

Institutional and engineering model of Armenia's defense infrastructure and civil protection system

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Introduction

The security challenges of the 21st century are more diverse and complex than ever before. Contemporary threats extend far beyond conventional armed confrontation, encompassing the vulnerability of civilian infrastructure and digital systems, disruptions to energy networks, natural disasters, and psychological pressure on the population. In such an environment, any state – regardless of its territorial size or military capacity – must develop a comprehensive defense infrastructure system capable of ensuring not only military security but also the protection and resilience of civilian society.

Armenia is situated in a strategically sensitive region and faces a wide range of long-term security challenges. Unresolved conflicts with Azerbaijan and Turkey, the persistent risk of war, almost permanent regional instability with outbursts of military actions in the neighboring countries, and significant natural hazards all underscore the need to develop a flexible, multi-layered, and integrated defense infrastructure network.

Scholarly research demonstrates that an effective defense infrastructure system typically consists of several key components, including underground and surface shelters, backup energy and water supply systems, protected communication networks, strategic reserves, and crisis response centers [1], [2]. At the same time, international experience shows that without strong institutional frameworks and sustainable financial mechanisms, such infrastructure cannot achieve the necessary level of preparedness and operational effectiveness.

This article presents a comparative analysis of international experience from Israel, Switzerland, Finland, Sweden, Ukraine, and Iran, and proposes a hybrid model for Armenia based on public–private partnership². The proposed approach combines state funding, private sector participation, targeted contributions through the All-Armenian Fund, and potential international support to develop a resilient national defense infrastructure system.

Global experience

Israel

Israel's civil defense system has been shaped not by abstract planning, but by prolonged exposure to intense and recurring security pressures. Frequent missile attacks, the activities of non-state armed groups, and the vulnerability of densely populated urban areas have compelled the state to develop a model in which civil defense is not a supplementary function, but a core component of the national security architecture. In this context, Israel's

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² Public-private partnerships (PPPs) are long-term, contractual agreements between government entities and private firms to finance, build, and operate infrastructure projects like roads, hospitals, and airports. These partnerships leverage private capital and expertise for public service delivery while sharing risks, aiming for increased efficiency, better service quality, and improved innovation over traditional procurement methods.

experience illustrates how persistent threats can act as a catalyst for institutional and engineering innovation.

A defining feature of the Israeli approach is the decentralization of protection, extending it beyond the state and community levels to the level of the individual household. This logic is grounded in a simple yet strategically critical observation: in the context of missile threats, response time is often measured in seconds, making it impractical to rely solely on centralized shelters. Protection, therefore, must be physically proximate to the individual [3].

This challenge is addressed through the Mamad³ system reinforced safe rooms integrated within residential units, designed to protect occupants from blast waves, shrapnel, and, in some cases, chemical threats. The mandatory inclusion of Mamad units in new construction, enforced through legislation, has enabled the gradual establishment of a near-universal layer of individual protection. This solution significantly reduces casualties, particularly in scenarios involving short warning times.

However, Israel's system is not limited to micro-level shelters. It is structured as a multi-layered architecture, incorporating public shelters, underground protected facilities, and the integration of transportation and strategic infrastructure into the broader defense system. This layered approach allows for differentiated responses depending on the intensity and nature of the threat, ranging from individual protection to large-scale civilian movement.

Importantly, Israel's engineering solutions are deeply interconnected with institutional and societal mechanisms. Civil defense authorities, local governments, and the military operate within an integrated framework that ensures coordination across warning, response, and recovery phases. Public preparedness also plays a critical role: regular drills, educational programs in schools, and widespread public awareness initiatives foster a culture in which citizens are not merely passive recipients of protection, but active participants in the security system.

At the same time, Israel's experience demonstrates that even highly advanced technological systems cannot fully eliminate risk. Missile defense systems and shelters mitigate damage, but do not neutralize threats entirely. This is a crucial insight, as civil defense should be understood as a mechanism for risk reduction rather than absolute prevention. At the institutional level, several key actors play a central role in the civil defense system:

1. **National Civil Defense Authority** – responsible for planning, coordinating, and supervising population protection systems.
2. **Integration with the Armed Forces** – the military actively participates not only in national defense but also in civilian protection and emergency response.
3. **Local Authorities** – responsible for managing community shelters, maintaining warning systems, and organizing preparedness training programs.

Engineering solutions

Israel employs a multi-layered protection system that includes several key engineering components:

³Mamads (short for *Merhav Mugan Dirati*) are reinforced security rooms built within individual apartments in Israel. They are designed to protect residents from rocket attacks, explosions, and chemical threats.

- **Micro-shelters in residential buildings (*Mamad*)** – reinforced rooms designed to protect residents from small- and medium-range missile attacks as well as chemical or biological threats.
- **Public and strategic shelters** – shelters integrated into schools, hospitals (*Maman*⁴), public infrastructure (*Miklat*⁵, *Mamak*⁶, *Migunit*⁷) and government institutions to ensure large-scale population protection.
- **Underground transportation tunnels** – designed to ensure the safe movement of both civilian and military personnel during emergencies.
- **Missile early-warning systems** – advanced alert systems that allow civilians to move quickly into shelters immediately after receiving an alarm.

Relevance and applicability to Armenia

The Israeli model is particularly relevant to Armenia due to its decentralized logic of protection. In conditions where certain settlements are exposed to immediate threats and response times may be extremely limited, the concept of micro-shelters similar to the Mamad system could be applicable, especially in the context of new construction. However, several constraints must be considered.

First, a significant portion of Armenia’s housing stock consists of existing buildings, where the integration of such solutions would be technically complex and financially demanding. This limits the feasibility of directly replicating the Israeli model. Instead, a hybrid approach appears more realistic combining the mandatory inclusion of micro-shelters in new developments with the expansion of community-level shelters in existing urban environments.

Second, an important lesson relates to public preparedness. Israel’s experience demonstrates that even the most advanced infrastructure is insufficient without an actively prepared population. In the Armenian context, this implies the need for a substantial expansion of educational programs, training exercises, and community-level engagement mechanisms.

Finally, the Israeli model offers important insights into financing. The combination of state funding and private sector participation allows for cost-sharing and accelerates infrastructure development. This is particularly relevant for Armenia, where public resources are limited and effective use of public-private partnerships (PPP) is essential provided that governance and oversight mechanisms remain robust.

In sum, Israel’s experience demonstrates that modern civil defense systems are most effective when they integrate engineering solutions, institutional capacity, and societal preparedness into a multi-layered, flexible, and responsive framework.

Switzerland

Switzerland represents one of the most comprehensive and institutionalized models of civil protection in the world. Unlike systems shaped primarily by immediate and recurring threats,

⁴ In the context of Israeli civil defense, *Maman* (Hebrew: *Merhav Mugan Mosadi*) refers to an Institutional Protected Space.

⁵ Unlike a *Mamad* (which is a room inside your apartment), a *Miklat* is a separate structure, usually located in the basement of an older apartment building or as a standalone public bunker in a neighborhood.

⁶ *Mamak* (Hebrew: *Merhav Mugan Komati*) is a Communal Protected Space located on a specific floor of a residential or office building.

⁷ A *Migunit* is a portable, prefabricated concrete shelter designed to provide rapid protection in public areas where traditional reinforced buildings are unavailable.

the Swiss approach has been built on long-term strategic planning, neutrality-driven security doctrine, and a strong emphasis on societal resilience. The result is a system in which civil defense is embedded into the very fabric of national infrastructure and legal regulation.

The Swiss approach is based on two fundamental principles: mandatory protection established by legislation and a flexible institutional governance system capable of coordinating protection measures at different administrative levels [4].

At the core of the Swiss model lies a fundamental principle: protection must be universal, not selective. This principle is codified in legislation, most notably the Federal Law on Civil Protection, which mandates that nearly the entire population must have access to protective shelter. As a result, Switzerland has achieved an exceptional level of coverage estimated at around 90% or higher making it unique in its ability to provide near-total physical protection for its citizens in crisis scenarios.

This legal obligation has profound implications for urban planning and construction practices. Civil protection is not treated as an auxiliary feature but as a mandatory design parameter. Residential buildings, public institutions, and industrial facilities are required to incorporate shelter spaces during the planning and construction phases. This proactive integration significantly reduces the need for retrofitting and ensures long-term system sustainability.

Engineering solutions

From an engineering perspective, Swiss shelters are designed to withstand a wide spectrum of threats, including nuclear blasts, chemical exposure, and high-intensity air strikes. These shelters are typically underground, or semi-underground structures equipped with independent ventilation systems, water supplies, food reserves, and basic medical facilities. The emphasis is not only on survival, but on maintaining functional living conditions for extended periods.

