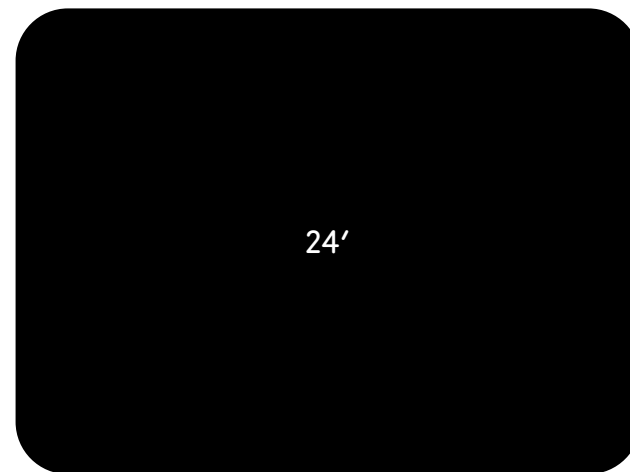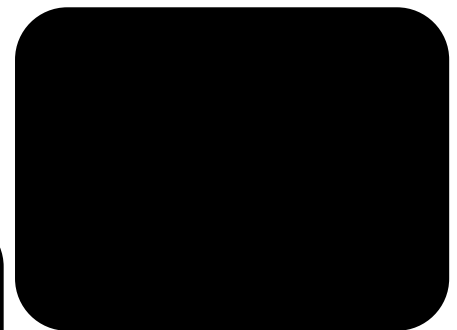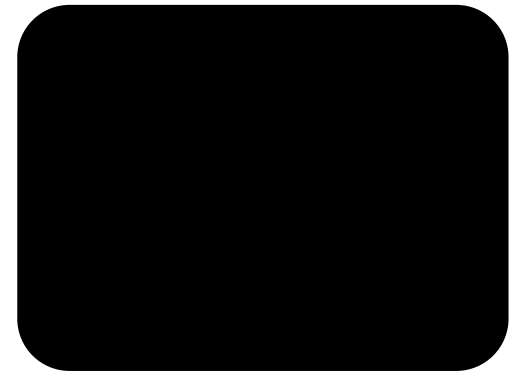Forensis as Critical Practice

Ursula Frohne in conversation
with Eyal Weizman

24'

URSULA FROHNE   To start, I think it would be good to hear your perspective on how the term *forensis* is programmatic for the investigative work of the project of Forensic Architecture. Could you elaborate on the meaning and emergence of this notion in the context of your critical practice?

EYAL WEIZMAN   Thank you for this question because I think the formation of the project of Forensic Architecture hangs on that word *forensis*. There are multiple ways to explain that. Of course, the word derived from *forensis—forensics—*is now undergoing or has, over time, undergone a kind of a meaning drift. So, what we associate today with the scientific expertise used by different state agents, such as the police, the secret services, and perhaps the military, to restore control and order of a society through the criminal justice system had a much wider meaning in the past, in the Classical Age. It is in this classical sense of the term *forensics* that we try to mine and, to a certain extent, rescue from this telescoping of meaning, which has reduced it to this extent. We do so primarily because we do not see ourselves as belonging to the history of forensic practices. The genealogy of our practice is derived from somewhere else. That is to say: we are not the continuation of the "Bertillons" of the world—those who started the police archive, physiognomy, fingerprints, etc. Rather, we come from a tradition of contestation, a tradition of militant truth, and a tradition by which the very frameworks within which truth is allowed to be spoken need to be contested. So, *forensis*, in its original meaning, in the way I understand it as it was used by the great orators of the first century, is really the presentation of things in the forum. *Forensis* is that which belongs to the forum, and the forum is the public space. It is a space of exchange of ideas and goods; it is a space of the polis. The forum also has a certain imperial flavor, but that is not the meaning it had in imperial Rome, of course. *Forensis* is making evidence public and the presentation of ideas, facts, and things within the public domain to promote a certain idea, a certain politics, to make a point, not only about what has happened in the past but what should happen in the future. The expansion of the term is really important: *forensis* is not what belongs to the court; it is what belongs to the forum. Taking the evidence from the privilege of the court and the legal system into the chaotic, conflictual, and to a certain extent, the civil war we are experiencing right now and placing it in the public domain as a militant claim is much more

figs. 1–2   Forensic Oceanography and Forensic Architecture, *Sea Watch vs The Libyan Coast Guard*, 2018. Images projected onto a 3D model to reconstruct the complicated scene of search-and-rescue operations by the Libyan Coastguard and NGO vessels on November 6, 2017.

