



The Subterranean Front

Lessons for Defeating Underground Threats From a Commander on the Front Lines



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Table of Contents

I. Executive Summary	1
II. The Subterranean Experience: A Personal Account	3
III. Evolution of the Subterranean Threat.....	5
A. Pre-World War II	5
B. World War II	5
C. The Vietnam War.....	6
D. Global War on Terrorism	7
E. Today	8
IV. Israel's Enemies and Subterranean Warfare.....	13
A. Gaza Strip	13
B. Lebanon.....	21
C. Iran	28
V. Operating in the Subterranean Domain	29
A. Israel's Underground Warfighters	29
B. Subterranean Missions	30
C. Subterranean Challenges	31
VI. Securing the Subterranean Domain: A Commander's Insights and Recommendations	32
A. Lessons Learned	32
B. Policy Recommendations	43
VII. Conclusion	46
Endnotes	48

I. Executive Summary

Israel's 2023-2024 full-scale war against Hamas in Gaza marked a watershed moment in the history of warfare: the subterranean domain became, for the first time, the primary theater of combat, command-and-control, logistics, resupply, and maneuver in a major war. Through almost three years of near-continuous action against enemies in the subterranean domain, the Israel Defense Forces (IDF) have gleaned hard-won lessons for how to conduct operations in this unique and challenging environment.

This report, co-authored by the person tasked with finding and neutralizing tunnels for the Israeli military—the former Commander of the Yahalom unit, the IDF's elite combat engineering unit—distills those lessons and details how Israeli, U.S., and other partner militaries can implement these lessons and prepare to face adversaries lurking belowground.

Tunnels have been utilized in wartime for thousands of years, dating back to the Peloponnesian War, and featured prominently in World Wars I and II, the Vietnam War, and the Global War on Terrorism, among other wars. But now, adversaries possess the tools and know-how to build tunnels with remarkable ease and sophistication.

Both Hamas and Hezbollah sought to use subterranean warfare to neutralize Israel's technological superiority and reduce the IDF's conventional advantages. For over a decade, Hamas transformed its Gaza tunnel network into a complex, multi-layered subterranean system, including command, logistics, movement, and survival arrangements. To Israel's north, Hezbollah similarly adopted a subterranean system with order-of-battle logic to counter any Israeli ground invasion—and stage its own.

Difficult battlespaces are nothing new for Israel. Yet the complexity of the subterranean domain, particularly in Gaza, still posed a massive challenge to this first-class, adaptive military.

Like Israel, the United States faces subterranean threats along its borders. In June 2026, officials uncovered a sophisticated tunnel between the United States and Mexico, reportedly a storage and transit hub for firearms and explosives. This was not anomalous. Since 1990, American security officials have located at least 236 cross-border tunnels entering the United States—potentially just a fraction of the total that exist.

Nor are underground threats only a problem for America's homeland security—they pose a risk to U.S. interests worldwide. The U.S. military will almost certainly have to detect, neutralize, and potentially fight in the subterranean domain abroad in the future. It already has. U.S. forces fought against al-Qaeda's labyrinthine mountainside tunnels during the 2001 invasion of Afghanistan.

In the 2026 conflict with Iran, the United States has faced an adversary making extensive use of underground missile and drone bunkers. Iran has also built elaborate, deeply buried, and reinforced subterranean chambers in an attempt to shield its nuclear program from airstrikes. Moreover, leading U.S. adversaries China, Russia, and, in particular, North Korea each have developed advanced subterranean networks of their own. These underground sites are designed to shield prized military assets and facilitate combat operations against U.S. allies and partners—and the United States itself. In North Korea's case, according to defectors, vast subterranean networks exist to facilitate a future invasion of South Korea.

State actors are not the only entities threatening the United States from belowground. Foreign drug cartels in Latin America, an increasing target of U.S. military operations in recent years, have utilized the subterranean domain for smuggling operations and to shield senior leadership.

Compounding each of these individual subterranean challenges is the fact that they are part of the same global threat family tree—one whose roots stretch underneath the borders of the United States and its partners. Thanks to modern advances in commercial engineering, telecommunications, and global commerce, dangerous U.S. adversaries spanning several continents—including transnational criminal syndicates, terrorist organizations, and rogue states like Iran and North Korea—can exchange subterranean construction expertise and materials at the touch of a button.

Yet there is, at a minimum, circumstantial evidence that this international subterranean construction network goes further than information or material exchanges. Iranian regime funders, Hamas and Hezbollah terror operatives, North Korean engineers, and smugglers from transnational drug cartels have reportedly aided with Hezbollah's underground sites in prior years, and it is quite plausible these efforts have extended to tunneling along America's southern border.

Now, Israel has extensive, hard-won operational experience confronting subterranean threats that can help inform and prepare U.S. forces to fight against adversaries who seek to gain advantage from burrowing underground. Israeli elite combat engineering forces, led by one of the co-authors, have spent nearly three years locating, mapping, and neutralizing terror tunnels. These forces have been operating in Gazan and Lebanese tunnels where every step forward is fraught with danger; where an almost superhuman level of concentration and bravery is required; and where troops conduct painstaking work without any sunlight, fresh air, or even a moment's rest. Those subterranean efforts are unearthed for the first time in this paper.

Israel has generated a long list of lessons learned from fighting against enemies that made the underground world their center of gravity. Out of all these lessons, though, each one reinforces a broader overlapping takeaway: subterranean threats can no longer be viewed as isolated battlefield threats that require an engineering response separate from other warfighting operations. They are increasingly an integral part of modern warfare and threats to homeland security—and must be treated as such.

Five lessons in particular stand out from Israel's subterranean combat experience. First, defeating underground threats requires integrating physical, intelligence, and technological measures, ideally via a subterranean-focused command center, to paralyze the adversary's underground operations. Second, in areas where enemy tunnels exist, aboveground and belowground operations must be synchronized and viewed as a single, cohesive effort. Third, traditional military concepts, language, and structures must adapt to the subterranean era, which in turn means treating the underground domain not as a specialized issue but one that impacts the entire conflict—including information warfare. Fourth, even in peacetime, a major strategic priority must be monitoring and disrupting the illicit supply chains—including the transfer of both materials and expertise—that enable the enemy's subterranean infrastructure to emerge down the line. Finally, subterranean threats transcend international borders, and so must the response to them—one that leverages the full array of research, development, and funding the United States and its partners and allies can bring to bear.

For the United States, implementing these lessons learned requires swift action. Even Israeli officials and soldiers, who faced underground threats for many years before October 7, 2023, had to adapt quickly to—and were often caught off-guard by—the challenges of Gaza and Lebanon's underground battlespaces. American officials should heed this lesson. That is, well before subterranean combat ever begins, it is critical to have sufficient protocols and technology in place for countering and neutralizing underground threats. Failure to do so ahead of time risks grave consequences and will force modern militaries to begin putting these systems into place only once fighting has begun, or after a cross-border tunnel attack has occurred. However, by then, it may be too late.

Attaining full readiness against subterranean threats is no mean feat. It requires a large toolkit, some of which Israel had to develop very quickly, or is still developing, to counteract its adversaries' use of the subterranean domain—and which the United States, to a considerable degree, still lacks. These include:

- Sufficient intelligence-collection means regarding the subterranean domain;
- Technological capabilities to enable underground detection and mapping;
- Adequate engineering capabilities to neutralize underground threats;
- Rapid response forces to address subterranean threats;
- Procedures and technology to ensure command-and-control functions remain robust while forces operate underground;
- The establishment of an intelligence center responsible for fusing subterranean and aboveground intelligence, involving political and military leaders to determine how to approach subterranean threats; and
- Greater multinational cooperation—particularly, but not exclusively, between the United States and Israel—regarding the subterranean domain, including technological research and development, and sharing best practices.

To implement these lessons, Israel should establish a new Subterranean Domain Directorate; create a strategy to better unify its disparate intelligence systems; accelerate and expand ongoing research into advanced detection and neutralization technologies; strengthen coordination between forces in different theaters; and more proactively incorporate the subterranean warfare concept in IDF training and strategic planning.

For the United States, this means doing more to prepare its troops, and law enforcement, to address the future threats of the subterranean domain. To that end, it should work to deepen U.S.-Israel cooperation on dealing with subterranean threats; accelerate investment in research, development, and acquisition regarding subterranean detection and neutralization tools; and, ideally, do more to engage other relevant partners—including South Korea, Taiwan, and others—in these critical efforts.

II. The Subterranean Experience: A Personal Account

The report's co-author, Colonel (COL) David, has strategized about, prepared for, and directly experienced subterranean threats like few others have. During his many years spent as an elite combat engineer, COL David fought underground, worked to locate, map out, and neutralize tunnels, and helped the IDF adapt and innovate in the subterranean domain.

COL David's role at the forefront of the IDF's subterranean efforts during Israel's post-10/7 multi-front war yielded a number of valuable strategic insights about the subterranean challenge—both those that Israel faced within the Middle East, and those well beyond. In sharing his experience, insights, and overall perspective, he hopes to help the United States and its partners and allies prepare for the subterranean threats of the present and future.

To help illuminate the unique challenges that the Western world faces from the subterranean domain, COL David is providing his personal reflection on what it is like to operate in the eerie underground world of Hamas and Hezbollah terrorists.

It is difficult to convey what it is like to spend any amount of time, let alone many hours, in a Hamas or Hezbollah tunnel dozens of feet underground.

Even for the co-author, who spent time in countless such tunnels before, and during, his time as Commander of Israel's Yahalom elite combat engineering unit, it is still a challenge to capture the experience and explain it to the world. Yet, for the first time ever, he is publicly doing so here.

Below is his account.

"Suffice it to say, these tunnels are well below ground level, with no quick way out. Operating within this environment is exceptionally challenging.

Only extensive training and specialized preparation can help personnel function effectively in such conditions. The transition from daylight to darkness occurs within seconds, and the feeling of isolation from the world sets in immediately.

Beyond that, the underground environment is confined, crowded, filled with turns and intersections, and often extremely difficult to navigate. Maneuverability is also impeded by the shields, respiratory devices, weapons, and other bulky items that forces must carry.

The air inside the tunnels is frequently humid and very thick. Breathing it in can, at times, be very unpleasant. In some areas the temperature can be extremely high, while in others a sharp coolness is noticeable, depending on how far underground one is.

Movement in the tunnels is always very slow and deliberate, with every turn, doorway, and new tunnel segment requiring constant attention and caution. The dangers loom, literally, at every corner. Unlike combat on the surface, where soldiers can observe terrain and identify threats from a distance, visibility inside tunnels is often limited to only a few meters. It is truly an experience unlike any other.

Every step forward may reveal a new threat that necessitates action, requiring an exceptionally high level of concentration for extended periods.

At the same time, of course, luxuries that are often taken for granted—sunlight, fresh air, and opportunities to take a pause—are out of the equation. In fact, carbon dioxide detectors are required for subterranean navigation, given the potential for dangerous chemical buildup.

The health risks of sustained underground presence are obvious. At times, combat engineers operated in the tunnels for several days with minimal breaks during the Swords of Iron War. In these circumstances, dehydration can quickly take effect.

It is hard to overstate the need for sustained mental, not just physical, toughness in such scenarios. While Yahalom forces are extensively trained to master breathing techniques, maintain mental focus, and keep calm in any situation, the tunnel environment is one that is nonetheless very challenging to get used to, even if no enemy threats were present.

The possibility of encountering enemy fighters, explosive devices, booby traps, or hostages creates an unusually tense operational environment in which every tactical decision could have major strategic consequences. Underground warfare demands not only professional expertise and combat skills, but extraordinary mental resilience, discipline, and patience.

What stunned me most was my first encounter with the underground strategic sites in southern Lebanon. Pictures and videos do not fully convey their size and sophistication. The terrorists that built them could live there for months at a time and launch attacks from there, too. It was stunning to see."

III. Evolution of the Subterranean Threat

The use of tunnels in warfare is neither unprecedented nor novel. In fact, underground warfare dates back several millennia and has featured prominently in modern wars as well.

What is new, and highly consequential, is the nature of what Israeli forces encountered belowground in the post-October 7 (10/7) multi-front fight against Iranian proxies. The sheer size, complexity, geographic scope, and engineering feats of the hundreds of tunnels under Gaza and Lebanon—built with commercially available technology—illustrate the subterranean threat, in its most potent-ever form, that confronts modern militaries.

A. Pre-World War II

Tunnel warfare is nearly as old as interstate war itself. The Assyrian Empire, as early as 880 BCE, used tunnels to stage attacks against enemy forces, and Sassanid forces used tunnels to weaken Roman fortifications in the 3rd century CE.¹ Despite the advent of new, sophisticated technology, subterranean warfare only became more common in modern times. It played a role, to varying degrees, in the American Civil War, the Russo-Japanese War, and World War I.² In World War I, both the British and German militaries made liberal use of tunnels to reach enemy positions and plant explosives, generating significant casualties on both sides.

B. World War II

During World War II, subterranean warfare shifted from the complementary effort it had been in World War I to a pillar of the enemy force's strategy. Imperial Japanese soldiers effectively used the Pacific islands' caves and tunnels to shield themselves from U.S. airstrikes. Like Hamas eight decades later, in anticipation of ground combat, Japanese forces used camouflaged tunnel entrances to set booby traps, preposition arms caches, and prepare to launch ambush attacks against advancing ground forces.



Soldiers from the U.S. Army's 147th Infantry Regiment work to clear Japanese combatants from Iwo Jima's cave networks in 1945 (Colorized). Source: Warfare History Network.

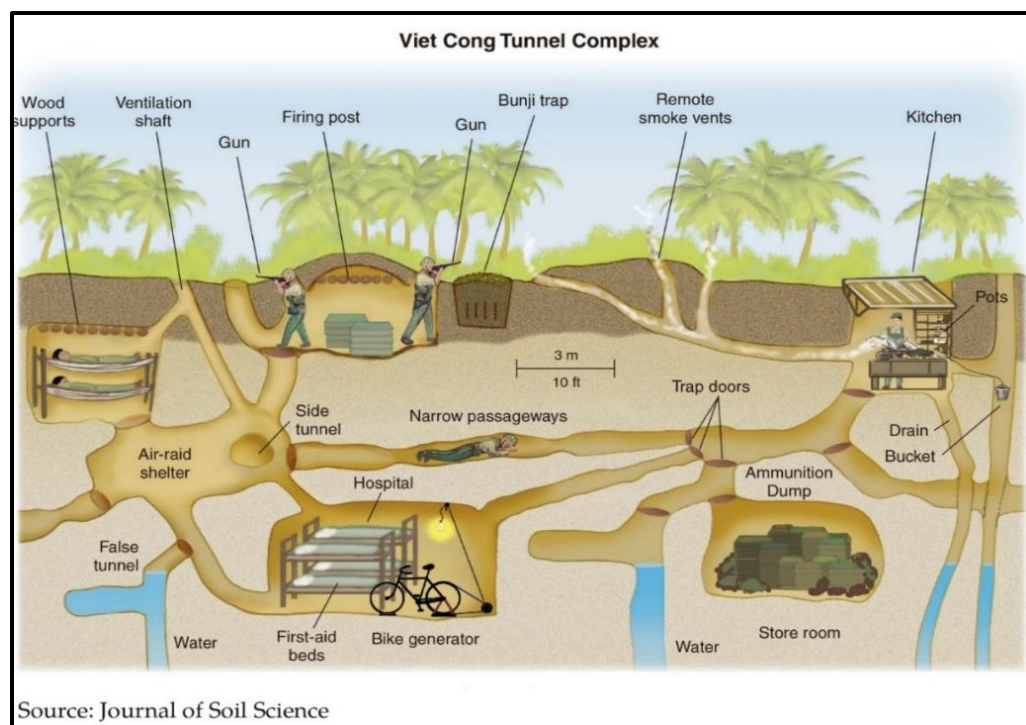
Japan's asymmetric tactics greatly complicated U.S. operations and Washington lacked easy answers. During the grueling two-month Battle of Peleliu in 1944, U.S. forces dropped over 600 tons of munitions in an air and ground campaign that resulted in over 1,000 American deaths.³

The United States would face an even steeper challenge several months later, in 1945, at the Battle of Iwo Jima. During those clashes, U.S. troops encountered the closest historical analogue to Hamas's tunnel maze: a sophisticated 7-mile-long tunnel complex with over 1,000 entrances, weapons stockpiles, fortified chambers, and ventilation systems.⁴ After U.S. airstrikes proved ineffective, Marines staged an amphibious landing—and quickly faced ambushes from roughly 20,000 Japanese soldiers operating from the tunnel network.⁵ Approximately 2,300 American troops were killed or wounded in the first day of the battle, which continued for another 35 days and ultimately claimed the lives of nearly 7,000 U.S. soldiers.⁶

The Pacific campaign highlighted how subterranean warfare provided weaker forces with an asymmetric advantage. For the first time in combat history, tunnels were used both for defense—to evade airstrikes—and for offense—ambushes, explosive traps, and so on—in a protracted campaign. Guerrilla fighters around the world would study these lessons for decades to come.

