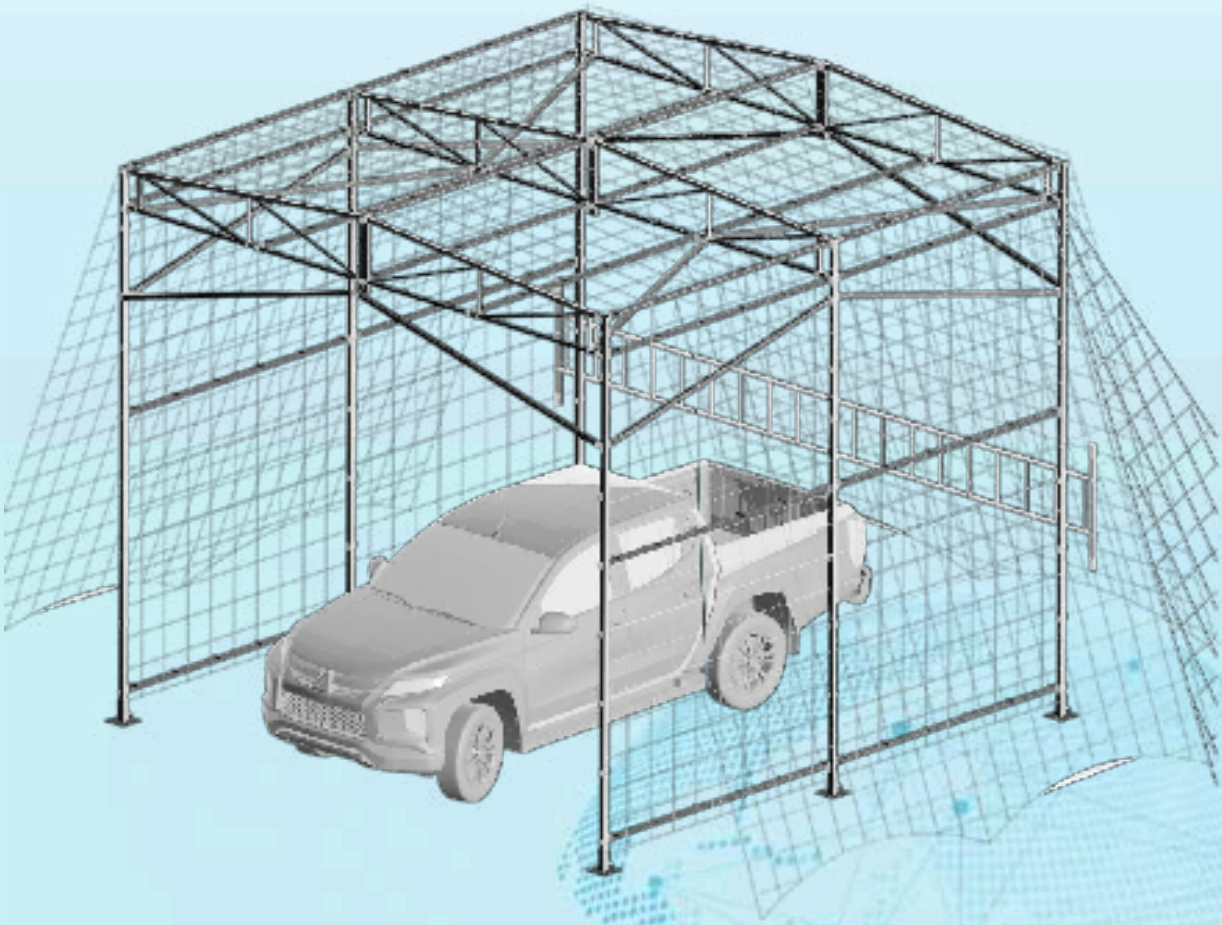
MODULAR PASSIVE PROTECTION SYSTEM

PASSIVE PROTECTION SYSTEM FOR MILITARY EQUIPMENT



CERTIFIED UKRAINIAN DEFENSE

INTERARMA
ADVISORY

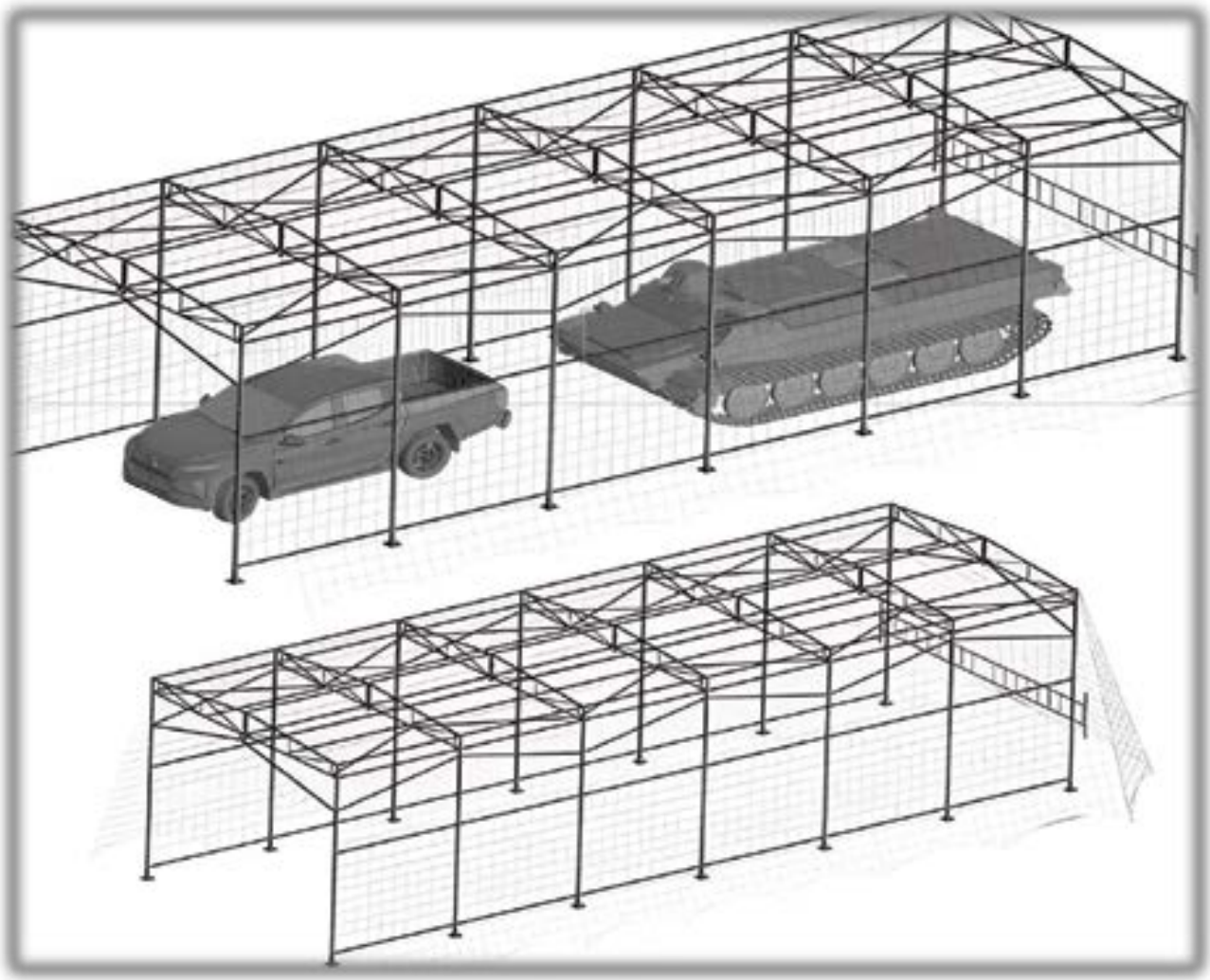
WHAT IS

modular passive protection system

Designed to reduce damage from UAV and drone attacks

Tested and used in combat environments

Developed by Ukrainian defense engineers



INTERARMA ADVISORY

USAGE

SYSTEM PURPOSE



FPV DRONE DEFENSE

Proven effectiveness against first-person view attack drones, disrupting impact trajectories and reducing warhead penetration.



LOITERING MUNITIONS

Counters Lancet-type systems and similar loitering threats through energy-absorbing mesh architecture.



MUNITION MITIGATION

Reduces effectiveness of shaped-charge warheads and impact munitions, extending equipment operational lifespan.



ASSET SURVIVABILITY

Critical protection for high-value platforms including armor, radar systems, and command vehicles in forward positions.

