



Inside the tunnels of Gaza

The scale, and the sophistication, of Hamas' tunnel network





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Published Jan. 1, 2024 01:00 AM GMT+9

Beneath the warscape of Gaza City lies a vast network of tunnels built by the Palestinian militant group Hamas. Some entrance shafts are hidden among what remains of the city's multi-storey buildings, ravaged by Israeli air strikes. Others are concealed in sandy dunes outside the city. Or tucked away in private homes. They lead to a warren of interconnecting passages that stretches below Gaza's streets, extending for hundreds of miles into almost every area of the enclave.

Reuters spoke to seven military experts and officials, and drew on its own reporting on the ground in Gaza, as well as descriptions and images from Hamas and the Israeli military, to piece together a picture of the scale and sophistication of the tunnel network.

Climbing bars

1m

Supporting wall can be
made from concrete
panels or bricks

**In many cases, a
concealed vertical
shaft provides an
access point to the
tunnels below**

**Inside the tunnel
itself is just sand,
dust, silence and
humidity**

The shaft can stretch deep underground before it connects to the horizontal tunnel network

Electricity and communication wires

The floor can be compacted or also have cement tiles or other materials.

The Gaza metro

Hamas, which has controlled the Gaza Strip since 2007, said two years before the current conflict erupted that it had installed a network of more than 500 kilometers (310 miles) of tunnels - roughly equivalent to half the length of the New York subway system.

Reinforced doors to block sections and entrances

The Israeli military has nicknamed it the Gaza metro.

Israel says the tunnels have been a primary target of its air strikes, artillery bombardment and ground forces since the war began. Images shared by the Israel Defense Forces (IDF), as well as Reuters reporting on the ground, show the tunnels have specialized sections for launching military attacks, as well as logistics areas, storage facilities and transportation routes.

Hamas has said it is using the tunnels, and other safe places, to hide hostages seized in its Oct. 7 attack on Israel. Hamas gunmen killed some 1,200 people and took 240 captives in the raid, which sparked the war. Around 110 of those hostages have been released, most of them during a week-long ceasefire that ended in late November, while Israel says 129 remain in Gaza, though it says 22 of those are believed to be dead.

Israel's air and artillery bombardment has killed more than 21,800 people, according to health authorities in Hamas-run Gaza.



Israeli soldiers walk through what Israel's military says is an iron-girded tunnel designed by Hamas to disgorge carloads of Palestinian fighters for a surprise storming of the border, amid the Israeli army's ongoing ground operation against Palestinian Islamist group Hamas, close to Erez crossing in the northern Gaza Strip, December 15, 2023. REUTERS/Amir Cohen

The scale of some of the tunnels demonstrate significant planning and resources. In mid-December, the Israeli military uncovered what it called the biggest tunnel to date. The passageway, wide enough to drive a car through, emerged in a sand dune at the northern edge of the Gaza Strip, just 100 meters south of Israel's Erez military checkpoint, which controls all pedestrian access from Israel into Gaza.

Reinforced with concrete and iron, the tunnel was 3 meters (10 feet) in diameter, and 4

