The Great Tower of St, Albans Abbey Church.

With a description of repairs recently carried out among its ancient timbers.

BY JOHN C. ROGERS, A.R.I.B.A.

BEFORE I describe the ancient timbers in the tower and the reparations recently carried out, some architectural notes on this extraordinary structure may be of interest.

The tower occupies a central position at the junction of the nave and transepts. Amongst our Cathedrals, it stands on higher ground than any other, the floor at the crossing being 340 feet above mean sea level, and it is the oldest of our great towers (1077-1088). Further, I believe this is the only great tower in this country built for the most part of Roman bricks, nearly 2,000 years old, as indeed is the rest of the church where the work of the Norman builders remains, the reason for this being that the ruins of Verulamium, the Roman city, but a few hundred yards to the south across the river Ver, provided an ideal quarry for this material.

The tower stands upon four rectangular legs or piers (each carrying a load of some 1,250 tons) and which at a height of about 50 ft. are connected by semi-circular arches; above these arches the tower walls rise 7 ft. thick to a total height of 144 feet. Externally, above the abutting roofs of the nave, presbytery and transepts, the tower is 47 feet wide east to west, and 45 feet north to south. Above the arches just referred to come the triforium and clerestory passages formed out of the thickness of the walls on the inner face, the former re-using stone shafts saved from the Saxon church; then still rising come the large clerestory windows—two to each face, and at 100 feet above the church floor is set a framework of huge beams enclosing sixteen boarded panels, the whole being decorated in colour.

Immediately above this painted ceiling is the floor of the ringing chamber supported upon the tie beams of

