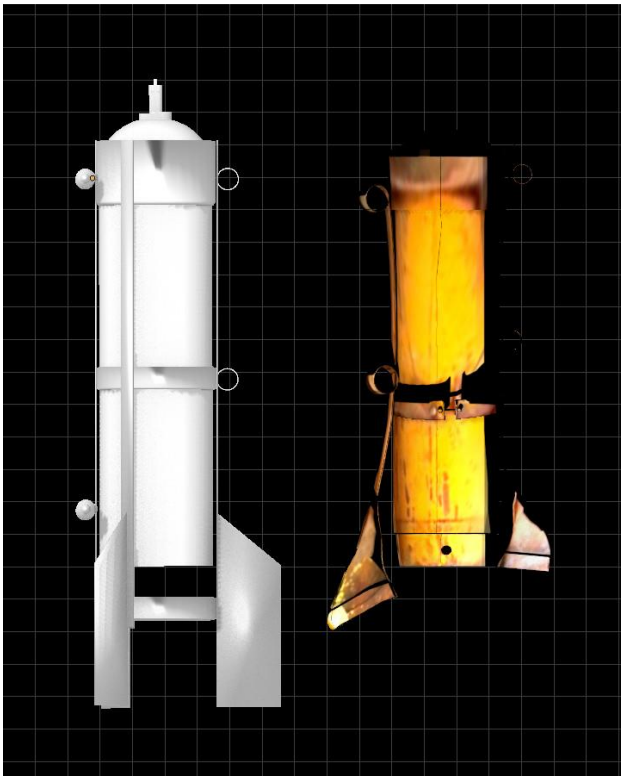
discussion regarding
"official narrative" releases

FFM/OPCW report on Douma
Forensic Architecture + New York Times



LOCATION 4

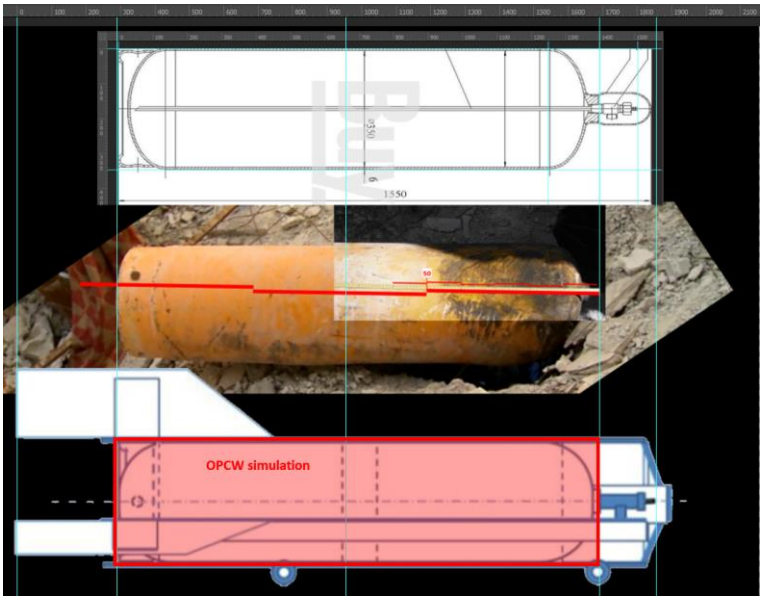
by Michael Kobs
March 7, 2019

plus some parts added after the leak of the
"Engineering-assessment-of-two-cylinders-observed-at-the-Douma-incident-27-February-2019-1"

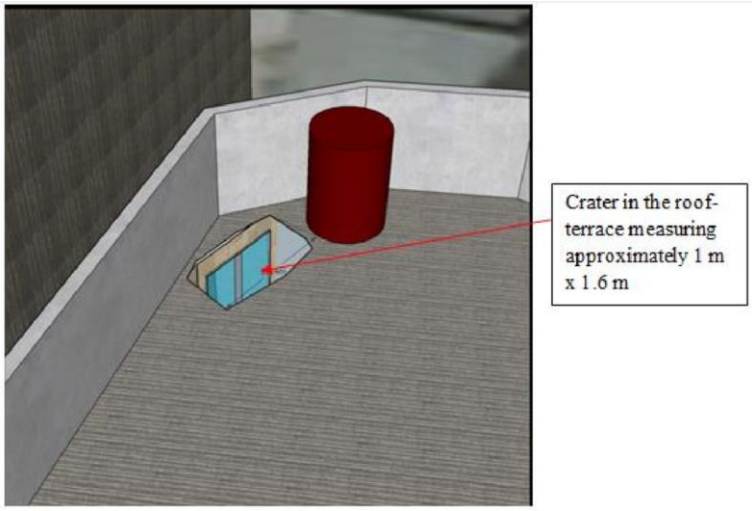
Re: FFM report

The size of barrel and hole

The OPCW report shows only a cropped photo of its measurement of the cylinder (p53) that allegedly shows a 1400 mm cylinder from the bottom to the top. In the simulation (see p62) they apparently used a cylinder of size 1400 x 350 mm, but the whole construction has a size of about 1900 x 800 mm (compare p61). In addition, the chlorine cylinder in its corset has slipped by about 150-200 mm, which extends the entire construction to about 2050 mm. It is therefore of decisive importance whether the cylinder slipped before or after the impact.



According to the same report the crater has a dimension of approximately 1600 x 1000 mm (more precise 1660 x 1050 mm). The suspicion is therefore obvious that this crater is too small for a horizontal impact (according to the flatten side) of the cylinder, even if the FFM/OPCW report concludes the opposite.



Presentation of the crater size in the FFM Report.

The damage patterns

Normally the wide ring at the end of the valve would protect the valve and thus perhaps prevent it from breaking off in a horizontal impact.



Front ring displaced – valve unprotected

In the case of the bed cylinder, however, the entire corset has slipped back a bit so that the valve would hit the concrete completely unprotected (making the assembly 200 mm longer). But this detail was not taken into account in the simulation. Wherever this cylinder hit, the corset had already slipped down and bent around the flattened side. However, the wide front ring is not flatten in any way as seen above.

The absence of any deformation of the front ring, however, raises the question of what force was applied to the concrete in the front part of the cylinder to destroy it in such a way that the exposed valve could pass through an “existing” hole undamaged.



Corset bent around the bottom of the cylinder

Surprisingly, the cylinder is flattened while the fin is bent but still partially upright. This kind of deformation seems to refer to a soft ground such as soil.



Cylinder deformed – fin still partly upright

So, in the case of the bed cylinder there are two mutually exclusive cases.

a) The corset was slipped before the impact and
b) the corset slipped after the impact and only bent around the bottom of the cylinder during the alleged bouncing.

In case b) the valve might be protected but the fin would be folded halfway (pink) around the bottom.



Cylinder deformed – fin still partly upright: The middle section (pink) of the fin is not deformed as it should have been if the corset had not slipped. The shear forces between concrete and cylinder would have deformed the fin along the pink line

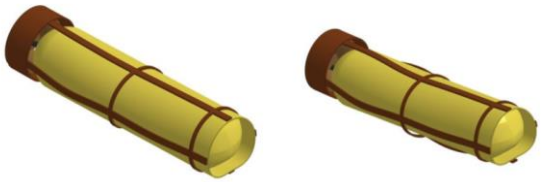
According to the photo the fin is not bent in this area and case b) can be excluded. Therefore, in case a), the valve would have been in direct contact with the concrete and would have been sheared off, similar to how the back of the corset was deformed. Strangely enough, the cylinder is deformed to the wide front ring of the corset, but the ring is not. In fact, every trace of the deformation energy is missing.



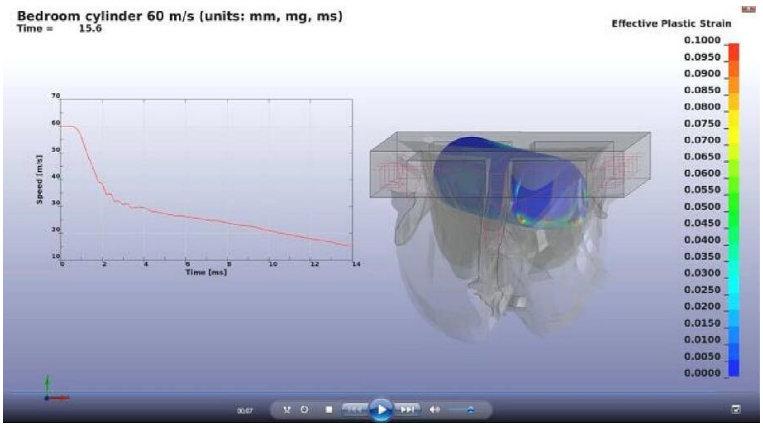
Direction of the forces acting on the corset and valve in a horizontal impact. The cylinder appears to be deformed up to under the undeformed front ring.

Curiously, the deformed 3D model of the yellow cylinder has been fitted with a similar undeformed but not-displaced corset that it looks as if the front ring had protected the valve. Since in this position neither the fin would have bent around the bottom nor the front ring would have protruded forward virtually unformed, this picture is misleading and has nothing to do with a FEA simulation result or even the reality. In the bad case it is fraud by intention.

FIGURE 13: COMPUTER-MODULATED DAMAGE TO THE CYLINDER WHILE PASSING THROUGH THE ROOF



This presentation suggests that the corset was included in the simulation. In fact, neither the corset with the fins nor the cylinder dome with the valve was part of the simulation. The model shown here is 10cm longer than the maximum longitudinal expansion of the crater.



The screenshot of the simulation shows the deformed cylinder bottom side.

I don’t want to speculate, but this little “trick” confirms exactly the impression, that an already deformed cylinder with a valve was put into an already deformed corset. This impression is further reinforced by the fact that a lighter corset with fins, extended to the rear, should have placed the cylinder vertically due to the air resistance. The problem, however, is that the deceleration on the fins due to drag would inevitably have caused the much heavier compact structure of the cylinder to slip out. The corset would probably have been lost during the fall.

There are two more points to add:

1) Two undamaged fins stick out perpendicular to the apparent fall direction according to the deformation of the cylinder. These fins would be hit flat on the concrete surface and would not stand straight to the side. In addition, the apparently missing ring around the bottom is bent back flat to the surface of the fins.



In principle, the cylinder lies in the position on the bed as it should have hit the concrete. The two undamaged fins are perpendicular to the direction of fall on both sides.



bent bottom ring / fins wrapped in a blanket

Due to the slipped corset the depicted ammunition from the tip of the valve to the end of the fins is about 2.05 meters long, which sounds almost half a meter longer than the maximum length of the crater. Furthermore, the crater looks much narrower at both ends than shown in the report.



In contrast to the presentation in the FFM Report, the crater appears much narrower at both ends than in the middle.



Since there is no undistorted photo or sketch of the top view of the crater, one can only assume the exact shape and extent of this hole. In order to make a definite statement regarding the initial suspicion, it is necessary to reproduce this crater from photos and videos as a 3D model as accurate as possible (see Part 2).

Traces of an impact?

Assuming a falling object has caused the hole in the ceiling, it cannot have had initial momentum towards the bed, because the wall and rain barrel above the hole rule out any trajectory in that direction.



Every change of direction, however, requires a corresponding impulse.[1]

- Impulse…
  - is a quantity that describes the effect of a net force acting on an object (a kind of "moving force").
  - is represented by the symbol **J** (boldface).
  - is the product of the average net force acting on an object and its duration.

$$\mathbf{J} = \bar{\mathbf{F}}\Delta t$$

  - is the force-time integral.

$$\mathbf{J} = \int \mathbf{F}\, dt$$

  - is a vector quantity (since force is a vector and time is a scalar).
- Impulse-Momentum Theorem
  - The impulse-momentum theorem states that the change in momentum of an object equals the impulse applied to it.

$$\mathbf{J} = \Delta \mathbf{p}$$

  - If mass is constant, then…

$$\bar{\mathbf{F}}\Delta t = m\Delta \mathbf{v}$$

  - If mass is changing, then…

$$\mathbf{F}\, dt = m\, d\mathbf{v} + \mathbf{v}\, dm$$

  - The impulse-momentum theorem is logically equivalent to Newton's second law of motion (the force law).

The required impulse is a vector and therefore this impulse would leave traces on the wall or floor opposite the bed.



Missing traces of the required impulse

But what demolished the shower cubicle?

It looks like a table collapsed under heavy weight (e.g. one or two men or the cylinder that was laid down in the meantime or vandalism). The tabletop itself seems undamaged, so nothing of the size of

[1] https://physics.info/momentum/summary.shtml

the cylinder fell on it. But apparently the table tilted on its four legs towards the bed, piercing the corner of the shower cubicle.





Sheared off columns of the shower cubicle.

It's hard to believe that the glass pyramid on the roof of the shower cubicle didn't fall down during this violent shock.



However, the damage to the shower enclosure can be months or years old. According to the kitchen, this apartment had been abandoned for quite some time. And this impression is confirmed by the things on the bed: Children's things in a bag, a lamp with a coiled cable… Obviously someone had packed his belongings here.





The FFM report just mentioned a missing glass in the back row of this pyramid.

FIGURE A.7.10 OTHER DISCREPANCIES



Glass pyramid on the destroyed shower cubicle.

The report does not mention, however, that at least 4 of these glasses were found on the bed under the cylinder.



Glasses on the bed.

Since these glasses are obviously not missing in the pyramid, they did not fall off the roof of the shower cubicle. So, it cannot be ruled out that this glass pyramid was erected after the destruction of the shower, which is very likely the case.

It must also be said that the crater was built in exactly the same place where some wrecking work had taken place before. Apparently, the top layer of concrete had been removed earlier in order to lay a rainwater pipe into the abandoned kitchen below.



3D model

The FFM/OPCW report assumes that the crater in the roof above the bedroom was penetrated by the chlorine cylinder that was later found in the bed. To prove this, the report shows screenshots of physical calculation models and a modelled cylinder hovering over a photo of the crater.

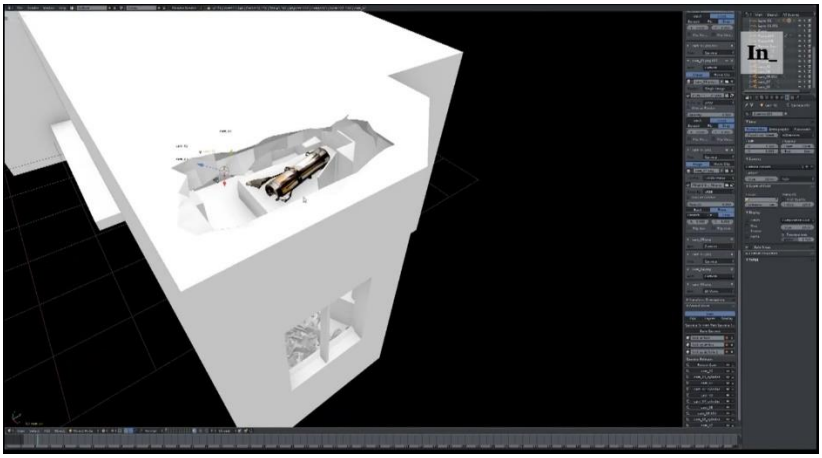
FIGURE A.7.6 SNAPSHOT OF SIMULATION OF THE POSSIBLE ROOF CRATER FORMATION



FFM/OPCW - cylinder model hovering over a photo of the crater

The illustration gives the impression that the cylinder had plenty of room to fall comfortably through the hole. But as in the physical model (see part 1), this cylinder has neither a cylinder dome nor a valve nor an armor with fins. Therefore, this picture is not very convincing.

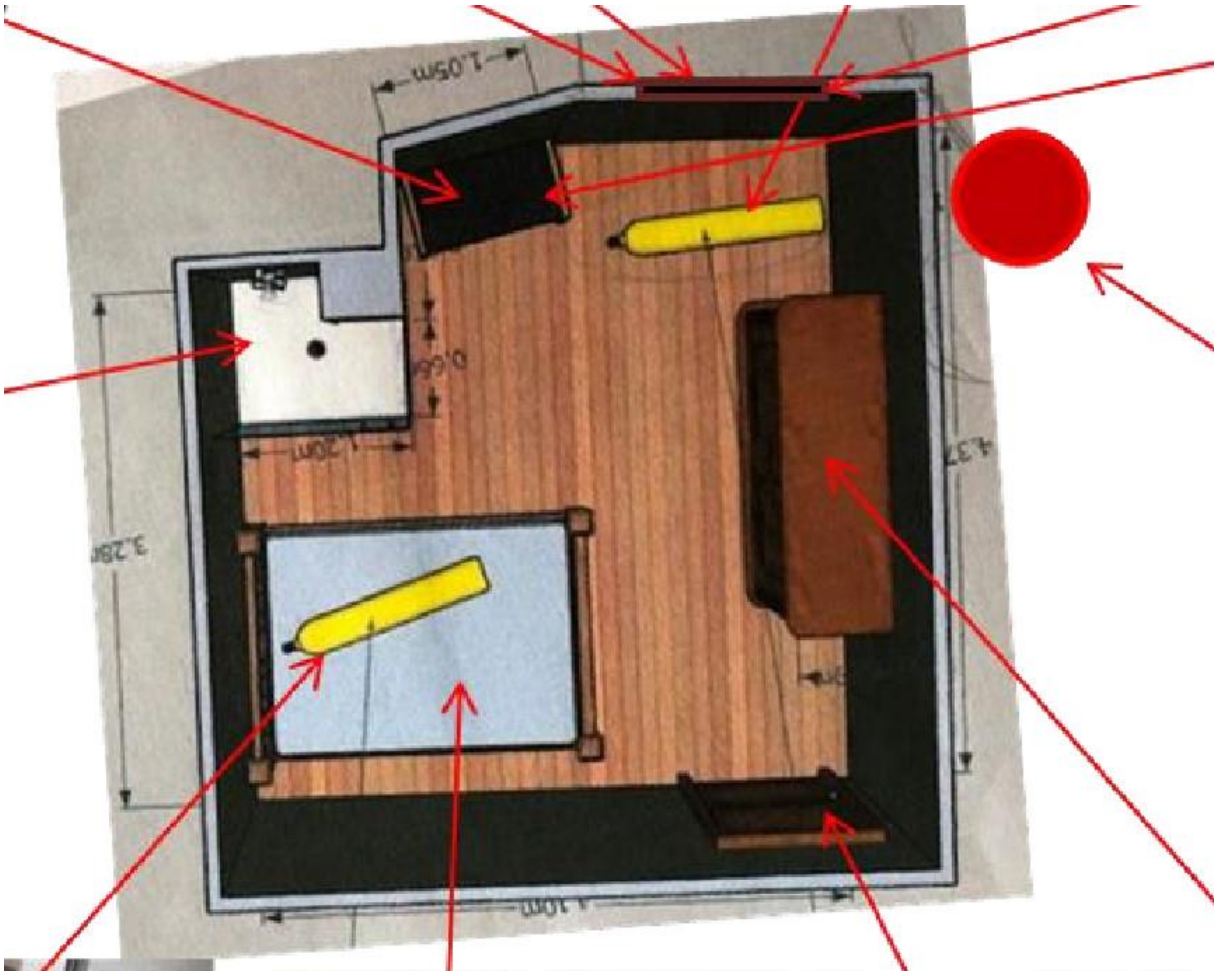
Forensic Architecture presented a 3D model of the crater and behind it the chlorine cylinder on the bed. The size of the model seems to be nearly correct, but the perspective pretends that the cylinder is much smaller than the hole.



screenshot from The Intercept video
https://theintercept.com/2019/02/09/douma-chemical-attack-evidence-syria/

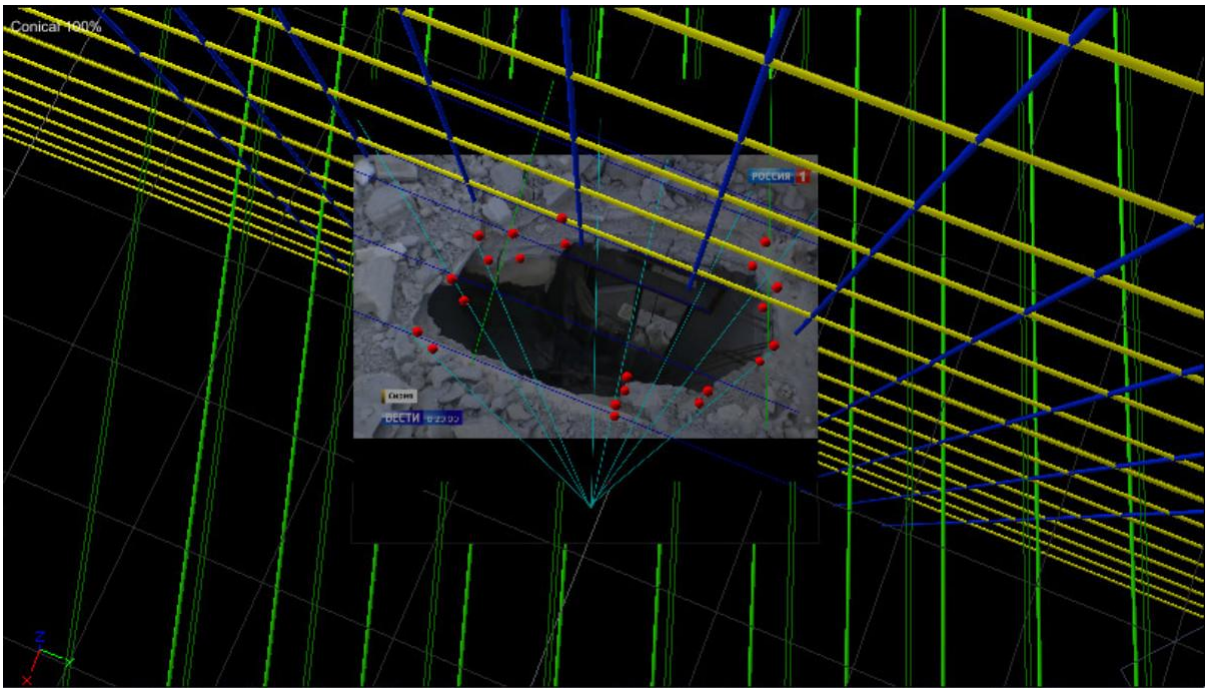
The only way to verify this non-verbal assertion is to create a scaled 3D model. Beside the known photos and videos the FFM/OPCW report gives some useful hints, e.g. a floor plan of the room with measurements. The report also mentions the dimensions of the crater as **166 x 105 cm** and writes (right below Figure A.7.6 of the hovering cylinder) ***"which is keeping with the dimensions of the***

cylinder of 140 x 35 cm. It should be noted that the cylinder had an additional structure attached to the body, which is still in line with the dimensions of the crater."



