EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH
ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE

CERN - PS DIVISION

PS/ PA/ Note 96-32

STRESS CALCULATIONS ON MAGNET YOKE LIFTING BEAM SMV 20

M. Hourican

Geneva, Switzerland
27 September 1996

Stress Calculations on Magnet Yoke Lifting Beam SMV 20

Drawing No. PS PA 9539.2

Introduction

The lifting beam is used for insertion of magnet yoke SMV20 in the vacuum tank and has a conventional "C" form. The total weight of the yoke / coil assembly is approximately 450 kg.

The major stresses occur at the junction of the horizontal member with the main vertical member and are a combination of bending and tensile stresses.

Reinforcing plates have been added to these areas but have been neglected for the purposes of calculation.

Calculations.

Assessing the lifting eye attachment, see fig. 3,

Tensile stresses occur in the shank whilst there is a bending stress in the main horizontal cross member.

Bending Stress at B-B,

$$=\sigma_{B\text{-}B} = M / W$$

where, $W = (bxd^2) / 6 = (20x15^2) / 6 = 750\ mm^3$

$$M = 2250N \times 20\ mm = 45000Nm$$

$\sigma_{B\text{-}B}$= 45000Nm / 750 mm^2 = **6 kg mm^{-2}**

Resultant Stress at X-X,

$\sigma_{X\text{-}X}$= Bending Stress at X-X + Tensile Stress at X-X

$$=(M / W) + (F / Area)$$

$$=((F/2 \times b) / W) + (F / Area)$$

$$=(45000\ Nmm / (20 \times 30^2 / 6\ mm^3)) + (2250\ N / (20 \times 30\ mm^{-2}))$$

$\sigma_{X\text{-}X}$ **=1.875 kg mm^{-2}**

Tensile Stress at C-C, fig 2.

$\sigma_{C\text{-}C}$= P/A = 4500Nm / 80 x 20 mm^{-2} = 0.28kg mm^{-2}

Bending Stress in lower plate at D-D, fig.2

W=(100mm x 20^2 mm^2) / 6 = 6667 mm^3

M= 2250 N x 115 mm = 258.7 KNm

$\sigma_{D\text{-}D}$=M / W =258.7 KNm / 6667mm^3 = 3.8 kg mm^{-2}

Assessing the junction of the horizontal cross member and the main vertical member, see fig.2,

