

SCIENCE OF THE SMALL

NANOTECHNOLOGY RESEARCH LABORATORY IN WASHINGTON, DC

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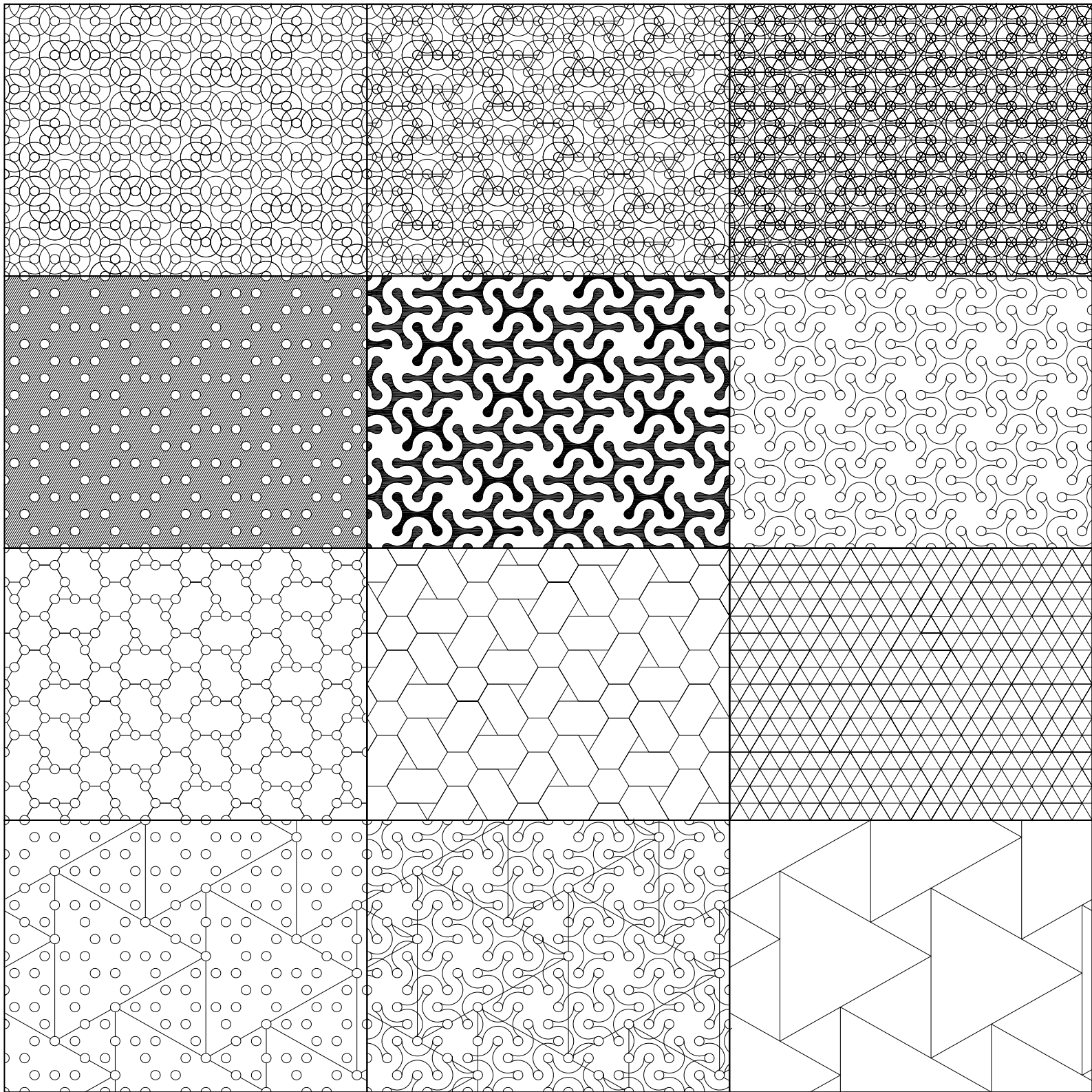
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NANOTECHNOLOGY, LABORATORY, CLEANROOM, SCIENCE, SCALE, LAYERS, REVEALING,
INDUSTRY, MATERIALITY, INTERACTION, MICROPROCESSORS



ABSTRACT:

THIS THESIS IS AN ATTEMPT TO EXPLORE POST INDUSTRIAL SOCIETY AND HOW MODERN INDUSTRY CAN BECOME PART OF THE URBAN EXPERIENCE. THROUGH THE DESIGN OF A NANOTECHNOLOGY RESEARCH LABORATORY, I WAS ABLE TO DISCOVER A CONNECTION BETWEEN MODERN ARCHITECTURE AND NANOTECHNOLOGY WHICH REVOLVED AROUND THE TOPICS OF SCALE, LAYERING AND REVEALING.

SMALL, MEDIUM AND LARGE TRIANGLES

I WAS LOOKING FOR A PATTERN / GEOMETRY THAT HAD MULTIPLE SCALES WITHIN IT, HAD MANY WAYS TO LOOK AT AND REVEAL / INTERPRET THE SAME INFORMATION, AND HAD MULTIPLE LAYERS OF INFORMATION

ACKNOWLEDGEMENTS

I OWE A GREAT DEAL OF GRATITUDE TO THOSE IN MY LIFE.

MY PARENTS **CATHERINE AND JOHN PORTER**, MY SIBLINGS **RICHARD, BRIDGET AND DANIEL**, AND MY **GRANDPARENTS**. THANK YOU FOR YOUR UNWAVERING SUPPORT.

TO MY COMMITTEE **JAAN HOLT, DR. PAUL EMMONS, PH.D, AND SUSAN PIEDMONT-PALLADINO** THANK YOU FOR PUSHING ME, AND CHALLENGING ME TO THINK ABOUT ARCHITECTURE IN WAYS THAT I COULD HAVE NEVER CONCEIVED ON MY OWN. YOU REALLY HELPED ME CHANGE THE WAY THAT I SEE ARCHITECTURE AND THE WORLD, AND FOR THAT I AM ETERNALLY GRATEFUL.

ESPECIALLY TO **ULRIKE ALTENMÜLLER** - WORDS CAN NOT BEGIN TO SAY HOW THANKFUL I AM TO YOU FOR ALL OF YOUR ENCOURAGEMENT, YOUR COMMITMENT, AND FOR NEVER LETTING ME GIVE UP. I TRULY DO NOT KNOW WHERE I WOULD HAVE BEEN WITHOUT YOUR GUIDANCE.

JONATHAN FOOTE, THANK YOU FOR HELPING ME TO DEVELOP MY PASSION FOR MATERIAL STUDIES, FOR YOUR CRITIQUES, AND FOR ALL OF YOUR HELP AND ENCOURAGEMENT.

MITSY CANTO-JACOBS OF CUH2A, THANK YOU FOR MEETING WITH ME TO REVIEW MY PROJECT AND HELP ME TO GAIN A BETTER UNDERSTANDING OF THE WORLD OF NANOTECHNOLOGY.

AND TO ALL THE WONDERFUL PEOPLE I HAVE MET AT WAAC:

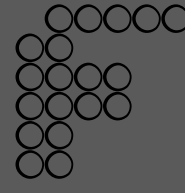
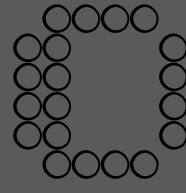
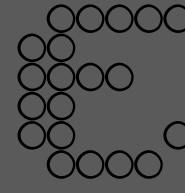
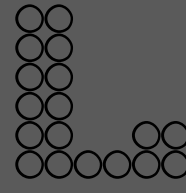
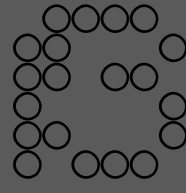
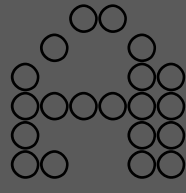
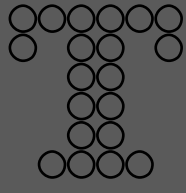
CHERYL MOY <3 | RAMONA SONNTAG | MATTHEW VALENTINE | PO-HAO CHEN | JOANNE TRUMBO | GUSTAVO DE JONG | NASHWELL HAYES | EDGAR DEL ARCO

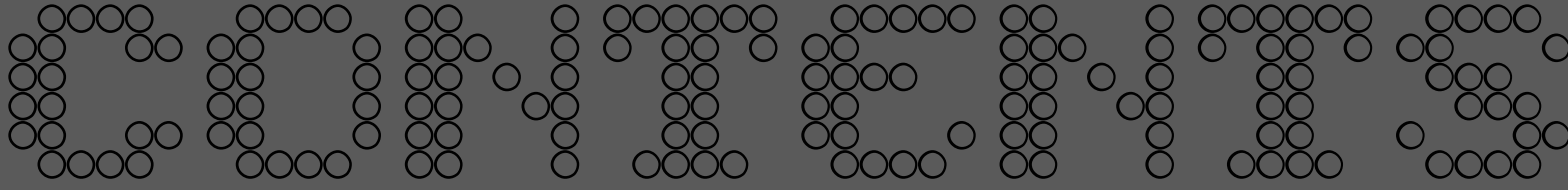
BENJAMIN BUTZ | BJORN STEUDTE | KYONGSIK JUN | MICHAEL RODRIGUEZ | RYOHEI SAITO | YANYAN LI | TANIA SARACHO-ROSALES | NEELUM KHALSA | YVES SIX | LEGARE ROBBIE HINDS | FLORENCIA CONALBI | PAOLA MERETTI | ELENA PARODI | CAROLINA DAYER | JOHN FOLEY | LAUREN SCHLATHER | HENDRIK KLEIN | GRZEGORZ WARTAK | ANDRO MAND | WERNER NERLICH | VALENTIN DIEZ | CHRISTINE BUTTNER-GRIFFENHAIN | ADAM PERRIS | CAROLYN PARRIS | KELVIN WEBSTER | THOMAS AND JJ CHEUNG | ALEC LUONG | BELITA ASFAW | BRIAN SYKES | DAWN PARKER | EMILY SCALI | JESSICA TURRIN | KERI KENNEDY | MARILYN SHEPPARD | PATRICK KNEE | RYAN PIPER | JOHN SCHIPPERS | KARISA DAVIES | KHALID KHRIESAT | MICHAEL FORD | RICHARDO VASQUEZ | DAFANG CHAI | DONG KEON KIM | MARIA ELENA GALVAN | PATRICIA JARA | BRIAN GAFFNEY | DENA KENNETT

TO SEE A WORLD IN A GRAIN OF SAND
AND A HEAVEN IN A WILD FLOWER,
HOLD INFINITY IN THE PALM OF YOUR HAND
AN ETERNITY IN AN HOUR.

AUGURIES OF INNOCENCE
- WILLIAM BLAKE

TITLE	i
ABSTRACT	ii
ACKNOWLEDGEMENTS	iii
DEDICATION	iv
TABLE OF CONTENTS	x
INTRODUCTION	10
THE INDUSTRIAL BUILDING	12
INFLUENCES & INSPIRATION	14
MATERIALS STUDIES - CUTTING	16
MATERIAL STUDIES - BREAKING	24
MATERIAL STUDIES - FERROCRETE	26
LAYERS	28
SCALE	30
NANOTECHNOLOGY	32
SITE ANALYSIS	42
EARLY THOUGHTS	54





SPATIAL STUDIES	56
FEATURES OF THE BUILDING	62
URBAN GARDENS & BONSAI FOREST	64
GLASS LAYERS	66
CIRCULATION	68
STRUCTURE	70
BIOFILTER GARDEN WALL	72
LIBRARY	74
LABORATORIES	76
MECHANICAL SYSTEM	78
CLEANROOM	80
VOLCANIC BLASTPROOF STORAGE	86
DETAILS	88
FINAL PROJECT	92
REFERENCES	140



POST REVOLUTION



INTRODUCTION

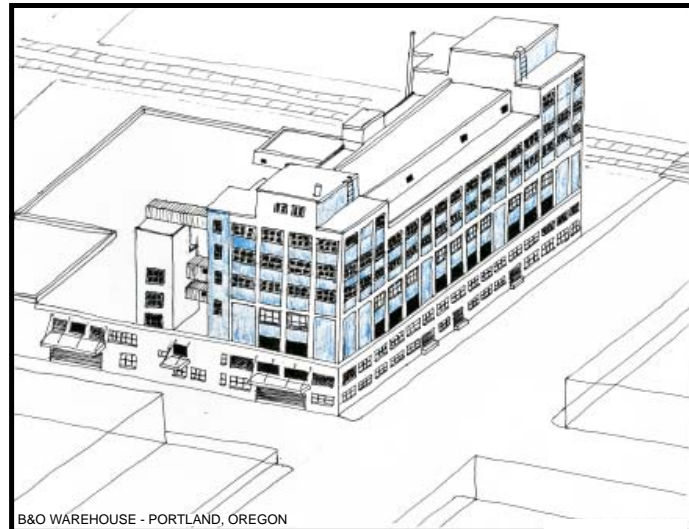
I BEGAN THE PROCESS OF THESIS, NOT REALLY KNOWING WHERE TO BEGIN, OR WHAT A THESIS WAS. INSTINCTIVELY, THOUGHTS OF MY CHILDHOOD CAME TO MIND. I REMEMBER HAVING A FASCINATION WITH THE OLD INDUSTRIAL BUILDINGS IN THE CITY OF SYRACUSE, NY, AND ALSO RECALL A PERSONAL DRIVE TO LEARN ABOUT SCIENCE AND TECHNOLOGY. THESE INDUSTRIAL BUILDINGS I SAW AS A KID WERE TECHNOLOGICAL RELICS THAT TOLD THE STORY OF A STRONG INDUSTRIAL AMERICA. ALTHOUGH I WAS NOT FULLY AWARE AT THE TIME, I NOW REALIZE THAT I WAS SURROUNDED BY A VERY RICH HISTORY OF MANUFACTURING AND EARLY TECHNOLOGIES.

THROUGH MY STUDIES, I HAVE LEARNED THAT THE LANDSCAPES OF EARLY AMERICA WERE ORIGINALLY THOUGHT OF AS UTOPIAN PASTORAL GARDENS. THESE IDEAS OF THE PASTORAL GARDEN WOULD CHANGE WITH THE INTRODUCTION OF THE INDUSTRIAL REVOLUTION, AS TRAINS AND OTHER MACHINES STARTED INVADING THESE GARDENS. THERE WAS NO TURNING BACK, AS THE MACHINE BECAME A STAPLE OF THE AMERICAN LIFE MAKING WORK, TRAVEL AND LEISURE TIME MUCH EASIER. THE FIRST SETTLERS OF AMERICA HAD A GENERAL IDEA OF WHAT THEY WERE TO EXPECT AND WHAT WAS TO COME IN TIME, BUT THINGS CHANGED SO RAPIDLY THAT THE INNOVATIONS WERE MUCH GREATER THAN ANYTHING THAT COULD HAVE BEEN IMAGINED.

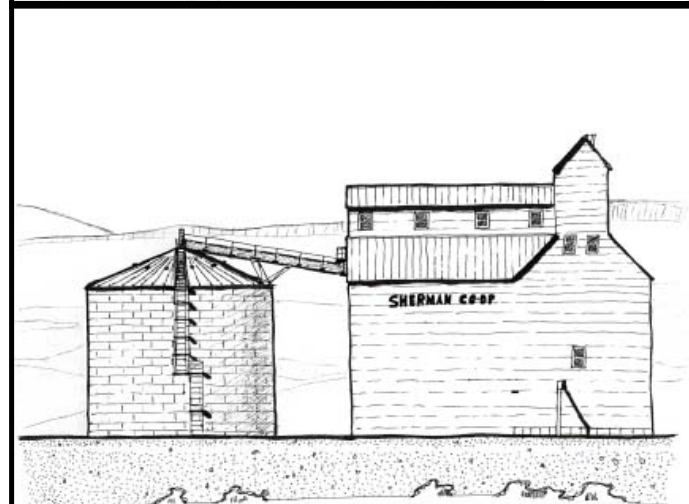
ALTHOUGH THE CHANGES DURING THIS TIME WERE DRAMATIC, IN HINDSIGHT IT IS POSSIBLE TO SEE THAT THESE CYCLES OF TECHNOLOGICAL EVOLUTION HAVE NEVER ENDED. ACCORDING TO MOORE'S LAW, IT STATES THAT TECHNOLOGY DOUBLES ITSELF APPROXIMATELY EVERY TWENTY-FOUR MONTHS. GORDON E. MOORE, WHO IS THE CO-FOUNDER OF INTEL, WAS FIRST TO CONCEIVE THIS IDEA. IN THE WORLD OF TECHNOLOGY, THIS IS AN IMPORTANT CONCEPT AS THIS PREDICTION HAS HELD TRUE SINCE IT WAS STATED IN 1965. EVEN THOUGH IT HAS ONLY BEEN FORTY-FOUR YEARS SINCE THIS IDEA WAS CONCEIVED, IT CAN BE SHOWN THROUGHOUT MODERN HISTORY TO BE FREQUENTLY CONSISTENT. THIS ABILITY TO PREDICT TECHNOLOGICAL ACHIEVEMENTS CAN HELP US LOOK INTO THE NEAR FUTURE AND CALCULATE WHAT KINDS OF HURDLES WE WILL JUMP AND WHERE WE COULD BE HEADED DURING THE REST OF THIS CENTURY.

ULTIMATELY, I BEGAN TO ASK MYSELF WHAT THE FUTURE IN THIS POST-INDUSTRIAL, TECHNOLOGY-DRIVEN SOCIETY WOULD BE LIKE, AND HOW IT COULD HELP TO SHAPE MODERN AMERICA. THIS MADE ME THINK ABOUT A TECHNOLOGY WHICH HAS THE POTENTIAL TO START A MODERN DAY TECHNOLOGICAL REVOLUTION, NANOTECHNOLOGY. I HAVE FOUND THIS SUBJECT TO BE FASCINATING, AND THIS IS PART OF THE REASON I DECIDED TO DESIGN A NANOTECHNOLOGY RESEARCH LABORATORY. THROUGH THE DEVELOPMENT OF MY THESIS, I LOOKED AT TOPICS THAT I FOUND TO BE CLOSELY RELATED TO BOTH NANOTECHNOLOGY AND ARCHITECTURE:

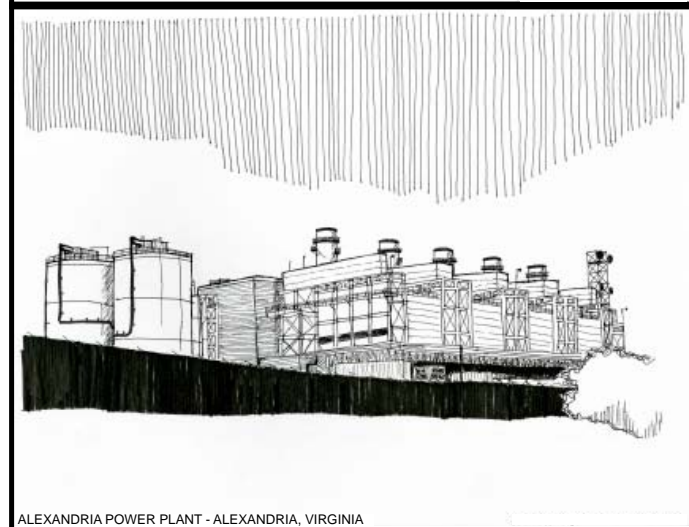
SCALE, REVEALING (OF INFORMATION), AND LAYERING



B&O WAREHOUSE - PORTLAND, OREGON



SHERMAN CO-OP MILL - ARLINGTON, WASHINGTON



ALEXANDRIA POWER PLANT - ALEXANDRIA, VIRGINIA



FORD FACTORY
BUFFALO, NY
BY ALBERT KAHN



ELECTRICAL SUBSTATION
WASHINGTON, DC
OWNED BY
DOMINION VIRGINIA
POWER



S EMPIRE ST GARMENT
FACTORY
WILKES BARRE, PA
20 FOOT INTERIOR BAYS



BLUE COAL FACTORY
WILKES BARRE, PA

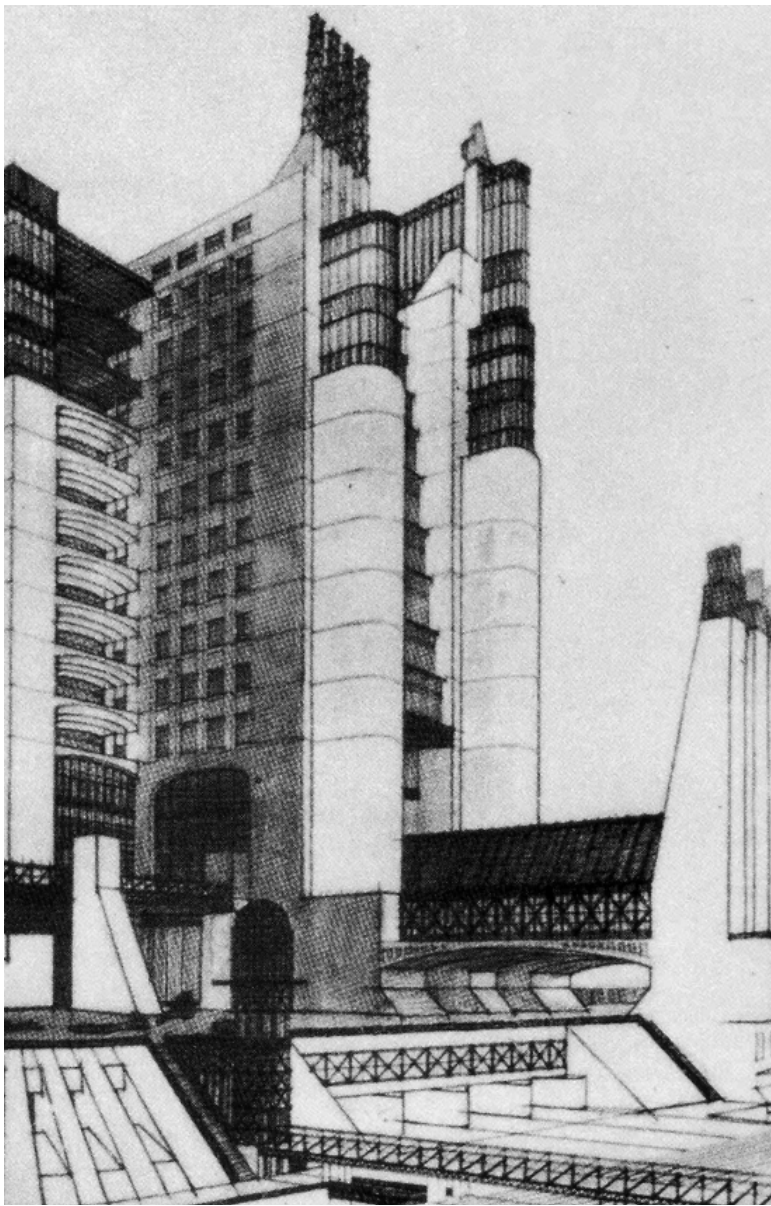
THE INDUSTRIAL BUILDING

AFTER THE END OF THE INDUSTRIAL REVOLUTION, AS INDUSTRY BEGAN TO LEAVE THE UNITED STATES, EMPTY INDUSTRIAL BUILDINGS WERE LEFT BEHIND. MANY OF THE BUILDINGS LAY DORMANT, AS IT WAS COST PROHIBITIVE FOR THE BUILDINGS TO BE USED FOR THEIR INTENDED PURPOSE. AFTER MANY YEARS, PEOPLE HAVE STARTED TO SEE THE BEAUTY AND VALUE IN THESE UNIQUE BUILDINGS AND STARTED USING THEM FOR NEW INDUSTRY, COMMERCIAL AND RESIDENTIAL ENDEAVORS. OTHERS SIT EMPTY AND VANDALIZED, AS MONUMENTS TO OUR TECHNOLOGICAL PAST. I FIND SOMETHING VERY BEAUTIFUL ABOUT THE IDEA OF BUILDING SOMETHING OF QUALITY, WHICH HAS THE ABILITY TO LIVE ON FOR MULTIPLE GENERATIONS, AND POSSIBLY HAVE MULTIPLE USES THROUGHOUT ITS LIFE.

IN THESE BUILDINGS, MAN MADE MACHINE AND ARCHITECTURE WORKED TOGETHER TO FILL THE MANUFACTURING NEEDS OF SOCIETY. THE BUILDINGS HAD THE ABILITY TO CONTROL HEAT, LIGHT, AND VENTILATION, WHILE PROVIDING A STABLE FOUNDATION FOR MACHINERY AND A RIGID FRAMEWORK FOR ELECTRICAL TRANSMISSION AND MATERIALS HANDLING. IT IS THEREFORE NO SURPRISE THAT ARCHITECTS ARE DRAWN TO INDUSTRIAL BUILDINGS, AS MODERN ARCHITECTURE HAS BEEN DIRECTLY INFLUENCED BY THIS BUILDING TYPE AS WELL AS THE ACCUMULATED INFLUENCE OF THE MACHINE ENVIRONMENT.

I WANTED TO EXPERIENCE FIRST HAND WHAT DREW ME TO THIS TYPOLOGY, SO I DECIDED TO VISIT INDUSTRIAL SITES DURING MY TRAVELS. THE BUILDINGS I VISITED RANGED FROM FACTORIES AND COAL PROCESSING FACILITIES, TO POWER PLANTS AND GRAIN SILOS.

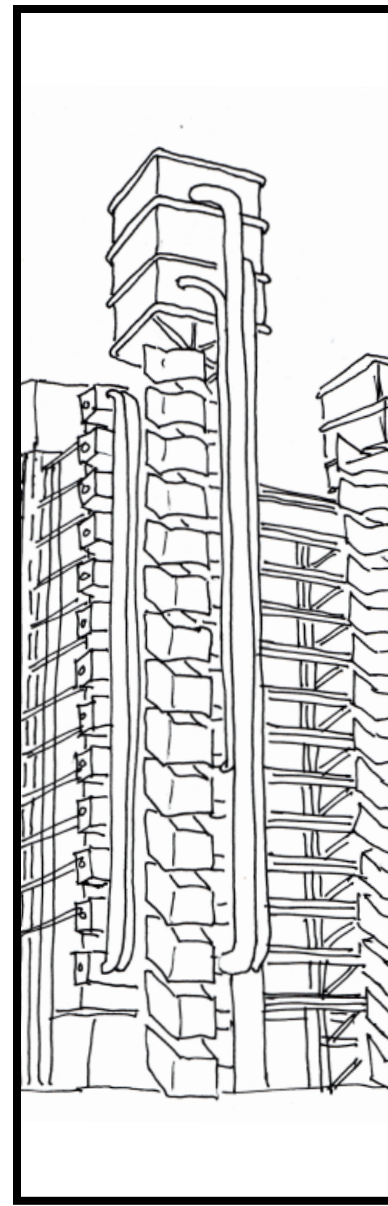
I REALIZED THAT THESE WERE VERY STRONG UTILITARIAN BUILDINGS, AND THE MATERIAL QUALITIES WERE SOMEHOW DIFFERENT THAN THE SURROUNDING BUILDINGS. THEY SEEMED TO HAVE THE ABILITY TO STAND THE TEST OF TIME.



ANTONIO SANTELIA
LA CITTÀ NUOVA
1914



TONY GARNIER
UNE CITE INDUSTRIELLE
(AN INDUSTRIAL CITY)
1918



LLOYDS OF LONDON
LONDON, ENGLAND
BY RICHARD ROGERS

- ASSEMBLY OF PARTS
- MACHINE AGE
- EXPOSED SYSTEMS



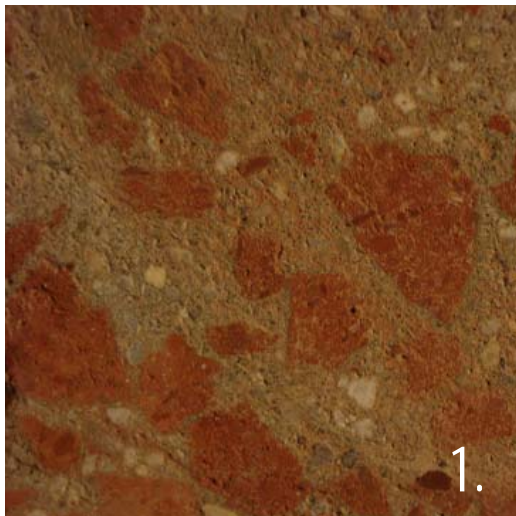
**BEINECKE RARE BOOK &
MANUSCRIPT LIBRARY
NEW HAVEN, CONNECTICUT**

- BUILDING WITHIN A BUILDING
- SEPARATE ENVIRONMENTS
- STONE PANELS AS LIGHT FILTER



**EASTERN STATE PENITENTIARY
PHILADELPHIA, PENNSYLVANIA**

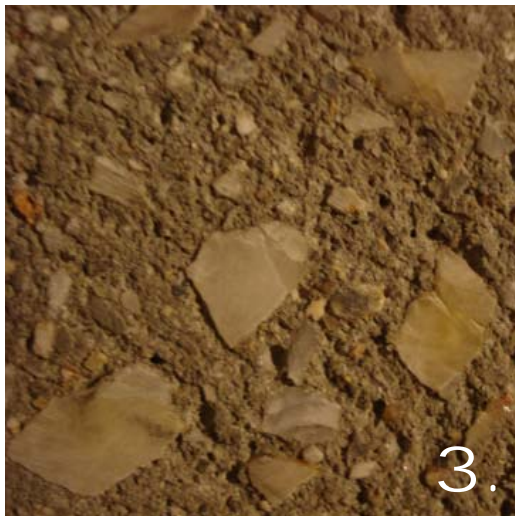
- ISOLATION CELLS
- IMPORTANCE OF INTERACTION
- VERY CONTROLLED ENVIRONMENT
- NEW MODEL FOR THE WORLD
- BUILDING SHOWS HOW IDEAS CHANGE WITH TIME



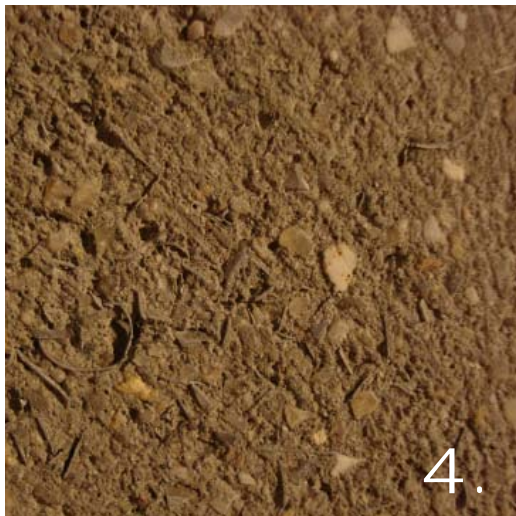
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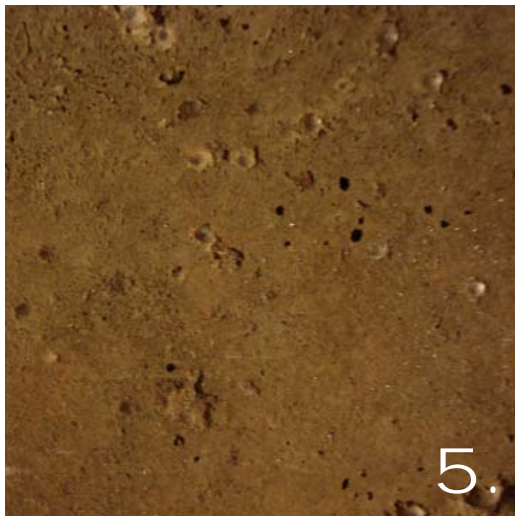
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4.

"WHEN I START, MY FIRST
IDEA FOR A BUILDING IS
WITH THE MATERIAL.
I BELIEVE ARCHITECTURE
IS ABOUT THAT. IT'S NOT
ABOUT PAPER, IT'S NOT
ABOUT FORMS.
IT'S ABOUT SPACE
AND MATERIAL."

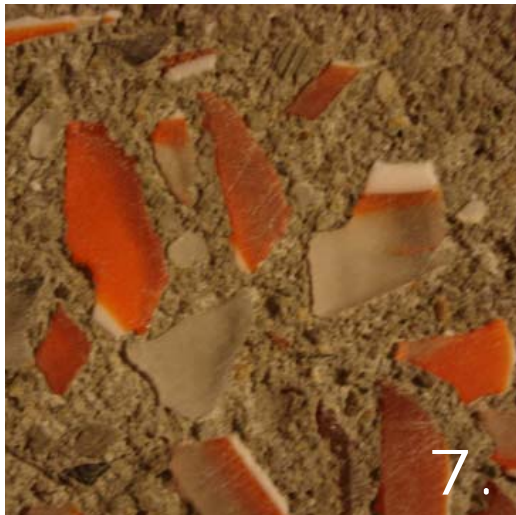
- PETER ZUMTHOR



5.



6.



7.



8.

REVEALING:

TO MAKE KNOWN; DISCLOSE; DIVULGE (1)

I DECIDED EARLY ON THAT I WANTED MY THESIS TO EXPLORE THE IDEA OF REVEALING, WITH A GOAL BEING SET TO CREATE AN ARCHITECTURE THAT WAS OBVIOUS AND CLEARLY UNDERSTOOD THROUGH ACTIVE OR PASSIVE COMMUNICATION, WHILE STILL LEAVING SOMETHING TO BE DESIRED OR IMAGINED.

THIS IDEA OF HOW ONE REVEALS INFORMATION ABOUT A SUBJECT MATTER WAS A CONSTANT THEME IN MY THOUGHT PROCESS. I DECIDED TO START EXPLORING THIS IDEA THROUGH MATERIAL STUDIES. USING UNIQUE MATERIALS I ACQUIRED DURING MY TRAVELS, THIS IDEA CAME ALIVE THROUGH CUTTING, BREAKING AND ILLUMINATION, AS WELL CREATING MATERIALS THAT REQUIRE TOOLS, SUCH AS MAGNETS OR BUSH-HAMMERS TO REVEAL INFORMATION. THROUGH THE USE OF THESE TECHNIQUES, I STARTED TO REVEAL A WORLD THAT WAS USUALLY HIDDEN FROM VIEW.

(1) "REVEAL." DICTIONARY.COM UNABRIDGED. RANDOM HOUSE, INC. 15 MAR. 2007. <DICTIONARY.COM HTTP://DICTIONARY.REFERENCE.COM/BROWSE/REVEAL>

- 1 BRICK
- 2 STEEL NAILS
- 3 QUARTZ
- 4 ALUMINUM
- 5 STEEL BALL BEARINGS
- 6 PLASTIC
- 7 GLASS
- 8 COPPER

CONCRETE WITH MIXED AGGREGATE:

THE CONCRETE STUDIES TO THE LEFT WERE INVESTIGATIONS INTO THE USE OF RECYCLED AND DISCARDED MATERIALS WITH A GOAL SET TO MAKE A BUILDING PRODUCT. THIS ALSO HELPED ME EXPLORE THE IDEA OF REVEALING MATERIALITY THROUGH CUTTING.

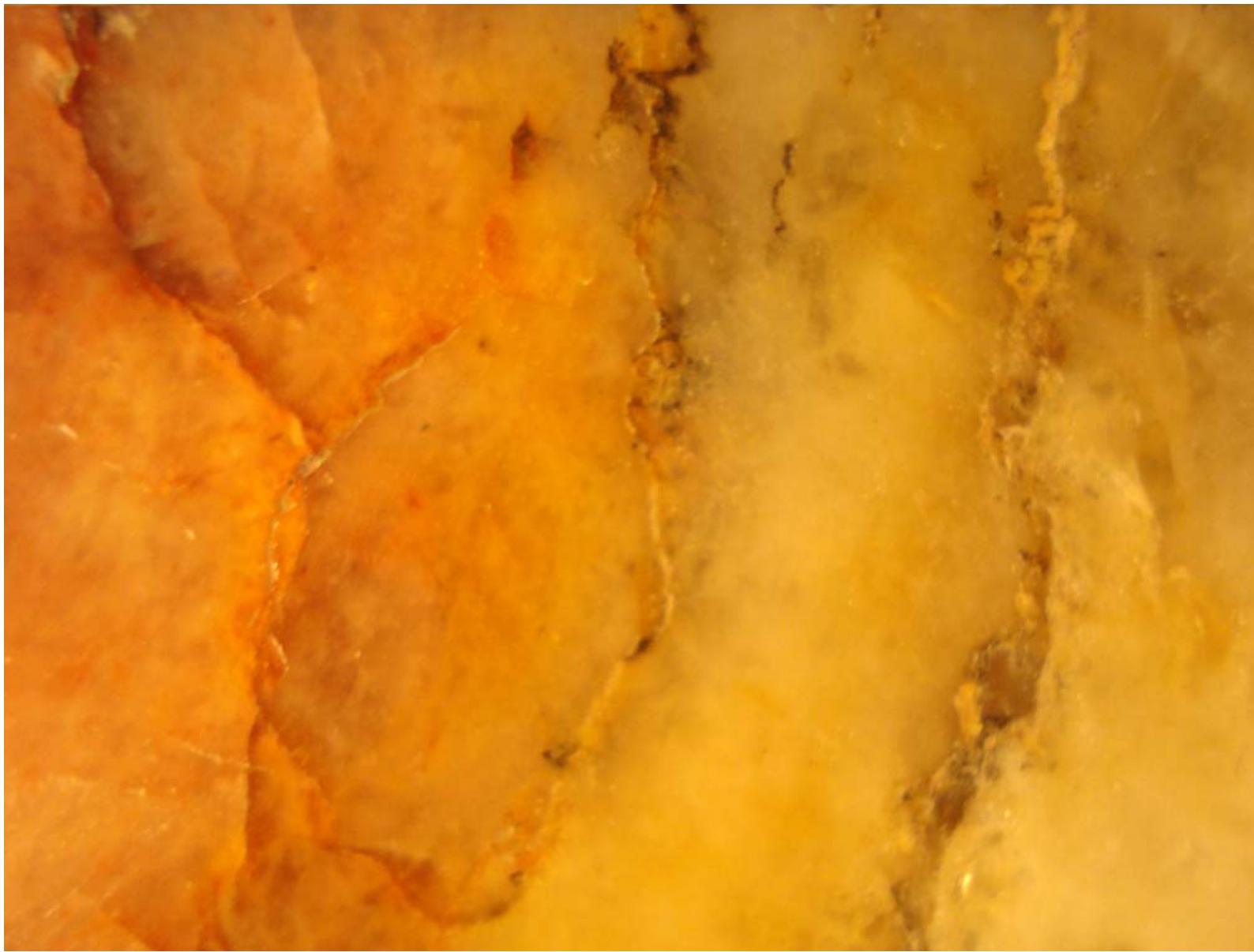


FRACTURED VEIN QUARTZ

SHOWN ABOVE IN ITS NATURAL STATE, AND BELOW IN ITS CUT AND POLISHED FORM.



