

# MP-IDSA

## *Issue Brief*

# IDF's Subterranean Challenge: Profiling Gaza Metro, Hamas's Centre of Gravity

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## **S***ummary*

The subterranean infrastructure developed by Hamas, popularly known as the 'Gaza Metro' consists of tunnels, command and control centres, living spaces, stores and contingency fighting positions. The infrastructure is the pivot of Hamas's irregular warfare strategy and allows it to undertake both offensive and defensive operations and has been assessed as one of its centres of gravity. The Israel Defense Forces (IDF) has been aware of the infrastructure but has possibly been surprised by the scale and sophistication achieved by Hamas in tunnel construction. The IDF's technologies and doctrinal concepts are being tested every day in the ongoing war and will have a number of lessons for the Indian Army.

Hamas has developed a complex subterranean infrastructure consisting of tunnels, command and control centres, living accommodation, stores and contingency fighting positions. The tunnels also have designated spaces for rocket-assembly lines, explosive stores, and warhead fabrication workshops.<sup>1</sup> This infrastructure is famously known as the ‘Gaza Metro’. The Metro is reinforced by concrete and other building material and protected by blast doors, improvised explosive devices (IEDs) and booby traps.

The tunnels have been in use since at least the early 1980s, and members of various Palestinian insurgent organisations have been known to use them since the first Intifada, beginning in 1987.<sup>2</sup> In the aftermath of the 2021 Israel–Hammas conflict, Hamas leader, Yahya Sinwar claimed that Hamas has 500 kilometres of tunnel system and that the Israel Defense Forces (IDF) has damaged only 5 per cent of it.<sup>3</sup> There is no way to verify Sinwar’s claim but is indicative of the magnitude of challenge the IDF faces in the ongoing war.

Tunnel warfare is not new and dates to the ancient times. Jews used them against Romans in Judea in the first century.<sup>4</sup> In the more recent times, the tunnels have been used in the battles of the Vimy Ridge, Messines and Somme of World War I, by the Viet Congs in Vietnam and in Mariupol, Bakhmut, and Soledar during the ongoing war in Ukraine.<sup>5</sup>

The Brief delves into the multifaceted dimensions of the Gaza Metro and seeks to flag its origins, development, and the strategic implications on the ongoing war. It also focusses on the IDF’s concerted efforts in developing technologies and deploying specialised forces to detect and dismantle this clandestine infrastructure.

Gaza Metro is more than a just any military infrastructure. It is the centre of gravity (COG) of Hamas’s military wing.<sup>6</sup> The Brief also attempts to analyse various aspects of operational significance of Gaza Metro using certain facets of the theoretical construct of COG advanced by Colonel John A. Warden of the US Air Force, Professor Joe Strange and Colonel Richard Iron, and Professor Antulio J. Echevarria II, retired US Army officer.

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<sup>1</sup> Edward Luttwak, “[What Israel Will Face in Gaza](#)”, *UnHerd*, 17 October 2023.

<sup>2</sup> Jacob Knutson, “[What to Know About Hamas’ Tunnel System Beneath Gaza](#)”, *Axios*, 19 October 2023.

<sup>3</sup> Tzvi Joffe, “[Hammas’s Sinwar: We Have 500 km of Tunnels in Gaza, Only 5% Were Damaged](#)”, *The Jerusalem Post*, 27 May 2021.

<sup>4</sup> Audrey Kurth Cronin, “[Hammas’s Asymmetric Advantage: What Does It Mean to Defeat a Terrorist Group?](#)”, *Foreign Affairs*, 22 November 2023.

<sup>5</sup> John Spencer, “[Underground Nightmare: Hammas Tunnels and the Wicked Problem Facing the IDF](#)”, *Modern War Institute*, 17 October 2023.

<sup>6</sup> “[What’s the Endgame of an Israeli Ground Assault in Gaza?](#)”, *NPR*, 17 October 2023.

## History of Gaza Metro

The tunnels in Gaza predate Hamas. It is believed that they have been in use since the early 1980s<sup>7</sup> after the city of Rafah was divided by the new border recognised in the 1979 peace treaty between Egypt and Israel.<sup>8</sup> It was initially used by the divided families to communicate among themselves and by smugglers to transport goods. Hamas was raised in 1987 and soon it realised the military importance of the tunnels. It began digging tunnels in the mid-1990s, when Palestine Liberation Organization (PLO) was granted some degree of self-rule in Gaza by Israel. The group began tunnelling in earnest since 2005, when Israel withdrew from Gaza, and later when Hamas assumed power in 2006 election.<sup>9</sup>

Among the early success of Hamas, using the tunnels, was abduction of IDF soldier Gilad Shalit and killing of soldiers Hanan Barak and Pavel Slutzker in a cross-border raid on 25 June 2006. Later Israel freed 1,027 Palestinian prisoners in return for Shalit’s release in October 2011.<sup>10</sup>

As per the reports, the tunnels in 1990s were approximately one meter wide and smugglers used winch motors to haul goods along the sandy tunnel floors in hollowed-out petrol barrels.<sup>11</sup> Hamas has since gained considerable expertise in tunnelling and construction of underground infrastructure which has advanced security features, sewage disposal and air-conditioning systems, etc.

## Hamas and Gaza Metro

The Gaza Strip has an approximate area of 365 square kilometres. If Yahya Sinwar’s claim of 2021 of Hamas having built 500 kilometres of tunnel system is true, then it would be equivalent of having 10 parallel north to south tunnel systems and eight parallel interconnecting tunnels running east to west.<sup>12</sup> The Gaza Metro is so designed that there may be dozens of shafts leading to a tunnel at depths of between 20 and 80 meters. As per some accounts, the density of tunnels is so high that some crisscross at different depths.<sup>13</sup> To create a subterranean system of this magnitude

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<sup>7</sup> Jeremy M. Sharp, “[The Egypt-Gaza Border and its Effect on Israeli-Egyptian Relations](#)”, CSR Report for Congress, 1 February 2008.

<sup>8</sup> Jacob Knutson, “[What to Know About Hamas' Tunnel System Beneath Gaza](#)”, no. 2.

<sup>9</sup> “[The Hamas Tunnel City Beneath Gaza - A Hidden Frontline for Israel](#)”, *The Jerusalem Post*, 27 October 2023.

<sup>10</sup> Raoul Wootliff and Stuart Wine, “[Hamas Airs Video of Captive Gilad Shalit, Hours After Releasing Photo](#)”, *The Times of Israel*, 30 December 2015.

<sup>11</sup> “[The Hamas Tunnel City Beneath Gaza - A Hidden Frontline for Israel](#)”, no. 9.

<sup>12</sup> Tzvi Joffe, “[Hamas's Sinwar: We Have 500 km of Tunnels in Gaza, Only 5% Were Damaged](#)”, no. 3.

<sup>13</sup> Marco Hernandez and Josh Holder, “[The Tunnels of Gaza](#)”, *The New York Times*, 10 November 2023.

requires a dedicated organisation, high level of technological expertise, and resources in terms of trained manpower, equipment and money.

Israeli officials have reported that Mohammad Sinwar, the brother of Yahya Sinwar, is heading the tunnel building project.<sup>14</sup> Gaza has been under land, sea and air blockade by Israel and Egypt since 2007 and it was not expected to possess capability or resources to dig such an infrastructure. It was appreciated that Hamas has employed diggers using basic tools, used basic electrical fittings, and diverted concrete meant for civilian and humanitarian purposes towards tunnel building project. However, two of the tunnel systems discovered during the ongoing war, viz. near al Shifa Hospital and other close to the Erez crossing belies this assessment. The details of these tunnels have been discussed later in the Brief.

During its operation in the house of Yahya Sinwar in Khan Yunis, the IDF collected significant amount of Hamas intelligence including Hamas’s report of financial transactions that gives details of more than a million dollars spent to construct tunnels in 2022.<sup>15</sup>

#### *Tunnel under al-Shifa Hospital*

In the second week of November 2023, IDF’s 162nd Division was operating in Hamas’s “security quarter” of Gaza City, adjacent to al-Shifa Hospital. The troops of Givati Infantry Brigade reportedly found intelligence materials, weapons manufacturing plants, anti-tank missile launch positions and tunnels.<sup>16</sup>

On 17 November, the IDF located one of the shafts which led to the entrance of a bigger tunnel. This tunnel led to a blast door leading to a complex which had multiple rooms and one of them “was a spacious bedroom with two large beds and a large modern air conditioning unit, a kitchenette, a bathroom, and other facilities, as well as extensive plumbing and electrical wiring to enable all of the infrastructure”.<sup>17</sup> The tunnel shaft leading to the main tunnel was approximately 2 metres high, lined with stones and concrete. The complex under the hospital was reportedly being used by Hamas as a command and control centre.<sup>18</sup>

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<sup>14</sup> Dov Lieber, [“Israeli Military Reveals Tunnel It Says Hamas Built for Large-Scale Attack”](#), *The Wall Street Journal*, 17 December 2023.

<sup>15</sup> Yonah Jeremy Bob, [“IDF Turns Yahya Sinwar’s Home to Dust in Gaza’s Khan Yunis”](#), *The Jerusalem Post*, 22 December 2023.

<sup>16</sup> Emanuel (Mannie) Fabian, [“IDF says the 162nd Division is operating in Hamas’s “security quarter” of Gaza City...”](#), X (formerly Twitter), 9 November 2023.

<sup>17</sup> Yonah Jeremy Bob, [“Post’ Joins Israeli Forces in Hamas’s Gaza Tunnel Underworld”](#), *The Jerusalem Post*, 22 November 2023.

<sup>18</sup> [“Watch: Israeli Army Displays Hamas Tunnel Under Gaza Hospital”](#), *NDTV*, 23 November 2023.

### *Tunnel near Erez Crossing*

The IDF reported on 17 December that it had discovered largest tunnel ever—four kilometre long and 50 metres deep—near the Erez crossing. The tunnel reinforced with concrete had electrical fitments and was wide enough to allow a vehicle to pass through. The IDF also released a video of Mohammad Sinwar driving a car through a tunnel. In another video released by the IDF, Hamas fighters were seen using a large drill. In the tunnel near the Erez crossing, the IDF reportedly found “unspecified digging machines” not reported earlier.<sup>19</sup> One section of the tunnel was approximately 400 metres from the Israeli border.

The IDF has informed that the Combat Engineering Corps’ elite Yahaom unit and Gaza Division’s Northern Brigade used “advanced intelligence and technological means” to uncover the tunnel network.<sup>20</sup>

### *Operational Employment of Subterranean Infrastructure*

The infrastructure is the pivot of Hamas’s irregular warfare strategy and allows it to undertake both offensive and defensive operations. It offers Hamas asymmetric advantage, negating some of the technological advantages available to the IDF. The fact that Hamas has constructed the subterranean system under one of the world’s densest urban locations complicates the matter further for IDF.

The system is designed to withstand IDF’s aerial and ground bombardment. The design and construction enable Hamas to locate its leadership, combat units, headquarters, command and control centres, weapons and supplies inside the complex. It also enables various military echelons to move freely between various prepared contingency positions. Hamas has located power generation and air-conditioning systems, plumbing and sewage disposal arrangements and food supplies within the infrastructure. This is helping its fighters to better withstand the siege laid by the IDF in the ongoing war. The tunnels also allow the fighters to escape the combat zone when they are decisively surrounded by the IDF, as was the case in battle near the al-Shifa Hospital.

Hamas fighters are using tunnels to undertake offensive operations by infiltrating behind IDF positions and launching surprise attacks using snipers, rocket propelled grenades (RPGs) and other weapon systems. It enables small teams to appear undetected behind IDF lines, strike and withdraw.

It is also assessed that Hamas has booby trapped the tunnels and will initiate the devices causing the tunnels to collapse over the advancing IDF troops.

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<sup>19</sup> Ashka Jhaveri, Andie Parry, Kathryn Tyson and Nicholas Carl, [“Iran Update, December 17, 2023”](#), Backgrounder, Institute for the Study of War (ISW), 17 December 2023.

<sup>20</sup> Emanuel (Mannie) Fabian, [“IDF says the 162nd Division is operating in Hamas’s “security quarter” of Gaza City...”](#), no. 16.

## Gaza Metro as Centre of Gravity

Clausewitz originated the concept of attacking the enemy’s centre of gravity which he described as “the hub of all power and movement, on which everything depends. That is the point against which all our energies should be directed.”<sup>21</sup> A fighting force can have multiple centres of gravity and each centre will have an effect of some kind on the others. Hamas too has multiple centres<sup>22</sup> and some analysts have described Gaza Metro as one of them.<sup>23</sup>

### *Warden’s Five-Ring Model*

Warden has conceptualised “Five-Ring Model” related to COG, of which infrastructure is the third critical ring. The infrastructure relates to enemy’s transportation system—that moves civil and military goods and services in the combat zone. Gaza Metro is essential to move troops, warlike stores, command instructions and intelligence around the battlefield and if the IDF can disrupt the movement, Hamas will have lesser ability to resist it. Although Warden agrees with Clausewitz’s description of COG as “the hub of all power and movement”, he goes further to describe it as “that point where the enemy is most vulnerable and the point where an attack will have the best chance of being decisive”.<sup>24</sup> Warden’s first ring and the “most critical” ring is the command ring, which refers to the leadership and communication resources.<sup>25</sup> It is assessed that Hamas’s leadership,<sup>26</sup> including Yahya Sinwar, leader of the Hamas movement within the Gaza Strip, Mohammed Deif, commander-in-chief of the Izz al-Din al-Qassam Brigades, and Marwan Issa, the deputy commander are hiding in the subterranean complex.

Neutralisation of Hamas leadership is likely to have a decisive impact on the outcome of war. It is also expected that Hamas leadership would have constructed multiple safe hideouts inside the subterranean infrastructure, from where they can direct their subordinate commanders and units. It is also likely that only the most trusted Hamas members would be aware of these locations. It would require sustained intelligence operations by Israel to generate actionable intelligence. However, once the Hamas leadership is cordoned inside the tunnels, they would be extremely vulnerable to IDF operations.

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<sup>21</sup> Carl von Clausewitz, *On War*, edited/translated by Michael Howard and Peter Paret, Princeton University Press, Princeton, NJ, 1976, pp. 595–596.

<sup>22</sup> U.S. Defense Secretary Lloyd Austin has described civilians in Gaza, the center of gravity. See Phil Stewart, “[Civilians are 'Center of Gravity' in Gaza War: US Defense Secretary](#)”, *Reuters*, 3 December 2023.

<sup>23</sup> “[What’s the Endgame of an Israeli Ground Assault in Gaza?](#)”, *NPR*, no. 6.

<sup>24</sup> John A. Warden, *The Air Campaign* (revised edn), Excel Press, Lincoln, 2000.

<sup>25</sup> John A. Warden, “[The Enemy as a System](#)”, *Airpower Journal*, Vol. 9, No. 1, pp. 40–55, 1995.

<sup>26</sup> Lina Alshawabkeh, “[Hamas: Who are the Group’s Most Prominent Leaders?](#)”, *BBC News*, 17 October 2023.

For the moment, the IDF is unaware of the exact location of the leadership and is destroying as much of this subterranean complex, as is possible to cause “strategic paralysis—by destroying one or more of the outer strategic rings or centers of gravity”<sup>27</sup>—the infrastructure ring—the Gaza Metro.

### *Strange and Iron’s Theory*

The Strange and Iron’s theory is helpful to identify the location of COG and the impact of operations against it. The theory aligns with the J.J. Graham’s translation of *On War*, published in 1874 which postulates that: “As a centre of gravity is always situated where the greatest mass of matter is collected, and as a shock against the centre of gravity of a body always produces the greatest effect, and further, as the most effective blow is struck with the centre of gravity of the power used, so it is also in war.”<sup>28</sup>

Hamis is cognizant of the incredible capability and resources of Mossad and Shin Bet to generate actionable intelligence and doctrinal, technological, and material superiority of the IDF to undertake combat operations. To counter Israel’s operational superiority, Hamas relies on low-tech solution in the form of subterranean infrastructure. The nature of infrastructure provides Hamas inherent physical protection, ease of movement and concealment to command and control elements and, combat, and logistic units.

The Gaza Strip is one of the densest urban locations anywhere in the world. Tunnels in conjunction with urban infrastructure helps to create extremely potent defensive localities and killing grounds. The IDF hopes to find the leadership and fighters of the al-Qassam Brigades inside the Gaza Metro.

Hamis has claimed that Gaza Metro is spread over 500 kilometres. Hamas is expected to dissipate its forces all along the Metro to avoid presenting a concentrated target to the IDF. However, once located, and fixed, the IDF will be able to neutralise Hamas forces with relative ease inside the tunnel system.

The Strange and Iron’s theory also introduces a model of COG analysis with three additional sub-concepts<sup>29</sup>:

- **Critical Capabilities (CC):** CC is the primary ability of the COG within a given context.
- **Critical Requirements (CR):** CR relate to conditions, resources and means essential for the COG to achieve its CC.

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<sup>27</sup> John A. Warden, “[The Enemy as a System](#)”, *Airpower Journal*, no. 25, p. 50.

<sup>28</sup> Carl von Clausewitz, *On War*, translated by J.J. Graham, Kegan Paul, Trench, Trübner, London, 1908, Volume I, Book Six, p. 354.

<sup>29</sup> Eystein L. Meyer, “[The Centre of Gravity Concept: contemporary Theories, Comparison, and Implications](#)”, *Defence Studies*, Vol. 22, No. 3, pp. 332–333, 2022.

- **Critical Vulnerabilities (CV):** CV refers to those CRs or components that are vulnerable to neutralisation in a way that will contribute to a COG failing to achieve its CC.

In the context of Gaza Metro, the subterranean nature of the infrastructure reinforced with concrete and other building material and further hardened using Improvised Explosive Devices (IEDs) and booby traps are the CCs. The camouflage and concealment arrangement to prevent detection of tunnels are the CRs while entry and exit points, ventilation and sewage arrangements, and communication infrastructure to enable command of Hamas fighters are the CVs.

### *Echevarria’s Theory*

Echevarria postulates COG is identified to achieve total collapse of the enemy—which is considered both as an effect and an objective.<sup>30</sup> He further elaborates on the construct to suggest that the COG helps in identifying “way”—course of action—within an “ends-ways-means” construct to achieve annihilation of the enemy.<sup>31</sup>

This aspect may not be true when fighting an ideologically motivated and radical organisation like Hamas. It is possible that the IDF may identify and destroy Hamas’s tunnel system and thereby achieve destruction of Hamas’s military leadership and fighting units, however, in all probability the organisation will survive and grow, perhaps even more radical. “Terrorist groups are known to survive the loss of their leaders and members. It is quite likely that even if Israel destroys Hamas’s military wing, the idea of Hamas may survive.”<sup>32</sup>

## **IDF’s Tunnel Warfare Capability**

### *Development of Technological Capabilities*

The IDF has been aware of Hamas’s underground infrastructure and has been working towards new technologies and doctrinal concepts. When the first tunnel was discovered, the IDF established a laboratory, manned by engineers, physicists, geologists and intelligence operatives under the Gaza Division. The laboratory employed innovative soil research techniques, including scanning and decoding signals, and developed new detection techniques. In 2018, a review of then IDF’s underground combat capability was undertaken and a new training manual was published.<sup>33</sup>

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<sup>30</sup> Antulio Echevarria II, *Clausewitz’s Center of Gravity: Changing Our Warfighting Doctrine—again!*, Carlisle, U.S. Army War College, Strategic Studies Institute, 2002, pp. 12–13.

<sup>31</sup> Ibid., p. 15.

<sup>32</sup> Daniel R. DePetris, “[Israel’s Gaza Problem](#)”, *RUSI*, 1 November 2023.

<sup>33</sup> Arie Egozi, “[Israelis Test Classified Tunnel Tech To Stymie Terrorists; US Watches](#)”, *Breaking Defense*, 13 August 2019.



The Israeli scientists and engineers have developed several new innovations, most of them are classified. The IDF’s specialised units have been equipped with special conical penetrators, drills, robotic systems that can inject special ‘emulsions’ either to seal or destroy the tunnels.<sup>34</sup> IDF also makes innovative use of technologies such as ground and aerial sensors, ground penetrating radars, geophones, fibre optics, microphones, special drilling equipment and others.

The Israeli scientists have developed radio and navigation equipment which can work underground, night vision devices that work in complete darkness and remote and wire-controlled robots that can see and map tunnels without risking the lives of the soldiers. The IDF has training simulators to train soldiers in near realistic situations. Israel has also developed variety of explosives and ground penetrating munitions, like the GBU-28 which can penetrate 20 feet of concrete or 100 feet of earth.<sup>35</sup>

Israel, over the years, has used satellite imageries, aerostat cameras and radars to map the tunnel system. These assets cannot reveal the layout of the tunnels but have been used to monitor location where cement-mixture trucks have halted over the years. The general area around these locations are possible entrances of the tunnels and may be probed using low-frequency, earth-penetrating radars, or basic probes.<sup>36</sup>

US and Israel have also been collaborating to develop newer technologies. Since 2016, Congress has appropriated US\$ 320 million towards the project.<sup>37</sup>

#### *IDF’s Special Units*

Fighting enemy inside subterranean system requires specialised units. The Gazan tunnels were first discovered during the first Intifada and the IDF recognised the need to raise specialised units. It raised ‘Yahalom’, specialist commandos from Israel’s Combat Engineering Corps. Yahalom specialises in discovering, clearing, and destroying tunnels and has the “Yael” Company to undertake engineering reconnaissance, “Sayfan” to neutralise the threat of non-conventional weapons (weapons of mass destruction). In addition, there are two explosive ordinance disposal units, and “Samur”, which specialises in tunnel warfare.<sup>38</sup>

The IDF has a specialised canine unit, “Oketz”, whose dogs are trained in special tasks such as attack, search and rescue, explosive detection, and weapon location.<sup>39</sup>

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<sup>34</sup> Ibid.

<sup>35</sup> John Spencer, “[Underground Nightmare: Hamas Tunnels and the Wicked Problem Facing the IDF](#)”, *Modern War Institute*, 17 October 2023.

<sup>36</sup> Edward Luttwak, “[What Israel Will Face in Gaza](#)”, no. 1.

<sup>37</sup> Michael Biesecker and Sarah El Deeb, “[Hamas Practiced in Plain Sight, Posting Video of Mock Attack Weeks Before Border Breach](#)”, *AP*, 14 October 2023.

<sup>38</sup> “[This is the IDF’s Plan to Combat Hamas Terror Tunnels](#)”, *The Israel Defence Forces*, 27 November 2016.

<sup>39</sup> Sneha Swaminathan, “[Israeli Canine Unit 'Oketz' Helped Rescue 200 lives, Neutralise 10 Hamas Terrorists](#)”, *WION*, 15 October 2023.

In addition, police and intelligence services too have specialist units—“like Sayeret Matkal, the Yamam, and others—who share best practices for dealing with terrorists and combatants underground.”<sup>40</sup>

## **IDF’s Subterranean Operations**

The IDF’s doctrine of subterranean warfare has evolved with the development of newer technologies to counter Hamas’s underground infrastructure, which too has become increasingly sophisticated and more potent with the passage of time.

Hamas fighters have advantage in narrow, dark, collapsible tunnels with which they are familiar. The IDF protocol demands that soldiers do not enter the underground structures unless it has been cleared of Hamas presence.<sup>41</sup> It uses many of the newly developed technologies including tracker robots and explosives to map and clear the tunnels.

During the ongoing war, Hamas prisoners have also provided intelligence about the tunnels. These prisoners do not have the complete picture of the Gaza Strip but have excellent knowledge of the underground system under their villages and localities.<sup>42</sup>

### *Namer Establishes Cordon*

Israel has one of the world’s best protected armoured vehicles, 70-ton *Namer*, to assist in tunnel demolition. It is armed with active defence system to intercept incoming rockets and missiles and machine guns to fight enemy on ground. The vehicle is equipped with cameras which allows the crew to operate in the safe environment from within the vehicle. The IDF employs *Namer* to provide protection by establishing a security cordon around the combat engineers who undertake the task of demolishing underground infrastructure.<sup>43</sup>

Having secured the area of operation, the IDF maps the structure either by using ‘exploding gel’ or other technologies. Thereafter, it has an option of either demolish the underground infrastructure using explosives or flood it with sea water.

### *IDF uses ‘Exploding Gel’ to Map Underground Infrastructure*

The ‘exploding gel’ is used to map the underground structure. Having located the entrance to the tunnels, the army engineers fill the passage with ‘exploding gel’ and

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<sup>40</sup> John Spencer, [“Underground Nightmare: Hamas Tunnels and the Wicked Problem Facing the IDF”](#), no. 35.

<sup>41</sup> [“Ex-IDF Deputy Chief: Soldiers Won’t Enter the Tunnels, Will Turn them into Hamas Death Traps Without Going In”](#), *The Times of Israel*, 3 November 2023.

<sup>42</sup> [“With Mapping Robots and Blast Gel, Israel Wages War on Hamas Tunnels”](#), *The Jerusalem Post*, 16 November 2023.

<sup>43</sup> Edward Luttwak, [“What Israel Will Face in Gaza”](#), no. 1.

fire it using detonators. The smoke travels the passage way and is used to map the underground infrastructure and also cause casualties to anyone inside the tunnels. The composition of the gel is classified and is brought in trucks because the scale in which it is used is huge. Several tons of gel are required every few hundred metres.<sup>44</sup>

The tunnel system runs for hundreds of kilometres. It is unclear how cost and resource effective this technology is.

#### *IDF Deploys Pumps to Flood the Tunnels*

The IDF maintains a tunnel flooding plan. In the middle of November 2023, it deployed five very large capacity pumps, approximately three kilometres north of Al-Shati refugee camp. Each of these pumps is reported to have capacity to draw thousands of cubic meters of water per hour from the Mediterranean Sea and flood the tunnels within weeks.<sup>45</sup> On 12 December, *The Wall Street Journal* reported “Israel’s military has begun pumping seawater into Hamas’s vast complex of tunnels in Gaza.”<sup>46</sup>

It is still unclear how effective this tactic will be to achieve its intended objective of demolishing the underground infrastructure. The plan, however, has a downside since it is likely to contaminate Gaza’s fresh water supply.<sup>47</sup>

## Conclusion

Hamas has expended a large percentage of its resources—money, material, and man-hours—to develop the subterranean infrastructure as a counter to technological and resource superiority of the IDF. It is the pivot around which Hamas’s defensive and offensive operations are planned and executed. The IDF, on the other hand, has been working to develop newer and more effective counters, however, there are yet to achieve the desired result. The ongoing Israel–Hamas war will bring out several new lessons of interest to Indian Army.

The concept of COG originally advanced by Clausewitz applied to conventional wars fought by regular armies. The world today faces challenge from religious and ideologically motivated non-state actors and the concept does not provide adequate explanation when planning operations against such organisations. This aspect requires greater deliberation.

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<sup>44</sup> [“With Mapping Robots and Blast Gel, Israel Wages War on Hamas Tunnels”](#), no. 42.

<sup>45</sup> Nancy A. Youssef, Warren P. Strobel and Gordon Lubold, [“Israel Weighs Plan to Flood Gaza Tunnels With Seawater”](#), *The Wall Street Journal*, 4 December 2023.

<sup>46</sup> Nancy A. Youssef, Carrie Keller-Lynn, Michael R. Gordon and Dov Lieber, [“Israel Begins Pumping Seawater Into Hamas’s Gaza Tunnels”](#), *The Wall Street Journal*, 12 December 2023.

<sup>47</sup> In 2015, Egypt had flooded 10 tunnels dug beneath the Gaza–Egypt border. See [“Steinitz: Egypt Floods Hamas Tunnels, in part due to Israel’s Request”](#), *The Jerusalem Post*, 6 February 2016.

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