

PHYSIOGNOMY OF SPEED: A VELODROME ON SEATTLE'S WATERFRONT

Justin Allen Farmer

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Committee:

Peter Cohan

Jennifer Dee

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*To my thesis advisers
Peter Cohan and Jennifer Dee
for their belief in this project;*

*To professors Kimo Griggs
for his early encouragement
and Kate Simonen for her
important role in developing
a “credibly integrated”
structural concept;*

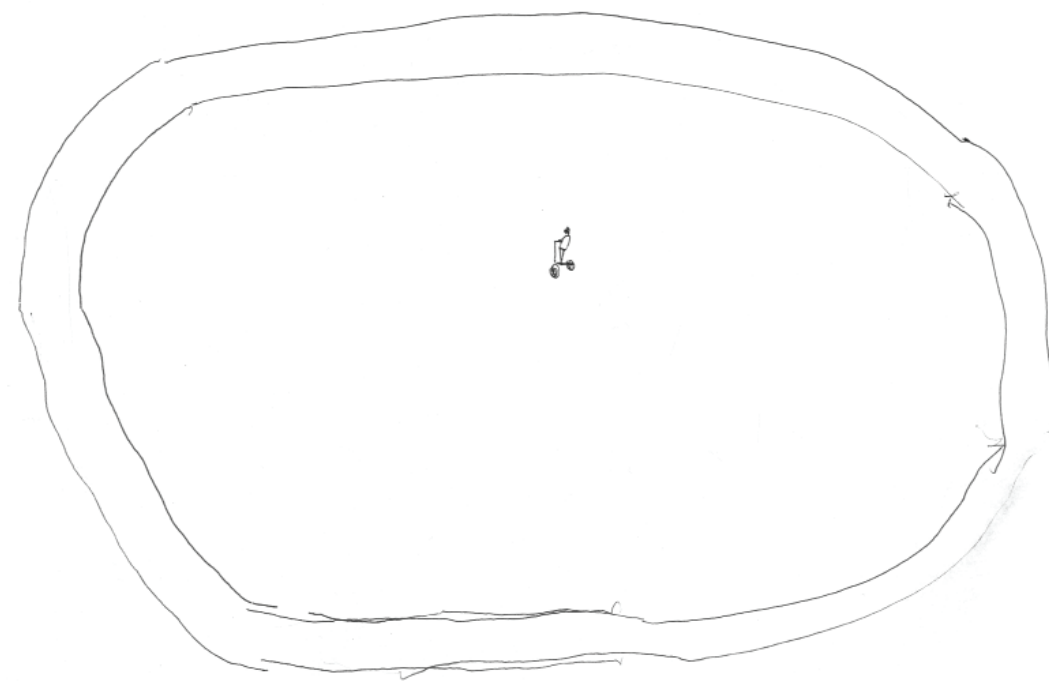
*To Alex Anderson and the
Department of Architecture
for their understanding
during this process;*

*To my friends for their help,
of all kinds;*

*And to my wife Sandy for
her enduring support:*

Thank you.

For Riley.

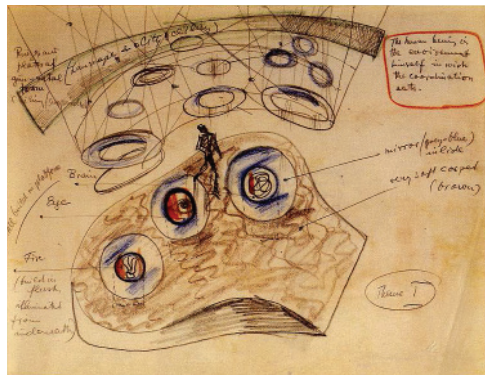


PROLOGUE	8
SUPERELEVATION	10
PHYSIOGNOMIES	26
PLACEMENT	32
RESOLVING	38
EPILOGUE	56
REFERENCES	58
SUPPLEMENTS	60

PROLOGUE

*Neither light, nor eye, nor brain... can see.
But rather, we see only through the total
coordination of human experiences;
and even then, it is our own conceived
image, and not the actual object which
we perceive.*

Frederick Kiesler,
“Brief Description of Vision Machine”



Study for Frederick Kiesler's
“Vision Machine,” exploring
the relationship between the
“psychological and physical
condition of human perception.”

This thesis explores the enduring relationship in architecture between form and use through the design of a velodrome on the current site of Pier 48 on Seattle’s waterfront.

The design for the Pier 48 Velodrome develops a contrast between the cyclist and spectator: the paramount experience of the cyclist subverts that of the otherwise all-seeing spectator. The velodrome typology is further reevaluated in terms of its use and siting: the velodrome and unique over-water site each make demands of, and present opportunities to, the other.

The city is in turn provided a unique means of engaging with one of its earliest developed and most diversely used waterfront sites.



The embodied point of view from which this thesis begins: a track cyclist riding at speed towards a fluid and relative horizon.

SUPERELEVATION

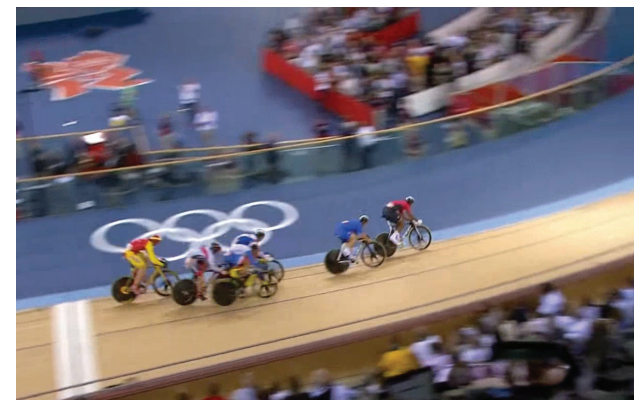
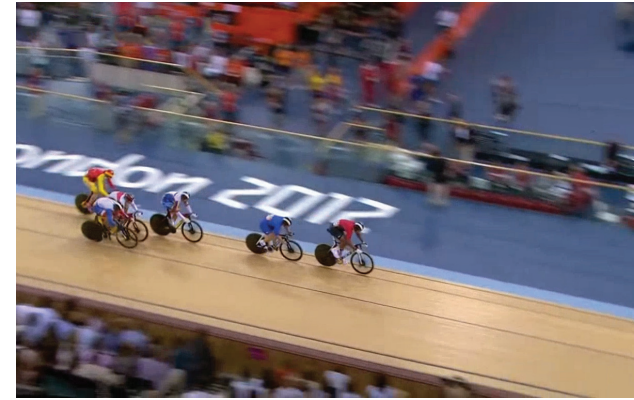
We affirm that the world's magnificence has been enriched by a new beauty: the beauty of speed.... Why should we look back, when what we want is to break down the mysterious doors of the Impossible?

*Filippo Tommaso Marinetti
"The Founding and Manifesto of Futurism"*

Track cycling, or the act of racing bicycles on a velodrome, is nearly as old as the bicycle, originating at the turn of the twentieth century in Europe and the United States.

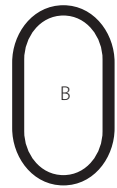
When riders accelerated beyond the limitations of the high-wheeler bicycle at that time, formerly flat race tracks were reconstructed with banked turns. This banking, or *superelevation*, allows cyclists to maintain their speed over the length of the track and gives velodromes their characteristic form.

Modern velodromes, particularly those constructed indoors, utilize sophisticated and continually evolving geometry in their design. A smooth transition between the straight section and the banked turn is demanded by riders and proves the expertise of the track designer. Though the UCI (an international organization that regulates competitive cycling) provides guidelines for the design of a standardized velodromes, several key aspects are left to the designer. Renowned track designer Ron Webb: "The whole secret of a bike track is really that exit from the curve and the way it joins on to the straight.... Every time I build a track I'm always tweaking that exit."



Track cyclists crossing the finish line at the 2012 London Olympics. The velodrome's expansive size belies its fluid use, and whether viewed in person or on a screen the relationship between the cyclist and the track is reduced to a fragment of the whole.

FUNDAMENTALS



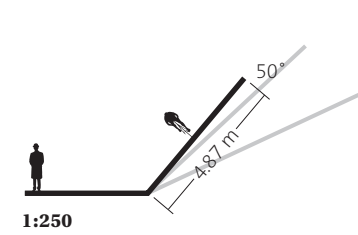
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	built	length
A CIRCUS MAXIMUS	c.300 BCE	795 m
B VELODROME	c.1990	250 m

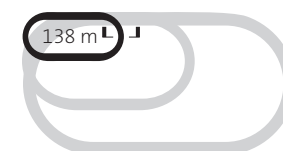
Athletic spectatorship is characterized by the relationship between players (athletes) and spectators. This relationship is largely dependent on the nature of the *field of play*. In track cycling the field of play is distinguished by its expansive, circular path. The cyclist's always ride in a counter-clockwise direction and their lateral movement is confined to the width of the track. Finishing a race first, or with the fastest time, is the simple goal in most cases. Simple rules and little strategy makes for an exciting and primal spectacle.

The superelevation of a velodrome is a product of its length, the proportion of the straight sections and turns, and the turn radius. Decreasing the turn radius typically increases the superelevation so that a cyclist may ride at maximum speed regardless of the specific geometry. Generally, shorter tracks have greater superelevation (steeper banking).

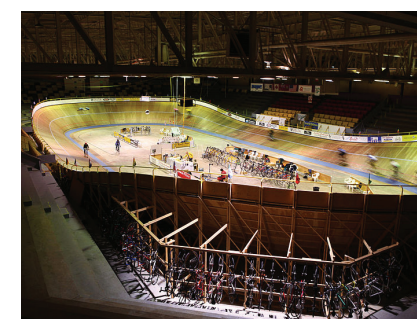
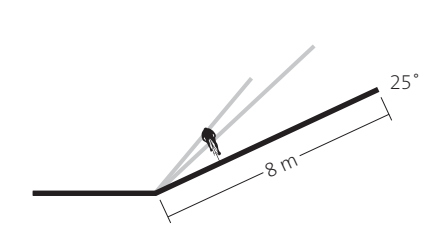
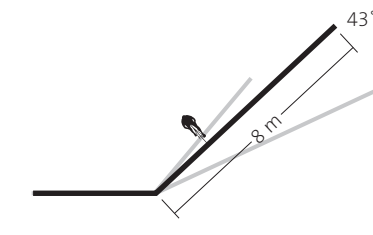
Velodrome design has trended to standardization towards the end of the 20th century. 250 meters is the desirable and required minimum length for indoor tracks used for international competition.



1:250



1:5,000



FOREST CITY
London, Ontario

One of four indoor velodromes in North America, though the smallest permanently-constructed track in the world at 138 meters. It was built to fit inside a former hockey arena.



LONDON
London, England

Built for the 2012 Olympics and integrated into a large cycling complex that includes an outdoor BMX track and a road-racing circuit. *The geometry of the London track served as the model for this thesis.*



MARYMOOR
Redmond, Washington

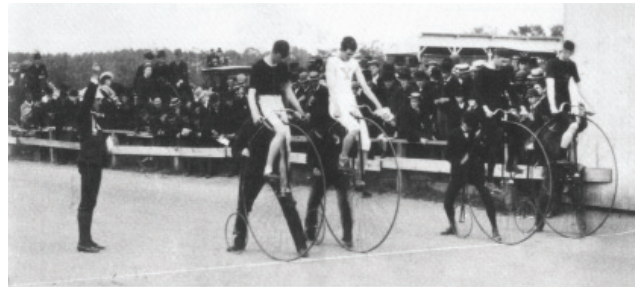
One of the largest velodromes in North America at 400 meters, though typical in size for an outdoor track.



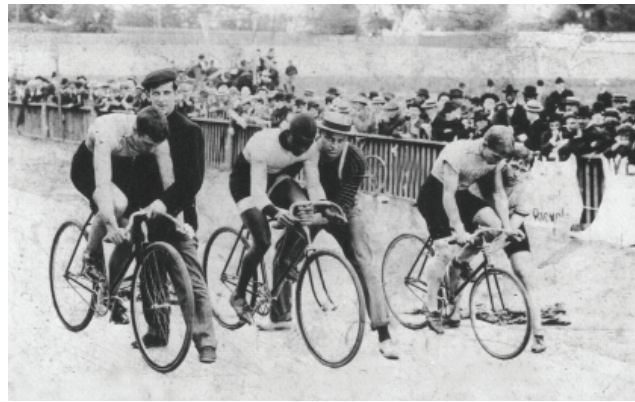
HISTORICAL SUMMARY

The feelings stirred by these races are instinctive and essential. They are the foundation of our being, from the very first man to ourselves today.

Mario Morasso
"Sensations of Speed"
1902



National collegiate bicycle race on a flat, outdoor track. 1884



Preparing for a race on an outdoor velodrome in Newark, New Jersey. 1901



Indoor velodrome. Madison Square Garden, New York City, 1907



Outdoor velodrome. Salt Palace, Salt Lake City, 1899



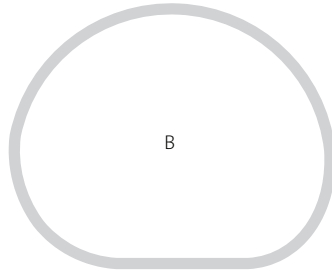
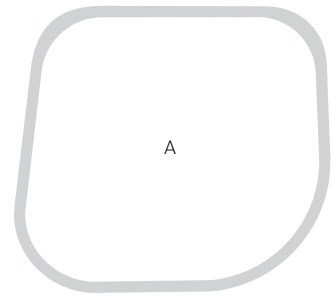
The only indoor velodrome in the United States. ADT Event Center, Carson City, California



The oldest outdoor velodrome in the United States still in use, constructed in 1927. Washington Park, Kenosha, Wisconsin

The modern track bike has more in common with the earliest forms of the bicycle than the majority of bicycles used today. It has one fixed-drive gear, no conventional brakes (the rider decelerates by resisting the movement of the pedals), and a diamond frame (historically made from steel though increasingly made from composite materials).

