

Northumbria University Architecture Portfolios

FLOW STRUCTURAL ART

Tim Ingleby

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Designers	Tim Ingleby
Title	Flow
Output type	Design / Artefact
Venue	ARTBAT 9 Festival
Curator	Martin Bricelj Baraga (Museum of Transitory Art) & Simon Jacquemin (Bellastock)
Location	Almaty, Kazakhstan / Quebec, Canada
Client	Eurasian Cultural Alliance / Private Commission
Also exhibited at	Royal Scottish Academy, UK
Convener	Professor Graeme Hutton
Dates	2018 - 2019
Collaborators	Stephen Orlando (Artist) Dr. Paul Hockett (Construction)
Support/acknowledgements	Amy Jane Lawes & Sarah Leeson (Fabrication)

1. Summary

Flow is a collaboration between artist Stephen Orlando and architect Tim Ingleby designed for the ninth annual ARTBAT Art Festival in Almaty, Kazakhstan. A version of it was later constructed in Quebec, Canada.

History offers many instances of artistic imperatives driving technological development. This collaboration seeks to take the '*Motion Exposure*' technique pioneered by Orlando, that captures ephemeral acts of movement in photographic form, and translate this into freestanding sculptural forms.

The project defies straightforward classification: it has both a crafted and a measured precision as it (necessarily) oscillates between the realms of the arts and sciences. To achieve its objective, the research establishes original methodologies for recording and translating motion, develops new structural morphologies based on these recordings, and innovates fabrication techniques for the economic construction of the resulting complex forms. It also seeks to develop the means by which the resulting design can be adapted to be constructed in radically different environmental conditions such that the ideas explored may be more widely transferrable.

At each stage a range of analogue and digital recording and modelling techniques were rigorously used to iteratively capture, translate, analyse and test the formal and structural qualities of the evolving design.

The design also draws on ongoing research conducted by Ingleby in collaboration with Dr. Paul Hockett of the National Research Council of Canada into the construction of thin-shell surface structures. A version of *Flow* was constructed in Quebec, Canada in the winter of 2019 acting as proof-of-concept for the methodologies developed.

The design was selected in open international competition by the ARTBAT organisers for inclusion within the 2018 festival programme. The version constructed in Quebec was subsequently exhibited (in photographic and drawn form) at the Royal Scottish Academy Open Exhibition of Art and Architecture in 2019. ■

2. Research Context



Figure 01
Annunciation,
 Ambrogio Lorenzetti [1344]

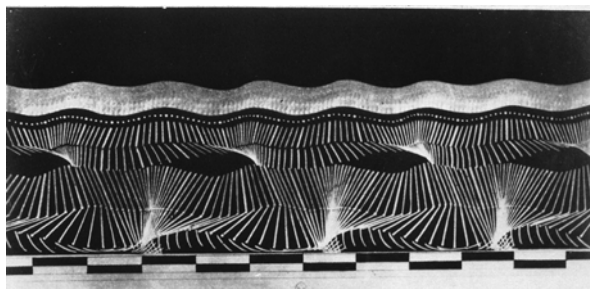


Figure 02
Geometric Chronophotograph
of the Man in the Black Suit,
 Étienne-Jules Marey [1883]

The imperative to give visual form to an artistic idea is a driver of technological innovation. In many instances without this initial artistic provocation the 'solutions' may not otherwise exist. Although these solutions, first and foremost, serve to realise the original artistic vision, it is interesting to note that they often offer wider utility. As such, on occasions, these innovations have the capacity to inform or change wider artistic, creative or even societal practices.

We need only look to Renaissance Italy for an interesting case in point. At that time, a desire to convey the illusion of depth in two-dimensional works had led a number of Italian artists to experiment with how this might be achieved. Lorenzetti's *'Annunciation'* (Figure 01) is one of a number of works that were innovative in using converging lines to lend a sense of depth to the scene, and has been cited as the pictorial origin of modern perspective (Panofsky, 1927). It is widely accepted however that it was only once the architect Brunelleschi combined these with the technical devices of vanishing points and horizon lines a century or so later, that true perspectival images were possible (Scolari 2012). Alberti's *'De Pictura'* (Alberti 2004) first published in 1435 subsequently codified Brunelleschi's principles, providing a manual by which others could employ them. The influence on western painting was almost immediate and profound: virtually all painting created since engages with this invention, either by virtue of adopting, or consciously rejecting, these principles.

