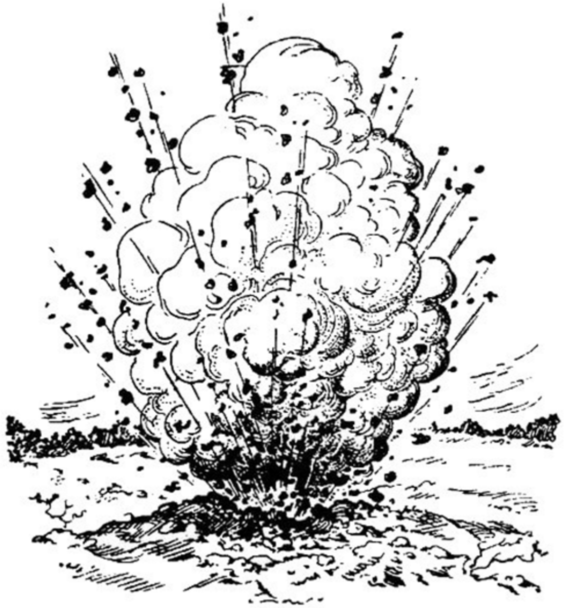
PROTECTION OF CRITICAL INFRASTRUCTURE FACILITIES BY THE “UMBRELLA” SYSTEM



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Science for Peace and Security (2024)
Energy infrastructure resilience in response to war and other hazards
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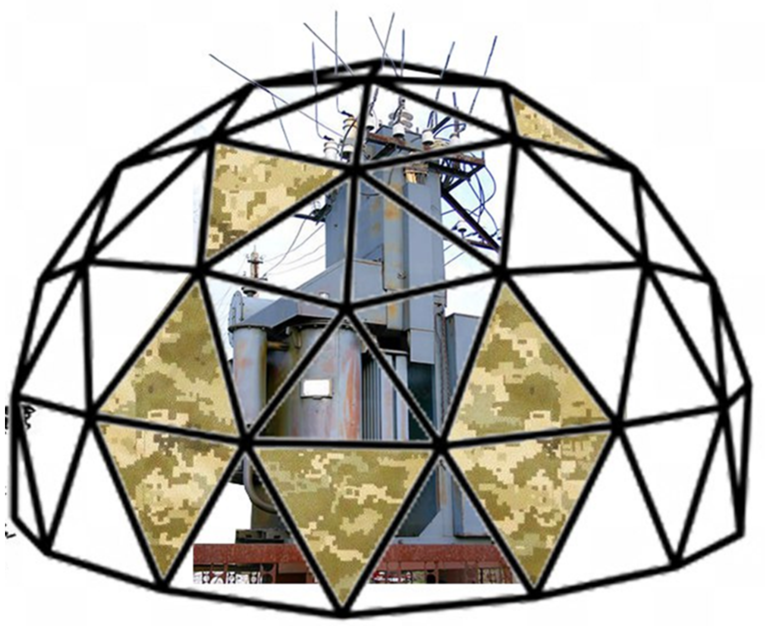
The war in Ukraine posed the problem of protecting local electricity supply facilities. For example, "Kyivteploenergo" purchased military gabions for 1.1 million hryvnias. This is a fairly cheap and fast method of protection, but it allows partial protection.

