4. Ionization Microclimate

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Ionization Microclimate

- **Ionization microclimate** is a component of indoor environment formed by flows of ionizing radiation produced by radioactive substances of **natural or artificial sources,** which act on the individual and form one's overall condition.

- The basic physical quantity of ionization is the **activity** (Ak) of a given amount of radionuclide expressing the proportion of the mean number of radioactive changes and the time interval. **The unit of activity is one decay per second or Becquerel (Bq).**

- The source of ionizing radiation may be radioactive substances **penetrating into the interior from the external environment,** or substances occurring inside the building due to **anthropogenic activities** and the release of **building materials and technological equipment containing** radioactive material.

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Ionization Microclimate

- **Radioactivity** is the transformation of the core of an element into the core of another element, while releasing large amounts of energy in the form of invisible radiation (so-called radioactive radiation) that is dangerous to humans. There is natural and artificial radioactivity.

- **Radionuclide** is a nuclide with an unstable nucleus whose atoms are subject to radioactive transformation together with the emission of ionizing radiation.

- **Half-life** is the time taken for half the radionuclide's atoms to decay. The half-life is constant for the isotope of the given element. The half-life has values from a fraction of a second to millions of years.

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Optimization of Ionizing Radiation

- Optimization of ionizing radiation can be ensured either by **intervention into the source** of radioactive material, or **interference into the transmission field** of ionizing radiation.
- **Intervention into the source** can be performed by:
  - Selecting a suitable building site (locality)
  - limiting or preventing the penetration of radon into the building (antiradon measures)
  - Choosing suitable building materials (certified materials and products)
- **Interferences into the transmission** involves:
  - Restricting the spread of radioactive substances in the building
  - Ventilation and air filtration
  - Surface deposition, i.e. sedimentation of radioactive substances
  - Electrostatic deposition

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Optimization of Ionizing Radiation

- The limitation of the spread of radioactive substances in the building can be achieved by **design-layout modifications** of the building such as **dividing vertical shafts into smaller sections, appropriately transferring sources of radioactive material in the building, or applying differential ventilation.**
- The spread of ionizing radiation is a problem especially in multi-storey buildings, when the radioactive material is propagated by **thermal buoyancy.**
- Continuous stairs along the height of the building without interruption can be a source of intense spread of radioactive gases throughout the building.

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Optimization of Ionizing Radiation

- In addition to ensuring adequate air exchange, it is advisable to design pressure zones between spaces according to the degree of their contamination (contamination).

- The largest negative pressure is chosen for areas with the highest contamination. Air recirculation is not included in such areas.

- Reducing the dose of fresh air in order to reduce the energy performance of a building can result in an increased concentration of radioactive substances in the building.

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Optimization of Ionizing Radiation

- Filters can reduce the spread of radioactive substances bound to some kind of aerosol. There are two types of filters - cassette or electrostatic:
  - **Cassette filters** are boxes with a filter cartridge. Filter cartridges are not washable, but they are replaced with new ones (low acquisition costs, but higher operating costs)
  - **Electrostatic filters** do not increase overall system pressure over time (like other filters). Captured particles can be washed with water (high cost of ownership, cheap operation).
- **Electrostatic deposition** operates on the principle of artificially created electrostatic field. Electrically charged particles settle on electrodes of opposite polarities.

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