Fermilab

TM-1141
1620.0000

TEVATRON I - LARGE BORE QUAD LAMINATION ANALYSIS

Mark Leininger

October 26, 1982

Abstract

Stacking, compression, and welding of the laminations for the TeV I Large Bore Quad results in a deformation due to springback which is unacceptable due to magnetic field requirements. ANSYS has been used to analyze a solution to this problem

Introduction

The reader is referred to TM No. 1138 on the small aperture quad for background on this problem. The problems are nearly identical; the only difference being that in the present case of the large bore quad, a threaded rod will be used to restrain the entire lamination stack. This results in an additional question to be answered, namely what is the optimum location for the rod. Fig. 1 shows a top view of the lamination along with the constraints applied. Three plate thicknesses will be analyzed: 2 in., 4 in., and 6 in. (total thickness). For each plate thickness, four cases will be examined: no retaining stud and stud at nodes 404, 420, and 436 (see Fig. 1).

Solution

The nodes shown in Fig. 1 are located at the following distance from the poleface tip (node 414):

Node No.	Distance from Poleface Tip (Inches)
414	0.00
404	2.21
420	5.51
436	7.87

Fig. 2 shows a sample distorted plot of a 4 in. pack with no restraining stud. Table I shows the results of the analysis. The node which generally showed the greatest deflection was node 414 at the poleface tip. However, in many of the cases where a restraining stud is included, node 543 (shown in Fig. 1) showed the greatest deflection. Note that positive deflections indicate a deflection in the positive y direction (out of the plane of the paper toward the reader in Fig. 1).

Table I

LARGE BORE QUAD LAMINATION SUMMARY

Thickness	Stud Location	Maximum Y Deflection (in.)	Location	Max τYZ (psi)	Max τYK (psi)
2	None	-0.206	414	20,280	26,750
2	404	+0.00378 -0.0164	414 543	1,058	1,200
2	420	+0.00275 -0.010	414 543	2,680	2,910
2	436	-0.0040 -0.0081	414 543	2,330	2,330
4	None	-0.041	414	5,850	7,870
4	404	+8.4E-5 -0.00269	414 543	1,123	1,180
4	420	-4.0E-4 -0.0019	414 543	1,058	1,000
4	436	-0.00183	414 (543 not a max)	1,356	1,480
6	None	-0.0160	414	2,900	3,780
6	404	-3.9E-4 -0.0011	414 543	720	835
6	420	-7.3E-4 -9.28E-4	414 543	894	854
6	436	-0.0015	414	1,130	1,220

Fig. 1

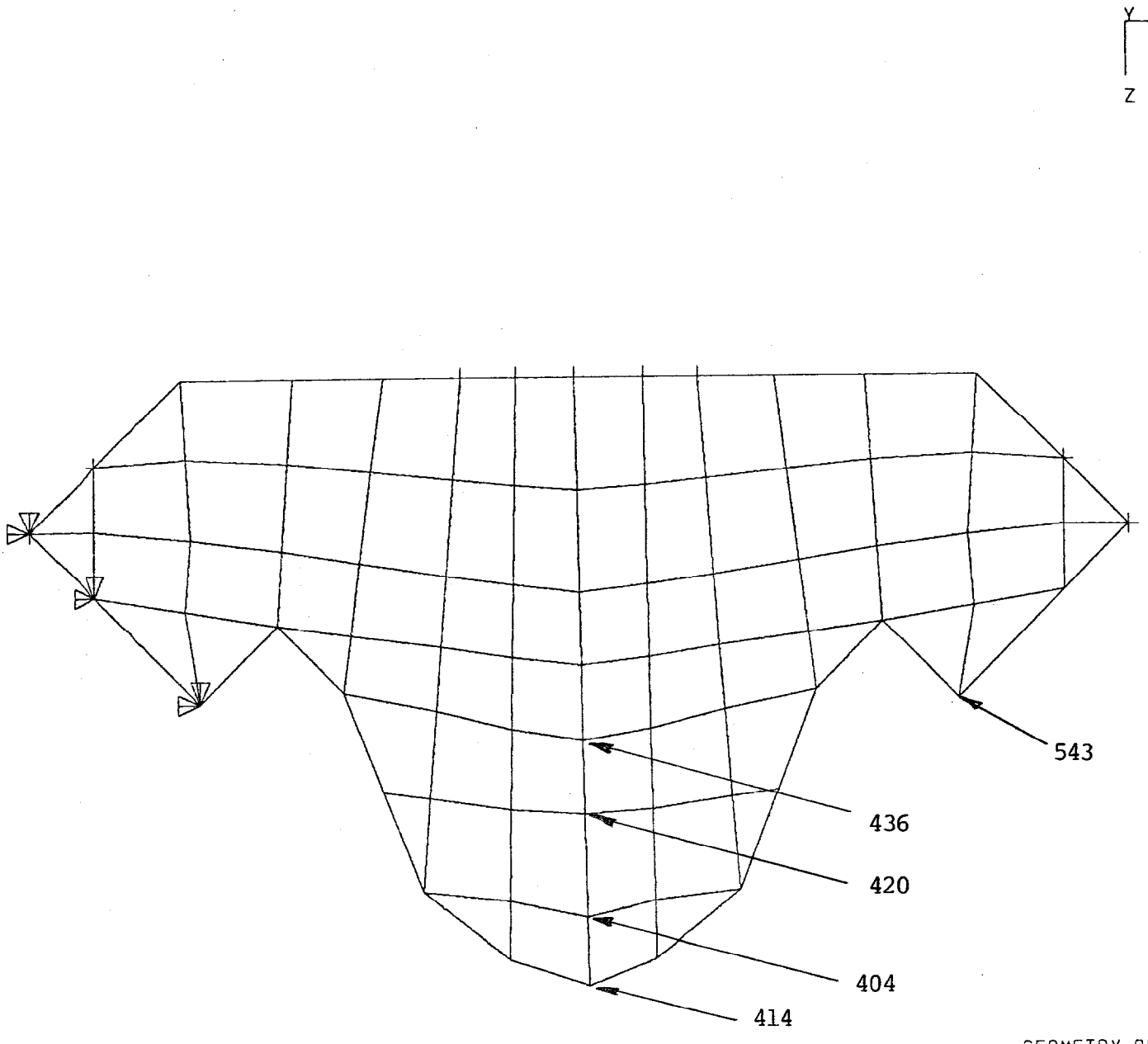
Y
X
Z
543
436
420
404
414
LARGE BORE QUAD. MODEL CHECK
GEOMETRY ANSYS

Fig. 2