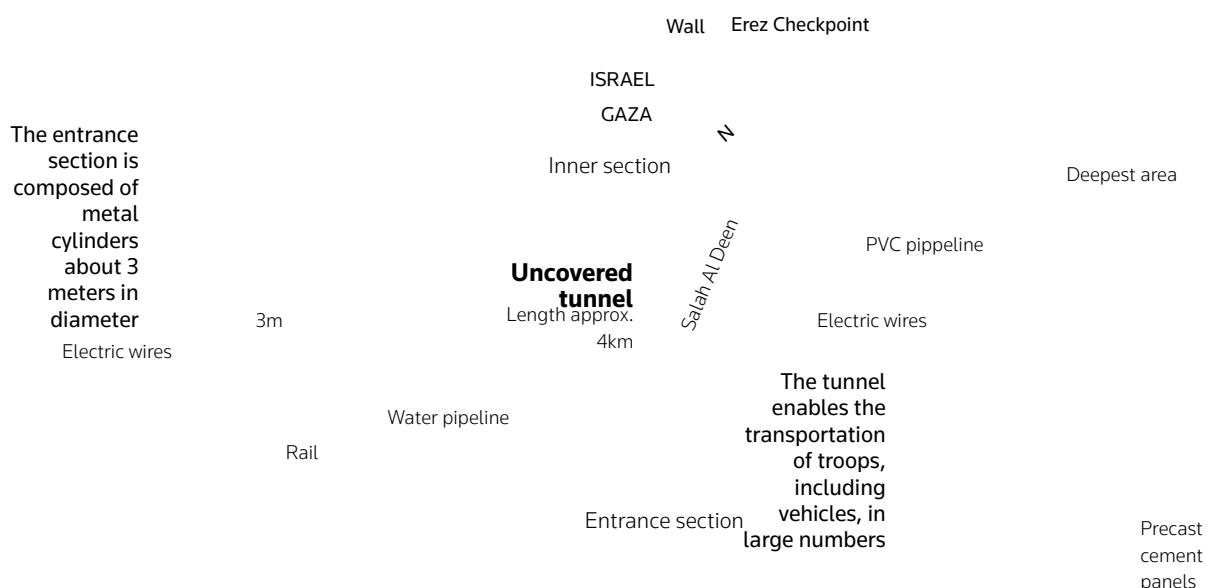
km (2.5 miles) long - enough to reach into northern Gaza City. With cables and piping to provide power and ventilation, the tunnel descended down a ramp to a depth of 50 meters below ground, the Israeli military said.

Erez was one of the places attacked by Hamas gunmen on Oct. 7. The Israeli military said the tunnel was designed to transport Hamas fighters to the border area, but didn't confirm it was used in the attack.

Hamas responded to Israel's discovery by releasing a video of what appeared to be bodycam footage of Oct. 7, showing fighters emerging from a tunnel in the dunes and attacking an Israeli military position. Reuters was able to confirm the location as the Erez crossing, using visible landmarks. "You arrived too late ... Mission had already been completed," read an on-screen message at the end of the video.

Hamas didn't immediately respond to Reuters' request for comment on its tunnel building activities.

The IDF said in a statement it has a variety of methods and successful experience in dealing with tunnels of all types. It did not provide further details.





REUTERS/Amir Cohen

On softer ground

The types of sandy or loamy soils common in Gaza made it both easier for Hamas to excavate the tunnels and harder for Israel to destroy them, two experts said.

The three main types of soil in the 365 sq. km. enclave are:

Sand dunes

Sandy material with fine-grained particles.

Loess, fluvial and eolian

Silty or loamy material, generally low moisture.

Calcareous sandstone

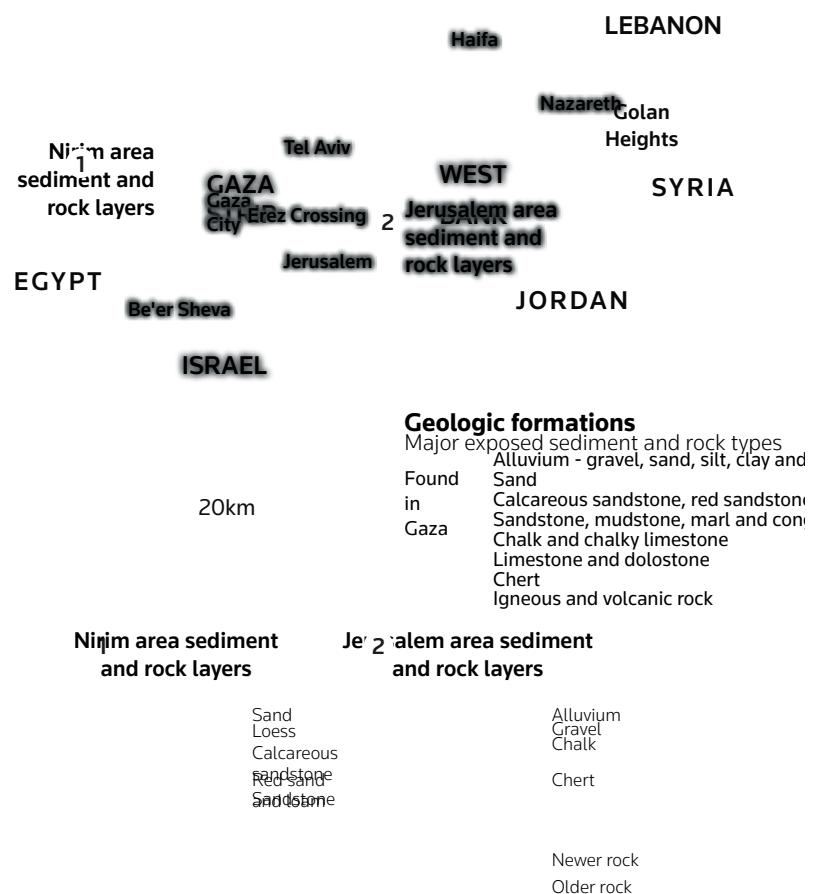
Also known as kurkar, is more compact and sturdy.