- **Shelters** – Underground or semi-underground structures designed to withstand nuclear threats, airstrikes, and powerful explosions. These shelters are equipped with air filtration systems, water and food reserves, and primary medical facilities.
- **Public infrastructure integration** – Schools, hospitals, and public administrative buildings are integrated into the national protection network, ensuring rapid accessibility and population safety during crises.
- **Mandatory stocks and National Redoubt** – Switzerland's integrated system relies on Mandatory Stocks held by roughly 300 private companies, ensuring that 3–6 months of essential food, fuel, and medicine are already decentralized at points of distribution to survive a logistics collapse. This is reinforced by the *National Redoubt*, a vast network of fortified alpine bunkers and secret caches designed to sustain military command and guerrilla resistance during a foreign occupation. The entire framework is self-funded through tiny consumer levies, allowing the state to maintain massive strategic reserves without direct budget costs.
- **Transportation and communication systems** – Networks of tunnels and reinforced infrastructure enable secure mobility and protected logistical supply, including the movement of armed forces when necessary.
- **Missile and chemical protection systems** – Specialized protective rooms and advanced filtration systems provide resistance to chemical and biological threats.

A well-balanced institutional structure also characterizes the Swiss system. While strategic direction is set at the federal level, implementation and maintenance responsibilities are largely delegated to cantonal and municipal authorities. This decentralized execution, combined with strong regulatory oversight, allows for both standardization and local adaptability. Regular inspections, maintenance protocols, and modernization requirements ensure that the infrastructure remains operational over time. Equally important is the role of public preparedness. Civil protection in Switzerland extends beyond infrastructure to include systematic training, public awareness, and community-level engagement. Citizens are expected to be familiar with shelter locations, emergency procedures, and basic survival practices. This integration of infrastructure and societal readiness creates a highly resilient system capable of functioning effectively under extreme conditions. However, the Swiss model also reflects a specific set of enabling conditions. Its high level of economic development, strong institutional capacity, and long-standing culture of compliance make such a comprehensive system feasible. Replicating this model in different contexts requires careful consideration of these underlying factors [5].

Relevance and applicability to Armenia

For Armenia, the Swiss experience offers valuable insights, particularly in legal enforcement, standardization, and long-term planning. The principle of integrating civil protection requirements into construction norms is especially relevant. Introducing mandatory shelter provisions in new residential and public buildings could gradually increase national protection coverage without requiring immediate large-scale investments.

At the same time, direct replication of the Swiss model is constrained by economic and structural realities. Achieving near-total shelter coverage would require substantial financial resources and a level of institutional capacity that may not be immediately attainable. Therefore, a phased and prioritized approach is more appropriate, focusing initially on high-risk areas, critical infrastructure, and densely populated urban centers.

Another important lesson concerns the role of local governance. Switzerland demonstrates that municipalities can play a central role in maintaining and operating civil defense infrastructure. In Armenia, strengthening the capacity of local authorities both technically and administratively would be essential for the effective implementation of a similar system.

Finally, the Swiss emphasis on maintenance and inspection highlights a frequently overlooked aspect of civil defense systems. Building infrastructure alone is insufficient; ensuring its long-term functionality requires continuous investment, monitoring, and regulatory enforcement. For Armenia, this implies the need to develop not only construction standards but also operational and maintenance frameworks.

In conclusion, Switzerland's model illustrates the effectiveness of a legally enforced, universally accessible, and institutionally robust civil protection system. While full replication may not be feasible, its core principles, mandatory integration, high standards, and decentralized implementation can significantly inform the development of a tailored model for Armenia.

Finland

Finland's approach to civil protection and defensive infrastructure is best understood through the concept of "Total Defense"⁸ (*kokonaisturvallisuus*), a comprehensive framework that integrates military, civilian, economic, and societal preparedness into a unified national system. Unlike Israel's threat-driven immediacy or Switzerland's legally enforced universality, Finland's model is rooted in strategic anticipation, shaped by its geopolitical position and historical experience of living alongside a major military power.

The Finnish system is built on the assumption that modern threats are multidimensional, encompassing not only military attacks but also disruptions to energy systems, supply chains, communications, and public order. As such, civil defense is not treated as a standalone sector, but as an integral component of overall national resilience. This systemic perspective enables Finland to prepare for a wide spectrum of crises, ranging from armed conflict to hybrid and non-military threats.

A key feature of the Finnish model is its emphasis on multi-functionality. Protective infrastructure is designed not solely for wartime scenarios but also for peacetime use, which significantly enhances cost-efficiency and sustainability. For example, underground shelters in urban areas often serve as parking facilities, sports complexes, or storage spaces under normal conditions, while being rapidly convertible into fully equipped shelters during emergencies. This dual-use approach ensures that infrastructure remains maintained, utilized, and economically justified [6].

Institutionally, Finland's model is characterized by a high degree of coordination across government agencies, the private sector, and civil society. Responsibilities are clearly distributed: central authorities define strategic priorities and standards, while municipalities are responsible for implementation, maintenance, and local preparedness. Crucially, the private sector plays an active role in maintaining critical infrastructure, including energy, telecommunications, and logistics networks.

Engineering solutions

From an engineering standpoint, Finnish shelters are highly advanced and capable of supporting extended stays. Many are equipped with independent ventilation systems, water supplies, sanitation facilities, and energy reserves, allowing for autonomous operation for periods typically ranging from 7 to 10 days. In addition to shelters, the system includes strategically distributed reserves of food, fuel, medical supplies, and critical equipment, ensuring continuity of essential services under crisis conditions.

Finland employs advanced, multi-layered technological protection mechanisms, including:

- Hybrid shelters – facilities that can serve both civilian protection and healthcare functions during emergencies.
- Independent energy and water systems – designed to ensure operational autonomy for at least 7–10 days during crises.
- Protected communication and information networks – ensuring the secure coordination of population movement and military communication.

⁸ Total Defense is a whole-of-society security strategy that integrates a nation's military and civilian resources to prevent, withstand, and recover from various crises, ranging from natural disasters to hybrid warfare and armed conflict.

- Strategic reserves – including food, medical supplies, fuel, and essential technical equipment [7].

Public preparedness is another cornerstone of the Finnish system. Citizens are expected to maintain a basic level of self-sufficiency, often summarized in the “72-hour preparedness” principle, which encourages households to be capable of sustaining themselves independently during the initial phase of a crisis. This expectation is reinforced through education, public information campaigns, and regular training exercises, fostering a culture of shared responsibility for national resilience. At the same time, Finland’s model demonstrates that resilience is not achieved solely through infrastructure or legislation, but through the integration of systems. The effectiveness of shelters, reserves, and emergency services depends on their coordination with communication networks, governance structures, and societal behavior. This systemic coherence is what distinguishes the Finnish approach from more fragmented models.

Relevance and applicability to Armenia

Finland’s experience offers particularly valuable lessons for Armenia in the development of a hybrid, integrated defense system. One of the most relevant aspects is the concept of multi-functional infrastructure. Given Armenia’s limited financial resources, investing in dual-use shelters such as underground parking facilities or public spaces that can be converted into shelters could significantly improve cost-effectiveness while ensuring operational readiness.

Another critical lesson concerns the integration of civil and military planning. Finland demonstrates that effective defense is not achieved through isolated sectors, but through coordination across all levels of governance and society. For Armenia, this implies the need to move beyond fragmented institutional arrangements and develop a unified framework that links civil protection, military logistics, infrastructure planning, and emergency management.

The Finnish emphasis on self-sufficiency at the household and community levels is also highly relevant. In scenarios where centralized systems may be disrupted whether due to military action or natural disasters local resilience becomes essential. Encouraging households to maintain basic storage of food, water, and emergency supplies could significantly reduce pressure on state systems during crises.

However, certain limitations must be acknowledged. Finland’s model relies on high levels of institutional trust, administrative capacity, and economic stability. Transferring this model to Armenia requires adaptation to local realities, particularly in terms of governance capacity and public engagement. Without strong coordination mechanisms and accountability structures, the effectiveness of such an integrated system could be compromised.

In conclusion, Finland’s “**Total Defense**” model illustrates the importance of integration, multi-functionality, and societal participation in building resilient defense systems. For Armenia, it provides a conceptual foundation for developing a hybrid model that bridges infrastructure, governance, and public preparedness into a coherent and sustainable framework.

