

Green Pergola-Class

Pergola with plant trough and trellis



Figure 1: Green Pergola in the schoolyard (Pop-Up) (Source: Dipl.-Ing. Ralf Dophiede e.U.)

Key Data

- LOCATION: Outdoor, Pop-Up
- TYPE OF GREENING: Vertical greening, plant trough, trellis
- VEGETATION: Climbing plants, perennials
- CONSTRUCTION: Wooden pergola with plant troughs (wood) and climbing support (steel cable)
- IRRIGATION: Automatic irrigation

Content

Key Data.....	1
Location Selection	3
Material	3
Pergola Structure - Wood	3
Wooden Plant Trough	3
Trellis Steel Cable	4
Vegetation Support Layer	4
Automated Irrigation System	4
Plants	5
Tools	5
Step-by-Step	6
Step 1: Plan Sketch and Dimensions	6
Step 2: Pergola Assembly	6
2.1 Cutting and Processing the Wood	6
2.2 Assembly	6
Step 3: Assembly of the Plant Trough	7
3.1 Cutting and Processing the Wood	7
3.2 Assembly	7
3.3 Sealing / Lining and Installing Drainage.....	8
Step 4: Mounting the Trellis	8
Install vertical cables at each climbing plant or across entire sections of the planter box frame, extending upwards to the outermost slat or cross beam, and fix them in place.	
Step 5: Filling / Layer Structure	8
Step 6: Planting	9
Step 7: Fitting an Automated Irrigation System.....	9
7.1 Required Connections	9
7.2 Installation	10
Plant Care and Maintenance	11

Location Selection

- Define the area and height of the installation site
→ **for maximum dimensions / expansion options of the green system**
- Determine exposure and shading (from buildings)
→ **for plant selection**
- Irrigation:
 - Water connection
 - Power connection (alternatively, control via battery)
 - Drainage, if necessary
 - Staff for manual watering (if automatic irrigation is not possible)
 -

Material

The following overview provides an outline of the required materials with approximate dimensions and quantities for a **pergola structure approx. 4 × 4 m** with a **planter box of approx. 6 linear meters length** over a corner.

The exact lengths, quantities, and amounts must be determined based on a detailed plan and the specific site conditions. The listed dimensions are intended as a guideline for material procurement and as an aid for construction. It is recommended to prepare a construction drawing or sketch based on the actual available component dimensions and individual measurements.

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

In principle, the use of reclaimed or leftover wood is also possible. By treating the surface and processing accordingly (e.g., placing the visually appealing side at the front), material can be saved and (re)used.

Pergola Structure - Wood

- **Squared timber ~ 100/100 mm ~ 50 m**
 - 8 pcs. ~ 250 cm each (Uprights)
 - 6 pcs. ~ 400 cm each (beams)
 - 12 pcs. ~ 50 cm each (headbands)
- **Wooden slats ~ 45/70 mm ~ 52 m**
 - 13 pcs. ~ 400 cm each (longitudinal timbers)
- **U-shaped post anchors (dimension according to upright size)**
Recommendation: height and width adjustable, height > 12 cm
 - 8 pcs. (one for each upright)
- **Screws**
 - Wood screws for joints (at least 2 screws per connection)
 - Anchor bolts for fixing the post anchors to the ground

Wooden Plant Trough

- **Squared timber ~ 50/80 mm ~ 16 m** – for frame construction

- 16 pcs. ~ 50 cm (cross timbers)
- 16 pcs. ~ 50 cm (uprights)
- **Wooden boards ~ 26/140 mm ~ 48 m** – for exterior walls
 - 8 pcs. ~ 350 cm each (longitudinal boards)
 - 8 pcs. ~ 200 cm each (longitudinal boards)
 - 8 pcs. ~ 50 cm each (cross timbers)
 - Additional base boards if needed
- **Spacer/support** to the floor (to protect the wood from moisture from below)
e.g., made of metal, plastic, or rubber
- **Screws**
 - Wood screws for all joints

