# Squaring a Block, version 2

## By R. G. Sparber with essential insights from Edmond Maisey



One thing you can be sure of with machining is that there is always one more way to do just about anything. Back on January 12, 2012, I wrote about this subject in great detail:

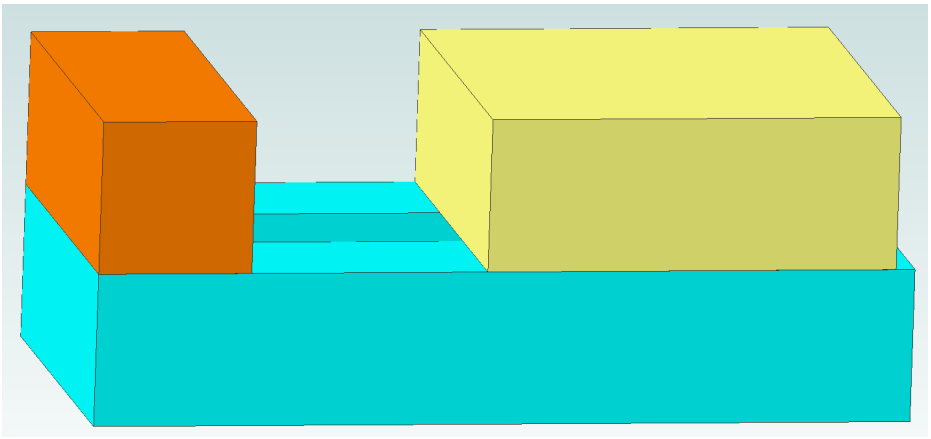
http://rick.sparber.org/cblock.pdf

So here it is, less than 5 months later and there is more to discuss. But since Edmond's method is so different, I felt it necessary to write a new article rather than adding to the January contribution. This method is not compatible[2] with the soft jaws described in the above article so I will not use them here.

Ed's method enables you to square a block using only a vise. No need for a square or V block.

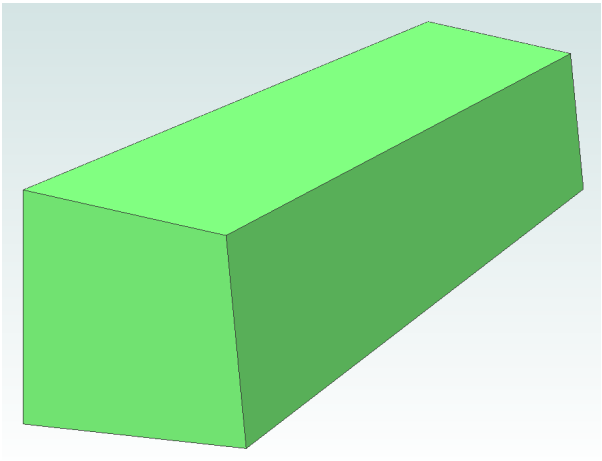
[1] You are free to copy and distribute this document but not change it.
[2] My soft jaws are shallow steps which are not secure enough to use when the stock must be on end.

## The Vise



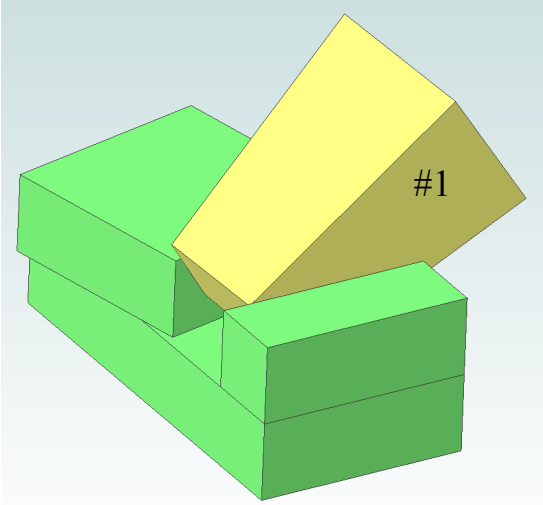
This is a simplified rendering of a vise used on a mill or shaper. The base, shown in blue, is clamped down on the machine's table. The fixed jaw, shown in orange, is securely bolted and often keyed to the base. The movable jaw, shown in yellow, is free to slide along the top of the base as driven by a threaded rod inside the base. The top of the base is called the vise ways.