St ALBANS ABBEY CHURCH

Plane of Tower at level of Ringers floor

Dotted lines indicate beams forming framework,

of panels of painted ceiling

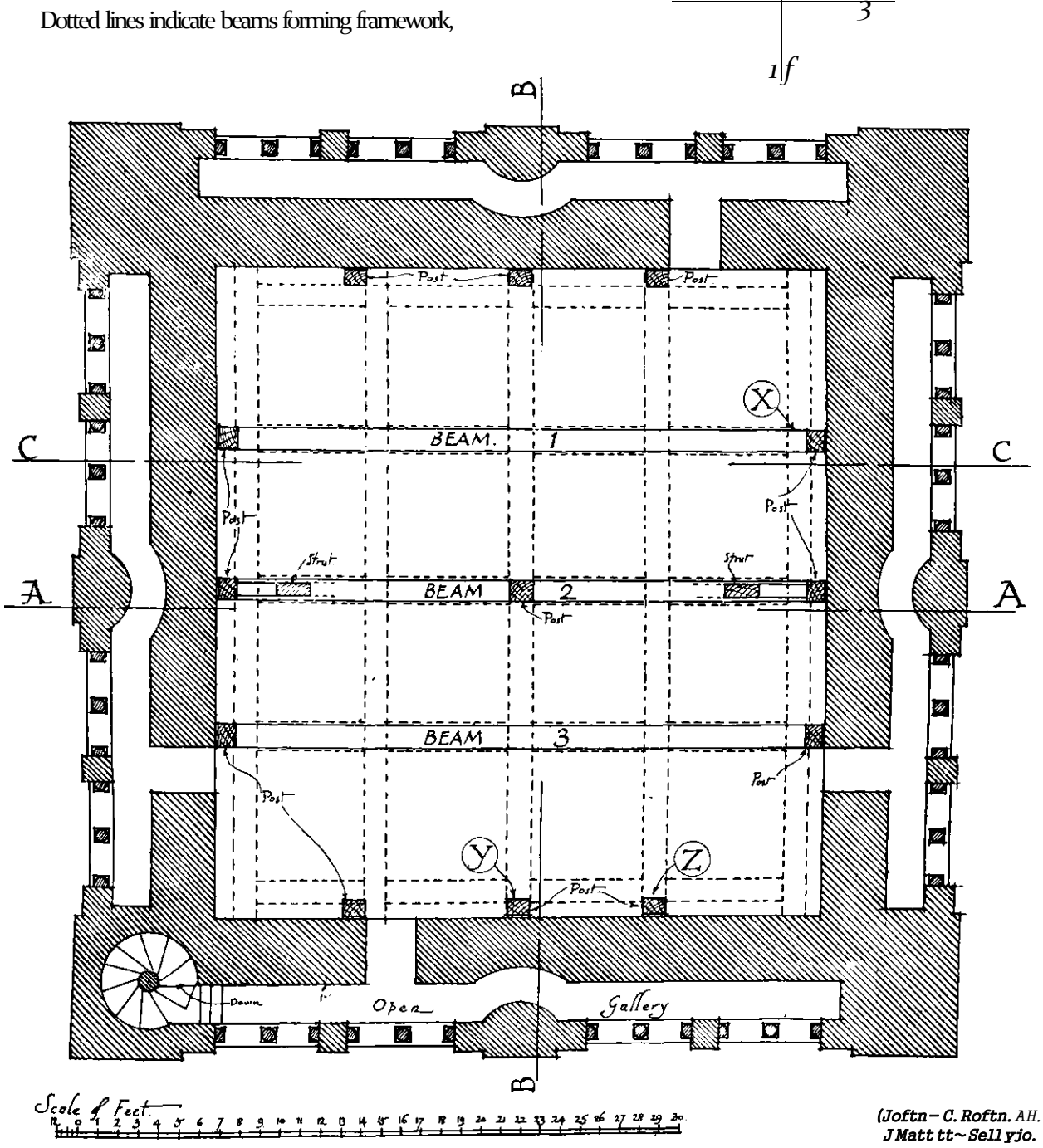

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PLATE I.

enormous wooden trusses, which in turn support on their upper beams the massive floor of the belfry.

A word must be said in reference to the spiral stairway by which the tower is ascended. Except tor reforming the riser and tread surfaces in stone, by Grimthorpe, this stair is the original work of the Normans, contrived entirely out of large rectangular Roman bricks which are actually employed for the central newel, necessitating constant cutting to obtain a more or less circular vertical shaft from which the steps radiate; and again, a rough arch continuous and rising with the upward moving spiral, is turned between this newel and the enclosing walls of the staircase to carry the steps. It has stood entire to this day, the ancient Roman brick polished almost black on the newel, where countless hands have guided the sense of direction round the darker bends.

Then again, when one reaches the charming gallery at the level of the ringing chamber, and also in the lofty belfry, one is thrilled beyond measure at the barbaric majesty and grandeur of these massive Norman walls and enormous arched windows. Here indeed is a lesson in the essentials of architecture.

Within this marvellous tower it has been my privilege to examine a veritable little forest of timbers, to carry out some strengthening measures, and counteract the activities of the wood-boring beetle Xe*stobium tessela-tum*, commonly known as the Death Watch Beetle.

It may be of interest to state briefly the life history of this insect. In size it varies between 1/4 inch and 5/16 inch in length, by 3/32nds. to 1/8 of an inch in diameter. It has wings and can fly. These beetles normally emerge in May and June from timbers in buildings and also from dying oaks and certain other trees in the open. When mating they make their characteristic call or tap-ping sound (made by the beetle striking the wood with its head) that has given them the name of " Death Watch." Eggs are deposited by the female generally in cracks or crevices, or holes bored by a previous generation. Up to eighty may be laid by one insect.

From the eggs are hatched the caterpillars or grubs, which immediately commence to bore into the timber. They work with the grain, feeding on the wood for about

two and a half years, making extensive honeycomb tunnels. In the third summer the grub's instinct tells it to alter its course and bore laterally until very near the surface; here it makes an enlarged chamber, seals up the hole by which it has arrived there and becomes a chrysalis. The perfect beetle develops during the ensuing autumn, but normally does not bite its way through the remaining crust of wood and emerge until next spring, though if the building be warmed this may happen earlier.

The wood most favoured for attack is oak, but in St. Alban's Abbey where chestnut also has been used, the beetle has been equally attentive to both.

