Fermilab

Particle Physics Division
Mechanical Department Engineering Note

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Project Internal Reference:

Project: NOvA

Title: FHEP Installation Block Pivoter Max. Deflection

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Reviewer(s):

Key Words: NOvA, FHEP, Block Pivoter

Abstract Summary: The following engineering note provides a calculation of the maximum deflection that could occur for the block pivoter as a result of the tolerances and allowances of various parts of the pivoter assembly.

Applicable Codes:

In calculating the maximum deflection between the bookend and the block pivoter, there are two areas of the assembly that have been determined which could possibly lead to a deflection of the table-and-pallet assembly and would cause it to be out of parallel alignment with the bookend assembly. These two areas are the cam followers and the rails.

As part of the design of the cam follower assembly, there is a gap between the cam followers and the sides of the rails.

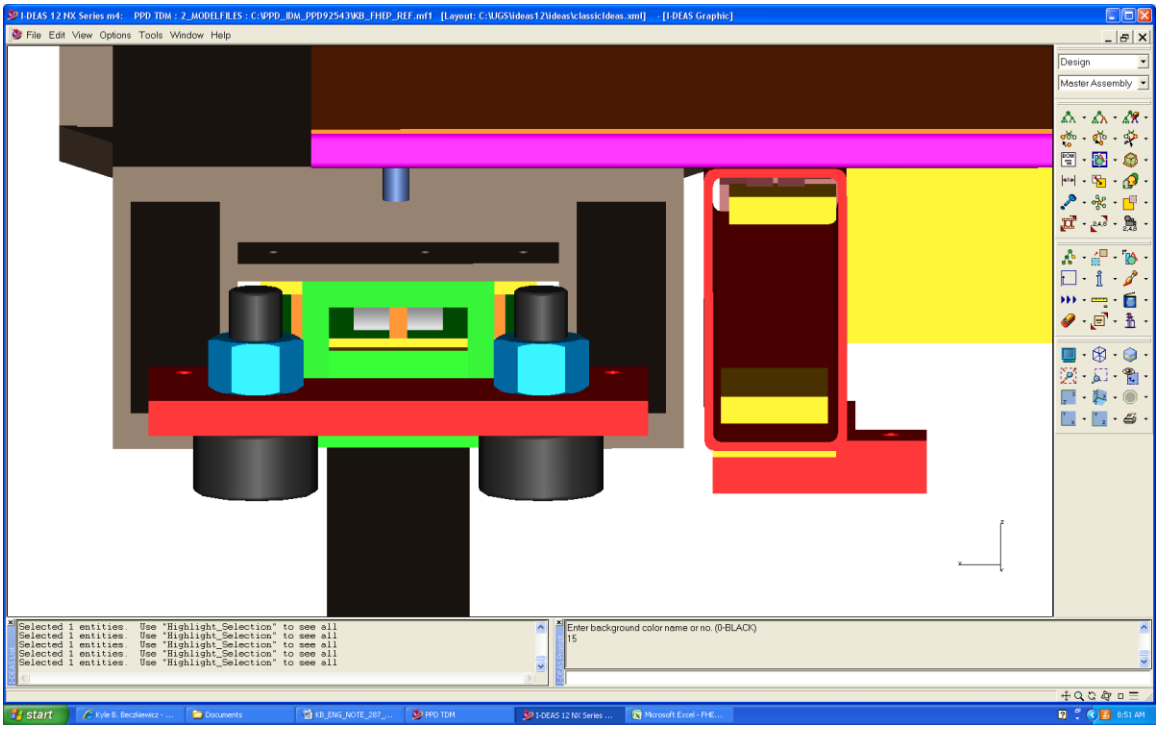


Figure 1: Cam follower assembly

When the cam follower assembly is centered along the rail, the gap on either side of the rail between the cam followers is assumed to be ¼". There are two sets of cam followers on each end of the block pivoter assembly, spaced 439.9" apart. The maximum angular deflection that would result from this gap is

$$\theta = \tan^{-1}\left(\frac{0.25\ in. + 0.25\ in.}{439.9\ in.}\right)$$

$$\theta = 0.065\ deg.$$

Another factor that could contribute to an angular deflection is the straightness of the rails that the block pivoter rides on. The assumption is made that the rails, at their maximum deviation, may be ¼" off of perfect straightness. Taking into consideration the length of the rails between the cam followers, which are 439.9" apart, the total deflection would be

$$\varphi = \sin^{-1}\left(\frac{0.25\ in.}{439.9\ in.}\right)$$

$$\varphi = 0.033\ deg.$$

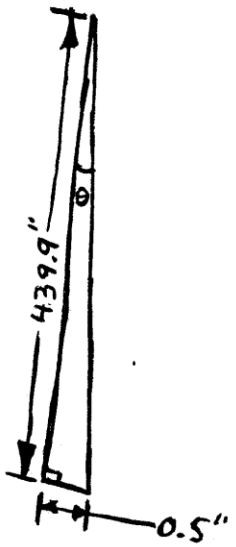
The total angular deflection is the sum of the values for θ and φ, which is 0.098 degrees. The width of the table-and-pallet assembly is 104". If one edge were in contact with the bookend, the maximum distance between the other end of the table-and-pallet assembly and the bookend would be

$$\sin(\theta + \varphi) = \left(\frac{x}{104\ in.}\right)$$

$$x = (104\ in.) * \sin(0.098\ deg.)$$

$$x = 0.177\ in.$$

CAM FOLLOWERS



$\tan\theta = \left(\frac{0.5\,in.}{439.9\,in.}\right)$

$\theta = \tan^{-1}\left(\frac{0.5\,in}{439.9\,in.}\right)$

$\theta = 0.065°$

RAILS

$\sin\varphi = \left(\frac{0.25\,in}{439.9\,in.}\right)$

$\varphi = \sin^{-1}\left(\frac{0.25\,in}{439.9\,in.}\right)$

$\varphi = 0.033°$

TOTAL DEFLECTION

$\sin(\theta+\varphi) = \left(\frac{x}{104\,in.}\right)$

$(104\,in.)\sin(0.065+0.033) = x$

$\boxed{x = 0.177\,in.}$