Q2: Design of a double riveted lap joint of zigzag pattern

Two plates of t = 7 mm thickness are connected by a double riveted lap joint of zigzag pattern. Calculate rivet diaameter, rivet pitch and distance between rows of rivets for the joint.
Assume S_t = 90MPa , S_s = 60MPa , S_c = 120MPa .
(*Hint:* According to IS code, the standard size is d = 19 mm and the corresponding rivet diameter is 18 mm)

The design parameters in a riveted joints are *d* , *p* and *m*.

Diameter of the hole (d): When thickness of the plate (t) is more than 8 mm, Unwin's formula is used
i.e. $d = 6 \times sqrt(t)$ mm.
Otherwise *d* is obtained by equating crushing strength to the shear strength of the joint.
In a double riveted zigzag joint, this implies
$$S_c t = (\pi/4) \times d \times S_s \text{ (valid for } t < 8 \text{ mm)}$$
However, *d* should not be less than *t* , in any case.

Pitch (p): Pitch is designed by equating the tearing strength of the plate to the shear strength of the rivets. In a double riveted lap joint, this takes the following form.
$$S_t(p-d)t = S_s \times 2(\pi/4)d^2$$
But $p \geq 2d$ in order to accommodate heads of the rivets.

Margin (m): $m\, d = 1.5$.
$$P_d = (P/3) + (2/3) \times d$$

Figure for Illustration: