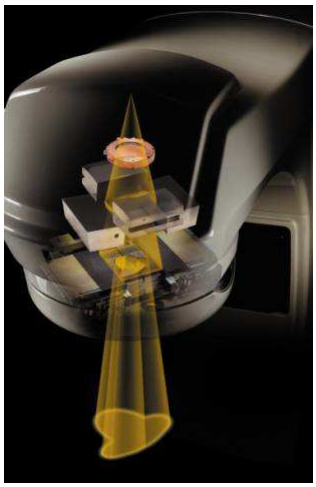
Monitor Unit Calculations

Photon Beam Dose Calculations

- Having a clear understanding of the factors that affect radiation therapy delivery is extremely important
- Small changes in the treatment parameters can change the absorbed dose delivered to the patient
- A field size, treatment depth, or distance set incorrectly will change the machine output in reference to the patient
- This lecture will focus on the practice application of dose calculations

Photon Beam Dose Calculations



Monitor Unit Calculations

- The general equation for performing monitor unit calculations (*or treatment time*) can be represented as follows

$$MU\ Setting = \frac{Dose\ @\ Point}{Dose\ Rate\ @\ Point}$$

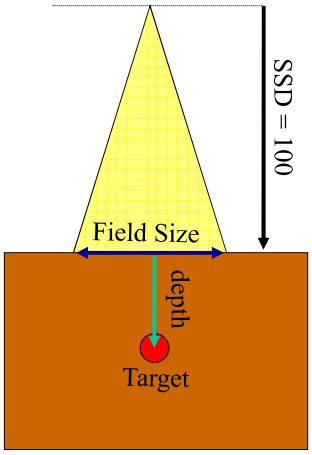
- The Monitor Units (*MUs*) represent the setting on the linear accelerator
- The dose at a point represents the prescribed dose

Photon Beam Dose Calculations

Monitor Unit Calculations

- There are three general points necessary when performing a MU calculation
  1. *One must know the dose at a point*
  2. *One must know the dose rate at that point*
  3. *The dose and the dose rate must be in the same medium (water)*

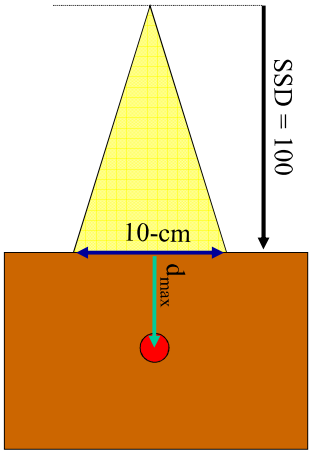
Photon Beam Dose Calculations



SSD Monitor Unit Calculations

- An SSD setup occurs when the patient's skin surface is setup at the machine isocenter (*typically at 100-cm*)
- For SSD setups, the field size is defined on the patients surface
- Percent depth dose (*PPD*) tables are used to ratio the dose rate from one depth to another
- Must determine the calibration point for the machine

Photon Beam Dose Calculations



1 cGy = 1 MU @ SSD +dmax

SSD Monitor Unit Calculations

- A patient is treated on a 6 MV linear accelerator at 100-cm SSD to the thoracic spine
- The patient is positioned prone and will be treated with a single treatment field
- The field size is 10x10-cm, and there is no custom blocking used for this field
- The prescription states that 3000 cGy will be delivered to d_{max} in 10 fractions

Photon Beam Dose Calculations

6 MV PDD Clinac 2100C/D
PERCENTAGE DEPTH DOSE
Thompson Cancer Survival Center

FSCF	0.834	0.875	0.898	0.929	0.950	0.968	0.984	1.000	1.011	1.023
Depth (cm)	3x3	4x4	5x5	6x6	7x7	8x8	9x9	10x10	11x11	12x12
0	39.2	40.3	37.3	38.3	39.4	40.4	41.5	42.5	43.5	44.4
1	97.3	97.4	97.6	97.7	97.8	97.8	97.9	98	98.1	98.2
1.5	100.0	100.0	100	100	100	100	100	100	100	100
2	99.1	99.1	98.7	98.8	98.8	98.9	98.9	99	99	99
3	93.9	94.2	94.4	94.5	94.6	94.7	94.7	94.8	94.8	94.8
4	88.9	89.4	89.4	89.7	90	90.3	90.6	90.9	91	91.1
5	83.6	84.4	84.9	85.2	85.6	86	86.3	86.7	86.9	87
6	78.2	79.3	80.4	80.9	81.4	81.8	82.3	82.8	83	83.2
7	74.0	75.1	76	76.6	77.2	77.7	78.3	78.9	79.1	79.4
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12	54.4	55.5	56.7	57.5	58.3	59.2	60	60.8	61.2	61.6
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14	48.0	49.2	50.1	51	51.9	52.9	53.8	54.7	55.2	55.6
15	45.1	46.2	47.5	48.3	49.2	50	50.8	51.6	52.1	52.6

Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.406

Tray Factor
0.970

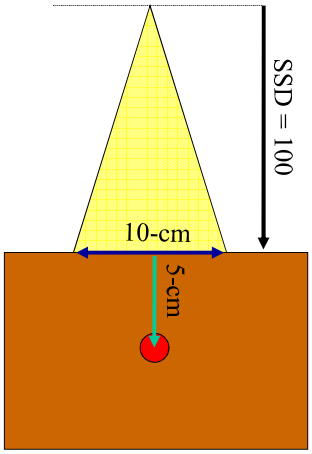
SSD Monitor Unit Calculations

- This is the most basic monitor unit calculation
- The prescription point is located at d_{max}, which is also the calibration point
- Furthermore, the field size is the reference field size

$$MU\ Setting = \frac{Prescription}{DR \times FSCF \times (PDD/100)} = \frac{300\ cGy / Fraction}{1\ cGy/MU \times 1.0 \times (100/100)}$$

$$= 300\ MU$$

Photon Beam Dose Calculations



1 cGy = 1 MU @ SSD +dmax

SSD Monitor Unit Calculations

- A patient is treated on a 6 MV linear accelerator at 100-cm SSD to the thoracic spine
- The patient is positioned prone and will be treated with a single treatment field
- The field size is 10x10-cm, and there is no custom blocking used for this field
- The prescription states that 3000 cGy will be delivered to **5-cm depth** in 10 fractions

Photon Beam Dose Calculations

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PERCENTAGE DEPTH DOSE
Thompson Cancer Survival Center

FSCF	0.834	0.875	0.898	0.929	0.950	0.968	0.984	1.000	1.011	1.023
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Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.406

Tray Factor
0.970

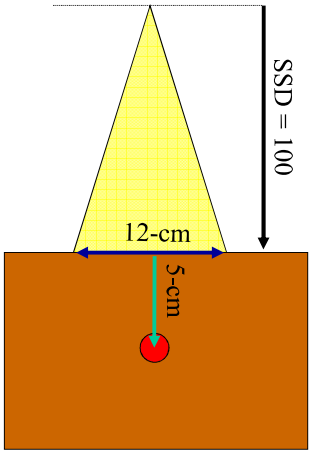
SSD Monitor Unit Calculations

- The prescription point is now located at 5-cm depth
- The PDD@5-cm must be used ratio the dose back to d_{max}
- The field size is the reference field size (*FSCF = 1*)

$$MU\ Setting = \frac{Prescription}{DR \times FSCF \times (PDD/100)} = \frac{300\ cGy / Fraction}{1\ cGy/MU \times 1.0 \times (86.7/100)}$$

$$= 346\ MU$$

Photon Beam Dose Calculations



1 cGy = 1 MU @ SSD +dmax

SSD Monitor Unit Calculations

- A patient is treated on a 6 MV linear accelerator at 100-cm SSD to the thoracic spine
- The patient is positioned prone and will be treated with a single treatment field
- The field size is **12x12-cm**, and there is no custom blocking used for this field
- The prescription states that 3000 cGy will be delivered to **5-cm depth** in 10 fractions

Photon Beam Dose Calculations

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Wedge Factors

Wedge	15	30	45	60
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Tray Factor
0.970