C. The Vietnam War

It did not take long for subterranean tactics to evolve further. In the Vietnam War, the Viet Cong guerrilla force utilized the underground domain for much more than fighting. The infamous 150-mile Cu Chi tunnel networks along the Vietnam-Cambodia border were used as makeshift logistics nodes and arms depots, but also bedrooms, kitchens, and hospitals to enable fighters to stay for extended periods.⁷



Like Hamas six decades later, the Viet Cong used tunnels for a range of functions, including as operational headquarters, arms caches, and command-and-control nodes.⁸ Some Viet Cong tunnels were located at depths of 50 feet and contained up to four different levels, enabling a single tunnel network to have multifaceted uses.⁹ In sum, the Viet Cong operated at least 4,800 tunnels across western Vietnam's jungles and marshlands.¹⁰

Detecting the Viet Cong's tunnels was difficult; neutralizing them proved to be even harder. The U.S. Army first relied on dispatching soldiers who were physically small enough to crawl through the tunnels to clear them and then detonate them with grenades.¹¹ Yet this led to numerous American soldiers being grievously injured, killed, or at a minimum traumatized from their harrowing experiences. In addition, the tunnels were able to withstand explosive charges due to the soil's high iron oxide content, leading the United States to resort to launching strike campaigns with B-52 heavy bombers—a tactic which also failed to destroy many Vietnamese tunnels.¹²

D. Global War on Terrorism

U.S. intelligence collection and precision strike capability grew significantly in the decades following the Vietnam War. Yet America's asymmetric enemies continued to keep pace, using, like the Viet Cong, the subterranean domain to avoid being seen or struck. Time and again, going underground gave terrorist foes a low-cost asymmetric advantage that helped offset world-class Western intelligence collection and strike capability.

Operation Enduring Freedom

During the U.S. operations in Afghanistan, in 2002, American forces faced real challenges when operating against terror tunnels in the rural Afghanistan-Pakistan (Af-Pak) border region, many left over from the Soviet-Afghan War. There, the craggy, cavernous terrain helped conceal terror operatives from American aircraft. The tunnels were extensively stocked with arms and food, ensuring fighters had no need to re-emerge from them. In a single al-Qaeda complex, American forces located over 70 interconnected tunnels, reinforced with steel beams, that contained extensive fuel reserves; a dedicated command-and-control hub; an advanced communications center; and over a million pounds of explosives and weaponry.¹³ It took U.S. forces nine days of operations to clear the tunnel complex.¹⁴

More generally, al-Qaeda's cavernous complexes, embedded in mountainsides and often fortified further with steel or granite, diminished conventional airstrikes' efficacy.¹⁵ This was by design: al-Qaeda's then-leader, Osama bin Laden, had sought to gain an asymmetric advantage and offset American strike capabilities. According to a U.S. Army report, bin Laden "imagined he could lure American ground forces into a trap and defeat them at Tora Bora, just as he had beaten the Soviets in 1987 in the Battle of Jaji. He believed Tora Bora's terrain would mitigate much of the United States' technological advantage."¹⁶ What ultimately proved effective against al-Qaeda's subterranean sites was the U.S. military's use of B-52 bombers and ground-penetrating GBU-24 and GBU-28 precision munitions, as well as "heat bombs," also known as thermobaric weapons.¹⁷ However, these measures are impractical against subterranean sites in urban settings like the Gaza Strip, particularly if tunnel-bound hostages are a factor.

Operation Enduring Freedom also showed how terrorist organizations accrue great benefits from porous borders, and even more so if tunnels are involved. During U.S. operations along the Afghanistan-Pakistan border, over 800 terrorist operatives—including Osama bin Laden—evaded capture by fleeing to Pakistan.¹⁸

While they did not escape Afghanistan via cross-border tunnels, these terrorists exploited inadequate border security, unique knowledge of local routes and topography, and local tribal dynamics and networks. Similarly, Hamas operatives would exploit each of these features in their yearslong cross-border tunneling scheme along the Egypt-Gaza border that enabled the group's vast military buildup. Both cases demonstrate that subterranean threats do not respect borders, and require closely coordinated multinational efforts to counteract.

Operation Serval

In the early 2010s, multiple Islamic terrorist groups in the West African nation of Mali joined forces against Mali's central government. With its military ill-equipped for counterterrorism missions, Bamako asked France to do the job. Yet French forces quickly found themselves outmatched. The jihadists built an elaborate tunnel complex wide enough for big vehicles, which allowed the terrorists to move arms, fuel, food, and construction materials to build yet more tunnels—all by vehicle, and largely undetected.¹⁹ They amassed over 100 drums, or roughly 21,000 liters, of gasoline in their hideouts, which doubled as command posts.²⁰

French forces had great difficulty locating jihadist fighters in this vast expanse, let alone neutralizing them.²¹ Even France's advanced Mirage F1 CR reconnaissance aircraft proved insufficient for the task, leading French forces to request U.S. surveillance drones in the middle of the mission. While France ultimately prevailed against the radical militants, it required 15 months of strenuous effort and several casualties. Of course, had French forces fought these militants on any other battlefield, France would have been the clear favorite. Yet that is the precise nature of modern-day subterranean warfare: it is the great equalizer.

E. Today

Subterranean threats, the underground equivalent of the aboveground drone threats facing modern democracies, are a persistent challenge for Western countries. They are hard to detect, map out, or neutralize. A skilled non-state terrorist adversary can use them for a variety of purposes, including criminal and military means, but also to serve a broader delegitimization strategy by maximizing the risks posed to nearby civilians. Moreover, there are few modern nations genuinely equipped to tackle a threat vector that poses a major asymmetric imbalance: like drones and cheap missiles, they are cheaper and easier to construct than they are to detect and destroy—and, like drones, just a handful can inflict a serious price on the defender at low cost to the attacker.

Another form of underground threat also faces the United States and its Arab, European, and Middle East partners—state actors' use of the subterranean domain. Advanced underground chambers, passageways, and logistical networks are weaponized by countries such as Iran and North Korea, and to a lesser extent China, to shield strategic assets and even launch missile strikes. These subterranean sites provide a considerable degree of secrecy as well, which is why Iran used them for covert uranium enrichment activities. Russia, too, has used tunnels to attack Ukrainian forces and is exploring greater use of the subterranean domain against Ukraine. This variety of the subterranean threat, though largely out of the scope of this paper, is worthy of detailed study. Indeed, it promises to play an increasingly central role in the global security landscape going forward.

i. China

The Chinese Communist Party (CCP) is no stranger to the subterranean domain. As early as 1980, U.S. intelligence agencies determined that China had developed a network of advanced underground command-and-control nodes and military headquarters across the country, including some tunnel sites capable of accommodating aircraft.²² It also spent years developing a subterranean nuclear processing facility, Project 816, located in central China's Sichuan Province. Though China discontinued the project in 1984, it used it to hone the engineering expertise relevant to its future underground activity. China claims the complex stretched for over 13 miles, contained artificial caves and over 130 separate underground roads and passageways, and was built to withstand conventional airstrikes, major earthquakes, and nuclear attacks.²³

Yet China's underground weaponization is not a relic of the past. According to public estimates, China has, since the 1980s, constructed over 3,000 miles of tunnels to form what it calls an Underground Great Wall. These networks are located in mountainous areas near the China-Mongolia border, which are replete with cliffs, canyons, and ravines that conceal Chinese military and nuclear activity below. That project aims to shield part of the Chinese nuclear arsenal, and, potentially, help the People's Liberation Army (PLA) stage nuclear or conventional missile launches from underground.²⁴ Located within these deeply buried corridors are heavy-duty trucks, rail cars, and fixed launch sites to enable rapid—and largely undetectable—missile strike preparation.²⁵

The Underground Great Wall is not an anomaly—it is part of an ongoing Chinese subterranean warfare strategy. According to the Pentagon, China maintains several thousand underground facilities, which are used to support a range of military purposes including defense logistics, command-and-control, missile arrays, and naval operations.²⁶ Moreover, Chinese planners are not getting complacent.

China continues to construct more subterranean facilities each year.²⁷ As technological advances evolve, these “Dragon Lairs,” as Chinese military strategists call them, are also becoming progressively easier and faster to build.²⁸ According to a U.S. Air Force assessment, “the use of heavy tunneling machinery ... has doubled efficiency [in subterranean construction] and projects that could span a decade or more now typically take two years to complete.”²⁹

However, among U.S. nuclear-armed adversaries, China is not alone in its subterranean technological advances. Its neighbor and junior partner, North Korea, has kept pace with, and perhaps eclipsed, China with its own decadeslong underground warfare preparations.

ii. North Korea

North Korea threatens U.S. treaty ally South Korea in a number of ways, most notably with its ballistic missile arsenal and the threat of an overland ground invasion. Yet North Korea has also prepared for an war on the peninsula by digging thousands of tunnels under its soil, most dating back several decades.³⁰ One such passage was built to facilitate the movement of around 30,000 North Korean troops per hour.³¹

The North Korean tunnel network is not a mere historical artifact. At least 5,000 tunnels reportedly remain active underneath the country, many fitted with weapons depots and located hundreds of feet belowground.³² In total, an estimated 8,000 underground facilities permeate the country.³³ Reportedly, some may store elements of North Korean chemical, biological, radiological, and nuclear (CBRN) programs.³⁴ In 2024, U.S. and South Korean forces conducted advanced joint drills simulating operations in North Korean tunnels, suggesting that North Korea's subterranean activity continues to threaten South Korea's national security.³⁵

In addition, North Korea's underground network is massive in scope and largely uncontained. It reportedly spans over 500 miles and has several thousand underground installations, including over 150 factories, intended to be impervious to airstrikes.³⁶ Parts of the network contain rail cars to transport troops and arms, and experts estimate North Korea could surge tens of thousands of troops across the South Korean border through its subterranean network.³⁷ At least four known tunnels have been uncovered under the demilitarized zone (DMZ) separating the two nations, some at depths of over 1,100 feet.³⁸ However, that may be a small fraction of the total. North Korean defectors assert that at least 21 such tunnels exist, including some that cross into South Korea itself.³⁹

North Korea's military strategy revolves around concealment and deception, both of which are advanced by underground activity. To this end, North Korea has built underground air bases connected to runways in the sides of mountains, as well as subterranean bunkers.⁴⁰ Additionally, according to U.S. military

assessments, the North Korean military stations warships in caves linked by tunnels to the Yellow Sea and the Sea of Japan.⁴¹

iii. Russia

Russia's warfighters repeatedly encountered subterranean threats in past decades, often struggling mightily against them. In the 1980s, Soviet forces struggled against jihadist forces operating from cave and tunnel networks across rural Afghanistan, and the Russian military again had to fight an underground enemy in the 1990s during Russia's war with Chechen rebels. In both wars, Russian soldiers incurred heavy casualties as a result of frequent ambushes and sniper attacks enabled by the enemy's use of tunnel networks.

Now, it is Russia that is using underground sites to its wartime advantage. During the Ukraine war, Russia utilized subterranean infrastructure in two major battles: the Battle of Avdiivka in February 2024 and the Battle of Sudzha in March 2025. By maneuvering through underground pipelines, sewage systems, and water culverts, Russian forces sought to evade detection by Ukrainian surveillance drones, infiltrate Ukraine-held positions, and launch surprise attacks.⁴² This tactic failed in Sudzha, but helped Russia force a Ukrainian retreat from Avdiivka, which had been an important element of Ukraine's defensive line.⁴³ Moscow has also sought Chinese financial, and possibly technical, assistance with a proposed major tunnel project to shield Russian supply lines from Ukrainian strikes.⁴⁴

In addition to using tunnels for kinetic warfare, Russia and its allies are also using them to wage hybrid warfare. With Russian backing, Russia's close ally Belarus has begun recruiting Middle Eastern specialists to build tunnels underneath the Belarus-Poland border.⁴⁵ These tunnels, at least four of which were detected by Polish authorities in 2025, are reportedly part of Russian gray-zone operations to subvert and threaten Europe.⁴⁶ The tunnels may have been transited by individuals posing security risks to Poland—a close partner of Ukraine—or other European countries.

iv. The U.S. Homeland

The United States need not look to the opposite side of the world to find examples of cross-border tunnel threats. This danger manifests itself on America's own southern border with Mexico, over 1,900 miles long. In recent years, drug cartels with close ties to Iranian proxies Hamas and Hezbollah have worked to move illicit narcotics and arms across the southern U.S. border.⁴⁷ These very drug cartels have also devoted significant resources to constructing advanced tunnels linking Mexico and the United States.

One recent example sheds light on the sophistication and dangers of cross-border tunnels. U.S. authorities announced on June 1, 2026, that they had uncovered a sophisticated tunnel in Otay Mesa, California, that crossed into Tijuana, Mexico. The tunnel stretched for nearly 2,000 feet, at a depth of over 50 feet.⁴⁸ It contained reinforced walls, an embedded rail line, and other advanced features, like a hydraulic lift for entry and exit, sophisticated ventilation systems, and extensive electrical wiring.⁴⁹ Drug cartels used the tunnel to transport narcotics, though authorities suspect the subterranean chamber doubled as a storage hub and transit point for firearms and explosives.⁵⁰

This was not an isolated case—far from it. Other significant, advanced tunnels authorities have discovered along the U.S.-Mexico border in the past decade include:

- An over 4,300-foot-long cross-border tunnel that reached depths of 70 feet discovered near San Diego, California, in January 2020.⁵¹
- A 2,000-foot-long cross-border tunnel found near San Diego in March 2020.⁵²

- A cross-border tunnel found in El Paso, Texas, in January 2025 connected to the city's storm drainage system.⁵³
- A 3,000-foot-long cross-border tunnel that reached depths of 50 feet found near San Diego in April 2025.⁵⁴
- A cross-border tunnel uncovered near El Paso in June 2025.⁵⁵

Each of these tunnels contained extensive ventilation and lighting systems, while two contained underground rail tracks like those in Hamas's tunnels. One contained an elevator at its opening in Mexico and contained high-voltage cables snaking through the tunnel.⁵⁶ Many of these tunnels' characteristics resemble some of those constructed by Hamas and Hezbollah operatives in the Middle East.

Like Hamas's subterranean network, the cartels' underground labyrinths are sometimes replete with entry and exit points, adding to the challenges of interdiction. That is the case in the El Paso, Texas, storm drain system long used by cartels to move goods and people between the United States and Mexico. Within this one network, 32 entry points exist along the Rio Grande River that marks the international border, and hundreds of different exit points permeate underground El Paso.⁵⁷ According to U.S. officials, a high volume of people, among them potential national security threats, have used this network to infiltrate into the United States in recent years.⁵⁸

These anecdotal snapshots only paint a partial picture of the tunnel threat's magnitude, but the data is even more jarring. According to U.S. government figures, 236 illicit cross-border tunnels have been discovered entering the United States since 1990, most along the southern border.⁵⁹ Many of these subterranean networks were located near large cities like San Diego, California. The Department of Justice has revealed that "there have been 99 subterranean passages discovered in the Southern District of California since 1993," of which "28 were considered sophisticated."⁶⁰ Since 2006, at least 15 advanced tunnels, each bearing similar hallmarks, have been uncovered crossing the California-Mexico border alone, which comprises just seven percent of the total U.S.-Mexico border.⁶¹ In total, over 65 cross-border tunnels have been located along the southern U.S. border since 2011.⁶² And, of course, those discovered tunnels may be a fraction of the total number built—as many are likely still unknown to authorities.