SYSTEM DEPLOYMENT



MODULAR STEEL FRAME

Precision-engineered components for consistent assembly and structural integrity across all variants.



MESH DISSIPATION DESIGN

Multi-layer mesh configuration disperses kinetic energy and disrupts shaped-charge jet formation.



TOOL-FREE ASSEMBLY

Standardized connection points allow quick field setup without specialized equipment or welding.

ENGINEERING & CONSTRUCTION

1 → 2 → 3 → 4

Frame Positioning — **Mesh Attachment** — **Structure Connect** — **Final Securing**

Field-optimized construction eliminates welding requirements, enabling rapid deployment even under austere conditions.

INTERARMA ADVISORY

BENEFITS

KEY ADVANTAGES

RAPID DEPLOYMENT

A standard 4-person team can assemble protection within hours. No heavy machinery required for most configurations.

EXTREME WEATHER RESILIENCE

Engineered materials maintain structural integrity from -30°C to +50°C, supporting operations across diverse climates and seasons.

MINIMAL MAINTENANCE

Weather-resistant coating and robust construction reduce field maintenance burden, allowing focus on mission-critical tasks.

MULTI-MODAL TRANSPORT

Compact packaging enables efficient movement via truck, rail, or tactical airlift to forward operating locations.

MULTI PURPOSE

Defends various types of vehicles and constructions. Resists different types of drones: FPV, assault and others.





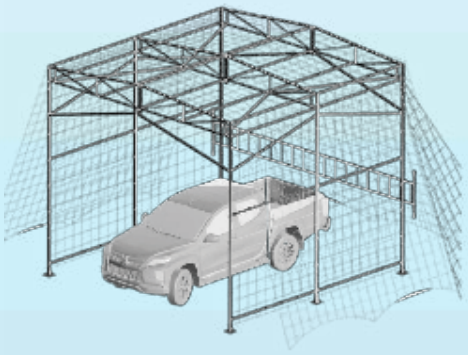


INTERARMA ADVISORY

VARIETY

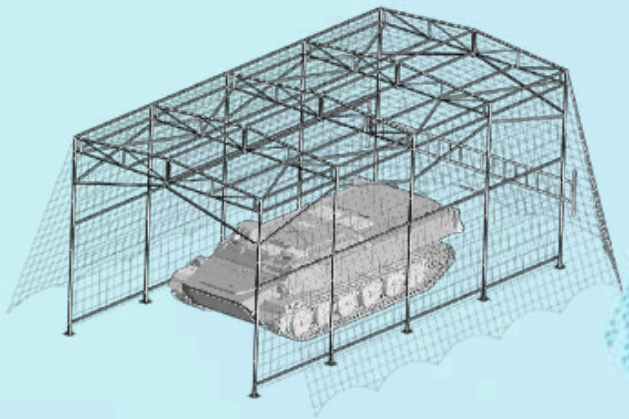
TYPES OF MODELS

Modular configuration depending on mission needs



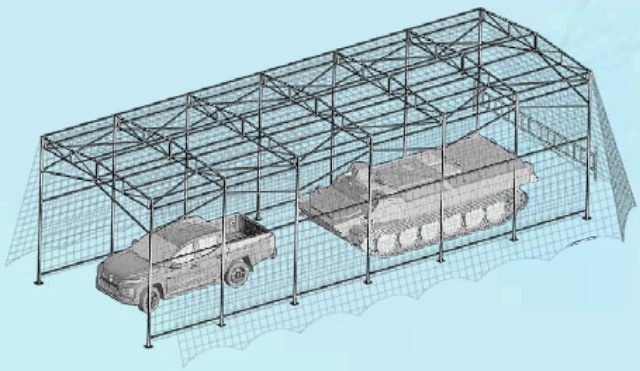
MODEL 5

For compact equipment units



MODEL 10

For large equipment (~10 meters coverage)



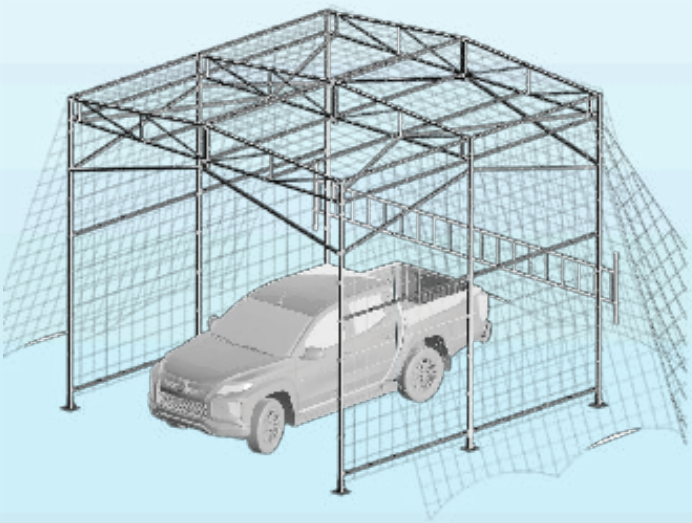
MODEL 15

Protection for two units simultaneously

INTERARMA ADVISORY

MODEL 5

Optimized for single equipment units and light platforms requiring high mobility with rapid protection deployment.



- Designed for compact or individual equipment units
- Ideal for light armored vehicles and small artillery systems
- Minimal footprint enables use in constrained forward positions
- Fast installation supports rapid-response mission profiles

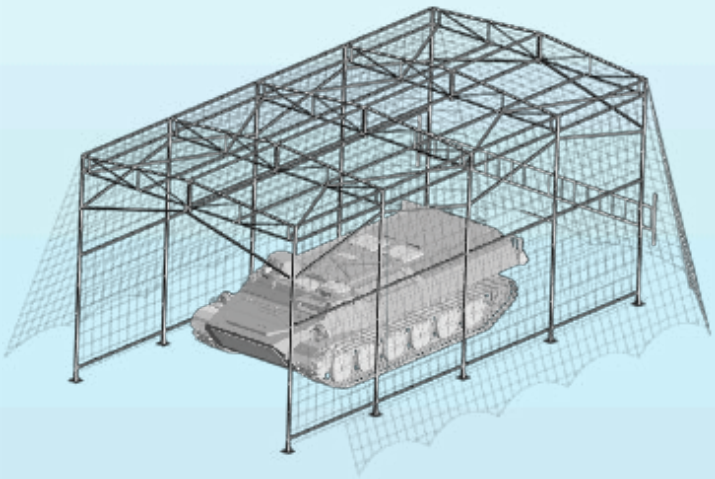
Perfect for temporary patrol bases and reconnaissance outposts.

SPECIFICATIONS

PARAMETER	VALUE
Overall dimensions (±0.02%), m	
• Length, unfolded / folded (for transportation)	5 / 2.7
• Width, unfolded / folded (for transportation)	5 / 1.2
• Height, unfolded / folded (for transportation)	4.6 / 0.9
Weight of the completed product (±3%), kg	630
Time of unfolding / folding, h, no more than	2 / 1
Color	RAL 6009

MODEL 10

The workhorse configuration providing approximately 10 meters of coverage, balancing protection capability with field mobility.



VERSATILE EQUIPMENT COVERAGE

Suitable for armored fighting vehicles, radar installations, and mobile command platforms.

ENHANCED STABILITY

Reinforced structural design provides superior resistance to environmental stressors and blast effects.

MOBILITY BALANCE

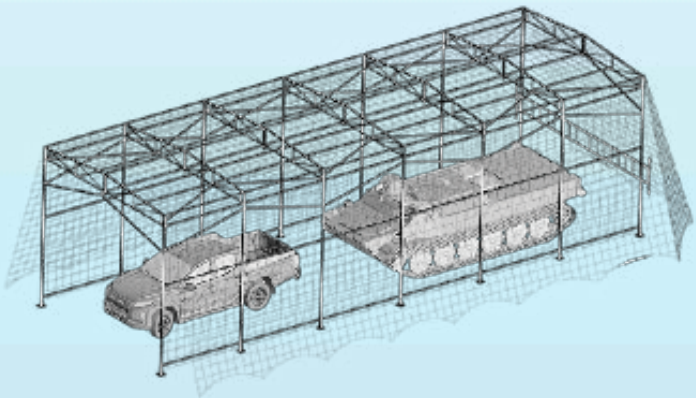
Optimized protection-to-weight ratio maintains tactical flexibility during repositioning operations.

SPECIFICATIONS

PARAMETER	VALUE
Overall dimensions (±0.02%), m	
• Length, unfolded / folded (for transportation)	10 / 2.7
• Width, unfolded / folded (for transportation)	5 / 1.2
• Height, unfolded / folded (for transportation)	4.6 / 1.3
Weight of the completed product (±3%), kg	1050
Time of unfolding / folding, h, no more than	2 / 1
Color	RAL 6009

MODEL 15

Delivers the largest single-structure protection footprint within the passive protection range, for semi-permanent positions.



LOGISTICS HUB DEFENSE

Ideal for ammunition storage points, maintenance areas, and artillery battery positions requiring expanded protection zones.

MODULAR SCALABILITY

Multiple units can be configured to create comprehensive protection networks for rear-area facilities.

DUAL-UNIT PROTECTION

Extended 15-meter coverage accommodates two equipment platforms or larger single assets like self-propelled artillery.

SPECIFICATIONS

PARAMETER	VALUE
Overall dimensions (±0.02%), m	
• Length, unfolded / folded (for transportation)	15 / 2.7
• Width, unfolded / folded (for transportation)	5 / 1.2
• Height, unfolded / folded (for transportation)	4.6 / 1.7
Weight of the completed product (±3%), kg	1440
Time of unfolding / folding, h, no more than	2 / 1
Color	RAL 6009

INTERARMA ADVISORY

GALLERY

DEPLOYMENT








LOGISTICS

STORAGE AND TRANSPORTATION



COMPACT TRANSPORT

Breaks down into standardized palletized loads for efficient strategic and tactical movement.

MODULE COMPONENTS

Damaged sections can be swapped without compromising overall system integrity or protection levels.

FIELD REPAIR CAPABILITY

Included repair kits enable component replacement using basic tools and minimal technical expertise.

ADAPTIVE CAMOUFLAGE

Configurable coating options support woodland, desert, urban, and winter operational environments.



STRATEGIC VALUE PROPOSITION

The system delivers asymmetric defensive advantage by maximizing asset survivability while minimizing logistical and financial burden.

01

COST-EFFECTIVE DEFENSE

Significantly lower acquisition and operational costs compared to active defense systems like C-UAS or hardened facilities.

02

EXTENDED EQUIPMENT LIFESPAN

Reduces catastrophic damage rates, keeping platforms operational longer and decreasing replacement procurement needs.

03

REDUCED OPERATIONAL LOSSES

Protects mission-critical assets during high-threat periods, maintaining operational tempo and combat effectiveness.

04

MISSION-SCALABLE ARCHITECTURE

Three model variants provide tailored solutions from small-unit operations to brigade-level logistics infrastructure.

QUALITY

NATO



STANAG COMPLIANCE

The architecture, data exchange protocols and procedural mechanisms are consistent with key NATO standards.

INTEROPERABILITY

The system is capable of operating in multinational infrastructures, ensuring seamless interaction with partner platforms.

CYBER DEFENSE ACCORDING TO NATO STANDARDS

The implemented security mechanisms comply with NATO policies on information protection and resilience to threats.

UNIFIED PROCEDURES

The response, information processing and access control algorithms meet the operational requirements of the Alliance.

The system is a continuous passive protection cocoon (CPCS) designed to protect both armored and conventional military vehicles (infantry fighting vehicles, self-propelled guns, tanks, radars, vehicles, and artillery) from modern threats. Its primary purpose is to create a reliable physical barrier against high-energy munitions, such as Lancet-type UAVs, as well as highly maneuverable FPV drones. The design consists of a modular metal base with a special protective mesh that is mobile and reusable. The system adapts to various terrain and vegetation conditions, allowing the integration of additional concealment and rapid deployment by several personnel in combat situations.

QUALITY

TESTING

The system goes through ongoing testing and field use to confirm it performs under changing conditions and at scale. Feedback from units in Ukraine drives continuous improvement of the design.





01 HIGH SYSTEM ADAPTABILITY CONFIRMED

The system quickly adapts to changing conditions, automatically optimizing the operation of modules without operator intervention.

02 OPTIMIZED INTERACTION BETWEEN MODULES

Communication between components has become faster and more accurate, reducing latency and increasing process consistency.

03 CONTINUOUS FIELD FEEDBACK

Units using the system in Ukraine report back on how it performs. This feedback is reviewed on an ongoing basis, and the design is improved where needed.

04 READY FOR LARGE-SCALE INTEGRATION

The system architecture demonstrates the resilience and flexibility needed to operate in extended infrastructures and multi-tier ecosystems.

PASSIVE (PHYSICAL) PROTECTION AGAINST UAVS

ApexDef Group and its manufacturing partners design and deliver comprehensive structural solutions for protection against all types of UAVs. The systems are based on practical experience gained in real war conditions and have been tested and proven in the field. They provide reliable, engineering-driven protection for critical infrastructure, combining durability, effectiveness, and adaptability to modern drone threats.

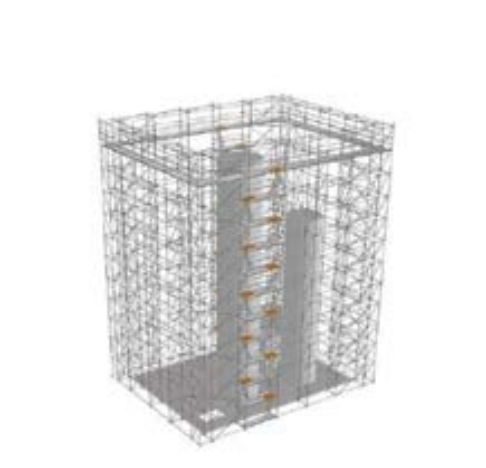
With the growing threat posed by unmanned aerial vehicles, passive protection against drones is becoming an essential component of security systems for industrial, civilian, and infrastructure facilities.

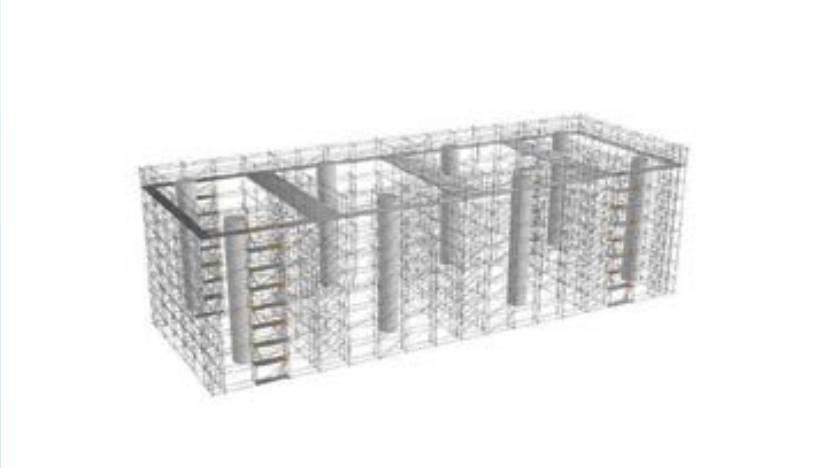
Passive protection against UAVs is an engineering barrier that does not depend on power supply, radio frequency signals, software, or weather conditions. Unlike electronic warfare systems, it does not require configuration, electricity, or complex maintenance. For this reason, passive protection structures are indispensable in the construction and operation of industrial, military, and civilian facilities in high-risk areas.

WHERE PHYSICAL UAV PROTECTION IS APPLIED

- Construction sites, especially in high-risk zones
- Industrial enterprises where it is critical to prevent external surveillance or sabotage
- Warehouses and infrastructure facilities, including fuel and ammunition storage, electrical substations, distribution stations, boiler houses, and pumping stations
- Hydraulic and energy facilities
- Civilian infrastructure such as railway stations, stadiums, and administrative buildings
- Mobile or temporary structures, including towers, hangars, and tent camps

REQUIREMENTS FOR PASSIVE PROTECTION





STRUCTURES MUST MEET STRICT REQUIREMENTS

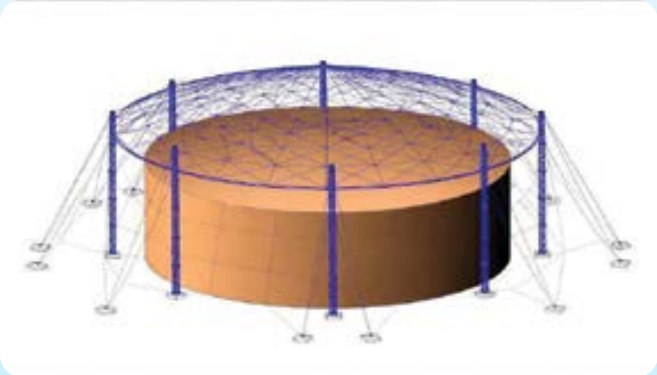
- **Strength:** withstand the impact of an object weighing up to 200 kg at speeds up to 170 km/h (kinetic energy of approximately 220 kJ)
- **Fire resistance:** must not support combustion, must not hinder firefighting efforts, and must withstand localized heating from explosions or incendiary mixtures
- **Resistance to external factors:** wind speeds up to 30–40 m/s, snow, rain, UV exposure, and temperature fluctuations from –40 to +50 °C
- **Installation and operation:** modularity, ease of assembly and disassembly, simple repair, and access for maintenance of tanks and for firefighting operations
- **Adaptability:** suitable for both permanent and temporary facilities, with the ability for rapid deployment

