Peter's Problem 2018 Suggested Solution

1. Write down the optimum internal dimensions of the room which would accommodate the needs of the hotel using the criterion of minimum area.

Calculations

Note: The 'width' dimension is parallel to the Top Table. The 'length' dimension is perpendicular to the 'width'. Measurements are in metres, correct to 3 places of decimals.

Top Table and space required for Top Table guests
70cm per person for 20 guests. 20x0.7 = 14m width.
Dimensions of table: 1m x 14m.
The table is to be centred on one wall facing guest tables. The overall space required is then 0.7 (aisle) + 0.65 (seat) + 1 = 2.35m length and 14m width.

Circular Table dimensions
65cm per person for 12 guests. 12x0.65 = 7.8m circumference.
$2\pi R = 7.8 \Rightarrow R = \frac{7.8}{2\pi} = 1.242$ rounding up to the nearest mm.

Circular Table space required:
R1 = radius of table = 1.242m.
R2 = radius of table + guest seating space (65cm) = 1.892m.
R3 = radius of table + seat + waiting aisle (70cm) = 2.592m.
(The corresponding diameters are D1 = 2.484m, D2 = 3.784m, D3 = 5.184m.)

Minimum distance between centres of tables: 2xR2 + 0.7 = 4.484m allowing adjacent aisle spaces to overlap (See [BD] on Diagram 1).

Maximum number of guests: 200.
20 guests at the Top Table, 180 guests at circular tables. 12 guests per table means that 15 circular tables are required.

Other spaces to be accommodated
3 Entrance/Exit doors, each 2m wide with 3m clearance: 2x3 space for each; to be placed to allow ease of evacuation.
2 Kitchen serving doors, each 1.5m wide with 3m clearance and separated by 1m: 4x3 space.
Bar area 4m with 2m clearance: 4x2 space.

Designing the layout of the function room
Considerations
Circular tables may be placed in a number of different arrangements. Observing the centre points of each of the 15 tables we may look at placing them in arrangements such as: a rectangular array (15x1 or 5x3);
a rectangular array of 4x4 with one space omitted;
placing every second row with centres offset allowing the tables to be placed closer to each other;
offset centres with varying numbers of tables in each row;
irregular placing of centres;
a mixture of irregular and regular placings.

The design presented here is a rectangular array of 3 rows of 4 tables with a further row of 3 tables offset to fit closer.

Calculation of distance between rows when centres are offset

Three centres may be placed in an equiangular triangular arrangement as ΔABD . The lengths of sides [AB], [AD] and [BD] are 4.484 (distance between centres of tables). The height of the triangle, h = |CD|, may be found by Pythagoras' Theorem (or trigonometry).

|CD| =

$h = \sqrt{4.484^2 - (\frac{4.484}{2})^2} = \sqrt{15.0797} = 3.883$. See Diagram 1.

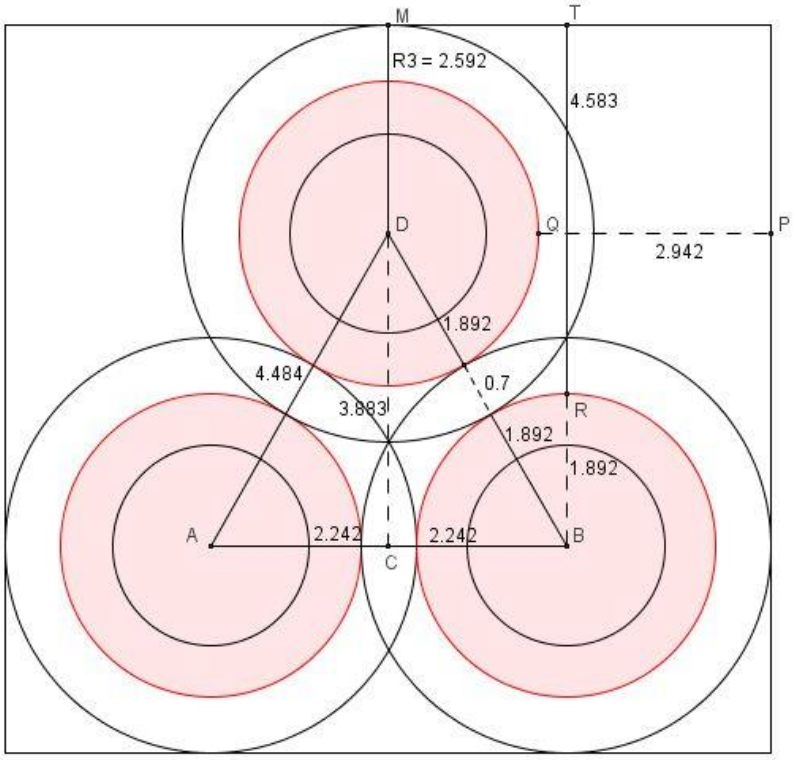


Diagram 1

A mock-up or sketch of the design is useful at this stage to visualise completion of the layout. The final design may be used for reference here.