Tunnels also pose security threats along America's northern perimeter. The U.S.-Canada border, which stretches for over 5,500 miles across mostly rural areas, is porous and mostly undefended aboveground, let alone underneath it.⁶³ While few tunnels have been uncovered along the U.S.-Canada border, in 2005, federal agents discovered an approximately 360-foot-long tunnel used for drug trafficking that breached the American border in Washington state. The sophisticated cross-border tunnel was reinforced with lumber, concrete, and metal bars and equipped with lighting and ventilation.⁶⁴

Notably, the tunnel threats facing the United States are similar to those facing Israel and other U.S. allies and partners worldwide. The actors involved in building these tunnels are also linked to each other. For example, the U.S. Drug Enforcement Administration (DEA) has revealed that there is "a clear connection" between Hezbollah's global network and transnational cartels.⁶⁵ More to the point, as a recent Pentagon publication put it, "Hezbollah [likely seeks to] ... collaborate with smugglers or cartels in northern Mexico [by] sharing and applying their tunneling expertise."⁶⁶

v. Modern Subterranean Threats: Main Challenges

Subterranean warfare has fundamentally and rapidly evolved in the 21st century. Whereas during World War II and the Vietnam War, enemy forces exploited rural terrain to wage underground warfare, the inverse is now the case: jihadist terrorists now increasingly fuse urban and subterranean warfare to exponentially increase the threat to opposing forces.⁶⁷ Significantly, due to modern international

commerce and communication tools, elaborate subterranean networks are easier than ever for terrorist groups to build—and, as the Gaza war showed, costlier for democracies to counteract. There are several reasons why this is so.

First, the machinery and other equipment needed to construct and use subterranean infrastructure are now commercially available worldwide, due to the advent of online commerce and global shipping. These developments have made it easier than ever before for nefarious actors to build sophisticated tunnels and hide, maneuver, and fight in the subterranean domain. To give just one example, as will be detailed, Hamas purchased the equipment to build and navigate its tunnels on publicly accessible commercial platforms.

Second, the global linkages among entities—including terrorist organizations and rogue states like Iran and North Korea—enable U.S. adversaries to share know-how about subterranean construction methods and resources. Of course, the internet is a dangerous accelerant: tunnel construction manuals have been posted in online jihadist forums.⁶⁸ But the global subterranean construction network is more closely linked than that. Iranian funders, North Korean engineers, and expert smugglers from Mexican drug cartels aided with Hezbollah's tunnel construction in prior years, and it is possible—even likely—that collaboration extends to America's borders.

Third, the subterranean domain compounds the dangers of urban warfare. Even absent the underground dimension, the urban battlespace is fraught with risk and confers many advantages to terrorist forces. Tunnels significantly increase enemies' ability to stage ambushes, move forces and materials, and conduct command-and-control. They complicate enemy detection—increasing terrorists' ability to blend in with civilian populations—and reduce airstrikes' effectiveness. They also require complementary efforts for tunnel detection, mapping, and neutralization, and underground combat.

Fourth, the subterranean domain exacerbates political and informational challenges for Western, law-abiding militaries. Hamas constructed its tunnels and their entrances in civilian sites for this very purpose: delegitimizing Israel by seeking to maximize aboveground, i.e., visible, damage, while Hamas's own role as instigator is metaphorically and physically shielded from sight.



When the urban and subterranean domains combine in a battlespace, Western forces face a dual threat. They must confront combat challenges on the one hand, and a political and informational one on the other. Terrorist actors' deliberate blurring of the line between combatants and civilians significantly complicates target identification, restricts operational freedom of action, and presents complex moral, legal, and operational dilemmas for Western armed forces.

None have done this more sweepingly, and to more tragic effect, than Hamas did in the Swords of Iron War. Hamas terrorists brazenly embedded command posts, weapons depots, launchers, and command-and-control infrastructure underneath residential facilities. This was a deliberate effort to deter strikes and constrain Israel's freedom of action. And, of course, this technique sought to make every IDF tactical success a strategic drawback. Hamas senior leader Yahya Sinwar privately acknowledged that this strategy aimed to make an Israeli military victory in Gaza "worse than defeat" by harming Israel's global standing.⁶⁹ The main takeaway is that in modern subterranean warfare, Western militaries are not waging a combat war alone—they are fighting an information one, too.

IV. Israel's Enemies and Subterranean Warfare

What is now an underground battlespace in the Gaza Strip and Lebanon did not materialize overnight. It happened over the course of decades, aided by foreign engineering know-how. Yet what is particularly striking is that these subterranean sites were built with the same commercial tools accessible to any adversary group worldwide who has access to the internet and sizable funds. These criteria apply to terror groups and cartels operating across the world—including in the Western Hemisphere.

In the Gaza Strip, Lebanon, and Iran, enemy forces' subterranean construction capabilities have evolved dramatically. The transition from narrow guerrilla tunnels to deep, wide, and heavily fortified tunnel complexes underscores that the underground domain is no longer a merely tactical layer of the battlefield. It has become a central strategic dimension of modern hybrid warfare. These facilities provide protection from airstrikes and preserve operational continuity under sustained bombardment in prolonged conflicts. In many cases, they include concealed launch sites or storage infrastructure that can only be neutralized through precise intelligence, specialized munitions, or dedicated counter-subterranean operations.

This subterranean model, pioneered and refined by the Iranian regime and exported to its regional proxies—chiefly, Hamas and Hezbollah—is reshaping the current and future battlefield. It reflects a strategic doctrine of survivability, denial, and endurance, in which underground infrastructure becomes a core pillar of military power for hybrid and non-state adversaries confronting technologically superior Western militaries.

A. Gaza Strip

Hamas's tunnels began quite modestly and were used for relatively benign activity—yet, in under 30 years' time, became a sprawling and highly advanced underground strategic fortress extending for hundreds of miles underneath the Gaza Strip.

Many, by now, know of Hamas's tunnel warfare strategy or have seen photographs or videos of the terror group's underground labyrinth. However, it is still difficult for someone who has not been inside these tunnels to appreciate the full scope of Hamas's yearslong engineering efforts and what they produced.

In one of the most extraordinary battlefield preparations in history, Hamas terrorists—first gradually, then quickly over several years—constructed a labyrinth of tunnels across the Gaza Strip to insulate its fighters and assets from airstrikes while shielding its infrastructure underneath civilian centers. The result was over 300 miles of tunnels stretching across the entirety of Gaza, the majority of which had been

constructed in just 10 years with relatively basic industrial equipment. No non-state actor has ever achieved an equivalent engineering feat, and Hamas's terror tunnel system eclipsed even most of the world's subways in length.

i. Hamas's Subterranean Evolution

While Gaza's tunnel networks would become a significant threat to Israel's security, they had modest and fairly innocuous origins. In fact, Gaza's tunnels predate Hamas itself and initially had no connection to terrorism whatsoever.

a. Gaza-Egypt Tunnels for Population Movement (1980s-1990s)

After Israel ceded the Sinai Peninsula to Egypt in 1982 as part of the two nations' 1979 peace agreement, the Gaza Strip, which remained under Israeli control, became divided from neighboring towns in Egypt. In particular, the city of Rafah, which straddles the Gaza-Egypt border, was effectively split by an international boundary. To bridge this gap, Palestinian families on either side of the border began constructing tunnels in the mid-1980s.

b. Hamas Begins Exploiting and Expanding Tunnels (1990s-2000s)

However, the tunnels' benign beginnings would soon turn sinister. Seizing the opportunity afforded by the cross-border tunnels, in the 1990s, smugglers began to transport goods and ammunition across the border through this subterranean network. It did not take long for Hamas, founded in 1987 and by the early 2000s a formidable terror force, to exploit Gaza's tunnels for terrorist activity. Between 2001 and 2004, Hamas terrorists used the tunnels to stage five terror attacks against Israeli military outposts, primarily by rigging the tunnels with explosives.⁷⁰ These incidents included June and December 2004 attacks that killed one and five Israeli soldiers, respectively.⁷¹

What at the time were a handful of tunnels running within Gaza and into Egypt soon metastasized into a much larger threat. Following the Second Intifada and Israel's September 2005 disengagement from the Gaza Strip, Hamas became stronger and more creative. In addition, Israel's departure from Gaza meant that Hamas operatives could operate more freely within the enclave, including belowground.

c. Hamas Starts Building Tunnels Into Israel (2000s)

Around this time, Hamas began experimenting with constructing terror tunnels to penetrate Israeli territory. Kicking off an avalanche of disasters for Israeli security, Hamas operatives built a tunnel that crossed into Israel in 2006, and on June 25, 2006, used it to kidnap Israeli soldier Gilad Shalit and kill two Israeli soldiers. Shalit would later be released in exchange for over 1,000 terrorists, including Hamas leader and October 7 architect Yahya Sinwar.

After the Shalit kidnapping and repeated Hamas rocket attacks, in 2008, Israel initiated a major campaign in Gaza called Operation Cast Lead. The campaign was tactically successful, showcasing Israel's ability to strike Hamas from the air, ground, and even sea. Yet it may also have been a Pyrrhic victory, in that Israel's overwhelming military success convinced Hamas it needed a new plan. Hamas operatives realized they were no match for the Israeli military in any domain on earth—so they went underneath it.

d. Hamas Increases Size and Sophistication of the Gaza Strip's Internal Tunnel System (2010-2023)

When Israeli forces next entered Gaza in a major campaign in 2014 after a major Hamas kidnapping and triple murder, they found tunnels: lots of them. Over 30 of them, in fact. While somewhat of a surprise to Israeli authorities, they quickly responded. Israel developed techniques using a combination of explosives, advanced technology, and physical barriers to neutralize each of the 32 Hamas tunnels. In 2016, Israel

even launched an investigation to identify and neutralize any tunnels entering Israel from Gaza, after it previously, between 2012 and 2014, located four such tunnels.

While Israel was busy shielding its border from Hamas's underground intrusions into Israel, Hamas was working beneath the surface inside the Gaza Strip. Given Israel's well-publicized efforts around this time to secure its underground border with Gaza, Hamas realized it had no prospects of burrowing into Israel itself. Instead, in 2016, it adopted the Jericho Wall plan, a large-scale effort to out-innovate Israel and threaten it with a major attack. Gaza's internal tunnel network was at the center of this project.

Over the next seven years, Hamas created a sprawling maze of command posts, weapons depots, logistics routes, and intelligence and computer hubs in Gaza's tunnels that complicated Israel's efforts to even monitor Hamas activities, let alone Israel's ability to quickly prevail in a future war with the terror group.

ii. How Hamas Constructed its Tunnels

Building tunnels, particularly sophisticated and extensive subterranean networks, is a long and arduous process. But it was a process that Hamas operatives mastered over time nonetheless.

Initially, Hamas terror operatives used bulldozers, excavators, and heavy equipment to create the initial penetration point. Industrial drills were then used to drill into the dirt, horizontally, a process which gradually created the now-infamous winding passageways. Then, concrete was applied above the tunnels, to create fortifying arches, and along the floor to ensure the tunnels could sustain weight.

Hamas used small, logistics tunnels to reinforce and maintain larger tunnels and build additional ones. Terrorists used multiple means to get rid of the discarded sand and dirt, including by placing them in bags and carts inside tunnel segments, or in some cases moving them aboveground to specialized warehouses. As they moved forward, they fortified the tunnels. And repeat.

iii. Features of Hamas Tunnels

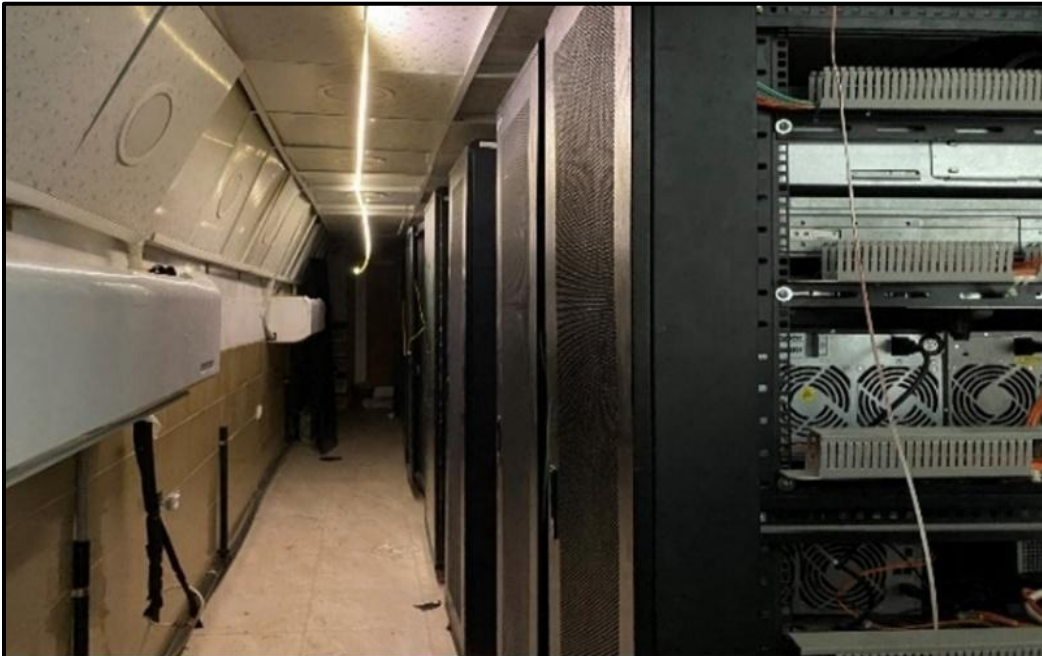
Over the course of many years, Hamas had constructed a spider web of tunnels stretching hundreds of miles under Gaza. Rather than the individualized underground segments for storage and ambushes that Israel had anticipated, the vast sprawl of tunnels was almost entirely interconnected. Beyond that, the tunnels themselves were highly sophisticated. Some Israeli officials dubbed the system the Gaza Metro.

Hamas, in effect, had created underground highways—and not just for foot traffic or large carts. In some cases, Hamas tunnels literally functioned as roads to transport materiel and terror operatives, engineered to have sufficient width and height for vehicles to pass through. Some of the Hamas tunnels capable of accommodating vehicles crossed between Gaza and Egypt, helping explain the sheer volume of dual-use components and weapons materials Hamas had been able to accumulate over the years leading up to the war.

Though the average tunnel was located at a depth of over 20 feet beneath the surface, several were buried at depths of 50 meters, or approximately 165 feet below the surface. At certain points, Hamas tunnels extended as far belowground as 70 meters, or over 200 feet. Cable wires enabling direct communication between underground sites were fused into the sides of the tunnels, as was extensive wiring for electricity generation and to support the use of power-drilling equipment.

And, without fail, Hamas's tunnels were built, by design, underneath civilian infrastructure in serial violation of the laws of armed conflict. These included some of the most sensitive targets imaginable, including hospitals, mosques, and UN sites. Hamas high-value data center sites were routinely constructed below United Nations Relief and Works Agency (UNRWA) facilities in Gaza. One notable example, pictured

below, was a major Hamas data hub under the UNRWA headquarters in Gaza with wiring extending up to the aboveground UNRWA facility's server room.⁷²



One of Hamas's major strategic facilities, which housed a central data hub, was located underneath UNRWA headquarters in Gaza.

Source: The Wall Street Journal



Hamas's underground network was built under residential areas, endangering civilians. Above: an uncovered camouflaged Hamas tunnel shaft adjacent to Gaza's Shifa Hospital.

Source: Israel Defense Forces

Hamas operatives frequently used the basements of civilian residential buildings as the starting point for tunnel construction. From there they either drilled downward—in the case of deeply buried tunnels, like the strategic sites that housed key weapons assets, brigade leaders, and command posts—or diagonally, in order to create the mazelike maneuver tunnels that zigzagged across Gaza’s underground.

The tools Hamas used to build, despite the terrifying engineering feats they yielded, were fairly rudimentary and can be purchased easily online. These include jackhammers, industrial demolition platforms, and other power drilling tools. Underscoring the tunneling expertise shared between the two terror groups, Hezbollah used similar drilling equipment to penetrate limestone when creating its own tunnels in southern Lebanon.

It was not just in the tunnels’ construction that Hamas terrorists used commercially available means. To navigate within the subterranean world, Hamas operatives used Light Detection and Ranging (LIDAR) devices purchased from online commercial vendors like Alibaba. Israeli officials located night-vision goggles and Nokia telecommunications systems in the tunnels, also purchased on the open market.⁷³

Hamas tunnels displayed an advanced degree of engineering prowess. In order to have access to oxygen, Hamas operatives constructed vents that pulled and pushed air to and from aboveground, enabling long tunnel stays. These ventilation systems had their own wiring system as well. In addition, Hamas constructed underground data centers.



