The density is now

\[
\text{mass of matter in a square} \over \text{area of the square}
\]

in units kg/m\(^2\) (not kg/m\(^3\)). (We think of the integration over the thin, uniform third dimension as having already been done.)

Set up the problem so that the body lies in the \(x-y\) plane. \(D\) is now the two-dimensional region in that plane occupied by the matter. Then the formula for total mass is

\[
M = \iint_D \rho(x, y) \, dA,
\]

the coordinates of the center of mass are

\[
\bar{x} = \frac{\iint_D \rho(x, y) x \, dA}{M}, \quad \bar{y} = \frac{\iint_D \rho(x, y) y \, dA}{M},
\]

and (since \(z\) is always 0 inside the body) the three moments of inertia are

\[
I_z = \iint_D \rho \left(x^2 + y^2\right) \, dA, \quad I_y = \iint_D \rho x^2 \, dA, \quad I_x = \iint_D \rho y^2 \, dA.
\]

Notice that if you know any two of the moments of inertia, then you know the third without further calculation! [Insert graphics of lamina spinning about axis perpendicular to lamina and about axis lying in lamina.]