It has been stated, though with little truth, that the warming of buildings in modern times has induced invasion by the beetle in places which had remained immune, and the trouble at St. Albans has been attributed to this cause; but in point of fact there is documentary evidence that in the 13th century this insect had ruined the upper part of the Chapel of St. Cuthbert, and my own investigations have disclosed a state of decay and loss of bulk which point unmistakably to worm activity over many centuries.

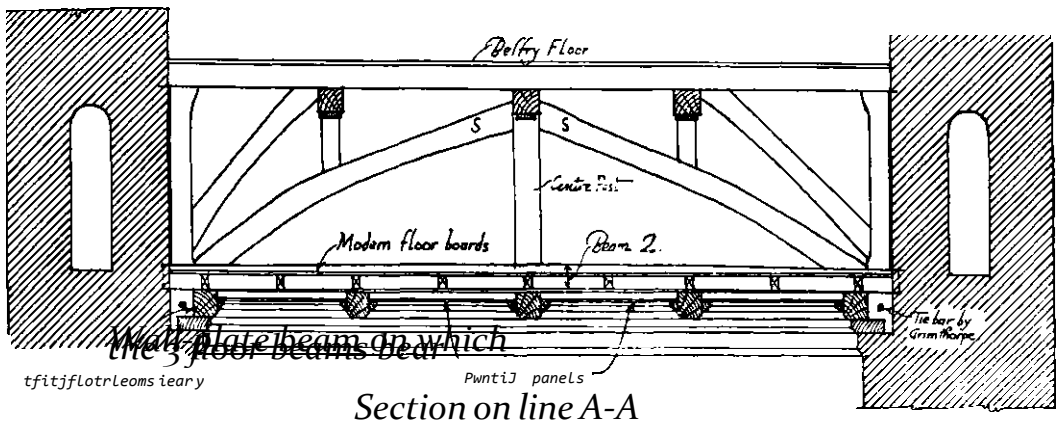
If the beetle can thrive in dead trees in open country he does not require warmth within a building, though that condition induces the imago to emerge at a somewhat earlier date than is normal.

At the time of my survey in May, 1930, it was possible only to surmise what lay beneath the boards forming the floor of the ringing chamber, or what relation the framing of the panelled ceiling had to the three beams (figured 1, 2, 3, on the plan) projecting slightly above the floor boards. My report advised exposing the ends of these beams entirely by removing a portion of the flooring and by cutting away the wall around them. This preliminary work led to unexpected discoveries.

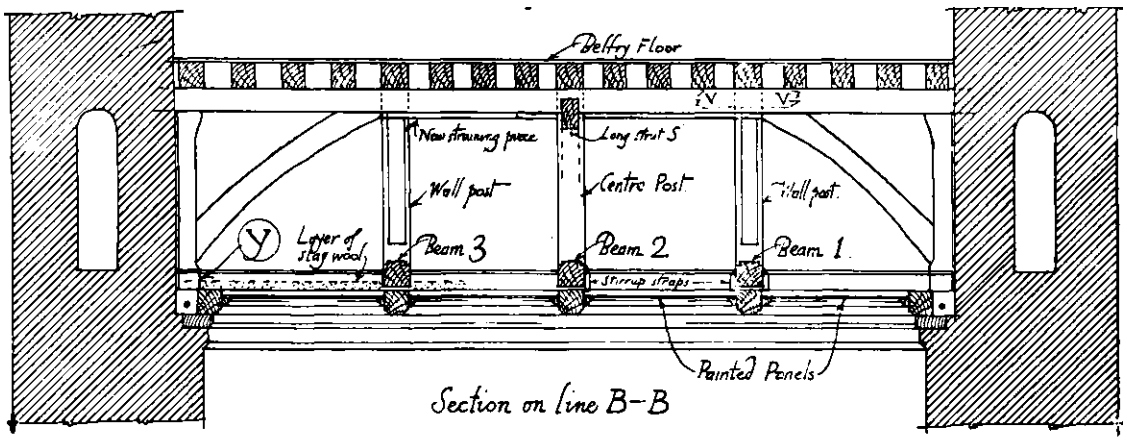
The ends of beams 1, 2 and 3 were found to penetrate but short distances into the walls—no more than from six inches to nine inches—pointing in unmistakable manner to some other form of support which at that juncture was not visible.