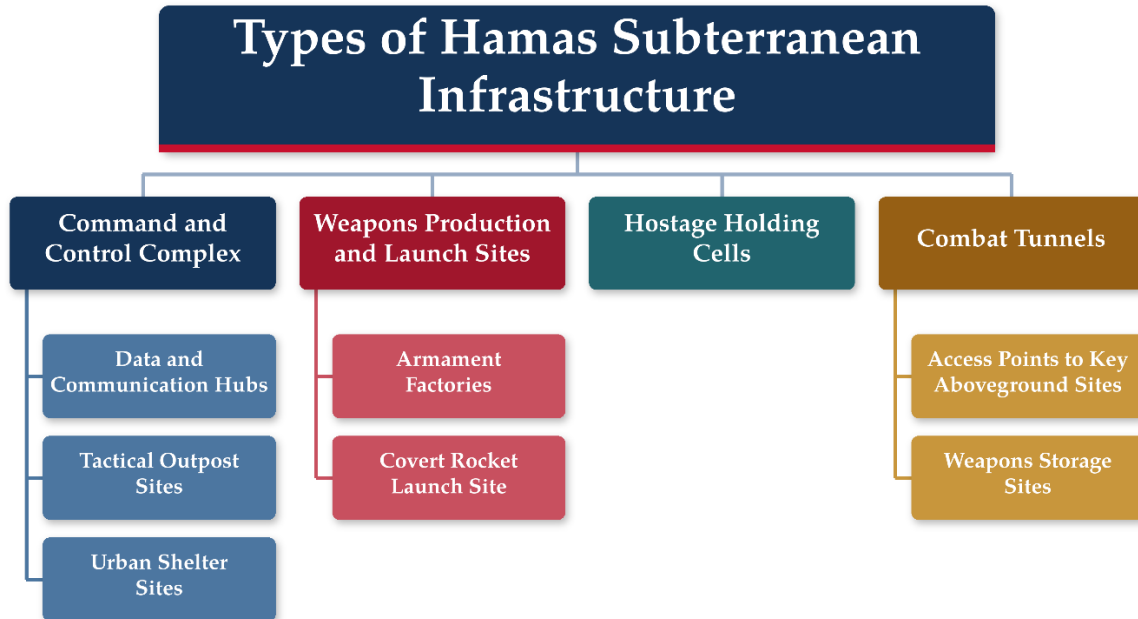
Example of a tunnel in the cross-border tunnel network between the Egyptian side of Rafah and the Gazan side of Rafah, consisting of over 250 tunnels used primarily for weapons smuggling.

Source: IDF materials provided to JINSA.

While not directly part of Hamas’s combat operations, the terror group was able to put up such a ferocious fight against Israel because of another subset of its tunnels: its smuggling tunnels extending into Egypt. Yahalom forces, as part of Operation Walls of Steel to seal Gaza from additional contraband flows, uncovered no fewer than 243 tunnels along the Gaza-Egypt border. Some were crude tunnels used to move merchandise; others were advanced smuggling tunnels that Hamas exploited for its gain; and a number were tunnels that Hamas operatives constructed, reinforced with concrete and steel. The latter category was how Hamas smuggled in items to arm and enrich itself, and prepare for battle.⁷⁴

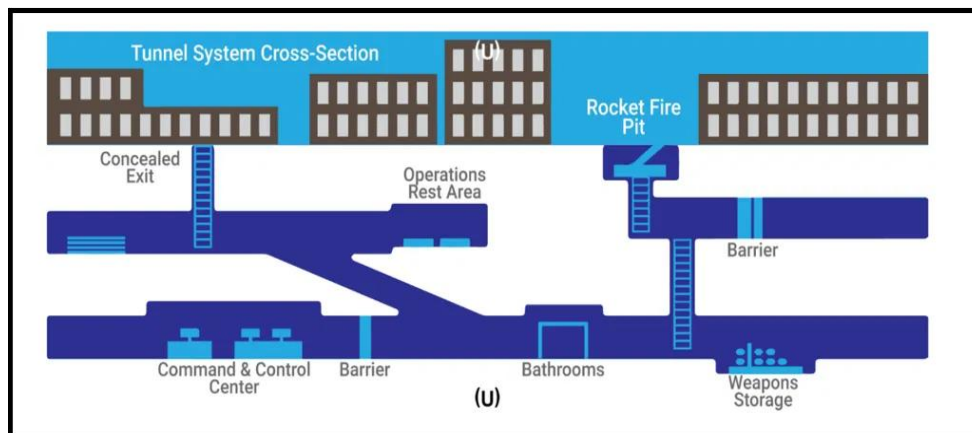
iv. How Tunnels Advanced Hamas's War Strategy

Only some of the tunnels were the tactical types which Israel had envisioned and previously uncovered in earlier campaigns in Gaza. These were mostly shallow tunnels, used to shift around fighters, stage ambush attacks, and shield terrorist leaders. Others were more complex and served a range of purposes, including command-and-control and intelligence hubs. Israel uncovered Hamas tunnels with pulley contraptions and even small factories.



While Israel was fighting on the ground, Hamas established an entire kill chain from the subterranean dimension. In one underground chamber, raw materials were gathered; in a second, industrial equipment would be used to construct crude projectiles; and in a third, a rocket could be launched from a camouflaged tunnel shaft. None of this would be perceptible to an Israeli surveillance drone overhead.

Hamas Tunnel Diagram



Source: Center for Lessons Learned, U.S. Army

Hamas's tunnels, though similar in characteristics, were used for six main purposes. These included command-and-control sites; weapons manufacturing sites; infiltration and ambush tunnels; maneuvering and attack tunnels; hostage tunnels; and high-value data centers. Hundreds of each kind permeated Gaza's underground world. The command-and-control hubs were linked by wiring to the locations of brigade and battalion leadership. The high-value hubs, which contained server banks, provided Hamas with critical means of intelligence gathering, data centralization and processing, and communications.

Later, during the early stages of the Gaza war, Hamas worked to make the tunnels a minefield, literally, for IDF forces poised to enter them. They were outfitted with a number of devices intended to detect, maim, and kill IDF soldiers. These included numerous booby traps, like initiation-trigger explosives; remotely monitored cameras; motion detectors; unmanned weapons that could be detonated; and pyrotechnic devices.

Command-and-Control Complexes



The underground living quarters—and command-and-control hub—of a senior Hamas operative.

These facilities were designed to enable the enemy to command-and-control military operations while maintaining continuity of command during airstrikes and ground maneuver operations. The complexes typically consisted of large underground chambers containing communication systems, cameras, monitors, command posts, and wired communication networks connecting battalion and brigade headquarters. They also included living quarters as well as food, water, weapons, and ammunition.

Most command complexes were directly connected to the operational tunnel network of their respective sector, enabling commanders to move rapidly between command functions and operational activities.

Military Production Facilities

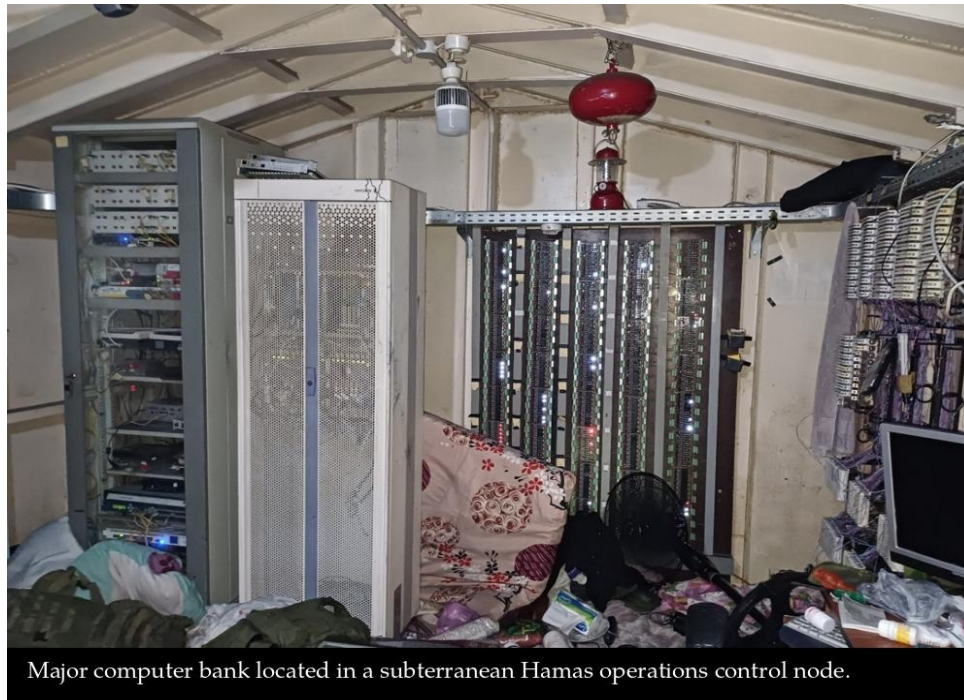
Production facilities consisted of large underground chambers used by Hamas for the manufacture, refurbishment, and enhancement of weapons and military equipment. These sites were remarkably sophisticated. In a single subterranean chamber, Hamas operatives developed a complete production chain involving the assembly of raw materials, the insertion of explosives, and the use of power equipment to fuse them into a final product.

Equipment found in these facilities included tools for dismantling ordnance, systems for separating explosive materials, metalworking and plastic-processing equipment, lathes, and additional industrial machinery. In some cases, storage areas for raw materials were also identified, enabling continuous weapons production despite prolonged siege conditions and ongoing combat operations.

Communications and Data Processing Complexes

Hamas maintained communications and server facilities that functioned as underground data centers, designed to preserve Hamas's command-and-control capabilities even during high-intensity and extended military operations.

The complexes contained servers, computers, communications equipment, network cabinets, and extensive cable infrastructure connecting various headquarters and operational elements. Security measures included surveillance cameras, warning systems, and dedicated guards. In several cases, the facilities were connected to independent power sources, enabling continued operations even if aboveground electrical infrastructure was damaged or destroyed.



Major computer bank located in a subterranean Hamas operations control node.

Hostage Holding Cells

These facilities were constructed as underground detention sites. They typically consisted of small rooms secured by steel doors, multiple security barriers, and layered protective measures intended to prevent escape or rescue attempts.

During the early stages of the war, some of these facilities were used to hold Israeli hostages. As the conflict progressed and IDF forces gained control of portions of the tunnel network, Hamas adapted its methods and began moving hostages between various tunnels and temporary hiding locations in an effort to complicate detection and rescue efforts.



Combat Tunnels

Combat tunnels represented the most common component of Hamas's underground system. Physically, these tunnels often resembled other underground passages; however, their primary purpose was to facilitate movement, force protection, and sustained combat operations. They typically included ammunition storage areas, living quarters for operatives, and access points leading to tactical sites.

These tunnels were equipped with surveillance cameras to support situational awareness and withdrawal operations. They frequently contained obstacles, blast doors, barricades, and extensive explosive devices positioned both at entrances and throughout the tunnel network. In many cases, the tunnels were deliberately designed to serve as kill zones for IDF forces, with the intent of luring troops into confined spaces, isolating them, conducting ambushes, detonating explosive devices, and creating opportunities for kidnappings.

Additionally, combat tunnels enabled the movement of personnel, commanders, and weapons between different sectors without exposure to aerial surveillance or airstrikes, making them critical to Hamas's overall military strategy and operational concepts.

B. Lebanon

Though not as well-known or expansive as Hamas's tunnel network in Gaza, Hezbollah constructed its own tunnel networks over the past two-and-a-half decades, work that may be ongoing. These tunnels pose their own threat to Israel, being physically more challenging to neutralize than Hamas's own tunnels and located farther into enemy territory.

Hezbollah's tunnels, like Hamas's, displayed a high degree of sophistication and technological prowess. These subterranean sites' advanced nature suggests that Hezbollah benefited from foreign tutelage, at a

minimum with technical expertise, and potentially with actual construction, in building them.⁷⁵ Iran certainly played a role in this regard, and other foreign actors seemingly did as well.

To understand how Hezbollah's subterranean fortifications advanced the organization's strategy, it is necessary to first examine Hezbollah's strategic aims more broadly. The terror group's organization chart, too, is crucial context for its subterranean efforts.

Hezbollah's operating structure involved a complex hierarchy with a range of formations. Hezbollah geographic divisions located in southern Lebanon were tasked with a certain sector. These networks were the operational backbone of Hezbollah. Lastly, there were the strategic formations—responsible for missiles, command-and-control, and more.

The formation in which Hezbollah invested the most prior to October 7 was its elite special forces unit, the Radwan forces. The Radwan forces' purpose was to attack and inflict great losses on the IDF, to massacre civilians, and ultimately to complete Hezbollah's big plan to conquer Israel's Galilee region. The plan, "Conquer the Galilee," was developed by Hezbollah over the course of 20 years, and involved an accelerated force buildup sponsored by Iran, which contributed enormous funds to this effort as part of its strategy to create a ring of fire encircling Israel with terror proxies.

The Radwan forces were supposed to invade the State of Israel by surprise and occupy the Galilee region—and even hold that vast territory for multiple days. That was supposed to be done by using dozens of battalions of the Radwan unit, a plan similar to that of Hamas's October 7 invasion of Israel which utilized its own special forces, the Nukhba unit. Each Radwan battalion had a specific mission for how to penetrate Israel: crossing a specific ridge, fence, valley, etc. In parallel with the attack, a thousand Hezbollah missiles were to be used to paralyze the IDF's operations and target Israeli population centers. At the same time, a plan was created to wear down the IDF before it even crossed the border, in the phase of accumulating forces, and create friction with the Radwan forces and rocket barrages.

Hezbollah's plan was that, when the IDF started a maneuver, the frontline village commands would receive the mission to wear down, kill and kidnap soldiers in order to stop the IDF advance. Hezbollah planned to manage all of this and actively facilitate it (fires, intelligence, command-and-control, etc.) from its strategic infrastructure in Beirut and northern Lebanon, but a geographic command was also built in areas across southern Lebanon for this mission.

To achieve all this, Hezbollah built its strategic formations to align with the plan. It conceived a strategic projectile launch plan; an overall command-and-control plan; and a supporting logistical plan. Each of these concepts was to be supported by infrastructure north of the Litani River. And, of course, tunnels played a key role.

i. Hezbollah's Subterranean Evolution

Hezbollah first started building tunnels in the mid-2000s. These were used for two purposes: one, to serve as fortified storage sites to shield its missiles from Israeli airstrikes, and two, to infiltrate its operatives into Israel for localized attacks like kidnappings and ambushes. In its first major direct war with Israel in 2006, Hezbollah stored over 1,500 launchers within its extensive tunnel system.⁷⁶

After the war, Hezbollah built on its existing underground infrastructure—which included underground rocket warehouses and sites chiseled into rock, effectively manmade caves, to store ammunition and explosives—to use its underground domain for more daring operational purposes.

Beginning in the late 2000s, Hezbollah adopted its most ambitious and dangerous plan to date. In addition to creating its Radwan elite force unit, it developed plans for a massive invasion of Israel's Galilee region, designs which were closely held among a select number of leaders.

This special, internally classified project to conquer the Galilee involved building tunnels into Israel that would enable terror operatives to infiltrate into Israel on a massive scale.⁷⁷ Even around the time of Hamas's October 7, 2023, attack, Hezbollah had a daring plan to infiltrate approximately 3,000 terrorists from its elite Radwan unit into northern Israel, which it never executed.⁷⁸

Hezbollah's invasion plans did not remain on the drawing board for long. Its operatives began building tunnels extending into Israel, requiring preemptive Israeli action. During its Operation Northern Shield from December 2018 to May 2019, Israel neutralized eight of Hezbollah's cross-border tunnels. These tunnels were massive in scale, extending over 3,000 feet at a depth of over 250 feet, and replete with many engineering feats: industrial air conditioning units, broadband phone lines, and even rail tracks to transport items.⁷⁹ Yet even after Israel's operation eliminated these cross-border tunnels, many more underground sites and tunnels remained on the Lebanese side of the border.

During Israel's monthslong ground operation in Lebanon in 2024, Israeli forces located yet more tunnels within Lebanon used as command posts, data centers, ammunition depots, and munitions manufacturing sites. In the 2024 maneuver, the IDF destroyed roughly 1,500 Hezbollah underground assets, including a Hezbollah attack tunnel that crossed into northern Israel.⁸⁰ Subsequently, at least 74 such tunnels were discovered by the Lebanese Armed Forces in late 2025.⁸¹ Still more subterranean sites were discovered later, during Israeli operations in 2026 to drive Hezbollah from southern Lebanon, including many with a high degree of sophistication.

ii. How Hezbollah Constructed its Tunnels

Hezbollah's strategic tunnels were constructed using commercially available industrial machinery. Often, these were bought online on e-commerce sites. However, these were not household power tools. The machines—including core drilling equipment—with which Hezbollah constructed its deeply buried, fortified, and hardened strategic tunnels are the same as those used for constructing train tunnels and other highly sophisticated projects.