TECHNOLOGICAL CAPABILITIES OF THE ENCLOSING STRUCTURE

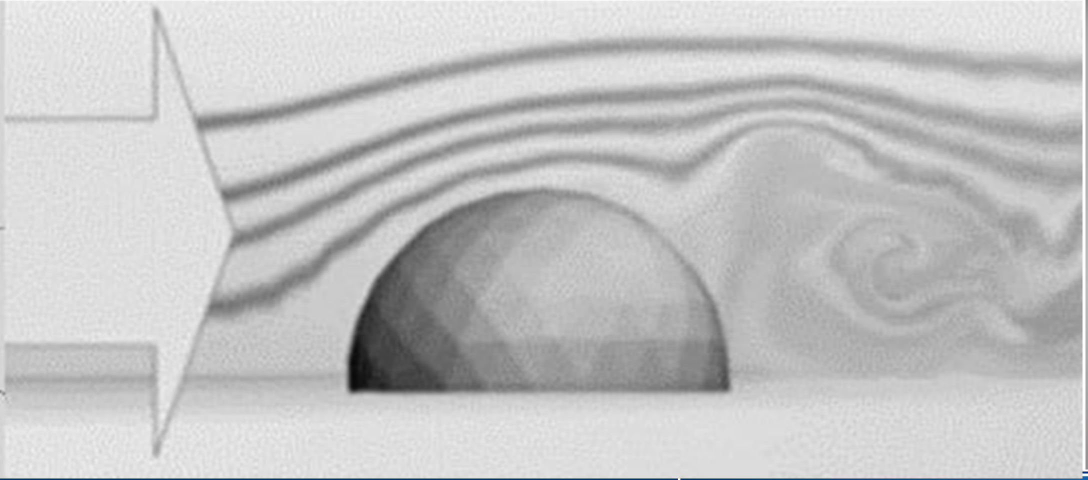


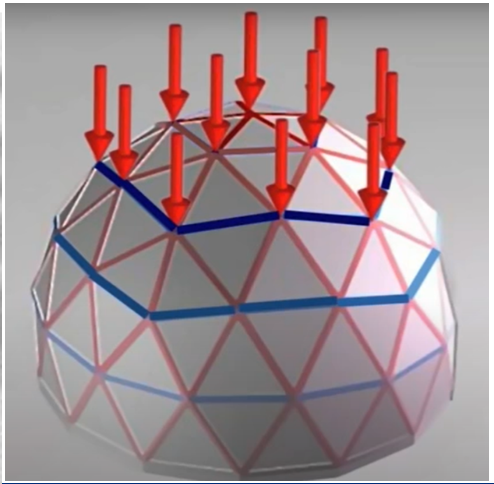
- Protection against shock wave and fragmentation
- Fire resistance
- Easy and quick installation
- Not difficult transportation
- Ability to easily bypass the upper wiring connection
- Military camouflage capability
- Low cost

The uniqueness of the dome rod structure lies in the redistribution of loads on the nodes of the structure and the easy flow around the hemisphere by waves

The dome is most effective when creating protective structures. The shape of the dome, compared to traditional rectangular structures, is ideal for strong explosive, seismic, wind and snow loads. An erected dome is much more difficult to destroy with dynamic loads.

Even if it is damaged in one or more places up to 30%, the dome does not lose its bearing capacity and does not collapse. This is a structure that does not require a significant amount of construction equipment.

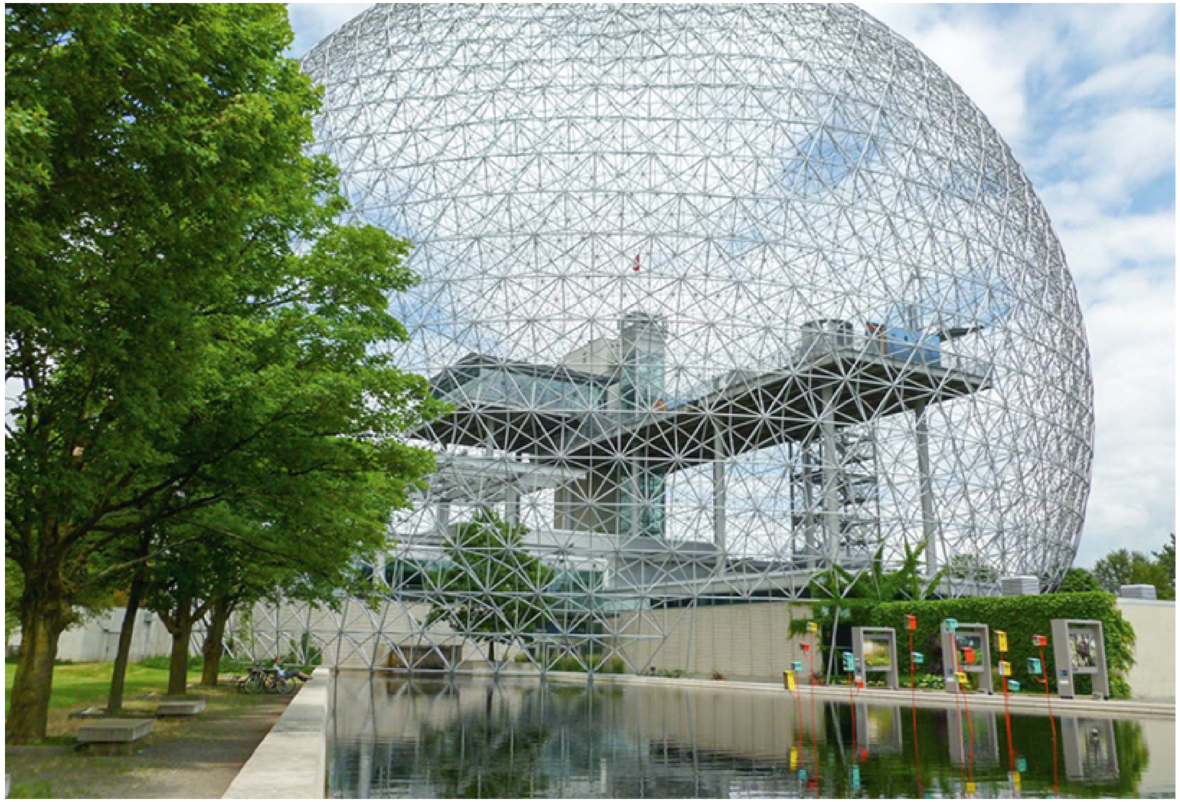




Fuller's Geodesic Dome

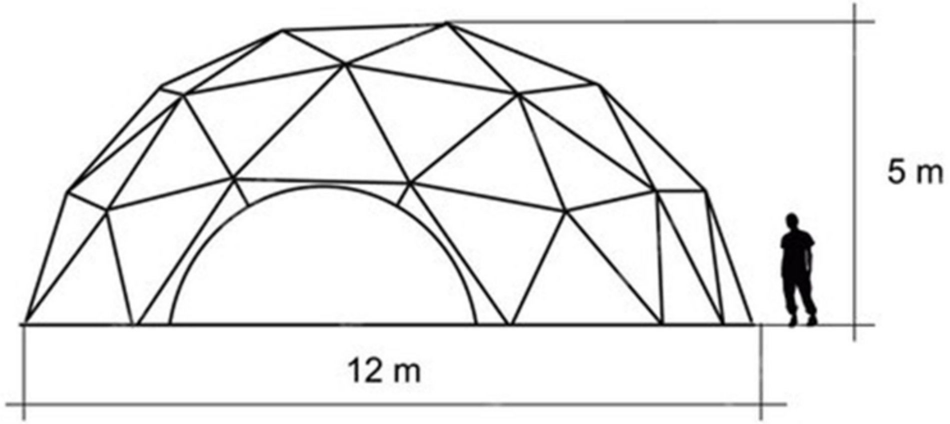
Mesh shells were most often used in industrial construction, where it was necessary to cover spans of more than 30-40 m with minimal metal consumption.

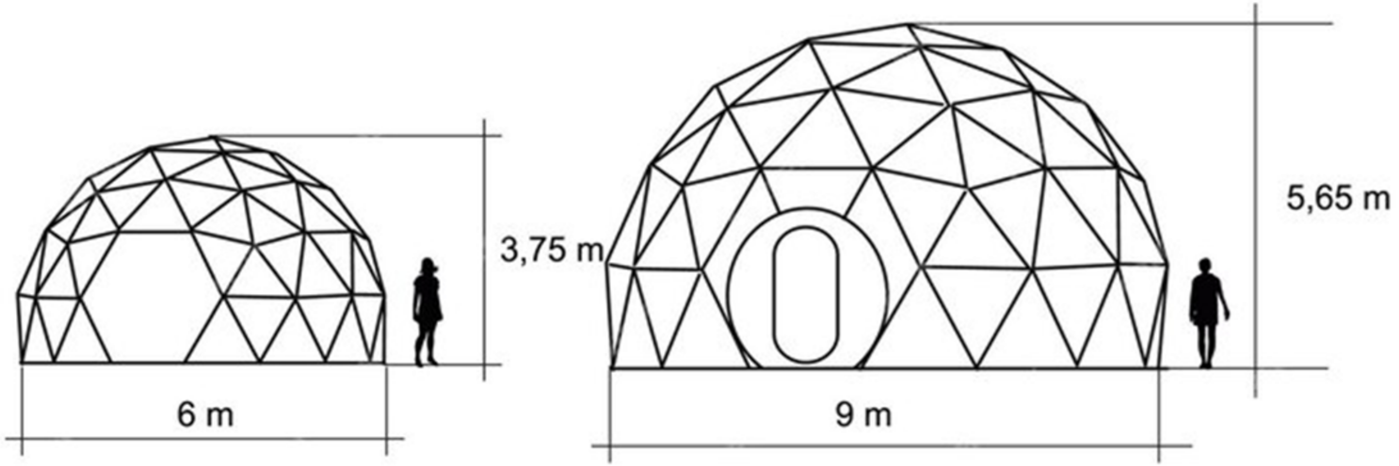
St. Louis, USA. The dome "Climatron", used as a greenhouse of the botanical garden (height 21 m, diameter 53 m). Made in aluminum structures. 1960 year

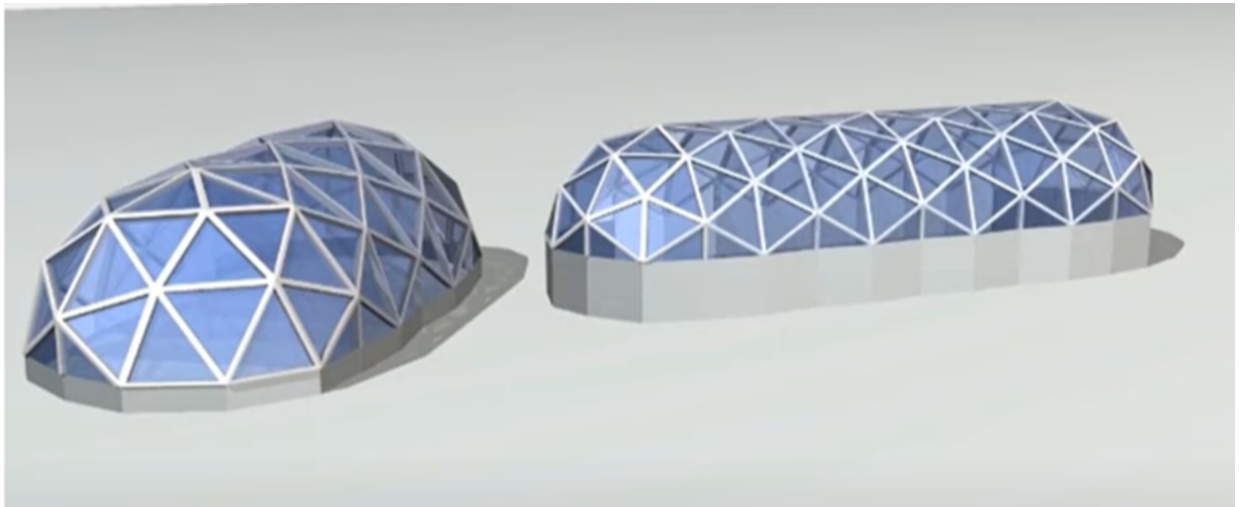


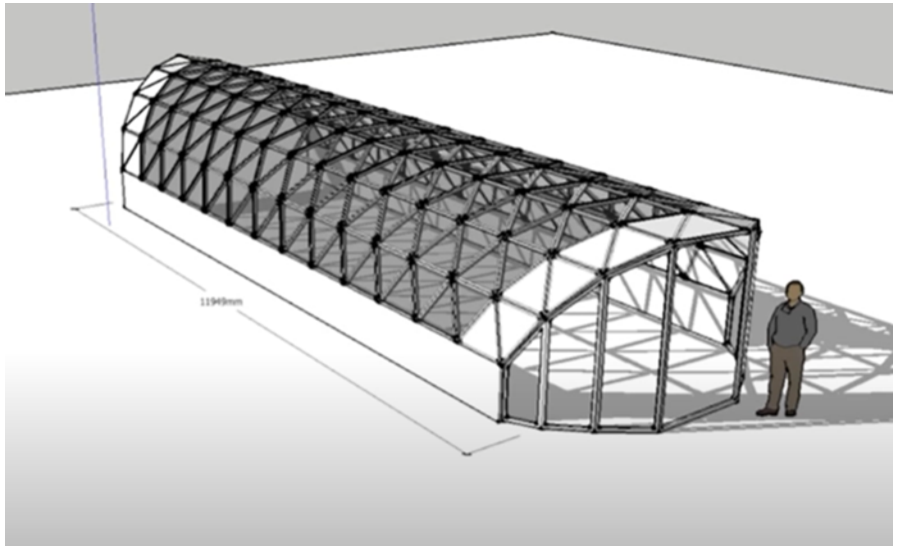
Exhibition pavilion "Expo-67" in Montreal (height 62 m, diameter 76 m).

Ability to change geometry and dimensions using a computer program calculator.









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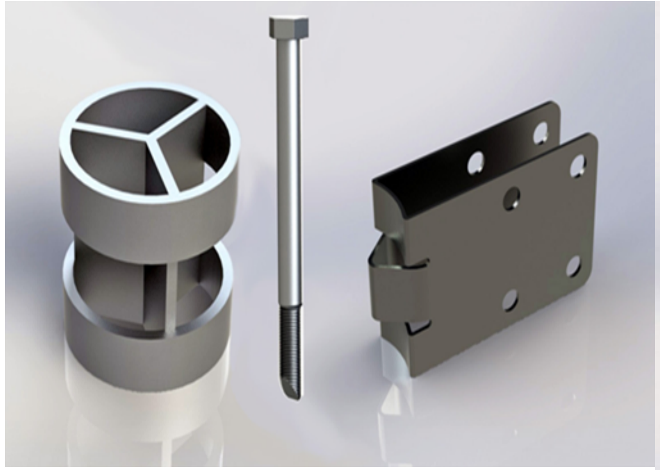
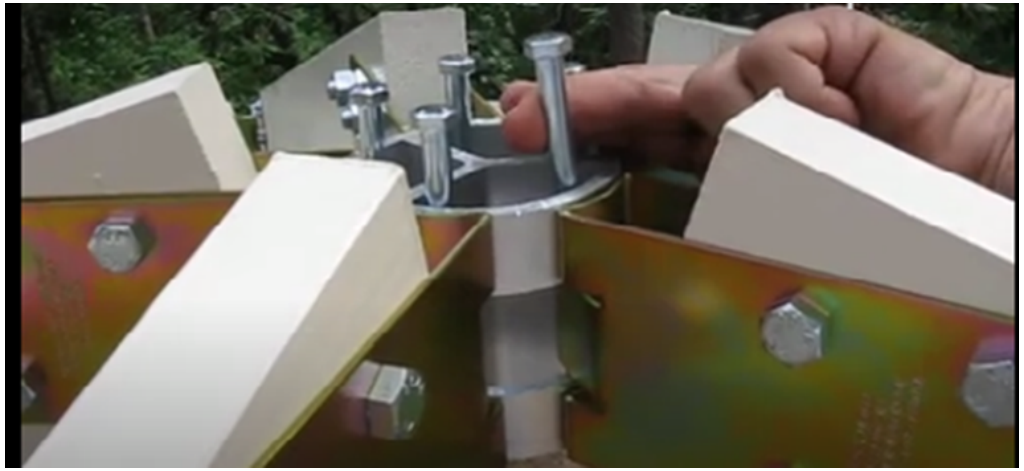
CONNECTORS

Decisive for the stability characteristics of the UMBRELLA dome are the design of the connection points, the material of the rods and the aggregate for the triangular elements.

The design of connectors is the fundamental importance. The best option is chosen when conducting computer modeling with the calculation of possible loads.





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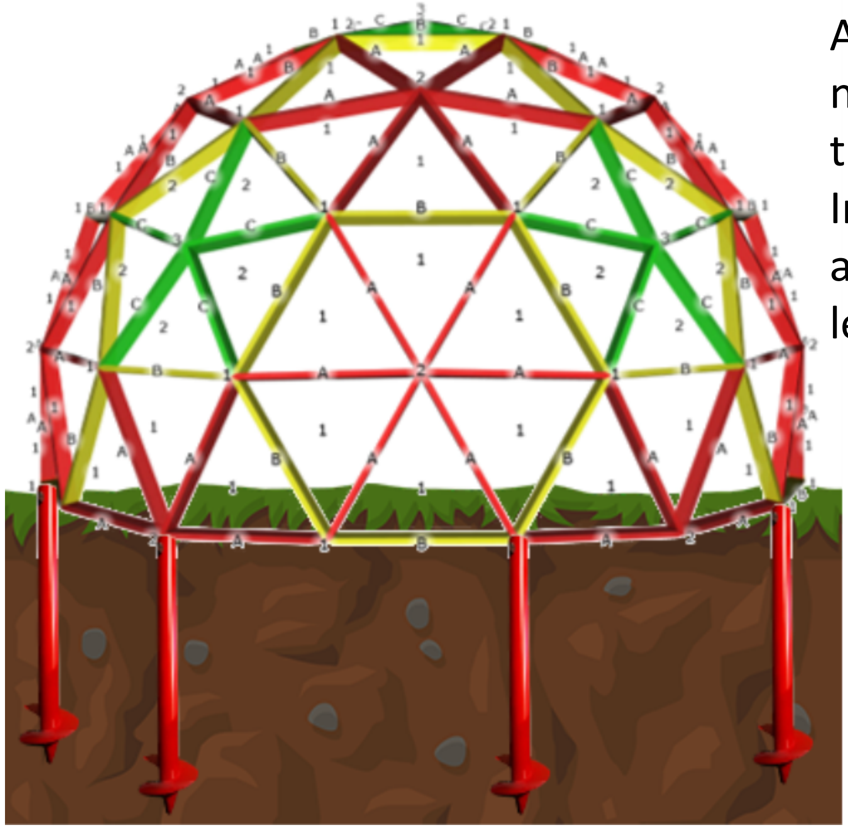
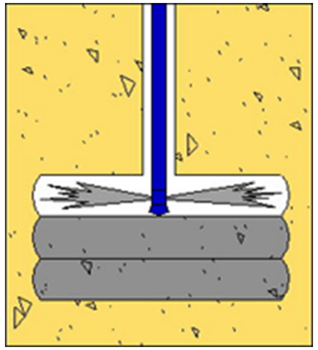
Fixing the UMBRELLA Dome

We recommend using a pile-screw foundation. JET-GROUTING technology can also be used. The advantages of this technology: high speed of construction of soil-cement piles, the ability to easily change the parameters of the pile, length and diameter, allows you to work in weak soils, but requires special equipment.



As for the number of supports, it depends on the calculations. The required number of **screw piles** depends on the size and weight of the structure, on average, the distance between the piles can be from 1.5 to 2.5 meters.

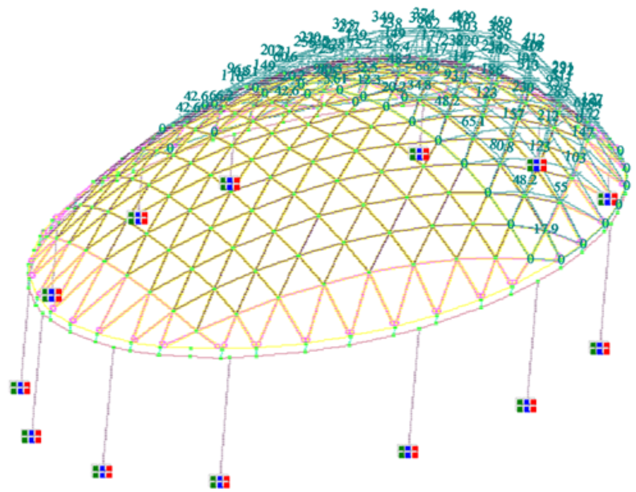
In the pile-screw foundation, metal screw piles with a diameter of 89 or 108 mm are used as load-bearing elements. With a bearing capacity of 5000-7000 kg and a length of 3 meters.



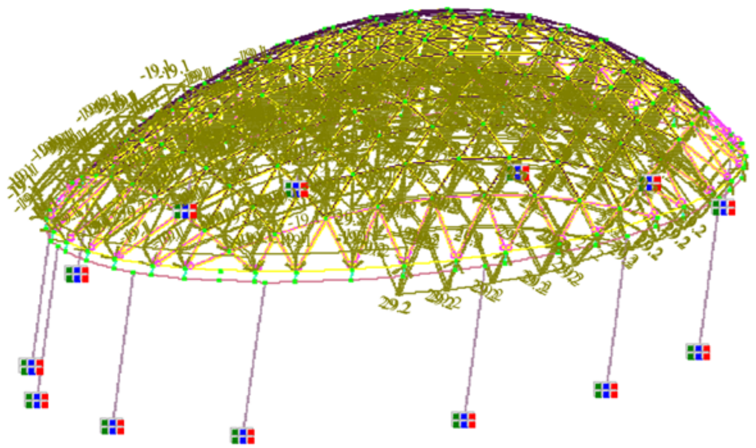
To create a pile foundation, we suggest using **jet technology**. This allows you to quickly and reliably create pile foundations regardless of unfavorable soil characteristics

CALCULATION OF THE PARAMETERS OF METAL RODS

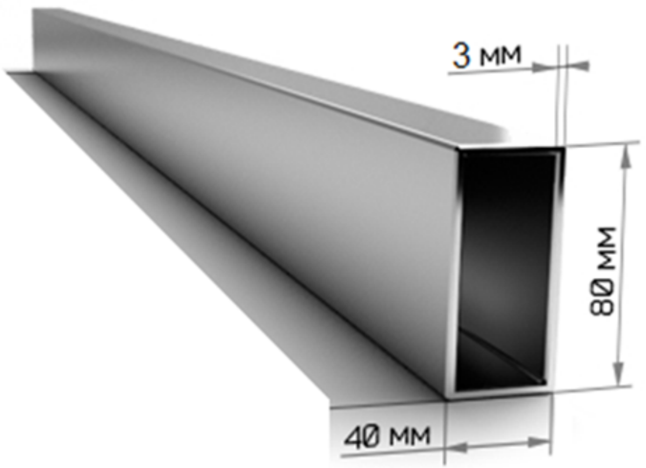
Computer simulation of deformations under vertical and lateral loads is carried out and in accordance with this, the optimal cross-sections and thicknesses of metal rods are selected



Dome deformations under vertical loads



Dome deformations under horizontal loads



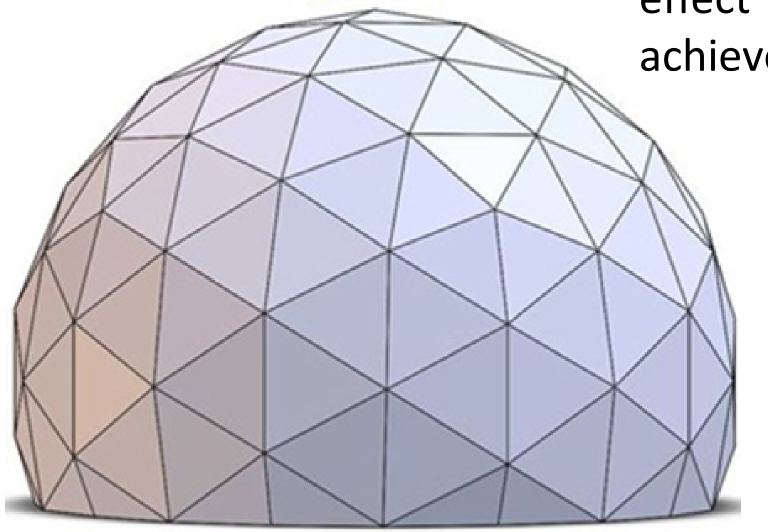
MATERIAL FOR COVERING THE DOME

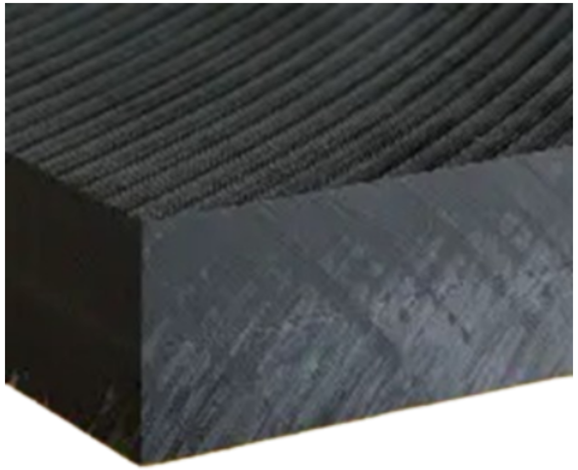
CAPROLON, (POLYAMIDE 6) is often used as a material to replace bronze, aluminum and other non-ferrous metals, because it has significant advantages (7 times lighter than bronze), has high mechanical strength, viscosity, hardness and elasticity, is non-electrically conductive.

In industry, polyamide PA-6 is produced in the form of sheets, rods and in granulometric form, it is possible to obtain different colors.

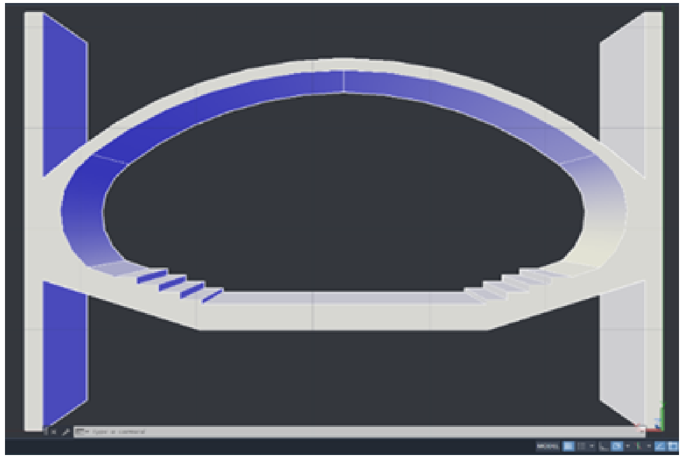
The use of granulometric polyamide with glass fiber will make it possible to melt triangles of the same size without residues in the form of scraps, as for sheet material.

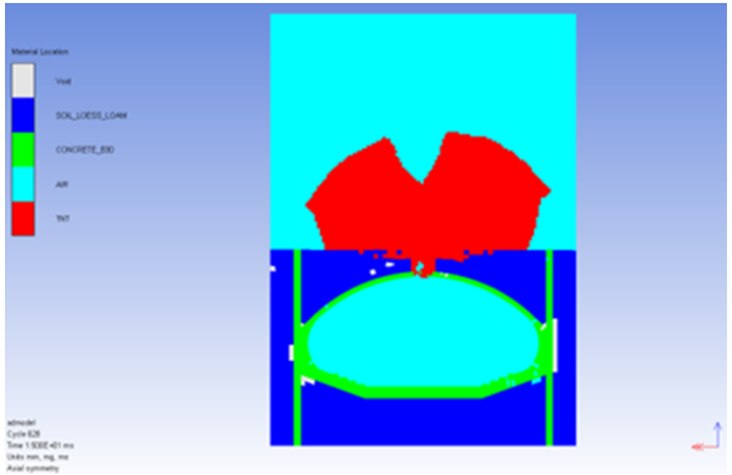
We suggest using for the out cover level lenticular plastic lenses are specialized with a 3D effect in the form of a film. The effect of blurring the outline of the Umbrella system is achieved both from the top observation and from the ground.



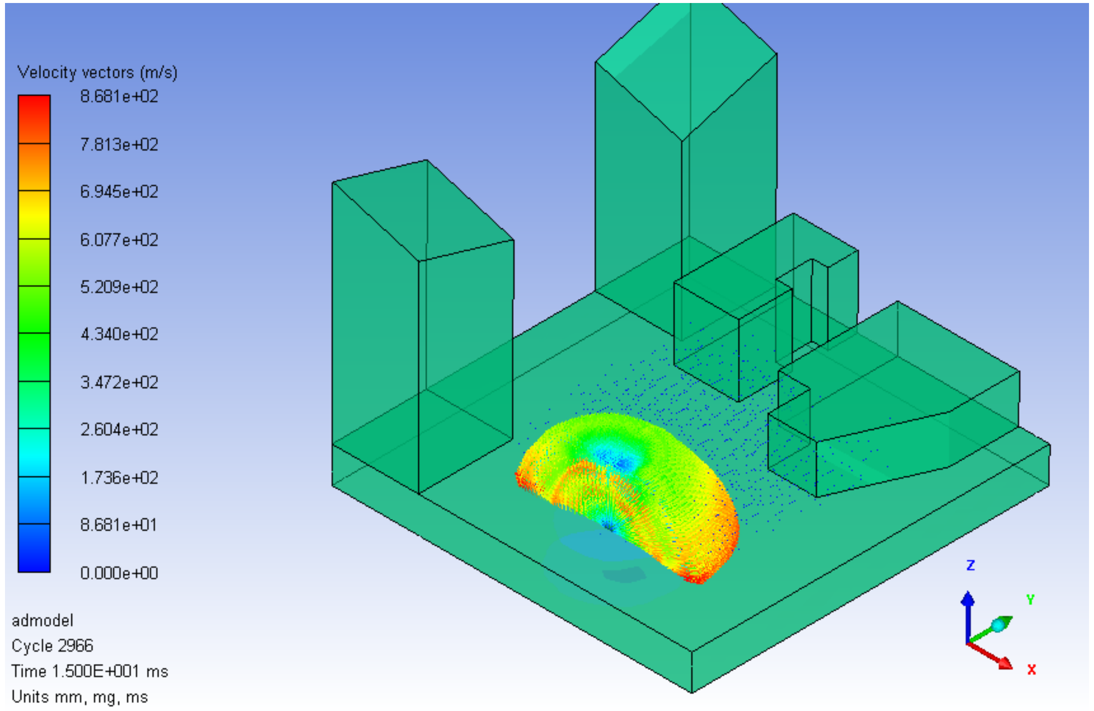


Experience of Department of geoengineering specialists in modeling the impact of an explosion on critical infrastructure facilities

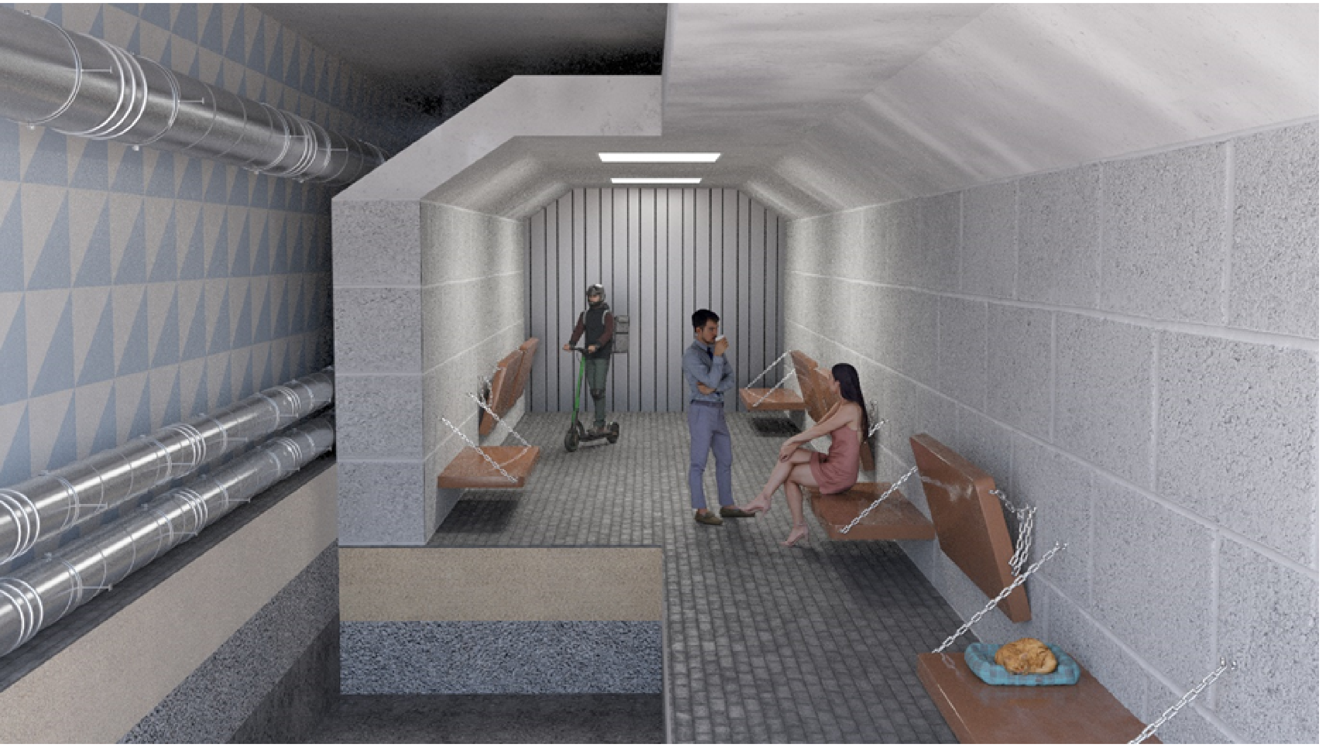


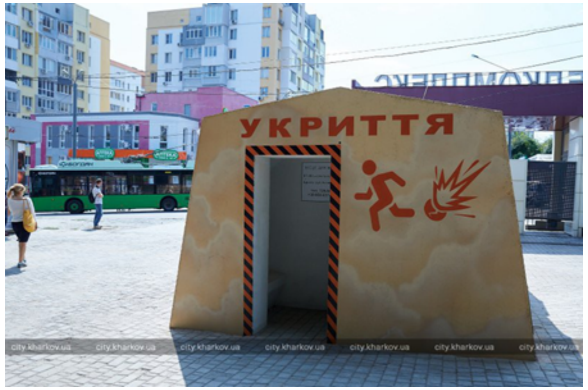


Specialists of the Department of Geoengineering use computer modeling to assess the consequences of an explosion in order to protect critical infrastructure. Modeling was carried out in the Ansys software package with a forecast of the possible destruction of concrete structures by various amounts of explosives.



On February 15, in a massive attack on Ukraine, Russia used a North Korean KN-24 missile, the fall of which caused a huge eruption in the Buchansky district near Kyiv (depth approx. 10 m). According to the American analytical center CSIS, the range of the KN-24 is up to 410 km, and the payload is 400-500 kg.





This 3D rendering shows the interior of an underpass that has been converted into a dual-purpose structure for temporary emergency shelter.

Thank you for your attention

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