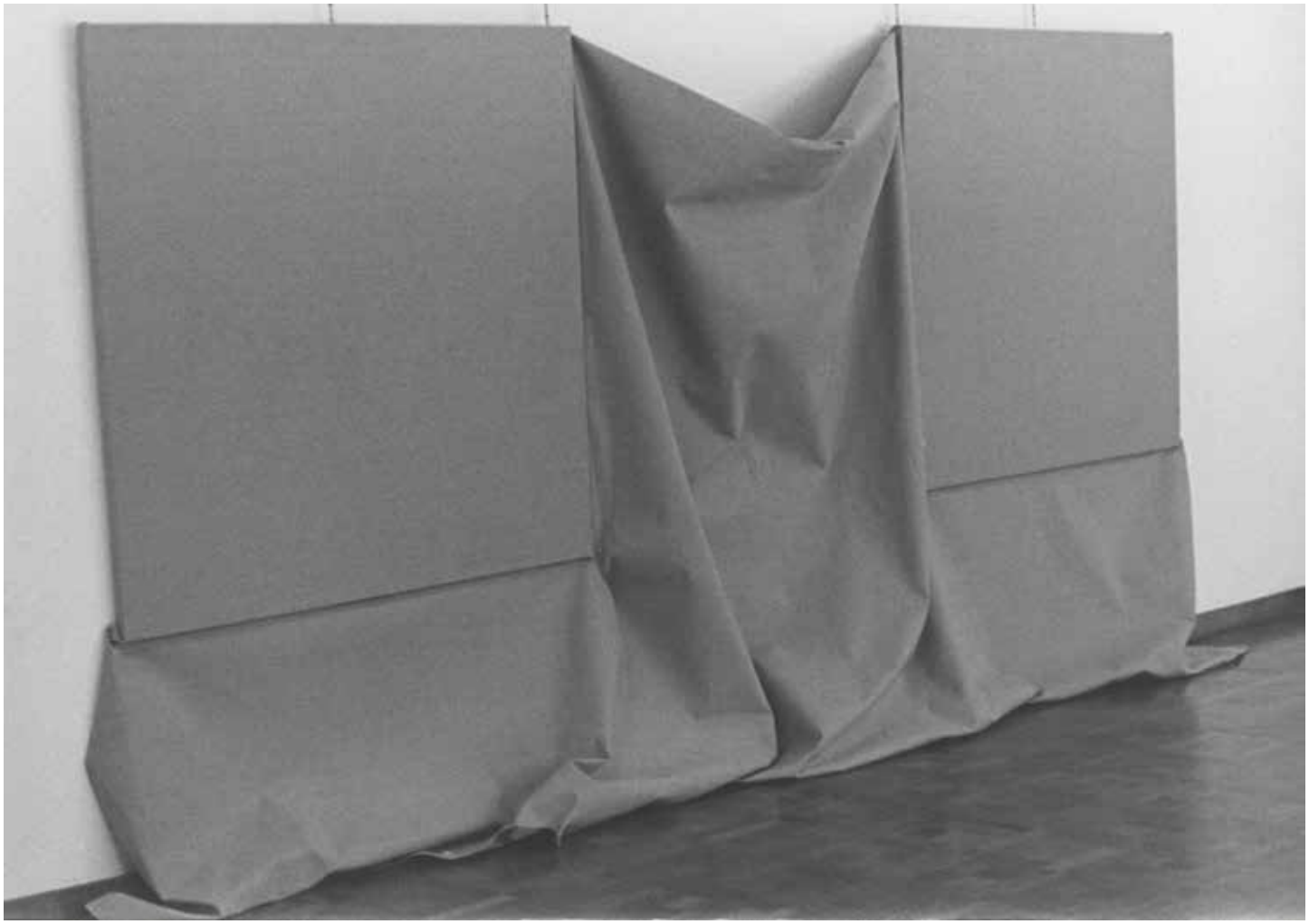
Studio Anne Holtrop

ETH Zürich

design studio **HS23**

MATERIAL GESTURE:

GRAVITY



Barry Flanagan, AUG 1 ’69, 1969. Made from two stretchers and flax (linen).

CONTENTS

MATERIAL GESTURE:

GRAVITY

The basque sculptor Eduardo Chillida wrote: from space, with its brother time under the persistent pull of gravity, feeling matter as a slower space, I ask myself, with wonder, what I do not know.

Chillida, in one sentence, joins together what I believe are also the fundamentals of architecture: space, time, and matter, all under the persistent pull of gravity. In this semester we will focus on the fundamental of the fundamentals, that binds building and ground: gravitation.

Chillida continues: ... but what I really dream about is gravity. I am becoming more and more conditioned by gravity, by gravitation, – by this ideal line that runs from top to bottom, and naturally, from bottom to top. It was my

preoccupation with gravity that led me to worry about matter. It's not that I worry about matter, because I like iron, concrete, or stone, no. It's that all works must be embodied in something: if not, then they are nothing, which presupposes a greater or lesser condition by that force, by gravity.

All matter from the earth to the atoms are under the influence of gravity. To human perception, the transmissions of the forces and motions caused by gravity, seem to come from contact. The way a building transfers its loads through slabs and columns is eventually brought to its foundations, which in turn rest on the ground. At an atomic level, though, it is known that bodies in apparent contact, in fact, do not touch each other. There is always an empty space between them. Chillida adds to this, as he sees matter and space as inseparable, due to the fact that either space is very fast matter or matter is very slow space. And from this, he questions the boundary limit, not only between densities but also between speeds.

I am interested in the processes all things undergo, the transitions from one state to another. How molten glass can set and solidify. Or how in Michael Heizer's Vertical Displacement works, he proposed, for example, Appenzell, to frost crack a gigantic solid piece of rock and let it slide down the slope,

leaving all its marks by its enormous mass. Transitions and processes that always include the presence of gravity.

In this semester we will with gravity influence space with matter and influence matter with space.

Anne Holtrop

DESIGN STUDIO

When we take all aspects of the material into consideration – the geology, the sourcing, the industry, the different properties, the craftsmanship, the specialised techniques and the cultural significance – we can deploy the full potential of the inherent qualities of the material itself and our way of working it in what we call MATERIAL GESTURE.

In this design studio, you will define your gestures of making and working with material(s) through research and experiment, and in response to the topic of the studio. You are required to produce an architecture that results from your specific engagement with the material and the spatial condition you construct with it. The architecture that results from this approach does not reference or represent something, but simply attempts to exist as a physical spatial reality in its own right.

Your research should be supported by the knowledge made available by our studio, and engaged through you with the use of available resources and facilities at departments of the ETH and from external specialists / fabricators.

Throughout the whole semester, and for your final presentation, we require that you work with physical (fragment) models of your building in the actual material(s). It is important, in this design studio, not to make a complete building, but to show and support the found values of the material engagement in a spatial way, based on the full potential of the inherent qualities of the material itself and your way of working it.

ASSIGNMENT

In this studio, we work in a workshop and laboratory-like setting where you research, design and test the proposed material. The material and the ways of making are not a presentation outcome of the design studio but rather, an integral part of a process of working, researching and designing.

There is no given program for the space. This can be chosen at any time in the development of your project and should support the spatial and material conditions that you have set out.

For the final presentation, you are required to make a physical model of your work, or a fragment of it, in a scale of 1:15. The model should show the material and the gestures (the ways of making) and the specific spatial conditions it constructs. This is the key element of your presentation, along

with samples of the material research and test models. You are required to display the material gesture research, drawings of the project and photos of the model alongside your model on portrait A2 sheets.

The A2 material will be collected in print and digitally in PDF format for the material gesture archive. A semester result book will be made after the presentation. From a selection of a maximum of three projects, the models and material research will be crated and archived for future exhibitions.

SCHEDULE DESIGN STUDIO HS23

INTRODUCTION **Sept 19 & 20**	**On the first day, the team will give an introduction to MATERIAL GESTURE and the specific topics of this design studio, GRAVITY. Members of the team and experts will give lectures and at the end of the session, you will choose the fields you want to engage with and make groups based on affinities of your shared interests. We will introduce how we work within the studio; we aim that you learn that model, image and drawing are tools to develop your project.**
STUDIO WEEK 2 **Sept 26 & 27** **research topic**	**Experiments with the material and ways of making. You are required to present the research topic of your interest through material tests and research, following your personal interest on GRAVITY. Grace, the material research assistant will be present for questions and input.**

FIRST TABLE REVIEW
Oct 3 & 4
gesture of gravity in realtion to matter
with Anne Holtrop, DS assistants

You will present your research and first experiments. In order to understand the idea of material gesture, you will be modeling, sketching and working together with Anne. In this review, your material research will be discussed, and you will have to present the sources and the specialists/ETH departments involved that are essential for your research. The material research and experiments are documented through photography, material samples, writing, and drawing.

STUDIO WEEK 4
Oct 10 & 11
spatial translation of research

You will find a way to translate your reseach, material gestures and experiments into the best suitable spatial configuration. Some first translation into the architectural context should be made and relate to the material engagement.

SECOND TABLE REVIEW
Oct 17 & 18
spatial condition, gesture and research
with Anne Holtrop, DS assistants

You will be required to present your research and your architectural spaces that are consequential to your material interest and fully exploits the material gesture in a spatial way. We will discuss architectural articulation and cultural significance in relation to material research and ways of making.

SEMINAR WEEK
Oct 23 – 27

STUDIO WEEK 7
Oct 31 & Nov 1
project development

We will continue our discussion of the previous reviews and aspects of working together.

STUDIO WEEK 8
Nov 7 & 8
project development
with Stephan as a guest assistant

Further inputs on presentation.

MID-TERM REVIEW
Nov 14
gesture, space and structure
with Anne Holtrop, guests and all studio assistants

It is important to understand your research and ambitions of your project as well as the constraints and conditions you will work with and what possibilities they offer. You will be required to present your projects through architectural drawings – floor plans and sections – and first more detailed construction drawings. You will be evaluated on the development of the previous table reviews (gestures and space) under the categories of research, conceptual approach, material development and presentation.

Nov 15
with Anne Holtrop, Mario Monotti and all studio assistants

Together we will discuss the relevance of structure and the ways of making in relation to your project.

STUDIO WEEK 10
Nov 21 & 22
ways of making space

In this week, we will elaborate more in depth the construction techniques and applications that you will develop out of your material research and their spatial consequences. We will use the constraints and problems of translating your project into reality

as a tool to find specific solutions for developing your project's narrative. Therefore, we will successively increase the scales of model making and drawing.

STUDIO WEEK 11
Nov 27 & 28
ways of making space
with Stephan as a guest assistant for further inputs

THIRD TABLE REVIEW
Dec 5 & 6
detailed project discussion
with Anne Holtrop, DS assistants

We will continue our discussion of the previous reviews and aspects of your work together with the ways of making and final model, drawings and photographies, which as tools become strongly representative of what your project is about.

STUDIO WEEK 13
Dec 12 & 13
pre-final presentation
with Stephan, Yuiko, Philip and Arturo

Your project should be in an almost final state and we will mostly discuss how to present your work at the final review.

FINAL PRESENTATION
Dec 19 & 20
with Anne Holtrop, assistants and guests

You will work on the final presentation with an exhibition of the final models, material samples and A2 drawings and photos.

TOOLS

In our design studio, we stress working on models, drawings, and photography as tools to develop projects. The three should link and grow together.

Model as Tool

The purpose of model-making is to study different conditions. The study will be constantly worked on on a weekly basis for different focuses such as material tests, the context of the project, volume, structure principles, materiality, atmospheric or spatial conditions, etc throughout the semester. It means you will experience different types of models. The scales and materials of the models can vary depending on the focus.

Drawing as Tool

Through the act of drawing, we can explore the physical process of making in an analytical sense and synthesise key aspects of a project. Together we will explore the different scales and methods of drawing, from surface textures that change over time to the constructive assembly of different elements, from the

illustration of experiment arrangements to the communication of technical details.

Photograph (Video) as Tool

An important tool of narration to communicate project intentions and research: it questions how we talk about things. Photography becomes an important part of the narrative that helps to explain the project once we have site visits, experiments, material tests, and model studies. It becomes a way of focusing, of editing, of looking, of putting work in relationships. It is important to think about the print and check how your photography narrates your intention clearly. With video, we can also include the aspect of time in photography. Together with drawings, are tools to analyse and annotate what we are doing, it is essential to document what we do.

VISUAL ESSAY

SPACE, TIME AND MATTER AS EXPRESSIONS OF GRAVITY

“The distinction between material and debris, therefore, involves a representation of time. Materials are inclined toward the future; debris both blurs and outlines its past ... Materials and fragments thus suggest the ‘before and after’ of architecture. These, to use a concrete metaphor, are the ‘three states’ through which construction materials pass.”

— Cuauhtémoc Medina

DISTORTED ROMAN REVERSE MOSAIC FLOOR, Fishbourne Palace, England
23

Wedge consists of a number of planks arranged around a large boulder between two rocks on the beach in order to create the impression that those planks keep it wedged in place.

Oddvar I. N. Daren, WEDGE, 1985, in collaboration with Lars Paalgard,

Terje Munthe. Photograph exhibited at Kunsthall Trondheim, 2018.

Photograph documenting the demolition of the unfinished social housing

BREEZY POINT 1979–2002, New York.

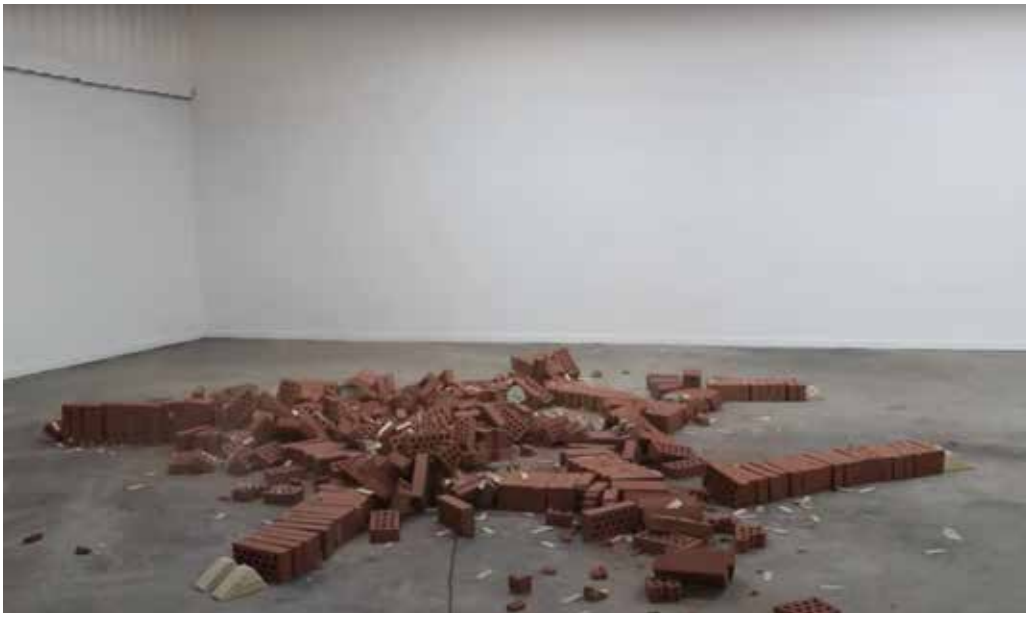
Image from page 436 of the book “Four Walls and a Roof” by Reinier

de Graaf. Chapter: In Memoriam, A Photo Essay.
26

Charlotte Perriand, LA CASCADE, Arc 1600, 1968
27

McBride explores the performative situations derived from urban objects, architectures, and elements, she incorporates them by altering their dimensions, colours, and materials. Camelback Parking Ramp is part of a series of model sized sculptures with forms derived from parking ramps. This work, cast in aluminium, and installed on the wall, exerts notions of falling, sliding, and gravitational weight.

Rita McBride, CAMELBACK PARKING RAMP, 2001, New York



“The collapse is the end. The work has the life of the exhibition. Instead of depositing each element, which would be expensive, I prefer an artistic gesture. I invite other artists, for example a climber or an archer. You have to pull on it one way or another, it’s inherent in the sculpture itself. And this gives the opportunity for a performance.”
— V. Ganivet

Titled “1:1,” this piece draws inspiration from the architectural solutions prevalent in commercial structures of 1960s and 70s Poland. Deliberately conceptualized in a scale surpassing the pavilion’s capacity, the steel was warped and compressed to fit the exhibition space. The outcome is a crushed and slightly collapsed black metal frame, leaving observers uncertain whether it will conform to its boundaries or eventually rupture the pavilion from within.

“It seems to me that what I do is somehow in opposition to what architecture stands for. I also think that my art is a completely different discipline, even though I focus on the same problems as architecture does: the forming of space. Utilitarianism is architecture’s fundamental attribute. My works introduce chaos and uncertainty instead”

— Monica Sosnowska

Monika Sosnowska, 1:1, Steel, 700 × 1400 × 600 cm. Polish Pavilion,

52nd Venice Biennale, Venice, 2007. Photo The Modern Institute/Toby Webster

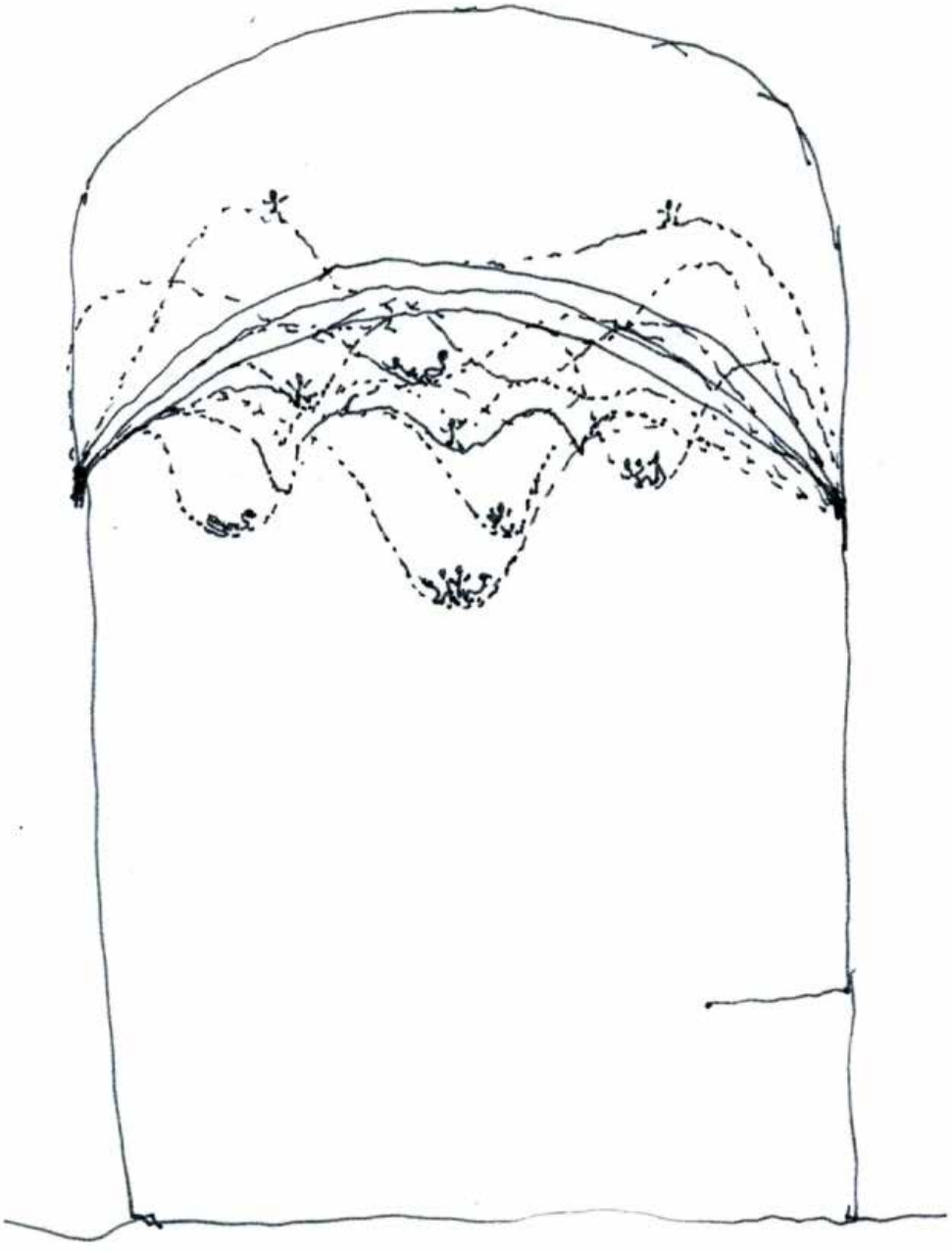
Materials:
water
scaffolding
steel grill age and troughs
pumps
piping
intake filter pool frames and filter fabric
LED lights
ultra-violet filters
concrete
switch gears
electrical equipment and wiring
control modules
anemometres

Studio Olafur Eliasson, THE NEW YORK CITY WATERFALLS, New York, 2008.

Photo Alan Schein

Smiljan Radic, Gonzalo Puga and Osvaldo Sotomayor, MODEL PROPOSAL MEETING POINT AND ELABORATED PROJECT MOON SHADOW, Crossing Dialogues for Emergency Architecture Exhibition, National Museum of China, Beijing, 2009. Image Gonzalo Puga

The Crossing Dialogues for Emergency Architecture Exhibition emerged as a direct response to the tragic Sichuan earthquake that shook the region in May 2008. In an effort to address the urgent need for emergency housing, 17 architecture studios from different corners of the world were invited to showcase their prototypes. “Moon Shadow,” serves as a communal gathering and meeting space while providing protection from the sun’s rays. Its assembly comprises a pre-stressed polyester framework, covered with vinyl, forming a spherical shape. The distinct bubble is entirely self-sufficient, employing a 100 Watt compressor to maintain its inflation. To suspend the bubble in place, ropes are secured to three pulleys, each equipped with two-ton counterweights. The system’s dynamic stability is further enhanced by ballast bags filled with a combination of water and sand. These bags are hung from five-meter-high tripods, effectively absorbing a portion of the energy and maintaining balance. Surrounding the bubble, a translucent copper-colored membrane skirt is suspended, acting as a shield against wind and reducing temperatures within the structure instead.”



Foam emerges as a complex habitat, comprising layers of diaphanous membranes suspended 24 meters above the ground. Its structure perpetually evolves, fluidly influenced by the interactions of those who find themselves embraced amidst its billows and wrinkles, contributing to the dynamic and inflated topography of this ethereal space.

Tomas Saraceno, ON SPACE TIME FOAM AND SKETCH, Hangar Bicocca, Milan,

2012. Photo by Alessandro Coco


TORS WEEKS 2019
Maison Margiela
PARIS

“With [Maison] Margiela, we did a catwalk show in 2018, shop windows in Osaka and a pop-up store in Tokyo. So these exist for one week, one day, a month – and in architecture, that’s a very short time. What I like about temporary work is it can be more radical in a way, because we have less to fulfil for a permanent use. So for instance, with Margiela, the [display] in the shop windows in Osaka, we made them out of very thick felt that we let hang. So it was a kind of architecture that’s literally soft; that has no rigidity. To make architecture that is literally soft is very difficult to maintain or to use. Although Margiela would love that idea, the practicality of it is just more difficult to manage. The driving force behind both temporary and permanent work is similar; it’s about the performance. You know, how can we form space and how can we also discover space?”
Anne Holtrop, Interview with NR Magazine, 2021

Studio Anne Holtrop, MAISON MARGIELA STORE FRONT, Osaka, 2019

Antoni Gaudí held a strong aversion towards drawings and instead preferred to design through hands-on exploration. In the case of notable projects like the unfinished Church of Colònia Güell and the Sagrada Família, Gaudí employed scale models constructed with chains or weighted strings. These physical models, fashioned in an inverted manner, demanded years of effort to assemble. However, they granted him greater freedom to experiment with organic designs, as each adjustment would instantly trigger a "physical recomputation" of optimal arches. Gaudí would then reverse the model's orientation using a mirror positioned beneath it or by capturing photographs.

Antoni Gaudí, HANGING WEIGHTS MODEL, 1889

Demolition of a Wooden House
21 Jana Pawła II St., Otwock

First day

Pre-demolition:

The house is emptied, and all equipment and furniture that can be sold is removed.
The interior is then stripped: the plumbing and more permanent equipment, including building wiring and wooden construction elements, such as shelves, are removed using hand tools.

Second day

Demolition:

For the actual demolition an excavator is used which tears down the walls of the house with a raised bucket.
The excavator moves back and forth, grinding the rubble and crushing the remains of the walls. The roof of the house comes down.
The foundation is destroyed with jackhammers and pulled down by a small crane. The two holes of the cellar in the ground are filled up and leveled.

Debris removal:

The debris and wooden remains of the house is loaded onto a truck with an excavator.
Finally, smaller debris and residue is cleared with shovels and rakes.
The truck may transport them to the dump at the Municipal Solid Waste Landfill Otwock Świerk or to another location, such as the forest.

Rozbiórka drewnianego domu
Ul. Jana Pawła II 21, Otwock

Pierwszy dzień

Przygotowania:

Dom zostaje opróżniony, a wszystkie sprzęty i meble nadające się na sprzedaż usunięte.
Wnętrze zostaje zdemontowane — instalacja wodno-kanalizacyjna i elektryczna oraz elementy stolarki, jak półki i zabudowy wnęk zostają usunięte przy pomocy narzędzi.

Drugi dzień

Wyburzanie:

Do właściwej rozbiórki użyta zostaje koparka, która burzy ściany domu uniesioną łyżką.
Koparka rozjeżdża gruz i zrównuje z ziemią pozostałości ścian doprowadzając jednocześnie do zawalenia się konstrukcji dachu.
Fundamenty zostają rozbite przy pomocy młota pneumatycznego i usunięte przez dźwig. Dwa otwory w ziemi będące pozostałościami po piwnicy zostają zasypane i wyrównane.

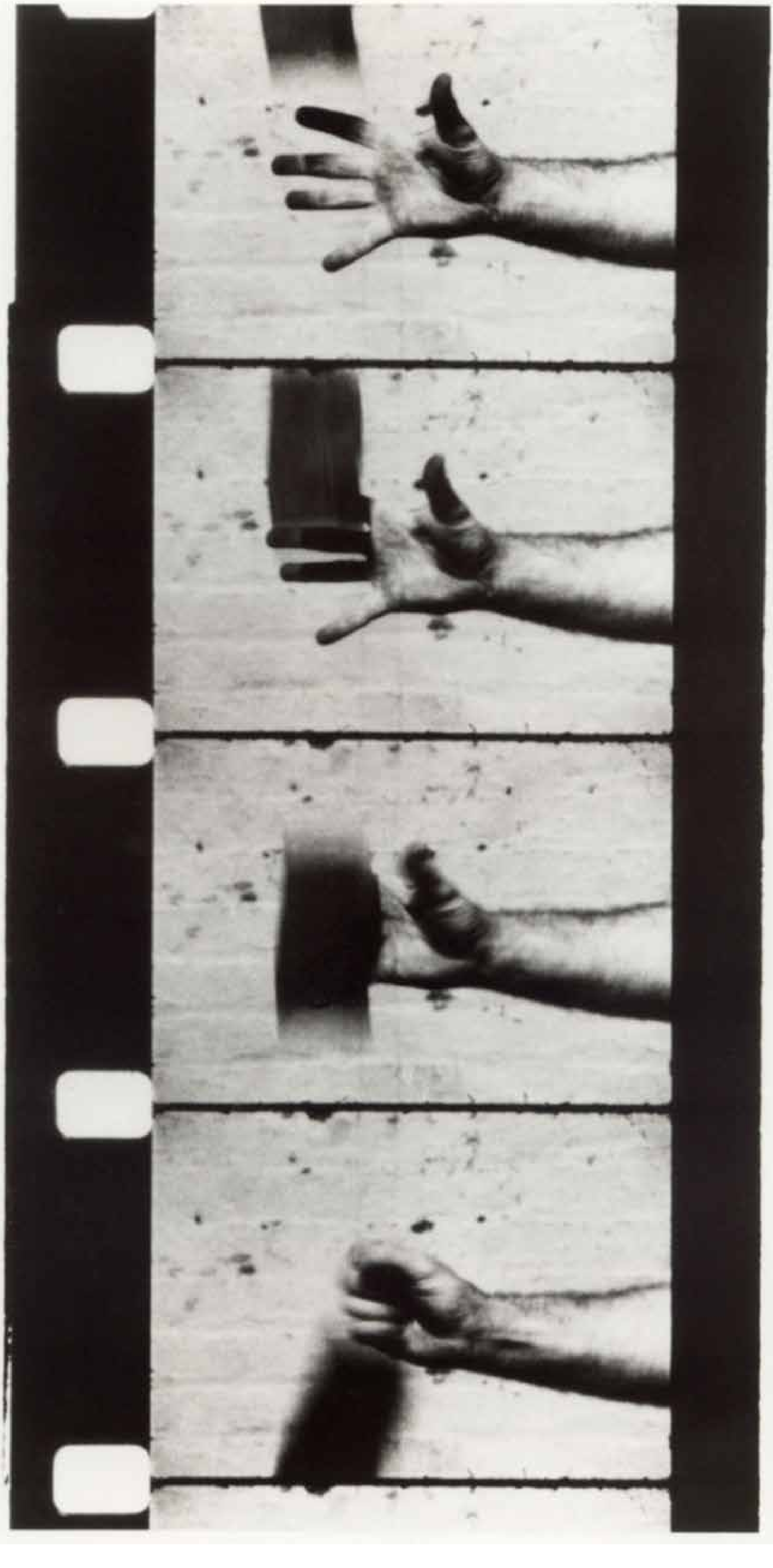
Usuwanie gruzu:

Gruz i drewniane elementy domu zostają załadowane na ciężarówkę przy pomocy dźwigu.
Resztki zostają usunięte przy użyciu grabi i łopat.
Ciężarówka wywiezie ładunek do składowiska odpadów komunalnych w Otwocku-Świerku, lub w inne miejsce, np. do lasu.

