COMMERCIAL & RESIDENTIAL GARAGE DOOR DIVISION
DASMA TECHNICAL DATA SHEET
#161

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Connecting Garage Door Jambs to Building Framing

Introduction

The members of DASMA recognize that connecting garage doors to building framing is as important as the design of garage doors themselves. The following series of "Garage Door Frame Connection Schedules" included in this Technical Data Sheet constitutes a basic introduction to some of the concepts of garage door framing.

Fastener Type	Schedule
• 1/4" diameter by 3" length Self-Tapping Anchors	TDS 161a
• 3/8" diameter by 3" length Sleeve Anchors	TDS 161b
• 3/8" diameter by 3½" length Expansion Anchors	TDS 161c
• 7/16" diameter by 8" length "L-Bolt" Anchors	TDS 161d
• 3/8" diameter by 3" length Lag Screws	TDS 161e
• 16d by 3½" length Common Wire Nails	TDS 161f
• 0.100" x 1" Long Fillet Weld (E60xx Electrodes Min)	TDS 161g
• 1/4" diameter by 3/4" length Self-Tapping Screws into steel	TDS 161h

Rationale has also been included in the following pages, including an explanation of methods used, loads and source data, and calculation methods.

The information contained in this Technical Data Sheet is presented to provide some clarification about the requirements and limitations of some of the methods of attaching garage door jambs to structural members of various buildings. Professional engineering advice should be obtained when considering the attachment of garage door jambs to a structure and to ensure that forces resulting from wind can be withstood by the structure and the garage door while maintaining the integrity of the building envelope.

Directions on using the charts, along with other important information, can be found on the next page.

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Using The Charts

1. Determine the door width, in feet.
2. Determine the positive wind load for a particular door. The positive wind load is the wind load that acts to push the door inward toward the garage and away from the garage door framing. This load determination can be achieved through one of these methods:
    - Use of the relevant DASMA Wind Load Guide (see TDS 155)
    - Job-specific calculation
    - Conservative design pressure obtained from a local building department
3. If the framing is made of wood, determine the type of lumber used. The charts include Southern Pine (SP) and Spruce-Pine-Fir (SPF).
4. Determine fastener to be used, from the alternatives listed in this Technical Data Sheet.
5. Find the appropriate Schedule to use.
6. For a given door load, door width and jamb type (if applicable), obtain the maximum fastener spacing per jamb from the appropriate Schedule.
7. Review the notes at the bottom of the Schedule used.
8. Review the detail referred to in the Schedule.

Information for Installers

- Establish location of reinforcements in concrete-filled masonry units, poured concrete walls, tilt-up concrete walls, etc.
- Use care to ensure that reinforcement will not interfere with jamb fasteners.
- If door jamb mounting or alternate door size cannot be accomplished without interference with reinforcement, then consult a structural engineer to determine a workable solution.
- Do not drill through or damage reinforcement.

Existing Construction

DASMA suggests that installers consider the following in locating reinforcement:

- *If the building has structural drawings*, obtain these drawings and have an engineer review the drawings to determine where reinforcement is located in the vicinity of the jambs. The engineer should compare the reinforcement location with where the door jamb fasteners are to be located.
- *If the building's structural plans cannot be obtained*, during the field inspection process, where existing wall opening dimensions are obtained, either drill representative "pilot holes" or use a device similar to an electronic wood stud locator to determine the steel reinforcement locations.

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Rationale

Explanation of Methods Used

The jamb attachment information in this document is presented in such a way as to provide clear and accurate connection schedules for wind loads from 10 PSF to 60 PSF.

The connection schedules show the maximum spacing permitted between anchors for a particular design wind load, as opposed to the minimum number of anchors required for a certain force applied to the jamb. The maximum spacing can be quickly determined by looking up the wind load and door width in the appropriate table for the particular anchor to be used.

All calculations used in determining the connection schedule are provided.

Comment on Concrete Load Source Data

For concrete anchors, information presented in this document is based on published fastener manufacturer data. The Allowable Loads for these anchors were determined using the published data along with ACI 318 (-08 and -11) Appendix D computations.

All wind pressure specifications for garage door products are for allowable stress design (ASD) because they are test results with an overload factor. Therefore, the ratings in this TDS for concrete anchors are also ASD results from ACI 318 using a 1.6 load combination factor for wind load.

Concrete anchors also have specific installation requirements and guidelines that are too detailed to reproduce in this document. The user is expected to know and follow the manufacturer's installation instructions.

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Calculations

General Formula for Maximum Anchor Spacing:

$$\frac{(12\ {}^{in}\!/_{ft})(F\ {}^{lb}\!/_{anchor})}{\frac{1}{2}(P\ {}^{lb}\!/_{ft^2})(W\ ft)} = S\ {}^{in}\!/_{anchor}$$

P = Door Design Wind Pressure (PSF)
W = Opening Width (ft)
F = Allowable Load per Anchor (lb)
S = Maximum Anchor Spacing (in.)

TDS 161a

1/4" **ITW Red Head Tapcon+**, 2" embedment, 1-5/8" min edge distance
Ref: ICC-ES Report ESR-3699, using load combination factor of 1.6 (Wind loads)
1/4" **Powers Wedge-Bolt+**, 1-3/4" embedment, 1-5/8" min edge distance
Ref: ICC-ES Report ESR-2526, using load combination factor of 1.6 (Wind loads)
3/8" **Simpson Titen HD**, 2.75" embedment, 4" min edge distance
Ref: ICC-ES Report ESR-1056, using factor of safety of 5 (ASD test result)
ACI 318-11 for computation of anchor loads into concrete
ANSI/AWC NDS-2015 for Wood Construction

Allowable Pullout Loads
C-90 Block, grout filled: F_{All} = **480** lb (Titen HD)
2500 psi min concrete: F_{All} = 687 lb (Tapcon+), **556** lb (Wedge-Bolt+)
3000 psi min concrete: F_{All} = 753 lb (Tapcon+), **609** lb (Wedge-Bolt+)
4000 psi min concrete: F_{All} = 869 lb (Tapcon+), **703** lb (Wedge-Bolt+)

Allowable Bearing Loads from flat washer on wood
For 1/4" diameter anchor using 1-1/4" OD washer with 1/16" hole clearance
Bearing Area, $A = \pi(5/8\text{ in})^2 - \pi(5/32\text{ in})^2 = 1.15\text{ in}^2$
Bearing Area Factor, C_b = 1.3 *(NDS p. 22, [=(OD+.375)/OD]*
Allowable Load, $F_{All} = F^*C_b$ where $F = F_c^*A$; therefore, $F_{All} = F_c^*A^*C_b$
Where: F_c = Allowable compression (psi); F = applied force (lb)
Southern Pine (F_c = 565 psi): $F_{All} = 565\text{ lb/in}^2 * 1.15\text{ in}^2 * 1.3 = 845$ lb
Spruce-Pine-Fir (F_c = 425 psi): $F_{All} = 425\text{ lb/in}^2 * 1.15\text{ in}^2 * 1.3 = 636$ lb

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For 3/8" diameter anchor using 1-1/4" OD washer with 1/16" hole clearance

Bearing Area, $A = \pi (5/8 \text{ in})^2 - \pi (7/32 \text{ in})^2 = 1.077 \text{ in}^2$
Bearing Area Factor, $C_b = 1.3$ *(NDS p. 22, [=(OD+.375)/OD]*
Allowable Load, $F_{All} = F^*C_b$ where $F = F_c^*A$; therefore, $F_{All} = F_c^*A^*C_b$
Where: F_c = Allowable compression (psi); F = applied force (lb)

Southern Pine (SP) (F_c = 565 psi): $F_{All} = 565 \text{ lb/in}^2 * 1.077 \text{ in}^2 * 1.3 = 791$ lb
Spruce-Pine-Fir (SPF) (F_c = 425 psi): $F_{All} = 425 \text{ lb/in}^2 * 1.077 \text{ in}^2 * 1.3 = 595$ lb

Note: Tabulated values for F_c *(NDS Supplement p. 42, Table 4C)* are species group average values associated with a deformation of 0.04" per ASTM D2555, D245.