The method of construction, and sophistication, of these tunnels depended on the specific variant of Hezbollah's subterranean infrastructure. Unlike its modest tactical subterranean sites, Hezbollah's strategic and shelter tunnels were built out of limestone, a thick, durable sedimentary rock. Southern Lebanon's craggy mountains provided ample opportunities for Hezbollah tunneling efforts, with a single mountain capable of hosting a range of tunnel shafts—at the base, side, and top—at different heights but feeding into the same tunnel network. Hezbollah therefore could exploit this terrain, and its familiarity with it, to establish several tactical outposts to counter the expected Israeli offensive. Hezbollah terrorists often built tunnels within just dozens of meters from one another, and frequently used tunnels to bridge observation posts and launch sites.

While much of the attention has focused on the attack tunnels Hezbollah constructed south of the Litani River, those primarily intended to enable cross-border raids into northern Israel and built largely according to Iranian tactical tunnel models, the organization's underground infrastructure north of the Litani River represents a fundamentally different and far more strategic architecture.

This evolution reflects a profound shift in Hezbollah itself. Its increasingly advanced use of the underground theater shows how the terror group used the subterranean domain to evolve not just tactically, but also strategically. As its subterranean infrastructure's features became more sophisticated, so did Hezbollah, going from a guerrilla organization relying on tactical tunnels and improvised launch cells, to a hybrid military force building hardened subterranean bases to protect strategic assets, sustain command continuity, and preserve long-range fire capability under heavy bombardment.

iii. Features of Hezbollah Tunnels

Hezbollah's tunnels, like Hamas's, display a high degree of sophistication and technological prowess and, according to media reports, cumulatively stretch over 100 miles.⁸² Certain advanced tunnels were discovered by Israeli forces to have reached depths of around 250 feet.⁸³ Many Hezbollah tunnels had stairwells, complex wiring, and overhead lighting.⁸⁴ Hezbollah, to construct its tunnels, likely received technical expertise—in addition to billions in funding—from Iran, and potentially other nation-states. And, naturally, Hezbollah largely learned how to construct tunnels from fellow Iranian terror proxy Hamas.



Hezbollah's tunnel networks bear similarly advanced features to those of Hamas, which is no coincidence given that the two Iranian proxies regularly shared tunneling expertise with one another. Many of Hezbollah's underground chambers contained water tankers, large food stockpiles, advanced ventilation and electric systems, and even makeshift medical clinics.⁸⁵ Some complexes contained cavernous underground sites for storing and launching missiles, including retractable shafts.⁸⁶ Others were large enough to accommodate pickup trucks with rocket launchers on them.⁸⁷

During the 2024 war, Hezbollah released a propaganda video showing a truck driving through a massive underground missile complex, complete with lighting, paved corridors, and wide passageways capable of supporting heavy vehicles. The footage provided rare visual confirmation of the scale and sophistication of Hezbollah's subterranean missile storage and transport infrastructure.⁸⁸

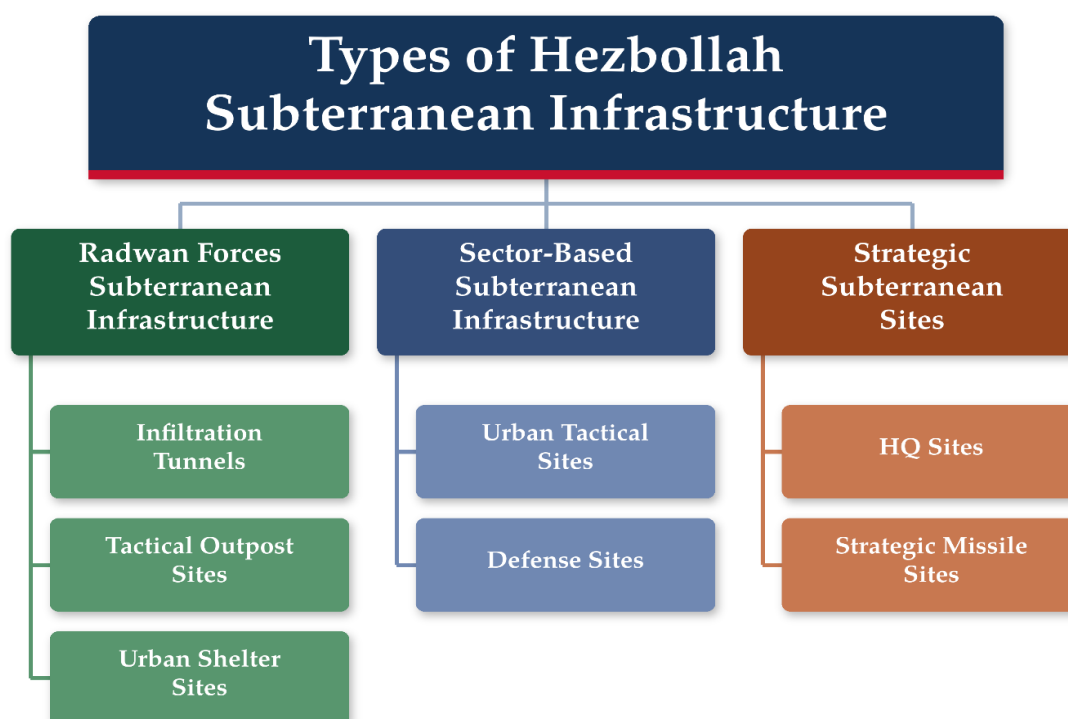
Hezbollah's large-scale tunneling effort proceeded largely uninterrupted from 2006 until 2024, helping advance the group's ambitious tactical and strategic plans. Hezbollah operatives used a shared blueprint that produced a series of tunnels following the same general template. These subtypes included those built at shallow depths under civilian residences, for shelter and weapons storage; those constructed at greater depths under civilian residences, for missile launches; and tunnels bored underneath roads to place improvised explosive devices (IEDs). Hezbollah fighters outfitted some of these roadside sites with camouflaged infrared sensors to detect and ambush approaching Israeli troops.

Over the past two decades, Hezbollah invested heavily in constructing large-scale, strategic subterranean complexes designed to serve multiple purposes: hardened command-and-control facilities, long-term

missile and rocket storage sites, concealed transport corridors, and hidden long-range launch infrastructure oriented toward central Israel. These include long and narrow guerrilla tunnels for mobility, but also fortified underground bases intended to ensure survivability and operational continuity during a prolonged high-intensity conflict with Israel.

iv. How Tunnels Advanced Hezbollah's War Strategy

Hezbollah constructed a variety of subterranean structures as it prepared for a major, unprecedented conflict with Israel. It made no secret of these projects: its longtime leader Hassan Nasrallah openly bragged of their existence in 2019, and Israel had previously neutralized several Hezbollah tunnels that crossed into northern Israel.⁸⁹ Yet even so, Israel was still surprised, in its 2024 maneuver into Lebanon, by the profound sophistication of Hezbollah's underground sites. Hezbollah subterranean infrastructure falls into three broad categories: underground sites used by its elite Radwan forces; sector-based sites embedded in and around southern Lebanese villages; and strategic sites used to house command-and-control hubs, Hezbollah leadership, and the group's most advanced missiles.



Category 1: Radwan Forces Subterranean Infrastructure

Infiltration Tunnels

Hezbollah constructed a number of advanced tunnels specifically meant for an invasion of Israel by Hezbollah's elite Radwan forces. Dozens of these were found, including the eight that crossed into Israeli territory which were uncovered during the IDF's 2018-2019 Operation Northern Shield. Israeli forces located more of Hezbollah's attempts at building cross-border tunnels during the IDF maneuver in Lebanon in 2024, yet these tunnels did not cross into Israel. However, they would have eventually—had Israel not preempted this outcome with its operation.

Tactical Outpost Sites

To prepare to stage a full-on invasion of Israel with thousands of Radwan special forces operatives, Hezbollah also built hundreds of small, shallow tactical outposts. Each of these subterranean outposts was fairly rudimentary and located at a modest depth. Yet what they lacked in quality, they made up for in quantity. Israeli forces later found several hundred of these subterranean outposts at various points within 10 miles' distance from the Israel-Lebanon border—and, consequently, in close range to many thousands of civilians living in Israel's border towns.

These tactical sites also were part of the Radwan invasion operational plan. However, unlike the Radwan infiltration tunnels, the sites were meant to help Hezbollah operatives invade Israel aboveground. To this end, they had a twofold purpose: one, to serve as points of shelter near the border to allow Hezbollah operatives to shield themselves from Israeli airstrikes; and two, to store small arms ahead of time that could be quickly grabbed during a rapid advance forward by Radwan operatives into northern Israel.

Major Strategic Sites – “City Shelters”

The third type of subterranean infrastructure Hezbollah built as part of its preparation for the elite Radwan unit's Conquer the Galilee operation were urban, underground tunnels that served as depots for weapons caches and as shelters for the Radwan terrorists.

These tunnels, which often had a large degree of sophistication and in some cases were as much as 100 feet underground, were used for more than just storing arms or briefly housing terrorists. Hezbollah's strategic complexes were multi-purpose strategic sites, used to fire missiles from ready-made launch sites next to living quarters. They were intended to shield terrorists and their arms caches from Israeli airstrikes, and prepare Hezbollah's most elite and well-trained Radwan force battalions for combat with Israel. These facilities were designed to enable long stays by terror operatives, and, as such, were fitted with kitchens, bedrooms, and restrooms. Hezbollah also had planned to connect its tunnel networks across southern Lebanon, but this plan never came to fruition.

During its advances against Hezbollah in southern Lebanon in mid-2026, including seizing key strongholds from the terror organization, Israel uncovered some of Hezbollah's most prized subterranean sites. Below is a sample of these discoveries, which, as of this report's publication, are still continuing.

- April 28: The IDF announces that it has located and dismantled a large pair of tunnels extending over 1.2 miles, around six miles from the Israeli border. The complex contained weapons caches, water tanks and other equipment, and was designed and bankrolled by the Iranian regime.⁹⁰
- June 7: The IDF unveils a Hezbollah tunnel network four miles from the Israeli border town of Metula. The multi-level subterranean complex was spacious enough for hundreds of terrorists to live in at any given time; contained medical equipment, electricity and drinking water infrastructure; and had designated rooms used for housing missiles and missile launchers. The tunnel complex, which was also used to plan and coordinate operations, facilitated over 400 projectile attacks on Israel between March and June.⁹¹
- June 28: The IDF reveals a sophisticated tunnel complex near the town of Majdal Zoun approximately 5 miles from the Israeli border and stretching over 650 feet, while extending as deep as 67 feet underground. The complex contained weapons caches; highly fortified command centers; and tunnel segments to ambush approaching IDF forces. In addition, the complex contained three rocket launch shafts aimed at Israel, and living quarters for terror operatives.⁹²

Category 2: Sector-Based Subterranean Infrastructure

In addition to the tunnels constructed for the Radwan Forces, Hezbollah constructed tactical tunnels in each of its brigades' geographic sectors in southern Lebanon. These were built using the rudimentary technique of "cut-and-cover," in which terror operatives cut dirt out of the ground, carved out a small tunnel, and then affixed the cut-out dirt back on top of the hatch to provide camouflage capability and reduce visibility of the tunnel entrance.

Urban Tactical Sites

Hezbollah's urban tactical subterranean sites were located across essentially every village in southern Lebanon. They were typically disguised well. Their entrances were located in the basements of residential or industrial locations.

In a typical southern Lebanese village, there were dozens of subterranean sites, falling into several categories:

- Anti-tank missile launch staging tunnels;
- Observation tunnels;
- Storage tunnels;
- Hiding tunnels;
- Residential tunnels;
- Improvised explosive tunnels;
- Tactical launch tunnels; and
- Command-and-control tunnels.

Each of these subterranean sites was located in population centers across Lebanon, complicating Israeli operations to detect and neutralize them. It is hard to overstate how widespread these tunnel networks were within southern Lebanon, several hundred of which Israeli forces found and destroyed in the 2024 ground maneuver.

Geographic Combat Complexes

In addition to the tunnels built inside southern Lebanon's villages, Hezbollah constructed subterranean combat complexes that were located in open, rural areas. These tunnels' main purpose was to create friction with any potential IDF maneuver into Lebanon and prevent Israeli forces from reaching the Litani River and further north in the country, in the inevitable event that the IDF sent ground troops into Lebanon in response to the planned Hezbollah attack. These sites aimed to inflict severe casualties on the IDF's ground troops and impose progressively greater costs on Israel for its ground operations as they expanded geographically.

While lacking in sophistication, these sites posed a serious threat to Israeli forces. Covered, typically, in dense vegetation, a typical Hezbollah defense subterranean site contained infrared sensors, improvised explosive devices, and a specialized hatch to enable sniper fire. Like the Viet Cong tunnels that U.S. forces contended with nearly six decades ago, they were heavily camouflaged and operated by guerrilla fighters who knew the terrain extremely well, itself a tactical advantage.

Category 3: Strategic Subterranean Sites

Finally, Hezbollah built advanced, strategic subterranean sites at locations in Lebanon far north of the Litani River. These sites were located mainly in Hezbollah strongholds in the central Baalbek and Beqaa

Valley regions, and even in cities like Beirut. These sites were buried far underground and reserved for the group's most critical and sensitive operations, like storing and launching advanced missiles and conducting strategic planning.

Strategic HQ Sites

Many of Hezbollah's subterranean strategic sites were used to house the group's strategic headquarters to mitigate the risk of being targeted by airstrikes. Here, the terror group conducted command-and-control functions, strategic planning, and other key elements of its leadership's decision-making. In some cases, they were embedded underneath sites in Lebanon's capital Beirut and its suburbs. For example, the deeply buried bunker in which Hezbollah's longtime leader Hassan Nasrallah was killed by Israeli airstrikes in September 2024 was located in the neighborhood of Dahiyeh, on Beirut's southern outskirts.

Strategic Missile Sites

The second type of Hezbollah's strategic subterranean infrastructure was also of paramount importance for the Iran-backed terror group, as they were used to house Hezbollah's prized arsenal of precision missiles. Such facilities were multifaceted in purpose, serving as storage facilities for these sophisticated missiles but also missile launch sites. These fortified sites were often built deep underground under rocky terrain in an effort to withstand even the most intensive Israeli strike campaigns.

Broadening the Aperture Out—and East

The evolution towards using the subterranean domain for both tactical and strategic purposes in Gaza and Lebanon is not unique to Iran's regional proxies. Far from an isolated phenomenon, it has been part of a broader strategic approach to gain an asymmetric advantage against world-leading air forces like the United States and Israel. The subterranean strategy has not been organically discovered and developed by Hamas and Hezbollah—it has been orchestrated and funded by the Islamic Republic of Iran. Moreover, as recent events have shown, the subterranean domain is increasingly a central strategic pillar of the Iranian regime itself: one used to physically shield, and qualitatively advance, Iran's nuclear and conventional military programs.

C. Iran

Iran has achieved success with its own use of the subterranean domain. The Iranian regime has systematically exploited mountainous terrain to create hardened underground facilities, designed to withstand aerial strikes and ensure the survivability of critical nuclear and military infrastructure. Crucially, these Iranian underground facilities are not tunnels in the classical sense. Rather, they are vast subterranean caverns—industrial-scale bunkers and halls—that function as missile storage depots and protected operational hubs capable of housing large quantities of equipment and personnel while concealing nearly all activity beneath the surface.

Iranian subterranean activity for military use is nothing new. Media reporting indicates that Iran has operated these underground sites since at least the early 1980s, particularly along the Iraq–Syria corridor, enabling concealed arms transfers and long-term weaponry stockpiling.⁹³ However, like its proxies, Iran's use of underground facilities has evolved considerably. Iranian subterranean sites became a major feature of Israel's Operation Roaring Lion and U.S. Operation Epic Fury in 2026, which featured hundreds of U.S. and Israeli strikes on underground Iranian missile storage and launch sites. Previously, Iran's underground projects were also on vivid display, though not to Iran's advantage, during the 2025 U.S. Operation Midnight Hammer, in which U.S. aerial forces penetrated and significantly degraded Iran's subterranean nuclear sites with never-before-used GBU-57 Massive Ordnance Penetrator munitions.

