Shadow Double Bench

Wooden construction with bench & trellis

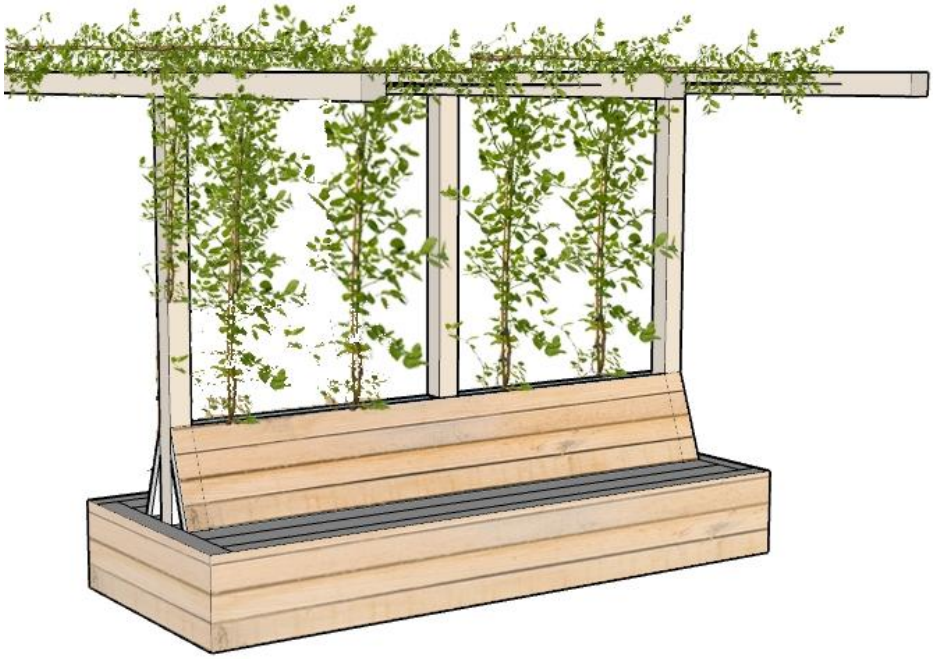

Figure 1: Shadow-Double-Bench with Trellis

Key Data

- LOCATION: Outdoor
- TYPE OF GREENING: Vertical greening - ground-based plant, trellis
- VEGETATION: climbing plants, perennials
- CONSTRUCTION: Wooden construction with double bench seat and climbing aid (steel cable)
- EXPANSION VARIANT: Pergola construction consisting of 2x double bench seat
- IRRIGATION: Automatic irrigation

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Content

Location Selection

- Fix the area and height of the installation site
  → **for maximum dimensions / expansion options of the greenery**

  Determine exposure and shading (from buildings)
  → **for plant selection**

- Irrigation:
  - Water connection
  - Power connection (alternatively, control via battery)
  - Personnel for manual watering (if automatic irrigation is not possible)

Figure 2: Expansion Version of the double shadow-double-bench

Material

The following list provides an overview of the required materials with approximate dimensions and quantities for a **simple double bench construction with integrated shading. The footprint of the structure is approximately 2 × 1.5 m, with a climbing area on top of around 2.5 × 2 m**. A "double" arrangement of two bench modules to form a large pergola (see Figure 2) is recommended. For this purpose, the quantities listed can be doubled, and only the length of the upper beams needs to be adjusted to the total length.

The exact lengths, quantities, and amounts must be determined based on a detailed plan adapted to the local conditions. The dimensions provided serve as a guideline for material ordering and as a construction aid. However, it is recommended to prepare a construction drawing or sketch based on the actual component dimensions or individual sizes.

For the wooden components, it is generally recommended to choose a local, easy-to-process, and durable type of wood. The surface should preferably be planed and untreated. For **outdoor use**, the wood should be weather-resistant; larch wood, for example, can be used here. For **indoor use**, spruce wood can be considered.

In principle, it is also possible to use reclaimed or leftover wood. By treating the surface or processing it accordingly (e.g., placing the good side facing outwards), material can be saved and (re)used.

Supports and Edging

For installation on a lawn area, it is recommended to provide a surrounding solid layer of concrete blocks or another edging material combined with gravel, serving as a walking surface and "mowing edge." As a support for the vertical posts, a gravel bed and concrete blocks are generally sufficient.

