

Stone Groining of a Semi-Circular Apse

By JOHN A. MARSHALL, IN STONE.

The following intricate and interesting example of stone work is by Mr. John A. Marshall, one of the greatest authorities in England, in this line of work. It illus-

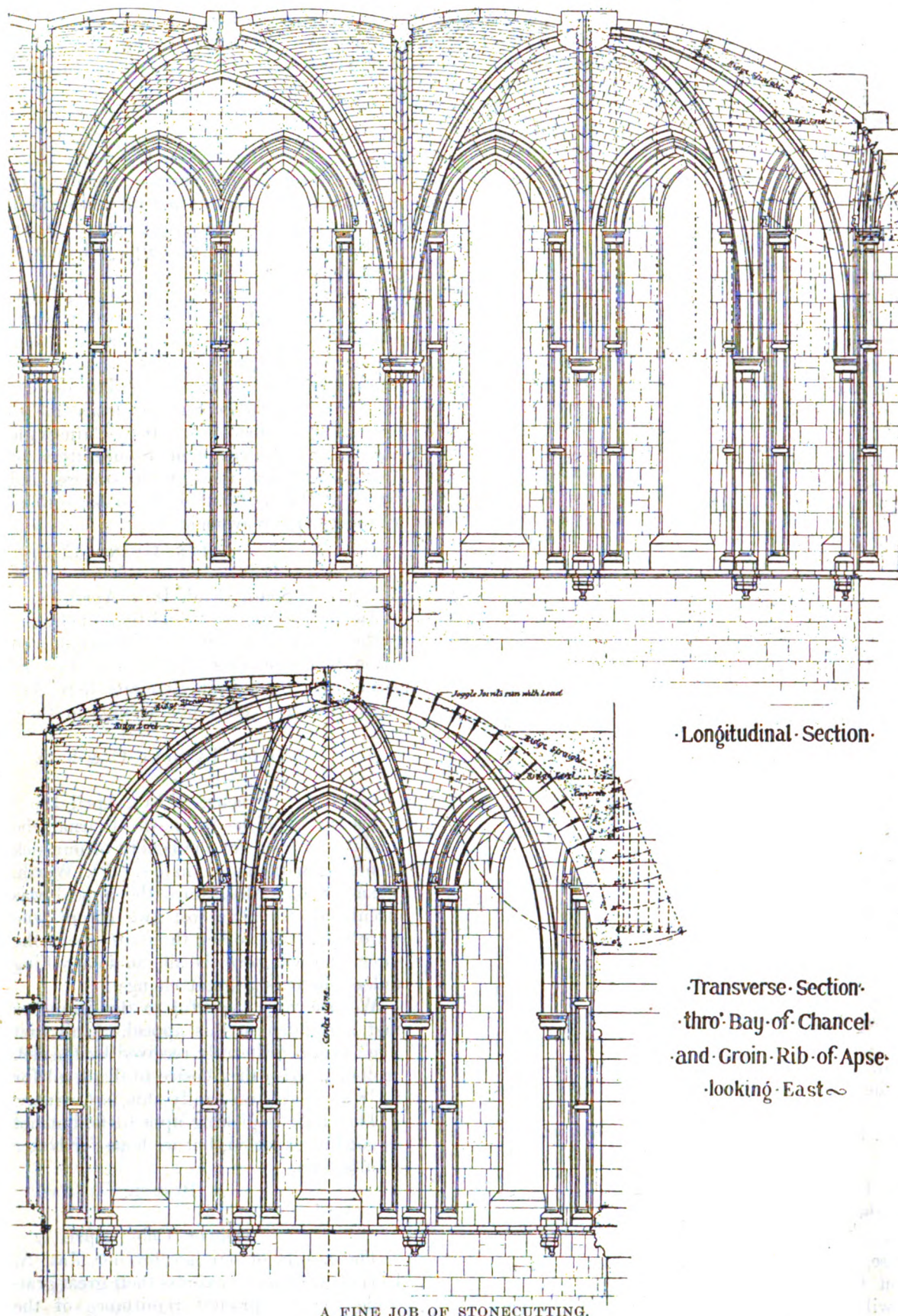
trates the setting out and construction of an ordinary Gothic vault. Accompanying the drawings, Mr. Marshall gives the following description: The space to be vaulted is a chancel 24 feet wide, terminating in a semi-circular apse. For the bays in front of the apse