Materials with high tensile strength and resistance to environmental factors are the most effective in passive anti-drone protection. These include steel pipes and cable mesh, which provide an optimal balance between flexibility and tensile strength, and effectively absorb dynamic loads.

A metal structure combined with cable mesh is technically justified against impact UAVs. Similar solutions are currently used to protect equipment and infrastructure in Ukraine.

EXAMPLE

PROTECTING AN OIL STORAGE TANK AGAINST SHAHED-136-TYPE UAVS





TYPICAL APPROACH ANGLES

Based on open-source observations and known characteristics of such drones:

- Low-angle or horizontal approach: 5–15°
- Standard attack angle: 10–25°
- Terminal dive before impact: 25–40°
- Near-vertical approach is rare (>45°)

Most impacts occur at shallow angles of 15–30° relative to the horizon, because the drone operates at low altitude, the autopilot typically avoids steep dives, and rear-mounted propeller engines perform poorly in sharp dives. Drones may also be guided toward thermal or high-contrast targets. Oil tanks often have elevated surface temperatures, so impacts more often occur on the side of the tank than on the roof.

PRACTICAL TANK PROTECTION DESIGN

A typical solution is a metal frame with tensioned mesh above and around the sides. Example parameters: mesh inclination 35–45°, tank diameter 20–30 m, structure height 12–18 m, with a sloped spatial frame above the tank and two layers of mesh to intercept or deflect incoming UAVs and dissipate impact energy.

EXAMPLE

FRAME AND STRUCTURAL SHAPE

FRAME (STRUCTURE)

- Steel pipes (square or round), angles, and channels
- Perimeter supports placed 10–15 m from the tank edge to create a safe standoff distance for potential detonation
- Canopy/roof height: 5–7 m above the top of the tank
- Roof angle: 35–45°, which increases the likelihood of drone deflection and reduces direct vertical impact

1. PYRAMID

Pros: simple design, easy to build with trusses.
Cons: impacts concentrate on edges, possible dead zones between faces.
Effectiveness: medium

2. DOME

Pros: impacts are almost always glancing, loads evenly distributed, high structural strength.
Cons: more complex and expensive to manufacture.
Effectiveness: very high

3. TRUNCATED CONE

Pros: impact is almost always tangential, simpler than a dome, works well with mesh.
Cons: requires greater height.
Effectiveness: high



PRACTICAL CONCLUSION

For oil storage facilities a truncated cone is often the best choice: it is easier to construct, integrates well with cable mesh, allows convenient perimeter skirting, and provides good impact angles.

MESH SYSTEM

TWO-LAYER MESH

The frame (dome and side walls) is covered with two layers of mesh spaced 1–1.5 m apart. The key factor is mesh cell size.

FIRST LAYER (400 × 400 MM)

Initial impact breaks wings, damages the propeller, and alters trajectory. Estimated probability of engagement: ~60–75% (wings or tail may pass through). Load on a cable may briefly reach 1–3 tons, but typically the drone fails before the cable.

INTERLAYER SPACE

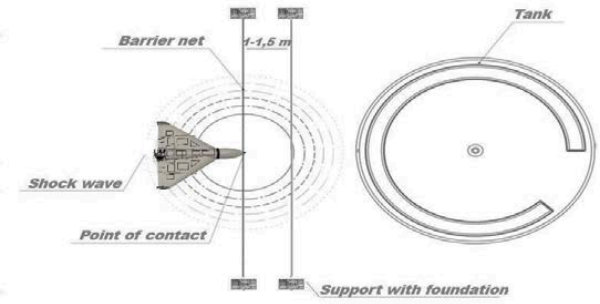
The drone body is already deformed, the engine often detaches, and stability is lost.