Architectural destruction and demolition are subject of interest for Almarcegui's work, viewing them as modern ruins avaliable for public enjoyment. This category includes interventions in which she invites the public to be present at the demolition and the presentation of mounds of debris comprised of demolished material in the places where they once stood. For Demolition of a Wooden House, Almarcegui selected one abandoned villa that was slated for demolition. She worked with a company that helped her describe the step-by-step phases of demolition that these buildings underwent, and catalogued this official process in text and photography form. This documentation was subsequently published in the local newspaper. The invisible, seemingly irrelevant process of demolition was now documented in a publicly acknowledged and archived format; the house's disappearance presented as a sign of the inevitable process of destruction and renewal that is driven by the machinery of capitalism.

Lara Almarcegui, DEMOLITION OF A WOODEN HOUSE, 2011, Poland.

Advert in a local newspaper (English translation).



Serra was initially asked to document the making of his sculpture, One Ton Prop (House of Cards), 1969, which involved balancing large sheets of lead against each other solely through their weight. However, he decided against a traditional documentary format, believing it couldn't effectively capture the creative process. Instead, he created a 'filmic analogy' of the sculpture's construction, where his precise handling of the lead pieces symbolised the laborious months spent moving lead blocks with Philip Glass in his attic.

Richard Serra, HAND CATCHING LEAD, 1968

In making it you must consult the laws of nature, and the consultation and approval of nature are absolutely necessary. There you will find, discover, the order of water, the order of wind, the order of light, the order of certain materials. If you think of a brick, for instance, and you consult the orders, you consider the nature of brick. This is a natural thing. You say to a brick, "What do you want, brick?" And brick says to you, "I like an arch." And you say to brick, "Look, I want one, too, but arches are expensive and I can use a concrete lintel." And then you say: "What do you think of that, brick?" Brick says: "I like an arch."

—Louis Kahn

Christopher Wilmarth, STREAM, ETCHED GLASS AND STEEL CABLE, 1972,

Estabrook Foundation, Massachusetts

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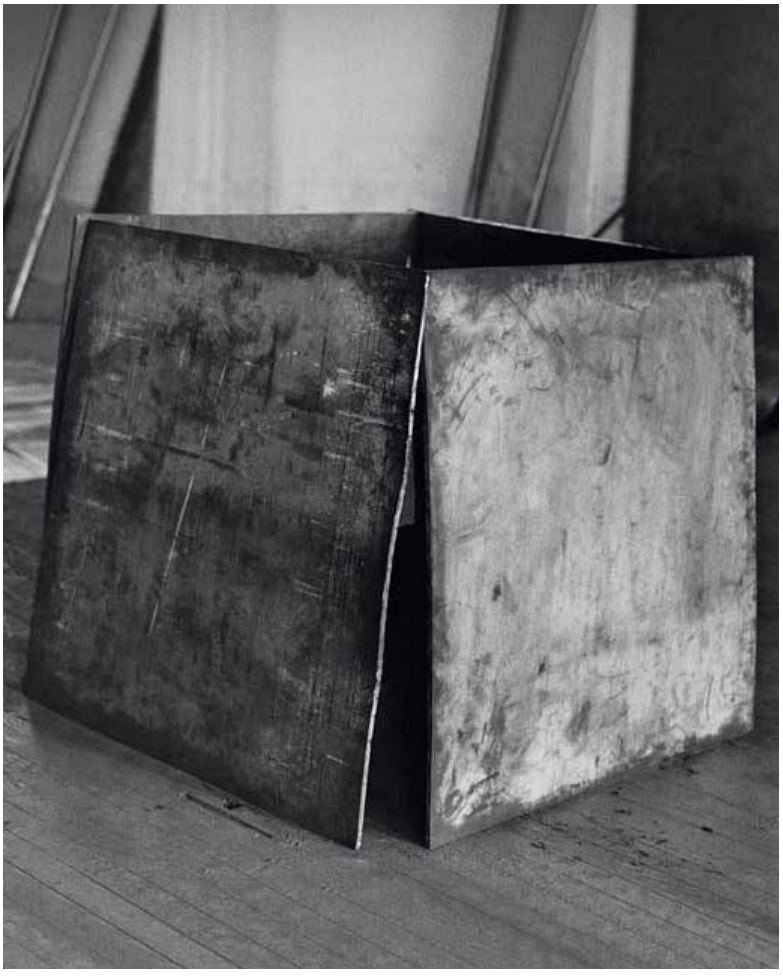

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Richard Serra, (1) 5:30, 1969. (2) V + 5: TO MICHAEL HEIZER, 1969.

(3) ONE TON PROP (HOUSE OF CARDS), 1969. The works are lead plates and a roll solely held together by friction and weight. 3rd image: Fred R. Conrad, New York Times

Impenetrable emanates a celestial presence, defying gravity as it hovers within the gallery space. Upon closer inspection, the artwork unveils a disquieting aspect: the cube comprises countless barbed wire rods suspended by fishing wire. Hatoum, known for her installations since the early 1990s, once again employs a grid-like structure in Impenetrable. However, this austere geometric form, reminiscent of Minimalist sculpture, carries a profound psychological weight. The steel lattice appears simultaneously fragile and menacing, while the presence of barbed wire conjures images of confinement and exclusion, reminiscent of fences, prisons, and camps. These evocative elements speak to themes of conflict, violence, and the authority of the state, often contextualised within Hatoum's own experience as a Palestinian exile. Nonetheless, the artist herself suggests that her work transcends personal narratives, embracing a more intricate and enigmatic web of meanings, paradoxes, and contradictions.

Mona Hatoum, IMPENETRABLE, Solomon R. Guggenheim Museum, New York,

2009
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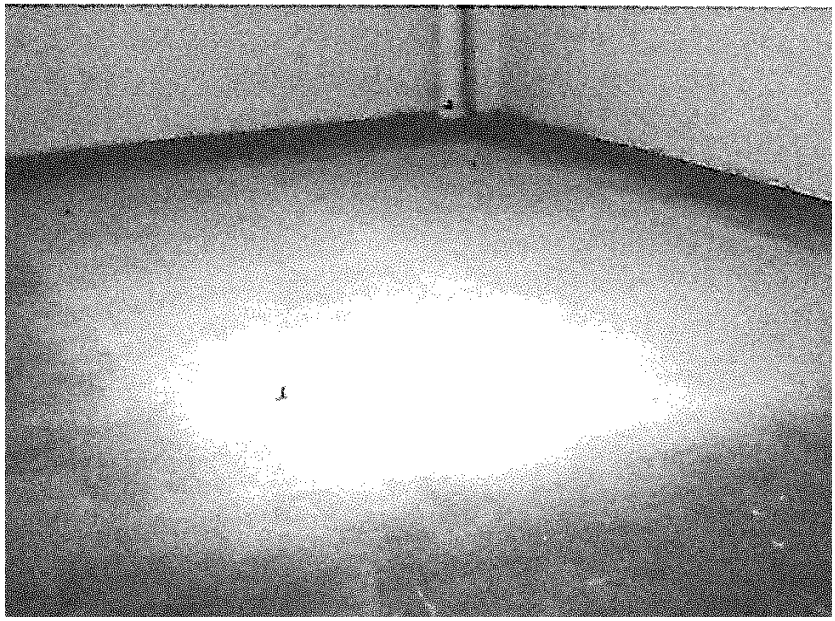

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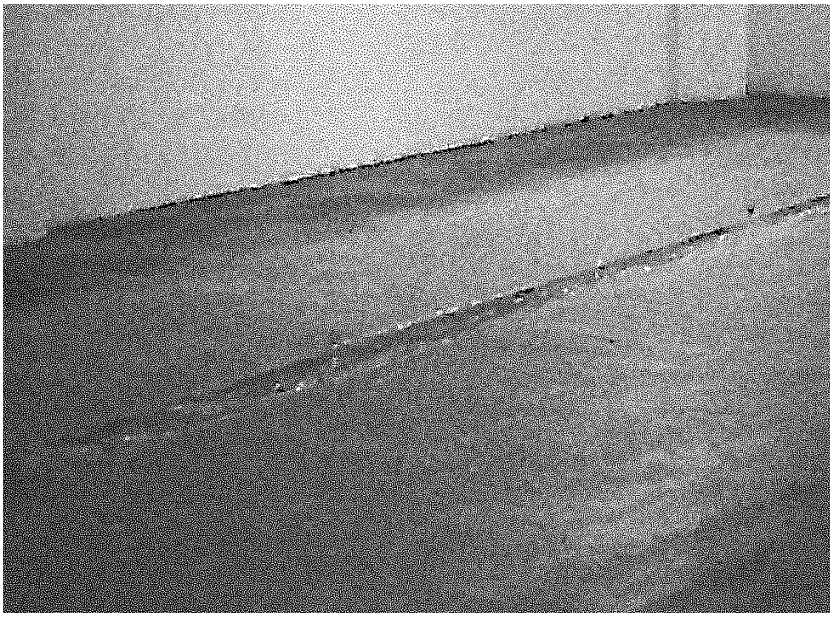

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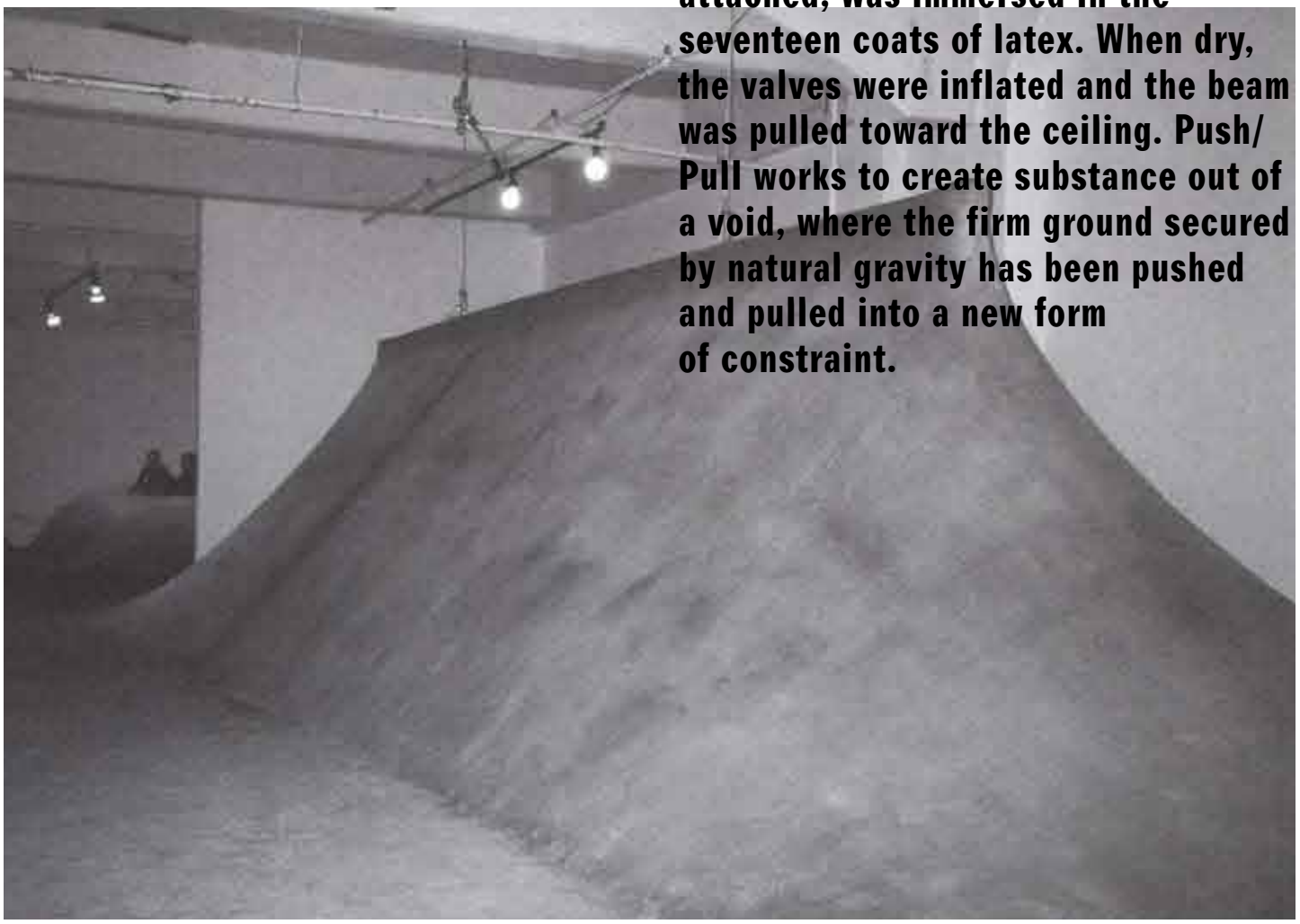
54

In a concrete building, one hundred gallons of latex were painstakingly, obsessively painted onto a twenty-six-hundred-square-foot concrete floor. In the section PUSH inflation valves, cut from bicycle inner tubes, were layered into the coats. In another section PULL a two-by-four-inch steel beam, with lift hooks attached, was immersed in the seventeen coats of latex. When dry, the valves were inflated and the beam was pulled toward the ceiling. Push/Pull works to create substance out of a void, where the firm ground secured by natural gravity has been pushed and pulled into a new form of constraint.



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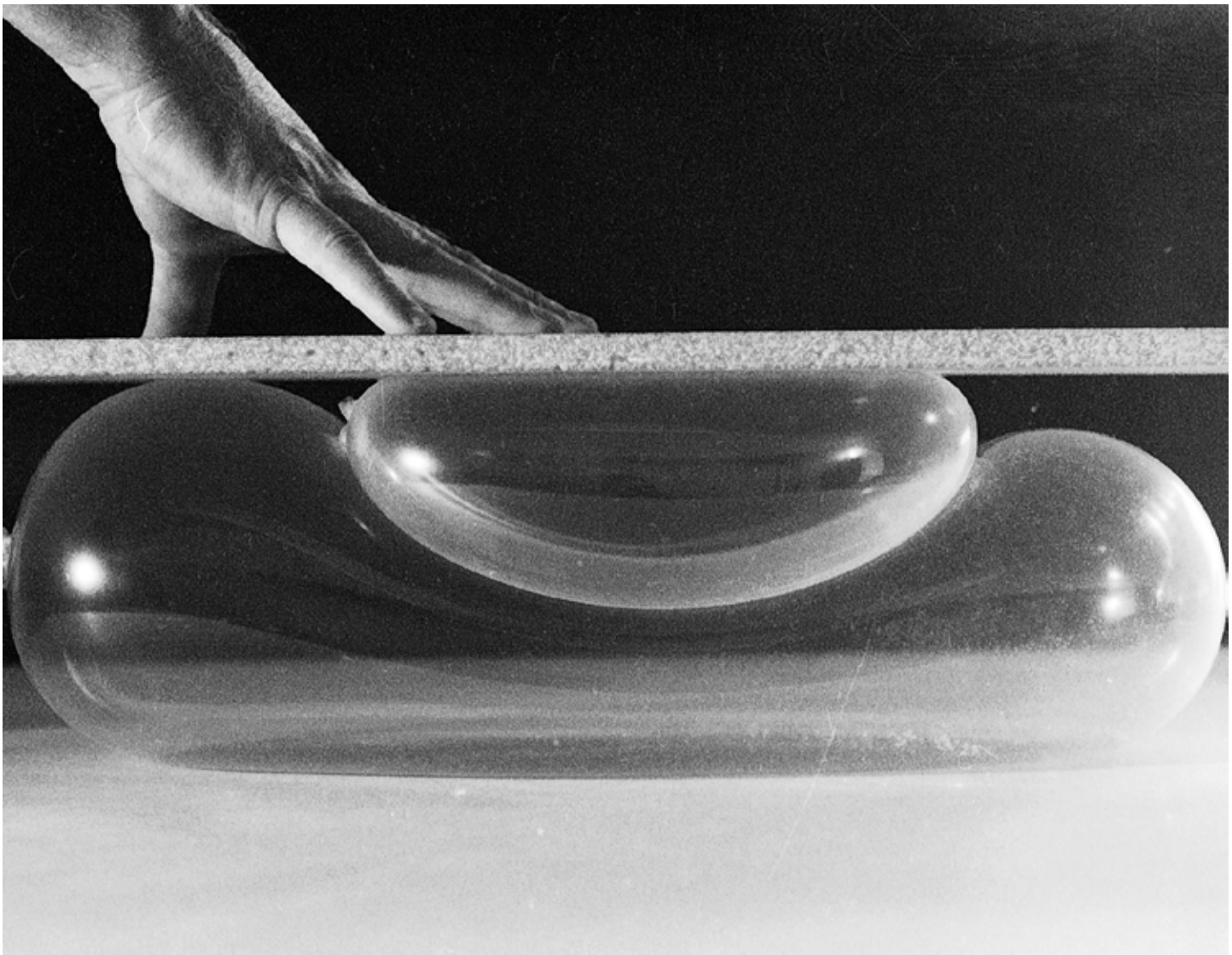
Push/Pull, Hallwalls Contemporary Arts Center, Buffalo, New York, 2001

(1) PUSH, painted floor (2) PUSH, inflated valves (3) PULL, painted floor with beam (4) PULL, beam pulled towards ceiling

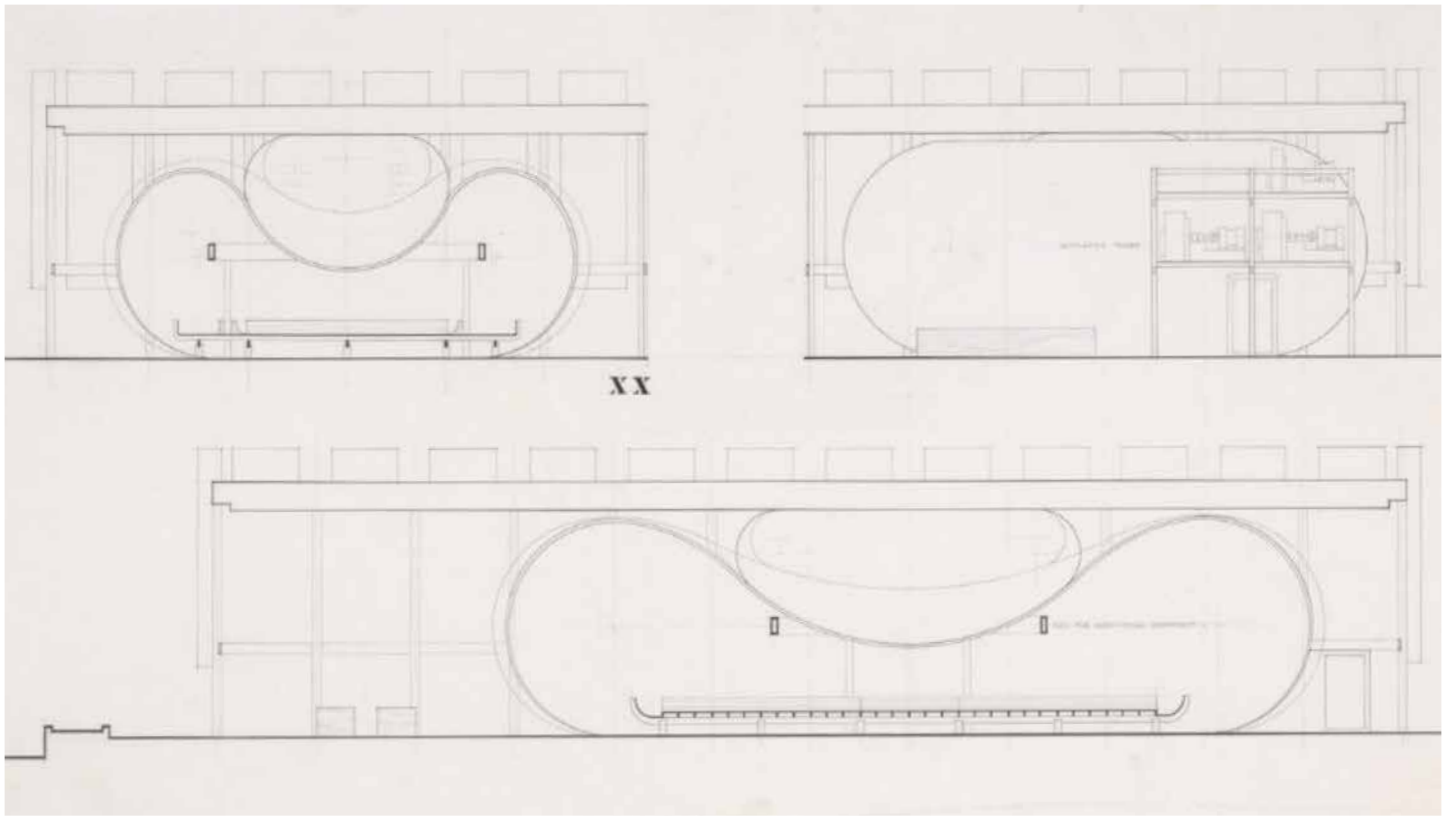
Bo Bardi took on the challenge of constructing a new museum of art with one crucial requirement: preserving the panoramic views of São Paulo. The resulting architectural concept involves the building suspended beneath two pre-stressed concrete beams, creating an open communal space. The design balances lightness and mass, defining the project's identity as a combination of modernism and brutalism.

Lina Bo Bardi Architecture, MASP SAO PAULO MUSEUM OF ART, Brasil, 1968.

Image The LIFE Images Collection via Getty



Architect Sverre Fehn's 'breathing space' pavilion design for the 1970 Osaka Expo's Scandinavian Pavilion went unrealised. After 45 years, architecture office Manthey Kula were commisioned to materialise the concept. The installation featured a timber airlock, an inflatable textile structure from Luft & Laune, and a steel bench for visitors to experience the space's 'breath'.



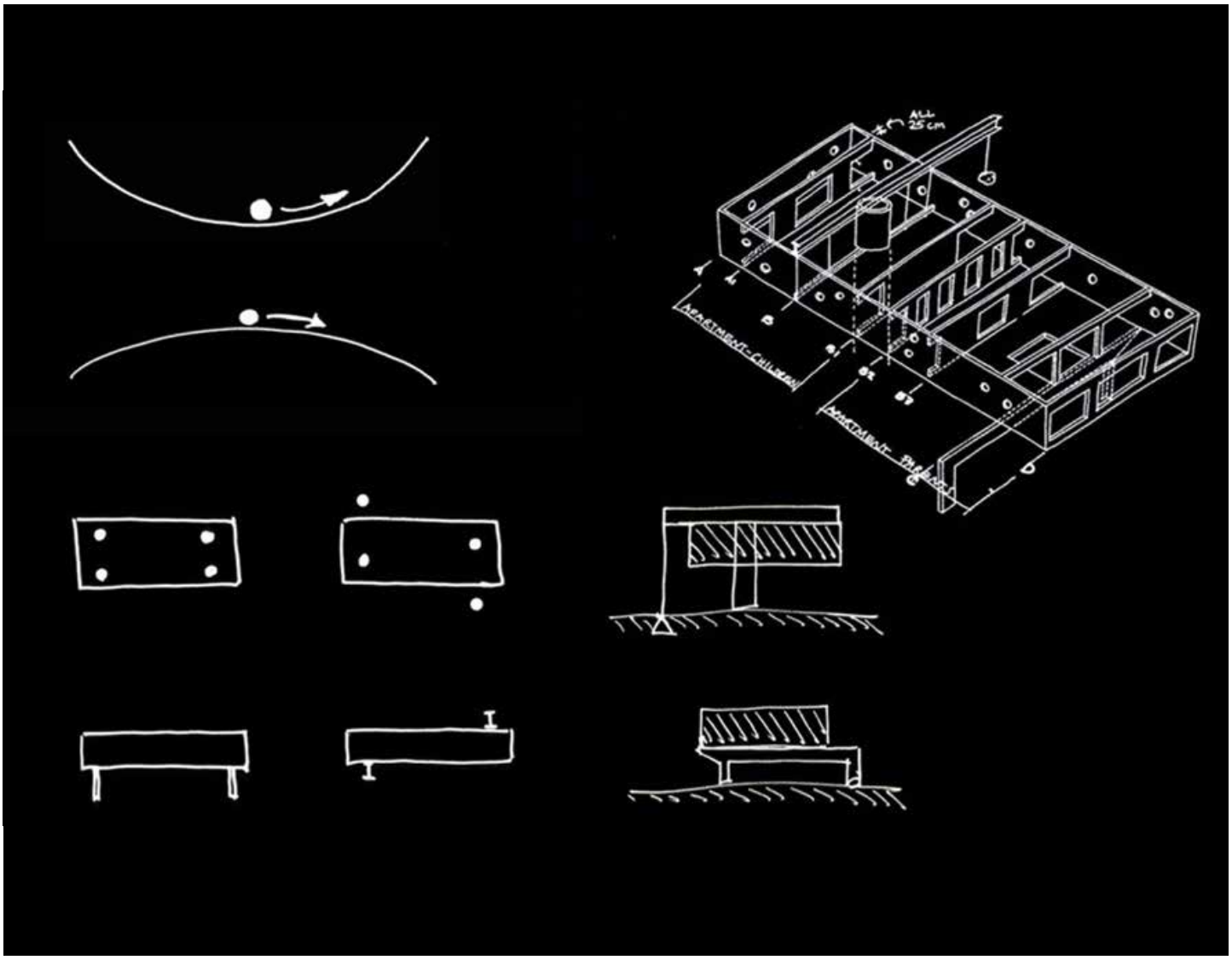
ODE TO OSAKA. Sverre Fehn, Scandinavian Pavilion, Osaka, 1970 (sketch and model competition entry)

Joint Effort is a series of spatial investigations which work in three distinguishable systems. The first system is how they are created — within a meticulously planned selection of materials such as marble slabs, glass or mirror panels, stones, concrete or granite forms, I-beams, bolts, and ratchet straps. The second system has to do with variables which are external to the materials; this is the correlational equilibrium that the artist determines for each sculpture, a physical interaction that weight cancels out pull, and pull cancels out immobility. Within this system, inside this play, the elements in the work are composed and balanced.

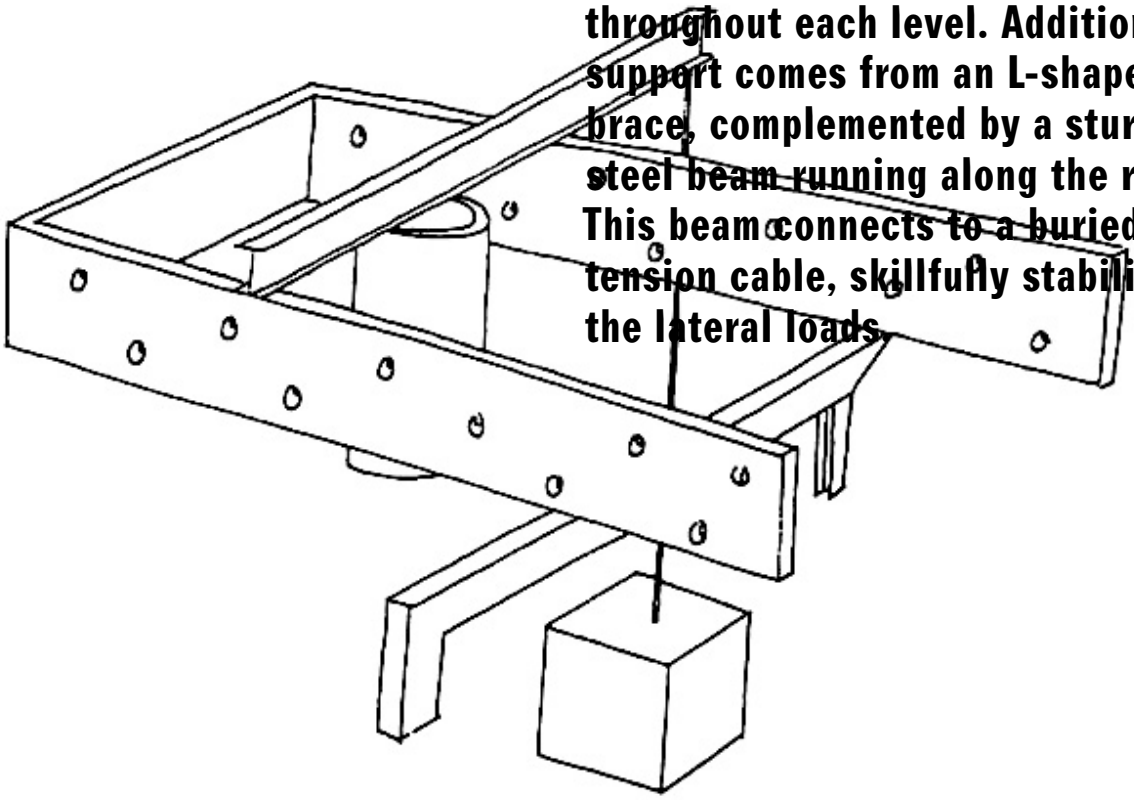
RCR's architectural philosophy finds significance in material textures. When closer to the volcanic ground, stone or concrete treatments appear rough and granular, while nearer to the sky, materials adopt a smoother, more transparent character. In the marquee, the steel rods supporting the bowing roof are detailed to stand free of the masonry walls on slender steel flanges, creating a hovering effect with a sense of strength and flexibility. The masonry joints are carefully designed to express mass and surface, reminiscent of ancient ruins concealed by a temporary shelter, evoking a post-industrial nomadic feel.

RCR Arquitectes, RESTAURANT LES COLS, Girona, 2013.

Image Pritzker Architecture Prize


ALL 25 cm

To fulfill the wheelchair access requirement, a room capable of vertical movement was designed within the house, infusing the office space with dynamic fluidity and constant redefinition. The building harnesses a gravity-defying illusion with a cantilevering volume, perched ontop of the middle section, seemingly floating in mid-air. Concealed within a steel tube, a spiral staircase gracefully extends throughout each level. Additional support comes from an L-shaped brace, complemented by a sturdy steel beam running along the roof. This beam connects to a buried tension cable, skillfully stabilising the lateral loads.