TRACK EVOLUTION



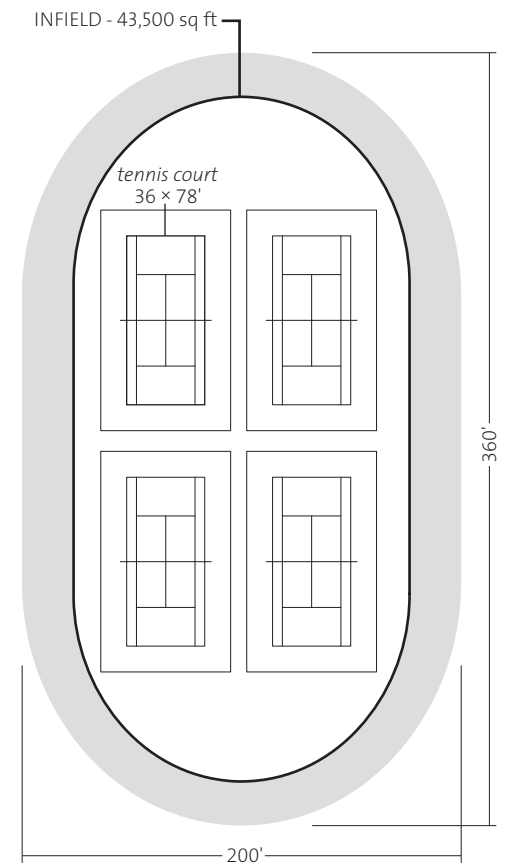
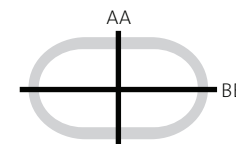
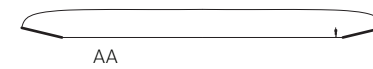
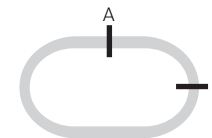
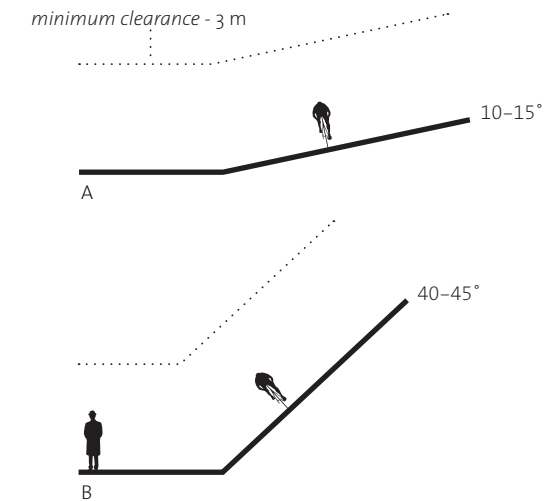
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	<i>built</i>	<i>length</i>	<i>width</i>	<i>max. slope</i>
A PRESTON PARK Brighton, England	1877	579 m	6.5 m	?
B MOUNTBATTEN CENTRE Portsmouth, England	c.1880	536 m	6.5 m	?
C LA CIPALE Paris, France	1894	500 m	10.5 m	?
D WASHINGTON PARK Kenosha, Wisconsin	1927	333 m	6 m	27°
E ALPENROSE Portland, Oregon	1967	268 m	8 m	43°
F MARYMOOR Redmond, Washington	1975	400 m	8 m	25°
G standard indoor track*	c.1990	250 m	7-8 m	40-45°

*The UCI requires newly constructed velodromes to fall within a range of dimensions to satisfy standards for international competition. The length must be at least 250 meters while the turn radius and track width may fall within a range determined by the track designer. The degree of superelevation and the transition from the straight sections into and out of the turns are less clearly defined and are ultimately determined by the expertise of the track designer.

OPPOSITE: approximate scale and dimensions for a standard, indoor 250 meter velodrome

STANDARDIZATION



TYPICAL SITING



LONDON

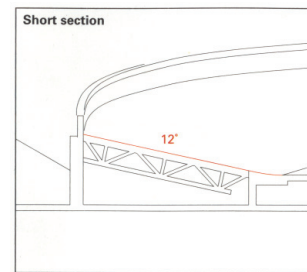
An indoor velodrome located in Queen Elizabeth Olympic Park, a 560 acres park built for the 2012 Olympics located eight miles from downtown London.

MARYMOOR

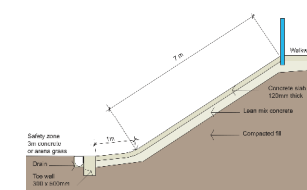
An outdoor velodrome in Marymoor Park, a 640 acres park located seven miles from Bellevue, and fifteen miles from downtown Seattle.

Velodromes are typically located on the periphery of townships or dense urban areas. Their expansive size and exclusive use present a challenge for doing otherwise.

TYPICAL CONSTRUCTION



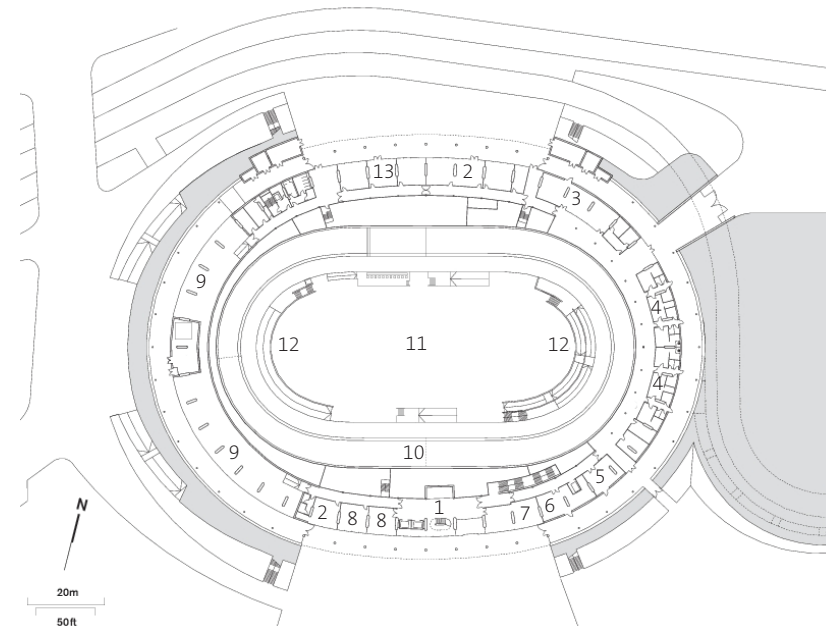
Indoor velodromes are typically constructed of large, timber trusses spanning the width of the track. The trusses are topped with Siberian pine planks measuring 4 x 4 cm. This system provides an ideal riding surface, rigid and uniform, suited for high-performance competition. The common length for an indoor velodrome is 250 meters.



Outdoor velodromes are typically constructed of concrete poured directly on bermed, compacted earth. Without the need for enclosure, and to reduce the slope upon which the concrete is poured, outdoor velodromes are typically larger than those built indoor. Common lengths are 333, 400, and 500 meters.

TYPICAL PROGRAM

- 1 Reception
- 2 Office
- 3 Gym
- 4 Changing room
- 5 Bike rental
- 6 Workshop
- 7 Retail
- 8 Meeting room
- 9 Storage
- 10 Track
- 11 Infield
- 12 Access ramp from basement
- 13 Seminar/conference



London velodrome
ground floor plan

Indoor velodromes require between one and three levels of program to support the use of the track. Supplemental amenities for additional users are sometimes included if the facility is located close to an urban center.

The inner area of the track, the *infield*, is kept clear of structure or permanent facilities so that spectators can see the entire track and for use by cyclists and their support staff during events. The infield's expansive size is often utilized for temporary, non-cycling related activities.



Theater stage with seating temporarily occupying the infield of the Saltair velodrome, Salt Lake City. c. 1900



Volleyball courts permanently occupying the infield of the Burnaby velodrome. Black netting suspended from the ceiling keeps volleyballs from interfering with the track.

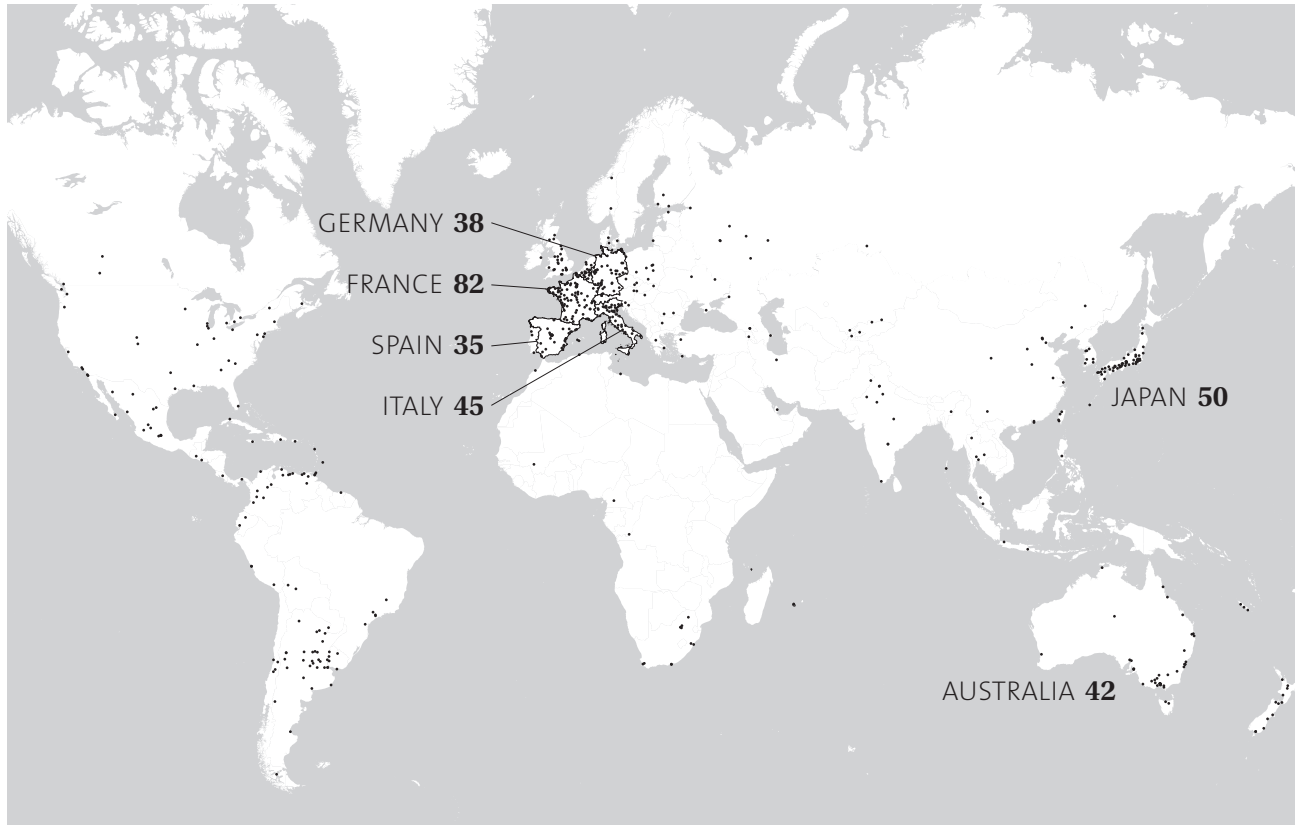


One-ring circus temporarily occupying the infield of the Vélodrome d'Hiver, Paris. c. 1910



Concert temporarily occupying the infield of the Berlin velodrome. When the facility is used for events other than track cycling the track is draped in black fabric.

INTERNATIONAL DISTRIBUTION



location of velodromes globally, with notable concentrations in several countries

DATA SOURCE:
www.juniorvelo.com

There are more than 600* velodromes globally. Roughly 7% are indoor. Most outdoor velodromes are unsuitable for international competition due to the varying quality of track surfaces, unpredictable weather conditions, and lack of amenities to support large crowd comfort and safety.

*The number amounts to between 600 and 800 depending on which database one uses. See those at www.juniorvelo.com and www.wikipedia.org, for example.

NATIONAL DISTRIBUTION



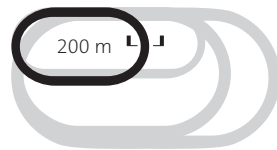
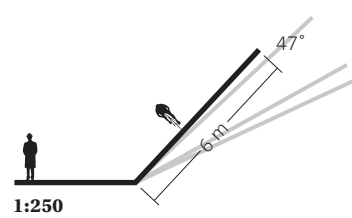
location of velodromes in North America, those currently in use

DATA SOURCE:
www.wikipedia.org
and www.usacycling.org

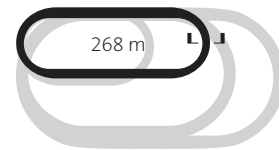
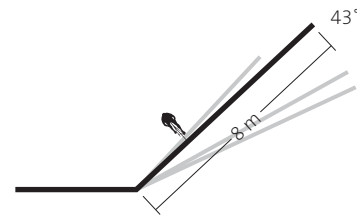
As of 2015 there are twenty-seven operational velodromes in the United States and eight in Canada. Four of these are indoors: one in the U.S. and three in Canada. Of these, two are approved for international competition: one in Carson City, California and one in Milton, Ontario.

REGIONAL DISTRIBUTION

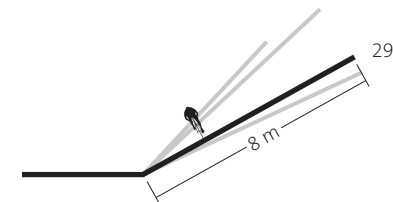
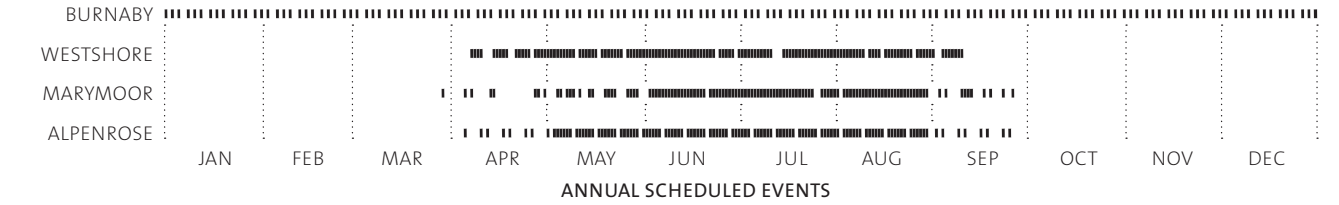
There are four velodromes in the Pacific Northwest region of the United States. Each supports an active track cycling community (see calendar, opposite) through at least the spring and summer seasons. One, Burnaby, is indoors and used year-round but its shorter 200 meter length and lack of large-crowd amenities preclude it from use for international competitions.



