We consider a dependent bond percolation model on $\mathbf{Z}^2$, introduced by Balint Toth, in which every edge is present with probability 1/2, and each vertex has exactly two incident edges, perpendicular to each other. We prove that all components are finite cycles almost surely, but the expected diameter of the cycle containing the origin is infinite. Moreover, we derive the following critical exponents: the tail probability $P(\text{diameter of the cycle of the origin} > n) \approx n^{-\gamma}$, and the expectation $E(\text{length of a cycle conditioned on having diameter } n) \approx n^{\delta}$. We show that $\gamma = (5 - \sqrt{17})/4 = 0.219...$ and $\delta = (\sqrt{17} + 1)/4 = 1.28...$ The relation $\gamma + \delta = 3/2$ corresponds to the fact that the scaling limit of the natural height function in the model is the Additive Brownian Motion, whose level sets have Hausdorff dimension 3/2. The value of δ comes from the solution of a singular sixth order ODE.