GBT MEMO 130

GBT Finite Element Analysis Macros in Quattro Pro

Library

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GBT Memo 124, The GBT Tipping-Structure Model in C, outlines a procedure for using the Finite Element Analysis Model in a C program. To facilitate simple analysis of individual nodes, the laser group has implemented a few macros in a Quattro Pro spreadsheet. It has been suggested that others may find the spreadsheet useful, so it is being made available. To obtain a copy send email to gbuzanos@sadira.gb.nrao.edu.

The GBT_NODE.WQ2 spreadsheet requires Quattro Pro, version 5.0 or higher to run.

Within the spreadsheet there are five macros. They are described according to which page they occur on in the spreadsheet. An example of each macro's output can be found at the end of this document.

A hoop and theta value (defined by 121010 Sheet 7, GBT Memo 114) can easily be changed to the node values used within the spreadsheet. All dish node values begin with the number 7. The three following digits are the positive angle and the last two digits are the hoop number. Thus, all the dish node values have six digits total.

Page A:

Includes information about the macros and spreadsheet as well as hints and bugs for the macros.

Page B:

The macro executed by 'Alt c' requests a node and elevation angle from the user. It then calculates the deformations from the rigid body at the specified angle, the elevation coordinates, and the alidade coordinates. These values are output in table form on page A of the spreadsheet. The equations used to calculate deformation and coordinates are found in the unpublished memo by David Parker (Par95) or in the GBT Memo 124. The macro uses a rigging angle of 66°, which can be easily changed in the field b:f12.

Page C:

The raw data is displayed on this page. If it is altered in any way the macros will not work properly. Node values and their coordinates such as ZdeltaZ or ZtiltZ are looked up here by the macros.

Page D:

The second macro can be executed with 'Alt g'. This program prompts the user for a range of elevation angles and a node value. The information is used to generate four graphs for the user. The default setting of the macro brings up the graph of all axis move-

ment versus theta, called Displacement. The remaining three graphs plot individual axes movement can and are saved as DeltaX, DeltaY, and DeltaZ. 'Alt g' works exactly the same way as 'Alt c', only it graphs the movement over a range of angles.

Page E:

'Alt N' creates a graph that plots the distance between the two nodes versus a range of elevation angles, called plt1.

The distance between nodes is calculated as:

Eq.1 $\sqrt{[(x_tot)^2+(y_tot)^2+(z_tot)^2]}$

$x_tot=x1-x2+\Delta x1-\Delta x2$

$y_tot=y1-y2+\Delta y1-\Delta y2$

$z_tot=z1-z2+\Delta z1-\Delta z2$

Page F:

Tilt is calculated on this page of the spreadsheet. To graph tilt versus elevation angle use 'Alt P'. The macro will save the graph as 'tilt'. The rigging angle used in this macro and in the one on page G is 44°.

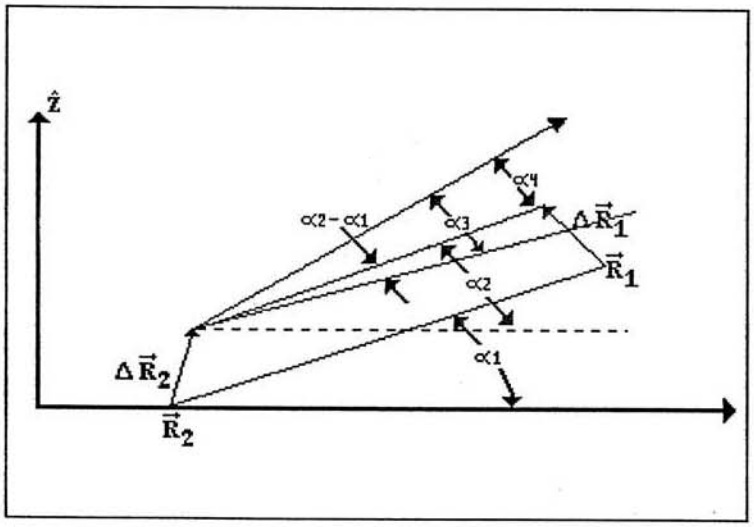
Eq.2 $Delta_x=ZtiltX(\sin(k) -\sin(j)) + HtiltX(\cos(k) - \cos(j))$

$k=theta*2\pi/360$

$j=rigging\ angle*2\pi/360$

Page G:

Lastly, the final macro can be executed with 'Alt F'. It prompts the user for two nodes and a range of elevation angles. This information is used to make the graph titled 'delta' which plots delta theta in seconds versus elevation angle. Thegraph models a laser mounted at point 2 and then aimed at point 1.



