INFORMATION SHEET

STRUCTURAL CONNECTIONS

NAILS
APPLICATIONS

The information provided below has been taken from the New Zealand Timber Design Guide 2007, published by the Timber Industry Federation and edited by Professor A H Buchanan. To purchase a copy of the Timber Design Guide, visit www.nztif.co.nz

TIMBER TO TIMBER JOINT

Timber to timber joints are typically joint used for house construction. The nails are usually loaded in shear (see diagram 1), although the nails can provide withdrawal strength as well (see diagram 2).

Diagram 1: Deformation of a typical nailed joint loaded in shear

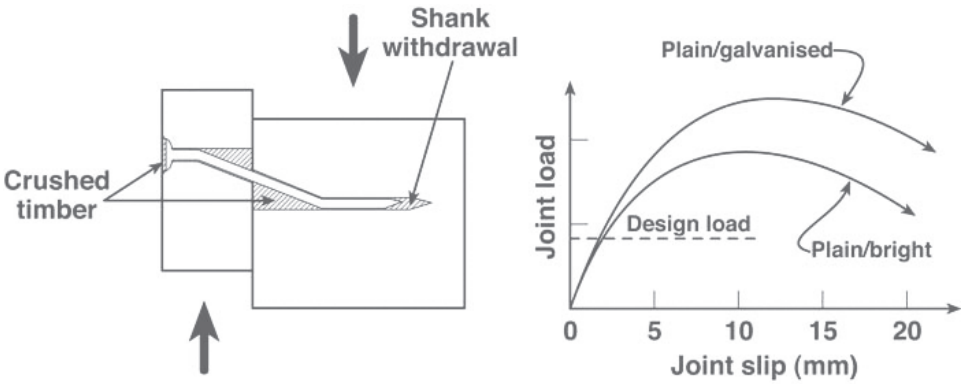
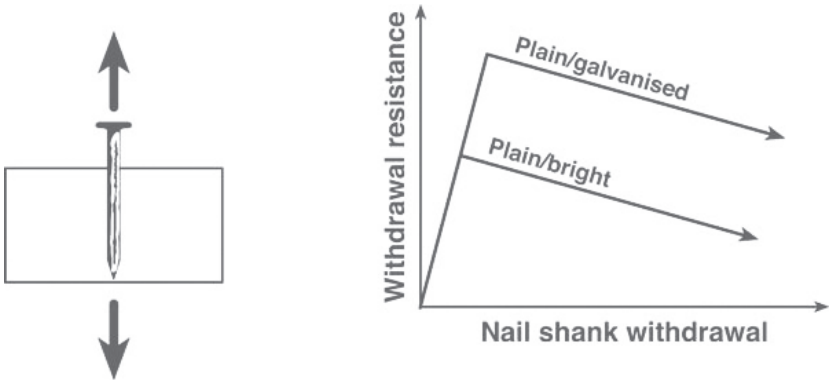


Diagram 2: Typical nailed joint with the nails loaded in withdrawal



SHEARWALLS AND DIAPHRAGMS

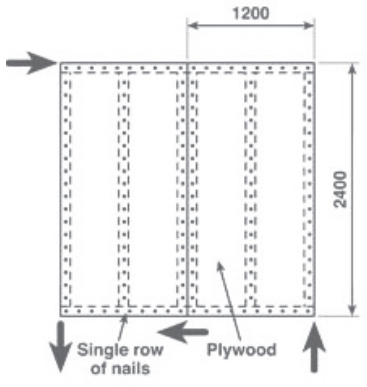
Nails in floor diaphragms are often required to be punched below the top surface of the sheathing material. The sheathing may be plywood or particleboard. The length of the nails used depends on the sheathing thickness.

The sheathing nails used in ductile shearwalls are important because they provide the large inelastic displacements necessary during seismic loading. To ensure ductility, only flat head nails should be used. Nail lengths should not be much greater than that necessary to provide 10d penetration.

Galvanised nails should be used only in corrosive environments, because they tend to have less ductility due to greater withdrawal resistance. Sheathing for shearwalls may be plywood, strandboard or particleboard. The minimum thickness of plywood is 7.5 mm for 2.8 mm diameter nails, or 12.0 mm for 3.3 mm diameter nails.

The type of sheathing nails used in elastically designed shearwalls is less restrictive than that required for ductile shearwalls. Table 27.5 from the New Zealand Standard NZS 3603 provides guidance on maximum fastener diameters in shearwalls and diaphragms, depending on the sheathing thickness.

Diagram 3: Shearwall

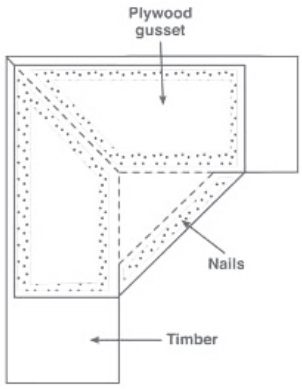


PLYWOOD GUSSET JOINTS

Gun nails are usually used for plywood gusset joints. While the exact location of each nail is not critical, a quality assurance method is necessary to ensure that the number and location of the nails is as specified in the design (see diagram 4). Spray painting the nail layout onto the plywood gusset using a cardboard template is one method to enable the nails to be readily placed correctly.

Ductility is generally not important for moment-resisting joints. If ductility is required, use the same nails as those recommended for ductile shearwalls. Refer to Other Structural Connectors / Plywood gussets for further specific information on the design of gusset joints for portal frames.

Diagram 4: Moment-resisting plywood gusset joint



STEEL GUSSET JOINTS

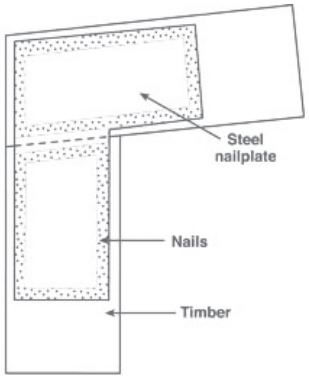
Construction tolerance is much more important for joints from steel plate to timber (see diagram 5) than for nailed plywood to timber joints. The shank diameter of nails available from New Zealand manufacturers may vary greatly within a common nominal nail size. It is a good idea to obtain the nails before drilling the steel plates, and to measure the diameter of a sufficient sample of these nails so that the correct size of drill bit can be selected before drilling.

Use of the correct hole diameter is important because oversize holes will result in a joint with less stiffness than that expected in design, and undersize holes will be impossible for the specified nails to be driven in.

For bright (uncoated) steel nails, the recommended hole diameter is 0.05 to 0.1 mm larger than the nominal nail diameter.

For galvanized nails, the recommendation is 0.1 to 0.15 mm larger. Hot dip galvanised nails will fit tightly within the steel plate and help to ensure the joints are stiff. Larger nail diameters are generally used because they give a more economic joint.

Diagram 5: Moment-resisting steel gusset joint



STEEL NAIL-ON PLATE

Nailon plate is the name given to steel plate (1 to 3 mm thickness) that is pre-punched with a regular pattern of holes suitable for nailing to wood (see diagram 6). Nailon plate is excellent for making strong and ductile connections. Nail pattern is not an important consideration as long as the minimum nail spacings as specified in NZS 3603 are maintained.

In order to maintain adequate edge distances, the width of the nailon plate should be slightly less than that of the timber members to which it is connected, as shown in diagram 6. For a connection producing stresses in tension perpendicular to the grain, it is important that the nailon plate covers the whole width of the cross section.

Diagram 6: Steel nail-on plate