Fabrication of the Waveguide Penetration Sections for the PEFP 100MeV Linac

Kyung-Tae Seol*, Hyeok-Jung Kwon, Han-Sung Kim, and Yong-Sub Cho
Proton Engineering Frontier Project, Korea Atomic Energy Research Institute
Daedeok-Daero 989-111, Yuseong-Gu, Deajeon, Korea
**Corresponding author : ktseol@kaeri.re.kr*

1. Introduction

The Proton Engineering Frontier Project (PEFP) 100MeV proton linear accelerator has been developed and will be installed in Gyeong-ju site [1]. The 20MeV Linac already operated in Korea Atomic Energy Research Institute (KAERI) site will be also moved and re-installed with the 100MeV Linac [2]. A waveguide layout was fixed to install HPRF systems for the 100MeV Linac. Currently, the building of the 100MeV Linac is under construction. One of the important interfaces with the building construction is the imbedded waveguide section into the tunnel. 1MW RF power from the klystron is transmitted to each accelerator in the tunnel through the waveguide penetration section. Because the waveguide penetration sections are installed inside the concrete floor of 2.5m for radiation shielding, it is difficult to repair after an installation. The penetration sections were designed and fabricated into a piece of waveguide to prevent the moisture and any foreign debris inside the concrete block. After fabrication, it needs to inspect leakage and the RF characteristic.

2. Calculation

The waveguide layout in the klystron gallery and the tunnel was fixed to install the HPRF system for the 100MeV Linac. The waveguide sections penetrating into the tunnel have the bending structure for the radiation shielding. With the waveguide layout, the penetration section was designed as shown in Fig. 1. It has the bending structure connecting two E-miters of WR2300 half height. VSWR (Voltage Standing Wave Ratio) and S-parameters were calculated by using MWS (Micro Wave Studio).

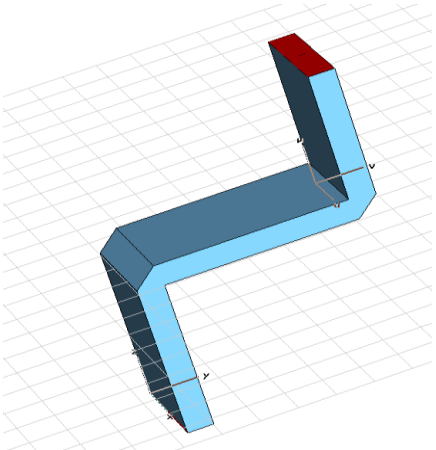

Fig. 1: Waveguide penetration section design

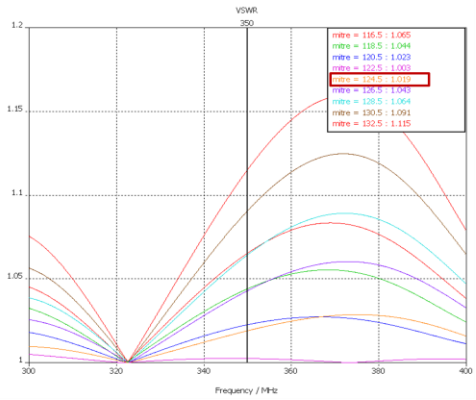

Fig. 2: VSWR calculation for the waveguide penetration

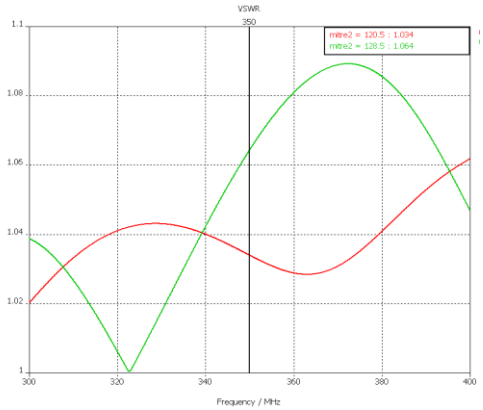

Fig. 3: VSWR calculation considering the chamfer error

Fig. 2 shows VSWR results calculated depending on the chamfer length of bending waveguide. The chamfer length of 124.5mm was determined and the VSWR was 1.019. Fig. 3 shows the VSWR calculated in the case of the chamfer error, and the VSWR was within 1.1.

3. Fabrication

The waveguide penetration sections having the bending structure of WR2300 half height was fabricated into a piece of waveguide to prevent the moisture and any foreign debris inside the concrete block of 2.5m. Fig. 4 shows 15 sets of the waveguide penetration sections fabricated for 100MeV Linac. Leakage from the waveguides was inspected with the pressure of 0.25 psig. VSWR was also measured as summarized in Table 1. The measured VSWR was 1.087 in average and 0.056 in the standard deviation. These VSWR results mean that RF power of more 99% can be transmitted into the tunnel. Fig. 5 shows VSWR measurement by using a network analyzer (Agilent,

5071C). After the fabrication and the measurements, the waveguide penetration sections have been installed within the sleeve of the building construction structure. Fig. 6 shows the installation of the penetration section.

Fig. 4: Fabricated waveguide penetration sections

Fig. 5: VSWR measurement for the waveguide penetration section.

Table 1: Measured VSWR

Waveguide Penetration NO.	Reflection Coefficient (mU)	VSWR
P_#1	49.477	1.104
P_#2	26.745	1.055
P_#3	7.821	1.016
P_#4	76.400	1.165
P_#5	22.951	1.047
P_#6	18.145	1.037
P_#7	3.853	1.008
P_#8	27.295	1.056
P_#9	73.036	1.158
P_#10	58.469	1.124
P_#11	53.601	1.113
P_#12	89.109	1.196
P_#13	40.238	1.084
P_#14	30.019	1.062
P_#15	41.368	1.086
Average	-	1.087
STD	-	0.056

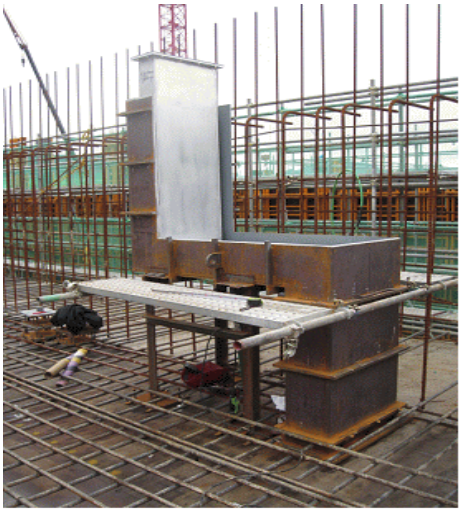

Fig. 6: Installation of waveguide penetration section

4. Summary

The waveguide section penetrating the concrete floor of 2.5m to the tunnel was designed and fabricated to the bending structure for the radiation shielding, and was made into a piece of waveguide to prevent the moisture and any foreign debris inside concrete block. Leakage was inspected with the pressure of 0.25 psig, and VSWR was also measured within 1.2. They have been installed within the sleeve of the building construction structure.

Acknowledgements

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REFERENCES

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[2] H. J. Kwon, “Operation of the PEFP 20MeV Proton Linac at KAERI”, Proc. of International Particle Accelerator Conference, Kyoto, Japan, 2010