Overall Allowable Loads to use (for Spruce-Pine-Fir and Southern Pine)
C-90 Block, grout filled: **480** lb for SPF (Spruce-Pine-Fir), **480** lb for SP (Southern Pine).
2500 psi min concrete: **556** lb for SPF, **556** lb for SP
3000 psi min concrete**: 609** lb for SPF, **609** lb for SP
4000 psi min concrete**: 636** lb for SPF, **703** lb for SP

TDS 161b

1/4" ITW Red Head Trubolt, 1.75" embedment, 1-5/8" min edge distance
Ref: ICC-ES Report ESR-2251, using load combination factor of 1.6 (wind loads)
1/4" Hilti Kwik Bolt 3 into CONCRETE, 2" embedment, 2-5/8" min edge distance
Ref: ICC-ES Report ESR-2302, using load combination factor of 1.6 (wind loads)
1/4" Hilti Kwik Bolt 3 into Filled CMU, 2" embedment, 4" min edge distance
Ref: Hilti North American Product Tech Guide
ACI 318-11 for computation of anchor loads into concrete
ANSI/AWC NDS-2015 for Wood Construction

Allowable Pullout Loads
C-90 Block, grout filled: F_{All} = **540** lb (Kwik Bolt 3)
2500 psi concrete: F_{All} = **556** lb (Trubolt), = 640 lb (Kwik Bolt 3)
3000 psi concrete: F_{All} = **619** lb (Trubolt), = 701 lb (Kwik Bolt 3)
4000 psi concrete: F_{All} = **715** lb (Trubolt), = 809 lb (Kwik Bolt 3)

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Allowable Bearing Loads from flat washer on wood:
For 1/4" diameter anchor using 1-1/4" OD washer with 1/16" hole clearance
Bearing Area, $A = \pi(5/8 \text{ in})^2 - \pi(5/32 \text{ in})^2 = 1.15 \text{ in}^2$
Bearing Area Factor, $C_b = 1.3$ *(NDS p. 22, [=(OD+.375)/OD]*
Allowable Load, $F_{All} = F^*C_b$ where $F = F_c{*}A$; therefore, $F_{All} = F_c{*}A^*C_b$
Where: F_c = Allowable compression (psi); F = applied force (lb)

Southern Pine (F_c = 565 psi): $F_{All} = 565 \text{ lb/in}^2 * 1.15 \text{ in}^2 * 1.3 = 845$ lb
Spruce-Pine-Fir (F_c = 425 psi): $F_{All} = 425 \text{ lb/in}^2 * 1.15 \text{ in}^2 * 1.3 =$ **636** lb

Note: Tabulated values for F_c *(NDS Supplement p. 42, Table 4C)* are species group average values associated with a deformation of 0.04" per ASTM D2555, D245.

Allowable Loads to use
C-90 Block, grout filled: **540** lb for SPF (Spruce-Pine-Fir), **540** lb for SP (Southern Pine).
2500 psi concrete: **556** lb for Spruce-Pine-Fir, **556** lb for Southern Pine
3000 psi concrete: **619** lb for Spruce-Pine-Fir, **619** lb for Southern Pine
4000 psi concrete: **636** lb for Spruce-Pine-Fir, **715** lb for Southern Pine

TDS 161c

3/8" x 3-1/2" Simpson Strong-Tie Wedge-All Expansion (Wedge) Anchors
1-3/4" minimum embedment, 3" (8 diameters) minimum edge distance
Ref: http://www.strongtie.com/products/anchorsystems/
ANSI/AWC NDS-2015 for Wood Construction

Allowable Pullout Loads (using .90 edge distance and 1.333 short term load adjustment factors)
2000 psi concrete: $F_{All} = 390$ lb * .90 * 1.333 = **468** lb
3000 psi concrete: $F_{All} = 555$ lb * .90 * 1.333 = **666** lb
4000 psi concrete: $F_{All} = 720$ lb * .90 * 1.333 = **864** lb

Note: C-90 Block is not an option for Simpson expansion anchors due to a minimum 12" edge requirement.

Allowable Bearing Loads from flat washer on wood:
For 1/4" diameter anchor using 1-1/4" OD washer with 1/16" hole clearance

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Bearing Area, $A = \pi (5/8 \text{ in})^2 - \pi (5/32 \text{ in})^2 = 1.15 \text{ in}^2$
Bearing Area Factor, $C_b = 1.3$ *(NDS p. 22, [=(OD+.375)/OD]*
Allowable Load, $F_{All} = F^*C_b$ where $F = F_c^*A$; therefore, $F_{All} = F_c^*A^*C_b$
Where: F_c = Allowable compression (psi); F = applied force (lb)

Southern Pine (Fc = 565 psi): $F_{All} = 565 \text{ lb/in}^2 * 1.15 \text{ lb/in}^2 * 1.3 =$ **844** lb
Spruce-Pine-Fir (Fc = 425 psi): $F_{All} = 425 \text{ lb/in}^2 * 1.15 \text{ lb/in}^2 * 1.3 =$ **635** lb
Note: Tabulated values for *Fc (NDS Supplement p. 42, Table 4C)* are species group average values associated with a deformation of 0.04" per ASTM D2555, D245.

Allowable Loads to use
2000 psi concrete: **468** lb for Spruce-Pine-Fir, **468** lb for Southern Pine
3000 psi concrete: **635** lb for Spruce-Pine-Fir, **666** lb for Southern Pine
4000 psi concrete: **635** lb for Spruce-Pine-Fir, **844** lb for Southern Pine

TDS 161d

7/16" x 8" Galvanized "L-Bolt" Anchors, ASTM A307, Grade C
6-1/2" minimum embedment, 2-5/8" (6 diameters) minimum edge distance

Allowable Pullout Load (2000 psi, 3000 psi or 4000 psi concrete)
Stress area, $A = .1063 \text{ in}^2$; tensile yield, $\sigma = 36$ ksi, Safety Factor, $s = 4$
Allowable Load, $F_{All} = \sigma^*A / s = (36{,}000 \text{ lb/in}^2)(.1063 \text{ in}^2)/4 =$ **957** lb/L-bolt

Allowable Bearing Loads from flat washer on wood:
For 7/16" diameter anchor using 1-5/8" OD washer with 1/16" hole clearance
Bearing Area, $A = \pi (13/16 \text{ in})^2 - \pi (1/4 \text{ in})^2 = 1.878 \text{ in}^2$
Bearing Area Factor, $C_b = 1.43$ *(NDS p. 22)*
Allowable Load, $F_{All} = F^*C_b$ where $F = F_c^*A$; therefore, $F_{All} = F_c^*A^*C_b$
Where: F_c = Allowable compression (psi); F = applied force (lb)

Southern Pine (F_c = 565 psi): $F_{All} = 565 \text{ lb/in}^2 * 1.878 \text{ in}^2 * 1.43 = 1517$ lb
Spruce-Pine-Fir (F_c = 425 psi): $F_{All} = 425 \text{ lb/in}^2 * 1.878 \text{ in}^2 * 1.43 = 1141$ lb
Note: Tabulated values for F_c *(NDS Supplement p. 42, Table 4C)* are species group average values associated with a deformation of 0.04" per ASTM D2555, D245.

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Allowable Loads to use (for Southern Pine or Spruce-Pine-Fir)
2000 psi concrete: **957** lb
3000 psi concrete: **957** lb
4000 psi concrete: **957** lb

TDS 161e

3/8" x 3" Lag Screws
1-1/2" minimum embedment, 1-1/2" (4 diameters) minimum edge distance
Ref: ANSI/AWC NDS-2015 for Wood Construction

Allowable Pullout Loads (using 5:1 safety factor)
Allowable Pullout force $W' = (W)(C_D)(C_M)(C_t)(L)$, where
W = lag screw withdrawal design value (lb/in.) *(see NDS p. 68, Table 11.2A)*
C_D = load duration factor = 1.6 for wind load *(p. 9)*
C_M = wet service factor for dry conditions = 1.0 *(p. 59)*
C_t = temperature factor for <100^{O}F = 1.0 *(p. 9)*
L = actual thread penetration = 1.5 in. nominal length - .219 in. ineffective thread = 1.281 in. *(p. 166)*
Southern Pine (Specific Gravity = 0.55):
W' = (352 lb/in.)(1.6)(1.0)(1.0)(1.281) = 721 lb
Spruce-Pine-Fir (Specific Gravity = .42):
W' = (235 lb/in.)(1.6)(1.0)(1.0)(1.281) = **482** lb

Maximum Tensile Loads
The lag screw maximum tensile load $P = (S)(A_s)/k$, where
S = material tensile strength = 60,000 psi for Grade A fasteners *(ASTM A 307, Section 1)*
k = safety factor = 4
A_s = stress area = $0.7854[D - (0.9743/n)]^2$ *(ASTM A 307, Section 6)*, where
D = nominal diameter of the screw = 0.375
n = the number of threads per inch = 7 *(IFI Fastener Standards 6th Ed., p. C-18)*

$A_s = 0.7854[0.375 - (0.9743/7)]^2 = 0.0437$ in^2
P = (60,000 psi)(0.0437 in^2)/4 = **655** lb

Allowable Bearing Loads from flat washer on wood
For 3/8" diameter anchor using 1-1/8" OD washer with 1/16" hole clearance
Bearing Area, $A = \pi\,(9/16\text{ in})^2 - \pi\,(3/16\text{ in})^2 = .844$ in^2

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Bearing Area Factor, C_b = 1.43 *(NDS p. 22)*
Allowable Load, $F_{All} = F^*C_b$ where $F = F_c*A$; therefore, $F_{All} = F_c*A*C_b$
Where: F_c = Allowable compression (psi); F = applied force (lb)

Southern Pine (F_c = 565 psi): F_{All} = 565 lb/in^2 * .844 in^2 * 1.43 = 681 lb
Spruce-Pine-Fir (F_c = 425 psi): F_{All} = 425 lb/in^2 * .844 in^2 * 1.43 = 512 lb
Note: Tabulated values for F_c *(NDS Supplement p. 42, Table 4C)* are species group average values associated with a deformation of 0.04" per ASTM D2555, D245.