The vise must be prepared for use. This means aligning the fixed jaw to the axes of the machine. The vise ways must be parallel to the ways of the machine. Only then will cuts over the top surface be true.



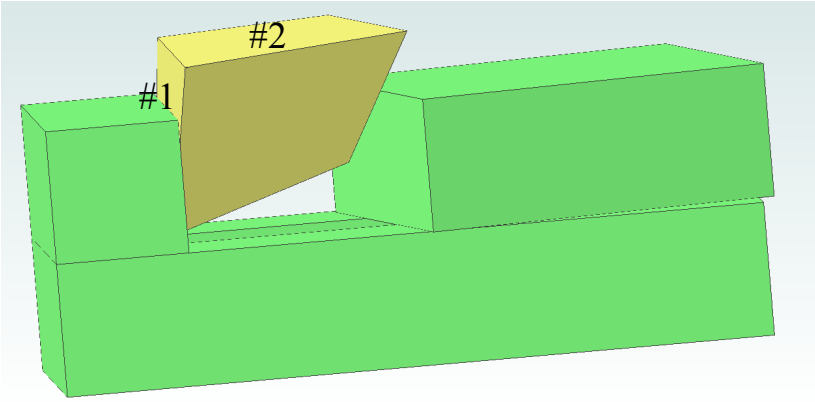
I have cooked up a test block where all faces are flat but none are true. During the machining steps, I will do my best to set the block as far away from true as possible. Yet the resulting block will be true.

If you have a block with questionable surfaces, machine one side flat and call it face #1.



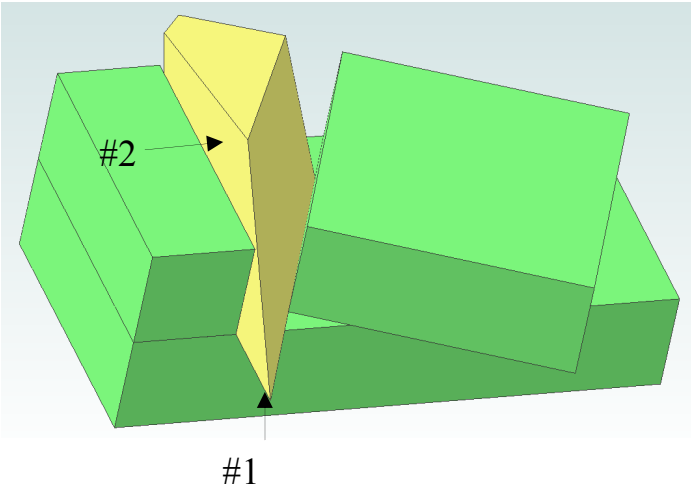

I placed one face of the block against the fixed jaw. Call this face #1.

Note that the movable jaw tilts sideways to accommodate the back side of the block.




I then machined the top face flat. Call this face #2. Face #2 is perpendicular to face #1 to the extent that the vise has been properly squared and the machine is square.

