David Santos 600+ Kite Technology Concept Drawings

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CC 3.0

Open-AWE Defensive Disclosure (kPower OADD April 16, 2014)
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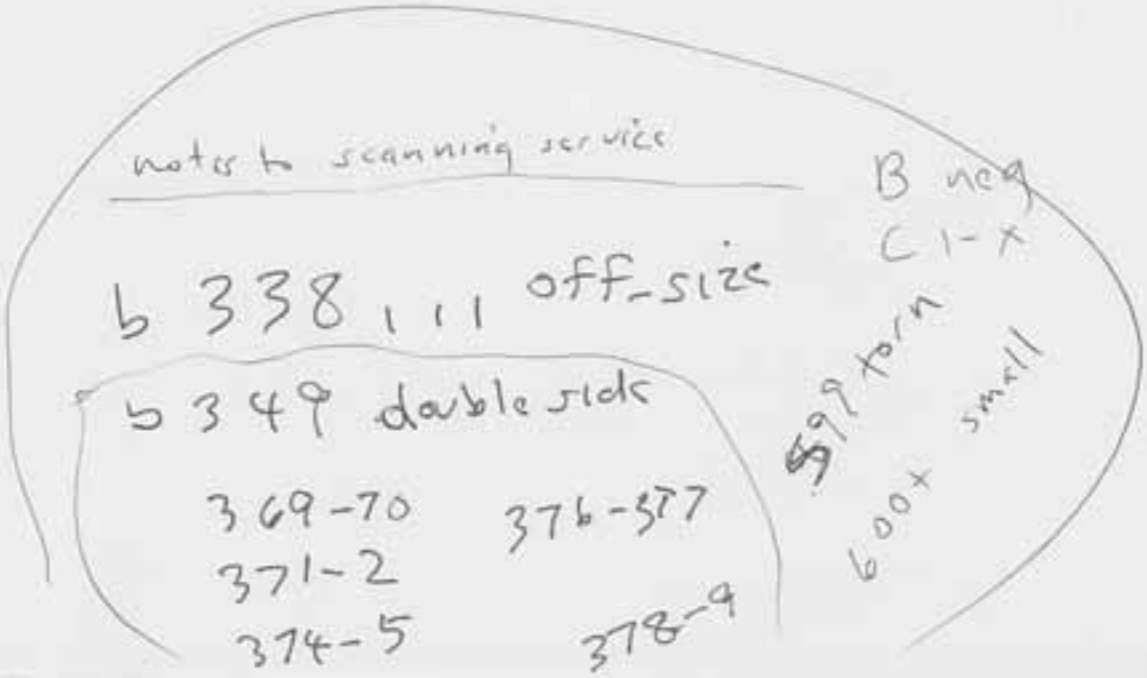
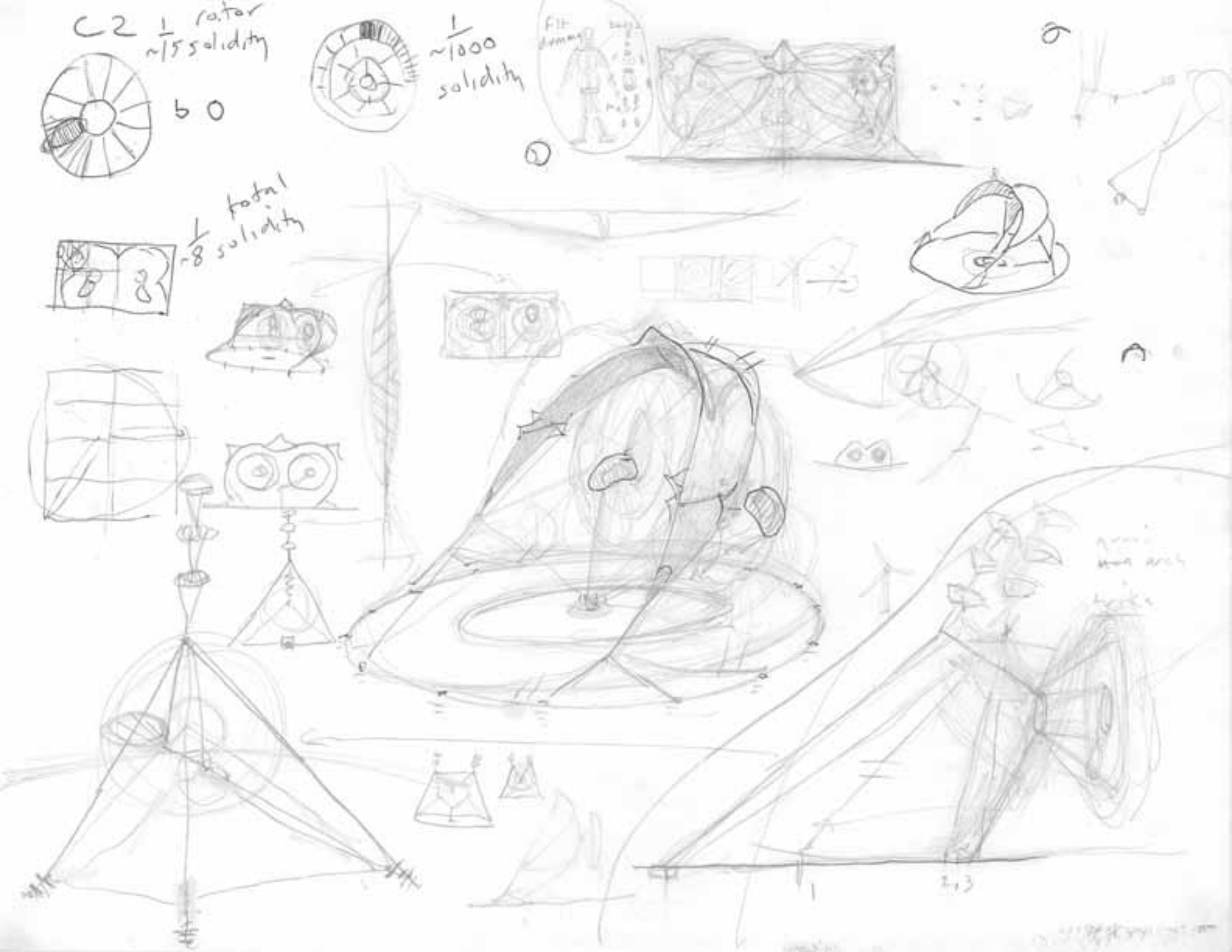
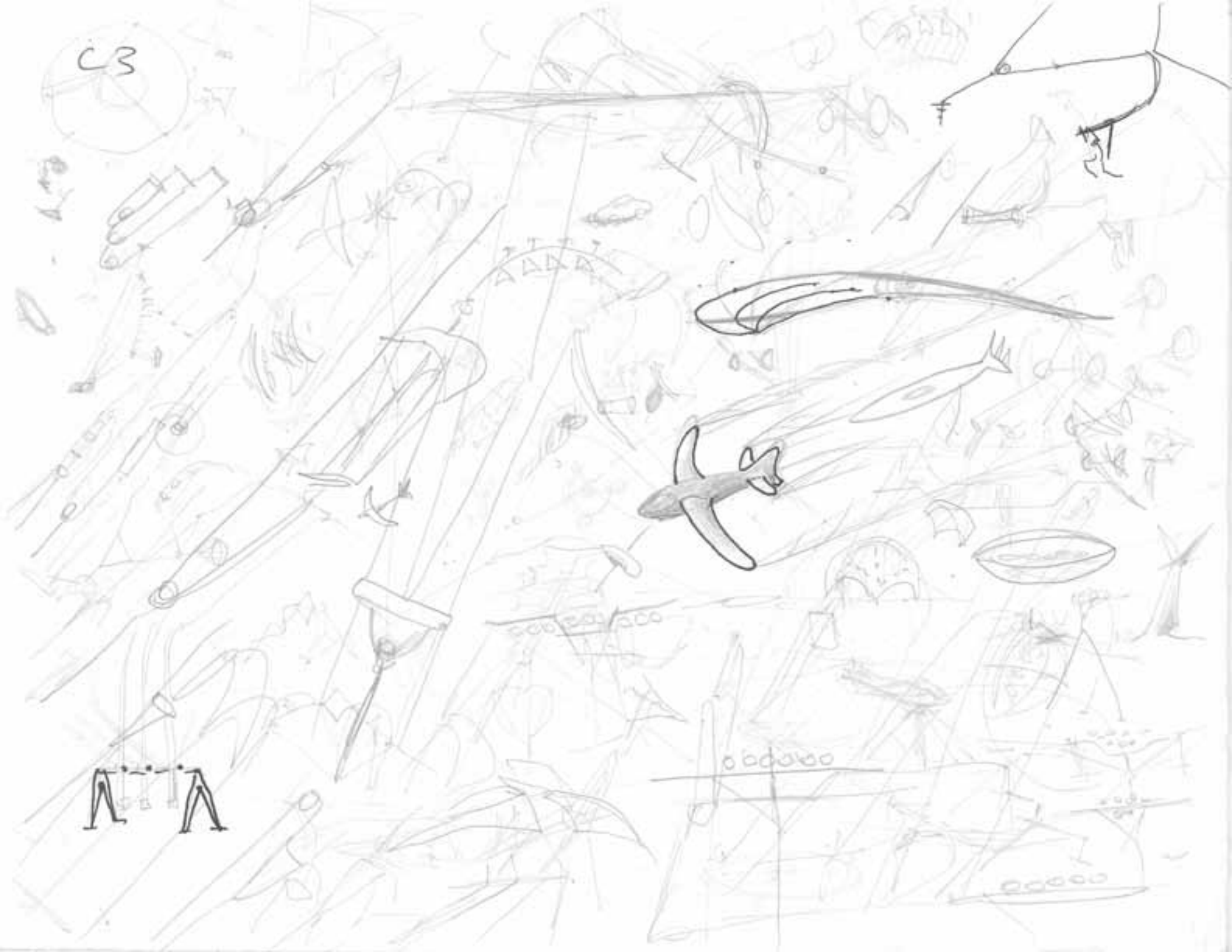
600+ pages, circa pre-2014.




C2
1/~15 rotor solidity
b 0
1/~1000 solidity
1/~8 total solidity
A
1
2,3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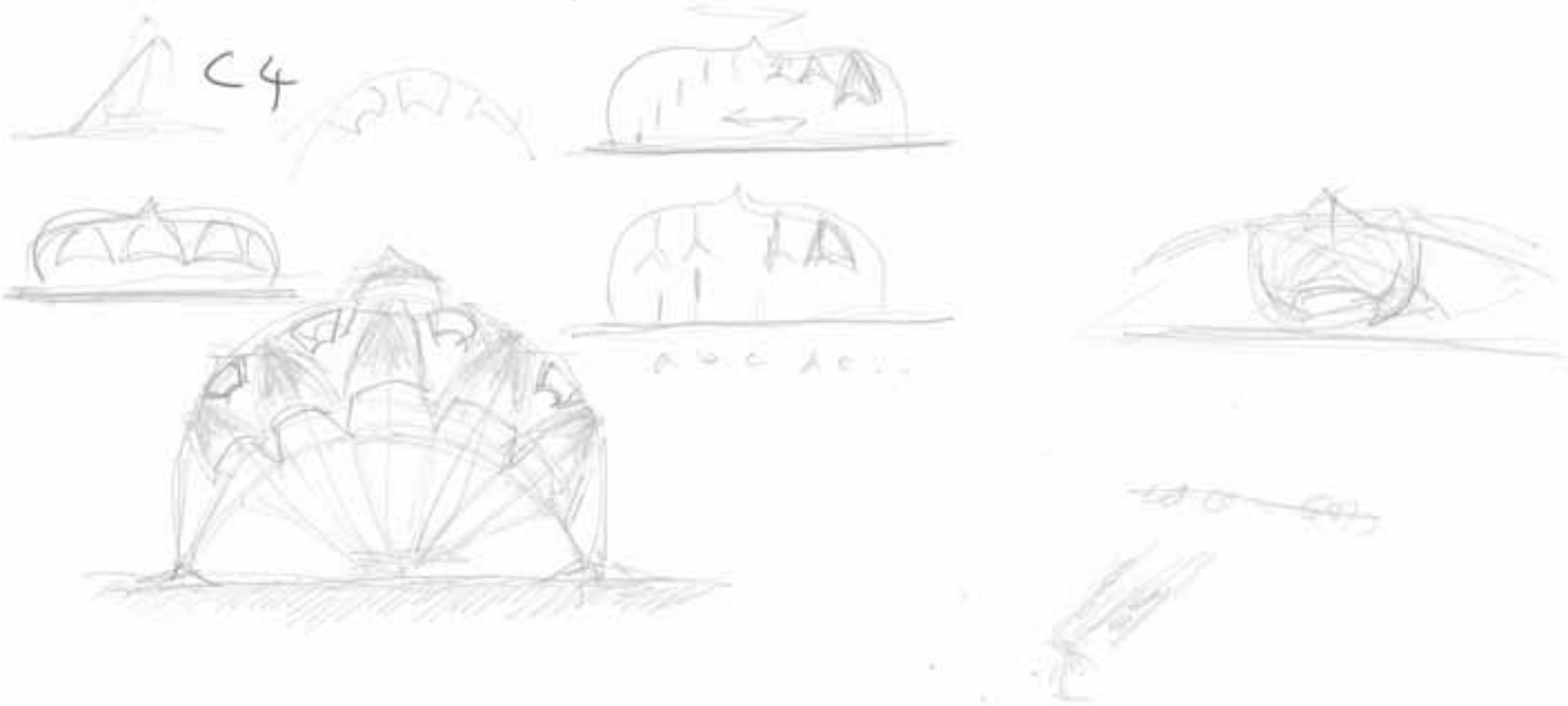
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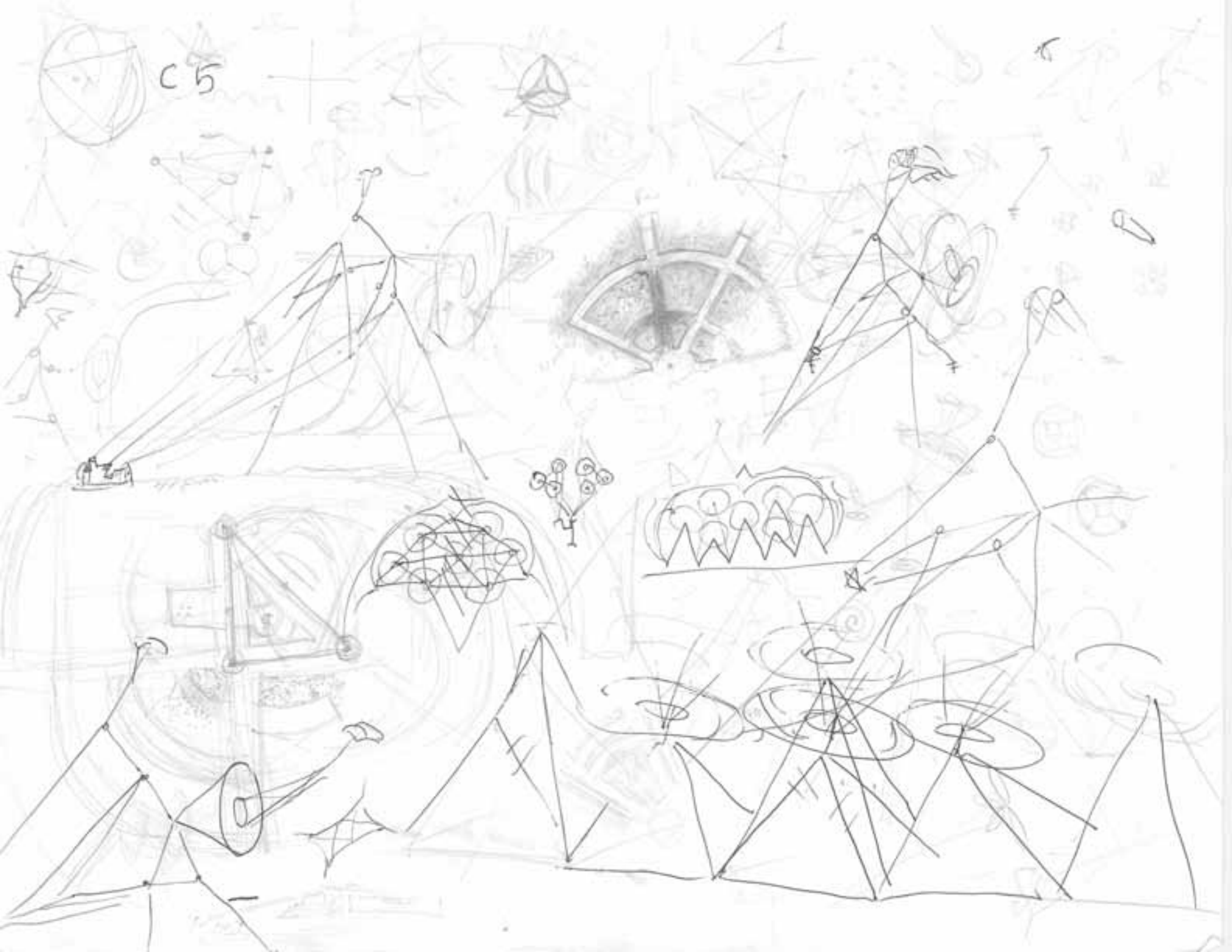
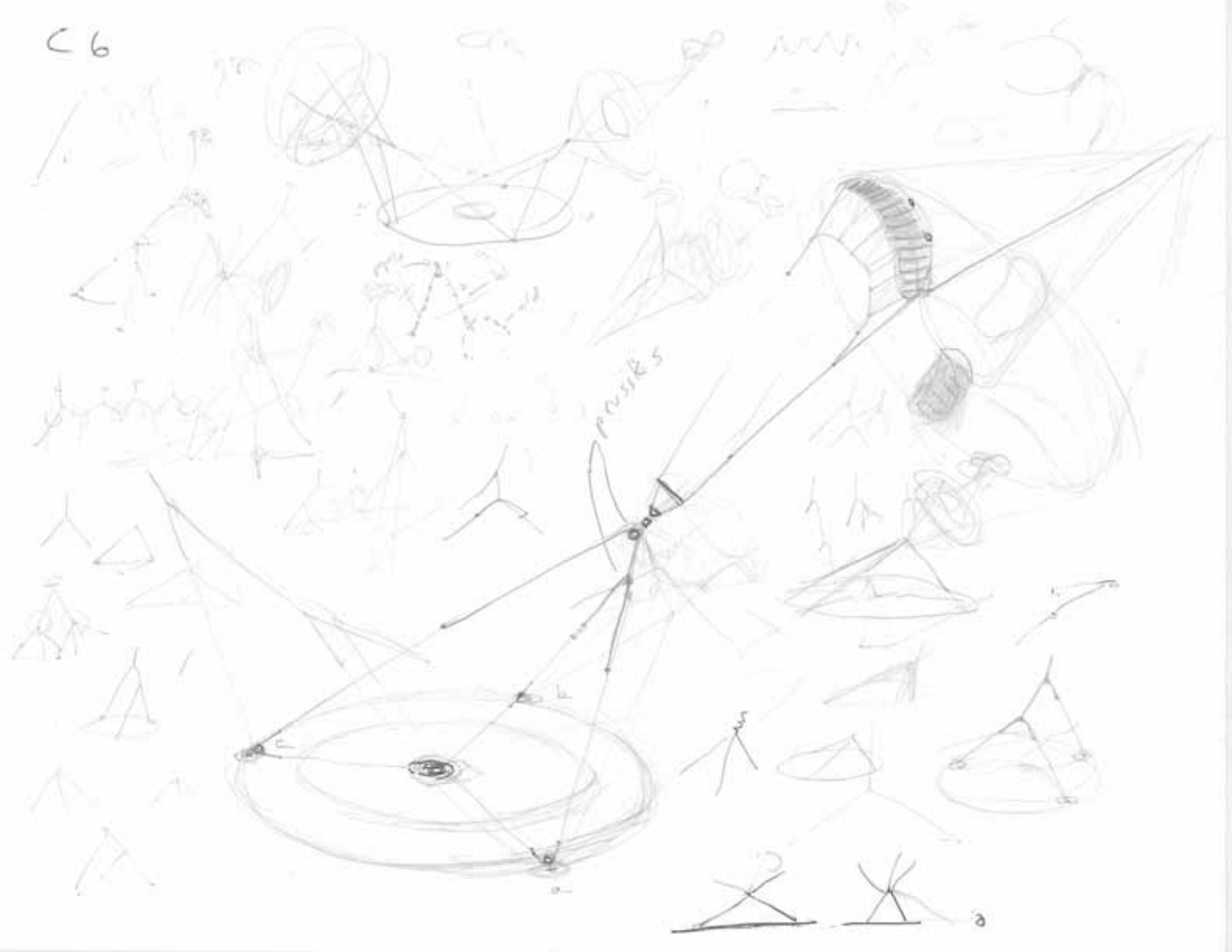
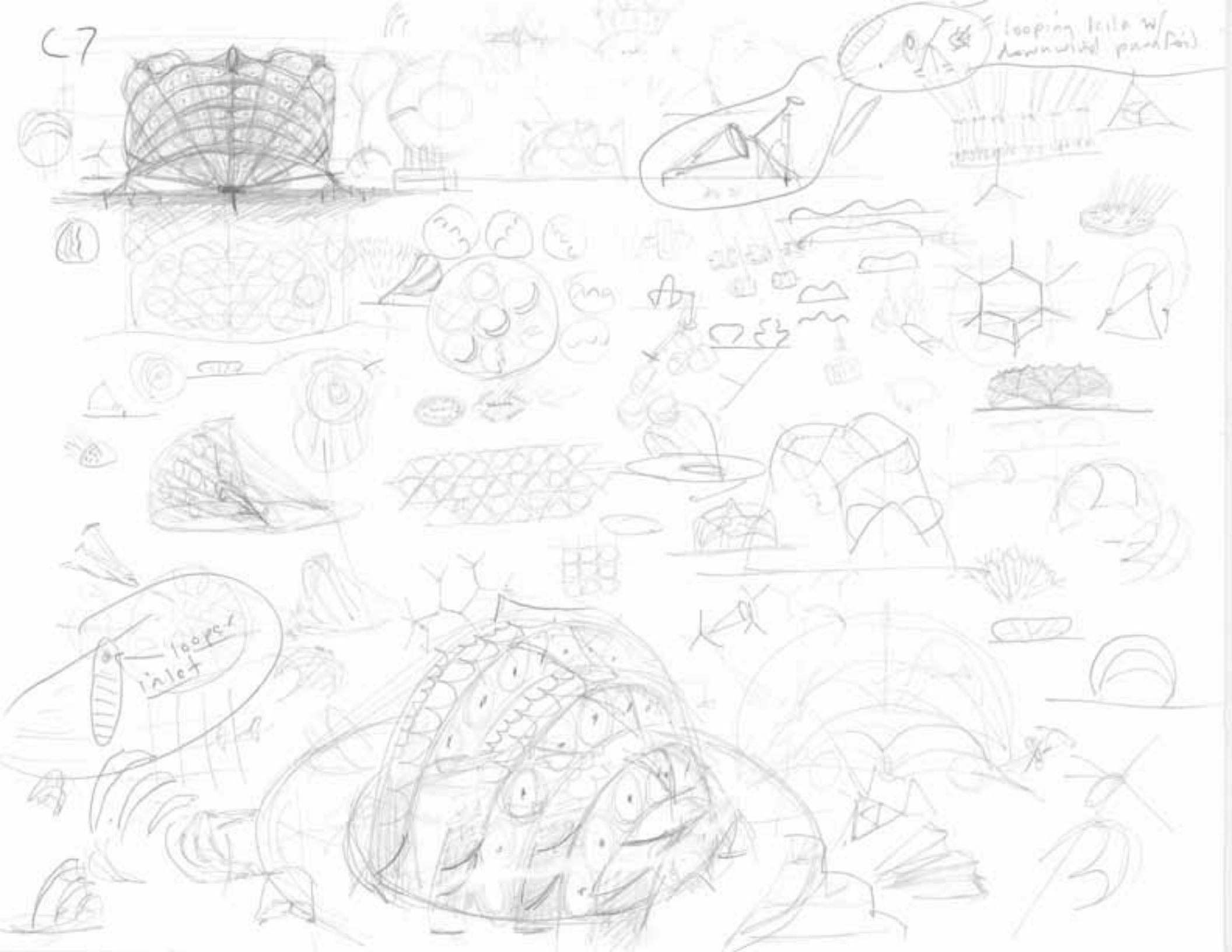
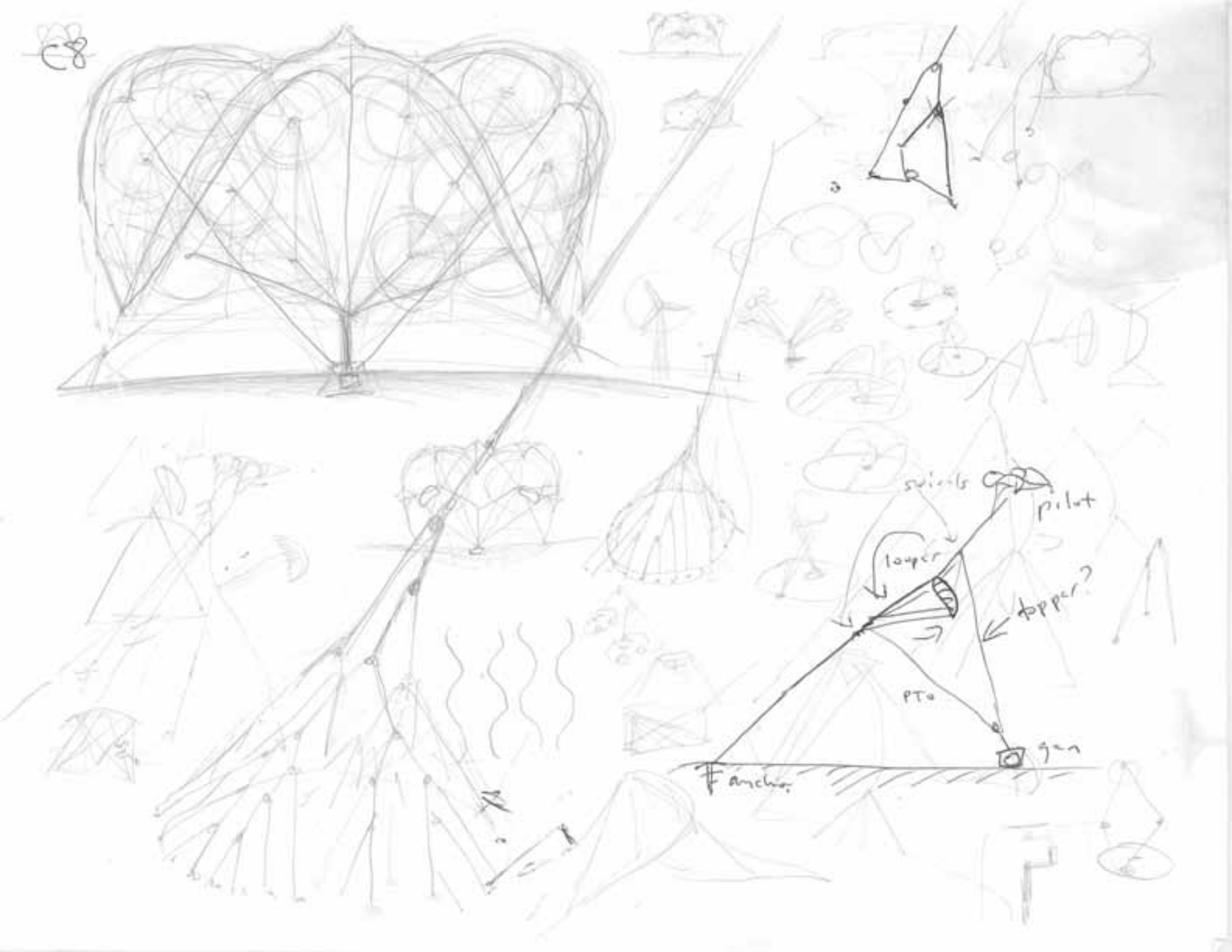

c5

C 6

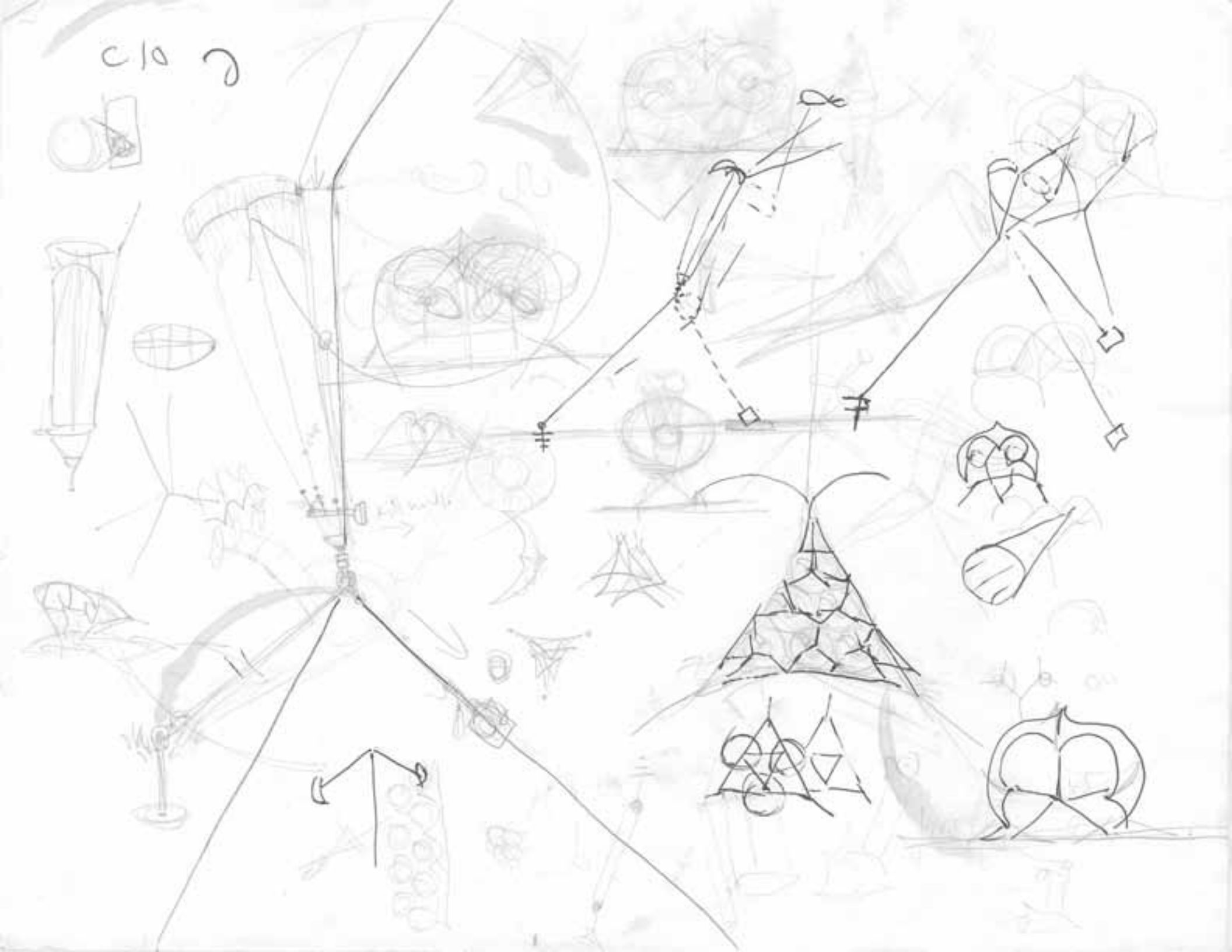


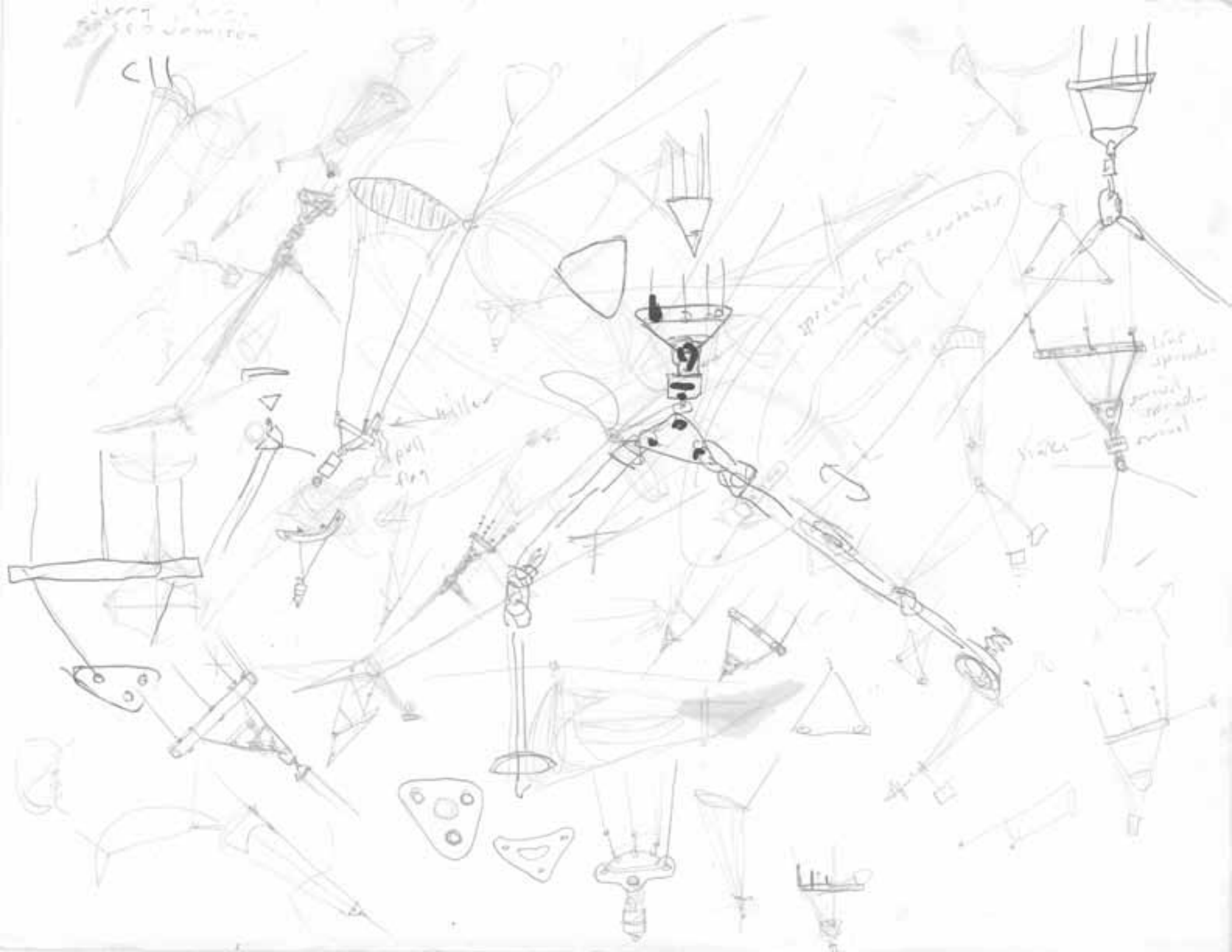
C7

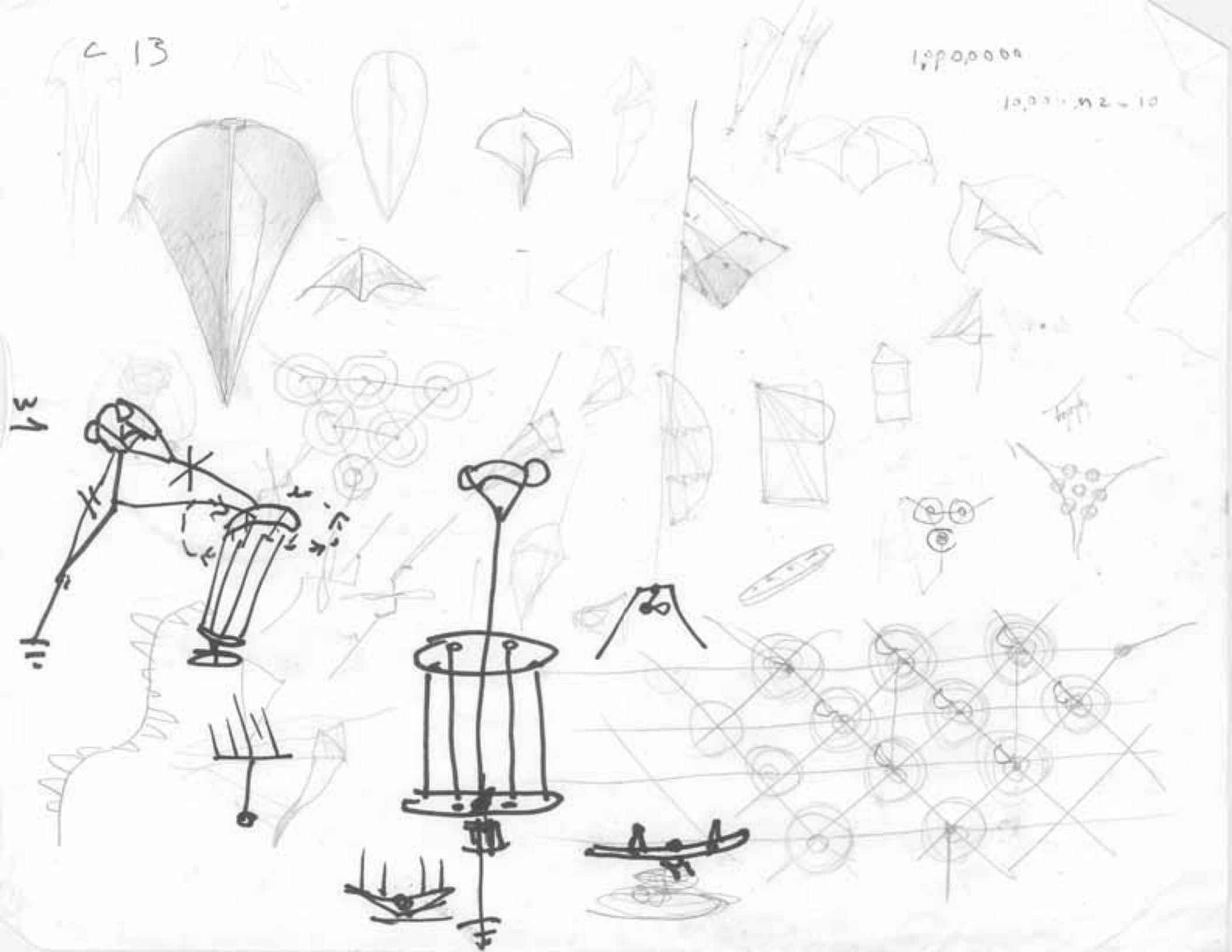



swivels
pilot
looper
topper?
PTO
gen
anchor

vertical
skyboom







C14

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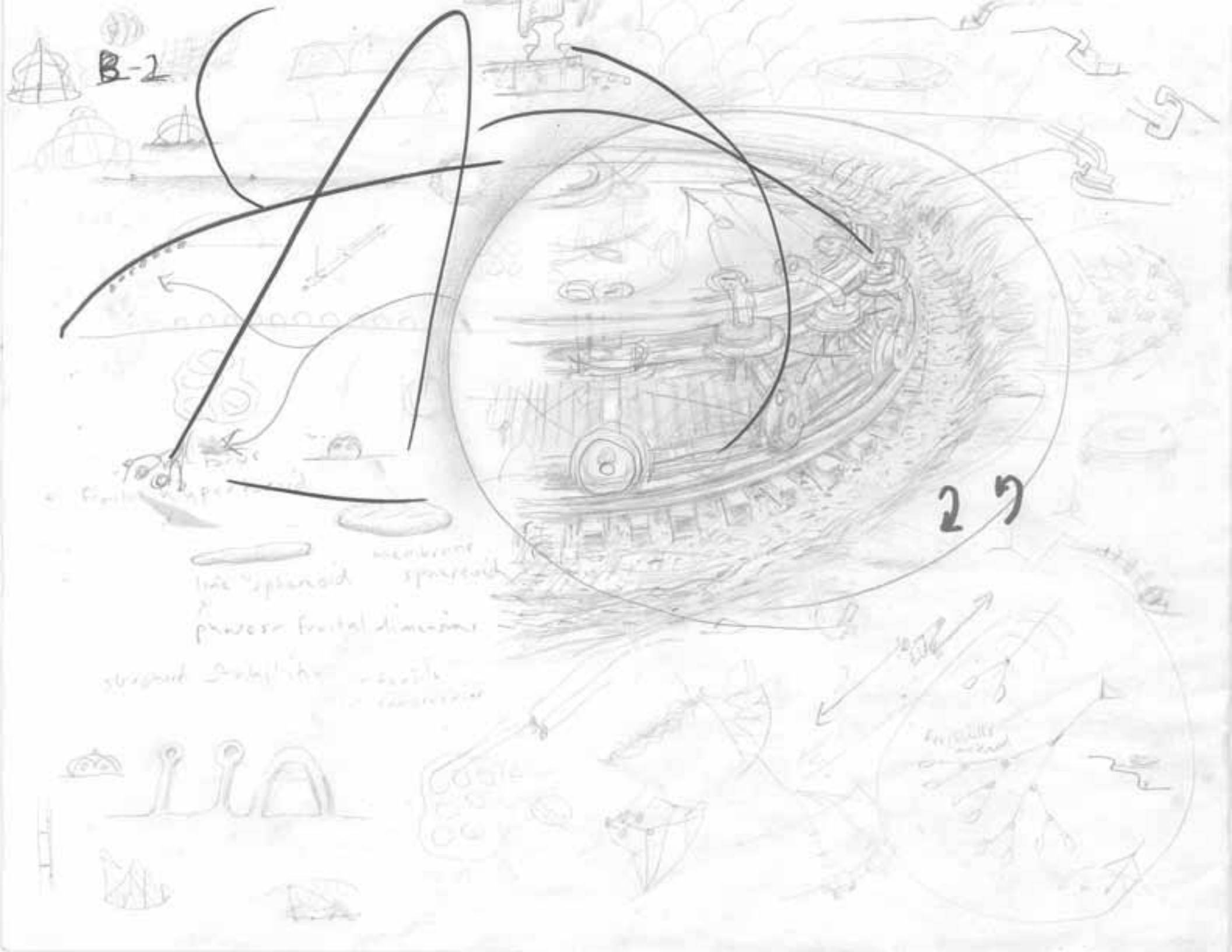
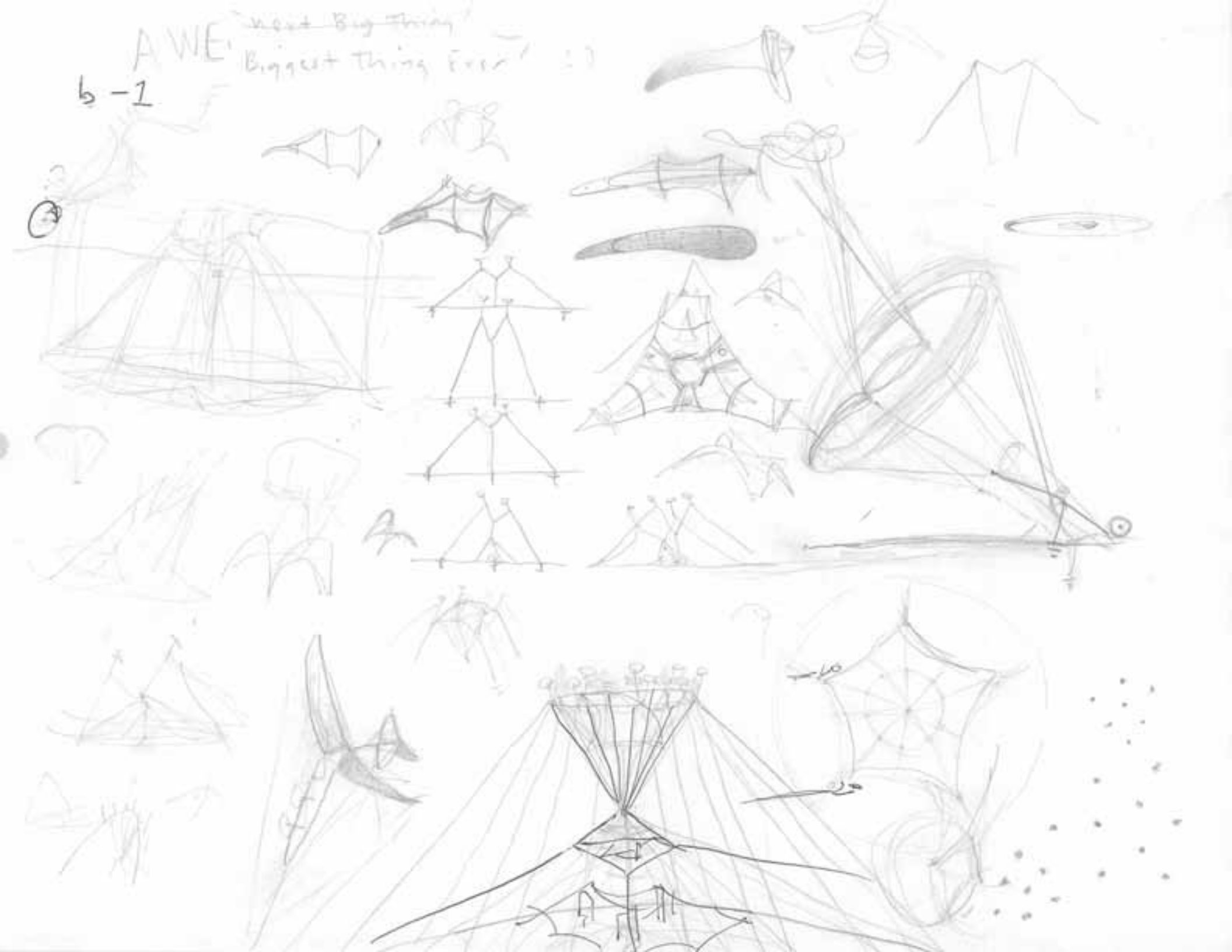
ISM
Jason Taylor
Penny Jamison
Jerry Agee
Dave


B-2
27

AWE ~~Next Big Thing~~ Biggest Thing Ever! :)

b-1



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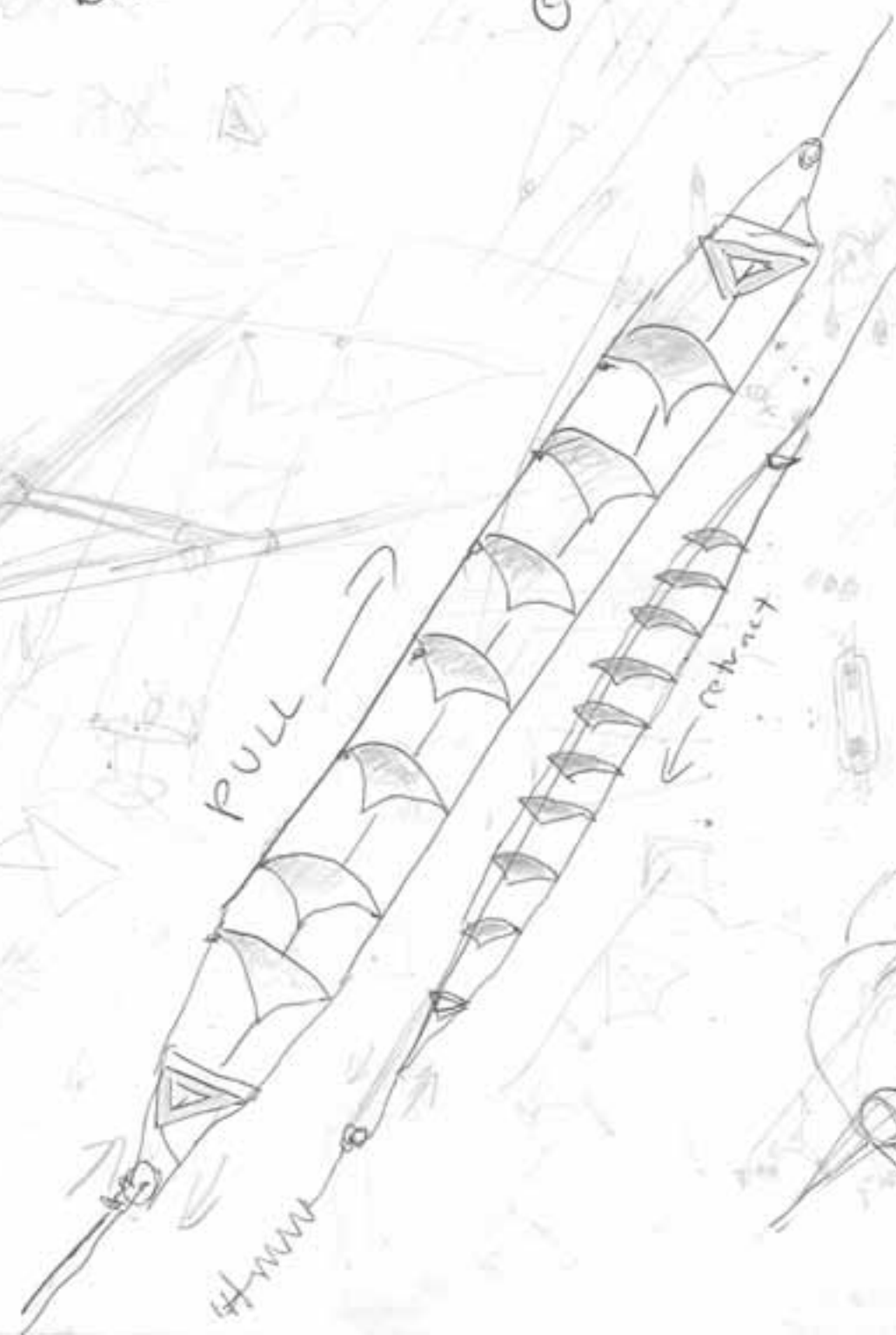

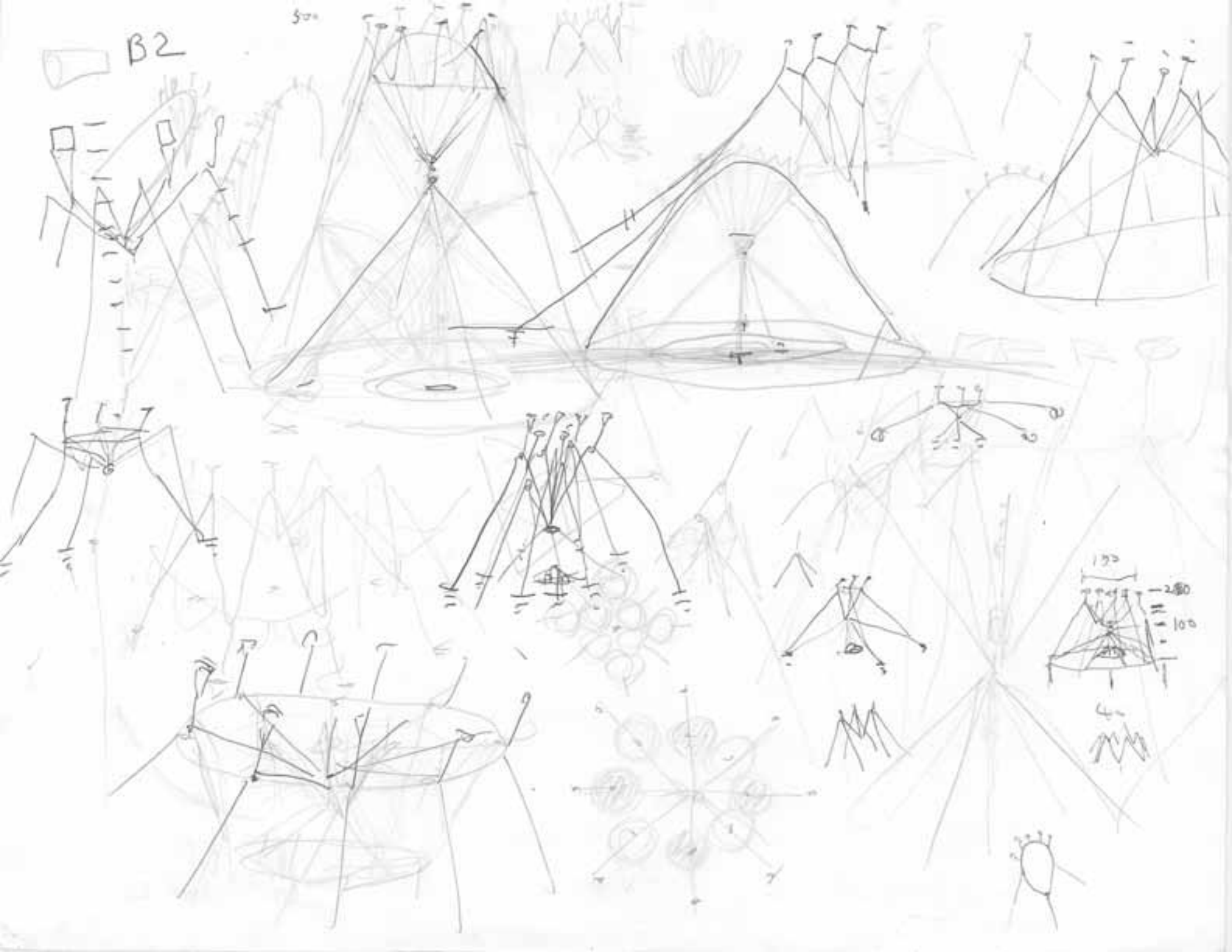
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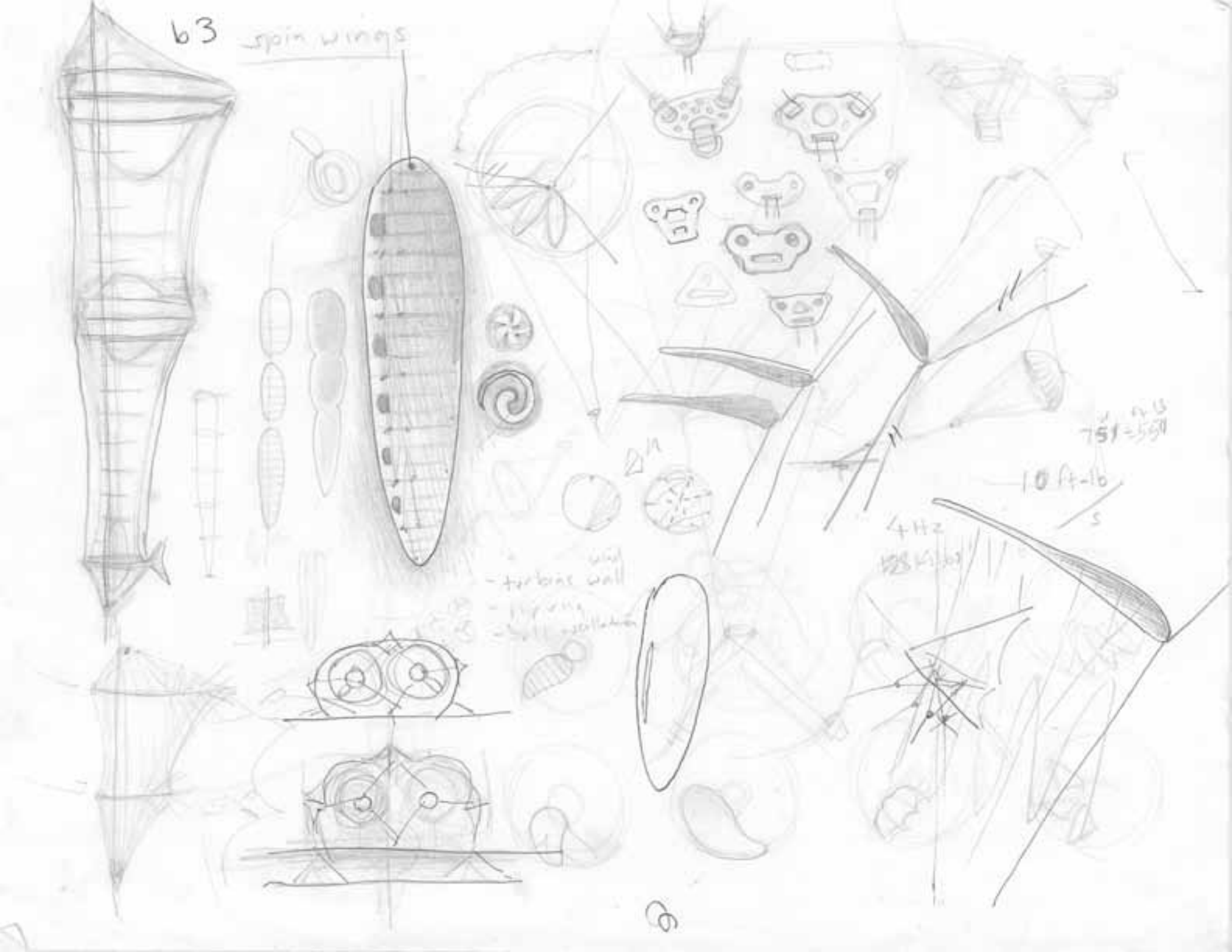
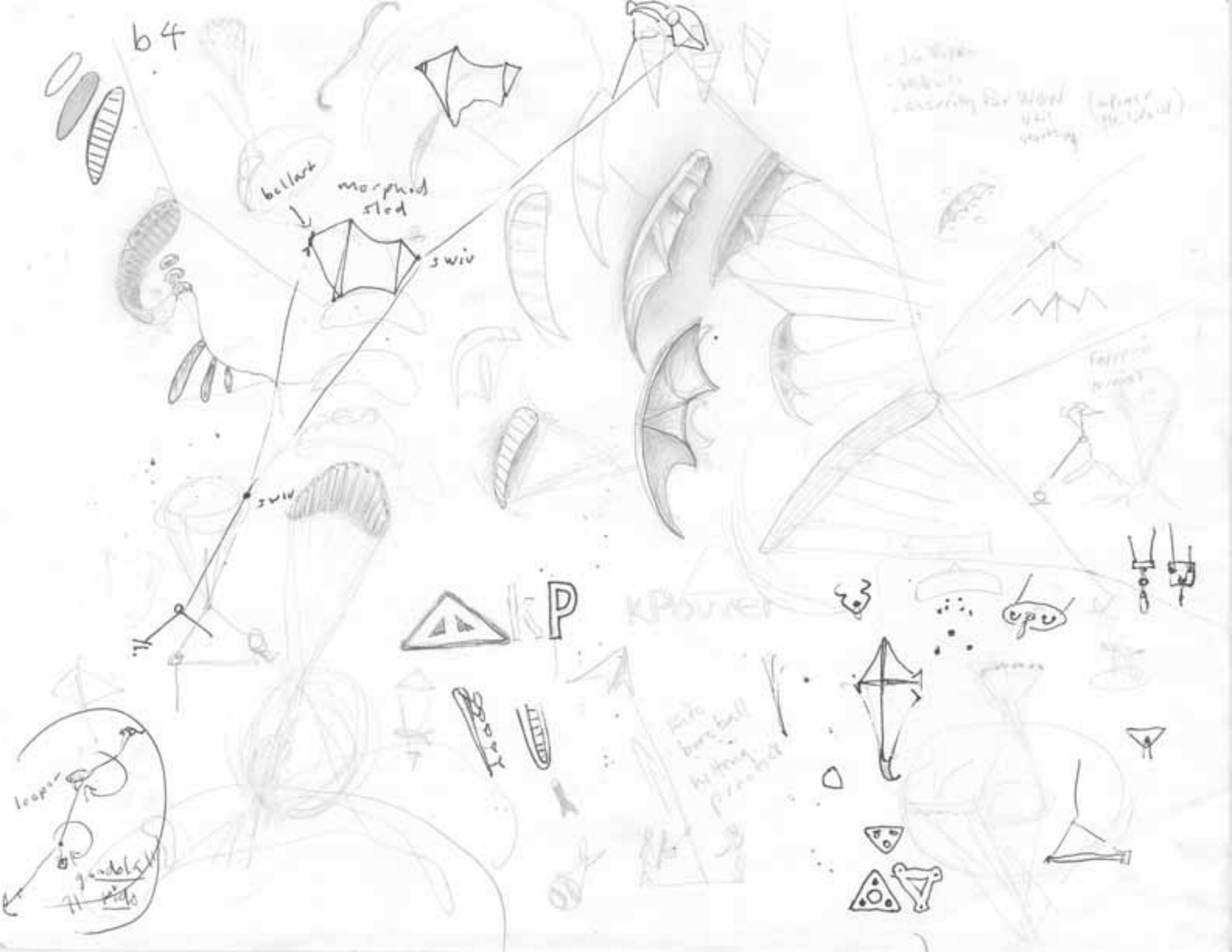

63
spin wings
10 ft-lb
s
4Hz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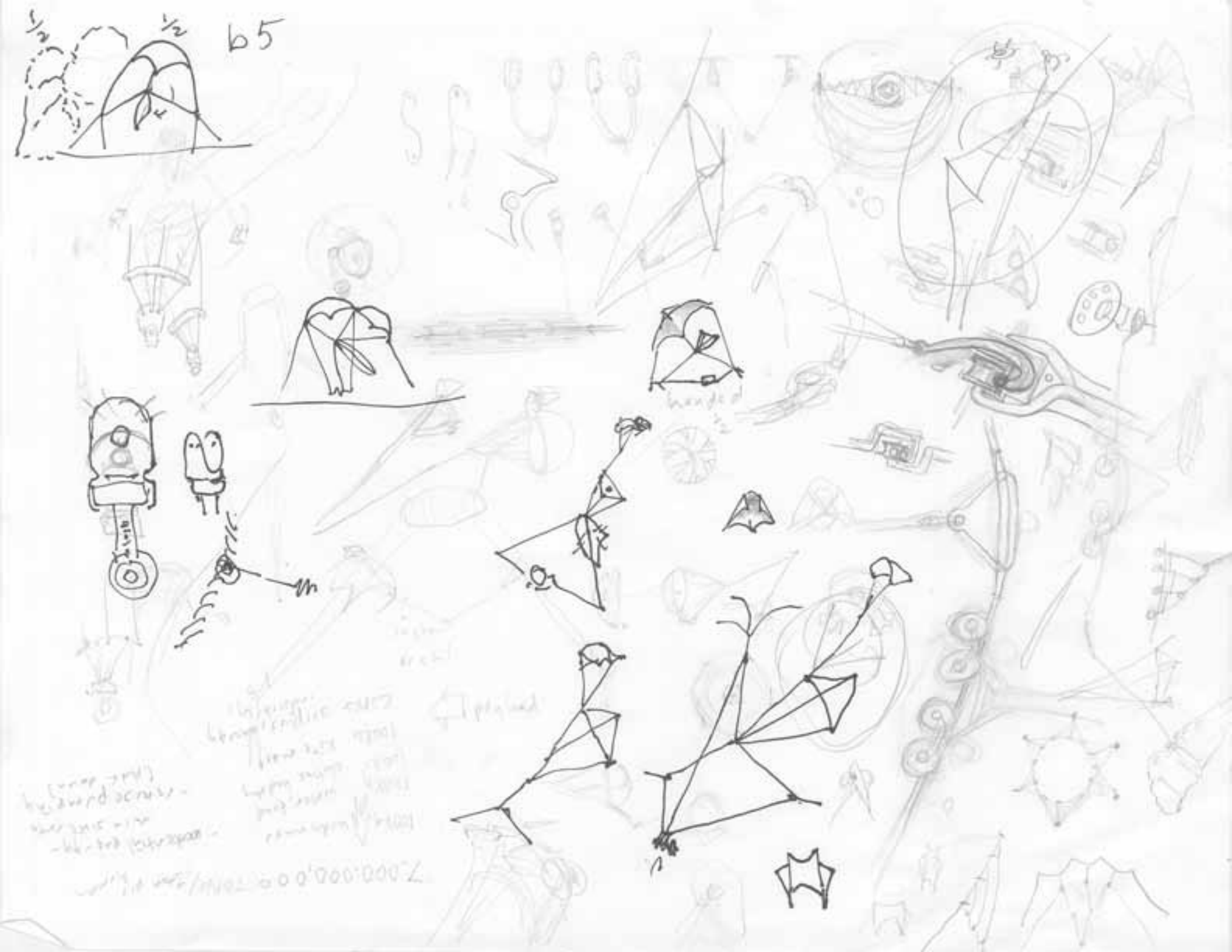
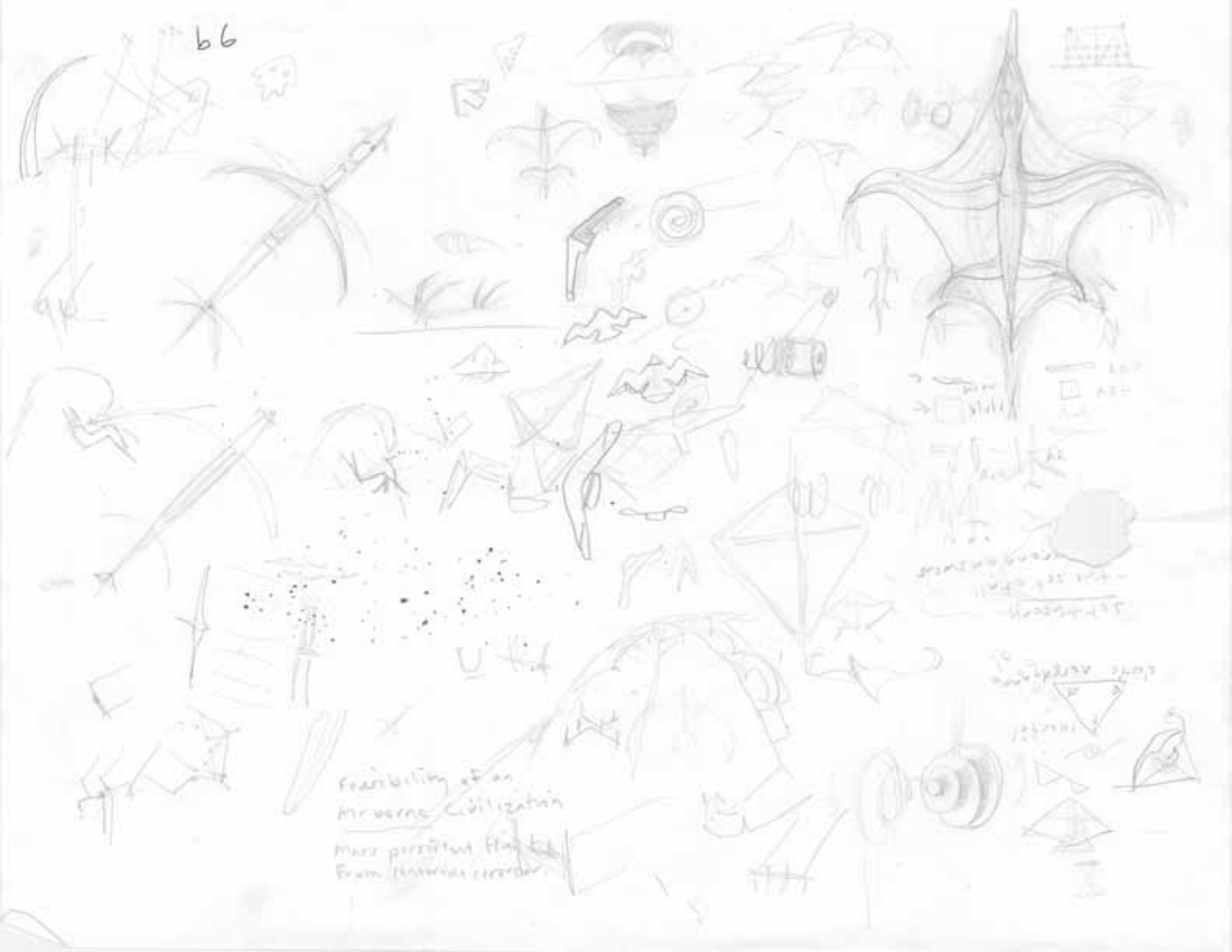
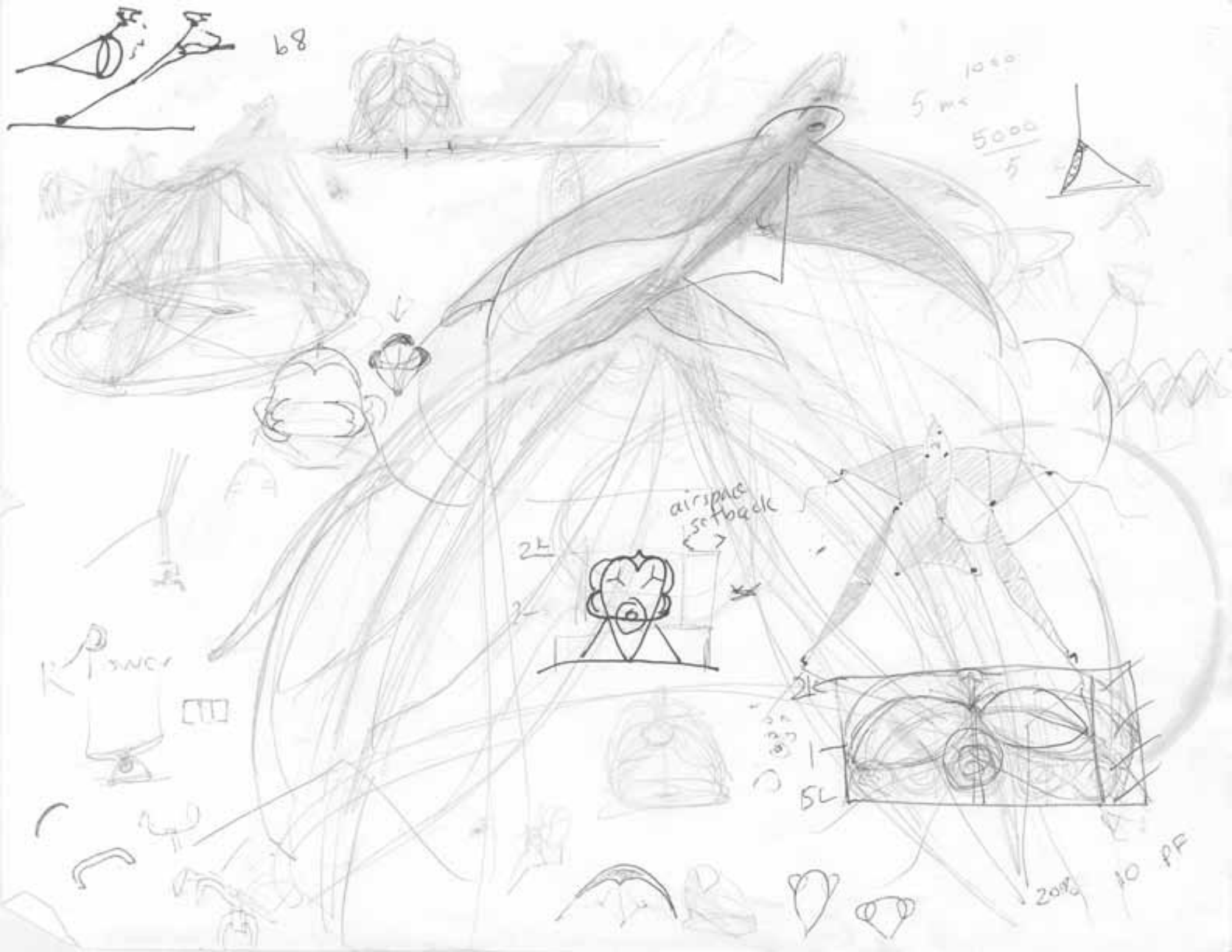
ballast
morphed sled
swiv
swiv
KP
looper
gondolall
pido


1/2
1/2
b5


b6

57
KPOWER
K
POWER
COOP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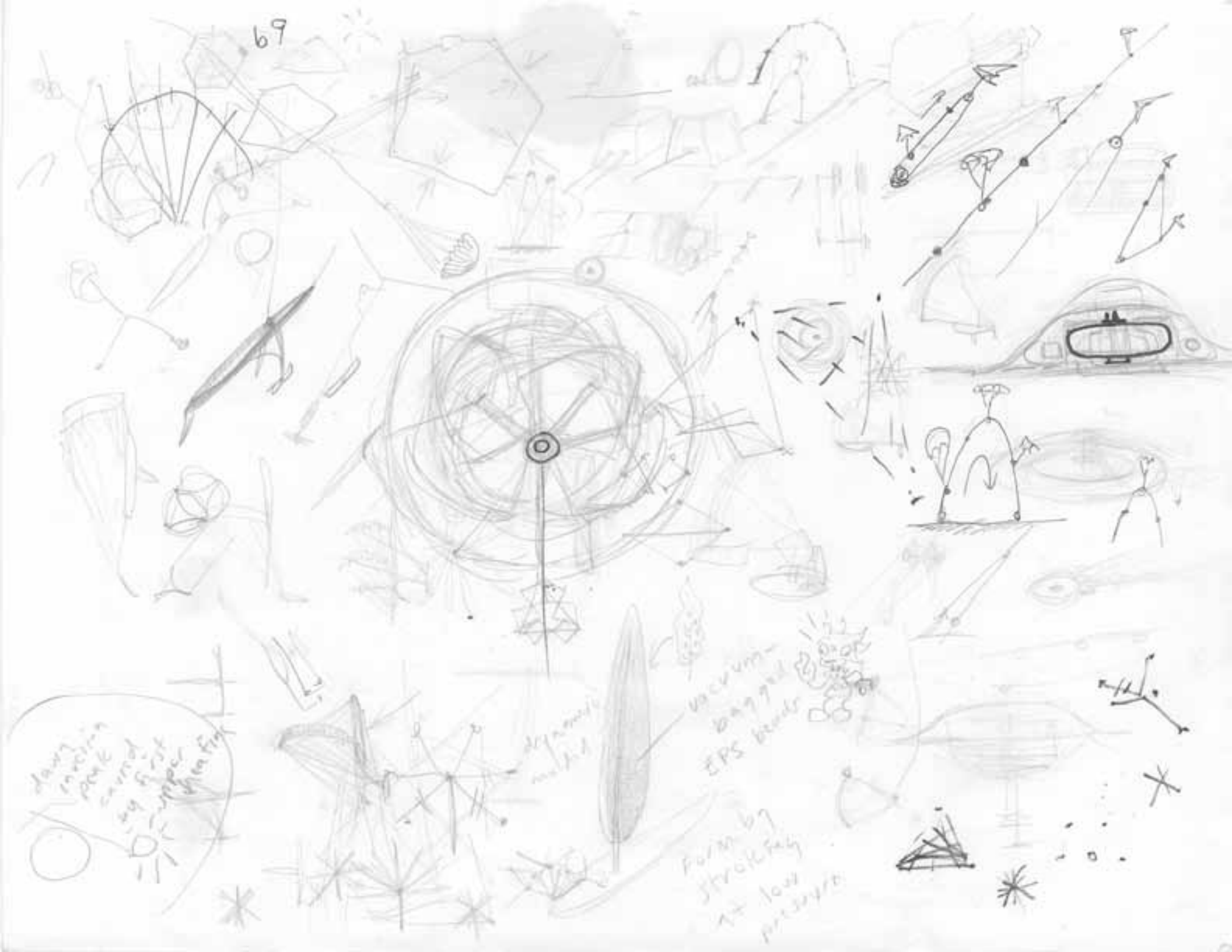
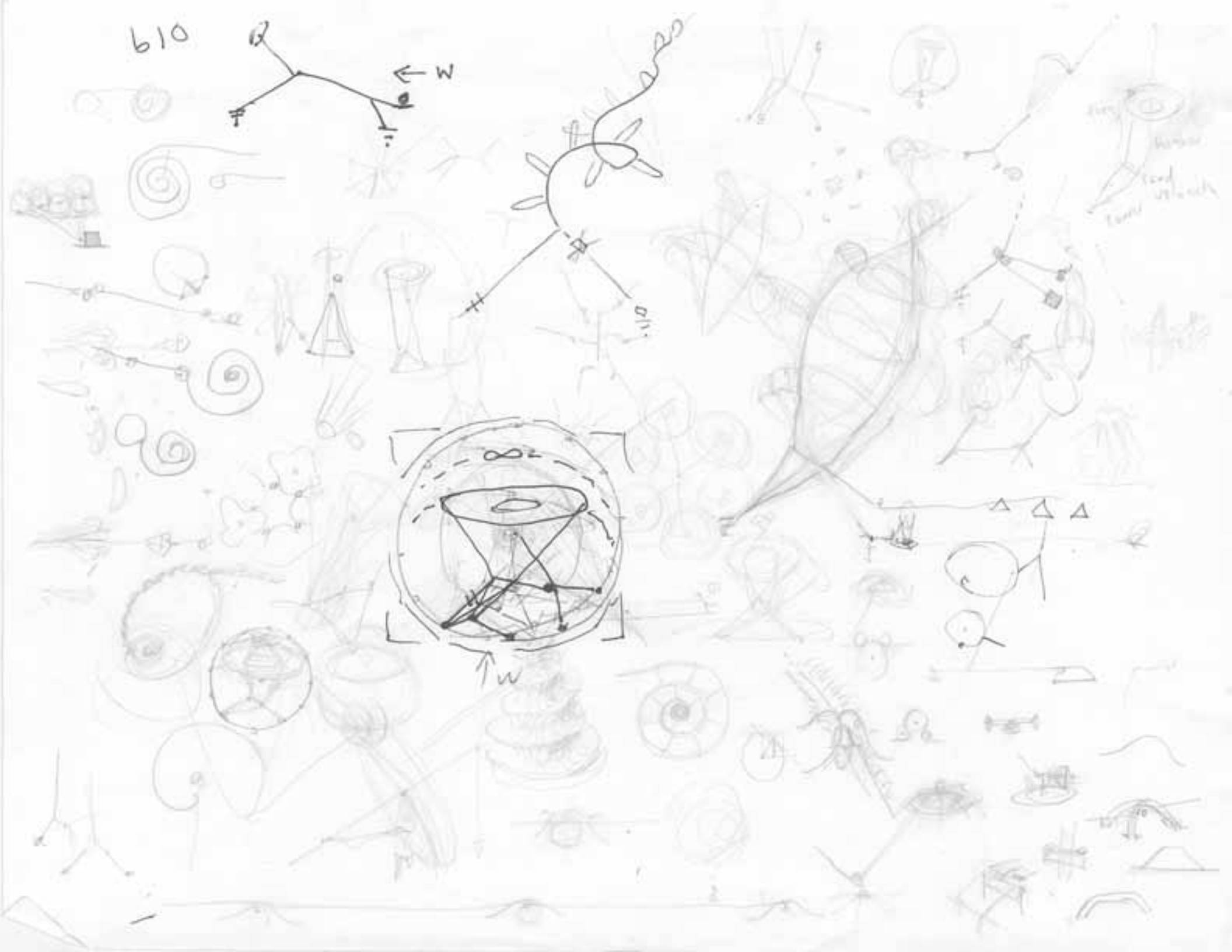
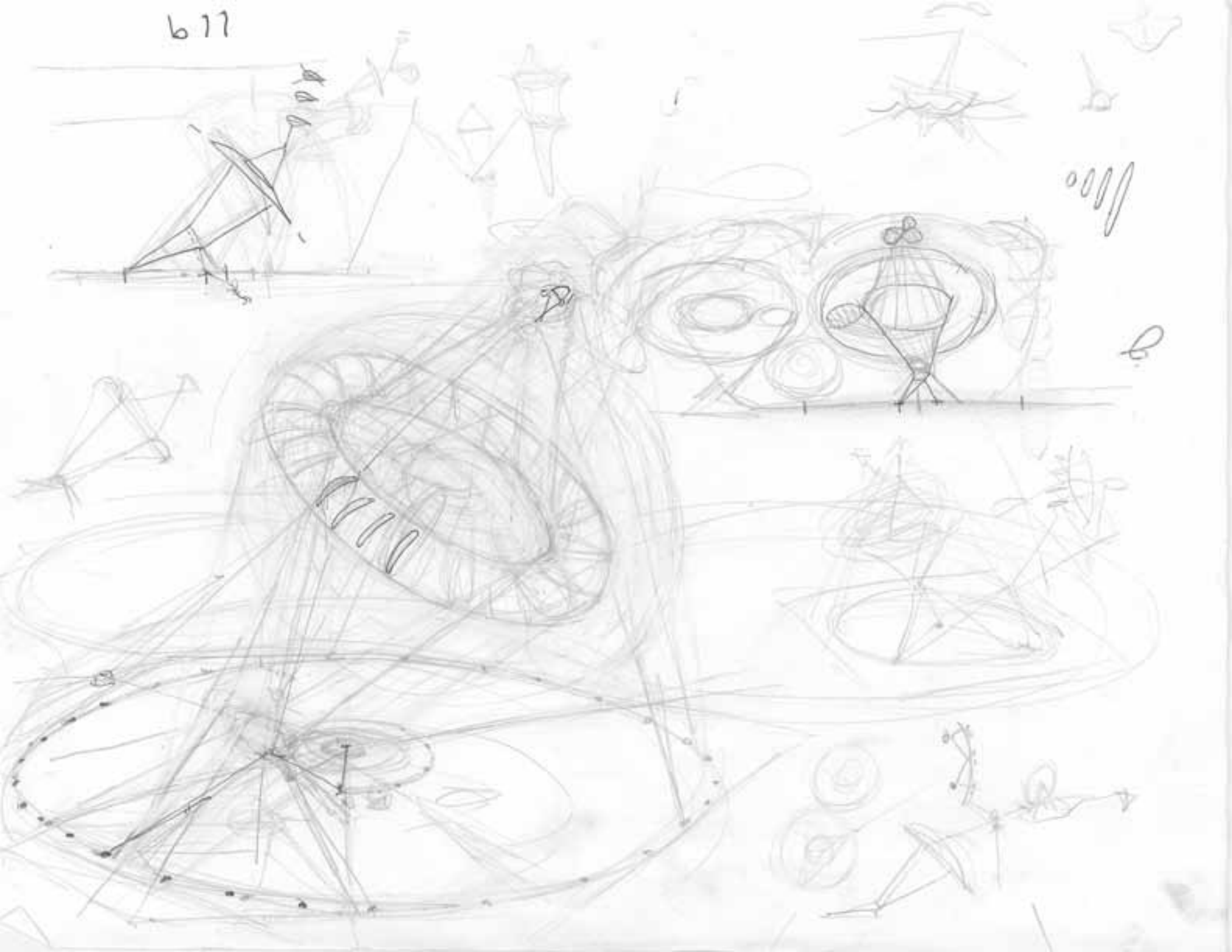
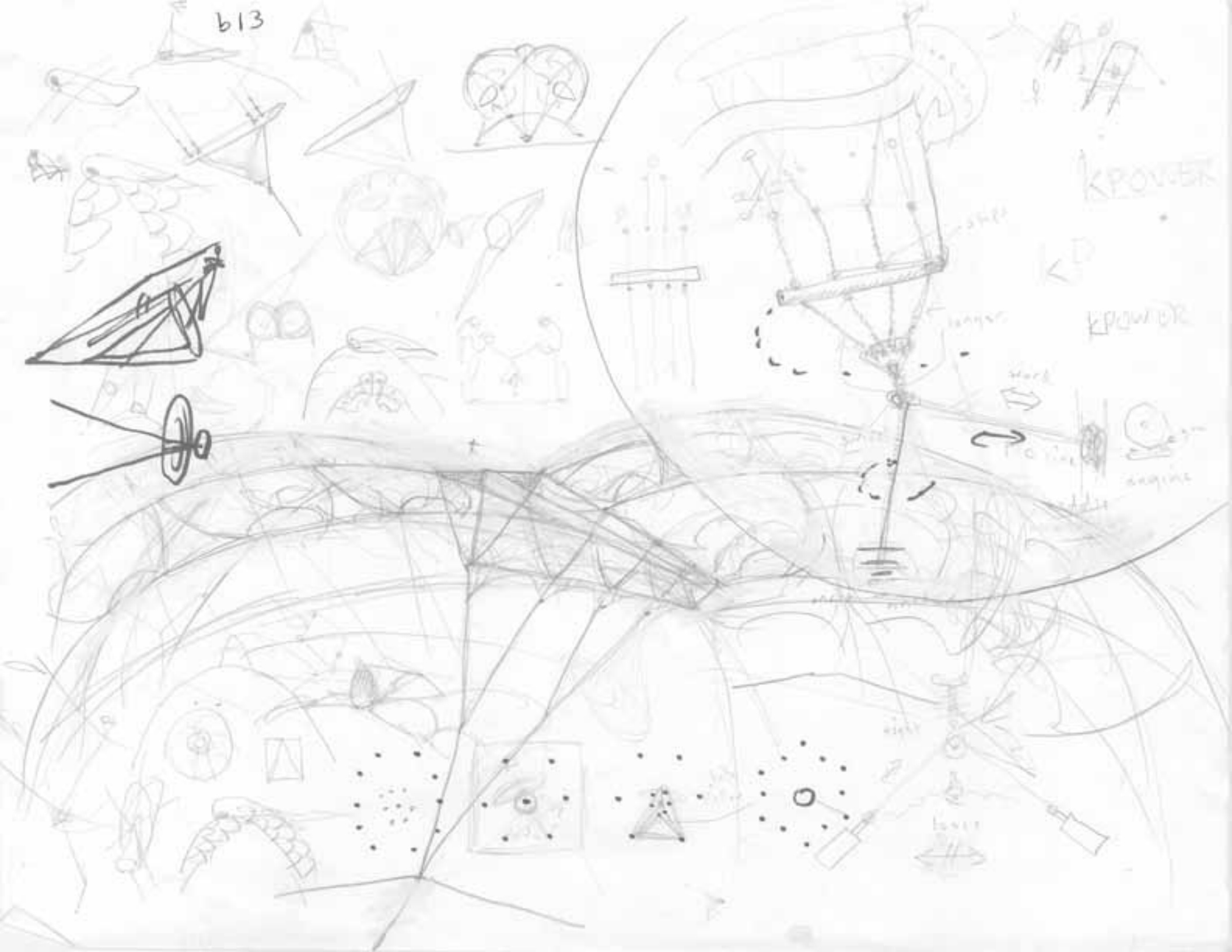
1000
5 ms
5000
5
airspace setback
2L
1
5L
10 PF




610
W


b 11

b12
upwind anchor
center anchor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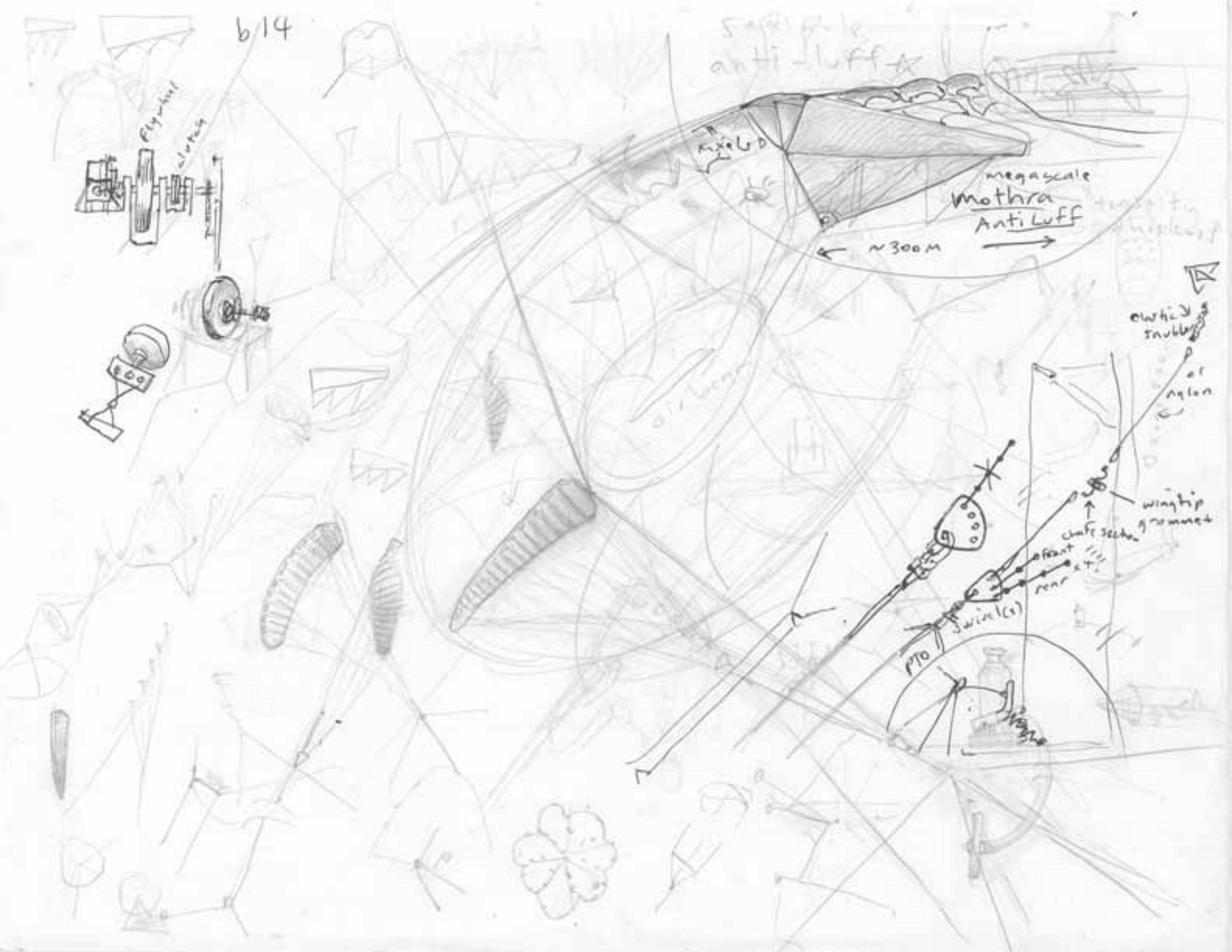
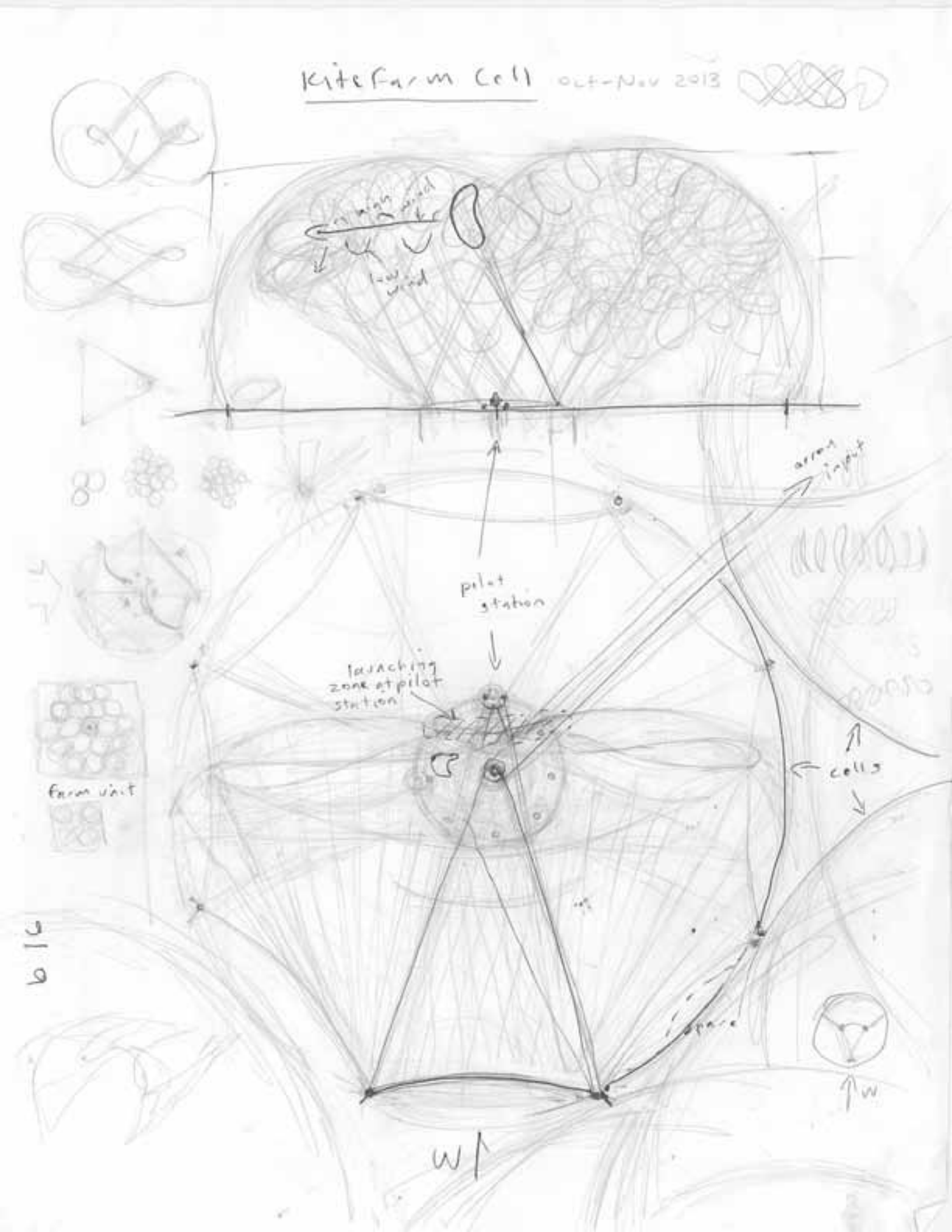

b14
flywheel
clutch
fixed
megascale
Mothra
Anti Luff
~300M
elastic
snubber
or
nylon
wingtip
grommet
chafe section
front
rear
swivel(s)
PTO

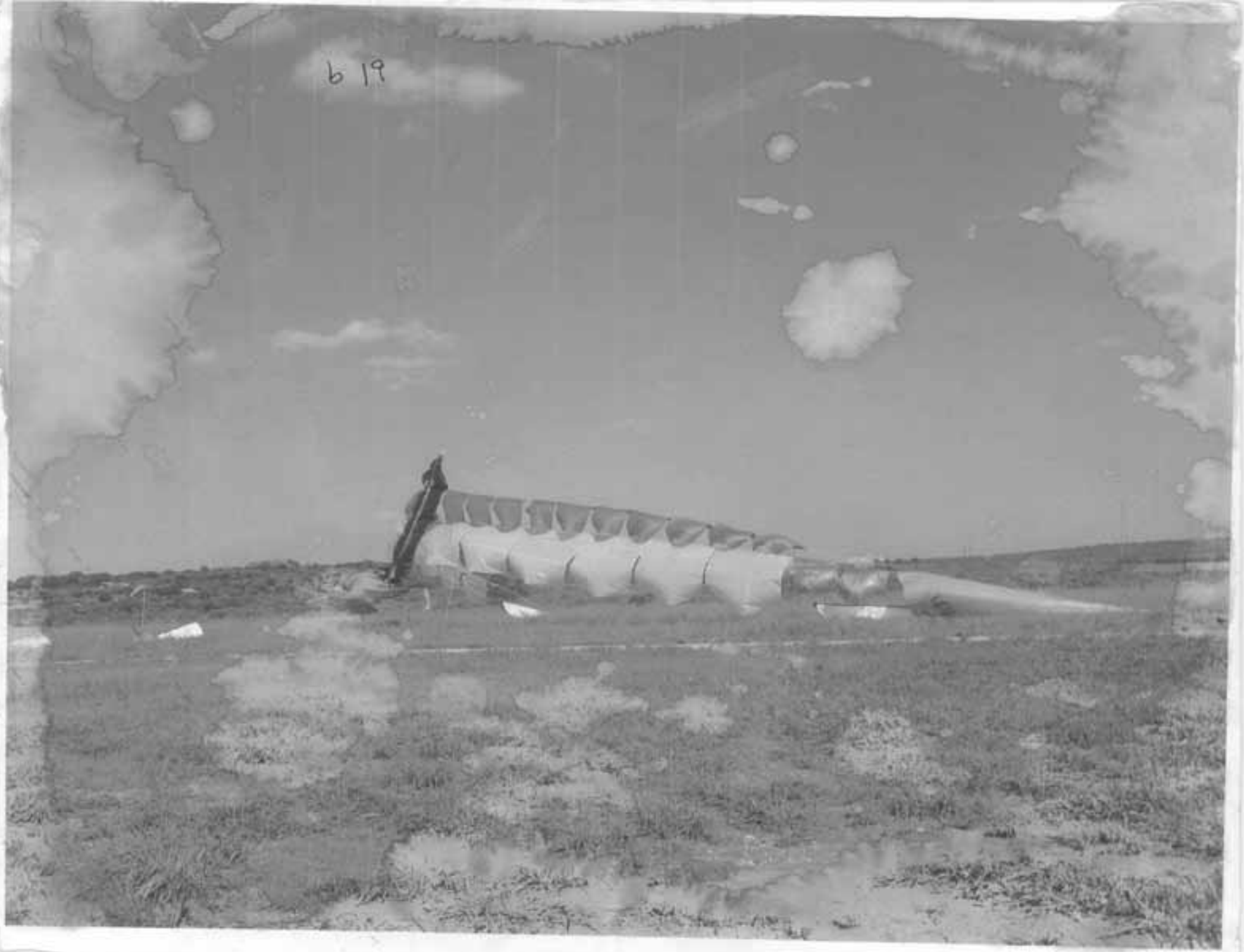
b15
can passive reeling be perfected?
cradle
elastic reel
- min start force
- land
5 9
906

Kitefarm Cell Oct-Nov 2013

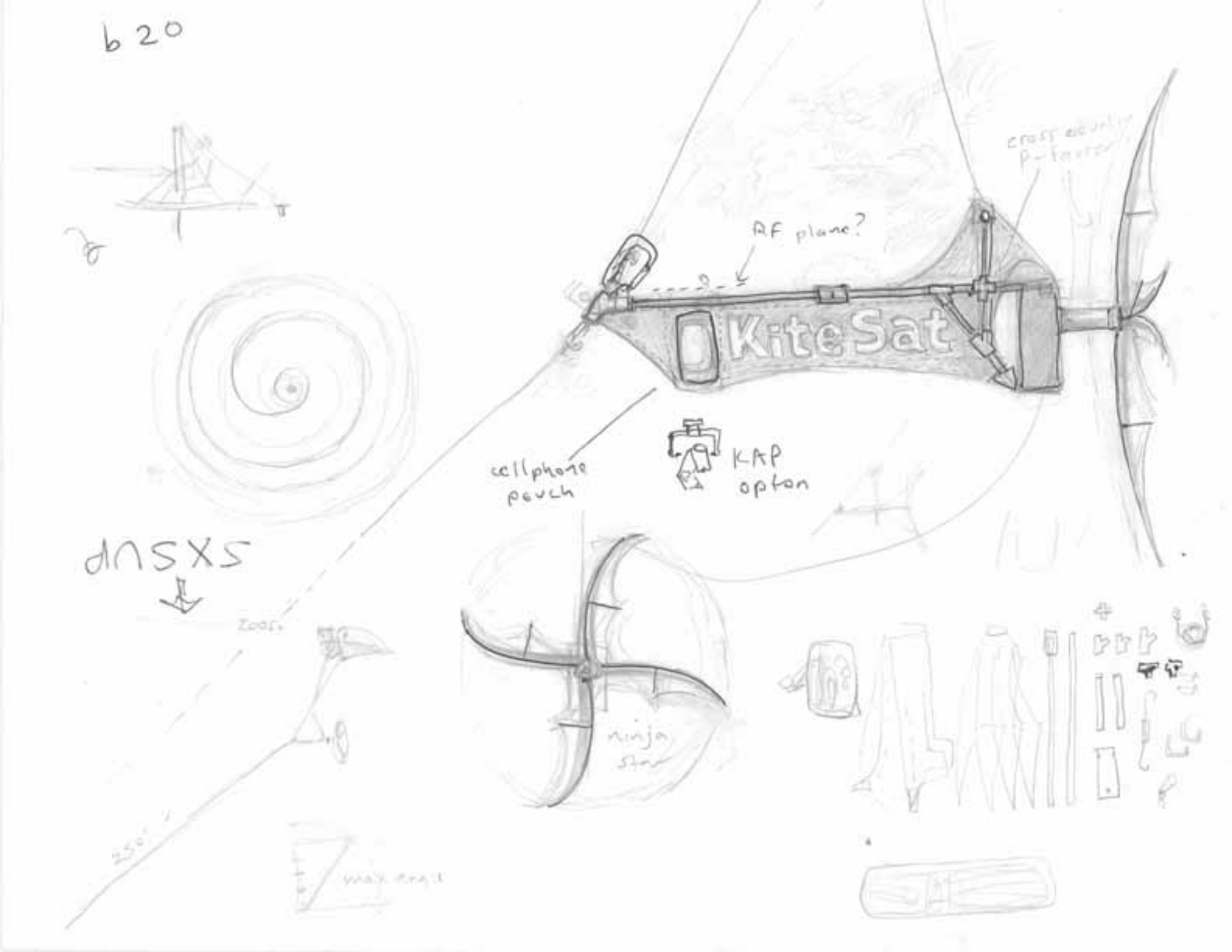


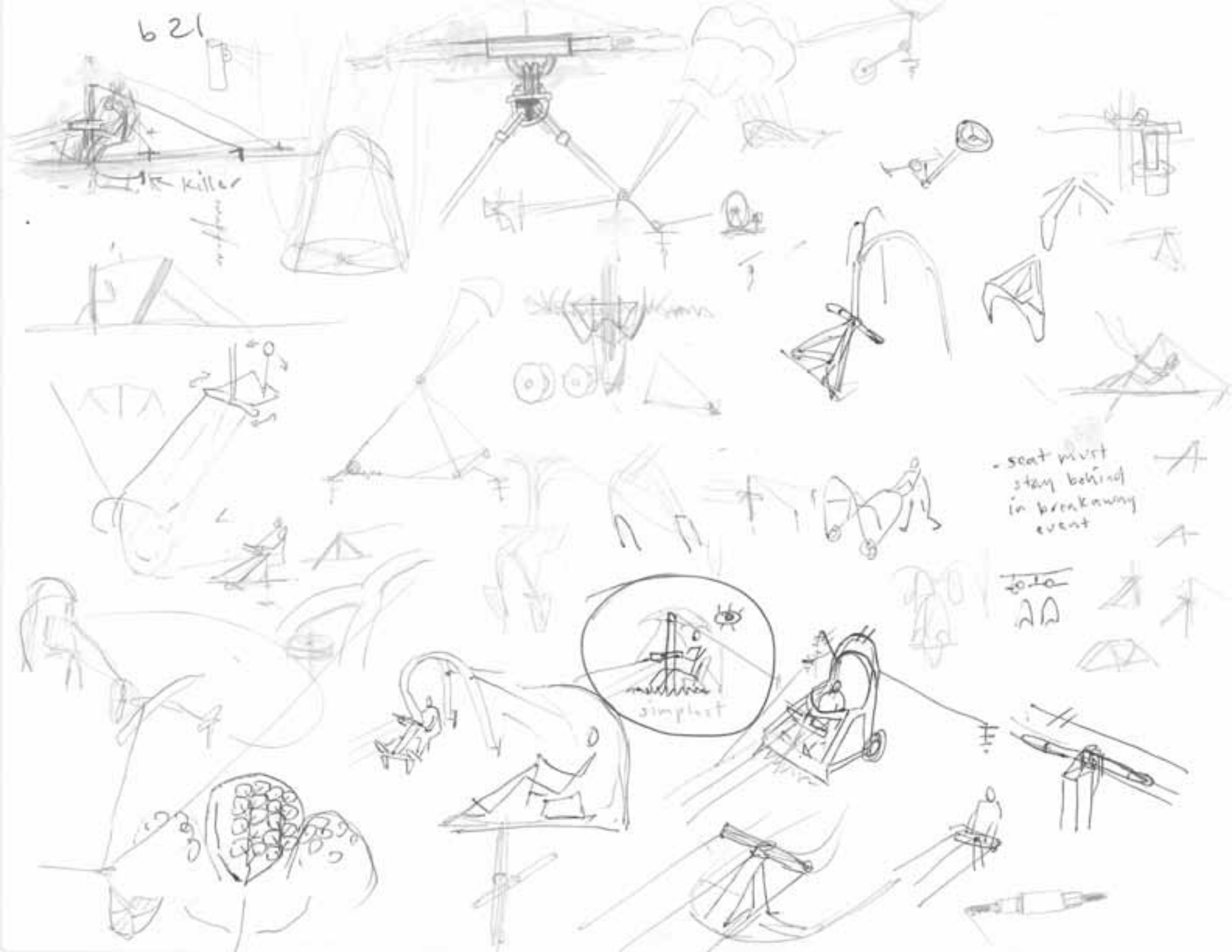
Mothra 1
First Flight
July 28, 2012
9 17
Util
Kate Lab Austin
W.O.W
Valley Way Farm

b 18

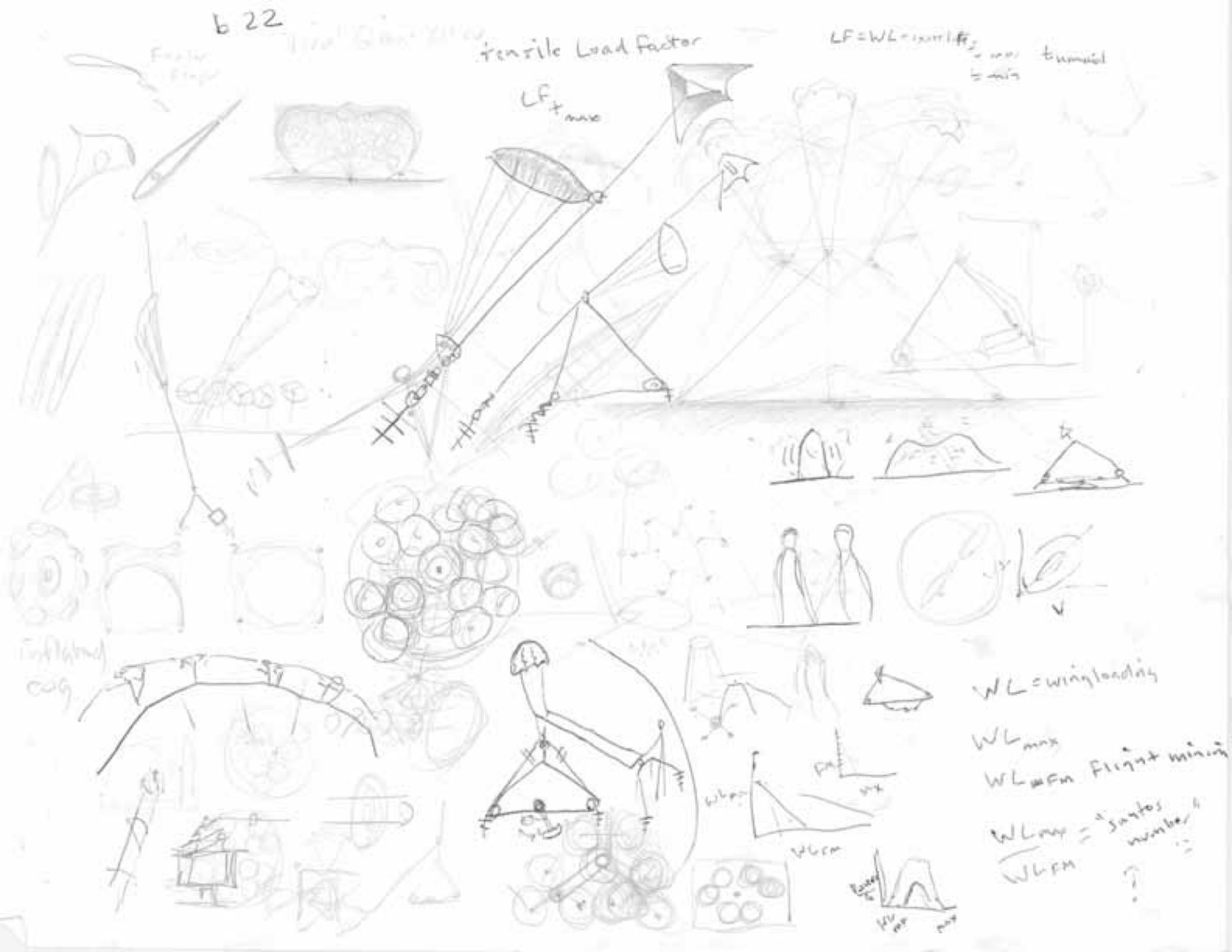

b 19

b 20

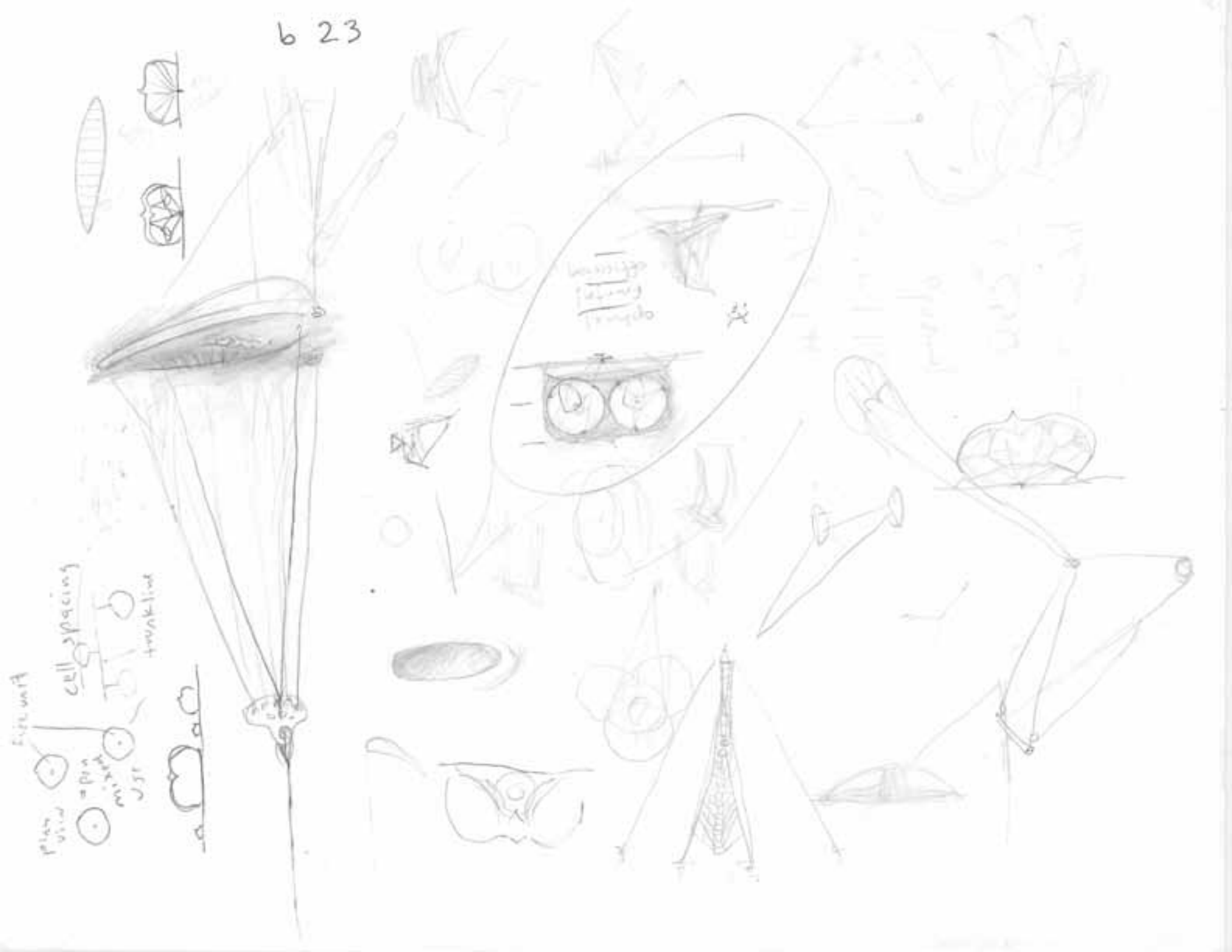



b 21
killer
- seat must stay behind in breakaway event
simplest

b 22


tensile Load factor
LF = WL = wingloading
t max
t min
t nominal
LF t max
inflated cog
WL = wingloading
WL max
WL FM flight minimum
WL max / WL FM = "santos number"
?

b 23



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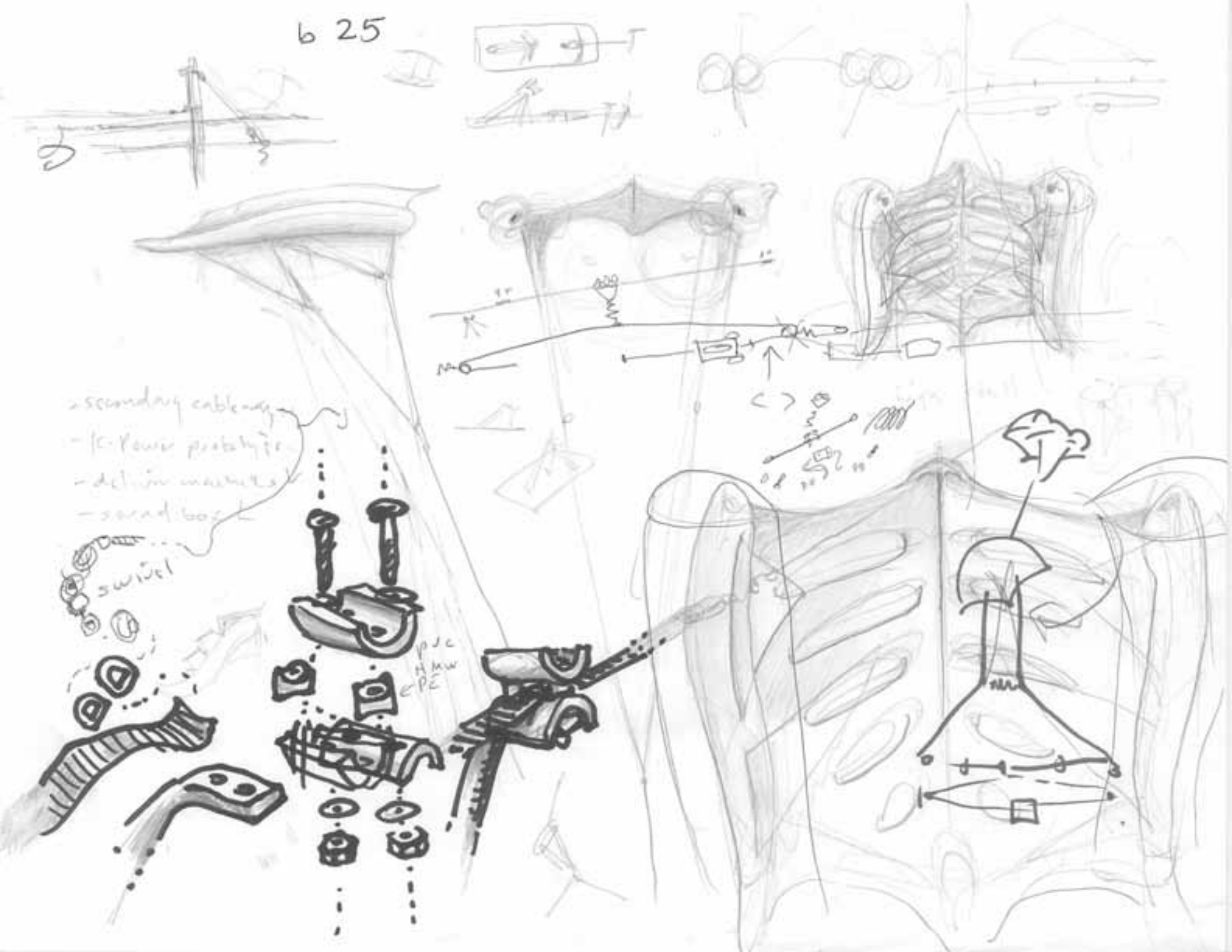
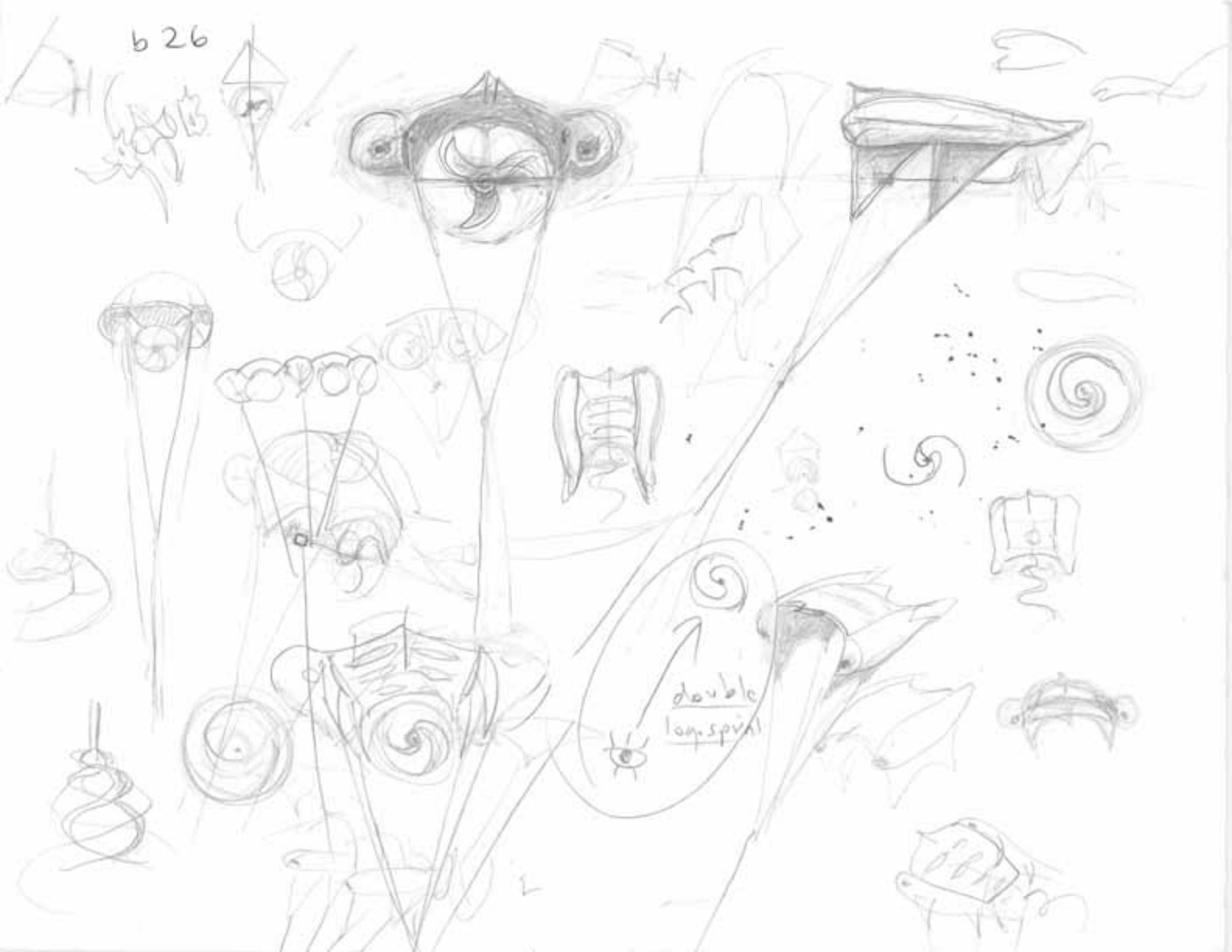
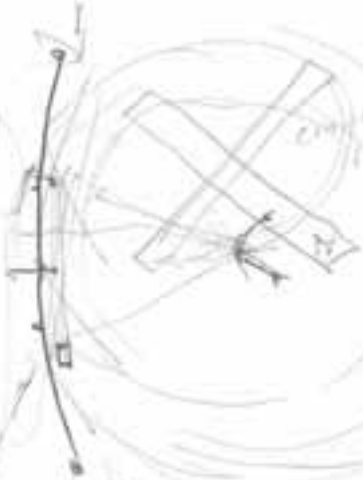
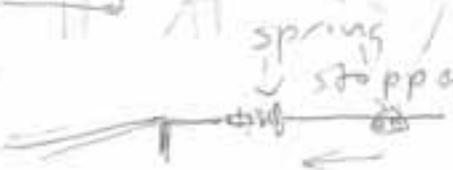

swivel
pvc
HMW
PE


b 26
double
long spiral

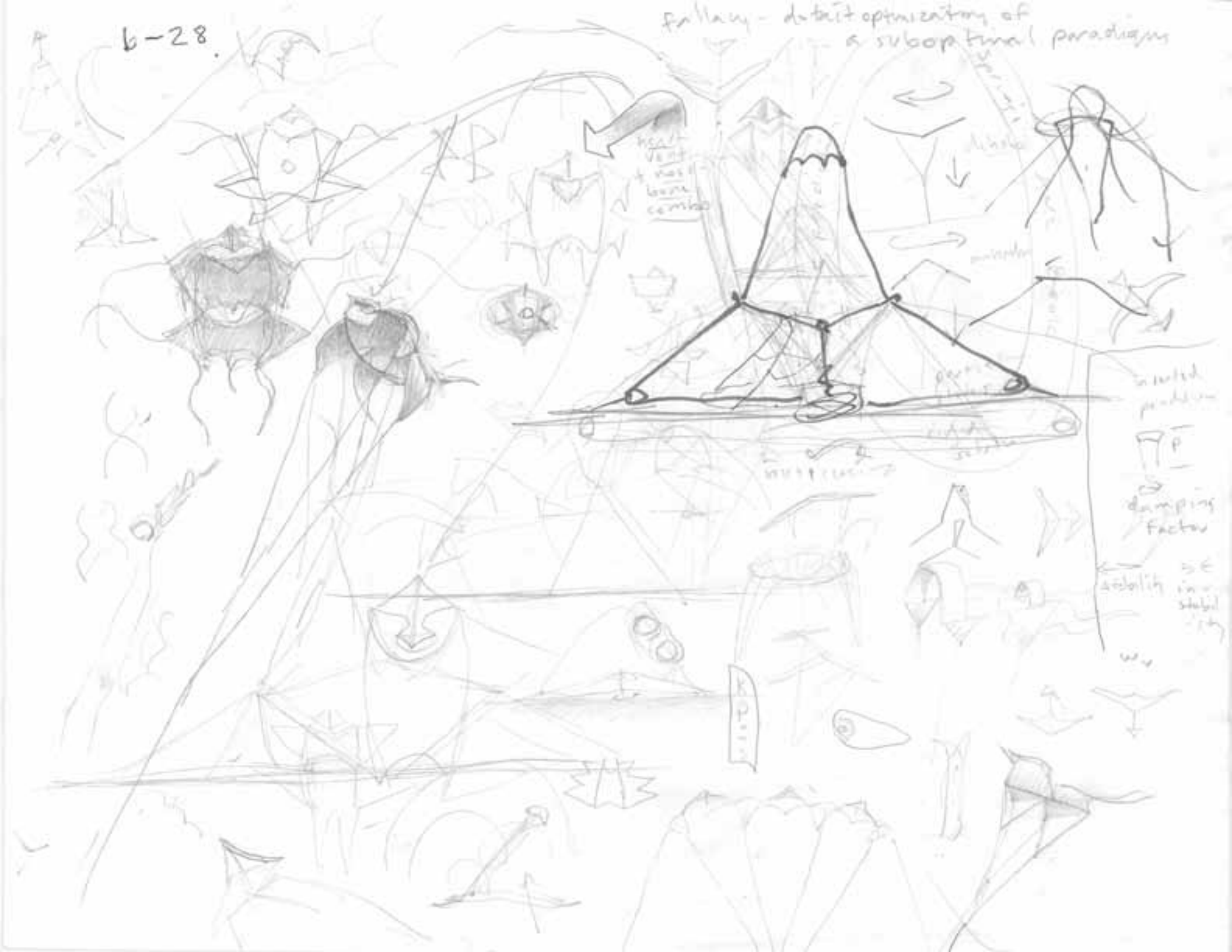
b 27





6-28.

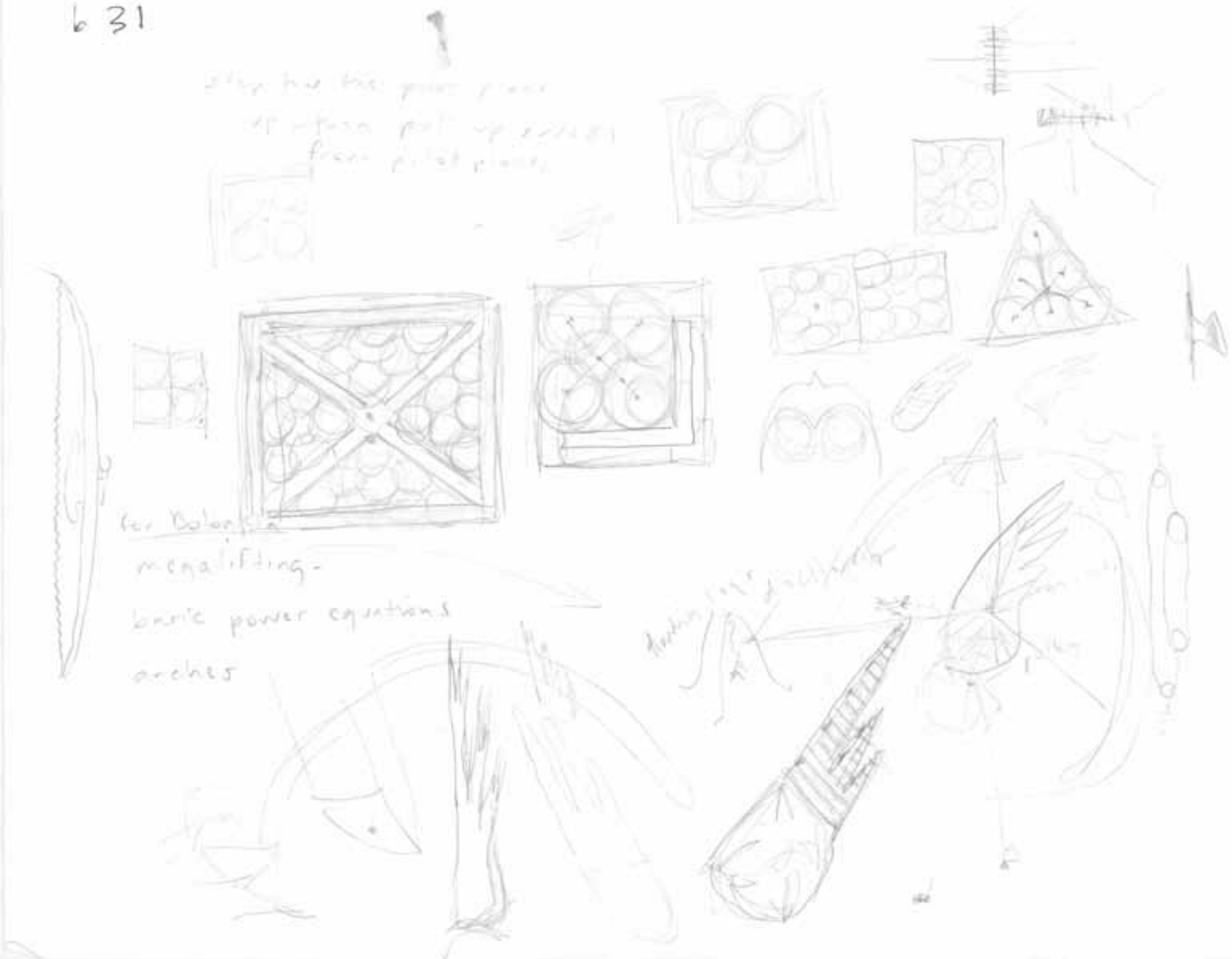
fallacy - deficit optimization of a suboptimal paradigm



Pitch
Roll
Modulation
variable
frequency/Stabil
halt!

b 30

6 31



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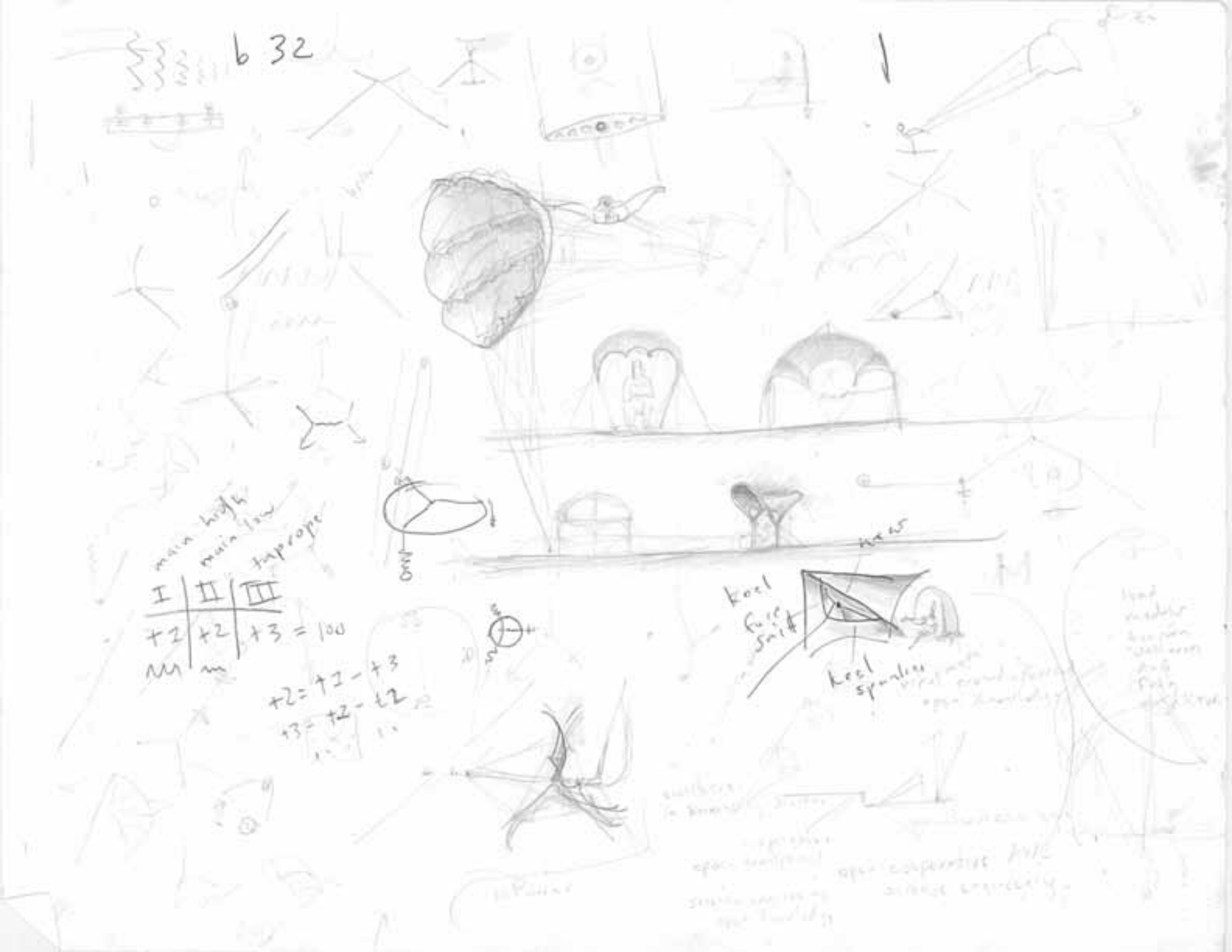
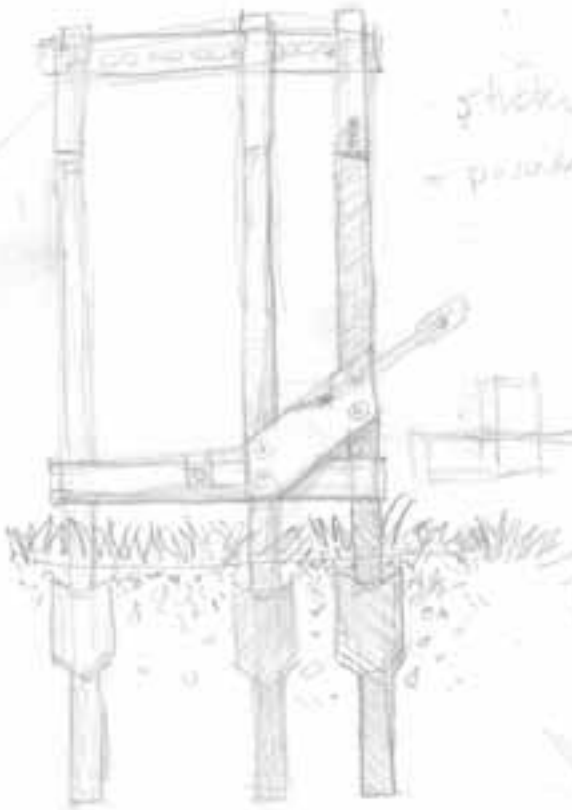
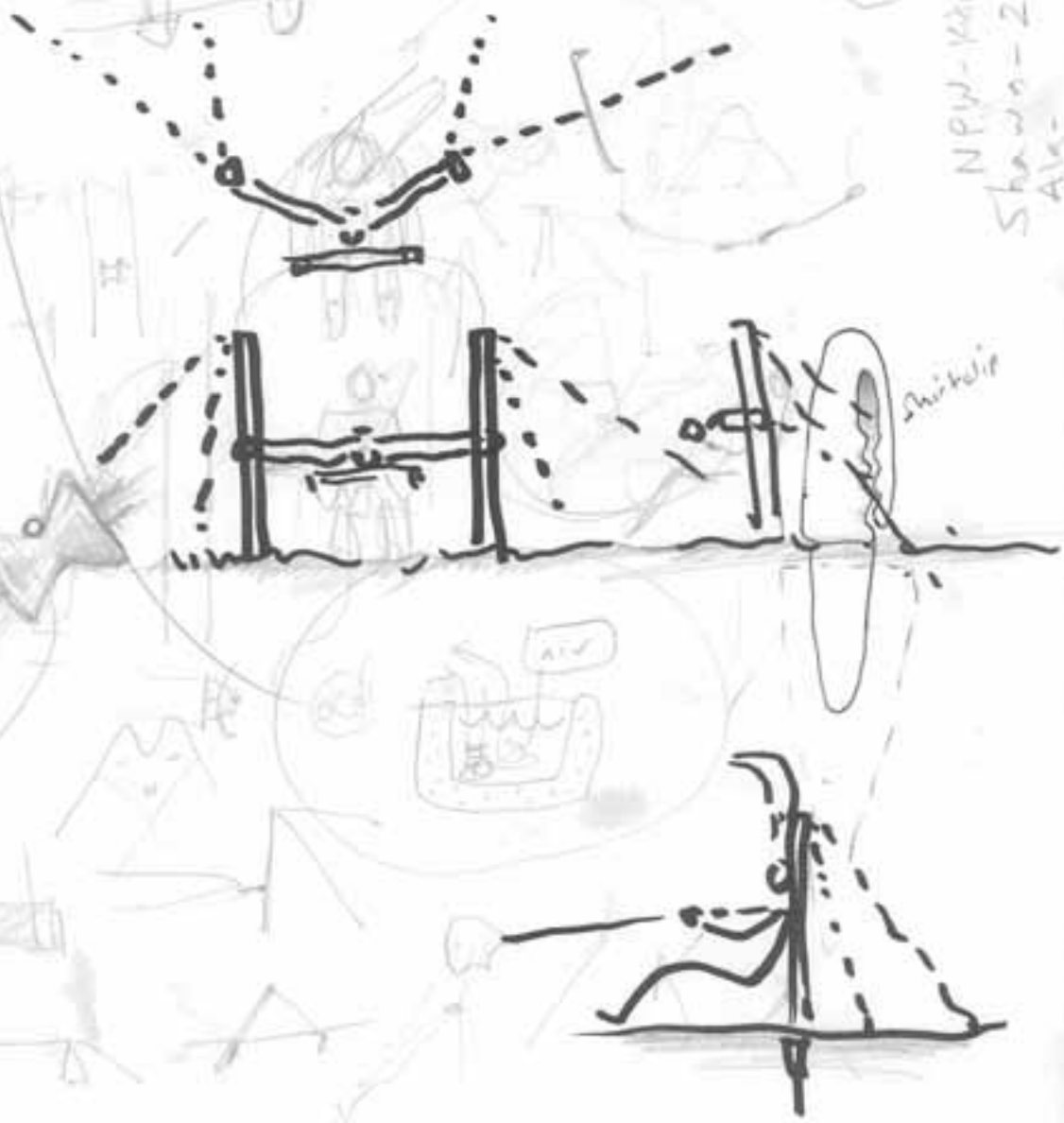
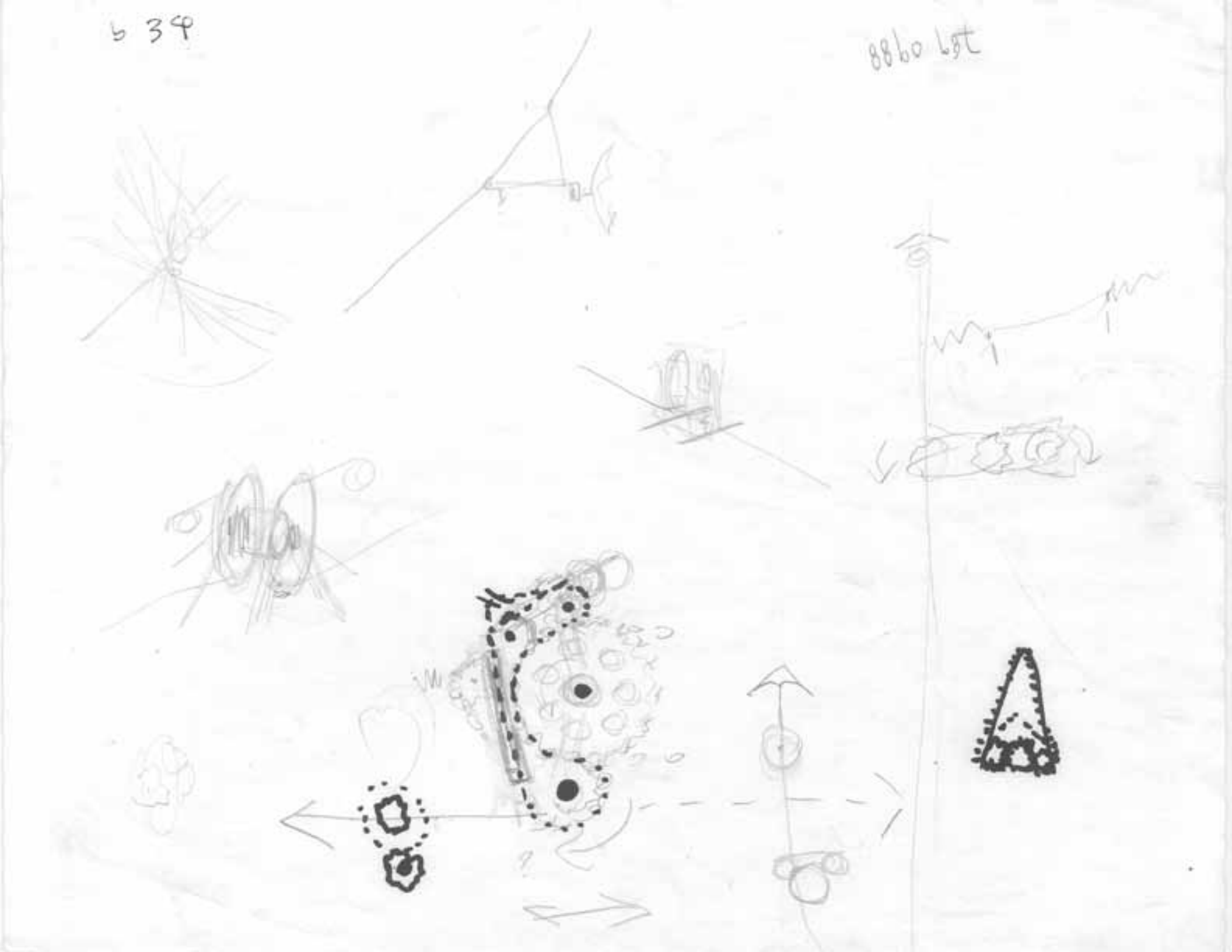

main high
main low
taprope
I
II
III
+1
+2
+3 = 100
+2 = +1 - +3
+3 = +2 - +2
new
keel
face
sail
keel
spanlier

b 33







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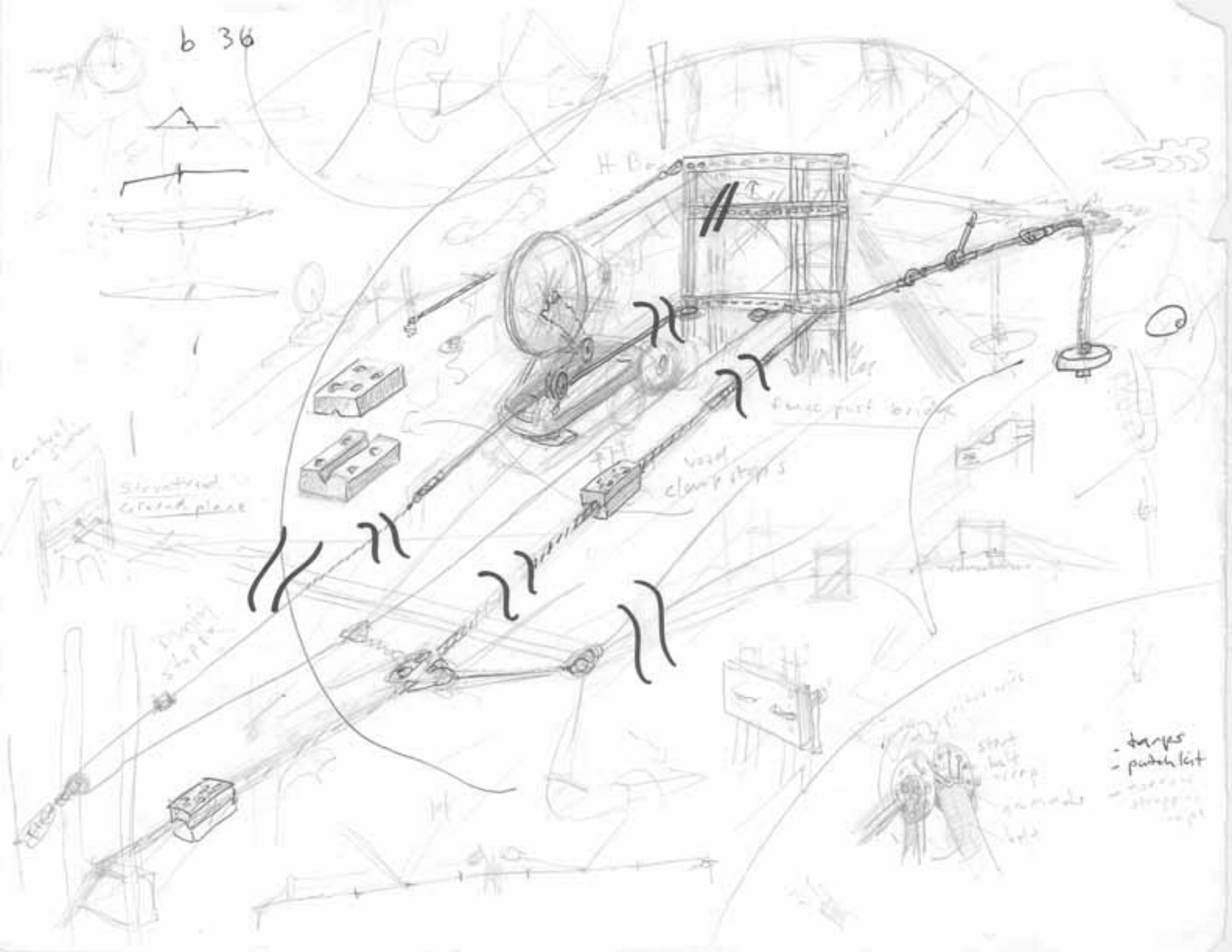
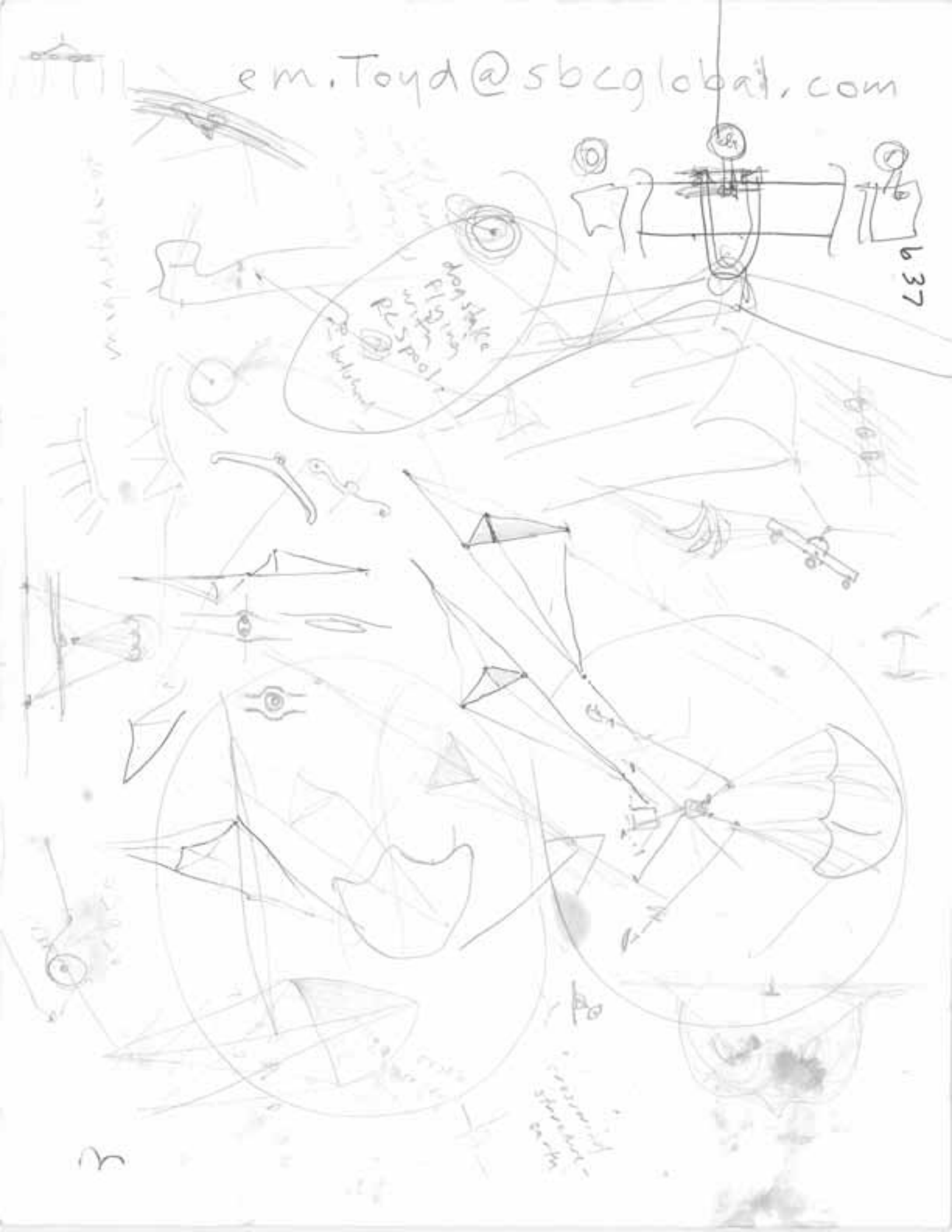
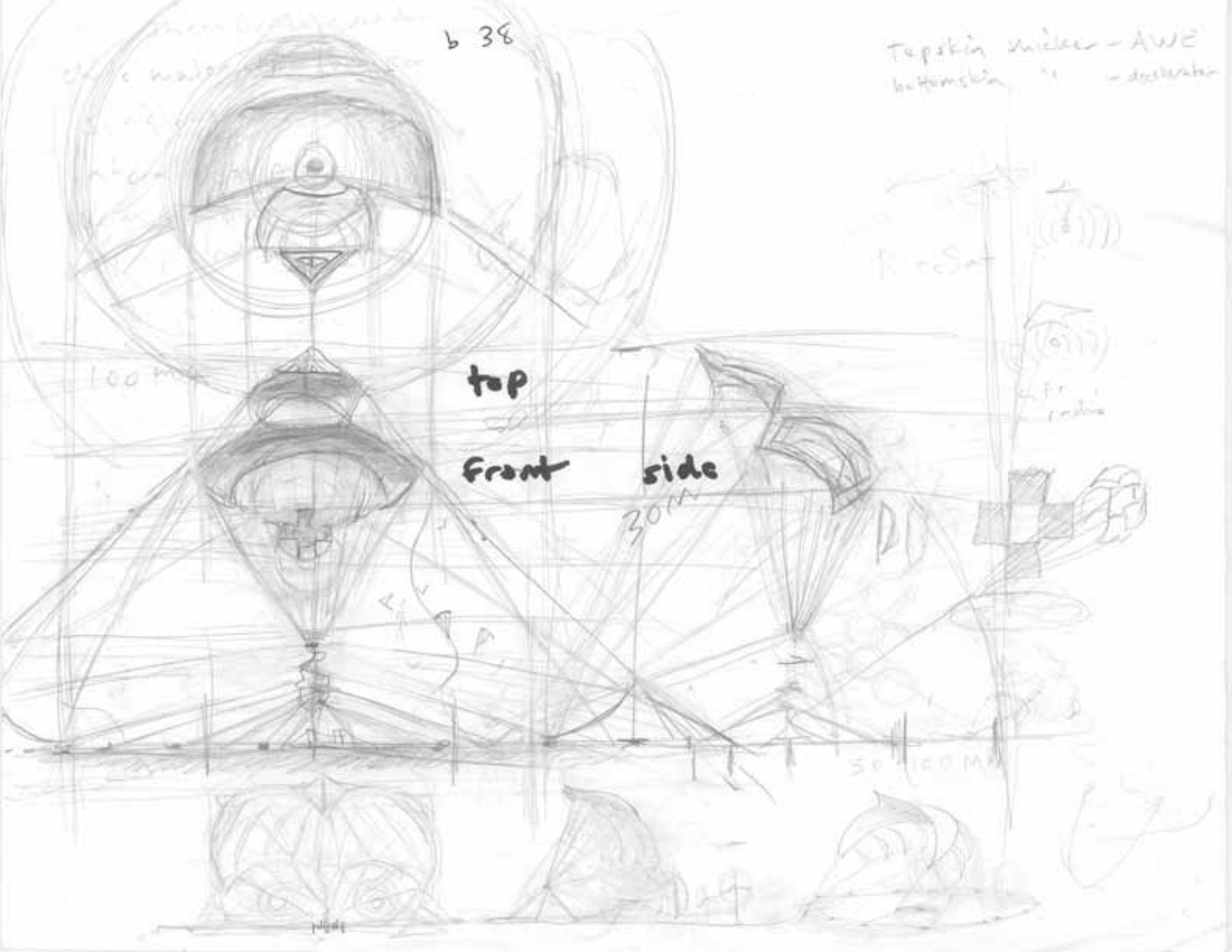
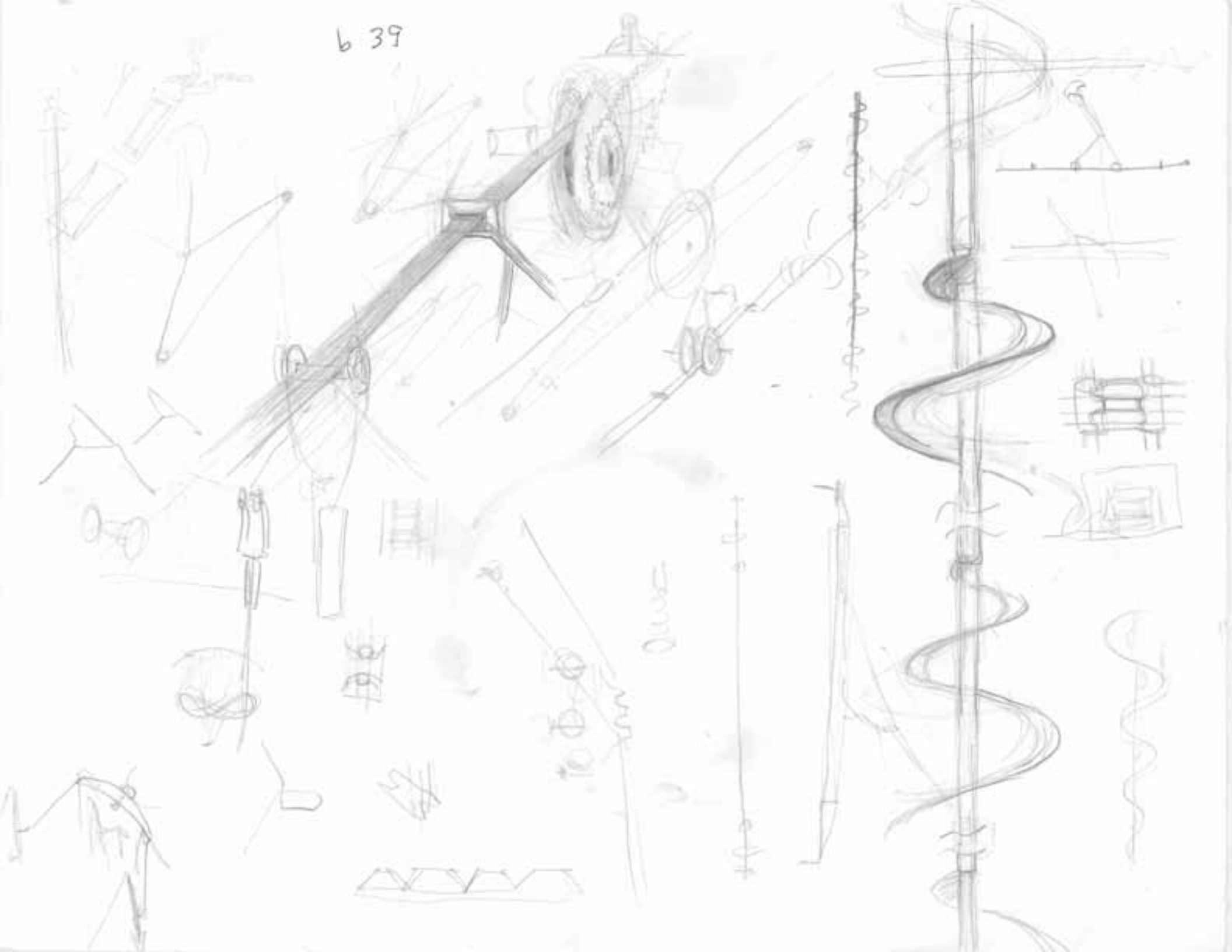

b 36
- tarps
- patch kit

em.Toyd@sbcglobal.com




b 38
top
Front
side

b 39



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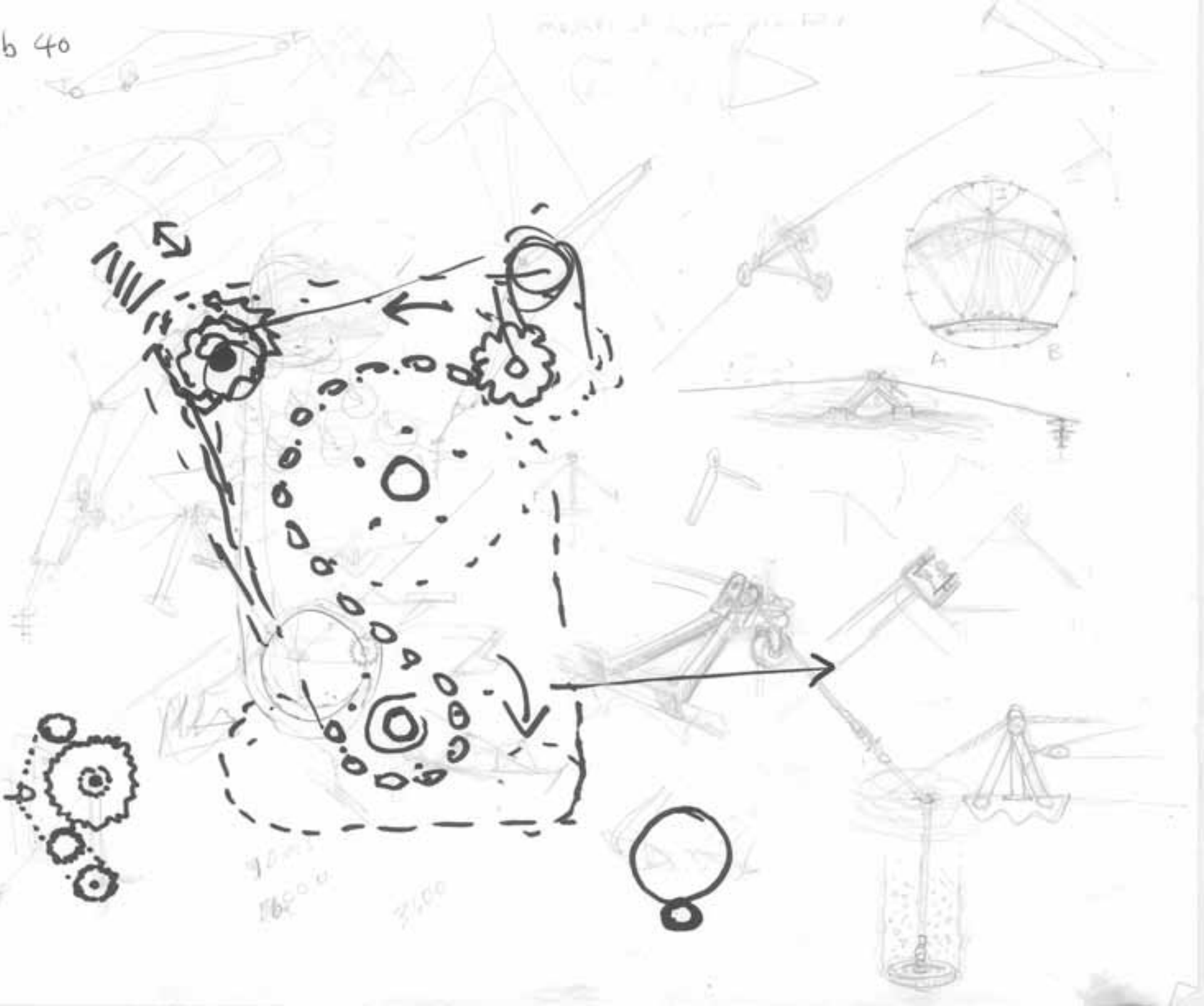
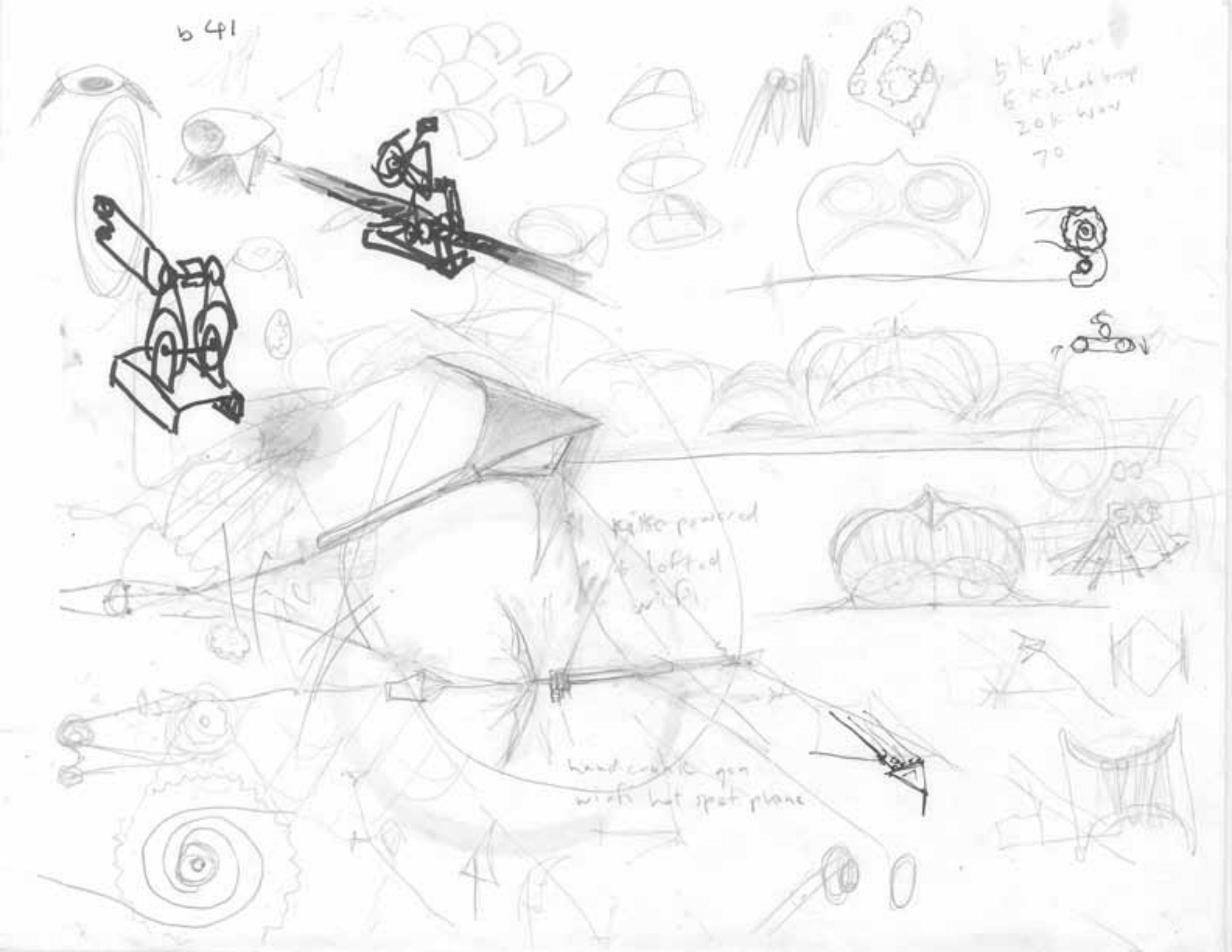
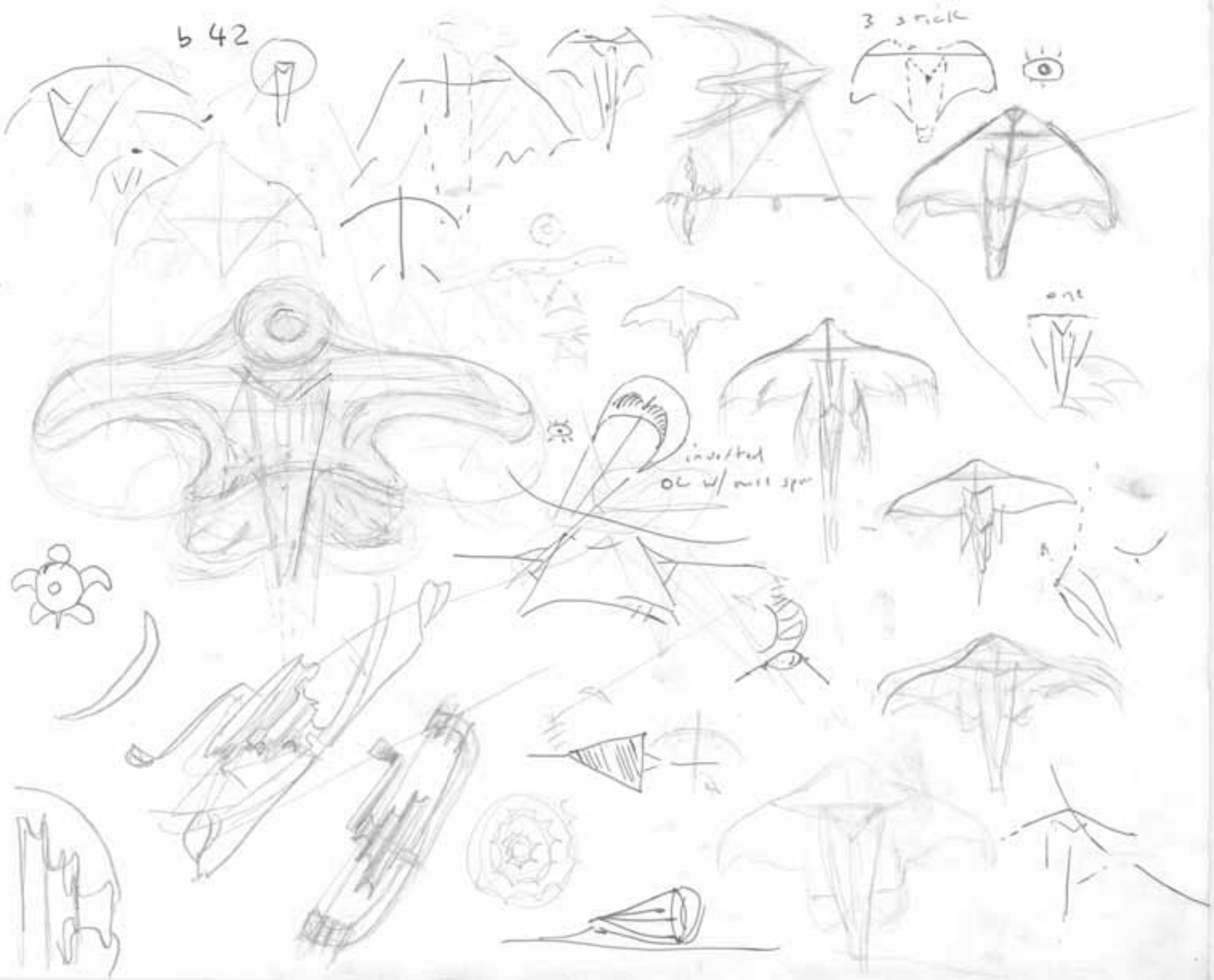
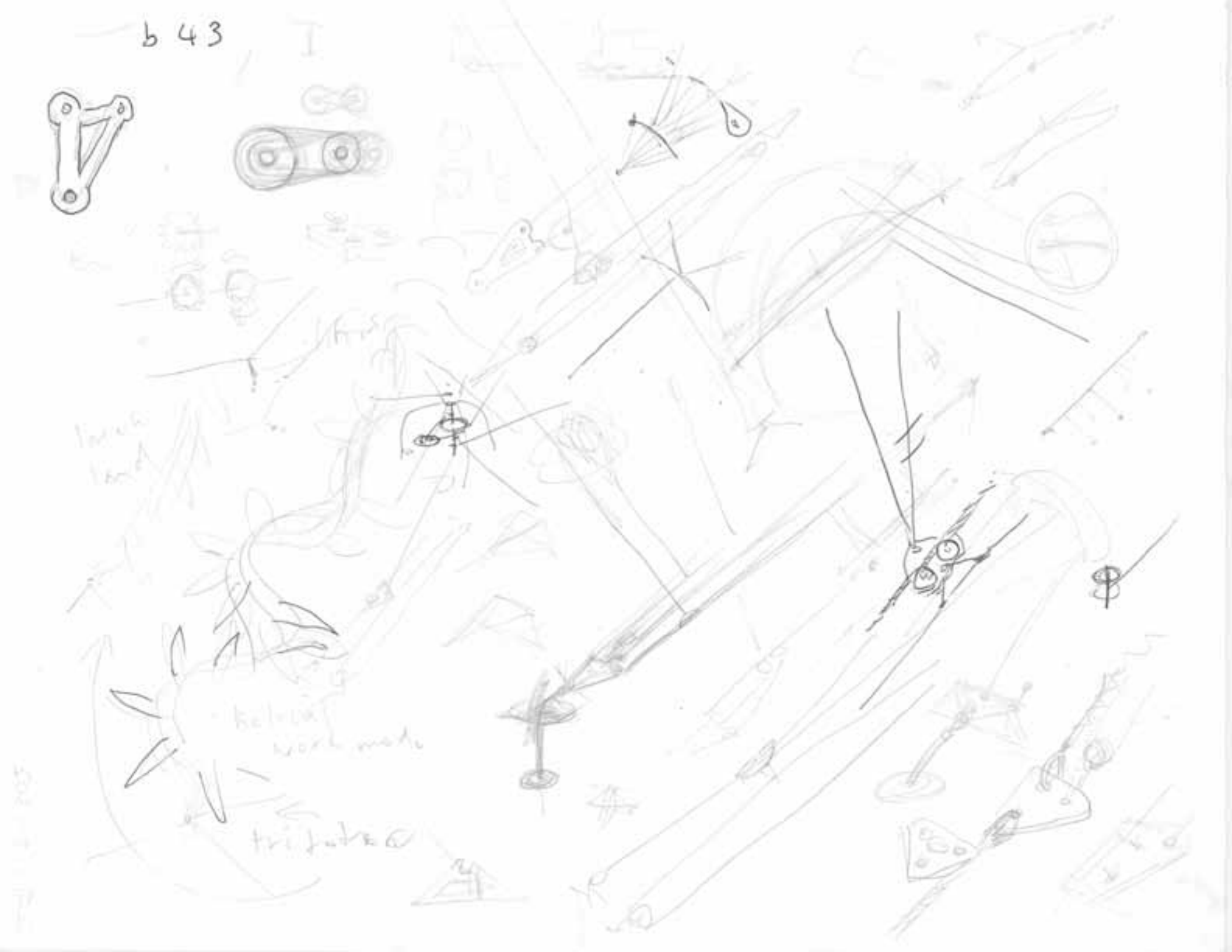
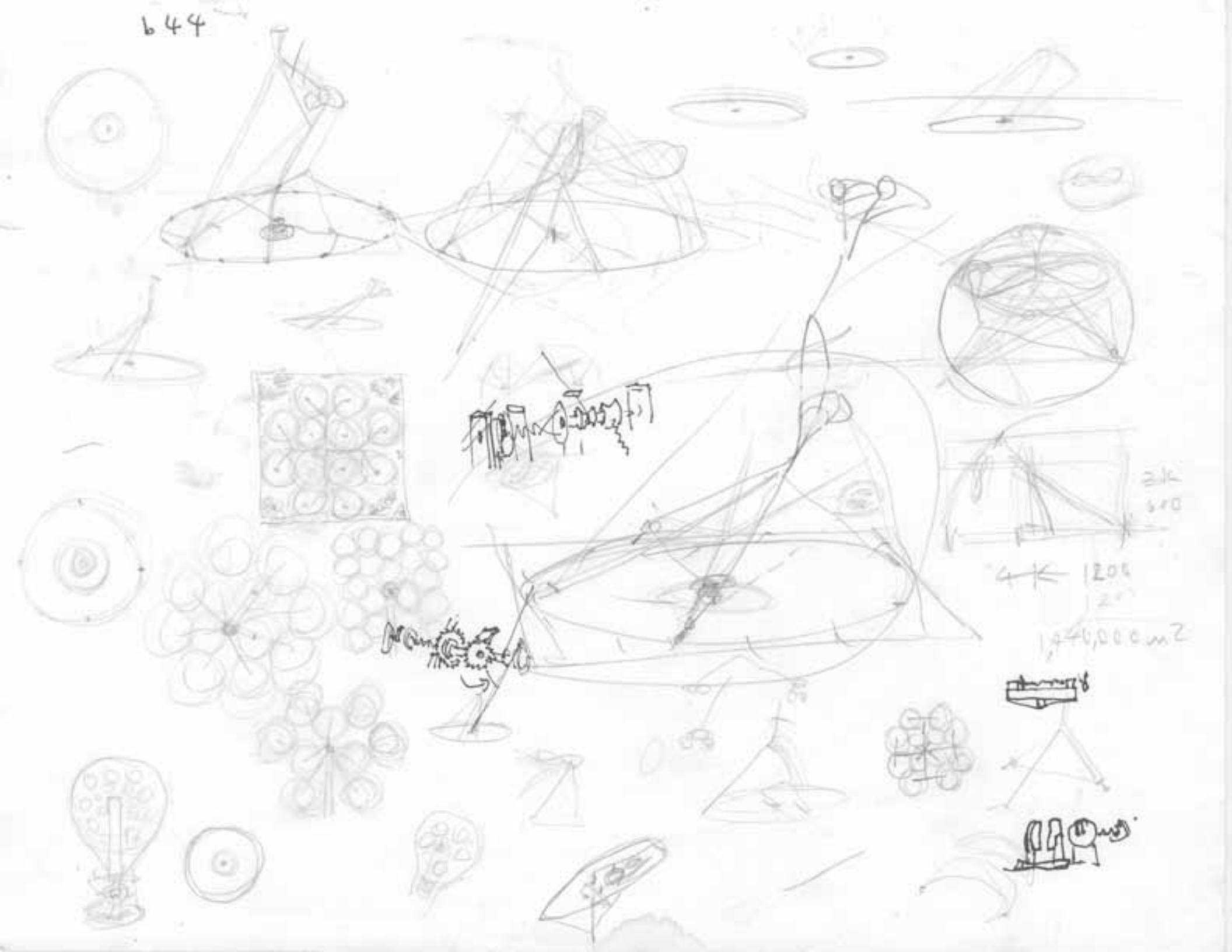



b 41
5 k power
20 k wow
70
kite powered
+ lofted
wifi
handcrank gen
wifi hot spot plane


b 42
3 stick
one

b 43





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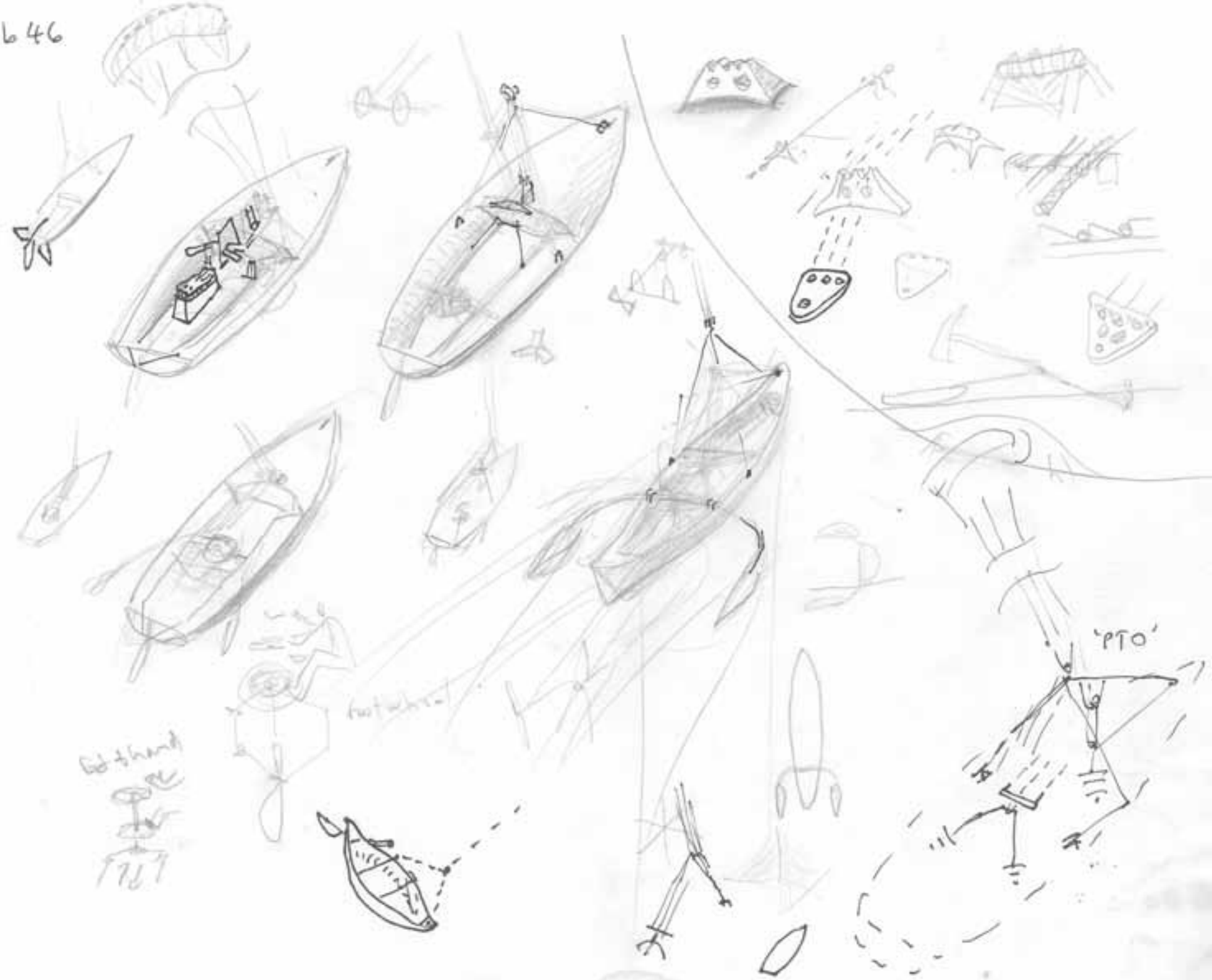
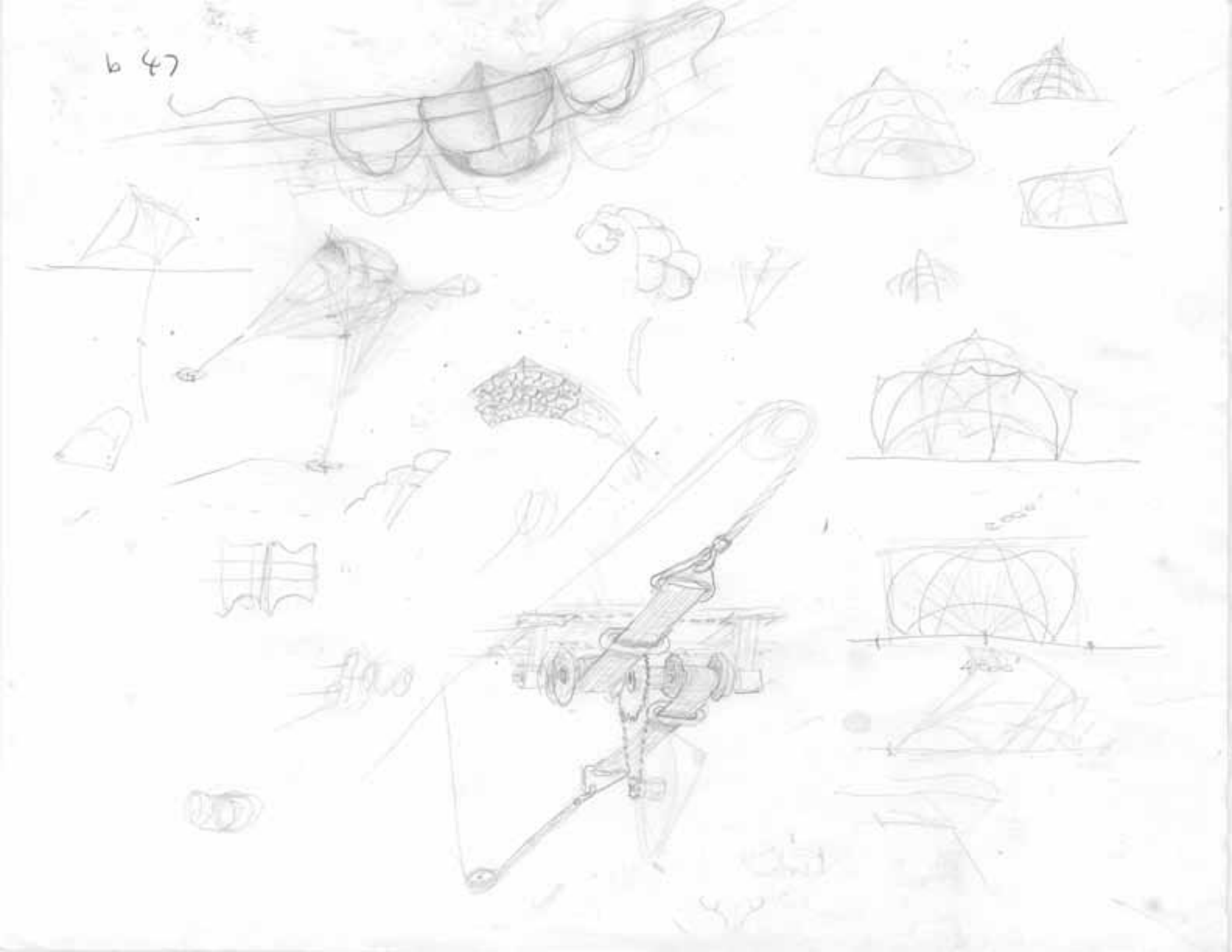
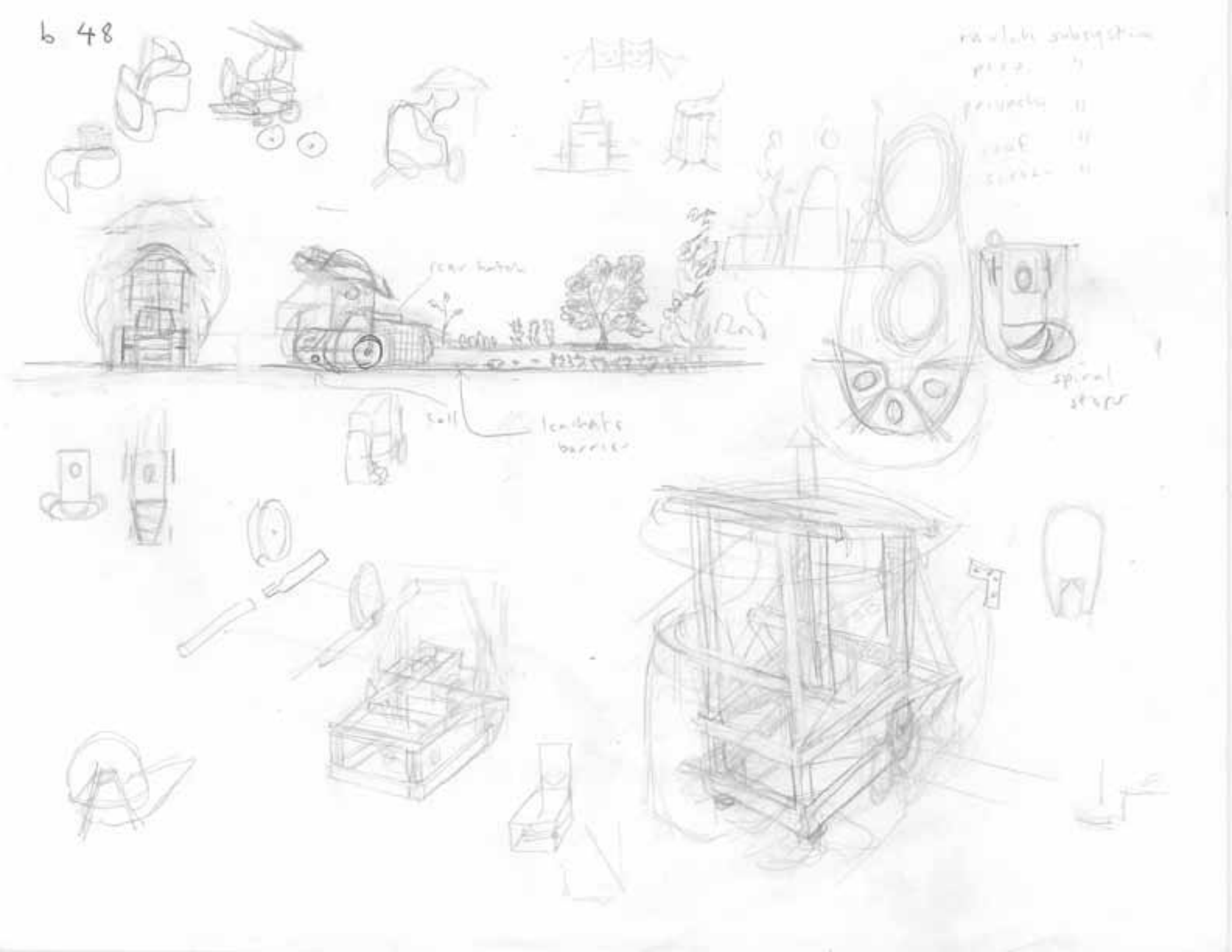
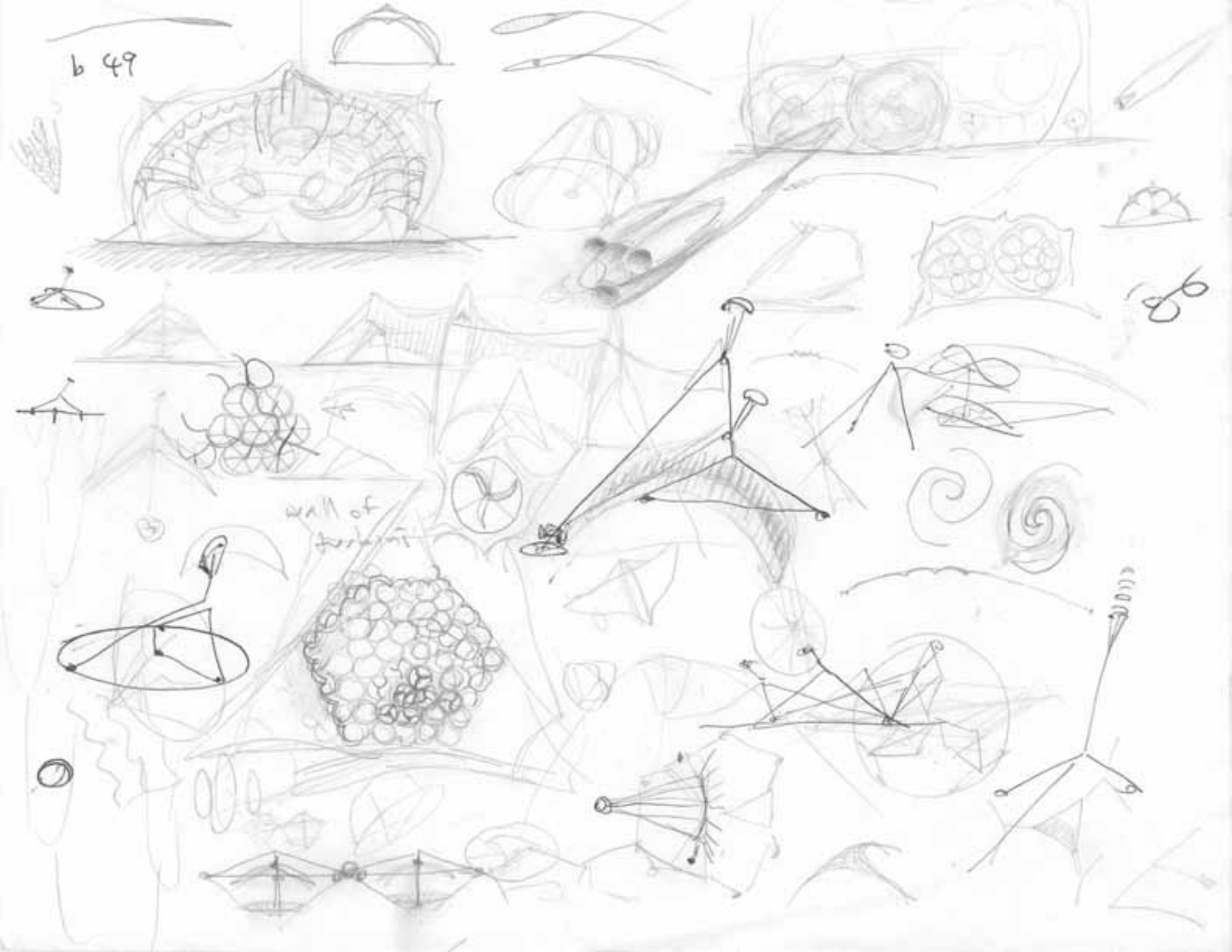

'PTO'

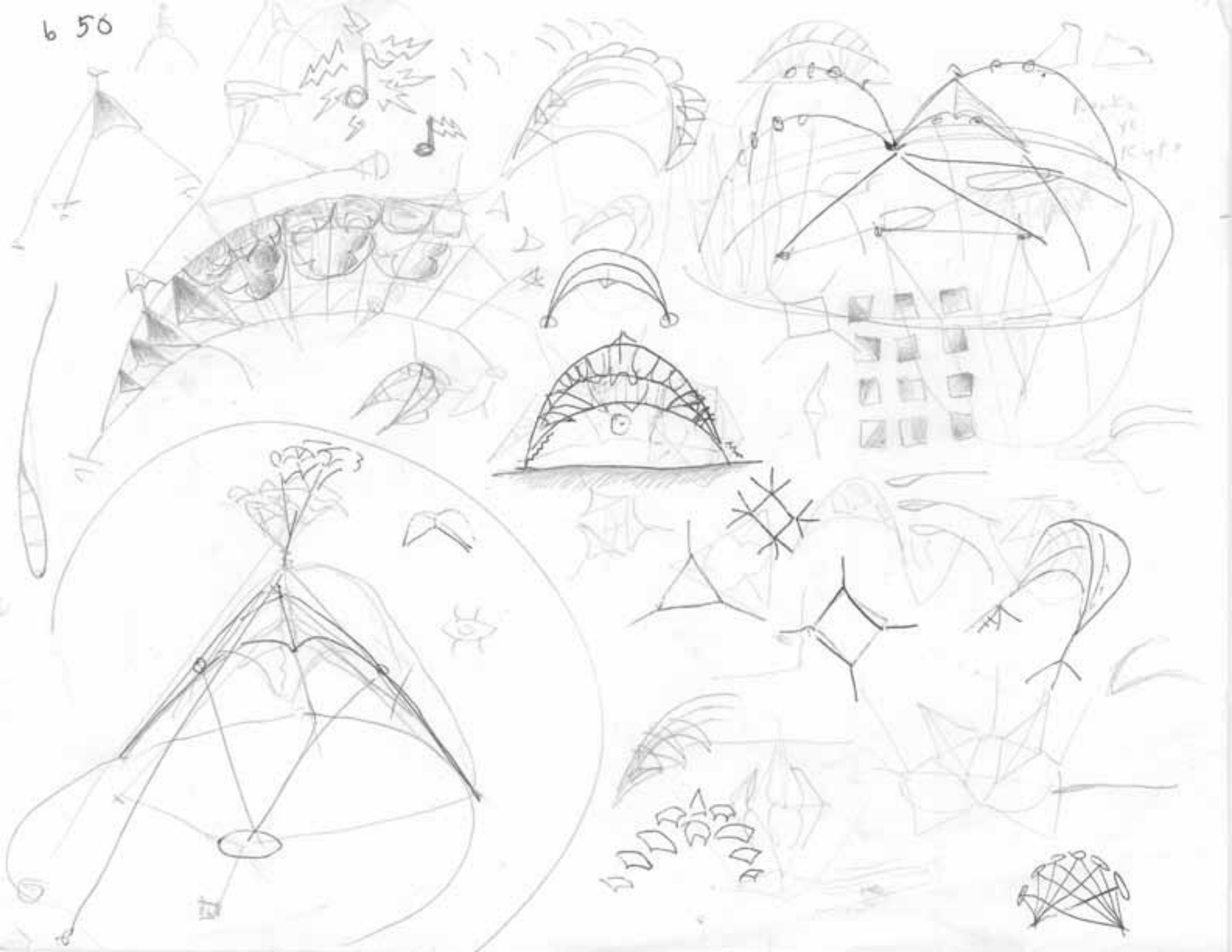
b 47

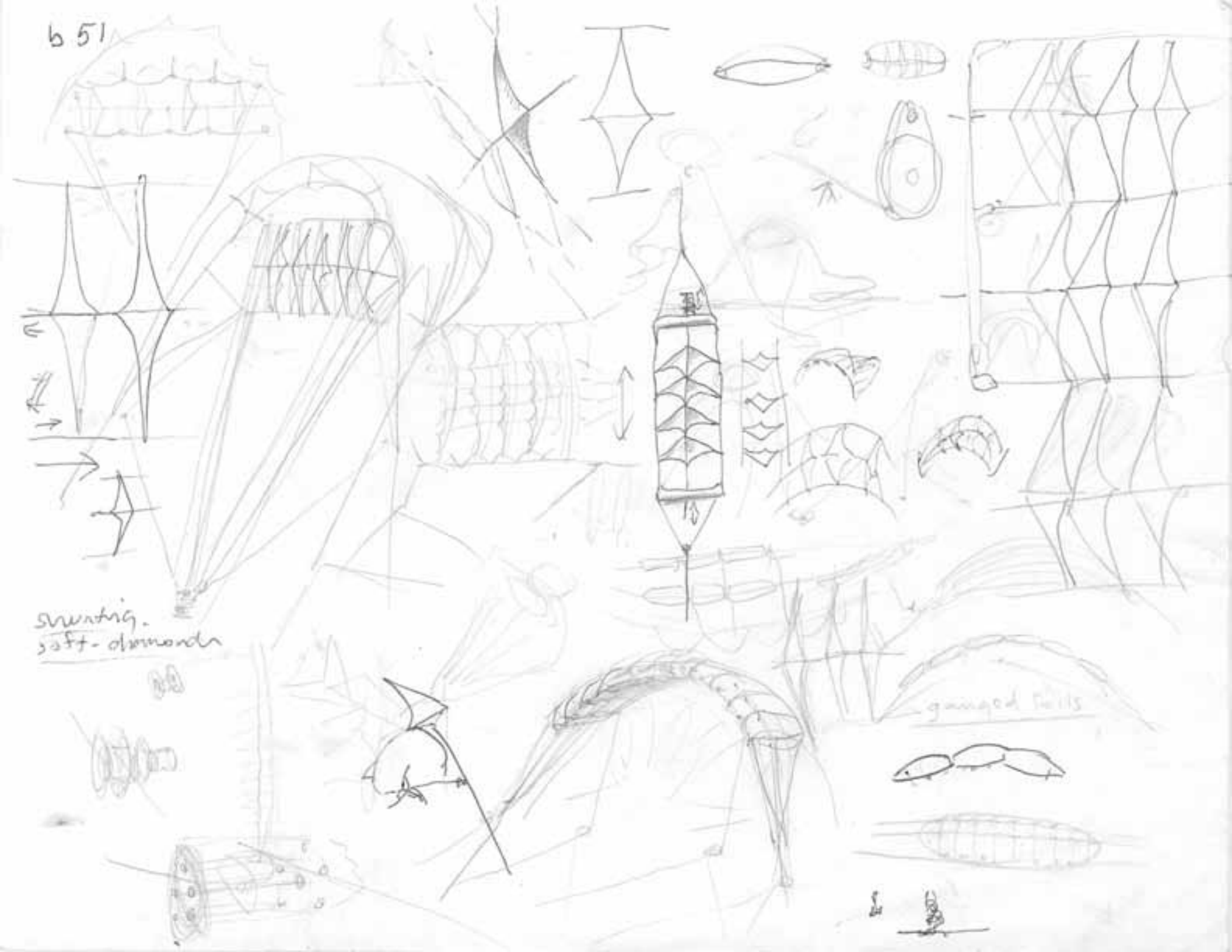


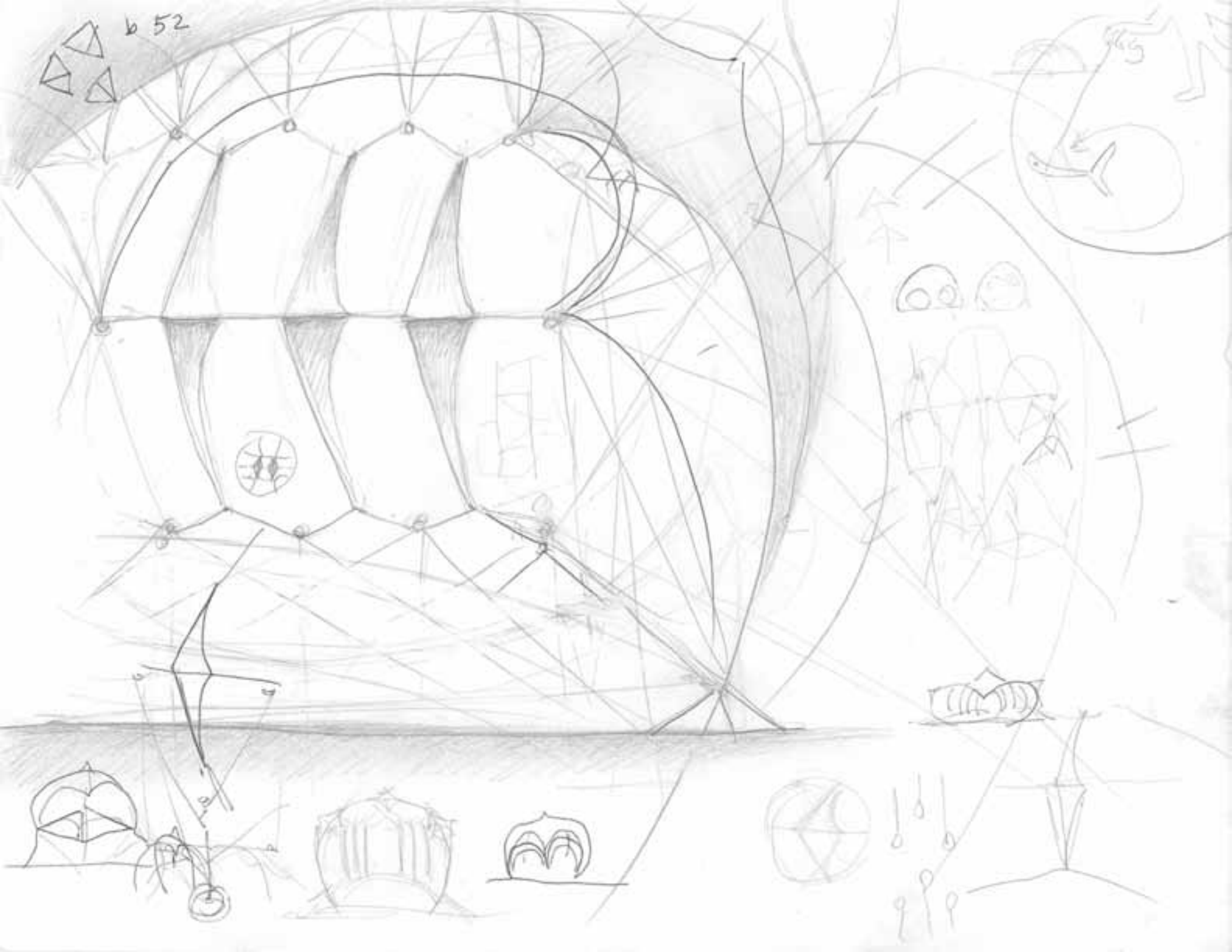
b 48

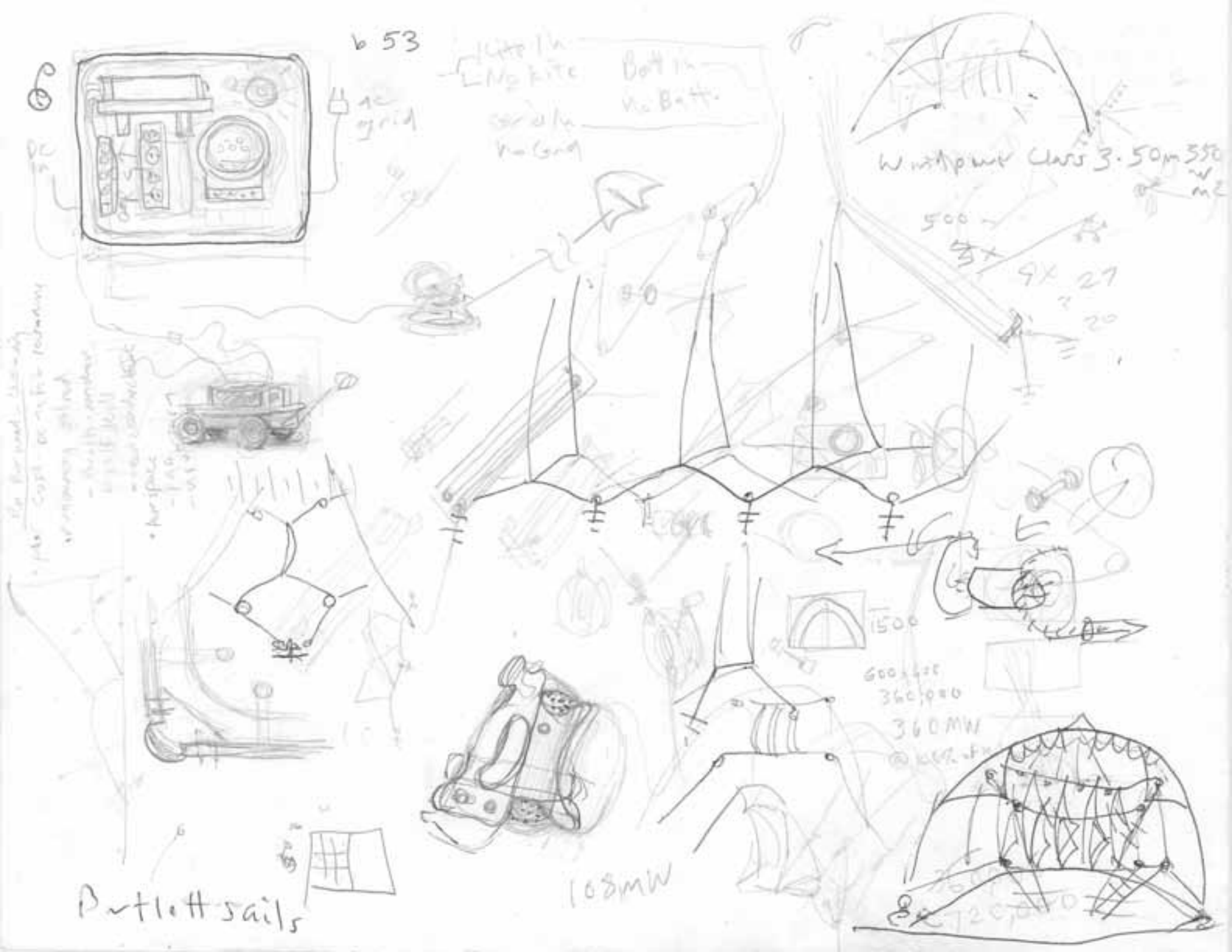


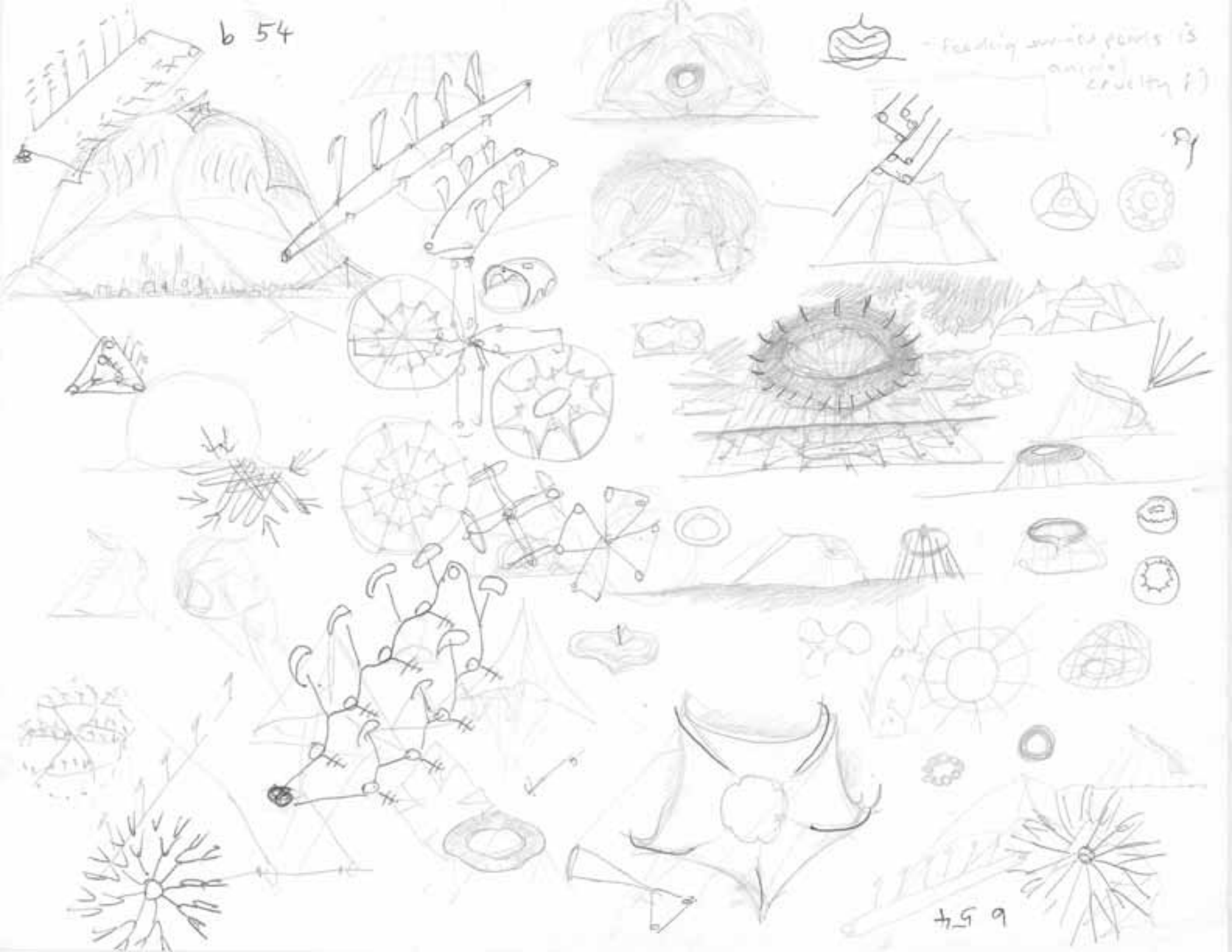

b 49



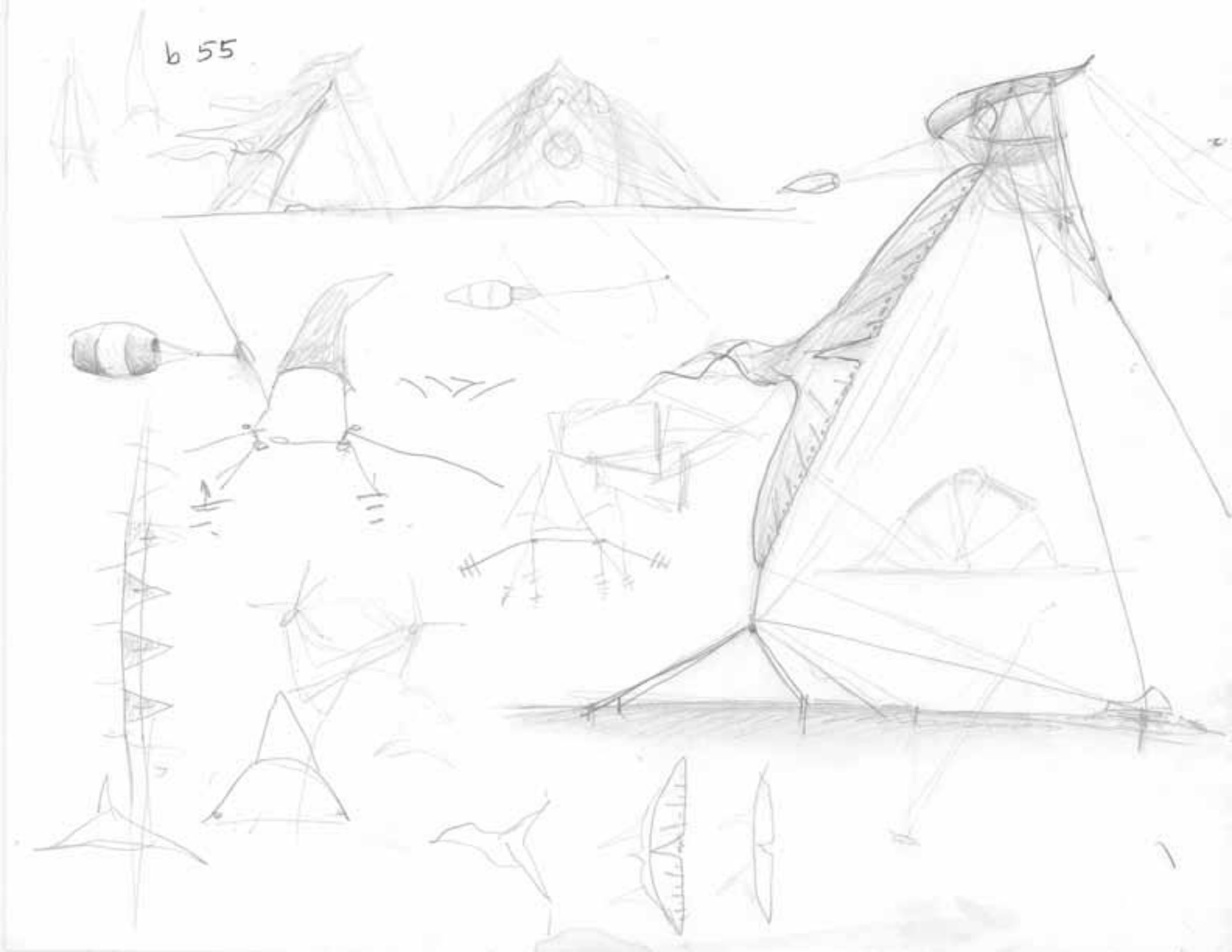

b 51
swirling.
soft - diamonds
gauged tails

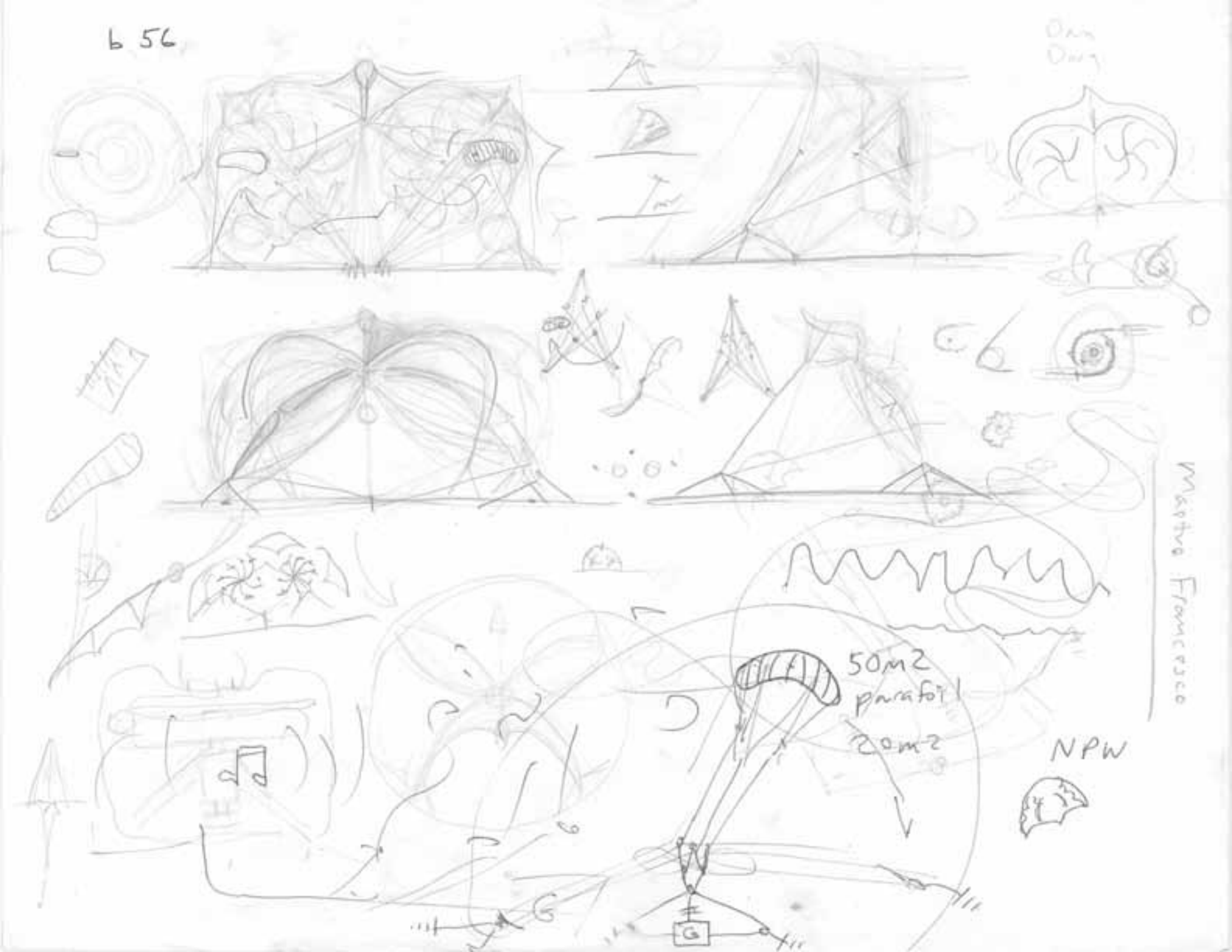

b 52


b 53
ac grid
Windpower Class 3 · 50m 350 W m2
500
9x 27
1500
360,000
360MW
108MW
Bartlett sails