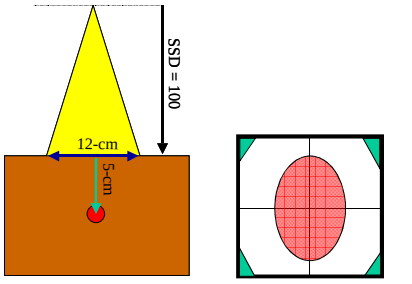
SSD Monitor Unit Calculations

- The prescription point is now located at 5-cm depth
- The PDD@5-cm must be used ratio the dose back to d_{max}
- The field size is now for a 12x12 field size (*FSCF = 1.023*)

$$MU\ Setting = \frac{Prescription}{DR \times FSCF \times (PDD/100)} = \frac{300\ cGy / Fraction}{1\ cGy/MU \times 1.023 \times (87/100)}$$

$$= 337\ MU$$

Photon Beam Dose Calculations



Patient Setup

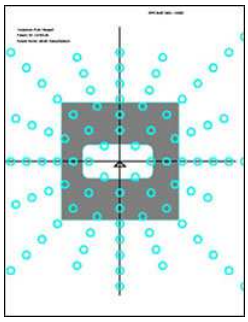
Beams Eye View

1 cGy = 1 MU @ SSD +dmax

SSD Monitor Unit Calculations

- A patient is treated on a 6 MV linear accelerator at 100-cm SSD to the thoracic spine
- The patient is positioned prone and will be treated with a single treatment field
- The field size is **12x12-cm**, and there are small cerobend ***"corner blocks"*** for this field
- The prescription states that 3000 cGy will be delivered to **5-cm depth** in 10 fractions

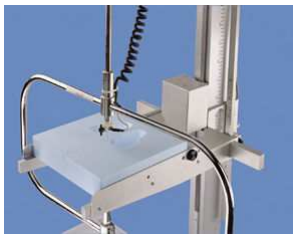
Photon Beam Dose Calculations



Custom Blocks

- Cerrobend is a metal used for designing custom field shapes for radiation therapy
- It contains 50.0% bismuth, 26.7% lead, 13.3% tin, and 10.0% cadmium
- Cerrobend melts at 70° C and is safer to use than lead, which melts at 327° C
- However, cadmium is toxic and can get into the blood stream
- For most megavoltage beams, a thickness of 7.5-cm is used, which is equivalent to 6-cm of lead

Photon Beam Dose Calculations



Blocks must be attached to trays, which attenuate the beam

Photon Beam Dose Calculations

6 MV PDD Clinac 2100C/D
PERCENTAGE DEPTH DOSE
Thompson Cancer Survival Center

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1.5	100.0	100.0	100	100	100	100	100	100	100	100
2	99.1	99.1	98.7	98.8	98.8	98.9	98.9	99	99	99
3	93.9	94.2	94.4	94.5	94.6	94.7	94.7	94.8	94.8	94.8
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Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.406

Tray Factor: 0.970

SSD Monitor Unit Calculations

- A tray factor must now be used (*TF = 0.970*)
- The PDD@5-cm must be used ratio the dose back to d_{max}
- The field size is now for a 12x12 field size (*FSCF = 1.023*)

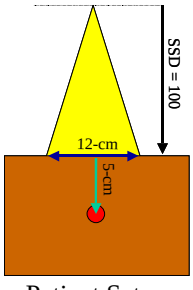
$$MU\ Setting = \frac{Prescription}{DR \times FSCF \times (PDD/100) \times TF} = \frac{300\ cGy / Fraction}{1\ cGy/MU \times 1.023 \times (^{87}/_{100}) \times 0.97}$$

$$= 348\ MU$$

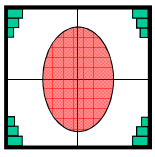
THOMPSON CANCER SURVIVAL CENTER

THE UNIVERSITY of TENNESSEE

Photon Beam Dose Calculations



Patient Setup


Beams Eye View

1 cGy = 1 MU @ SSD +dmax

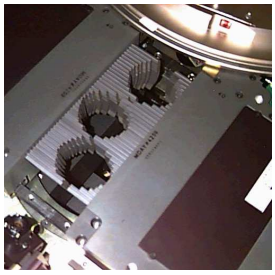
SSD Monitor Unit Calculations

- A patient is treated on a 6 MV linear accelerator at 100-cm SSD to the thoracic spine
- The patient is positioned prone and will be treated with a single treatment field
- The field size is **12x12-cm**, and there are small **MLC** ***"corner blocks"*** for this field
- The prescription states that 3000 cGy will be delivered to **5-cm depth** in 10 fractions

THOMPSON CANCER SURVIVAL CENTER

THE UNIVERSITY of TENNESSEE

Photon Beam Dose Calculations



Multileaf Collimator

- A multileaf collimator (*MLC*) system customizes the field shape using individual leaf pairs
- Each leaf is independently positioned using drive motors
- MLC system eliminate the use of Cerrobend blocks for photon beam fields
- The transmission is typically 1 to 2 percent of the primary beam dose
- MLC width at isocenter ranges from 0.3 to 1.0-cm

Photon Beam Dose Calculations

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Thompson Cancer Survival Center

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Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.406

Tray Factor
0.970

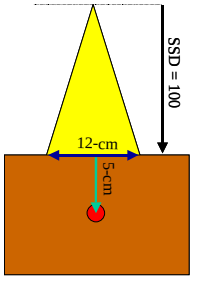
SSD Monitor Unit Calculations

- MLC's modify the shape of the field, but do not have a factor
- The PDD@5-cm must be used ratio the dose back to d_{max}
- The field size is now for a 12x12 field size (*FSCF = 1.023*)

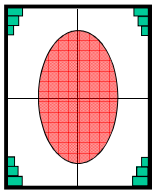
$$MU\ Setting = \frac{Prescription}{DR \times FSCF \times (PDD/100)} = \frac{300\ cGy / Fraction}{1\ cGy/MU \times 1.023 \times (87/100)}$$

$$= 337\ MU$$

Photon Beam Dose Calculations



Patient Setup


Beams Eye View

1 cGy = 1 MU @ SSD +dmax

SSD Monitor Unit Calculations

- A patient is treated on a 6 MV linear accelerator at 100-cm SSD to the lumbar spine
- The patient is positioned prone and will be treated with a single treatment field
- The field size is **5x12-cm**, and there are small **MLC *"corner blocks"*** for this field
- The prescription states that 3000 cGy will be delivered to **5-cm depth** in 10 fractions

Photon Beam Dose Calculations

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PERCENTAGE DEPTH DOSE
Thompson Cancer Survival Center

FSCF	0.834	0.875	0.898	0.929	0.950	0.968	0.984	1.000	1.011	1.023
Depth (cm)	3x3	4x4	5x5	6x6	7x7	8x8	9x9	10x10	11x11	12x12
0	39.2	40.3	37.3	38.3	39.4	40.4	41.5	42.5	43.5	44.4
1	97.3	97.4	97.6	97.7	97.8	97.8	97.9	98	98.1	98.2
1.5	100.0	100.0	100	100	100	100	100	100	100	100
2	99.1	99.1	98.7	98.8	98.8	98.9	98.9	99	99	99
3	93.9	94.2	94.4	94.5	94.6	94.7	94.7	94.8	94.8	94.8
4	88.9	89.4	89.4	89.7	90	90.3	90.6	90.9	91	91.1
5	83.6	84.4	84.9	85.2	85.6	86	86.3	86.7	86.9	87
6	78.2	79.3	80.4	80.9	81.4	81.8	82.3	82.8	83	83.2
7	74.0	75.1	76	76.6	77.2	77.7	78.3	78.9	79.1	79.4
8	69.4	70.6	71.4	72.1	72.8	73.5	74.1	74.8	75.1	75.4
9	65.6	66.7	67.7	68.4	69	69.6	70.3	70.9	71.2	71.6
10	61.3	62.5	63.8	64.5	65.3	66	66.8	67.5	67.9	68.3
11	57.6	58.8	60.4	61.1	61.9	62.6	63.4	64.1	64.5	64.9
12	54.4	55.5	56.7	57.5	58.3	59.2	60	60.8	61.2	61.6
13	50.9	52.2	53.5	54.3	55.1	55.9	56.7	57.5	58	58.4
14	48.0	49.2	50.1	51	51.9	52.9	53.8	54.7	55.2	55.6
15	45.1	46.2	47.5	48.3	49.2	50	50.8	51.6	52.1	52.6

Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.406

Tray Factor
0.970

SSD Monitor Unit Calculations

- The equivalent square field size must be calculated:

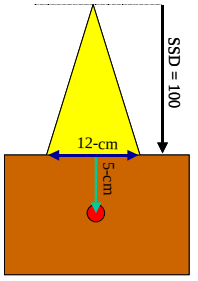
$$EqSq = \frac{2(\,length \cdot width)}{length + width}$$

$$= \frac{2(5 \cdot 12)}{5 + 12} = 7.1\text{-cm}$$

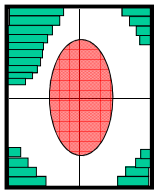
$$MU\ Setting = \frac{Prescription}{DR \times FSCF \times (PDD/100)} = \frac{300\ cGy / Fraction}{1\ cGy/MU \times 0.95 \times (85.6/100)}$$

$$= 369\ MU$$

Photon Beam Dose Calculations



Patient Setup


Beams Eye View

1 cGy = 1 MU @ SSD +dmax

SSD Monitor Unit Calculations

- A patient is treated on a 6 MV linear accelerator at 100-cm SSD to the lumbar spine
- The patient is positioned prone and will be treated with a single treatment field
- The field size is **8x12-cm**, and the **MLC** is used to block the right kidney
- The prescription states that 3000 cGy will be delivered to **5-cm depth** in 10 fractions

Photon Beam Dose Calculations

6 MV PDD Clinac 2100C/D
PERCENTAGE DEPTH DOSE
Thompson Cancer Survival Center

FSCF	0.834	0.875	0.898	0.929	0.950	0.968	0.984	1.000	1.011	1.023
Depth (cm)	3x3	4x4	5x5	6x6	7x7	8x8	9x9	10x10	11x11	12x12
0	39.2	40.3	37.3	38.3	39.4	40.4	41.5	42.5	43.5	44.4
1	97.3	97.4	97.6	97.7	97.8	97.8	97.9	98	98.1	98.2
1.5	100.0	100.0	100	100	100	100	100	100	100	100
2	99.1	99.1	98.7	98.8	98.8	98.9	98.9	99	99	99
3	93.9	94.2	94.4	94.5	94.6	94.7	94.7	94.8	94.8	94.8
4	88.9	89.4	89.4	89.7	90	90.3	90.6	90.9	91	91.1
5	83.6	84.4	84.9	85.2	85.6	86	86.3	86.7	86.9	87
6	78.2	79.3	80.4	80.9	81.4	81.8	82.3	82.8	83	83.2
7	74.0	75.1	76	76.6	77.2	77.7	78.3	78.9	79.1	79.4
8	69.4	70.6	71.4	72.1	72.8	73.5	74.1	74.8	75.1	75.4
9	65.6	66.7	67.7	68.4	69	69.6	70.3	70.9	71.2	71.6
10	61.3	62.5	63.8	64.5	65.3	66	66.8	67.5	67.9	68.3
11	57.6	58.8	60.4	61.1	61.9	62.6	63.4	64.1	64.5	64.9
12	54.4	55.5	56.7	57.5	58.3	59.2	60	60.8	61.2	61.6
13	50.9	52.2	53.5	54.3	55.1	55.9	56.7	57.5	58	58.4
14	48.0	49.2	50.1	51	51.9	52.9	53.8	54.7	55.2	55.6
15	45.1	46.2	47.5	48.3	49.2	50	50.8	51.6	52.1	52.6

Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.406

Tray Factor
0.970

SSD Monitor Unit Calculations

- The blocked square field size must be calculated:

$$EqSq = \frac{2(\text{length} \cdot \text{width})}{\text{length} + \text{width}}$$

$$= \frac{2(8 \cdot 12)}{8 + 12} = 9.6\text{-cm}$$

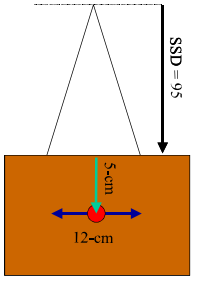
$$BlSq = EqSq \cdot SQRT\,(\%Open/100)$$

$$= 9.6 \cdot SQRT\,(80/100) = 8.6\text{-cm}$$

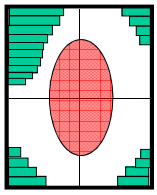
$$MU\ Setting = \frac{Prescription}{DR \times FSCF \times (PDD/100)} = \frac{300\ cGy / Fraction}{1\ cGy/MU \times 0.992 \times (86.2/100)}$$

$$= 351\ MU$$

Photon Beam Dose Calculations



Patient Setup


Beams Eye View

1 cGy = 1 MU @ SAD (d_{max})

SAD Monitor Unit Calculations

- A patient is treated on a 6 MV linear accelerator at 100-cm **SAD** to the lumbar spine
- The patient is positioned prone and will be treated with a single treatment field
- The field size is **8x12-cm**, and the **MLC** is used to block the right kidney
- The prescription states that 3000 cGy will be delivered to **5-cm depth** in 10 fractions

Photon Beam Dose Calculations

6 MV TMR Clinac 2100C/D
TISSUE MAXIMUM RATIO
Thompson Cancer Survival Center

FSCF	0.875	0.898	0.929	0.950	0.968	0.984	1.000	1.011	1.023
Depth (cm)	4x4	5x5	6x6	7x7	8x8	9x9	10x10	11x11	12x12
0	0.391	0.402	0.407	0.413	0.422	0.431	0.441	0.449	0.457
1	0.964	0.965	0.967	0.970	0.970	0.970	0.970	0.971	0.972
1.5	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	1.001	1.001	1.001	1.002	1.002	1.001	1.000	1.000	0.999
3	0.969	0.971	0.975	0.979	0.980	0.980	0.981	0.981	0.981
4	0.937	0.942	0.946	0.950	0.952	0.955	0.957	0.959	0.959
5	0.901	0.910	0.915	0.919	0.923	0.926	0.929	0.931	0.933
6	0.861	0.872	0.880	0.887	0.893	0.896	0.900	0.902	0.904
7	0.830	0.841	0.849	0.856	0.862	0.867	0.871	0.876	0.879
8	0.794	0.807	0.816	0.825	0.832	0.837	0.842	0.847	0.851
9	0.763	0.776	0.785	0.794	0.802	0.808	0.814	0.819	0.824
10	0.728	0.741	0.753	0.764	0.774	0.780	0.786	0.792	0.797
11	0.696	0.710	0.721	0.732	0.741	0.750	0.757	0.765	0.770
12	0.668	0.681	0.693	0.704	0.714	0.722	0.729	0.737	0.743
13	0.638	0.653	0.666	0.677	0.686	0.695	0.703	0.711	0.717
14	0.612	0.626	0.638	0.649	0.659	0.668	0.676	0.685	0.692
15	0.584	0.596	0.608	0.621	0.633	0.642	0.649	0.657	0.664

Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.405

Tray Factor
0.970

SAD Monitor Unit Calculations

$$EqSq = \frac{2(length \cdot width)}{length + width}$$

$$= \frac{2(8 \cdot 12)}{8 + 12} = 9.6\text{-cm}$$

$$BlSq = EqSq \cdot SQRT(\%Open/100)$$

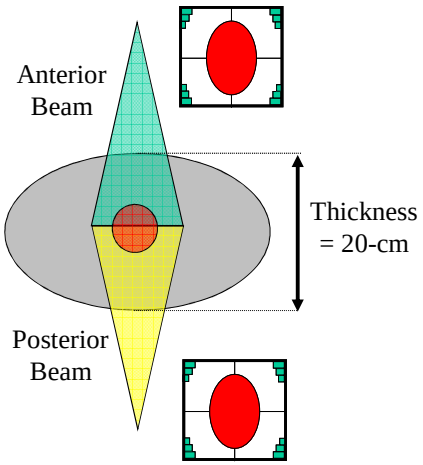
$$= 9.6 \cdot SQRT(80/100) = 8.6\text{-cm}$$

- TMR tables are used for isocentric calculations

$$MU\ Setting = \frac{Prescription}{DR \times FSCF \times (TMR)} = \frac{300\ cGy / Fraction}{1\ cGy/MU \times 0.992 \times 0.925}$$

$$= 327\ MU$$

Photon Beam Dose Calculations



1 cGy = 1 MU @ SAD (d_{max})

SAD Monitor Unit Calculations

- A 20-cm thick lung patient is treated on a 6 MV linear accelerator isocentrically
- The patient is positioned supine and will be treated with two equally weighted parallel opposed treatment fields (*APPA*)
- The field size is 10x10-cm, and the MLC is used to for "corner blocking"
- The prescription states that 4500 cGy will be delivered to midline in 25 fractions