THE QUARTZ WAS CUT TO A THICKNESS OF $\frac{3}{16}$ " WHICH ALLOWED LIGHT TO PASS THROUGH THE MATERIAL. THIS WAS ONE OF MY FIRST THOUGHTS ABOUT HOW TO FILTER LIGHT WITHIN MY BUILDING, AND HAD A DIRECT RELATIONSHIP TO MY STUDY OF THE BEINECKE RARE BOOK & MANUSCRIPT LIBRARY IN NEW HAVEN, CONNECTICUT

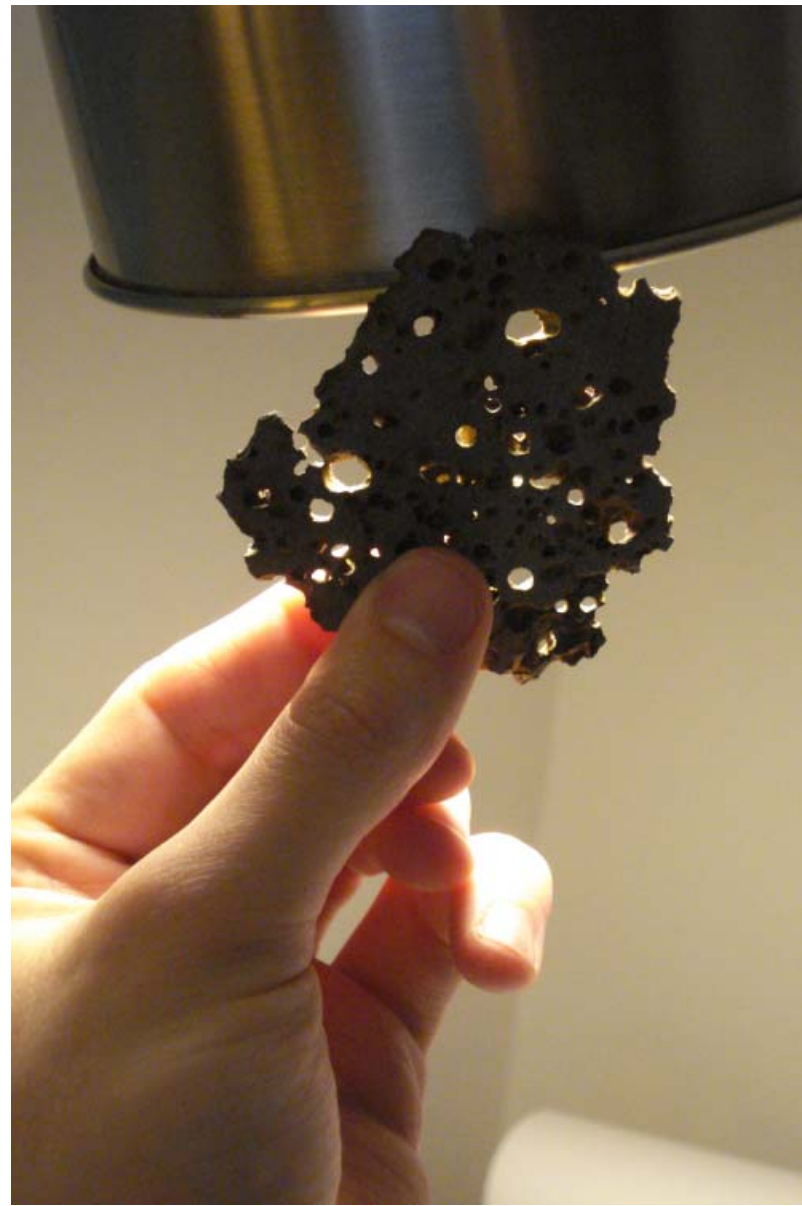


**FRACTURED VEIN QUARTZ
CUT AND POLISHED**

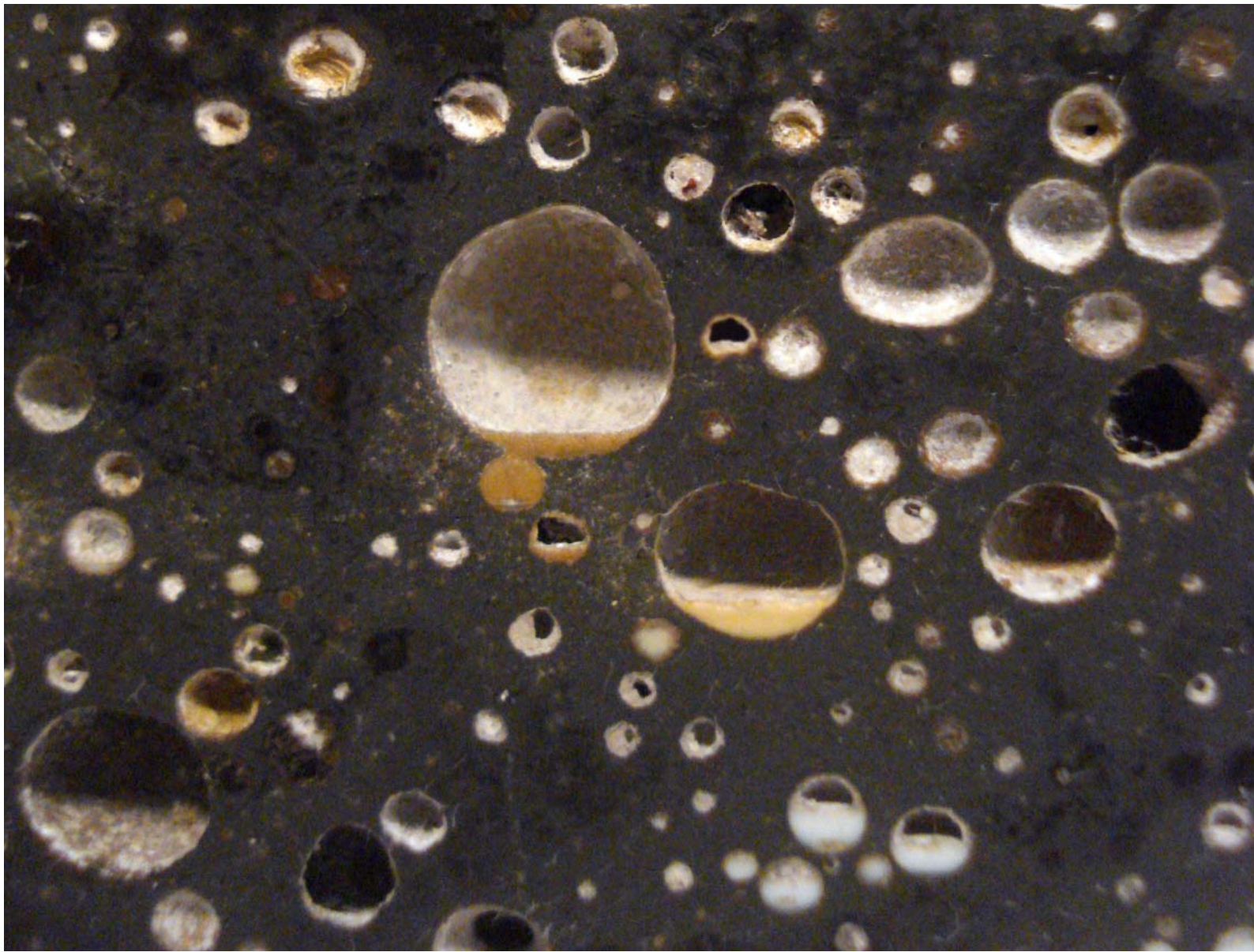
**CLOSE UP VIEW SHOWS THE FRACTURED
VEINS AS WELL AS MULTIPLE COLORS
AND VEINS COMPOSED OF METALLIC
ORE. THE PROCESS OF CUTTING AND
POLISHING THIS VERY HARD MATERIAL
HELP ME TO APPRECIATE THE AMOUNT
OF EFFORT IT TAKES TO CREATE A FINAL
PRODUCT FROM A RAW MATERIAL**



SCORIA - BASALT WITH
AMYGDALOIDAL OLIVINE
VESICLES, CUT AND
POLISHED



THE SCORIA - BASALT WAS CUT
TO A THICKNESS OF 3/16" TO
STUDY HOW LIGHT CAN PASS
THROUGH THIS MATERIALS, AND
TO TEST WHETHER THIS WOULD
BE A PRACTICAL BUILDING
MATERIAL



**SCORIA - COMPOSED OF BASALT WITH
AMYGDALOIDAL OLIVINE VESICLES**

**A CLOSE UP VIEW SHOWS A NUMBER
OF INDIVIDUAL AMYGDALOIDAL
VESICLES FILLED PART WAY WITH
OLIVINE DEPOSITS.**

**THERE IS SOMETHING VERY
ARCHITECTURAL ABOUT THIS STONE
IN THAT CUTTING THROUGH IT REVEALS
THE DIRECTION THAT THE MATERIAL
LAID WITHIN NATURE WHEN IT WAS
FORMED.**



BASALT

THIS IMAGE SHOWS A PIECE OF BASALT THAT WAS CUT INTO THREE SECTIONS TO EXPLORE THE DIFFERENT WAYS OF WORKING WITH BASALT. IN ORDER FROM RIGHT TO LEFT, IT SHOWS THE NATURAL WEATHERED IGNEOUS BASALT, THEN A CUT FACE OF BASALT, AND LASTLY WITH A CUT AND POLISHED SURFACE.



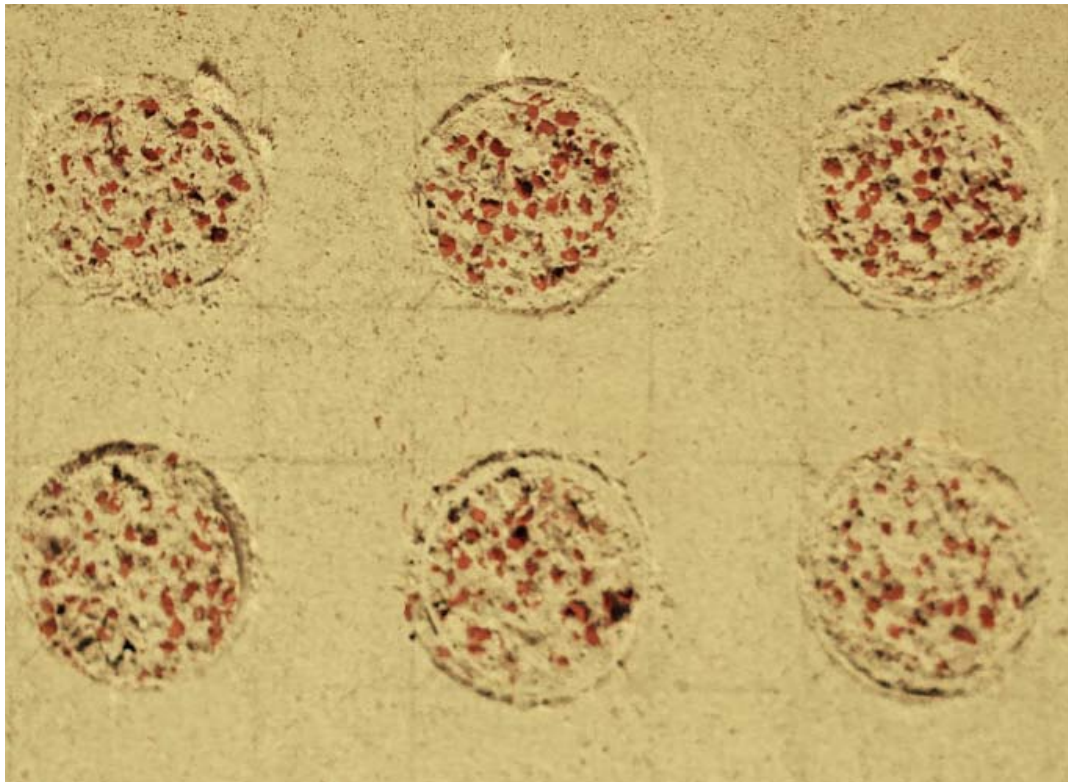
RED SCORIA - VESICULAR BASALT

THIS IMAGE SHOWS A PIECE OF RED SCORIA VESICULAR BASALT. ON THE RIGHT IS THE NATURALLY WEATHERED SURFACE, AND ON THE LEFT IS A PIECE WITH A CUT AND POLISHED SURFACE.

THIS WAS ABOUT THE TIME THAT
SUSAN PIEDMONT-PALLADINO
ASKED ME THE QUESTION:

HOW CAN YOU REVEAL
BEYOND CUTTING?

AND IT GOT ME THINKING...



TOP LEFT: VERTICAL FRACTURED RIB CONCRETE WITH RED ORE.

BOTTOM LEFT: CYLINDRICAL FRACTURED CONCRETE WITH RED ORE.

TO EXPLORE THE IDEA OF REVEAL
INFORMATION WITHOUT CUTTING, I
DECIDED TO STUDY THE **BREAKING** OR
FRACTURING OF A MATERIAL. I WAS ABLE
TO EXPOSE THE INTERIOR AGGREGATE
OF CONCRETE BY FRACTURING THE
SURFACE USING SPECIALLY DESIGNED
FORMWORK AND A BUSH-HAMMER.

FERROCRETE EXPERIMENTS

FROM THE BEGINNING OF MY THESIS, I HAD SET A GOAL TO EITHER CREATING A NEW BUILDING MATERIAL OR TO FIND A WAY TO USE A MATERIAL THAT IS NOT COMMONPLACE IN THE BUILDING INDUSTRY.

THIS SPECIFIC EXPLORATION CAME ABOUT THROUGH A QUESTION ASKED BY SUSAN PIEDMONT-PALLADINO, WHICH WAS:

HOW CAN YOU REVEAL BEYOND CUTTING?

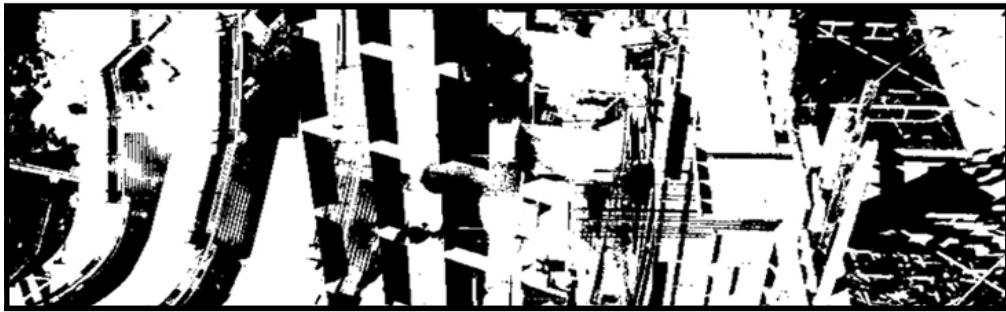
THIS MADE ME THINK ABOUT WAYS IN WHICH INFORMATION ABOUT AN OBJECT OR MATERIAL CAN BE HIDDEN, OR MADE NOT EASILY RECOGNIZABLE THROUGH GENERAL OBSERVATION.

THROUGH THE INFUSION OF IRON INTO CONCRETE* THE CONCRETE HAS TAKEN ON SOME OF THE PROPERTIES OF STEEL WHICH ALLOWS MAGNETICS TO BE ATTACHED, YET BECAUSE OF THE SPECIFIC FORMULA, WILL NOT ALLOW THE STEEL TO CORRODE.



ADDITIONAL STUDIES INTO THE ACT
OF REVEALING PRODUCED A NEW
BUILDING MATERIAL

FERROCRETE



LAYERING OF THE CITY: A COLLAGE OF WASHINGTON, DC

ON THE LEFT SHOWS AN EARLY COLLAGE WHICH IS COMPOSED USING MULTIPLE OVERLAYING TRANSPARENCIES. EACH TRANSPARENCY SHOWS THE SAME LOCATION WITHIN WASHINGTON DC, BUT FROM DIFFERENT POINTS OF VIEW AND ANGLES. I WAS TRYING TO SHOW HOW THINGS LOOK DIFFERENT BASED ON YOUR POINT OF REFERENCE, BUT ALSO THAT EVERY OBJECT AND PLACE IN THE UNIVERSE HAS AN INFINITE AMOUNT OF INFORMATION THAT CAN BE EXTRACTED FROM IT. WE PICK AND CHOOSE WHAT IS IMPORTANT TO US, FROM THESE LAYERS OF INFORMATION, AND MOVE ON ON. IF ONE WERE TO LOOK AT SOMETHING HARD ENOUGH, THE OBJECT CAN REVEAL ITS TRUE NATURE, OR BE LOST WITHIN THE LAYERS OF INFORMATION.

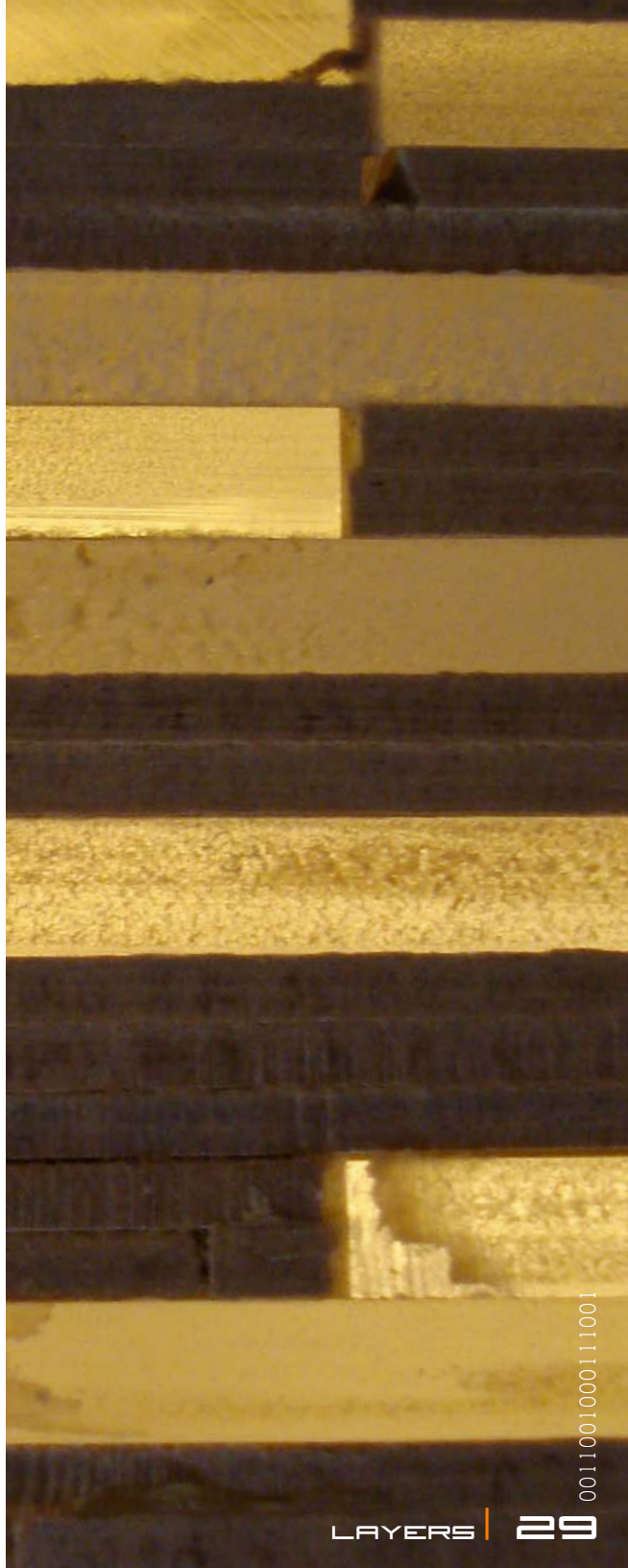
LAYERS

ANOTHER CONSTANT THEME THROUGH MY RESEARCH WAS THE IDEA OF LAYERS AND LAYERING. LAYERING COMPOSES EVERYTHING AROUND US, WHETHER IT IS IN THE FORM OF THE PHYSICAL REALM, TO THE MATHEMATICAL AND THEORETICAL.

IN THE PHYSICAL REALM, NO MATTER HOW LARGE OR SMALL AN OBJECT IS, IT IS COMPOSED OF LAYER UPON LAYER OF NATURES' BUILDING BLOCK, THE ATOM. TO LOOK AT SOMETHING THAT IS MORE IN SCALE WITH ARCHITECTURE, WE CAN LOOK AT OUR BUILDING SYSTEMS. THE WALLS AND FLOORS OF OUR BUILDINGS ARE CREATED BY ADDING LAYERS OF MATERIAL, UNTIL THERE IS A FINISHED PRODUCT. WE EVEN CREATE DOUBLE PANE GLASS FOR OUR CURTAIN WALL SYSTEMS, WHERE AIR (OR LACK OF AIR) ACTS AS AN ADDITIONAL LAYER. WE CAN EVEN GO AS FAR AS TO LOOK AT THE MACRO SIZED PARTICLES WITHIN THE PAINT ON OUR WALLS, OR THE NANO SIZED LAYERS WITHIN A MICROCHIPS, WE USE TO DESIGN OUR BUILDINGS.

IF SOMETHING IS LOOKED AT IN THE RIGHT WAY, THERE CAN BE AN INFINITE AMOUNT OF INFORMATION. THIS CAN BE MANIFESTED IN THE FORM MATHEMATICS, ATOMIC MAKE UP, VISUAL SPECTRUM, ULTRAVIOLET SPECTRUM, WEIGHT, COMPOSITION OR CONTEXT. WE PICK AND CHOOSE THE INFORMATION WE NEED FROM OUR SURROUNDINGS, FOR TOO MUCH INFORMATION WOULD OVERLOAD OUR SYSTEMS.

THROUGHOUT THE THESIS, LAYERS HAVE BECOME AN IMPORTANT PART OF MY DESIGN, AND MY THINKING.



1001110001001100



LEFT IMAGE:
"MICROMEAS SKILLFULLY
PICKS UP THE SHIP WHICH WAS
CARRYING THESE GENTLEMEN",
ENGRAVED BY:
GERARD VIDAL (1742-1801)
ARTIST:
MONNET, CHARLES (1732-1808).
BIBLIOTHEQUE NATIONALE,
PARIS, FRANCE

RIGHT IMAGE:
EARLY DENSITY / SCALE
STUDIES OF WASHINGTON DC.
THESE DRAWINGS SHOW THE
DENSITY OF BUILDINGS WITHIN
DIFFERENT PARTS OF THE CITY.
THE SCALE IS BASED UPON
WHERE ONE LOOKS IN THE
CITY AND THE POSITION FROM
WHERE THEY LOOK.

SCALE

HOW DOES YOUR POSITION, IN RELATION TO WHAT YOU ARE LOOKING AT, INFLUENCE YOUR PERCEPTIONS? THE EASY ANSWER TO THIS QUESTION IS SCALE, BUT WHAT REALLY IS SCALE AND WHAT DOES IT TELL US ABOUT THE ENVIRONMENTS AROUND US?

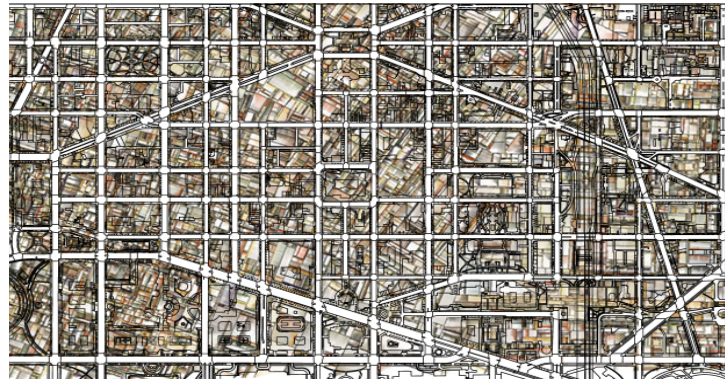
SCALE IS A WORD THAT IS USED IN MANY CONTEXTS AND COVERS A WIDE RANGE OF TOPICS, BUT ITS ORIGINS RELATE TO MEASUREMENT AND INDICATE A CHANGE FROM ONE PHYSICAL SIZE TO ANOTHER. AS A WHOLE, WE TEND TO TAKE SCALE FOR GRANTED IN EVERYDAY LIFE, PROCESSING SCALE AND SHIFTS IN SCALE AUTOMATICALLY, USUALLY WITHOUT CONSCIOUS THOUGHT. EVERYTHING WE OBSERVE IN THE NATURAL ENVIRONMENT, FROM THE EXTREME OF AN EXTRASOLAR PLANET TO THE MINUTE SCALE OF AN ATOMIC NUCLEUS, IS PUT INTO PERSPECTIVE BASED ON WHAT WE KNOW BEST, THE HUMAN SCALE.

MANY OF US CAN NOT FULLY GRASP THE EXTREME DIFFERENCES OF SCALE BETWEEN OUR WORLD AND THE ATOMIC WORLD, SO WHEN WE ACTIVELY DECIDE TO ALTER OUR POSITION SO THAT WE MAY OBSERVE THIS ALTERNATIVE SCALE, OUR VISION OF REALITY MAY NEED TO SHIFT TO BE ABLE TO ACCEPT WHAT WE OBSERVE.

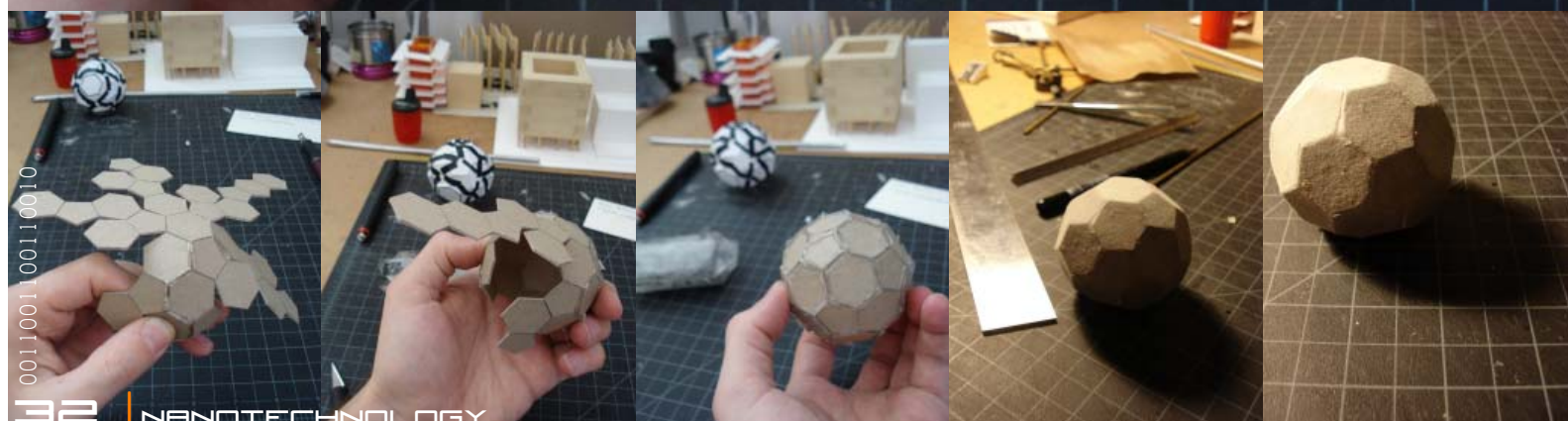
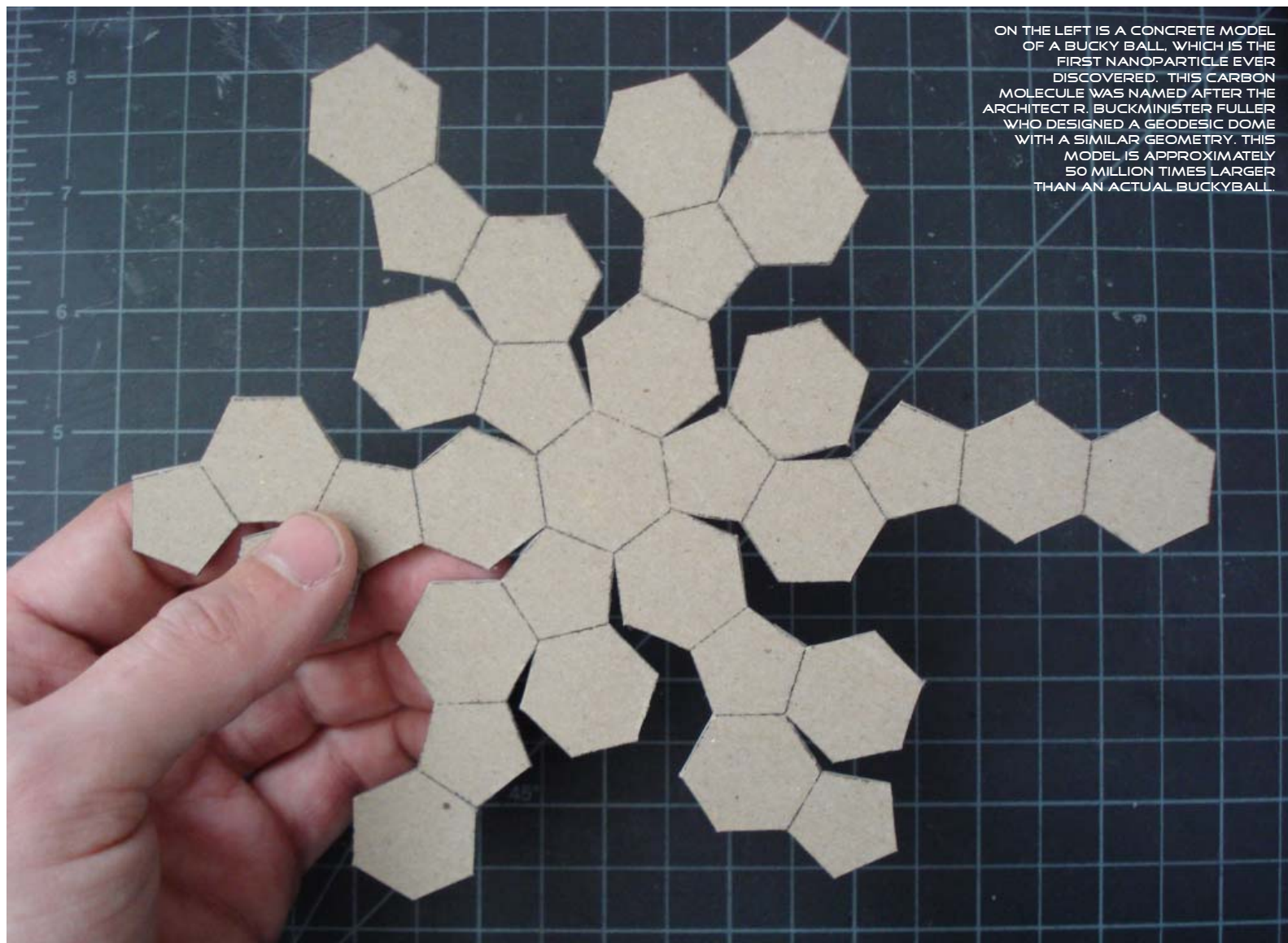
WHEN IT COMES TO ARCHITECTURE, THE MAIN FUNCTION OF SCALE IS TO COMMUNICATE FACTS AND IDEAS ABOUT A BUILDING THAT ARE NOT REVEALED BY OTHER ASPECTS OF ITS PHYSICAL FORM. IN TURN, SCALE ACTS AS THE DEFINING FEATURE IN ARCHITECTURE THAT TELLS US HOW WE SHOULD RELATE TO A BUILDING. RELATION CAN BE BASED ON THE MATERIALS, THE NATURAL WORLD, OR THE HUMAN BODY. ONE OTHER GREAT ASPECT OF SCALE IS ITS ABILITY TO CONVEY COMPLEMENTARY SETS OF INFORMATION ABOUT AN OBJECT AT DIFFERENT DISTANCES. FOR EXAMPLE, AS A PERSON APPROACHES A BUILDING FROM A GREAT DISTANCE, THE INCREASING RESOLUTION REVEALS DIFFERENT INFORMATION IN STAGES. IN TURN, THE PERCEIVED SCALE OF A BUILDING HAS A DIRECT CORRELATION TO THE OBSERVERS DISTANCE FROM THE BUILDING.

SINCE I AM DESIGNING A NANOTECHNOLOGY RESEARCH LABORATORY, WHICH DEALS WITH THE MANIPULATION OF MATERIALS AT THE ATOMIC SCALE, IT SEEMS QUITE APPROPRIATE TO EXPLORE HOW SCALE CAN WORK TO ENHANCE A USERS EXPERIENCE WITHIN THE REALM OF ARCHITECTURE. ULTIMATELY, A PERSONS POSITION WITHIN THE BUILDING WILL HAVE TO PLAY A LARGE ROLE IN THIS, AS WELL AS WORKING WITH THE MONUMENTALITY AND DIMINUTIVENESS OF KEY SPACES.

THROUGHOUT MY THESIS, SCALE HAS BEEN THE MOST IMPORTANT AND INFLUENTIAL TOPIC I HAVE LOOKED AT, AND THIS HAS HAD A PROFOUND EFFECT ON MY THINKING ABOUT ARCHITECTURE AND MY PROJECT.



ON THE LEFT IS A CONCRETE MODEL OF A BUCKY BALL, WHICH IS THE FIRST NANOPARTICLE EVER DISCOVERED. THIS CARBON MOLECULE WAS NAMED AFTER THE ARCHITECT R. BUCKMINISTER FULLER WHO DESIGNED A GEODESIC DOME WITH A SIMILAR GEOMETRY. THIS MODEL IS APPROXIMATELY 50 MILLION TIMES LARGER THAN AN ACTUAL BUCKYBALL.



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NANOTECHNOLOGY

THE PROPOSED BUILDING FOR MY THESIS IS A NANOTECHNOLOGY RESEARCH LABORATORY, BUT WHAT GOES ON IN A BUILDING LIKE THIS? WHAT EXACTLY IS NANOTECHNOLOGY?

BY DEFINITION, NANOTECHNOLOGY IS THE WILLFUL MANIPULATION OF ATOMS AND MOLECULES. THIS TECHNOLOGY CAN CHANGE MATERIALS AT THE ATOMIC AND MOLECULAR LEVEL TO BUILD THINGS NOT BEFORE POSSIBLE. IN FACT, THIS TECHNOLOGY HAS THE POTENTIAL TO BE ABLE TO MAKE ANYTHING THAT CAN BE IMAGINED. THE FIRST PERSON TO ENVISION THE CONCEPT OF NANOTECHNOLOGY WAS THE NOBEL-LAUREATE PHYSICIST RICHARD FEYNMAN DURING HIS 1959 SPEECH TITLED "THERE'S PLENTY OF ROOM AT THE BOTTOM", BUT IT WAS NOT UNTIL 1986 THAT THE TERM NANOTECHNOLOGY WAS CREATED BY ERIC DREXLER, IN HIS 1986 BOOK, ENGINES OF CREATION. THE GREAT THING ABOUT THIS TECHNOLOGY IS THAT IT CAN BE DEVELOPED FOR USE IN DESIGN, FOR ELECTRONIC APPLICATIONS, MEDICINE, MANUFACTURING, AND TO EVEN CREATE ENERGY. NOT JUST THAT, BUT NANOTECHNOLOGY WILL PLAY A CRUCIAL ROLE IN THE DEVELOPMENT OF HIGH SPEED COMPUTERS AND ARTIFICIAL INTELLIGENCE. ACCORDING TO MONICA LUNDQUIST, "IT WILL MAKE POSSIBLE COMPUTERS A MILLION TIMES MORE POWERFUL THAN TODAY AND MUCH SMALLER." REALLY, THIS TECHNOLOGY HAS THE POTENTIAL TO SPAWN A NEW INDUSTRIAL REVOLUTION, AND CHANGE THE WORLD AS WE KNOW IT.

ONE THING THAT DREW ME TO THIS TOPIC WAS THE DISCOVERY OF A FEW BUILDING MATERIALS THAT USE NANOTECHNOLOGY TO ENHANCE THEIR EXISTING QUALITIES, SUCH AS ADHESIVES WITH ENHANCED TENSILE STRENGTHS, UV COATINGS ON A MAGNITUDE OF SURFACES, COATINGS THAT PROVIDE ANTIMICROBIAL PROTECTION, AND SELF CLEANING SUPER STRONG GLASS. IT MADE ME START TO WONDER HOW BIG OF A ROLE THIS NEW TECHNOLOGY WILL PLAY ON THE CONSTRUCTION SITE. I THINK THIS HAS THE ABILITY TO TAKE THE INDUSTRY BY STORM, AND TO EVENTUALLY SATURATE THE MARKET. BEFORE WE KNOW IT, IT COULD BE HARD TO FIND A BUILDING PRODUCT WITHOUT NANOTECHNOLOGY SOMEHOW INCORPORATED INTO ITS DESIGN, WHETHER WE KNOW IT OR NOT. ONE DOWNSIDE TO THE CURRENT TRENDS OF THIS BEING AN EMERGING PRODUCT IS THE HIGH COST. BECAUSE OF THIS, MANUFACTURERS HAVE ONLY BEEN ABLE TO USE SMALL AMOUNTS OF NANOMATERIAL IN THEIR PRODUCTS, USUALLY ON THE OUTSIDE LAYER OF THE OBJECT. IF ONE CAN GET PAST THE CURRENT COSTS, ONE CAN SEE THAT THE BEST PART ABOUT USING THESE NANOLAYERS IS THAT THEY CAN IMPROVE AN OBJECT, WITHOUT CHANGING ITS DIMENSIONS IN ANY NOTICEABLE WAY, SINCE IT IS ONLY CHANGING THE SURFACE ON AN ATOMIC SCALE. THIS TECHNOLOGY HAS HELPED CREATE SURFACES THAT RESIST SCRATCHING, WEAR, CHEMICALS, AND DIRT. IMAGINE A TOILET SEAT OR COUNTERTOP THAT ALWAYS HAS AN ANTIBACTERIAL QUALITY, OR A PAINT THAT FIXES SCRATCHES AS THEY ARE MADE. IT COULD EVEN GO AS FAR AS TO MAKE STRONGER WALL PANELS, MICROSCOPIC FIREPROOF BARRIER IN BUILDING MATERIALS, NEW TYPES OF CONCRETE THAT DOES NOT NEED ANY INTERNAL METAL REINFORCEMENT, OR EVEN GLASS WHICH IS MORE TRANSPARENT, TO LET SOLAR PANELS RECEIVE AND MAKE USE OF MORE SUNLIGHT.

