

DOME CONSTRUCTION MANUAL



This manual is a step-by-step work plan based on the knowledge of UAB "Sferos" engineers and designers, as well as the extensive experience of construction specialists. By following it, you can avoid mistakes and misunderstandings. To better absorb and understand the information described below, we recommend watching the essential informational videos on our YouTube channel: UAB Sferos. Before starting construction, it is crucial to thoroughly review the entire manual provided below.

- The dome component set is transported as separate parts without being stacked on transport pallets. Loading and unloading are carried out manually, as using lifting equipment may damage the expanded polystyrene elements.

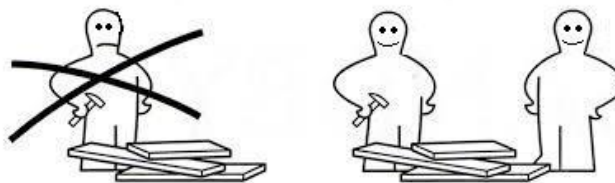


- If the dome component set will not be used immediately, it is essential to ensure its protection from potential damage by third parties, direct sunlight, precipitation, and other factors that could reduce its value and quality.

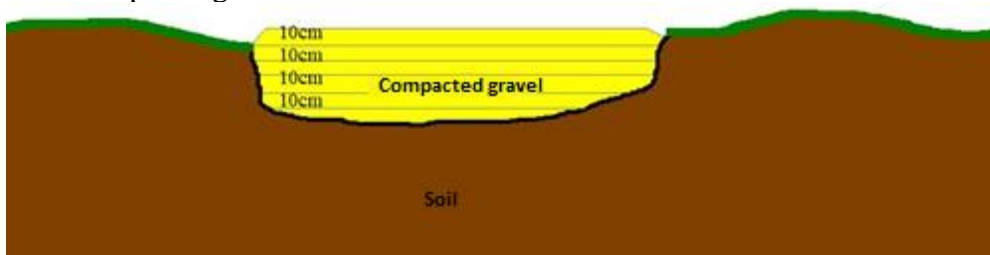




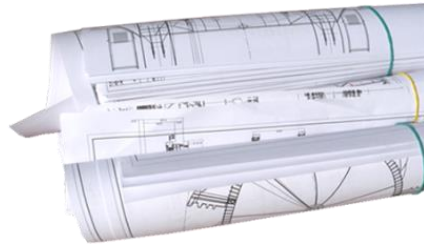
- It is recommended that all construction work be carried out by a team of at least two people.



- Earth preparation works involve removing the fertile layer of soil, leveling the terrain, and bringing in gravel or crushed stone. The material is compacted using a vibratory plate or vibratory pole, with each compaction layer not exceeding 10 cm in thickness. If necessary, the gravel should be periodically watered to ensure proper compaction, as dry gravel may not compact well. A level base or site is prepared for the construction of the dome, taking into account the relief, the soil on which it is built, and the depth of groundwater.



- If the purpose of the dome being built is a "Residential House," all layers must be constructed according to the project (drainage, gravel - crushed stone cushion, foundation). If the dome is designated as a "Support Building," then a concrete foundation is not mandatory, and construction can begin directly on the compacted gravel surface, but in compliance with construction regulations and standards.



- It is advisable to install all utilities (water supply and electrical connections, sewage pipes) at the construction site before starting construction.



- For more information on the installation of a slab foundation, you can watch the YouTube video: "*Installation and Assembly of the Dome House Foundation and Floor*".
- When building without a foundation: after preparing a level surface, the center of the future dome is marked. A wooden stake is driven into the ground at that point. A wooden beam (rod) is then attached or screwed to the stake, with its length corresponding to the planned dome's radius. For example, if the dome diameter is 8 meters, the distance from the center (the driven stake) to the end of the beam should be exactly 4 meters. This will later be referred to as the "focal point." The same principle is used to construct temporary formwork for the dome (taking into account the thickness of the planned dome walls and the temporary formwork).



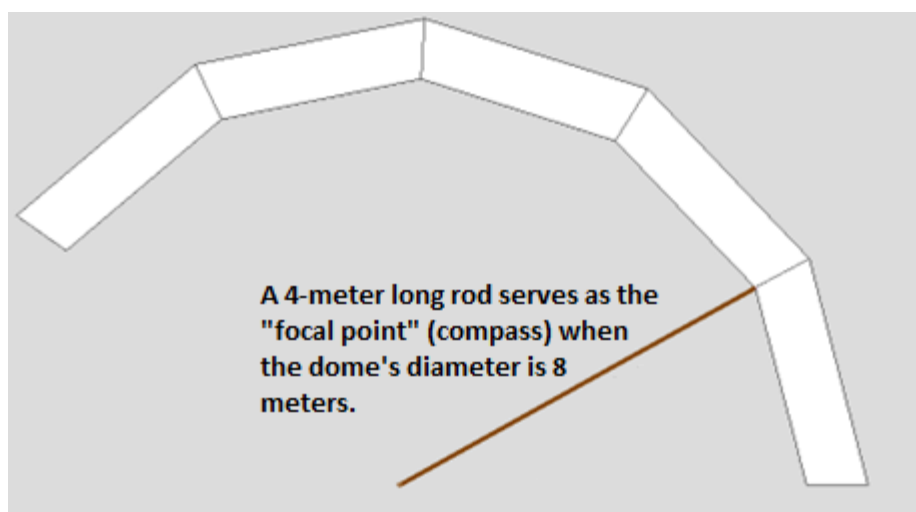
- The dome component set consists of parts that are labeled with numbers (0, 1, 2, 3, etc.). The elements of the temporary formwork are usually marked as "00". The first ring of components is assembled from parts labeled "0" (although it could also be "1", depending on the specific order requirements). The elements labeled "0" are usually flat, without bending, and are used to form the vertical ring of the dome).



- Before starting to assemble the dome components, they must be prepared. Each dome component set includes special plates ("spacers"), which need to be glued to each piece to maintain an even gap between the dome elements for adhesive filling. For the first ring, two plates are used on each component (one on the top part and one on the bottom), while the components of the following rings should have only one plate (on the top). The plates should always be glued on one side only. The plates are pre-prepared for gluing, and once the protective paper is removed, they can be immediately glued in place.



- For the construction of the first ring, the "focal point" should be used. Each component is placed at an equal distance from the planned center of the dome.



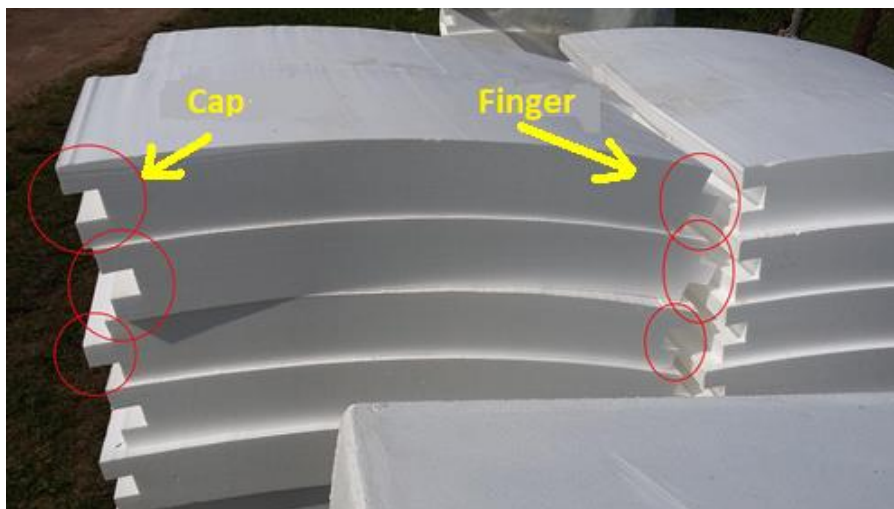
- Once the first ring is formed, it must be secured with straps (slings or ropes). The straps should be tightened just enough to prevent the components from shifting relative to each other and to avoid deformation or crushing.
- Throughout the entire dome formation process, a technological gap must remain between the components (vertically), which will later be filled with adhesive specifically designed for polystyrene (assembly foam is not suitable).



- The higher the dome ring is assembled, the more its components tend to "tilt" (the top leans downward). Therefore, when assembling the ring, it is necessary to slightly lift the already placed components (bend their tops using wooden rods or beams) to make it easier and more accurate to insert the next component next to them.



- Once the first ring of components is assembled and secured with straps or ropes, and the distance from the center is uniform, you can begin spraying the polystyrene adhesive using high-pressure spray bottles. Once the adhesive expands and hardens, you can start placing the next ring of components. It is also recommended to reinforce this ring with straps or ropes (this should be sufficient to ensure the subsequent dome rings stay in place on their own).
- Note: The size of each component may vary slightly (i.e., the dimensions are not perfect). For example, the "finger" in one joint may fit loosely in the "cap," while in another joint, the "finger" might be inserted quite tightly into the "cap." This is not due to the precision of the equipment used by UAB "Sferos," but rather the properties of the polystyrene material, as the manufacturer presses the blank, resulting in slightly different densities and material elasticity each time.



- For further dome formation, it is advisable to cut a small hole to allow access to the interior of the dome being built. The temporary hole should be made in the location where the door opening will eventually be cut.

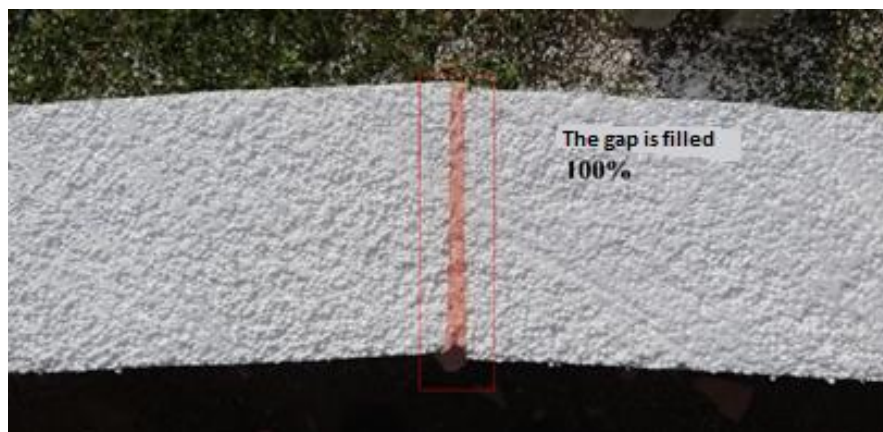


- **VERY IMPORTANT: WHEN FORMING THE DOME, IT IS ESSENTIAL TO USE ALL THE COMPONENTS DESIGNATED FOR EACH RING. THAT IS, IF 33 COMPONENTS ARE INTENDED FOR A RING, ALL 33 MUST BE USED. IT IS ALSO NOT ALLOWED TO NARROW THE COMPONENTS, AS THIS WILL PREVENT THE PROPER COMPLETION OF THE DOME FORMATION WORK**

- Once the first ring of the dome is properly arranged and the components are tightly aligned (relative to each other), you can begin gluing. For gluing, it is necessary to use a glue gun (there is no need to use professional or expensive tools).
- Gluing specifics: One of the most important aspects when gluing the dome is that the technological gap, mentioned earlier, must be filled 100%. This can only be achieved **by gradually filling the gap**. The dome gluing process may require between 50 to 144 (or even more) adhesive bottles, depending on the adhesive manufacturer, the dome's diameter, and the wall thickness).



- Filling the gaps: Once all the conditions for correctly assembling the dome ring are met, you can start blowing the adhesive into the wall's interior, specifically at the center (this can be done both from the inside and outside). It is very important that the adhesive is blown in just enough to fill a 5-8 cm layer. Otherwise, the adhesive might expand too much and create voids, which would reduce the strength. Once the first layer of adhesive has stopped expanding and hardened, you can blow in another 5-8 cm layer. If there is suspicion that the adhesive may expand too much and spill outwards, there is no need to worry, but it's better to use the materials rationally. Instead of blowing a large amount of adhesive at once, it's better to fill the same gap in 5-8 stages, adding small amounts of adhesive each time. For careful adhesive application, it's advisable to use a straw attached to the adhesive gun, which usually comes in the package with a new glue gun. The straw is typically thinner than the nozzle of the glue gun, which helps keep the dome components stable while applying the adhesive.