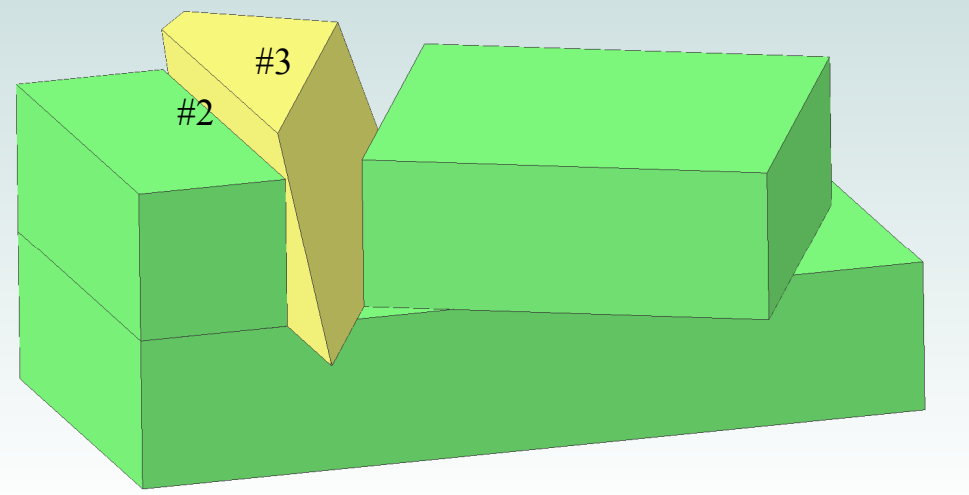
I then deburred the edges and cleaned all mating surfaces on both the block and vise.



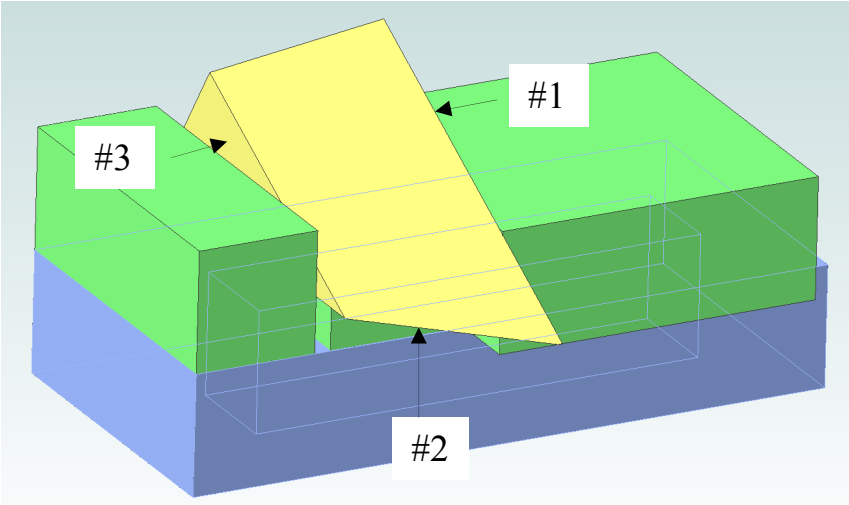

When I rotated the block again, face #1 was in contact with the vise ways.

Face #2 was in contact with the vertical part of the fixed jaw.

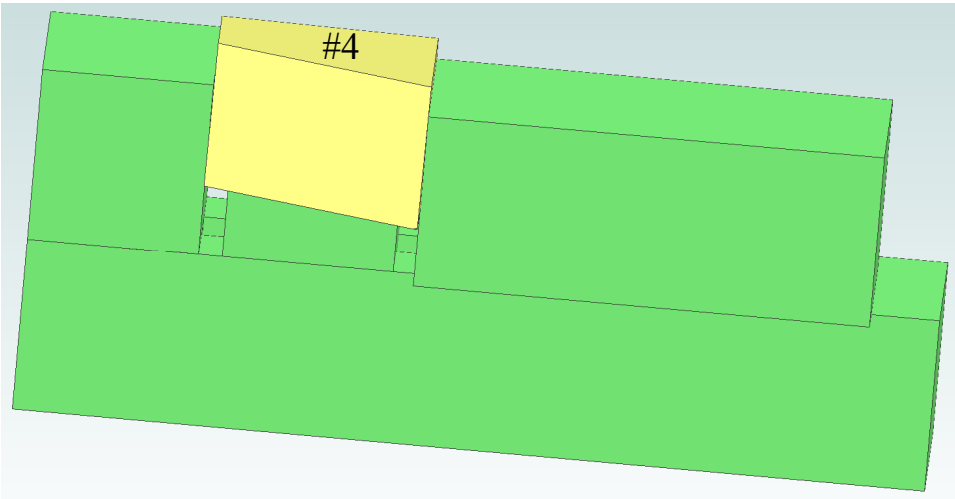
I cut face #3 which was then parallel to face #1 and perpendicular to face #2.




