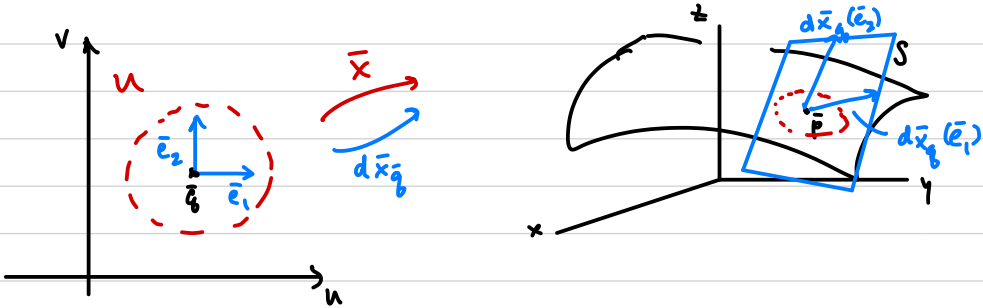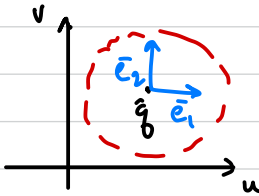Q: Why do we require $d\bar{x}_q$ to be 1-1 (i.e. rank 2)?
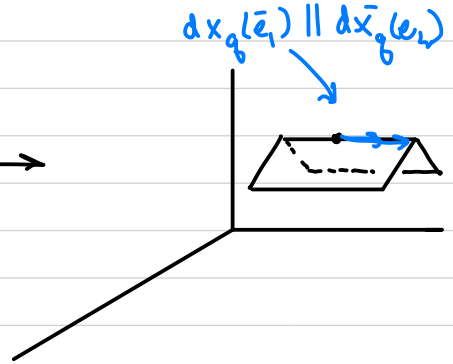

This tells us that there is a well-defined <u>tangent plane</u> to S at $\bar{p}$.

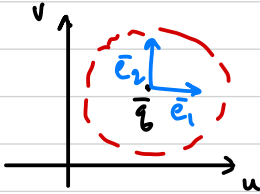If $d\bar{x}_q$ $\underset{=}{not}$ 1-1, picture would look more like!

e.g.

$\bar{x}, d\bar{x}_q$ →

$dx_q(\bar{e}_1) \parallel d\bar{x}_q(e_2)$

or

$\bar{x}, d\bar{x}_q$ →

$d\bar{x}_q(\bar{e}_1) = d\bar{x}_q(\bar{e}_2) = \bar{0}$