THE MORE I LEARNED ABOUT THIS TOPIC, THE MORE DREAMS I HAVE ABOUT THE FUTURE AND ALL THE POSSIBILITIES OF WHAT COULD BE. EVEN THOUGH THIS IS A TECHNOLOGY THAT IS STILL VERY MUCH IN ITS INFANCY, IT HAS POTENTIAL TO DRAMATICALLY ALTER OUR IDEA OF REALITY.

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WT | NANOTECHNOLOGY

WHAT IS THE SCALE OF NANOTECHNOLOGY?

WHEN MEASURING AN OBJECT AT THE ATOMIC SCALE, THE LENGTH IS MOST OFTEN MEASURED USING THE **NANOMETER**, OR **NM**. THE NANOMETER IS A UNIT OF LENGTH IN THE METRIC SYSTEM, EQUAL TO ONE BILLIONTH OF A METER. THIS MEASUREMENT SYSTEM IS SO MUCH SMALLER THAN WHAT WE ARE USED TO SEEING ON A DAILY BASIS, THAT IT IS DIFFICULT TO WRAP OUR MINDS AROUND HOW TINY THIS REALLY IS. IT IS ALSO VERY HARD TO GRASP THE CONCEPT THAT WE AS HUMANS ARE ABLE TO MANIPULATE MATERIALS AT SUCH A SMALL SCALE.

IT IS COMMONLY KNOWN THAT NANOPARTICLES ARE THINGS THAT CAN NOT BE SEEN BY THE HUMAN EYE. BECAUSE OF THE TINY NATURE OF THE ATOM, WE MUST USE TOOLS SUCH AS THE ELECTRON MICROSCOPE TO REVEAL INFORMATION THROUGH FRAMED AND CONTROLLED VIEW. THE FRAMED VIEWS ARE REALLY ONLY GLIMPSES INTO A MUCH LARGER WORLD. IT IS SORT OF LIKE TRYING TO UNDERSTAND THE EARTH BY LOOKING AT ONE PLANT, ANIMAL, BUILDING, OR MOUNTAIN. EVEN THOUGH THIS IS MAY SEEM SOMEWHAT INEFFECTIVE, SCIENTISTS ARE ABLE TO GAIN A GREAT UNDERSTANDING OF THE ATOMIC WORLD THROUGH THESE GLIMPSES.

IN THINKING ABOUT THE SCALE OF NANOTECHNOLOGY, I CAN'T HELP BUT BE BROUGHT BACK TO ARCHITECTURE AND THOUGHT OF MATERIALS. IN SOME OF MY READINGS, THERE HAS BEEN TALK OF THE FUTURE AND THE IDEA OF NANOBOTS CREATING BUILDING THROUGH SELF REPLICATION OF NANOMATERIALS. IF THIS WERE EVER THE CASE, WHAT WOULD HAPPEN TO OUR BUILDING MATERIALS WHICH WOULD THEN BE TOO SMALL TO BE SEEN WITH THE NAKED EYE? WOULD THE RELATIONSHIP BETWEEN MATERIALS CHANGES? THE IDEA OF "TRUTH IN MATERIALS" WILL NO LONGER BE CORRECT. AS FRANK LLOYD ONCE SAID "EACH MATERIAL SPEAKS A LANGUAGE OF ITS OWN", BUT I MUST ASK THE QUESTION, **WHAT IS THE LANGUAGE OF NANOTECHNOLOGY?**

THIS MAY NOT BE SOMETHING THAT CAN BE ANSWERED AT THE PRESENT, BUT IN USING MY THESIS AS A TOOL TO STUDY THIS SUBJECT MATTER, I HAVE GIVEN MY BEST SHOT AT TRYING TO CREATE AN ARCHITECTURE THAT CAN ALLOW MAN AND MACHINE TO WORK TOGETHER, WHILE MESHING THE IDEAS OF ARCHITECTURE AND NANOTECHNOLOGY.

1

THE WIDTH OF A BUCKY BALL IN NANOMETERS

2

THE WIDTH OF DNA IN NANOMETERS

6

THE NUMBER OF BONDED CARBON ATOMS IN A SINGLE NANOMETER

22-100

THE WIDTH OF A SINGLE TRANSISTOR IN A MICROPROCESSOR -IN NANOMETERS-

75-100

THE WIDTH OF A TYPICAL VIRUS IN NANOMETERS

1,000-10,000

THE WIDTH OF TYPICAL BACTERIA IN NANOMETERS

10,000

THE WIDTH OF A WHITE BLOOD CELL IN NANOMETERS

0011001100110110

20,000

THE APPROXIMATE NUMBER OF RESEARCHERS CURRENTLY WORKING IN NANOTECHNOLOGY

100,000

THE WIDTH OF A HUMAN HAIR OR A PIECE OF PAPER IN NANOMETERS

25,400,000

THE NUMBER OF NANOMETERS IN ONE INCH

100,000,000

THE NUMBER OF TRANSISTORS IN A TYPICAL MICROPROCESSOR

1,000,000,000

THE NUMBER OF NANOMETERS IN ONE METER

1,727,200,000

THE HEIGHT OF MYSELF (GREGORY PORTER) IN NANOMETERS

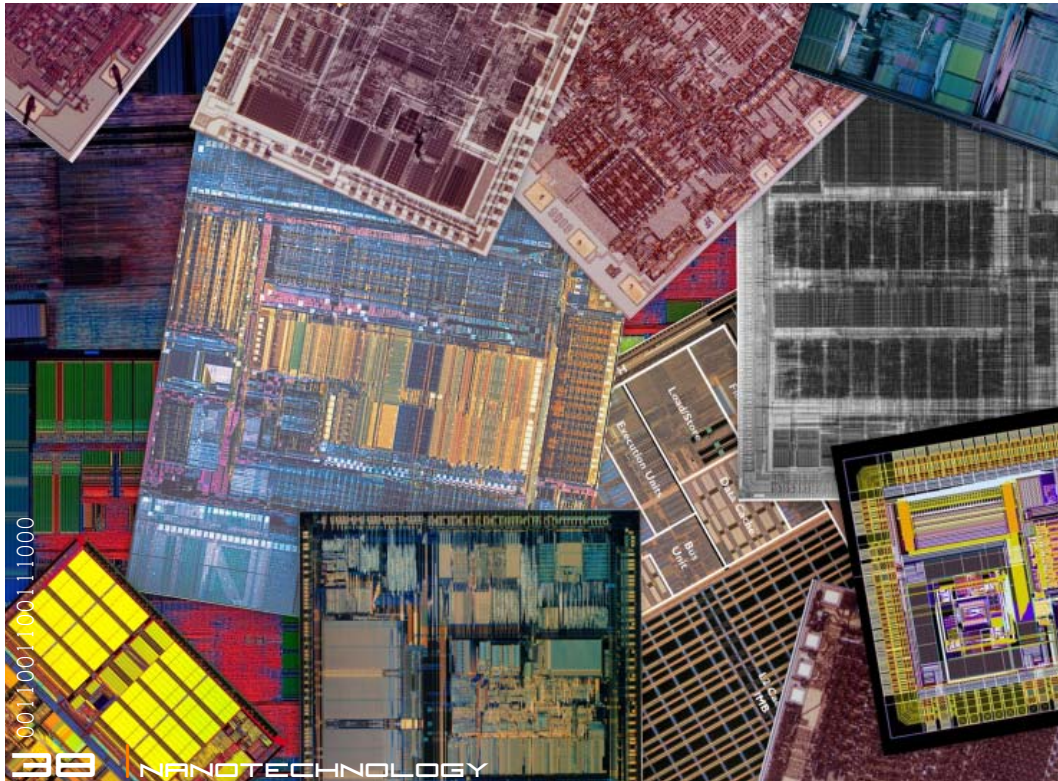
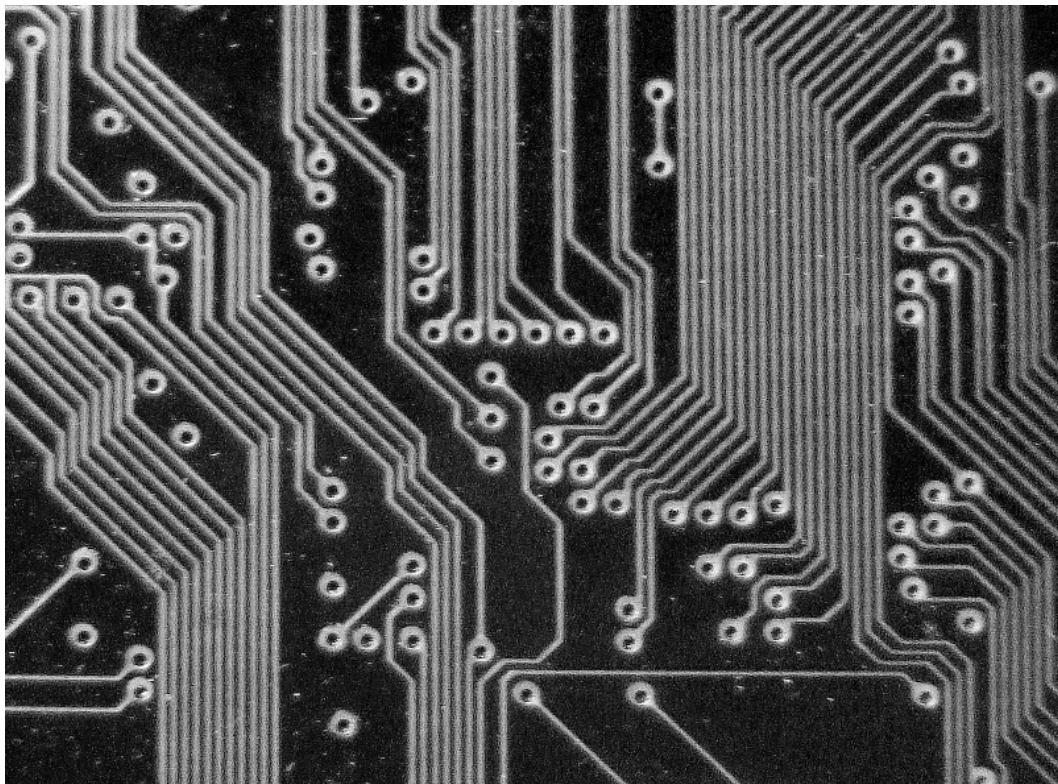
443,090,000,000

THE HEIGHT OF THE EMPIRE STATE BUILDING IN NANOMETERS

MICROPROCESSOR

A MICROPROCESSOR IS A MINIATURIZED INTEGRATED CIRCUIT THAT IS CAPABLE OF ARITHMETIC, LOGIC AND CONTROL OPERATIONS, FOR OUR MANY COMPUTING NEEDS. THEY ARE CURRENTLY USED IN EVERYTHING FROM OUR COMPUTERS, TO OUR CARS, AND CELL PHONES. THESE ARE VERY COMPLEX AND HIGHLY SENSITIVE PIECES OF ELECTRONICS, AND ARE THE RESULT OF COUNTLESS HOURS OF RESEARCH AT NANOTECHNOLOGY LABORATORIES THROUGHOUT THE US.

MICROPROCESSORS ARE MADE FROM SILICON WAFERS THAT HAVE MANY ATOMIC SIZED TRANSISTORS PRINTED ONTO ITS SUBSTRATE. THIS CAN BE THOUGHT OF AS A MINIATURIZED VERSION OF A CIRCUIT BOARD.



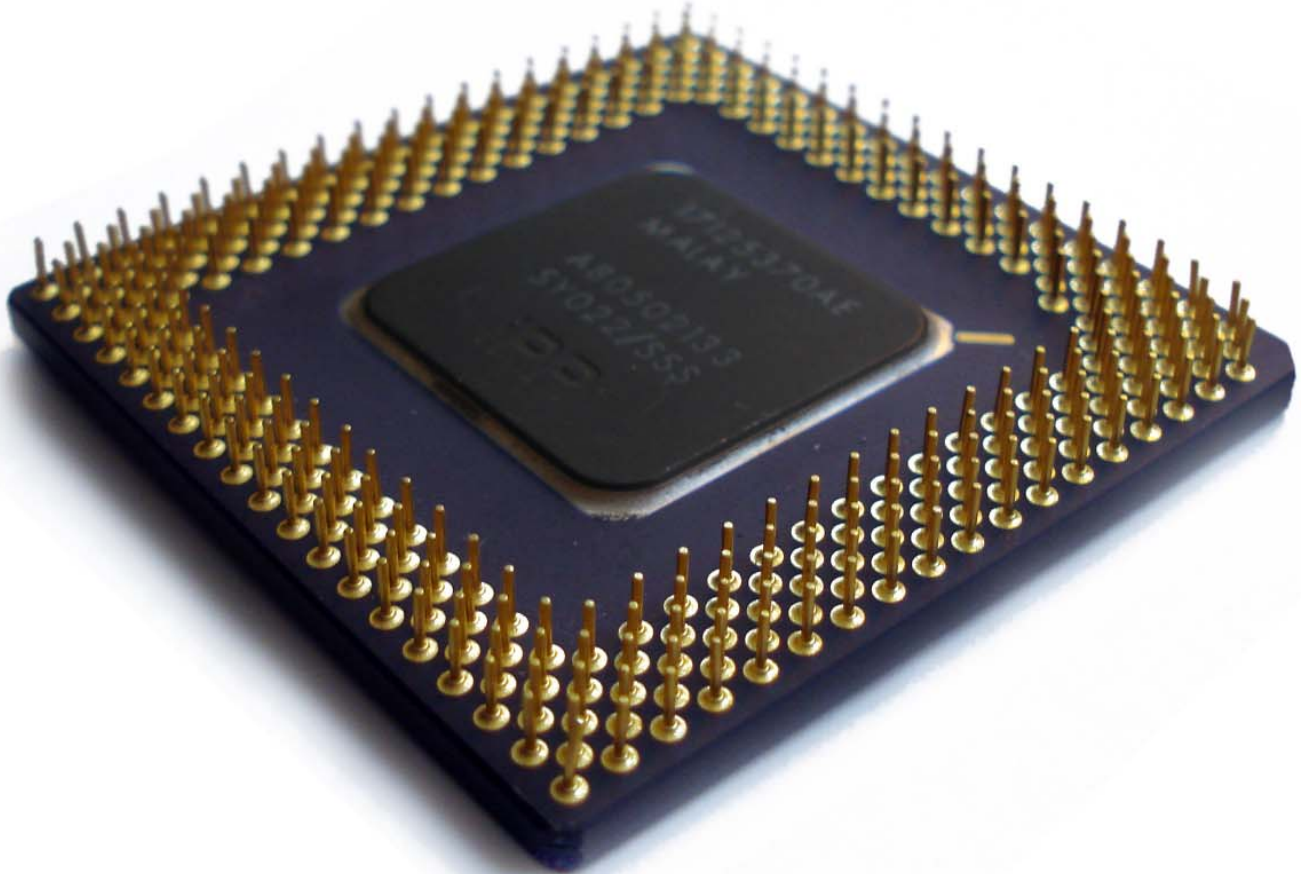
TOP LEFT:
CIRCUIT BOARD FROM AN
OUTDATED FAX MACHINE,
SCANNED AT 300 DPI.

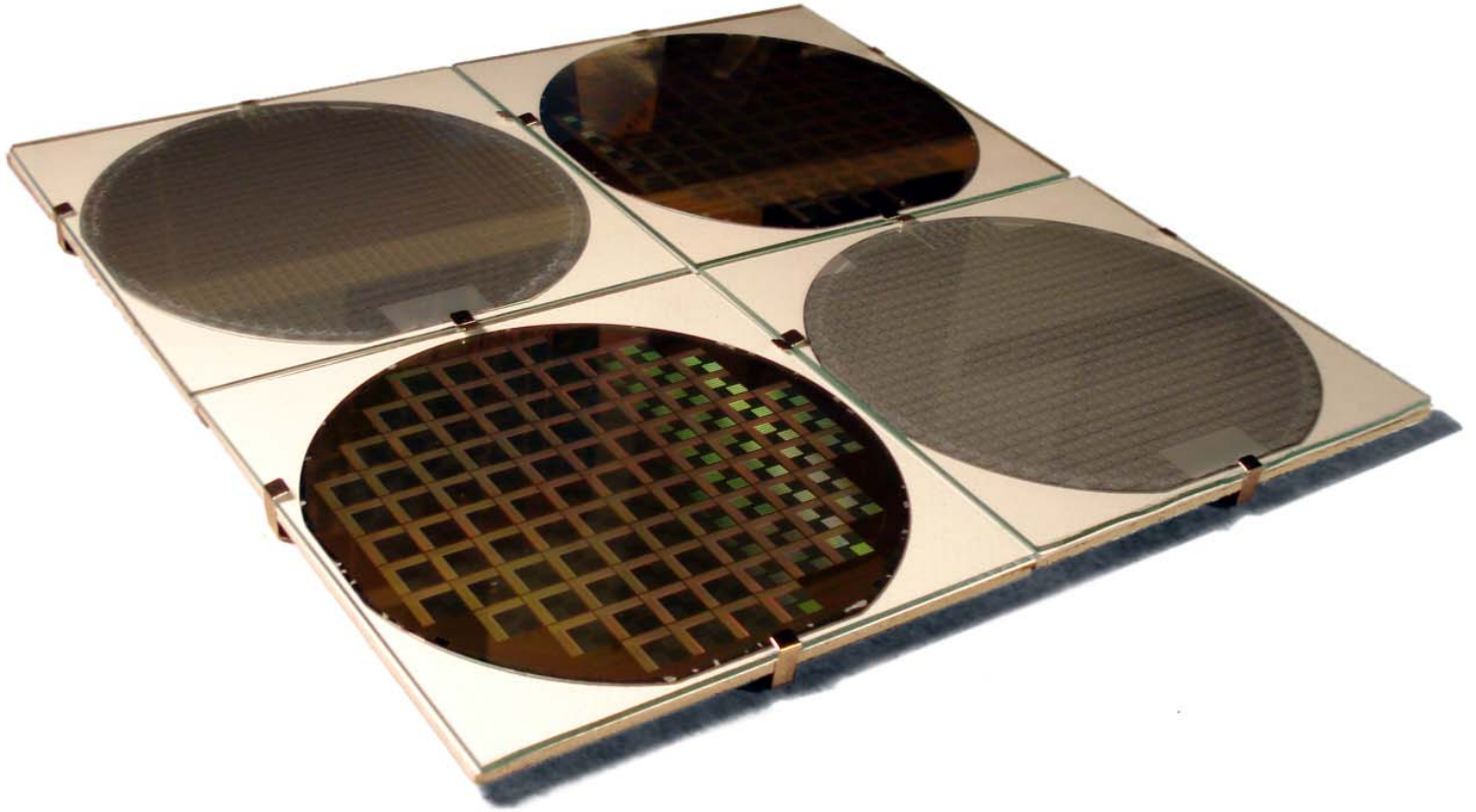
BOTTOM LEFT:
COLLEGE OF MULTIPLE IC
MICROPROCESSOR
SCHEMATICS, MADE EARLY
ON IN THE THESIS PROCESS.

BOTTOM RIGHT:
INTEL PENTIUM I
MICROPROCESSOR, CUT IN
HALF AND POLISHED TO
SHOW THE INTERIOR COPPER
LAYERS OF THE
MICROPROCESSOR.
SCANNED AT 2400 DPI

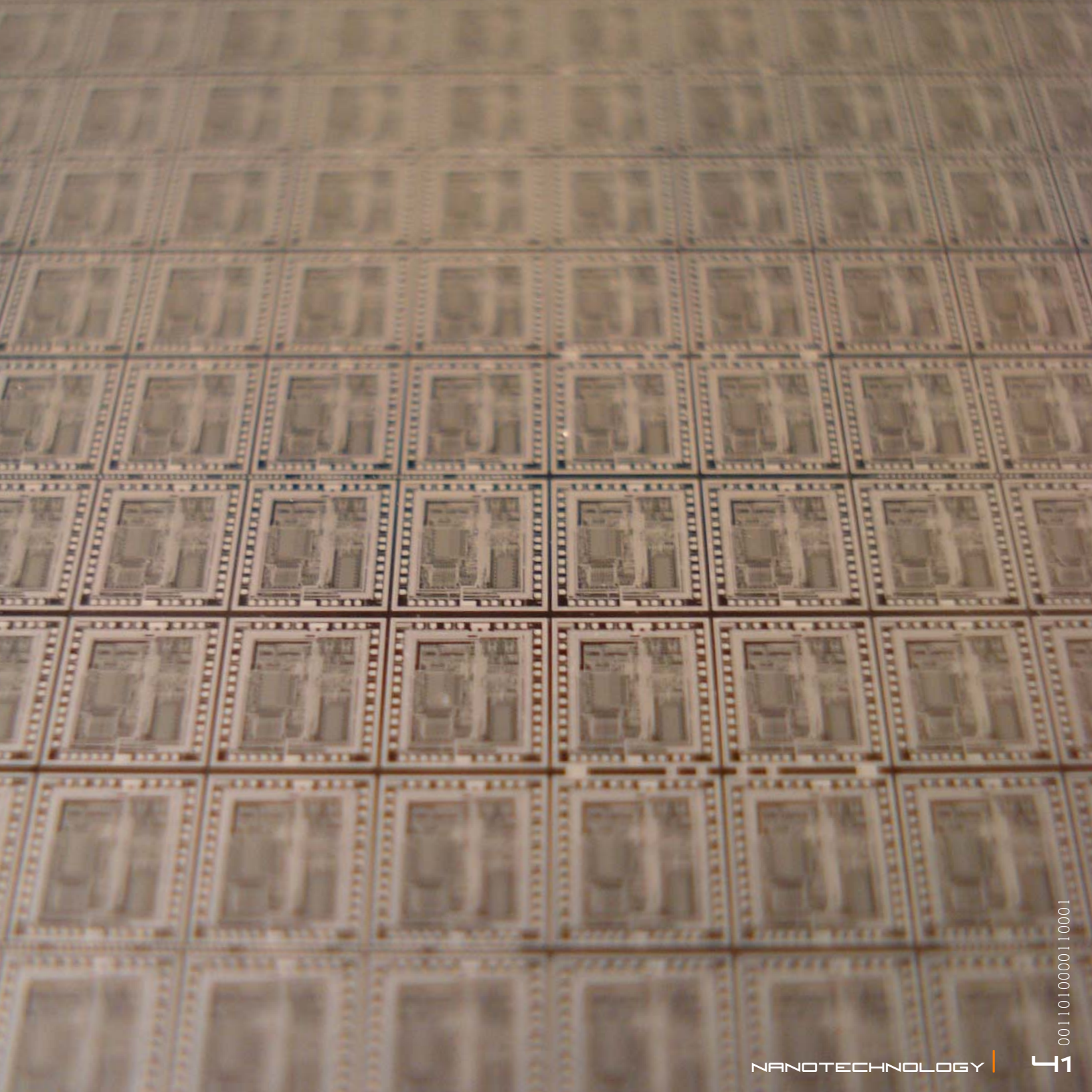


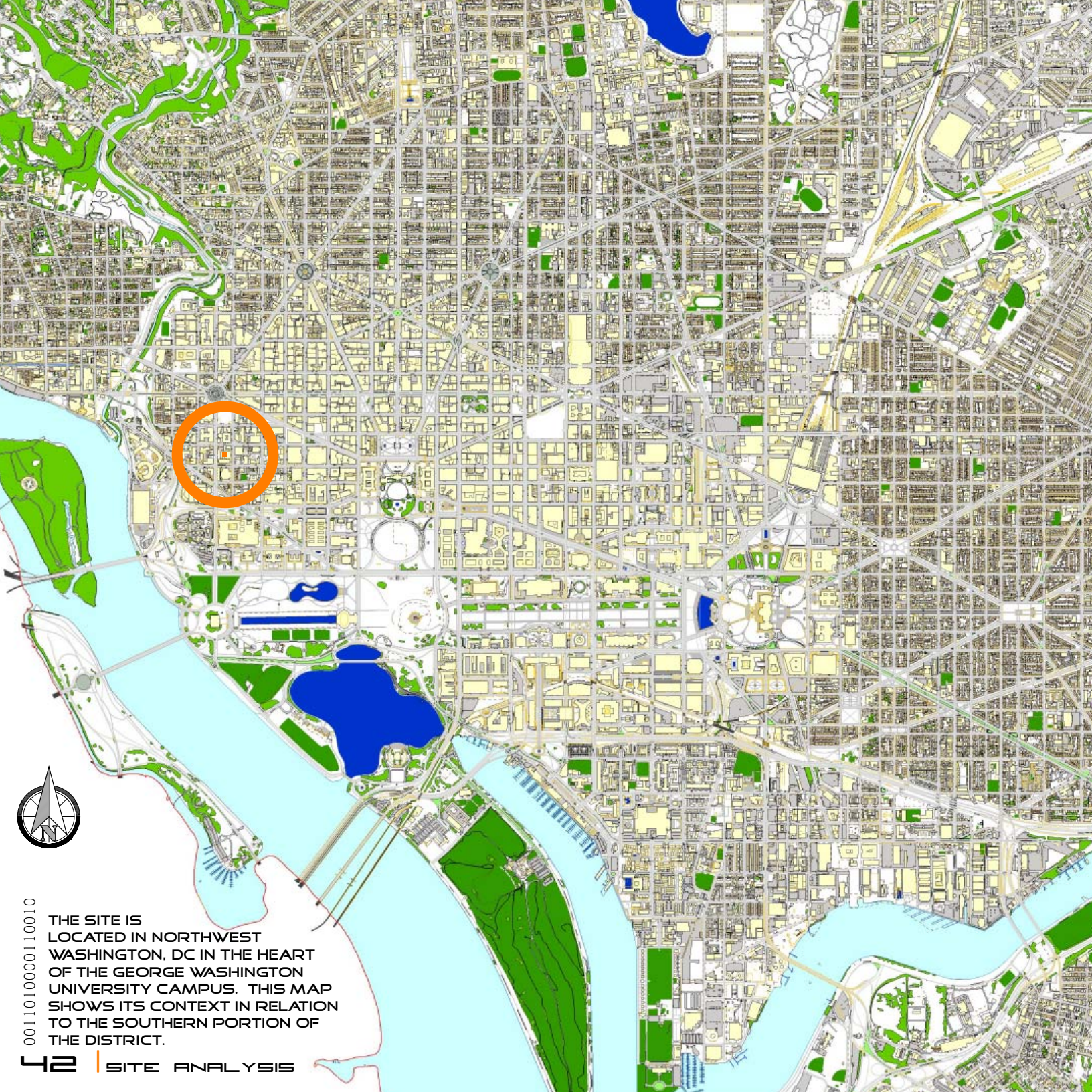
INTEL PENTIUM I
MICROPROCESSOR,
CIRCA 1994





4" DIAMETER SILICON
WAFERS WITH INTEGRATED
CIRCUITS PRINTED FROM AN
IC DIE. THE INTEGRATED
CIRCUITS ON THESE SILICON
WAFERS ARE EXAMPLES OF
THE NANO SCALED CIRCUITS
THAT CAN BE RESEARCHED
AND CREATED USING A
NANOTECHNOLOGY
RESEARCH LABORATORY





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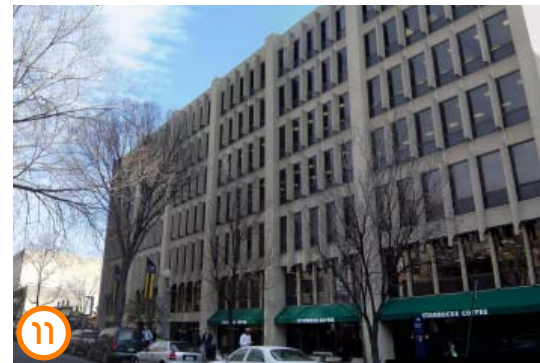
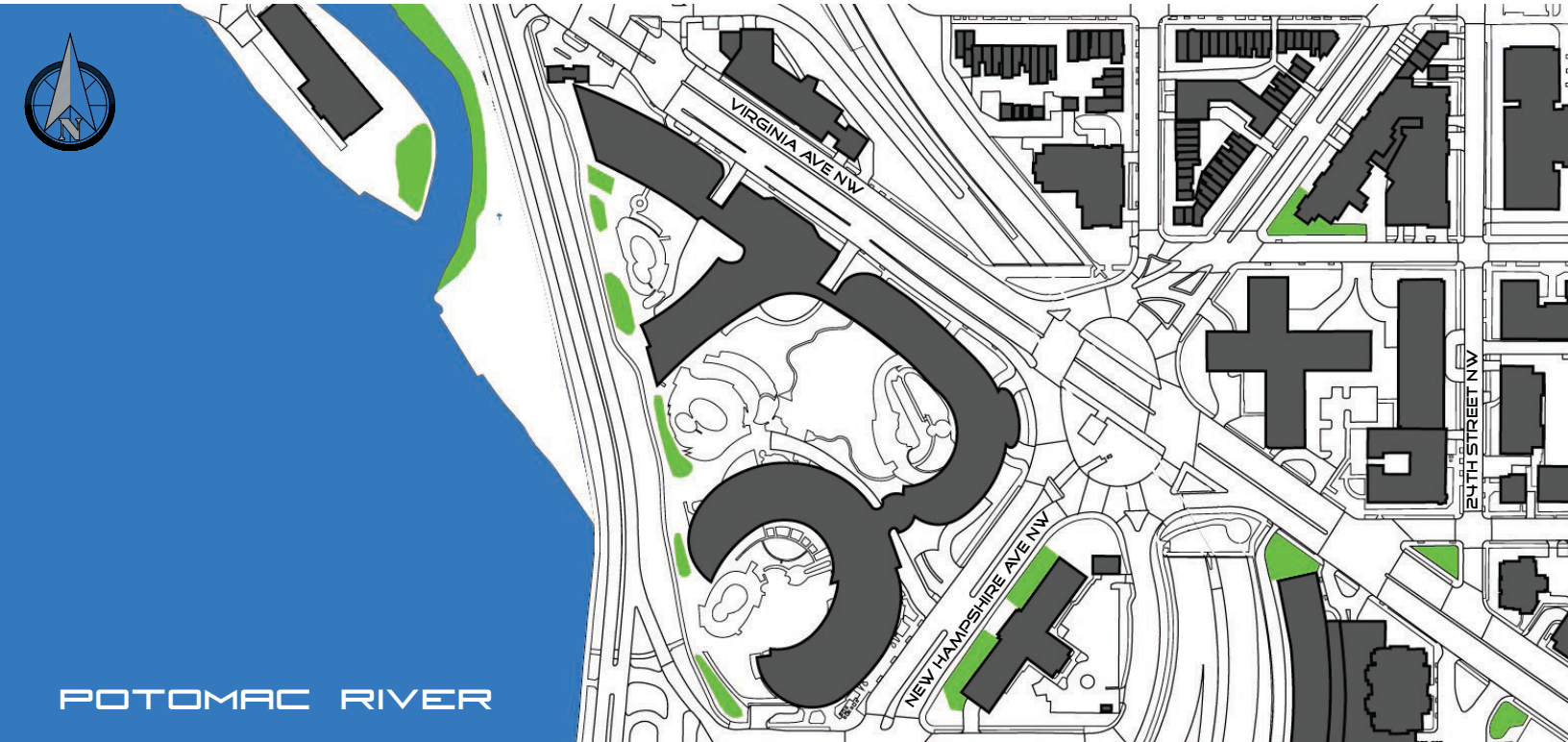
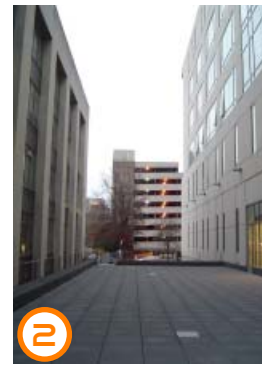
THE SITE IS
LOCATED IN NORTHWEST
WASHINGTON, DC IN THE HEART
OF THE GEORGE WASHINGTON
UNIVERSITY CAMPUS. THIS MAP
SHOWS ITS CONTEXT IN RELATION
TO THE SOUTHERN PORTION OF
THE DISTRICT.

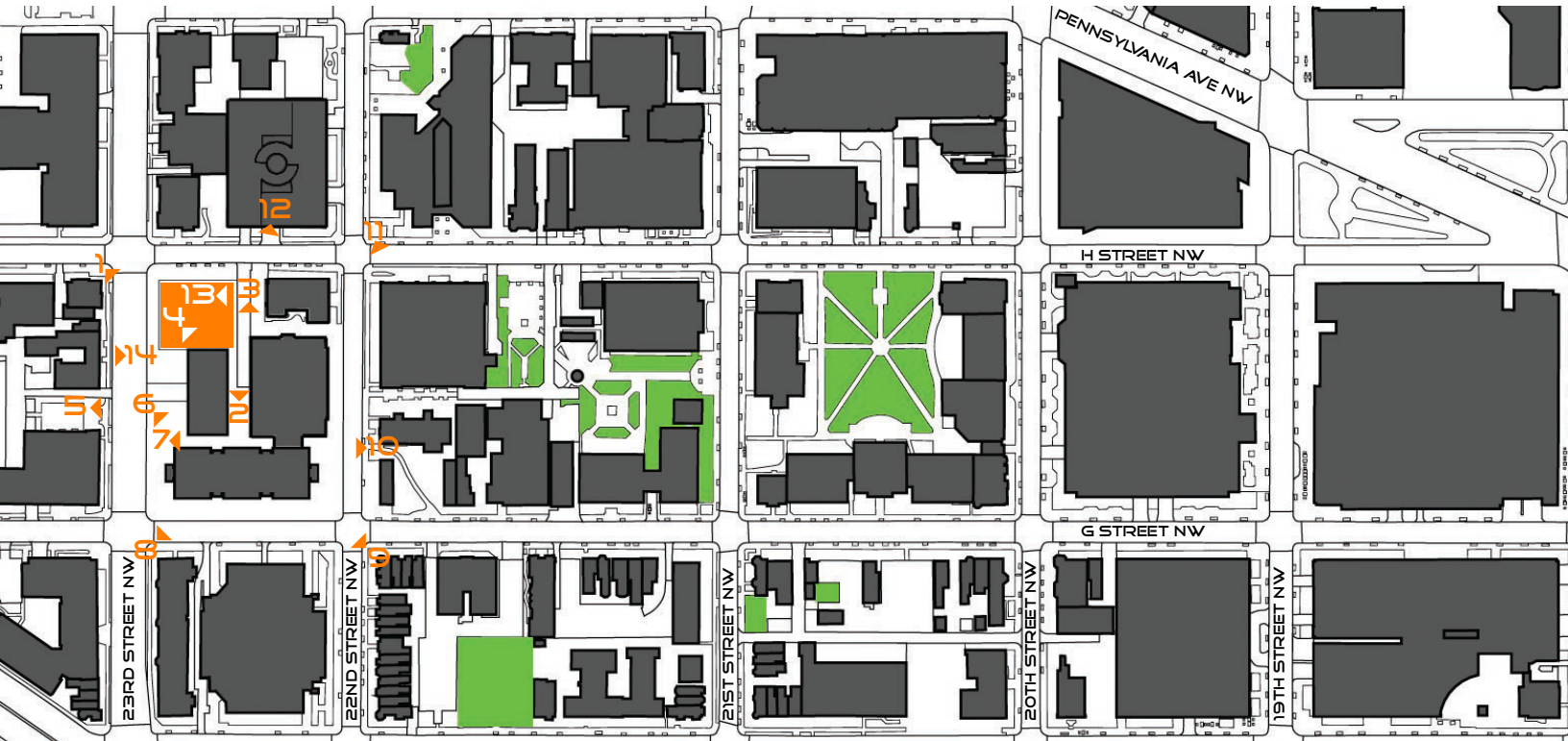
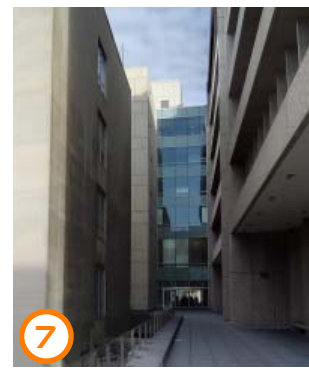
SITE ANALYSIS

ON THE SOUTHEAST CORNER AT THE INTERSECTION OF 23RD STREET NW AND H STREET NW IS A SMALL PARKING LOT LOCATED IN THE HEART OF THE GEORGE WASHINGTON UNIVERSITY. THIS SITE IS RATHER SMALL, BUT GIVES A GOOD AMOUNT OF LIMITATION IN WHAT CAN BE BUILT WITHIN THE URBAN SPACE. THE SITE CAN VERY REASONABLY ACCOMMODATE A NANOTECHNOLOGY RESEARCH LABORATORY, AND WOULD BE ABLE TO BE ASSOCIATED TO THE SCHOOLS ENGINEERING AND APPLIED SCIENCES BUILDING, TOMPKINS HALL. THE SITE ALSO SITS ADJACENT TO AN ALLY WHICH LEADS TO AN UNDERGROUND PARKING GARAGE. THE YELLOW BUILDINGS SHOWN BELOW ARE OWNED AND OPERATED BY THE GEORGE WASHINGTON UNIVERSITY, AND MY SITE IS REPRESENTED BY A MICROCHIP WITH AN ORANGE SQUARE PAINTED ON TOP.