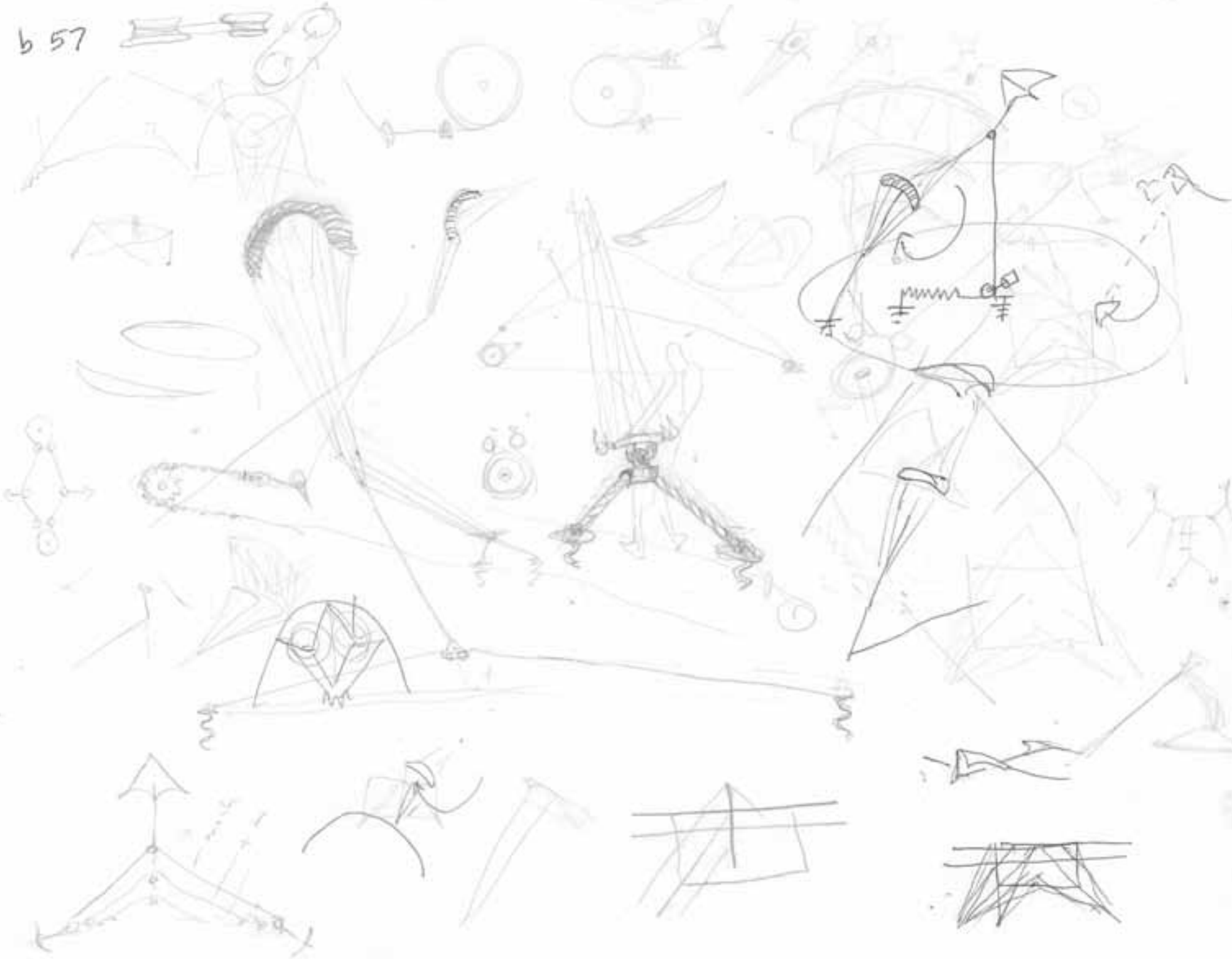

b 54

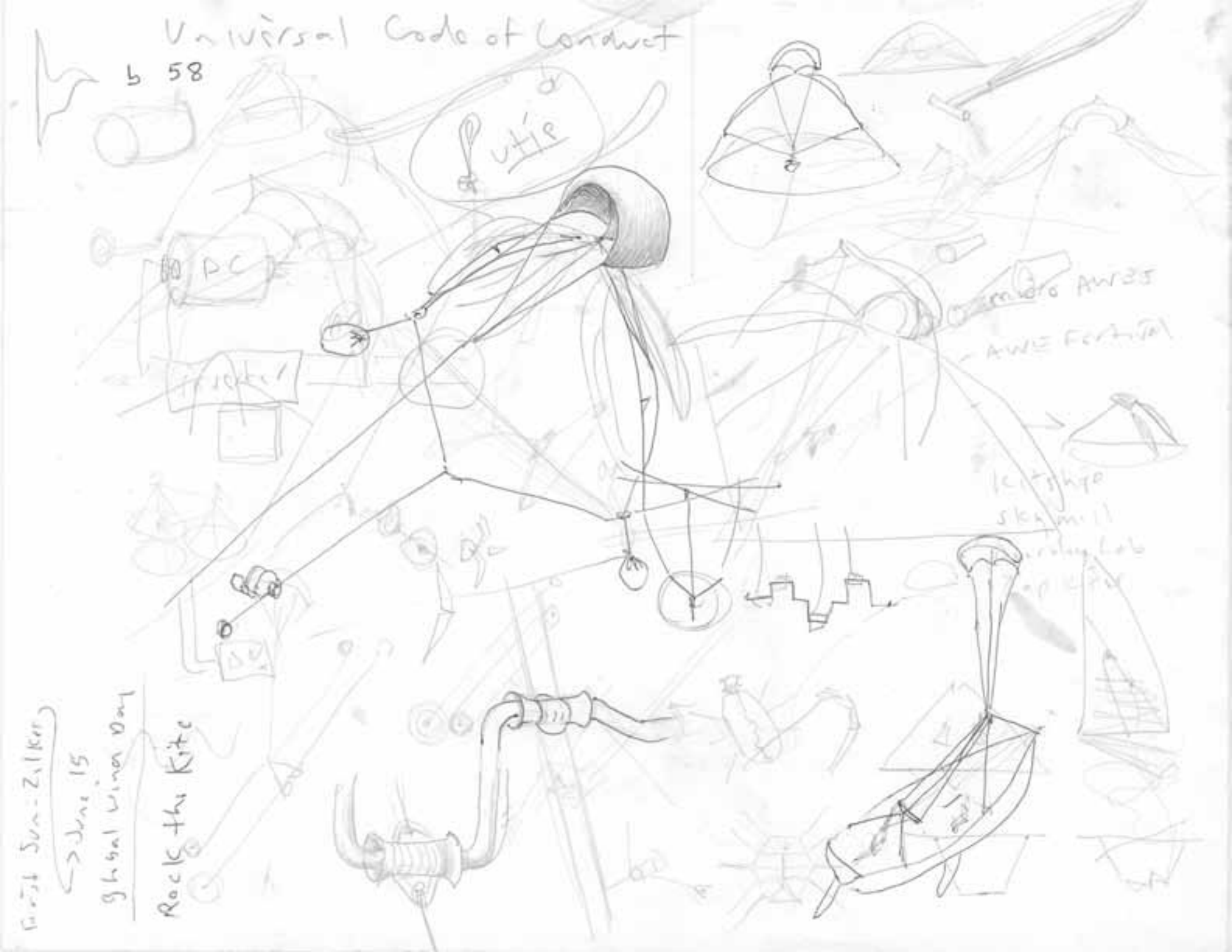
b 55



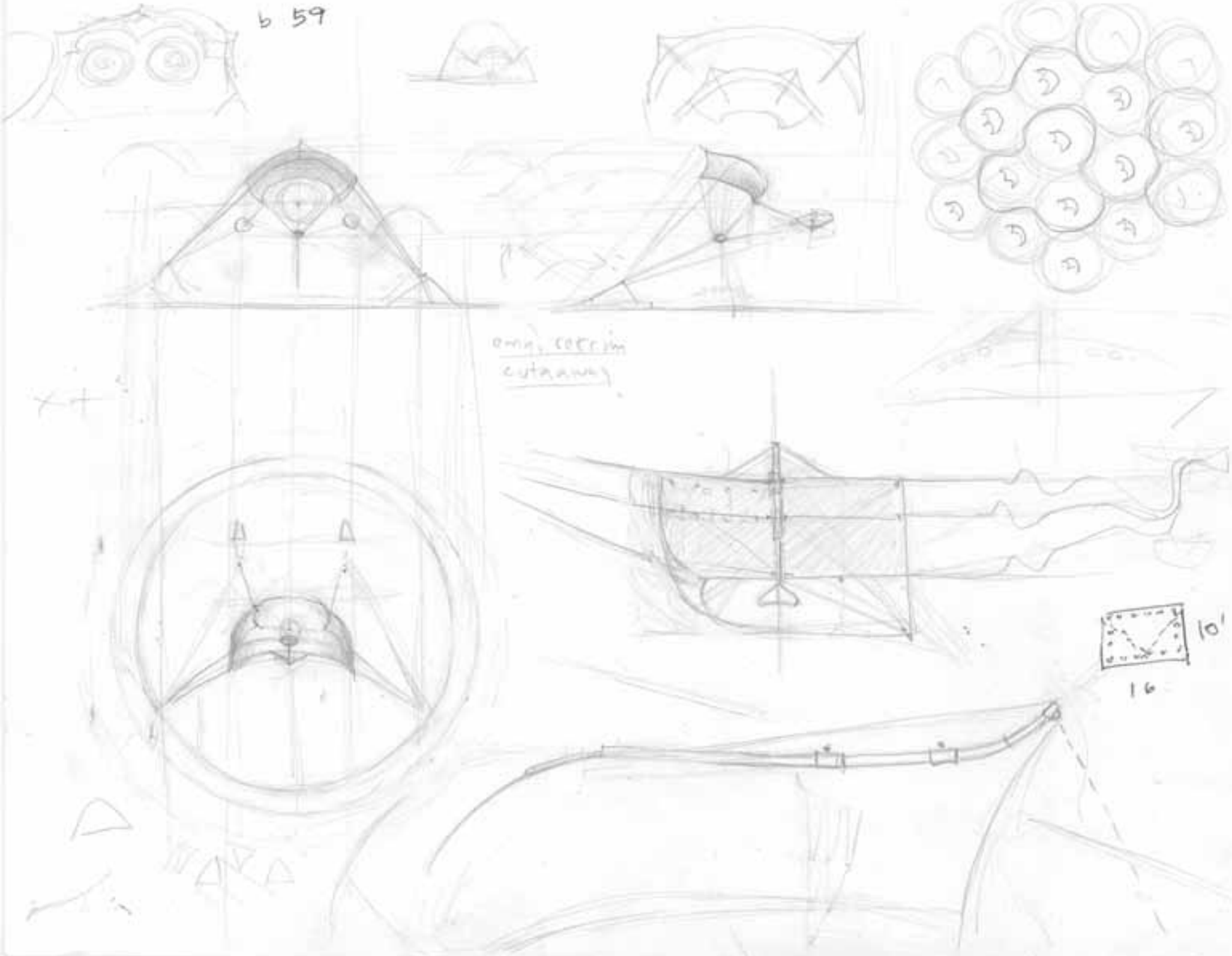

b 56
50m2
parafoil
20m2
NPW
Massimo Francesco

b 57



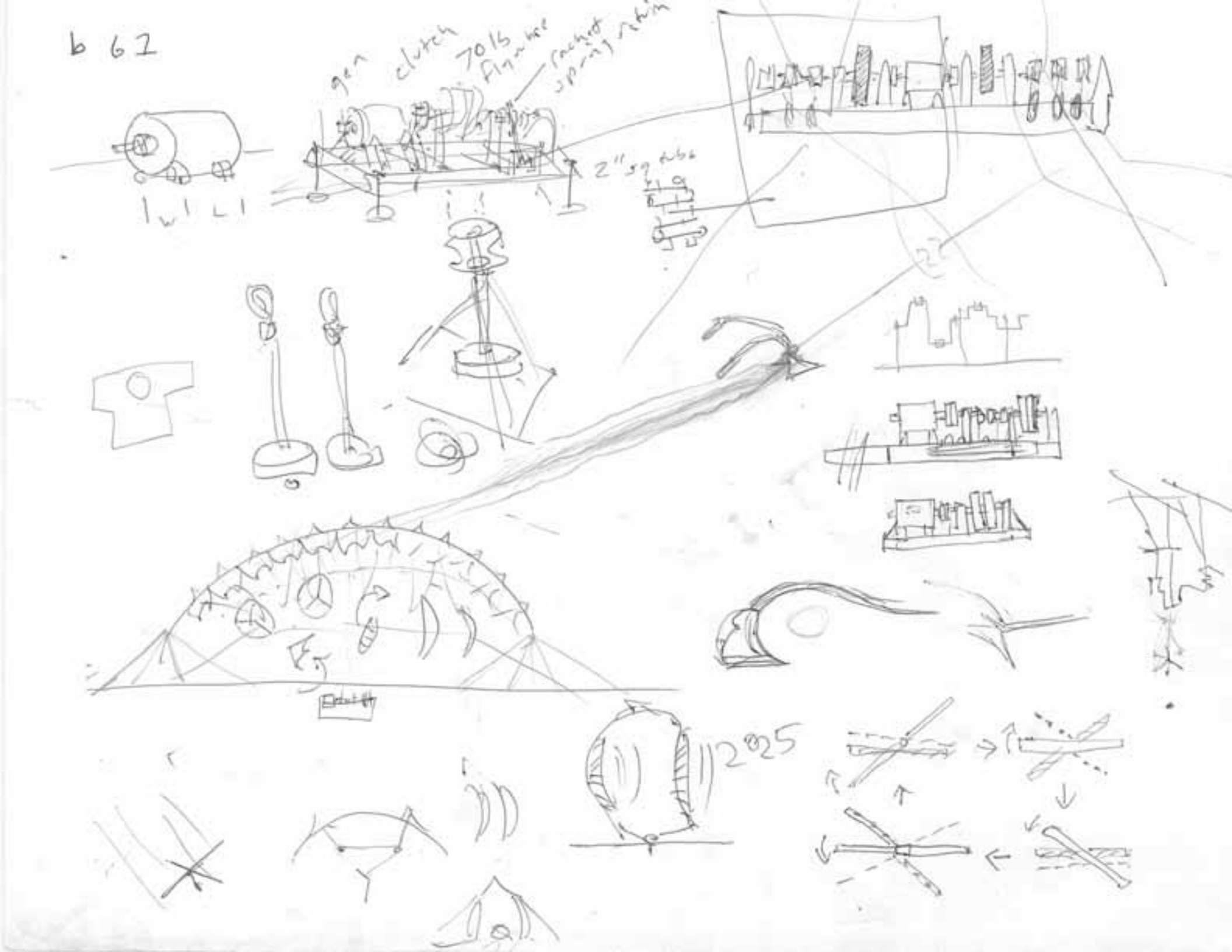

Universal Code of Conduct
5 58
kite
PC
Rock the Kite

b 59



b 60
Grid
Grid Tie
Inverter

b 61

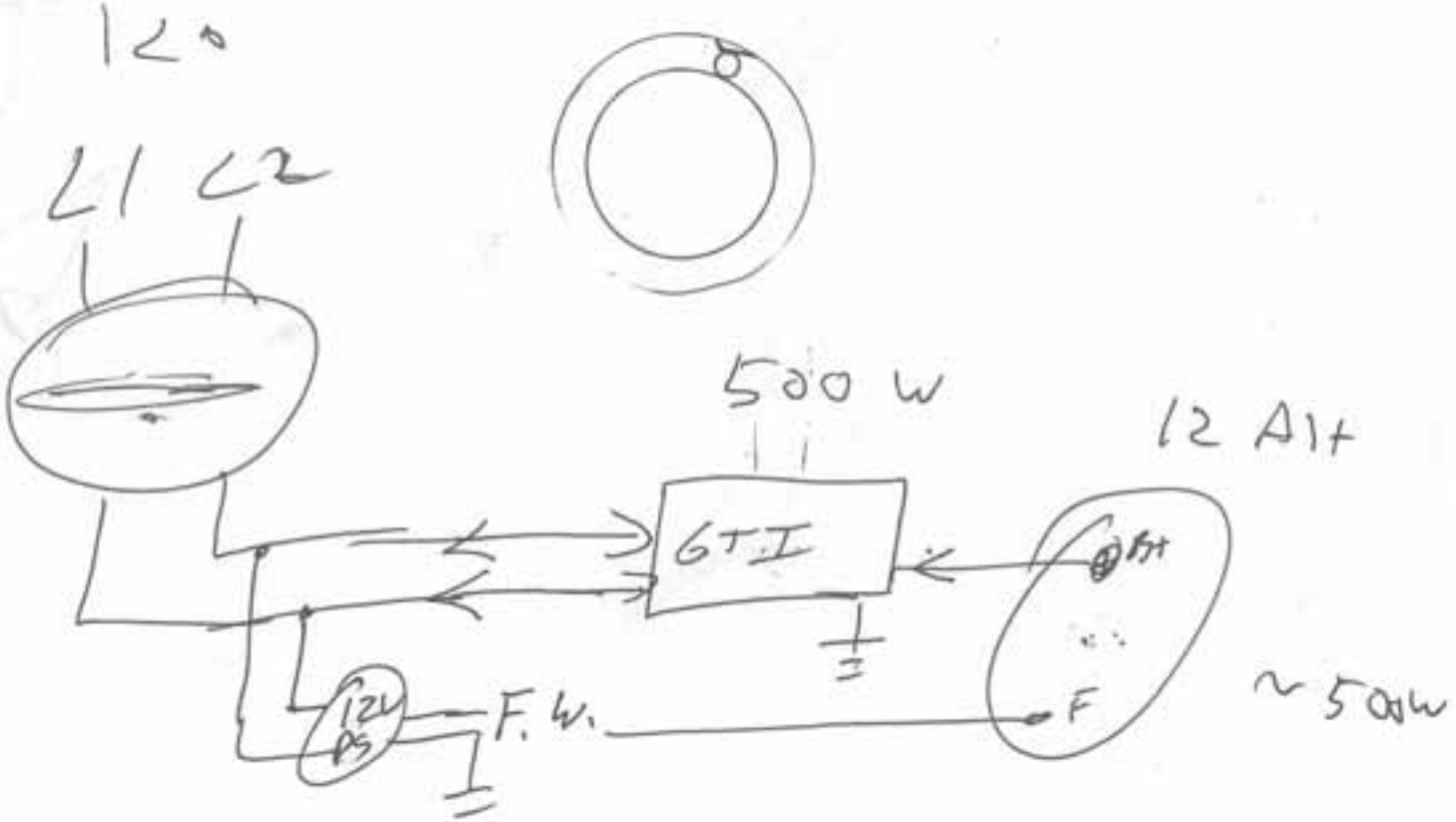


grid tie inverter for wind

12V power meter

12V alternator

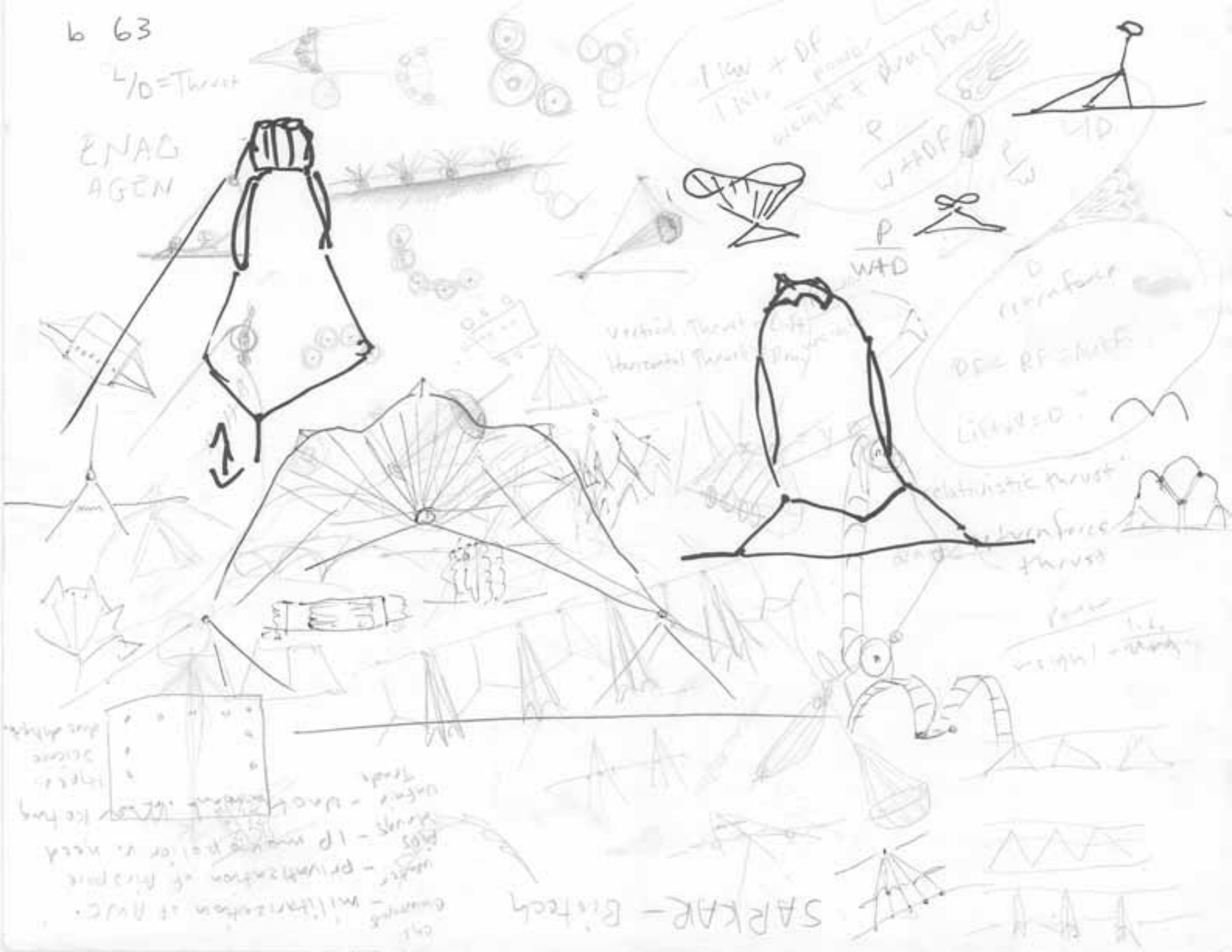
12V ~~primary battery~~ exciter



b 63

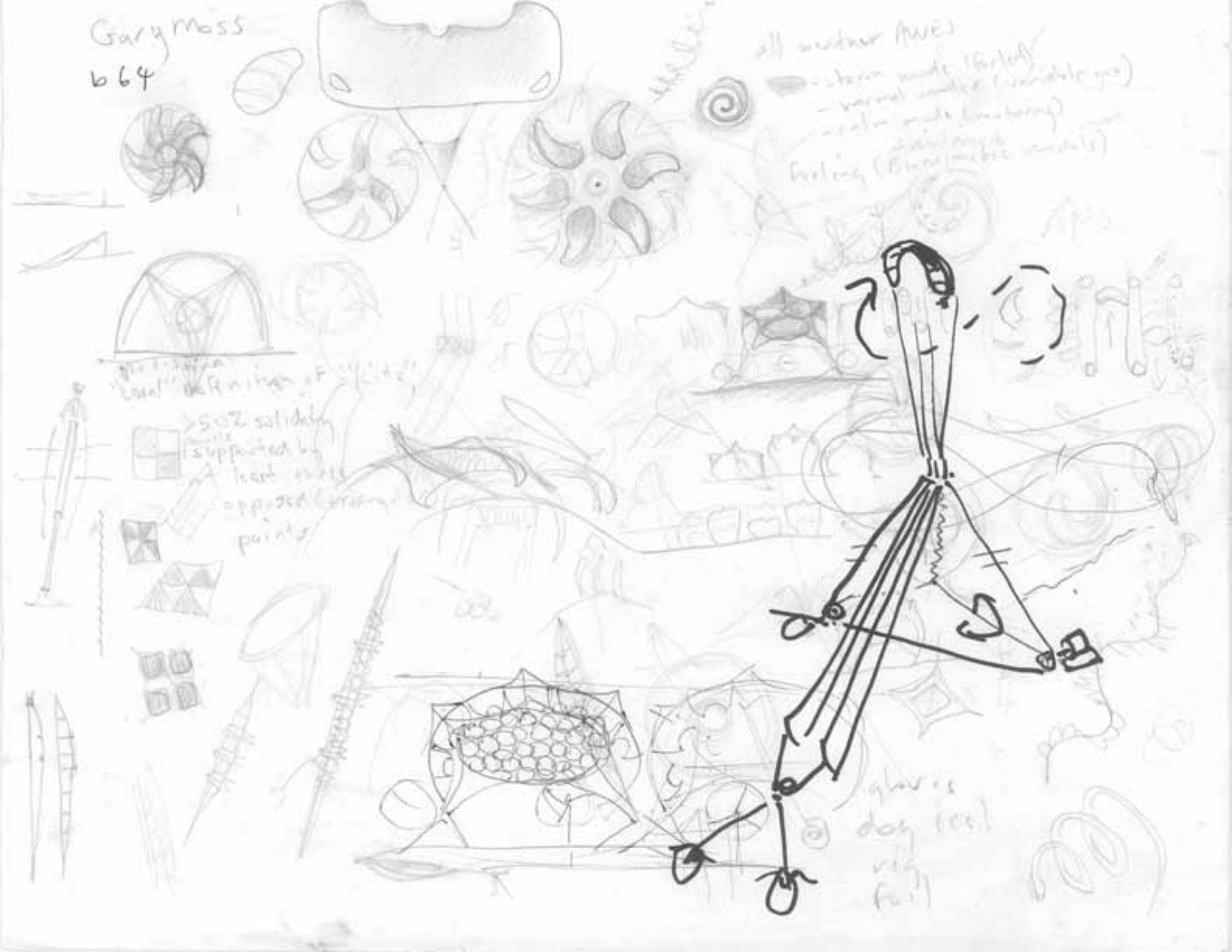
L/D = Thrust

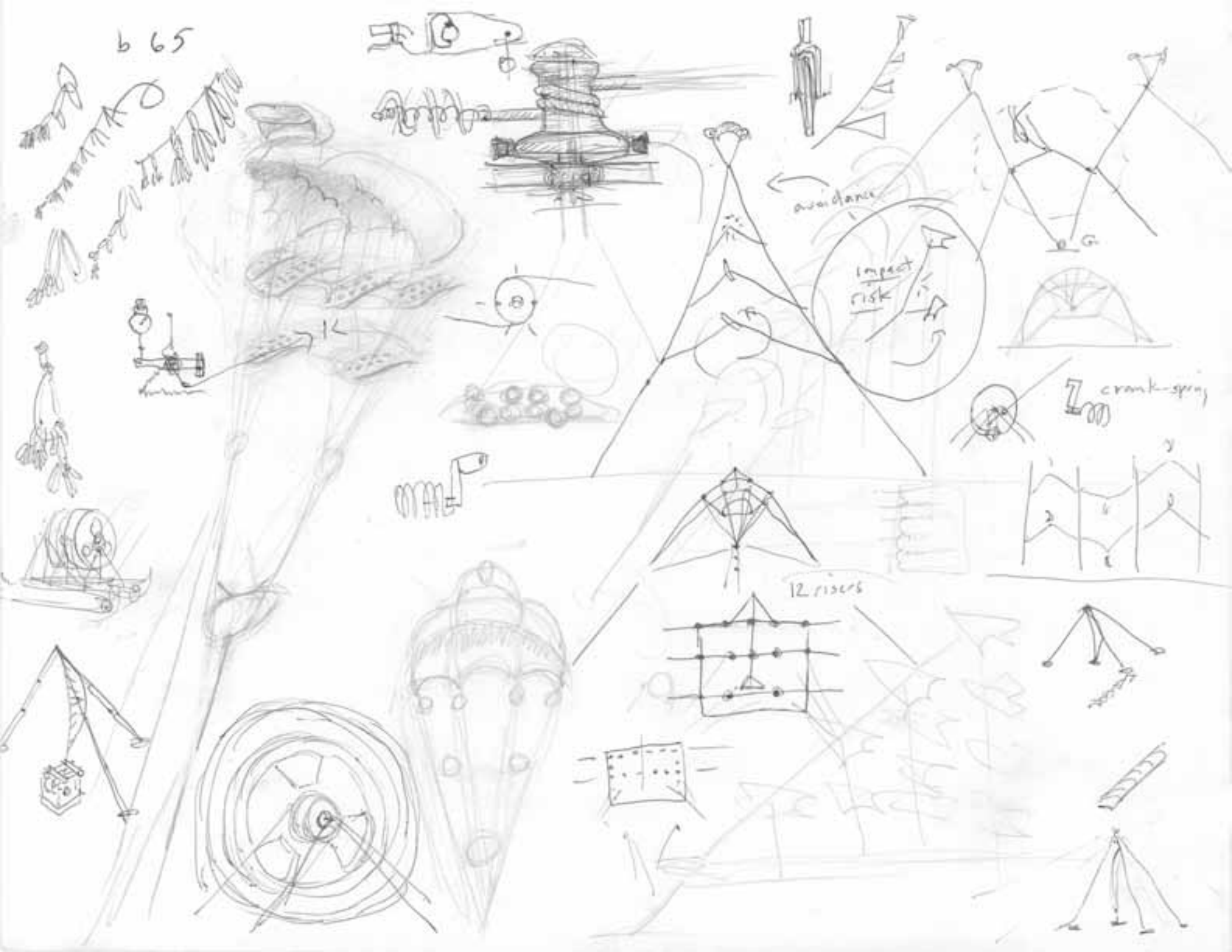
ENAG
AGEN



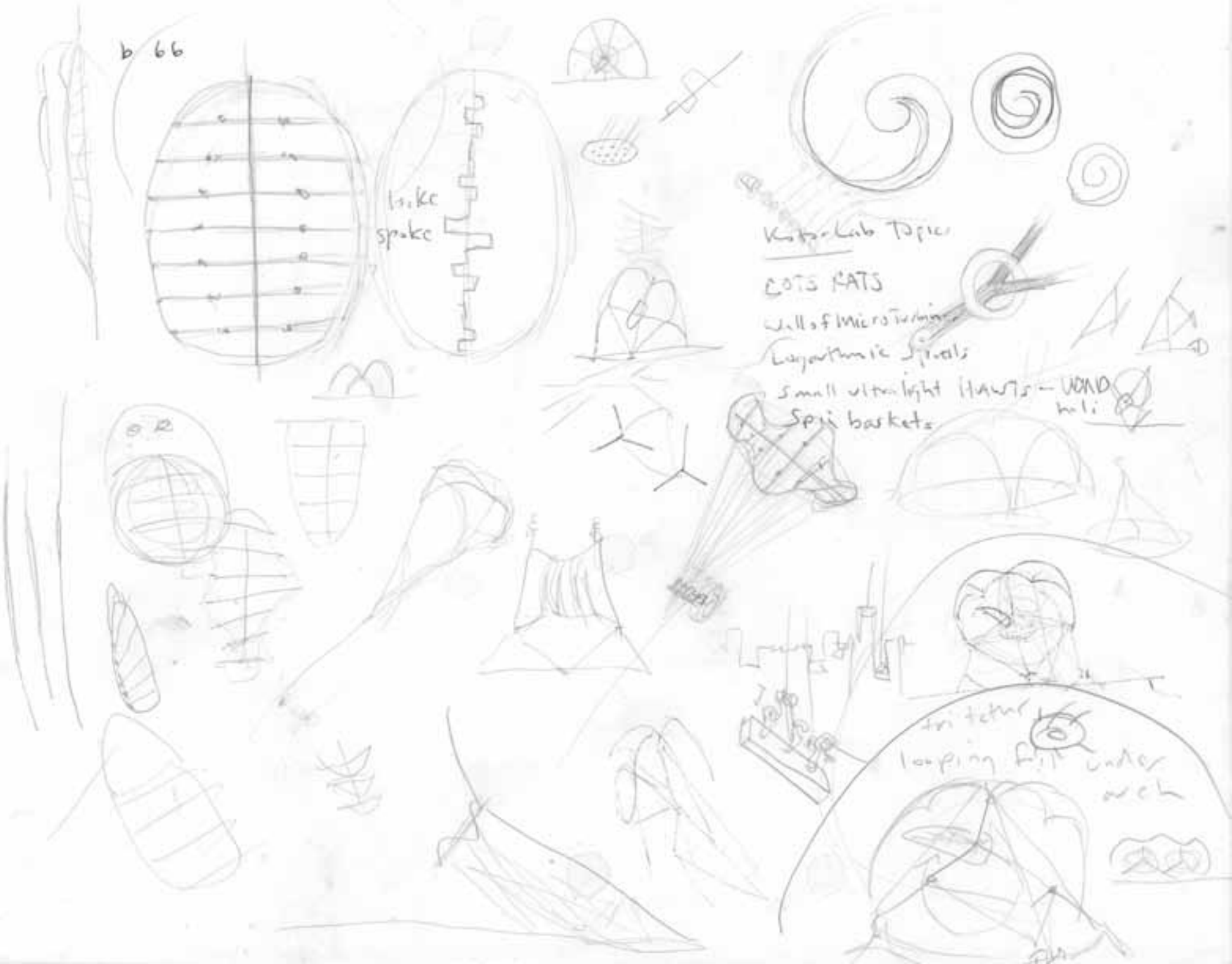
Gary Moss

b64




b 65
avoidance
impact risk
crank-spring
12 risers

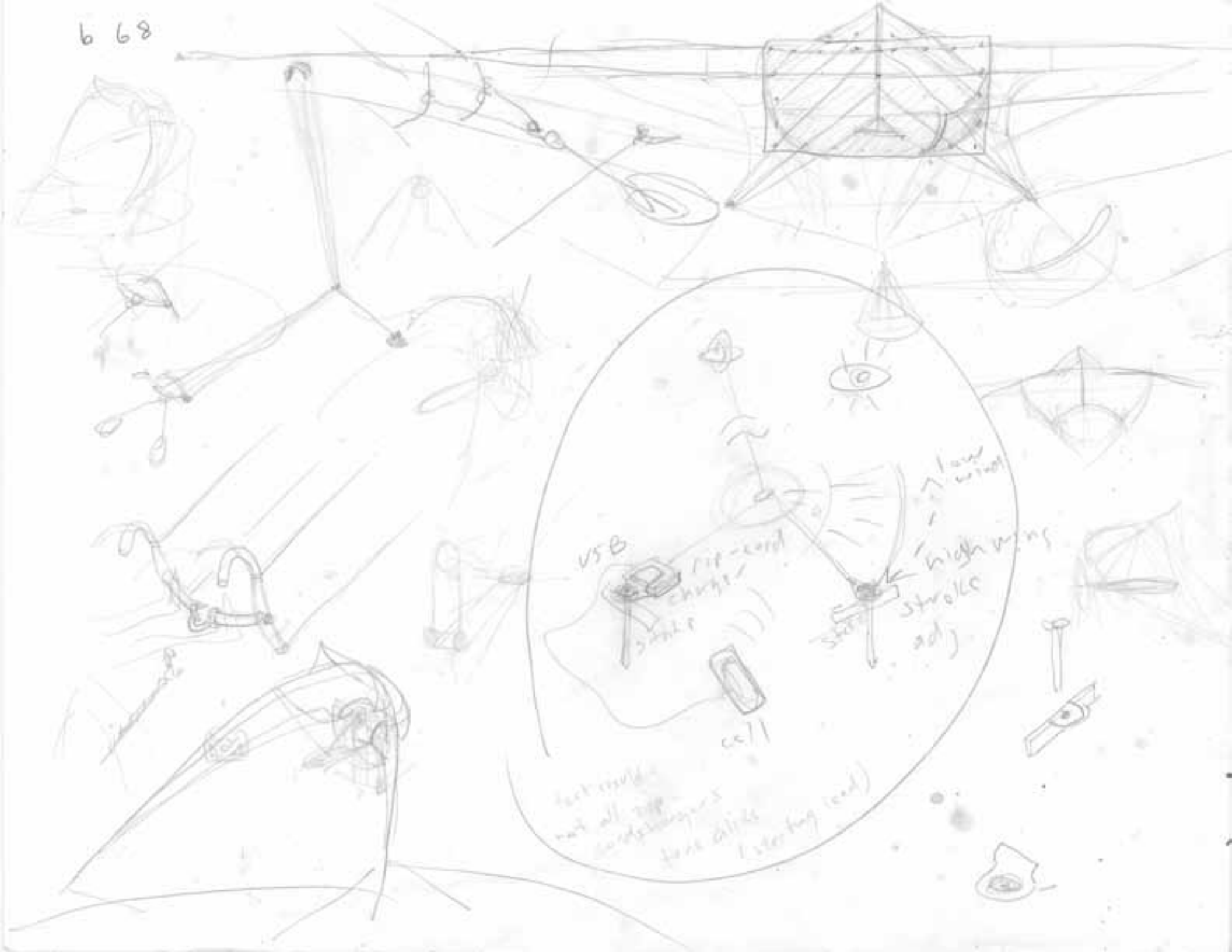
b 66



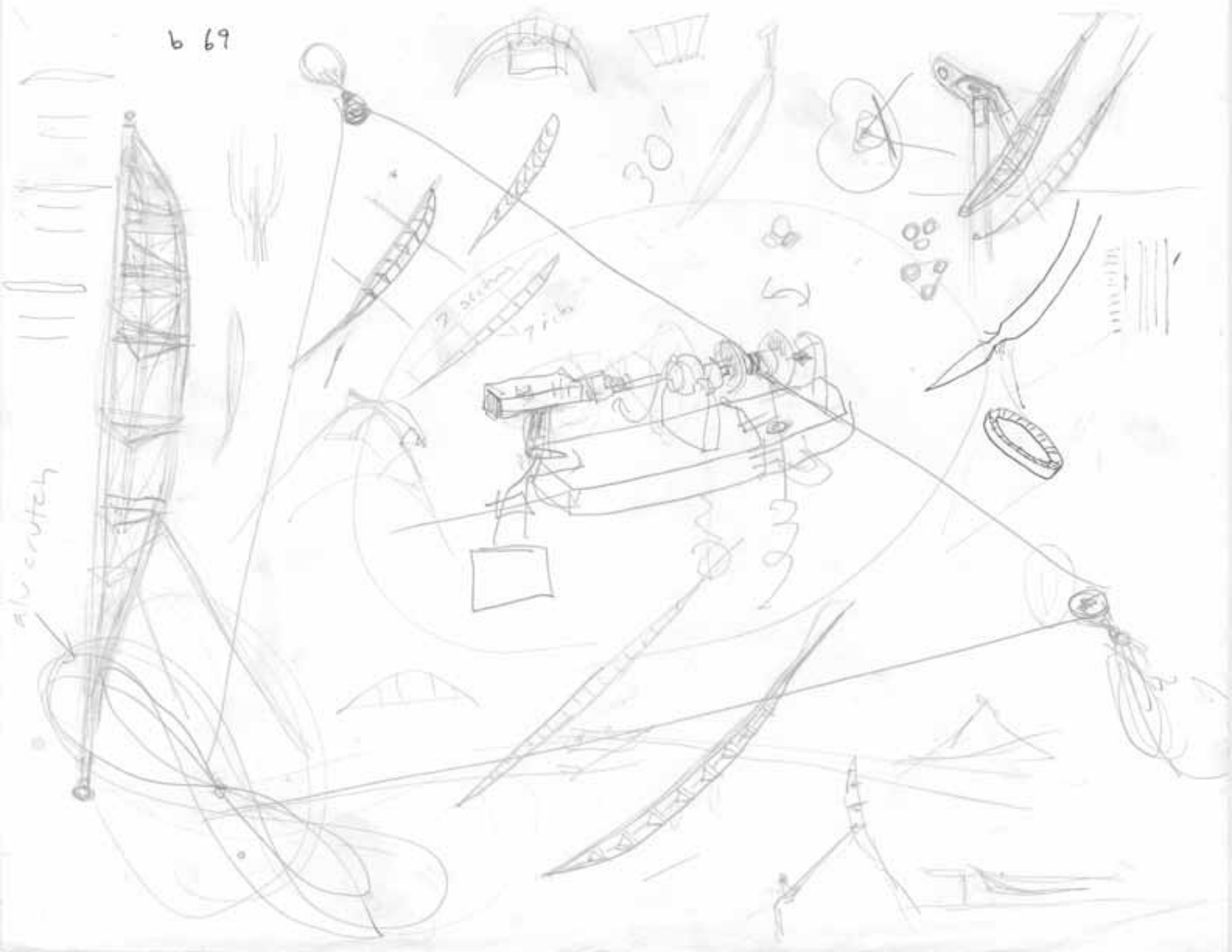
Kotor Lab Topics
COTS RATS
Wall of Micro Turbines
Logarithmic Spirals
Small ultralight HAWTs – UAND
Spin baskets
tri tether
looping fall under
arch

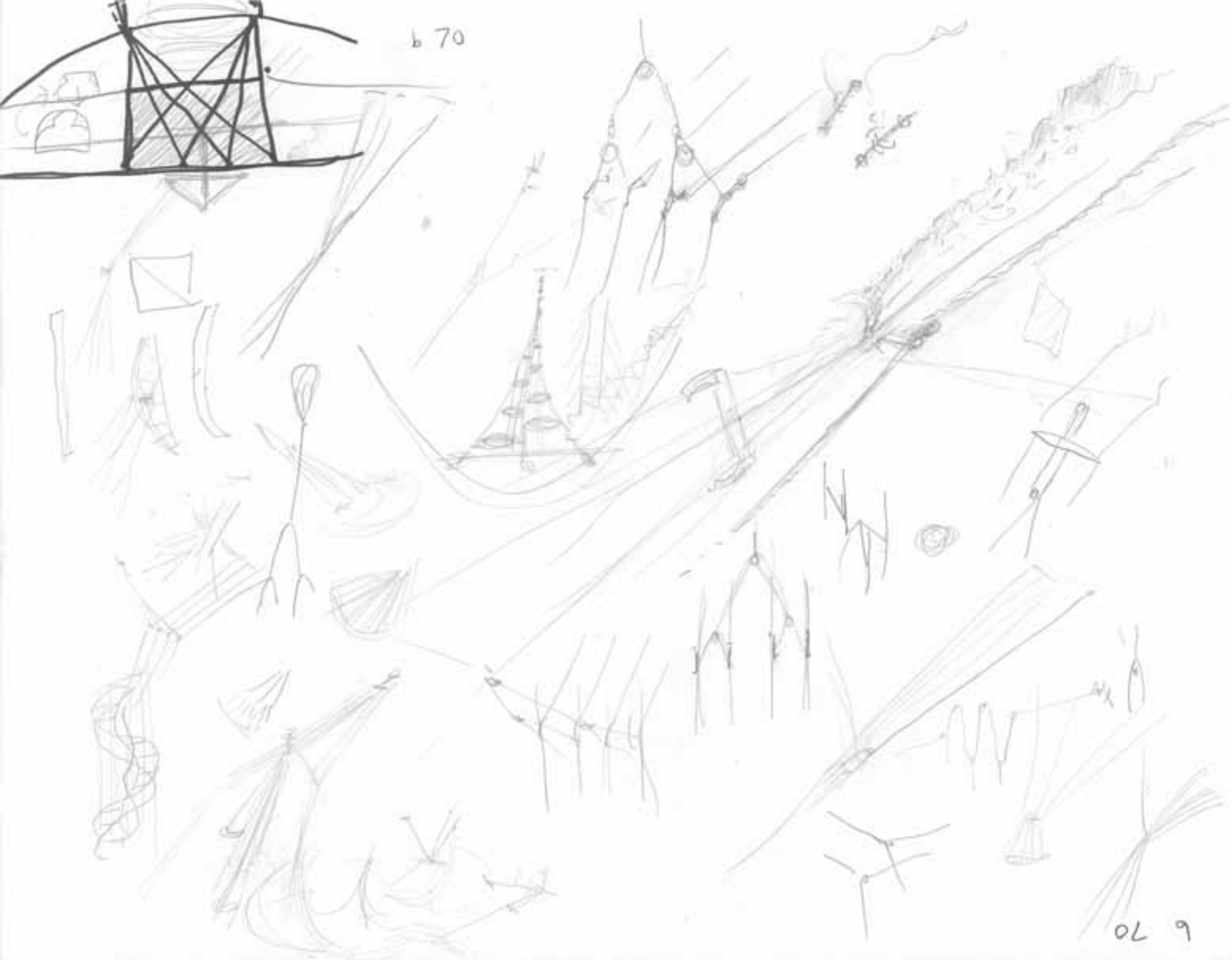
b 67

Kite Pirates of the Golden Triangle


USB
rip-cord
charger
stroke
low wind
high wing
stroke
adj
cell

b 69

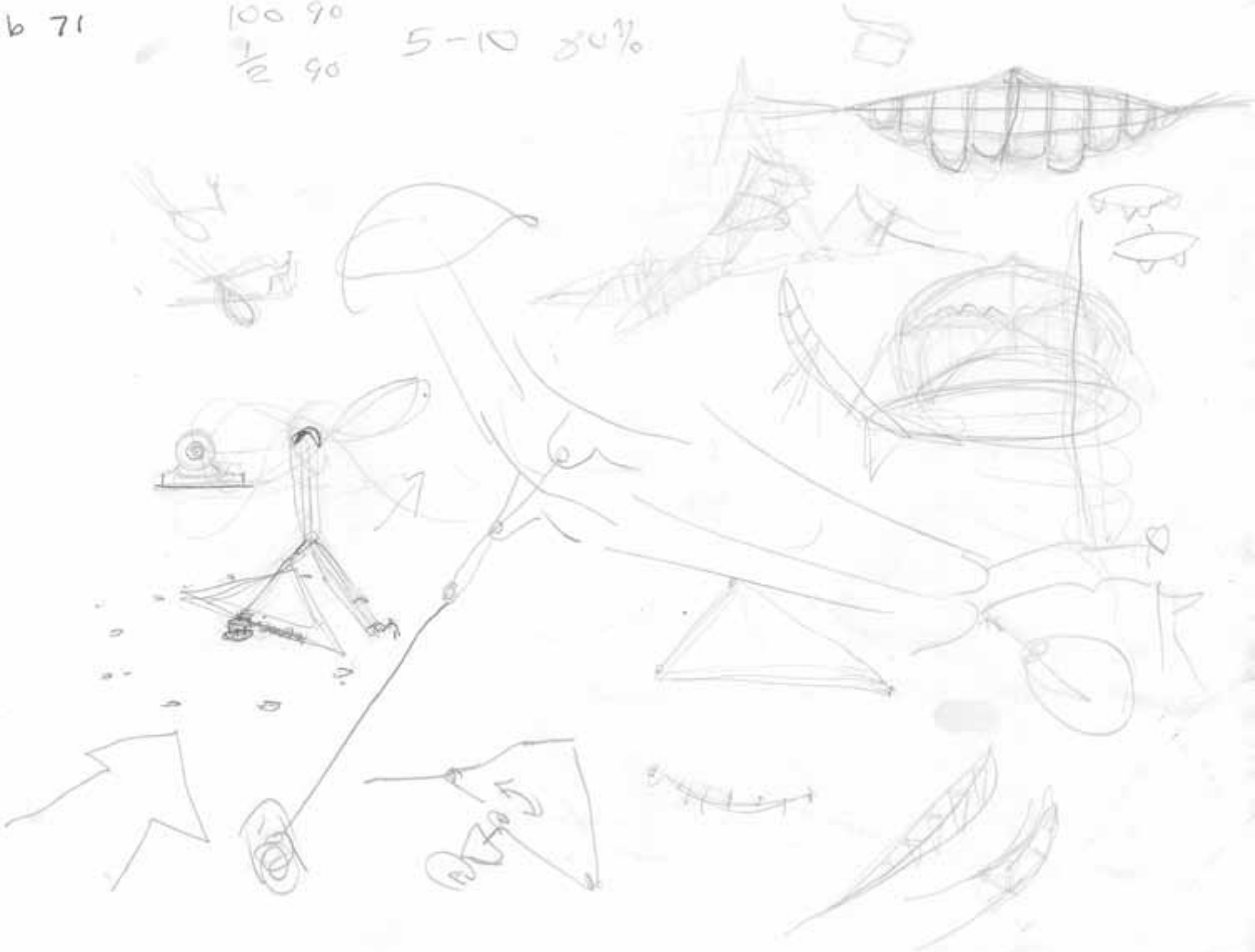


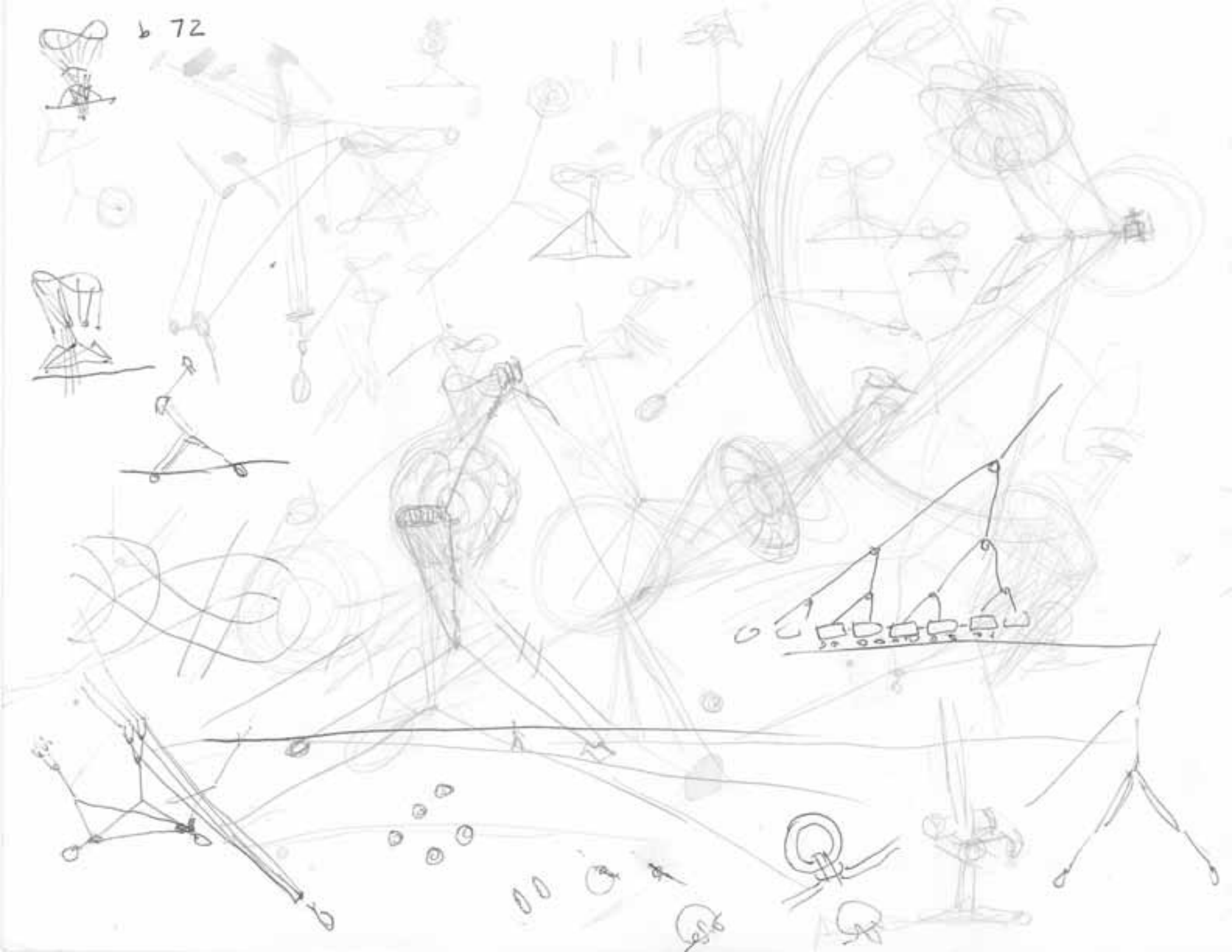

b 70
OL 9

b 71

100 90
½ 90

5-10 30%

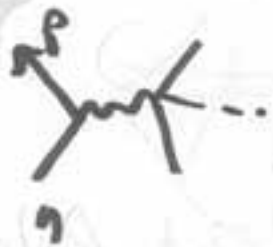



b 72

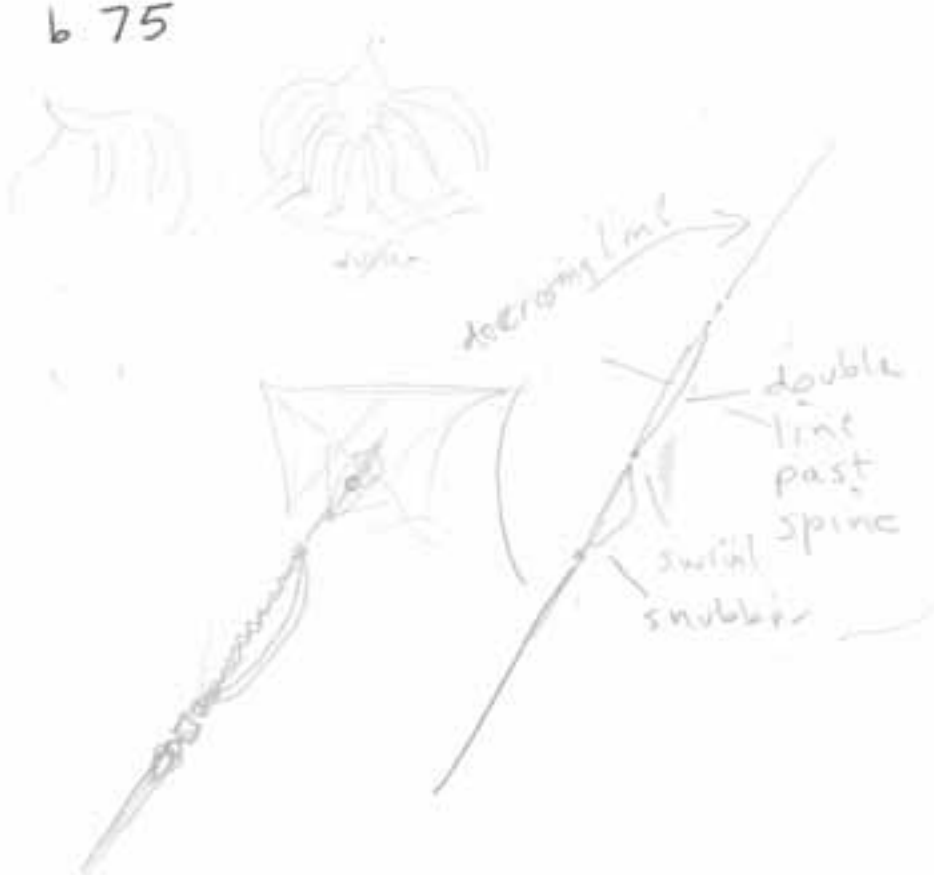
b 73

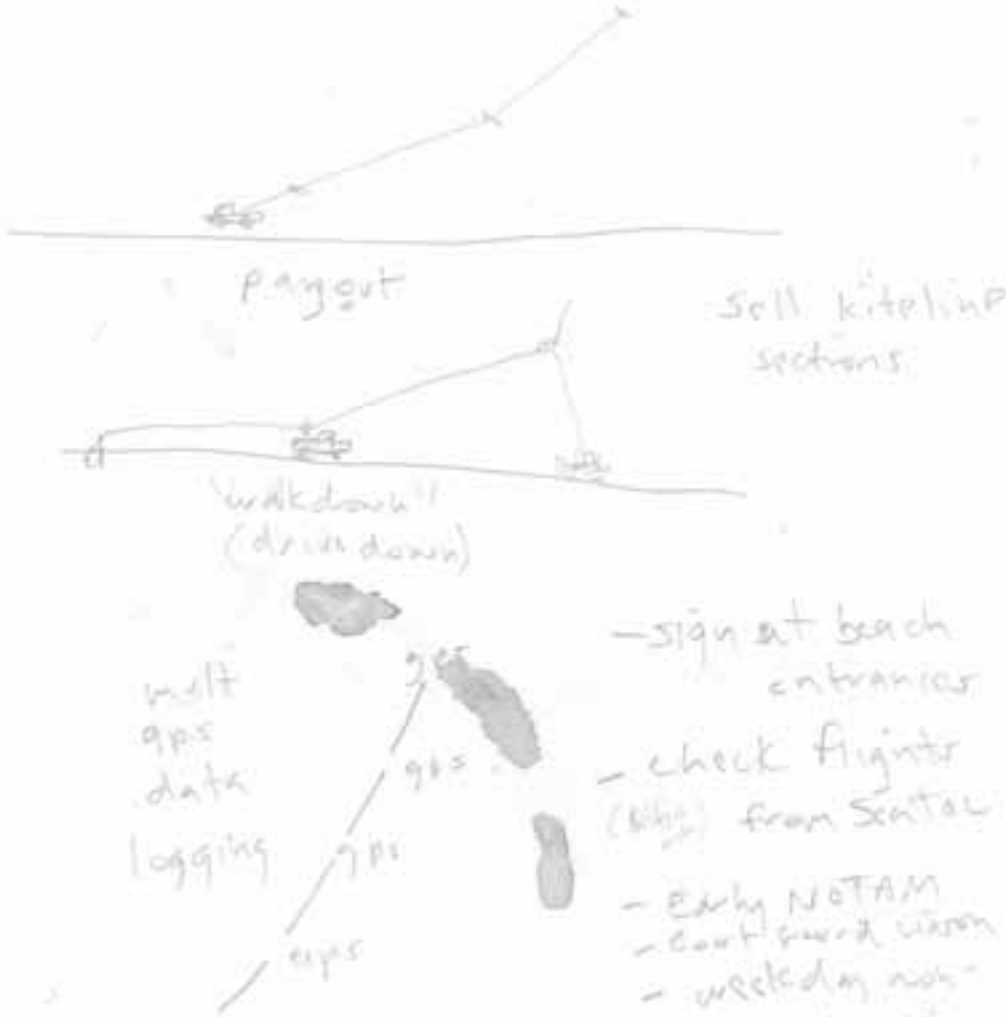
nano	monoatomic	graphene
	poly layered	nanotube riptstop
micro		nanotube bead
	anthro	
meso		natural width of woven tarp
		rope loadpath
macro		↓
		cascabe
mega		ship hawser
cosmic		

b 74
phonograviton



b 75

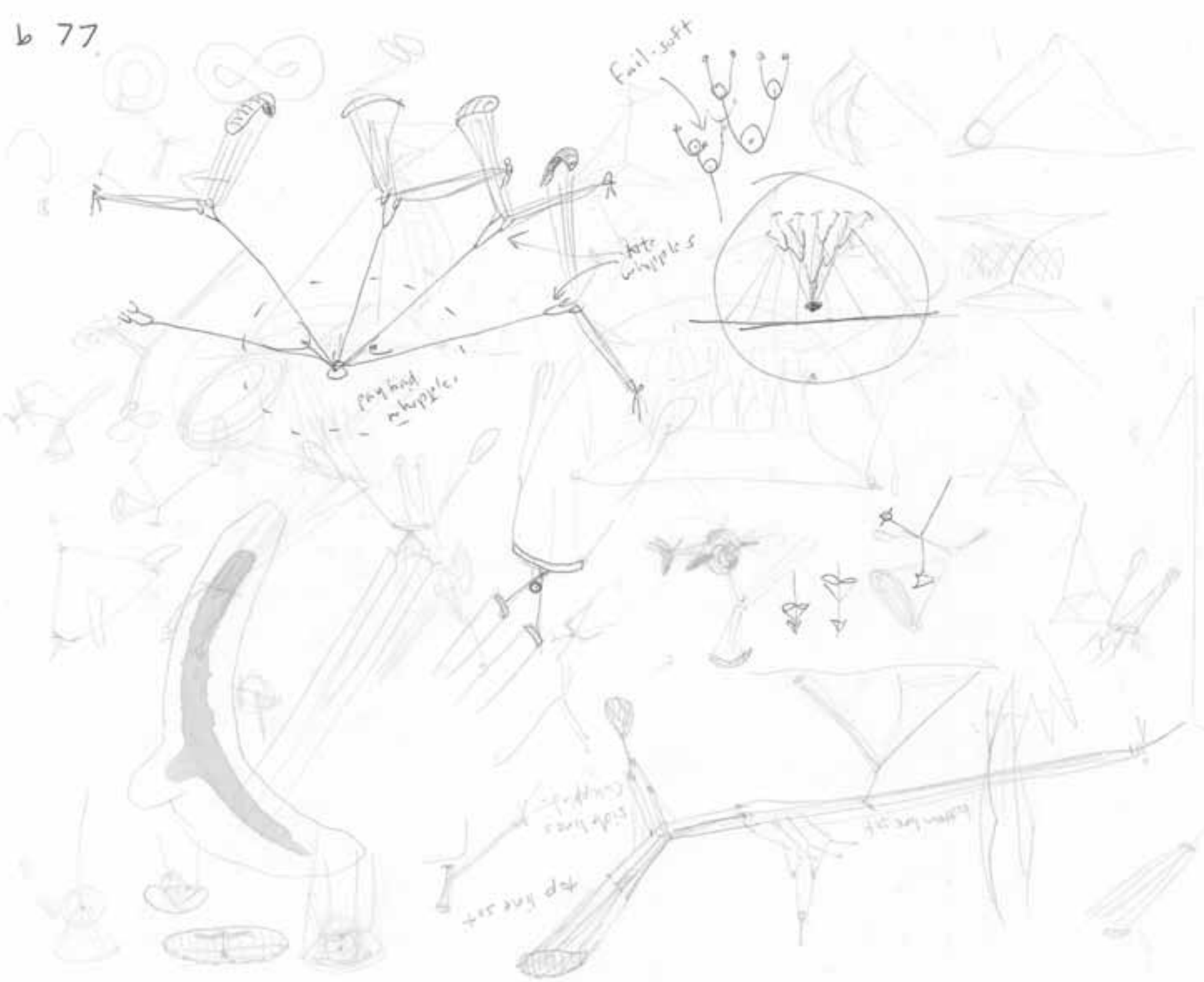




chase crew

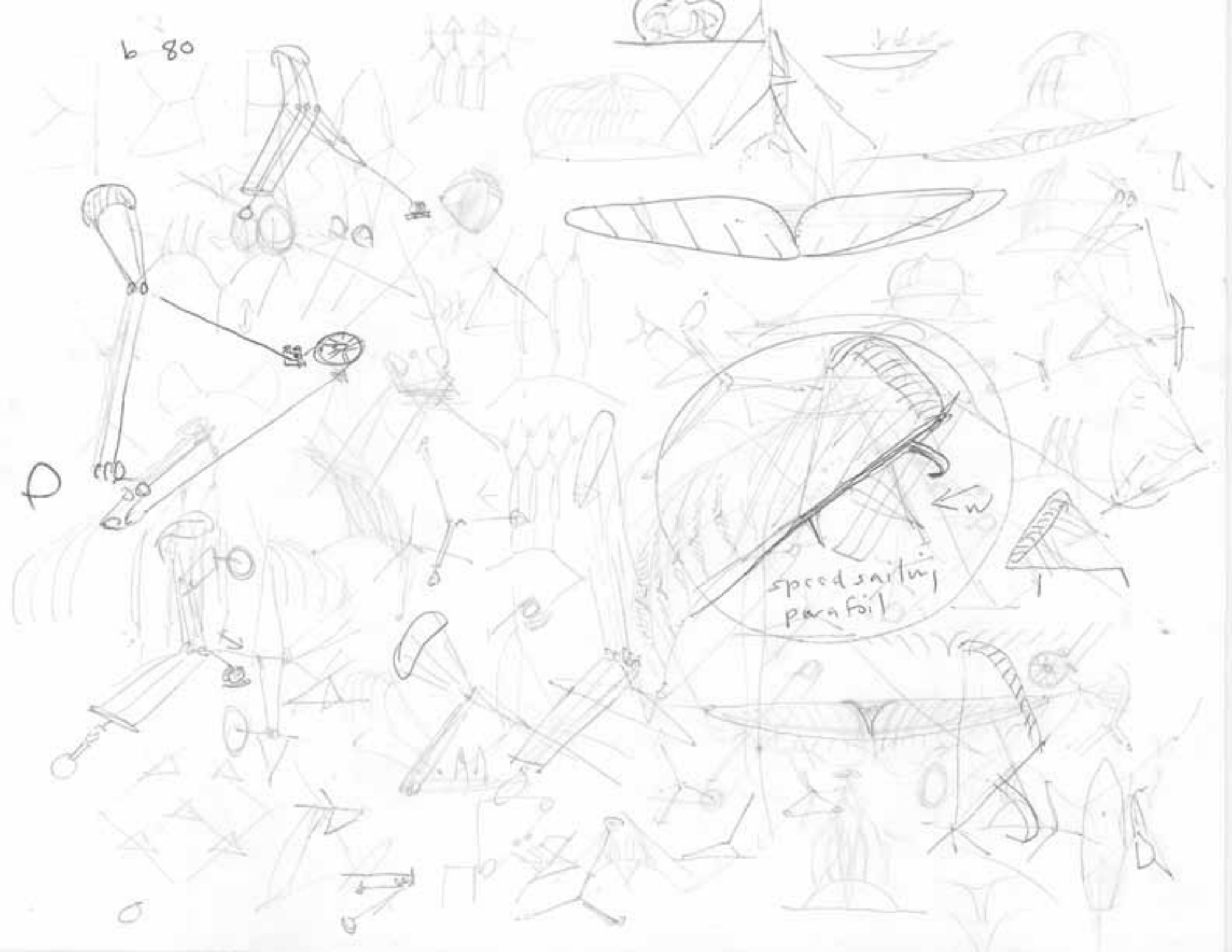
- boat
- oars
- speed reels

b 76


Fail-soft
late whipples
payload whipples

b 78

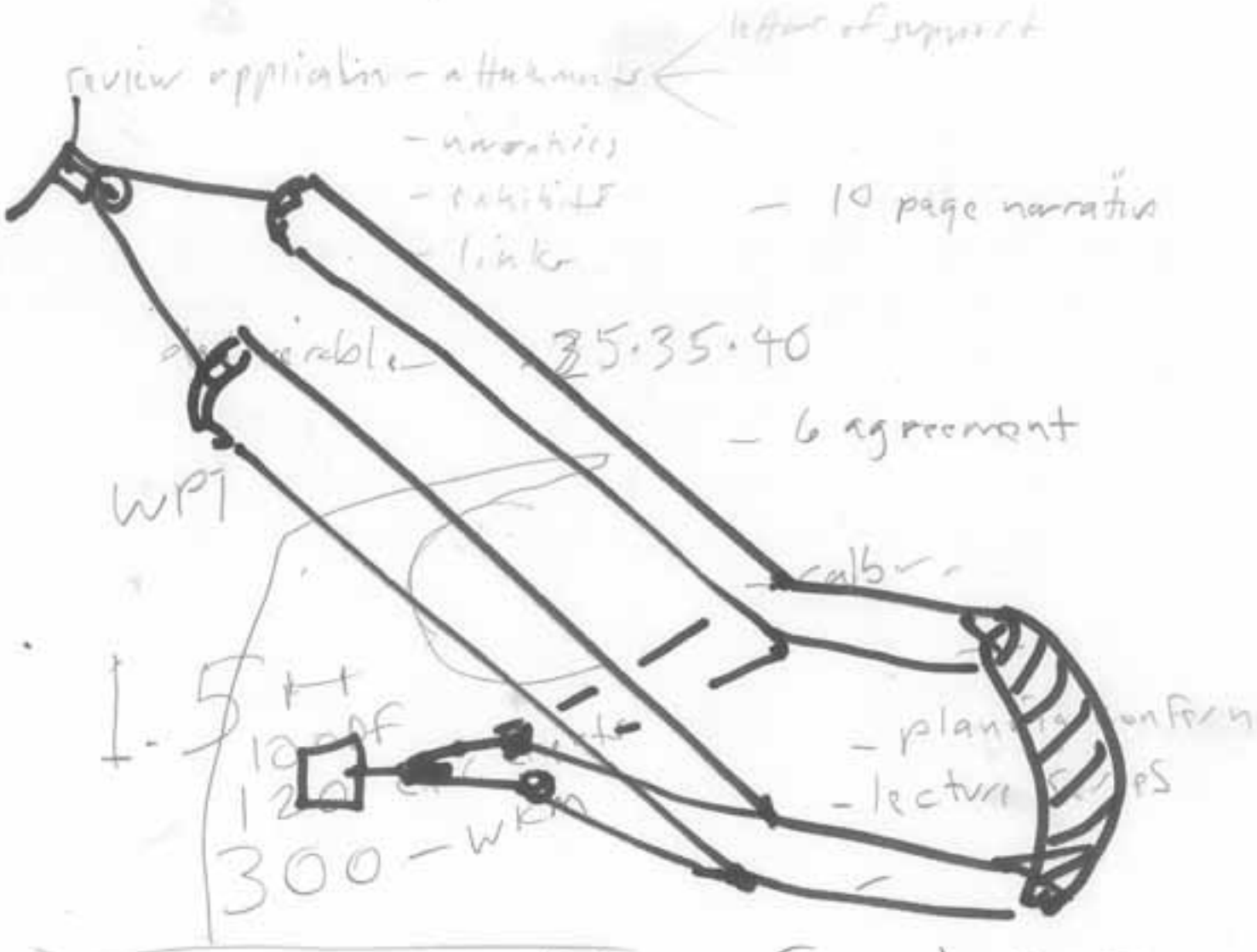
b 79
2000
Boring
Build
Test
mothra
flipWing
Kixelated
flip-Wing
elastomer
gathers
arch
within
field
heat gun
thermo
plastic
knot-lock


b 80
speedsailing
parafoil

b 81

b 82

b 83



Accellerate & Develop
& Deployment
Low Middle
Income

- Sweden -
Answer -

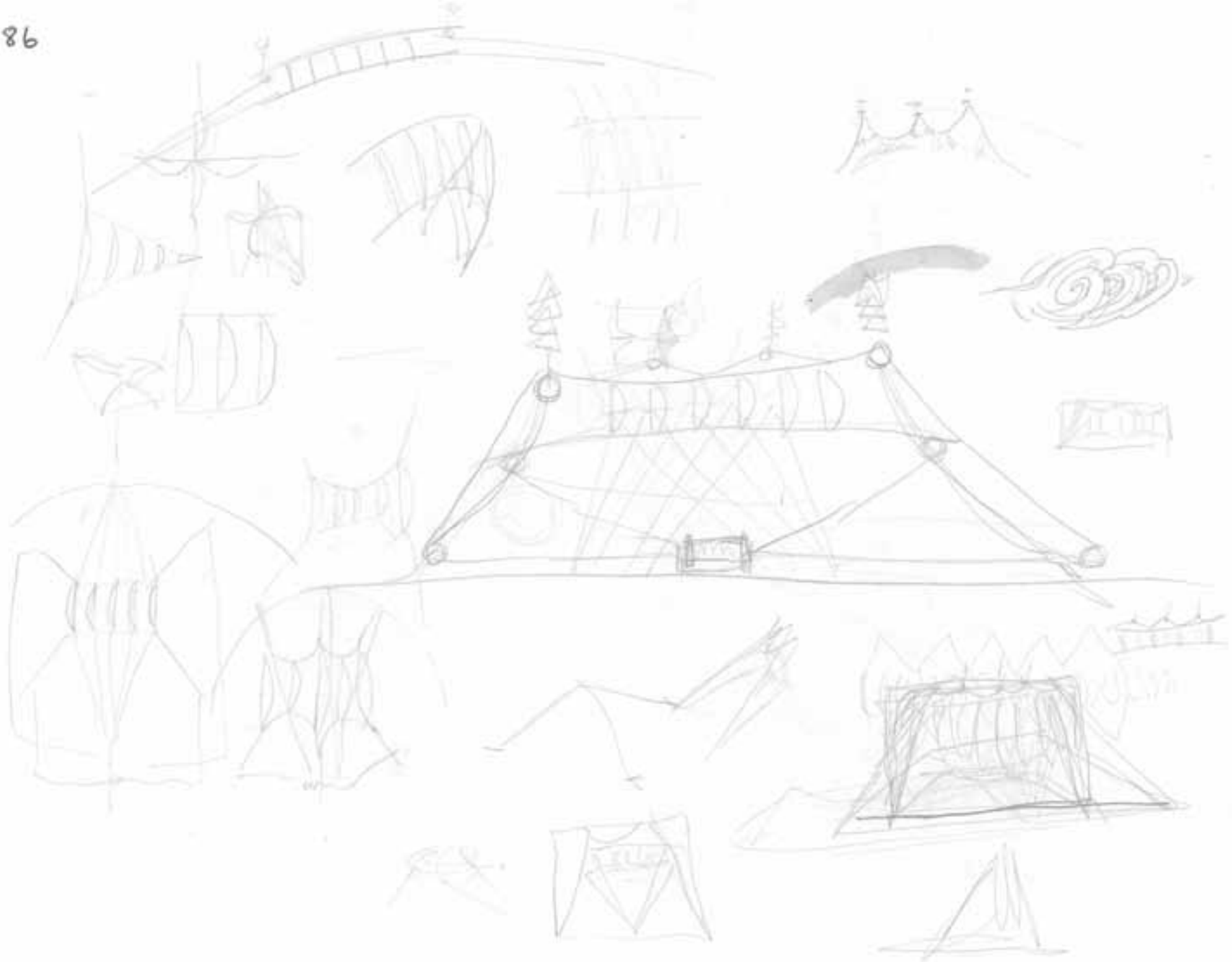
100K cash
500 inkind labor

5k per yr WKM

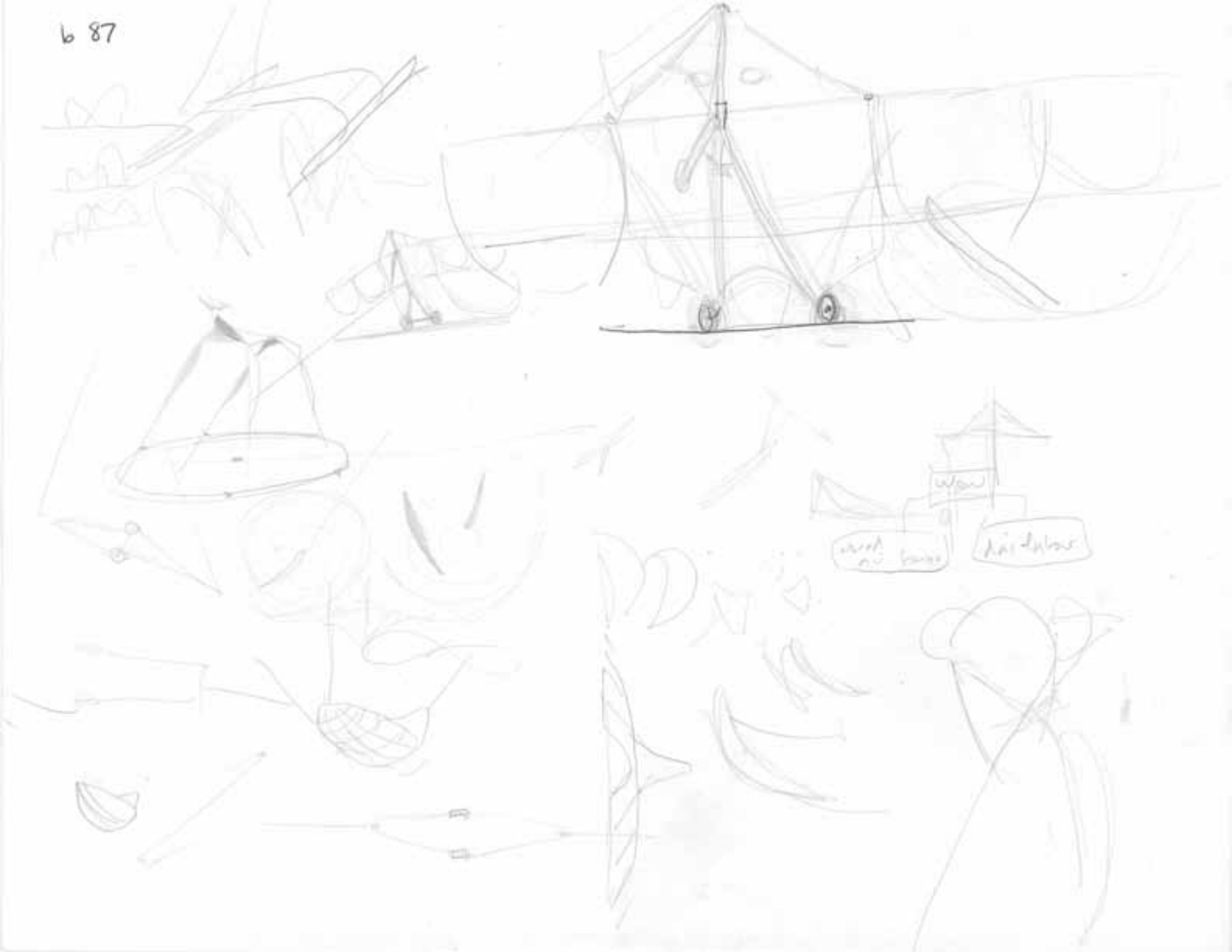
Marc Ricketts

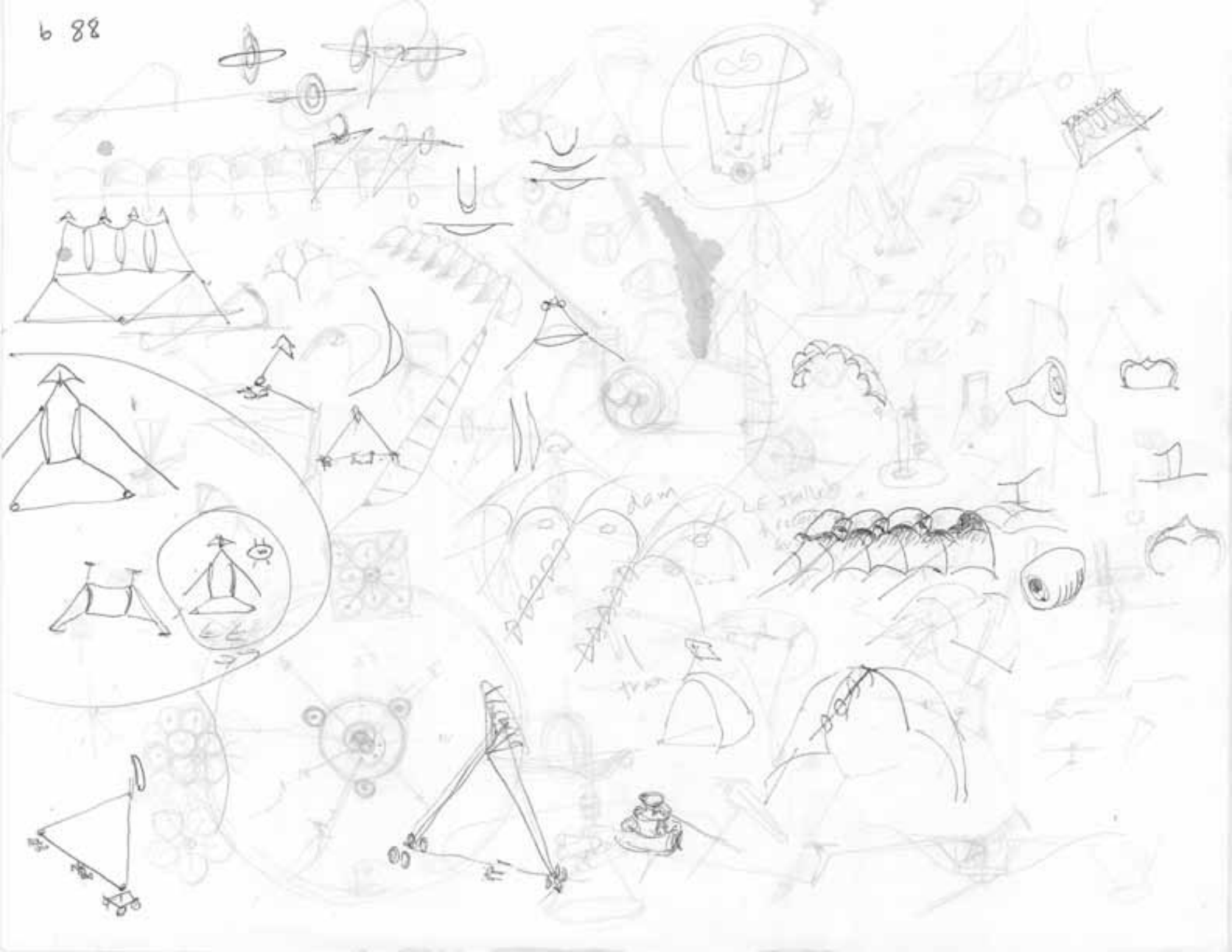
b 85 AWEmotion

B 86

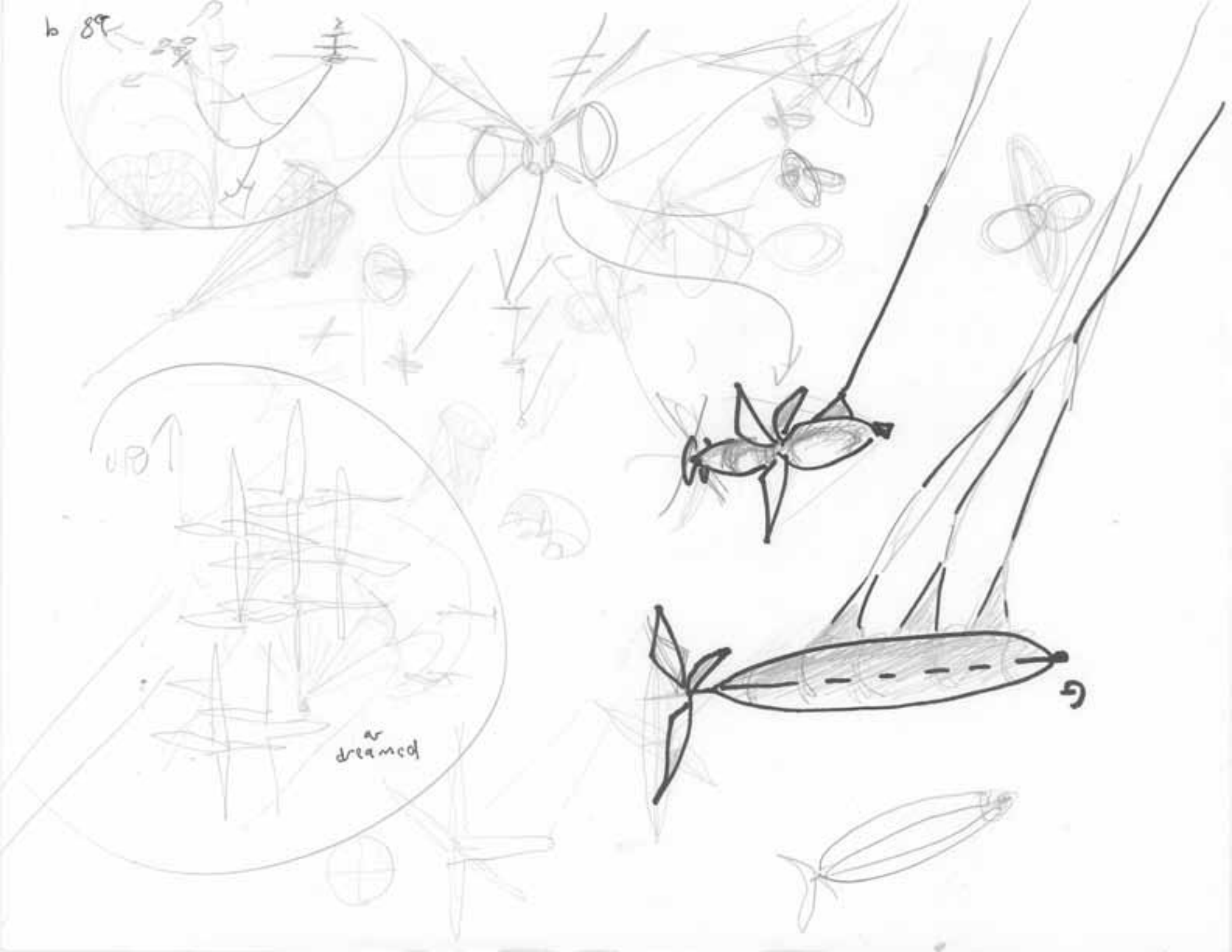


b 87

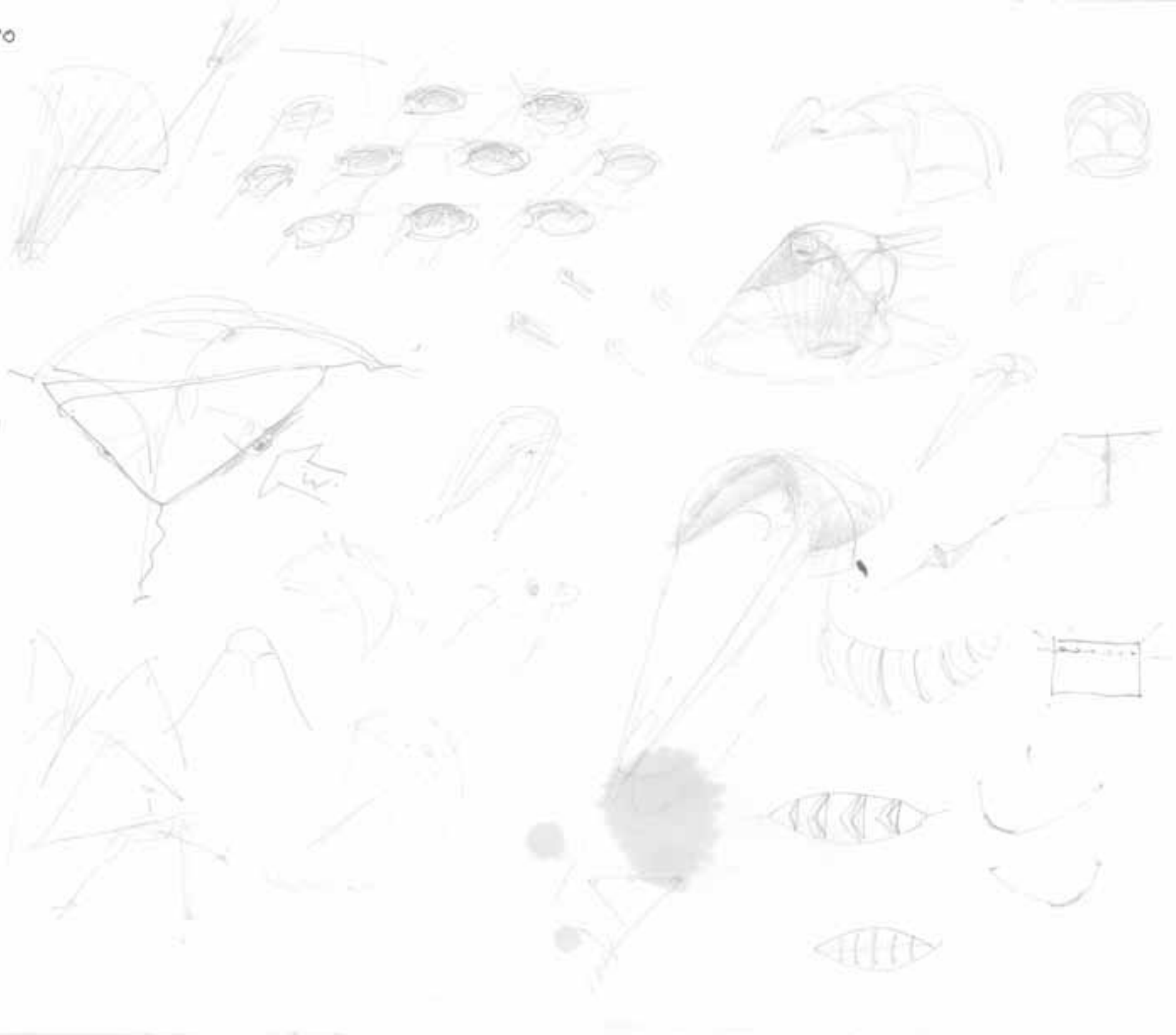



b 88

b 89



b 90

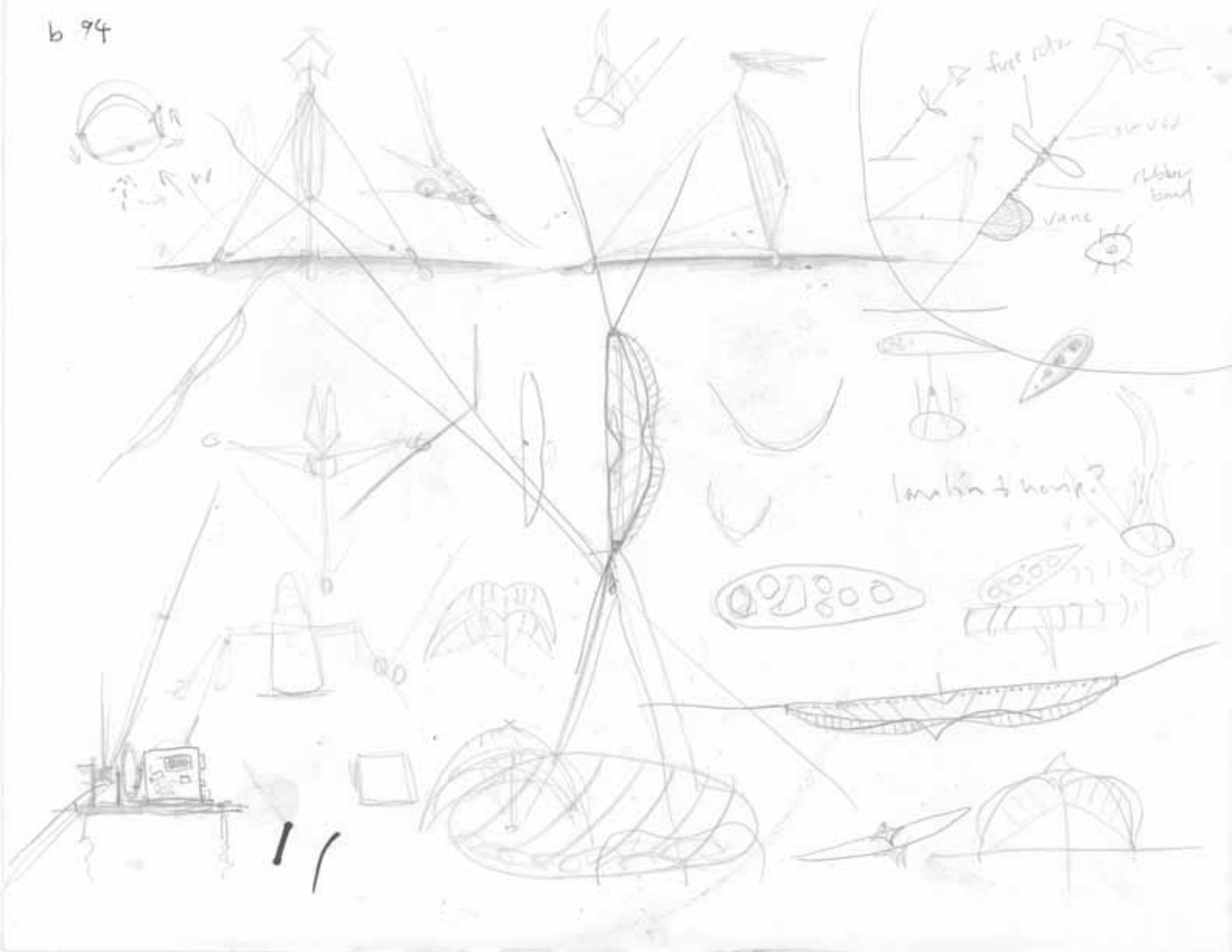


b 91

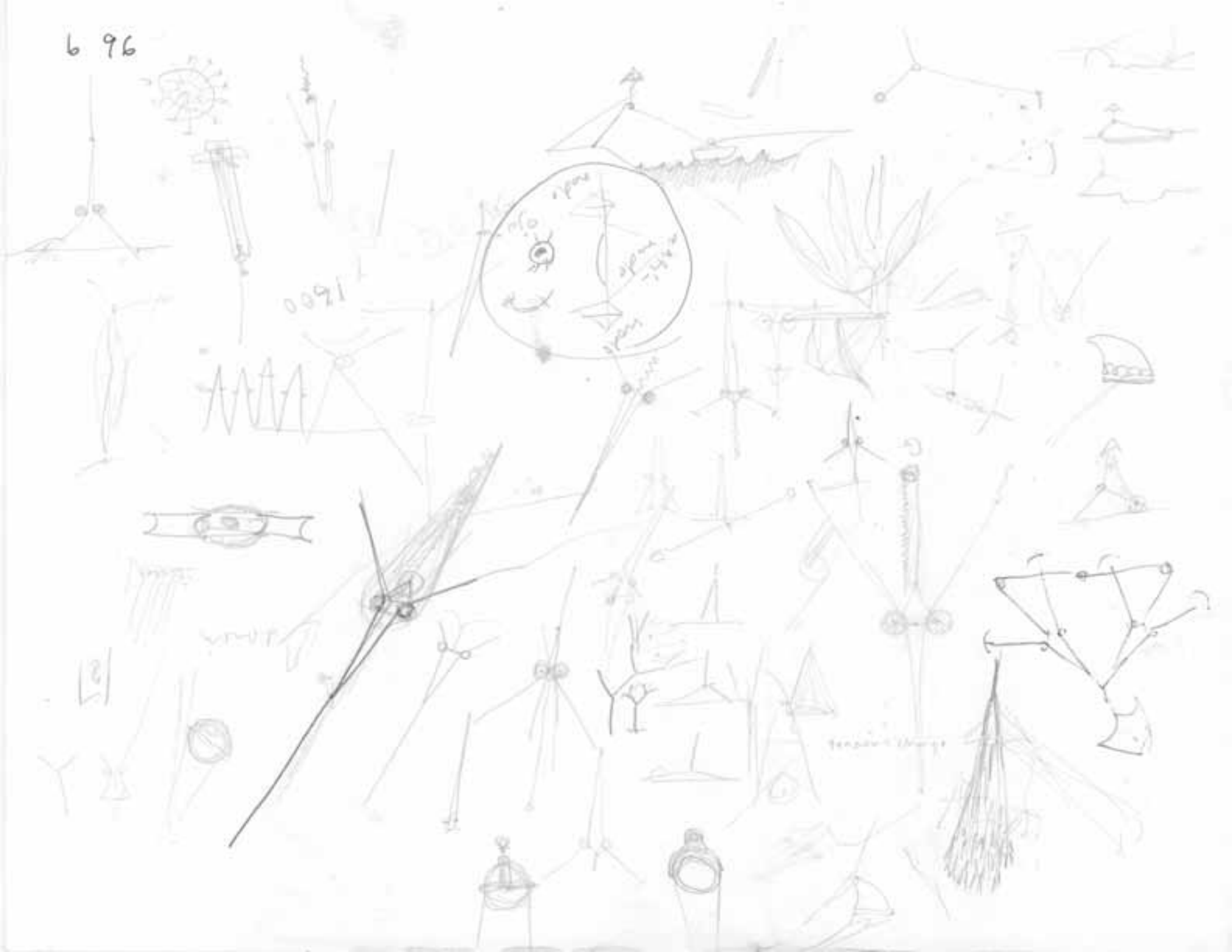
b 92

b 93

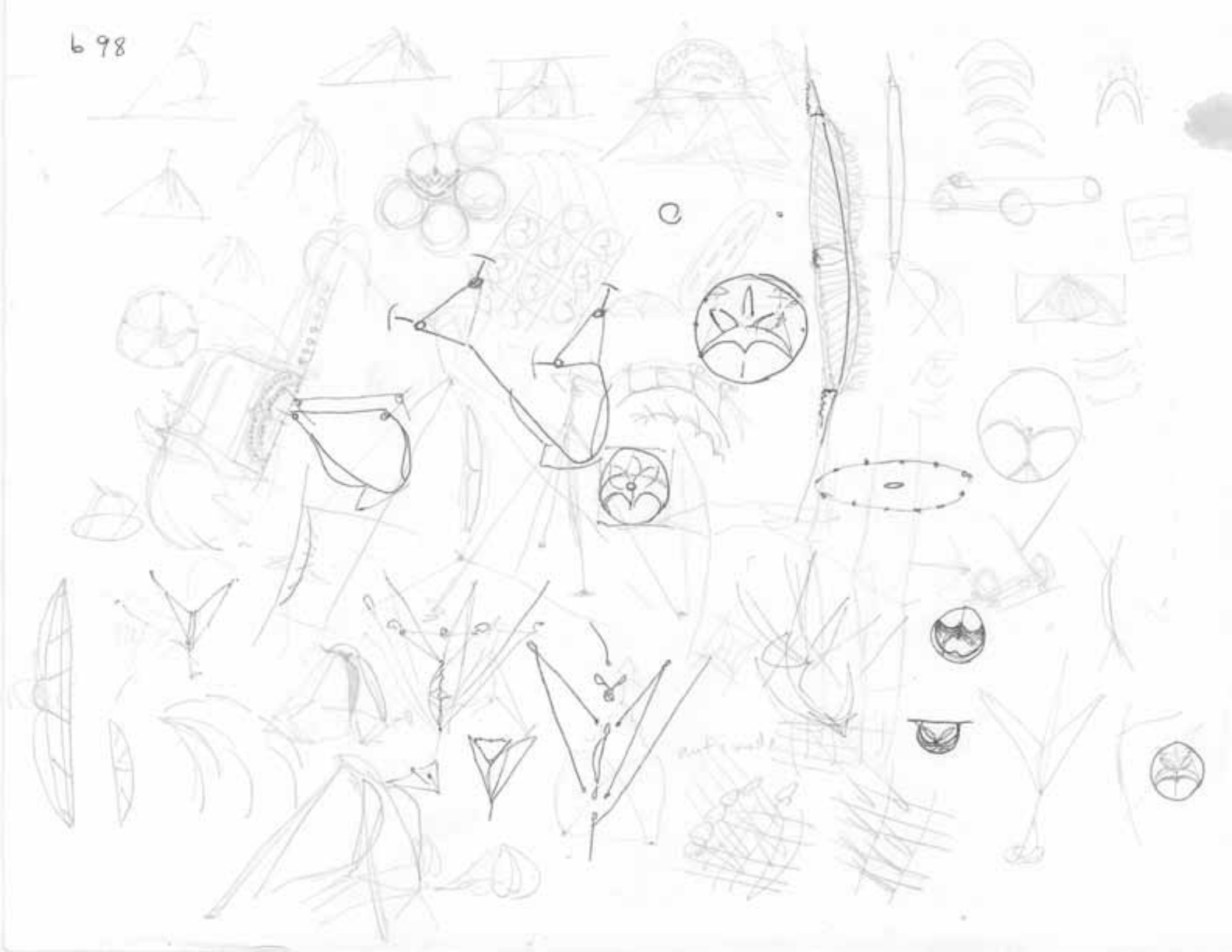
b 94



b 95

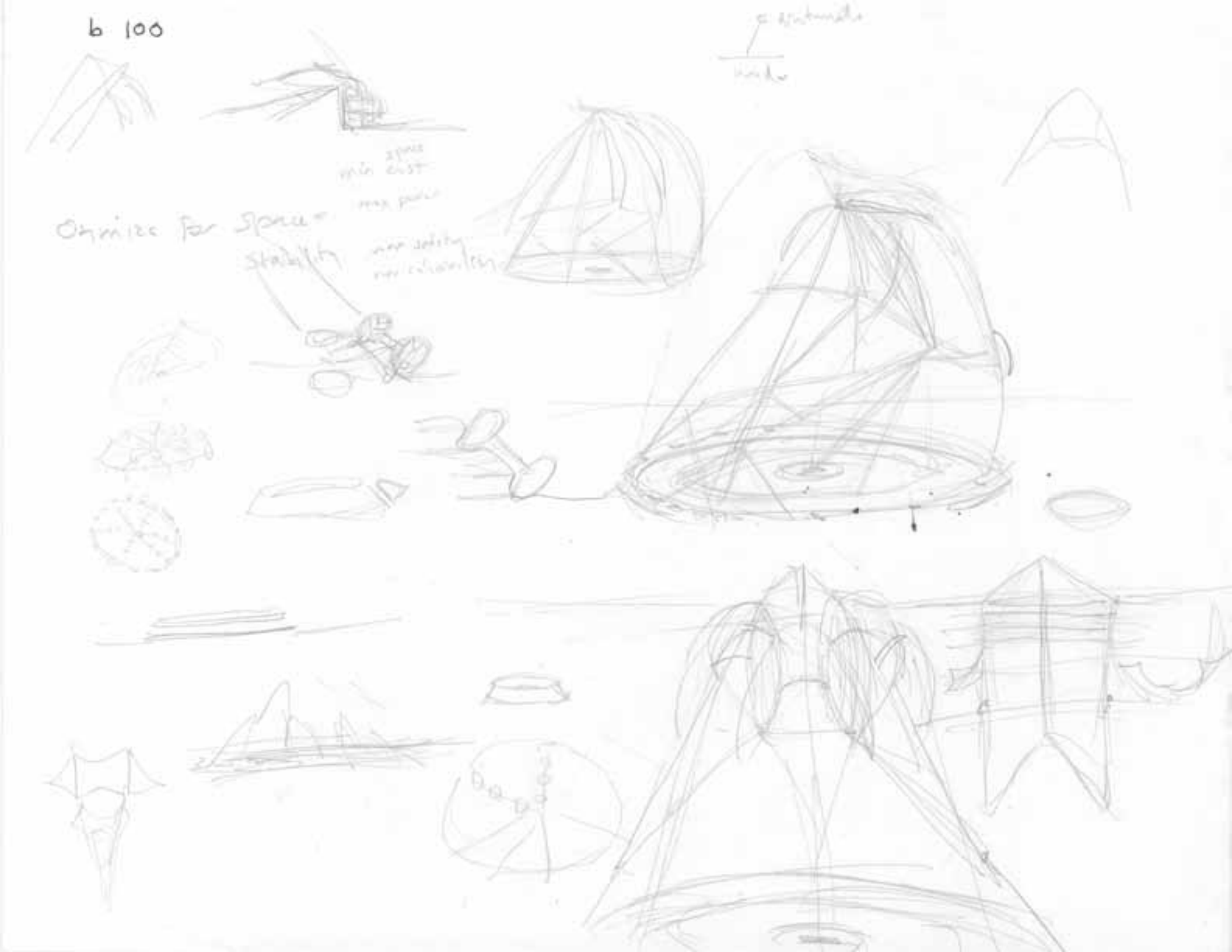


b 97



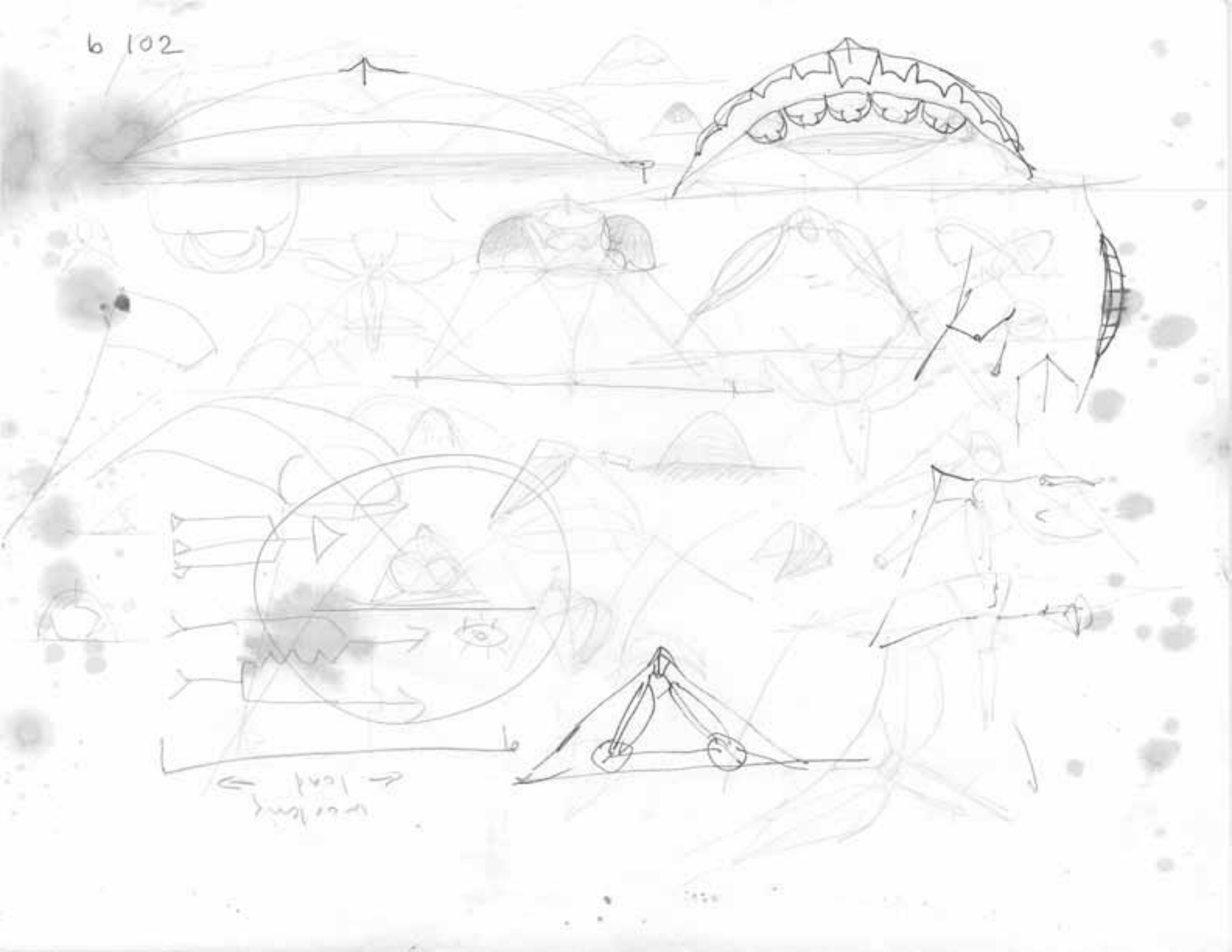
b 99

b 100

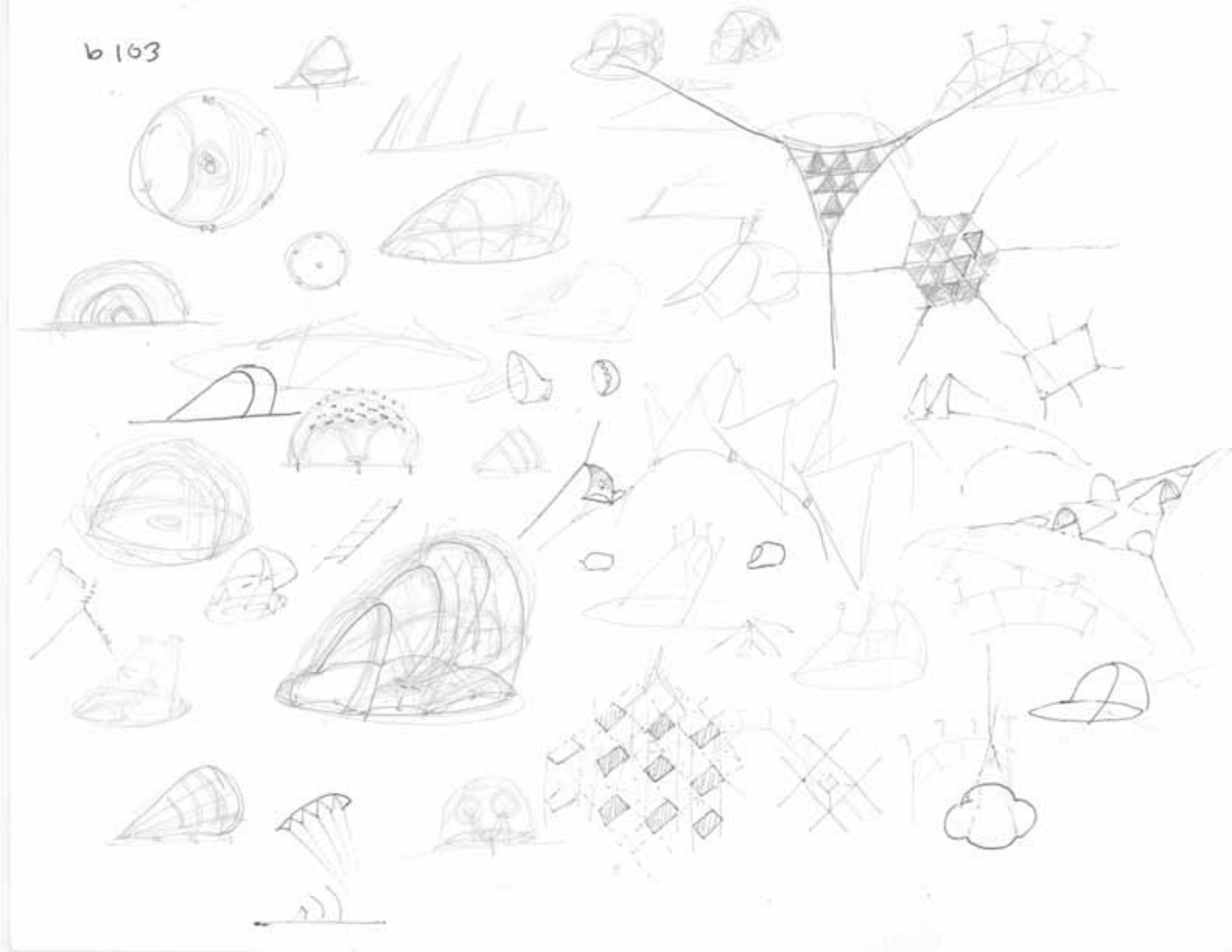


b 101
W
2000'
lift layer
power
understory
surface

b 102



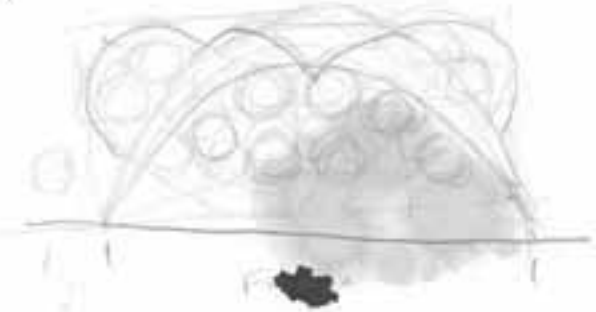
b 103



b 104

b 105

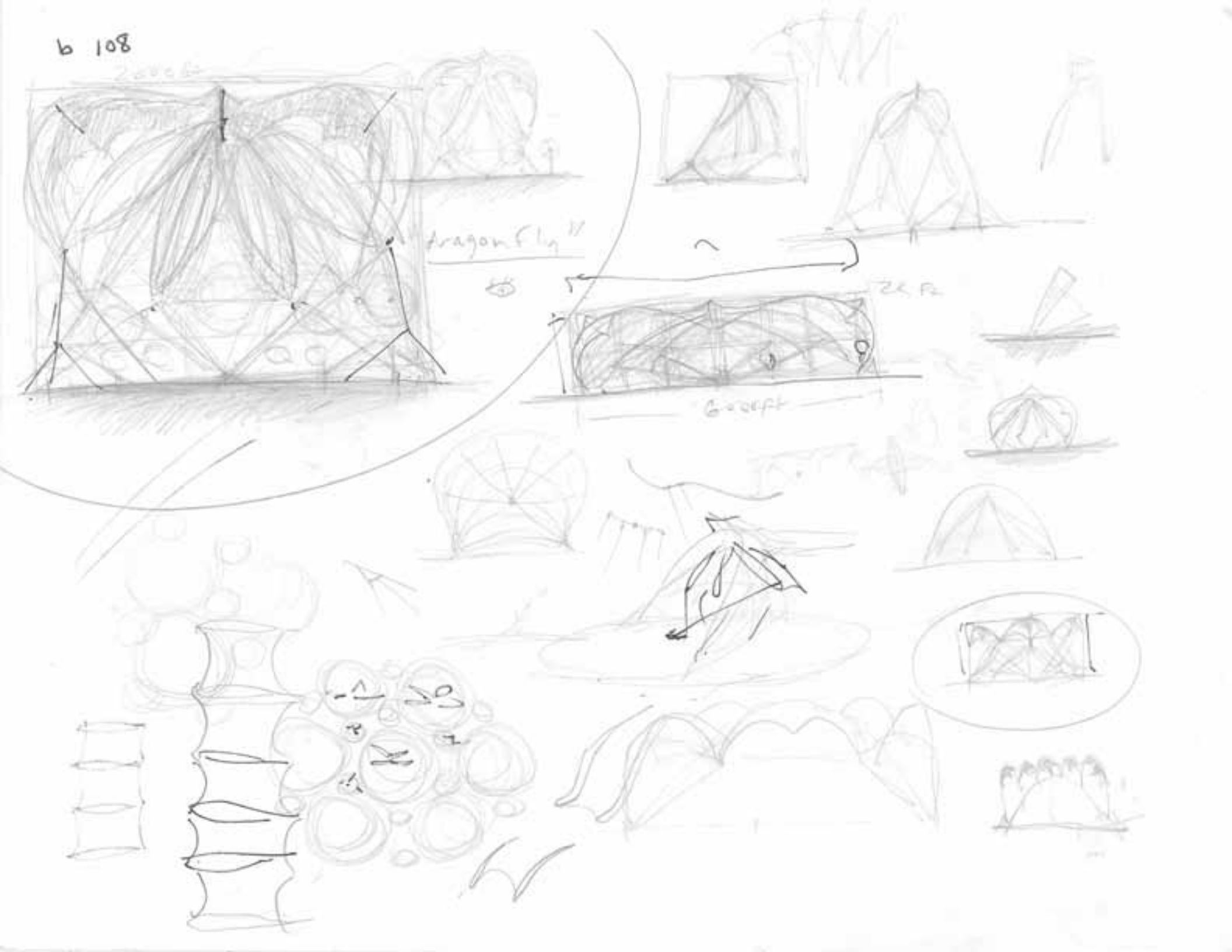
b 107



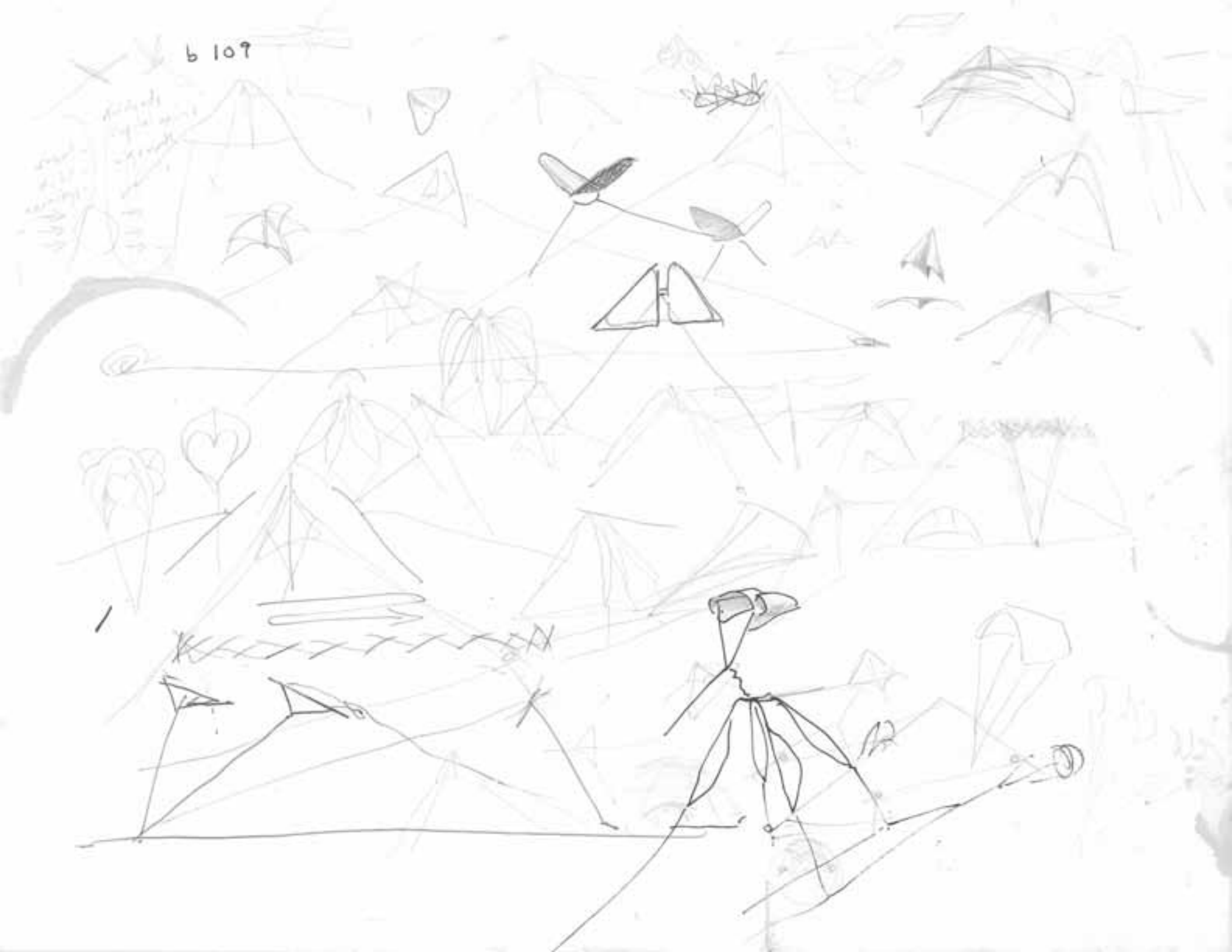
Mae West

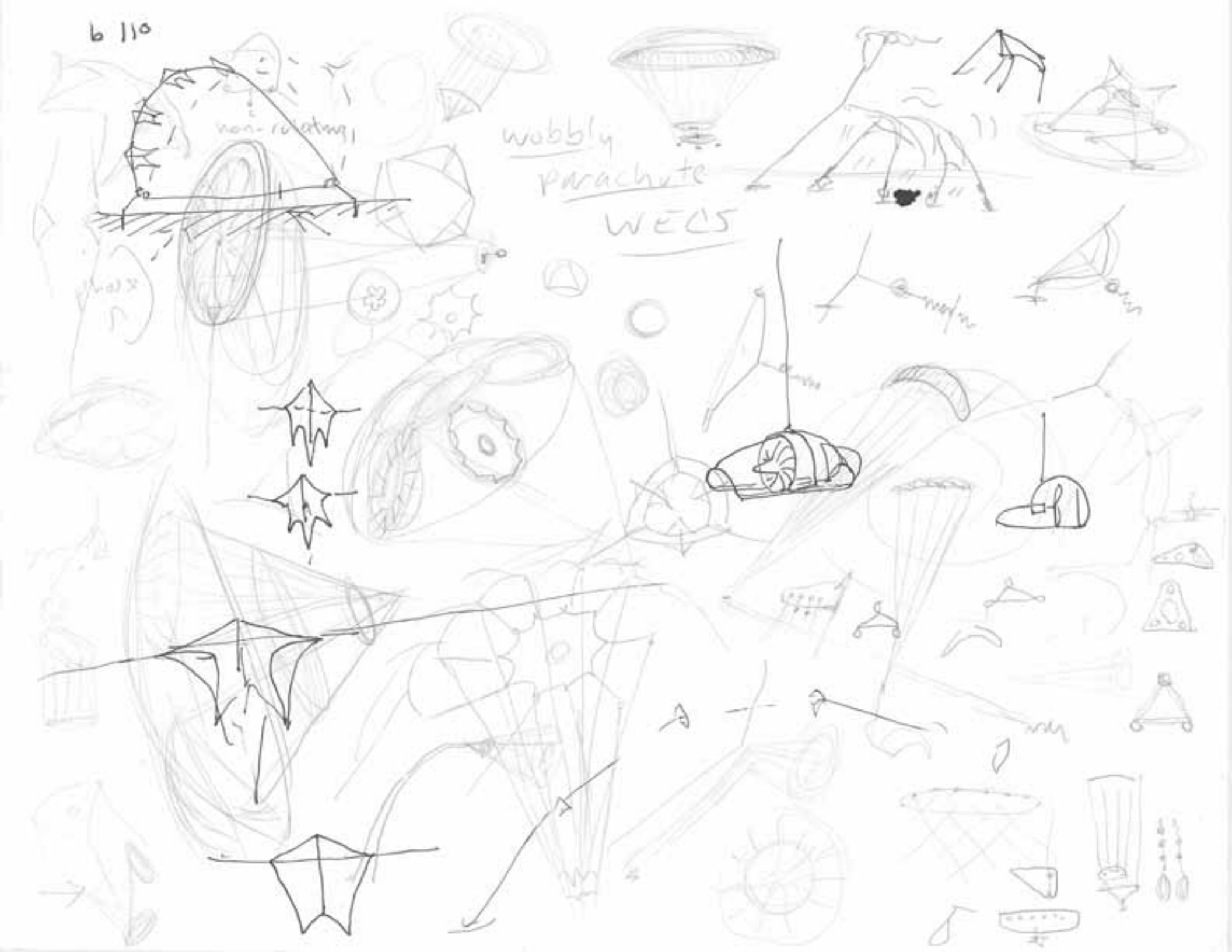
Jose Zayas
Meyer Najon

b 108

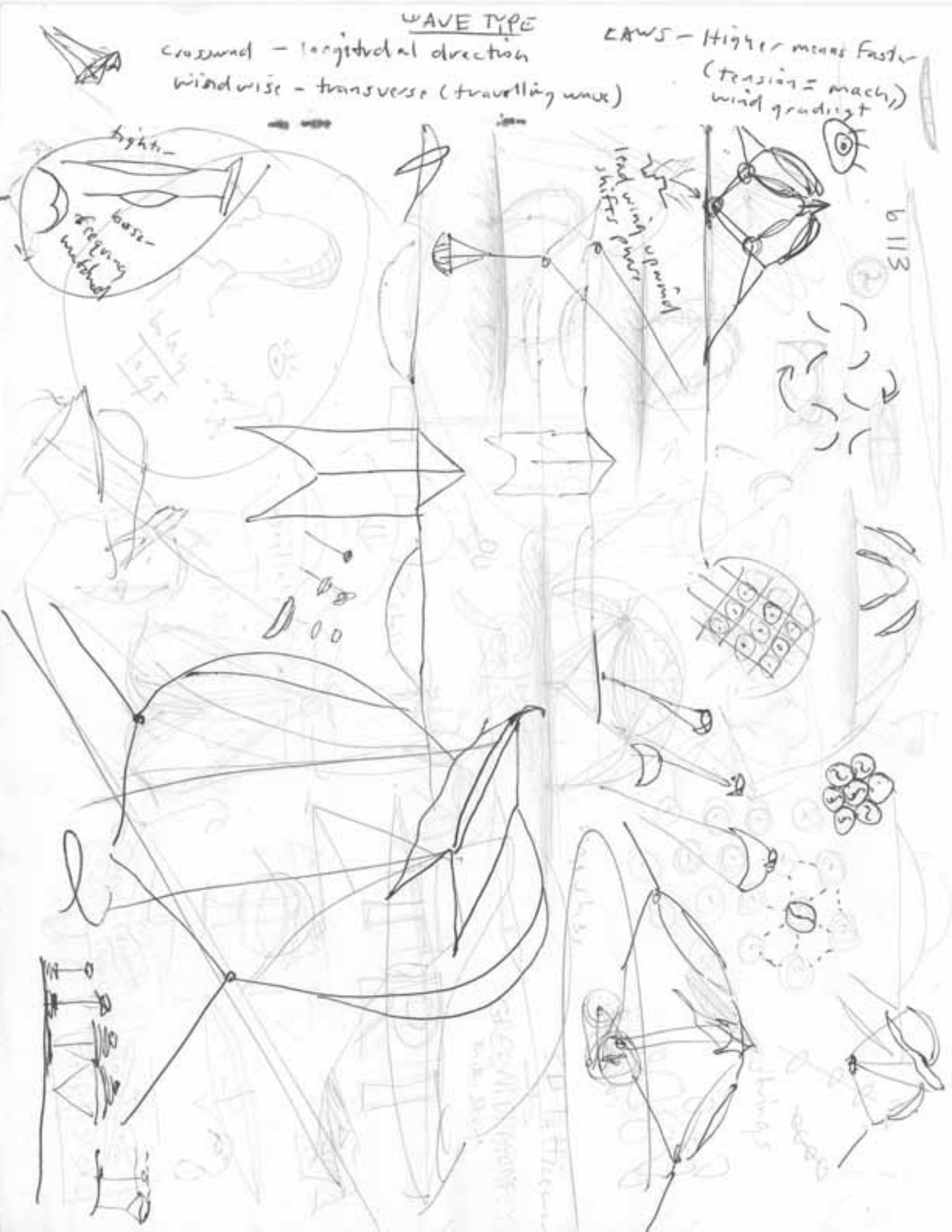


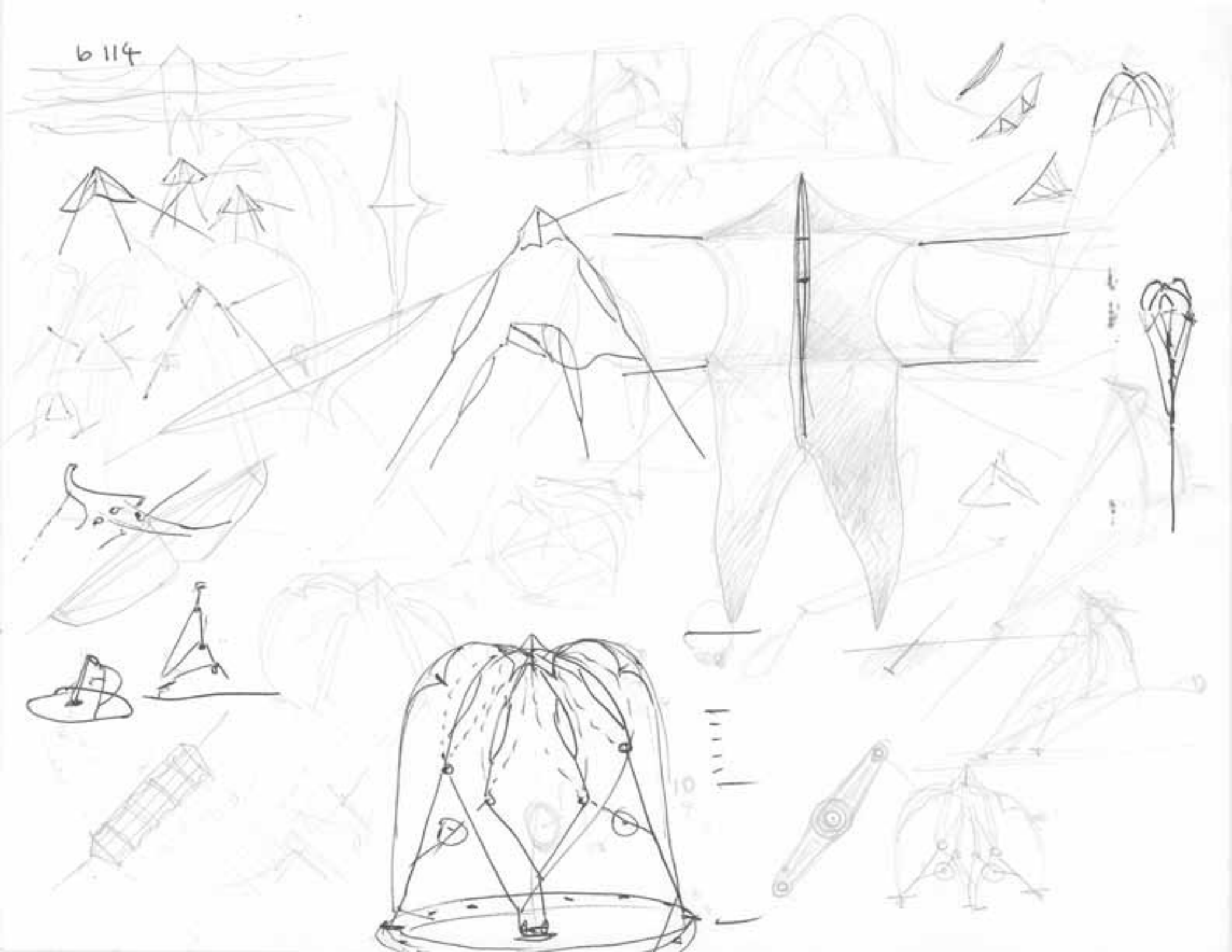
b 109




b 110
non-rotating
wobbly
parachute
WECS

b 112
Engineering Review
1500
- review
high alt design
- review Motora?
- Analyze string power
transmission
AC vs DC
Testing
1500
wear,
maintain
ability
Stringtronics
stringon - a minimal
string, a maximal
string unit, and
everything in between
phononics -
percent set
stringister -
string
processor,
amp
or
switching


WAVE TYPE
crosswind - longitudal direction
windwise - transverse (travelling wave)
LAWS - Higher means faster
(tension = mach,)
wind gradient
tighter
base-
frequency
watched
lead wing upwind
shifts phase
6113


6 114

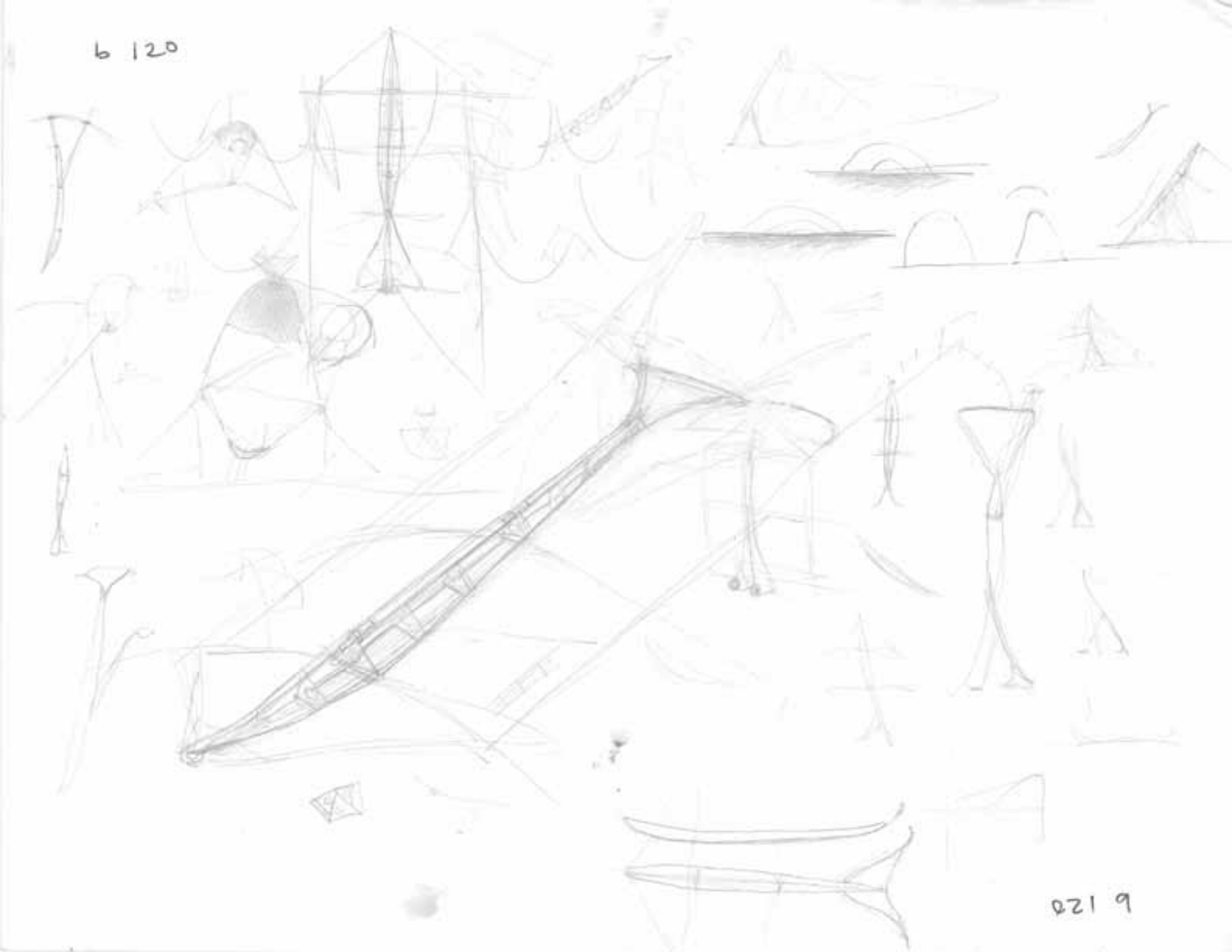
b 115

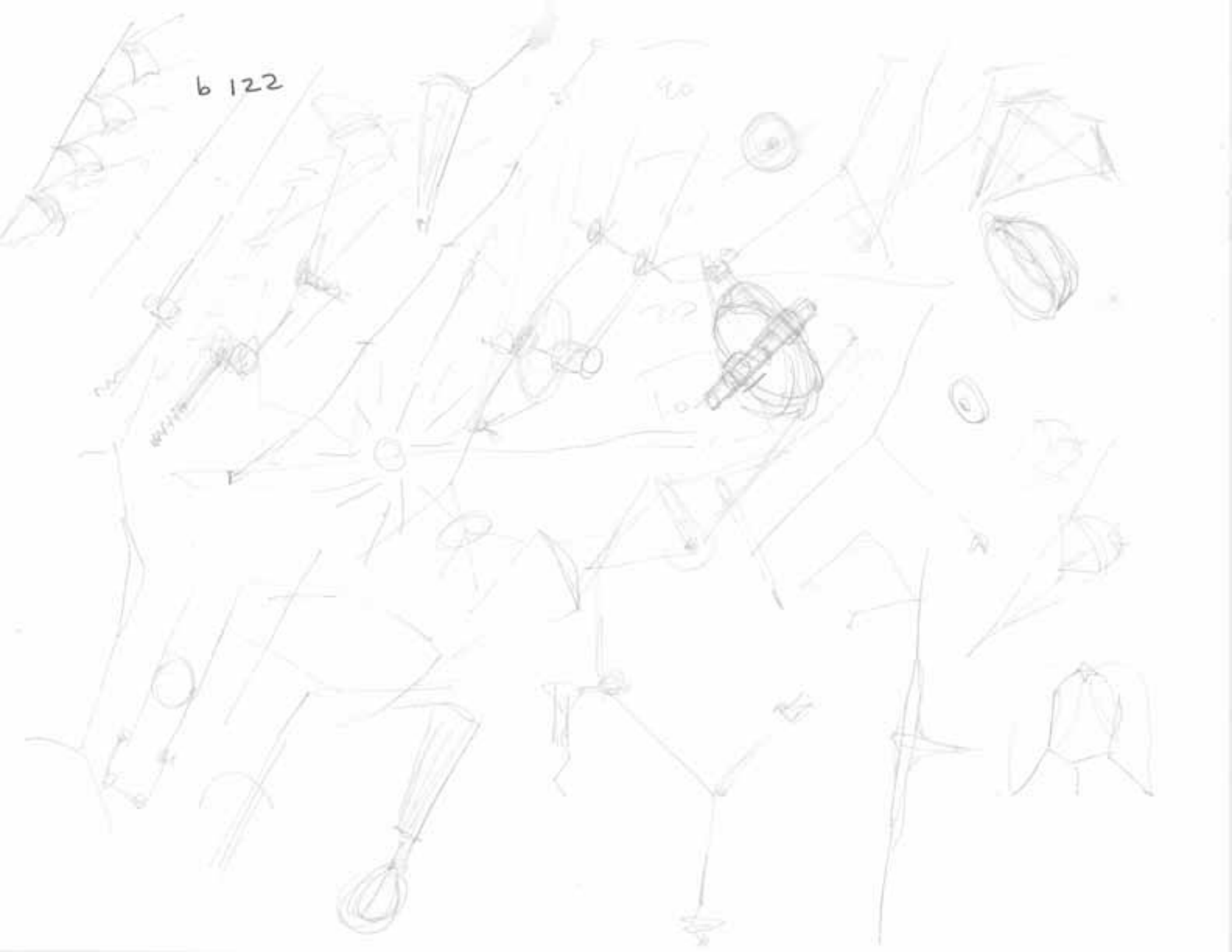
b 116

b 117

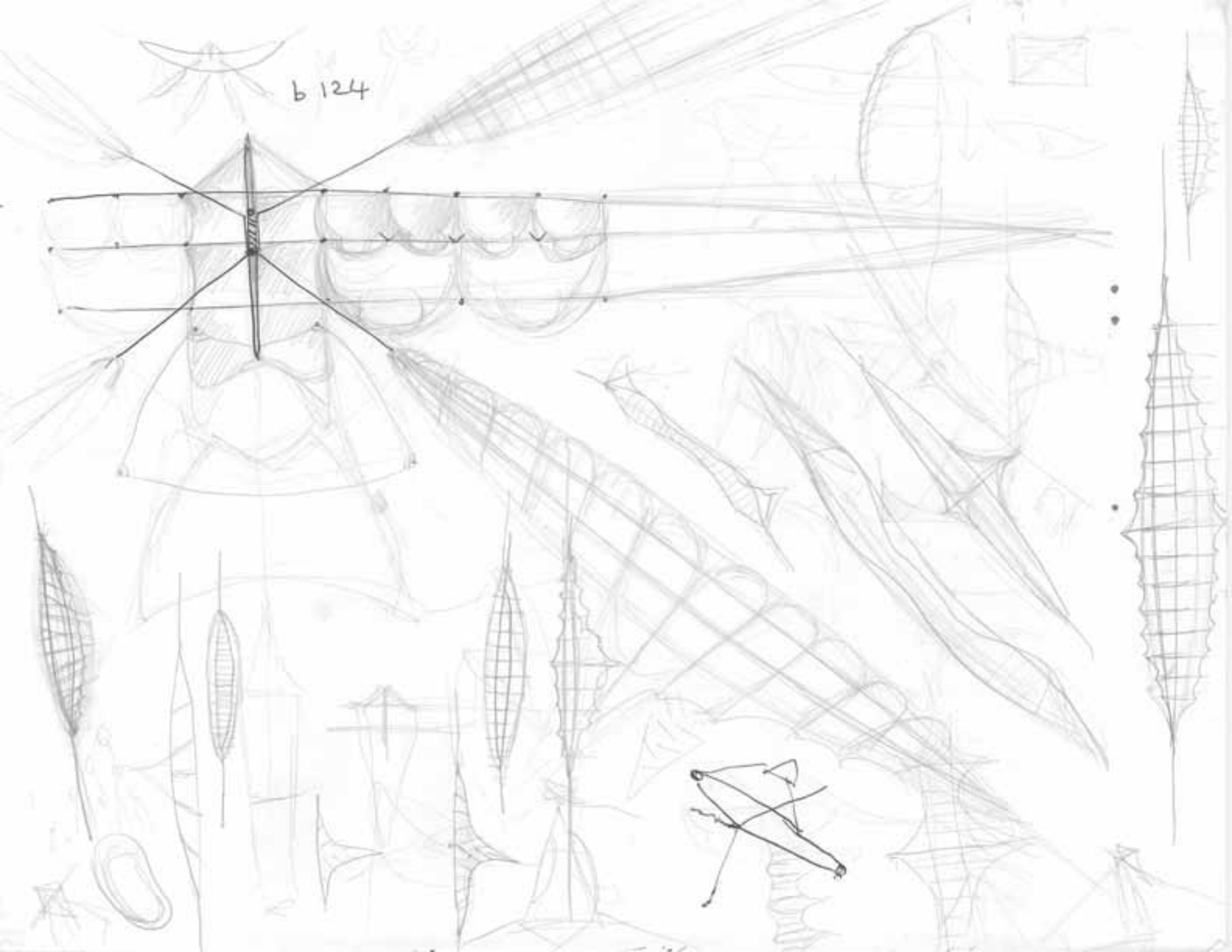
b 118

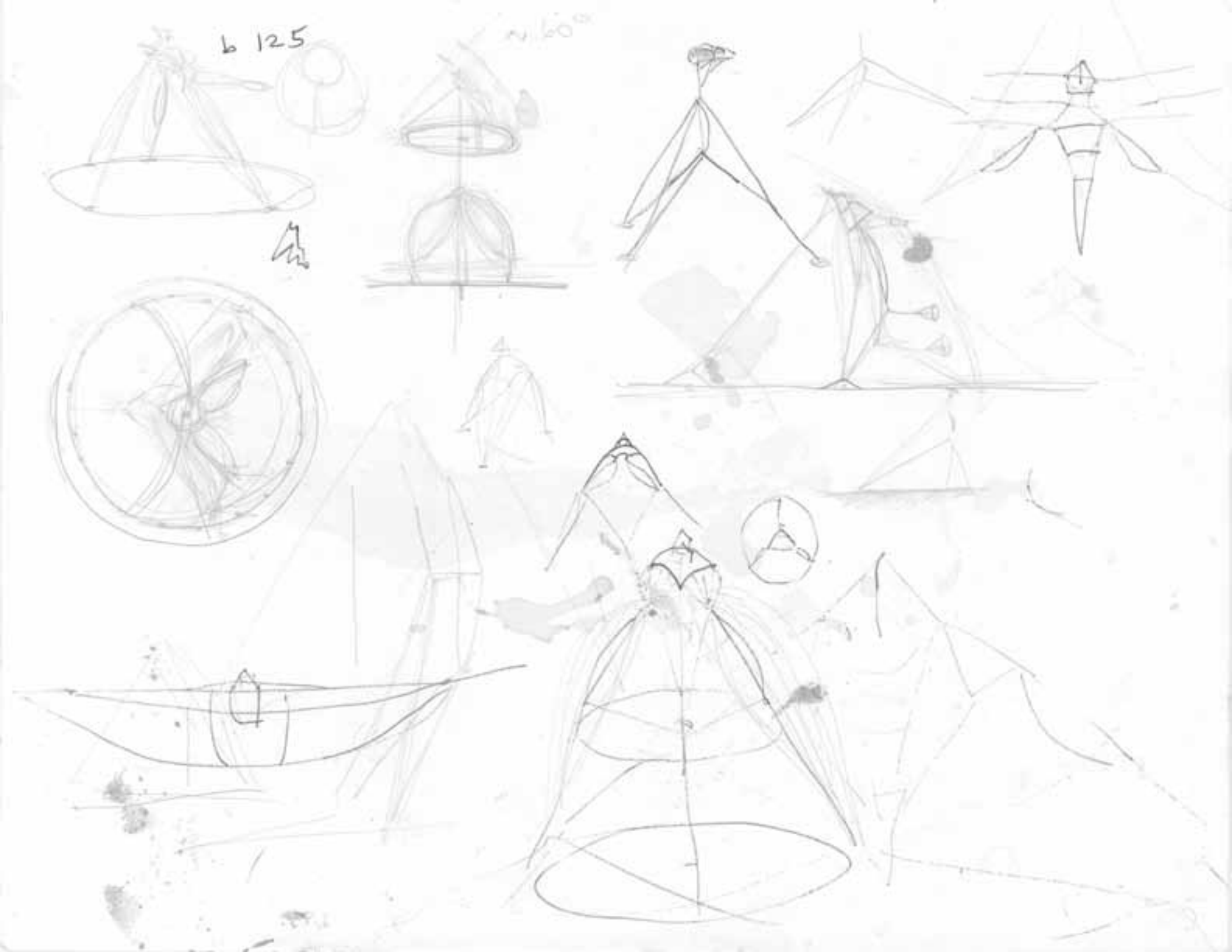
b 119

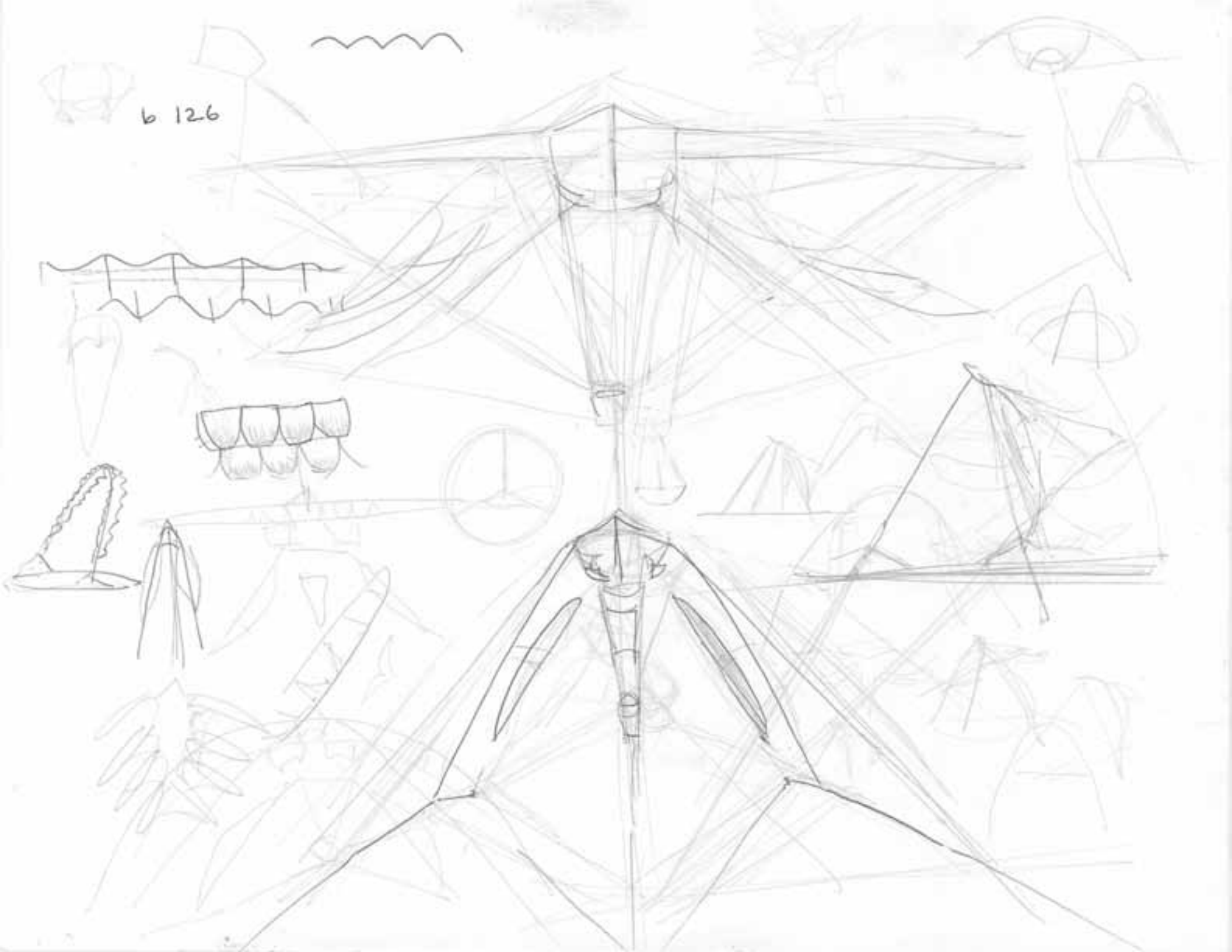

b 120
021 9


b 122

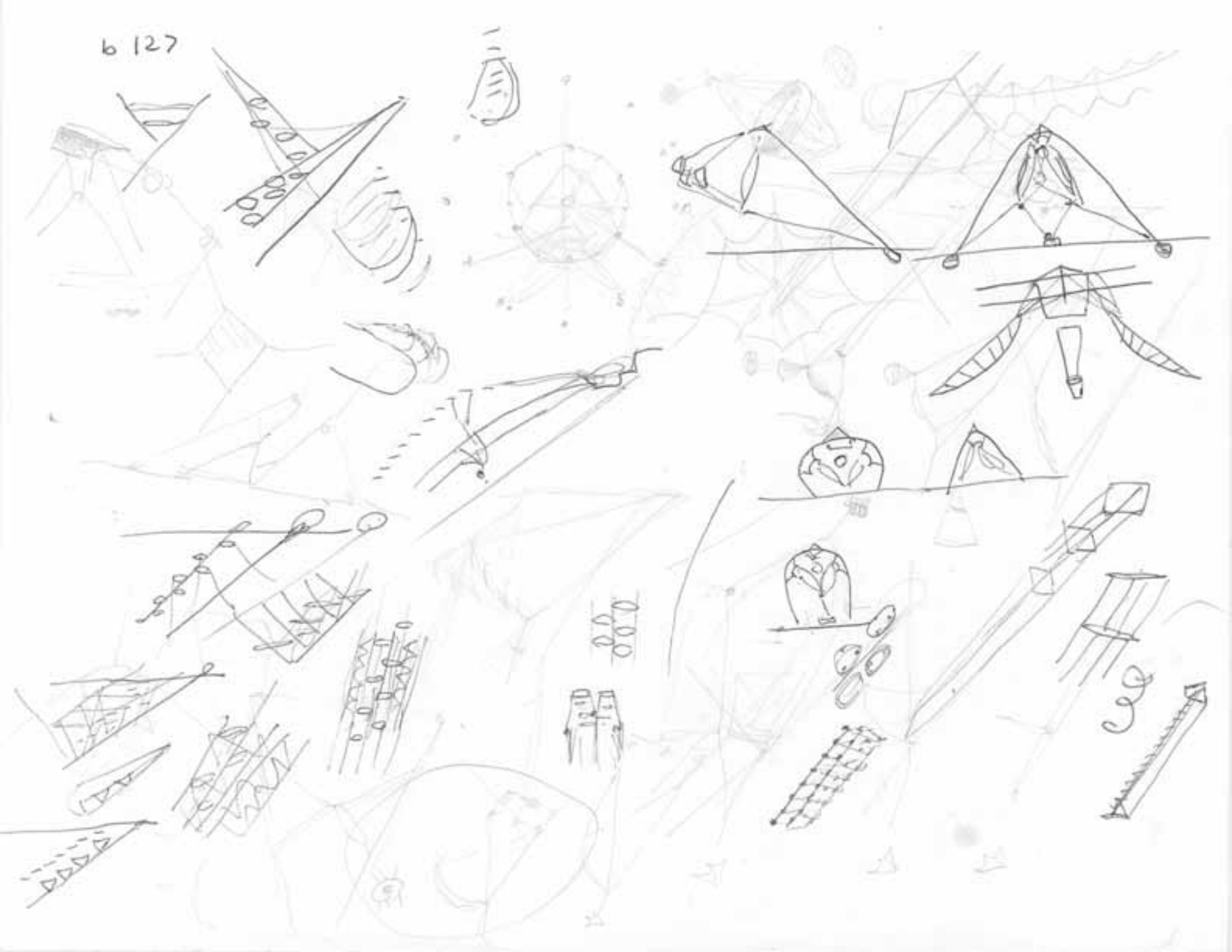
6 123


b 124

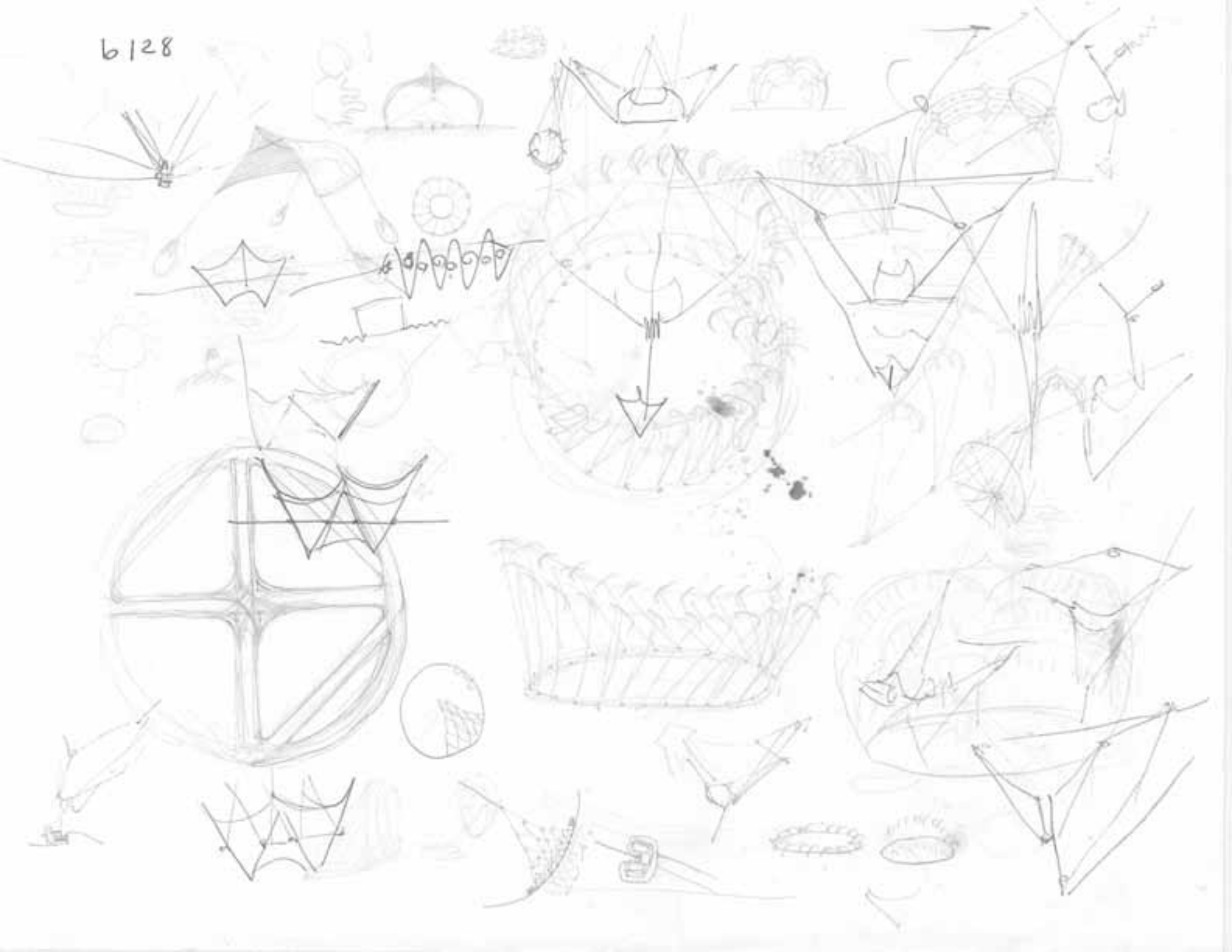

b 125


b 126

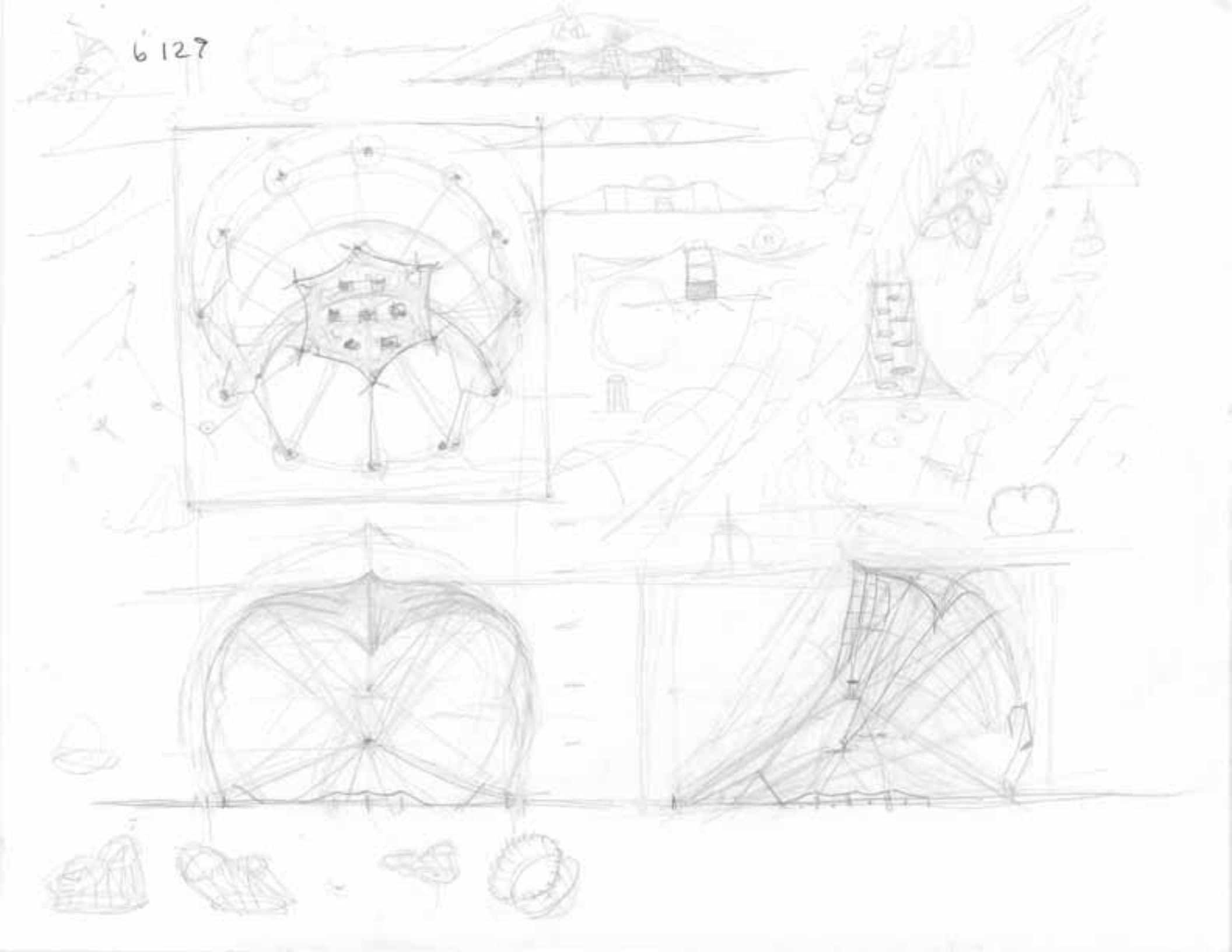
b 127

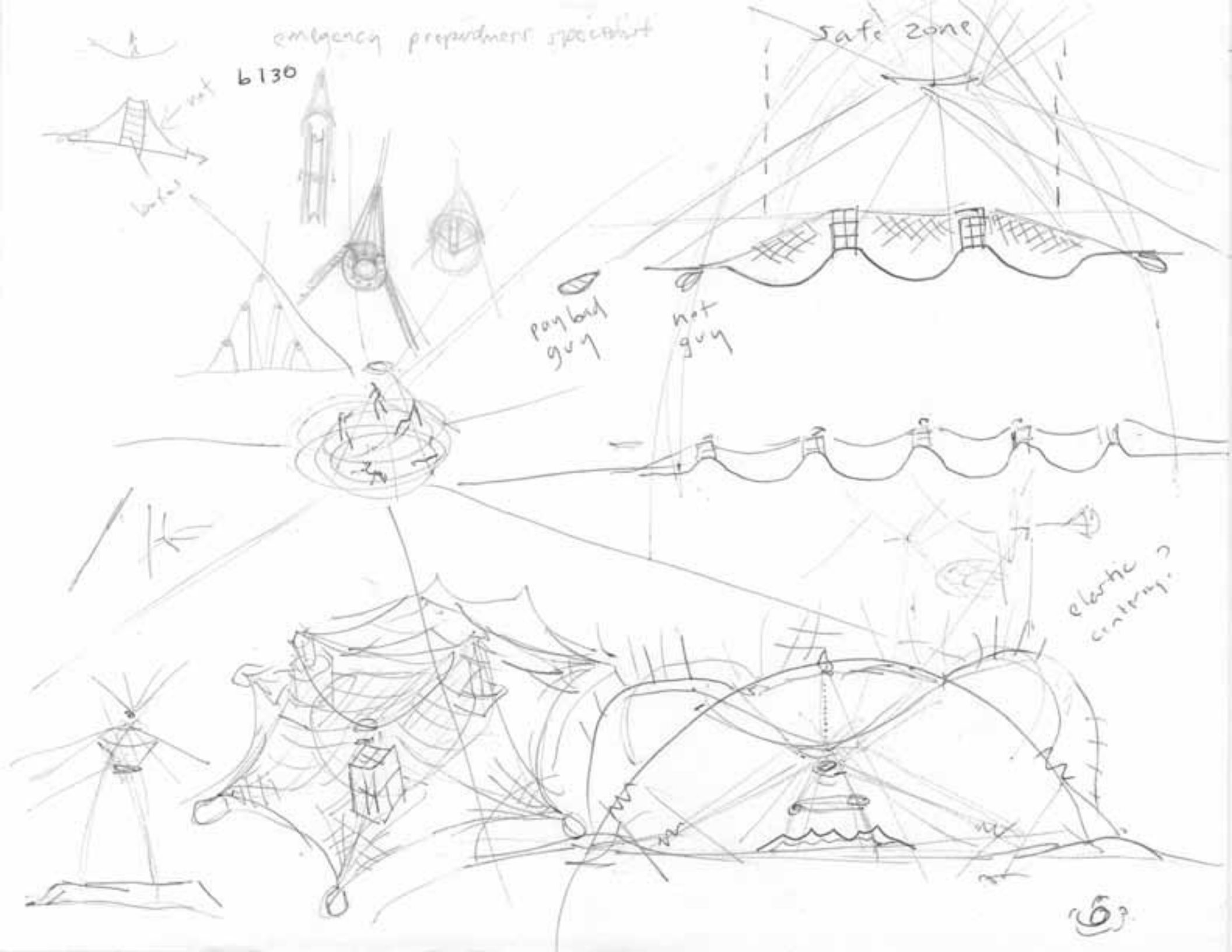


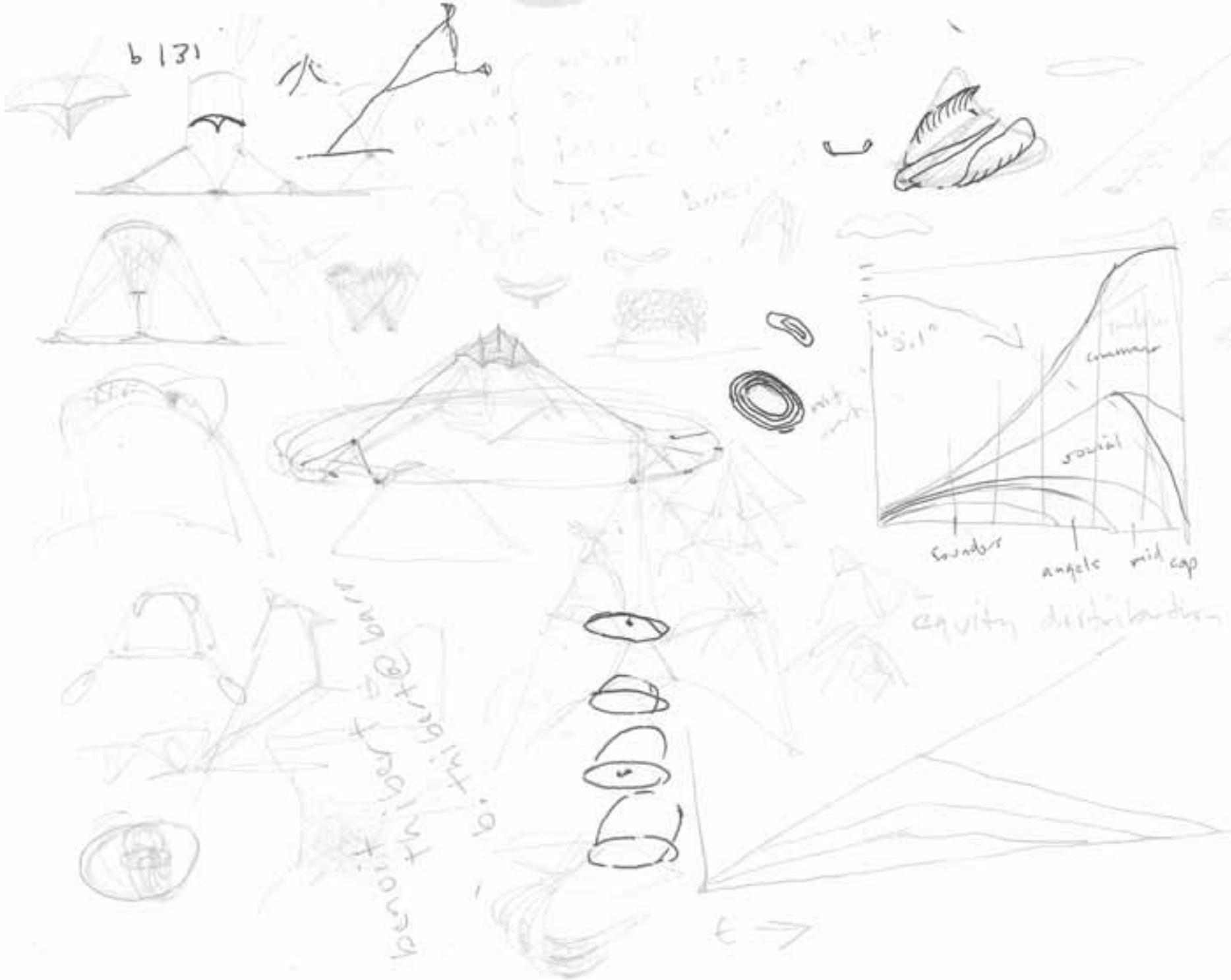
6/28



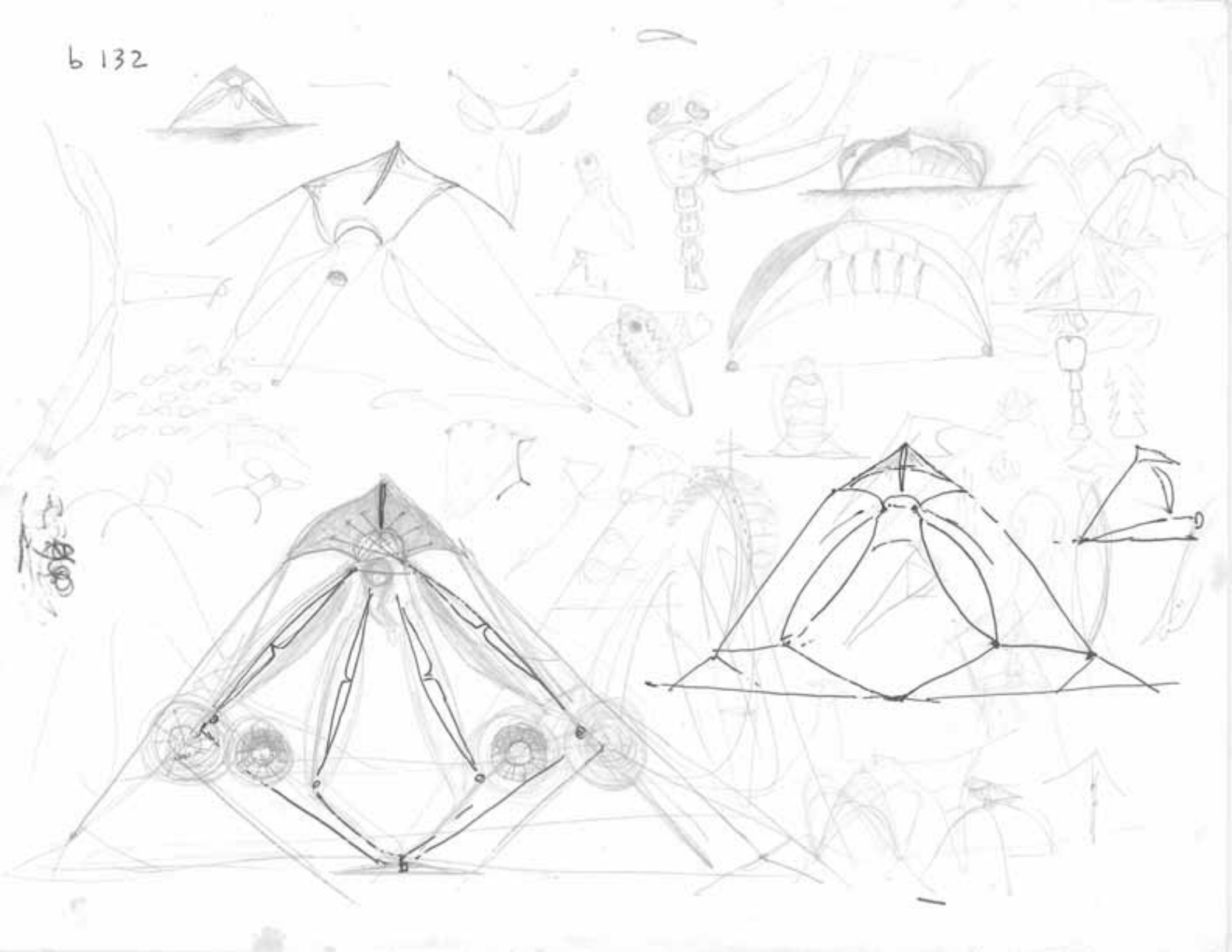
6127




emergency preparedness specialist
6130
safe zone
payload guy
hot guy
electric century ?


b 131
"0.1"
common
social
founders
angels
mid cap
equity distribution
t →

b 132

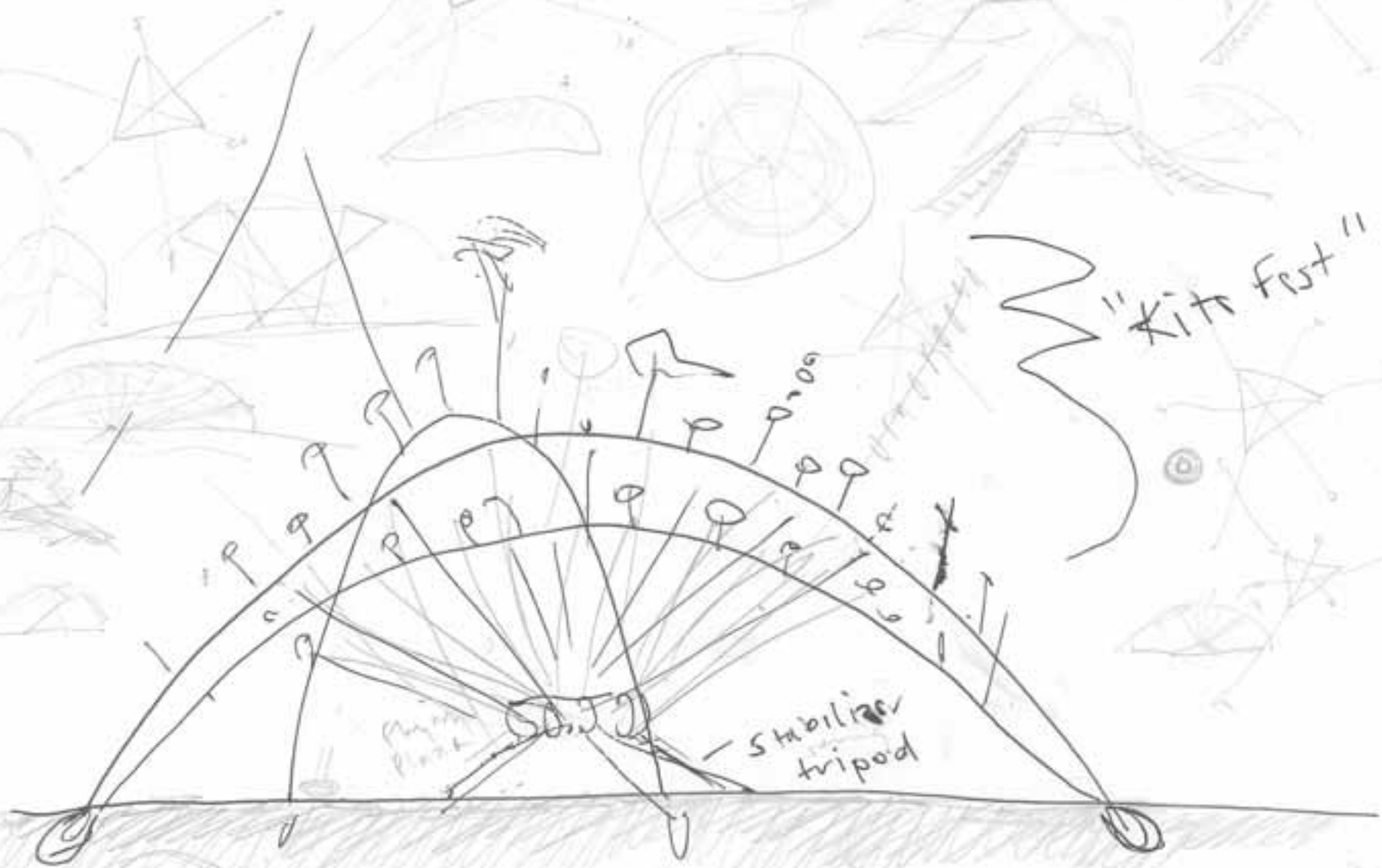


6133

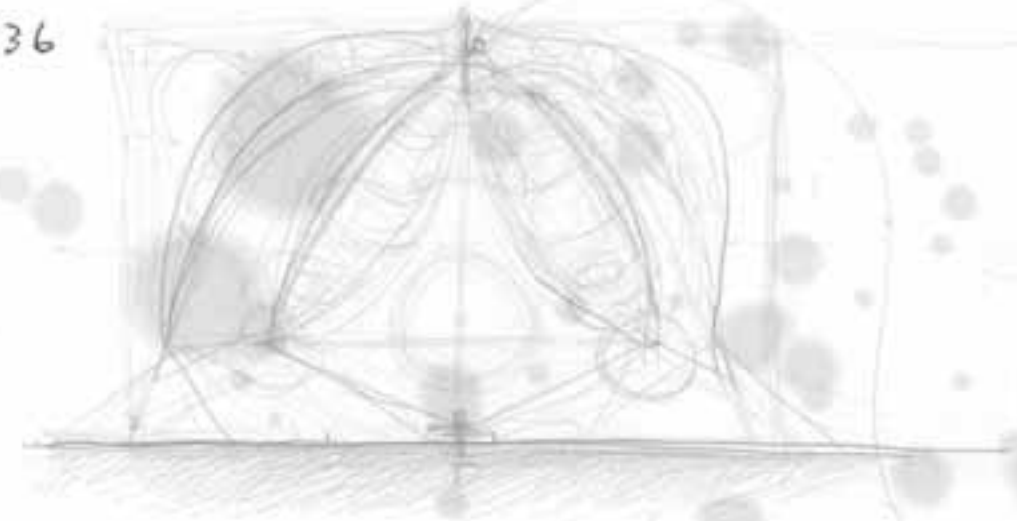
Kite as Central Human Artifact

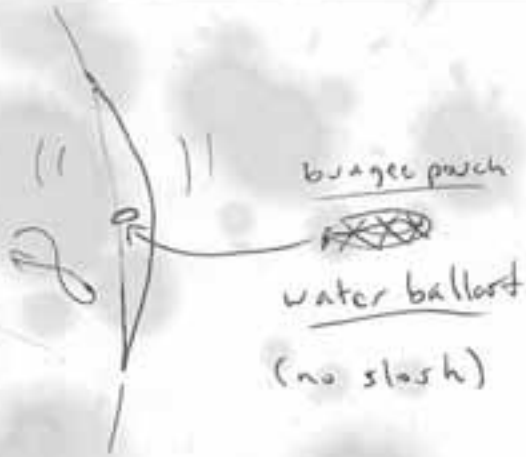
- Kite Therapy / Kite Education Enhancement
- Validate Claim - Kiting #1 pastime!
- New World Records - Altitude - 100 yrs old
  Distance - 181 hrs
  Size - 2000 m2
- Airborne Wind Energy - Upper wind is the only renewable that can power the whole world
- New designs
  New tools
  New sports

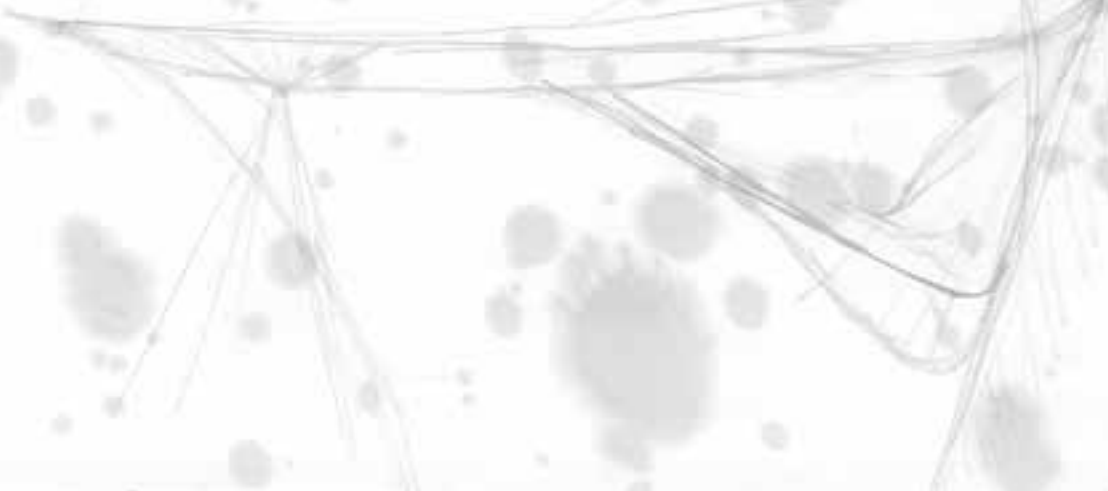
b 135

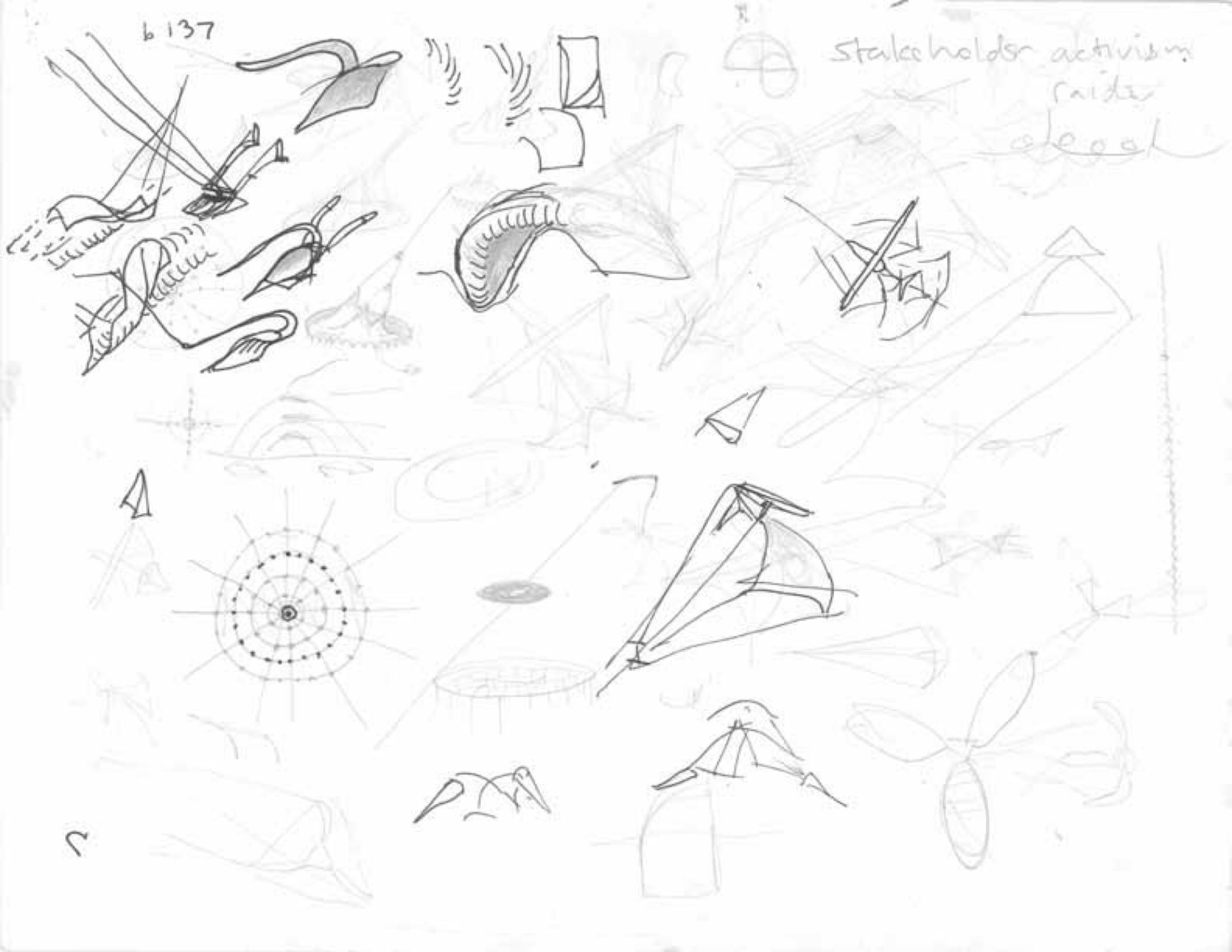


b 135

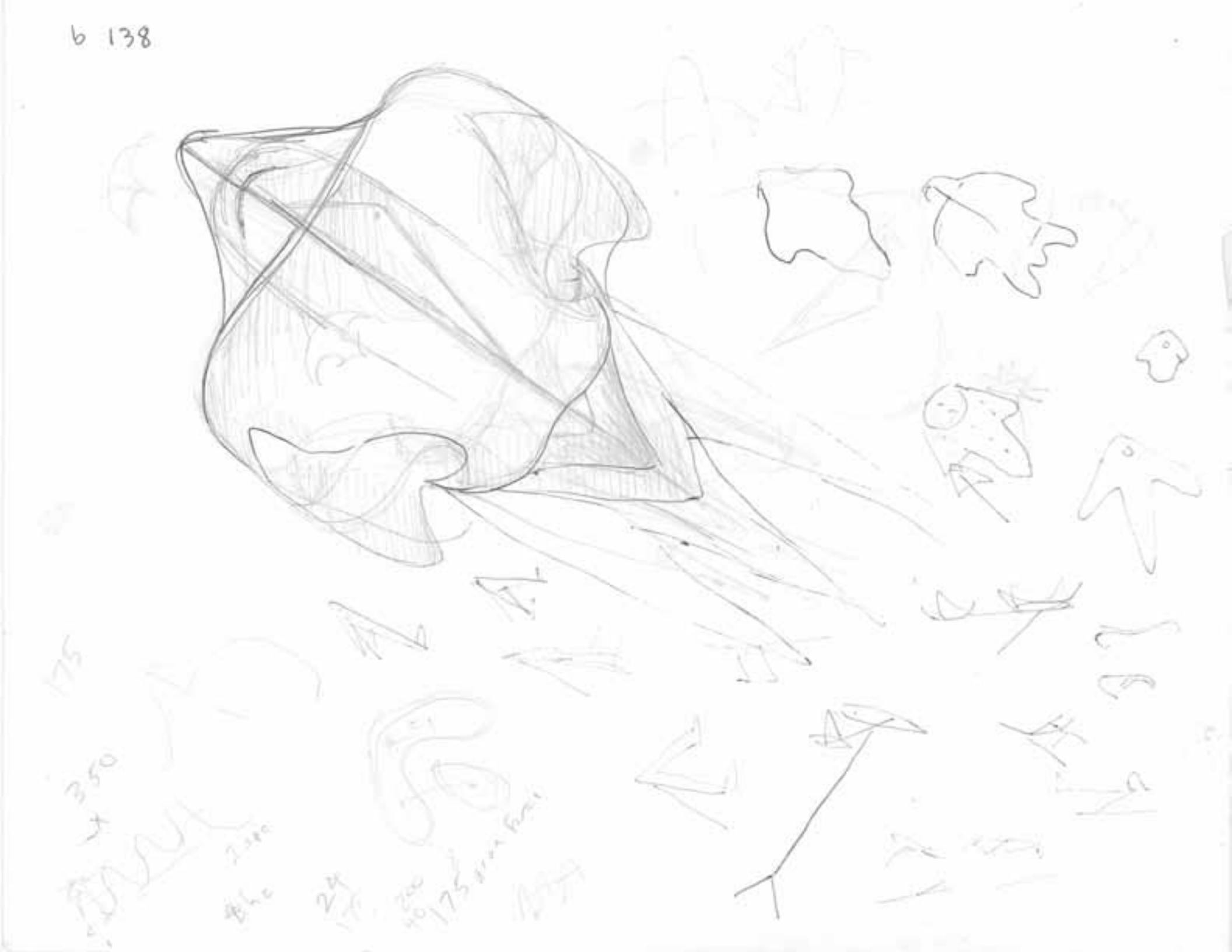



bungee pouch
water ballast
(no slosh)



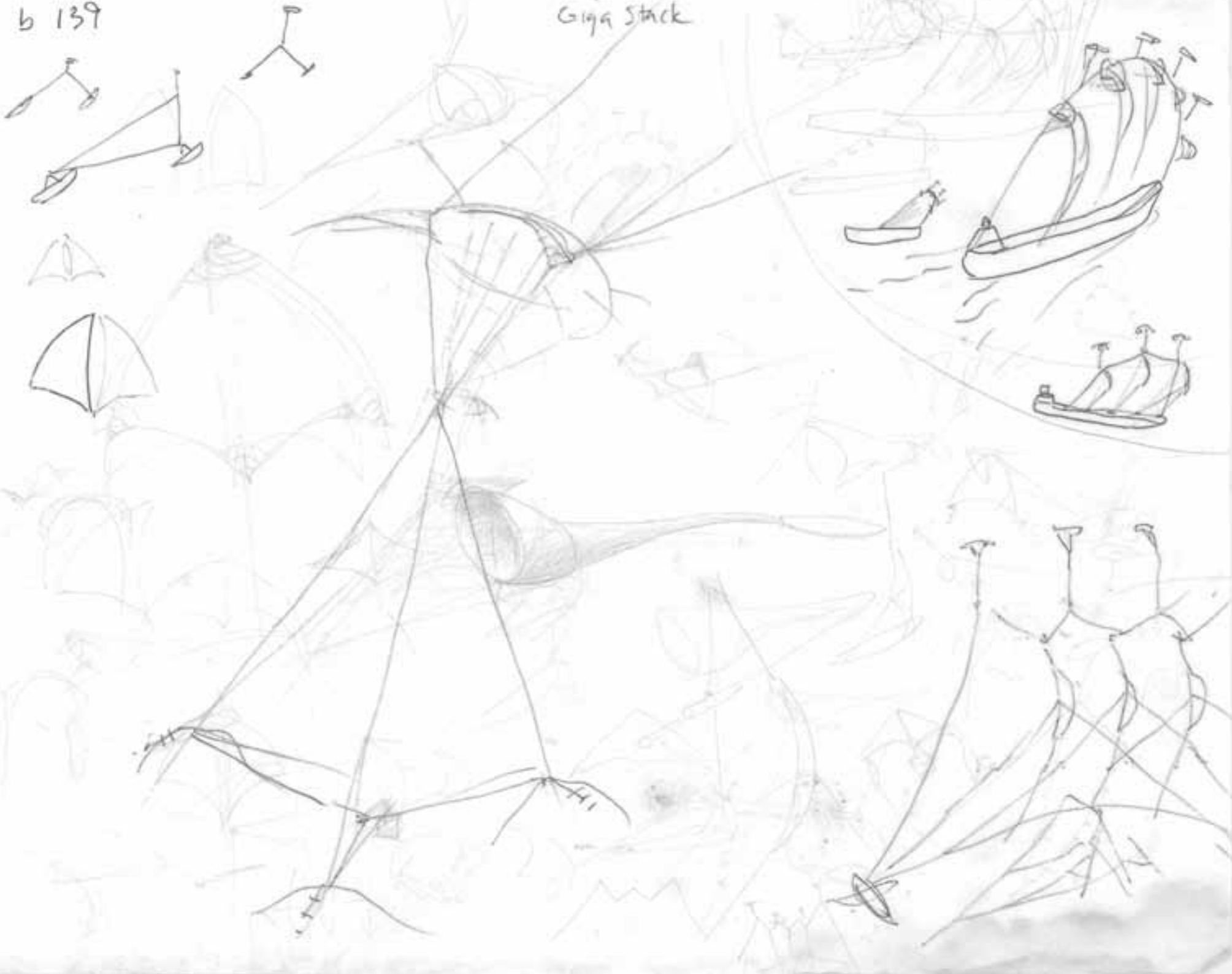

b137
stakeholder activism
raider
legal

b 138

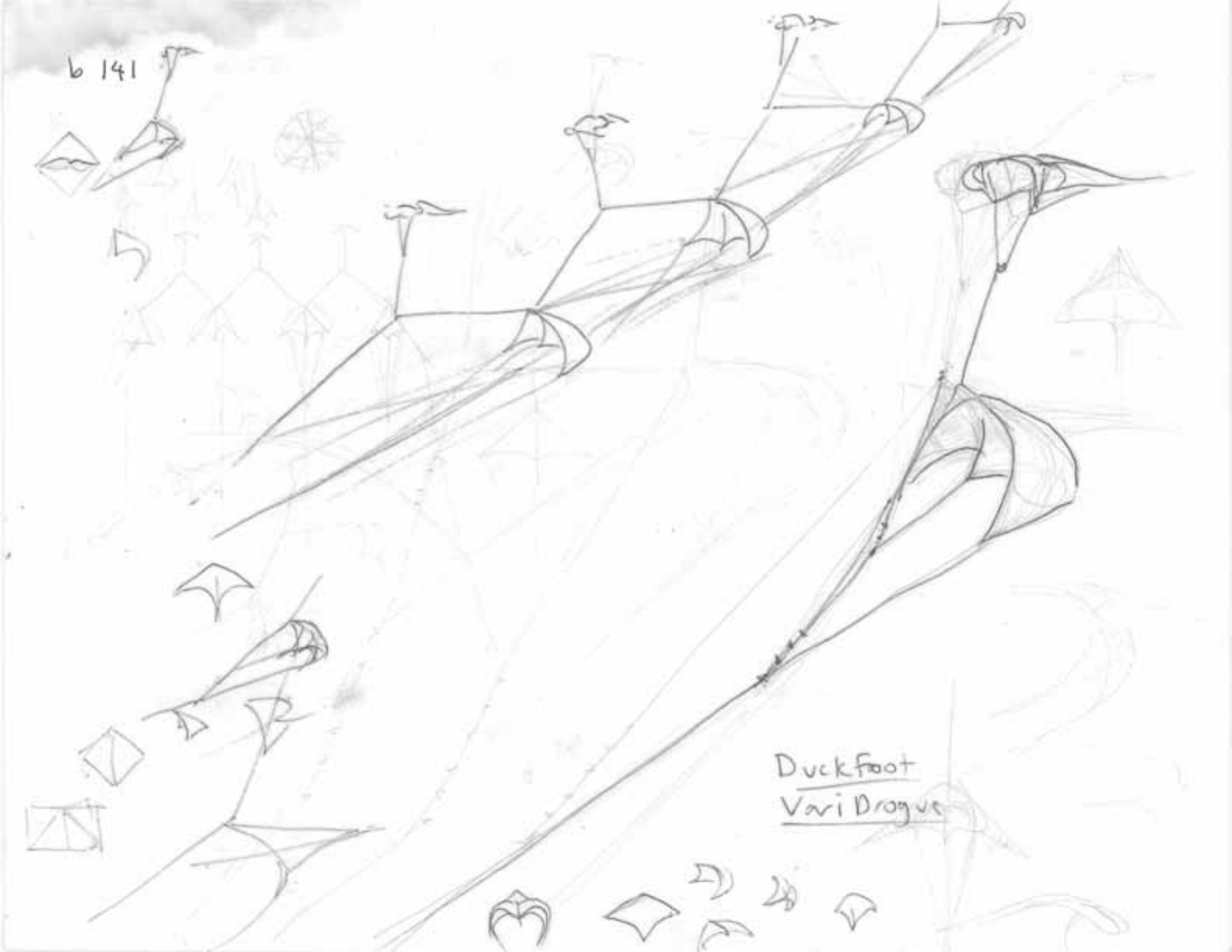


b 139

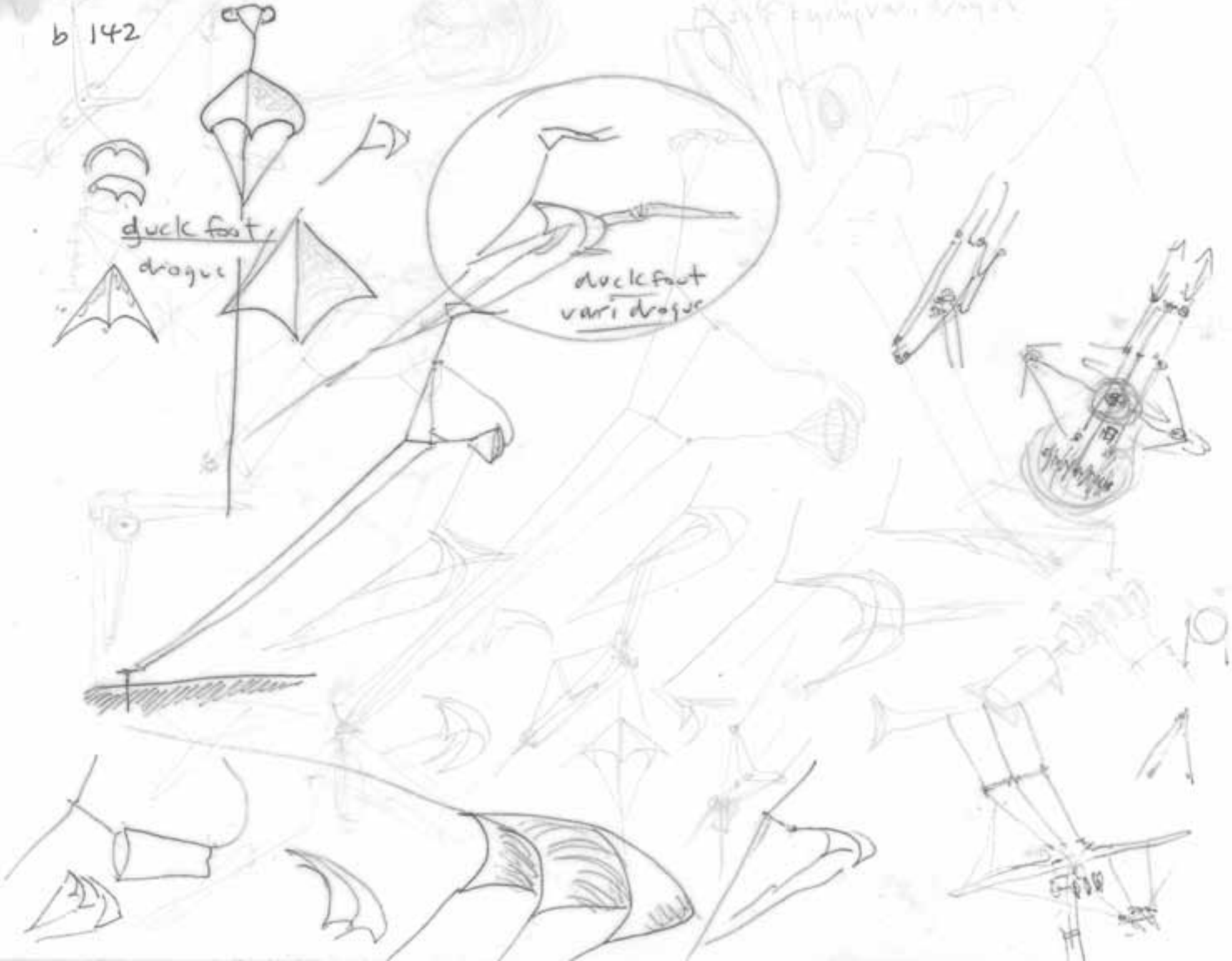
Giga Stack

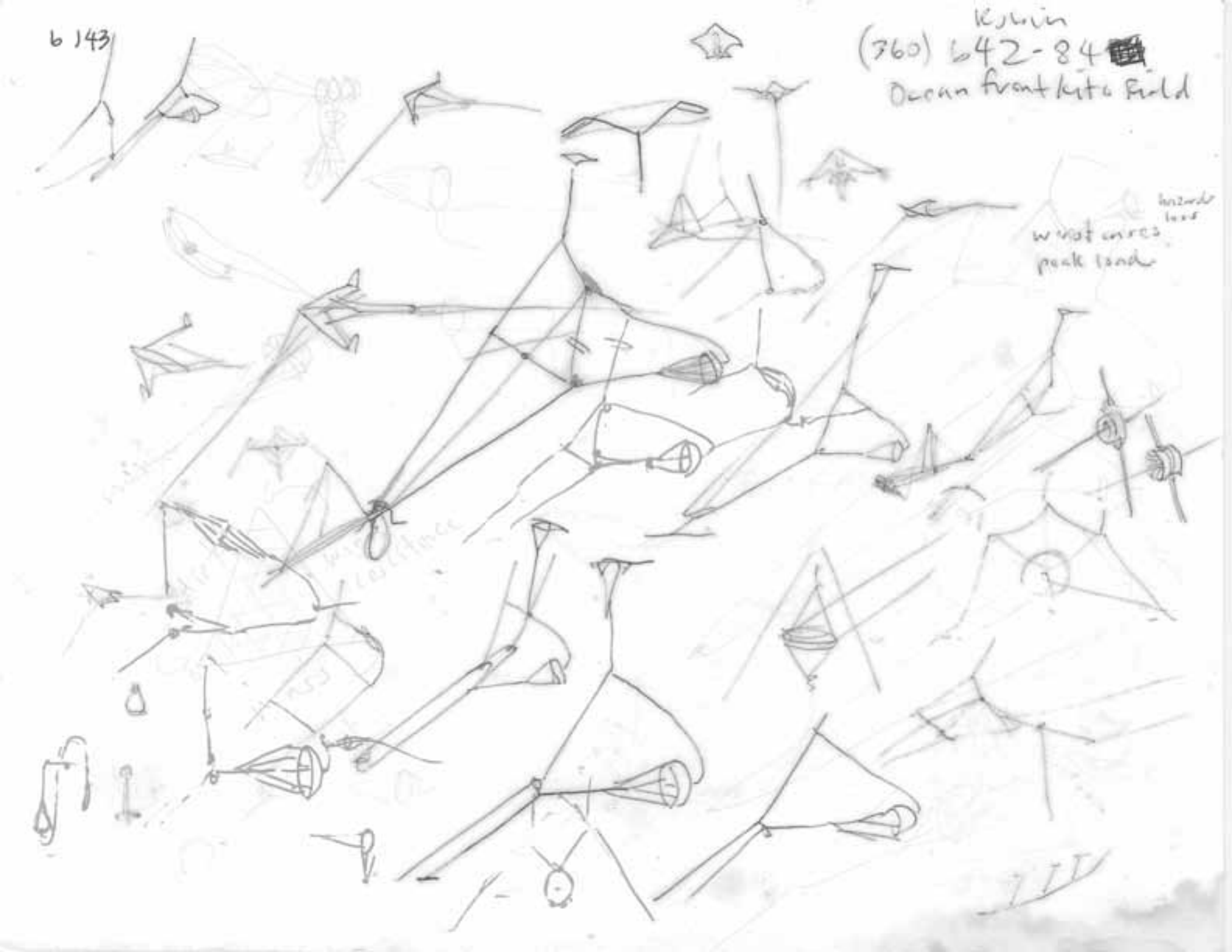


b 140
Hon FSDO
808 837 8305


b 141
Duckfoot
Vari Drogue

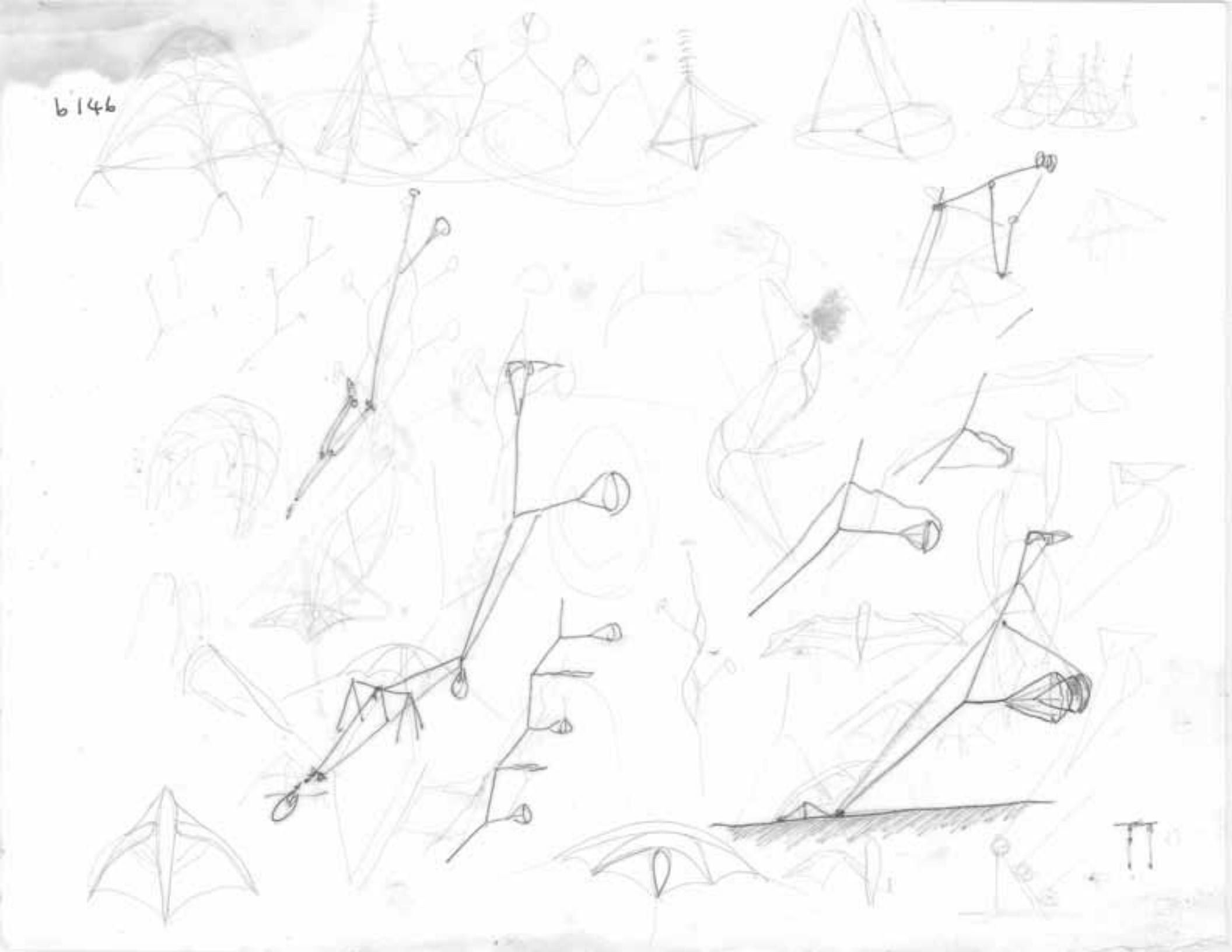
b 142




b 143
Kristin
(760) 642-84
Ocean front kite field
wrist curves
peak land

b 144

b146



b 147

Virtues

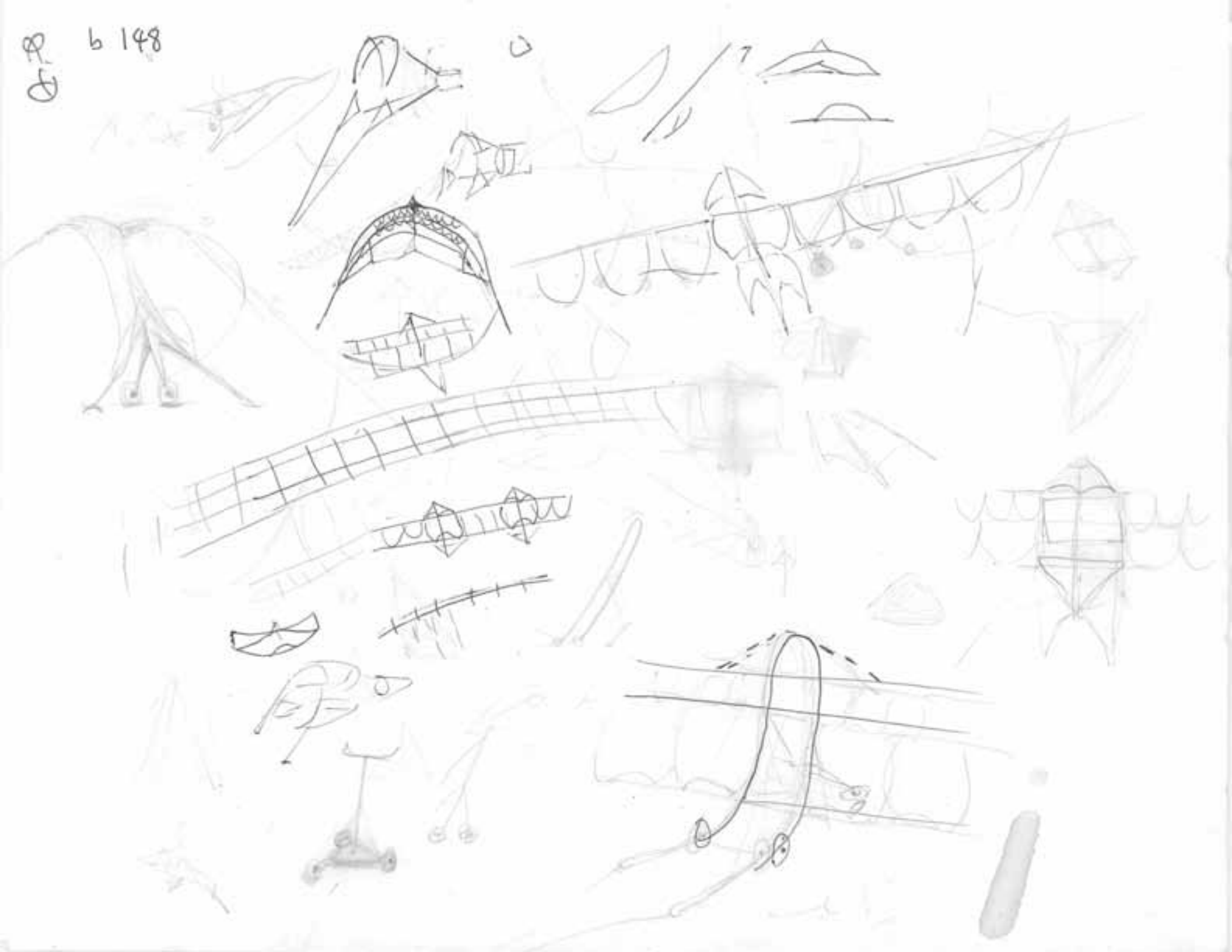
Heuristic Semantic Virtue Index - SVI

- ✓ crosswind power
- ✓ inherent stability
- low wing loading
- ✓ low capital cost
- ✓ high availability (high capacity factor)
- high infill factor
- ✓ low mass generator on ground
- ~~weight~~ safety/critical
- low cut-in
- high wind capable
- ✓ simplicity (no helium, no airborne, low personnel)
- high altitude capable
- ✓ insurability
- ✓ high scalability
- low surface ~~ground~~ footprint
- absence of large rigid structure for failure modes

Turbine Virtues

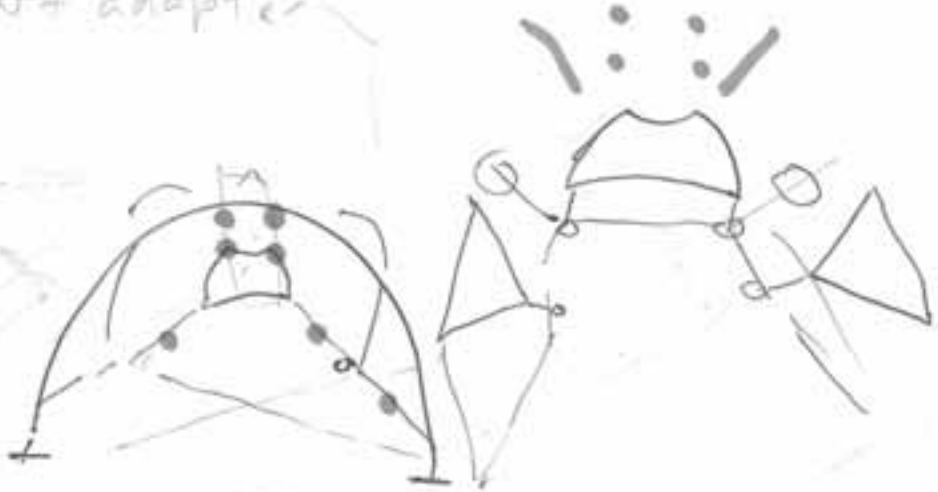
- 100% AoA
- 2 blades
- variable pitch
- no marking/interference

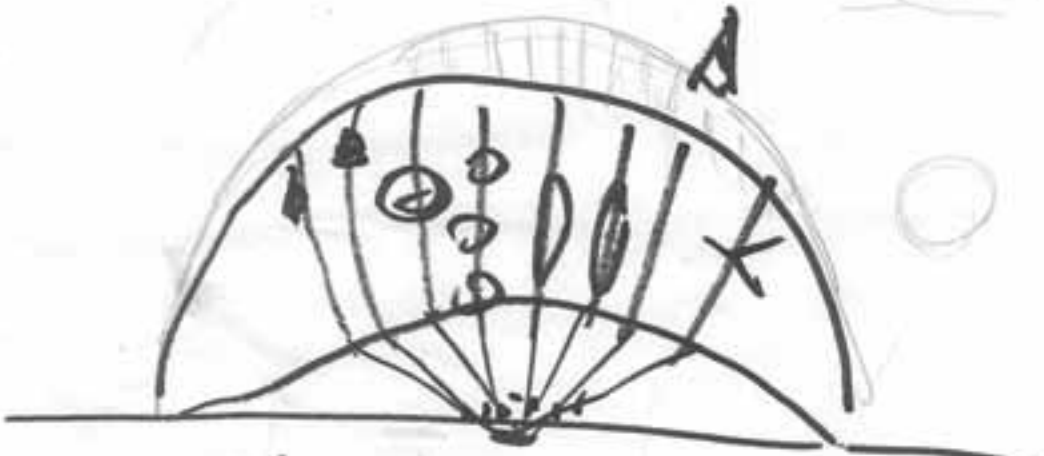
Wing Virtues



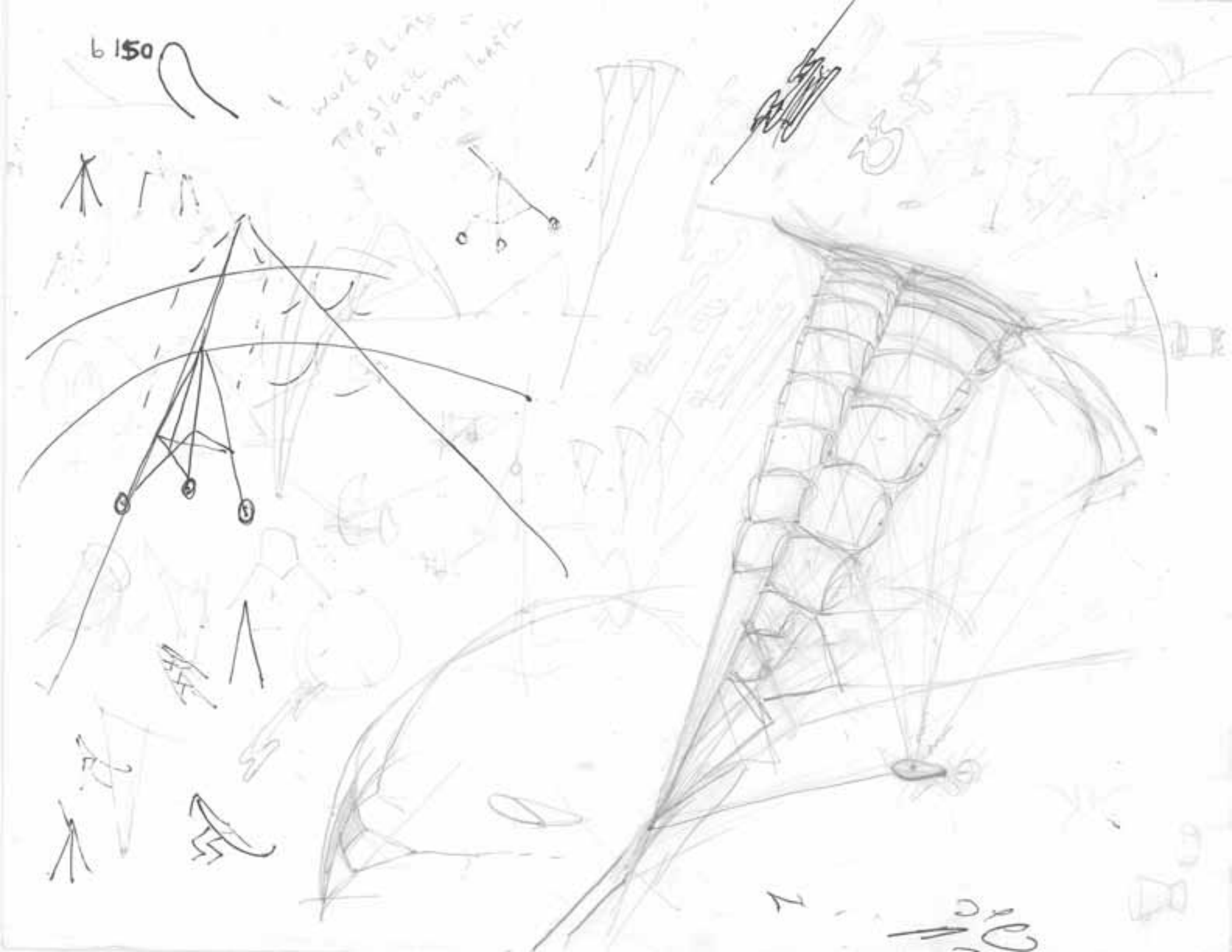
6 149

Shaft adapter

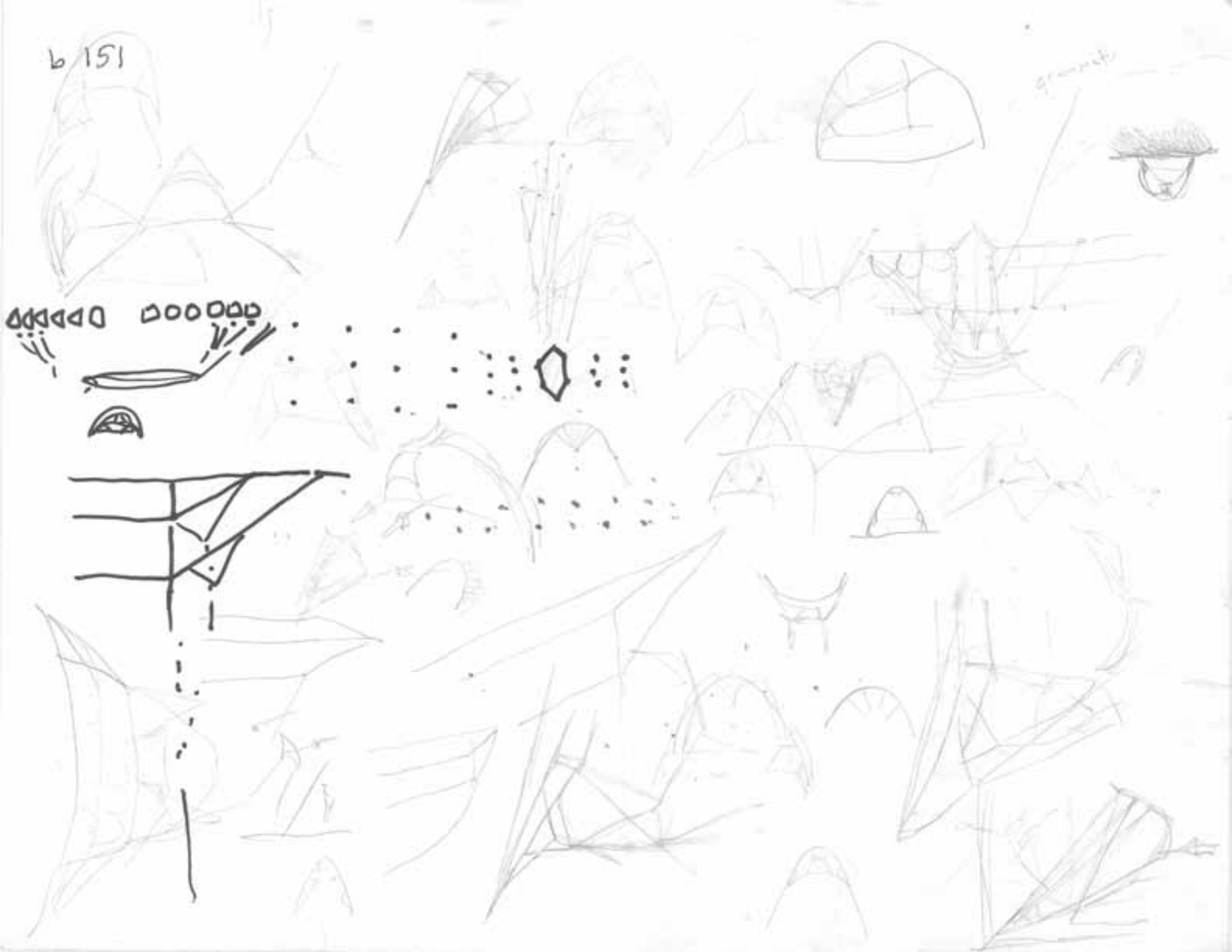


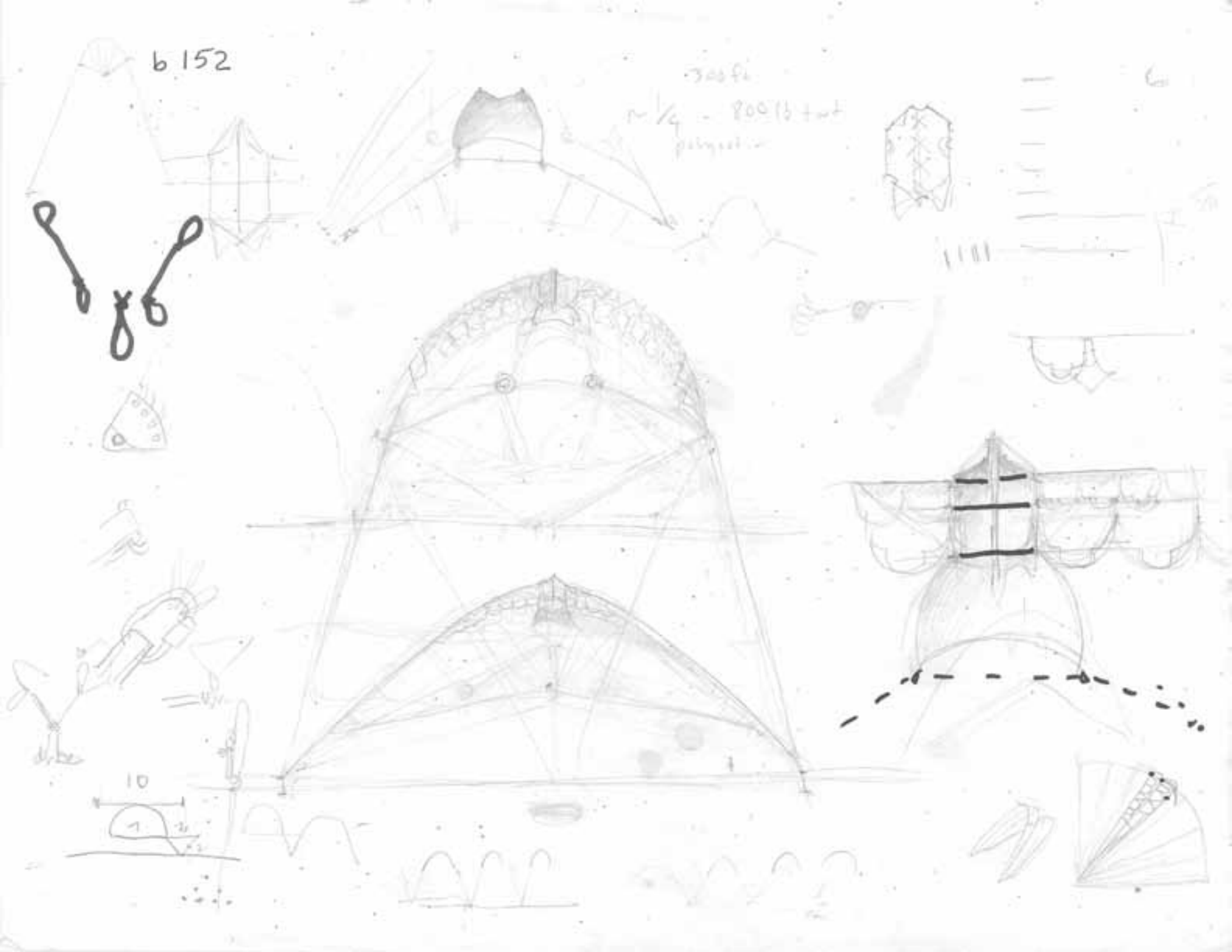


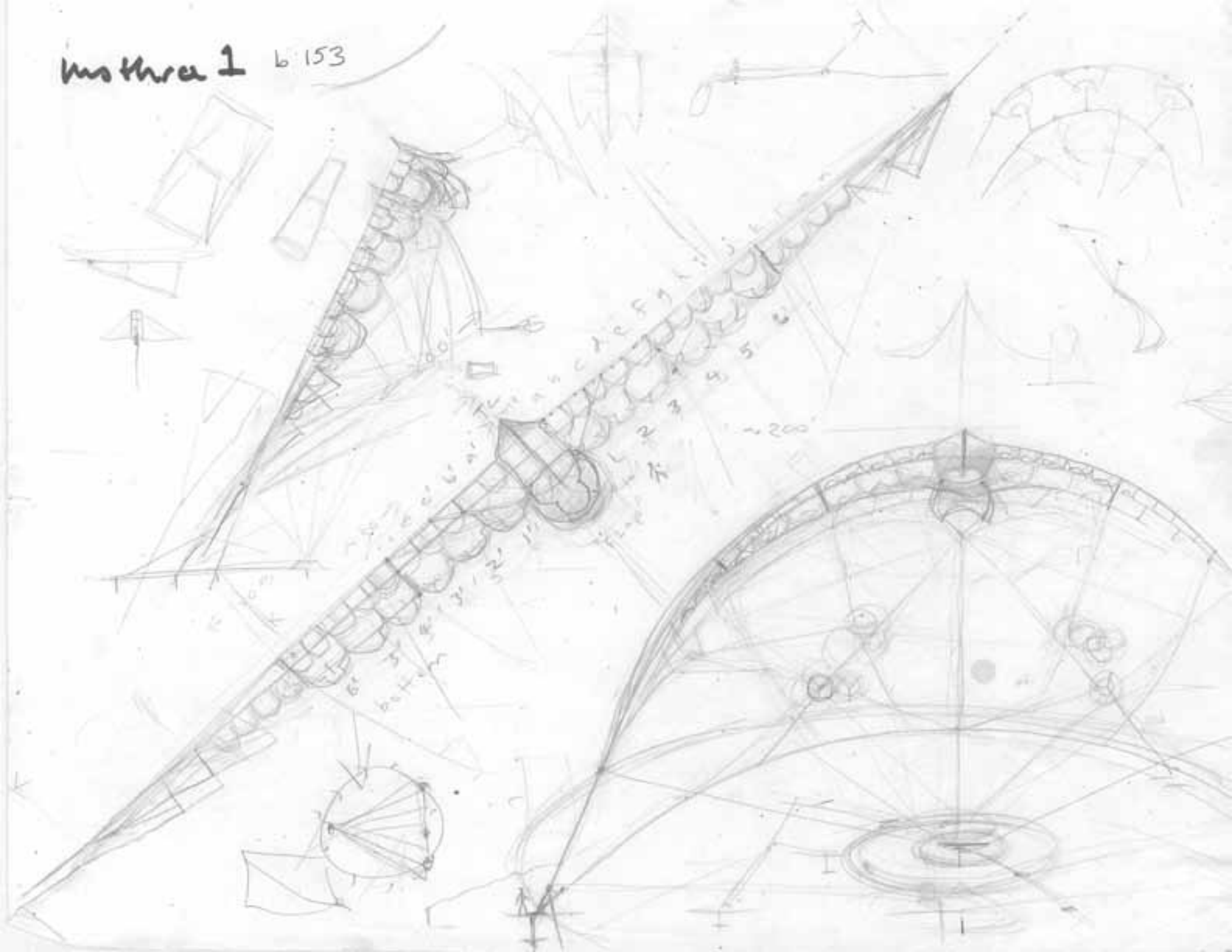
660 883


b 150

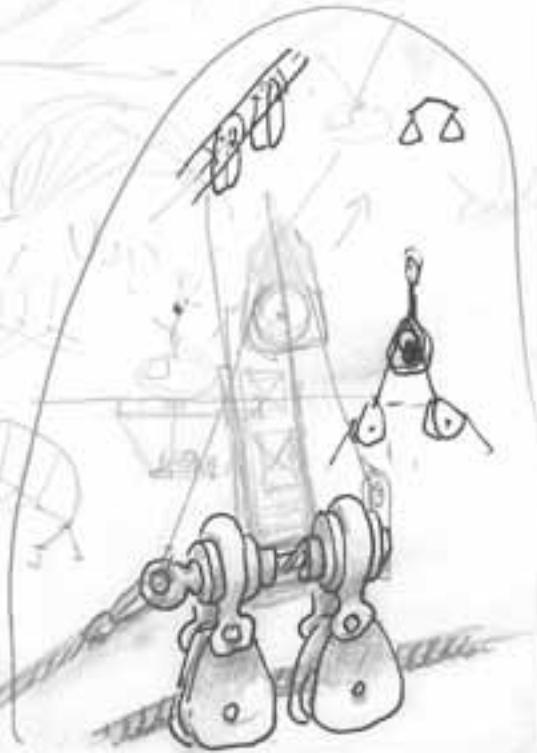
b 151



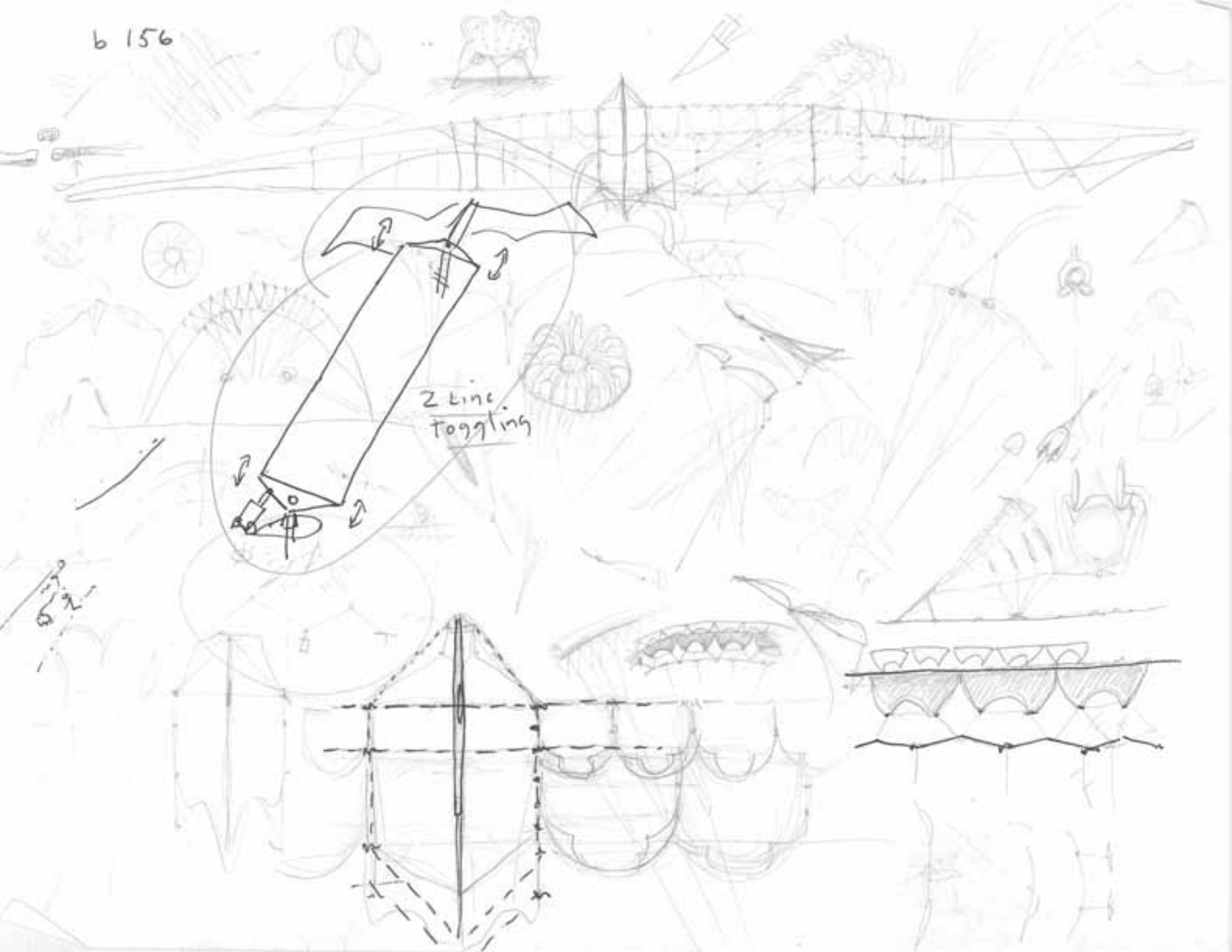

b 152
10


mothra 1 b 153

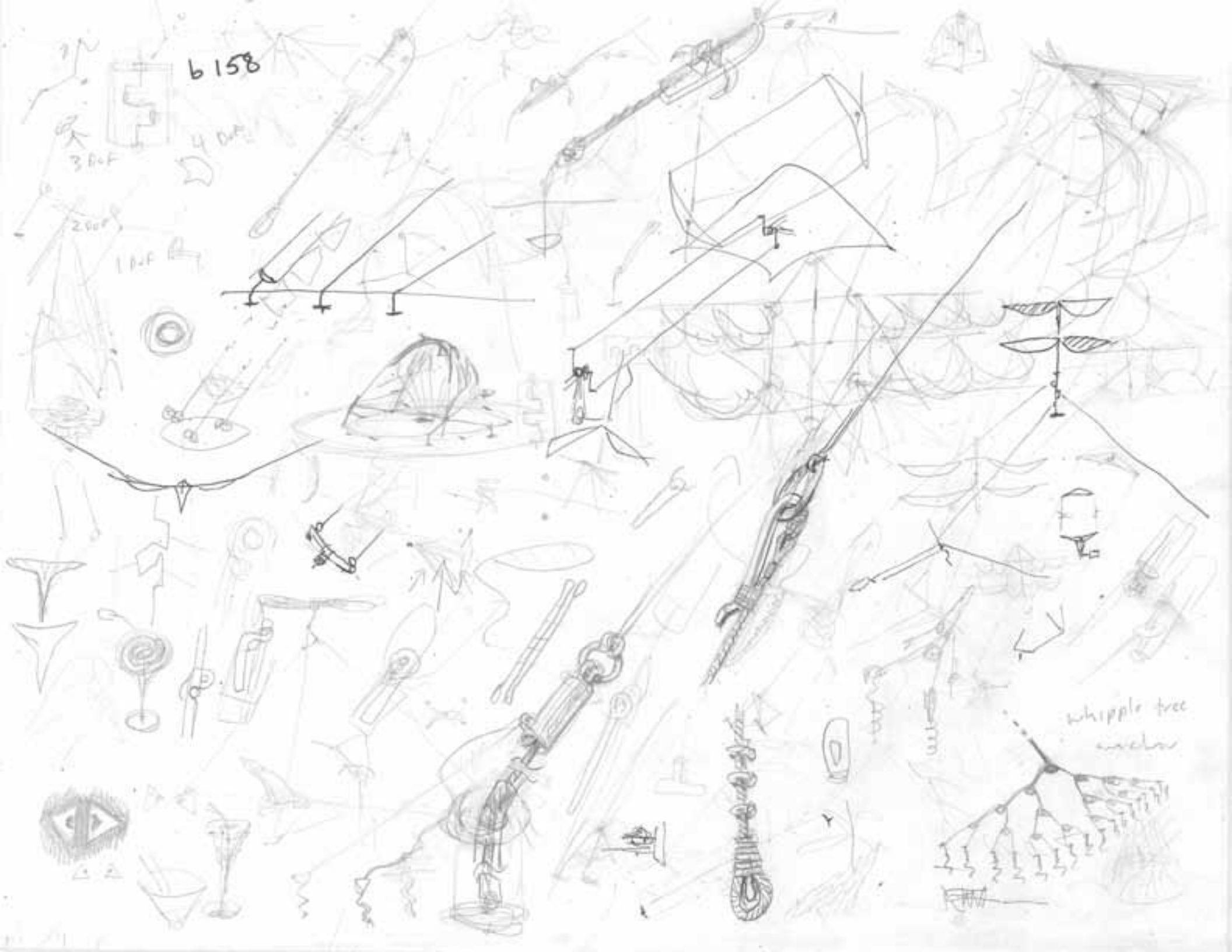
b 154

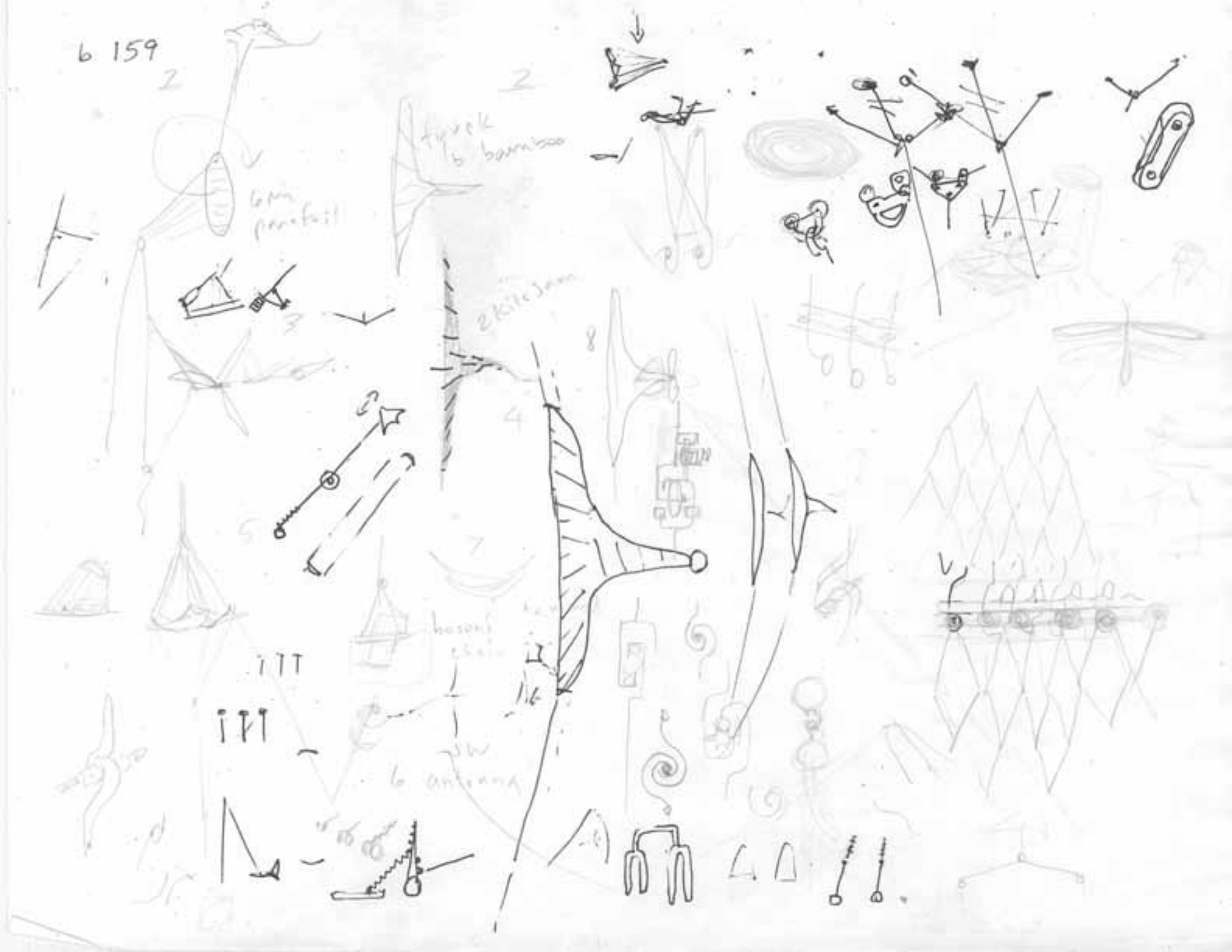


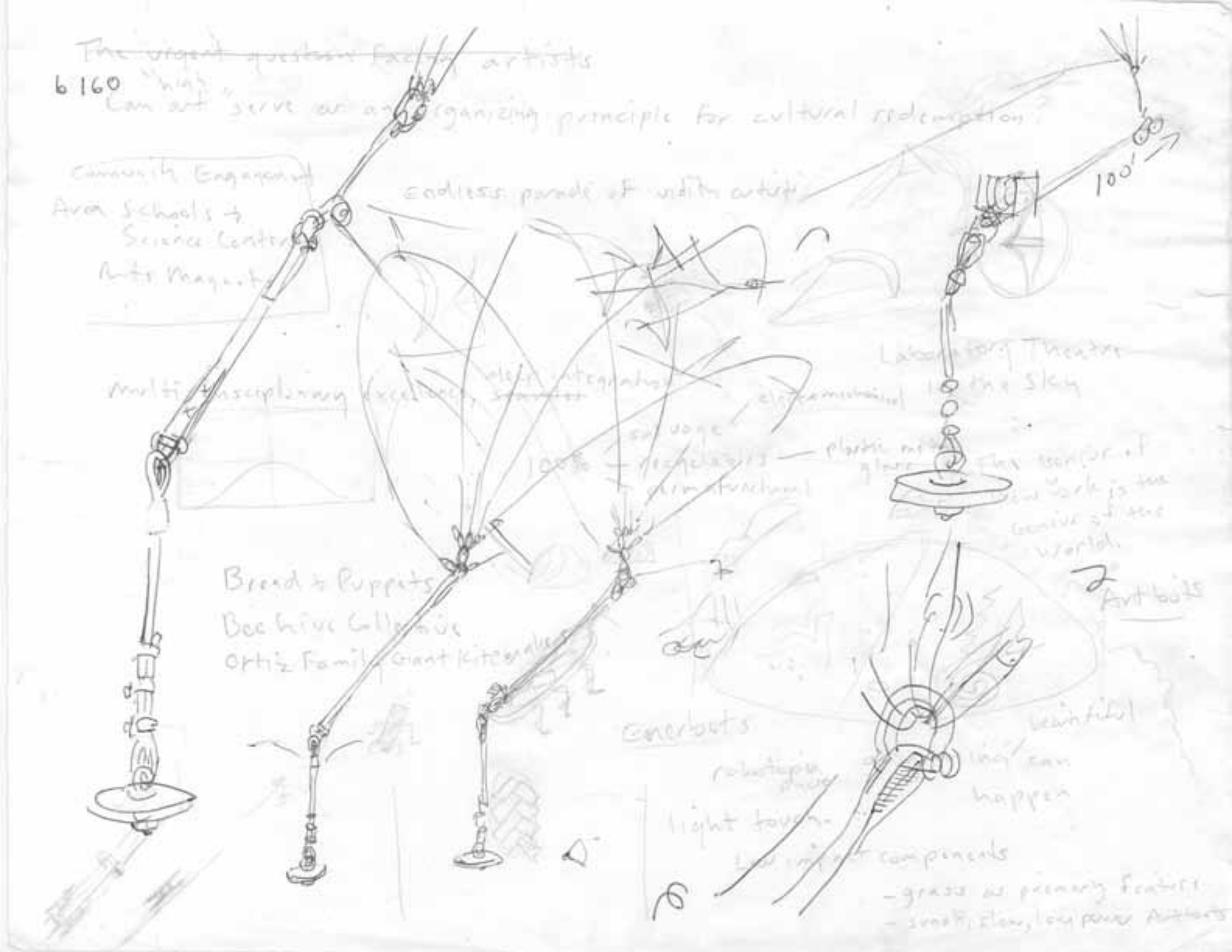
b 156

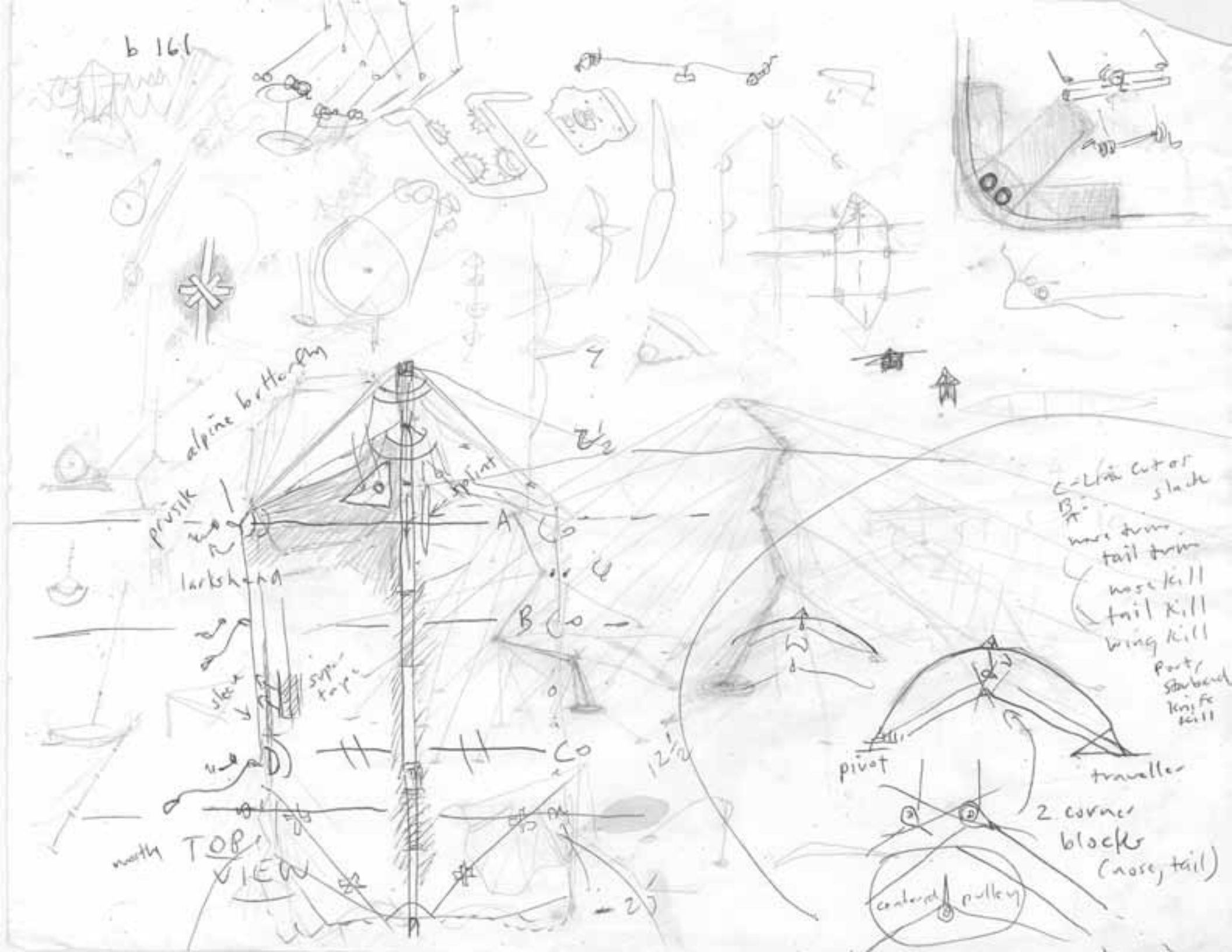


b 157

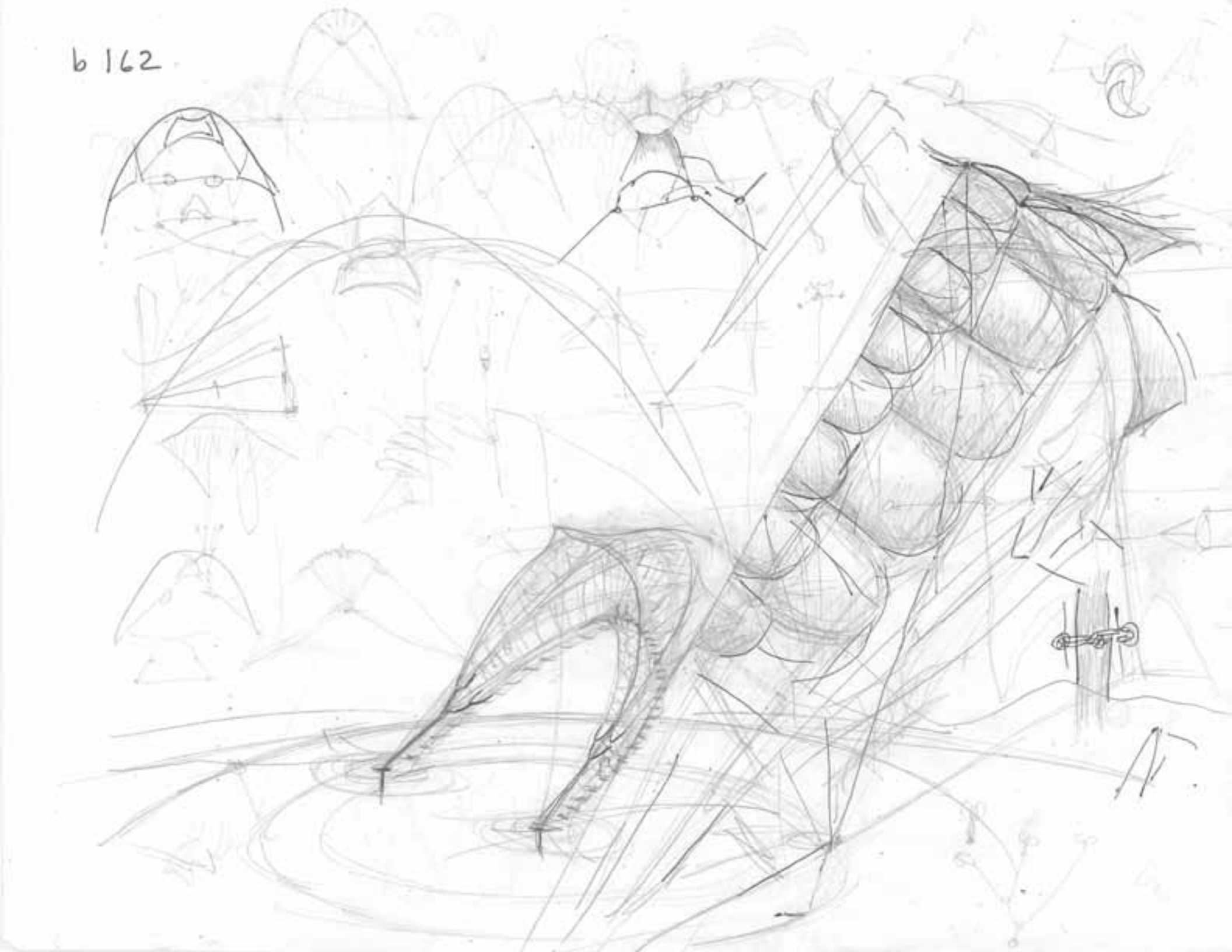

b 158
3 DoF
4 DoF
2 DoF
1 DoF
whipple tree
anchor


b 159

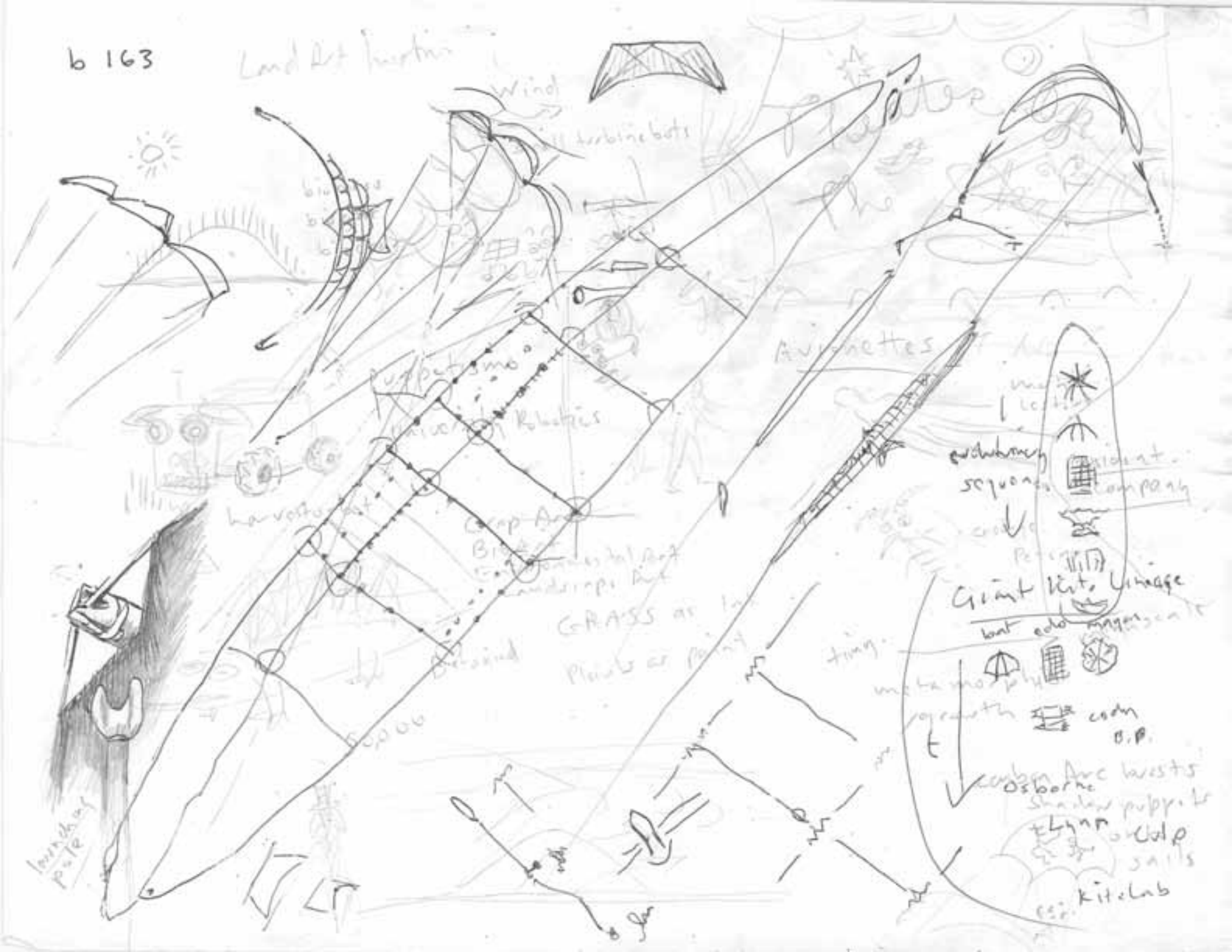

6160
100'
Bread & Puppets
Beehive Collective
Ortiz Family Giant Kites


b 161
alpine butterfly
prusik
larkshead
splint
A
B
C
D
sleeve
super tape
math TOP VIEW
12½
pivot
traveller
2 corner blocks (nose, tail)
condensed pulley
C-Line cut or slack
B/A
nose trim
tail trim
nose kill
tail kill
wing kill
Port, Starboard knife kill

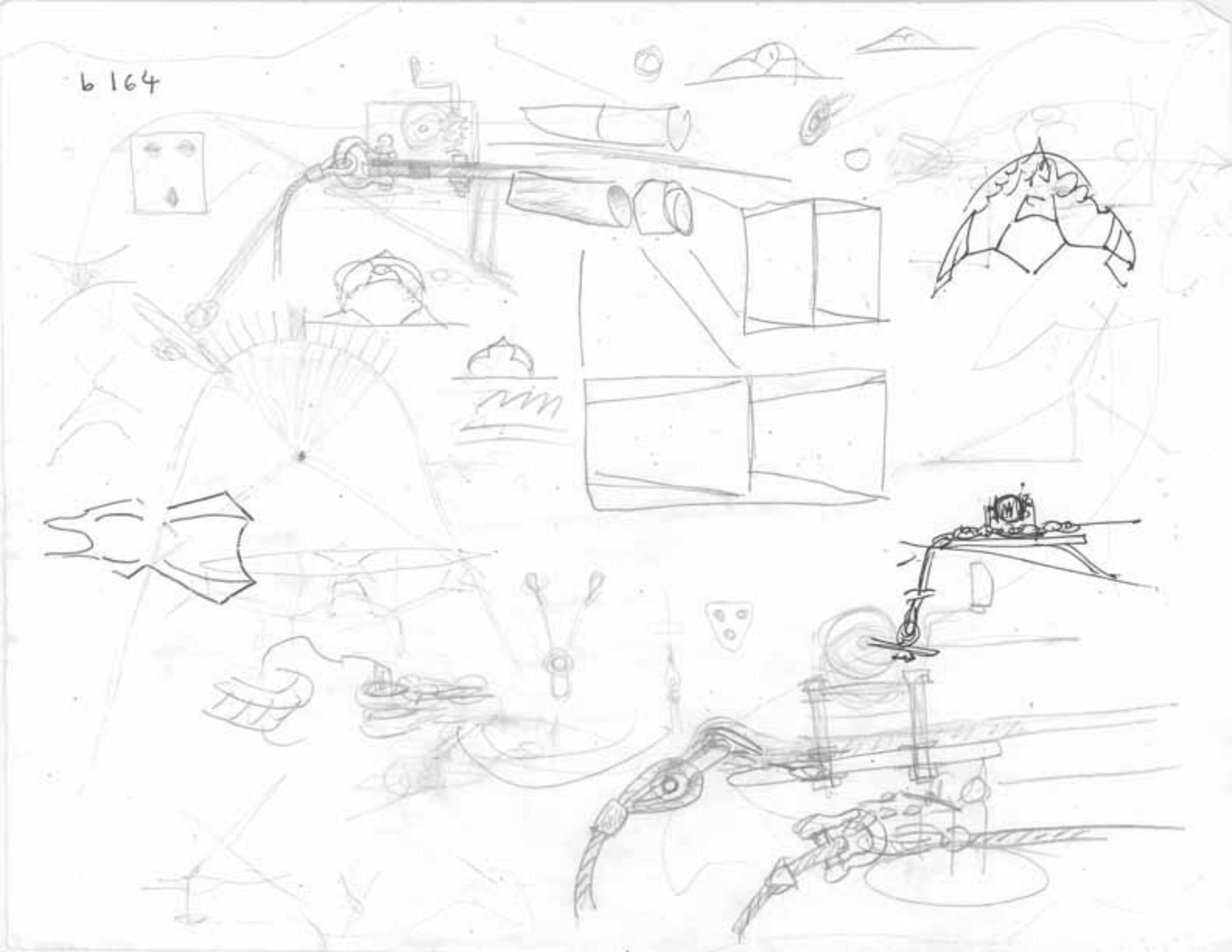
b 162



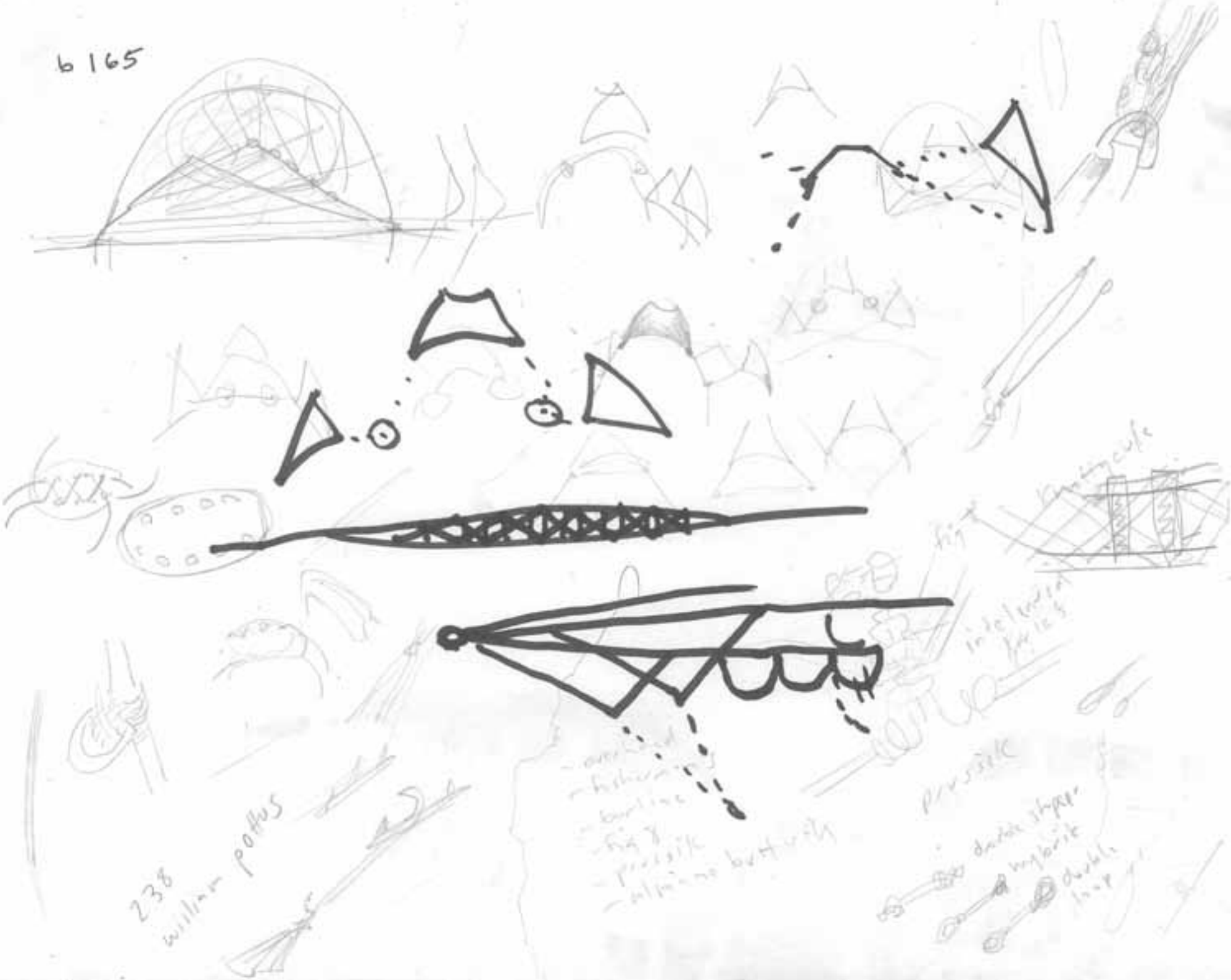
b 163



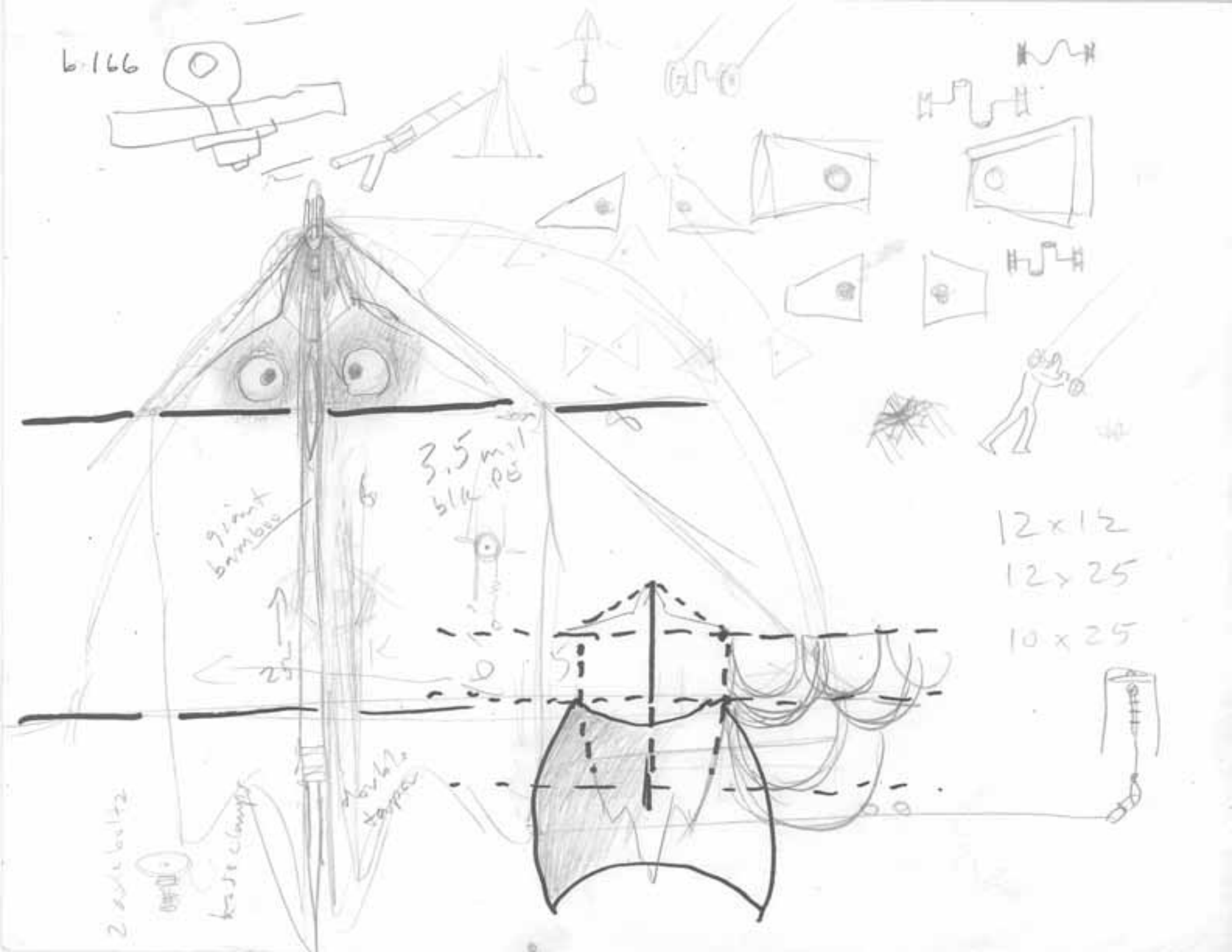
b 164



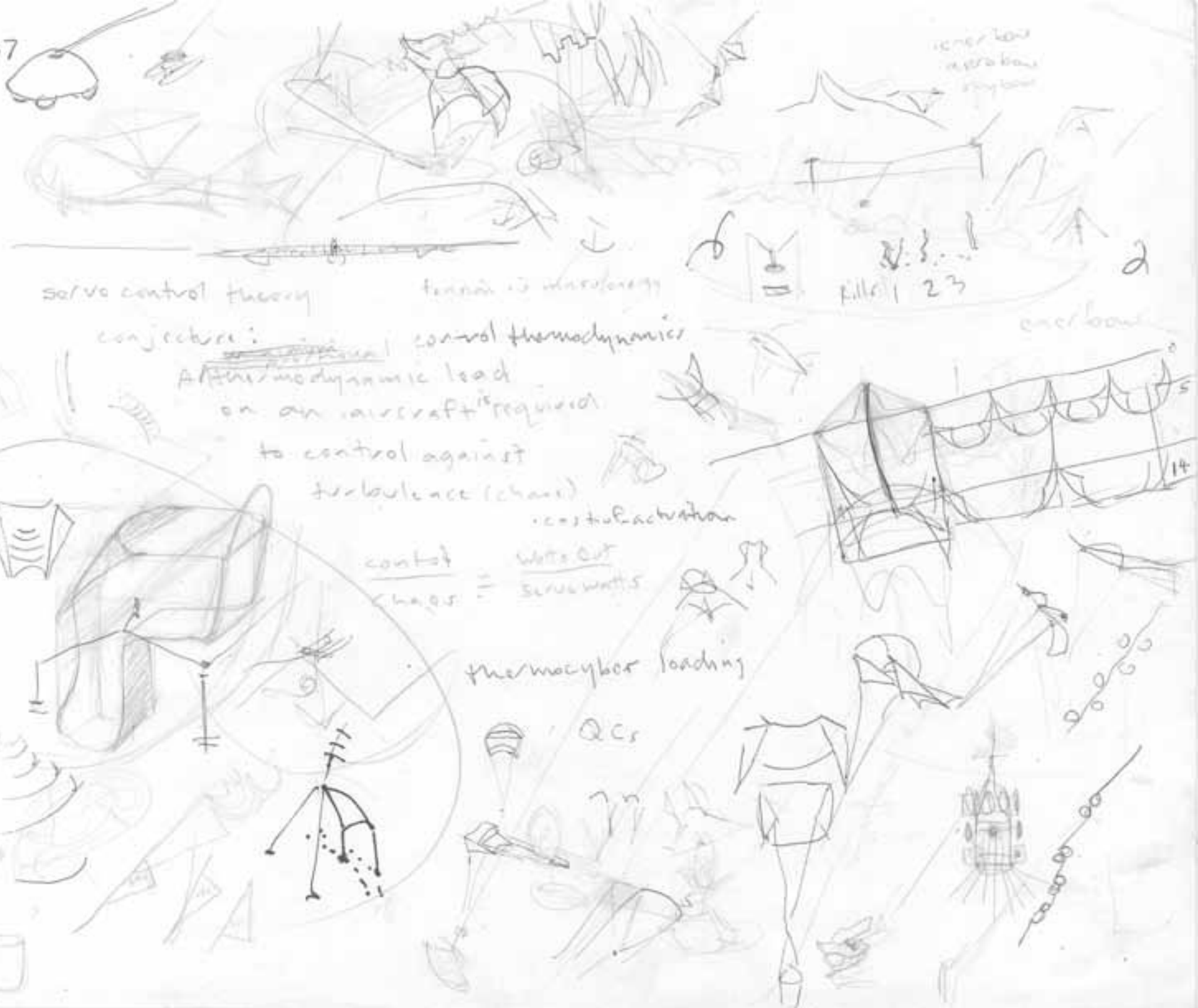
b 165



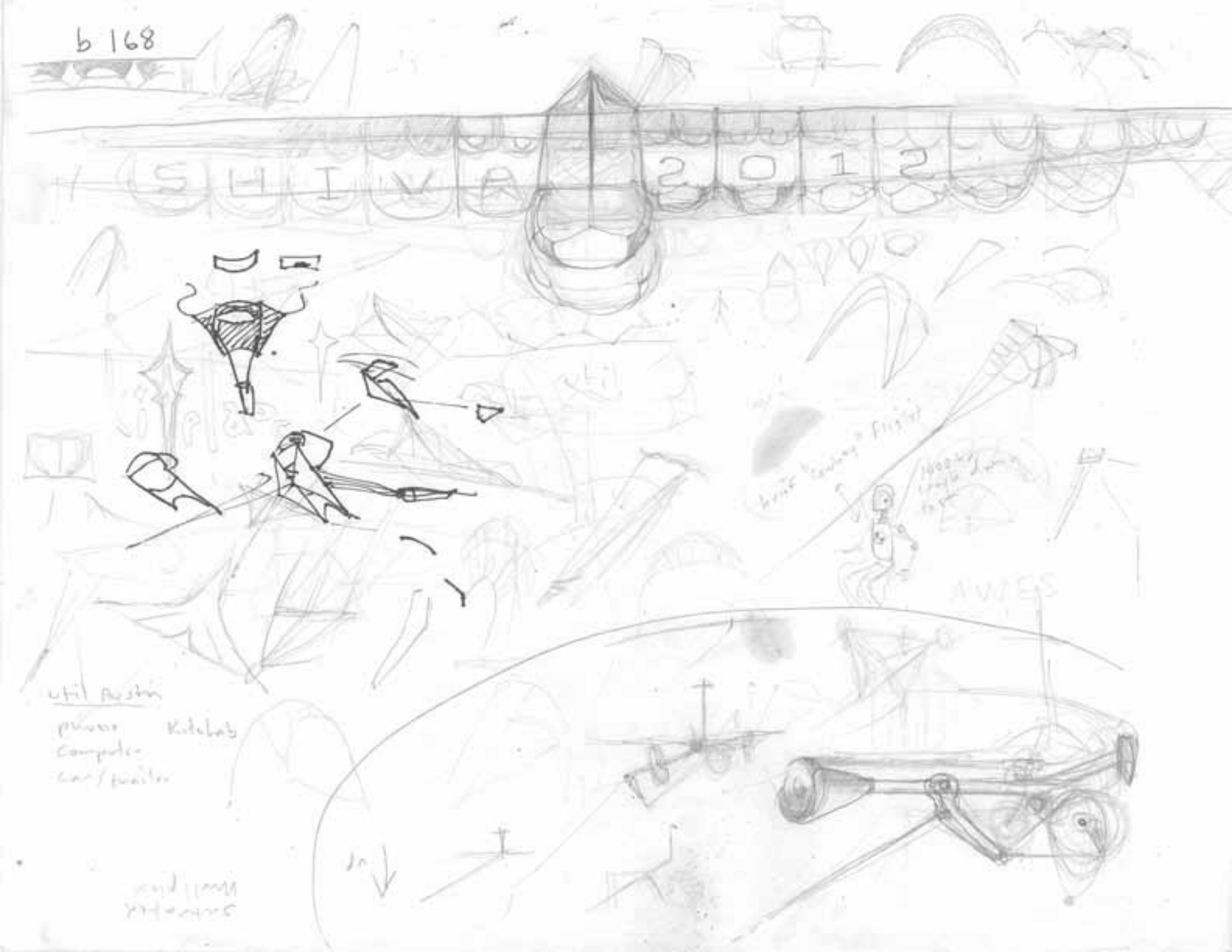
238
William Pottus
prussik
double stopper
hybrid
double loop

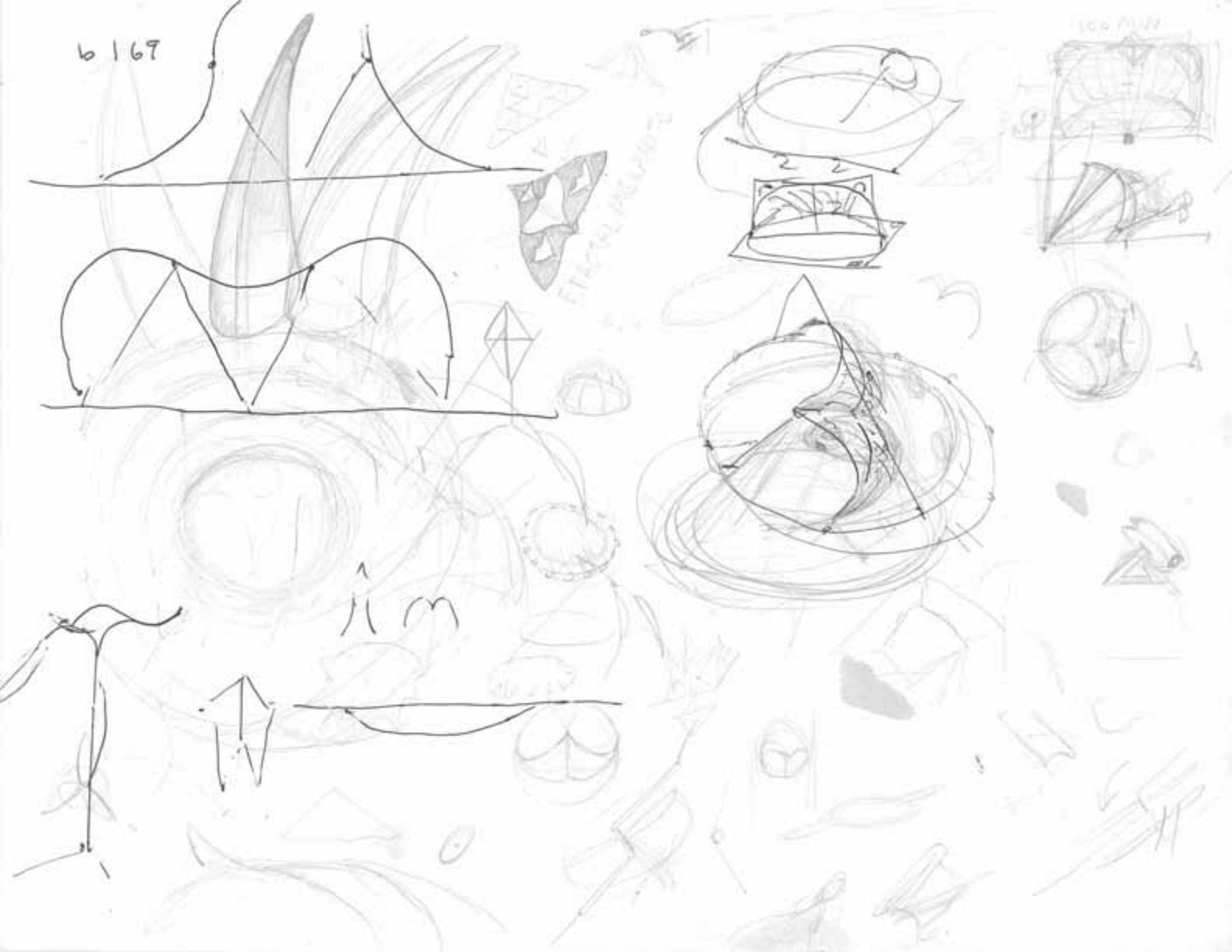

b.166
3.5 mil blk PE
giant bamboo
12x12
12x25
10x25

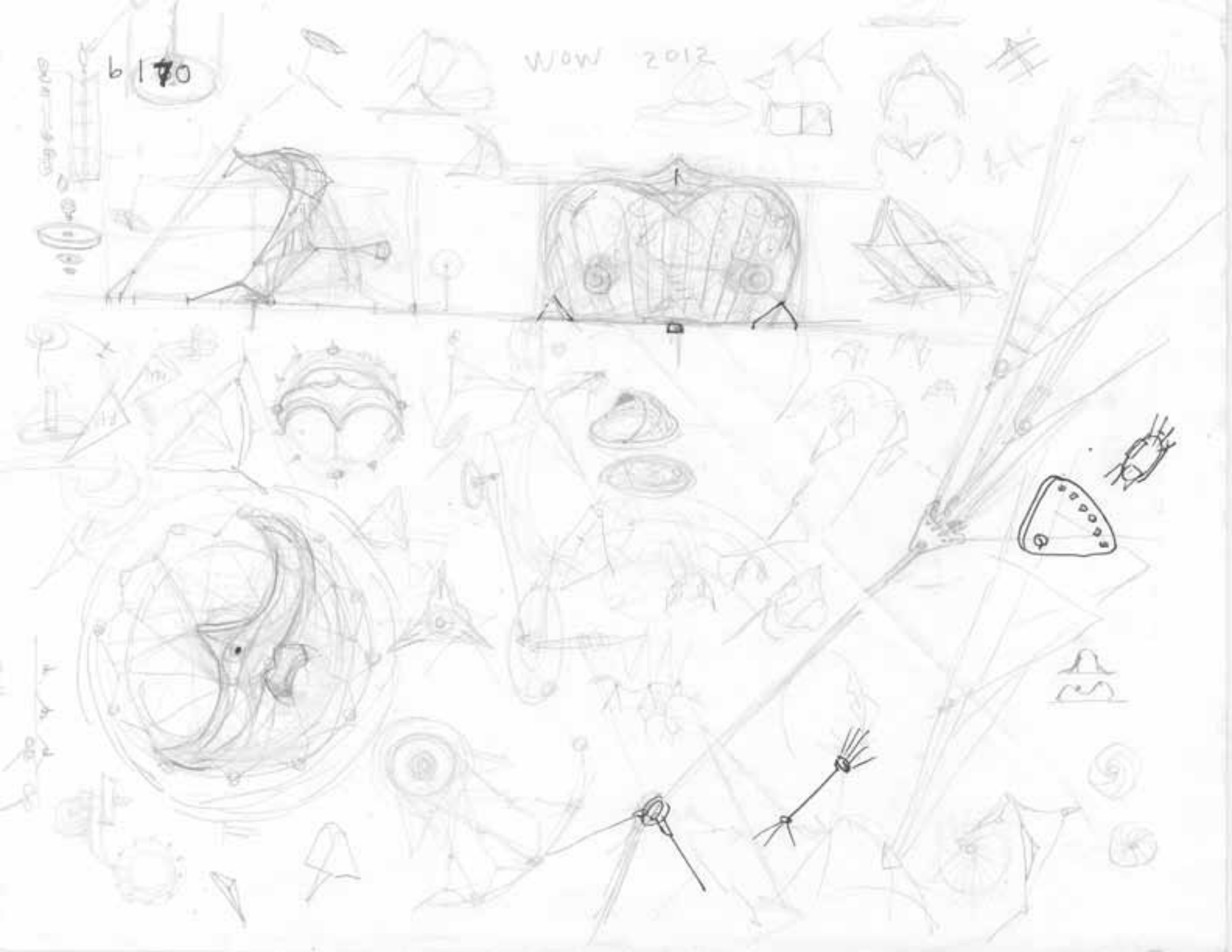
b167


servo control theory
conjecture:
control thermodynamics
aerothermodynamic load
on an aircraft is required
to control against
turbulence (chaos)
constructivism
control / chaos = watts out / servo watts
thermocyber loading
QCs

b 168

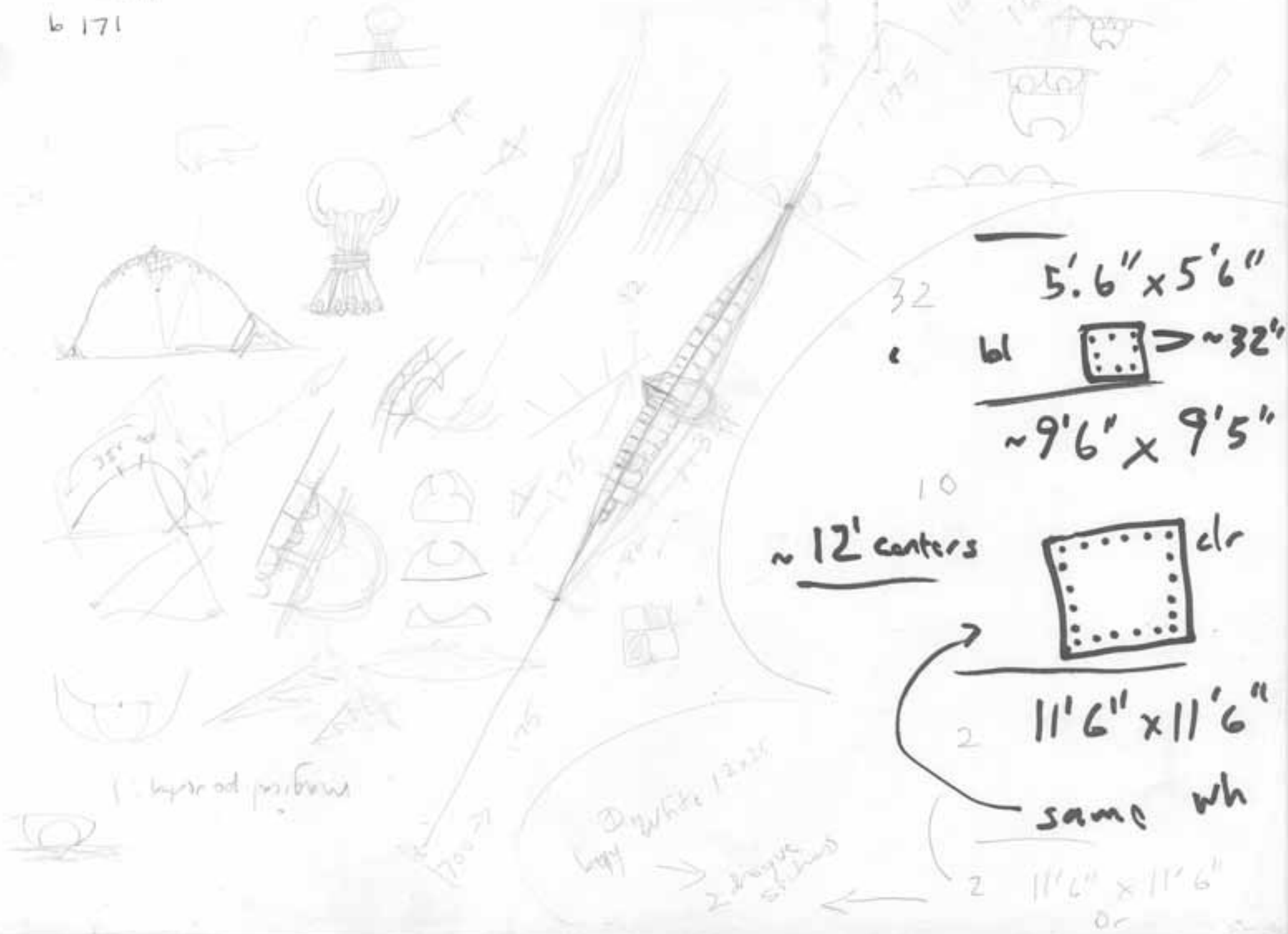



b 169

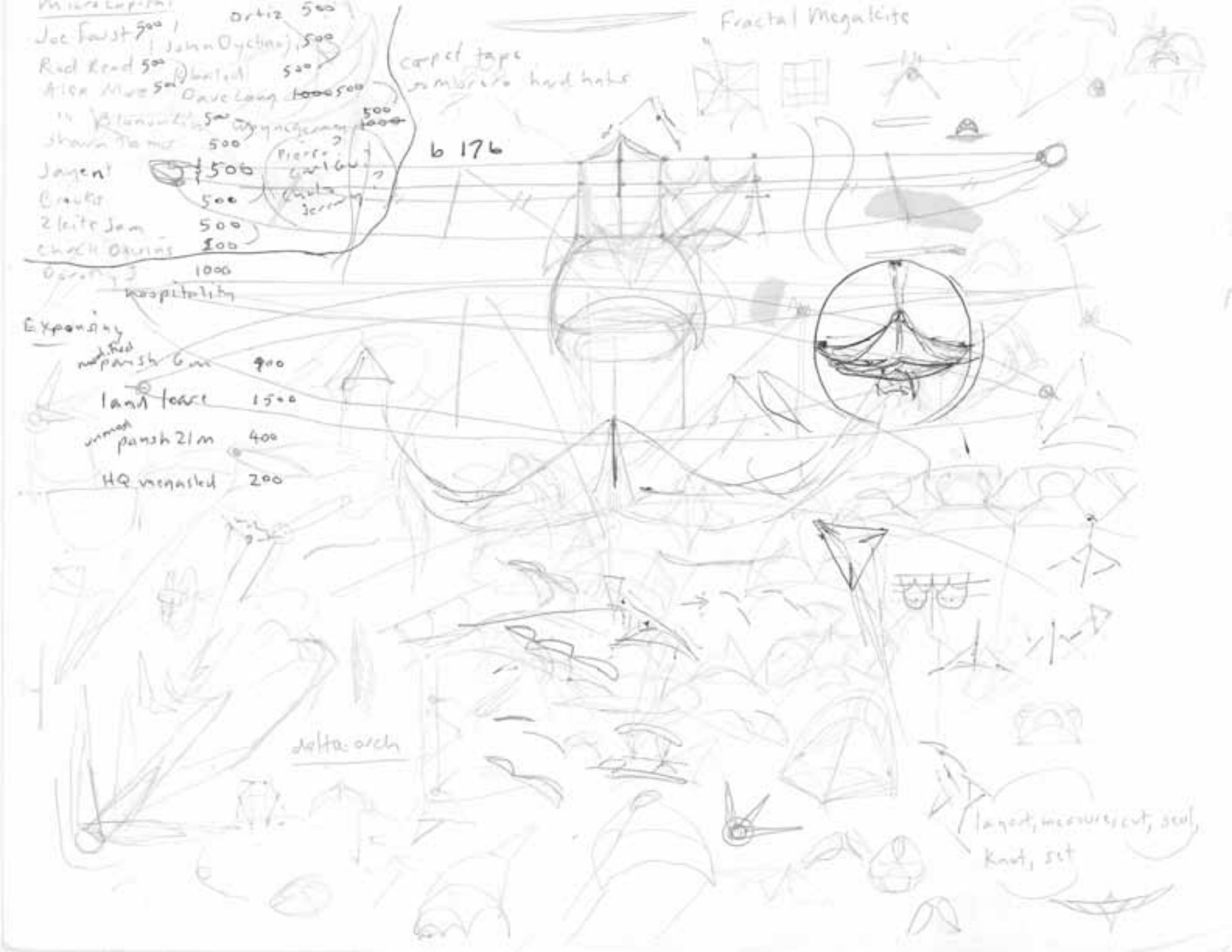

WOW 2012

Dicippe Sept 2012

b 171



b 172



Micro Capital

Joe Faust 500
Rod Read 500
Alex Moe 500
Shawn Tomes 500
Jayent 500
Brooks 500
Zleite Jam 500
Chuck Owens 500
Dorothy J 1000
hospitality

Ortiz 500
John Dyctinoj 500
Ubaldo 500
Dave Long ~~1000~~ 500
Wayne Germany 500 ~~1000~~
Pierre Carl Gu
Chula Jerrany

carpet tape
sombrero hard hats

b 176

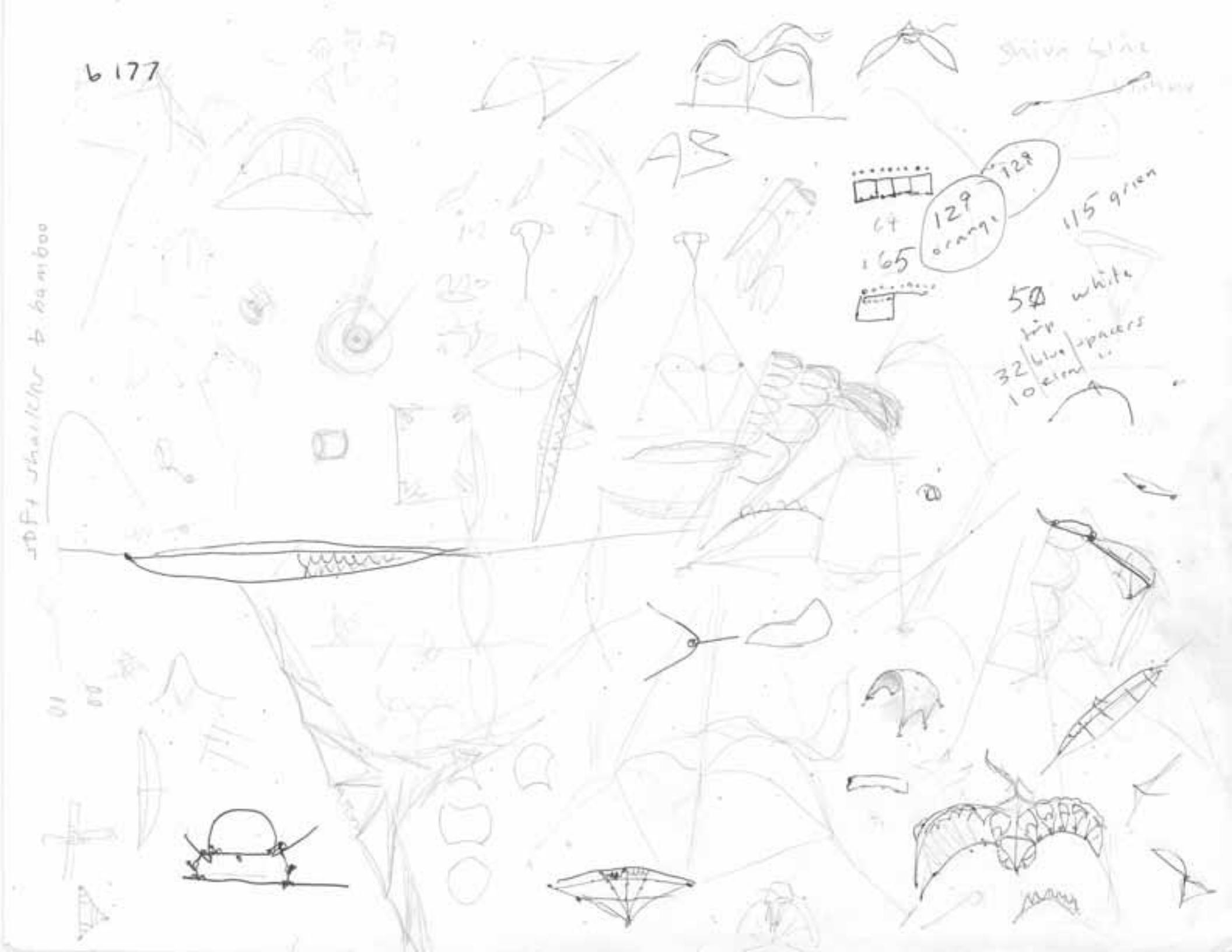
Fractal Megakite

Expansing

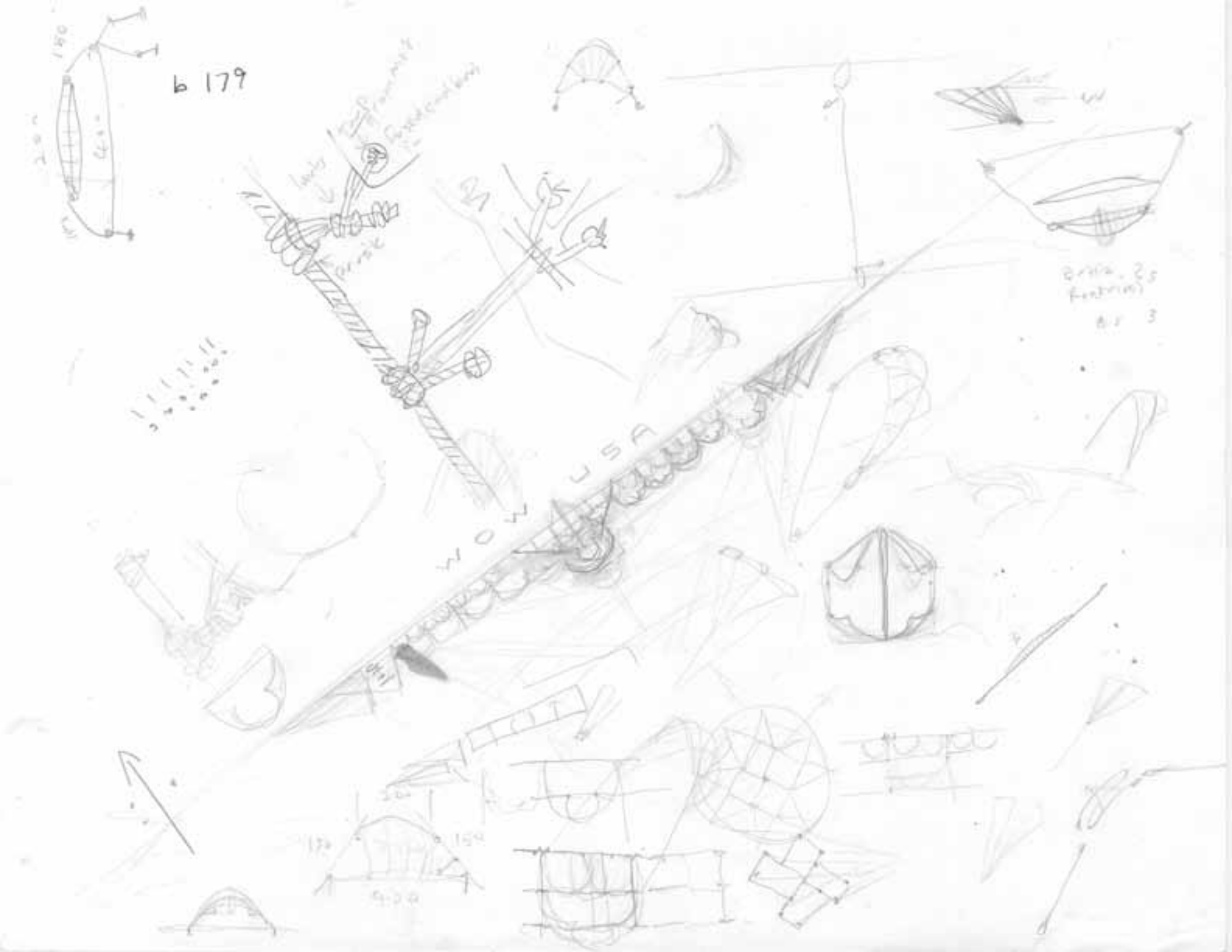
modified parish 6m 900
land leave 1500
unmod parish 21m 400
HQ megasled 200

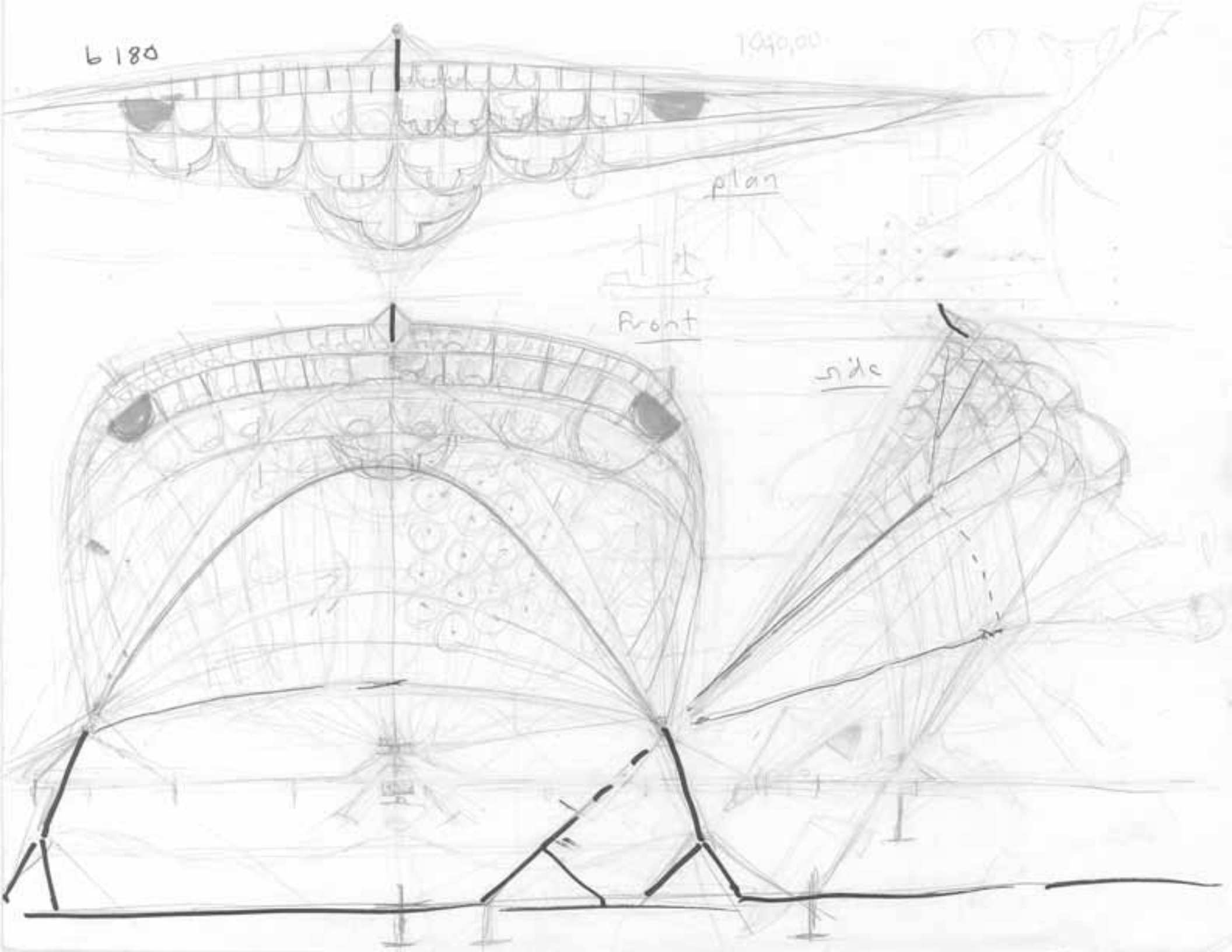
delta arch

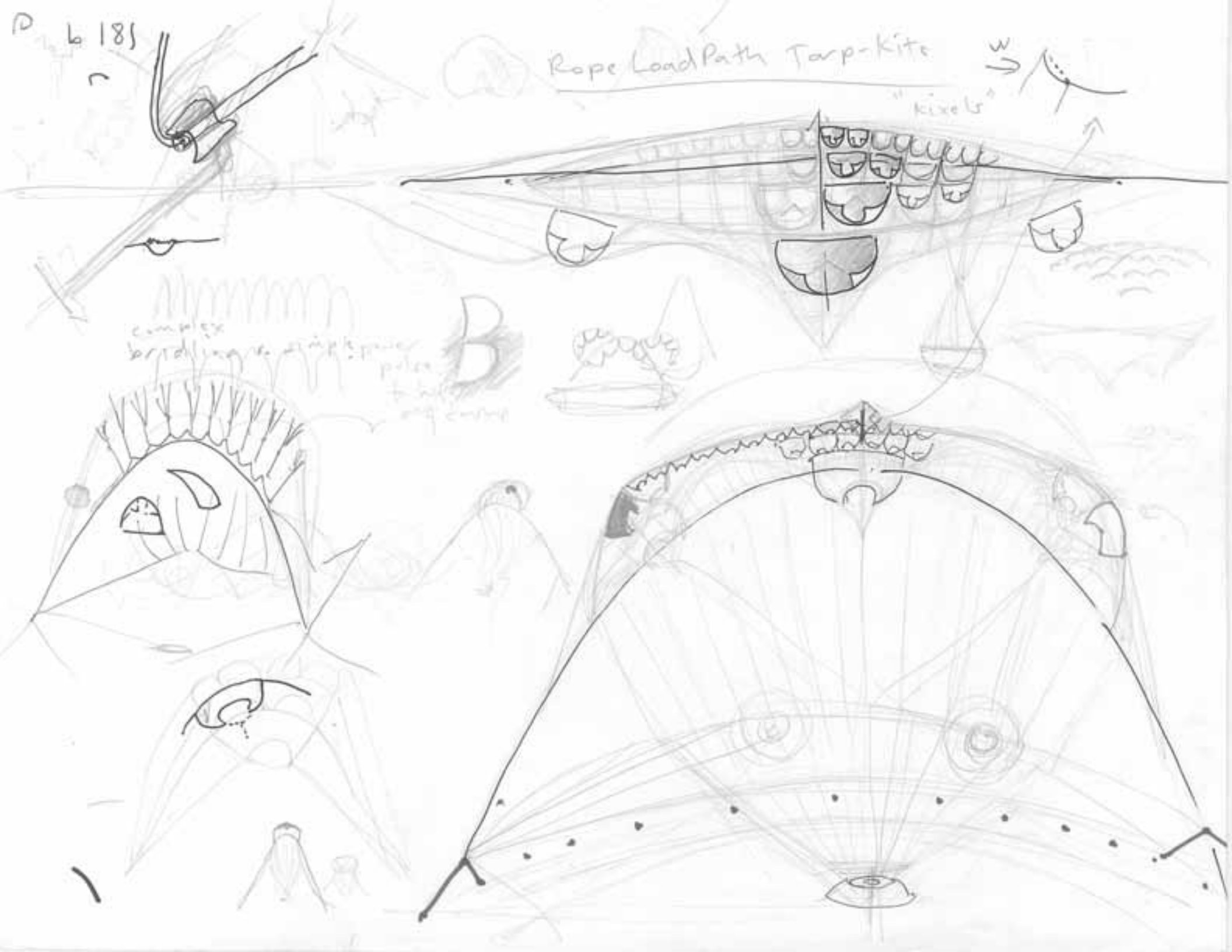
lagert, measure, cut, seal, knot, set

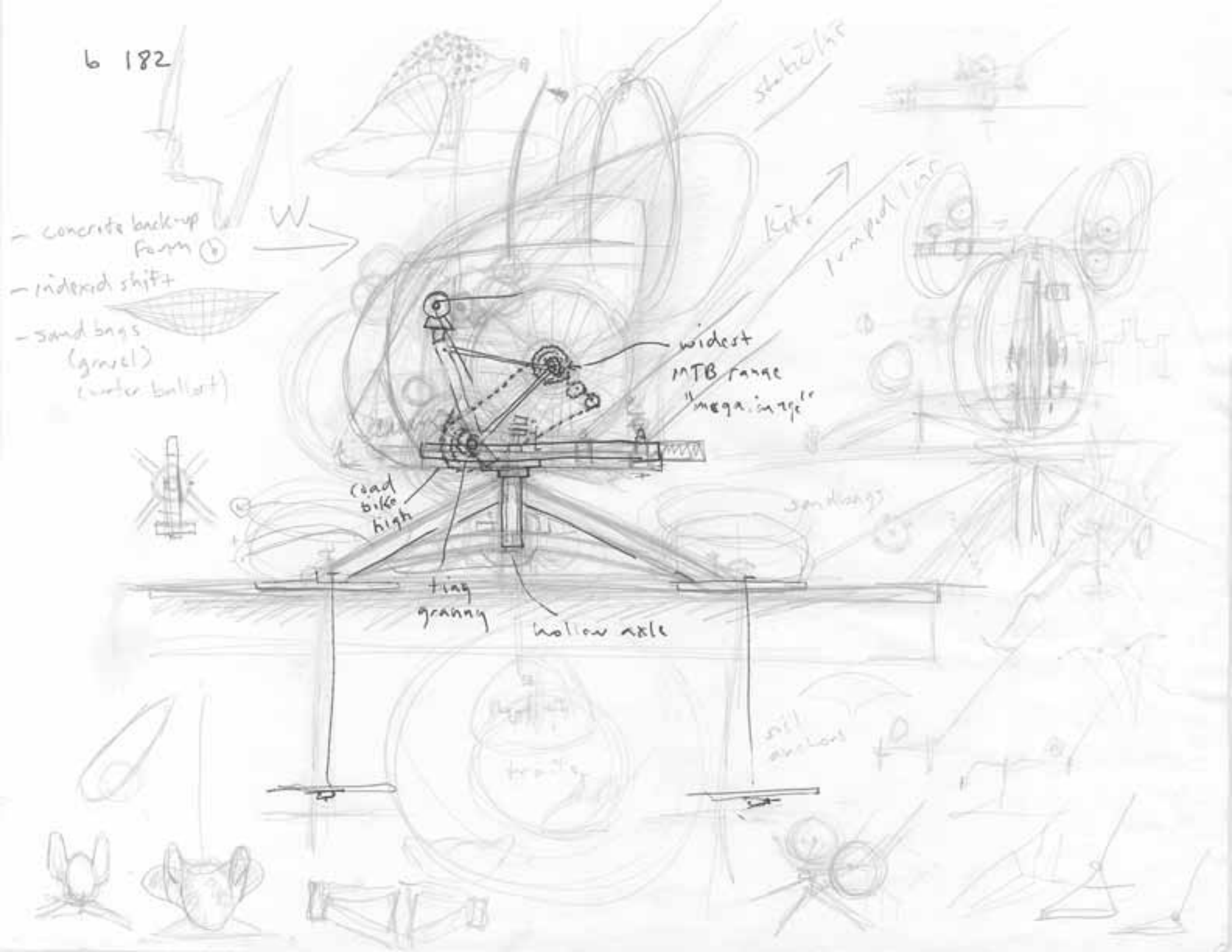

6177
shiva blue
129
129
orange
64
165
115 green
50 white
32 blue spacers
10 clear
soft shackles & bamboo

6 178
A1a
A1b
nylon lashing -2
ring & soft shackle -2
-3
-4
-5
prusiks at corners
stow line
Rub 5
A
B
7/8
3/16

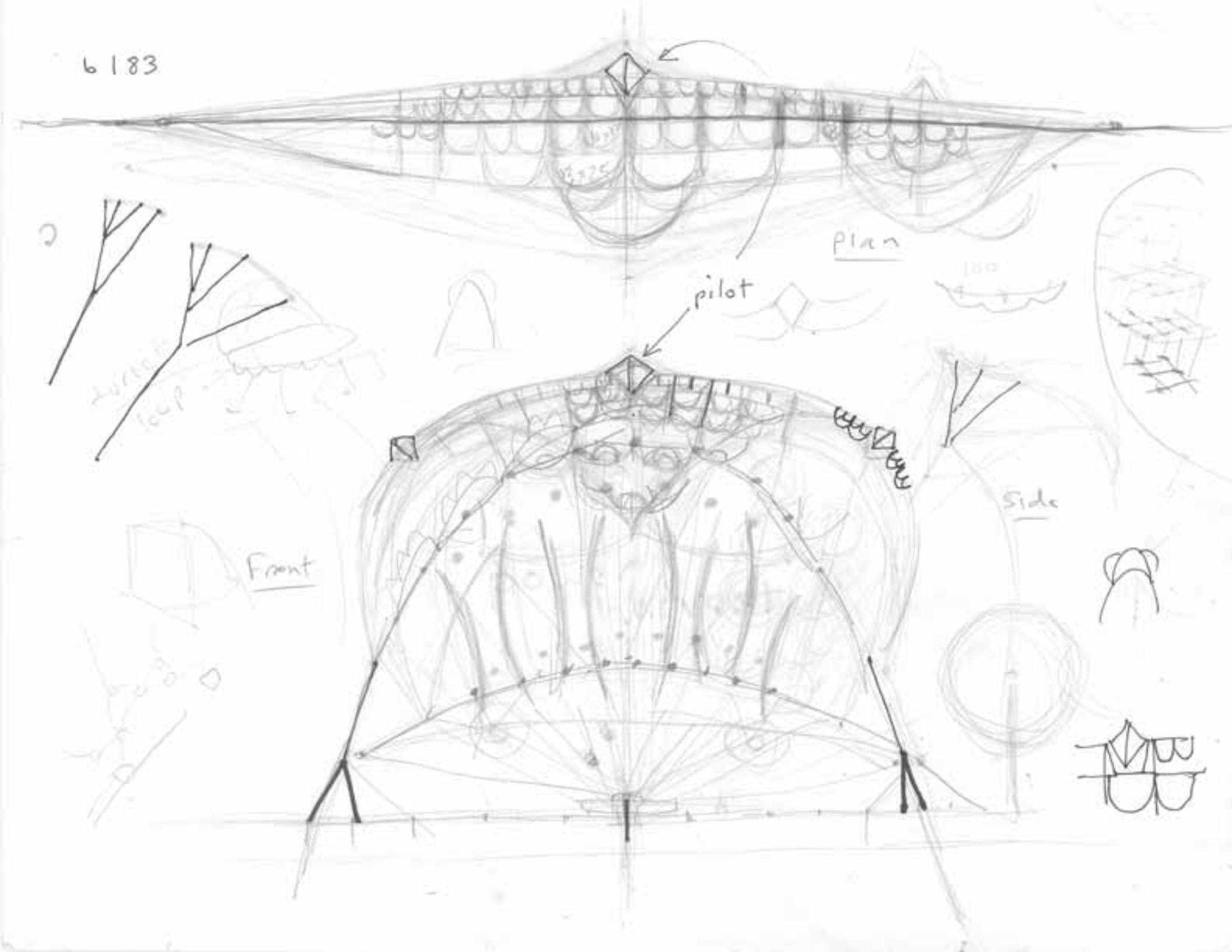

b 179

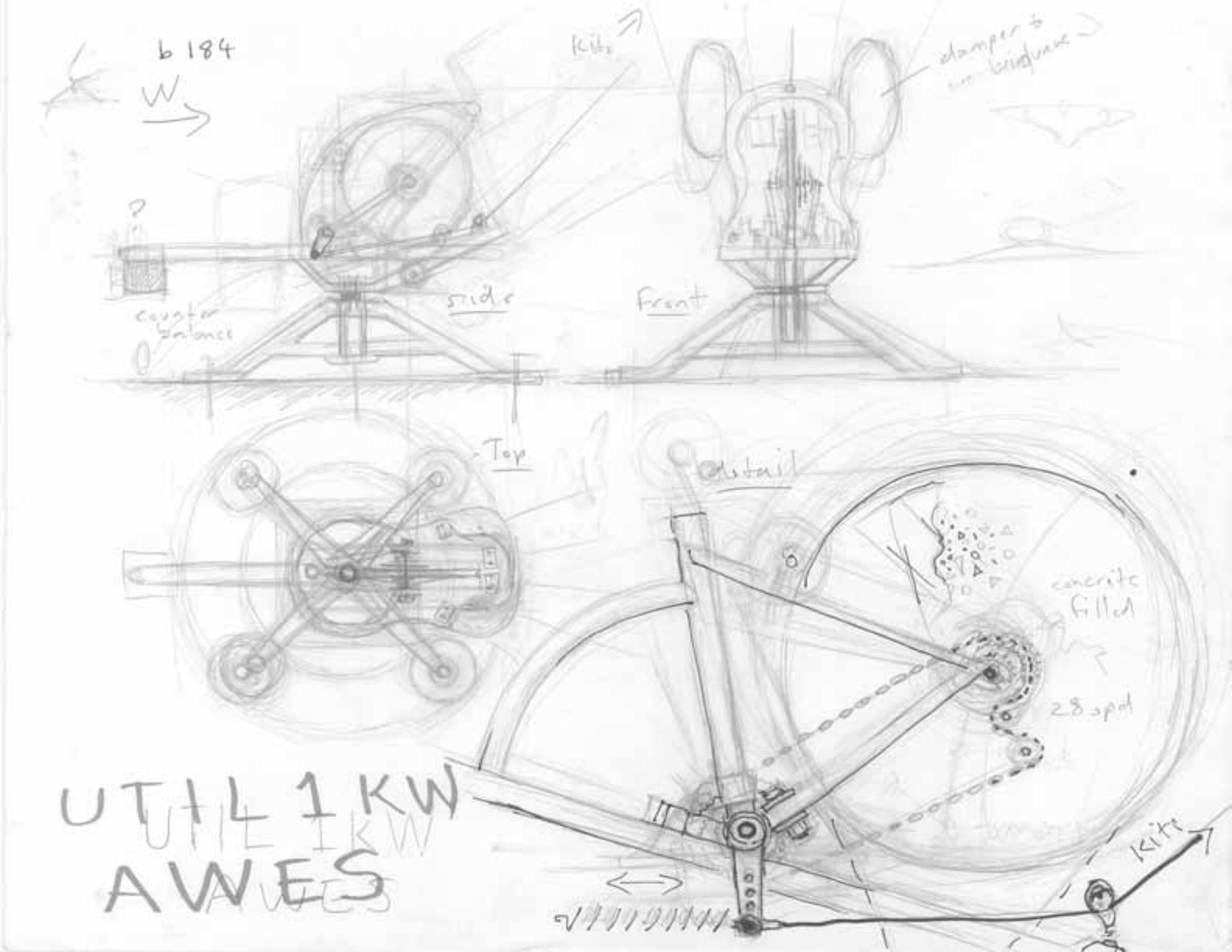

b 180
plan
Front
side

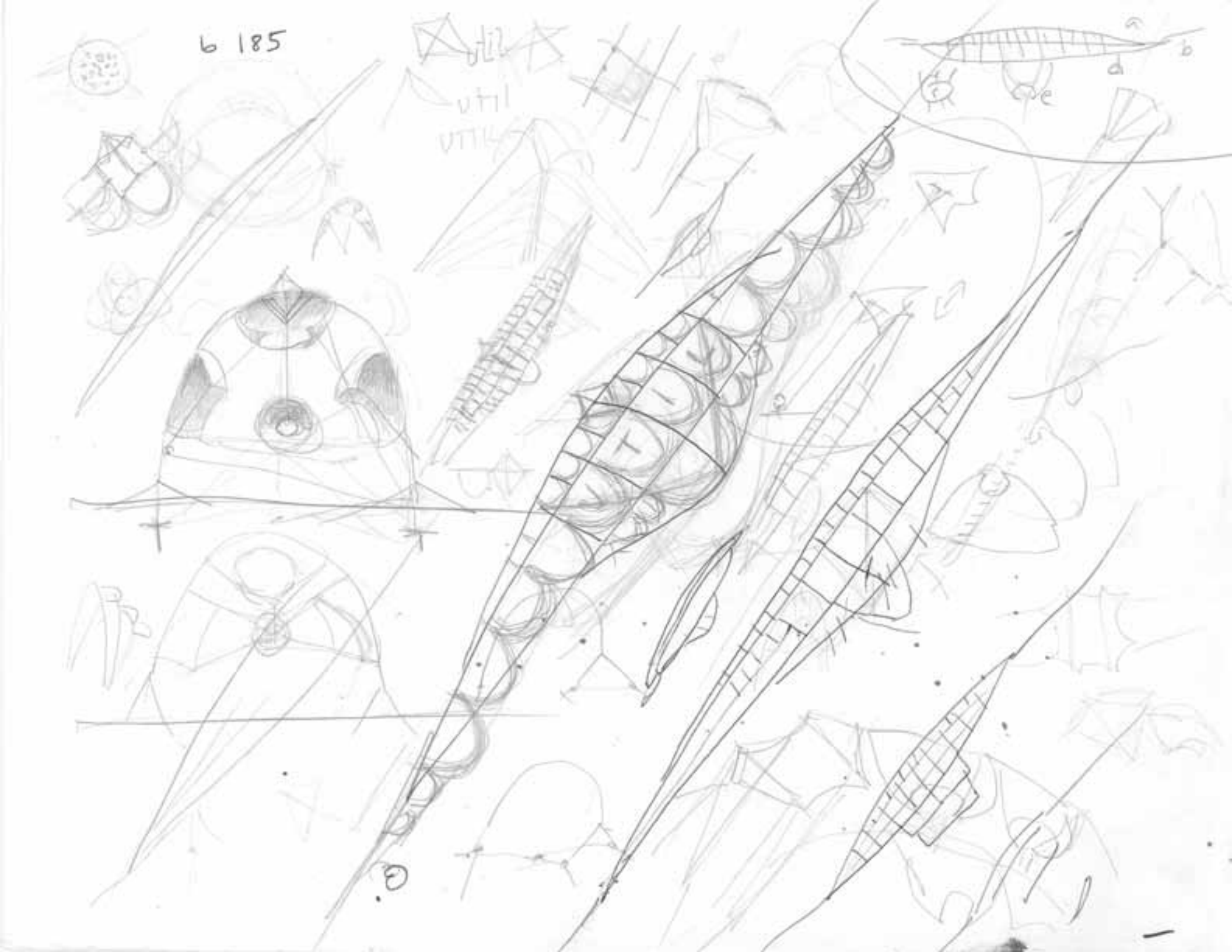

Rope Load Path Tarp-Kite
"kixels"
complex
bridling
simple power
pulse
B

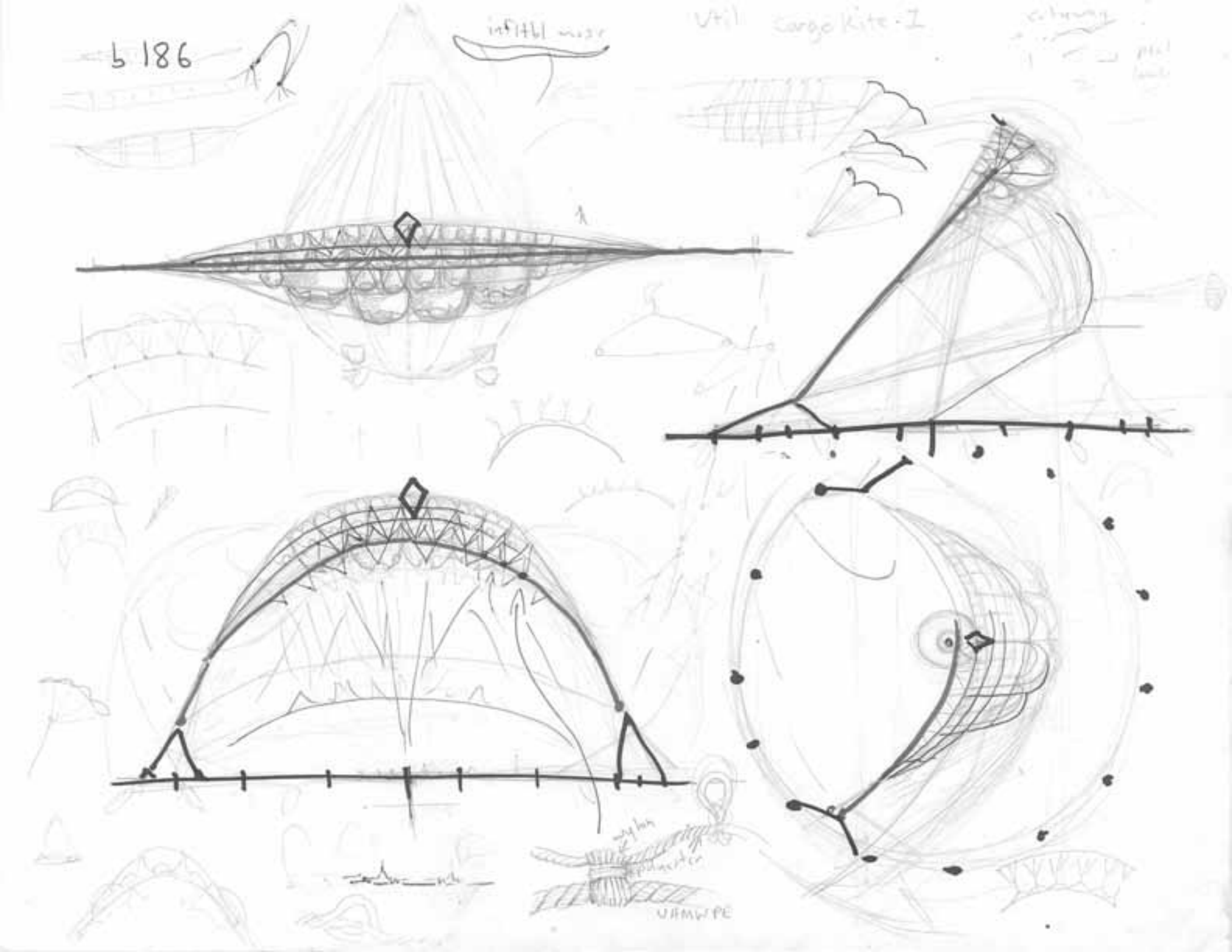

b 182
- concrete back-up form
- indexed shift
- sand bags (gravel) (water ballast)
widest MTB range "mega range"
road bike high
tiny granny
hollow axle
sandbags

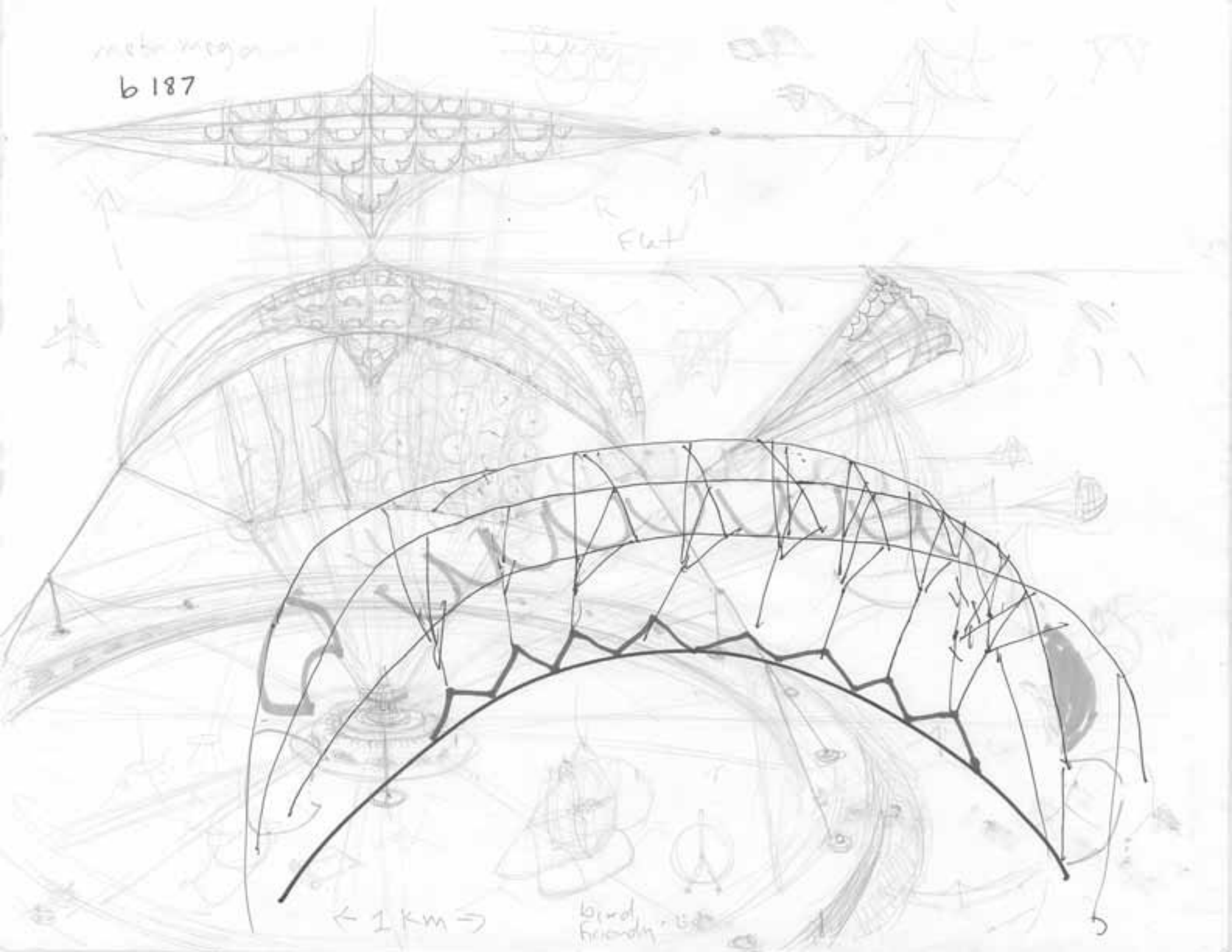
6183

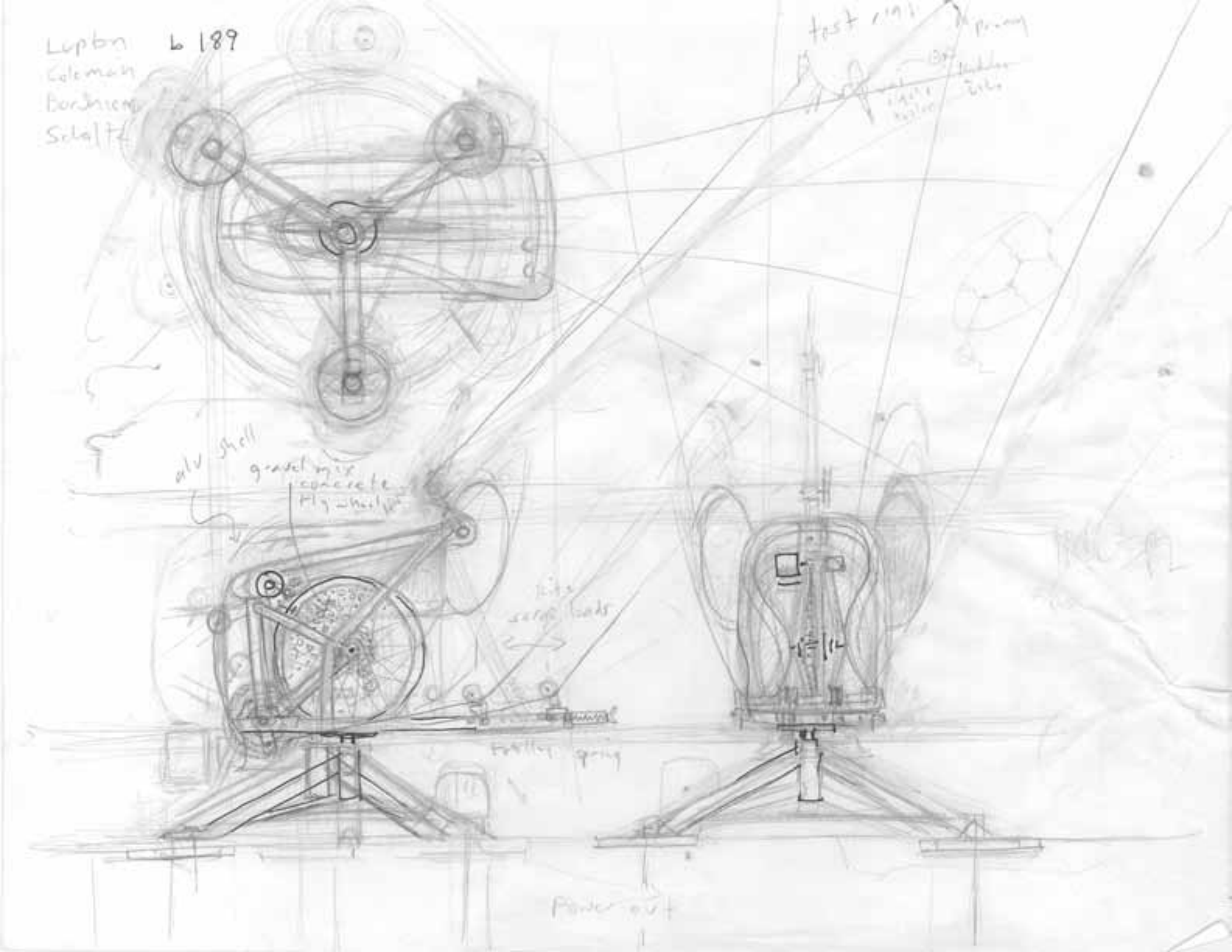



b 184
W
kite
damper to
side
front
counter balance
Top
detail
concrete filled
28 spd
kite
UTIL 1KW
AWES

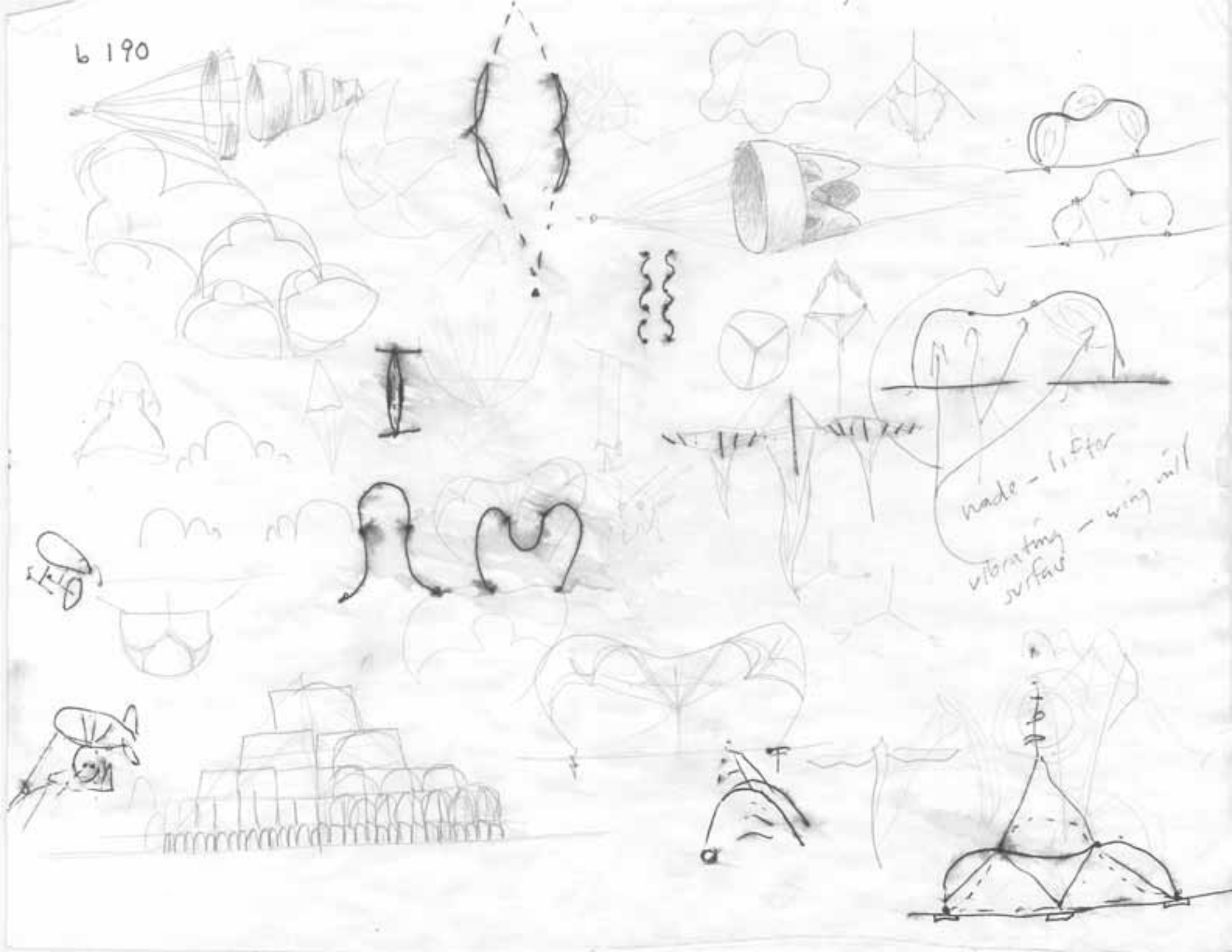

b 185
a
b
e


b 186
Util
Cargo Kite - I
UHMWPE


b 187
Flat
← 1 km →


Lupton b 189
Coleman
Borshiem
Schaltz
test rig
alv shell
gravel mix
concrete
fly wheel
kite
sarge loads
Power out

b 190



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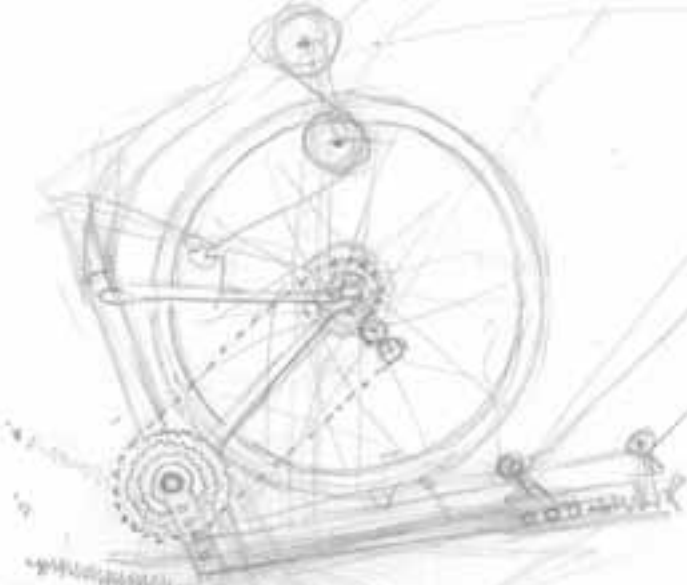

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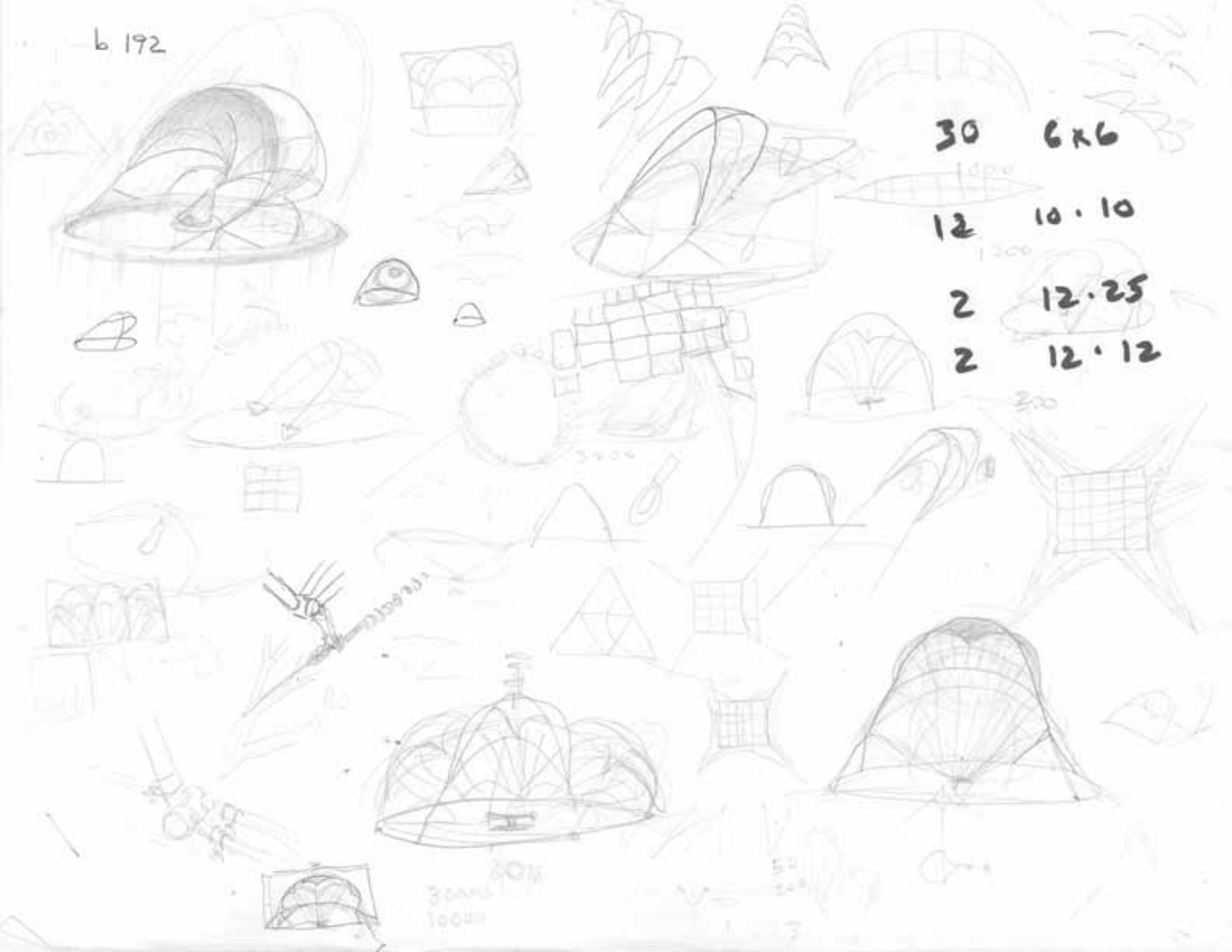

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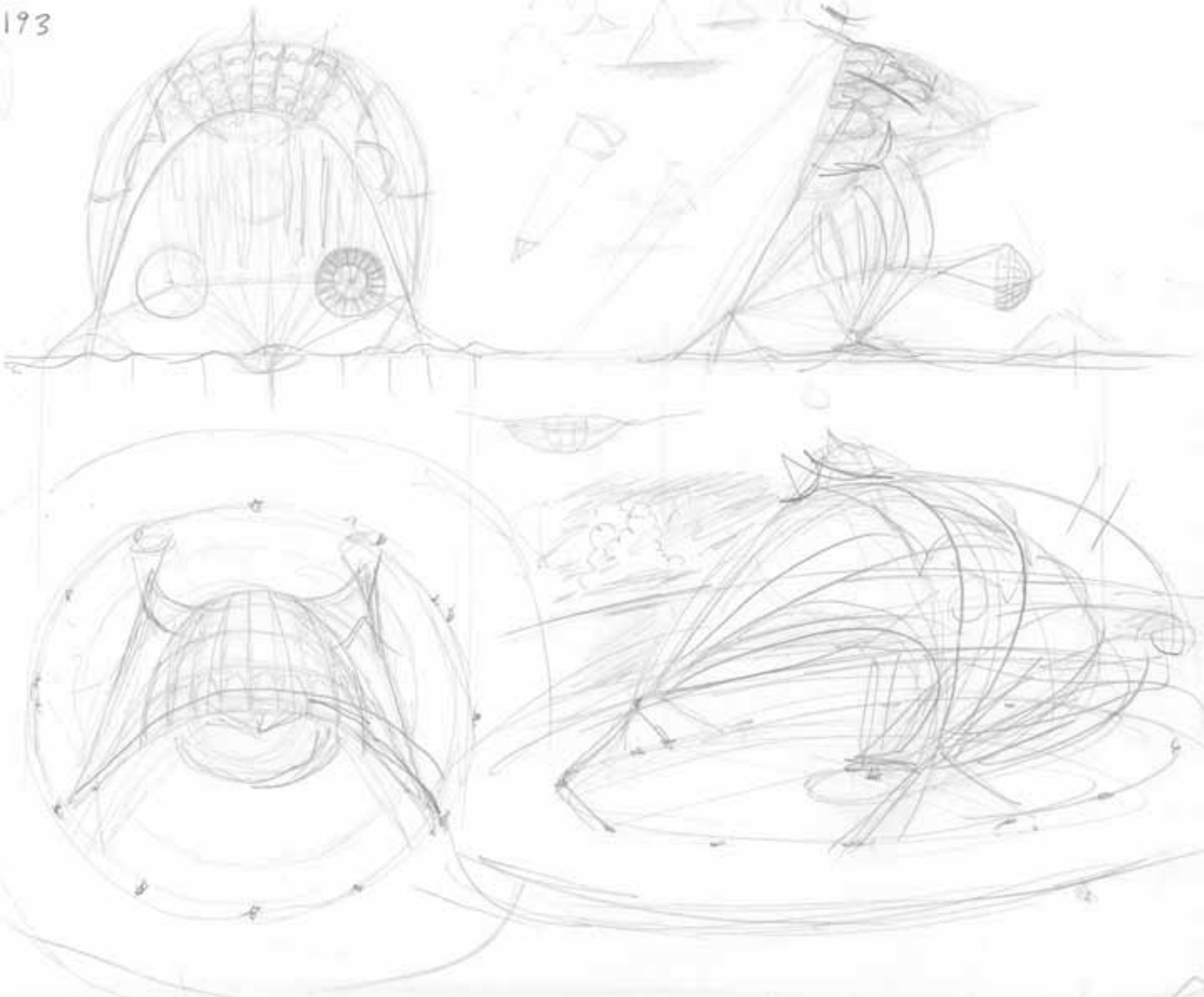

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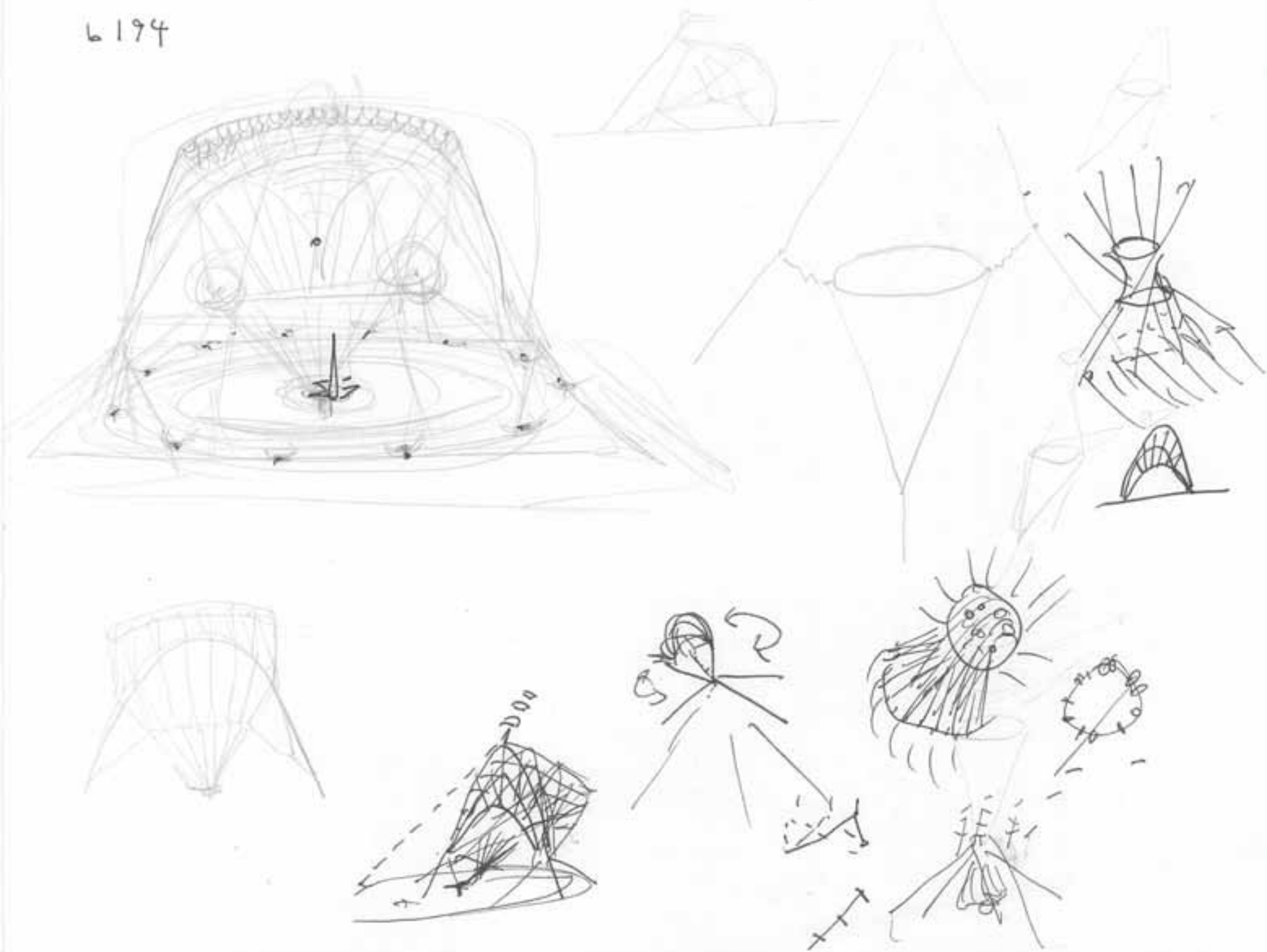
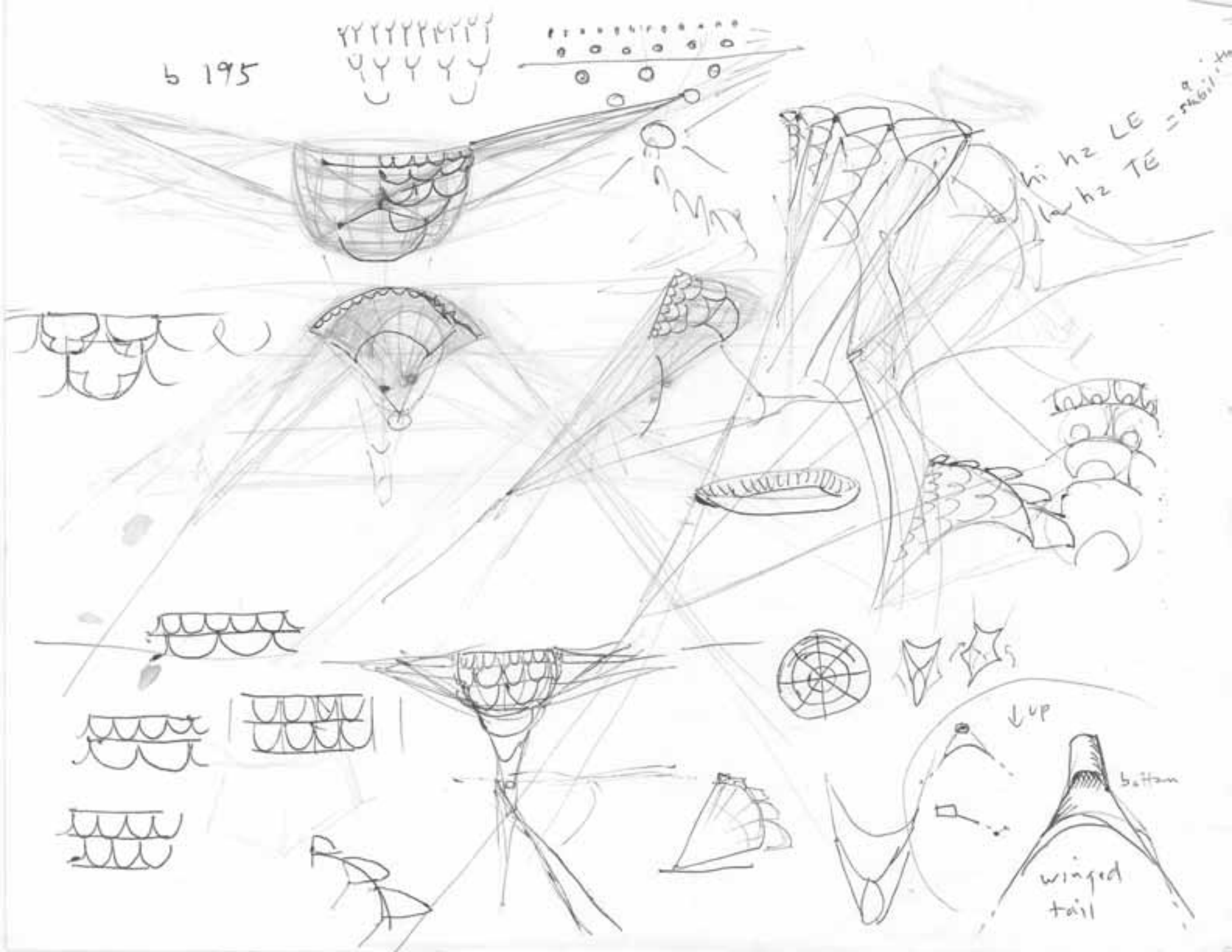
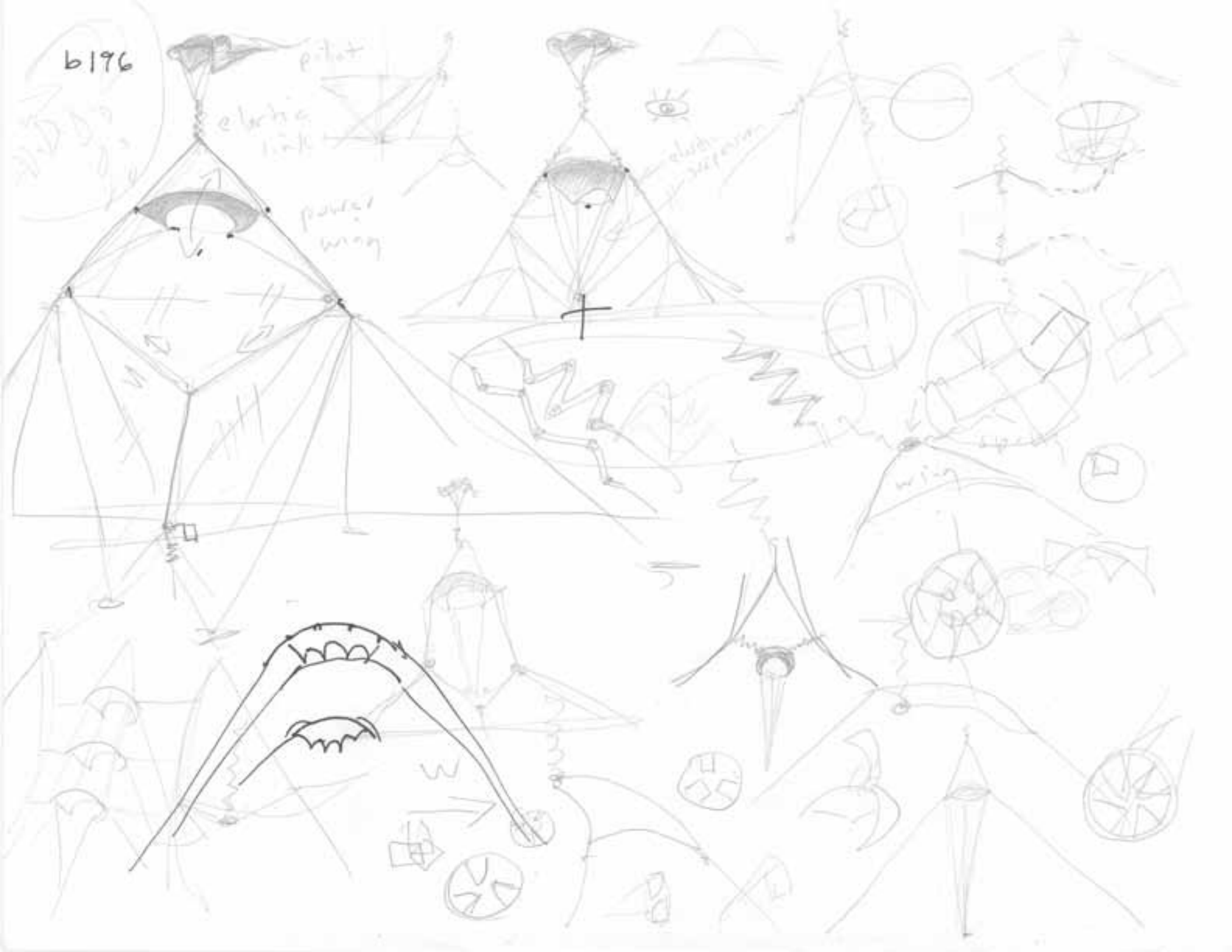
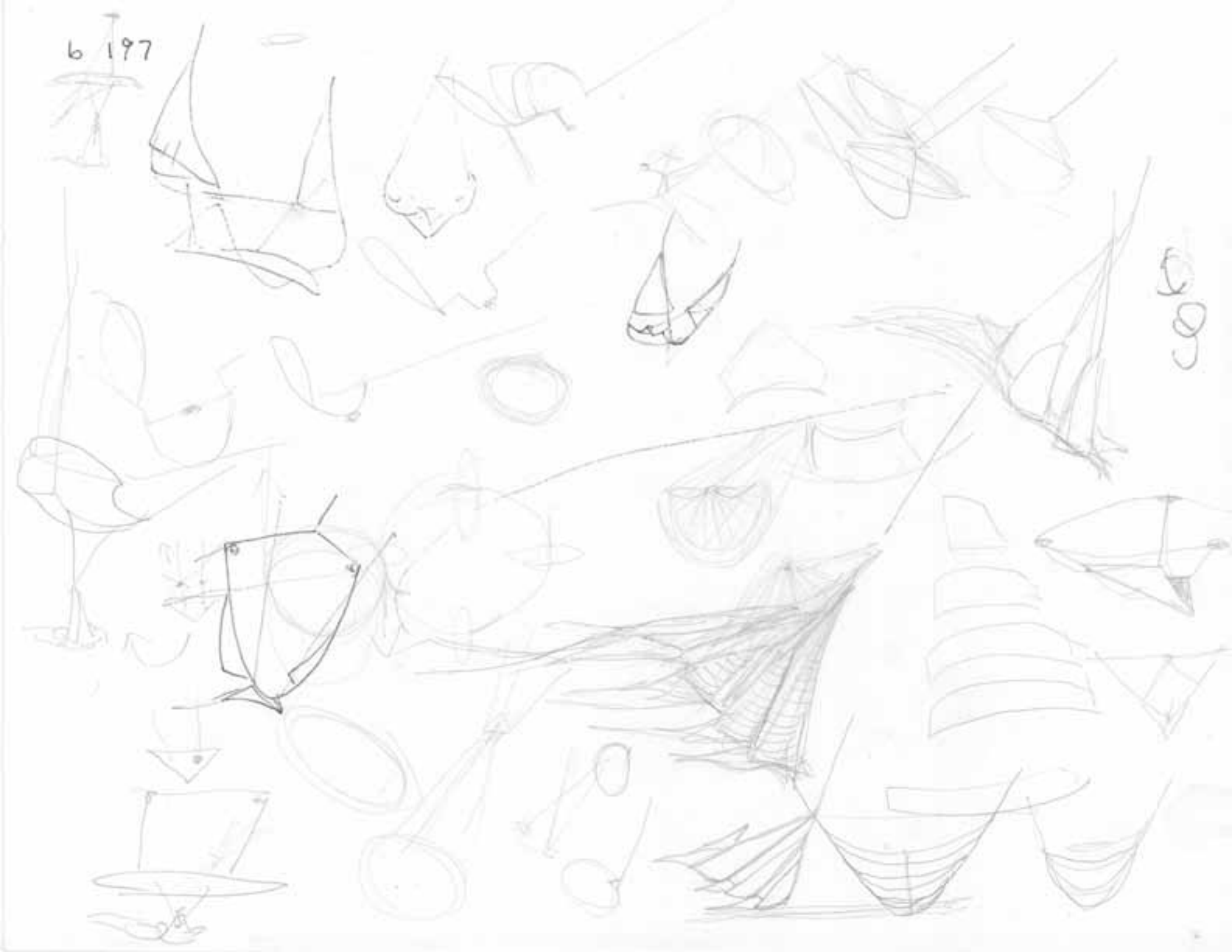


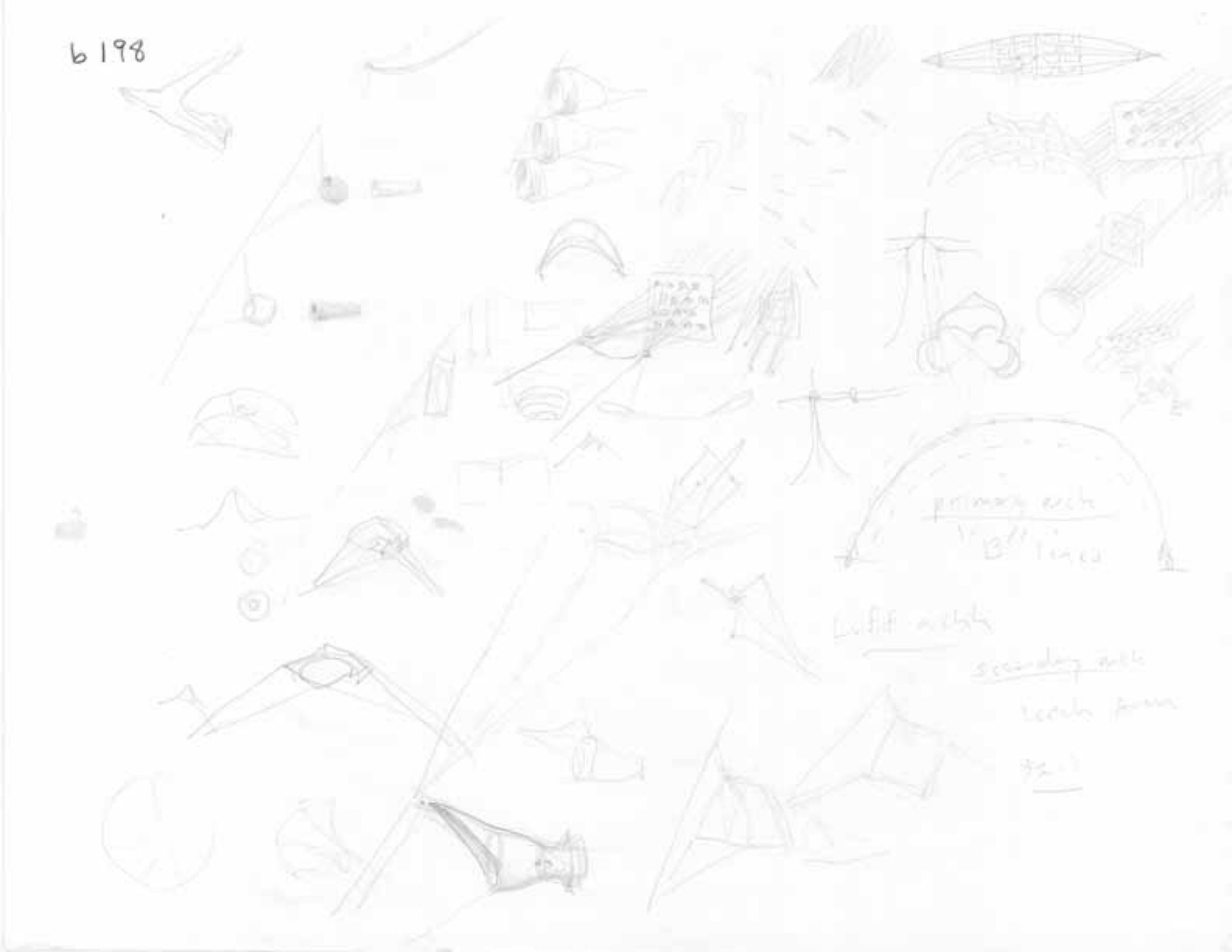

b 195
hi hz LE
low hz TE
UP
bottom
winged
tail

b196

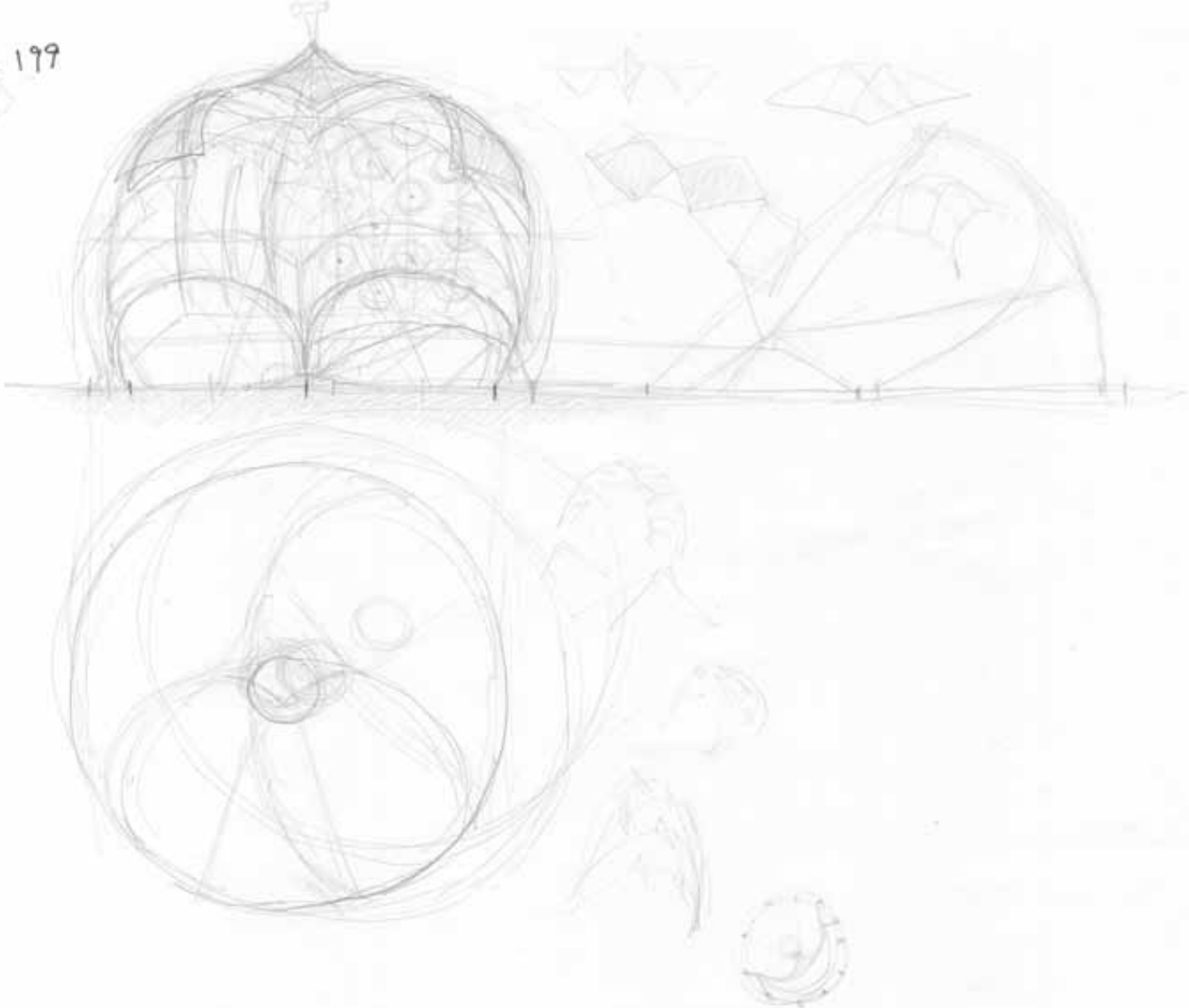



b 197

b 198

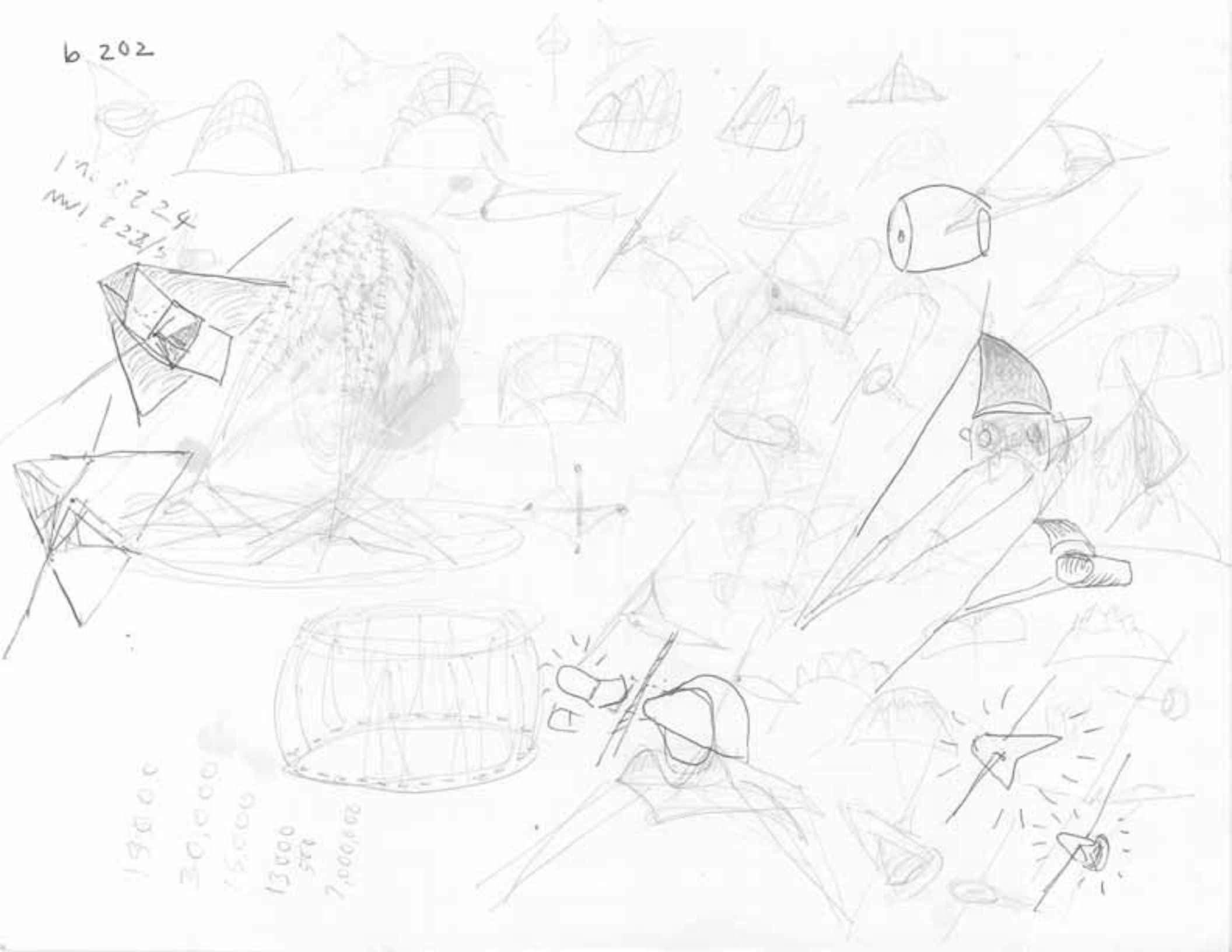


b 199

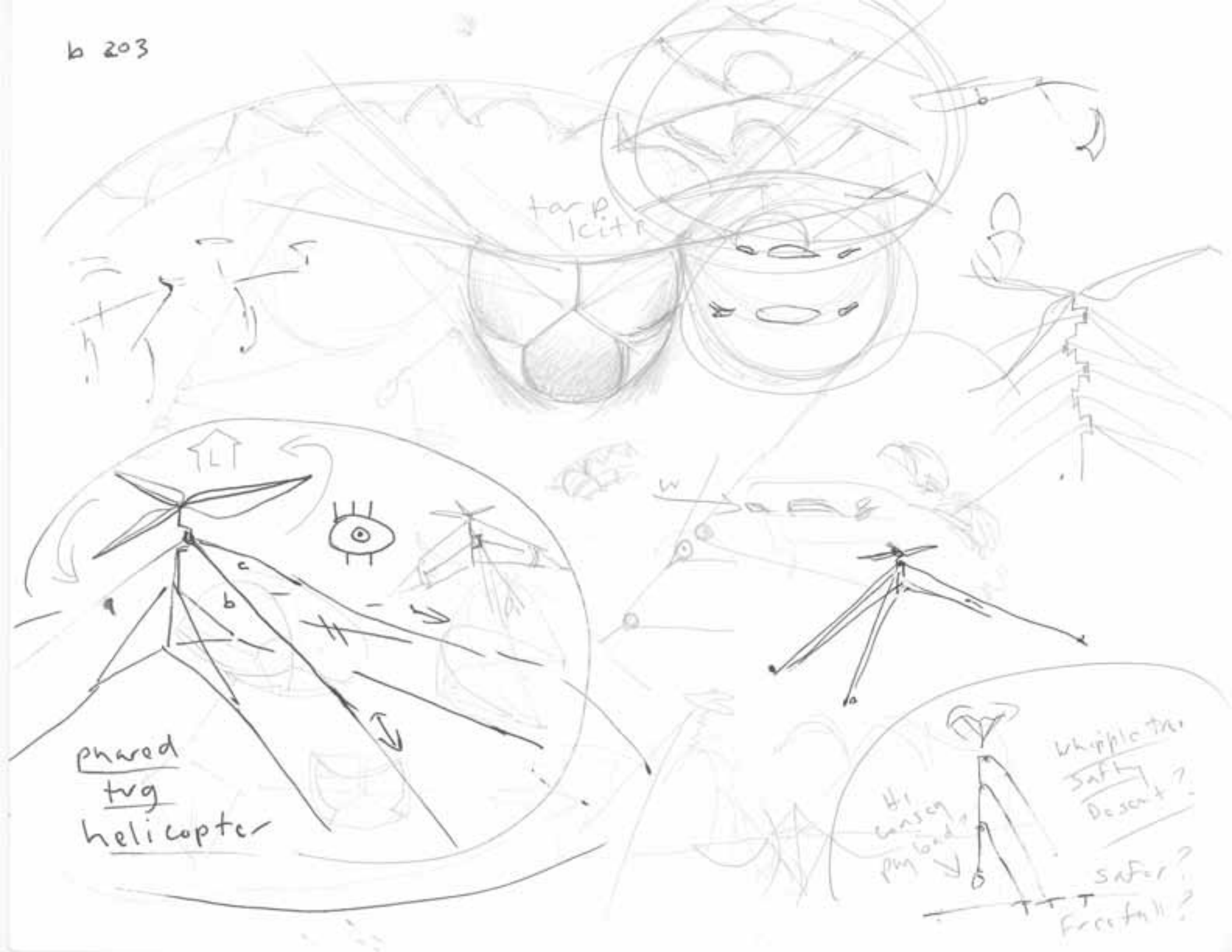


b 200

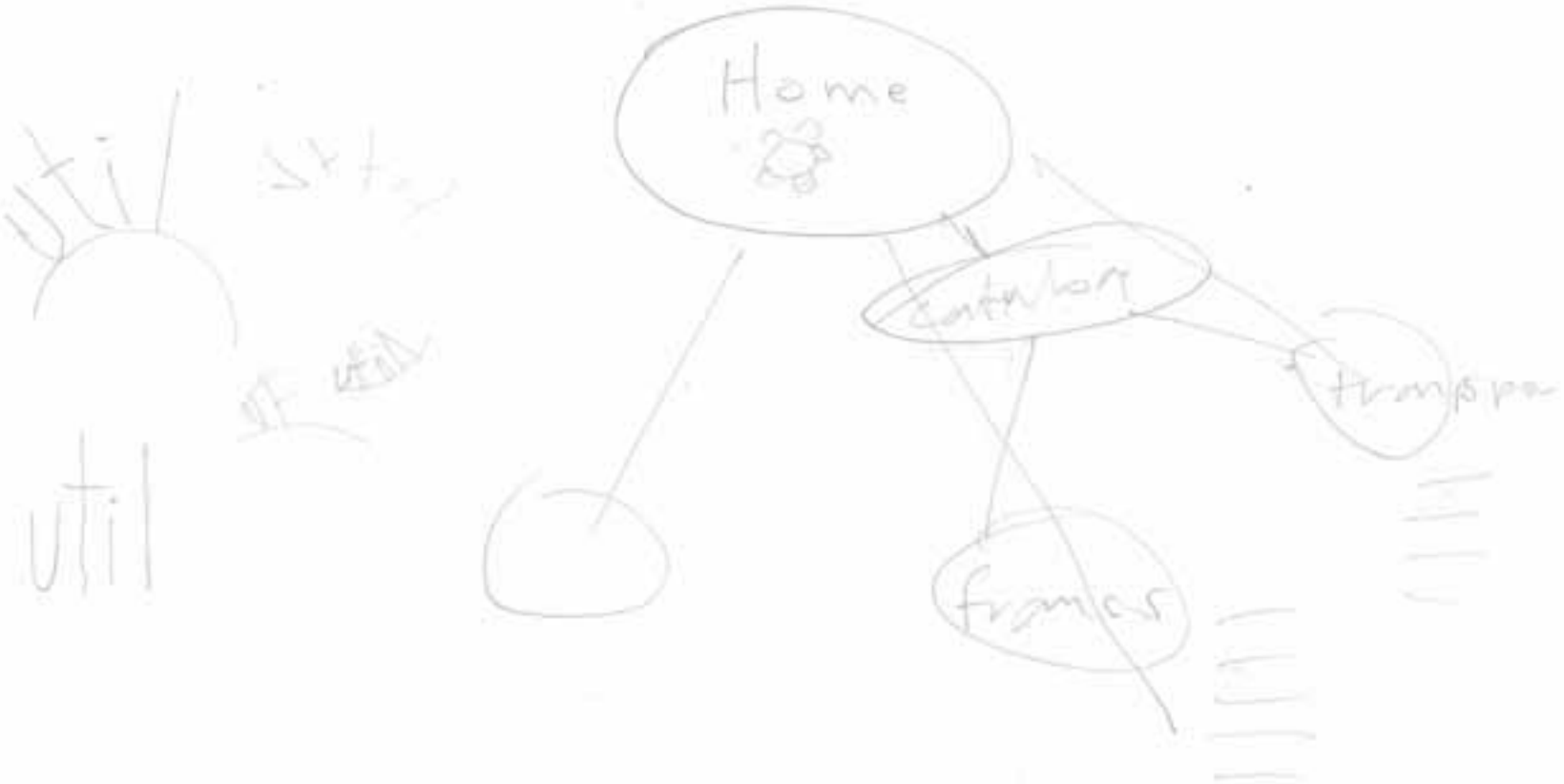
b 201


b 202

b 203


tarp
kit
L
a
b
c
w
phared
tug
helicopter
Whipple tree
Safty
Descent?
Safer?
Freefall?

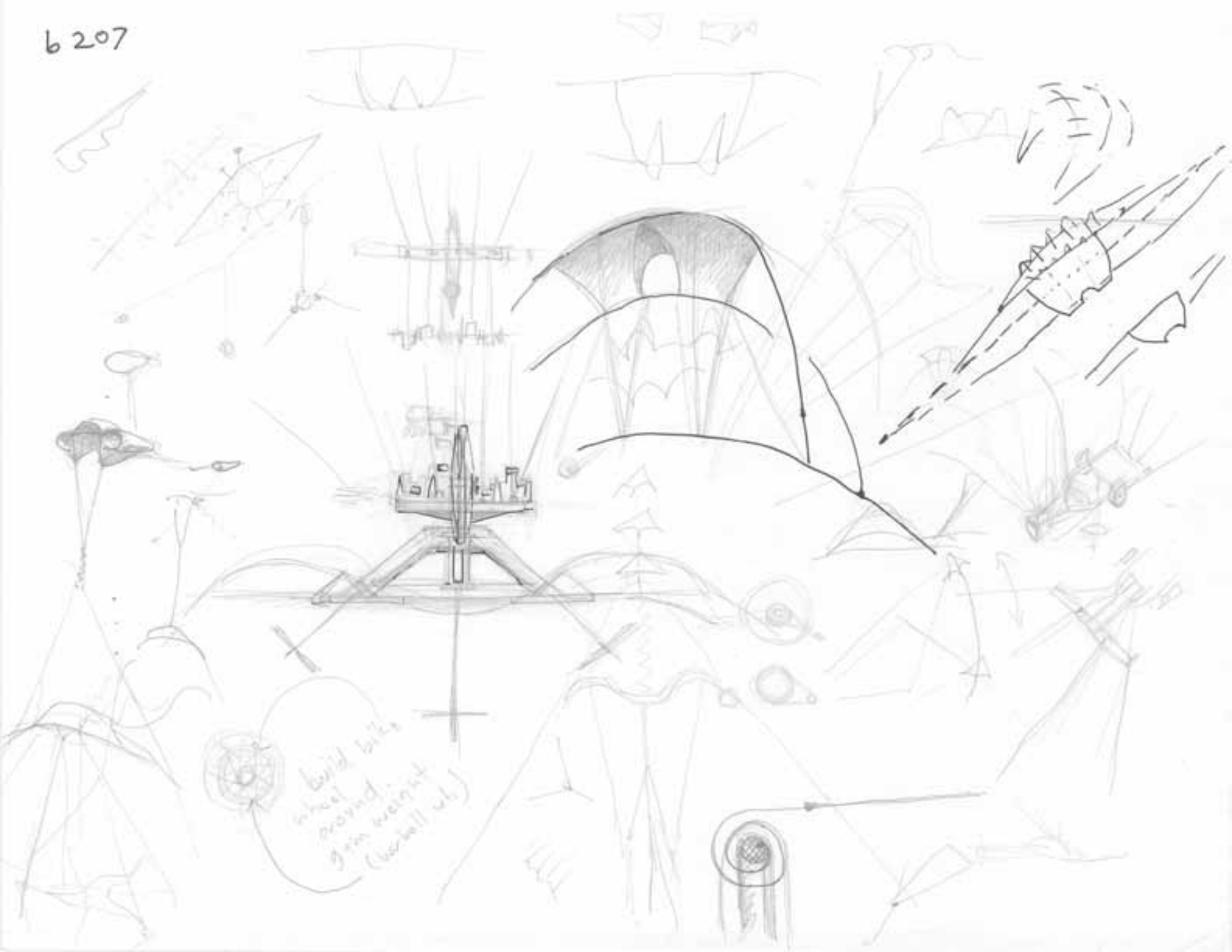
b 204



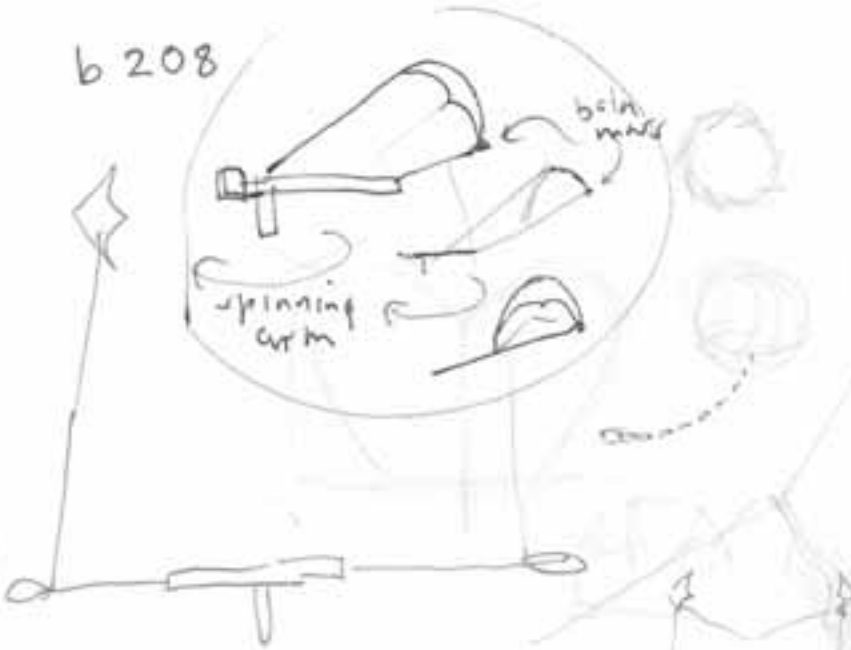
b 205

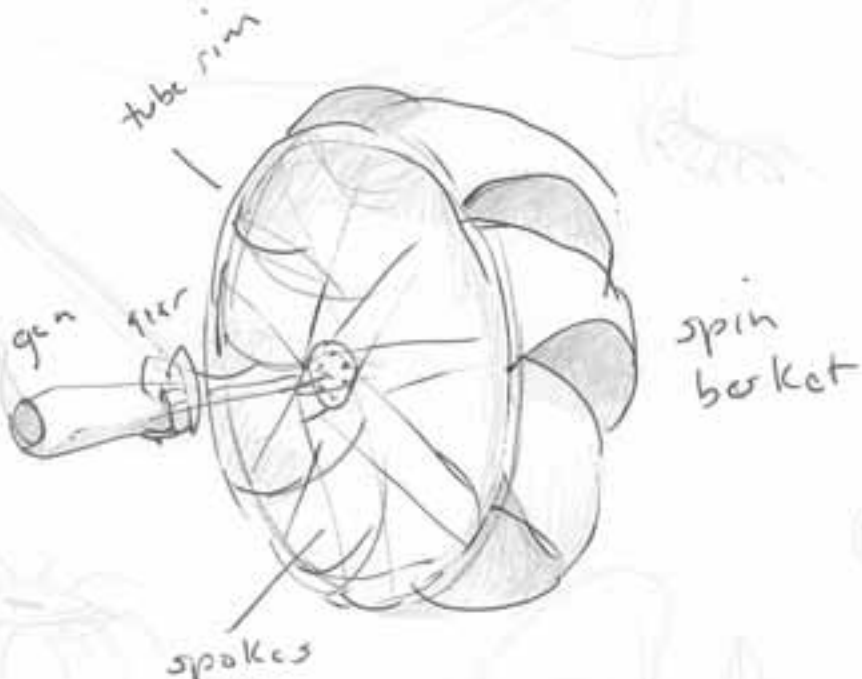
b206

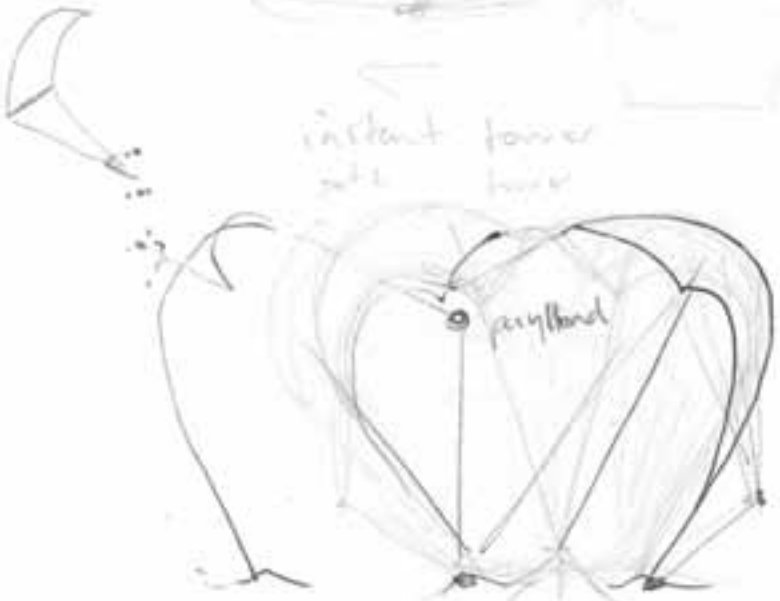
b 207



b 208

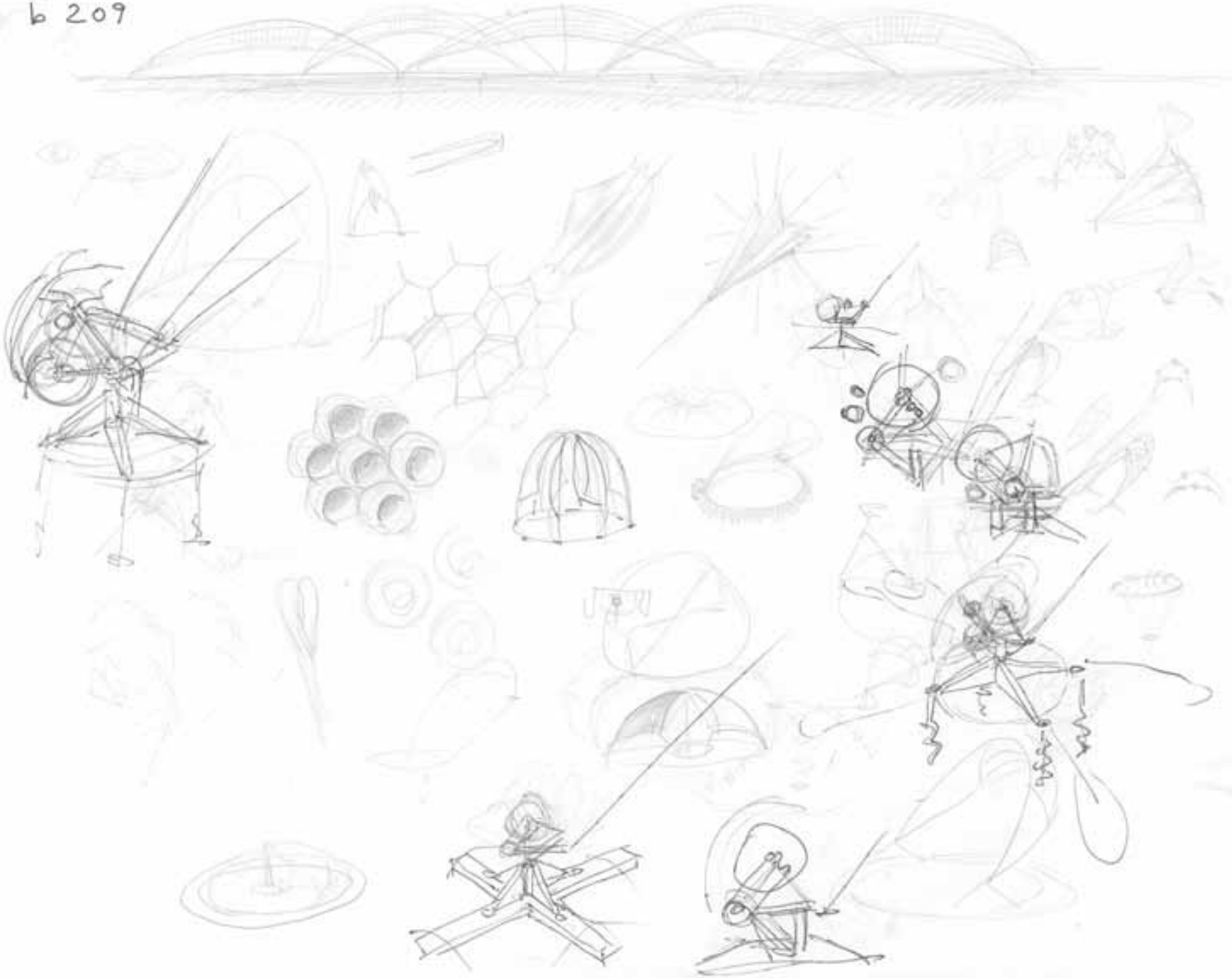


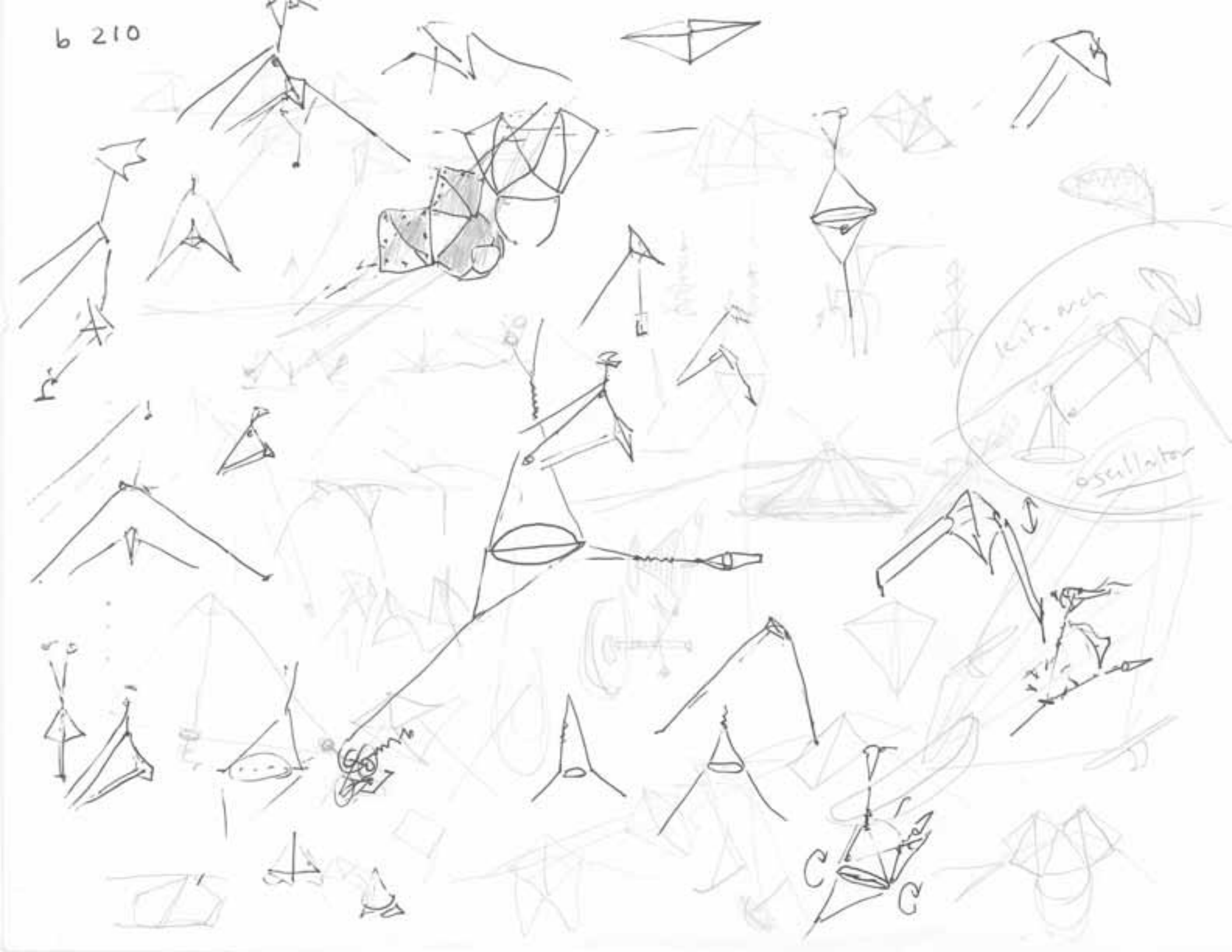




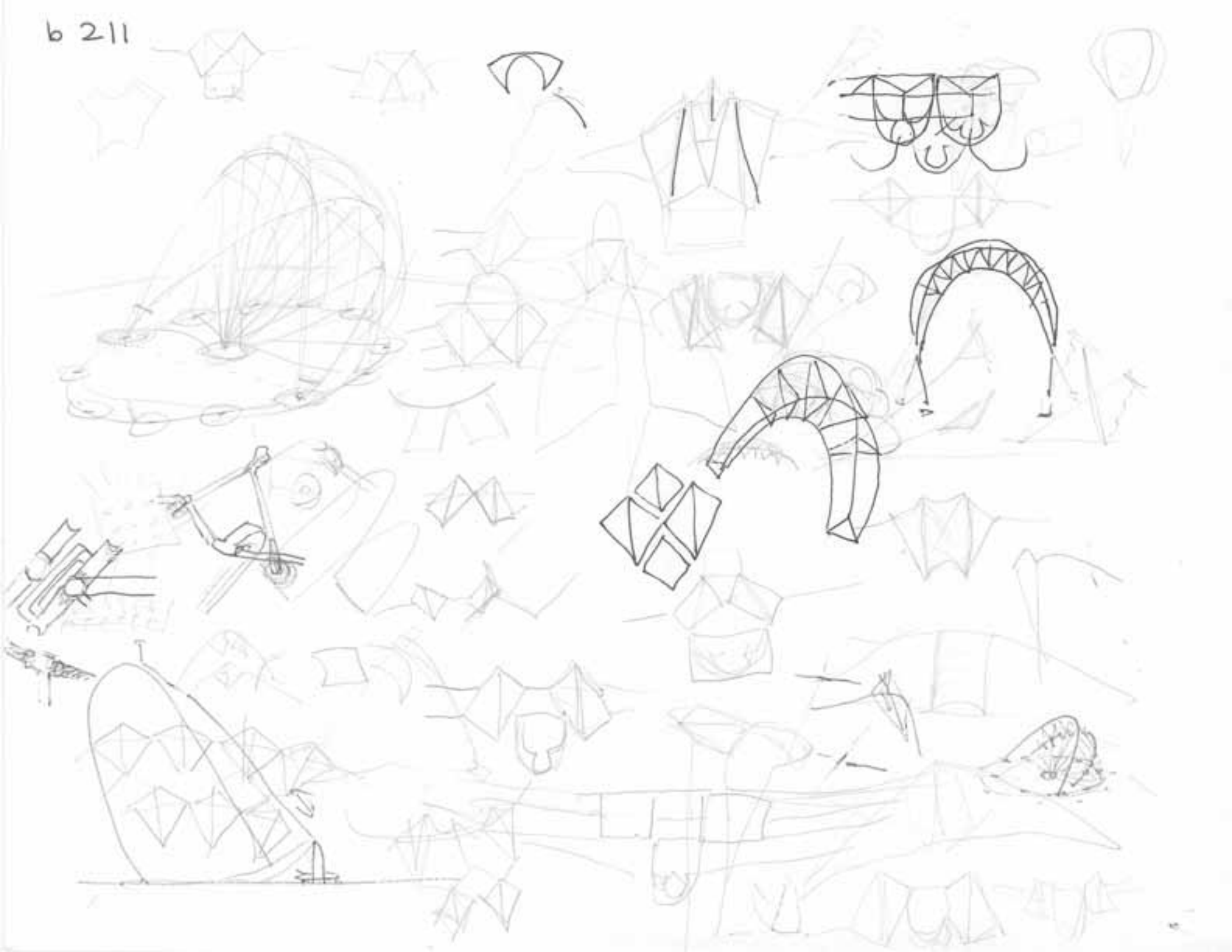
Spin Basket Persistent Flight
Station keeping

b 209

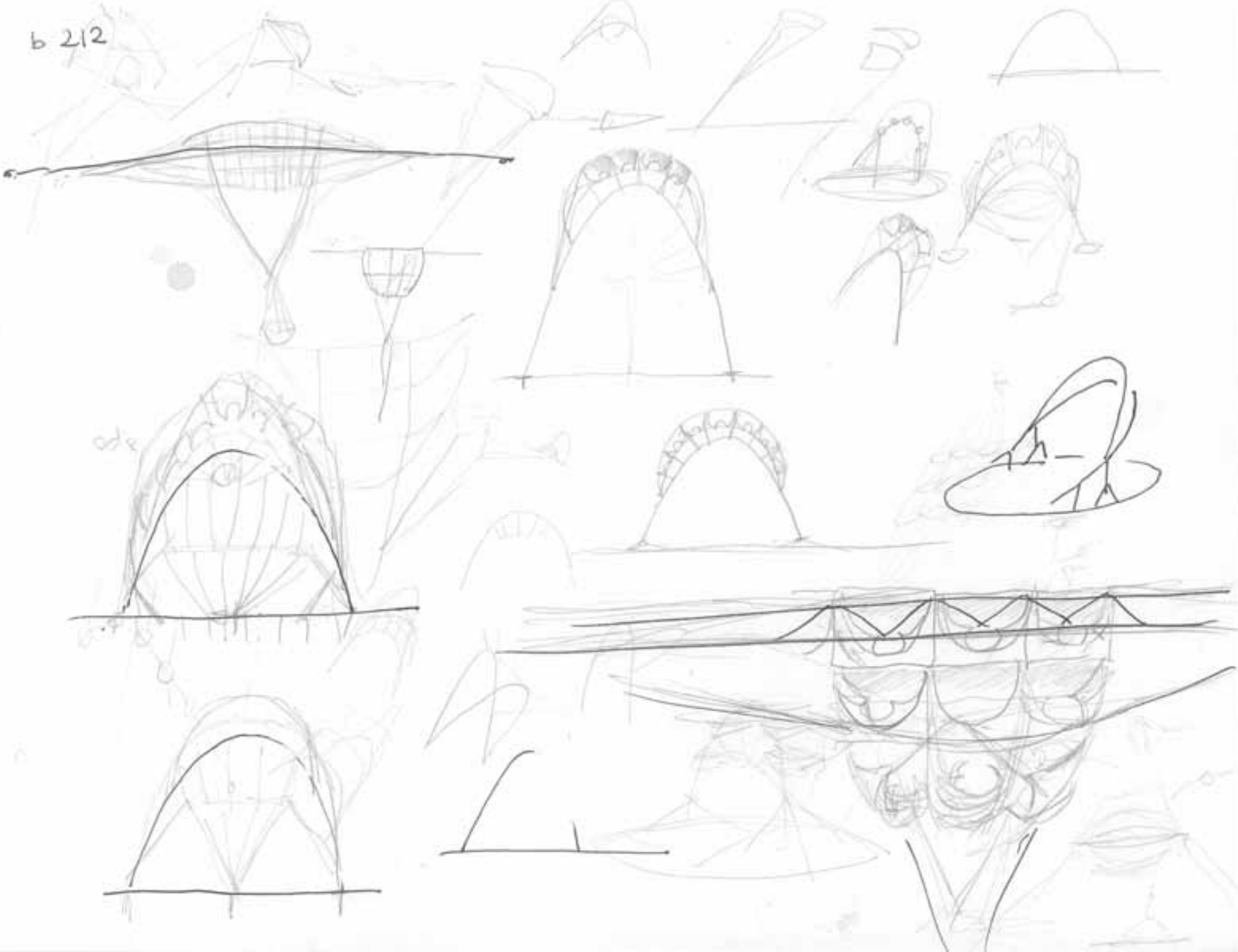



b 210
oscillator
C
C

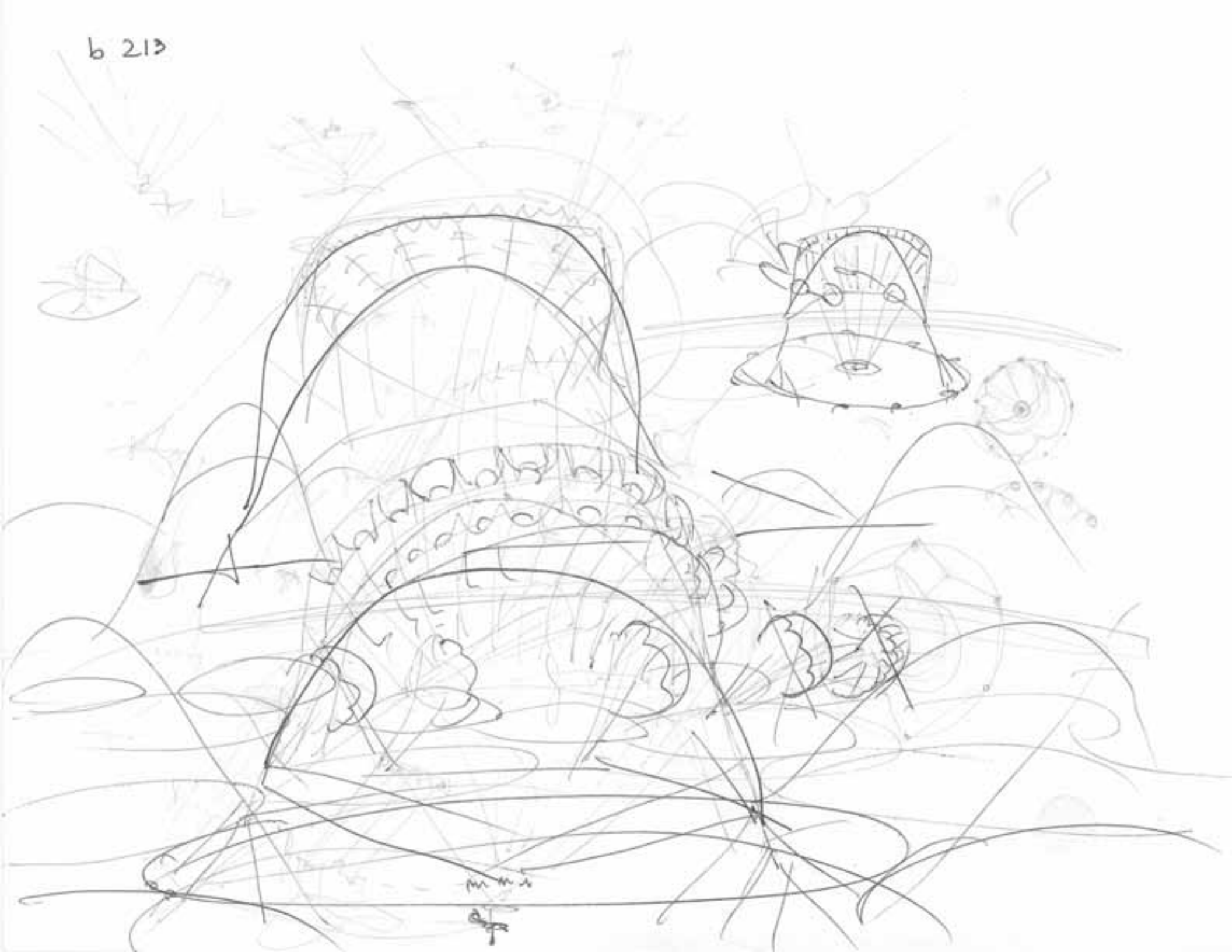
b 211



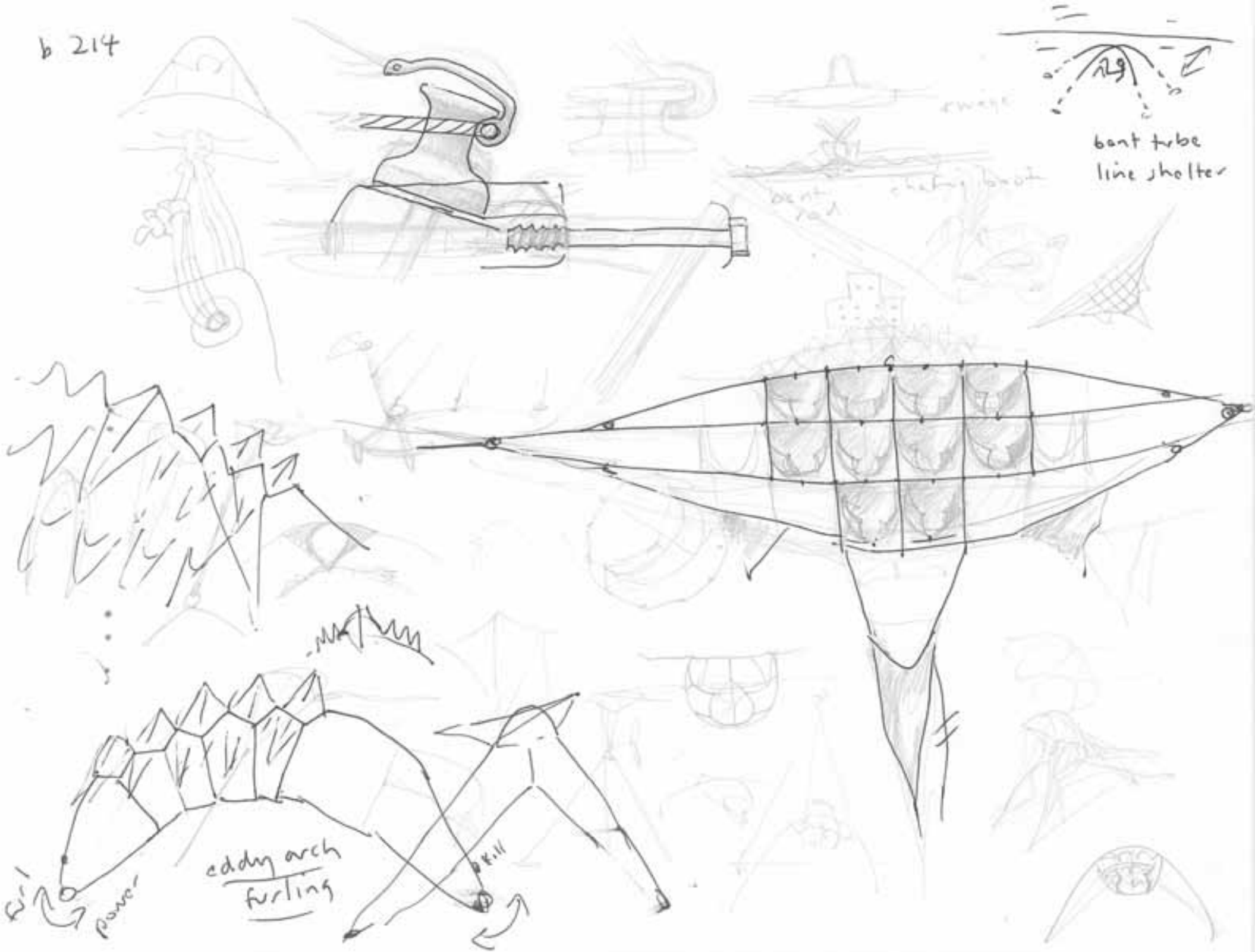
b 212



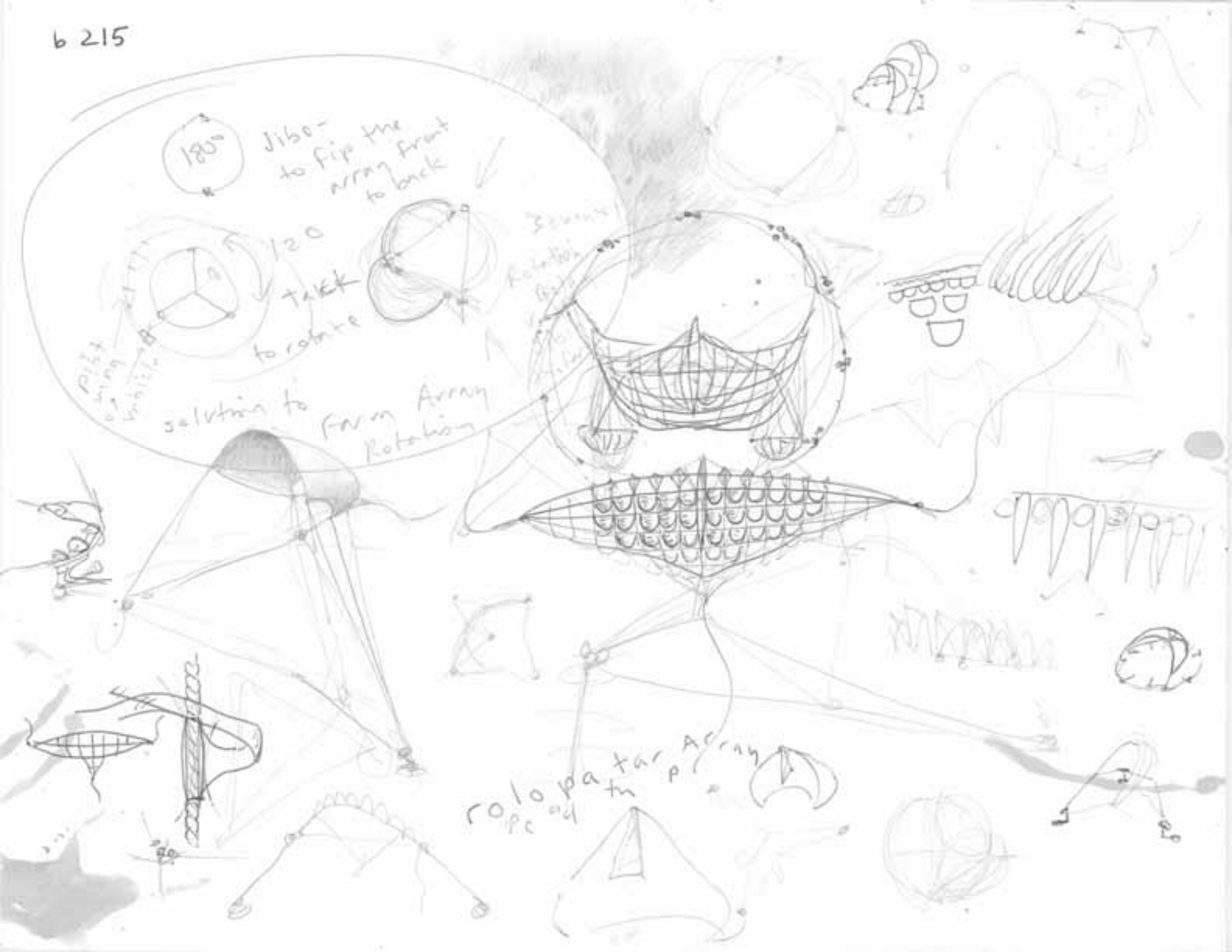
b 213



b 214

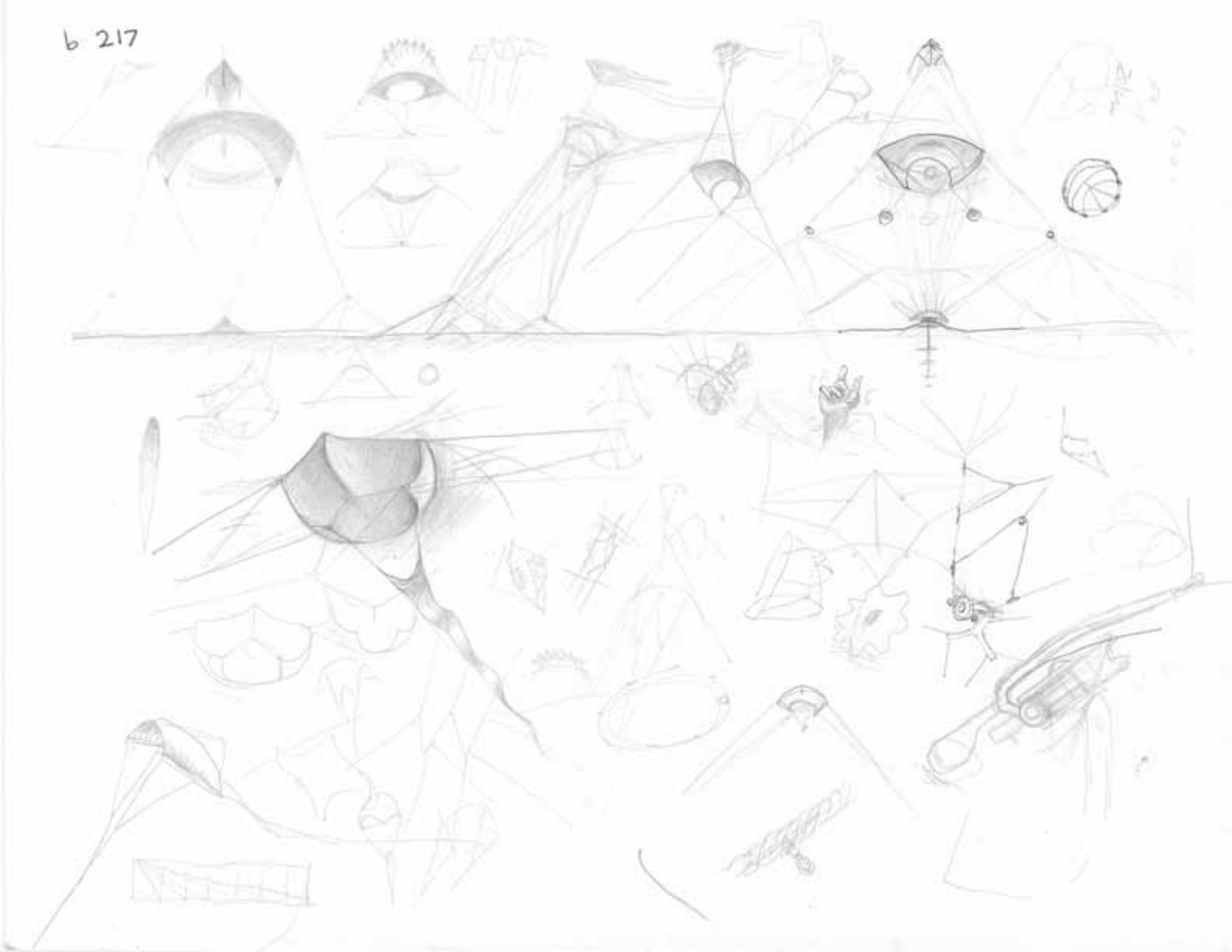


b 215

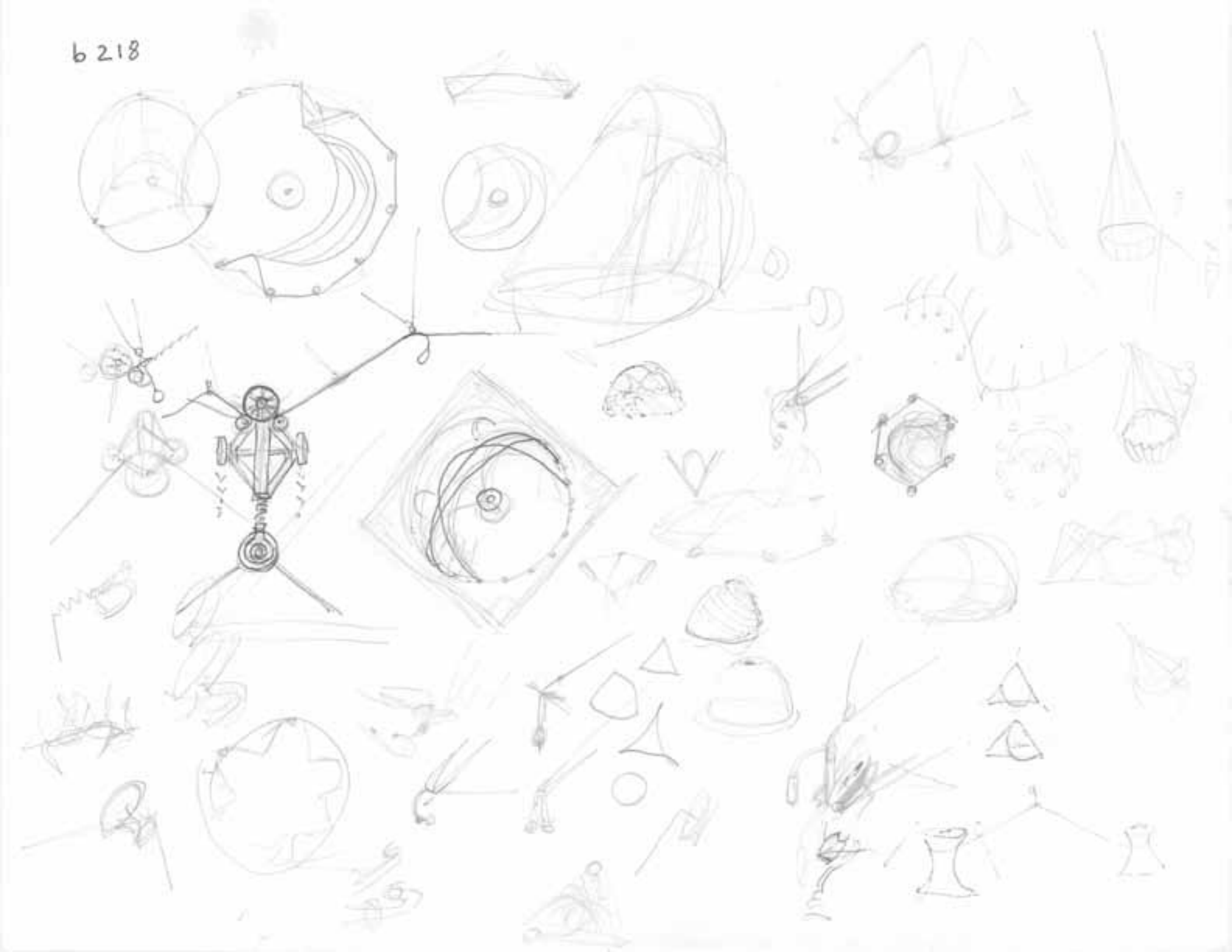

180°
Jibo-
to flip the
array front
to back
120
tack
to rotate
solution to
Form Array
Rotation
rolopatar Array

b 216

b 217



b 218



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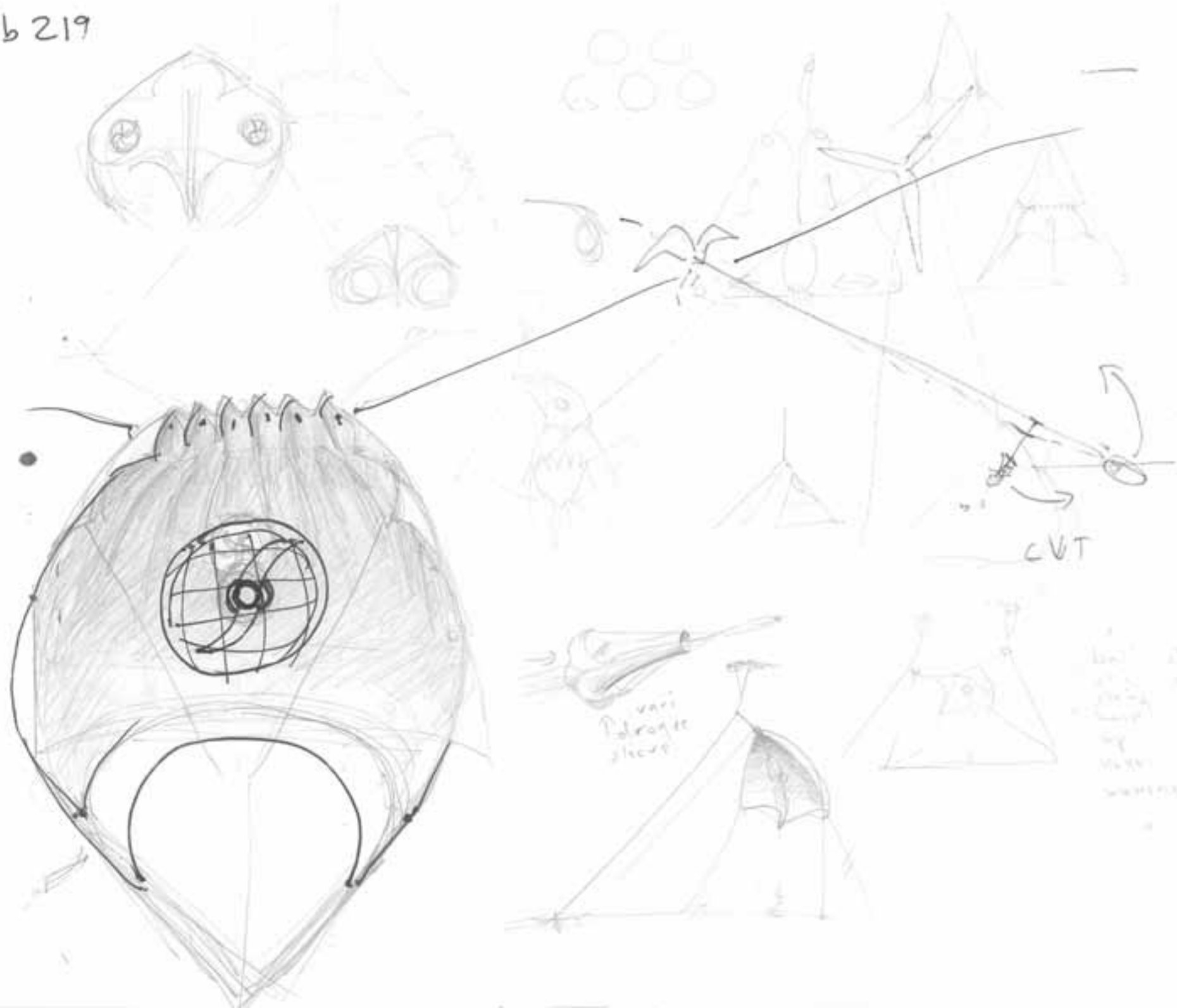
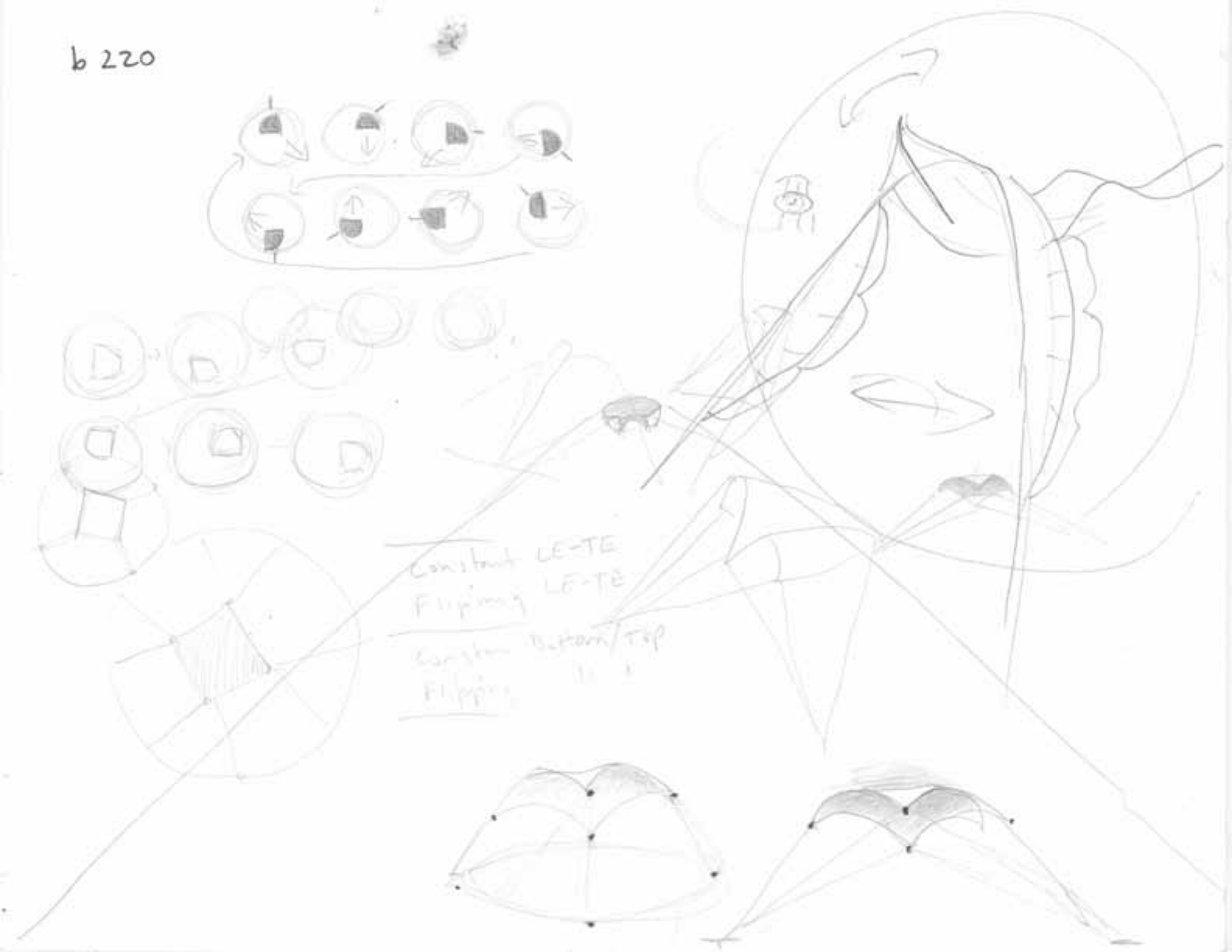
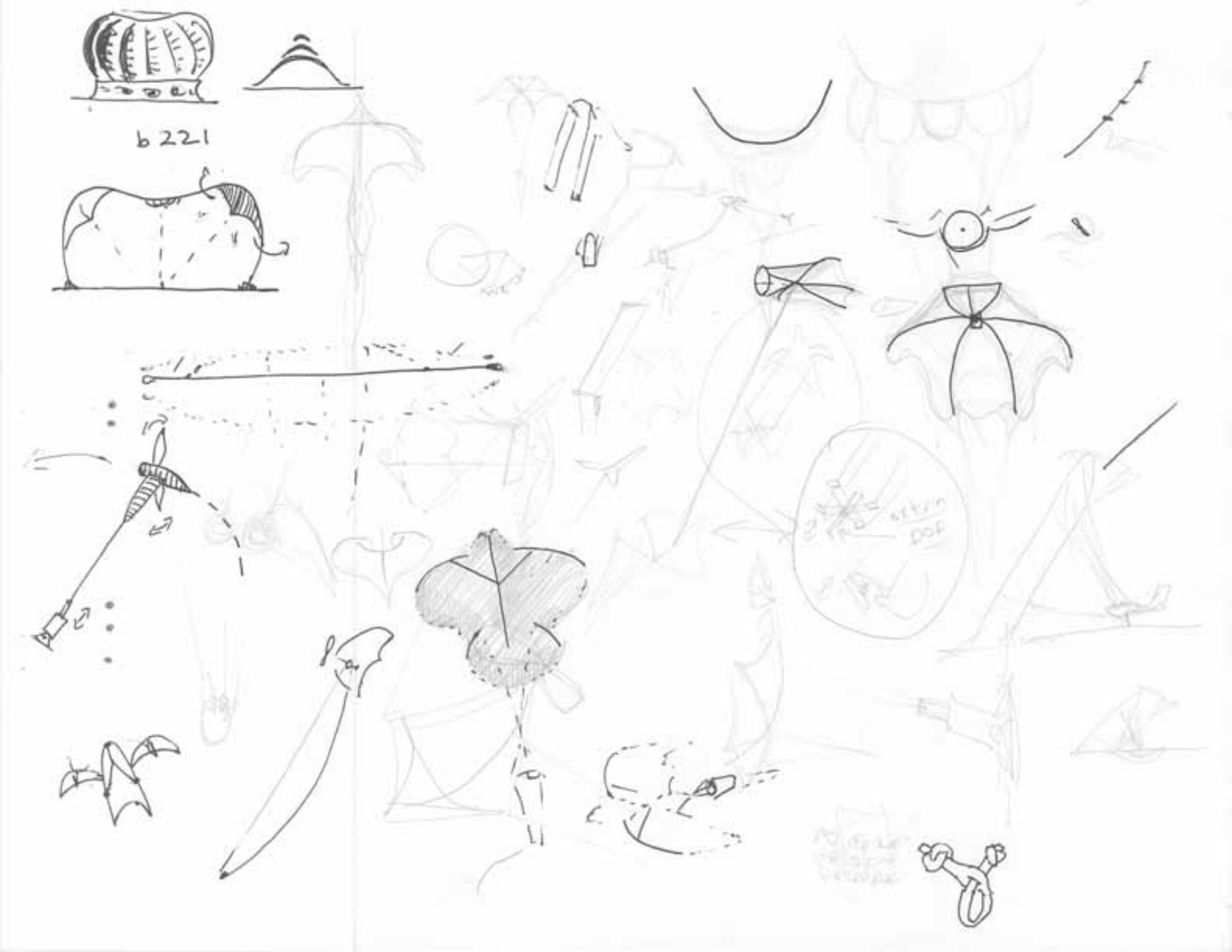


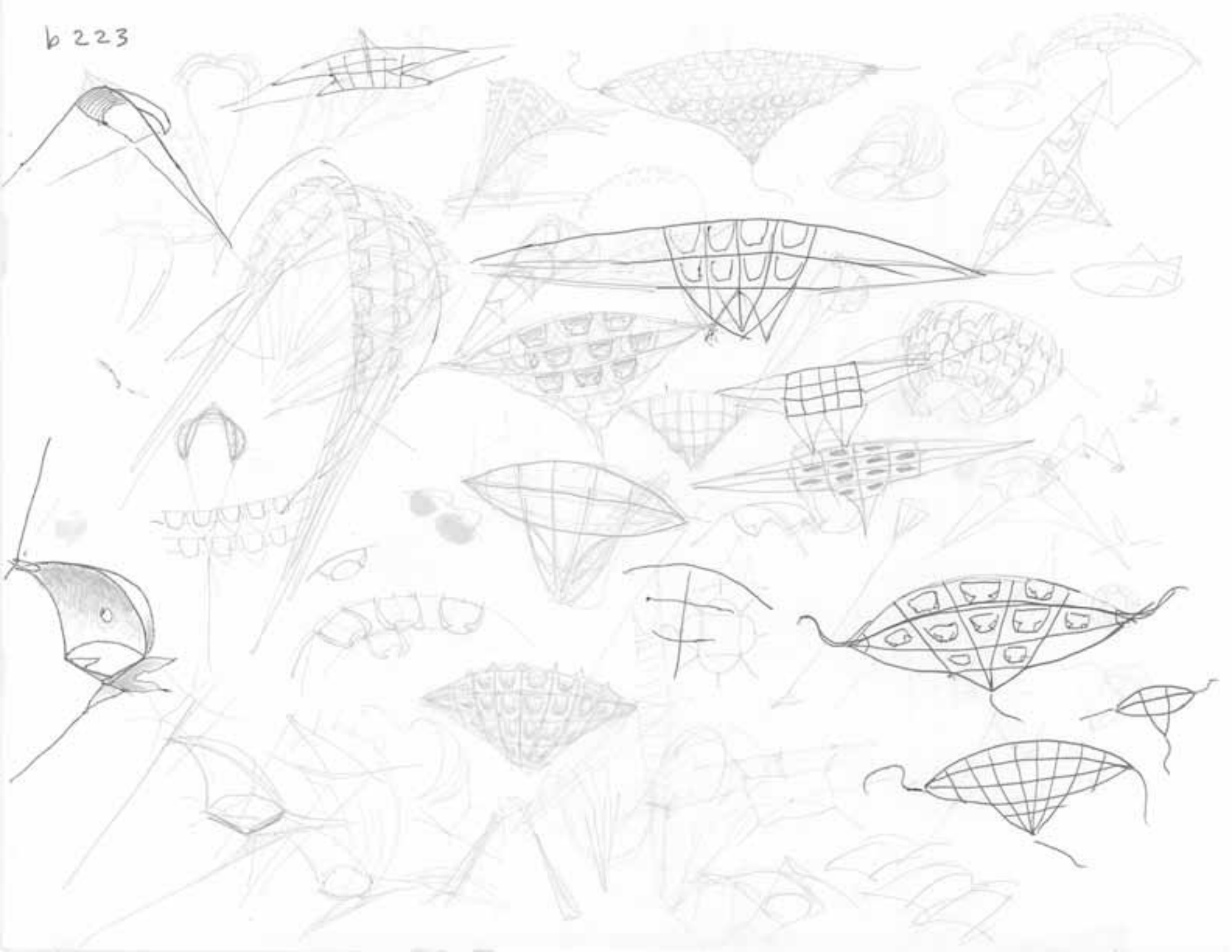
b 220



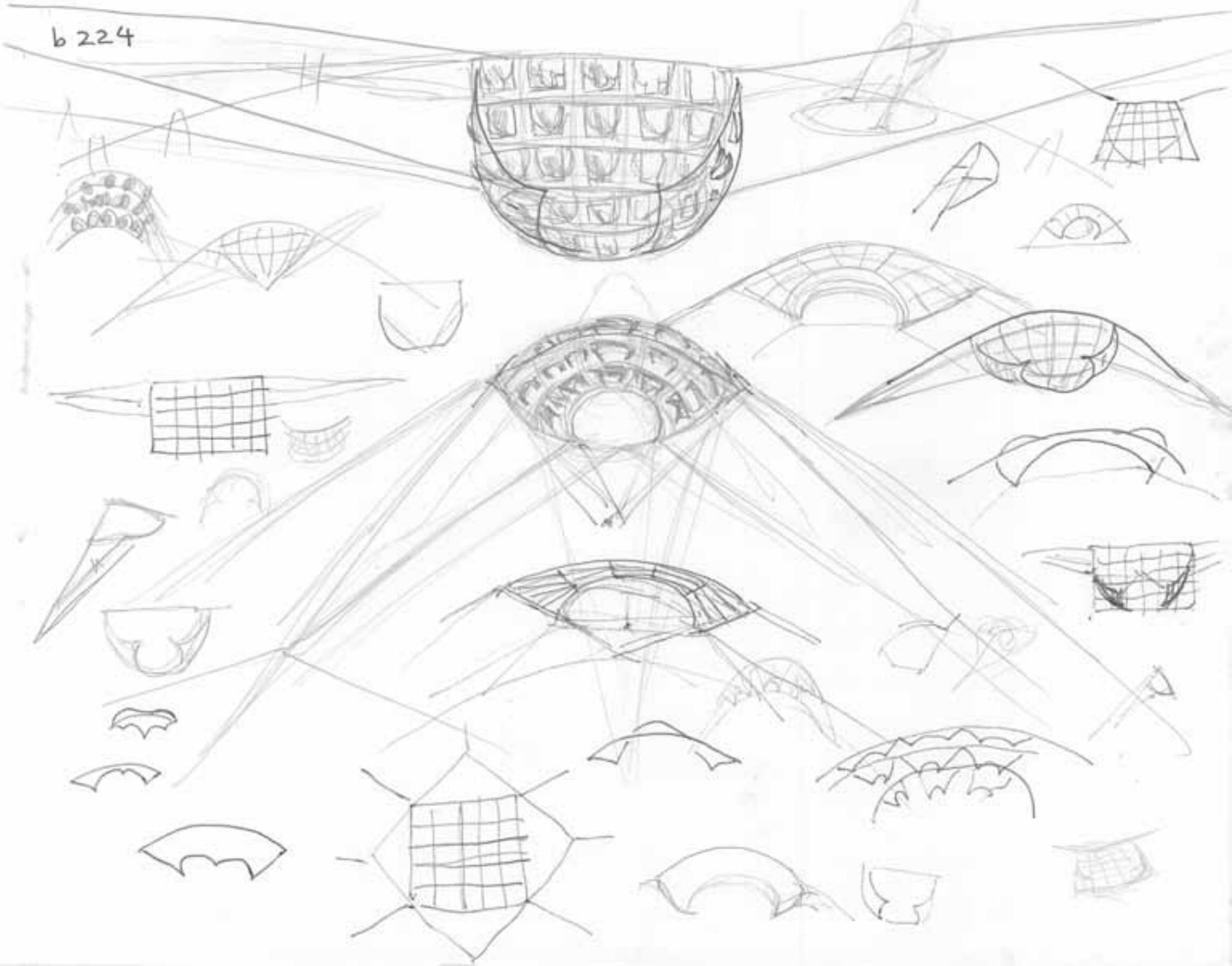

b 221

b 222

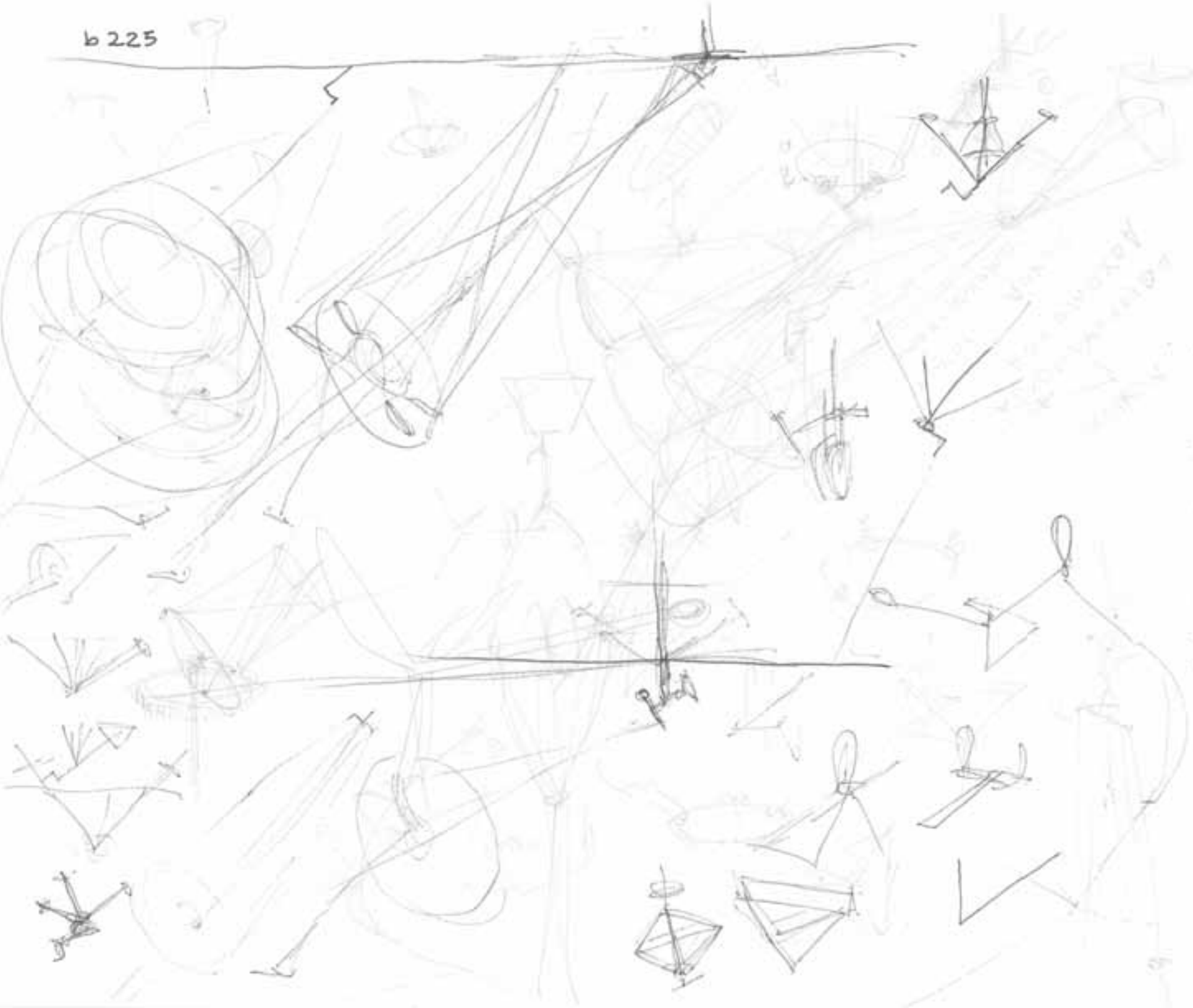
b 223

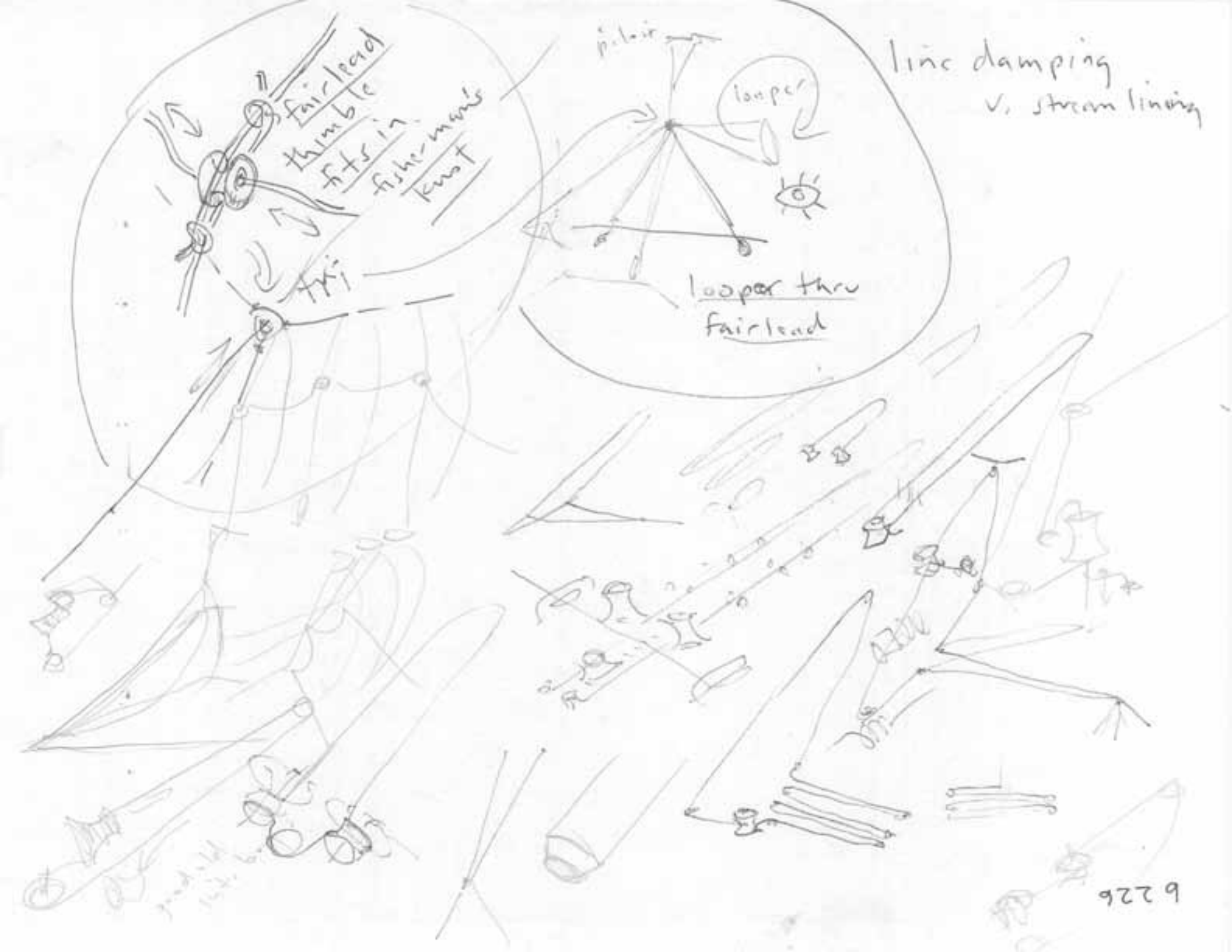


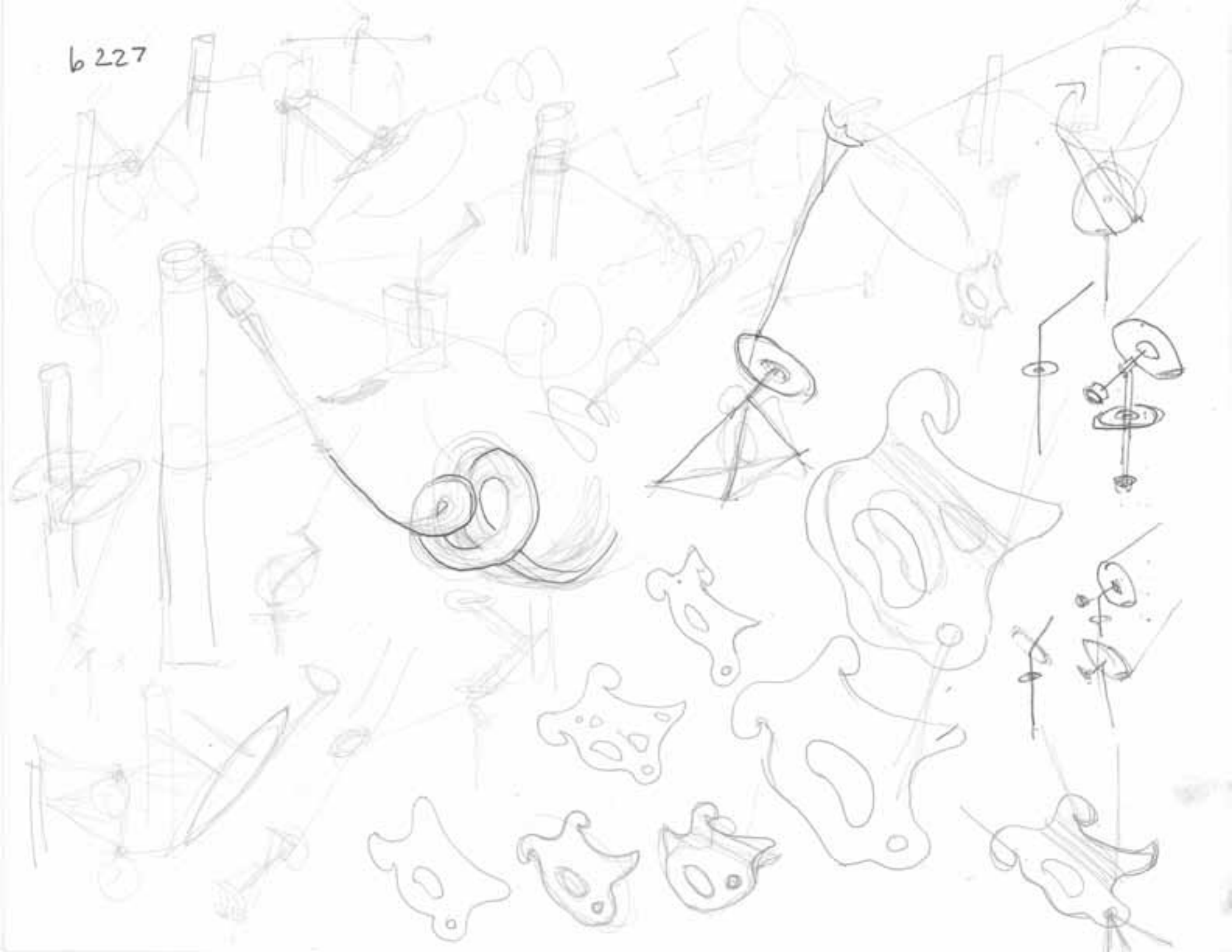
b 224

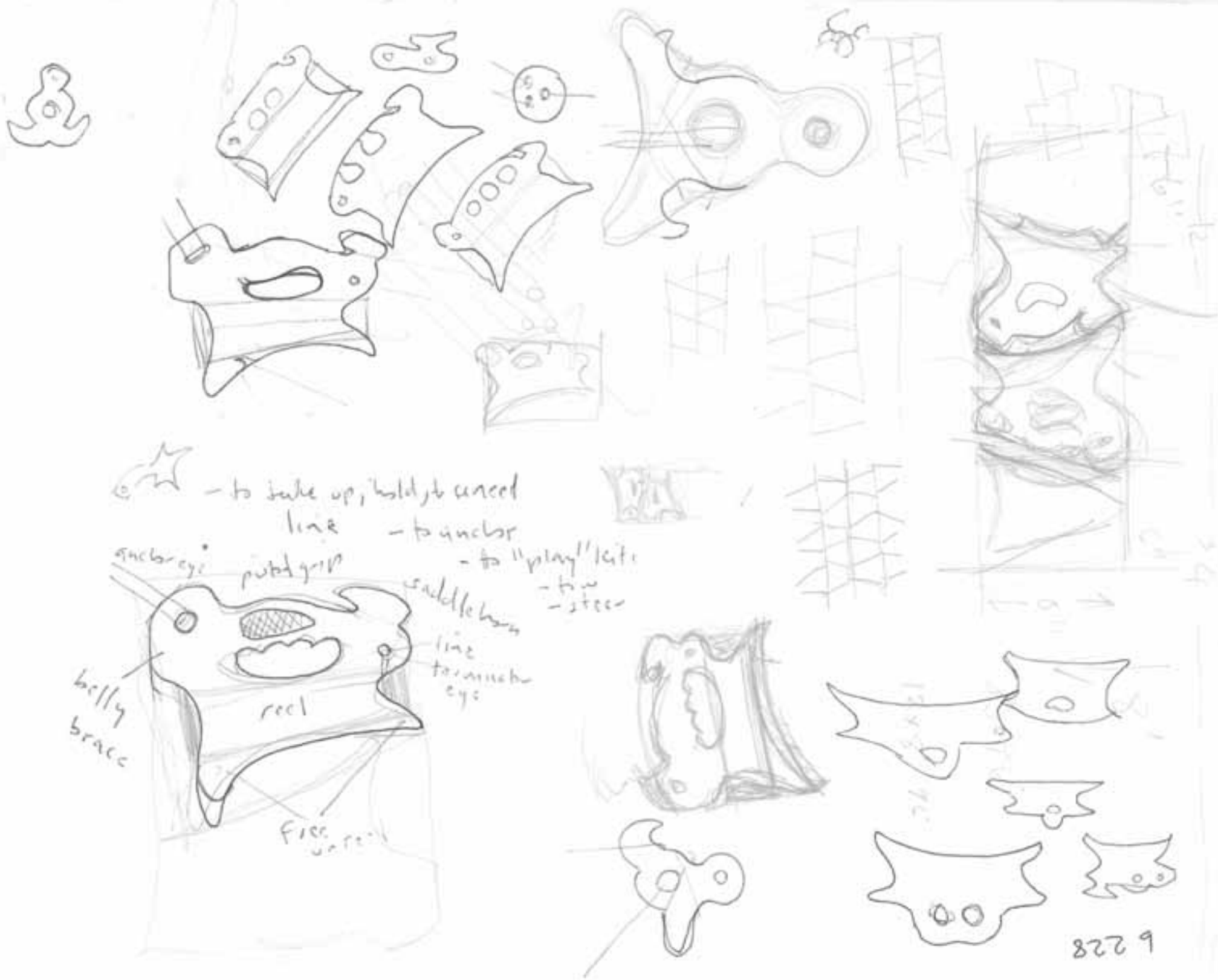


b 225



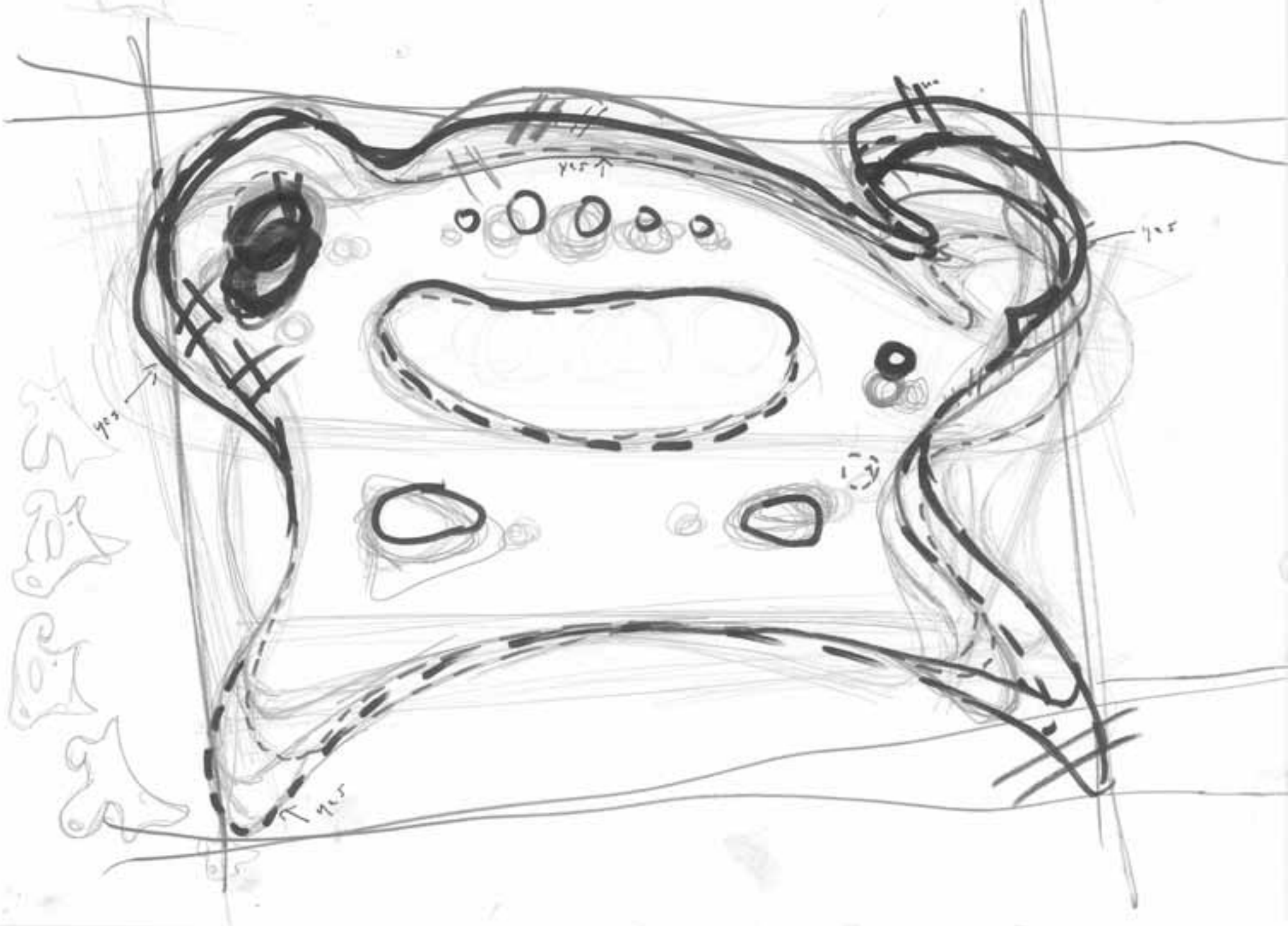

fairlead
thimble
fits in
fisherman's
knot
thru
p. hair
looper
looper thru
fairlead
line damping
v. streamlining
6226


b 227


- to take up, hold, & unreel
line
- to anchor
- to "play" kite
- tow
- steer
anchor eye
pistol grip
saddle horn
line
terminator
eye
belly
brace
reel
free
unreel
8229

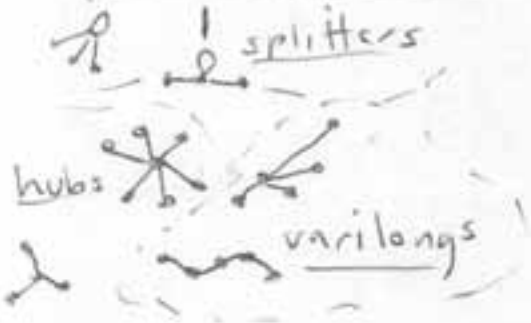
b 229

DREAM GAME

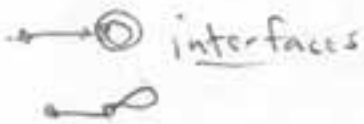


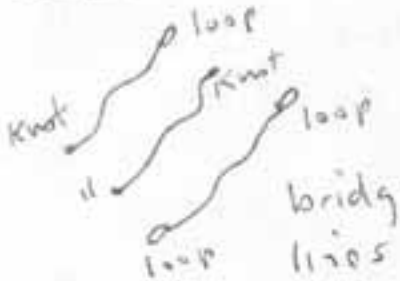
b 230

stringycules



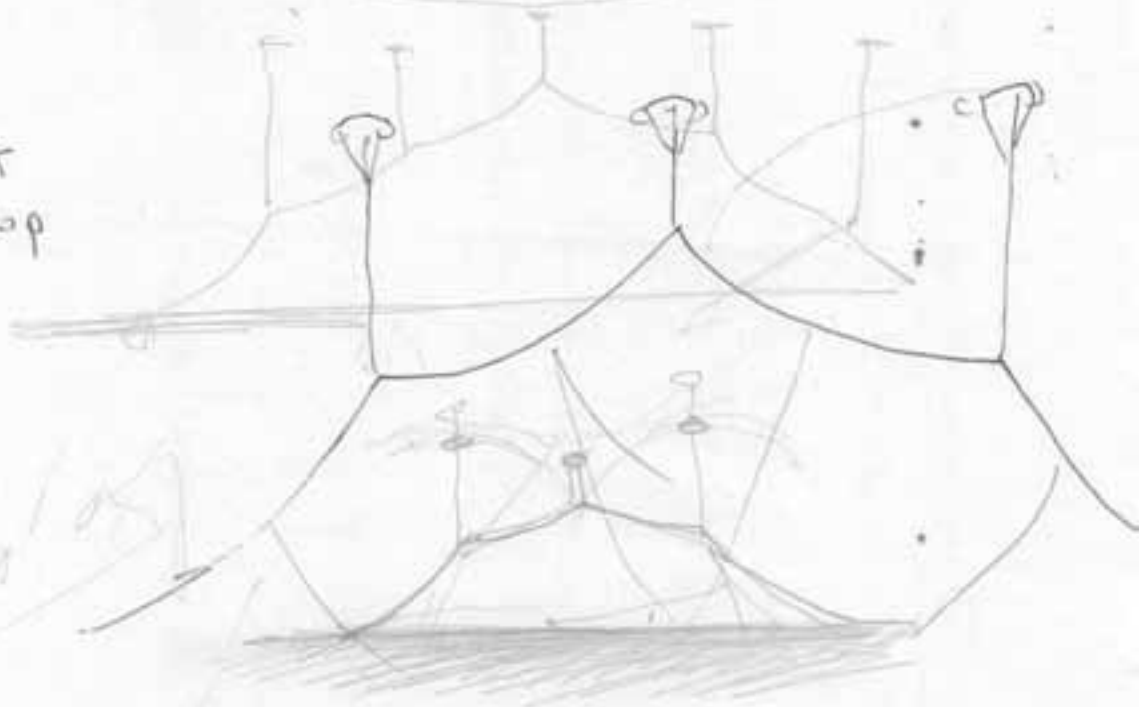
- larkshead - tailed larkshead
- alpine butterfly
- prussik
- figure eight knot
- figure eight loop

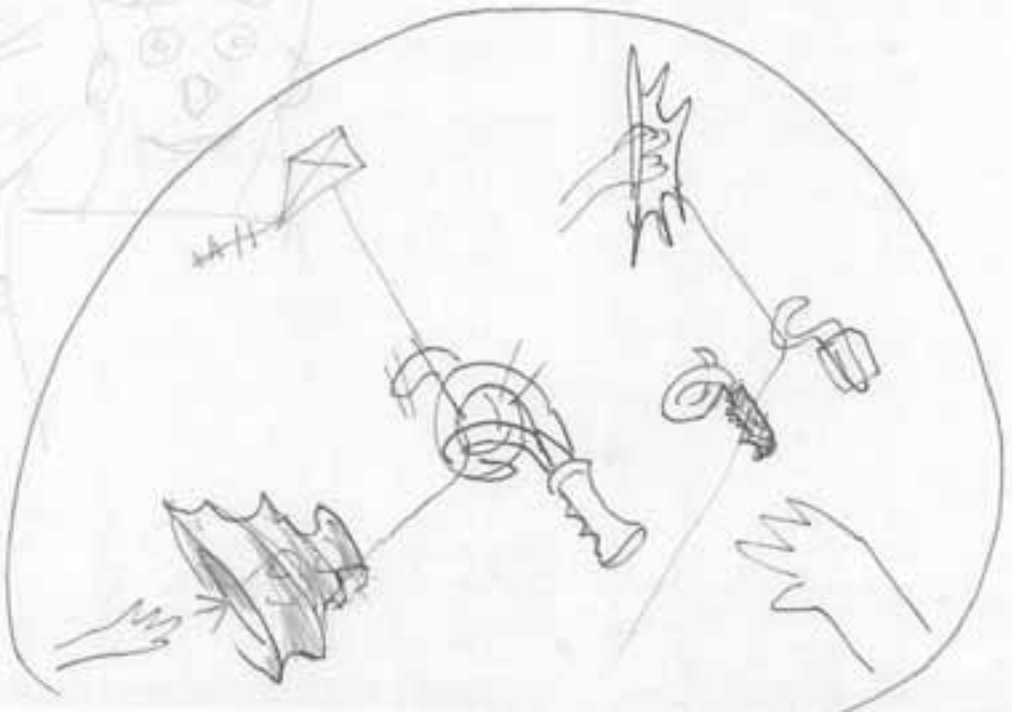




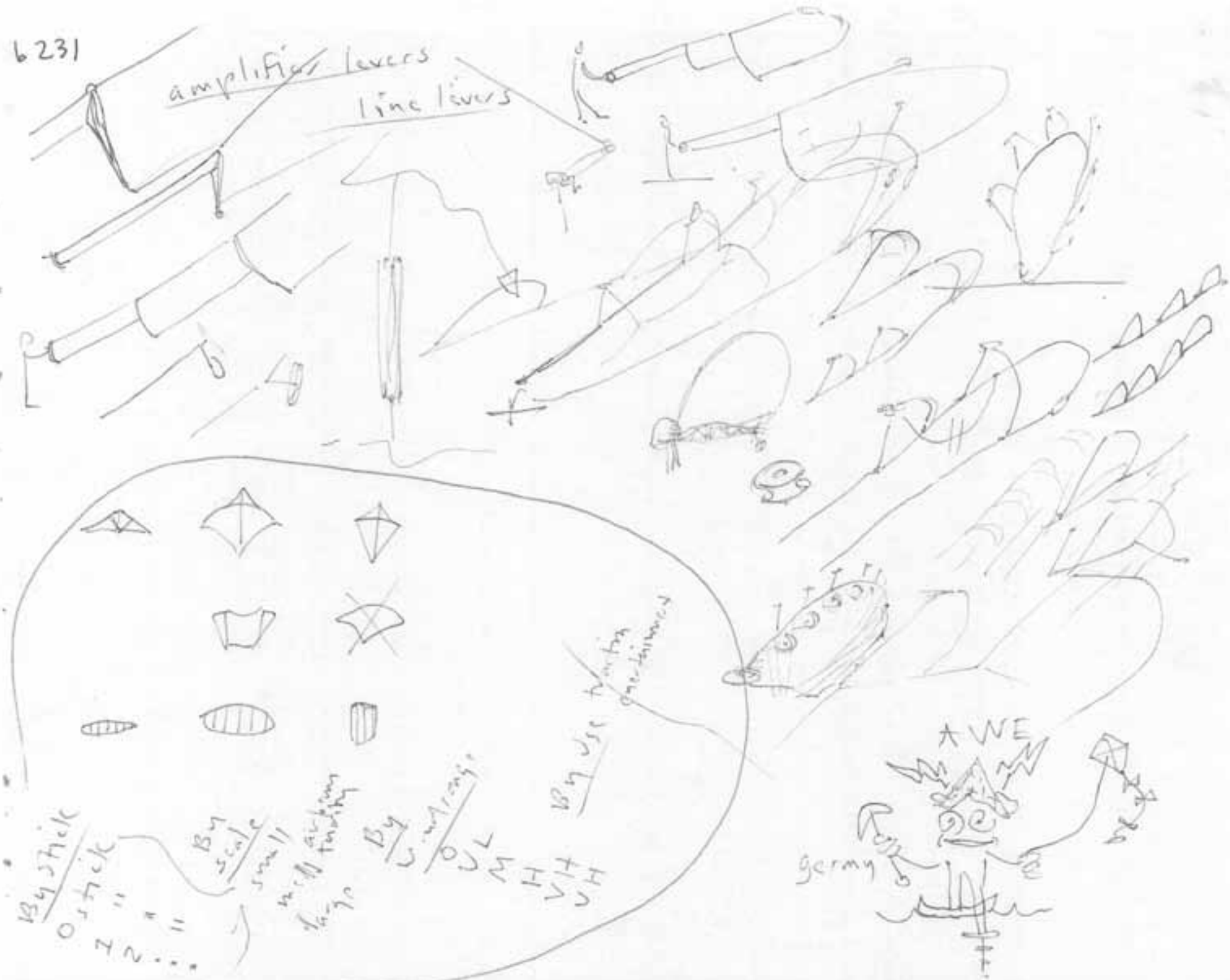
bridgelines
lines
connectorlines
leaders
biridles

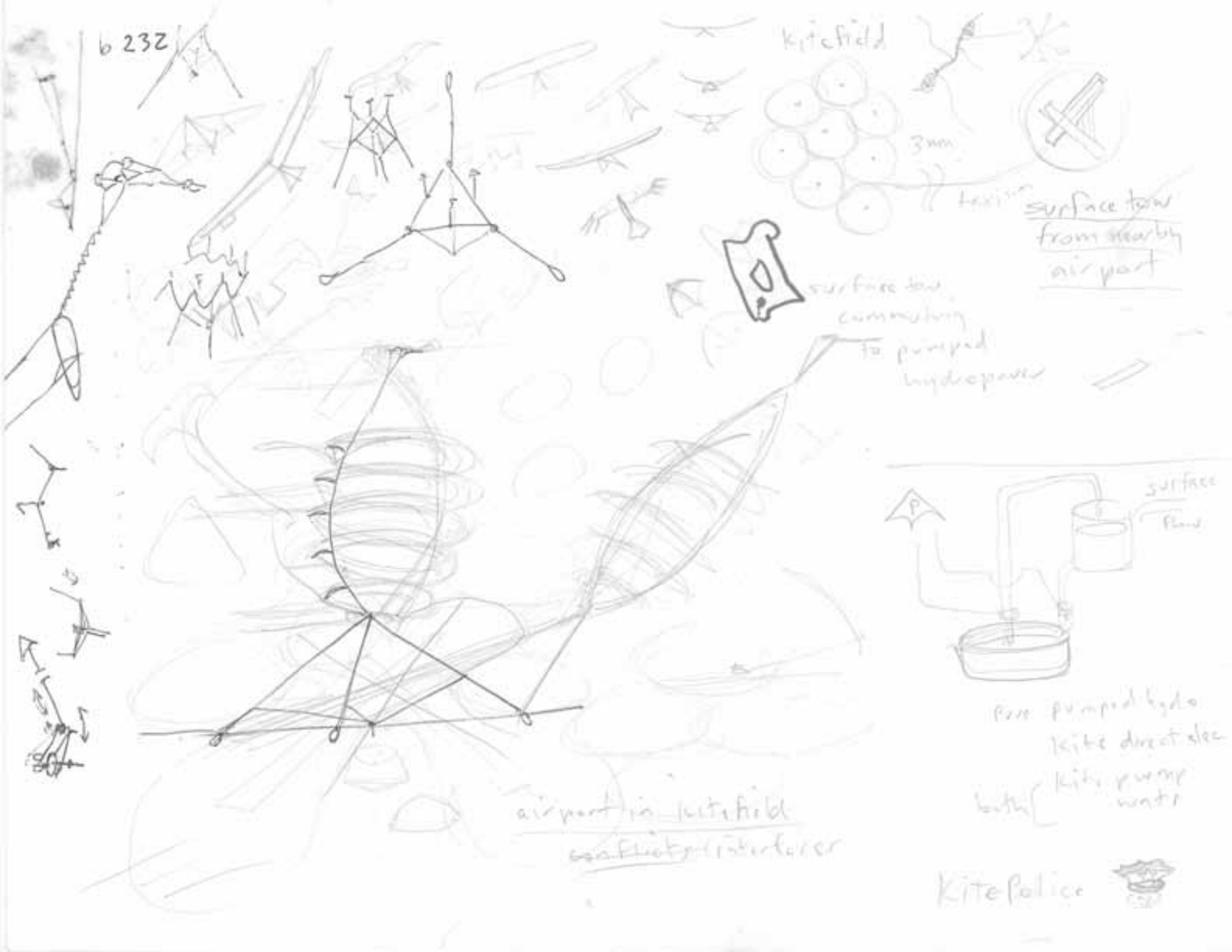
photon ⟷ electron ⟷ phonon ⟷ flowon



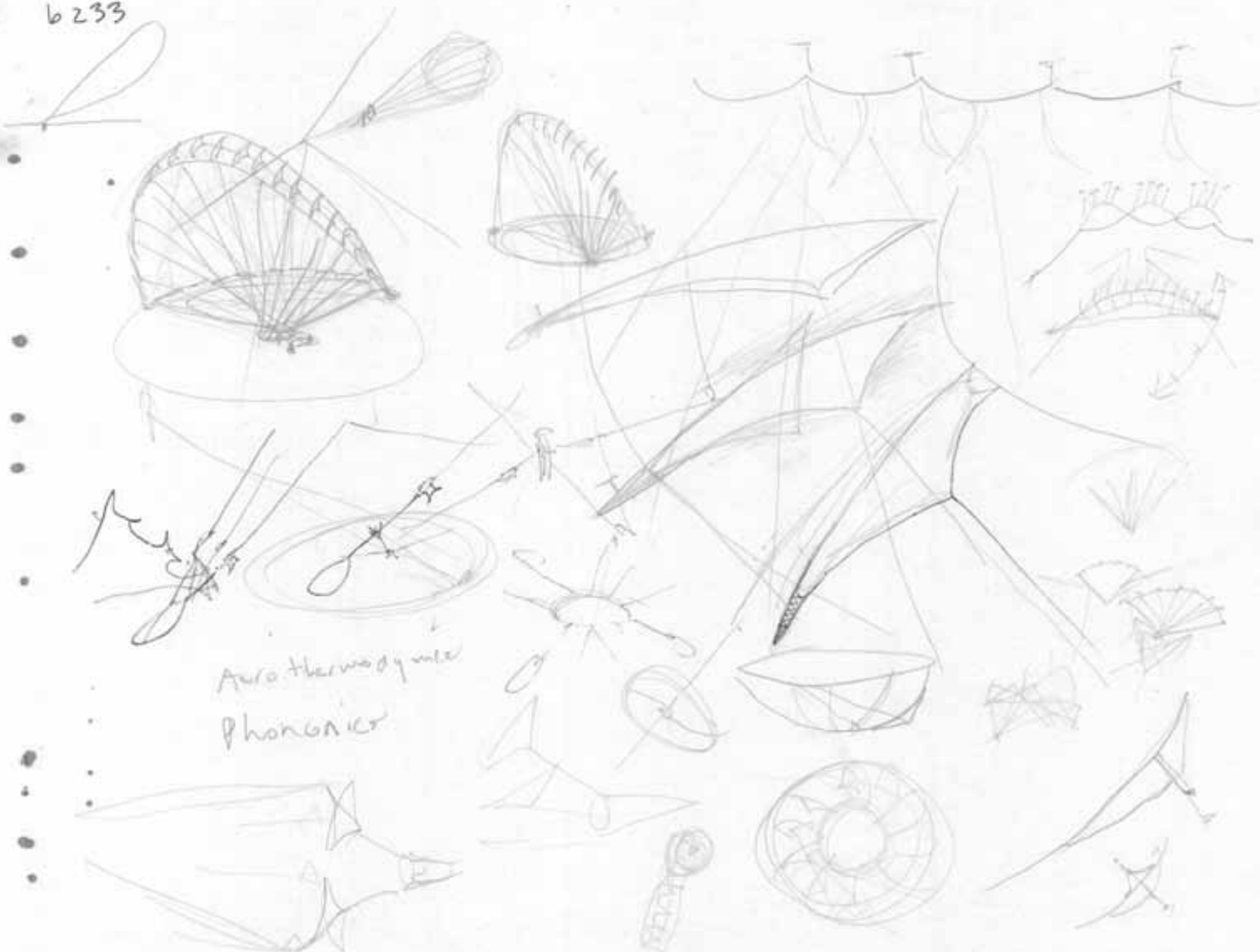


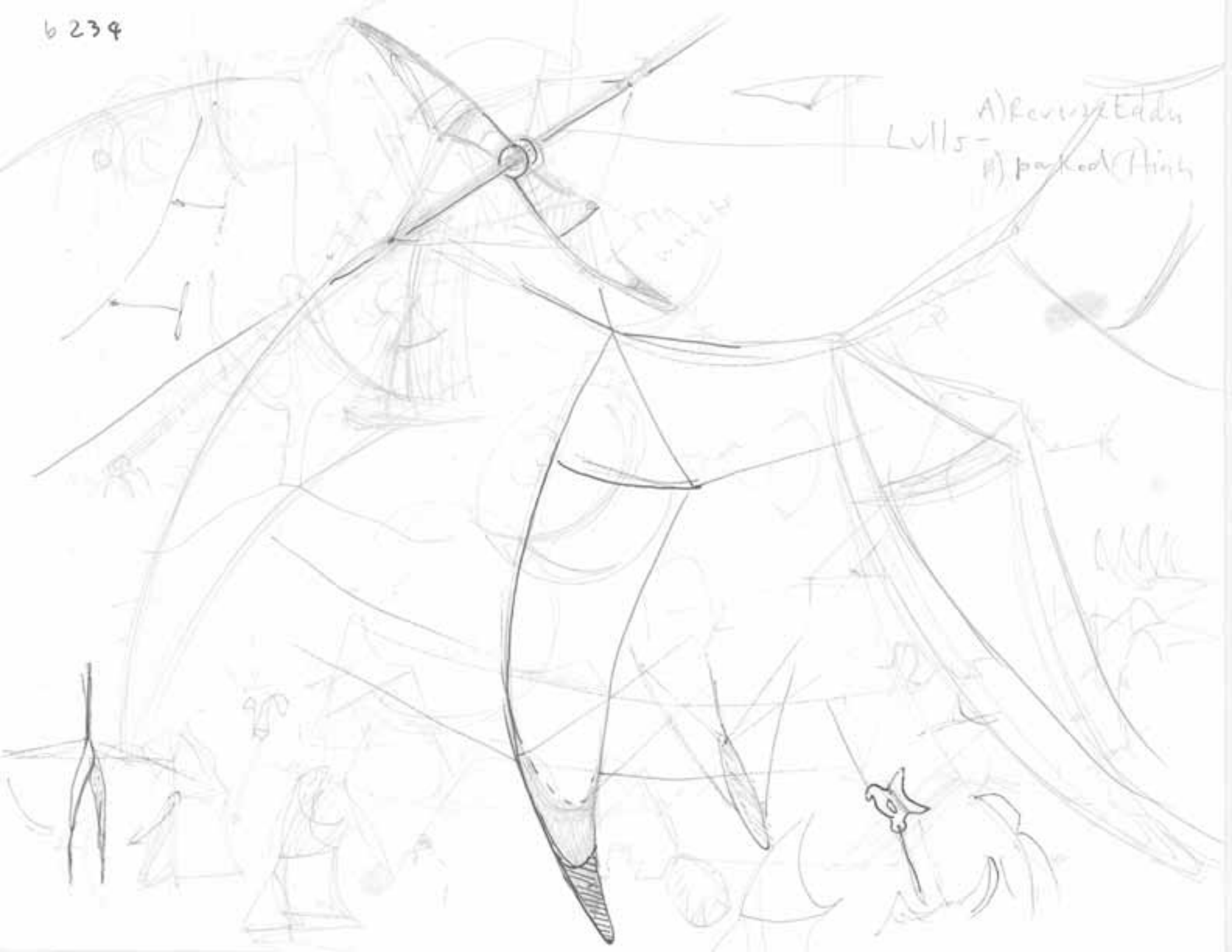
6231

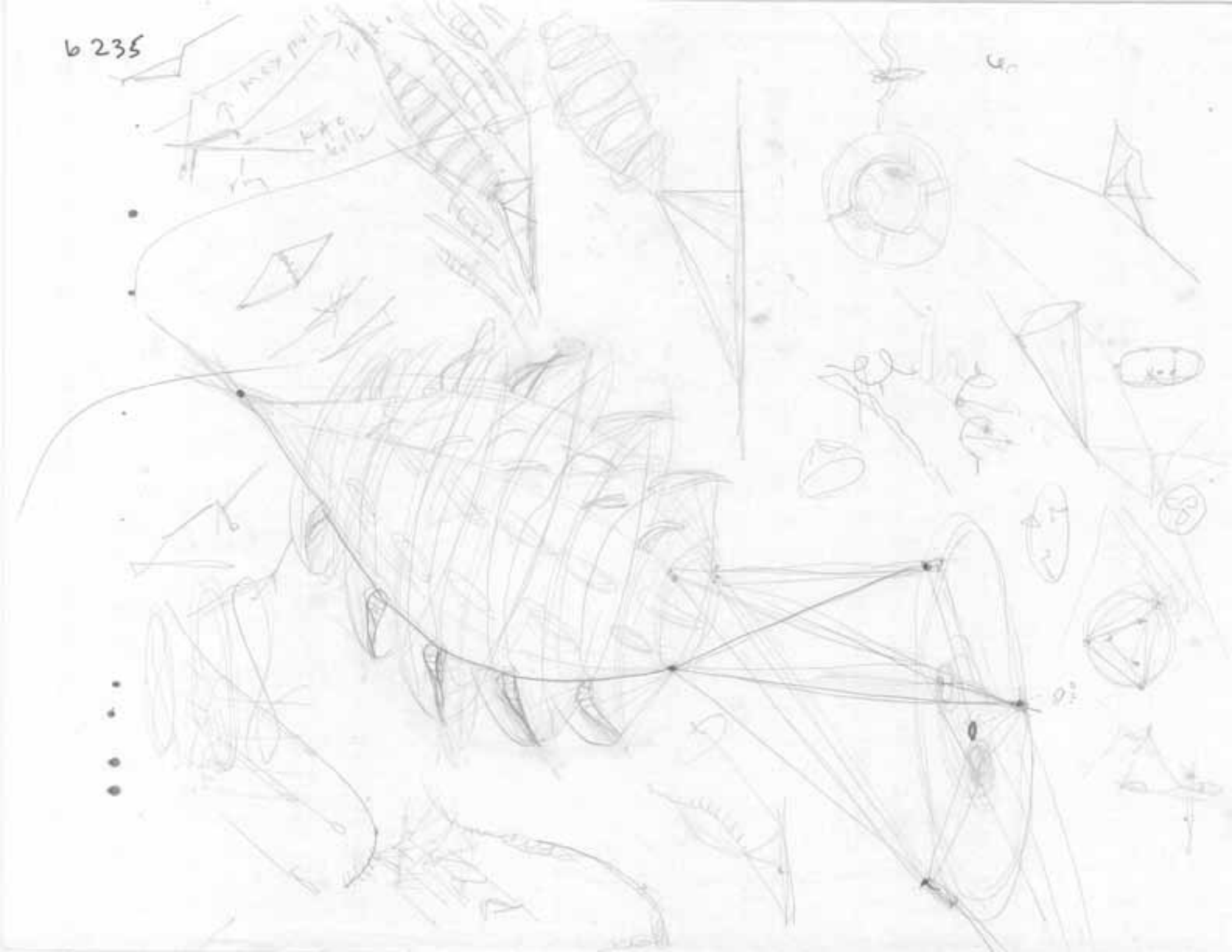

amplifier levers
line levers
By stick
O stick
1 "
2 "
By scale
small
By
O
VL
M
H
VH
VH
By use
AWE
germy

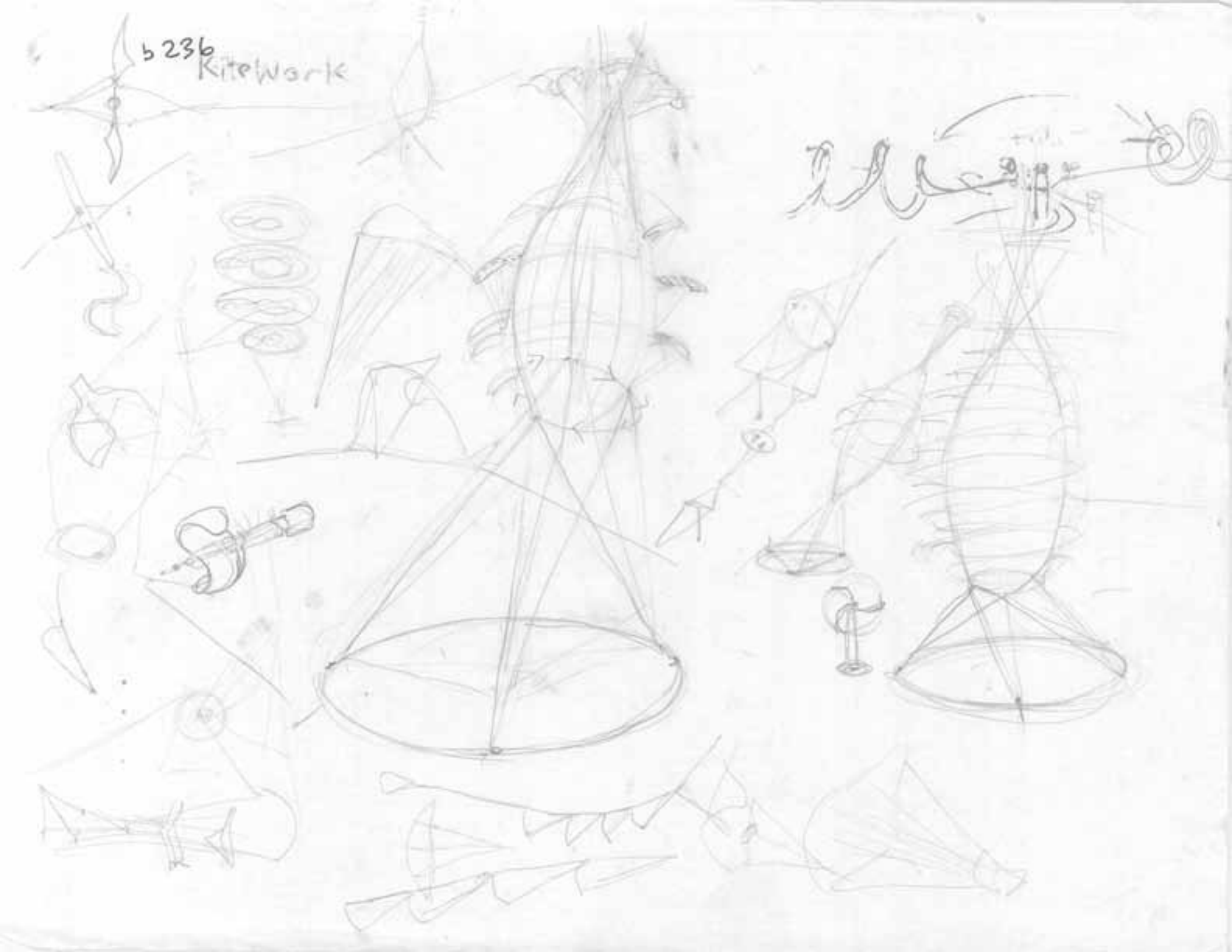

b 232
kitefield
3mm
surface tow
from nearby
airport
surface tow
commuting
to pumped
hydropower
surface
flow
pure pumped hydro
kite direct elec
both
kite pump
water
airport in kitefield
conflicts interferer
KitePolice

6233

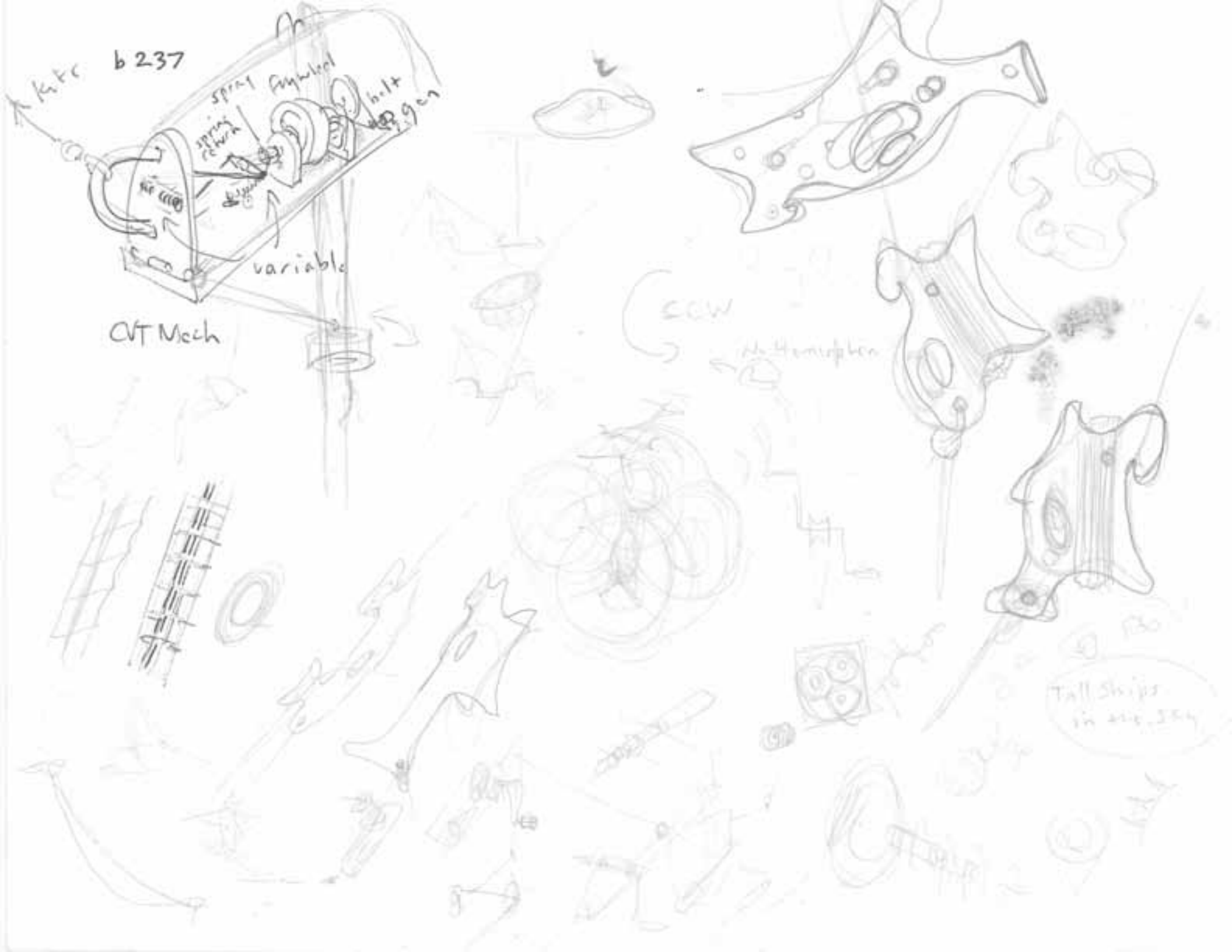




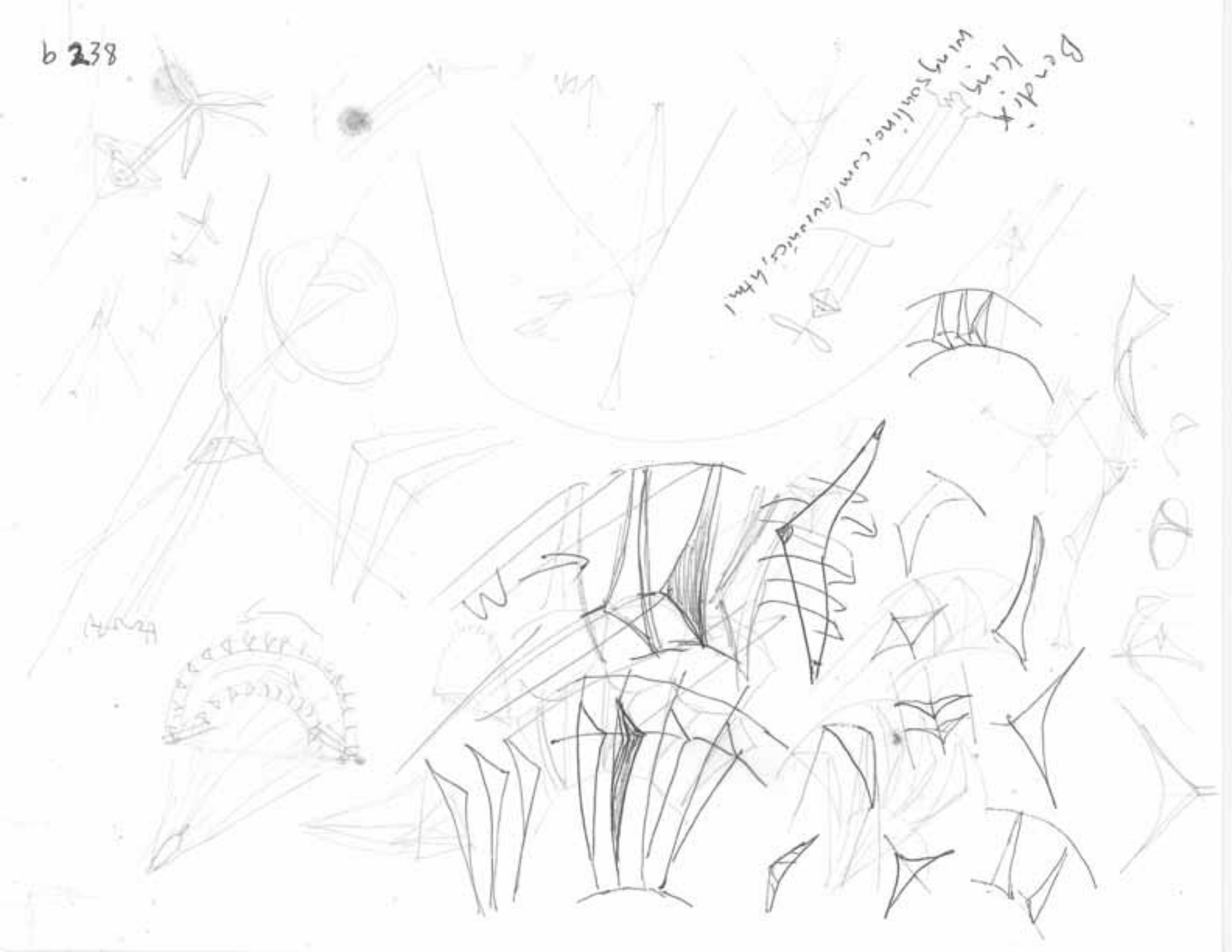

b 235


b 236
KiteWork

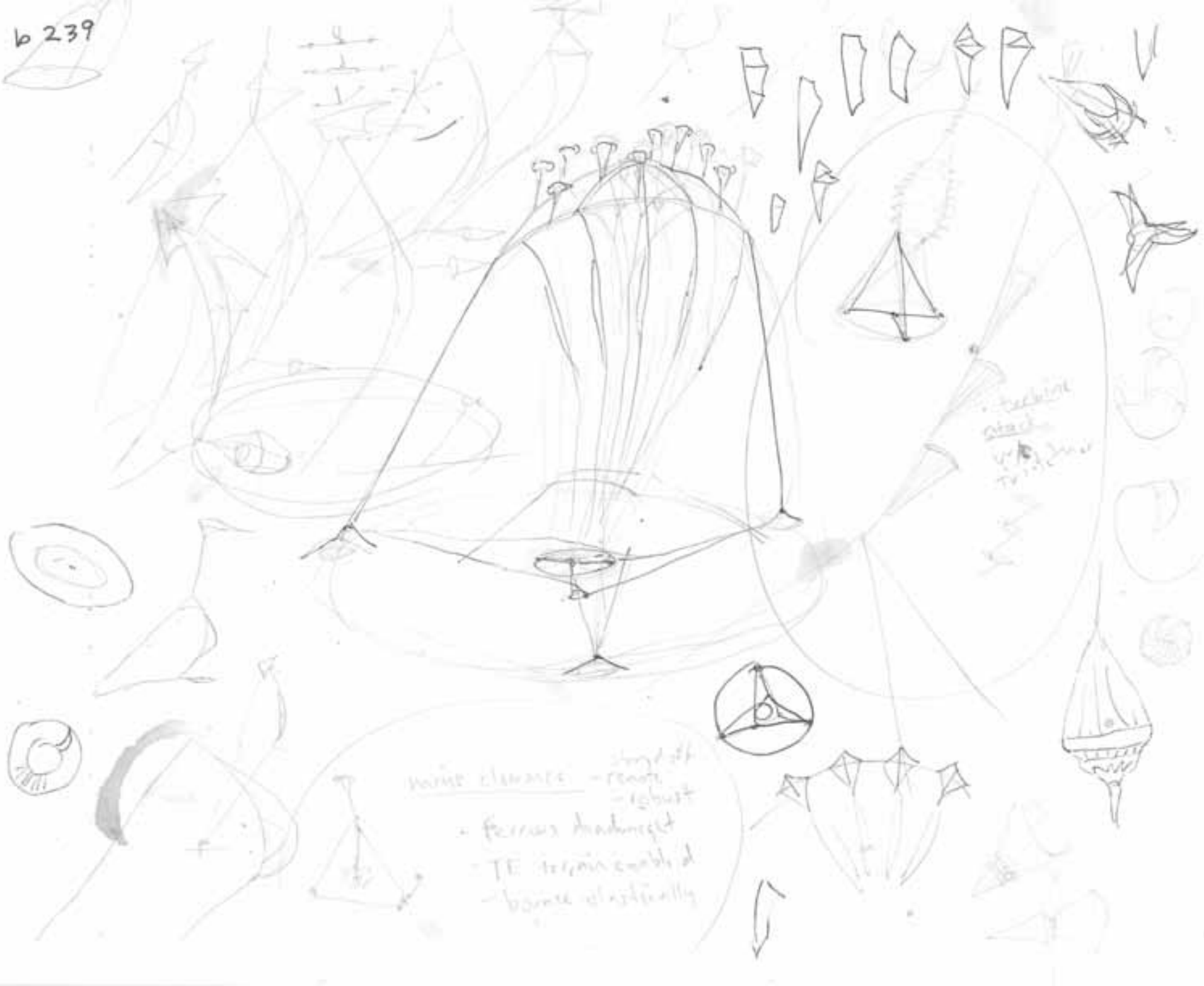
CVT Mech



b 238

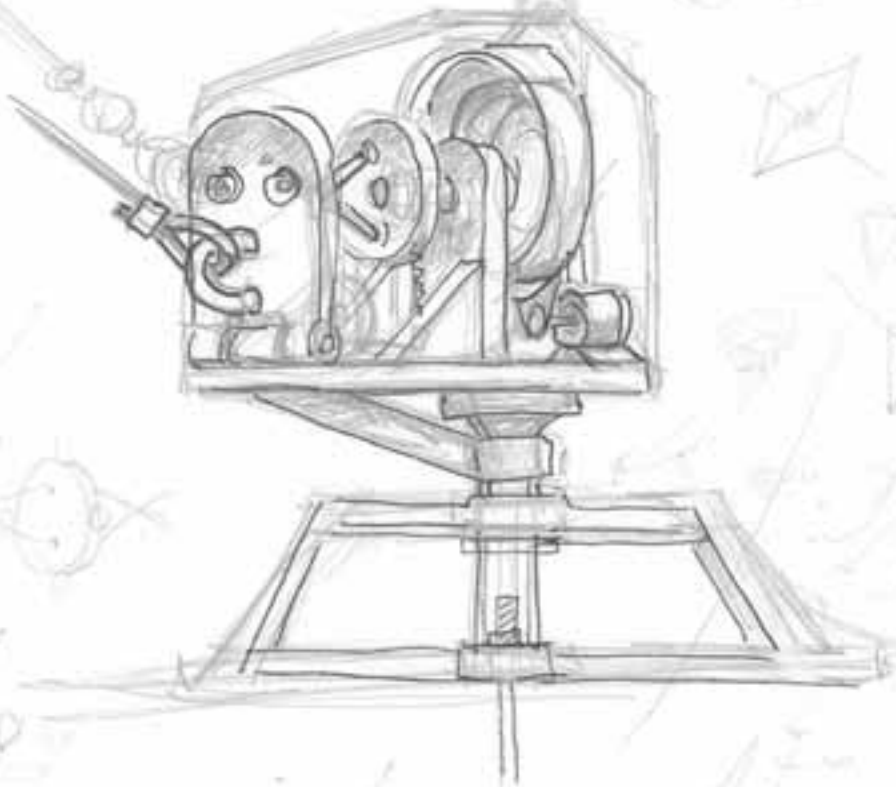


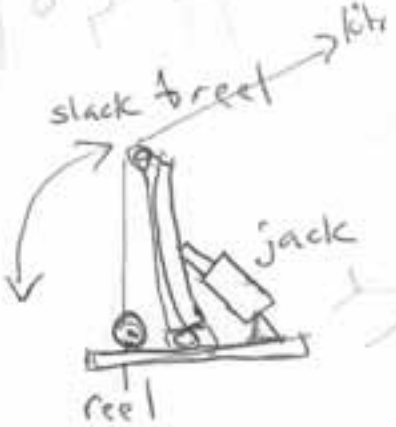
b 239



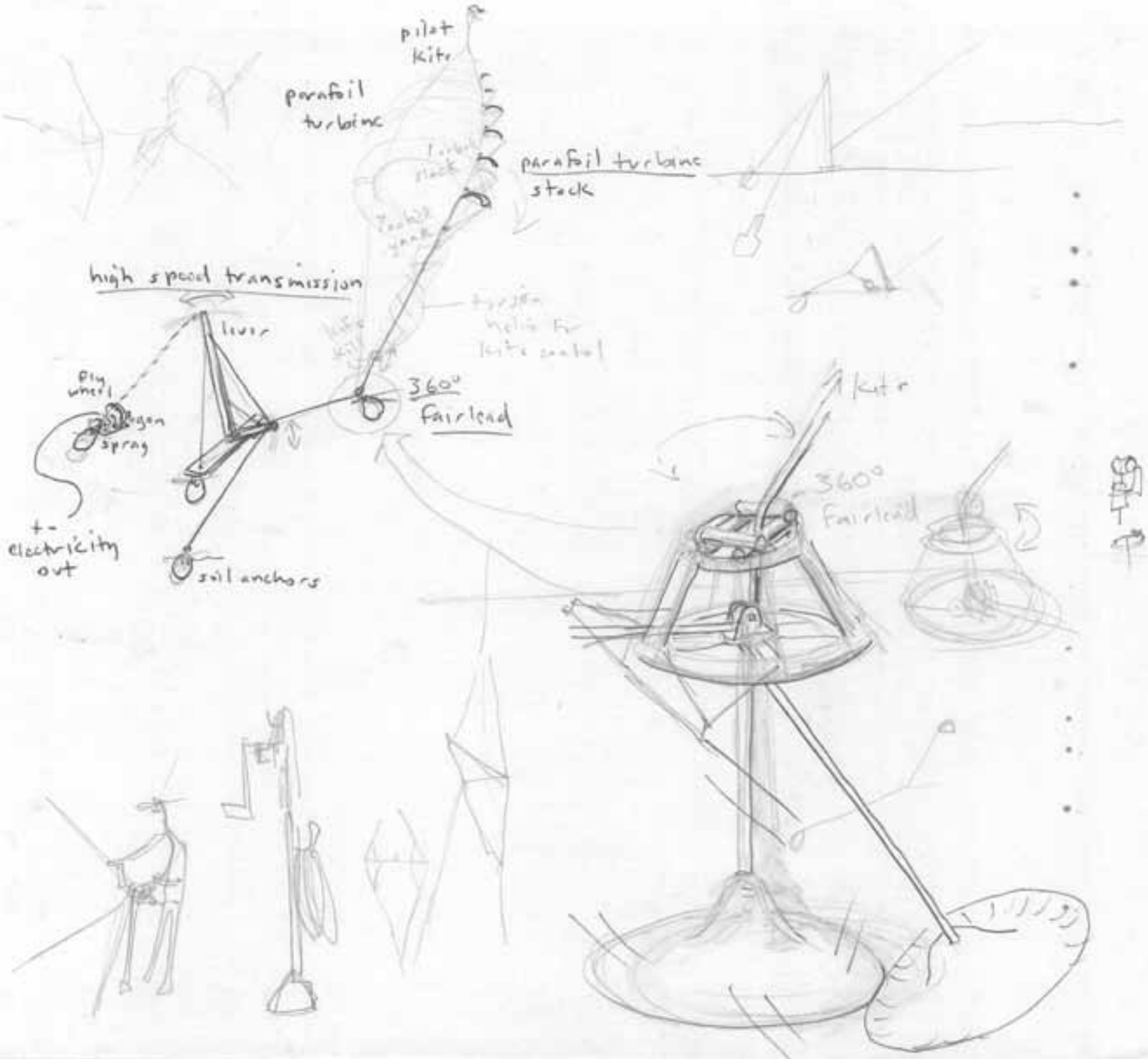
b 246

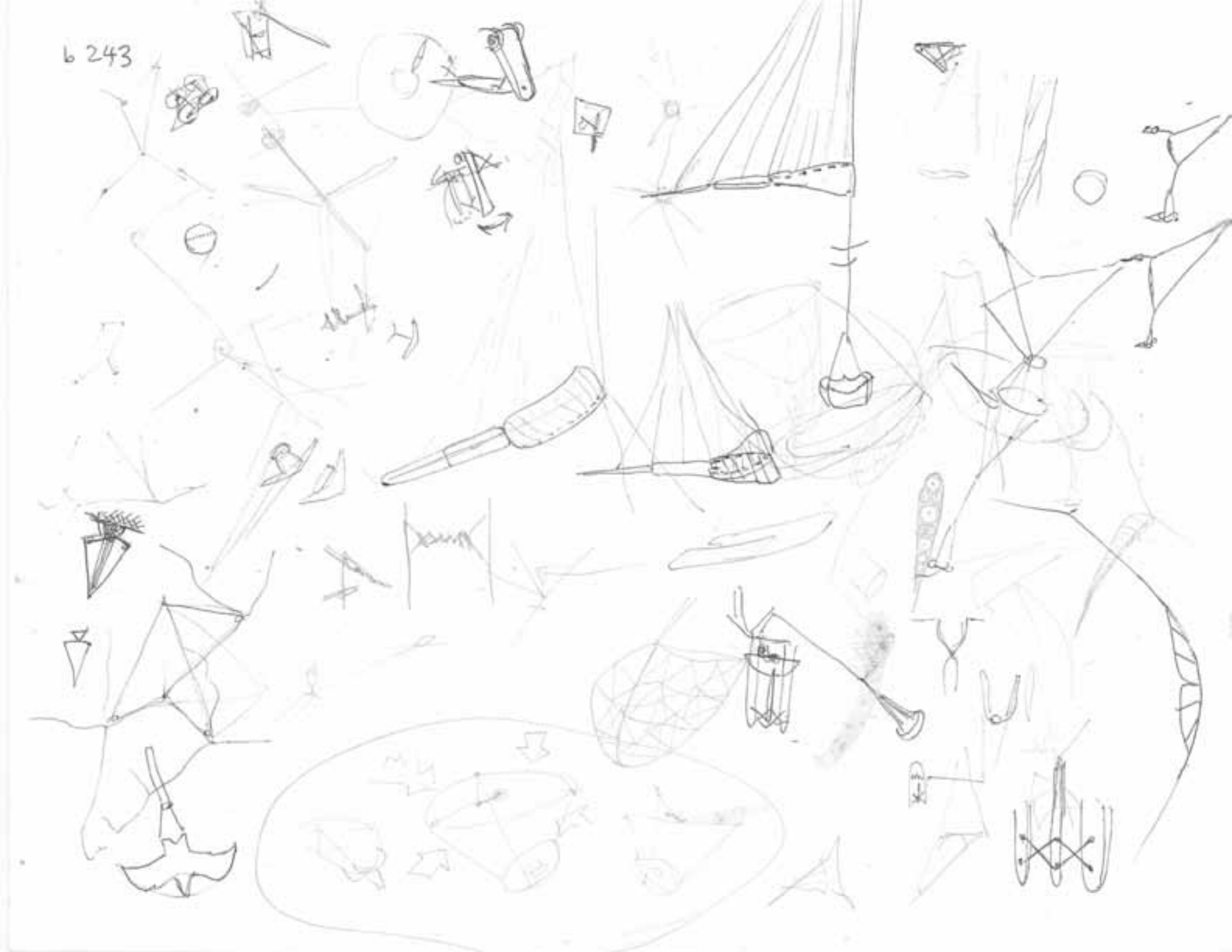
b 241





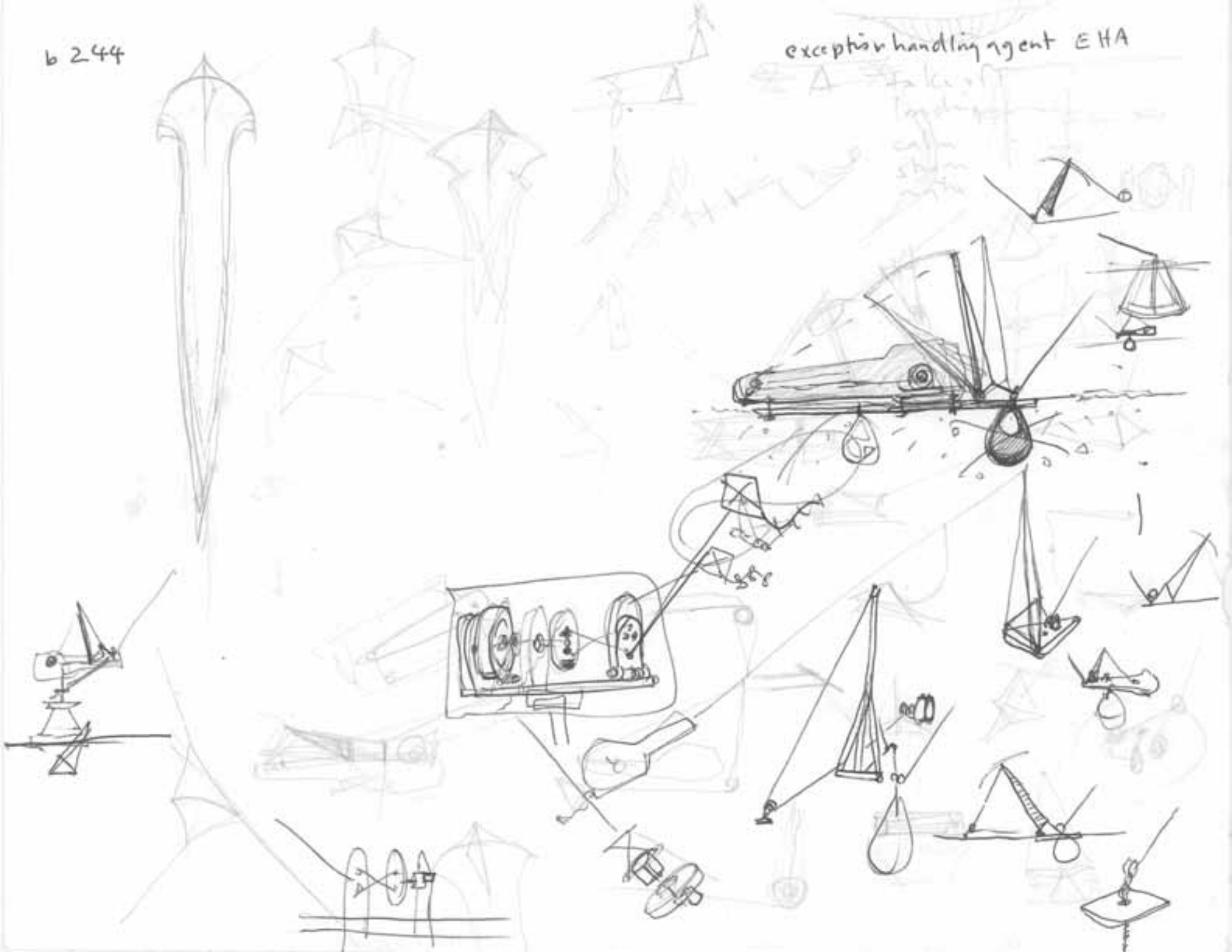
b 242


pilot kite
parafoil turbine
parafoil turbine stock
high speed transmission
lever
fly wheel
sprag
360° fairlead
+ - electricity out
soil anchors
kite
360° fairlead

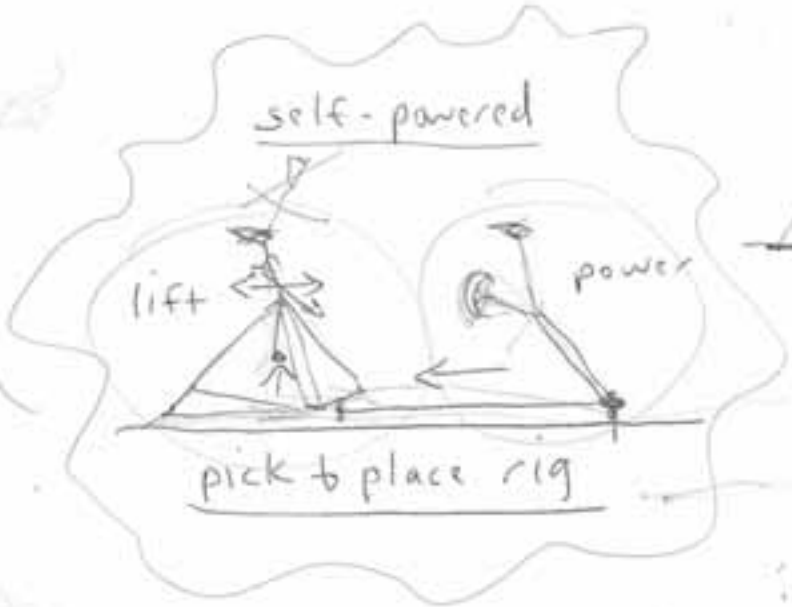

b 243

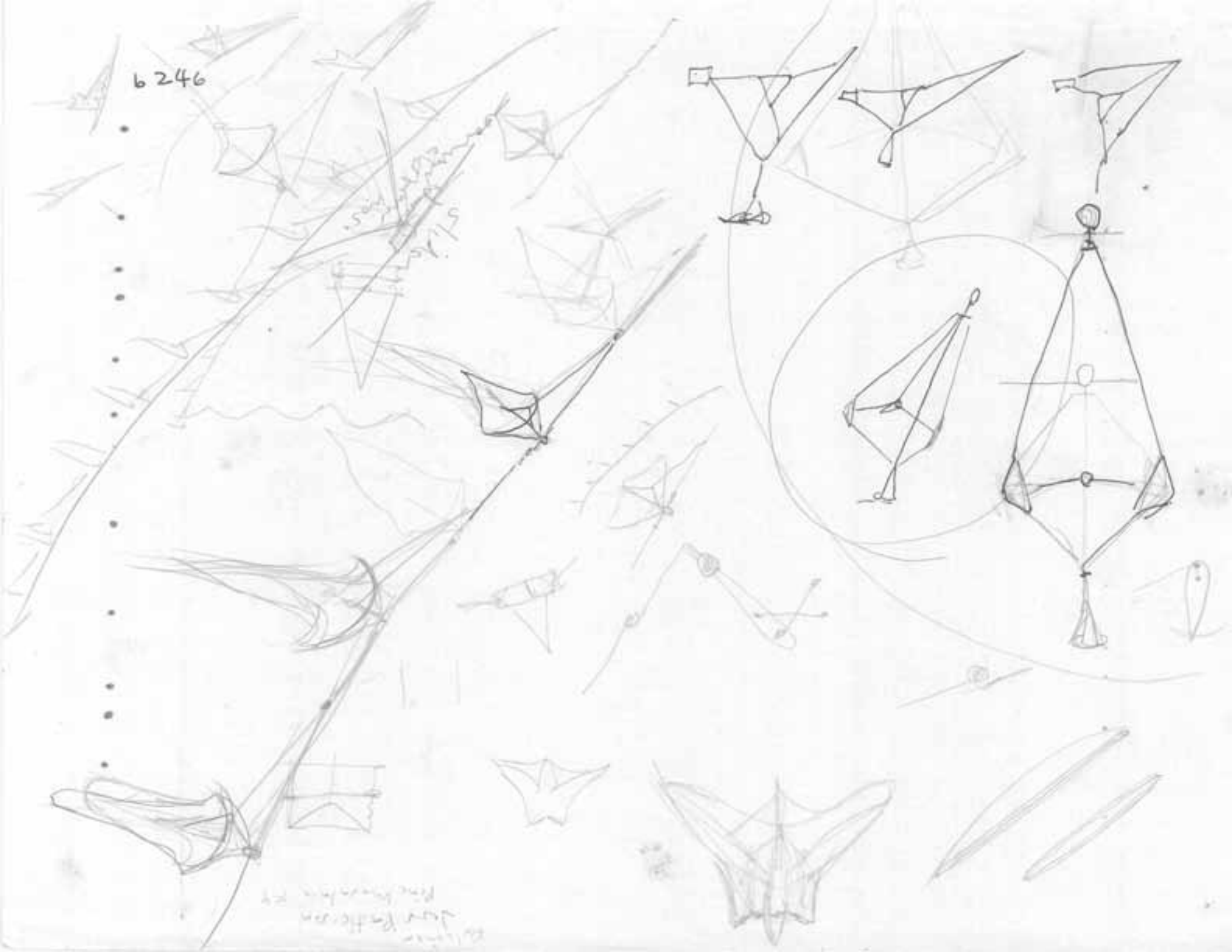
b 244

exception handling agent EHA

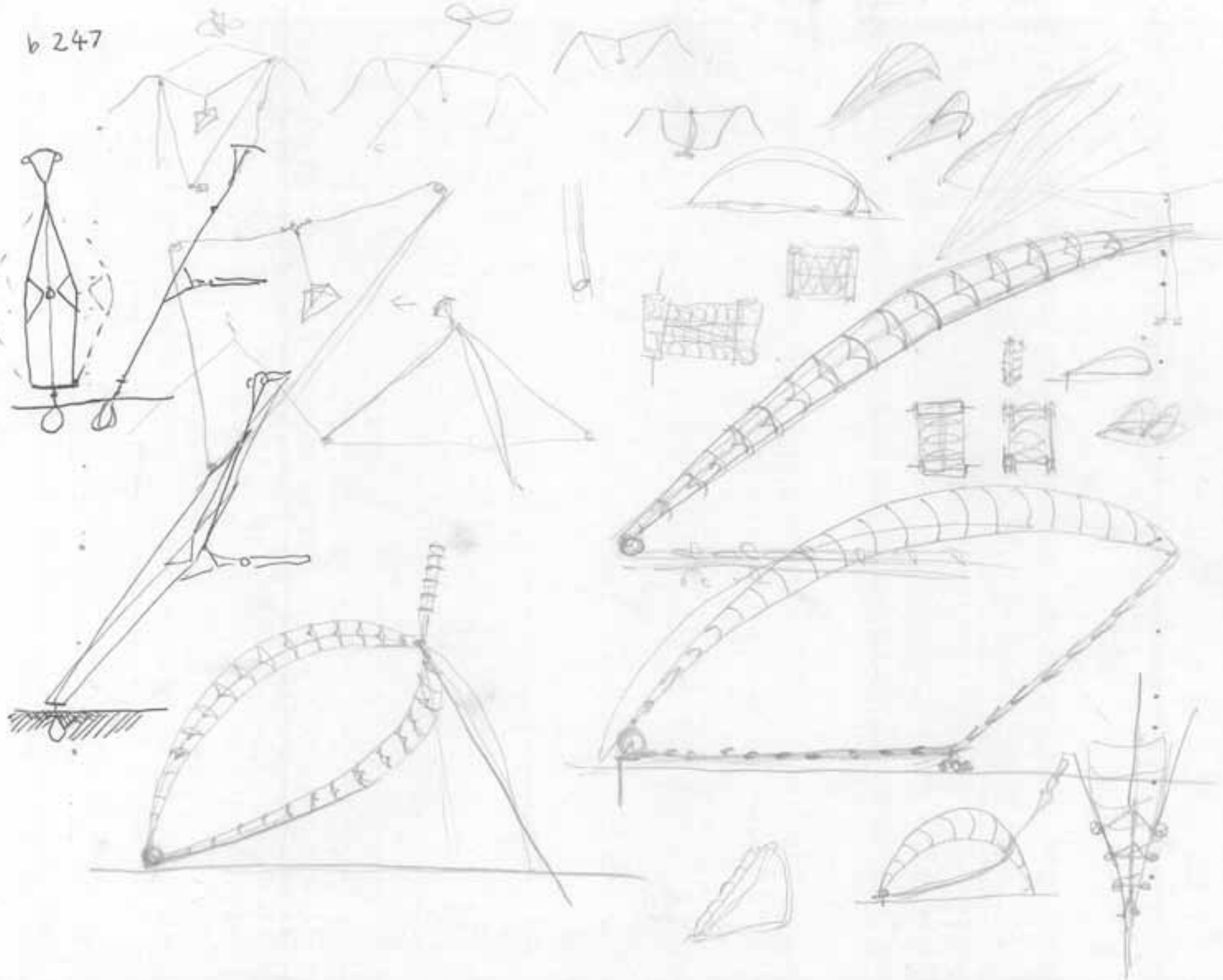


b 245




6246

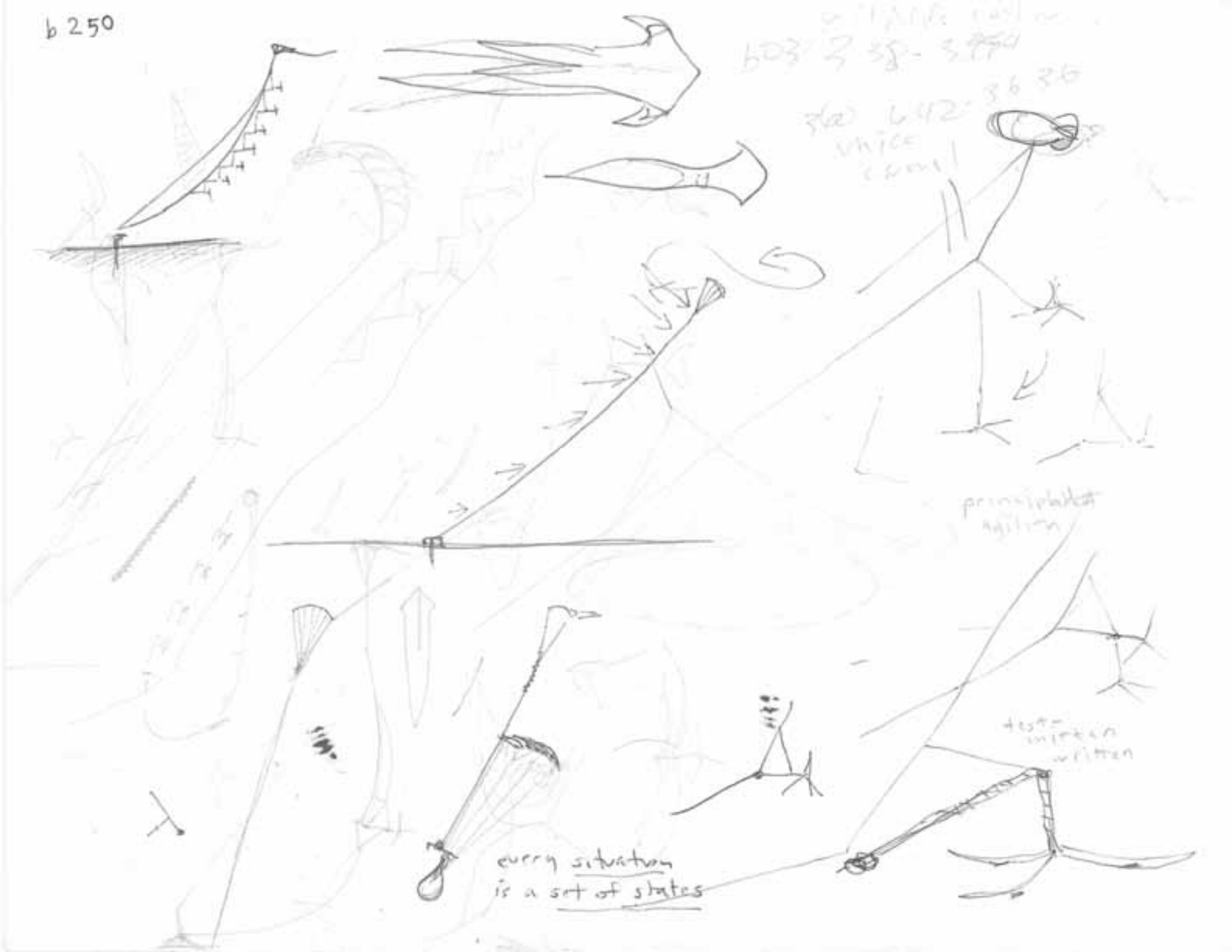
b 247

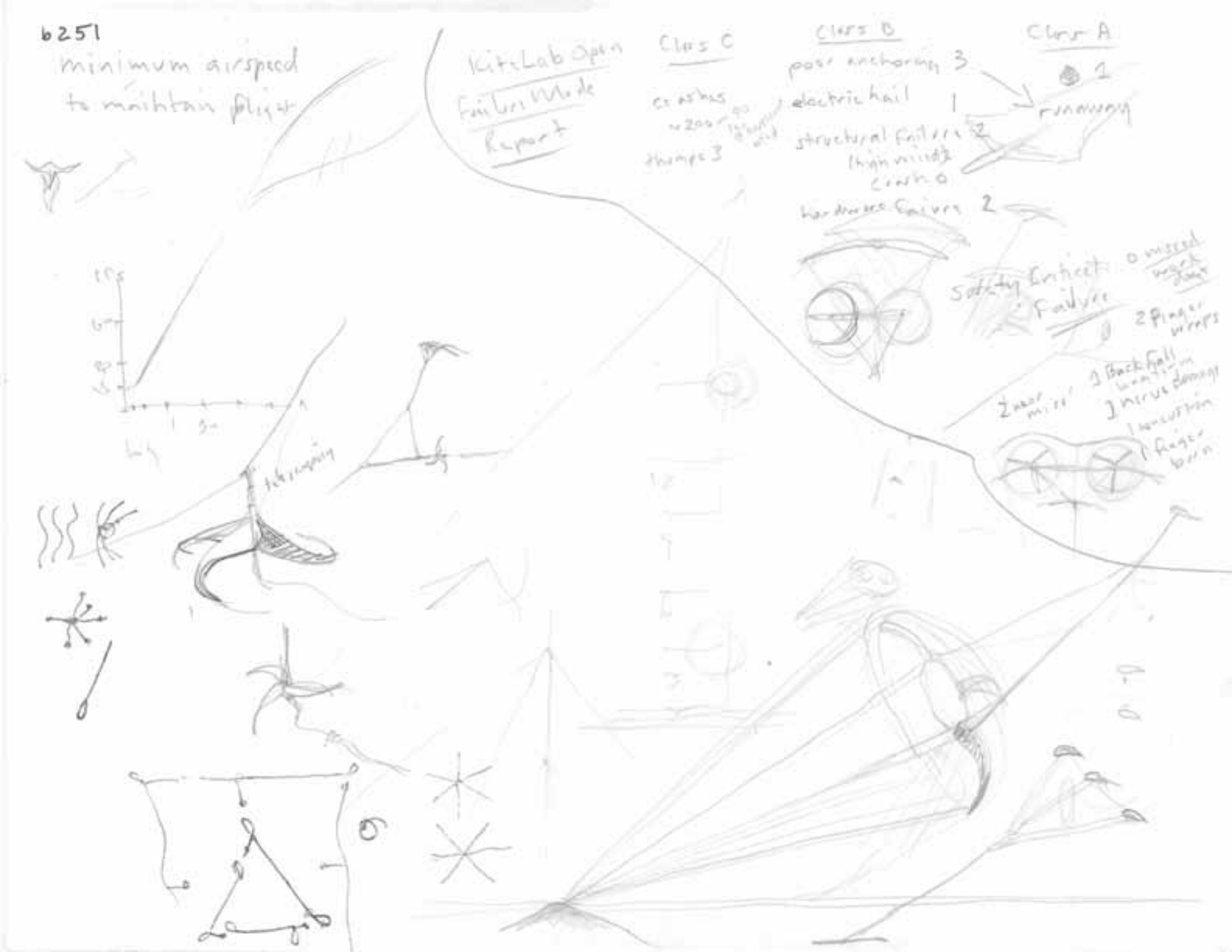


Tethered Aviation Control Theory TACT
+ inherent stability mechanisms - ease sorus duty
+ geographic positional assumption
- tether uncertainty - minimal tension requirement
ram intake manipulation
hardware - pneumatic membrane actuators
multi agency
wind agency
kite
tether
human agenda
anti reel bursting
- low stretch line
- soft reel
b 248

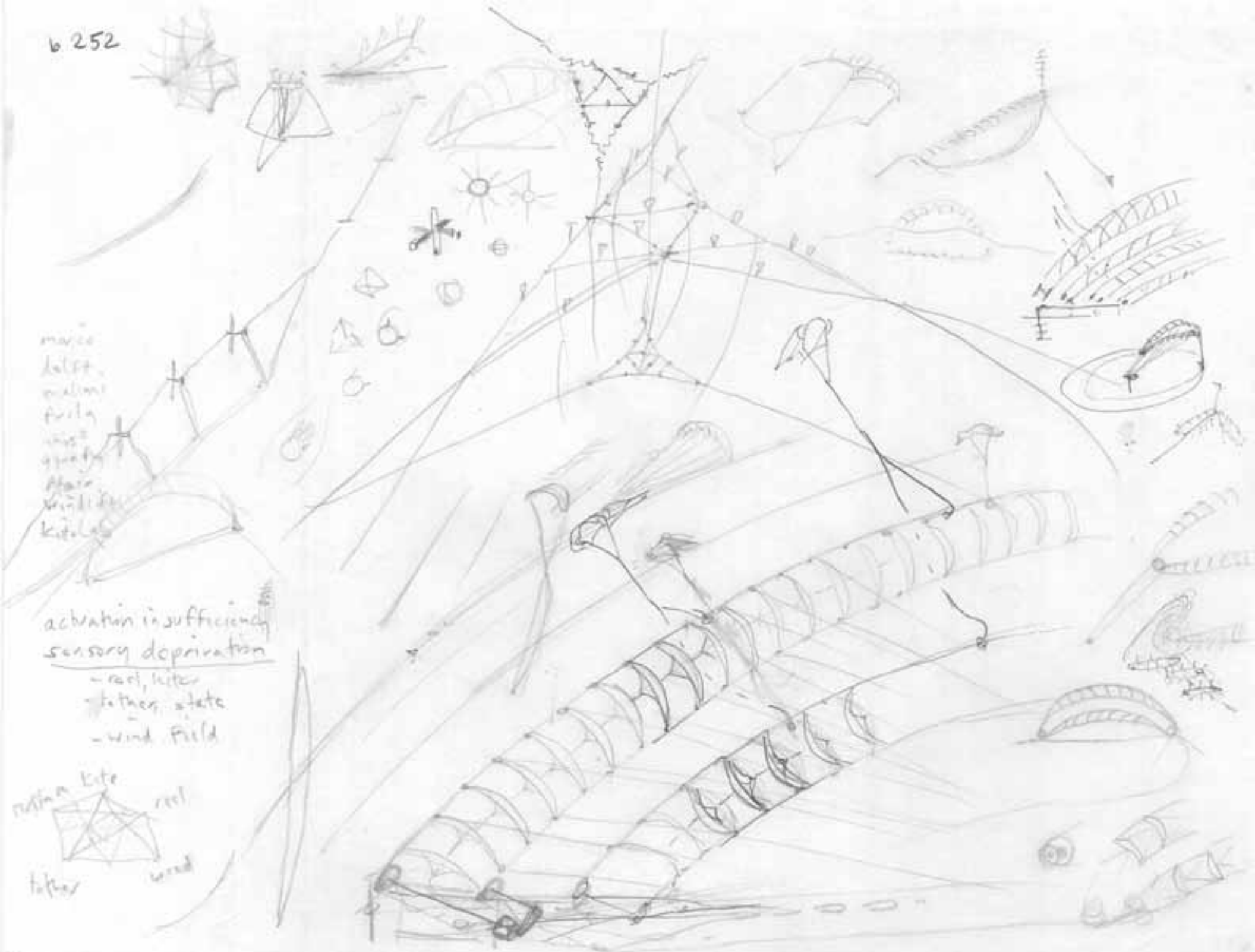
b 249

b 250

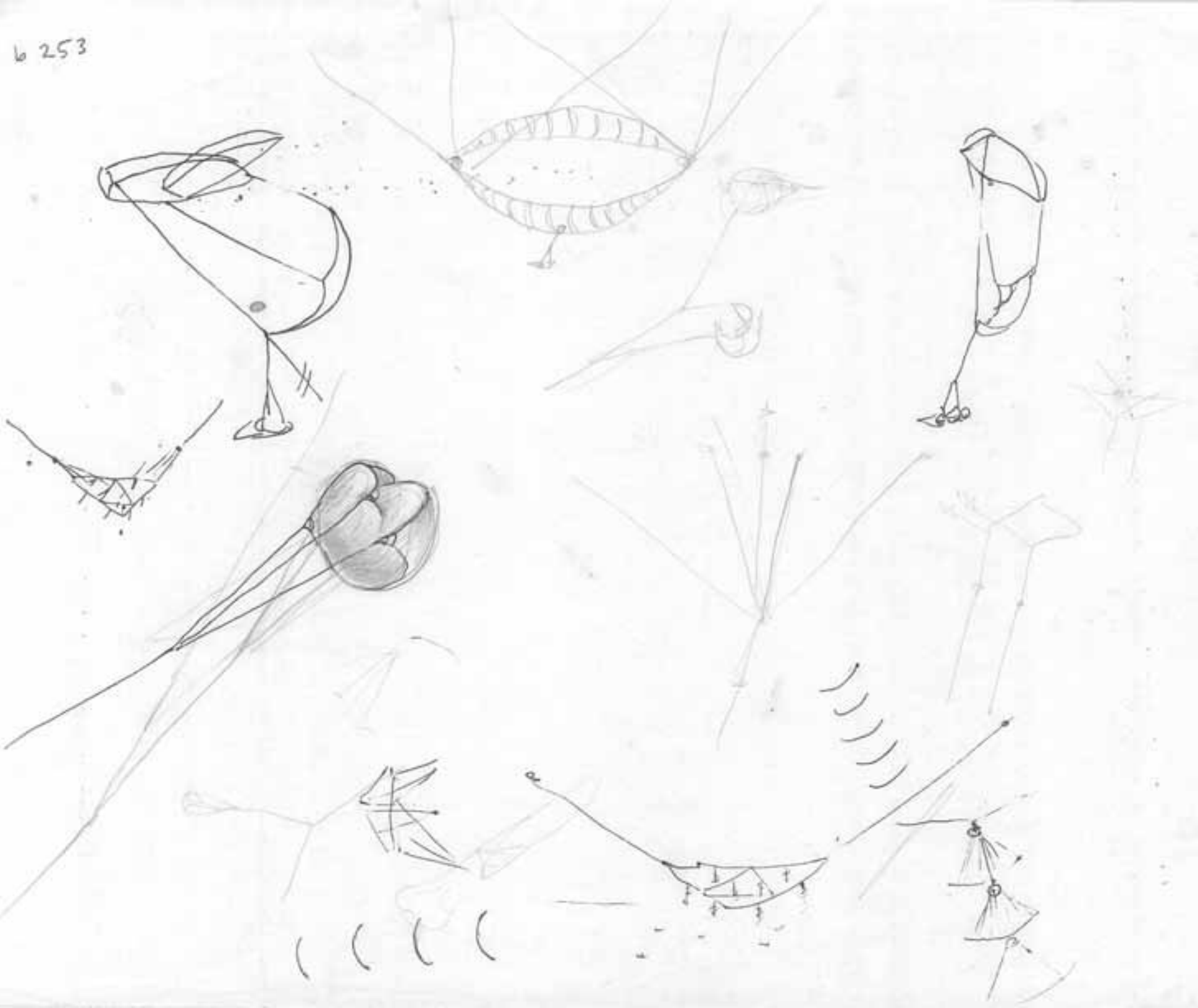



b251
minimum airspeed
to maintain flight
KiteLab Open
Failure Mode
Report
Class C
crashes
~200
thumps 3
Class B
poor anchoring 3
electric hail 1
structural failure 2
high wind
crash 0
hardware failure 2
Class A
1
runaway
Safety Critical
Failure
0 missed
work
2 finger
wraps
1 Back fall
1 nerve damage
1 concussion
1 finger
burn
2 near
miss
tetrapoing

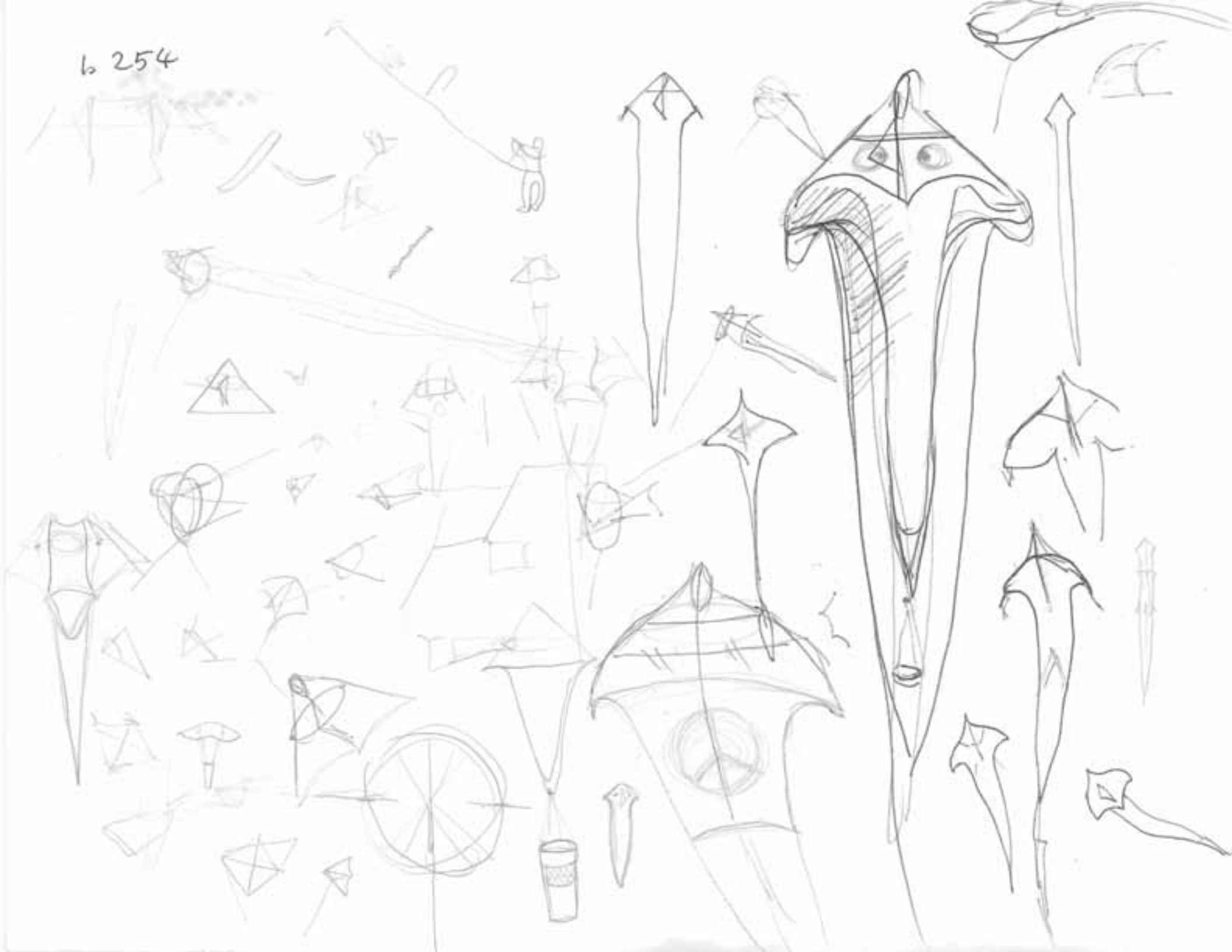
b 252

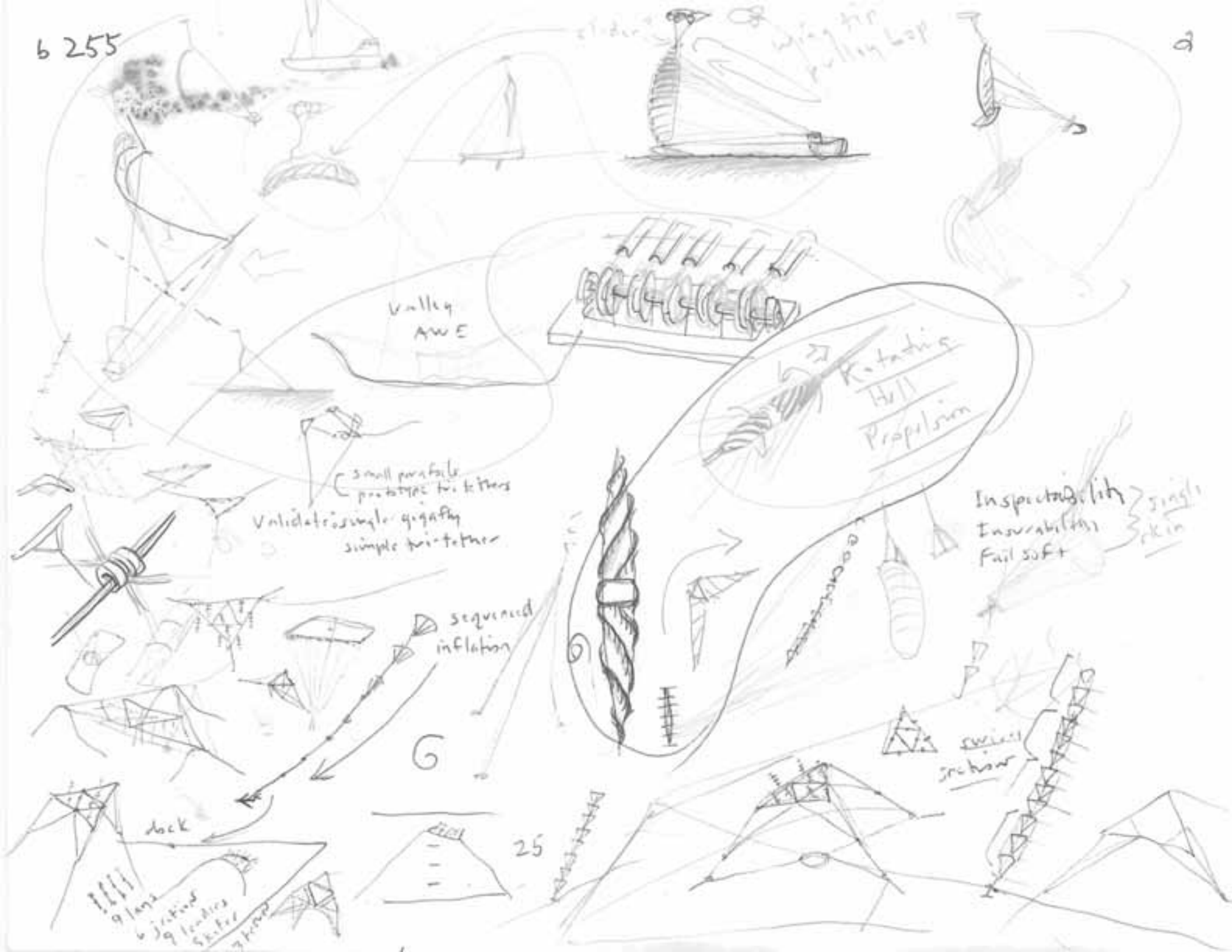

activation insufficiency
sensory deprivation
- reel, kite
- tether, state
- wind field
kite
reel
tether
wind

b 253

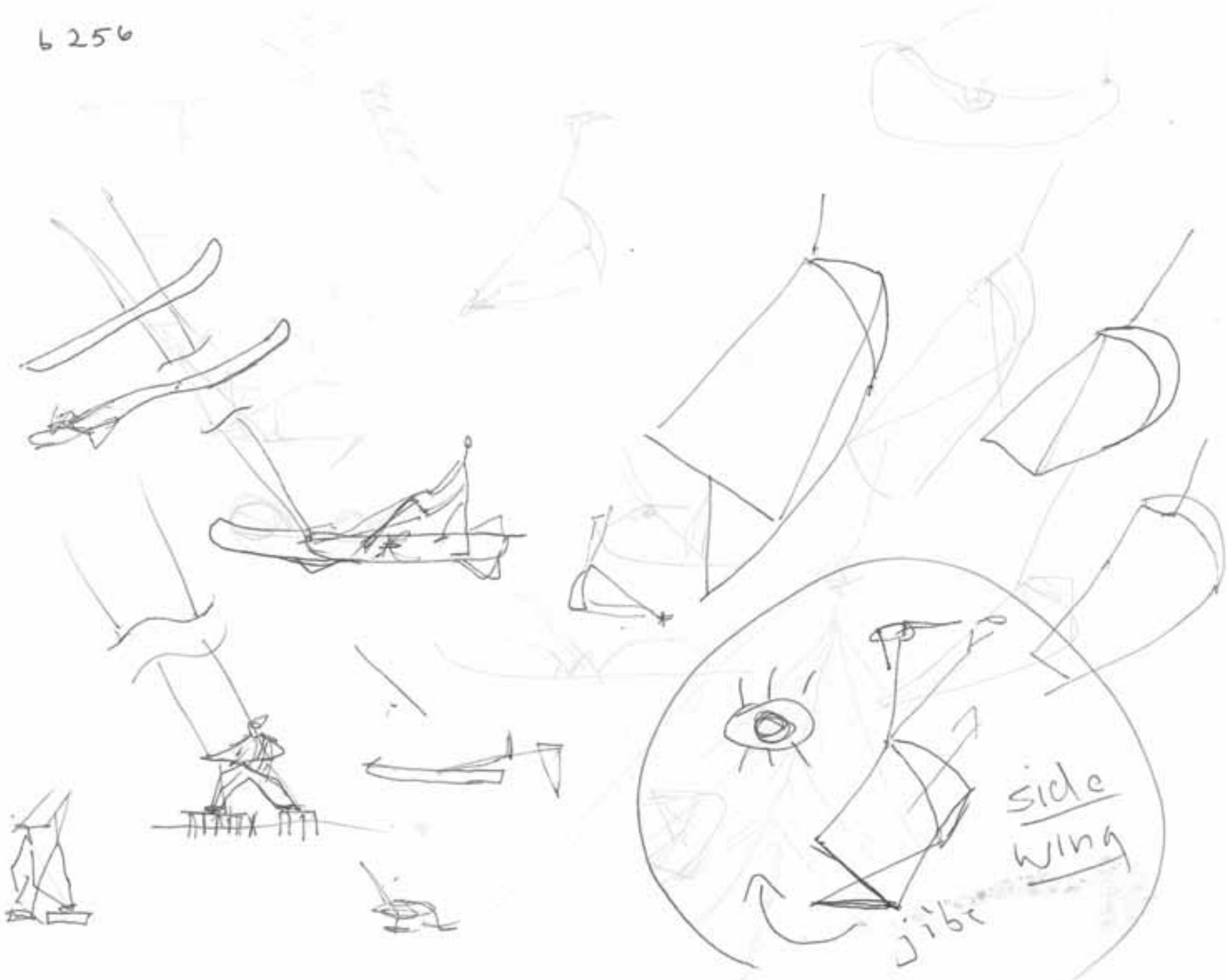


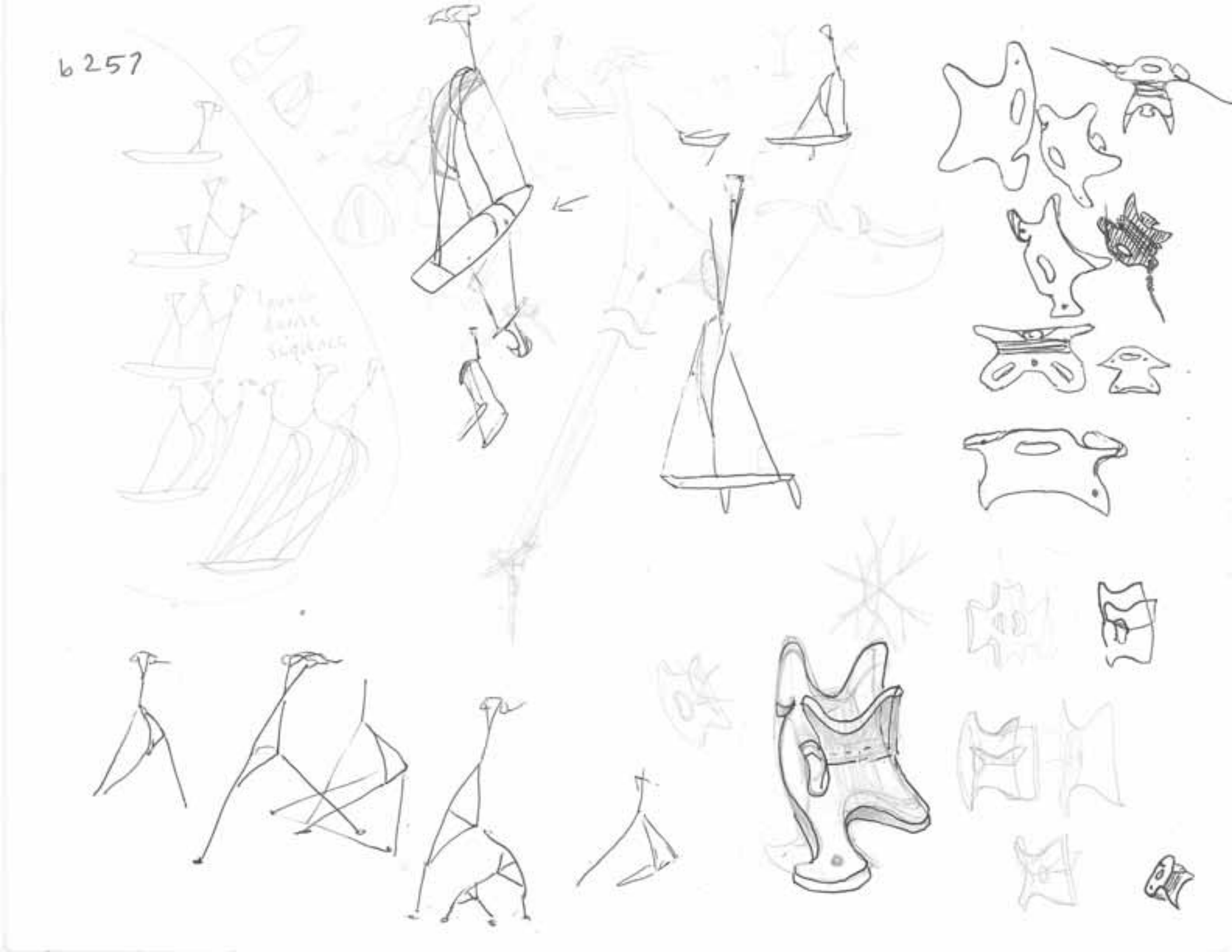
b. 254

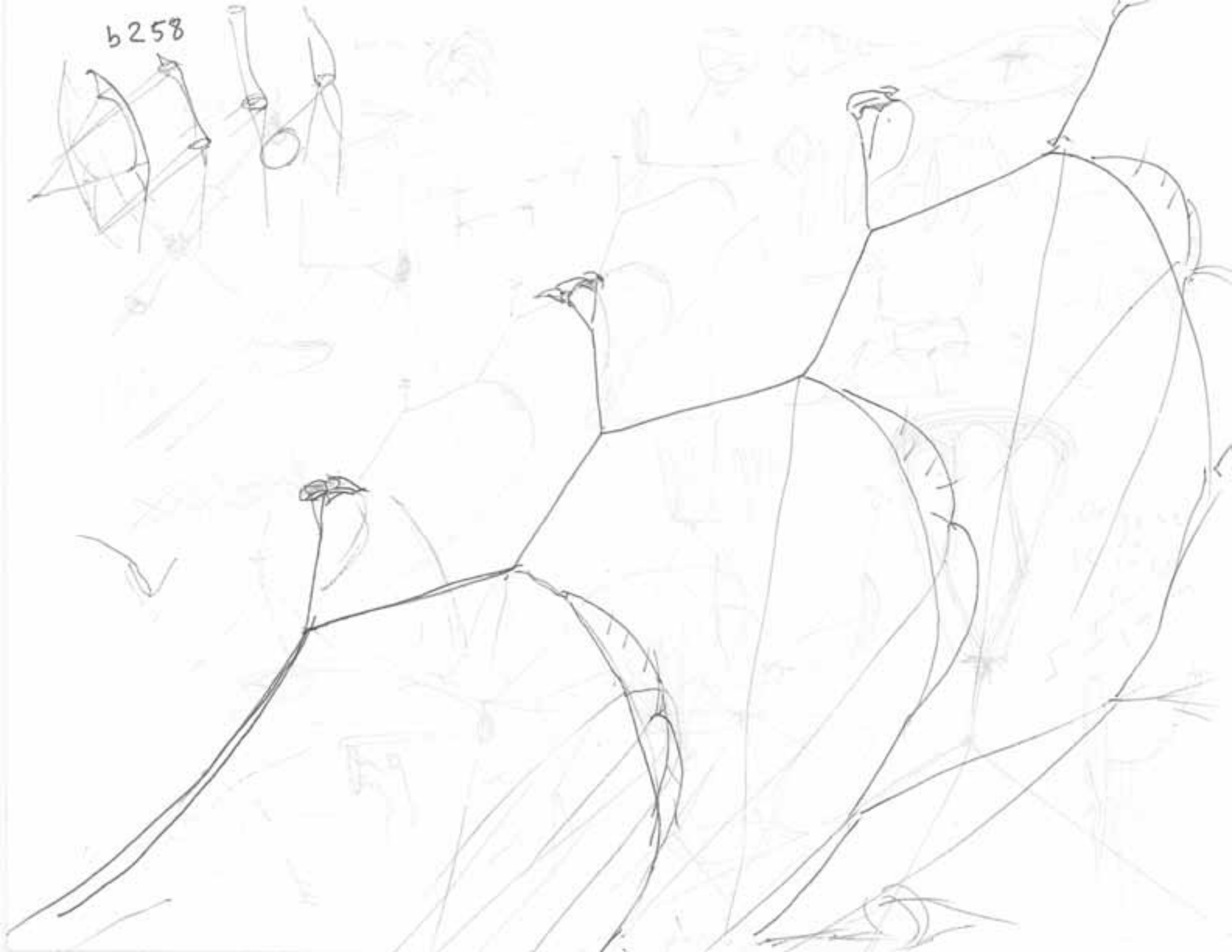



b 255
Valley
AWE
Rotating
Hull
Propulsion
small portable
prototype tri-tethers
Validate single gigafly
simple tri-tether
sequenced
inflation
Inspectability
Insurability
Fail soft
single
skin
swivel
section
dock
25

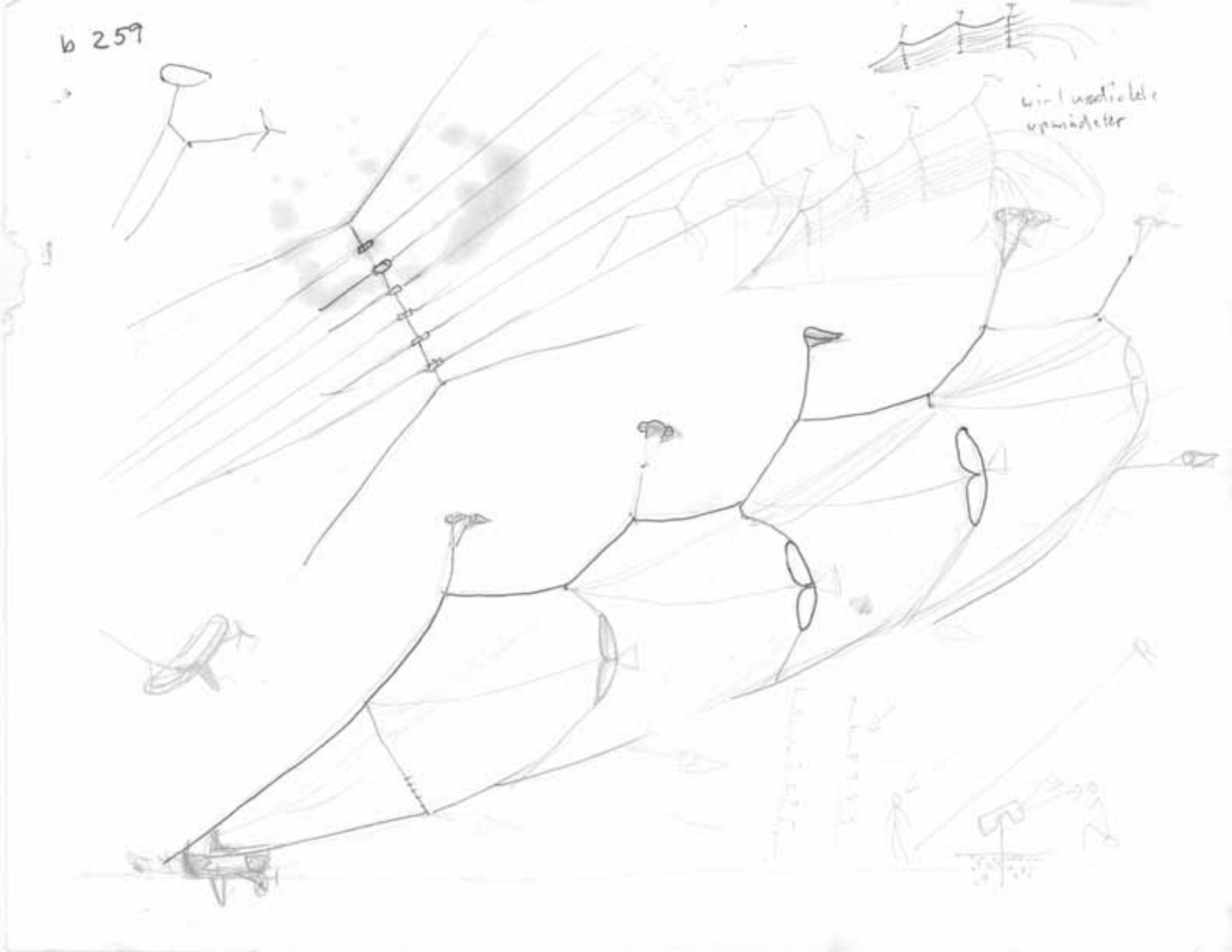
b 256




6257

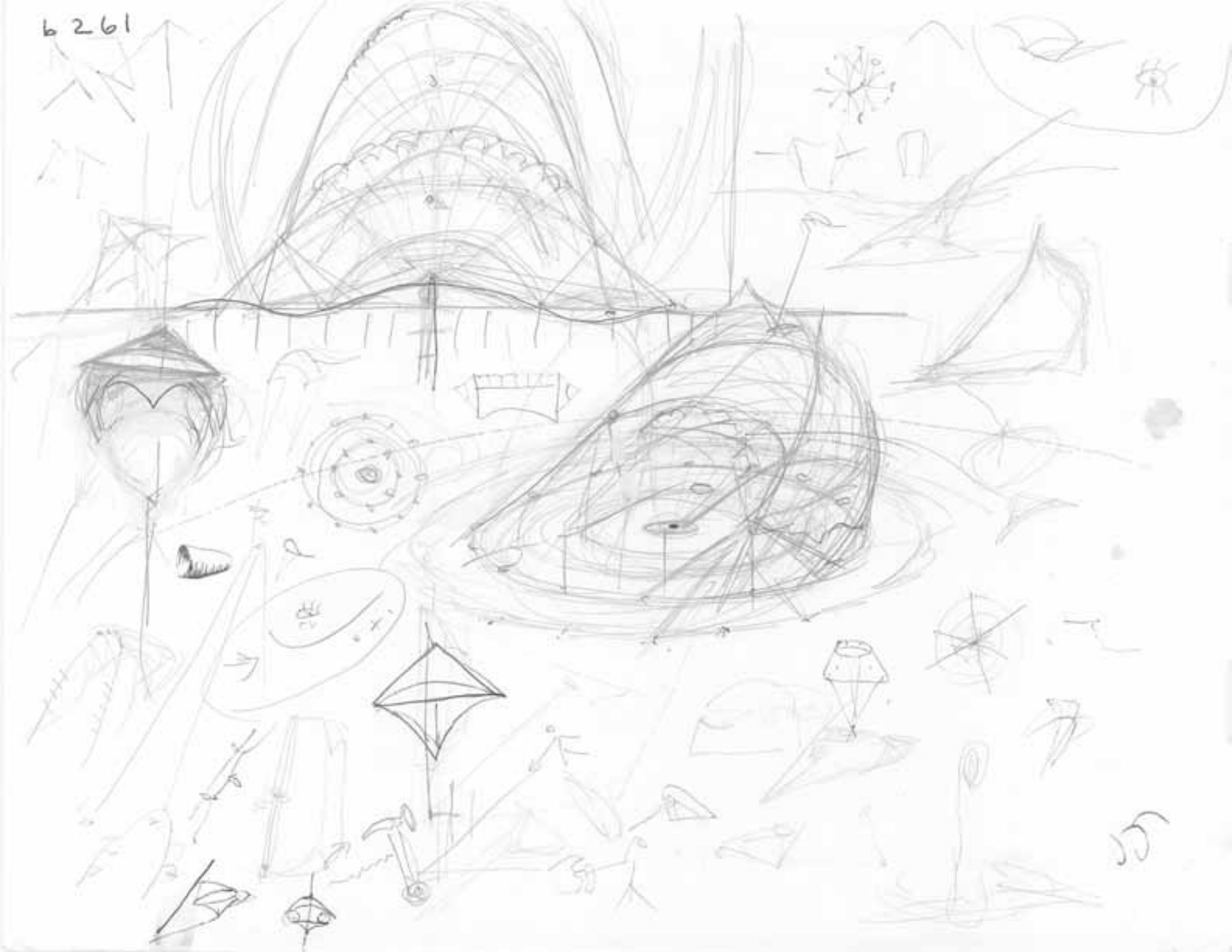

b258

b 259

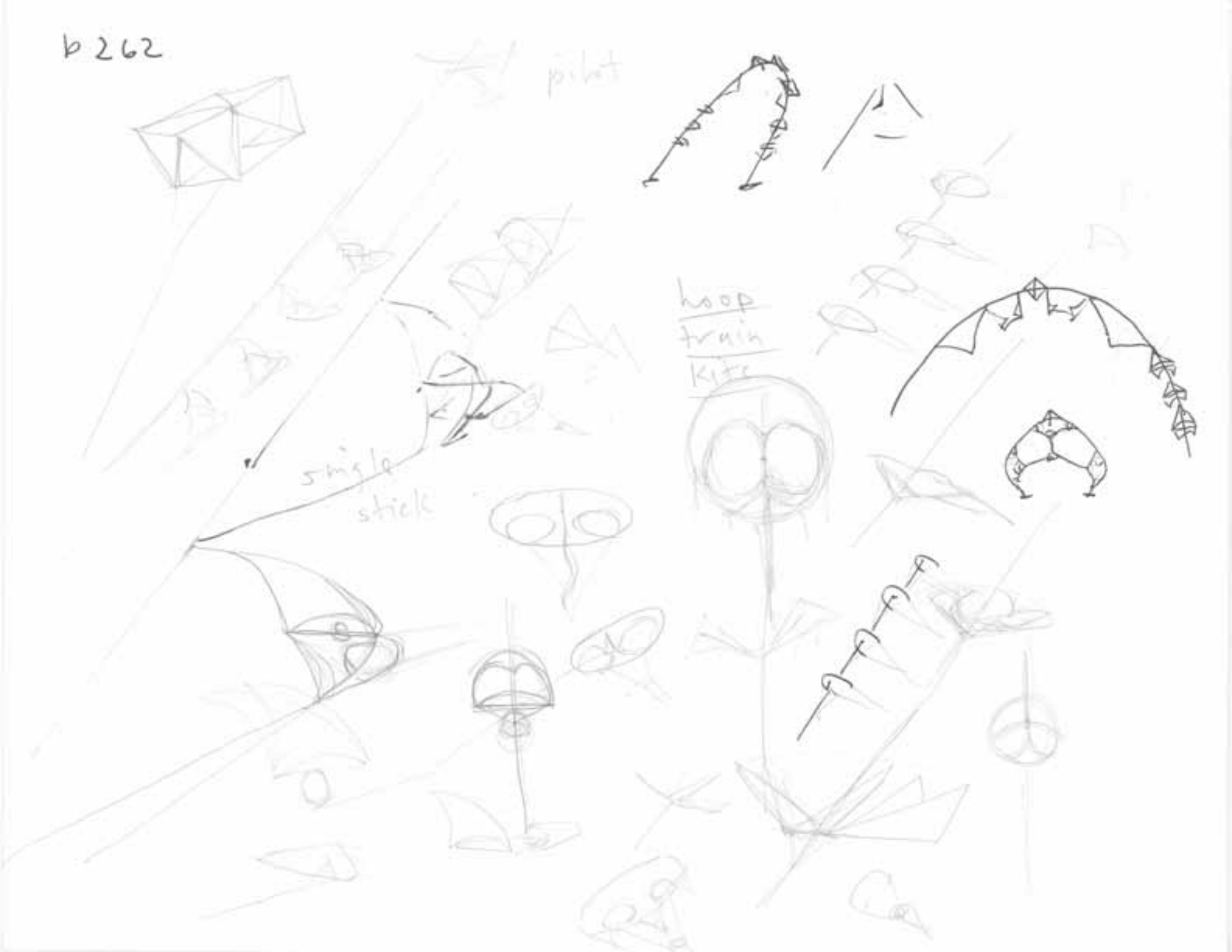


b 260

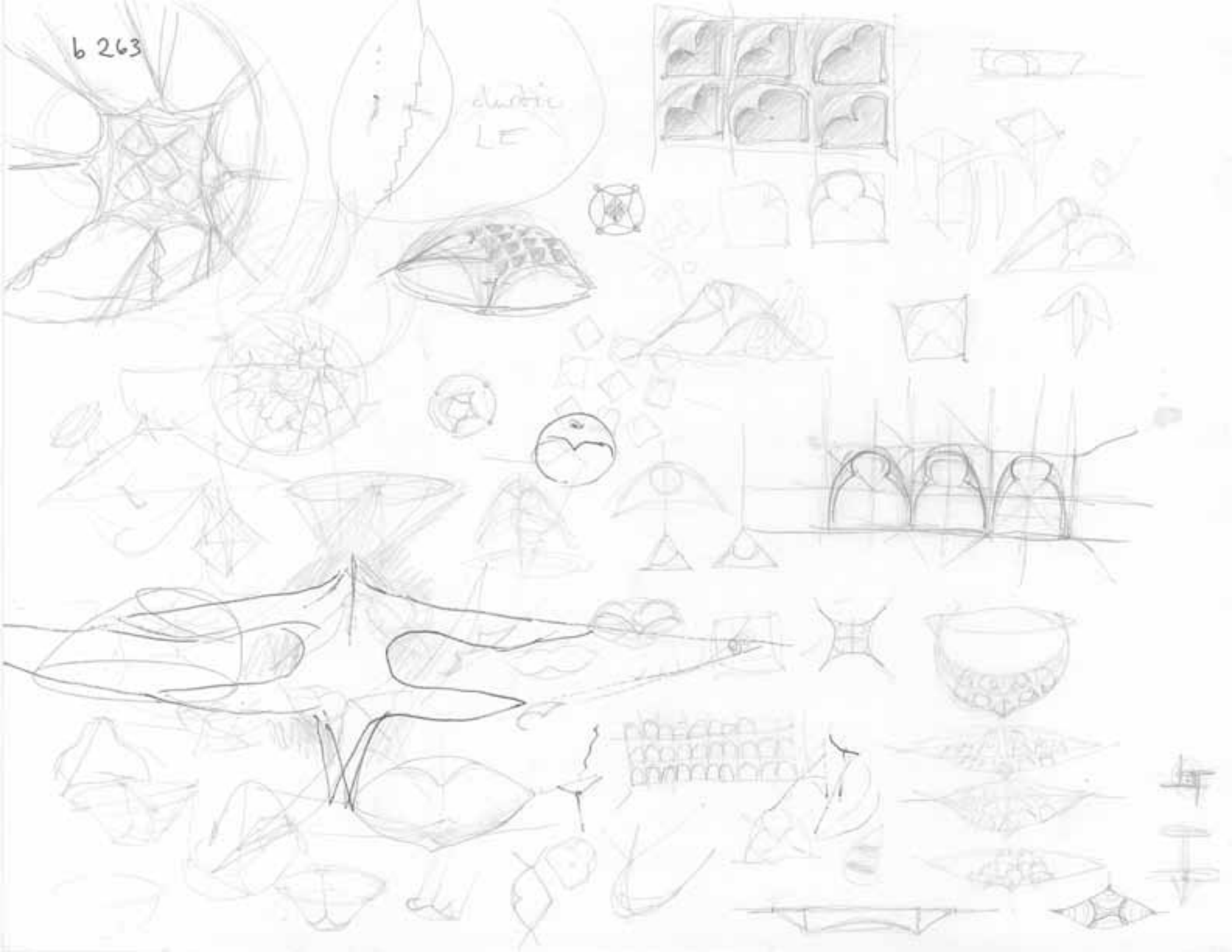
b 261

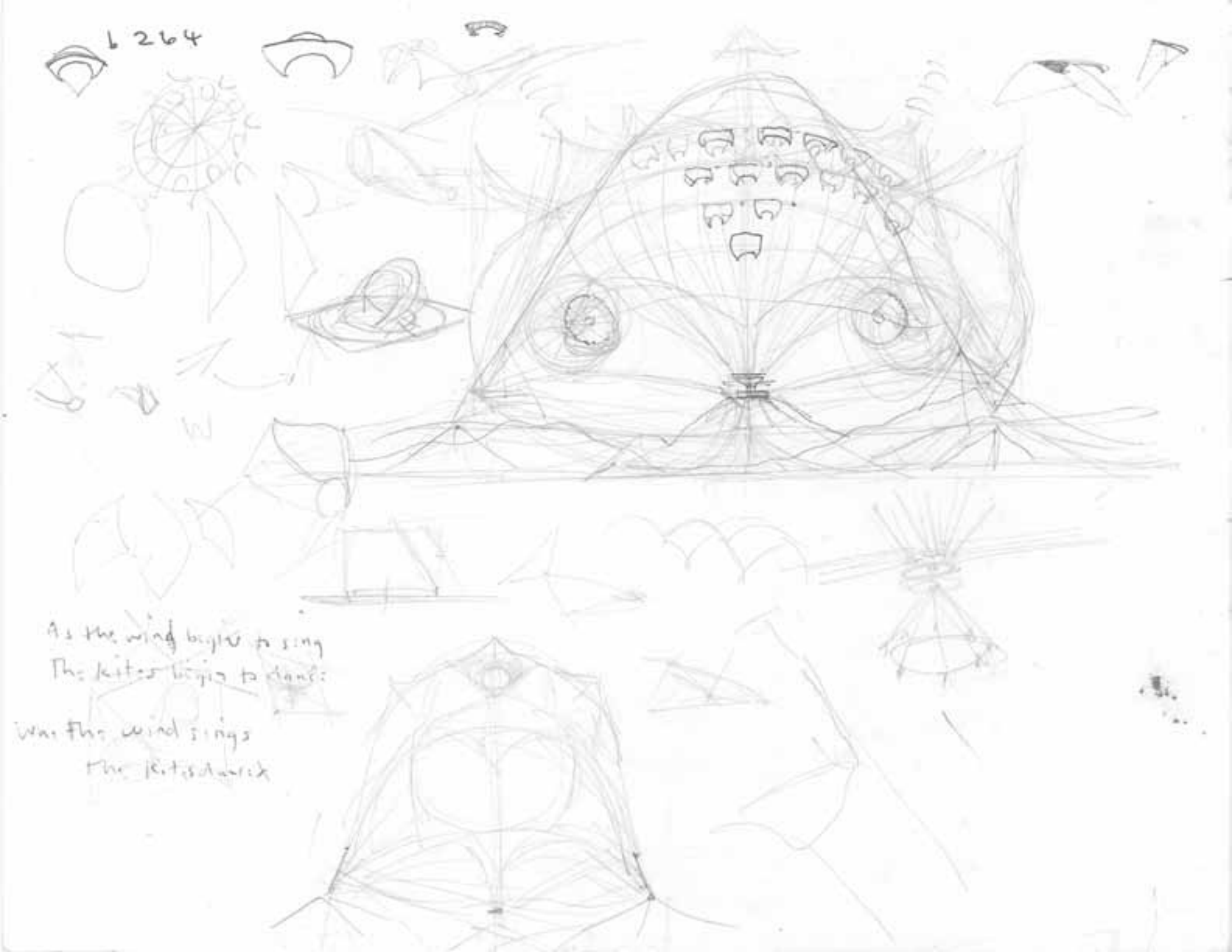


b 262

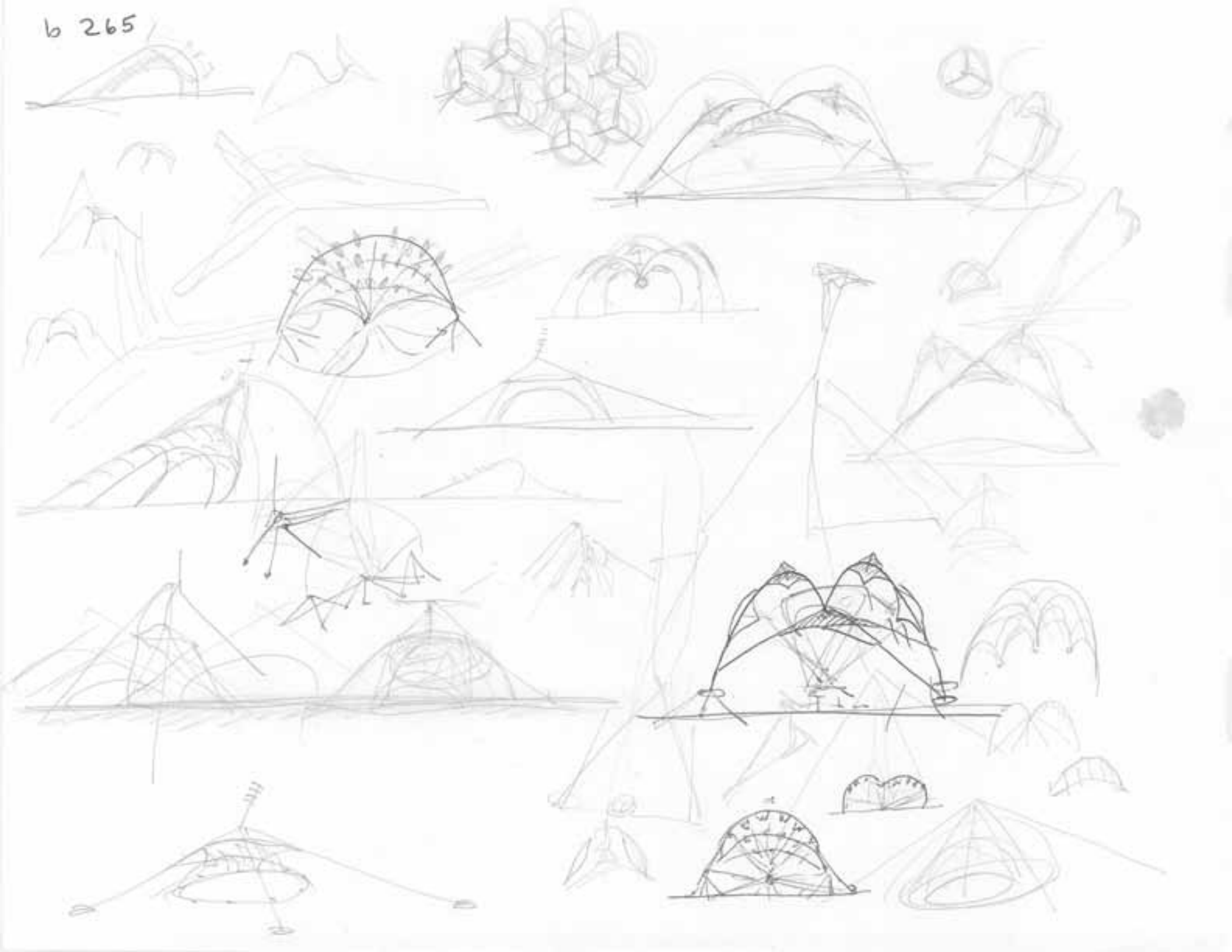


b 263

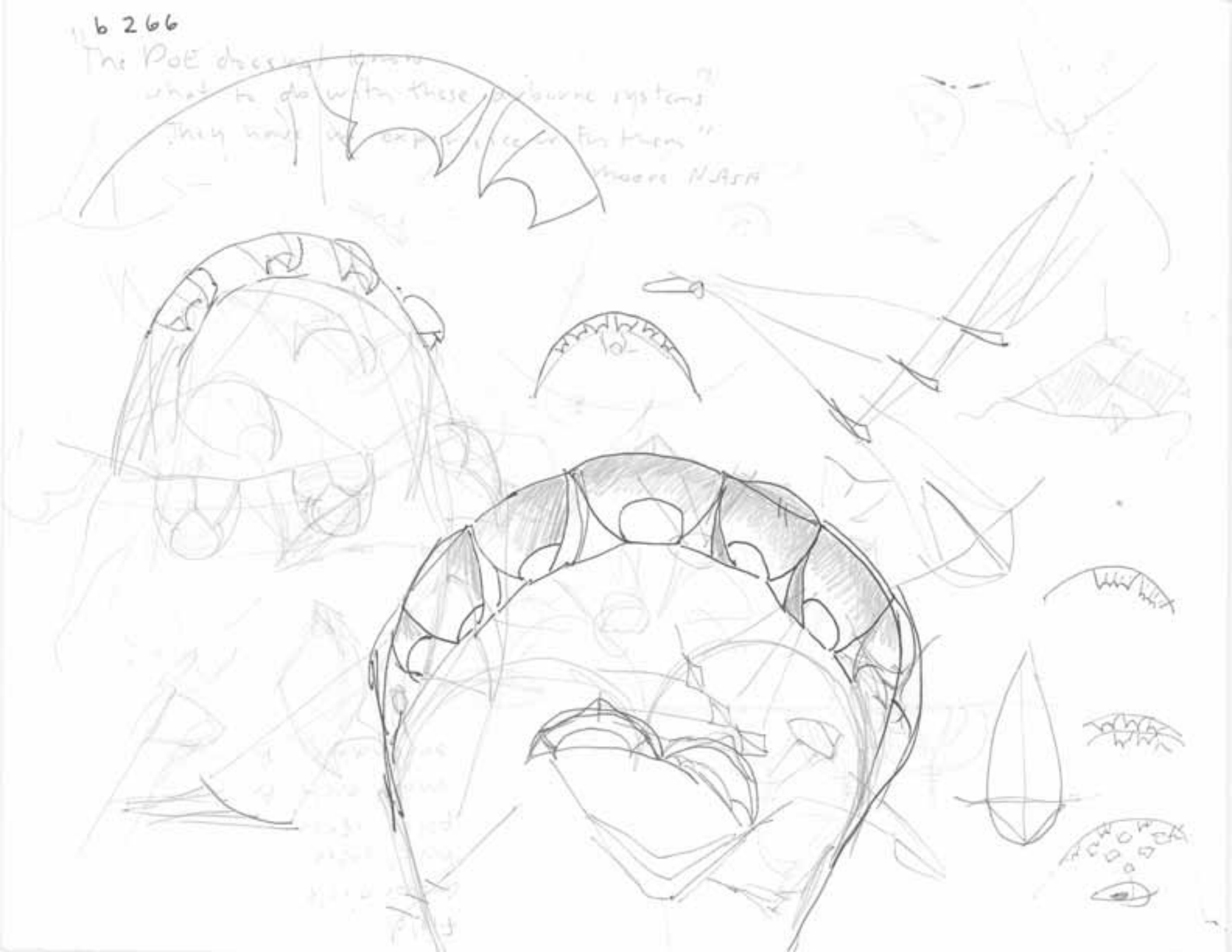



b 264
As the wind begins to sing
The kites begin to dance
When the wind sings
the kites dance

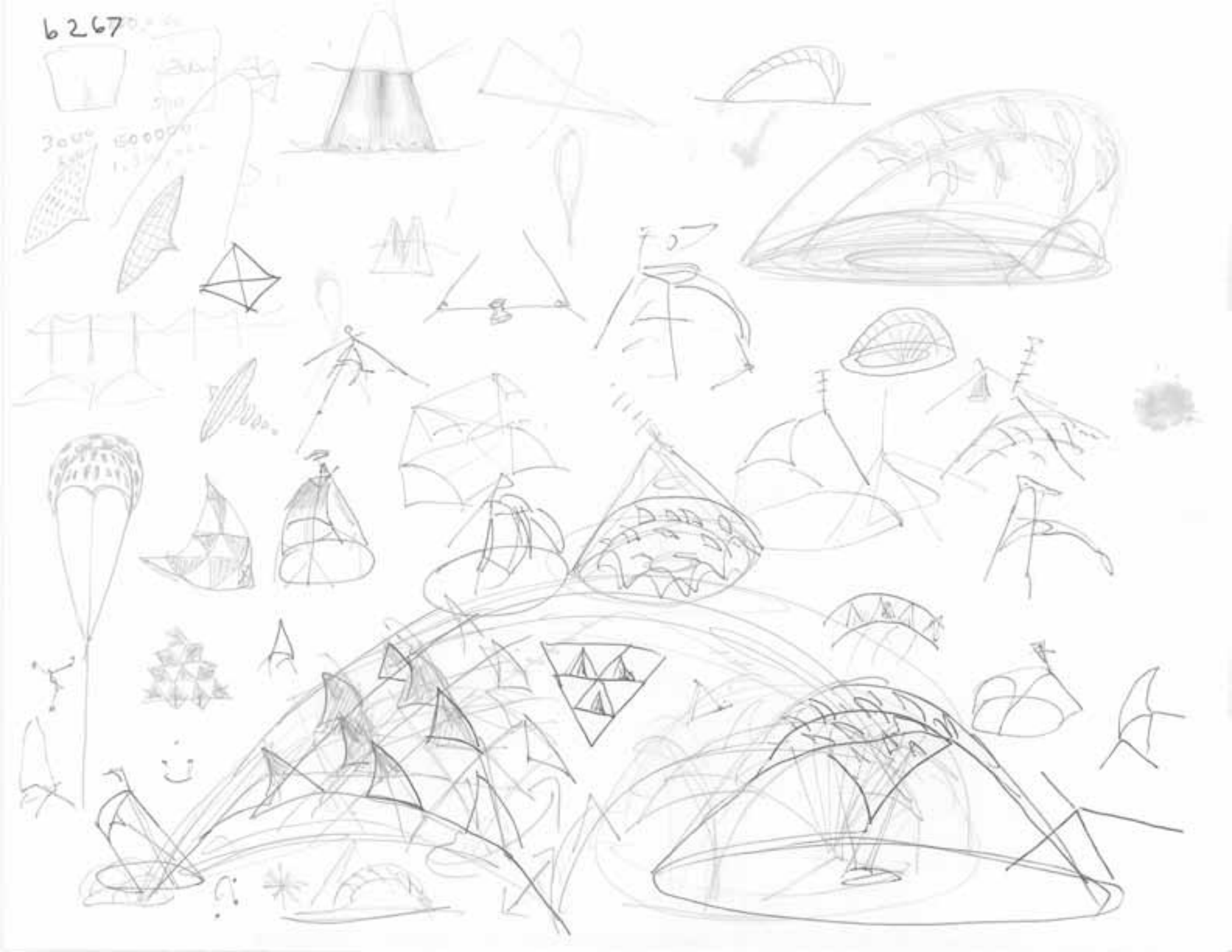
b 265

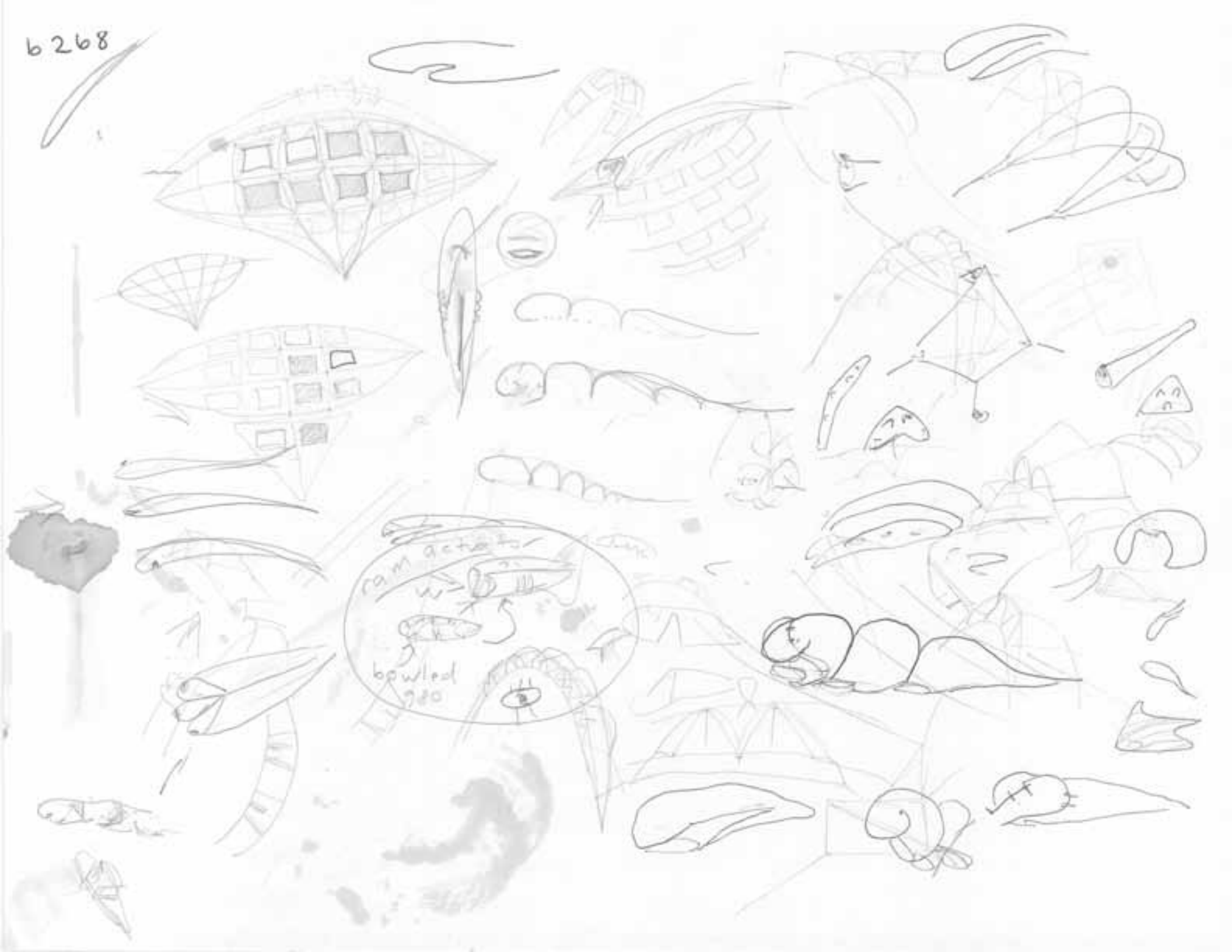


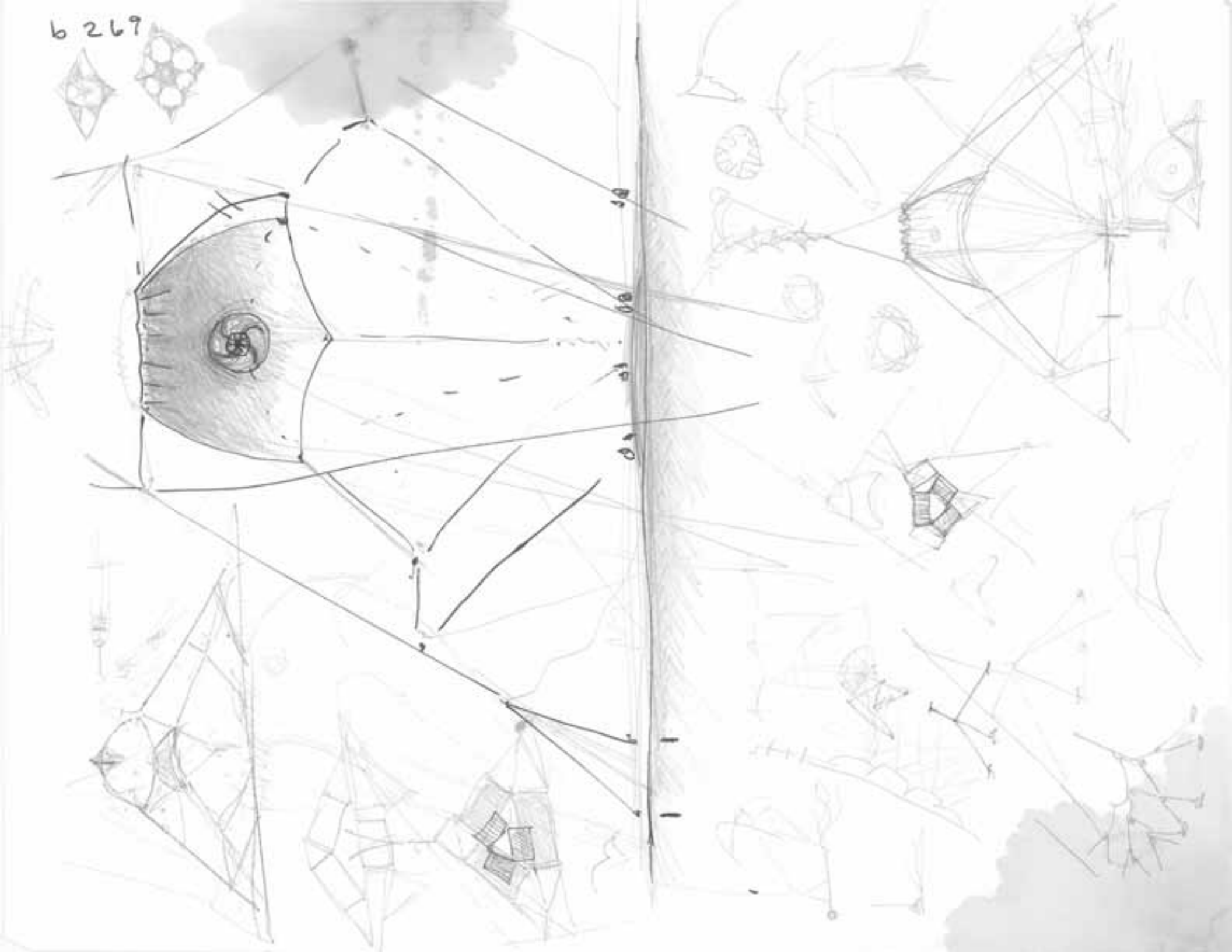
b 266



6267




6268
cam actuator
bowlead
980


b 269

6270

stance-out stability

spread anchor

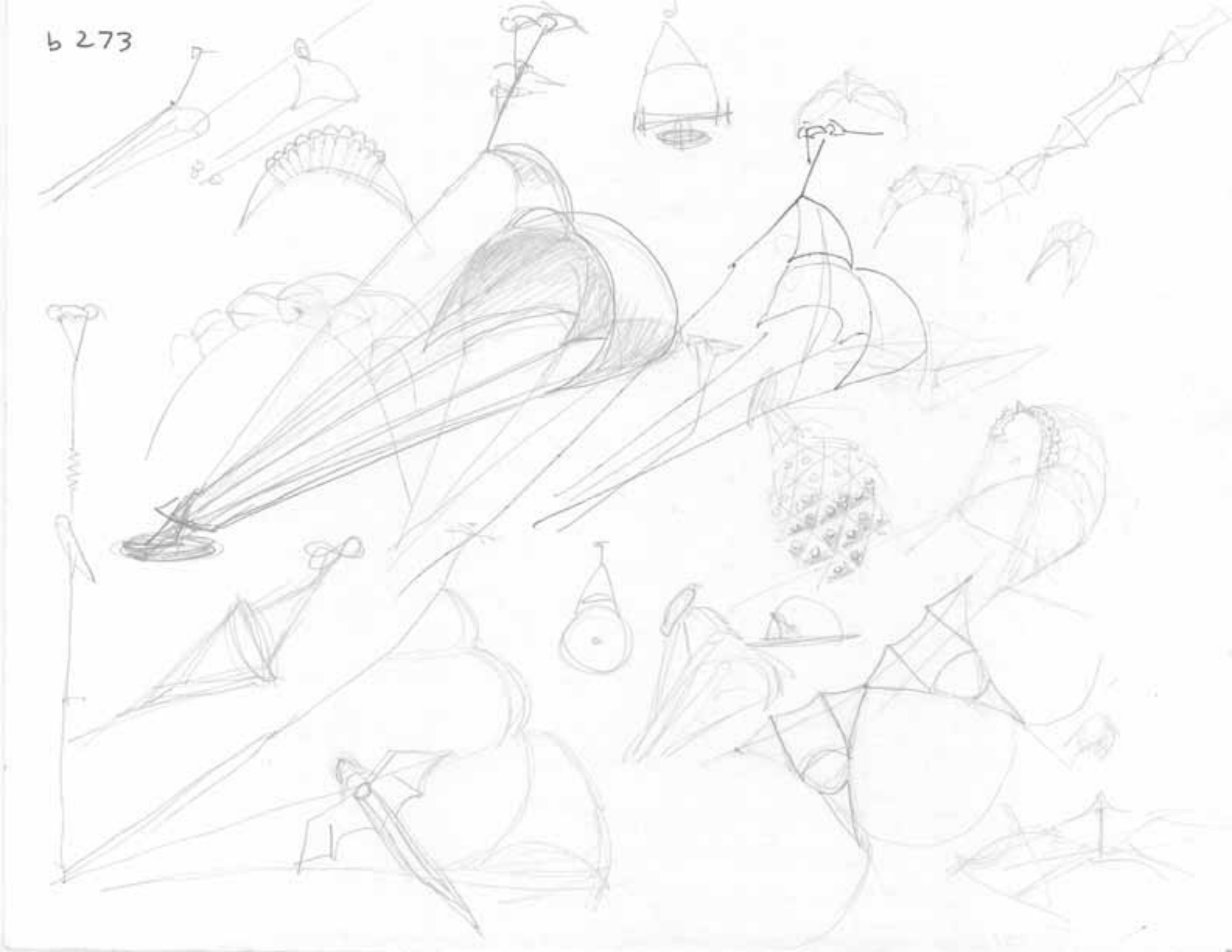
stability

b 271

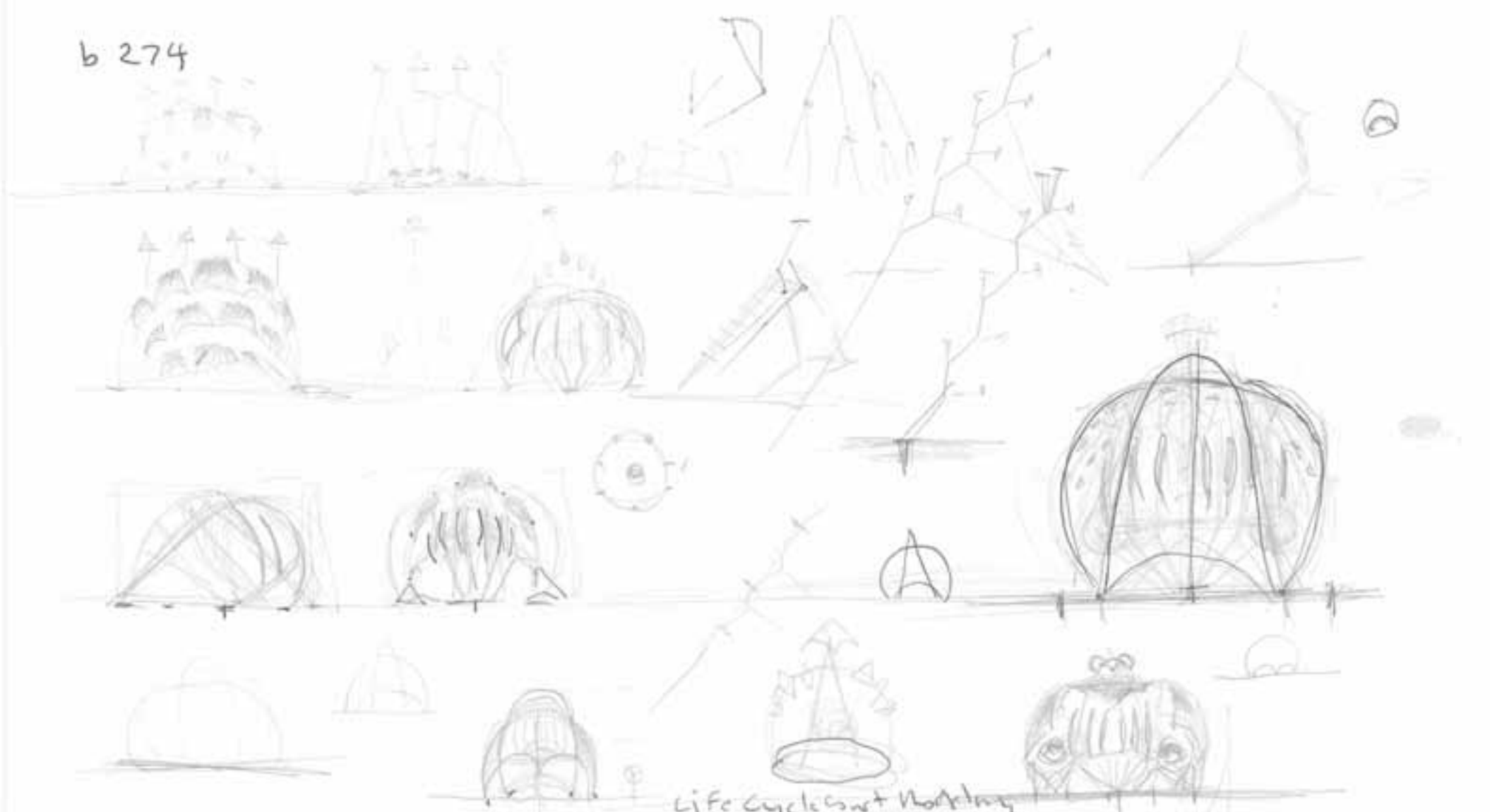
rock bolas
throwing stick
sling shot
boomerang
arrow
spear
kite
sail
stick
feather
paddle jumper
paddle/oar
fan

b272

b 273



b 274



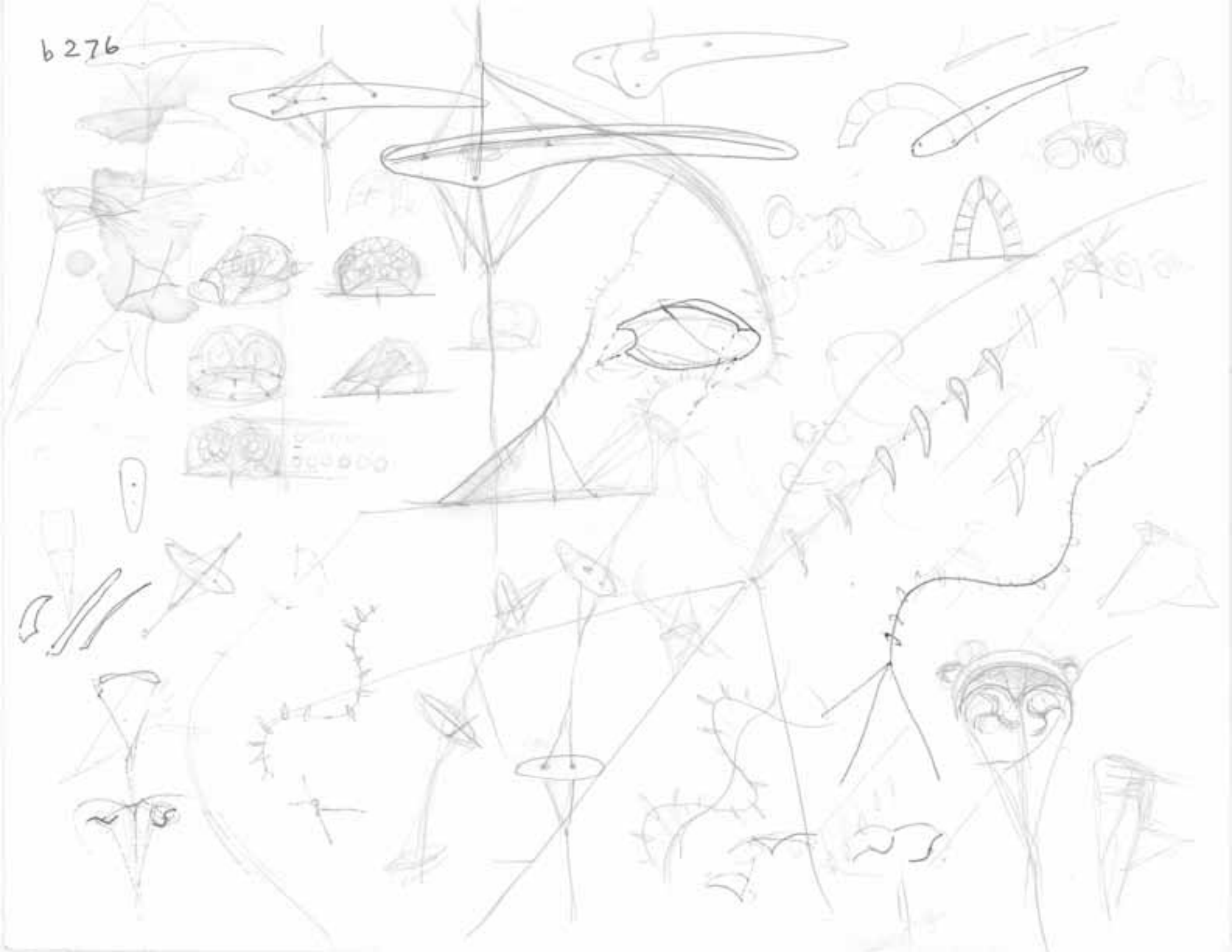
design environment
" load cases
margins of Safety
3rd party validation
certification

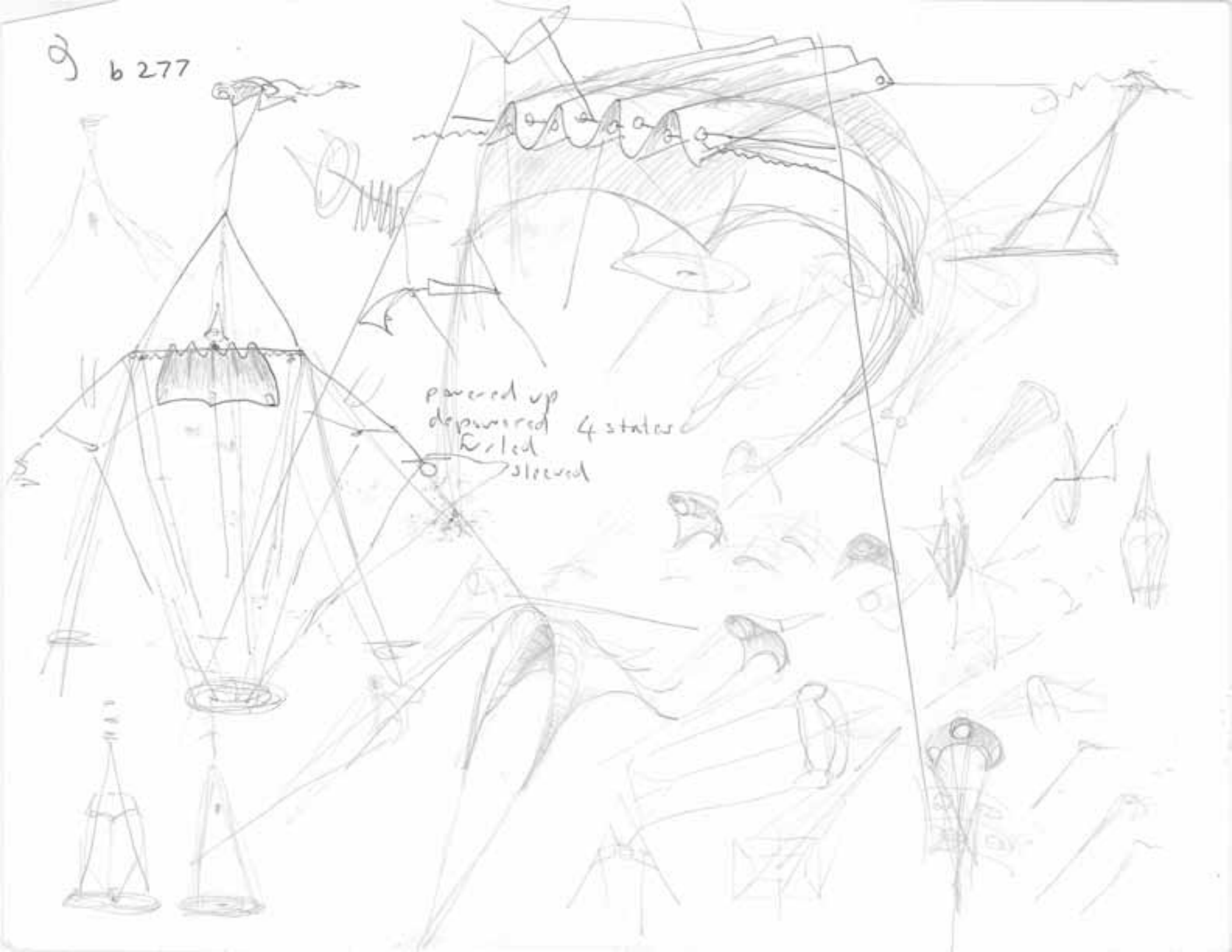
Life Cycle cost Modeling
dev cost
manufacturing to deployment cost
financing cost
O & M
Replacement cost
Decommissioning

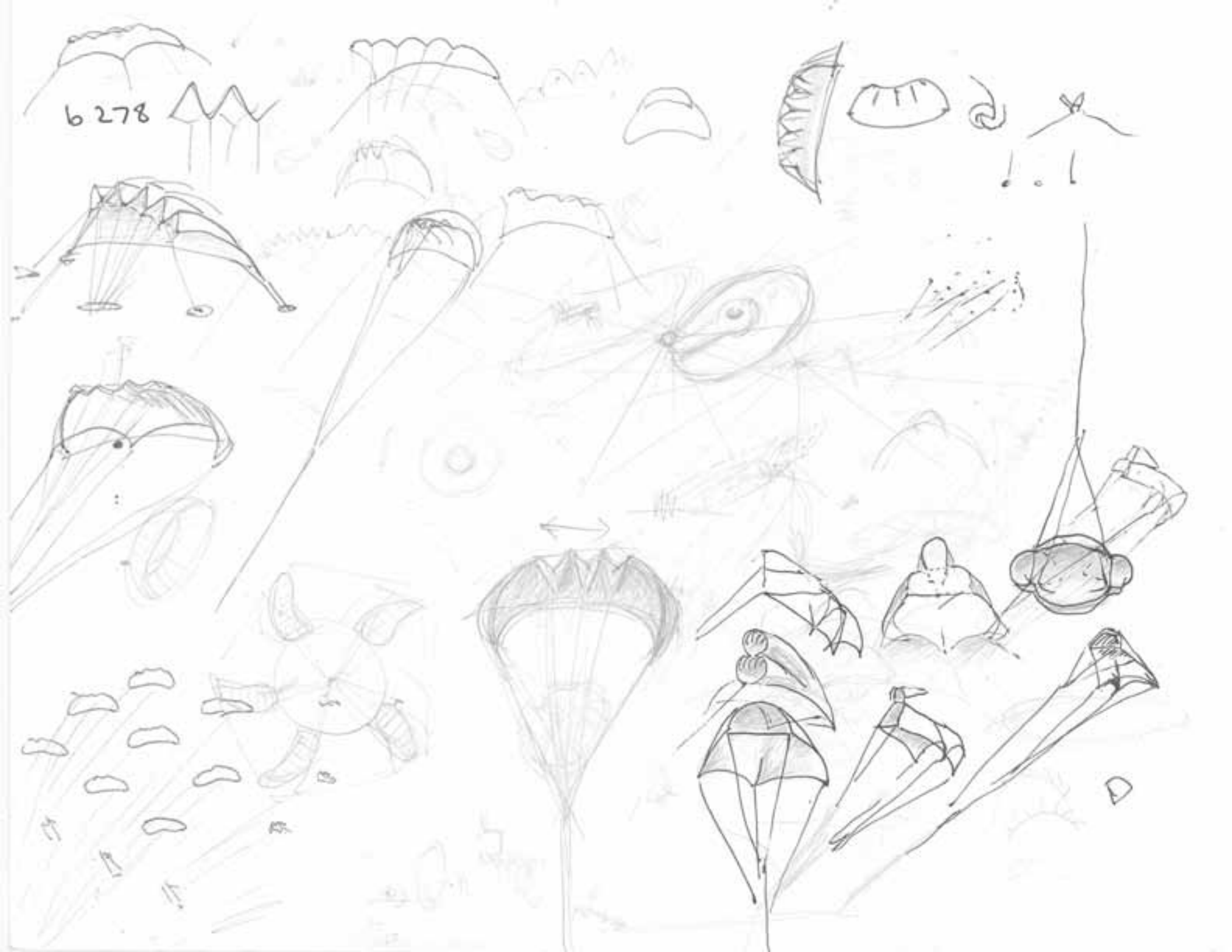
cost of financing (land x 100 for Impl. Tether)

b 275

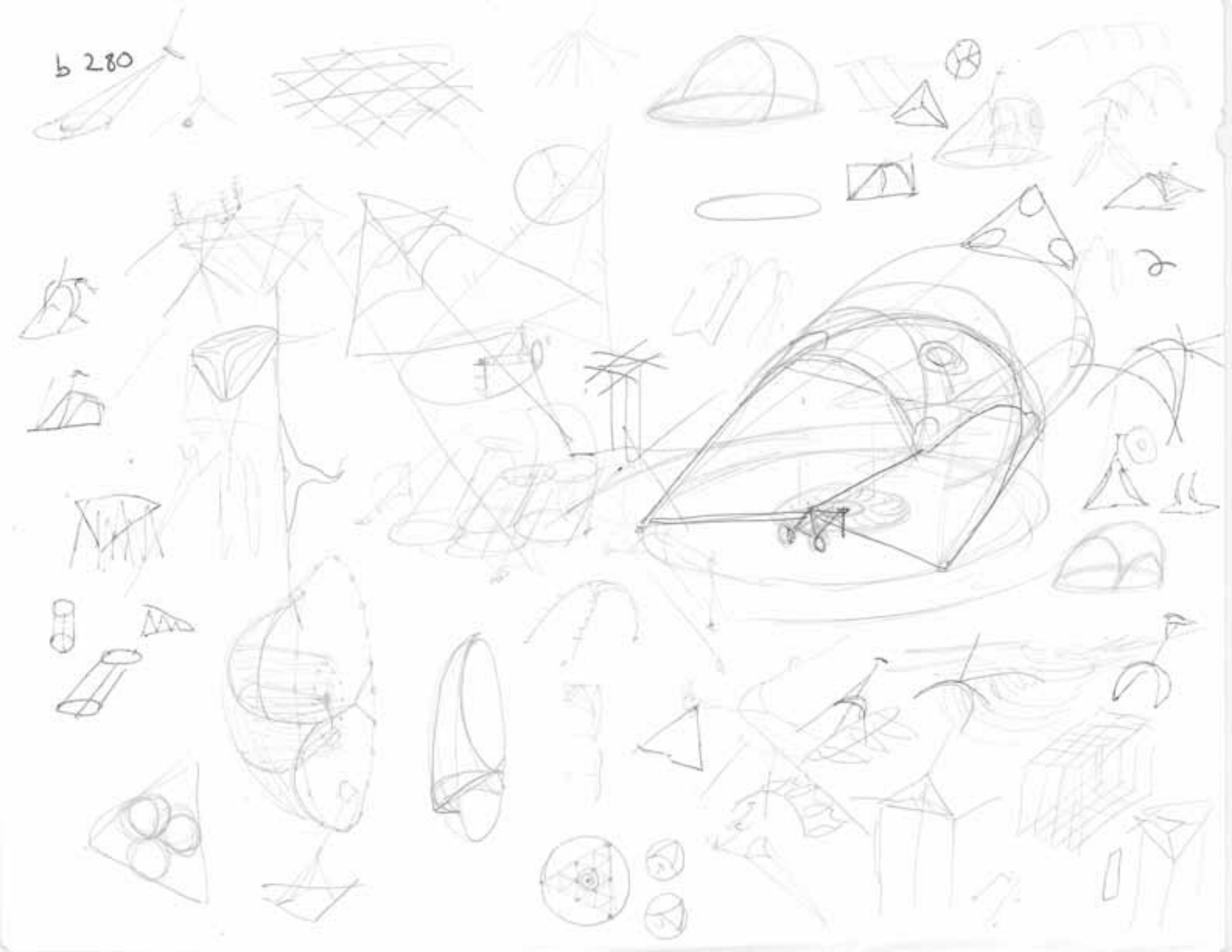
b276



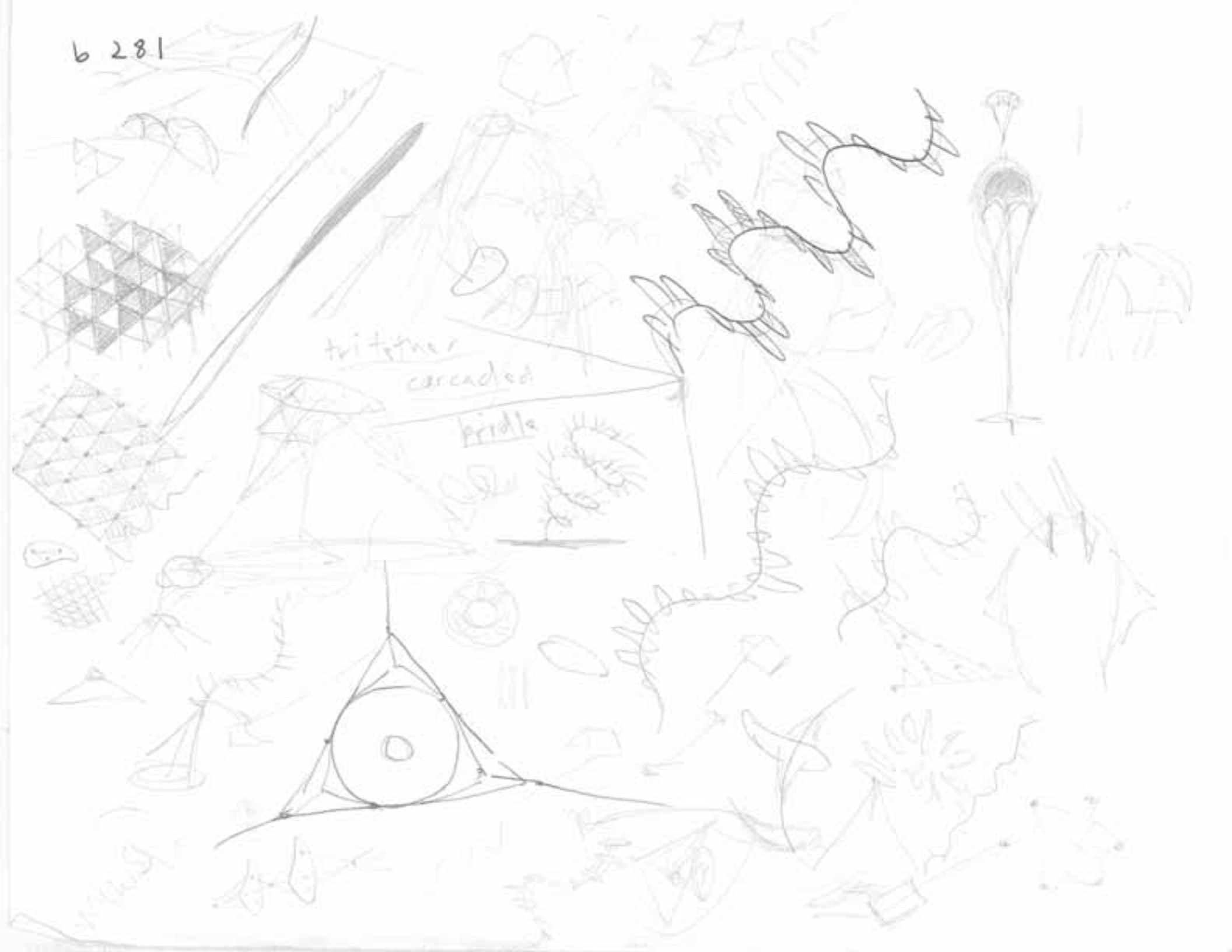

9 b 277
powered up
depowered 4 states
Riled
sleeved


6278

b 280

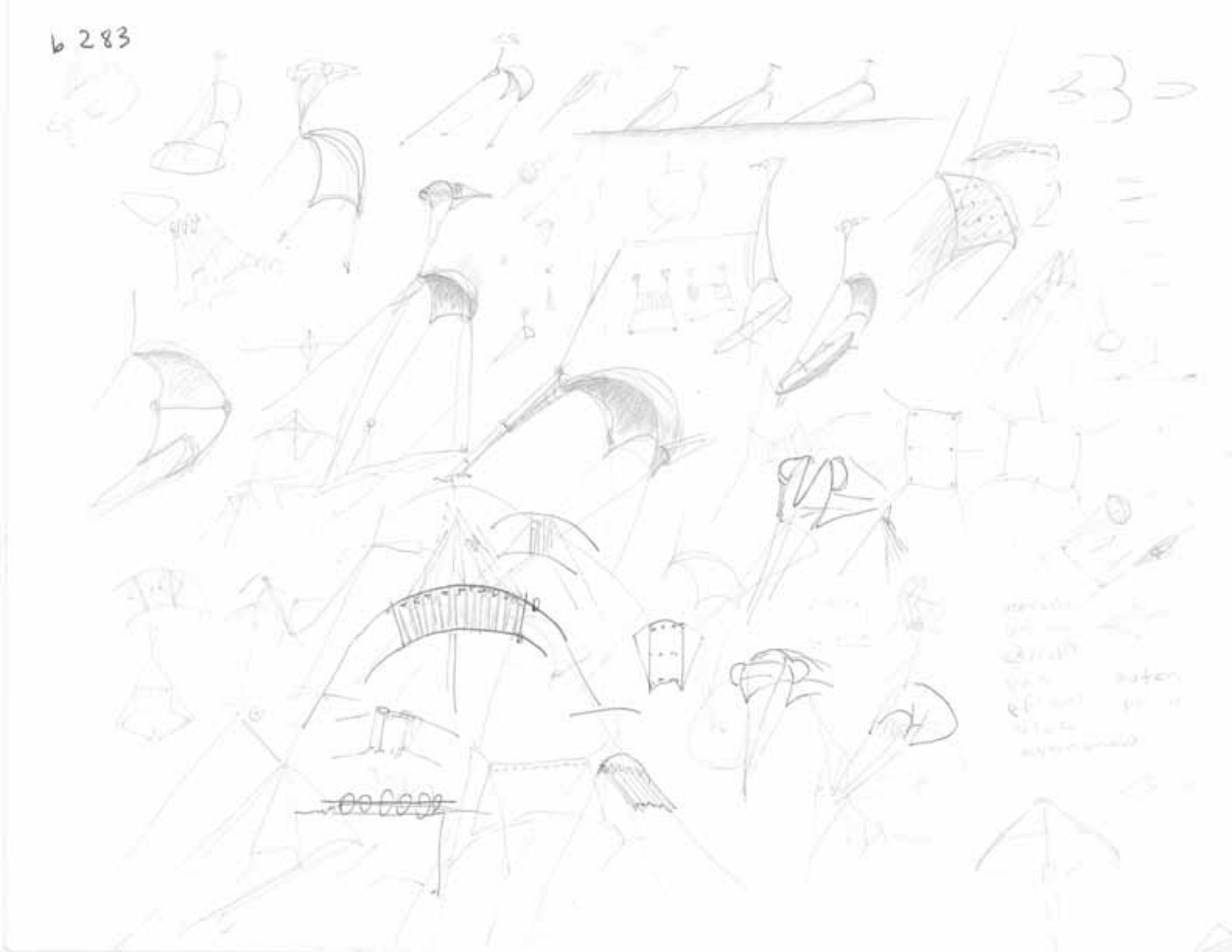


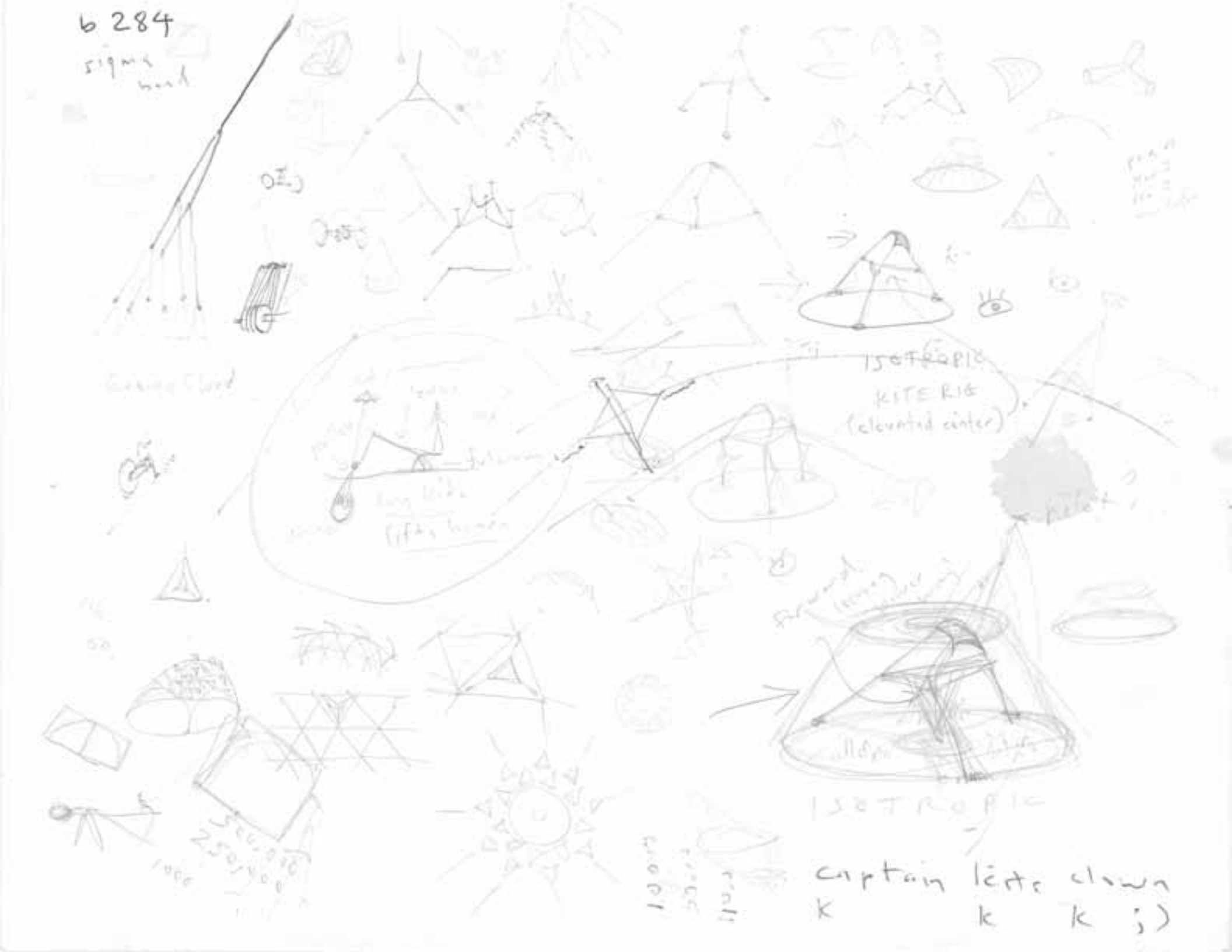
b 281



b 282

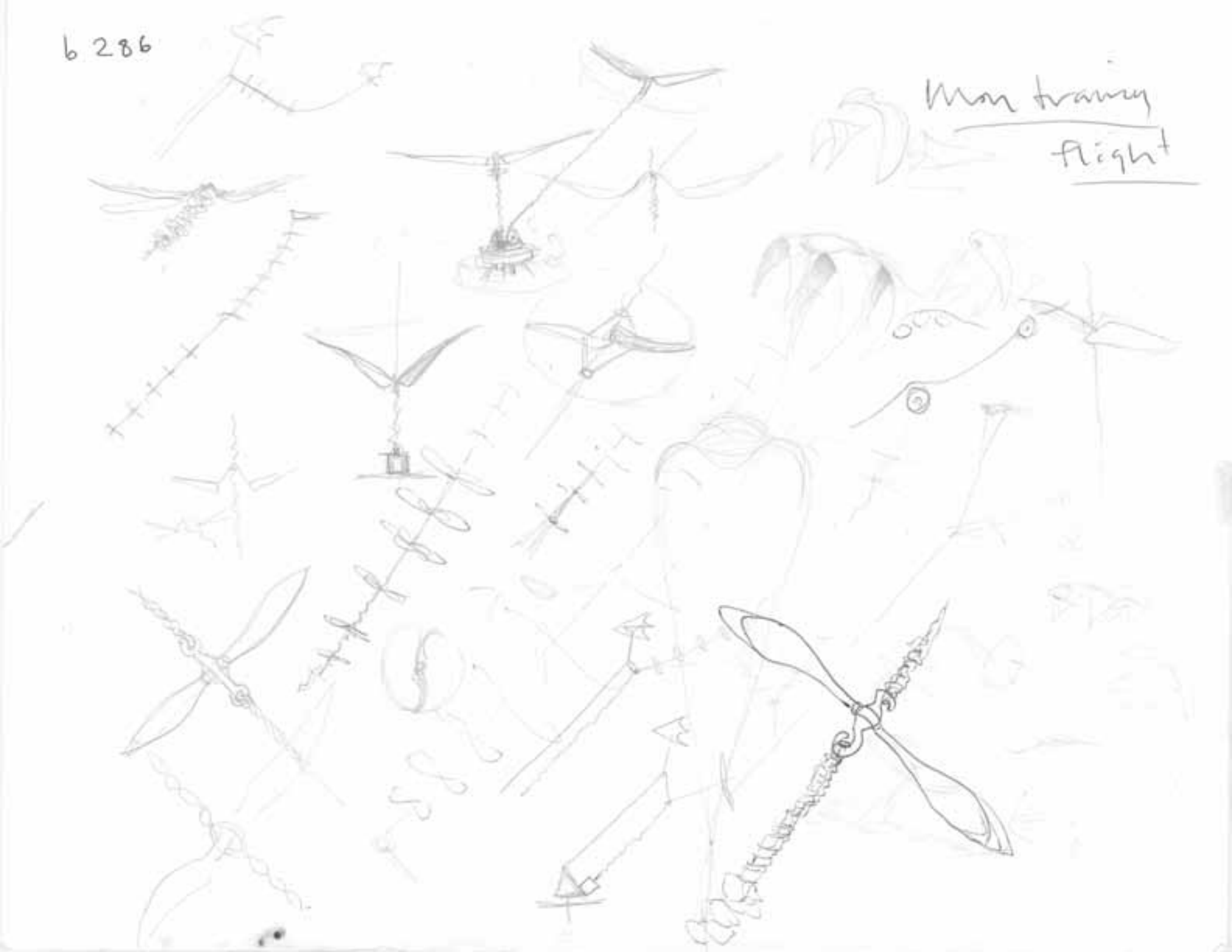
b 283

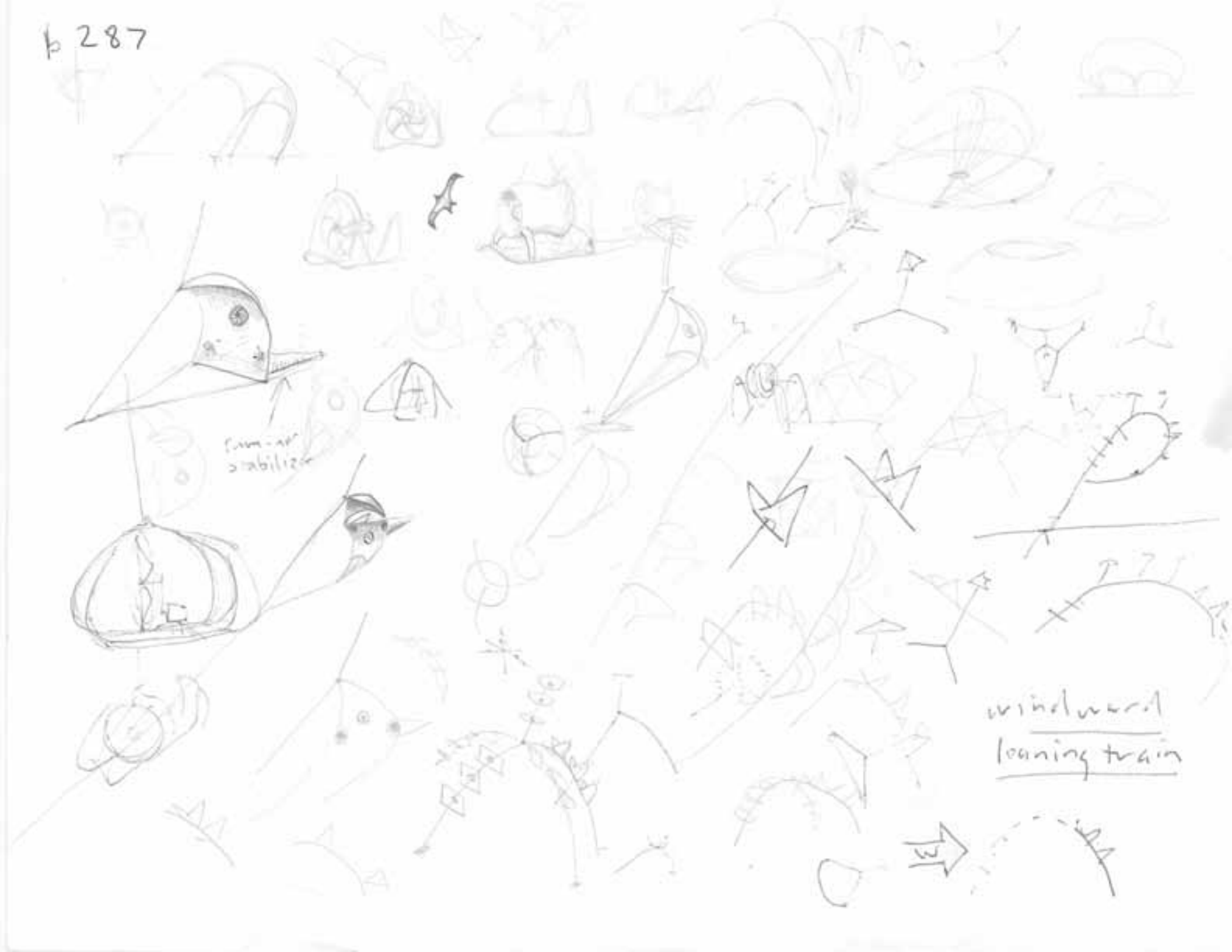



b 284
ISOTROPIC
KITE RIG
(elevated center)
ISOTROPIC
captain late clown
k k k ;)

b 285

b 286



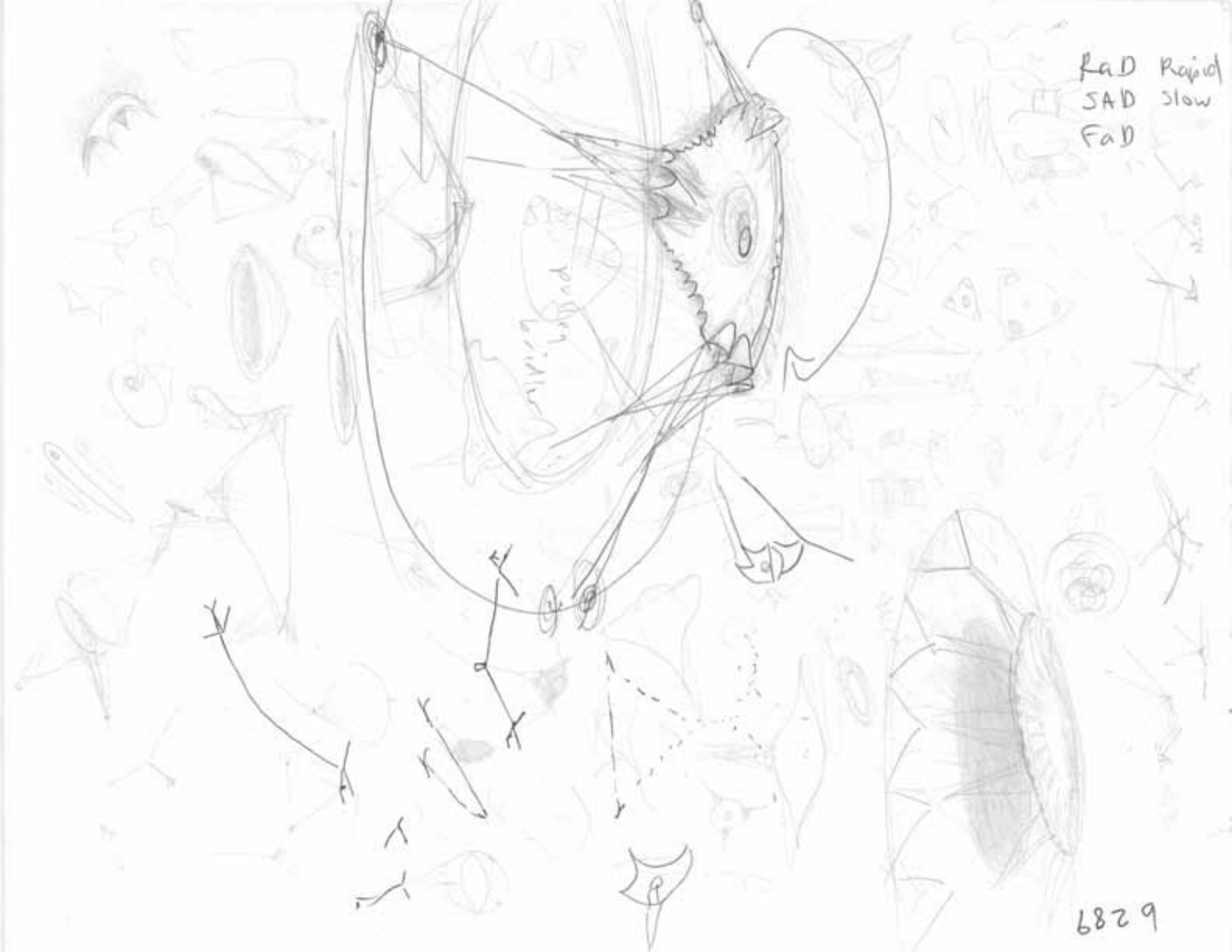

rum-ar
stabilize
windward
leaning train

b 288

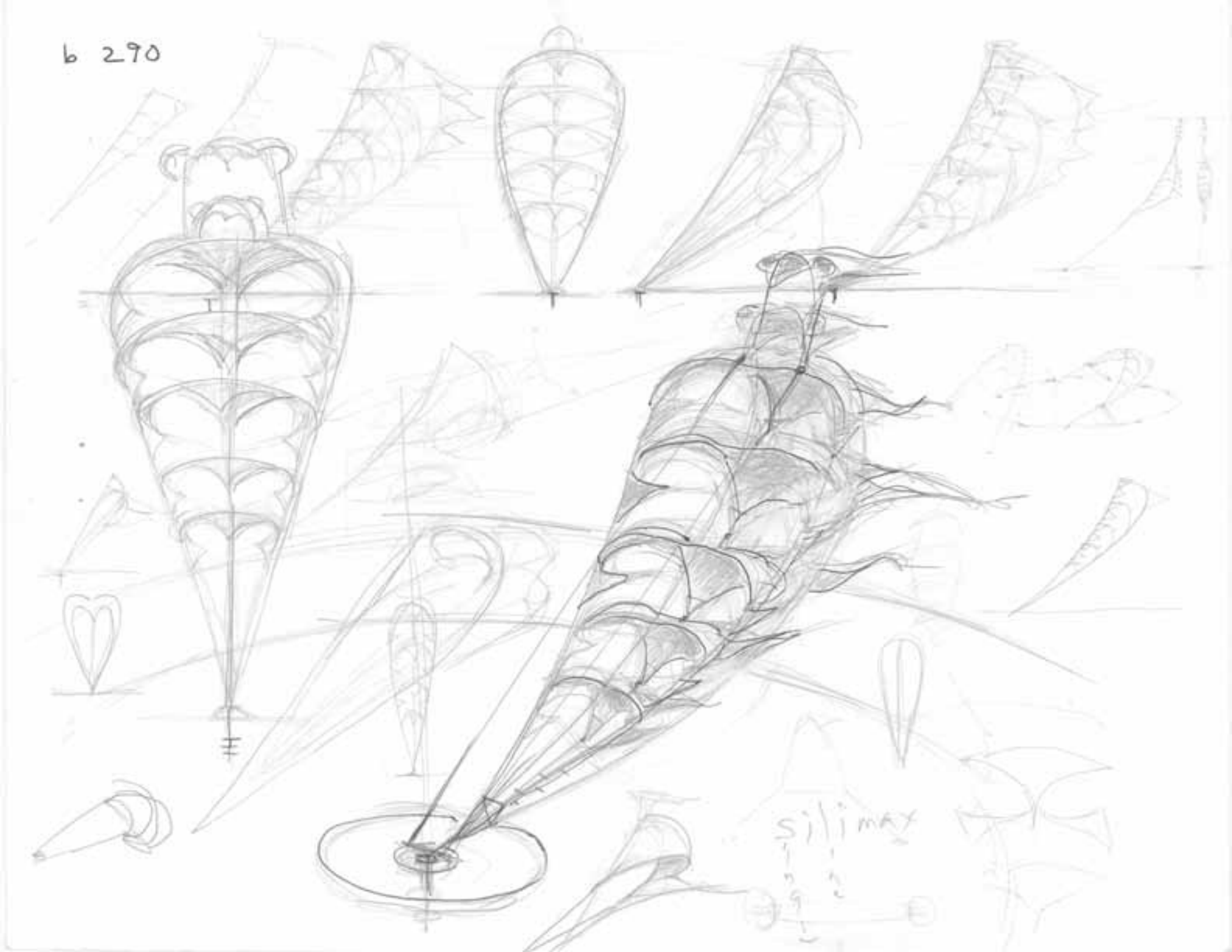
David Santos / Kite Energy
santos137@yahoo.com