The representation of movement has also proven influential as an artistic and technological provocation. Photography and subsequently film, emerged pursuant to a desire to graphically record and communicate motion such that it could be understood with scientific precision. Photography would latterly become accepted, in certain

circumstances, as a form of fine art. The motion studies of early photographic pioneers such as Eadweard Muybridge and Étienne-Jules Marey (Figure 02) prefigured a looser, though equally expressive, language developed by Cubists and Futurists artists such as Duchamp or Bragaglia thereafter.

There is of note that a tendency exists, across all these examples, towards some sort of compression or 'flattening': the dynamic become static, three-dimensional space is portrayed in two-dimensions. Further 'solutions' or devices are devised to convey the information 'lost' by this compression, which ultimately inform an aesthetic that becomes increasingly established. Other artistic imperatives are borne out of this.

The work presented here exists within - and continues - these traditions. It starts with an artistic provocation, itself concerned about capturing and conveying dynamic motion, while also addressing this matter of 'compression'. In doing so an imperative emerges that poses a series of design questions necessitating the devisal of technological solutions to realise a version of an original artistic vision. It concludes with a consideration as to how these solutions might be adapted and transferred to other material or geographical situations while still retaining meaning.

The nature of any such inquiry is inherently interdisciplinary which is here both inter- and intra- personal. The first stage of the inquiry was undertaken in collaboration with the photographer Stephen Orlando. Stephen is a photographer based in Ontario, Canada. During his Engineering studies, he became adept at highly technical photography by employing high-speed photography to study fluid flow: he now specializes in 'light painting' photography. Stephen's work focuses on motions in both natural and urban landscape settings, as well as human movement. Inspired by the works and

pioneering techniques of Étienne-Jules Marey, Anton Giulio Bragaglia, and Frank Gilbreth, he has created photographic series that reveal the hidden patterns of kayaking, canoeing and skiing, amongst other sports.

The mid-stages of the inquiry draw on approaches Ingleby developed and utilised in his fifteen years as a practising qualified architect. Architecture is distinct as a discipline by being situated between the worlds of art and science. Architects are therefore well positioned to mediate between the abstract and the particular. Or, as in this case, the artistic and the technical. During his time in professional practice Ingleby regularly collaborated with artists on a range of projects both speculative and realised, including

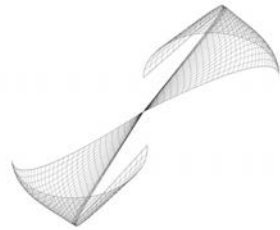
landscape design (Vision Akureyri, Iceland) public landmarks (Belvedere, Swansea) and art installations / public artworks (Bonn Square, Oxford).

The final stage of the inquiry continues an ongoing collaboration between Ingleby and Dr. Paul Hockett of the National Research Council of Canada. Hockett is a physicist, and while his primary professional interests lie at molecular level, like Orlando through his work he has developed expertise with various imaging techniques that inform his practise as a photographer. Since 2016 Ingleby and Hockett have together conceived and constructed a number of innovative thin-shell surface structures (Figure 03). The version of *Flow*, constructed in January 2019, is one such structure. ■

Figure 03

Thin Shell Surface Structure,
Tim Ingleby & Paul Hockett
[2019]

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3. Research Questions

1.

What design methods can enable a photographer and an architect to collaboratively give the photographer's artistic vision three-dimensional form?

2.

How can structural morphologies be developed so as to enable (the resulting) three-dimensional sculptural figures to act as freestanding structures while maintaining the original artistic intent?

3.

How can these freestanding structures be fabricated in a materially and economically sustainable way?

