WORCESTER CATHEDRAL Bell Frame Improvements
Statement of Needs

The ring of bells comprise 15 ringing bells and 1 fixed Bourdon bell. The tenor bell weighs 2.5 tonnes and the smallest 347kilogrammes. The timber bell frame, which dates from 1869, rests on the top of a large timber supporting structure, known as the Wigwam due to its tapered design. The wigwam starts at Clock Floor level rising through the Ringing Chamber, Carillon chamber to the underside of the bell frame.

The wigwam at Clock Chamber level

The Wigwam is essentially square in plan with chamfered corners and a very large post at each corner.

The bell frame is constructed of oak beams and posts/struts with steel cleats, tension rods etc. It is supported on large softwood foundation joists, mostly 300 x 350mm. These in turn are carried by diagonal bearers of similar size, at each corner of the tower. These bearers sit on top of the wigwam posts with morticed joints but the ends are supported on stone corbels built into the masonry.

The different behaviour of the oak frame and the softwood supports has resulted in twisting and bowing where they come into contact, resulting in high point loads, in the cases of twisting and in some cases lack of contact altogether. The frame below the tenor bell, in the south west corner is almost completely unsupported. Motion of the frame is imparting some movement to the diagonal tie beams with resultant abrasion at the end bearings.

The bells at Worcester are notoriously difficult to ring. This is due, in part, to the geometry of the bells, frame and contorted rope alignments and partly due to flexing of the frame and consequential unwanted movement of the bells during ringing.

Tapered joint at top of Wigwam post

Complete lack of contact between bell frame and foundation beam

Tests were undertaken a few years ago using strain gauges, to ascertain if the bell frame was flexing and moving significantly enough to warrant major repairs or replacement of the frame. These tests indicated that the frame is indeed flexing but the tower also moves both laterally and torsionally, by several millimetres during ringing. Nothing can be practically done to reduce the movement of the tower structure but ringing would be easier if the frame could be made more rigid.

The bellringers have monitored this flexing of the frame and following investigations, have identified the problems of the timbers as outlined previously.

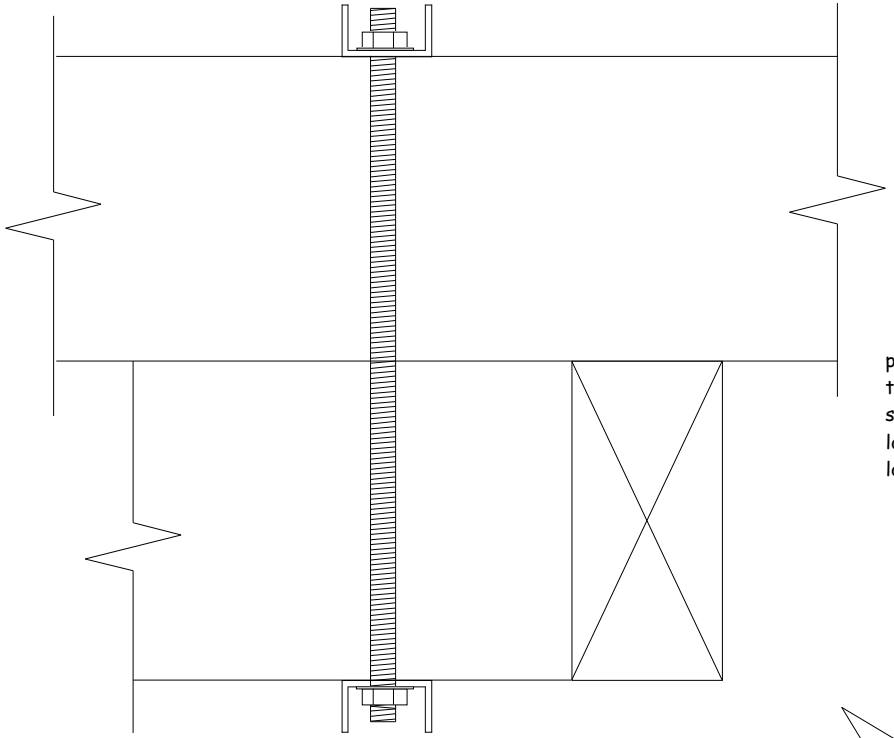
The bellringers have devised a non invasive and reversible method of clamping the lifted joints and a combination of clamps and bespoke steel wedges where twisting has occurred.

The form of these clamps is a pair of mild steel channels, one above and one below the timbers where they cross, and two vertical large diameter threaded stainless steel rods one each side of the beams. These rods will be fitted with washers and nuts and tightened to correct some of the twist or to bring the frame timbers and the foundation joints back into contact. Those joints which cannot be corrected by clamps alone will have mild steel wedges machined to match the geometry of the gap. This method will then distribute the load on the joint to the full area of the joint faces. These wedges will not be forced into place as this would impose further stresses on the timbers.

By these means the frame will flex less and transfer loads as intended. No beam or other timbers will be interfered with in order to provide these clamps and wedges. Every joint has been carefully examined by the Architect and the setting out of the clamps has been agreed.

This work will be undertaken by the Guild of Bellringers themselves: they have demonstrated themselves to be competent, particularly in connection with the fixing of the training dumbbells.

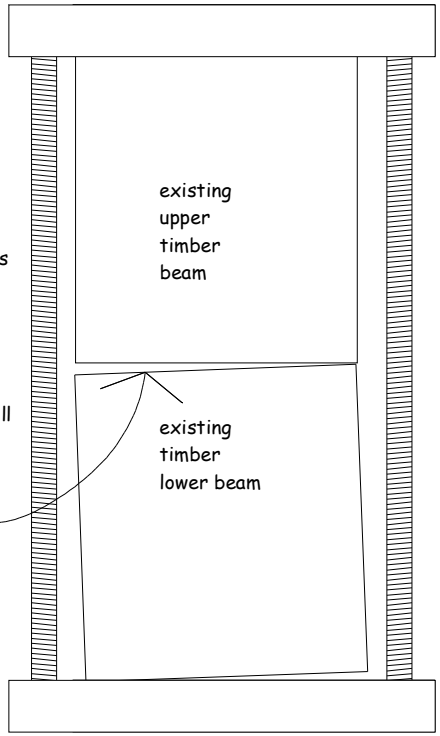
C Romain
Cathedral Architect for and on behalf of Cathedral Chapter
April 2010



100 x 50 mild
steel channel
above and
below joint
between beams

25mm dia grade 316
stainless steel threaded
rod with washers and nuts

purpose made machined
tapered mild steel
shim to uneven joint to give full
load transfer from upper to
lower beam



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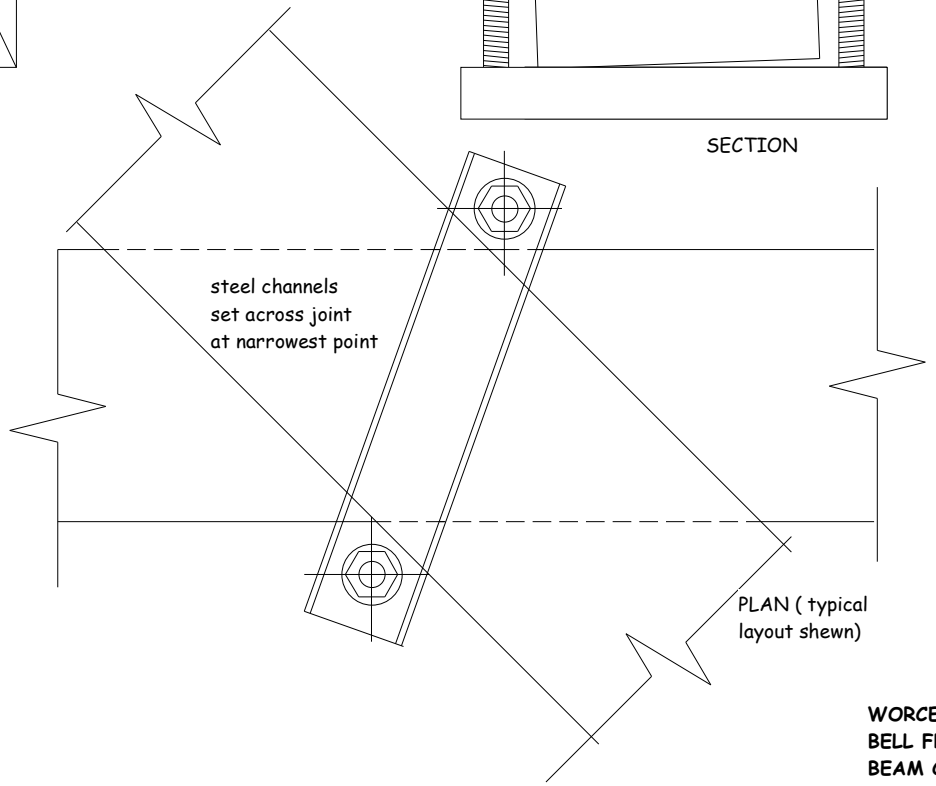

PLAN (typical
layout shewn)

WORCESTER CATHEDRAL
BELL FRAME FOUNDATION
BEAM CLAMPS not to scale