Trellis Steel Cable

- **Steel cable 4 mm [d] ~ 100 m**
- **Cable clamps 4 mm [d] ~ 20 pcs.**

Vegetation Support Layer

- **Waterproofing plant trough:**
 - Dimpled membrane (available at construction supply stores)
 - And/or pond liner, e.g., made of EPDM
- **Inspection pipes** diameter 5 cm, length approx. 60 cm, 2–5 pcs.
 - e.g., drainage pipe (PP) DN 50 + cap
- If necessary, **tank valves** 5 pcs. + **drain hose** for targeted drainage
- **Drainage layer** height 5 cm, approx. 150 litres
 - e.g., expanded clay, clay granulate, mineral bulk material
- **Separation layer – fleece** approx. 100 cm wide, 7 linear meters
 - e.g., recycled fleece (200 g/m²)
- **Substrate** approx. 1200 litres
 - e.g., intensive roof garden substrate
 - or planting substrate with mineral and organic components (peat-free)
- **Cover layer / mulch material** 3 cm, approx. 100 litres
 - Garden fibre / wood fibre
 - or mineral bulk material
 - ➔ no bark mulch (inhibits plant growth)

Automated Irrigation System

- Water connection
- Supply pipe (e.g., PE pipe 25 mm or 16 mm)
- Drip pipe approx. 12 linear meters (e.g., PE pipe 16 mm or micro-drip with emitter spacing approx. 20 cm)
- Ground stakes for drip pipes
- Control unit
- Solenoid valve as needed (depending on control unit)
- Connectors (T, L, etc.)
- Automatic drain valve
- Water meter if necessary
- Frost sensor if necessary (for winter operation) + cable (2-pole)

Plants

- **Climbing plants** (twining, winding), small shrubs, perennials, herbs
→ *Note: Pay attention to exposure and moisture requirements!*
- **Binding materials** (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
- Drill bits for the substrate (stone, concrete)
- Optional: wood planer
- Sander
- Sandpaper
- Utility knife
- Stapler + staples
- Wrench for ground anchors and cable clamps
- Wire rope cutter
- Scissors (for cutting fleece)
- Garden shears
- Buckets
- Shovels
- Hand shovels
- Watering can or garden hose
- Ladders ~ 2 m standing height (2 pcs.)
- Spirit level
- Hammer
- Chisel

Step-by-Step

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

For efficient assembly, many tasks can be carried out simultaneously. As soon as the basic pergola structure (uprights and beams) is in place, work on the pergola as well as on the planter boxes and the trellis can continue simultaneously.

Step 1: Plan Sketch and Dimensions

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

Step 2: Pergola Assembly

First, all lengths are marked on the wood ("marked out"), then the wood is cut and processed. The pergola structure is then assembled. Numbers in figure 2 have commas not decimals.

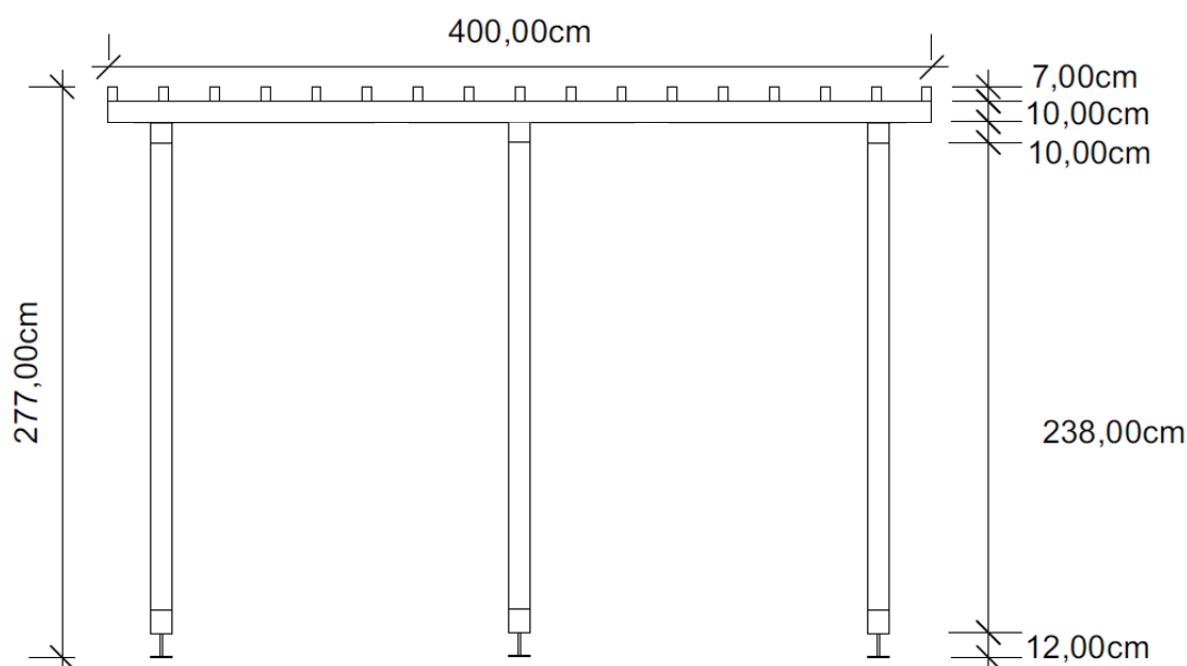


Figure 2: Pergola (Roof top 4x4 m) side-view (Source: Dipl.-Ing. Ralf Dophiede e.U.)

2.1 Cutting and Processing the Wood

1. Transfer length measurements onto the wood.
2. Cut the wood to the exact lengths.
→ The beams should protrude beyond the uprights (constructive wood protection).
3. Chamfer or sand the edges.
4. Pre-drill screw holes (distance to end grain edge > 2 cm).

2.2 Assembly

1. Anchor the **post bases** to the ground (concrete floor or point foundations).

2. Prepare the **longitudinal beams** at the upright connection points using appropriate screws:
 - a. Mark and label the connection points on the uprights.
 - b. Pre-drill holes.
 - c. Partially insert the screws (halfway).
3. Provide one **ladder** per **upright** and have the cordless screwdriver + bit ready.
4. Screw the two **outer uprights** onto the post bases (check alignment with spirit level) and hold them in place.
5. Position the **longitudinal beams** evenly on top of the uprights (according to markings) and screw them in place.
6. Check the alignment of the **uprights** with the spirit level and install the **middle uprights**.
7. Place the **cross beams** on top of the **longitudinal beams** and screw them in place.
8. Install the **braces** between the uprights and the beams for reinforcement.

Step 3: Assembly of the Plant Trough

First, all lengths are marked on the wood ("marked out") and then the wood is cut and processed. The frames are then assembled and, together with the wooden boards, screwed together to form planter boxes.

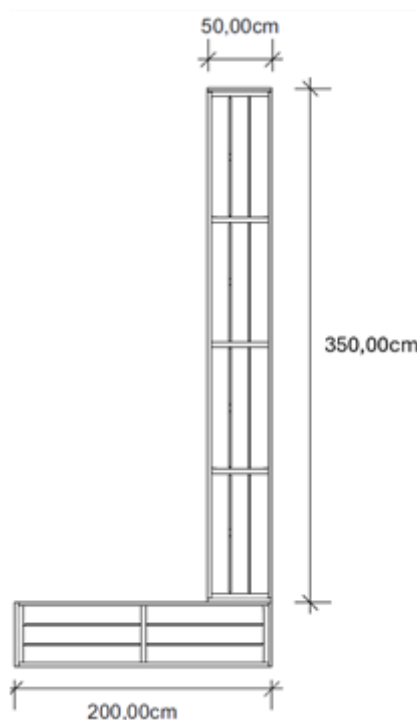


Figure 3: Plan trough plan view (with floorboards) (Source: Dipl.-Ing. Ralf Dophiede e.U.)

3.1 Cutting and Processing the Wood

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

3.2 Assembly

1. First, assemble individual **rectangular frames** ("O"-shape) from the **squared timbers** and screw them together.
2. Mount spacers at the bottom to elevate the box from the ground.

3. Then screw the inner **longitudinal** timbers to the pergola uprights.
4. Next, position the **frames** and attach them to the already fixed longitudinal timbers.
5. Now screw the remaining **longitudinal and cross timbers** to the frames.
6. If required, insert and screw in place the **base boards**.

3.3 Sealing / Lining and Installing Drainage

1. Line the plant trough with **dimpled membrane** and/or **pond liner** (up to the top edge) and fix it to the inner upper edge of the frame using a stapler every approx. 20 cm.
2. Install the drainage:
 - a. Either install **tank valves** (2–3 pcs. per planter box) by drilling/cutting holes either 3 cm above the bottom level on the side or in the bottom with an internal length of 3 cm (for water retention). Insert, tighten, and seal the valves.
 - b. If necessary, connect a **drainage pipe** to the tank valves and lay it with a slope.
3. Without tank valves: fold the **lower dimpled membrane/sealing foil** approx. 3 cm upwards at the sides and place another layer of membrane/foil overlapping on top. This allows excess water to drain off above the retention height.
 → **An outdoor plant trough must have a drainage option.**
4. Prepare the **inspection pipes**: drill many small holes in the lower section of the pipe and wrap it with fleece (to prevent substrate material from entering the pipe).
 → One inspection pipe per tank valve (or one per planter box without tank valves)

Step 4: Mounting the Trellis

1. **Drill holes** (minimum diameter 5 mm) through all **slats** for the horizontal cable installation (drill through the narrow side).
 → **Distribute the holes evenly** (e.g., every 30 cm).
2. Screw the **slats** vertically onto the cross beams of the pergola (drill holes must be positioned horizontally).
3. Thread the **steel cable** horizontally through all slats and initially fix it at the starting point using cable clamps. Continue threading in a snake-like pattern, tensioning the cable after each change of direction.
4. At the end, **tension** the cable again and fix it with **cable clamps**.
 → Leave extra loops ("reserve") at the beginning and end for later tension relief.

