Vince Pitelka, 2014

Building a Hinged IFB Kiln Door

When firing a kiln on a regular basis, especially within the demanding schedule of a professional potter, it is not difficult to justify the effort and expense to build a hinged door. A hinged door will require a very stout welded kiln frame, especially an IFB door as opposed to ceramic fiber. For an IFB door, the door frame should be fabricated from ¼" by 4" by 4" angle iron, with heavy hinges fabricated from ¾" black iron pipe, ¾" steel shaft, and flatbar. Note that 4" angle should be used for the door frame no matter the size of the kiln, because the 4" dimension is needed to adequately support the IFB.

The door is constructed and mounted after the rest of the kiln is completely finished, and if you are building a kiln with the expectation of fitting it with a door, pay special attention to keeping the front face of the kiln very flat and true. The brick lining in the door should extend approximately four inches beyond the actual door opening on all sides (including four inches above the highest point of the arch opening if a sprung-arch), closing against the front face of the kiln. You will thank yourself if you take special care to ensure that the face of the kiln is all on one flat plane. If you are fitting a door to an existing kiln and the front surface is at all irregular, it would be wise to grind off the highs spots with a diamond cup wheel on an angle grinder, and fill any low spots with an appropriate high-duty refractory mortar like ANH Refractories "Greenpatch 421."

A single 4.5" thickness of IFB provides plenty of insulation for almost any kind of kiln. Consider that many toploader kilns that fire to cone-6 or even cone-10 have only 2.5" of IFB insulation. If you want the exterior face of the door to remain cool to the touch, add a layer of 1" ceramic fiberboard outside the brick, but then you will also need a layer of 18-gauge sheet metal outside the fiberboard to protect it from abrasion and prevent release of carcinogenic fibers. Even without the layer of fiberboard, you may wish to include the sheet metal to protect the brick and give an especially sanitary appearance.

The door frame is just like a giant picture frame assembled from four pieces of ¼ x4x4" angle-iron cut at 45 degrees and arc-welded together, and of course the dimensions of the frame will depend on your kiln dimensions. Commercially-made studio kiln doors are usually mortared together, but this design requires no mortar and utilizes a very simple and effective clamping mechanism that holds the bricks in place securely and permanently. Purchase a supply of 1½"-long ½" bolts with nuts (the number will depend on the size of the door, as per the instructions below). On the outer side (the edge of the door, not the front face) of the vertical angle iron on the side where the hinges are going to be attached, draw a vertical line ½" off-center towards the open side of the frame (the side that will face the kiln). Mark a point 4" from the bottom and 4" from the top, and between those two marks divide the remaining space along the line into equal increments of approximately six to eight inches and mark each point. Center-punch each point and drill a ½" hole. Insert a ½" bolt through one of the holes from the inside, thread

a nut snugly on the outside, and weld the nut to the door frame. Remove the bolt and move on to the next hole until you have welded nuts to the outside of every hole.

Once the frame is fabricated and the row of nuts welded in place, block the frame up against the kiln face in the correct location with a brick clamped in proper position inside each corner of the frame to establish the exact correct position. Be sure the frame is placed so as to ensure the correct overlap of the brick lining against the kiln face on all sides of the door opening. If you are including a layer of sheet metal and/or fiberboard, place them into the frame before clamping the bricks in the corners. With the frame securely blocked up against the face of the kiln in the exact correct position with the brick spacers in each corner, fabricate the hinges and weld them to the kiln frame and door frame. As long as this is done correctly, once the bricks are permanently laid in the door frame the door will close absolutely flush against the kiln face.

The Hinges

I have never found commercially-made hinges that I found to be satisfactory, and it is so easy to fabricate very functional hinges from ¾" hot-rolled or cold-rolled steel shaft and ¾" black-iron pipe. These materials are sized such that the shaft is a nice fit inside the pipe but turns easily.

This is a simplified explanation assuming some experience with welding and fabricating and good sense about the specifics of designing appropriate hinge brackets. Take all your measurements for the hinge members after you have temporarily blocked up the door frame in correct position as explained above, with an IFB clamped inside each corner of the frame to establish the proper spacing against the face of the kiln.