1100110000101100







VIEW OF SITE FROM THE CORNER OF 23RD STREET NW AND H ST NW LOOKING SOUTHEAST



VIEW OF SITE FROM H STREET NW LOOKING SOUTH



VIEW OF SITE IN DISTANCE, FROM 22ND STREET NW LOOKING WEST DOWN H STREET

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NIGHTTIME VIEW OF SITE FROM 23RD STREET NW LOOKING EAST

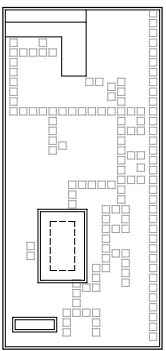
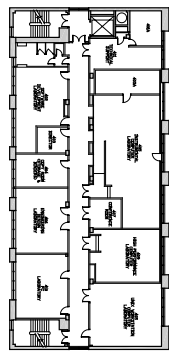
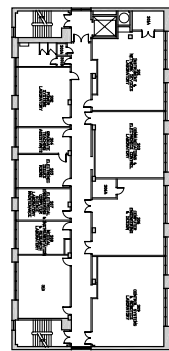
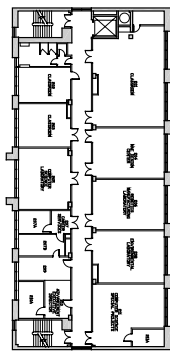
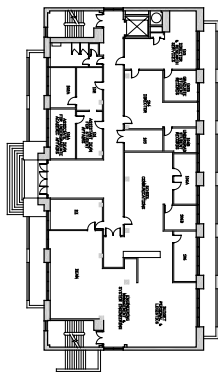
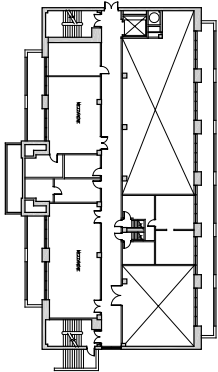
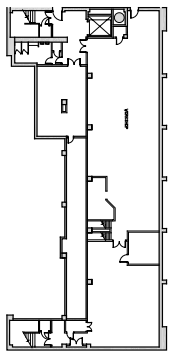
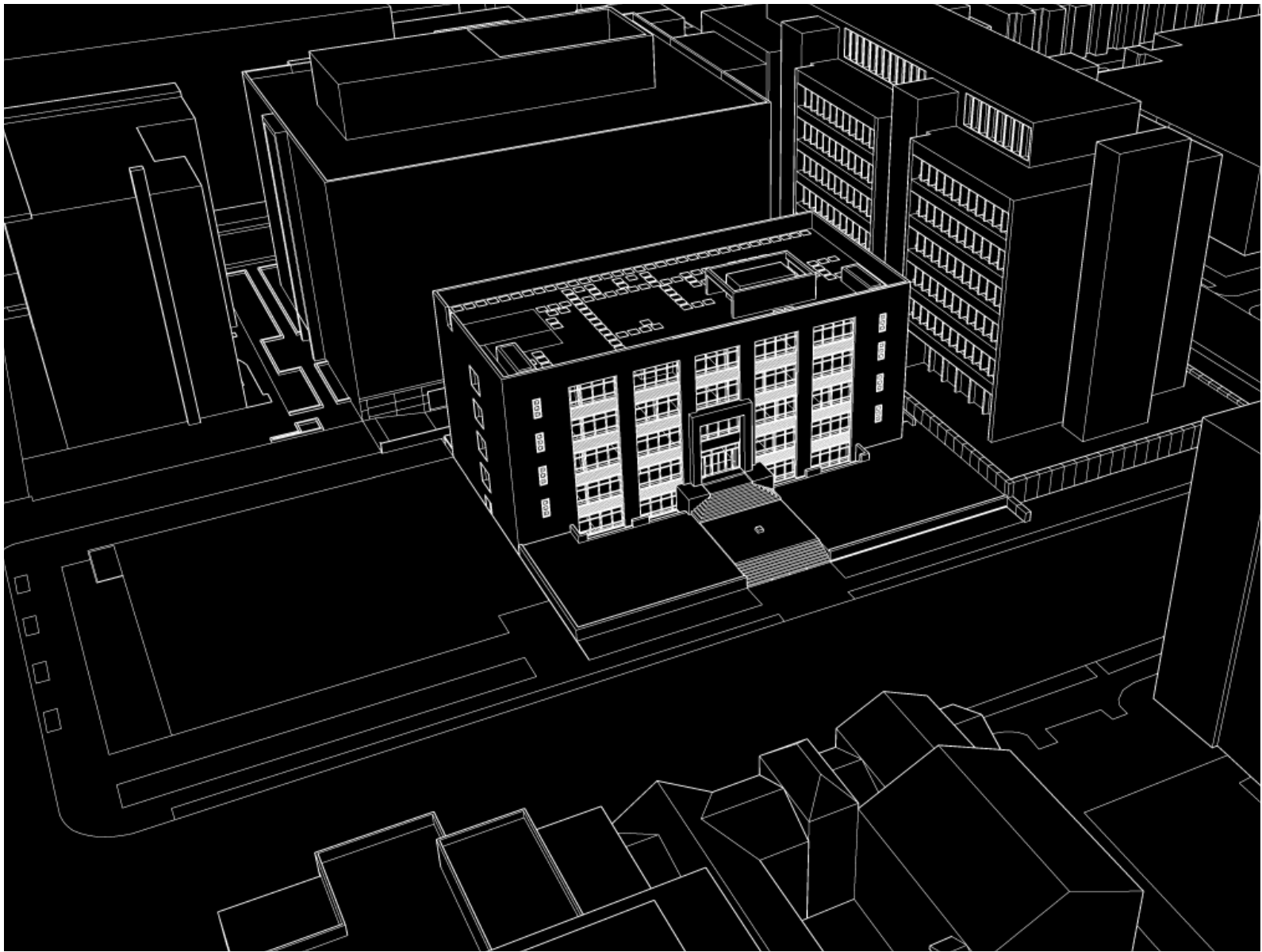


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AERIAL VIEW OF THE SITE FROM THE TOP OF THE PARKING GARAGE OPPOSITE THE SITE, ON H ST NW. VIEW LOOKS SOUTH / SOUTHWEST.



AERIAL VIEW OF SITE FROM
INSIDE OF THE GEORGE
WASHINGTON UNIVERSITY'S
ENGINEERING BUILDING,
TOMPKINS HALL. VIEW LOOKS
NORTH / NORTHWEST.

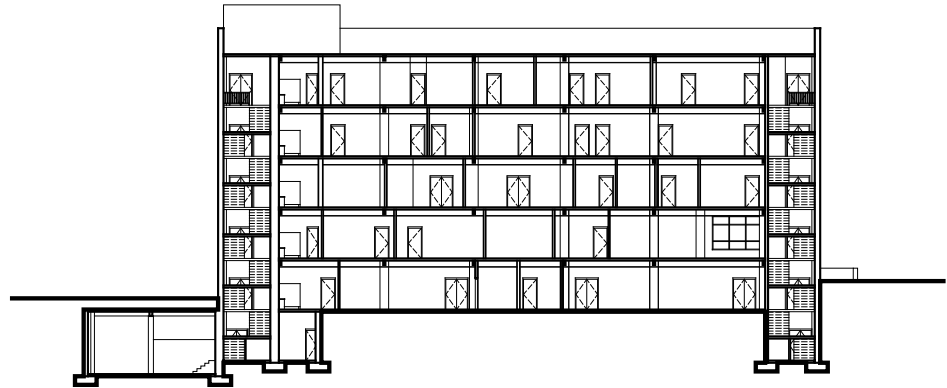
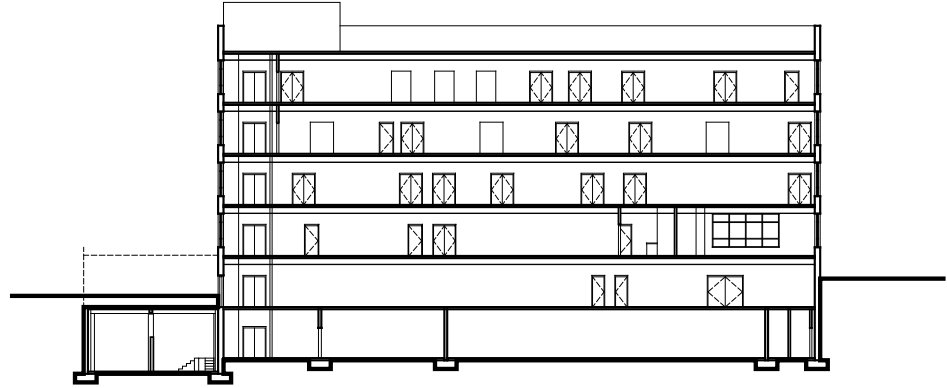


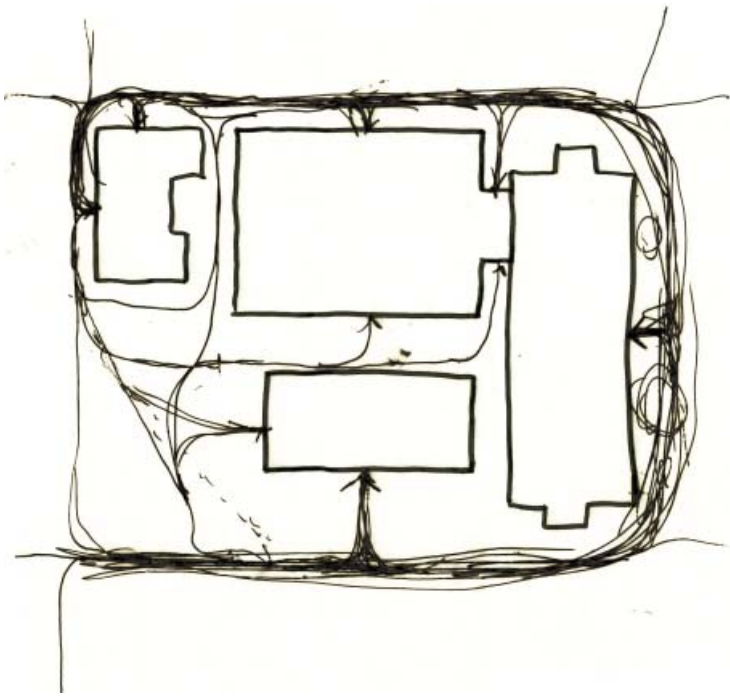
TOMPKINS HALL OF ENGINEERING AND APPLIED SCIENCES

(EXISTING BUILDING)

AN IMPORTANT PART OF THE SITE ANALYSIS WAS TO EXPLORE AND DOCUMENT THE EXISTING TOMPKINS HALL OF ENGINEERING AND APPLIED SCIENCES. THIS BUILDING IS THE HOME OF GEORGE WASHINGTON UNIVERSITY'S SCHOOL OF ENGINEERING AND APPLIED SCIENCE. THE BUILDING ITSELF IS A LIMESTONE CLAD BUILDING, WHICH WAS CONSTRUCTED IN 1956, ABUTS MY THESIS SITE.

SINCE THIS SITE IS SO SMALL, IT WAS DECIDED EARLY ON THAT MY BUILDING WOULD CONNECT TOMPKINS HALL, SO THAT THE TWO BUILDINGS COULD SHARE SERVICES, AND TAKE ADVANTAGE OF EACH OTHER'S AMENITIES. ULTIMATELY, THIS ADDED ANOTHER LAYER OF COMPLEXITY AND LIMITATION TO MY SITE, WHICH ALLOWED FOR A MORE FOCUSED DESIGN IN THE END.

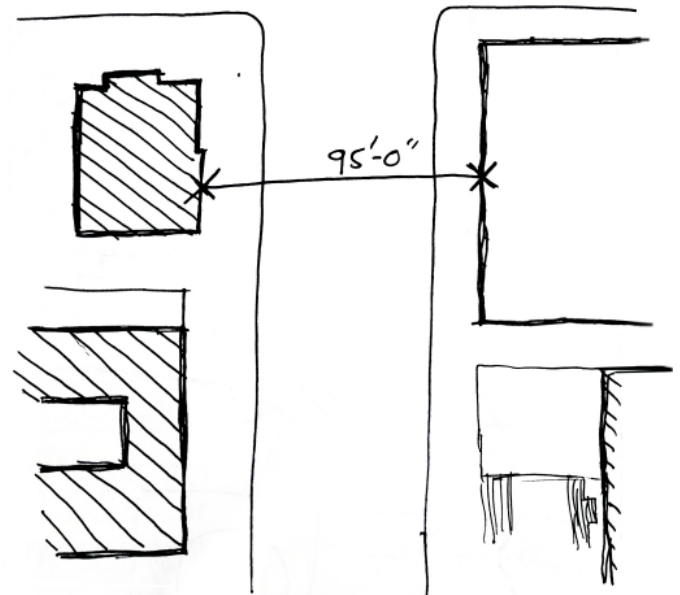


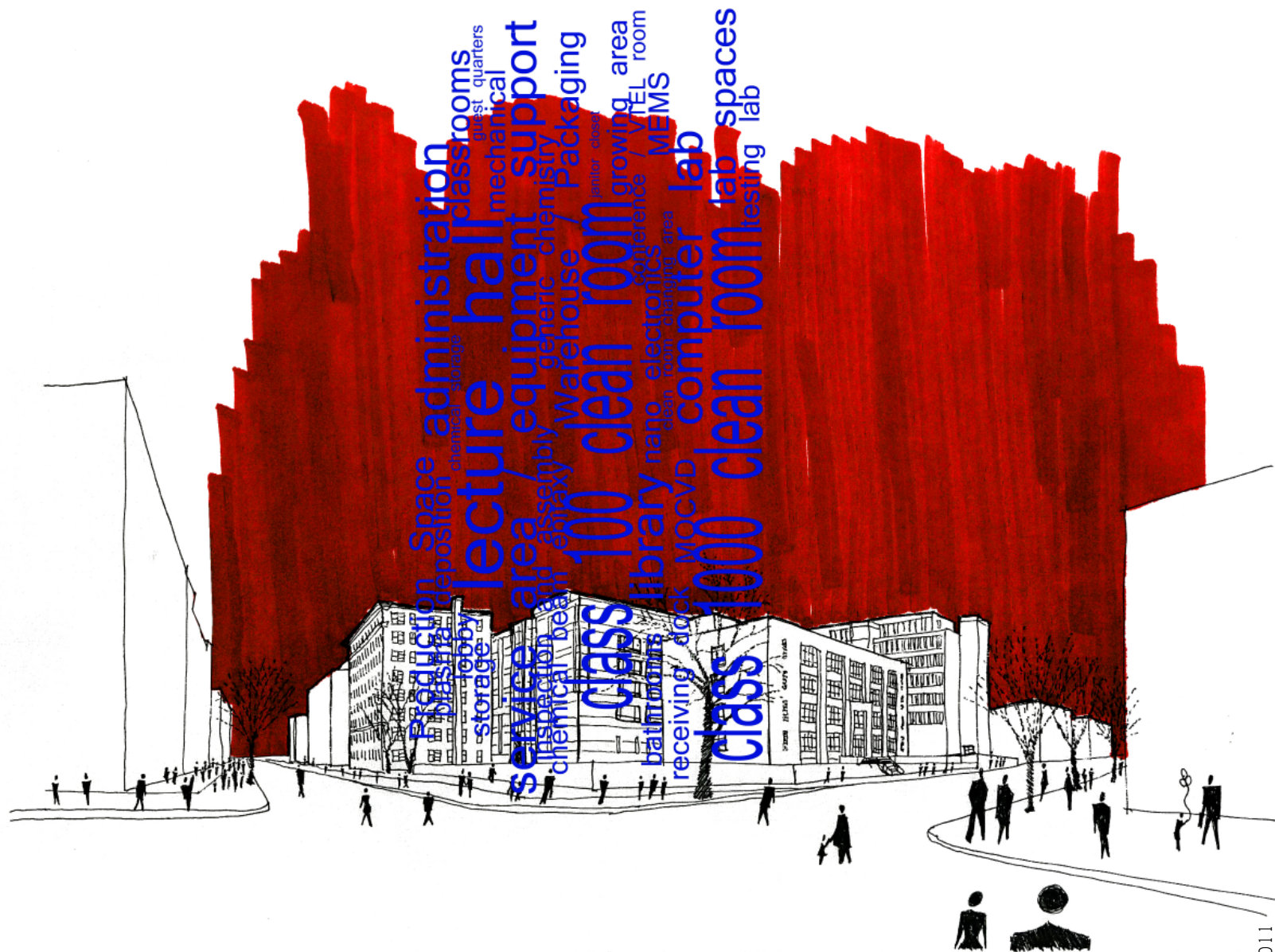


PLAN REPRESENTING THE CIRCULATION OF STUDENTS AROUND THE SITE AREA. THE STUDY WAS CREATED THROUGH OBSERVATION DURING NORMAL CLASS HOURS.

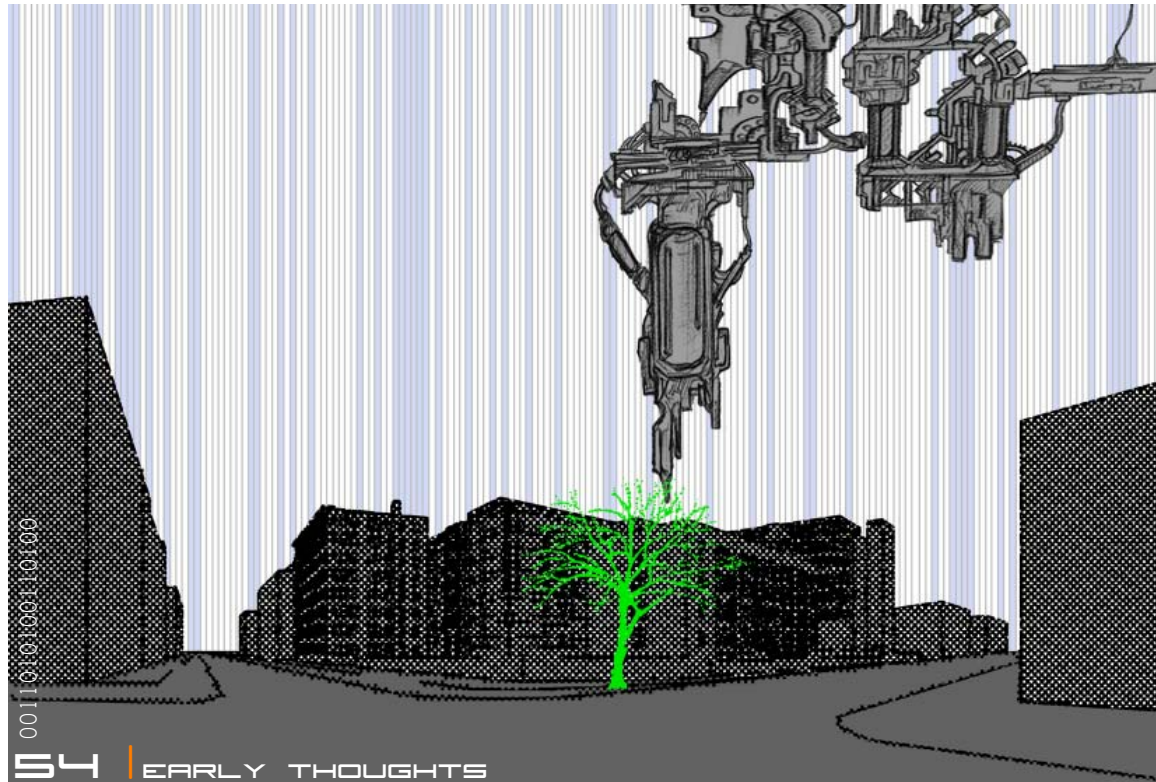
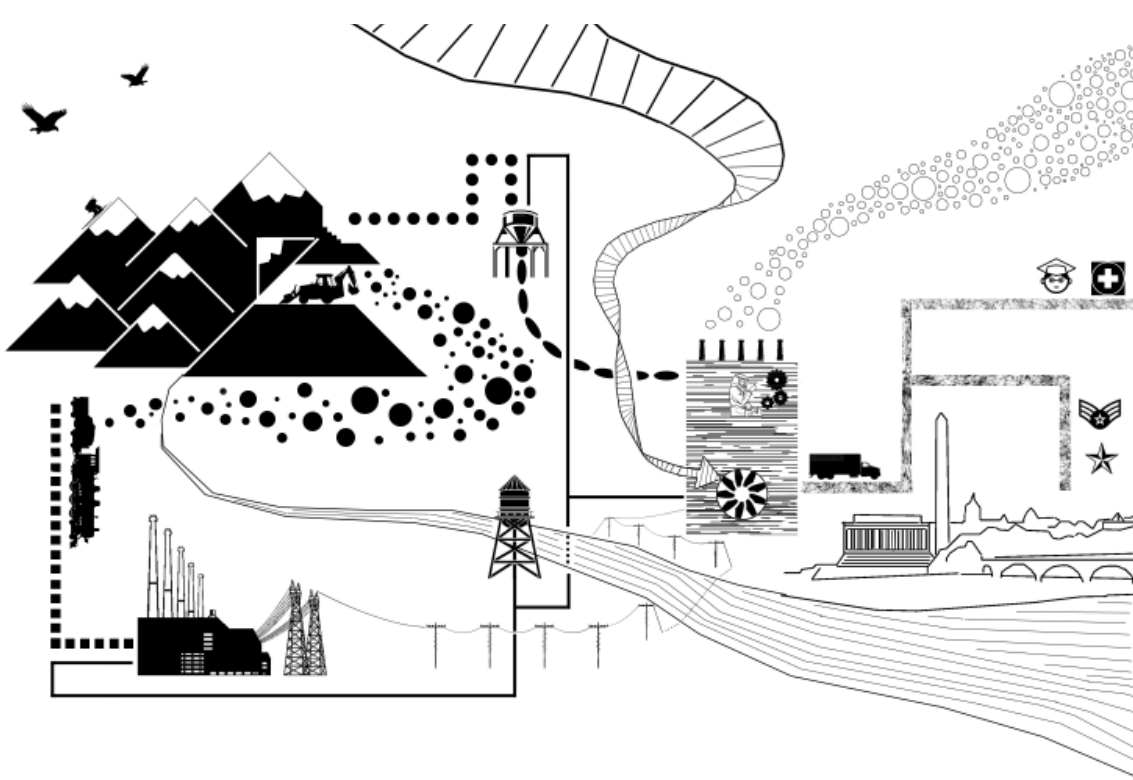
1910 LAW:
 NO BUILDING CAN BE MORE THAN 20 FEET TALLER THAN THE DISTANCE BETWEEN BUILDINGS ACROSS A STREET OR AVENUE.
 (DCOZ.DC.GOV)

TOTAL BUILDING HEIGHT CAN BE 115'-0" HIGH + MECH EQUIPMENT





CONCEPTUAL PERSPECTIVE DRAWING OF THE SITE ON THE CORNER OF H ST NW AND 23 ST NW. THE DRAWING REPRESENTS THE NUMBER OF PEOPLE PROJECTED TO USE THE BUILDING, AND LISTS SOME OF THE SPACES THAT WILL MAKE UP THE BUILDING.



TOP LEFT:
EARLY ENVIRONMENTAL
IMPACT SKETCH

BOTTOM LEFT:
EARLY CONCEPTUAL
NANO ASSEMBLER
PERSPECTIVE

EARLY THOUGHTS

EARLY ON I REALIZED THAT MY PRECONCEIVED NOTIONS ABOUT RESEARCH LABORATORIES GAVE ME THE IDEA THAT MANY OF THESE PLACES ARE SOMEWHAT SECRETIVE AND DULL PLACES TO WORK. IN MANY OF THE LABORATORIES I HAD SEEN IN THE PAST, I HAD REALIZED THAT THE ARCHITECTURAL QUALITIES WERE NOT AS SIGNIFICANT AS THE FASCINATING SUBJECT MATTER BEING RESEARCHED INSIDE. I BELIEVE THAT THIS MAY BE BECAUSE MANY OF THESE BUILDINGS WERE DESIGNED AROUND THE MACHINES THEY HOUSED, AND NOT THE HUMANS WHO WERE THE REAL INHABITANTS.

DURING MY DESIGN PROCESS, I DECIDED THAT I HAD TO BE CAREFUL NOT TO MAKE THE MAIN FOCUS ON THE MACHINE ENVIRONMENT. I STARTED TO ASK MY SELF WHAT STEPS I COULD MAKE TO MAKE THE LABS HUMAN. THE MAIN DRIVING FORCE BEHIND THE DESIGN HAD TO BE THE OCCUPANTS. ULTIMATELY, I DECIDED THAT THE BUILDING COULD WORK AS A MACHINE FOR SOCIALIZATION AND INTERACTION, AND THAT THE TOOLS AND MACHINES THAT IT HOUSED WOULD BE THERE TO COMPLEMENT THE ARCHITECTURAL SPACES AND TO ALLOW THE USERS TO REACH THE GOALS OF THEIR RESEARCH.

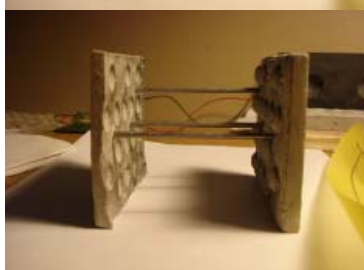
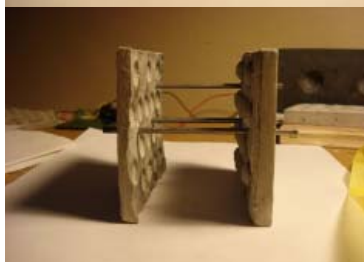
WHEN I STARTED THINKING ABOUT THE ARCHITECTURAL AND ENVIRONMENTAL QUALITIES THAT MADE UP A NANOTECHNOLOGY RESEARCH LABORATORY, THE FIRST THOUGHT THAT CAME TO MIND WAS HOW MUCH OF AN IMPACT MY BUILDING WOULD HAVE ON THE WORLD AROUND IT. I WAS WELL AWARE THAT THESE BUILDING REQUIRE INCREDIBLE AMOUNTS OF ENERGY, AND SO I DECIDED TO EXPLORE AND DOCUMENT THIS IDEA BY CREATING A PICTORIAL REPRESENTATION OF WHAT WAS REQUIRED TO CREATE AND RUN THIS BUILDING. THIS DRAWING IS LOCATED IN THE UPPER RIGHT, AND INCLUDED TOPICS SUCH AS MINING, ENERGY PRODUCTION AND DISTRIBUTION, CONCRETE USE, THE VAST AMOUNTS OF WATER AND AIR BEING USED BY MY BUILDING, AND DISTRIBUTION OF THE FINAL NANO-PRODUCTS THROUGHOUT THE PUBLIC AND PRIVATE SECTORS.

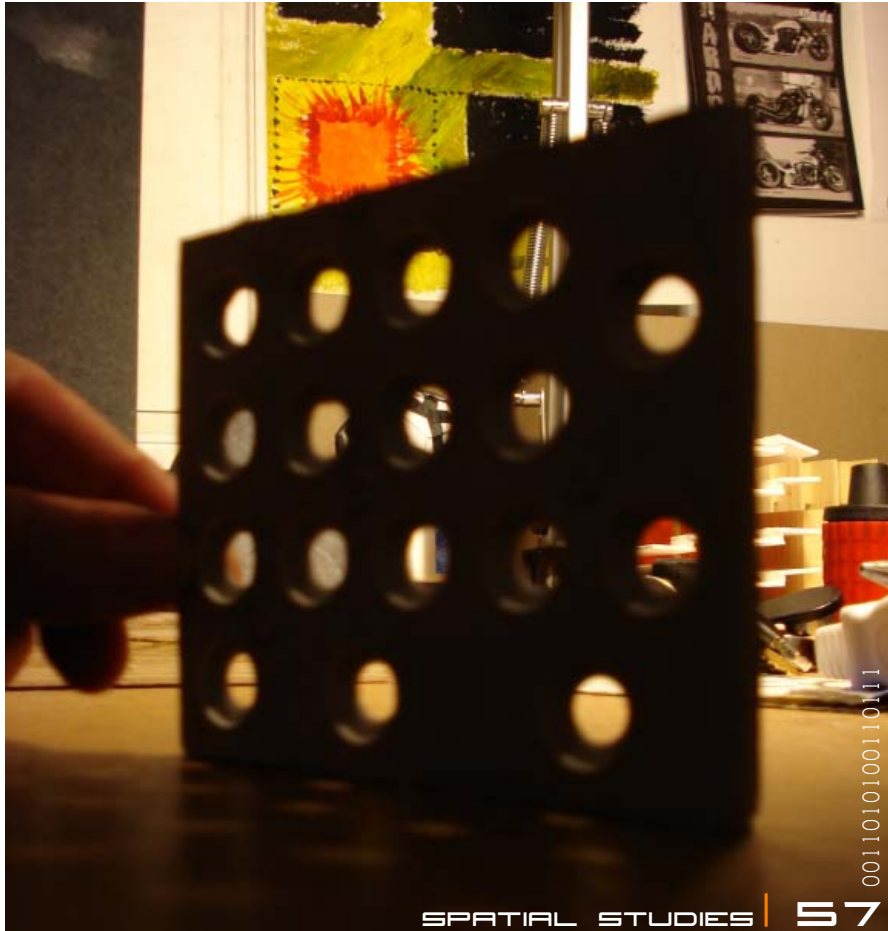
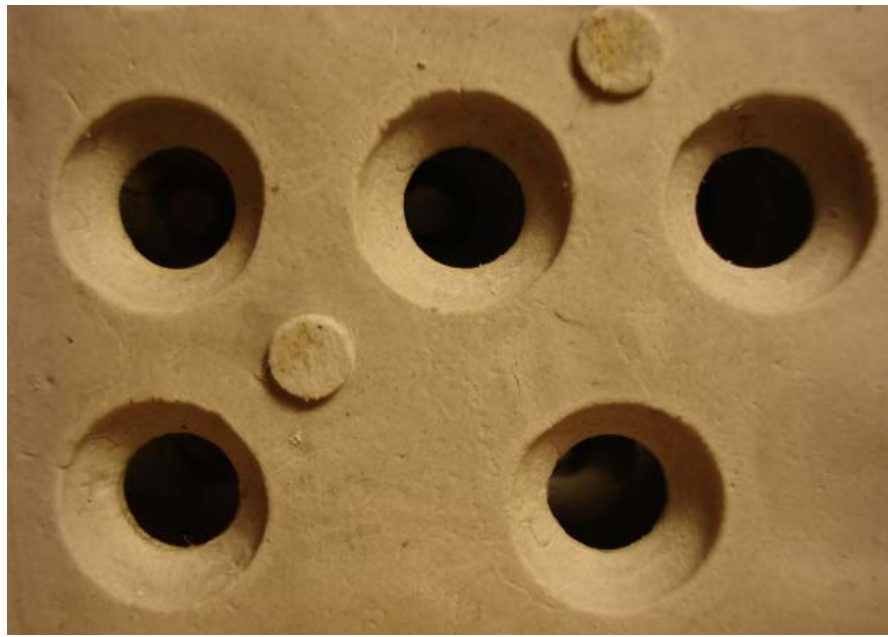
ULTIMATELY THIS LED ME TO THE CONCLUSION THAT I NEEDED TO TAKE IN TO CONSIDERATION WAYS THAT WOULD MAKE THE BUILDING MORE EFFICIENT AND RESPONSIBLE. PASSIVE SOLAR SYSTEMS, AND DOUBLE SKINS WERE TWO OF THE THINGS I DECIDED MUST BE INCLUDED IN MY BUILDING DESIGN.

THE BOTTOM IMAGE ON THE LEFT WAS INSPIRED BY ARTICLE I READ BY LANCE HOSEY IN THE JUNE 2002 ARCHITECTURAL RECORD CALLED "WHY THE FUTURE OF ARCHITECTURE DOESN'T NEED US." IN THIS ARTICLE, HOSEY PUT FORTH A PROFOUND IDEA SUGGESTING THAT "WITHIN THE NEXT FEW DECADES, LARGE-SCALE OBJECTS, INCLUDING BUILDINGS, COULD BE FABRICATED USING MICROSCOPIC ROBOTS CALLED ASSEMBLERS, WHICH WOULD JOIN TO MAKE A CYBERNETIC GLUE, ABLE TO ASSUME ANY SHAPE AND SIZE." I FOUND THIS IDEA FASCINATING, BUT VERY MUCH IN THE REALM OF SCIENCE FICTION. THE IDEA OF A BUILDING BEING BUILT ATOM BY ATOM IS VERY FOREIGN TO ME, BUT AT THE SAME TIME SHOWS THE EXTREME OF WHAT THIS TECHNOLOGY COULD BE CAPABLE OF IN THE FUTURE.

SPATIAL STUDIES

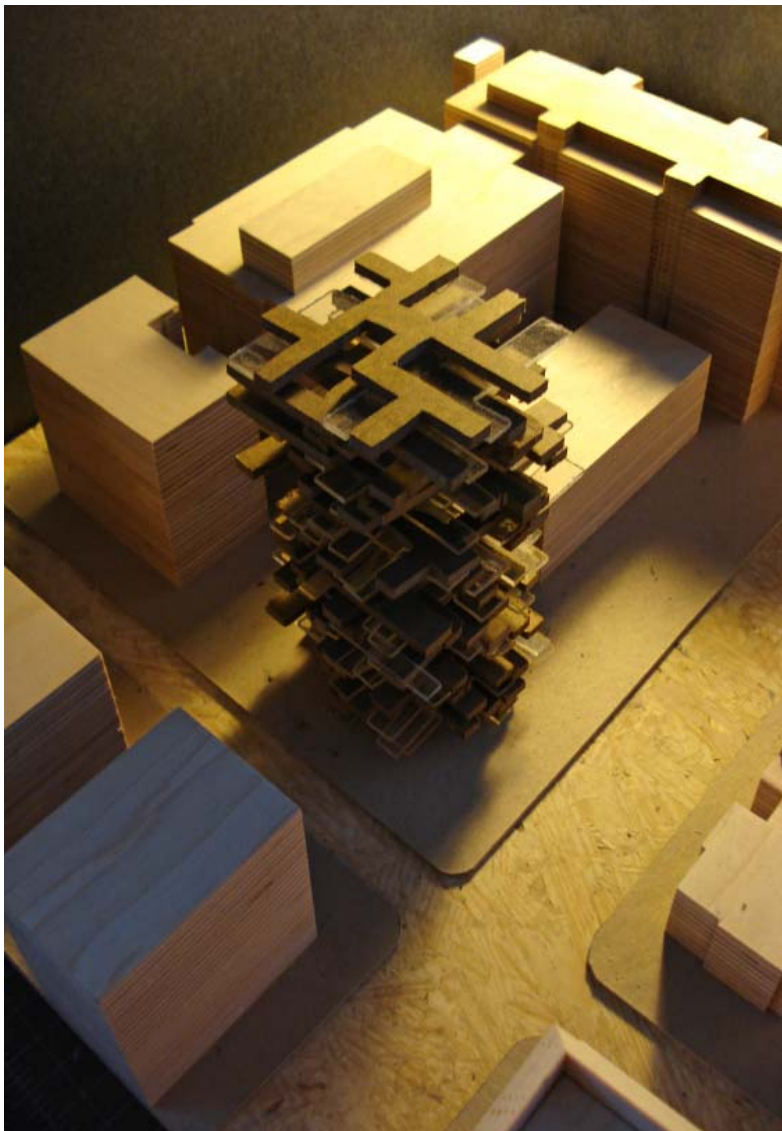
AS A PRIMER TO MY SPATIAL STUDIES, I EXPLORED THE IDEAS OF POSITIVE AND NEGATIVE SPACE, IN-BETWEEN SPACE, AND EXPANSION / CONTRACTION. I DID THIS THROUGH THE USE OF AN INTERACTIVE CONCRETE AND STEEL STUDY MODEL, CREATED USING COMPUTER PARTS AS CONCRETE MOLDS.





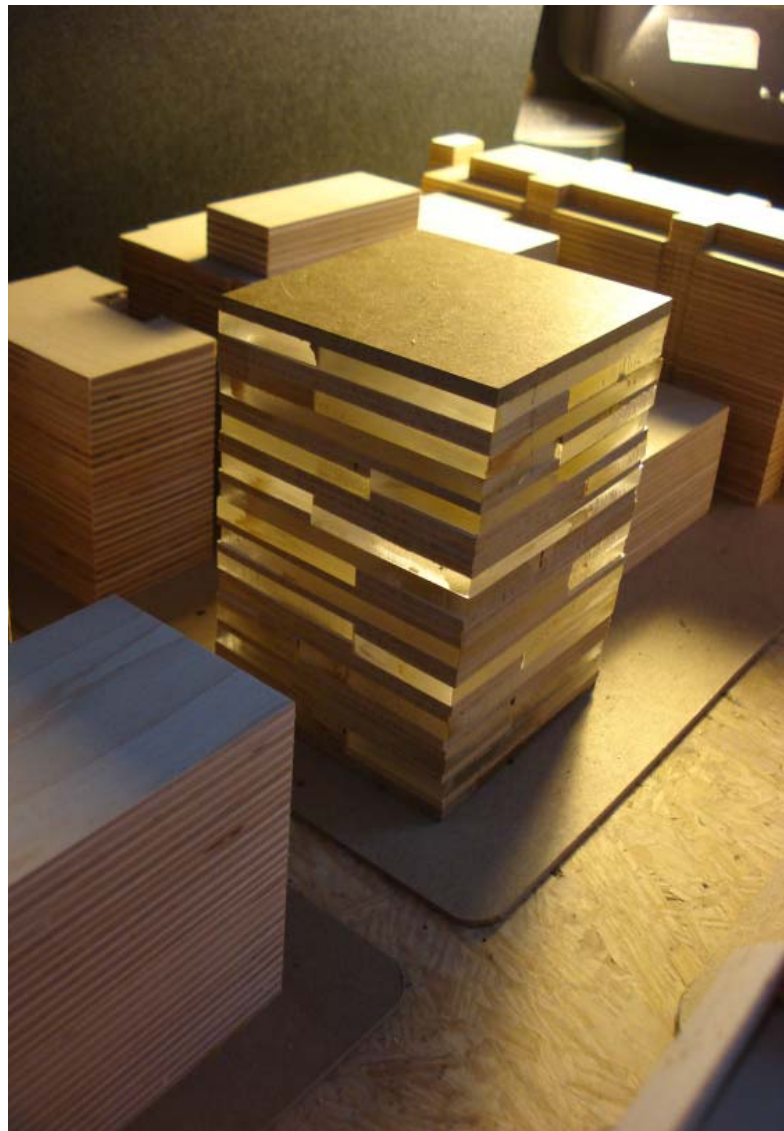
LIGHT SCREEN STUDY

THIS WAS ANOTHER CONCRETE STUDY CREATED USING FORMWORK FROM OLD COMPUTER PARTS. I USED THESE STUDIES TO EXPLORE THE IDEA OF A LIGHT SCREEN WHICH IN TURN HELPED ME START THINKING ABOUT THE WAY LIGHT WOULD ENTER MY BUILDING.



SPATIAL STUDY # 01

THIS STUDY EXPLORED THE IDEA OF A TALL BUILDING, BUT MORE IMPORTANTLY, WAS A STUDY IN HOW THERE CAN BE SLOT AND PLACES TO ESCAPE OR GET LOST WITHIN THE BUILDING, FOR BOTH MAN AND AIR. THIS WAS MY FIRST APPROACH AT DEFINING INTERIOR AND EXTERIOR SPACE.