Even in the trickier areas - such as the dunes near the Mediterranean coast that are prone to water infiltration - Hamas had enough building materials and resources to

adjust to the type of soil they were dealing with, said Professor Joel Roskin, a geomorphologist and geologist with Israel's Bar-Ilan University near Tel Aviv, who has studied the tunnel network.

"What we've seen is that there are so many tunnels that have been reinforced with concrete," Roskin said, adding that Hamas had invested considerable money and manpower in construction.

"To dig deeper demands more resources, more energy. The deeper tunnels are of course more difficult to detect."



John Spencer, chair of urban warfare studies at the Modern War Institute and a founding member of the International Working Group on Subterranean Warfare, said the sandy nature of the soil had certainly made it easier for Hamas.

"I have seen many videos of them digging by hand or using simple power tools," he told Reuters. "The soil is conducive to rapid and unskilled digging." By contrast, he

said, the Lebanese Shi'ite group Hezbollah had to dig through solid rock in south Lebanon to build cross border tunnels into northern Israel.

Hezbollah has not confirmed the existence of the tunnel network but, in 2019, the Israeli military put on display one tunnel that, it said, reached depths of 80 meters (265 feet) as it ran from a kilometer inside Lebanon into Israel near Zar'it in the Upper Galilee.

The relative softness of the soil in Gaza is also a disadvantage to the IDF teams seeking to clear and destroy the network, Spencer said.

“The loose soil actually reduces the IDF use of explosives to destroy tunnels as the soft soil absorbs explosive force. Add the blast doors in the tunnels we've seen, and that further reduces the effects of explosive force traveling through the tunnel.”

1 Initial excavation is usually done manually, with the help of shovels and other tools

2 In areas where the terrain is tougher, pneumatic hammers are utilized

Air compressor

Soil

3 As progress is made, the walls are reinforced with prefabricated concrete or wooden slabs

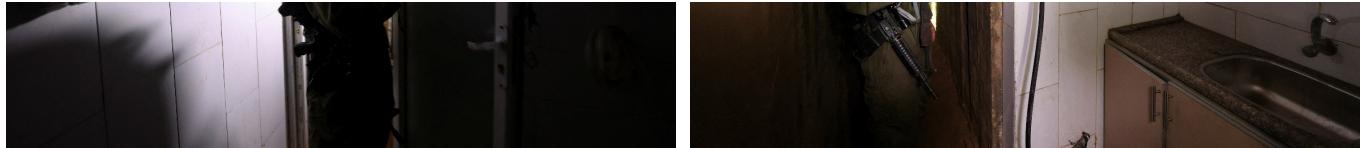
Wooden boards to contain the weak soil

Concrete slab

On Nov. 22, the Israeli army showed some news organizations a concrete-lined tunnel near Al Shifa Hospital in Gaza City that, it said, was a command post for Hamas fighters. The tunnel complex, which the IDF said was at a depth of around 10 meters below ground, featured a bedroom, a tiled bathroom, kitchen and meeting room.

Reuters photographer Ronen Zvulun went inside the tunnels. “The tunnel floor is sand but the walls and roof are lined with concrete, like a tiny road or train tunnel. And just about high enough for someone to stand upright.”





An Israeli soldier stands in a room inside a tunnel underneath Al Shifa Hospital in Gaza City, November 22, 2023. REUTERS/Ronen Zvulun

"Inside, you hear nothing. If an air strike hit directly above or nearby, it would no doubt register, but anything a few blocks away, you would probably hear nothing that far underground," Zvulun said.

