Most timber framers learned their roof framing using the steel square. This is adequate for stick-built hips and valleys with their thinnest members set plumb and level, but timber-framed roofs use thick stock, often cut into non-rectangular shapes and set in a variety of orientations to the roof plane. To make things worse, timber framers don’t simply butt pieces together, but connect them with mortise and tenon joints. These multiple compound intersections result in angles which cannot be obtained with the steel square in any straightforward way.

Help does sometimes arrive from an unexpected quarter. In the decades near the turn of this century, fashions in architecture ran to a new variety of orientations to the roof plane. To make things worse, timber framers don’t simply butt pieces together, but connect them with mortise and tenon joints. These multiple compound intersections result in angles which cannot be obtained with the steel square in any straightforward way.

To perform the latter exercise, all you need is a developed drawing. In this technical sense, a development is the unfolding of a three-dimensional object so that all of its surfaces lie in a two-dimensional plane. This is done by locating where the face of the purlin intersects the lattice and ground. A word about the notion of the purlin track: assume for the moment that the lower edge of the purlin (laid out from the corner where its front face is perpendicular to each of the three runs, and connected to these three sides at right angles to the hip itself. With the center at the hip butt joint, draw a line connecting this point to the main common peak (Fig. 1). The extension of this line throughout the building is the ground line. The roof surface as defined by the tops of the rafters and purlins is called the lattice. Once you have laid out the lattice and valley line, you can create a developed drawing that will generate all the framing angles.

Our model is a hip roof with both purlins and jack rafters. You can tell from the roof plan (Fig. 2) that this is an irregular pitch roof in which the adjacent pitch on the ends is steeper than the main pitch on the sides of the building. One advantage of geometric methods is that they produce a developed roof in any pitch, regular or irregular, so no more challenging to deal with than simple ones. Eaves and ridges which don’t meet at 90 degrees, or hips or valleys that don’t join them at 45 in plan are no more difficult to draw than ones that do. In addition, all drawing procedures are identical for main and adjacent purlins. One problem that is worth mentioning: in order to maintain a level gutter line all around, builders of irregular pitch hips must vary either plate heights or overhang widths on main and adjacent eaves.

All the information needed for framing is contained in the roof plan. To determine the purlin side cuts, need some additional drawing and terminology. The lip cut is needed only in those instances where the purlin is deep enough that part of it passes under the hip. The lip cut is on the side of the hip between the bottom of the purlin and the back edge of the purlin perpendicular to the lower end of the hip. Extend it and the purlin ground intersections (triangles). The angle between the two (solid line) is the purlin side cut. The lip cut is used only in those instances where the purlin is deep enough that part of it passes under the hip. The lip cut is on the side of the hip between the bottom of the purlin and the back edge of the purlin perpendicular to the lower end of the hip. Extend it and the purlin ground intersections (triangles). The angle between the two (solid line) is the purlin side cut. The lip cut is used only in those instances where the purlin is deep enough that part of it passes under the hip. The lip cut is on the side of the hip between the bottom of the purlin and the back edge of the purlin perpendicular to the lower end of the hip. Extend it and the purlin ground intersections (triangles). The angle between the two (solid line) is the purlin side cut.