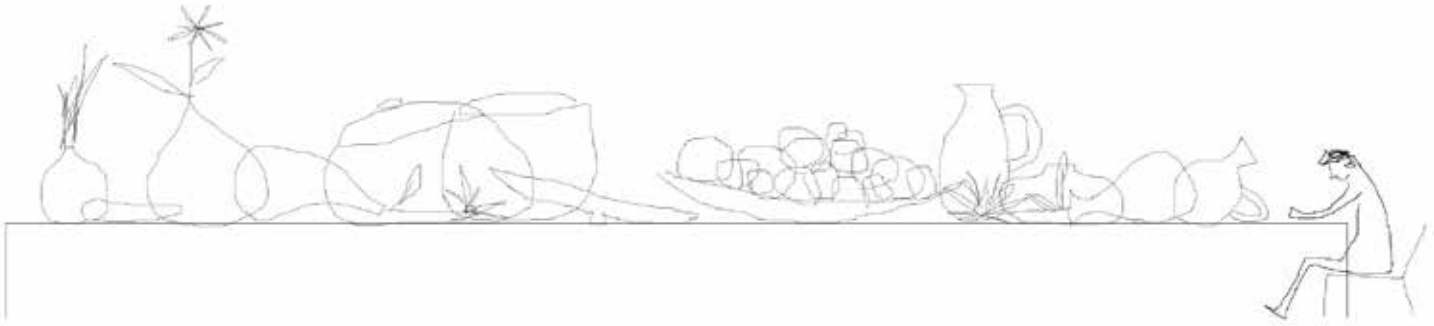
OMA with structural engineer Cecil Balmond, Arup, Maison Bordeaux, France,

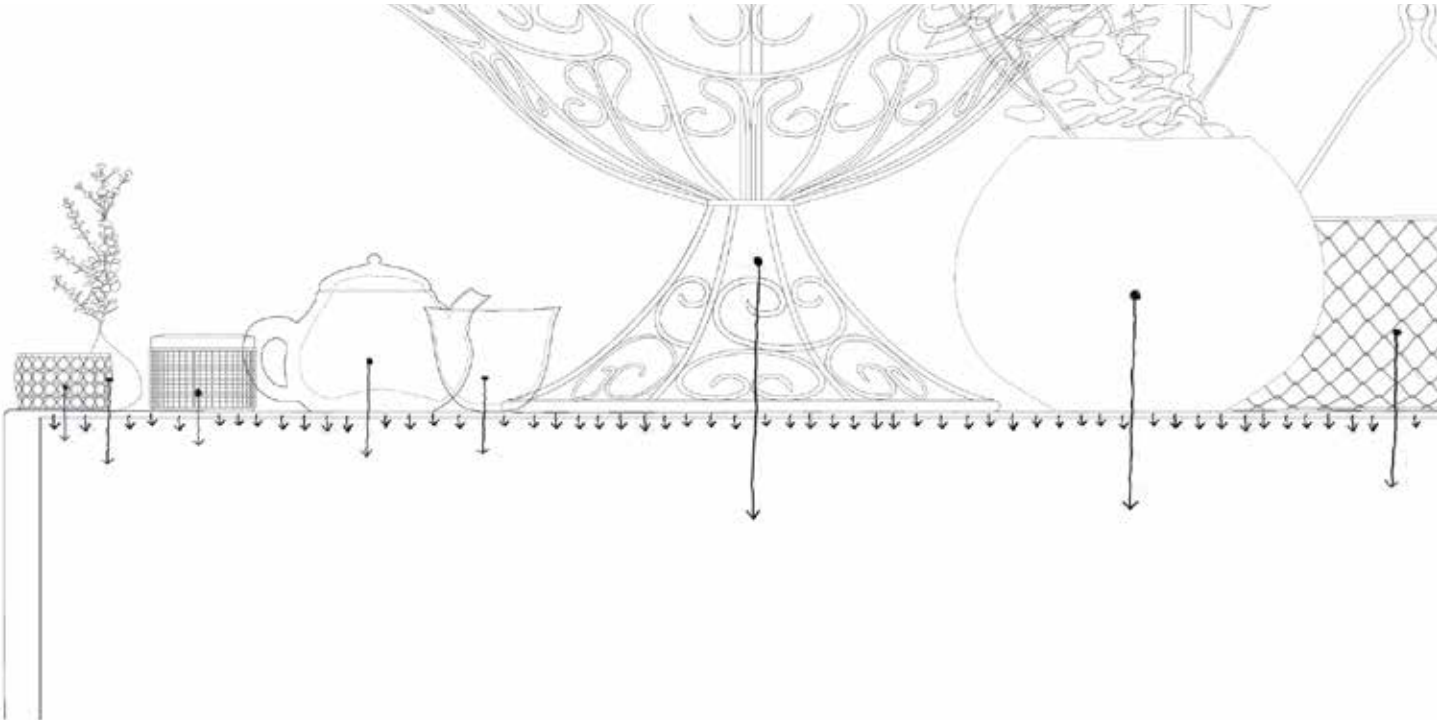
1998. Structural sketches by Balmond.

A semi-exterior void shapes a public square for the students of the Kanagawa Institute of Technology. The roof spans the buildings width without any interior supports, creating a seamless and unobstructed expanse that seems to embrace the outdoors due to the huge rectangular perforations above. The roof comprises of a series of welded steel plates, 12 millimeters thick. This velarium-like canopy possesses the ability to expand and contract, responding to changes in temperature, and offering a dynamic spatial experience, magnifying the users connection to the space.

Junya Ishigami + associates, KAIT PLAZA, Tokyo, 2020.

Photography Junya Ishigami + Associates



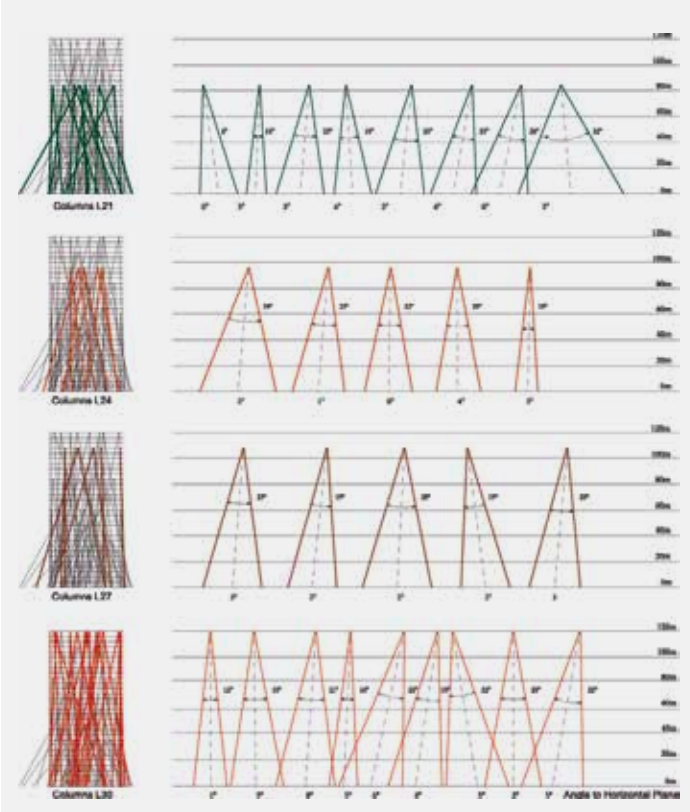


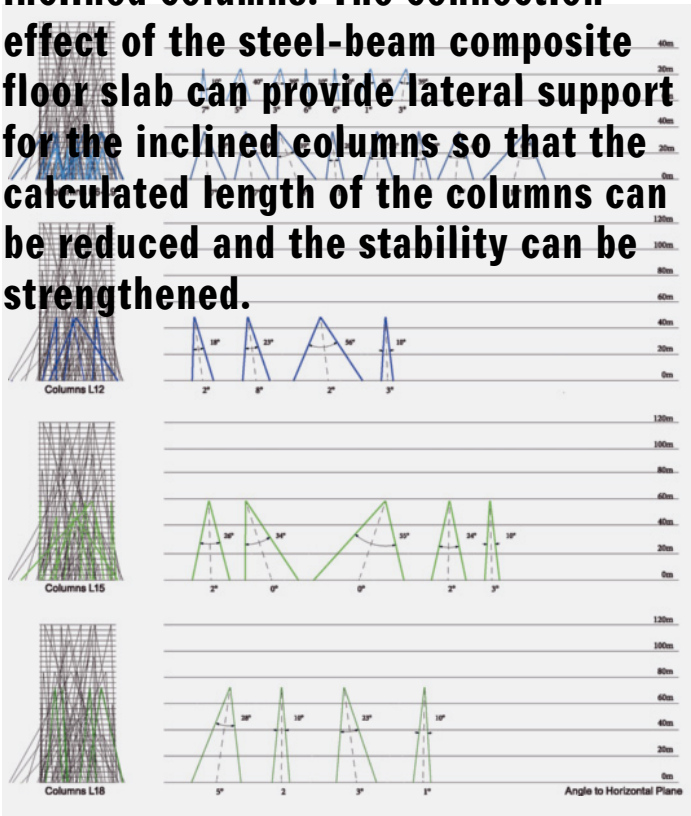
The table is constructed from a solitary 700 kg sheet of pre-stressed aluminium. It is first shaped and contoured into the likeness of a pig's tail. To achieve a level surface, the table is subjected to precise positioned loads from numerous objects, as calculated and applied, in order to ensure its structural stability. The intangibility of the finished piece is heightened by the subtle undulations that the surface creates when touched.

Junya Ishigami, TABLE, 2005–06, Tokyo, Osaka, Basel

1
70

The lateral resistant system consists of inclined steel frame work and shear wall. Because the inclined columns are slim and large in amount, they will redistribute the tension and the pressure in order to resist the horizontal load. Considering about the stability of the inclined columns, the additional steel beam will be used where the inclined columns and slab meet in order to connect different inclined columns. The connection effect of the steel-beam composite floor slab can provide lateral support for the inclined columns so that the calculated length of the columns can be reduced and the stability can be strengthened.





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1 Christian Kerez, HIGHRISE IN ZHENGZHOU 1, Zhenzhou CBD, China, 2011

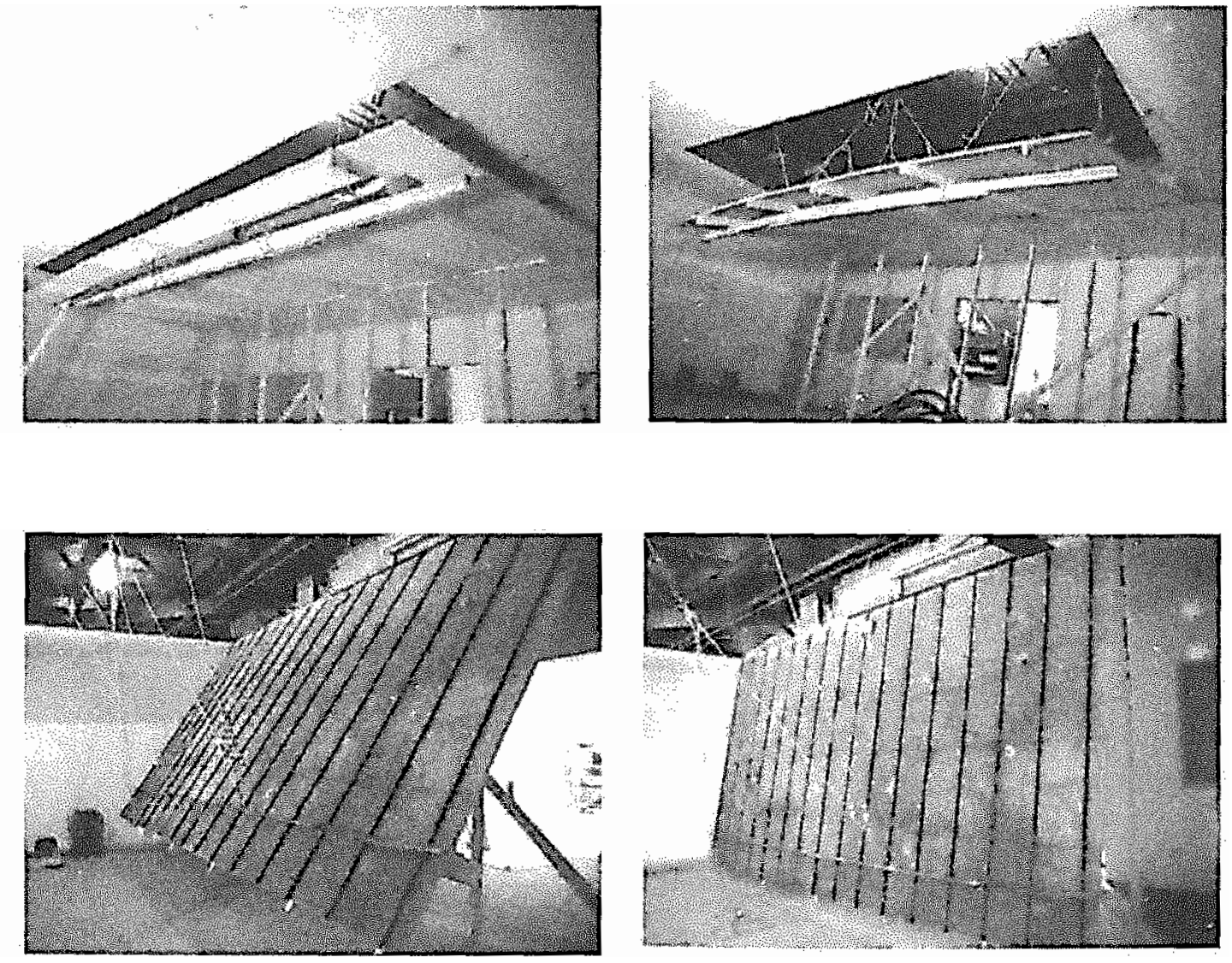
Photo. Milan Rohrer 2 Christian Kerez (1992–2015). EL CROQUIS, 2022.

Information taken from pg 290 & 291. Levels 6–18: Columns angles and

heights. Levels 21–30: Columns angles and heights.

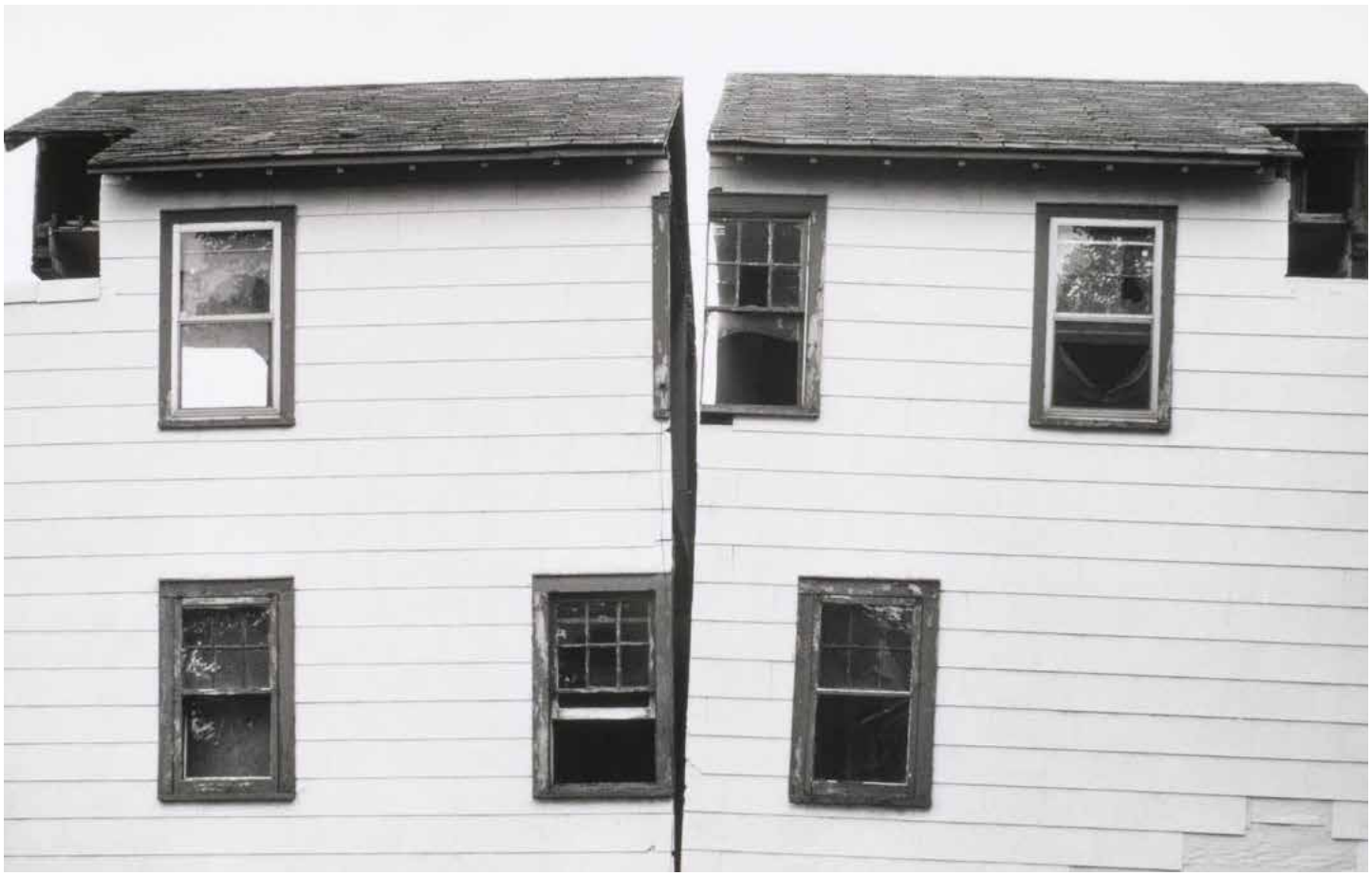
“An object on the wall does not confront gravity: it timidly resists it ... the ground plane, not the wall, is the necessary support for the maximum awareness of the object.”

—Robert Morris



STILL, Cranbrook Academy of Art, Bloomfield Hills, Michigan, 1989.

A gallery space was divided in half by cutting and rotating a portion of the ceiling vertically.

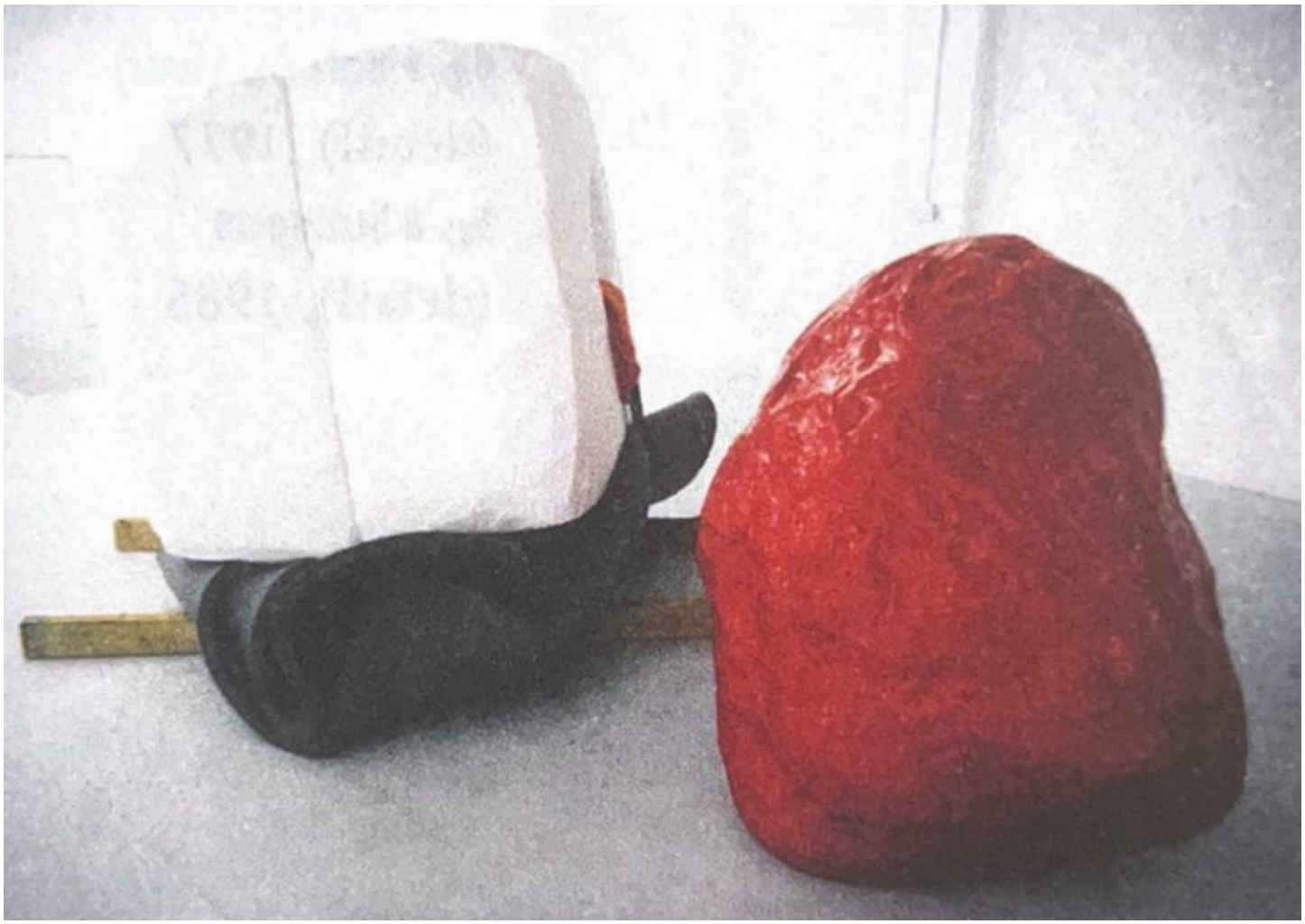


Gordon Matta-Clark held a profound fascination with voids, gaps, and especially those left abandoned. In his work, Splitting, he embarked on a daring venture alongside his companions to intentionally split a house, destined for demolition, into two distinct parts. The act involved a daring vertical slice that partitioned an old frame house in New Jersey, which belonged to the New York art dealer Holly Solomon.

Gordon Matta-Clark, SPLITTING, New Jersey, 1974.

The video captures the laborious efforts of Matta and his friends as they

grappled to create the rift through the very heart of the building.



“Drop, weigh, lazy, casual. I very much like the lazy gesture. And actually, the lazy gesture requires an enormous amount of organisation and exact precision to get it right. So, the lazy gesture might be something that’s thrown over or something that’s just rolled into place, or something placed on top of folded materials (above image). But in order to get that kind of sense of informality, there is a precision involved. Weight I find intriguing. I like the fact that gravity is a material in sculpture just as much as spaces. That the way gravity has to be worked with and against means it’s a very powerful companion alongside everything that one is doing with this kind of sculptural work. And it never goes away. It’s always there pushing things over, making things sit in a perculiar way. Working with it and against it becomes a real force in the making of the work. Then, along with gravity, there comes a way of using it through dropping and letting things fall. And I think that’s also part of a kind of a lazy gesture, which intrigues me.”
— Phyllida Barlow

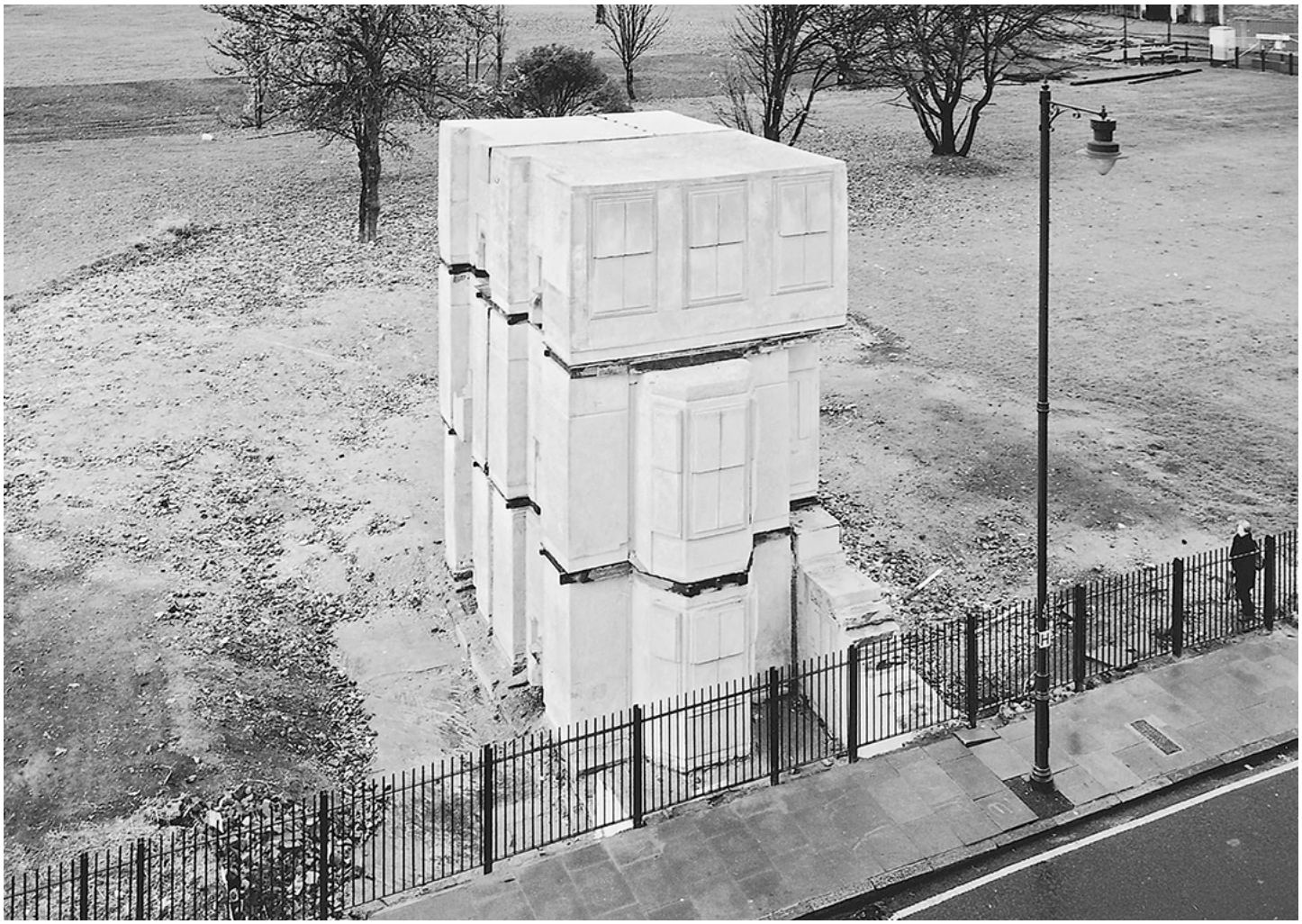
Phyllida Barlow, TRUCE (detail), Norwich School of Art and Design, 1997.

Text extract from Phyllida Barlow Collected Lectures, Writings and Interviews.

Hauser et Wirth Publishers, 2021.

The architectural design of the building presents a reinterpretation of the traditional tripartite composition found in 19th-century structures along the Cours Charlemagne or Place Bellecour. This reinterpretation involves a construction technique that emphasises a heavier foundation and gradually lighter elements as it reaches towards the sky, departing from the conventional base, shaft, and capital structure. The first three levels showcase columns constructed with stamped concrete, providing a sturdy and visually appealing foundation. Moving up, the middle two levels incorporate columns created through a vibrating process, similar to the technique used for the slabs and spandrels. Finally, the topmost three floors boast prefabricated columns made from centrifuged fiber concrete, ensuring strength and efficiency in their construction.

Christian Kerez, OFFICE BUILDING, Lyon, France, 2018. Photos Maxime Delvaux



In 1993 Whiteread leased the building and decided to produce a concrete cast of the inside of the house. After the furniture was removed and the windows sealed, new foundations were laid. The house was sprayed with a de-bonding agent in three layers and the walls were reinforced with steel mesh. Three floors were internally sprayed with concrete, after which a demolition team peeled away the skin of the building from the exterior, leaving the imprint of the house. The project proved controversial with the local council and was eventually demolished.

Rachel Whiteread, THE HOUSE, 1993, London. Completed on 25 October 1993

and demolished eleven weeks later on 11 January 1994.