Allowable Loads to use
Spruce-Pine-Fir: **482** lb, Southern Pine: **655** lb

TDS 161f

16d (.162" Dia.) x 3-1/2" Common Wire Nails (2" Min Embedment)
Ref: ANSI/AWC NDS-2015 for Wood Construction

Allowable Pullout force $W' = (W)(C_D)(C_M)(C_t)(L)$, where
W = nail withdrawal design value (lb/in.) *(see NDS p. 70, Table 11.2C)*
C_D = load duration factor = 1.6 for wind load *(p. 9)*
C_M = wet service factor for dry conditions = 1.0 *(p. 59)*
C_t = temperature factor for <100^{O}F = 1.0 *(p. 9)*
L = length of embedment
Spruce-Pine-Fir (Specific Gravity = .42):
W' = (26 lb/in.)(1.6)(1.0)(1.0)(2 in.) = **83** lb
Southern Pine (Specific Gravity = 0.55):
W' = (50 lb/in.)(1.6)(1.0)(1.0)(2 in.) = **160** lb

TDS 161g

.100" x 1" Long Fillet Weld (E60xx Electrodes Min)
Ref. AISC Manual of Steel Construction Allowable Stress Design (9th Edition)
(Note: The 14th Edition is current; ASD is "unsupported" after the 9th Edition)

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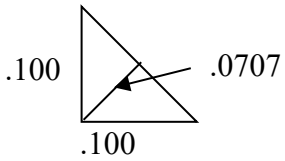
Design criteria from AISC manual:

1) The effective area of fillet welds shall be taken as the effective length times the effective throat thickness. (p. 5-67)
2) The effective length of fillet welds, except fillet welds in holes and slots, shall be the overall length of full-size fillets. (p. 5-67)
3) The effective throat thickness of a fillet weld shall be the shortest distance from the root of the joint to the face of the diagrammatic weld. (p. 5-67)
4) Maximum size of fillet weld (if welded along edge(s) of connecting parts) shall be not greater than the thickness of the material. (p. 5-67)
5) Allowable fillet weld shear stress (based on effective area) = 30% of nominal tensile strength of weld metal. (p. 5-70, Table J2.5)

Assumptions:

1) 0.100" (12 gauge) steel angle attached to steel jambs of at least greater thickness.
2) Use E60xx Electrode minimum. This electrode has a yield strength of 60 ksi.



Calculation:
Effective throat thickness: $(0.100^2 + 0.100^2)^{1/2}/2 = 0.0707$ in.
Effective length of fillet weld: 1.00 in.
Effective area of weld: (0.0707 in.)(1.00 in.) = 0.0707 in^2
Allowable fillet weld force: F = (60,000 lb/in^2)(30%)(0.0707 in^2) = **1272** lb

TDS 161h

1/4" x 3/4" self-tapping screws into steel in thicknesses from 16 ga. to 3/16"
Ref: https://www.icc-es.org/wp-content/uploads/report-directory/ESR-1976.pdf
For 1/4" self-tapping screws the allowable tensile pullout loads range from 191 lb for 16 gauge steel to 596 lb for 3/16" steel with a 3:1 safety factor. Spacing is calculated as follows:
Spacing = (24 * Allowable Load)/((Door Width) * PSF)

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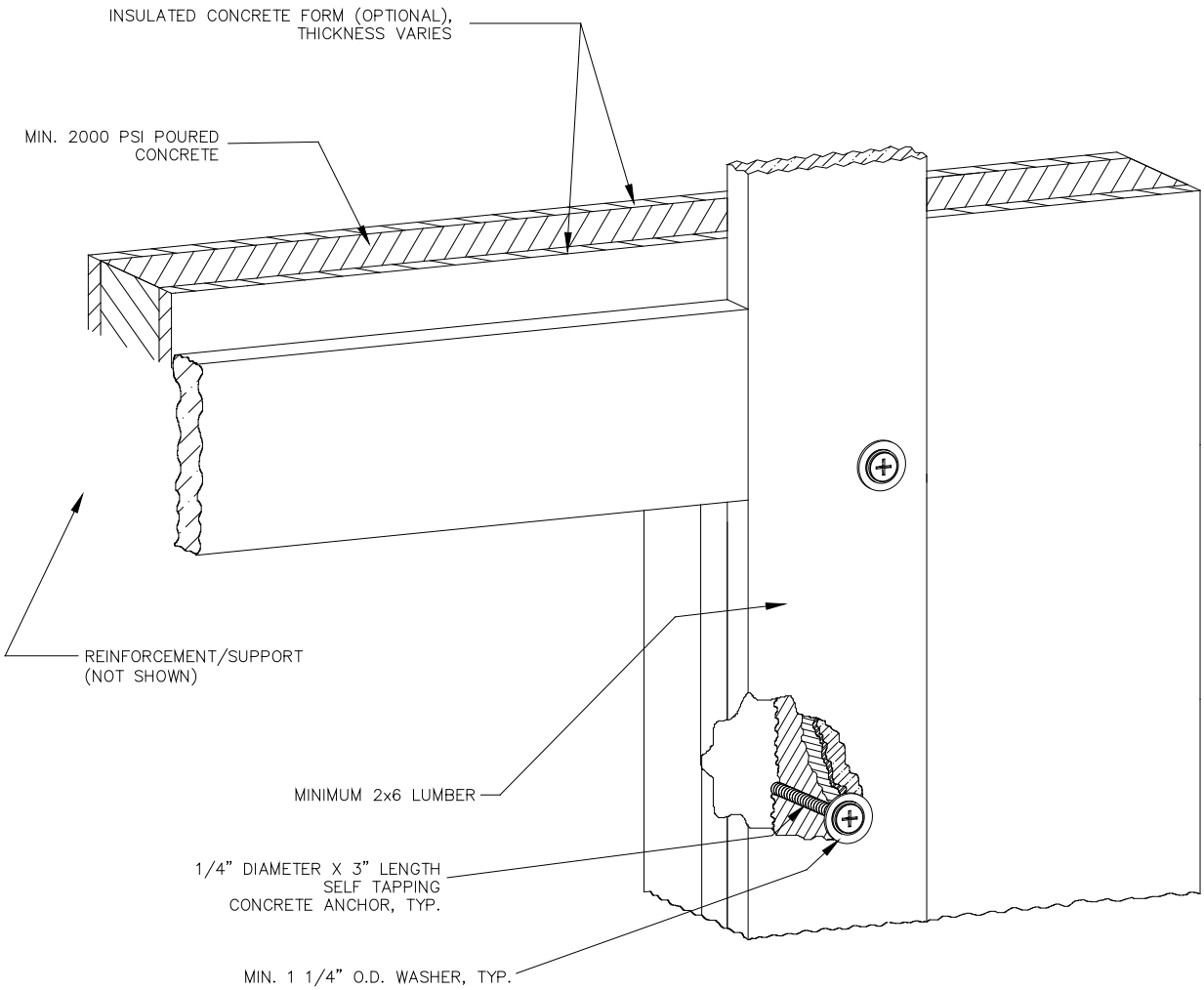
TDS 161a
SELF-TAPPING CONCRETE ANCHORS



- Alternate design may be approved by a registered professional engineer
- Alternate wall may be a Concrete Masonry Unit wall, using 3/8" diameter fasteners
- Wood jambs may be counter-bored up to 3/8" deep at each self-tapping concrete anchor location
- Spring pad connection not included

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TDS 161a – Self-Tapping Anchors into Filled CMU and Concrete

Grout-Filled CMU Block
Fasteners include:
3/8" Simpson Titen HD with 2-3/4" embedment, 4" min edge distance, 8" min spacing
480 lb/anchor allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	24
15 PSF	24	24	24	24	24	24	24
20 PSF	24	24	24	24	24	24	24
25 PSF	24	24	24	24	24	24	23
30 PSF	24	24	24	24	24	21	19
35 PSF	24	24	24	24	21	18	16
40 PSF	24	24	24	21	18	16	14
45 PSF	24	24	21	18	16	14	13
50 PSF	24	23	19	16	14	13	12
55 PSF	23	21	17	15	13	12	10
60 PSF	21	19	16	14	12	11	10

SEE NOTES FOR TDS 161a FOLLOWING THE CHARTS

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Min 2500 PSI Concrete
Fasteners include:
1/4" ITW Red Head Tapcon+ with 2" embedment, 1-5/8" min edge distance
1/4" Powers Wedge-Bolt+ with 1-3/4" embedment, 1-5/8" min edge distance
556 lb/anchor allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	24
15 PSF	24	24	24	24	24	24	24
20 PSF	24	24	24	24	24	24	24
25 PSF	24	24	24	24	24	24	24
30 PSF	24	24	24	24	24	24	22
35 PSF	24	24	24	24	24	21	19
40 PSF	24	24	24	24	21	19	17
45 PSF	24	24	24	21	19	16	15
50 PSF	24	24	22	19	17	15	13
55 PSF	24	24	20	17	15	13	12
60 PSF	24	22	19	16	14	12	11