The spaces below the floor were choked with dust and

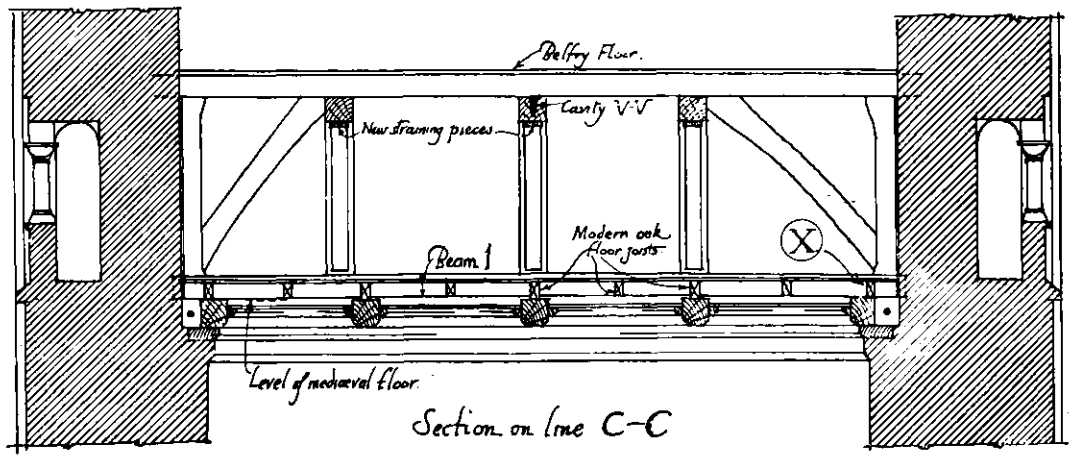
S[T]ALBAN'S ABBEY CHURCH Section through belfry stage in Tower (see plan)



Section on line A-A



Section on line B-B



Section on line C-C

Scale of Feet.
0 1 2 3 4 5 6 7 8 9 10

John. C Rogers A. R. I. B.A.
Mens et manu deft

PLATE 2.

rubbish which, when sufficiently cleared against the walls and beam ends, showed that these beams had a good bearing on a large baulk of timber placed parallel with the wall and about one foot therefrom. Further delving and the raising of more floor boards disclosed that this timber was in fact a huge wall plate, in four lengths of about 30 feet each, forming a square frame by running around all four sides of the tower, and resting upon a thickening of the main walls at this level.

Everywhere the spaces were full of dust and rubbish, through the denser parts of which the bore holes of the beetle could be traced, and the imperative necessity of examining the buried timbers and of discovering their full number and positions compelled me to remove entirely the modern floor.

When this was done, the wall plate frame was found to encompass a series of intermediate beams which apparently comprised the series of panels seen from the church below, but the almost indescribable accumulation of dust, etc., rendered further scavenging necessary.

The removal of this rubbish and dust proved slow work for the Vacuum Cleaning Company's men, as it consisted of a conglomerate mass of wood chippings, splinters, twigs, bones, lumps of mortar, stone, brick, walnut shells, straw, rope and other materials used in making nests of vermin and birds, all of which had to be sorted and sifted to prevent the suction-tube becoming choked, as now and again unavoidably occurred.

When all this refuse was cleared away I found the boards of the mediaeval floor, not more than three-quarters to one inch thick, and evidently not designed to carry any great weight. These boards were tongued together in ancient manner and were partly of oak and partly of elm, the latter being totally worm-eaten and rotten.

At this stage it was possible to make a careful examination of the main bearing and weight carrying beams, and it was at once clear that the three great floor beams numbered 1, 2 and 3 were practically independent of the under series of beams composing the frame of the panelled ceiling, except that in two or three places ancient iron straps united one beam to another.

Decay by Death Watch Beetle was found in more extensive form than had been the case with timbers above the floor level, with one exception, and which had been examined prior to my first report.