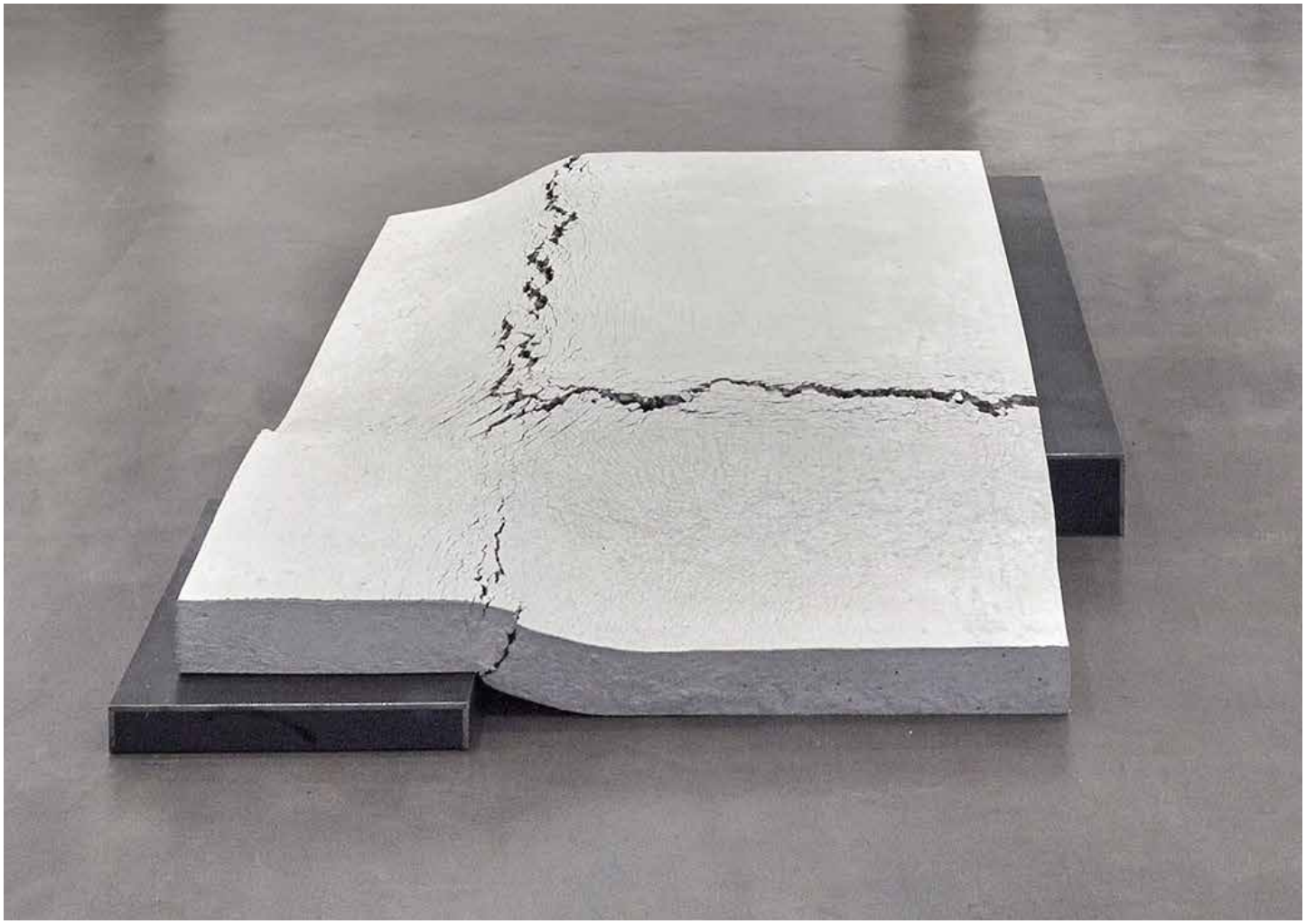
The Unfinished Obelisk was discovered in the early twentieth century after it had been covered by sand for thousands of years. It remains as you see it today in one of the Aswan quarries, famous for its supply of hard and high-quality stone. Believed to have been commissioned by Hatshepsut (c. 1473–1458 BC) for the temple of Amun in Karnak, work was abandoned because of flaws in the stone and the presence of multiple fissures. Had it been finished, it would have weighed 1168 tonnes, and stood at a height of around 42 metres, taller than any other ancient Egyptian obelisk.

THE UNFINISHED OBELISK, Aswan, Egypt, c. 1473–1458 BC

Amalgam as the opaque ability of a substance to forget. Amalgam is to override, to overwrite. To disallow the past. As opaque in appearance as transparent in its lack of structure. This indecipherable material responds to a parasite hierarchy, ours. The one where a extreme close-up prevails over any possible angle. As a sound, it would just be a collection of echoes. Plain reverberation where the original source is disconnected and not again recognisable.
But lifeless stuff is also subject to dynamics. The one of entropy, acceleration and the complication that systems suffer by default. That exponential progression of time and space. The opaque character of amalgam generates a position free of connotations but also the ability of mediating between subjects.
The healing of systems by enabling them forget.

Carlos Irijalba, THE CONQUER OF A VIRUS AND THE SCALE OF ITS BATTLEFIELD.

2013



“Concrete is typically characterized by its robustness. What other aspect would you want to show? Concrete does stand for robustness, but at the same time it is also quite brittle. I intend to fight against the gray, dull impassivity that concrete represents. To do that, I break it and try to dominate it. Or I manipulate it in its fresh, still very soft, clay-like state. Or I possess it instantly in such an almost fluid state, that as it sets, the fragility is in the foreground; this way, I don’t have to break the concrete first in order to create spatial tension through contrast.”
— Christoph Weber in an interview with Gabriel Roland

Christoph Weber, UNTITLED, 2015, exhibited at Anna Marra Arte

Friday, March 12, 1971 — THE DETROIT NEWS — 8-C

While spectators watch from the best available vantage points (above) three bulldozers (photo at right) move a 35-ton granite slab across the lawn of the Detroit Institute of Arts, completing the earth art of artist Michael Heizer.

Earth art

Artist's 35-ton granite slab buried in Institute lawn

By JOY HARVISON
News Art Critic

With a 20-ton crane, four bulldozers and a crane, New York artist Michael Heizer pushed a 35-ton granite slab through Michigan clay for nearly five hours yesterday to complete his earthwork sculpture outside the Detroit Institute of Arts.

He made eight trips and changed plans completely before the piece he calls "Main Displacement Detroit" was finished at 4:30 p.m.

HEIZER hadn't counted on the weight of what one excavator called "inner city leather clay."

The artist, whose work involves gouging and shaping the ground with earth-building equipment originally considered ripping his big stone with steel cables and dragging it through a previously dug trench with two dozer bulldozers.

Hooked one low on the first try, the granite skimmed across the ground with hardly a trace.

After loosening the cracked clay with their blades, the bulldozers hitched on to the stone for a second try. This time the granite shook and tore its 34-foot exit in the clay by the center.

Two smaller bulldozers, weighing in at 11 tons and nine tons, were added from a job at Harper Hospital at 1 p.m. Then pulled while the big bulldozers pushed the stone.

"I started a new path behind the stone," Heizer said at 3:10 p.m. "Not irredeemable."

Wearing two jackets, jeans and leather boots, the artist followed the bulldozers.

Was he discouraged? No, he said at 3:45 p.m.

"I'VE DECIDED to accept the trend matrix and all the footprints," he said. "That's part of working on a site. I'm used to doing this kind of thing in the desert where nobody sees the mistakes."

From 10 a.m., when the equipment arrived, and throughout the afternoon, a changing audience of 100 or so, mostly students from the Detroit Society of Arts and Crafts School across Kirby, watched.

The artist's wife, Sharon Heizer, rode on one of the machines.

Engineers from Gordon Sid-Way Co., rigging from Thomas Goodfellow Inc. and the crew of the bulldozers were impressed with Heizer.

From time to time they called out, "We'll get it this time, Mike."

Mark Jung, of Michigan Tractor and Machinery Co. said, "This is the first time we've been involved in an art work. We're having a great time."

HEI COMPANY donated machines and men for the Art Institute's sculpture, which was paid for by private funds raised by curator Samuel Wagstaff.

When the work was finished, Heizer said, "The public stays on. If we leave it off totally, it will wonder how such a big stone got dropped on the museum lawn."

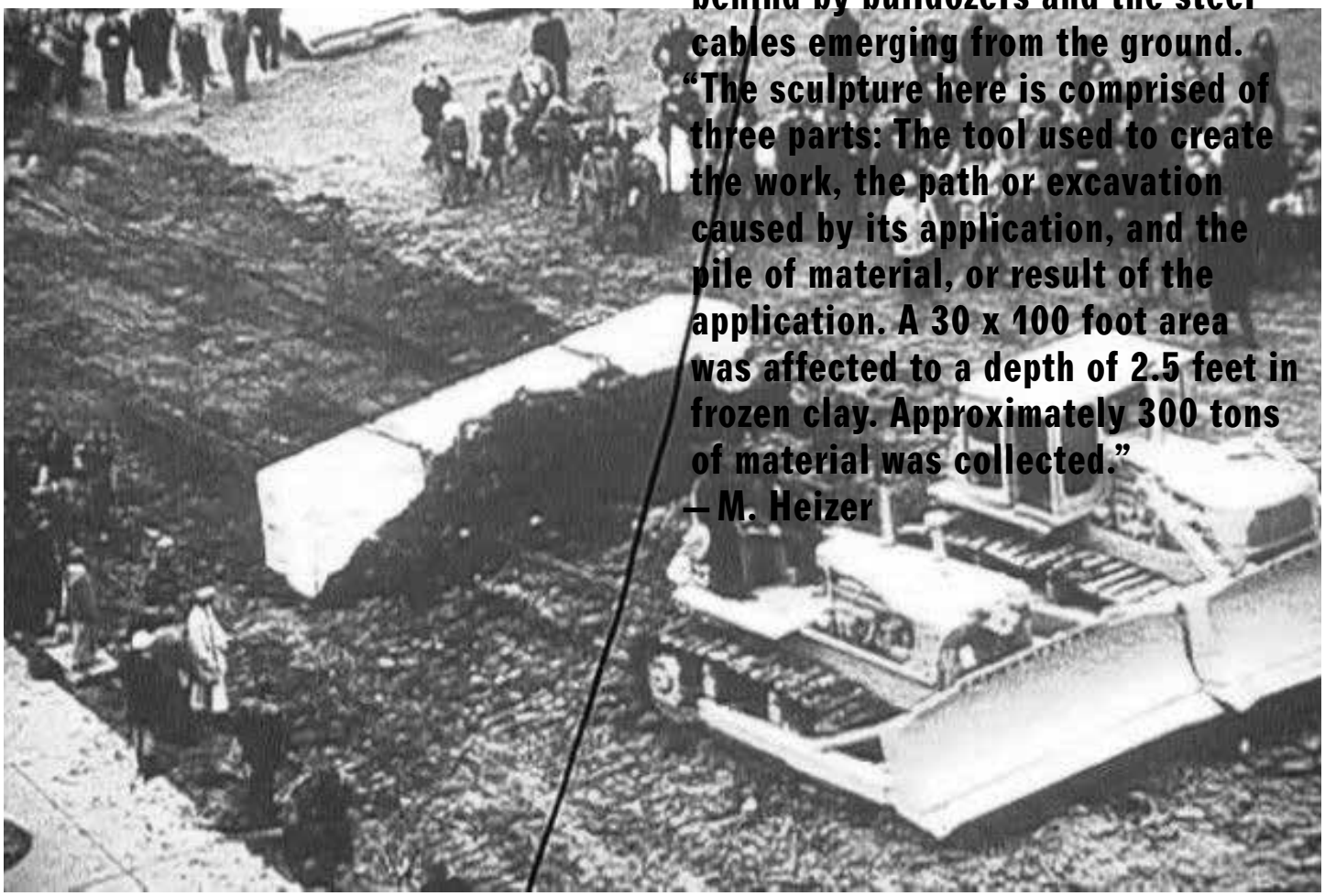
Not beautiful, but certainly honest and inspiring, Heizer's sculpture is certain to be controversial.

"I'm satisfied," he said. "Detroiters have learned needs me to help. This is the first sculpture of its kind in the country."

The artist's exhibit of photographic projections will open Wednesday at the museum for a month. His big piece on the lawn is permanent.

Artist Michael Heizer (left) supervises placement of the slab

The work centers around a thirty-ton granite block donated by the Rock of Ages Corporation. The piece entailed dragging this large mass across the north lawn of the Detroit Institute of Arts, as its sheer weight was pulled it imprinted it's movements into the earth, amassing a large heap of excavated soil. The scene marked by the distinct tracks left behind by bulldozers and the steel cables emerging from the ground. "The sculpture here is comprised of three parts: The tool used to create the work, the path or excavation caused by its application, and the pile of material, or result of the application. A 30 x 100 foot area was affected to a depth of 2.5 feet in frozen clay. Approximately 300 tons of material was collected."
— M. Heizer



Michael Heizer, DRAGGED MASS DISPLACEMENT, 1971,

Detroit Institute of Arts

The forms are crafted from solid glass, featuring smooth as-cast surfaces with oculus. Though these cylinders may seem static, they possess an imperceptible motion. Glass exists in a unique state, neither fully liquid nor solid, but rather an amorphous liquid solid, residing between those two states of matter. Its atoms move at a pace too slow for us to perceive the constant change it undergoes via gravity.

Roni Horn, WATER DOUBLE V. 3, 2013–15, New York. Photo Ron Amstutz

Bitumen is a sticky, black, semi-solid form of petroleum. Deformation properties and fatigue performance are strong characteristics of bitumen material, meaning that over time the material will deform by itself. Bitumen is mainly used as the liquid binder that holds asphalt together for roadworks. A bitumen-sealed road has a layer of bitumen covered with an aggregate. This is then repeated to give a two-coat seal. Asphalt is produced in a plant that heats, dries and mixes aggregate, bitumen and sand into a composite mix, it is then applied through a paving machine on site as a solid material at a required thickness, relative to the end use. Due to bituen's tendency to deform, asphalt results in a smoother and more durable asphalt road surface than a bitumen-sealed road.

Vilanova Artigas set out to challenge conventional notions of gravity's intensity and direction, drawing from our inherent understanding and bodily experiences. To achieve his vision, he approached load transmission in a unique manner, particularly concerning the interaction between the building and the ground.
See text in reader which furthur describes Artigas's understandings on architectural form and gravity.

João Batista Vilanova Artigas, UNIVERSITY OF SÃO PAULO FACULDADE DE

ARQUITETURA E URBANISMO (FAU/USP), 1961–1969

Oddvar I. N. Daren's artistic practice is often about making visible what already lies in the landscape, and the stories that came to light through physical traces. As the artist's body gradually steps down into the block extractions, the depth of the snow becomes visible.

Oddvar I. N. Daren, MEASUREMENT OF SNOW DEPTH, 1981.

Photographs exhibited at Kunsthall Trondheim, 2018.

GRAVITY

GRAVITY EXPLAINED

OXFORD DICTIONARY DEFINITIONS

Gravity: The force that attracts objects in space towards each other, and that on the earth pulls them towards the centre of the planet, so that things fall to the ground when they are dropped.

Center of gravity: The point in an object at which its weight is considered to act: at this point, the object is evenly balanced.

Synonyms: Pressure, Weight, Force, Heaviness

Antonyms: Levity, Weightedness

Gravity governs the vast expanse of the universe. It is responsible for the cohesion of the one hundred billion stars within our Milky Way galaxy, as well as the orbital movements of celestial bodies like the Earth around the Sun and the Moon around the Earth. The study of free and restricted fall was thoroughly examined by Galileo Galilei, who made significant contributions to our understanding of these processes. Isaac Newton further expanded upon these ideas, proposing the concept of gravity as a universal force. Albert Einstein,

in his groundbreaking work, described gravity as the manifestation of the curvature of the four-dimensional space-time continuum. Together, these brilliant minds have shed light on the fundamental nature of gravity and its profound impact on the workings of the cosmos.

HOW OBJECTS FALL

The roots of cosmology can be traced back to the Greek astronomer Ptolemy and the philosopher Aristotle. According to their beliefs, all material objects naturally moved toward the center of the Earth, with the exception of Fire, which possessed a divine quality and ascended from burning logs. For centuries, Aristotelian philosophy and scholasticism dominated human thinking. Scientific inquiries were resolved through dialectic arguments, without attempting to provide empirical evidence.

The first genuinely scientific exploration into the nature of falling objects was undertaken by the renowned Italian scientist Galileo Galilei (1564–1642). Galileo observed that when objects of different weights were suspended on equally long strings and deflected at the same angle, they took equal time to descend. From this, he deduced that if these objects were simultaneously dropped from the same height, they should also take the same amount of time to reach the ground. For instance, if you were to drop a coin and a small piece of paper from the same height, the coin would quickly descend while the paper would linger in the air for a longer duration. However, if you crumpled the piece of paper into a ball, it would fall almost as swiftly as the coin. Furthermore, if you were to conduct this experiment in a long glass cylinder devoid of air, you would observe that a coin, an uncrumpled piece of paper, and a feather would all fall at exactly the same speed.

Galileo also made a significant contribution to the burgeoning field of mechanics with his discovery of the principle of superposition of motion. He illustrated this concept by considering the motion of a stone thrown horizontally. In the absence of gravity, the stone would move in a straight line. However, if the stone were dropped instead, it would fall vertically with an increasing velocity. In reality, both motions are combined, resulting in the stone moving horizontally with a constant velocity while simultaneously undergoing accelerated vertical descent.

Arrows like these that show the consecutive positions of a moving object with respect to the point of origin are called displacement vectors and are characterised by their length and their direction in space. Forces can also be represented using vectors, which indicate both the direction and magnitude of the

applied force. These vectors can be combined using the same rules of vector addition. Let's consider the gravity force acting on an object placed on an inclined plane as an example. Although the gravity force is directed vertically downwards, we can represent it as the sum of two (or more) vectors pointing in different directions by employing the reverse method of vector addition. In this particular example, we want one component of the vector to point in the direction of the inclined plane, while the other component is perpendicular to it, as depicted in the figure.

Isaac Newton is widely recognised for his significant contributions to the discovery and understanding of gravity, particularly in establishing that the force of gravity diminishes as the distance from the Earth increases. One of Newton's fundamental laws of mechanics states that a force acting on a material body imparts an acceleration that is directly proportional to the force and inversely proportional to the mass of the body. For instance, it requires twice the effort to accelerate a body with double the mass to the same speed. Based on Galileo's observation that all bodies, regardless of their weight, fall with the same acceleration in the presence of gravity, one can deduce that the gravitational forces acting on these bodies are proportional to their mass, representing their resistance to acceleration. Consequently, it follows that gravitational force is also expected to be proportional to the mass of another body.

The gravitational attraction between the Earth and the Moon is very large because both bodies are very massive. The attraction between the Earth and an apple is much weaker because the apple is so small, and the attraction between two apples must be quite negligible. By using arguments of this kind, Newton came to the formulation of the Law of Universal Gravity, according to which every two material objects attract each other with a force proportional to the product of their masses, and inversely proportional to the square of the distance between them.

EINSTEIN'S LAW OF GRAVITY

In 1914, Albert Einstein made a significant breakthrough. His ideas stemmed from his earlier formulation of the special theory of relativity. This theory is based on the principle that observations made within a closed chamber cannot determine whether the chamber is at rest or moving in a straight line at a constant speed. Therefore, an individual inside an enclosed cabin, such as the author in the present scenario aboard the S.S. Queen Elizabeth sailing on a calm sea, cannot perform any experiment – mechanical, optical, or otherwise - to determine whether

the ship is in motion or docked at port. However, if a storm arises, the situation changes dramatically, as the departure from uniform motion becomes evident.

To address the issue of non-uniform motion, Einstein envisioned a laboratory located far from any significant gravitational masses within a spaceship. If the vehicle is at rest or moving uniformly relative to distant stars, the observers inside and all unsecured instruments will experience free-floating conditions. There will be no sense of up or down. However, once the rocket engines are activated and the ship accelerates, instruments and individuals will be pressed against the wall opposite to the direction of motion. This wall will effectively become the floor, while the opposite wall becomes the ceiling, allowing people to stand up and move around much like they would on the ground. In fact, if the acceleration matches the acceleration due to gravity on Earth's surface, passengers may even mistakenly believe that the ship is still on its launch pad.

Let's imagine that one of the passengers simultaneously releases two spheres, one made of iron and the other of wood, which they were holding next to each other in their hands. The 'actual' occurrence can be described as follows: While the spheres were held, they experienced accelerated motion along with the observer and the entire ship. However, once released, they are no longer influenced by the rocket engines. Consequently, the spheres will move side by side, each with a velocity equal to that of the spaceship at the moment of release. Meanwhile, the ship itself will continue to gain speed, causing the 'floor' of the ship to catch up to the two spheres rapidly, ultimately striking them simultaneously.

ANTIGRAVITY

The concept of gravitational polarisation, which could potentially enable protection against the force of gravity, relies on the presence of two types of particles in matter: those with positive gravitational mass, which are attracted by the Earth, and those with negative gravitational mass, which are repelled. While positive and negative electric charges and north and south magnetic poles are both commonly observed in nature, particles with negative gravitational mass have not yet been discovered, at least within the framework of ordinary atoms and molecules. Consequently, ordinary matter cannot undergo gravitational polarisation and cannot function as a shield against gravity.

Gyroscopes, when twisted, generate a force that operates in a direction perpendicular to the plane of rotation and may appear to lift themselves against gravity. Although this force is known to be deceptive, even in

the context of Newtonian models, it has nonetheless led to numerous claims of anti-gravity devices and the development of various patented apparatuses.

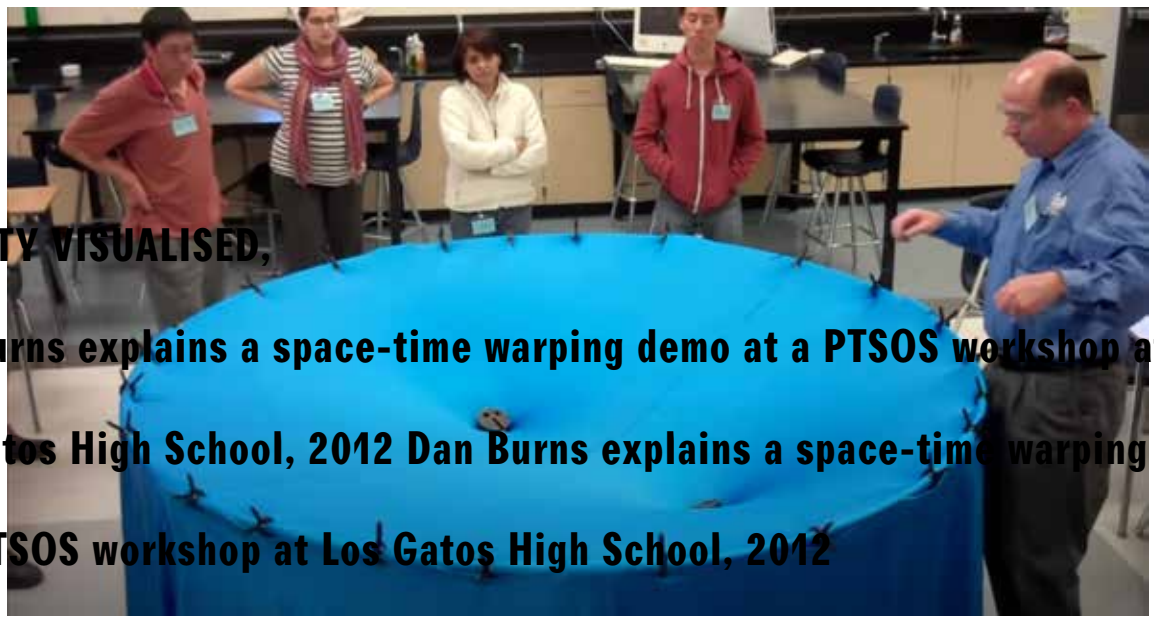
NASA ARTIFICIAL GRAVITY

A tether satellite system refers to a system in which two satellites are connected by a tether. By rotating the two bodies connected by the tether, it is possible to create artificial gravity within the system. This can be useful for studying the effects of gravity on biological systems or conducting experiments in a simulated gravity environment.

GRAVITY ENERGY STORAGE

Gravity energy storage is a type of energy storage system that utilises the potential energy of objects raised to higher positions to store energy. The basic concept involves lifting heavy objects or materials against the force of gravity when there is excess energy available in the electric grid, and then releasing that energy when it is needed.

A common example of gravity energy storage is the use of stacked concrete blocks or other heavy masses. During times of excess energy production, the energy is used to lift these blocks to a higher position. This process stores potential energy in the elevated position of the blocks. When the stored energy is needed, the blocks are allowed to descend, and the potential energy is converted back into kinetic energy, which can be used to generate electricity.