The ¾" shaft serves as the vertical hinge pins, and in this design the pins are supported by brackets welded to the front face of the kiln frame, with the pins sticking up above the brackets so that if you ever needed to remove the door, it can be lifted off the pins. It's your choice whether you place the hinges on the left or right, depending on your particular situation.

Cut two 10" lengths of the shaft, and two 4" lengths of the black iron pipe. Bevel one end of both hinge pins. Fabricate two plate-steel brackets that will place the center line of the hinge pin about 2 ½" out from the brick face of the kiln. Don't weld the brackets to the kiln frame yet. Weld a hinge pin to each bracket so that the bevel is at the top of the hinge pin, and the pin extends vertically five inches above the upper edge of the bracket. Place a ¾" I.D. steel washer over the hinge pin directly against the bracket, ensure that it is absolutely level, and weld in place underneath the washer (so that there is no weld atop the washer where the other member of the hinge will sit).

Fabricate the brackets that will be attached to the door, and at the hinging end of the bracket weld the 4" length of black-iron pipe vertically. The upper and lower surfaces of the brackets should incorporate lengths of ¼" flat-bar with a ¾" hole drilled in both corresponding to the position of the black iron pipe, so that the hinge pin goes through both thicknesses of flat bar and the pipe. This greatly strengthens the hinge, and also provides a flat surface at the lower edge to ride against the washer welded to the stationary member of the hinge.

With the door member of the hinge placed over the pin on the stationary member, clamp both hinges to the face of the kiln frame and to the door frame so that the door members of the two hinges attach to the side of the door frame near the top and bottom. Make absolutely sure that the hinge pins are both vertical and perfectly aligned with each other before you weld anything in place. These brackets/hinge members can be simple, but use good sense in bracing them to support the stresses applied by the weight of the door in the closed and open positions. Make absolutely sure to check the position of the hinge pins to ensure that they are vertical and perfectly aligned with each other with no variation at all. Otherwise the steel will flex every time you open the door and the bricks will work loose. Weld the brackets securely to the kiln face and the door frame.

Laying the Bricks in the Door and Clamping the Bricks in Place

Once the door frame is hanging on the hinges and the steel shell and/or fiberboard are in place if that is in your design, begin laying the IFB from the bottom with no mortar. Cut the last brick in each course very carefully to leave a 3/8" space vertically inside the frame up the side where the nuts are welded, and keep this space as even as possible all the way up. As per normal bricklaying practice when laying stretcher courses, stagger the bricks ½-length on each layer.

You will no doubt have to cut and fit bricks to fill the space at the top of the door, and take the time to do this carefully to snugly fill the space. Once all brick are in place, cut a length of ¼"x3" flatbar that just fits the space inside the full height of the door frame next to the brick. With the flatbar shim in place, thread ½" bolts into all the nuts on the outside of the door, and tighten them snugly, pressing the flatbar against the brick inside the frame. This makes a very secure door, with the added advantage that portions of it can easily be replaced if needed, although if this door is properly constructed it is unlikely that it will need any maintenance in the life of the kiln.

Note that a hinged door should never be built from hardbrick no matter the type of kiln. Even on a salt or soda kiln otherwise constructed of hardbrick on the hotface, it would not make sense to hang that much weight on the door. An IFB door sprayed on the inside with several thin saturating coats of a 40-40-20 slip of Zircopax, alumina, and EPK will resist salt effectively for at least five years in heavy use or indefinitely in light use. While it is never worthwhile to build a salt kiln or heavy-use soda kiln with an IFB hotface inside the kiln itself, the door is an easy-maintenance area, and it benefits so much from the reduced weight of IFB. Also, with an IFB door it is a simple matter to bore the spyholes after the door is finished, as explained below.

Always open and close a kiln door gently. The less stress placed upon it, the longer it will last and the more tightly it will close. As the door and kiln age, it may be beneficial to cement on a strip of ceramic fiber webbing as a door seal. Regular ceramic fiber blanket should not be used because of the release of carcinogenic fibers.