SEE NOTES FOR TDS 161a FOLLOWING THE CHARTS

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Min 3000 PSI Concrete
Fasteners include:
1/4" ITW Red Head Tapcon+ with 2" embedment, 1-5/8" min edge distance
1/4" Powers Wedge-Bolt+ with 1-3/4" embedment, 1-5/8" min edge distance
609 lb/anchor allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	24
15 PSF	24	24	24	24	24	24	24
20 PSF	24	24	24	24	24	24	24
25 PSF	24	24	24	24	24	24	24
30 PSF	24	24	24	24	24	24	24
35 PSF	24	24	24	24	24	23	21
40 PSF	24	24	24	24	23	20	18
45 PSF	24	24	24	23	20	18	16
50 PSF	24	24	24	21	18	18	15
55 PSF	24	24	22	19	17	15	13
60 PSF	24	24	20	17	15	14	12

SEE NOTES FOR TDS 161a FOLLOWING THE CHARTS

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Min 4000 PSI Concrete
Fasteners include:
1/4" ITW Red Head Tapcon+ with 2" embedment, 1-5/8" min edge distance
1/4" Powers Wedge-Bolt+ with 1-3/4" embedment, 1-5/8" min edge distance
636 lb/anchor allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	24
15 PSF	24	24	24	24	24	24	24
20 PSF	24	24	24	24	24	24	24
25 PSF	24	24	24	24	24	24	24
30 PSF	24	24	24	24	24	24	24
35 PSF	24	24	24	24	24	24	22
40 PSF	24	24	24	24	24	21	19
45 PSF	24	24	24	24	21	19	17
50 PSF	24	24	24	22	19	17	15
55 PSF	24	24	23	20	17	15	14
60 PSF	24	24	21	18	16	14	13

NOTES FOR TDS 161a:

1. Anchors to be evenly spaced between the header and the floor.
2. First (bottom) anchor starting at no more than half of the maximum on-center distance. Highest anchor installed at least as high as the door opening.
3. Vertical jambs shall be minimum 2 x 6 lumber, free of cracks, splits and knots in the area of attachment fasteners.
4. Use with 1-1/4" min O.D. washers.
5. Special requirements for garage doors with center post systems. See manufacturer instructions for details.
6. Ratings determined per ACI 318 Appendix D
7. Supporting structural elements shall be designed by a registered professional engineer for wind loads in addition to other loads.
8. **SPACING LESS THAN 6 INCHES NOT RECOMMENDED**
9. It is acceptable to attach fastener directly through brackets or continuous angle into the concrete with no wood jambs, as long as the spacing and edge distances meet the requirements in the charts above.

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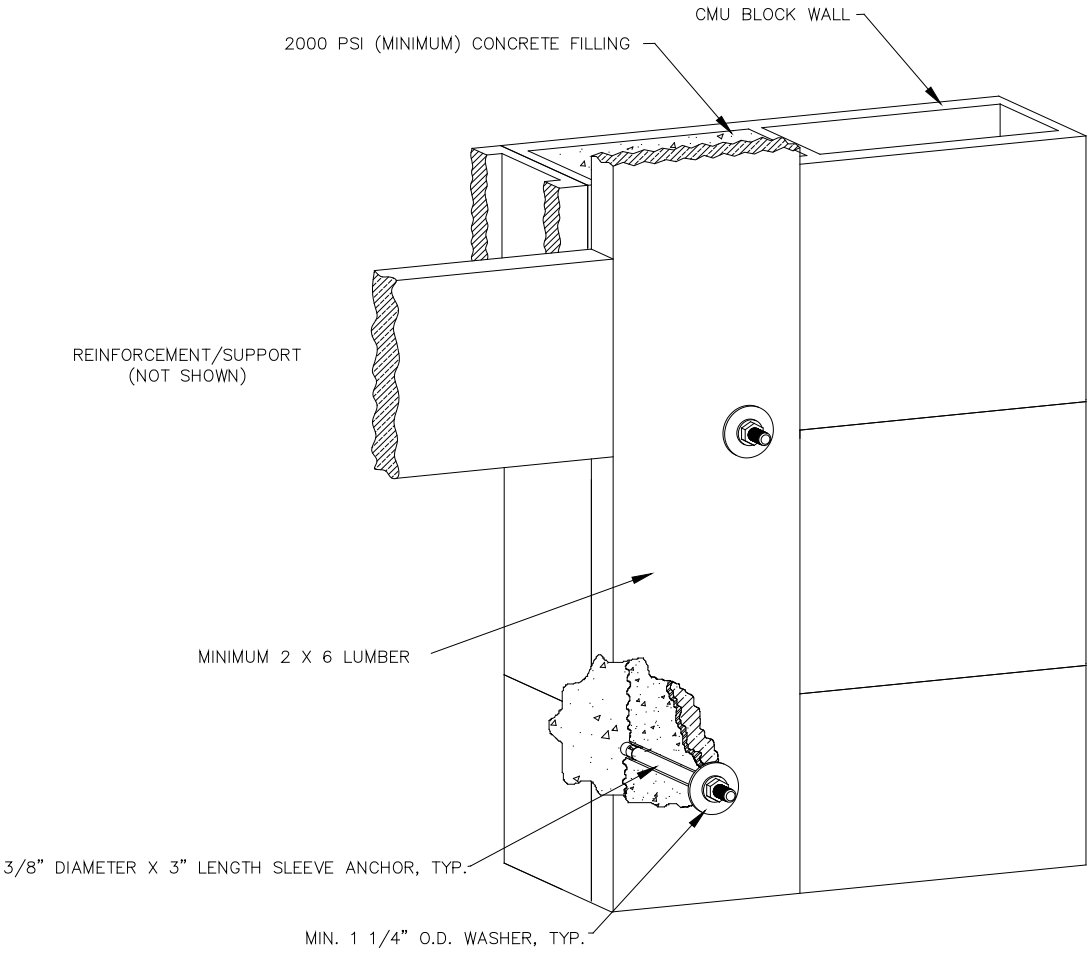
TDS 161b
SLEEVE ANCHORS



- Alternate design may be approved by a registered professional engineer
- Alternate wall may be a minimum 2000 psi poured concrete wall, with (optional) insulation
- Wood jambs may be counter-bored up to 3/8" deep at each sleeve anchor location
- Spring pad connection not included

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TDS 161b – Expansion Anchors into Filled CMU and Concrete

Southern Pine Jamb (Specific Gravity = 0.55), 2500 psi Min Concrete
556 lb/anchor allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	24
15 PSF	24	24	24	24	24	24	24
20 PSF	24	24	24	24	24	24	24
25 PSF	24	24	24	24	24	24	24
30 PSF	24	24	24	24	24	24	22
35 PSF	24	24	24	24	24	21	19
40 PSF	24	24	24	24	21	19	17
45 PSF	24	24	24	21	19	16	15
50 PSF	24	24	22	19	17	15	13
55 PSF	24	24	20	17	15	13	12
60 PSF	24	22	19	16	14	12	11

SEE NOTES FOR TDS 161b FOLLOWING THE CHARTS

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Spruce Pine Fir Jamb (Specific Gravity = 0.42), 2500 psi Min. Concrete
556 lb/anchor allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	24
15 PSF	24	24	24	24	24	24	24
20 PSF	24	24	24	24	24	24	24
25 PSF	24	24	24	24	24	24	24
30 PSF	24	24	24	24	24	24	22
35 PSF	24	24	24	24	24	21	19
40 PSF	24	24	24	24	21	19	17
45 PSF	24	24	24	21	19	16	15
50 PSF	24	24	22	19	17	15	13
55 PSF	24	24	20	17	15	13	12
60 PSF	24	22	19	16	14	12	11

NOTES FOR TDS 161b:

1. Anchors to be evenly spaced between the header and the floor.
2. First (bottom) anchor starting at no more than half of the maximum on-center distance. Highest anchor installed at least as high as the door opening.
3. Anchor spacing calculated from loads per Simpson Strong-Tie online performance data and ANSI/AF&PA NDS-2005 for Wood Construction.
4. Vertical jambs shall be minimum 2 x 6 lumber, free of cracks, splits and knots in the area of attachment fasteners.
5. Use washers provided by anchor manufacturer with additional 1-1/4" flat washer.
6. Special requirements for garage doors with center post systems. See manufacturer instructions for details.
7. Supporting structural elements shall be designed by a registered professional engineer for wind loads in addition to other loads.
8. **SPACING LESS THAN 6 INCHES NOT RECOMMENDED IN CONCRETE.**
9. **SPACING LESS THAN 8 INCHES NOT ALLOWED WITH CMU.**
10. It is acceptable to attach fastener directly through brackets or continuous angle into the concrete with no wood jambs, as long as the spacing and edge distances meet the requirements in the charts above.

