

# Penentuan Ketebalan Perisai dan Laju Dosis pada Instalasi Bedah Sentral

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## Abstrak

Telah dilakukan perhitungan ketebalan perisai ruang *C-arm* pada instalasi bedah sentral dan pengukuran laju dosis yang dihasilkan oleh penggunaan fluoroskopi *C-arm*. Perhitungan ketebalan perisai dilakukan menggunakan NCRP-49, sedangkan pengukuran laju dosis phantom antropomorfik dilakukan menggunakan surveymeter yaitu pada permukaan tabung sinar-X, 1 meter dari sumber sinar-X, 6 titik ukur pada posisi petugas operasi, 8 titik ukur di luar dinding ruang *C-arm* dengan dan tanpa perisai timbal. Pengukuran laju dosis pada 1 meter dari sumber dilakukan dengan 8 variasi sudut yaitu  $0^\circ$ ,  $45^\circ$ ,  $90^\circ$ ,  $135^\circ$ ,  $180^\circ$ ,  $215^\circ$ ,  $270^\circ$ , dan  $315^\circ$ . Enam titik ukur pada posisi petugas operasi tersebut secara berurutan adalah posisi dokter anestesi, asisten anestesi, dokter operator, perawat instrument, perawat sirkel dan radiologis. Delapan titik ukur di luar dinding dengan dan tanpa perisai timbal tersebut adalah di sisi pintu ruang persiapan, di sisi dinding ruang persiapan, di sisi pintu ruang cuci, di sisi dinding ruang operasi 1, di sisi dinding koridor, di sisi pintu koridor, di sisi dinding ruang operasi 3 dan di lantai atas (atap). Ketebalan perisai minimal yang dibutuhkan ruang *C-arm* berdasarkan perhitungan NCRP-49 adalah 14,38 cm setara beton atau 1,84 mm setara Pb. Tebal batu bata minimal yang dibutuhkan berdasarkan perhitungan adalah 17,79 cm, sehingga perancangan penahan radiasi setara 2 mm Pb atau beton setebal 20 cm atau batu bata setebal 25 cm sesuai Perka Bapeten No. 8 tahun 2011 aman sebagai penahan radiasi primer dan sekunder pada ruang *C-arm* di instalasi bedah sentral. Laju dosis di permukaan tabung sinar-X adalah 75,92 mSv/h. Laju dosis 1 meter dari sumber paling tinggi yang diterima adalah pada penggunaan sudut  $270^\circ$  sebesar 1,42 mSv/h dan laju dosis paling rendah diterima adalah pada penggunaan sudut  $135^\circ$  sebesar 28,92  $\mu$ Sv/h. Laju dosis pada titik-titik posisi petugas operasi, paling tinggi yang diterima adalah posisi dokter operator sebesar 1,34 mSv/h dan laju dosis paling rendah diterima adalah posisi dokter anestesi serta asisten anestesi yaitu sebesar 0,197 mSv/h. Laju dosis di luar dinding ruang *C-arm* tanpa perisai timbal, terdapat 3 titik ukur yang melebihi NBD yaitu di sisi pintu ruang persiapan (A) sebesar 34,92  $\mu$ Sv/h, di sisi dinding ruang persiapan (B) sebesar 1,29  $\mu$ Sv/h dan di sisi pintu ruang cuci (C) sebesar 37,92  $\mu$ Sv/h. Laju dosis di luar dinding ruang *C-arm* dengan perisai timbal, pada masing-masing titik ukur didapatkan angka *background* yaitu 0,02  $\mu$ Sv/h – 0,08  $\mu$ Sv/h. Laju dosis di luar dinding ruang *C-arm* dengan perisai timbal adalah aman.

**Kata kunci** : Fluoroskopi, Laju Dosis, *Phantom Antropomorfik*, Titik Ukur

# Determination of Shield Thickness and Dose Rate in Central Surgical Installation

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## Abstract

The calculation of the thickness of the C-arm space shield at the central surgical installation and measurement of the dose rate generated by the use of C- arm fluoroscopy. The calculation of the thickness of the shield is done using NCRP-49, while the measurement of the anthropomorphic phantom dose rate is done using a surveymeter on the surface of the X-ray tube, 1 meter from X-ray source, 6 measuring point on the position of the operation

officer, 8 measuring point outside the space wall C-arm with and without lead shield. Measurement of dose rate at 1 meter from source was done with 8 angle variations :  $0^{\circ}$ ,  $45^{\circ}$ ,  $90^{\circ}$ ,  $135^{\circ}$ ,  $180^{\circ}$ ,  $215^{\circ}$ ,  $270^{\circ}$ , and  $315^{\circ}$ . Six measuring points in the position of the officer are sequentially anesthesia doctor, anesthesia assistant, dispenser doctor, nurse instrument, nurse and radiologist. The eight measuring points outside the wall with and without the lead shield are on the side of the preparatory door, on the side of the preparatory wall, at the side of the laundry room, on the side of the operating room wall 1, on the side of the corridor wall, on the side of the corridor door, wall of operating room 3 and upstairs (roof). The minimum shield thickness required C-arm space based on NCRP-49 calculation is 14,38 cm equivalent of concrete or 1.84 mm Pb equivalent. The minimum thickness of brick required based on the calculation is 17.79 cm, so that the design of radiation retainer equal to 2 mm Pb or 20 cm thick concrete or 25 cm thick brick according to Perka Bapeten. 8 of 2011 is safe as a primary and secondary radiation barrier on C-arm space at central surgical installation. The dose rate on the surface of the X-ray tube is 75.92 mSv/h. The dose rate of 1 meter from the highest source received is at the use of a  $270^{\circ}$  angle of 1.42 mSv/h and the lowest acceptable dose rate is at the use of a  $135^{\circ}$  angle of 28.92  $\mu$ Sv/h. The dose rate at the operating officer position points, the highest received is the operator doctor position of 1.34 mSv/h and the lowest acceptable dose rate is the position of anesthesiologist and anesthesia assistant is 0.197 mSv/h. Dose rate outside the walls of the C-arm space without a lead shield, there are 3 measuring points exceeding NBD ie on the side of the preparatory chamber (A) of 34.92  $\mu$ Sv/h, on the side of the preparatory chamber (B) of 1.29  $\mu$ Sv/h and on the side of the washer room (C) of 37.92  $\mu$ Sv/h. Dose rate outside the walls of the C-arm chamber with a lead shield, at each measuring point, background radiation is 0.02  $\mu$ Sv/h - 0.08  $\mu$ Sv/h. The dose rate outside the walls of the C-arm chamber with a lead shield is safe.

**Keywords:** Fluoroscopy, Dose Rate, Anthropomorphic Phantom, Measure Point

### **Pembimbing Akademik**

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