"On the night of November 5 to 6, 2017, a rubber boat left Tripoli, carrying between 130 and 150 people. That night, the vessel of the rescue NGO Sea-Watch was patrolling off the Libyan coast, just outside of Libya's contiguous zone, waiting for the next boat to rescue. At around 3 a.m., the crew on duty saw the returns of two large ships on its radar screen. As these were not accounted for by AAS vessel tracking data, which most civilian ships are required to emit, the Sea-Watch crew believed them to be military: either part of EUNAVFOR MED, the EU's anti-smuggling operation, or of Italy's Mare Sicuro operation, which has provided support to the Libyan coast guard and navy in combating illicit traffic. Both these operations are part of a policy that aims to prevent migrants from crossing the sea by outsourcing border policing to Libya.

As the migrants advanced, the sea became rougher, and their boat began taking in water. The passengers contacted the Italian coast guard for help via satellite phone. At 5:53 and 6:01 a.m., Sea-Watch received a distress signalization from the Italian coast guard indicating no specific position but that the vessel had departed from Tripoli. Sea-Watch adapted its course immediately. The Italian coast guard also informed their Libyan counterparts, who had a vessel on patrol off the coast of Tripoli and, according to a Libyan official we interviewed, requested their intervention.
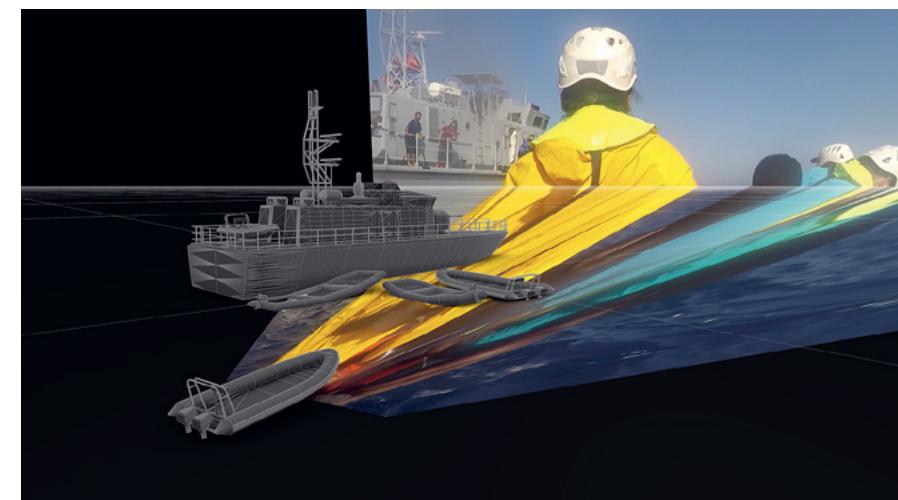
On August, 10 2017, the Libyan authorities had unilaterally declared the search and rescue zone within which they claimed the responsibility to coordinate rescue and repeatedly threatened NGOs entering it. Through the satellite phone provider, the Italian coast guard was soon able to determine the boat's location at 6:00 a.m.—the only georeferenced position we possess for the migrants' trajectory prior to rescue—and passed it on to Sea-Watch at 6:31 a.m. The Italian coast guard also warned Sea-Watch that the Libyan coast guard was present within a nine nautical-mile radius from the migrants' boat and that Sea-Watch should proceed with caution.

Sea-Watch's vessel is equipped with seven wide-angle cameras mounted on the mast and deck that are constantly recording; two of these capture crucial video evidence for our investigation. Two additional GoPro cameras mounted on Sea-Watch's rigid-hulled inflatable boats, or RHIBs, provide close-up perspectives. Triangulating visual data from these cameras as well as from another located on the Libyan coast guard vessel allowed us to generate a dynamic model of the scene. Navigating the model between different camera perspectives and cross-referencing this evidence with testimony and locational data allowed us to reconstruct the entire rescue operation and its dire consequences as they unfolded." (1)

(1)
Title credits and voiceover transcription of an excerpt from *Mare Clausum: Sea Watch vs The Libyan Coast Guard* (2018), video and further information accessible on Forensic Architecture's website, "Sea Watch vs The Libyan Coastguard," April 4, 2018, https://forensic-architecture.org/investigation/seawatch-vs-the-libyan-coastguard.

important to us. Counter-forensics is an aspect of *forensis* that contests the modes, means, spaces, and institutions in which society has established where in the state's buttress facts can and should be uttered and by whom and in what manner. We want to break all these and find new fora, new places, and new ways to address our audience. We want to present our work not only in courts but also on the street, in truth commissions, in art and cultural spaces, in the media, and wherever we can so that we can make facts public in the way they should be and have been, I believe, at some point.