4.

How can an (abstract) sculptural form be realised in a different way to respond to the specifics of place?

□

4. Research Methods

Research-by-design was conducted using a variety of architectural methods. Each method was chosen to be able to address the questions derived from an understanding of the research context set out above. The way the method is used is referred to within the commentary for each section. Methods include the following:

A.

Analysis of existing research papers, reports and books and designs on topics relating to the research questions, including:

- structural design theory (including thin-surface shell structures)
- architectural theory (incl. theory of construction)
- structural and architectural design precedents

B.

Inscriptive methods, including:

- surveys to establish planimetric and topographic site conditions
- analysis to establish other physical and environmental site conditions

C.

Praxis and practice-related activity applied to the research questions, including (in combination):

- analogue and digital drawing
- analogue and digital modelling
- digital photography and video
- 1:1 scale in-situ prototyping to pioneer construction techniques

A version of *Flow* was constructed on Lac-McGregor in Val-des-Monts, Quebec, Canada (45° 38' 21.48"N 75° 39' 23.76" W) over the winter of 2018-19.

Assistance in the construction was provided by the following team:

- Paul Hockett
- Amy Lawes
- Sarah Leeson ▣

5.1 Almaty, Kazakhstan

How can an (abstract) sculptural form be realised in a different way to respond to the specifics of place?

An international Open Call to artists' curatorial brief set-out the following ambition and explanation of the festival's theme of 'Water Stream':

Water Stream [acts] as a central structural element underlying the urbanistic layout of Almaty. Water as a threat, but also as a structural and organisational agent in cities and human landscapes.

Water Stream as a main theme, for the "ARTBAT Fest 2018", seems also an open and fruitful topic for [a] wide range of creators. As water is the first vital resource, an element common and essential to all species, it brings questions from religion, geopolitics, energy, leisure & entertainment, science, spirituality. Furthermore, it can raise awareness of the audience about the cycles of matter.

We will be especially interested in ideas for public space interventions, performances and installations that underline the potential of water to connect and destroy, movements of water, water as a natural force and water as a social catalyst.

(TESLA, 2018)

Flow was conceived in response to this curatorial brief as a means of reminding the audience not only of water's physicality, but also to amplify the influence of water upon Almaty's climate, and thus its urban, industrial and economic structures. It does so not only through its form, but also through its material qualities and also through how it is located within the landscape.

Through its form, with its twisting polychromatic description of a kayaker's graceful movement on water, *Flow* reminds us that while our relationship with water is at times precarious we can – at least temporarily – achieve a state of harmonious equilibrium with it. *Flow* is therefore an allegory for Almaty. As a city, Almaty endures as a result of the equilibrium between static and dynamic forces due

to the Medeu Dam, which protects Almaty from potentially devastating *ceŋ* [mudflows] at times of heavy rainfall.

Through its materiality, *Flow* calls attention to how aspects of the region's industry and economy are sensitive to, and reliant upon, Kazakhstan's water streams. Of the aforementioned methods discussed for structurally conceiving and fabricating *Flow* as a freestanding three-dimensional form, the method proposed for ARTBAT is as a geometric shell formed from a developable surface using the inverted hanging membrane technique. The preferred material for fabrication is cotton – one of Kazakhstan's largest crops. Cotton harvests rely upon exacting conditions for growth, requiring large quantities of water between germination and the formation of cotton bolls, and thereafter an extended period of warm, dry weather. The choice of cotton is symbolic of place: a local material nurtured in response to climatic conditions. As a cloth that is made wholly using natural fibres, cotton is also a pragmatic material choice. Natural fibres are significantly more absorbent than man-made fibres. Ingleby's previous research demonstrates the importance of ensuring a fabric-based construction's absorbency is maximised, when seeking to impregnate it with a state-change material to render it static.

