



# Research Report

## Overdriven Nails in Structural Sheathings

SRR No. 1506-15

Structural Building Components Association (SBCA)

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This research report is based on practical scientific research (literature review, testing, analysis, etc.), with the goal of supporting strategic needs for code and standards development and market expansion. This research report complies with the following sections of the building code:

- [IBC Section 104.11.1](#) and [Section 1703.4.2](#) – "**Research reports.** Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from *approved sources*."
- [IBC Section 202](#) – "**APPROVED SOURCE.** An independent person, firm or corporation, *approved* by the *building official*, who is competent and experienced in the application of engineering principles to materials, methods or systems analyses."

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### **Introduction:**

All building codes provide provisions for the attachment of structural sheathing to wall and roof framing members. These connections are important because they often are the mechanism used to provide the lateral shear resistance of the building. In other words, the building's ability to resist the loads imposed by wind and seismic events are dependent on these connections. When building designers design buildings, they rely on data as published in the building codes and referenced standards or from proprietary sources.

In almost every case, the published capacity of the sheathing and fasteners assume the head of the fastener is flush with the surface of the sheathing. In cases where the fasteners used to attach the structural sheathing to the framing are overdriven (i.e. embedded beneath the surface of the sheathing), the building may not be able to resist the intended loads. Overdriven fasteners reduce the shear strength of the sheathing by reducing the effective thickness of the panel. At panel edges, overdriven fasteners allow for easier pull-through or tear-out due to the reduced thickness of the panel at the fastener head. At intermediate framing members, overdriven fasteners provide reduced resistance to panel buckling.

When overdriven fasteners are identified, there is no guidance in the International Building Code (*IBC*), International Residential Code (*IRC*) or ANSI/AWC National Design Specification for Wood Construction (*NDS*) as to what the capacity reduction is for the overdriven fasteners nor what corrective action could be taken to rectify the situation.

### **Key Definitions:**

**Overdriven** – Head or crown of the fastener embedded beneath the surface of the sheathing.

### **Background:**

#### ***IBC 2009 & 2012<sup>1</sup>***

The *IBC* only outlines, in a perfect world, how sheathing fasteners should be installed, and not how to resolve situations where fasteners have been installed improperly:

**2304.9.2 Sheathing fasteners.** Sheathing nails or other *approved* sheathing connectors shall be driven so that their head or crown is flush with the surface of the sheathing.

This same requirement is not included in the *IRC*. However, since the prescriptive requirements are based on testing or calculations that assume the fasteners are driven flush to the surface of the sheathing, it is still necessary to achieve the intended function of the prescriptive requirements. Regardless of code requirements for the sheathing fastener (spacing, diameter, length, etc.) the fastener must be driven flush with the sheathing surface to achieve the intended capacity of the wall system.

### **Analysis:**

#### ***National Design Specification for Wood Construction (NDS)***

The 2015 *NDS* does not address the issue of over-driven nails but does offer design values for dowel-type fasteners in Chapter 12. These design values are calculated assuming fasteners are installed correctly.

#### ***International Building Code (IBC)***

The 2009 and 2012 *IBC* Commentary for Section 2304.9.2 provide the following information regarding overdriven fasteners:

This requirement is a matter of workmanship (see Figure 2304.9.2 for an illustration of a nail driven to fasten sheathing properly). Protruding nails do not provide the intended connecting capacity and could be hazardous. Likewise, nails overdriven into structural sheathing may not perform as expected. Framing installation is often less than perfect and fasteners are overdriven to a point where the top layer of sheathing is crushed beneath the nail head. An occasional overdriven nail may not be significant. As the percentage of overdriven fasteners increases, the issue raised is at what point does this adversely affect the shear capacity of a diaphragm or shear wall

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<sup>1</sup> 2015 *IBC* Section 2304.10.2

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element. The APA has recognized that this is a common occurrence and has made a guideline available at no cost on its website ([www.apawood.org](http://www.apawood.org)). Another condition to be aware of in sheathing nailing is where the depth of the supporting member is less than the length of a commonly used fastener, such as in a case where sheathing will be applied over the top of flat decking. Shorter nails are available for these situations, but the holding and shear capacities are typically reduced.