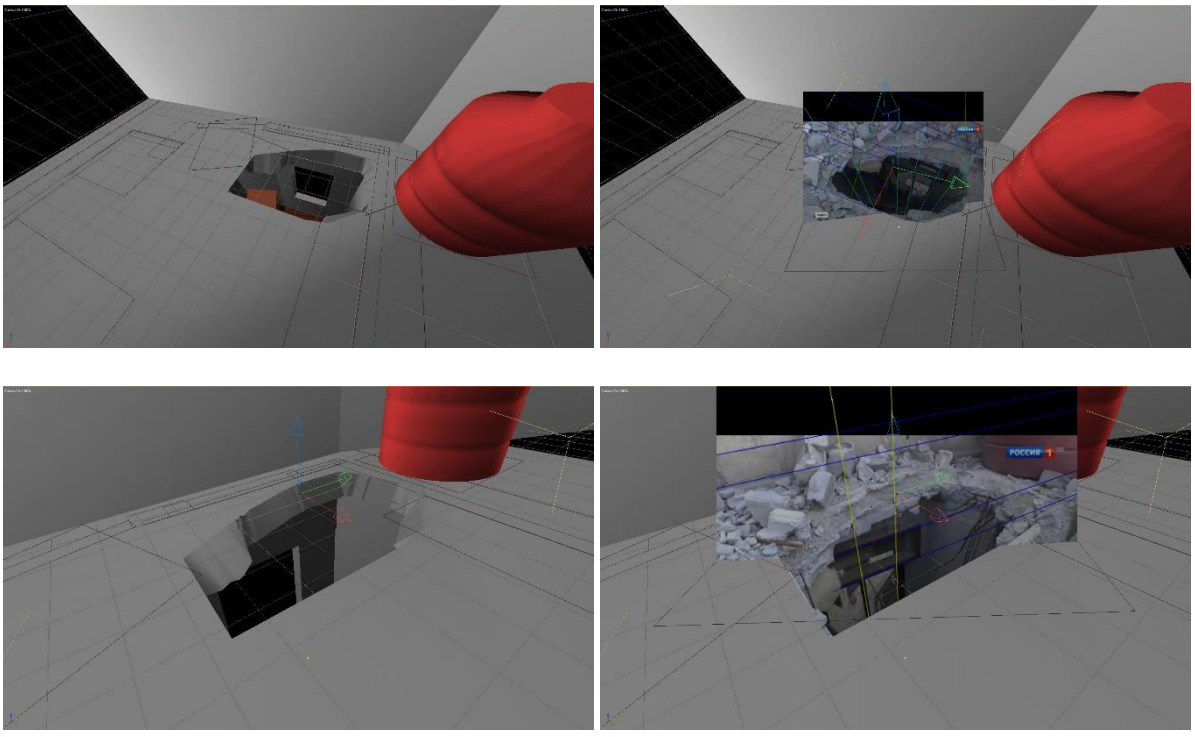
FFM/OPCW: floor plan

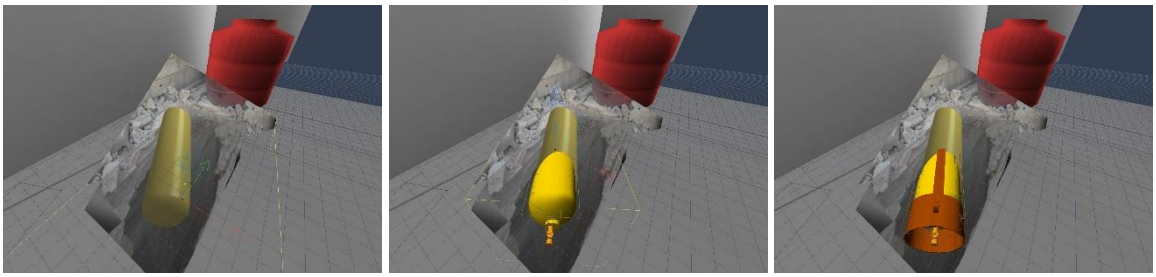
the crater, Since there is no undistorted top view of the crater, we must first analyze the relative position of the camera using the vanishing lines. In a second step we can position red spheres in the horizontal plane so that they match the edges of the crater in the projection.



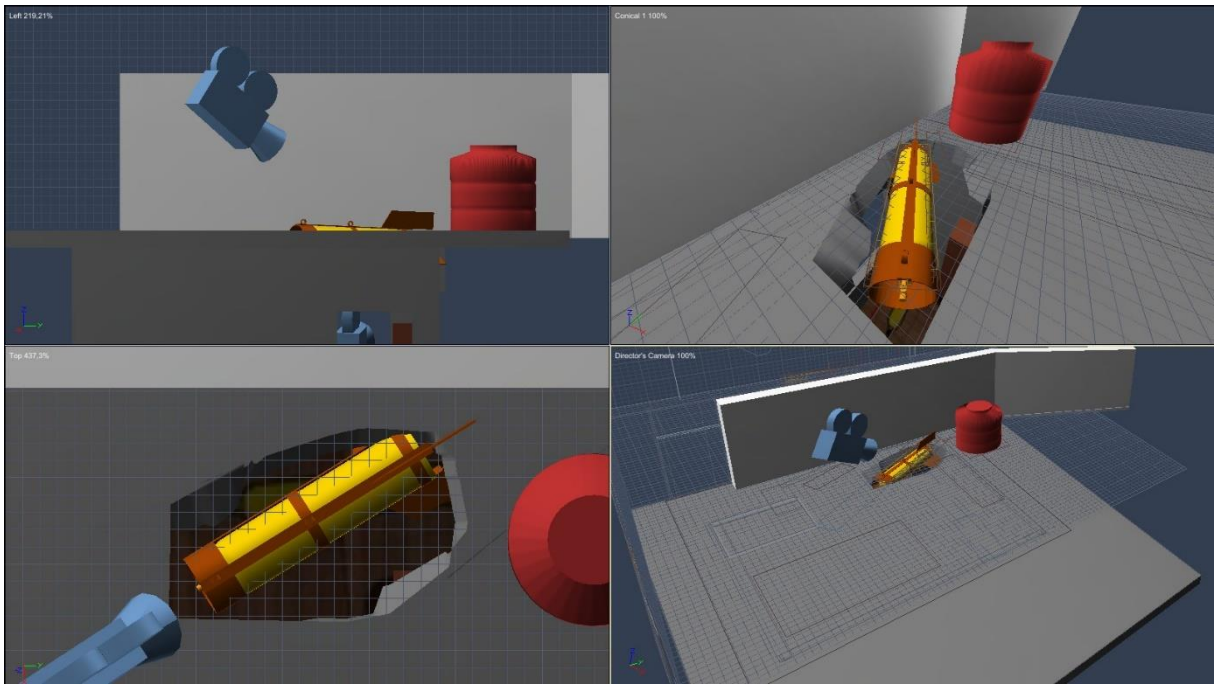
camera position in 3D space with matching vanishing lines in the projection of the crater

The result is an undistorted shape of the crater, which we can scale to the dimensions of 166 x 106 cm in the third step.

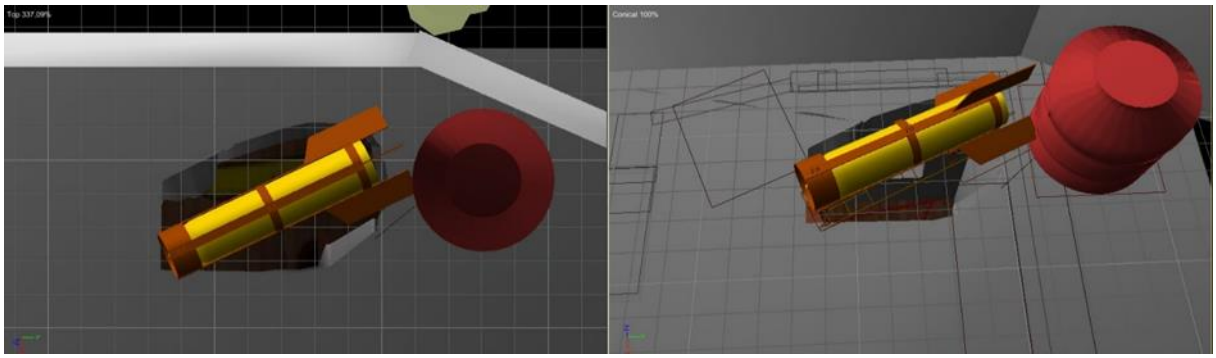




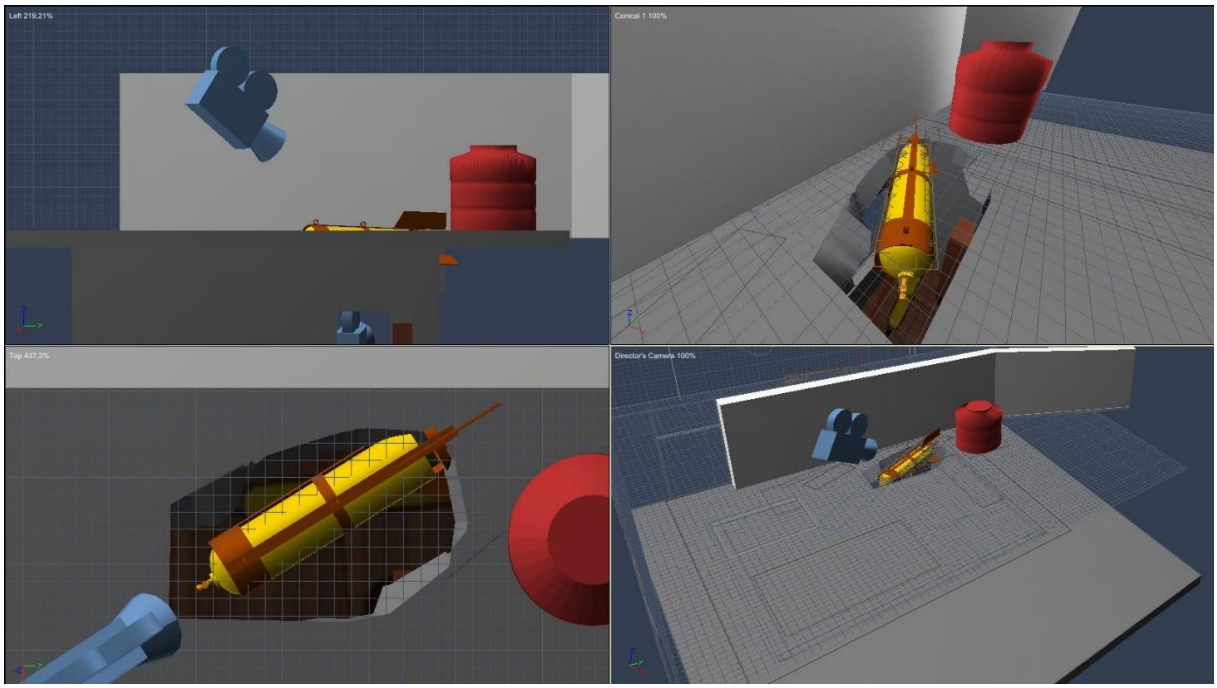
Finally we can compare the scaled crater with a model of the chlorine cylinder with cylinder dome and valve with and without corset and fins.



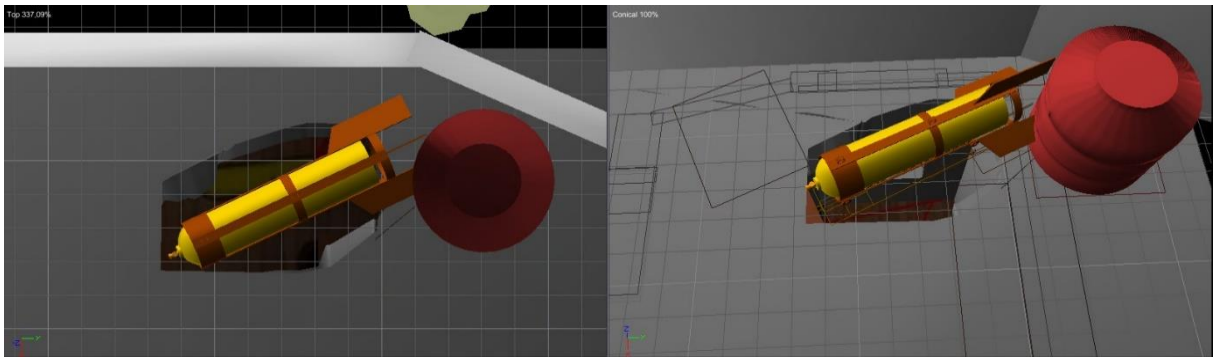
Position of the hovering OPCW/FFM cylinder with harness in place



Ideal position of the yellow cylinder harness in place



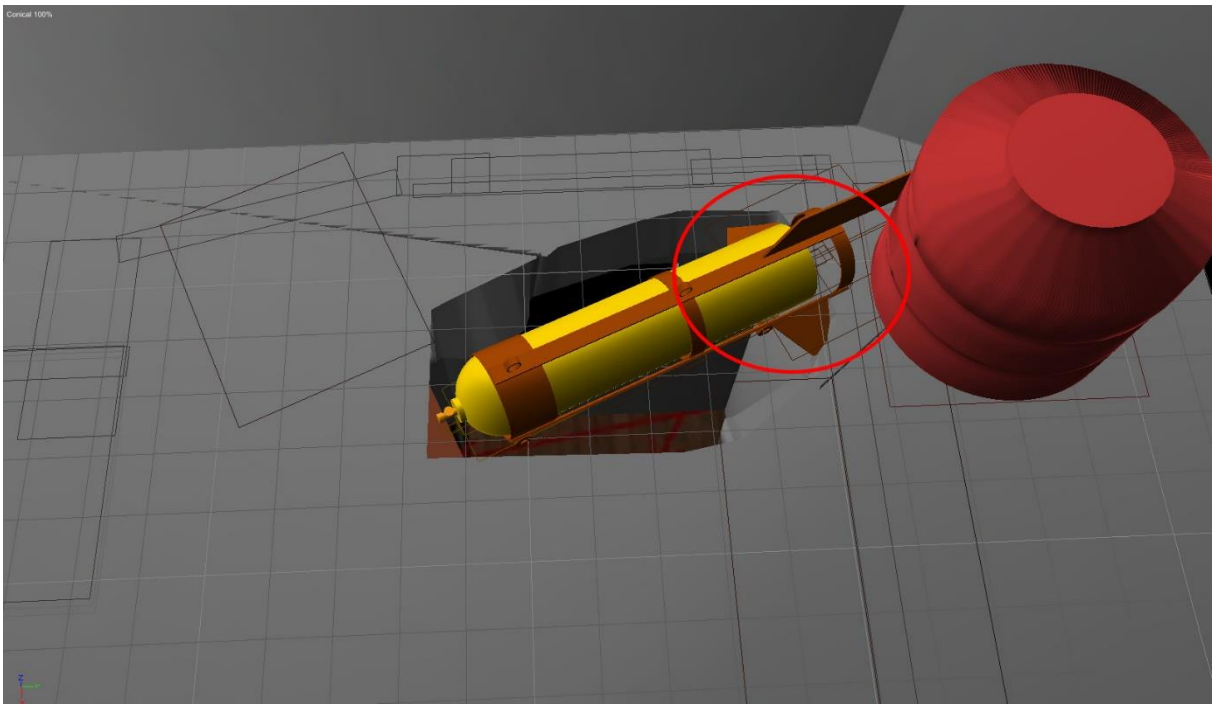
Position of the hovering OPCW/FFM cylinder with slipped harness as suggested by the damage

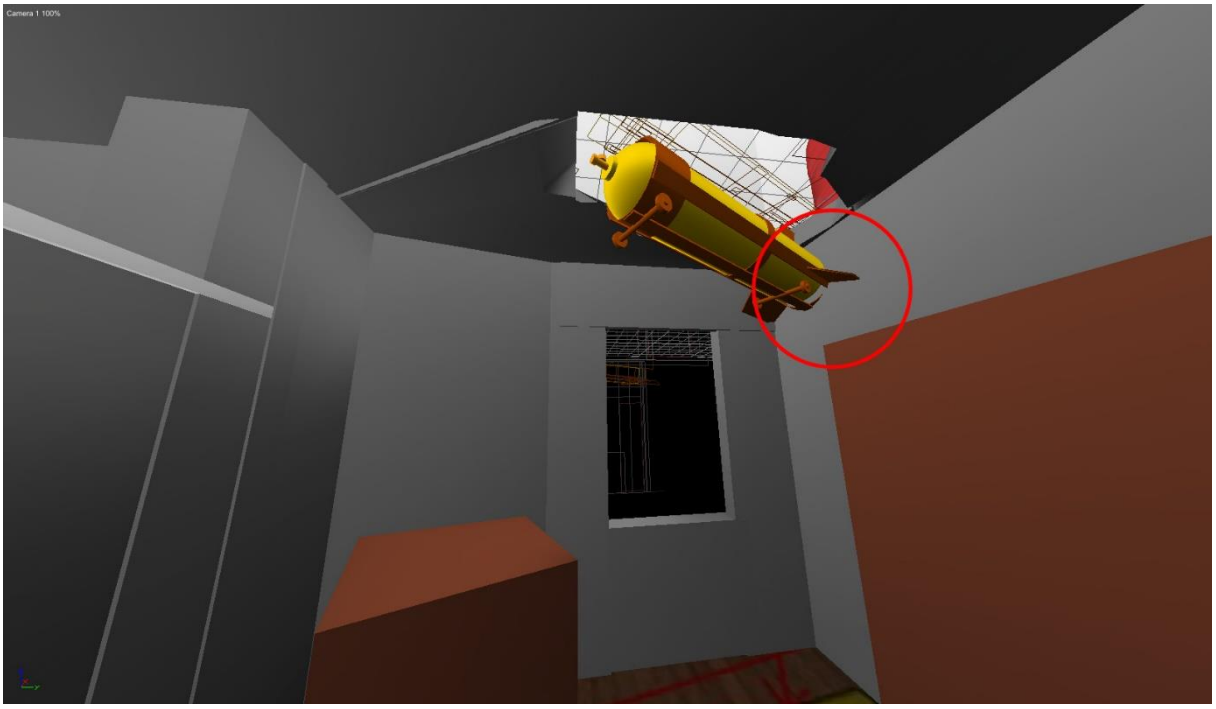


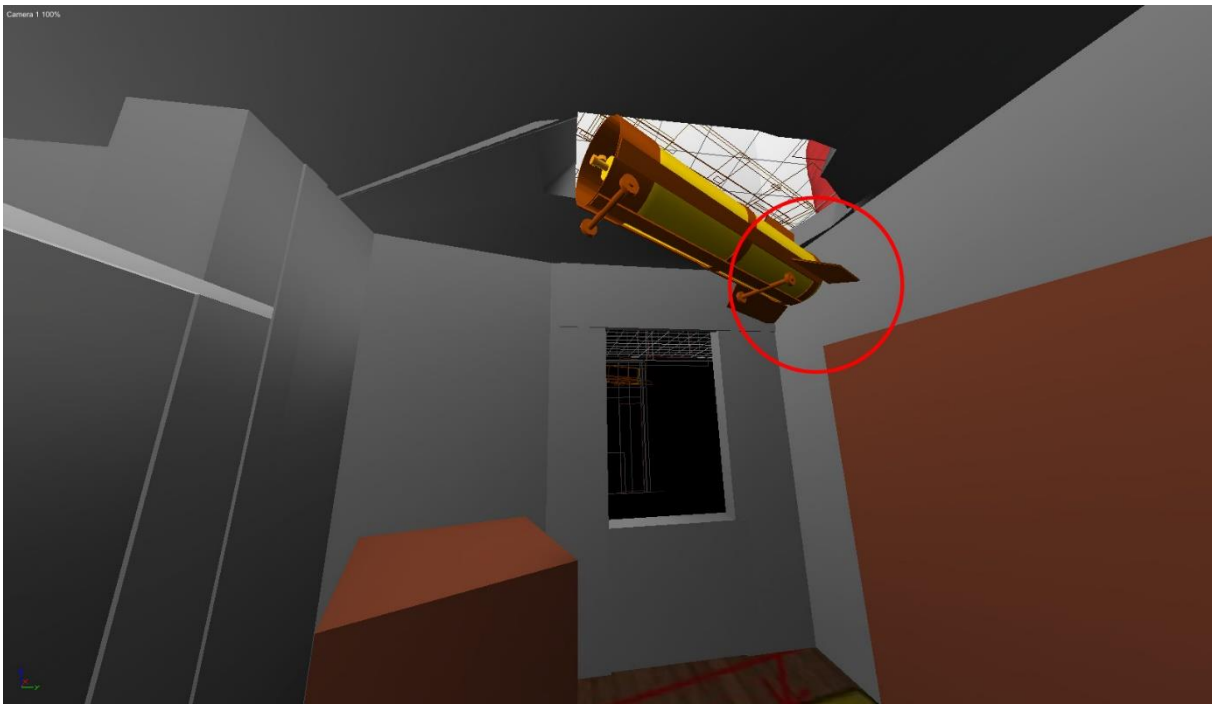
Ideal position of the yellow cylinder with slipped harness as suggested by the damage

The illustration makes it impressively clear that the cylinder with its harness and fins would by no means have fit horizontally through the existing hole. It doesn't matter if the harness was in its normal position or if it slipped like the cylinder in the bed.

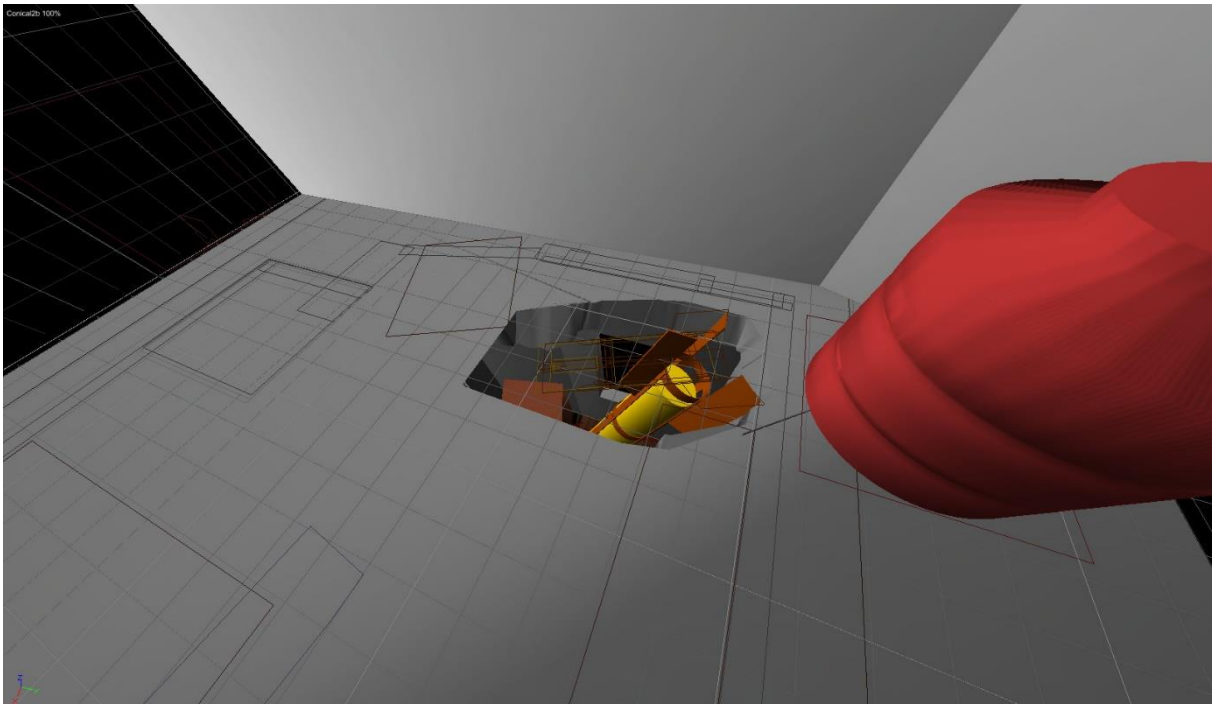
The fins would probably have been torn off by the concrete edge. In addition, the hole borders directly on a room wall. Also, this wall would have had to be damaged by the fins (and the wall would have to damage the fins). It is the same wall that showed no trace of an impulse towards the bed. (see image part 1 "*Missing traces of the required impulse*")


Conical 100%


Camera 1 100%

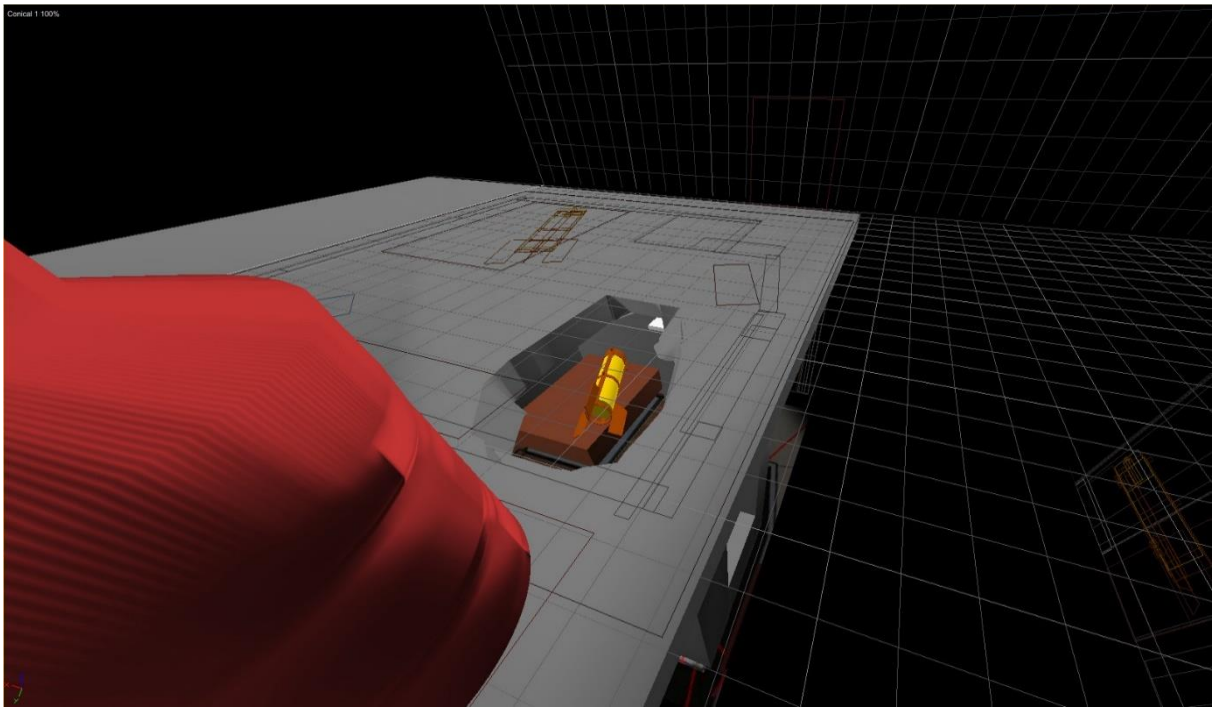


Let's assume – for the sake of completeness – that the impact on the concrete deformed the cylinder and powdered the concrete, but that the corset survived this impact more or less undamaged. In this (absurd) case, the cylinder would have had to rotate into the hole to fit through. But that would also mean that the valve would hit the ground with enough force to bounce the cylinder further into bed.

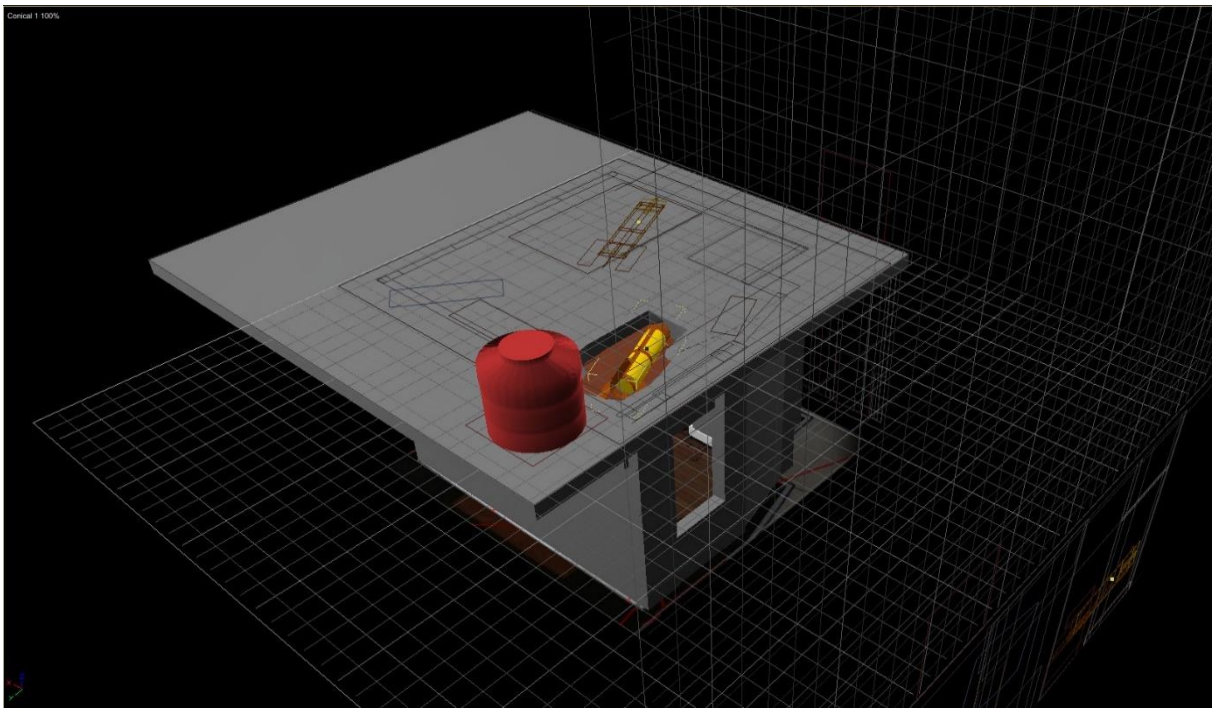


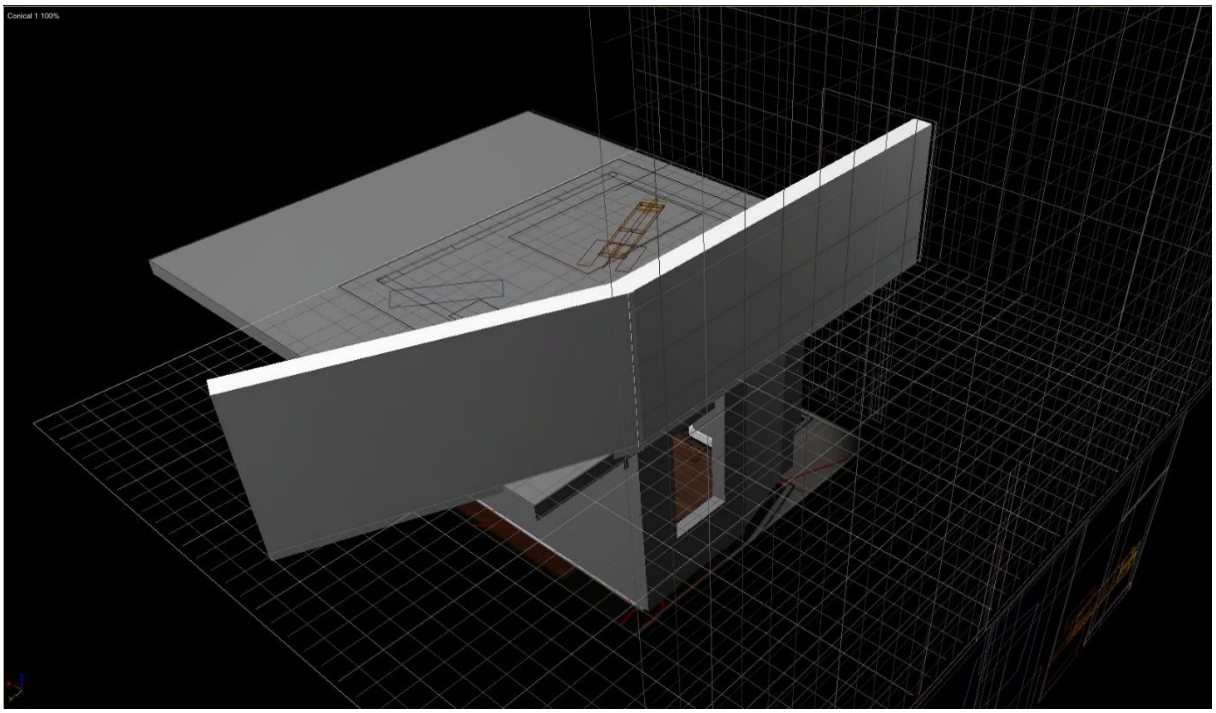


It remains a perspectival mystery how Forensic Architecture managed to show such a small cylinder behind such a big hole. Even a 15mm focal length close to the hole is unable to produce this optical effect.



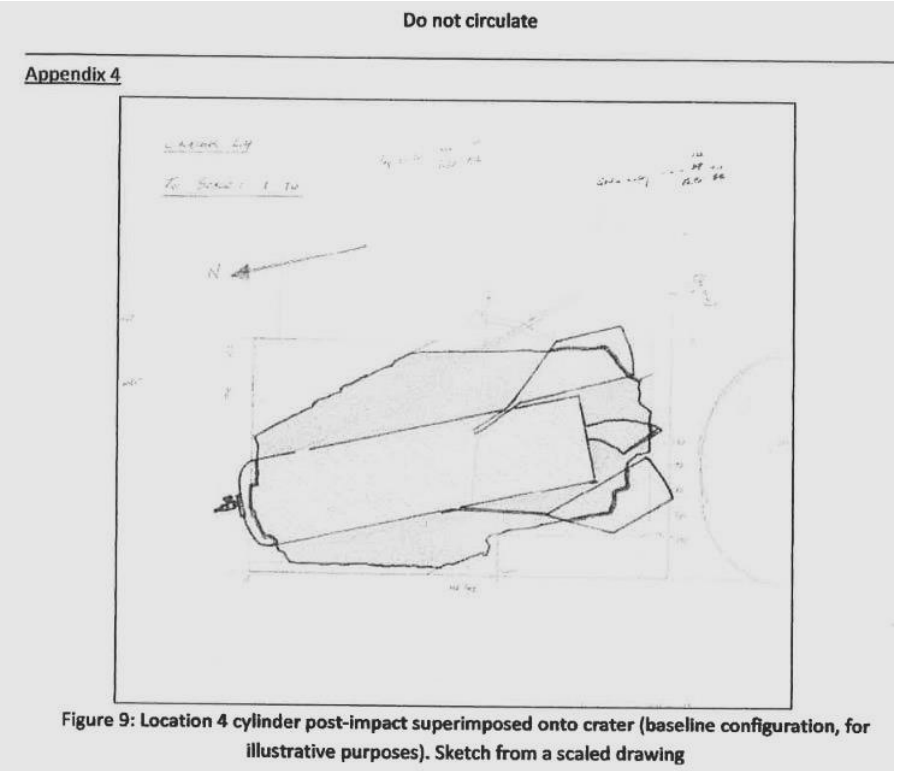
A camera with a normal focal length (50mm focal length) would image the cylinder from a distance about the same size as the hole. In reality, of course, this angle does not exist, because a wall stands in this “direct trajectory”.





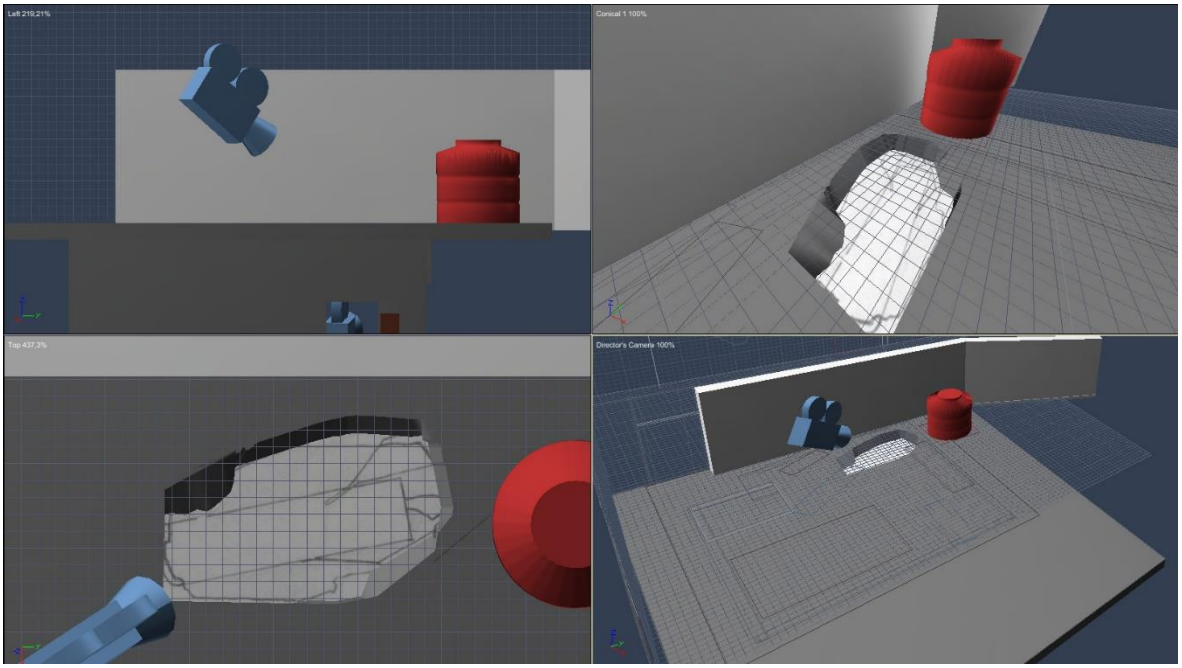
In this sense a 3D model can only confirm the conclusions of part 1.

Addition: The later published report "Engineering Assessment of Two Cylinders Observed at the Douma Incident" signed by Ian Henderson contains detailed drawings of the shape and size of the crater, which are not included in the official FFM/OPCW report.



crater drawing | source: leaked engineering report

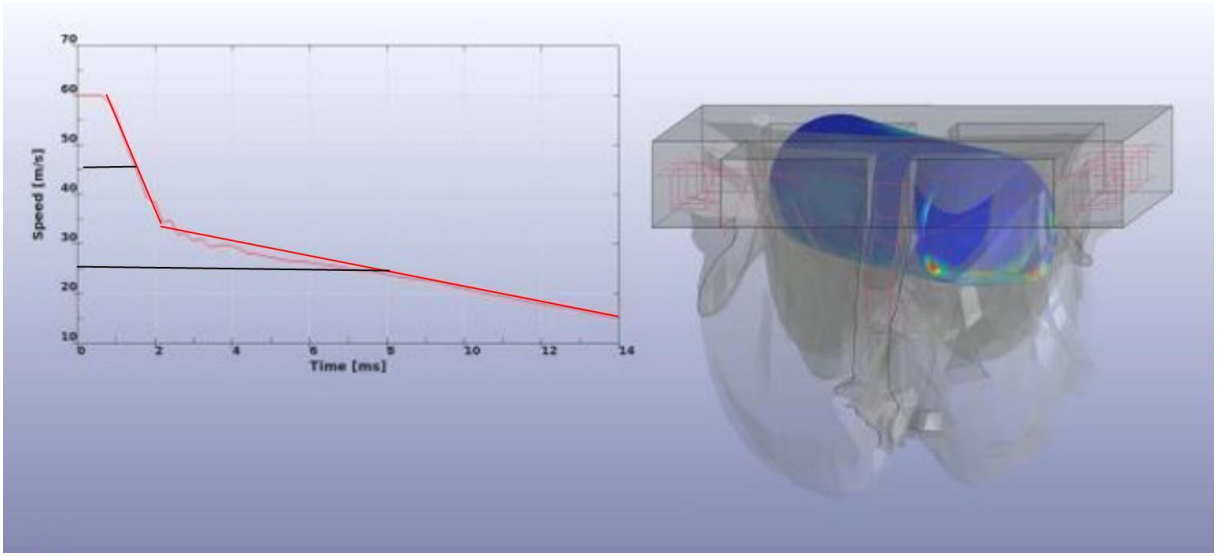
These drawings confirm in detail the shape of the crater as I was able to determine using the triangle method and various camera perspectives.



internal FFM drawing from the leaked engineering report
layered with the 3D model used above

Impact velocity

The FFM/OPCW report shows, as it seems, the LS-DYNA simulation of a horizontal 1.4 meter long cylinder without harness and valve, which hits the concrete at 60m/s and is decelerated during the next 14 milliseconds.



It can also be said that this cylinder moves at an average speed of 45m/s for 1ms and then at an average speed of 25m/s for another 12ms. This cylinder dips 34cm deep into the concrete, then has a momentary speed of 15m/s, but is still decelerated. This means that the image does not give any information about how fast the cylinder was in the simulation after the concrete had passed completely.

The cylinder is an aerodynamically complex structure with a rather streamlined front and stabilizing fins at the rear. Since the report does not publish exact figures, one can generally distinguish several cases:

1) the cylinder can be full or empty or something in between. Especially interesting is the 100% filled case, because the dropping of a half-filled weapon hardly seems plausible.

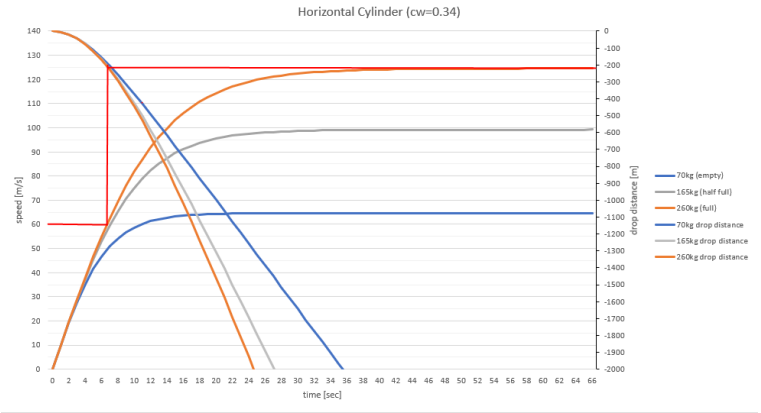
2) The cylinder has a flow resistance coefficient in the front which corresponds to a streamlined shape (cw-value ~0.35), while the fins act like a parachute (cw-value ~1.35) in the horizontal case.

The truth lies somewhere in between.

If you calculate the corresponding drop heights, you get a drop height of 224 meters for the 100% filled streamlined cylinder. (see image below)

The corresponding drop height for the parachute cylinder would be about 500m. However, it must be said that the parachute-like air resistance - if it is present in a horizontal position - comes from the fins at the rear. Exactly this effect would put the cylinder vertically and a horizontal impact would be impossible. (see image below)

The two cases seem equally excluded.

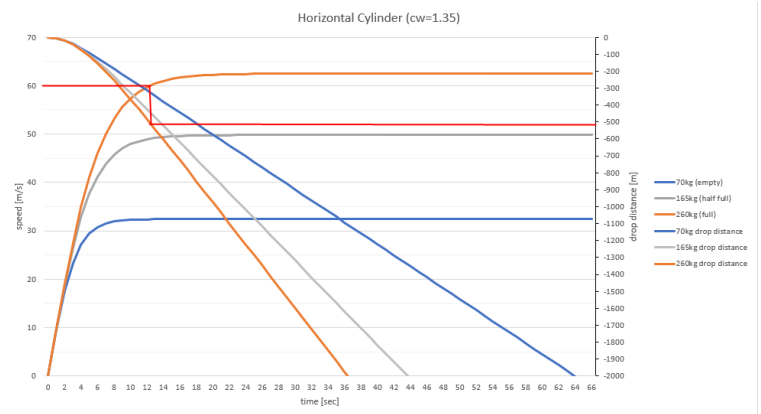


A helicopter flight altitude of 220 meters seems absurd since Syrian helicopters were shot down with MANPADS in 2012.



Figure 1 Syrian Helicopter Shot Down With Rebel Fired MANPADS

Even a flight altitude of 500 meters seems questionable, but it seems much less likely that a bomb with high drag on its fins will hit the ground almost perfectly horizontally.



Re: Forensic Architecture

The 3D Model

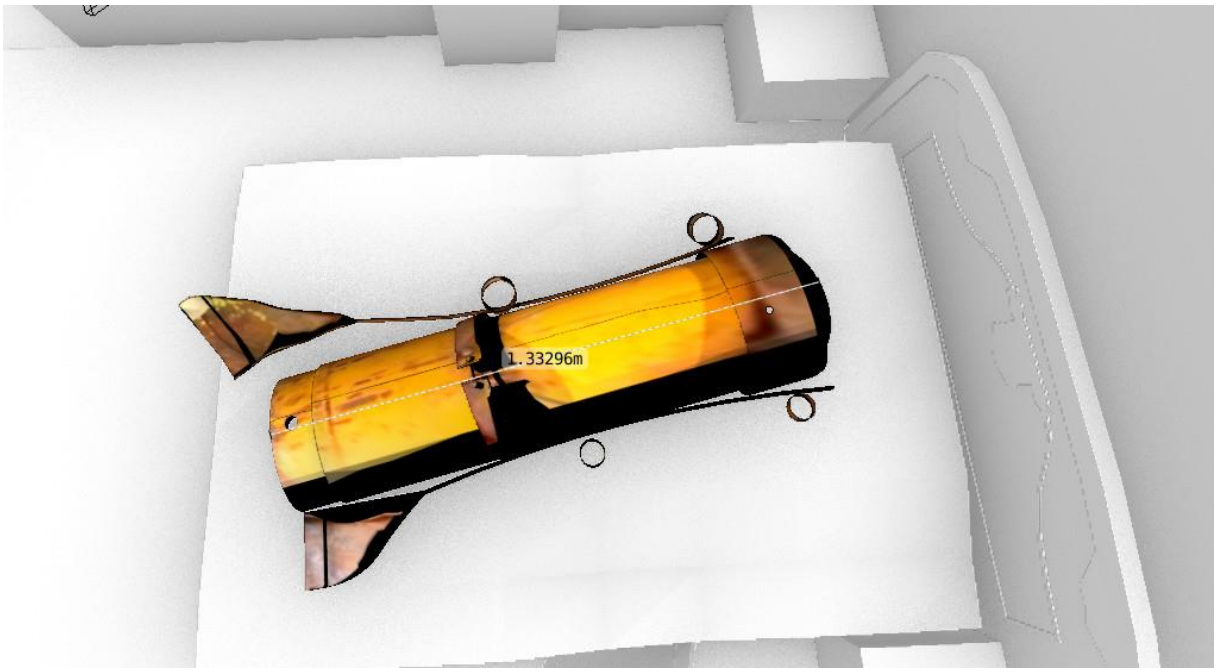
I don’t know how the London based company Forensic Architecture created their model, but they probably used a software like VisualSFM from Changchang Wu to create a point cloud from the existing videos. This point cloud can then be opened in a 3D program like Blender to remodel the room.



point cloud of Douma bedroom

source: https://twitter.com/malachybrowne/status/1012068614457954306

This method brings with it some problems that must first be mastered. The point cloud has to be scaled to the real dimensions and what the video does not see has to be added. In both aspects the model of Forensic Architecture has considerable problems, which rather mislead a forensic view.



1.33m Blender Model of the 1.40m Cylinder by Forensic Architecture without valve and cropped fins

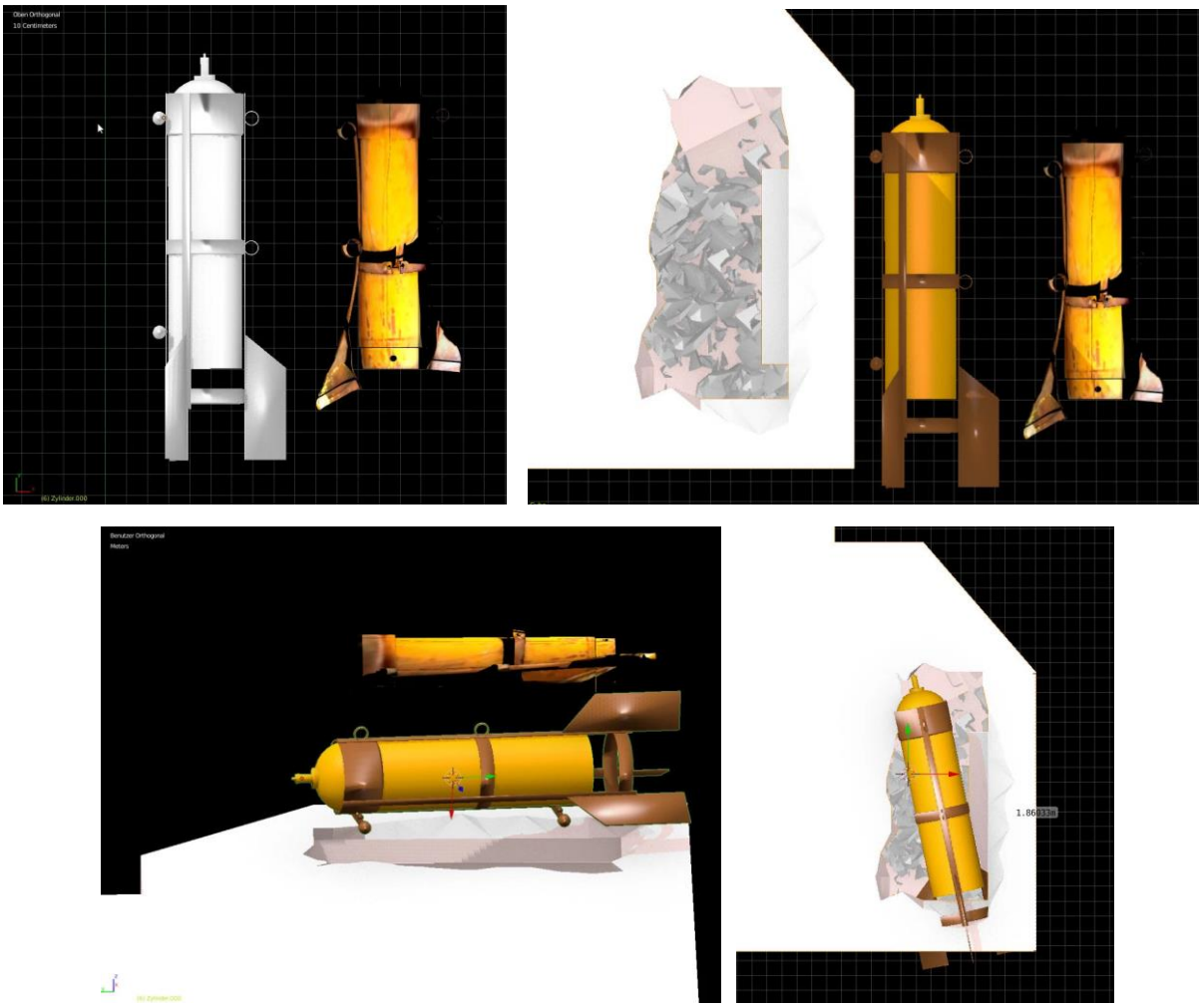
A quick glance is all it takes to identify some significant differences from reality. The cylinder in the model is clearly too far away from the head end of the bed, the cylinder is clearly smaller than in reality, and the valve and fins appear cut off.

Apparently, a video was used that does not show the valve. In addition, the fins are cut off where a blanket covered them.



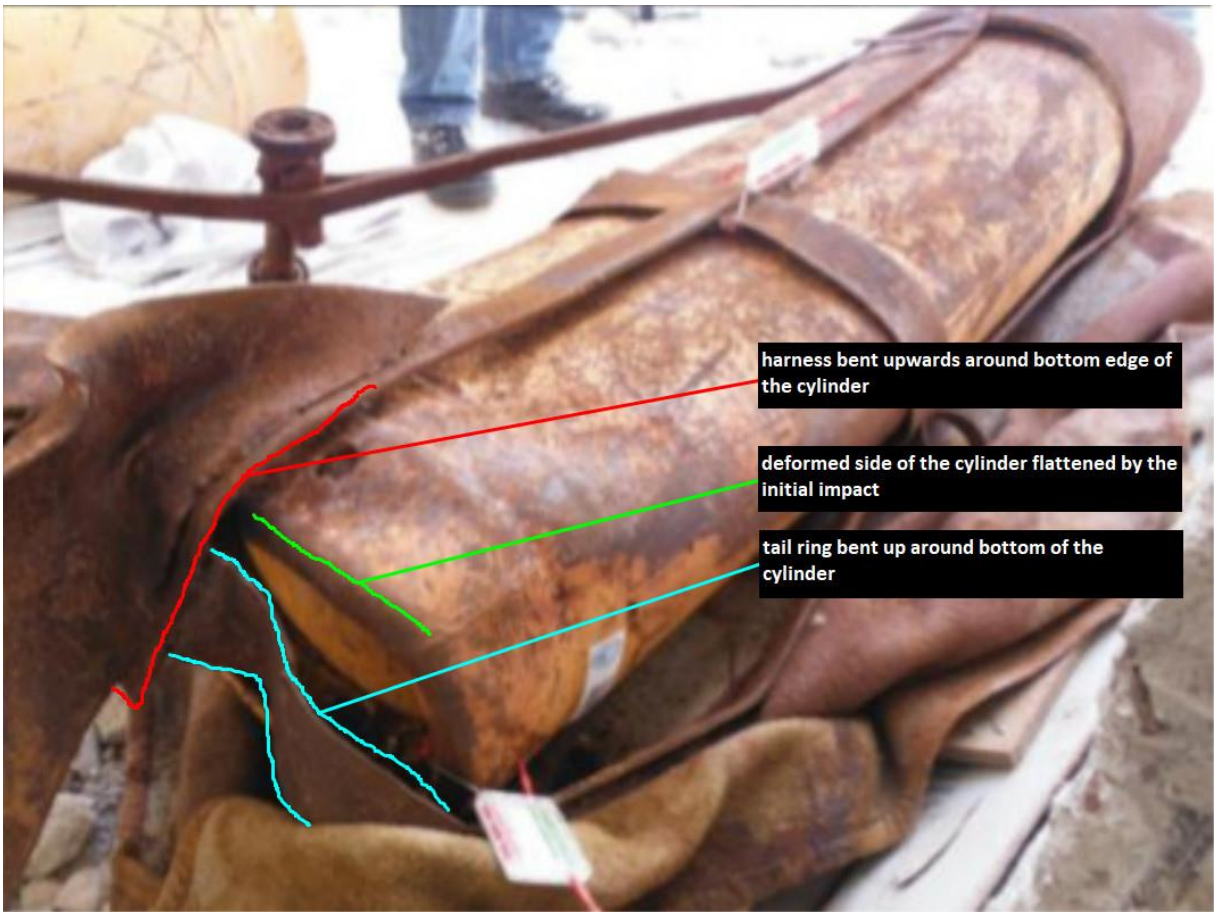
Al-Doumani video – valve invisible, fins covered by a blanket

But just the right relations and the missing parts of the alleged weapon would be necessary, e.g. to answer the question whether this cylinder with valve and fins fit through that hole in the ceiling. The comparison with a model in the real dimensions makes the difference clear.



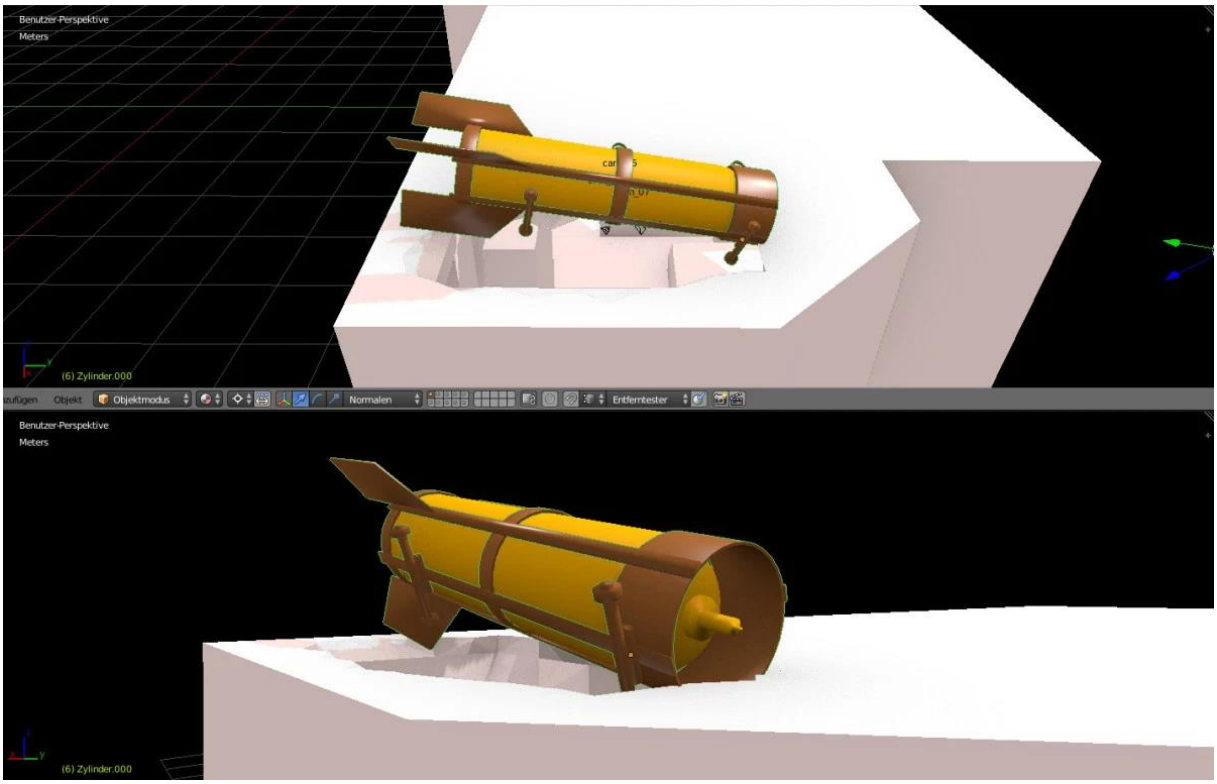
Comparison of the Forensic Architecture model with the true dimensions of the cylinder in its finned harness.

In the comparison shown above, it should be noted that the finned harness is shifted by the same amount as in the videos and consequently in the model of Forensic Architecture. As discussed before, this shifting of the harness must have happened before this cylinder – according to the official representation of the process – has hit the roof horizontally. The reason for this conclusion is that 1) the cylinder is laterally deformed, which can only happen by an almost horizontal impact, and 2) the tail ring and fin have bent around the bottom of the cylinder.

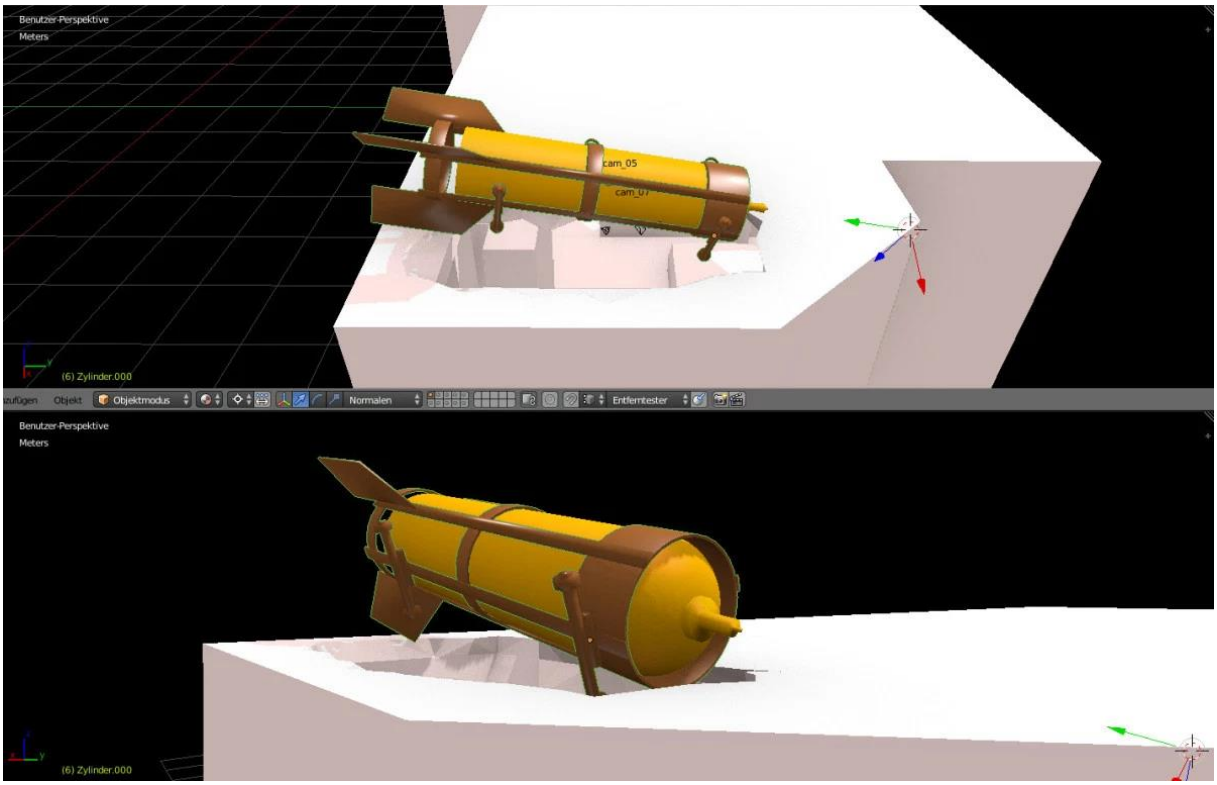


source OPCW/FFM report p20

As mentioned earlier, if the harness had not slipped prior to the initial impact, the same force that deformed the cylinder would have caused a different damage to the harness and the fins, which is not observable in the known photos. [Note: The slipping of the harness during the fall from about 2000m altitude and a horizontal impact at the same time are implausible. It would mean that the relatively large fins had no influence on the aerodynamics of the bomb – no drag.]



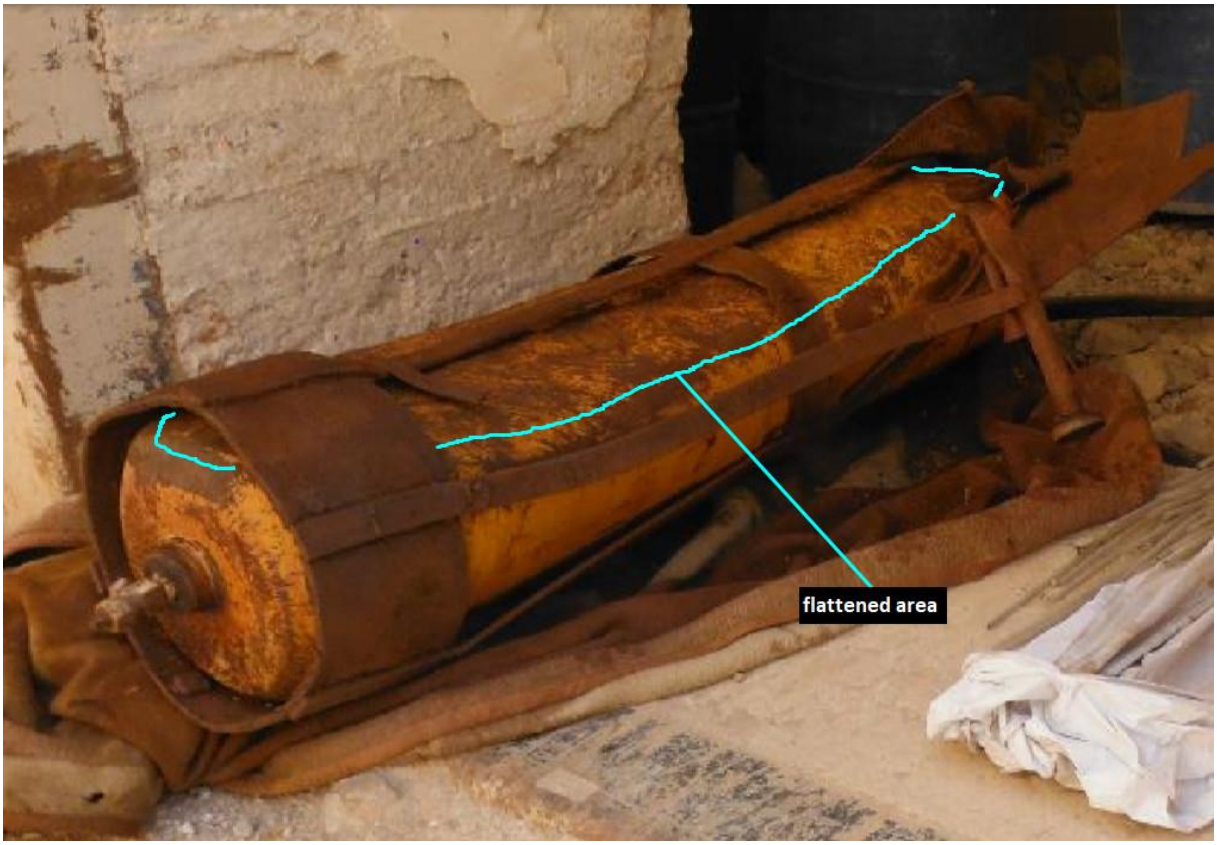
hypothetical impact orientation: tail ring supported by cylinder cannot bend upwards



hypothetical impact orientation: tail ring unsupported by cylinder would bend upwards

But apart from the current position of the harness, the hole in the roof of the Forensic Architecture model would be too small for both variants to fit horizontally through. Again, the cylinder could only rotate into the hole and would most likely land on the valve with all its weight.

A rotation of the cylinder dome and valve into the hole, however, can be ruled out for another reason. This rotation around the lower end of the cylinder – just like a horizontal passing of the alleged crater – would cause the front ring or the unprotected valve to hit the concrete sideways (almost perpendicular). The valve would not have survived such an impact and the front ring should show clear traces of deformation.



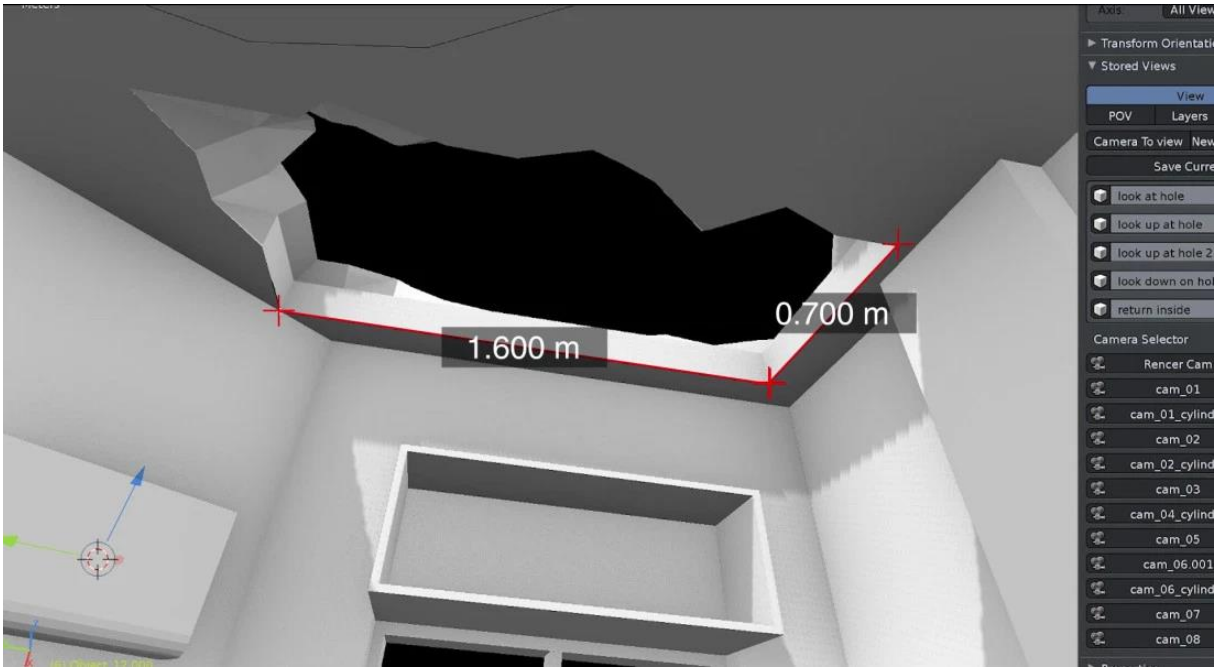
missing deformation of front ring and valve

A forensic examination of the 3D model of Forensic Architecture should at least have revealed the possibility of an alternative explanation. And this alternative explanation seems much more likely than a horizontal impact on the roof with slipped harness.

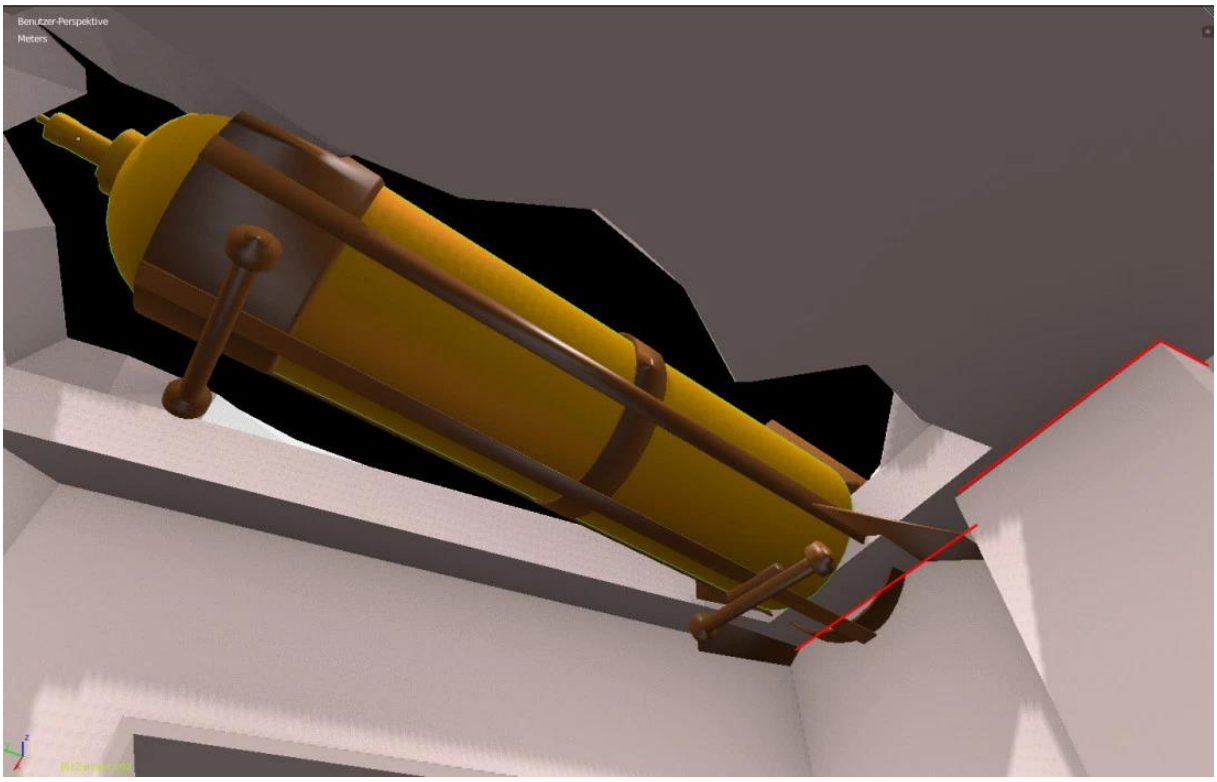
Another point of forensic interest apparently went wrong with the model of Forensic Architecture. In the corner of the room below the alleged crater there was a shaft that is vertically in line with the crater's edge. The fins – too long for the hole – would therefore not only have to overcome the ceiling itself, but would also be practically stuck in the wall over the entire distance to the floor, since a rotation would inevitably have led to an impact with the valve.



shaft aligned with the hole / "crater"



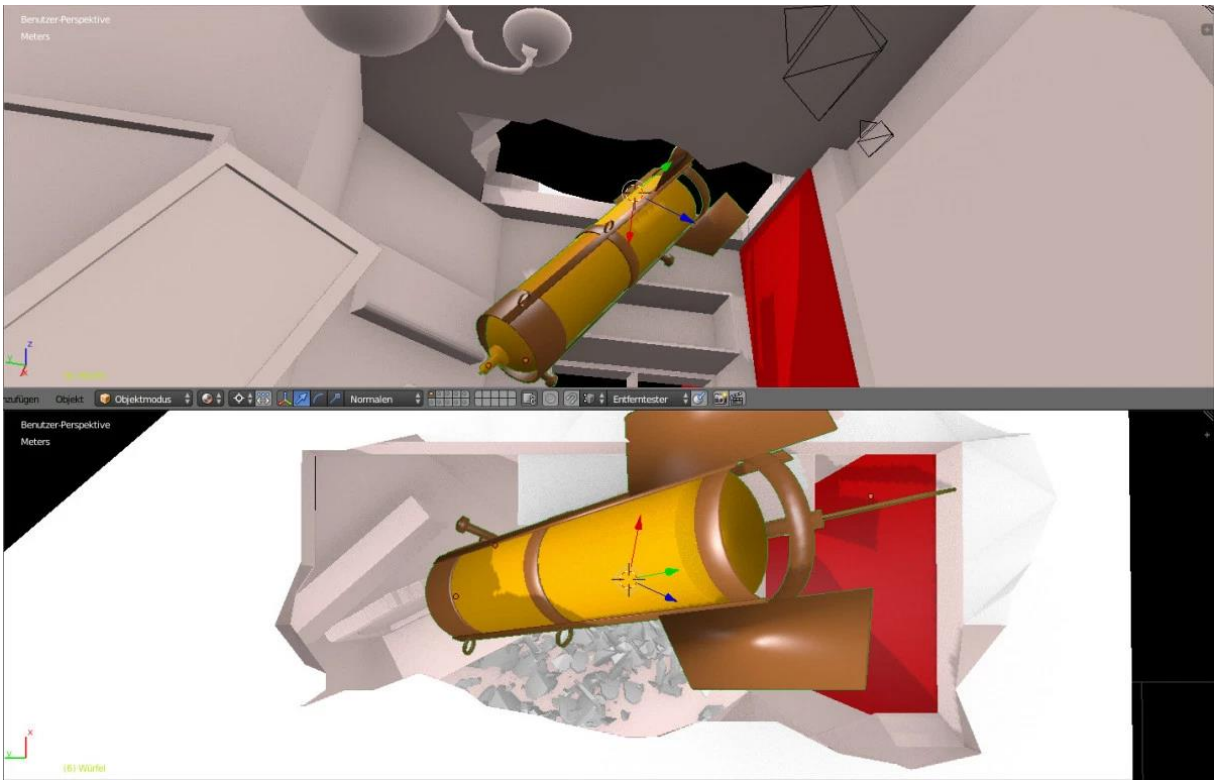
Forensic Architecture model – displaced shaft

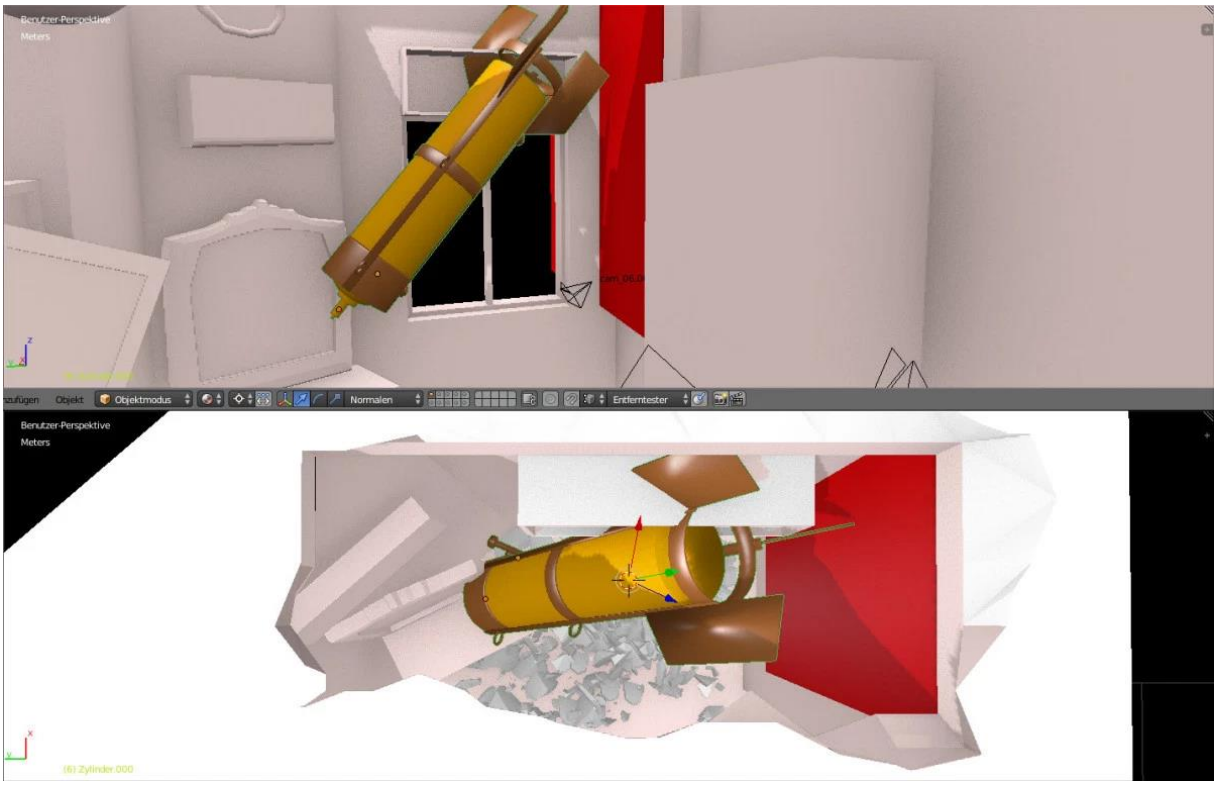


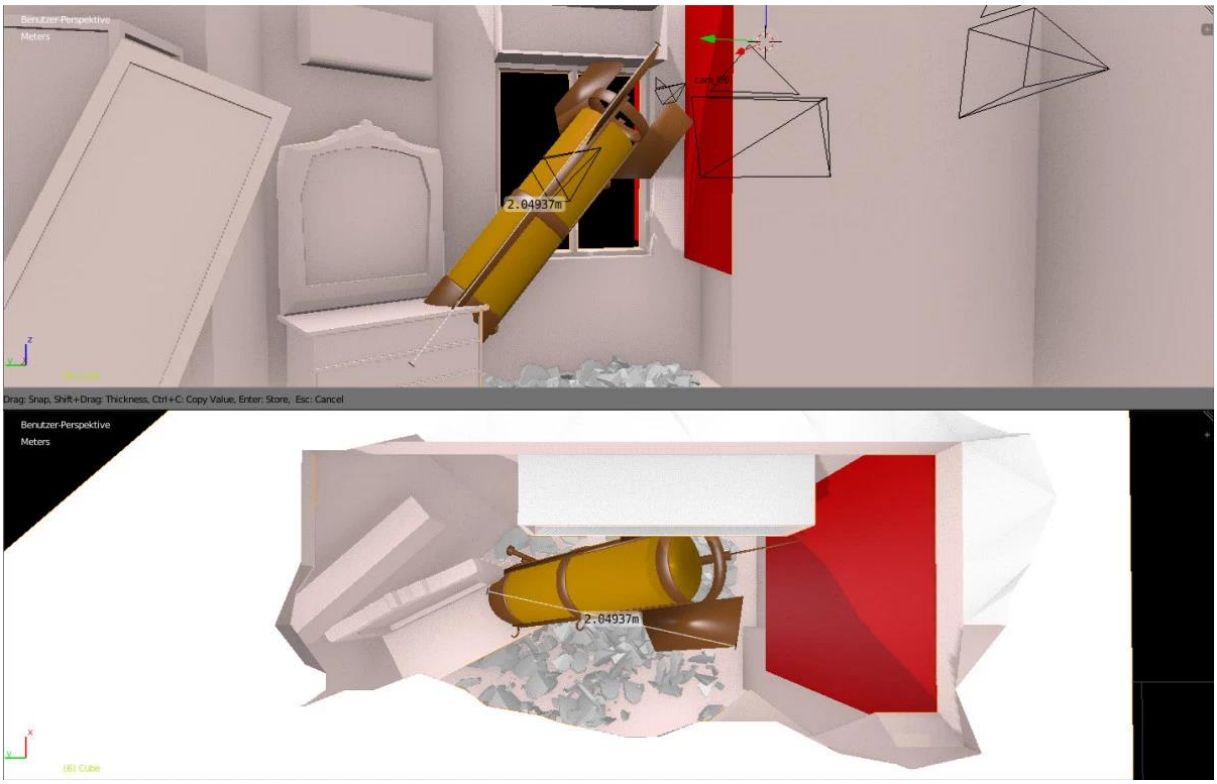
As long as the valve can pass the opposite edge of the hole that long the fins are sticking in the wall

The correct position of the shaft makes it even more “impossible” to pass the hole. The fins would have had to tear this shaft open along its entire length to prevent an impact on the valve.

But even if the valve had somehow survived the lateral impact on the concrete without being sheared off, even if the cylinder had rotated to pass the edge of the hole with the fins first and then the shaft, in the Forensic Architecture model it would next have been driven into the box above the window and then into the chest of drawers.


Benutzer-Perspektive
Meters
Objektmodus
Normalen
Entferntester
Benutzer-Perspektive
Meters
(0) Würfel

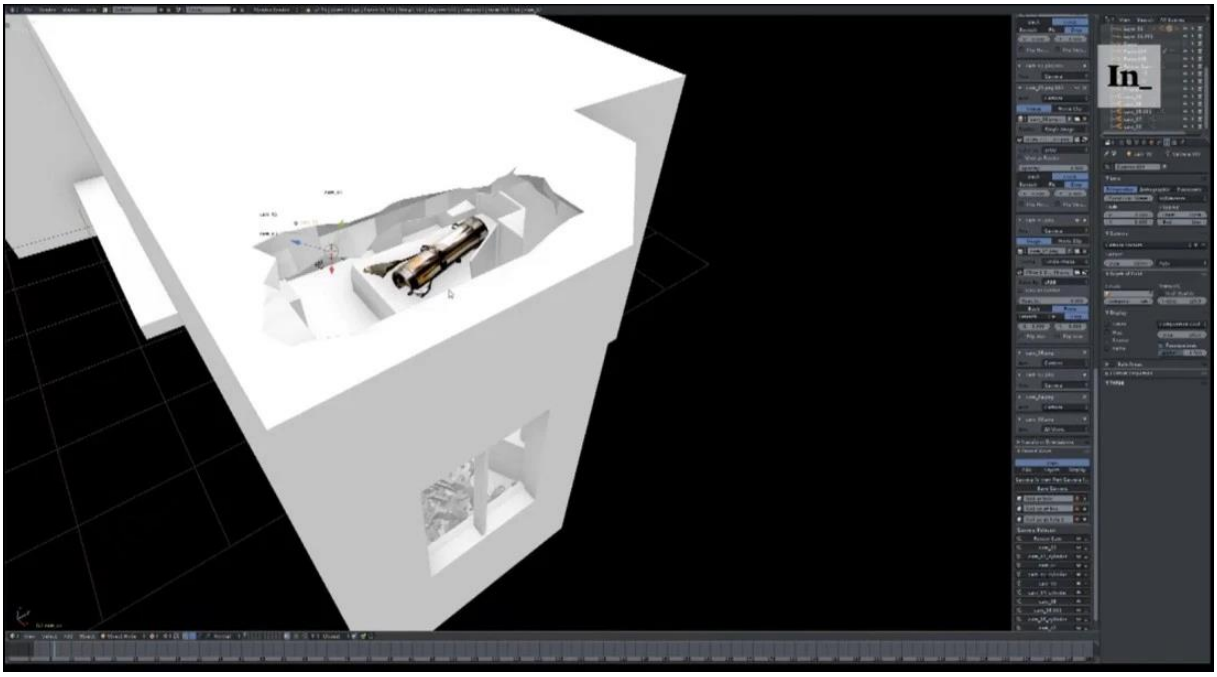

Benutzer-Perspektive
Meters
Objektmodus
Normalen
Entferntester
Benutzer-Perspektive
Meters
(0) Zylinder.000



Vertical fall rotated to pass the hole (Room model by Forensic Architecture with added shaft [red])

An unbiased forensic investigator would probably rule out the possibility of falling through this hole. Considering the intact valve, I think this case can be completely ruled out.

In this context, the misleading play with size and perspective, which makes the cylinder tiny and the bed reachable on a straight trajectory (due to a missing wall of about 1.80 meters in height), can only be described as wanton misleading. And that's the diametral opposite of "forensic" analysis.



Snapshot from the Forensic Architecture video published by The Intercept and Forensic Architectur

The gradually melting cylinder

Malachy Browne (New York Times) and Forensic Architecture claim to have studied the bomb in detail, using their model to detect a gradual melting of the ice layer on the cylinder. The timing of the melting is consistent, and so it is now believed, Malachy Browne wrote on Twitter, that the bomb was actually dropped on April 7. Forensic Architecture gave it the first “like”.



https://twitter.com/malachybrowne/status/1012068614457954306

The OPCW/FFM report describes the same white deposit on the cylinder as “white powder”. So it’s worth taking a closer look, because white powder can’t melt gradually .

Observed changes to the scene

The team observed some differences in the state and content, as well as location of certain items in the room, when referenced to open source videos released shortly after the alleged event. The observed changes are listed below:

- The cylinder appears to have been cleaned. The layer of a white powder seen in the videos was not present when the FFM team visited the location.

OPCW/FFM report S/1731/2019 Annex 7, page 63

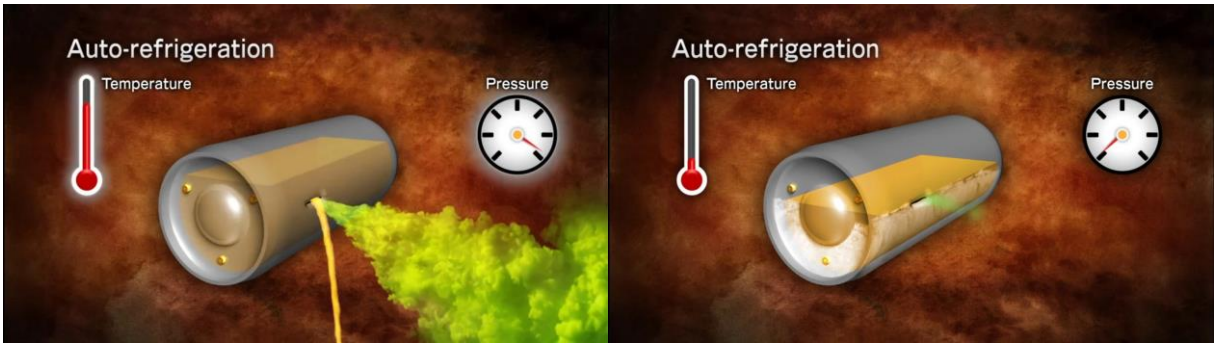
Malachy Browne also tweeted a link to a YouTube video of the Chlorine Institute, in which the process of auto-refrigeration is vividly explained.

The two main stages are

1) escape of liquid chlorine above the damage to the canister under pressure
2) boiling of the chlorine remaining in the canister below a damage, whereby the boiling chlorine

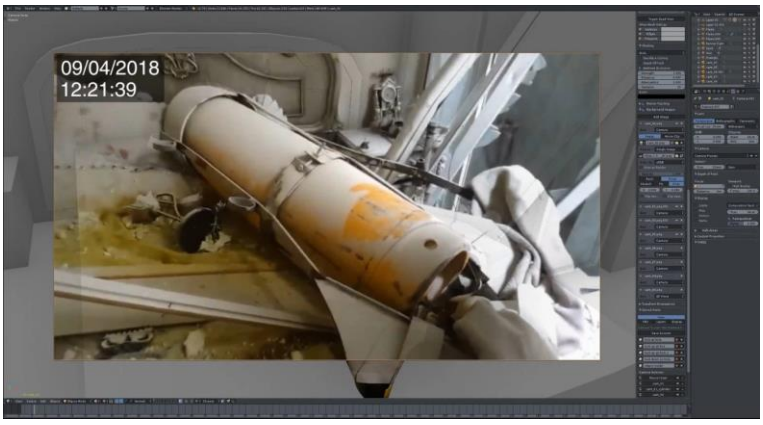
withdraws the necessary thermal energy for evaporation from the environment. The condensate on the surface of the canister freezes to the level of the remaining liquid chlorine inside the canister. The gas above the level of the fluid does not consume much heat from the environment so that the canister **does not freeze above that level**.

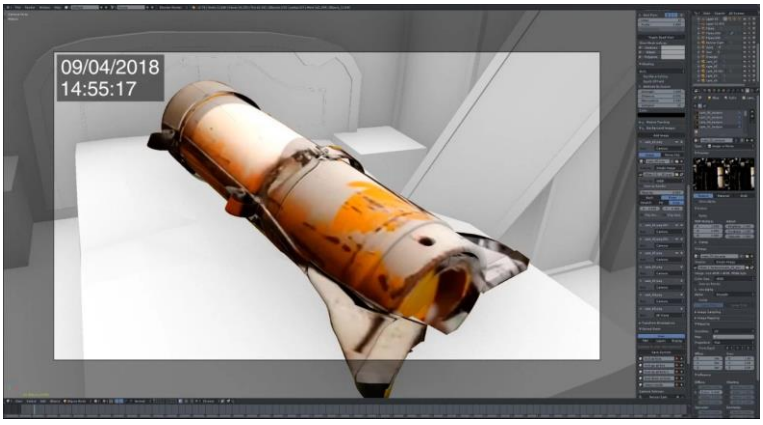
Logically, the first stage is very fast as the pressure in the canister pushes the liquid chlorine out of the opening and the heat required for evaporation is consumed from the atmosphere outside the canister. The second stage can take considerably longer, especially as it is additionally slowed down by a layer of ice.

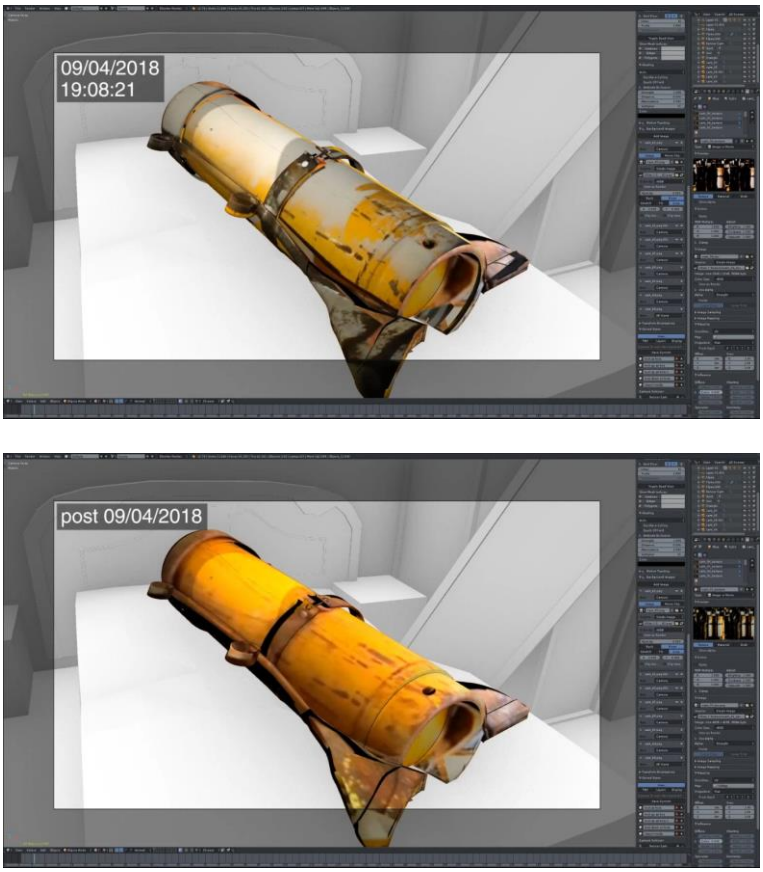


https://youtu.be/1A41PEGUXYg?t=35

In their video Forensic Architecture presents the following timeline for the gradual melting of the cylinder:

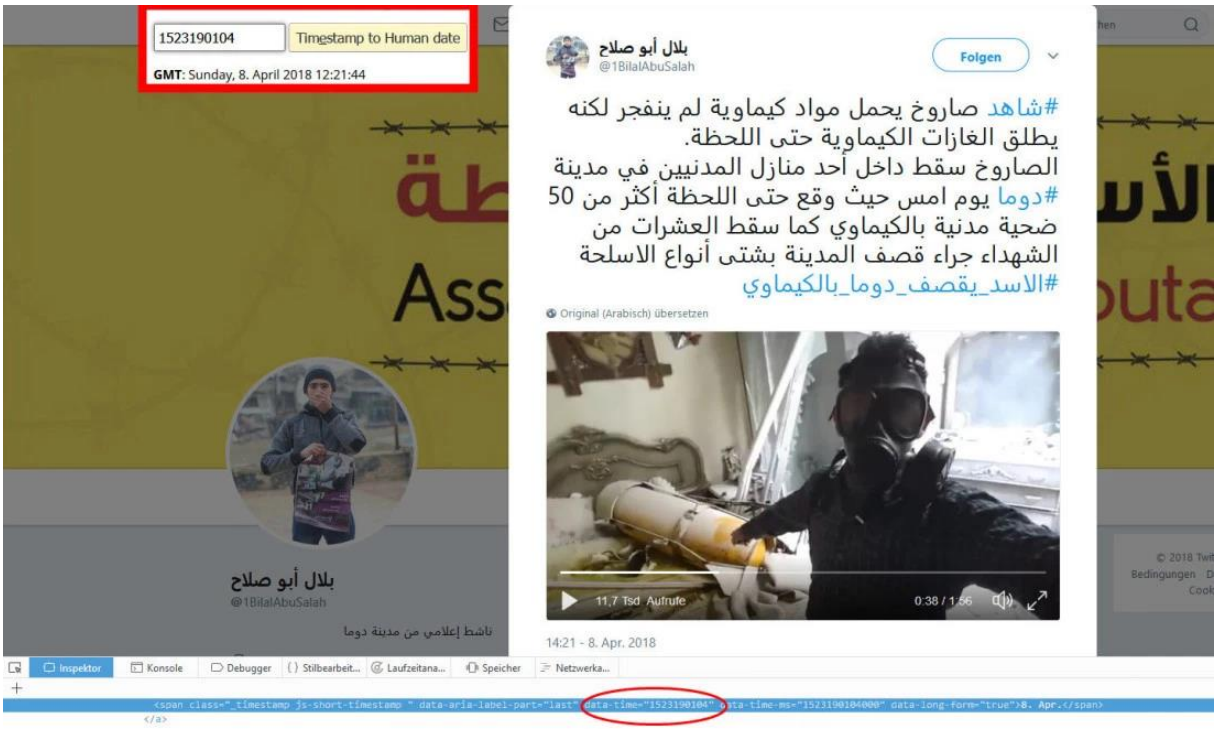




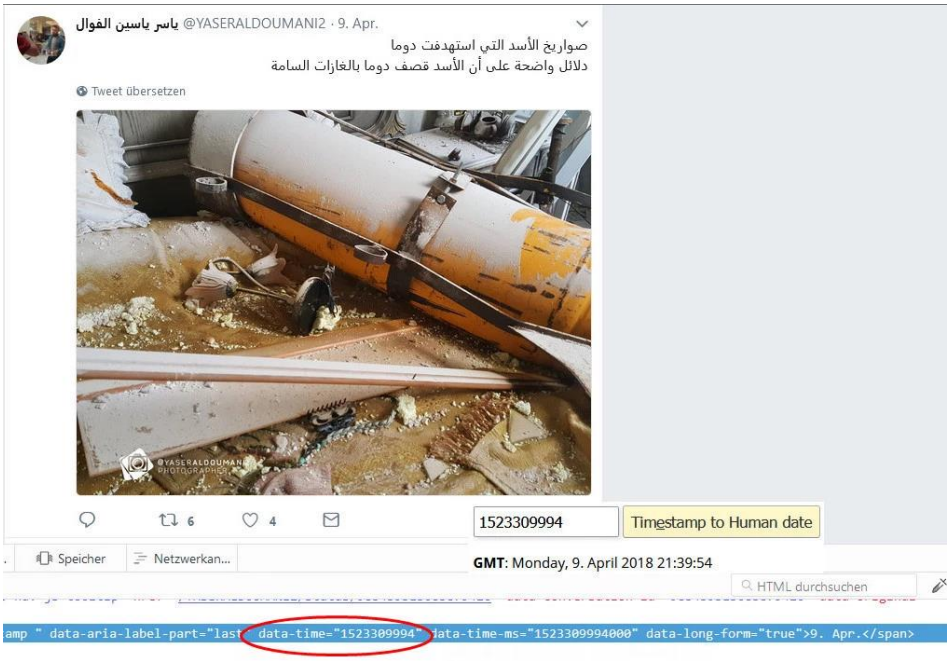


compiled timeline of the NYT/FA "gradually melting" claim

The first picture, however, undoubtedly comes from the video by Bilal Abu Salah and was taken in the morning or noon of 8 April – 24 hours earlier. At 12:21 GMT (15:21 local time) Abu Salah uploaded the video to Twitter. So, the time stamp of Forensic Architecture is the upload time (as GMT) but one day off.

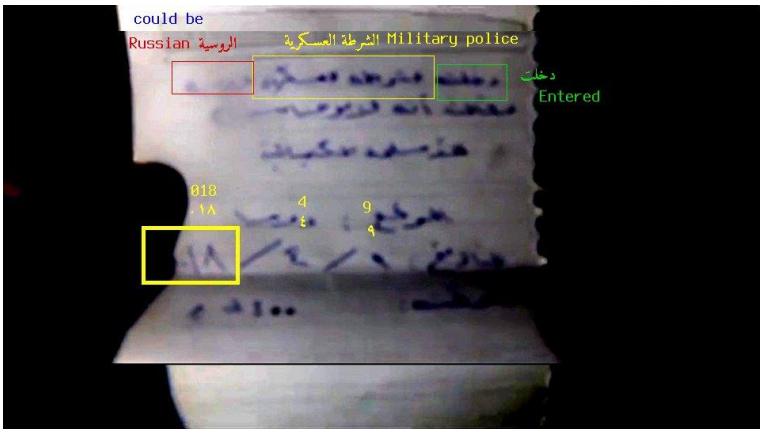


The second image is a screenshot of Al Doumani's video. He and Bilal Abu Salah are friends, both videos were shot in a very similar lighting situation and the style of the two videos is almost identical. However, Al Doumani released his video on the Baladi-News Channel at 06:52 GMT and on Facebook at 13:46 GMT on April 10th. Nothing is known about the exact date of the recording, but a photo of his recordings appeared on Twitter at 21:39 GMT on April 9.





The third image in Forensic Architecture's timeline comes from a previously unreleased video. However, Forensic Architecture shows a part of it in their video. The cameraman of this third video holds a note in the picture with the date of April 9th. If the time 19:08 (Syrian time) is correct, this third video was taken after the visit of the Russian military at "location 2" (OPCW/FFM name for the house full of dead bodies allegedly hit during the same attack). It is not known whether the Russian military also visited the bedroom "location 4" on 9 April and possibly made their own video recordings.



source: https://www.forensic-architecture.org/case/douma-chemical-attacks/
translation: Amin

The last picture of the "defrosted" cylinder was taken by Russian TV Zvezda days later.

Addition: The later published timeline of the median with timecode in the OPCW/FFM report gives the following timeline:

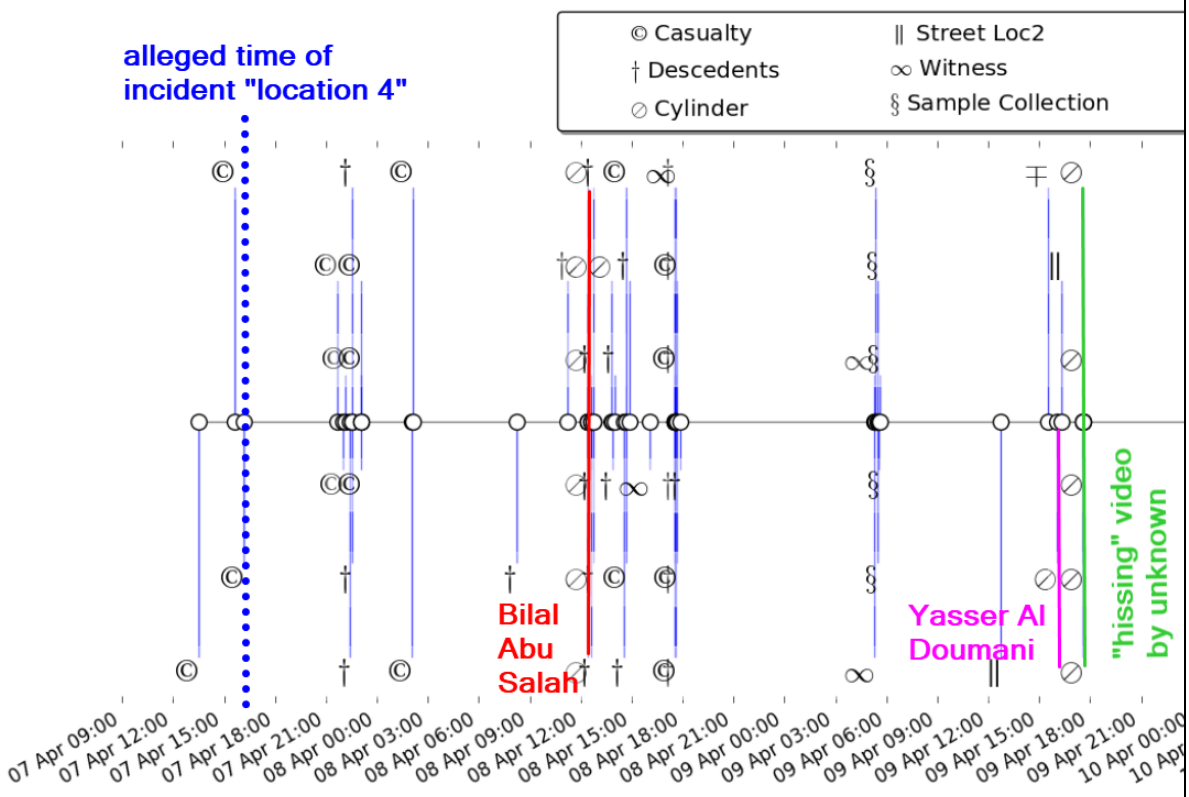


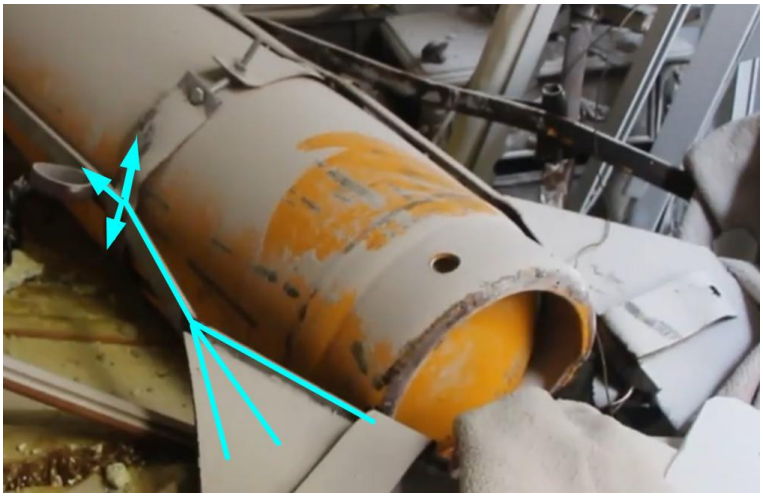
Figure A.11.6 Timeline made with the date of original of the file with

So, the first video was taken about 12 hours after the alleged chemical attack. The third video was recorded 24 hours after the Bilal Abu Salah video and therefore about 36 hours after the alleged bomb attack.



At first it is noticeable that the top side of this cylinder is covered in white, while the underside shows neither condensation nor frost. Since this completely contradicts the physical conditions of auto refrigeration, this fact alone is proof enough that it is not frost, but rather fine white dust. As explained above, stage 1 (escape of the liquid chlorine to the level of the opening) is very fast, so it can be assumed that the cylinder can only be filled up to the level of the damage. And this is also a remarkable point. Nothing is known about the damage. Furthermore, it can be physically ruled out that the fin in

the foreground is completely covered with “frost”, while the heat conduction from this fin to the cylinder and the chlorine has to take awkward paths through the linkage of the harness, which then touches the cylinder only in places that are not frozen.



heat conduction from the white fin to the cylinder

In short, the assertion that the white appearance of the cylinder is the result of auto-refrigeration is absurd. However, there is another very important circumstance to note. The bed in Bilal’s video including the wooden board appears yellow-greenish. The raised headboard of the bed, on the other hand, appears completely white. The impression is that the bed is frozen by auto-refrigeration and a lake of cold chlorine gas rises above the blanket and board.



left: Bilal Abu Salah – noon April 8 right: Yaser Al-Doumani – afternoon April 9

Apart from the dramatic effect of the apparently frozen bed and a layer of yellow-green chlorine gas above the blanket, there is no significant change (e.g. of the dust layer) during the approximately 24 hours that have passed between the two videos of Bilal Abu Salah and Yaser Al-Doumani.

Comparing the first (Abu Salah) and the third (Unknown) video, the harness in the first video appears whitish along the longitudinal struts and on the underside of the front ring. However, these longitudinal struts have no direct contact with the cylinder and the underside of the cylinder is frost-free for the entire period. In this respect it is questionable whether it is a matter of frost or dust and lightning or whether the frosted bed has consumed so much heat from the room that even the harness became frosted.



harness initially appears whitish

So the question is, how is it possible that 12 hours after the alleged attack, obviously a larger amount of probably liquid chlorine could escape from the cylinder?

(If this amount of chlorine had escaped as a gas, the underside of the cylinder would actually have frozen, but the bed would not. In any case, the liquid chlorine above a leak would have been squeezed out long ago during the past 12 hours.)

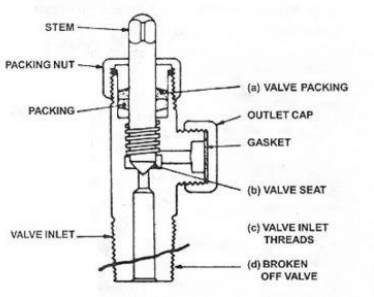
The only plausible explanation for this physical miracle is that the cylinder is **not damaged** and someone opened the valve shortly before the recording of the video started. A continuous leak of liquid chlorine over 12 hours is not impossible with a very tiny hole, but this tiny amount would evaporate immediately upon leakage.

In this case, the liquid chlorine would consume the necessary heat for the transition into the gas phase from the environment of the leak. The environment of the leak can cool down to the boiling point of the chlorine (-34°C / -29°F). It would not freeze the cylinder, but the surroundings of the leak.



the valve on April 8 (Bilal Abu Salah) / the valve days later (TV Zvezda)

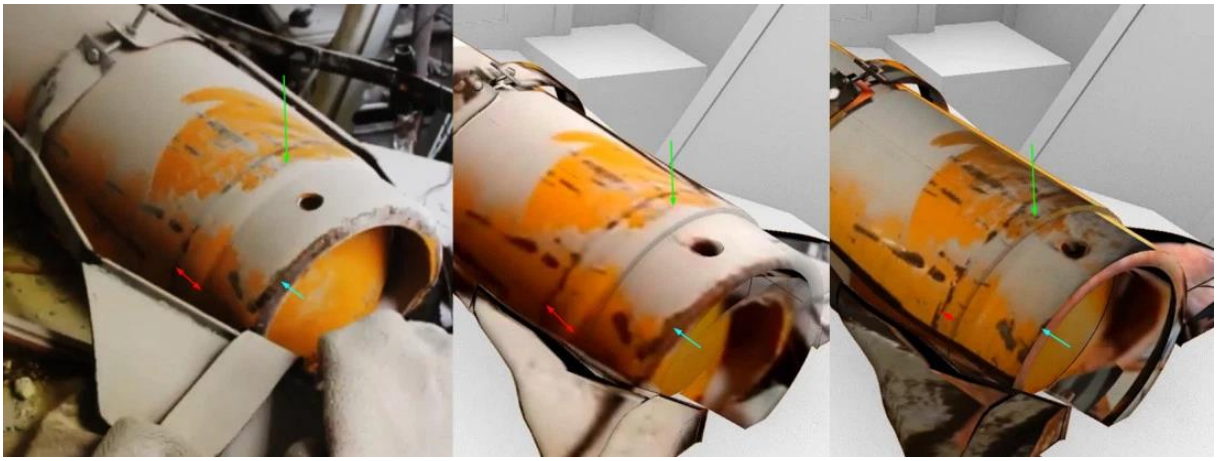
If you look at the screenshot of TV Zvezda there seems to be a tiny leak at the thread of the valve, which releases liquid and/or pressurized chlorine even after days. This means that the cylinder is still under pressure and maybe even filled over the valve. But if one compares the screenshot of Bilal Abu Salah about 12 hours after the alleged gas attack, then the whole valve made of red copper appears white frosted up to the steel socket and the cylinder dome. Although copper is a 7 times better heat conductor than steel, the copper outlet cap is not frosted.



valve with outlet cap

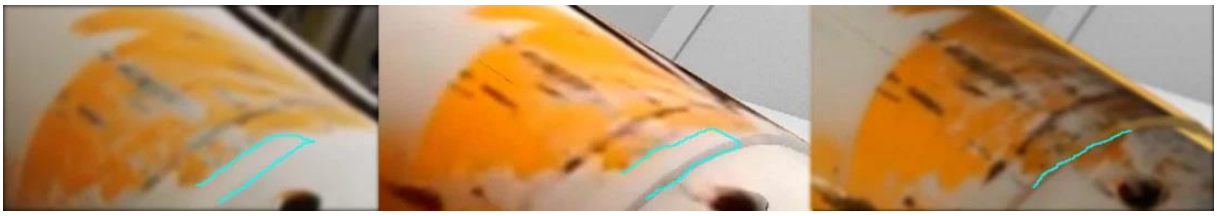
This detail may explain how a tiny leak on the thread of the cylinder – after 12 hours of continuous gas flow – could suddenly release enough liquid chlorine to freeze the blanket and form a lake of concentrated (visible) gas.

With regard to Forensic Architecture's timeline, the following can be said: The three screenshots were taken in different lighting situations with different cameras. While Bilal's video seems slightly overexposed, the video that was taken on the evening of April 9th was shot in low light with the help of a handheld spotlight. In addition, there are traces of mechanical impact around the hole on the lower ring of the cylinder and the texture along the boundary between the lower ring and the cylinder was mapped in different ways onto the 3D model (red arrows). Due to the different mapping, a rust spot (blue arrow) appears wider at the lower edge while a white-covered stripe (green arrow) has practically disappeared into the 3D cylinder. This does not mean, however, that the white material has melted.



different texture mapping but no melting

In the area where someone obviously wiped away the dust before Bilal's video recording, fine traces can be seen. If it were frost, these fine traces would thaw first. 32 hours after the Bilal video, these traces are completely unchanged.

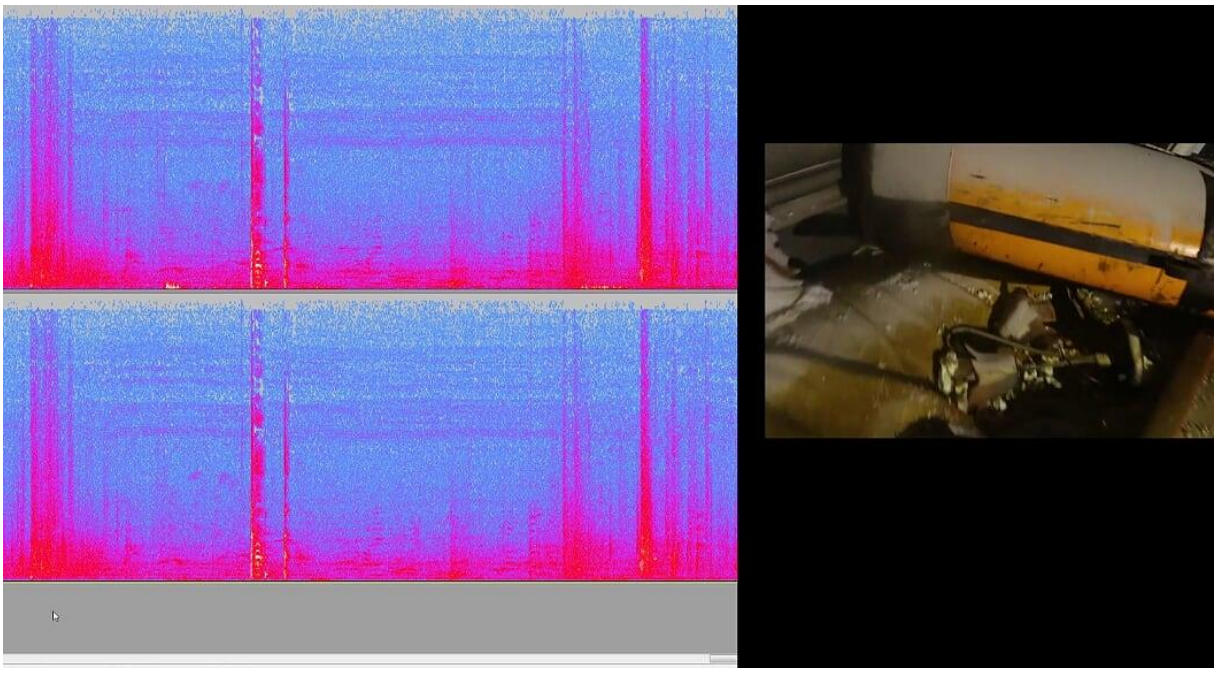


12hrs, 36hrs, 48hrs after the alleged impact – equally blurred
missing area due to mapping error (blue)

Over a period of 48 hours, a color change can actually be observed, especially on the vertical surfaces of the harness linkage. In connection with the other observations explained here, however, it is not possible to trace them back to a “melting”. It could be dust that had settled on the vertical surfaces and fell down over time, e.g. due to vibrations of the bed during various visits.

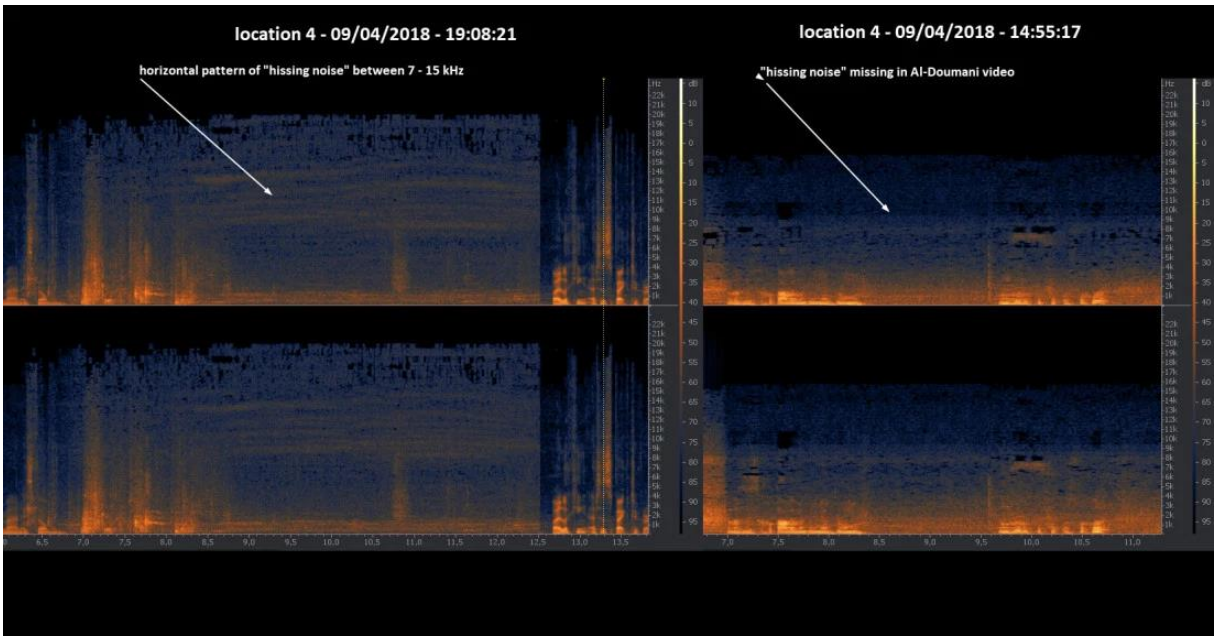
The hissing sound

Towards the end of her presentation video, Forensic Architecture shows an excerpt of that unknown video from the evening of April 9. The highlighted aspect is a hissing sound like gas leaking from a leak or valve. The spectrogram shows the noise as a horizontal pattern.



hissing sound on the evening of April 9 – 48 hours after the alleged attack
source: Forensic Architecture

The sound alone suggests a gas emission that could not possibly last for 48 hours without completely emptying the cylinder. However, Forensic Architecture failed to analyze the soundtrack of Yasser Al-Doumani’s and Bilal Abu Salah’s videos or refrained from showing the spectrograms.

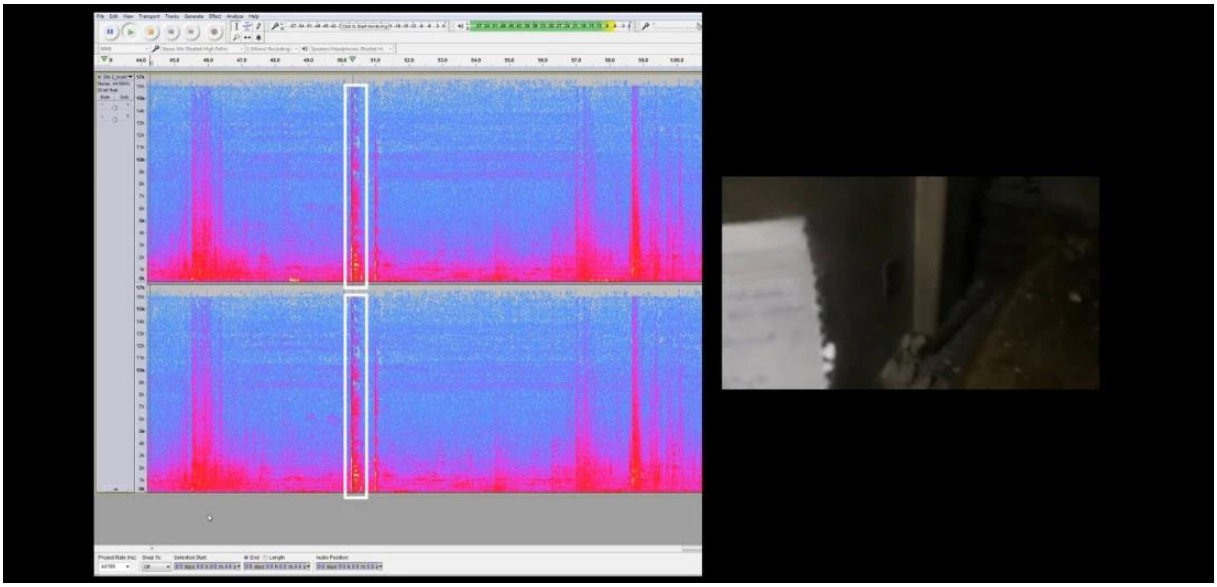


comparison of "hissing noise" video (left) with the earlier Al-Doumani video (right)

In the video of Al-Doumani, which was recorded hours earlier, no comparable noise is detectable, although the sound quality is comparatively good.

In addition, Forensic Architecture explicitly refers to the cough in the soundtrack of the video from the evening of April 9th. The cough is a tower of frequencies that easily reaches 16kHz. The voice of Al-Doumani under his gasmask, as expected, misses all higher frequencies in the spectrum as seen above.

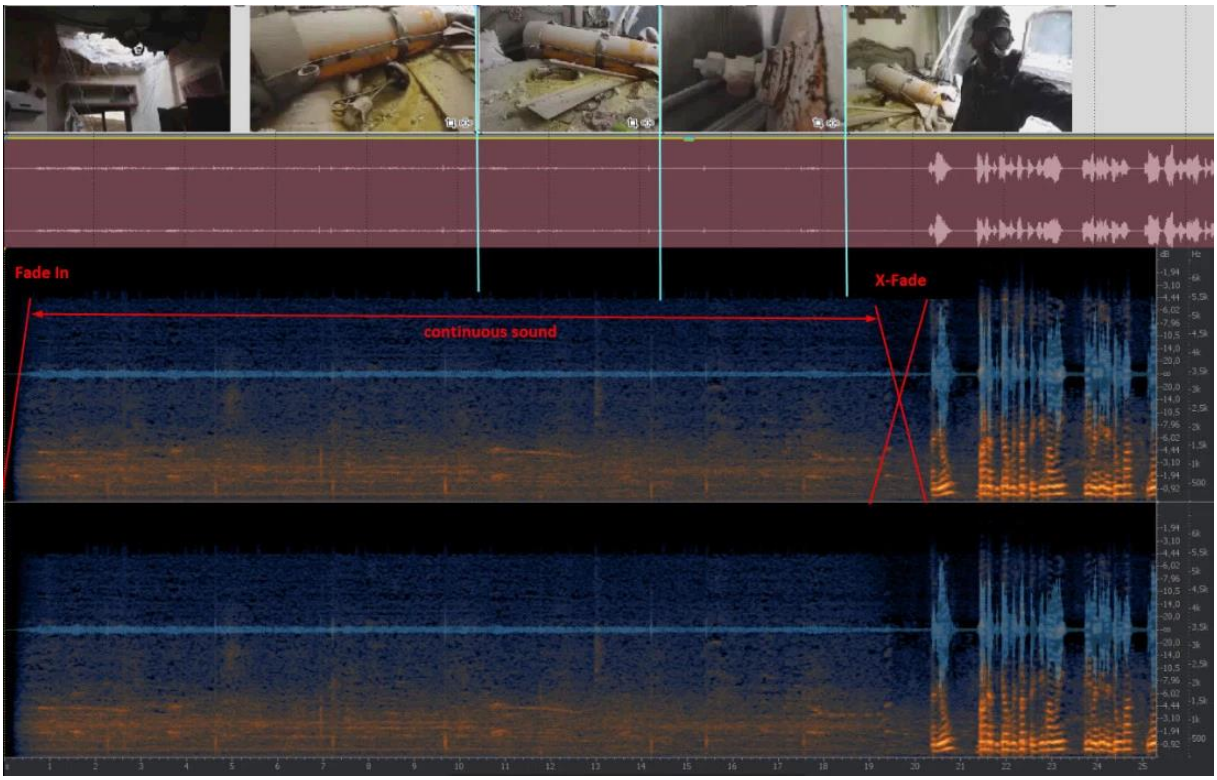
Al-Doumani's gas mask acts like a steep low-pass filter that strongly reduces all frequencies above 3kHz. Above 9kHz practically no frequencies of his voice are recognizable. In other words, the cameraman of the "hissing sound" video and his companion with the spotlight wore no gas masks.



Forensic Architecture highlights the cough

At the beginning of the Bilal Abu Salah video – which was recorded about 32 hours earlier – a noise is detectable for the first seconds. The sound cannot be clearly assigned to the escape of a gas; it could also be an atmospheric noise. What is important, however, is that this noise fades out before Bilal

begins to speak. As long as he speaks no noise is detectable while the noisy sound is not related to the image but was added during the editing / post-production process.



X-faded noise prior to speech
Spectrogram of the Bilal Abu Salah video

The post-production is confirmed by the fact that the beginning of the video was edited from pictures that were shot afterwards. Among these initial images are, for example, a close-up of the valve and a shot of the bed with the cylinder. In order to film the valve, Bilal Abu Salah obviously had to move the pillow. The moved pillow can also be seen in the video of Al-Doumani and the video taken in the evening of April 9th. While Bilal speaks into his camera, the pillow still clamps to the cylinder. This shows that the beginning of the Bilal video was edited from pictures he shot after his speech. The uniform (atmospheric) noise was subsequently put to the video and fades out before his attached speech begins.



edited beginning – moved pillow



speech – initial position of the pillow

In summary, it can be said that the "hissing noise" proven by Forensic Architecture by no means stands for the continuous release of the gas for about 48 hours. The conclusion suggested by Forensic Architecture is therefore wrong. This noise either means that the valve for the recording has been opened or that the sound has been manipulated during the post-production of that video also.

Timeline

- 07/04/2018 – 16:00 – 21:00 – alleged chlorine attack
- 08/04/2018 – 08:00 – 15:00 – Abu Salah records "frozen bed but no noise" video
- 09/04/2018 – 08:00 – 15:00 – Al-Doumani records "no frost and no noise" video
- 09/04/2018 – afternoon – Russian military visits alleged CW sites in Douma
- 09/04/2018 – 19:00 – 20:00 – unknown records "no frost but hissing noise" video

The essential questions that arise from this timeline are:

- Can a bomb about 2 meters long in horizontal position hit a 1.66 meters hole in a concrete ceiling with reinforcing steel without damaging attached fragile parts such as fins and valve?
- Can a nearly horizontal 85kgs chlorine cylinder continuously release liquid chlorine for 12 hours from a leak at the valve level, so that after 12 hours the bed surface and the harness rods are frozen, but the cylinder doesn't even sweat?
- Can the same 12-hour continuous decompression of chlorine from a leak close to the thread of the valve freeze the valve and the threaded steel socket without also freezing the outlet cap?
- Is it possible that the same leak has continuously released gas for 48 hours without making a noise, but after 48 hours starts hissing loudly?
- Which alternative scenario might explain these observations?

Chlorine behavior

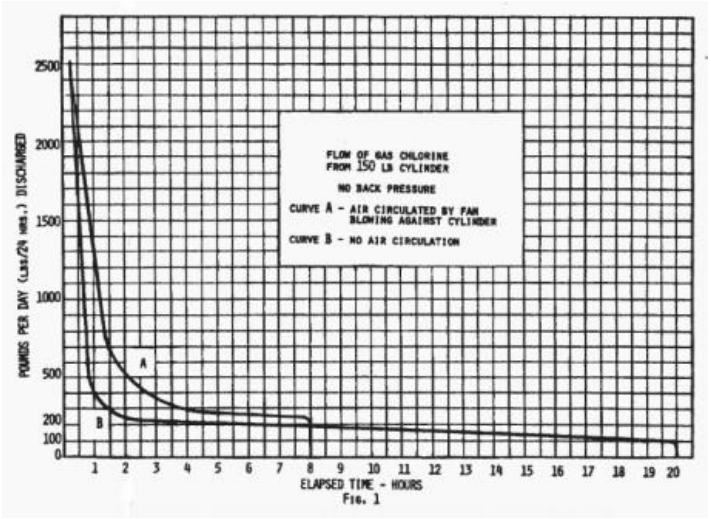
In order to answer the questions raised above, one must first know how chlorine behaves in a cylinder. The two stages of chlorine emission from a leak described above (see Chlorine Institute training video) are directly related to the amount of chlorine that a cylinder can release into the environment.

As mentioned, if the leak is below the liquid level, then liquid chlorine is ejected under pressure, which can happen very quickly depending on the size of the leak.

However, as soon as the liquid level drops below the opening, the gas in the cylinder takes on atmospheric pressure. The remaining fluid chlorine only escapes if it first changes from the liquid to the gaseous state, i.e. boils and evaporates. The fluid cools down to the boiling point and consumes any further heat necessary to vaporize from the environment, which then freezes the container from the bottom up to the level of the liquid in the container. [Note: In order to avoid condensation and freezing of the cylinder, it is necessary to throttle the chlorine withdrawal to about 1.75 lbs/hr (800g/h). At about twice the extraction quantity, the cylinder not only begins to "sweat" but also to freeze inevitably. The boiling point of Chlorine is about -34°C.]



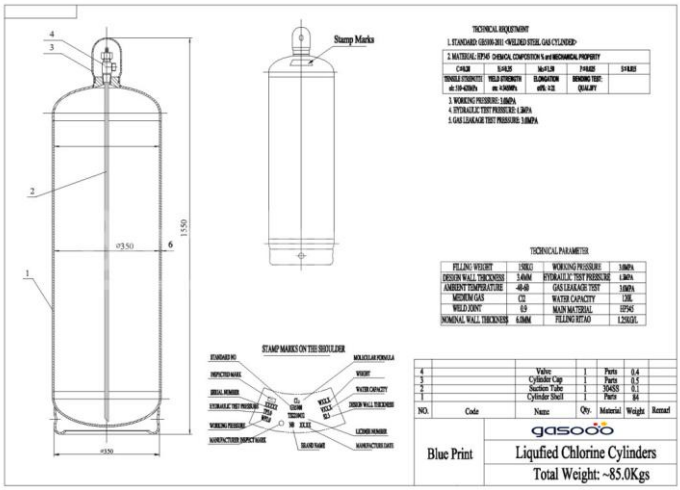
This icing in turn slows down the heat exchange, so that after 1-2 hours an equilibrium between icing and evaporation is achieved. This equilibrium is relatively stable for the next few hours and is around 4kg/hr (slowly decreasing to 2kg/hr after 20 hrs) for a 150lb cylinder. Without ventilation, which prevents the cylinder from sweating, a standing chlorine cylinder with an open valve would need about 20 hours to empty all its contents.



chlorine discharge rate from a 150 lb (68 kg) cylinder, at 70° F (21° C)
source: https://chlorinators.com/wp-content/uploads/2017/01/Bull_5010_Chlorine_Withdrawal_rates.pdf
NOTE: the high release rates during the first 30min are not included

In other words, at no time did more than 1.75 lbs/hr (800g/h) of chlorine escape from the cylinder in the bed (location 4), because from a larger leak the liquid chlorine above the leak would have run off very quickly and after 20 hours (Bilal Abu Salah video) the underside would either be wet from condensate or frozen.

The chlorine cylinders found in Douma are slightly larger. With a height of 1400 mm up to the valve and a diameter of 350 mm these cylinders are offered e.g. by buycylinder.com for a filling quantity of 120ltr.



cylinder size found in Douma

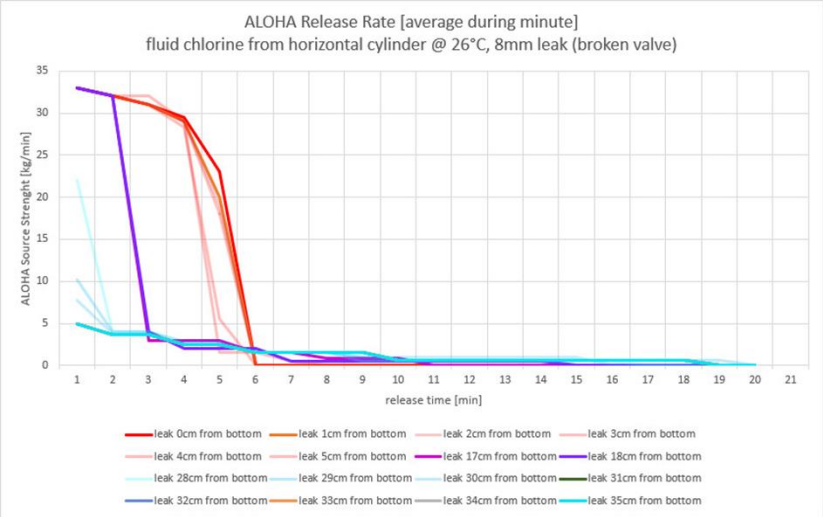
The volume of such a cylinder is 120 ltr [0.12m³].

The liquid density of chlorine at 74°F (23°C) is 1400 kg/m³.[2]

[2] http://www.almsawwa.org

This means that a full cylinder carries 168kg of liquid chlorine and about 90% of the pressurized cylinder is occupied by the liquid.

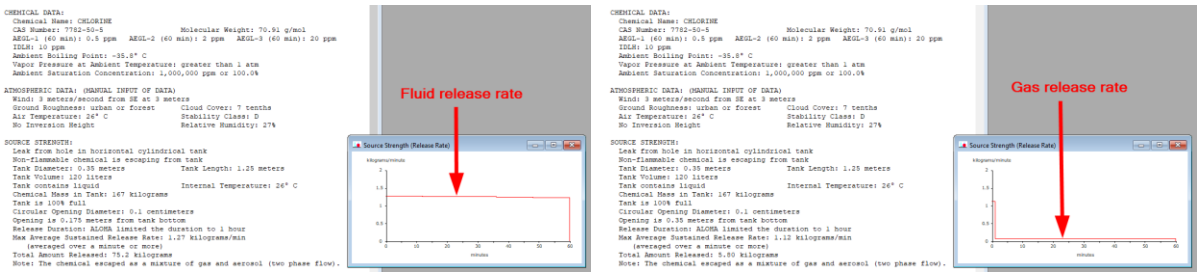
The ALOHA software developed by the Office of Emergency Management (EPA) and the Emergency Response Division (NOAA) for the analysis and evaluation of emergency situations simulates, among other things, the escape of liquid chlorine. The smallest simulable leak is 1mm in diameter.



mapped ALOHA release rates for a horizontal cylinder with a broken valve
NOTE: drop of release rate when fluid level drops below leak level within less than 6 minutes

Case 1mm leak:

In a horizontal position and with a leak at the valve level, there is about 40% liquid chlorine above the valve. This 40% would escape at high pressure and even a 1mm hole allows a release rate of 1.27kg/min. After 132 minutes the liquid above the leak would have completely escaped. The remaining 50% of the volume (~90kg) would have to boil in the cylinder and would escape with approx. 4...2kg/hr.



ALOHA output for the smallest considered leak (1mm): release rates fluid / gas

With a 1mm leak Bilal Abu Salah would come right in time (20 hours after the alleged chlorine attack according to the OPCW media timeline) before the cylinder is completely empty. However, the cylinder would be clearly recognizable as iced up on the entire underside, but it would be impossible for the valve to freeze, because the liquid level would now be well below the tiny leak at valve level. Nevertheless, the valve in the Salah video must be regarded as "frozen" because the white dust would not have settled on the underside.



frozen valve in the Bilal Abu Salah video
NOTE: unfrozen outlet cap from the same reddish material as the valve

The Joule-Thomson effect can also be taken into account. This effect describes the temperature change of a gas with pressure change and is known e.g. from a deodorant spray.

If gaseous chlorine were to escape from a leak, the pressure would drop from the maximum working pressure (~7bar at 25°C) to ambient pressure (~1bar). The Joule-Thomson coefficient for chlorine is μ = 1.35 K/bar. This means that the temperature of the gaseous chlorine would drop by a maximum of 8K to 17°C when it exits the valve, and only until the pressure in the vessel is higher than the external pressure.

Therefore, the inconsistency of the frozen valve is at least from my point of view a strong indication of manipulation, because the valve of an otherwise dry and unfrozen cylinder can only freeze if liquid chlorine withdraws the heat directly from the valve, in order to change from the liquid to the gaseous state.



chlorine cylinder, 8mm leak (broken valve): frozen underside, slow gas release
(right: enhanced for better visibility of the gas flow)

Flash freezing effect

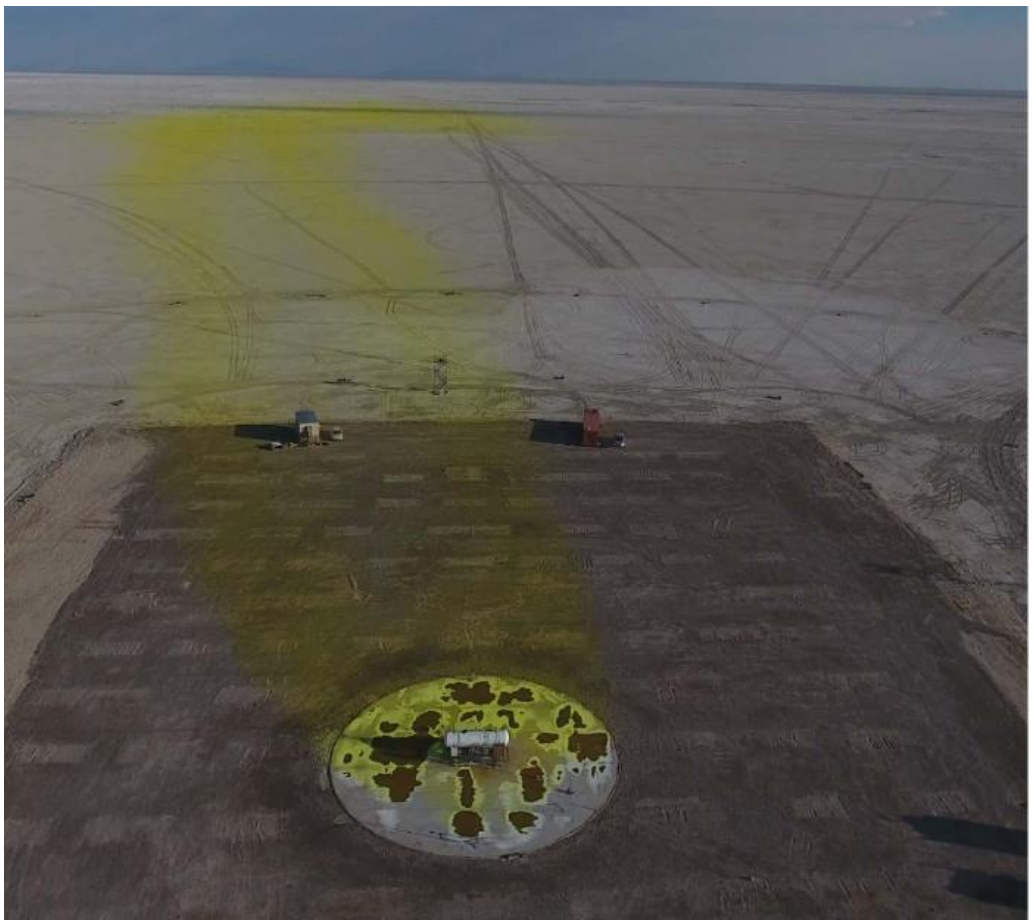
Utah Valley University and the Emergency Services Department undertook a series of tests from 2015 to 2016 called the Jack Rabbit Project II to study Catastrophic Releases of Liquefied Compressed

Chlorine. For this purpose, liquid chlorine was fed into a trough at the U.S. Army Dugway Proving Ground, Utah. One aim of the investigations was to investigate the effect of flash freezing.[3]

Academy in Emmitsburg, Maryland, in 2013. RPT defines the physical change from liquid to gas in the soil which has been impregnated by a liquid release and frozen over by the cooling effect of a decompressing gas as its volume expands. The liquid then transitions to a gas under the frozen surface of soil and liquid product until the pressure builds and is then rapidly released. This phenomenon was only seen in JR 2010. See Figure 47.

They describe the effect as follows:

One notable reaction exception was Release 5, 2015, when witness board #10 was exposed to liquid chlorine directly from the release. The board was located ~15m from the release point. Cameras captured a cold, vaporous green cloud enveloping the board and subsequent liquid on the board which continued to boil off as the surrounding area was covered in frosty layers of ice. The only result was that heavy hydrocarbons dissolved and metals were corroded to a higher degree than exposure to gas only. See Figure 49.



frozen ground and chlorine gas at the U.S. Army Dugway Proving Ground, Utah

This effect would be a plausible explanation (maybe the only one) for the dramatic color change of the blanket, which obviously has a slightly brown color with woven patterns. In the Bilal Abu Salah video,

[3] https://www.uvu.edu/esa/jackrabbit/docs/jrii17/finalreports/uvu-jack-rabbit-final-report-2017.pdf

however, this blanket appears covered by a white layer that only hints at the actual woven pattern below. Yellow chlorine gas floats above the blanket and filters the color appearance of wood blanket and anything under that gas layer.

The apparently frozen blanket, the gas layer and the iced valve (without an iced outlet cap) are evidence that corroborate each other and from my point of view only allow the following conclusions:

1) 20 hours after the alleged attack is the cylinder still filled with liquid chlorine up to the alleged leak (valve level). The cylinder is undamaged.

2) Shortly before the video was shot by Bilal Abu Salah, someone unscrewed the outlet cap and let liquid chlorine flow onto the blanket. The blanket in the video is covered with a layer of frost, which is due to the effect of "flash freezing" described above.

The following alternative explanations were excluded:

a) The white appearance of the blanket is not due to dust, as it was impossible to sweep the ceiling off after the video. All other small particles such as Styrofoam flakes and debris remained unchanged in their position. When sweeping the blanket, these particles would also have been swept away.



Bilal Abu Salah video
NOTE: The coloring of the head part above the table lamp is uniformly white. The pattern of the blanket is hardly recognizable.



Yasser Al-Doumani video (24hrs later)
NOTE: The coloring of the head part above the table lamp shows a clear color difference between white dust and brown blanket. The pattern of the blanket is clearly visible. The position of the Styrofoam flakes is unchanged.

b) The white appearance of the ceiling is not due to overexposure, a wrong white balance of the camera or a defect of the camera. All these parameters would affect the entire image content or would move with the camera movement, which is not the case.
Note: The yellow coloring is visible in the Salah video up to the lower part of the wooden board, which shows the expected wood coloring in the Al-Doumani video 24 hours later.

c) The original color of the blanket was not white and later changed to brown due to chemical exposure. The fact that the blanket in the Yasser Al-Doumani video and photo one day later shows the pattern in a much more differentiated way without appearing stained speaks against the 'white blanket' theory. The original color is also confirmed by photos and videos days later, which show a uniform brown color right into the corners.



Russia1 video (days later):
NOTE: The blanket has yellow spots, but the brown color is uniform all the way to the edges. In the foreground, the woven pattern is clearly visible in the various shades of brown.

A possible but ignored hint

The previously unpublished video by an unknown author shows views of the room, which are not to be seen in the known videos.





video taken by unknown | source: Forensic Architecture
NOTE: amount of debris and dust on the cabinet



video taken by unknown | source: Forensic Architecture
NOTE: missing dust on all up-facing areas e.g. in the window frame

As in location 2 (OPCW/FFM) a plastic package is lying on the floor and the curtains are torn down. While the cylinder is wrapped in a white layer of dust, there is no visible dust on the plastic package – as in location 2. Neither has dust settled on the torn down curtains – as in location 2. However, the question arises how this cylinder could fall through the hole in the ceiling without damaging the box above the window, but at the same time tearing down the curtains.

The cylinder would not only have to perform the trick through the hole, but also to bounce to the window first, tear down the curtain, push against the cabinet, get caught in a blanket with its fins, to

finally land on the bed and cover its fins with the blanket. And all this has to happen before the dust settles in the room – except on the curtains and the plastic package.

A much simpler explanation is that the cylinder was placed on the bed, an existing hole was manually widened, then the curtains were torn down, the plastic package was thrown to the ground, chlorine was released from the valve, and a video was shot. The similarity of details might be a hint for the same crew preparing both scenes in location 4 and location 2.



location 2: similar appearance
NOTE: no dust settled on fallen curtains and plasic package