The Iranian regime constructed dozens of underground missile bases in recent years, which it continues putting to use. Iran frequently utilized these sites to stage projectile attacks against U.S. forces in the region and Arab countries in the 2026 U.S.-Iran-Israel war.⁹⁴ Iranian officials claimed the ballistic missiles used to attack Israel were stored and prepared inside these facilities.⁹⁵ The Israeli newspaper *Globes* recently described the so-called missile cities: “[Iran created] nearly 30 underground missile cities, carved deep into granite mountains over the past few decades; rich in concrete missile depots; with dozens of exit tunnels connected by automatic trains, and pop-up doors that effectively protects them from air attacks.”⁹⁶ At some of these facilities, Iran has stockpiled not just missiles and launchers but also drones and other weaponry.⁹⁷ Though Israel damaged the entrances of many of these facilities during Operation Roaring Lion, rendering them at least temporarily inaccessible, Iran has reportedly regained access to the majority of its underground missile sites.⁹⁸

V. Operating in the Subterranean Domain

Israel’s adversaries enjoyed a head start in the subterranean domain, but Israel worked hard to catch up and prepare its forces to fight in the underground world. At the center of that effort is Yahalom, the IDF’s elite special engineering combat unit, which evolved from an explosives-disposal specialized outfit into a brigade-sized force leading the detection, mapping, penetration, and destruction of enemy underground infrastructure.

During Israel’s post-10/7 multi-front conflict, Yahalom’s operations in Gaza and Lebanon uncovered hundreds of tunnel openings, destroyed dozens of miles of tunnels, and enabled the seizure of scores of tons of enemy weaponry. Israel’s underground operations served a range of purposes beyond demolition, including locating and recovering hostages and exploiting captured facilities for critical intelligence. Each operation carried a unique set of challenges.

Israel’s subterranean missions were conducted in an environment that few militaries have ever operated in. Hamas’s tunnel network, in particular, was a subterranean expanse with no precedent in the history of war. Yahalom operations in those tunnels were marked by psychological challenges, limited or nonexistent communications and navigation capabilities, and constant risk. Yet like Ukraine with the drone threat, Israel did not have the luxury of failing to adapt to the tunnel threat. The tunnel networks of the Gaza Strip and Lebanon became a battlefield laboratory for Israel—one the United States would be wise to study.

A. Israel’s Underground Warfighters

Yahalom, also known as the Special Engineering Missions Unit, is the Special Forces unit of the IDF Combat Engineering Corps and serves as the IDF’s leading authority in specialized combat engineering and underground warfare. It is also the unit that this paper’s co-author spent several years commanding.

Yahalom was formally established in March 1996 as a merger of multiple combat engineering corps detachments. When first created, Yahalom specialized in detecting and disarming explosives, but its role soon evolved dramatically. Beginning in the early 2000s and particularly following the emergence of the tunnel threat from both the Gaza Strip and the Lebanese border, the unit invested significant resources in developing doctrine, technological capabilities, and operational methods designed for underground warfare.

With Yahalom’s landmark success in Israel’s Operation Protective Edge against Hamas in 2014—a war in which Yahalom combat engineers neutralized over a dozen of Hamas’s terror tunnels, demolished several dozen enemy structures, and successfully conducted hundreds of explosive ordnance disposal missions

despite coming under regular enemy fire—the unit grew in prestige and operational value. This experience established Yahalom as the IDF’s primary organization tasked with the detection, investigation, mapping, penetration, and destruction of underground infrastructure. Soon after, in 2015, the position of Yahalom commander was raised to colonel rank, and the unit expanded in structure, size, and capabilities to become a brigade-sized force. Its operational scope expanded, and it began utilizing new platforms like drones and robotics.

During Israel’s post-10/7 wars, Yahalom faced the most significant challenge in its history. The scale, sophistication, and quality of the underground infrastructure constructed by Hamas and Hezbollah required the unit’s engagement in a broad spectrum of missions. These included tunnel detection, exploration, mapping, intelligence exploitation, hostage recovery operations, support to maneuvering forces, and the destruction of underground facilities. Simply put, Yahalom was responsible for taking the lead on all of this.

It rose to the challenge. During Operation Swords of Iron in the Gaza Strip, by May 2025, Yahalom forces had identified several hundred tunnel openings, destroyed dozens of miles of Hamas tunnels, and found and comprehensively mapped out dozens of miles of Gaza’s subterranean maze. As a result of these efforts, Israeli forces were able to seize over a dozen tons of terror weaponry and remove Hamas’s ability to use its subterranean network for warfare in any meaningful sense.

In Lebanon, the story was no different: Yahalom forces achieved considerable success against Hezbollah’s advanced subterranean network. During the IDF’s Operation Northern Arrows in late 2024, Yahalom forces located hundreds of tunnel openings and destroyed over two miles of enemy tunnels. Yahalom’s success in locating and mapping these tunnels enabled IDF forces to find and seize over 75 tons of weaponry from the Iranian proxy.

Yahalom’s activities throughout the war demonstrated that underground warfare is no longer solely an engineering challenge, but rather a distinct warfighting domain that requires the close integration of intelligence, technology, engineering, and combat operations. The experience accumulated during the conflict is expected to influence not only future IDF operational concepts, but also the development of underground warfare doctrine among militaries across the world.

B. Subterranean Missions

Throughout the war, the State of Israel conducted a wide range of operations within the underground environment for operational, intelligence, and strategic purposes. A significant cognitive and operational shift occurred within the IDF at the beginning of the ground maneuver, when it became clear that a substantial number of the hostages were being held underground and that the tunnel network constituted Hamas’s primary operational and command center of gravity.

While the IDF possessed a basic capability for underground warfare prior to the war, this capability evolved during the conflict into a systematic, multi-domain operational approach designed to dismantle Hamas’s underground infrastructure. This capability became one of the central components of the broader effort to degrade and ultimately dismantle Hamas’s military capabilities, integrating intelligence, engineering, special operations forces, and maneuvering units.

Dozens of operations were conducted in underground environments throughout both the southern and northern theaters. Although a significant portion of these activities remains classified, several can now be publicly revealed, some for the first time, in this report.

Operations to Collect Intelligence

While operating in Hezbollah's underground sanctuary complexes and strategic Hamas facilities in the Gaza Strip, IDF forces were able not only to locate these sites but also to exploit them for intelligence purposes before ultimately neutralizing or destroying them. These activities provided the IDF with significant intelligence regarding enemy construction methods, command-and-control systems, communication networks, and the broader operational concept employed by adversaries in the underground domain.

Operations to Locate Hostages

Operations aimed at locating hostages represented the most significant and sensitive objective for underground operations. Throughout the war, numerous missions were conducted to identify hostage holding locations based on intelligence collected from multiple sources. One of the most notable operations involved the discovery and seizure of the "Kingdom Complex," Hamas's central command bunker, where Israeli hostages were held at various periods and where Yahya Sinwar and members of his family reportedly resided during portions of the conflict. The operation included locating the underground facility, conducting prolonged combat to gain control of the site, clearing and exploiting it for intelligence purposes, and ultimately destroying it.

Operations to Recover Hostages

During the war, the IDF conducted multiple hostage recovery operations within the underground environment. In total, Israeli forces recovered dozens of hostages from Hamas's tunnel network, the majority of whom were unfortunately deceased when found. Ultimately, though, several hostages were rescued alive from tunnels in recovery operations, representing major tactical accomplishments. These rescue operations are highly complex and involve months of intelligence collection before they can be initiated. Even after the baseline intelligence groundwork had been amassed and analyzed, weeks of combat operations to retrieve additional information followed, complemented by systematic searches within the central command bunker of Hamas's Rafah Brigade.

C. Subterranean Challenges

Tunnel warfare presented forces with unique challenges that are rarely encountered in any other combat environment. Unlike operations in open terrain, the underground domain severely limits visibility, mobility, and the ability to develop a complete understanding of the surrounding battlespace. Indeed, one of the most significant challenges of operating underground is the constant uncertainty. Every turn, room, or tunnel junction could contain enemy fighters, explosive devices, booby traps, civilians, or hostages. In many cases, forces had little or no knowledge of what existed beyond a few meters ahead.

Furthermore, the underground environment inherently favors the defender. The enemy enjoys a significant tactical advantage due to the structure of the terrain itself, which typically includes a limited number of entry points and highly canalized movement routes that force attacking troops to move through predictable paths within the tunnel network.

Communications and navigational abilities inside tunnels are often limited or intermittent. Navigational systems based on global positioning systems (GPS) do not function underground. Therefore, Israeli forces frequently relied on alternative navigation methods and, adding to the tactical complexity, continuous mapping of the environment during subterranean maneuver operations.

In addition, Israeli troops faced very real dangers that compounded the existing psychological challenges inherent in such an environment. These threats included the omnipresent risk of tunnel collapse; oxygen

deficiencies in certain areas; stifling humidity that could cause overheating; extended periods of total darkness in a threat-saturated environment; and the prospect of explosive devices at each turn.

The operational complexity increased even further when there was a possibility that hostages were present within a given tunnel system. In such cases, Israeli forces were required to strike a delicate balance between acting rapidly and decisively on the one hand and minimizing potential harm to innocent hostages on the other. Balancing those two important objectives is extremely difficult.

Fortunately, in dealing with this array of challenges, Israel has learned—and continues to learn—how to better address them. With intensive focus, on a daily basis, Israel is developing the correct tools and procedures to mature its capabilities against subterranean threats well into the future. The United States stands to benefit greatly—and improve its own readiness against subterranean threats—by studying the battlefield laboratory of Israel’s underground operations, and applying the lessons Israel has learned.

VI. Securing the Subterranean Domain: A Commander’s Insights and Recommendations

Nearly three years of continuous operations in the tunnels of Gaza and Lebanon have given Israel a body of subterranean experience unparalleled in modern history. That real-world experience yields lessons, earned through both hard-won successes and early missteps, that extend far beyond Israel’s borders, since the United States and its friends across the world face similar—if not almost identical—subterranean threats to those Israel has faced.

A. Lessons Learned

Israel’s subterranean campaigns produced five primary lessons. These lessons converge upon a single overarching theme: subterranean threats can no longer be viewed as the isolated engineering problem of years past. Instead, they are increasingly an integral part of modern warfare and must be treated as such.

First, defeating underground threats requires a single system integrating physical and kinetic measures; dynamic and multi-source intelligence; and advanced technology that is always adapting to the subterranean threat.

Second, what happens underground does not stay there. The subterranean and surface domains are one battlespace, and territory cannot truly be cleared or held without addressing both.

Third, traditional Western military concepts and structures must adapt to the subterranean era. That means treating the underground not as a specialist or engineering problem, or a separate domain, but as a potential cornerstone of the enemy’s strategy and physical system. In turn, modern militaries need command centers dedicated to the subterranean domain.

Fourth, as the saying goes, an ounce of prevention is worth a pound of cure when it comes to the subterranean domain. Successful prevention means not only eliminating the terror operatives involved in subterranean projects but also interdicting the relevant materials and equipment that make tunnel construction possible. Severing these illicit supply chains, including through rigorous monitoring and interception of dual-use materials entering enemy territory, is necessary to prevent subterranean threats from emerging—and far preferable to facing them down the line.

Fifth, the underground threat transcends international borders, and so must the response to it. Deepening coordination between the United States, Israel, and their global partners and allies—building on a solid

foundation of existing U.S.-Israel subterranean cooperation—is a critical next step to confront the full range of subterranean challenges.

i. The Strategic Triad of Subterranean Warfare



The modern military needs a whole new approach to assessing and neutralizing subterranean threats, one that must be preventative, dynamic, and systemic in nature. Thinking about subterranean threats correctly is essential to successful action against subterranean threats.

Below, the report lays out a three-tier conceptual roadmap—a strategic triad for the subterranean domain—that has proven useful for Israeli military planners, conventional forces, and combat engineers in the field. The strategic triad involves the physical, intelligence, and technological dimensions of subterranean warfare.

a. The Physical Dimension

Israel discovered that neutralizing underground sites requires viewing them as integral parts of the broader enemy system, not as isolated engineering problems. Put differently, striking underground infrastructure is not an end in itself, but rather a means of disrupting and paralyzing broader enemy capabilities: rocket fire, command-and-control, logistics, maneuver, and communications. As long as large underground networks remain intact, the enemy can hide, move, maintain command-and-control, stockpile and potentially manufacture weapons, and sustain fire—even under aerial bombardment and other forms of military pressure.

Moreover, by dealing with each tunnel threat as a distinct, individual issue, countries run the risk of misallocating resources and failing to harm the enemy. When a military prioritizes targeting secondary or strategically irrelevant sections of the adversary's tunnel network, it expends time and energy on risky operations that are unlikely to deal the enemy a major blow.

Thus, denying infrastructure is not merely a tactical or engineering mission, but a systemic strategic objective. The goal of this overall approach is not necessarily the complete destruction of every single

tunnel but preventing the enemy from using the subterranean domain to advance its aims. Physical efforts to neutralize an enemy's subterranean network should therefore involve more than demolishing tunnel segments as they are found. They should focus on limiting the operational value of underground infrastructure to the enemy well into the future, including after conflict. With this principle in mind, physical action to neutralize subterranean threats should involve a three-tiered approach in which each phase builds upon one another.

One, forces should prioritize blocking, isolating, and disconnecting critical underground nodes. Surgical, efficient neutralization can temporarily cripple enemy subterranean operations. By fusing real-time intelligence gathering with tactical operations, modern militaries can locate and neutralize the key nodes, links, and sites that constitute the true center of gravity of the adversary's underground maze. By monitoring enemy forces' underground movement patterns, key exits and tunnel segments can be blocked or destroyed — trapping enemy units, cutting them off from escape and logistics nodes, and paralyzing their movement without the need for face-to-face combat. This step is essential, but insufficient on its own.

Two, wide-scale physical destruction through a sustained engineering-operational effort should be implemented. This neutralization effort should not be viewed as all-or-nothing, since the enemy's operations can be brought to a halt even if some of its subterranean infrastructure remains intact. The objective, rather, should be to destroy high-value underground infrastructure at scale using penetrating munitions, controlled detonations to collapse tunnels, flooding, and other means of sophisticated engineering.

Three, a long-term strategy is required—even if tactical operations against enemy tunnels are successful—to erode the enemy's ability and will to rebuild its subterranean infrastructure at a later date. Here, perception, not just physical achievements, is a critical factor. The goal is for the enemy to perceive underground activity—in the present and the future—as an operational burden rather than a strategic asset. For this third, longer-term phase to succeed, it must involve:

- Disrupting economic and logistical supply chains for underground construction;
- Regulation and interdiction of relevant dual-use materials entering enemy territory;
- Round-the-clock visibility into the enemy's underground operational environment, including systemic mapping and identification of key nodes;
- Multinational efforts to boost relevant intelligence, technology, and methodology sharing in the subterranean domain; and
- Continuous learning and doctrine development to ensure full readiness against underground threats.

Effective subterranean warfare includes the ability to stop reconstruction. Without measures to forestall adversary reconstruction, even long after adversary tunnels have been neutralized, progress against subterranean threats will be reversed.

b. The Intelligence Dimension

Israel learned that advanced, integrated multi-source intelligence is necessary to mitigate subterranean threats and preemptively stop future ones from developing. In the murky depths of the underground world, victory requires visibility. Deeply buried and fortified underground facilities, Israeli forces discovered, cannot be effectively neutralized by kinetic means alone. Given the evolution of subterranean technology and know-how, and their dispersion among U.S. adversaries worldwide, the threat is

increasingly shifting from one or a few tunnels to that of an underground system-of-systems. Without high-quality intelligence, even the most precise munitions and capable forces will be unable to locate, characterize, and strike critical underground sites of any kind, let alone the sophisticated and expansive subterranean ones utilized by Hamas and Hezbollah.

Responding to this evolving threat landscape requires a sophisticated, multidimensional intelligence picture of the subterranean domain. This dynamic “window into the underground” should be aided by several complementary lines of effort supported by military forces in the field. These include:

- Mapping the enemy’s subterranean functions, movement, storage, command, launch, logistics, shelter sites, and more;
- Identifying chokepoints, bottlenecks, and critical nodes;
- Understanding the adversary’s plan to interface between underground and surface domains; and
- Creating a dynamic, continuously updated underground target bank.

