LS-123
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LOSSES OF VACUUM-CHAMBER FULL-PENETRATION WELDMENTS

In the storage ring of the 7 GeV Advanced Photon Source, there are 480 vacuum-chamber end flanges and 80 tube welded joints, accounting for a total of 560 full-penetration weldments. Figure 1 is an illustration of such a welded joint, in which the dimensions are taken from a sample weldment made by Ferranti Sciaky. This note is to give an estimation of the longitudinal and transverse losses contributed by these weldments. For this purpose, the elliptical cross-section of the structure shown in Fig. 1 is approximated by a circular one. The 2D code TBCI is then employed to calculate the losses for three different beam bunch lengths, which are, respectively, 0.58, 1.16, and 1.76 cm.

The separation between two neighboring weldments varies from 2.5 inches to 15 inches. This distance is large compared to the dimensions of the welded joint. Therefore, the composition rule discussed in Ref. 1 can be applied here. It says that one need only compute the losses of one weldment and that the losses of two neighboring weldments are just two times as large. This means a big saving of CPU time. To check the validity of this rule in our case, we also calculate the longitudinal loss of a two-weldment structure, which is shown in Fig. 2, for a bunch length of 0.58 cm. The separation between the two weldments is chosen to be 2.5 inches. The result agrees rather well with what is predicted by the composition rule.

The TBCI output of our calculations is listed in Table 1. As a comparison, the losses of the RF cavities and of the transitions between beam chamber and insertion device (ID) sections are also listed. It is seen that the losses contributed by the weldments are very small. They should not have any significant effects on beam dynamics.

REFERENCES

1. W. Chou and Y. Jin, "Impedance Studies - Part 1: A Composition Rule," ANL Light Source Note LS-112 (1988).

Table 1. Loss Factors Calculated by TBCI

Loss Factor	Structure	Number	Loss of a Single Structure, Bunch Length (cm) 0.58	1.16	1.76	Total Loss, Bunch Length (cm) 0.58	1.16	1.76
Longitudinal (V/pC)	Weldment	560	1.3E-4	8.8E-6	4.6E-7	0.07	0.005	0.0003
	RF cavity (HOM)	15	0.40	0.26	0.20	6.0	3.9	2.9
Transverse (V/pC m)	Weldment	560	0.23	0.11	0.075	130	62	42
	Transition between chamber & ID	34	78	35	22	2650	1190	750