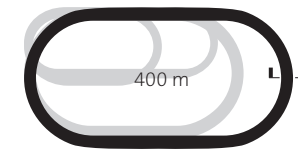
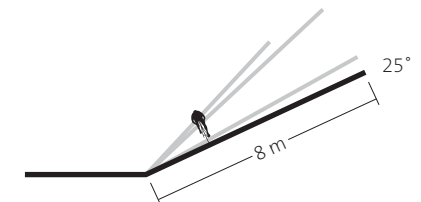
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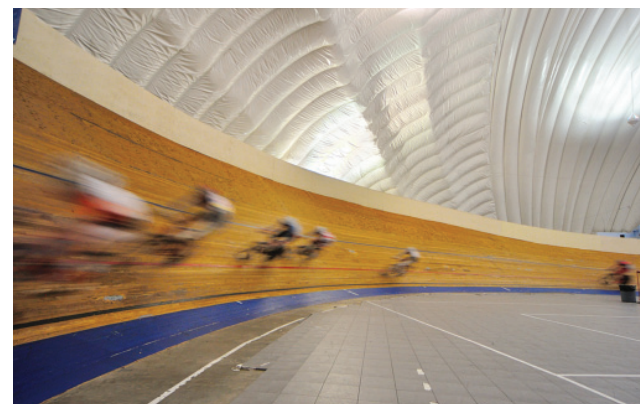
ALPENROSE
Portland, Oregon
built: 1967



WESTSHORE
Victoria, British Columbia
built: 1994



MARYMOOR
Redmond, Washington
built: 1975



BURNABY
Burnaby, British Columbia
built: 1997

PHYSIOGNOMIES

We cannot describe our impressions of an object without treating it as a living thing with its own physiognomy. For even the most precise description, enumerating all visible characteristics, will not give an inkling of what we feel is the essence of the thing itself. Just as we do not notice the individual letters in a word but receive a total impression of the idea that the word conveys, we generally are not aware of what it is that we perceive but only of the conception created in our minds when we perceive it.

Steen Eiler Rasmussen
Experiencing Architecture

In *Experiencing Architecture*, Steen Eiler Rasmussen describes the embodied rhythms of the built environment across eras. “In the Spanish steps we can see a petrification of the dancing rhythm of a period of gallantry,” while New York has a “motor rhythm... [and] only at the wheel of an automobile can you mark its beat.”

In this section the character of the velodrome is anticipated by reviewing the role that themes of motion have played for artists and designers throughout history.



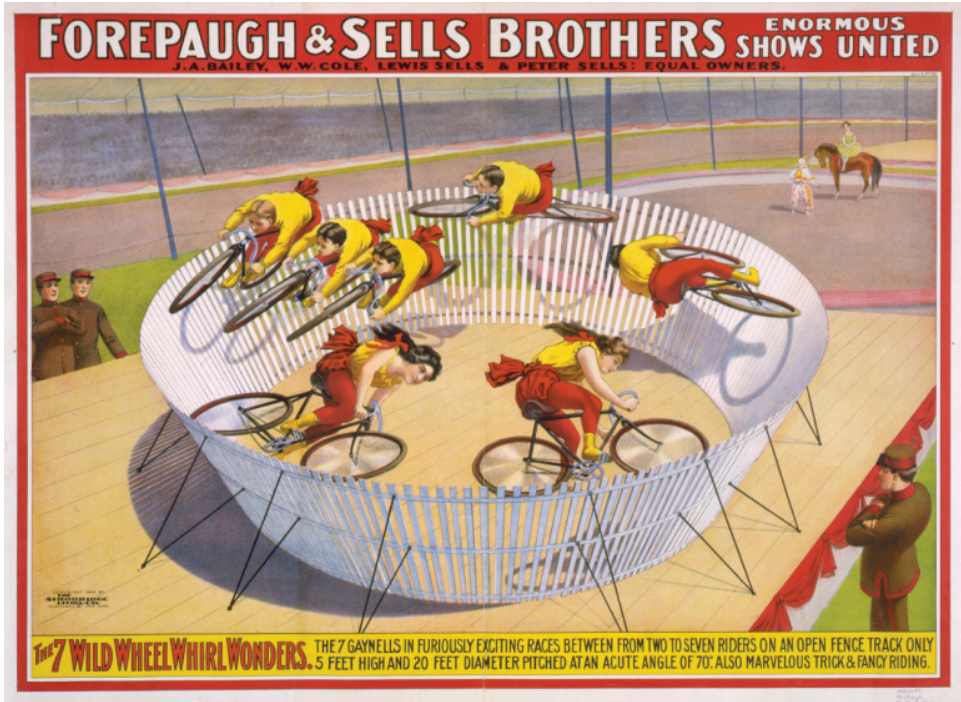
the built environment's movement-based rhythms, shaped by social convention and technological innovation



Le Velodrome, Marcel Stobbaerts, c. 1925

phys-i-ogno-my \,fɪz'ɒ(ɡ)nəmē, -mi\ n -es [alter. (influenced by LL *physiognōmīa*) of earlier *phisnami*, fr. ME *fysnamye*, *phisnomye*, *phisnomie*, fr. MF *phisnomie*, fr. LL *physiognōmīa*, fr. Gk *physiognōmīa*, alter. of *physiognōmonia*, fr. *physi-* + *gnōmōn-*, *gnōmōn* interpreter, discerner + *-ia*, *-y* — more at GNOMON] 1 **a** : the technique or art of discovering temperament and character from outward appearance (as from facial features) **b** : divination by means of facial features : fortune-telling or a fortune told by one reading a face 2 **a** : the facial features that show the qualities of mind or character by peculiarities of configuration or cast or characteristic expression (a stern ~ indicative of great pride); *broadly* : characteristic facial appearance or type (as of a race or group) (a Grecian ~) (slender aristocratic ~) **b obs** : a representation of a human face 3 : external aspect : characteristic or peculiar contour; *also* : inner character or quality as revealed outwardly (the ~ of a mountain) (<~ of a political party) *syn* see FACE

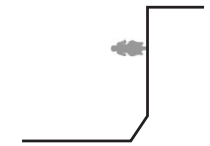
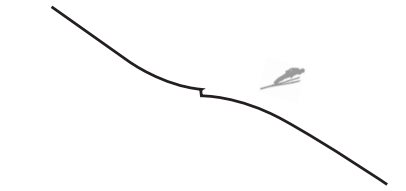
from Webster's Third New International Dictionary



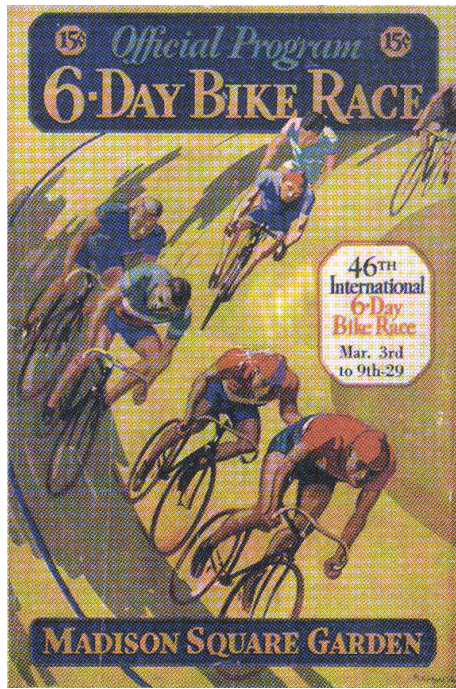
circus poster advertising "The 7 Wild Wheel Whirl Wonders" who performed on an inclined surface that was a cross between of a velodrome and a Wall of Death, 1902



Like the velodrome, these forms exemplify their (alternate) extreme uses: the ski jump, an empty swimming pool, the Wall of Death. And like the bike on the velodrome, these gravity-fed arenas require assisted means of linear conveyance for maximum effect: skis, the skateboard, the motorbike.



POINT OF VIEW



THE SPECTATOR

A 1929 poster depicting the speed and excitement of track cycling from the conventional point of view of the spectator.



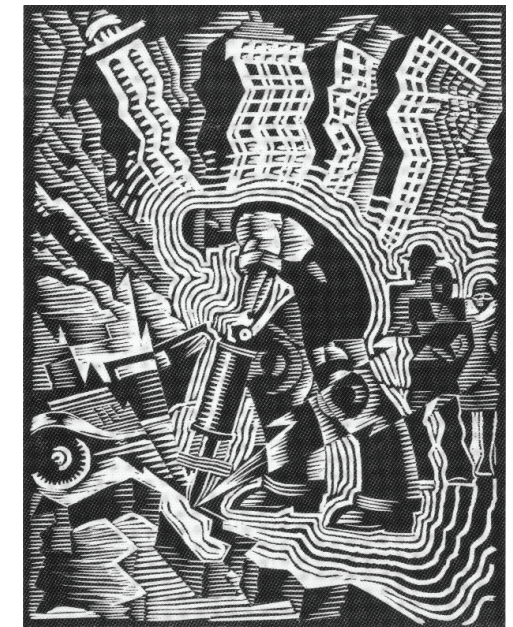
THE CYCLIST

As an alternative to firsthand experience as a track cyclist, one may become partially accustomed to the quality of their environment through the use of video. The viewer momentarily adopts their fluid movement and shifting horizon.

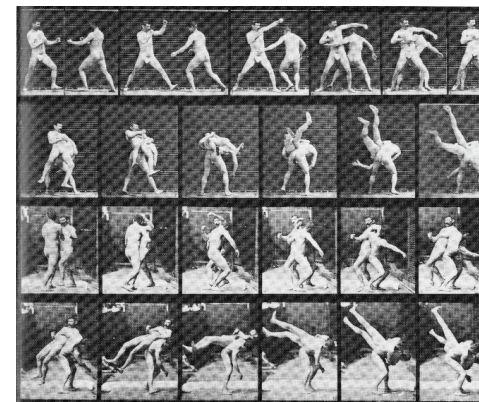
BODY MOTION



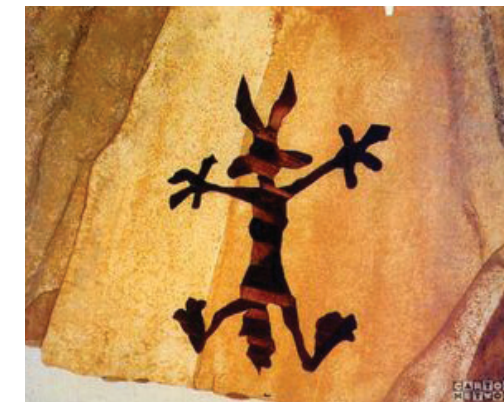
Unique Forms of Continuity in Space, Umberto Boccioni, 1913



Man with a Drill, Charles Turzak, c. 1935



Boxing, Eadweard Muybridge, 1887



evidence of Wile E. Coyote's accelerated but reckless trajectory

PLACEMENT

The paths, the network of habitual or potential lines of movement through the urban complex, are the most potent means by which the whole can be ordered. The key lines should have some singular quality which marks them off from the surrounding channels: a concentration of some special use or activity along their margins.

Kevin Lynch
The Image of the City

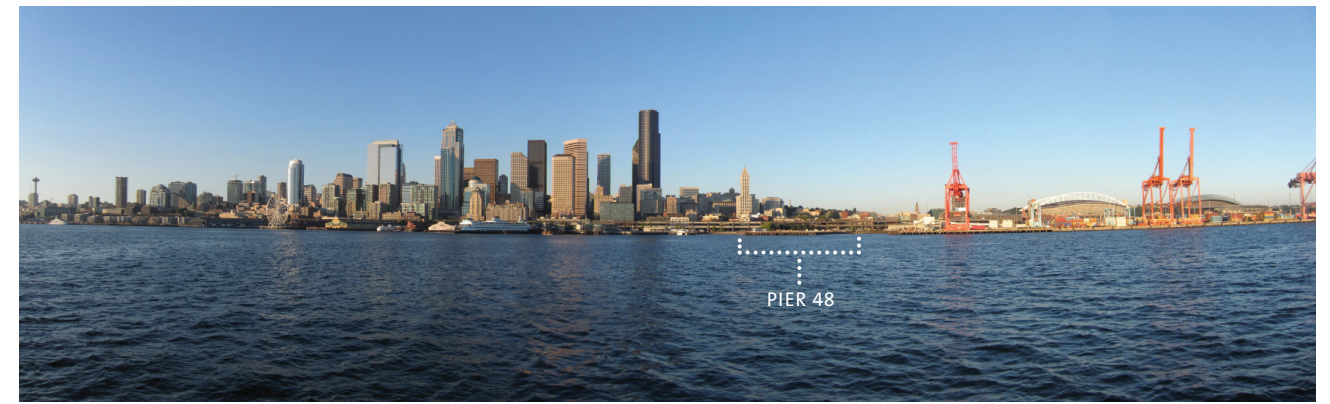


Pier 48, "at the intersection of urban development, industry and spectacular views of big nature," as seen from downtown Seattle



distances from regional velodromes to Seattle

Seattle is an ideal home for an indoor velodrome, centrally-located for supplemental use by the existing regional track cycling communities.





view of Pier 48 from S. Main St.



between Terminal 46 and Pier 48



Pier 48's existing structure is deemed unsafe for reuse and any use of the property would require new building



first structure built on the current site of Pier 48, c. 1900

Most recent Pier 48 structure and building (building now demolished) was used for decades in a variety of ways: as a shipping and cruise terminal, storage facility, and finally as an event space



Seattle's 1855, 1888, and 2015 waterfront boundary

RESOLVING

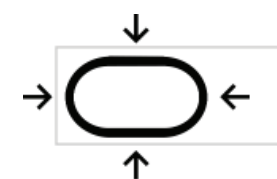
Form conveys its inner meaning with finer vibration and deeper expressiveness than can the spoken tongue.

