WALL FIXINGS

THIS CONTINUES FROM January's column on calculating wind loadings.

AS WE SAW IN January's edition of *In Practice*, even quite a small antenna installation can generate considerable wind forces on a wall mounting bracket. We analysed a 'typical' situation of a 10m mast carrying a rotator and a small 2m yagi, supported by a bracket bolted to the wall at 5m height, with a second steadying bracket farther down. The wind forces are concentrated at the upper bracket, and a cautious estimate of the force was over 120kg (270 pounds). How do we fix the bracket to a brick wall, to withstand that kind of force?

Think about the directions in which the wind force could act. If the wind is pushing the bracket on to the wall, the force is spread over several bricks, and the fixing is as strong as the wall itself. If the wind is blowing parallel to the wall, and the bracket is strong enough, most kinds of wall fixings will be extremely secure against the sideways forces. The difficult situation is when the wind is blowing away from the wall and trying to pull the bolts straight out of the bricks... or the bricks straight out of the wall! This latter possibility is a serious one unless the wall is well built. Older houses with mortar that has weakened over the years, and bricks made before the era of factory quality control, are simply not a good prospect for a mast bolted to the wall.

Assuming your house does have reasonably sound brickwork, what then? You should aim to mount the top bracket as high as possible, to reduce the wind forces (see January) but always leave at least three courses of bricks between the ones you drill and the top of the wall. Also leave plenty of sideways clearance from upstairs window openings, which considerably weaken the brickwork. Obviously the best place to mount the top bracket is quite high on a gable end wall, to shorten the unsupported length of mast and reduce the wind forces.

The bracket itself is important. Don't go down to the local TV shop and buy cheap, poorly-made wall brackets intended for UHF TV antennas - that's probably all they are fit for. Go to an amateur radio dealer and get something substantial and well made, and preferably galvanized. For example, Barenco make a good range specifically for amateur radio and similar applications, including some interesting tilt-over models (RAS Nottingham, 0115 928 0267, and at large rallies). A suitable bracket will look something like **Fig 1**, with a T-shaped piece that bolts to the wall and a well-braced arm for fixing the mast. All the component parts should be solidly double-seam welded, not just 'tacked' together. Typically there will be two or more bolt holes in the horizontal member of the T, and one or two more in the vertical member. The top row of fixings will bear almost all of the load, and **Fig 2** shows a typical drilling pattern.

To fix the bracket, you must use some kind of expanding wall anchor. These come in several kinds, but they all work by expanding outwards and gripping the sides of the holes. Here I'll mostly be writing about the traditional 'Rawlbolts', which can give a very secure fixing, but I will mention some other systems as well. I wouldn't recommend a 'DIY' fixing using large plastic wall plugs and 'coach bolts'. This is a safety-critical application, so spend some money on properly engineered fixings that are designed to work together as a system, and follow the manufacturer's instructions exactly. What size of anchors should you use? For this job, the biggest you can! When fixing to brickwork, you must drill the hole into the centre of the brick, as shown in Fig 2, and there's a limit to the size of hole that will not weaken the brick. In ordinary brickwork this corresponds to an M10 Rawlbolt which requires a 16mm diameter hole. Three or four of these should be more than adequate to withstand the wind forces we're envisaging - but only if you install them correctly. Here are a few pointers, culled from an interesting discussion on packet several months ago.

Choose a sound set of bricks for drilling, free from any hairline cracks. If necessary, be prepared to move the mast a little from its planned location. You're going to drill into the exact centre of each brick, not near the edges, and never into mortar. If necessary, make new mounting holes in the bracket to suit your own brickwork. The holes in the brackets should be 10mm diameter for M10 bolts, with some extra clearance to help the bolts line up. Hold the bracket to the wall, level it with a spirit level and mark the centres of the holes. Begin drilling with a small masonry bit. Before you use the electric drill, place the point of the bit exactly on your drilling mark and tap gently with a hammer to chip out a small dimple. This will prevent the point from wandering when you start drilling. If you're using a hammer-drill, start without the hammer action until you've made a deep enough hole to prevent the bit from wandering. Do the same at each change of bit as you open out the holes gradually, using progressively larger sizes. Use patience rather than brute force, and you're more likely to make good cylindrical holes, square to the wall and exactly where you want them. It's also kinder to your electric drill; and above all it's much safer for you on the ladder.

The final holes must be exactly the right diameter as specified by the manufacturer. For example, the hole for an M10 Rawlbolt must be 16mm diameter - not 15, not 17, but 16mm! This is very important because the entire strength of any type of wall fixing comes from the contact of the anchor sleeve against the inside of the hole. The sleeve should be a gentle tap fit, so that when you begin to tighten the bolt, the anchor will immediately start to grip hard. To sum up, you're going to need several sizes of masonry bits, and the largest one must be exactly the size specified.

Tap the anchor sleeve into place, just below the surface of the wall, so that when the bracket is bolted on it contacts the wall and isn't sitting on the end of the sleeve. Do this without the bolt inserted, and then fit the bracket. Leave the bolts slightly loose until you've levelled the bracket, and then tighten them. The tricky part is to tighten the bolts to the correct torque - enough to expand the anchor sleeve and develop the fixing strength, but not so much that it splits the brick and ruins the whole fixing. I have used Rawlbolts here as an example, but they can be very prone to split the bricks if over-tightened. You might consider alternative types, such as the Fischer bolts which use a softer plastic sleeve to grip the inside of the hole. In any case, use the type of anchor with a free bolt that screws in, and not the type with a stud that takes a nut.

