(3) A basketball thrown from the top of a tall building lands on the street below. How high will it bounce?

To estimate v_0, the terminal speed of a basketball falling through air, I shall assume that its diameter is 0.3 m, its mass is 0.7 kg, and the drag coefficient C_D is unity. Drag $= C_D \times$ frontal area $\times \frac{1}{2} \rho v_0^2$, where ρ is the air density, 1 kg/m^3. Setting the drag equal to the weight gives $v_0 = 14$ m/s. A terminal speed of that magnitude would be nearly attained in a distance small compared to the height of a tall building. Assume first that the bounce is elastic. Then in the absence of drag the ball would rise to a height $h_0 = 7$ m. But the initial drag, now downward, is just equal to the ball's weight. The ball's upward velocity subsequently decreases according to $dv/dt = -g(1 + v^2/v_0^2)$. Integrating this twice, one finds that the ball rises to a height $h_0 \ln 2$, in this case 4.9 m. To allow for inelastic bounce I'll reduce my prediction of the height to 3 m. If I had looked up the drag coefficient for a sphere at the appropriate Reynolds number ($\sim 10^5$ in this case) I would have used $C_D = 0.5$, obtaining thus $v_0 = 21$ m/s, and doubling all my height estimates. (See Landau and Lifschitz, *Fluid Mechanics*, Sec. 45.) Perhaps someone will find the real answer by an experiment.