Israel accuses Hamas of deliberately locating its tunnels, rocket-firing sites and other military infrastructure near schools and hospitals, and in densely populated areas, using civilians as human shields. Hamas rejects the accusation. Meanwhile, Palestinian human rights groups say they have asked the International Criminal Court (ICC) to investigate Israel on war crimes charges for carrying out air strikes on civilian areas.

The IDF says it has taken steps to minimize casualties and abides by the rules of war. It has pledged to continue its military operation until Hamas is destroyed, the hostages released and any threat to Israel from Gaza is removed.

The ICC said in a statement to Reuters that it had extensive contacts with Palestinian civil society groups as part of an investigation of possible war crimes in Palestinian territories that it opened two years ago, covering the period back to 2014. "This cooperation, combined with other investigative actions, has allowed the Office to collect considerable information with respect to alleged crimes committed in Gaza," it told Reuters.

Vault

Most tunnels are narrow enough for single-file movement and their height varies

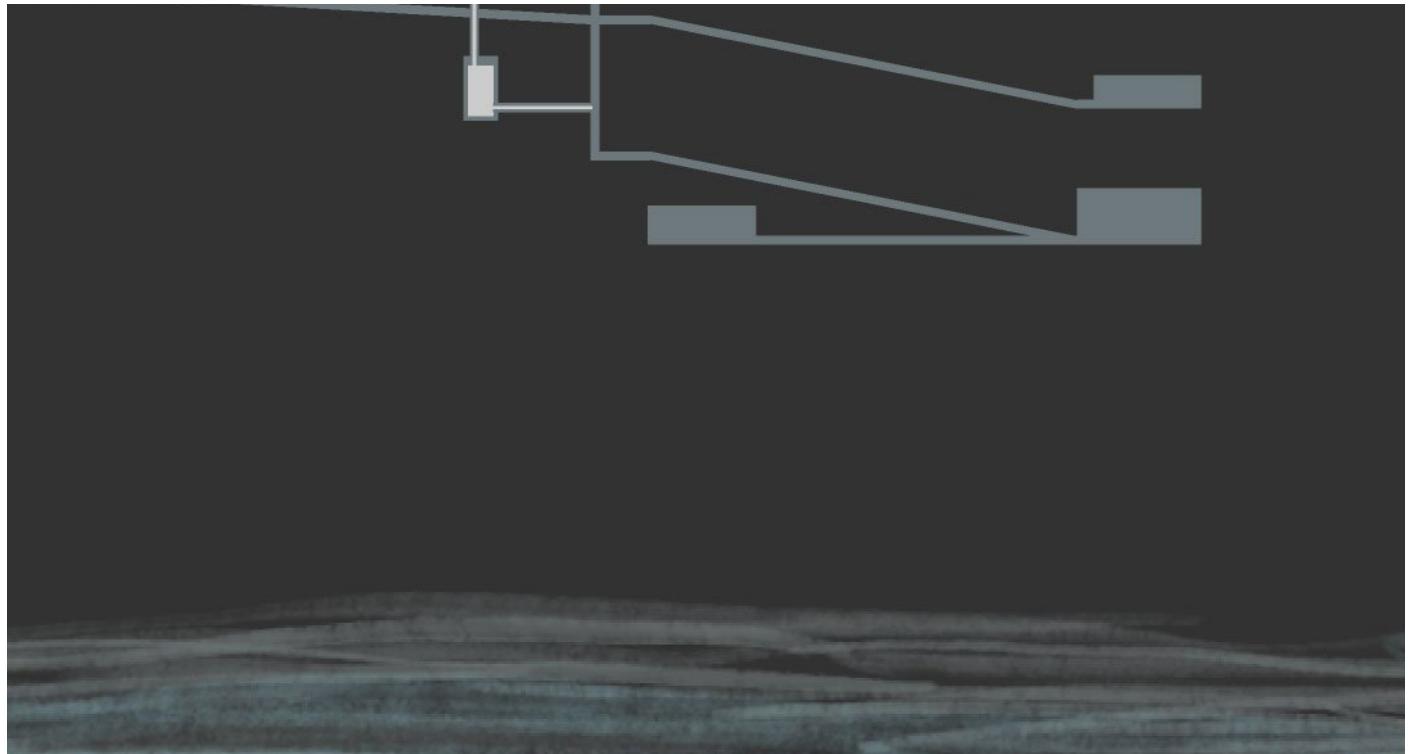
Bulb lights

Steel
rebar
0.80m

Electricity and communication wires

Concrete panel wall

Compacted floor



Tunnel warfare

Israel's military said its ground forces had uncovered around 1,500 Hamas tunnels and

shafts throughout the Gaza Strip, as of Dec. 19.

