CHAPTER 5

DISCUSSION

The mitered angles were checked for the errors which differ from ninety degrees, as shown in table 3-2. They are found that the angles are in the range of 90 ± 0.75 degrees, these show that the errors of the angles which were caused by welding can be neglected.

From the calibration of AVERY and AMSLER Testing Machine, corrected load values are obtained, they are seen from table 3-3. that for the first machine at the first ten percents of load range the errors are in the wide range of about 0 to 35 percents but for the higher range the errors successively decrease to about 3.8 percents. For AMSLER Testing Machine as shown in table 3-4. the errors are about 0 to 19.4 percents, and for SIGURD STENHØJ Testing Machine the errors of pressure gage used are in the range of -0.20 to + 0.46 percents of the actual value as shown in table 3-5. which is too small so the correction for the gage is not necessary.

Dial gage used can be read to 0.01 mm. This is accurate enough for our tests. From the graph that plotted deflection against load, straight lines through origin are obtained which is as expected during the elastic range.

It is seen from table 4-3. that at R = r for pipe bend no. 1a and 2a the values of calculated flexibility factor are negative which are not likely. These may be due to the calculated flexibility factor K having a negative value if $\frac{3YEI}{F}$ is less than C^3. The value of $\frac{Y}{F}$ or Z is low for the reinforced pipe bend and the value of C is high for low value of R, such as at R = r, then negative values are obtained for these bends which $\frac{3YEI}{F}$ less than C^3. Hence this formula should not be used when $\frac{3YEI}{F}$ less than C^3.

From the comparision of calculated flexibility factor and Karman flexibility factor in table 4-3. at each equivalent radius R, for unreinforced mitered pipe bends the result is nearly agree with those of Kasipar's but the two flexibility factors compared very well at R = 5r than at R = 4r of Kasipar's. The calculated flexibility factors are varied between 0.91 to 1.25 times of Karman's flexibility factor at R = 5r except pipe bend no. 8b and 9b which the calculated flexibility factors are 1.50 ans 1.78 times of the values from Karman's expression. The difference between equivalent radius obtained here and from Kasipar's occured because the pipe dimensions of Kasipar such as diameter and thickness are far larger than the pipe used here, so weld bead is thin with respect to the pipe dimension, the strength of joint due to welding less than that of the small pipe where weld bead is thick when compared with the pipe dimension. The thickness,t also effects on flexibility factor K because $\lambda = \frac{tR}{r^2}$ and K depends on λ.

For reinforced pipe bends, strength of the joint is higher than that of unreinforced pipe bends but less flexible. So that flexibility under in plane bending of reinforced ninety degree mitered pipe bend is the same as that of smooth bend of the same dimension having higher equivalent radius, which is found that this equivalent radius is about seven times the pipe bore mean radius. At this equivalent radius the calculated flexibility factors are varied between 0.83 to 1.06 times that of Karman's expression except pipe bend no. 7a which the calculated value is 0.77 times the value from Karman's expression.

As for the analysis of stresses, if theoretical values of this longitudinal stress in the theoretical formula are plotted against angular positions as shown in Fig. A14., the angular position axis is shifted to the point that the curve passes the zero degree position which equals to $\frac{F}{A'}$, the curve obtained will be a sine curve. In this experiment if the angular position axis is shifted to the point that the curve passes the zero degree position, the curve obtained will be nearly a sine curve too, which agrees with the theoretical one, as shown in Fig. A13.

So that the results are very satisfactory. The practical values of $S_{z\theta}$ obtained are higher than the theoretical values, as shown in table 4-6. These should be caused by stress concentration on pipe surface because the surface is not really smooth and the theory assumes circular crosssection at the pipe while in actual fact the section has become oval under the load. The average value of longitudinal stress, S_z is approximately 1.4 times of practical value except at zero degree position, which the theoretical value is too small compared with the practical value. In designs the suggesstion for minimum value of safety factor should not be less than 1.8 base on longitudinal stress.

For circumferential direction, at position -30 degrees the value of circumferential stress is out of trend of graph of circumferential stress, S_θ versus angular position as shown in Fig. A15. This might be due to much warping or distortion in this circumferential direction of pipe because of the weak or low strength at this point. The radial stress, S_r at this position have a little effect by this warping as shown in Fig. A16.

For shear stresses, they are very difficult to measure these values directly, so that $S_{z\theta}$ was assumed vary on the pipe in the form of porabolic curve, zero at the top and the bottom edges and being maximum at the neutral plane, the graph of $S_{z\theta}$ against angular position is shown in Fig. A17. The values of $S_{\theta r}$ and S_{rz} are zero and maximum in the same manner but these values vary in the form of a cosine wave as shown in Fig. A18.