The site in Almaty proposed by the collaborators was one of the concrete-lined water channels that are prominent in the city (Figure 04). Although these have the appearance of canals, they are in fact rivers whose embankments have been heavily engineered since 1973 as a flood-defence mechanism to protect the city from the aforementioned mudflows. Locating *Flow* here calls into question whether these large-scale pieces of urban infrastructure might not have a more productive presence, for while they pragmatically address the issue of flooding, they also

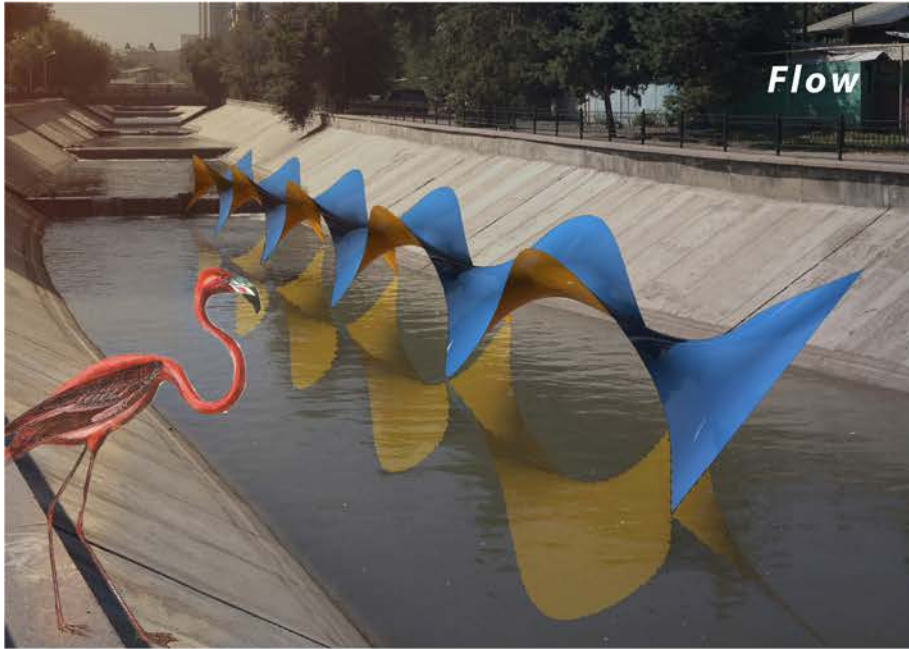
bisect the city and consequently serve to divide and fragment the urban structure.

It was also intended that locating the work in one of these channels would result in a heightened sense of contrast between the static sculpture and the flowing water around it. Elliptically, the static sculptural presence being a product of a dynamic action, stilled, momentarily, by the original 'Motion Exposure' technique.

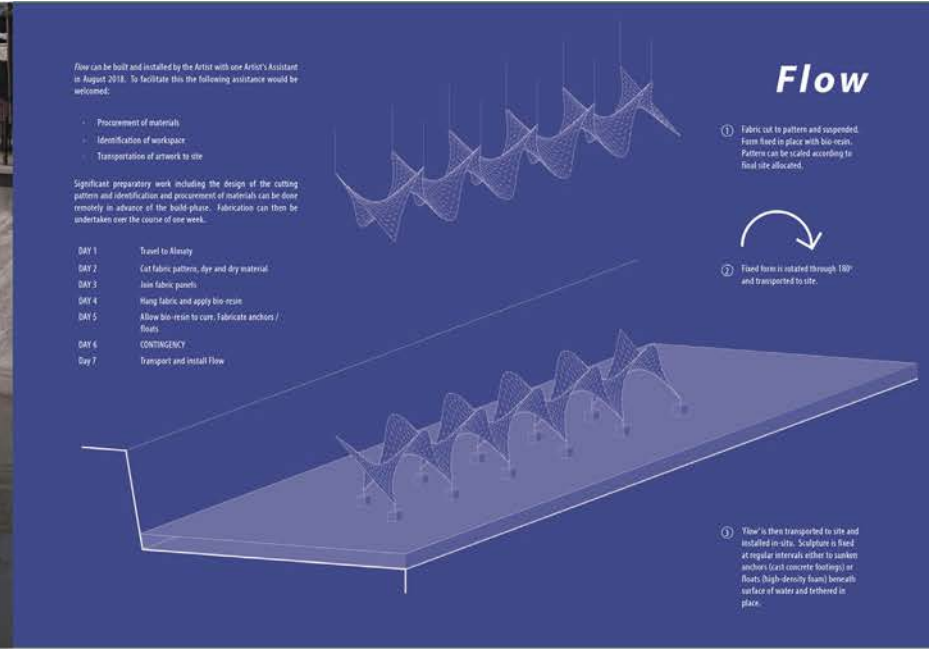
The proposal's success in meeting the curatorial brief is evidenced by its selection for inclusion in the 'ARTBAT Fest 2018' by festival organisers the Eurasian Cultural Alliance. The judging panel included members of the Eurasian Cultural Alliance, MoTA – the Museum of Transitory Art, and Bellastock – a research-action organisation. 'ARTBAT Fest 2018' partners include the British Council, the Goethe Institut, The State Museum of Contemporary Art PERMM and UNESCO. ■