Photon Beam Dose Calculations

6 MV TMR Clinac 2100C/D
TISSUE MAXIMUM RATIO
Thompson Cancer Survival Center

FSCF	0.875	0.898	0.929	0.950	0.968	0.984	1.000	1.011	1.023
Depth (cm)	4x4	5x5	6x6	7x7	8x8	9x9	10x10	11x11	12x12
0	0.391	0.402	0.407	0.413	0.422	0.431	0.441	0.449	0.457
1	0.964	0.965	0.967	0.970	0.970	0.970	0.970	0.971	0.972
1.5	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	1.001	1.001	1.001	1.002	1.002	1.001	1.000	1.000	0.999
3	0.969	0.971	0.975	0.979	0.980	0.980	0.981	0.981	0.981
4	0.937	0.942	0.946	0.950	0.952	0.955	0.957	0.959	0.959
5	0.901	0.910	0.915	0.919	0.923	0.926	0.929	0.931	0.933
6	0.861	0.872	0.880	0.887	0.893	0.896	0.900	0.902	0.904
7	0.830	0.841	0.849	0.856	0.862	0.867	0.871	0.876	0.879
8	0.794	0.807	0.816	0.825	0.832	0.837	0.842	0.847	0.851
9	0.763	0.776	0.785	0.794	0.802	0.808	0.814	0.819	0.824
10	0.728	0.741	0.753	0.764	0.774	0.780	0.786	0.792	0.797
11	0.696	0.710	0.721	0.732	0.741	0.750	0.757	0.765	0.770
12	0.668	0.681	0.693	0.704	0.714	0.722	0.729	0.737	0.743
13	0.638	0.653	0.666	0.677	0.686	0.695	0.703	0.711	0.717
14	0.612	0.626	0.638	0.649	0.659	0.668	0.676	0.685	0.692
15	0.584	0.596	0.608	0.621	0.633	0.642	0.649	0.657	0.664

Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.405

Tray Factor
0.970

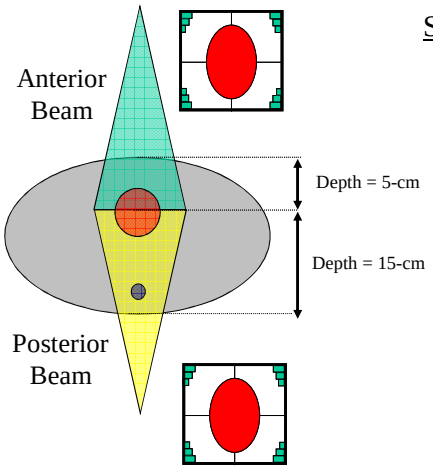
SAD Monitor Unit Calculations

- The prescription is 180 cGy per fraction to midline (*90 cGy from the anterior field and 90 cGy from the posterior field*)
- The patient is 20-cm thick, and the treatment depth is 10-cm
- The treatment SSD will be 90-cm (*not used in calculation*)

$$MU\ Setting = \frac{Prescription}{DR \times FSCF \times (TMR)} = \frac{90\ cGy / Fraction}{1\ cGy/MU \times 1.000 \times 0.786}$$

$$= 115\ MU$$

Photon Beam Dose Calculations



1 cGy = 1 MU @ SAD (d_{max})

SAD Monitor Unit Calculations

- A 20-cm thick lung patient is treated on a 6 MV linear accelerator isocentrically
- The patient is positioned supine and will be treated with two equally weighted parallel opposed treatment fields (*APPA*)
- The field size is 10x10-cm, and the MLC is used to for "corner blocking"
- The prescription states that 4500 cGy will be delivered to the tumor in 25 fractions

Photon Beam Dose Calculations

6 MV TMR Clinac 2100C/D
TISSUE MAXIMUM RATIO
Thompson Cancer Survival Center

FSCF	0.875	0.898	0.929	0.950	0.968	0.984	1.000	1.011	1.023
Depth (cm)	4x4	5x5	6x6	7x7	8x8	9x9	10x10	11x11	12x12
0	0.391	0.402	0.407	0.413	0.422	0.431	0.441	0.449	0.457
1	0.964	0.965	0.967	0.970	0.970	0.970	0.970	0.971	0.972
1.5	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	1.001	1.001	1.001	1.002	1.002	1.001	1.000	1.000	0.999
3	0.969	0.971	0.975	0.979	0.980	0.980	0.981	0.981	0.981
4	0.937	0.942	0.946	0.950	0.952	0.955	0.957	0.959	0.959
5	0.901	0.910	0.915	0.919	0.923	0.926	0.929	0.931	0.933
6	0.861	0.872	0.880	0.887	0.893	0.898	0.900	0.902	0.904
7	0.830	0.841	0.849	0.856	0.862	0.867	0.871	0.876	0.879
8	0.794	0.807	0.816	0.825	0.832	0.837	0.842	0.847	0.851
9	0.763	0.776	0.785	0.794	0.802	0.808	0.814	0.819	0.824
10	0.728	0.741	0.753	0.764	0.774	0.780	0.786	0.792	0.797
11	0.696	0.710	0.721	0.732	0.741	0.750	0.757	0.765	0.770
12	0.668	0.681	0.693	0.704	0.714	0.722	0.729	0.737	0.743
13	0.638	0.653	0.666	0.677	0.686	0.695	0.703	0.711	0.717
14	0.612	0.626	0.638	0.649	0.659	0.668	0.676	0.685	0.692
15	0.584	0.596	0.608	0.621	0.632	0.642	0.649	0.657	0.664

Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.405

Tray Factor
0.970

SAD Monitor Unit Calculations

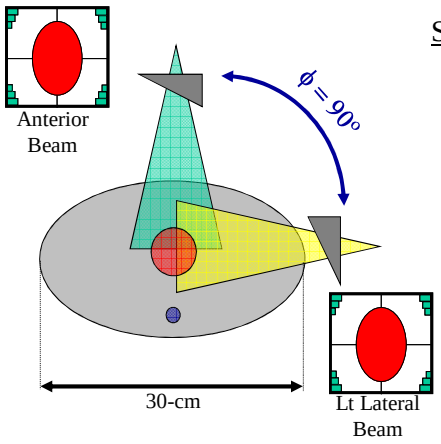
$$AP\ MU = \frac{Prescription}{DR \times FSCF \times (TMR_5)}$$

$$\frac{90\ cGy / Fraction}{1\ cGy/MU \times 1.000 \times 0.929}$$

= 97 MU

$$PA\ MU = \frac{Prescription}{DR \times FSCF \times (TMR_{15})} = \frac{90\ cGy / Fraction}{1\ cGy/MU \times 1.000 \times 0.649}$$ ***= 139 MU***

Photon Beam Dose Calculations



$\theta = 90 - \phi/2$

$\theta = 90 - 90/2$

$\theta = 45$ - Degree Wedge

SAD Monitor Unit Calculations

- A 20-cm thick and 30-cm wide lung patient is treated on a 6 MV linear accelerator isocentrically
- The patient is positioned supine and will be treated with an equally weighted **wedge pair**
- The field size is 10x10-cm, and the MLC is used to for "corner blocking"
- The prescription states that 4500 cGy will be delivered to the tumor in 25 fractions

1 cGy = 1 MU @ SAD (d_{max})

Photon Beam Dose Calculations

6 MV TMR Clinac 2100C/D
TISSUE MAXIMUM RATIO
Thompson Cancer Survival Center

FSCF	0.875	0.898	0.929	0.950	0.968	0.984	1.000	1.011	1.023
Depth (cm)	4x4	5x5	6x6	7x7	8x8	9x9	10x10	11x11	12x12
0	0.391	0.402	0.407	0.413	0.422	0.431	0.441	0.449	0.457
1	0.964	0.965	0.967	0.970	0.970	0.970	0.970	0.971	0.972
1.5	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	1.001	1.001	1.001	1.002	1.002	1.001	1.000	1.000	0.999
3	0.969	0.971	0.975	0.979	0.980	0.980	0.981	0.981	0.981
4	0.937	0.942	0.946	0.950	0.952	0.955	0.957	0.959	0.959
5	0.901	0.910	0.915	0.919	0.923	0.926	0.929	0.931	0.933
6	0.861	0.872	0.880	0.887	0.893	0.896	0.900	0.902	0.904
7	0.830	0.841	0.849	0.856	0.862	0.867	0.871	0.876	0.879
8	0.794	0.807	0.816	0.825	0.832	0.837	0.842	0.847	0.851
9	0.763	0.776	0.785	0.794	0.802	0.808	0.814	0.819	0.824
10	0.728	0.741	0.753	0.764	0.774	0.780	0.786	0.792	0.797
11	0.696	0.710	0.721	0.732	0.741	0.750	0.757	0.765	0.770
12	0.668	0.681	0.693	0.704	0.714	0.722	0.729	0.737	0.743
13	0.638	0.653	0.666	0.677	0.686	0.695	0.703	0.711	0.717
14	0.612	0.626	0.638	0.649	0.659	0.668	0.676	0.685	0.692
15	0.584	0.596	0.608	0.621	0.632	0.642	0.649	0.657	0.664

Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.405

Tray Factor
0.970

SAD Monitor Unit Calculations

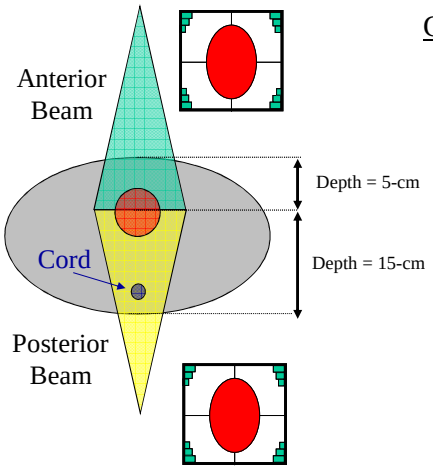
$$AP\ MU = \frac{Prescription}{DR \cdot FSCF \cdot WF \cdot (TMR_{10})}$$

$$\frac{90\ cGy / Fraction}{1\ cGy/MU \cdot 1.000 \cdot 0.495 \cdot 0.786}$$

$$= 228\ MU$$

$$PA\ MU = \frac{Prescription}{DR \times FSCF \times (TMR_{15})} = \frac{90\ cGy / Fraction}{1\ cGy/MU \cdot 1.000 \cdot 0.495 \cdot 0.649} = 280\ MU$$

Photon Beam Dose Calculations



1 cGy = 1 MU @ SAD (d_{max})

Cord Dose Calculations

- A 20-cm thick lung patient is treated on a 6 MV linear accelerator isocentrically with two equally weighted parallel opposed treatment fields (*APPA*)
- The field size is 10x10-cm, and the MLC is used to for "corner blocking"
- The prescription states that 4500 cGy will be delivered to the tumor in 25 fractions
- What is the dose to the spinal cord, which is located 5-cm from the posterior surface

Photon Beam Dose Calculations

6 MV TMR Clinac 2100C/D
TISSUE MAXIMUM RATIO
Thompson Cancer Survival Center

FSCF	0.875	0.898	0.929	0.950	0.968	0.984	1.000	1.011	1.023
Depth (cm)	4x4	5x5	6x6	7x7	8x8	9x9	10x10	11x11	12x12
0	0.391	0.402	0.407	0.413	0.422	0.431	0.441	0.449	0.457
1	0.964	0.965	0.967	0.970	0.970	0.970	0.970	0.971	0.972
1.5	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	1.001	1.001	1.001	1.002	1.002	1.001	1.000	1.000	0.999
3	0.969	0.971	0.975	0.979	0.980	0.980	0.981	0.981	0.981
4	0.937	0.942	0.946	0.950	0.952	0.955	0.957	0.959	0.959
5	0.901	0.910	0.915	0.919	0.923	0.926	0.929	0.931	0.933
6	0.861	0.872	0.880	0.887	0.893	0.898	0.900	0.902	0.904
7	0.830	0.841	0.849	0.856	0.862	0.867	0.871	0.876	0.879
8	0.794	0.807	0.816	0.825	0.832	0.837	0.842	0.847	0.851
9	0.763	0.776	0.785	0.794	0.802	0.808	0.814	0.819	0.824
10	0.728	0.741	0.753	0.764	0.774	0.780	0.786	0.792	0.797
11	0.696	0.710	0.721	0.732	0.741	0.750	0.757	0.765	0.770
12	0.668	0.681	0.693	0.704	0.714	0.722	0.729	0.737	0.743
13	0.638	0.653	0.666	0.677	0.686	0.695	0.703	0.711	0.717
14	0.612	0.626	0.638	0.649	0.659	0.668	0.676	0.685	0.692
15	0.584	0.596	0.608	0.621	0.633	0.642	0.649	0.657	0.664

Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.406

Tray Factor
0.970

SAD Monitor Unit Calculations

$$AP\ Dose = \frac{AP\ Dose \cdot TMR_{\ Depth\ of\ Cord}}{TMR_{\ Depth\ of\ tumor}}$$

$$\frac{90\ cGy \cdot 0.649}{0.929} = \mathbf{63\ cGy}$$

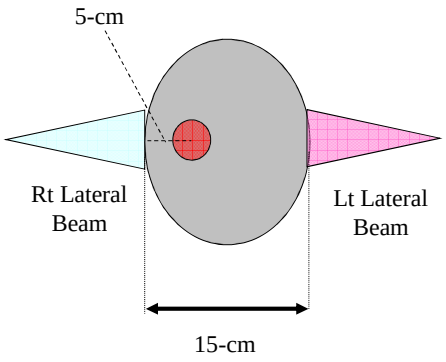
$$PA\ Dose = \frac{AP\ Dose \cdot TMR_{\ Depth\ of\ Cord}}{TMR_{\ Depth\ of\ tumor}}$$

$$\frac{90\ cGy \cdot 0.929}{0.649} = \mathbf{129\ cGy}$$

Cord Dose = 25 (63 +129) = 4800 cGy*

NOTE: The cord dose is higher than the prescribed dose

Photon Beam Dose Calculations

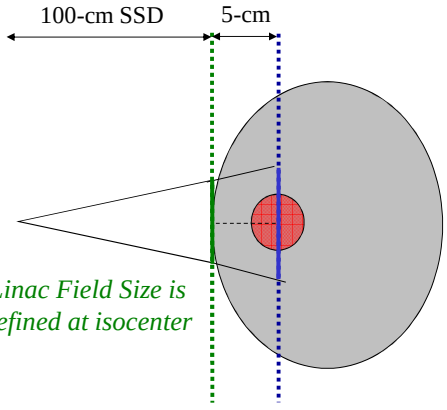


1 cGy = 1 MU @ SSD +dmax

SSD Field Size Determination

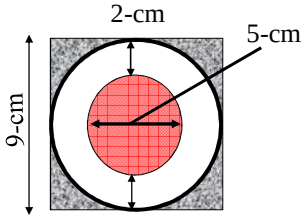
- A patient has brain spherical tumor located in the right hemisphere
- According to the MRI report, the tumor is 5-cm in diameter
- The prescription states that 4500 cGy will be delivered to the tumor in 25 fractions
- The setup is for opposed 6 MV fields
- Assuming an SSD setup, what is field size and monitor units for each field

Photon Beam Dose Calculations



Linac Field Size is defined at isocenter

9x9-cm Field Size at the Plane of the Tumor



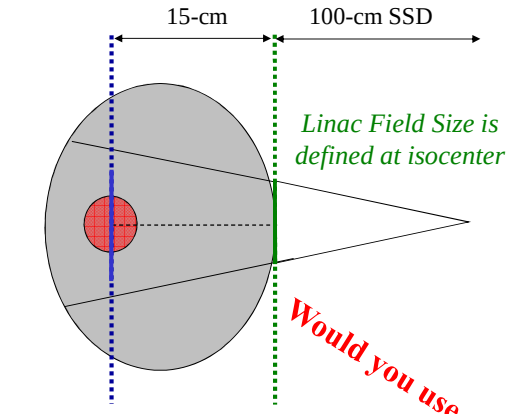
Field Size at the Plane of the Tumor

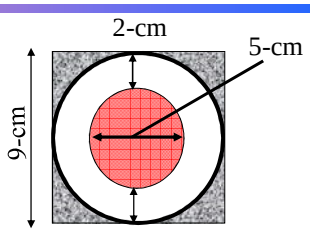
$$\text{Field Size} = \text{EqSq}\,\frac{\text{SSD}}{\text{SSD} + \text{d}}$$

