$$\lim_{x\to 2} \frac{\int_2^x (x-t)\sin^2(t-2)\,dt}{\tan^4(x-2)}$$ $\left(\frac{0}{0}\right)$ form use l'hopital rule

$$\Rightarrow \lim_{x\to 2} \frac{\int_2^x \sin^2(t-2)\,dt + 0 - 0}{4\tan^3(x-2)\times \sec^2(x-2)}$$ $\left(\frac{0}{0}\right)$ form

$$\Rightarrow \lim_{x\to 2} \frac{\sin^2(x-2)}{4\left[3\tan^2(x-2)\cdot\sec^2(x-2)\times\sec^2(x-2) + \tan^3(x-2)\cdot 2\sec^2(x-2)\tan(x-2)\right]}$$

$$\Rightarrow \lim_{x\to 2} \frac{\sin^2(x-2)}{4\left[3\tan^2(x-2)\cdot\sec^4(x-2) + 2\tan^4(x-2)\cdot\sec^2(x-2)\right]}$$

$$\Rightarrow \lim_{x\to 2} \frac{1}{4\left[3\sec^6(x-2) + 2\sin^2(x-2)\cdot\sec^6(x-2)\right]}$$

$$\Rightarrow \frac{1}{4[3\times 1 + 2\times 0\times 1]} = \frac{4}{12} \Rightarrow \boxed{\frac{1}{3}}$$ Ans