- As the dome formation work nears completion, it may seem that the dome is too weak to climb on top of it. It is important to wait for the adhesive to fully harden before doing so.



- If the dome is being built on a foundation, it is recommended to glue the lower components of the dome to the base. This should only be done after the dome is fully formed and glued. The lower components usually have horizontal grooves that are not visible in the assembled structure. To fill these grooves with adhesive, you need to drill a hole in the polystyrene component through which the glue gun will be inserted to blow in the adhesive.

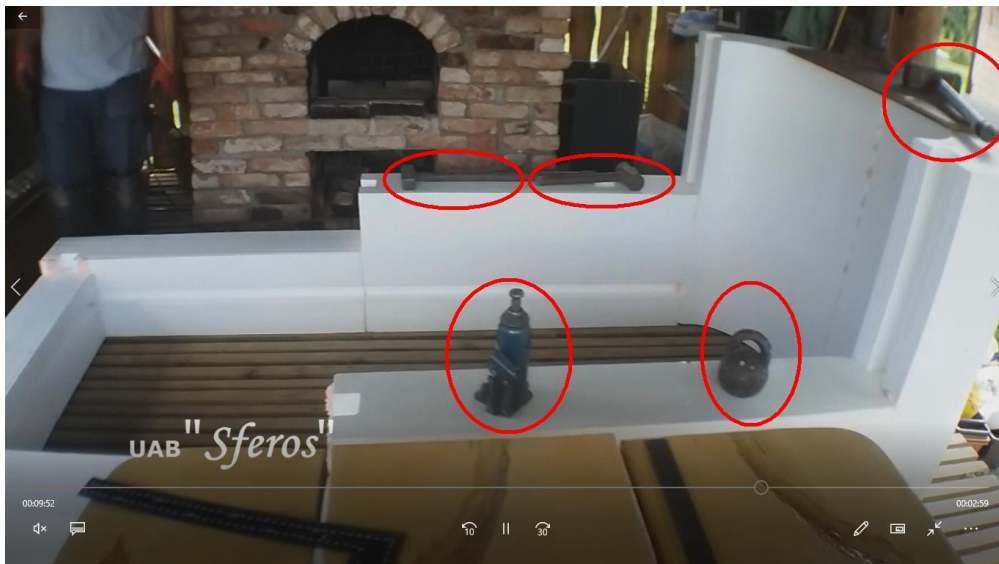




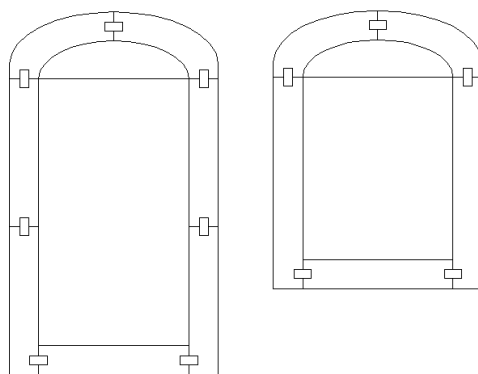
- All hardened and excess adhesive should be cut off with a sharp knife (it is most convenient to use snap-off utility knives with the blade fully extended).



- Forming and gluing window and door arches: Assembling the arches is not difficult, but it is important to do it on a flat surface, using weights to press and secure the components while they are being glued. It is essential to maintain the right angles for the entire structure and ensure that the diagonals are equal.



- Below is the commonly used layout diagram for door and window arch components:



- When gluing the arches, a level must be used. The glued arch is placed in the selected location and must be vertical. Once the arch is preliminarily positioned, it is important to mark the cutting seam for the opening. The cutter used can be wooden or metal, or similar, but it is important that it is straight, thin, and easily slides through the arch component.





- When marking the cutting seam, it is important not to move the arch. The cutter should be drawn while maintaining its horizontal position. There is no need to press the cutter strongly to create a groove on the dome; it is enough to draw a faint line, which can later be emphasized with a pencil just before cutting the opening.