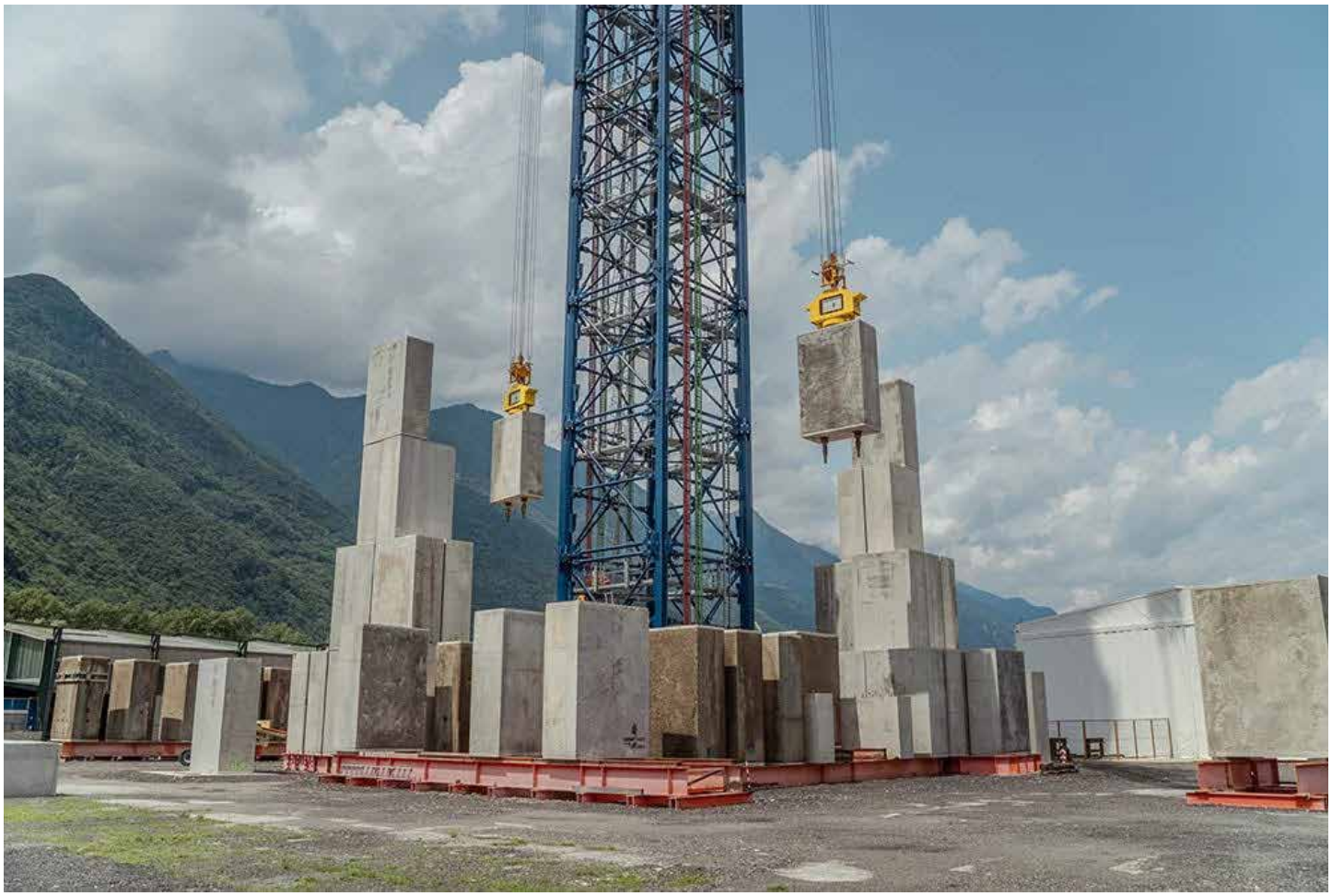


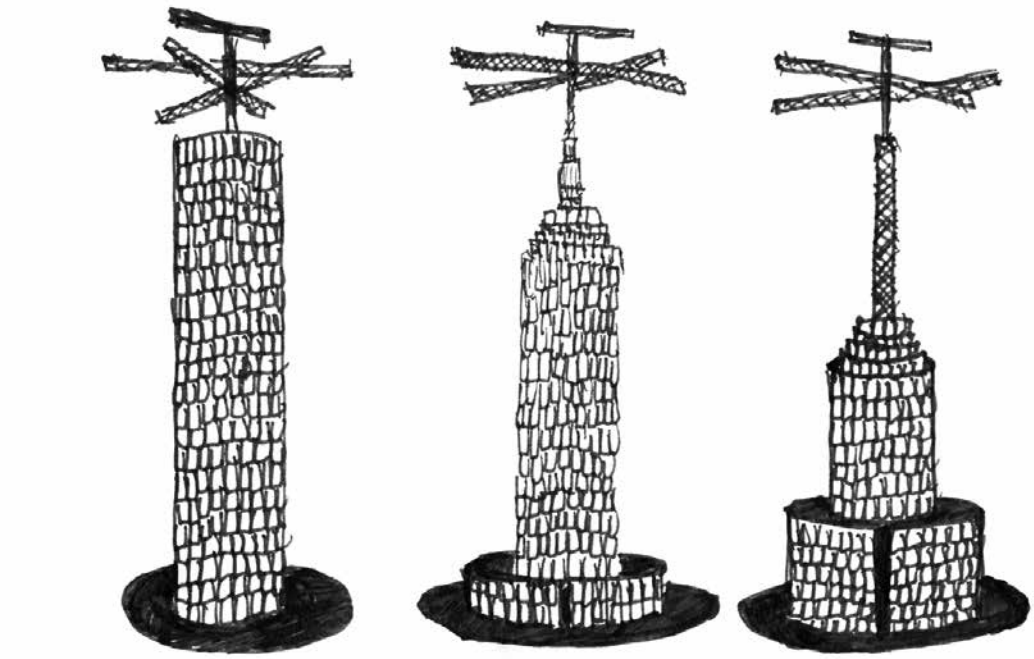
GRAVITY VISUALISED,

Dan Burns explains a space-time warping demo at a PTSOS workshop at

Los Gatos High School, 2012 Dan Burns explains a space-time warping demo

at a PTSOS workshop at Los Gatos High School, 2012





GRAVITY ENERGY STORAGE
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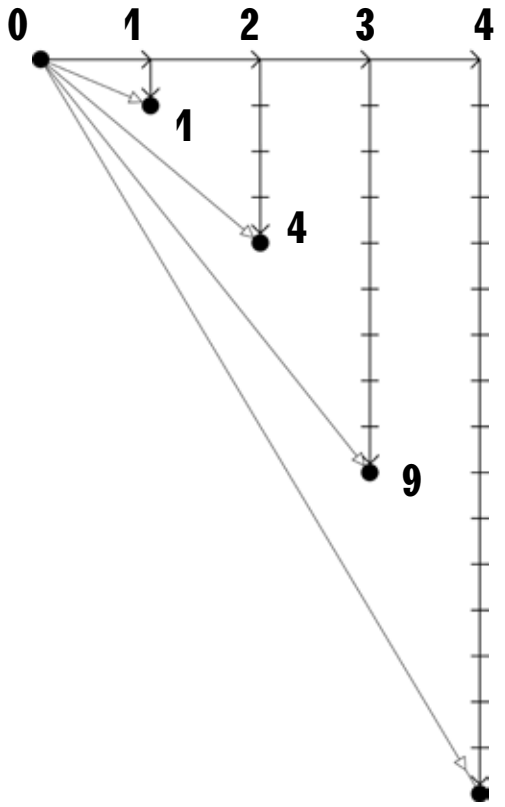
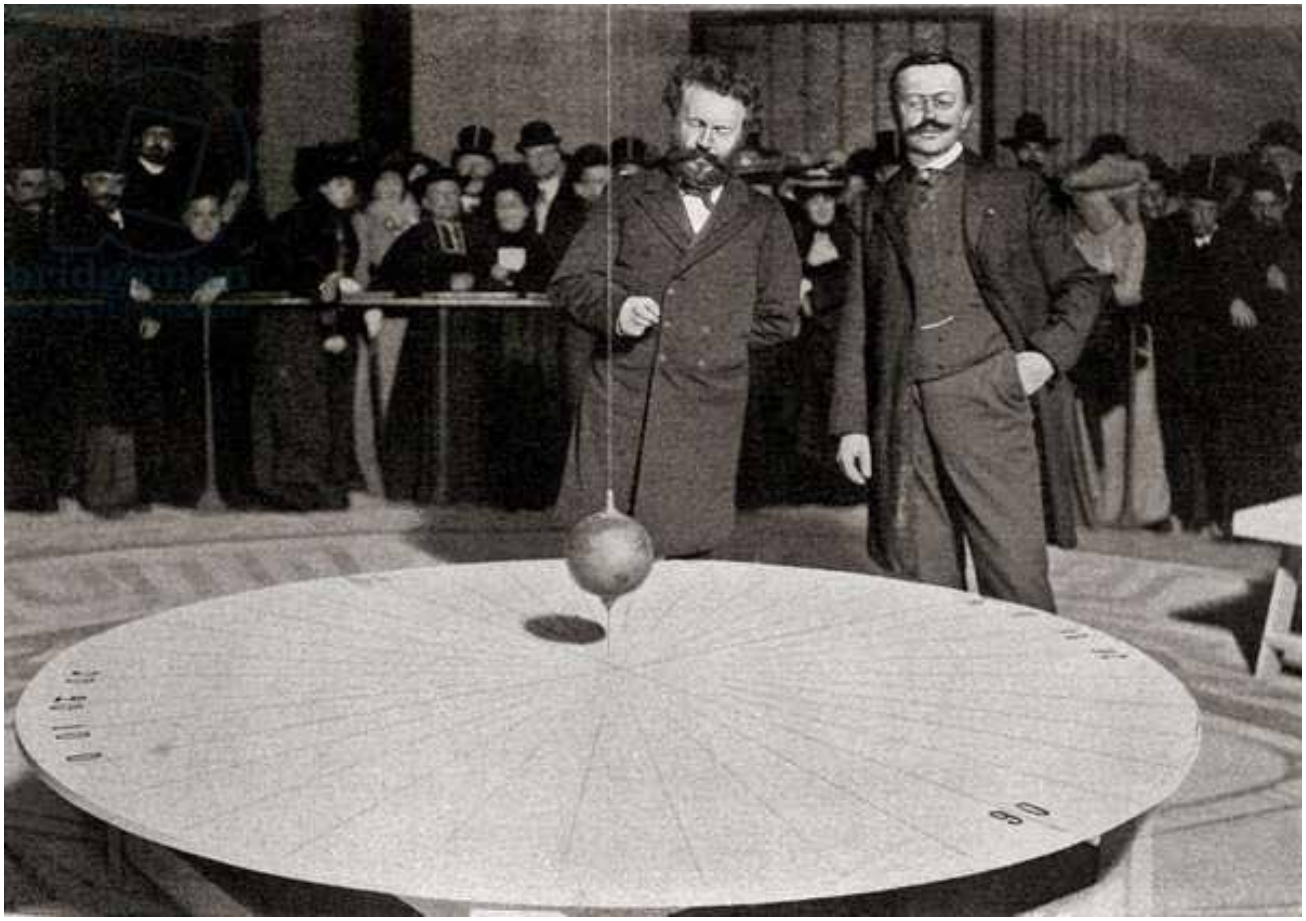
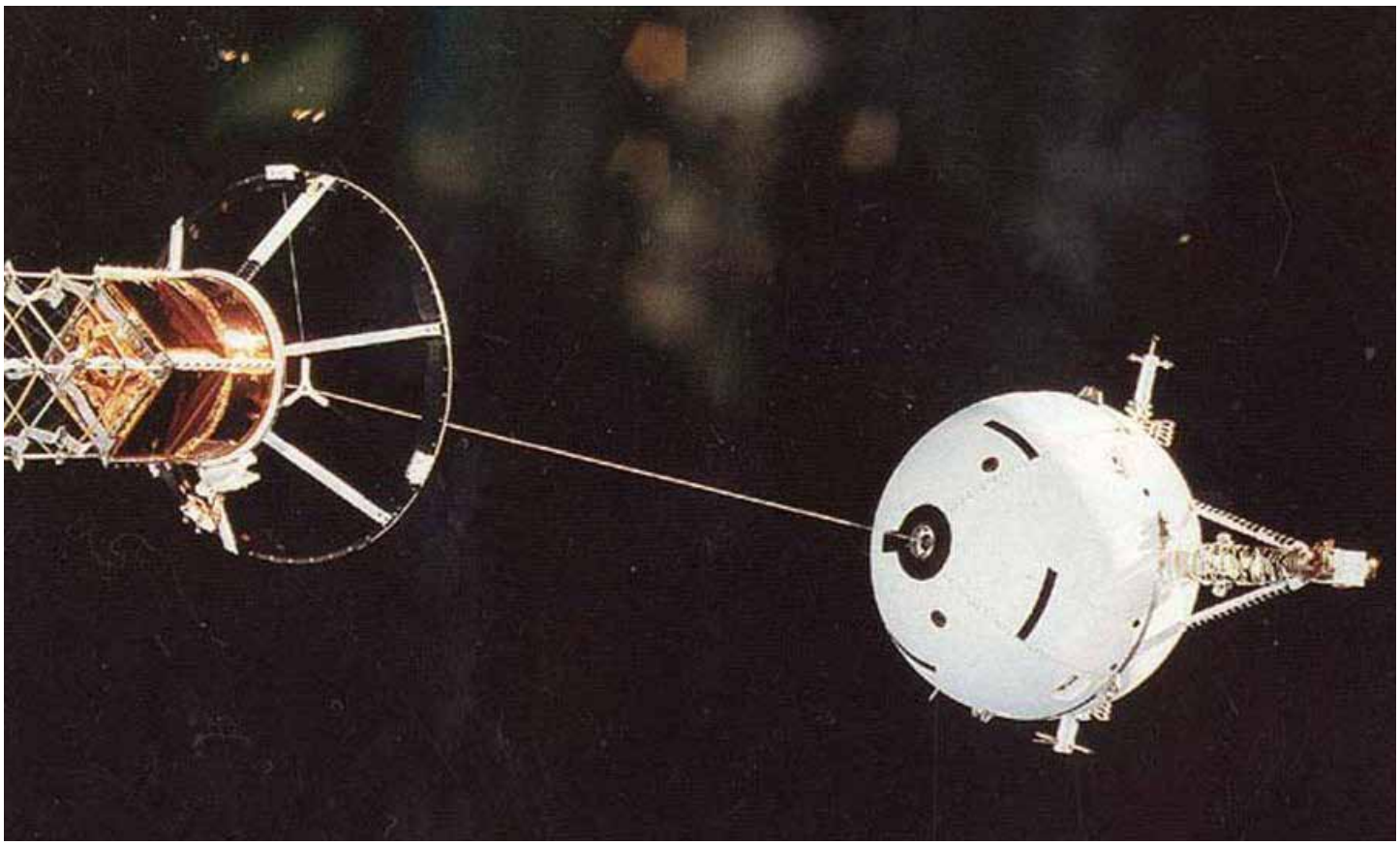


A COMBINATION OF HORIZONTAL MOTION WITH CONSTANT VELOCITY,

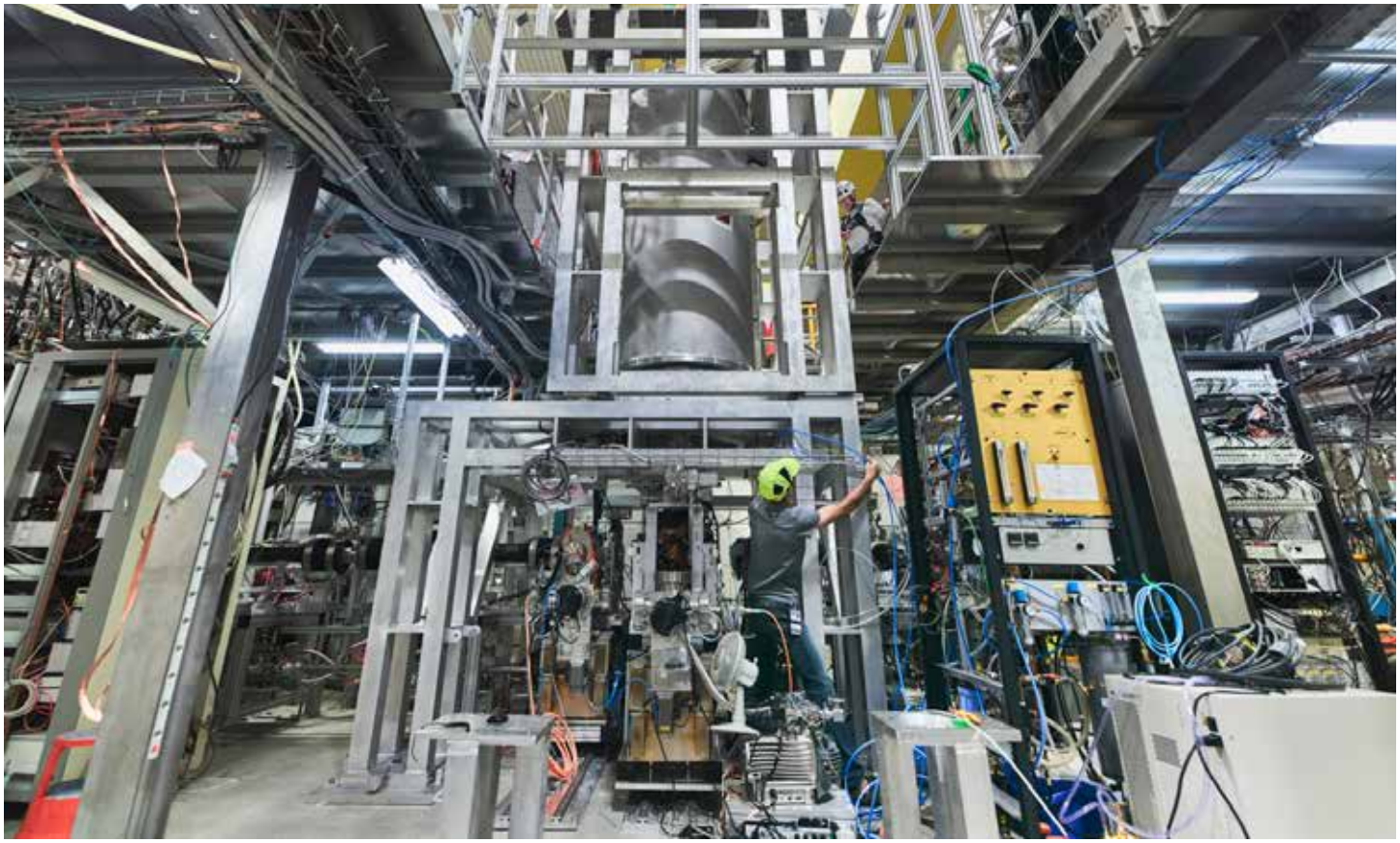
AND VERTICAL, UNIFORMLY ACCELERATED MOTION



FOCAULT'S PENDULUM



NASA ARTIFICIAL GRAVITY



ANTIMATTER GRAVITY EXPERIMENTS

EFFECTS ON STRUCTURE: IMPACT, TENSION & LOAD

THE INFLUENCE OF GRAVITY ON IMPACTS ON STRUCTURES

According to the formulation, when an impact occurs in the direction of gravity, it is influenced by both gravity and displacement of the structure, as well as the contact force. The formulation establishes that, for a given mass of the projectile, the structural response can be expressed as the sum of a kinetic term, dependent on the impact velocity, and a gravitational term, which remains constant for that particular mass. Consequently, as the impact velocity (or the height of the fall) increases, the significance of the gravitational term diminishes in comparison to the kinetic term. Remarkably, the formulation has been demonstrated to accurately match test results, regardless of the relative importance of these two terms in each specific case. Research findings suggest that when experiencing large accelerations, the influence of gravitational acceleration can be disregarded.

The failure modes of reinforced

concrete deep beams can be summarised as follows:
Flexural failure: This occurs when there is a low percentage of tension steel, resulting in the yielding of reinforcement at a section of maximum moment.
Diagonal-Tension failure: The initiation of a diagonal crack starts from the last flexural crack and gradually turns into a more inclined crack under shear loading. With further applied load, the tension crack extends at a very flat slope until sudden failure ultimately occurs.
Shear-Tension failure: In regions where both moment and shear are present, a curved tensile crack may develop. This crack can propagate backward along the longitudinal reinforcement from the inclined crack, leading to a loss of bond. As the main reinforcement begins to slip, the deformations on the bars contribute to the splitting of the concrete and further propagation of the crack.
Shear-Compression failure: Under the load, the vertical compressive stress reduces the likelihood of additional tension cracking. Similarly, the vertical compressive stresses over the reaction limit bond splitting and diagonal cracking along the steel. However, this crack concentrates shear resistance within a limited depth, resulting in increasing stresses. As a result, the crack tends to propagate until it is halted by the load or reaction forces.

FORM-FINDING

Frei Otto, Heinz Isler and Sergio Musmeci opened up new ways to form finding. Their broad curiosity in multiple fields and their innovative approaches contributed to changing the perspective on the discipline of structural engineering. The wide-ranging fascination with natural phenomena formed the starting point for the development of their design methods. Otto's biological processes, Isler's natural references and Musmeci's studies of the mathematical laws behind them were reflected in their practical production. Vector active structure systems in their skeletal transparency are a convincing expression of our inventive genius of manipulating forces and mastering gravity.

HEINZ ISLER

Isler's primary objective in design is to recreate 'natural' shell shapes by employing a physical form-finding process. While the designer establishes the experimental setup, including boundary conditions and material selection, the subsequent evolution of the process occurs organically. Isler's experiments share similarities with Otto's work but differ in their underlying goals. Whereas Otto focuses on studying the evolutionary process, Isler relies on his static intuition to achieve a specific form. The concept of a pneumatic membrane pertains to

a surface subjected to pressure, while the form derived from the hanging membrane is an extension of the catenary curve into three-dimensional space. Throughout his work, Isler also draws inspiration from biological objects, employing them as powerful imagery to reinforce his design approach.

FREI OTTO

Otto's approach to form-finding serves as a methodology rooted in direct observation and the emulation of natural processes. In both living and non-living entities, each element develops a distinct form through an adaptive process, influenced by a combination of compressive, tensile, and bending forces. One of Otto's most renowned experiments involves studying soap films, which adhere to the principles of minimal surface tension within defined boundaries. This behaviour ensures constant stresses and an optimal distribution of material. By investigating natural phenomena through physical experiments, Otto gains insights for designing spatial cable networks, enabling him to conceive forms that surpass conventional structural typologies and have yet to be realised in the artificial realm.

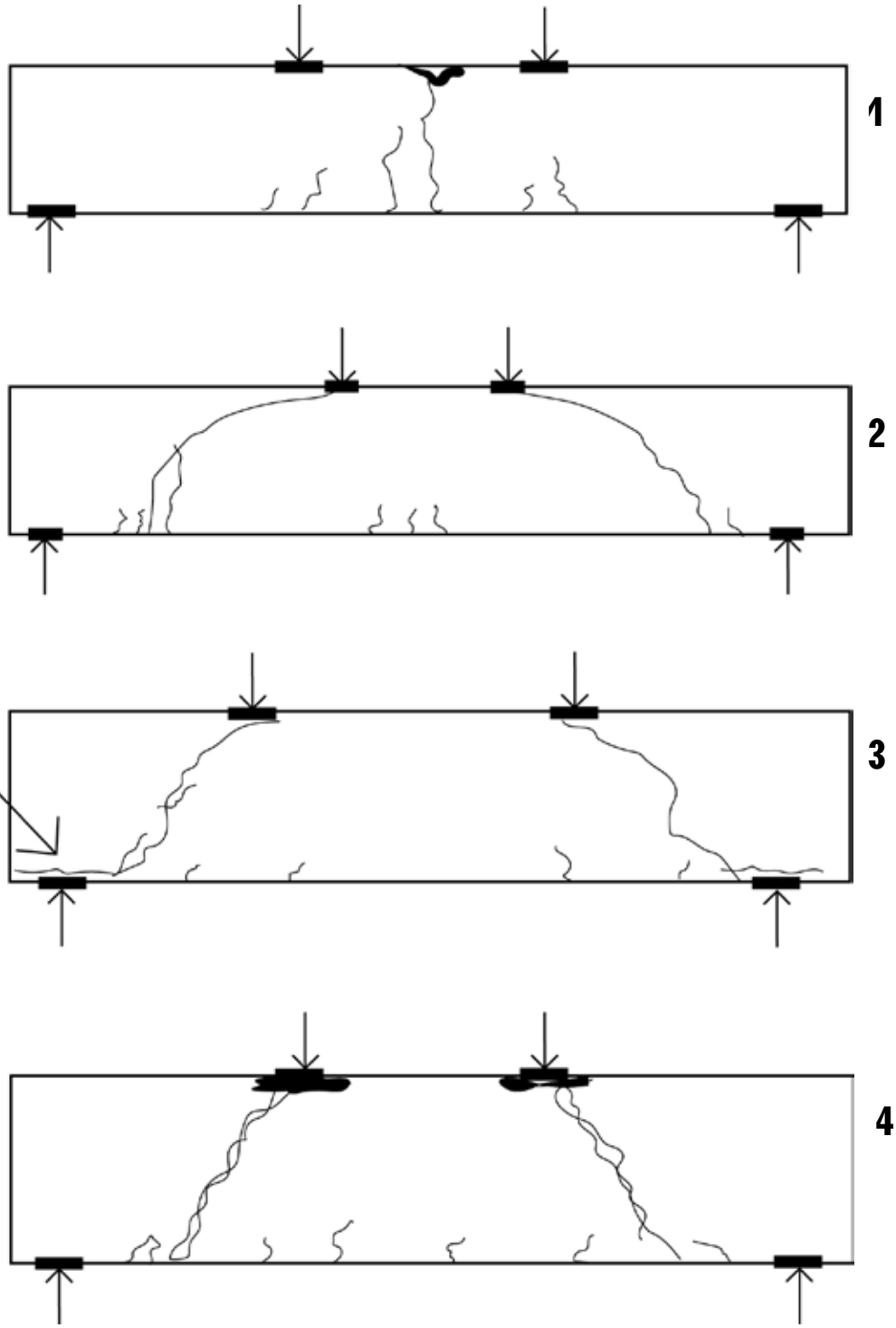
INITIAL DESIGN FOR THE MANNHEIM SHELLS

In January 1970, the decision was made to host the Bundesgartenschau 1975 (Federal Garden Show) in Mannheim. As part of the event, a multipurpose hall was planned to be the central attraction. It would be situated alongside a thoroughfare, with a restaurant on the opposite side. One distinctive feature of the site, located in the flat Rhine plain, was a large mound created from war debris. The landscape architect envisioned extending the hilly form using architectural techniques. This led the architects to approach Otto, who had conducted grid shell experiments, and they arranged a meeting at Atelier Warmbronn. Initial wire mesh models were created by the architects and collaborators at Atelier Warmbronn. Eventually, a 1:500 scale model emerged, featuring two large dome structures connected by covered walkways. This model served as the sketch design. Once the design was approved, the architects finalised the boundary lines, and the Atelier began working on the final model using hanging chains. This model, at a 1:100 scale, defined the building's geometry. The chains consisted of hooked links connected to small circular rings, which served as nodes. Each chain grid dimension represented every third lath line of the actual structure. The ends of the link lines were attached to the boundary line using small adjustable springs, ensuring reasonably uniform tension within the grid. These springs were crucial in achieving a balanced

distribution of forces in both directions of the grid.
Stereo photography was employed to measure the model, and the resulting photos were processed to obtain the node coordinates. The engineers at the Institut Für Anwendungen der Geodäsie im Bauwesen at the University of Stuttgart, led by Professor Linkwitz, then analyzed the form using a recently developed method called force densities, pioneered in their department.
The construction principle involved laying out the laths at ground level and inserting the node bolts without tightening them. The laths would then be raised to their intended shape as a doubly curved shell. This process caused the squares of the mesh to distort into parallelograms, necessitating the adjustment of the lath ends to fit within the boundary edges. The grid had to be supported in this shape until the node bolts were tightened, allowing it to become sufficiently rigid to bear its own weight. Flexibility was crucial during installation, while rigidity was required afterward.

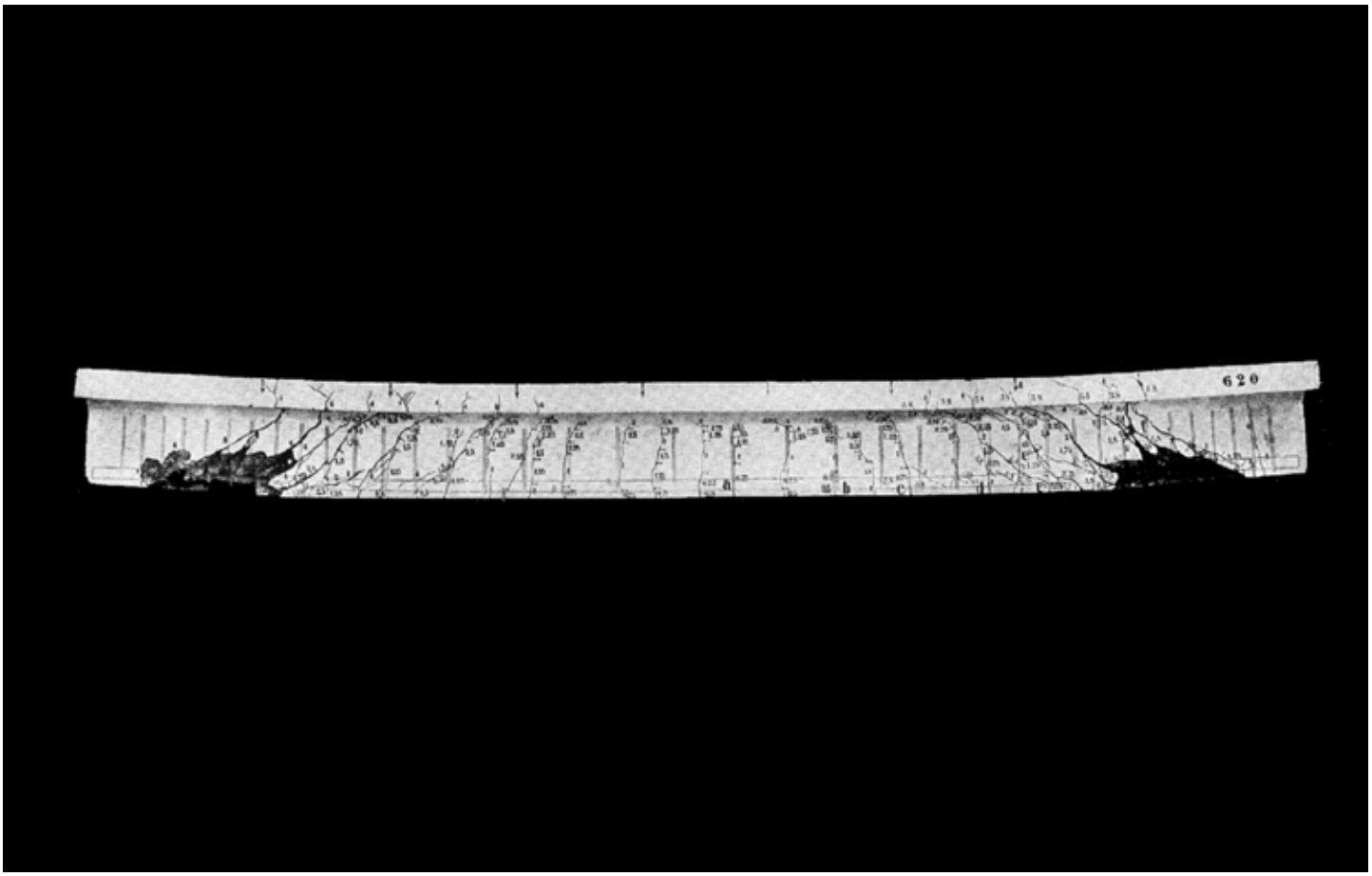
SERGIO MUSMECI

In contrast to the traditional theory of structures, which assumes geometry as a predetermined input and focuses on assessing and verifying internal stresses as the primary goal of the analytical process, Musmeci emphasises that the true unknown in structural design is the form itself. This groundbreaking perspective introduces new possibilities and avenues in the field of structural design. Consequently, analytical methods transform into powerful design tools for shaping and optimising structures, as well as efficiently utilising materials.
Musmeci introduced the concept of 'static action'. This refers to the algebraic product of the force acting on a structural element (positive for tension and negative for compression) and the length of that element. By summing up the 'static actions' across all structural elements in equilibrium, Musmeci defines the 'total static action,' which characterises the system of external forces applied to the structure and remains independent of its specific configuration.
This fresh perspective on structures paves the way for Musmeci's exploration of various structural typologies that exhibit a harmonious relationship between form and force flow. Ranging from continuous surfaces to spatial lattice structures, these typologies embody meticulous consistency. Musmeci's primary design objective lies in discovering forms that minimise the amount of material necessary to withstand a given load. This pursuit of essentiality ultimately leads to achieving maximum synthesis in design.