Sweden

Sweden’s approach to civil protection and defensive infrastructure represents a modern reinterpretation of the “Total Defense” concept, combining elements of traditional territorial defense with contemporary understandings of societal resilience and hybrid threats. While

historically Sweden reduced its civil defense capabilities following the end of the Cold War, recent geopolitical developments particularly the deterioration of the European security environment have led to a rapid reactivation and modernization of its civil protection system.

Unlike Switzerland's rigidly codified universal shelter system or Finland's deeply institutionalized integration model, Sweden has opted for a more flexible and adaptive approach. Its system prioritizes functional resilience over absolute coverage, focusing on the ability of society to continue operating under stress rather than ensuring full physical protection for every individual.

At the strategic level, Sweden's model is built around the principle that modern conflicts target not only military assets but also critical civilian infrastructure and societal cohesion. As a result, civil defense is designed to ensure the continuity of essential services, including energy supply, communications, transportation, healthcare, and governance [8].

Institutionally, Sweden relies on a distributed governance model. The Swedish Civil Contingencies Agency (MSB) plays a central coordinating role, setting guidelines and ensuring national-level preparedness, while municipalities and regional authorities are responsible for implementation. This structure allows for flexibility and local adaptation, though it also requires strong coordination mechanisms to avoid fragmentation.

Public preparedness is treated as a critical component of the system. The Swedish government has actively promoted awareness through initiatives such as the widely distributed brochure "**If Crisis or War Comes**", which provides citizens with practical guidance on how to prepare for emergencies. Citizens are encouraged to maintain basic supplies and to be capable of sustaining themselves independently for at least several days.

At the same time, Sweden's model reflects a strategic choice: rather than investing in maximum physical protection, it prioritizes adaptive capacity, enabling society to absorb shocks and recover quickly. This approach is particularly suited to addressing hybrid threats, including cyberattacks, disinformation campaigns, and infrastructure disruptions.

Engineering solutions

From an engineering perspective, Sweden emphasizes redundancy and decentralization rather than maximum fortification. Protective infrastructure includes shelters integrated into urban environments, but unlike Switzerland, coverage is not universal. Instead, priority is given to urban centers, critical facilities, and high-risk areas. Many shelters are designed for dual use, similar to Finland, allowing them to function as everyday infrastructure while remaining convertible during emergencies.

A defining feature of the Swedish system is its focus on critical infrastructure resilience. Energy systems are increasingly supported by microgrids and decentralized production, reducing vulnerability to large-scale disruptions. Communication networks are reinforced through redundancy, including backup data centers and secure communication channels. Transportation systems are designed with alternative routes and contingency planning to ensure mobility under crisis conditions.

Sweden employs a range of engineering and infrastructure solutions designed to strengthen national resilience:

- **Protected residential spaces** capable of withstanding medium- and large-scale missile attacks, providing population protection for approximately **72-96 hours**.

- **Microgrids and redundant energy systems**, allowing critical infrastructure and communities to maintain an electricity supply during large-scale power disruptions.
- **Redundant data centers**, ensuring the continuity and security of communication and information flows.
- **Alternative transportation and supply routes**, enabling rapid mobility and secure logistical deliveries during emergencies.

Relevance and applicability to Armenia

Sweden's experience offers important insights for Armenia, particularly in the areas of flexibility, prioritization, and infrastructure resilience. One of the most relevant lessons is the shift from the idea of universal protection toward a more targeted and risk-based approach. Given Armenia's financial and structural constraints, attempting to replicate a Swiss-style universal shelter system may not be feasible. Instead, prioritizing high-risk zones, urban centers, and critical infrastructure could provide a more efficient allocation of resources.

The emphasis on redundancy in energy and communication systems is also highly relevant. Armenia's infrastructure is vulnerable to both physical and cyber threats, and the development of decentralized energy systems, such as microgrids, could significantly enhance resilience. Similarly, investing in backup communication systems and data protection would improve both civilian and military operational continuity.

Another key takeaway is the role of public awareness and preparedness. Sweden demonstrates that relatively low-cost measures, such as information campaigns and basic preparedness guidelines, can have a significant impact on societal resilience. For Armenia, where large-scale infrastructure investments may take time, such measures could provide immediate benefits.

However, Sweden's model also highlights potential risks. A highly decentralized system requires strong institutional coordination and clear distribution of responsibilities. In the absence of such mechanisms, fragmentation and inefficiency may arise. For Armenia, this implies that flexibility must be balanced with clear governance structures and accountability.

In conclusion, Sweden's approach illustrates a shift from protection-centric models toward resilience-oriented systems. By focusing on adaptability, redundancy, and societal preparedness, it offers a pragmatic framework that can complement more infrastructure-heavy approaches. For Armenia, integrating elements of this model could enhance the overall flexibility and sustainability of its defense infrastructure strategy.

Ukraine

Ukraine's experience represents one of the most critical contemporary case studies in civil defense, as its infrastructure and institutional systems have been tested under conditions of full-scale war. Unlike the previously discussed models, which are largely based on preparedness and deterrence, Ukraine's system has evolved through continuous real-time adaptation to active threats, including missile strikes, drone attacks, and large-scale disruptions of civilian infrastructure.

At the core of Ukraine's approach lies a shift from pre-designed, stable systems toward dynamic and adaptive resilience. The war has demonstrated that no static infrastructure, no matter how well designed, can fully withstand sustained attacks. As a result, Ukraine has

focused on combining existing legacy infrastructure, rapidly deployable solutions, and decentralized community-based responses into a flexible and evolving defense system.

One of the most visible components of Ukraine's civil defense is the extensive use of urban underground infrastructure. Metro systems, underground passages, parking facilities, and basements have been repurposed as shelters, enabling rapid protection for large segments of the population during missile attacks. This approach highlights a key principle: in high-intensity conflict environments, speed and accessibility of shelter often outweigh structural perfection [9], [10].

The system is based on three main pillars:

1. Civilian protection – rapid population movement, public and underground shelters, and local community-based protection systems.
2. Military integration – rapid deployment of armed forces, protection of strategic facilities, and management of strategic reserves.
3. Technological and communication security – protected information networks, digital mapping and early-warning systems, and nationwide public alert mechanisms.

Equally important is the role of digital and communication technologies. Ukraine has effectively utilized mobile alert systems, digital mapping tools, and real-time information platforms to inform citizens about threats and guide their responses. These systems significantly reduce reaction time and improve the efficiency of evacuation and sheltering processes.

Perhaps the most distinctive aspect of Ukraine's experience is the role of society itself as a defense resource. Volunteer networks, local communities, and civil society organizations play a central role in logistics, emergency response, and infrastructure support. This societal mobilization compensates for institutional limitations and significantly enhances overall system resilience.

At the same time, Ukraine's experience reveals critical vulnerabilities. Continuous attacks on energy infrastructure have exposed the fragility of centralized systems, leading to widespread blackouts and service disruptions. This underscores the importance of decentralized energy solutions, backup systems, and micro-level resilience areas where Ukraine has been forced to adapt rapidly under pressure.

Engineering solutions

In parallel, Ukraine has actively developed modular and rapidly deployable shelters, which can be installed in urban areas, near schools, hospitals, and public spaces. These structures, while less robust than permanent underground shelters, provide critical short-term protection and can be deployed at scale within limited timeframes. This reflects a strategic trade-off between durability and speed of implementation.

Another defining feature of the Ukrainian model is the emphasis on redundancy and mobility. Strategic reserves of fuel, food, medical supplies, and technical equipment are distributed across multiple locations rather than concentrated in a few large facilities. This reduces vulnerability to targeted strikes and ensures continuity even if part of the system is destroyed. Mobile logistics units further enhance this flexibility, enabling rapid redistribution of resources in response to changing conditions.

Ukraine applies large-scale, multi-layered engineering approaches to civil defense infrastructure:

- **Modular shelters** – rapidly deployable underground or semi-underground structures designed to protect against medium-range missile strikes.
- **Shelter networks** – schools, hospitals, and government buildings integrated with protected underground spaces. “**Warming centers**” provide for warming, hot drinks, and food in the case of an energy and central heating system collapse.
- **Strategic reserves** – storage facilities for food, fuel, medicine, and technical equipment that can be mobilized for emergency and military needs.
- **Redundant transportation and communication systems** – ensuring the secure movement of both armed forces and civilian populations.

Relevance and applicability to Armenia

Ukraine’s experience is particularly relevant to Armenia because it reflects conditions of high-intensity conflict involving missile and drone warfare, which closely resemble the threats Armenia has faced and may face in the future. One of the most important lessons is the need for speed and scalability in civil defense solutions. In the Armenian context, relying solely on large-scale, capital-intensive infrastructure projects may be insufficient. Instead, a combination of permanent and modular shelters offers a more flexible and realistic approach.