“Dismantling Hamas’s underground strongholds in the north, center, and south is a significant step in dismantling Hamas, and it takes time,” military spokesman Rear Admiral Daniel Hagari told a press briefing.

The network has been in construction for years. In the early 1990s, Egyptian and Israeli forces reported finding cross-border tunnels used to smuggle weapons, supplies and militants from Egypt into Gaza. Tunnel-building became easier after Israel pulled its troops and settlers from Gaza in 2005. Two years later, Hamas seized full control of the Gaza Strip from President Mahmoud Abbas’s Palestinian Authority.

The tunnel-makers are thought to have dumped much of the excavated soil into the sea, making it difficult to detect the scale of their activities, according to Israeli security sources. The rest is used for construction.

In previous conflicts, the IDF failed to decommission the tunnel network. After a brief 2014 conflict, in which the Israeli military said it neutralized 32 Hamas tunnels, the militant group showed Reuters that parts of its network were untouched. And following the last round of hostilities in 2021, Hamas’ leader in Gaza, Yahya Sinwar, said the group had more than 500 km of tunnels, of which the Israelis destroyed only a fraction.

The IDF has not publicly estimated how large the tunnel network may be.



An Israeli soldier secures a tunnel underneath Al Shifa Hospital in Gaza City, November 22, 2023. REUTERS/
Ronen Zvulun

Tackling the tunnels

During the current conflict, the Israeli air force has typically first bombed the area above suspected tunnels to flatten any structures. Then bulldozers are used to uncover the tunnel shafts and locate any booby traps or improvised explosive devices (IEDs). Finally, ground troops go in to destroy, or to seal off, the tunnels and shafts, according to two security sources and IDF footage reviewed by Reuters.

Israel says it is doing what it can to spare civilians. Israel's Chief of Staff Lieutenant-General Herzi Halevi said on Dec. 26 the military was being "focused and precise in its actions". However, some of Israel's staunchest allies - including the United States, Britain and Canada - have urged it to do more to reduce civilian deaths from what President Joe Biden has called "indiscriminate bombing".

Eyal Pinko, a former senior official with Israel's intelligence services until 2017, said part of the challenge was that it was hard to precisely locate the whereabouts of tunnels: even Israel's Ground Penetration Radar (GPR) was only effective to 15 or 20 meters below ground for major tunnels. Below that depth, it would struggle to detect anything at all, he said. "They are digging very, very low and this is very problematic," Pinko said, adding that some tunnels could be 70 or 80 meters deep. "There is a huge intelligence gap about those tunnels."

"They (Hamas) are popping up from tunnels and you don't know that there is a tunnel over there."

The IDF declined to provide specific details on its tactics in locating and destroying the tunnels.



Once inside the tunnels, specialists including the Combat Engineering Corps' elite Yahalom unit use a wide variety of methods to search, record and destroy the tunnels,

including K-9 dog units fitted with cameras, and explosive gel charges.

