

How microwaves reflect off building surfaces and into buildings

Microwave radiation comes from a variety of transmitters, from radio and TV masts, mobile phone base stations, local radio operators, amateur radio users, digital cordless phones and wireless network systems (wLANs) which extend into neighbourhoods from individual houses, WiFi and WiMAX systems that enable laptop use 'on the move'.

Microwave radiation leaves its source in a 'more or less' straight line. When it encounters an obstacle it is not stopped (like light), it flows around to a certain extent (a bit like water, but not as flexible). It also reflects off the ground, so what you will experience will depend on the geography around you.

Building materials change the pattern. A little of the radiation is absorbed by building materials, some is reflected (a great deal in the case of metal obstacles, such as metal roofs or walls, metal advertising hoardings, road barriers, lorries, cars, metal downpipes, gutters and other structures on buildings and many other things you will find in most environments). The rest goes through the 'obstruction' as if it weren't there, depending on the material. Glass, for instance, lets virtually everything through. Most building materials let through less than glass, but still a significant amount. A study by Bürgi (2010) concluded that the modelling of the shielding effects by walls and roofs requires considerable simplifications of a complex environment.

Where there is metal (such as steel frames and joists) used in building construction these, too, are likely to influence the places where microwave radiation can be detected. Metal equipment within buildings, such as mirrors, metal lamps, etc. will also distort the fields.

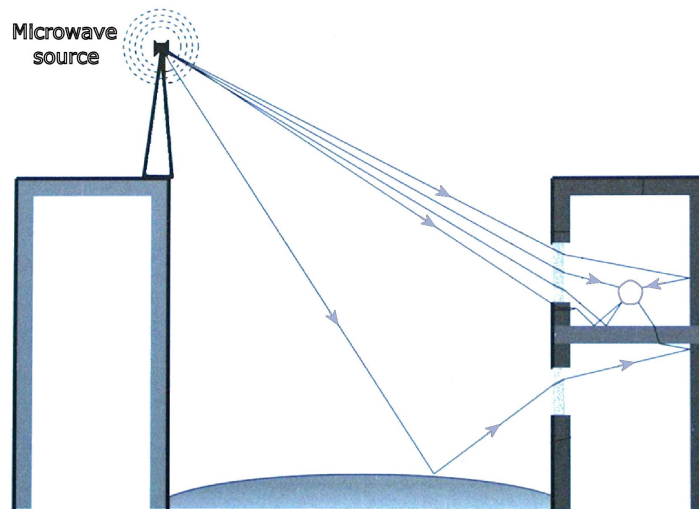
The level of microwave radiation that you may be exposed to can be quite complicated, and also depends on what other buildings surround the one you are in.

The *simplified* diagram below shows what could be experienced by people in a building with a mobile phone base station on the roof of a nearby building. In the diagram there is only one mast, and only the radiation from one antenna is what is shown. All base stations have more than one antenna, pointing in different directions, and subject to the same 'bounce' off buildings, the ground, and other objects as is shown for this one.

The bottom ray, in the diagram below, is shown bouncing from a ground floor surface and being reflected upwards through the window below and opposite.

The diagram does not show where the rays reflect off the building and return to enter the windows (and to a certain extent the walls) of the building on which the base station stands. It also only shows the microwaves entering through the windows and not the building materials, as the inclusion of these as well would make it too complicated to interpret.

People in buildings near a source of radio-frequency radiation will be exposed to levels of microwaves that are unpredictable. They will come from 'line of sight' direction, but also from reflections from many places depending on the surroundings. All computer programmes predicting exposure are grossly simplified and do not reflect a true picture of the reality of exposure.



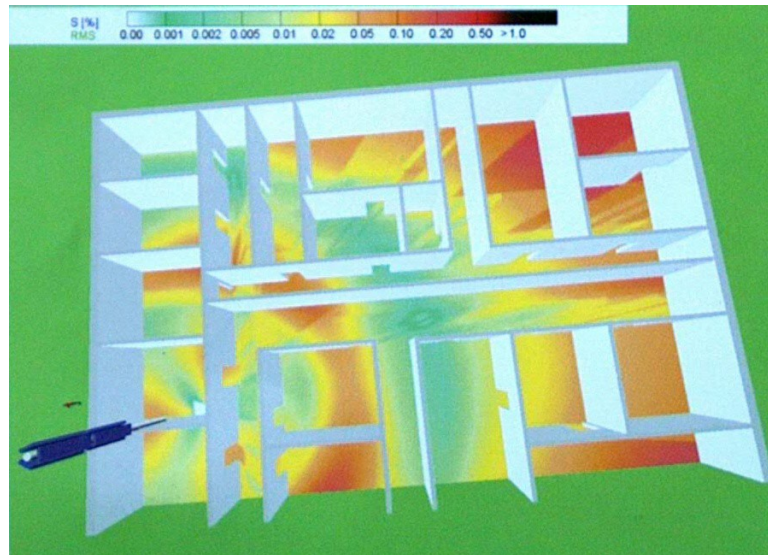
A base station radiating a nearby property, based on a diagram in 'Antennas & Propagation' by Simon Saunders (ISBN 0 471 98609 7)

A person in the top floor of the building on the left, would be affected by 'hot spots' of radiation, as shown in the plan below. These spots are unpredictable and may not be where you may expect to find them.

People on other floors are likely to be exposed to reflected radiation from the ground, and other buildings nearby. This is impossible to predict. Most software programmes intended to do so, exclude details of buildings, topography and nearby parked vehicles and other reflective surfaces because of the complexities of including them.

Generally "rules of thumb" with regard to microwave radiation are pretty useless in practice. If you have a free-standing mast, across open ground (no trees) to a row of buildings, then some rules of thumb can be applied, but it would depend on the beam shape, down-tilt of the antennas, height of the antennas and the distance between the antennas and the buildings. At 200 metres from a typical 15 metre mast, there may not be much difference with height. On a 24 floor block of flats at that distance, then the higher floors would have lower microwave levels and floor 0 to about 15 would be similar, with maybe floors 3-5 having slightly higher levels than the others. The levels would be very difficult to predict and would depend on the microwave reflectivity of the ground surface. There would be much higher levels if it were tarmac or concrete compared to the levels if it were reasonable length grass. As regards close masts, then the closer you are to the level of the antennas, the higher the radiation level is likely to be. If you are at the same height, or slightly lower, then you are likely to be in the main beam and hence have high levels.

There is really no alternative to measuring your exposure as predicting it without measuring could be very inaccurate, either overestimating or underestimating levels significantly.



The floor directly underneath the base station (at the front left) showing the levels of radiation experienced by occupants of the various rooms. The most exposed room is at the top right, at the corner furthest from the base station position. Diagram from <http://www.fgf.de/english/fgf/index.html>

The only way to know for certain whether you are being exposed to microwave radiation that may be affecting your health is to measure it using an Acoustimeter or another suitable microwave measuring instrument.

References:

Bürgi A et al 2010 - *A model for radiofrequency electromagnetic field predictions at outdoor and indoor locations in the context of epidemiological research* *Bioelectromagnetics* 31(3):226-36 PMID: 19834920

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