The use of existing infrastructure as shelters is another highly applicable lesson. In Armenia, underground spaces, tunnels, basements, and even mountainous terrain can be utilized as natural defensive assets if properly adapted and integrated into a coordinated system.

Ukraine’s emphasis on decentralization and redundancy also provides important guidance. Distributing strategic reserves across multiple regions and developing mobile logistics capabilities can significantly enhance Armenia’s resilience in crises especially given its small geographic size and exposure to border threats.

The role of digital systems and early warning mechanisms is equally critical. Armenia needs to develop a modern, comprehensive alert system that ensures nationwide coverage, including rural and remote communities.

Finally, Ukraine highlights the importance of societal engagement. A prepared and organized population can substantially increase national resilience. For Armenia, this implies the need to develop structured volunteer networks, integrate them into official frameworks, and provide systematic training.

At the same time, Ukraine’s experience serves as a cautionary example. Adaptation during wartime often occurs at the cost of significant losses. Therefore, Armenia’s strategic objective should not be to replicate Ukraine’s reactive model, but rather to anticipate threats and build adaptive capacity in advance.

In conclusion, Ukraine demonstrates that modern civil defense systems must be flexible, decentralized, and capable of rapid transformation under pressure. Its experience provides a crucial bridge between theoretical models and real-world applications, offering both practical solutions and strategic warnings for countries facing similar security challenges.

Iran

Iran’s approach to civil defense and protective infrastructure is fundamentally shaped by its geopolitical environment, long-term exposure to regional tensions, and strategic emphasis on state control over critical systems. Unlike decentralized or society-driven models,

Iran has developed a highly centralized framework in which the state plays the dominant role in planning, financing, and managing both civilian and strategic protection systems.

At the core of Iran's model lies the prioritization of strategic infrastructure protection over universal civilian coverage. The system is designed primarily to ensure the survivability and continuity of critical state functions, including energy production, military operations, industrial capacity, and communication networks. Civilian protection is included within this framework but is often secondary to broader strategic objectives [11].

The overall strategic orientation of the system is based on three primary directions:

- Strategic protection – safeguarding critical national infrastructure and major industrial facilities, including energy, hydrotechnical, and communication networks.
- Civil protection – ensuring the safety of the population in the event of missile attacks as well as chemical or biological threats.
- Technological security – the establishment of protected communication systems, monitoring networks, and nationwide early-warning mechanisms.

From an institutional perspective, civil defense is coordinated through a centralized structure involving the Passive Defense Organization, the Ministry of Defense, and other key governmental bodies responsible for infrastructure, energy, and emergency management. This centralized governance model enables unified decision-making, rapid mobilization of resources, and strict enforcement of security standards across sectors.

Legislation in Iran mandates the protection of critical infrastructure and requires the integration of passive defense measures into major industrial and strategic projects. These measures include physical fortification, spatial dispersion of key assets, and the development of redundant systems to ensure operational continuity under attack. However, unlike Switzerland or Israel, there is less emphasis on mandatory protection measures at the level of individual residential buildings.

Engineering and technical solutions

Engineering solutions in Iran reflect a focus on high-intensity threat scenarios, including potential exposure to missile strikes, air attacks, and even unconventional threats such as chemical or nuclear incidents. Strategic shelters are often designed to withstand extreme conditions and are equipped with independent ventilation systems, reserves of water and food, and basic medical capabilities. These facilities are typically associated with government institutions, military sites, and critical infrastructure rather than widespread civilian use.

A key feature of Iran's system is the emphasis on redundancy and dispersion. Critical facilities, such as power plants, communication hubs, and industrial facilities, are often geographically distributed to reduce vulnerability to targeted attacks. Backup systems, including alternative energy sources and parallel communication networks, are developed to ensure continuity even if primary systems are disrupted [12].

The main pillars of Iran's civil defense system are:

- **Strategic shelters** – designed to withstand nuclear threats as well as chemical and biological attacks. These shelters are equipped with ventilation systems, water reserves, and emergency food supplies.

- **Strategic storage facilities** – centralized reserves of food, medicine, fuel, and technical equipment managed through state-controlled systems.
- **Redundant transportation and communication networks** – ensuring secure mobility for both military forces and civilians while maintaining protected information flows.
- **Emergency energy systems** – backup power infrastructure, including protected substations and redundant hydropower platforms, designed to maintain strategic resilience.

In terms of public involvement, Iran adopts a more controlled approach. Civilian participation is generally limited to basic preparedness training and awareness programs, while operational control remains firmly within state institutions. This contrasts with models such as Finland or Ukraine, where societal engagement plays a more active role.

The financial structure of Iran's civil defense system is also highly centralized. The state provides the majority of funding for strategic infrastructure, while the private sector plays a limited role, primarily in technical implementation and maintenance. This allows for coherent long-term planning but may limit flexibility and innovation compared to more open, partnership-based models.

At the same time, Iran's model demonstrates both strengths and limitations. Centralized control enables consistency, security, and strategic focus, but may also lead to inefficiencies, slower adaptation at the local level, and reduced societal engagement.

Relevance and applicability to Armenia

Iran's experience offers several important lessons for Armenia, particularly in the domain of strategic infrastructure protection and centralized coordination. One of the most relevant aspects is the prioritization of critical systems, energy, communications, logistics, and military infrastructure. In the Armenian context, ensuring the resilience of these systems is essential for both national security and civilian stability.

The principle of dispersion and redundancy is also highly applicable. Given Armenia's vulnerability to targeted strikes, concentrating critical assets in limited locations increases systemic risk. Distributing key infrastructure and developing backup systems could significantly enhance survivability and operational continuity.

Another important takeaway is the role of centralized planning. In the early stages of developing a national civil defense system, strong central coordination may be necessary to establish standards, allocate resources, and ensure coherence across sectors. However, Iran's experience also highlights the risks of over-centralization.

For Armenia, a purely centralized model would likely be insufficient. The absence of strong community-level engagement and private sector participation could limit the system's flexibility and responsiveness. Therefore, while elements of Iran's approach, particularly in strategic infrastructure protection, are valuable, they should be integrated into a broader hybrid model that includes decentralized and participatory components.

Finally, Iran's limited emphasis on civilian-level protection underscores an important lesson: infrastructure alone is not enough. Without an informed and prepared population, even the most robust systems may fail to achieve their intended outcomes.

In conclusion, Iran’s model illustrates the strengths of centralized control and strategic prioritization in civil defense planning. For Armenia, it provides a useful reference point for strengthening state-led coordination and protecting critical infrastructure, while also highlighting the importance of balancing central authority with flexibility and societal involvement.

Table 1⁹

Country	Model	Types of shelters	Level of public preparedness	Financing model	Key strength
Israel	Comprehensive	<i>Mamad</i> (reinforced residential safe rooms), public shelters, underground shelters, strategic shelters, tunnel-based protected spaces	High	PPP	Rapid response
Switzerland	Mandatory	Private household shelters, apartment building shelters, public underground shelters, nuclear-resistant shelters	Very high	PPP	Near-total coverage
Finland	Total defense	Hybrid shelters (civil + medical), urban underground shelters, multifunctional protected spaces	High	PPP	Multi-functionality
Sweden	Total defense	Public shelters, underground shelters, residential protected spaces, convertible shelters	High	PPP	System redundancy
Ukraine	Adaptive	Modular shelters, underground shelters (metro, basements), public shelters, temporary protective spaces	Medium–high	PPP + International	Rapid adaptability
Iran	Centralized	Strategic shelters, deep underground shelters, military shelters, nuclear-protected shelters	Medium	State	Strong central control

Rethinking Civil Defense: from isolated models to integrated resilience

The examination of civil defense systems across Israel, Switzerland, Finland, Sweden, Ukraine, and Iran reveals not merely a diversity of approaches, but fundamentally different ways of understanding security itself. Each country’s model reflects a particular answer to a shared question: how can a state ensure the survival and functionality of both its population and its critical systems under extreme stress?

What becomes immediately evident is that civil defense is no longer a purely technical or military issue. Rather, it is a systemic construct, shaped by the interaction of institutions, infrastructure, society, and threat perception. Countries differ, therefore, not only in resources

⁹ Comparative Table of International Practices

but also in their understanding of what “protection” is and for whom it is being built.

A key dividing line emerges between centralized and decentralized models of protection. Iran represents perhaps the clearest example of a system built on centralized control, where the state assumes primary responsibility for identifying, protecting, and maintaining critical infrastructure. This approach ensures coherence and strategic clarity, particularly in high-risk geopolitical environments. Yet, it also reveals an inherent limitation: the relative passivity of society and the system’s dependence on state capacity.