Install **vertical cables** at each climbing plant or across entire sections of the planter box frame, extending upwards to the outermost slat or cross beam, and fix them in place.

Step 5: Filling / Layer Structure

1. Place the **inspection pipe** at the bottom (on top of the tank valves) and hold it upright.
2. Add approx. 5 cm of **drainage material**.
3. Cut the **separation fleece** to size and cut openings for the inspection pipes.
4. Place the **fleece** inside and pull it up along the inner sides of the planter box.
5. Fill in the **substrate** (leave enough space for large plant root balls if necessary).

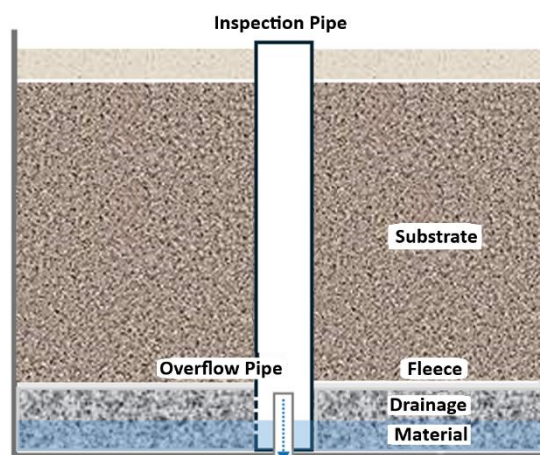


Figure 4: Layer structure plan trough (Source: Dipl.-Ing. Ralf Dophiede e.U.)

Step 6: Planting

1. Remove the **root ball** from the nursery pot and slightly loosen or score the roots at the bottom (to promote root establishment).
2. Place the plant in position and fill in with **substrate**.
3. Press the substrate down around the plants by hand and continue filling until approx. 5 cm below the top edge.
4. Apply approx. 3 cm of mulch material.
5. Fix the climbing plants to the trellis using binding material.
→ Note: **Strong twining or choking climbing plants (e.g., wisteria) should be tied "parallel" to the cable — do not wrap them directly around the cable!**
6. Water thoroughly (the substrate will initially absorb a large amount of water).

Step 7: Fitting an Automated Irrigation System

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

7.1 Required Connections

- Water connection (ideally also usable in winter and frost-proof) with a minimum pressure of 3.5 bar
- Power connection (for irrigation control unit) or alternatively – control unit with battery operation
→ **Reliable battery replacement required!**
- Connections should preferably be located indoors in a frost-protected area (storage room, basement, etc.).
- The supply line should ideally be laid with a slope leading outside or, if installed outdoors → without winter operation

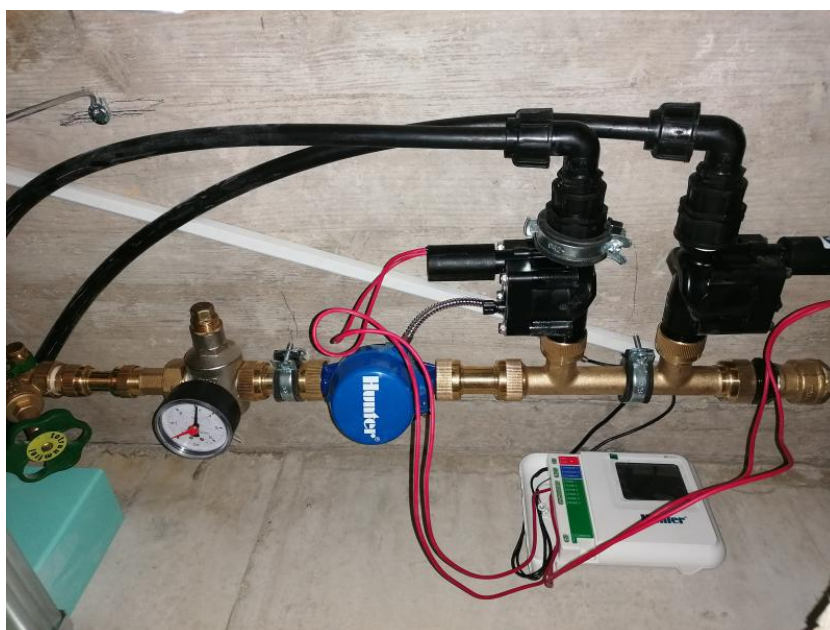


Figure 5: Control unit with solenoid valves in the interior (left) and with battery control unit outside (right) (Source: Dipl.-Ing. Ralf Dophiede e.U.)