- For cutting the opening, it is recommended to use an electric chainsaw (a gasoline one may damage the polystyrene dome due to its hot exhaust gases). When using an electric tool, it is essential to protect its ventilation openings from polystyrene pellets, as they can clog the vents, causing the motor to overheat and fail. The ventilation openings of the electric tool can be wrapped with a single layer of loose fabric, and periodically, the pellets should be shaken off. Additionally, allow the tool to cool down naturally from time to time.



- When cutting the opening, it is crucial to maintain the highest possible accuracy in horizontal alignment on the dome wall, regardless of the location of the cut opening, whether it's the apex of the arch or a corner. This ensures the consistency and stability of the structure during and after the cutting process.

The cut opening must be as precise as possible for the arch installation, meaning the angles of the cut opening should match the surfaces of the arch being installed. In any case, any mistakes or inaccuracies can be corrected. If the opening is insufficiently cut, it can be easily adjusted using the same saw. If the opening is cut too wide, it can be filled with adhesive, especially large gaps, which can be filled with polystyrene pieces as inserts, followed by adhesive).



- After cutting the opening and inserting the arch, it can be temporarily fixed in place with rods (the most convenient option is to use welding electrodes, after removing the powder coating and sharpening one end to make it easier to insert).
- The gaps between the arch and the dome wall are filled in the same manner as between the dome elements, gradually allowing the adhesive to fully expand and harden.
- Once the arch is installed and glued into the dome, it may seem that there are not enough arch elements. In fact, the arch is designed in such a way that the elements cut to align with the inner dome wall are reused. The cut element is flipped and glued into the missing spot.





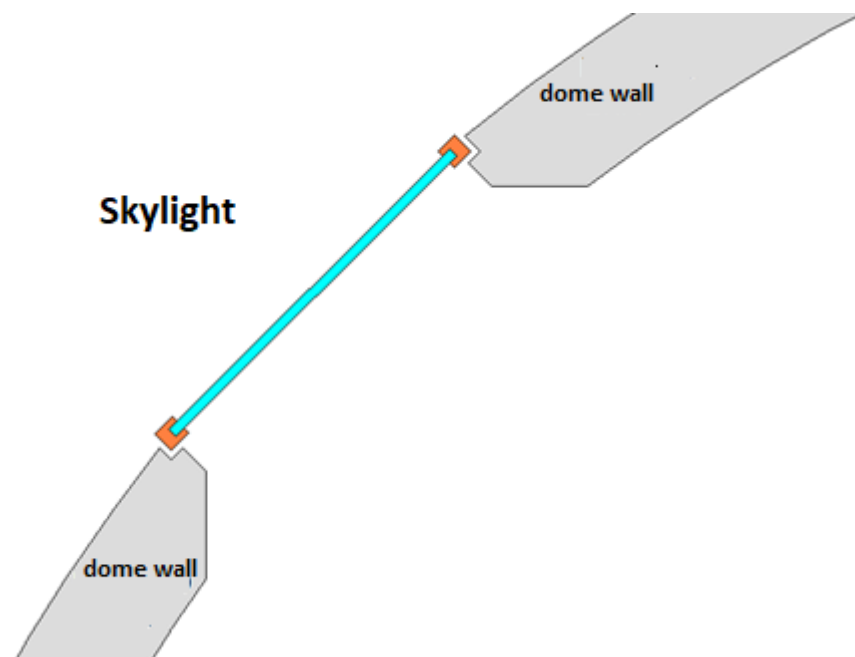
- The curing of the glue is accelerated by humid air, for example, during rain, as higher relative humidity speeds up the process. If the air is very dry, like when it is hot and sunny, it is necessary to moisten the expanded glue with a gardener's sprayer using clean water.



- In the window and door openings, a wooden beam (50/50mm) is glued in place. The same polystyrene glue is used with a glue gun.



- When installing windows and doors, they are secured to the wooden beams with screws.
- Skylight installation is very similar to the installation of windows on the first floor. That is, a niche is prepared, and the skylight is glued into it.



- All formed irregularities, expanded and hardened glue can be removed with a sharp knife, and then further smoothed using a polystyrene rasp or an electric sander with a vibrating pad. (Note: Using an angle grinder may create even more unevenness, so it is better not to use it).