Eliel Saarinen

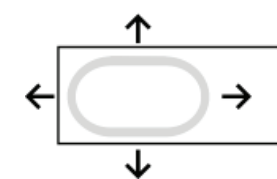
The Search for Form
in Art and Architecture



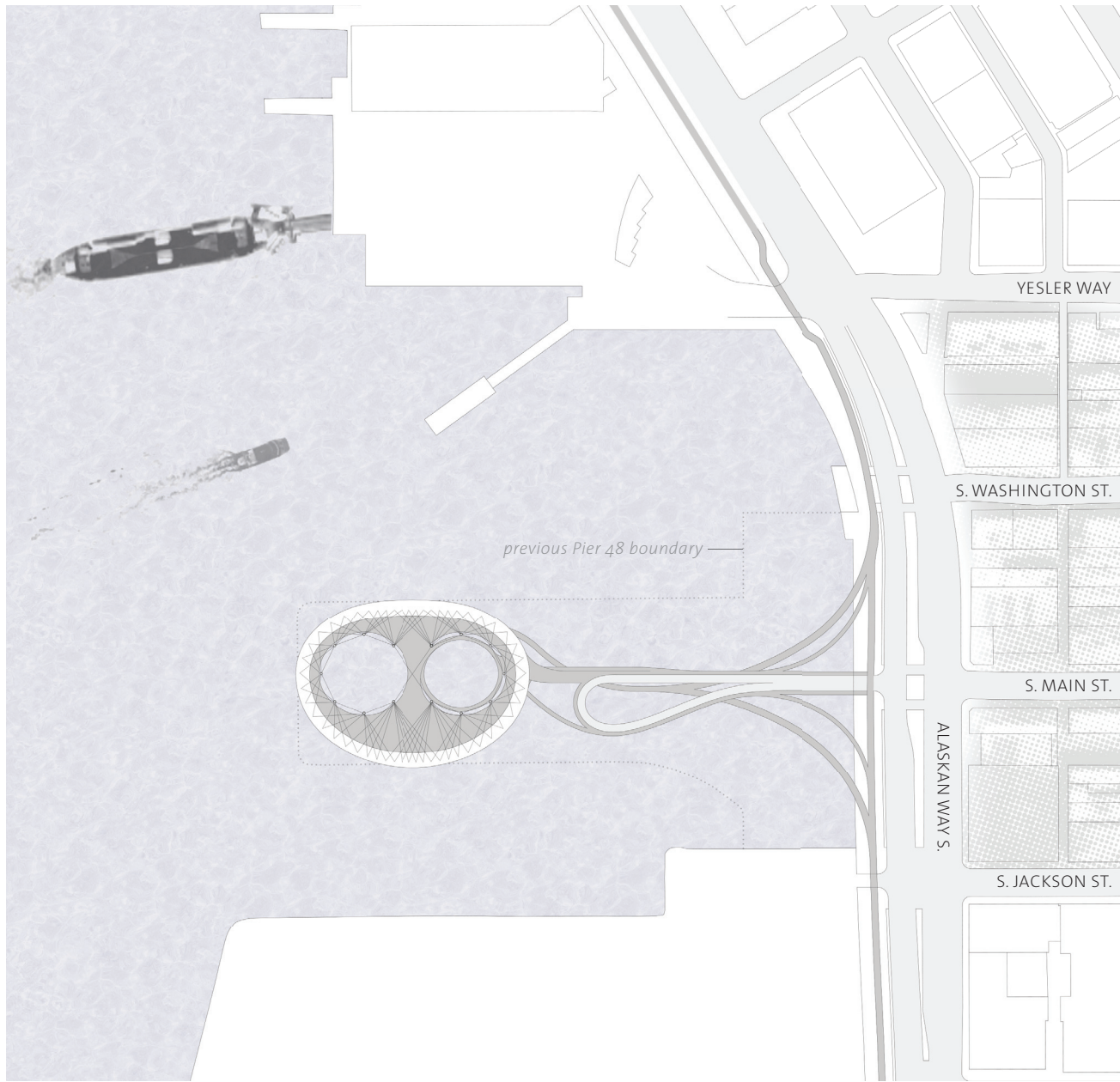
The Pier 48 Velodrome, viewed from the water taxi that departs to the north of the facility.



VELODROME: fixed and introverted



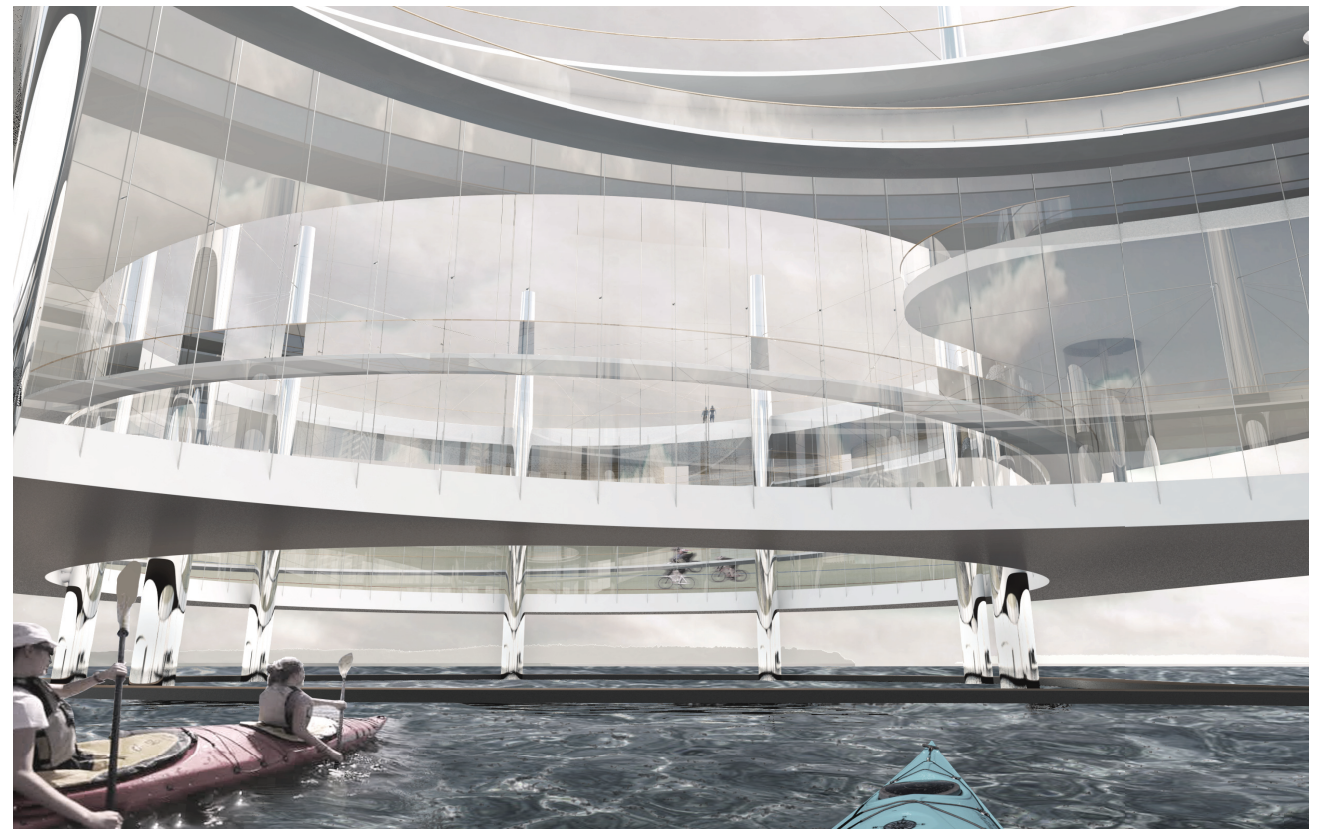
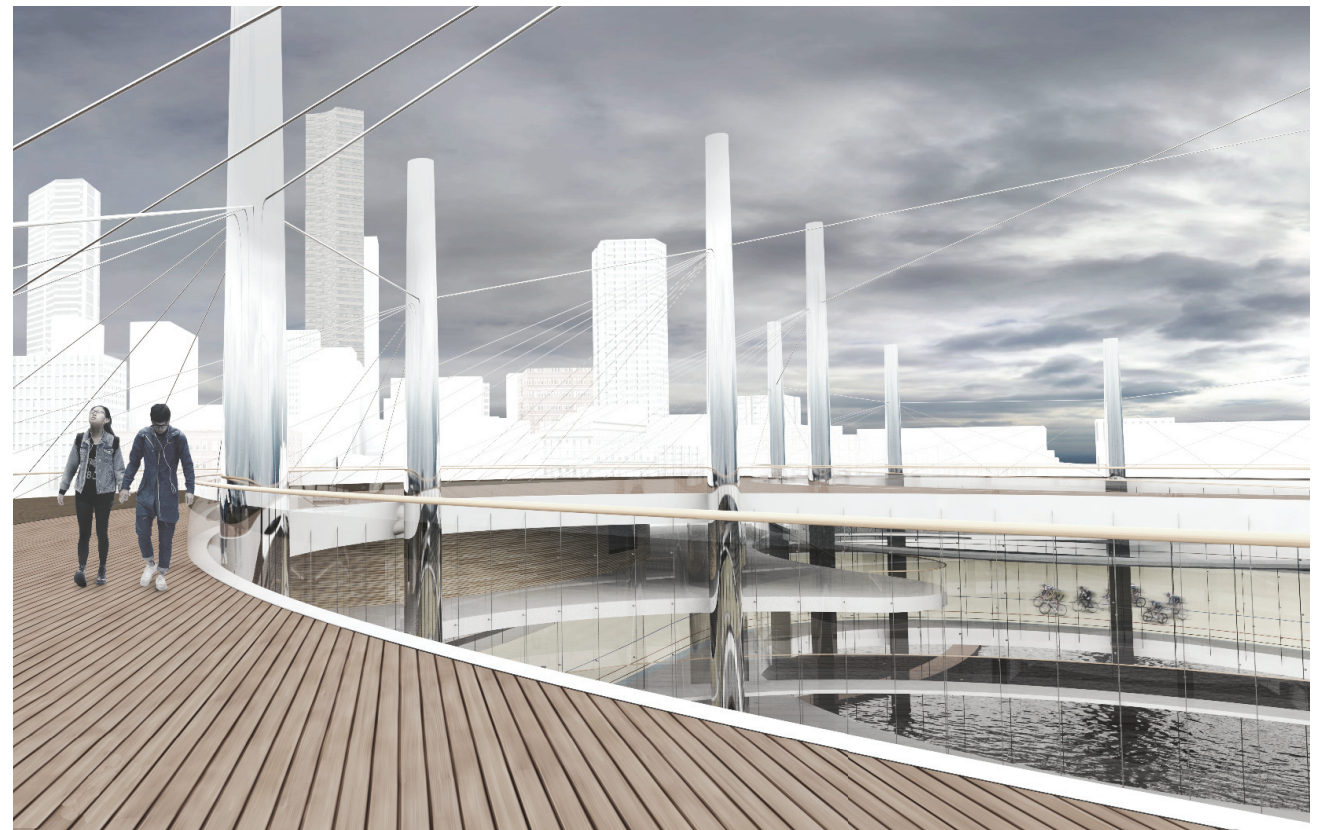
PUBLIC PIER: flexible and extroverted

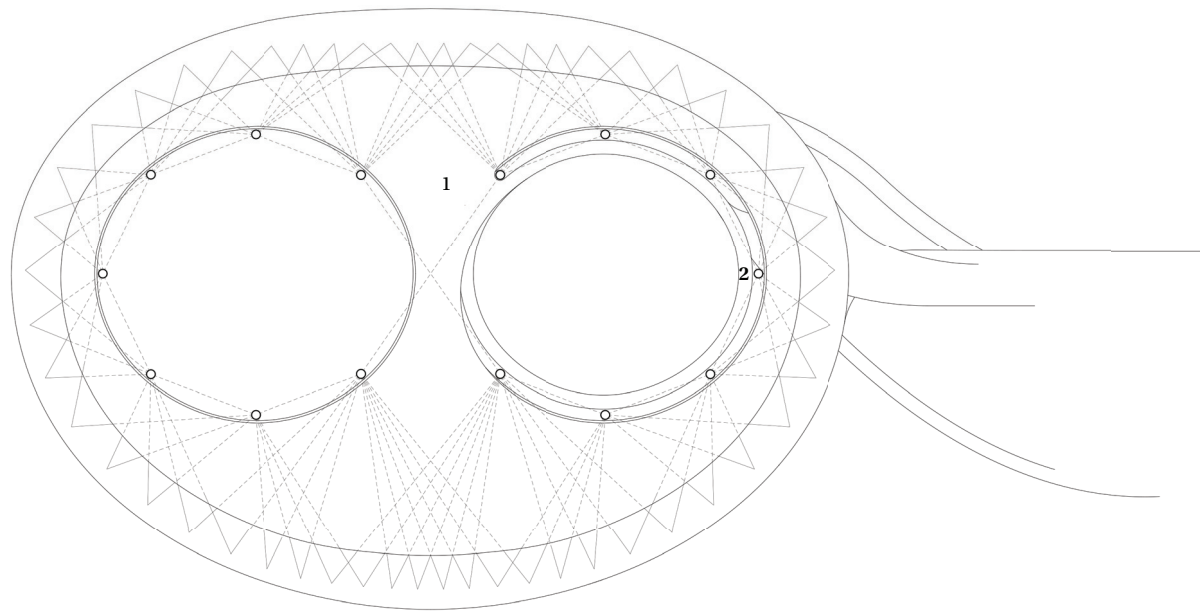


site plan / 1:3,000

OPPOSITE, top: The roof terrace provides pedestrians a simultaneous view into the facility and out to Elliott Bay. It emulates the tourist-centric waterfront to the north and is publicly accessible from Alaskan Way without entering the velodrome below.

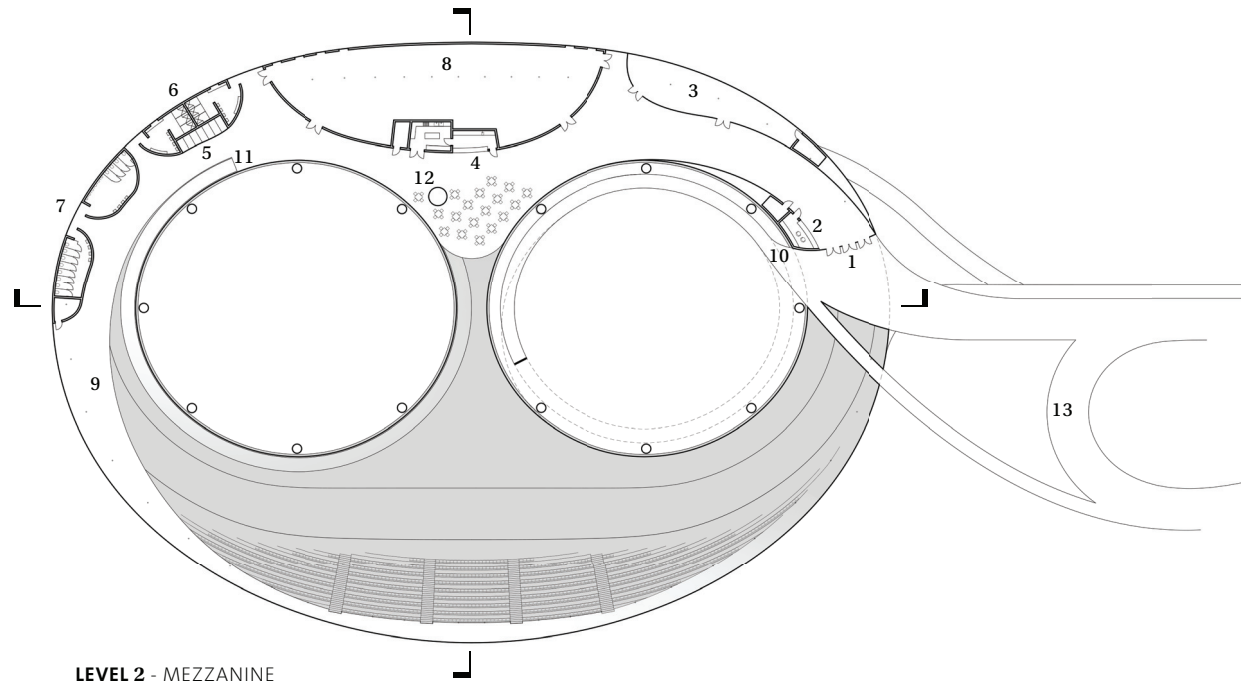
OPPOSITE, bottom: The waters of Elliott Bay serve as the first "level" from which the facility may be navigated. Divers and small watercraft can exclusively occupy the two central voids.





