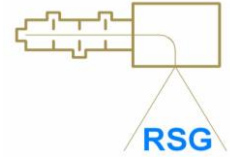


RADIATION SERVICES GROUP

Incorporating



***RADIATION SERVICES AUSTRALIA
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Radiation Shielding Suppliers ABN 14 002 813 309

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Preliminary Considerations for Radiation Shielding

At present there is no available information concerning the extent and layout of the project, so the information contained herein is very basic and general. Building constraints may require other methods and details, but these are too varied to possibly include in this stage of the design.

Linear Accelerator Bunkers and Brachytherapy

Given a site where there is little restriction on the building envelope, poured concrete is, without doubt, the simplest and most cost-effective shielding material.

If there are volume constraints, then use of steel cast in to the concrete is the simplest and cheapest method of increasing the efficacy of a shield of given thickness. There are limitations on how much thickness reduction can be achieved and there are constraints on sequencing of shielding materials, but typically a primary shield can be reduced from of the order of 2400mm concrete to a laminar shield some 1300mm thick.

Typical primary shields are 2400mm thick and secondaries 100mm thick. Concrete is specified at 2350kg.m^{-3} , with small variations able to be calculated by linear interpolation.

Mazes remain an issue with high energy accelerators, in that there is a trade off regarding maze length and the use of a neutron absorbing door. Long mazes have two main limitations, being cost of floor area and increase in distance (and time) for staff transit to and from the treatment volume. A sensibly placed neutron door reduces maze length and does not cause any delays (as it is open before the staff arrive at the door location).

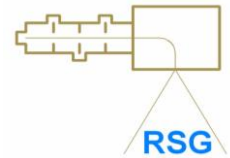
It is recommended that the bunkers be generically designed, with allowance for the largest accelerator, greatest workload and highest energy likely to be used. It is easy to put a low energy machine in a high energy bunker, but the converse is definitely not true.

A maze structure is recommended for brachytherapy to reduce the intensity and energy of radiation incident on the door, as a typical direct shielded door weighs about 6 tonnes. Typical brachy walls are 400-500mm thick concrete.

Positron Emission Tomography and Ablative ^{131}I Treatment Rooms

The energies of the gamma rays from these isotopes fall into a region where the thickness ratio of lead to concrete to achieve the same attenuation is of the order of 1 to 10-15. In other words, 10mm of lead is roughly equivalent to 100 to 150mm of concrete. Under these circumstances, poured concrete walls are the construction method of choice, due to cost and structural strength. **Core filled blocks are not a suitable alternative as QA issues and voids become problematic.**

Depending on surrounding areas, shielding for PET scanners may need to be slab to slab (to stop scatter to surrounding imaging equipment). Otherwise, shielding to 2400mm AFFL is recommended.



Typical walls for PET scanners are 150-200mm concrete, for uptake rooms, 200-250mm concrete and for ablative ^{131}I rooms varying from 150mm to 300mm, depending on surroundings. Note that slabs above and below these rooms may need to be cast thicker than dictated by structure alone.

Diagnostic X-ray (including Fluoroscopy and CT scanners)

In these areas the shielding method of choice is the use of lead sheet laminated onto normal drywall sheets. The type of sheet required depends on the building requirements and lead gauge. Sheets long enough to reach ceiling height are laminated with lead to the required height (2100mm AFFL generally and 2400mm AFFL for CT) and these are fitted vertically rather than horizontally.

Stud centres at 400mm are recommended for strength and ease of installation. Lead flashing for penetrations is fitted to the other skin of the wall or suitable noggings as required.

For estimation purposes, an average of 20kg.m^{-2} lead will give a reasonable accurate guess at materials cost.

Due to the nature of radiation shielding on walls, in that shielding does not continue to the full wall height, the assessment of quantities in square metres for walls is not sensible. For shielded walls, using linear metres makes estimating far simpler.

Lead is specified in kg.m^{-2} , as this is how it is commercially specified. 10kg.m^{-2} is equivalent to 0.88mm. Conversions for wall dimensioning are linear from this figure.