$\alpha 1$=original angle
$\alpha 2$=angle of deformed structure
$\alpha 3$=rotation about X axis of point 2
$\alpha 4$=change in pointing $=\alpha 3-(\alpha 2-\alpha 1)$

Eq.3 Delta theta is:
[[atan((z1-z2+Δz1-Δz2)/(y1-y2+Δy1-Δy2))-atan((z1-z2)/(y1-y2))] - Eq.2 (above)]*57.296*3600.

If the reader has additional questions or problems, Grace Buzanoski should be contacted at (304) 456-2117 in Green Bank, WV, or using email gbuzanos@sadira.gb.nrao.edu.

Alt c

DELTA X	DELTA Y	DELTA Z	node #
0	9.476723	3.082061	50000

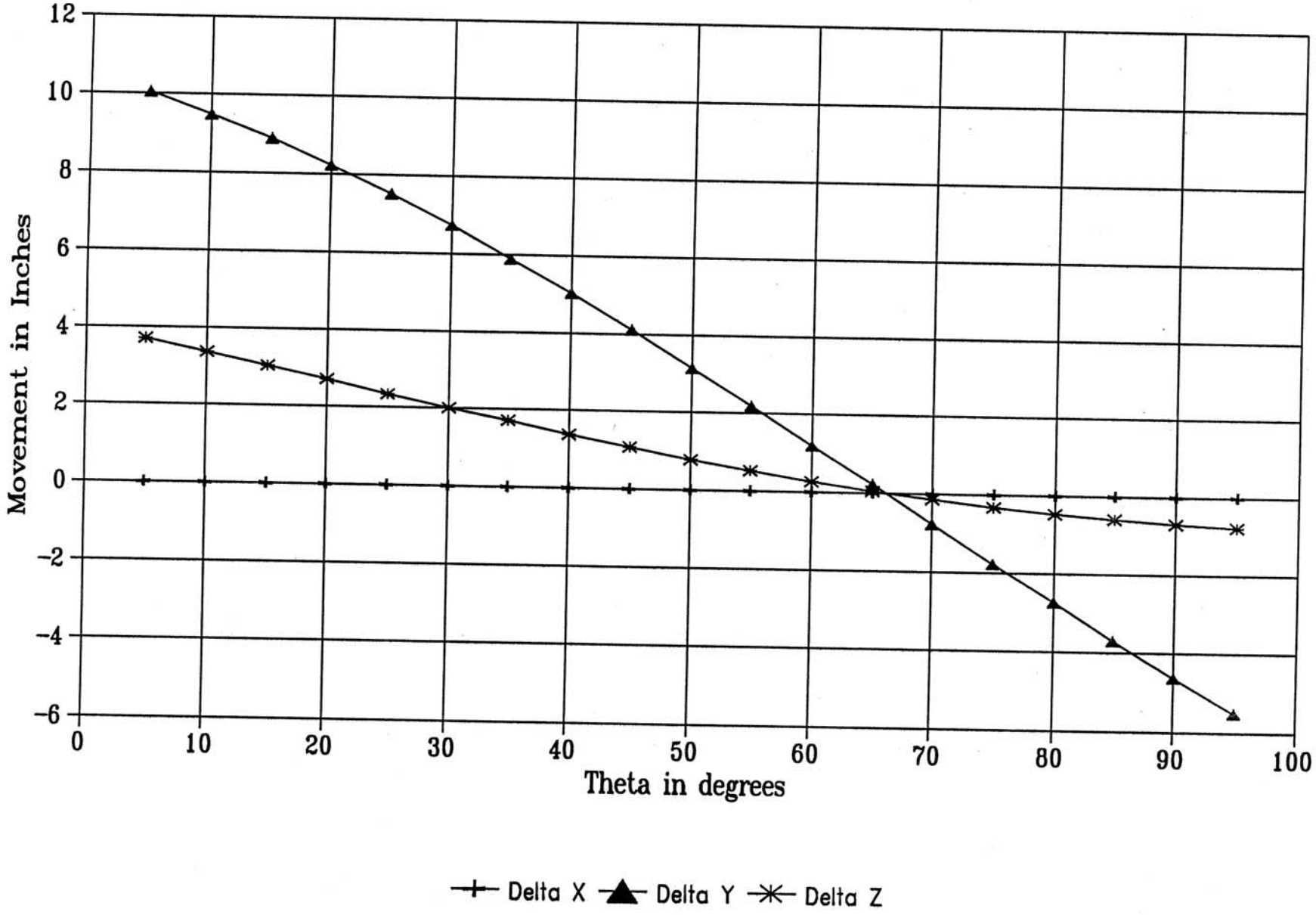
Xe	Ye	Ze	theta
0	-2159.02	2559.06	5

Xa	Ya	Za
0	2365.047	4264.669