- Once the dome is prepared and formed, both the exterior and interior surfaces are reinforced with the same materials used for all buildings insulated with polystyrene foam. This includes using a cement-based reinforcement mix and facade reinforcement mesh made of fiberglass.
- Window installation is carried out in the same way as in conventional buildings. The window/door is fixed with self-tapping screws into the wooden beam through an adjustment (mounting) block and sealed with standard sealing foam.
- Installing and securing lighting fixtures inside the dome. A groove is cut, and a wooden beam is glued in place (this is done before reinforcement). The location of the installed beam is marked to ensure that after finishing work, the correct mounting spot can be easily found.





- After finishing the interior of the dome, a spiral anchor designed for screwing into polystyrene foam can be used to mount lighting fixtures.



- Electrical cable installation: After cutting grooves, the cables are placed in corrugated conduits and secured with polystyrene adhesive foam.



- Floor Installation. This process is carried out in the same way as in any other construction. One of the most common methods involves laying an insulation layer—

expanded polystyrene (EPS100)—in a 10-30 cm layer over a compacted (vibrated) gravel base. A plastic film is then placed, followed by a reinforcement mesh, and finally, a concrete layer (commonly called "steškė") is poured in a 5-10 cm thickness, which is typical for small domes. If underfloor heating is planned, heating elements (pipes or electric heating cables) are installed within the concrete layer. In such cases, the concrete layer should be thicker (10-30 cm).

- **The ceiling cannot be installed directly onto the dome structure; it must be a separate system from the dome. In other words, the second-floor floor (the first-floor ceiling) must rest on columns, first-floor walls, or other supporting structures. The dome walls are not designed to bear the weight of the ceiling.**



- Installation of interior partitions. Interior partitions and walls can be constructed using wooden or metal frames, covered with drywall or wooden finishing boards, with the interior filled with soundproofing materials (e.g., mineral wool). Masonry walls are also an option.