SPATIAL STUDY # 02

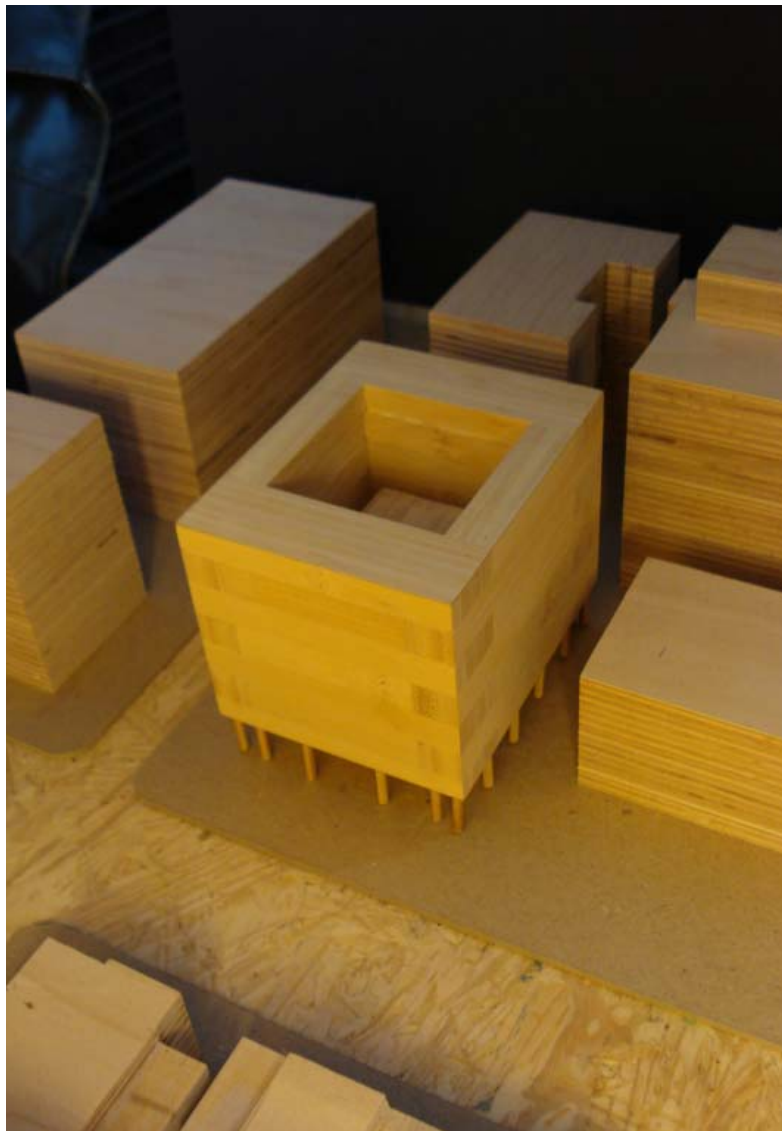
THIS STUDY FILLED THE ENTIRE BUILDING CONSTRAINTS OF THE SITE AND LOOKED AT THE IDEA OF LAYERING AS WELL AS MAKING ME START THINKING ABOUT THE RELATIONSHIP BETWEEN DARK AND LIGHT WITHIN THE BUILDING AND HOW MUCH OF THE SITE I WANTED THE BUILDING TO CONSUME.

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SPATIAL STUDY # 03

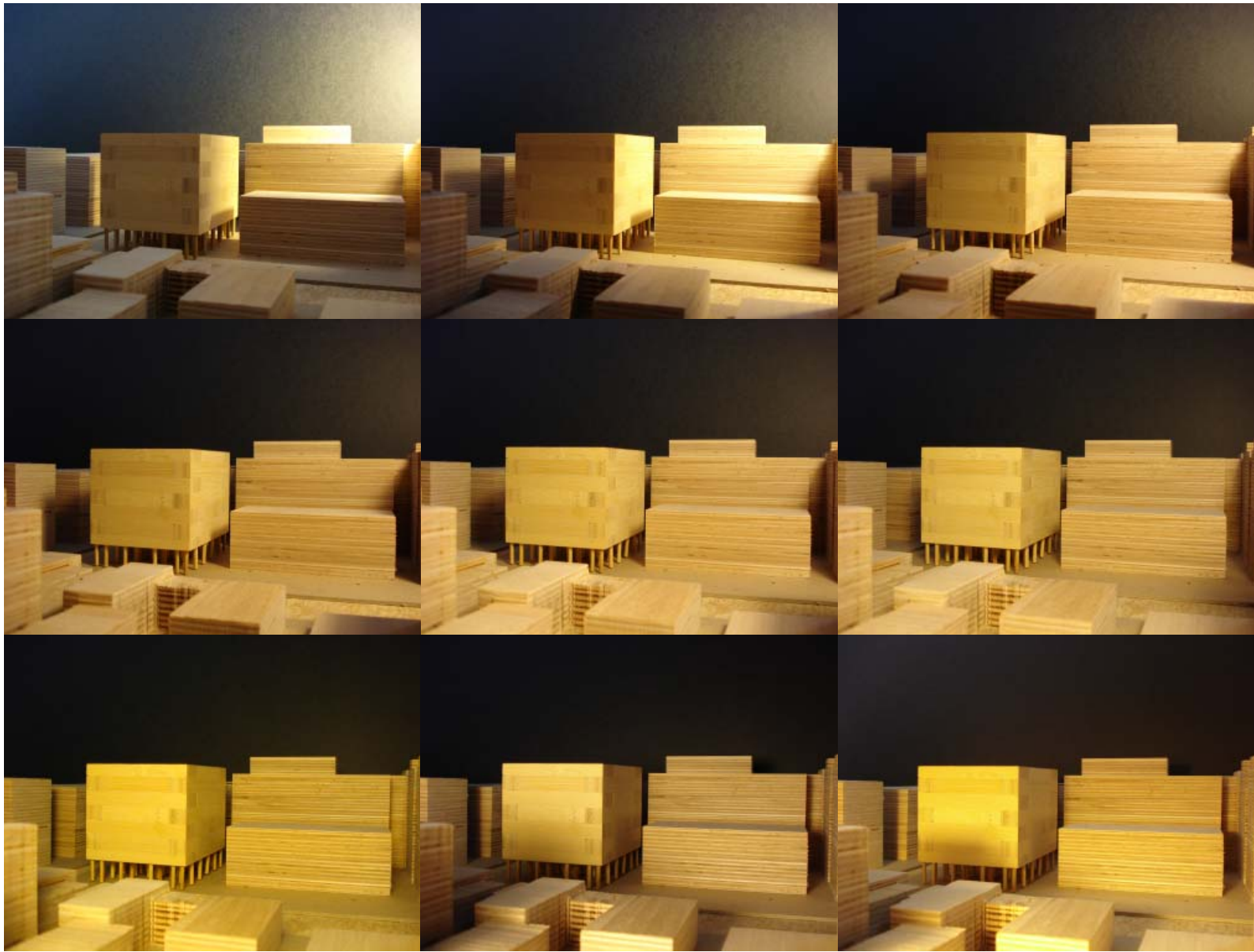
A BUILDING CAN GET LOST IN ONE MONOLITHIC MASS, AS IN STUDY NUMBER TWO. THIS STUDY IS STILL A MASS, BUT IS MORE OF AN ASSEMBLY THAN A CAST, AND WAS USED TO START DEFINING SPACE. THE WESTERN SIDE OF THE BUILDING (THE SIDE CLOSEST TO THE OBSERVER) IS DESIGNATED AS OFFICES, THE CENTER MASS IS DESIGNATED AS LABORATORY AND CLEANROOMS, AND THE TALLER MASS WAS AS EARLY THOUGHT FOR AN EXPOSED MECHANICAL SYSTEM.



SPATIAL STUDY # 04

THIS STUDY STARTS TO LOOK AT THE IDEA OF THE CLEANROOM BEING SEPERATE FROM THE REMAINDER OF THE BUILDING, BY CREATING A BUILDINGS WITHIN A BUILDING. IT ALSO STARTS TO ADDRESS A POSSIBLE COLUMN SYSTEM, AND HOW THE BUILDING WILL FIT CONTEXTUALLY WITH THE OTHER BUILDINGS

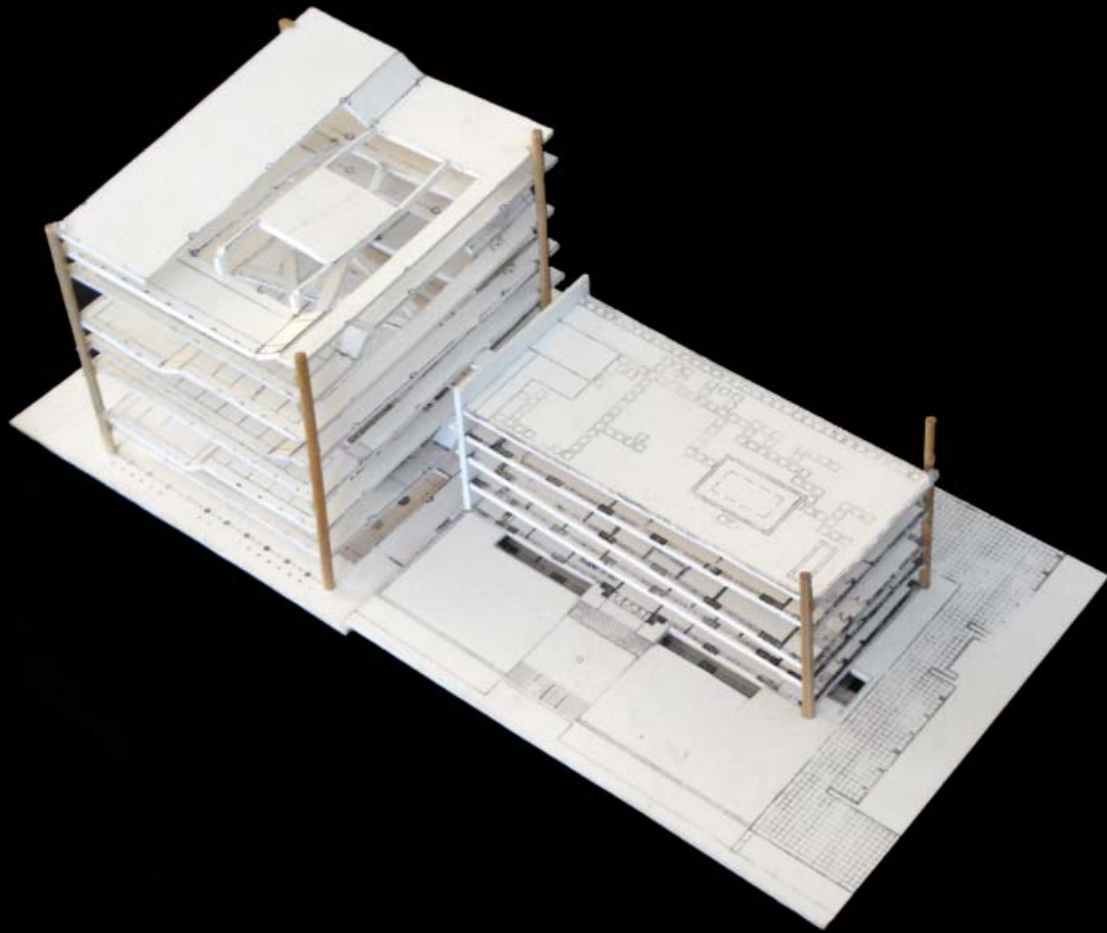
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CONCEPTUAL STUDY MODEL / SUN STUDY

THIS SUN STUDY WAS CONDUCTED TO GIVE AN IDEA OF WHAT THE SUN CONDITIONS WOULD BE LIKE FOR THE NANOTECH BUILDING BECAUSE OF THIS SUN STUDY, I REALIZED THAT THE SITE WOULD BE SOMEWHAT DARK IN THE MORNINGS AND MID AFTERNOON. BECAUSE OF THIS, I DECIDED USE AN ALL GLASS FACADE TO HELP BRING IN AS MUCH AMBIENT LIGHT AS I COULD.

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CONCEPTUAL STUDY MODEL.

THIS MODEL WAS CONSTRUCTED TO HELP STUDY HOW THE FLOORS BETWEEN TOMPKINS HALL, THE SPIRAL FLOOR PLAN AND THE CLEAN ROOM INTERACT. IT ALSO HELPED GIVE AN IDEA OF WHAT THE SPACIAL QUALITIES OF THE BUILDING WOULD BE LIKE. CONSTRUCTED OUT OF WHITE MATTE BOARD.



EARLY CONCEPTUAL SKETCH
SHOWING THE IDEA OF A BUILDING
WITHIN A BUILDING, AND THE
MECHANICAL SYSTEM SITTING ON
THE ROOF. THIS DRAWING ALSO
CONVEYED THE IDEA THAT THE VEIL
OF SECRECY WHICH OCCURS AT MOST
NANOTECHNOLOGY FACILITIES COULD
BE LIFTED TO CREATE A BUILDING THAT
IS WELCOMING FOR ALL PEOPLE.

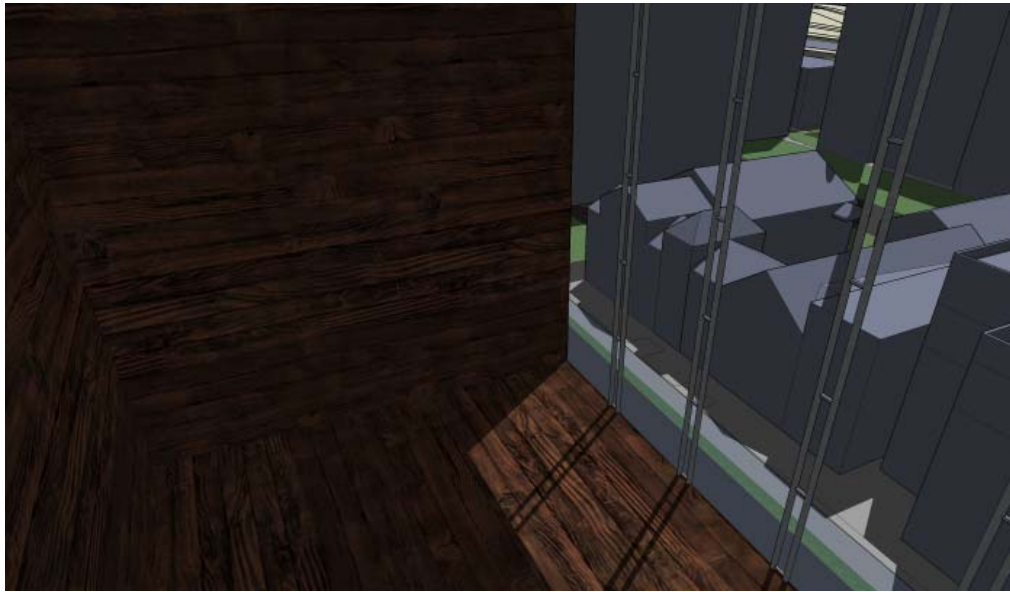
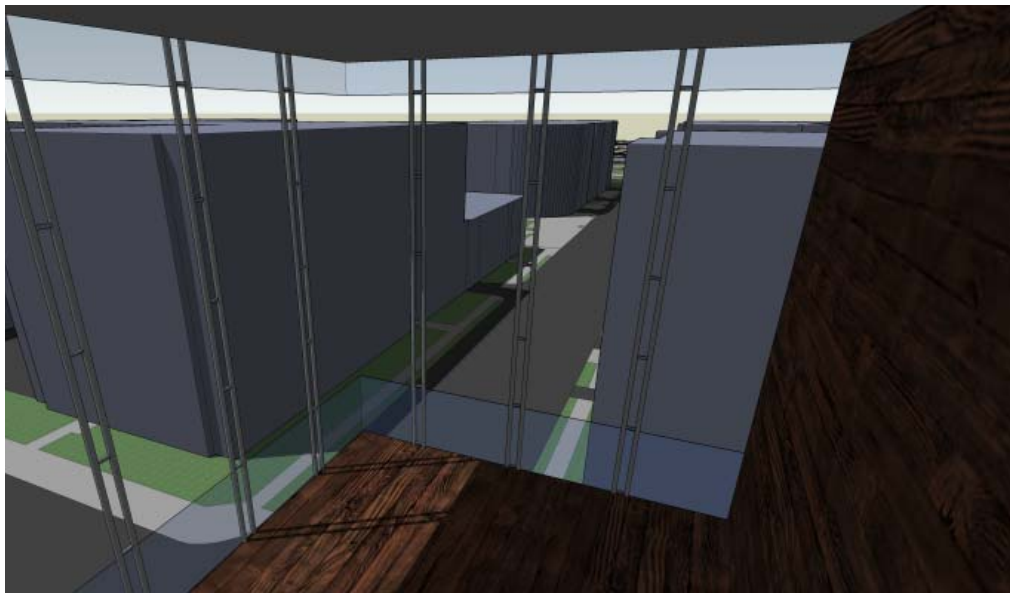
FEATURES OF THE BUILDING

THE NEXT SECTION OF THIS BOOK SHOWS SOME OF THE MULTIPLICITY OF FORCES THAT HELPED TO PRODUCE THIS NANOTECHNOLOGY RESEARCH LABORATORY. THE FEATURES AND COMPONENTS OF THE BUILDING ARE BROKEN DOWN INTO MULTIPLE SECTIONS, EACH ORGANIZED BY SCALE, STARTING AT THE LARGER CITY LEVEL AND SCALING DOWN TO THE LEVEL OF THE DETAIL.

THROUGHOUT THE PROJECT, I QUESTIONED HOW TO GET THE MATERIALS TO MATCH THE SCALE OF THE CITY, THE HUMAN AND THE NANO-WORLD, ALL SIMULTANEOUSLY. MY SOLUTION WAS TO PLAY WITH THE IDEA OF MONUMENTALITY VS. DIMINUTIVENESS, IN BOTH THE SCALE OF SPACE, STRUCTURE, AND MATERIAL.

TO ACCOMPLISH THIS, I STARTED WITH THE IDEA OF HAVING THE EXTERIOR PERIMETER REPRESENT THE CITY, AND THE CENTER OF THE BUILDING (WITHIN THE CLEANROOM) REPRESENTS THE ATOM. THE MANIFESTATION OF THIS IDEA CREATED SCALE SHIFTS WITHIN THE BUILDING WHICH ARE INTENDED TO MAKE A PERSON FEEL LARGER OR SMALLER. FOR EXAMPLE, THE MATERIALS AND THE COLUMNS ON THE EXTERIOR PERIMETER WERE DESIGNED TO BE SMALL, BUT WOULD GROW IN SIZE AS ONE MOVES TOWARDS CENTER OF BUILDING. IN ADDITION, THE SCALE OF THE EXTERIOR SPACES ARE LARGER AND BECOME SMALLER AS ONE MOVES TOWARD CENTER OF BUILDING. THE LARGER SCALE OF THE MATERIALS AND STRUCTURE, AND AT THE SAME TIME THE SHRINKING OF THE SPACE CREATES A FEELING THAT THE PERSON IS GETTING READY TO ENTER THE ATOMIC WORLD. THE OPPOSITE IS TRUE OF THE EXTERIOR PERIMETER. THESE IDEAS OF MONUMENTALITY AND DIMINUTIVENESS ARE THINGS THAT WILL CARRY THROUGH THIS NEXT SECTION.

IT MAY ALSO BE WORTH NOTING THAT THIS BUILDING WAS DESIGNED MORE AS AN EDUCATIONAL EXPLORATION RATHER THAN A TRUE LABORATORY OR PRODUCTION FACILITY. TYPICAL NANOTECHNOLOGY BUILDINGS ARE DESIGNED TO BE ADAPTABLE WITH TIME AND THE CHANGING NEEDS OF THE TENANT. THROUGH THE THESIS PROCESS, I DECIDED TO CREATE A SET OF SELF IMPOSING LIMITATIONS, WHICH IN TURN CREATED THE BUILDING ON A VERY SMALL SITE THAT WOULD LIMIT THE ABILITY OF THE BUILDING TO BE EXPANDED IN THE FUTURE. AS A RESULT, I IMAGINE THAT THE BUILDING WOULD START TO TAKE ON THE ROLE OF THE MORE TRADITIONAL INDUSTRIAL BUILDINGS OF THE PAST, WHERE THEY HAVE SECOND AND THIRD LIVES, AS TECHNOLOGY CHANGES



TOP LEFT:
THIS IMAGE SHOW A
PERSPECTIVE FROM ONE OF
THE URBAN GARDENS LOOKING
NORTHWEST

BOTTOM LEFT:
THIS IMAGE SHOWS A
PERSPECTIVE OF THE SAME UR-
BAN GARDEN ABOVE, BUT
LOOKING SOUTHWEST.

AXON DRAWING SHOWING THE
IDEA OF DARK VS. LIGHT &
GARDEN VS. LAB

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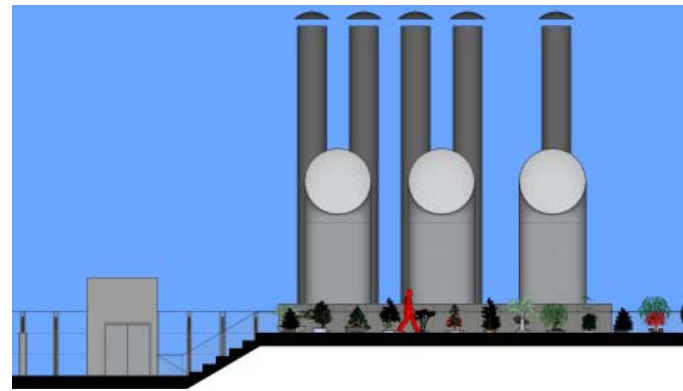
URBAN GARDENS & BONSAI FOREST

A GARDEN IS A PLACE OF ESCAPE - ESCAPE FROM ONES WORK, AND ALSO A PLACE THAT ENCOURAGES REFLECTION.

THE GARDENS IN THIS BUILDING ARE A DESIGNED AS A PLACE THAT BREAKS THE RULES SET UP FOR THE BUILDING. FOR EXAMPLE, A TYPICAL BUILDING HAS WALLS THAT ARE OPAQUE, REQUIRING A PERSON TO LOOK FOR THE LIGHT OF GLASS WINDOWS AND DOOR, TO GAIN ACCESS TO NATURE.

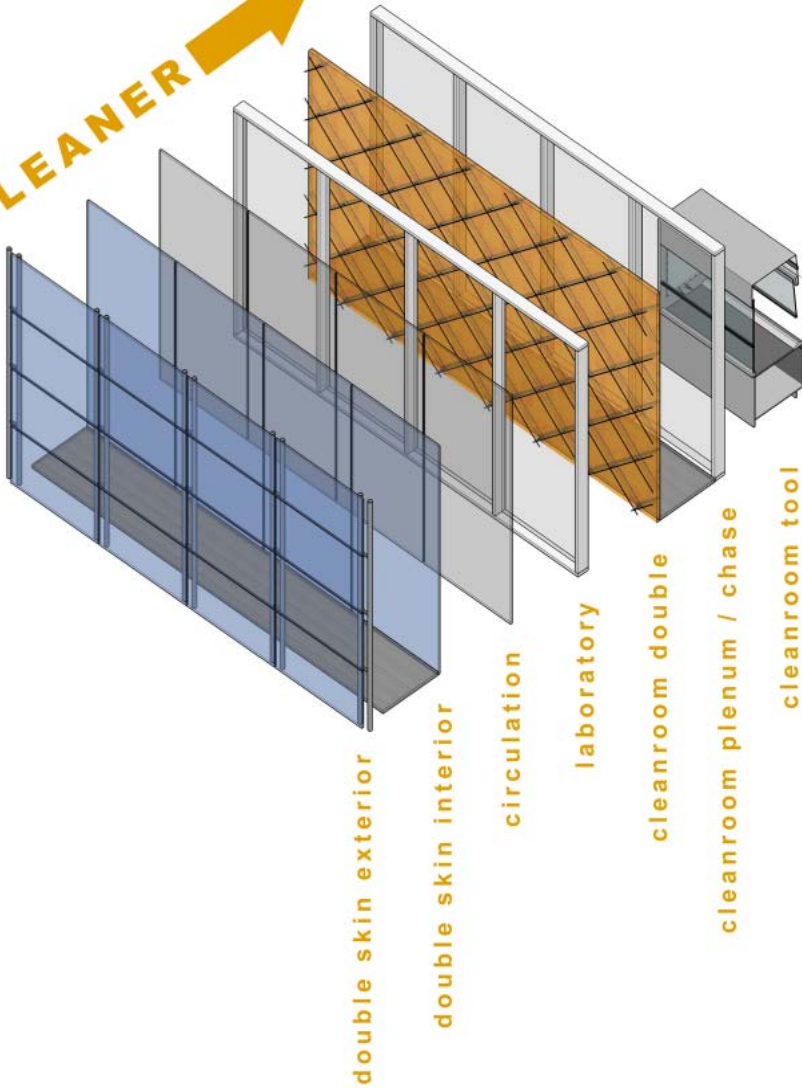
IN THE CASE OF THIS BUILDING, THIS NOTION OF HOW TO ACCESS OUTDOOR SPACE IS REVERSED. SINCE THE BUILDING'S PRIMARY FAÇADE IS GLASS, IT SEEMED LOGICAL TO CREATE THE OUTDOOR SPACES AS A SOLID DARK WOOD MATERIAL. THIS DOES TWO THINGS; IT CREATES A FOCAL POINT ON THE FAÇADE WHICH DRAWS THE USER TO THE SPACE, BUT ALSO IS A PHYSICAL BARRIER TO THE SCHOOL WORK OCCURRING WITHIN THE BUILDING. THIS BARRIER BETWEEN THE WORKING WORLD AND THE OUTDOOR SPACE ALLOWS A SENSE OF ESCAPE AND LETS ONE TAKE IN THE SIGHTS AND SOUNDS OF THE CITY.

ON THE RIGHT IS THE BONSAI FOREST. THIS IS A PLACE FOR THE STUDENTS AND PROFESSORS TO ESCAPE TO TAKE IN THE CITY, BUT ALSO TO REFLECT ON THE WORK THEY ARE DOING BY IMMERSING THEMSELVES IN A SCALE CHANGING SCENARIO. THE SCALE OF AN OBJECT IS RELATIVE TO WHAT YOU ARE LOOKING AT, AND FROM WHERE YOU ARE LOOKING.



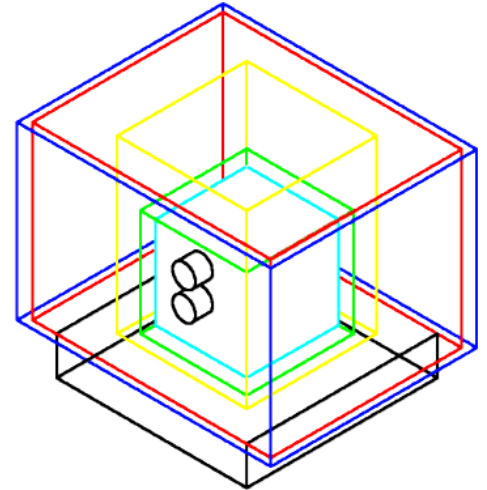
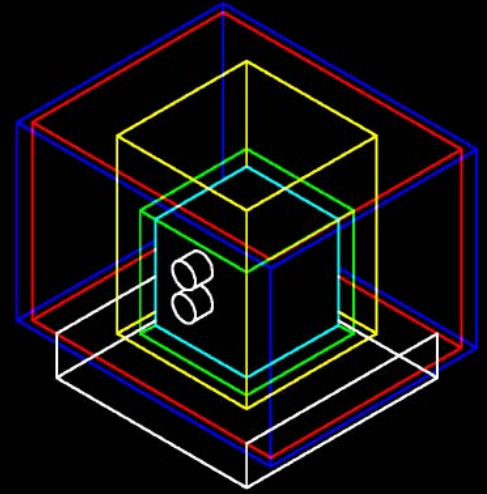
BONSAI FOREST /
URBAN GARDEN

CLEANER 



FINAL LAYER STUDY

THE MANY LAYERS OF GLASS WITHIN THE BUILDING WORK TOGETHER TO MAKE THE BUILDING FUNCTION EFFECTIVELY AND EFFICIENTLY. AS A PERSON MOVES FROM THE OUTSIDE PERIMETER TOWARDS THE CENTER OF THE BUILDING, THE AIR GETS GRADUALLY CLEANER UNTIL THERE ARE ONLY TEN DUST PARTICLES PER MILLION IN THE CLEANROOM VENT HOOD.

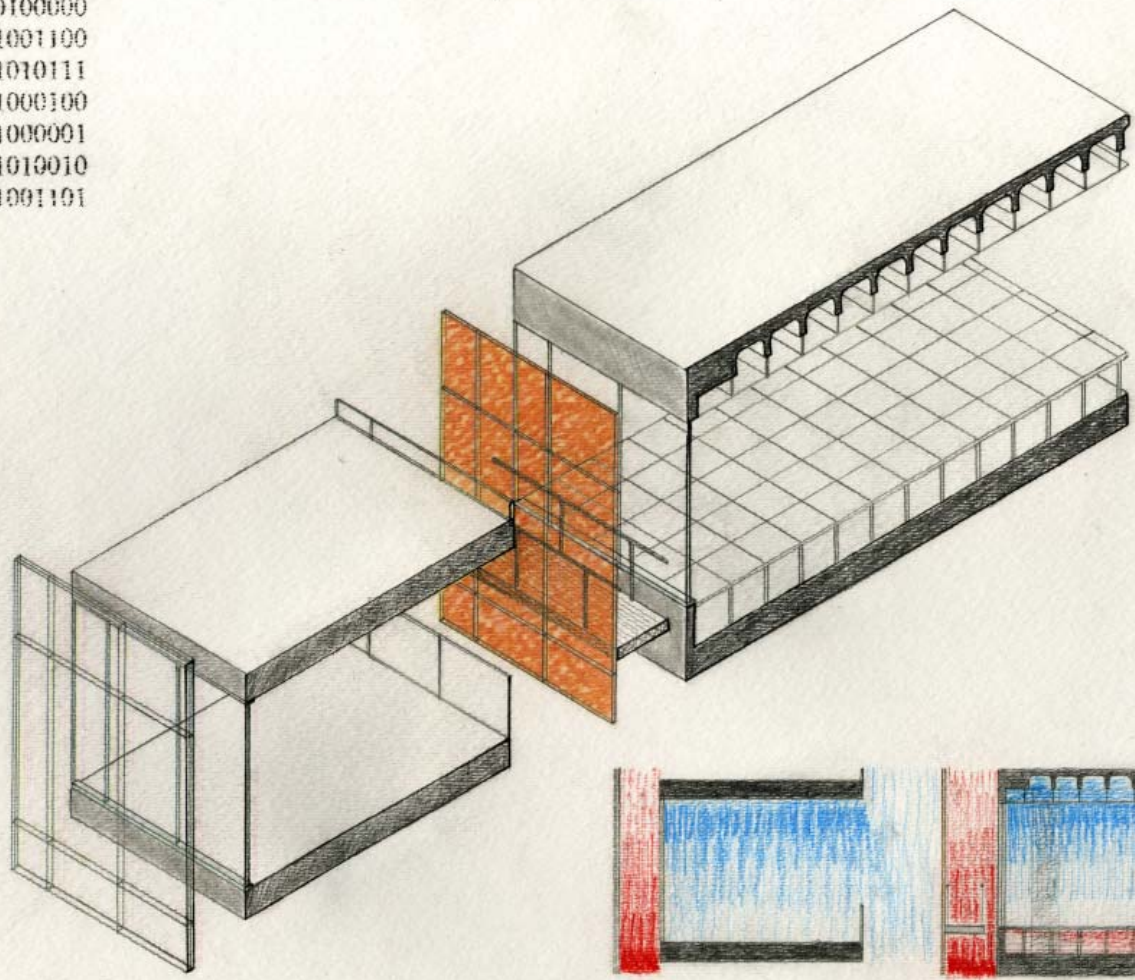


LAYER DIAGRAMS

THESE ARE CONCEPTUAL LAYER DIAGRAM WHICH START TO DEFINE DIFFERENT SPACES WITHIN THE BUILDING

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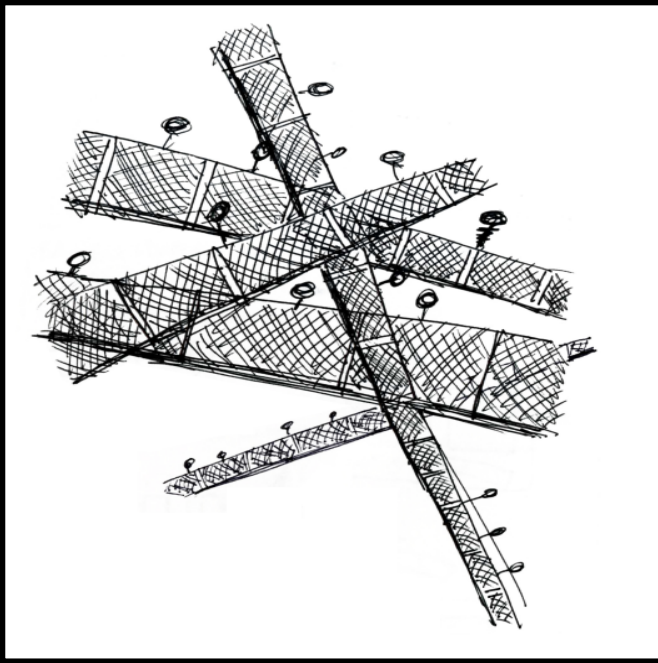
AIR FLOW DIAGRAM

AIR FLOW DIAGRAM

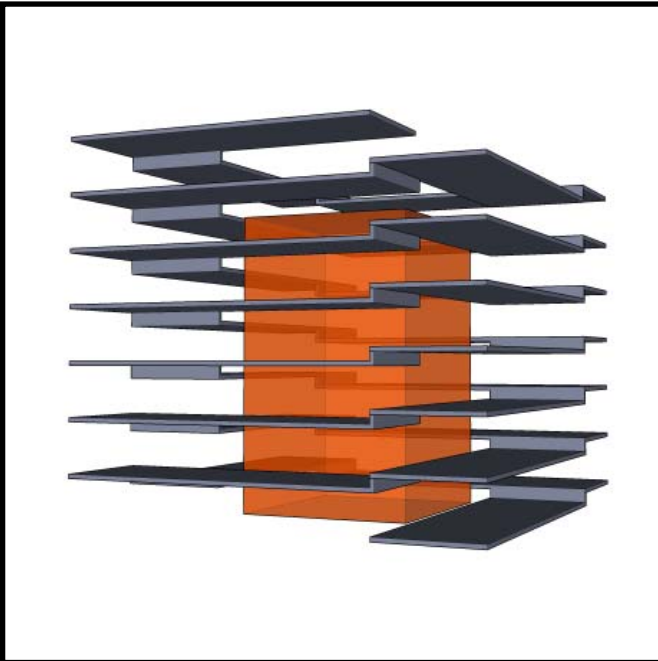
THIS IS A CONCEPTUAL DRAWING SHOWING THE DOUBLE SKIN ON THE EXTERIOR OF THE BUILDING AND THE DOUBLE SKIN PLENUM FOR THE CLEANROOM. IN TOTAL THERE ARE EIGHT DIFFERENT ENVIRONMENTS ASSOCIATED WITH THIS PROJECT, AND REPRESENTING DIFFERENT ENVIRONMENTAL AIR QUALITIES

THE DIFFERENT AIR ENVIRONMENTS INCLUDE: CITY AIR, DOUBLE SKIN, HALLWAY, LABORATORY, ATRIUM, CLEANROOM PLENUM, CLEANROOM, AND CLEANROOM TOOL (WHICH INCLUDES A LAMINIAR FLUE HOOD).

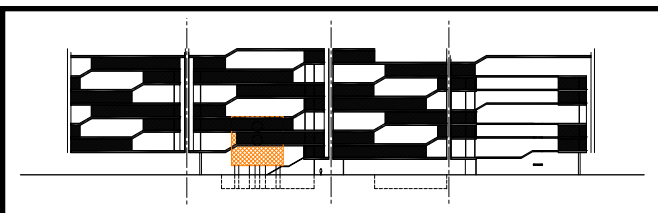
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TOP LEFT:
CONCEPTUAL SKETCH SHOWING
INTERSECTING BRIDGES. THIS
REPRESENTS SOME OF MY FIRST
THOUGHTS ABOUT USING
CIRCULATION AS A TOOL FOR
INTERACTION.



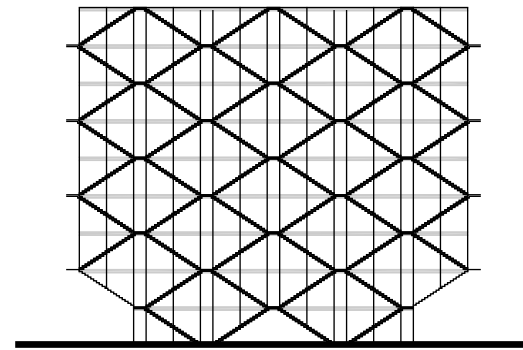
MIDDLE LEFT:
EARLY 3D STUDY OF THE SPIRAL
FLOOR PLAN. THIS THOUGHT CAME
ABOUT THROUGH A DISCUSSION WITH
PAUL EMMONS ABOUT THE IDEA OF
"ONE STAIR THAT TAKES YOU
TO DIFFERENT PLACES".



BOTTOM LEFT:
FACADE STUDY LOOKING AT HOW
THE SPIRAL PLAN WAS EXPRESSED
ON THE EXTERIOR OF THE BUILDING,
AND HOW THAT COULD RELATE
INTERACTION. THIS HELP LEAD ME
TO CREATE CIRCULATION ON THE
EXTERIOR PERIMETER OF THE
BUILDING.

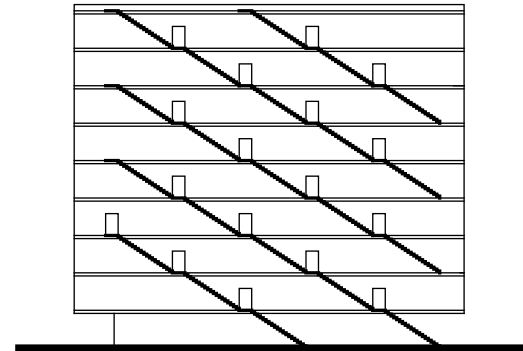
CIRCULATION

THE DESIGN OF THE CIRCULATION IS A VITAL PART OF THE ORGANIZATION OF THIS BUILDING. THE PATH THROUGH THE BUILDING WAS SET UP AS A WAY TO ENCOURAGE INTERACTION BETWEEN THE BUILDINGS OCCUPANTS. IT COULD BE LOOKED AT AS A SORT OF FORCED INTERACTION. THE IDEA BEING THAT GETTING PEOPLE TO BUMP INTO EACH OTHER WOULD ENCOURAGE COMMUNICATE AND THE EXCHANGE IDEAS, RESULTING IN MORE INSPIRED AND CREATIVE SOLUTIONS TO THE WORK AT HAND. THIS IS ACCOMPLISHED BY HAVING THREE DIFFERENT WAYS TO MOVE THROUGH THE BUILDING - SPIRAL FLOOR PLAN, STAIRS, AND ELEVATORS.



