength grout is introduced using a low pressure pump, the splice to meet the TYPE 1 or 2 requirements of ACI 318.

**AASHTO:**
The NMB SPLICE-SLEEVE exceeds the requirements (min. 125%Fy) of the AASHTO, Standard Specification for Highway Bridges, Division I- Design, Section 8.32.2. This article sets down requirements for fatigue design of mechanical connections. The NMB is listed generically as the ”Grout-filled sleeve (without threaded ends), with or without epoxy coated rebar”, which gains the 18-ksi stress category (highest) under 5 million cycle testing per NCHRP 10-35 methodology.

**APPROVAL AND RECOGNITION**

- New York City Board of Standards and Appeals, Calendar No. 329-89-SM
- City of Los Angeles, Departments of Building and Safety, Research Report: RR25385
- Various U.S. State Department of Transportation
- Building Center of Japan, Ministry of Construction
- Housing Development Board, Singapore
- Ministry of Works and Development, New Zealand