In contrast, Israel and Ukraine demonstrate that under persistent or acute threat, civil defense tends to evolve in the opposite direction toward decentralization. In Israel, this is institutionalized through the integration of protective spaces into individual housing units, effectively transforming each household into a basic unit of defense. In Ukraine, decentralization emerged less by design and more by necessity, as local communities, volunteer networks, and municipal authorities assumed operational roles in response to the breakdown or overload of centralized systems during wartime.

Between these poles lie countries such as Switzerland and Finland, which have managed to construct balanced hybrid systems. Their experience suggests that the most sustainable models are neither fully centralized nor fully decentralized, but rather those that combine centralized standard-setting with decentralized implementation. This balance allows for both uniformity and flexibility, two qualities that are often tense but essential for resilience.

Another fundamental distinction concerns the scope of protection. Switzerland stands out for its commitment to near-universal coverage, embedding civil defense requirements into building codes and ensuring that the vast majority of its population has access to protective infrastructure. This model reflects a normative choice: protection is treated as a public good, not a selective privilege.

Other countries adopt a more selective logic. Sweden, for example, prioritizes critical infrastructure and urban density, accepting that full coverage may be neither feasible nor necessary. Ukraine, under wartime conditions, has been forced into a similar approach, where the emphasis shifts from completeness to immediacy, ensuring that as many people as possible can access some form of protection, even if it is temporary or improvised.

These differences are closely linked to contrasting engineering philosophies. In Switzerland and Iran, the emphasis is on durability and resistance. Structures are designed to withstand extreme scenarios, including high-impact military or technological threats: By contrast, Nordic countries such as Finland and Sweden increasingly favor multi-functional and adaptable infrastructure, where shelters are integrated into everyday urban life and can be repurposed depending on the situation.

Ukraine introduces yet another dimension: the primacy of speed and scalability. In conditions where threats are continuous and unpredictable, the ability to deploy solutions quickly becomes more valuable than their long-term robustness. This shift challenges traditional assumptions about what constitutes “effective” infrastructure.

Perhaps the most consequential difference across all cases lies in the role of society. In some models, the population is treated primarily as a beneficiary of protection. In others, it becomes an active participant and even a co-producer of resilience. The experiences of Israel, Finland, and especially Ukraine demonstrate that a prepared and organized society can

significantly enhance the effectiveness of formal systems. Conversely, the absence of societal engagement can limit even the most well-funded and technically advanced infrastructures.

A recurring theme across all examined cases is the importance of redundancy. Whether through duplicated energy systems in Sweden, distributed reserves in Ukraine, or dispersed strategic assets in Iran, resilience is consistently built on the assumption that failure is inevitable. The objective, therefore, is not to prevent disruption entirely, but to ensure continuity despite it.

Finally, these systems differ in how they relate to time. Some, like Switzerland's, are the product of decades of consistent planning and incremental development. Others, like Ukraine's, are being reshaped in real time under the pressure of war. Israel occupies an intermediate position, combining long-term institutionalization with continuous adaptation. This temporal dimension is critical, as it highlights that resilience is not a static condition, but an evolving capacity.

Taken together, these observations suggest that there is no single "ideal" model of civil defense. Instead, each country represents a particular configuration of trade-offs between control and flexibility, coverage and efficiency, durability and adaptability, state capacity and societal participation.

For Armenia, the implications are clear. The challenge is not to replicate any one system, but to synthesize a model that reflects its own constraints, risks, and institutional realities. Such a model must combine centralized coordination with decentralized implementation, integrate protection into everyday infrastructure, and, perhaps most importantly, recognize society not merely as a population to be protected, but as an essential component of the defense system itself.

Only through such a synthesis can civil defense move beyond a collection of measures and become what it must ultimately be: a coherent, adaptive, and resilient system.

Armenia

Structural vulnerabilities and the urgency of systemic transformation

The comparative analysis of international experience makes one conclusion unavoidable: the effectiveness of civil defense systems is determined not only by resources or technology, but by the ability to align infrastructure, institutions, and society into a coherent and adaptive whole. When viewed through this lens, Armenia's current state reveals not simply a set of gaps, but a deeper issue: the absence of an integrated system.

Armenia's security environment is defined by a rare combination of risks. Unlike many European states, where civil defense systems are designed primarily as precautionary measures, Armenia operates under conditions of persistent and immediate threat. The experience of recent conflicts has demonstrated that military escalation is not hypothetical, but recurrent. Missile strikes, drone warfare, and targeted attacks on civilian infrastructure are not future scenarios; they are already part of the country's recent past.

At the same time, these external threats intersect internal structural constraints. Armenia's geographic characteristics, including its mountainous terrain, limited strategic depth, and concentration of population in a few urban centers, create both vulnerabilities and opportunities. While certain regions are difficult to access and defend, the same terrain also

offers natural potential for underground and protected infrastructure. However, this potential remains largely underutilized.

A critical weakness lies in the fragmentation of existing systems. Civil defense, emergency response, infrastructure protection, and military planning operate largely as parallel domains rather than as components of a unified framework. This fragmentation leads to inefficiencies, delayed responses, and, most importantly, an inability to scale under crisis conditions.

The issue is particularly visible in the domain of civilian protection. Unlike Switzerland or Israel, Armenia does not have a comprehensive network of shelters integrated into residential and public buildings. Existing facilities are limited in number, unevenly distributed, and often outdated. In many communities, especially in border regions, access to protective infrastructure is either insufficient or absent.

This gap is further exacerbated by the lack of modern early warning systems. While certain mechanisms exist, their coverage is incomplete, and their technological capacity is limited. In high-intensity scenarios, where response time is measured in minutes, such limitations can have critical consequences.

Equally important is the issue of public preparedness. International experience consistently demonstrates that infrastructure alone is not enough. In Armenia, however, civil defense education remains limited, and systematic training programs are largely absent. The result is a population that, despite its resilience, is not institutionally integrated into the defense system.

At the community level, there are signs of potential. Volunteer groups, civil society organizations, and informal networks have demonstrated their effectiveness during crises. Yet, this capacity remains largely unstructured and disconnected from formal institutions. Unlike Ukraine, where such networks have been integrated into operational frameworks, Armenia has yet to develop mechanisms for their systematic coordination.

Another critical dimension concerns strategic infrastructure resilience. Energy systems, communication networks, and logistics corridors remain vulnerable to both physical and cyber disruptions. The lack of redundancy, particularly in energy and data systems, creates systemic risks, where the failure of a single node can lead to cascading effects across sectors.

Storage and logistics infrastructure present similar challenges. Strategic reserves of food, fuel, and medical supplies exist, but their distribution, scalability, and mobility are limited. In crisis conditions, this can significantly constrain both civilian support and military operations.

Taken together, these factors point to a fundamental conclusion: Armenia's challenge is not the absence of individual elements, but the lack of integration, standardization, and scalability. The country possesses fragments of a civil defense system, but not yet a system in the full sense of the term.

At the same time, Armenia's constraints also define the contours of its potential solutions. Limited financial resources make it unrealistic to replicate models based on universal, high-cost infrastructure, such as Switzerland's. Similarly, a purely centralized model, as seen in Iran, would likely prove insufficient given institutional limitations and the need for rapid local response.

Instead, Armenia requires a selective and adaptive approach, one that prioritizes critical areas while enabling gradual expansion. This implies a shift from static, large-scale planning toward modular, scalable, and multi-functional solutions. The integration of shelters into

new construction, the use of existing underground spaces, and the development of hybrid infrastructure capable of serving both civilian and strategic purposes are all essential components of such an approach.

Equally important is the need to rethink governance. A purely top-down system would be too rigid, while a fully decentralized model would lack coherence. The challenge, therefore, is to establish a structure that combines central coordination with local implementation. This includes clearly defined institutional responsibilities, standardized technical requirements, and mechanisms for coordination across sectors.

The role of the private sector and diaspora resources is particularly significant in this context. Given the scale of required investments, state funding alone will not be sufficient. Public-private partnerships, especially in construction, energy, and technology sectors, can play a critical role in accelerating implementation and introducing innovation.

Finally, and perhaps most importantly, Armenia must recognize that civil defense is not only about infrastructure, but also about culture. A resilient system requires a society that is informed, prepared, and engaged. This implies the integration of civil defense into education, the development of training programs, and the institutionalization of volunteer networks.

In this sense, Armenia stands at a critical juncture. The lessons of international experience are clear, but their value lies not in replication, but in adaptation. The task ahead is to transform a fragmented set of capacities into a coherent system, one that is capable not only of responding to crises but of anticipating and absorbing them.