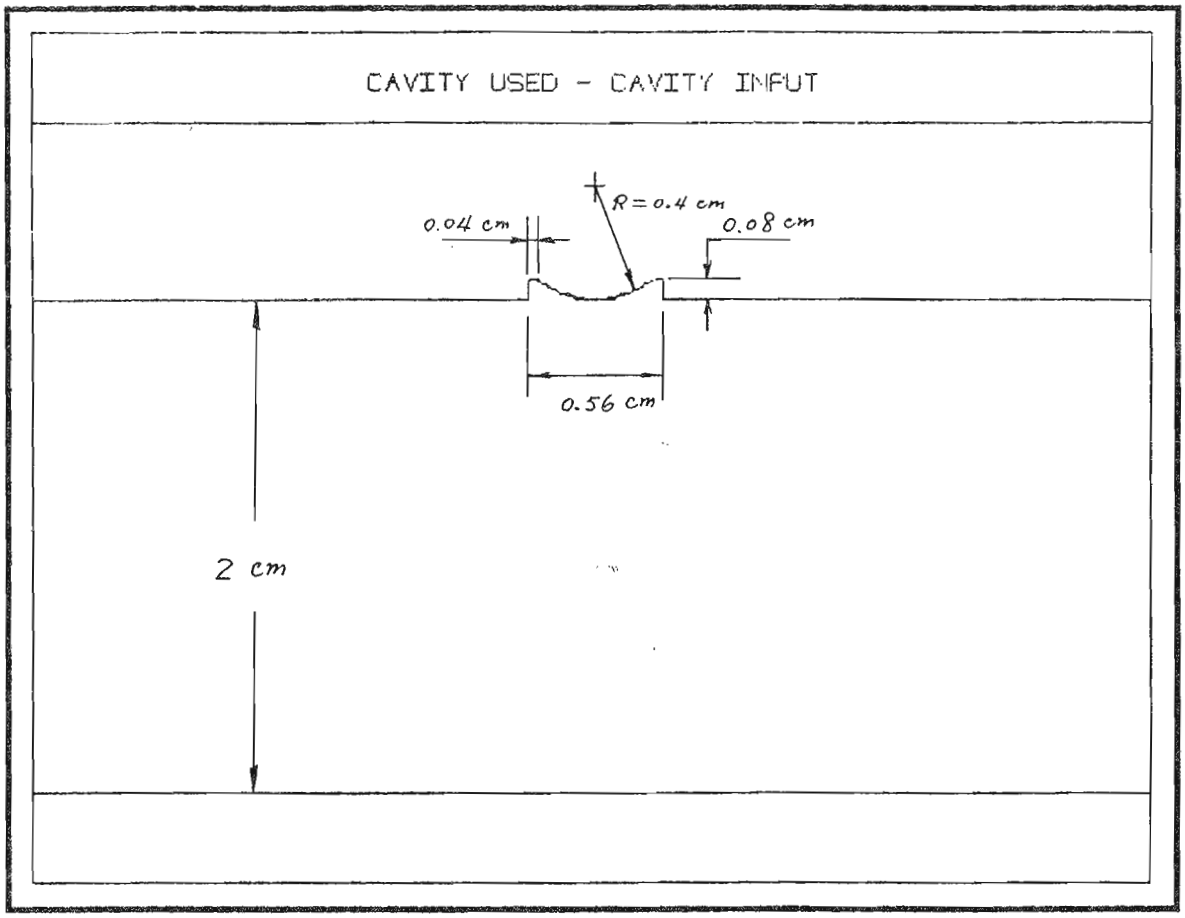

Fig. 1. The structure of a welded joint. The dimensions are taken from a sample weldment made by Ferranti Sciaky.

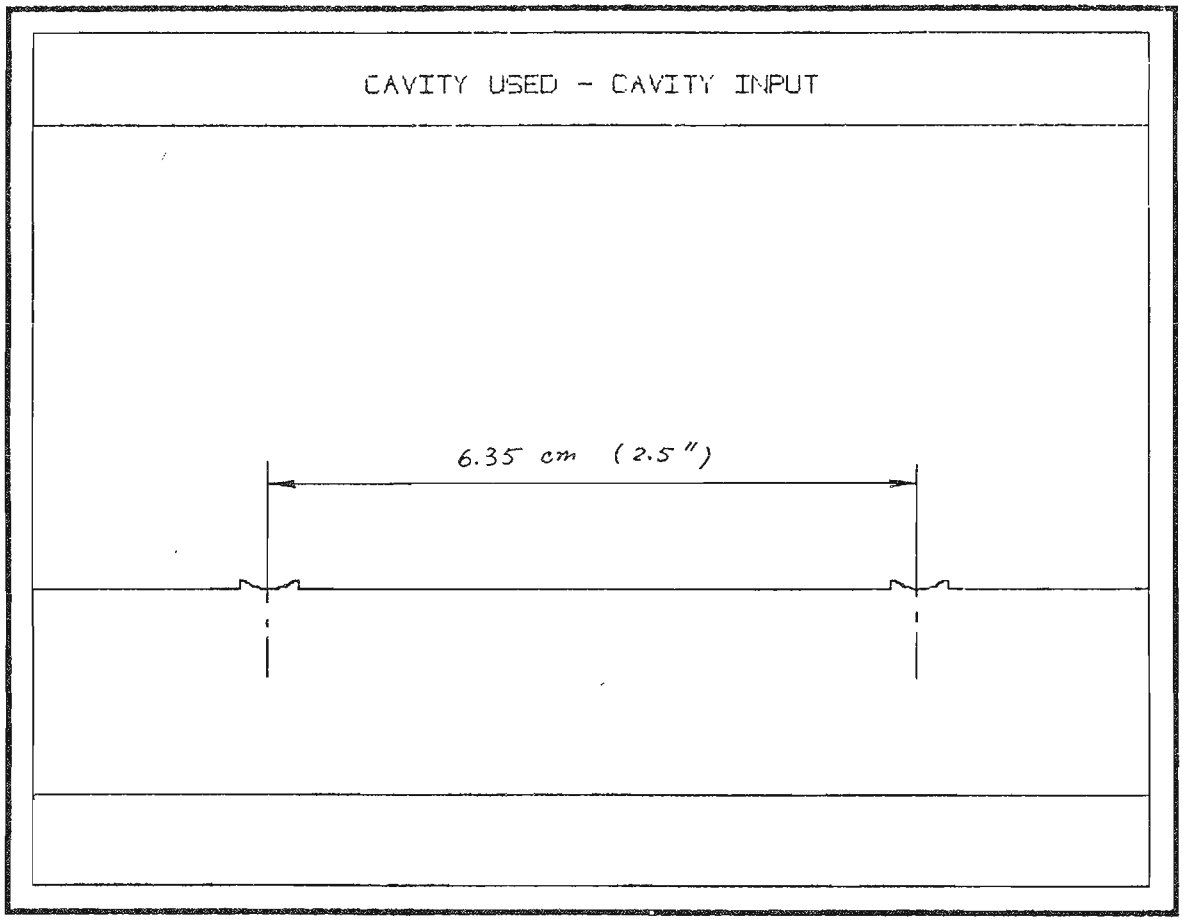

Fig. 2. A two-weldment structure.