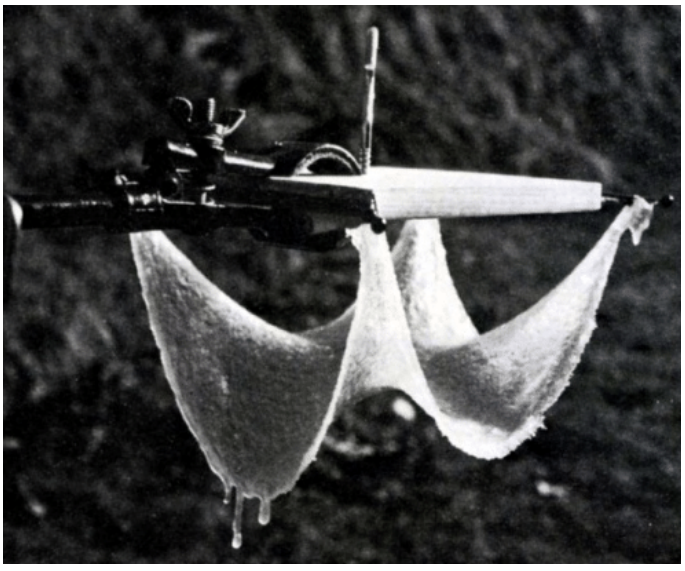
TYPICAL FAILURES IN SLENDER AND SHORT BEAMS

(1) Flexural Failure, (2) Diagonal-Tension Failure, (3) Shear-Tension Failure, (4) Shear-Compression Failure



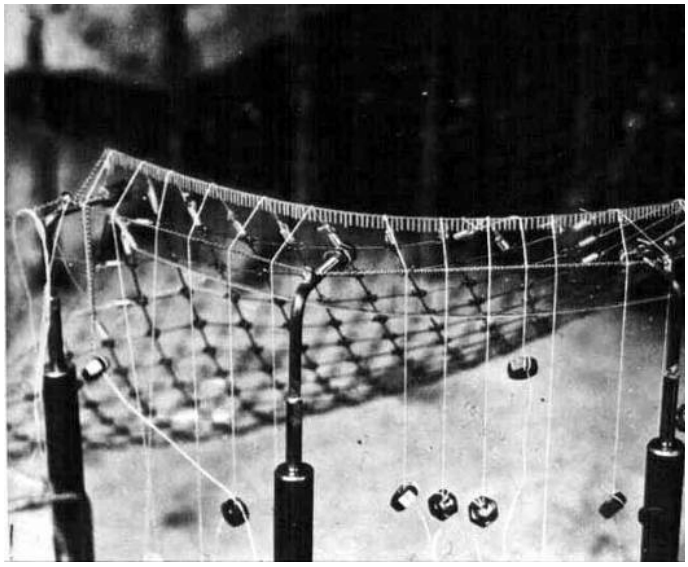
MAPPED FAILURES IN CONCRETE BEAMS

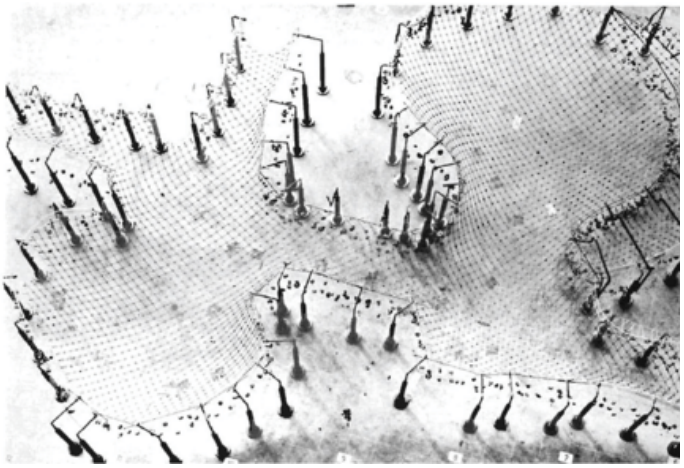
Sergio Musmeci, PONTE MUSMECI, Italy, 1976

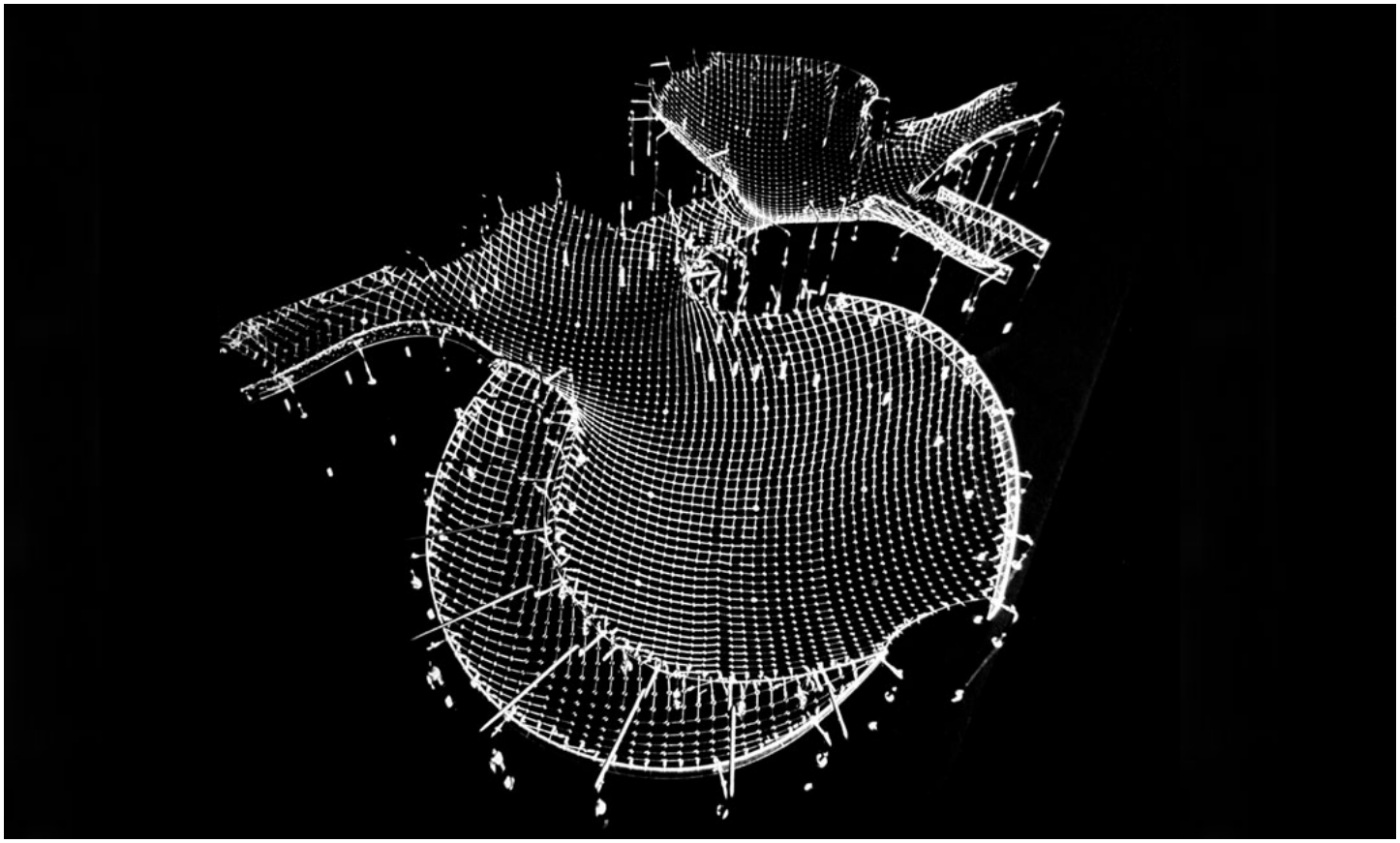


Heinz Isler, STUDIES ON THE FORM FINDING MODEL OF THE SICLI PROJECT,

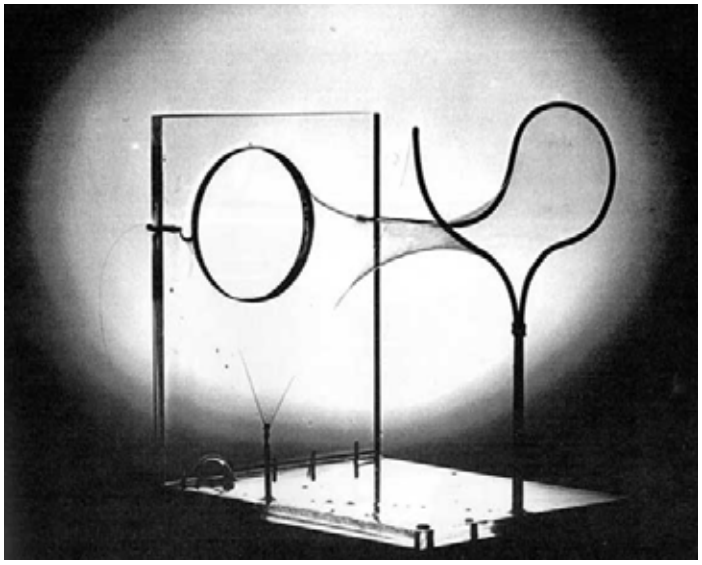
1968 (gat Archives, ETH Zurich)
117

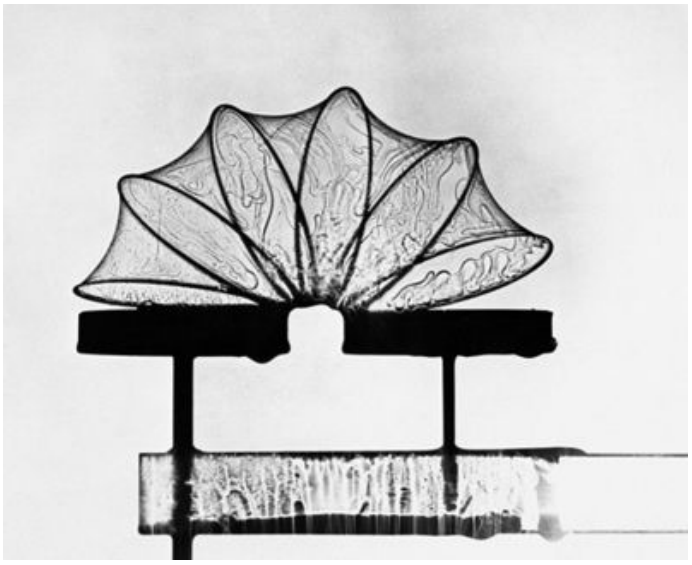






Frei Otto, MANNHEIM FINAL HANGING CHAIN MODEL, scale 1:100





Frei Otto's SOAP FILM EXPERIMENTS at The Institute for Lightweight

GRAVITY OBSERVED IN NATURE: GRAVITROPISM, ROOTS, STATOLITHS

PEDESTAL ROCKS

Pedestal rocks are the result of natural geological processes such as erosion, weathering, and the composition of the rocks themselves. One example is The Devil's Marbles in Australia. Originally part of a granite body that formed deep within the Earth's crust. Around 1.7 billion years ago, molten magma intruded into the surrounding rock, cooling and solidifying to form a large granite batholith. The distinctive rounded shape of the Devil's Marbles is a result of a process called exfoliation. This occurs when the outer layers of the granite peel away due to the release of pressure caused by erosion and weathering. The exposed granite boulders were then further shaped by wind and water erosion, creating their unique spherical and seemingly gravity-defying formations.

GRAVITROPISM

Many organisms, including plants and fungi, display a phenomenon called gravitropism. In this process, the roots of plants tend to grow in the

direction of the gravitational field, while the stem grows away from it. Positive gravitropism refers to the downward growth of roots, whereas negative gravitropism describes the upward growth of roots.

Calcite veins These veins can form within fractures or faults in the Earth's crust due to the circulation of hot, mineral-rich fluids. Gravity plays a role in these formations by guiding the downward movement of the fluids and their subsequent deposition of calcite along the fractures.

Flowstone Refers to sheets of calcium carbonate that form along cave walls. Flowstone hangs downward and may create curtain-like sheaves along ledges, better known as draperies. Flowstone forms from actively flowing water rather than water squeezed through cracks.

Stalectites These rock formations grow when dripping water comes into contact with the cave air. The water carries dissolved minerals, via its journey from Earth's surface. As it passes through the cave, it leaves tiny traces of those minerals behind, building a stalactite.

TIDES

As the Moon orbits around Earth, its gravitational pull affects the water on our planet. The gravitational attraction between the Moon and the water molecules on the side of Earth closest to the Moon is stronger than the gravitational force acting on the center of the Earth, causing a bulge of water on that side. This is called the 'tidal bulge' or the 'direct tidal effect.'

On the opposite side of Earth, there is also a bulge of water formed, although it is not directly under the Moon. This bulge is caused by the centrifugal force resulting from the Earth-Moon system's rotation around their common center of mass. This is referred to as the 'opposite tidal bulge' or the 'indirect tidal effect.'

Between these bulges, there are regions where the water is pulled away from, creating low tides. So, as the Earth rotates, different parts of the planet experience high tides and low tides as a result of the Moon's gravitational pull.

It's important to note that the Sun also exerts a gravitational pull on Earth, and its influence can also contribute to the formation of tides. When the gravitational forces of the Sun and the Moon align, we experience spring tides (higher high tides and lower low tides). When the gravitational forces of the Sun and the Moon act in opposition, neap tides (lower high tides and higher low tides) occur.

HYDROLOGICAL CYCLE

The water cycle is driven by the energy from the Sun and the force of gravity. It is a crucial process that helps distribute water across different parts of the Earth,

replenishes freshwater sources, sustains plant and animal life, and influences weather patterns and climate.

1. Evaporation: Sunlight provides the energy needed to convert liquidwater into water vapour. This occurs when the heat energy causes water molecules to gain enough energy to break their bonds and escape into the atmosphere as invisible water vapour. Evaporation mainly takes place from oceans, lakes, rivers, and the moist surfaces of plants and soils.

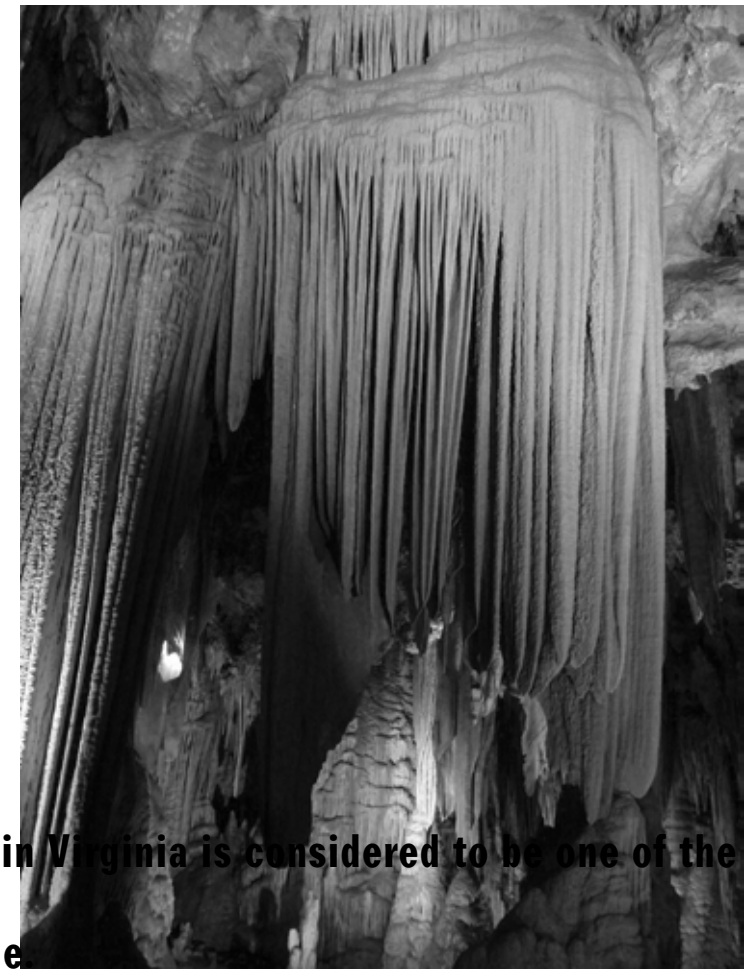
2. Transpiration: Transpiration is the process through which plants absorb water from the ground through their roots and release it into the atmosphere through tiny openings called stomata on their leaves. This contributes to the overall moisture in the atmosphere.

3. Condensation: As water vapour rises into the atmosphere, it encounters cooler temperatures at higher altitudes. The cooling causes the water vapour to lose energy, and its molecules come closer together, forming tiny water droplets or ice crystals. These droplets or crystals cluster together to form clouds.

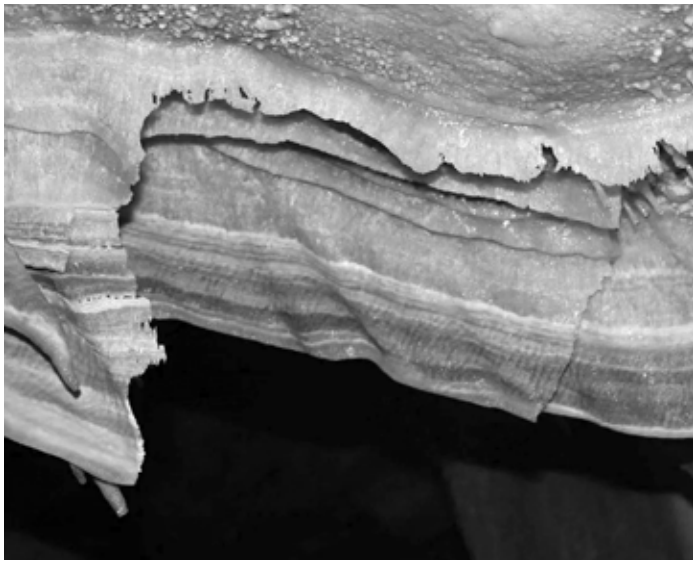
4. Precipitation: When the water droplets or ice crystals in clouds combine and become too heavy to be suspended in the air, they fall back to Earth's surface as precipitation. Precipitation can take various forms, including rain, snow, sleet, or hail.

5. Runoff: When precipitation reaches the Earth's surface, it can flow over the land as runoff. Runoff occurs when the ground is saturated, or when the precipitation exceeds the rate at which it can be absorbed by the soil. Runoff collects in streams, rivers, and eventually flows into lakes and oceans, replenishing the water bodies.

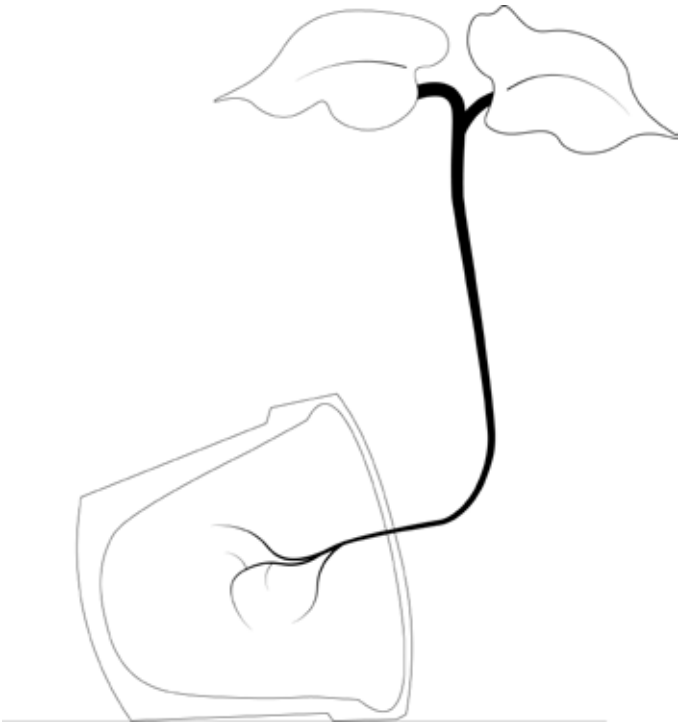
6. Infiltration: Infiltration refers to the process by which water seeps into the ground, penetrating the soil and underlying rocks. It occurs when the soil is porous and allows water to pass through. Infiltrated water can replenish underground water reservoirs, known as aquifers.



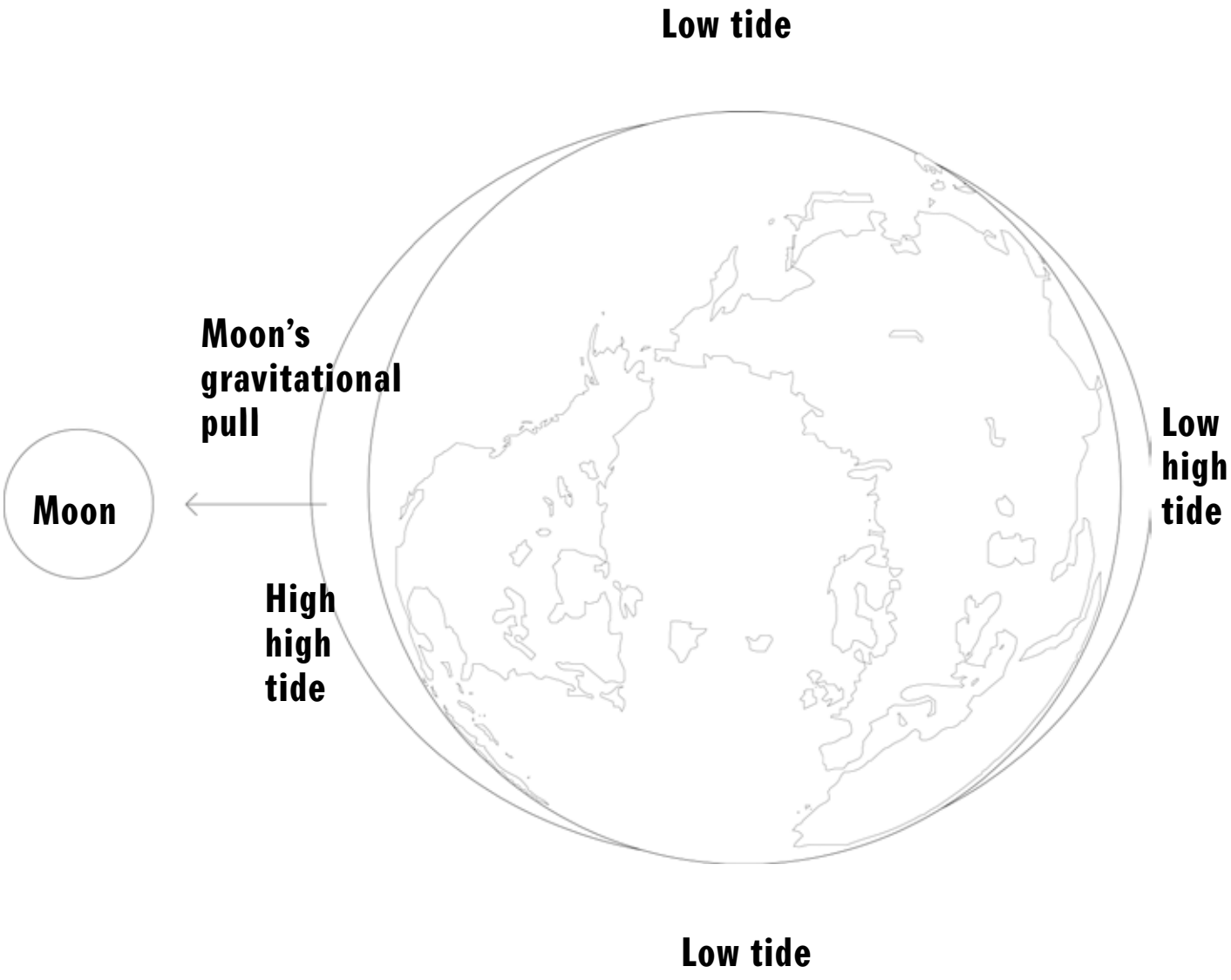
SARACEN'S TENT in Virginia is considered to be one of the most well-formed flowstone draperie.



An example of CAVE BACON, a deposit of flowstone in the Caverns of Sonora



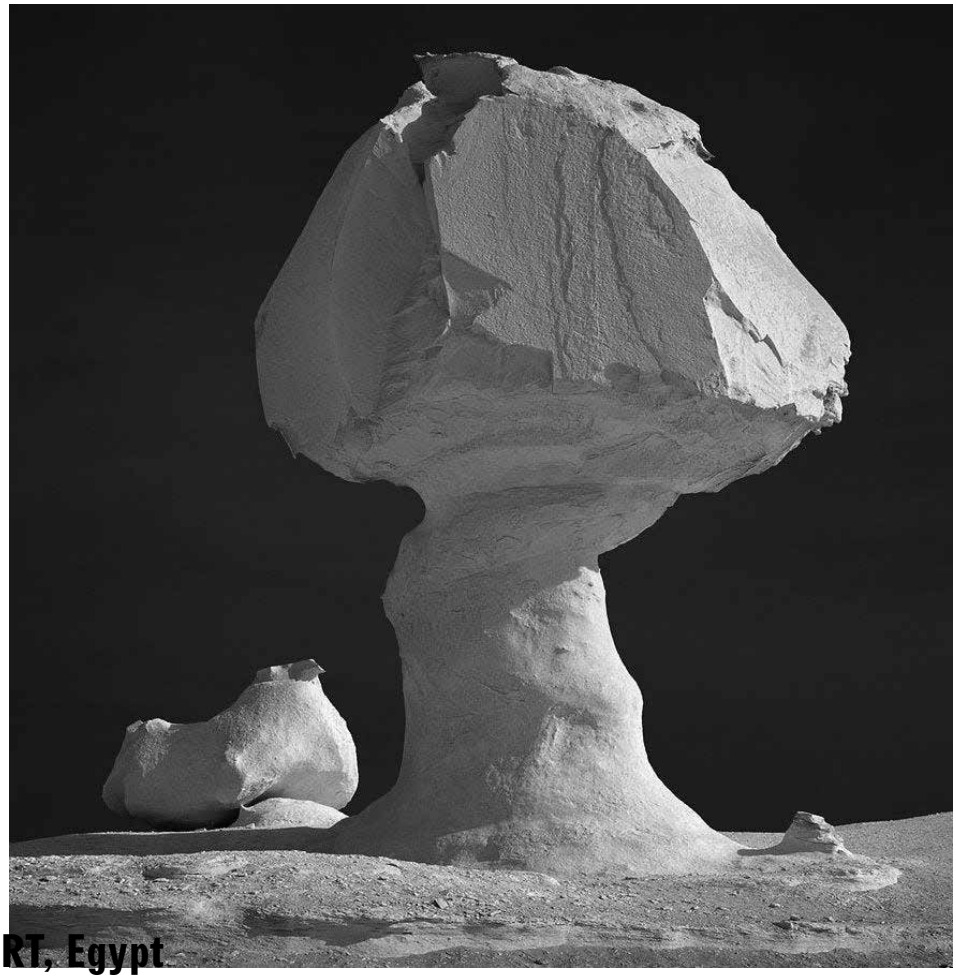
POSITIVE AND NEGATIVE GRAVITROPISM
125



EARTH'S TIDES

CALCITE VEINS

DEVILS MARBLES, Australia



WHITE DESERT, Egypt

READER

ENTROPY MADE VISIBLE
An interview with Robert Smithson by Alison Sky, ON Site #4, 1973.

Taken from the book: Flam, J. Robert Smithson: THE COLLECTED WRITINGS. University Of California Press, 1996.

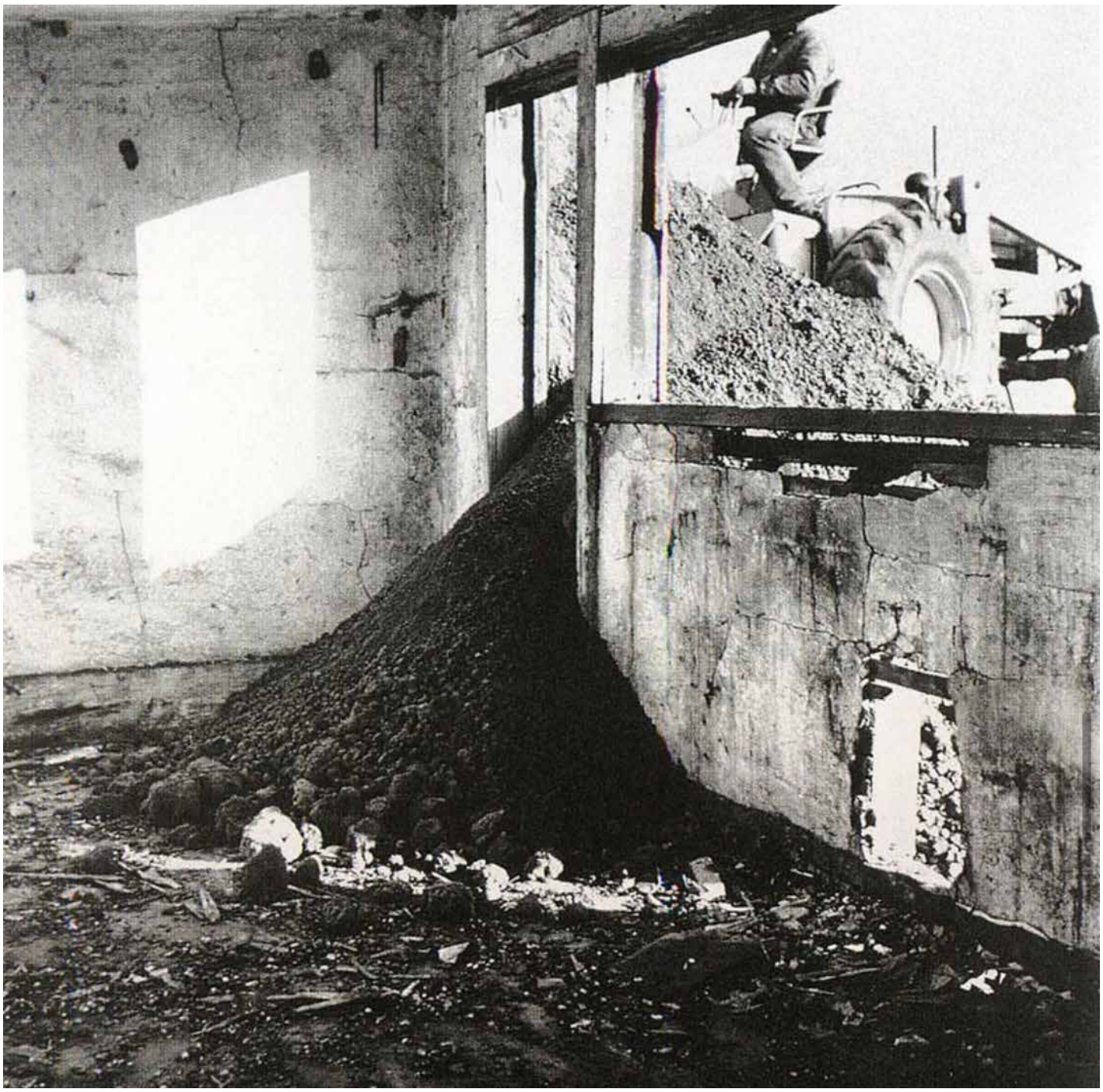
The interview talks on the subject of entropy within the scope of geology, and the factors that exist within it; equilibrium, irreversibility, collapse, and debris. Smithson proposes a 'dialectics of entropic change' and cites examples of human-induced changing landscapes, such as mining, and the lawmaking involved during, and in the land reclamation aftermath. Smithson and Sky comment on these entropic conditions that gravity facilitates, and social and political preoccupations that drove Smithsons work. This interview took place about two months before Smithson's death. Although published posthumously, Smithson and Sky completed the editing of the text together.

ENTROPY MADE VISIBLE, 1973, Interview between Robert Smithson and Alison Sky.

Entropy Definition (Oxford English Dictionary): Lack of order or predictability; gradual decline into disorder.

ROBERT SMITHSON: O.K. we'll begin with entropy. That's a subject that's preoccupied me for some time. On the whole I would say entropy contradicts the usual notion of a mechanistic world view. In other words it's a condition that's irreversible, it's condition that's moving towards a gradual equilibrium and it's suggested in many ways. Perhaps a nice succinct definition of entropy would be Humpty Dumpty. Like Humpty Dumpty sat on a wall, Humpty Dumpty had a great fall, all the king's horses and all the king's men couldn't put Humpty Dumpty back together again. There is a tendency to treat closed systems in such a way. One might even say that the current Watergate situation is an example of entropy. You have a closed system which eventually deteriorates and starts to break apart and there's no way that you can really piece it back together again. Another example might be the shattering of Marcel Duchamp Glass, and his attempt to put all the pieces back together again attempting to overcome entropy. Buckminister Fuller also has a notion of entropy as a kind of devil that he must fight against and recycle. Norbert Weiner in The Human Use of Human Beings also postulates that entropy is a devil, but unlike the Christian devil which is simply a rational devil with a very simple morality of good and bad, the entropic devil is more Manichean in that you really can't tell the good from the bad, there's no clear cut distinction. And I think at one point Norbert Weiner also refers to modern art as one Niagara of entropy. In information theory you have another kind of entropy. The more information you have the higher degree of entropy, so that one piece of information tends to cancel out the other. The economist Nicholas Georgescu-Roegen has gone so far as to say that the second law of thermodynamics is not only a physical law but linked to economics. He says Sadi Carnot could be called an econometrican. Pure science, like pure art tends to view abstraction as independent of nature, there's no accounting for change or the temporality of the mundane world. Abstraction rules in a void, pretending to be free of time.