At point X on the plan the end of the floor beam and foot of the upright post framed into it were found to be badly attacked; the tenon of the post had almost entirely vanished and the mortice in the beam so enlarged that my hand could be inserted and large quantities of powder extracted. Further, by striking the post sharply a continuous rain of worm powder poured down into the mortice cavity.

In such situations as this the vacuum tool is invaluable, in fact without its aid I cannot imagine how it would have been possible to extract all dust and powder, as has been done, thereby rendering it possible effectively to apply the solution.

A similar case existed at point Y on the plan. The post was somewhat sounder, but the ceiling beam had a large cavity on one side, fortunately on the wall side of its bearing on the plate beam.

At point Z on the plan both beam end and post foot, though apparently without cavities, were tunnelled by the worm and gave a hollow sound. In these three positions a set of steel reinforcements were designed to stiffen the beam and to relieve the foot of the post from the load transmitted to it by upper beams and struts. The bolting up of the plates necessitated the through boring by hand of both beams and posts, an operation difficult and arduous in the extreme, yet most efficiently performed under conditions which many would have regarded as hopeless.

The ends of all beams in this floor have suffered more or less from the ravages of the beetle, but the position would have been much more serious were it not for the offset or thickening of the tower walls by about twelve inches immediately below the floor, upon which the beforementioned wall beams rest, and which has proved an invaluable margin of safety, the badly decayed parts occuring on the wall side of this offset.

The worst case of worm-eaten timber I discovered in a ceiling beam which lies parallel with, and immediately