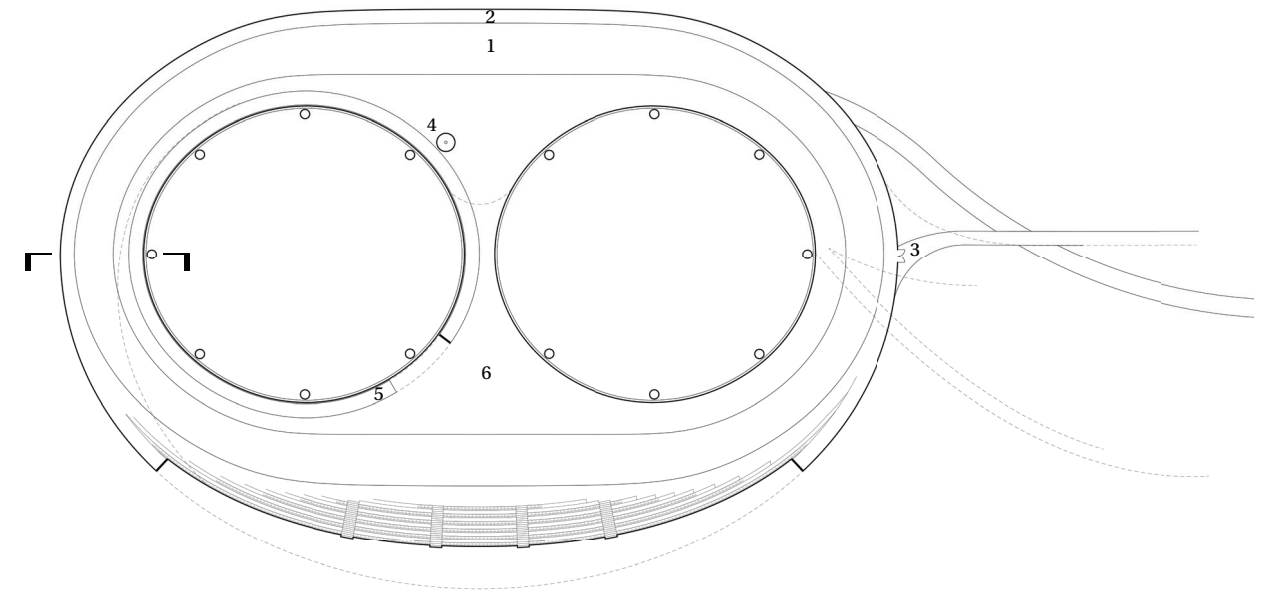
LEVEL 3 - ROOF / 1:1,000

- 1 TERRACE
- 2 RAMP TO ENTRANCE



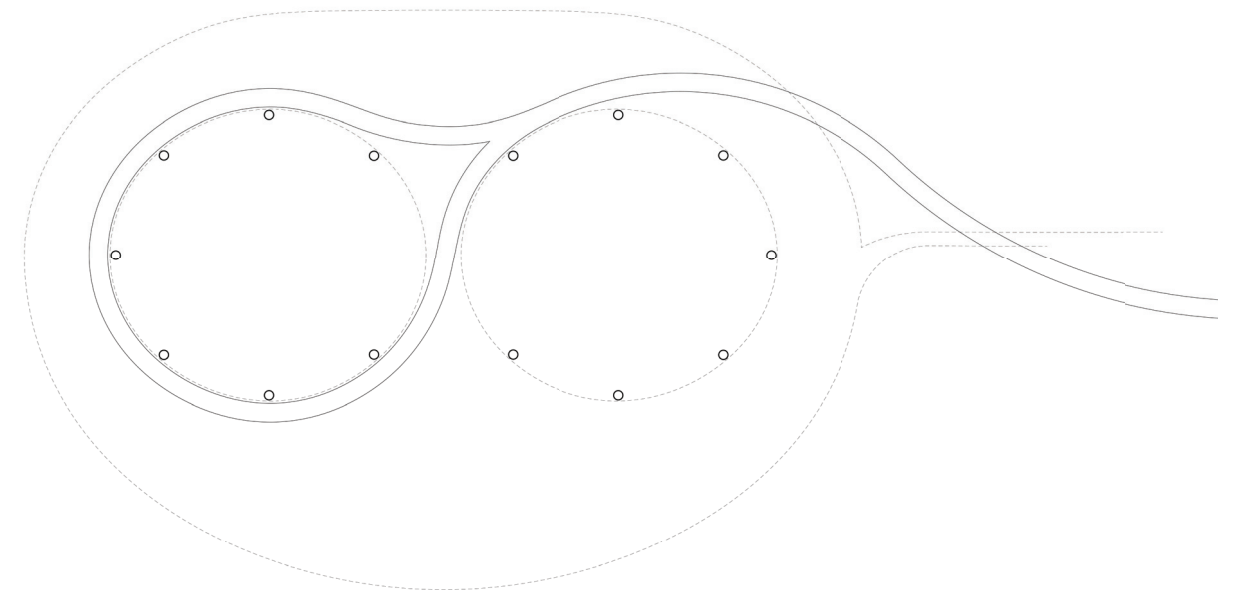
LEVEL 2 - MEZZANINE

- | | | | |
|------------------------|----------------|------------------------|----------------------------|
| 1 ENTRANCE | 4 CAFE | 7 RESTROOMS | 10 RAMP UP TO ROOF TERRACE |
| 2 RECEPTION | 5 BIKE LOCKERS | 8 MECHANICAL / STORAGE | 11 RAMP DOWN TO VELODROME |
| 3 BIKE SHOP / MECHANIC | 6 SHOWERS | 9 PATH TO STANDS | 12 ELEVATOR TO INFIELD |
| | | | 13 MOTOR VEHICLE ACCESS |



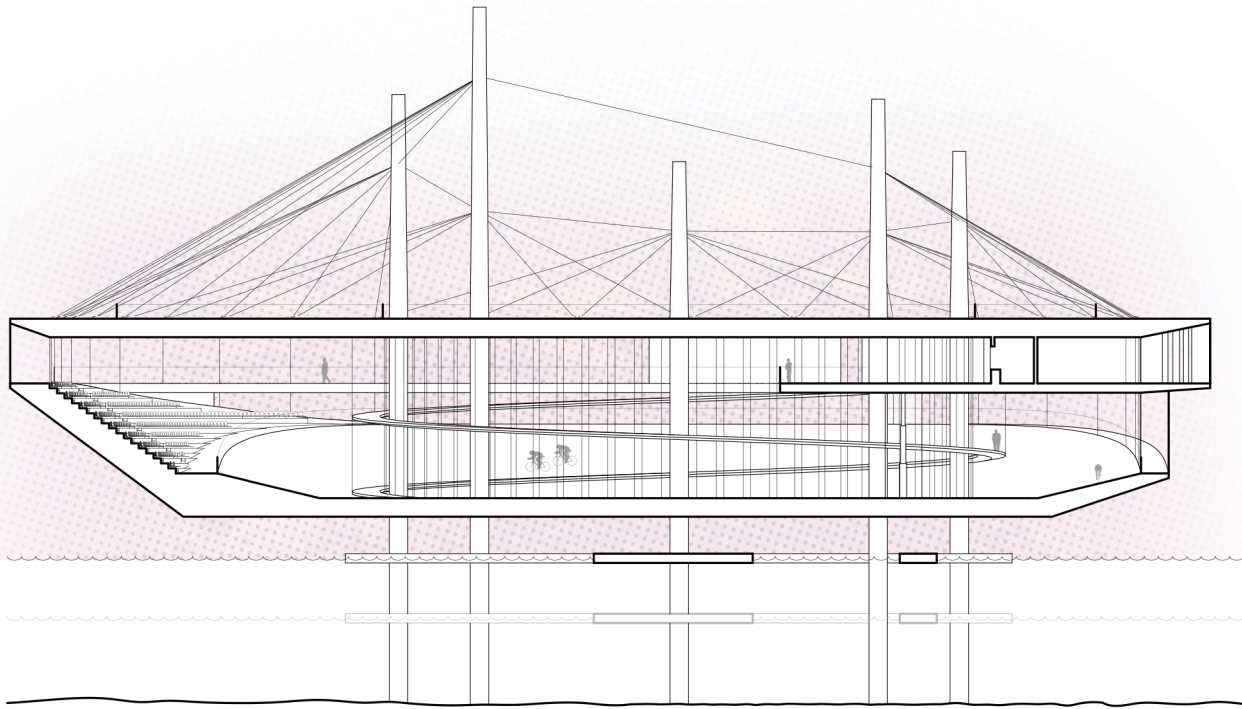
LEVEL 1 - TRACK

- | | |
|------------------|-------------------------|
| 1 VELODROME | 4 ELEVATOR TO MEZZANINE |
| 2 VELODROME PATH | 5 RAMP TO MEZZANINE |
| 3 EMERGENCY EXIT | 6 INFIELD |