Only through such a transformation can civil defense evolve from a reactive function into a foundational pillar of national security.

Table 2¹⁰

Threat	Type	Impact level	Probability	Proposed solution
Missile strikes	Military	High	High	Shelter network
UAV attacks	Military	Medium	High	Micro-shelters
Cyberattacks	Technological	High	Medium	Data redundancy
Earthquakes	Natural	Very high	Medium	Seismic standards
Energy disruption	Systemic	High	High	Microgrids

Proposed institutional model

If the analysis of international experience demonstrates anything with clarity, it is that effective civil defense systems are never the result of isolated measures. Rather, they emerge from the gradual alignment of institutions, infrastructure, and society into a coherent and mutually reinforcing structure. For Armenia, this implies that the challenge is not simply to introduce new mechanisms, but to fundamentally rethink the architecture through which protection is conceived, organized, and implemented.

The model proposed here builds on this premise by avoiding the two extremes observed in global practice. A fully centralized system, while offering a high degree of control, would likely prove too rigid and resource-intensive within the Armenian context. Conversely, a purely decentralized approach risks fragmentation, inconsistency, and uneven levels of protection. The objective, therefore, is to construct a hybrid system in which strategic

¹⁰ Threat Assessment Matrix (Armenia)

direction is maintained at the national level, while operational capacity is distributed across multiple layers of governance and society.

Such a system must begin with a redefinition of the role of the state. Rather than acting solely as a provider of infrastructure, the state should function as a system integrator, responsible for setting standards, coordinating actors, and ensuring interoperability across sectors. This shift is critical, as the effectiveness of civil defense increasingly depends not on the strength of individual components, but on the quality of their interaction.

Within this framework, infrastructure itself must be reconceptualized. Instead of being treated as a separate domain, protective capacity should be embedded into the fabric of everyday life. New residential and public buildings, for example, should not merely comply with safety regulations in a narrow sense, but incorporate protective features as a standard element of design. Over time, this approach enables the gradual transformation of the built environment into a distributed network of protection, reducing the need for large, standalone investments.

At the same time, Armenia cannot rely solely on incremental change. Certain elements, particularly those related to strategic continuity, require deliberate and targeted development. This includes the creation of protected facilities capable of supporting governance, healthcare, and logistics under crisis conditions. In this regard, Armenia's mountainous geography, often perceived as a constraint, can instead be leveraged as a natural defensive asset, enabling the development of underground and semi-underground infrastructure with enhanced resilience.

Equally important is the relationship between civilian and military systems. The separation that often characterizes these domains in peacetime becomes increasingly untenable under crises. International experience demonstrates that resilience is significantly enhanced when these systems are designed to operate in coordination. For Armenia, this implies not only shared infrastructure where appropriate, but also joint planning processes and interoperable communication systems. Civil defense, in this sense, should not be understood as parallel to military defense, but as one of its essential dimensions.

However, the Armenian case introduces an additional and often underestimated dimension, the presence of active, experience-based volunteer networks that have already demonstrated their relevance in both military and civilian contexts. Organizations such as the “**Yerkrapah**” **Volunteer Union**, **VOMA**, “**Metsn Tigran**”, and the **Armenian Red Cross Society** represent diverse yet highly capable structures that have emerged through different crises and wartime experiences.

Despite their differences, these organizations share a critical common feature: they form the practical foundation of societal preparedness, which remains insufficiently integrated into the formal state system. For instance, “Yerkrapah” and VOMA possess significant military and paramilitary training experience, which can play an important role in territorial defense and emergency response. Initiatives such as “Metsn Tigran” focus more on civic resilience and national preparedness, while the Armenian Red Cross Society brings internationally aligned expertise in humanitarian response, first aid, and crisis management.

At present, however, this capacity operates more in parallel than as part of a unified system. Their activities are often driven by situational mobilization rather than institutional integration.

This creates a paradox in which a trained and motivated human resource base exists, yet the mechanisms required to utilize it effectively at the national level remain underdeveloped.

The proposed institutional model directly addresses this gap. These organizations should not be viewed as external or auxiliary actors, but as structural components of the civil defense system. This does not imply their full incorporation into the state apparatus. A more effective approach would involve their integration through clearly defined roles, unified training standards, and coordinated operational frameworks.

Such integration would preserve their flexibility while significantly enhancing their effectiveness by linking them to formal governance structures. The result would be a system in which volunteer capacity does not merely respond to crises but becomes an integral part of preparedness and resilience-building.

This approach also has important implications for financial and institutional sustainability. Since these networks already exist and possess operational capabilities, integrating them into the system reduces the need to build entirely new structures and accelerates the overall development of national resilience.

At the same time, no institutional model can function effectively without addressing the question of resources. Given Armenia's financial constraints, the development of such a system cannot rely solely on public funding. Public-private partnerships thus become not merely an option, but a necessity. The private sector can contribute both financial resources and technological innovation, accelerating implementation and improving efficiency.

Yet even a well-designed institutional and financial framework remains incomplete without a corresponding transformation at the societal level. One of the most consistent lessons from international experience is that resilience is as much a social phenomenon as it is an infrastructural one. A population that is informed, trained, and organized does not merely benefit from protection; it actively contributes to it.

In Armenia, where informal networks and civic solidarity have repeatedly demonstrated their value, the challenge is not to create such capacity from scratch, but to institutionalize and integrate it. Civil defense education should therefore be treated not as a specialized field, but as a fundamental component of public knowledge. Training programs, community preparedness initiatives, and volunteer networks must be developed in a way that connects them to formal institutions without undermining their flexibility.

Ultimately, the proposed model is built not through the accumulation of individual elements, but through the strengthening of relationships between them. It is grounded in principles that ensure not only stability, but also adaptability in the face of evolving threats.

For Armenia, adopting such a model would represent a shift from a reactive posture toward a proactive and systemic understanding of security. It would redefine civil defense not merely as a technical function, but as a central pillar of national resilience.

In this context, the challenge is not whether Armenia can afford to build such a system, but whether it can afford not to [13], [14].

Proposed strategic infrastructure for Armenia

Strategic and territorial reserves

- **Strategic storage facilities** containing food, medical supplies, fuel, and technical equipment are essential for ensuring resilience during crises. Currently, their number and capacity in Armenia remain limited and insufficient.
- **Mobile storage systems** should be developed to enable the rapid relocation of essential reserves during emergencies, ensuring that both the armed forces and civilian populations can be supplied when primary logistics routes are disrupted.
- It is also necessary to establish a **network of territorial and community-level storage** facilities, which would significantly reduce emergency response time and ensure wider geographic accessibility to critical supplies.

Energy and communication infrastructure

- In emergency situations, **redundant energy systems** must be available to ensure uninterrupted operation of critical infrastructure. This includes the development of microgrids at the community level, allowing local systems to function independently during large-scale power disruptions.
- **Redundant communication networks** are equally important, ensuring secure communication channels for both civilian population movement and strategic military coordination.

Shelter network

- Micro-shelters integrated into residential buildings and schools, similar to Israel's reinforced Mamad safe rooms. This would require the introduction of new construction regulations governing shelter integration in building design.
- Hybrid and underground shelters, capable of serving both civilian populations and strategic infrastructure protection.
- Utilization of Armenia's mountainous terrain for the construction of deeply embedded underground shelters, which could significantly enhance protection against missile strikes and other threats.
- The planning of the shelter network must take into account population coverage, evacuation speed, and logistical accessibility to ensure effective protection during emergencies.

Table 3¹¹

Layer	Components	Purpose	Example
Individual	Mamad, home reserves	Immediate protection	Israel
Community	Shelters, local storage	Local resilience	Ukraine
National	Energy, communications	System continuity	Finland
Strategic	Reserves, tunnels	Long-term resilience	Iran

¹¹ Layered Defense Infrastructure Model for Armenia

Table 4¹²

Level	Actor	Responsibilities
National	Ministry of Defense / Emergency Authority	Strategy, regulation, oversight
Local	Municipalities	Shelter management, training
Private	Businesses	Construction, technology
Public	Citizens	Preparedness

Legislative and regulatory framework

No institutional model, no matter how well designed, can function sustainably without a corresponding legal and regulatory foundation. In the absence of clear rules, standards, and enforcement mechanisms, even the most advanced infrastructure and the most capable institutions risk becoming fragmented, inconsistent, and ultimately ineffective. For Armenia, therefore, the development of a civil defense system must be accompanied by an in-depth review of its legislative environment, ensuring that resilience is not treated as an ad hoc priority, but as a structurally embedded principle.

