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BLUEFIELD REGIONAL MEDICAL CENTER

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Mr. Earl G. Wright
USNRC
Regional II
101 Marietta St., N.W., Suite 2900
Atlanta, GA 30323-0199

RE: License Numbers ~~47-19142-01~~ & 47-19142-02

Dear Mr. Earl G. Wright:

Per our telephone discussion with the physics consultant, Ms. Sharon Long of NPC, I would like to provide you with the following information about RADIATION SAFETY evaluation on hospital's Emergency Room expansion besides Cobalt-60 Teletherapy Room.

As shown by the attached map, the new expansion only involves the "South Wall" of the Cobalt room. Based on our original application to Materials Branch of NRC dated May 1 of 1981, Dr. Lee Anthony of PHYSICS ASSOCIATES in Roanoke, VA performed the Cobalt room shielding calculation.

From enclosed copies of his work, it is clear to me that Dr. Anthony used "Occupancy Factor" T = 1 in his shielding evaluation. Therefore, he assumed that the other side of "South Wall" to be fully occupied at that time, even though it was only the sidewalk.

Based on Dr. Anthony's calculation, the new "Waiting Area" on the other side of "South Wall" will have very limited radiation exposure rate, i.e., 0.13 mrem/week or 7.02 mrem/year. Even considering the "worst case" --- the primary Cobalt beam rotated toward the "South Wall", radiation exposure rate will be 0.23 mrem/week or 12.42 mrem/year. This is well below the "100 mrem/year" limit to the general public.

Therefore, it is my judgement that the shielding of the Cobalt-60 Teletherapy Room is adequate for the new Emergency Room expansion of BRMC.

Please feel free to contact me if further information is needed !

Sincerely Yours,

Yuenian Zhang

Yuenian (Neal) Zhang, Ph.D.

I

Isocenter to East Wall (E.R. Cast Room)

1) d is at least 15 feet, or 4.57 meters.
2) It is stated that the room is rarely used. T = 1/16? For calculations, use T = 1. ✓
3) W is assumed to be 40,000 R/week at a meter, in accordance with Table 2, Appendix C, NCRP report # 49.
4) This is a secondary barrier to uncontrolled area.
5) Actual barrier thickness is 2'8" or 81.3 cm concrete.

Calculation of leakage rate:

1) For leakage radiation, from table 22, p. 83, NCRP #49,
   1 H.V.L. of concrete = 6.2 cm.
   Therefore, $I_x/I_o = e^{-0.693 \times 81.3cm/6.2cm} = 0.0001141 = B_{LG}$.

   equation 5d:

$$P = \frac{B_{LG}\ W\ T}{1000(d_{sec})^2} = \frac{(0.0001141)(40,000)(1)}{1000\ (4.57)^2} = 0.23 \text{ mrem/week leakage.}$$

Calculation of scatter radiation:

Equation 6g, p. 60, NCRP #49:

$$= \frac{a\ W\ T\ F\ B_{sg}}{(d_{sca})^2 \times (d_{sec})^2 \times 400}.$$

For B_{sg} & 90 degree scatter, 1 H.V.L = 4.6 cm concrete.

$$B_{sg} = e^{-\frac{0.693}{4.6\ cm} \times 81.3\ cm.} = 2.1 \times 10^{-8}.$$

$$= \frac{(0.0009)(40,000)(1)(2.1 \times 10^{-8})(400)}{(0.5)^2(4.57)^2(400)}$$

$$= 1.5 \times 10^{-4} \text{ mrem / week scatter.}$$

Total transmission rate through wall to Cast Room = 0.23 mrem/week.

V

Isocenter through <u>primary</u> beam stopper (wall):

d approximately 13 ft. or 3.96 meters.

W = 40,000 R/week

U = 1/4

T = 1

$$P = \frac{W\ U\ T\ B_{ug}}{(d_{pri})^2}.$$

B_{ug}: 4'6" = 54" = 137 cm; 1 H.V.L. = 6.2 cm.

$$B_{ug} = I_x/I_o = e^{\frac{-0.693 \times 137\ cm}{6.2\ cm}}$$

$$= 2 \times 10^{-7}$$

$$P = \frac{(40,000)(1/4)(1)(2 \times 10^{-7})}{15.7\ m^2}$$

P = 0.13 mrem from isocenter per week.