Making Spy-Holes

The spyholes are created after the door is constructed. If your door has a steel shell, use a drill with an adjustable fly-cutter or an appropriate hole-saw to cut 2” holes in the sheet metal. For a 40 cubic foot sprung-arch kiln, the bottom spyhole is normally about 8" up from the inside floor-level, a few inches to left of center, and the top spy hole should be about a foot below the inside peak of the arch, a few inches to the right of center. For a smaller kiln, these measurements should be reduced slightly. Always make sure that the spy holes are offset like this so they do not interfere with a center shelf support, and make sure that they are offset in opposite directions so that when you fire very large things in the kiln, you can build a tower of hardbrick to support the upper cone pack without blocking off the lower spy hole.

The following is a simple, no-nonsense way to create spyholes in an IFB door. Purchase an 18" length of 3/8" threaded rod (the kind with threads along its entire length). With a bench-grinder or angle-grinder, sharpen one end like a chisel. Mount this in an electric drill and use the chisel end to bore the initial holes through the IFB. Remove the threaded rod from the drill and use it like a file to enlarge and shape the spyhole to the desired dimensions. Ideal spyholes are round and 1 ½” to 2” in diameter on the outer surface of the door, and expand to about 2 ½” square on the inside face, giving a broader field of view. If the design is a salt or soda kiln, you will need to make an additional larger port about midway up the door for pulling draw rings to gauge glaze deposition.

Door Latches

There are many designs for door latches, but this one is simple to build and use, and it requires the same raw materials as the hinges. It features two latches that hold the door snugly closed at the opposite edge of the door from where the hinges are located. The following description is approximate, since the specific dimensions will depend on your kiln. Mark a vertical line ½” from the front edge (the edge closest to the kiln face) of the side of the door frame opposite the hinge side and weld two 2” by 2” tabs of ¼” steel plate or flatbar along this line, placed directly opposite where the hinges are located. These tabs will protrude from the door frame and will be parallel to the kiln face but off the surface at least one inch.

Cut two lengths of ¾” black iron pipe long enough to extend from the adjacent outside corner of the kiln frame to two inches away from the outer edge of the tab welded onto the door. Make sure that the lengths of pipe do not extend closer than two inches from the tabs, because this space allows you to retract the latches before opening the door.

Cut two lengths of ¾” steel shaft five inches longer than the length of black iron pipe. Cut two 2”-diameter disks of steel plate at least ¼”-thick and preferably ½”-thick. For each latch, weld a disk onto the end of the steel shaft ¼” off-center to create an eccentric “wheel” on the end of the shaft. Insert the shaft through the black iron pipe, and weld an 10” length of 1/4x1” flatbar to the other end of the steel shaft to provide a lever handle to tighten and loosen the latching mechanism. The lever should be welded on so that it extends out from the shaft directly opposite the direction of the eccentric wheel. Remove all weld spatter and scale to ensure that the shaft slides and rotates smoothly in the pipe.

You will need to fabricate a flatbar or steel-plate spacer to mount the black iron pipe the appropriate distance off the surface of the kiln frame, and again, the exact distance will depend on your kiln. The distance off the surface must be such that when you slide the latch sideways so that the eccentric wheel overlaps the steel tab on the door, and then rotate the lever on the other end of the steel shaft, the rotating eccentric wheel presses against the tab, holding the door securely shut. The distance should be such that the eccentric wheel easily slides over in front of the tab when the eccentric is rotated away from the kiln face, but then when the lever is turned the eccentric almost immediately begins pressing against the tab.

Do not overtighten the door, as this can cause the steel tabs to bend and can cause slow breakdown of the contact surface between door and kiln face. When latching the door, close it gently but snugly against the kiln face, slide the latch all the way towards the door frame with the lever pointing upwards, and then pull the lever towards you, rotating the eccentric up against the tab. In the ideal situation, after the latch is tightened, the lever will be extending out at an angle so that the weight of the lever helps to keep the latch snug. Paint the levers a bright color so people will see them since they stick out into space.