

EXPLORATION FUTUREFARM.2025



VERTICAL FARMING

Vertical farming is the practice of growing crops in vertically stacked layers. It often incorporates controlled-environment agriculture, which aims to optimize plant growth, and soilless farming techniques such as hydroponics, aquaponics and aeroponics. Some common choices of structures to house vertical farming systems include buildings, shipping containers, tunnels, and abandoned mine shafts. As of 2020, there is the equivalent of about 30 hektar of operational vertical farmland in the world. Current applications of vertical farmings coupled with other state-of-the-art technologies, such as specialized LED lights, have resulted in over 10 times the crop yield than would recieve through traditional farming methods.

The main advantage of utilizing vertical farming technologies is the increased crop yield that comes with a smaller unit area of land requirement. The increased ability to cultivate a larger variety of crops at once because crops do not share the same plots of land while growing is another sought-after advantage. Additionally, crops are resistant to weather disruptions because of their placement indoors, meaning fewer crops lost to extreme or unexpected weather occurrences. Because of its limited land usage, vertical farming is less disruptive to the native plants and animals, leading to further conservation of the local flora and fauna.

Also there are some challenges of vertical farming technologies. The large start-up cost compared to traditional farms, the large energy demands due to the use of supplementary LED lights...

Our aim is to find out how we could establish a research building and production plant with this high-end crop production technology in very extreme climatic and geographical conditions.

Design site:

The design site is different for each group. We have identified nine sites, with very extreme climatic and geographically different conditions.

| | | |
|--------|--------------------|-----------------------------|
| Group1 | hot belt | Tataouine / Tunisia |
| Group2 | north | Seyðisfjörður / Iceland |
| Group3 | mountain range | Fogaras Mountains / Romania |
| Group4 | war reconstruction | Kabul / Afghanistan |

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|--------|----------------------|----------------------|
| Group5 | Middle-East | Syria |
| Group6 | industrial landscape | Rudabánya / Hungary |
| Group7 | two seasons | Tepoztlán / Mexico |
| Group8 | desert | Lake Turkana / Kenya |
| Group9 | Mediterranean | Alexandria / Egypt |

Design program:

The design task consist of two parts. The first step is to create an installation concept for the design area as a concept design site plan. It should house a main building or group of main buildings (including the factory building, the office block, the product showroom building and the accomodation building, if the main functions will be in separate buildings), factory buildings / greenhouses – which provide crop production. To do this, you have to think about the operation of the area, the technological requirements, exploration by car, truck, etc.

Only the main building, or group of main buildings need to be planned fill the end of the semester. An important aspect of the design is that the building or buildings should be of outstanding architectural quality and forward-looking, reflecting the quality of the high-tech crop production solution used in them.

This gives everyone the opportunity to design a building with a higher environmental quality instead of the usual, very simplified architectural solutions. At the same time rationality, environmentally conscious thinking, the search for smart solutions are also important. The aim is to achieve an end result that meets these criteria, but is characteristic, memorable and induces further research.

Technological process:

Plant production and processing, as well as research, take place at the site at the same time. In this case, the technological building (vertical farm) that ensures the cultivation process is also part of the design task. Processing, in this method, means the harvesting and packaging of plants grown on trays. So the products created by different crop production methods are packaged and sold after harvest. The purpose of establishing the plant is twofold: on one hand, to provide research areas in the Earth's extreme geographical locations to test alternative crop production

methods under specific climate conditions, and on the other hand to provide food for the local population and introduce new sustainable crop production methods.

To understand the technological line, the list of rooms has been compiled in such a way that the process can be understood, but the following points serve as a guiding principle.

LIST OF ROOMS

During the planning we do not want to restrict the creative freedom too much, so the rooms listed below and their dimensions are just informative. The purpose of the room list is to clarify the room connections and technological sequences. If a change is required due to the architectural concept, everyone should do it after consultation with the consultant.

FACTORY – RESEARCH CENTER

01 Airlock

30 m² arrival space, with entrance gate, changing room.

02 Climate chamber (6pcs)

10 m² room, small amount of tray plant growing in air-conditioned chambers, 2x 3 rooms in groups.

03 Mechanical room (2pcs)

25 m² room, connected to air-conditioned chambers, 3 air-conditioned chambers has 1 mechanical room.

04 Aeroponic growing room (2pcs)

30 m² room, site of aeroponic crop research. Ceiling height min. 3.0 m.