However, the primary beam would be directed at the wall from the circumference of the source travel, with the head normal (unrotated) or rotated toward the nearest wall.

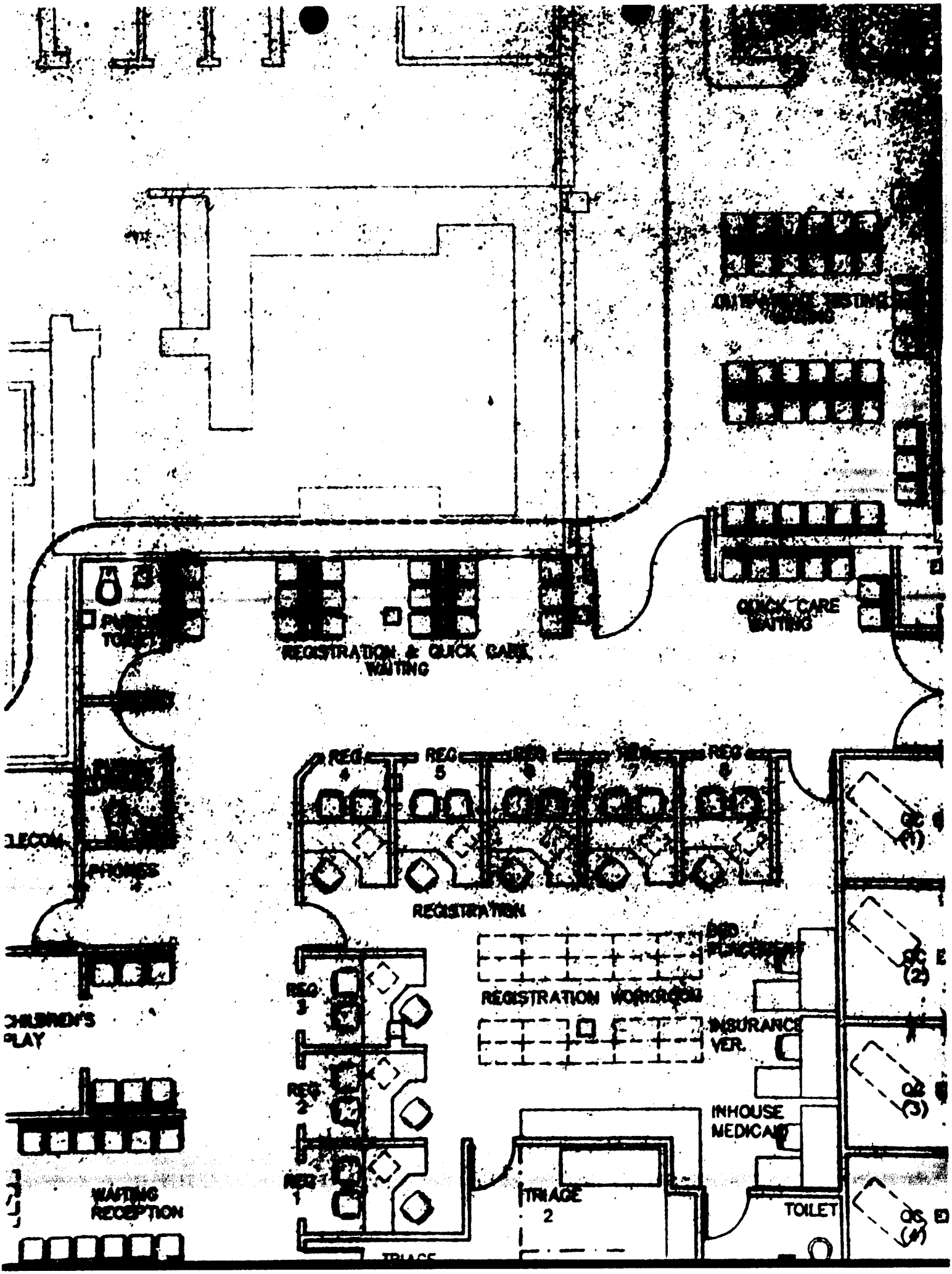
In these "best" and "worst" cases, we have:

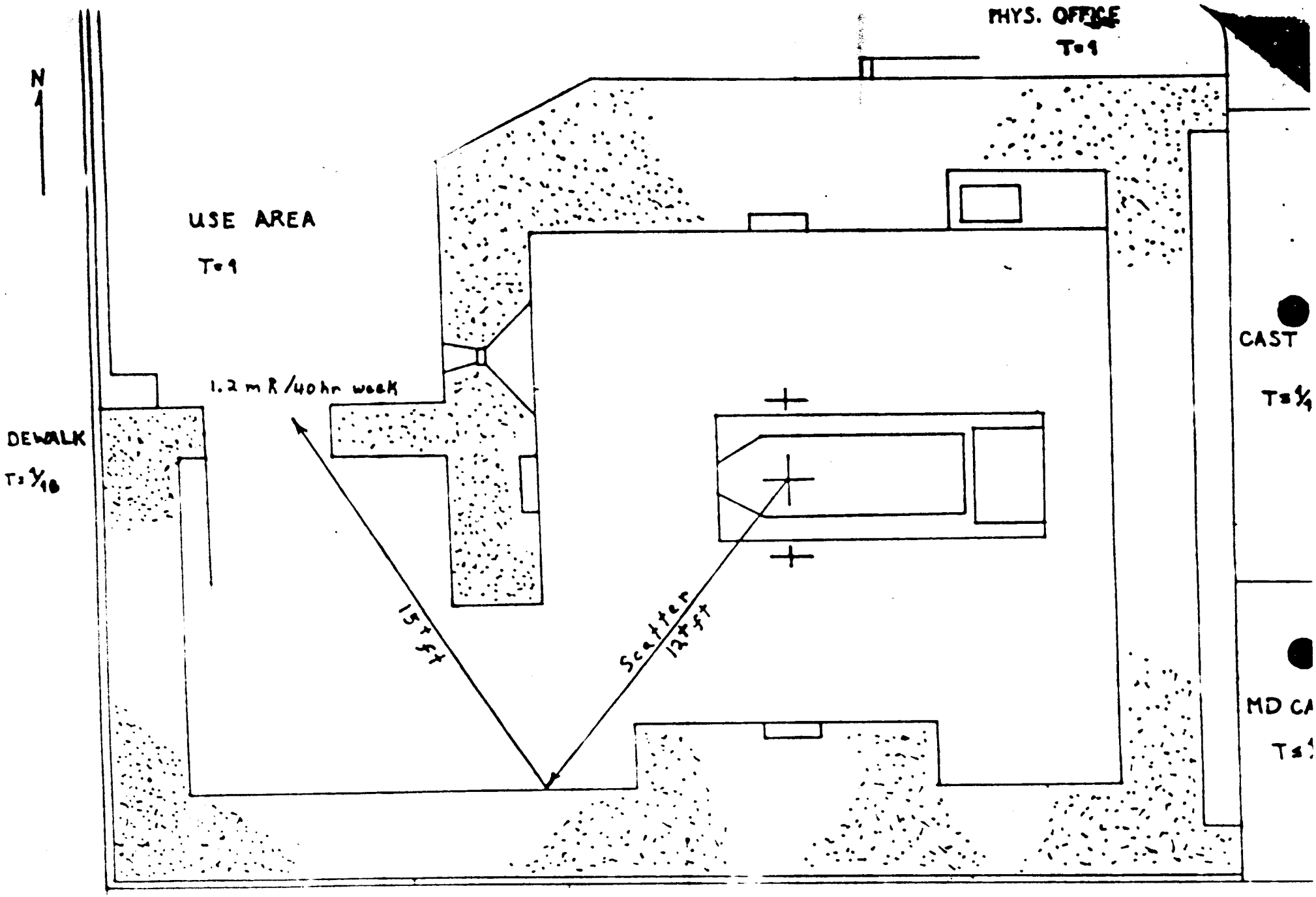
d_{pri} = 4.96m and 2.96m, respectively:

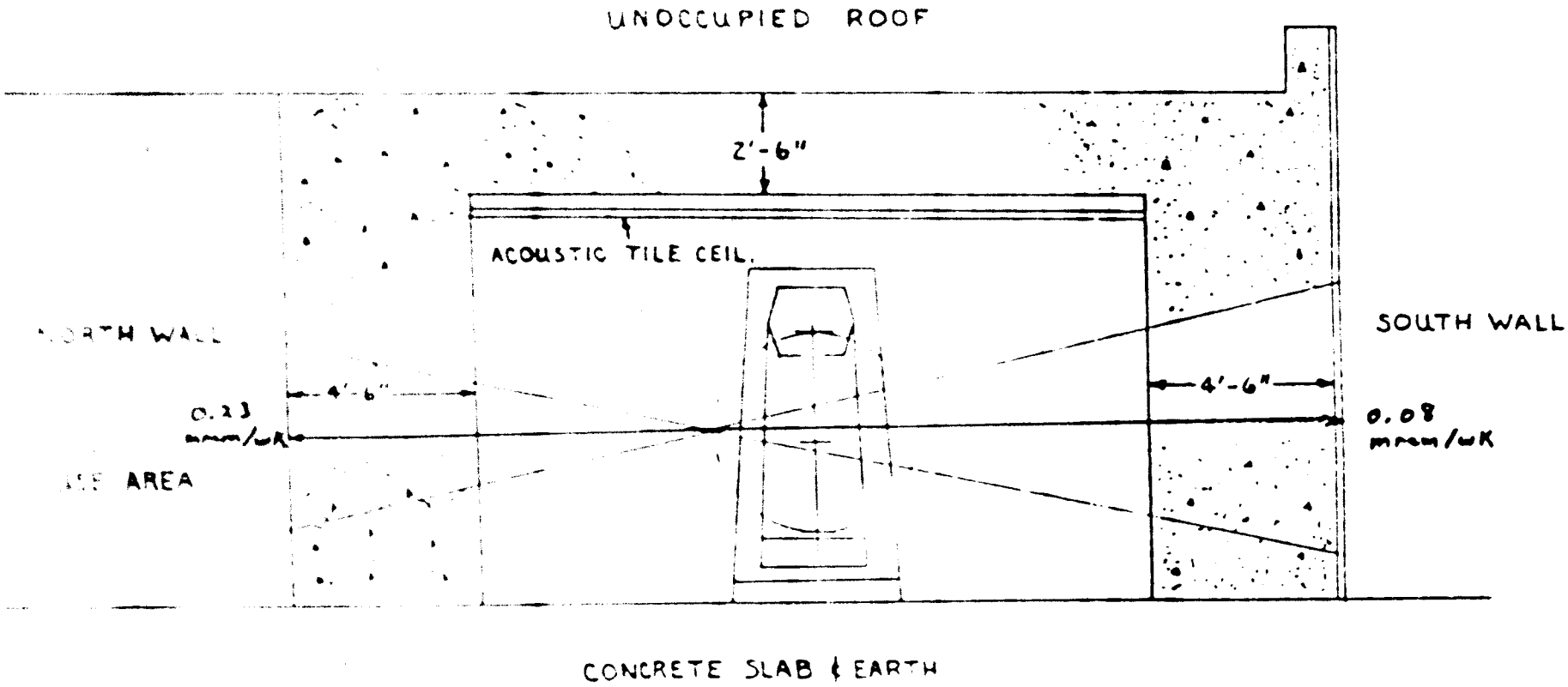
$$P = \frac{(40,000)(1/4)(1)(2 \times 10^{-7})}{24.6} = 0.81 \times 10^{-4}\ R/week = \underline{0.08\ mrem/week}$$

(Normal Head Orientation)

$$P = \frac{(40,000)(1/4)(1)(2 \times 10^{-7})}{8.76} = \underline{0.23\ mrem/week}$$ (for Head Rotated)


QUICK CARE WAITING
REGISTRATION & QUICK CARE WAITING
REG 4
REG 5
REG 6
REGISTRATION
PHONES
CHILDREN'S PLAY
REG 3
REG 2
REG 1
REGISTRATION WORKROOM
INSURANCE VER.
INHOUSE MEDICAID
WAITING RECEPTION
TRIAGE 2
TOILET
TRIAGE


PHYS. OFFICE
T=1
N
USE AREA
T=1
1.2 mR/40hr week
DEWALK
T=1/10
15+ft
Scatter
12+ft
CAST
T=1/4
MD CA
T=1
LAWN & SIDEWALK
1/8" = 1 FT


UNOCCUPIED ROOF
2'-6"
ACOUSTIC TILE CEIL.
SOUTH WALL
4'-6"
4'-6"
0.23
mrem/wK
0.08
mrem/wK
AREA
CONCRETE SLAB & EARTH