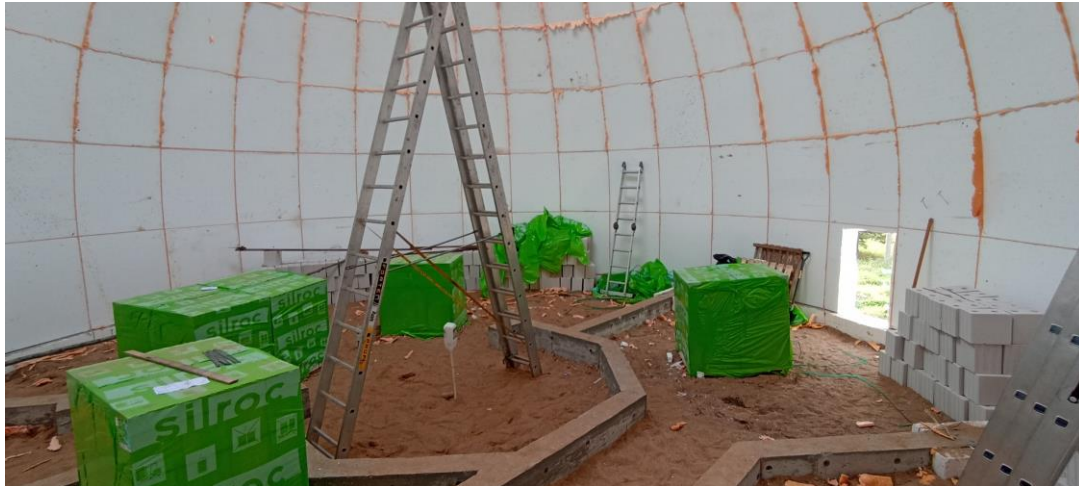




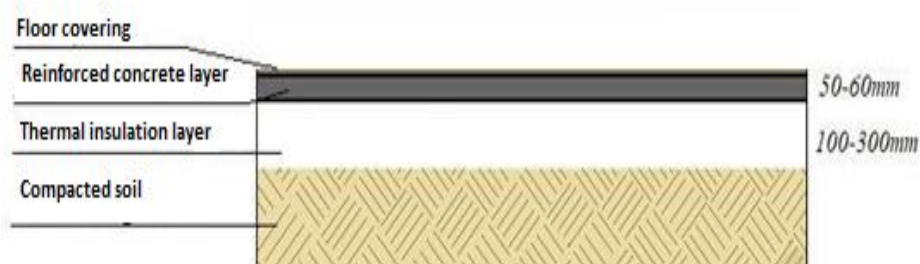
- It is important to pay attention to the weight of the structures. If columns are to be made, it is necessary to prepare a strong and reliable support point for each column by installing drilled piles (reinforced concrete with a rebar frame), or additional reinforcement must be provided in the concrete layer.



- If the internal partitions are to be masonry, it is recommended to prepare a solid "foundation" under all the masonry walls, or additional reinforcement must be provided in the concrete layer.



- If the internal partitions are to be installed using metal profiles, the frame is attached to the dome's polystyrene via wooden battens, which are glued to the dome wall (the principle is the same as for hanging light fixtures). In this case, it is not necessary to install a foundation; the frame can be mounted directly onto the concrete base (on the "steškė"). If underfloor heating is being installed, care must be taken to protect the underfloor heating elements embedded in the concrete layer to avoid damaging them when drilling holes for anchors.



- Installation of additional elements after the finishing work is completed. Even after a long period, if it is decided that more light is needed or an additional entrance is required, it is possible to install an extra window or door. Since the dome structure is monolithic and there are no separate elements carrying loads (e.g., like in a frame building), after cutting an opening, additional elements can be installed. It is very important that such work is only done after consulting with a representative from UAB "Sferos," as it may affect the validity of the warranty
- During the construction of a dome building, it is essential to use only materials that have all the necessary certifications ensuring the safety and quality of the materials. If the Client or their representative uses materials that do not have certifications or uses materials for purposes other than their intended use, UAB "Sferos" does not provide any guarantees for the stability and durability of such a building.
- During construction, all construction requirements and regulations must be followed.
- During the operation of the dome building, defects such as scratches, tears, cracks, etc., on the building's surface must be immediately repaired to prevent the loss of stability and durability. Defects must be removed in accordance with the Construction Law of the Republic of Lithuania using only certified materials and under proper conditions.
- **LAND AND PLOT WORKS.** Trench shoring: All earth excavations must be reinforced. Reinforcements are done using wooden structures or metal panels,

depending on the excavation depth. All earthwork areas must be fenced off, and warning signs should be installed to inform about the nearby danger zone..

- *Filling of Pits:* The soil used for filling must be specified in the project (if available). Soils containing organic matter or other impurities, and soils with soluble salts that could cause aggressive effects on nearby buildings and pipelines, should not be used. The foundation filling must be done using: sandy soil, when the foundations are placed in sandy soil. Local clay or loam (protected from moisture) should be compacted to a coefficient of $k=0.95$. The soil is compacted in layers, each 250 to 600 mm thick, depending on the type of soil used and the compaction method. If the project does not specify, the quality of the compacted layer must be checked with instruments on at least 700 m² of compacted area, using at least two samples. Additional layers of soil can be poured and compacted once the lower layer is compacted and checked. Before starting the filling work, it is necessary to ensure that the buried structures or equipment are well-maintained, and that the joints are of good quality and verified. The compaction coefficient of the soil is determined from the weight of the dry volume of the soil (based on the volume test) and the maximum dry volume weight of the filled soil. The soil used for filling must meet the standards' requirements.
- *Floor Installation:* All foundation installation work is carried out using gravel, sandy soil, and crushed stone. Inside the building, a 200 mm layer of gravel is poured under the floor, compacted to a coefficient of $k=0.95$. The soil under the existing building is left as it was before.
- *CONCRETE WORK.* Concrete Mixture Production. The quality of concrete mixtures depends on the proper selection of the concrete composition. The composition of the concrete is selected based on the required strength, water resistance, and frost resistance indicators. The production of mixtures includes the reception, storage, dosing, mixing of inert and binding materials, fillers, and cement, as well as pouring the concrete mixture into transport vehicles..
- *Reinforcement.* Only new materials are used for reinforcement. The arrangement of reinforcement must be done according to the project. For the production of non-stressed reinforced concrete structures, S400 class reinforcement should be used, with a calculated tensile strength of $R_s=355$ MPa (365 MPa), and A-I class reinforcement with $R_s=225$ MPa. Reinforcement products are tied with wire or welded by contact or spot welding. Anchor bolts and other details inserted into the concrete, such as inserts, pipe collars, cable ducts, pipes, etc., must be placed in position before pouring the concrete.
- *Placing Concrete Mix into Formwork.* The concrete mix is placed on the prepared base into checked and well-reinforced formwork. The formwork must be clean, and wooden formwork should be dampened and sealed to close any cracks. The surfaces of non-removable formwork and reinforced concrete or concrete slabs are washed with a water jet. Before concreting, the placed reinforcement elements, welded joints of the reinforcement, and the quality of materials (visually and mechanically) are checked, as well as the arrangement and securing reliability of embedded details and the reliability of reinforcement fixings. The preparation of the formwork, reinforcement, and base for concreting is documented with a covering work act. When pouring concrete into non-reinforced structures, the concrete is allowed to fall freely from no more than a height of 6 meters. The thickness of the concrete mix layer

