We investigate the magnetostatic problem on exterior domains which are the complement of a compact set. In the first part, we prove the existence and uniqueness of a solution of the magnetostatic problem posed on the complement of a toroidal domain with an additional curve integral constraint under suitable assumptions. In the second part, we focus on the numerical approximation of solutions of the 2D magnetostatic problem on an annulus domain involving a curve integral constraint where we investigate the idea to substitute this constraint using integration by parts and including it directly in the variational formulation. We prove well-posedness and an a-priori estimate of this formulation and present numerical examples in the end that confirm our theoretical predictions.