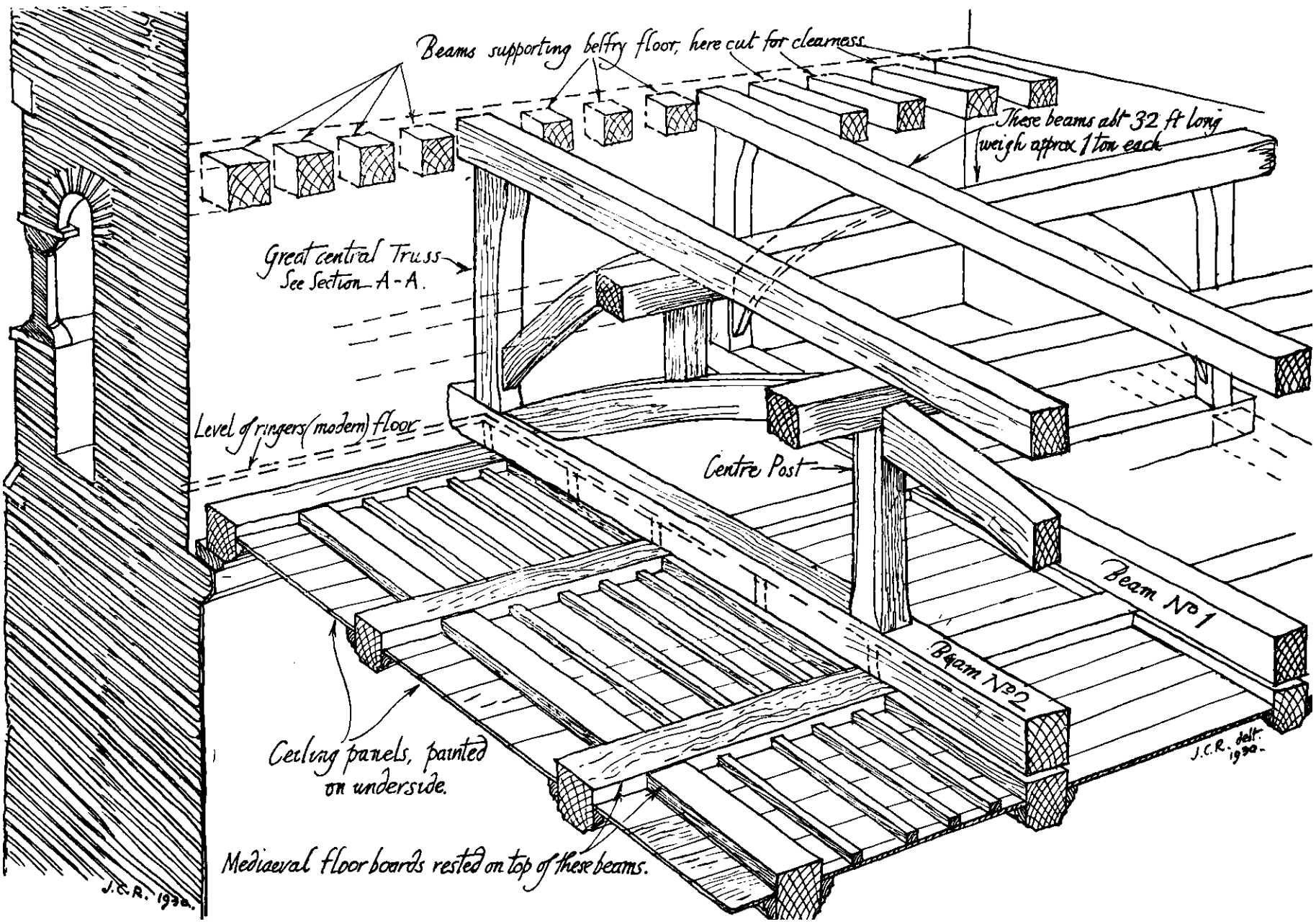


PLATE 3.

ISOMETRIC SECTION SHOWING ARRANGEMENT OF TIMBER TRUSSES AND FLOOR BEAMS IN THE TOWER, ST. ALBANS ABBEY CHURCH

below the floor beam at point X on the plan. Fortunately, this is only a secondary or filler beam, but its end towards the wall plate had three quarters of the substance eaten right away and terminated in a jagged stump about one foot short of its original framed-up end.

At first it appeared there was nothing to prevent its falling, being in a most difficult position for complete examination, but it was eventually found to have been clumsily repaired in recent times, the efficacy of which I regarded with some doubt: accordingly this under beam has been strapped up to the new steel plates lining the sides of the floor beam over, by stirrups cleverly contrived and inserted by one of the workmen.

It was found absolutely necessary to remove the whole of the mediaeval thin floorboards, as pockets of caked dust and rubbish were found embedded upon the actual boards forming the painted ceiling panels; and the panel bearers, formed of members about four inches by three inches in section, were much decayed.

It was now clear that many of the old panels had been unfairly treated by those who put in the modern floor, for the new bearers or joists had been so arranged that one rested centrally upon each panel without making any serious attempt to support their ends upon the sides of the main floor beams, with the result that the weak and badly wormed original panel bearers have for long been taking a part of the modern floor load, causing the panels to bulge. It is astonishing and almost miraculous that total failure has not occurred in certain cases, which had it taken place would have caused the collapse and fall of the panels.

These modern bearers were found badly attacked by worm in a few cases, and such have been replaced bv new : those requiring support have now been given steel strap hangers whereby they are slung to the main beams, so relieving all weight from the old panels, which even when new were not intended to carry such loads.

The weak condition of the original panel bearers in many cases pointed to the necessity of renewal, which could only be done by the complete removal of every panel concerned. This proceeding presented several strong objections, and I finally decided to leave the old

wood in place, to canvas the upper surfaces of the panel boards, and to place alongside each defective bearer a two inch by one and a half inch steel L bar, drilled for screws which were driven into the panels and the old bearers where sound enough. This method avoided both removal of the panels and touching the old painted under surfaces (though it is abundantly clear that many of the panels have been much restored in recent times with deal boards upon which the colour decoration must, of course, be modern. It is to be regretted that such restoration was not better and more wisely carried out: the original panels are entirely of oak with a lapped tongued joint, whereas modern replacements are of common deal boards of all shapes and sizes, merely butted, and leaving many crevices through which dust could fall).

The removal of the dust, which amounted to no less than four tons exclusive of solid rubbish, raised an unexpected problem, for it was found that any noises made above the panelled ceiling were intensified and reverberated about the body of the church below. Therefore I was asked to provide a sound deadening layer in the ringers floor and which finally took the form of a four inch layer of slag wool upon sheets of celotex resting upon the lower framework of beams supporting the painted panels.