SECOND LAYER (200 × 200 MM)

Captures the fuselage, may initiate the warhead or stop fragments. Estimated probability of engagement: ~85–95%. Using two layers increases overall effectiveness to approximately 90–97%.

OPERATIONAL RECOMMENDATIONS

- **Clearance gap:** the lower edge of the side mesh should sit 0.5–1 m above ground level to reduce wind load and allow access for service vehicles.
- **Grounding:** the entire metal structure must be integrated into the facility's lightning protection system.
- **Primary function of the mesh:** to catch the propeller or wing, so the drone breaks apart before reaching the protected object.



STEEL GALVANIZED CABLE MESH

The mesh is made of galvanized steel cables, providing high corrosion resistance and durability under harsh weather conditions. Mesh types vary by cell size and weaving method.

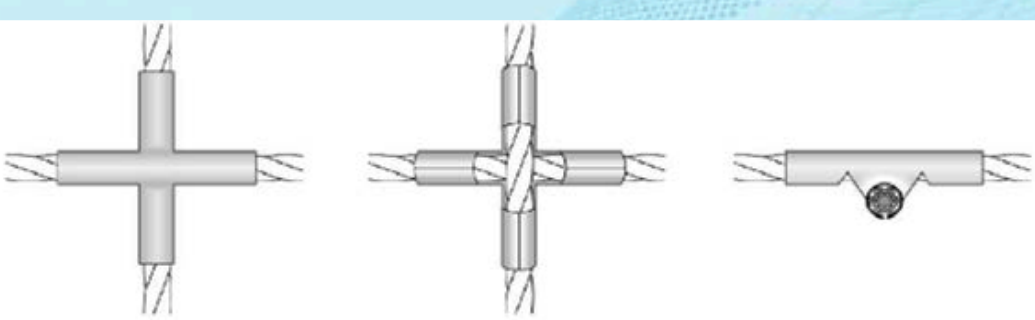
ADVANTAGES

- **Strength:** high load capacity (breaking load 1.8–2.2 tons)
- **Flexibility:** adaptable to various structural designs
- **Weather resistance:** corrosion protection and tolerance to temperature fluctuations
- **Ease of installation:** simple setup without specialized tools

MESH CONSTRUCTION

The mesh is made from 5 mm diameter galvanized steel cables. Each cable intersection is secured with a special cross-shaped clamp using a pneumatic press, forming a rigid structure that maintains its geometry over time.

The mesh is produced as rectangular panels with diamond or square patterns, simplifying joining, tensioning, and installation.



ENGINEERING ESTIMATE

IMPACT LOAD CALCULATION

To evaluate the strength of the mesh barrier, we estimate the load generated by impact of a UAV such as the Shahed-136. Initial parameters: UAV mass m ≈ 200 kg; speed V ≈ 170 km/h ≈ 47 m/s.

KINETIC ENERGY

$E = ½ m v^2$

$E ≈ 0.5 × 200 × 47^2$

$E ≈ 220{,}000$ J

Comparable to a passenger car impact at ~60 km/h, or a 2-ton object falling from ~11 m.

DECELERATION AND FORCE

Assuming a stopping distance S ≈ 0.7 m:

$a ≈ V^2 / 2S ≈ 47^2 / (2 × 0.7) ≈ 1{,}580$ m/s^2

$F = m·a ≈ 200 × 1{,}580 ≈$ **316 kN**

(about 32 tons of force)

LOAD DISTRIBUTION

The load is distributed across multiple mesh cables (typically 4–8) and connection nodes. In reality, because the drone fails structurally, wings break first, the engine and propeller detach, and the fuselage collapses. Observed loads are typically 1–3 tons per cable (short duration). A 5 mm galvanized steel cable has a breaking load of 1.8–2.2 tons; the load is shared across multiple cables and the entire structure, and mesh flexibility helps absorb impact energy.

TIGHT MESH

Pros: faster drone destruction, less deflection.
Cons: higher risk of warhead detonation on the mesh.

LOOSE MESH

Pros: better energy absorption.
Cons: risk of excessive deformation.

CONCLUSION

Optimal: moderate tension with damping capability. A double-layer cable mesh on a metal frame destroys UAV components before impact, reduces impact energy, shifts the detonation point away from the protected object, and significantly increases overall facility safety. This makes it a technically sound and practical solution for passive UAV protection.