- **Concrete blocks or edging + gravel ~ 20 cm wide, approx. 7 linear meters (**for mowing edge, edging, bench supports)
  → or **paved surface** (as walking area) – as required
- **Concrete blocks ~ 40 × 40 cm, approx. 3 pieces** (for post supports)
- **Gravel/crushed stone** (for substructure of the supports)
- Alternatively, **3 individual foundations – concrete ~ 40 × 40 cm, at frost-free depth**

Wooden Construction

- **Square timber ~ 80/80 mm ~ 22 m**
  - 3 pcs. ~ 250 cm each (vertical posts)
  - 3 pcs. ~ 200 cm each (beams)
  - 1 pc. ~ 200 cm each (cross beam)
  - 6 pcs. ~ 100 cm each (bracing)

- **Wooden slats ~ 45/70 mm ~ 15 m**
  - 6 pcs. ~ 250 cm each (longitudinal elements)

- **U-shaped post anchors (Dimension according to posts)**
  Recommendation: height- and width-adjustable, height > 12 cm
  - 3 pcs. (one for each post)

- **Screws**
  - Wood screws for connections (at least 2 per connection)
  - Anchor bolts for post anchor fixation

Bench-Construction and Cladding

- **Square timber ~ 50/80 mm ~ 20 m** – for frame construction
  - 4 pcs. ~ 200 cm each (longitudinal elements)
  - 6 pcs. ~ 50 cm each (cross elements)
  - 3 pcs. ~ 50 cm each (additional cross elements for removable seat)
  - 6 pcs. ~ 50 cm each (vertical supports)
  - 6 pcs. ~ 50 cm each (backrest supports)

- **Wooden slats ~ 45/70 mm ~ 75 m** – for seat, backrest, cladding
  - 10 pcs. ~ 200 cm each (seat elements)
  - 10 pcs. ~ 200 cm each (backrest elements)
  - 10 pcs. ~ 200 cm each (longitudinal cladding elements)
  - 10 pcs. ~ 150 cm each (cross cladding elements)

- **pacers/supports** from the ground (to protect the wood from ground moisture)
  e.g., made of metal, plastic, or rubber

- **Screws**
  - Wood screws for connections

Trellis – Steel Cable

- **Steel wire rope 4 mm** [diameter], **approx. 40 linear meters**
- **Wire rope clamps 4 mm** [diameter], **approx. 10 pieces**

Vegetation Support Layer

If the existing soil is no longer suitable as a plant substrate, a growing medium can be used as a soil replacement. If the soil is still well-draining and nutrient-rich, a small amount of planting soil is sufficient for planting.

- If necessary, **substrate approx. 300 litres** (as soil replacement in case of poor soil conditions)
    - e.g., intensive roof garden substrate
    - or planting substrate with mineral and organic components (peat-free)
- Alternatively, **planting soil** approx. 50 litres (for planting in good soil conditions)
- **Cover layer/mulch material 5 cm thick, approx. 25 litres**
    - garden fibre/wood fibre
    - or mineral loose material
      → do not use bark mulch (inhibits plant growth)

Automated Irrigation System

- Water connection
- Supply pipe (e.g. PE pipe 25 mm or 16 mm)
- Drip pipe ~12 linear meters (e.g. PE pipe 16 mm or micro-drip with dripper spacing ~20 cm)
- Ground stakes for drip pipes
- Control unit
- Solenoid valve if required (depending on control unit)
- Connectors (T, L, –)
- Automatic drain valve
- Optional: Water meter
- Optional: Frost sensor (for winter operation) + cable (2-core)

Plants

- **Climbing plants, at least 2 pcs**. (twining or winding types)
  → Note**: Pay attention to exposure and climbing type!**
- **Binding material** (e.g. string, clips, wire)

Tools

- Measuring tape, folding ruler
- Marking square
- Pencil
- Wood saw: circular saw or mitre saw
- Cordless drill/driver + bit set
- Wood drill bits
- Optional: Drill bits for substrate (stone, concrete)
- Optional: Wood planer
- Sander
- Sandpaper
- Wrench for ground anchors, rope clamps
- Wire rope cutter

- Pruning shears
- Buckets
- Shovels
- Spade
- Hand shovels
- Watering can or garden hose
- Ladders ~2 m standing height (2 pcs.)
- Spirit level
- Hammer
- Chisel
- Rubber hammer

Step by Step

Once all materials have been procured, preparations and assembly can begin.