But before this was inserted, the whole of the timber in the floor was sprayed under pressure with two to three coats of special insecticide solution suitable for structural timbers. The lower layer of ceiling beams and panel bearers were treated first, but not before the whole upper surfaces of the actual panel boards had been covered with stout canvas, glued down. On account of the proximity of ancient paintwork, a solution generally employed on old' furniture was used, as it has on many previous occasions where painted worm-eaten woodwork required treatment: this solution contains only a slight quantity of di-chlor-benzine, which is present in large proportion in the ordinary timber fluid and might possibly injure paintwork. No part of the actual panels was sprayed, but only their top bearers, which were much wormed and badly needed an insecticide. Due to the

conductivity of the old fixing nails and honeycombed bearers, a certain amount of solution soaked into the panels, but with one exception which unfortunately is rather severe, only slight staining resulted. This should dry out gradually, but owing to the old colour work being of a nature similar to distemper or water paint, the badly affected panel may retain its darkened tone for some time. Following this, the insulation was well packed into the irregular spaces about the beams, and the modern floor of stout deal planks relaid after having the tongued joints renewed and the whole given a coat of creosote. Formerly nailed, the boards are now screwed down, and after an interval of say ten years I consider it would be wise if they were again lifted in places to test the efficacy of the insecticide solution which has just been applied.

With the whole of the floor back in position it remained for the posts, struts and upper series of beams supporting the belfry to be treated with solution, all of which has been thoroughly carried out.

Among these upper beams, which number twenty and are set in two layers as shown on the sectional drawings, several badly worm-eaten and wet-rotted cases were examined, but in no case was it considered sufficiently serious to use steel plating. The deepest cavity occurs at the point marked V—V (see sections B—B and C—C) where the worm had eaten a long narrow chase down to the heart while leaving the flanks of the beam sound, borings having been made to test this. Fortunately the affected part lies immediately above a perfectly sound strut and a new oak straining piece. The half length of this beam alone consumed two gallons of solution. The six straining pieces, bolted to the under sides of the lower set of beams in the belfry floor, are of modern introduction and are very valuable stiffeners against rocking when the bells are rung. They were found to be of deal or pine and worm-eaten; consequently I have replaced them all with new nine inch by three inch oak well saturated with timber fluid. While these straining pieces were removed for treatment of the old beams, etc., temporary raking struts were inserted to preserve the requisite stiffness and allow the bells to be rung when required. Due

to natural shrinkage, etc., wedges were found inserted in all positions where beams cross and one rests upon the other. All were found more or less loose and badly wormed; consequently I have removed them and had new oak wedges inserted and tightly driven home after being well saturated with timber fluid.

I should point out that it was impossible to examine the framework of beams supporting the panelled ceiling with the same thoroughness as those above them; they were inspected as far as was possible from the ringers' floor and their tops and upper parts of their sides have been treated, but their lower painted surfaces could be examined only from a scaffold spanning the tower from below, which has not been done as it did not appear to be justified from the examination as carried out.

In a similar way, the top surfaces of the seventeen beams carrying the actual belfry floor have not been examined, nor their bearings in the walls exposed, as this is rendered impossible for the most part by the bells with their frame and chiming gear and also the huge tank.

The load of the bells is eccentric on account of their being grouped towards the south-west angle of the tower, while the rain-water tank is placed in the north-east angle; this tank is of stout wood construction lined with lead and weighs about six tons. It was provided by Grimthorpe as a means of solving the problem of disposal of rain-water from the lead roof and also, to use his own words, " for safety against fire." The tower of Lincoln, he adds,"was once saved by one."

However, its great weight would seem to be a severe load upon the old beams, yet it may act as a counterpoise to the bell frame in the opposite corner. If it be of any value on such account it may well justify its permanent retention, but on this point I am not competent to speak.

The total quantity of timber fluid used in the tower amounts to approximately 100 gallons.