Displacement vs. Theta for 50005

Disk: B92 FIle: GBT_NODE.WQ2

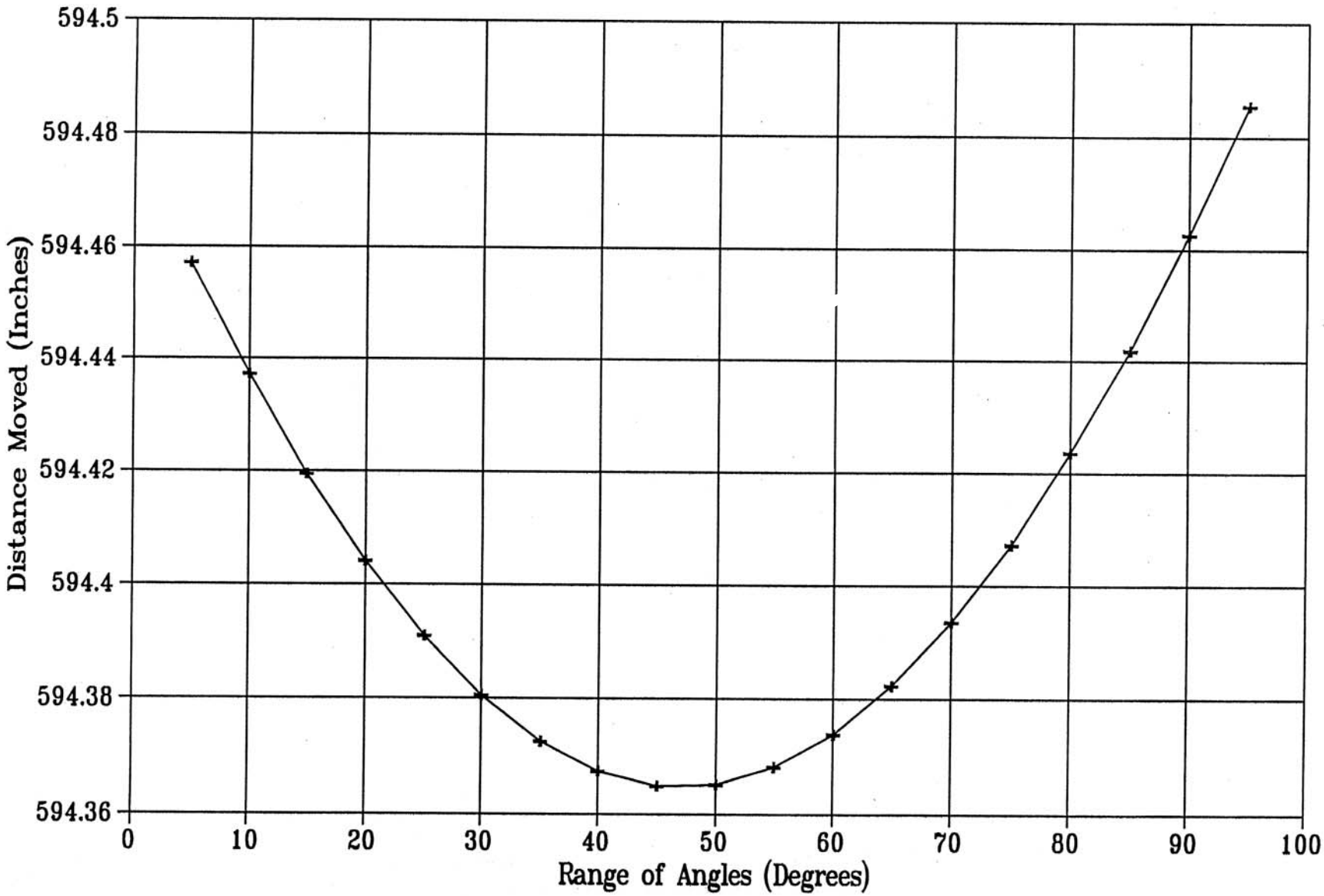
Alt g

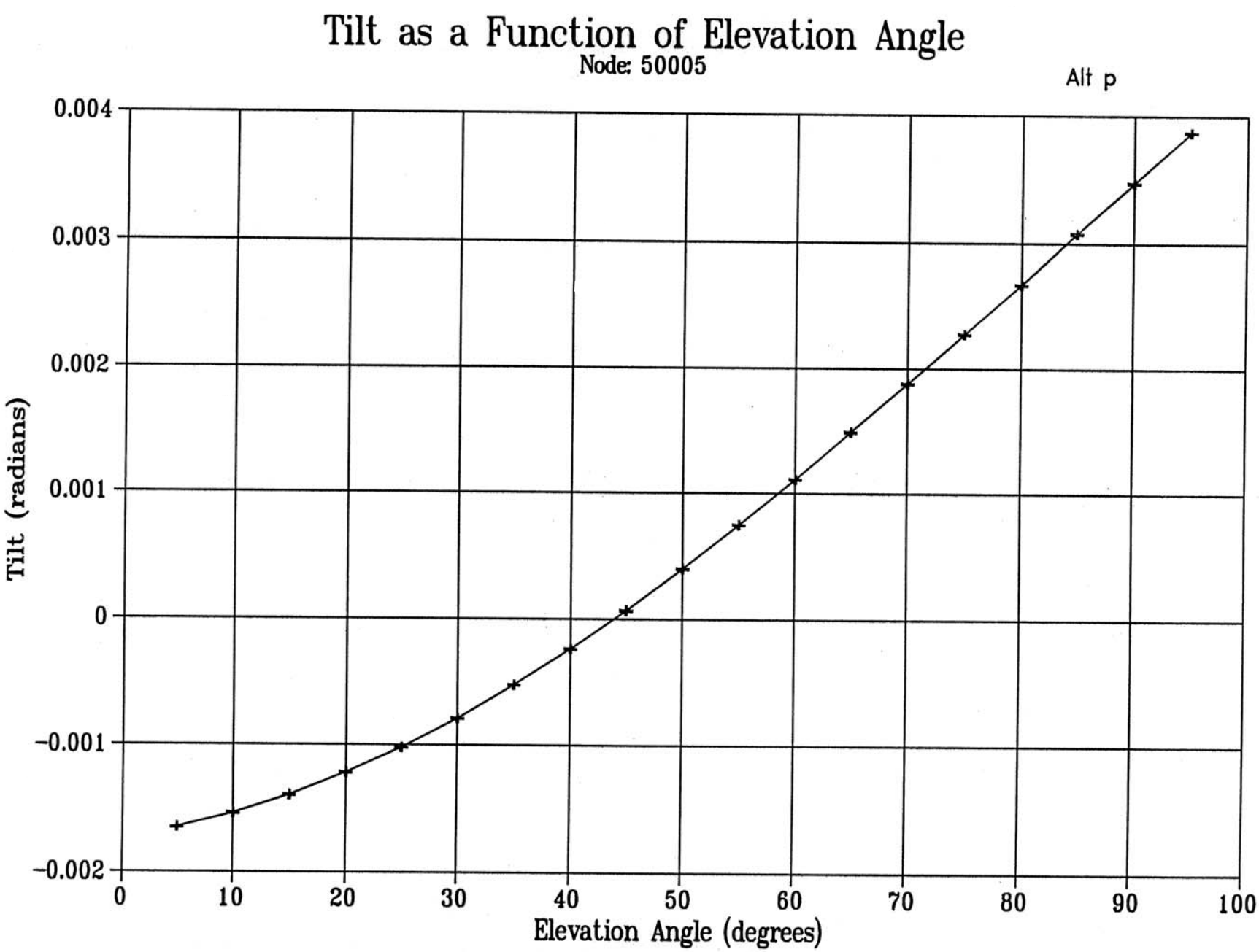


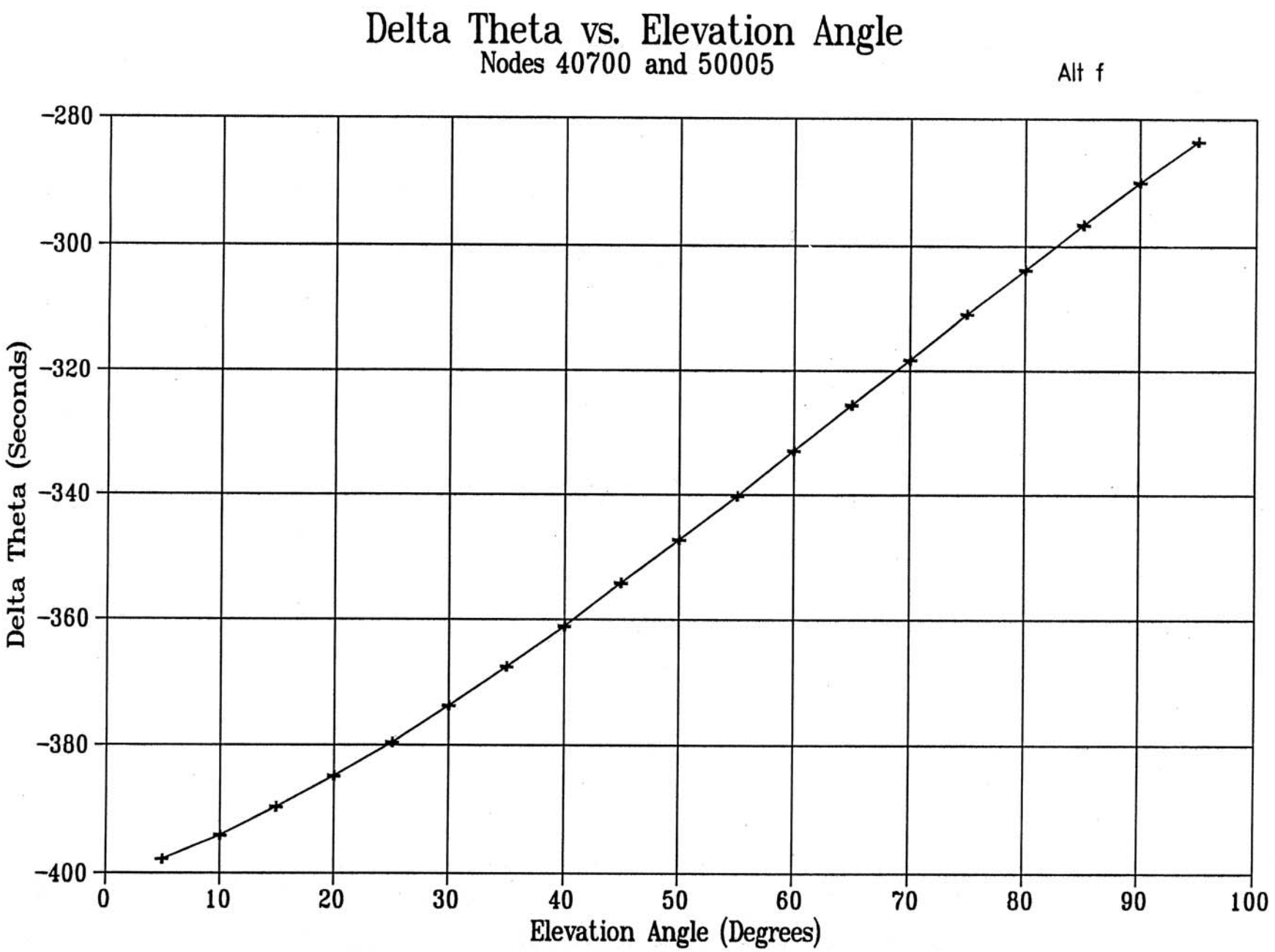
Node Distance vs. a Range of Angles

Nodes 40700 and 50005

Alt n




Tilt as a Function of Elevation Angle
Node: 50005
Alt p
0.004
0.003
0.002
0.001
0
-0.001
-0.002
Tilt (radians)
0
10
20
30
40
50
60
70
80
90
100
Elevation Angle (degrees)


Delta Theta vs. Elevation Angle
Nodes 40700 and 50005
Alt f
-280
-300
-320
-340
-360
-380
-400
Delta Theta (Seconds)
0
10
20
30
40
50
60
70
80
90
100
Elevation Angle (Degrees)