UF Thank you very much for elaborating on the depth of the term *forensis*, which has been narrowed by modernity to these criminological or psychological discourses that are indeed very problematic. In your practice, it apparently refers to a deeper historical context, which could be aligned with Bruno Latour's notion of "making things public," a forum to engage in debates about contested issues. Accordingly, Forensic Architecture is taking measures of human-rights crimes and political controversies by investigations on behalf of civil society. With this kind of critical practice, it becomes apparent that the finding of truth is a matter of public concern and a profoundly political process. How is this approach related to specific formats of mediation, for example, when a project is presented in a semi-public contemporary art context compared to the open access of Forensic Architecture's website?

EW When we present our work or evidence in art and cultural spaces, we often face art and cultural critics saying that this is evidence, not art. Art needs to be freer. Art does not carry the same burden of truth that we seek to carry. Indeed, there is a debate within the field of art about whether our practice belongs there or not. Is it a positive practice, or does it sometimes even have a corrupting influence? When we have shown our work in court, the defence, which is the team that we usually face, says, "Hold on! You are artists. You are not evidence producers. You have shown at the Tate, Whitney, documenta, Venice Biennale, etc. This is not evidence—this is art." I think this shows that, in whatever forum we present, we do not perfectly belong, or we have a certain antagonistic, alienated relation to it.

The gaps could be closed in two ways: on the one hand, as we have seen, through the art world opening up to a certain extent to include our practice as a creative, aesthetic, and critical practice within the domain of media, art, film, and documentary art and, on the other, through the court, which has increasingly started accepting and admitting our evidence as legitimate and admissible in cases. But sometimes, there are frictions and problems, and those are very productive for us. We believe that all institutions in every forum that we address—whether we choose to show our work in *Der Spiegel*, *Neue Zürcher Zeitung*, *The New York Times*, or *The Guardian*—are imperfect platforms with their own biases, histories, and editorial agendas, which we sometimes do not agree with. But we also believe that placing something that does not fit within one forum allows that forum to change—that is our critical practice. We do not think that the art world is the answer to the problems in the legal system regarding the way the law is weaponized and manipulated against the weak. We think the art world has its own institutional and financial

problems and biases, which we also address in some of our work. But we do try to offset the limitations in one forum by presenting our evidence in another.

You referred to our website, which is important to note because part of the work is to make public where it has been shown, the response it has garnered, and the influence it may have had. The way we present the work is not simply in the form of a video. We tell you exactly in which forum it has been presented. In the forum section of each case, you usually see a completely schizophrenic collection, including, for example, a human-rights watch report, a European human-rights case at the European Court of Human Rights, in this gallery, that museum, and that newspaper. This shows the nonbelonging, the alienation, and the somewhat itinerant way we take the same piece of evidence and put it in different forums. In each one, it does different work because it does not fit. This misfit is also what the kind of system requires in order for it to be digested and understood, it needs to transform.

UF Could you give us an example in this context? I have, for example, been intrigued by the reconstruction of the NSU murder in Kassel, where you worked with a YouTube video in which Andreas Temme, the undercover agent, reenacted his movements through the Internet café for the police with a variety of other information that was collected. The video is apparently based on digital and analog modeling to reconstruct the crime scene and also to correlate the spatial coordinates with the temporal course of the shooting. The footage of this investigative reconstruction was not only presented and framed by public discussions at the documenta 14 in 2017, but I think it was also used as evidence at the trial of the NSU murders at court in Munich. Could you comment on the effects and the precise impact this work had for example in the truth finding in the juridical negotiation of this criminal case?

EW It has indeed cast a shadow on the legal process in Munich. It was invited, then contested, and ultimately it was not presented in Munich. But it was referred to by the lawyers continuously. In her closing speech, the lawyer for the Yozgat family—every victim has had their own legal representation—accused the court of not showing that film in court and, thus, of limiting the judicial question to the guilt or innocence of Beate Zschäpe rather than looking at the wider NSU Complex, as it is called by a group of activists, namely the state and institutional support that the NSU and other neo-Nazi groups in Germany have received. However, when it was presented at documenta, delegations from the Green Party, the Social Democratic Party (SPD), and the Left visited documenta to study the film and invited it to be presented in the so-called *Untersuchungskommission* (investigation committee) in Wiesbaden, the capital of Hesse, where the political aspects of this murder were debated. This decision was contested by the Christian Democratic Union (CDU), which, at the time, was the ruling party and in charge of the *Verfassungsschutz* (German domestic intelligence services) and wanted to deny its presentation before the *Untersuchungskommission*. However, they were not successful, and Andreas Temme himself had to watch it in the *Untersuchungskommission*, which was a very interesting situation:

you have the perpetrator watching his own image, making slights and stupid jokes about it, saying things like, "I'm the main actor. I should get royalties. I should go to Hollywood." So, it has made its political appearance in at least parliamentary inquiries. Our investigation indeed shifted the question. We did not investigate the murder. It was clear that the two Uwes (Uwe Mundlos and Uwe Böhnhardt) coming in through the front door of the Internet café shot and killed Halit Yozgat in April 2006. What was not clear is the way in which the state has dealt with this or how, in particular, a *Verfassungsschutz* agent was allowed by state agents, by his own employers in the *Verfassungsschutz*, not to reveal the truth to the police—to lie to the police. And the *Verfassungsschutz* has put, I believe, a 120-year embargo on the file—classifying it for 120 years—as you know.

UF   Yes, this excessive embargo on the inspection of files in the end only fuels the suspicion that a massive failure on the part of the authorities is being covered up. This juridical order appears like a continuation of the deliberate destruction of files on the undercover persons from the Right-wing extremist scene, which was uncovered shortly after the NSU exposed itself in November 2011.

EW   I think the fact that the secret service is doing this should concern every German citizen and every European citizen.

UF   I agree, absolutely.

EW   It should concern, again, any conscientious person with stakes in the matter that the CDU would protect this, would cover this up rather than deal with this shameful moment. So, our investigation is a side-story within the happenings inside this Internet café. We often investigate videos of shootings or beatings or explosions elsewhere, and here we had a leaked video of a reenactment of a crime. Andreas Temme was reenacting how he moved through the Internet café for the police camera and how he was able to miss seeing the body of Halit Yozgat. We thought the reenactment was interesting because it's not only a representation of a crime; it is a crime itself—the crime of perjury, of lying through acting out your movement in space. So, we did not take it as a representation—it's the original crime. We were looking at how he lies, and reenactment is a testimony: it's a testimony that is done with your body and the way your body moves in space, with the camera and the way the camera is positioned. We reconstructed the use of the camera and the movement of the body to show a kind of performative, mediatic form of perjury, which is the political aspect of this murder.

UF   The work of Forensic Architecture is apparently based on a stereoscopic practice that includes scientific research methods, reenactment, cartography, and analog and digital modeling in correlation with tracking records of mobile phones, simulations of sound distribution in space and found-footage videos or photographic material— aligned and cross-referenced with witness statements. This entanglement of data evaluations enacted by animations and a voiceover that comments on the reconstruction of the events produces a narrative flow. While the informational level reintroduces methods such as cartography and diagrams that have been criticized as positivistic by means of providing access to the missing links of precarious events, Forensic Architecture always also works with very intriguing aesthetic forms of displaying the research results. How do you define this relation between the adherence to factual knowledge as a normative precondition for truth finding and the aesthetic features of representation, for example, in the exhibition context? Could this constellation be described as an investigative forensic aesthetics that also provides a model for interpretations of factual knowledge? With regard to the growing impact of so-called alternative truth regimes that have overturned the faith in facts in today's societies, Forensic Architecture's techniques obviously stimulate a different kind of speculative imagination. Could the transparent production of evidence also be seen as a way of refuting conspiracy narratives? Forensic Architecture is taking measures of human-rights crimes on behalf of civil society by counter-investigation. After all, the multi-dimensional assembly of facts based on source-critical approaches to documents and verifications of witness statements have also disclosed the blind spots of the investigative authorities themselves. It is a critical engagement that turns *matters of fact* into *matters of public concern*.

EW   Indeed, facts do not exist *a priori*. Facts need to be produced, and a form of production of anything, whether it is labor in a factory, news, or fact, is a political act. So, the political question is not whether we accept facts or don't accept facts. The question is how we produce facts and how we contest them today. I would say something quite controversial—I would say that, on the one hand, we can reconsider the challenge of post-truth, and that sounds very weird. Post-truthers are very obstinate about mainstream media, the judiciary, police accounts, sometimes the FBI, and established scientific authority. And very often, I find myself in the same position, contesting the police, contesting things that happen in a kind of politicized media— usually Right-wing media, and so on. So, that is not the question. Contestation is important, but regarding this challenge, this massive challenge to truth, we need not respond to it by buttressing the way in which facts have traditionally been produced and saying we need to believe scientists. Because if the question is whether you believe in science or don't believe in science, you treat science as a transcendent thing. You basically say it occupies a kind of theological position. Of course, then, you know you have the rebels against Rome saying "no," because where power is, resistance lies. The question is: what is now on the ruin of institutional truth; what we need to do; how to establish new ways of truth production; to open up the diagrams of relation, the social relation that produces facts; how to open up the way in which facts are disseminated; and how to open up the way in which they are contested, presented, etc. Now, we go back to the forum. We say we actually need to find other ways to do it, and these are not the ways of the state. They're much more collaborative—it's something that we call "open verification," in which there is always a diagram between the people suffering state repression of violence firsthand and then the people that are next to them, who stand in solidarity with them. And then you have multiple orbits of diffused experts, artists, curators, lawyers, remote sensing

Kassel, Germany
6 April 2006

77 sqm
9:26 minutes

The Murder of Halit Yozgat

3

"Shortly after 5 p.m., on April 6, 2006, Halit Yozgat was found dead behind the counter of his family-run Internet café in Holländische Straße 82, Kassel, Germany. This was the ninth in a series of ten killings targeting mainly migrant communities, across Germany between 2000 and 2007."

Enver Simşek	09 September 2000, Nuremberg
Abdurrahim Özüdoğru.	13 June 2001, Nuremberg
Süleyman Taşköprü	27 June 2001, Hamburg
Habil Kılıç	29 August 2001, Munich
Mehmet Turgut	25 February 2004, Rostock
Ismail Yaşar	09 June 2005, Nuremberg
Theodoros Boulgarides	15 June 2005, Munich
Mehmet Kubaşik	04 April 2006, Dortmund
Halit Yozgat	06 April 2006, Kassel
Michèle Kiesewetter	25 April 2007, Heilbronn

"The perpetrators were later identified as members of the National Socialist Underground or the NSU, a neo-Nazi group whose core allegedly consisted of three people. The only surviving member of those three, Beate Zschäpe, currently faces a criminal trial in Munich. During the police investigation into the Kassel murder, it emerged that an intelligence agent of the state of Hesse, named Andreas Temme, was present at the shop around the time of the murder. He did not disclose this fact to the police but was later identified from his Internet records. In 2015, many of the police records documenting this investigation—police reports, witness testimonies, computer and phone logs, and site photographs—were made public. Amongst these files was a crucial piece of evidence: a police video showing Andreas Temme's reenactment of his visit to the shop. He sought to demonstrate how he has missed seeing the body of Halit as he exited the shop.

    Forensic Architecture was commissioned by the People's Tribunal, a civil society initiative working with the families of the victims, to investigate the validity of Temme's testimony. What time did the murder happen? Where was Temme at that time? Could he not have witnessed the incident? Could Temme's testimony and reenactment be truthful? If not, larger questions could be asked.

    Working from leaked photographs of the crime scene, we constructed a digital model of the Internet café. Within those 77 square meters, different actors—the victim, his killers, and a state employee—were architecturally disposed in relation to each other. The shop was thus a microcosm for the larger political controversy that ensued. We reduced the model into its most relevant elements and built it as a full-scale installation at the Haus der Kulturen der Welt (HKW) in Berlin. We then undertook a series of experiments within both the physical and the digital models. Because the murder took place in an Internet café, every witness was connected to a time-coded device: a computer or a phone. We located each digital device in the model and reconstructed a timeline from the login data. This created the space-time matrix within which different possible events could take place.

[…]

We then investigated whether Andreas Temme could have seen the body of Halit as he exited the Internet café. Andreas Temme claimed that he did not see the body as he left the coin on the front desk. Aided by motion detection software and analog measures, we recreated Temme's police reenactment digitally to establish his moving cone of vision. We repeated this test in the physical model with a camera attached to the head of an actor. Witness testimony places the body in this position. We also tested for other positions in which Halit could have fallen. All body positions would have been visible to Andreas Temme as he bent over the counter. Out of the three scenarios, we have determined that scenario one, in which the murder took place after Andreas Temme left the Internet café, is not possible. The evidence does not exclude scenario two, in which Andreas Temme was at the front part of the shop when the murder took place. Scenario three, in which the murder took place while Andreas Temme was still sitting at PC 2, is also possible. In this case, he would have witnessed the event.

    This story suggested layers of violence, misrepresentations, and cover-ups. Halit Yozgat was murdered on April 6, 2006. Twenty days later, Andreas Temme reenacted his experience of the event. We reenacted Temme's reenactment to discover it was yet another act of violence, potentially a crime in its own right." (2)
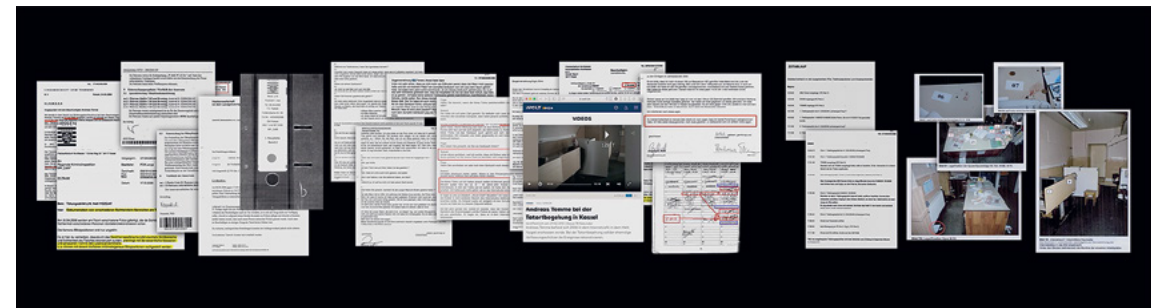
(2)
Title credits and voiceover transcription of excerpts from *The Murder of Halit Yozgat* (2017), video and further information accessible on Forensic Architecture's website, "The Murder of Halit Yozgart," June 8, 2017, https://forensic-architecture.org/investigation/the-murder-of-halit-yozgat.

4

fig. 5   Shortly after his arrest in 2006, Andreas Temme reenacted his exit from the Internet café on April 6, 2006, still from the original video.

fig. 6   Forensic Architecture, *The Murder of Halit Yozgat*, 2017. Digital reconstruction of the desk at which Halit Yozgat was murdered.
fig. 7   Forensic Architecture, *The Murder of Halit Yozgat*, 2017. Computer simulation and motion tracking of Andreas Temme's line of vision in the Internet café.
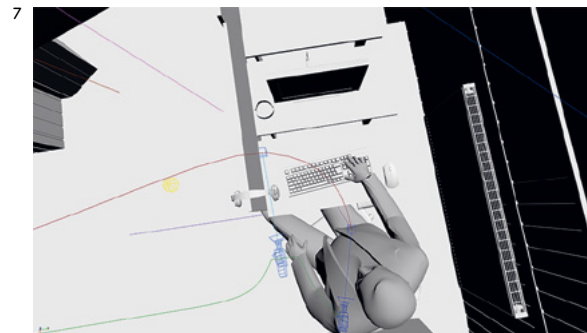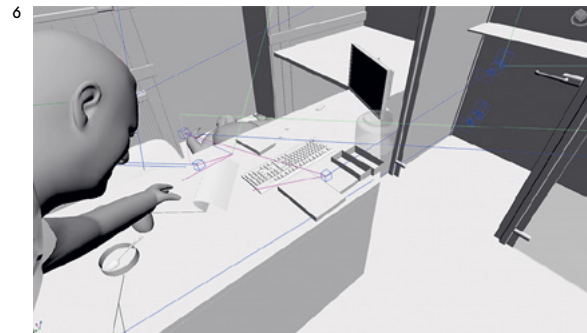
fig. 8   Forensic Architecture, *The Murder of Halit Yozgat*, 2017. Real-scale reconstruction of Halit Yozgat's Internet café at the House of World Cultures (HKW) in Berlin, constructed between March 6–11, 2017.
fig. 9   The Society of Friends of Halit, installation view of Forensic Architecture's *The Murder of Halit Yozgat*, documenta 14, Kassel, 2017. Photo: Michael Nast. This timeline highlights the likely time at which Halit Yozgat was murdered, set against the computer login data of the witnesses in the Internet café.

specialists, and artificial intelligence coders, who work in solidarity and create very wide networks of truth production, which are alternative to those of the state. They are based on open-source methods, collaborative methods, and the leveling of the hierarchy between expert and witness. To a certain extent, one can use different aspects, not only technology, in order to do that. I am not saying it's easy; it's always hard work negotiating. But every piece of evidence we produce like that is both evidence of a crime and evidence of the social relation that went into the production of that evidence. That is the most important thing: to find new ways of producing truth, break the barriers between the temple of beauty and the temple of truth, as in science, and find ways to work laterally and collaboratively in establishing the truth.

UF   May I direct your attention to the term *architecture* because I find the emphasis on the semantics of architecture in the project's self-definition remarkable. How do you define architecture's role in this discourse of truth production? It seems to relate on the one hand to design tools that are used for architectural modelling, as for example, CAD-technologies for the creation of virtual models of future buildings. On the other hand, Forensic Architecture applies these tools to reconstruct events that have happened in the past. Also, the etymological origin of *forensic* translates as "belonging to the forum," as you explained at the beginning, hence a place not only for the administration of justice, but also a site where controversial matters are negotiated. Does this allude then to the tightly woven network of media, architecture, and the environment that your investigative practice sheds light on? Could you explain this aspect a little more and comment on the importance of the semantic field of architecture for your work?

