the swinging of the bells to a greater degree than in any other material, and also that it offered the greatest resistance in proportion to its weight, and was capable of resisting tensile as well as compression stresses, and in addition to these advantages was perfectly fireproof.

The tower (Figs. 6 and 7) rests on 12 reinforced concrete columns connected with 8-inch-thick concrete walls; they go



Fig. 12.

along the total height of the tower and are at the base 1 foot by 7 feet, and at the top 1 foot by 2½ feet. They are stiffened laterally by the floors. The foundation slab, 40 feet square, is situated 20 feet under the church floor, from this slab and up to a height of 60 feet the tower is 25 feet by 25 feet. From that elevation the corners are taken off so that it continues as an octagon. In elevation 90 feet above the floor the reinforced concrete walls stop short and are continued in brick. Over the room for the bells are only four columns carrying the last story, 16 feet high.

The bells are hung up in a special manner (Kurz system) which causes the tongue of the bell to meet the clapper when it is inclined at about 45 degrees to the vertical, and both are swinging outwards as opposed to many other systems, in which the tongue meets the clapper during the backward swing, thus causing greater impact stresses in the tower. After the Kurz system church bells have been built up to 13,000 lbs. weight, and are capable of being rung by only two men.

In the garrison church in Kiel the roof, the top of the tower and the gallery pews are constructed in reinforced concrete. The roof (Fig. 8) is supported by two diagonal Polonceau trusses of 75-foot span, built entirely of concrete and reinforced with thin bars. The tower top, placed upon the 85-foot-high brick tower, has 4-inch-thick walls, is 21 feet square at the base and 65 feet high.

In Russia reinforced concrete has already been in use for over 10 years in church buildings, not only in the greater cities but even in the villages, where one would think that the very low temperature during the long winter, the difficulty of transport and of getting the necessary able labors would throw insuperable obstacles in the way. This view (Fig. 9) shows the typical plan of such a village church and with the interior entirely built up in reinforced concrete. The roof slab is supported by concrete beams with 26-foot span between the columns and 16 feet between the brick walls and columns. Not only in those churches roofed by arches but also in those roofed by domes a great number are to be found in which reinforced concrete is employed.

One of the most interesting and characteristic examples is the church in the Russian city, Poti, situated in the swampy delta territory between the Black Sea and the Caspian.

As at the outset the cost prohibited the carrying of the

foundation 70 feet deep through shifty sand down to firm ground, the chief consideration was to reduce the weight of the walls and domes to a mini-Of the schemes sent in, the reinforced mum. concrete one was selected, which not only met these requirements, but was the cheapest and also the most expeditious in spite of the fact that the work had to be performed by unskilled local labor. The walls are only 14 inches thick, including a 7inch-thick airspace. The main piers, in accordance with the architect's desire for massive exterior, are built hollow (Fig. 10) containing pipes for heating and ventilation. The roof is formed of one main dome (Fig. 11) with 42-foot span and attached to this are two half-domes and to one of these again smaller half-domes.

A dome of similar size is built in reinforced concrete in Christ Church in Dusseldorf (Fig. 12). This dome is supported by four arch girders of 45-foot span, and over these four parabolic arches are arranged, carrying the weight of the tower.

The dome in Los Angeles, with its 62-foot span, (described in the February 6th, 1913, issue of The Canadian Engineer) is still one of the largest church domes built in reinforced concrete, but in other



passed. For instance, the span of the dome shown in Fig. 13 is nearly 100 feet, and at the present time one with 200 feet span is under construction.