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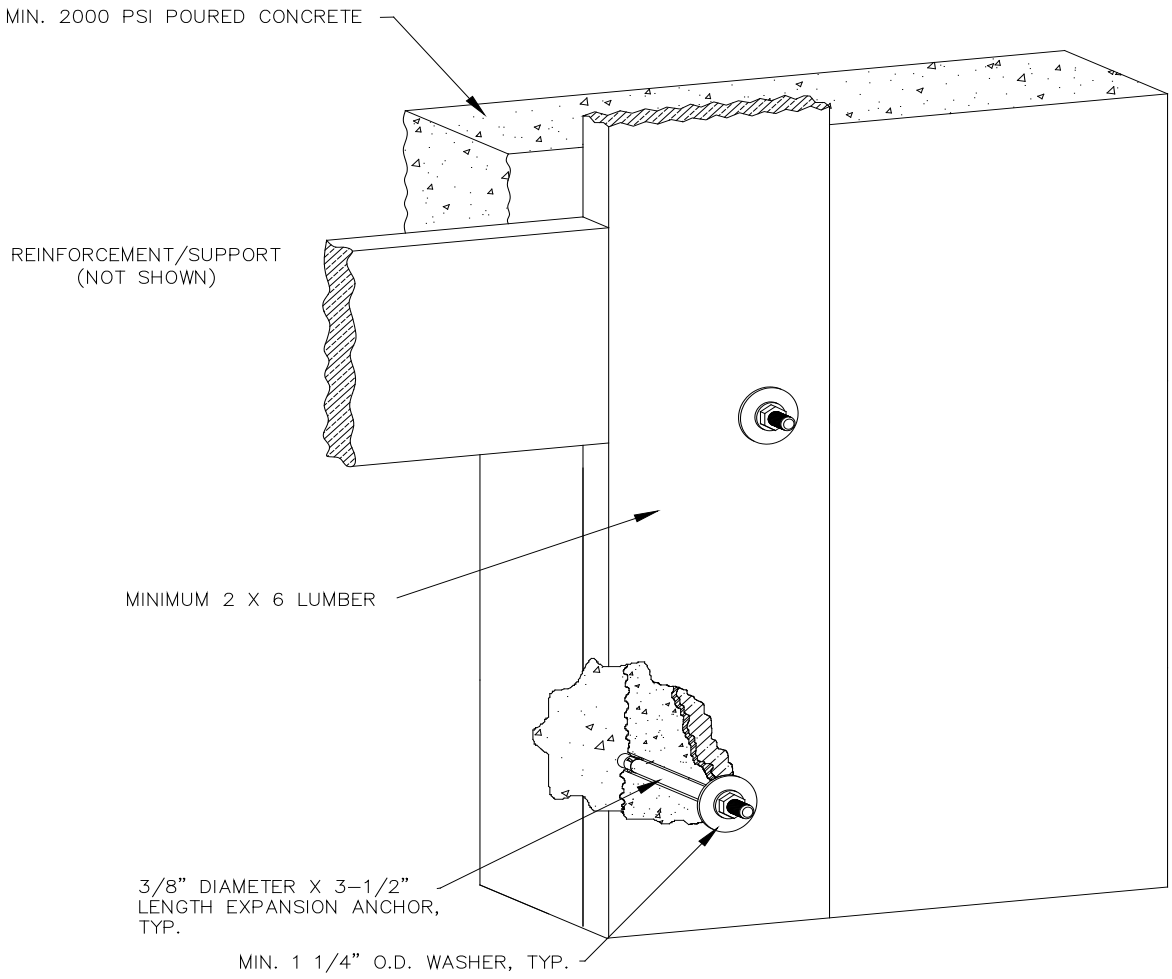
TDS 161c
EXPANSION (WEDGE) ANCHORS



- Alternate design may be approved by a registered professional engineer
- Alternate wall may be a Concrete Masonry Unit wall
- Wood jambs may be counter-bored up to 3/8 deep at each wedge anchor location
- Spring pad connection not included

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TDS 161c – 3/8" x 3-1/2" Expansion (Wedge) Anchors (1-1/2" Embedment)

Reference: Simpson Strong-Tie Online Load Tables, www.simpsonanchors.com,
ANSI/AF&PA NDS-2005 for Wood Construction, p. 22, 28, 74

Southern Pine Jamb (Specific Gravity = 0.55), 2000 psi Min Concrete
468 lb/anchor allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	24
15 PSF	24	24	24	24	24	24	24
20 PSF	24	24	24	24	24	24	24
25 PSF	24	24	24	24	24	24	22
30 PSF	24	24	24	24	23	21	19
35 PSF	24	24	24	23	20	18	16
40 PSF	24	24	23	20	18	16	14
45 PSF	24	24	21	18	16	14	12
50 PSF	24	22	19	16	14	12	11
55 PSF	23	20	17	15	13	11	10
60 PSF	21	19	16	13	12	10	9

SEE NOTES FOR TDS 161c FOLLOWING THE CHARTS

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Spruce-Pine-Fir Jamb (Specific Gravity = 0.42), 2000 psi Min Concrete
468 lb/anchor allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	24
15 PSF	24	24	24	24	24	24	24
20 PSF	24	24	24	24	24	24	24
25 PSF	24	24	24	24	24	24	22
30 PSF	24	24	24	24	23	21	19
35 PSF	24	24	24	23	20	18	16
40 PSF	24	24	23	20	18	16	14
45 PSF	24	24	21	18	16	14	12
50 PSF	24	22	19	16	14	12	11
55 PSF	23	20	17	15	13	11	10
60 PSF	21	19	16	13	12	10	9

NOTES FOR TDS 161c:

1. Anchors to be evenly spaced between the header and the floor.
2. First (bottom) anchor starting at no more than half of the maximum on-center distance. Highest anchor installed at least as high as the door opening.
3. Anchor spacing calculated from loads per Simpson Strong-Tie online performance data and ANSI/AF&PA NDS-2005 for Wood Construction.
4. Vertical jambs shall be minimum 2 x 6 lumber, free of cracks, splits and knots in the area of attachment fasteners.
5. Use washers provided by anchor manufacturer with additional 1-1/4" flat washer.
6. Special requirements for garage doors with center post systems. See manufacturer instructions for details.
7. Supporting structural elements shall be designed by a registered professional engineer for wind loads in addition to other loads.
8. **SPACING LESS THAN 6 INCHES NOT RECOMMENDED.**
9. It is acceptable to attach fastener directly through brackets or continuous angle into the concrete with no wood jambs, as long as the spacing and edge distances meet the requirements in the charts above.

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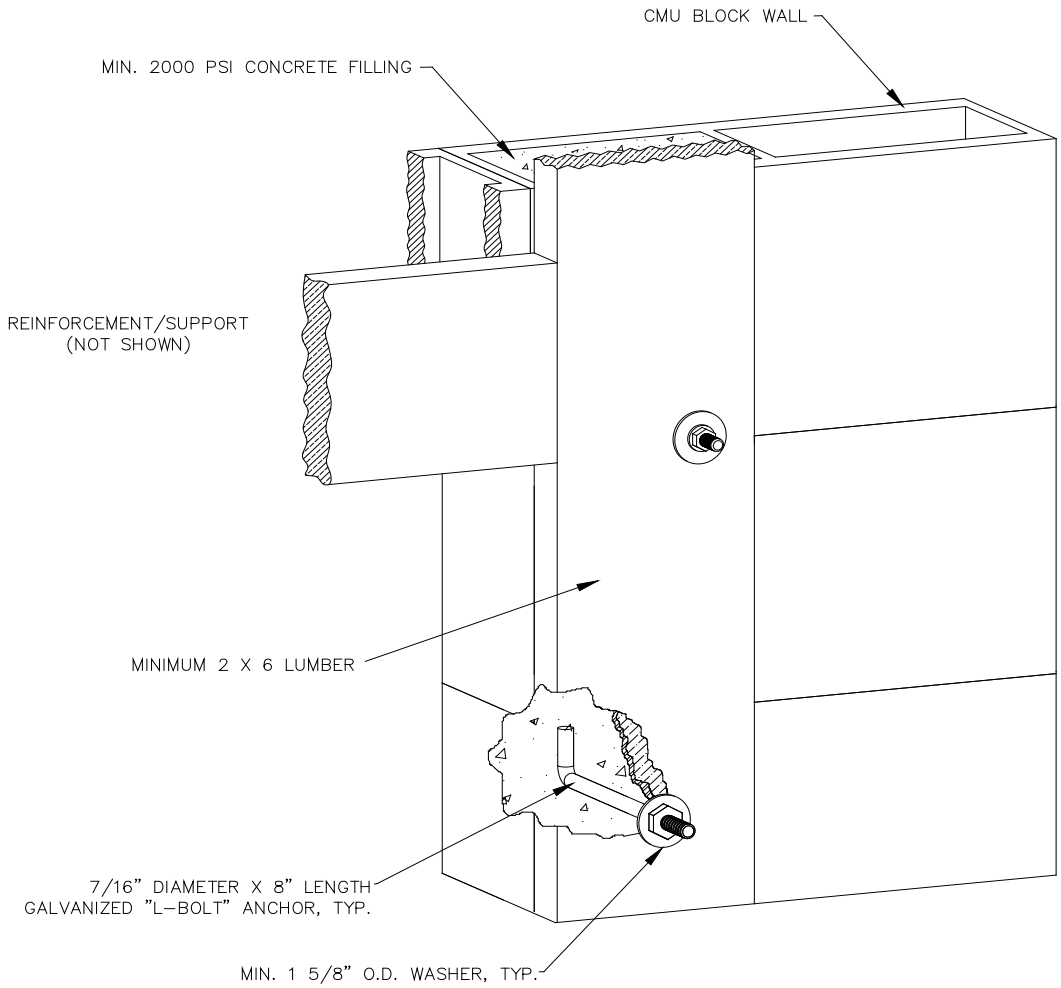
TDS 161d
GALVANIZED L-BOLT ANCHORS