In turn, achieving these objectives requires successful integration and analysis of a range of intelligence-gathering tools. These include:

- Signals Intelligence (SIGINT), Imagery Intelligence (IMINT), and Geospatial Intelligence (GEOINT) to comprehensively map underground networks and identify key tunnel shafts, excavation areas, and aboveground supporting infrastructure.
- Seismic, acoustic, and signature intelligence, also known as Measurement and Signature Intelligence (MASINT), involving the use of sensors to detect underground engineering activity; the movement of people and vehicles belowground; and above- and belowground excavation, drilling, and the broad use of industrial equipment for subterranean construction.
- Human Intelligence (HUMINT) that penetrates the enemy’s engineering, logistics, and construction networks, providing information on tunnel locations, excavation phases and logistics, subterranean operations, sources of expertise, and supply chain bottlenecks that can be exploited or disrupted.
- Artificial Intelligence and Machine Learning (AI/ML) systems to continuously analyze and streamline data from all intelligence sources; identify patterns and anomalies; cross-reference and verify anecdotal information; and create analytical and predictive models about the enemy’s operations aboveground and in the subterranean realm.

Only through a multi-layered integration of these sources can an effective intelligence picture of the underground network be constructed—not just as a geometric drawing of tunnels, but as a living and dynamic system with patterns, operational hierarchies, and relations between the subterranean combat layer and the combat layer above ground.

Interweaving intelligence tools enables effective, cross-domain action to disrupt the adversary’s subterranean operations even after combat concludes. To maximize their effect, such efforts should include:

- Deep integration of cyber and electronic warfare to disrupt the enemy's underground command-and-control nodes, intelligence gathering capabilities, physical connectivity, and communications between underground headquarters and surface forces;
- Closely aligned kinetic strikes, ground maneuvering, and combat engineering efforts in a coordinated manner so that tunnel collapses, blocked exits, or isolated spaces align with ground maneuvers, targeted raids, and airstrikes aboveground; and
- Information and public messaging campaigns, including detailed exposure of underground infrastructure that enemy forces deliberately built beneath civilian areas. Widely disseminating this information is critical to prevailing in the theater of global information warfare—and to refuting false narratives that accrue to the enemy's benefit.

The information fusion process is necessarily an ongoing one, composed of diverse data streams. The most significant is the integration between the two bases of the strategic triad depicted earlier in the paper: intelligence and technology. This process is always conducted by the relevant unit commander, who ultimately determines whether to proceed with physical action or if further intelligence or technological information is required first. This is also where the true ability of Western militaries to defeat hybrid enemies is tested: not in the firepower they deploy, but in their ability to accurately analyze a combat space where most of the enemy's center of gravity is underground.

c. The Technological Dimension

In the subterranean domain, there is no substitute for having the technological edge. Israel is at the forefront of the world in tunnel detection and neutralization. Yet, there is significant, and largely untapped, potential for Israel to further enhance its subterranean detection and neutralization technologies, use those tools to help the United States and its partners against subterranean threats they face, and jointly invest in research, development, and testing of new technologies with the United States and relevant partners.

There are three key points to be made here. One, as the saying goes, necessity is the mother of invention: thanks to the tunnel threats Israel faced relentlessly through months of war, Israel is a world leader in finding and neutralizing enemy tunnels, and the adversary forces within them. Two, Israel still seeks to achieve further advancements in this domain, and is actively seeking other countries' collaborative efforts. Three, the rest of the Western nations—including the United States—have significant work to do in order to level the playing field with foes that have spent decades on tunnel construction, smuggling, and warfare techniques.

The subterranean challenge demands a new capability architecture consisting of many counter-tunnel technologies. There is no one solution, or tool, to find a tunnel—there is a toolbox. Fortunately, Israel is already a global pioneer at innovating and adapting these technologies on the battlefield. These include various sensing, mapping, and tunnel-exploration technologies, as well as neutralization technologies like sophisticated air-to-ground munitions capable of penetrating subterranean sites.

These are capabilities that other countries, including the United States, could benefit from adapting into their toolkits. Systematic U.S. study of, and investment in, these emerging technologies is a crucial next step for the United States—already, it is collaborating with Israel on these efforts, but there is a great deal of untapped potential in this partnership. Focused, long-term investment can unlock a new generation, so to speak, of tools to advance underground detection, mapping, and neutralization capacity for both nations.

While Israel is a world leader in developing and deploying these tools, what is needed now are better techniques to combine and integrate them, fuse emergent subterranean technologies, and better incorporate AI/ML tools in the field. This effort should involve building a new combat architecture for the subterranean domain that integrates AI/ML platforms and large language models, advanced sensors, robotics, specialized munitions, and non-kinetic threat location tools into a unified system.

Specifically, future subterranean research and development should emphasize the following high-priority areas:

- Advanced ground-penetrating radar and low-frequency sensors capable of deeper penetration and three-dimensional mapping;
- Integrated seismic and acoustic detection arrays;
- Robotic and autonomous platforms for underground reconnaissance, mapping, and neutralization without risking personnel;
- Advanced bunker-busting munitions;
- Precision delayed fuses; and
- Non-kinetic neutralization methods such as flooding, inert filling, and long-term sealing of underground spaces.

Systemic, institutionalized investment in these capabilities can provide the United States, Israel, and their partners with a major advantage against subterranean adversaries. Without the necessary organizational focus and funding, however, all other components needed to counter the subterranean threats discussed in this report — intelligence superiority, blocking and isolation of tunnel segments, high-volume destruction methods, aboveground-belowground synchronization, and sophisticated supply chain interdiction—will encounter a technological glass ceiling that limits their effectiveness.

ii. What Happens Underground Doesn't Stay There: The Need for Synchronized Aboveground-Belowground Maneuver

The second lesson Israel has learned is that the subterranean domain cannot be divorced from the aboveground theater, and vice versa. Strategically and tactically, when fighting an enemy like Hamas that operates underground, forces are really waging war simultaneously in two theaters wrapped into one. In Gaza, Israel learned this lesson as time went on, but often the hard way. It realized that tactical success against Hamas's aboveground sites in Gaza was irrelevant without complementary neutralization of Hamas's underground networks. Furthermore, it became clear that freedom of action in one domain required operational control of the other.

During the opening stages of fighting in Gaza, in late 2023 and early 2024, Israel separated Gaza's aboveground and belowground domains in its combat operations, prioritizing combat against Hamas terrorists on the surface level. Yet it soon discovered the risks of fighting an enemy above the surface while not neutralizing its safe haven below it. In late 2023 and well into 2024, IDF troops initially struggled to defeat Hamas forces in northern Gaza's Beit Hanoun area situated less than two miles from the Gaza-Israel border.

Later, once Israel cleared and began holding territory east of the Yellow Line in 2025, including the Beit Hanoun area, it became obvious why Israeli forces had struggled to take control of Beit Hanoun. Hamas operatives had evaded defeat in the neighborhood by shifting back and forth between the aboveground and belowground domains. Israeli forces were stuck, unbeknownst to them, in a treacherous game of

whack-a-mole, as terrorists continued to slip in and out of a sprawling tunnel network via camouflaged shafts. In early 2026, approximately 30 months after Israeli troops initially entered Beit Hanoun, Yahalom combat engineering forces—finally able to operate there without threat—conducted hundreds of drilling missions in the Beit Hanoun area, locating and neutralizing nearly seven miles of Hamas tunnels.⁹⁹



iii. Traditional Military Concepts + Structure Must Be Adapted for Subterranean Era

Conventional military doctrine, structure, and terminology, Israel learned, must be applied to the underground sphere and updated accordingly. As noted above, Israel learned early on the pitfalls of not aggregating the two domains in strategy, communication, and technique, as terminology like “clearing and holding” changes dramatically in an urban-subterranean combat arena.

Traditionally, in military terminology, the term “clearing” refers to surface areas, which is how Israeli forces used it during the opening stages of the Gaza war. However, only clearing areas aboveground and not underground is insufficient in a combat theater like the Gaza Strip, and this dynamic created, in many cases, a dangerously false sense of security and mission success. It also caused tactical setbacks on the battlefield.

The need for modern militaries to adapt their terminology to the underground domain underscores the broader paradigm shift required to prevail against subterranean threats. Modern militaries need to move away from viewing underground warfare through a narrow, tactical lens and instead adopt a systemic, strategic, and military-wide approach.

a. Conceptual Changes Needed

A common conceptual mistake is treating the underground as a “problem in itself” to be handled by specialized engineering units or special forces. Indeed, Israel has itself erred, at times, by doing so in the past. In reality, the enemy’s underground infrastructure is not an independent system but a hidden depth layer of the same enemy system operating above ground. It is organically connected to command-and-

control, rocket and missile fire, logistics, intelligence, narrative warfare, and control of civilian populations. Any attempt to conduct a separate “underground campaign” detached from the overall campaign is therefore destined to achieve only partial effectiveness.

Conceptually, it is crucial for modern militaries to recognize the subterranean domain is no longer a secondary tactical issue or a niche engineering and special-forces challenge. The transition by Hamas and Hezbollah from narrow offensive tunnels intended mainly for infiltration, movement, and tactical surprise to deep, fortified, multi-purpose underground complexes demonstrates that the subterranean domain has become a central strategic pillar for a number of hybrid and non-state enemies.

The underground theater is a strategic dimension and an operational center of gravity for the enemy—meaning time is of the essence when working to deny the enemy access to it. Slow, selective, point-by-point tunnel destruction is insufficient. Decisive action in the subterranean domain requires more than sporadic destruction of individual tunnel segments, an approach Israel adopted in the past against Hezbollah tunnels but which proved to be inadequate. Instead, what is needed is a systematic effort targeting hundreds or even thousands of entrances, shafts, tunnel segments, operational chambers, and underground complexes in the subterranean domain.

The clear military superiority of modern Western militaries — chief among them the United States — in the aboveground environment has led U.S. and Israeli adversaries to adapt, and their shift to the subterranean domain is the clearest example. Compared to terrorist actors like Hamas and Hezbollah, these advanced forces possess near-absolute air superiority, precise real-time intelligence, long-range precision fire, and control of the electromagnetic spectrum. This conventional superiority deprived terrorist organizations of the ability to operate openly above ground, maneuver as organized forces, or concentrate assets without exposing them.

In response, terror groups like Hamas shifted their operational and organizational center of gravity belowground. As five senior U.S. military officers wrote in a 2018 JINSA report, subterranean warfare is an “iconic example of [military] adaptability, whereby the militarily weaker enemy utilizes a relatively primitive tactic to nullify the extensive intelligence, surveillance and target acquisition assets of their more advanced opponent.”¹⁰⁰

As their enemies evolve, so too must the United States and its partners. Israeli military planners have contended with how to operate against subterranean threats during the wars against Hamas and Hezbollah, but other Western militaries will have to follow suit. They will have to grapple with questions such as:

1. How is an attack conducted underground? What are the obstacles to executing strikes in the underground domain?
2. How can successful defensive measures be implemented while forces are operating inside tunnels?
3. How are principles of isolating and neutralizing the enemy applied to the subterranean front?

These are familiar concepts in Western military doctrine for aboveground operations but rarely addressed regarding the underground domain. That will have to change in order for the United States, and its

partners and allies globally, to maintain readiness in the battlefield of today—and the future. While classic combat principles should not be discarded when it comes to the subterranean domain, and remain relevant to this emerging threat landscape, they must be adapted accordingly.



b. Structural Changes Needed

Successful subterranean threat monitoring also requires the establishment of a dedicated, joint, and interdisciplinary body responsible for synchronizing and integrating the subterranean effort with the above-surface effort and the broader campaign. Such an entity should oversee the detection and destruction of the adversary's underground infrastructure. However, it also should incorporate systemic planning, operational timing, strike sequencing, and the employment of all relevant tools—kinetic and non-kinetic—against enemy subterranean networks. Recognizing all this, Israel established a dedicated headquarters in theater to jointly command and synchronize underground and surface combat. This new entity has been a force multiplier for Israel's subterranean operations.

Continuous investment is necessary to stay ahead of evolving subterranean threats. Israel has elected to do this in real time, and in the field, during its post-10/7 wars. The Yahalom unit's Doctrine and Development Detachment is at the forefront of this effort. It operates a laboratory to develop and adapt advanced weaponry and coordinates closely with IDF leadership and the Israeli Ministry of Defense. The detachment itself is tasked with being the "start-up" for Yahalom and is designed to quickly find solutions and circumvent bureaucracy. Its sub-components are tasked with innovations in robotics; subterranean combat; explosives and obstacle breaching; and more, including a dedicated team that tests new defense technology in real-world combat conditions.

Countering enemies in the subterranean theater is thus not strictly a military task. Indeed, it is much more than that. It is a long-term national project that, to be successful, requires integrating not just intelligence and combat operations but also diplomacy, military alliances, scientific innovation, and the civilian defense industry.

iv. Ounce of Tunnel Prevention Worth Pound of Cure

The fourth lesson Israel has learned—unfortunately, the hard way—is that prevention is the best means of subterranean threat neutralization. Confronting the subterranean challenge once it has already become a behemoth—as Israel was forced to do in subterranean Gaza’s vast, dystopian world—is not a recipe for strategic success. The Gaza war showed the pitfalls of a military focusing solely on the final stage of the subterranean construction supply chain—namely, locating and destroying existing tunnels and underground complexes. Interdiction efforts are necessary at the earlier stages of that subterranean supply chain—namely the planning, material acquisition, and initial construction phases.

Underground networks like those Hamas and Hezbollah constructed are not built out of nothing. They are logistically complex, resource-intensive, and dependent on specialized and sustained international supply chains. The scale of tunnel and underground complex construction observed in Gaza and Lebanon requires enormous quantities of raw materials and infrastructure—most notably cement, steel, timber supports, excavation equipment, generators, ventilation systems, water pumps, and electrical systems. This means that the enemy’s subterranean infrastructure is not merely an engineering or tactical problem, but an entire economic-logistical system that can—and must—be targeted at its early stages, long before a tunnel is actually dug.

Here, Israeli authorities came to learn, systematic integration of economic and logistical dimensions into the military campaign is required. Tight border control and stopping isolated smuggling incidents are necessary, but insufficient, elements of success. Instead, a broad intelligence and military effort is required to generate a full analysis of the supply chains of tunnel construction: identifying sources of raw materials, supply chain nodes, intermediaries, storage and distribution networks, and locating the actual excavation sites. It is especially critical to identify the individuals in the supply chain supplying the relevant funding, engineering expertise, and logistical support.

As long as the enemy can import, divert, produce, and store raw materials and industrial equipment for underground construction, success in destroying tunnels will be reversed over time. Therefore, it is vital to interdict materials in the supply chain used to construct tunnels and prevent the adversary from obtaining them to begin with. This will prevent the enemy from rebuilding its subterranean infrastructure by disrupting the flow of concrete, cement, and other raw materials. It also enables monitoring—and interception where necessary—of the enemy’s electrical wiring, construction equipment, ventilation systems, and similar items used to construct tunnel networks or operate inside them.

v. Shared Threat, Shared Response

The final main lesson Israel has taken away from the post-10/7 wars is the critical need for more multinational efforts to counter underground foes—a lesson the United States, too, is quickly learning. The underground threat transcends borders, and so, too, must the response.

Without this cooperation in place, even initially manageable cross-border subterranean threats can grow and become far more threatening. To give just one example, in past cases where the U.S. Department of Homeland Security (DHS) has identified tunneling along the U.S.-Mexico border, the agency ran into jurisdictional issues that prevented a more robust response against tunnel threats on the Mexican side.¹⁰¹ That phenomenon was on display with Hamas’s cross-border Gaza-Egypt tunnels, where Hamas exploited Egyptian security forces’ permissiveness—to put it lightly—to create a vast smuggling enterprise.

Efforts to secure the subterranean domain therefore must be international. Fortunately, a wide range of opportunities for collaboration between the United States and its partners exist, including:

- Increased sharing of underground doctrine and technology;
- Standardized terminology and mapping methodologies;
- Joint development of detection and neutralization technologies;
- Multinational training and testing facilities and frameworks; and
- Shared underground target banks for key arenas.

The U.S. military and those of its partners and allies should not fight the subterranean fight alone, and none should prepare for it alone, either. Instead, Western countries should work together to ensure each is equipped with the proper strategic and tactical understanding, and technological means, to prepare for a future—and present—security landscape that increasingly involves the subterranean domain. They should each be ready to prevent, neutralize, and, if necessary, fight in adversary tunnels. And relevant domestic and law enforcement agencies should be similarly empowered to deal with the insidious cross-border tunnel threat that the United States faces on a regular basis.