must meet (but not exceed) the requirements of construction standards and regulations. For deep vibration, the working part of the vibrator should be 1.25 times the length of the vibrator's working section; for surface vibration of non-reinforced and single reinforcement structures, it should be 250 mm; for structures with double reinforcement, it should be 120 mm. The mix should fully fill the formwork between the reinforcement bars and form the required protective layer thickness.

- *Safety Measures for Concrete and Reinforced Concrete Works.* When installing formwork, reinforcement, and transporting concrete mix to the concreting location, it is necessary to ensure the inspection of supporting scaffolding, platforms, and handrails. Reinforcement should not be installed near power lines. When performing welding work, metal structures, welding equipment, transformer generators, and similar devices must be grounded. Concrete mixers and other concrete machinery can only be moved to another work site after disconnecting the power.
- *Fixing Details.* All metal fasteners (nails, screws, anchors, etc.) used must have galvanic corrosion protection. Metal frame details should be either galvanized or coated with two layers of epoxy-based corrosion-resistant paint. For fastening drywall, galvanized or oxidized screws should be used. For supporting structures, rectangular profile twisted or ridged galvanized nails and screws are used. If non-factory-made black metal fasteners or profiles are used, they must be cleaned of rust and coated with corrosion protection by painting or galvanizing. Any damaged surfaces of metal details must be additionally coated with corrosion protection paint. The type of paint should correspond to the previously used type. Fastening elements from different manufacturers can be used as long as their strength ratings meet the specifications.
- *Wood Fireproofing and Biological Protection.* All wooden building elements are coated with fire-resistant and antiseptic paints. The painting technology should follow the instructions provided by the paint manufacturer. The ends of wooden elements that come into contact with concrete or masonry surfaces must be treated with silicone sealants. Wooden structures that come into contact with masonry or concrete surfaces must be wrapped with a single layer of roll-on waterproofing material.
- *Insulation Works.* Insulating materials must not be toxic and must meet fire safety requirements. The materials used for insulation should be intact and undamaged. All structures, including external and roof constructions (including insulation materials), must be approved by the Fire Protection Department of the Republic of Lithuania.
- *Floor Hydroinsulation on the Ground.* A single-layer rolled waterproofing is installed. In case of a high groundwater level, the waterproofing should be glued with overlapping strips of at least 100 mm. The waterproofing must be installed on dry and leveled surfaces.

Soaked Room Ground Insulation. In wet rooms, the floor insulation is installed in two layers of rolled material on bitumen (hot or cold) mastic or using a torch-applied rolled material. When laying rolled materials, they should overlap by 100 mm. Each new layer is laid after the previous one has hardened. The layer thickness when using hot bituminous mastics is 2 mm +/- 10%, cold asphalt mastics 7 mm, and emulsions 3 mm



During dome construction, if there are any uncertainties, it is recommended to contact a representative of UAB "Sferos" through the provided contacts at kupoliniainamaistatyba.lt.

Last changes – entries made on 2023-05-27