



RADIATION AND COLLISION LENGTHS FOR VARIOUS
FERMILAB SHIELDING MATERIALS

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May 29, 1974

To help in shielding calculations, the radiation and non-elastic collision lengths have been calculated or collected for a number of common radiation shielding materials used at Fermilab. The composition of these materials is taken from an earlier TM.¹

The formula used to calculate the mean free path of a compound or mixture is,

$$\frac{1}{\lambda} = \sum_i \frac{P(i)}{\lambda(i)},$$

where, $P(i)$ = fractional weight of i^{th} element.

The non-elastic mean free paths were calculated using Bellettini's results obtained at 20 GeV.² The radiation lengths were taken from the High Energy and Nuclear Physics Handbook.³

The heavy concrete is made with ilmenite ore and has a nominal density of 240 lb./cu. ft.

Material	Density g/cm ³	Collision Length			Radiation Length		
		g/cm ²	cm	inch	g/cm ²	cm	inch
Moist Soil	1.9-2.2	88.4	46-40	18-16	37.7	20-17	7.8-6.7
Limestone	-----	86.6	-----	-----	26.8	-----	-----
Heavy Concrete	3.8	98.6	26	10	17.5	4.6	1.8
Ordinary Concrete	2.3	86.2	37	15	25.8	11	4.4
Al	2.7	95	35	14	24.0	8.9	3.5
Fe	7.8	112	14	5.6	13.9	1.8	.70
U	18.9	223	12	4.6	6.13	.32	.13

REFERENCES

1. M. Awschalom, T. Borak, and P. Gollon, NAL-TM-168, May 2, 1969.
2. Bellettini, et. al., Nucl. Phys. 79, 609(1966).
3. National Inst. for Research in Nucl. Phys., Rutherford High Energy Laboratory, Chilton, England.