- Alternate design may be approved by a registered professional engineer
- Alternate wall may be minimum 2000 psi poured concrete, with (optional) insulation
- Wood jambs may be counter-bored up to 3/8 deep at each anchor location
- Spring pad connection not included

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TDS 161d – 7/16” x 8” Galvanized L-Bolt Anchors

Reference: ANSI/AF&PA NDS for Wood Construction, p. 22, 28, 74

957 lb/anchor allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0”	10'-0”	12'-0”	14'-0”	16'-0”	18'-0”	20'-0”
10 PSF	36	36	36	36	36	36	36
15 PSF	36	36	36	36	36	36	36
20 PSF	36	36	36	36	36	36	36
25 PSF	36	36	36	36	36	36	36
30 PSF	36	36	36	36	36	36	36
35 PSF	36	36	36	36	36	36	33
40 PSF	36	36	36	36	36	32	29
45 PSF	36	36	36	36	32	28	26
50 PSF	36	36	36	33	29	26	23
55 PSF	36	36	35	30	26	23	21
60 PSF	36	36	32	27	24	21	19

NOTES FOR TDS 161d:

1. Anchors to be evenly spaced between the header and the floor.
2. First (bottom) anchor starting at no more than half of the maximum on-center distance. Highest anchor installed at least as high as the door opening.
3. Anchor spacing calculated from loads per ASTM A307 and ANSI/AF&PA NDS-2005 for Wood Construction.
4. Vertical jambs shall be minimum 2 x 6 lumber, free of cracks, splits and knots in the area of attachment fasteners.
5. Use with 1-5/8” min O.D. washers.
6. Special requirements for garage doors with center post systems. See manufacturer instructions for details.
7. Supporting structural elements shall be designed by a registered professional engineer for wind loads in addition to other loads.
8. 7/16” diameter mounting holes to be drilled in 2 x 6 to match bolt pattern.
9. **SPACING LESS THAN 6 INCHES NOT RECOMMENDED.**

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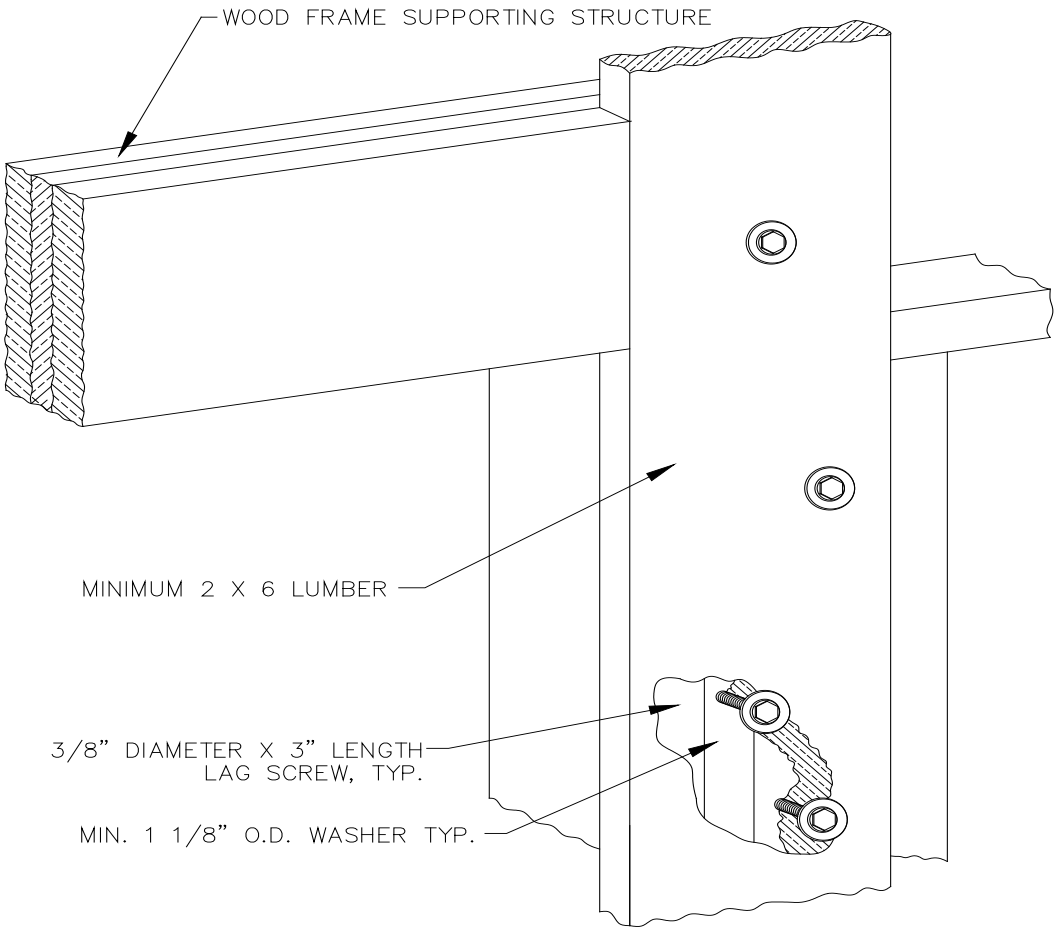
TDS 161e
LAG SCREWS



- Alternate design may be approved by a registered professional engineer.
- Wood jambs may be counterbored up to 1/2" deep at each lag screw location.
- Wood jamb width should allow connection to as many full length vertical framing members as possible.
- Lag screws should connect vertical jamb to full-height vertical framing members at door opening, and should be located away from framing member edges.
- Spring pad connection not included.

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TDS 161e – 3/8" x 3" Lag Screw W/ 1-1/8" Dia. Washer (1-1/2" Embedment)

Reference: ANSI/AF&PA NDS-2005 for Wood Construction, p. 9, 59, 68, 74, 166

Southern Pine, Specific Gravity = 0.55
655 lb/anchor allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	24
15 PSF	24	24	24	24	24	24	24
20 PSF	24	24	24	24	24	24	24
25 PSF	24	24	24	24	24	24	24
30 PSF	24	24	24	24	24	24	24
35 PSF	24	24	24	24	24	24	22
40 PSF	24	24	24	24	24	22	20
45 PSF	24	24	24	24	22	19	17
50 PSF	24	24	24	22	20	17	16
55 PSF	24	24	24	20	18	16	14
60 PSF	24	24	22	19	16	15	13

SEE NOTES FOR TDS 161e FOLLOWING THE CHARTS

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Spruce-Pine-Fir, Specific Gravity = 0.42
482 lb/anchor allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	24
15 PSF	24	24	24	24	24	24	24
20 PSF	24	24	24	24	24	24	24
25 PSF	24	24	24	24	24	24	23
30 PSF	24	24	24	24	24	21	19
35 PSF	24	24	24	24	21	18	17
40 PSF	24	24	24	21	18	16	14
45 PSF	24	24	21	18	16	14	13
50 PSF	24	23	19	17	14	13	12
55 PSF	23	21	18	15	13	12	11
60 PSF	21	19	16	14	12	11	10

NOTES FOR TDS 161e:

1. Anchors to be evenly spaced between the header and the floor.
2. First (bottom) anchor starting at no more than half of the maximum on-center distance. Highest anchor installed at least as high as the door opening.
3. Anchor spacing calculated from loads per ANSI/AF&PA NDS-2005 for Wood Construction.
4. Vertical jambs shall be minimum 2 x 6 lumber, free of cracks, splits and knots in the area of attachment fasteners.
5. Use with 1-1/8" min O.D. washers.
6. Special requirements for garage doors with center post systems. See manufacturer instructions for details.
7. Supporting structural elements shall be designed by a registered professional engineer for wind loads in addition to other loads.
8. Pre-drill 1/4" diameter holes.
9. Lag screws must conform to ANSI/ASME Standard B18.2.1.
10. **SPACING LESS THAN 6 INCHES NOT RECOMMENDED.**