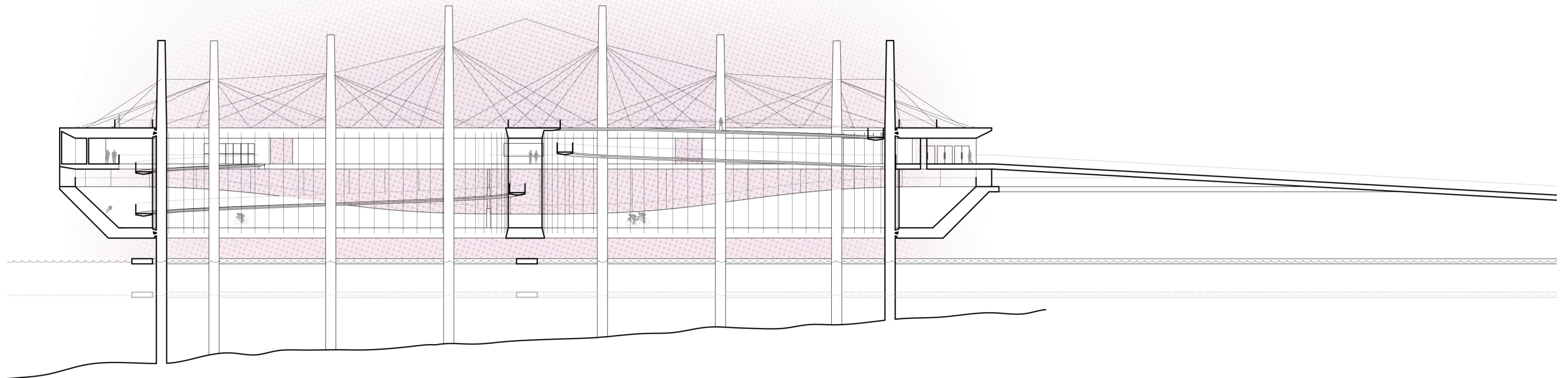


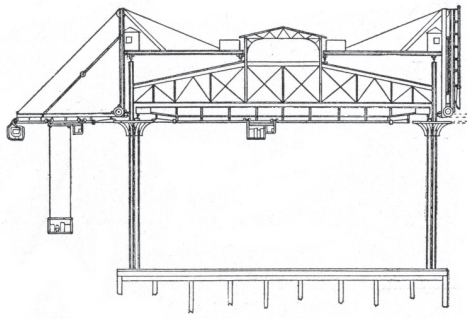
LEVEL 0 - WATER

- FLOATING PATH



west and north sections, with highest and lowest tide / 1:500

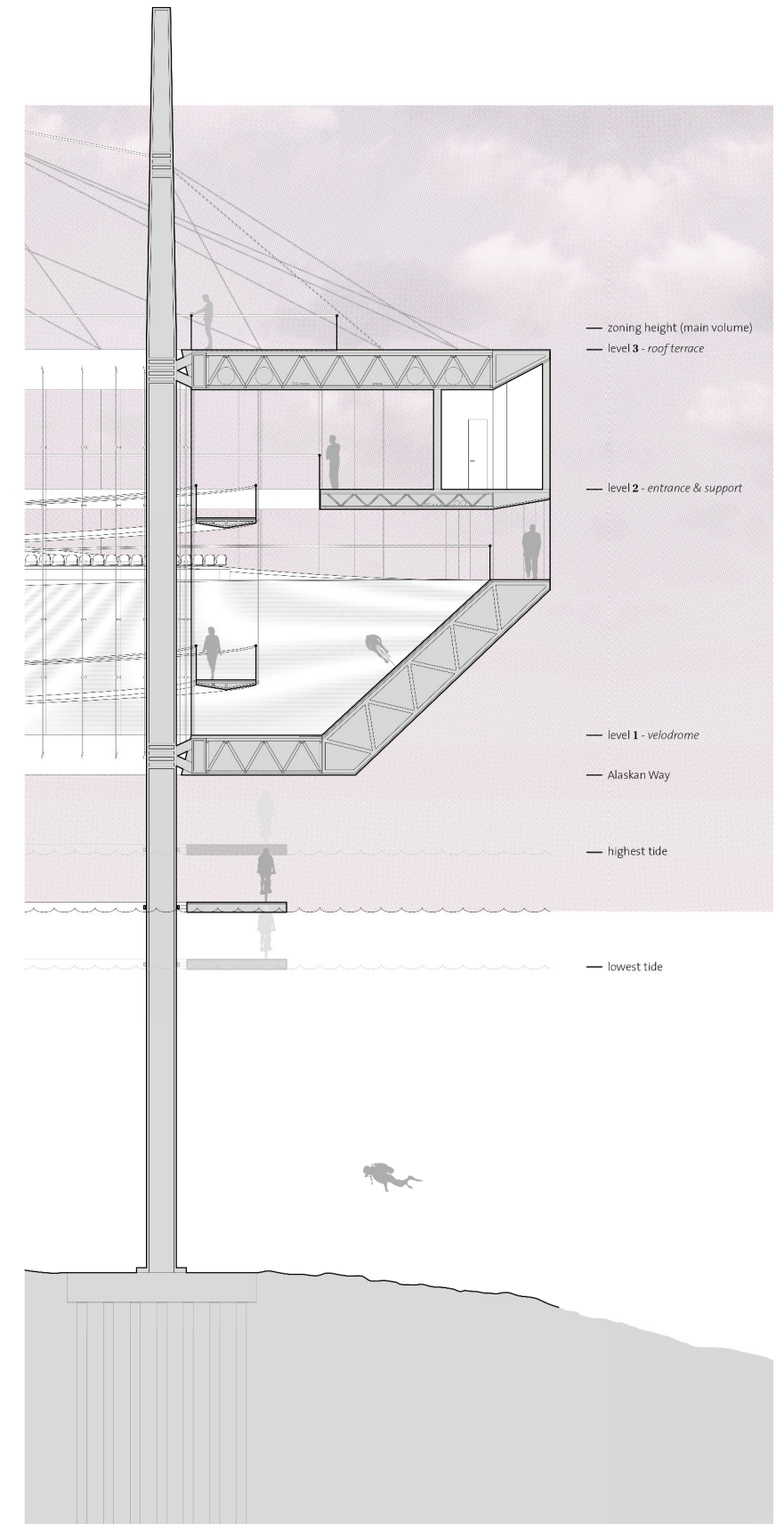
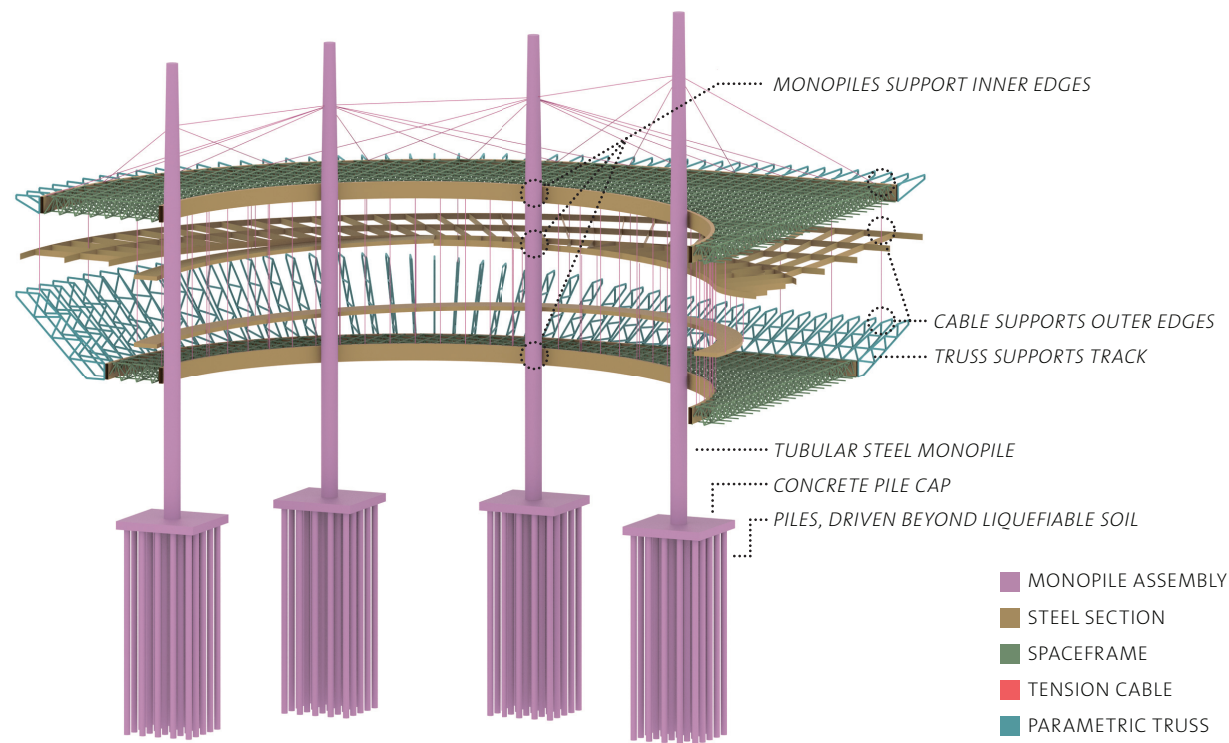


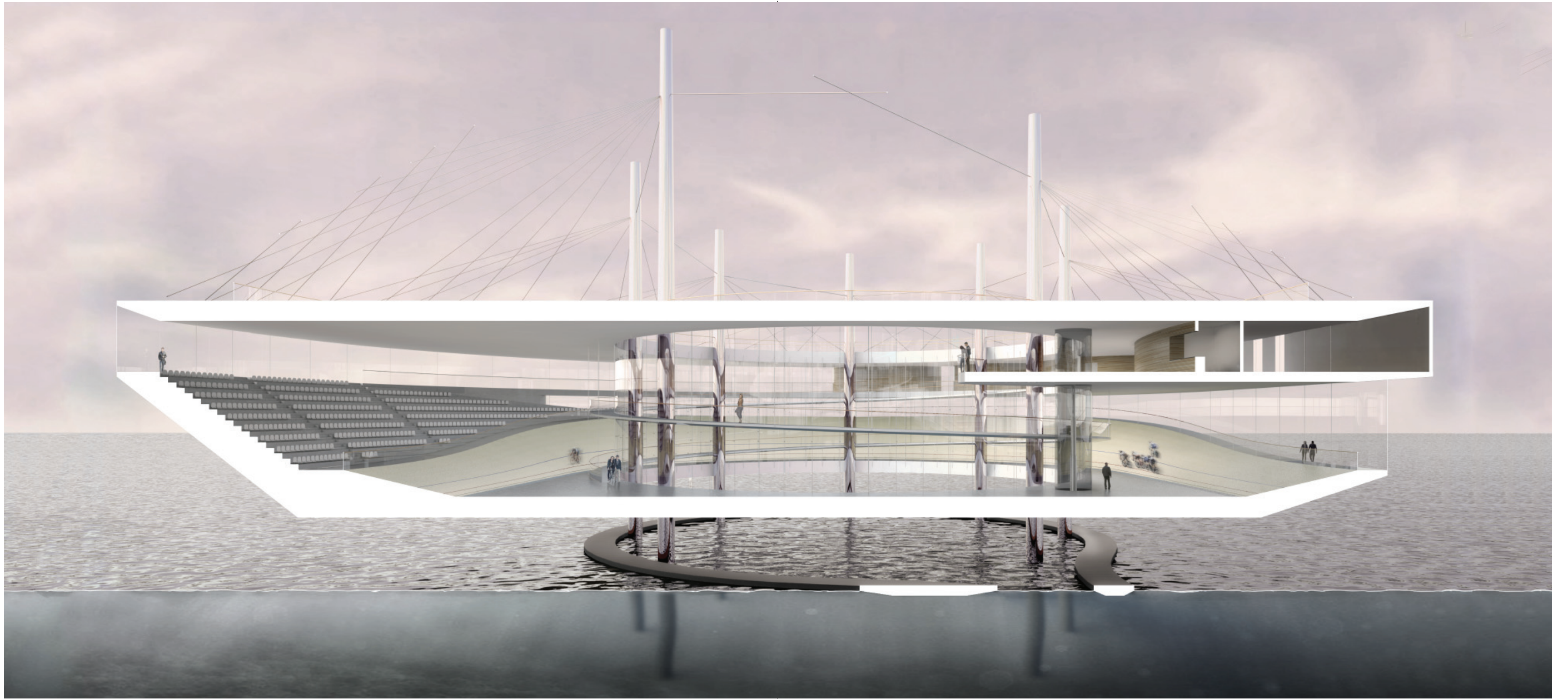


The facility shares a material and formal kinship with large, industrial waterfront structures.

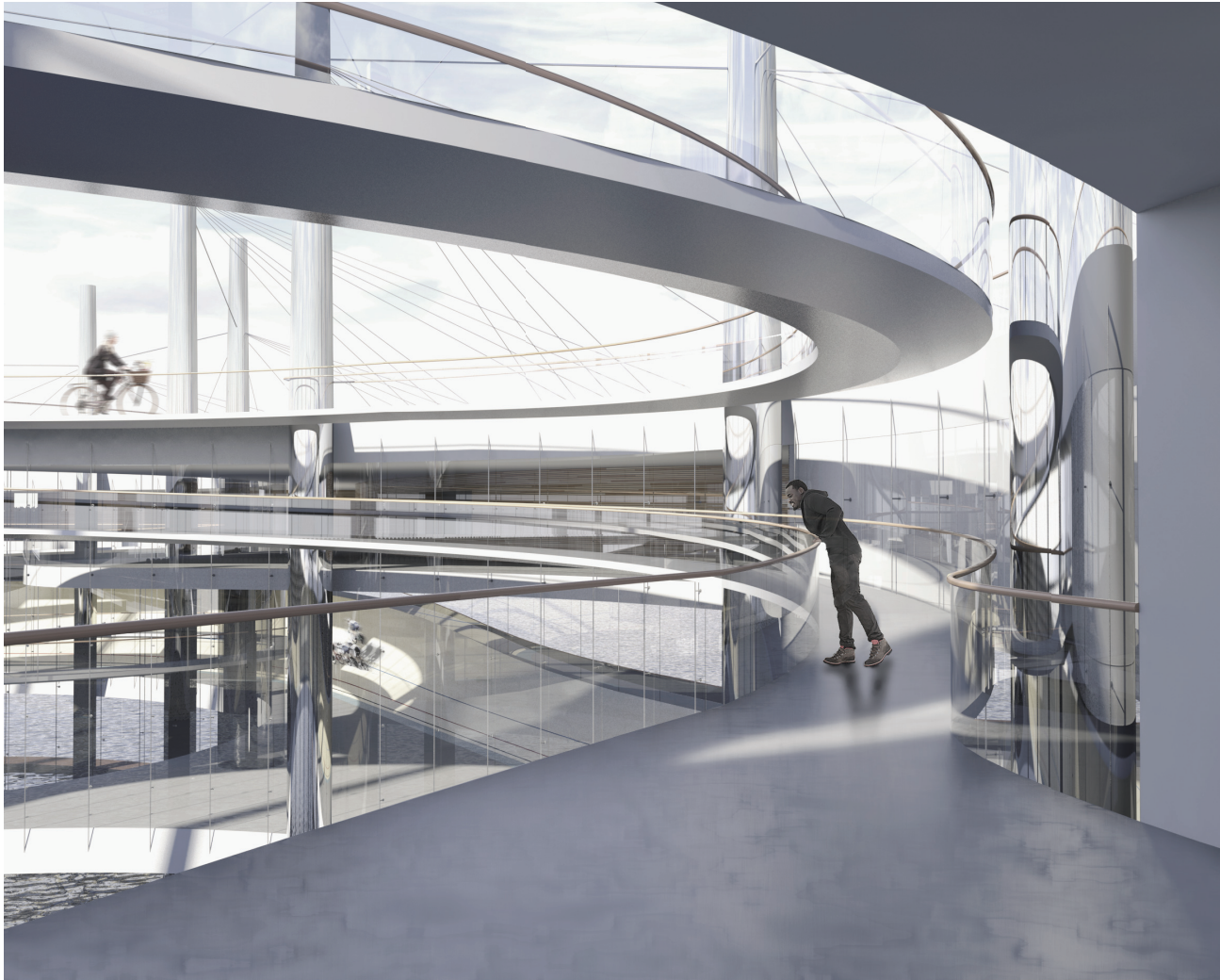
BELOW: structural diagram, northwest quarter of the facility

OPPOSITE: detailed section / 1:200





west section perspective, with median tide / section plane = **1:250**



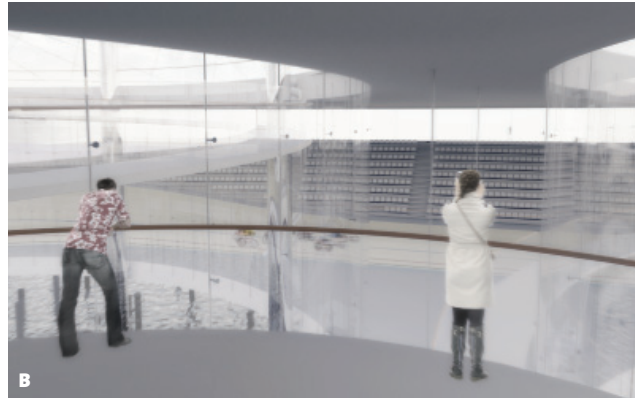
Architectural space must be viewed as an activity of forces, not as a static arrangement of objects and interstices.... Space, however, is not empty. It is an invitation to transit, traversed by actual and potential trajectories and beset by barriers representing obstacles, promises, and protection.

*Rudolf Arnheim
The Split and the Structure*



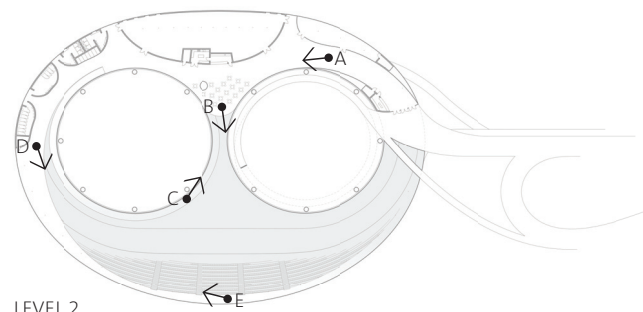
locker room entrance

OPPOSITE: after approaching the facility from Alaskan Way, instead of entering one can remain outside and continue along a spiraling ramp to the roof terrace



The simple combination of two or three details of a material kind yields a perfectly finished representation of another kind—psychological.