EW   The use of the term *architecture* is a little archaeological in our work, meaning the origin of my work—the very origin of my personal development—is architecture: I'm a trained architect. The project developed through my work as an Israeli anti-colonial activist. My focus was on the use of architecture in buttressing the Israeli occupation of Palestine and Israel's colonization of Palestine via spatial-architectural means and providing evidence for the architecture of the wall; the settlements in the West Bank, in Galilee, in the Negev; and other elements. Slowly, with the evolution of technology, we've moved on to doing other things. However, as in archaeology, there's always a kind of architectural-spatial basis to the work that we do. It is through three-dimensional models that we view the storm of images that we find online. In fact, we think we need to adopt something that we call the *spatial* or *navigational* viewing of videos. Rather than creating edits, *montage*, we move in space between one video and the next. We never cut—never cut—a video that comes to us as evidence. Space becomes the optical device that allows us to see media. Architecture is also a doorway for us to memory. We understand that traumatized witnesses sometimes need to return to the crime scene in architectural models so that they can relive their experience, always with a psychologist, human-rights advocates, or lawyers next to them. Thus, there is a kind of underlying architectural

basis to our work. But, as I said, people in the art world say that this is not art, and people in the legal world say that this is not evidence. In the architectural world, people say that it's not architecture. So, I think that it's always that gap that allows us to challenge those vested interests and deep institutional frameworks and open them up—shake them up a little bit. (3)

(3)
The conversation between Ursula Frohne and Eyal Weizman, edited and revised for this print version, was held as part of the video symposium "Taking Measures: Usages of Film and Video Art," 2020, https://takingmeasures.ch/videos/forensis-as-critical-practice/.

"Shortly after 6 p.m. on August 4, an explosion ripped through the port of Beirut. It killed more than 200 people, wounded over 6,500, and destroyed large parts of the city. Forensic Architecture was invited by Mada Masr to examine open-source information, including videos, photographs, and documents, to provide a timeline and a precise 3D model to help investigate the events of August 4. The model is available via this link: https://github.com/forensic-architecture/models.

The first photograph of the warehouse on fire was uploaded to Twitter at 5:54 p.m. We carefully geolocated this photograph by identifying the key buildings and calculated the camera's cone of vision. In this image, we identified the location of the source of the smoke plume at the northeast corner of warehouse 12. Smoke plumes are continuously transforming and have a unique shape at every moment. We modeled the plume at this crucial stage to help synchronize other videos without a timestamp. A video shot around the same time from one of the balconies of the residential tower building shows the same source of fire clearly on the same side of the warehouse. The shape of the plume and the heat source suggest that the fire had evolved. Another video starting at 5:58 p.m. from the nearby St. George hospital provides ten minutes of uninterrupted footage of the warehouse. Within two minutes, the smoke thickens, and its color changes to a darker shade. According to Gareth Collett, a UN explosives analyst we consulted, this suggests that the material burning inside the warehouse has changed. At 6:07 p.m., a new intense heat source appears on the other (northwestern) side of the warehouse, here, followed by a different larger plume. The sparks that follow suggest the presence of small explosive charges, such as fireworks. Thirty-five seconds later, at 6:08 p.m., a large spherical plume appears above the center of the warehouse. According to the explosives analysts, the symmetrical shape of the sphere suggests that it's a single point explosion originating in one particular place within the warehouse, and it's possible that as little as half of the 2,750 sacks of ammonium nitrate stored inside detonated. We use the shape of the two plumes from these explosions as metadata to synchronize the remaining footage. This video, taken from further back, provides an uninterrupted view of the events that followed. Within the span of nine seconds, the spherical plume projected high into the atmosphere. Several tons of particulates thicken the air, and a red-colored plume 755 meters high rose over the warehouse.

We have thus identified four types of smoke plumes emanating from different parts of the warehouse within the space of these fourteen minutes. The first plume, at 5:54 p.m., emanates from the northeast corner of the warehouse. The second plume, at 6:00 p.m., is from the same source point but has a darker color. The third plume appears on the northwest side of the warehouse at 6:07 p.m. The final plume is developed from a spherical explosion located at the center of the warehouse at 6:08 p.m. Each of these smoke plumes, with their distinct shape and color, provides indications of the arrangement of goods in the warehouse, the way the fire developed, and the layout of what was stored inside.