the simple "quadripartite" system is adopted, the space being spanned by light stone arched ribs, some taking a transverse direction, others a diagonal, so that they may serve as a permanent centering for the thin filling-in of the vault; the weight and thrust are thus concentrated on a few points. As a commencement for the radi-

two parts, each with a ridge inclined on plan from the point of intersection to the crown of the windows. One-half only of this arrangement is adopted in our illustration, because the transverse rib just mentioned is placed on the chord of the apse as a starting point for the radiating ribs. Having settled the general disposition of the vaulting ribs, their section, and the plan at the springing on the abacus of the cap, it remains to determine their curve. We have commenced by making the diagonal ribs a semi-circle, struck from a centre on the level of the caps; this gives two points that regulate the curve for the transverse ribs, viz., the height of the filling-in at the apex and the point where these ribs separate, a little above the springing; this point on the curve is found by transferring it from the plan to the soffit line on the elevation. In striking the curve for the transverse rib it may be a compound curve or struck from one centre only, so long as it passes through the two points mentioned above. Although in this design the curve of the diagonal ribs was settled first, and that of the transverse ribs made dependent on it, this order of setting out the work may be reversed if desirable.

The wall rib can seldom be arranged to part from the others at the same level unless the compartment to be vaulted is square, or nearly so, and having no weight to sustain, this rib is generally made subordinate to the others, while the main transverse ribs should be made larger than the rest. The common expedient of stiling the walls ribs to make room for the windows is another factor affecting the point of separation. Up to this point it is usual to build the work in horizontal courses, each course in a single stone, with the beds cutting the mouldings obliquely, instead of being normal to the curve. This method of corbelling practically reduces the span and simplifies the working of the stones, for it will be evident that if the top bed of all the springers is bevelled in front for the mouldings, the under side will have to be hollowed out to fit, thus involving a waste of material and labor. At the level where the ribs become free, or independent of each other, the top bed is of course bevelled to take the voussoirs, which are turned on centring in the usual way.

Keystones, or bosses, are introduced to receive the ribs at the apex; this avoids irregular intersection of the mouldings, and the stability of the vaulting is increased by



trates the setting out and construction of an ordinary Gothic vault. Accompanying the drawings, Mr. Marshall gives the following description:

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ating system of the apse the first narrow bay is arranged on what is known as the "sexpartite" system, or rather a modification of that system—common in France and adopted at Canterbury—wherein the ordinary diagonal ribs are intersected by a transverse rib, which divides the bay into

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the pressure of the key at the crown. The top of the boss should project above the filling, and be worked with a level surface on which the radiating centre lines can be inscribed to serve as a guide when the ribs are being turned.