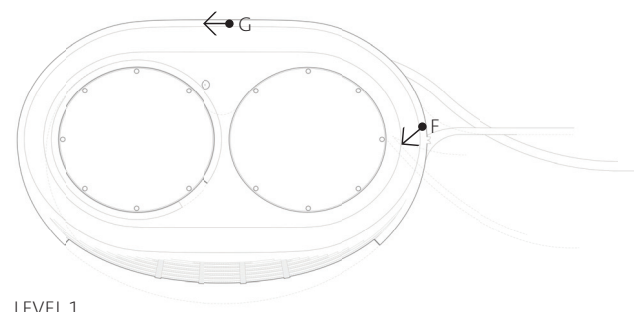
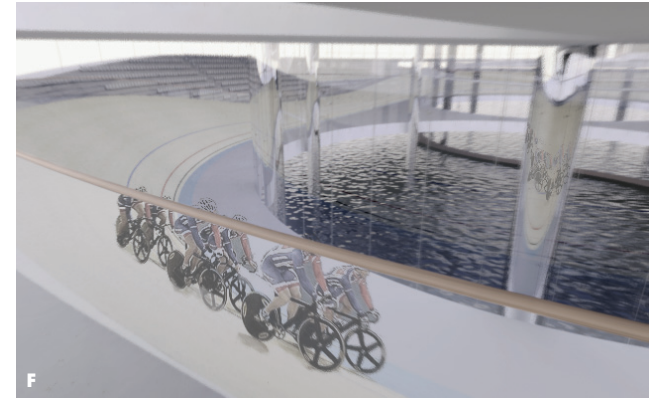
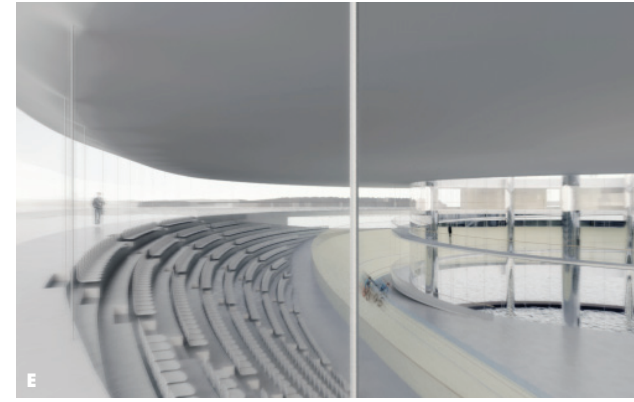
*Sergei Eisenstein
“The Cinematographic Principle
and the Ideogram”*



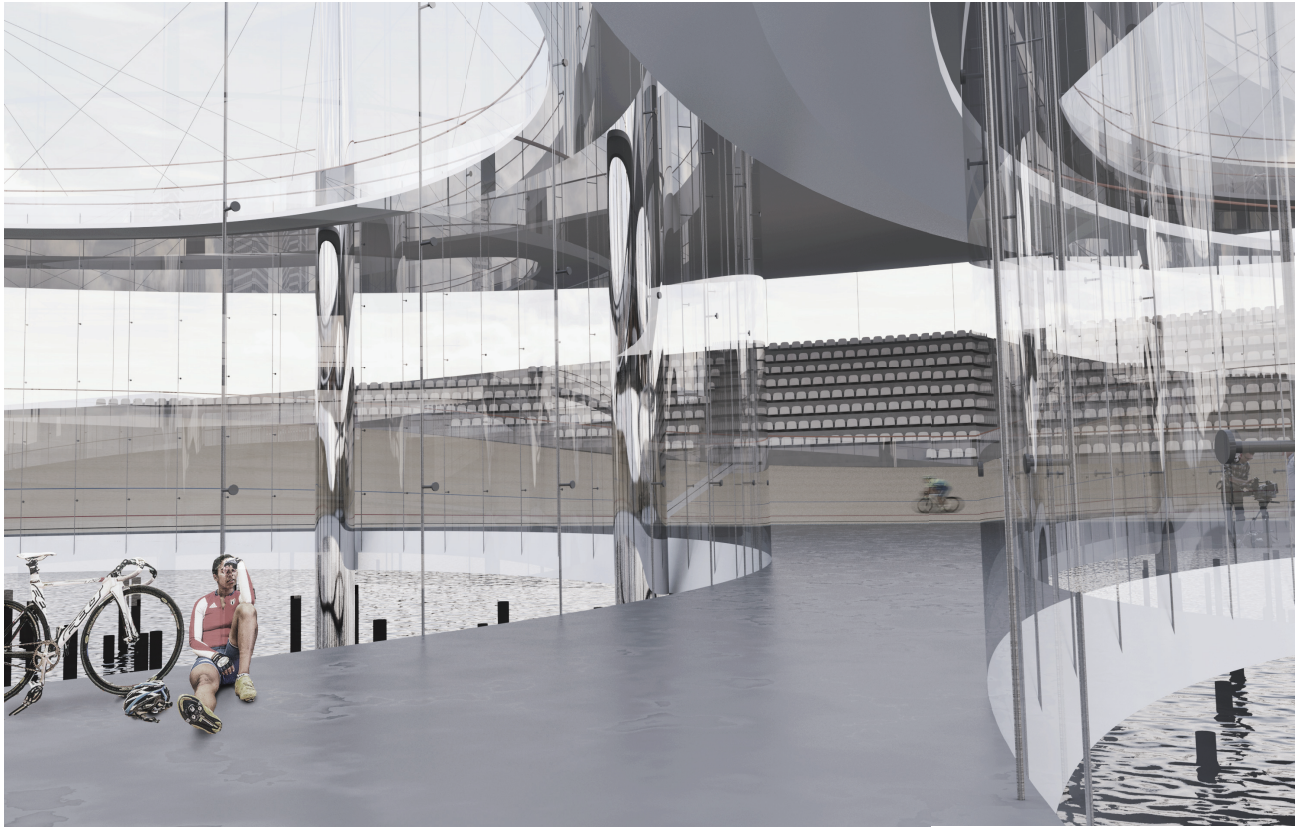
LEVEL 2

The spectator's experience is formed through a series of sweeping movements and fragmented views: down, up, into, out of, through.

- A** past the entrance, moving towards the track
- B** facing stands from the cafe seating area
- C** down the ramp to the infield
- D** continuing from the entrance to the stands
- E** path along top of stands
- F** path continues around track
- G** path continues from here to bottom of stands

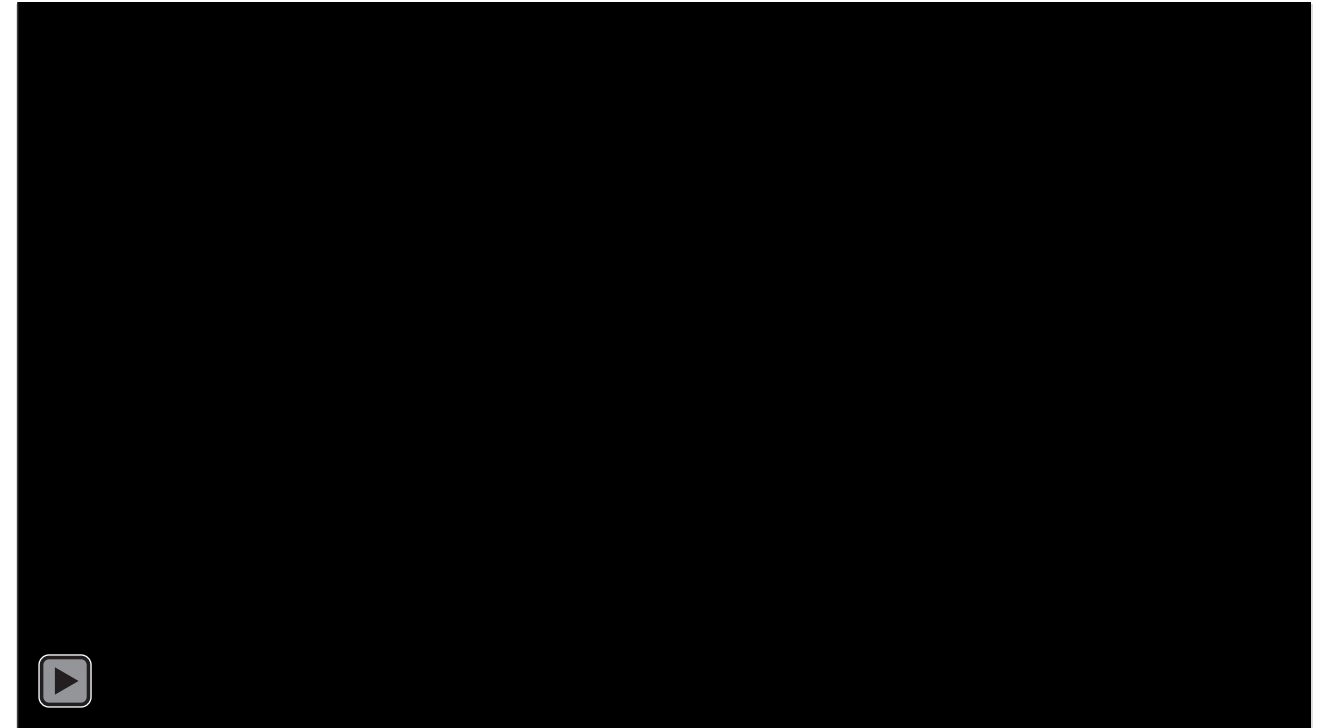


LEVEL 1

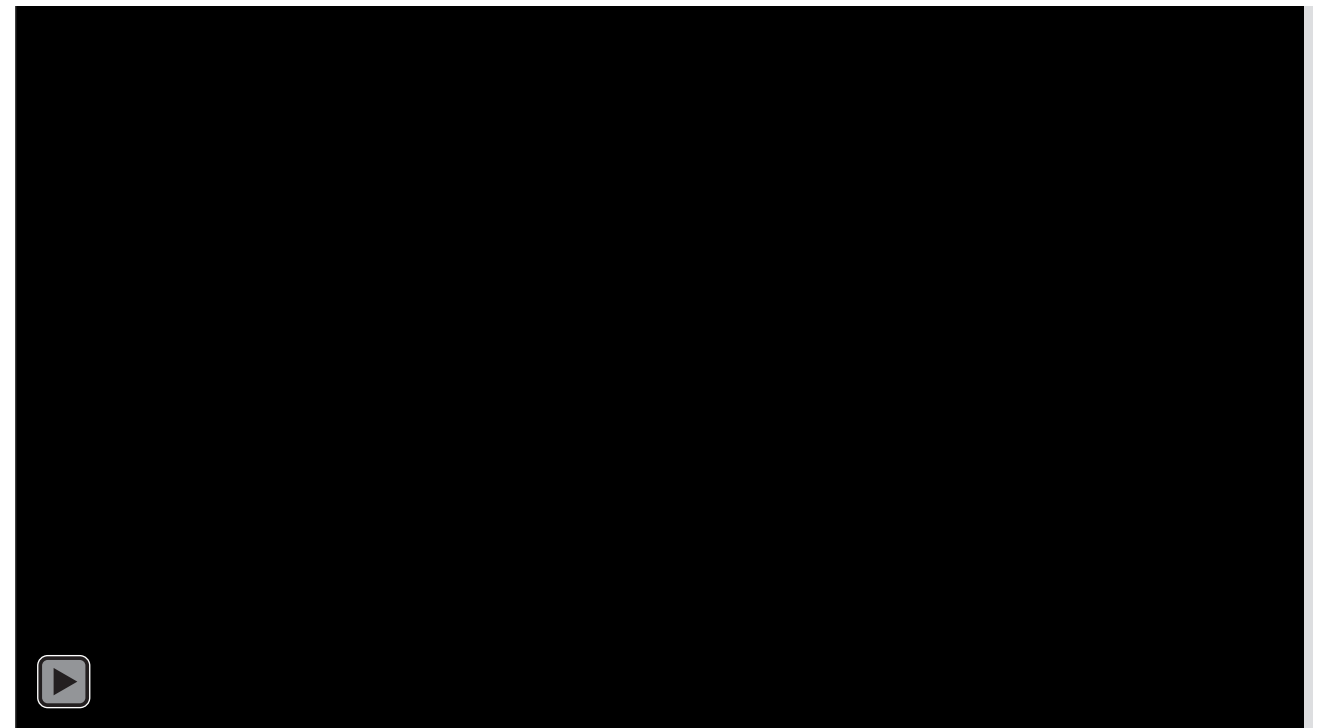


view from the infield, the in-between space that merges the decisive gaze and trajectory of the cyclist with the meandering gaze and trajectory of the spectator

Two animations (opposite page) illustrate the contrast developed between the linear-fluid experience of the cyclist and the subordinate though heightened fragmentary experience of the spectator. Each animation lasts the duration of a cyclist completing two laps of the 250 meter track at roughly 40 mph, nearing the maximum speed at which one moves through the facility.



cyclist's point of view – *click to activate one-minute video*
or visit: www.vimeo.com/131248787

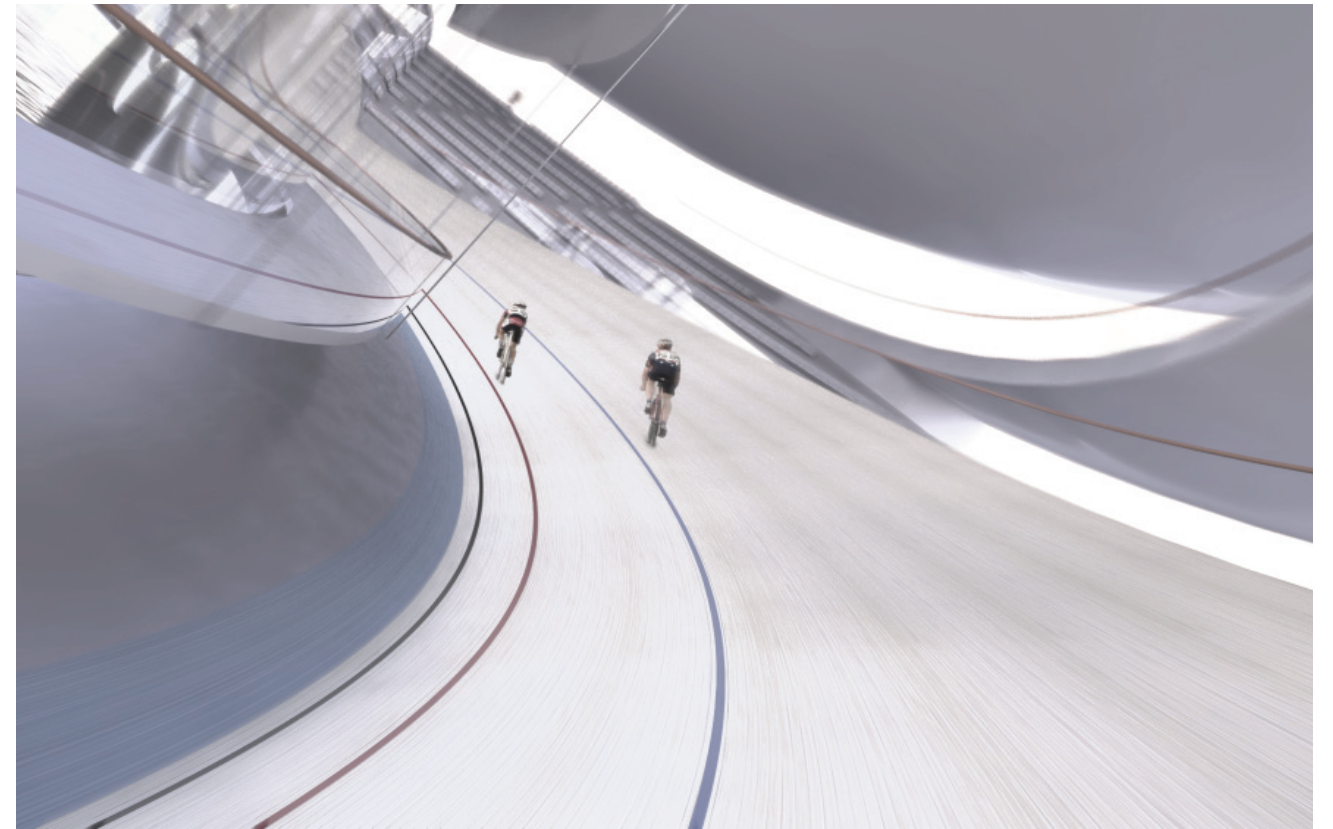


spectator's point of view – *click to activate one-minute video*
or visit: www.vimeo.com/131248788

EPILOGUE

There is an inherent suggestion of action in images of architecture, the moment of active encounter, or a 'promise of function' and purpose. 'The objects which surround my body reflect its possible action upon them,' writes Henri Bergson.... As a consequence of this implied action the bodily reaction is an inseparable aspect of the experience of architecture.