I Deburred and cleaned all mating surfaces.



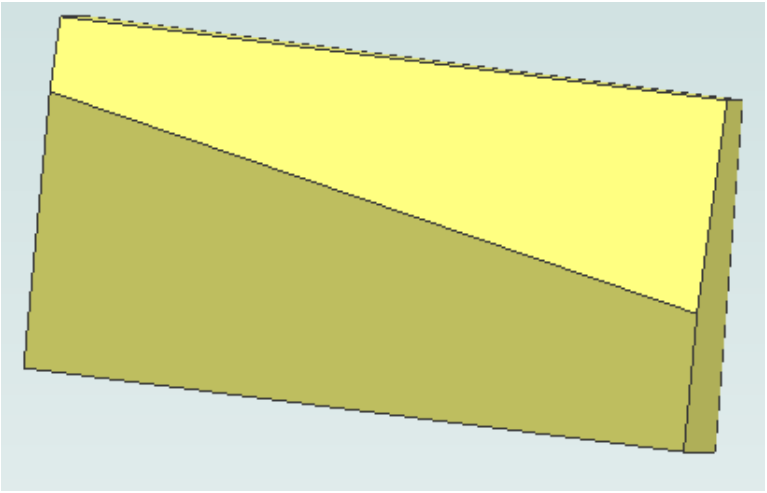

The block was rotated so face #1 was in contact with the vertical part of the movable jaw. Face #2 was in contact with a parallel resting on the vise ways. This height boost was necessary in order to expose enough of the top surface. Face #3 was in contact with the vertical part of the fixed jaw.



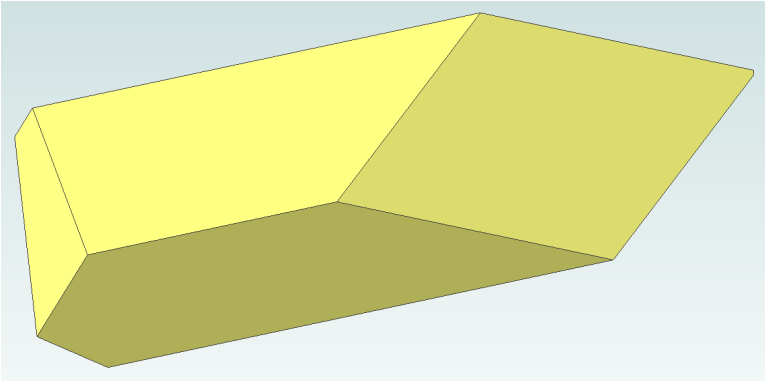

When I cut the top face, #4, it was perpendicular to faces 1 and 3 plus parallel to face #2.

I again deburred and cleaned all mating surfaces.

I then had the first 4 faces cut and they were all perpendicular to each other. Recall that I used face #1 as my first reference surface.



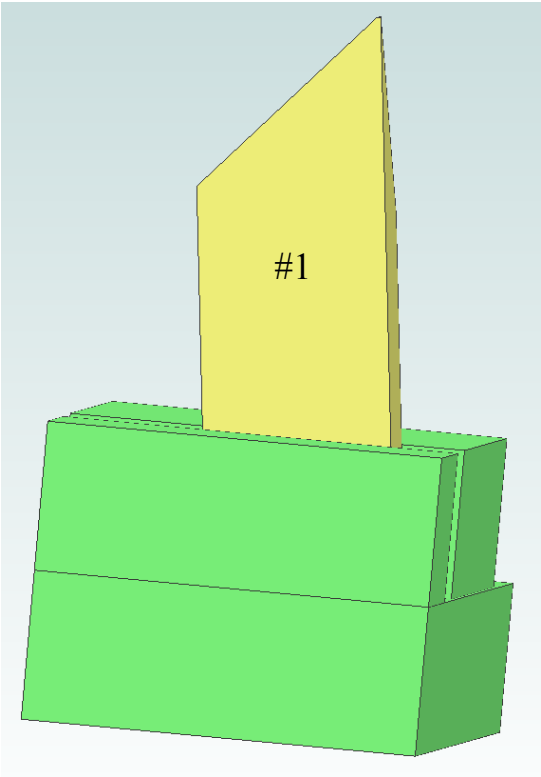
This end view may help to convince you that the first 4 faces are all perpendicular.