One might even say that the whole energy crisis is a form of entropy. The earth being the closed system, there's only a certain amount of resources and of course there's an attempt to reverse entropy through the recycling of garbage. People going around collecting bottles and tin cans and whatnot and placing them in certain compounds like the one over on Greenwich Avenue across from St. Vincent's Hospitals. Well this seems to be a rather problematic situation. Actually right now I would like to quote from Georgerscu-Roegen, The Entropy Law and the Economic Process, about what he calls entropic



Robert Smithson, PARTIALLY BURIED WOODSHED, Kent State University,

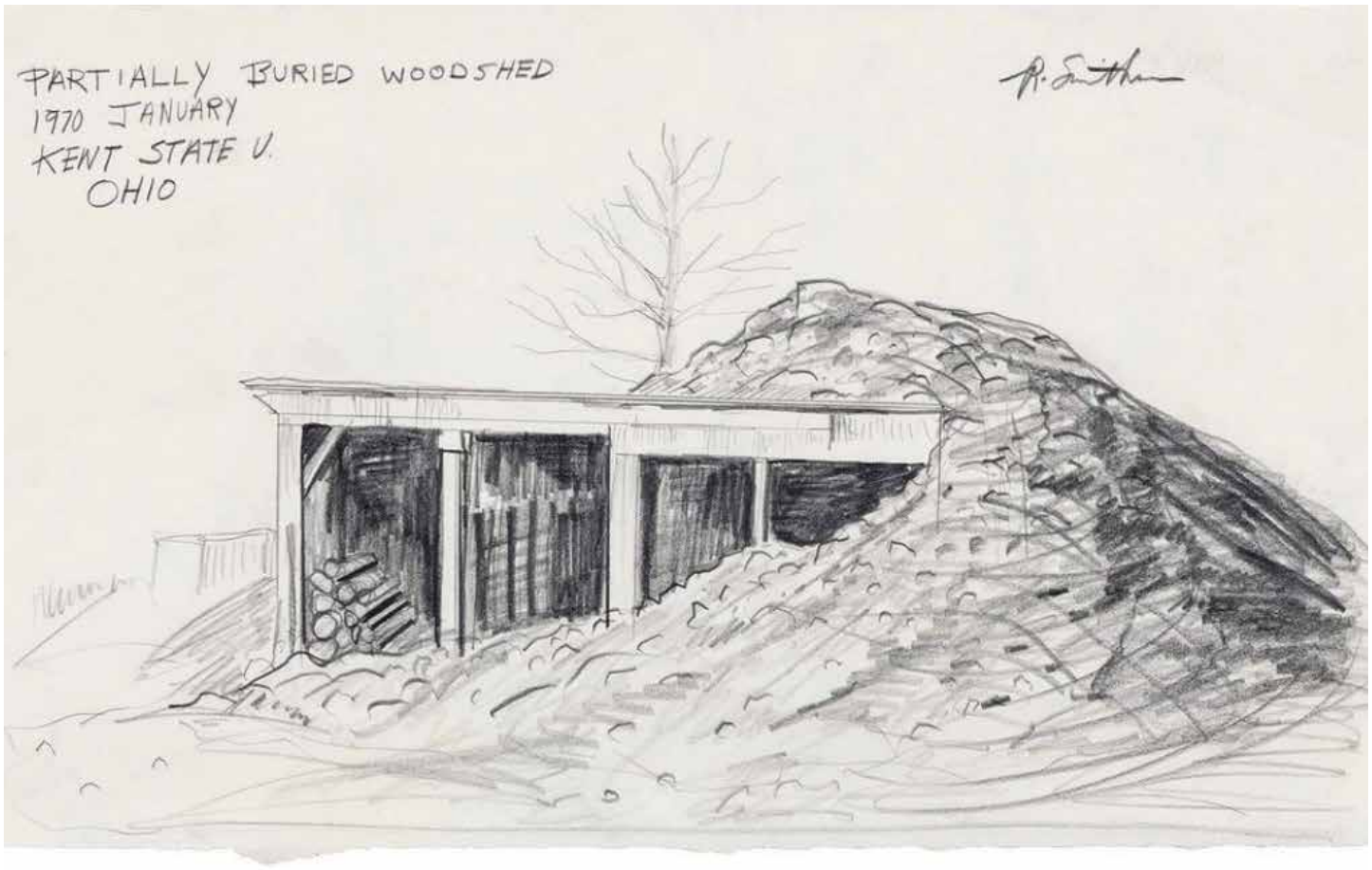
Ohio, also seen on pages 136 & 138

bootlegging. It's an interesting conception I think. This is what he says about recycling waste materials. "This is what the promoters of entropy bootlegging fail to understand. To be sure, one can cite numberless scrap campaigns aimed at saving low entropy [low entropy in his definition is raw materials before they're processed into refined materials. In other words raw ore would be low entropy and high entropy would be the refined material such as steel]... by sorting waste. They have been successful only because in given circumstances the sorting of, say, scrap copper required a smaller consumption of low entropy than the alternative way of obtaining the same amount of metal. It is equally true that the advance of technological knowledge may change the balance sheet of any scrap campaign, although history shows that past progress has benefited ordinary production rather than scrap saving. However, to sort out the scrap molecules scattered all over the land and at the bottom of the sea, would require such a long time that the entire low entropy of our environment would not suffice to keep alive the numberless generations of Maxwell's demons needed for the completed project."

In other words he's giving us the indication that recycling is like looking for needles in haystacks. Now, I would like to get into an area of, let's say, the problems of waste. It seems that when one is talking about preserving the environment or conserving energy or recycling one inevitably gets to the question of waste and I would postulate actually that waste and enjoyment are in a sense coupled. There's a certain kind of pleasure principle that comes out of preoccupation with waste. Like if we want a bigger and better car we are going to have bigger and better waster productions. So there's a kind of equation there between the enjoyment of life and waste. Probably the opposite of waste is luxury. Both waste and luxury tend to be useless. Then other's kind of middle class notion of luxury which is often called 'quality.' And quality is sort of based on taste and sensibility. Sartre says Genet produces neither spit or diamonds. I guess that's what I'm talking about.

ALISON SKY: Isn't entropy actually metamorphosis, or a continual process in which elements are undergoing change, but in an evolutionary sense?

SMITHSON: Yes and no. In other words, if we consider the earth in terms of geologic time we end up with what we call fluvial entropy. Geology has its entropy too, where everything is gradually wearing down. Now there may be a point where the earth's surface will collapse and break apart, so that the irreversible process will be in a sense metamorphosized, it is evolutionary, but it's not evolutionary


PARTIALLY BURIED WOODSHED
1970 JANUARY
KENT STATE U.
OHIO

in terms of any idealism. There is still the heat death of the sun. It may be that human beings are just different from dinosaurs rather than better. In other words there just might be a different situation. There's this need to try to transcend one's condition. I'm not a transcendentalist, so I just see things going towards a... well it's very hard to predict anything; anyway all predictions tend to be wrong. I mean even planning. I mean planning and chance almost seem to be the same thing.

SKY: I with the architectural profession would recognize that. In their grand masterplan schemes for the world, architects seem to find the 'final solution' to all possible situations.

SMITHSON: They don't' take those things into account. Architects tend to be idealists, and not dialecticians. I propose a dialectics of entrophic change. There is an ongoing aspect of things that fascinates me like my recent involvement with Central Park (see Frederick Law Olmsted and the Dialectical Landscape, Artforum, February 1973). You see that photograph there showing a pit in Central Park. Now you might say that's a kind of architecture, a kind of entropic architecture or a de-architecturization. In other words it's not really manifesting itself the way let's say Skidmore Owings and Merrill might manifest itself. It's almost the reverse of that, so that you can observe these kinds of entropic building situations which develop around construction. That pit will eventually be covered, but it's there right now with all its scaffolding, and people have been confused by that pit, they think it has something to do with the Met [Metropolitan Museum of New York]. There's a lot of graffiti on it attacking the Met, but it's really the city.

SKY: It's ironic that we've been able to perpetuate this attitude of set design solutions throughout the world. Traveling through Europe you can go for miles and it all looks exactly alike and like everywhere else. Mimic Lefrak City architecture is covering the earth. How did this manage to take over as opposed to the opposite view exemplified in places like Rome where there are no two buildings, angles, textures, etc., the same. Ruins melt and merge into new structures, and you get this marvelous and energetic juxtaposition occurring – with accident a large part of the whole process.

SMITHSON: Well, Rome is like a big scrap heap of antiquities, America doesn't have that kind of historical background of debris. But I'd like to mention another mistake which is essentially an engineering mistake and that's the Salton Sea in southern California, which happens to be California's largest lake. It happened back during Teddy Roosevelt's

administration. There was a desperate attempt to try to reroute the Colorado River. The Colorado River was always flooding and destroying the area. There was an attempt to keep the Colorado River from flooding by building a canal, in Mexico, and this was illegally done. This canal was started in the delta of the Colorado and then it was rerouted back toward Mexicali, but what happened was that the river flooded into this canal and the canal overflowed, and fed back into the Imperial Valley which is below sea level. So that this thirty mile lake was created by this engineering mistake, and whole cities were inundated, the railroad also was submerged, and there were great attempts to try to fight back this deluge, but to no avail. Since then, people have come to live with this lake, and recently I was out there I spent some time in Salton City which is a city of about 400 people. And another example of blind planning is this maze of wide boulevards that snake through the desert. Now it was the idea that they would turn this into a huge retirement village or whatever, maybe a new Palm Springs, but the bottom fell out of that so that if you go there now you just see all these boulevards going all through the desert, very wide concrete boulevards and just sign posts naming the different roads and maybe a few trailer encampments near this city. It's impossible to swim in the Salton Sea because barnacles have grown all over the rocks. There is some water skiing and fishing.

There's also a plan to try to desalinate the whole Salton Sea. And there's all kinds of strange schemes for doing that. One was to bring down slag from the Kaiser Steel Company, and build a dike system. So that here we have an example of a kind of domino effect where one mistake begets another mistake, yet these mistakes are all curiously exciting to me on a certain kind of level – I don't find them depressing.

SKY: There's an inherent energy level present in an accidental or mistake occurrence. I was listening to a discussion of the I. M. Pei buildings near Washington Square Village, and apparently in the two towers owned by New York University an attempt was made at 'total control.' Even the curtains were specified so as not to disturb the 'esthetic resolution' of the building façade. The third tower is not owned by N. Y. U. and houses the people replaced by the construction. There people were free to choose their own curtains and you get an incredible diversity of styles and colors which I find much more dynamic. Ironically the white curtains so carefully controlled have since faded to different tones of white so the process occurred anyway.

SMITHSON: Right. It's like the Anchorage earthquake that was responsible for creating a park.

After the earthquake they set aside a portion of earthquake damage and turned that into a park, which strikes me as an interesting way of dealing with the unexpected, and incorporating that into the community. That area's fascinated me quite a bit. Also, the recent eruptions outside of Iceland.

At Vestmann Islands an entire community was submerged in black ashes. It created a kind of buried house system. It was quite interesting for a while. You might say that provided a temporary kind of buried architecture which reminds me of my own Partially Buried Woodshed out in Kent State, Ohio where I took 20 cartloads of earth and piled them on this woodshed until the central beam cracked. There was a problem from one of the local papers. They didn't really see that as a very positive gesture, and there was a rather disparaging article that went under the heading "It's a Mud Mud Mud World."

But basically I think that those preoccupations do escape architects and I'm thinking of another problem that also exists, that of mining reclamation. It seems that when they made up the laws for mining reclamation they wanted to put back the mines the way they were before they mined them. Now that's a real Humpty Dumpty way of doing things. You can imagine the result when they try to deal with the Bingham pit in Utah which is a pit one mile deep and three miles across. Now the idea of the law being so general and not really dealing with a specific site like that seems unfortunate. One person at Kennecott Mining Company told me that they were supposed to fill that pit in; now of course one would wonder where they were going to get the material to fill that pit in.

SKY: Did you ask them?

SMITHSON: Yes, I mean they said it would take something like 30 years and they'd have to get the dirt from another mountain. It seems that the reclamation laws really don't deal with specific sites, they deal with a general dream or an ideal world long gone. It's an attempt to recover a frontier or a wilderness that no longer exists. Here we have to accept the entropic situation and more or less learn how to reincorporate these things that seem ugly. Actually there's the conflict of interests. On one side you have the idealistic ecologist and on the other side you have the profit desiring miner and you get all kinds of strange twists of landscape consciousness from such people. In fact there's a book that the Sierra Club put out called Stripping. Strip mining actually does sort of suggest lewd sex acts and everything, so it seems immoral from that standpoint. It's like a kind of sexual assault on mother earth which brings in the aspect of incest projections as well as illicit behavior

and I would say that psychologically there's problem there. There's a discussion of aesthetics in this book Stripping from the point of view of the miner and from the point of view of the ecologist. The ecologist says flatly that strip mines are just ugly and the miners says that beauty is in the eye of the beholder. So you have this stalemate and would say that's part of the clashing aspect of the entropic tendency, in other words two irreconcilable situations hopelessly going over the same waterfall. It seems that one would have to recognize this entropic condition rather than try to reverse it. And there's no stopping it; consider the image that Norbert Weiner gives us – Niagara Falls.

In fact they even shored up Niagara, speaking of Niagara. They stopped Niagara for a while because it was wearing away. And then they put these steel rods into the rock so that it would maintain its mutual appearance.

SKY: Have they been able to stop it?

SMITHSON:They did stop it.

SKY: From wearing away?

SMITHSON: Well, it's still there. It didn't fall spare yet. Niagara looks like a giant open pit quarry. In other words it has high walls which offend people greatly in the strip mining regions. There are defects called 'high walls' that exist in the strip mining areas and there's a desire on the part of ecologists to slope these down. The cliffs all around Niagara suggest excavation and mining, but it's just the work of nature. So there's constant confusion between man and nature. Is man a part of nature? Is man not a part of nature? So this causes problems.

SKY: There is definitely some sort of perverse fascination attached to the process of inevitable and impending destruction that will occur either in your own environment or be observed vicariously because people persist in living at the bases of volcanos, on earthquake zones such as the fault line which is supposed to destroy all of California, on top of sinking landscapes such as Venice which is a city built entirely on rotting wooden pilings and will eventually fall into the sea.

SMITHSON: Well, that may be something that's human – that's human need. It seems that there's almost a hope for disaster you might say. There's that desire for spectacle. I know when I was a kid I used to love to watch the hurricanes come and blow the trees down and rip up the sidewalks. I mean it fascinated me. There's kind of pleasure that one receives on that level. Yet there is this for something more tranquil – like babbling toward mining regions and volcanic conditions – wastelands rather than he usual notion of scenery or quietude, tranquility – though they somehow interact.

SKY: I think man turns to the wooded

glens in the last moments for the most part. He probably wouldn't like to admit it but I don't think it's of prime importance to him – from a fascination viewpoint. I mean he really hasn't done much to protect these pockets of tranquility. At the last moment, after it's almost all destroyed he starts screaming 'put up the trees' but only in a token gesture sense. That's always the answer, especially in public spaces in a city like New York – stick up a few isolated trees.

SMITHSON: Well, it seems that in a city like New York where everything is concrete here's this craving to stick up a tree somewhere.

Also in regard to the origin of parks in this country it's interesting to note that they really started as graveyards. There's something in the mid-19th century that's called the 'rural graveyard movement' where there was an attempt to get away from the dreary little churchyard graveyards. They introduced a kind of sylvan setting so that nature would intermingle with the graveyards, and they developed a whole funerary school of art you might may. I know for a fact over near Fort Lee there are all these vaults – little pyramids, you know, for the dead.

There is an association with architecture and economics, and it seems that architects build in an isolated, self-contained, a historical way. They never seem to allow for any kind of relationship outside of their grand plan. And this seems to be true in economics too. Economics seem to be isolated and self-contained and conceived of as cycles, so as to exclude the whole entropic process. There's very little consideration of natural resources in terms of what the landscape looks like after the mining operations or farming operations are completed. So that a kind of blindness ensues. I guess it's what we call blind profit making. And then suddenly they find themselves within a range of desolation and wonder how they got there. So it's rather static way of looking at things. I don't think things go in cycles. I think things just change from one situation to the next, there's really to return.

CONFRONTATION BETWEEN BUILDING AND GROUND: NOTIONS OF FORCE AND GRAVITY IN THE WORK OF JOÃO VILANOVA ARTIGAS

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This text centers on the work of architect and engineer Joãn Vilanova Artigas, renowned for his designs that intentionally challenge the force of gravity, resulting in a compelling interplay between the building and the ground. Artigas understands gravity as a fundamental element governing structural behavior. Borgonovi e Silva and Kotnik provide commentary on Artigas' engagement and often unconventional relationship between architectural form and structural stress in his creations.

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ABSTRACT: João Vilanova Artigas (1915-1985) was one of the major thinkers of Brazilian architecture. Engineer and architect, he witnessed the intense industrialization process that took place in the city of São Paulo in the twentieth century. Focused on the rapid changing urban landscape and on the possibilities offered by new construction materials – especially reinforced concrete – his designs were mostly built of large and prismatic roofs supported by strongly oblique and sometimes slender structural elements. Although highly concerned with the physical properties of building materials and with the mechanics of structures, Vilanova Artigas also aimed at addressing the social context in which he lived. He believed that architecture could express the societal dramas of his time – especially the notion of struggle, which he intended to materialize through designs that dialectically opposed the force of gravity, thus revealing a confrontation between building and ground, artifact and nature.

1 INTRODUCTION

All bodies exert gravity. It is the only primal force of nature that technology never managed to nullify, the only one that exerts only attraction, and the only one that remains effective even at infinite distances. The force that attracts an object to the ground is the same that keeps the Earth in orbit around the sun. The reason for this is that although both celestial bodies exert a force of attraction, the sun, by being a body of greater mass, exerts a greater attraction than the gravitational pull of the Earth. The result is a natural balance between both gravitational centers. Similarly, the gravitational force of the Earth is greater than the force of attraction that buildings exert upon it: the body of greater mass attracts the smaller one. It is a law of nature.

João Vilanova Artigas, however, developed an architectural aesthetic that raised questions on the natural flow of gravity. He played with the tacit knowledge that our bodies, as well as other objects such as buildings, are inevitably pulled by the Earth. Through the construction of large and suspended volumes supported by strongly oblique and sometimes slender structural elements, he created new perceptions of gravitation that may contradict the common sense and our bodily experience.

Particularly important for Vilanova Artigas was the design of the encounter between roof and ground. Wisnik (2010:21) remarks that Artigas himself mentioned the importance of leaving a sign of the attitude that always moved him, which was "placing the work in the landscape with some respect for the way it 'sits' on the ground. Balancing, it expresses itself by lightness, the sign of the dialectic between doing something and the difficulty to accomplish it." The lightness that results from this dialectic, however, is not only an act of heroism or an ability to realize something technically challenging. Considering the importance given by Vilanova Artigas to the way the building "sits" on the ground, the transfer of force between building and ground becomes a major issue in his architecture.

2 A TWOFOLD CONCEPTION OF FORCE

2.1 *Action and reaction*

The ground absorbs and reacts to the weight of a building. It is the third law of Newton: action and reaction. If the way a building "sits" on the ground is a key issue for Vilanova Artigas, the design of the ground reaction to the load of a building must also be, by logic, of key importance. In statics, supporting structure and supported elements are always in balance in order to achieve a sum of resulting moments that is equal to zero. Therefore, in rigid bodies, the force that the Earth exerts upon them must be equivalent to the force that they exert upon the Earth.

In order to make the law of action and reaction evident, Vilanova Artigas gradually eliminated the image of a column from his designs – an atittude that led him to a direct connection between roof and foundations. Vilanova Artigas (1999:103-104) explains that "in the beginning we made our columns as a concrete support hidden within walls that appeared to be bearing walls. After that, we freed those columns and showed them as they were. Later, we started to oppose them – in countless and different ways: reducing them to a minimum; bending them to one side; deforming them and, eventually, not using them at all."

Vilanova Artigas designed footings that sprout from the ground in order to meet the roof directly, without the need for columns. Wisnik (2010:21) notes that this attitude is anti-classical and describes Vilanova Artigas's design of the Dressing Rooms of the São Paulo Football Club as "a foundation block that sprouts from the ground to support an enormous concrete beam, with no column to provide the transition. This artistic approach he [Artigas] shared with the master of Taliesin, having a clear anti-classical inspiration. The 'column with no shaft', with the base in contact with the capital, also appears in the Faculty of Architecture and Planning." Therefore, the foundations become the direct support of the roof in his designs.

The same emphasis that Vilanova Artigas placed on the action of the ground in relation to the roof, he also placed on the action roof in relation to the ground. Frampton (2010:4) observes that Vilanova Artigas created "*diaphragmatic roofs* (...) that were sometimes covered and lit from above and at other times open to the air." This is, according to Frampton (2010:6), a new structural type to which he refers as "a folded structure that turns down at its eaves so as to form a continuous concrete apron elevated above grade on reinforced concrete piers." However, in the most significant works of Vilanova Artigas, those folded structures taper down without the need for piers, therefore reducing even more the area of contact between roof and ground.

2.2 *Aware and unaware*

By placing the *diaphragmatic roof* in direct contact with the foundations that spring from the ground, Vilanova Artigas brought to the fore what was previously non-visible. In this case, foundations are raised to a conscious level and play a visually active role in his designs. They react to large and prismatic suspended roofs, and vice-versa. Raising the volume of a building is a realization of the twentieth century. Vogt (2006:152) observes that among pioneers, such as Mies van der Rohe, Walter Gropius, Frank Lloyd Wright and Le Corbusier, the new possibilities of construction "with reinforced concrete enabled them to lift the body of the building from the ground, and to make a previously non-visible surface, its sixth, the bottom, visible." In addition to making it visible, in some of his designs, the sixth side of the building volume, which was previously in direct contact with the ground, Vilanova Artigas also made visible the foundations – an essential part of the building, normally thought of as having a purely technical function. By making the footings sprout from the underground, he raised them to a level of awareness compatible with his aspirations of raising social awareness through design.

Raising the footings to a visible level is but a technical procedure for the construction of bridges, especially the ones built of timber or steel. Nevertheless, in Vilanova Artigas's designs, there is no technical necessity for building foundations that extrapolate the underground level. He actually creates a contradiction by applying an exclusively technical procedure without technical necessity. In his designs, the foundations extrapolate their condition of building elements placed in the underground, and come to the surface – much like a reptile that emerges from the depths of the water to the air, in order to breathe.

The footings sprout from Vilanova Artigas's designs, just as the footings of timber or steel bridges may sprout from the ground or emerge from the water. These essential parts of a build-

ing structure, that normally remain invisible, acquire visibility and become a subject of attention and awareness. Sigmund Freud compared the levels of awareness and unawareness of human mind with the visible and the invisible, that is, what is figuratively above or below the surface of the water. He made, for example, an analogy between the conscious mind and the water of a fountain, which arises that falls back and into the subterranean pool of subconscious. Carl Gustav Jung (1968:18), in its turn, contended that "water is the commonest symbol for the unconscious".

Freud also developed a well-known topographic model of the mind, which he associated with an iceberg that floats with only a small part of it above the surface of the water. But if the footings that sprout from the ground in Vilanova Artigas's designs would be associated with bulks of icebergs, the ground line in his projects may be, by inference, interpreted as a waterline. It is a view that is shared by Vogt (2006:155), who assumes that modernity has produced houses that look like ships that float on the water: "A picture of serene elegance, a colossus in a seemingly effortless balance with the surroundings. (...) The ship glides silently, it swims, it suggests a lightness on the surface of the water, as if it would take off and levitate."

2.3 *Ground and underground*

The tectonics of Vilanova Artigas is based on a the contact between roof and foundations. The encounter of the two is, in many cases, marked by slightly suggested lines of the horizon that set a man-made duality between visible and invisible, up and down, ground and underground. This new horizon in Vilanova Artigas's designs is no longer treated as a natural topography, but rather as a straight and smooth line that can be seen in the Faculty of Architecture and Planning of the University of São Paulo – known as FAU –, the Lanara Laboratories, the Santa Paula Boathouse, and the Guarulhos High School. In the design of the FAU, for example, he builds a line made of a strip in low relief that resembles expansion joints placed in the encounter between the pyramid formed by extension of the footings with the inverted triangle that tapers from the roof down to the ground. Both make up the vertical structural elements of the facade.

By raising the foundations, Vilanova Artigas creates an imaginary ground line above the original ground, and thereby contradicts the common sense that foundations must always be in the underground. In many of Vilanova Artigas's designs, they are visible, yet remain below the imaginary line of the horizon designed by him. Vilanova Artigas thus eliminates from his designs not only the orthodox concept of foundation – which implies a portion of the structure that, in most cases, remains unseen – but also the very idea of underground. In his designs, he apparently makes the entire structure visible in order to make public even parts that normally do not have any aesthetic significance, such as footings. By doing this, Vilanova Artigas turns his architectural design, particularly the structure, into a public asset – an attitude that corresponds to his deep political engagement, and to the social role that he ascribed to architects during virtually his entire career.

Vilanova Artigas *relocates* the natural ground at a lower level in relation to the new line of the horizon created by him, thereby promoting a visual change in the landscape that, to the human eye, significantly changes the relation between building and ground. It is a visual effect that creates a counter-attraction effect in which the gravitational pull of the building becomes more evident. The large volumes of his diaphragmatic roofs become apparently capable of exerting a force of attraction that partially overcomes the gravitational pull of the Earth. Vilanova Artigas's designs thus create a visual effect that alter the direction and intensity of the gravitational force – which naturally points to the Earth (ground) – in the direction of another horizontal plane: the great diaphragmatic and prismatic roof built of reinforced concrete.

2.4 *Vertical and horizontal*

Vilanova Artigas called attention to the transmission of forces between artificial and natural bodies, respectively building and Earth, by enlarging the distance between them in both vertical and horizontal axes. In his designs, large spans, as well as reduced areas of contact between building and ground, are ways of building a gap in the permanent, inextinguishable and – as Vilanova Artigas (1989:72) himself stated – "inexorable" force of gravity. In his designs, the transitions of forces made vertically through hinges – reduced areas of transition of load be-

tween two or more bearing elements or between building and ground – are usually designed in "V" or trapezoidal shapes.

By applying these triangular forms in his structural designs, Vilanova Artigas minimized the point of contact between roof and foundations – which are the primary interface between the volumes of these two building elements. Stresses concentrated in small areas of inverted triangular shapes visually mitigate the gravitational force that flows naturally from the roof to the ground and might make buildings appear lighter. It is a perception related to a common sense apparent in construction techniques such as masonry, which work based on compression forces. Therefore, to the extent that a masonry structure grows in height, its base must become proportionally larger to avoid buckling.

Vilanova Artigas, however, contradicts once again the common sense by distributing vertical loads in the form of inverted pyramids or triangles, that is, through elements with only one vertex in contact with the ground – which makes their areas larger at the top and lower in the base. He thus also contradicts a weight-lightness hierarchy of construction techniques that work based on compression forces – in which thick and heavy elements are located at the bottom, and slender and light ones on top. The reduction of the surface of contact between roof and ground in Vilanova Artigas's designs might cause one to believe that once contact is reduced, loads are also reduced. The opaque box of the FAU – apparently supported by slender pillars – as well as the Santa Paula Boathouse – a viaduct-shaped structure resting upon metal hinges and apparently placed upon stone walls – are just two examples of Vilanova Artigas's designs that visually altered the direction and intensity of the force of attraction between Earth and building.

On the horizontal axis, Vilanova Artigas also increased the area of contact between building and ground through the design of long spans built of reinforced concrete. In other words, by drawing long extensions of construction without vertical supports, he increased longitudinally the distance between roof and ground.

2.5 *Contact and distance*

Vilanova Artigas's designs reduced the surfaces of contact through which loads could be transferred from one structural element to another, and ultimately to the Earth. This attitude, often present in his designs, points to a topic that is historically much debated in science: the concept of force and the mystery about its cause and mode of transmission. For centuries this debate has divided the West into two factions of intellectuals: those who advocated the transmission of forces by contact, and those who believed that they are transmitted by action-at-a-distance. For the layman, however, the answer to the problem may seem clear: the idea of transmission by contact is much more understandable than the transmission by action-at-a-distance. But the fact is that, in both cases, scientists face the same insurmountable obstacles. Jammer (1999:206) explains that "the transmission of motion by impact or contact is as problematic as that by action-at-a-distance."

To human perception, the transmission of force and motion by contact seems to be more plausible than the transmission at a distance simply because, at a macro-cosmic level, one has the impression of touching objects and people. At the atomic level, however, it is known that bodies in apparent contact, in fact, do not touch each other. There is always an empty space between them. Hesse (1961:199) explains that "in the Experimental Researches of 1837 he [Michael Faraday] speaks of induction as an action between 'contiguous particles' and adds a note a year later to explain more carefully what he means by 'contiguous': 'The word contiguous is perhaps not the best that might have been used here and elsewhere; for as particles do not touch each other it is not strictly correct... By contiguous particles I mean those which are next.' So ultimately it seems that even this action is at a distance if regarded on the atomic scale."

Jammer (1999:208) also contends that "logical analysis is powerless and inadequate to explain transfer of motion in either case, whether the force is conceived as an action of contact or as an action at a distance. The two concepts face equal logical and metaphysical difficulties, since both of them are nothing but constructs, descriptive names of perceptible and measurable empirical relations. It is pure prejudice to assume that action at contiguity is more intelligible and more rational than action at a distance. [...] It is only our tactile experience with common objects that leads us to the concept of impenetrability and enables us to formulate the rules and laws of impact, without affording the least information about the real occurrence behind the

phenomenon." The discussion on what causes force and movement is not anymore present among scholars since scientific pragmatism found ways to apply methodologies without the need for interrelating the cause and effect of something named *force*. This pragmatism towards manipulating the effects of different forces, however, does not mean that the idea of cause and effect disappeared from scientific investigation. It simply raised the importance of asking the question "how" instead of "why" a phenomenon occurs.