Juhani Pallasmaa
The Eyes of the Skin:
Architecture and the Senses



the cyclist's point of view around
which this thesis evolved

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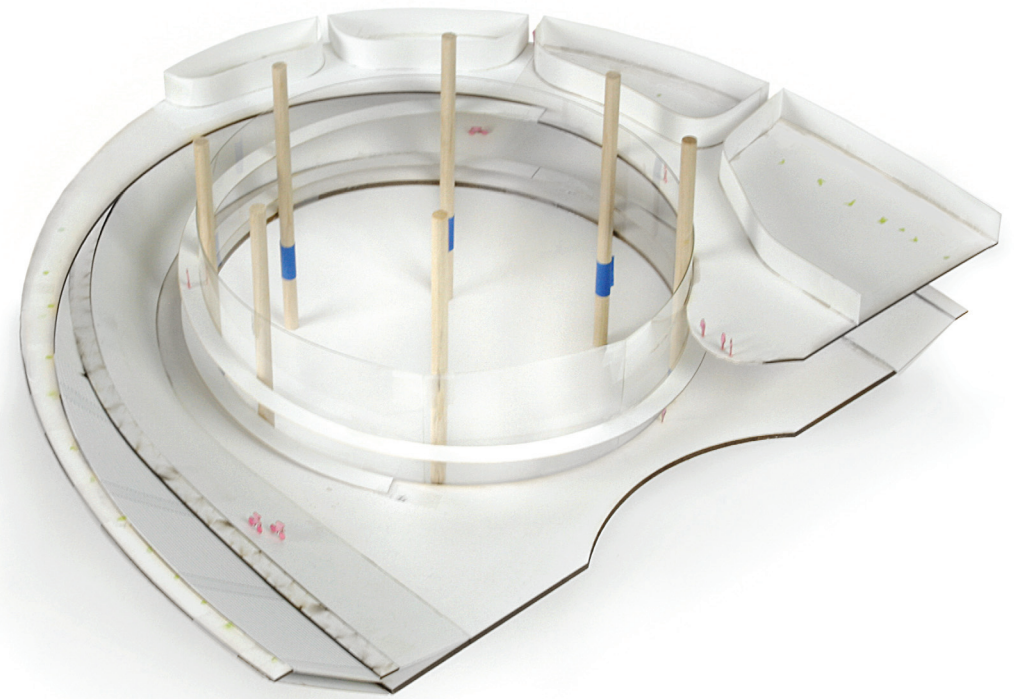
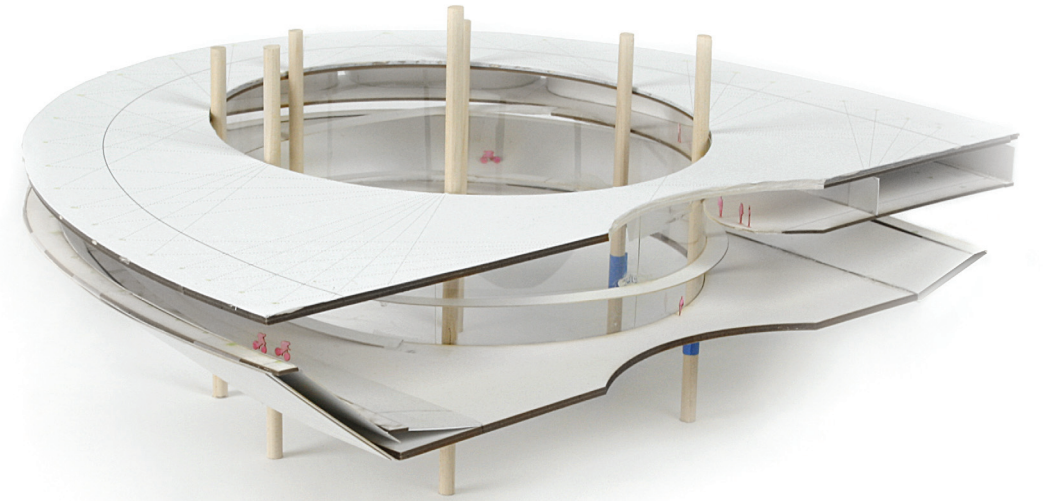
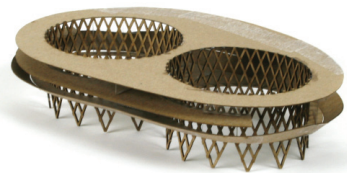
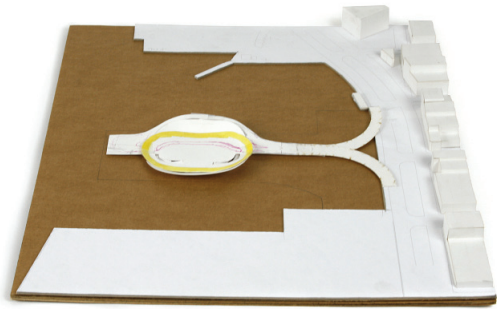
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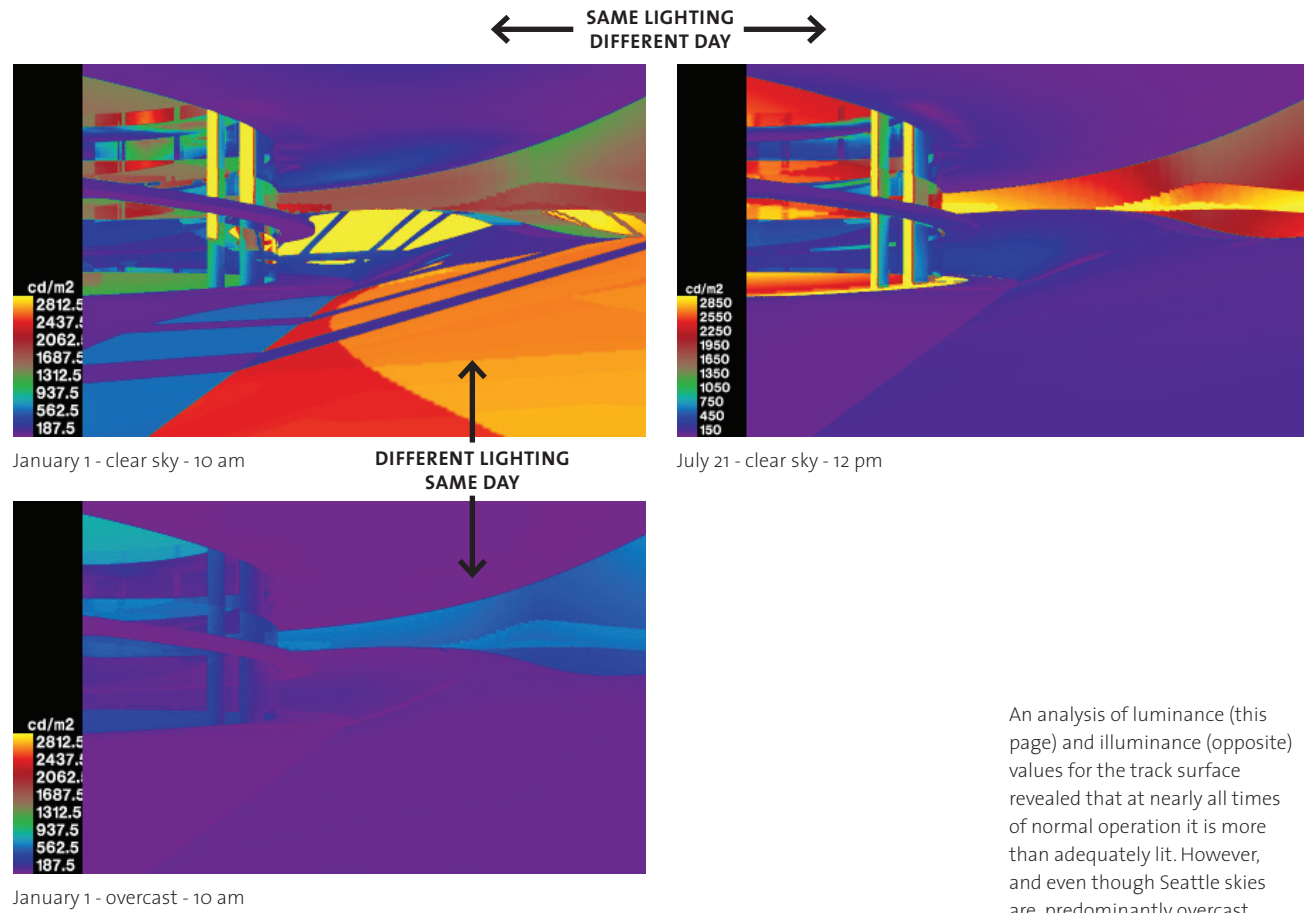
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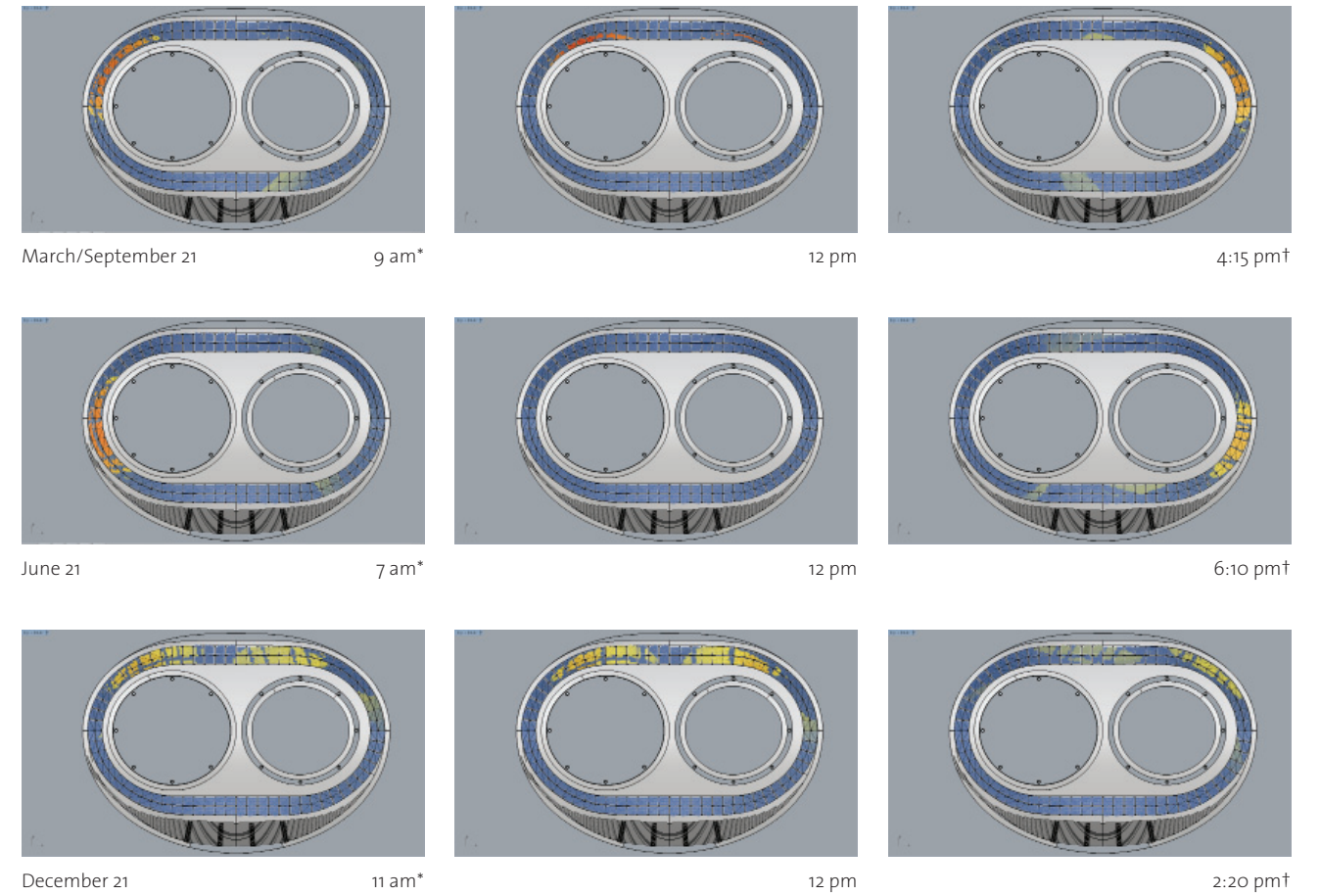
SUPPLEMENTS



DAYLIGHTING ANALYSIS



An analysis of luminance (this page) and illuminance (opposite) values for the track surface revealed that at nearly all times of normal operation it is more than adequately lit. However, and even though Seattle skies are predominantly overcast throughout the year, strategies for managing glare at key times would require attention if the design were developed further.



analysis uses clear sky condition

* two hours after sunrise

† two hours before sunset