Of course, the ends of the block are not perpendicular to any other part of the block.

So far, the machining steps are common practice. I could side mill the ends or put the work piece in a V block and end mill the ends. What makes Ed's procedure so interesting is that I can finish truing the block with just the vise.

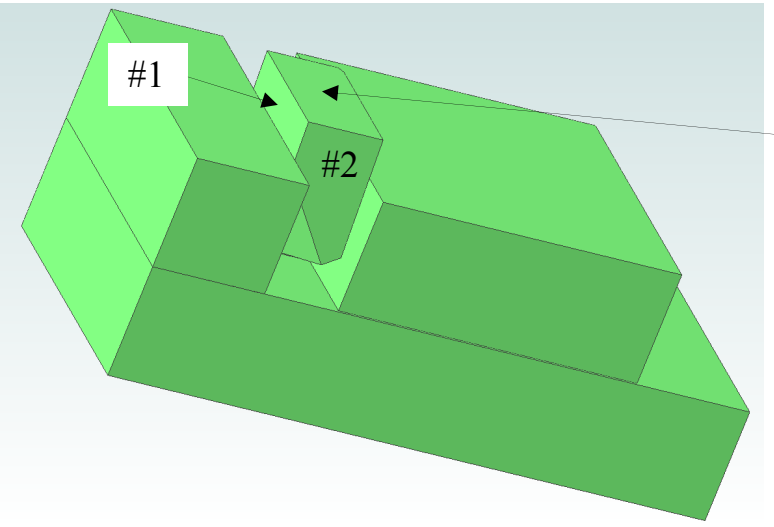
I made one more cut and then sat back and figured out what was going on with this procedure.




I clamped the part in the vise with no attempt at making it vertical. This was done to underscore how well the truing procedure works.

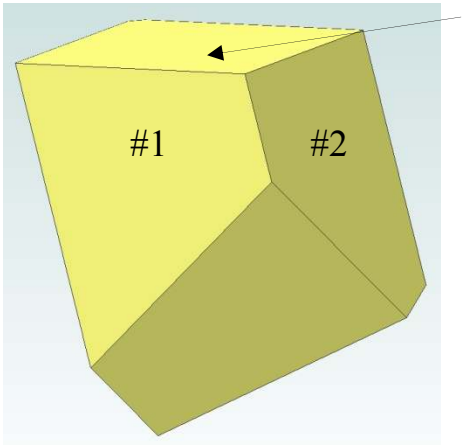
In practice, the closer you can get to vertical, the less material will need to be removed.

Face #1 is against the fixed jaw so face #3 is against the movable jaw. Faces 2 and 4 are not vertical.



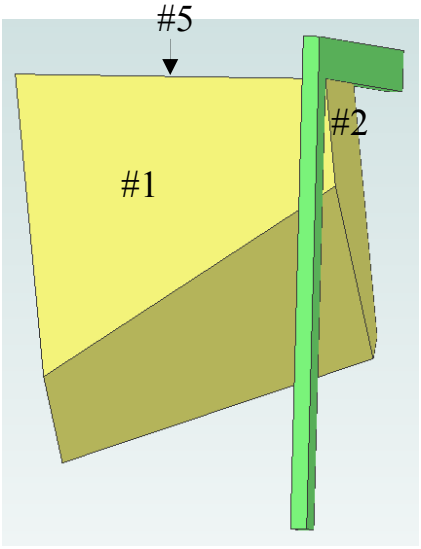

In order to get a flat surface, I had to remove a lot of this sloped end. But now I have face #5 ***partially*** cut. I say "partially" because face #5 is perpendicular to face #1 but is not perpendicular to face #2 yet. It will need to be recut before I'm done.

