



wind tunnel bulletin

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Impressum

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p. 94: Ahmed Bluff Body: https://qph.is.quoracdn.net/main-qimg-8f1864da6d51aea4142cd1385496682a?convert_to_webp=true, 19.05.2016.

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wind tunnel bulletin n° 05, june 2016

This fifth issue of the Wind Tunnel Bulletin marks the end of the research project *Size Matters: On Scale and Size of Models* that was financed by the Swiss National Science Foundation (SNSF) from 2013 to 2016. Our application for an extension was put down by the SNSF. We assume that our ideas were too airy and we like that – a certain airiness. It is the basis of our project: an invisible wind that returns to itself having its open test-section precisely there.

Our frontispiece for this issue is the Ouroboros, the self-eating serpent (pp. 84–85). The Ouroboros stands for constant regeneration and cyclical return. While some things end, like projects (pp. 86–87), some arise, like *The Inflatable Wind Tunnel* (pp. 88–89), that Kaspar König and Florian Dombois developed, and some stay the same, like wind tunnels in general. A wind tunnel is a place and instrument that hasn't changed much in the past 100 years and as such is a rare example in the history of science. This is reason enough to take a closer look at wind tunnels and the working processes in and around them like research groups and calibration objects and rituals (pp. 90–105). As the Ouroboros eats its tail we're finally passing the mic to our faithful friend, our own wind tunnel, to let him/her interview us, the Size Matters team (p. 106). Even though it's an end, it's also a beginning. Sooner or later our wind tunnel research projects will have a return and we are faithful that it will again be financed by the SNSF. It demonstrates far too clearly what is at stake when it comes to research at an art school. We know that the questions will return like the little cloud of smoke that you can send into the tunnel and watch coming back.

Auf Wiedersehen!

Haseeb Ahmed, Florian Dombois,
and Sarine Waltenspül



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The symbol of the Ouroboros, a dragon eating its own tail, has been used as early as by the ancient Egyptians and Indians. It stands for self-reflexivity, and we know what that means. Dear reader, come with us.

– «Oh Zarathustra, sagten darauf die Thiere, Solchen, die denken wie wir, tanzen alle Dinge selber: das kommt und reicht sich die Hand und lacht und flieht – und kommt zurück. Alles geht, Alles kommt zurück; ewig rollt das Rad des Seins. Alles stirbt, Alles blüht wieder auf, ewig läuft das Jahr des Seins. Alles bricht, Alles wird neu gefügt; ewig baut sich das gleiche Haus des Seins. Alles scheidet, Alles grüsst sich wieder; ewig bleibt sich treu der Ring des Seins. In jedem Nu beginnt das Sein; um jedes Hier rollt sich die Kugel Dort. Die Mitte ist überall. Krumm ist der Pfad der Ewigkeit.» –

– Oh ihr Schalks-Narren und Drehorgeln! antwortete Zarathustra und lächelte wieder, wie gut wisst ihr, was sich in sieben Tagen erfüllen musste: – und wie jenes Unthier mir in den Schlund kroch und mich würgte! Aber ich biss ihm den Kopf ab und spie ihn weg von mir. Und ihr, – ihr machtet schon ein Leier-Lied daraus? Nun aber liege ich da, müde noch von diesem Beissen und Wegspein, krank noch von der eigenen Erlösung. Und ihr schautet dem Allen zu? Oh meine Thiere, seid auch ihr grausam? Habt ihr meinem grossen Schmerze zuschauen wollen, wie Menschen thun? Der Mensch nämlich ist das grausamste Thier.

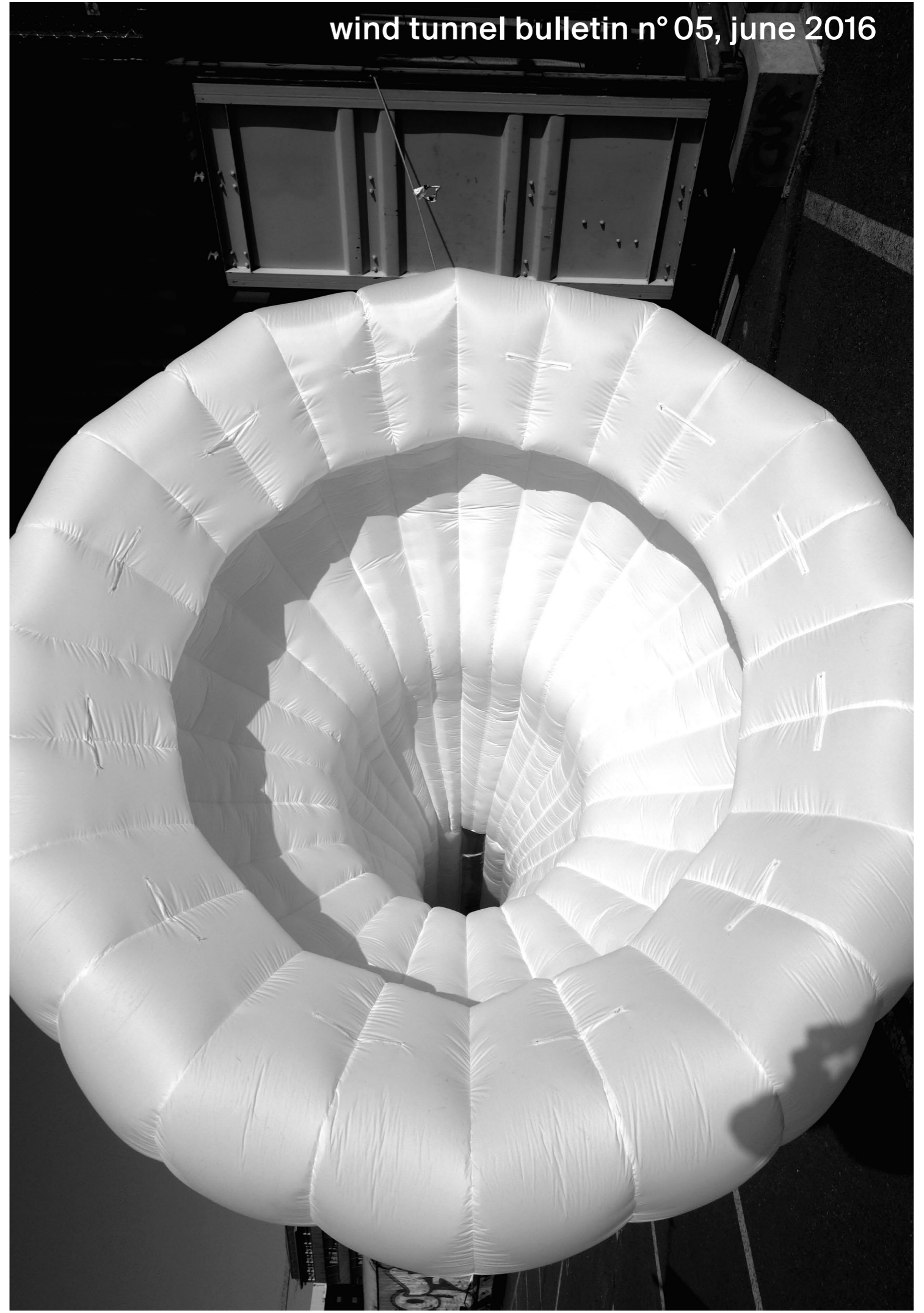
Friedrich Nietzsche, Also sprach Zarathustra. Ein Buch für alle und keinen, dritter Teil (1884)

Théorème I.

Supposons que le point P reste à distance finie, et que le volume $\int dx_1 dx_2 dx_3$ soit un invariant intégral; si l'on considère une région r_0 quelconque, quelque petite que soit cette région, il y aura des trajectoires qui la traversent une infinité de fois.

Henri Poincaré,
Théorème de récurrence (1890)





A wind tunnel never exists as an object for itself. Wind tunnels always test objects within them. Furthermore, there are two other factors framing these tests: on one hand are the people setting them up and on the other, the process of calibrating the wind tunnel and its objects. In the following we've collected wind tunnels, research groups, and calibration objects and rituals that tune both an experimenter and the experiment to the world that they wish to observe in a test-section of a wind tunnel.

Parts of the collection of the wind tunnel calibration objects and rituals are historical while others are still used by the fluid dynamics engineering community, still others are from members of the Size Matters research team. In research calibration is key. Calibration ensures that an instrument is measuring the phenomena observed and not merely its own body. It ensures that the representation is bound to reality and that this reality is being created in accordance with its representation. The ritual of calibration tunes the senses, the test objects, the apparatus and the infrastructure it represents, and a body of knowledge to one another.

There are many different experiments possible in the wind tunnel. But there are also many different wind tunnels. For example the von Karman Institute for Fluid Dynamics has over 50 wind and water tunnels. Often a new experiment requires a new wind tunnel design, varying with the scale of the test object, the speed of the wind etc. In this issue we present a selection of personal favorites.

Last but not least, there is one more parameter in wind tunnel experiments: the research group. The collection of interviews with leading wind tunnel scientific research groups in Europe shows the practices of wind tunnel work and its ritual parameters like the camera's role in observing an experiment and analogies of scientific facilities to the animal kingdom.

Haseeb Ahmed, Florian Dombois,
and Sarine Waltenspül

Untitled (2016)

Ritual Object or Ritual:
Ritual

My calibration ritual is to imagine the inside space of the wind tunnel.

My calibration ritual is to imagine the wind in this.

My calibration ritual is to watch the test-section and all its invisibilities.

Florian Dombois
2016

Piano Wind Tuning (2015-16)

Ritual Object or Ritual:
Both

My personal calibration object is a «prepared» piano without keyboard and front panels. By placing this piano in front of the wind tunnel nozzle the wind slowly vibrates the strings and a sound evolves slowly. Calibration can take up to three minutes before a sound appears. I am literally tuning into the wind. I am sensing differences when I change wind speed or the angle of the piano towards the wind. Observing and listening to a soundscape depends on the air and resonance of the individual strings. In this way, the calibration-sound is a type of acoustic «weather forecast» for the tests to come.

Kaspar König
2016



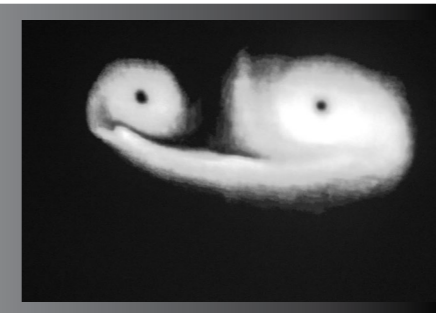
Meeting the Face of the Wind (2016)

Ritual Object or Ritual:
Both

Before beginning a wind tunnel test I confer with the face of the wind by conjuring him up in the wind tunnel. I know the wind is male because it can fertilize wind eggs.

I conjure up the face of the wind by performing a flow visualization with a delta wing, incense smoke, and a laser wall. As the smoke is carried by the wind over the delta wing model in the wind tunnel test-section, a 3D turbulence pattern is made. Projecting a 2D laser wall through this pattern reveals the wind face.

Haseeb Ahmed
2016



Tuft Wand (early 20th century-present)

Ritual Object or Ritual:
Both

I probe the flow of the wind in a wind tunnel test-section with a wand that has a tuft of yarn attached to the end of it. If the yarn is held parallel to the ground by the wind this means there is little turbulence present in this area. If the yarn acts erratically this means it is placed in an area of high turbulence.

Jeroen van Beeck
2016



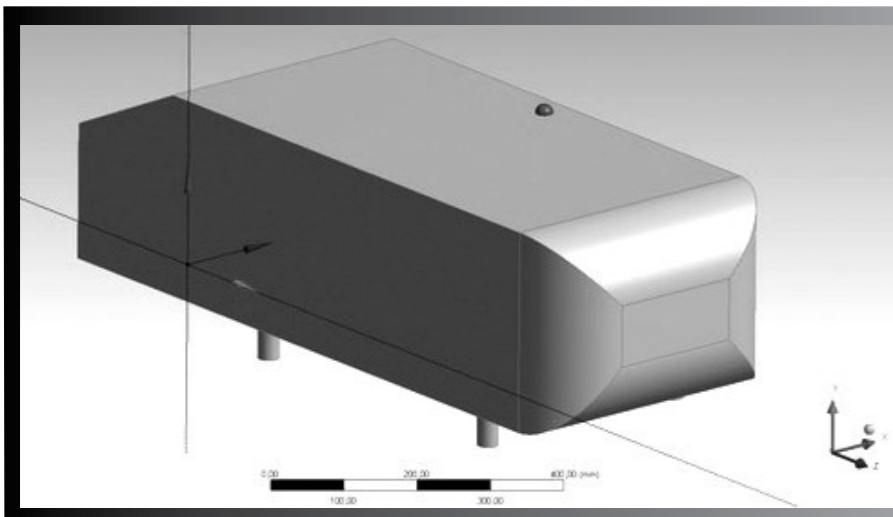
**Ahmed Bluff Body
(1984-present)**

Ritual Object or Ritual:
Ritual Object

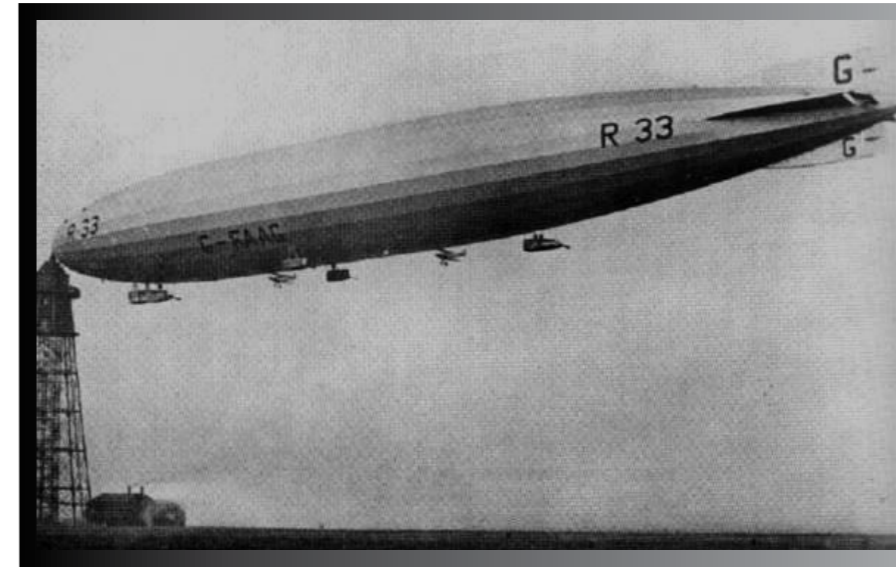
The Ahmed body is a model car originally described by S. R. Ahmed in 1984. Three main features were seen in the wake:

1. The A recirculation region that is formed as the flow separates at the top of the vertical back surface of the model.
2. The B recirculation region that is formed due to the separation at the base of the model.
3. The C-pillar vortices that form as the vorticity in the side boundary layers roll up over the slant edges.

The wake was shown to be highly dependent on slant angles. For slant angles less than 12°, the flow remains attached over the slant. The flow is essentially two-dimensional and has low drag. Between 12° and 30° the flow becomes much more three-dimensional as the C-pillar vortices form. These reach maximum strength at 30°. The drag increases significantly as the low pressure cores act on the rear surfaces. Past 30° the flow separates fully off the slant. This results in a sudden decrease in drag and weaker C-pillar vortices.¹



¹ S.R. Ahmed, G. Ramm, Some Salient Features of the Time-Averaged Ground Vehicle Wake, SAE-Paper 840300, 1984.



R33 (1911-21)

Ritual Object or Ritual:
Ritual Object

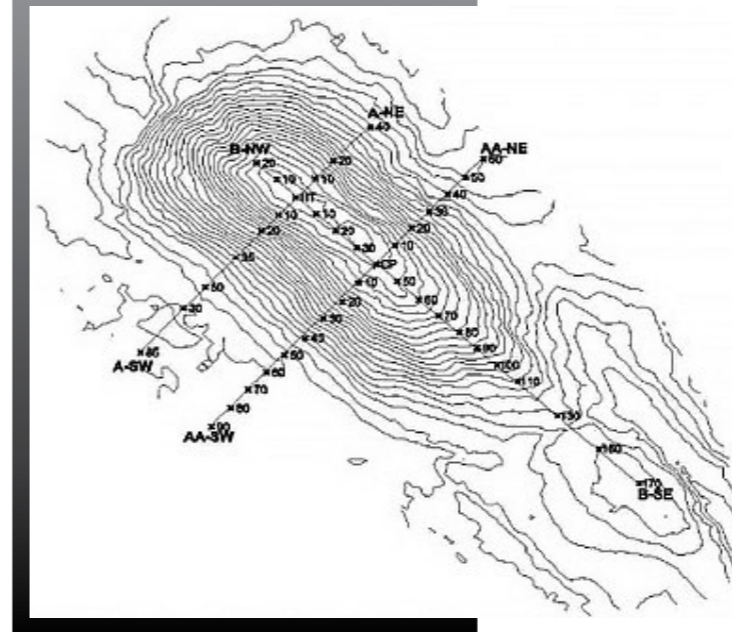
The R33 was the second model of the British National Physics Laboratory tests and is a model airship. The British R33 calibration object had a previous life as the L33 German airship. The massive state-of-art airship had been shot down after an air raid over London in 1916. Its hydrogen exhausted, the German crew was unable to set it alight and it was captured by the British and reverse-engineered.

Germany was not included in the international tests. Spreading a guarded German design to each of the Allied countries ensured their absence. The denial of Ludwig Prandtl's *Boundary Layer Theory* also ensured a fundamental flaw in these tests.

**Origin-Atmospheric
Service of Canada:
Askervein Hill (1997)**

Ritual Object or Ritual:
Ritual Object

Askervein Hill is a standard object originally created as an experimental study for the placement of wind energy farms in coastal regions. Due to its complete topographical mapping it has since become a standard calibration object for wind tunnels themselves around the world.



Jan Carmeliet, Building Physics, Eidgenössische Technische Hochschule (ETH) / Eidgenössische Materialprüfungs- und Forschungsanstalt (Empa), Zurich, Switzerland

1

Please give a short description of the group, i.e. institution name, size of group, head of group/or head of wind tunnel facilities.

We have a large atmospheric boundary layer wind tunnel and water tunnels that have been newly installed in the first weeks of January 2016. The tunnels are used by the urban microclimate group of the Laboratory of Multiscale Studies in Building Physics at Empa and by the Chair of Building Physics at ETH, Zurich. The head of the group is Prof. Jan Carmeliet. Two to three PhD students and about two postdocs/scientists use the tunnels. Also, ETH students from other groups use our tunnels for projects and their master's thesis.

The wind and water tunnels are used to study the physical processes related to urban microclimates and heat island effect in order to evaluate comfort and health conditions in cities, especially during heat waves that are expected to increase due to climate change. The experiments are conducted at different scales ranging from the scale of individual buildings to the scale of a city. To better understand the observed physical mechanisms, numerical simulations accompany these experiments. The final aim of the work is to formulate possible mitigation measures for urban heat island effects and climate change.

Please give a short description of your wind tunnel, i.e. type, size, name, specialties.

Both tunnels are mainly used to study the wind flows around buildings and in urban areas. The wind tunnel is an atmospheric boundary layer wind tunnel. It can be used in a closed or open circuit mode. The test-section is 1.9 meters wide and 1.3 meters high. The total length of the tunnel is 26 meters. It is equipped with a time-resolved stereoscopic particle imaging velocimetry (PIV) system. It has a speed range of about 0.5–25 meters per second.

Our water tunnel is an atmospheric boundary layer water tunnel. The test-section is 1 meter wide and 0.6 meters high. The total volume of the water tunnel is about 20 meters. It is also equipped with a time-resolved stereoscopic particle imaging velocimetry (PIV) system and a laser induced fluorescence (LIF) measurement system. The LIF system is used to measure temperatures and concentrations. The maximum speed is about 1.3 meters per second.

How many hours does your wind tunnel run during a working week? How many test sessions?

A test session usually takes 2–3 weeks. Most of this time is used for the installation of the models and the adjustment and calibration of the measurement system. A single measurement (of a test session) usually takes only a few minutes. Therefore the tunnels only run a few hours a week. Post-processing of the experimental results takes several hours to days, while the analysis of these results can take upwards of weeks and months.

What do you use for calibration?

For PIV the flow is seeded with small particles. A laser light sheet illuminates the particles in one plane and cameras take images of these particles. The velocities are determined by identifying how far the particles moved between two images taken with a known time difference between each image. To determine the velocity of the particle it must be known how far the particle moved in the tunnel. For instance, if they moved one pixel in the images taken with the cameras a calibration is needed to determine this magnification factor. To calibrate images are taken of a calibration plate featuring dots separated by a known distance.

We did wind and acoustic measurements at the same time to evaluate the impact of wind on sound propagation in an urban environment.

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Was there a special «ritual» conducted at the inauguration and first use of your tunnel?

No, we had an opening of the wind tunnel, with speeches and scientific lectures, followed by a reception.

What cameras do you use for experiments?

For the PIV measurements we use special CMOS and sCMOS cameras. These are very fast cameras that can take two images within very short time.

What was the strangest, most special set up, phenomenon, or situation you have tried to model in your wind tunnel?

We did wind and acoustic measurements at the same time to evaluate the impact of wind on sound propagation in an urban environment. The measurements were partly successful, since the main problem we encountered was reflections of sound from the wind tunnel walls themselves. We could not sufficiently solve these reflections by the placement of materials for acoustic absorption.

If your tunnel would be an animal, which one would it be?

Wind tunnel: Swallow
Water tunnel: Beluga whale

Kai Steffen, Focke Windkanal, Bremen, Germany

2

Please give a short description of the group, i.e. institution name, size of group, head of group/or head of wind tunnel facilities.

Der Name der Gruppe ist Focke-Windkanal e.V. Wir haben in etwa 20 Mitglieder, von denen 5 aktiv im Windkanal mithelfen. Vorstand des Fördervereins und der technischen Einrichtung ist Dr.-Ing. Kai Steffen

Please give a short description of your wind tunnel, i.e. type, size, name, specialties.

Es handelt sich um einen Windkanal Göttinger Bauart mit einem Messquerschnitt von 2 x 1 Meter bei einer maximalen Geschwindigkeit von 12 m/s. Der Querschnitt kann auf 1.2 x 1m verkleinert werden. Die Windgeschwindigkeit erhöht sich dann auf etwa 17 m/s. Der Windkanal steht unter Denkmalschutz, besteht vollständig aus Holz und wurde von dem Luftfahrtpionier Henrich Focke erbaut.

How many hours does your wind tunnel run during a working week? How many test sessions?

Der Windkanal läuft etwa 1 Stunde pro Woche und hat 0,25 Test-Session in dieser Zeit. Oder anders ausgedrückt: Der Windkanal läuft etwa 4 Stunden im Monat und hat 3 Test-Sessions pro Jahr.

What do you use for calibration?

Zum Kalibrieren wird eine computergesteuerte 3D Messeinrichtung mit einer 6-Kanal Druckmessanlage genutzt.

Was there a special «ritual» conducted at the inauguration and first use of your tunnel?

Das wissen wir leider nicht so genau, da 1963 bei der Eröffnung noch niemand von uns geboren war. Es ist überliefert, dass alle wichtigen deutschen Aerodynamiker bei der Eröffnung anwesend waren, dass Prof. Focke eine Rede gehalten hat, den Windkanal vorführte und anschließend Kaffee und Butterkuchen reichte.

What cameras do you use for experiments?

Wir verwenden normale Digitalkameras und ansonsten die Geräte, die unsere Kunden für die Messung mitbringen.

An Nikolaustagen nehmen die Engel von Knecht Ruprecht häufig bei uns Flugstunden.

What was the strangest, most special set up, phenomenon, or situation you have tried to model in your wind tunnel?

An Nikolaustagen nehmen die Engel von Knecht Ruprecht häufig bei uns Flugstunden. Sehr spannend war auch die Vermessung einer oloiden Windkraftanlage.

If your tunnel would be an animal, which one would it be?

Eine Schildkröte

Bernd Leitl, Environmental Wind Tunnel Laboratory (EWTL), University of Hamburg, Germany

3

Please give a short description of the group, i.e. institution name, size of group, head of group/or head of wind tunnel facilities.

The Environmental Wind Tunnel Laboratory (EWTL) at Hamburg University is a part of the Meteorological Institute. Together with the MeMi group (Mesoskalige und Mikroskalige Modellierung), EWTL represents the so-called Technical Meteorology, which is a unique feature of geosciences in Hamburg. The head of the group is Bernd Leitl. The size of the group varies typically from five to fifteen group members depending on project funding. Currently, the group is relatively small, consisting of two senior scientists, two PhD students, and four BSc/MSc students.

Please give a short description of your wind tunnel, i.e. type, size, name, specialties.

EWTL operates four wind tunnel facilities. Three of them are dedicated to fluid modeling of atmospheric flow and dispersion phenomena and one is a conventional Göttingen-type industrial wind tunnel. Technical specifications of the tunnels can be summarized briefly as follows: BLASIUS wind tunnel (model scale range 1:500 ... 1:1000), test-section: 1.5 x 1 x 11 meters, adjustable ceiling, wind speed: 0–20 meters per second. Multi-Layer Wind Tunnel (model scale range 1:350 ... 1:1000), test-section: 2.3 x 1.1 x 8.7 meters, wind speed: 0–5 meters per second. Stratification modeling, air heating: max. 100 kW, floor cooling: 20 kW. WOTAN wind tunnel (model scale range 1:200 ... 1:3000), test-section: 4 x 2.75 x 18 meters, adjustable ceiling, wind speed: 0–20 meters per second. Calibration Wind Tunnel (Göttingen-type with open test-section, closed return), uniform flow, low turbulence, 1 meter jet diameter, 2 meter test-section length, wind speed: 0–40 meters per second.

How many hours does your wind tunnel run during a working week? How many test sessions?

Our wind tunnels are operated as necessary. This can range from a few hours per week to 12–18 hours, seven days a week.

What do you use for calibration?

Independent calibration standards are available for flow speed, pressure, mass, volume flow, and image calibration. For instance rotating discs, a micro-pressure balance, volumeters, and calibration targets for image-based flow measurements.

Was there a special (ritual) conducted at the inauguration and first use of your tunnel?

Yes – for example, the large boundary layer wind tunnel facility was baptized as WOTAN with music from Richard Wagner. In particular, the first part of the Rheingold Overture. It was (turbulence made audible.)

Our wind tunnels are operated as necessary. This can range from a few hours per week to 12–18 hours, seven days a week ...

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What cameras do you use for experiments?

The camera used depends on the purpose of the experiment, however we use different types of digital still and video cameras.

What was the strangest, most special set up, phenomenon, or situation you have tried to model in your wind tunnel?

Generally, all setups are special. Applications range from basic research on turbulence in the lower atmospheric boundary layer to specific flow and dispersion phenomena such as hazmat dispersion in complex urban terrain, pedestrian wind comfort studies, dense gas dispersion, wind energy related research, or wind flow over complex terrains.

If your tunnel would be an animal, which one would it be?

No comment ...

Olivier Chazot, Aeronautics and Aerospace Dept., von Karman Institute for Fluid Dynamics (VKI), Rhode-St-Genese, Belgium

4

Please give a short description of the group, i.e. institution name, size of group, head of group/or head of wind tunnel facilities.

The von Karman Institute (VKI) is an international educational and research institute devoted to the field of fluid dynamics. It was founded in 1956 by a number of European countries, the U.S., and Canada. With respect to education, the VKI offers the following programs: VKI proposes a one-year postgraduate course for 30–35 young scientists, covering both experimental and computational fluid dynamics. Applications are in the areas of Aeronautics & Aerospace, Environmental and Industrial Flows and Turbomachinery, each is covered by one of the three departments of the VKI. VKI offers facilities for 25–30 PhD candidates carrying out their research at the VKI over a period of 3–4 years. VKI organizes 8–10 lecture series per year, with lecturers and participants from industry, research institutes and academia in Europe and the U.S. Extensive notes of these courses are published and are recognized world-wide as a primary source of information for the field.

Please give a short description of the group, i.e. institution name, size of group, head of group/or head of wind tunnel facilities.

About 50 wind tunnels covering the regimes from very low speed to hypersonic are available at the von Karman Institute. In the high speed range, four wind tunnels are currently used by the research programs: two supersonic tunnels, Mach 2 and 3.5 respectively, a hypersonic Mach 6 blow-down facility, and the Longshot free piston tunnel providing a Mach 14 flow. The Plasmatron, a large plasma wind tunnel, is also in operation at VKI. It allows the duplication of re-entry flight conditions around TPS samples and it is specifically equipped for the study of Gas-Surface Interaction phenomena under moderate incident heat fluxes.

How many hours does your wind tunnel run during a working week? How many test sessions?

Among the 50 wind tunnels at VKI, 7 are of major importance: L1 (subsonic), S1 (supersonic), H3 (hypersonic), Longshot (hypersonic M=14), Plasmatron (Plasma wind tunnel), CT3 (Compression tube), Acous (Aeroacoustic facility). Each has a calendar and is used periodically according to the specific activities. During a typical test campaign a wind tunnel runs up to four hours a day. The Longshot facility is a particular case. An experiment requires a full day of work for operating the facility, but the testing time is only 25 milliseconds.

Usually the wind tunnel is qualified by a dedicated characterization of its testing conditions.

What do you use for calibration?

Usually the wind tunnel is qualified by a dedicated characterization of its testing conditions. Classically, pitot tubes and heat-flux probes are used to determine and map the velocity and temperature distribution in the wind tunnel exit-section.

Was there a special «ritual» conducted at the inauguration and first use of your tunnel?

For the large wind tunnels at VKI an official inauguration was organized with an invited scientific delegation and political representatives.

What cameras do you use for experiments?

Four types of cameras are used: video camera, high-speed camera, CCD camera, and IR camera.

What was the strangest, most special set up, phenomenon, or situation you have tried to model in your wind tunnel?

In our plasma facility of 1.2 MW we usually test water-cooled probes made of copper or high temperature ceramic thermal protection material. However, one day we were asked to test a broken piece of this material to see how such material would be consumed during a planetary re-entry.

If your tunnel would be an animal, which one would it be?

The L1 would be an elephant, S1 an eagle, H3 and Long-shot have no equivalent in the animal reign ... Plasmatron: a dragon and CT3: a bull.

Kaspar König, Florian Dombois, Forschungsschwerpunkt Transdisziplinarität, Zürcher Hochschule der Künste

Please give a short description of the group, i.e. institution name, size of group, head of group/ or head of wind tunnel facilities.

5
Institution: Zurich University of the Arts, Research Focus in Transdisciplinarity, Zurich, Switzerland
Team: One professor, two assistants, two PhD candidates, and one postdoc.
Head of team: Prof. Florian Dombois
Head of Wind Tunnel Facilities: Kaspar König

Please give a short description of your wind tunnel, i.e. type, size, name, specialties.

Our main wind tunnel follows the Göttingen design, but has an Eiffel-type section integrated. We built it on the rooftop of the institution. The dimensions are 7.33 x 5.40 meters, however its specialty is its modularity and the fact that one can easily change functions and dimensions by swapping parts of the tunnel. For instance, we can change nozzles and use the two test-sections (one open, one closed) for blowing and sucking.

How many hours does your wind tunnel run during a working week? How many test sessions?

Our wind tunnel runs a minimum of 1–2 hours a week. This is the actual runtime and excludes the preparations and wrap up of tests. Since our wind tunnel is in public space, on the rooftop of the art school, we have a visitor flow of seven days a week, 24 hours daily.

What do you use for calibration?

Our head of facilities uses a modified piano to get a feeling for the sound and the power of the wind of the day. Originally we started each experiment at our wind tunnel shrine and made small offerings to the gods of the winds.

Was there a special «ritual» conducted at the inauguration and first use of your tunnel?

Yes, the first inauguration and ritual was part of our event Modell-Apéro (21.11.2013) and there we removed the last «construction pillar» of the main curve, snapped it into place, and fixed a transparent window into place in one

We have two wind tunnels: We see our mother ship wind tunnel as a unicorn. Our inflatable wind tunnel could be called a sea anemone.

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move. From that moment on the wind tunnel was airtight and ready to use.

What cameras do you use in experiments?

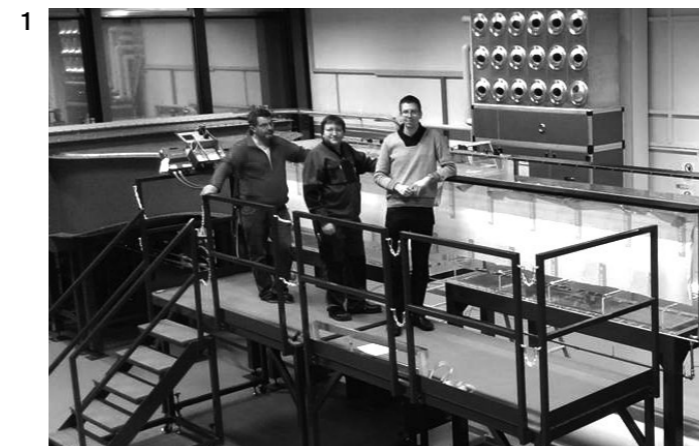
Sony, Model NEX-6, for photos
JVC, Model GC-PX10, for slow motion captures
Sony, Model A7R, for photos
Sony, Model Cybershot DSC-RX100, for photos
GoPro, Hero2, for photos and time lapse

What was the strangest, most special set up, phenomenon, or situation you have tried to model in your wind tunnel?

Our wind tunnel is an artistic wind tunnel. From the perspective of aerodynamics most of our experiments are strange. However, to give three specific examples: (i) our tunnel is placed on the roof of a building called Toni-Areal. Once we put a burning model of the Toni-Areal in the tunnel and observed its flaming and smoking characteristics. (ii) Our head of facilities laid in the tunnel naked, having only a straw hat protecting his genitals. The test was to blow the hat away. (iii) We tested a series of microphones in respect to their wind noises, depending on the wind direction. This series resulted in a CD.

If your tunnel would be an animal, which one would it be?

We have two wind tunnels: We see our mother ship wind tunnel as a unicorn. Our inflatable wind tunnel could be called a sea anemone.



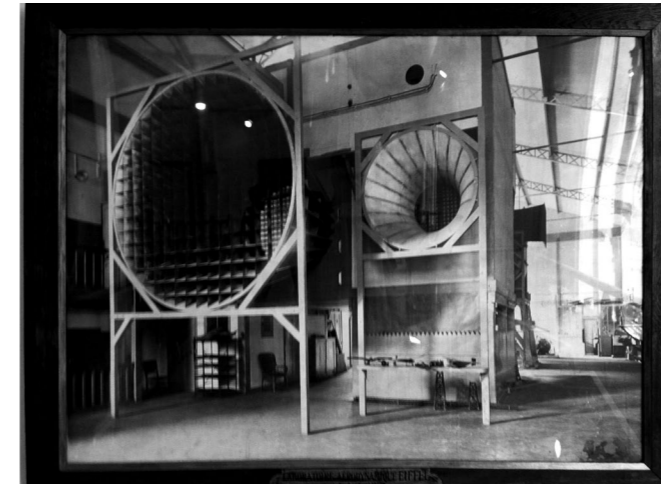
The Temple of Winds

Göttingen-type
A wind tunnel developed by the Research Focus in Transdisciplinarity, Zurich University of the Arts, constructed in 2012, constantly extending
Now on the roof top of Toni-Areal, Zurich, 8th floor

This is our home, our center, and our biggest team member. It is the physical space where we meet, and also the mental space where we meet too. Two in one: abstract and concrete, real and metaphorical. One day it might become a work of art.



102, 103 Portfolio: Wind Tunnels by Florian Dombois



Laboratoire Aérodynamique Eiffel

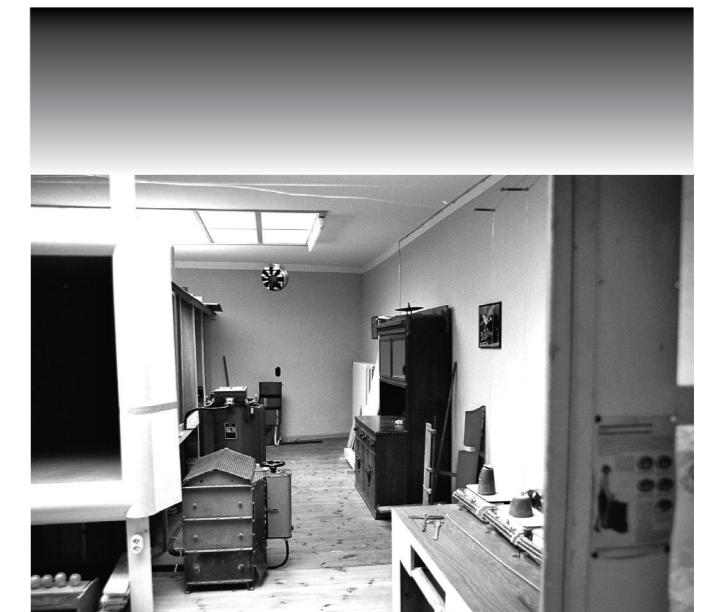
Eiffel-type
Wind tunnel developed by Gustave Eiffel
Constructed in 1912
Now run by a private company for aerodynamic experiments

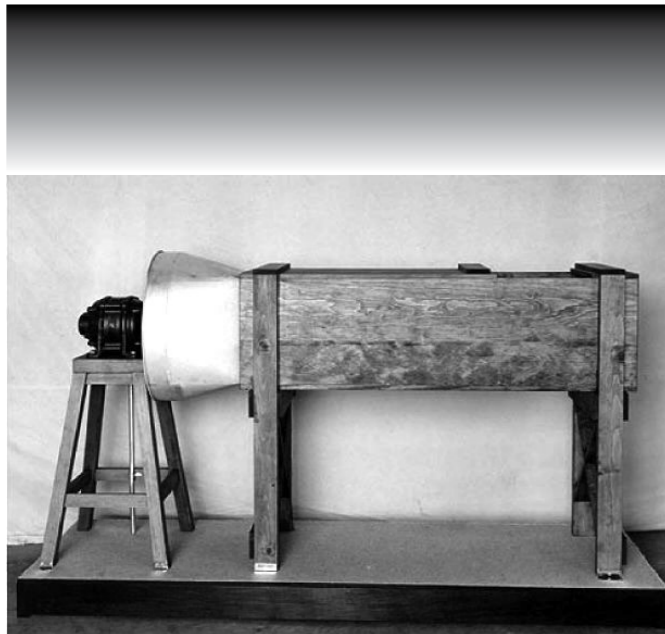
Gustave Eiffel built his second wind tunnel facility 1912 in Paris and this tunnel is still in use. I wonder if there is any other laboratory in science that has remained functional for over a hundred years unchanged? In French a wind tunnel is called «soufflerie.» I agree, this is full of breath – full of inspiration.

Henrich Focke Wind Tunnel

Göttingen-type
Wind tunnel developed by Henrich Focke in his private home
Constructed in 1961–1963, restored 1998–2007
Now run by *Focke-Windkanal e.V.*, Bremen, as a museum and an aerodynamic research facility

Focke is our father for style. Kaspar and I visited this tunnel in October 2012 before we started to build ourselves. The poverty of post-war Germany combined with ingenious engineering demonstrated in this tunnel has been of great inspiration for our artistic approach.





Wright Brothers Wind Tunnel

Open-return design
Wind tunnel developed by Wilbur and Orville Wright in their bicycle shop
Constructed in 1901
Replica, original is lost

This single speed, open-return design consisted of a fan pushing a flow of air through a long wooden box that exited into a room. It was used by the Wright Brothers in 1901. To me it looks like a dog. And here I learned an important detail: a good wind tunnel sucks the air. This one here never really had laminar flow because the ventilator is on the wrong end.



Cardboard Wind Tunnel

Eiffel-type
Wind tunnel developed by Goalieguy
Constructed in 2010
No more info found

Reinhard Wendler sent me this picture just before we went to Focke's tunnel. We never saw it in reality, but it has flown through our minds. There exists a detailed DIY-construction description written by Goalieguy. You can watch it suck, meaning work for a wind tunnel, then sit down on the sofa.



Trudelturm

Göttingen-type
Wind tunnel developed by Deutsche Versuchsanstalt für Luftfahrt (DVL)
Constructed in 1934-1936
Now part of the Aerodynamic Park of Humboldt University of Berlin

When I found this tower around 2001 I was struck by how beautiful a functional architecture can be, how sculptural! And this was long before the new Bilbao architects stepped onto the stage.



The Wind Tunnel Asks ...

... where is your wind?

JH: Excuse me?
Where is *your* wind?

KK: My wind is below me. I try to stay in the air. If I am on the floor, reality hacks me. Rather, I want to keep hacking reality. Blooming flowers and smells are coming into my nose. My breath and wind tunnel become one, only if I fly. Will there be a moment of an intense long kiss between you and me? Or did I miss that, and you already kissed me so strongly that my memory got blown away ...

SW: Hmm, as impetus it is probably my curiosity.

HA: The thing about wind is that there is no single wind; it's like the old adage about another fluid, water: every body of water leads to another larger body of water. If I may change the question, what do you do with the wind when it comes to you?

... how was your time during the Size Matters Project?

MB: Die Zeit während des Size Matters Projekts fliegt in slow-motion. Angekommen, dieser Eindruck bleibt bei jedem Aufbruch, dem ich in diesen Jahren Ausdruck gebe. Von den vertrauten Orten über die vertrauten Menschen zu den Brüchen im Kontinuum, im Handlungsraum. Ich bleib am Zeitbegriff hängen. Und erkenne ihn kaum wieder: bist du, Windkanal, derselbe geblieben während all den Turbulenzen? Ja. Derselbe, der die Forschungsgruppe trägt, stützt, begleitet. Florian lässt die Zeit andersrum fließen und dieses Strömen zieht mich mit, zerrt an meinen Gedanken und zurrt an meinen Händen. Bis ich merke: Die Zeit ist um. Vakuum. Bumm.

HA: A lot changed in this time and so did you, dear wind tunnel, metamorphosing slowly under the care of Kaspar. For about a year and a half you were half formed; a veritable blower of air. Then your circuit was completed but only as it was com-

pleted were you moved and incomplete once again. It took months more to reconstitute you on the roof of the Toni-Areal. Now near the end of the time frame you are complete and continue to change.

FD: Full of wind.

... what is your test object?

FD: Myself.

SW: I agree!

JH: Why you, of course!

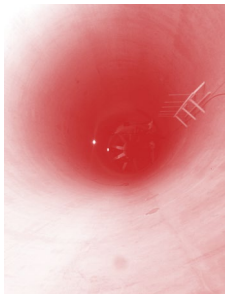
MB: Testen mag ich gar nicht. Entweder richtig oder spielen. Oder so richtig spielen.

HA: I have a wind tunnel in my head; it has its own imaginary wind.

KK: My favorite test object is the prepared piano. A piano consolidated as a wind harp that opens the sound spectrum of the wind, depending on force, angle, and resonance in the room. It is not only to calibrate (see the calibration article) it is also to tune into the wind and hear the unseeable.

HA: Haseeb Ahmed
MB: Martin Burr
FD: Florian Dombois
JH: Julie Harboe
KK: Kaspar König
SW: Sarine Waltenspül

- 075 10.06.15 mk421 Manipulation
 076 11.10.15 McDouble in VKI L7 WT
 077 17.10.15 Piano Wind
 078 17.10.15 Wind Rain Harp
 079 18.10.15 Piano Flag Wind
 080 21.10.15 Mic Tube I and II
 081 23.10.15 McDouble in Wright Brothers WT
 082 05.11.15 Two Half Spheres
 083 06.11.15 Wind Reading
 084 06.11.15 Balcony Wind Tunnel
 085 17.11.15 Sound of Domesticated Wind
 086 11.12.15 Inflatable Wind Tunnel
 087 17.12.15 WT Travel Agency
 088 17.01.16 Lessons for Vortex Face
 089 11.04.16 McDouble in Temple of Winds
 090 11.04.16 ReForming Boccioni
 091 04.05.16 Acoustic Vortex Incubator
 092 04.05.16 Vulture Aviary
 093 04.05.16 Wind Egg Inseminator
 094 04.05.16 Circling Hexagon



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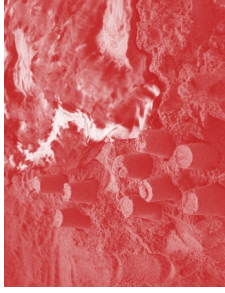
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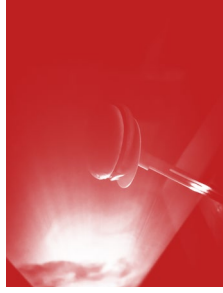
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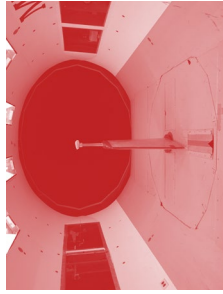
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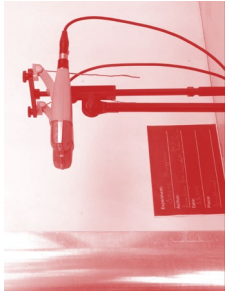
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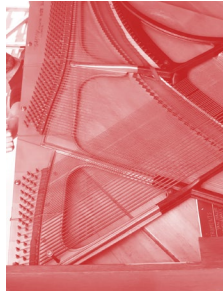
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