If your house is built using modern bricks that have holes right through the middle,

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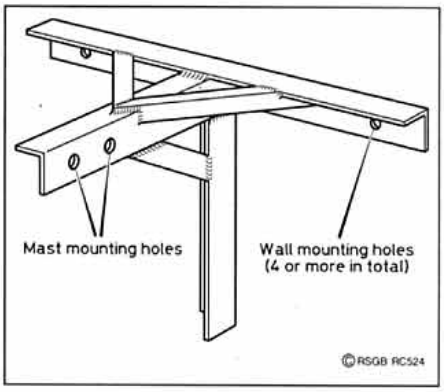

Fig 1: A typical well-braced wall bracket.

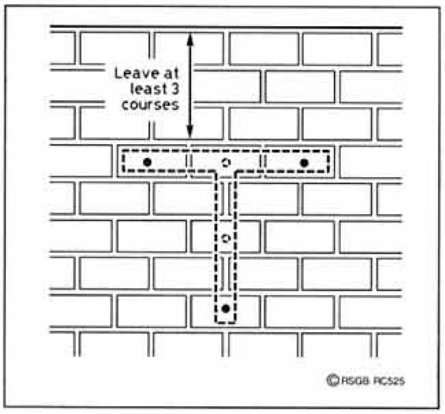

Fig 2: Typical drilling pattern for wall bracket. Patterns may vary, but always drill into the centres of the bricks.

IF YOU HAVE NEW QUESTIONS, or any comments to add to this month's column, I'd be very pleased to hear from you by mail, packet or E-mail (see head of column). But please remember that I can **only** answer questions through this column, so they need to be on topics of **general** interest.

conventional expanding anchors are no use, and you'll need to investigate other systems. Wall anchors using a chemical adhesive fixing system are also available, and have the advantage of not stressing the bricks at all, while having higher claimed strengths than conventional expanding anchors. They can also be used for fixing into hollow bricks, but the strength of the bricks themselves may become a factor. As with any adhesive bonding system, success depends on careful preparation and following the instructions **exactly**. One suggestion when using conventional Rawlbolts in ordinary brickwork is to use epoxy resin as well, to try and obtain the best of both worlds. If you are fixing to a gable end wall, yet another possibility is to drill right through the whole wall and into the loft space, and then use long bolts or studs to secure the bracket to a steel plate that spreads the load over the inside wall.

The lower bracket is much simpler, because it bears much less load than the upper one. Its main purpose is to steady the mast and prevent it from bowing below the upper bracket. Mark out and drill for the lower bracket after fixing the upper one, lining them up with a plumb-line. The bottom of the mast should also be fixed to prevent it from moving sideways.

In the longer term, wall anchors can work loose owing to either frost or thermal expansion/contraction cycles, and then the wind will work on them further. Check the fixings every spring and autumn.

WARNING - Actually, there's no such thing as the 'typical' situations I have tried to describe. You need to think carefully about every detail, as applied to your situation. As you may gather, wall anchors can be very strong, but there are a number of things you need to consider in order to do the job properly. Unless you already have some experience, check with a builder or builder's merchants (a real one that sells to the trade) and see what they recommend. Finally, if you are intending to mount a commercial mast or tower against a wall, obtain specific advice from the manufacturer and follow it exactly.

Thanks to G0PAN, G0TMD, G1ZPU, G4PMK, G4WEA, G8AMG, G8UYZ and Tennamast Scotland for their contributions.

MEASURING CHIP CAPACITORS

HOW CAN I MEASURE the values of ceramic chip capacitors? There are no markings on them.

A CAPACITANCE BRIDGE or capacitance-measuring digital multimeter often has sockets into which you can push the leads of conventional capacitors. This is no good for chip capacitors, and to make matters worse the socket contacts are often too deep inside the instrument case for short-leaded conventional capacitors. **Fig 3** shows what I did with my own multimeter, which has a row of six sockets at 0.1in pitch to accommodate lead spacings from 0.1 to 0.5in. Clipped-off component leads are pushed into the most closely-spaced pair of sockets, and each lead is soldered to a small patch of adhesive-backed copper foil. The chip cap is simply nudged into place and held down by a wooden toothpick or similar. You can use the same contacts for miniature ceramic plate capacitors supplied with short leads. Ordinary digital multimeters are not very accurate for low capacitances, but are generally good enough to identify which preferred value they are supposed to be. (Unfortunately I can't recommend a source of copper foil - it's over £30 for a 16m reel of adhesive-backed 1in tape, so this is a clear case for scrounging!) ♦

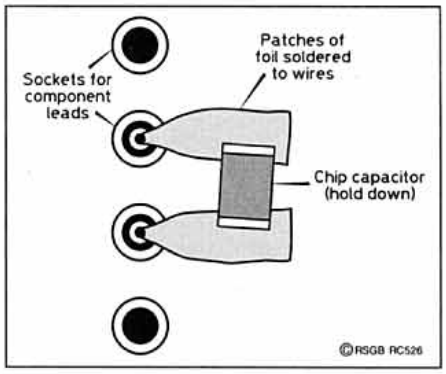

Fig 3: Two patches of adhesive-backed copper foil convert ordinary test sockets to work with chip capacitors.

CORRECTION

THE FORMULA IN Finding Coax Impedance (February) had the square-root sign in the wrong place. It should have read:

$$Z_{CABLE} = \sqrt{(50 \times Z_{MEASURED})}$$