2.6 *Scientific and unscientific*

Vilanova Artigas's intention to provoke changes of perception related to the gravitational force between buildings and the Earth also raised questions about the notion of cause and effect. By playing with the effects of gravitaty in his designs, he complied with the modern spirit of scientific investigation, which looked for the manipulation of forces, more than for the search of their cause. The relationship between cause and effect, in the case of transfer of force between two or more bodies, loses the logical-scientific sense to acquire an exclusively empirical value. Jammer (1999:208) explains that "it became more and more obvious that the scientific notion of force has little to do with causal explanation, and that, moreover, the connection between 'cause' and 'effect' in science, or antecedent and sequent in the succession of phenomena, is not a matter of logical inquiry, but of experimental experience or observation."

In the absence of a verifiable cause, the very notion of force turns out to be a construct of the mind. Jammer (1999:209) quotes Maupertuis, an eighteenth-century French scientist and philosopher who observed that "we should always remember that the concept of force is but an invention to satisfy our desire for explanation." Deeply linked to mass and motion (F = m.a), the notion of *force* has been always part of a system of beliefs and corresponds to the intellectual and technological status of the period in which it is formulated.

Notions of *force* have already been defined and redefined many times throughout history. It is more similar to a *view of the world*, than to a scientific concept. Jammer (1999:7) explains that "taken originally in analogy to human will power, spiritual influence, or muscular effort, the concept [of force] became projected into inanimate objects as a power to dwelling in physical things. (...) Subsequently classical mechanics redefined the concept of force as the time rate of change of momentum, excluding thereby, at least prima faciae, all animistic vestiges of earlier definitions." From the eighteenth century on, however, the concept of force began to be gradually eliminated from scientific vocabulary in order to become a relational and operational concept without any causal or metaphysical connotation. Jammer (1999:242) observes that, "[...] it became increasingly clear that the concept of force, if divested of all its extra-scientific connotations, reveals itself as an empty scheme, a pure relation."

2.7 *Measurable and immeasurable*

As an architect and engineer who held a degree from a polytechnic school, Vilanova Artigas was familiar with the modern concept of force – which is inseparable from the idea of vector. As a modern engineering science, structural analysis addresses the concept of force in its relational and operational form, representing it with the aid of vectors and force diagrams, i.e., mathematical and geometric constructs. The equivalence of force and vector added to Vilanova Artigas's intellectual background the notion that force is subject to abstraction, quantification, mechanization and to be transformed into a graphical *phenomenon* – which forms the base of the science of statics. Duhem (1991:11) starts telling the history of statics by the development of mechanics made by Aristotle and Archimedes, passing through Leonardo da Vinci, Galileo Galilei and Simon Stevin, among others, until its whole systematization in seventeenth century. Statics, as we know it today, is the result of an intellectual process that culminated with the understanding that the physical world is, in its essence, mathematical and mechanical in its mode of functioning. As translated by Drake (1957:238-9), Galileo contended that the language of the universe is mathematical – the most abstract of all sciences: "Philosophy is written in this grand book, the universe, which stands continually open to our gaze. But the book cannot be understood unless one first learns to comprehend the language and read the letters in which it is composed. It is written in the language of mathematics, and its characters are triangles, circles and

other geometrical figures, without which it is humanly impossible to understand a single word of it."

Geometry was adopted by the science of statics as a means to represent the physical world through the concept of lines of force, i.e., vectors. Hall et al (1999:3) define force as "that which changes, or tends to change, the velocity of a body. Force is a vector quantity, possessing direction as well as magnitude. A force is not completely defined unless its magnitude, direction and line of action are specified." Vector is therefore a mathematical form used to represent forces acting within a coordinate system of time and space. It is a graphical configuration of the phenomenon of the transmission of forces that occurs within an object that is subject to the laws of static as, for example, a building or a bridge.

However, even if it can be translated graphically in the form of vectors, a force must be necessarily abstracted from a physical *phenomenon* – the later defined by Hoad (1993:349) as the "fact, occurrence" or "that which appears or is seen". What one names *force* has thus never been isolated from its effects in the world of phenomena. The same is true for the concepts of energy, mass or matter. We perceive, identify and manipulate only forms of energy: electric, solar, atomic, never only pure energy. In the same way, we know only the effects of what we refer to as force – such as tension or compression – not its cause.

For methodological purposes however, both concepts of force, either defined as a vector or as a phenomenon, can be treated independently. This is what structural engineering does by understanding the term force only as a support for structural analysis – without taking into account any phenomenological reflection on that term. This discipline only recognizes the quantitative or vectorial dimension of the forces in play in statics. On the other hand, structural design, while also directly connected to quantitative forces, also deals with forces of language and expression related to the generation and the dynamics of form – which are not part of the scientific scope of structural engineering. The difference lies in the fact that language naturally involves expression and, consequently, qualitative aspects that are not subject to mathematical verification. From this viewpoint, structural design, unlike structural engineering, deals with a concept of force that acquires both a measurable and immeasurable sense, which is at the same time quantitative and qualitative – in physical terms as in linguistic and perceptive ones. In addition, the very fact that *design* is a term that etymologically relates to the idea of wish or will, turns structural design into a discipline that shares a concept of force that is located in an intermediate zone between the measurable and the immeasurable.

2.8 *Known and unknown*

Vilanova Artigas used the transition of forces between beam and column in the Greek temple to exemplify the notion of force as something located between the measurable and the immeasurable. Through this example, he indirectly referred to the mystery of the transfer of force in buildings. In his (1989:71) own words: "This expression: 'the points of support must sing' – you know as well as I do that the origin of this quote by Auguste Perret – is an observation by a historian of architecture, of the man who marvels at the Greek column and who knows that at the moment at which it meets the beam it turns into flowers and talks in another language."

The sense behind Vilanova Artigas's idea of "talking in another language" originates in the fact that it is impossible to explain rationally the [up to nowadays mysterious] transfer of force and motion – since it escapes, as previously mentioned, a logic of cause and effect. It is a form of addressing the unknown using a proper linguistic form. By describing as flowers the encounter between column and beam in the Greek temple, Vilanova Artigas constructs a metaphor. The etymology of the word metaphor itself is rooted in the concept of transfer, according to Barnhart (1988:656) "especially the transfer to one word of the sense of another". The flowers of the Greek capital mentioned by Vilanova Artigas are obviously not real flowers. Their image was actually taken from an original and natural context, and placed in an architectural and man-made environment, the temple.

To move an object from one context to another is, according to Da Matta (1983:70), a means for creating symbols: "a skull would be nothing more than a natural remain in a grave, where it belongs ; but it coms to represent a lot in a drawing room or in a kitchen drawer (...). The basis of the symbolization process, then, is the displacement or passage of an object and its aberrant manifestation in a different, unfamiliar domain."

The displacement of an object from its original context to an artificial one creates an interplay between denotative and connotative meanings. The flowers carved in the capital give a particular connotation to the transition of loads between beam and column in the Greek temple. In this case, the displacement of an object fuses and confuses measurable (loads) and immeasurable (language) forces into the single notion of symbol.

2.9 *Objective and subjective*

When measurable and immeasurable notions of force interact in such a way as to be impossible to set a borderline between them, the architect speaks not only another language, but a language that merges objective and subjective meaning. In Vilanova Artigas's designs, technical needs and personal views are merged, among others, through the dramatization of certain aspects of the structure that might lead to an apparent increase of stresses. Ferro (1986:68) explains that Vilanova Artigas used to say, in his lectures, that one "could and should in certain cases exaggerate in some details (...) in order to make the real structure and the actual behavior of [construction] materials even more explicit. It was almost an ethical lie, a didactic lie. But never like the European or Japanese Brutalism, in which the interplay of masses and forms often hide another structure."

Besides being an engineer and architect, Vilanova Artigas was also a professor. He was the founder, among others, of the Faculty of Architecture and Planning of the University of São Paulo – one of the most important in Brazil and South America. Vilanova Artigas worked in a period in which buildings of eclectic inspiration hid or masked load bearing elements behind *stucchi* and stylish facades. As a teacher, he had the opposite attitude by showing the entrails of buildings. More than that, Vilanova Artigas pointed to the mechanics of structures and their relation to the generation of form in his designs – an attitude that was contrary to that of Oscar Niemeyer, to whom structural design also played a significant role. Telles (1996:7) contended that "Niemeyer, unlike Vilanova Artigas, withdraws from the design any structural tension, making the generation of form able to divert, hide and almost nullify the effort necessary to build it". In spite of the essential differences in the design of these two masters of Brazilian architecture, both were pushed forward in their works by a common motif. In an informal conversation with Bruand (1981:302), Vilanova Artigas states: "Niemeyer and I have the same concerns and face the same problems, [but] he [Niemeyer] always endeavours to resolve the contradictions in a harmonious synthesis, whereas I express them openly. In my opinion the adaptation is not the architect's job: existing struggle should not be hidden under an elegant mask – we must not be afraid to reveal it." Whatever contradiction Vilanova Artigas was referring to, he intended to translate it into an antagonism of structural stresses – particularly those involved in the transition of loads between roof and foundations. Vilanova Artigas intended to materialize the "existing struggle" basically through the design of structures – which in his own words (1997:101) were considered the building's "most worthy part".

To contend, however, that structures may express subjective notions such as "struggle" contradicts the very notion of scientific objectivity – at least as defined by the common sense. As a science, mathematics cannot explain architectural language, or vice-versa. Wilber (1996:4) explains that "science *cannot* pronounce on the meaning or purpose of any phenomenon it encounters. That is not its job, that is not what it is engineered to do, and we certainly should not hold that against science [...]. The tragedy is that science moves into scientism by saying: 'Therefore meaning does not exist, since science can't measure it.' There is, however, no scientific proof that scientific proof alone is real. Thus, we needn't prematurely cut ourselves off from such important concerns as 'meaning' simply because a microscope does not detect them."

By inference, Vilanova Artigas's intention to convey the subjective notion of "struggle" essentially through structures built of reinforced concrete, may reach realms of expression that cannot be reached through the application of pure and objective methods of structural engineering. In a documentary recorded by Cabral e Rodrigues (1978), Vilanova Artigas himself stated that he never wanted to "objectify himself as an architect, to the point of being called engineer".

3 CONCLUSIONS

As a primal force that governs structural behavior, the notions of gravity and force became the means for merging mechanical performance as well as aesthetic and social concerns in Vilanova Artigas's designs. Gravitation, which inevitably binds building and ground, turns out to be in the core of his tectonics. This force is conceived by him as twofold which, to a certain extent, blurs the boarders between science and art in his designs. Vilanova Artigas aimed at changing the perceptions of intensity and direction of the force of gravity based on tacit knowledge and on our bodily experience. To achieve his goals, he treated the transmission of loads in an original way, especially when it came to the transfer of forces between building and ground. Some of his exemplary designs feature a direct contact between roof and foundations, mostly dispensing with load bearing walls and column shafts. Technical needs and personal views were therefore fused, among others, through the dramatization of certain aspects of the structure that encouraged him to create unusual relations between architectural form and structural stresses. Vilanova Artigas showed the entrails of his buildings, bringing to light the mechanics as well as the visual dynamics of structures, eventually turning structural design into a public asset.

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CHAPTERS MUNICH MOUNTAIN (ARIZONA VERSION) & METEOR CRATER; DISPLACED / REPLACED MASS; VERTICAL DISPLACEMENT.

Interview transcripts from the book THE ONCE AND FUTURE MONUMENTS, Fox, William L, and Michael Heizer. Michael Heizer: The Monacelli Press, 2019.

Guido Deiro, a pilot and head of aviation for Howard Hughes in Las Vegas, Nevada, was hired first in the late 1960s by artist Michael Heizer, then soon thereafter by Walter De Maria, to scout for large tracks of empty land for Land Art projects. He continued to work with the artists to locate and facilitate the purchase of land for their most important works, including Heizer's City project and De Maria's The Lightning Field.

This interview transcript is between Guido Deiro and Ann M. Wolfe, the senior curator and deputy director of the Nevada Museum of Art, provides fascinating anecdotes of time spent

with Heizer as well as detailing how the ideas for the work Vertical Displacement came about, and some of the technical and political efforts that went into its planning, and eventual discontinuance.

MUNICH MOUNTAIN (ARIZONA VERSION)

Walter was a little upset about the response in Germany, and he came to me and said, "Let's do it somewhere else. Because it's not the debris that I want, it's the concept." It was never realized, but we have all the studies, site location, proposals—everything.

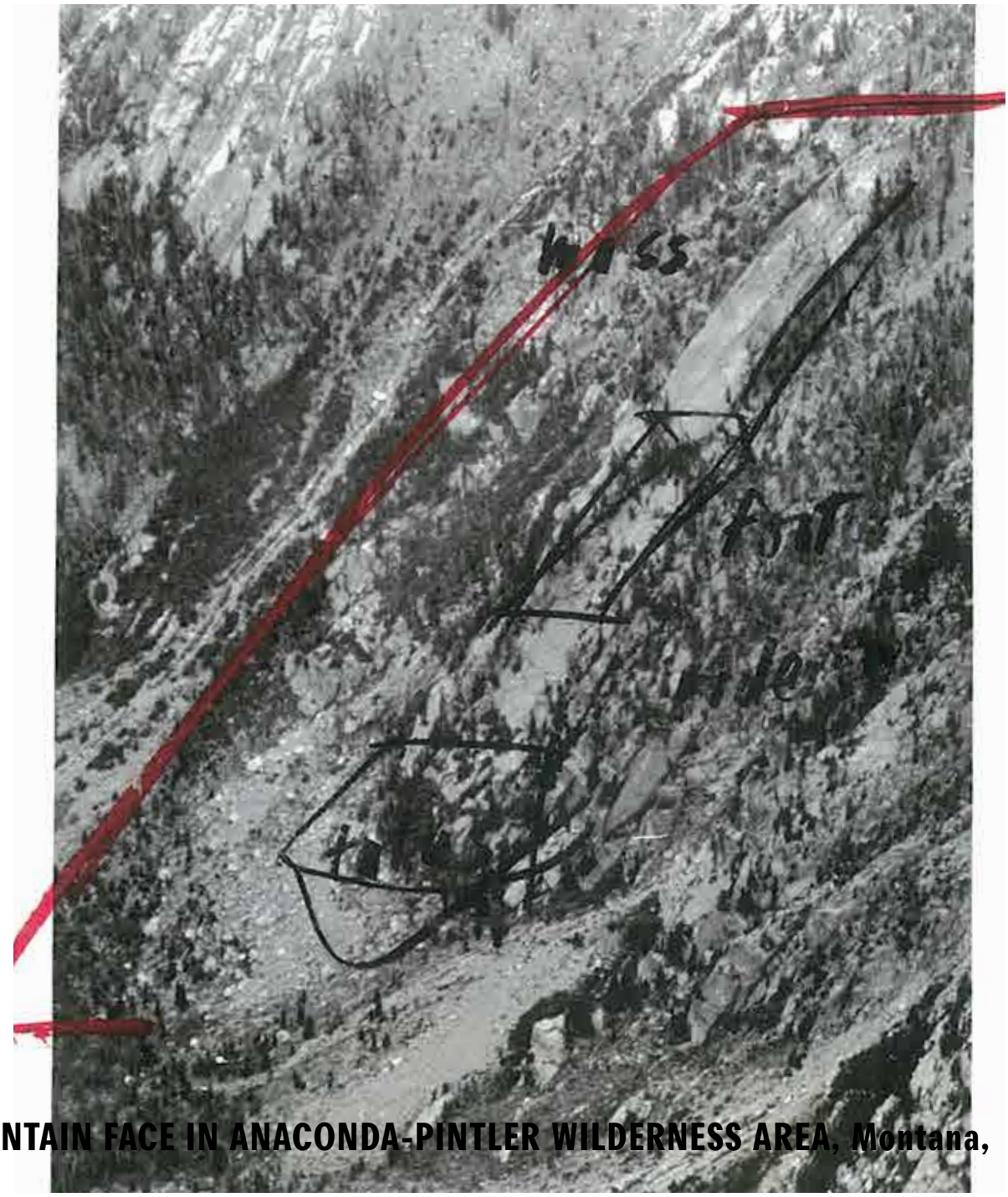
GUIDO DEIRO: Here he says number two, "a photo of the drawing for Olympic earth sculpture." He said that *Die Deutsche Zeitung*, that's the publication, shows the photo of the mountain, the relative size of the stadium, and the small cross section drawing and the Olympic brochure with a topo elevation. Now this—he was having me do a study of how to construct this vertical shaft that was going to have a bronze plate on top.

And now he talks about the Olympic earth sculpture, underlines that and captions it and puts a handwritten note over here that you might be able to help me read—says something about map search to be followed by photos, etc. So he's thwarted in doing this macabre *Munich Mountain* piece outside the Olympic Village and now we're going to do it in Nevada. And furthermore, we're going to stick it on top of Mike or appropriate where Mike wants to go. But of course I steered him away from Nevada.

ANN WOLFE: So he was referring to it as *Munich Mountain*. Here he refers to it as Olympic earth sculpture and then we have a separate folder that refers to *Munich Mountain* again.

DEIRO: Yeah. Later he decided it was hotter to label it *Munich Mountain*, there was so much notoriety over the first piece. Sixty-meter-high hill, approximately two hundred feet. Note it could be slightly higher and then cleaned off. Should be isolated in the center of the valley. Plain or wash. Note center location of course too difficult to find but near center best.

Now here are some drawings. Requirements continued. Mountain ideally should be cone-shaped. So he draws some contour lines to represent what he wants in the way of a shape contour. Also the mountain could be near a larger range, so he's actually picking the exact spot that he must have known Michael was also thinking about, because I had site located it. Mountain should be on a buy basis but a lease is possible.



MOUNTAIN FACE IN ANACONDA-PINTLER WILDERNESS AREA, Montana, the proposed site for Vertical Displacement. Photograph by Guido Deiro. Marks in ink by Michael Heizer. Archive collections of the Center for Art + Environmental at the Nevada Museum of Art.

WOLFE: So we'll move on to the folder titled *Munich Mountain.*

DEIRO: Now it becomes definitely named *Munich Mountain* and I started my searches near Nogales, Arizona. Here is a series of legal descriptions that I pulled from the Santa Cruz County Assessor's Office. I developed that Mr. Raymond Rich of Great Western Investment Company owned this mountain and so, scribbled on an envelope here and a couple of sheets of paper, are the legal descriptions of the mountain and a letter sent to Great Western Investment on March 8, 1973.

WOLFE: And these are some other letters relating to the land search, correct?

DEIRO: Yes, these were all—this is a letter to the owner and I make an explanation of why we want to purchase this. And I said I wanted to purchase it for a friend, Walter De Maria, of New York. He wishes to purchase a property like this for his personal use. And I'm not a salesman or a broker and we'd like to know if you'd like to sell it. Basically in four paragraphs. And the mountain had a name, Biscuit Mountain.

I received a reply less than a month later from Patagonia Corporation. "Mr. Raymond Rich has forwarded us your letter. Mr. Rich is chairman of the board of Patagonia Corporation of which Grace Western Bank and Trust is a subsidiary. Mr. Rich owns the Rail X Ranch in Patagonia and Arizona. However, we're unable to identify the particular property you mention and therefore are unable to help you."

So I don't know where it went from there.

METEOR CRATER; DISPLACED/REPLACED MASS; VERTICAL DISPLACEMENT

I spent time flying Michael and Walter to different parts of the Western United States I had seen (or was aware of from topographical maps) and that had land shapes that might be interesting to them, without knowing exactly what it was they might do. There probably weren't a half a dozen times that I was working for them both at the same time, when I was with them together. On one of those occasions, a flight that covered the southern tip of Nevada and most of northern Arizona, we eventually ended up at Meteor Crater, which in itself is a natural work that leads to a lot of inspiration.

There's no vegetation around it for miles. When this thing impacted the ground I would imagine that it killed all the life within hundreds of square miles and much of

it hasn't grown back. So it leaves this naturally made object, which in itself is quite interesting, and its ejecta, what it threw out, were some very large masses.[1]

First we flew around it, to have a look, and Michael said, "I want to see that rock. I want to see that." We landed, and we investigated the rim and the whole crater itself. And this rock that Michael wanted was the best one there, the only large mass that we could find. Fat chance that we were going to get that out of there! But he loved that rock because it had been displaced.

Michael wanted to do another displaced mass. The idea followed on the work *Displaced/Replaced Mass* that he had done earlier, with the help of Earl Casazza of Casazza Trucking. He had moved three immense granitic blocks from an elevation of seven thousand or so feet in the Sierras back to emplacements in the dirt at Silver Springs, with the concept that they had been elevated there by tectonic movement millennia ago, and with the work they'd been replaced to something like their original location. (That piece didn't weather well out in Silver Springs; it was on private property and had been done before he had me working for him. So we later relocated it to Michael's land in south central Nevada.)

On a trip with Michael that included Wyoming and Montana, he said, "I would like you to find the largest contiguous mass—granite diorite, or something with good integrity—that you can, and I'm going to relocate it." So I made a couple more trips by myself, and went back to an area that he had showed some interest in, the Anaconda–Pintler Wilderness in southwestern Montana.

I took some photographs of a mass that I found in a narrow box canyon; the only way in was by horseback trailing into the bottom, and then the mass was there. It was near the tree line, seven or eight thousand feet, so it definitely would freeze during the winter. Michael took one of my photographs and drew on it in red and black ink the first sketch for *Vertical Displacement.* His idea was to freeze-crack this enormous chunk of granite diorite and have it slide the length of a football field down onto the talus slope. On another photo he's drawn a diagonal orange line to show the angle and force of the piece. And this piece relates to what he did at the Detroit Museum, when he took a forty-ton block of granite and dragged it through the lawn. So it all relates to his mass and movement conversation.

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1. There is low desert brush all around Meteor Crater in Arizona, but the vegetation is thinner than on the surrounding desert floor.

It was very ambitious—we had to fly in, and go the rest of the way on horseback. It was dangerous to fly in to the mountains, with air currents and weather—I think the highest elevations might have approached nine or ten thousand feet. The approach to the location was extremely difficult. And when you start trying to freeze-crack a four-hundred-ton block of granite diorite on the slope of a mountain in the middle of nowhere you're talking about millions of dollars in drilling. Then it might not work: he was going to inject water underneath and hope that it would all freeze at the same time. That at one miraculous moment it's going to pop-pop CRACK and go down.

DEIRO: This four-page document is a copy of the *Vertical Displacement* directions from Michael to me, with the scope of the work he wanted me to do relating to the piece of rock we'd found.

He says, "require a geologist, mining engineer"—this is very comprehensive and covers dozens of specific and technical instructions. He's gone into very fine detail, lists the equipment that we decided we're gonna have to—after we went in on horseback, we packed in further and looked at the mass close up. We couldn't even get up to it without climbing gear. And I began to understand the scope of this thing, how expensive it would be.

I said, "You know, Michael, trying to bring people in over a mile and a half from the nearest paved road, into this canyon and up several thousand feet, ain't gonna work, so we're going to have to hire a heavy lift helicopter." So that's in there, and he has an eighteen-point equipment list, every detail, how much fuel, how it was going to be done. Then he instructed me to see if I could get the land. Now this is very interesting. His first idea, apparently, was to do this piece in Nevada, in the Granite Range, fronting where his *City* complex is now. But I couldn't find him a contiguous piece of granite. Here's a very nice drawing, eight by ten, cross section of forty-degree slope, proposal for the Granite Range, Nevada, with the township and range number. And it's a cross-sectional drawing of this very same concept of cracking loose a big block of granite diorite and having it slide 507 feet down the mountain onto a talus slope and how large the extricated mass would be—25 feet thick by 75 feet by 100 feet. And he puts his name, Michael Heizer, general delivery, Reno, Nevada. Right here. So he thought he was going to do this in Nevada, but we just couldn't find privately owned property or the proper material.

So off we went on the search to Montana, where we found that mass, and I contacted the Miner's Bank of Montana in Butte, I went to the assessor's office, I talked to people in Portland, Oregon, all trying to develop who owned the property. I finally discovered who owned the land, and it hadn't been surveyed since the 1800s.

WOLFE: So we're on to the "O'Neill Land" folder.

DEIRO: Now we're into a letter-sized manila folder labeled "O'Neill Land, Anaconda, Montana." Here is the contour map for the canyon, shows its location, who owns what sections, and it was the Mount Hagen Livestock Company. And this is where the piece would be, right here, on this black and white topographical map. Also in the folder is a certificate of a survey of the property done by Walter Everly, and it's a legal survey.

The owner, William O'Neill, was a multimillionaire who lived in Miami Beach, Florida. So in October of 1972, I flew to Florida and sat down with Mr. O'Neill in his residence. I made a presentation to him on the Land Art movement, Michael Heizer's importance to it, and what we wanted to do with this rock that was located on his land.

Mr. O'Neill thought it was a very worthwhile use of the land. He liked the idea. So for the consideration of $10 he conveyed the property to Michael.

WOLFE: Was that $10 an acre? The entire—

DEIRO: No, that's the consideration. You have to have some consideration. And this is the real deed. And a letter from Mr. O'Neill's secretary, Margaret Ann DeSharte, dated October 26, 1972. She says, "Dear Mr. Deiro, I have enclosed a copy of the deed for the Mount Hagen property, along with a certified resolution, prepared by our Montana attorneys. I have this day forward that it will say Mr. Heizer. Best regards, Margaret."[2]

And this is the resolution from the Corporation of Mount Hagen Land Company. It says:

> *The following is a full, true and correct copy of the resolution duly prepared and adopted by the executive committee of the board of directors of Mount Hagen Livestock Company, a Montana corporation, by unanimous written consent of the committee, on October 4, 1972; whereas, Michael Heizer, Michael M. Heizer, a single man, of PO Box 1452, Reno, County of Washoe . . . it is the wishes of Michael M. Heizer, sculptor, to create a work of sculpture from a large mass of granite rock on the real property hereinafter described; and whereas Mount Hagen Livestock, Incorporated is the owner of said real property; and*

2. In real estate terms, a "consideration" is something of value, usually money, that is required for a buyer and seller to execute a contract.

whereas, Mount Hagen Livestock Inc. is desirous of facilitating the aesthetic and artistic endeavors of Michael M. Heizer . . .

(I believe that's the first time those words, "to create a work of sculpture," were ever used in a deed to real property, to land; it's an extraordinary resolution.)

Now, therefore, be it resolved that William O'Neill, the president of Mount Hagen Livestock Inc., and Margaret Ann DeSharte, secretary, be authorized and directed to execute a deed conveying the said real property to Michael Heizer. Said real property is described as follows . . . It is further resolved that this conveyance is made in fee simple

(meaning there are no conditions)

and the property is to be granted upon and subject to the conditions hereafter set forth. In the event Michael Heizer fails, omits, or otherwise does not satisfy any of the hereinafter named conditions

(so there are some conditions, but they're contractual conditions, not deed restrictions)

the real property will automatically, absolutely, and without further legal or other action on the part of Mount Hagen Livestock Inc., revert in fee simple ownership to Mount Hagen.

(So if he doesn't do what he says he's going to do it goes back.)

The conditions which have conveyance as subject follow: the use to which the land can be put is for the creation of the grantee of a sculpture work of the grantee's choice and the use of the described land is prohibited for any other purpose, and the property shall not be fenced, and no other improvement of any kind or nature whatsoever shall be placed thereon. If the sculpture work is not completed within ten years from this date, the land shall revert to the grantor and to its heirs represented . . . and effectually as if this deed had not been made or executed. Three, grantor will allow a reasonable passage over the land to the property and may be designated by the grantor and its representatives, but grantor shall not be required to furnish or pay for any other road or access.

—but they gave us right-of-way over their land to the piece.

WOLFE: So we can assume that the property was reverted back.

DEIRO: It reverted, yes. When I got done with that very complete description of what he wanted to know, my estimate came back in the millions, and it was too dangerous, even for the helicopter operation. And the concept of how to break it loose—it was an elegant idea to freeze-crack it out, but it left too much to chance. But to drill it and blow it out was not what Michael wanted, not the statement he wanted to make. So it didn't get realized.

We never failed in a presentation to somebody, informed or uninformed, in our request to have them accept or cooperate with us in the construction of earthworks. This is a prime example. A man who lives in Florida, who owns a remote ranch as part of his holdings in Montana, a busy man, a wealthy man who listens to a twenty-minute presentation and then negotiates a legal document based on him giving up land in order to construct a sculpture.

That we could do that in, literally, a couple of phone calls, a letter, and then a visit, shows you the strength of—I'll take credit for my presentation, but it's the validity of the movement, the extraordinary attraction of earth sculpture.

Bijoy Jain: ARCHITECTURE IS NOT ABOUT AN IMAGE, IT IS ABOUT SENSIBILITY in conversation with Vladimir Belogolovsky for ArchDaily, 2016

Vladimir Belogolovsky: You said, “Architecture is an interface between ground and sky.” What do you mean by that? You also said, “Architecture emerges from the ground and returns to the ground.” Could you elaborate?

Bijoy Jain: I was referring to gravity. This is what we are all confronted with. And it is all about how we negotiate gravity that gives architecture its form.

(...)

Vladimir Belogolovsky: Gravity is the most direct challenge to all architects. What is it for you? Do you try to accentuate it in your work? As you know, some architects fight it hard. They don’t want to accept it.

Bijoy Jain: I think we all strive for a certain lightness, but in recognition that there is weight too. There is a beautiful posture in yoga where half of the body is rooted into the ground, while the other half strives to go into the sky, like a rocket. So you can propel yourself up into the sky and deep into the ground at the same time. The state of equilibrium is very important.

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