A close-up examination helps in understanding the evolution of fire inside the warehouse. Early footage shows smoke leaking out of every opening, including the windows and the ceiling vents. From this point, at about 5:56 p.m., the temperature inside the warehouse started rising rapidly. The smoke is visible as it changes color to a darker shade in this footage from the east side. We stabilized the footage to reveal the full extent of the warehouse. The sounds of fireworks start being heard at approximately 5:59 p.m. It shows that many windows and doors are shut. According to the expert, confinement creates hot spots, areas of high temperature in which ammonium nitrate can get close to its combustion point. As reported by media outlets, the fire brigade arrived approximately four minutes after an initial call was made to the station at 5:54 p.m. In this footage, taken by the fire brigade on their arrival to the scene, the sound of fireworks continues to be heard.

The 2,750 tons of ammonium nitrate were unloaded to this hangar in October 2014, and as early as December of that year, various port and customs officials warned of the dangers posed by its storage. Many subsequent warnings were issued. In February 2015, for example, a chemical forensics expert commissioned by the Lebanese courts to report on the state of the stored ammonium nitrate described that 70 percent of the sacs were torn open, their content spilling out, and some of the crystals had darkened. Leaked images from February 2020 indicate that the storage conditions had not improved. The sacs were still torn open, and their contents were still spilling out. The bay numbers visible in the ceiling allowed us to locate these bags in bays nine and ten. The images show the presence of a container and a stack of wooden pallets. Another video taken on December 18, released by news outlet Al Jadeed, shows the state of ammonium nitrate bags stored at bay six and surrounding door nine. Stacked ammonium nitrate bags are blocking the entrance. Here, we can see the numbers for bays four and five. On the right of the videographer, between doors nine and ten, a white-colored wall is visible, suggesting the presence of a small service room.

Together these videos and images allowed us to map a total of 243 bags of ammonium nitrate in the space. Given the location of the source of the spherical plume here at bay eight, the remaining 2,507 bags of ammonium nitrate should have been stored here, occupying almost 2,000 square meter of space. But given the haphazard way the visible bags are stored, the space the entire stockpile occupied was likely larger. News reports suggest that in addition to the ammonium nitrate, the warehouse also stored twenty-three tons of fireworks, fifty tons of ammonium phosphate, five tons of tea and coffee, five rolls of slow-burning detonating cord, and 1,000 car tires. Each of these materials burns differently. The combustion of tires, for example, produces a dark and thick plume. According to the explosives expert, it could correspond to the dark plume we had located on the northeast corner of the warehouse, so we placed the tires roughly here. The expert also told us that the white plume that appeared on the northwest side of the warehouse corresponds to the ignition of fireworks. We, therefore, placed the fireworks roughly in this corner.

From an engineering perspective, this is the spatial layout of a makeshift bomb on the scale of a warehouse awaiting detonation. According to Gareth Collett (CBE 2020, CEO and Founder, Brimstone Consultancy Limited): "Ammonium nitrate is extremely difficult to detonate by fire alone. However, when confined and contaminated, this … can lead to catastrophic detonation." It is sensitized by the presence of even the smallest quantity of additives and hence should be separated. We reviewed international standards for the storage of ammonium nitrate. Internationally accepted benchmarks include British regulations. According to British standards, stacks of ammonium nitrate must be limited to 300 tons, and each stack must be at least one meter away from walls and other stacks. Australian standards are more stringent: bags must be arranged in 500-ton stacks but should be stored 890 meters away from the closest residential buildings. Using their equation to calculate safe distances, we can determine that a 2,750 stack of ammonium nitrate should have been stored 1,570 meters away from the closest residential building.

NASA's damage map illustrates the extent of the blast. All these regulations prohibit the storage of combustible or explosive materials such as tires or fireworks in proximity to ammonium nitrate. This fact highlights the substantial and sustained state negligence which led to the formulation of a makeshift bomb. Around 1,000 of the survivors and victims' families have called for an independent investigation and public access to all relevant documents. As the search for political and economic accountability for the explosion of August 4 continues, Forensic Architecture and Mada Masr are making the model, the geolocated videos, and the source material used in the research publicly available via this link: https://github.com/forensic-architecture/models." (4)

(4)
Voiceover transcript of *The Beirut Port Explosion* (2020), video and further information accessible on Forensic Architecture's website, "The Beirut Port Explosion," November 17, 2020, https://forensic-architecture.org/investigation/beirut-port-explosion.

12

11

fig.10 Forensic Architecture, *The Beirut Port Explosion*, 2020. The source of the third smoke plume on the northwest of the warehouse.
fig.11   Forensic Architecture, *The Beirut Port Explosion*, 2020. Layout of bags of ammonium nitrate within the warehouse, as indicated in images from January 2020.

fig.12   Forensic Architecture team at work. Courtesy of Forensic Architecture.