The United States and Israel should lead the charge for this effort. Out of sheer necessity, Israel has become a world leader in developing tunnel detection, mapping and neutralization technologies, and deploying them. It has fought inside tunnels on a daily basis over the course of a protracted war, the only modern nation to do so. And it has extensive experience neutralizing a range of tunnel types, including in both rural and urban settings, that is not shared by any other country.

Recognizing this, the United States has allocated a considerable amount of funding to joint efforts with Israel on researching, developing, and deploying technologies to address subterranean threats. The first major U.S. action to leverage Israel's advances came in 2015, when Congress allocated \$25 million, authorized under the United States-Israel Anti-Tunnel Defense Cooperation Act, for bilateral tunnel warfare efforts.

Since then, cooperation has been ongoing, on two parallel tracks. One is the cooperation framework codified in defense bills (NDAAs) dating back to 2015. Since 2016, when this cooperation formally began, the budget has gradually increased, currently standing at approximately \$80 million. The second track, which had already been in existence for 20 years at the time, was part of the Counter-Terrorism Research and Development Agreement (CTRDA). CTRDA is known by officials in both countries to have minimal bureaucracy compared to normal defense processes in Washington or Jerusalem, and a relatively short time horizon for project approval.

At first, U.S. Border Patrol was almost the only entity that showed interest in the initiative, but gradually the American military began participating over time. Today, nearly all U.S. special forces units are involved, as are conventional American forces responsible for operational planning for underground warfare contingencies. U.S.-Israel subterranean cooperation has expanded in recent years to include biannual joint exercises, brainstorming sessions, and focused research projects to advance both countries' security posture against underground threats.

This investment has yielded dividends. Not only is Israeli tunnel detection technology already deployed on America's borders, but the two countries' security apparatuses have worked closely against subterranean threats and continue to share know-how and best practices.¹⁰² As Israeli technology evolves to better counter underground enemies, the potential for the United States to benefit increases, including by acquiring and deploying sophisticated Israeli systems.

Yet this effort can and should go further. It can include a shared subterranean research and development center; a joint subterranean training center; and a joint operations center in either country entirely devoted to the subterranean domain. It should involve greater bilateral intel-sharing and training,

including not just the American and Israeli militaries but also relevant law enforcement entities like U.S. Customs and Border Protection (CBP). Currently, there are two main lines of effort before Congress to do just that.

First, there is Section 1222 of the 2027 National Defense Authorization Act (NDAA). Section 1222 would extend the Pentagon's authority to conduct research, development, testing, and evaluation (RDT&E) with Israel on subterranean capabilities. Proposed funding under the provision would include \$100 million for subterranean cooperation with Israel, funds which Israel matched in years past.¹⁰³

Second, subterranean collaboration would be included under the NDAA's Section 219 provision. Section 219 aims to streamline U.S.-Israel defense technology cooperation by designating a lead authority for it, and through this framework, identify more bilateral defense co-production, co-development, and acquisition opportunities. Section 219 could identify further opportunities for expanding and deepening the U.S.-Israel subterranean teamwork already underway, including more directly engaging industry.

B. Policy Recommendations

The United States faces three primary types of subterranean threats: subterranean threats facing ground troops in future wars; subterranean challenges in striking hard-and-deeply buried targets in future air campaigns; and subterranean threats to U.S. border security. Each, in turn, requires a qualitatively different response. These are: 1) preparing for subterranean maneuver warfare in future conflicts; 2) readying new approaches to air power for evolving subterranean threats; and 3) revamping U.S. law enforcement's border security approach to better secure American soil from the cross-border subterranean threat.

Israel's experience with subterranean warfare is illustrative for the United States and its partners in two main ways. American forces have already contended with enemies operating from underground in Iraq and Afghanistan, yet never fully adapted to the threat—and U.S. subterranean border security remains a vulnerability on a conceptual, not just operational, level. U.S. partners, too, can glean specific tactical lessons from Hamas's subterranean network and asymmetric warfare, and Israel's battle against it.

i. Recommendations for the U.S. Military

a. Think About the Unthinkable: A Major Subterranean War

Pentagon leaders should make the subterranean domain a more systemic focus of their strategic and tactical planning. While this may require Pentagon planners to allocate greater time and resources for subterranean readiness, more importantly, it requires a conceptual shift. The prospect of American troops operating in underground combat theaters for extended periods can no longer be viewed as a relic of Vietnam War-era combat or a remote possibility. Again, Israel's experience is instructive—indeed, it is a cautionary tale.

Israel, too, thought it neither likely, nor conceivably necessary, that its troops would have to operate in the subterranean domain. It, after all, had cleared its Gaza border of underground infiltration threats over the course of years, installed a robust underground barrier there, and possessed a world-class air force against an adversary that lacked advanced conventional weapons systems. Along the Israel-Lebanon border, too, Israel had addressed tunnel threats for years with success. Yet it faced monthslong, highly intensive subterranean warfare all the same.

b. Prepare Ground Forces for Subterranean Maneuver and Combat

Israel's subterranean experience shows, at a minimum, that American ground troops must prepare for such a contingency—and U.S. military leaders are beginning to take note. Several years ago, then-Marine

Corps Commandant General Robert Neller, who later participated in JINSA's Generals and Admirals Program, entered the U.S. Army's Maneuver Center of Excellence and noticed a gap in the center's training. General Neller simply asked, "What are we doing about subterranean?"¹⁰⁴ Separately, one Marine platoon commander went public several years ago about the fact that, in his words, "nowhere in my training had tunnels come up."¹⁰⁵

Marines stationed in South Korea have conducted some subterranean exercises, but it would make sense for subterranean warfare to be part of all Marines' instruction and training.¹⁰⁶ The U.S. Army has also taken note of the need for increased readiness against underground threats. In recent years, the Army has set up a subterranean training facility at Fort Bragg, the headquarters of U.S. Army Special Operations Command; increased training for subterranean operations; and created a dedicated field manual for the underground warfighting domain.¹⁰⁷

c. Increase Airpower Readiness Against Strategic Underground Sites

The United States also faces an uphill battle to address the challenge presented by nation-states' strategic subterranean sites. Subterranean chambers, like those possessed by Iran and North Korea, provide—just as with Hamas and Hezbollah tunnels—an asymmetric advantage to the defender. As subterranean know-how continues to be exchanged between China, Iran, North Korea, Russia, and their global affiliates, the complexity of targeting underground sites in each of these nations will grow. That cooperation is well underway. Chinese and Russian officials reportedly have discussed China helping Russia build a major tunnel system to aid its war effort in Ukraine, and both China and North Korea have reportedly aided Iran with constructing its subterranean nuclear facilities.¹⁰⁸

These subterranean high-value sites represent a growing challenge for Western air forces. Both natural and industrial factors insulate these facilities from airstrikes. In addition to the problem of subterranean facilities' sheer depth, their outer layers are often durable enough to withstand even advanced air-to-surface munitions. In some cases, that is because the sites are built into mountainsides made of igneous rock, like granite, while in other cases, manmade fortifications like steel or concrete ceilings add resiliency.

Even the United States' most advanced ground-penetrating munitions, including the GBU-57 bombs used against Iranian nuclear sites in June 2025 which reportedly can penetrate up to 60 meters of hardened rock, may be insufficient to strike these facilities and could have to be supplemented or replaced.¹⁰⁹ The Iranian nuclear site at Pickaxe Mountain, for example, is reportedly located at depths of over 100 meters underground beneath both natural granite stone and manmade fortifications.¹¹⁰

Therefore, novel approaches to targeting subterranean sites may be required. Promising U.S. research into new bunker-buster munitions that use shockwaves rather than brute force to penetrate surface material is worthy of further exploration and, potentially, adoption.¹¹¹ Significantly more research and development, and accompanying resources, are needed to develop the technological means to hold foreign adversaries' hard and deeply buried targets (HDBT) at risk in the years ahead.¹¹²

ii. Recommendations for U.S. Law Enforcement

a. Increase Border Data Processing and Fusion Capabilities...

The U.S. Department of Homeland Security, the largest federal law enforcement agency, has primary responsibility for defending America's perimeter. Evidence suggests, however, that the DHS—namely its border control agency, U.S. Customs and Border Protection (CBP), and the CBP's own subordinate border security agency, U.S. Border Patrol—has not yet fully adopted the posture needed to defend U.S. borders from cross-border tunnel threats. For the United States to be secure, that must change.

The key to successfully detecting and neutralizing subterranean threats is, in two words, data fusion. What Israel has learned is that data without fusion and analysis, on a continuous and largely autonomous basis, is not worth very much. Israel has a handful of subterranean threat data centers across key sectors, and the tools to amalgamate and, using AI/ML systems, sift through vast amounts of sensor data.

b. ...Through Structural Change

The United States does not have an equivalent system in place. CBP operates command centers at each of its nine geographic sectors along the U.S.-Mexico border, as well as localized tunnel detection platforms.¹¹³ However, no subterranean data fusion and processing center, or a dispersed technological system capable of serving that function in the interim, exists—and is sorely needed. Without automated and centralized data fusion, U.S. officials will not be able to detect threat patterns, gather real-time surveillance across geographic domains, and mount a coordinated response if necessary. Simply put, like a car alarm or home security alarm, sensor data is not ultimately helpful unless it is quickly detected by the right parties and acted upon.

CBP has made institutional shifts over the past several years to increase the agency’s focus on cross-border subterranean threats, as a 2025 DHS Office of Inspector General (DHS OIG) report highlighted.¹¹⁴ The report notes the existence of:

- The National Subterranean Operations office, established in 2021 and led by the Border Patrol’s Operations Directorate to be a “centralized operational coordination point for subterranean missions along the U.S. border” and the “lead office for countering cross-border tunnel vulnerabilities”;
- The Tunnel Reachback Center, established in 2023 and led by the CBP’s Laboratories and Scientific Services to “provide Border Patrol with sensor data analysis, scientific guidance, and on-demand deployable support for counter-tunnel operations” and be “a hub for subterranean missions”; and
- The Subterranean Operations Center, established in 2025 and led by Border Patrol’s Headquarters Intelligence Division, into which the Tunnel Reachback Center will be folded. Very little is publicly known about this new center.

The establishment of dedicated subterranean-focused entities is a positive step, but problems remain. In addition to potentially being duplicative, none of these tunnel-focused entities have what is ultimately needed: real-time, around-the-clock data fusion and processing capabilities. An encouraging step is the DHS’s recent addition of Tunnel Entry Applications within its Intelligence Reporting System-Next Generation, laying the groundwork for a future database to track subterranean activity—but one which requires manual inputs.¹¹⁵ Automatic sensor data fusion, however, is precisely what is needed to combat subterranean threats and should be a primary focus for the DHS and lawmakers moving forward.

c. Acquire and Deploy Better Intelligence Tools for Addressing Subterranean Border Threats

At the same time, it is not clear that the CBP has adequate technology for subterranean threat detection to begin with. The CBP has explored deploying a persistent surveillance system for cross-border tunnel threats, but no such system is operational along much of the southern U.S. border.¹¹⁶ An August 2025 DHS Inspector General report found that the CBP remains in the early testing phase for wide-ranging tunnel detection systems, with actual deployment likely years away.¹¹⁷ This, too, is an important vulnerability for the United States to patch, and one which Israeli expertise, detection and neutralization platforms, and technological advances can help address.

iii. Recommendations for U.S. Partners and Allies

a. South Korea

Of all U.S. partners and allies, or countries where American troops are stationed, South Korea faces the most volatile and dangerous subterranean threat landscape. South Korea and Israel have close military ties, and Seoul has bought many advanced Israeli systems. Yet there is limited known cooperation on the subterranean domain. This lack of joint subterranean initiatives is both problematic and ironic. North Korea and Iran's proxies have seemingly cooperated more closely on subterranean combat readiness than their foes South Korea, Israel, and the United States have with one another. In fact, former South Korean President Yoon Suk Yeol reportedly told U.S. officials in November 2023 that both South Korea and the United States should increase readiness against potential " Hamas-style " attacks against their respective countries, highlighting Seoul's keen awareness of the similar threats all three nations face. Washington should explore facilitating closer trilateral cooperation, including by inviting Israeli forces or technical experts to annual U.S.-South Korea subterranean training exercises.¹¹⁸

b. Taiwan

Hamas and Hezbollah's subterranean strategies may, conversely, also be applicable to U.S. partners worldwide in need of asymmetric advantages. Chief among these is Taiwan. It is not hard to see why Taiwan could benefit from preparing the subterranean domain to repel a potential Chinese attack.¹¹⁹ Adopting this approach would enable it to disperse weaponry across the island, shield strategic assets from aerial assault, and make a Chinese amphibious invasion especially grueling and costly by mobilizing the Taiwanese population. Ukraine's initial success fending off the 2022 Russian offensive against Mariupol in using a Cold War-era tunnel complex, despite being vastly outnumbered, shows the potential upside of this asymmetric approach.¹²⁰ Taiwan should explore adopting a subterranean-based strategy to counter a Chinese amphibious assault and mitigate the strategic impact of Chinese aerial bombardment.

VII. Conclusion

The subterranean domain is evolving to become a major, if at times overlooked, threat facing Western militaries even in the age of advanced precision weaponry, cyber warfare, quantum, space, and more. Yet basic tools in the hands of determined adversaries are offsetting conventional power imbalances.

Policymakers and media have rightly placed considerable attention on the increasing use of drones as a form of asymmetric warfare. These low-cost, mass-produced, and commercially available systems have become a central feature of this decade's wars in Europe and the Middle East, often favoring the conventionally weaker force. Less attention has been paid to how subterranean warfare is having the same effect. Tunnels made with basic power tools are exploiting strong countries' vulnerabilities and intelligence blind spots, using industrial equipment bought on the internet and with techniques and machinery known to the average construction worker. U.S. adversaries are using the subterranean domain to offset their conventional weakness vis-à-vis more powerful actors, like Israel and America.

What's more, those enemies are almost certainly not done adapting. If the various adaptations by Iran's proxies are any indication—like Hezbollah's evolution to fiber-optic drones, the Houthis' use of underwater drones, and Hamas's utilization of paragliders—the enemies of democracy will continue their race to innovate, and the subterranean front will be no exception. That trend will accelerate as relevant know-how and technology becomes more widely accessible, and shared between terror groups, transnational criminal syndicates, and rogue states worldwide. In the authors' judgment, the nearly identical features of tunnel networks in Gaza, Lebanon, North Korea, and along the U.S.-Mexico border

are not a coincidence. While these tunnels range in scale, they share many attributes, particularly their sophisticated use of rail lines, electric wiring, ventilation shafts, and in some cases, hydraulic lifts.

The subterranean domain's use by Iranian proxies Hamas and Hezbollah unlocked, for those terrorist organizations, a new tactical plane. Moreover, the U.S.-Israel war with Iran has shed light on how the Iranian regime has used the subterranean domain in ways that overlap with those of its proxies. Iran's regime similarly engineered underground missile cities to store and manufacture projectiles—large subterranean chambers that, pre-war videos show, were used to store hundreds of drones and missiles. More troublingly, Iran's nuclear program has long been housed well below the earth's surface. While U.S. Operation Midnight Hammer in 2025 showed that these sites are not impervious to airstrikes, in the future, Iranian underground facilities very well could be.

The Islamic Republic of Iran is not alone in its use of the subterranean domain to shield its most prized sites. North Korea most prominently, but also China, Russia, and other U.S. adversaries are storing their most sensitive strategic assets underground in a bid to make them airstrike-proof. And at the same time, for Americans, the threat is far closer to home.

Discoveries of major, highly advanced tunnels along America's southern border in recent years have been shocking—but not surprising. Transnational criminal organizations are quickly adapting these techniques, likely with the help of Iran's global terror network. Even a single undetected tunnel used by a terrorist to infiltrate U.S. territory with a weapon of mass destruction could lead to catastrophe.

There is good news in all this. Israel and the United States are making significant progress in counteracting this threat, mostly thanks to Israel's forced, rapid, and successful adaptation to its enemies' subterranean laboratories. Israel has made it a signal priority to achieve subterranean superiority — no less so than in the air and cyber domains. Israeli subterranean technology is undergoing continuous refinement, and cutting-edge platforms undergo constant experimentation by Israel's military and defense sector. America is fortunate to have a partner that has faced the subterranean threat on an unprecedented scale, and with striking success—creating the tools and a strategic blueprint for prevailing against it.

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