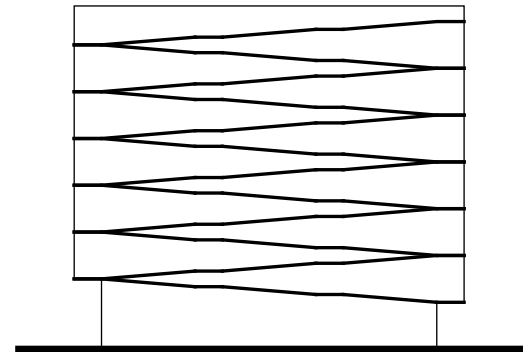
THE FLOOR PLAN SPIRALS AROUND THE CLEANROOM IN THE CENTER OF THE BUILDING, CREATING A SORT OF CLOISTER WALK WITH CONTROLLED VIEWS THROUGH THE LABORATORY SPACES, TO THE CENTER ATRIUM AND CLEAN ROOM.

THE STAIRS INHABIT THE EXTERIOR PERIMETER OF THE BUILDING AND GIVE THE USER MULTIPLE OPTIONS FOR HOW TO ASEND TO THEIR DESIRED FLOOR. IN ADDITION, THERE ARE TWO ELEVATORS IN THE BUILDING, WHICH ARE DESIGNED TO BE ABLE TO ACCESS EACH OF THE FLOORS THAT MAKE UP THE SPIRAL.



THERE ARE COUNTLESS NUMBERS OF WAYS TO MOVE THROUGH THE BUILDING, BUT WHETHER A PERSON IS WORKING IN THE CLEANROOM, A LABORATORY, THE LIBRARY, OR WANDERING THROUGH THE BUILDING, THERE IS ALWAYS A LINE OF SITE THAT ALLOWS PEOPLE TO SPOT ONE ANOTHER, AND INTERACT.

IN ADDITION, I SET THE FLOOR PLAN UP WITH AN IDEA THAT GOES AGAINST THE MORE TRADITIONAL LAYOUT FOR AN EDUCATIONAL TOWER. TYPICALLY, THE FRESHMAN WOULD BE IN THE LOWER FLOORS OF THE BUILDING, AND THE GRADUATE LEVEL WOULD BE ON THE HIGHER FLOORS. IN THIS BUILDING HOWEVER, IT SEEMED MORE APPROPRIATE FOR THE NANOTECHNOLOGY PROGRAM TO START AT THE TOP OF THE BUILDING, AFTER THE LIBRARY. THE STUDENT WOULD THEN WORK THEIR WAY DOWNWARD THROUGH THE SPIRAL FLOOR PLAN, AND WOULD GRADUALLY GET CLOSER TO THE CLEANROOM, CULMINATING THEIR LEARNING EXPERIENCE BY CREATING THEIR FINAL "ATOMIC SCALED" PROJECT. THIS ALLOWS A SITUATION WHERE NOT ALL THINGS ARE REVEALED AT ONCE BUT IN STAGES UNTIL THERE IS A CLEAR PICTURE, ALLOWING A MORE COMPLETE UNDERSTANDING. AT THE END OF THE STUDENT'S CURRICULUM, THE STUDENT IS THEN ABLE TO LEAVE THE BUILDING BY CONTINUING ALONG THE SPIRAL PATH. THEY LEAVE THE BUILDING, DEGREE IN HAND.



EARLY STAIR STUDIES
EXPLORING THE IDEA OF
CIRCULATING VERTICALLY
AT THE PERIMETER OF
THE BUILDING.

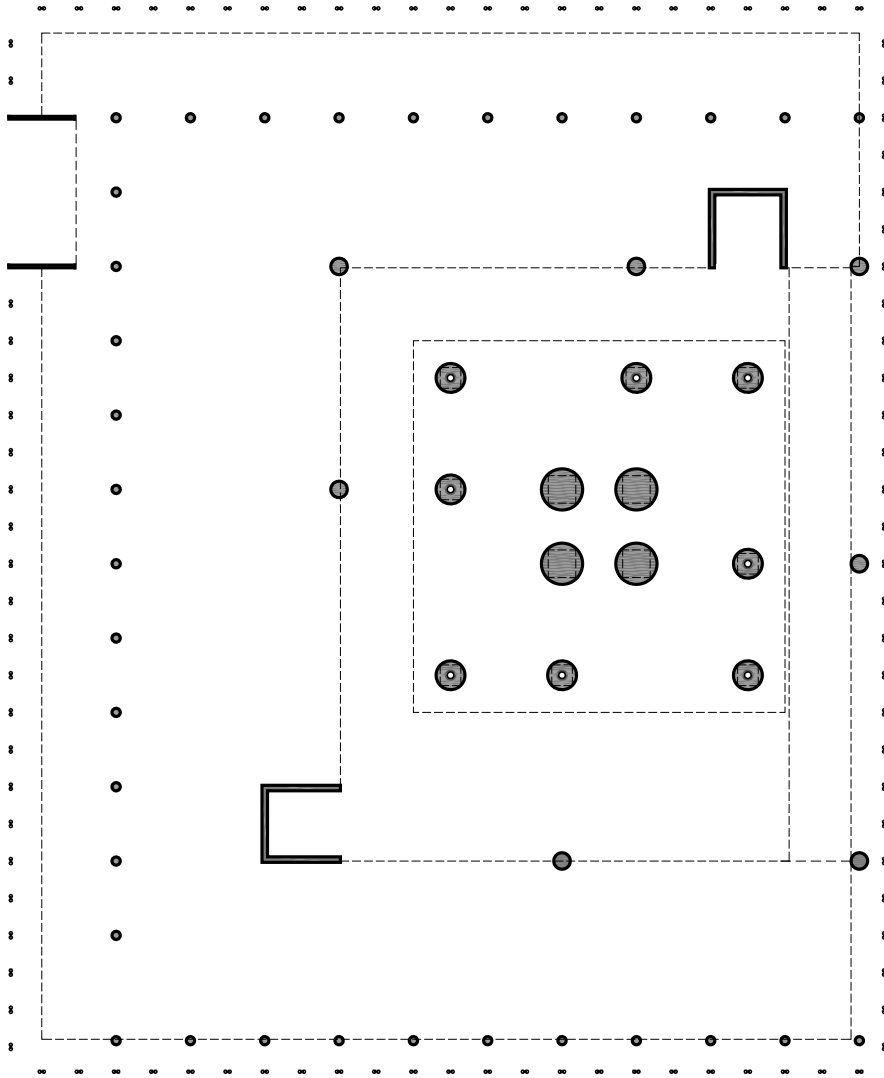
AS MENTIONED BY PAUL EMMONS AT MY FINAL DEFENSE, THE BUILDING HAS A CORRELATION TO THE TOWER OF BABEL, BUT IN A WAY, HAS THE OPPOSITE EFFECT OF THE TOWER. SINCE A STUDENT HAS A DOWNWARD PROGRESSION THROUGH THE BUILDING, THE STUDENT LEAVES THE BUILDING AT ITS' BASE, GROUNDED AND WITH A GREATER UNDERSTANDING OF THE WORLD, BE IT AT THE ATOMIC WORLD.

STRUCTURE

THE SCALE OF COLUMNS IS SMALL ON EXTERIOR PERIMETER AND LARGER AS ONE MOVED TOWARDS THE CENTER OF BUILDING. THIS IDEA CAME ABOUT BY CREATING A RELATIONSHIP BETWEEN THE CITY THE ATOM AND THE COLUMNS.

AS A PERSON MOVES TOWARDS THE CENTER, THEY MOVE CLOSER TO THE SCALE OF THE ATOM. TO MAKE A PERSON FEEL AS IF THEY HAVE ENTERED THE WORLD OF THE ATOM, I HAD TO TAKE THE ATYPICAL APPROACH OF MAKING THE PERSON FEEL THE MONUMENTALITY AND DIMINUTIVENESS OF THE SPACE AT THE SAME TIME. THE IDEA IS THAT THE PERSON WOULD FEEL DISPROPORTIONATELY LARGE COMPARED TO THE SPACE AROUND THEM, BUT AT THE SAME TIME WOULD BE OVERWHELMED BY THE SIZE OF THE MATERIALS AND STRUCTURE REPRESENTING LARGE ATOMIC BUILDING BLOCKS.

IN THIS SPACE, ONE CONCEPTUALLY ENTERS THE WORLD OF THE ATOM



TYPICAL STRUCTURAL COLUMN LAYOUT SHOWING THE SHIFT IN SCALE FROM CITY TO ATOM.

CITY



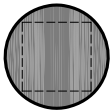
CIRCULATION



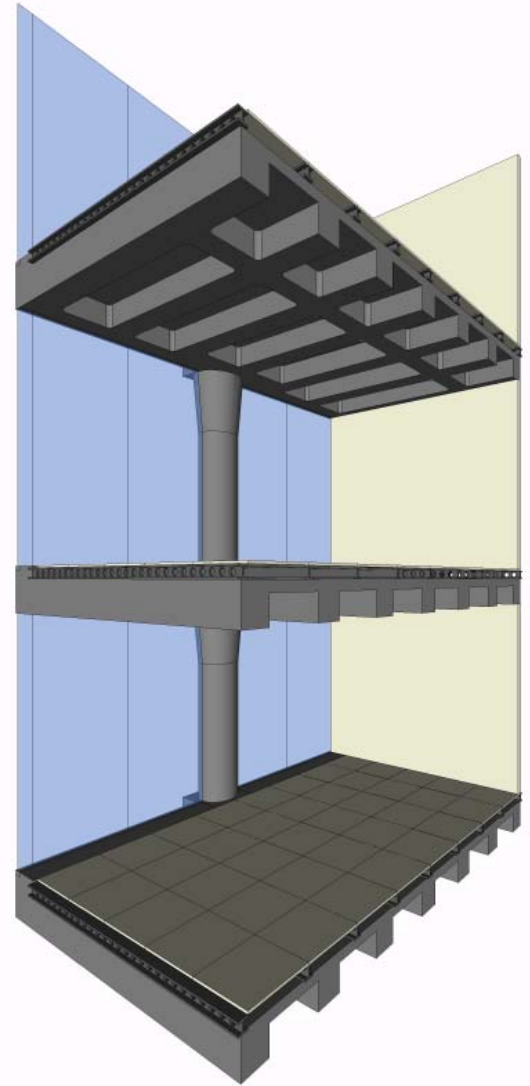
LABORATORY



CLEANROOM



ATOM



RELATIONSHIP / SCALE OF STRUCTURAL MEMBERS. THE SCALE OF THE COLUMN INCREASES AS ONE MOVES FROM THE CITY, TOWARDS THE CLEANROOM.

THE STRUCTURE IS COMPOSED OF WAFFLE SLABS THROUGHOUT THE BUILDING FOR STRENGTH, AND TO ALSO ALLOW THE ESSENCE AND PURITY OF THE STRUCTURAL SYSTEM TO BE EXPOSED THROUGHOUT THE BUILDING.

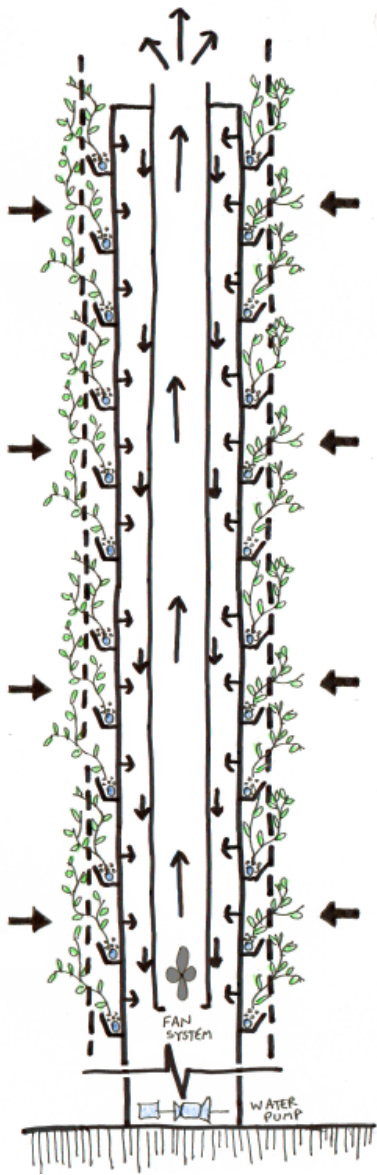


BIOFILTER GARDEN WALL

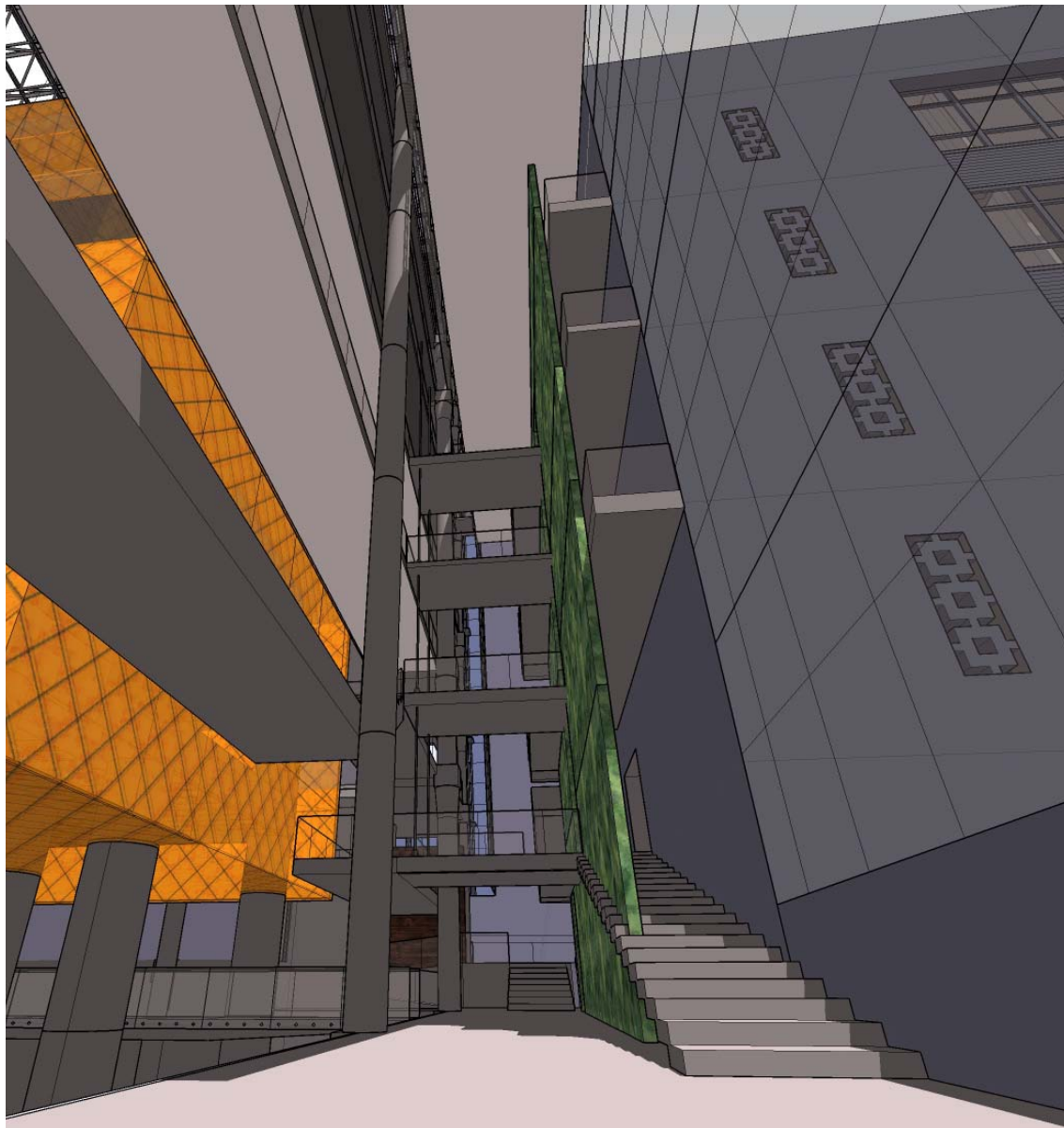
SECTION THROUGH THE ATRIUM
 LOOKING SOUTH AT THE INDOOR
 AIR BIOFILTER GARDEN WALL.
 THIS GARDEN WALL IS A PHYSICAL
 BARRIER BETWEEN TOMPKINS HALL
 AND THE NANOTECHNOLOGY
 RESEARCH LABORATORY, AND
 BRINGS LIFE AND GREENERY TO
 THE ATRIUM, WHILE PROVIDING A
 WAY TO FILTER THE AIR.

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CLEAN AIR

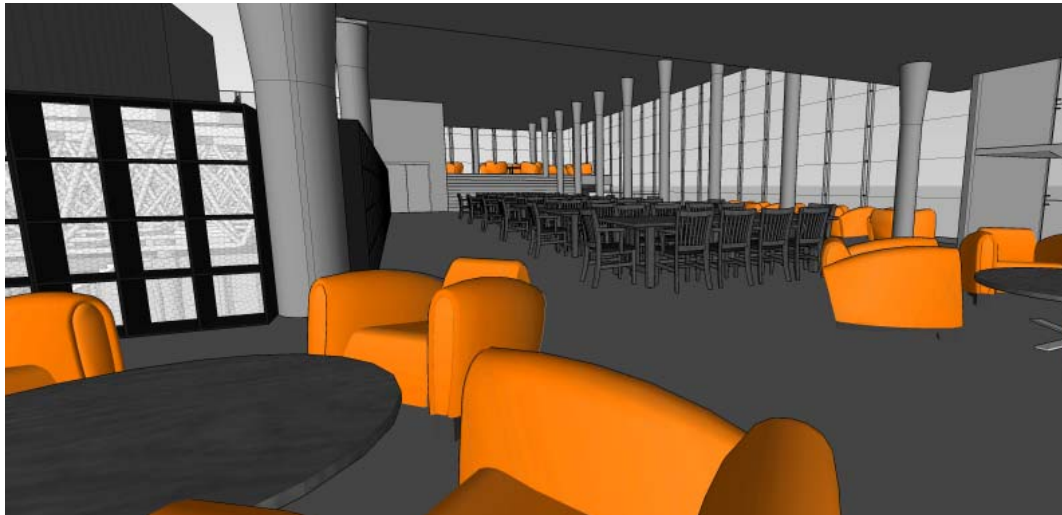
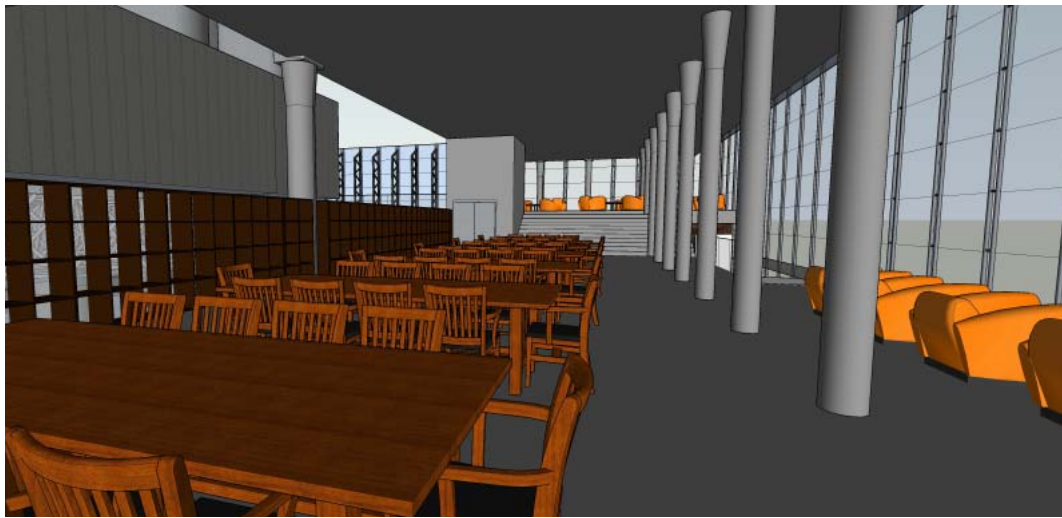


SKETCH OF A SECTION THROUGH THE BIOFILTER GARDEN WALL. THIS SYSTEM IS DESIGNED TO BE VERY LOW MAINTENANCE, AND TO USE THE VEGETATION GROWING THROUGHOUT THE WALL AS AN AIR FILTER, CLEANSING THE AIR IN THE ATRIUM AND AROUND THE CLEAN ROOM.



VIEW OF THE ATRIUM AT THE FRONT ENTRANCE. THIS SHOWS THE GARDEN WALL, THE BRIDGES ABOVE, AND THE STAIRS THAT CONNECT TO TOMPKINS HALL.

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TOP RIGHT:
LIBRARY GREAT ROOM
LOOKING TOWARDS THE
READING ROOM IN THE DIS-
TANCE.

MIDDLE RIGHT:
GROUP LOUNGE, LOOK-
ING TOWARDS THE GREAT
ROOM.

BOTTOM RIGHT:
VIEW INTO LIBRARY'S
GREAT ROOM FROM
UPPER ROOF GARDEN.

LIBRARY

THE NANO-SCIENCE LIBRARY IS LOCATED ON THE PENTHOUSE OF THE BUILDING AND IS THE STARTING POINT FOR ALL OF THE SCHOOL'S DEGREE PROGRAMS. THIS IS THE PLACE WHERE ALL OF THE SCHOOL'S CUMULATIVE KNOWLEDGE ON THE TOPIC OF NANOTECHNOLOGY IS HOUSED, AND IS DESIGNED AS A PLACE FOR STUDENTS AND PROFESSORS TO MEET AND EXCHANGE IDEAS.

ONE MUST PASS THROUGH THE LIBRARY TO GET TO THE UPPER URBAN GARDENS AND THE BONSAI FOREST. THE READING ROOM ALLOWS DIRECT ACCESS TO THESE GARDENS, AS WELL AS PROVIDES AN OUTDOOR READING SPACE.

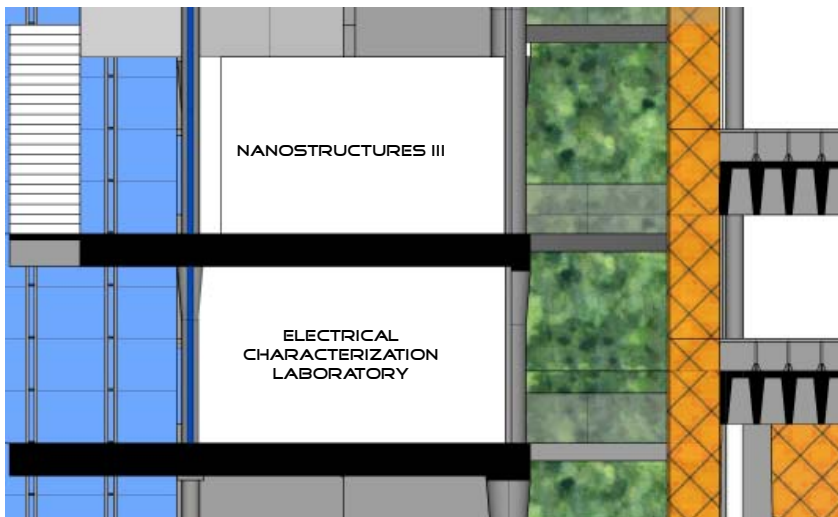


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LABORATORIES

IT IS IMPORTANT FOR A LABORATORY SPACE TO ALLOW INTERACTION OF SCIENTISTS, WHILE ALSO BEING REMINDED OF THE GOALS SET FOR THEIR WORK. SOME OF THE GREATEST SCIENTIFIC ACHIEVEMENTS ARE THE RESULT OF COLLABORATION WITH PEERS. MANY LABORATORY BUILDINGS HAVE BEEN DESIGNED IN A WAY THAT EXCLUDES THIS IMPORTANT FEATURE, AND THE BUILDINGS BECOME STERILE ENVIRONMENTS THAT ARE LESS THAN INSPIRING PLACES TO WORK.

IN THIS BUILDING, THE LARGER LABORATORIES, WITH HIGHER CEILINGS, WERE DESIGNED AS THINK TANK AREAS FOR GROUP WORK AND INTERACTION, WHEREAS THE SMALLER LABORATORIES ARE MORE PRONE TO ONE ON ONE WORK. THESE SPACES WERE ALSO CONCEIVED OF AS IN-BETWEEN SPACE FOR THE SCIENTISTS, AMID THE MACHINE AND THE HUMAN WORLDS. ON ONE SIDE IS THE PUBLIC CIRCULATION AREAS AND THE OTHER IS THE CLEANROOM IN THE CENTER ATRIUM. THE LABORATORIES ARE BUILT AROUND THE SCALE OF THE HUMANS WHO INHABIT THEM, AND ALLOW THE USER VIEWS INTO THE CLEANROOM AND OUT TO THE CITY, SO THAT THEY CAN ESCAPE FROM THE RIGOR OF THEIR WORK AND EXPERIENCE MULTIPLE SCALES AT ONCE.

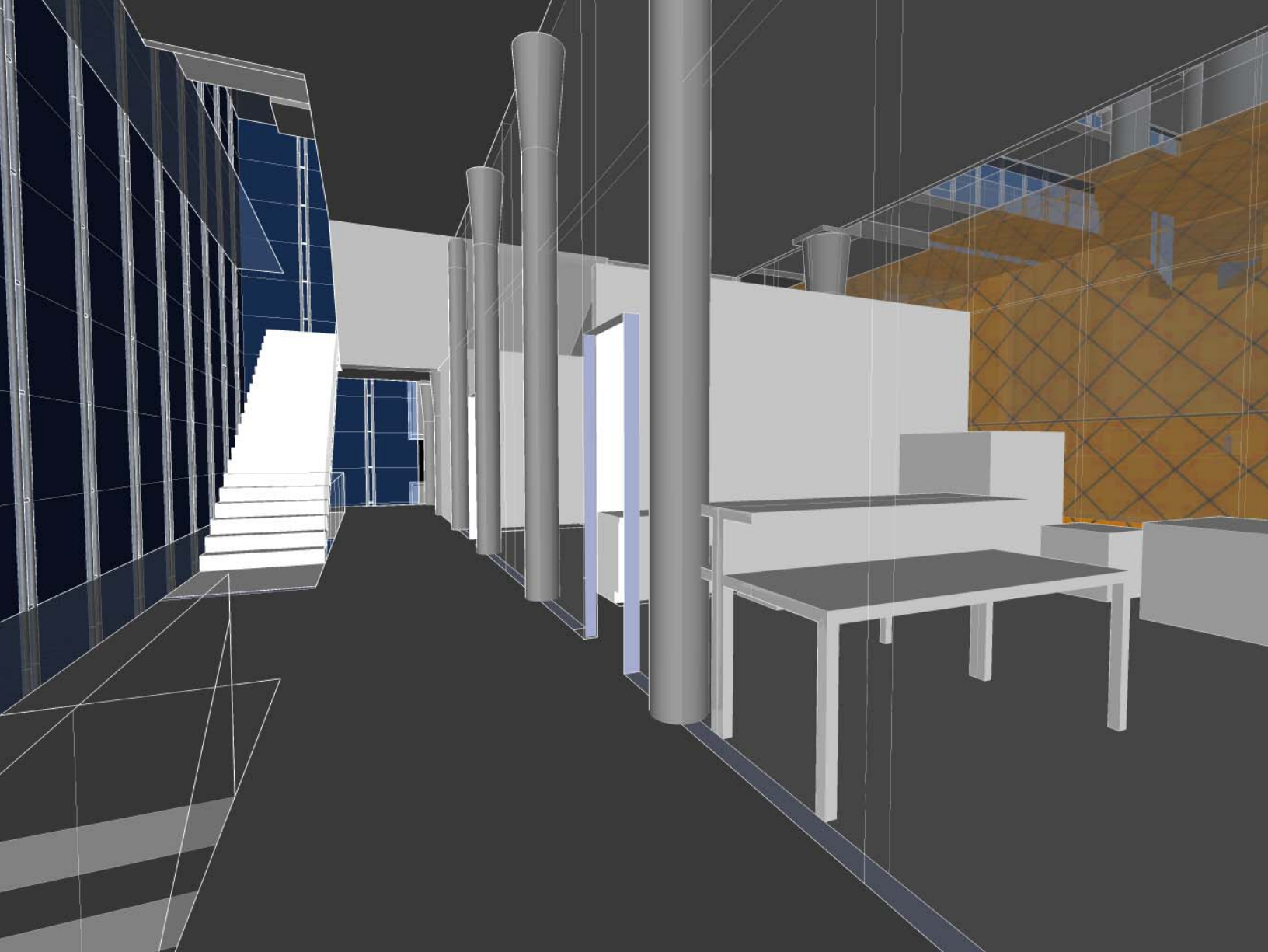


TOP LEFT:
STUDY OF LABORATORY WITH
CIRCULATION ON EXTERIOR
PERIMETER.

MIDDLE LEFT:
SECTION THROUGH THE ELECTRICAL
CHARACTERIZATION LABORATORY
SHOWING CIRCULATION ON ONE SIDE
AND THE CLEANROOM ON THE OTHER.

BOTTOM LEFT:
PERSPECTIVE OF THE ELECTRICAL
CHARACTERIZATION LABORATORY

RIGHT:
PERSPECTIVE DOWN EASTERN
CORRIDOR SHOWING THE ELECTRICAL
CHARACTERIZATION LABORATORY
ON THE RIGHT.



THE CURRICULUM FOR THE NANOTECHNOLOGY PROGRAM STARTS AT THE TOP OF THE BUILDING AND FOLLOWS A LINEAR PATH THROUGH TO COMPLETION OF THE PROGRAM. THE LABORATORIES THAT ARE LOCATED WITHIN THIS BUILDING, IN ORDER OF USE, ARE AS FOLLOWS:

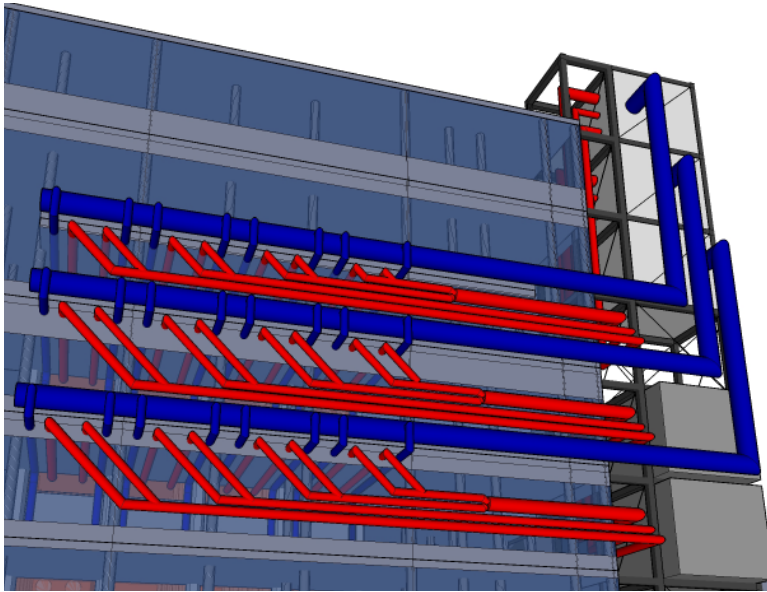
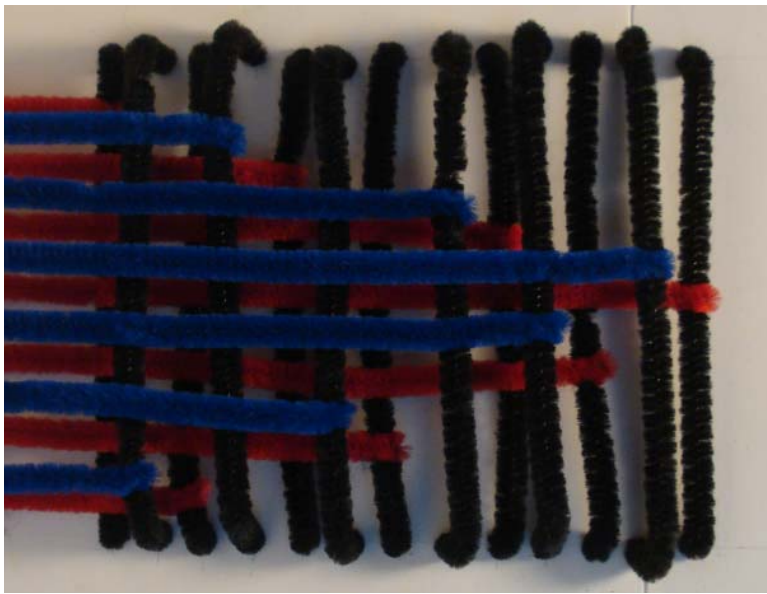
- | | | | | | |
|----|--|-----|------------------------------|-----|---|
| 1. | INSTRUCTIONAL LABORATORY | 6. | TEM I | 15. | ELECTRICAL CHARACTERIZATION |
| 2. | OPTICAL CHARACTERIZATION DEVICES AND FLUIDICS LABORATORY | 7. | TEM II | 16. | RF/MICROWAVE CHARACTERIZATION |
| 3. | MOLECULAR ELECTRONICS LABORATORY | 8. | TEM III | 17. | COMPUTER LAB / INSTRUCTIONAL LABORATORY |
| 4. | OPTICAL AND SURFACE ANALYSIS LABORATORY | 9. | NANOSTRUCTURES I | 18. | NANOMECHANICAL - MEMS LABORATORY |
| 5. | TEM PREP | 10. | NANOSTRUCTURES II | 19. | MOLECULAR BEAM EPITAXY |
| | | 11. | NANOSTRUCTURES III | | |
| | | 12. | CHEMICAL VAPOR DEPOSITION I | | |
| | | 13. | CHEMICAL VAPOR DEPOSITION II | | |
| | | 14. | INSTRUCTIONAL LABORATORY | | |

MECHANICAL SYSTEM

THE MECHANICAL SYSTEM IS AT THE HEART OF THE CLEANROOM, AND IS WHAT TRULY MAKES IT CLEAN.

THE TYPICAL MECHANICAL SYSTEM OF A CLEANROOM, IS MUCH LARGER THAT WHAT IS NEEDED FOR A TYPICAL BUILDING, BECAUSE OF THE FACT THAT ALL OF THE AIR NEEDS TO CIRCULATE ALL OF THE AIR IN THE CLEANROOM UP TO NINE TIMES EACH MINUTE. DEPENDING ON WHAT IS BEING PRODUCED WITHIN THE CLEANROOM, THE MECHANICAL SYSTEM WILL CYCLE THE AIR UNTIL THERE ARE 10, 100, OR 1000 FOREIGN PARTICLES PER MILLION. THIS IS EXTREMELY CLEAN AIR, AND IT HAS TO BE BECAUSE OF DUST FALLS ON ANY OF THE RESEARCH PROJECT, THE WORK CAN BE DESTROYED.

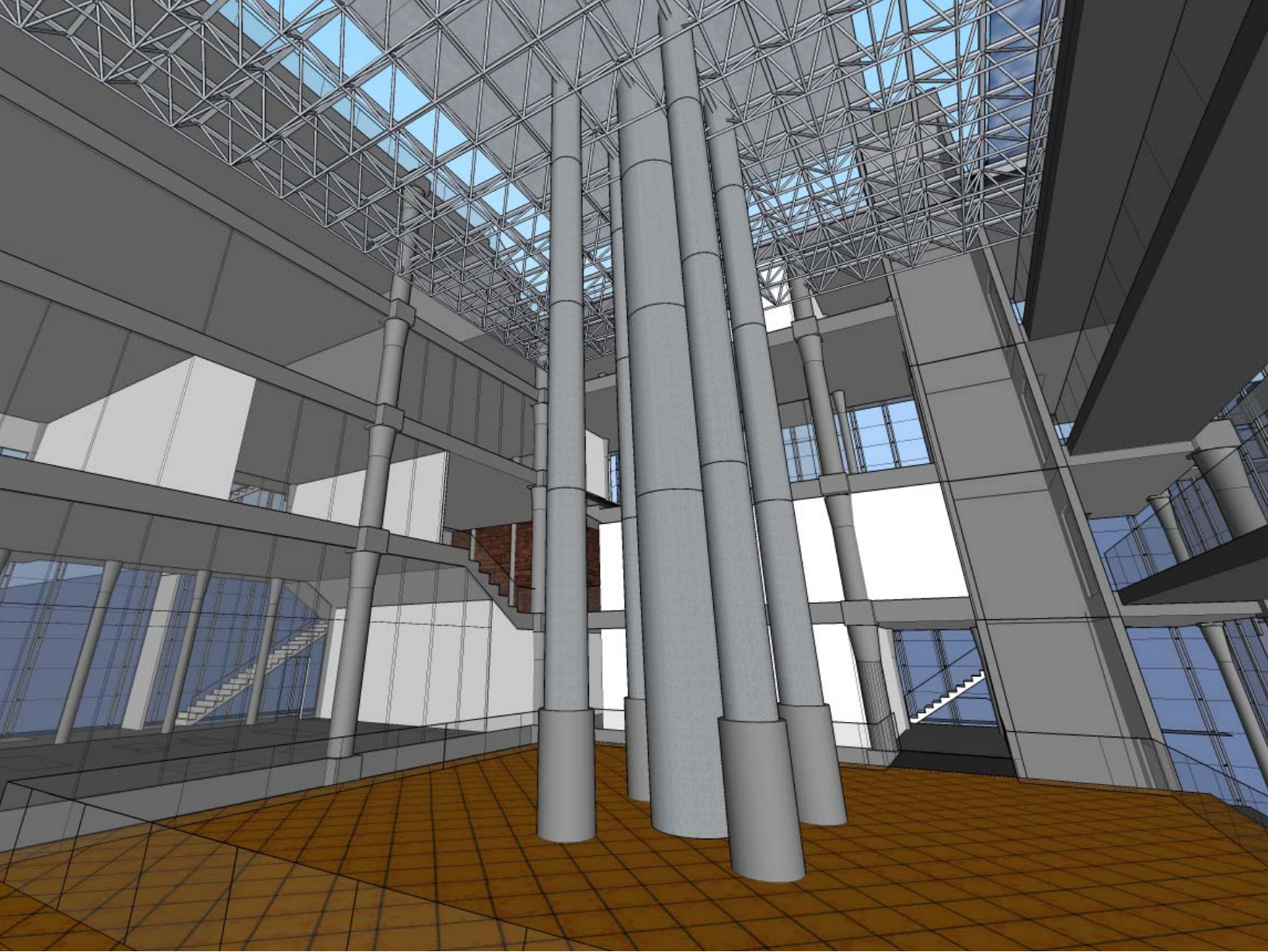
BECAUSE THE CLEANROOM IS VERY SENSITIVE TO VIBRATION, I DECIDED TO MOVE THE MECHANICAL SYSTEM DIRECTLY ABOVE IT, AND ALLOWED THE UNITS TO REST ON THE STRUCTURE FOR THE LABORATORIES. THIS WILL HELP PREVENT ANY VIBRATIONS FROM BEING TRANSFERRED TO THE CLEANROOM, AND ENSURE A PRODUCTIVE ENVIRONMENT FOR ANYONE USING THE CLEANROOM,



TOP LEFT:
EARLY CONCEPTUAL MODEL OF MECHANICAL SYSTEM MADE FROM PIPE CLEANERS. THIS DESIGN WAS INSPIRED FROM A PIECE OF EQUIPMENT AT A FACTORY THAT PRODUCES CIRCUIT BOARD. THIS DIAGRAM CAN REPRESENT THE FLOW OF HOT AND COLD WATER, OR SUPPLY AND RETURN AIR.