April 2011 # b 288 + art pre Apr 2011

Note: Do not shuffle order-
top is most recent,
bottom is 2009

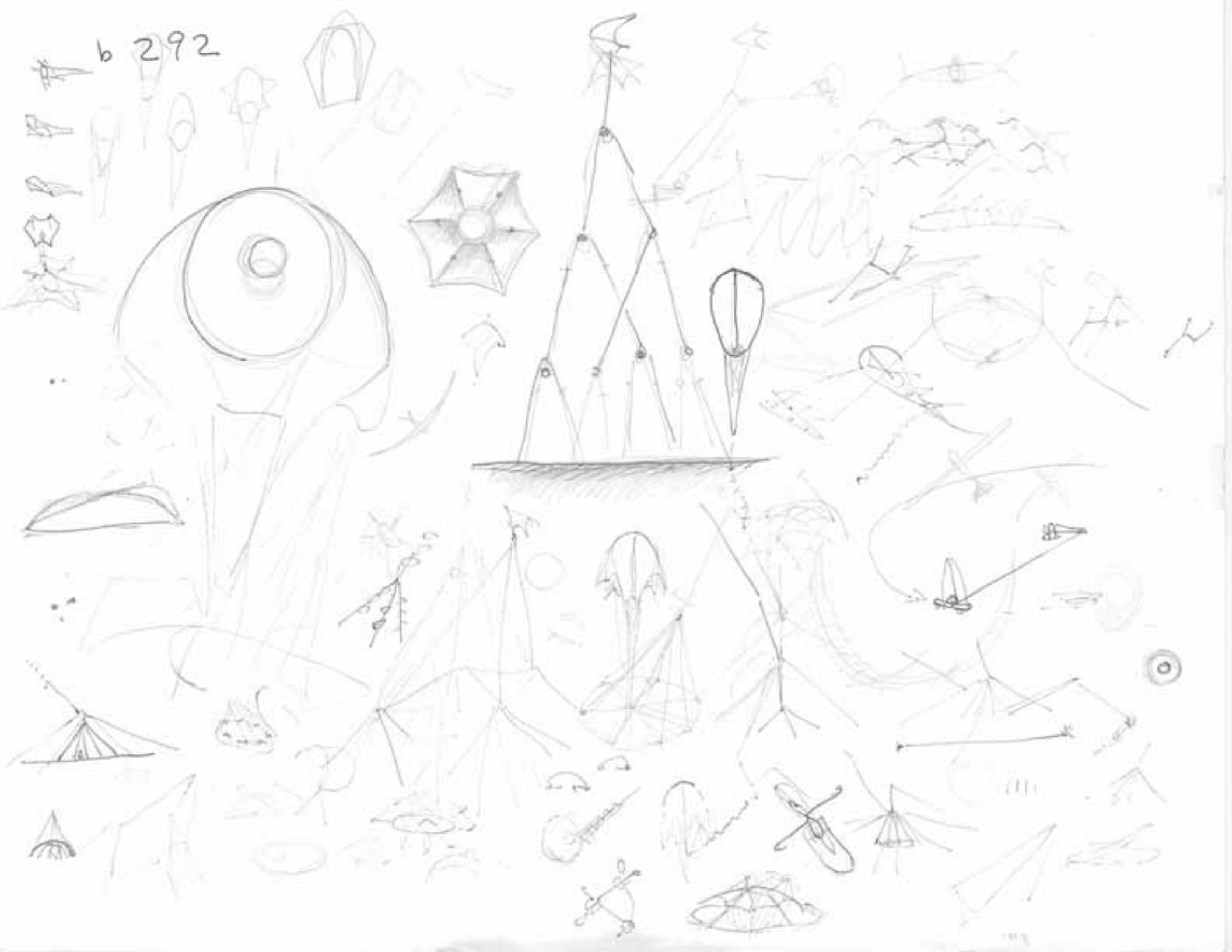

RaD Rapid
SAD Slow
FaD
6829

b 290



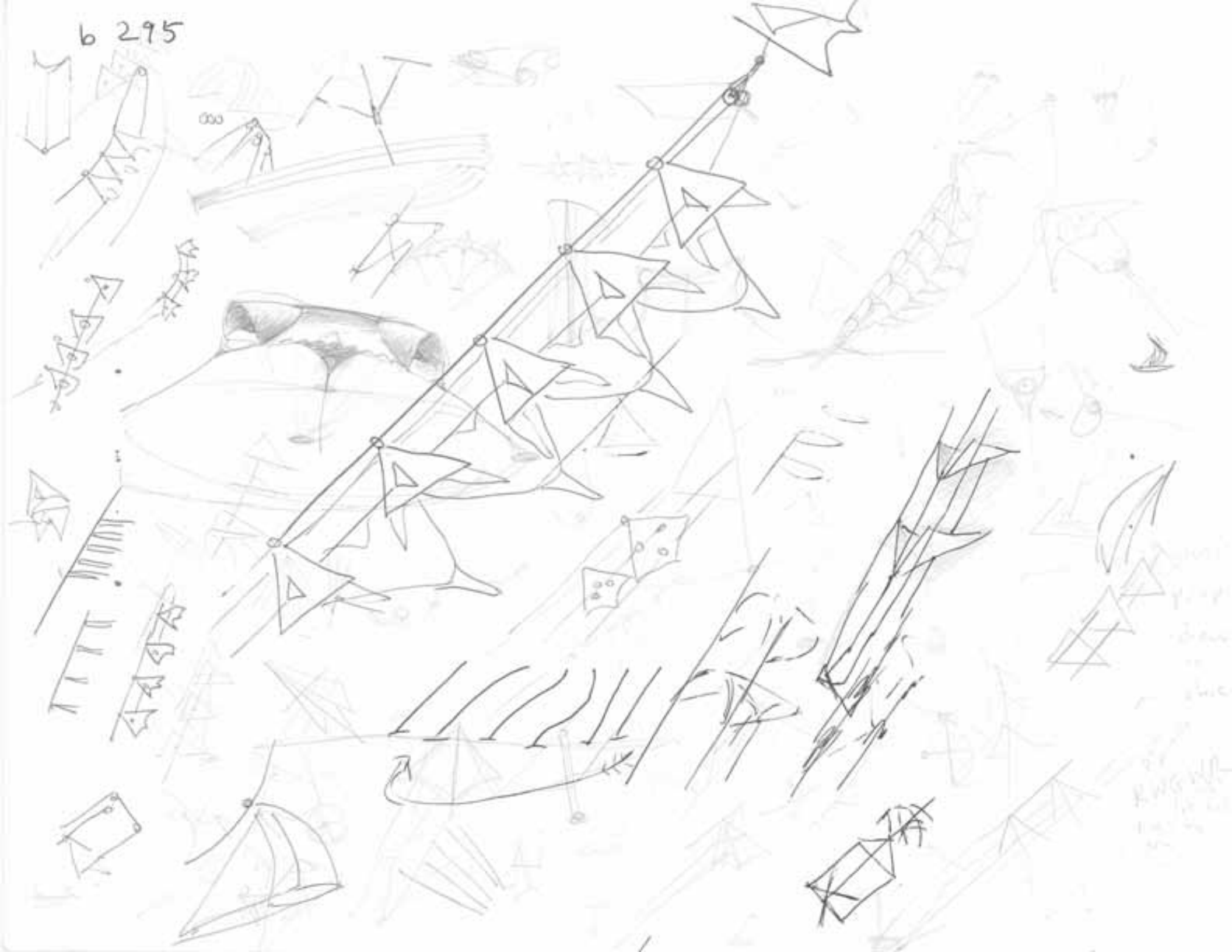
b 291

b 292



b 293

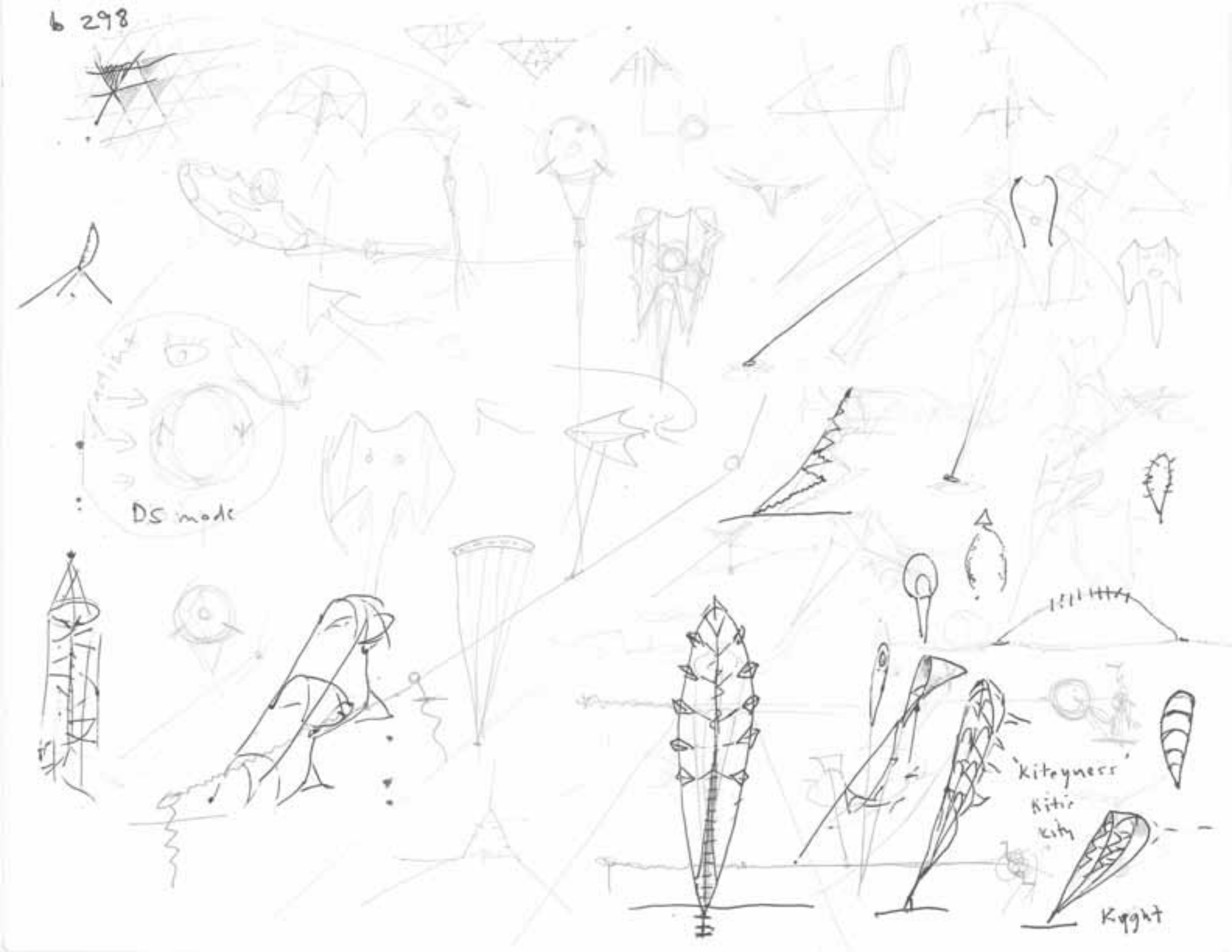
b 294


b 295

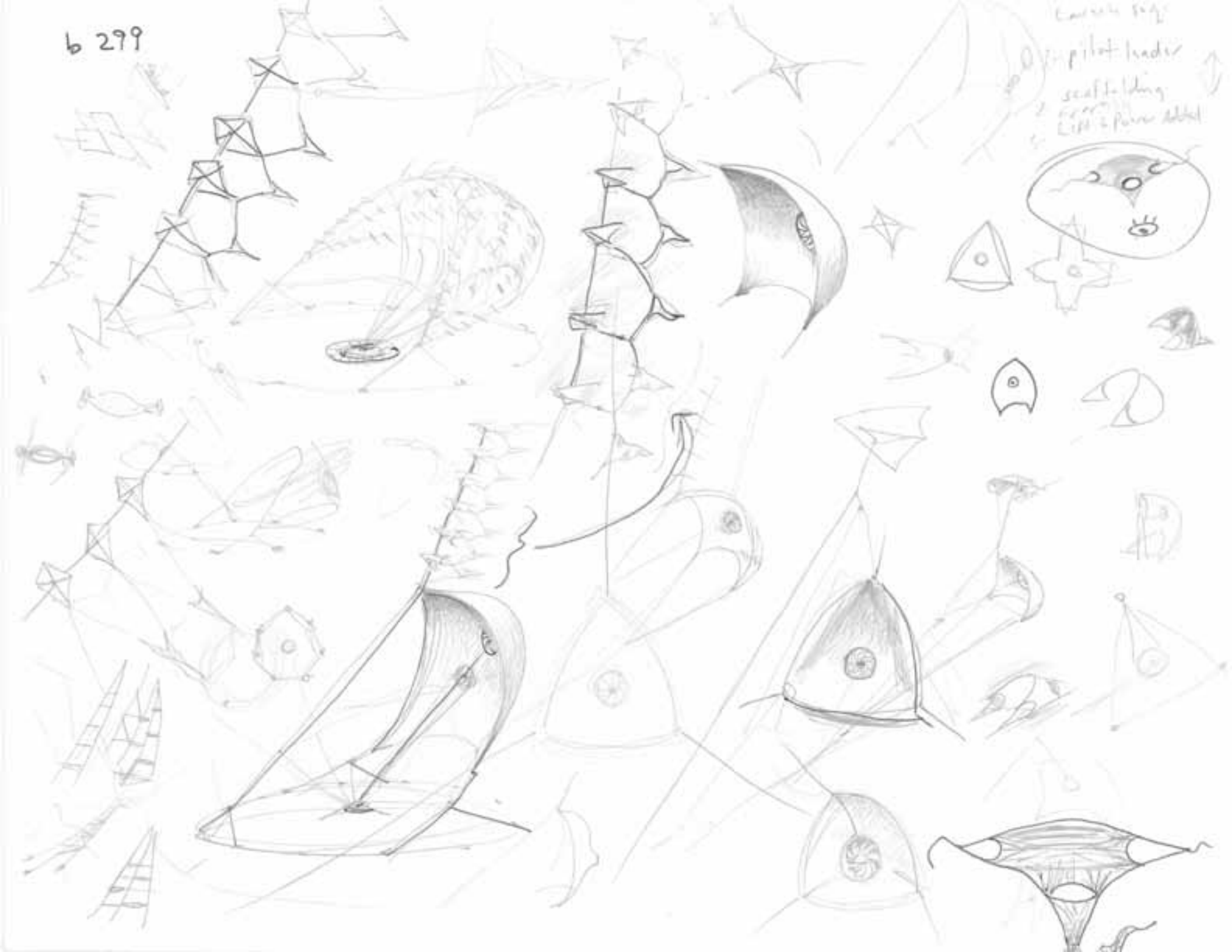
b 296

b 297

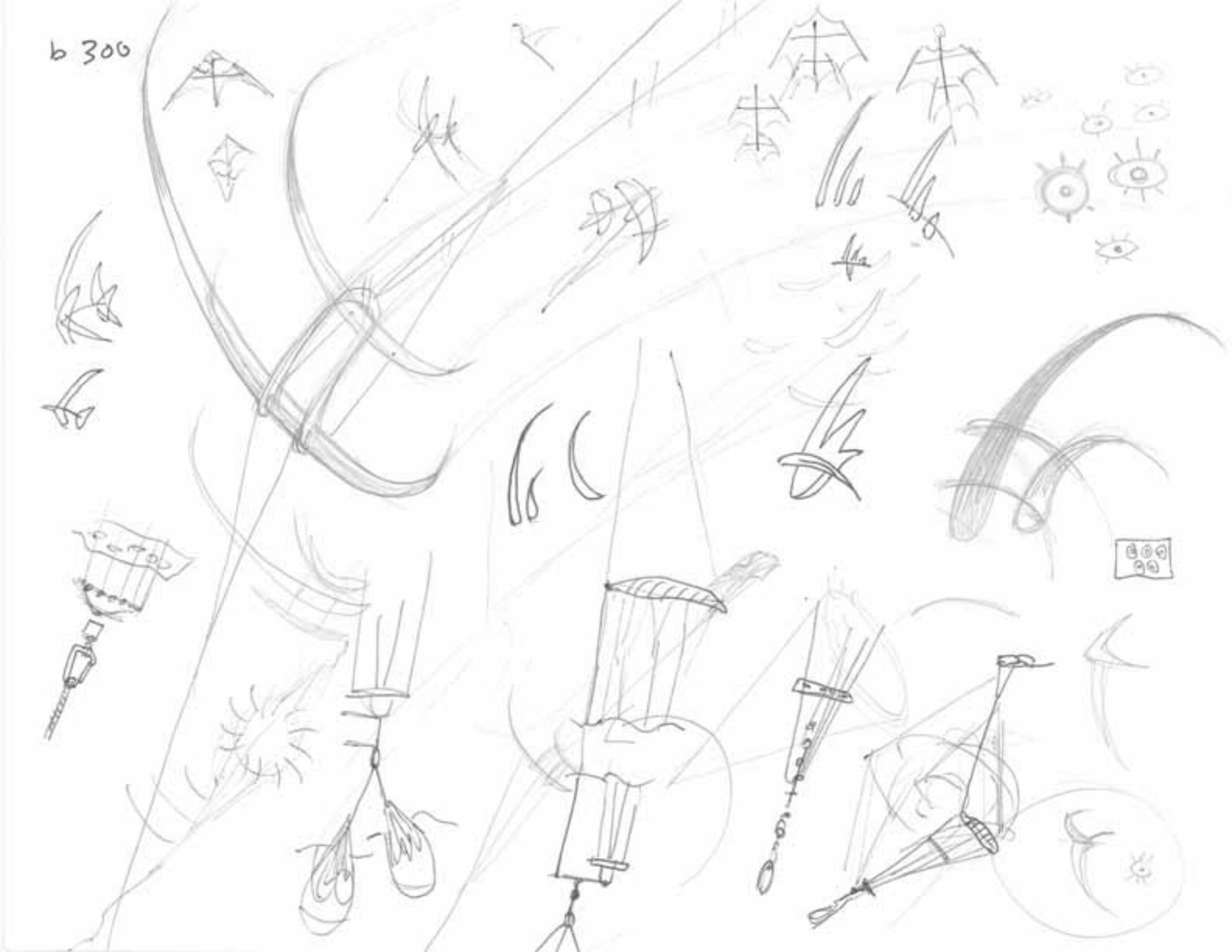
b 298

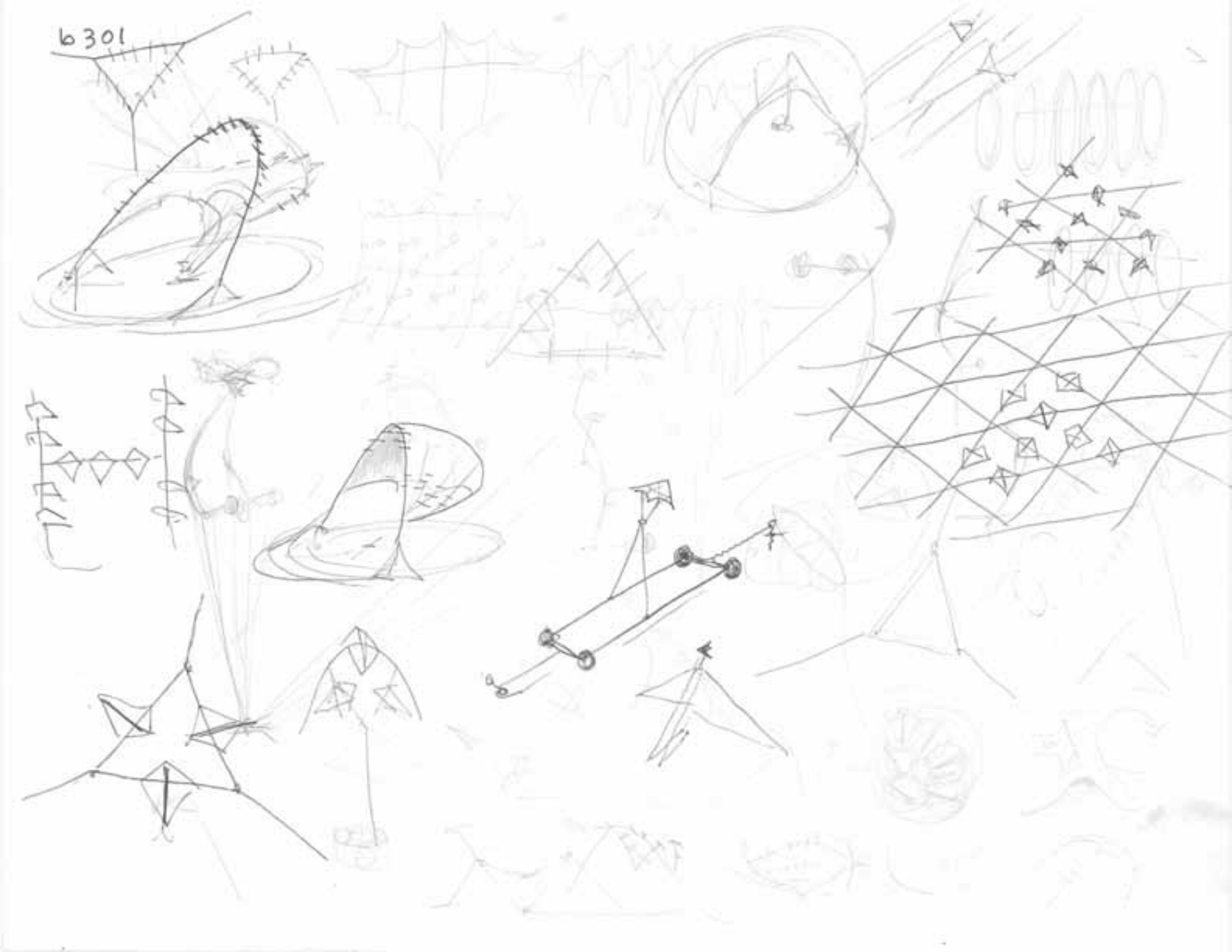


b 299



b 300

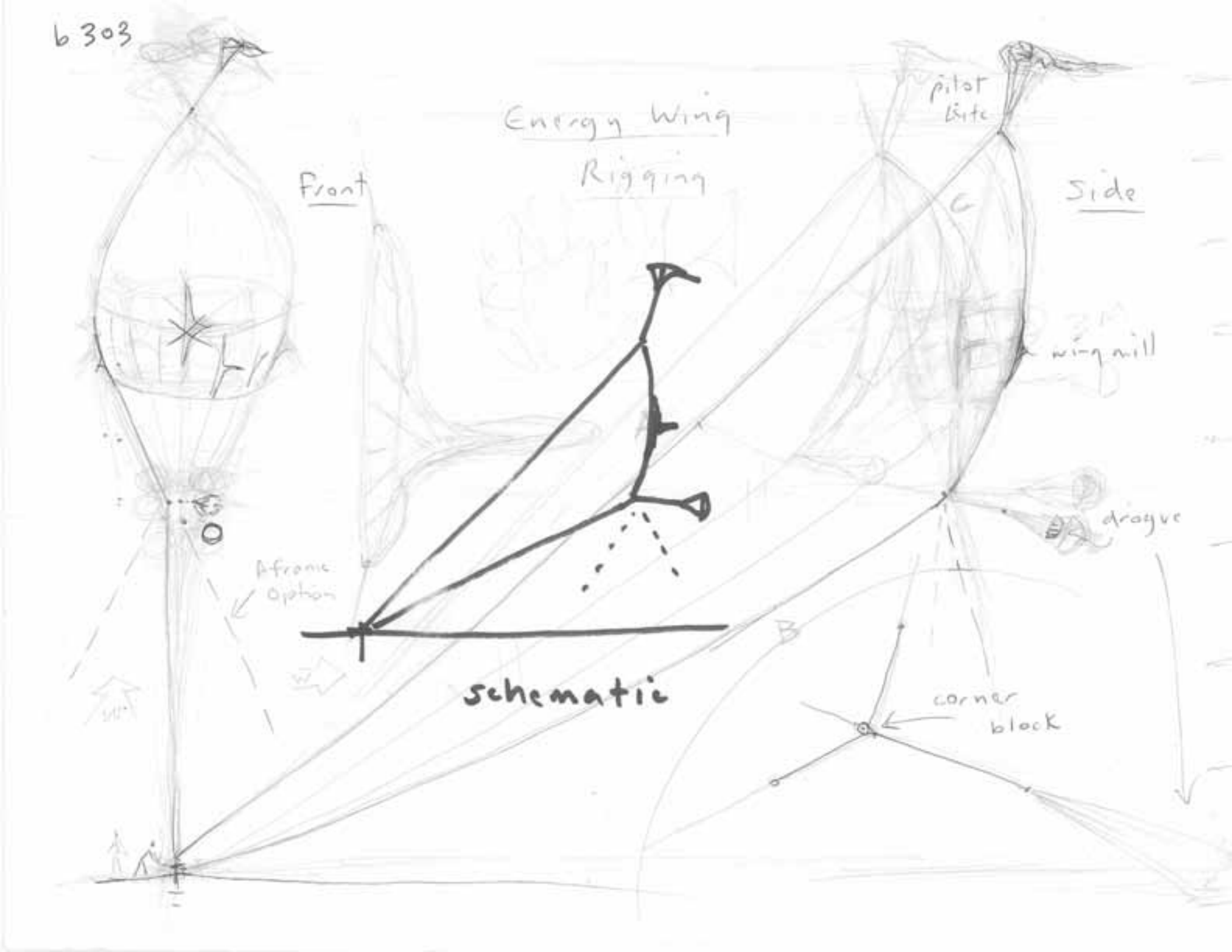



6301

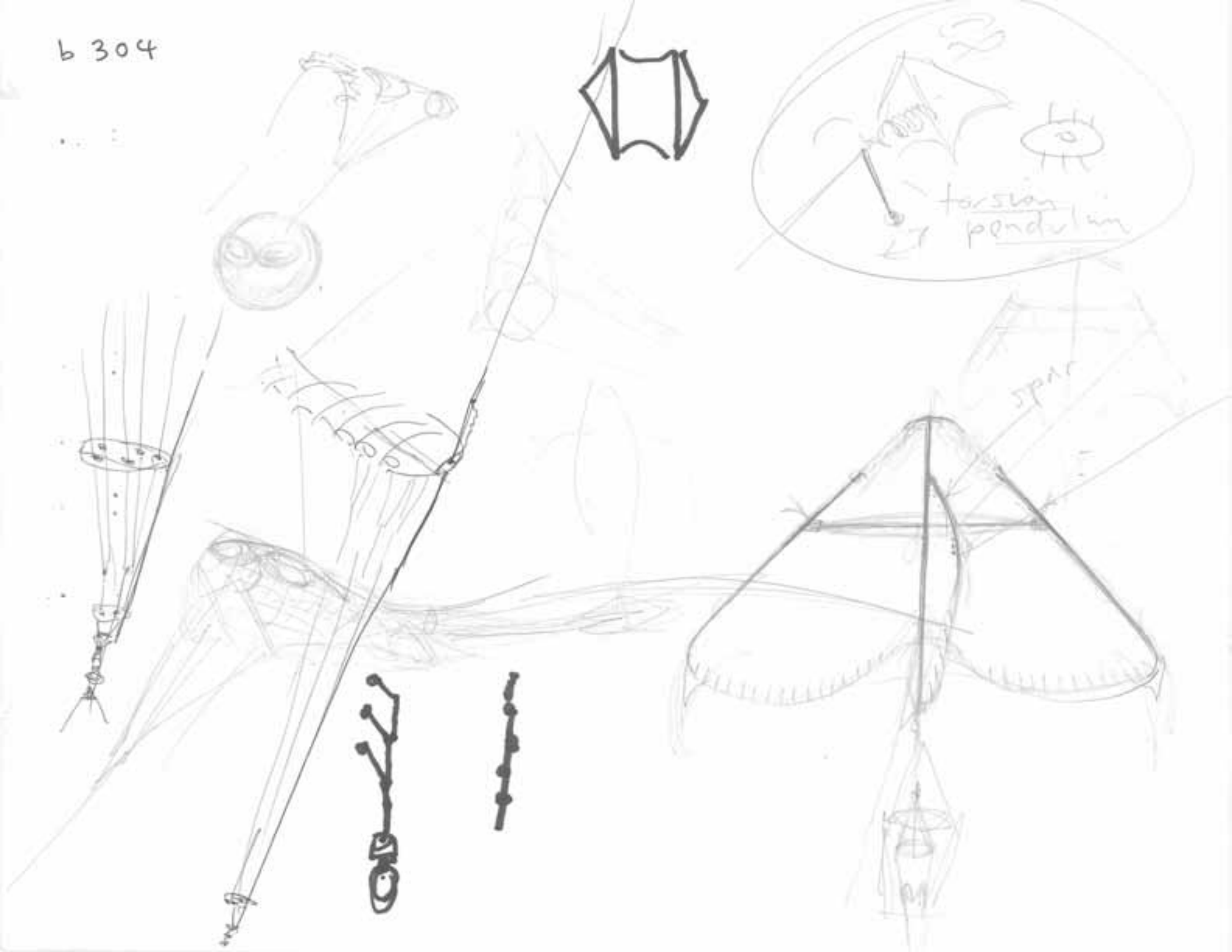
b 302

b 303

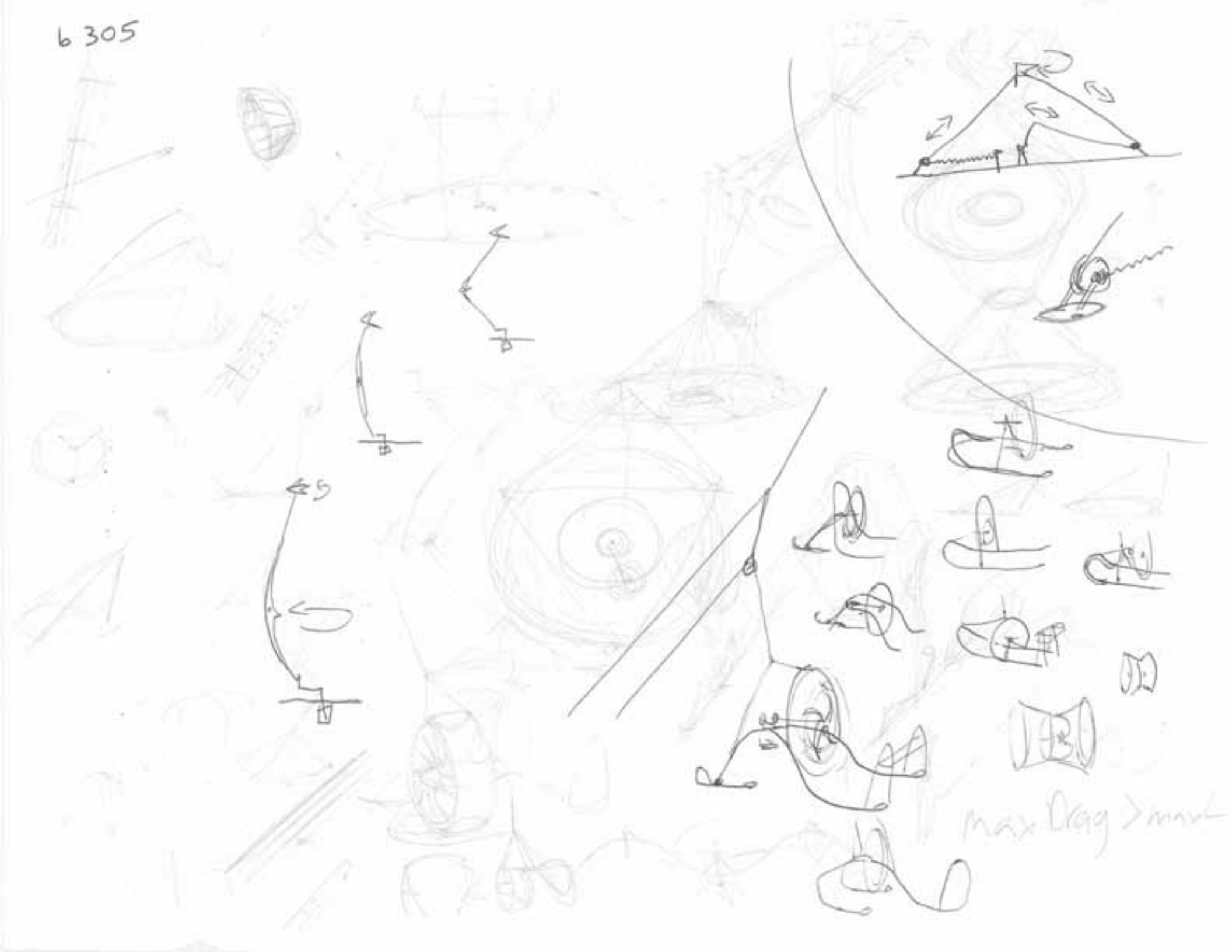
Energy Wing Rigging



b 304

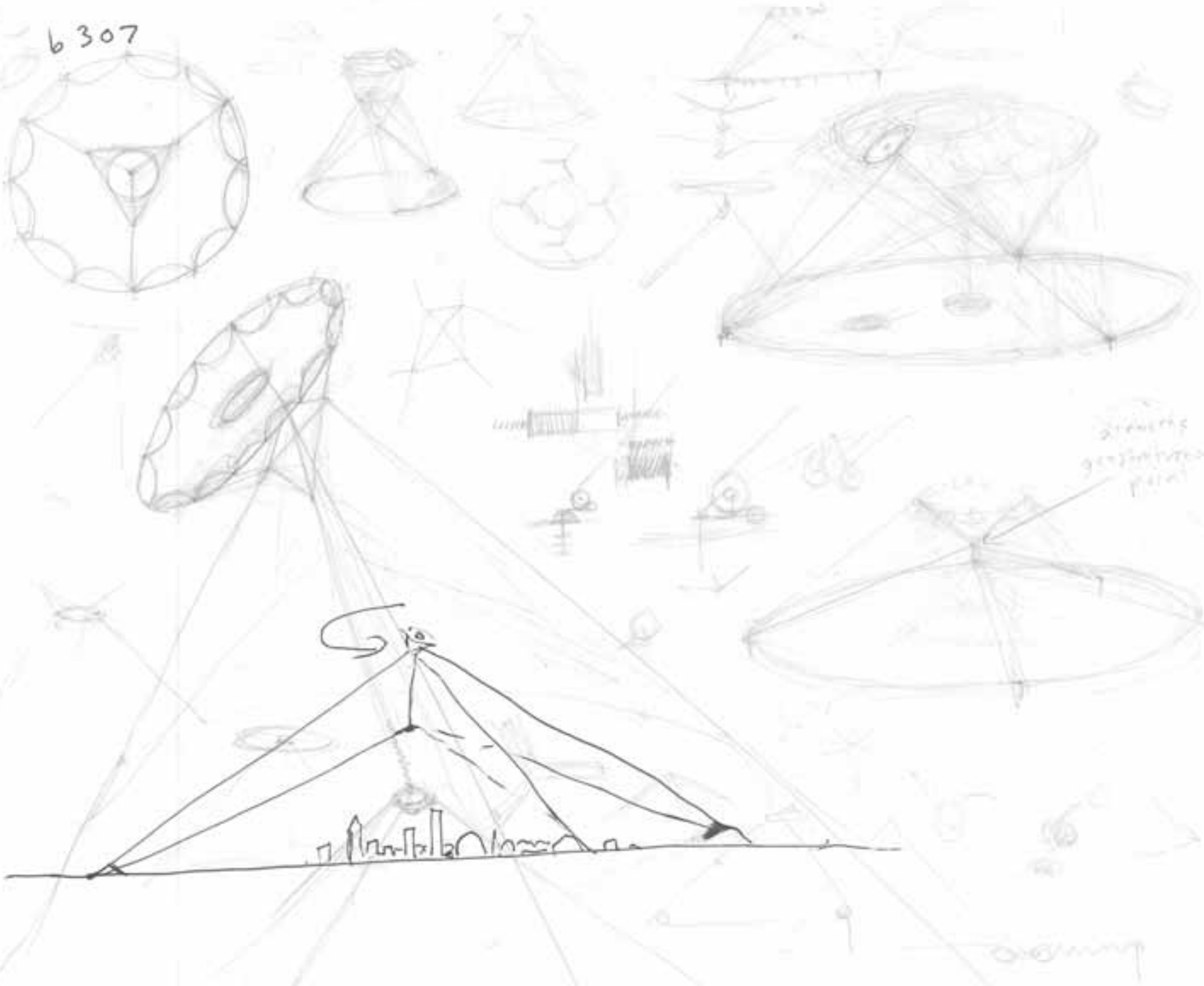


6 305



b 306

6307



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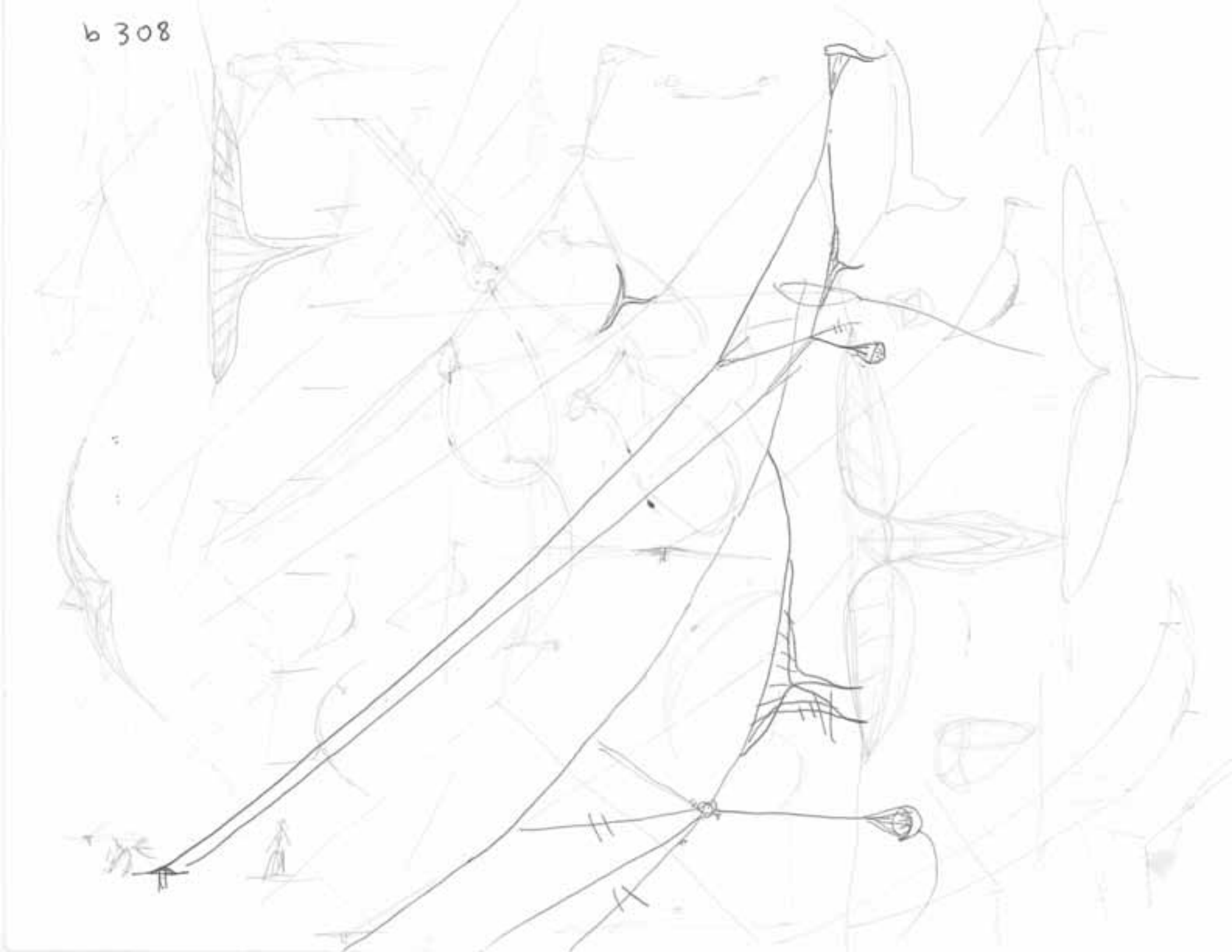
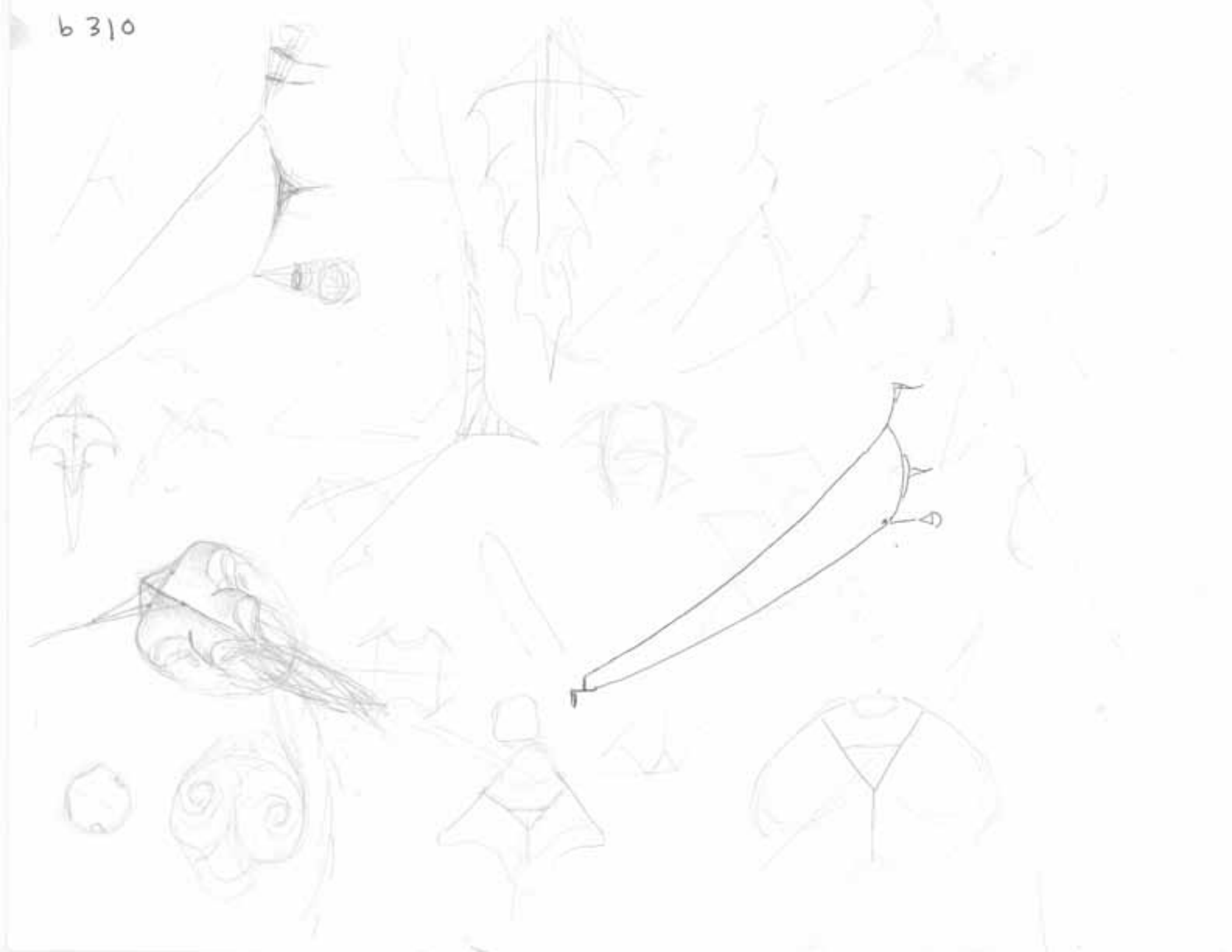


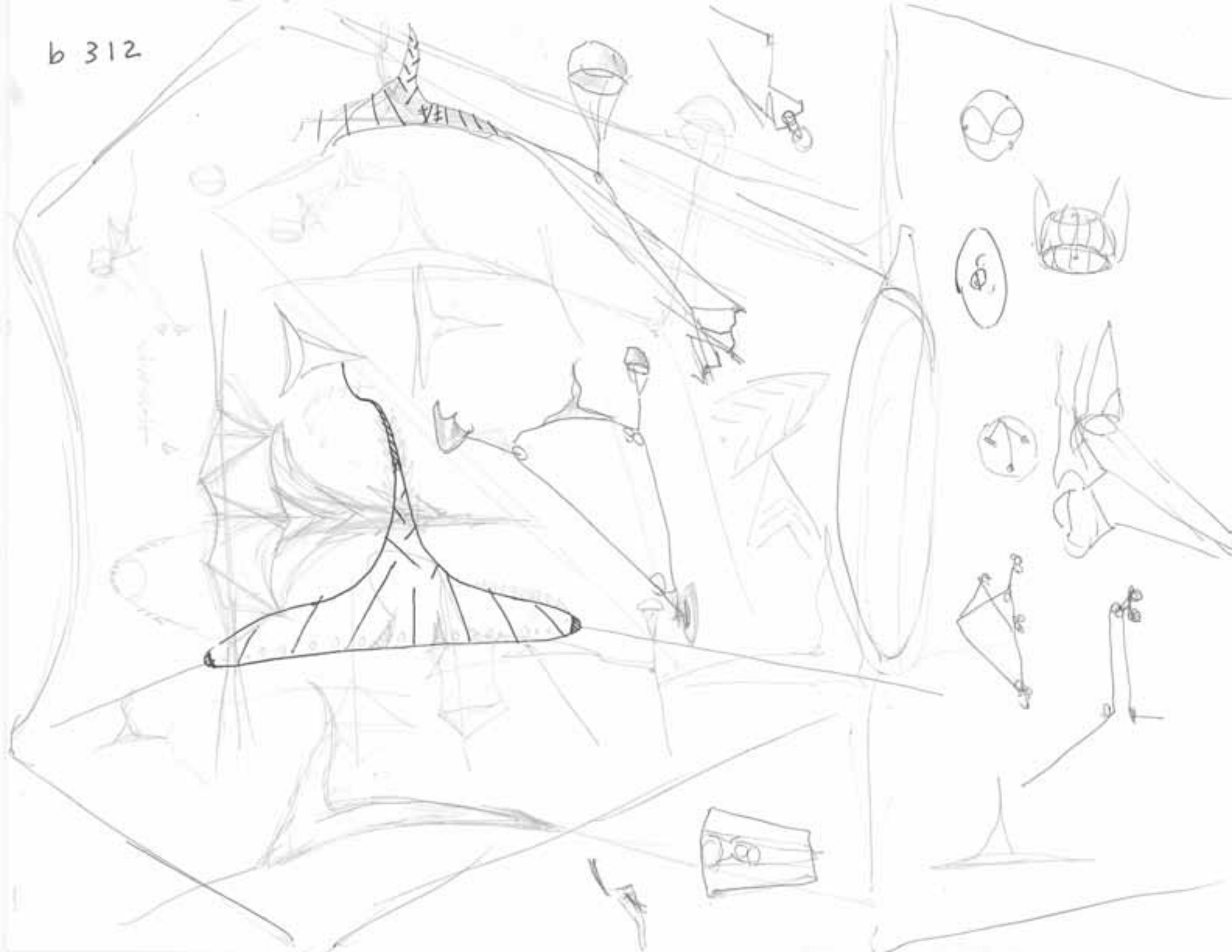
B 309

b 310

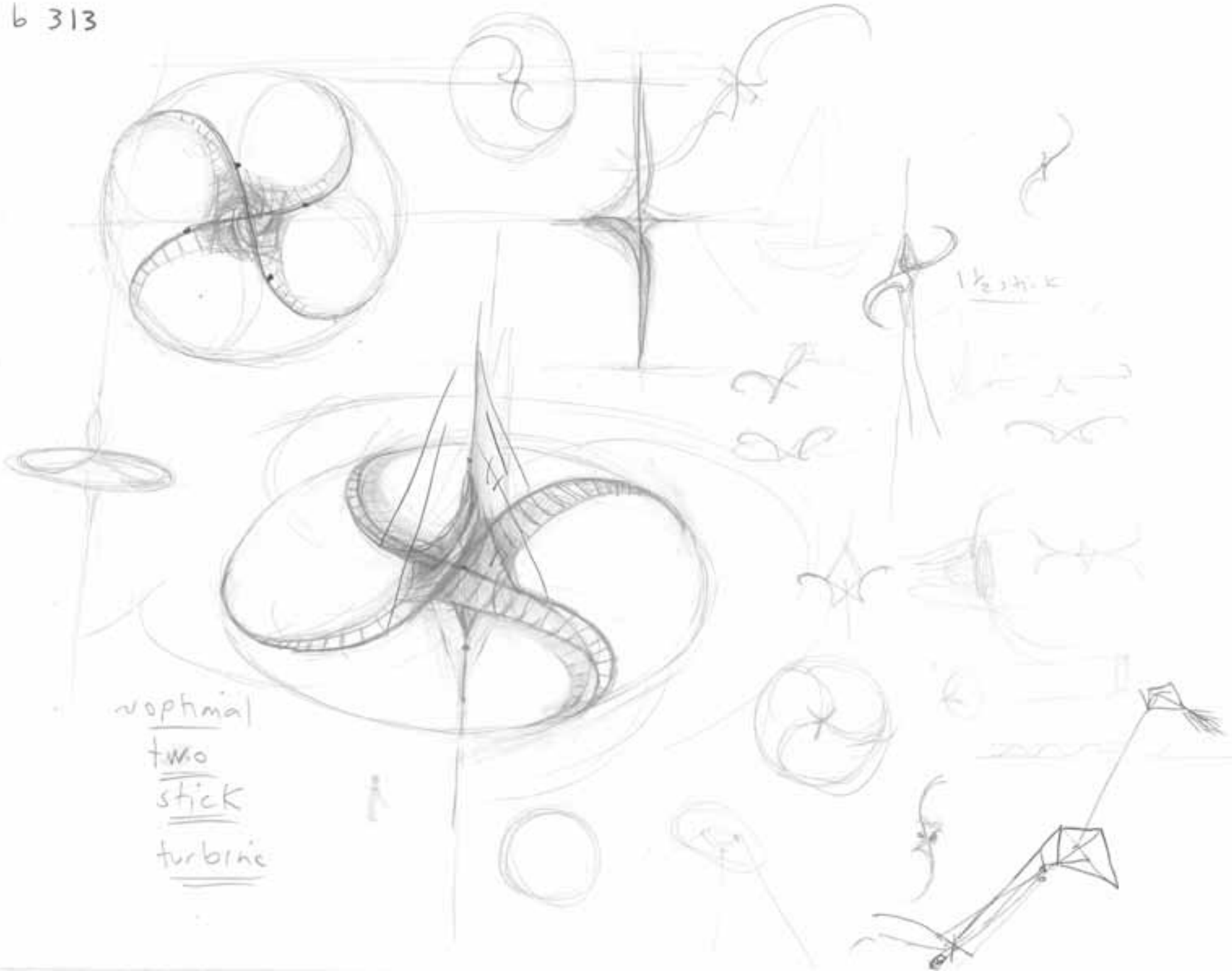


b 311

b 312

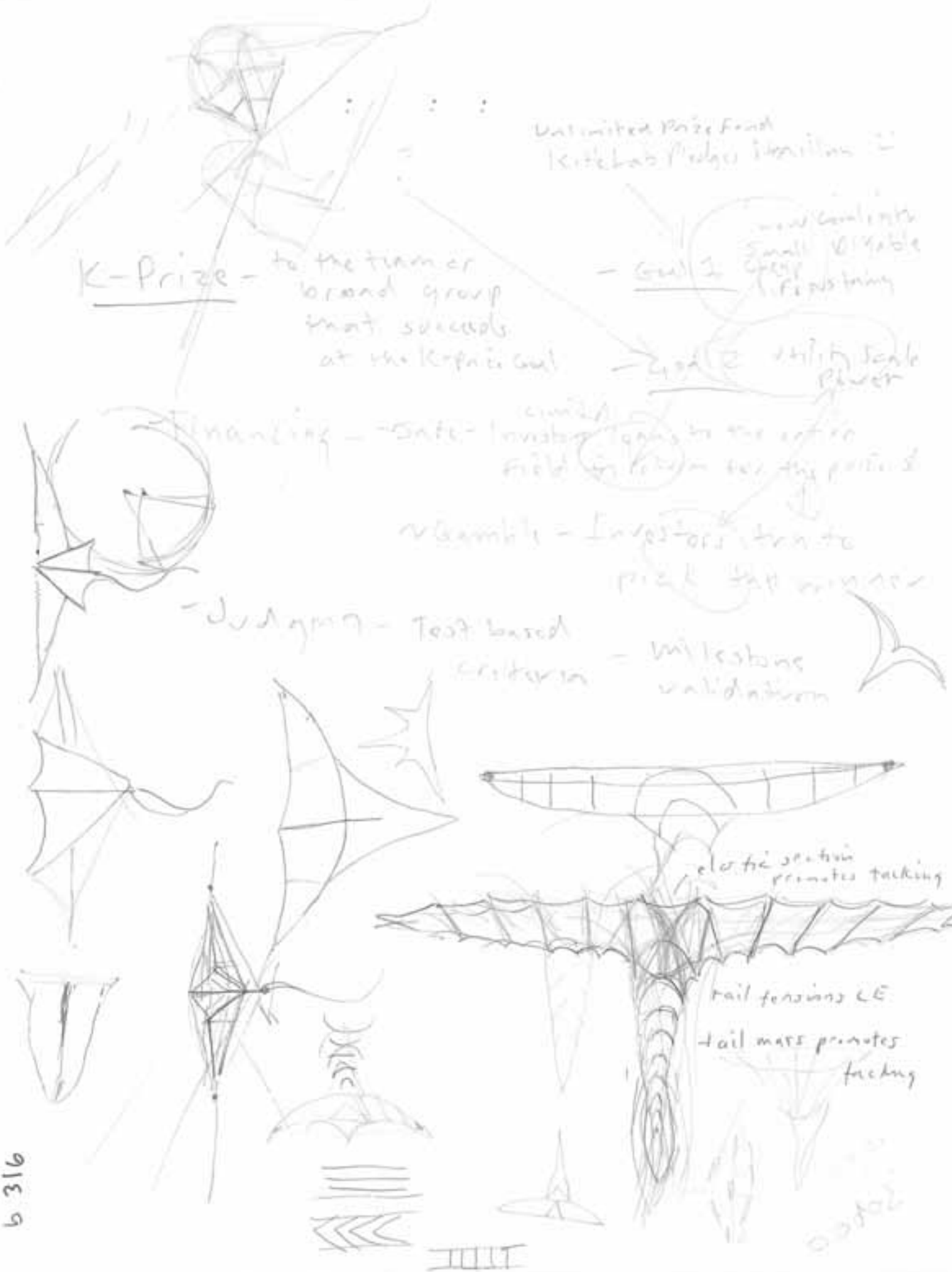


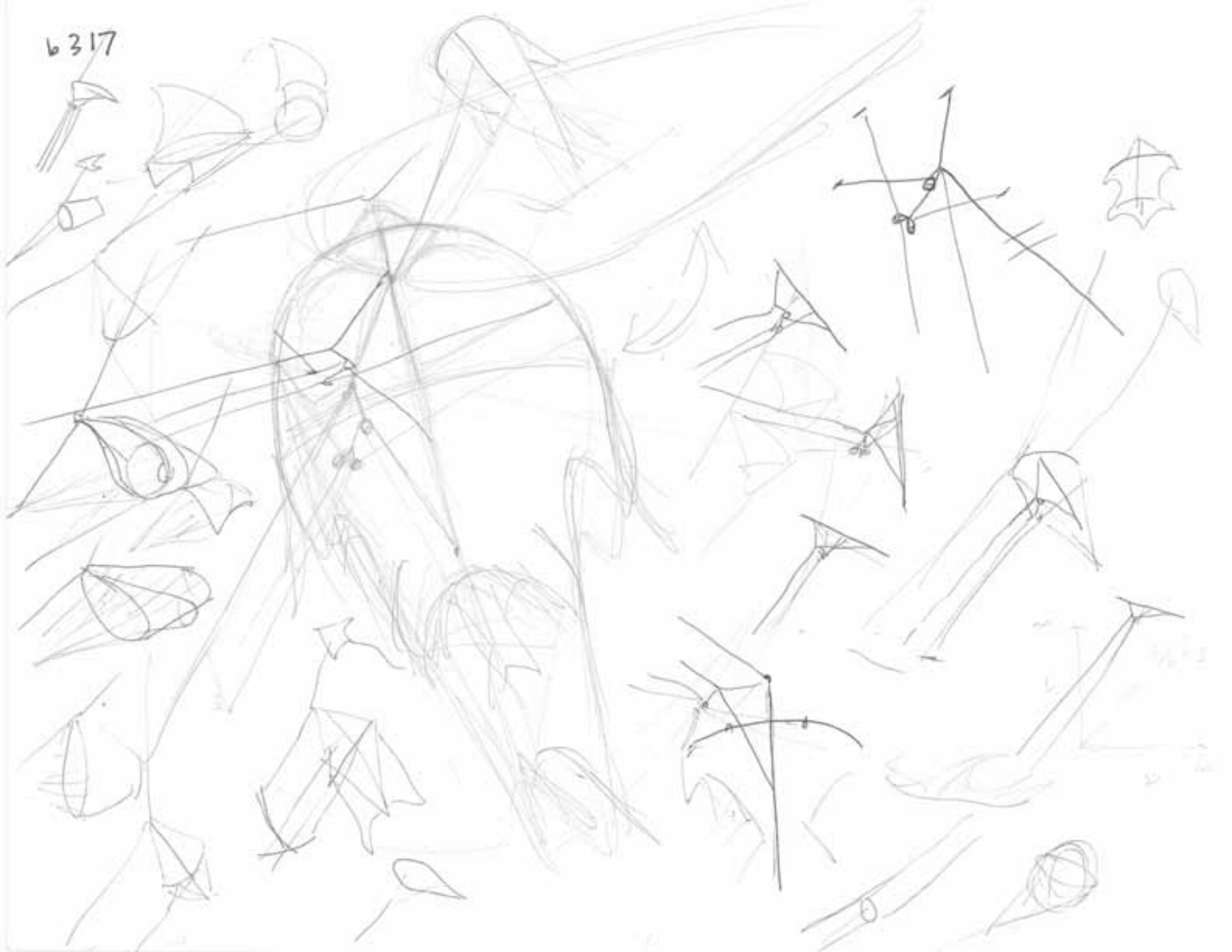
b 313



b 314

b 315


Unlimited Prize Fund
Kitelab Pledges Imaillon
K-Prize - to the team or broad group that succeeds at the K-Prize Goal
- Goal 1 Small Dirigible Cheap Lifespanning
- Goal 2 Utility Scale Power
- Financing - Safe - Investors (limited) loans to the entire field in return for the prizes
~Gamble - Investors turn to pick the winner
- Judging - Test based criteria - Milestone validation
elastic section promotes tacking
tail tensions LE
tail mass promotes tacking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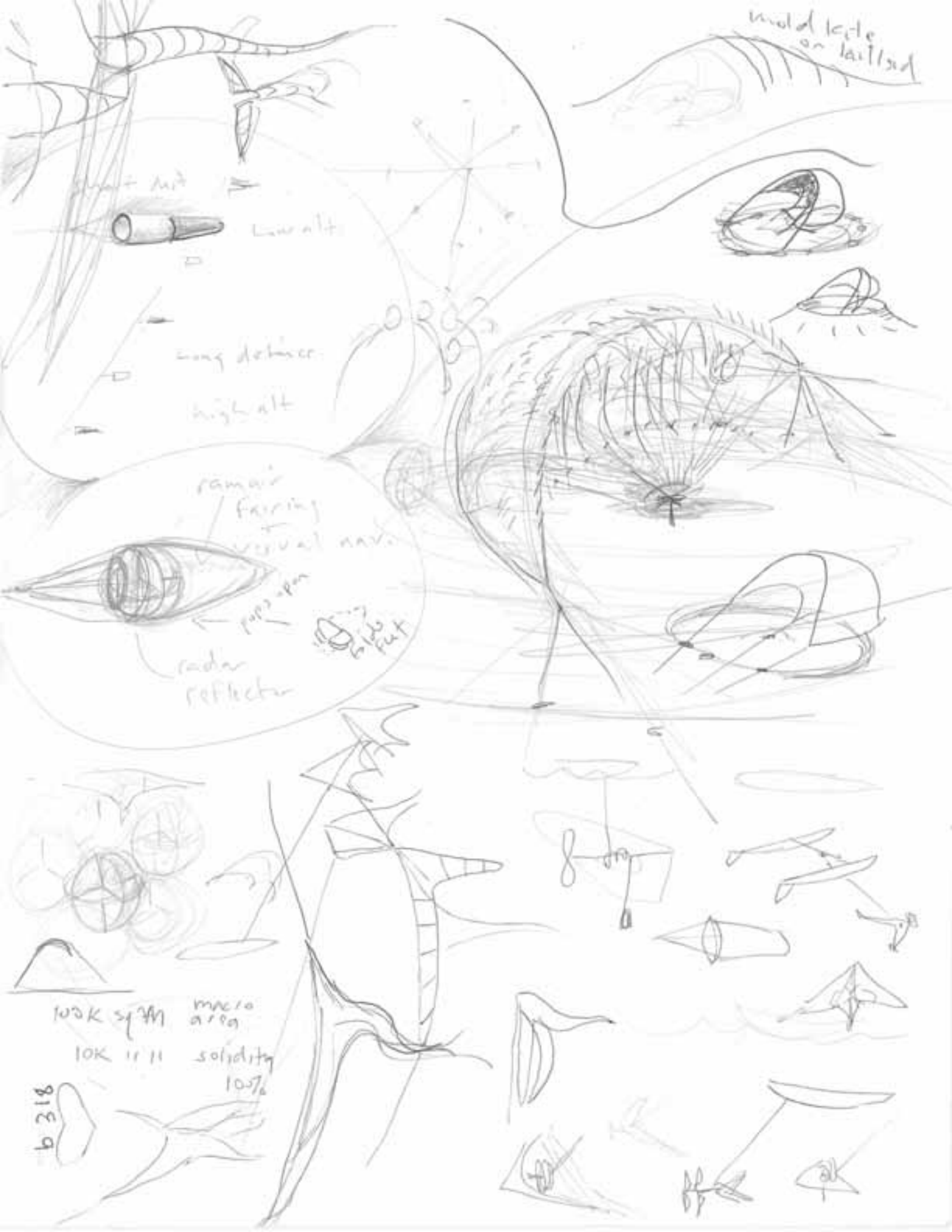
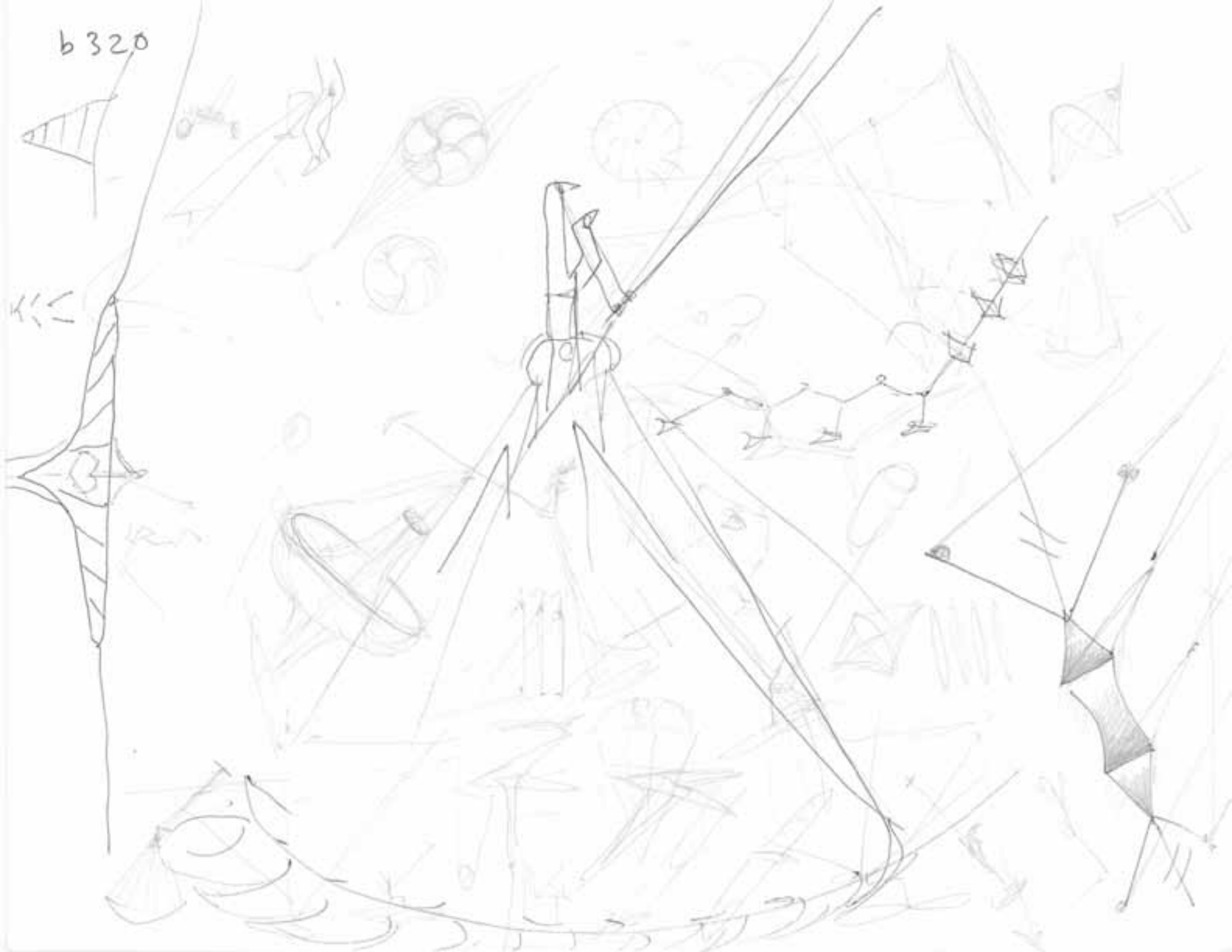
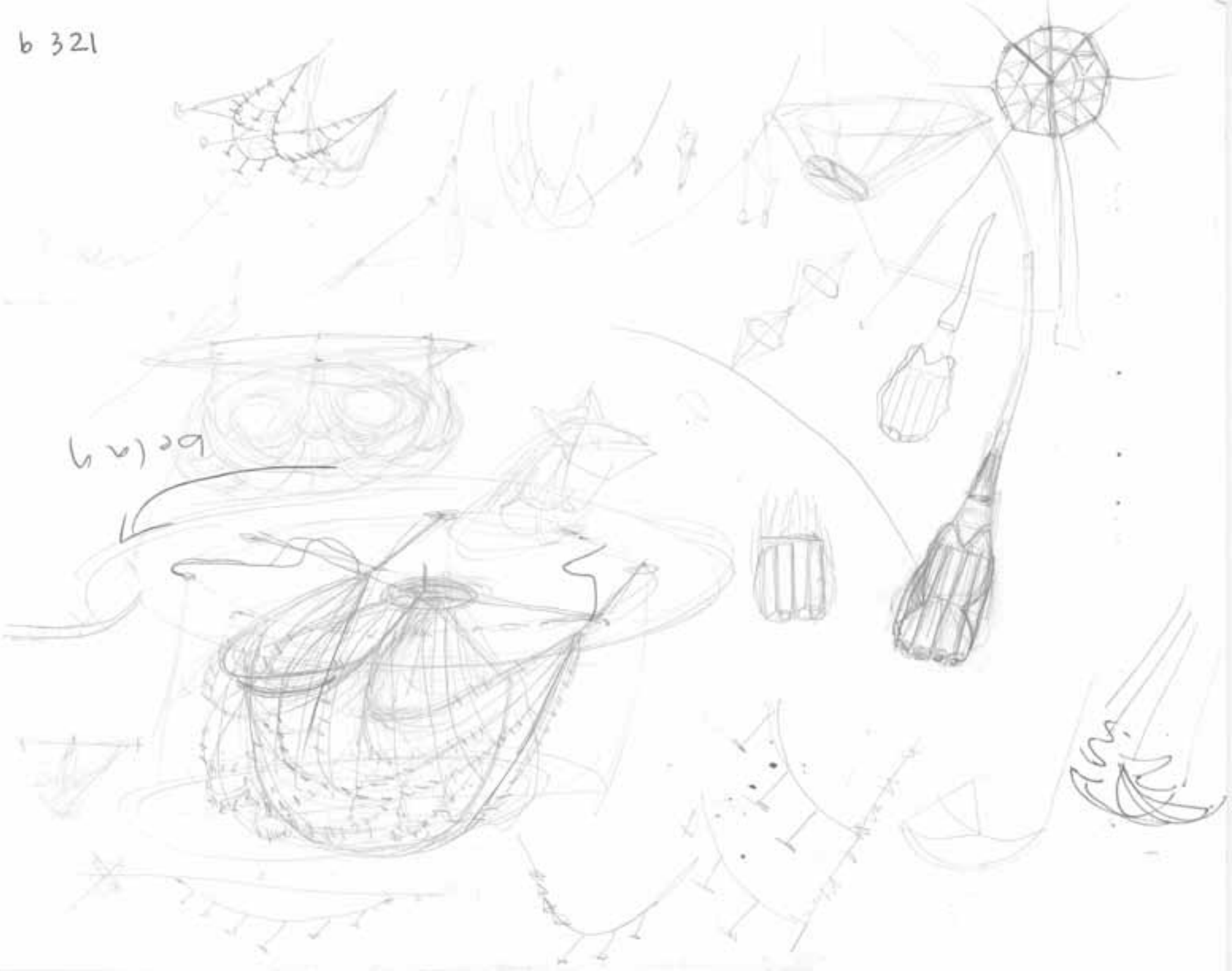

mold kite on tailsid
Low alt
long distance
high alt
ramair fairing + visual nav.
pops open
folds flat
radar reflector
100K sq M macro area
10K " " solidity 100%
b 318

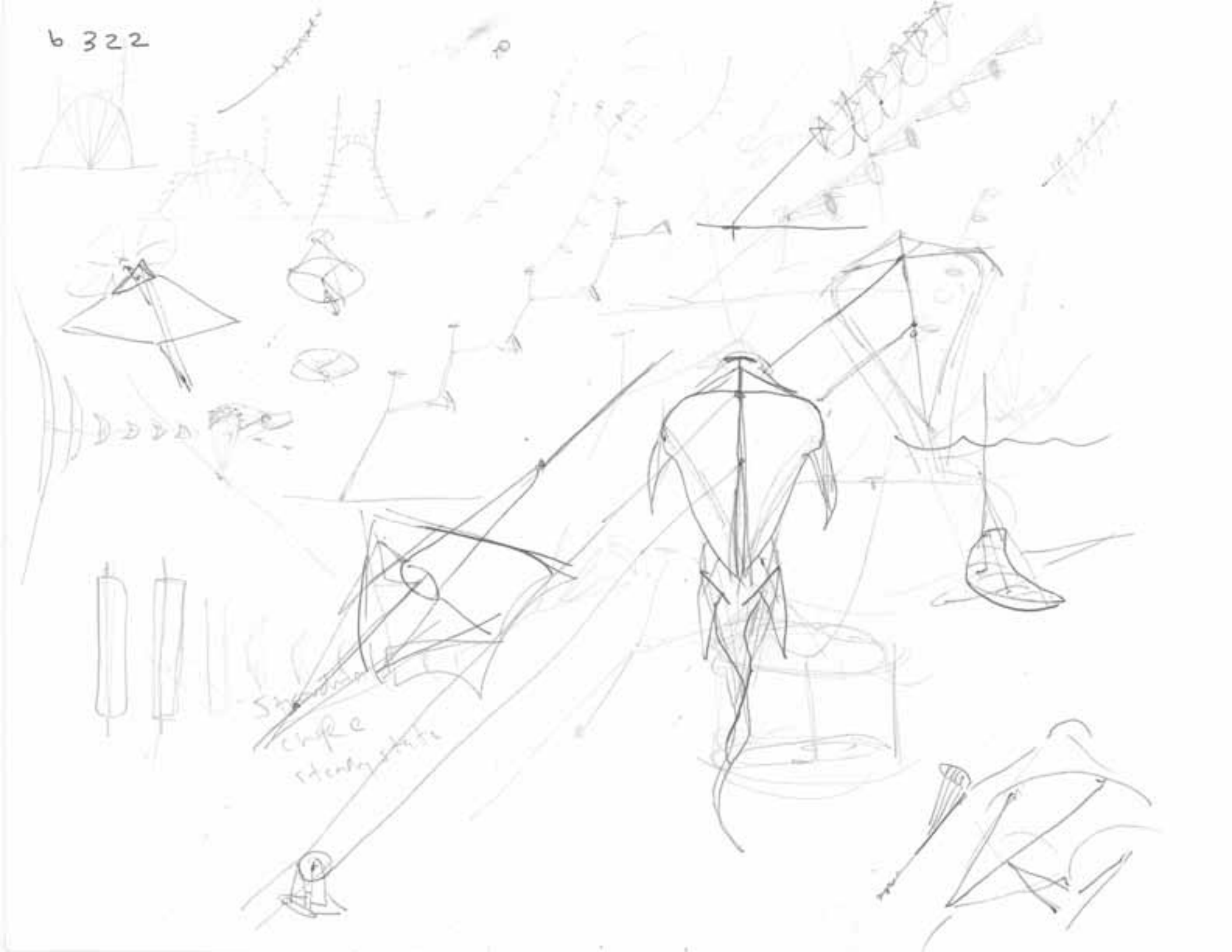
b 319
Allen
Amtrak
433
1:47


b320

b 321



b 322



b 323

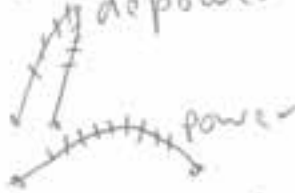
light wind -
high, unloaded

med wind -
med altit

no wind -
low

Arch.

Flying



luff to

walk down

b 324

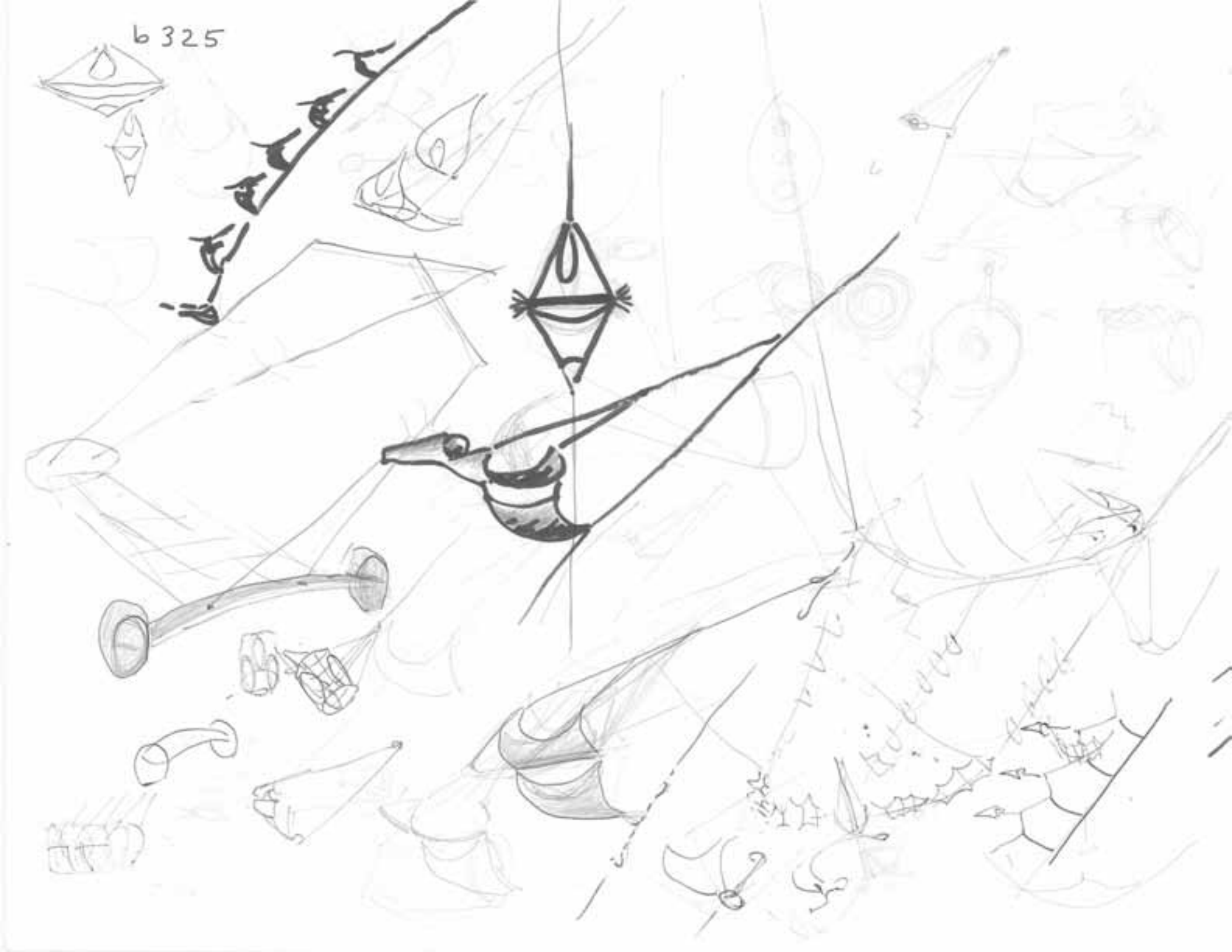
KITE LAB GROUP

AWEIA/NIGERIA	300 ✓	
Pierret	200	
Pietro	2000	3400
Kitebot/Kite Lab Ilwaco	300	4400
Cambridge	300	
WPK	100	
	1000	

800

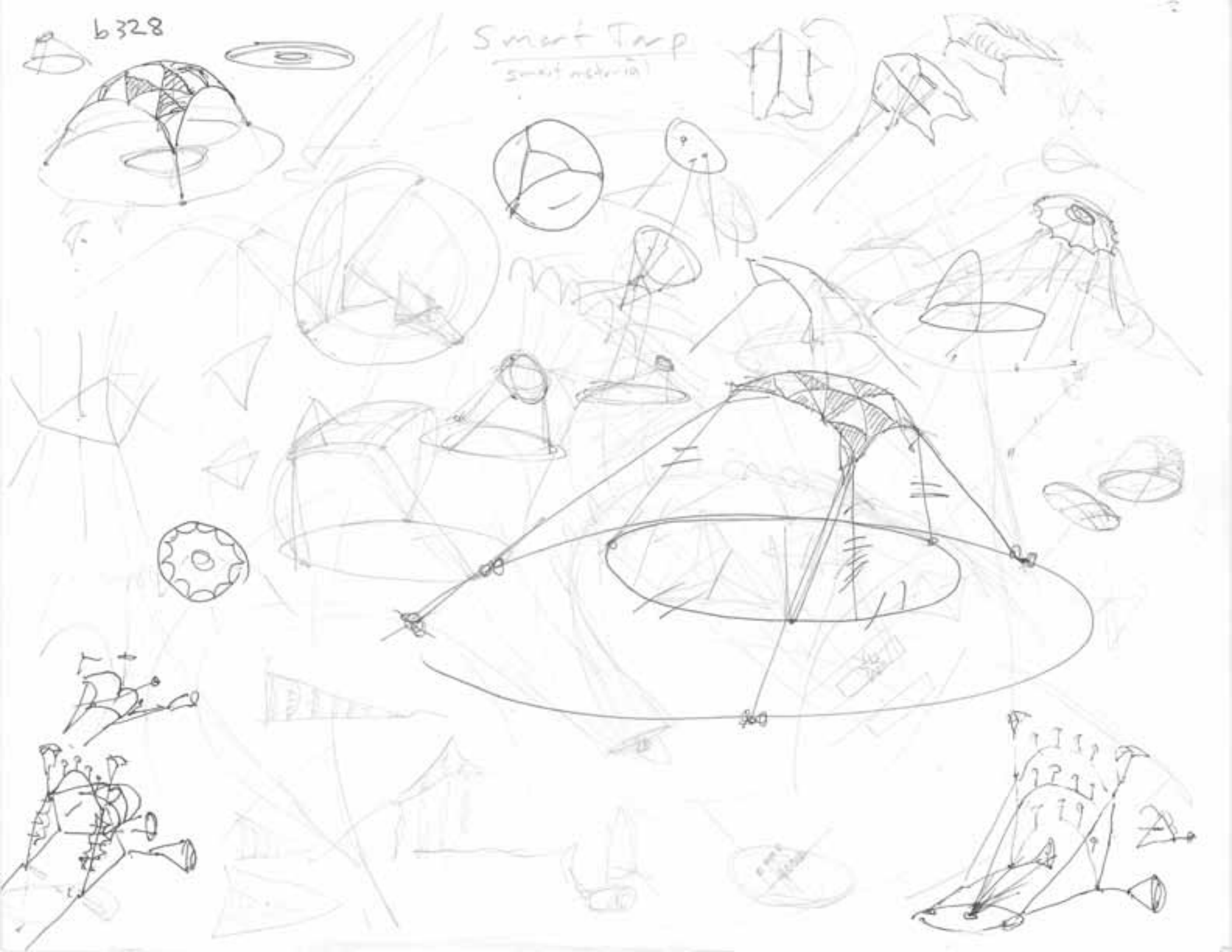
3mL 50 200

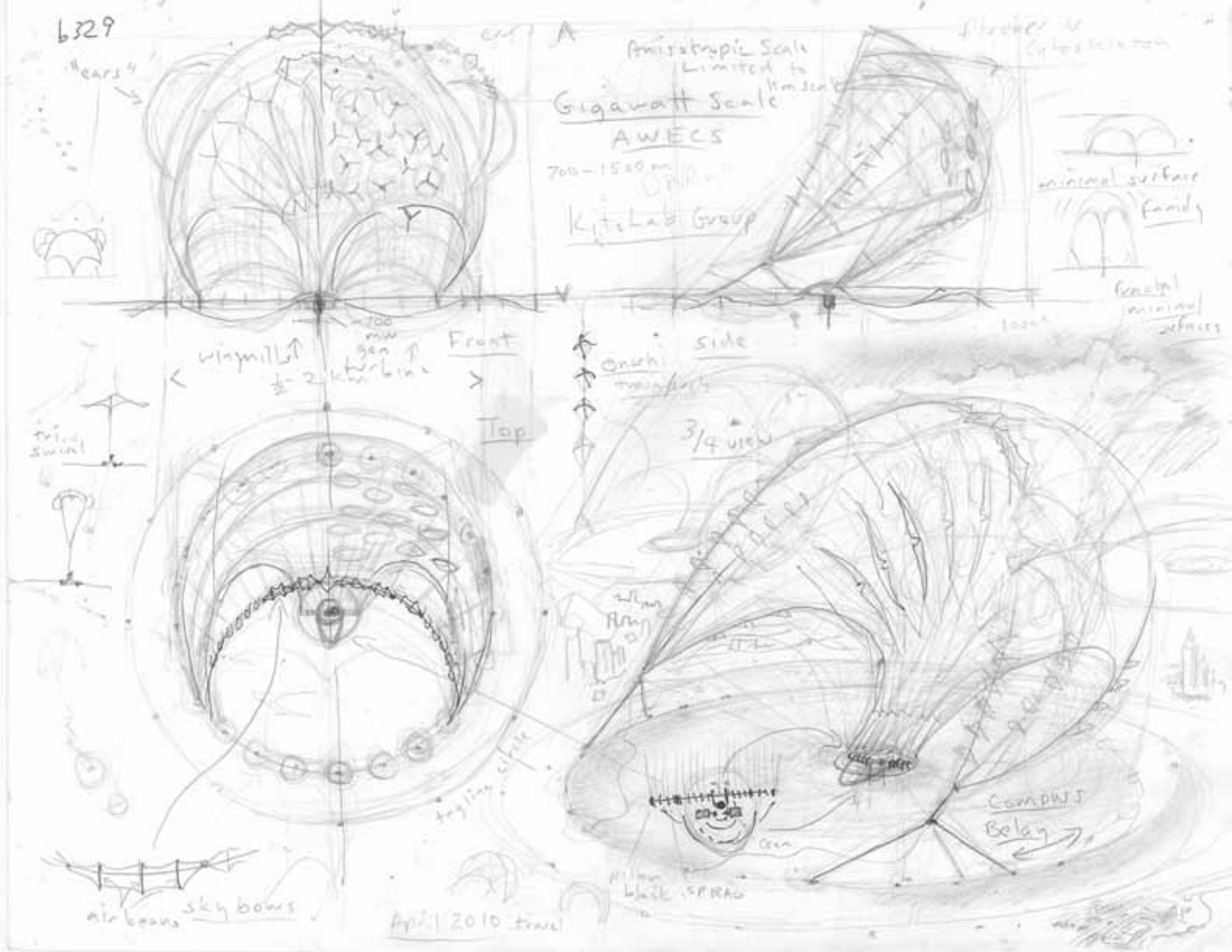
1.5A 1000


6325

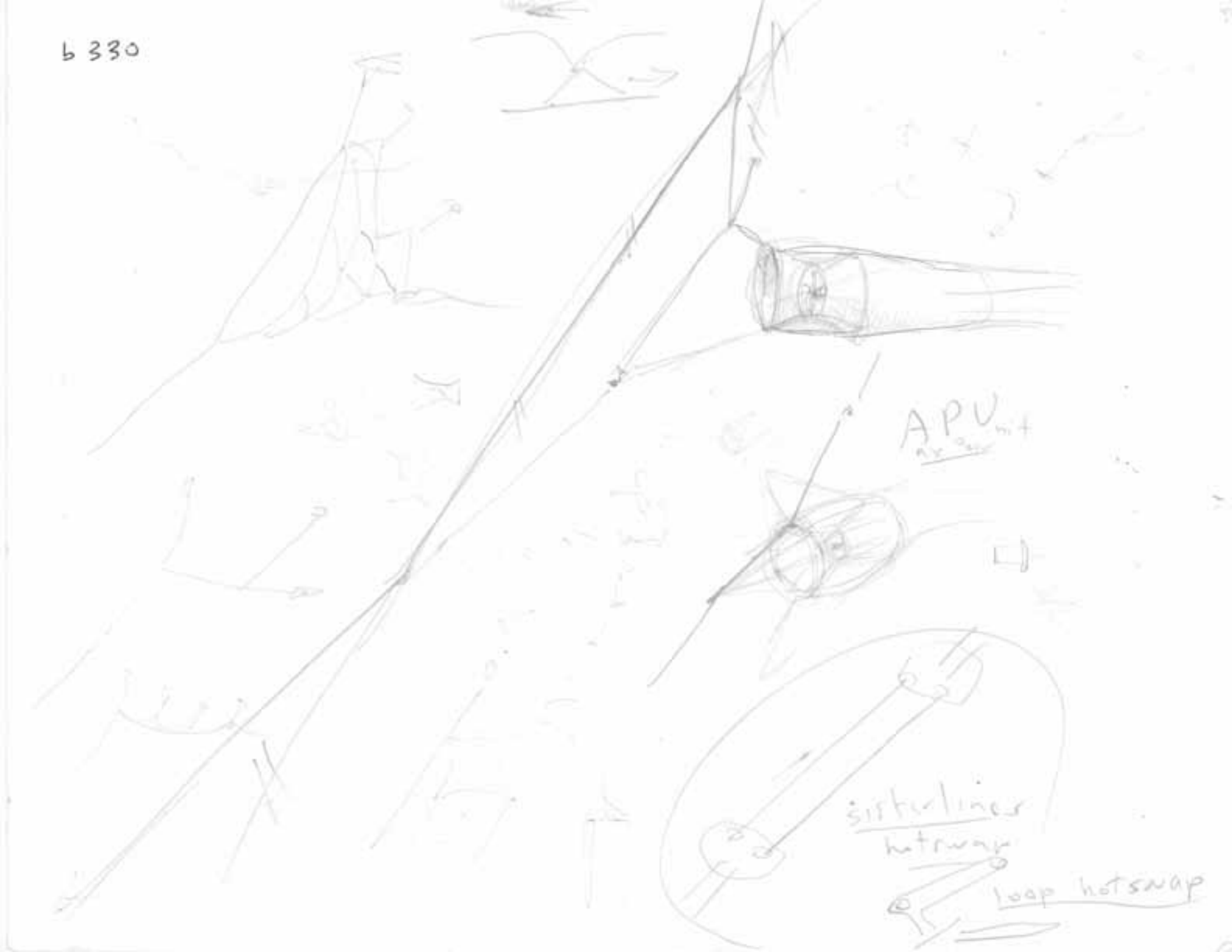
b 326

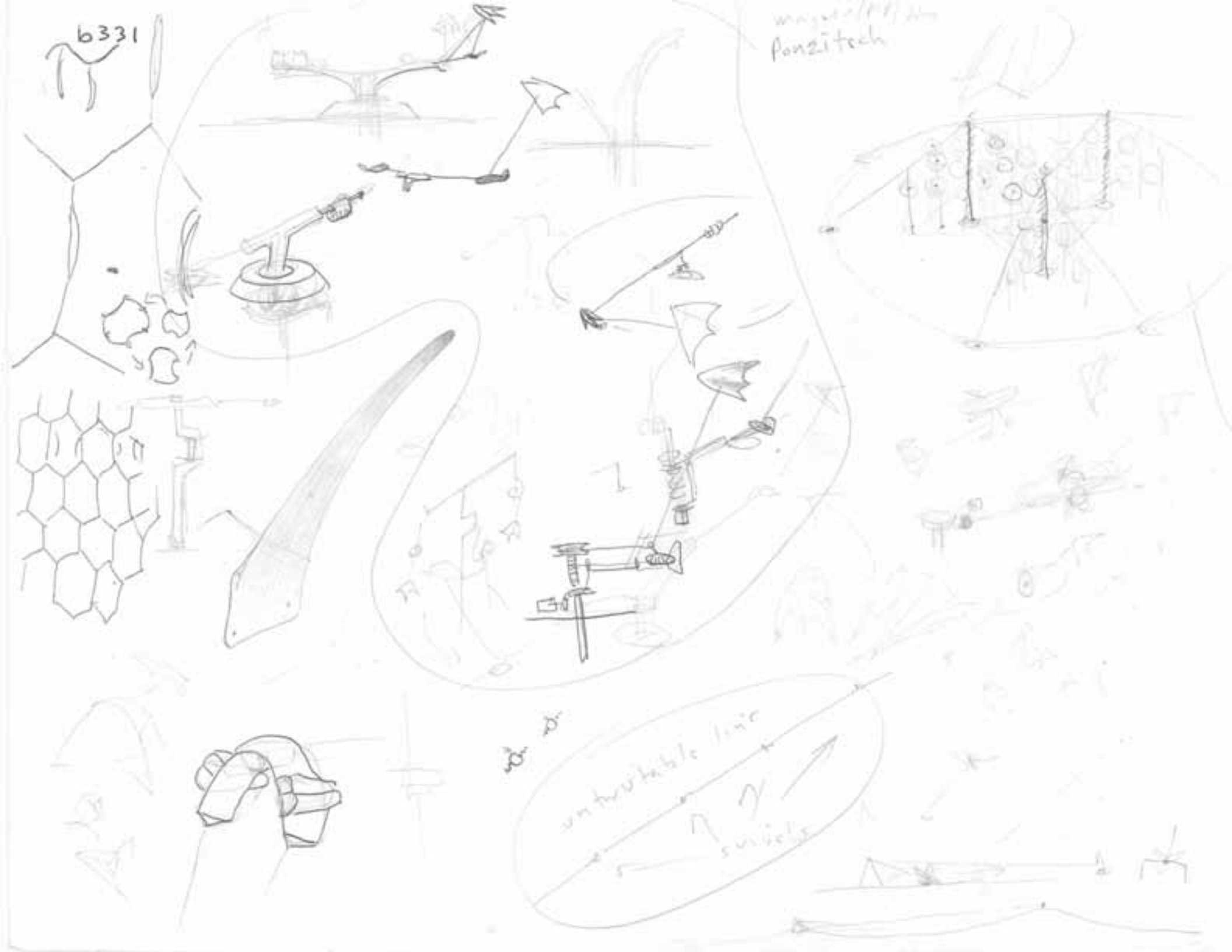
b 327

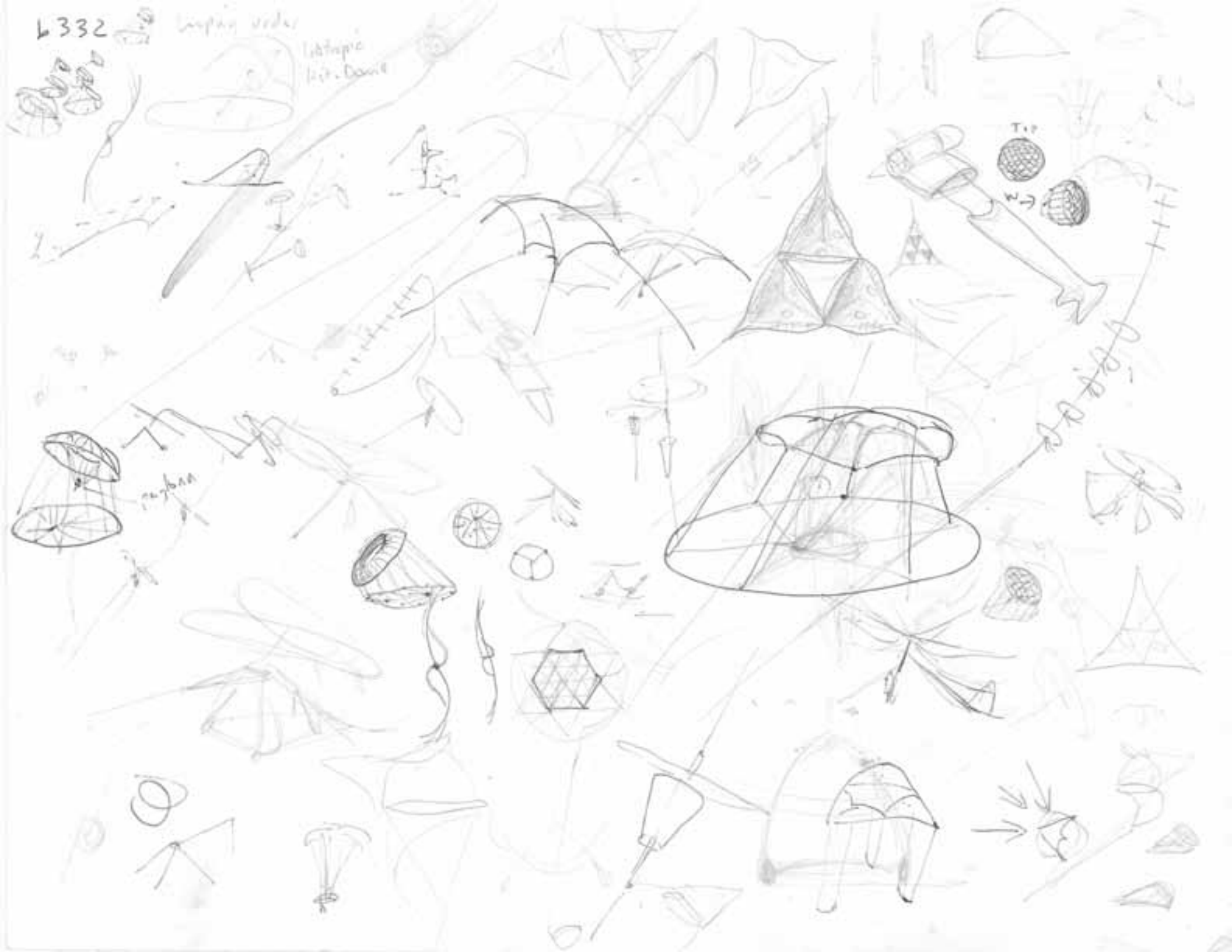

b328
Smart Tarp


b329
"ears"
Anisotropic Scale
Limited to
km scale
Gigawatt Scale
AWECS
700 - 1500 m
KitoLab Group
minimal surface
family
fractal
minimal
surfaces
~700
mw
gen
turbine
Front
side
Top
3/4 view
tagline circle
Compass
Belay
air beans
sky bows
April 2010 travel

b 330




b331
Ponzitech
untrutable line
swivels



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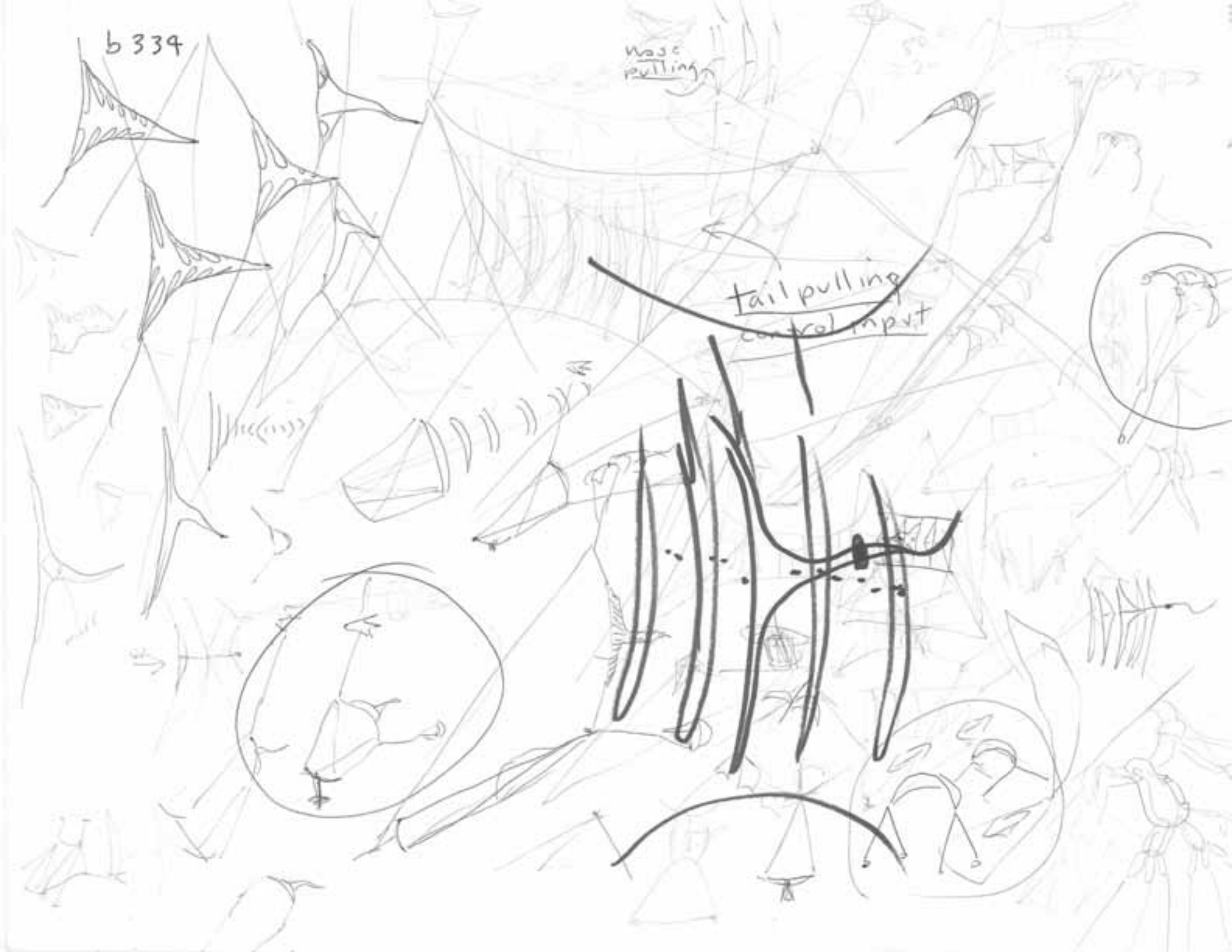
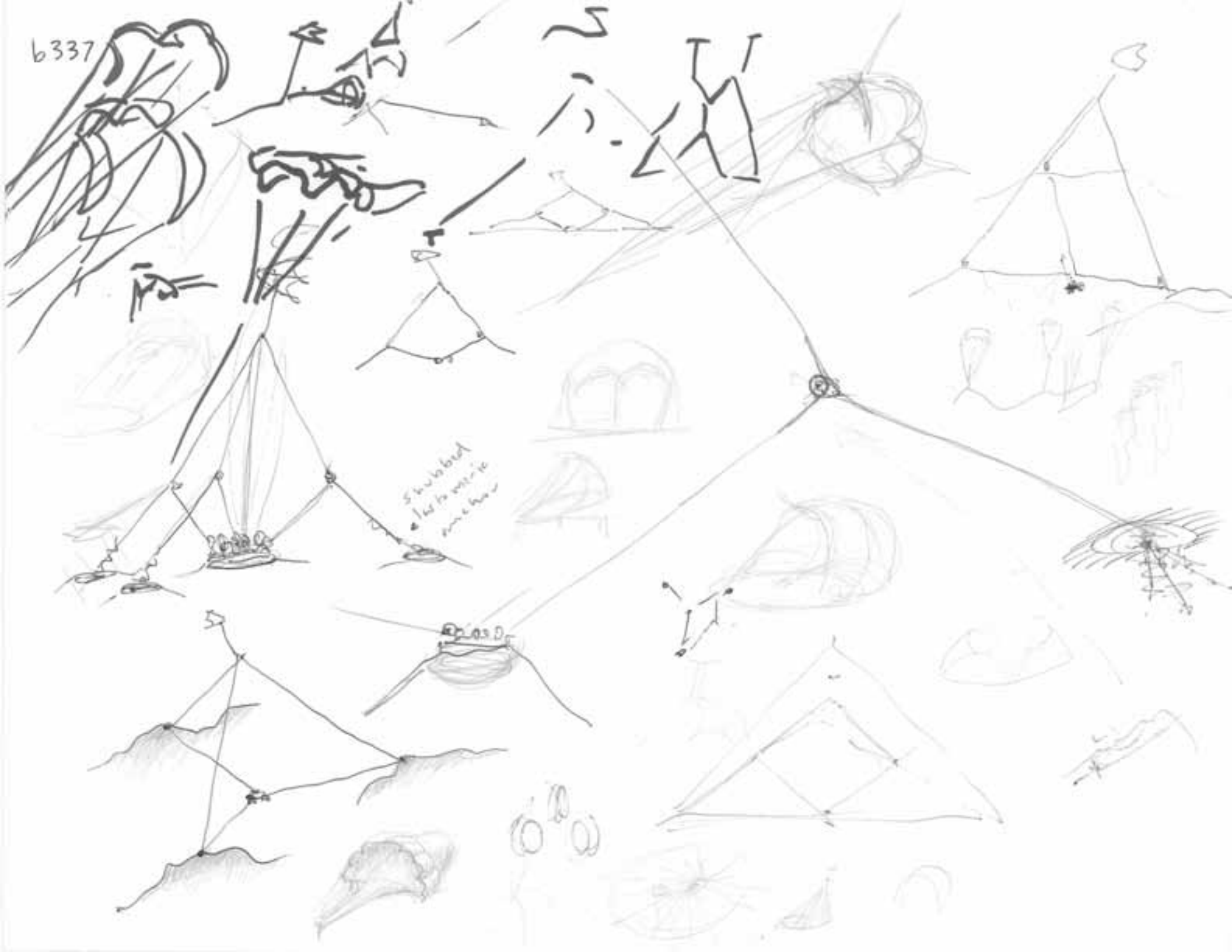

b 339
tail pulling

6335

b 336
power stroke
A-A


6337

Free Boundary FB? semi constrained boundary

fixed "

FiB

Tensioned v. Slack FB

Free Membrane

2 stretch DOFs
3 translation DOFs
2 pitch/yaw

elastic inelastic

jelly fishing synched
inverse synched

- Membrane Boundary
- Geo Boundary
- Bounded Flow
- Mega Boundary
- Planetary Boundary

W

flag parks

G

polarized wind + Gravity

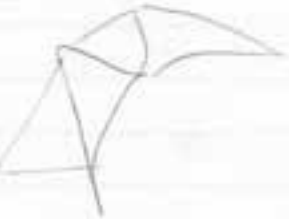
"flag always flaps"

W

dog-ear flip-flop

G

Depolarized W + G



sensitive stability

- sensitive to control input
- stable to disturbance

single leader

double leader

6338

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251 Mercer St (lobby area)

Jun Zhang Lab Visit Rm 104

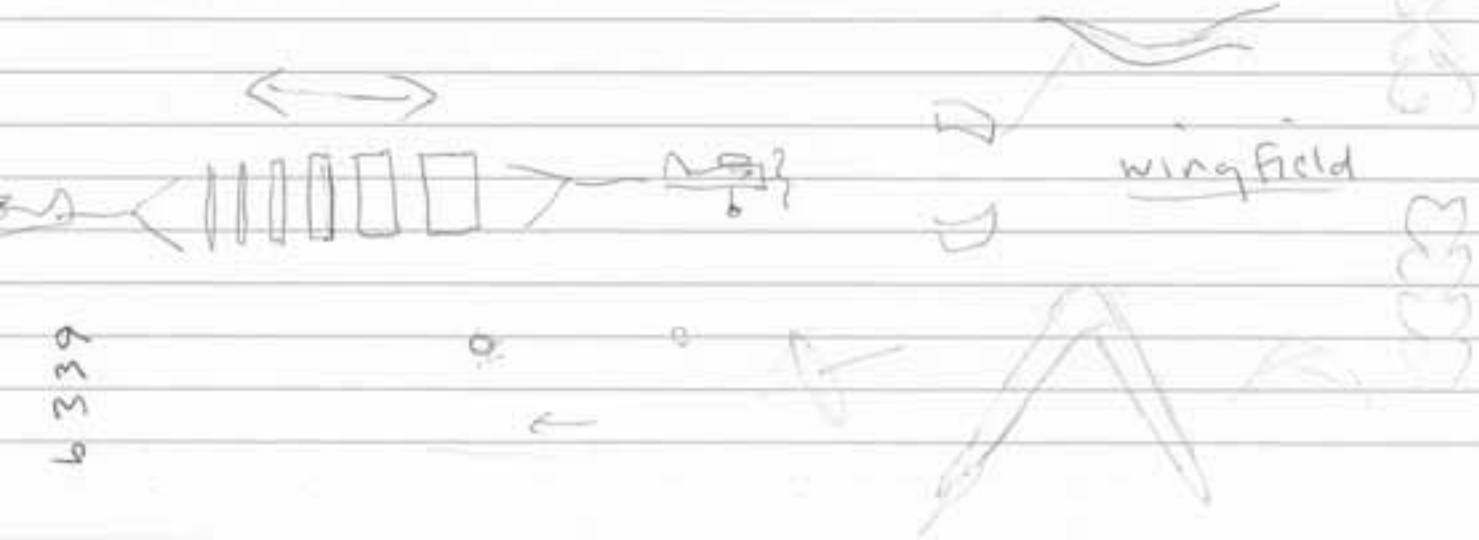
- Free Boundary = "Single Skin"
- Flocking / SDO
- Synchrony / Metachrony
- Modeling + validation (R&D funding)

Lab: 212-998-3239 Leif. Jun

Cell: 646-714-8924 Jun

VINCE MARRONE
MJORDAN1290@AOL.COM

How Does increased Re by (altitude variable (wind gradient) graph against wing Scaling: WS/V



339

6340
TAIPOD?
Cap cost
ROI
Financial
Safty-Critical
mass
velocity
Performance
Scalability
Control demand
Capital cost

$$Re = \frac{\rho V L}{\mu} = \frac{VL}{\nu} = \frac{\text{total momentum transfer}}{\text{molecular momentum transfer}}$$

V mean velocity of object in fluid (m/s) 50-200 kts

L characteristic dimension (travelled length) 20m chord, 200 m WS

μ dynamic viscosity $\left(\frac{kg}{m \cdot s}\right)$ @50°F 3.68 2×10^{-5}

ν kinamatic viscosity 1.52 1.6×10^{-5}

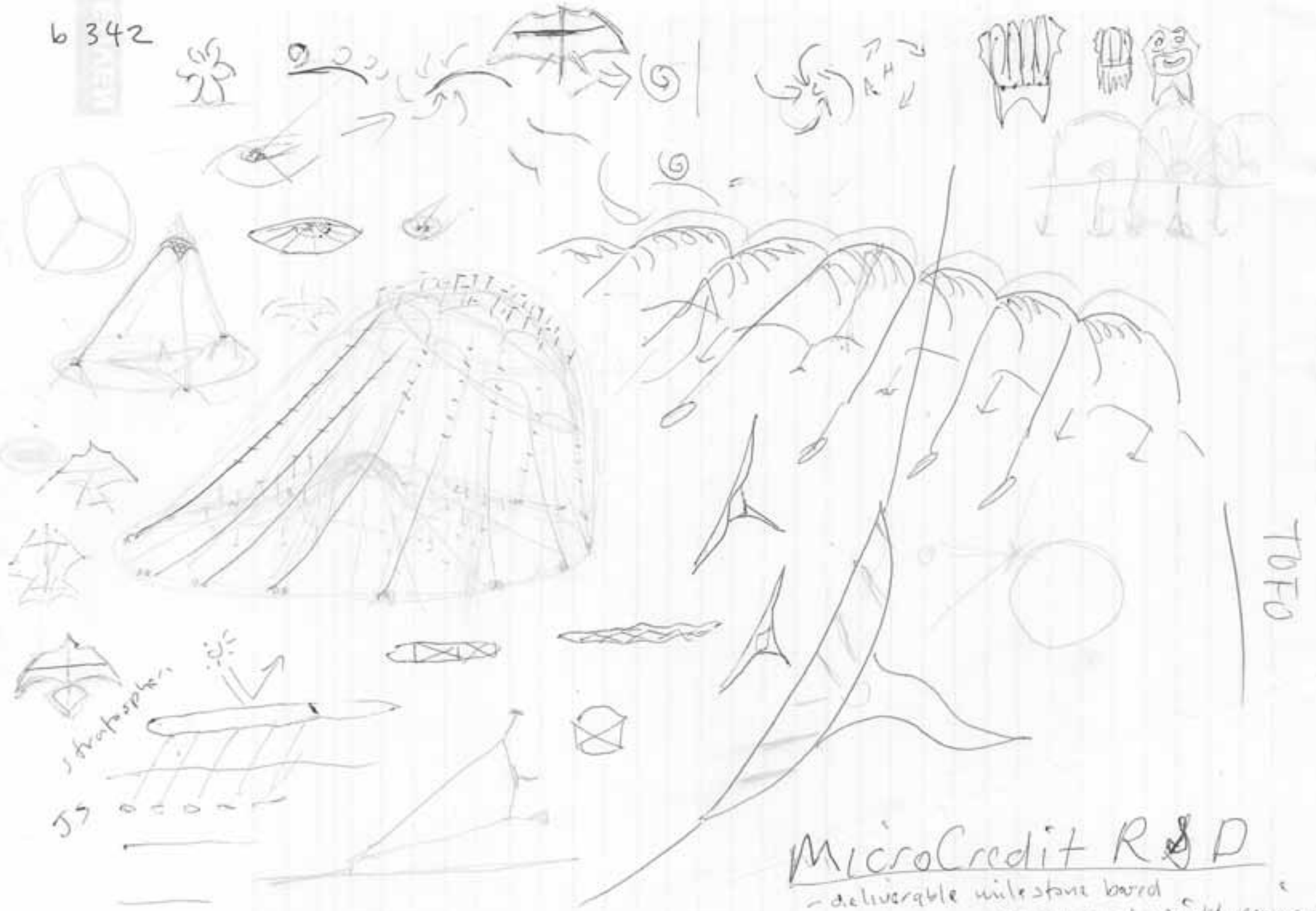
ρ fluid density (kg/m^3) 1.2

$$\frac{1.2 \cdot 20m}{3.68}$$

$$Re \sim \frac{(2m)(2\frac{m}{s})}{1.6 \times 10^{-5}} \sim 10^5$$

b 341

b 342



MicroCredit R&D

- deliverable milestone based
- Revenue not strictly required

2006

40kw

Italia

Early Opportunity

Low Complexity

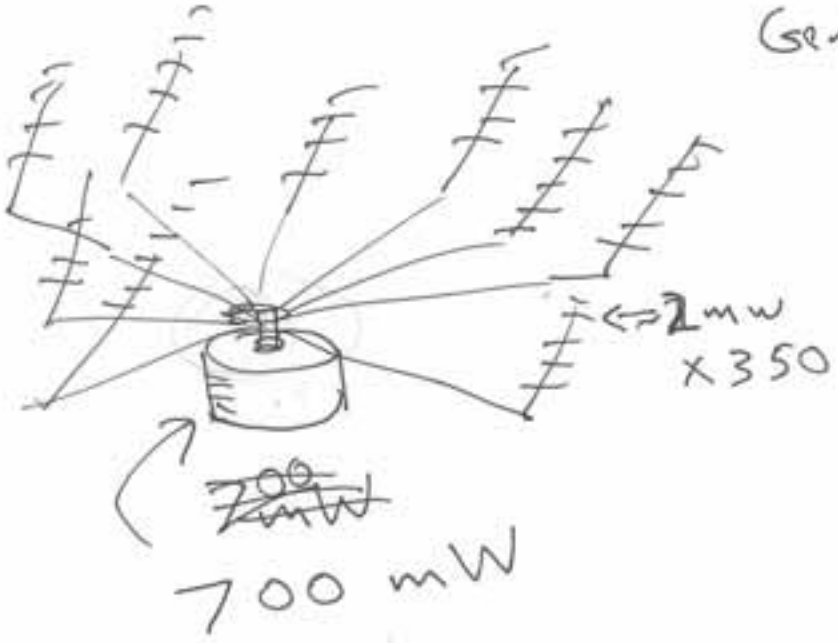
Low Capital Cost

Low consequence failure

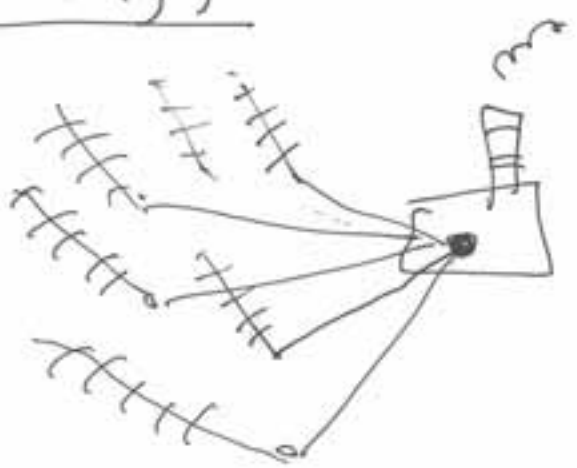
Human-in-the-Loop Control

1 human operator per 1-3 mW

Generator on the Ground



Scaling Strategy



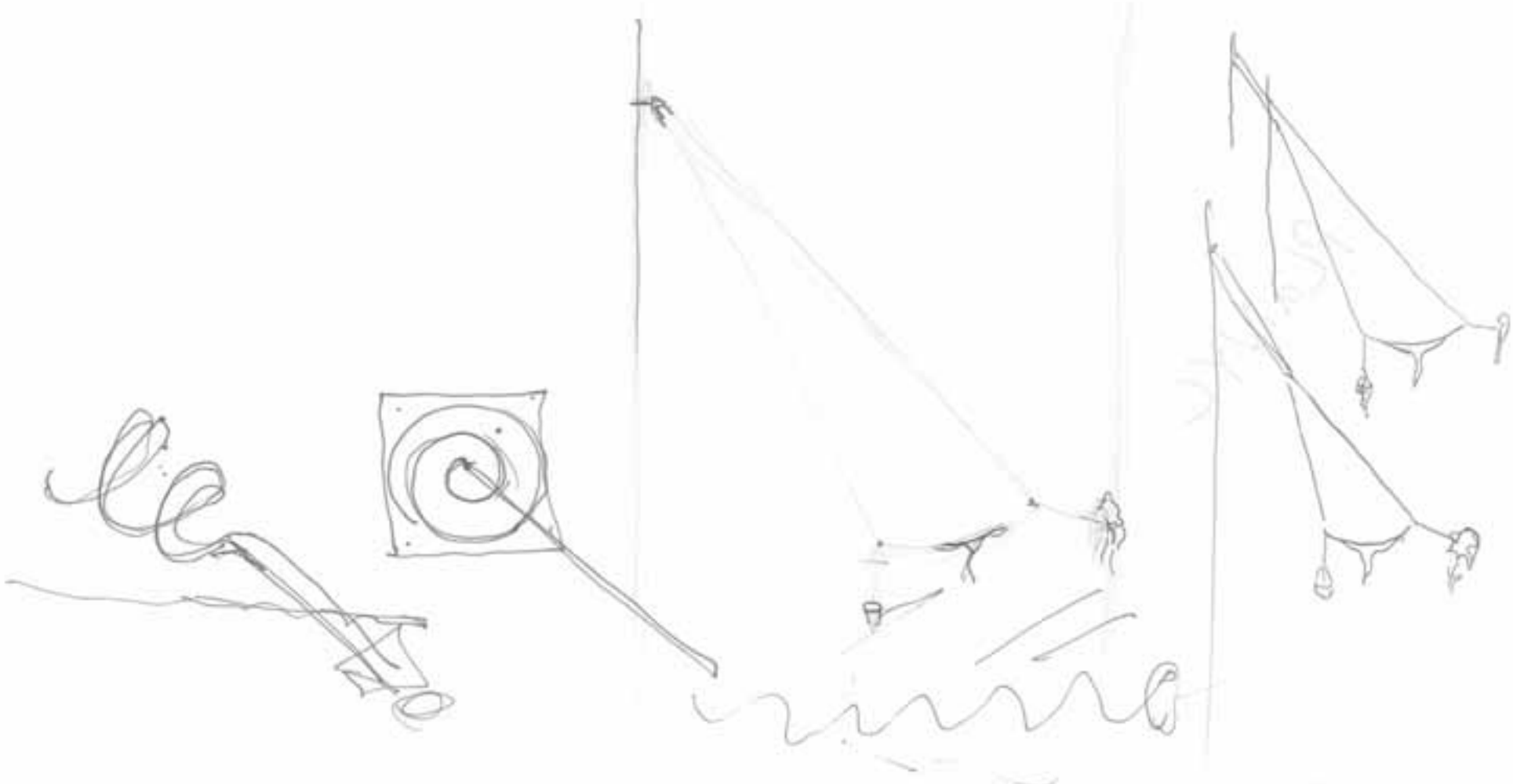
b 343

b 345

SkySails 200 kW

1/4 Scale comparative test phase

b 346



6347

b 348

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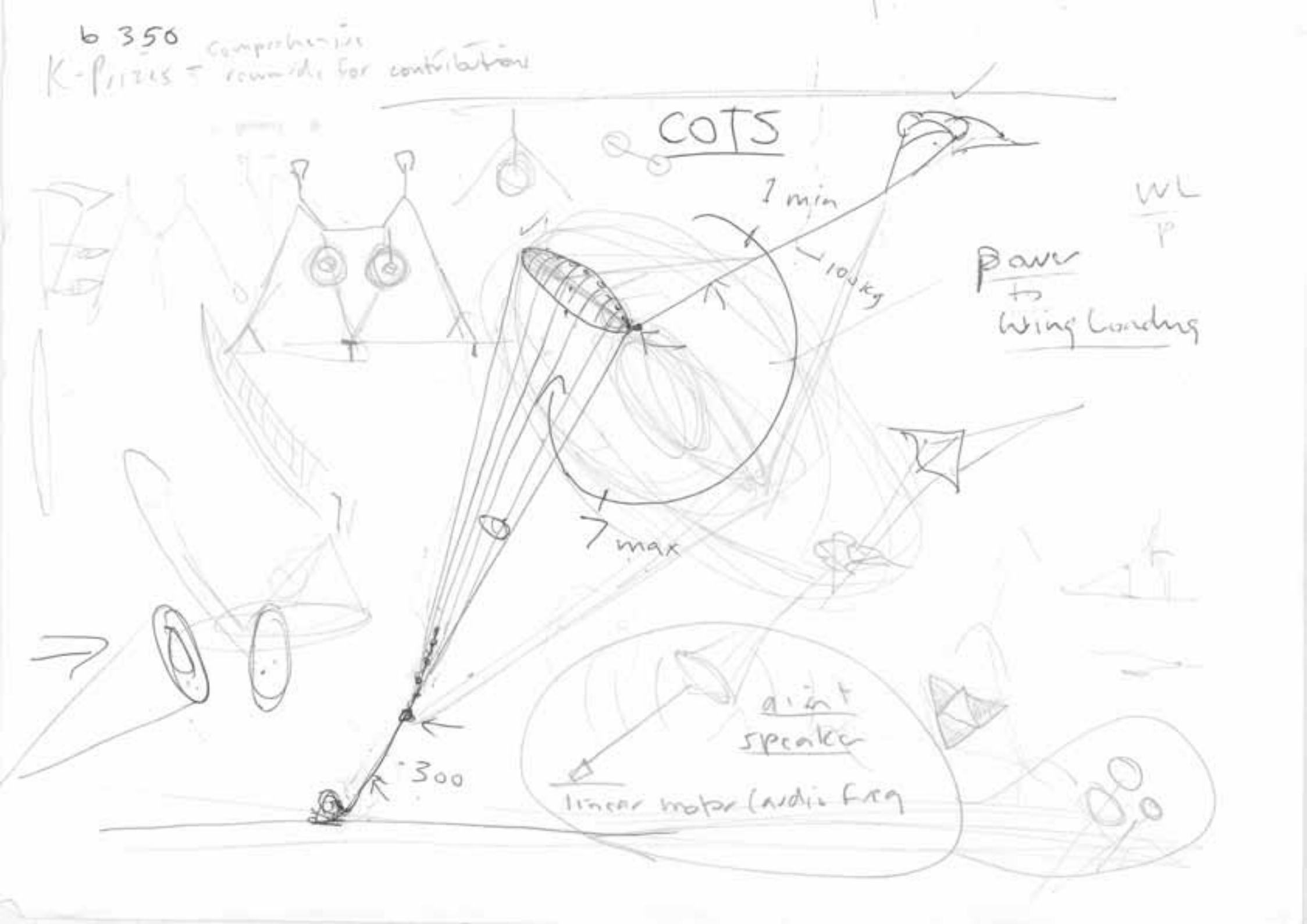
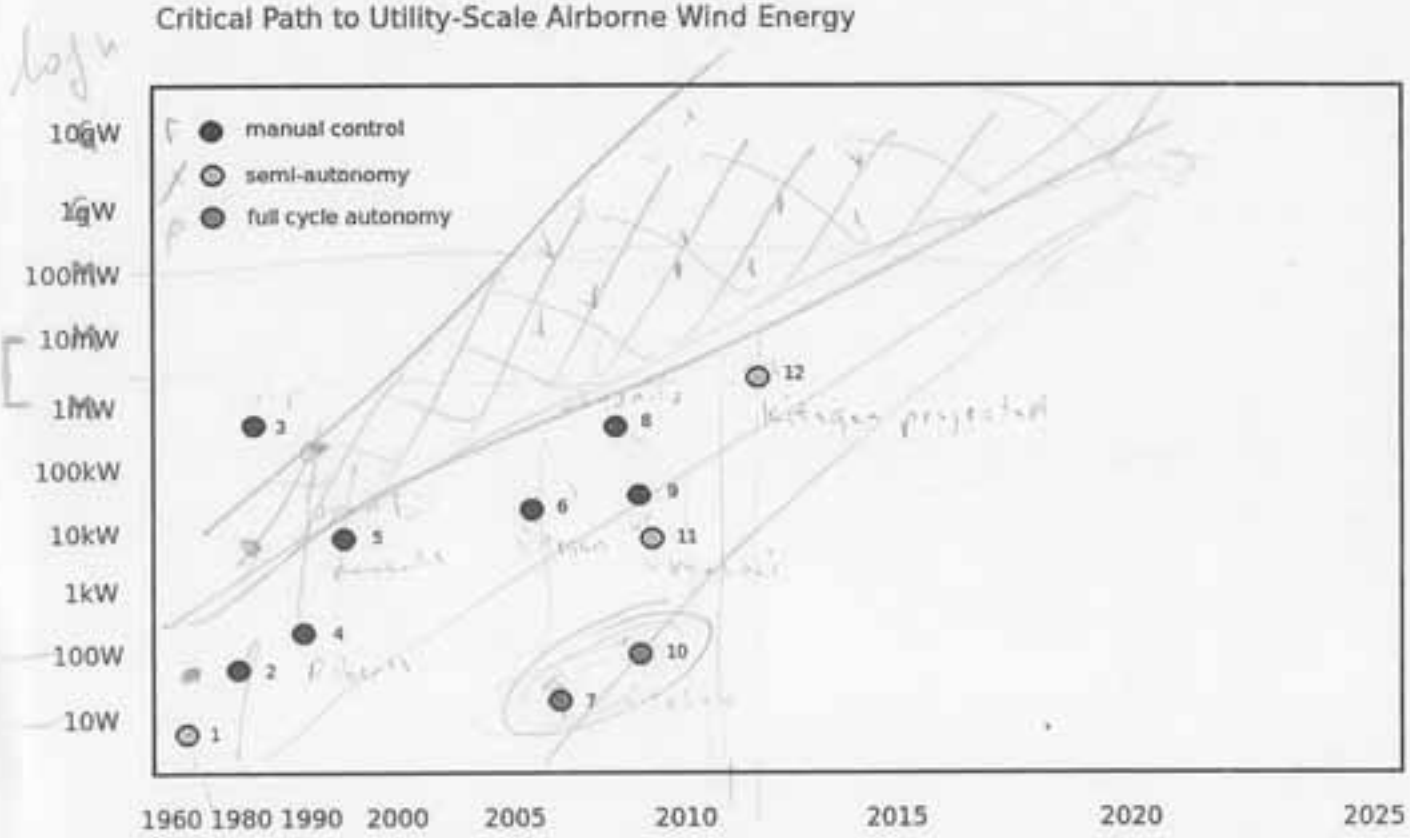
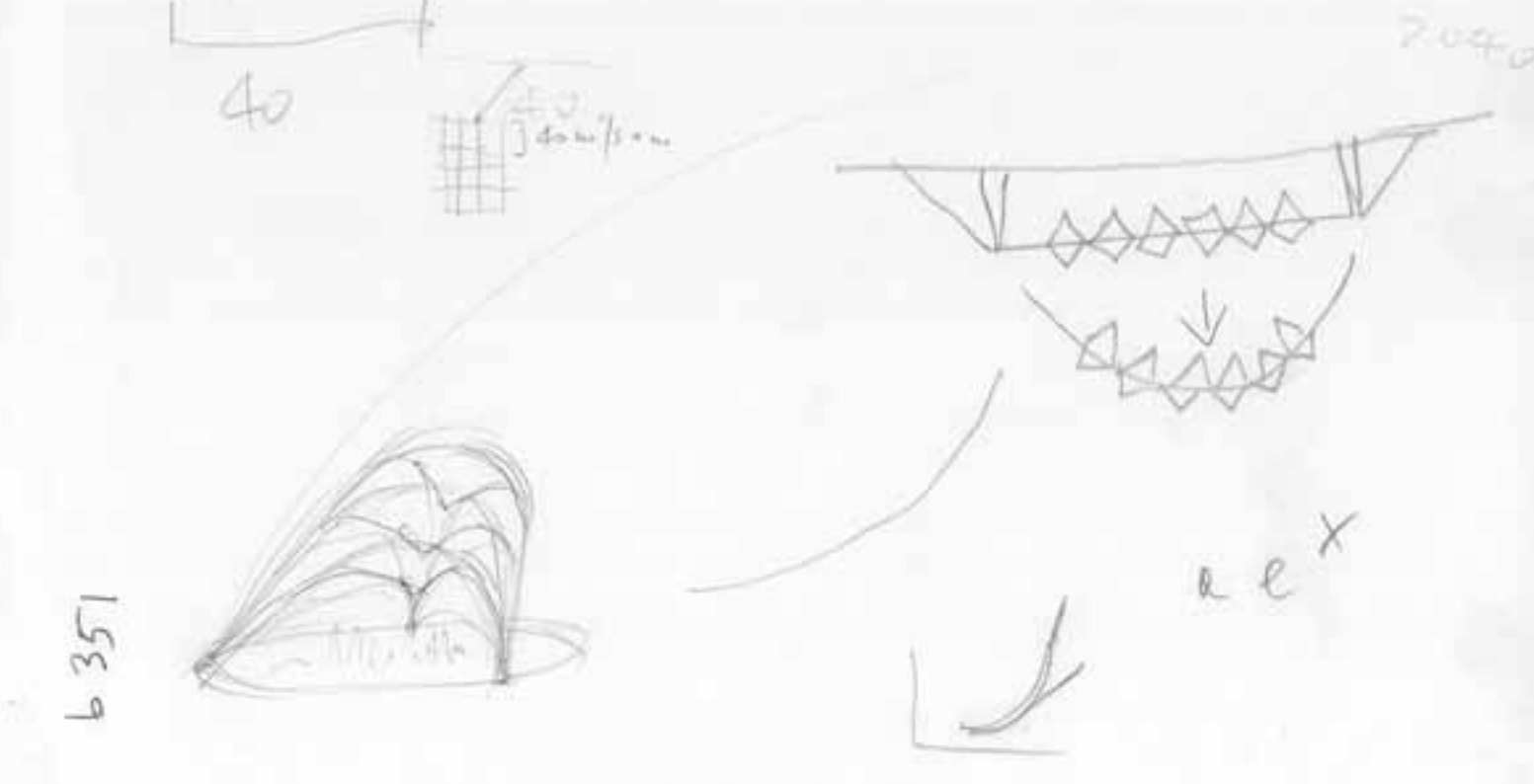
b 350

K-Prizes = comprehensive rewards for contribution



Critical Path to Utility-Scale Airborne Wind Energy





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United

airport 9:10

DULLES

Flt. 967 July 9 11:10 depart 15:08 arrive

PNR# ~~K3B6SO~~ NWK923

Flt UA Express @ 17:04 Arrive LGA 18:18

Community Energy

SUNY Columbia Rutlia NYU

PlaNYC

.SunPower Funding Model

UN

9

b353

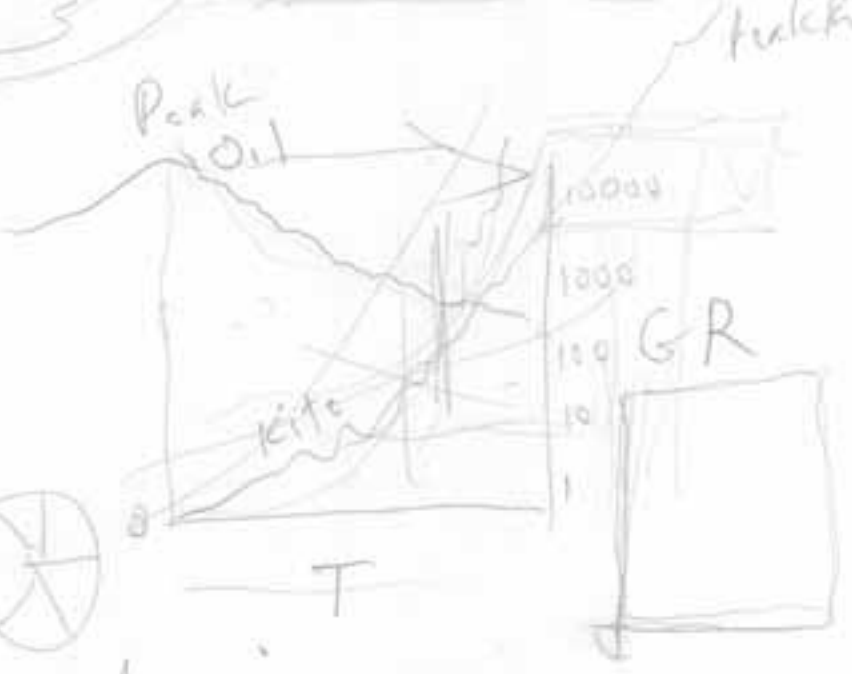
1. What kite can generate 1-3 MW?
2. How will kitegen launch thru the common surface inversion?
3. How will kitegen sensors detect turbulence (fronts, downbursts, etc.)?
4. How much land does each 3 MW kitgen need?
5. What is the estimated cost
   - cost per installed watt
   - per kilo watt hour
6. How will kitegen be insured?
7. Why custom turret & ground-based custom carbon-fiber parts?
8. When will kitegen storm produce 1 MW

b 354 500 $ 100 € + 15 Peak Kite.

100% 50 K €

100% | 100 K
1000 $

par



b 355
pick 3
plans
control mode
variable
pilot-lift
W
aerostat
W

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Engineering Care for AWE

Its well established that the "upper wind" resource is vast & widely distributed. Less well known is that tapping upper wind to do work is ancient & that ~~beginning in~~ since the 1960s ~~various~~ many experimenters have been able to generate electricity in increasing amounts. Operational challenges ~~have~~ are being generally ~~been~~ resolved & no scaling law or other major obstacle seems to prevent large-scale AWE. The ~~existence of~~ proliferation of working designs ~~to~~ gives confidence that highly optimal systems are practical. The trends are clear to allow a projection of likely progress. (see graph). The main early challenge is to identify best methods to bring them to market at competative cost.

A rough ~~consensus favors~~ early dominance of low-complexity low-capital cost methods with high inherent safety & human-in-the-loop control. Extensive testing by many teams is resolving open issues.

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III. Scope of Study - Deliverables

Work on specific ~~issues posed~~ questions identified by Poste.

Strategic Analysis - Business Core
- Technical

Monitoring progress - early detection & fast response

Data Mining & Viewing

Engineering risk mitigation -

Training for Poste staff - Workshops, briefings

The scope of ~~this~~ study is ~~to~~ a survey & analysis of ~~the~~ ~~aspects of~~ Airborne Wind Energy ~~that have a strategic~~ as ~~this~~ it relates to Posteitaliano, its energy needs, & its strategic business goals. ~~This~~ wow Consultants will work on specific questions identified by Poste. The consultants ~~to~~ will ~~provide~~ perform industry-wide data mining & ~~perform~~ business & technical analysis ~~from a data~~ baseline experiments. The consultants will monitor progress in the field, with early detection & fast response to milestone events. Engineering risk mitigation will be a priority, with exit strategies & minimal exposure, while keeping the early opportunity in hand. The consultants will provide briefings, seminars, workshops, & training as required.

357

FAIR

KATHOLIEKE UNIVERSITEIT LEUVEN

6358

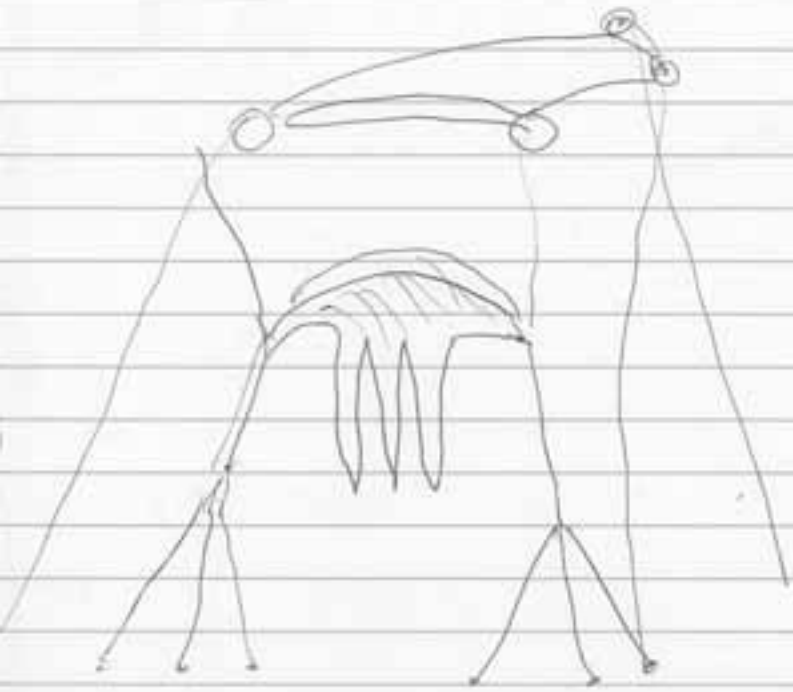
RIAF

info@TWRC.it GIANLUCA / SIMONE

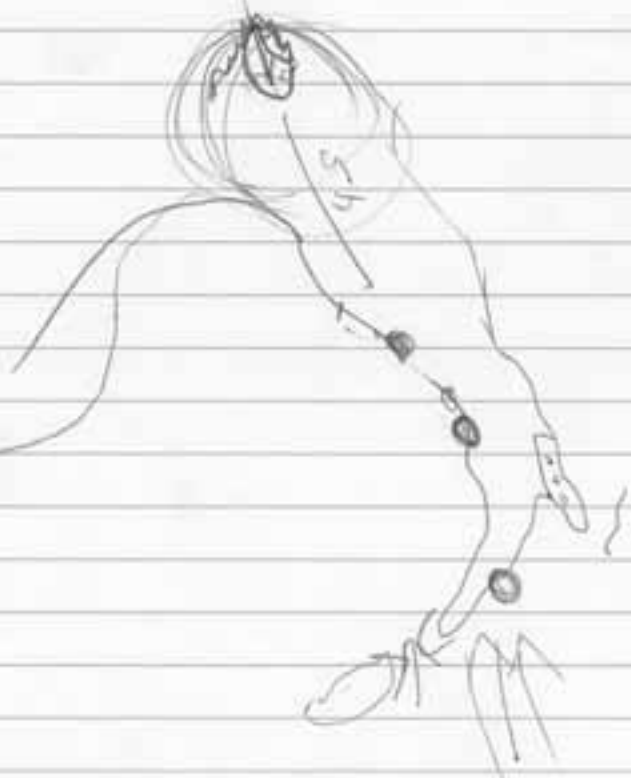
INFO@DUDEKITE.IT ANDREA@DUDEKITE.IT 3281186331

www.lelykan.ch kiteboarding school

AWEC 2011



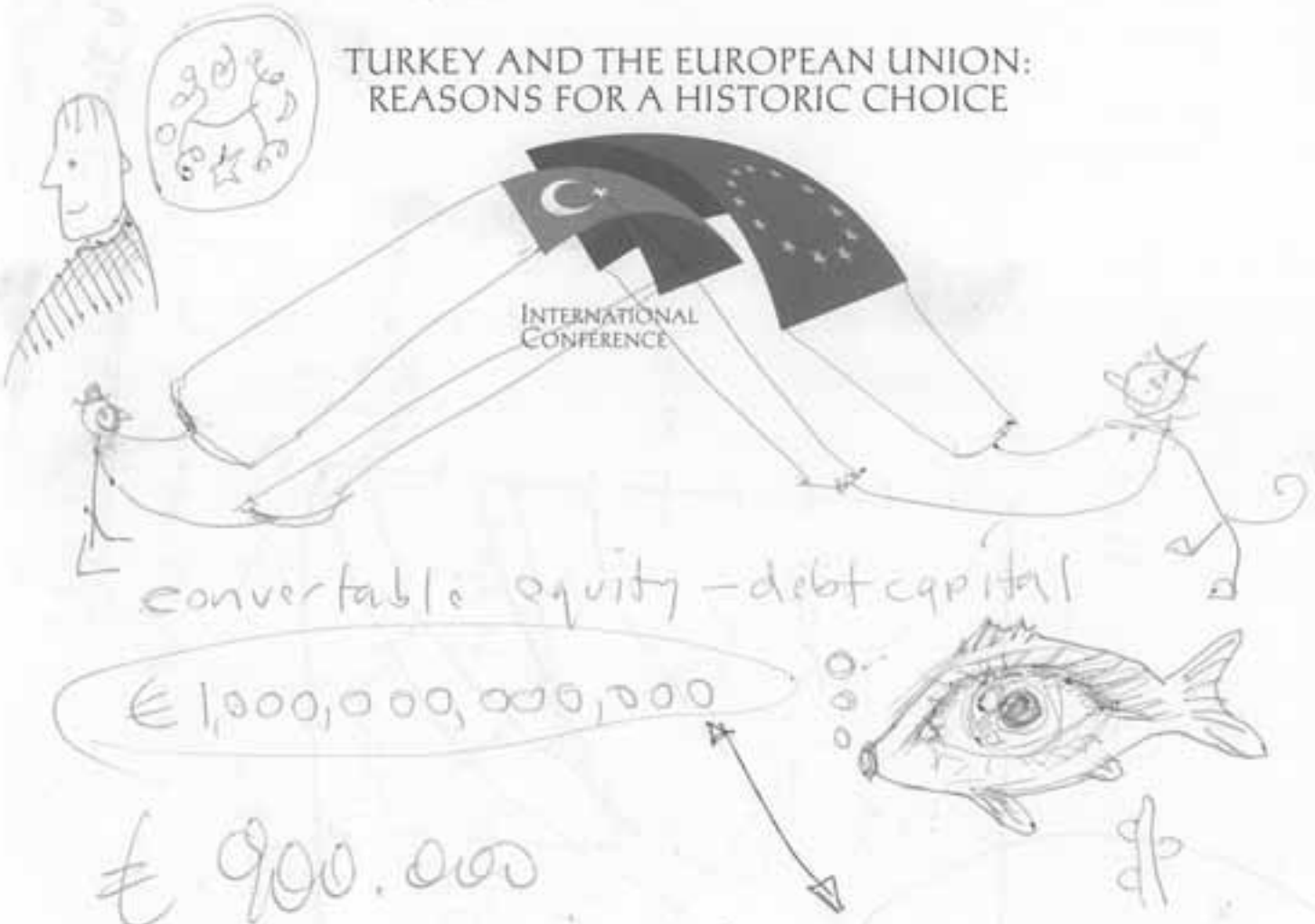
KAFKA
OMPLICATED
AIR
ORE
KITES
AMERICA



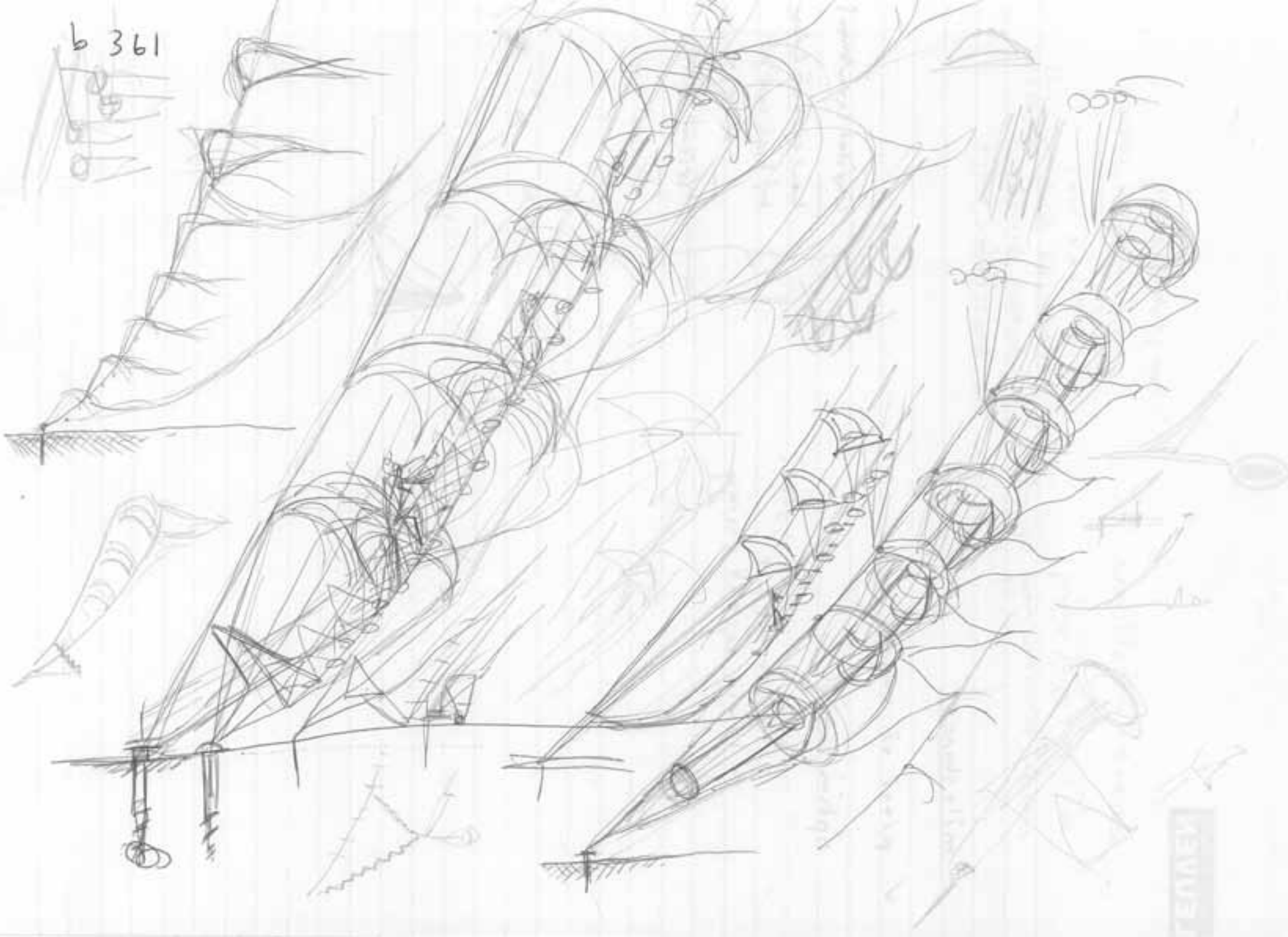
ERAT.

FIASCO
RIENPCY
TOCIAN
VIATION

TURKEY AND THE EUROPEAN UNION: REASONS FOR A HISTORIC CHOICE



6 AND 7 DECEMBER 2004
EUROPEAN PARLIAMENT
BRUSSELS


b 361

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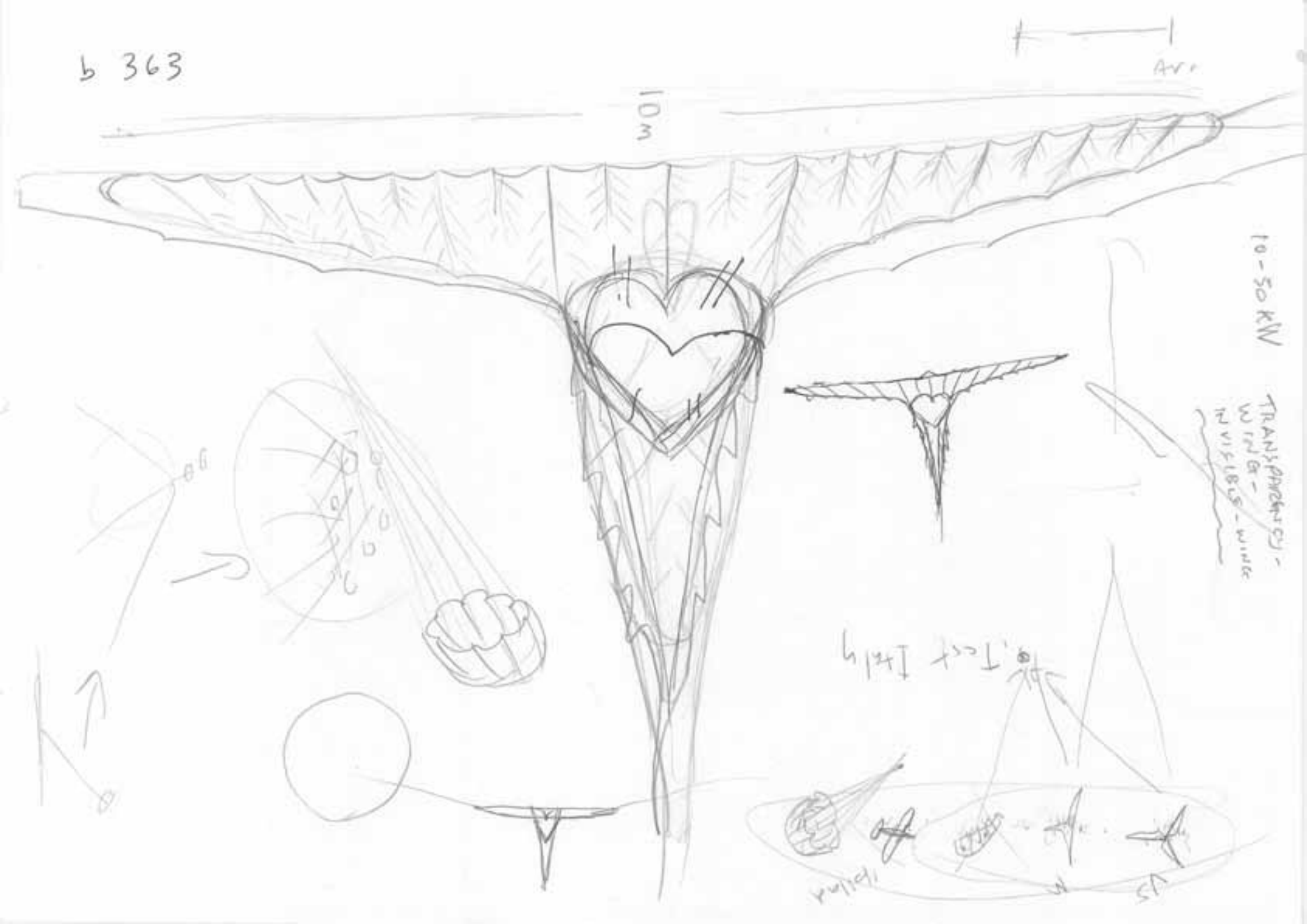
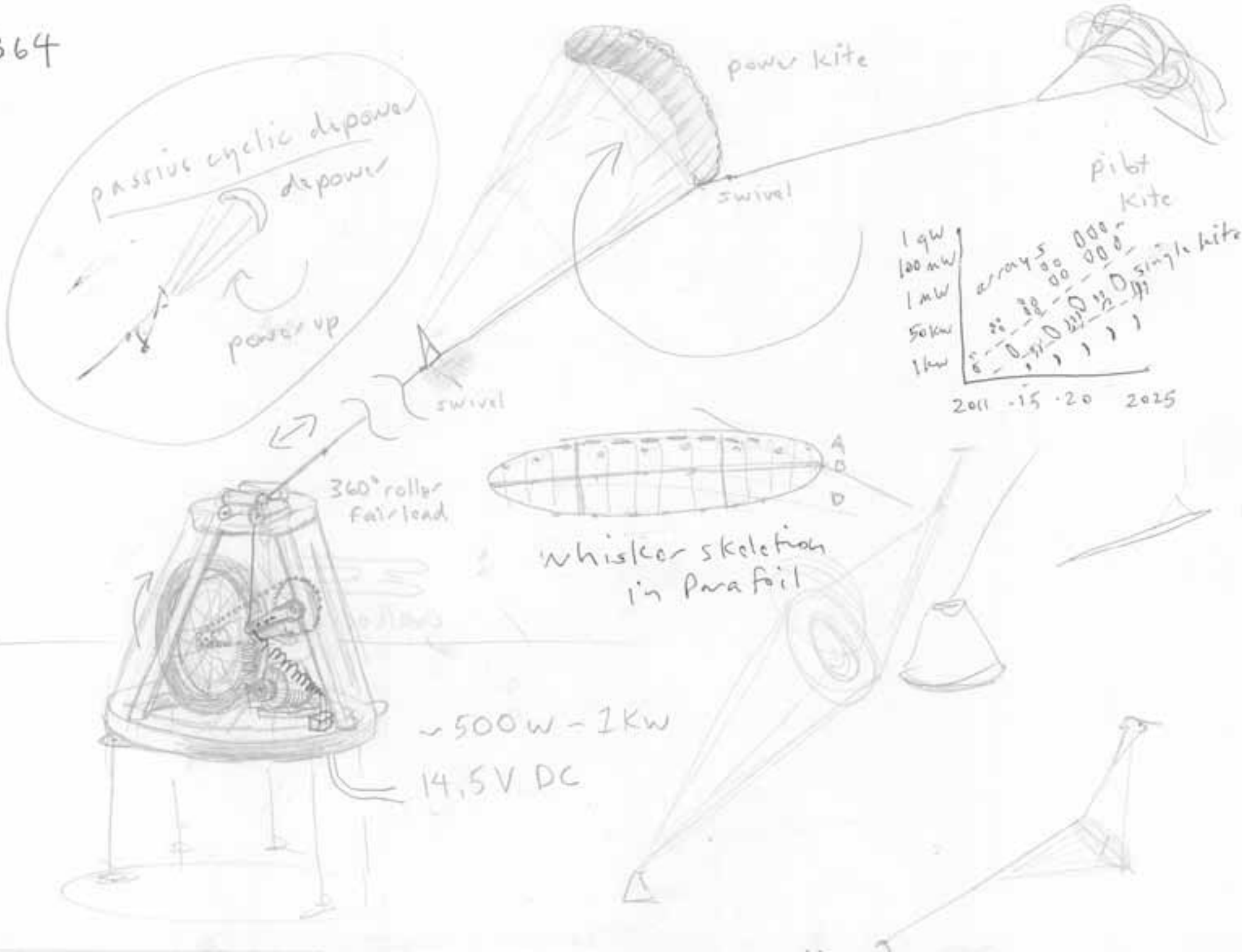
LEUVEN

b362

b 363



b 364


passive cyclic depower
depower
power up
power kite
swivel
swivel
pilot kite
1 gW
100 mW
1 mW
50kw
1kw
arrays
single kite
2011
15
20
2025
360° roller fairlead
A
B
D
whisker skeleton in Parafoil
~500w - 1Kw
14.5V DC

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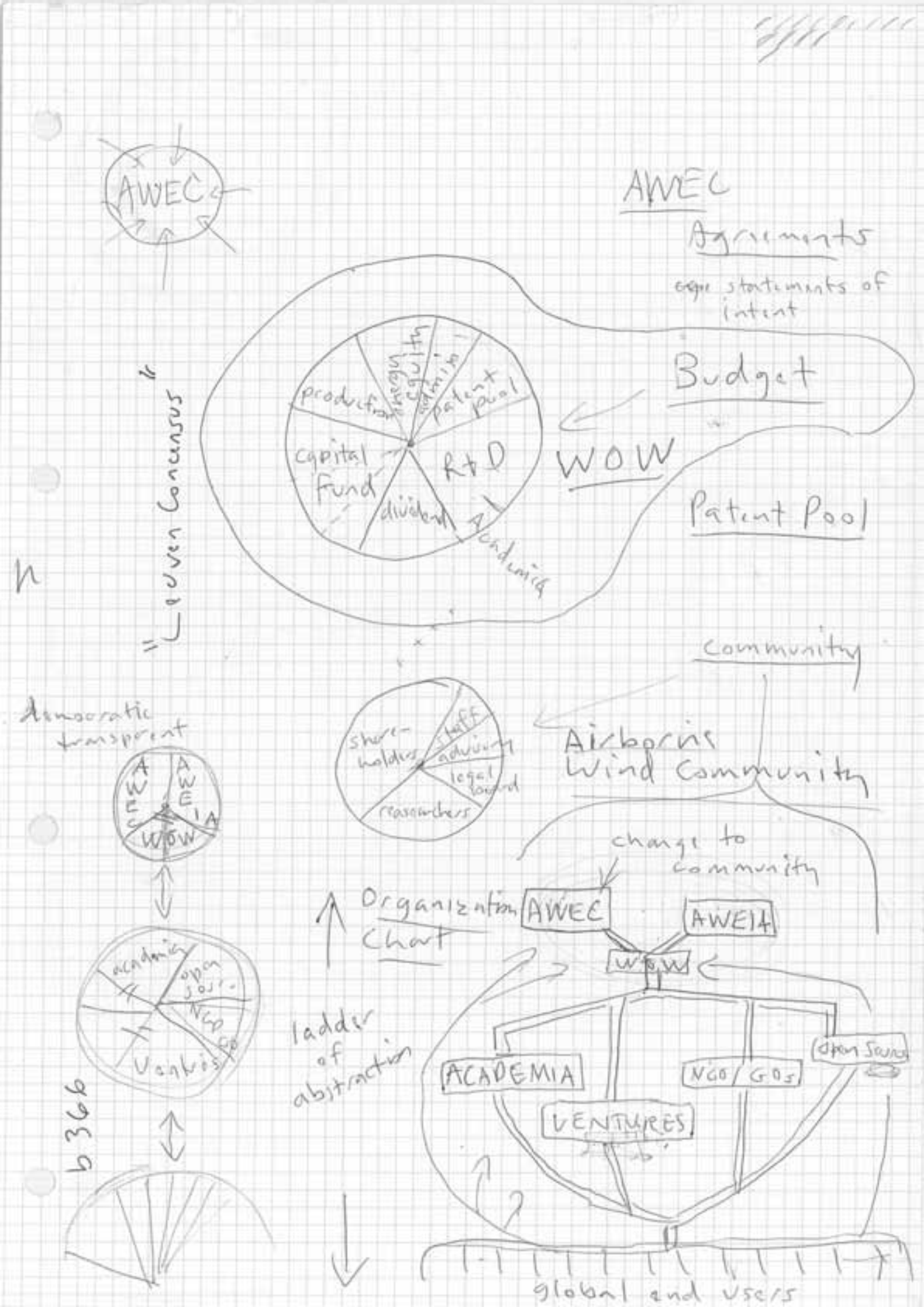

AWEC
AWEC
Agreements
statements of intent
Budget
WOW
Patent Pool
production
patent pool
capital fund
R+D
dividend
Academia
"Leuven Concensus"
n
community
Airborne Wind Community
shareholders
staff
advisory
legal board
researchers
democratic transparent
AWEC
AWEIA
WOW
academia
open source
NGO
Ventures
b366
change to community
Organization Chart
ladder of abstraction
AWEC
AWEIA
WOW
ACADEMIA
VENTURES
NGO / GOs
Open Source
global and users

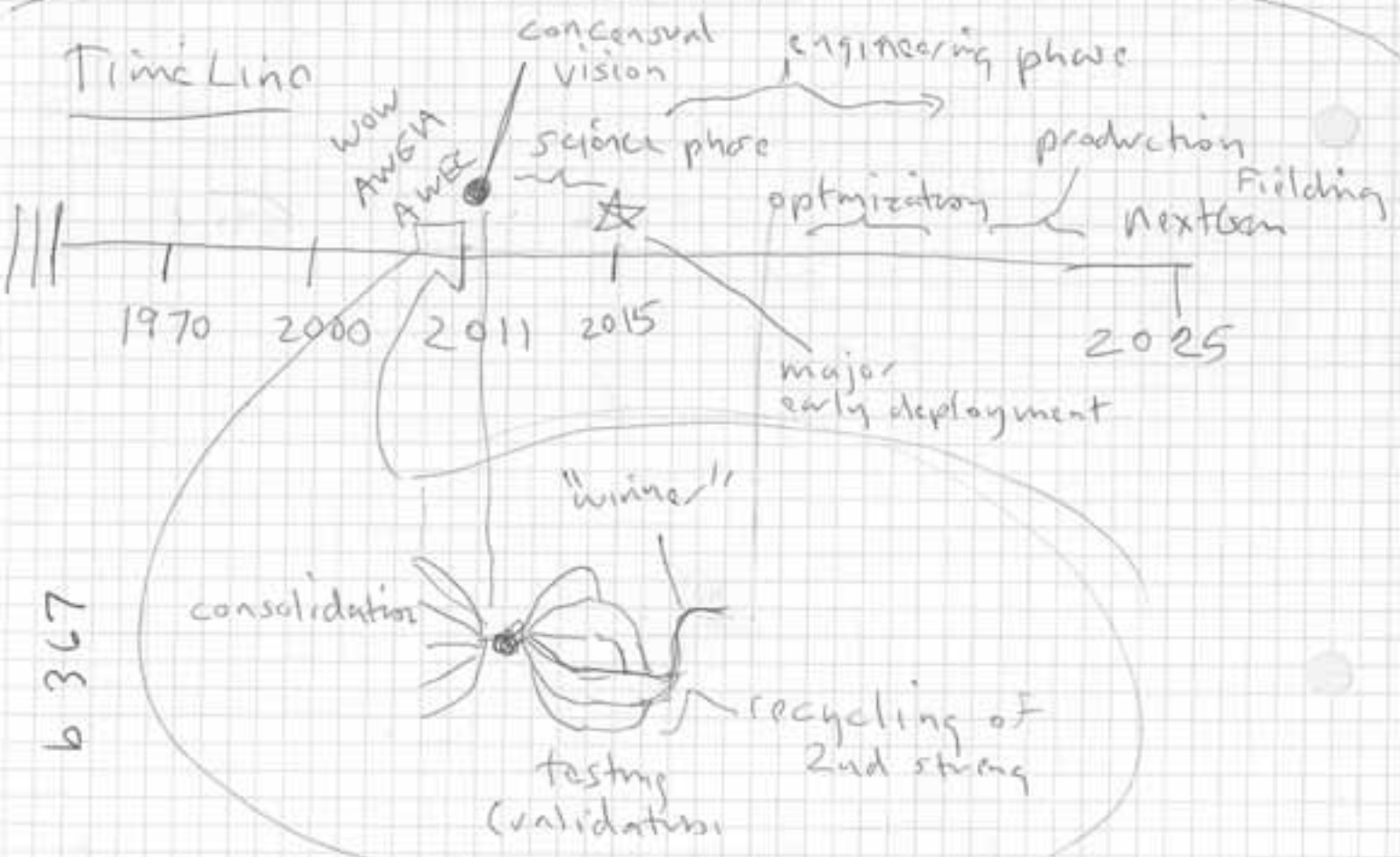
Brief, Research Report

EARLY ~Y2K-2015 & beyond
- human-in-the-loop
- low capital cost
- low complexity
- low consequence failure

maintain safety

2025 NextGen
MATURE
- remote autonomous
- optimal performance
= high consequence failure

Timeline



b 367

KATHOLIEKE UNIVERSITEIT
LEUVEN

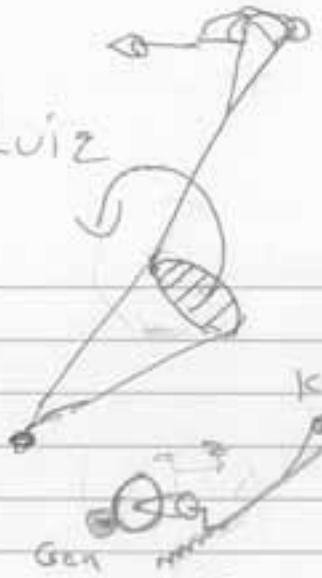
25 min walk from Ave Luiz

Shultes

MARTIN Shultes

Hanry Wafelaert, 19

Bruxelles



.Wafelaert. 19

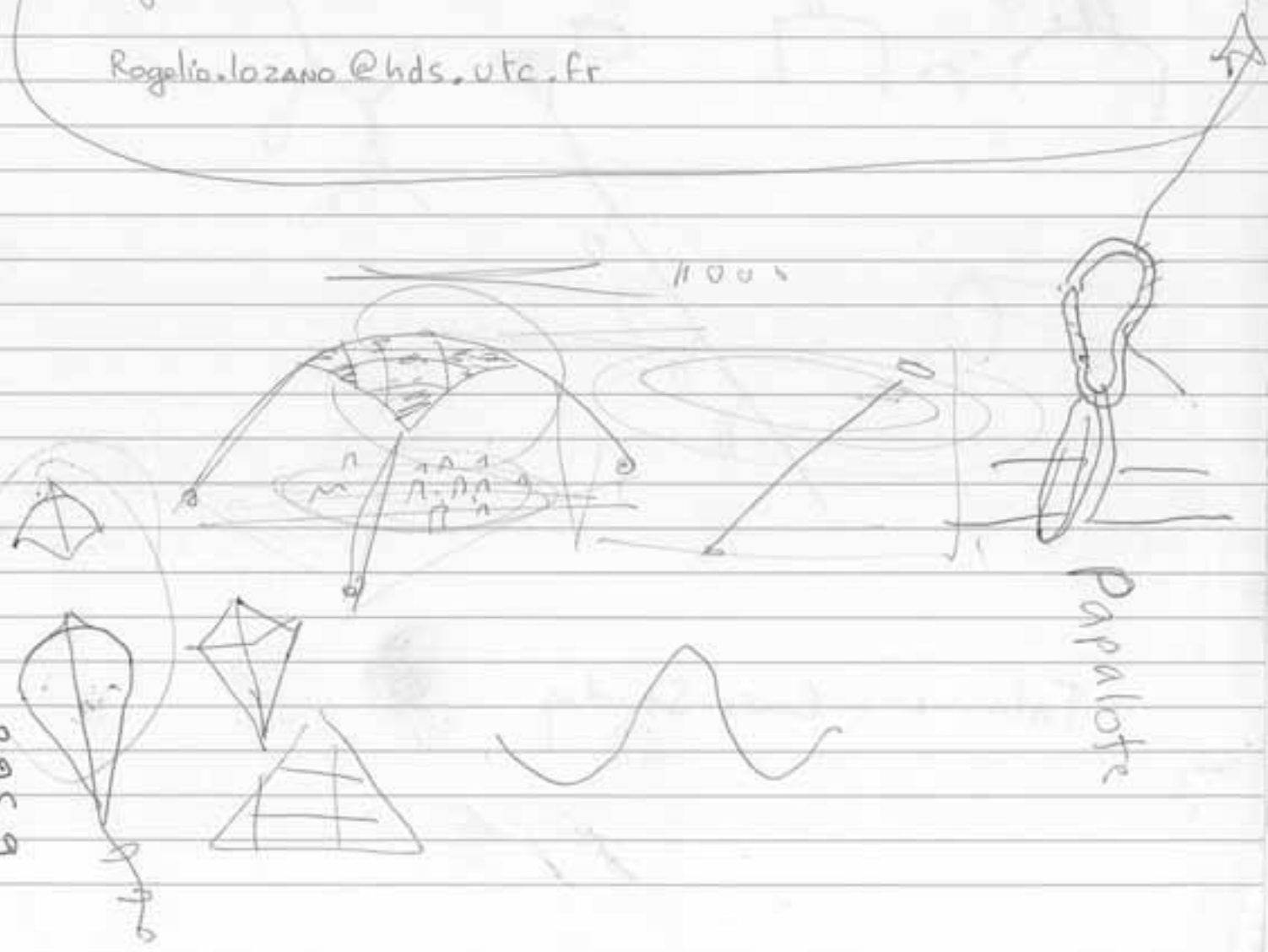
Schulthes

0032/473930482

Kite Mex

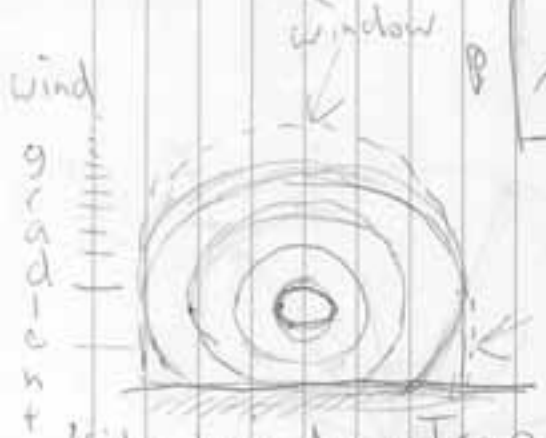
Rogalioskiutc2010@Gmail.com ← MIO

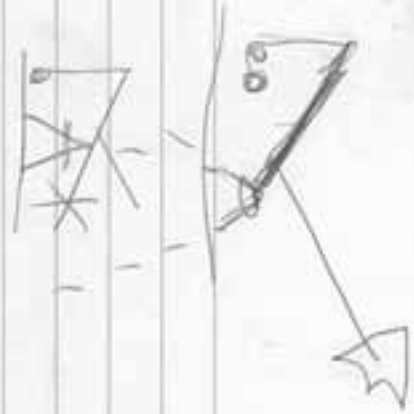
Rogalio.lozano@hds.utc.fr



6368

b 371





Kite Window Isopower

EKEA

Passive Autonomy / Inherent Stability / Open Loop Control

Persistent Flight

Aggregate Stability - chaos canceling

Lower Re by shortened characteristic Dimension

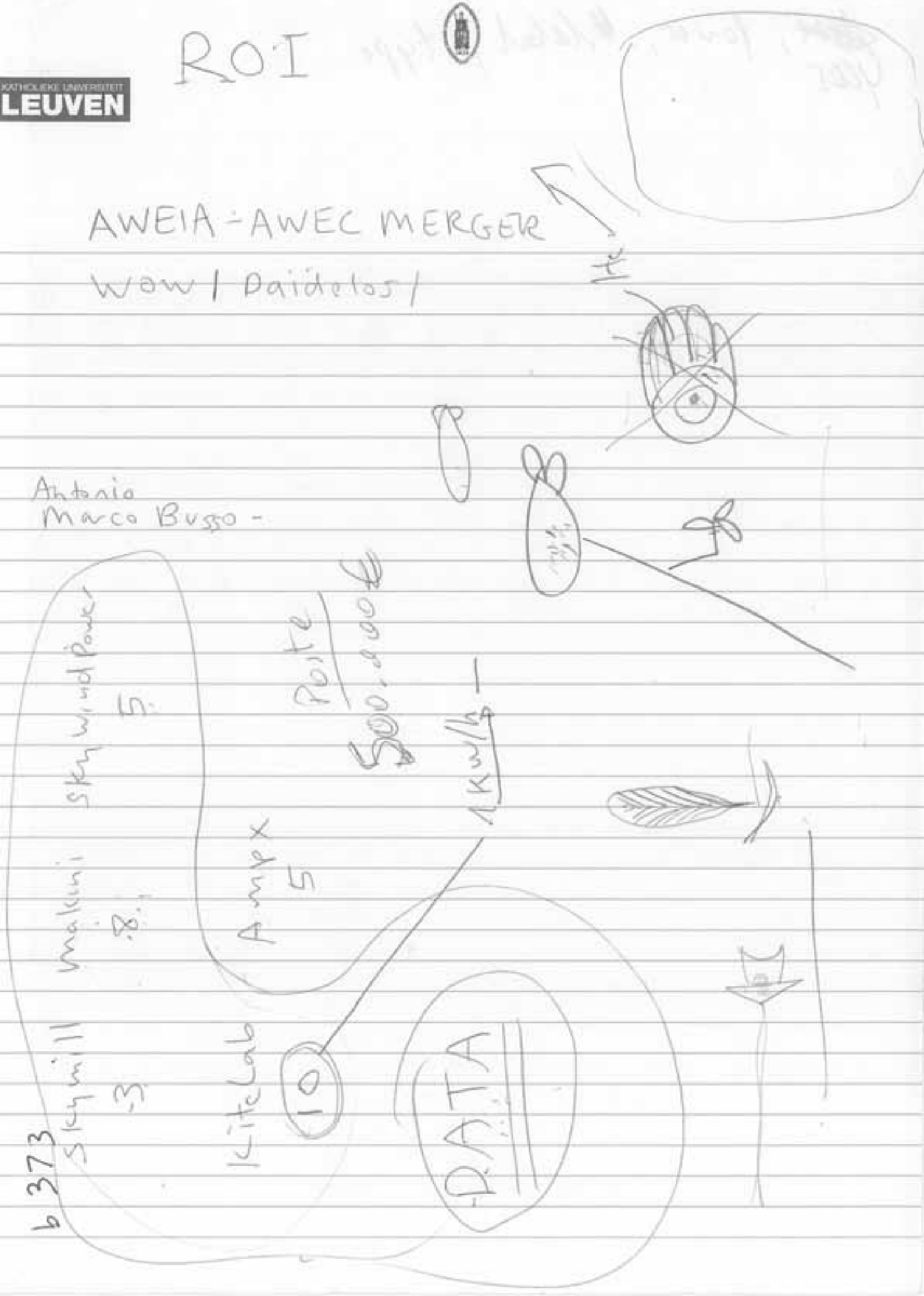
Salt Spray App

KATHOLIEKE UNIVERSITEIT LEUVEN

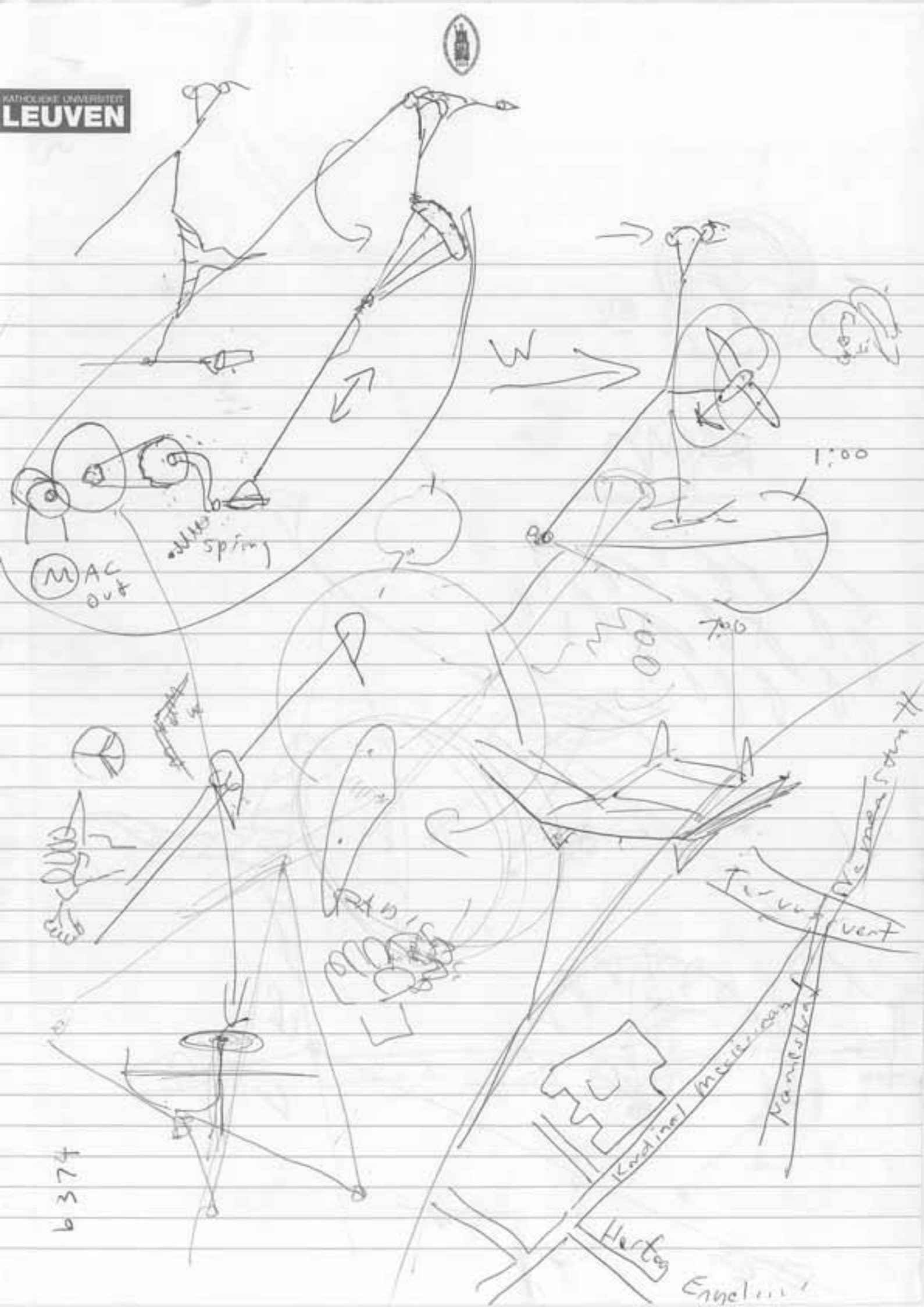
ROI

AWEIA - AWEC MERGER

Wow / Daidelos /

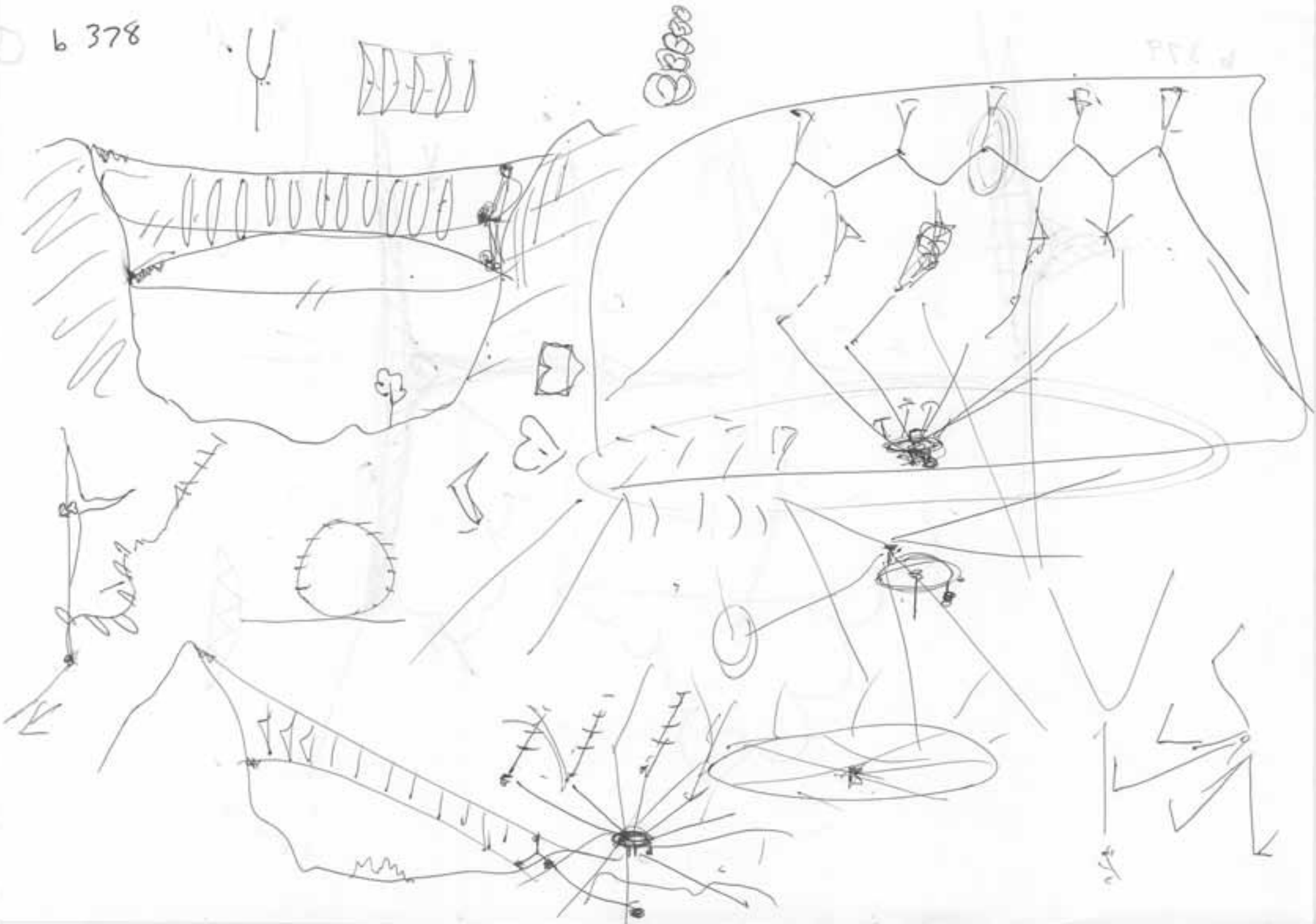


KATHOLIEKE UNIVERSITEIT
LEUVEN



b 376
De Prony Brake - Power Data
brake horsepower
Power shaft
mechanical power out
variable Friction brake (load)
Scale
Newtons
(load)
electrical out
Generator
mechanical to electrical
transmission
Scale

b 378



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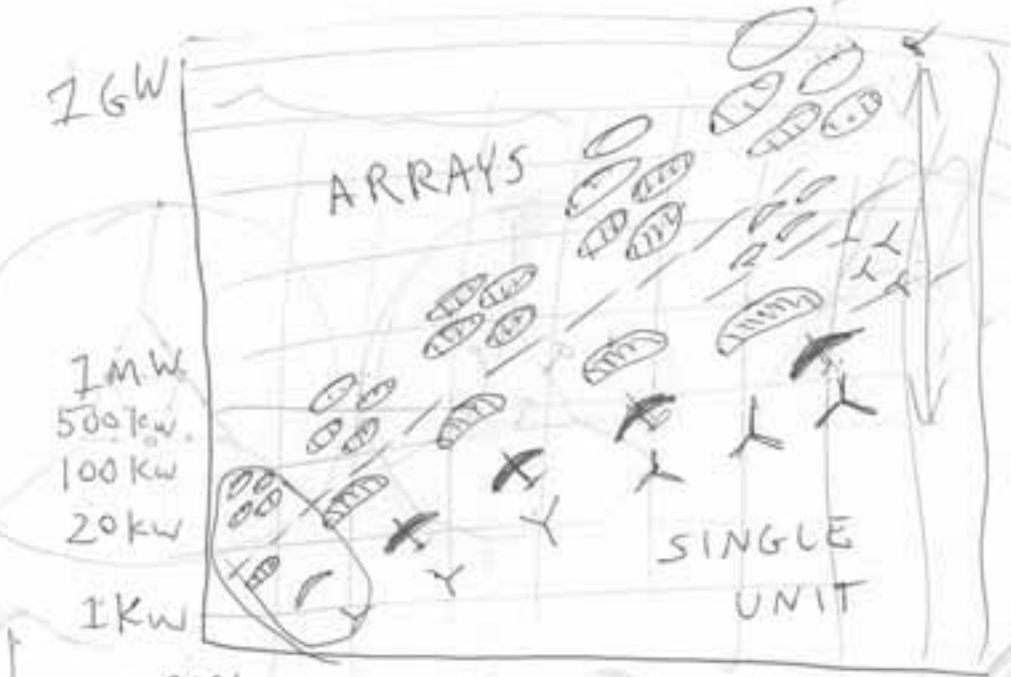
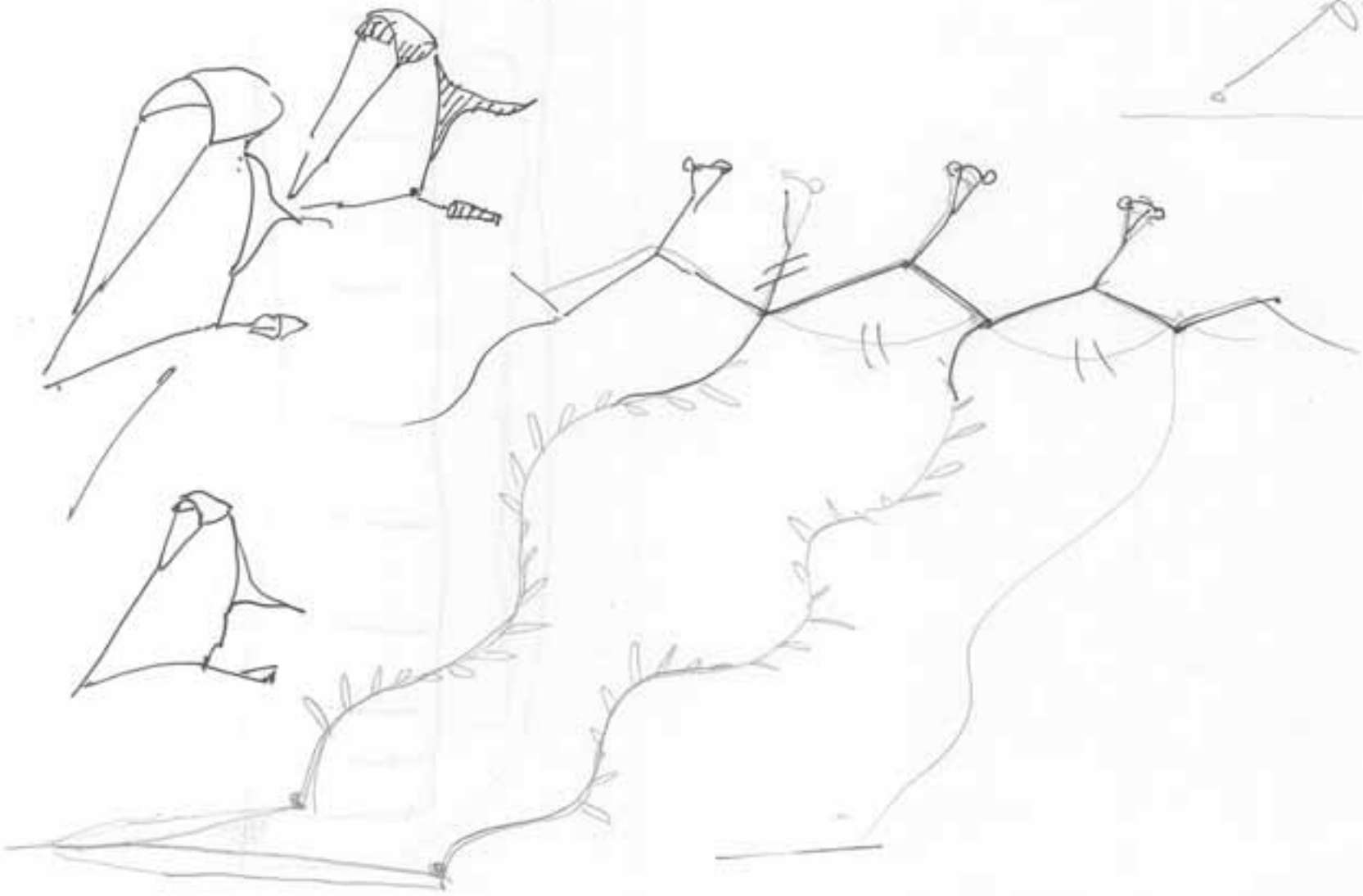


- Business Case
- Engineering Case
- Evaluation Plan

6381



b 382

Talamone Case Study – Italian kite surf capitol – 1½ hr from Rome – Vacationers – Old Town

Sea Breeze + Westerly – Peak Power

Moderate light aircraft (one or two occurance ~ per day

~~Poste Italiano is a great institution facing profound changes. As it transforms into a new diversified enterprise~~

– business case

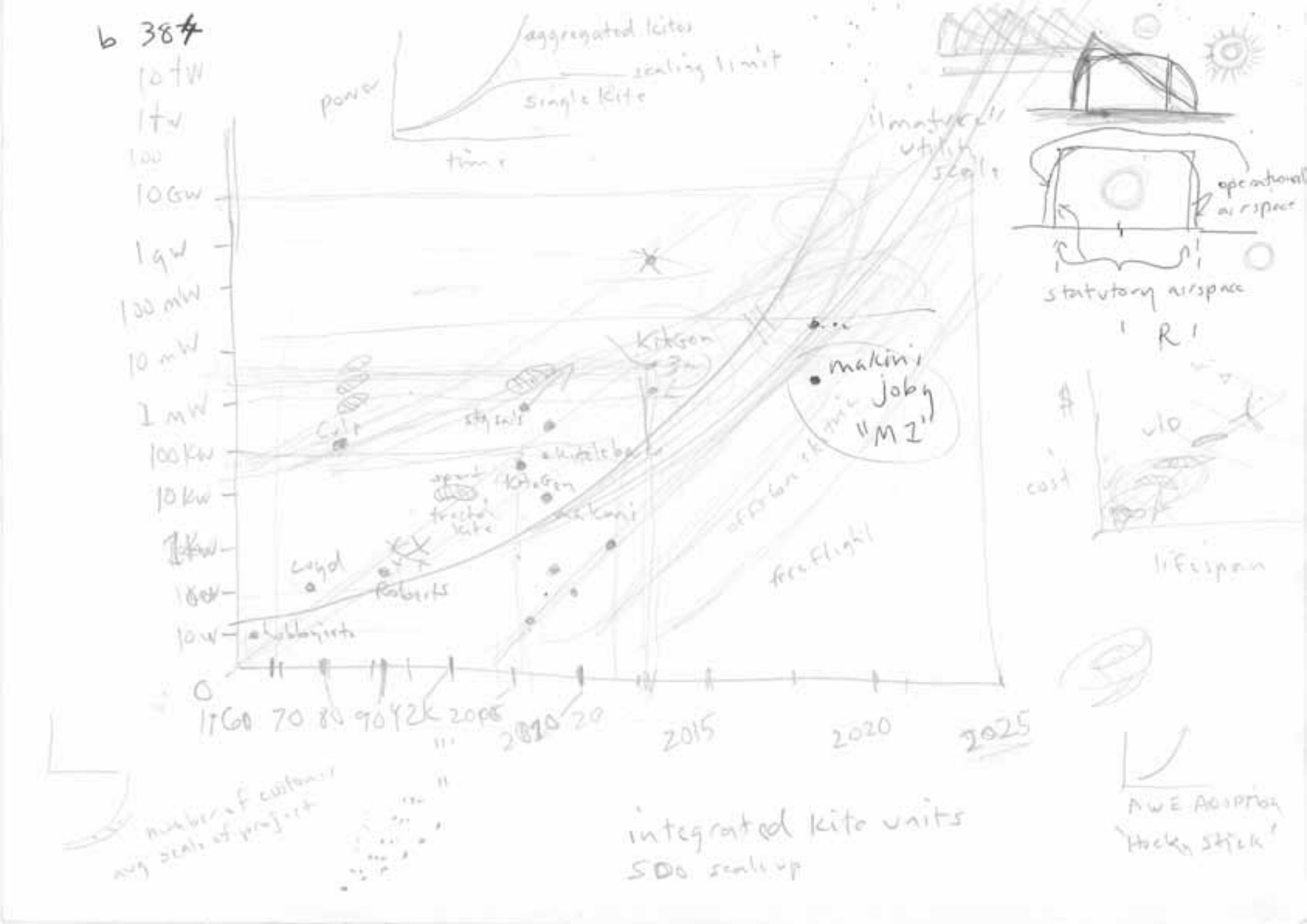
– three page prosectus

– "percourso"?

Profound changes ~~in service & energy sectors are~~ drives innovation & diversification of (great) institutions like Poste italiano. The classic service of mail delivery is being replaced by innovative diversification ~~into~~ innovative. Poste has always been a ~~sophisticated user~~ of energy ~~in all its forms~~ major smart consumer of ~~Italian~~ Energy, with many areas of energy excellence ~~expertise~~. ~~So its natural that~~ Poste ~~[illegible]~~ ~~identifies & explores~~ tracks new directions in energy supply. ~~[illegible]~~ Airborne wind energy has lately emerged as a major opportunity, with a strong Italian pioneering role. Poste has the internal depth & expertise to lead in the evaluation of this new source of abundant renewable energy. It is proposed that the Italian experts in Airborne Wind Energy prepare a small preliminary study of AWE for Poste & Italian national planning. If the preliminary indications are found attractive, the study can proceed toward actions. With low risk, its possible Poste can lead in a major new global market.