05 General warehouse

50 m² room, refrigerated storage room with a minimum internal height of 3.0 m.

06 Ozone disinfection room

15 m² room, site of ozone disinfection. Ceiling height min. 3.0 m.

07 Preparatory room

25 m² room, preparation site for germination of plant seeds. Ceiling height min. 3.0 m.

08 Hydroponic growing room (2pcs)

30 m² room, site of hydroponic crop production research. Ceiling height min. 3.0 m.

09 Observation corridor

It is used to observe aeroponic and hydroponic crop production research.

10 Black and white dressing room

For those working in the research center. To be scaled to 6 male, 6 female employees. The changing room and the washroom must be opened from the airlock connected to the plant.

FACTORY – PRODUCTION FACTORY / VERTICAL FARM

11 Plant manager's office

10 m² office for one person (desk, laptop, printer, bookshelf, etc.) Ceiling height min. 3.0 m.

12 Delivery space

45 m² room. It has a sectional gate on the facade to ensure unloading of a van. No need for a loading ramp, no need for raised floor level. The materials required for the nutrient solution are manually unloaded from the vans. The number of people working here at the same time is 2. Ceiling height min. 3.0 m.

13 Covered space for delivery

Covered, open space belonging to delivery space. Clear height minimum 430 cm! Trucks get to the sectional gate in reverse. The depth of the canopy / roof must be at least 4.0 m.

14 Nutrient storage

50 m² warehouse for storing nutrients for plants. It is directly connected to the Growing space and Delivery space.

15 Preparatory room

50 m² room, preparation site for germination of plant seeds. Ceiling height min. 3.0 m. It is directly connected to Growing space.

16 Growing space (Vertical farm) – 1 unit

500 m² room with a min. height of 6 meter, but it can also be a tower if justified. This is where the crops are grown on shelving systems arranged side by side in trays placed one above the other. The system is fully automated, requiring human intervention for sowing in the preparation room, pollination in the growing room and harvesting in the harvest room. The system automatically provides the necessary amount of light, nutrients and water for the growth of the plants. There is no need for natural lighting, the plants have the right amount and quality of light provided by special LED luminaries.

The location of several growing units must be ensured at the site, 1 unit must be planned in detail, at the same time the units and the transportation must be shown on the site plan. The units can form blocks!

17 Growing space (greenhouse) – 1 unit

500 m² room with a min. height of 6 meter, but it can also be a tower if justified. Plant cultivation takes place here, as well as fish storage pools for the aquaponic system (4 stainless steel pools with a size of 2×2×1 m each). Pay attention to sunbathing!

The location of several growing units must be ensured at the site, 1 unit must be planned in detail, at the same time the units and the transportation must be shown on the site plan. The units can form blocks!

18 Harvest room

100 m² room, the finished trays come from the vertical farm, the vegetables / fruites are harvested, the trays are cleaned and washed. Ceiling height min. 5.0 m. It is directly connected to the Growing space.

19 Tool washing

20 m² room available for washing tools used manually during the technological process.

20 Tool dryer

20 m² room available for drying tools used manually during the technological process.

21 Packaging

A 150 m² room with a 50 m² foyer, where vegetables / fruites from other growing units arrive. Ceiling height min. 5.0 m. The vegetables are packed in ventilated plastic or paper box.

22 Finished goods warehouse

Refrigerated storage room with a floor area of 250 m² and the minimal internal height of 6.0 m.

23 Delivery department

A covered open area connected to the finished goods warehouse, where trucks are packed. Clear hight is min. 430 cm. Trucks approach the sectional doors in reverse. The depth of the canopy must be at least 4.0 m.

24 Packaging warehouse

Storage of labels and other packaging materials, minimum 20 m². Direct external connection, and connection to the packaging space (even via a corridor).

25 Black and white locker room

For workers of the packaging and workshop area. To be scaled to 10 male, and 10 female employees. The toilet and the min. 30 m² kitchenette, where the daytime meal takes place, must be opened from the foyer connected to the plant.

26 Dressing room

For employees of external unpacking and packing work. Men's locker room for 5 people.

27 Electrical switch room

Minimum 15 m².

28 Pumping room

75 m² room. Mechanical room for irrigation and flow of nutrient medium.

29 Waste storage

The 20 m² waste storage is connected to the growing space. It must have an external connection.

30 Detergent storage 1

Connected to the black and white dressing room.

31 Detergent storage 2

Connected to the growing space.