BOTTOM LEFT:
EARLY CONCEPTUAL DRAWING EXPLORING THE IDEA OF AN EXPOSED MECHANICAL SYSTEM.

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ON TOP OF THE CLEAN ROOM, IN THE CENTER OF THE ATRIUM SHOWS THE EXPOSED DUCTWORK WHICH RISES TO THE MECHANICAL SYSTEM SUPPORTED ABOVE.

CLEANROOM: CONCEPTUAL IDEAS

THE CLEANROOM IS THE DEFINING FEATURE OF THIS NANOTECHNOLOGY RESEARCH LABORATORY. IT IS THE PLACE WHERE ALL OF THE RESEARCH CUMULATES, AND WHERE SOMETHING IS PRODUCED. IT COULD BE A PRODUCT, AN ELECTRONIC CIRCUIT, A NEW MATERIAL, OR MAYBE EVEN A NANOBOT.

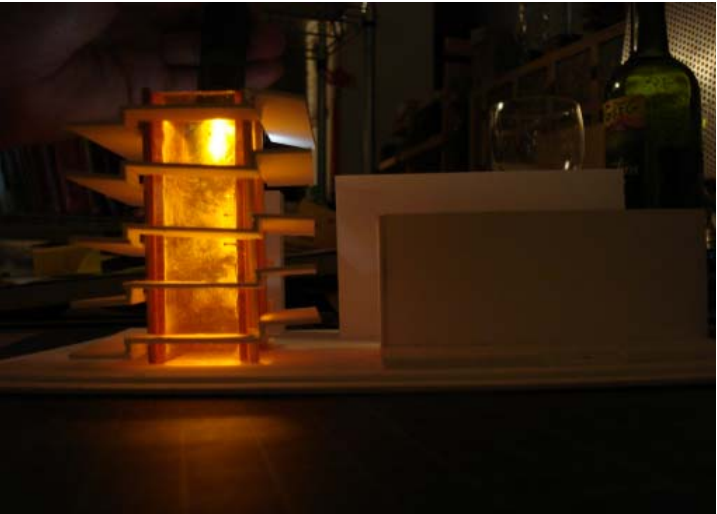
THE DEFINING MOMENT FOR ME WAS WHEN I DECIDED TO SEPARATE THE CLEANROOM FROM THE REST OF THE BUILDING, ESSENTIALLY CREATING A BUILDING WITHIN A BUILDING. I HAD SPENT A GREAT DEAL OF TIME DOING RESEARCH ABOUT THE TYPES OF SYSTEMS, SPACES, STRUCTURES, AND MATERIALS THAT WERE NEEDED IN A CLEANROOM, AND DURING THE PROCESS NOTICED THAT EVERY PICTURE I SAW OF A WINDOW IN A CLEANROOM WAS ORANGE. I CAME TO LEARN THAT THIS WAS A FILM THAT WAS USED TO BLOCK STATIC AND UV LIGHT. ULTIMATELY THIS EVOLVED INTO AN IDEA TO CONTAIN THE ENTIRE CLEANROOM IN AN ORANGE GLASS CUBE. ESSENTIALLY A GLOWING JEWEL IN THE CENTER OF THE BUILDING.

BECAUSE OF THIS IDEA OF THE GLOWING JEWEL, I WANTED TO HAVE THE CLEANROOM FLOATING BY ITSELF IN THE CENTER OF THE BUILDING. WITH THE HELP OF ULRIKE ALTENMÜLLER, AND MY COMMITTEE, THIS IDEA EVOLVED INTO THE IDEA OF LIFTING THE SPACE ONTO COLUMNS. THIS MOVE ALLOWED A PERSON TO INHABIT THE SPACE ABOVE AND BELOW THE CLEANROOM.

TOP LEFT:
CONCEPTUAL PAINTING
EXPLORING THE IDEA OF
THE CLEANROOM AS A
GLOWING ORANGE JEWEL.

MIDDLE LEFT:
CONCEPTUAL MODEL
EXPLORING THE IDEA OF AN
ORANGE GLOWING MASS
SURROUNDED BY THE
SPIRAL FLOOR PLAN.

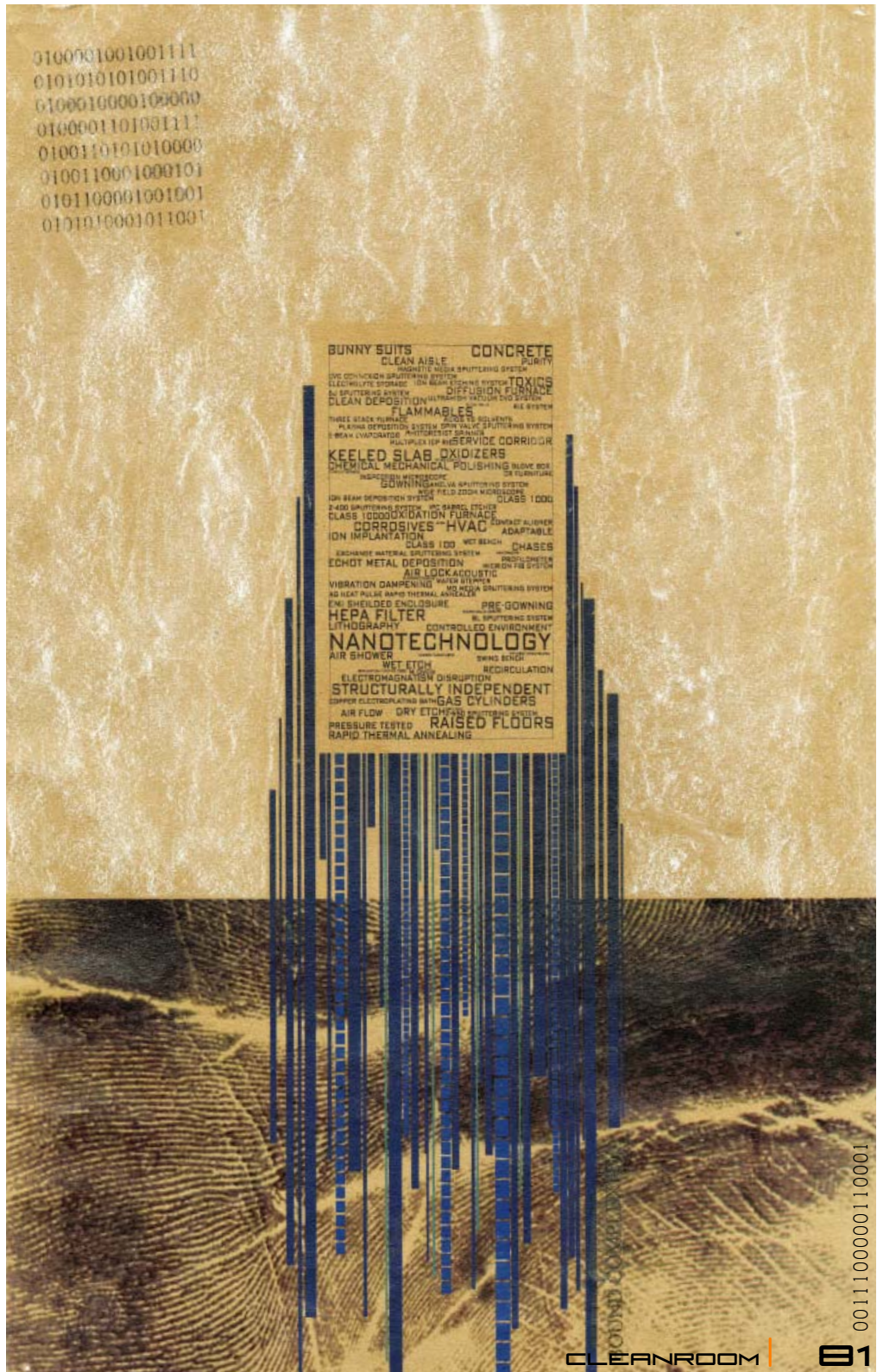
BOTTOM LEFT:
CONCEPTUAL PHOTOGRAPH
SHOWING WHAT A CORNER
OF THE GLOWING ORANGE
CLEANROOM COULD LOOK
LIKE



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0100001101001111
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BUNNY SUITS CLEANABLE CONCRETE
MAGNETIC FILM SPUTTERING SYSTEM
DYE COCHROME SPUTTERING SYSTEM
ELECTROLYTE STORAGE ION BEAM ETCHING SYSTEM
AL SPUTTERING SYSTEM DIFFUSION FURNACE
CLEAN DEPOSITION FLAMMABLES TOXICS
THREE SLAB FURNACE CLASS 10 SOLVENTS
PLASMA DEPOSITION SYSTEM GASEOUS SPUTTERING SYSTEM
1-BREAK CRYSTALLINE POLYESTER DRUMS MULTIPLE STEP RESERVE CORRIDOR
KEELED SLAB OXIDIZERS
CHEMICAL MECHANICAL POLISHING SLUVE BOX
INGRESSION MICROSCOPE DOWNING AND VA SPUTTERING SYSTEM
ION BEAM DEPOSITION SYSTEM WET FILM ZOOM MICROSCOPE CLASS 1000
2400 SPUTTERING SYSTEM WET BARREL ETCHER
CLASS 10000 OXIDATION FURNACE CONTACT ALIGNER
CORROSIVES HVAC ADAPTABLE
ION IMPLANTATION CLASS 100 WET BEACH CHASES
KROHNE MATERIAL SPUTTERING SYSTEM PROFLIGHTER
ECHO METAL DEPOSITION WATER FILM SYSTEM
VIBRATION DAMPENING WATER STEPPER
HEPA FILTER PRE-GOWNING
LITHOGRAPHY CONTROLLED ENVIRONMENT
NANOTECHNOLOGY
AIR SHOWER WET ETCH
ELECTROMAGNETISM DISRUPTION RECIRCULATION
STRUCTURALLY INDEPENDENT
SUPPORT ELECTRONIC GAS CYLINDERS
AIR FLOW DRY ETCHING SPUTTERING SYSTEM
PRESSURE TESTED RAISED FLOORS
RAPID THERMAL ANNEALING

BOUND COMPLEXITY.
CONCEPTUAL DRAWING
LISTING MANY OF THE
THINGS THAT A CLEANROOM
IS COMPOSED OF. ALSO
SHOWS THE IDEA OF THE
CLEANROOM BEING
SUPPORTED FROM BELOW,
BOTH STRUCTURALLY AND
SYSTEMICALLY.



CLEANROOM: GLASS

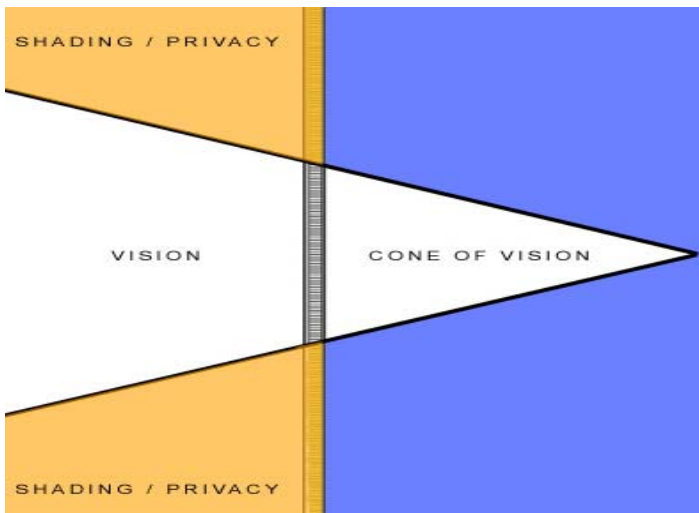
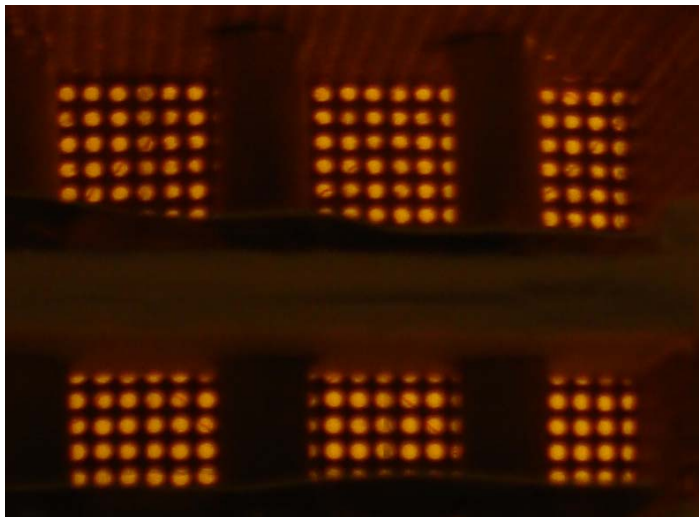
THE GLASS OF THE CLEANROOM IS ONE OF THE MOST IMPORTANT PARTS OF THE CLEANROOM, FOR BOTH ARCHITECTURAL REASONS, AND FOR THE FUNCTION OF THE SPACE. THIS GLASS SYSTEM WAS DESIGNED TO BLOCK ALL EXTERNAL ENVIRONMENTAL FACTORS THAT COULD POTENTIALLY DISRUPT OR DESTROY ANY WORK THAT IS OCCURRING IN THE CLEANROOM. THE SYSTEM IS BROKEN DOWN AS FOLLOWS:

1. UV LIGHT, AND STATIC ARE BLOCKED THROUGH FILMS THAT ARE APPLIED TO THE GLASS FAÇADE.
2. RADIO WAVES AND ELECTROMAGNETIC FIELDS ARE SHIELDED FROM A COPPER WIRE MESH OVERLAY, WHICH GIVES THE CUBE ITS UNIQUE DIAMOND PATTERN.
3. SOUND VIBRATIONS ARE REDUCED THROUGH THE USE OF A DOUBLE WALL AND DOUBLE PANE GLASS SYSTEM.
4. DETAILED VIEWS INTO THE CLEANROOM ARE OBSCURED THROUGH A SERIES OF PLASTIC TUBES IN THE PANELITE DOUBLE PANE GLASS SYSTEM.

IT IS A COMPLEX SYSTEM, BUT EACH PIECE WORKS TOGETHER TO CREATE AN ISOLATED ENVIRONMENT INSIDE THE CLEANROOM, WHICH IS IDEAL FOR THE STUDY AND MANIPULATION OF OBJECTS AT THE ATOMIC SCALE.

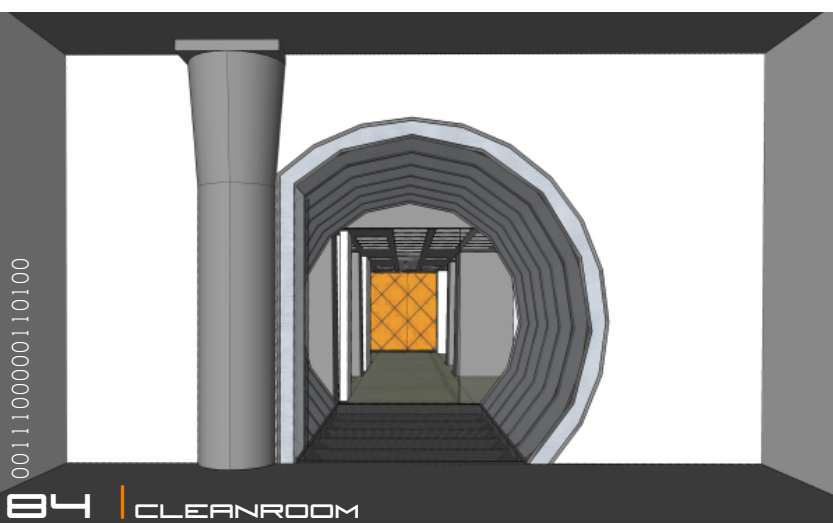
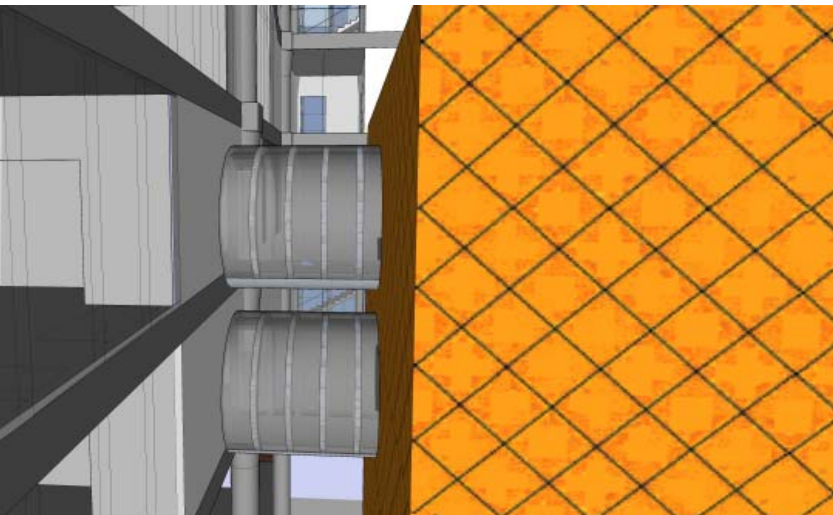
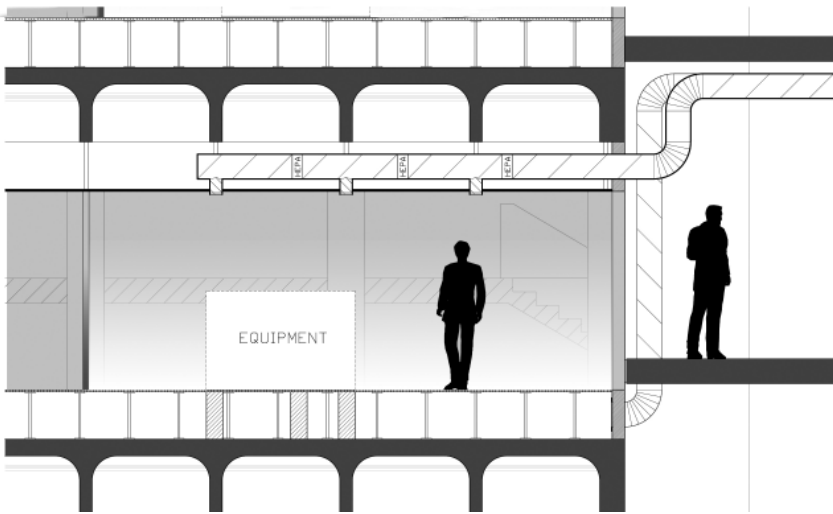
PANELITE CLEARSHADE IGU SERIES GLASS PANELS

THE PANELITE SYSTEM THAT IS USED TO LIMIT VIEWS INTO THE CLEANROOM IS A VERY INTERESTING SYSTEM BECAUSE AS ONE VIEWS THE CLEANROOM FROM A DISTANCE, THE OVERALL CONTEXT OF THE ACTIVITY INSIDE CAN BE SEEN, BUT IN LIMITED DETAIL. AS ONE MOVES CLOSER TO THE CLEANROOMS' EXTERIOR WALL TO TRY AND OBSERVE MORE DETAIL, THE TUBES WITHIN THE GLASS CREATES A PERSPECTIVE WHICH OBSCURES THE LINE OF SITE AT AN OBLIQUE ANGLE, LIMITING HOW MUCH INFORMATION CAN BE SEEN AT ONCE. THIS SYSTEM GIVES FULL DISCLOSURE OF THE EVENTS OCCURRING IN THE CLEANROOM, YET HELPS PROTECT SENSITIVE INFORMATION, BY NOT REVEAL ALL OF ITS SECRETS AT ONCE. THE USER IS GIVEN UNOBSTRUCTED VIEWS INTO THE CLEANROOM, BUT IS LIMITED TO HOW MUCH THEY CAN SEE AT A TIME. AT THE ATOMIC SCALE.



ONE CAN SEE THE OVERALL
CONTEXT BUT MUST LOOK
CLOSER TO FIND THE TRUTH
OF THAT WHICH IS NOT FIRST
REVELED.



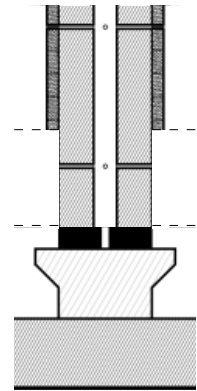


TOP LEFT:
EARLY CONCEPTUAL IDEA FOR THE RELATIONSHIP OF THE CLEANROOM TO THE LABORATORY, WITH EARLY MECHANICAL SYSTEM STUDY.

MIDDLE LEFT:
GLASS BRIDGE CONNECTION THE GOWNING AREA TO THE CLEANROOM.

BOTTOM LEFT:
ENTRANCE TO CLEANROOM FROM GOWNING AREA. THE GLASS TUBEULAR BRIDGE HAS A SECONDARY FUNCTION AS AN AIR SHOWER.

BOTTOM RIGHT:
CONCRETE COLUMNS HAVE ANTI-VIBRATION TECHNOLOGY IN THE FORM OF A RUBBER VIBRATION DAMPENER



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CLEAN ROOM

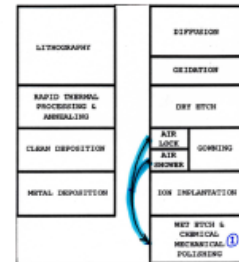
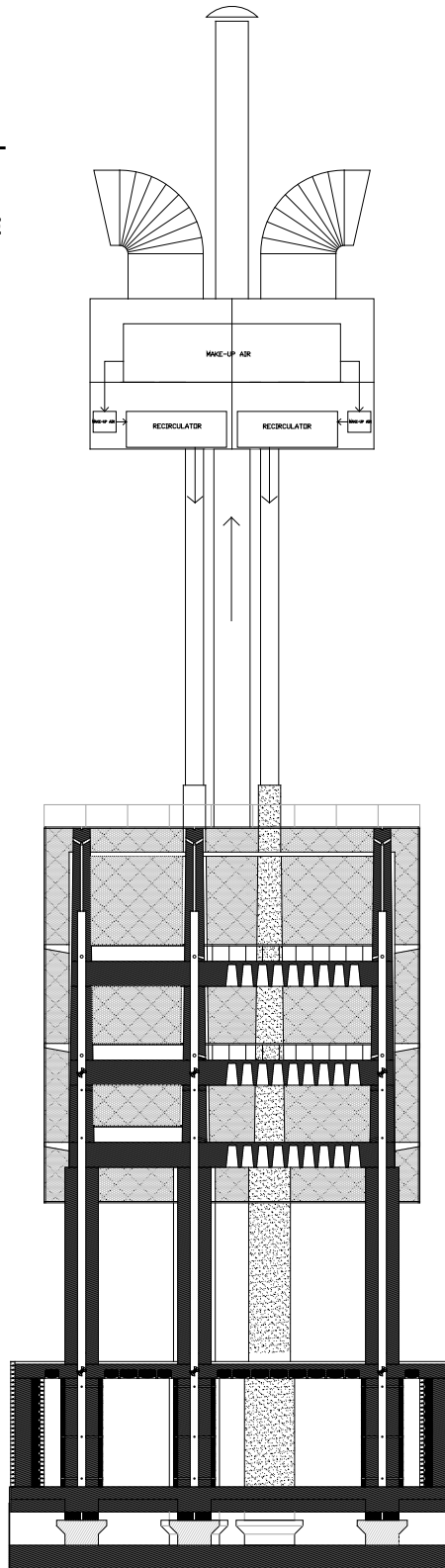
THE CLEANROOM IS DIVIDED INTO ITSELF IS BROKEN INTO A FEW DIFFERENT CATEGORIES. SUPPORT SPACE, WORKS SPACE, AND MECHANICAL SPACE. IN THE BASEMENT IS THE STORAGE SPACE FOR THE VOLATILE GASSES AND LIQUIDS THAT ARE USED IN THE CLEAN ROOM. THEY ARE STORED HERE UNTIL NEED, AND THEN TRANSPORTED TO THE FIRST FLOOR OF THE CLEANROOM, KNOWN AS THE SUBFAB. THE SUBFAB IS THE FLOOR RIGHT BELOW THE FAB AREA(OR CLEANROOM). THIS IS ESSENTIALLY A UTILITY SPACE WHERE IT IS OK NOT TO HAVE THE HIGHLY FILTERED AIR OF THE CLEANROOM.

THE CLEANROOM ITSELF IS MADE MOSTLY OF CONCRETE AND GLASS. CONCRETE IS USED IN LARGE SCALES HERE, BECAUSE IT IS ABLE TO ABSORB VIBRATIONS QUITE WELL. THIS MAKES IT AN IDEAL MATERIAL FOR CLEANROOM CONSTRUCTION. THE FLOORS OF THE CLEANROOM ARE MADE FROM UNUSUALLY LARGE THREE FEET DEEP WAFFLES SLABS WITH THE CAVITIES SET AT TWO FOOT THREE INCHES ON CENTER. THE COLUMNS ARE MADE OF TAPERED CONCRETE AND ACT AS DUCTS TO TRANSFER SOME OF THE FILTERED AIR INTO THE CLEANROOM SPACES.

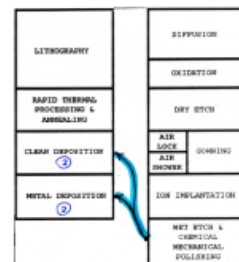
THE AREA BETWEEN THE ORANGE GLASS WALL AND THE INTERIOR WALL IS A CHASE SPACE, WHICH DOUBLES AS A PLENUM. THIS PLENUM CREATES A PLACE FOR THE AIR FROM WITHIN THE CLEANROOM TO ESCAPE TO BEFORE IT IS RE-CIRCULATED THROUGH THE MECHANICAL SYSTEM UP ABOVE THE CLEANROOM. IT IS IMPORTANT TO NOTE THAT THE MECHANICAL SYSTEM IS ATTACHED TO THE MAIN LABORATORY BUILDING TO PREVENT VIBRATIONS BEING TRANSFERRED TO THE CLEANROOM.

RIGHT:
SECTION THOUGH THE CLEANROOM FROM THE ANTI-VIBRATION DAMOENERS THROUGH TO THE MECHANICAL SYSTEM

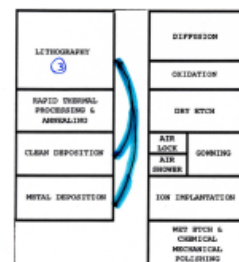
FAR RIGHT:
SPACE STUDY DIAGRAM TO HELP UNDERSTAND THE MANY WAYS THAT A CLEANROOM IS USED, BASED ON WHICH TYPE OF EXPERIMENT IS TAKING PLACE.



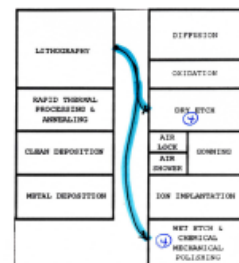
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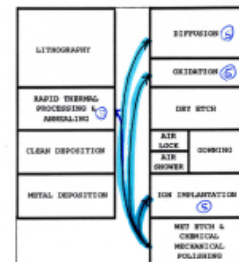
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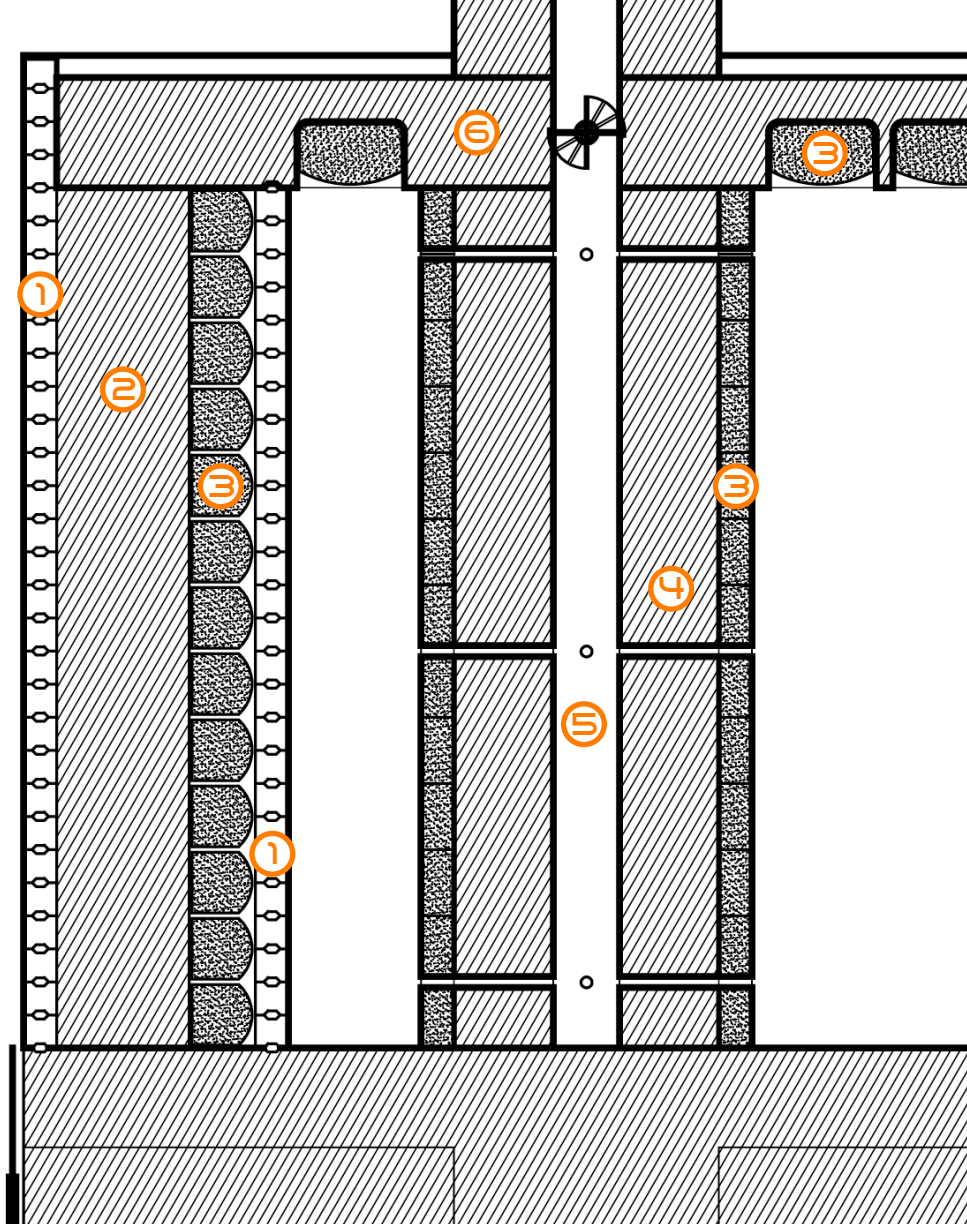
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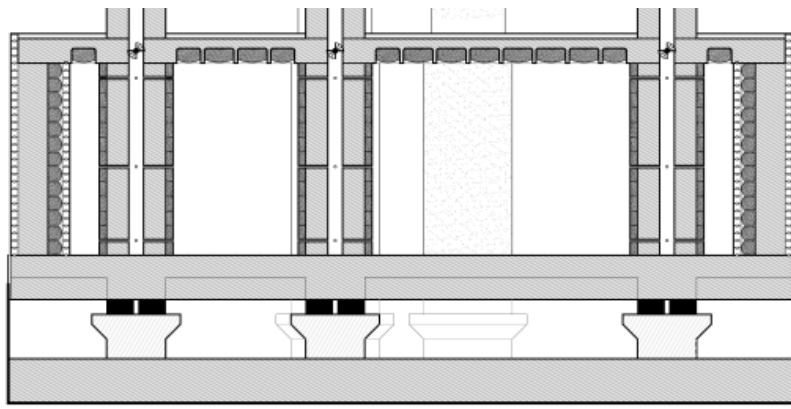
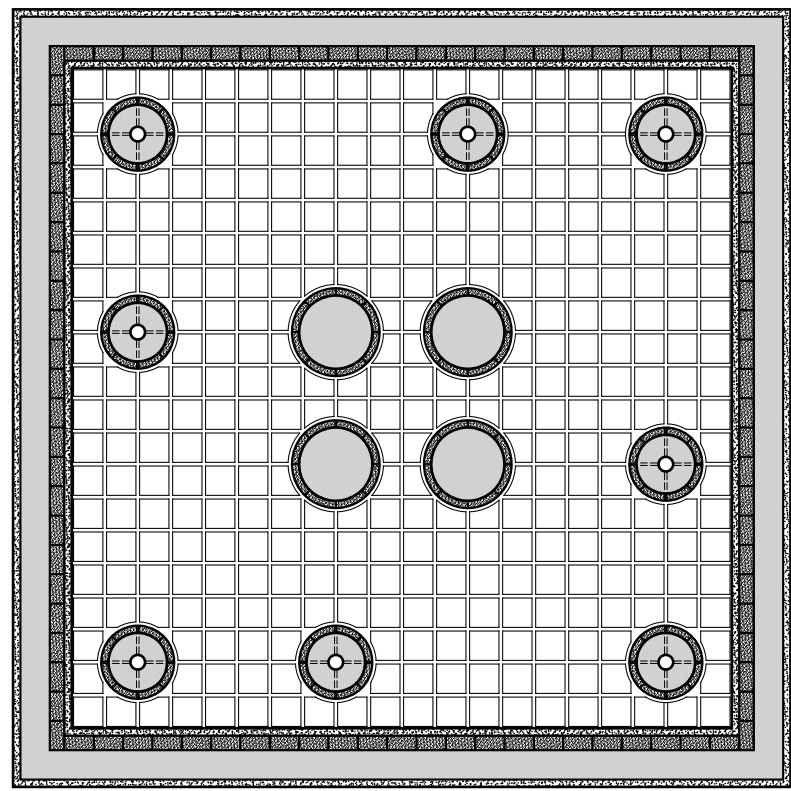
5.



- ① VESICULAR BASALT FACING
- ② CONCRETE WALL
- ③ PERLITE / PUMICE VOLCANIC GLASS FILLING
- ④ CONCRETE COLUMN
- ⑤ VENTING WITH DAMPER
- ⑥ CONCRETE WAFFLE SLAB

THE GAS AND LIQUID STORAGE ROOM IS LOCATED UNDER THE CLEANROOM, IN THE SUB-BASEMENT. SINCE MANY OF THE ITEMS STORED IN THIS ROOM ARE UNSTABLE, THE ROOM WAS DESIGNED TO ABSORB POTENTIAL EXPLOSIONS. THIS IDEA WAS INSPIRED FROM AN UNLIKELY SOURCE; A METRO TRASH CAN. YOU SEE, THE TRASH CANS IN THE METRO SYSTEM ARE DESIGNED TO ABSORB EXPLOSIONS, AND THE

FASCINATING PART OF IT IS THAT THEY USE A MIXTURE OF VOLCANIC STONES CALLED PERLITE AND PUMICE, SURROUNDED WITH PLASTIC WRAPPING, TO ABSORB BLASTS. THIS MATERIAL IS VERY POROUS, WITH MANY VESICLES, WHICH ALLOWS THE MATERIAL TO COMPRESS UNDER FORCE, AND ABSORB THE BLAST. ULTIMATELY THIS TIES BACK TO MY EARLY MATERIAL STUDIES INVOLVING SCORIA AND IGNEOUS STONES.



SINCE THE INTERIOR PORTION OF THE BLAST STORAGE ROOM IS COMPOSED OF VOLCANIC PUMICE, I DECIDED TO FACE THE INTERIOR AND EXTERIOR OF THE ROOM IN SCORIA COMPOSED OF BASALT WITH AMYGDALOIDAL OLIVINE VESICLES. EACH PIECE OF STONE WOULD BE LAID SO THAT THE OLIVINE DEPOSITS WERE AT THE BOTTOM OF THE VESICLE TO SHOW HOW THE STONES WERE WHEN THEY WERE FORMED BY THE EARTH.

THE DRAWING ON TOP SHOWS A REFLECTED CEILING STORAGE PLAN OF THE BLASTPROOF STORAGE ROOM WITH THE WAFFLE SLAB DESIGN. EACH OF THE CAVITIES WITHIN THE SLAB WOULD BE FILLED WITH THE PERLITE / PUMICE MIXTURE. THE BOTTOM DRAWING SHOWS A SECTION WHICH GIVES THE OVERALL IDEA OF THE ROOM, AS WELL AS SHOWING THE CAVITY FOR THE CLEANROOM COLUMNS RUBBER VIBRATION DAMPENING SYSTEM.



**RECYCLED SILICON
WAFER GLASS WALL**

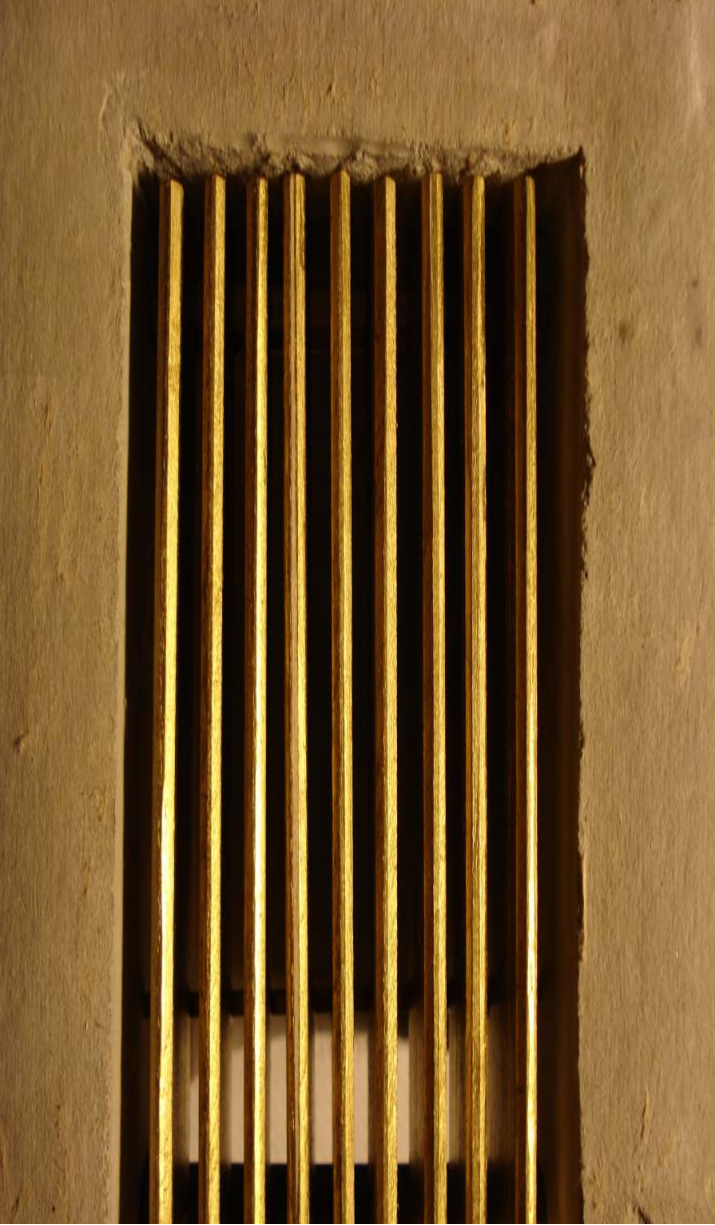
BROKEN WASTE SILICON WAFERS
ARE RECYCLED AND USED AS LIGHT
SCREENS AND VISUAL BARRIERS
WITHIN THE NANOTECHNOLOGY
LABORATORY BUILDING.



