# Comparison of Distances on Nebraska Page Baseline 

Earl F. Burkholder - May 27, 2015

## Note - this posting is defective. See instead www.globalcogo.com/NebBaseLineMay2015.pdf

The associated sheet shows:
A. Position of Page NE Base and Page SW base. The latitudes, longitudes, geoid heights, and elevations were taken from the current NGS data sheets for those points.
B. The geocentric ECEF coordinates were computed for:

1. Point 1 - Page Southwest Base
2. Point 2 - Page Northeast Base
3. Point 3 - latitude/longitude for Page SW on the ellipsoid, i.e., $\mathrm{h}=0.0 \mathrm{~m}$.
4. Point 4 - latitude/longitude for Page NE on the ellipsoid, i.e., $\mathrm{h}=0.0 \mathrm{~m}$.
5. Point 5 - latitude/longitude for Page SW, but at ellipsoid height of Page NE.
6. Point 6 - latitude/longitude for Page NE, but at ellipsoid height of Page SW.
C. The definition of horizontal distance is taken to be a line whose ellipsoid height is the same at both ends - called HD(3) in item \#4 at www.globalcogo.com/refbyefb.html. (Note ASCE holds the copyright of that article and does not permit me to post it. But, if you ask me personally, I am permitted to send you a copy.)
D. $\mathrm{HD}(3)$ is a chord distance and computed as:

$$
\begin{equation*}
\text { Dist }=\sqrt{\left(X_{2}-X_{1}\right)^{2}+\left(Y_{2}-Y_{1}\right)^{2}+\left(Z_{2}-Z_{1}\right)^{2}} \tag{1}
\end{equation*}
$$

E. In this case, the arc distance is longer than the chord by 0.0006 m . - see on sheet.
F. The "horizontal distance" was computed at the ellipsoid height of each end-point using equation (1). The "mean horizontal distance" is the dotted line $=8,251.7602 \mathrm{~m}$.
G. The reported measured distance in 1900 is $8,251.7569 \mathrm{~m}$.
H. The difference is 0.0033 meters in a distance of $8,251.76 \mathrm{~m}$ or $1: 2,500,000$, very close.
I. As John Hamilton points out, the difference may be due to a number of reasons.

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$$
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nEBRASKA BASELINE COMPARISON

1. SW END

2 NE EMO
3. SW ON EUPSOID
4. NE ON ELIPSOID

5. SWC EIEV NE
6. NE P ELEV SW
sw

$$
\begin{aligned}
& \phi=42^{\circ} 25^{\prime} 25.39941 \\
& \lambda=98^{\circ} 26^{\prime} 00.79833 \\
& h=626.231+-21.76=601.52 \mathrm{~m}
\end{aligned}
$$

NE

$$
\begin{aligned}
& \phi=42^{\circ} 28^{\prime} 53.47527 \\
& \lambda=98^{\circ} 22^{\prime} 13.99939 \\
& h=580.1+-25.04=555.06 \mathrm{~m}
\end{aligned}
$$

$$
R=\sqrt{M A}=\frac{a \sqrt{1-e^{2}}}{1-e^{2} \sin ^{2} \phi} \quad \phi_{m}=42^{\circ} 27^{\prime} 09.43734
$$

$$
\begin{array}{ll}
a=6,378,137.00 & R=6,376,199.397 \mathrm{~m} \\
e^{2}=0.006694380023 &
\end{array}
$$

ARC $+C H O R D \quad \theta=2 * \sin ^{-1}\left(\frac{C H}{2 R}\right) \quad L=R \theta$

$$
L=6,376,199.397 *\left[\sin ^{-1}((2) 6251.0115)\right.
$$

ARSIS... $=8,251.0121 \mathrm{~m}$, LONGER BY 0.0006 m
MEAN (DOTTED LINE) $\left.8,251.760^{2} \mathrm{~m}\right\}$ WITHIN MEASURED IN $1900 \quad 8,251.75$ X m $_{69}$

