Case Study 2

A renowned architect is designing a new wing for the City Science Museum. The floor plan of this wing is shaped like a large parallelogram. The base of this parallelogram-shaped hall is 60 meters, and its corresponding height (perpendicular distance from the base) is 40 meters. To make the entrance grand, the architect has designed a triangular glass atrium at one corner of the hall. This triangle has a base of 15 meters and a height of 20 meters.

Inside the main hall, there is a dedicated section for a digital display which is also in the shape of a parallelogram, but smaller in size, with a base of 10 meters and an altitude of 8 meters. The museum board wants to cover the remaining floor area of the hall (excluding the triangular atrium and the digital display section) with premium marble flooring. The cost of this marble is Rs 1200 per square meter. Furthermore, to ensure safety, a special rubber grip tape will be placed along the entire perimeter of the triangular atrium. The sides of the triangular atrium are 15 meters, 20 meters, and 25 meters.

1. What is the total area of the parallelogram-shaped museum hall?

   (a) 1200 square meters

   (b) 2400 square meters

   (c) 2000 square meters

   (d) 4800 square meters

   Answer: (b) 2400 square meters
   Solution: Area of a parallelogram = base $\times$ height. Area $= 60 \times 40 = 2400$ sq m.

2. Find the area of the triangular glass atrium designed at the corner.

   (a) 150 square meters

   (b) 300 square meters

   (c) 200 square meters

   (d) 100 square meters

   Answer: (a) 150 square meters
   Solution: Area of a triangle $= \frac{1}{2} \times$ base $\times$ height. Area $= \frac{1}{2} \times 15 \times 20 = 15 \times 10 = 150$ sq m.

3. What is the total length of the safety rubber grip tape required for the perimeter of the triangular atrium?

   (a) 50 meters

   (b) 60 meters

   (c) 70 meters

   (d) 45 meters

   Answer: (b) 60 meters
   Solution: Perimeter of a triangle = sum of all sides. Perimeter $= 15 + 20 + 25 = 60$ meters.

4. Calculate the floor area that needs to be covered with premium marble flooring.

   (a) 2170 square meters

   (b) 2250 square meters

(c) 2150 square meters

(d) 2320 square meters

Answer: (a) 2170 square meters

Solution: Total hall area = 2400 sq m. Area of triangular atrium = 150 sq m. Area of digital display parallelogram = $10 \times 8 = 80$ sq m. Net area for marble = $2400 - (150 + 80) = 2400 - 230 = 2170$ sq m.

5. If the height of the main hall was doubled while keeping the base the same, how would the total area change?

   (a) It would remain the same.

   (b) It would be halved.

   (c) It would be doubled.

   (d) It would increase by four times.

   Answer: (c) It would be doubled.

   Solution: Area is directly proportional to height ($A = b \times h$). If h becomes $2h$, the new area $A' = b \times 2h = 2(b \times h) = 2A$.