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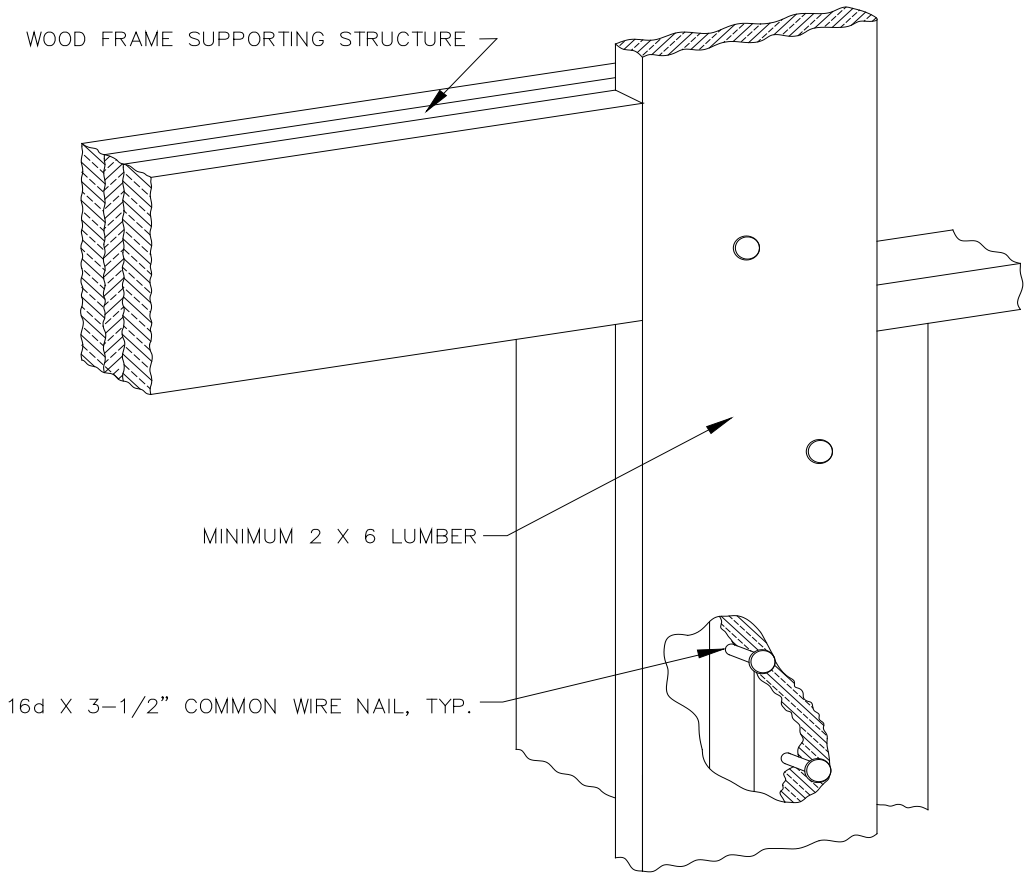
TDS 161f
COMMON WIRE NAILS



- Alternate design may be approved by a registered professional engineer
- Wood jamb width should allow connection to as many full length vertical framing members as possible
- Nails should have a minimum edge distance of 1-1/2" from alternating vertical jamb edges, for maximum holding power and to minimize jamb cross-grain bending
- Nails should connect vertical jamb to full-height vertical framing members at door opening, and should be located away from framing member edges
- Spring pad connection not included

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TDS 161f – 16d x 3-1/2" Common Wire Nails (2" Min Embedment)

Reference: 2005 NDS-2005 for Wood Construction, p. 9, 59, 70, 74, 167)

Southern Pine, Specific Gravity = 0.55
160 lb/anchor allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	21	19
15 PSF	24	24	21	18	16	14	13
20 PSF	21	19	16	14	12	11	10
25 PSF	17	15	13	11	10	9	8
30 PSF	14	13	11	9	8	7	6
35 PSF	12	11	9	8	7	6	-
40 PSF	11	10	8	7	6	-	-
45 PSF	9	9	7	6	-	-	-
50 PSF	9	8	6	-	-	-	-
55 PSF	8	7	6	-	-	-	-
60 PSF	7	6	-	-	-	-	-

SEE NOTES FOR TDS 161f FOLLOWING THE CHARTS

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Spruce-Pine-Fir, Specific Gravity = 0.42
83 lb/anchor allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	22	20	17	14	12	11	10
15 PSF	15	13	11	9	8	7	7
20 PSF	11	10	8	7	6	6	-
25 PSF	9	8	7	6	-	-	-
30 PSF	7	7	6	-	-	-	-
35 PSF	6	6	-	-	-	-	-
40 PSF	6	-	-	-	-	-	-
45 PSF	-	-	-	-	-	-	-
50 PSF	-	-	-	-	-	-	-
55 PSF	-	-	-	-	-	-	-
60 PSF	-	-	-	-	-	-	-

NOTES FOR TDS 161f:

1. Anchors to be evenly spaced between the header and the floor.
2. First (bottom) anchor starting at no more than half of the maximum on-center distance. Highest anchor installed at least as high as the door opening.
3. Anchor spacing calculated from loads per ANSI/AF&PA NDS2005 for Wood Construction.
4. Vertical jambs shall be minimum 2 x 6 lumber, free of cracks, splits and knots in the area of attachment fasteners.
5. Special requirements for garage doors with center post systems. See manufacturer instructions for details.
6. Supporting structural elements shall be designed by a registered professional engineer for wind loads in addition to other loads.
7. Nails must conform to ASTM F1667.
8. **SPACING LESS THAN 6 INCHES NOT RECOMMENDED.**

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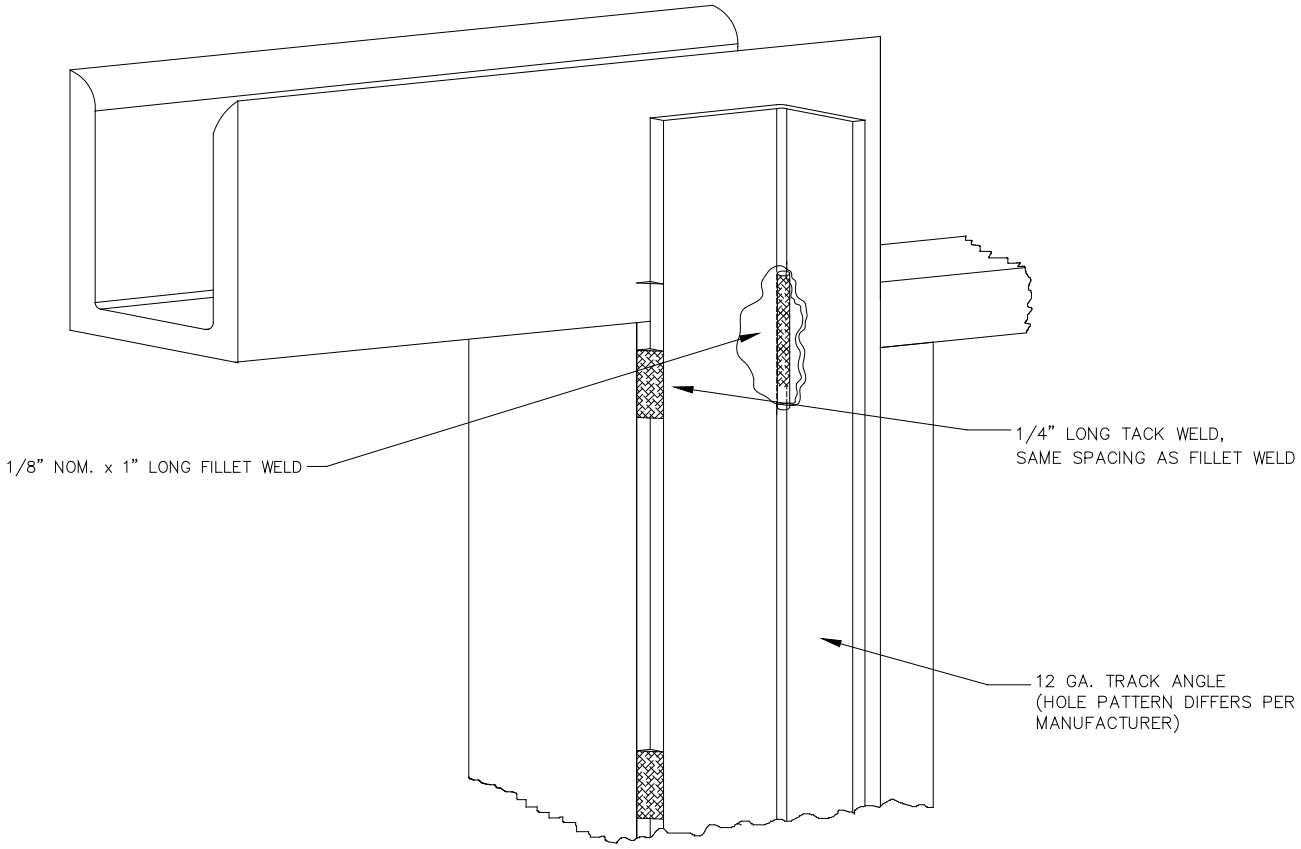
TDS 161g
0.100" x 1" Long Fillet Weld (E60xx Electrodes Min) Into 1/8" Min Steel Jambs



- Alternate design may be approved by a registered professional engineer.
- Spring pad connection not included.

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TDS 161g – .100" x 1" Long Fillet Weld (E60xx Electrodes Min)

Reference: AISC Manual of Steel Construction Allowable Stress Design (9th Edition) p. 5-67, 5-70.