For a quick installation, many tasks can be carried out simultaneously. First, the installation area (in the garden) is prepared, followed by the construction of the basic framework (posts and beams). At the same time, work can continue on the trellis and the seating structure, as well as digging the planting holes and planting.

Step 1: Plan Sketch and Dimension

Based on the determined overall dimensions, a plan can be drawn, and the exact lengths of the components can be calculated. It is recommended to prepare a list of all cutting dimensions.

Step 2: Preparation of the Installation Area

If the greenery is to be installed on a garden area, such as a lawn, the ground should be prepared accordingly.

1. Mark out the **installation area**
   ➔ at least 10 cm larger than the seating bench cladding
   ➔ or pave a wider desired stepping area all around
2. Cut out the turf and remove the sod
3. Level the **supports** for the posts (point foundations or gravel + concrete slabs) → use a spirit level
4. If necessary, mount the **post supports** on the base (e.g. with anchor bolts)
5. Dig **planting holes** (approx. twice the size of the root ball)
6. If required, **replace the soil** with **substrate** (dig a larger planting hole and fill it)
7. If necessary, **dig** a trench for **the irrigation supply line** and lay it
8. Lay the **edging evenly** (e.g. concrete slabs or edging + gravel)

Step 3: Pergola Assembly

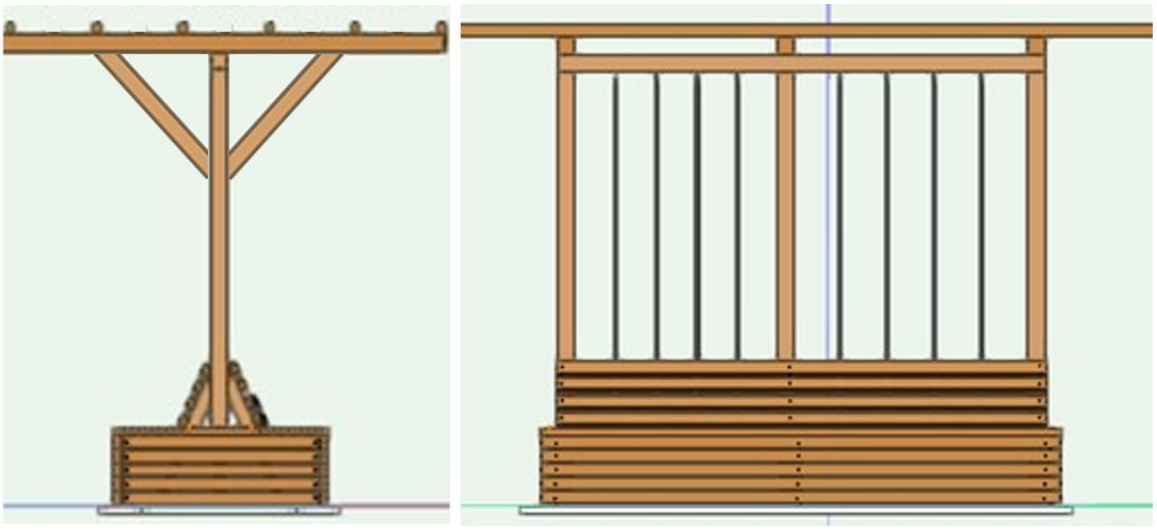

Figure 3: Simple double bench seat construction View to the side and front (dimensions below ~ 2x1.5 m, above ~2.5x2 m)

First, all lengths are marked onto the timber ("scribed"), then the timber is cut and prepared. Afterwards, the structure is assembled.