$$= 9.0\text{-cm}\,\frac{100}{100 + 5}$$

= 8.6-cm

Photon Beam Dose Calculations





Field Size at the Plane of the Tumor

$$\text{Field Size} = \text{EqSq}\,\frac{\text{SSD}}{\text{SSD} + \text{d}}$$

$$= 9.0\text{-cm}\,\frac{100}{100 + 15}$$

= 7.8-cm

Photon Beam Dose Calculations

6 MV PDD Clinac 2100C/D
PERCENTAGE DEPTH DOSE
Thompson Cancer Survival Center

FSCF	0.834	0.875	0.898	0.929	0.950	0.968	0.984	1.000	1.011	1.023
Depth (cm)	3x3	4x4	5x5	6x6	7x7	8x8	9x9	10x10	11x11	12x12
0	39.2	40.3	37.3	38.3	39.4	40.4	41.5	42.5	43.5	44.4
1	97.3	97.4	97.6	97.7	97.8	97.8	97.9	98	98.1	98.2
1.5	100.0	100.0	100	100	100	100	100	100	100	100
2	99.1	99.1	98.7	98.8	98.8	98.9	98.9	99	99	99
3	93.9	94.2	94.4	94.5	94.6	94.7	94.7	94.8	94.8	94.8
4	88.9	89.4	89.4	89.7	90	90.3	90.6	90.9	91	91.1
5	83.6	84.4	84.9	85.2	85.6	86	86.3	86.7	86.9	87
6	78.2	79.3	80.4	80.9	81.4	81.8	82.3	82.8	83	83.2
7	74.0	75.1	76	76.6	77.2	77.7	78.3	78.9	79.1	79.4
8	69.4	70.6	71.4	72.1	72.8	73.5	74.1	74.8	75.1	75.4
9	65.6	66.7	67.7	68.4	69	69.6	70.3	70.9	71.2	71.6
10	61.3	62.5	63.8	64.5	65.3	66	66.8	67.5	67.9	68.3
11	57.6	58.8	60.4	61.1	61.9	62.6	63.4	64.1	64.5	64.9
12	54.4	55.5	56.7	57.5	58.3	59.2	60	60.8	61.2	61.6
13	50.9	52.2	53.5	54.3	55.1	55.9	56.7	57.5	58	58.4
14	48.0	49.2	50.1	51	51.9	52.9	53.8	54.7	55.2	55.6
15	45.1	46.2	47.5	48.3	49.2	50	50.8	51.6	52.1	52.6

Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.406

Tray Factor 0.970

SSD Monitor Unit Calculations

$BlSq_{RT}$ = EqSq · SQRT (%Open/100)

= 8.6 · SQRT (85/100) = 7.9-cm

$BlSq_{LT}$ = EqSq · SQRT (%Open/100)

= 7.8 · SQRT (85/100) = 7.2-cm

$$\text{MU Setting} = \frac{\text{Prescription}}{\text{DR} \cdot \text{FSCF} \cdot \text{TF} \cdot (\text{PDD}/100)}$$

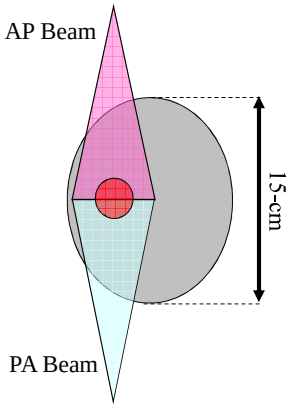
$$RT = \frac{90\ \text{cGy / Fraction}}{1\ \text{cGy/MU} \cdot 0.976 \cdot 0.97 \cdot ({}^{86}/_{100})}$$

$RT = 111$ MU

$$LT = \frac{90\ \text{cGy / Fraction}}{1\ \text{cGy/MU} \cdot 0.968 \cdot 0.97 \cdot ({}^{49.2}/_{100})}$$

$LT = 195$ MU

Photon Beam Dose Calculations

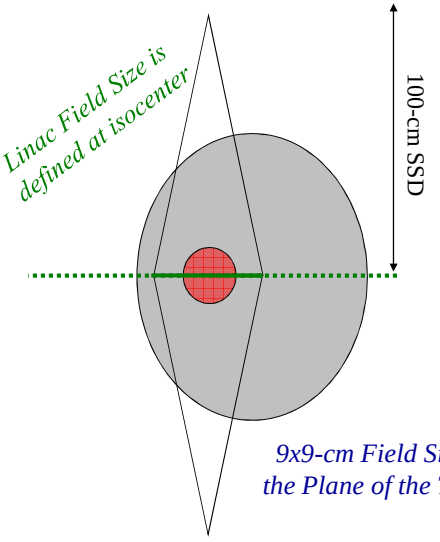


1 cGy = 1 MU @ SAD (d_{max})

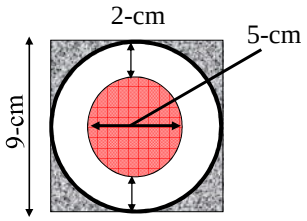
SAD Field Size Determination

- A patient has brain spherical tumor located in the right hemisphere
- According to the MRI report, the tumor is 5-cm in diameter
- The prescription states that 4500 cGy will be delivered to the tumor in 25 fractions
- The setup is for opposed 6 MV fields
- Assuming an SAD setup, what is field size and monitor units for each field

Photon Beam Dose Calculations



9x9-cm Field Size at the Plane of the Tumor



Field Size at the Plane of the Tumor

Would you use a Wedge?

Photon Beam Dose Calculations

6 MV TMR Clinac 2100C/D
TISSUE MAXIMUM RATIO
Thompson Cancer Survival Center

FSCF	0.875	0.898	0.929	0.950	0.968	0.984	1.000	1.011	1.023
Depth (cm)	4x4	5x5	6x6	7x7	8x8	9x9	10x10	11x11	12x12
0	0.391	0.402	0.407	0.413	0.422	0.431	0.441	0.449	0.457
1	0.964	0.965	0.967	0.970	0.970	0.970	0.970	0.971	0.972
1.5	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	1.001	1.001	1.001	1.002	1.002	1.001	1.000	1.000	0.999
3	0.969	0.971	0.975	0.979	0.980	0.980	0.981	0.981	0.981
4	0.937	0.942	0.946	0.950	0.952	0.955	0.957	0.959	0.959
5	0.901	0.910	0.915	0.919	0.923	0.926	0.929	0.931	0.933
6	0.861	0.872	0.880	0.887	0.893	0.896	0.900	0.902	0.904
7	0.830	0.841	0.849	0.856	0.862	0.867	0.871	0.876	0.879
8	0.794	0.807	0.816	0.825	0.832	0.837	0.842	0.847	0.851
9	0.763	0.776	0.785	0.794	0.802	0.808	0.814	0.819	0.824
10	0.728	0.741	0.753	0.764	0.774	0.780	0.786	0.792	0.797
11	0.696	0.710	0.721	0.732	0.741	0.750	0.757	0.765	0.770
12	0.668	0.681	0.693	0.704	0.714	0.722	0.729	0.737	0.743
13	0.638	0.653	0.666	0.677	0.686	0.695	0.703	0.711	0.717
14	0.612	0.626	0.638	0.649	0.659	0.668	0.676	0.685	0.692
15	0.584	0.596	0.608	0.621	0.633	0.642	0.649	0.657	0.664

Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.405

Tray Factor
0.970

SAD Monitor Unit Calculations

$$BlSq = EqSq \cdot SQRT\,(\%Open/100)$$

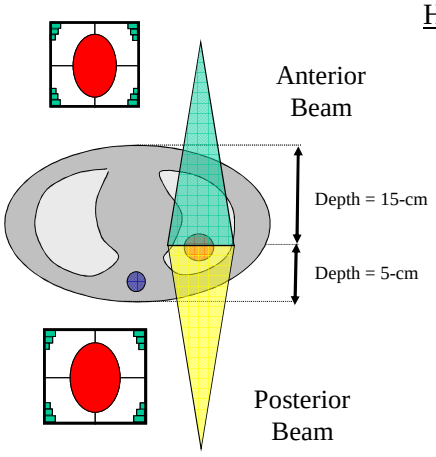
$$= 9 \cdot SQRT\,(85/100) = 8.3\ cm$$

$$MU\ Setting = \frac{Prescription}{DR \cdot FSCF \cdot TF \cdot WF \cdot TMR}$$

$$MU = \frac{90\ cGy\ /\ Fraction}{1\ cGy/MU \cdot 0.984 \cdot 0.97 \cdot 0.627 \cdot 0.85}$$

$$MU = 177\ MU$$

Photon Beam Dose Calculations



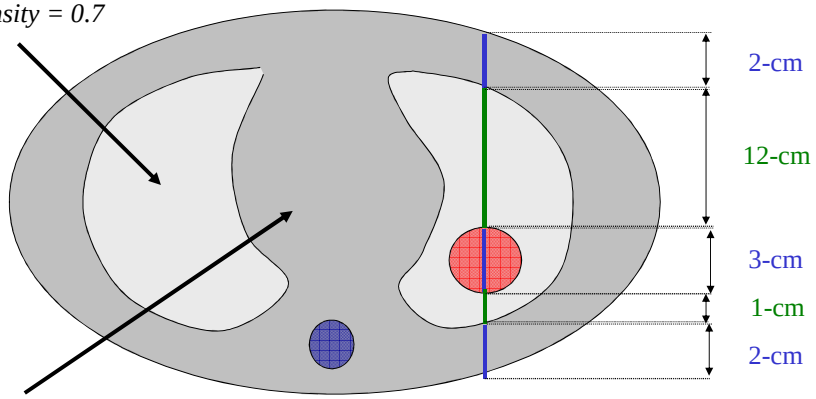
1 cGy = 1 MU @ SAD (d_{max})

