**PROBLEM 1**

A geostationary satellite operating at 12 GHz is 40° above the local horizon. The ground receiving station RX is located on a tower, 25 metres away from a building that is 35 metres high. Calculate the minimum height $h$ of the tower that guarantees full "radio" visibility.

![Diagram of PROBLEM 1](image)

**PROBLEM 2**

For the multipath environment shown in figure, knowing that the frequency is 433 MHz, that the obstacles are marble surfaces ($\varepsilon_r=7.5$) and that the coherence distance $d_c$ can be expressed as a function of the angle spread $\sigma_\Omega$ as $d_c = \frac{\lambda}{2\sigma_\Omega}$, calculate the minimum distance between two receiving antennas to implement an effective diversity countermeasure. All antennas are isotropic.
PROBLEM 3

The median field strength in the street surrounding a concrete building is $|E|=-50$ dBV/m. A receiver inside the building is connected to an antenna with a gain $G=2.5$ dBi. The frequency of operation is 1800 MHz. Knowing that the thickness of the concrete walls is $W=25$ cm, that concrete has $\varepsilon_r=4.5$ and $\tan\delta=0.1$, and that large scale variations inside the building are log-normally distributed with $\sigma=6$ dB, calculate the receiver's minimum sensitivity that guarantees that the fraction of the area inside the building covered is 80%.