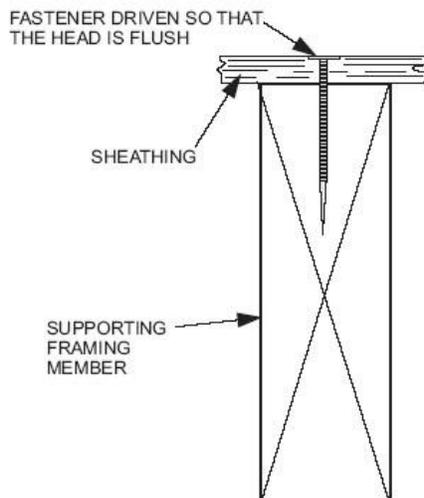


Figure 2304.9.2

### Engineered Wood Association (APA)

The topic of overdriven fasteners is however covered in a [publication](#) from the APA titled “Technical Topics: Form TT-012B, *Effects of Overdriven Fasteners on Shear Capacity*”. In it, APA recommends the following guidelines for determining if overdriven fasteners will indeed affect the shear capacity of a given wall assembly:

1. If any of the following are met, then no reduction in shear capacity needs to be taken:
  - All nails are overdriven into panels by no greater than 1/16” under dry conditions (moisture content less than 16%)
  - No more than 20% of the perimeter fasteners are overdriven by no greater than 1/8”
  - All perimeter fasteners are overdriven by the same amount and it appears that wetting occurred during construction, fastener embedment may be due to panel swelling in thickness. This can be verified by measuring the thickness of panels where fasteners appear to be over-driven, and comparing the measurements where panels have been protected from the weather, or the original nominal panel thickness
  - If panels installed are thicker than that required for panel shear capacity, and the overdriving is less than or equal to the difference between the two panel thicknesses.

For example: re-analyze capacity based on average thickness of panel measured from the bottom of the fastener head. (i.e. 5/8” panel with fasteners overdriven by 1/8” would have the capacity of 1/2” panel.) Adjust nailing schedule accordingly.

2. If any of the following are met, then a reduction in shear capacity needs to be taken:
  - If > 20% of the fasteners around the perimeter are overdriven by over 1/16”, or if any are overdriven by more than 1/8”, then add 1 additional fastener for every 2 that are overdriven. If the additional nails violate the minimum spacing requirements (3” o.c. for 2 inch lumber for splitting), use staples for the additional fasteners to reduce the potential for splitting.

### Timber Engineering Company (TECO)

Independent third-party certification agency, TECO, addresses overdriven nails in their [Tech Tip](#). The publication outlines an example of calculating reduction in shear capacity and draws attention to the various other factors that impact shear capacity including fastener type, size, and spacing, amount of penetration into the framing members, wood species, width of framing members, etc.

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Consider the following example:

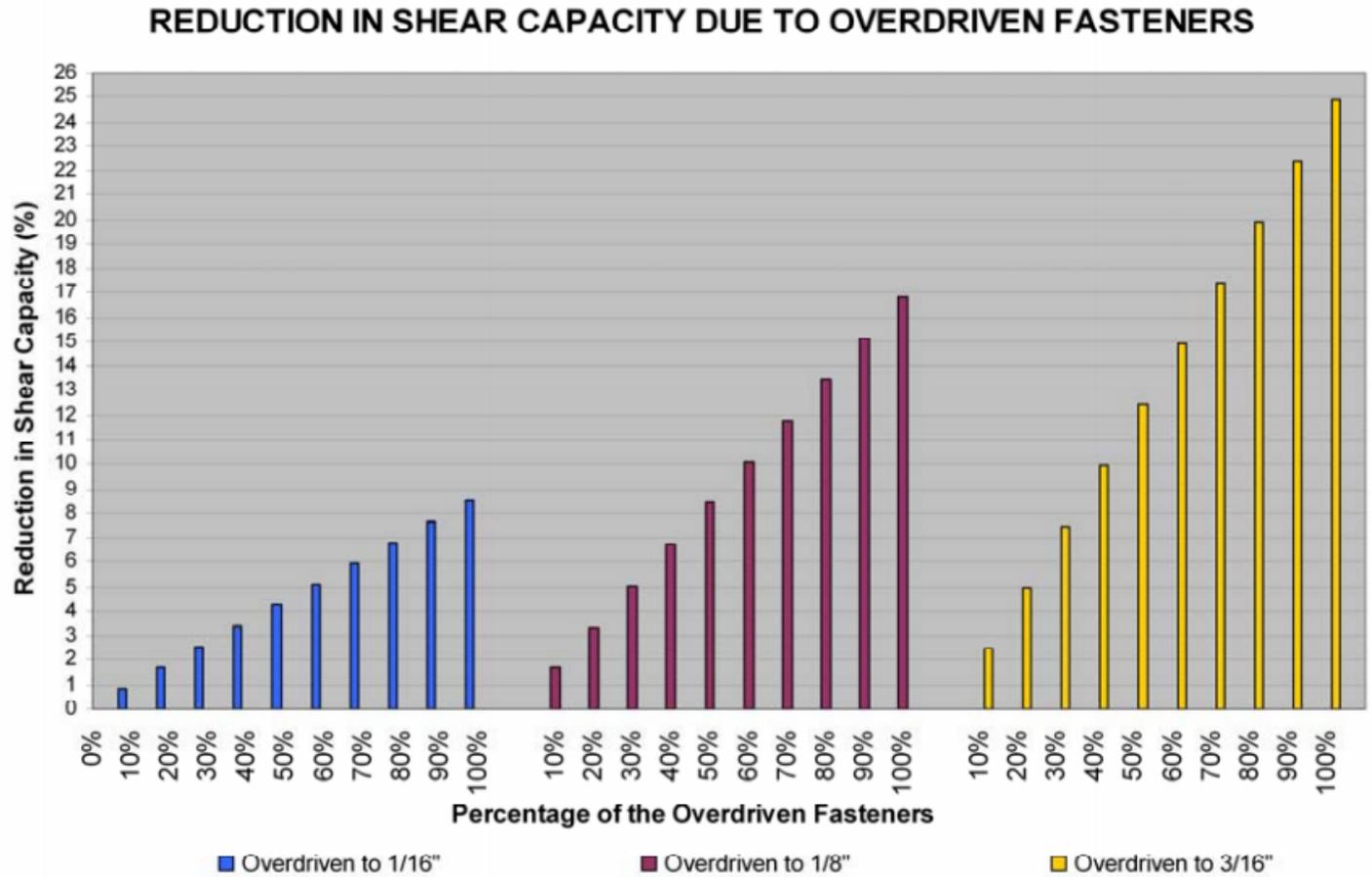
Assume that 20% of the nails in a shear wall are driven flush with the sheathing and the remaining nails are overdriven as follows:

- 30% between flush up to 1/16",
- 40% between 1/16" up to 1/8", and
- 10% between 1/8" up to 3/16".

Using the chart (see [Figure 1](#)), an estimate of the reduction in shear capacity based on the number and magnitude of overdriven nails would be:

- 20% flush = 0% reduction
- 30% up to 1/16" ≈ 2.6% reduction
- 40% between 1/16" up to 1/8" ≈ 6.7% reduction
- 10% between 1/8" up to 3/16" ≈ 2.5% reduction

Total Reduction ≈ 11.8%



**Figure 1:** TECO Chart of Reduction in Shear Capacity Due to Overdriven Fasteners

## Conclusion

When sheathing fasteners are overdriven, the sheathing panel or structure should be evaluated to determine the impact of the overdriven fasteners on the shear performance of the building. If it is determined that a sufficient number of fasteners are overdriven, corrective action per APA or TECO recommendations should be followed.

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### References

*ANSI/AWC National Design Specification for Wood Construction*; American Wood Council; 2015.

*APA – Engineered Wood Association*, 2011, “Effect of Overdrive Fasteners on Shear Capacity,” TT-012B.

*Timber Engineering Company*, 2008, “Reduction in Shear Capacity Due to Overdriven Fasteners,” V1.0.

*International Building Code*, International Code Council; 2015