Let's stop and think about what we have so far.



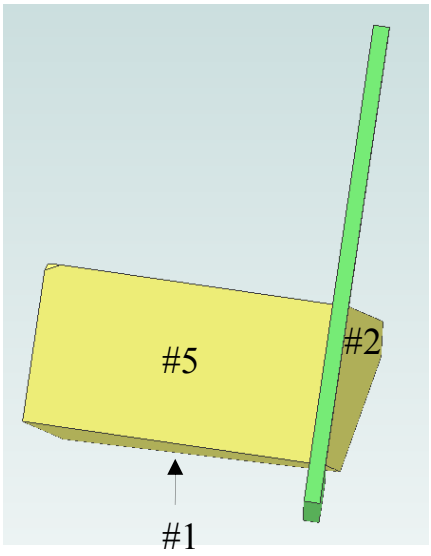

Face #1 is perpendicular to face #5.

Face #5 is ***not*** perpendicular to face #2.

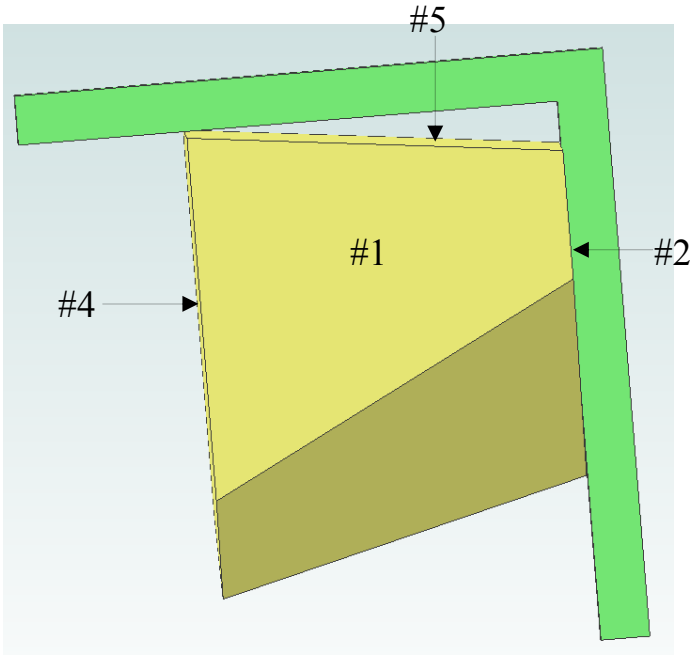



Say I put a machinist square on face #1 and face #5. The square's vertical blades must be in full contact with face #1. In this way, the square is able to pick up the exact orientation of this face.

I am able to slide this square back and forth over the entire #1 face and still remain in contact with face #5. At any position, I could draw a line parallel to the horizontal arm of the square. This line would be perpendicular to the edge where faces #1 and #5 meet. These two lines completely define the position of face #5 which is perpendicular to face #1.




One line of particular interest is the edge formed by face #2 and face #5. This edge is just another line on face #5 so could be used with the 1-5 edge to fully define face #5. What makes this edge useful is that it is also on face #2.



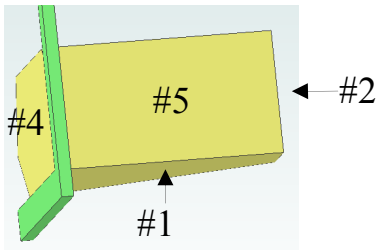

I put the vertical blade of the square flat on face #2 with the horizontal blade touching face #5. If face #5 was in full contact with the horizontal part of the square, I would have face #5 perpendicular to face #2. This would mean that I could fully define face #5 by the 2-5 edge plus a line guided by the horizontal part of the square.

Think about this from a machining standpoint. If I set the 2-5 edge parallel to the vise ways plus set face #2 perpendicular to the vise ways, I can cut face #5 perpendicular to face #2.