Stress at A-A shown below,

Resultant Stress = Bending Stress + Tensile Stress

Moment of Resistance at A-A, for 2 rectangular tubes,

=W=2 x (BH^3- bh^3)/6H
= 2 x ((40x80^3) - (34x74^3)) / 6H= 27926mm^3

Bending Stress = M / W
= (4500 N x 600 mm) / 27926mm^3
=9.67 kg mm^{-2}

Tensile Stress at A-A
= F / Area
= 4500 N / 684 mm^2
= 0.66 kg mm^{-2}

Resultant Stress is therefore,
96.7 + 6.6
=103.3 Nmm^{-2}
=10.3 kg mm^{-2}

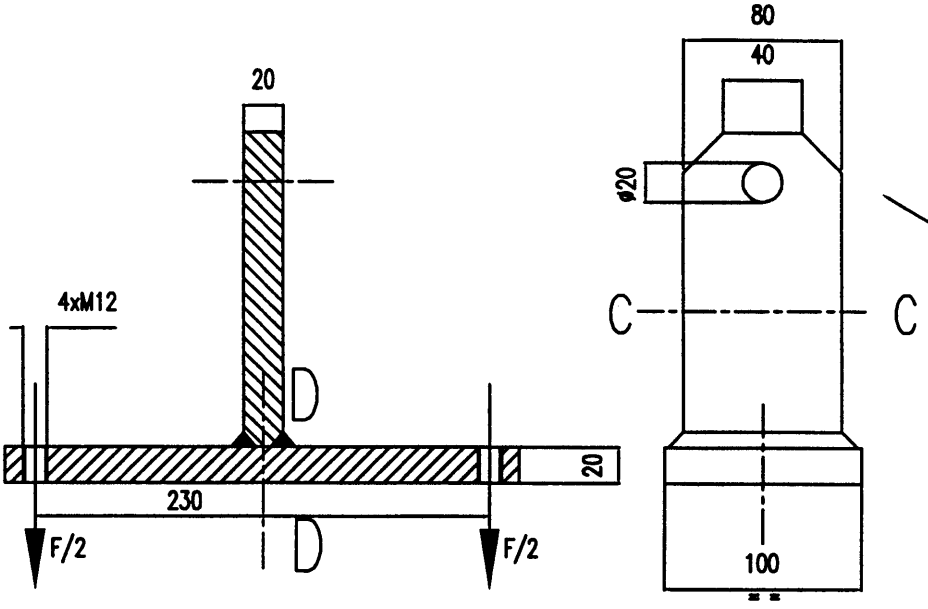

fig. 1

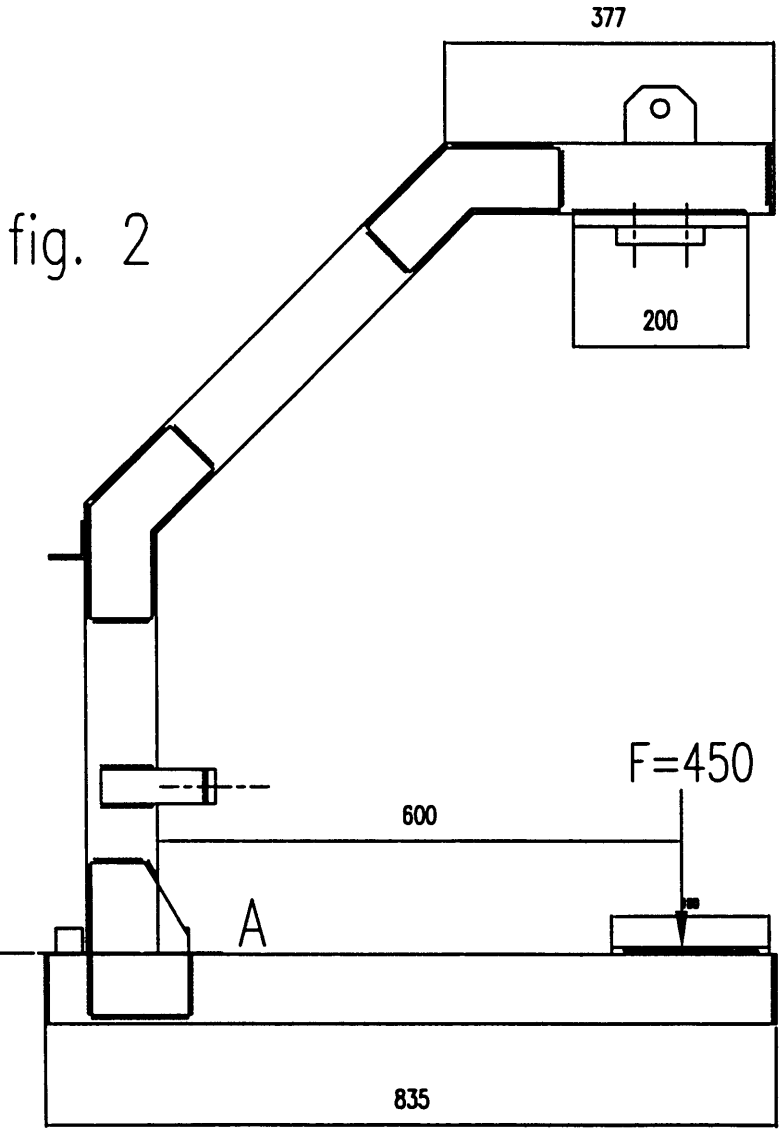

fig. 2

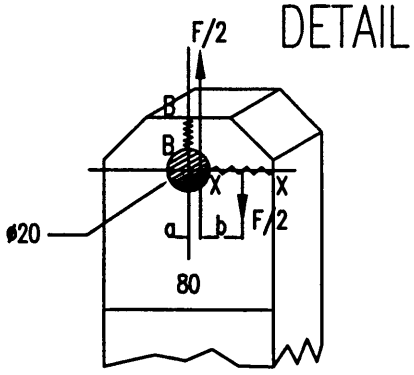

fig. 3