We present new necessary and sufficient conditions for a function on $\partial \Omega \times S^1$ to be in the range of the (non) attenuated Radon transform of a sufficiently smooth function support in the convex set $\Omega \subset \mathbb{R}^2$. The approach is based on an explicit Hilbert Transform associated with $A$-analytic functions in the sense of Bukhgeim. (Received January 28, 2014)