Width of the room: 4 tables in a row across the room: 3xdistance between centres + ½ table at each end = 3x4.484 + 2xR3 = 13.452 + 5.184 = 18.636m.

Length of the room: 3 tables in a row up the room + next table offset = 2xdistance between centres + offset distance between centres (|CD| in Diagram 1) + ½ table at each end (R3 + R3 or D3) = 2x4.484 + 3.883 + 5.184 = 18.035m.

Dimensions so far: LxW = 18.035 x 18.636 (in metres).

Placing the Top Table, Doors, Kitchen doors and Bar area, with reasons

From a mock-up of the layout so far, it can be seen that the doors may be strategically placed at or near three corners of the room. This will allow ease of evacuation and also keep the overall area as low as possible. The Kitchen doors may be placed on the right-hand side near the back. The Bar may be placed on the left-hand side near the back. The Top Table and two doors may be placed on the wall facing the row of four circular tables. The third door may be placed on the back left near the corner with clearance space overlapping the clearance space of the Bar.

1. Calculations of space adjustments to accommodate the Top Table and 2 Doors

a) Width: Width of room to accommodate 4 circular tables (as calculated above) = 18.636m. Width of Top Table + 2 doors = 14 + 2 + 2 = 18m. The Top Table and two doors will fit without adjustment of width.

b) Length: From the wall behind the Top Table guests to the front edge of the Top Table is 2.35m and the length of the room increases accordingly by 2.35m which will now be 18.035 + 2.35 = 20.385m.

2. Calculation of space requirements for the door clearances near the Top Table

a) **Width:** The width of the doors together (4m) is accommodated in the calculation in 1(a) above. The doors may be placed at the corners of the room adjacent to the Top Table.

b) **Length**: The closest seating of the circular tables is 2.35 (edge of Top Table) + 0.7 (aisle) = 3.05m from the wall behind the Top Table which allows enough space for the 3m door clearance required for Door 1 and Door 2.
The doors may be placed at the corners.

3. Calculation of space adjustments in order to place the Kitchen Doors on the back right-hand side and the Bar and third Door on the back left-hand side

a) Width:

The three offset tables on the back row need a width of 2x4.484 (2xdistance between centres) +2x1.892 (2xR2) = 12.752m. Since the width of the room is 18.686m the remaining available space on each side is (18.636 – 12.752) ÷ 2 = 2.942m (|QP| in Diagram 1).
This means that the Bar clearance area (2m) may be accommodated on one side (Left) but there needs to be 3 – 2.942 = 0.58m extra space on the Right side in to accommodate the Kitchen clearance (3m).

Adjustment of Room Width

As a consequence, the width of the room must be adjusted to 18.636 + 0.058 = 18.694m.

Door 3

By allowing the door clearance area to overlap the Bar clearance area the third door (2m) may also be placed at the back left corner.

b) **Length: From 3rd Row to Back wall ([TR] in Diagram 1):**

The centre of the 3rd row is R3 + h = 2.592 + 3.883 = 6.475m from the back wall (|MD| + |DC| in Diagram 1). The free space is 6.475 – R2 (|BR| in Diagram 1)= 6.475 – 1.892 = 4.583m.

This means that there is enough space available to accommodate the Kitchen access (4m) and the Bar (4m) on their respective sides. They may be placed up to 0.583m from the back wall.
Here, they are placed 0.5m from the back wall.