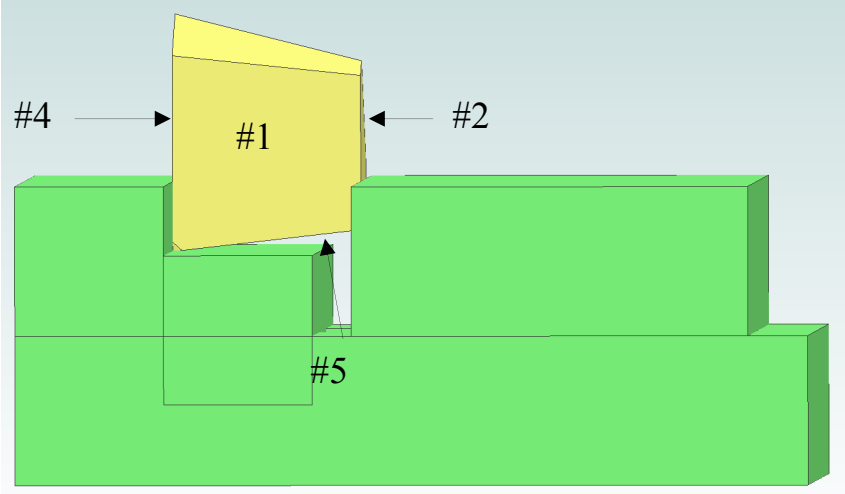
But wait; the best way to set the 2-5 edge parallel to the vise ways is to put it in contact with the vise ways. This puts face #5 facing down where it can't be machined. That is not a problem because I can cut face #6 which must be parallel to the final face #5.

Oops, one more snag; face #5 sloped down from my 2-5 reference edge. This prevents me from getting this edge down on the vise ways.

What to do? Face #4 is parallel to face #2 so either face will do for my vertical alignment. If I move over to face #4 I will be at the 4-5 edge which will put face #5 rising from this line. But is edge 4-5 equivalent to edge 2-5?



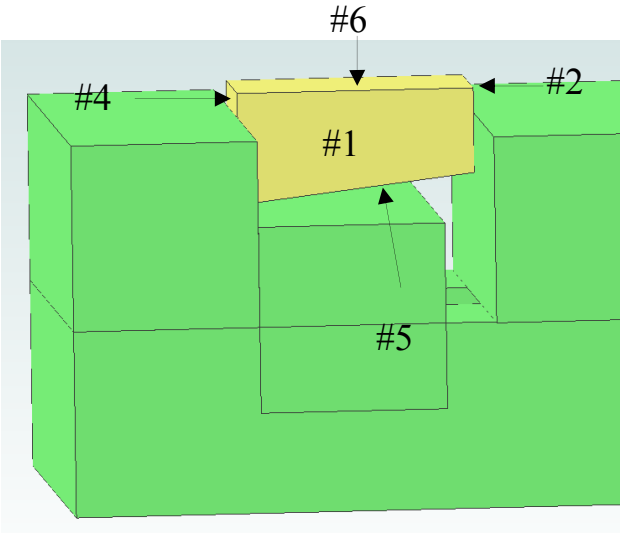

I put the vertical part of my square back on face #1 so it is in full contact. The horizontal part of the square is now aligned with the 4-5 edge. So the answer is "yes". Edge 4-5 is equivalent to edge 2-5 for the purpose of aligning face #5.




I put face #4 against the fixed jaw so the edge formed by the meeting of face #4 and face #5 was at the corner formed by the fixed jaw and the parallel.

This edge aligns the block side to side in the vise while face #4 aligns the block front to back.

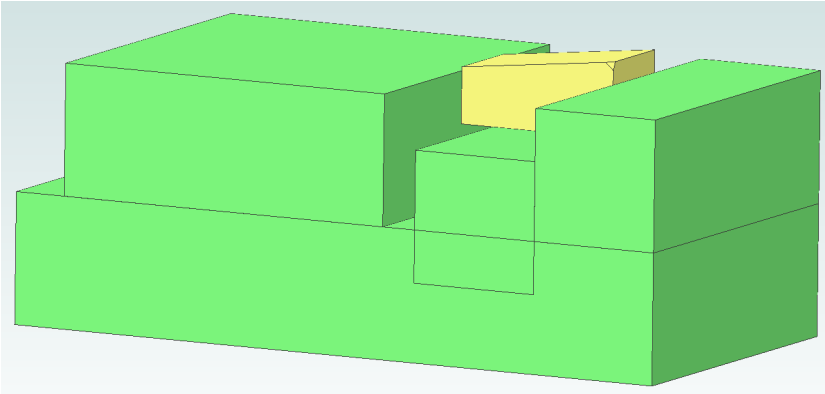
We don't normally use an edge for alignment because it is rather delicate. If you pound the block down in the vise, you may distorting this edge and lose side to side alignment. Finger pressure on the block while tightening the vise would be best.



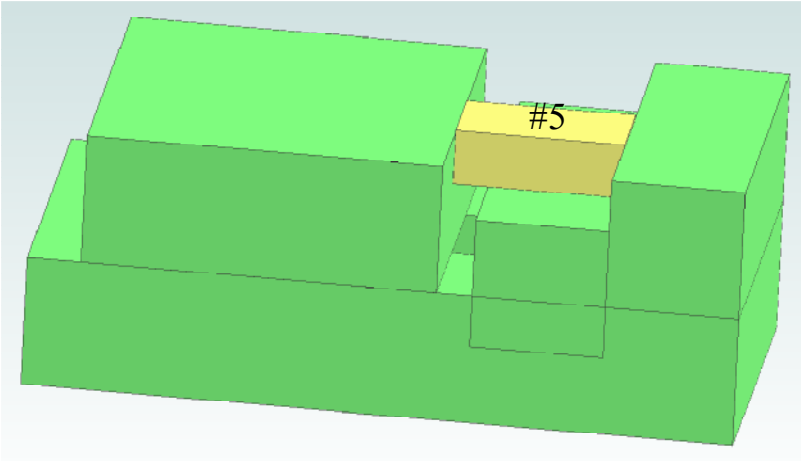

Face #6 was then cut and is perpendicular to face #4 and the 4-5 edge. Since this edge is perpendicular to face #1, face #6 is perpendicular to faces #1.

Face #6 is perpendicular to face #1. It must also be perpendicular to face #3. And since face #6 is perpendicular to face #4, it must also be perpendicular to face #2. So we now have our first end face, #6, square.

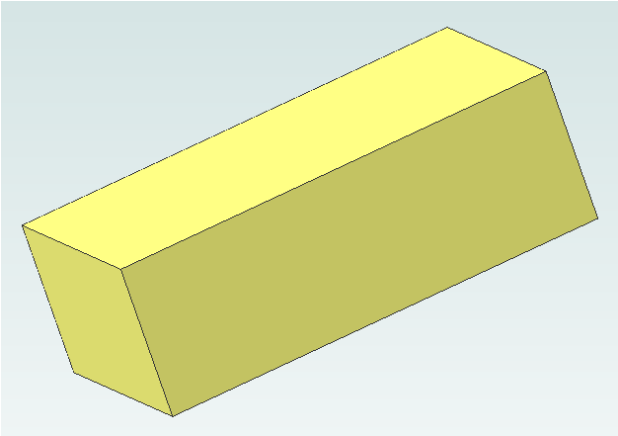
I found it very hard to explain why this machining step was valid but actually doing the cutting is just as straight forward as cutting faces 1 through 4.



The final step was to put face #6 down on a parallel with any other face against the fixed jaw. Face #5 was then cut for the second time to make it true.




With face #5 cut, we now have a block that is true on all faces.



Tah dah!

## Acknowledgements

First and foremost, I wish to thank Edmond Maisey for bringing this procedure to my attention. Thanks to Dale King for helping me to understand why this procedure works.

I welcome your comments and questions.

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