7.2 Installation

- Control unit indoors:
 - The supply line leading outside should have a slope starting from the solenoid valve towards the outside (→ frost-proof drainage).
 - Install a water meter if required.
 - Connect the solenoid valve.
 - Mount the control unit and connect it to the solenoid valve.
 - Route a 2-core cable for the frost sensor to the outside and connect it.
- Control unit outdoors:
 - Use a valve box for the solenoid valve and control unit.
 - Alternatively, use a control unit with an integrated valve directly at the water connection.
- Lay the **supply pipe** to the greening system.
- Install an automatic **drain valve** at the lowest point (closes when pressure builds up and opens when pressure drops).
- Lay the **drip pipes** on the planting areas and fix them in place with ground stakes.
- Close the drip pipe circuits (e.g., with end pieces).
- If required, install a **frost sensor** outdoors and connect it to the control unit.
- Check connectors and fittings for **leaks**.
- Set **watering times** and **duration**
 - **Start time/interval** - depending on substrate volume, location, season: 1x/day to 3x/week
 - **Duration** per start - depending on dripper quantity/spacing and substrate volume: ~ 3 to 30 minutes

Plant Care and Maintenance

- Visual inspection – daily → Are the plants vital? Is the irrigation system functioning properly?
- Establishment care:
 - Water approx. once per day.
→ After good root establishment, reduce frequency to 3–5 times per week.
 - Guide and tie the shoots to the trellis.
→ **Unwind young shoots of strong twining or choking climbers and tie them parallel to the cable.**
 - Remove brown leaves and dead shoots as needed.
 - Fertilize (spring/summer) with, for example, slow-release fertilizer or solid fertilizer.
- Check water retention and drainage (weekly):
 - Water level in the inspection pipe max. approx. 6 cm.
 - Check drainage function and clean if necessary.
- Pruning and replanting:
 - Prune dead or excessively long shoots as needed.
 - Remove dead above-ground parts of perennials in spring.
 - In case of plant loss – remove the entire root ball and replace.
- Automated irrigation system and winter preparation:
 - Adjust irrigation times and duration according to seasonal needs (e.g., spring – summer – autumn – winter, if applicable).
 - Winterize before the first frost – unless a frost-proof system is installed:
 - Shut off the water supply.
 - Open valves and drain the pipes.
 - Remove the control unit if necessary and store it in a frost-protected place.
 - Water manually during winter if no frost-proof system is installed.
 - In spring (after frost period) – reinstall and reactivate the system.

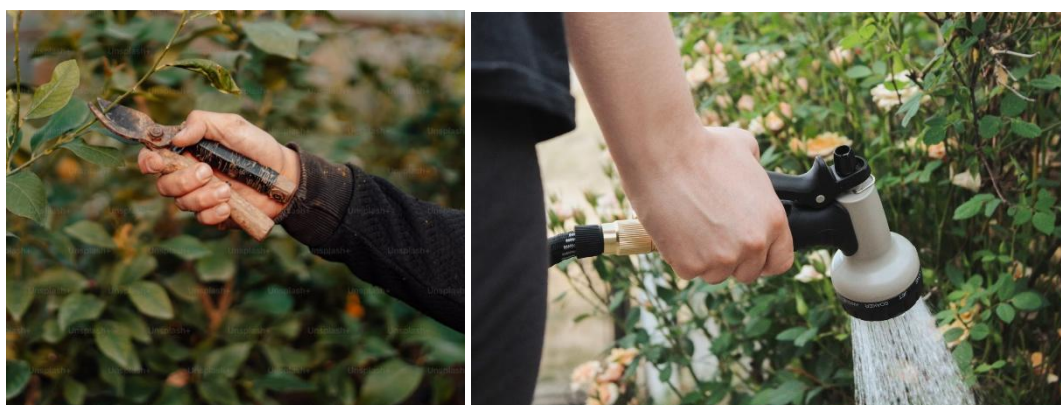


Figure 6: Plant care (Source: Dipl.-Ing. Ralf Dophiede e.U.)

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