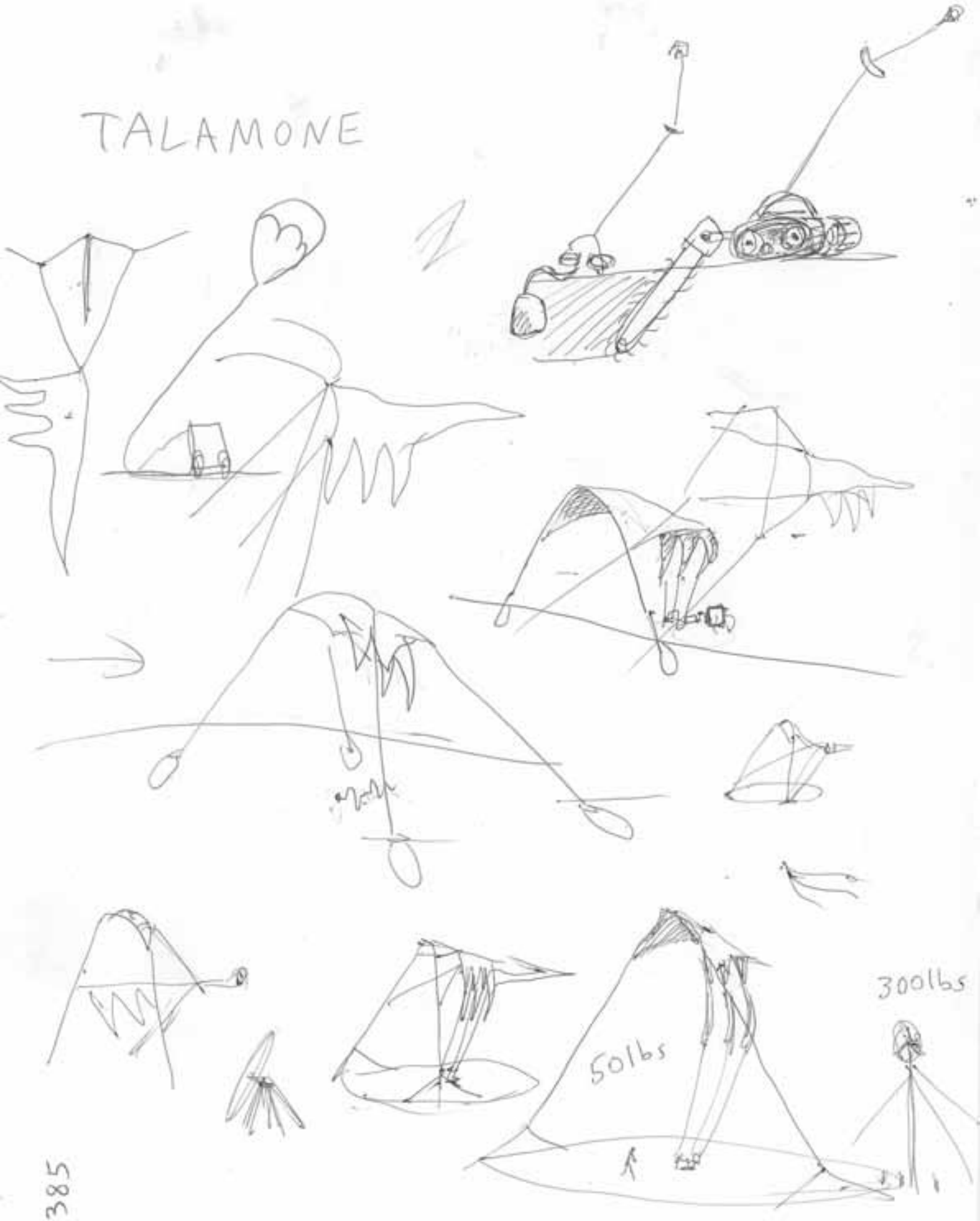
6383

b 384



aggregated kites
scaling limit
single kite
power
time
10 tW
1 tW
100
10 GW
1 gW
100 mW
10 mW
1 mW
100 kW
10 kW
1 kW
100 W
10 W
0
1960 70 80 90 92K 2000 2010 20 2015 2020 2025
"mature" utility scale
makini joby "M1"
Kitegen
Culp
stg sails
kitelebert
sport
kitegen
fractal kite
makini
Loyd
Roberts
hobbyists
free flight
operational airspace
statutory airspace
R
$
cost
lifespan
number of customers
avg scale of project
integrated kite units
SDO scale up
AWE Adoption
'Hockey stick'

TALAMONE



b 385

30kw
3K USD

20kUSD

b 386

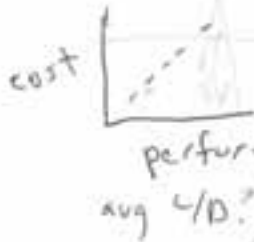
cost per installed watt
- per kW hour

Estimated market price of kite Energy = (wholesale cost of all parts × life span) + assembly + site costs + operational costs
- watts

Volumetric Efficiency

Sprawl - density comparable to conventional wind. Low STube Eff

(super) High Density - near betz 'stream-tube' efficiency



safety metrics -
- ~~cost time~~ workman's comp
- fatalities

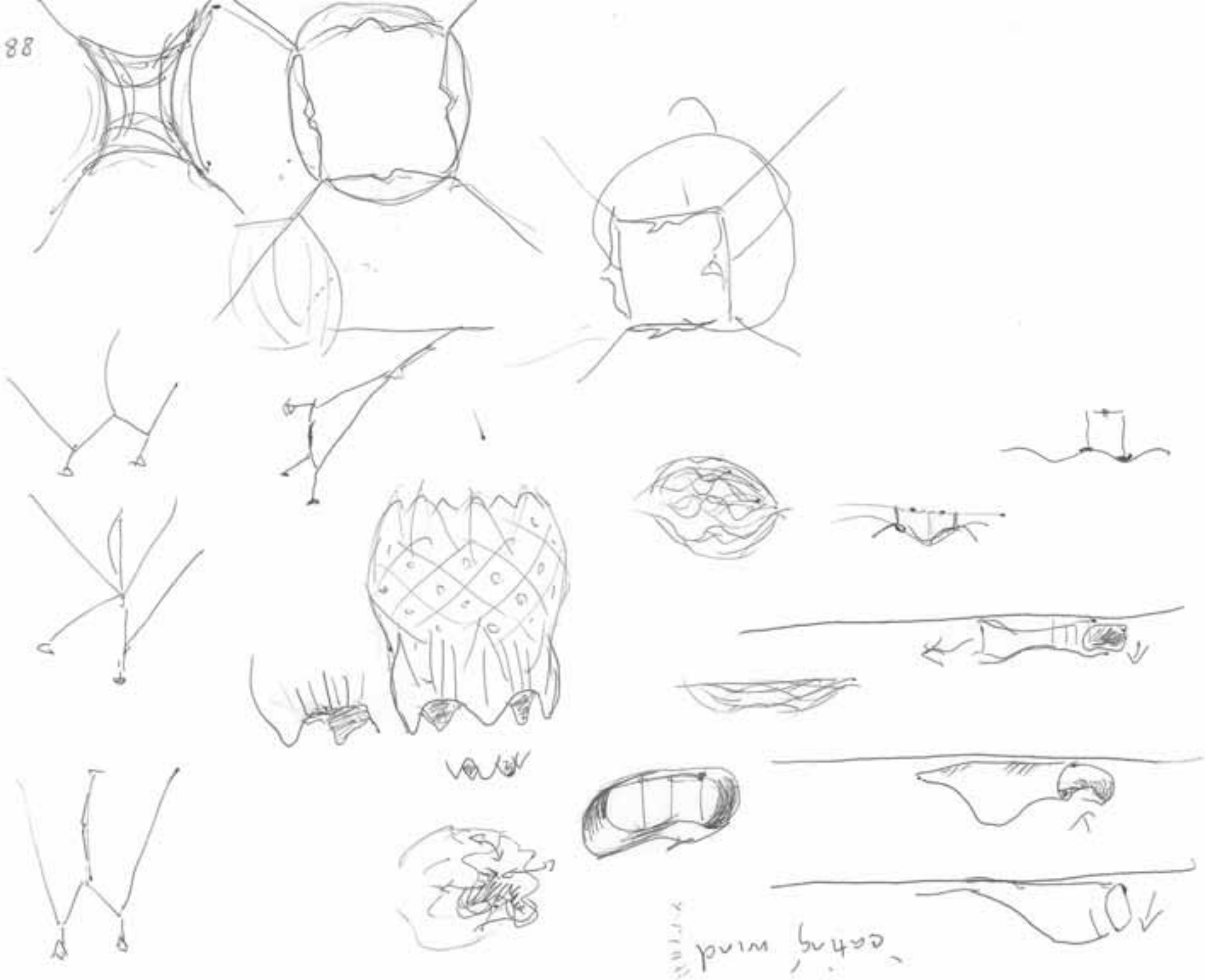
LT+F / Whr ← current standard

Strange Dreams at Fans

I dreamed of a small desert village
much like northern Mexico, but it was filled
with kites. The idea had been
taken hold
~~established~~ to "go up & "live" in
the sky. Spontaneously the kites
began to lift cars & trucks far overhead,
first a white panel truck went up about a
I rushed about worried by the hundred m.
lack of safety procedures, but
for to wide the cars went up, &
no problems occurred. Then a mighty
train of many kites went up, a "stairway
to heaven" as folks called it. A second
stairway went up & kids particularly
rushed up it. I began to climb it,
doubting its capacity. It was soft,
but it held. A general air of
jubilee, a sense of a new world
characterized the whole

6387

b 388



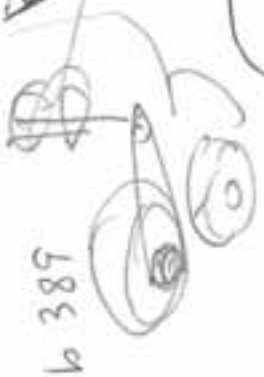
(Small) Scale Operations Research

SKYBOX

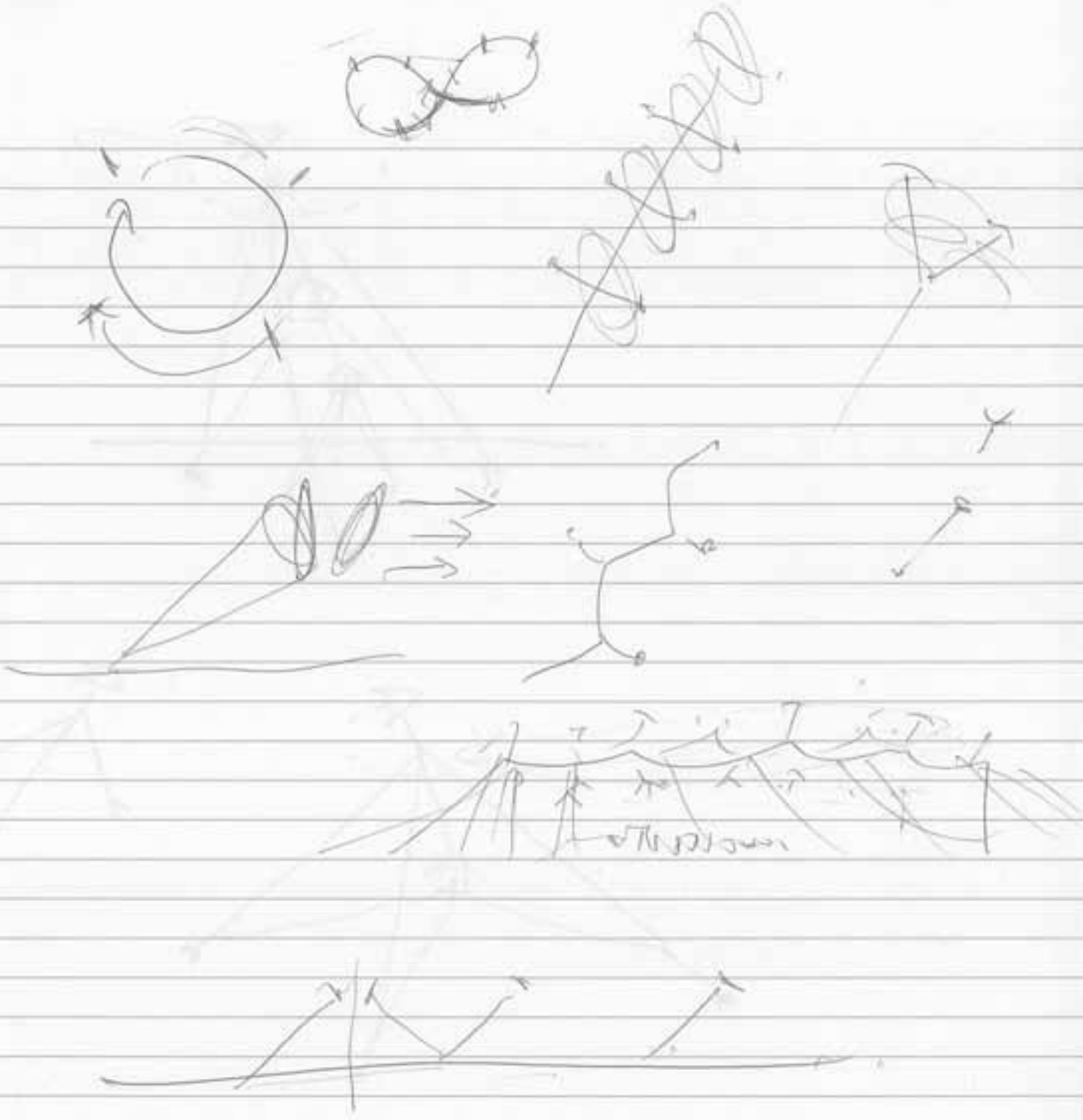
Supervised Automation

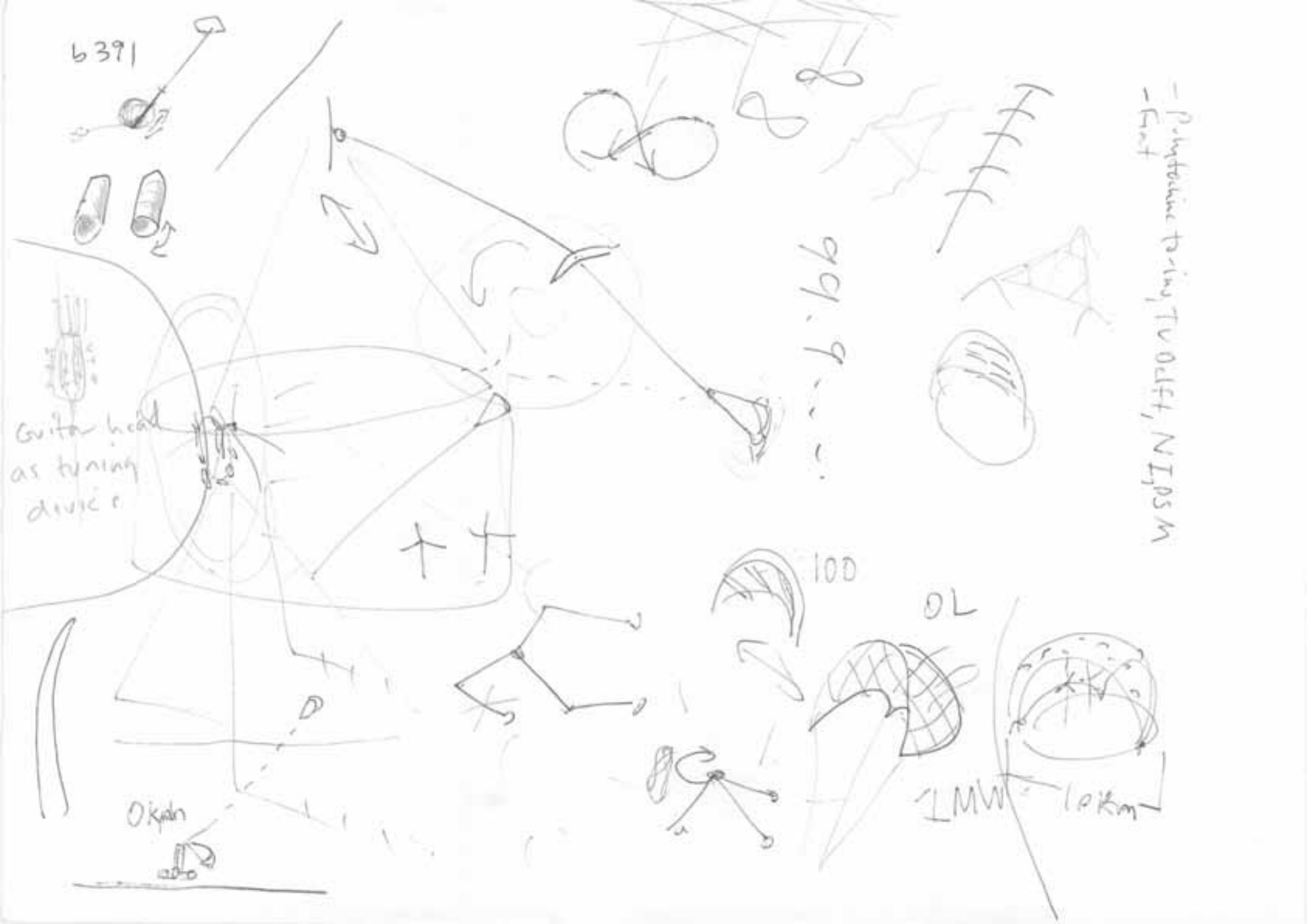
Breve Termine

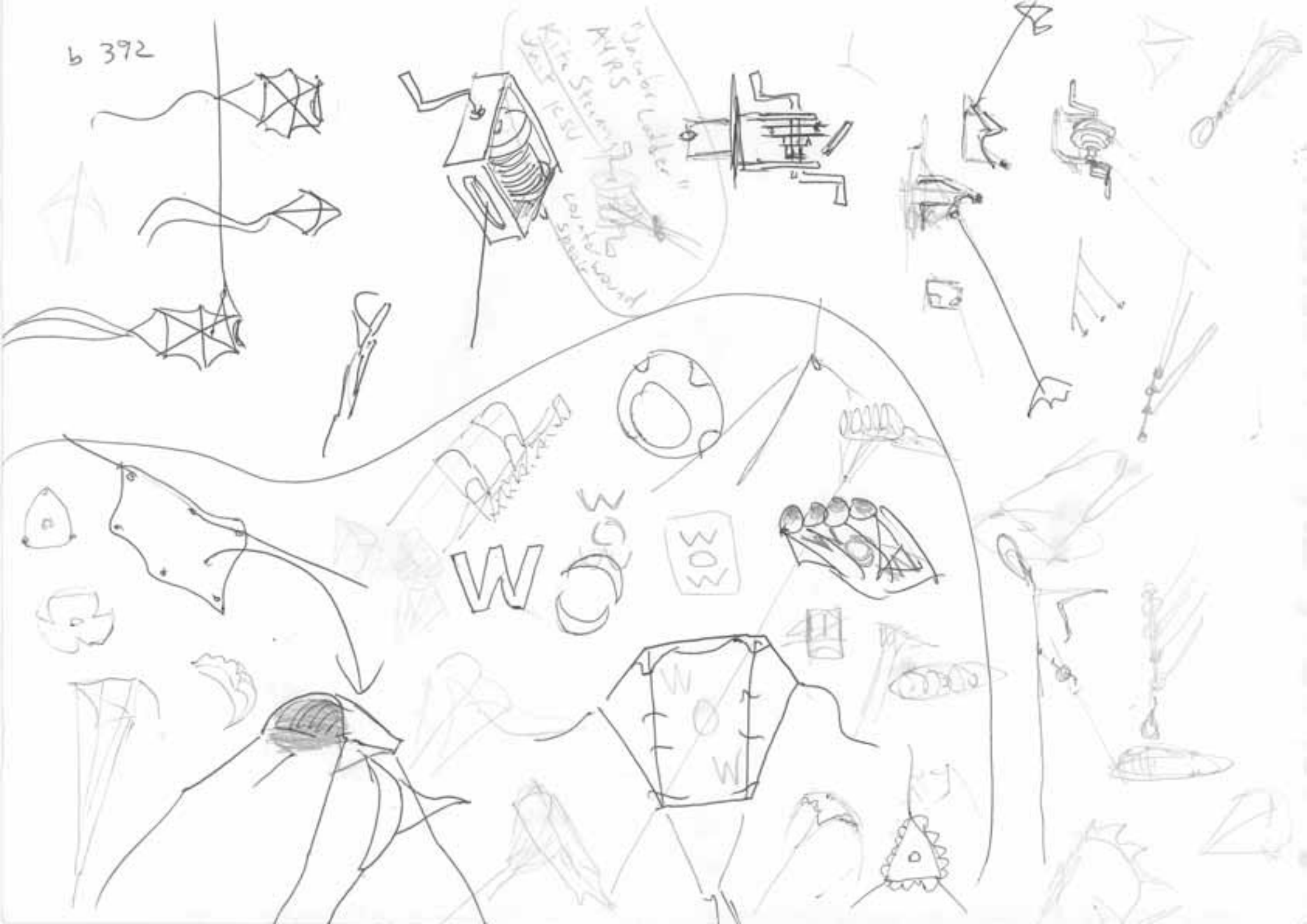
- Low-Complexity
- Human-in-the-Loop Control
- Low mass - Low velocity = safe
- Low Capital-Cost



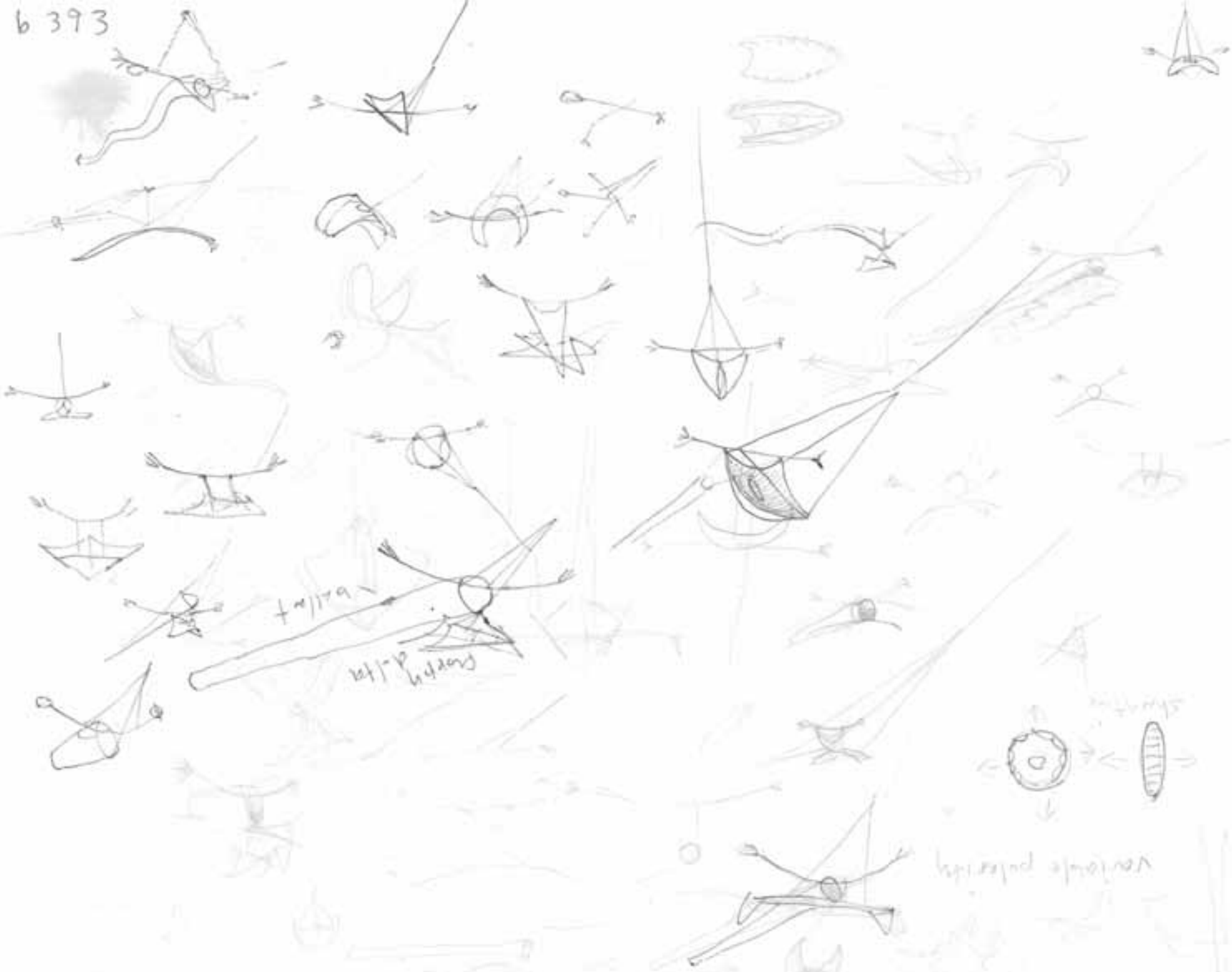
KATHOLIEKE UNIVERSITEIT
LEUVEN




b391
Guitar head as tuning device
0kph
100
OL
1MW
10km
99.9...
- Polytechnic tuning, TV Oclft, NI, DSM
- Fast


b 392
WOW

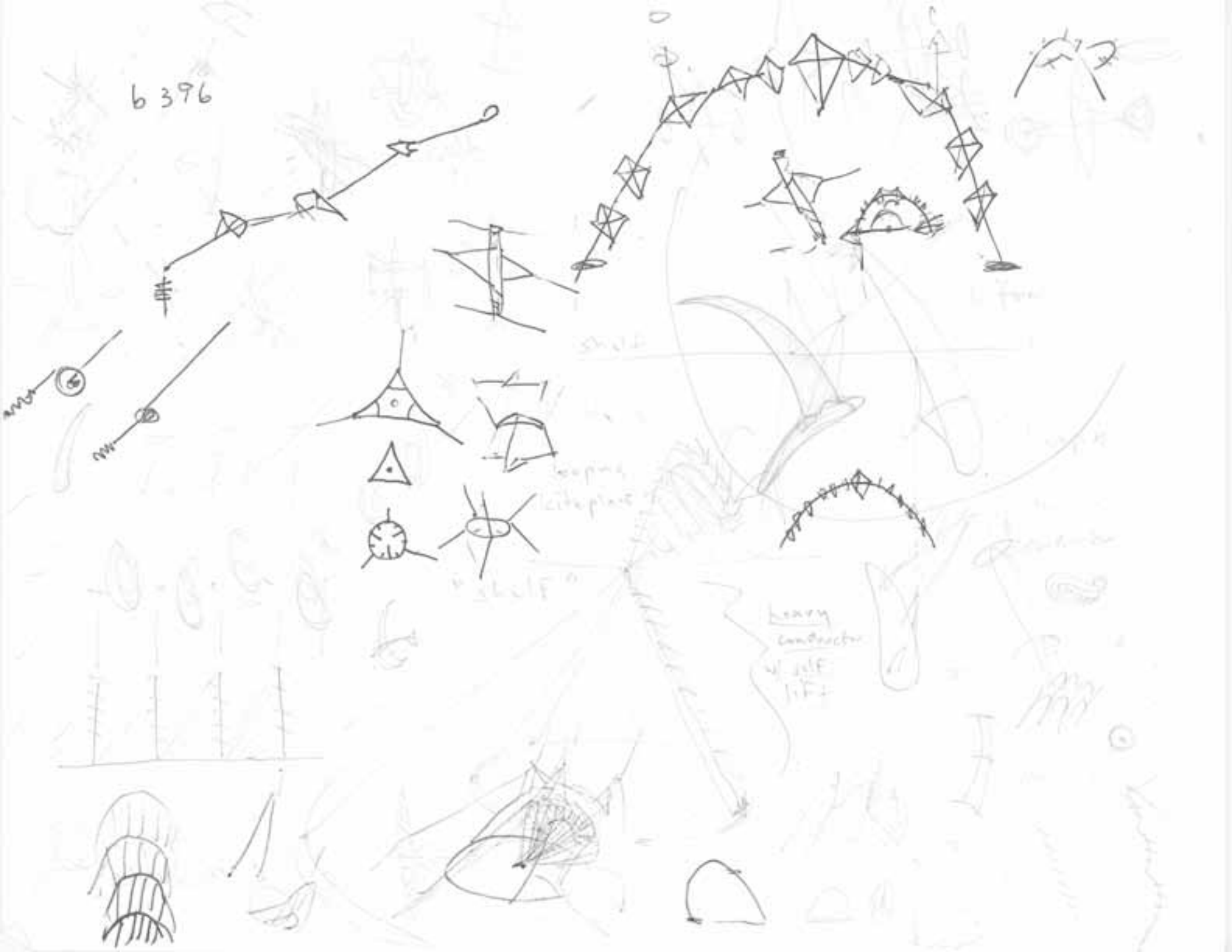
b 393



b 394

Fractal
Playsail
paper plate prototype
omnikite
- 360° wind rose
- self launch
- self trim (AoA)
AoA limiter tether

6395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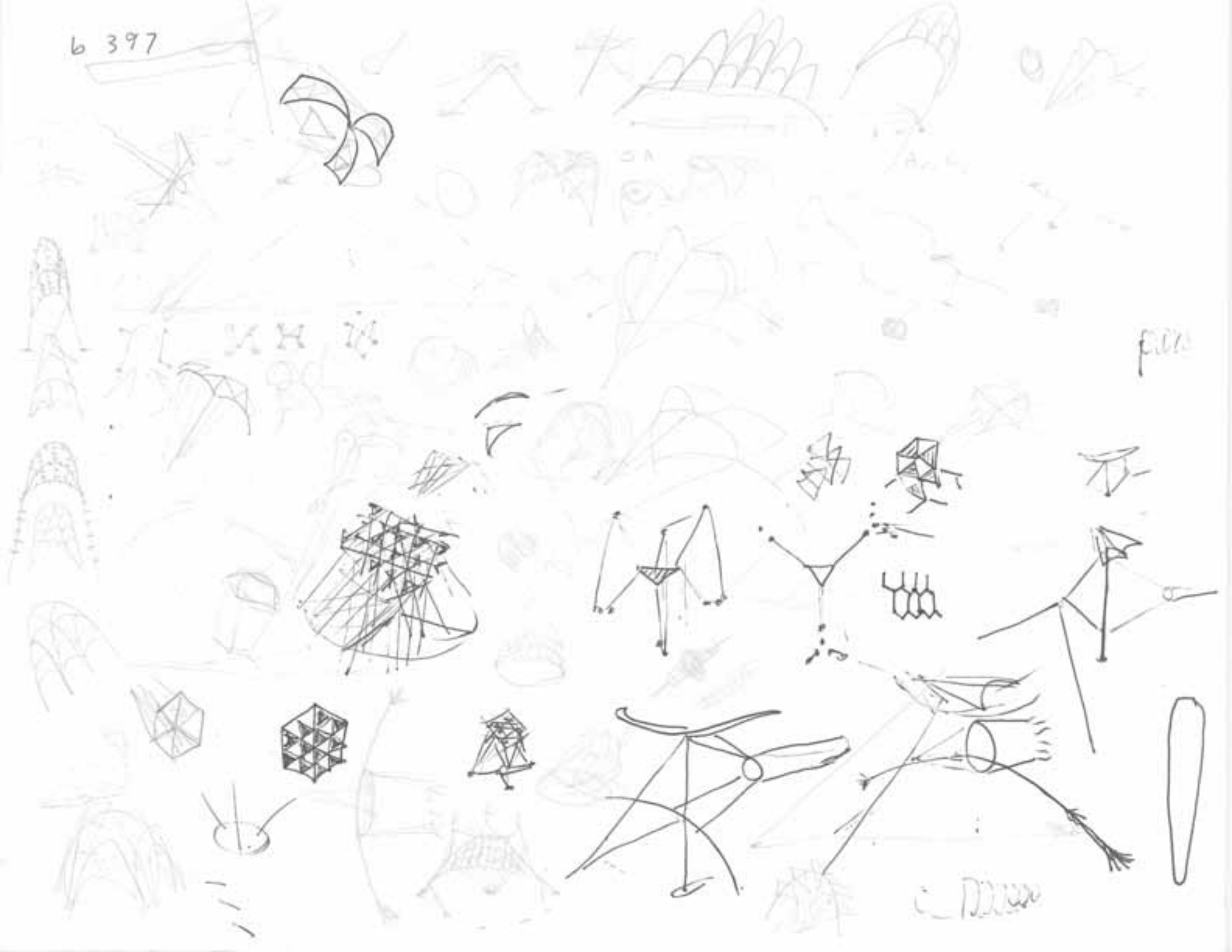
b 397



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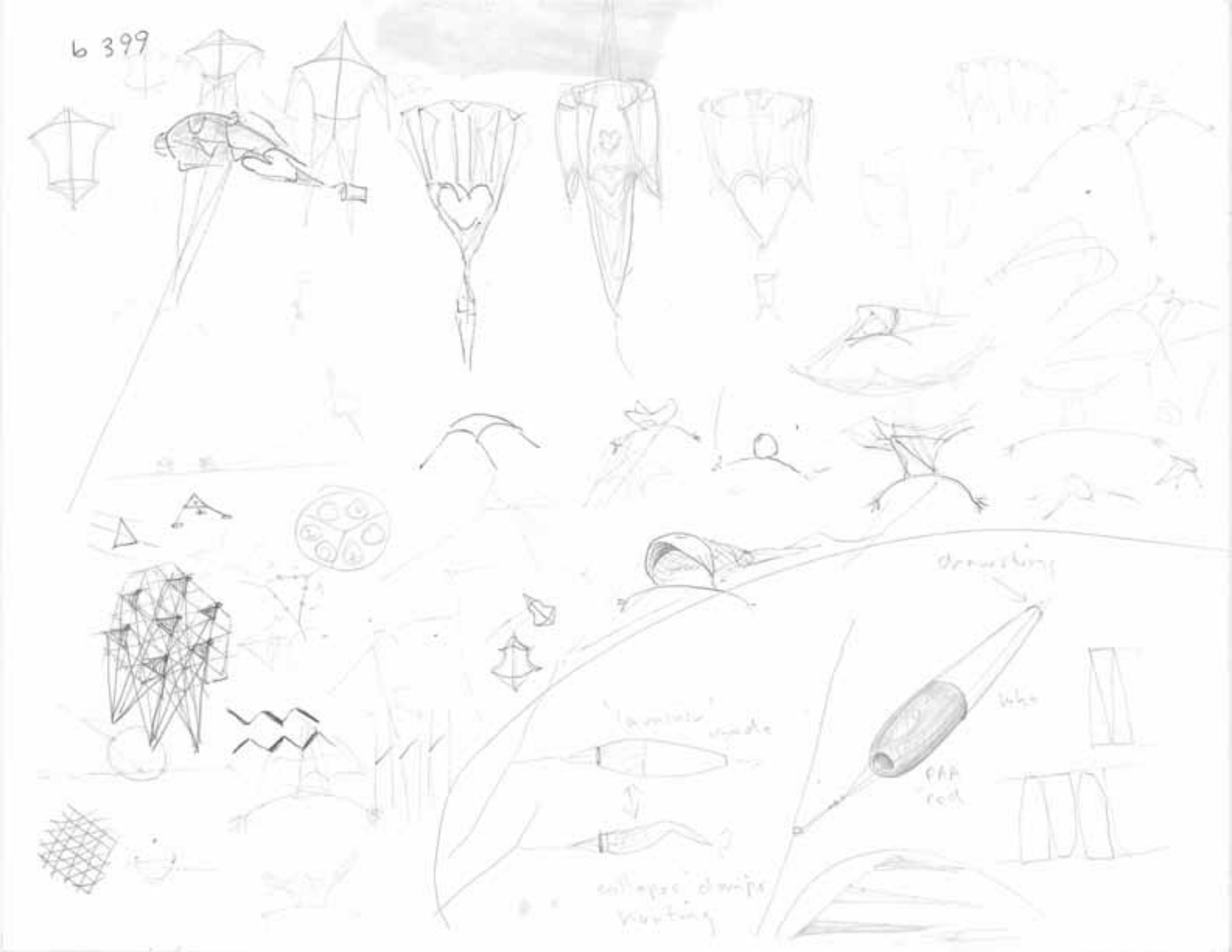
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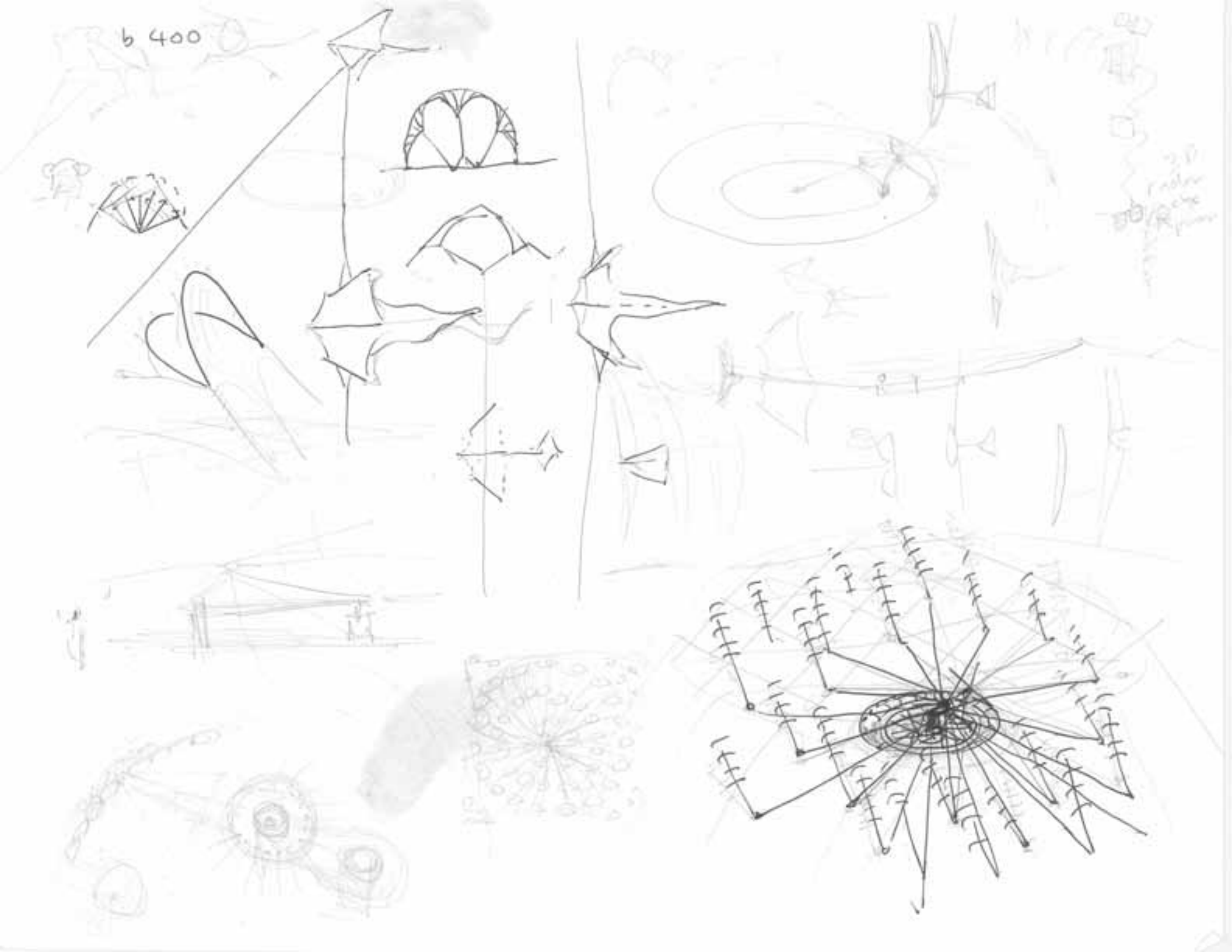
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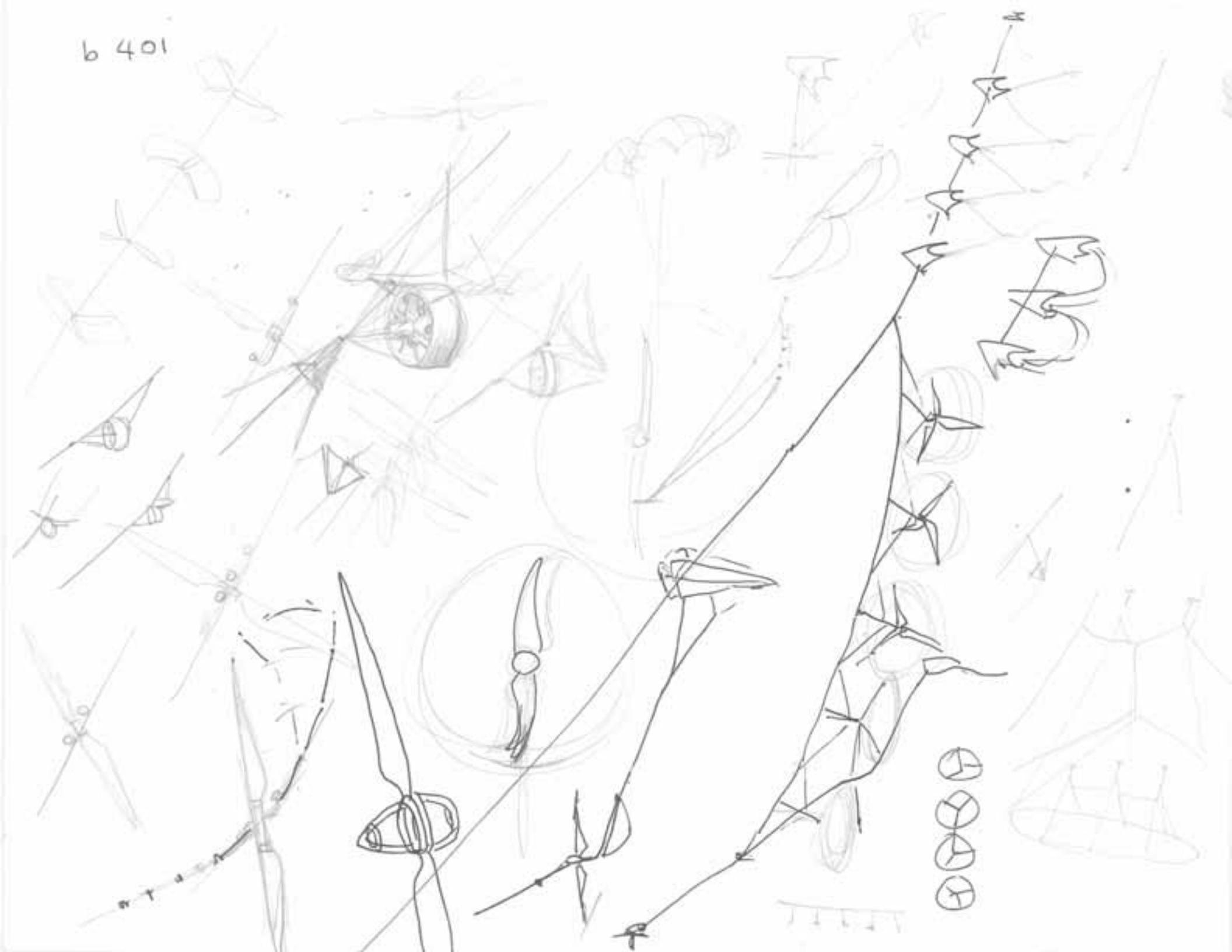

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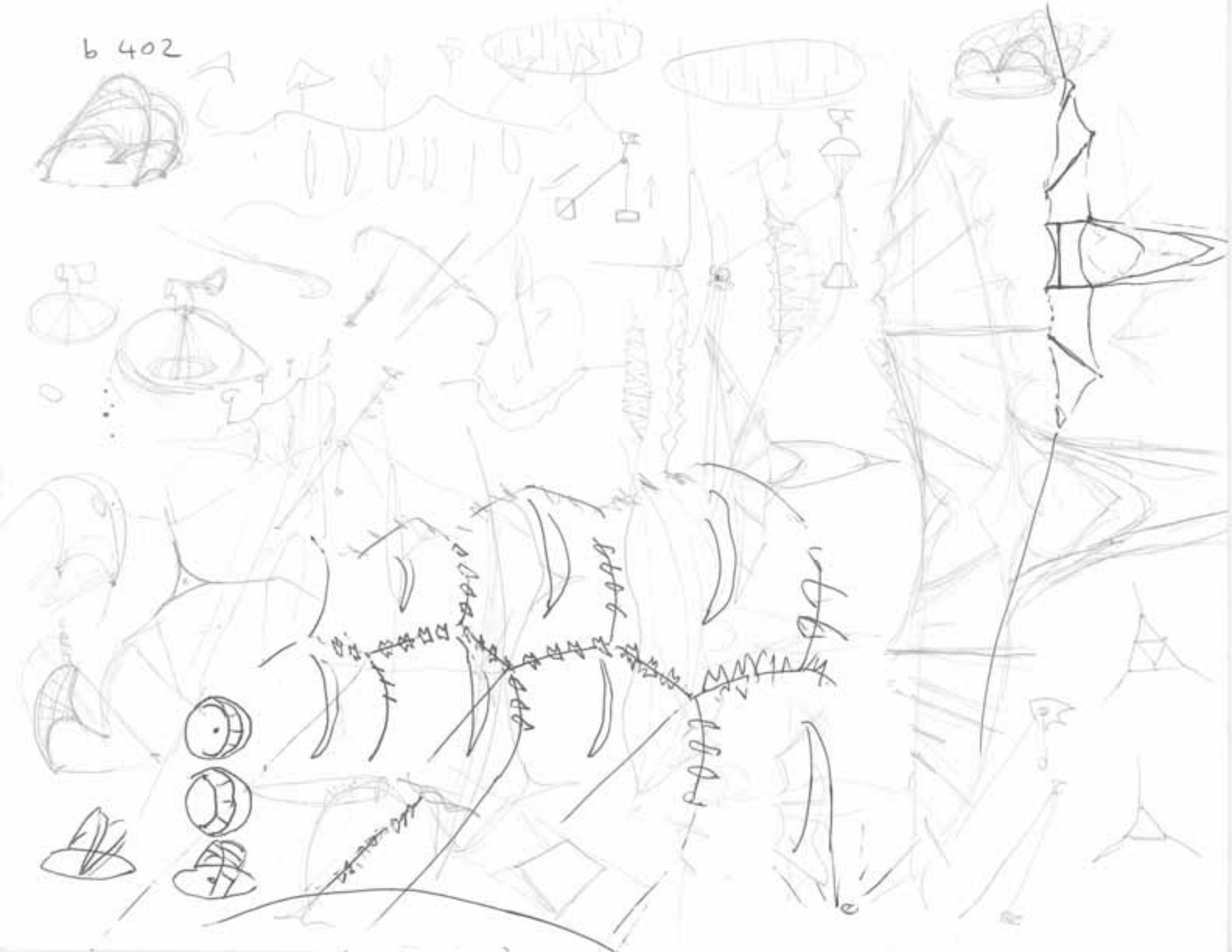
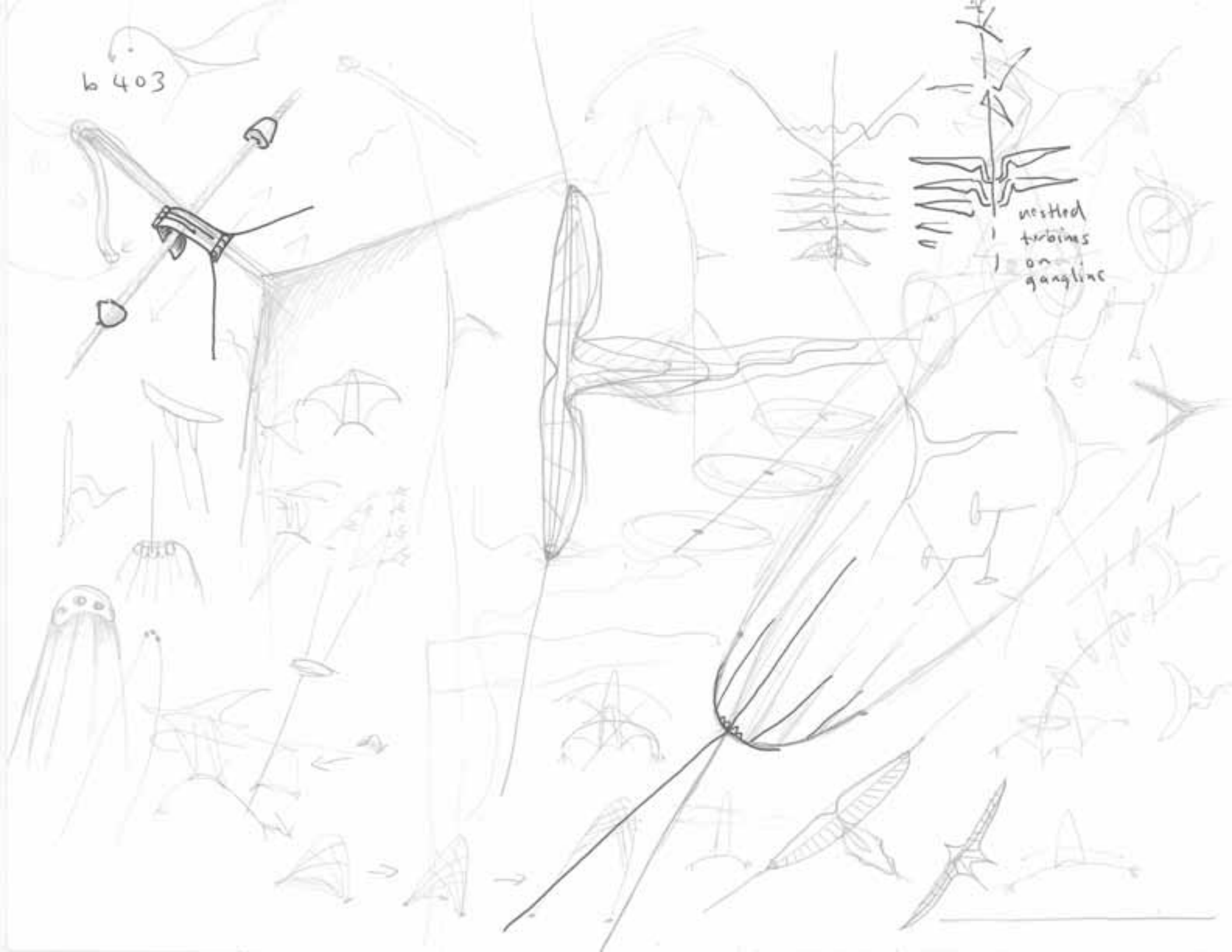
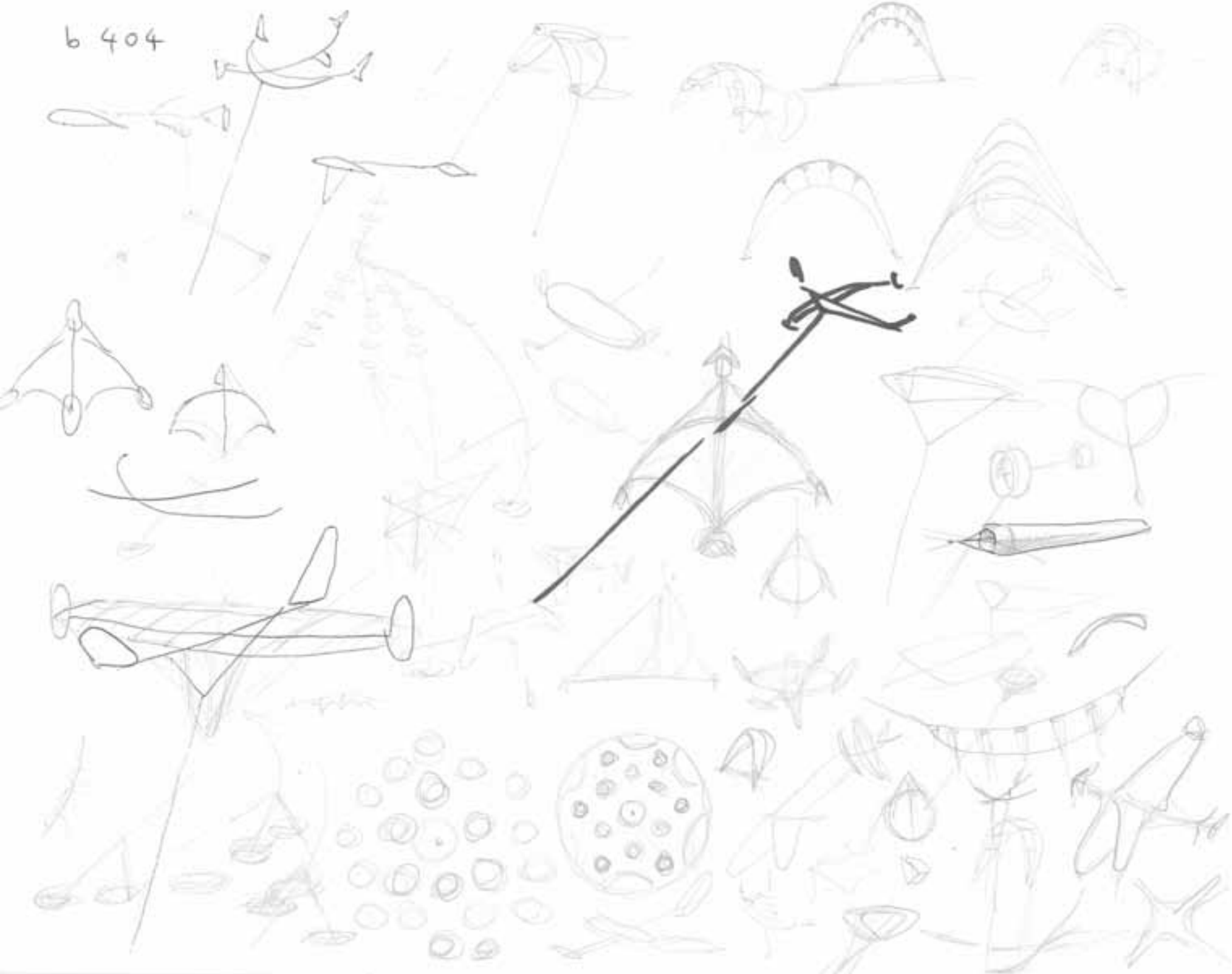


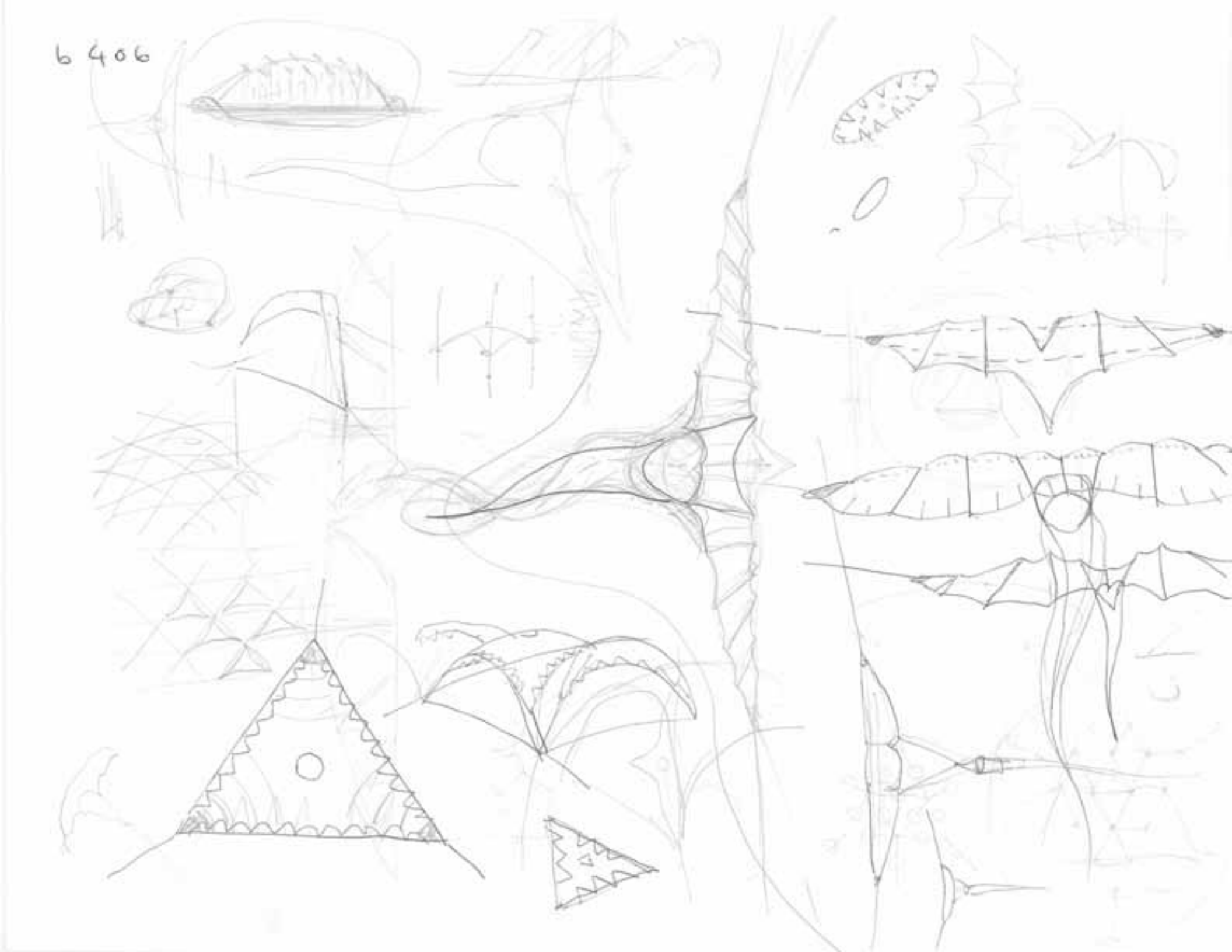

b 403
nestled
turbines
on
gangline

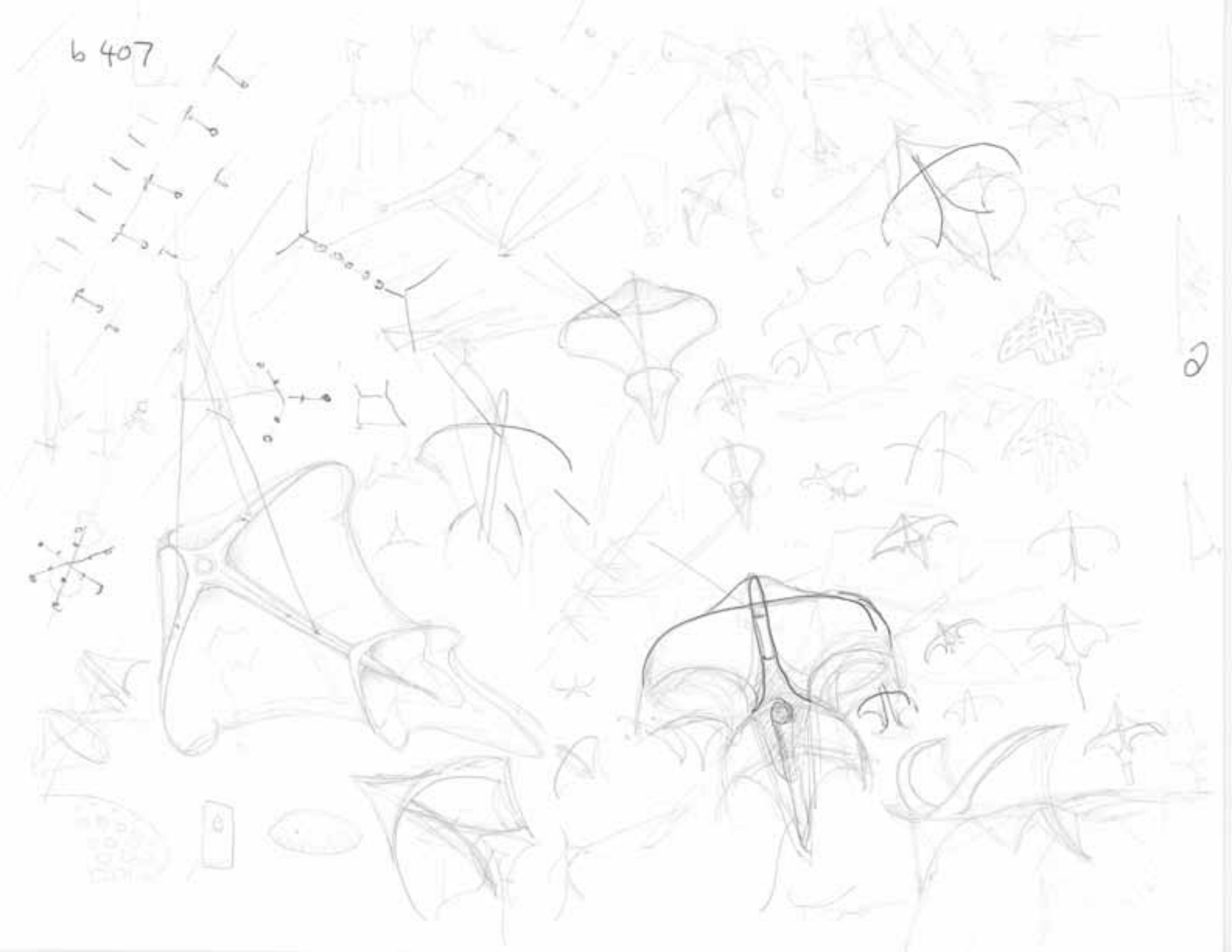
b 404



6405
vectored trim

b 406

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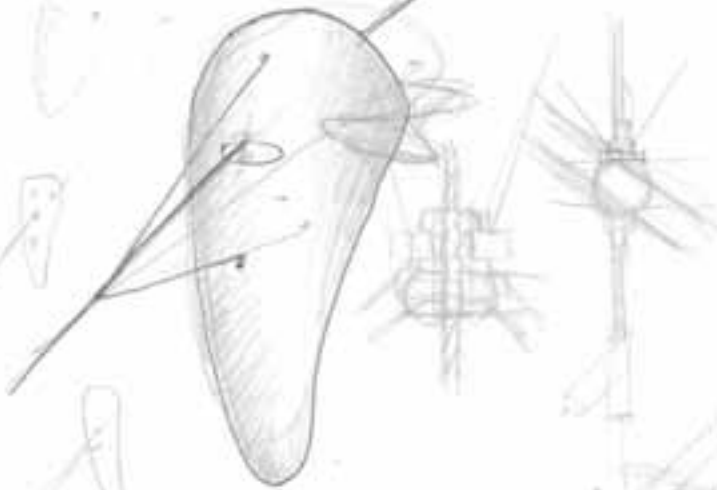
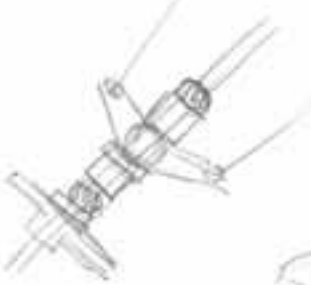
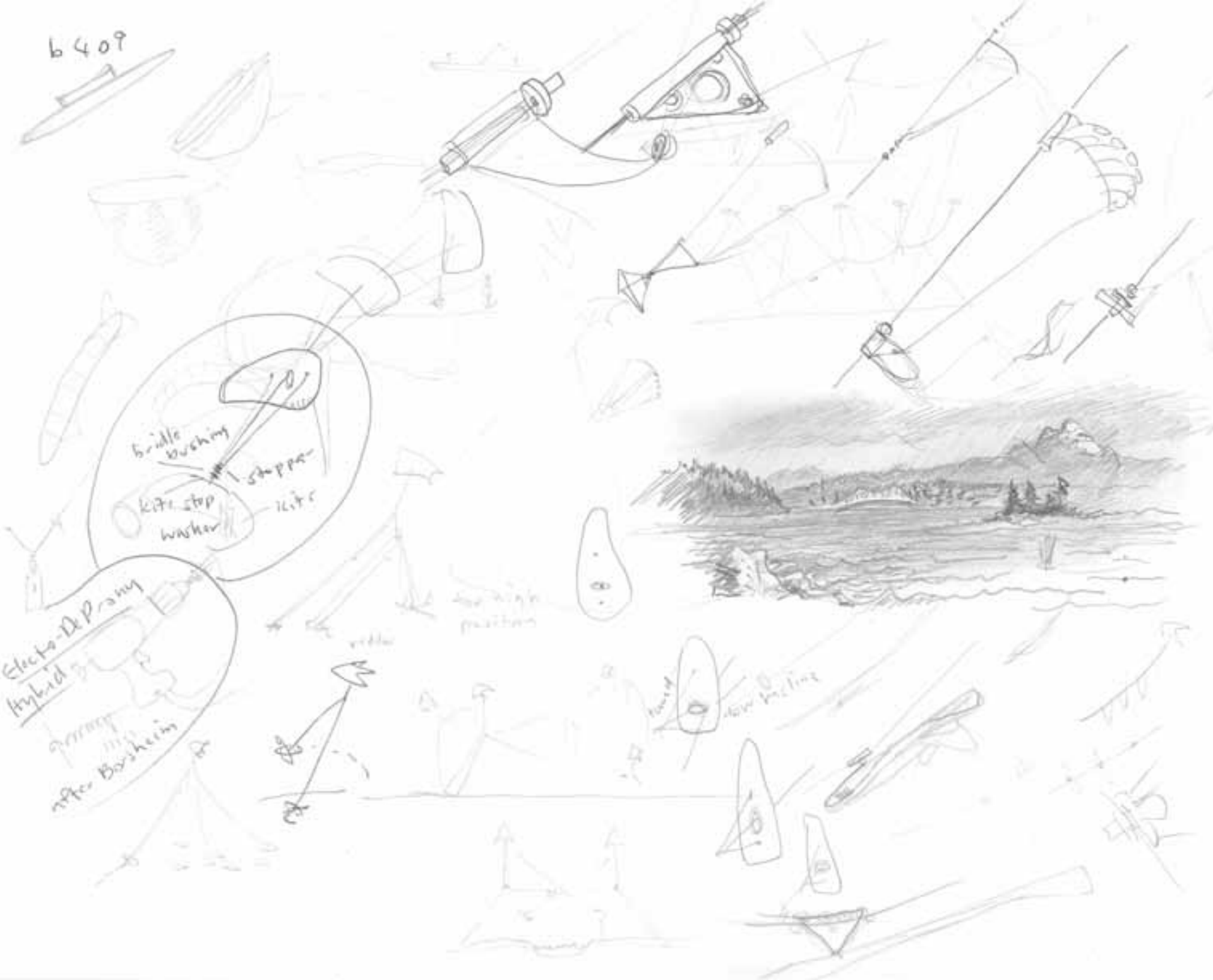
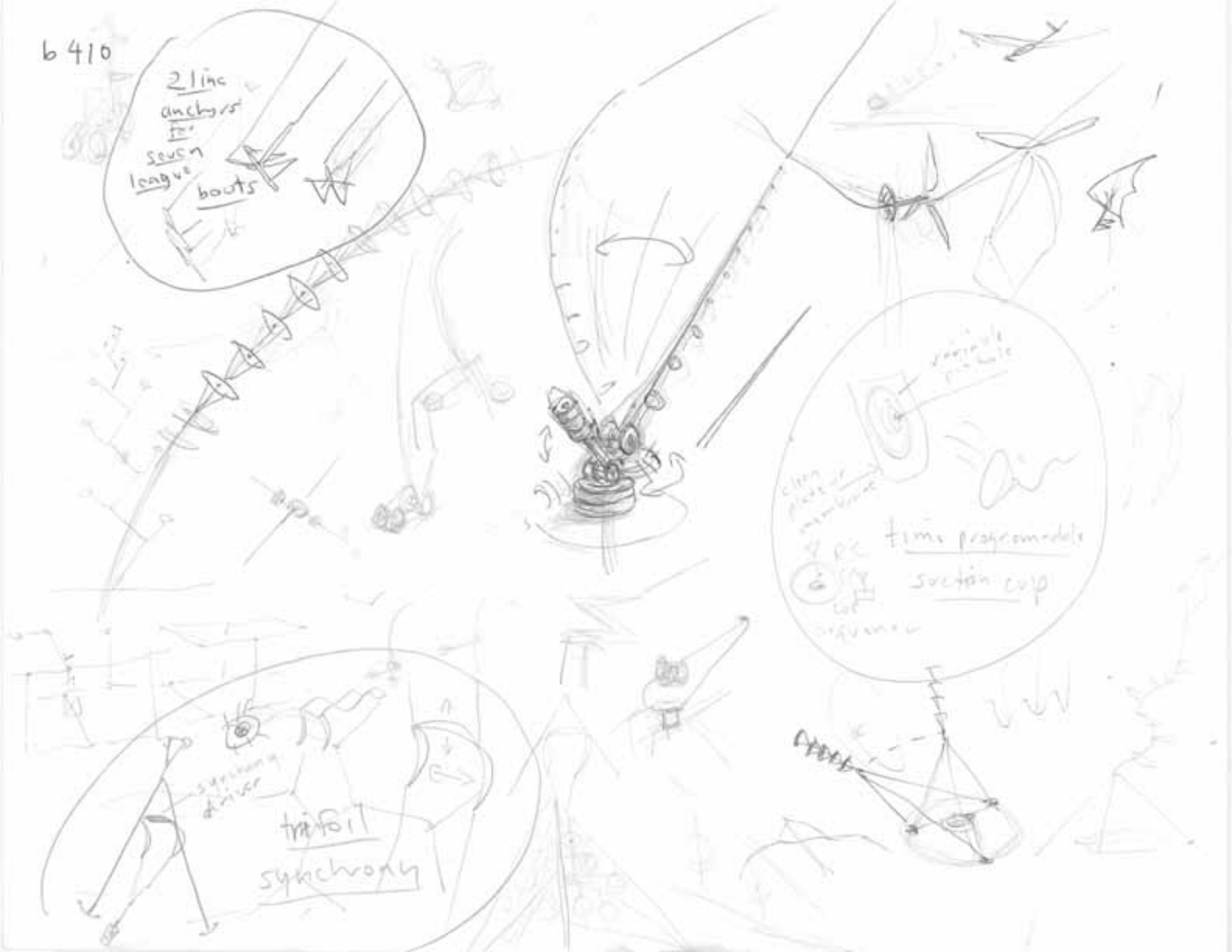
b408





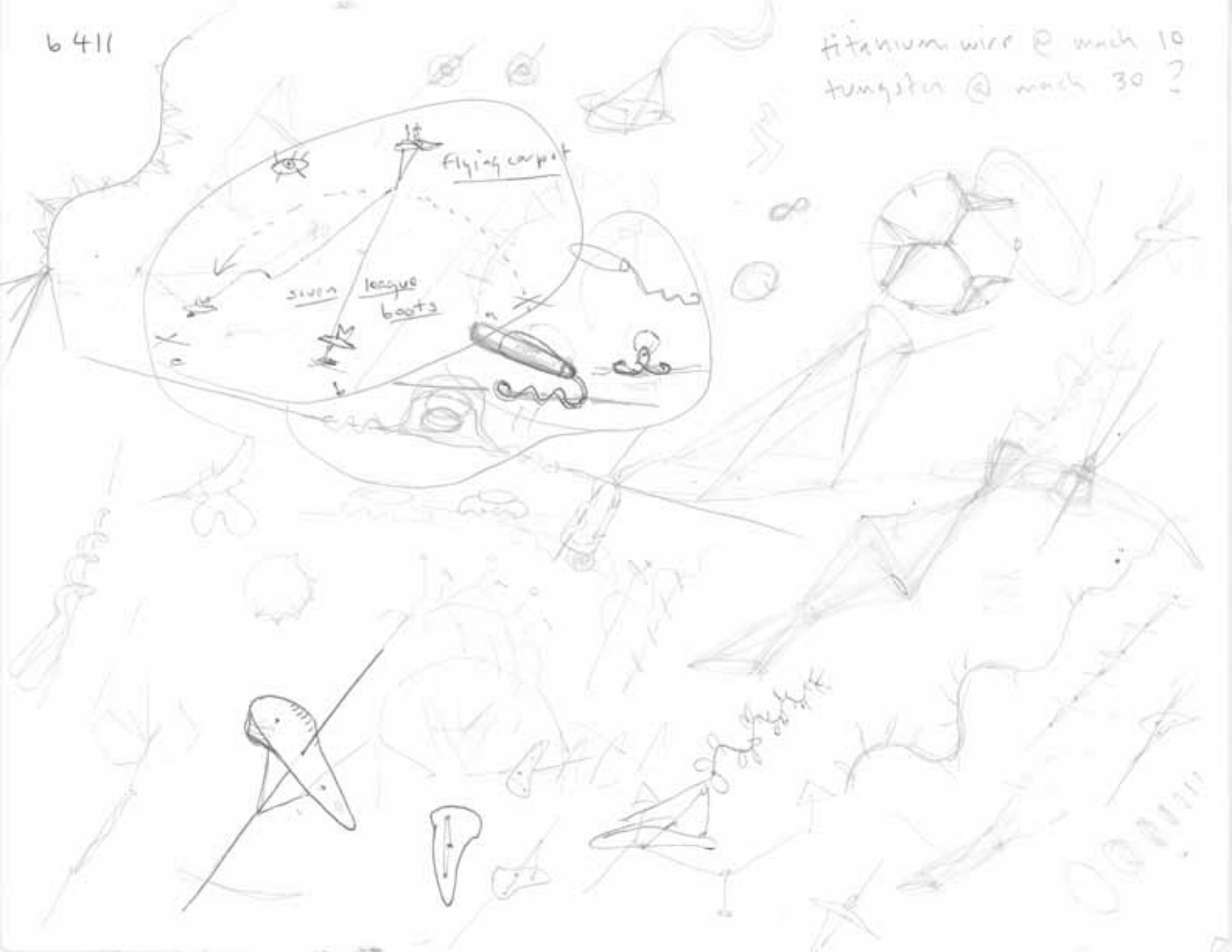

b409
bridle bushing
stopper
kite stop
washer
kite
Electro-DeProny
Hybrid
after Borsheim
low high
position
low pasting

b 410


2 line anchors for seven league boots
time programmable suction cup
trifoil synchrony

6411

titanium wire @ mach 10
tungsten @ mach 30 ?



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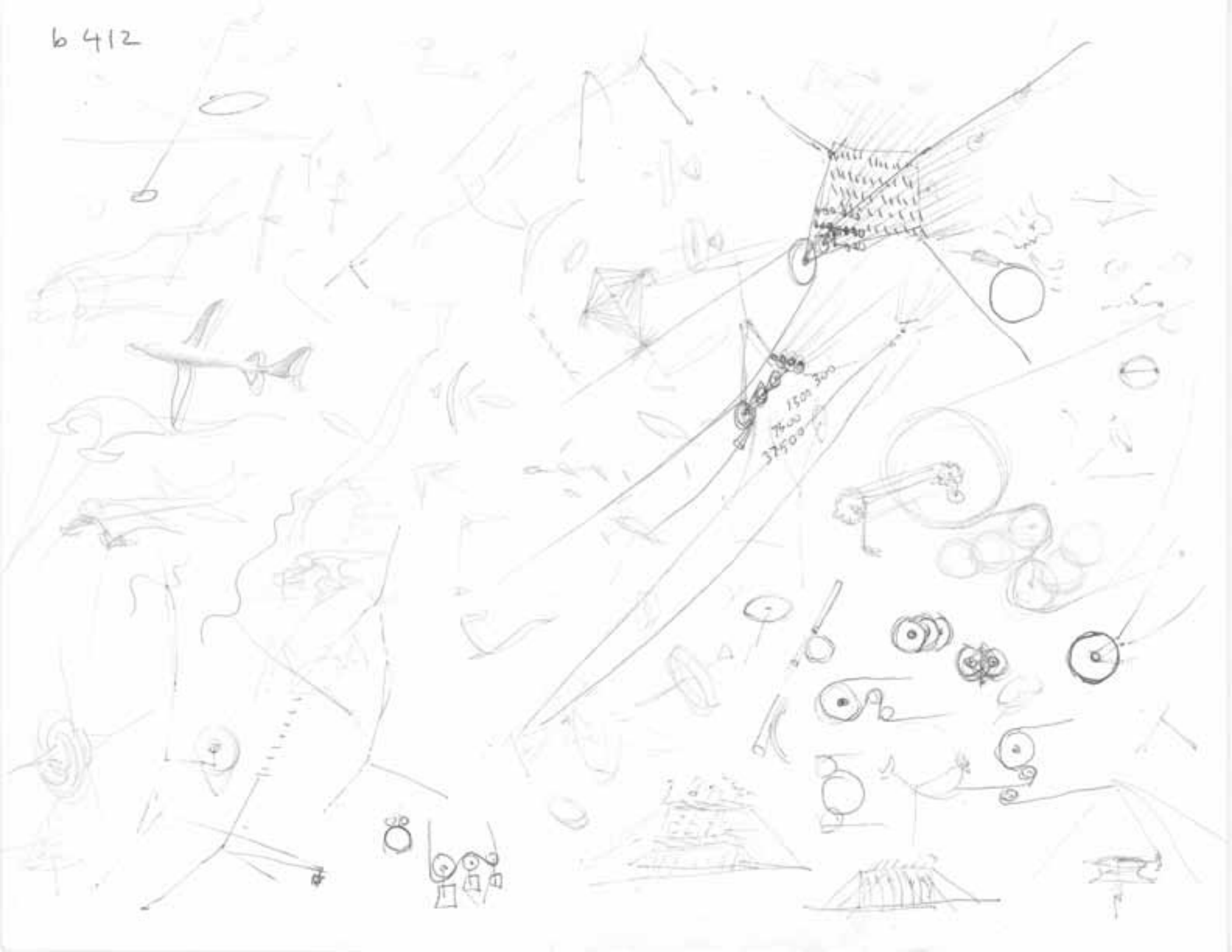
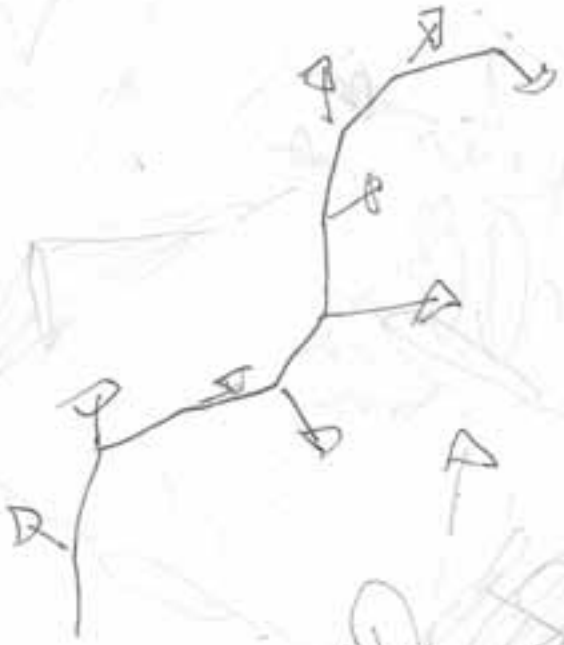


6 413

b 414

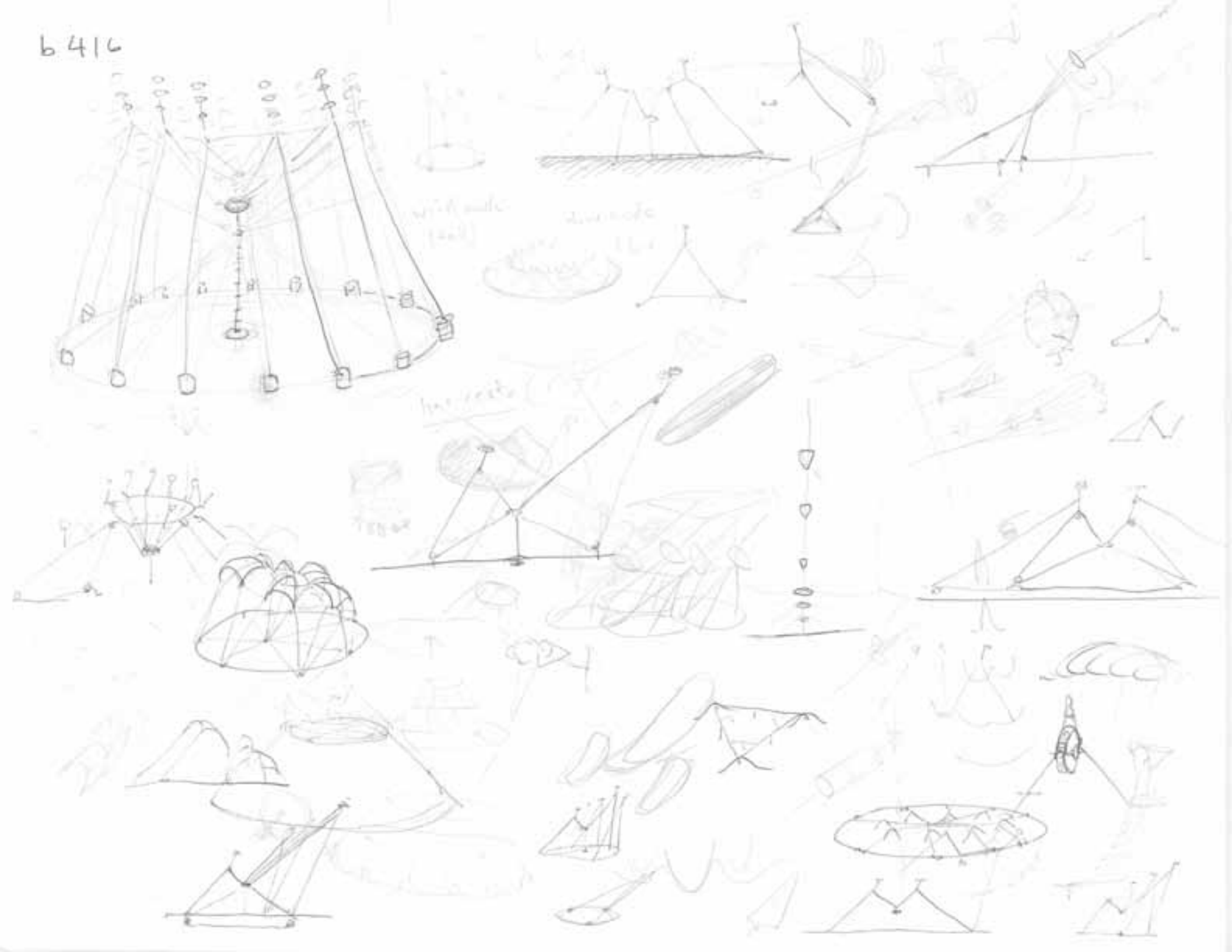
is math that
Natural Language Operates
in full-blown Hilbert Space

Cross tethers phase-lock units
that otherwise interfere

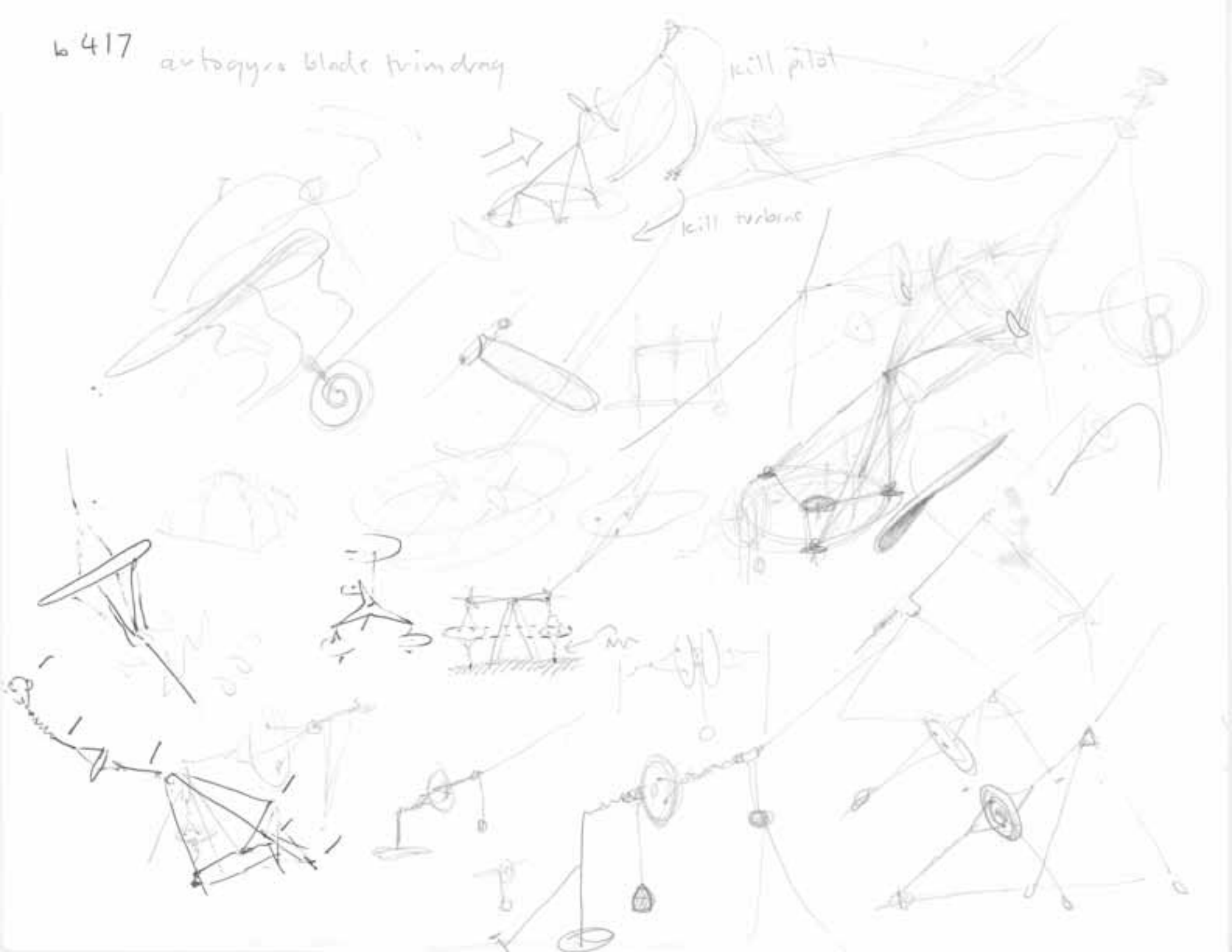


5th 9

b 416



b 417 autogyro blade trim drag



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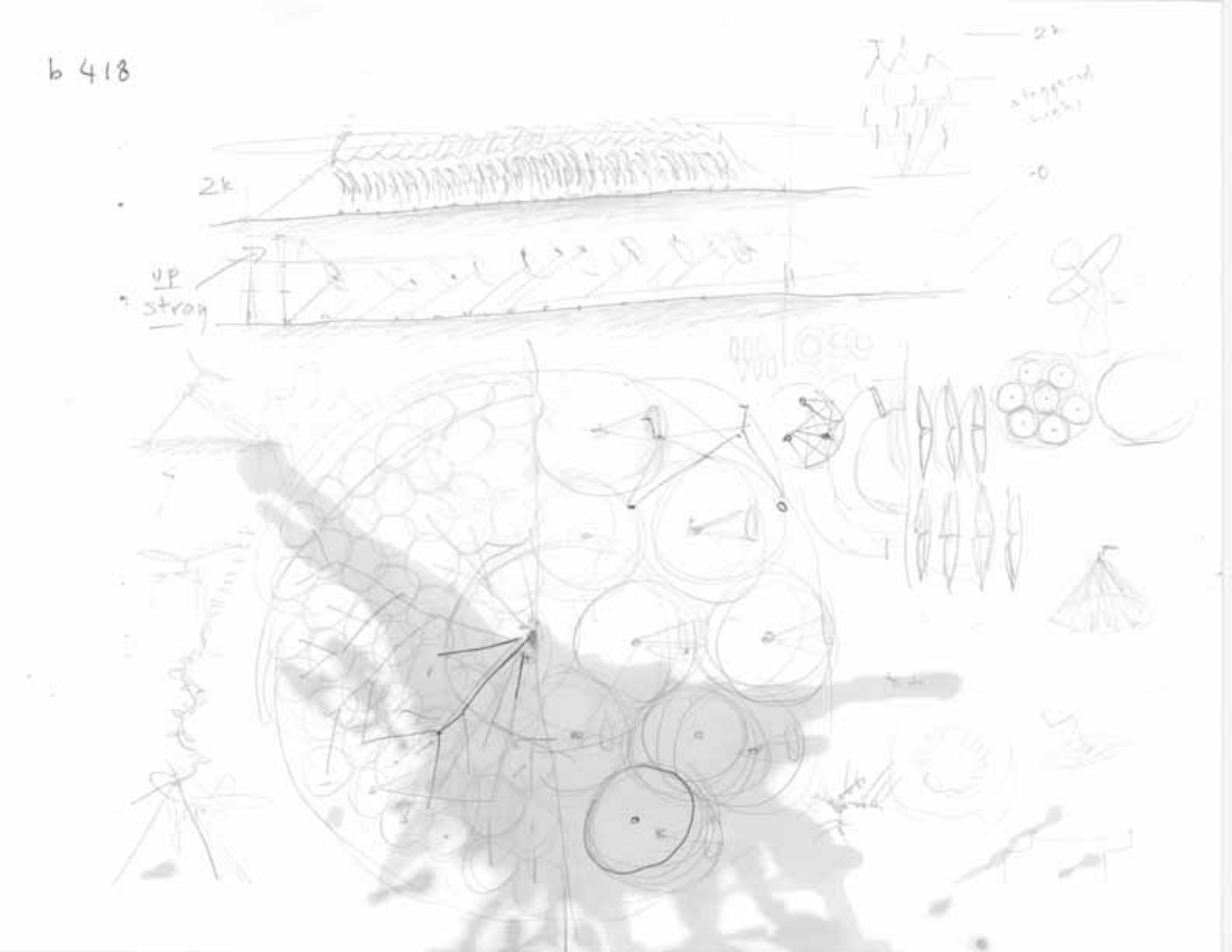

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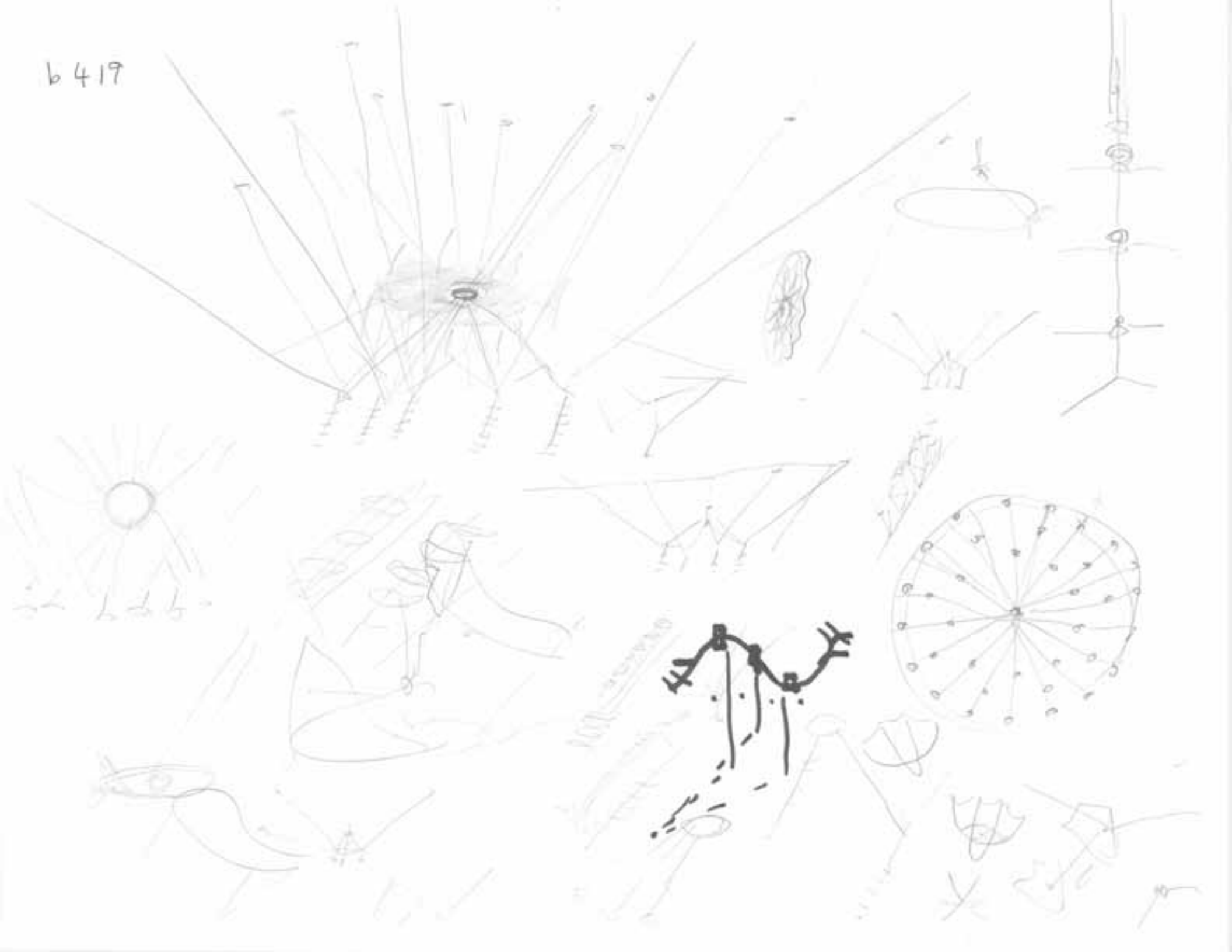

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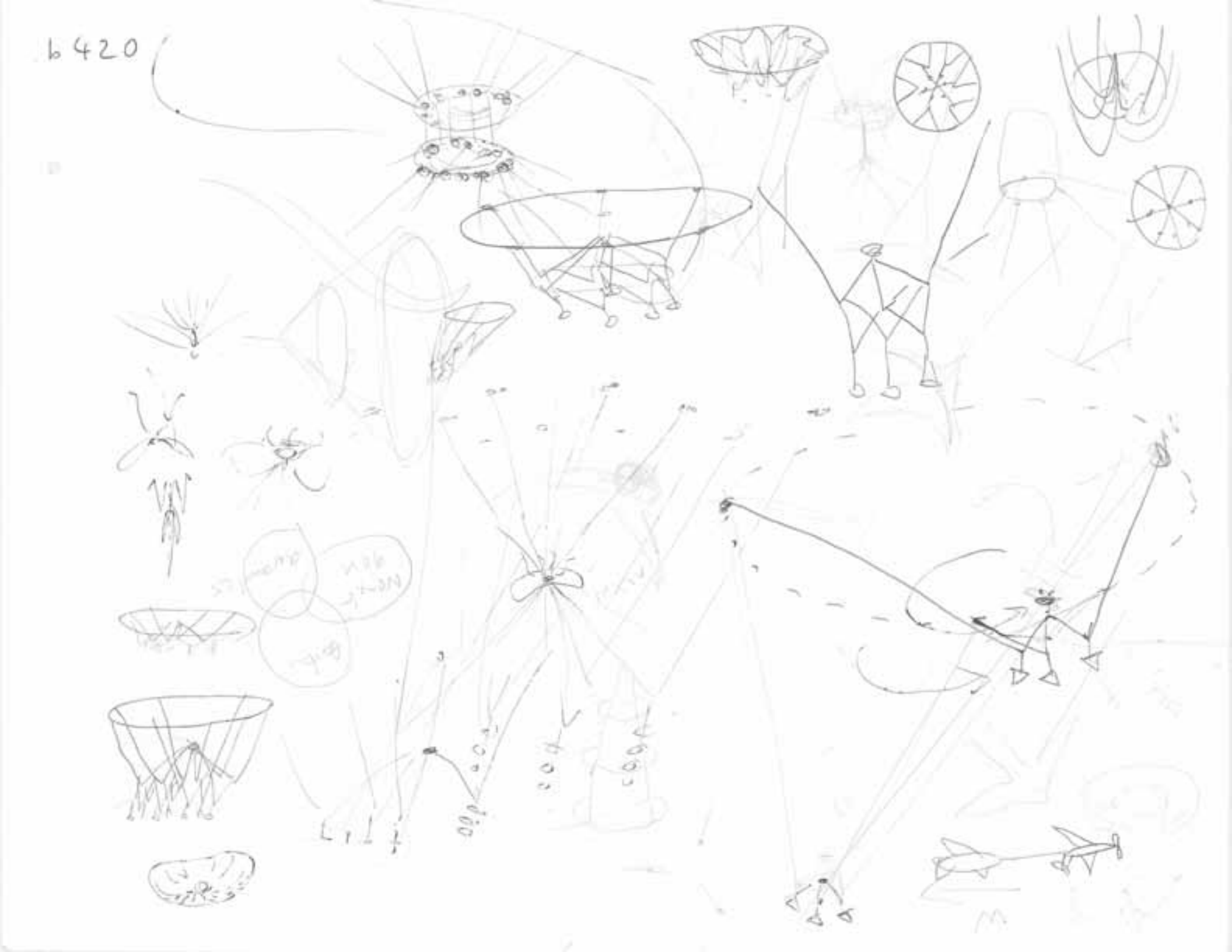

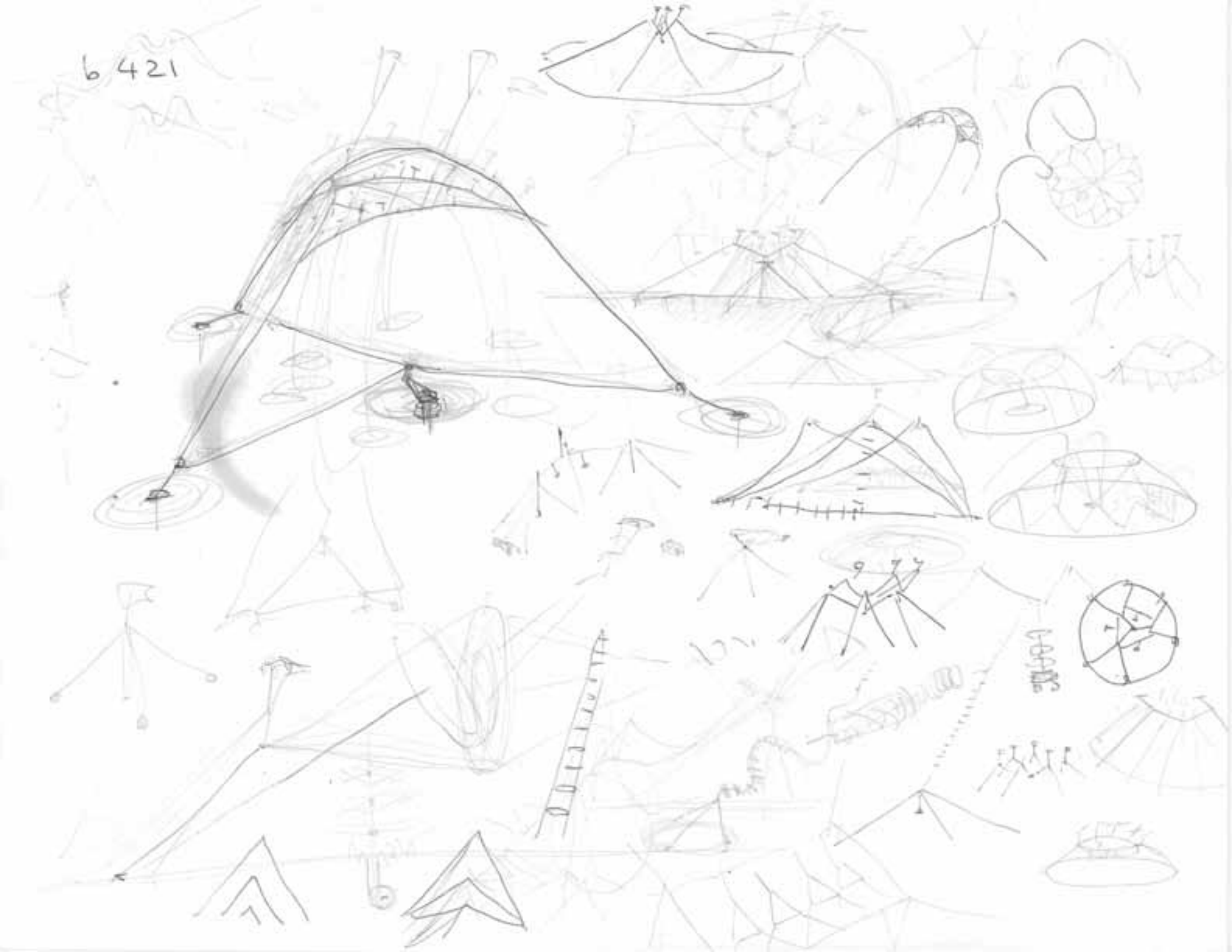
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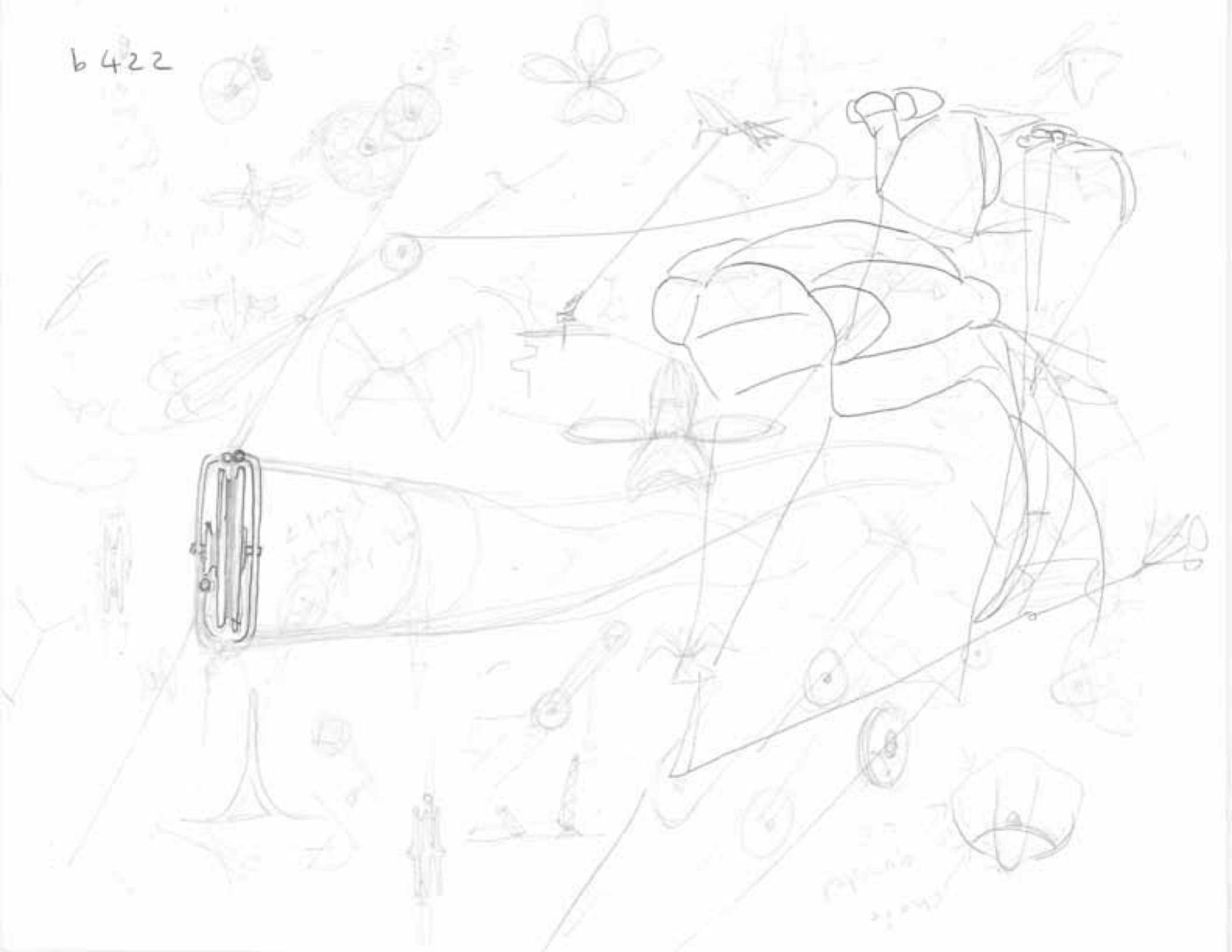

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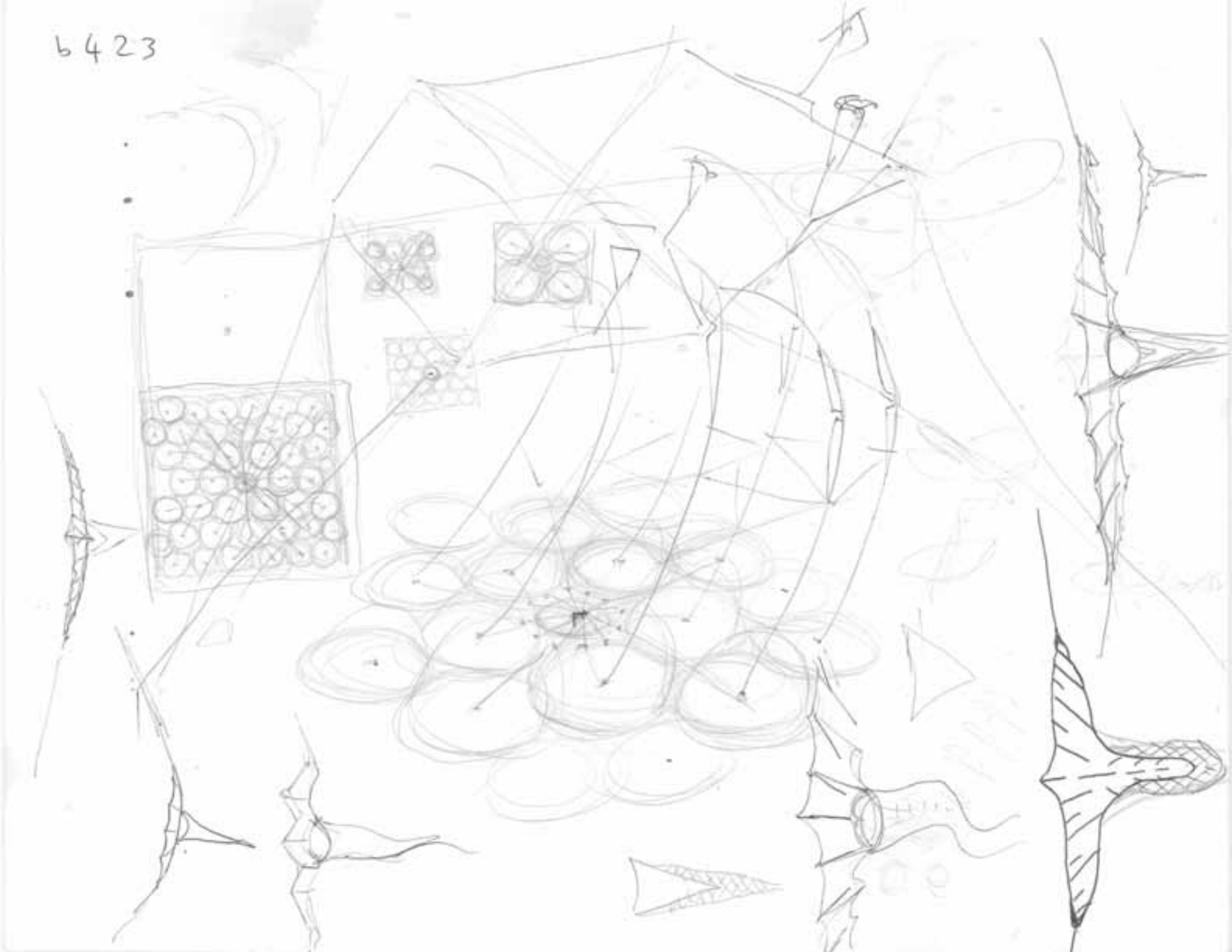
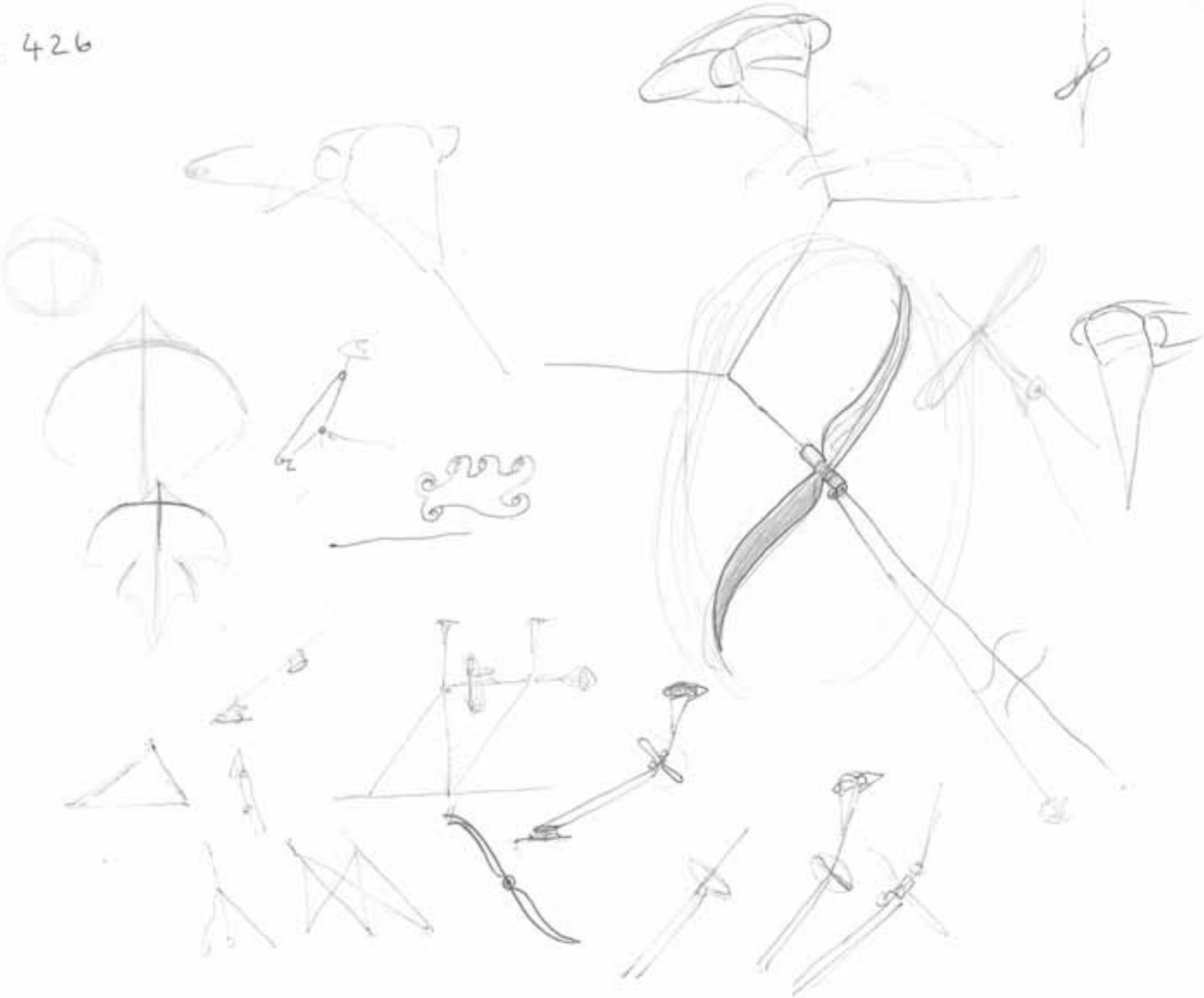
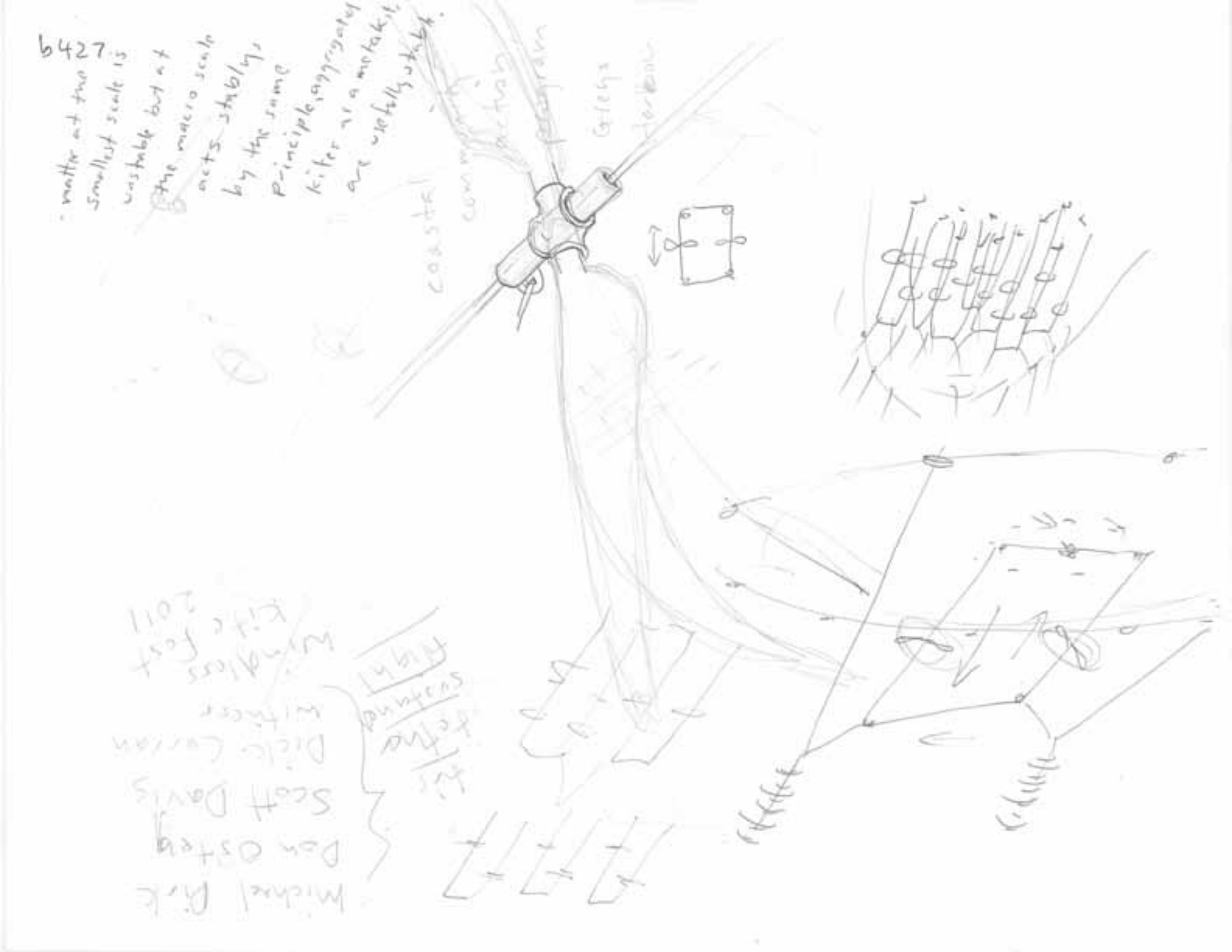


b ~~240~~ 424
100 mt

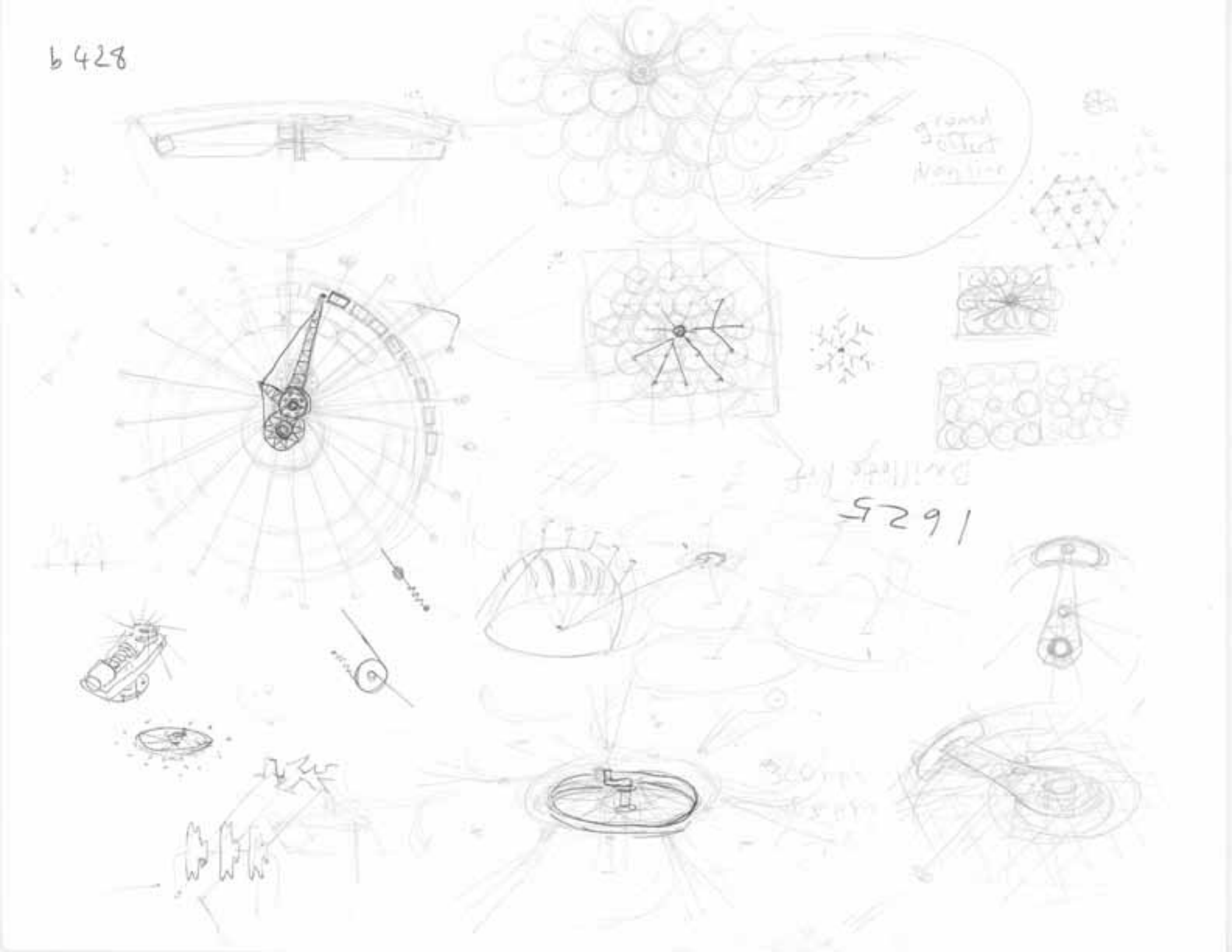
b 425

b 426

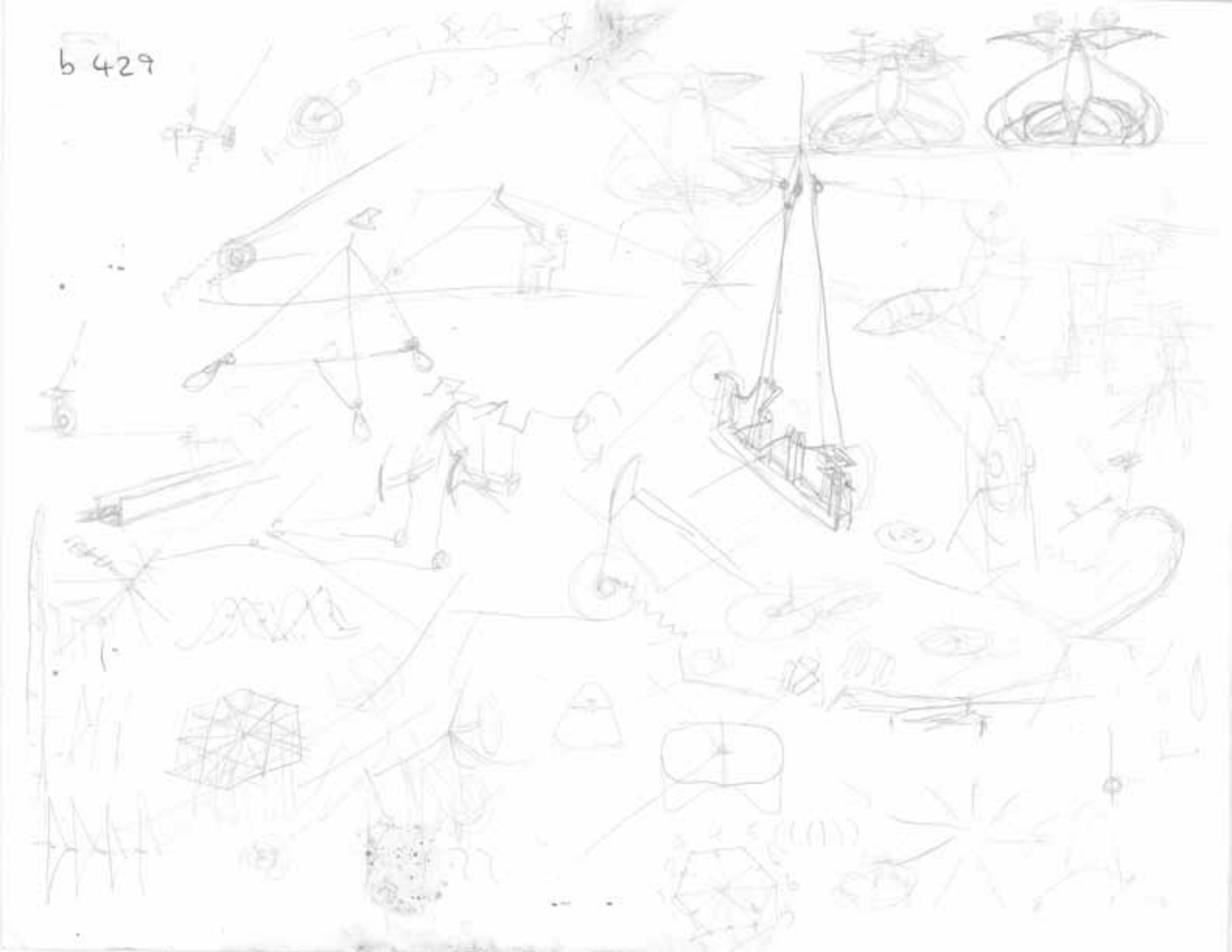




b 428



b 429



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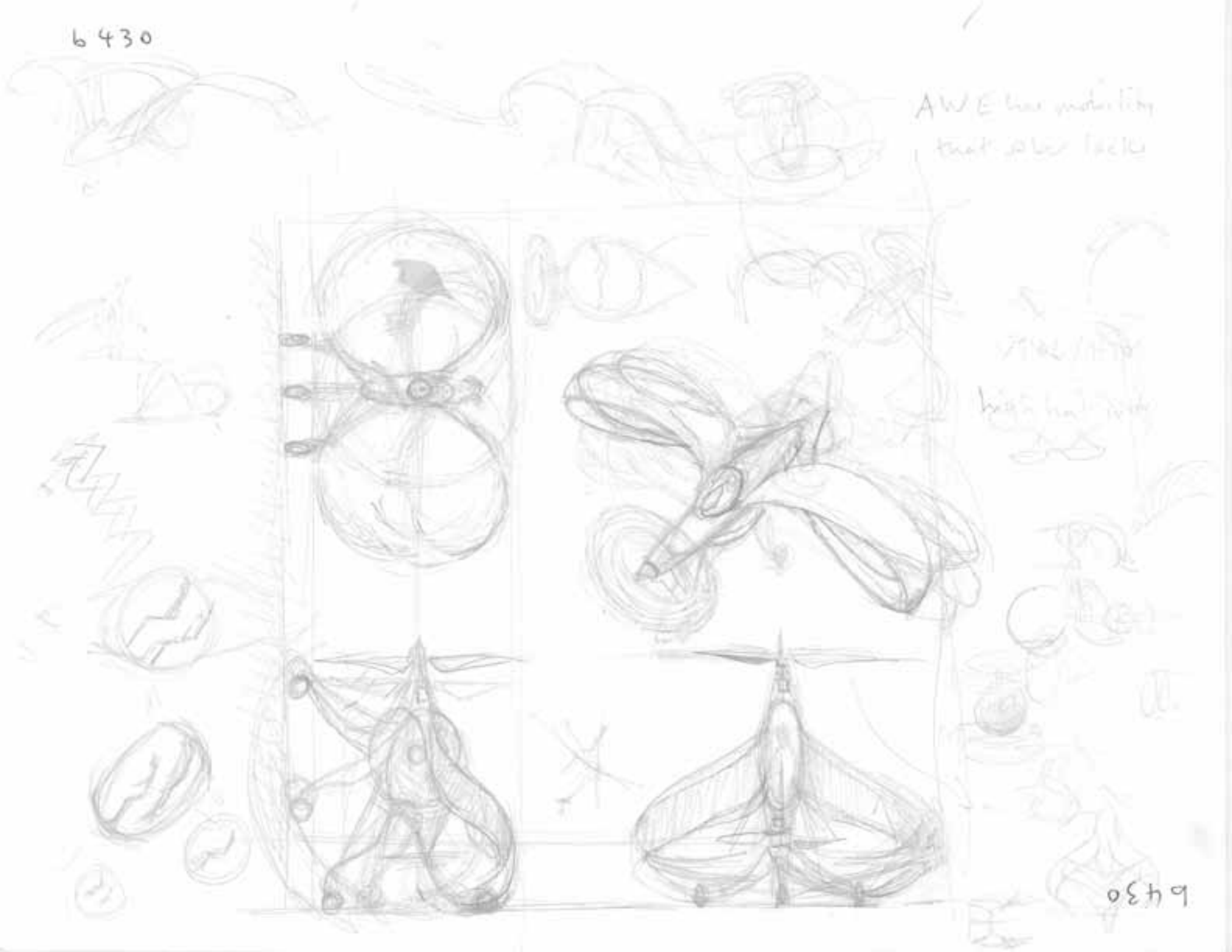

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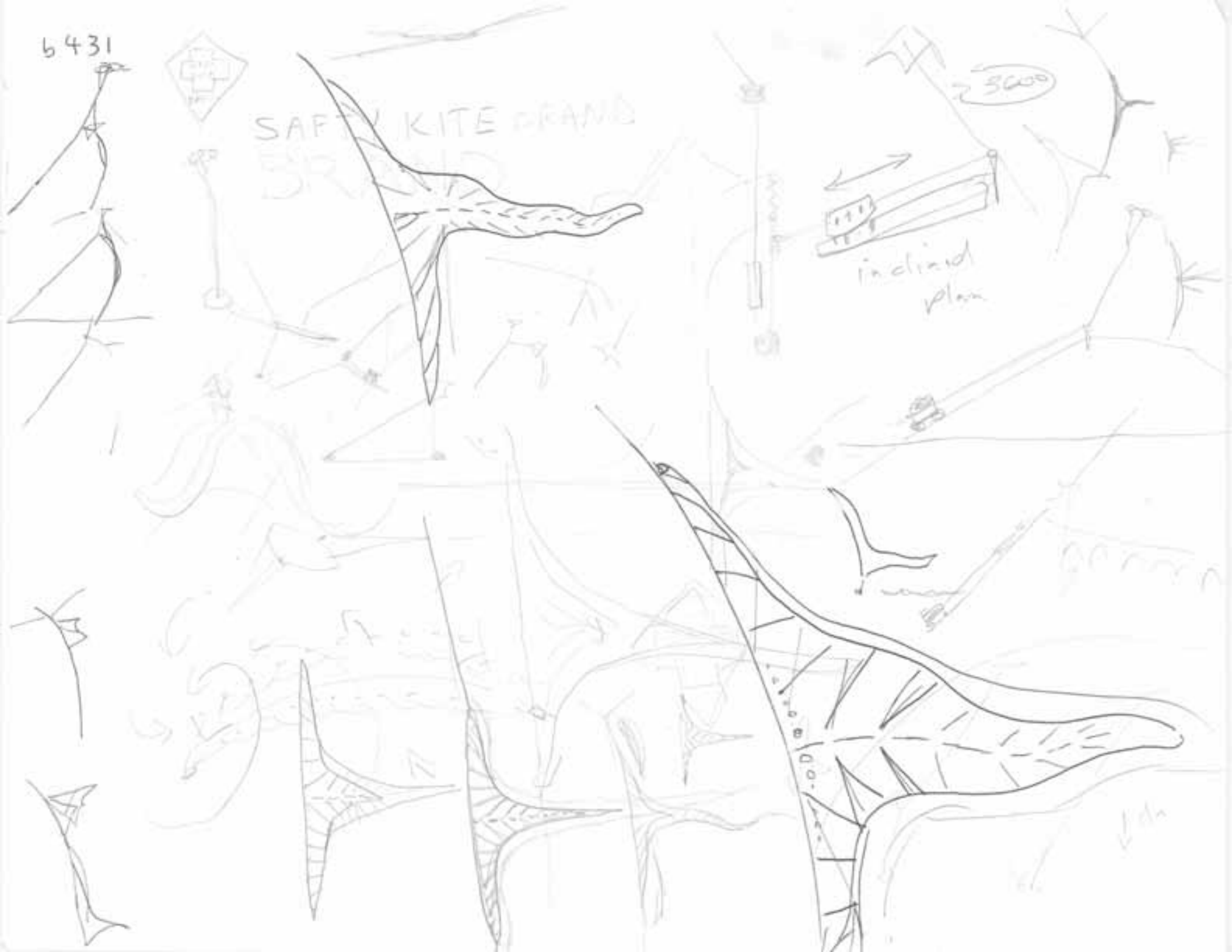
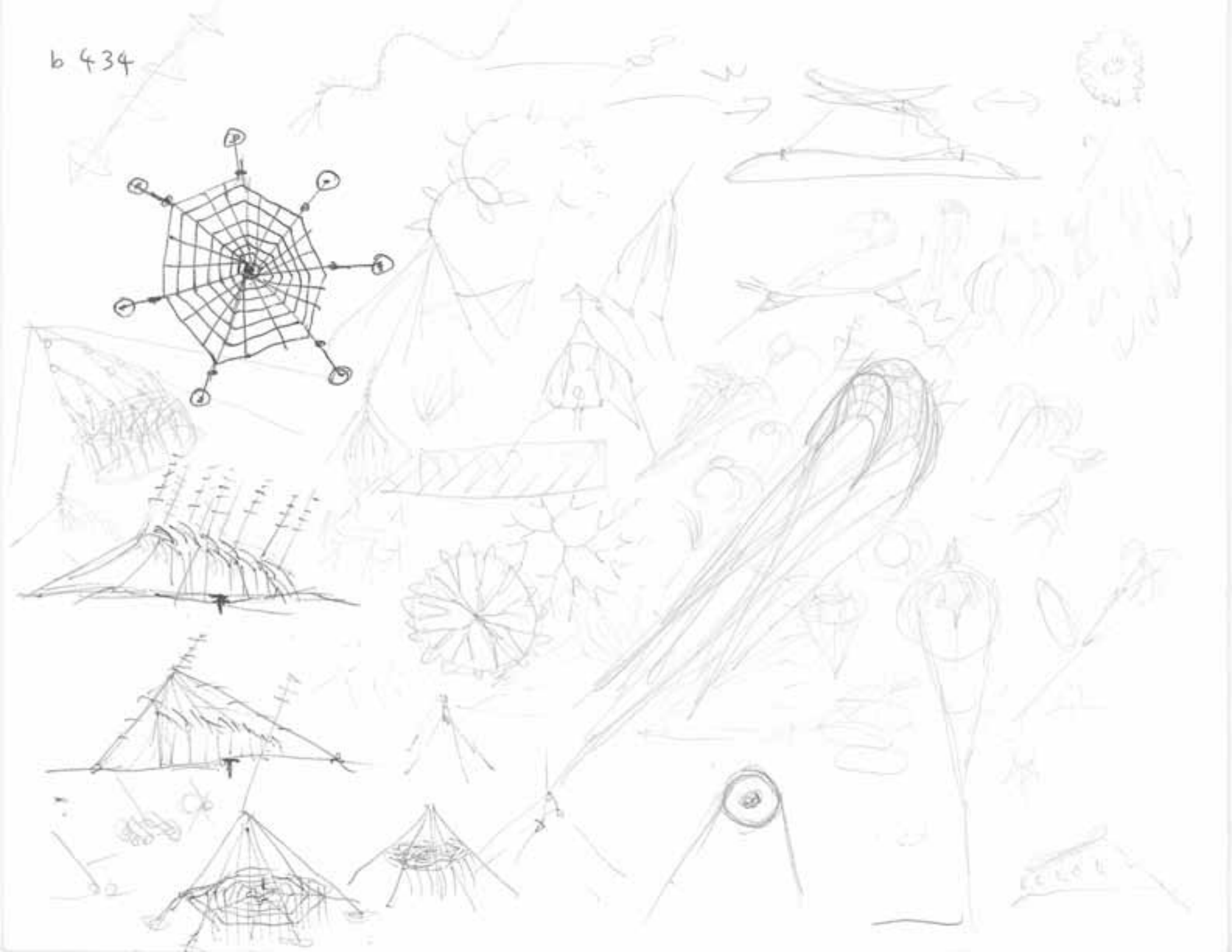
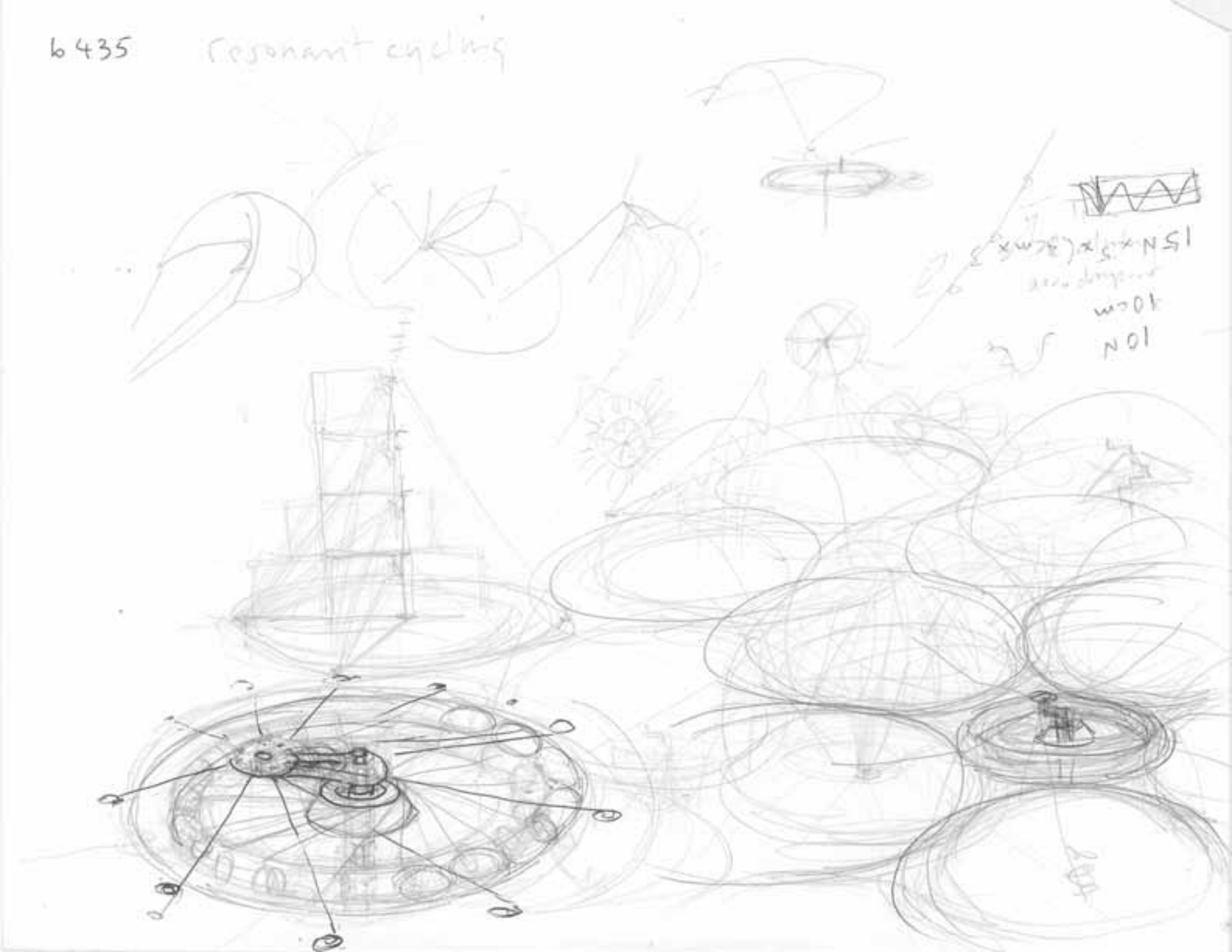

b431
SAFTY KITE BRAND
3600
inclined plan

6433

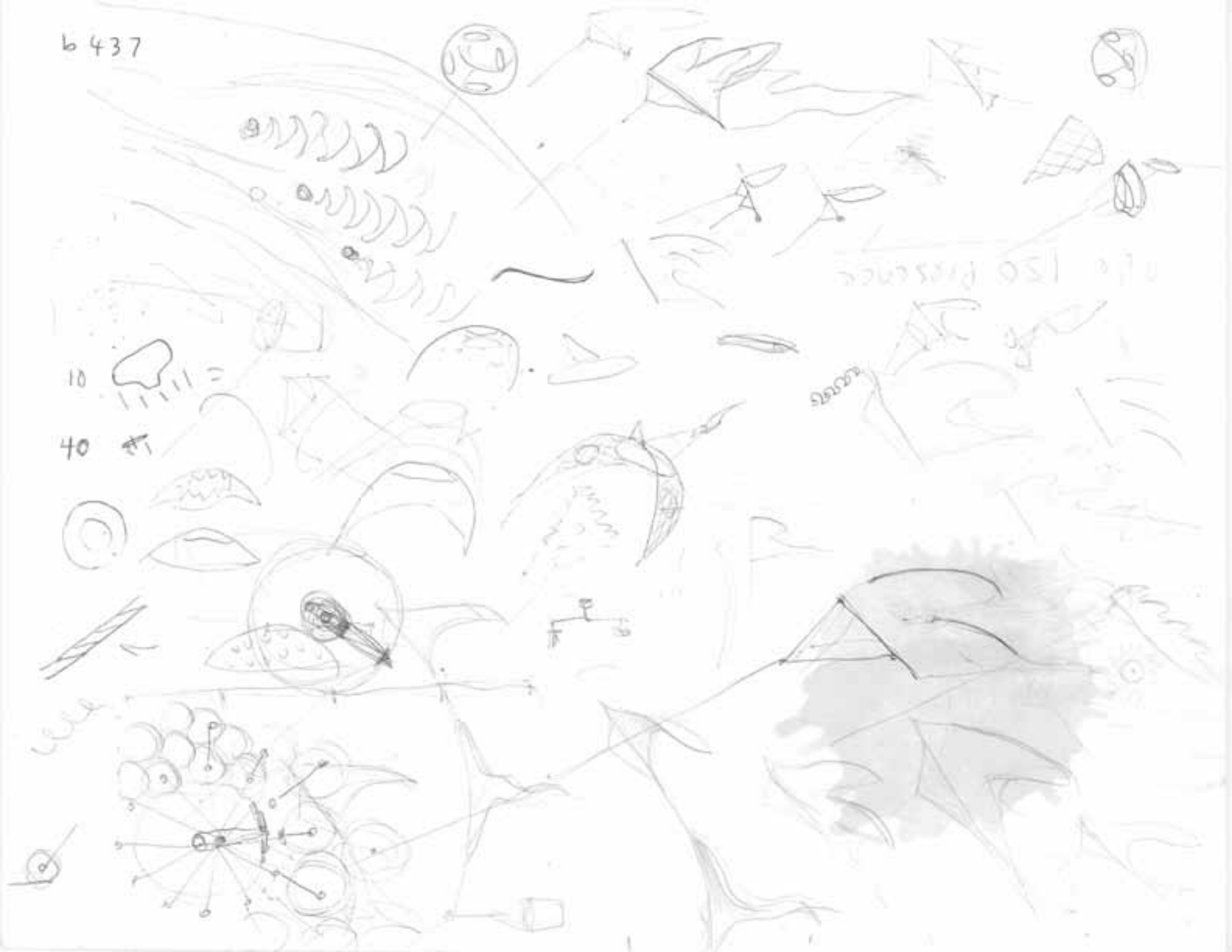
b 434

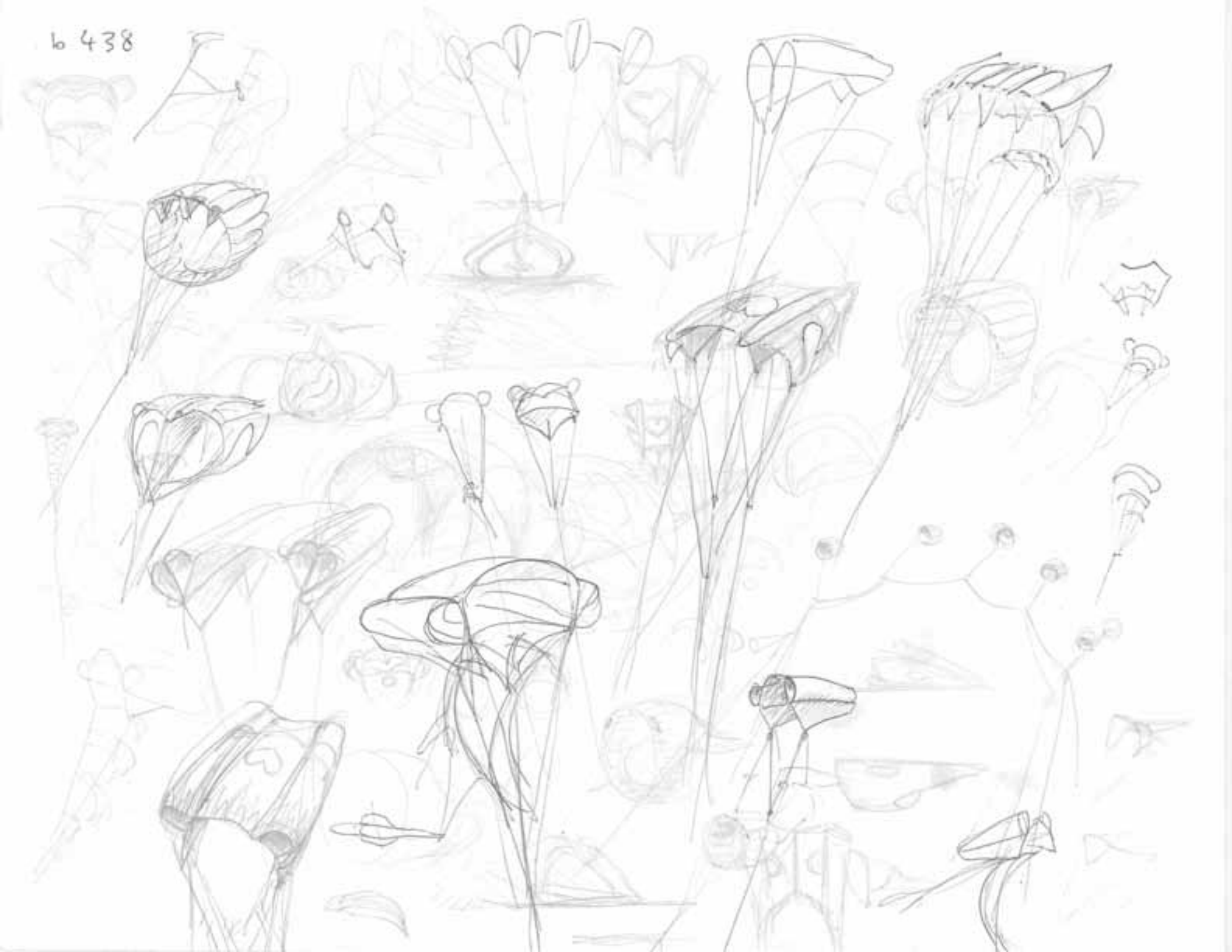


b 435 resonant cycling



b 436


b 437
10
40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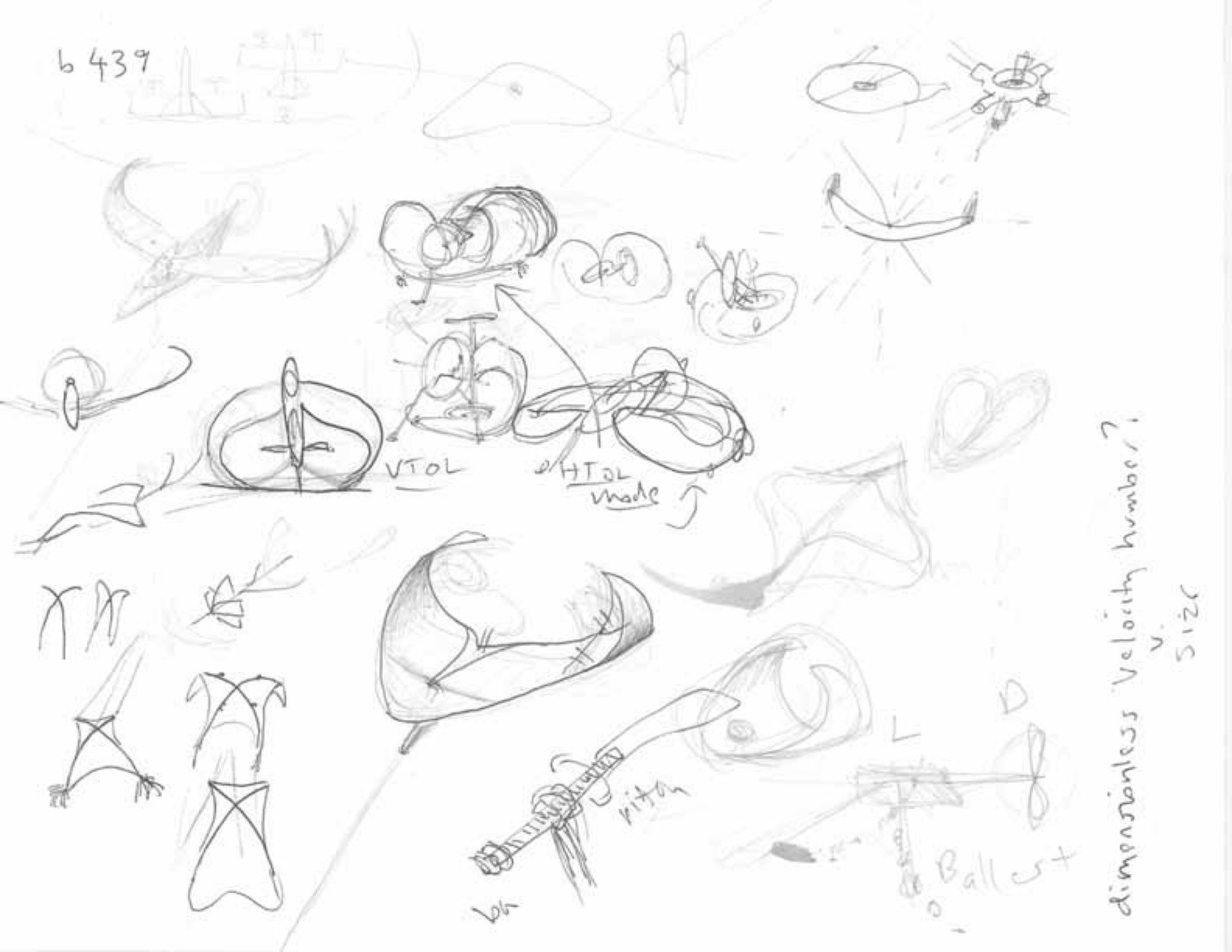
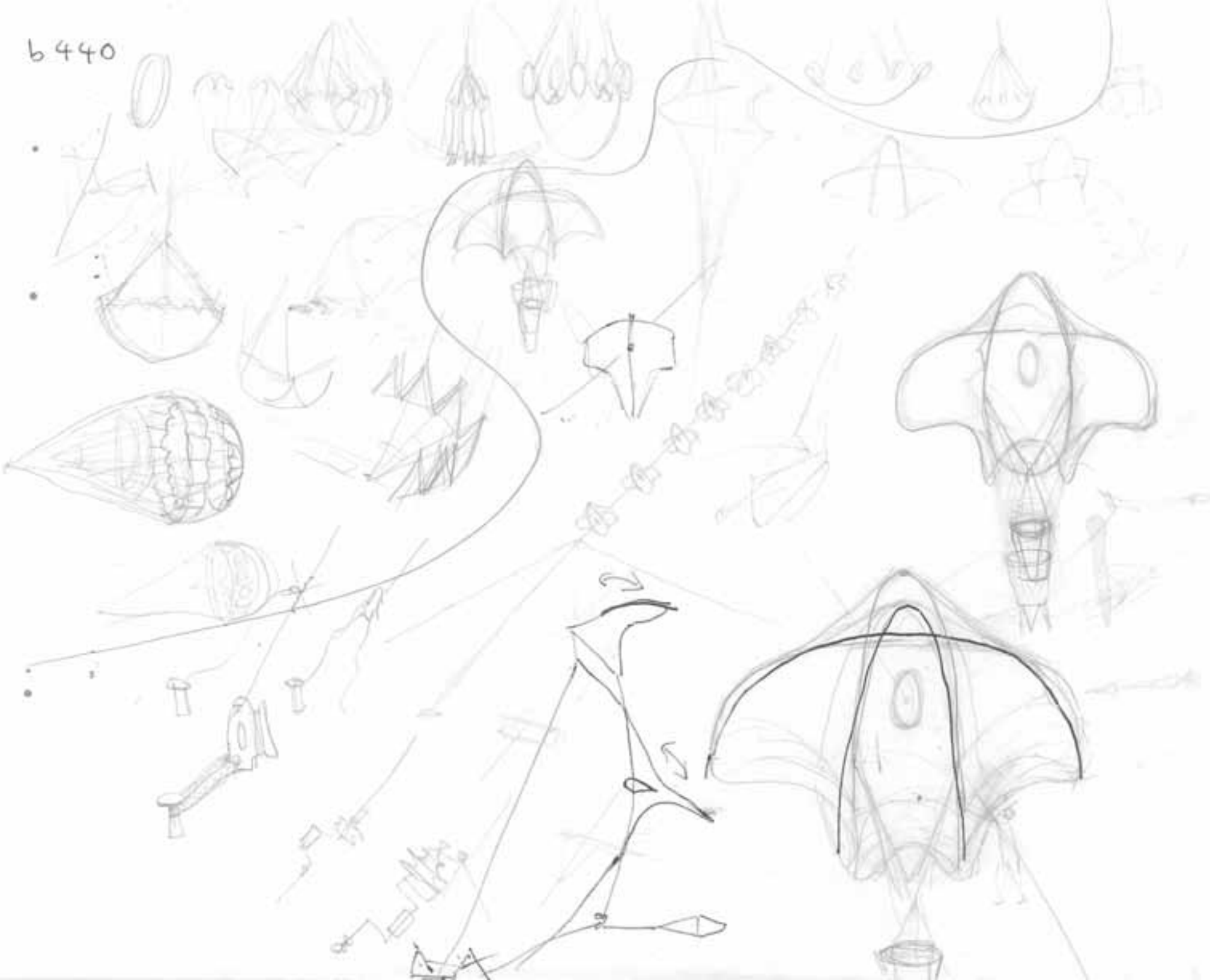
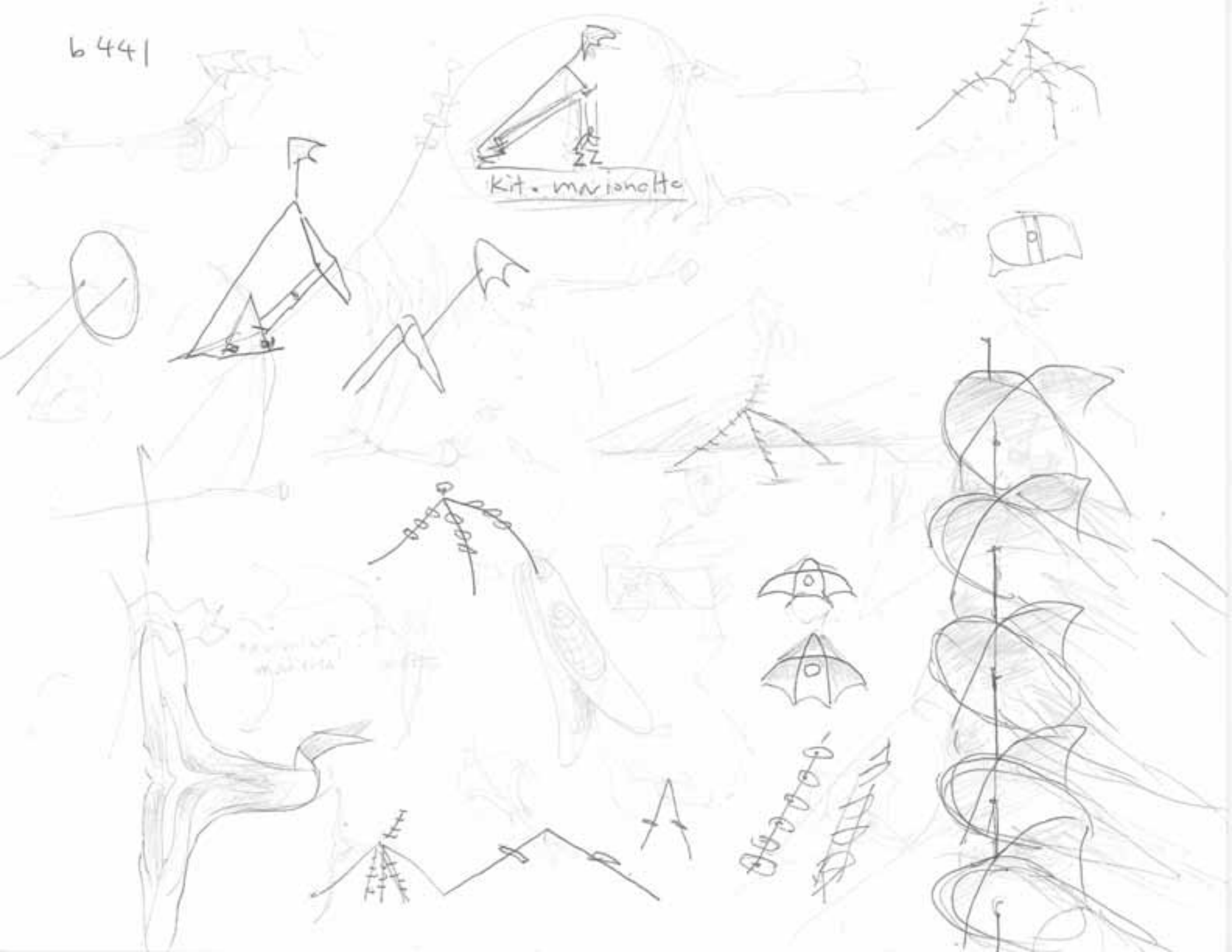

b 439
VTOL
HTOL mode
pitch
L
D
Ballast
dimensionless velocity number?
v.
size

b440



b 441



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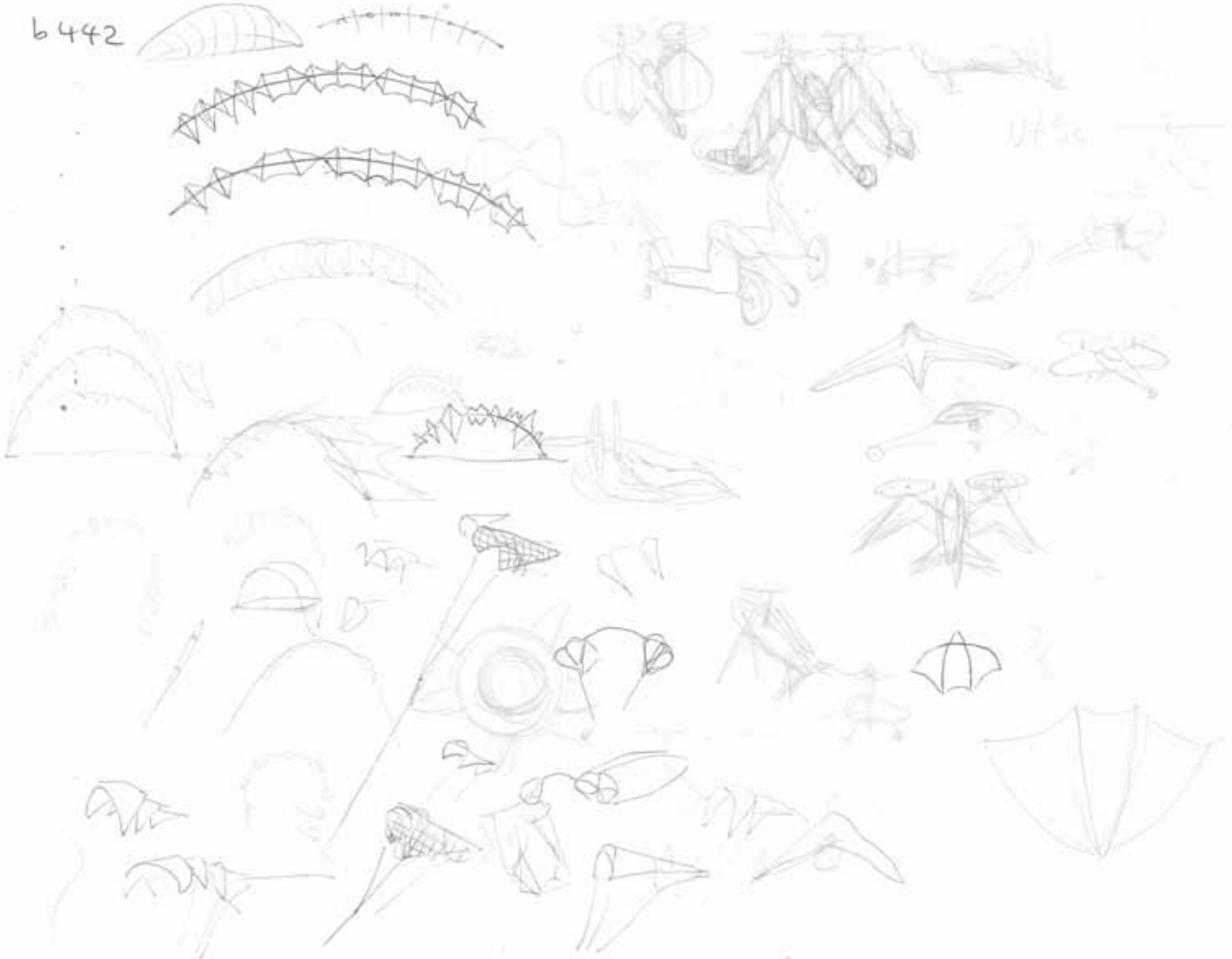
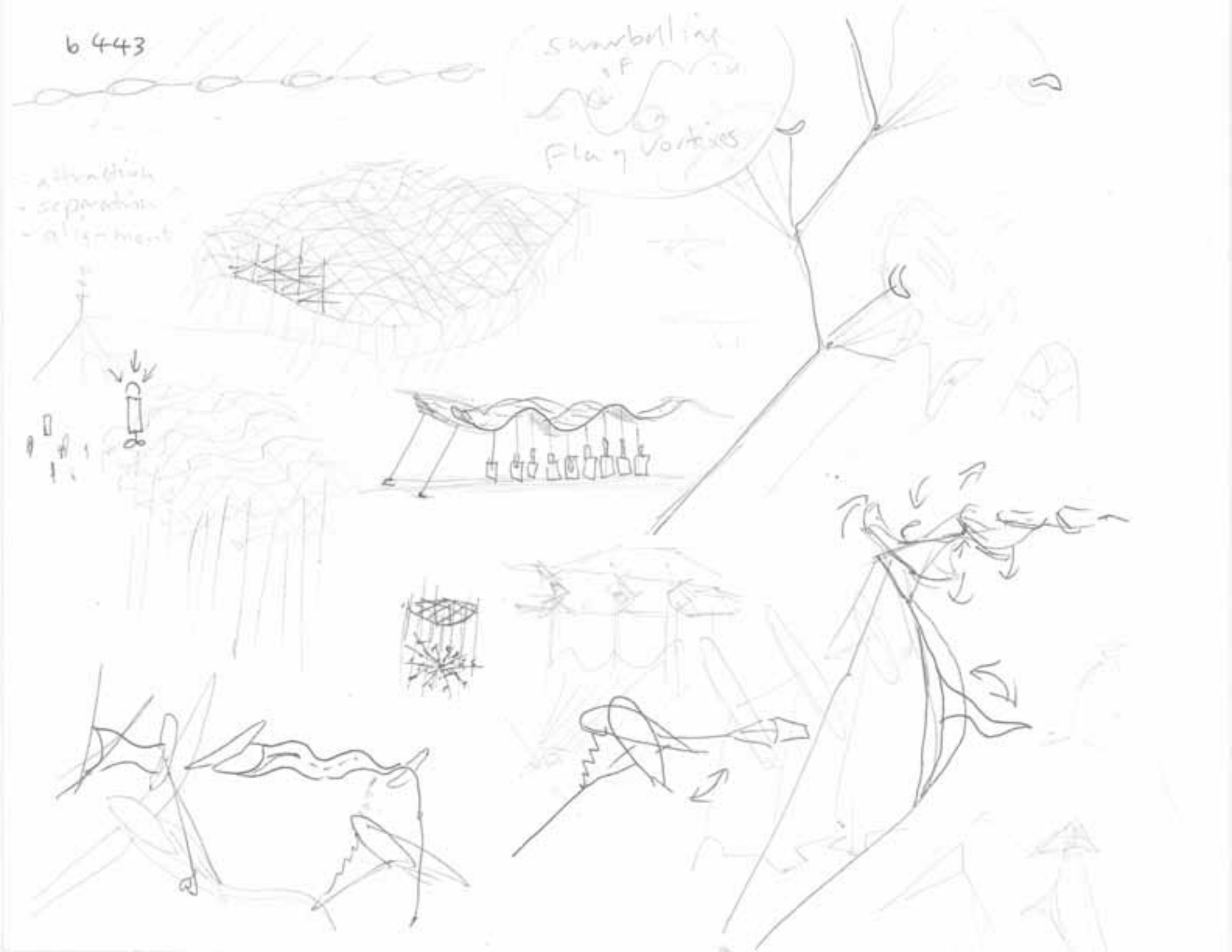
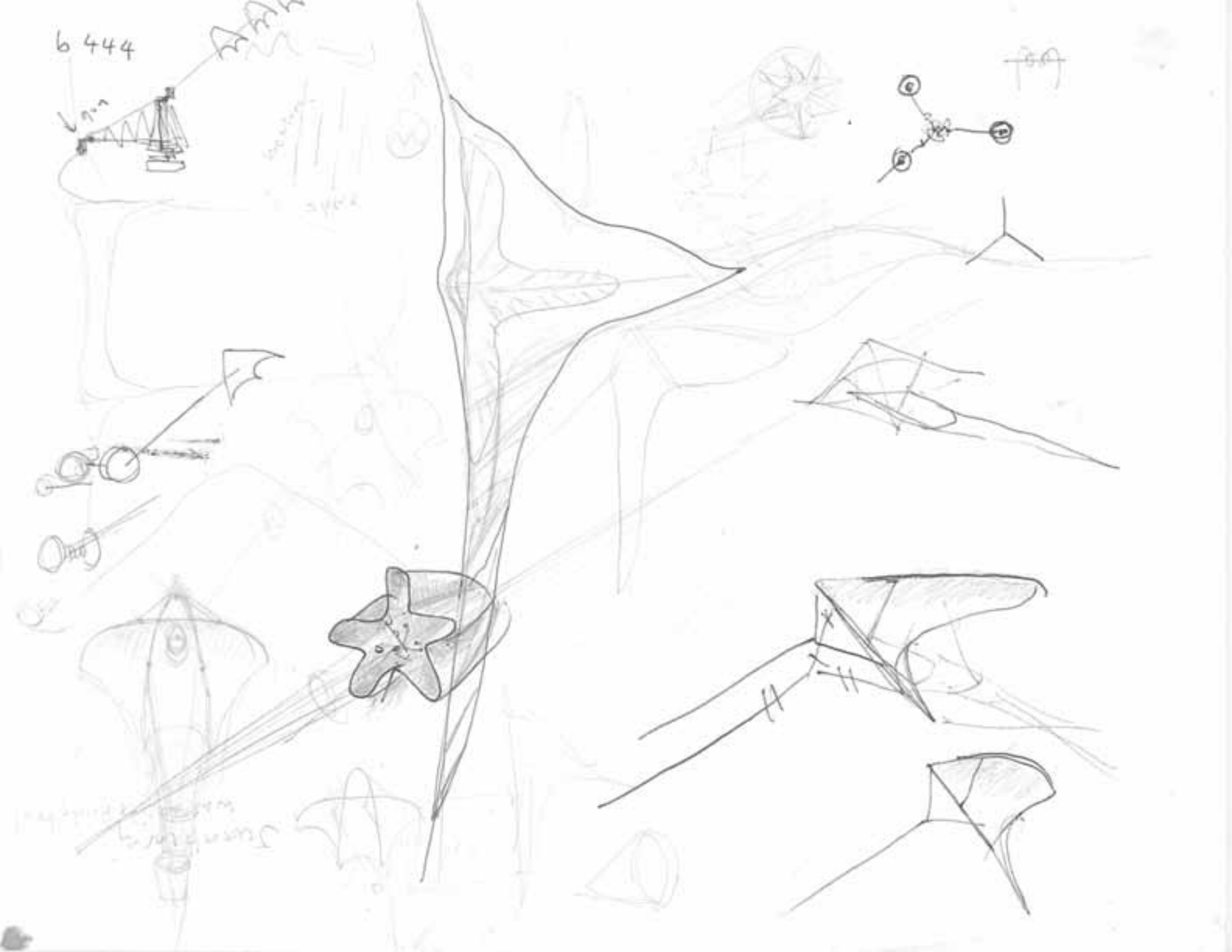



6443
swarbling
of
flag vortices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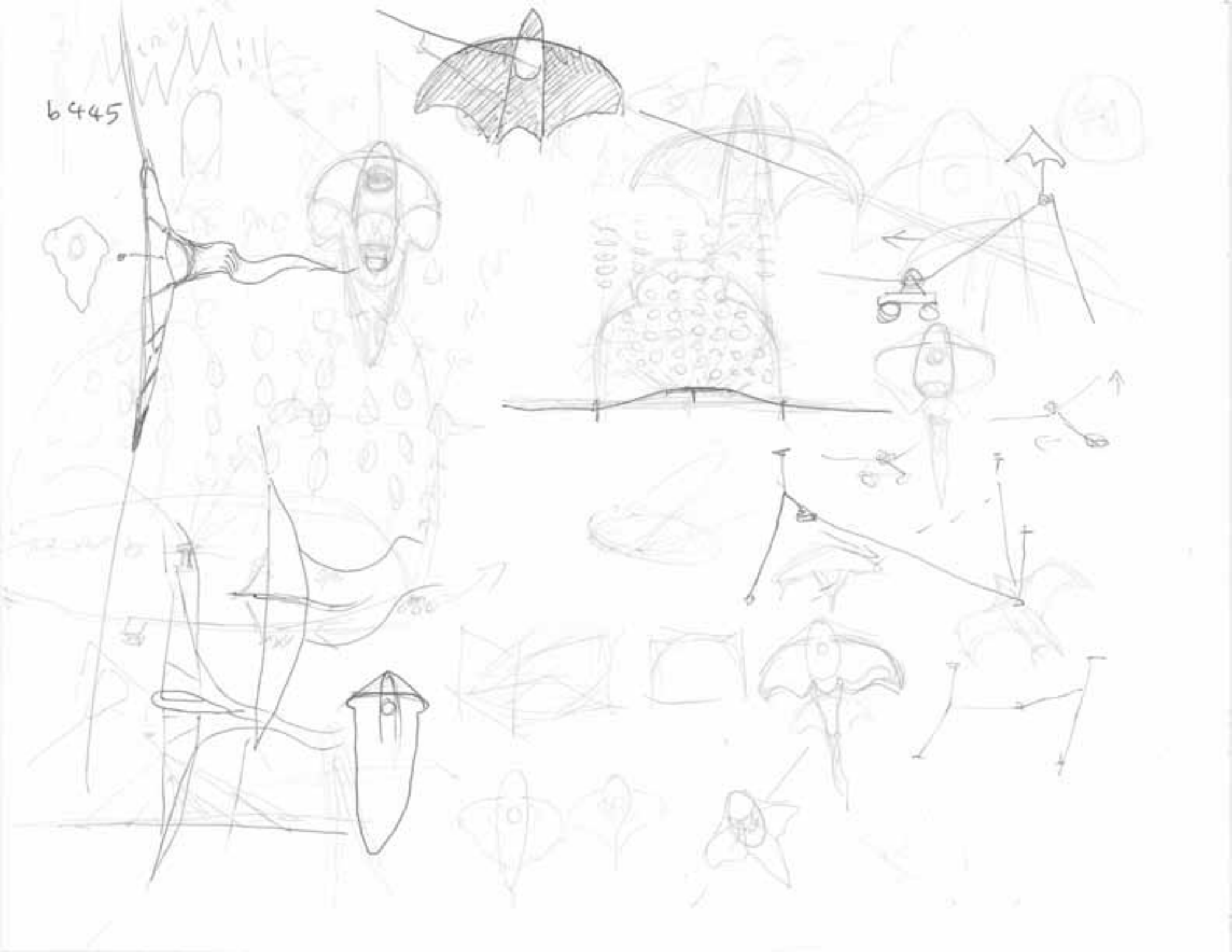
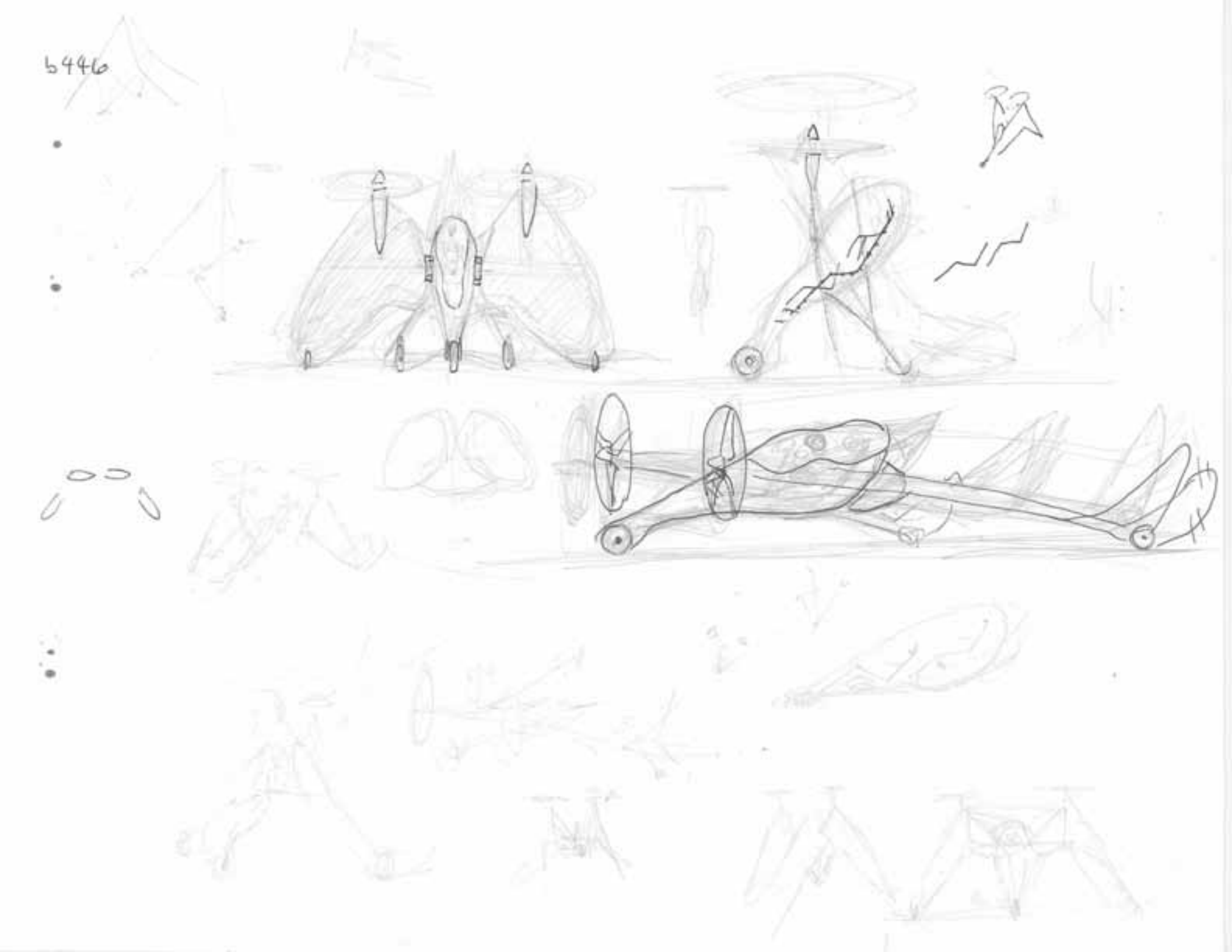

6445

b446



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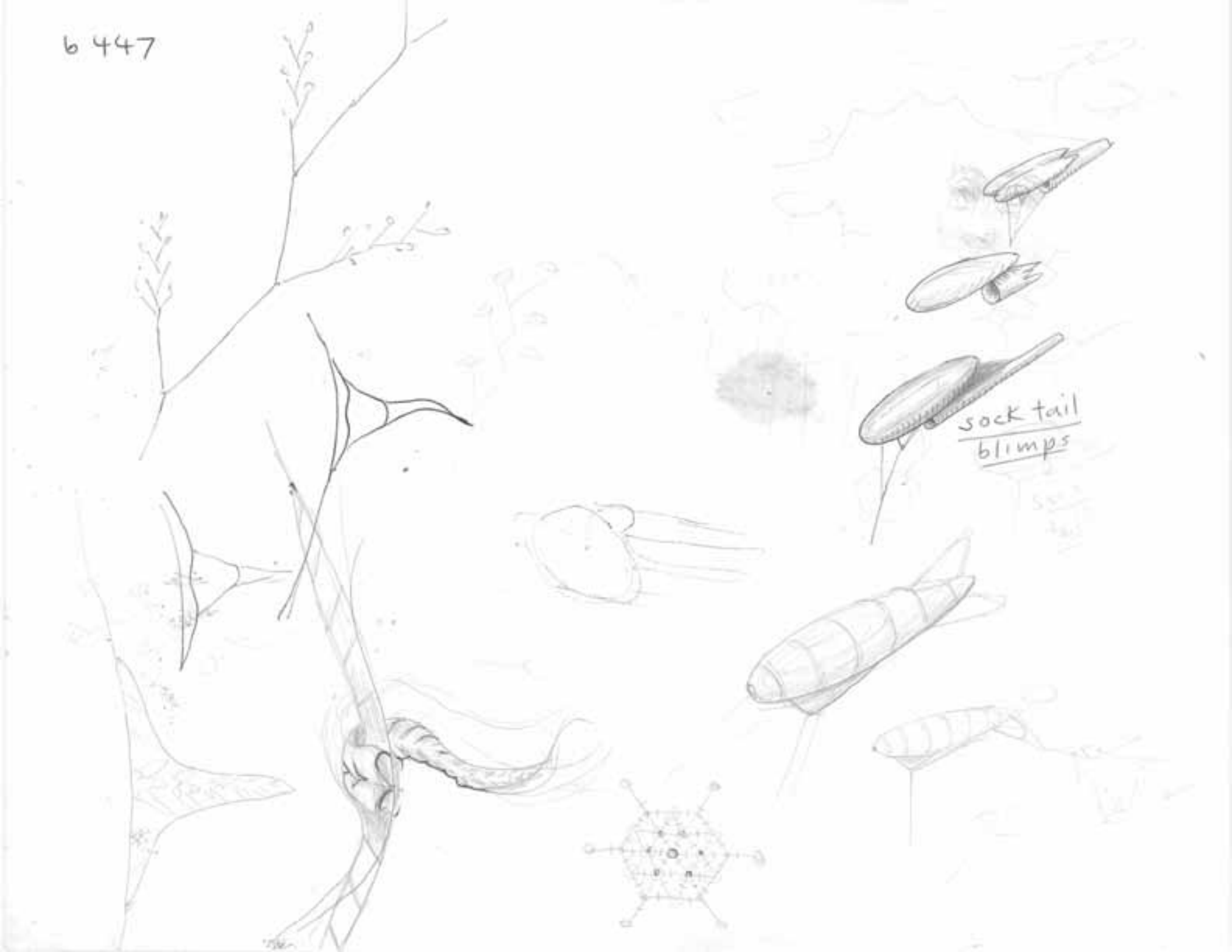
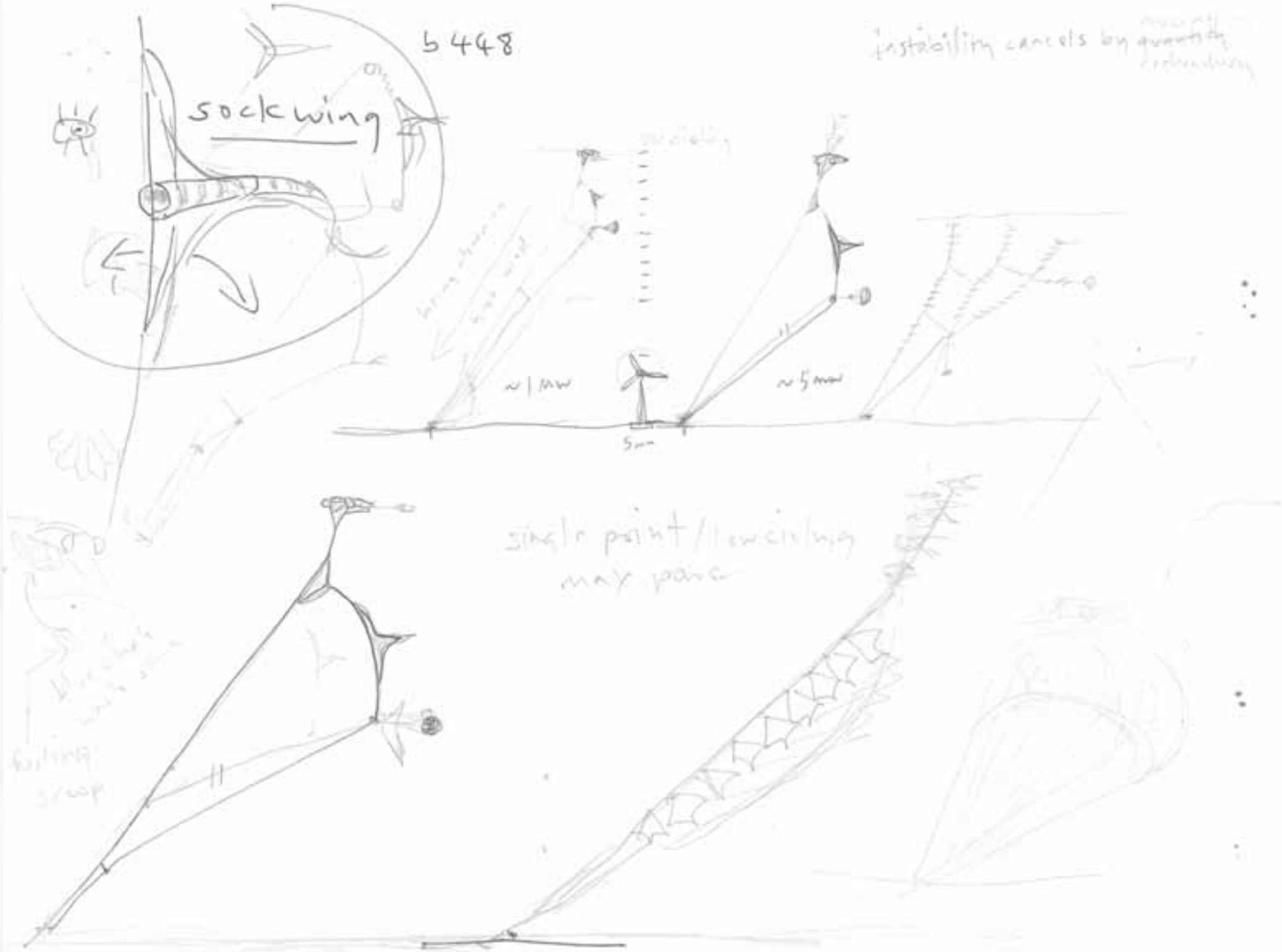
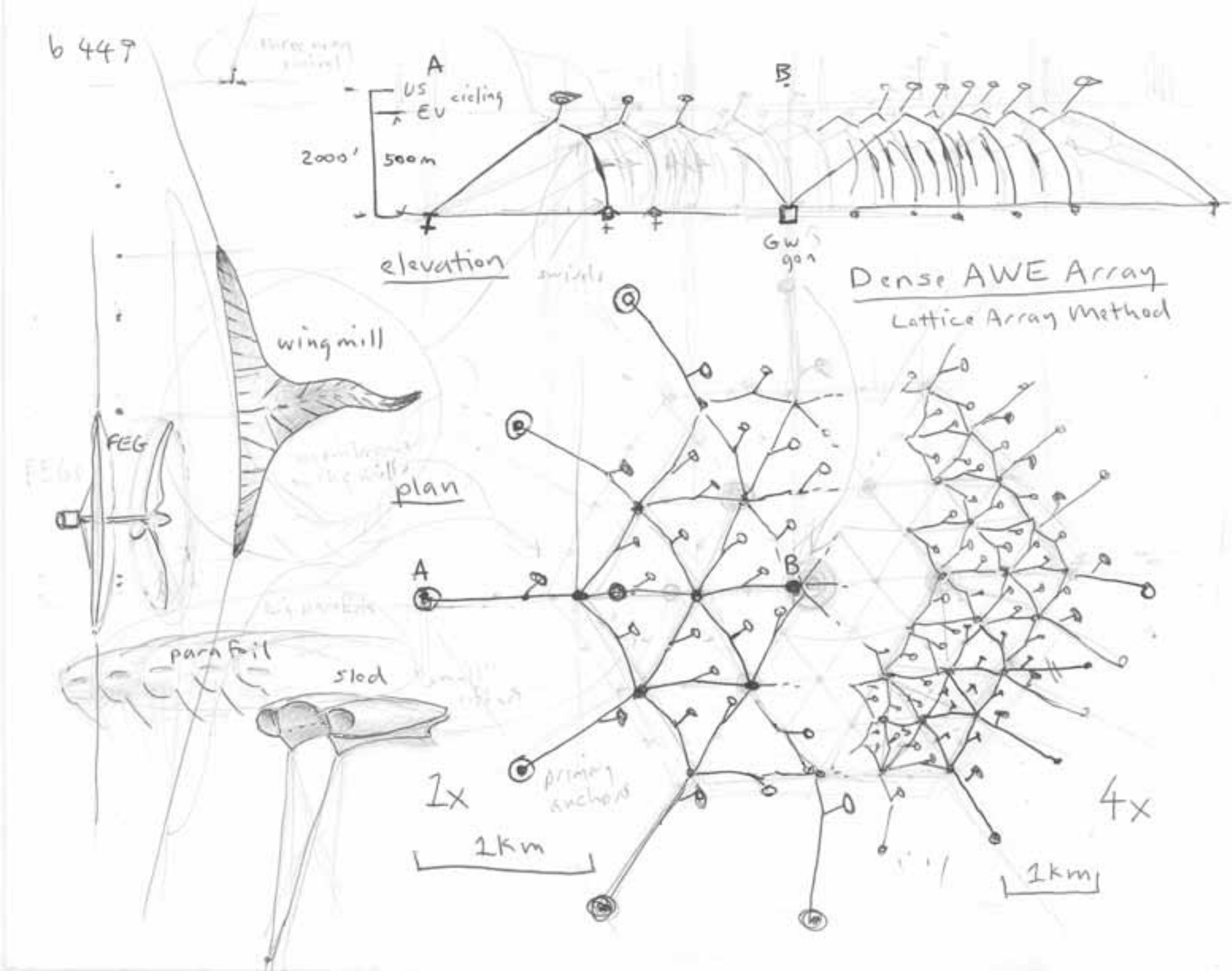
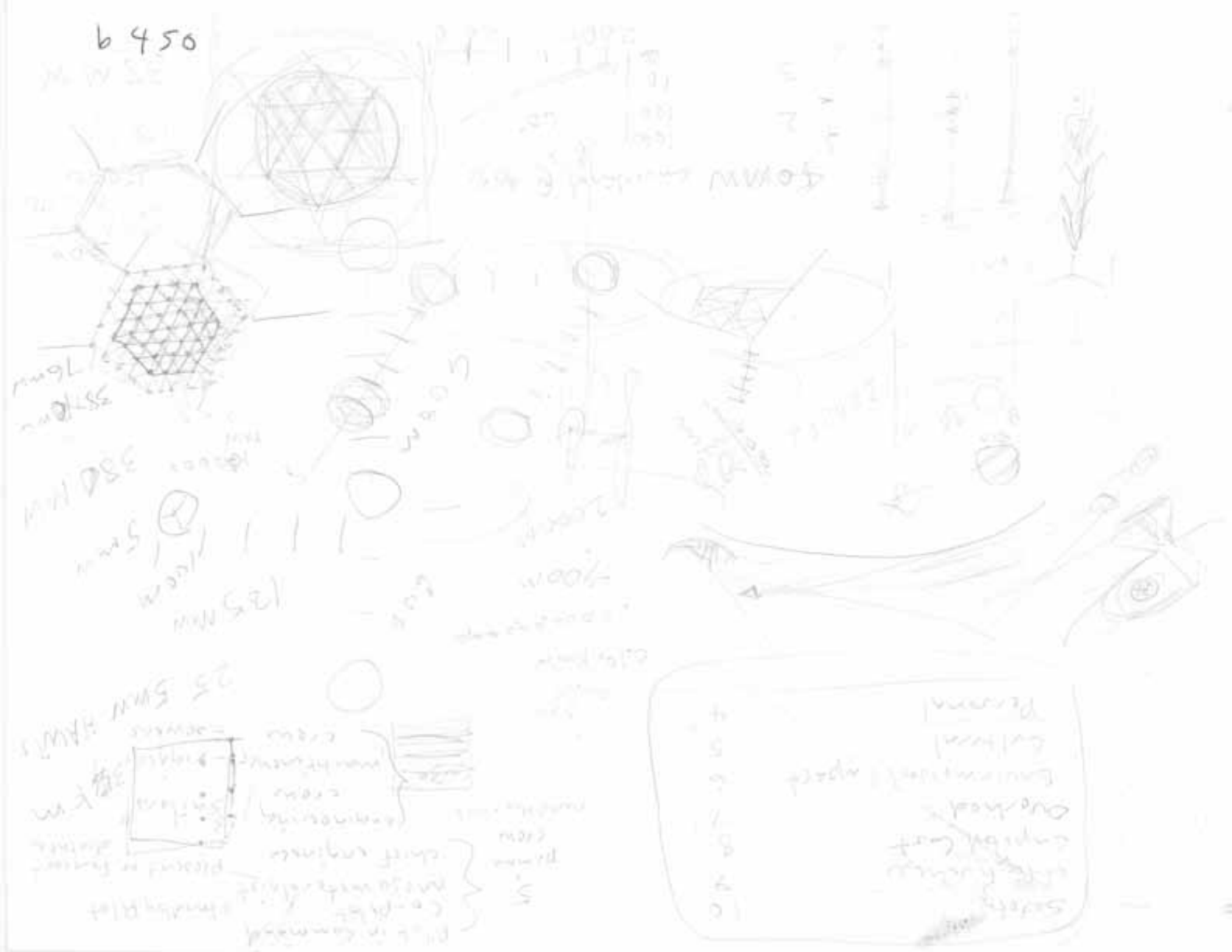


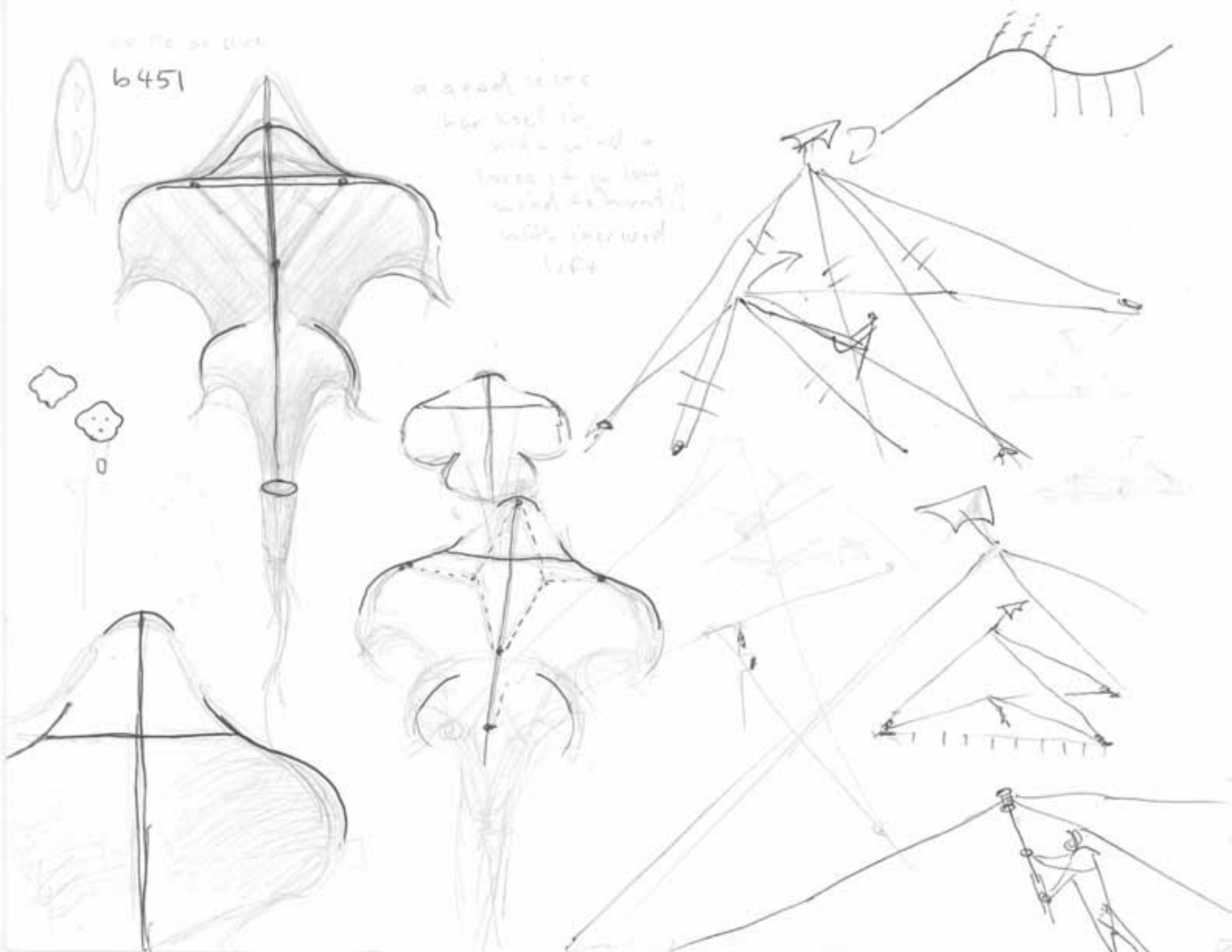

b 448
instability cancels by quantity
sockwing
~1 MW
~5 MW
single point / low cycling
max pore

b 449

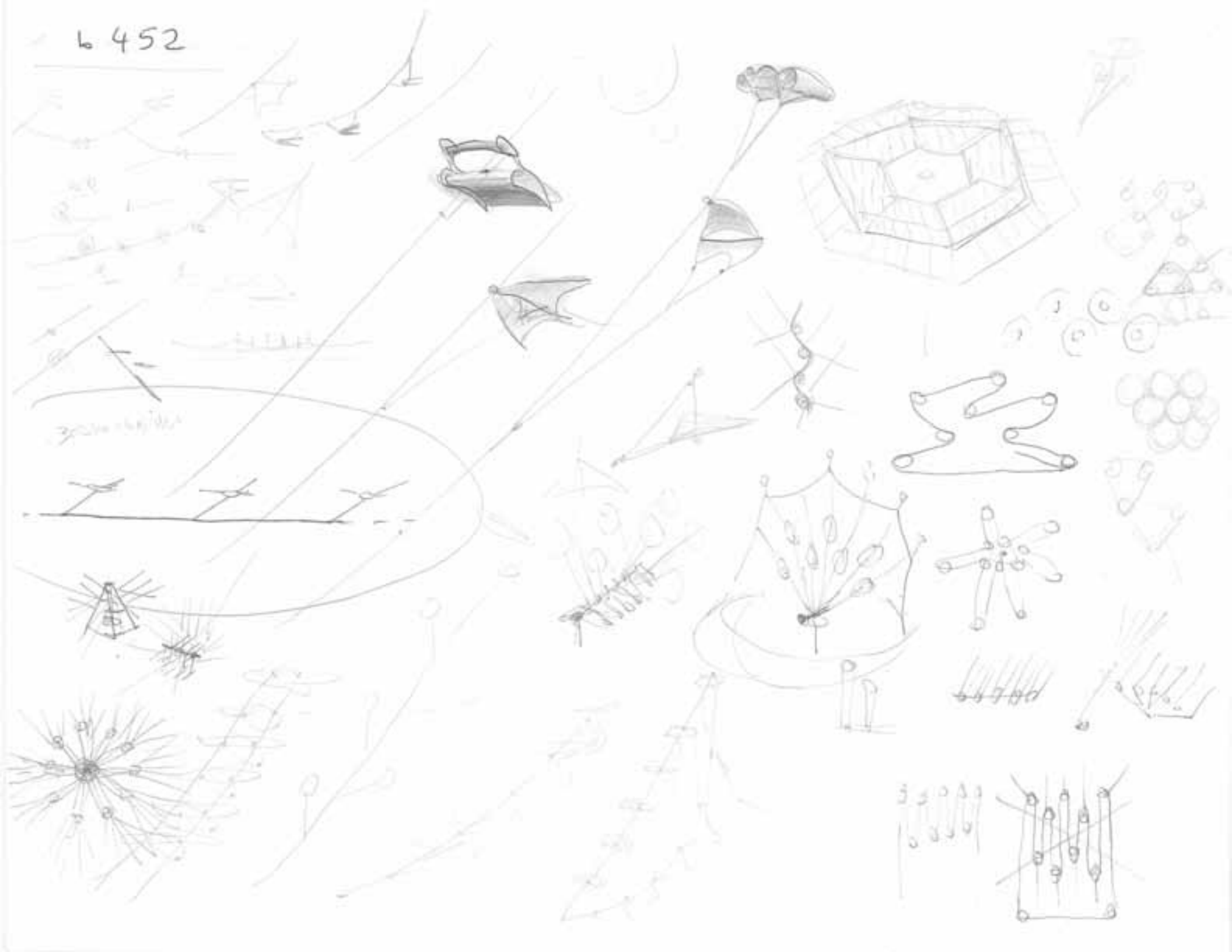

A
B
US
EU
ceiling
2000'
500m
GW
90°
elevation
Dense AWE Array
Lattice Array Method
wingmill
FEG
plan
parafoil
sled
A
B
primary anchors
1x
1km
4x
1km