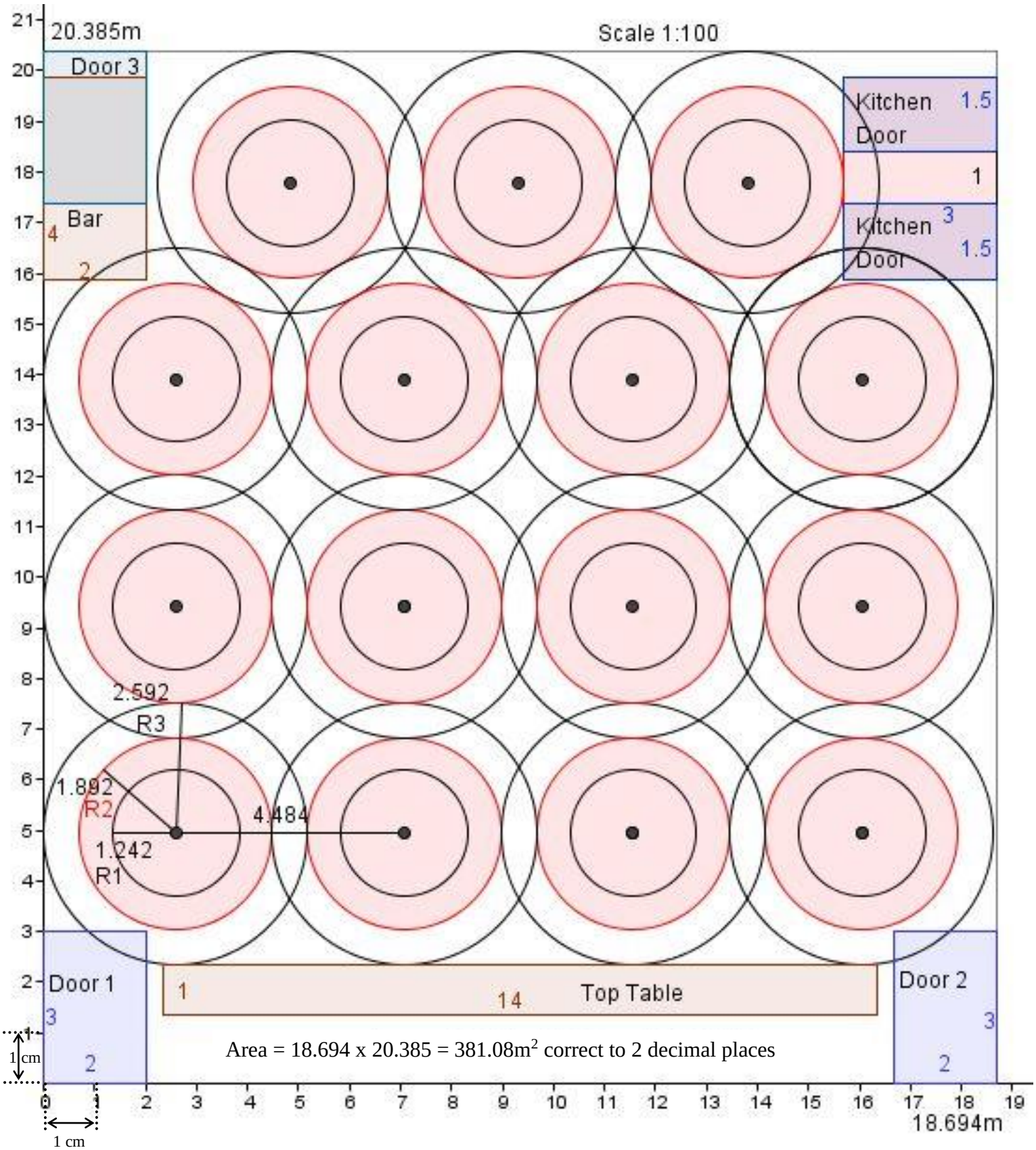
4. Placing the Top Table

The Top Table will be placed centrally on the width of 18.694m.

The dimensions of the room are 18.694m x 20.385m.
The area of the room is 381.08m^2, correct to 2 decimal places.

2. *Include a 1:100 scale drawing of your room design, indicating clearly the position of all the features included. State the reason(s) for positioning each of the features in the plan.*

The design has been completed using GeoGebra. Measurements are in metres. The drawing is done at a scale of 1:100 so that 1cm represents 1m.



3. *Include your proposal for the name of the room. You may choose any name for the room, including a local reference or a reference to a feature in your proposed room which does* ***not*** *require an increase in the finished floor area.*

This question provides for creative thinking and personalises the design process.

4. *Find how many conference delegates can be accommodated in your function room (when theatre style seating is installed).*

Calculation of space available for seats:

a) Width: The width of the room is 18.694m. The room may be divided in two since there is a central aisle. On each side aisle space is 1 (½ centre aisle) + 1.6 (side aisle)= 2.6m. The remaining space is ½ (18.694) – 2.6 = 6.747m.

Number of seats in a row:

Each seat is 0.55m wide so we can accommodate 6.747÷0.55 = 12.267 seats. This must be rounded to 12 seats which occupy 12x0.55 = 6.6m leaving 6.747 – 6.6 = 0.147m extra aisle space on each side. The aisle space on each side will then be 1.6 + 0.147 = 1.747m. Each row can hold 24 seats

b) Length: The length of the room is 20.385m. The available space is 20.385 – 2.35 (Top Table) – 1.6 (aisle between rows 10 and 11) – 2 (front aisle) = 14.435m.
Each seat requires 0.5 (seat depth) + 0.5 (row clearance) = 1m.
Thus, 14 rows may be accommodated.

Adjustments for clearance on Door 3 at the back

There is one door clearance (2x3) which must be accommodated.
a) Width: The 12 seats in a row on the left-hand side end at 1.747m from the left-hand wall which is too short. Eleven seats would end 1.747 + 0.55 = 2.297m from the side wall. The clearance for the door is 2m from the side-wall so that only one seat has to be removed from the back row to accommodate the door clearance.

b) Length: The door clearance of 3m will require 3 seats, in total, to be removed.