3.1 Cutting and Preparing the Timber

1. Transfer the length measurements onto the timber
2. Cut the timber to the exact lengths
   → the beams at the top should protrude beyond the posts (for structural wood protection)
3. Chamfer or sand the edges
4. Pre-drill screw holes (distance from the end grain edge > 2 cm)

3.2 Assembly

1. If necessary, anchor the **post supports** to the ground
2. Prepare the **cross beams** at the three post connection points using suitable screws
   a. Mark and label the connection to the posts
   b. Pre-drill holes
   c. Screw in the screws halfway
3. Place one **ladder** next to each **outer post** and prepare cordless screwdriver and bit
4. Screw the two **outer posts** onto the post supports (use a spirit level) and hold them in place
5. Position the **cross beams** evenly on both sides of the posts (use markings) and screw them in place
   ➔ in the extended version (2 double benches), assemble both "components"
6. Check the **posts** with a spirit level and mount the **middle post**
7. Place the **longitudinal beams** on the cross beams and screw them in place
8. Install the diagonal **braces** between posts and beams for reinforcement

Step 4: Assembly of the Seating Structure and Cladding

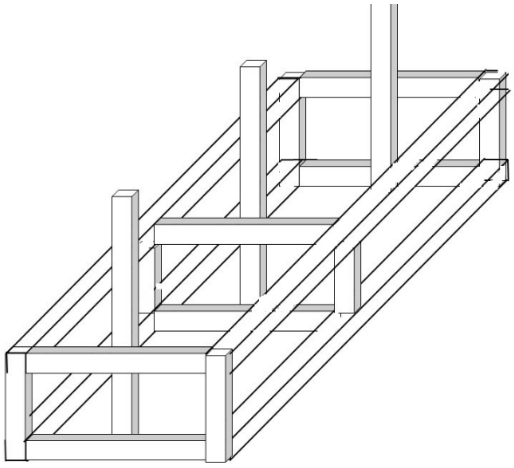

Figure 4: Square frame seat construction

First, all lengths are marked onto the timber ("scribed"), then the timber is cut and prepared. A frame is then constructed, onto which the slats for the seat surface, backrest, and cladding are screwed.

4.1 Cutting and Preparing the Timber

1. Transfer the length measurements and drill hole positions onto the timber
2. Cut the timber to the exact lengths
3. Chamfer or sand the edges (only the visible ones)
4. Pre-drill screw holes (distance from the end grain edge > 2 cm)

4.2 Assembly

1. First, form a **rectangular frame** from **squared timbers** and screw it to the posts
2. Mount **spacers** between the bottom of the frame and the ground/edging (for moisture protection)
3. Screw the **squared timbers** for the **backrest** with an inclination between the posts and the frame (observe the angle)
4. Evenly distribute the **slats** for the **seat surface** and **backrest** (with approx. 1 cm gap in between)
5. Mount one part of **the seat surface** in a removable way (for future maintenance)
   ➔ To do this, screw the **slats** onto **additional squared timbers** (offset to the frame) and then place the entire seat surface onto the frame; if necessary, secure with 2 screws
6. Fix the other **slats** permanently to the frame structure and backrest
7. Evenly distribute and screw on the **cladding** in the lower area as well

Step 5: Mounting the Trellis

1. **Drill holes** (at least 5 mm) through all **slats** for the horizontal cable installation (drill through the narrow side)
   ➔ Evenly **distribute the hole spacing** (e.g. every 30 cm)

2. Screw the **slats** vertically onto the longitudinal beams of the pergola (the drill holes must be aligned horizontally)
3. Thread the **wire rope** horizontally through all slats and initially fix it at the starting point with wire rope clamps. Guide it in a zigzag pattern and lightly tension the rope after each change of direction
4. Lightly **tension** the wire rope at the end and fix it with wire **rope clamps**
   ➔ Leave extra loops as "reserve" at the beginning and end to relieve tension later if needed
5. Stretch and fix **vertical ropes** for each climbing plant from the seat frame/backrest up to the cross beam

Step 6: Planting

1. Remove the **root ball** from the nursery pot and slightly score the bottom of the roots (this promotes rooting)
2. Place the plant in the planting hole and fill it with **substrate** or **planting soil**
3. Press the substrate down evenly by hand and continue filling until approx. 5 cm below the top edge
4. Apply approx. 5 cm of mulch material
5. Fix the climbing plants to the trellis using binding material
   ➔ **Important: Strongly twining/constricting climbing plants (e.g. Wisteria) should be tied parallel to the cable, not twisted directly around it!**
6. Water thoroughly (~ 50 litres per plant, as the substrate initially absorbs a lot of water)

Figure 4: Climbing plant tied up and covered with mulch material

Step 7: Fitting an Automated Irrigation System

An automated irrigation system is always recommended, if possible, to ensure continuous watering (also during holiday periods or changes in students/staff).