Heterogeneous Dose Calculations

- A 20-cm thick lung patient is treated on a 6 MV linear accelerator isocentrically with two equally weighted parallel opposed treatment fields (*APPA*)
- The field size is 5x5-cm, and the MLC is used to for "corner blocking"
- The prescription states that 4500 cGy will be delivered to the tumor in 25 fractions
- Take into consideration the different density of the lung

Photon Beam Dose Calculations

Lung Density = 0.7



Tissue Density = 1.0

7-cm (Water) + 13-cm (Lung)
AP Depth ≈ 11.9-cm
PA Depth ≈ 4.2-cm

THOMPSON CANCER SURVIVAL CENTER

THE UNIVERSITY of TENNESSEE

Photon Beam Dose Calculations

6 MV TMR Clinac 2100C/D
TISSUE MAXIMUM RATIO
Thompson Cancer Survival Center

FSCF	0.875	0.898	0.929	0.950	0.968	0.984	1.000	1.011	1.023
Depth (cm)	4x4	5x5	6x6	7x7	8x8	9x9	10x10	11x11	12x12
0	0.391	0.402	0.407	0.413	0.422	0.431	0.441	0.449	0.457
1	0.964	0.965	0.967	0.970	0.970	0.970	0.970	0.971	0.972
1.5	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	1.001	1.001	1.001	1.002	1.002	1.001	1.000	1.000	0.999
3	0.969	0.971	0.975	0.979	0.980	0.980	0.981	0.981	0.981
4	0.937	0.942	0.946	0.950	0.952	0.955	0.957	0.959	0.959
5	0.901	0.910	0.915	0.919	0.923	0.926	0.929	0.931	0.933
6	0.861	0.872	0.880	0.887	0.893	0.896	0.900	0.902	0.904
7	0.830	0.841	0.849	0.856	0.862	0.867	0.871	0.876	0.879
8	0.794	0.807	0.816	0.825	0.832	0.837	0.842	0.847	0.851
9	0.763	0.776	0.785	0.794	0.802	0.808	0.814	0.819	0.824
10	0.728	0.741	0.753	0.764	0.774	0.780	0.786	0.792	0.797
11	0.696	0.710	0.721	0.732	0.741	0.750	0.757	0.765	0.770
12	0.668	0.681	0.693	0.704	0.714	0.722	0.729	0.737	0.743
13	0.638	0.653	0.666	0.677	0.686	0.695	0.703	0.711	0.717
14	0.612	0.626	0.638	0.649	0.659	0.668	0.676	0.685	0.692
15	0.584	0.596	0.608	0.621	0.632	0.642	0.649	0.657	0.664

Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.405

Tray Factor
0.970

SAD Monitor Unit Calculations

$$AP\ MU = \frac{Prescription}{DR \cdot FSCF \cdot TF \cdot WF \cdot TMR}$$

$$AP\ MU = \frac{90\ cGy / Fraction}{1 \cdot 0.898 \cdot 1 \cdot 1 \cdot 0.681} = 147\ MU$$

$$PA\ MU = \frac{90\ cGy / Fraction}{1 \cdot 0.898 \cdot 1 \cdot 1 \cdot 0.942} = 105\ MU$$

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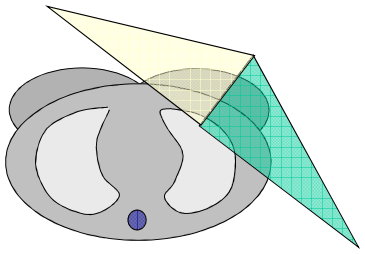
Photon Beam Dose Calculations

Medial Tangent



Lateral Tangent

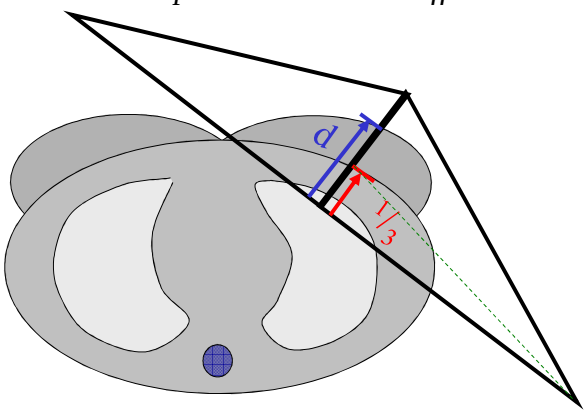
Tangent Dose Calculations

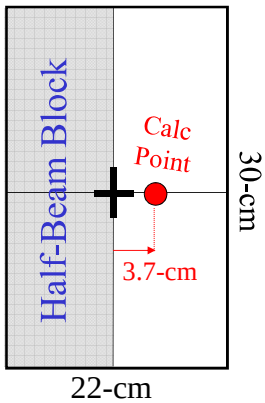
- A tangent pair is used to treat a breast patient using 6 MV photons
- The patient is setup isocentrically and the tangents are equally weighted
- The field size is 22x30-cm and half beam blocking is used
- The prescription states that 4500 cGy will be delivered to the tumor in 25 fractions

1 cGy = 1 MU @ SAD (d_{max})

Photon Beam Dose Calculations

The calculation point for breast patients is located off-axis





Photon Beam Dose Calculations

6 MV TMR Clinac 2100C/D

TISSUE MAXIMUM RATIO

Thompson Cancer Survival Center

FSCF	1.055	1.061	1.070	1.077	1.085	1.091	1.098	1.106
Depth (cm)	15x15	16x16	17x17	18x18	19x19	20x20	22x22	24x24
0	0.483	0.491	0.499	0.508	0.516	0.524	0.542	0.561
1	0.976	0.977	0.978	0.978	0.978	0.979	0.981	0.982
1.5	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	0.997	0.997	0.997	0.997	0.997	0.998	0.998	0.998
3	0.982	0.982	0.982	0.982	0.982	0.982	0.983	0.985
4	0.960	0.961	0.962	0.962	0.963	0.964	0.965	0.967
5	0.936	0.937	0.938	0.939	0.940	0.941	0.944	0.948
6	0.909	0.911	0.913	0.915	0.917	0.920	0.924	0.928
7	0.890	0.894	0.895	0.897	0.898	0.899	0.902	0.907
8	0.863	0.867	0.870	0.872	0.875	0.877	0.882	0.887
9	0.837	0.842	0.845	0.848	0.851	0.854	0.859	0.866
10	0.811	0.816	0.820	0.823	0.826	0.829	0.835	0.841
11	0.786	0.791	0.795	0.798	0.801	0.804	0.809	0.816
12	0.760	0.766	0.771	0.774	0.777	0.780	0.786	0.793
13	0.733	0.738	0.744	0.748	0.752	0.756	0.763	0.771
14	0.709	0.716	0.722	0.726	0.729	0.733	0.740	0.748
15	0.682	0.688	0.694	0.699	0.704	0.709	0.719	0.727

Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.406

Tray Factor

0.970

6 MV Off-Axis Factors Measured at 10-cm Depth

	Wedge Angle				
Distance	0	15	30	45	60
0.0	1.000	1.000	1.000	1.000	1.000
0.5	1.003	1.000	0.989	0.987	0.967
1.0	1.006	0.996	0.985	0.972	0.940
1.5	1.010	0.989	0.971	0.958	0.910
2.0	1.013	0.985	0.958	0.942	0.878
2.5	1.013	0.985	0.947	0.930	0.851
3.0	1.011	0.978	0.937	0.911	0.823
3.5	1.014	0.973	0.929	0.898	0.795
4.0	1.018	0.969	0.919	0.882	0.763
4.5	1.015	0.959	0.909	0.862	0.734
5.0	1.017	0.955	0.896	0.850	0.682