6450



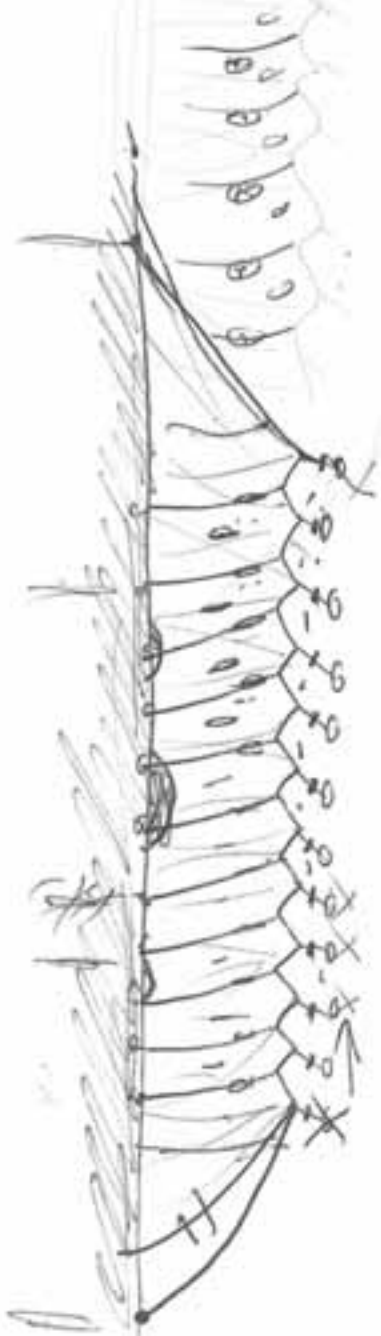

6451

6 452

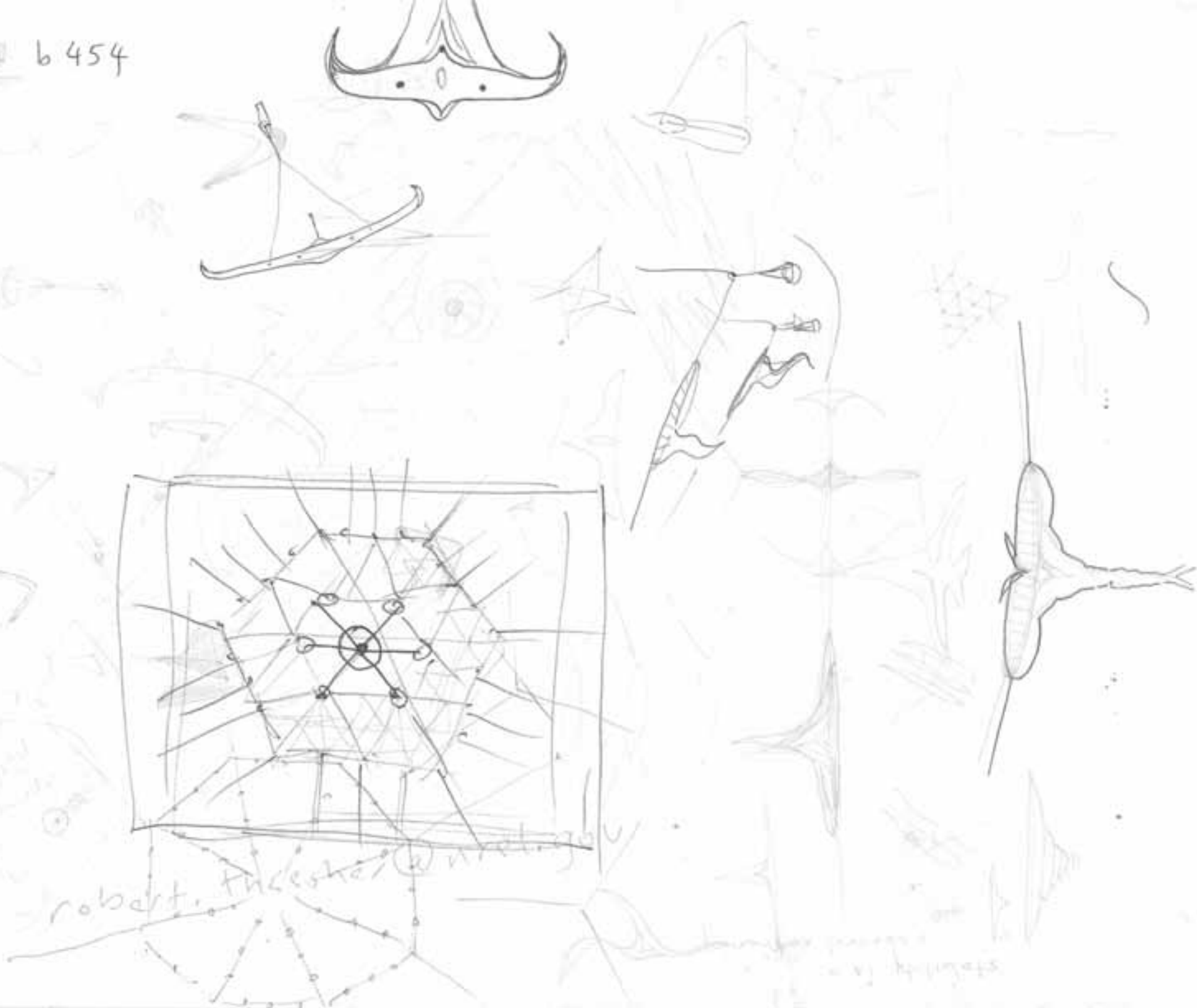


b 453

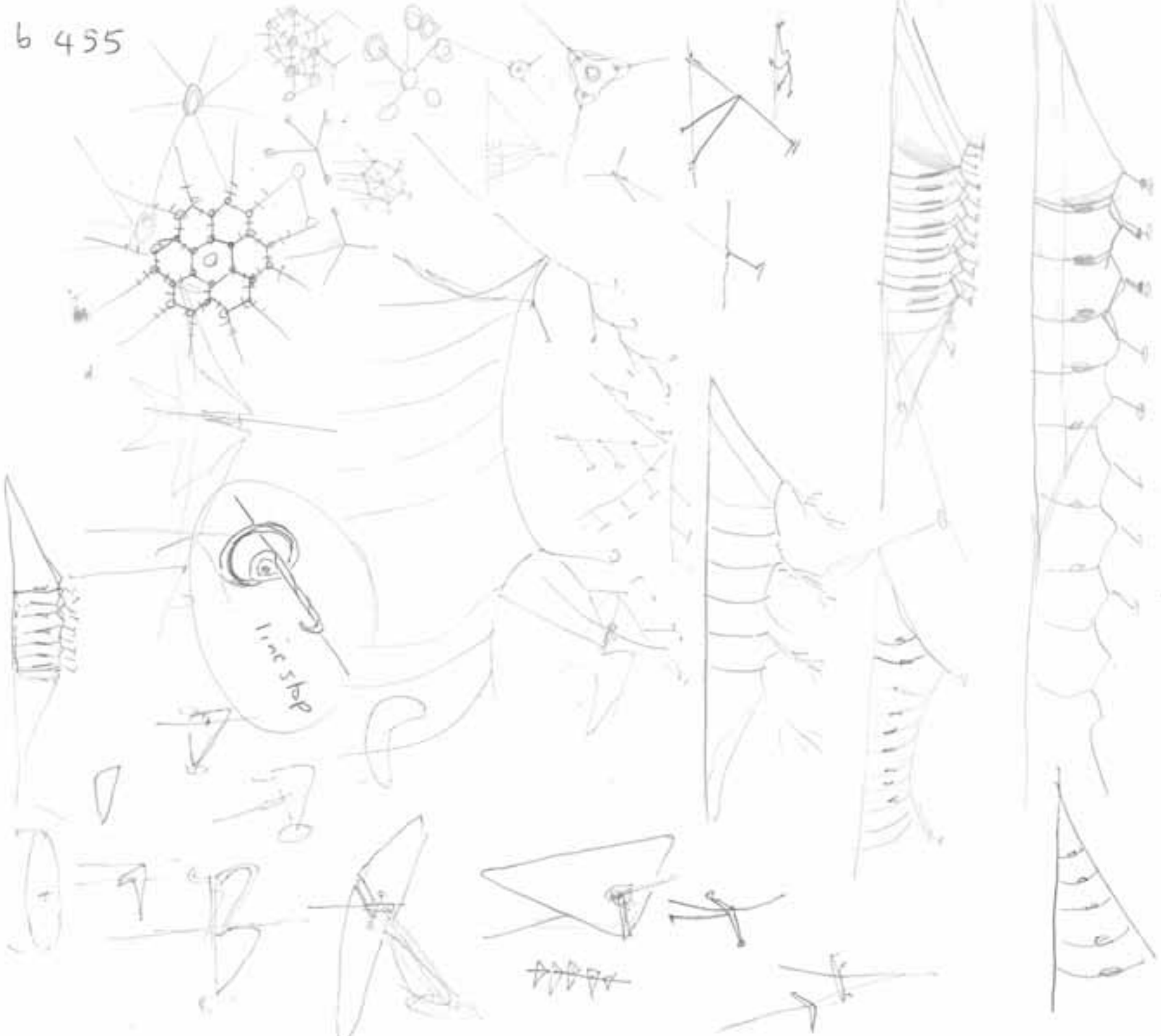
Knowledge Creation

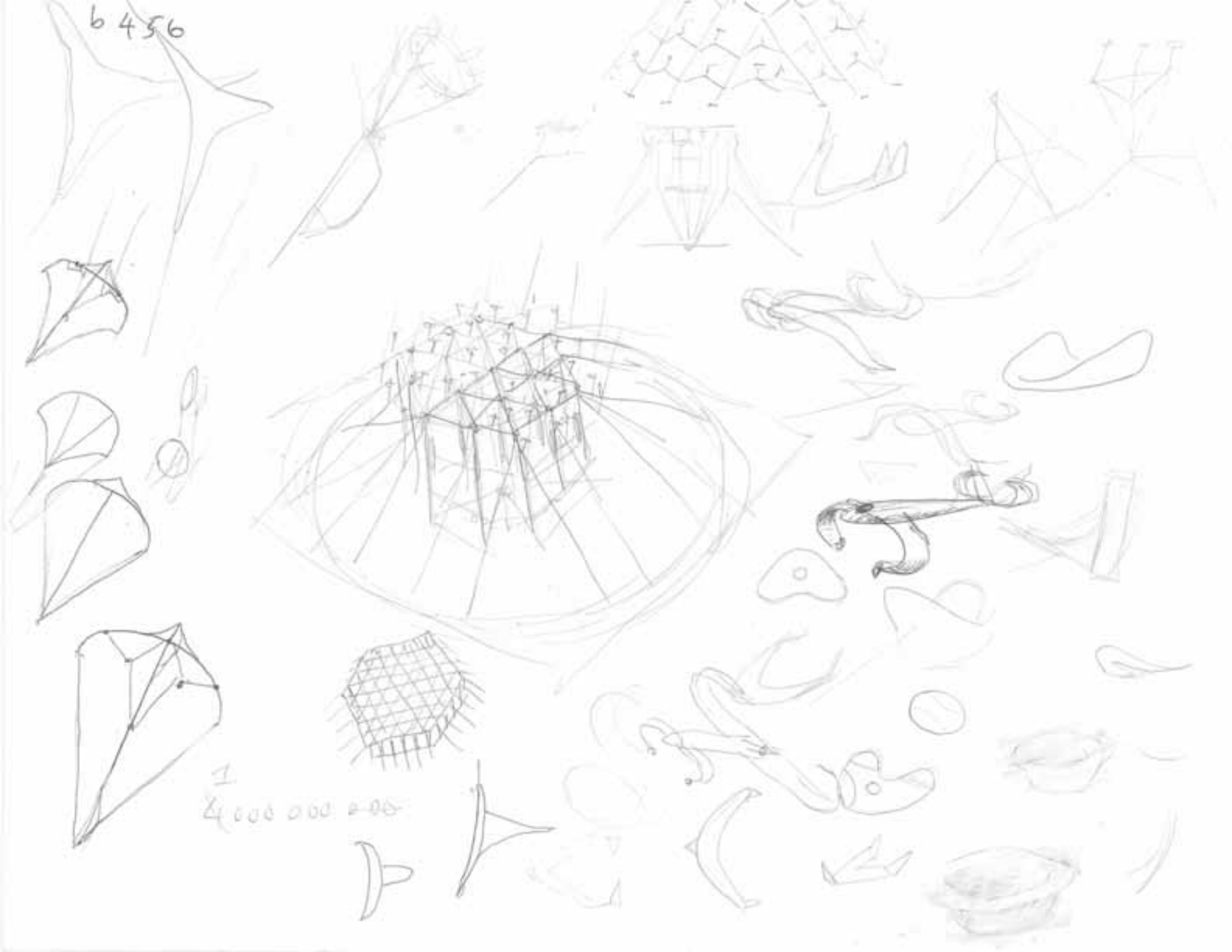


b 454



b 455



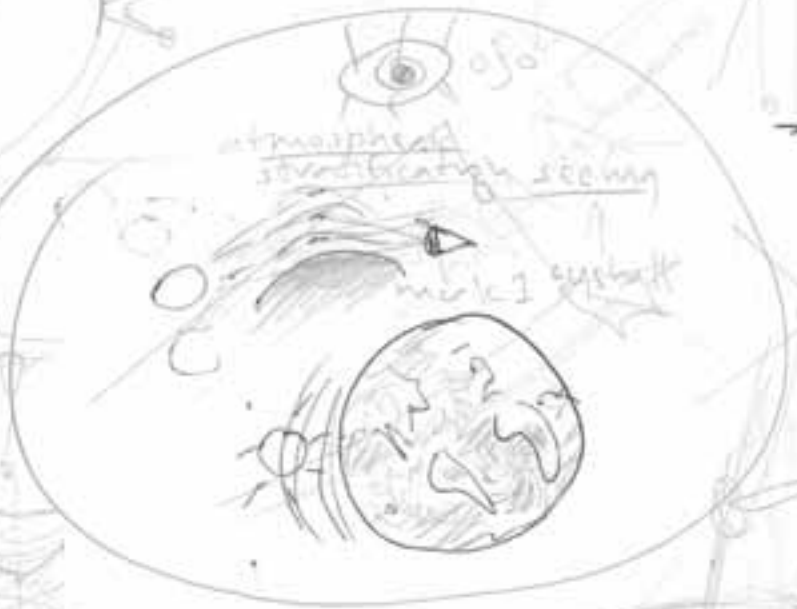

6456

protopolymagoid
-mesian

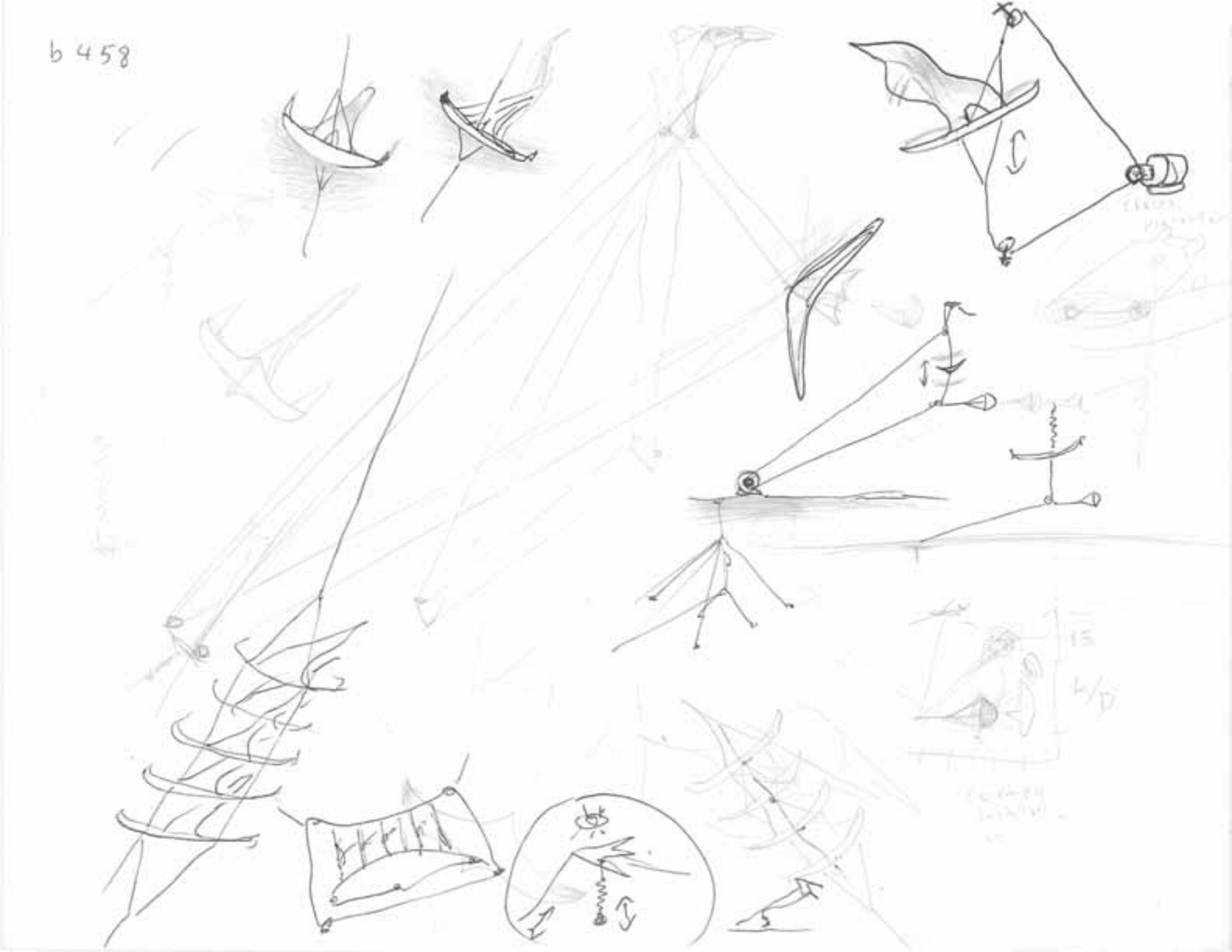
6457

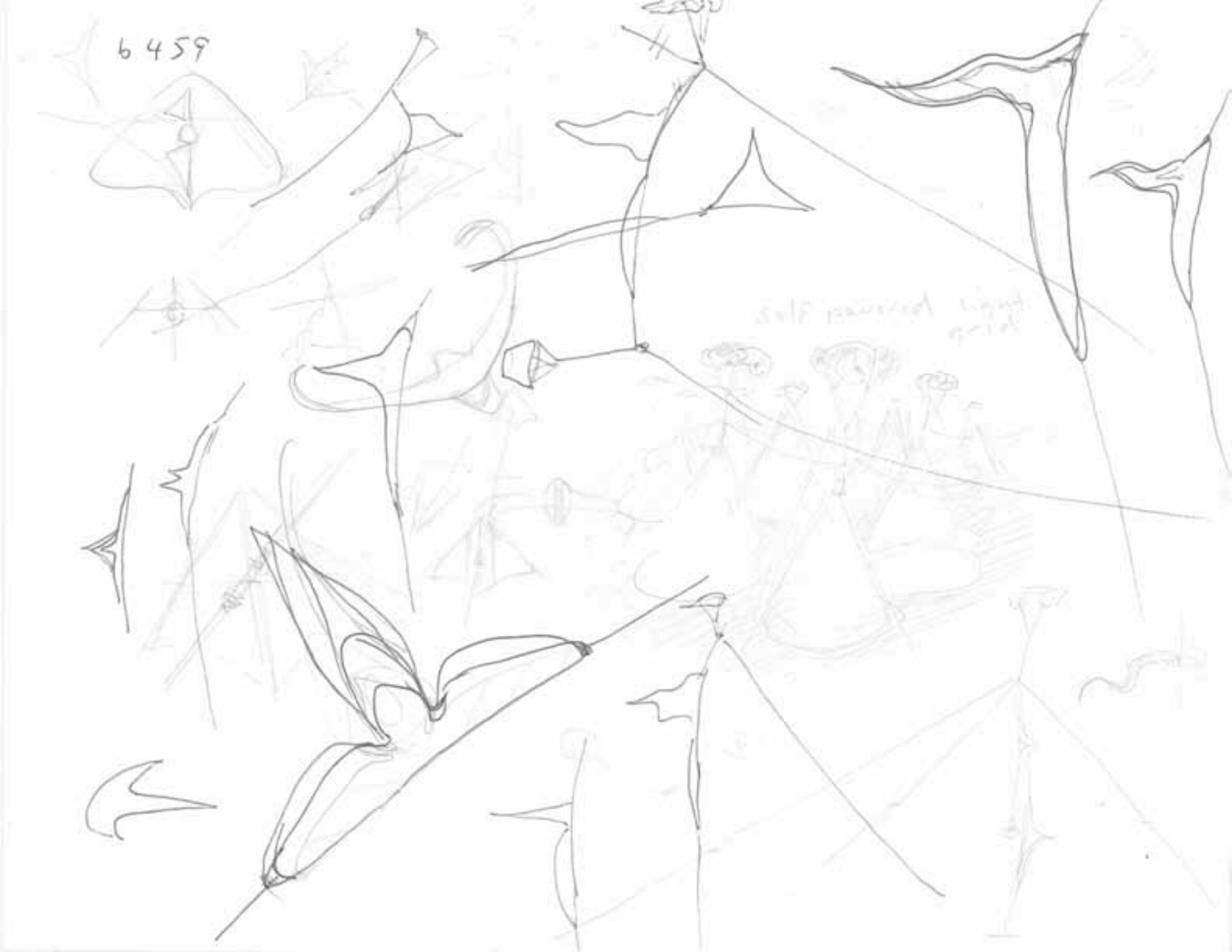
take-off

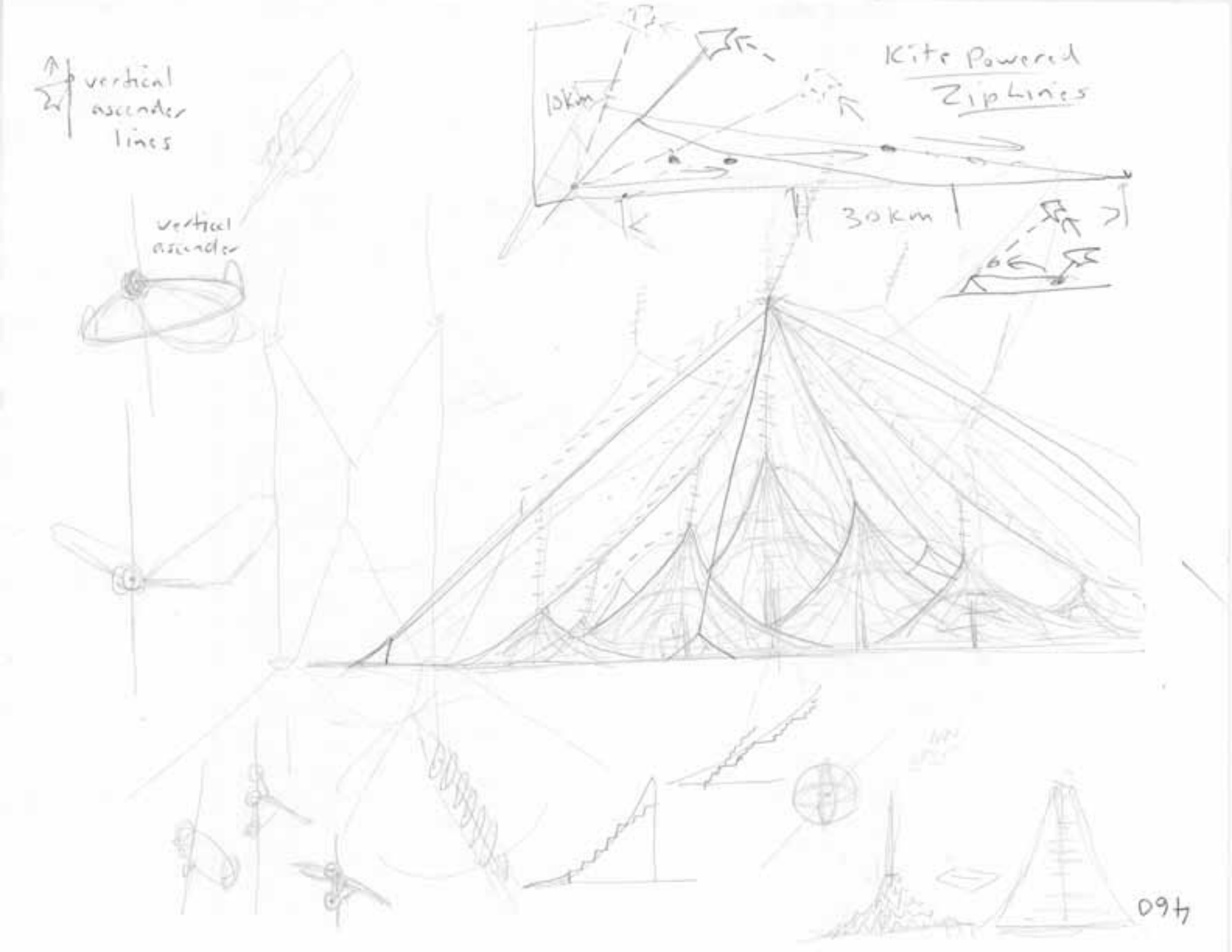
staged landing sequence



b 458

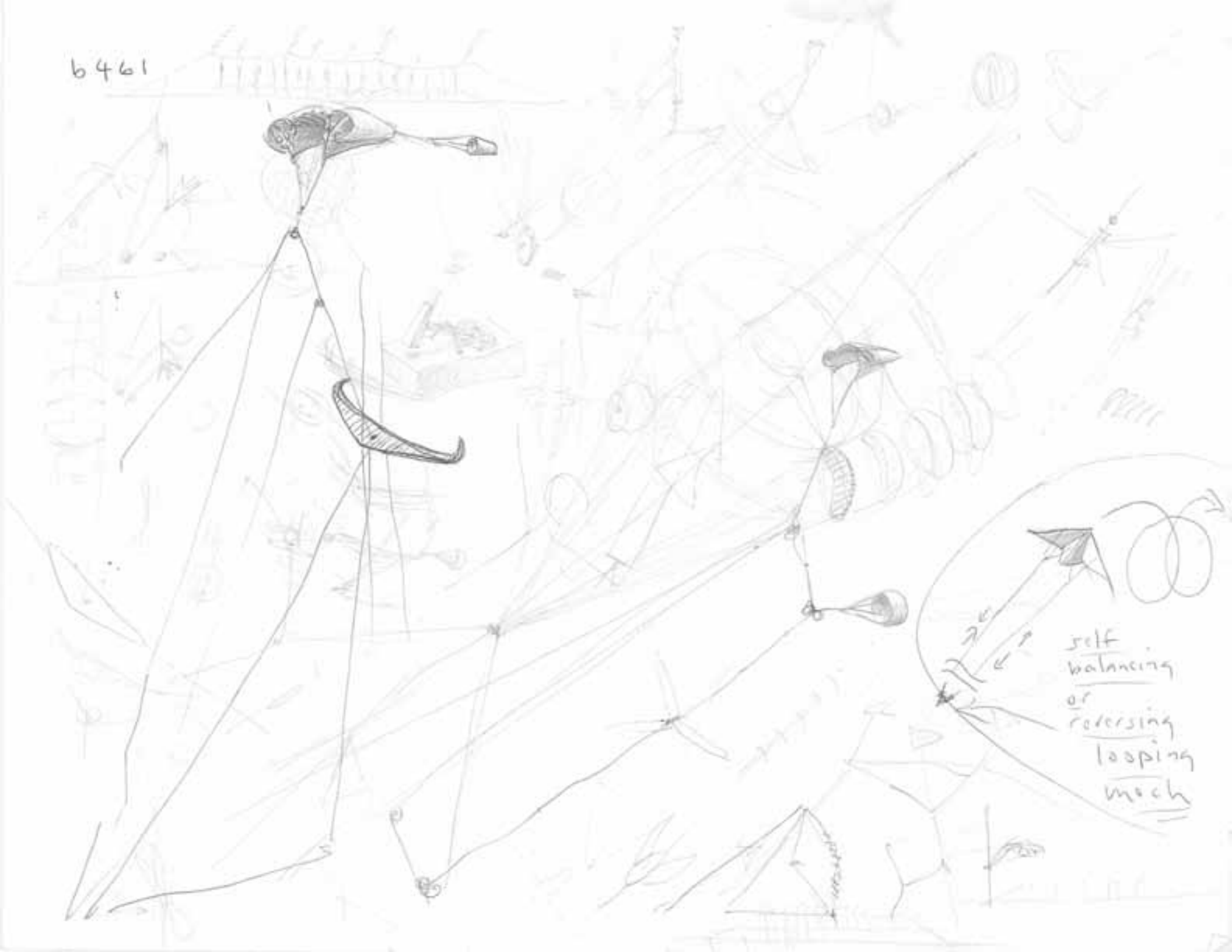


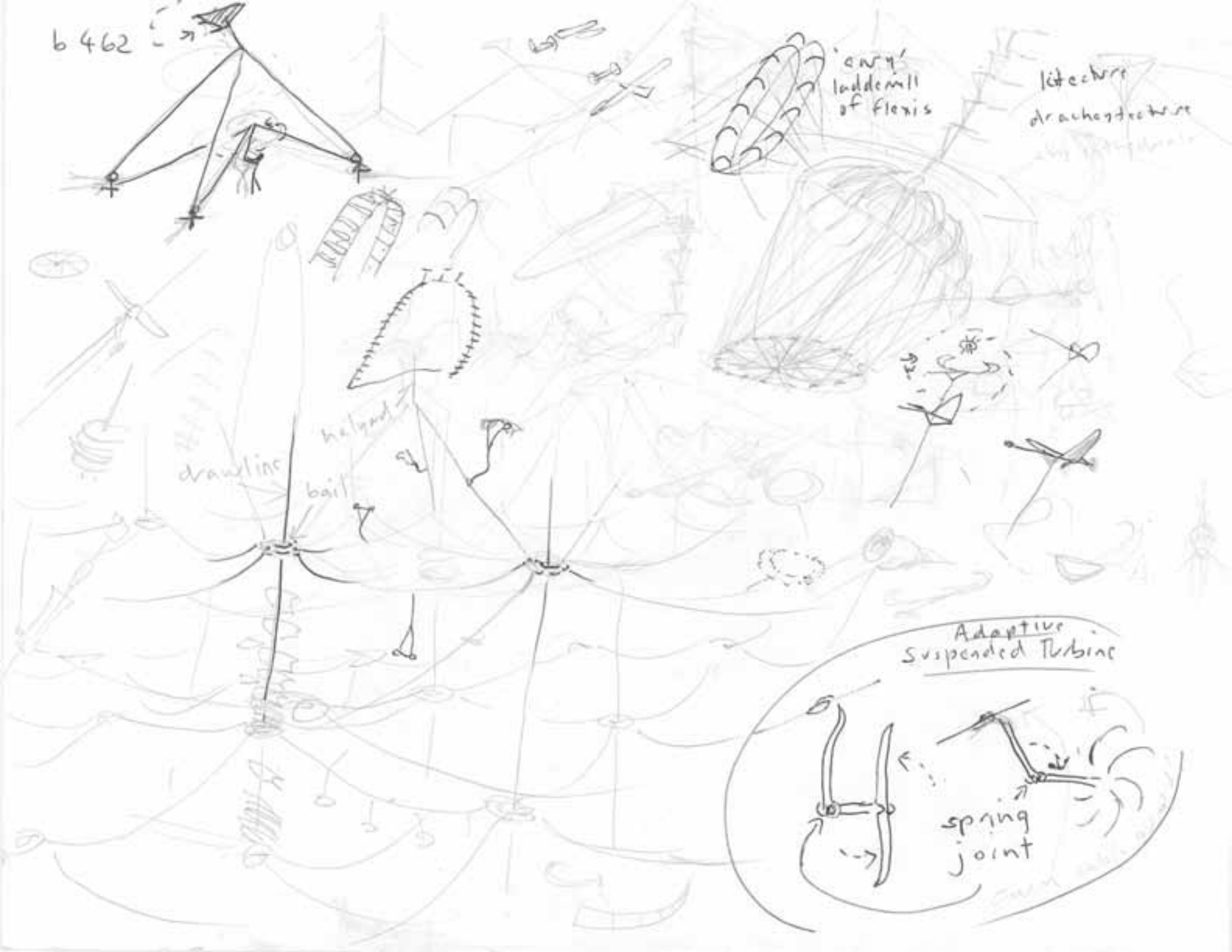

b 459

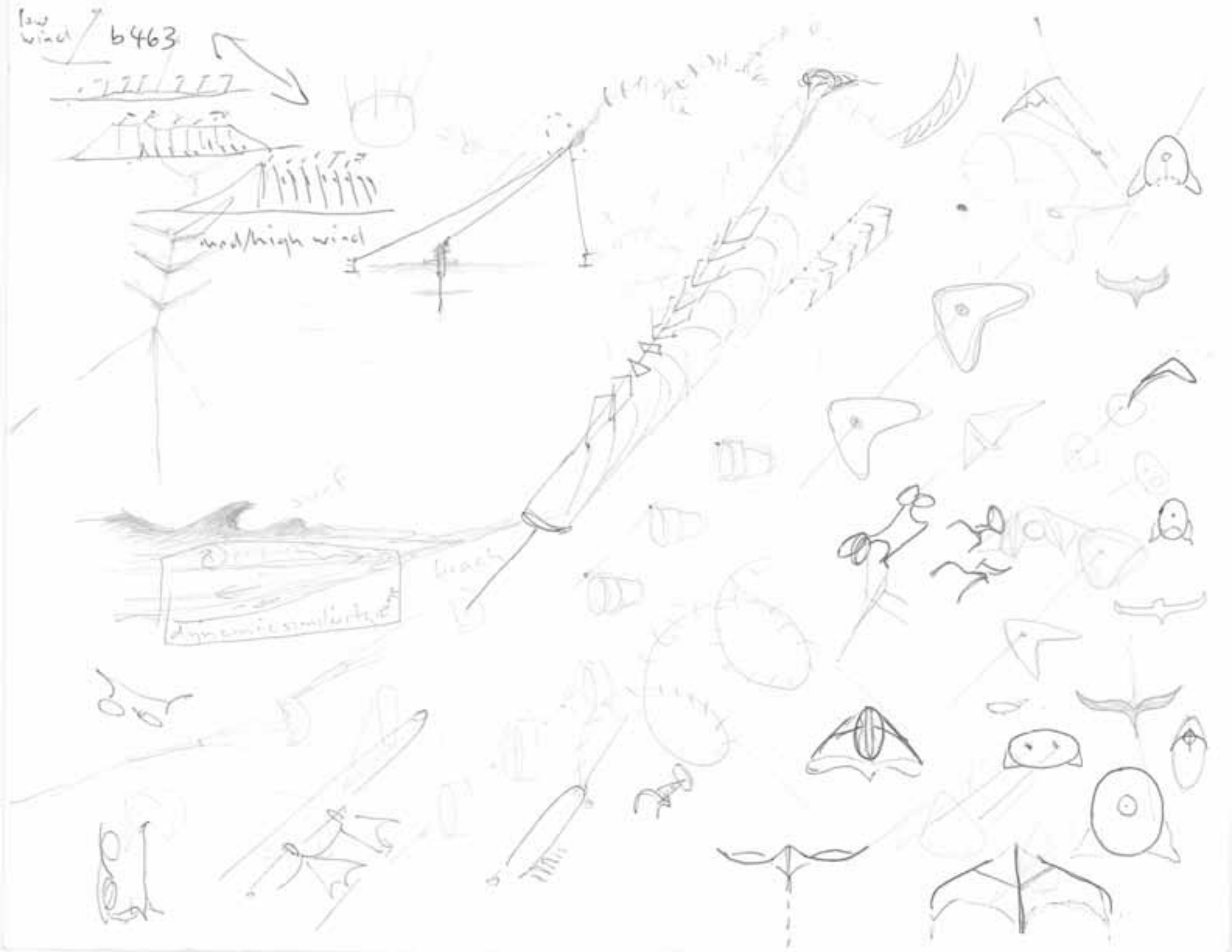

vertical ascender lines
vertical ascender
10km
Kite Powered Ziplines
30km

094

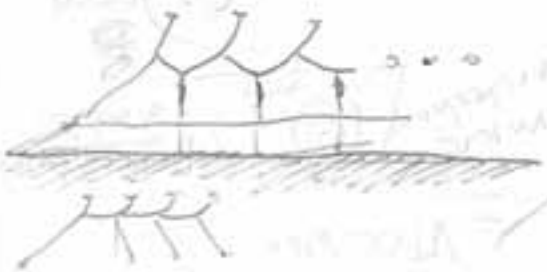
b461

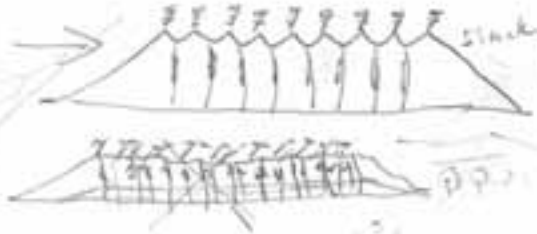



b 462
'cory'
laddermill
of flexis
kitecture
drachentecture
halyard
drawline
bail
Adaptive
Suspended Turbine
spring
joint


low wind
b463
mod/high wind

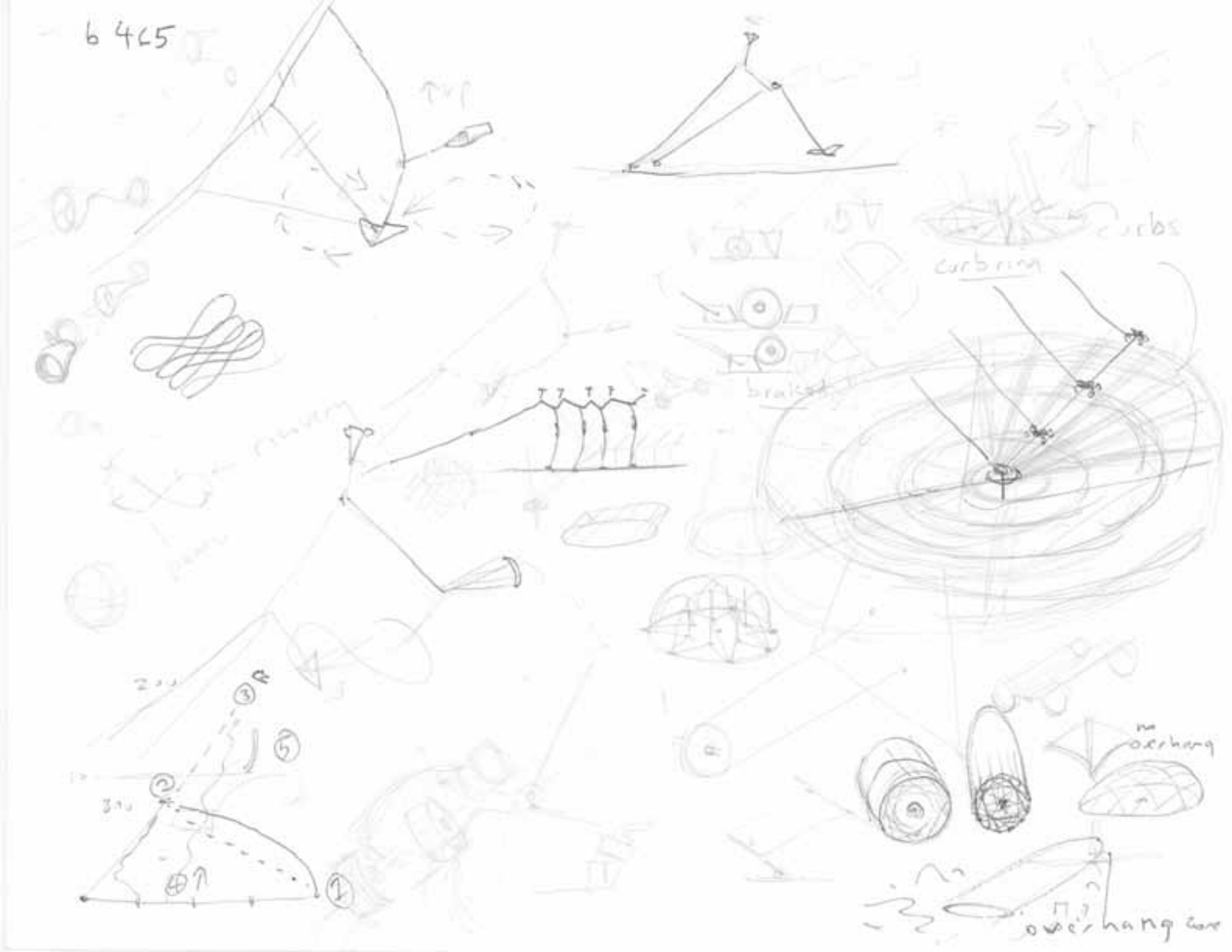
b464





tensile mechanical
advantage demo

b 465

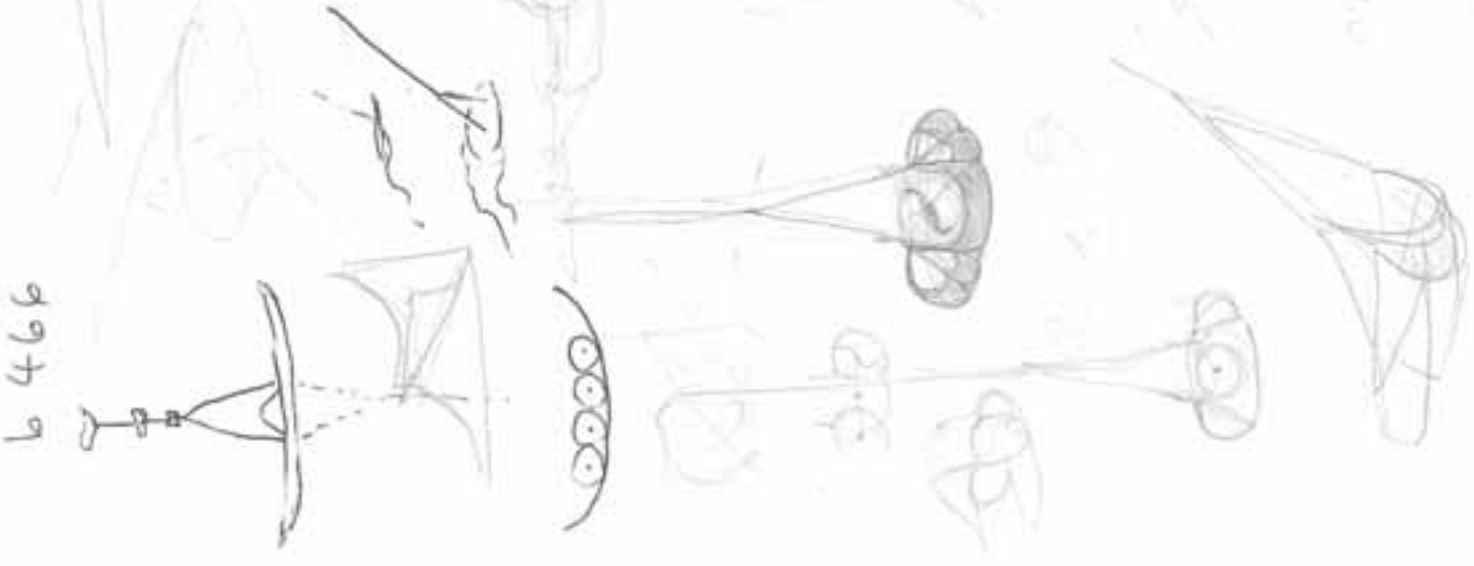


Surface Layer
Atmospheric Boundary layer } troposphere
} stratosphere
} mesosphere
} Ionosphere } thermosphere
} exosphere
} SPACE

Tropopause
ozone layer
Turbopause
D layer
E Layer

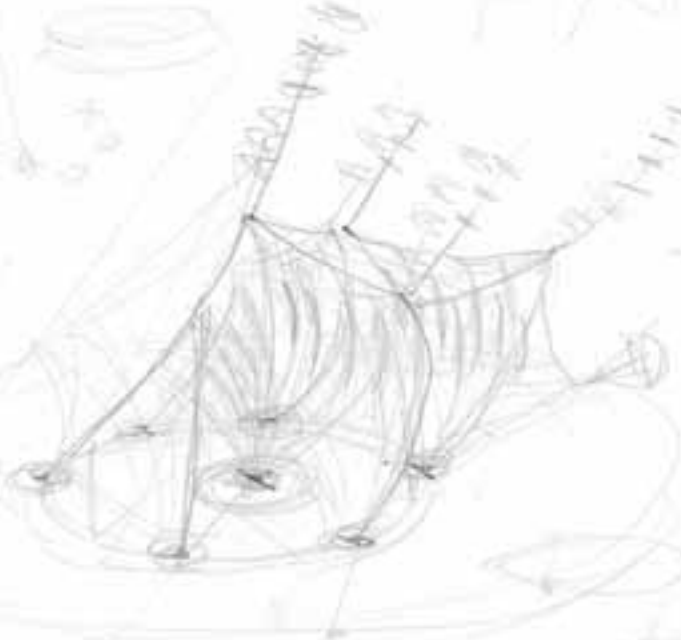
Leo
geosych

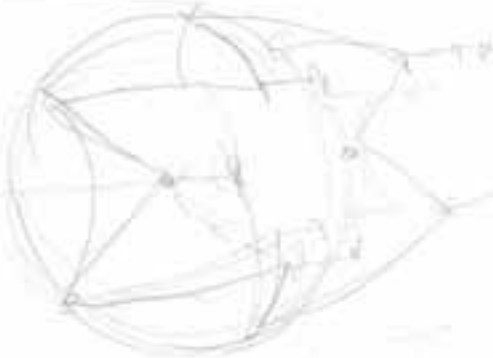
Tropobase
Stratobase
Mesobase
Exobase Thermobase

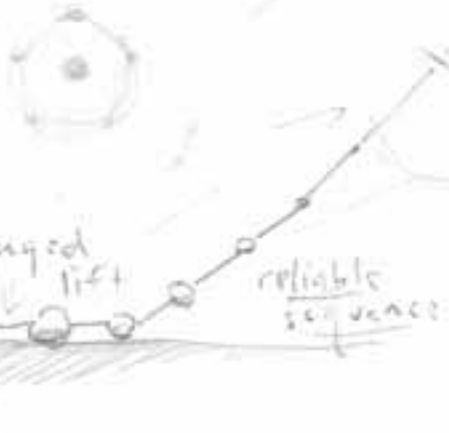


6466

b 467



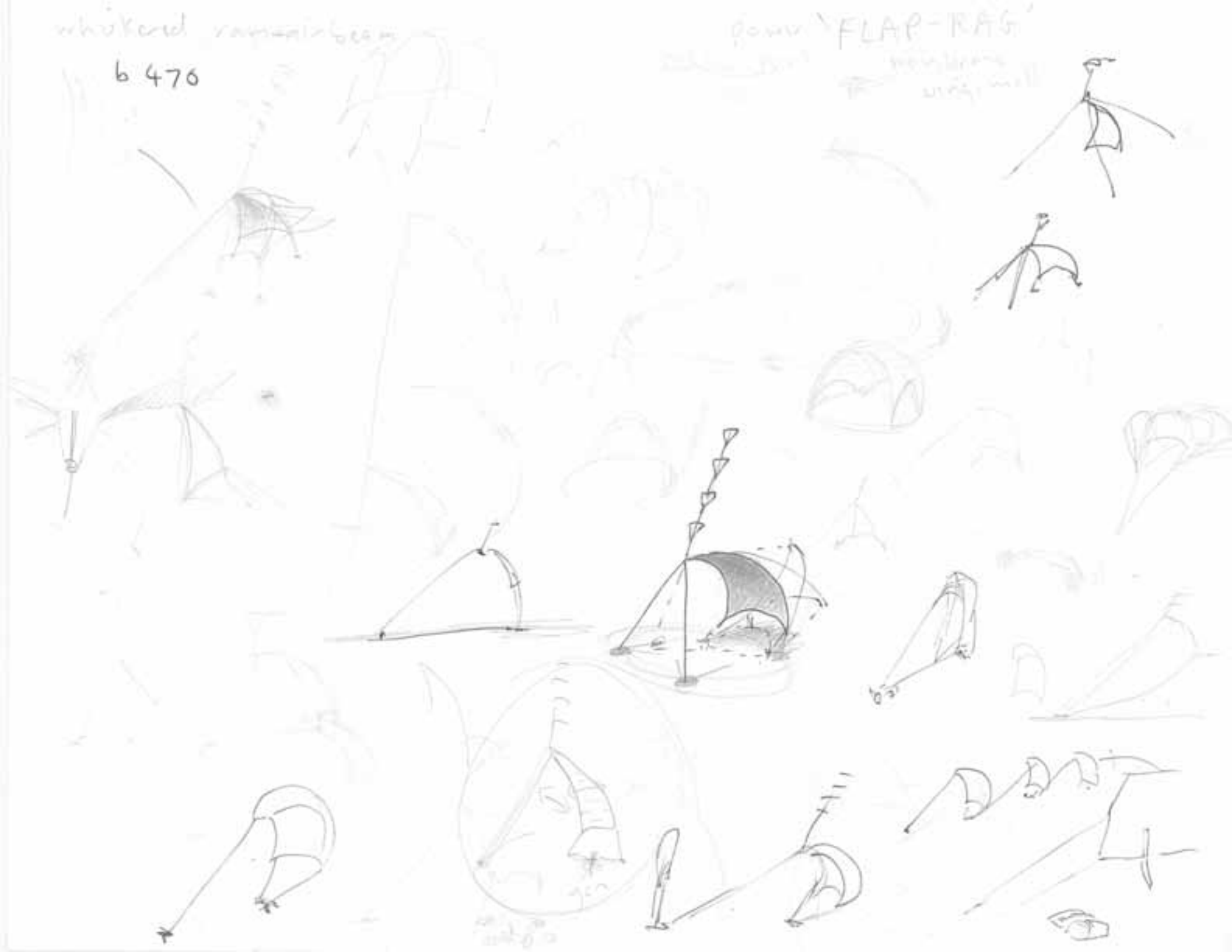




6468

b469

b 476



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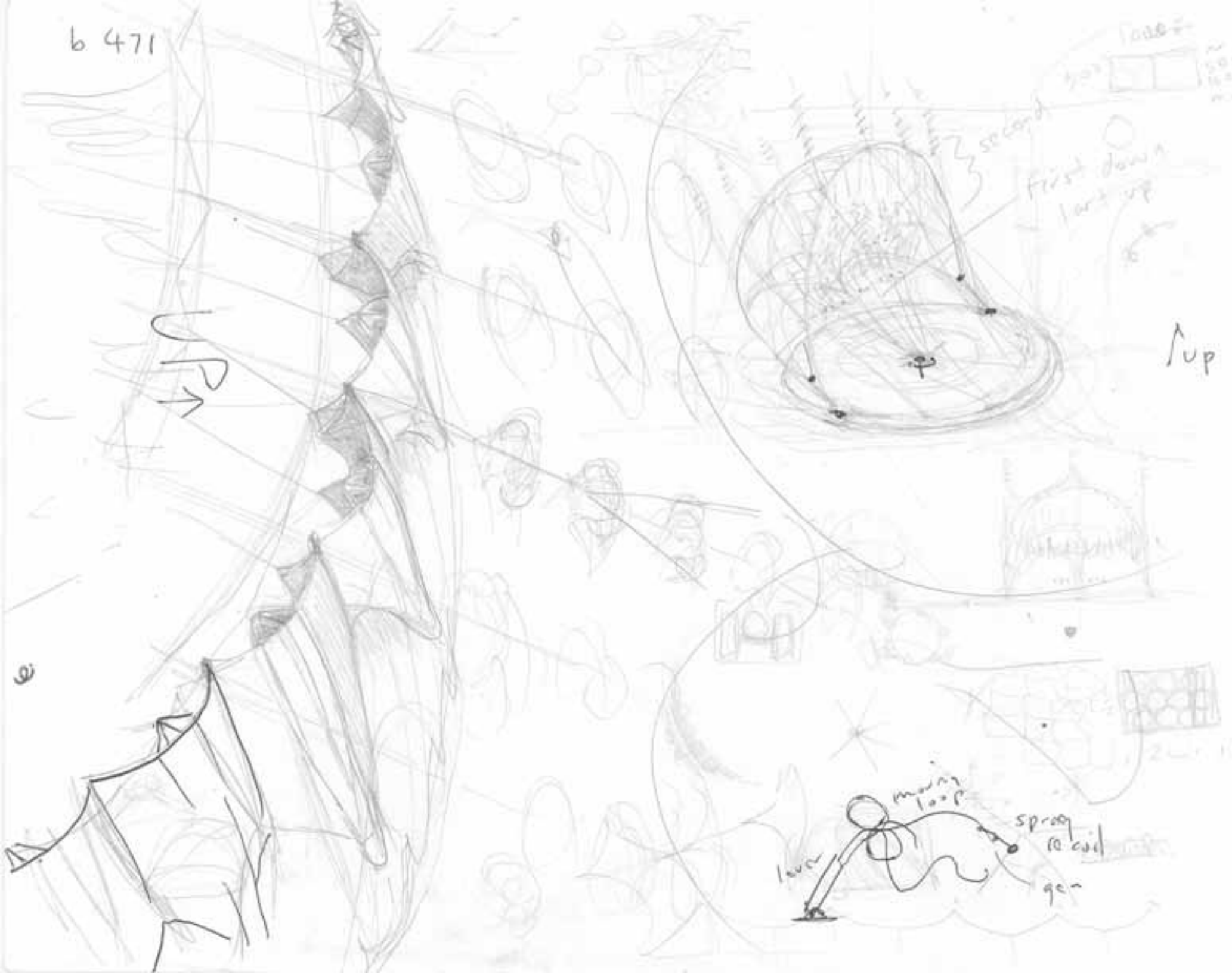
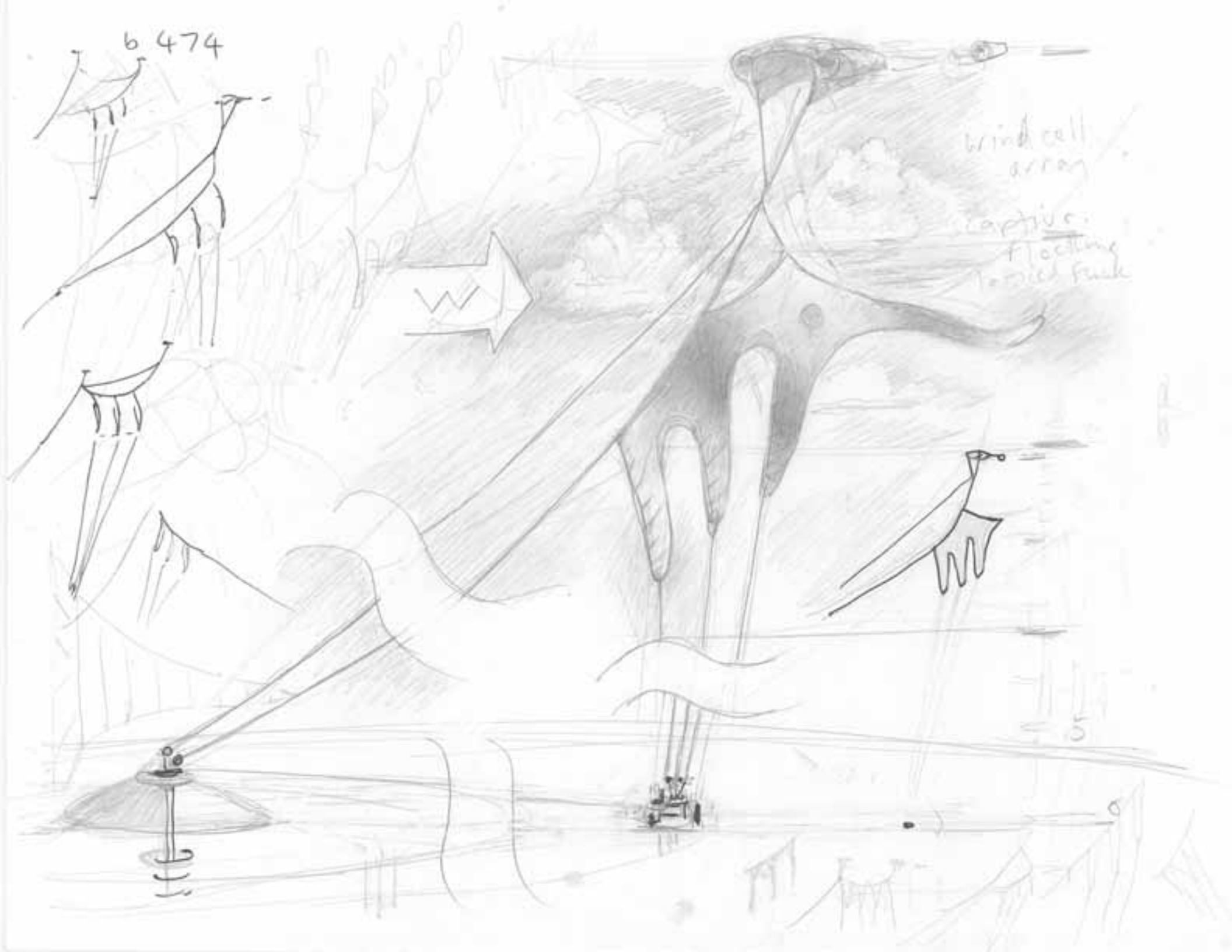
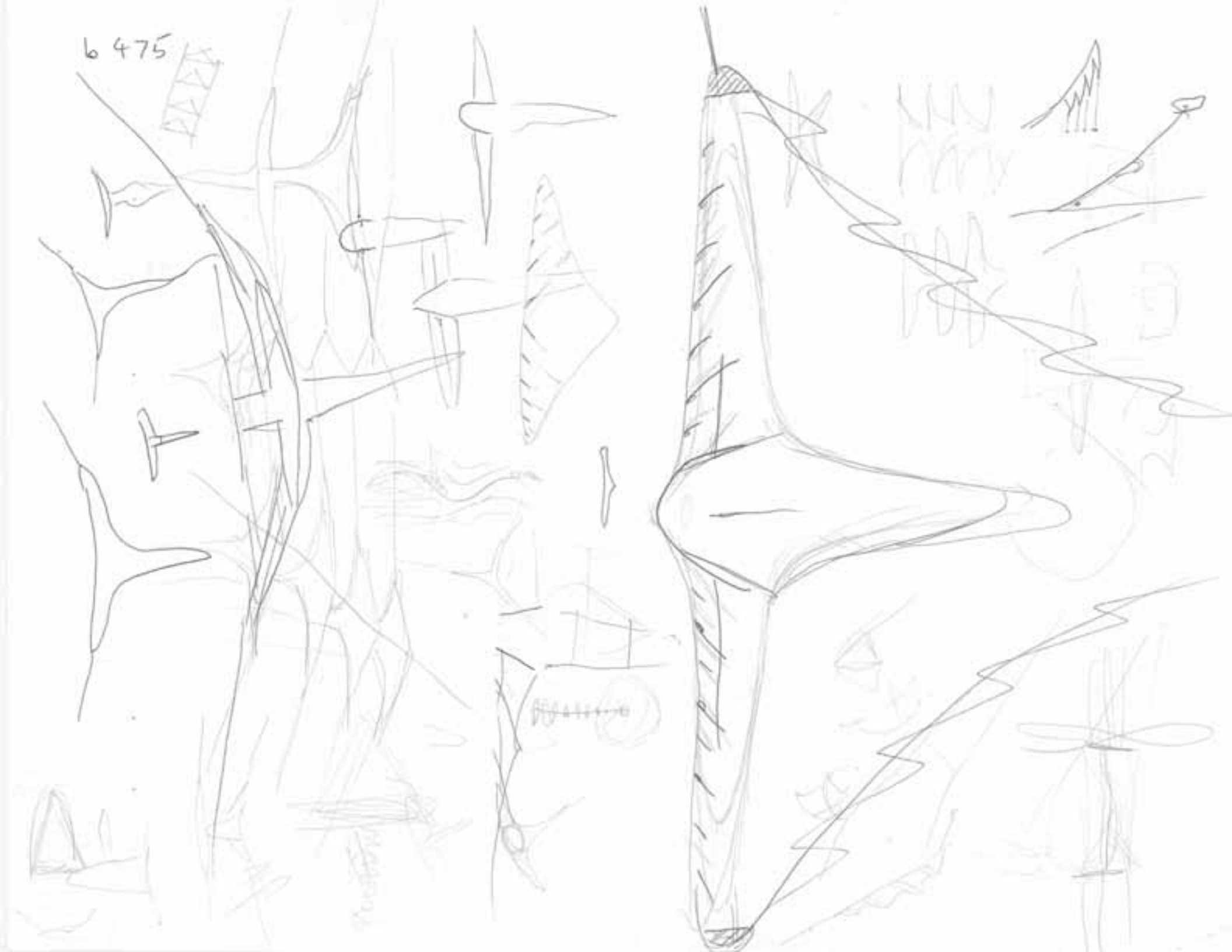


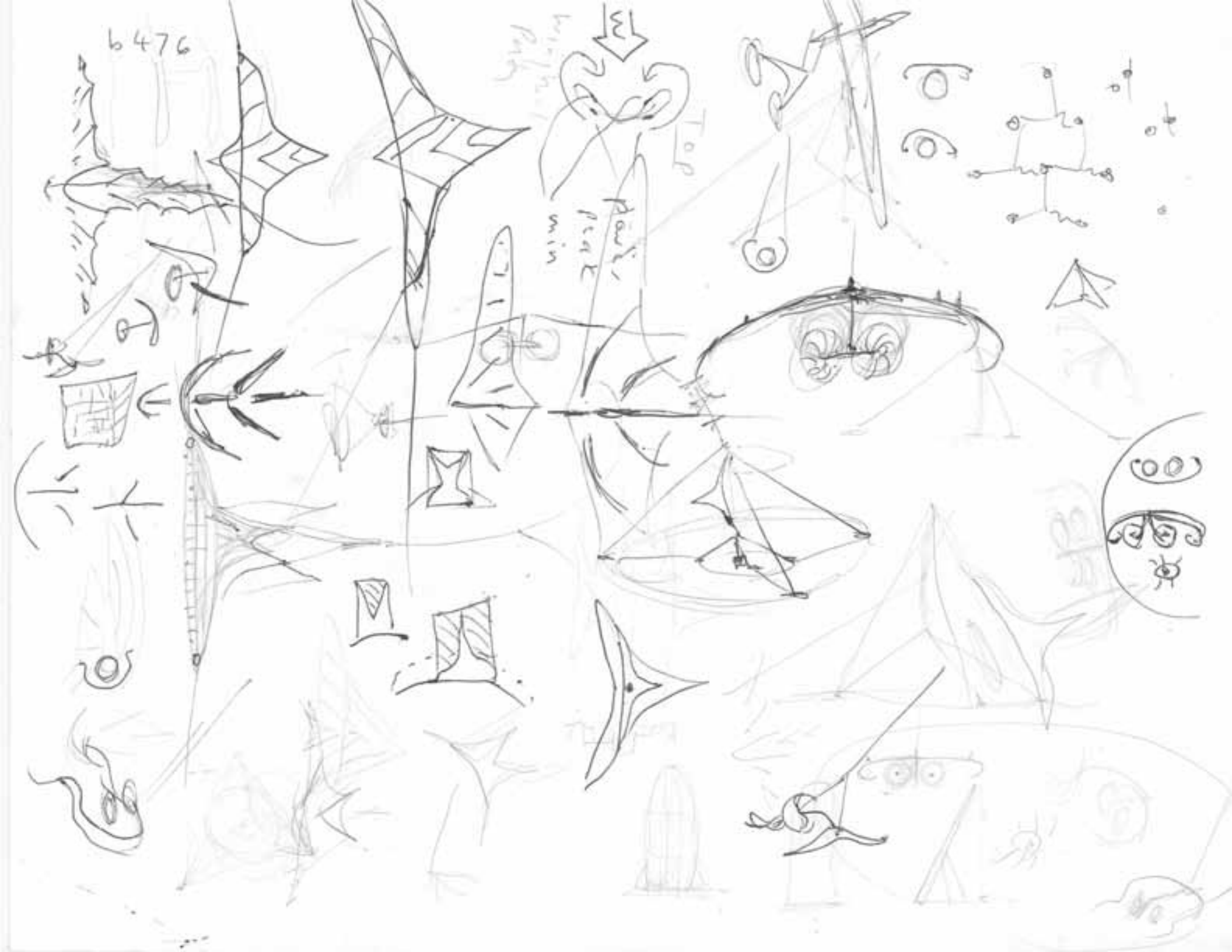
b 472

a coherent array
is going to be
a meta-plate-the
fundamental mode

6473


6 474
wind cell array
captive
floating
tossed fuck


6 475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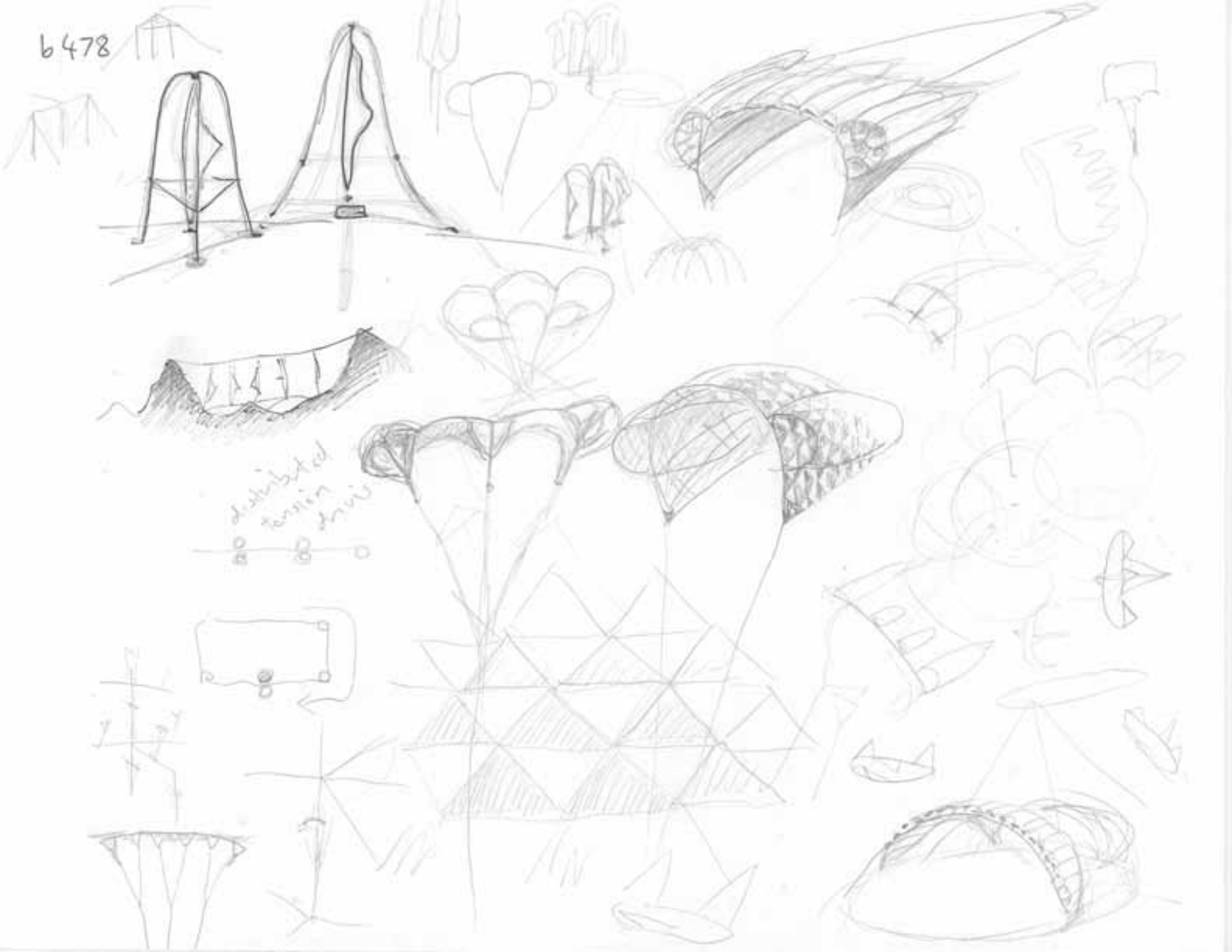
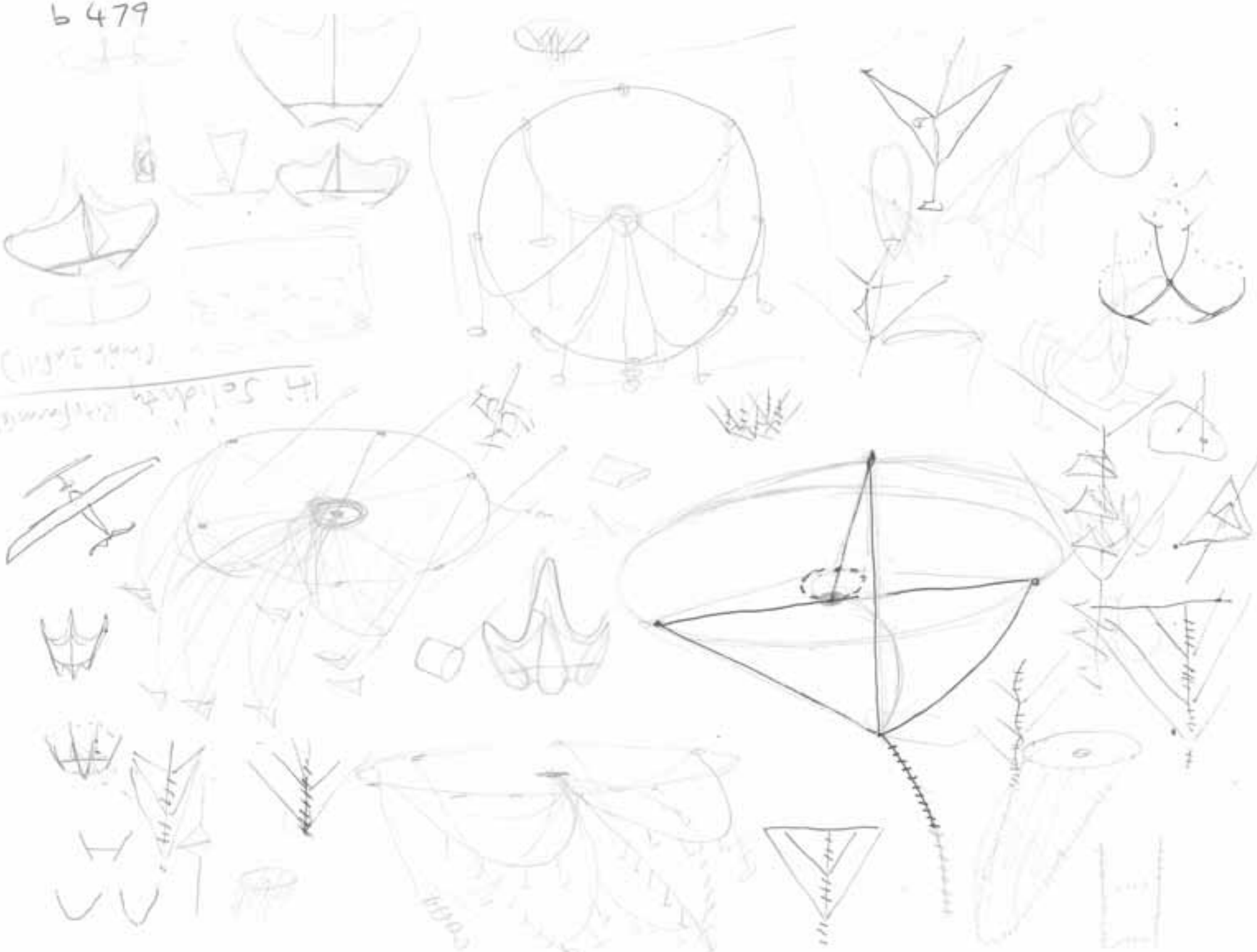
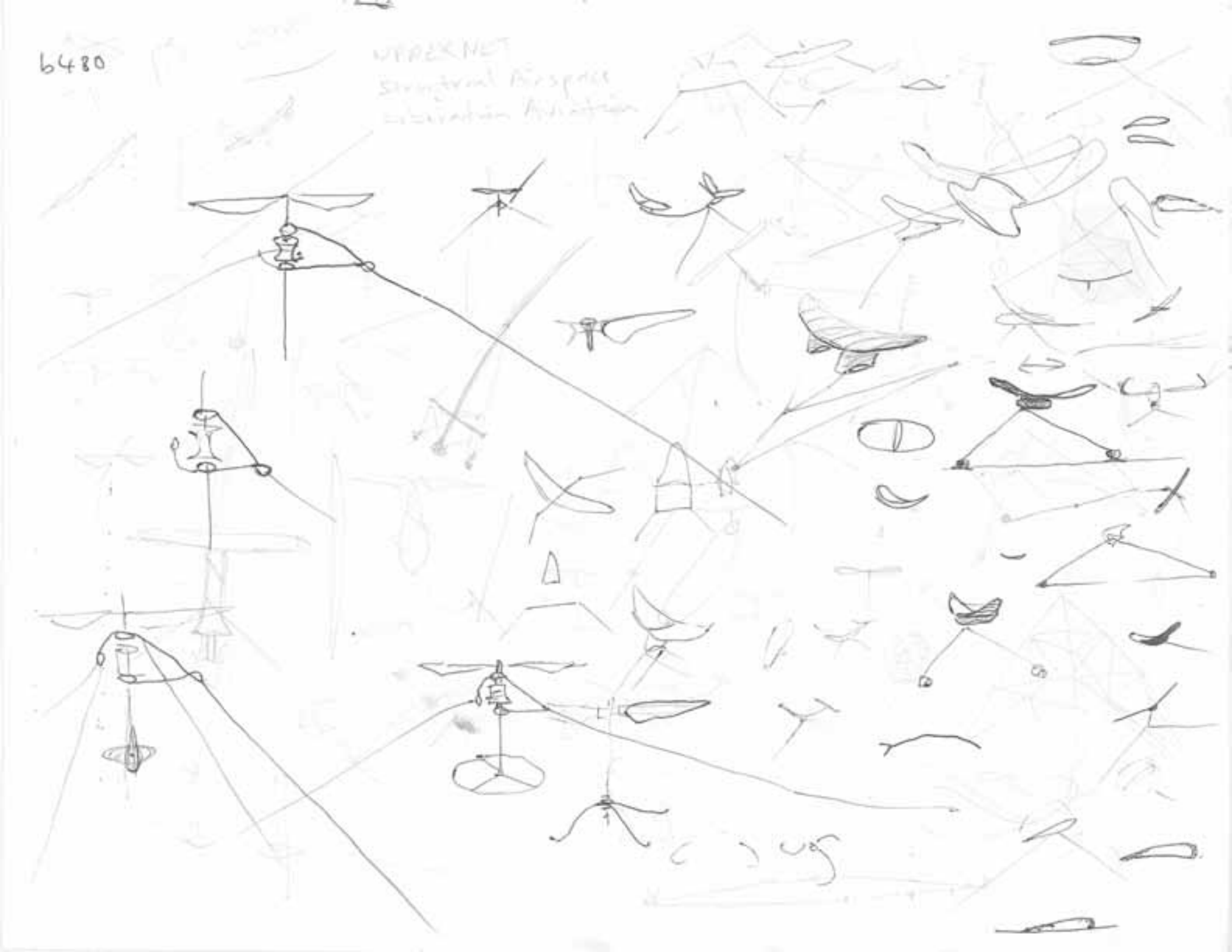
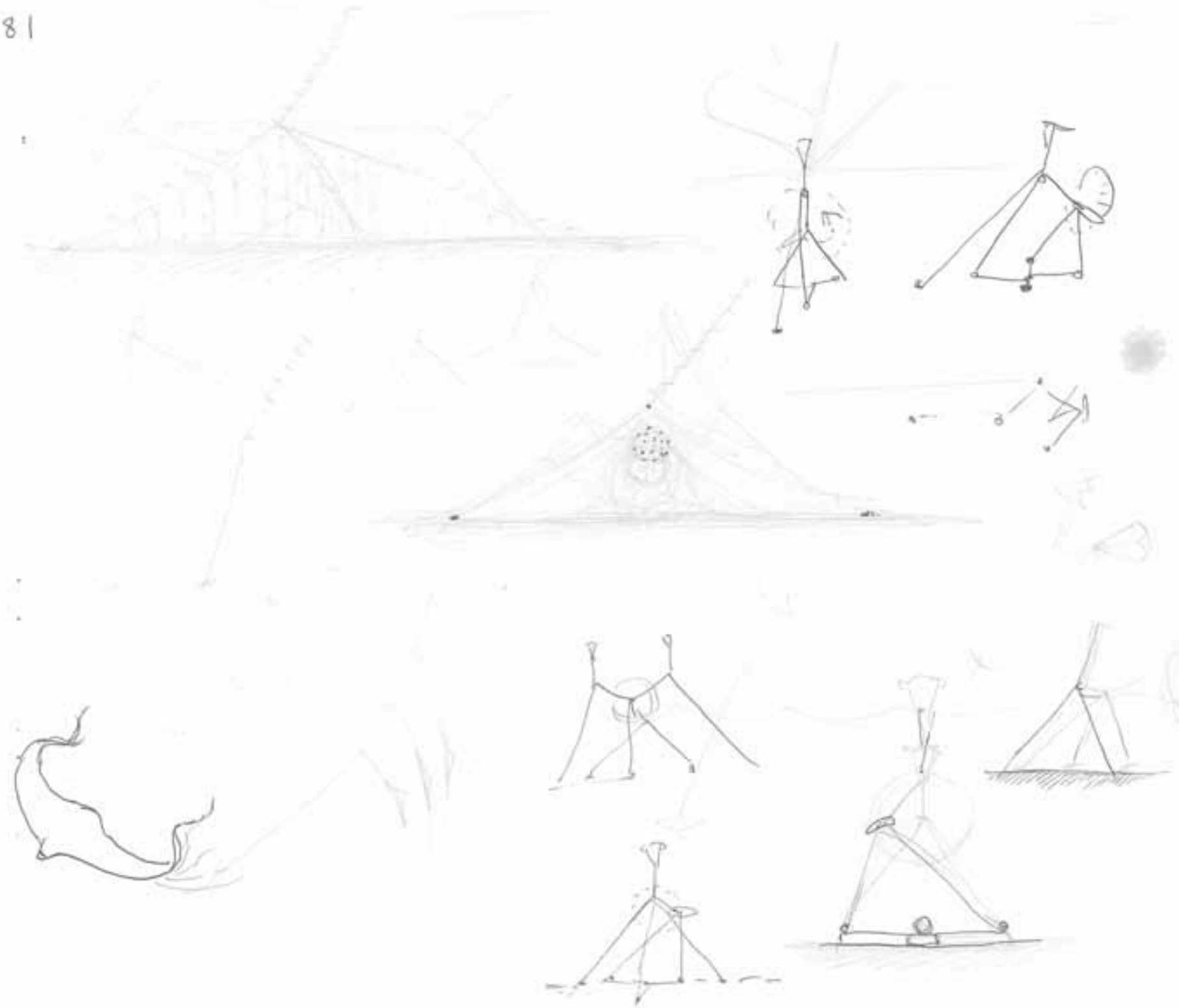

6478
distributed
tension
shell

b 479

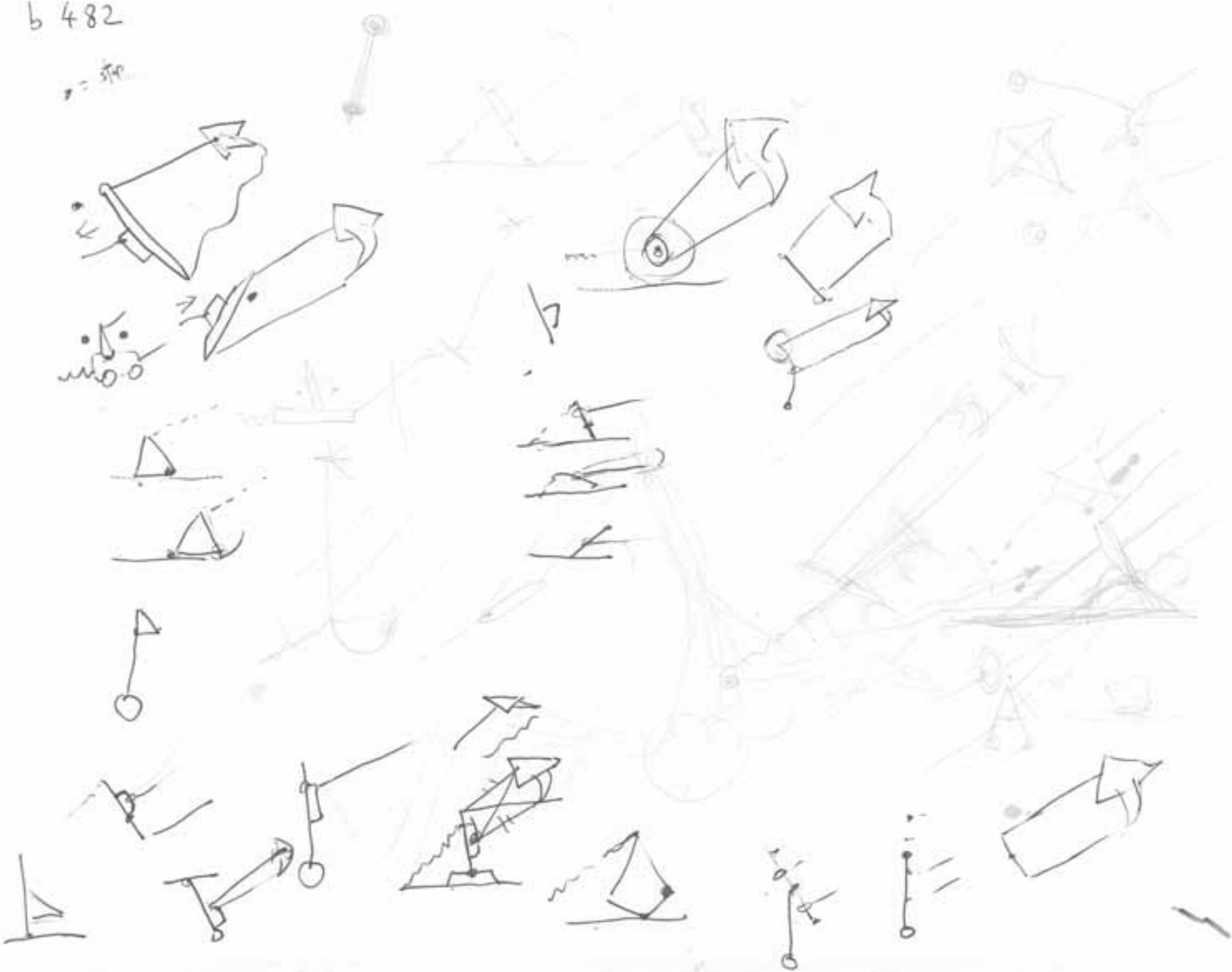


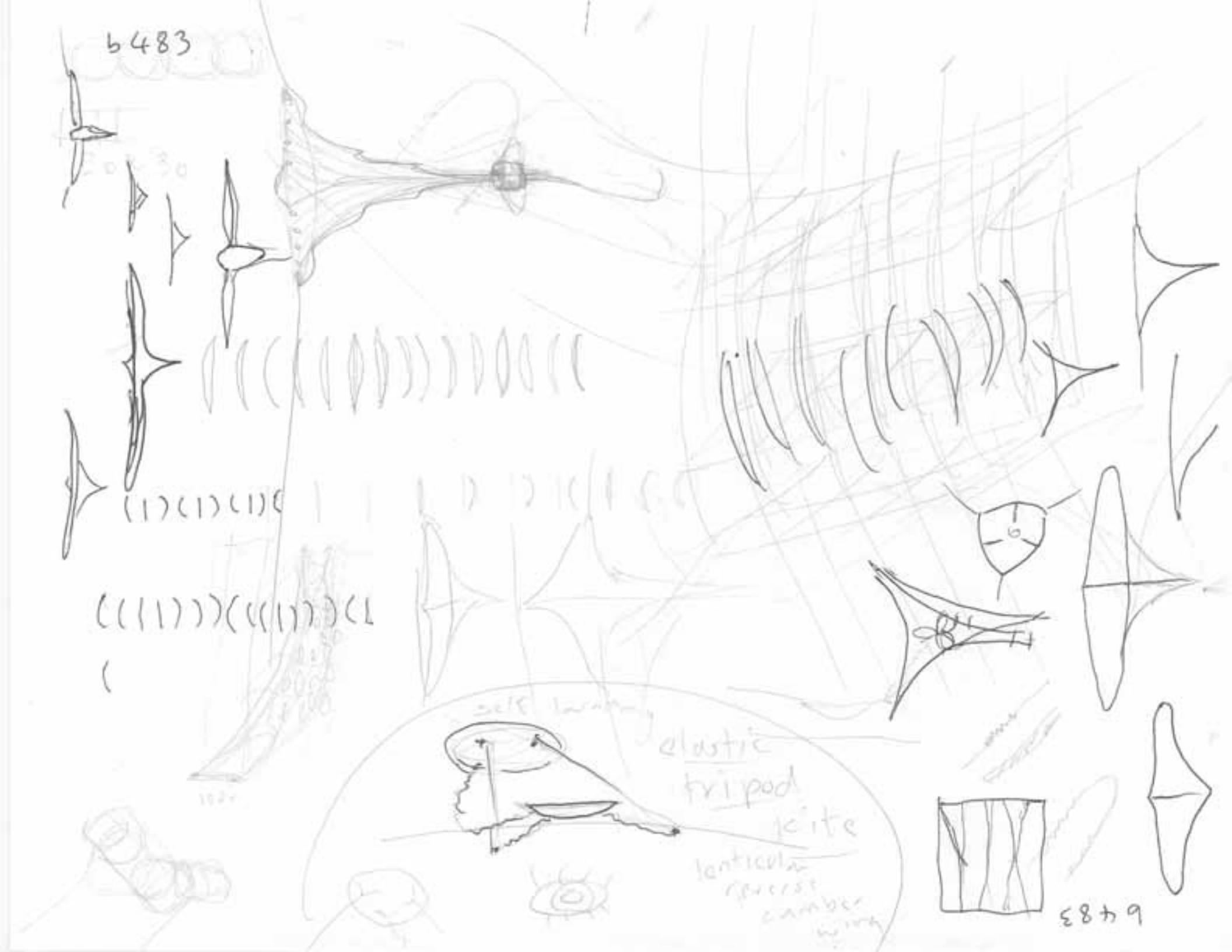


6481



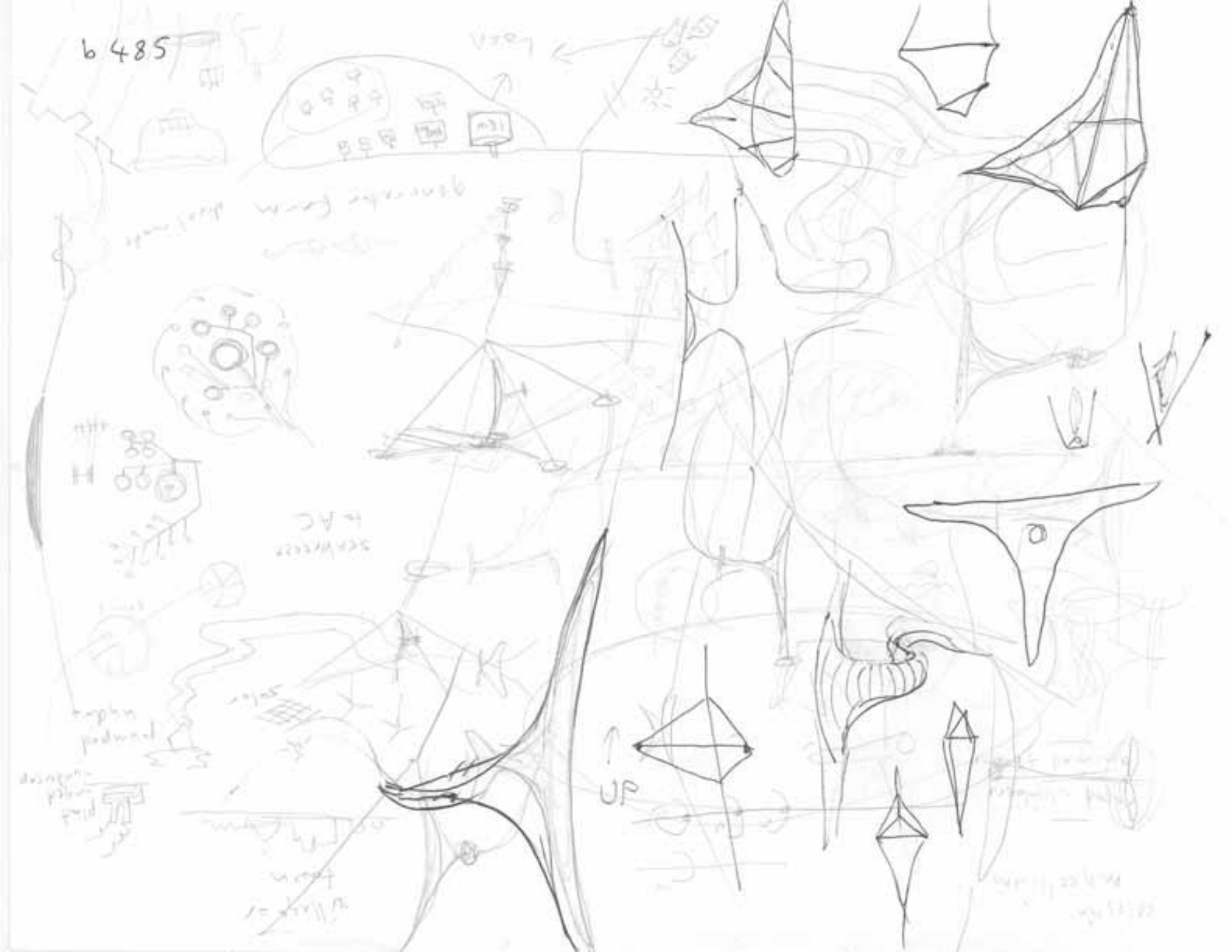
b 482

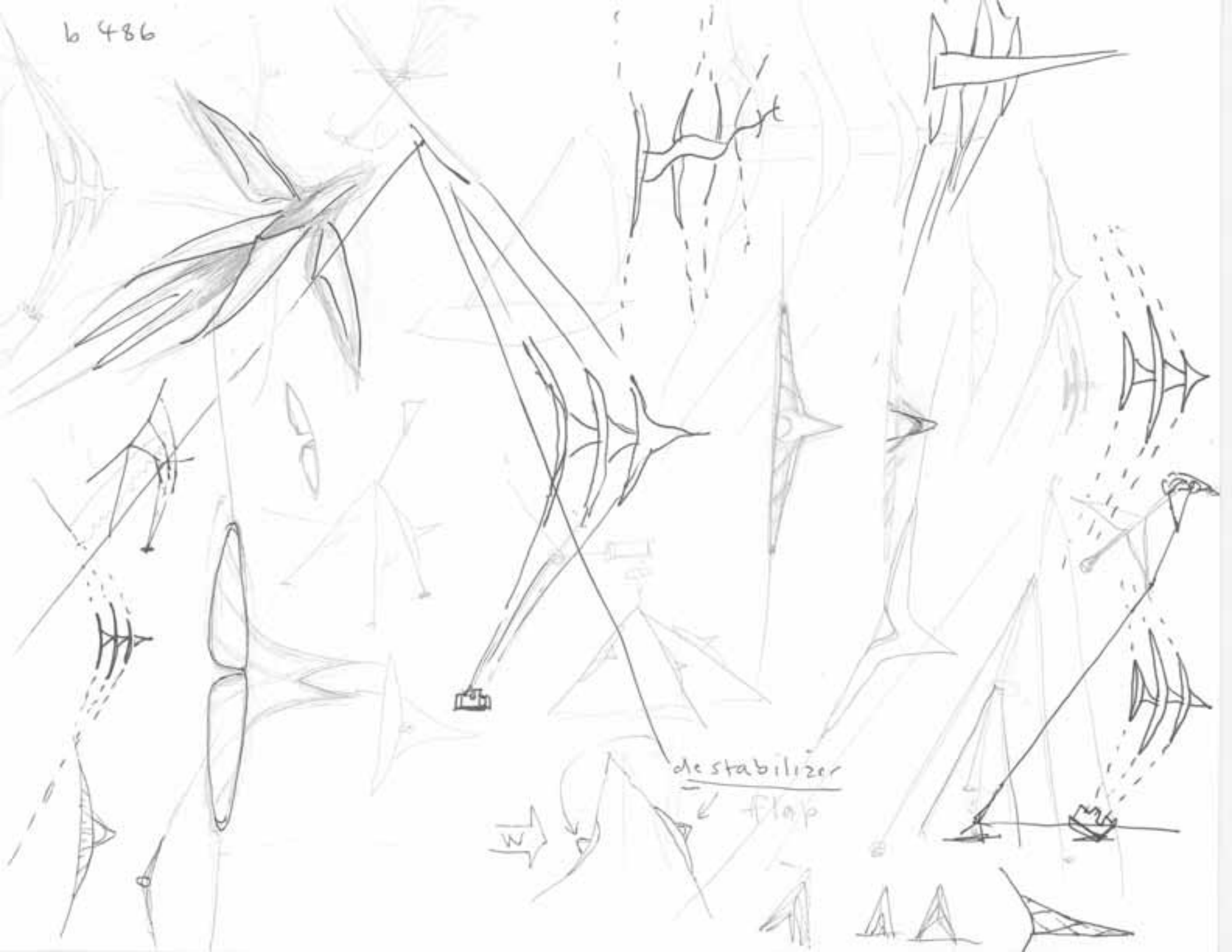



b483
(1)(1)(1)(
((((1)))((((1)))(1
(
self
elastic
tripod
kite
lenticular
reverse
camber
wing
b483

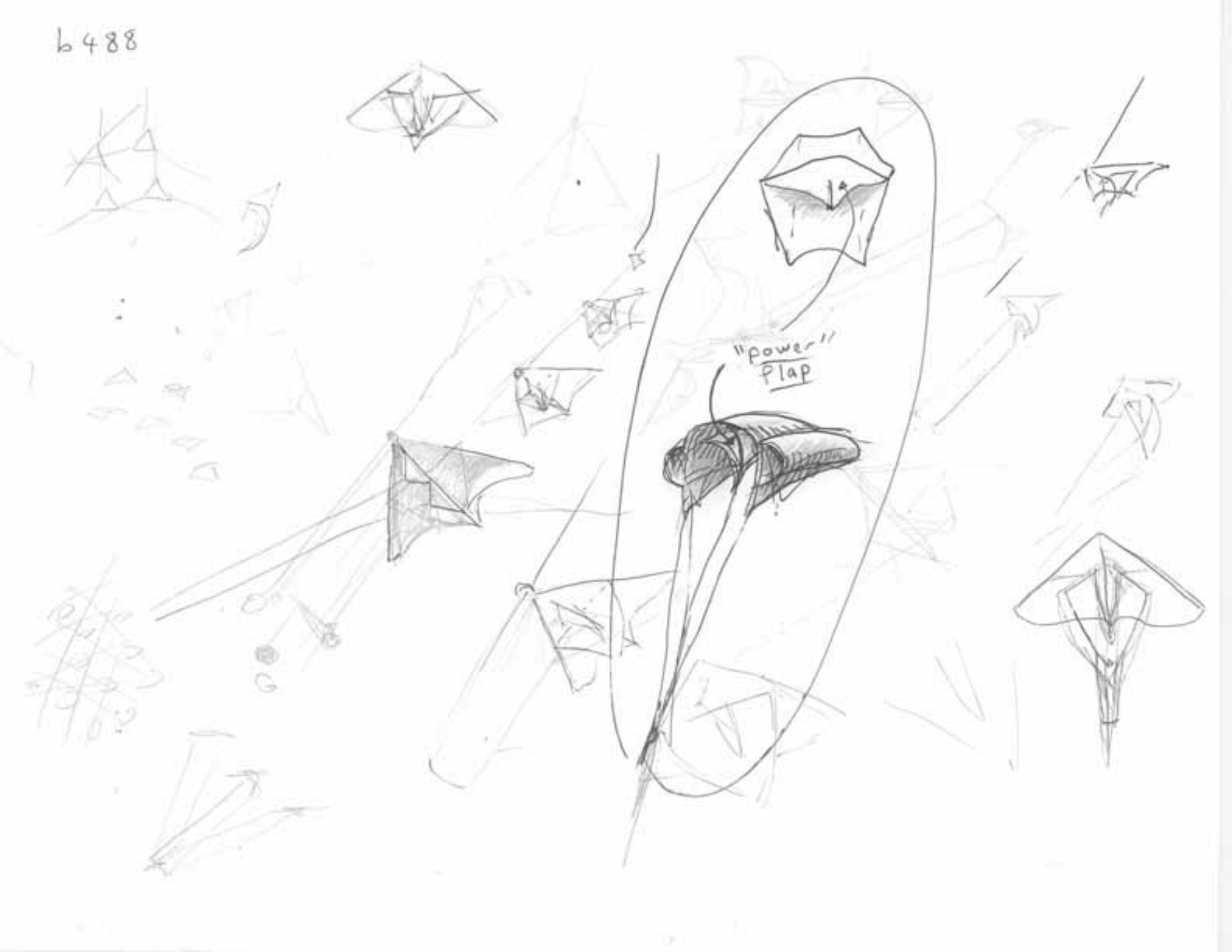
b 484
spring mass oscillator

b 485

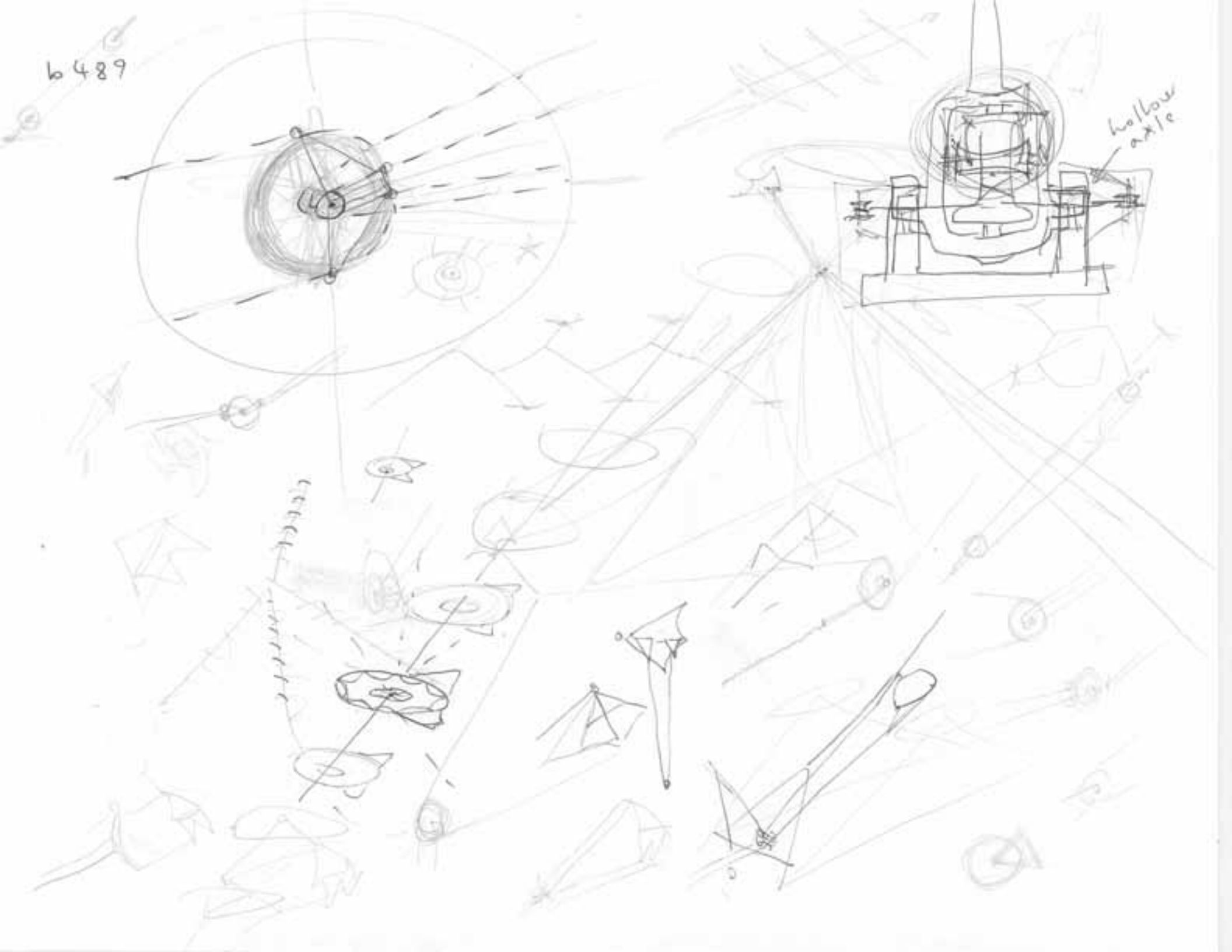



b 486
destabilizer
flap

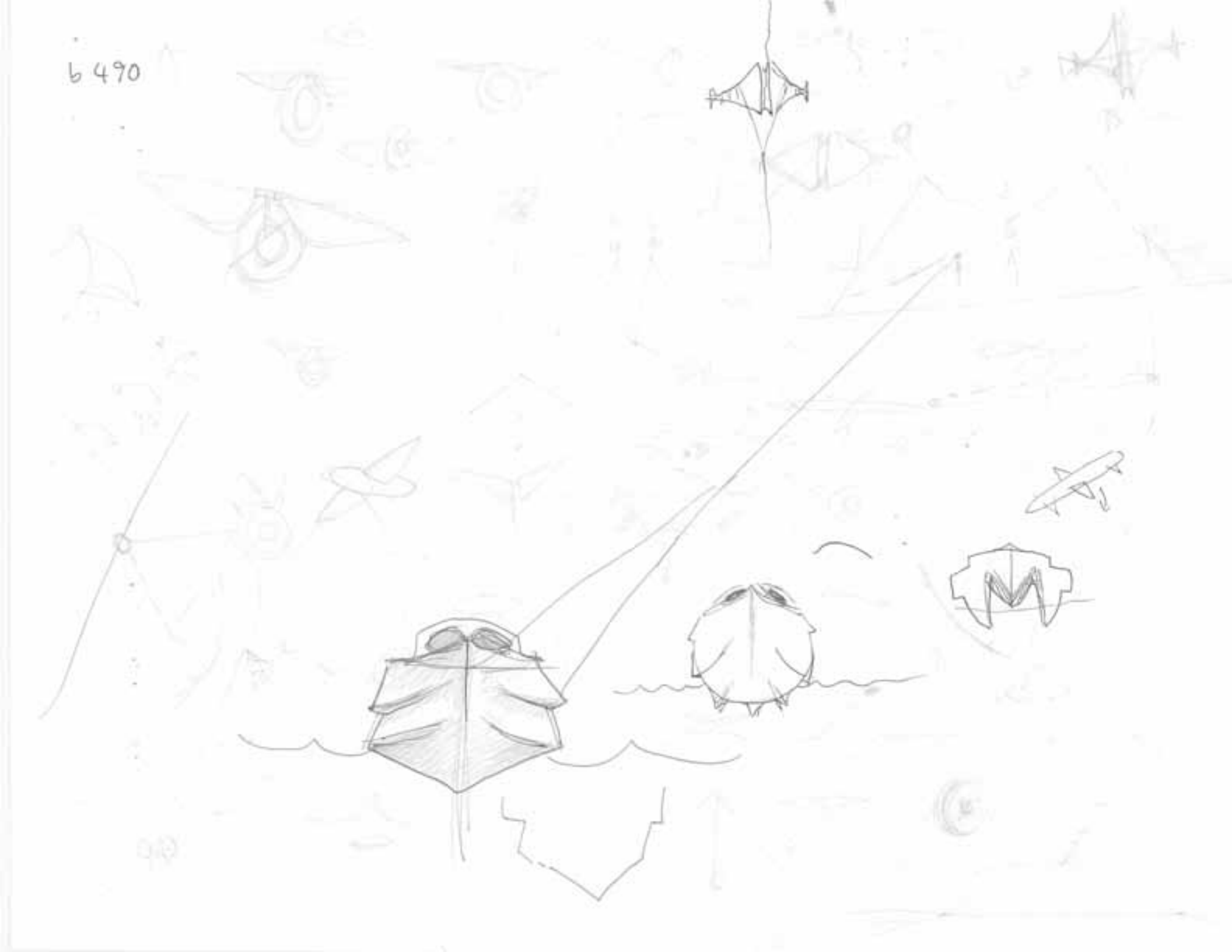
b488



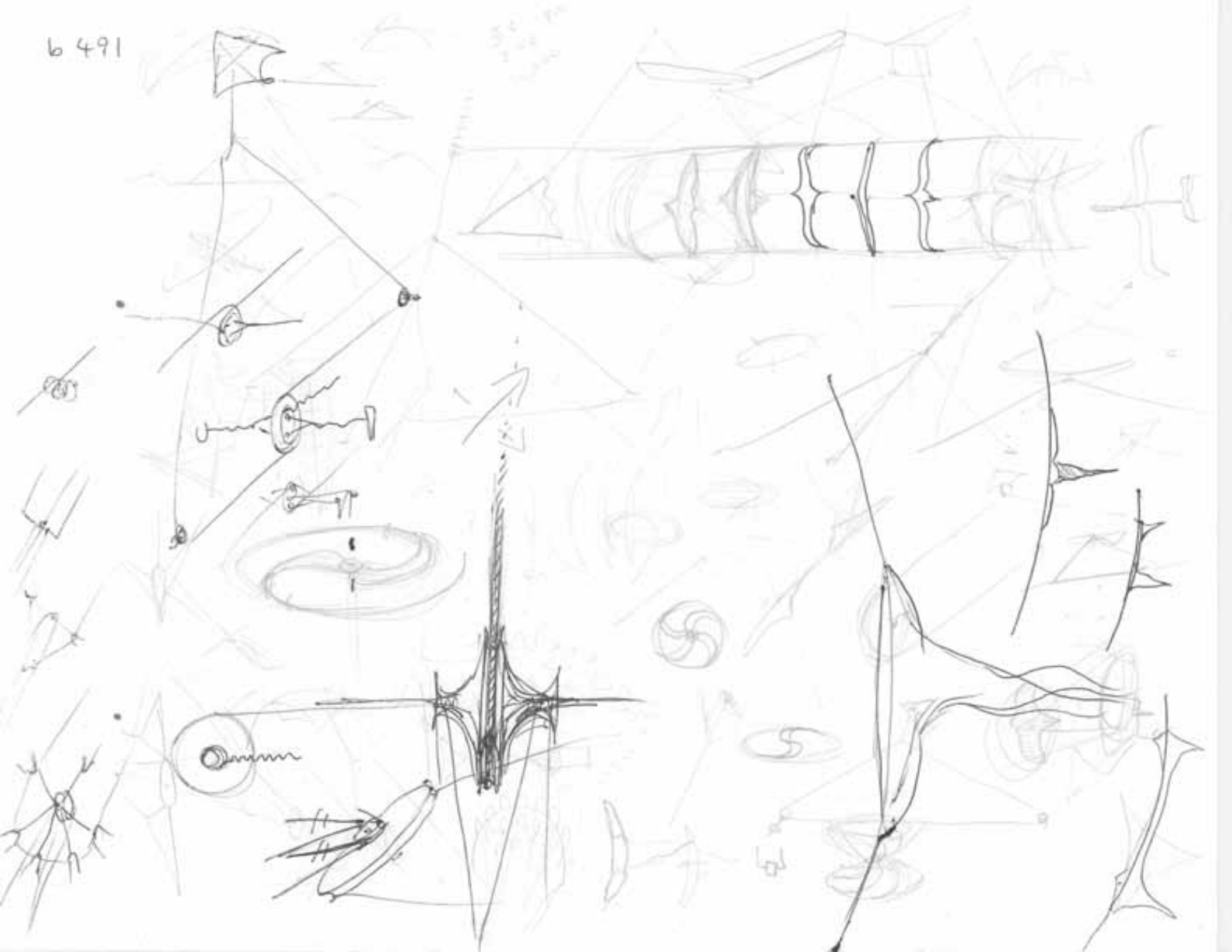
6489



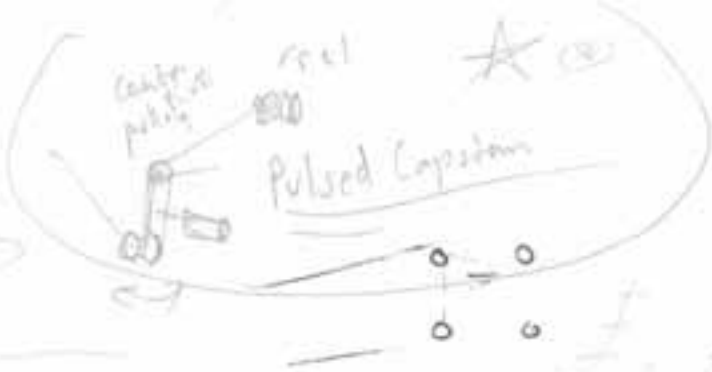
b 490

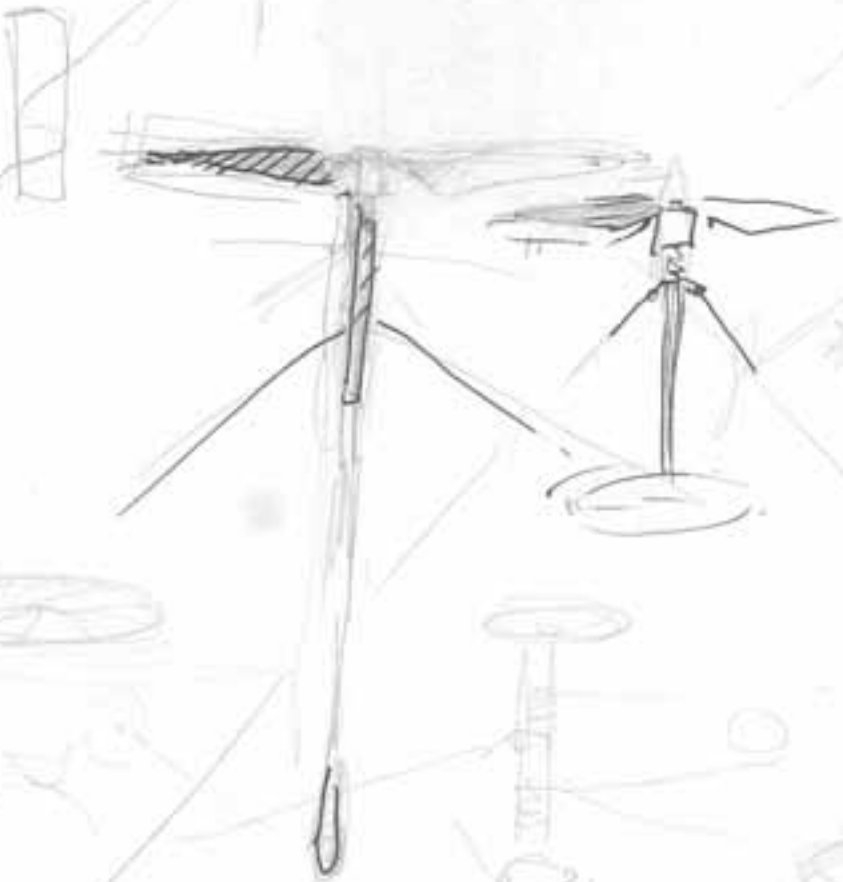


b 491



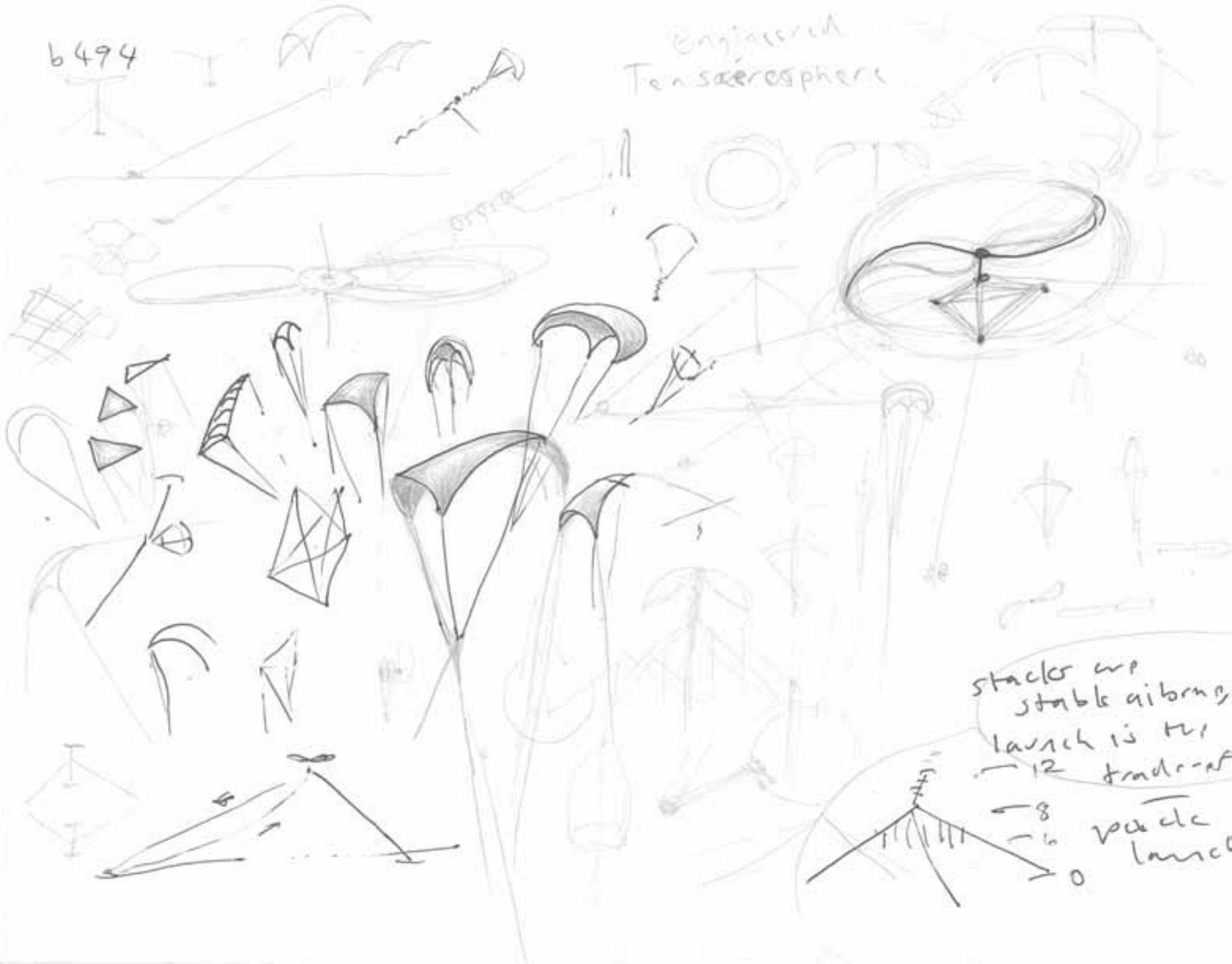
b 492





tethersphere

b 493


b494
Engineered
Tensaerosphere
stacks are
stable airborne
launch is the
12
8
6
0
packe
launch

6475

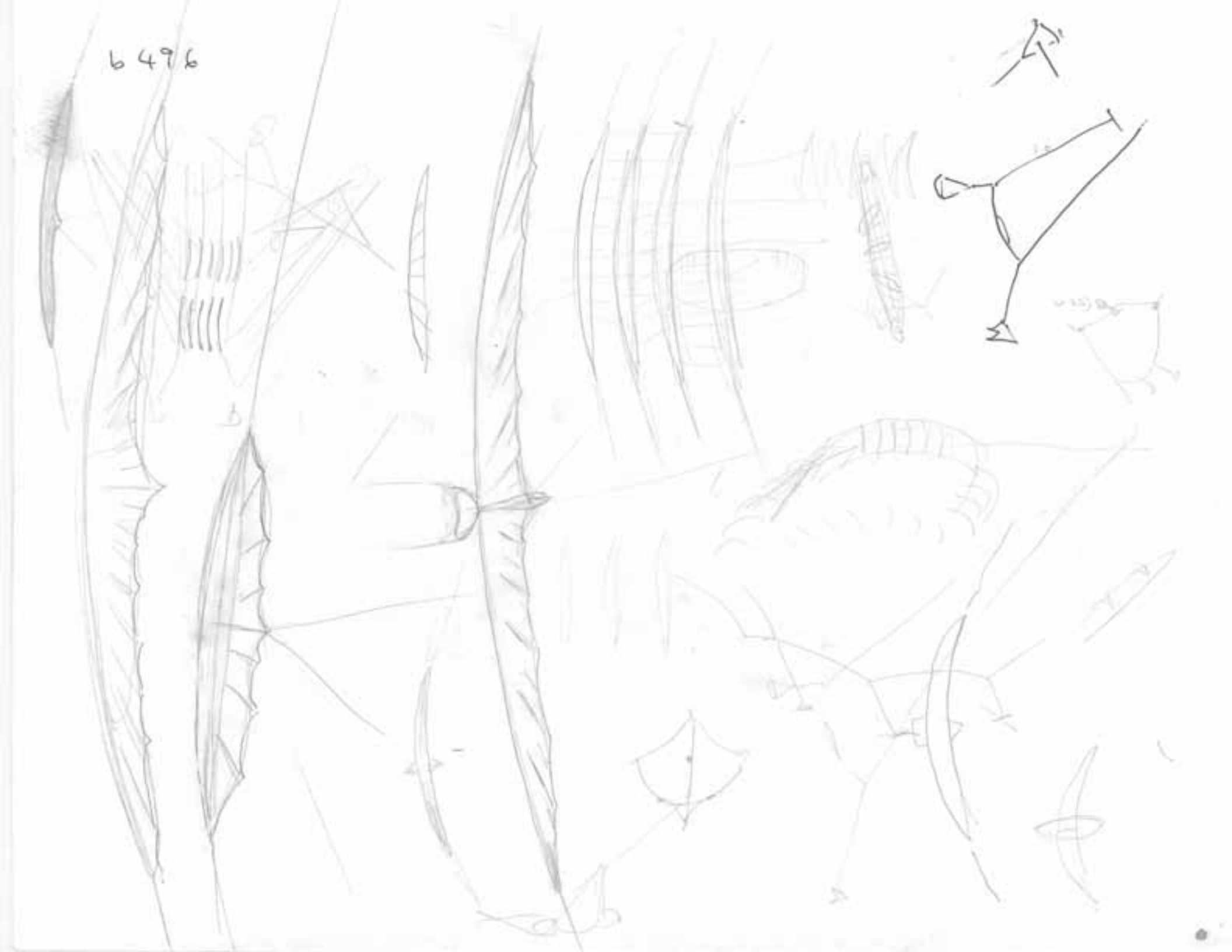
Structural Airspace Lattice Tech

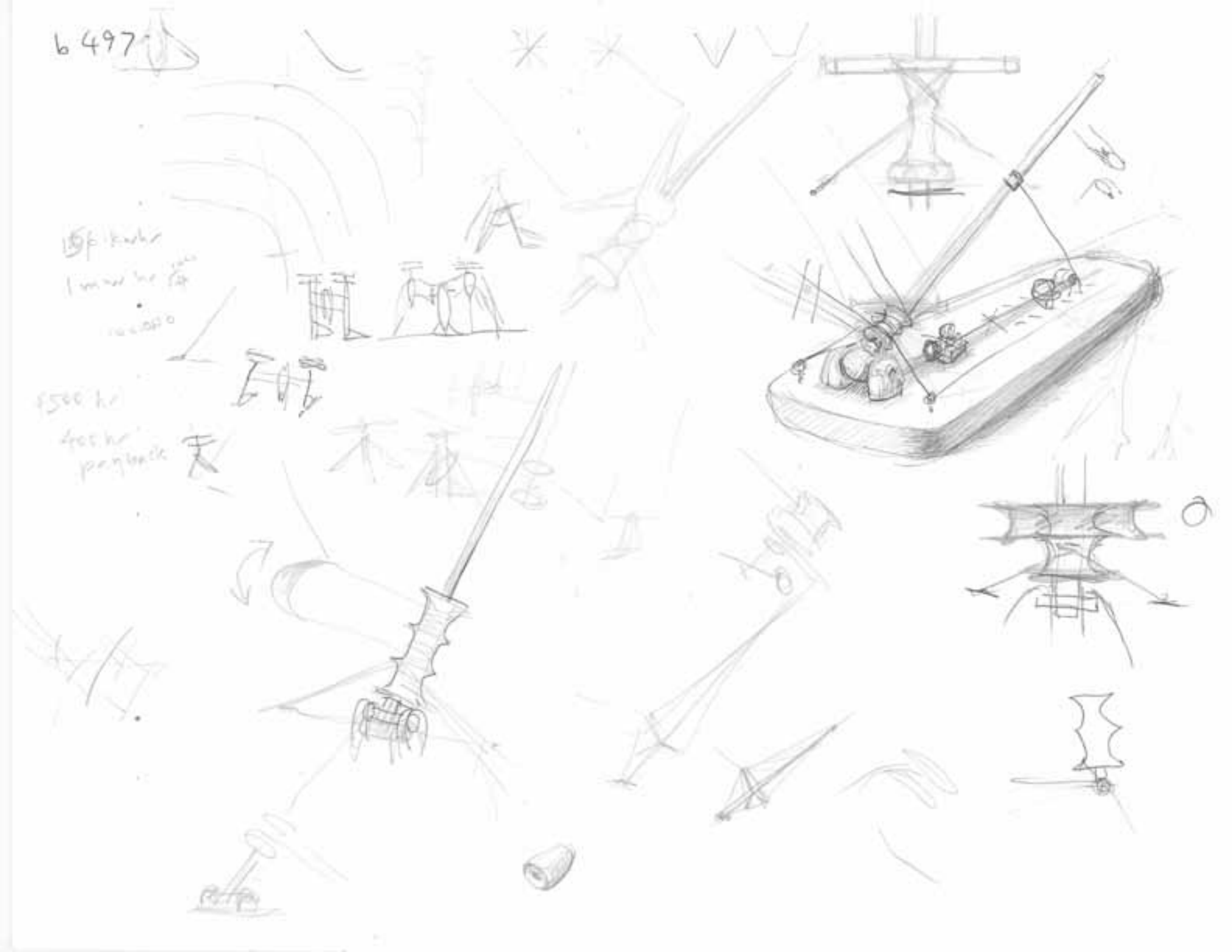
Airspace frames

Toellicod AWECS

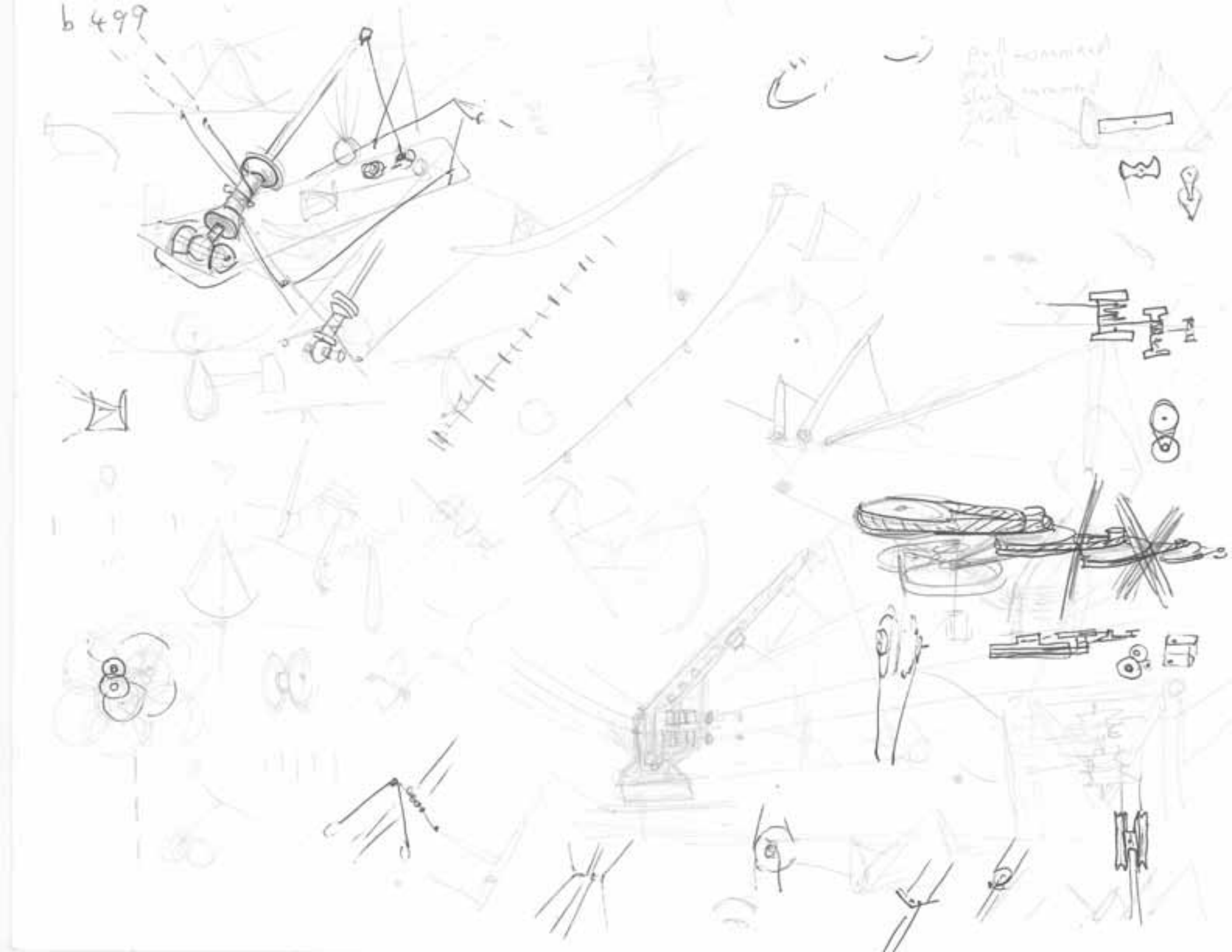
Rovina whirlwinlines

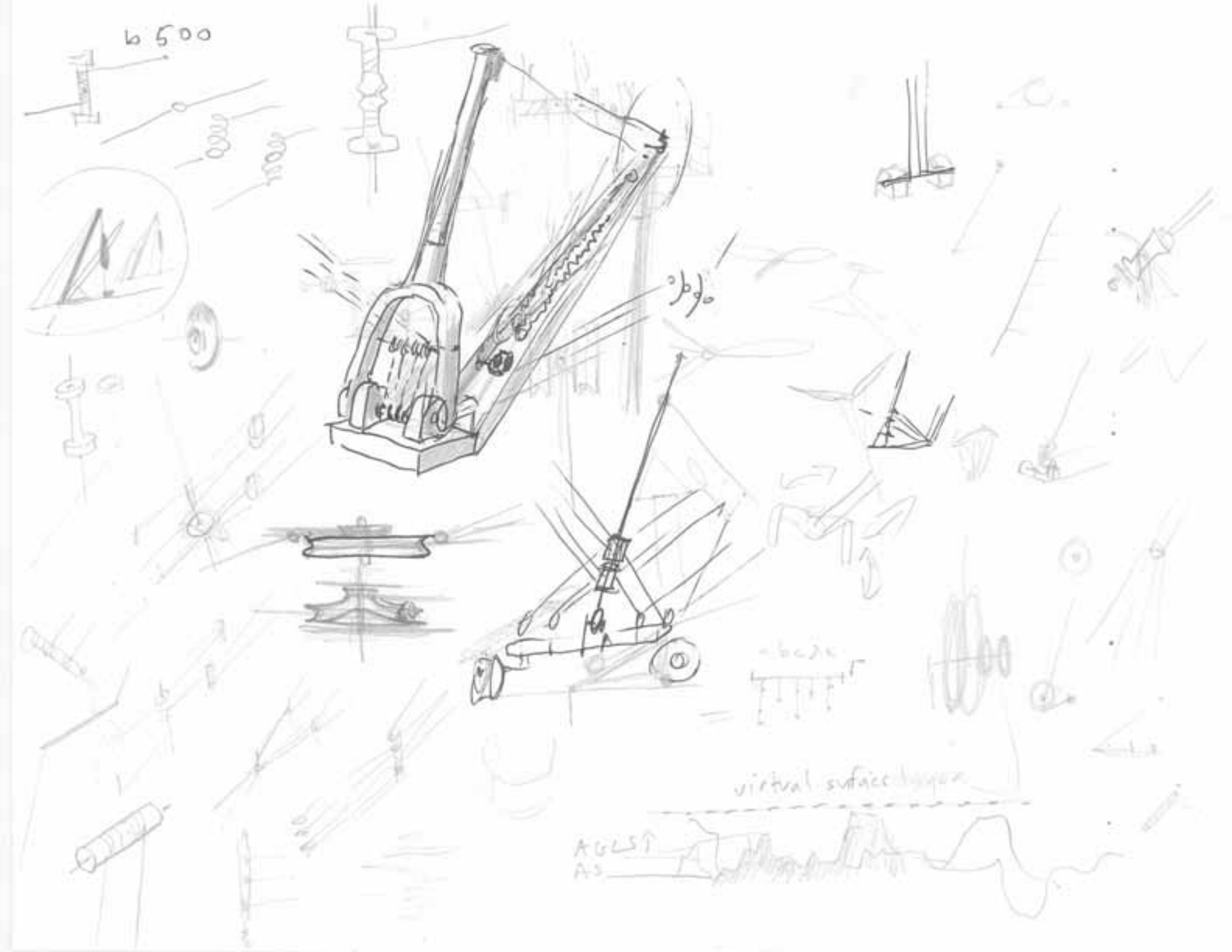
b 496



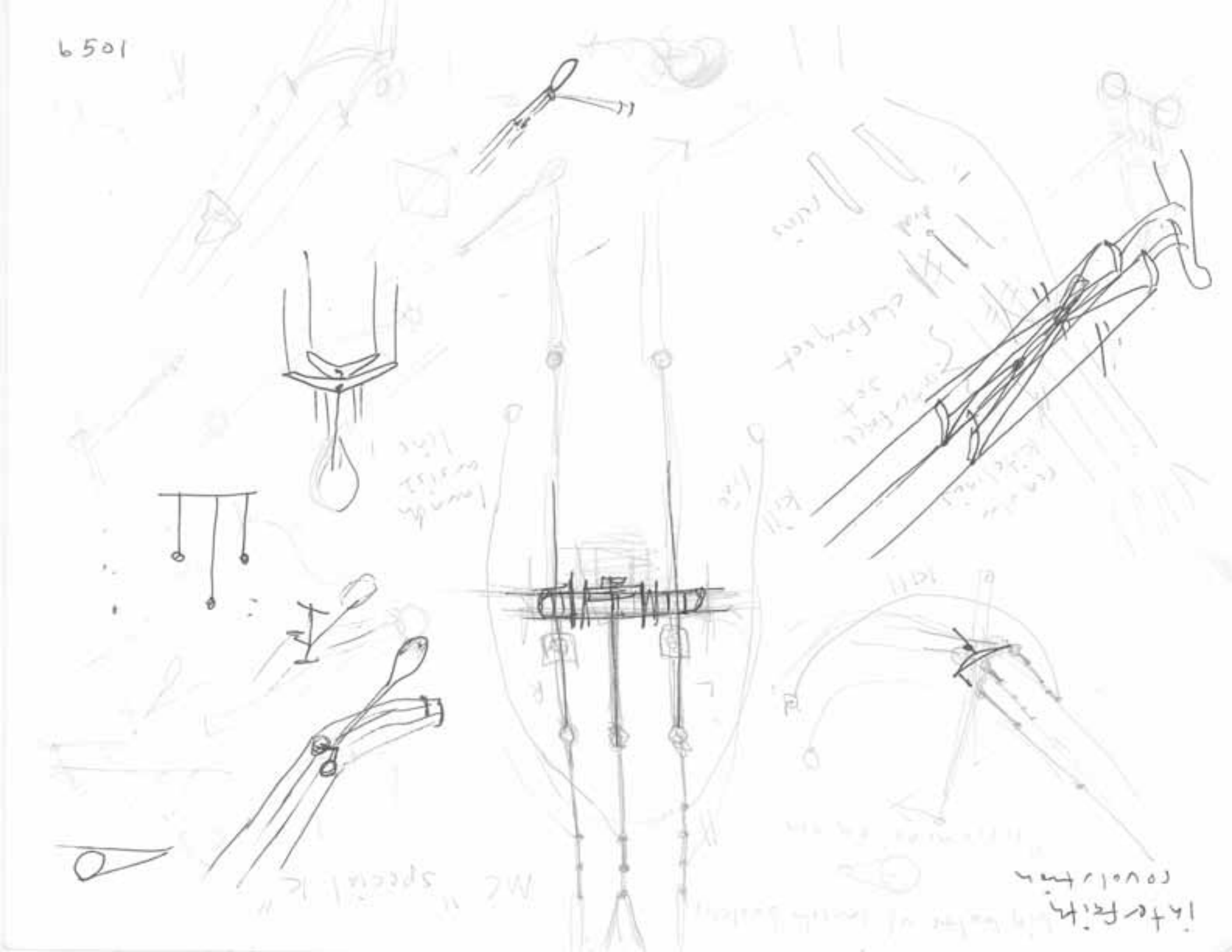


5° 498


b 499

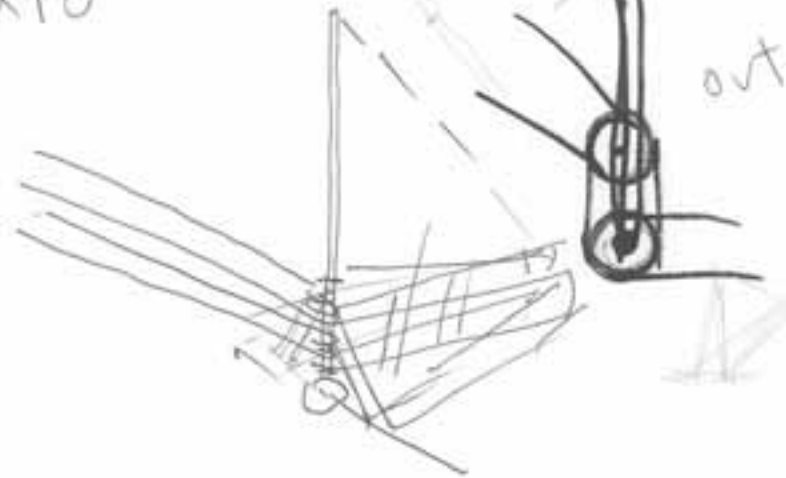

virtual surface layer

6501

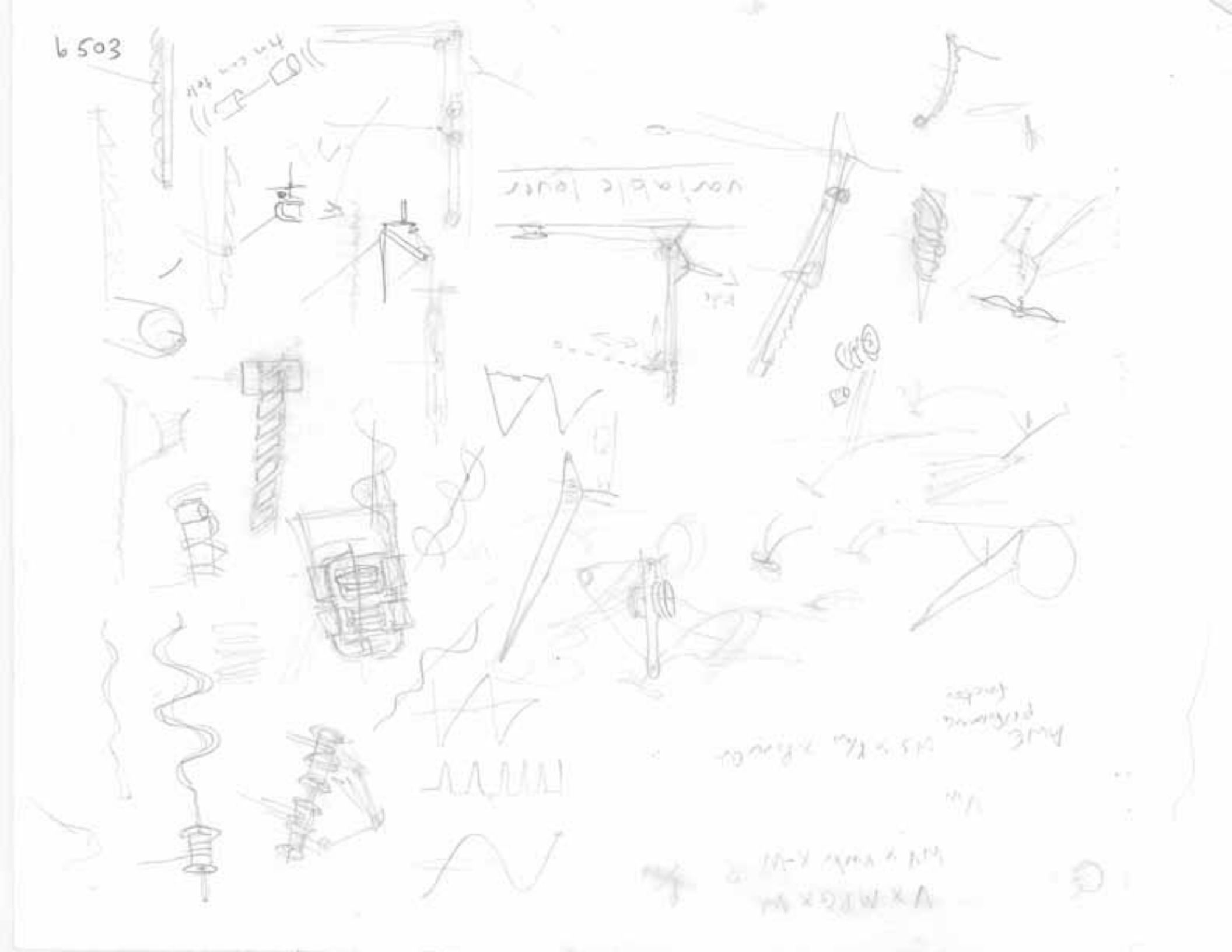


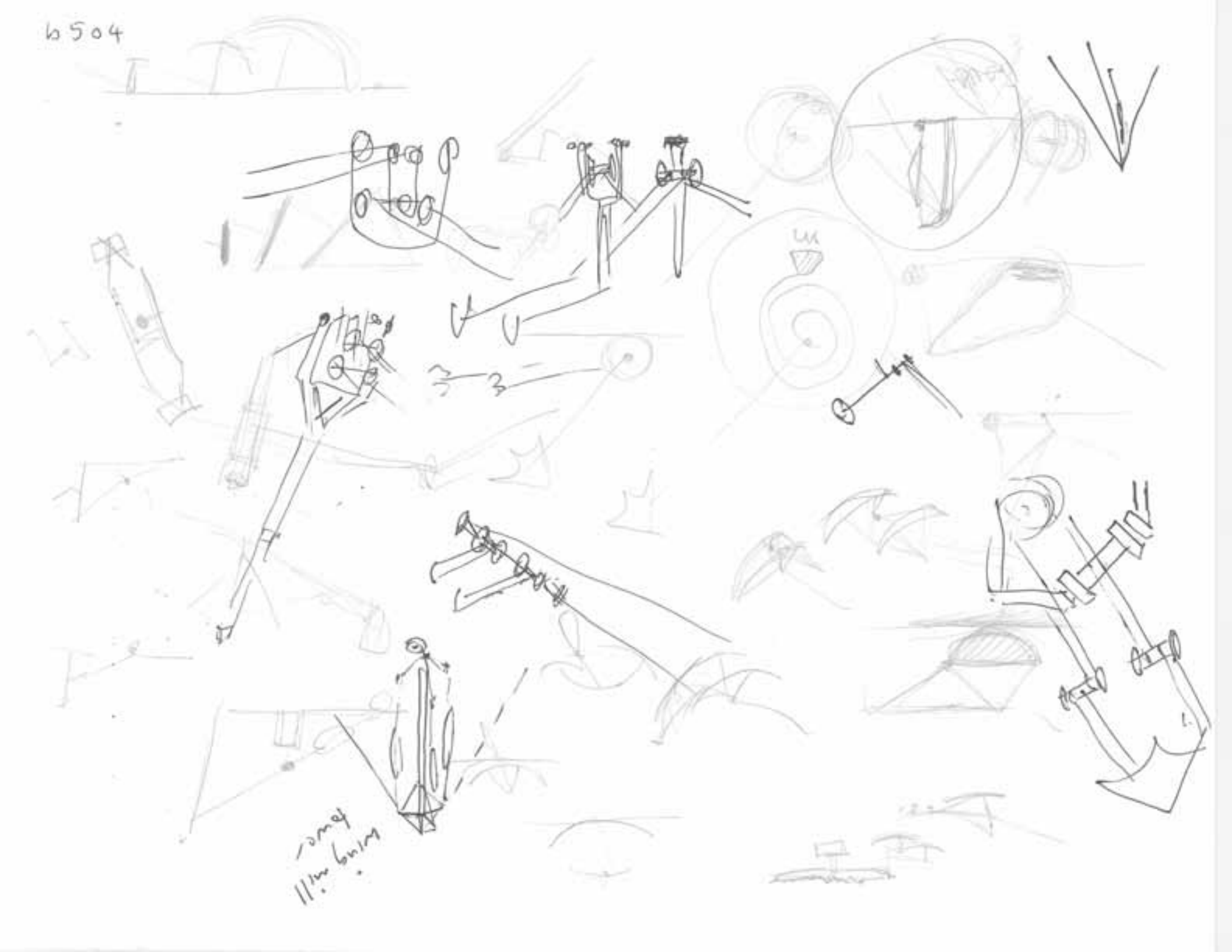
b 502

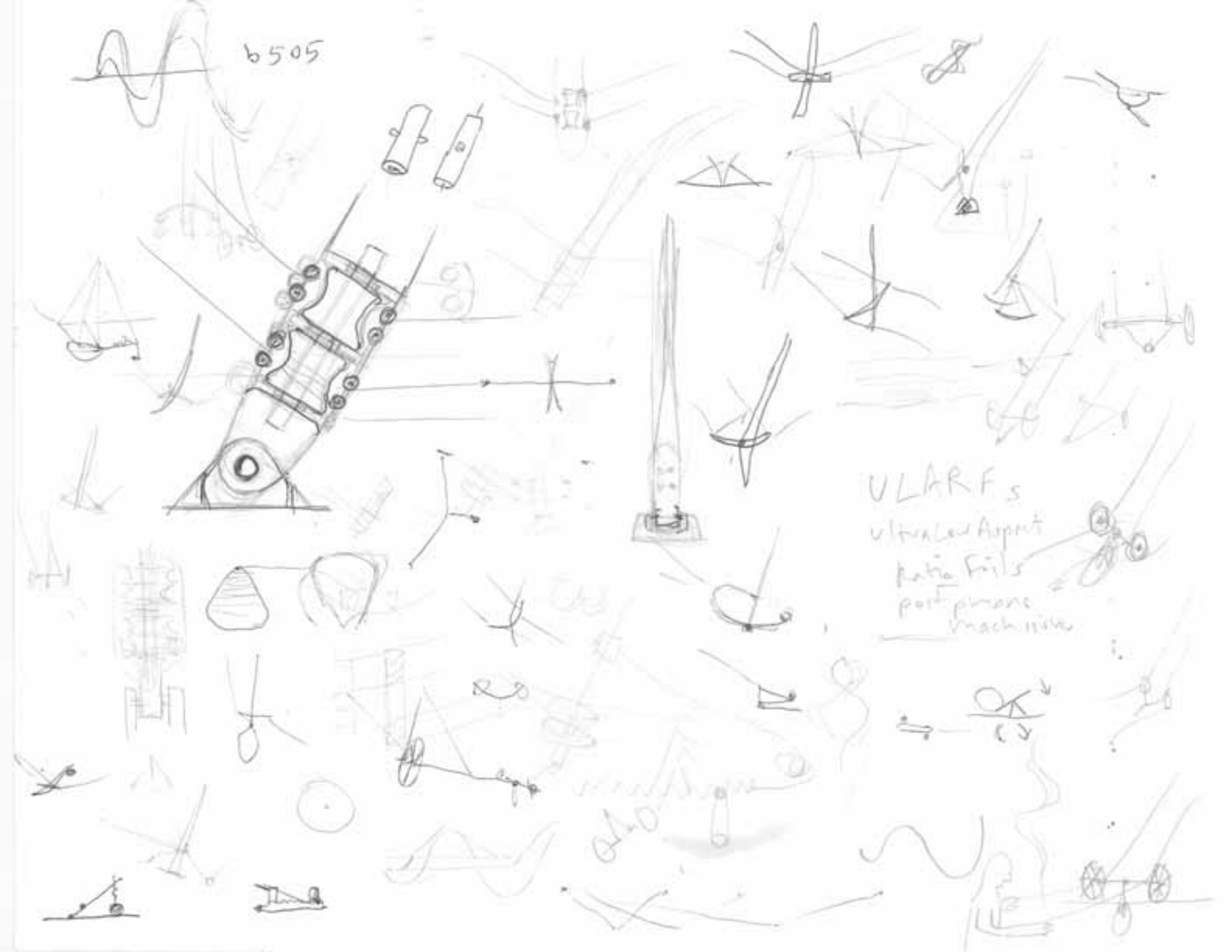
AVLÆ
EXPO

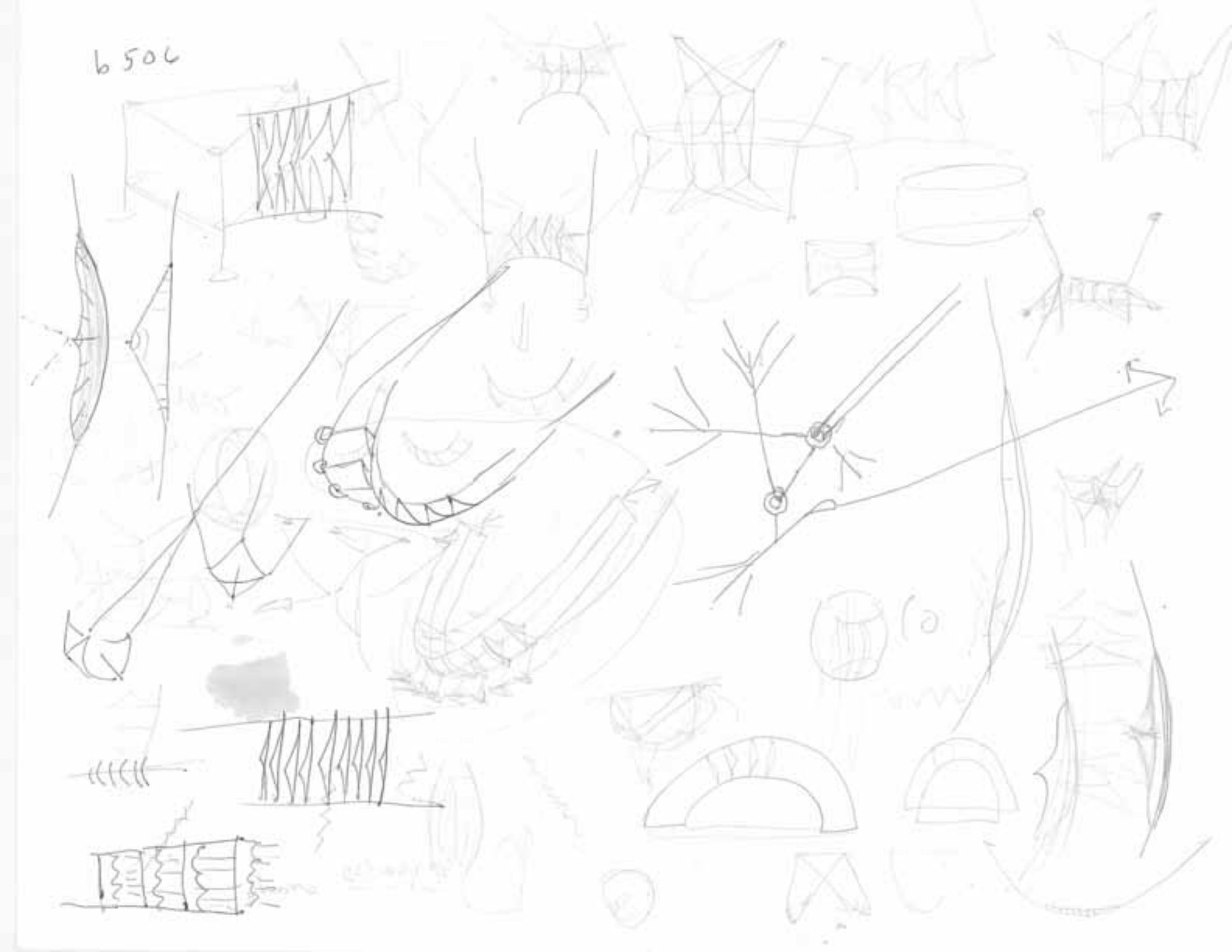


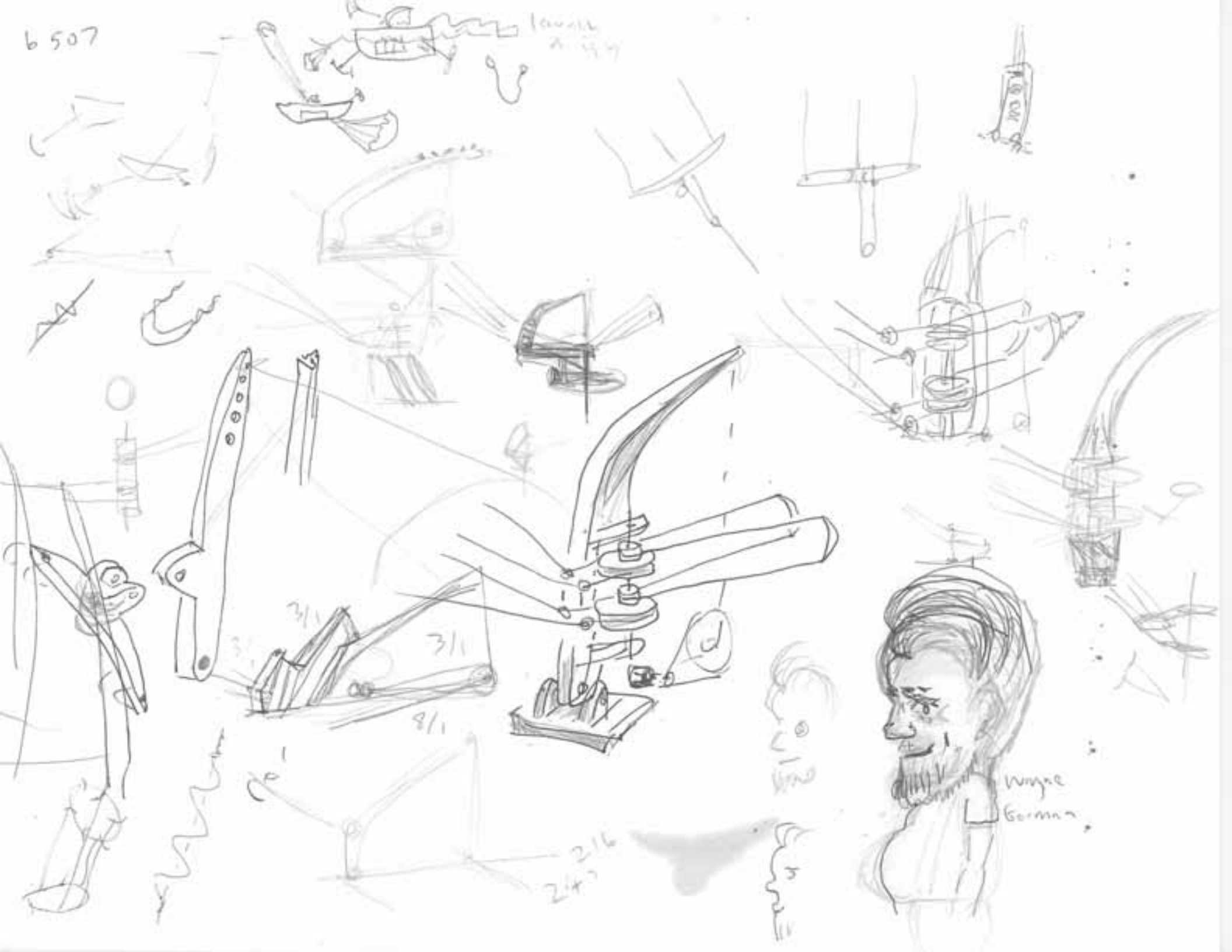
6503

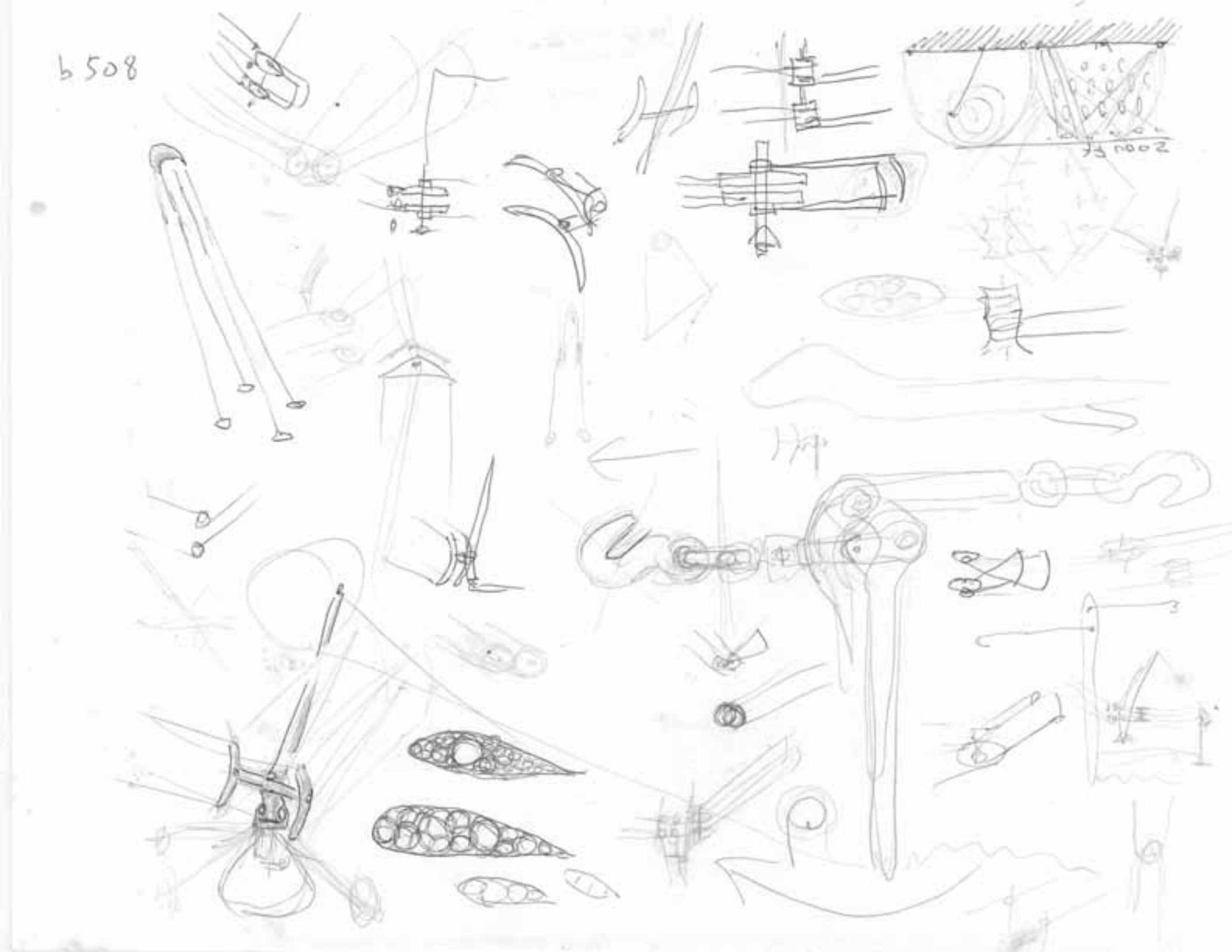


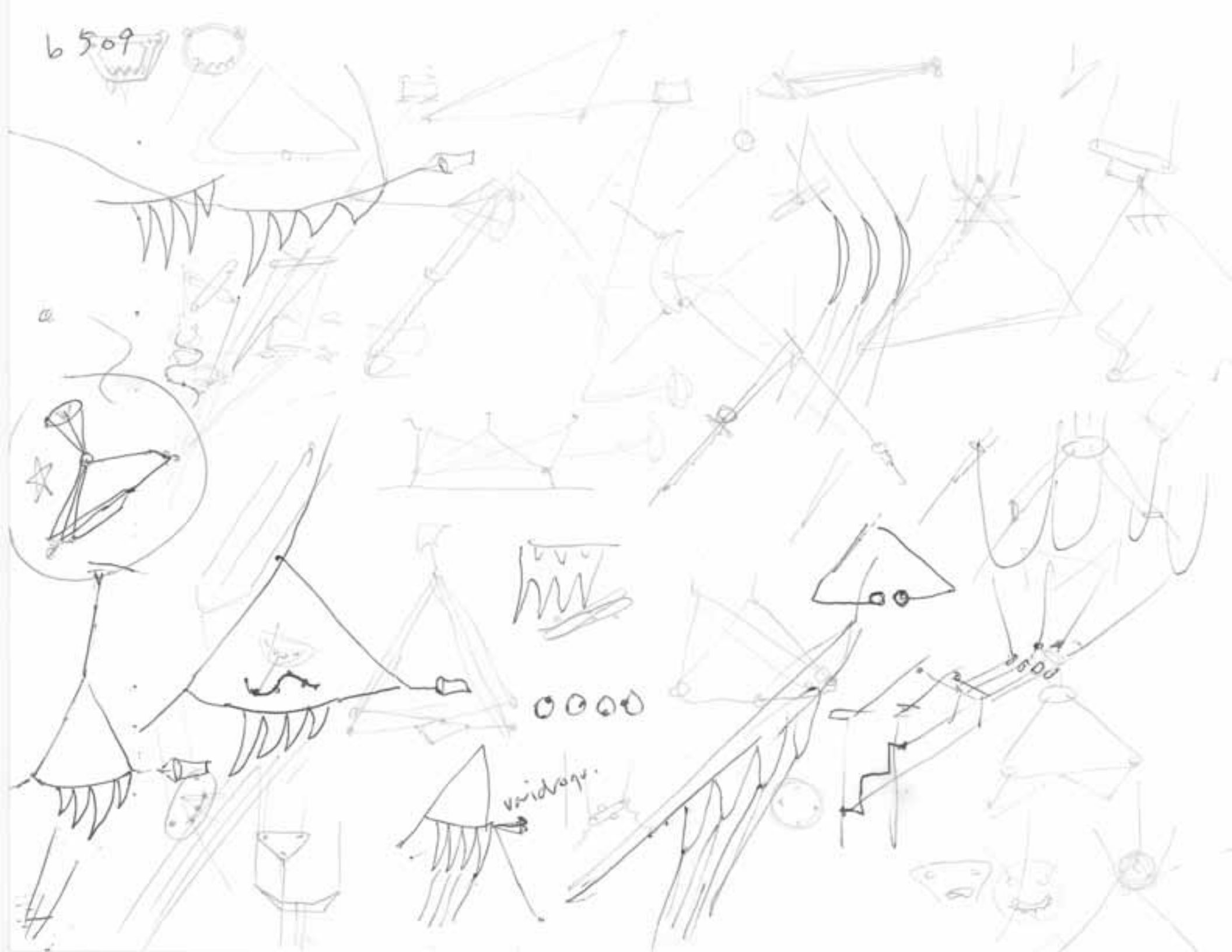



b505
ULARFs
Ultra Low Aspect
Ratio Foils
post phrase
mach issue

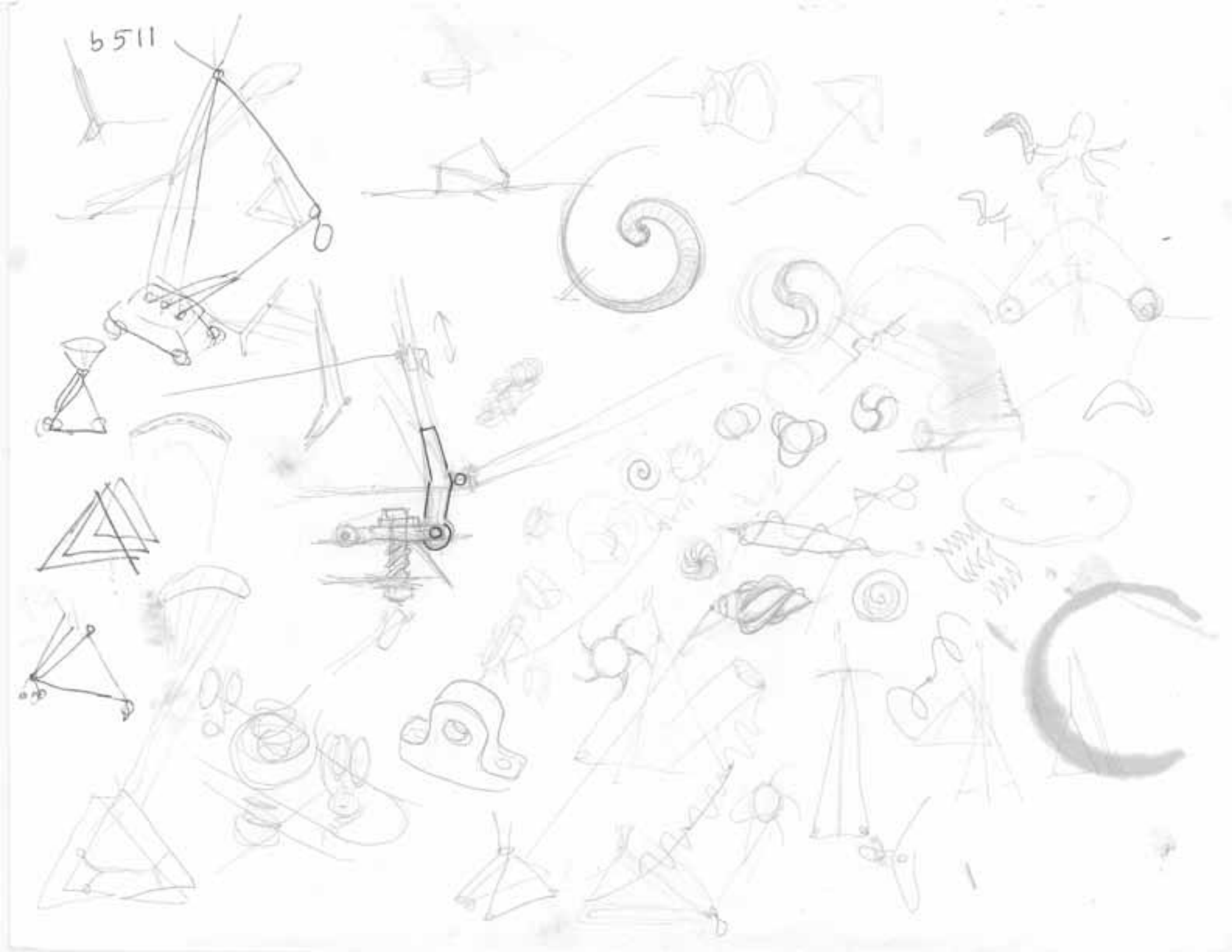

b 50c


b 507
launch
Wayne
German


b508


b 509
varidrogu.

b 510


b511

b 512
tacking
arch
cp shift
pow

b 513

"They think Privatized Air Space airspace is free for all, they still don't have the mentality yet of the FCC, that you can license it"

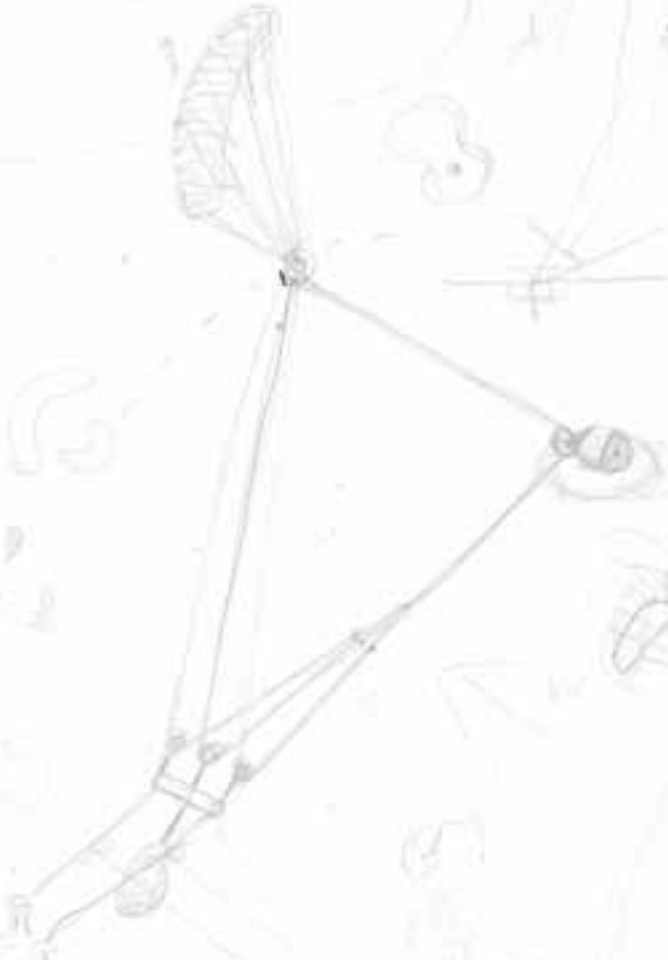
JB

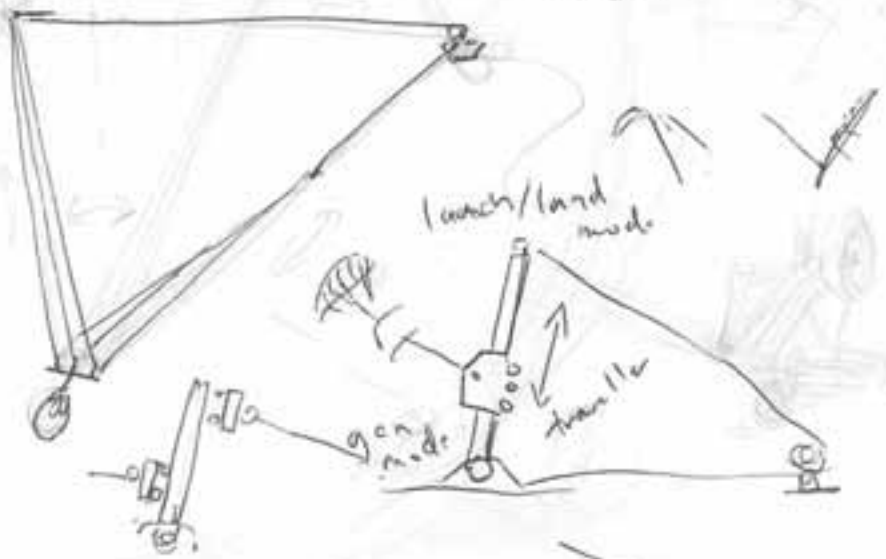
"We would rather pursue civilian applications"

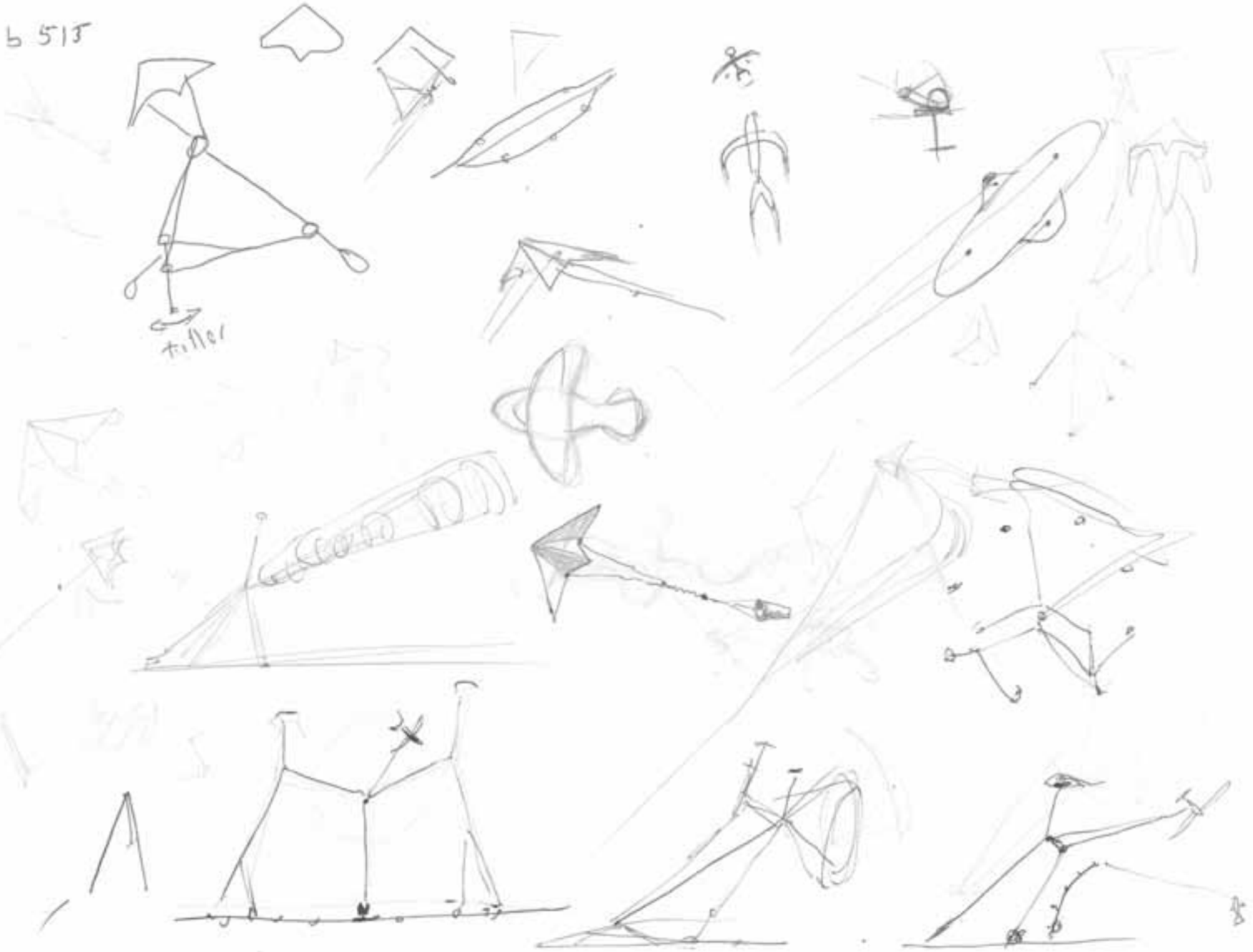
JB

---

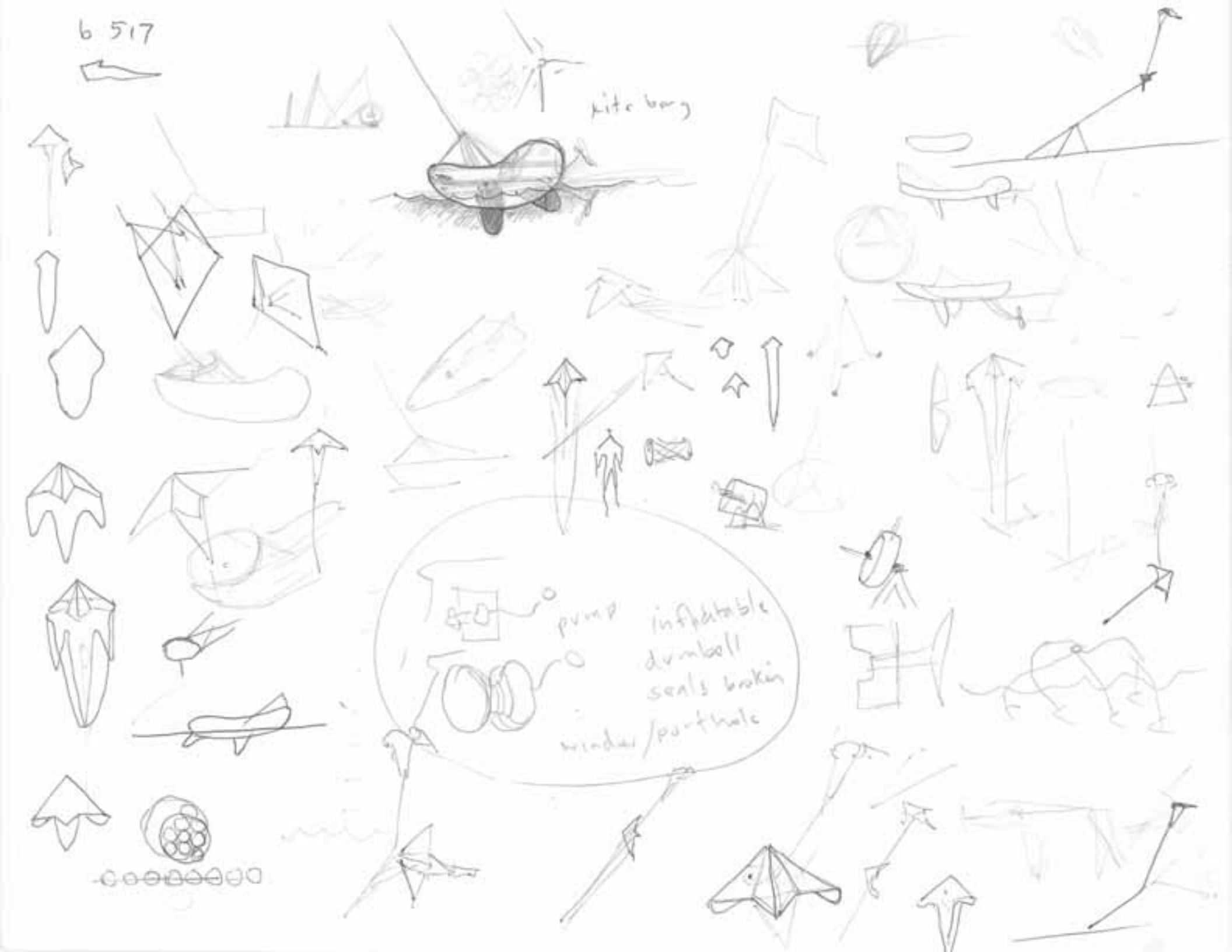
b 514



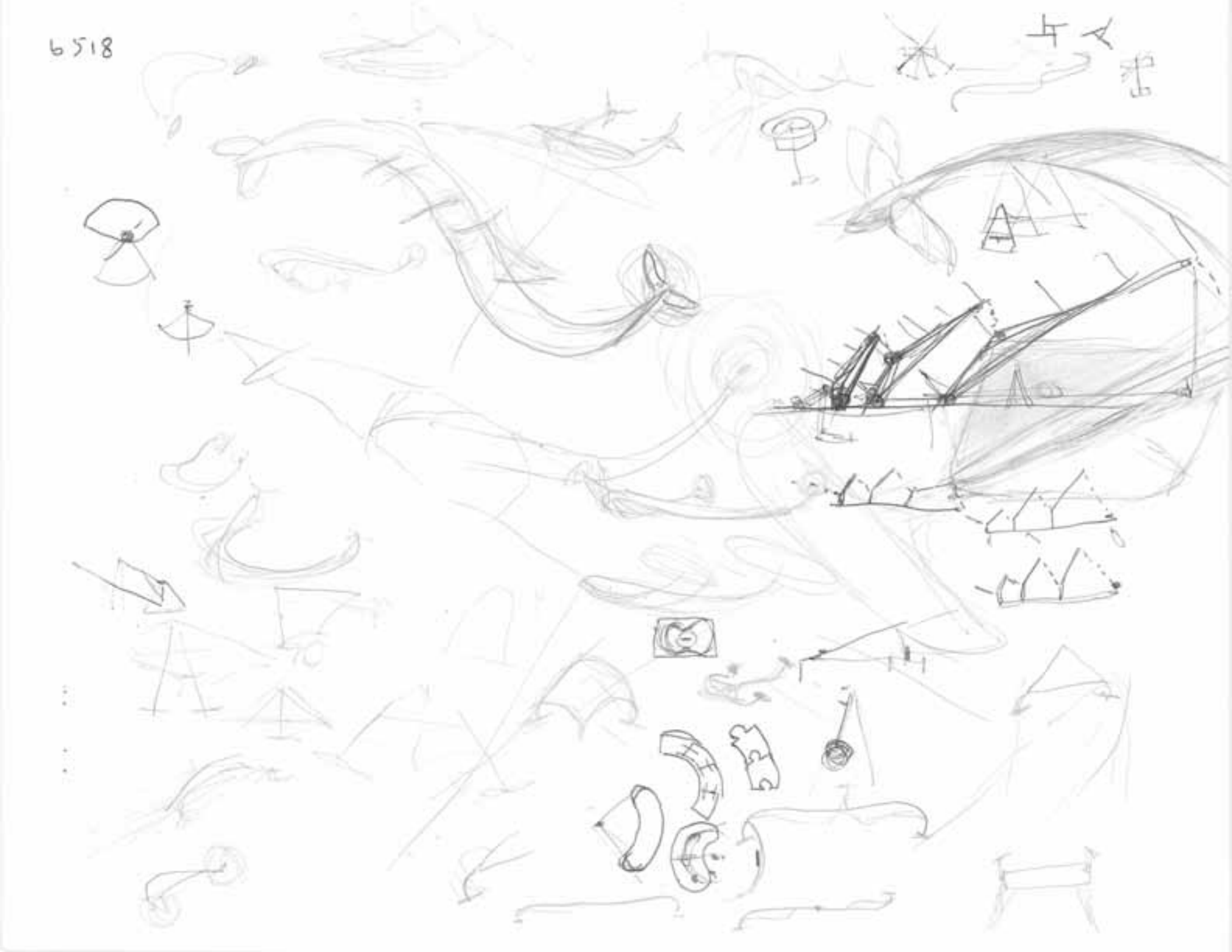



b 515
trailer

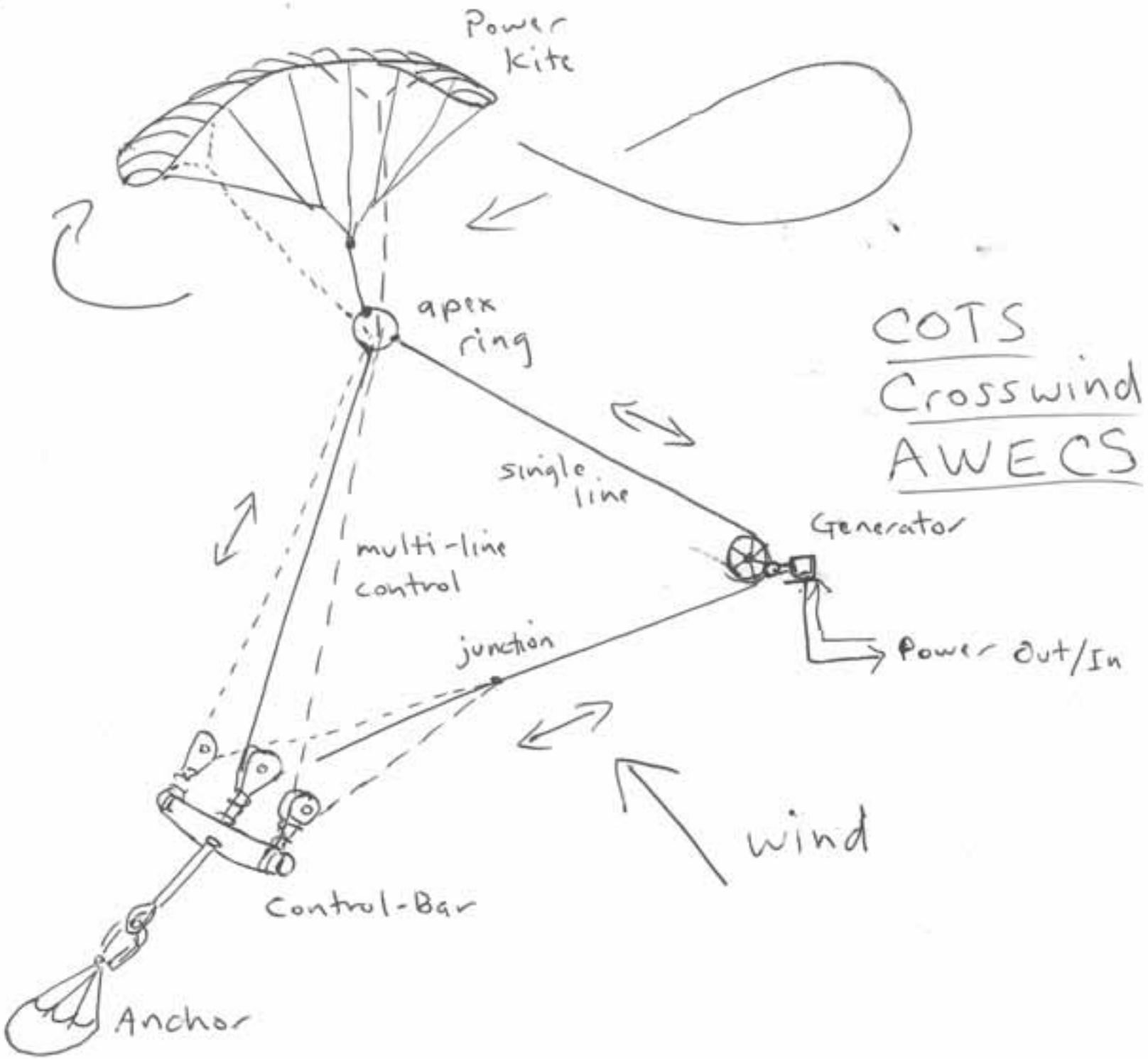
b 516


b 517
kite bag
pump
inflatable
dumbell
seals broken
window/porthole

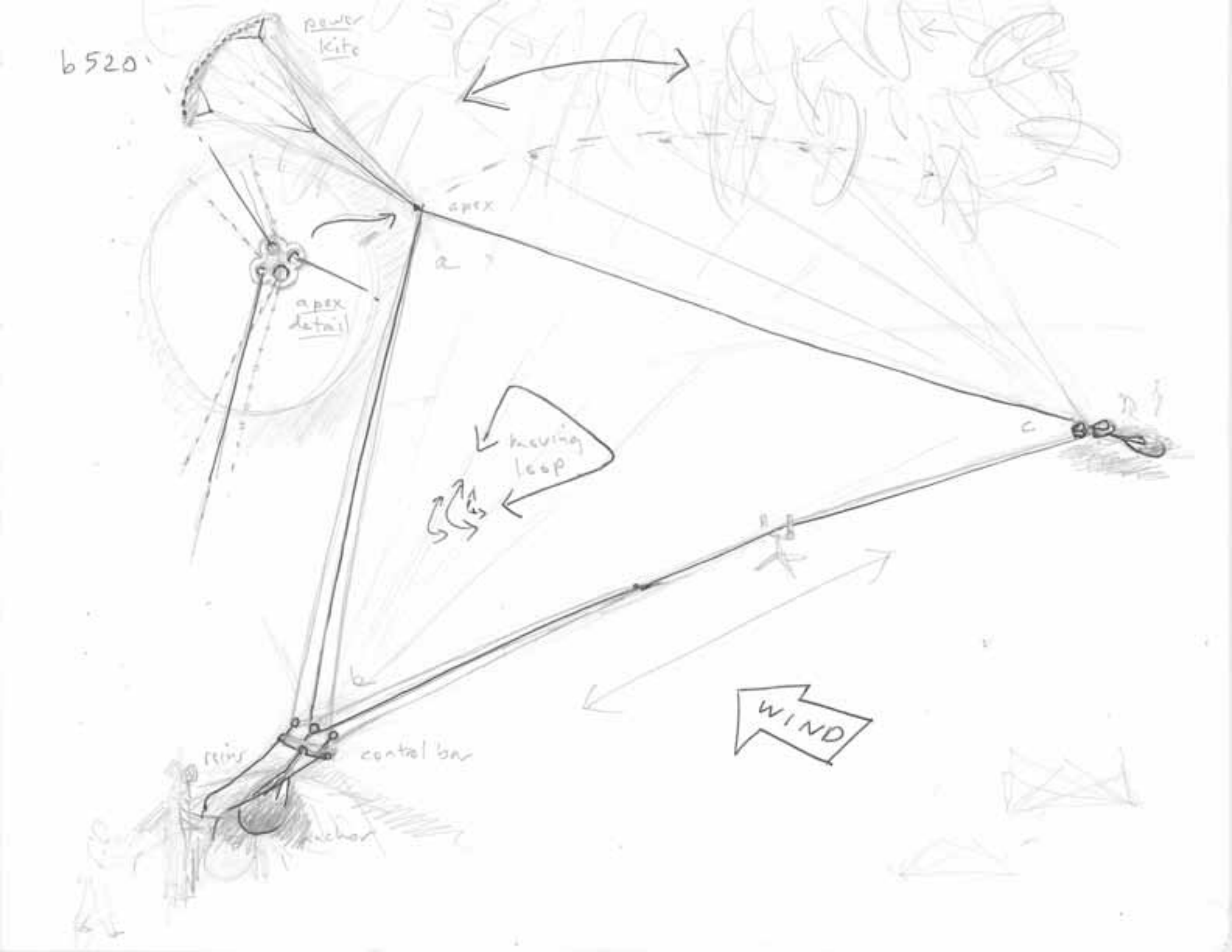
6518



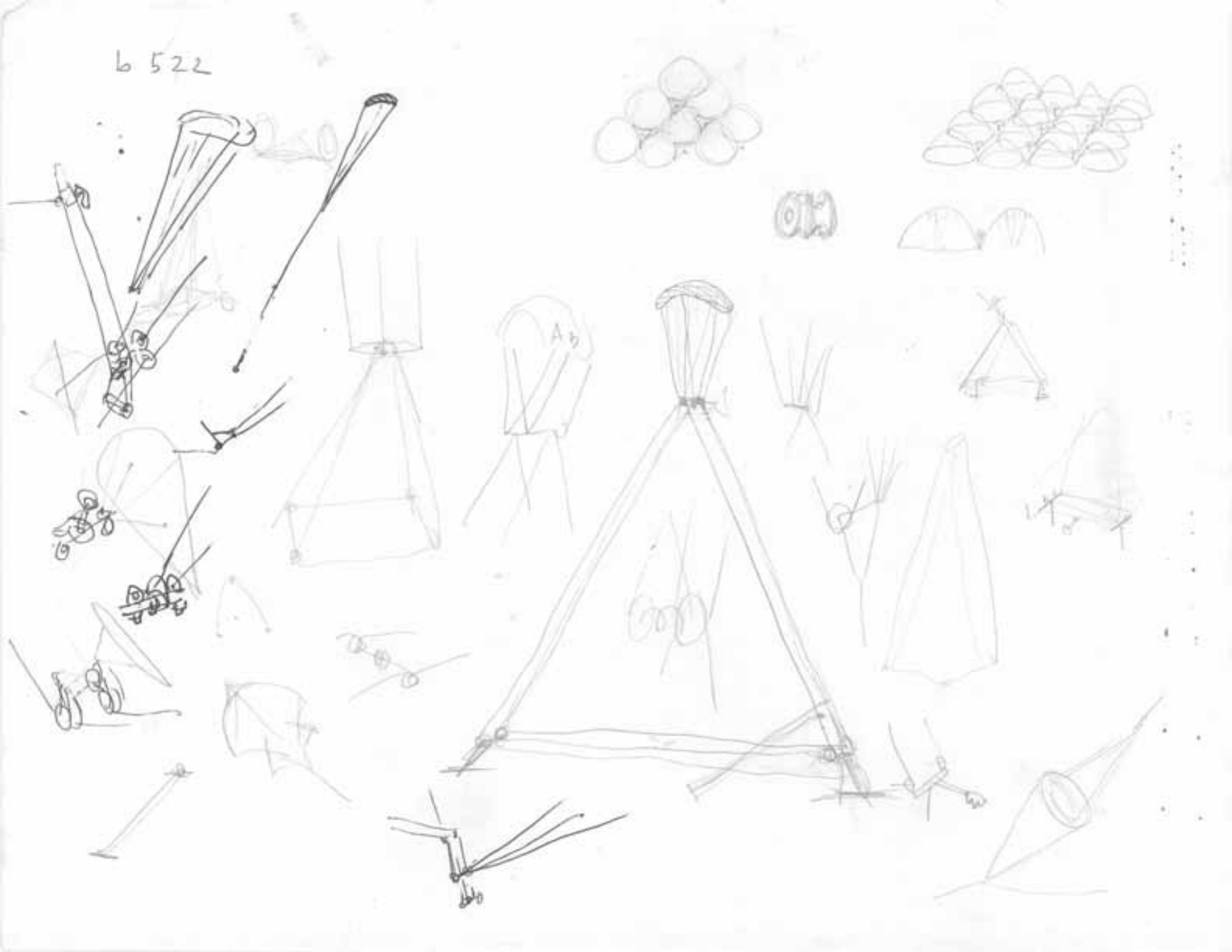
B 519

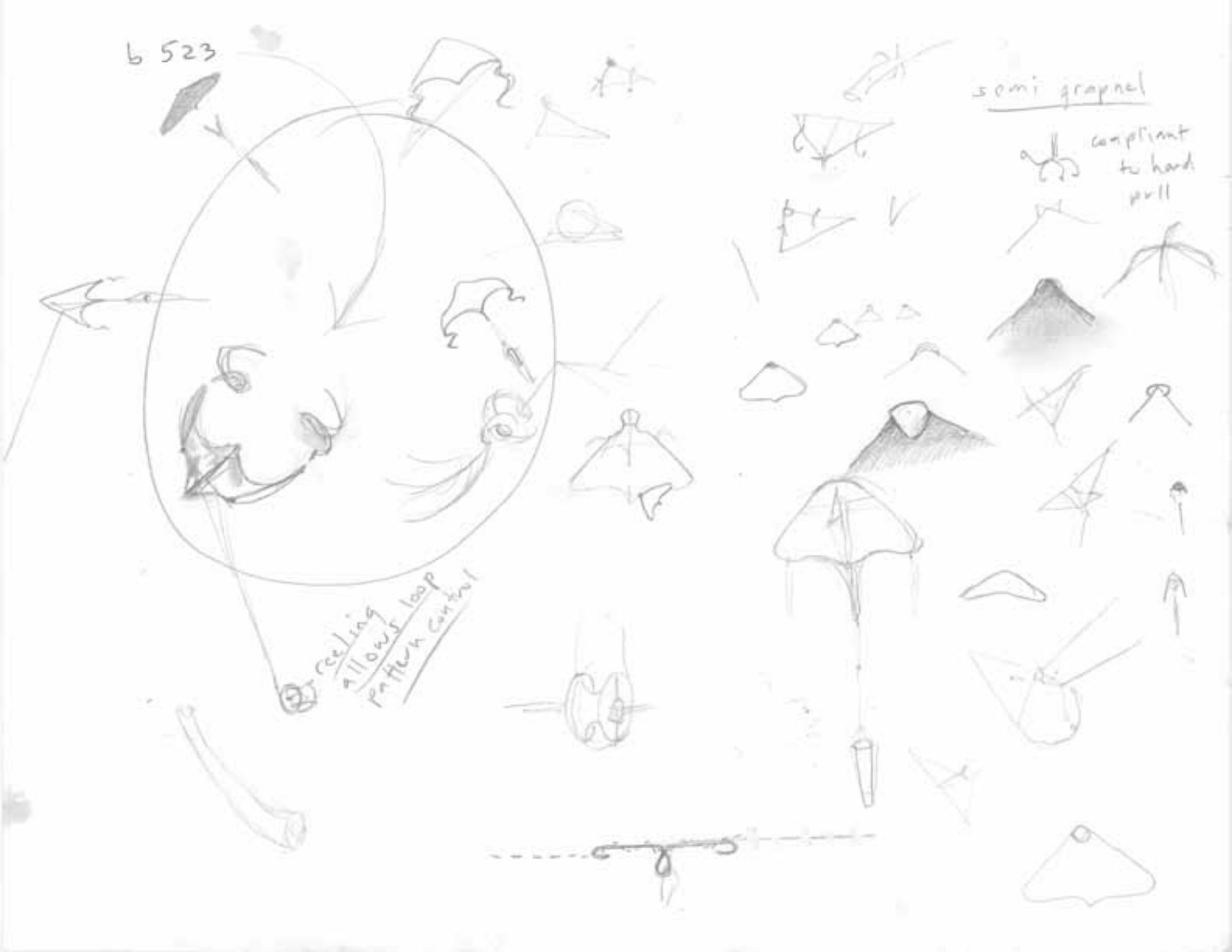


COTS
Crosswind
AWECS


power kite
apex
apex detail
a
b
c
leading loop
WIND
reins
control bar
anchor

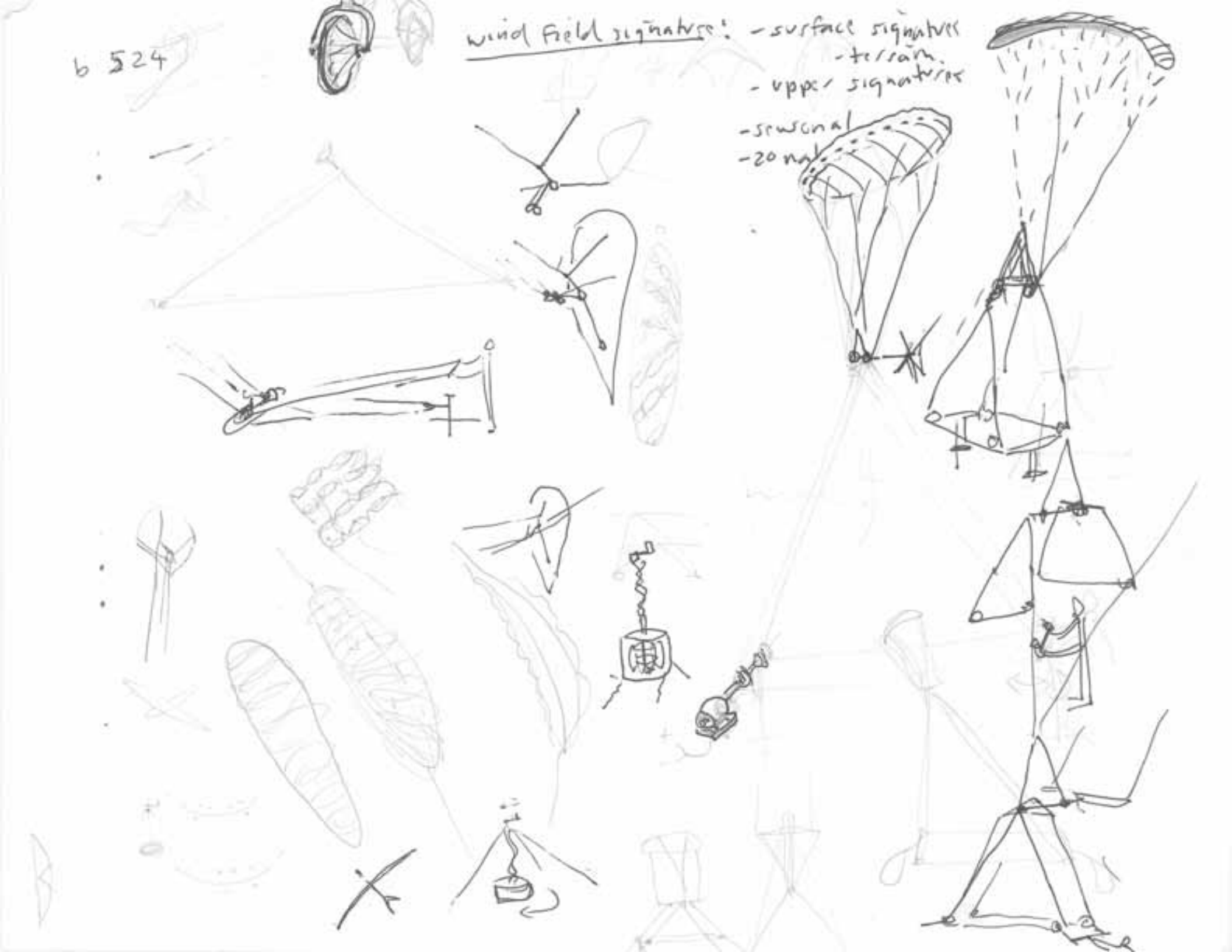
6521

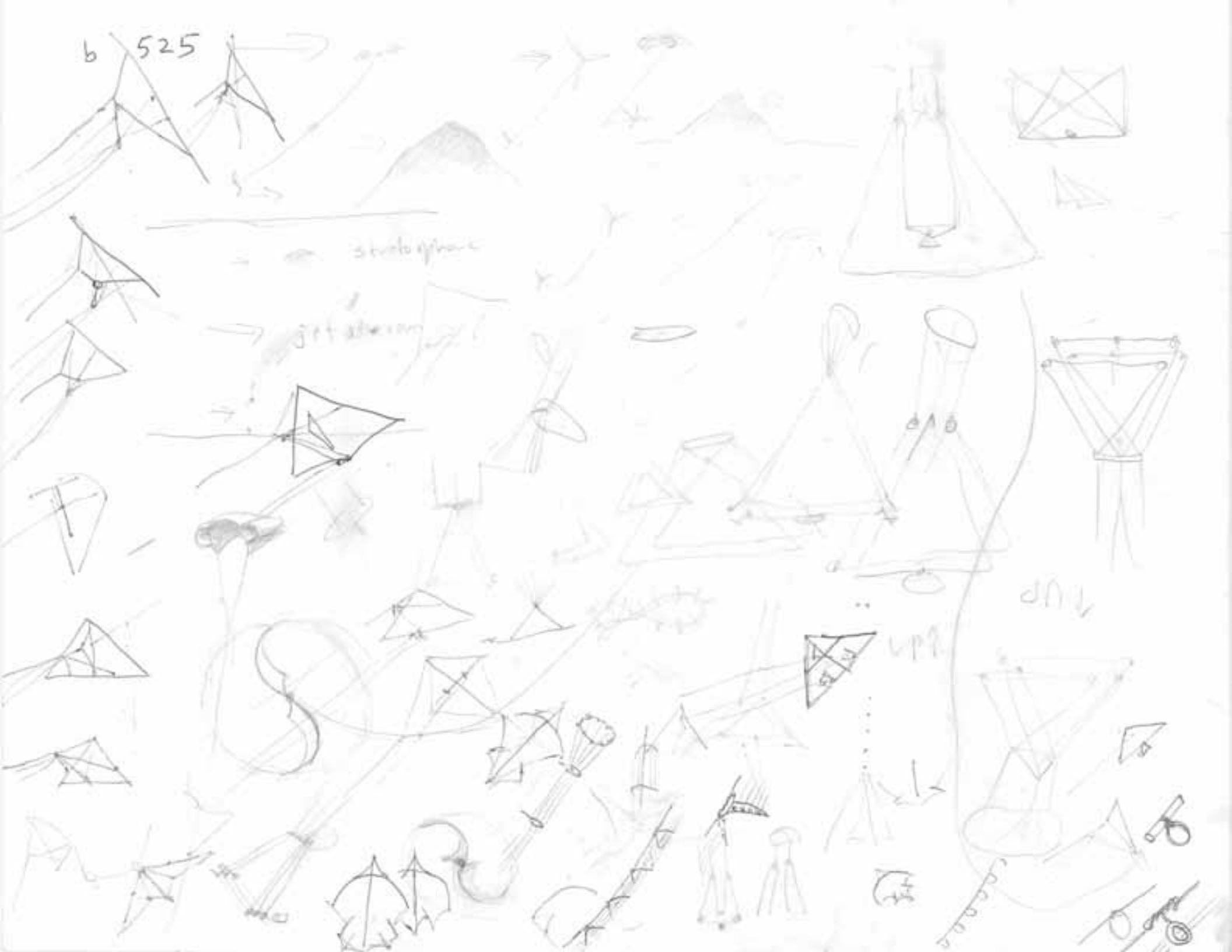

b 522

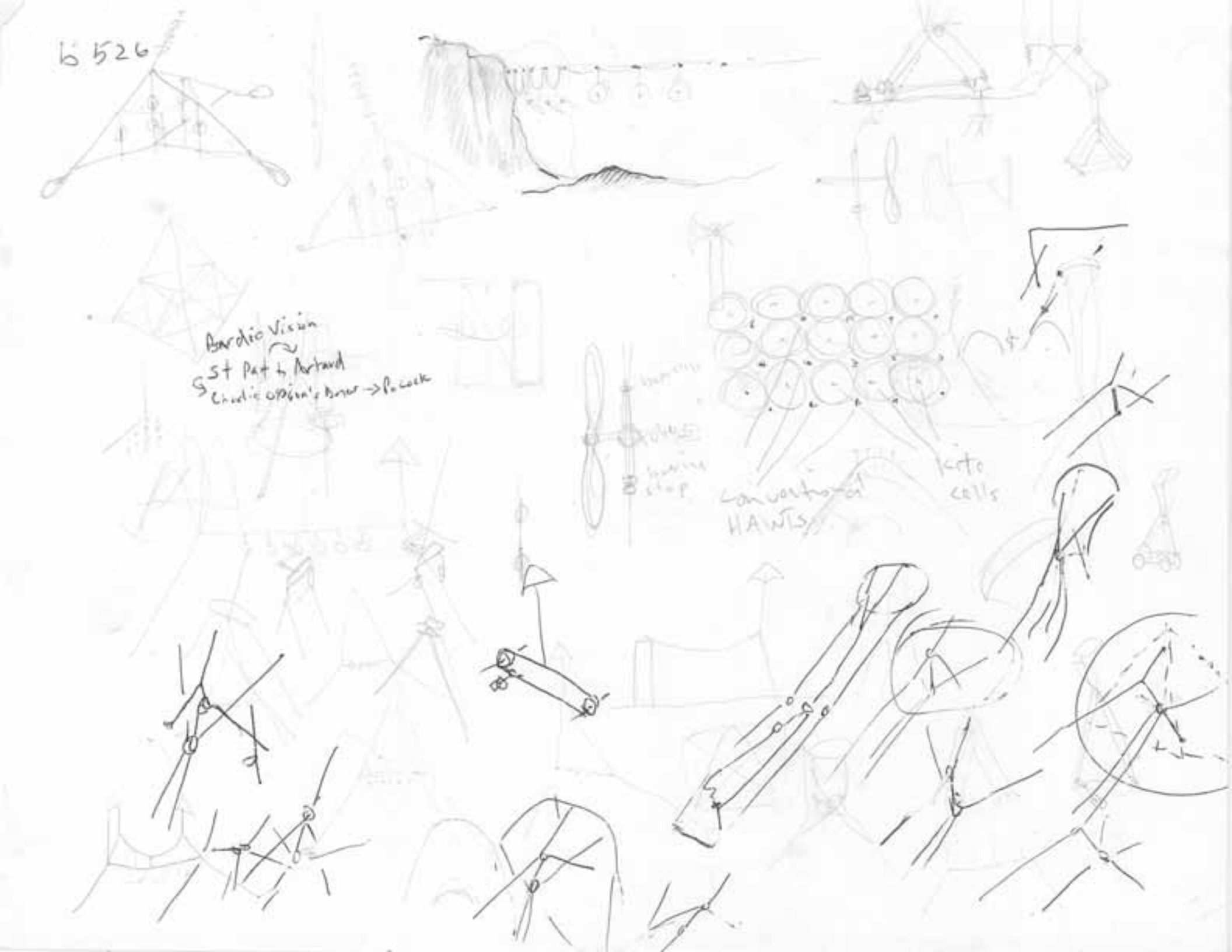

b 523
semi grapnel
compliant to hard pull
reeling allows loop pattern control

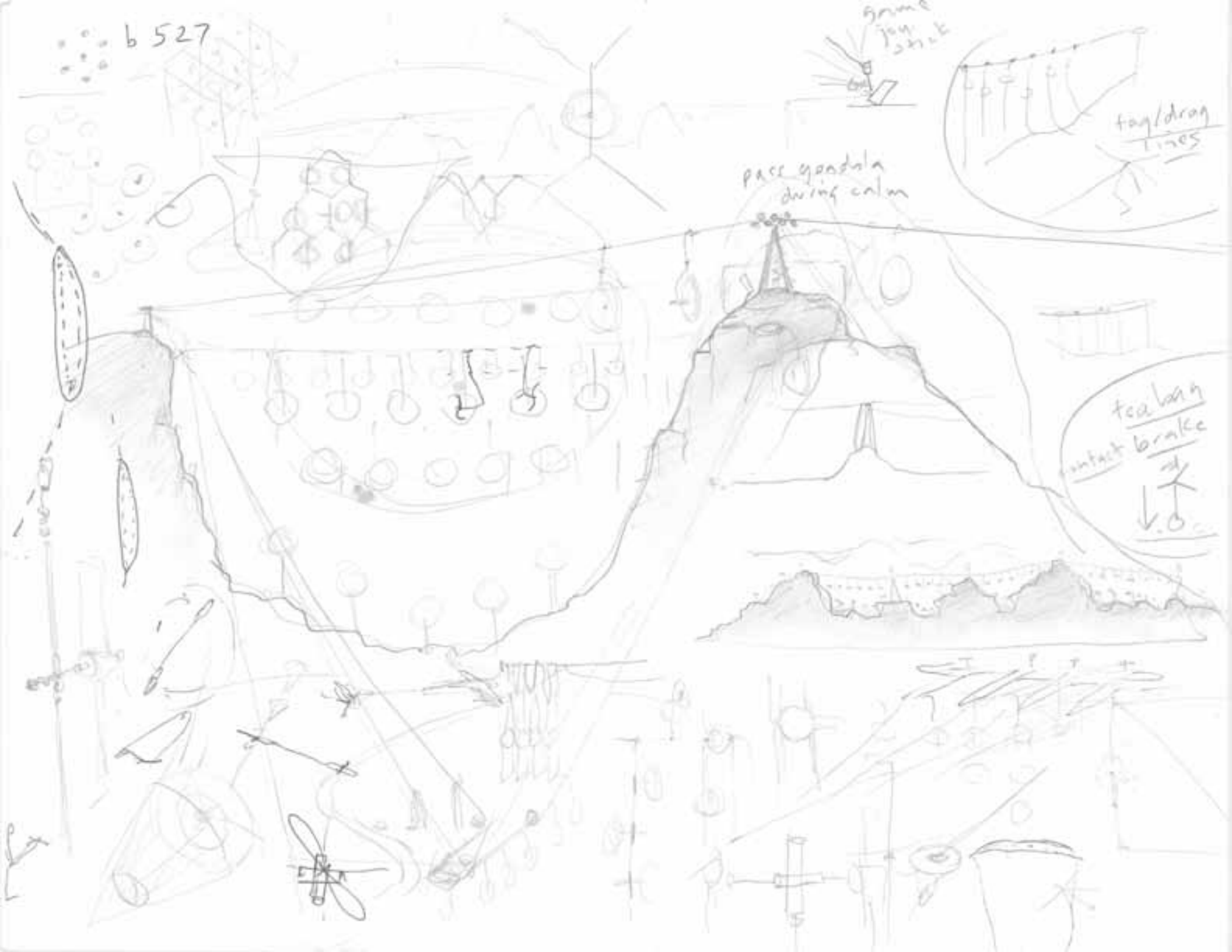
b 524

wind field signatures: - surface signatures
- terrain
- upper signatures
- seasonal
- 20 mb

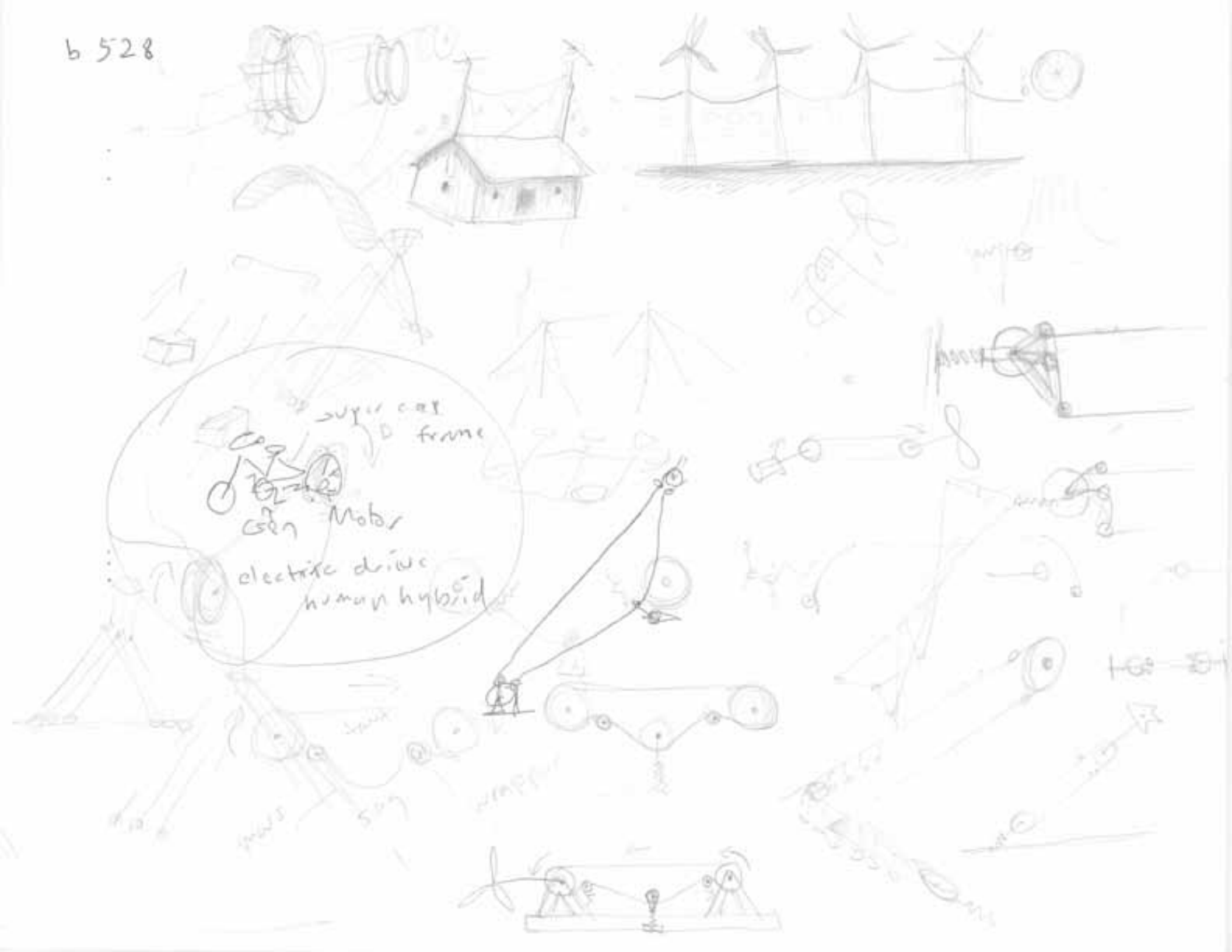


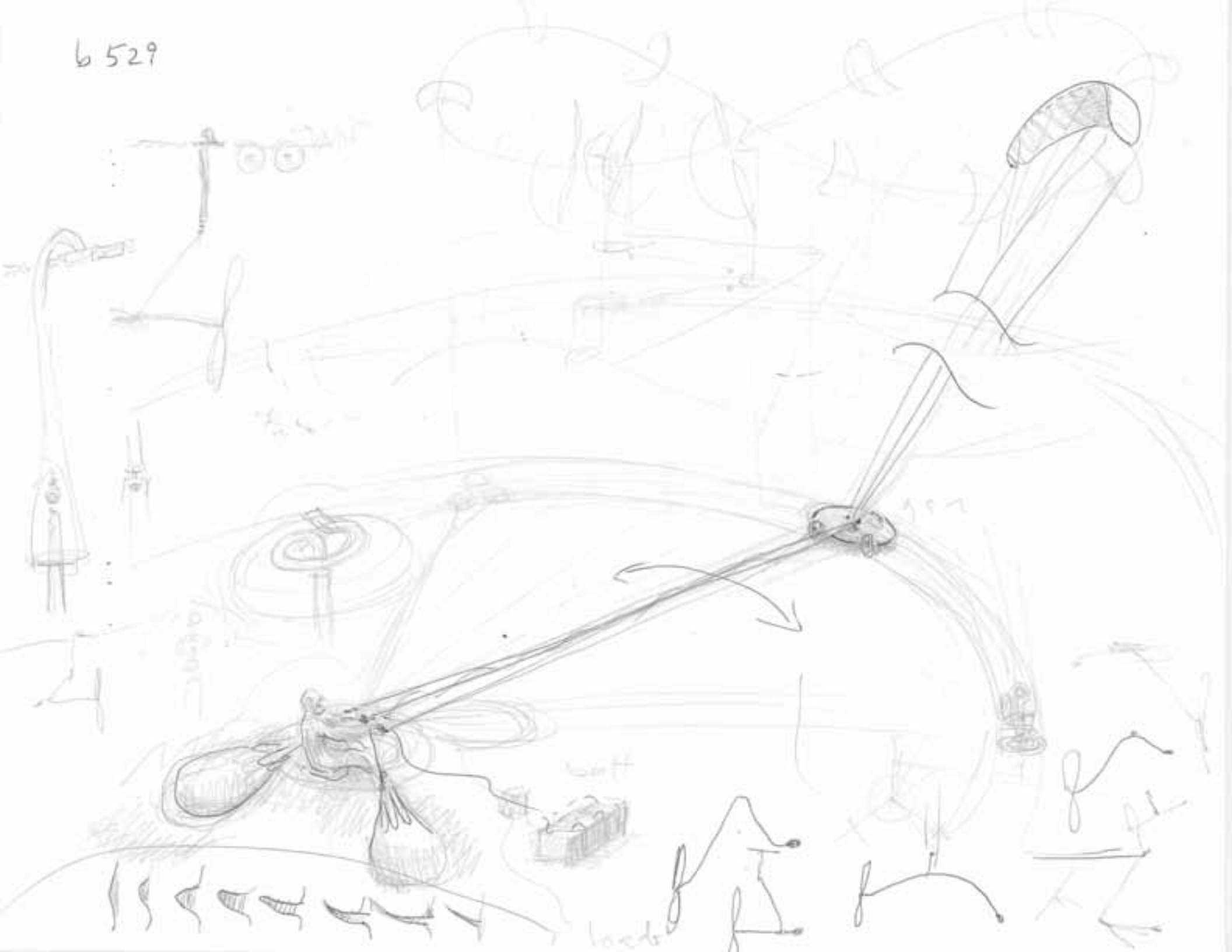

b 525


b 526
Bardic Vision
St Pat to Portland
Charlie Oxford's Bower -> Pocock
Conventional
HAWTS
Kite
cells

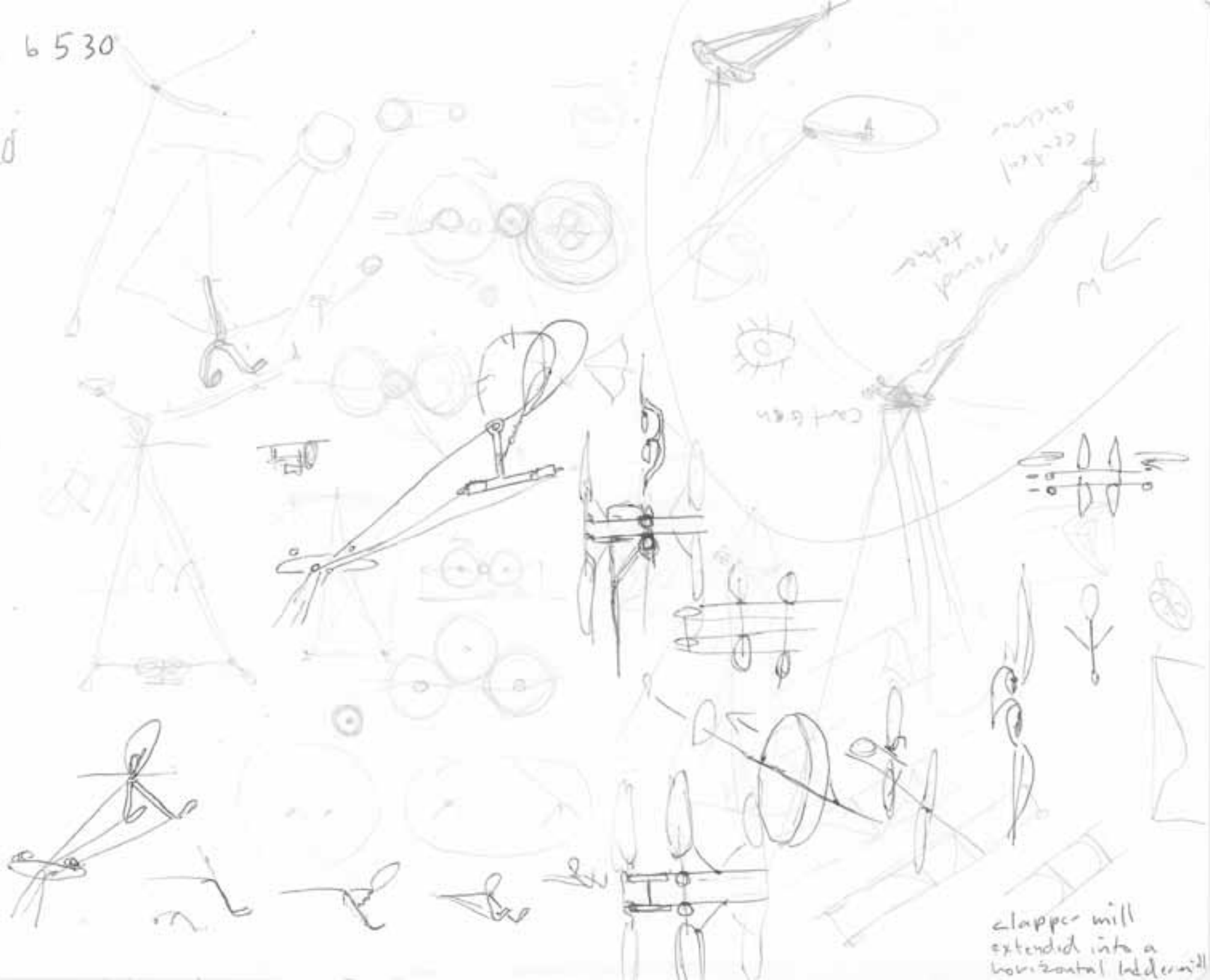

b 527
game joy stick
tag/drag lines
pass gondola during calm
tea bag contact brake

b 528



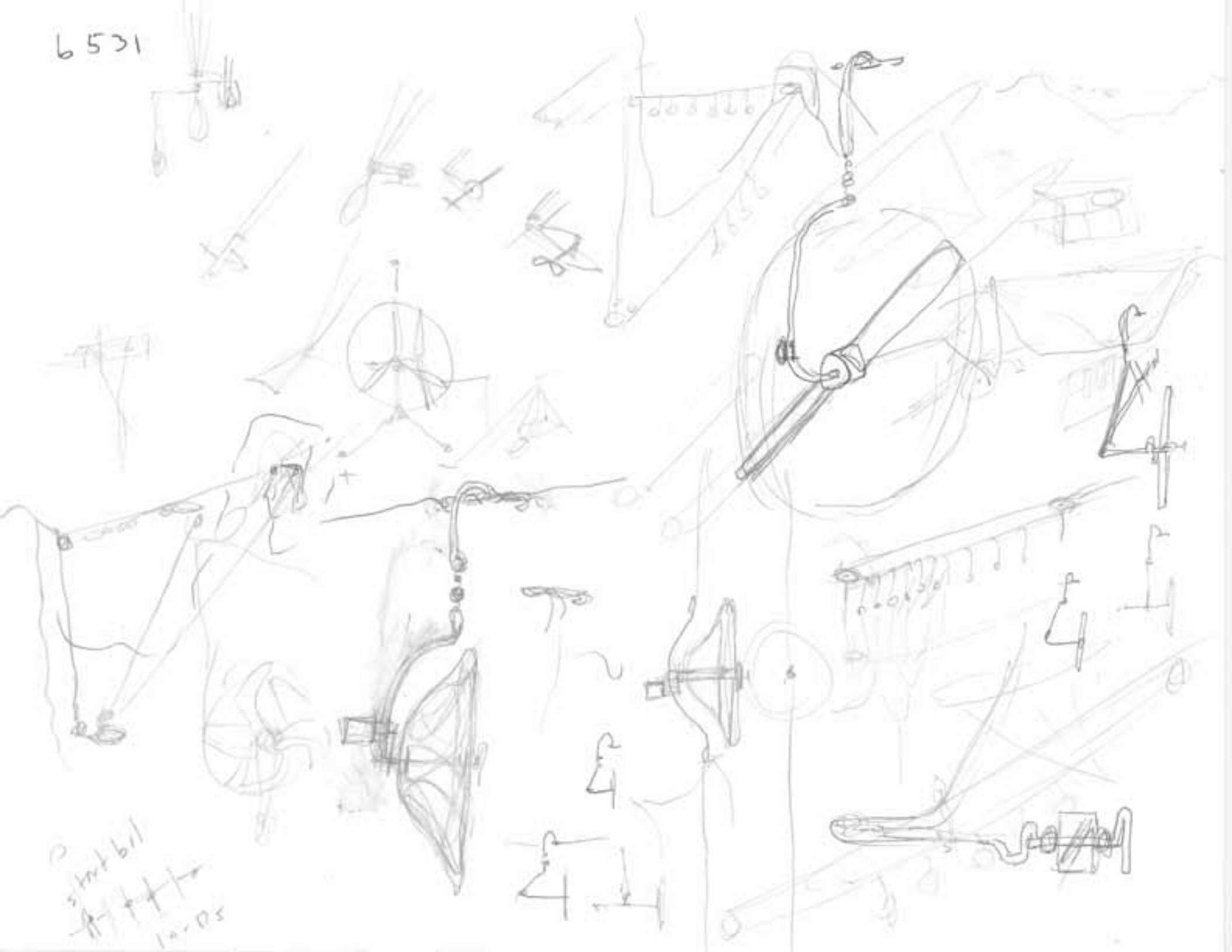

6529

6530

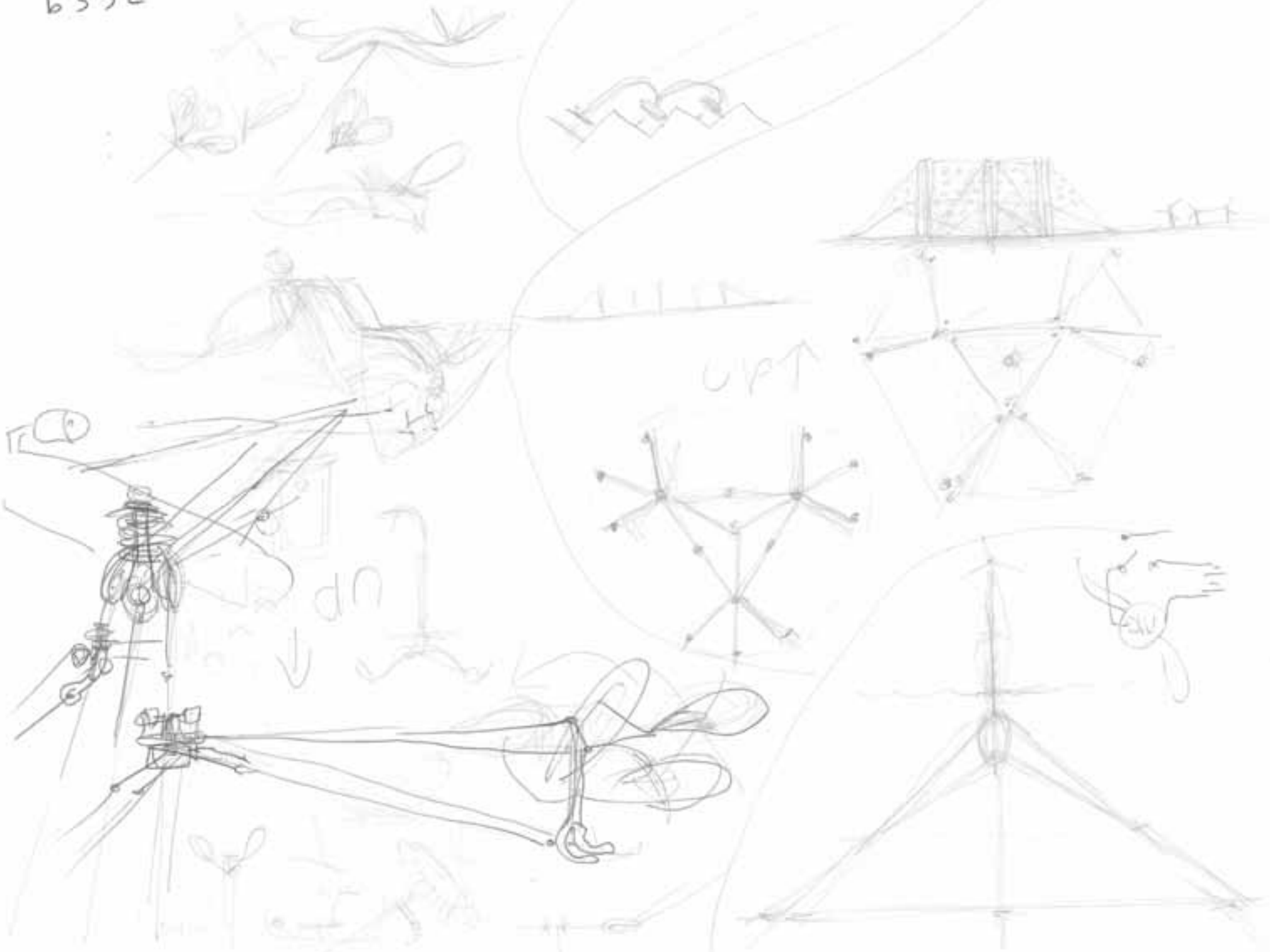


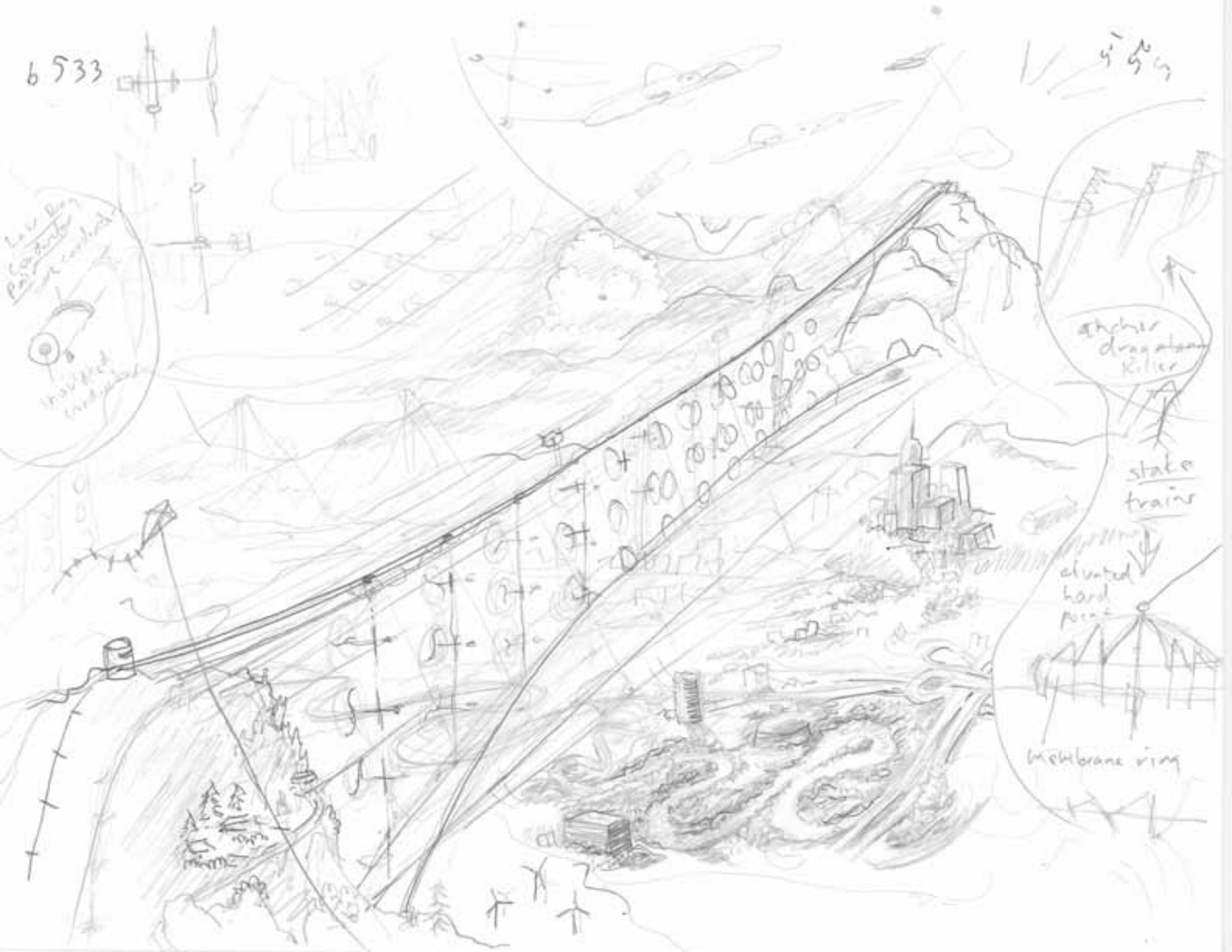
clapper mill extended into a horizontal tide mill

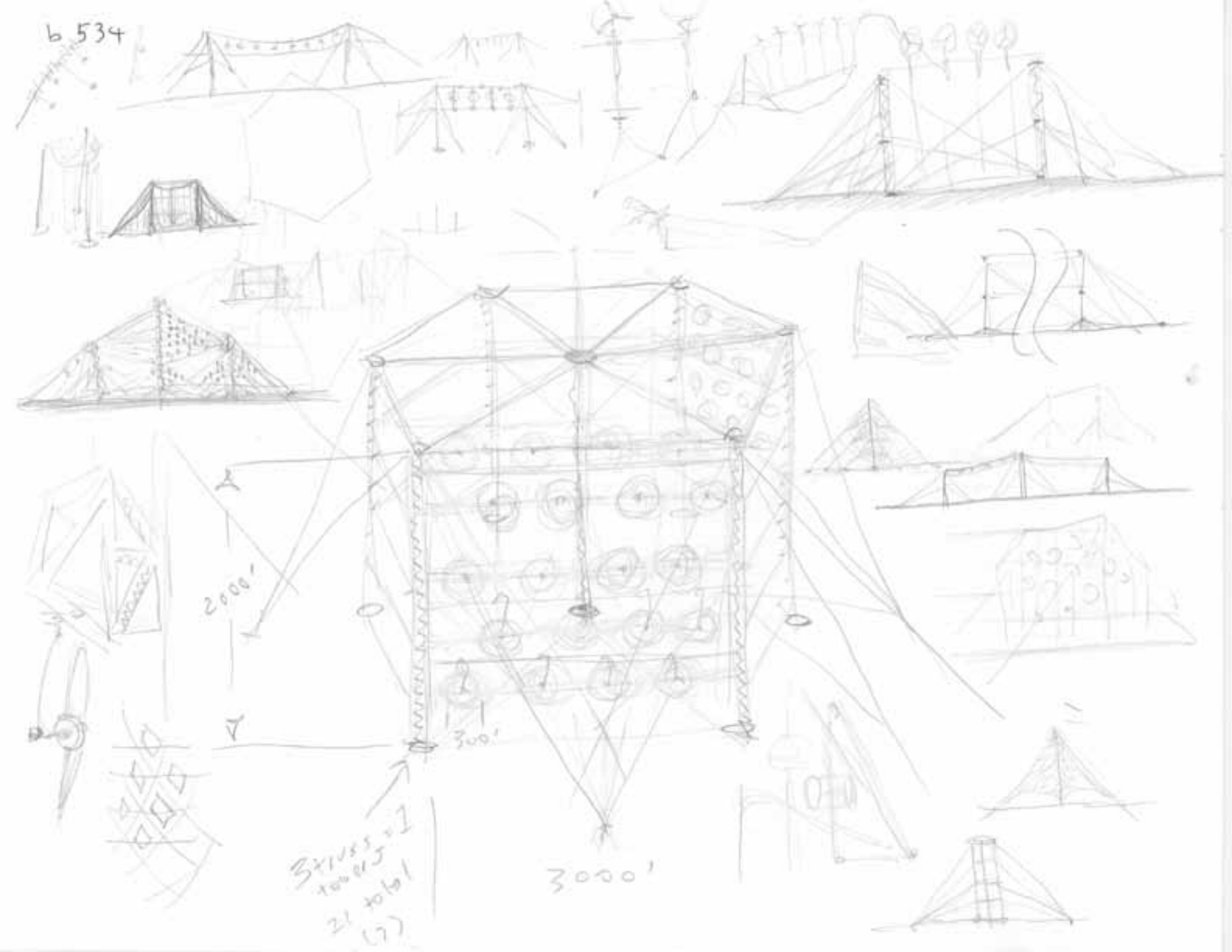
6531



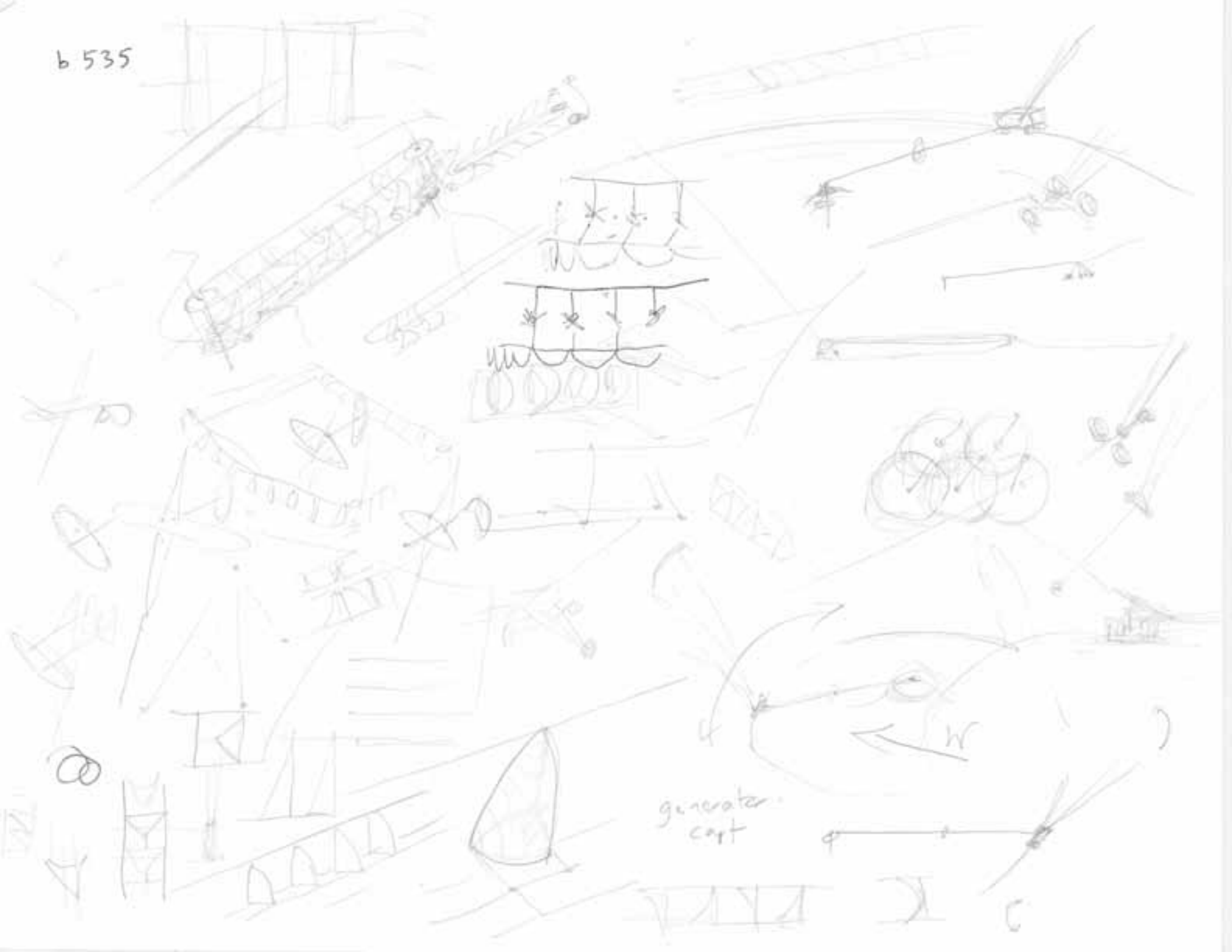
6532

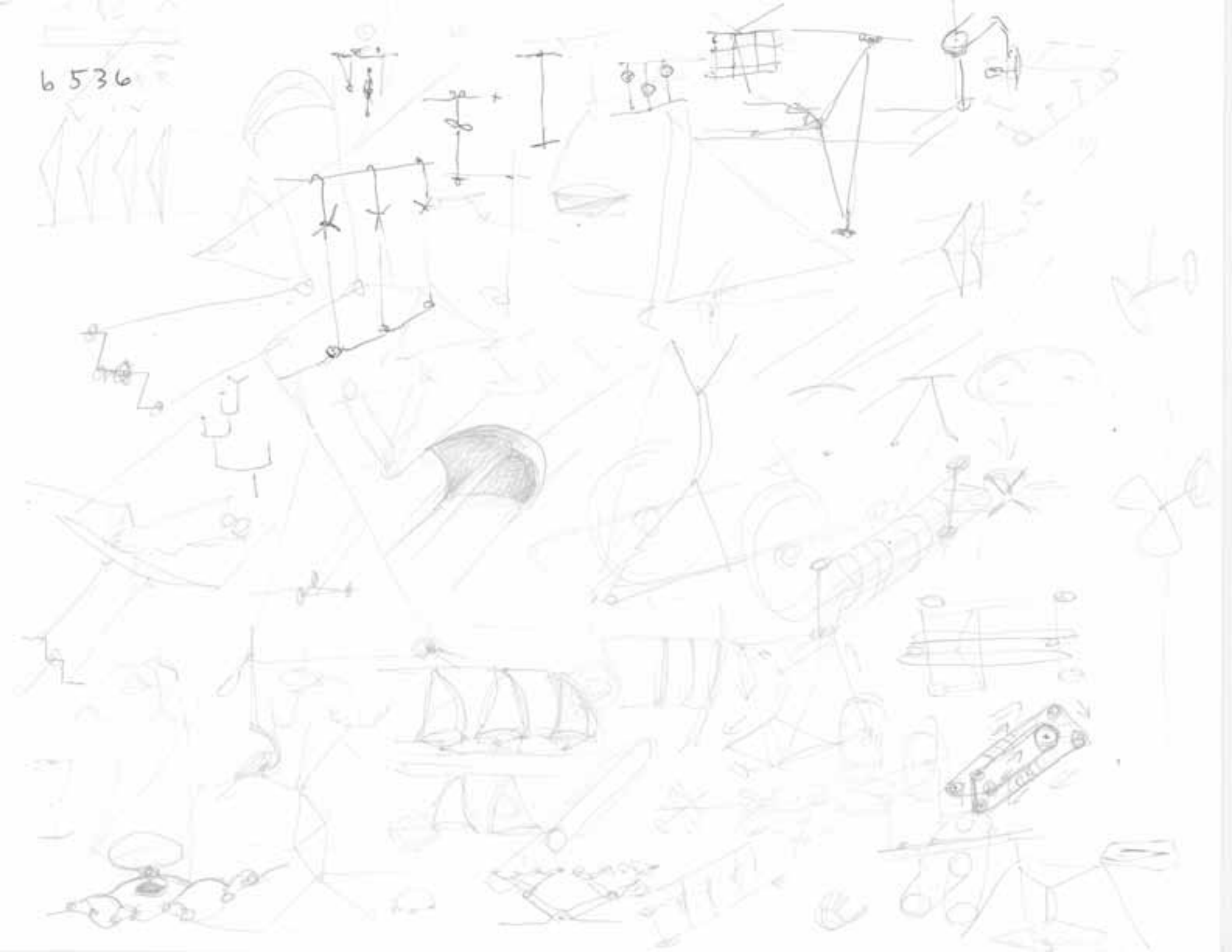



6533
anchor
drag
Killer
stake
trains
elevated
hard
point
membrane ring

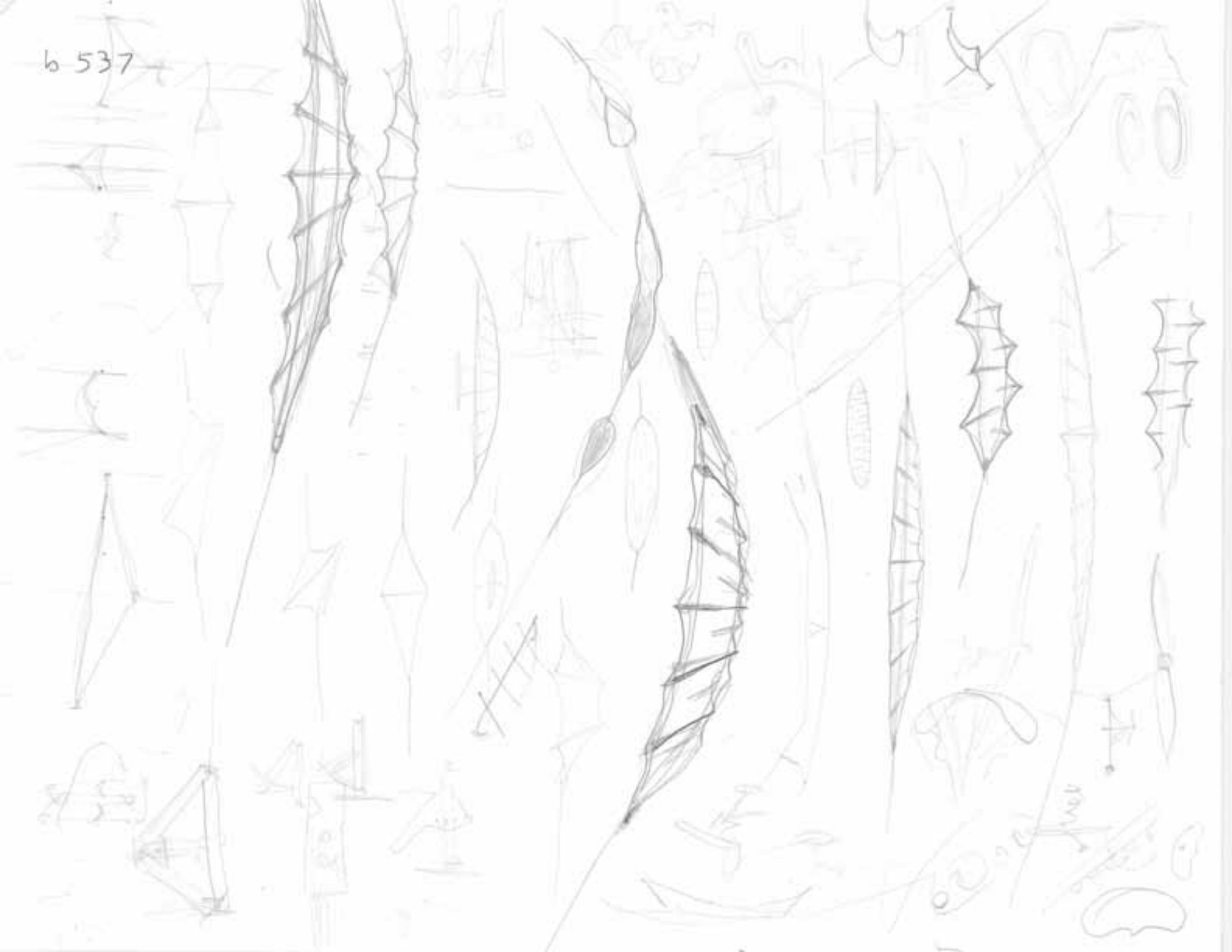

b 534
2000'
300'
3000'

b 535

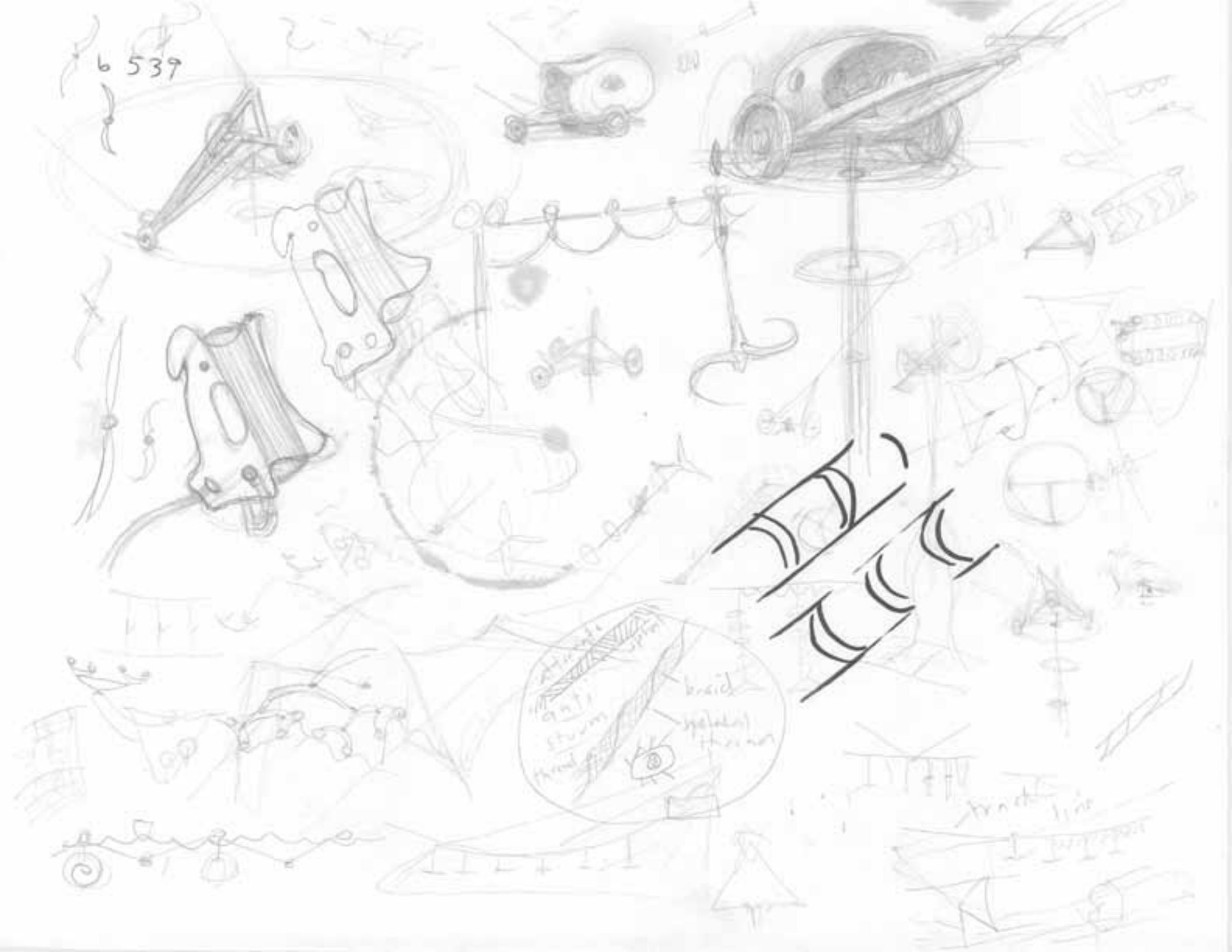


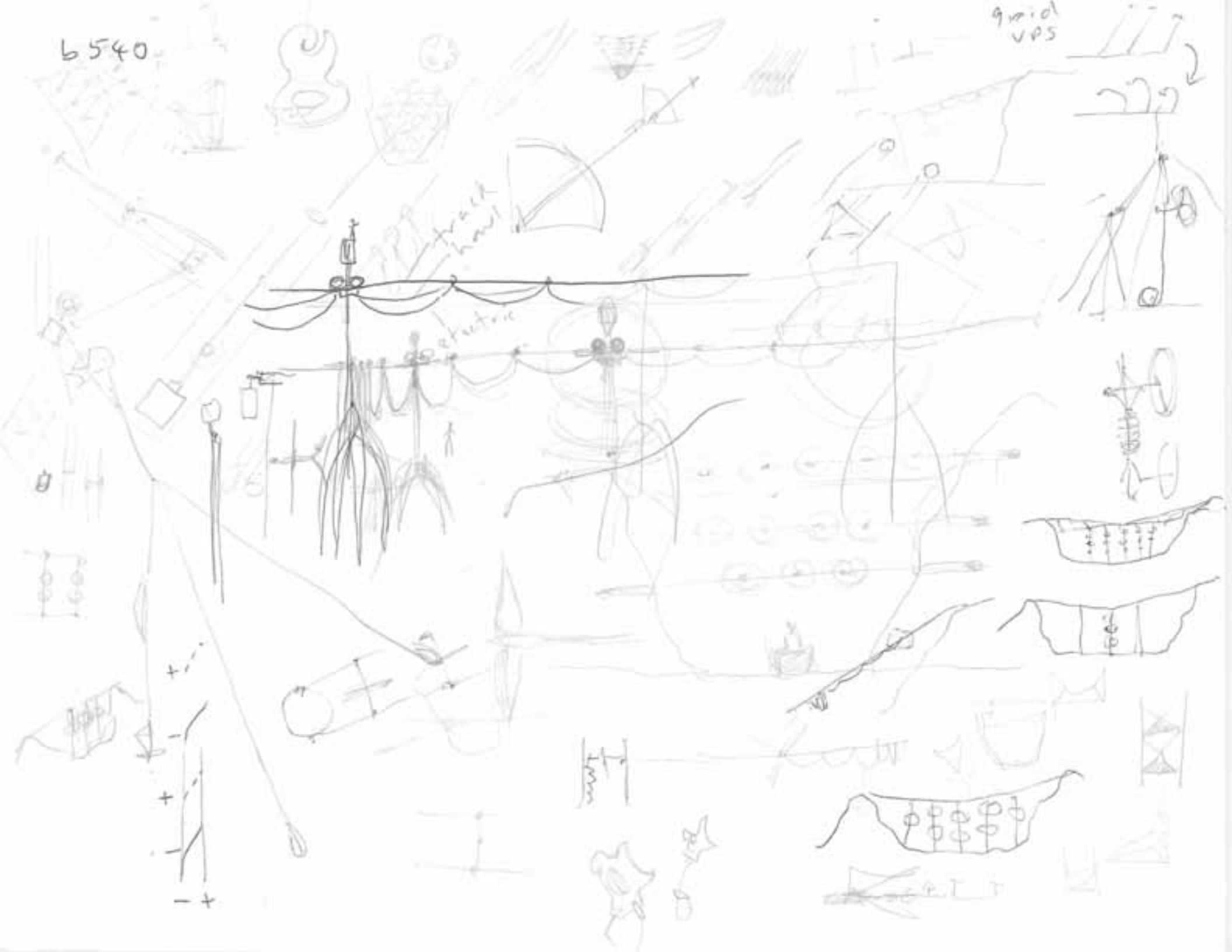

6536

b 537



6 538

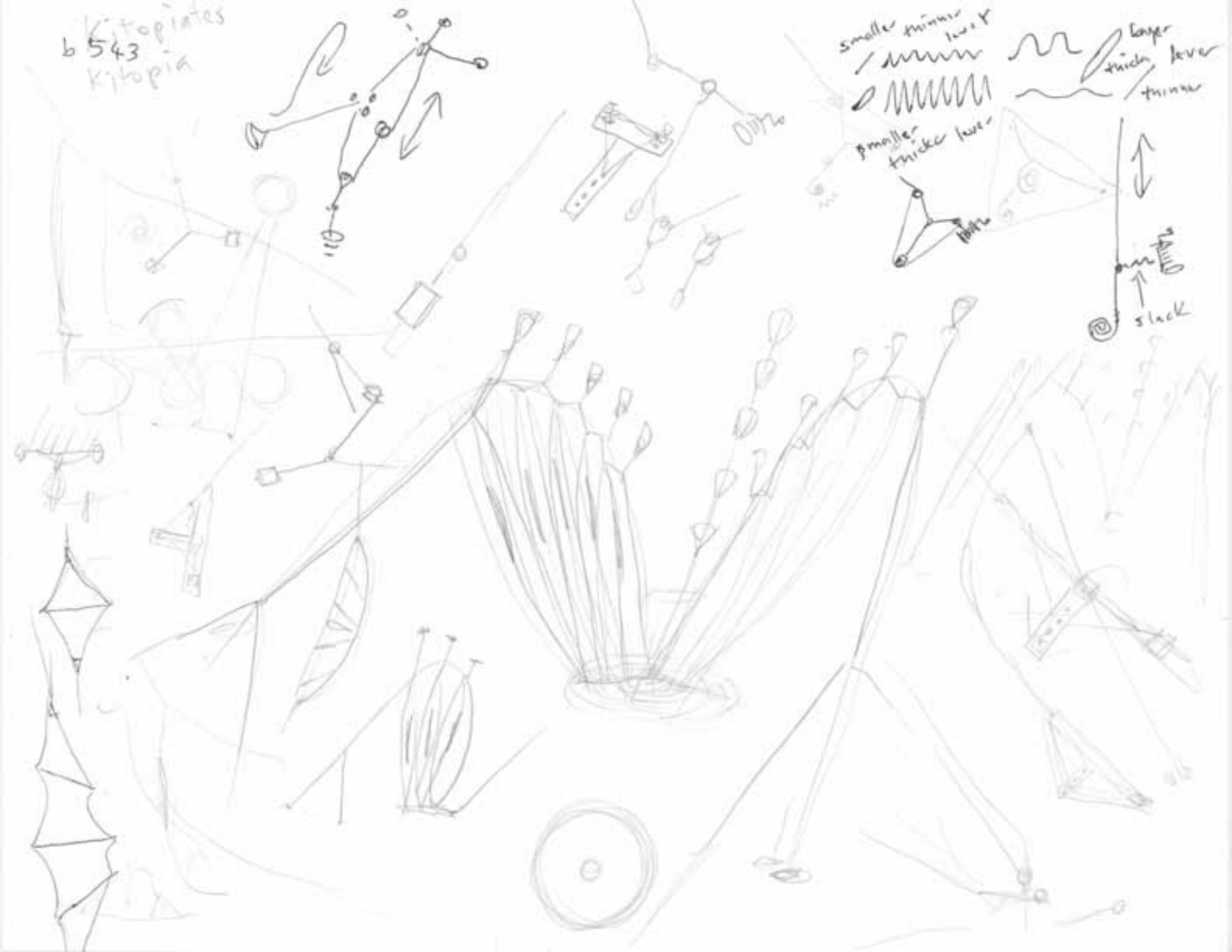

b 539


b540

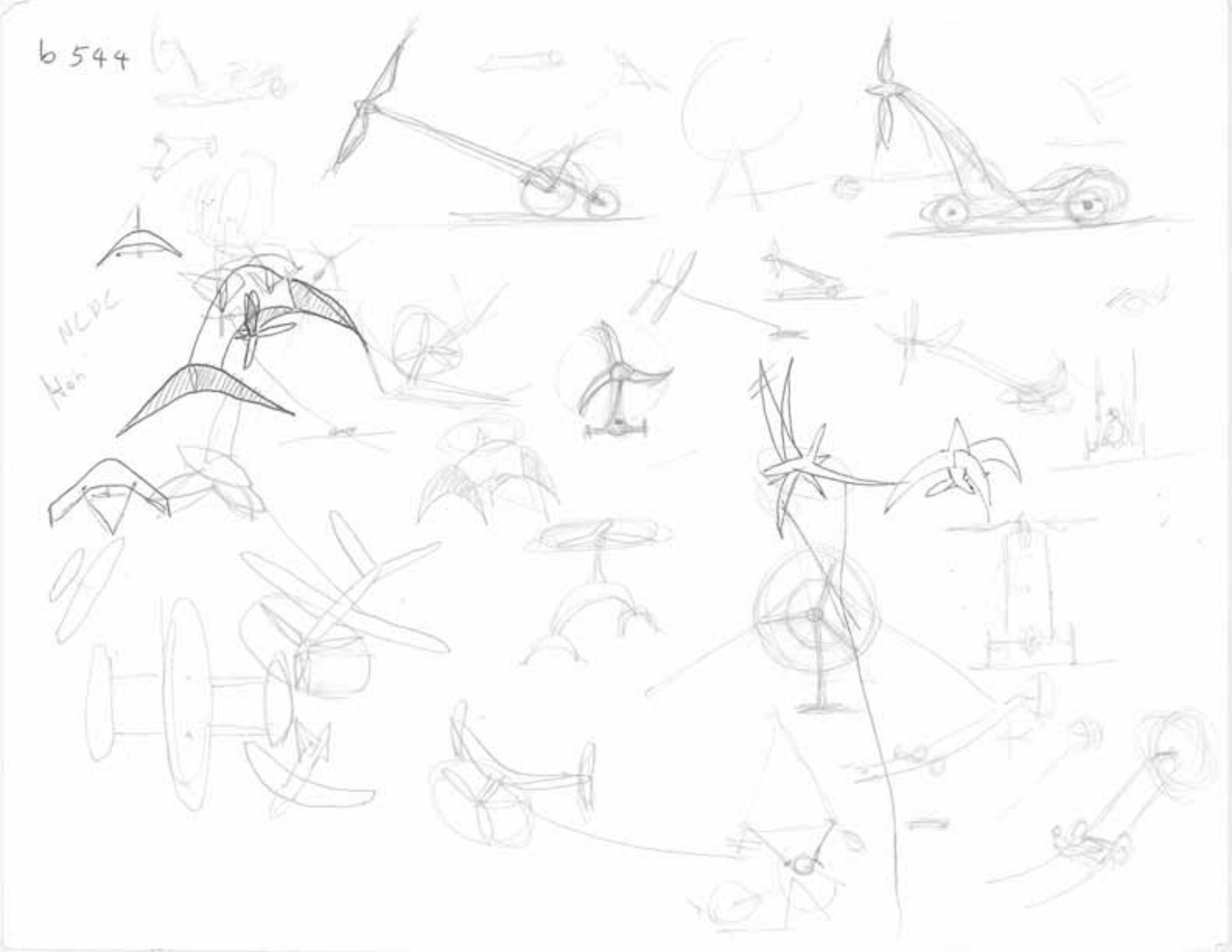
b 541

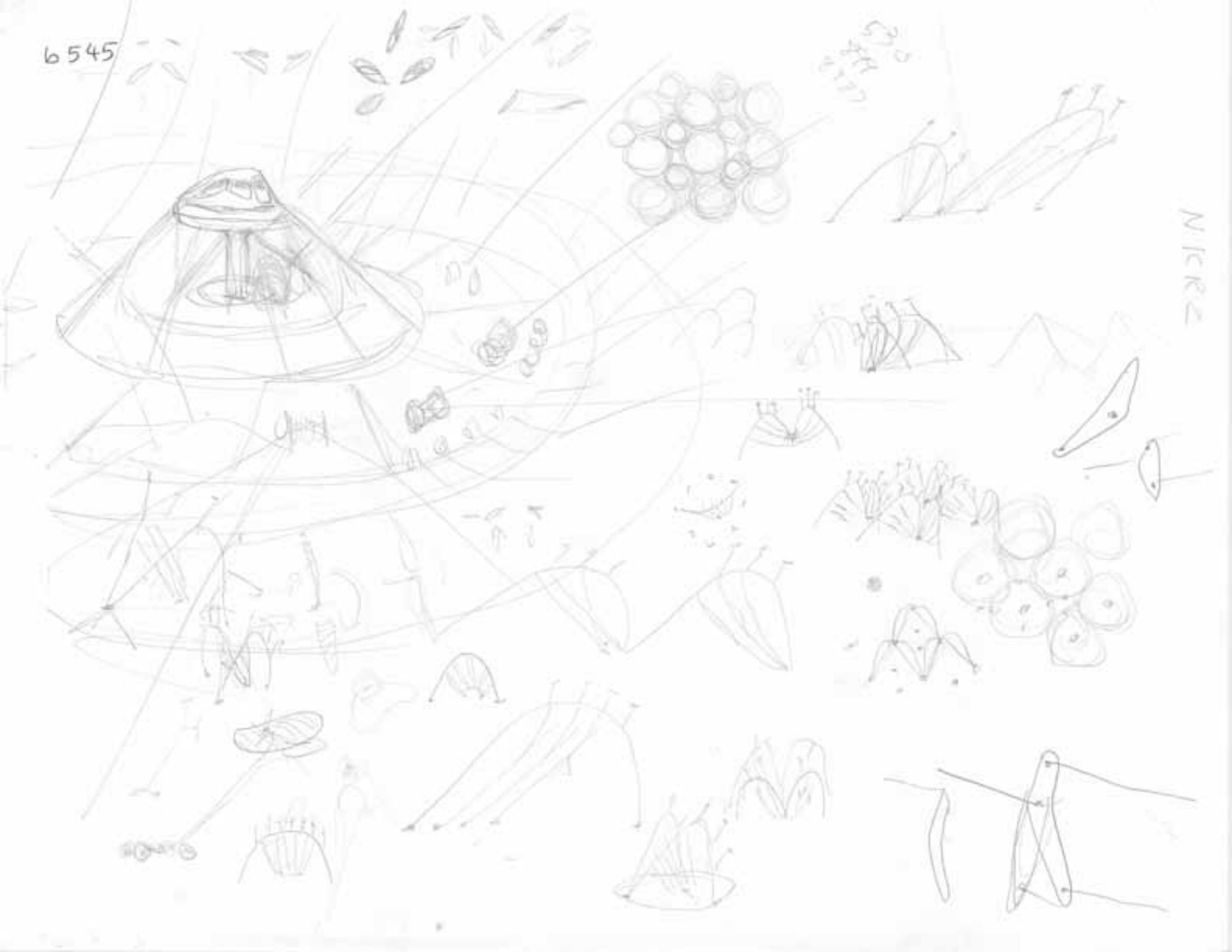
following Sea Stern
shield

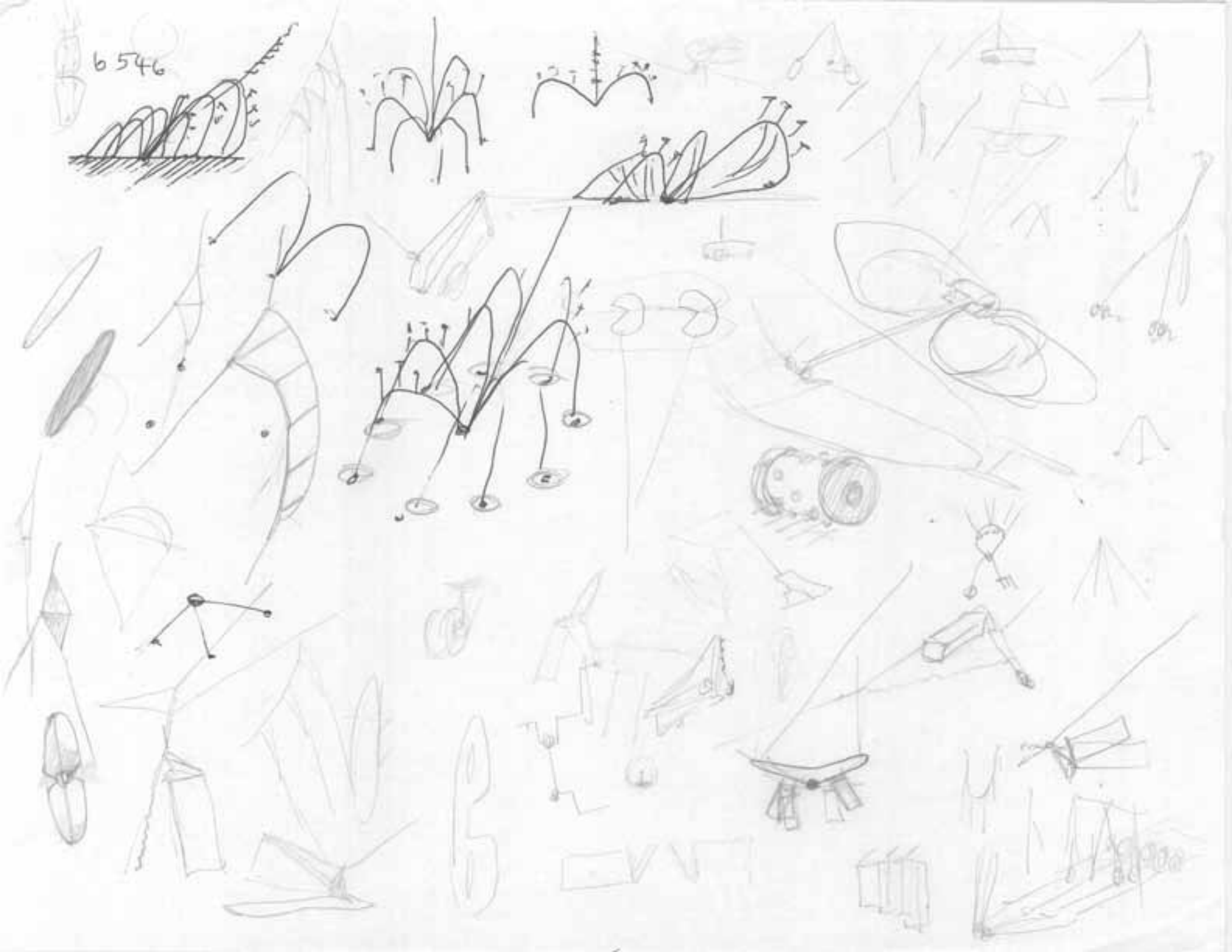
b
542


b 543
smaller thinner lever
smaller thicker lever
larger thicker lever
thinner
slack

b 544




6545


6546

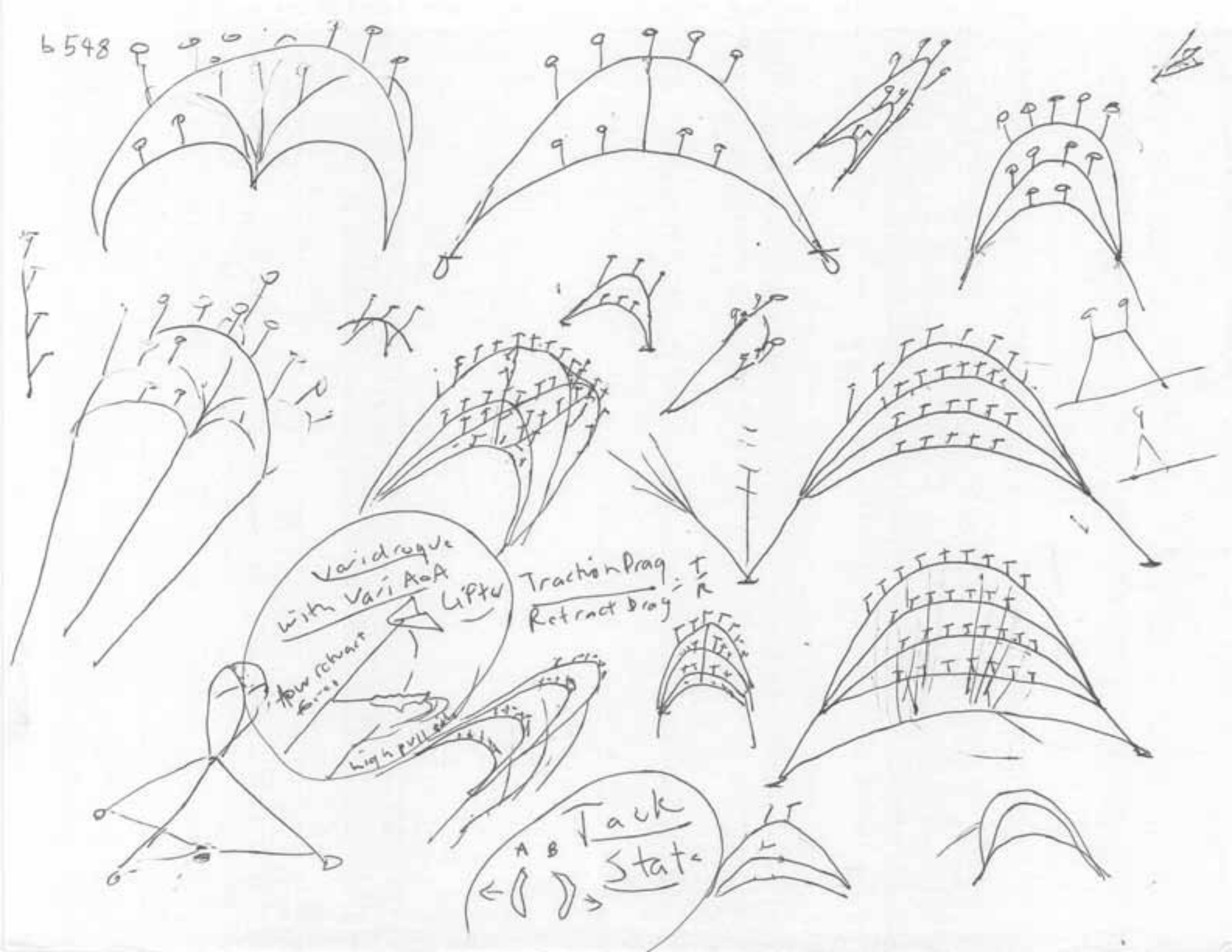
6547

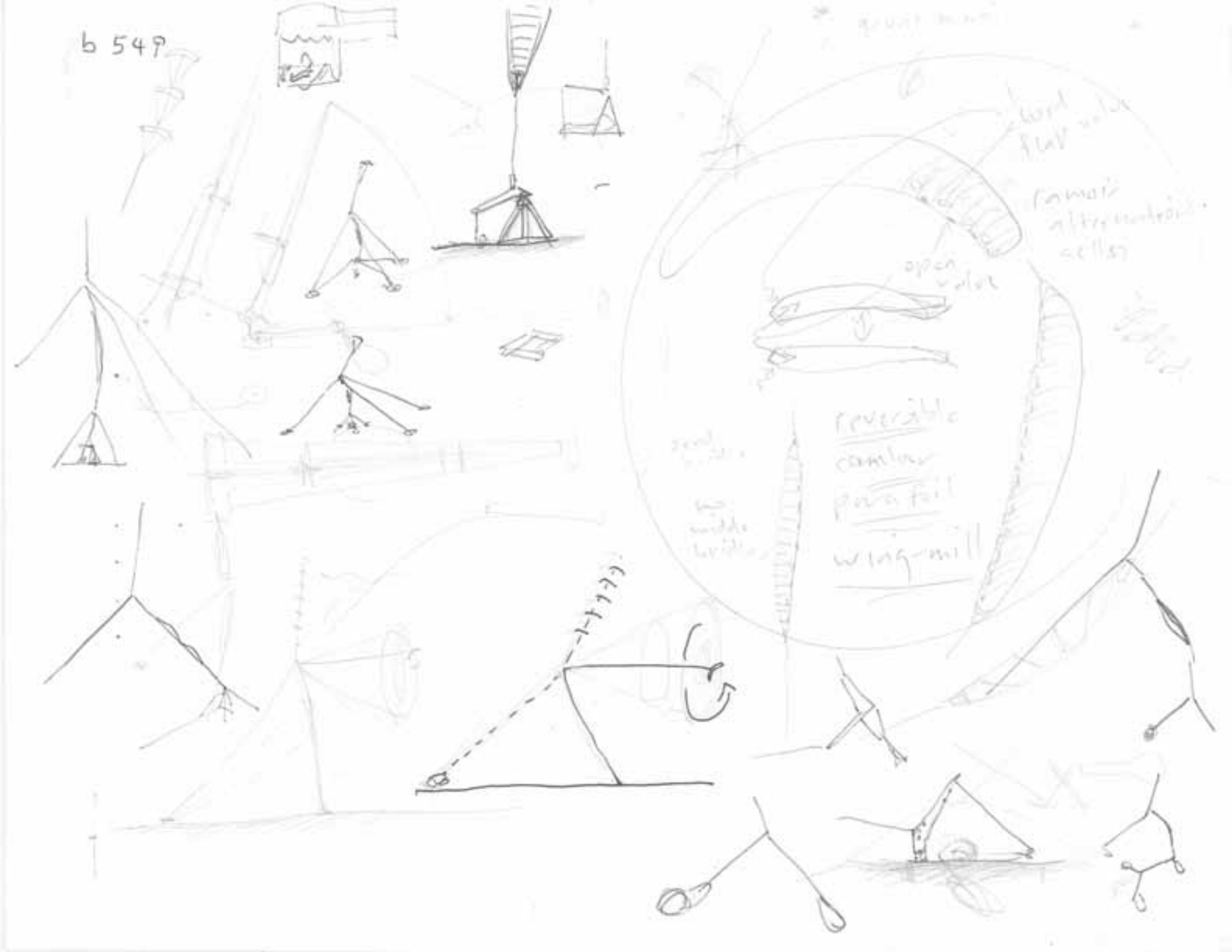
"obsolete mythologies of redemptive violence"

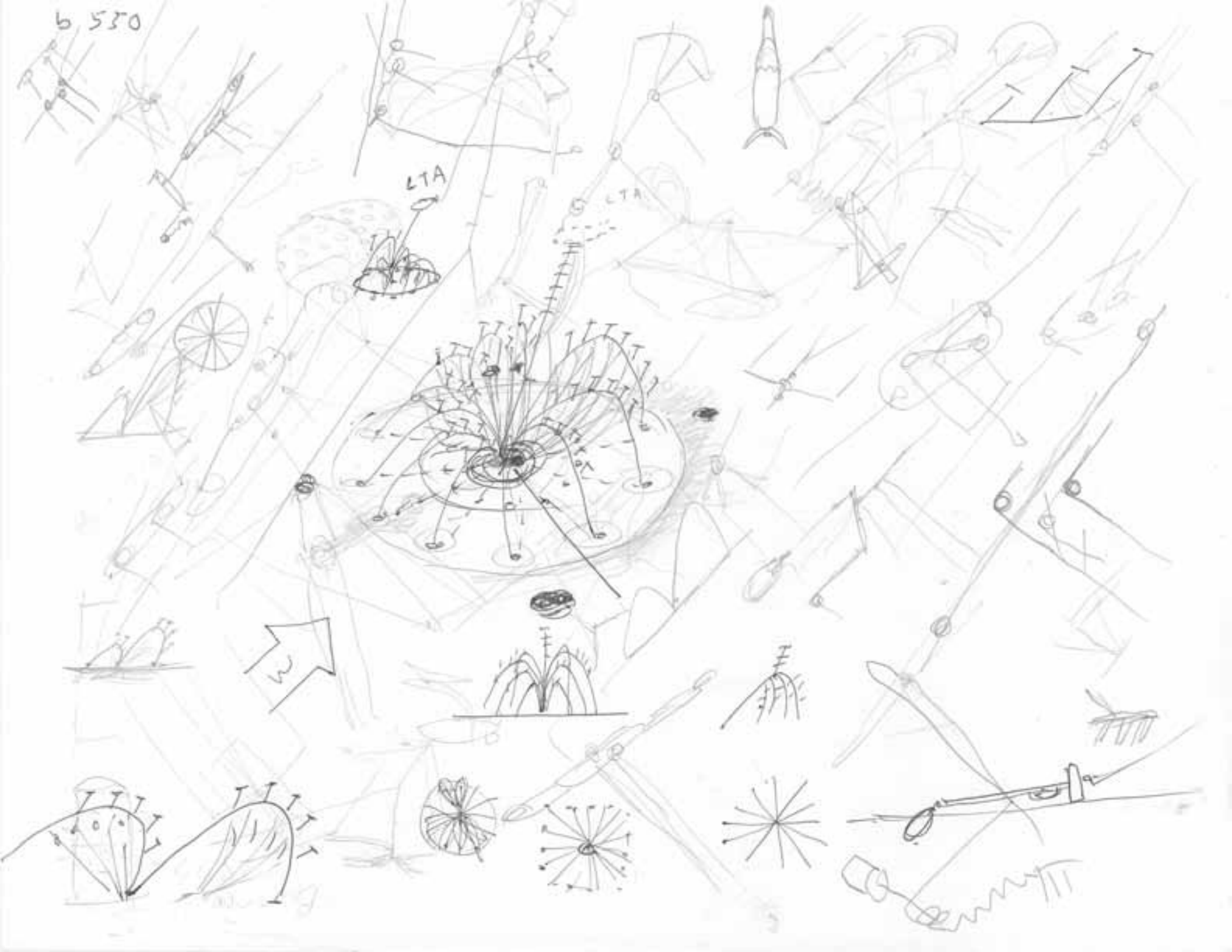
The Fisher Poet of old
This [illegible] foretold
The [illegible]
[illegible]

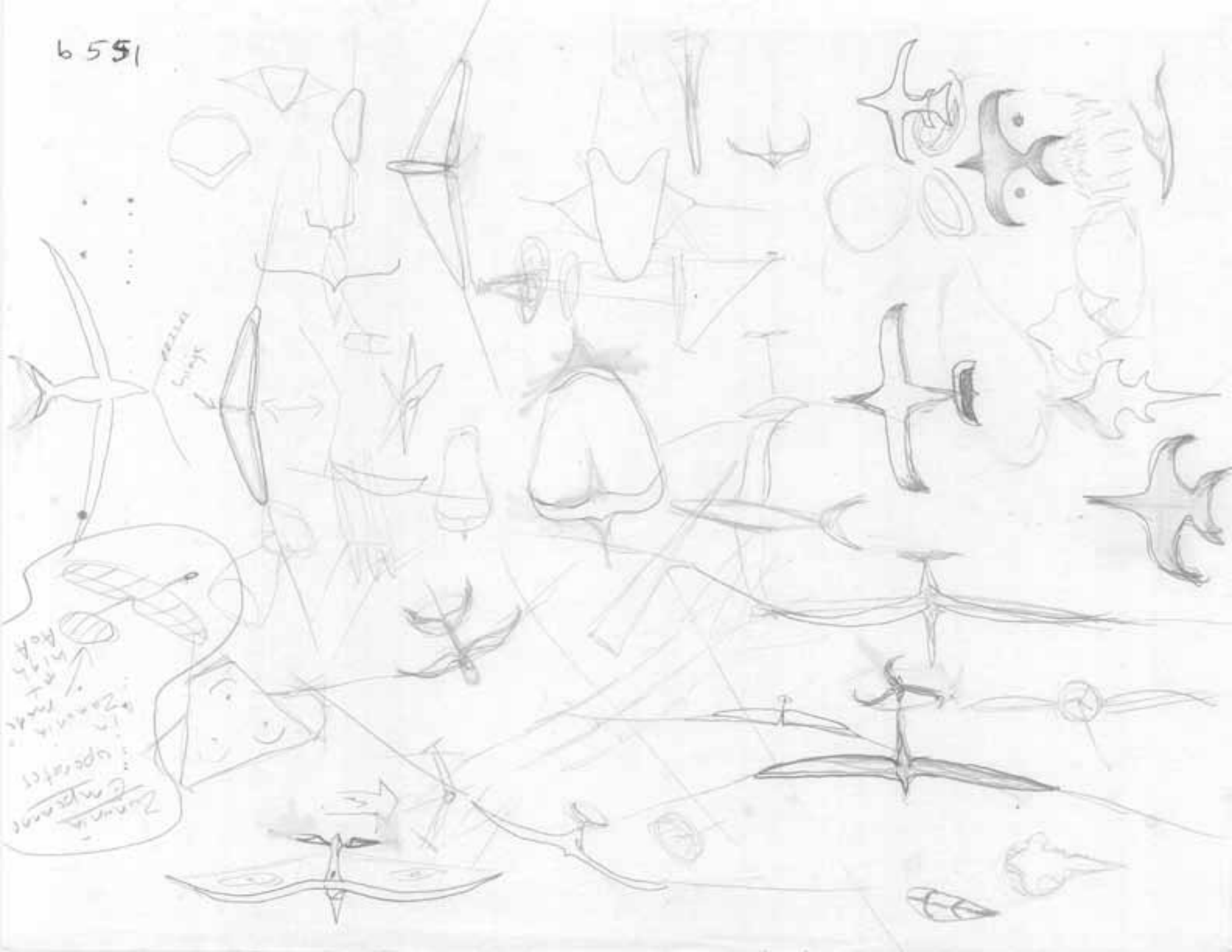
Hurrah!

pinpoint Landing
by Tri-Jetter

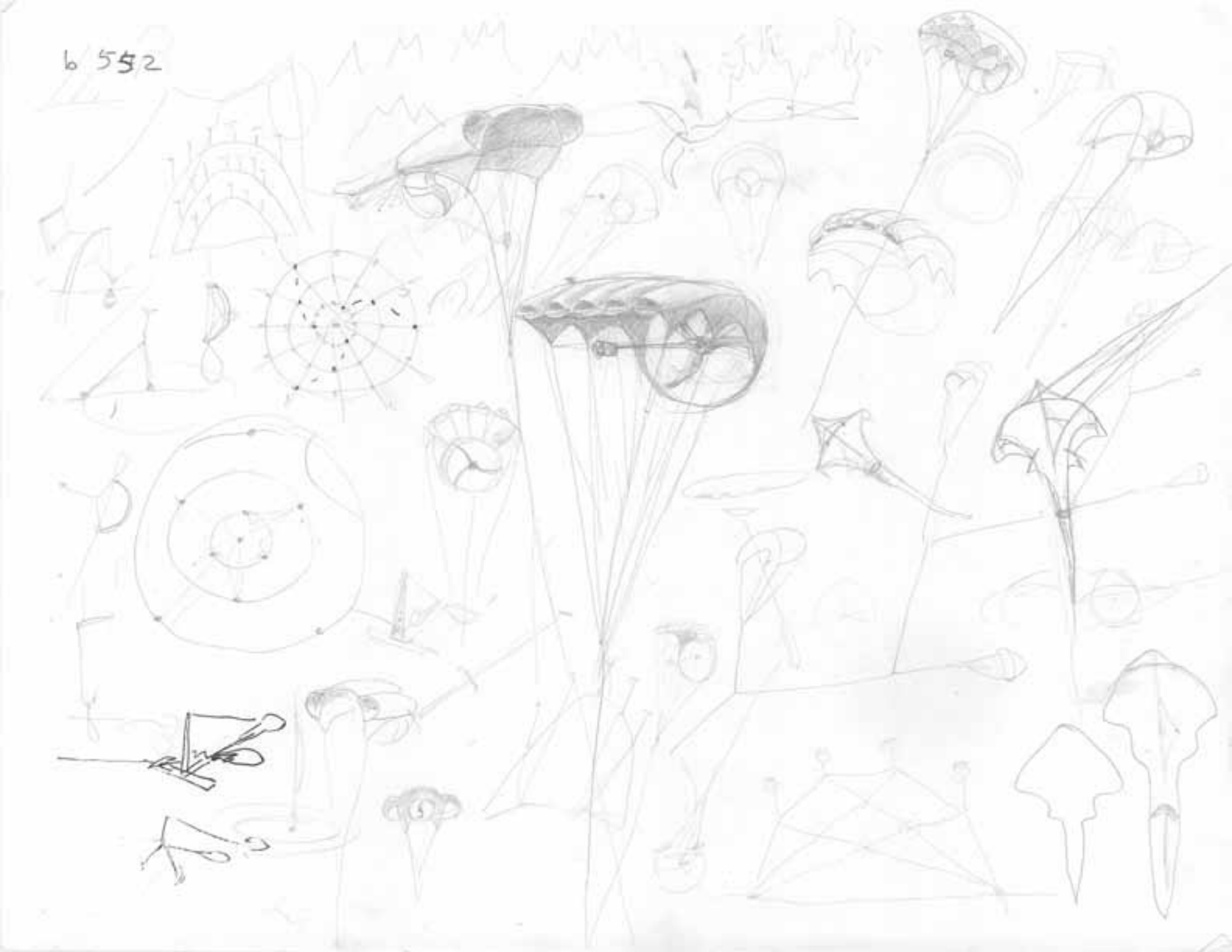

b548
Varidrogue
with Vari AoA
Lifter
Traction Drag / Retract Drag = T/R
low retract force
high pull side
A B
Tack
State

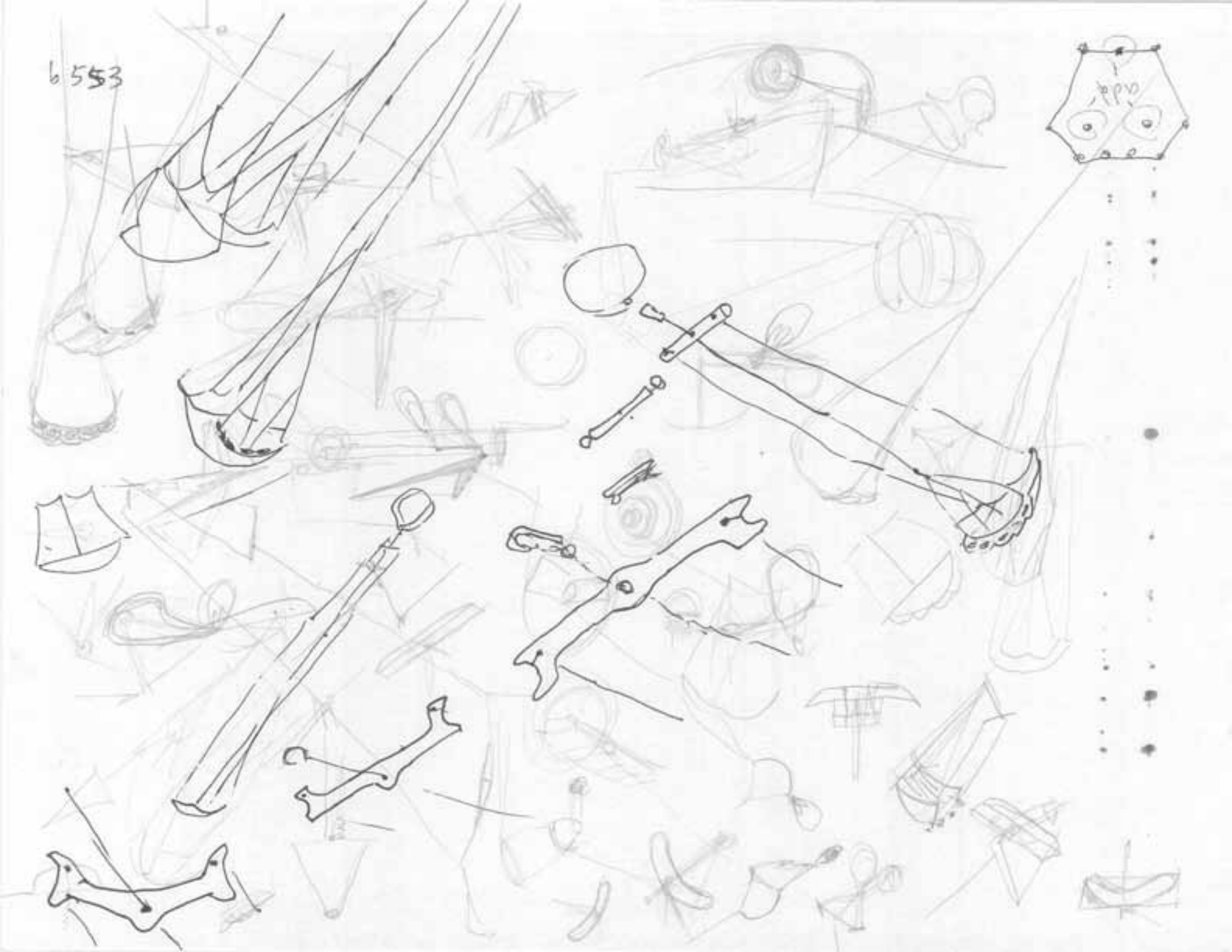

b 549
open water
reversible
camber
aerofoil
wing-mill


b 580
LTA
LTA

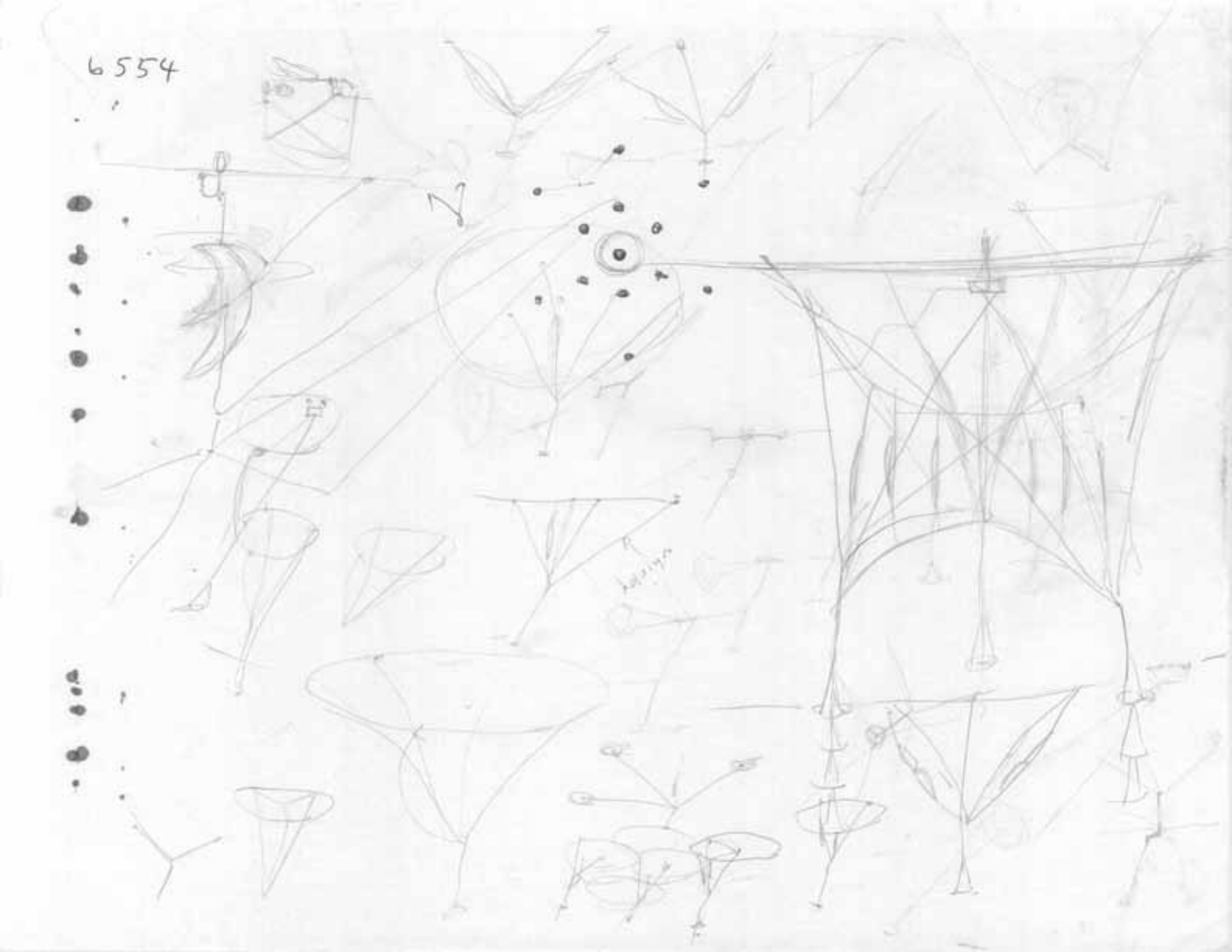

6551

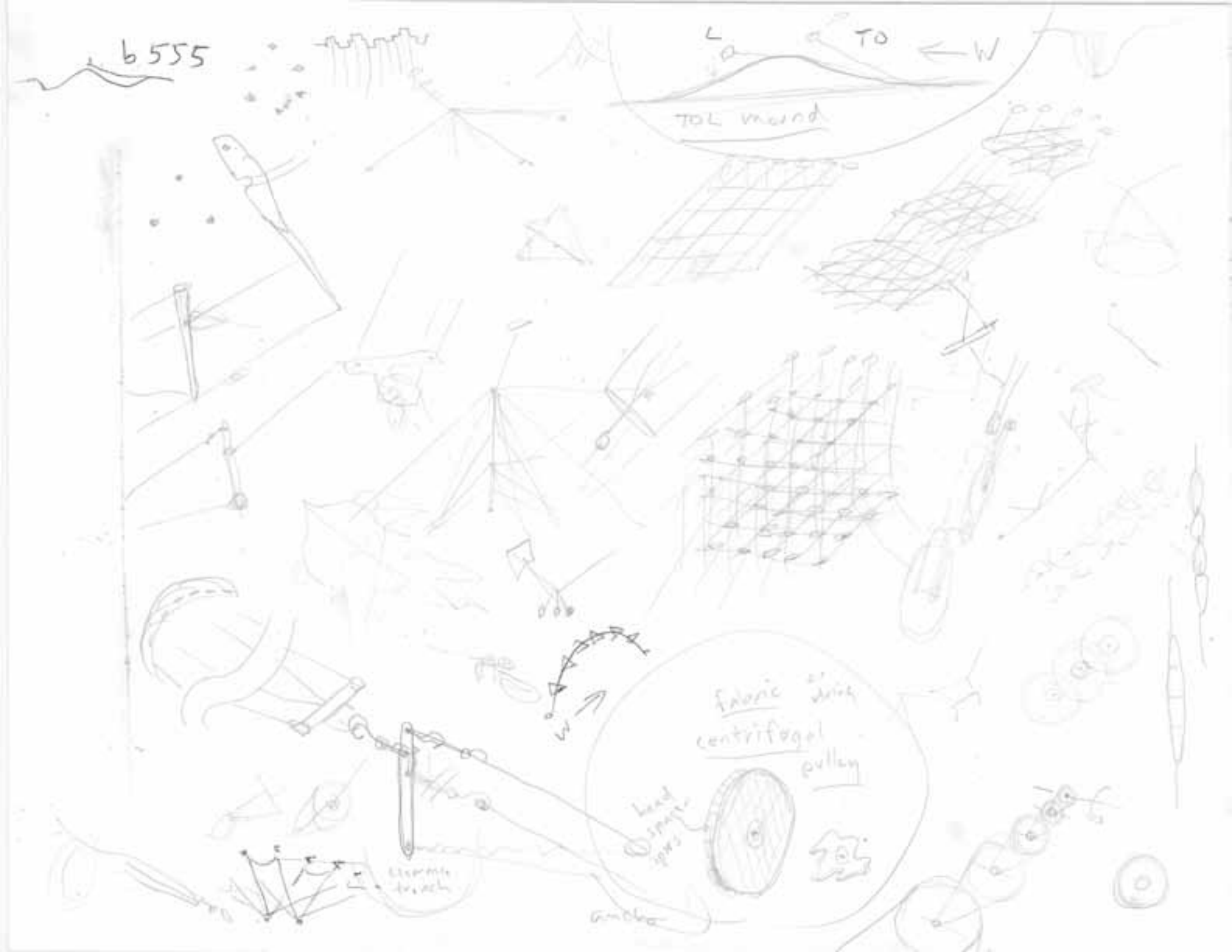
b 552

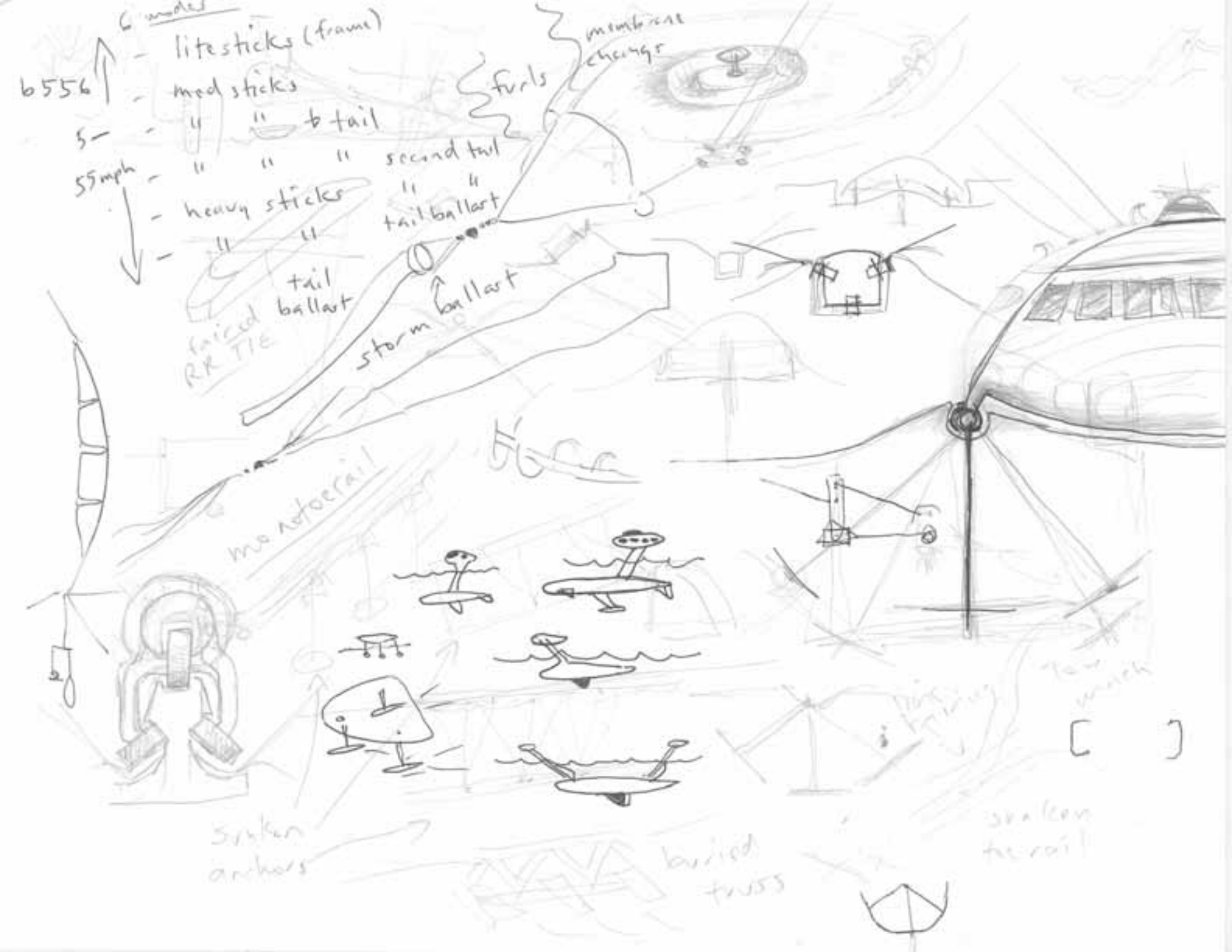


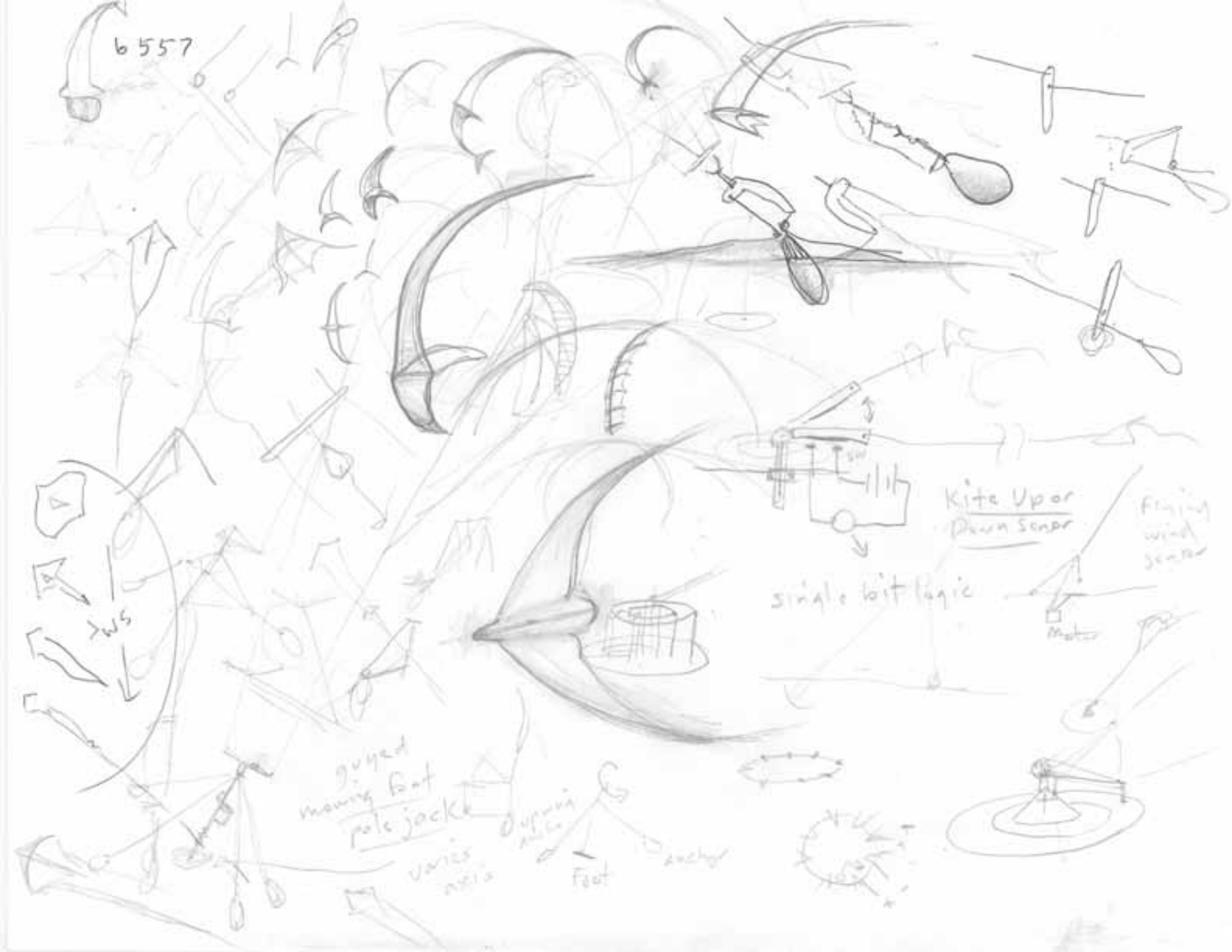

6553

6554

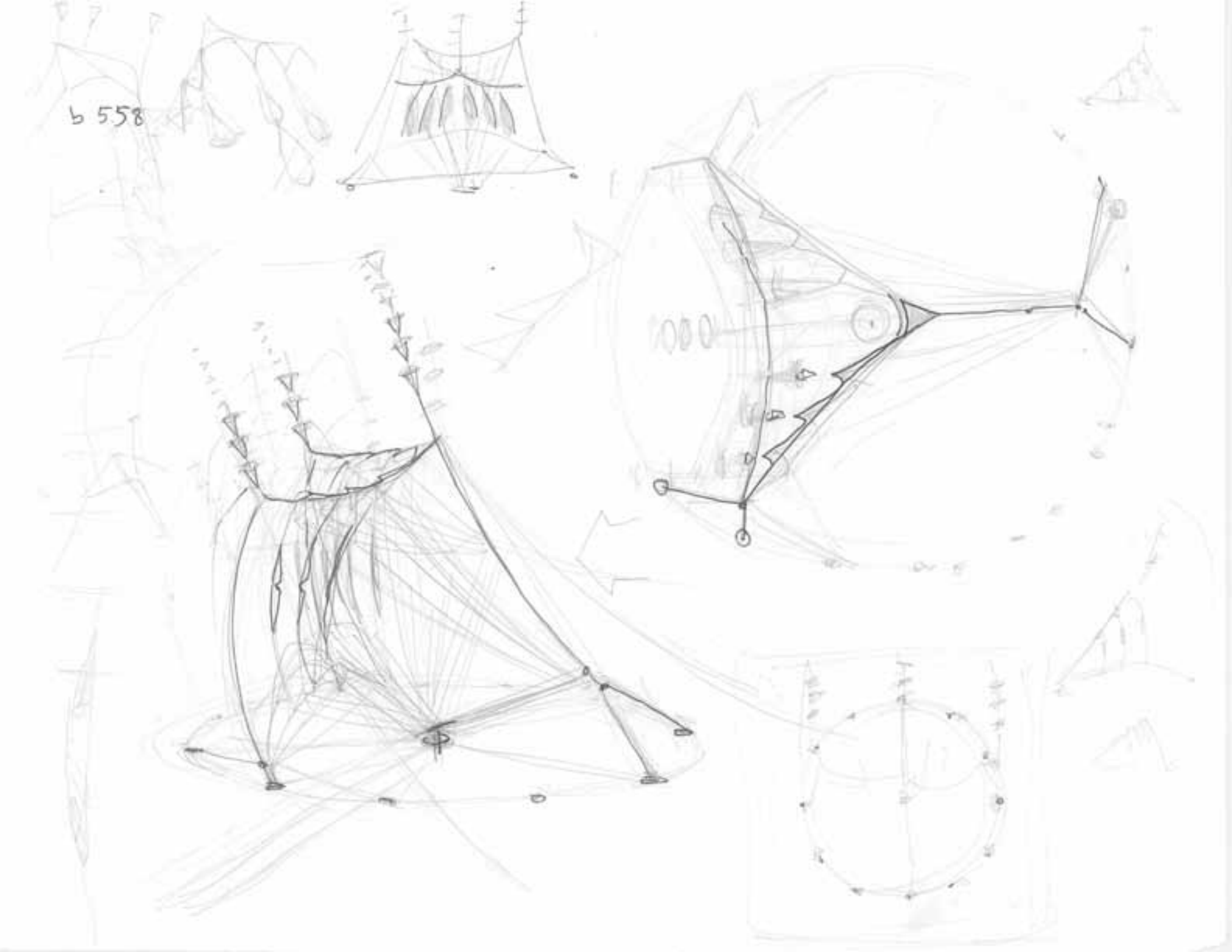


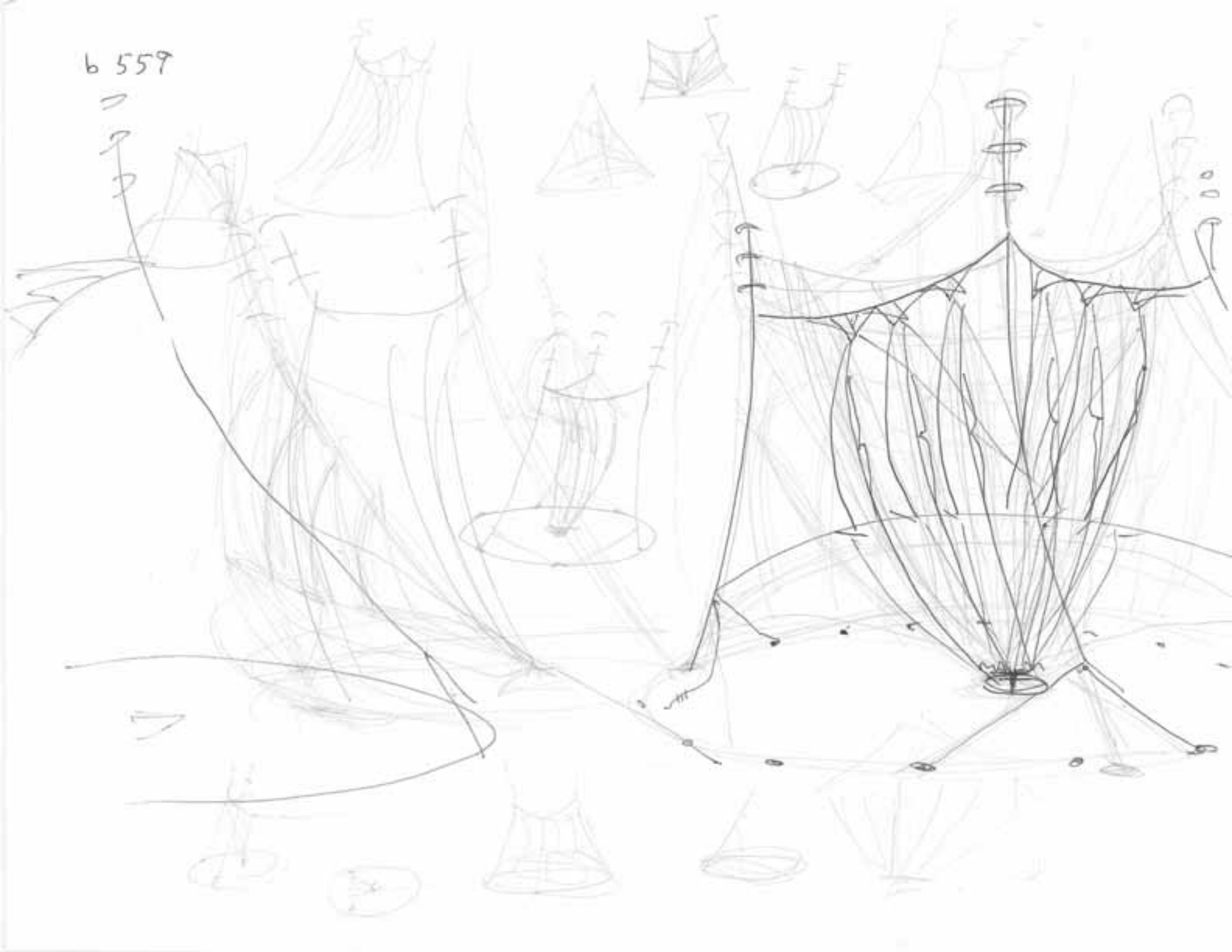

6555
TO
W
TOL mound
fabric
centrifugal
pulley

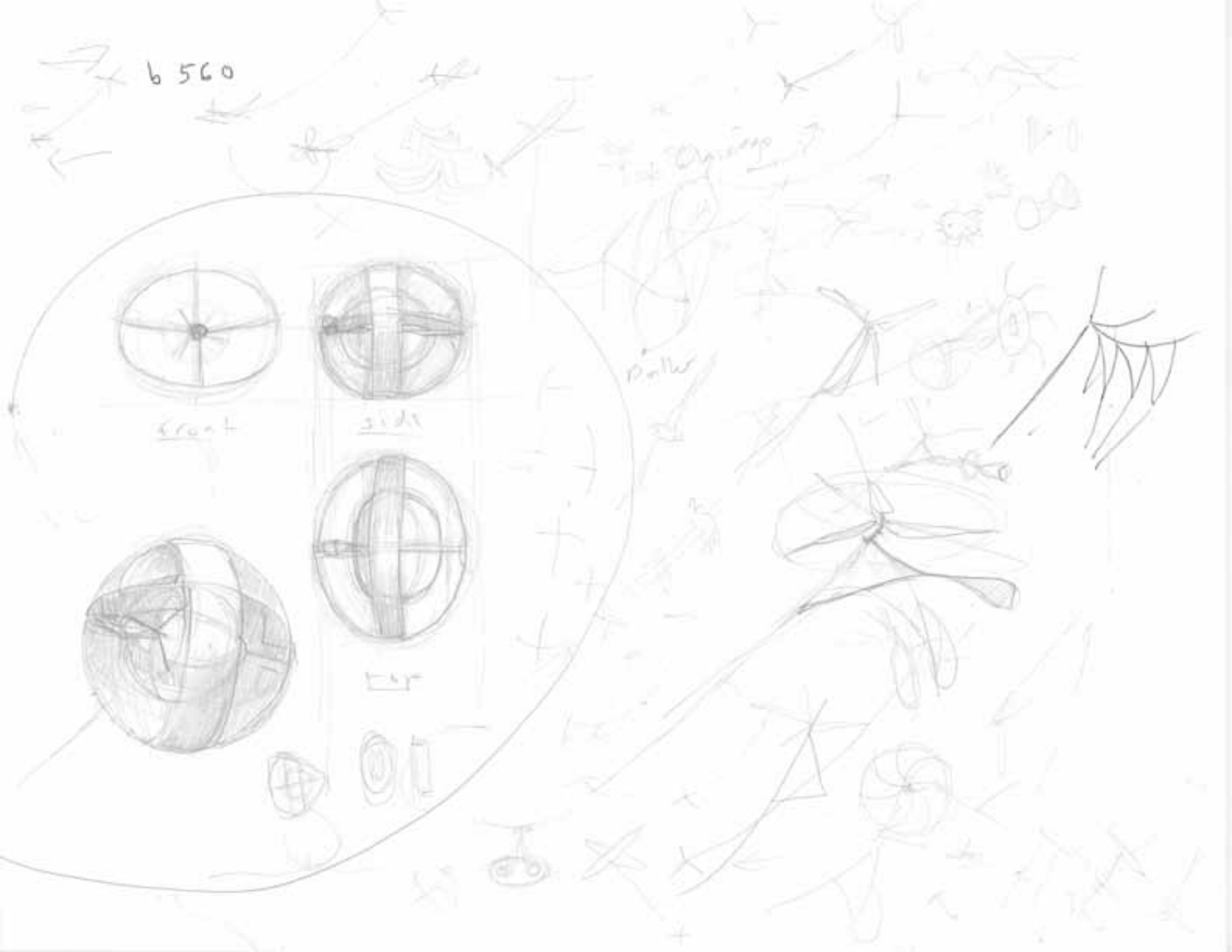

6 modes
- litesticks (frame)
b556
- med sticks
5 -
- " " b tail
55mph
- " " " second tail
- heavy sticks " "
- " " tail ballast
tail ballast
faired RR TIE
storm ballast
furls
membrane changes
monotoerail
sunken anchors
buried truss
sunken toerail
Tow winch


6557
Kite Up or
Down Sensor
single bit logic
Motor
guyed
mowing foot
pole jack
varies
axis
Foot
anchor

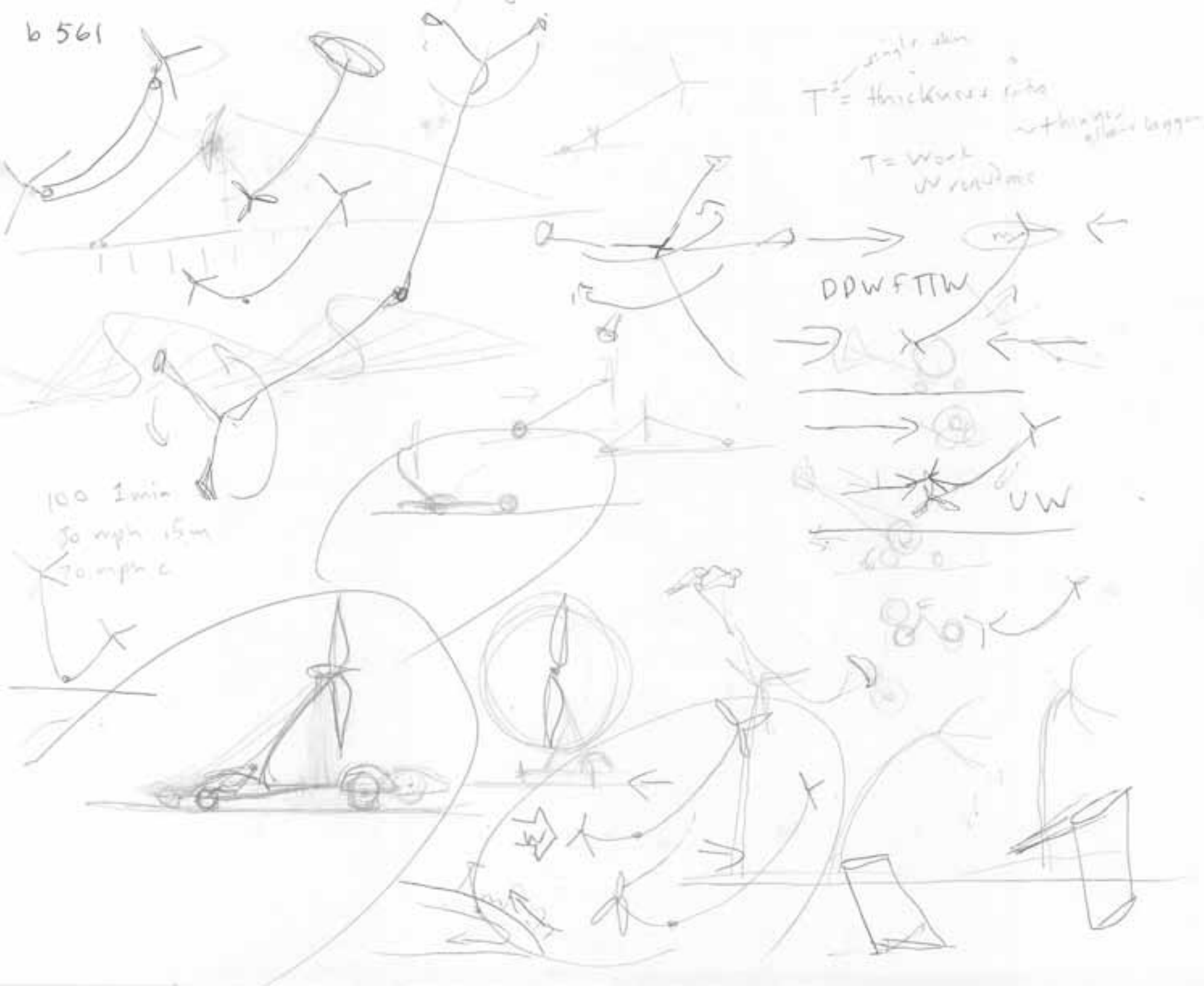
b 558



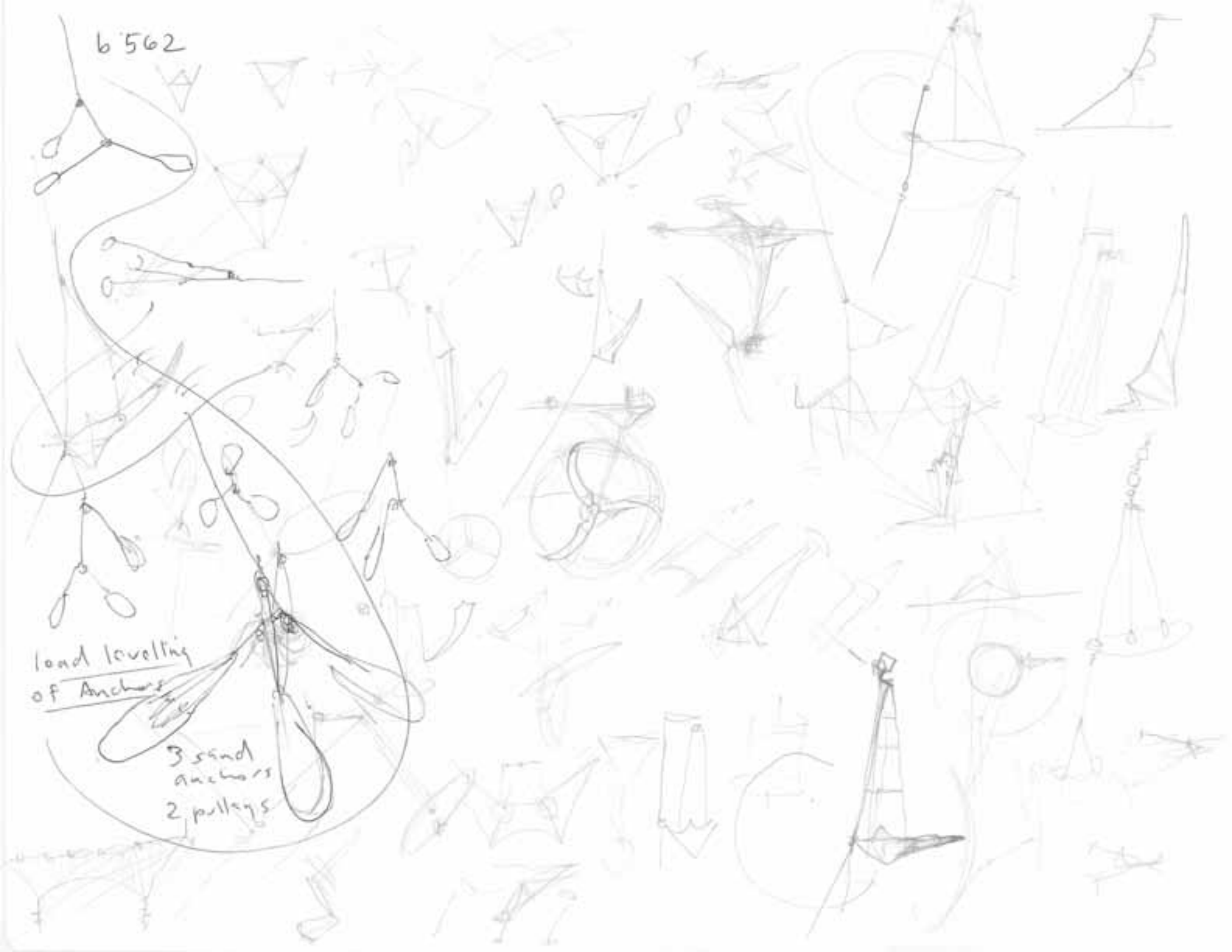

b 559



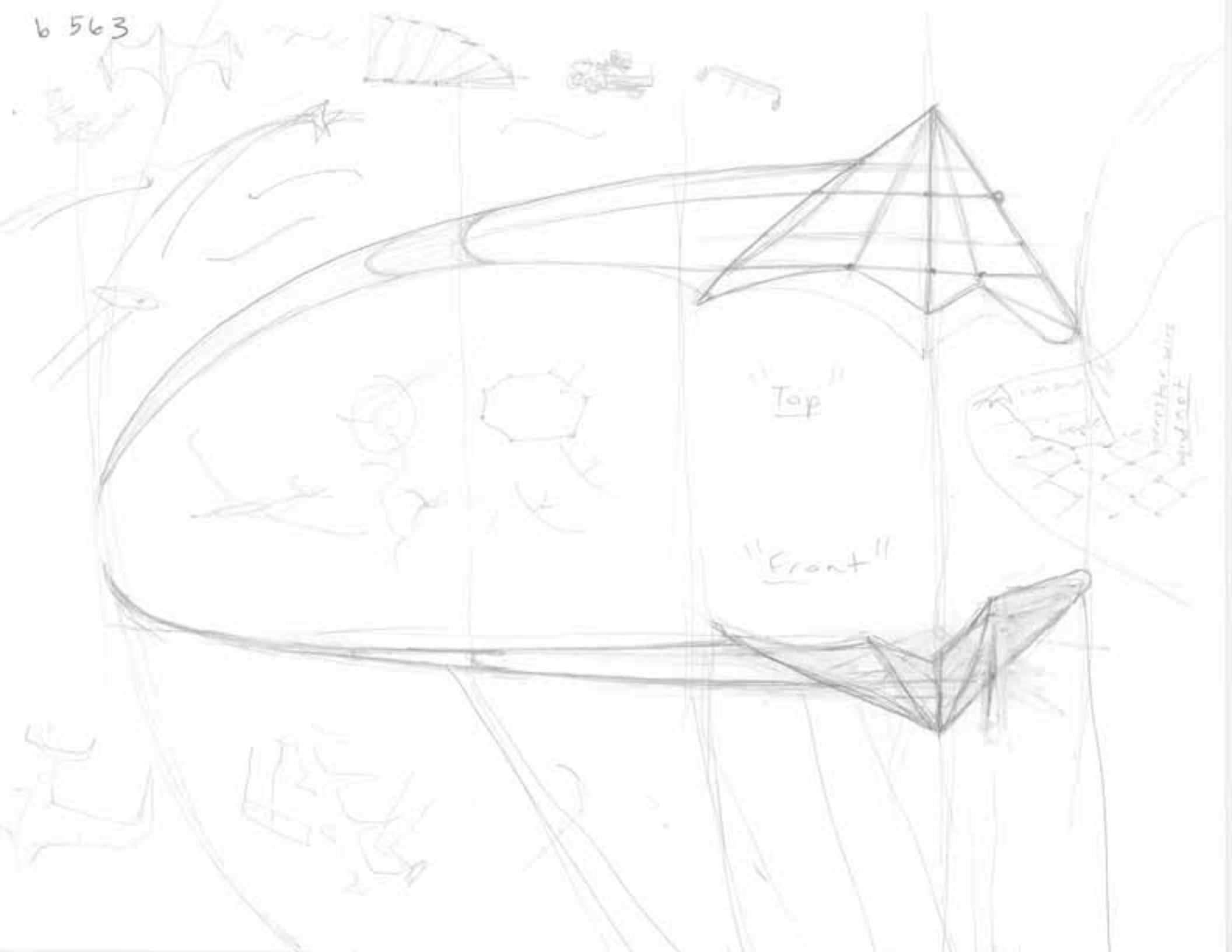
b 561

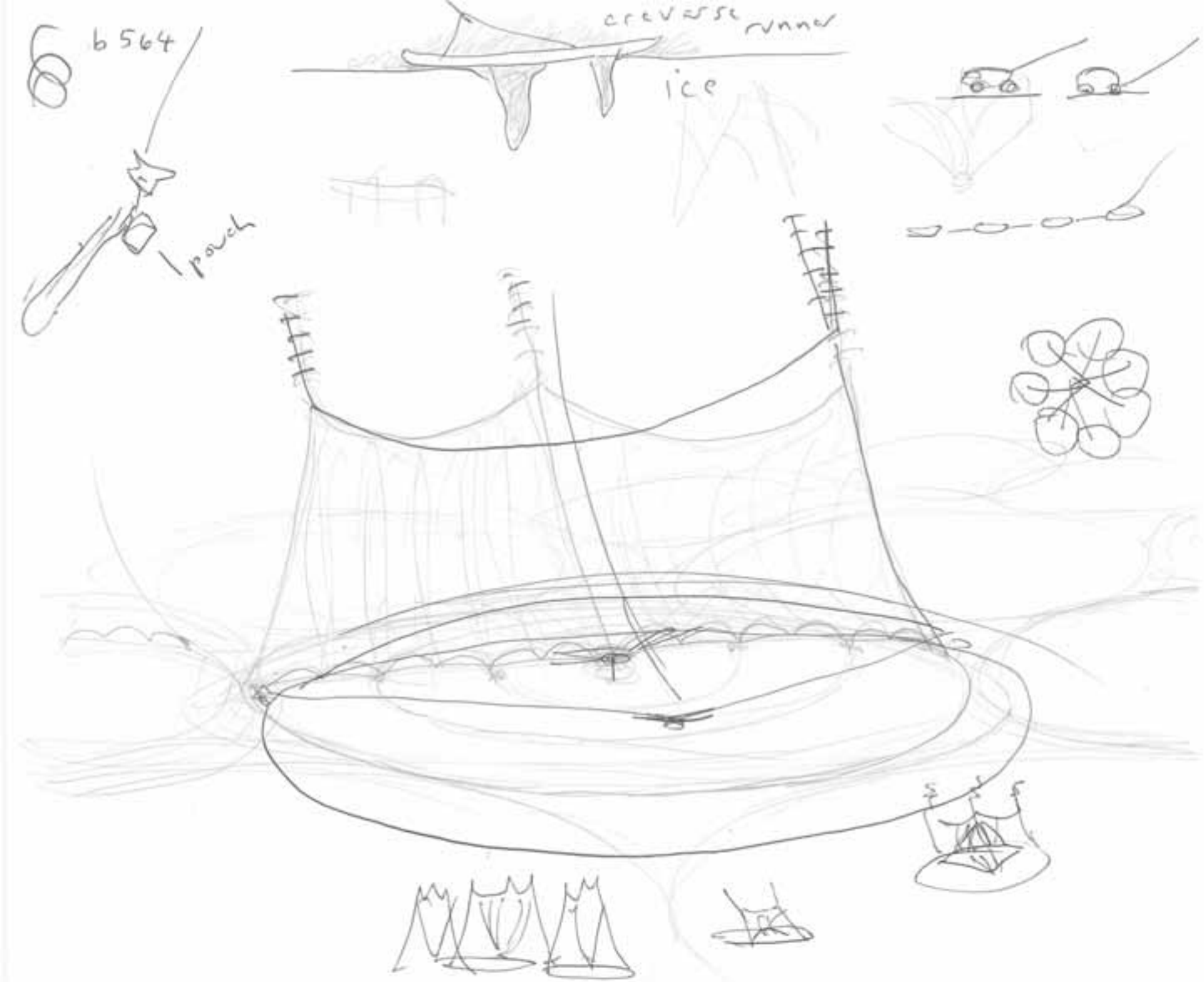


T² = thickness ratio
T = Work
DDWFTTW
UW
100 1min
50 mph 15m
70 mph c


b 562
load levelling
of Anchors
3 sand
anchors
2 pulleys

b 563



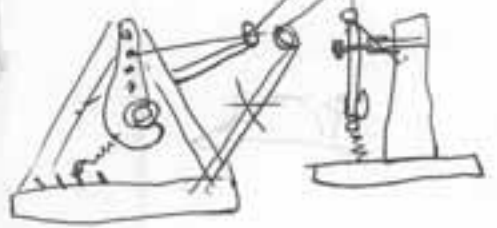

b564
crevasse runner
ice
pouch

b 565

b 566

6567

division
hydraulic
tripod



b568

B 569

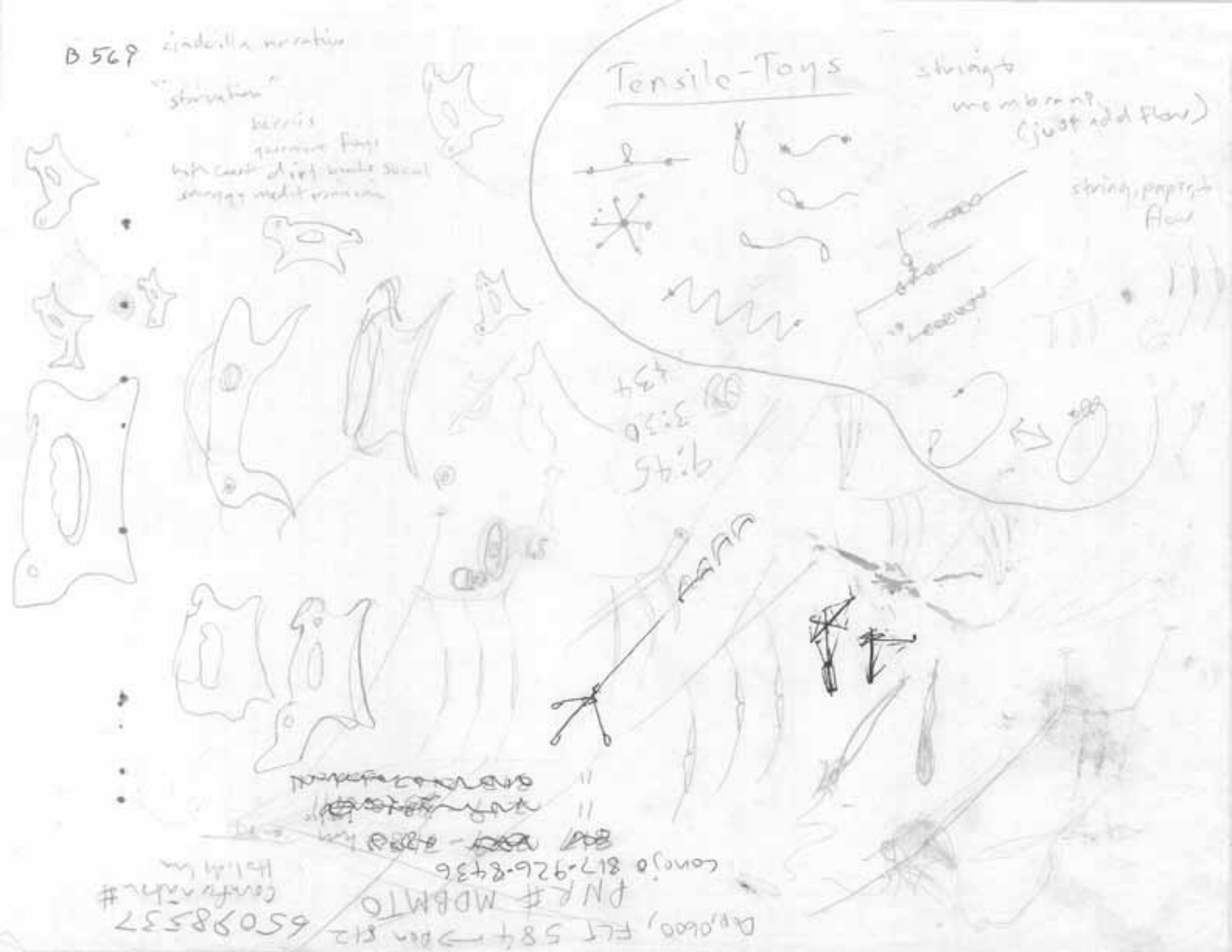
cinderella narrative

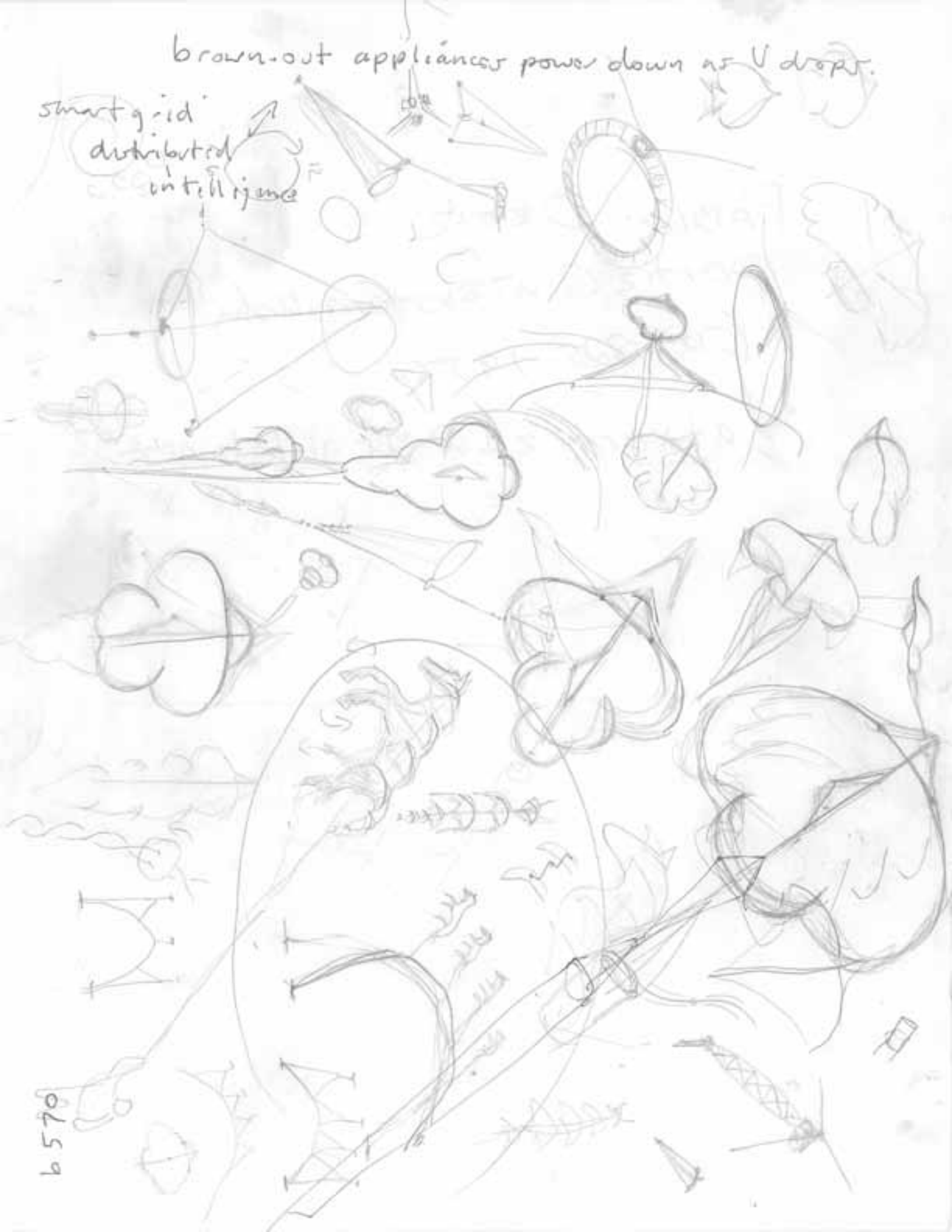
"starvation"

Tensile-Toys

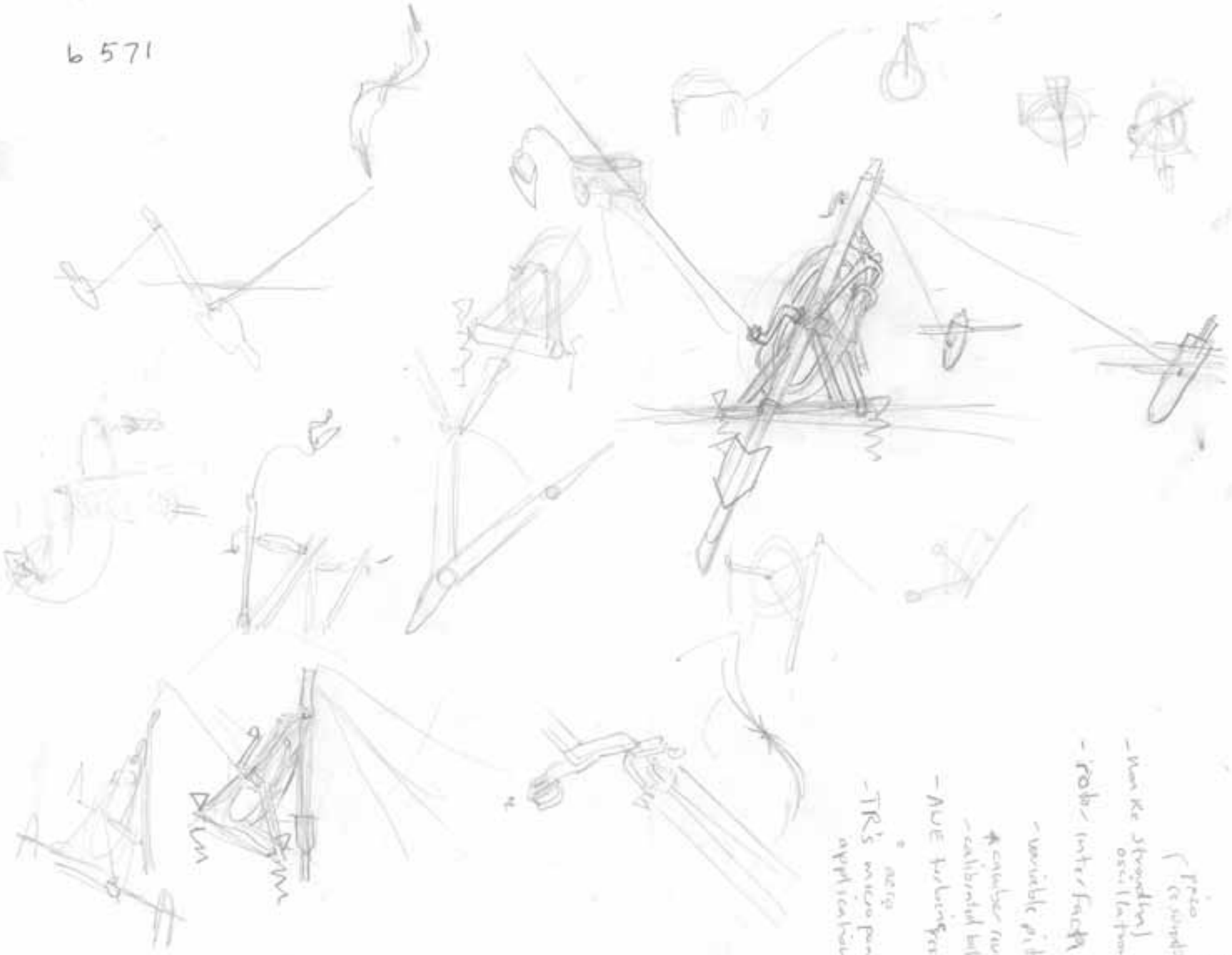
string to membrane? (just add flow)

string, paper to flow



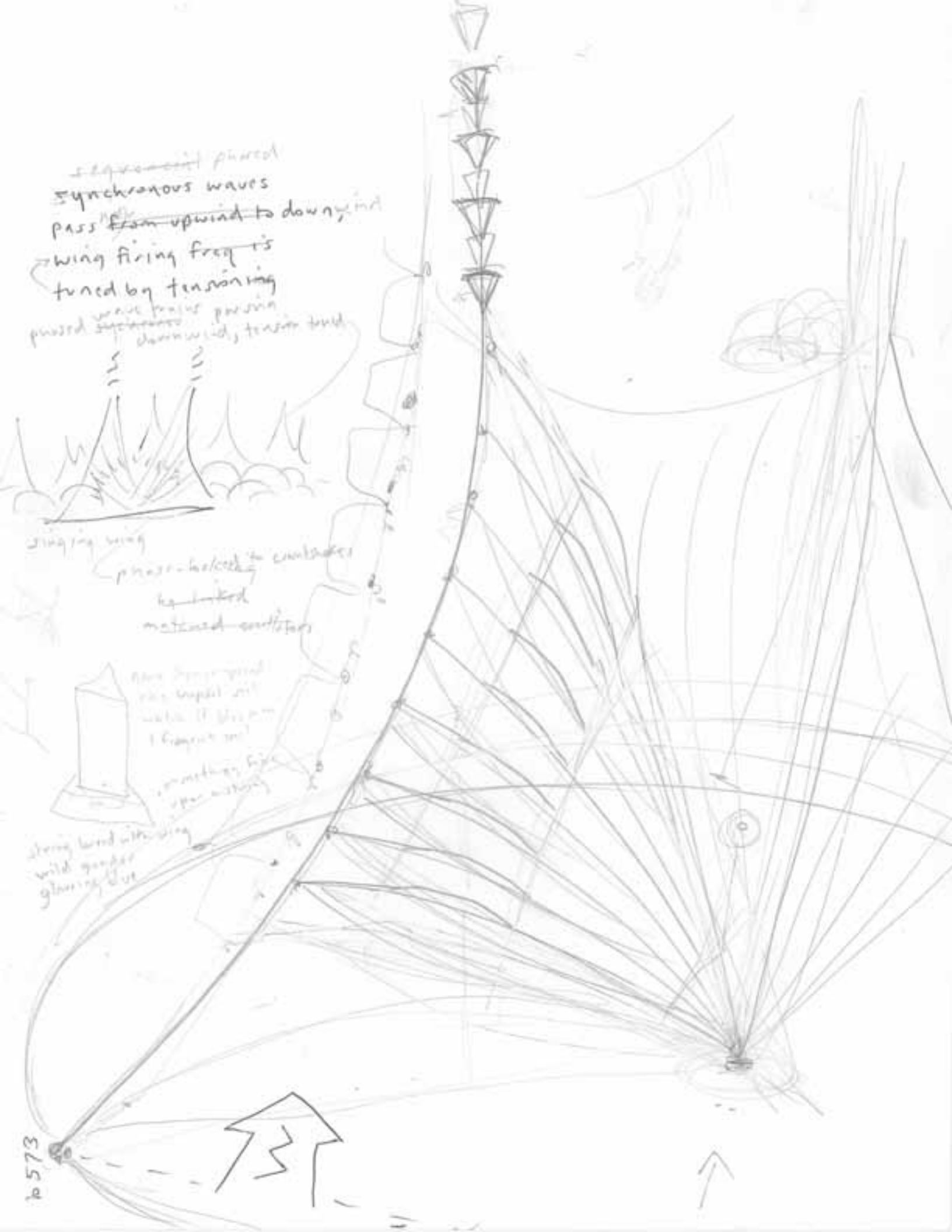

brown-out appliances power down as V drops.
smart grid
distributed
intelligence

6 571

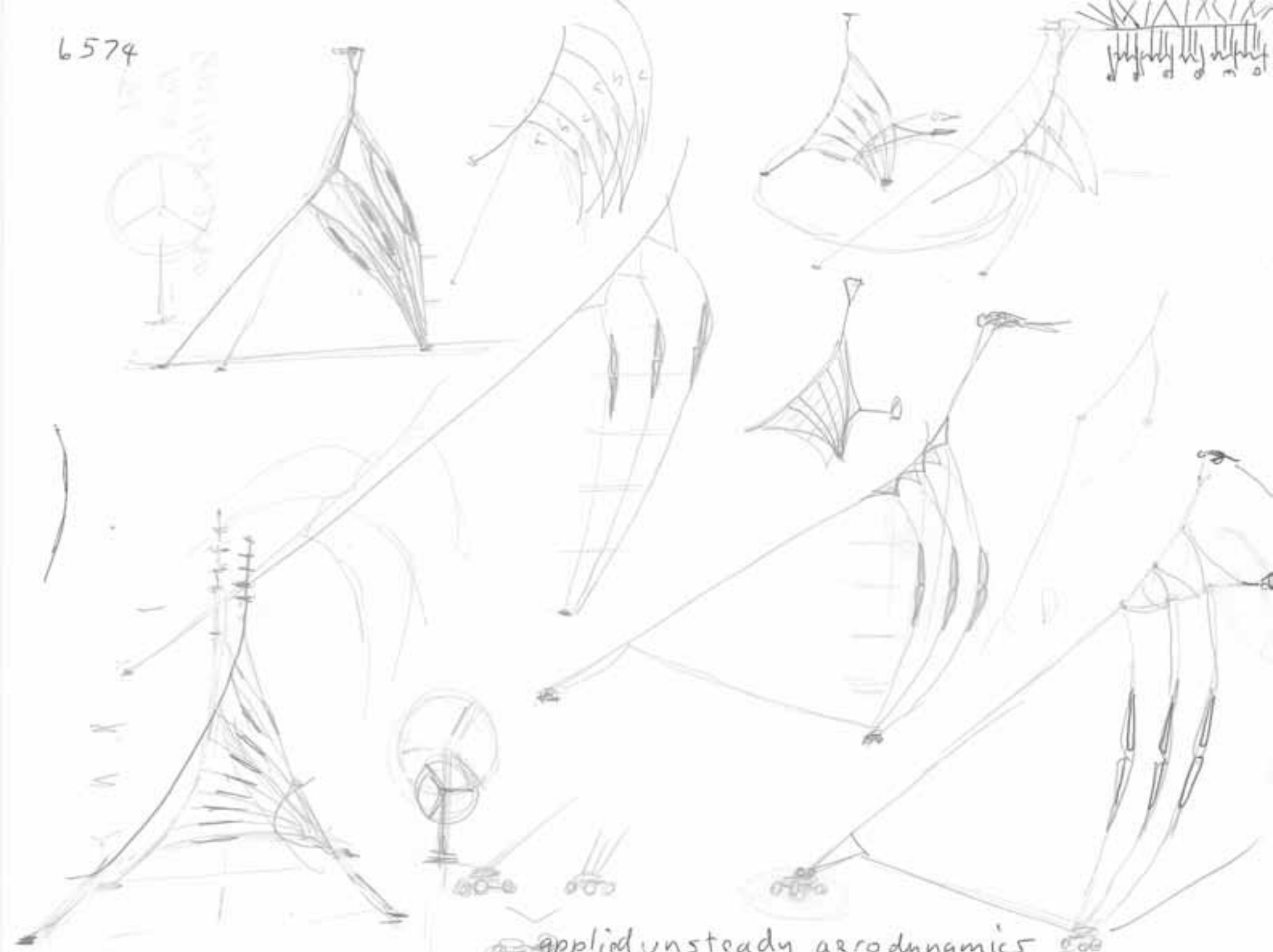


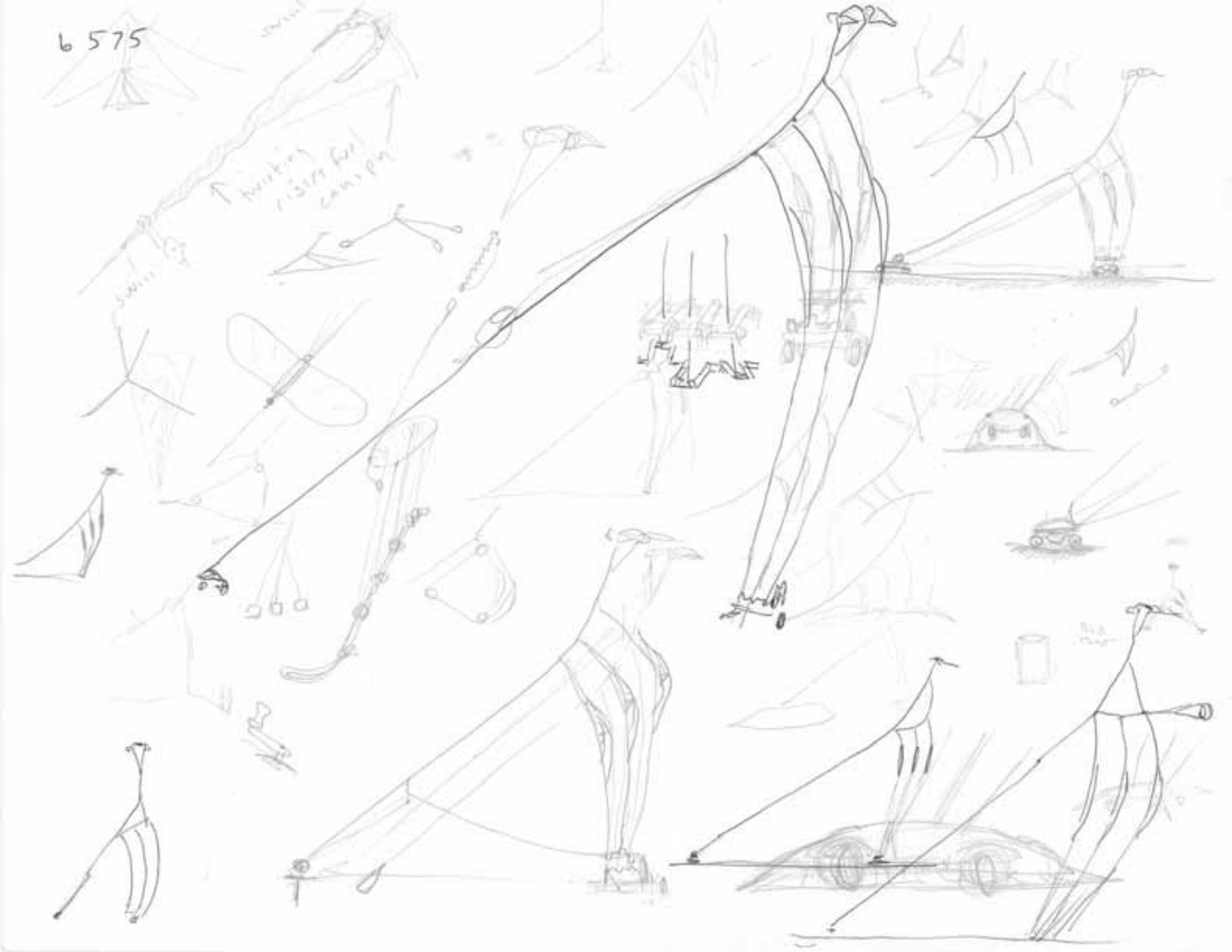
6 571

6572
water
up
pump

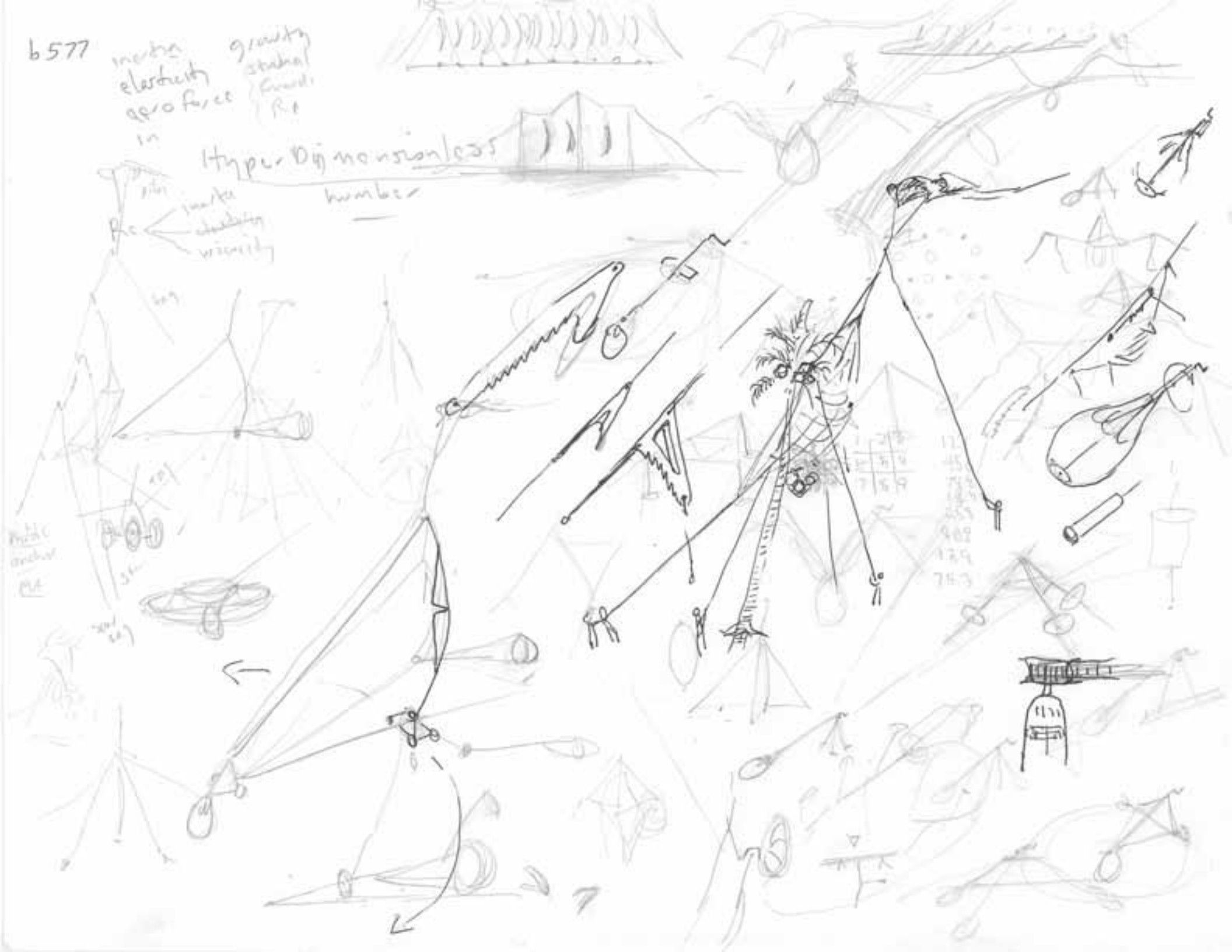

~~sequencial~~ phased
synchronous waves
pass ~~from upwind to~~ downwind
wing firing freq is
tuned by tensioning
phased ~~synchronous~~ wave trains passing downwind, tension tuned
singing wing
phase-locked to countdown
~~be linked~~
~~matched~~ ~~oscillators~~
string bound with wing
wild gander
glowing blue
b 573

6574

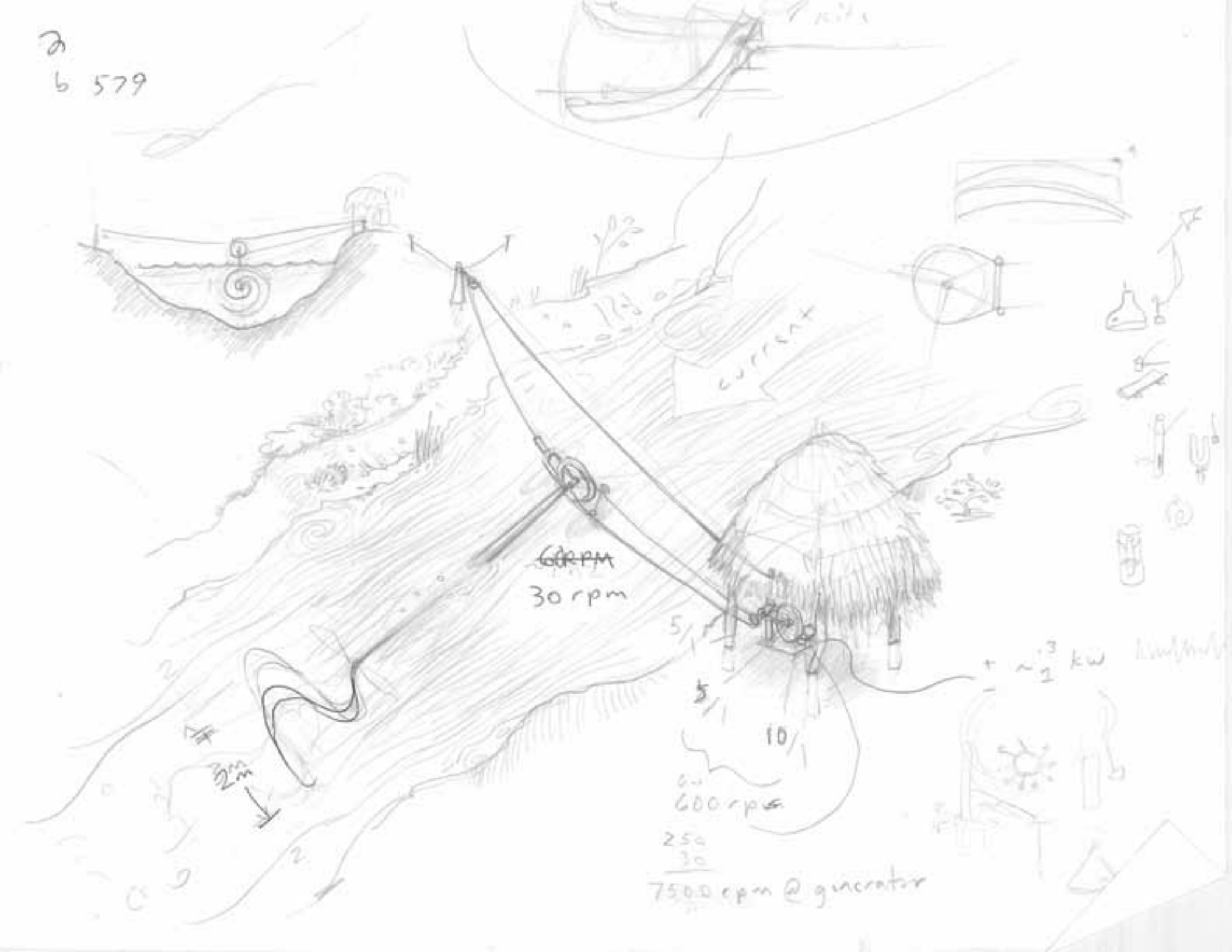



6575

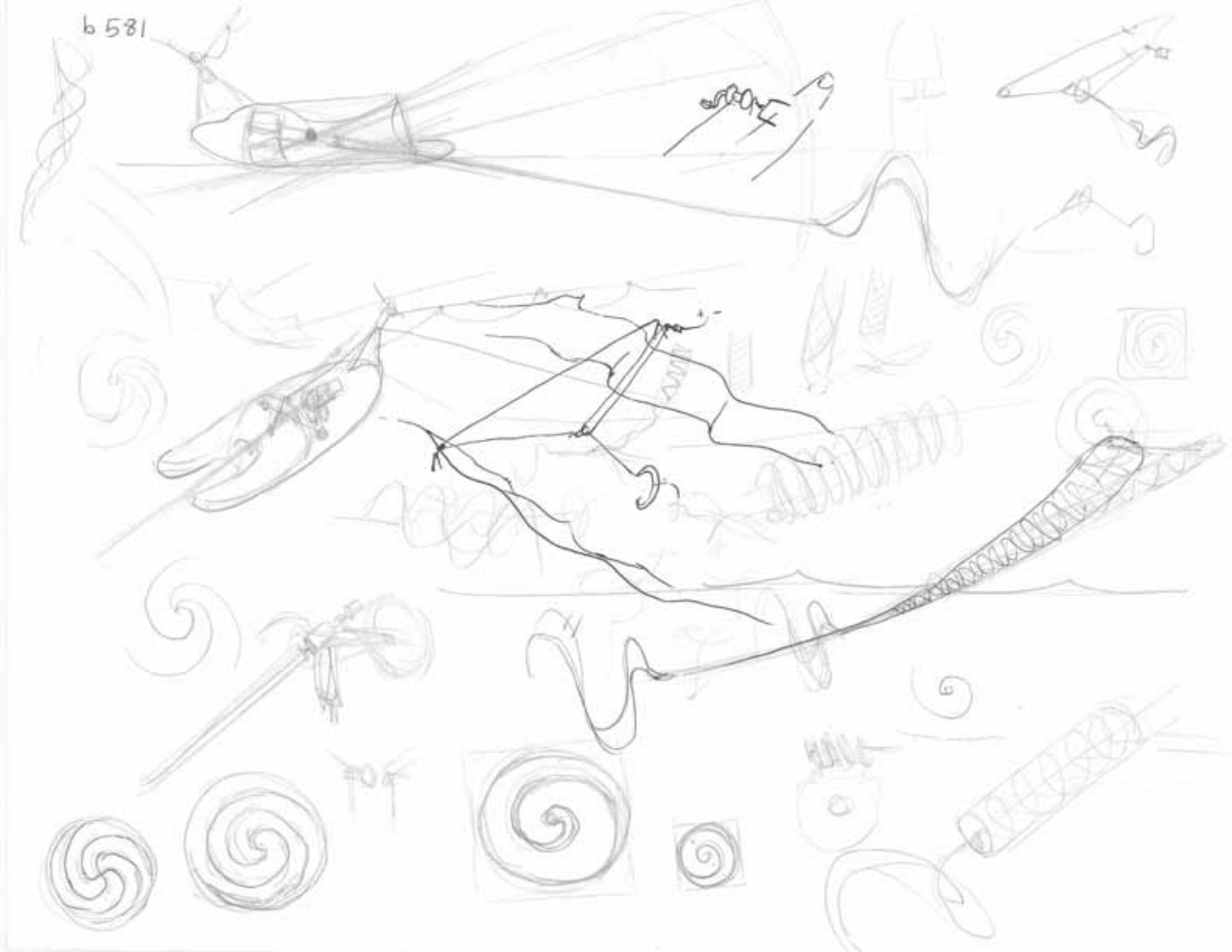
6 576


b577
inertia
elasticity
aero force
in
gravity
Hyper Dimensionless
number
Re
inertia
viscosity

6578

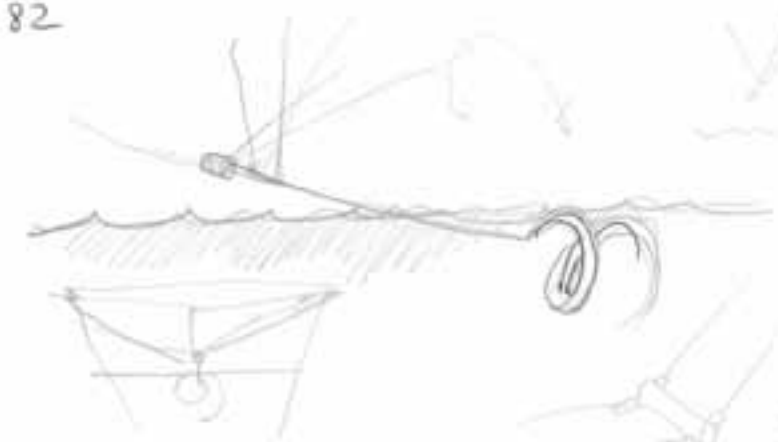

2
b 579
~~60 RPM~~
30 rpm
current
5/1
10/1
600 rpm
750.0 rpm @ gencrator

6 580


b 581

b 582

Soft Hydro - mostly tensile
- compliant
- low fouling



'cork screw' model

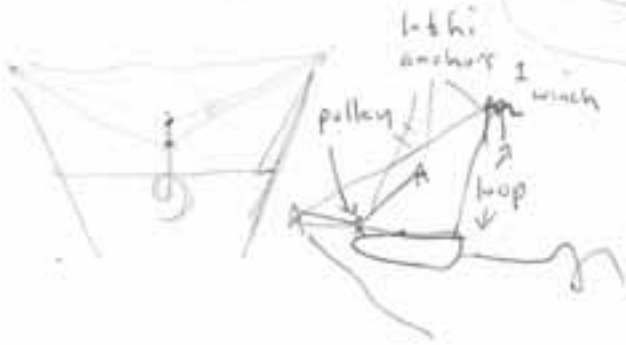
blended transitions

self limited ~~regulated~~ rpm

self furling

balanced single blade

bola mars

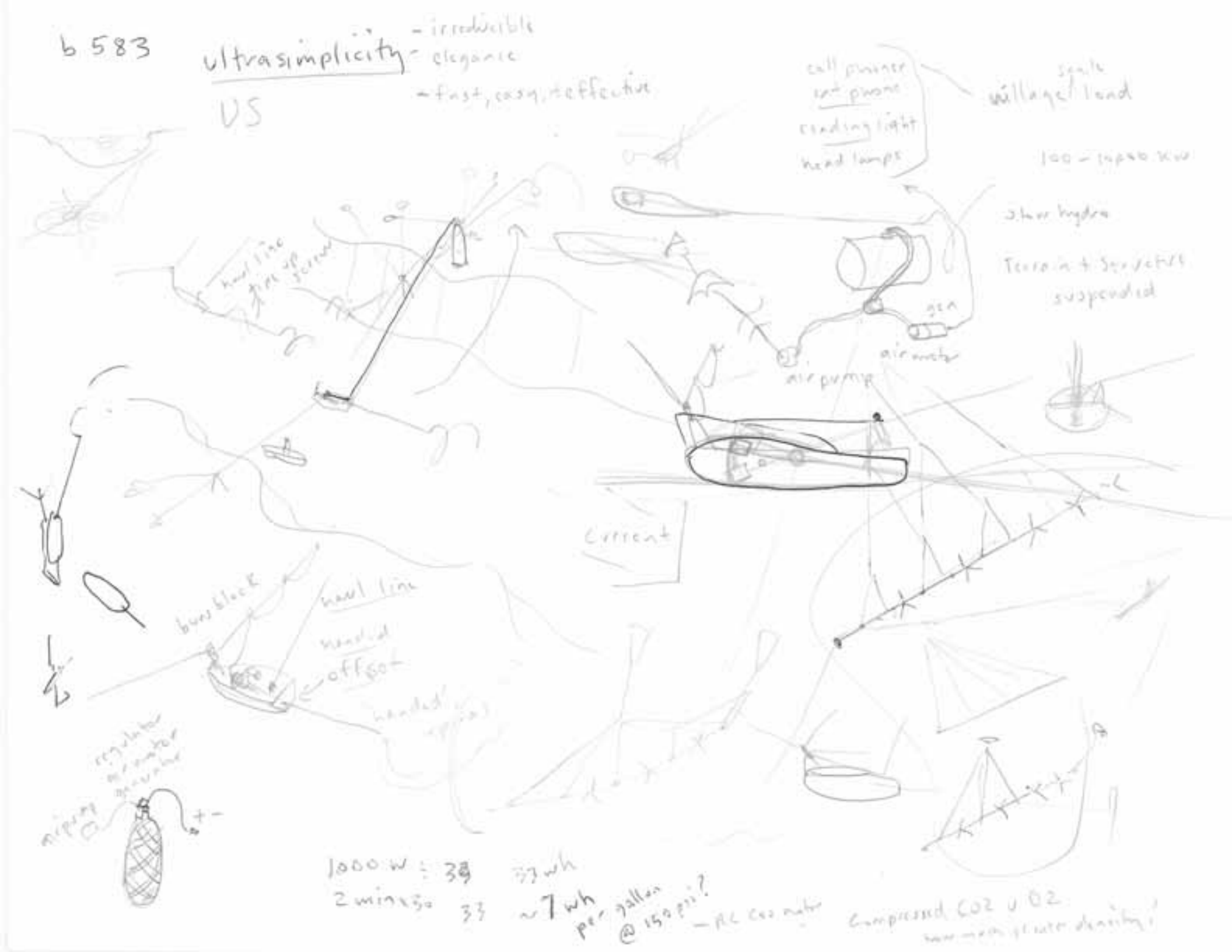


- spiral spinnaker

b 583

ultrasimplicity - irreducible
- elegance
- fast, easy, effective

US



b 584

SLKs
Arrays
membrane wing
ground station

milli

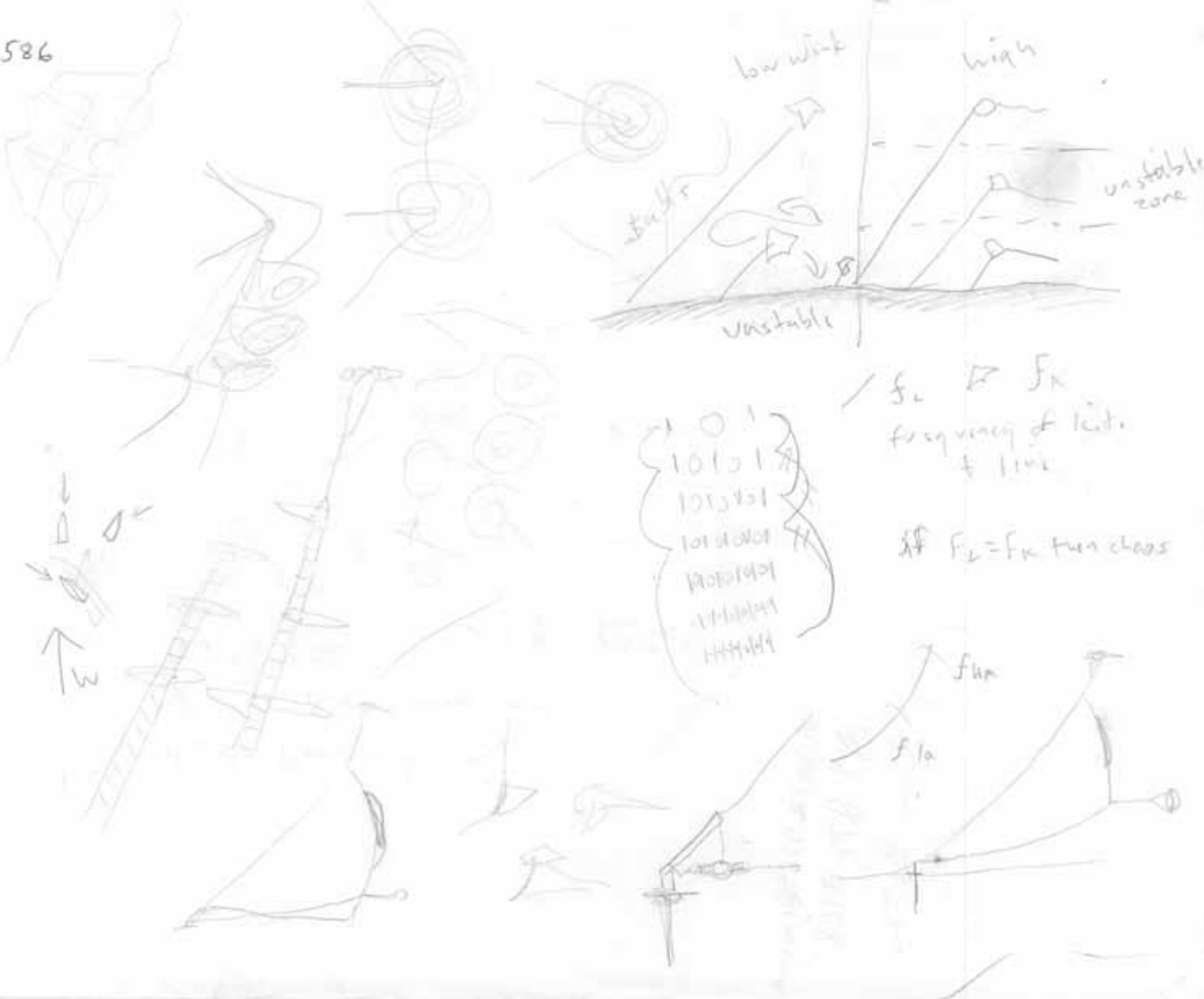
MWM

6585

Self Stable Stack
Looping Parafoils

Drive a TGV
in a banked
loop at 350 mph

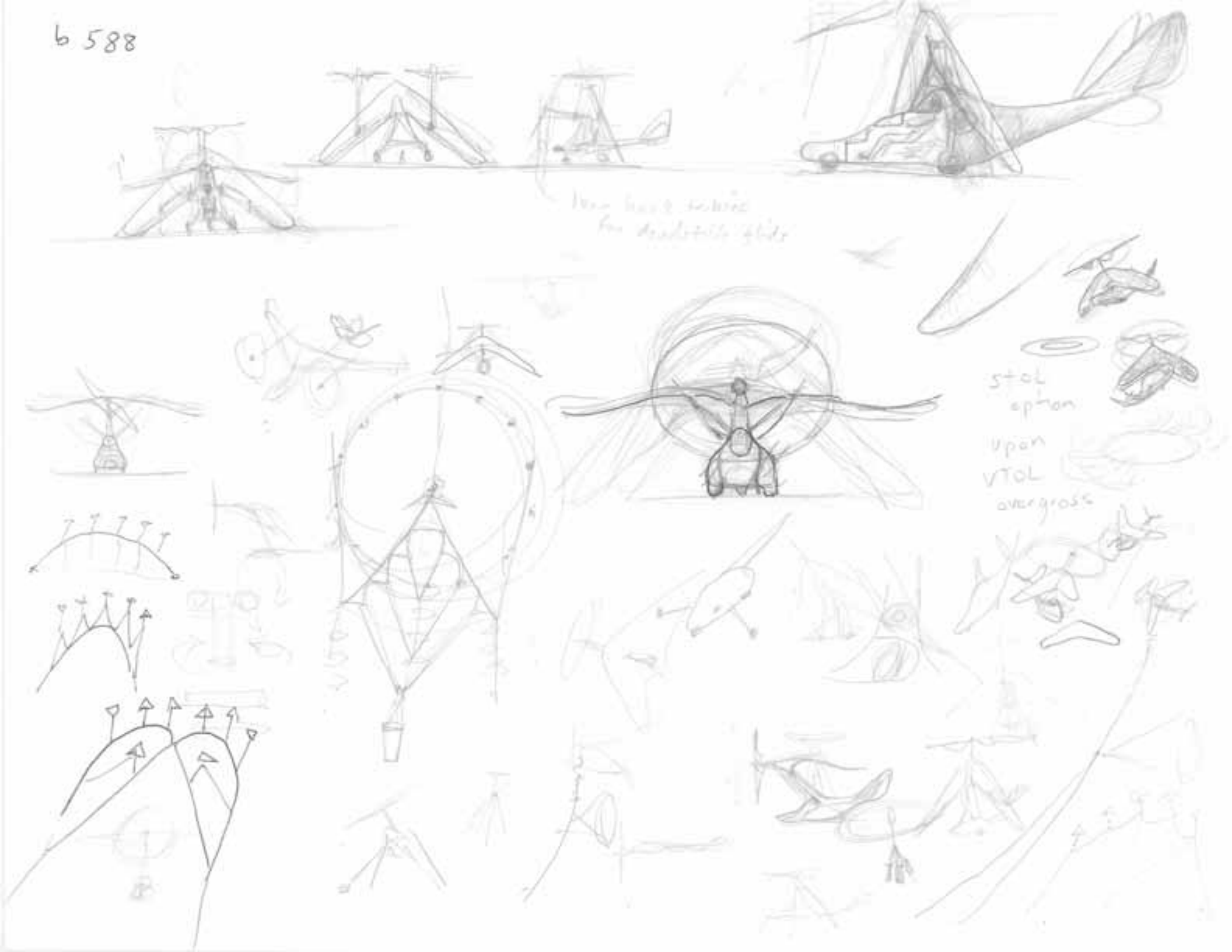
b 586



low wink
high
unstable zone
unstable
f_L f_K
frequency of kit. + line
$f_L = f_K$ then chaos
f_{HA}
f_{la}
W

6587

b 588



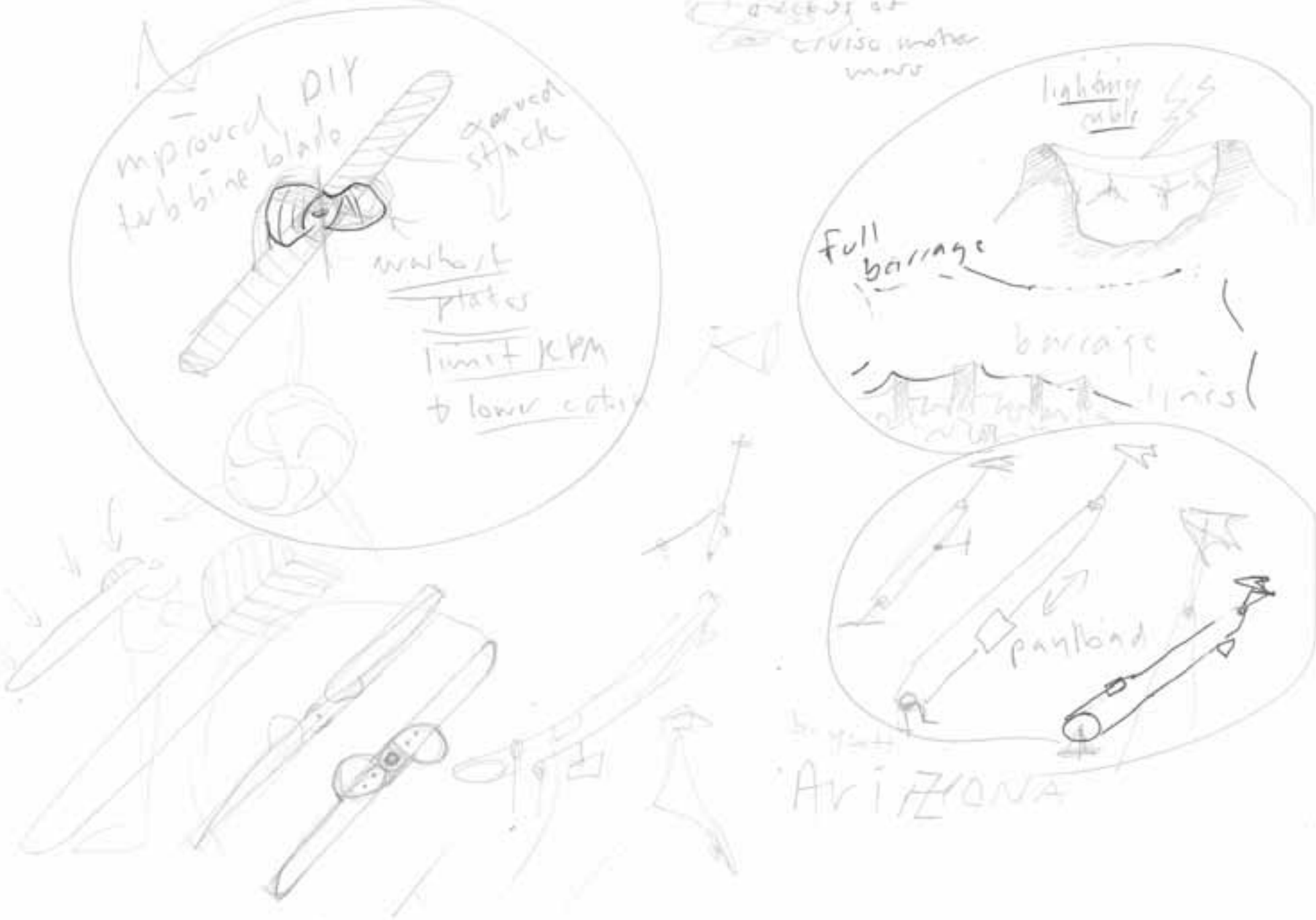
6589

Energy AeroSpace (TM)

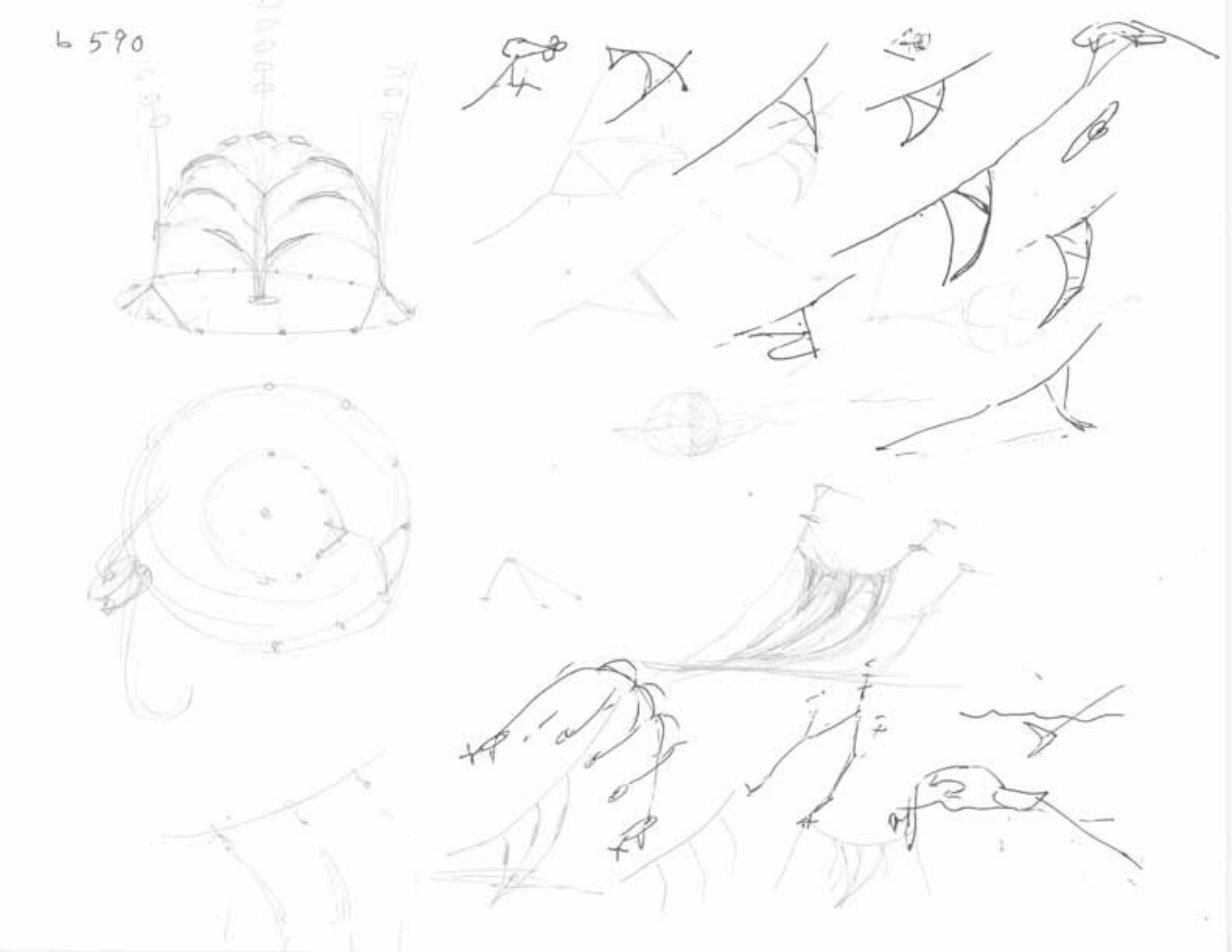
AirSpace Rights

leased airspace

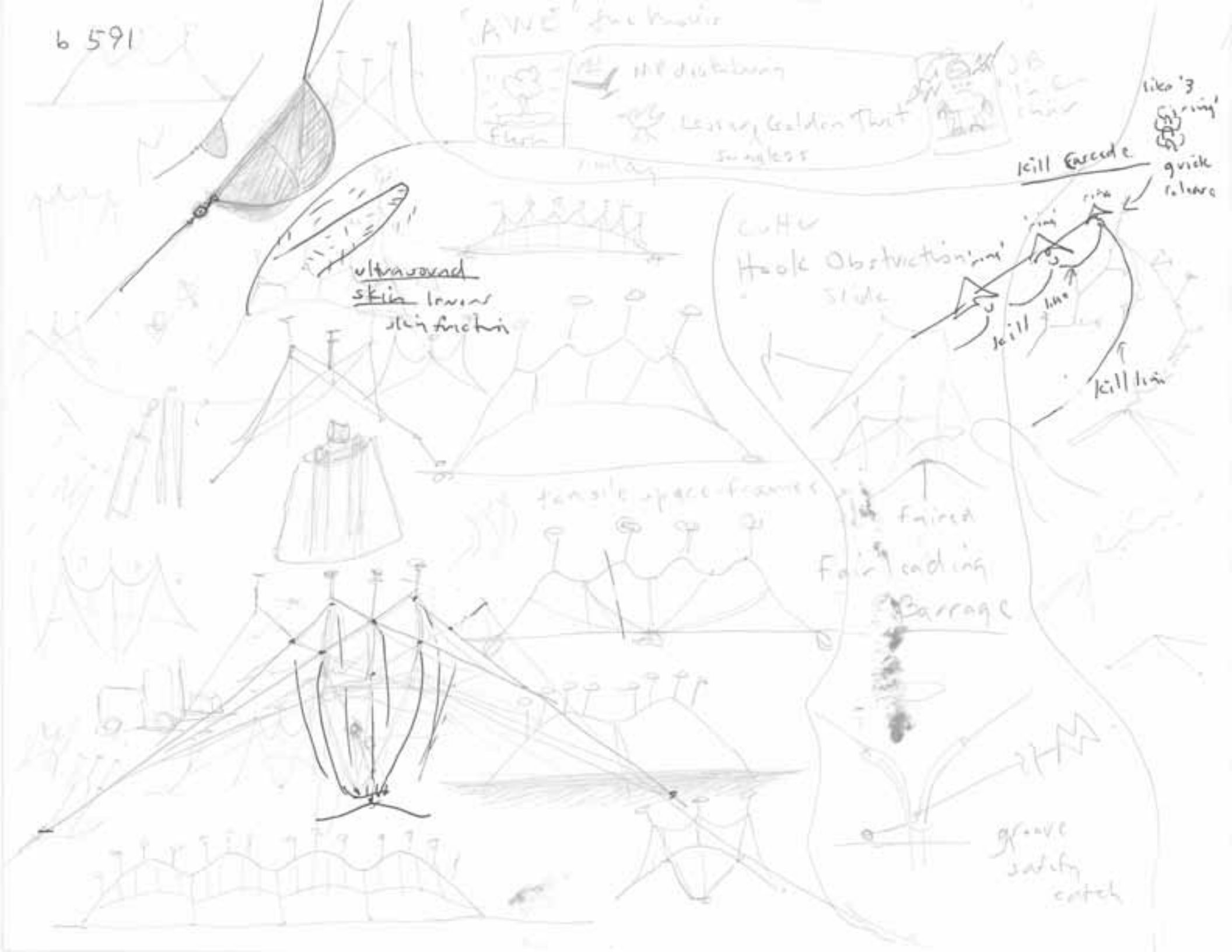
UTOL motor mass is far in excess of cruise motor mass



b 590



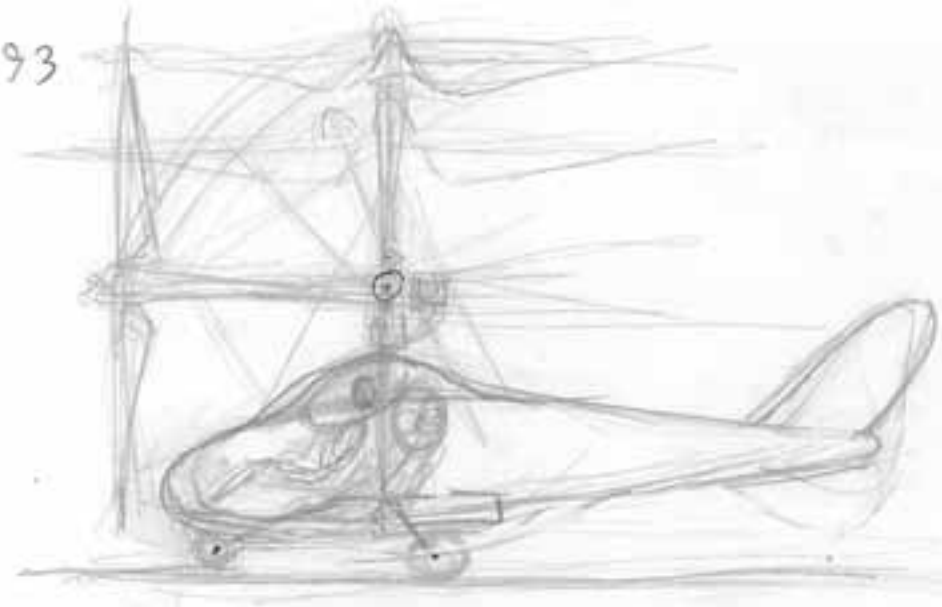
b 591

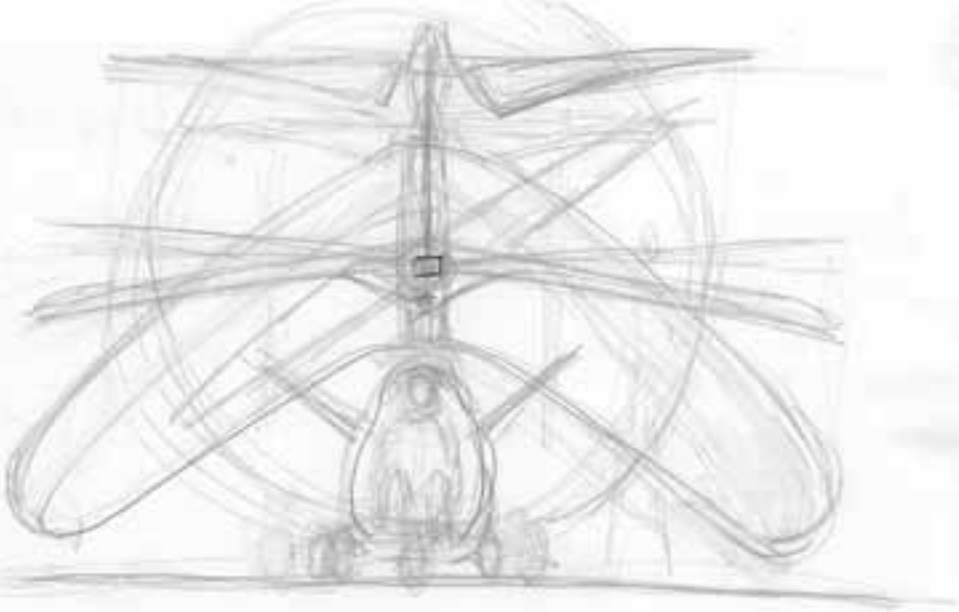


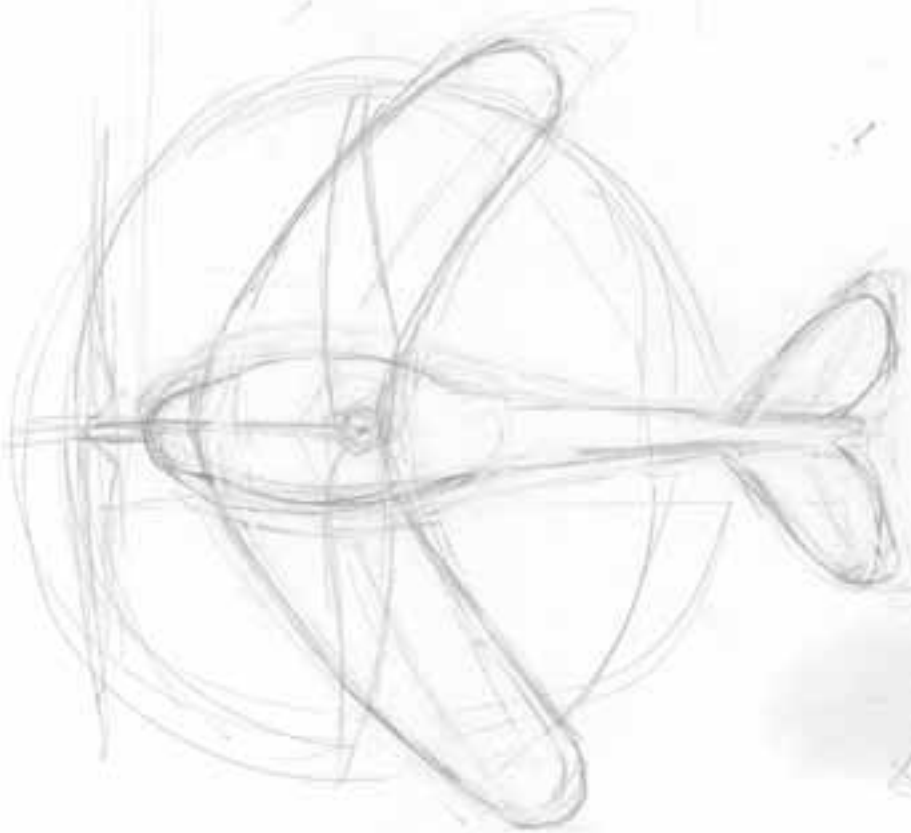
AWE
Lessons Golden Thrit
Sunglass
ultrasound
skin lessons
skin friction
Cutter
Hook Obstruction
Slide
like '3
'ring'
kill Cascade
quick
release
'ring'
'ring'
kill
line
kill line
tensile space frames
Faired
Fairleading
Barrage
groove
safety
catch

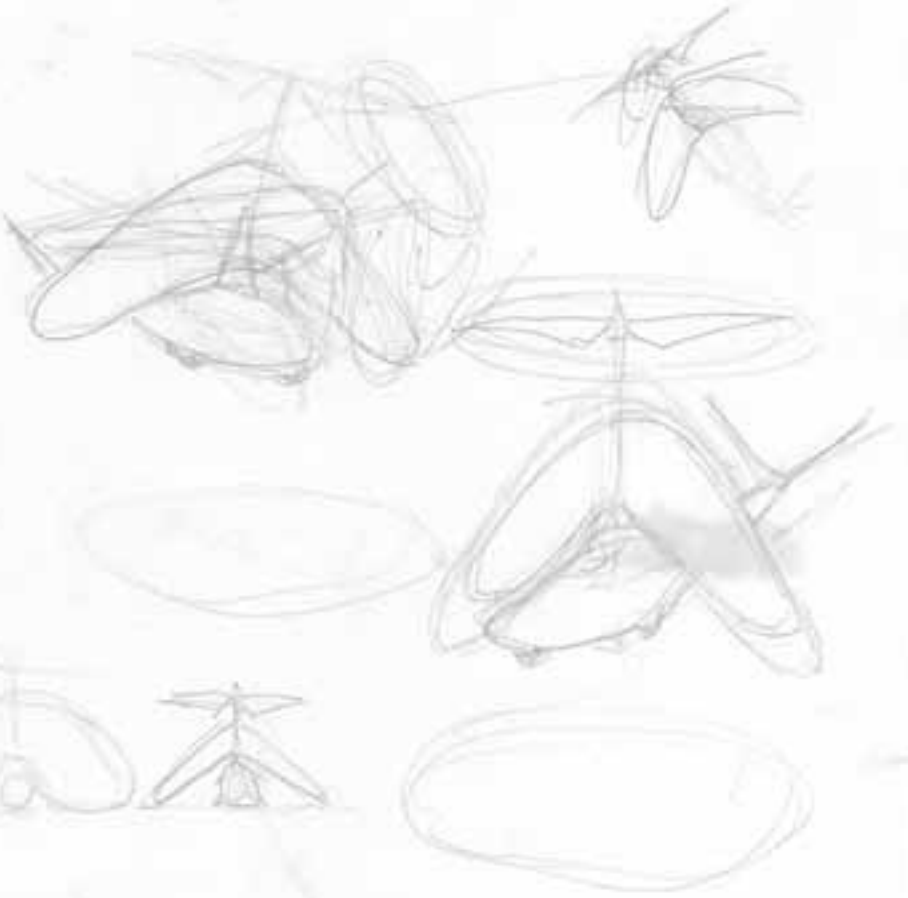
6592

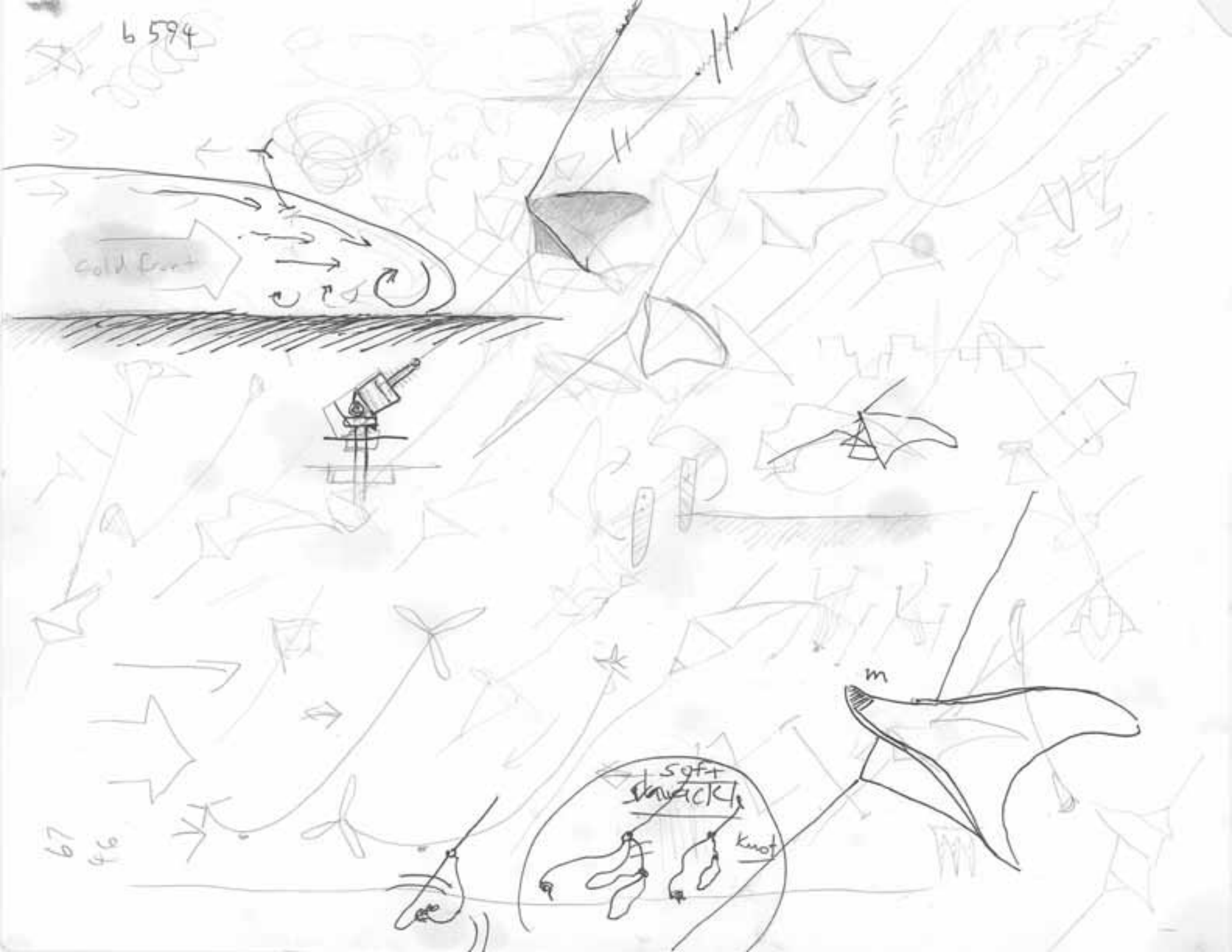
b 593

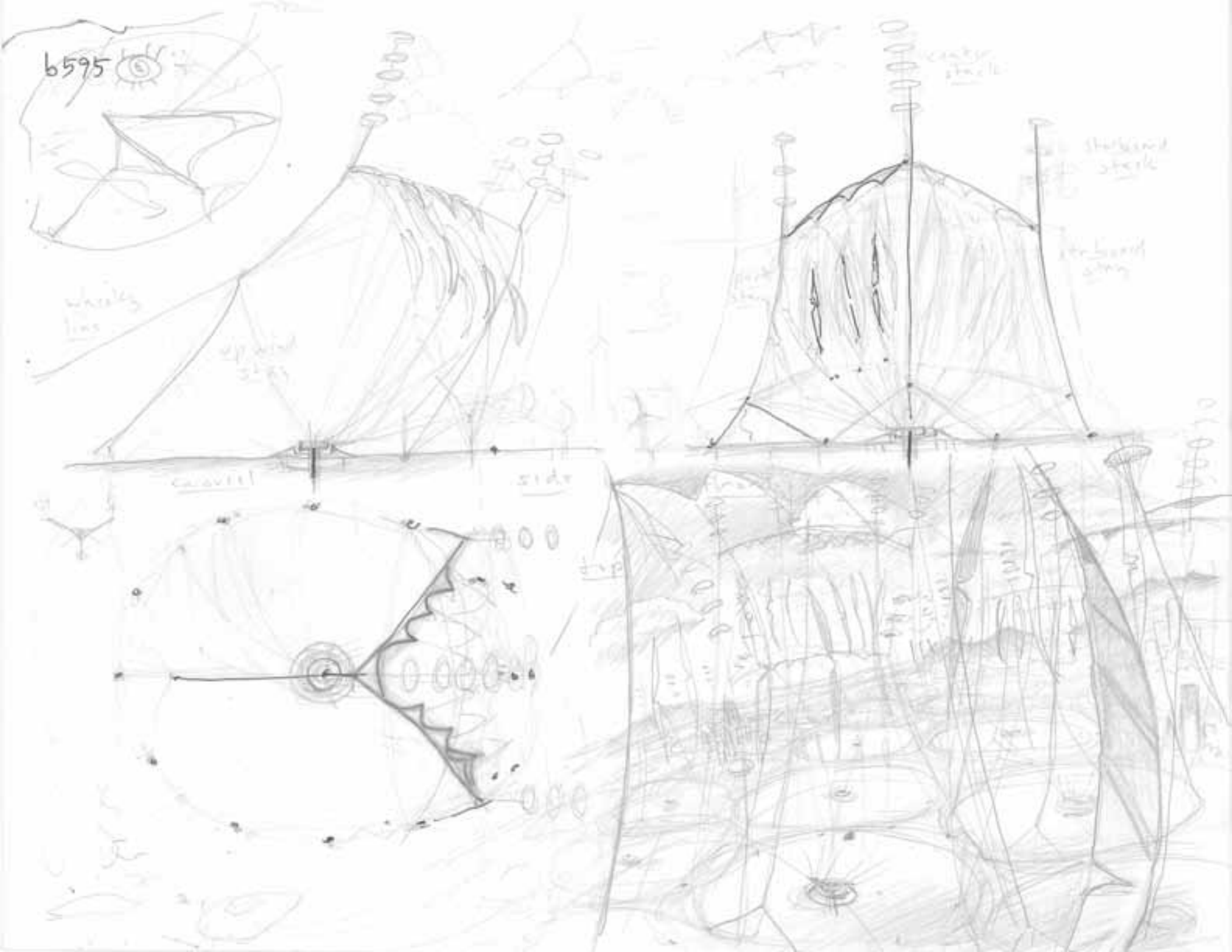






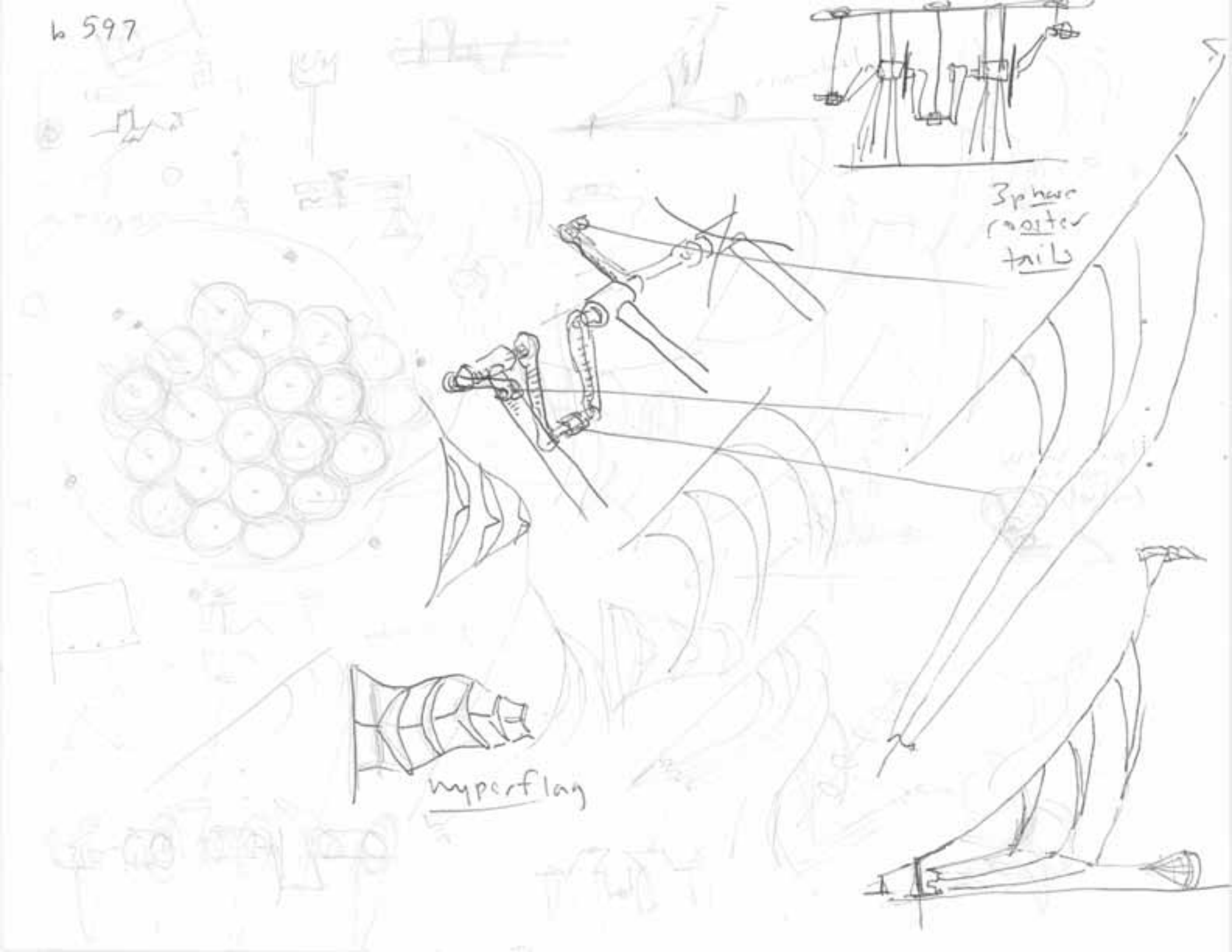



b 594
cold front
soft
knot
m


6595

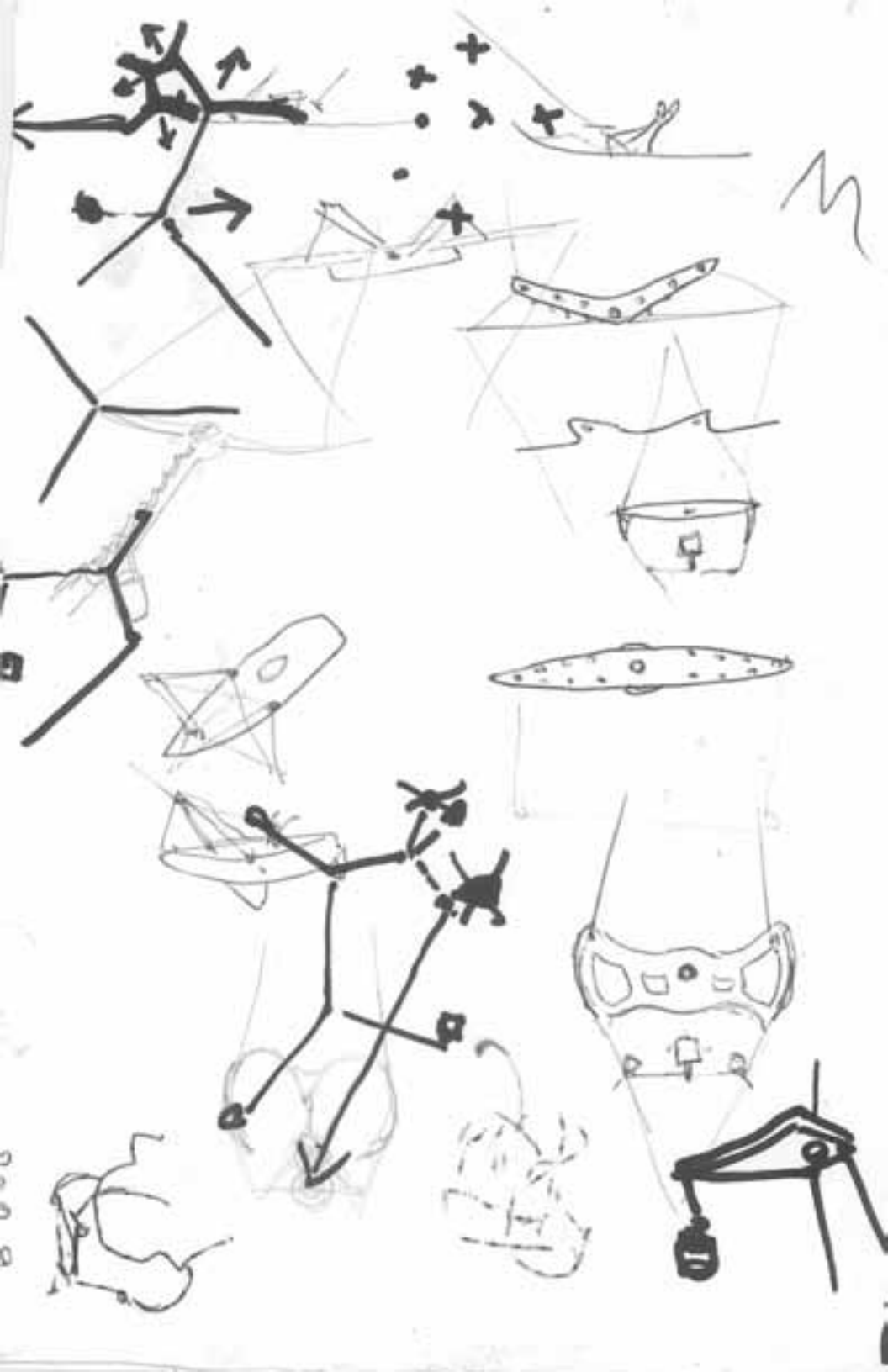
b 596

b 597



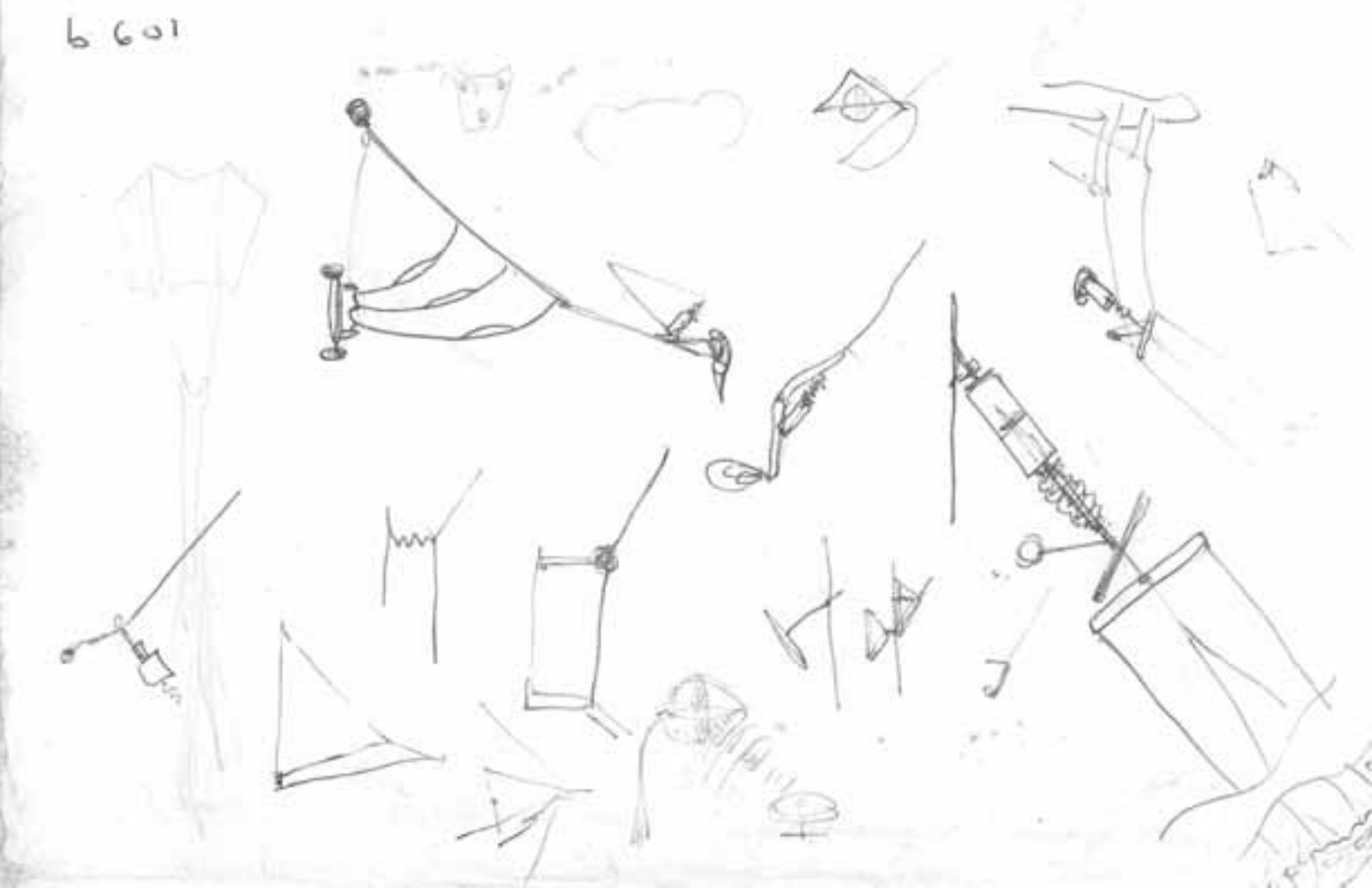
b 598
planing
carving
wave piercing
jumping/diving

b 599
crank
loader



Kite selection
altitude
tack - middle AoA
spacers
tensioner
air-dampener
mass dampener
longest
yaw/flat spin
freq
tail freq
line
freq
Kite Flight Dynamics
half mode
death
dive
major mode
high
amplitude
tail coupling
adjacent "
de "

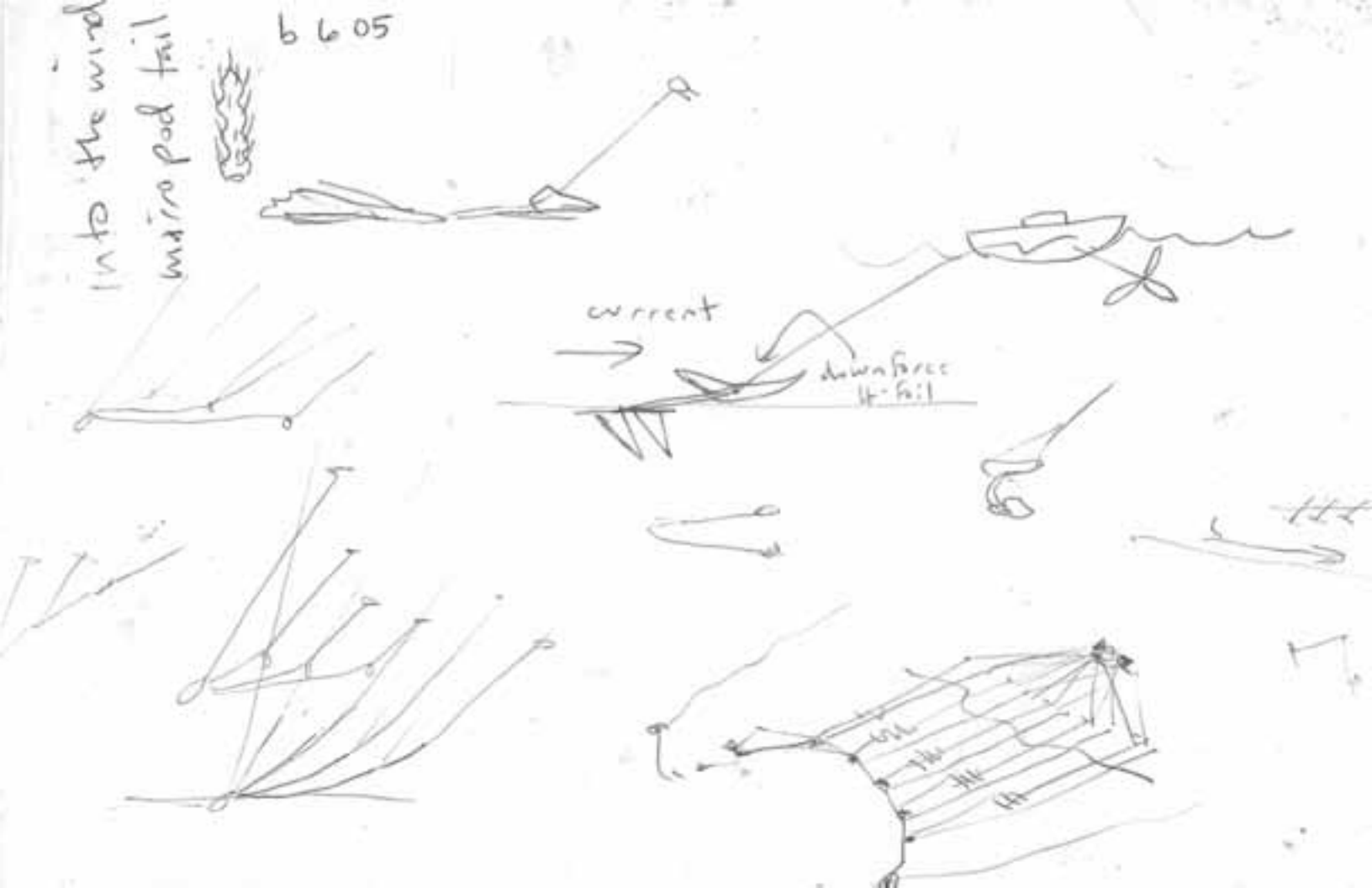
b 601



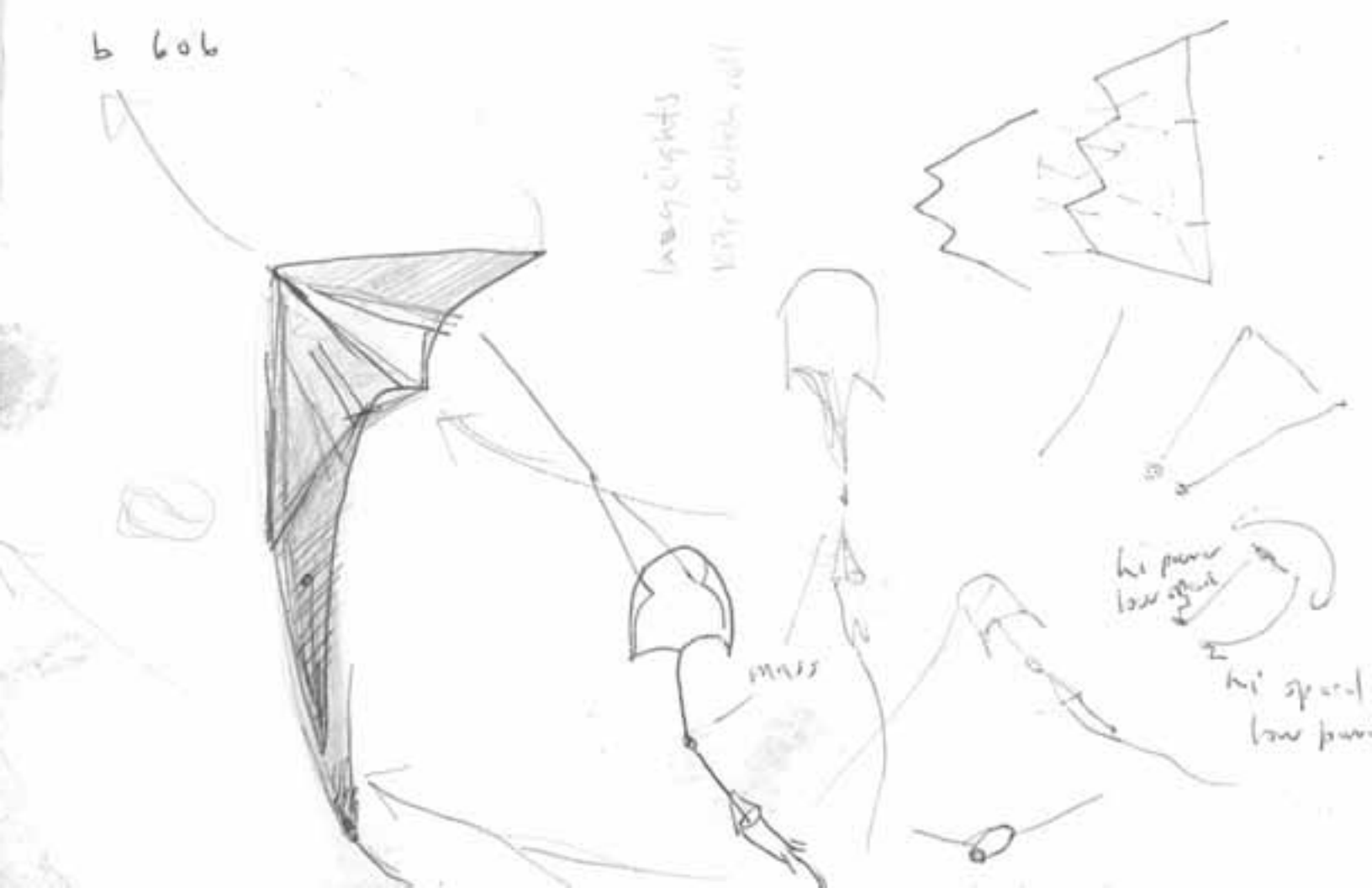
b 602
math as ~~fagoots~~ candle
in the darkness. ~~t~~ The over zealous
mathematician risks playing
the moth

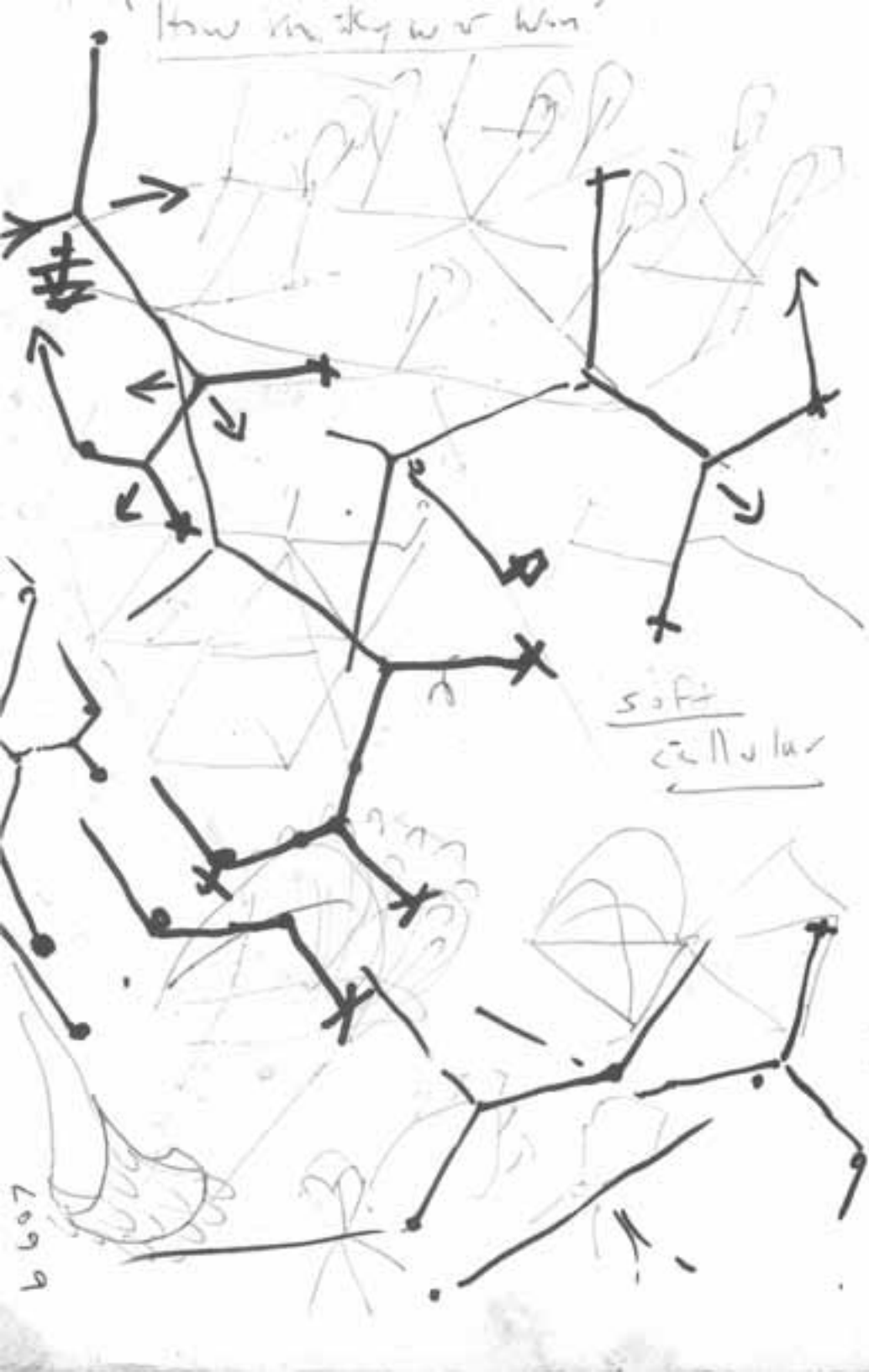
b 603

WWOOFing


b 6 05
into the wind
mirro pod tail
current
downforce
H-foil

b 606




soft
cellular