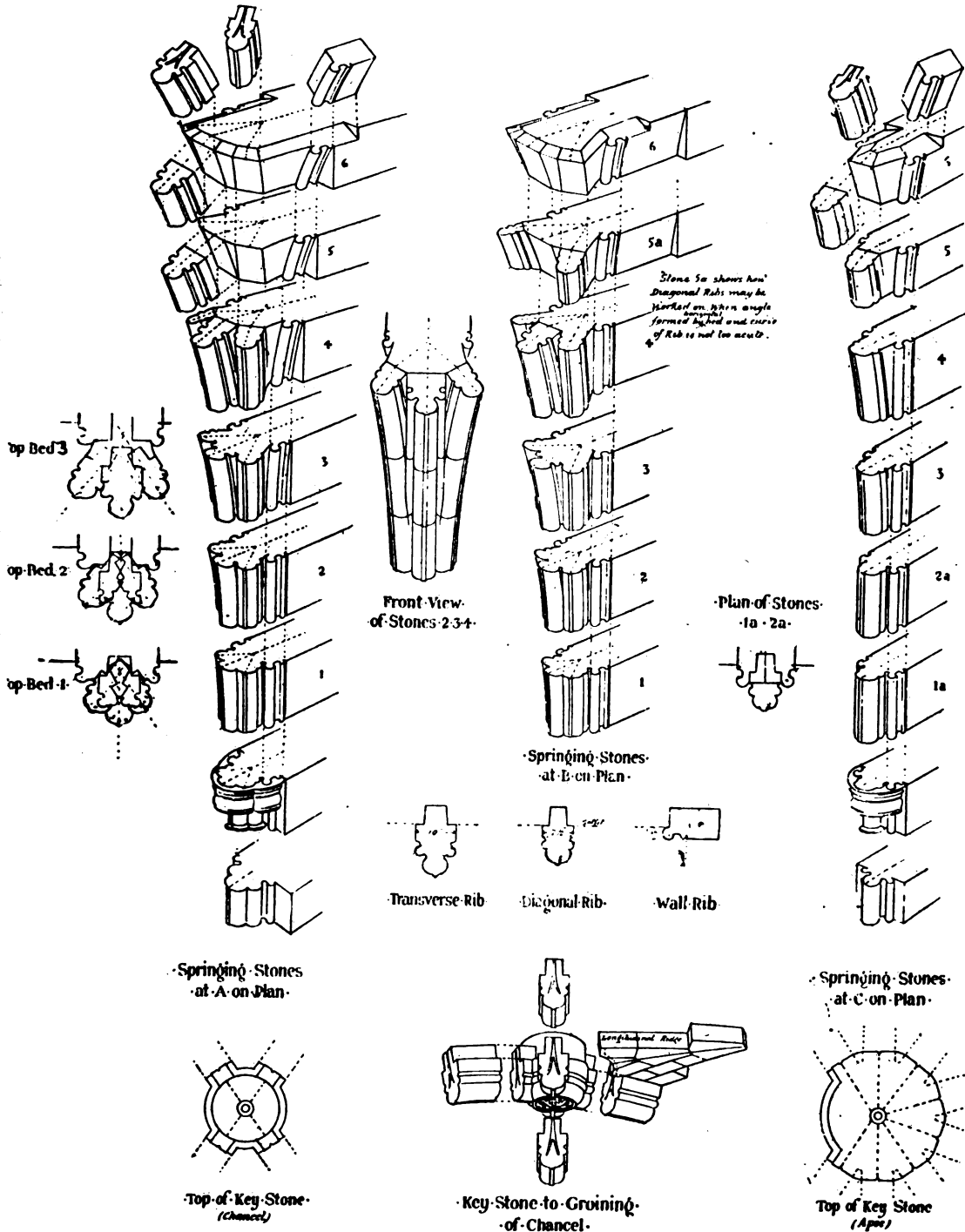
To take the filling it is usual to form rebates on the sides of the ribs. These rebates need not be cut back more than three-quarters of an inch, as it is important not to weaken the ribs, but a slight skewback should be formed in addition to the rebate

sary, though in England the usual practice was to form the spandrels rendered flat from rib to rib. When the soffit is domical the ridge requires a special centre, because its curve is developed by the intersection of the spandrels at the apex. The ridge stones on which this curve is worked are sometimes made long enough to include two or three courses of the filling, and the notching of the ridge stones for this purpose may then be worked in situ to insure accurate adjustment.

and in order to diminish the thrust, it is proposed to make the filling-in of the vaulting of a light concrete like that used at Salisbury Cathedral. It is much lighter than any stone, and should a settlement occur does not become detached in small pieces as a brick vault would, but simply cracks. For a similar reason it is carried over the ribs and not rebated on to them. In France, where this system is followed, the author has seen several vaults (the cloisters of Rouen, for instance) where the ribs have fallen, but the filling-in remains perfect."

Lastly, cement should never be used in the jointing of Gothic vaulting. It will prevent elasticity and stain the stonework. The rib stones should be dowelled together, either as shown or with slate dowels. For the ribs, only very light framed centreings is required, but to keep the voussoirs in position until the completion of the vaulting small pieces of bracketing must be nailed on each side of the centres.

The Senate Committee on Public Buildings and Grounds ordered reported bills for new buildings as follows: Muskogee, Okla., \$265,000; Minot, N. D., \$220,000; Walla Walla, Wash., \$220,000; Kansas City, Kan., \$240,000, extension; Easton, Pa., \$150,000; Miami, Fla., \$175,000.



DETAILS OF STONE GROINING OF SEMI-CIRCULAR APSE

when the filling is arched or domical, as in the present instance. There is no fixed rule for the direction on plan of the narrow courses of the filling-in, but by placing them at right angles to a line bisecting the angle formed by the ribs the pressure on the ribs is equalized, and, perhaps, the most satisfactory appearance is obtained. It also facilitates the application of a movable hand centre that can be adjusted to suit the varying spans of each course. The domical method of turning the spandrels rendered the use of continuous centreing unneces-

From the level where the ribs separate the pockets are generally filled in up to about one-third of the height with stone chippings or a light kind of concrete. Sometimes the whole of the vaulting was covered with a layer of mortar and rubble, probably poured on hot so that the filling and the ribs become one entire substance—practically concrete. In this connection the following extract from the report accompanying the drawings submitted by Mr. Burges for a church at Constantinople may not be uninteresting: "For the sake of lightness,

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