Total number of delegates

The theatre seating can accommodate 14 rows with 24 seats in each row, less the 3 seats in the door clearance space at the back.
Total: 24x14 –3 + 20 (Top Table) = 353 delegates.

A drawing helps to establish these figures and although not requested in the specifications may be included for clarity, as is given here.

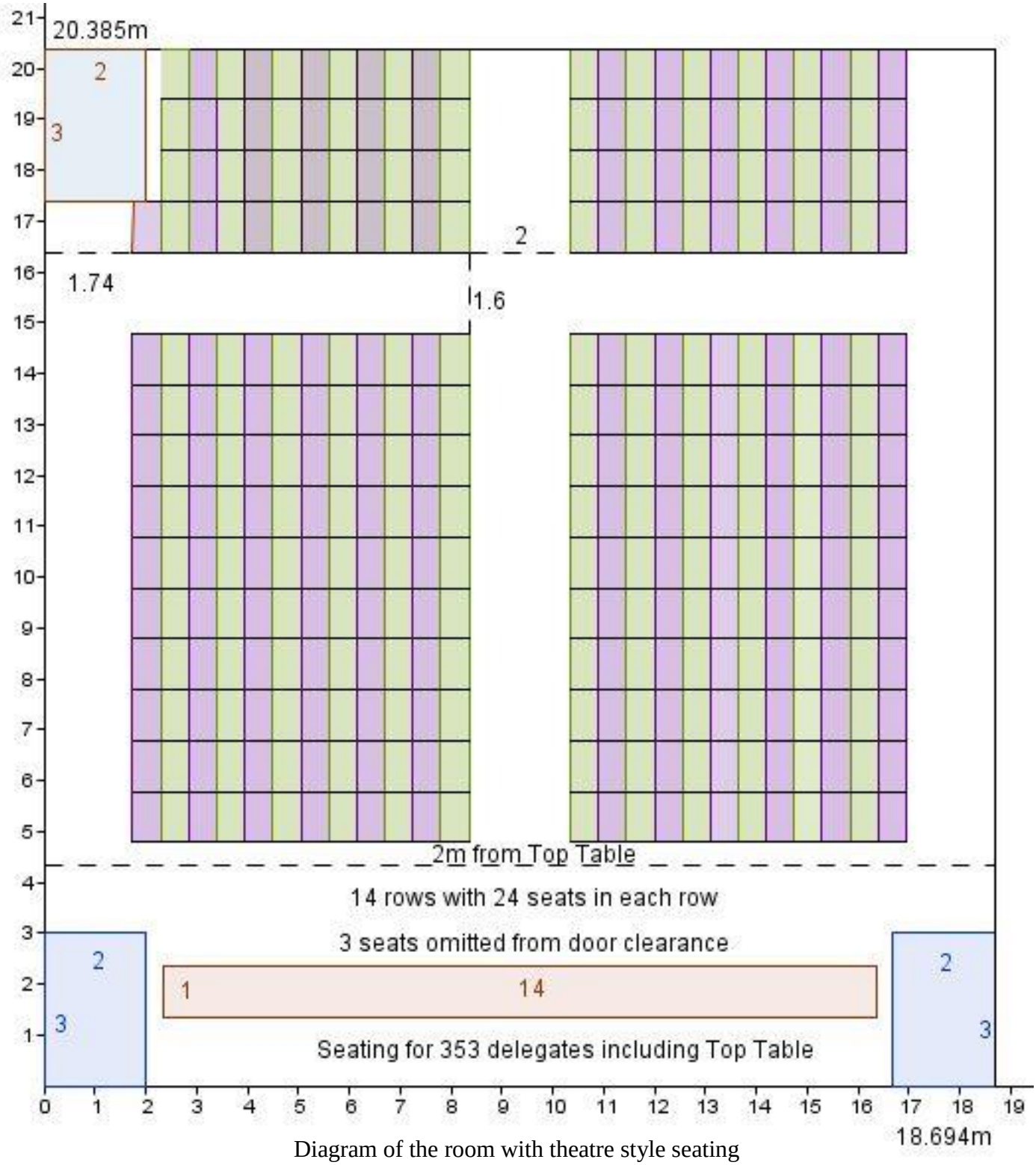


Diagram of the room with theatre style seating

5. *Use the World Wide Web to find and list two Irish companies which could manufacture the tables and/or the chairs for your room. Recommend one of these companies, stating the reason for your choice.*

This question provides for an interesting investigation of the companies which provide such services in Ireland.

IMTA Peter's Problem 2018 Co-ordinators