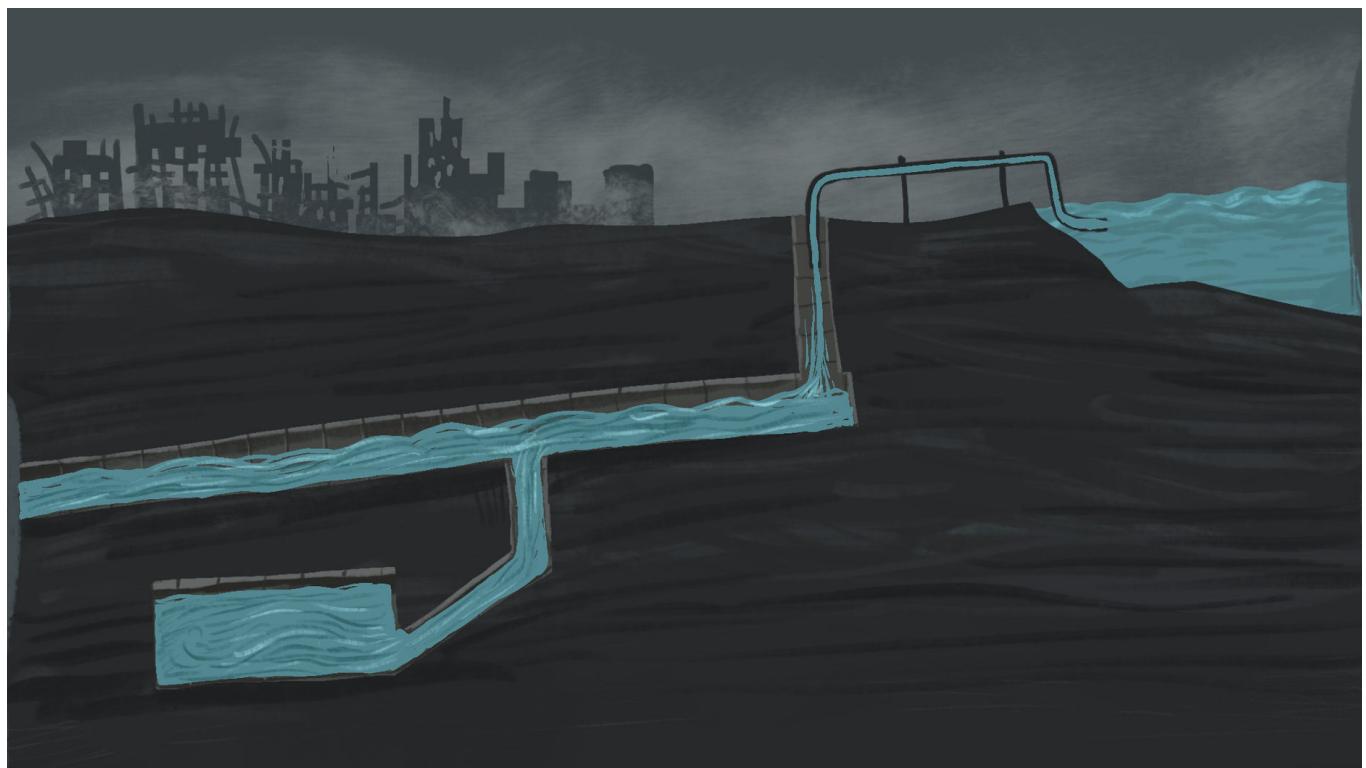
Four military experts say that clearing the tunnels manually would be a lengthy process and expose soldiers to the risk of booby traps or ambush by concealed Hamas fighters. The Israeli military said it had lost 167 personnel during the Gaza operation, as of Dec. 28, many of them killed by attacks launched from the tunnel network.

The military is experimenting with drones to search the tunnels without risking the lives of soldiers.

“The biggest problem in deploying drones underground right now is they get maybe a hundred feet into a tunnel network, then the tunnel makes a right or left turn and they completely lose signal,” said Blake Resnick, CEO of U.S. based drone maker BRINC, who said it is testing drones with the Israeli military.

The latest drones being tested have a networking facility that allows its operators to fly one a few hundred feet into a tunnel, until the structure changes direction. “They can land that drone, use it as a repeater, and then send in another drone deeper into the network,” he said. “And they can do that, practically as many times as they want.”

He said a new generation of drones they were testing has thermal imaging, night vision illuminators, and front-facing lidar sensors that create a 3D map of their environment as they fly.



After President Abdel Fattah al-Sisi came to power in Egypt in 2014 and decided to shut down the cross-border tunnel network in southern Gaza, he ordered it flooded with sea water.

However, the risk of killing Israeli hostages may make that an unlikely option for Israel. There was outcry in Israel in mid-December after three hostages were accidentally shot dead by Israeli forces, when they were waving a white flag.

Sources:

Israel Defense Forces; "A Case Study of Thin Concrete Wall Elements Subjected to Ground Loads, by Davide Elmo and Amichai Mitelman, MDPI; Haaretz; Bar-Ilan University - Prof. Joel Roskin; Britannica; Geological Survey of Israel; Natural Earth; SRTM

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