Figure 04 (overleaf)

*Flow project proposal. Almaty,
Kazakhstan (2018)*



Flow - Project Visualisation



Flow - Technical Sketch and Project Timeline

Flow is a transdisciplinary and unique collaboration between Photographer Stephen Orlando and Architect / Structural Artist Tim Ingleby.

Abstracting from Orlando's light-painting photographic technique, Ingleby's materials-based research method of creating self-supporting 'shell' structures provides a transformative process for translating streams of light into a fluid and elegant sculptural form.

Conceived in response to the TESLA Award Call's theme of 'Water Stream' Flow reminds us not only of water's physicality, but also amplifies the influence of water upon Almaty's climate, and thus its urban, industrial and economic structures.

Orlando's *Kayak Series* [2015] freezes the motion of a solitary kayaker paddling through water. These photographic studies capture human motion as streams of coloured light. *Flow* reimagines these two-dimensional images as a twisting polychromatic ribbon-like sculptural form. *Flow* could be installed anywhere, however its ideal home would be amidst flowing water to provide a contrast between static and dynamic elements.



Great Marine Kayak
 Stephen Orlando (© 2015)

Flow is an allegory for Almaty. As a city it endures as a result of the equilibrium between static and dynamic forces due to the Medeu Dam, which protects Almaty from potentially devastating mudflows at times of heavy rainfall.

Ingleby's research into inverted structural forms creates self-supporting thin-shell structures that will translate the abstract into the structural.

Flow will be constructed using a technique that involves carefully cut fabric patterns being suspended, their forms 'fixed' under their own weight, before inverting them to create self-supporting thin-surface structures. As a process developed and prototyped by Ingleby, initially in a series of Ice-Shell Structures [2017], this unique work will contribute to his ongoing materials-based design research.

In drawing on themes of construction, economy and sustainability, Cotton – one of Kazakhstan's largest crops – is the preferred construction fabric for *Flow*. It will be dyed in two colours to create contrasting upper- and lower-surfaces.

Flow's materiality calls attention to how aspects of the Region's industry and economy are sensitive to, and reliant upon, Kazakhstan's water streams. Cotton harvests

rely upon exacting conditions for growth, requiring large quantities of water between germination and the formation of cotton bolls, and thereafter an extended period of warm, dry weather.

With its twisting polychromatic form, *Flow* reminds us that while our relationship with water is at times precarious we can – at least temporarily – achieve a state of harmonious equilibrium with it.



Ice-Shell Structures
 Tim Ingleby with Paul Hockett (© 2017)

5.2 Val-des-Monts, Quebec, CA



Figure 05

Lac-McGregor, Val-des-Monts,
Quebec, Canada

The site for the realisation of *Flow* in Val-des-Monts is, in many ways, the diametric opposite of Almaty: a wooded hillside in the Canadian wilderness that is covered by snow throughout the winter months. Much of the site is impractical for construction, due to its varied topography and dense tree cover. Moreover, the form that implies a person kayaking would be a non-sequitur in such a setting, however formally compelling it may be.