SAD Monitor Unit Calculations

$$EqSq = \frac{2(length \cdot width)}{length + width}$$

$$= \frac{2(22 \cdot 30)}{22 + 30} = 25.4\text{-cm}$$

$$BlSq = EqSq \cdot SQRT(\%Open/100)$$

$$= 25.4 \cdot SQRT(50/100) = 21.4\ cm$$

$$MU = \frac{Prescription}{DR \cdot FSCF \cdot OAF \cdot WF \cdot TMR}$$

$$MU = \frac{90\ cGy}{1\ cGy/MU \cdot 1.11 \cdot 1.016 \cdot 1 \cdot 0.880}$$

$$MU = 91$$

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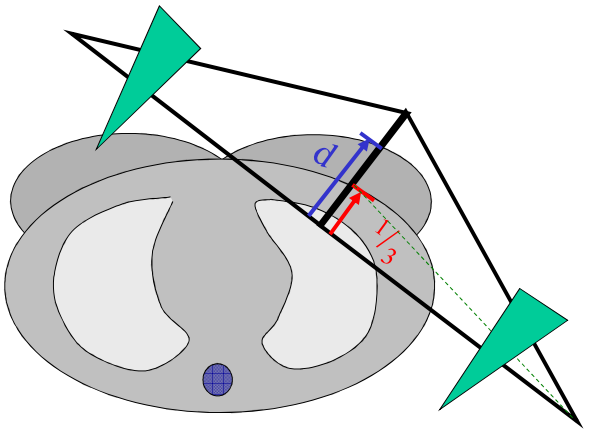
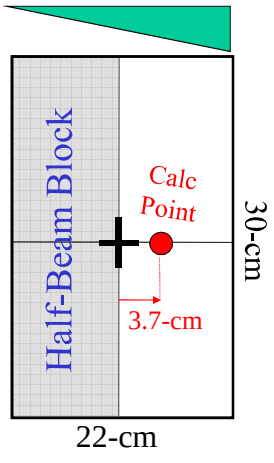
Photon Beam Dose Calculations

Wedges factors are measured through the center of the wedge





THOMPSON CANCER SURVIVAL CENTER

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Photon Beam Dose Calculations

6 MV TMR Clinac 2100C/D
TISSUE MAXIMUM RATIO
Thompson Cancer Survival Center

FSCF	1.055	1.061	1.070	1.077	1.085	1.091	1.098	1.106
Depth (cm)	15x15	16x16	17x17	18x18	19x19	20x20	22x22	24x24
0	0.483	0.491	0.499	0.508	0.516	0.524	0.542	0.561
1	0.976	0.977	0.978	0.978	0.978	0.979	0.981	0.982
1.5	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	0.997	0.997	0.997	0.997	0.997	0.998	0.998	0.998
3	0.982	0.982	0.982	0.982	0.982	0.982	0.983	0.985
4	0.960	0.961	0.962	0.962	0.963	0.964	0.965	0.967
5	0.936	0.937	0.938	0.939	0.940	0.941	0.944	0.948
6	0.909	0.911	0.913	0.915	0.917	0.920	0.924	0.928
7	0.890	0.894	0.895	0.897	0.898	0.899	0.902	0.907
8	0.863	0.867	0.870	0.872	0.875	0.877	0.882	0.887
9	0.837	0.842	0.845	0.848	0.851	0.854	0.859	0.866
10	0.811	0.816	0.820	0.823	0.826	0.829	0.835	0.841
11	0.786	0.791	0.795	0.798	0.801	0.804	0.809	0.816
12	0.760	0.766	0.771	0.774	0.777	0.780	0.786	0.793
13	0.733	0.738	0.744	0.748	0.752	0.756	0.763	0.771
14	0.709	0.716	0.722	0.726	0.729	0.733	0.740	0.748
15	0.682	0.688	0.694	0.699	0.704	0.709	0.719	0.727

Wedge Factors

Wedge	15	30	45	60
WF	0.777	0.627	0.495	0.406

Tray Factor
0.970

6 MV Off-Axis Factors Measured at 10-cm Depth

	Wedge Angle				
Distance	0	15	30	45	60
0.0	1.000	1.000	1.000	1.000	1.000
0.5	1.003	1.000	0.989	0.987	0.967
1.0	1.006	0.996	0.985	0.972	0.940
1.5	1.010	0.989	0.971	0.958	0.910
2.0	1.013	0.985	0.958	0.942	0.878
2.5	1.013	0.985	0.947	0.930	0.851
3.0	1.011	0.978	0.937	0.911	0.823
3.5	1.014	0.973	0.929	0.898	0.795
4.0	1.018	0.969	0.919	0.882	0.763
4.5	1.015	0.959	0.909	0.862	0.734
5.0	1.017	0.955	0.896	0.850	0.682

SAD Monitor Unit Calculations

$$EqSq = \frac{2(length \cdot width)}{length + width}$$

$$= \frac{2(22 \cdot 30)}{22 + 30} = 25.4\text{-cm}$$

$$BlSq = EqSq \cdot SQRT(\%Open/100)$$

$$= 25.4 \cdot SQRT(50/100) = 21.4\ cm$$

$$MU = \frac{Prescription}{DR \cdot FSCF \cdot OAF \cdot WF \cdot TMR}$$

$$MU = \frac{90\ cGy}{1\ cGy/MU \cdot 1.11 \cdot 0.924 \cdot 0.627 \cdot 0.880}$$

$$MU = 159$$

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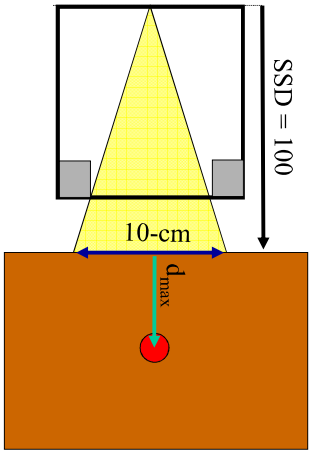
Electron Beam Dose Calculations



1 cGy = 1 MU @ SSD +dmax

SSD Monitor Unit Calculations

- A patient with skin cancer is treated with 6 MeV electrons
- The patient is positioned supine and will be treated with a single treatment field
- The 10x10-cm cone is used and there is no custom blocking used for this field
- The prescription states that 3000 cGy will be delivered to **d_{max}** in 10 fractions

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Electron Beam Dose Calculations

6 MeV Electron PDD
Thompson Cancer Survival Center

FSCF*		0.60	0.80	0.98	0.98	1.00	1.01	1.01	1.01
Depth (cm)	1.6 circ.	2x2	3 circ.	4 circ	6x6	10x10	15x15	20x20	25x25
0	-	-	-	-	73.9	72.7	73.5	74.6	75.3
0.2	-	-	-	-	78.7	77.4	77.0	77.6	77.9
0.4	-	-	-	-	82.6	81.6	81.1	81.3	81.3
0.6	-	-	-	-	86.9	85.7	85.2	85.6	85.3
0.8	-	-	-	-	91.8	90.1	89.3	90.2	89.6
1	-	-	-	-	96.7	94.9	93.6	94.7	93.7
1.2	-	-	-	-	99.8	98.7	97.6	97.9	97.6
1.4	-	-	-	-	100.0	100.0	100.0	100.0	100.0
1.6	-	-	-	-	96.8	97.3	97.7	97.7	98.2
1.8	-	-	-	-	89.3	90.7	91.9	91.8	93.0
2	-	-	-	-	78.5	80.4	82.5	82.3	82.5
2.2	-	-	-	-	61.8	65.6	68.0	67.3	69.0
2.4	-	-	-	-	44.9	48.7	51.7	50.6	52.8
2.6	-	-	-	-	28.7	32.0	34.6	33.7	35.8
2.8	-	-	-	-	14.8	17.6	19.0	18.6	20.2
3	-	-	-	-	6.1	7.5	8.6	8.3	9.4
3.2	-	-	-	-	2.6	3.1	3.5	3.5	4.0
3.4	-	-	-	-	1.2	1.3	1.5	1.5	1.7

Monitor Unit Calculations

- Electron monitor units are the simplest to calculate
- Electrons treatments are typically prescribed to d_{max}
- In most cases, you only need to divide by the Field Size Correction Factor

$$MU\ Setting = \frac{Prescription}{DR \times FSCF \times (PDD/100)} = \frac{200\ cGy / Fraction}{1\ cGy/MU \times 1.0 \times (100/100)}$$

$$= 200\ MU$$

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