7.1 Required Connections

- Water connection with a minimum pressure of 3.5 bar
- Power connection (for irrigation control) or alternatively – control unit with battery operation
  → **reliable battery replacement required**!
- Connections should preferably be located in a frost-proof interior space (storage room, basement, etc.)
- Pipes should be laid with a slope towards the outside

Connection is also possible outdoors

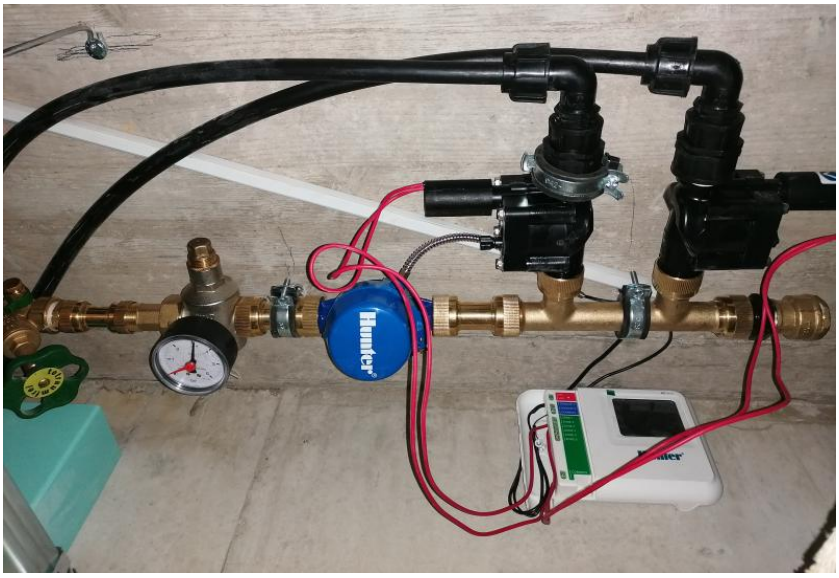

Figure 5: Control unit with solenoid valves in the interior (left) and with battery control unit outside (right)

7.2 Installation

- Interior control:
  - The pipe leading outside should have a slope from the solenoid valve towards the exterior (→ frost-proof drainage)
  - If necessary, install a water meter
  - Connect the solenoid valve
  - Mount the control unit and connect it to the solenoid valve

- Outdoor control:
  - Valve box for the solenoid valve and control unit
  - or control unit with integrated valve connected directly to the water supply

- Lay or connect the **supply line** to the greenery
- **Lay drip pipes** over the planting areas and fix them with ground stakes
- Close the drip pipe circuits (e.g. with end pieces)
- Check all connectors and fittings for leaks
- Set the **irrigation times** and **duration**
  - **Start time/interval** – depending on location and season: 1× per day up to 3× per week
  - **Duration per start** – depending on dripper output and spacing: approx. 3 to 30 minutes

Greenery Maintenance and Care

- Visual inspection – daily → Are the plants healthy and the irrigation system intact?
- Establishment care:
  - Pouring - approx. daily to 3× per week
    After successful rooting → reduce frequency (~3× to 1× per week)
  - Guide and tie the shoots to the trellis
    → **Untwist and tie young shoots of strong twining/constricting plants parallel to the cable**

- Remove brown leaves and dead shoots as needed
- Fertilize (spring/summer) with e.g. organic slow-release fertilizer, solid fertilizer, or compost

- Pruning and replanting:
  - Prune dead or excessively long shoots as needed
  - In case of plant failure – remove the entire root ball and replace

- Automated irrigation system and winterizing:
  - Adjust irrigation times and duration according to needs (e.g. spring – summer – autumn)
  - Winterize before the first frost
    - Turn off the water supply line
    - Open valves and drain the pipes
    - Remove the control unit if necessary and store it in a frost-free location
  - In spring (no frost days) – reinstall and reactivate

Figure 6: Plant care

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