Our aim is to design generator matrices of Maximum Distance Separable (MDS) codes such that each row of the generator matrix has a specific support. More specifically, we consider an \((n, k)\)-MDS code for which each row of its generator matrix contains up to \(k - 1\) zeros at certain places, and the elements at the remaining places can be assigned any values from the underlying finite field. We call such a generator matrix as the constrained generator matrix \(G_{\text{con}}\). It can be shown that if \(G_{\text{con}}\) does not contain an \(l \times m\) zero sub-matrix such that \(l + m = k + 1\), then randomly choosing the values of non-zero elements over a finite field of sufficiently large size results in an MDS code with high probability. We say that \(G_{\text{con}}\) is feasible if it is possible to complete it to an MDS code. We conjecture that it is possible to linearly transform a Vandermonde matrix to obtain the constrained generator matrix with high probability for any feasible matrix \(G_{\text{con}}\). We verify this conjecture for a large number of cases. This conjecture admits a number of reformulations that lead to interesting conjectures in algebraic geometry, abstract algebra and number theory. In particular, our method to verify it is based on a purely geometric reformulation of the problem. (Received September 17, 2014)