32 Detergent storage 3

Connected to the packaging space.

OFFICE BLOCK – RESEARCH DEPARTMENT

- 33 Lobby**
30 m² foyer, waiting room with waiting areas suitable for waiting.

- 34 Secretariat**
15 m² office with direct visual connection to the foyer.

- 35 Meeting room**
30 m² room, opening directly from the foyer.

- 36 Management office**
20 m² office opening from the secretariat.

- 37 Economic office**
15 m² office.

- 38 Scientific management office**
15 m² office.

- 39 Research offices**
4x15 m² office.

- 40 Kitchenette**
20 m² room near to meeting room.

- 41 Restroom for office workers**

Separate male and female restroom with toilet and sink. 1-1 cabin, +2 urinals for men.

42 Restroom for guests

One toilet for disabled.

43 Archives

20 m² room.

44 Detergent storage 4

Connected to office block.

PRODUCT PRESENTATION

The plant building uses special technology that fits into a sustainable approach. It is important that the results of the research draw attention to it, make it known to wider audience, and introduce the local population to alternative cultivation methods under extreme natural conditions. In the showroom, new technologies used in research, cultivated plant species are presented, or in the salad bar connected to the exhibition space, salads and refreshments made from locally grown vegetables can be tasted. The salad bar is not open on a permanent basis and can only be used when a group of visitors arrives.

45 Product presentation space / Showroom

120 m² space, with kitchen island, chairs and counters suitable for eating. With shelves and exhibition elements suitable for product presentation.

46 Restroom for visitors

Separate male and female restroom with toilet and sink. 1-1 cabin, +2 urinals for men.

47 Storage

10 m².

48 Counter

To store the raw materials needed for cooking, 5pcs of 120 liter refrigerators must be placed under the counter.

49 Preparatory

Refrigerator with pre-made salads, work table where refreshing drinks are made from vegetables.

50 Dressing room

For 2 people with separate water block.

ACCOMMODATION

51 Researchers apartments (4 for 2 people and 4 for individuals)

10 m²/person bedroom area, private bathroom with shower and separated toilet.

52 Employee apartments (12 for 2 people and 4 for individuals)

10 m²/person bedroom area, private bathroom with shower and separated toilet.

53 Common areas

100 m² zone with lounge, library, TV room, self-catering kitchen and dining area.

54 Detergent storage 5

Connected to accomodation block.

55 Group of medical rooms

Basic medical care and medical room for simpler surgeries performed by research participants, with private bathroom and washroom, medicine and medical equipment storage, convalescent / patient room.

CENTRAL SUPPLY UNITS

56 Solar park and electric-supply center

The solar park is located next to the plant, only the central switching room needs to be located in the building. About 15 m².

57 Battery room

Positioned next to the switching room, it supplies power to the whole facility during the dark month of winter and at night. About 100 m².

58 Water- and wastewater treatment center

50-100 m² zone, engine room of the water and wastewater treatment system.

59 Air handling unit

2 units with 50-100 m² zones, engine room of a closed air handling system, the accommodation, laboratories and the plant area (vertical farm) supplied in separate circles.

60 Heating center

100 m² room. This heating center serves the plant building, accommodation and office block and is responsible for the entire heat supply of the plant.

GENERAL COMMENTS

It is a design decision whether the plant building, research laboratories and offices, and accommodation functions are in one building, as well as whether the hall-space required for vertical farm cultivation will be a tower building with a small floor area or a larger floor area hall.

The design and location of the buildings is greatly influenced by the design location. The exact design and program of the buildings to be designed for the different geographical and climatic conditions must be specified with the consultants.

It is necessary to ensure the connection of the plant with the outside world. The way of connection vary from the design site (heliport / port / car or truck).

It is necessary to ensure access to the site by car or truck.

Visitor car parks (10 pcs) must be located outside the fence.

Staff car parks must be provided in a covered, closed garage for min. 4 vehicles (snow dredges, transport vehicles, off-road vehicles).

It is necessary to plan the internal transport routes of the site, for this it is recommended to use the departmental guide!

It is recommended to use the departmental guide to design the locker rooms!

The site should be surrounded by a fence.

A checkpoint and porter building must be established at the entry point of the site (this is also the accomodation building of the armed security controlling / protecting the entire site!)

In addition to the location of the planned building(s) a temporary outdoor storage of the resulting compost must be placed in the site plan. It needs an area of 15x20 m.

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