At present, Armenia’s regulatory framework reflects a partially developed approach to civil protection, where certain elements exist but lack systemic coherence. This creates a situation in which responsibilities are often diffused, standards are unevenly applied, and long-term planning is constrained by institutional ambiguity. Addressing these limitations requires more than incremental amendments; it calls for the articulation of a unified legal logic that connects infrastructure, institutions, and society.

One of the central pillars of such a framework must be the integration of protective requirements into urban planning and construction regulations. International experience consistently demonstrates that the most cost-effective and sustainable way to build resilience is to incorporate it at the design stage. In practical terms, this means that all new residential, public, and strategic buildings should be required to include protective features, whether in the form of reinforced spaces, underground shelters, or dual-use safety zones. Over time, this approach allows the gradual accumulation of protective capacity without the need for large-scale retrofitting programs.

However, regulatory changes in construction alone are insufficient. A comprehensive framework must also define clear standards for strategic infrastructure, including energy systems, water supply networks, communication platforms, and logistics chains. These systems must be designed with redundancy and continuity in mind, ensuring that partial failure does not lead to systemic collapse. Legal provisions should therefore mandate the creation of backup systems, distributed networks, and protected operational centers capable of functioning under crisis conditions.

Equally important is the formalization of roles and responsibilities across different levels of governance. A recurring weakness in many civil defense systems is the lack of clarity regarding who is responsible for what, particularly in rapidly evolving emergencies. In the Armenian context, this challenge is compounded by the coexistence of state institutions, local authorities, and semi-formal actors. A well-designed legal framework must therefore clearly delineate competencies, while simultaneously establishing mechanisms for coordination and joint action.

¹² Institutional Responsibility Distribution

This issue becomes particularly significant when considering the role of volunteer organizations. As discussed earlier, Armenia possesses a unique ecosystem of civic and semi-structured groups such as the “*Yerkrapah Volunteer Union*”, *VOMA*, “*Metsn Tigran*”, and the Armenian Red Cross that already contribute to national resilience in various ways. Yet their integration into the formal system remains incomplete. Legislation should therefore move beyond merely recognizing these actors and instead define their operational status, responsibilities, and rights within the broader civil defense architecture.

Such recognition must be accompanied by standardized training requirements, certification mechanisms, and coordination protocols. This ensures that volunteer engagement enhances, rather than complicates, crisis response. Importantly, the objective is not to bureaucratize these organizations, but to create a shared operational language that allows them to function effectively alongside state institutions.

Another critical dimension of the legislative framework concerns public preparedness. In many countries, civil defense obligations extend beyond institutions to include citizens themselves. While the Armenian context requires careful calibration to avoid excessive burdens, there is nonetheless a strong case for introducing basic preparedness standards at the societal level. These may include mandatory awareness programs, integration of civil defense topics into educational curricula, and periodic training exercises at the community level.

At the same time, the legal framework must address the issue of early warning and information systems. Modern civil defense relies heavily on the rapid dissemination of accurate and actionable information. This requires not only technological infrastructure, but also legal provisions that regulate data sharing, define communication protocols, and ensure the reliability of public alerts. Without such safeguards, even advanced warning systems may fail to produce the desired behavioral response.

Financial regulation represents another key component of the system. Given the reliance on public-private partnerships and diaspora engagement, it is essential to establish transparent and predictable rules governing investment, procurement, and project implementation. Legal clarity in this domain serves not only to prevent misuse of resources but also to build trust among potential investors and partners. In the absence of such trust, even well-designed financial models are unlikely to deliver results.

Finally, the regulatory framework must remain adaptive. One of the defining characteristics of modern threats is their dynamic nature. Cyber risks, hybrid warfare, and climate-related disasters evolve in ways that are difficult to predict through static legislation. As such, the legal system must incorporate mechanisms for periodic review, allowing standards and requirements to be updated in response to emerging challenges.

In this sense, legislation should not be viewed as a fixed set of rules, but as an evolving instrument of governance, one that both reflects and shapes the broader transformation of the civil defense system. Its ultimate purpose is not merely to regulate, but to enable coordination, ensure accountability, and create the conditions under which resilience can be systematically developed.

For Armenia, establishing such a framework would mark a decisive step toward aligning institutional ambition with practical capability. It would transform civil defense from a reactive set of measures into a structured, predictable, and enforceable system capable of supporting both national security and societal stability in an increasingly uncertain environment.

Engineering solutions

If the institutional and legislative frameworks define the logic of a civil defense system, engineering solutions represent its tangible expression. It is at this level that abstract principles such as resilience, redundancy, and adaptability are translated into physical structures, technological systems, and operational capabilities. For Armenia, the challenge is not merely to replicate existing international models, but to develop engineering approaches that are both context-sensitive and scalable, reflecting the country's geographic, economic, and security realities.

A fundamental shift in perspective is required. Engineering solutions should not be conceived as isolated protective elements, but as components of an integrated system in which each element reinforces the others. This implies moving away from reliance on large, centralized infrastructure toward distributed and layered configurations, where protection is embedded across multiple levels of the built and natural environment.

One of the most critical components of such a system is the development of a multi-layered shelter network. International experience demonstrates that no single type of shelter can address the full spectrum of modern threats. Effective systems, therefore, combine different layers of protection, each serving a distinct function. In the Armenian context, this would involve the parallel development of micro-shelters within residential and public buildings, community-level shelters with larger capacity, and strategically located underground facilities designed to withstand high-intensity threats.

Micro-shelters, inspired in part by the Israeli Mamad model, offer a crucial advantage: immediacy. By being physically integrated into everyday living and working spaces, they eliminate the need for long-distance movement during emergencies, significantly reducing exposure time. Their widespread implementation, however, depends on enforceable construction standards and cost-efficient design solutions that can be incorporated into both new developments and, where feasible, existing structures.

At a broader level, community and hybrid shelters serve as critical aggregation and protection points, capable of accommodating larger populations for extended periods. These structures must be designed not only for physical protection, but also for functional autonomy. This includes ventilation systems, an independent water supply, backup energy generation, and basic medical capabilities. Importantly, such shelters can also serve dual-use purposes during peacetime, such as parking facilities or storage spaces, thereby improving their economic feasibility and social acceptance.

A particularly significant opportunity for Armenia lies in the development of underground infrastructure. The country's mountainous terrain, often perceived as a constraint, can instead be leveraged as a strategic advantage. Properly engineered underground and semi-underground structures can provide a high level of protection against aerial attacks and other high-impact threats. When integrated with transport and logistics systems, such infrastructure can support both civilian evacuation and military mobility, enhancing overall system resilience.

Beyond shelters, the robustness of energy and water systems is a defining factor in crisis resilience. The failure of these systems can trigger cascading disruptions, affecting both civilian safety and operational continuity. Engineering solutions must therefore prioritize decentralization and redundancy. The introduction of localized microgrids, supported by

backup generation systems, can ensure a minimum level of energy independence even in the event of large-scale network failure.

Water infrastructure requires a similar approach. Protected reservoirs, distributed storage systems, and emergency purification capabilities can significantly enhance resilience, particularly in rural and border communities where access may already be limited. The objective is not complete autonomy under all conditions, but the ability to maintain essential vital functions during critical periods.

Communication systems represent another domain where engineering decisions have systemic consequences. Modern civil defense depends on the rapid and reliable transmission of information, both for institutional coordination and for guiding public behavior. This necessitates the development of redundant and protected communication networks, including independent channels capable of functioning even if primary systems are compromised. Geographically distributed and physically secured data centers are essential for maintaining operational continuity.

An increasingly important dimension is the integration of digital technologies into civil defense infrastructure. Early warning systems, real-time monitoring platforms, and data-driven decision-making tools can significantly enhance responsiveness and efficiency. However, their effectiveness depends not only on technological reliability but also on usability and public trust. Systems must therefore be designed in a way that ensures accessibility, clarity, and actionable communication for the population.

Mobility and logistics constitute another critical layer of the system. A resilient civil defense structure must ensure the efficient movement of people, resources, and information under both normal and crisis conditions. This requires not only protected transportation routes, but also alternative pathways and modular logistics systems capable of adapting to rapidly changing circumstances. Armenia's terrain presents both challenges and opportunities in this regard, necessitating careful planning while also offering naturally protected routes.

Ultimately, the effectiveness of engineering solutions lies not in the sophistication of individual components, but in their ability to function as part of a coherent system. Redundancy must be balanced with efficiency, protection with accessibility, and technological complexity with practical usability. This balance is particularly important in a resource-constrained environment, where overengineering can be as problematic as insufficient investment.