1,272 lb/weld allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	24
15 PSF	24	24	24	24	24	24	24
20 PSF	24	24	24	24	24	24	24
25 PSF	24	24	24	24	24	24	24
30 PSF	24	24	24	24	24	24	24
35 PSF	24	24	24	24	24	24	24
40 PSF	24	24	24	24	24	24	24
45 PSF	24	24	24	24	24	24	24
50 PSF	24	24	24	24	24	24	24
55 PSF	24	24	24	24	24	24	24
60 PSF	24	24	24	24	24	24	24

NOTES FOR TDS 161g:

1. **Most garage door industry track is galvanized steel. Use all necessary precautions when welding galvanized steel.**
2. Welds to be evenly spaced between the header and the floor.
3. First (bottom) weld starting at no more than half of the maximum on-center distance. Highest weld at least as high as the door opening.
4. All welds should be performed by a Certified Welder or inspected by a Certified Welding Inspector to verify the integrity of the welds.
5. Fillet welds to have a straight or convex face surface.
6. Tack weld toe of angle at same spacing to prevent rotation of track angle.
7. Cracks and blemishes shall be ground to a smooth contour and checked to ensure soundness.
8. Special requirements for garage doors with center post systems. See manufacturer instructions for details.
9. Supporting structural elements shall be designed by a registered professional engineer for wind loads in addition to other loads.

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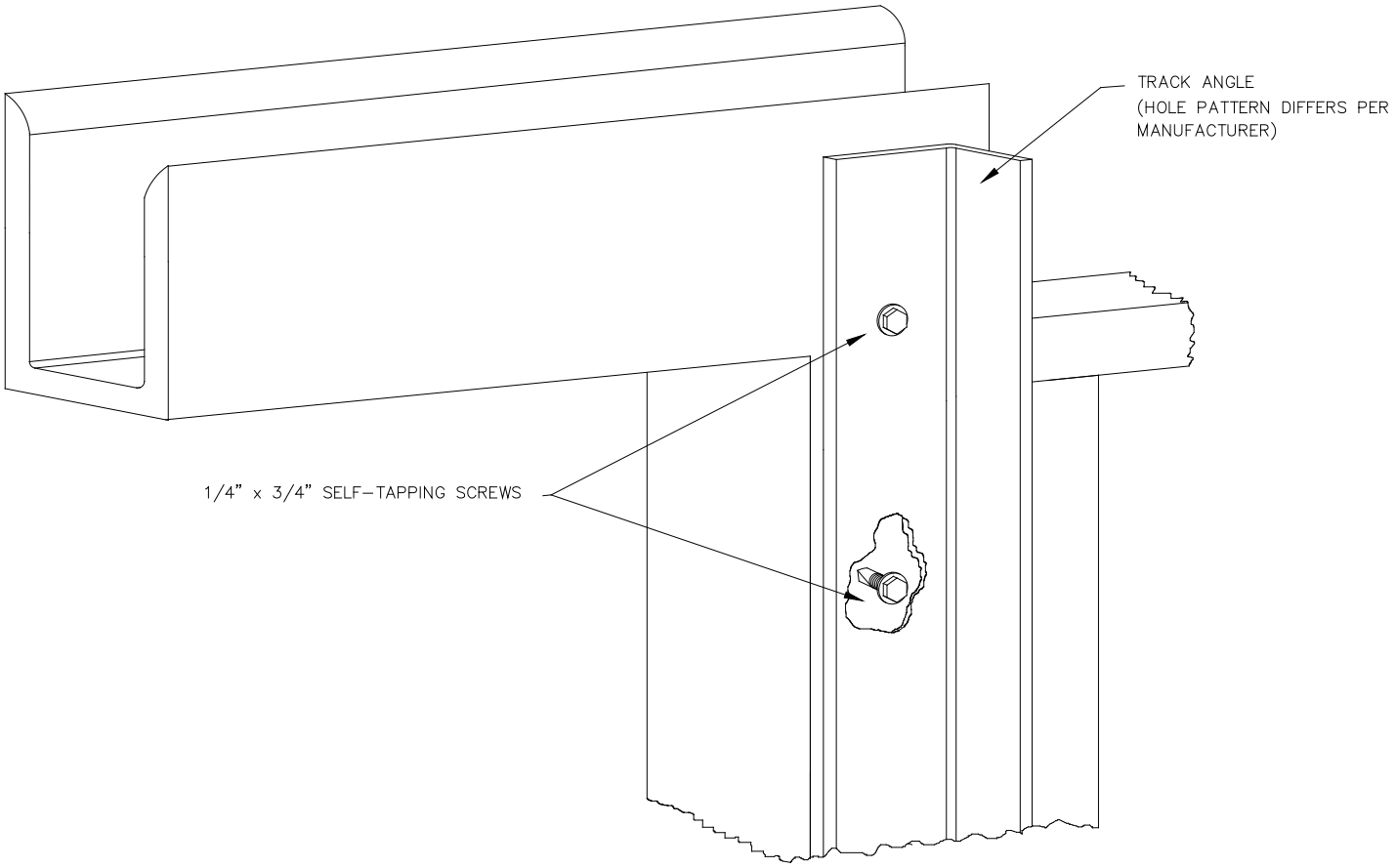
TDS 161h
SELF-TAPPING SCREWS INTO STEEL



- Alternate design may be approved by a registered professional engineer
- Spring pad connection not included

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TDS 161h – 1/4" x 3/4" Self-Tapping Screws

Reference: ITW Buildex ICC-ES Evaluation Report ESR-1976 (Table 2)

16 ga. (.056") Steel Jambs
191 lb/screw allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	22
15 PSF	24	24	24	21	19	16	15
20 PSF	24	22	19	16	14	12	11
25 PSF	20	18	15	13	11	10	9
30 PSF	16	15	12	10	9	8	7
35 PSF	14	13	10	9	8	7	6
40 PSF	12	11	9	8	7	6	-
45 PSF	11	10	8	7	6	-	-
50 PSF	10	9	7	6	-	-	-
55 PSF	9	8	6	-	-	-	-
60 PSF	8	7	6	-	-	-	-

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14 ga.(.075") Steel Jambs
239 lb/screw allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	24
15 PSF	24	24	24	24	23	21	19
20 PSF	24	24	23	20	17	15	14
25 PSF	24	22	19	16	14	12	11
30 PSF	21	19	15	13	11	10	9
35 PSF	18	16	13	11	10	9	8
40 PSF	15	14	11	10	8	7	7
45 PSF	14	12	10	9	7	7	6
50 PSF	12	11	9	8	7	6	-
55 PSF	11	10	8	7	6	-	-
60 PSF	10	9	7	6	-	-	-

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12 ga. (.105") Steel Jambs
335 lb/screw allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	24
15 PSF	24	24	24	24	24	24	24
20 PSF	24	24	24	24	24	24	23
25 PSF	24	24	24	24	23	21	19
30 PSF	24	24	24	22	19	17	15
35 PSF	24	24	22	19	17	15	13
40 PSF	24	23	19	17	14	13	11
45 PSF	23	21	17	15	13	11	10
50 PSF	21	19	15	13	11	10	9
55 PSF	19	17	14	12	10	9	8
60 PSF	17	15	13	11	9	8	7

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1/8" (.125") Steel Jambs
398 lb/screw allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	24
15 PSF	24	24	24	24	24	24	24
20 PSF	24	24	24	24	24	24	23
25 PSF	24	24	24	24	23	21	19
30 PSF	24	24	24	22	19	17	15
35 PSF	24	24	22	19	17	15	13
40 PSF	24	23	19	17	14	13	11
45 PSF	23	21	17	15	13	11	10
50 PSF	21	19	15	13	11	10	9
55 PSF	19	17	14	12	10	9	8
60 PSF	17	15	13	11	9	8	7

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3/16" (.187") Steel Jambs
596 lb/screw allowable load

	Maximum Spacing (INCHES)						
Door Width (ft) → Design Load	9'-0"	10'-0"	12'-0"	14'-0"	16'-0"	18'-0"	20'-0"
10 PSF	24	24	24	24	24	24	24
15 PSF	24	24	24	24	24	24	24
20 PSF	24	24	24	24	24	24	24
25 PSF	24	24	24	24	24	24	24
30 PSF	24	24	24	24	24	24	23
35 PSF	24	24	24	24	24	22	20
40 PSF	24	24	24	24	22	19	17
45 PSF	24	24	24	22	19	17	15
50 PSF	24	24	23	20	17	15	14
55 PSF	24	24	21	18	16	14	13
60 PSF	24	23	19	17	14	13	11

NOTES FOR TDS 161h:

1. Screws to be evenly spaced between the header and the floor.
2. First (bottom) screw starting at no more than half of the maximum on-center distance. Highest screw installed at least as high as the door opening.
3. Special requirements for garage doors with center post systems. See manufacturer instructions for details.
4. Supporting structural elements shall be designed by a registered professional engineer for wind loads in addition to other loads.
5. **SPACING LESS THAN 6 INCHES NOT RECOMMENDED.**

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