At the foot of the hill the wood meets the shore of Lac-McGregor, a large lake used for recreational purposes during the summer months which then freezes over to become traversable by foot during winter (Figure 05). This presented an apt situation for a reimagining of *Flow* in which both lake and kayaker were becalmed by the onset of winter, as opposed to the juxtaposition of static (sculptural form) and dynamic (flowing water). Whereas in Kazakhstan this contradistinction served to call to attention water as a divider of territory, in Val-des-Monts the assimilation of object in the landscape would infer how, once frozen, the water unifies terrain.

In Almaty, *Flow* was conceived as being constructed by saturating cotton fabric with a bio-epoxy resin which would cure to form a rigid composite. The resin identified was selected for its various properties, including (but not limited to) structural capabilities, compatibility with cotton fibres, and low-viscosity for improved workability and evenness of distribution. It is derived from co-products and/or waste products of other industrial processes and is formulated using green chemistry techniques, which substantially reduces its embodied energy. It is also environmentally inert when cured: an essential characteristic given its proposed location in a water course.

These material choices were not however appropriate in Val-des-Monts. As a result of the climate cotton cannot be grown in Canada. Indeed while the country does have an established textile industry this is increasingly geared towards industrial textiles (generally with high manmade fibre content) using imported raw materials (CTT Group, 2008). Resins, be they (bio-) epoxy, polyurethane, polyester or silicone, require stable working environments, ideally at or above room temperature (20 – 25°C) and with low humidity (<50% RH). Lower temperatures will prolong a resin's workability ('pot time'), but at temperatures that are too low (generally considered 10°C and below) or humidity that is too high, resin will fail to cure correctly. In Val-des-Monts the average monthly temperature in January is -11.0°C, with an average daily max / min. variation of -6.0°C and -16.1°C, with Relative Humidity between 67-77% (Government of Canada, 2020). For this reason resin was not a viable option.

In light of this, any fabric would likely be imported: unbleached organic cotton remained appropriate from a material performance-related view due to high absorption and environmental inertness but would not be what connected construction with place. Instead this connection would be created by the replacement material for resin – environmentally inert, locally-sourced, available in abundant quantities, capable of state-change, and total saturation of the fabric, and workable in the climatic conditions: water, drawn directly from the lake.

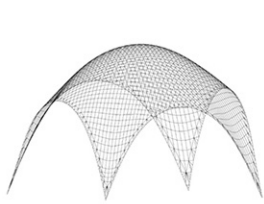


Figure 06

Ice/fabric composite structure,
Tim Ingleby & Paul Hockett
(2018)

Figure 07 (overleaf)

Flow
Lac-McGregor, Val-des-Monts,
Quebec (2019)

Ingleby has previously conducted research in construction using ice/fabric composites (Figure 31). Following in the footsteps of Heinz Isler's 'playful experiments' (Chilton and Royal Institute of British Architects. 2000) he has created a series of small-span structures. Constructing *Flow* in this way presented several novel solutions not seen in Isler's works, including:

- geometrically defined shell
- fabric pattern cutting
- lamination (colour differentiation of surfaces, increases weight but also thickness which results in additional strength)
- allied to the above, concealed seams
- speed of construction, if not necessarily fabrication
- development of tension ties to counteract lateral thrust

The territory selected for the construction and placement of *Flow* was a sloping area of woodland on the banks of Lac-McGregor. All low-level vegetation normally found in this area was covered by snow, meaning access and the working surface were relatively clear of obstructions.

Flow was constructed at an ambient air temperature of -12°C, or -19°C when adjusted for windchill. In these conditions the saturated fabric froze solid in less than 15 minutes, whereupon it was inverted and easily carried by four people to its final location on the middle of the lake. Such expediency of time and labour as well as materials is of paramount importance to reducing the amount of constructional energy required to realise a minimal structure according to the original principles set out by Frei Otto. ■



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