For Armenia, the objective should not be to maximize protection uniformly across all locations, but to develop a system in which different layers of infrastructure collectively provide a high level of resilience. This requires prioritization, phased implementation, and continuous adaptation, rather than a one-time, comprehensive buildout.

In this sense, engineering is not merely a technical domain within the civil defense system; it is the bridge between strategic intent and operational reality. Its effectiveness ultimately determines whether the broader model remains theoretical or becomes a functioning pillar of national security.

Type of engineering solutions proposed for Armenia:

- Micro-shelters, integrated into residential buildings, schools, and public facilities.

- Hybrid and underground shelters, capable of serving civilian protection, healthcare, and strategic infrastructure needs.
- Independent energy and water systems, designed to ensure at least 7–10 days of operational autonomy during emergencies.
- Redundant data centers and protected communication systems to ensure continuity of governance, emergency coordination, and military communication.
- Strategic, regional, and mobile storage facilities for food, medical supplies, and technical equipment.

Table 5¹³

Solution	Purpose	Duration	Example
Micro-shelters	Immediate protection	24–48 hours	Israel
Hybrid shelters	Multi-purpose	7–10 days	Finland
Microgrids	Energy independence	Continuous	Sweden
Data redundancy	Governance continuity	Continuous	Ukraine

Financial model and Public–Private Partnership (PPP)

The development of a comprehensive civil defense infrastructure in Armenia depends not only on institutional design and engineering capacity, but also on the creation of a financial model that is realistic, flexible, and sustainable. In a resource-constrained environment, the central challenge is not simply to secure funding but to structure it in a way that enables rapid implementation while maintaining long-term stability.

A fundamental premise of this model is that reliance on the state budget alone is neither feasible nor strategically optimal. While public funding must play a leading role, particularly in areas related to national security and strategic infrastructure, it cannot sustain the full scale of development required. Overreliance on public finances would either slow implementation or place excessive pressure on fiscal stability.

For this reason, the proposed framework is based on a multi-source financing architecture, combining public funding, private sector participation, and diaspora-driven resources. The strength of this approach lies not only in diversification but in its ability to support parallel development across multiple components of the system.

The state budget serves as the foundational pillar of the model. Its primary function is to finance core strategic elements that are non-commercial in nature or critical for national continuity. These include protected government infrastructure, strategic storage facilities, and backbone communication systems. In addition, public funding plays a signaling role, demonstrating commitment and reducing uncertainty for other participants in the system.

Beyond this foundational layer, the role of the private sector becomes essential. Public-private partnerships (PPPs) provide a structured mechanism through which financial resources, technical expertise, and operational capabilities can be combined. In sectors such as construction, energy systems, and digital infrastructure, private participation can significantly accelerate implementation while improving efficiency and innovation.

The effectiveness of PPP mechanisms, however, depends on the existence of a stable and predictable regulatory environment. Clear standards, transparent procurement processes,

¹³ Engineering Solutions Overview

and well-defined risk-sharing arrangements are necessary to ensure sustained private sector engagement. Without these conditions, private investment is likely to remain limited or unevenly distributed.

A distinctive feature of the Armenian context is the potential role of the All-Armenian Fund as a strategic financial instrument. The Fund has a unique capacity to mobilize large-scale contributions from the global Armenian diaspora, supported by a relatively high level of public trust and emotional engagement. Temporarily directing its financial flows toward a clearly defined national resilience program would allow for the concentration of resources in a strategically critical domain.

At the same time, the use of diaspora funding requires a high degree of transparency and accountability. Sustained engagement depends on the confidence that resources are allocated efficiently and in accordance with clearly defined priorities. For this reason, the integration of the Fund into the broader financial model should be accompanied by strong governance mechanisms, including transparent reporting, independent oversight, and clear project selection criteria.

Additional external support may serve as a complementary resource, particularly in areas requiring specialized expertise or technological capacity. However, such support should remain supplementary rather than foundational, ensuring that the system retains its strategic autonomy and financial independence.

One of the key advantages of this diversified model is its capacity to enable simultaneous implementation across different sectors. By allocating distinct funding streams to specific components, public funding for strategic infrastructure, private investment for development-linked projects, and diaspora resources for community-level initiatives, the system avoids bottlenecks associated with single-source financing.

At the same time, this complexity requires a high level of coordination. Effective financial governance is essential to ensure that resources are aligned with strategic priorities. Without such alignment, there is a risk of duplication in some areas and underinvestment in others. Integrated planning and transparent allocation mechanisms are, therefore, critical components of the model.

Equally important is the issue of public trust. In the Armenian context, confidence in financial management structures cannot be taken for granted. The proposed model therefore emphasizes simplicity and institutional continuity, avoiding the creation of unnecessary intermediary structures and relying instead on existing mechanisms wherever possible.

Ultimately, the success of the financial model depends not only on the volume of available resources but on the effectiveness with which they are mobilized and deployed. Well-targeted and coordinated investments can achieve significant impact even under resource constraints, provided that they are aligned with long-term strategic objectives.

For Armenia, the establishment of such a financial model is not merely a supporting element of civil defense reform, but a central pillar of its viability. In an environment defined by persistent risk and limited resources, the ability to organize and sustain financial capacity becomes a decisive factor in ensuring national resilience.

Proposed financial model for Armenia:

- Public–private cooperation provides both financial and technological flexibility for the development of defense infrastructure.

- Resources of the All-Armenian Fund (Hayastan All-Armenian Fund) may be utilized, with all funds collected temporarily directed exclusively toward the implementation of this national program.
- Private investments should be attracted in the areas of technology development, construction, and infrastructure maintenance.
- The PPP model enables the simultaneous implementation of multiple projects, accelerating overall program completion while reducing pressure on the state budget.

Table 6¹⁴

Source	Role	Advantage	Risk
State Budget	Core funding	Stability	Budget pressure
PPP	Acceleration	Investment inflow	Governance risks
Hayastan All-Armenian Fund	Supplementary	National mobilization	Allocation efficiency
International Support	External aid	Technology access	Dependency

8. Phased implementation

The implementation of the proposed system should follow a phased yet parallelized approach, allowing key components to be developed simultaneously rather than sequentially. In the initial stage, priority should be given to establishing the legal framework and launching pilot infrastructure projects. This should be followed by the rapid expansion of shelter networks, energy resilience systems, and public preparedness programs. In the final phase, the focus shifts toward full system integration, optimization, and continuous technological modernization.

Phase 1 (1–2 years)

- Development of design frameworks and adoption of legislative standards.
- Establishment of central strategic storage facilities.
- Installation of pilot community shelters in selected regions.
- Funding: state budget + *Hayastan All-Armenian Fund*.

Phase 2 (3–5 years)

- Large-scale construction of hybrid shelters.
- Implementation of nationwide public training and preparedness programs.
- Establishment of redundant data and communication centers.
- Funding: state budget + PPP + *Hayastan All-Armenian Fund*.

Phase 3 (5–10 years)

- Full integration of the national defense infrastructure system.
- Comprehensive implementation of micro-shelters and local protection networks.
- Technical and engineering modernization, incorporating the best global practices.
- Funding: state budget, private sector investment, *Hayastan All-Armenian Fund*, and international support.

¹⁴ Financing Structure

Table 7¹⁵

Phase	Timeline	Key actions	Financing
Phase 1	1–2 years	Legislation, pilot projects	State + Fund
Phase 2	3–5 years	Mass construction, training	PPP + State + Fund
Phase 3	5–10 years	Full integration	PPP + State + Fund + International

Conclusion

The changing nature of modern threats requires a broader understanding of national security, one that extends beyond military capabilities to include the resilience of civilian infrastructure and society as a whole. For Armenia, this shift is not optional but essential, given its geopolitical environment and exposure to both military and non-military risks.

International experience demonstrates that effective civil defense systems are built on the integration of institutional frameworks, engineering solutions, and public preparedness. No single component is sufficient on its own; resilience emerges only when these elements function as a coordinated system. Armenia’s current vulnerabilities, particularly in shelter coverage, infrastructure redundancy, and public awareness, highlight the urgency of adopting such an integrated approach.

The model proposed in this study offers a practical pathway forward by combining centralized strategic planning with decentralized implementation, supported by a hybrid financial structure. By leveraging state resources alongside private sector participation and diaspora engagement, Armenia can accelerate implementation while maintaining financial sustainability.

Ultimately, the development of a comprehensive civil defense system should be understood as a continuous and adaptive process. Its success will depend not only on design, but on consistent execution, institutional coordination, and public involvement. Strengthening these dimensions will allow Armenia to build a more resilient and secure future in an increasingly uncertain environment.

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