**BUCKYBALL SPACE
FRAME CONNECTOR**

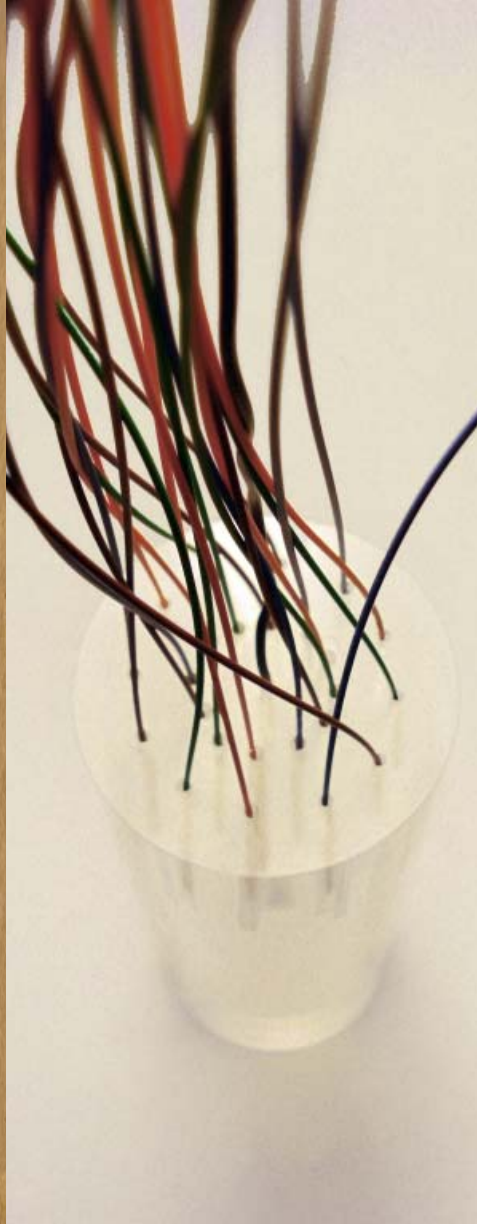
THIS BUCKYBALL SHAPED
CONNECTOR WOULD BE CAST
OF STEEL AND THREADED TO
RECEIVE THE SPACE FRAME'S
STRUCTURAL COMPONENTS

BUCKYBALL AS A CONNECTOR
- BEAUTIFUL IDEA - ULRIKE



CLEAN THRESHOLD

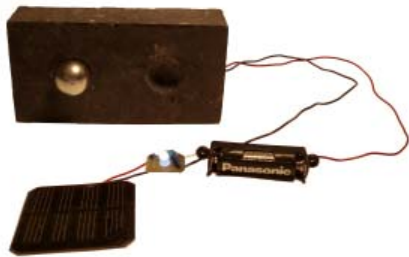
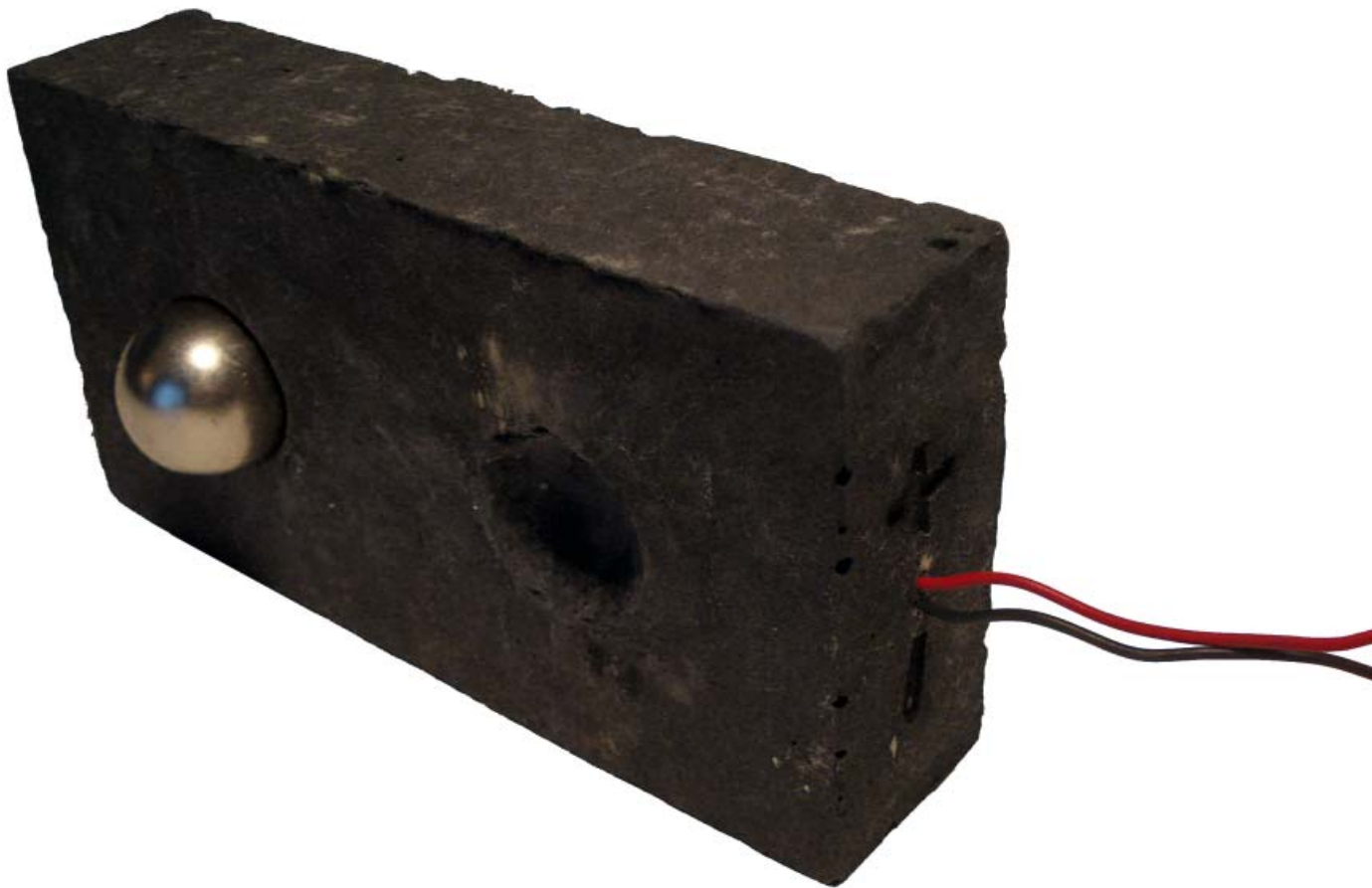
LOCATED AT THE ENTRANCES TO THE BUILDING, THE GRILL IS MADE OF BRONZE, AND IS SET INTO A CONCRETE FRAME WITH A RAINWATER DRAIN BELOW. WHEN IT RAINS OUTSIDE THE DRAIN WASHES AWAY THE DIRT AND DEBRIS WHICH FALLS FROM PEOPLES SHOES.



LOW VOLTAGE LIGHTING SYSTEM

ACRYLIC CYLINDER AND FIBER OPTIC CABLES. CAN BE HUNG FROM CEILING OR EMBEDDED INTO WALLS / FLOOR FOR ACCENT LIGHTING.





ITERATION 01

THIS ITERATION SHOWS TWO DIVOTS WHICH INDICATE AN ON AND OFF POSITION FOR A LOW VOLTAGE LIGHTING SYSTEM.

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FERROCRETE LIGHT SWITCHES

AFTER MY EARLY EXPERIMENTS WITH THE FERROCRETE, I STARTED LOOKING FOR A WAY TO USE THE MATERIAL WITHIN MY BUILDING. THE FERROCRETE DID NOT SEEM LIKE THE RIGHT MATERIAL FOR THE LABORATORY OR CLEANROOM AREAS, BECAUSE IT HAS A LARGE AMOUNT OF IRON EMBEDDED WITHIN AND IT COULD AFFECT SOME OF THE SENSITIVE EQUIPMENT. AS A RESULT, I DECIDED THAT WHATEVER WAS CREATED FROM THE MATERIAL WOULD HAVE TO BE LOCATED IN THE WESTERN WING OF THE BUILDING, WHERE THE OFFICE AND GROUP MEETING AREAS ARE LOCATED.

THE PROPERTIES OF THE MATERIAL INDICATED TO ME THAT MY SOLUTION SHOULD USE MAGNETS, TO REALLY SHOW THE UNIQUE NATURE OF THE MATERIAL. THE FIRST IDEA I HAD WAS TO CREATE A TYPE OF LOW VOLTAGE LIGHT SWITCH, WHICH WAS ACCOMPLISHED BY CREATING A CONCRETE FORM WITH TWO DIVOTS; ONE FOR THE ON POSITION, AND ONE FOR OFF. AS THE MAGNET IS SET TO THE ON POSITION, A CHROME PLATED NEODYMIUM MAGNET TOUCHES TWO CONNECTOR PLATES, WHICH COMPLETES A LOW VOLTAGE CIRCUIT. THIS WOULD ULTIMATELY POWER AN LED LIGHTING SYSTEM, OR A SIMILAR LOW VOLTAGE SYSTEM. ANOTHER ALTERNATIVE WOULD BE TO HAVE AN EMBEDDED SWITCH THAT WAS SWITCHED THROUGH THE ACT OF PLACING THE MAGNET INTO THE DIVOT. THE DIVOT FOR THE OFF POSITION IS SIMPLY A PLACE HOLDER FOR THE NEODYMIUM MAGNET.

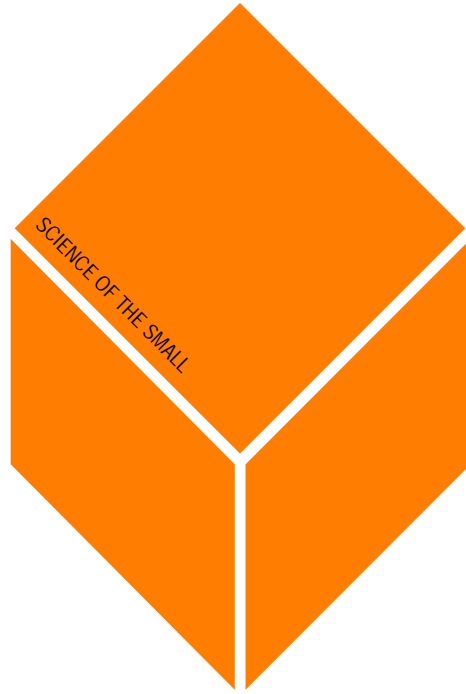
I CREATED TWO ITERATIONS OF THIS IDEA WHICH CAN BE SEEN ON EACH OF THE PAGES ON THIS SPREAD.



ITERATION 02

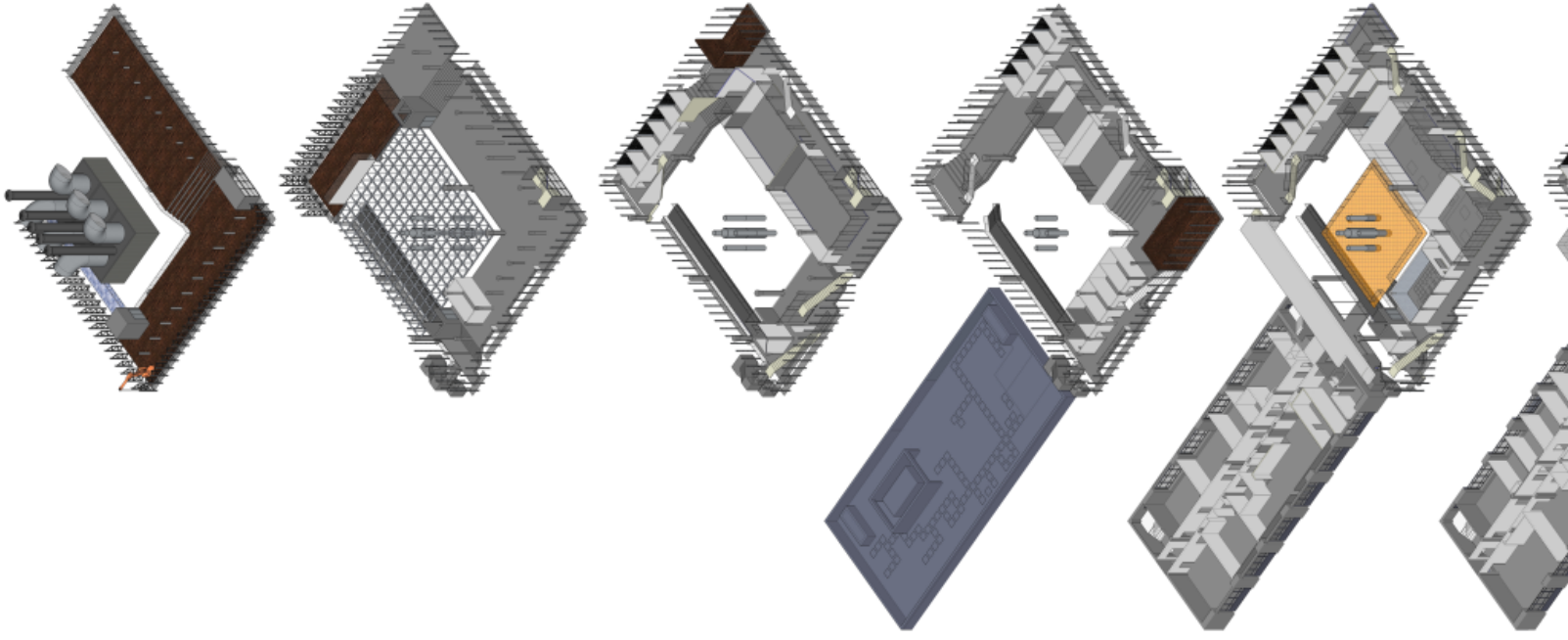
THIS ITERATION SHOWS A CHANNEL CONNECTING THE TWO DIVOTS. THIS ALLOWS THE USER TO ROLL THE MAGNET FROM THE OFF POSITION TO THE ON POSITION, WITHOUT HAVING TO REMOVE THE MAGNET FROM THE SWITCH. THE ACT OF ROLLING WILL TURN THE LOW VOLTAGE

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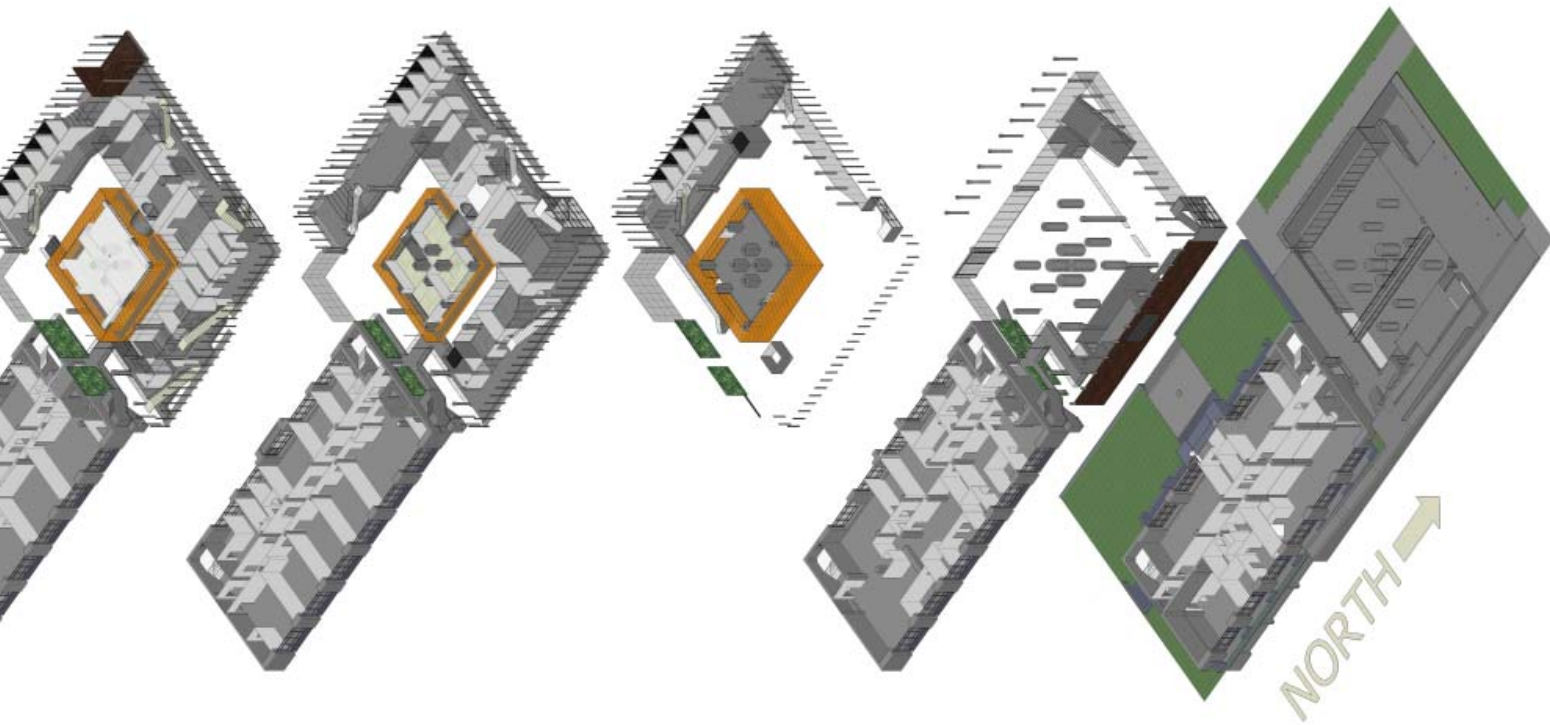


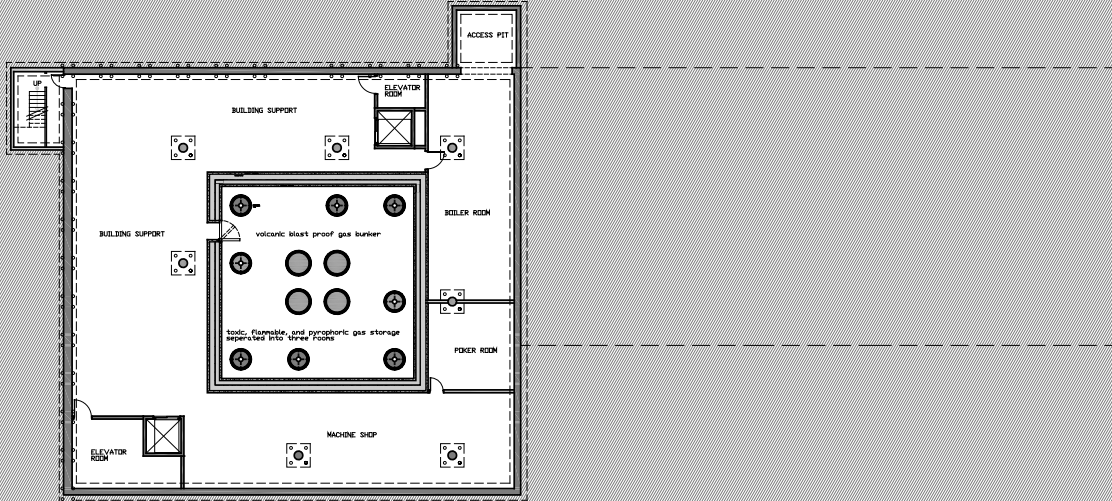
**NANOTECHNOLOGY
RESEARCH
LABORATORY**

FINAL PROJECT

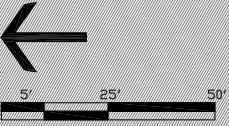


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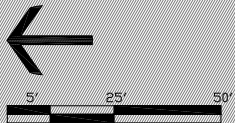
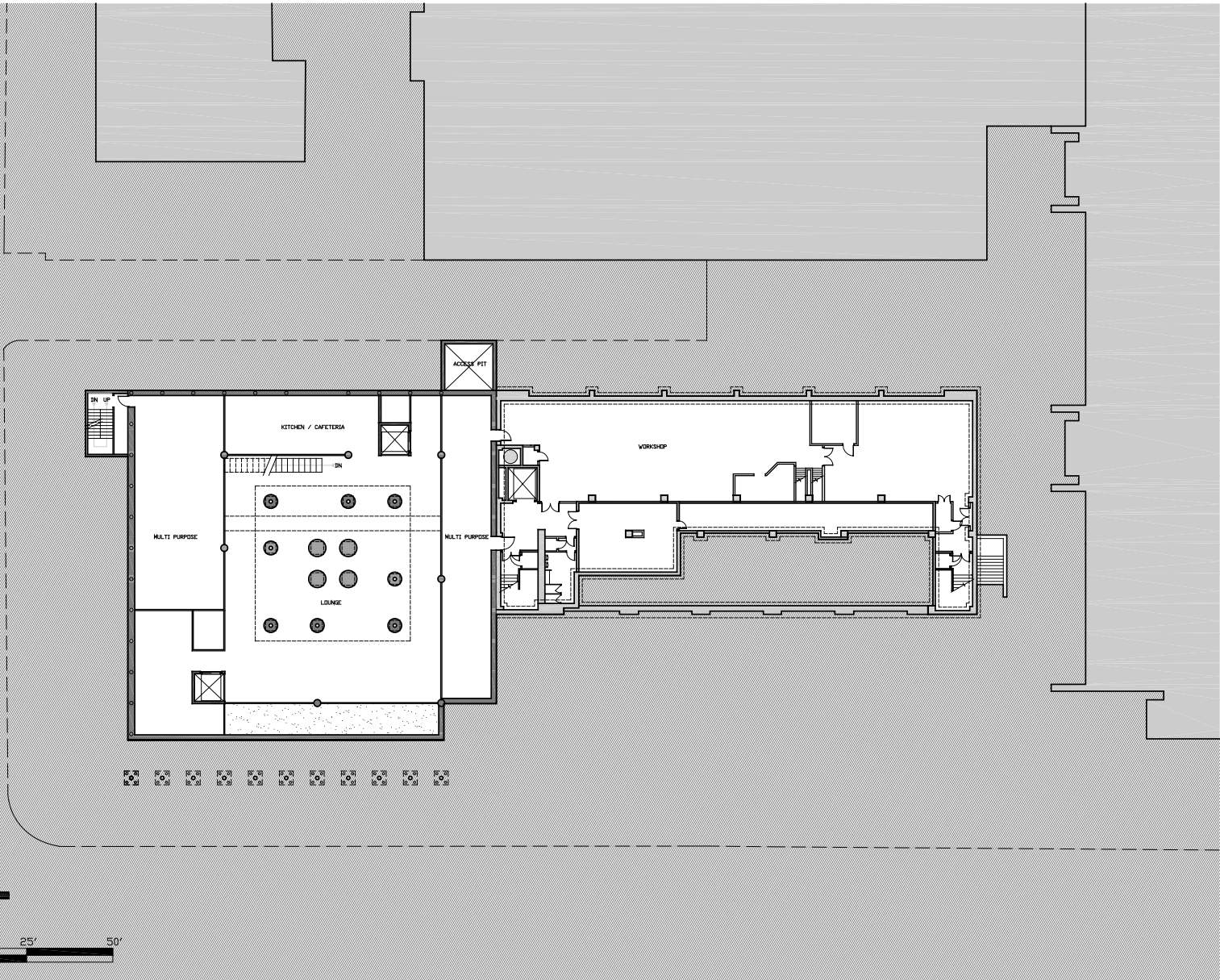


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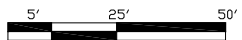
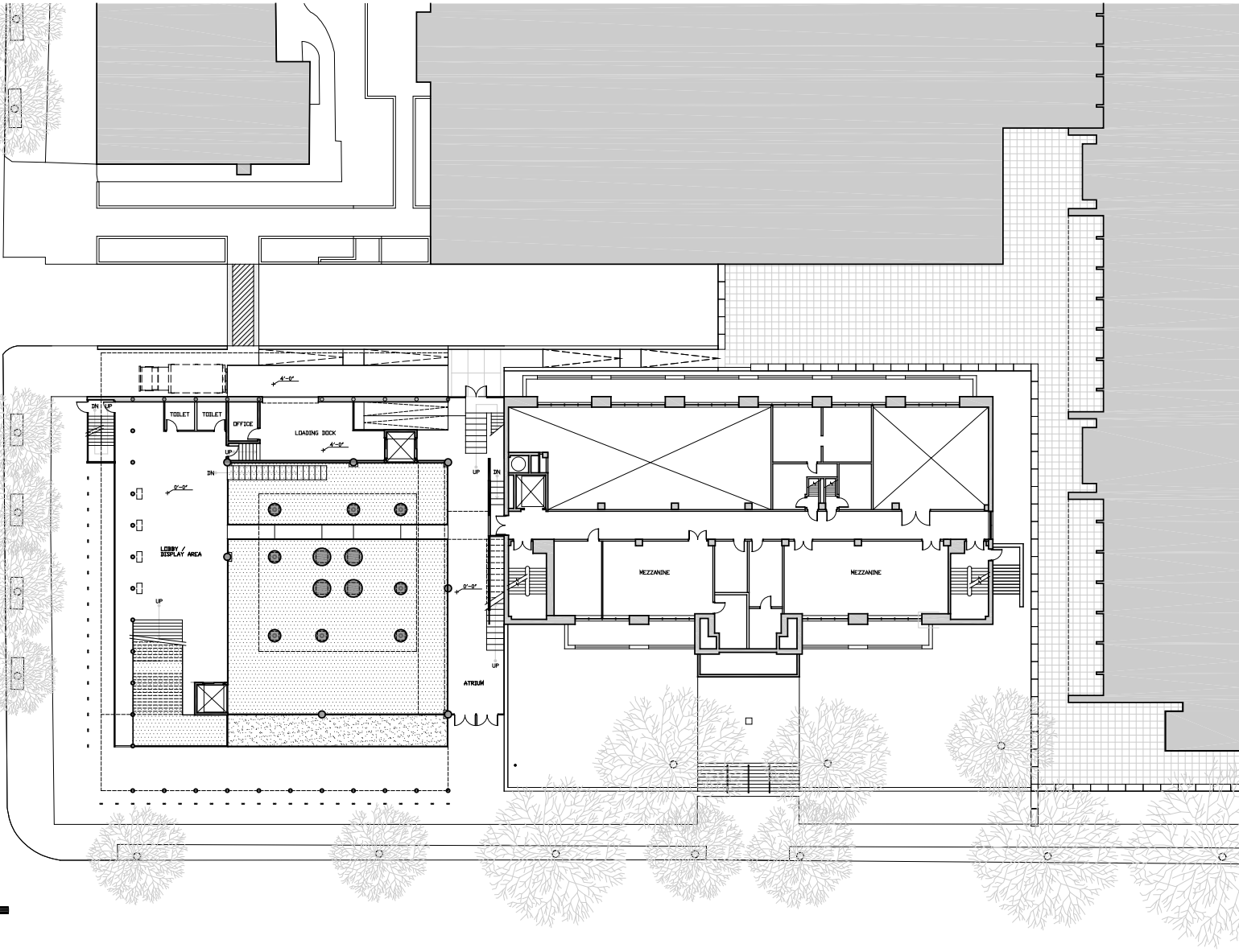


SUB BASEMENT

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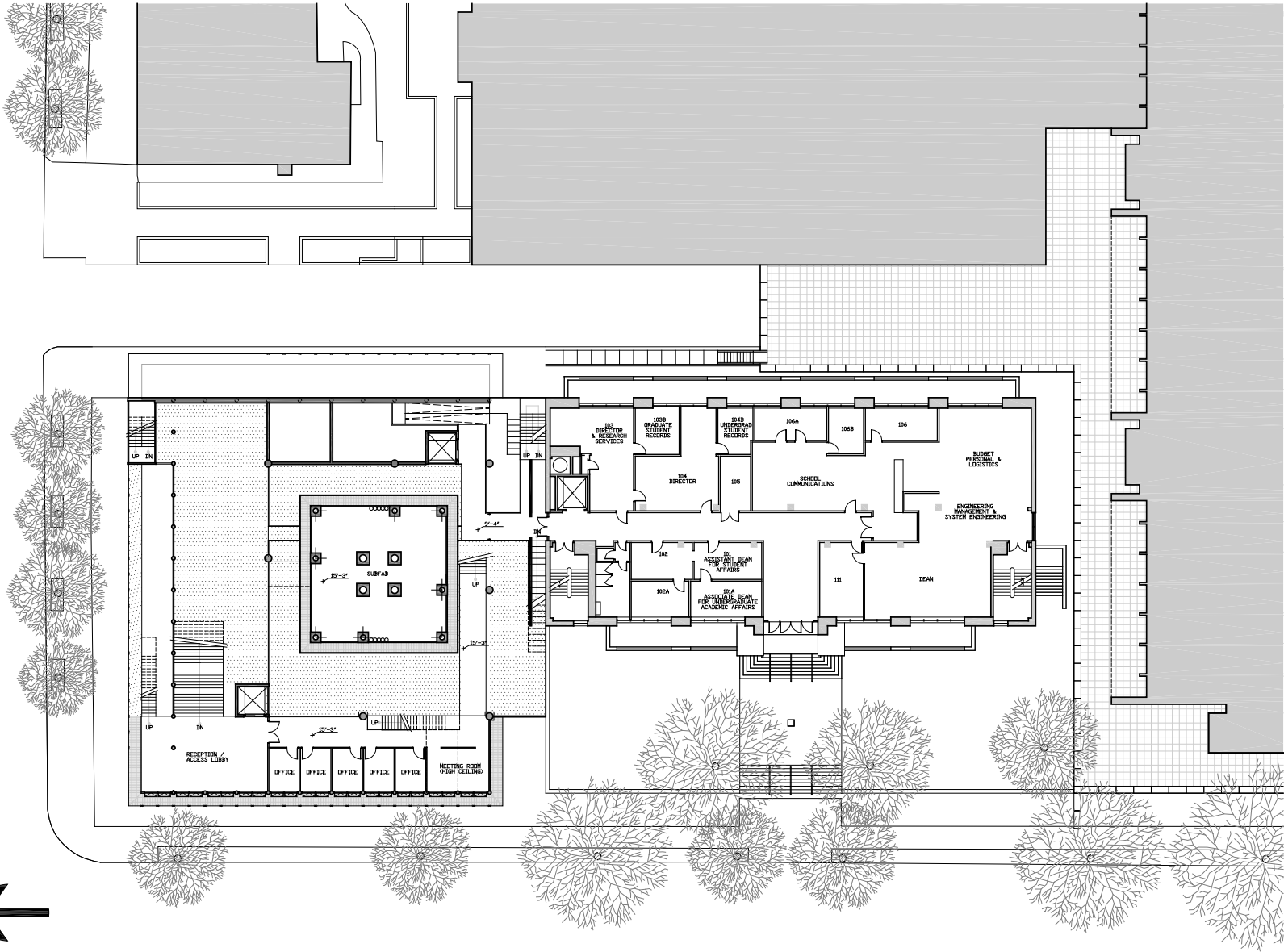


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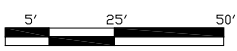
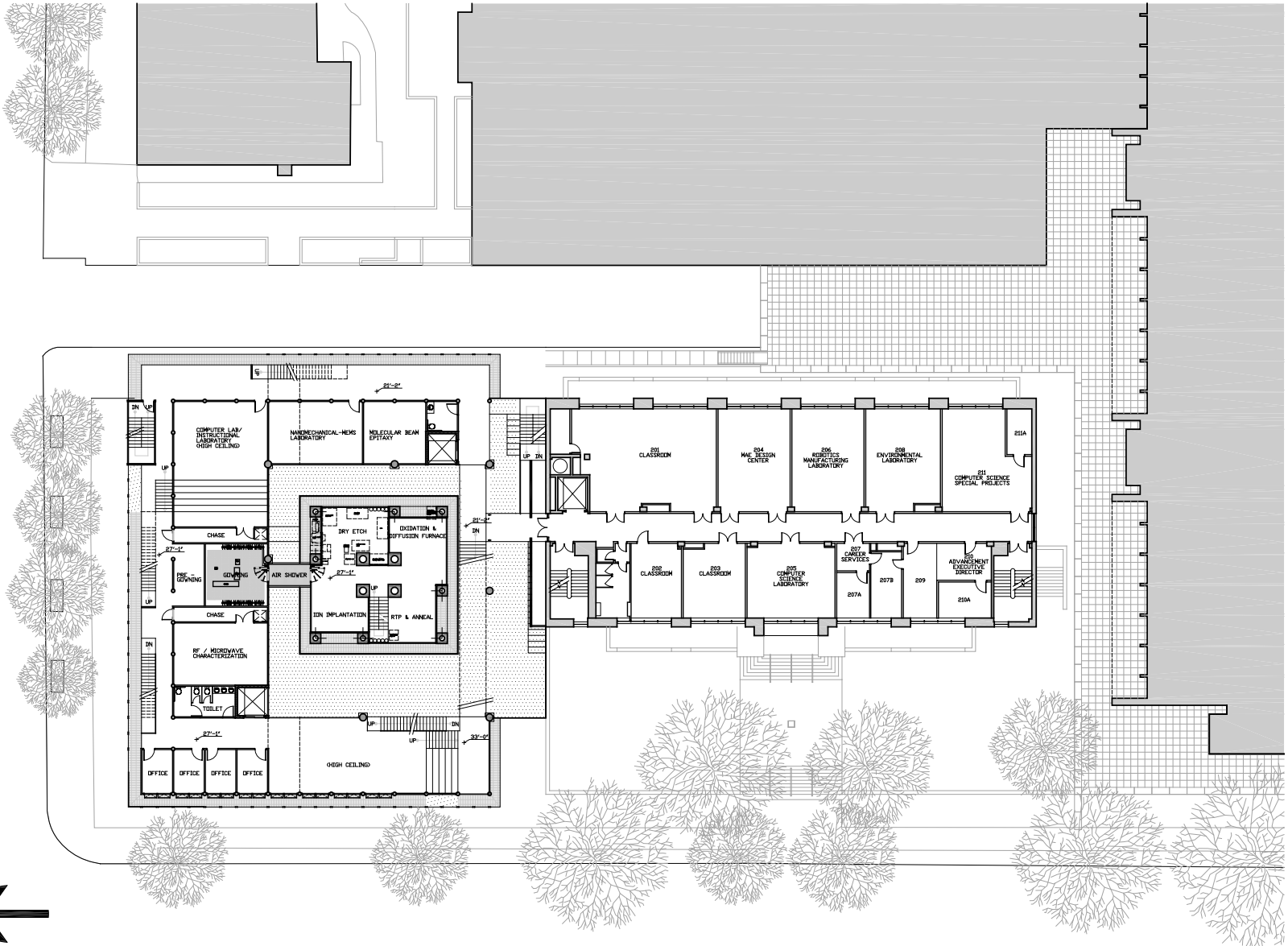


GROUND FLOOR

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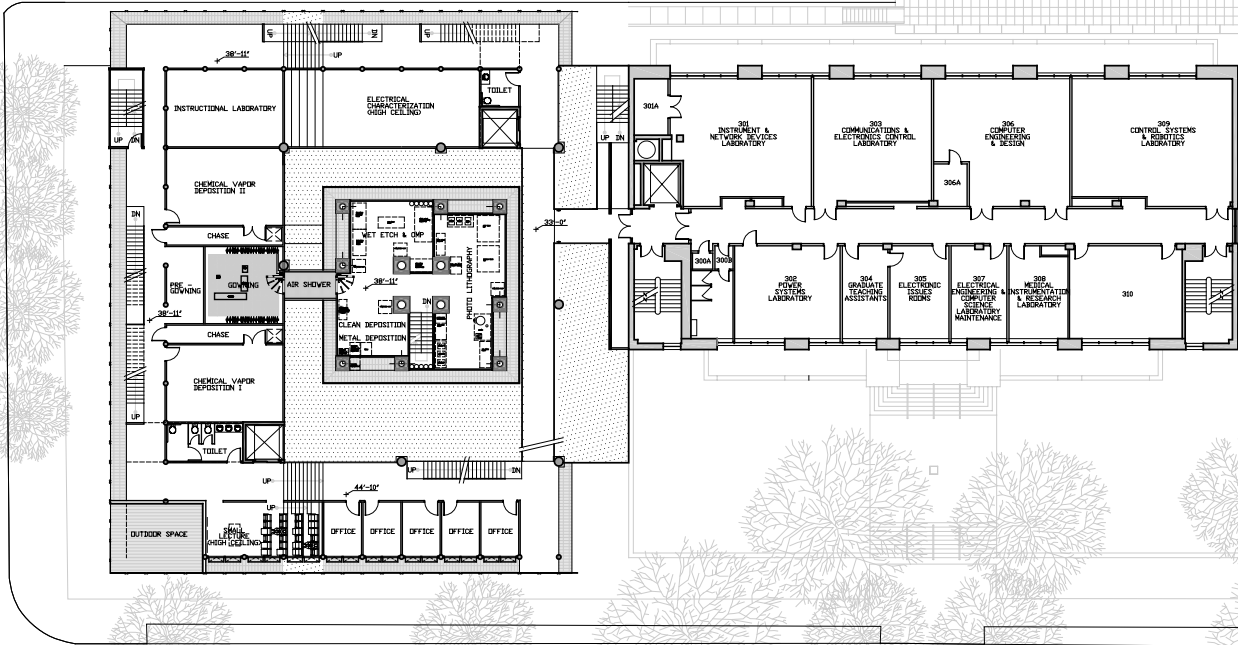


FIRST LEVEL AND MEZZANINE



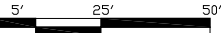
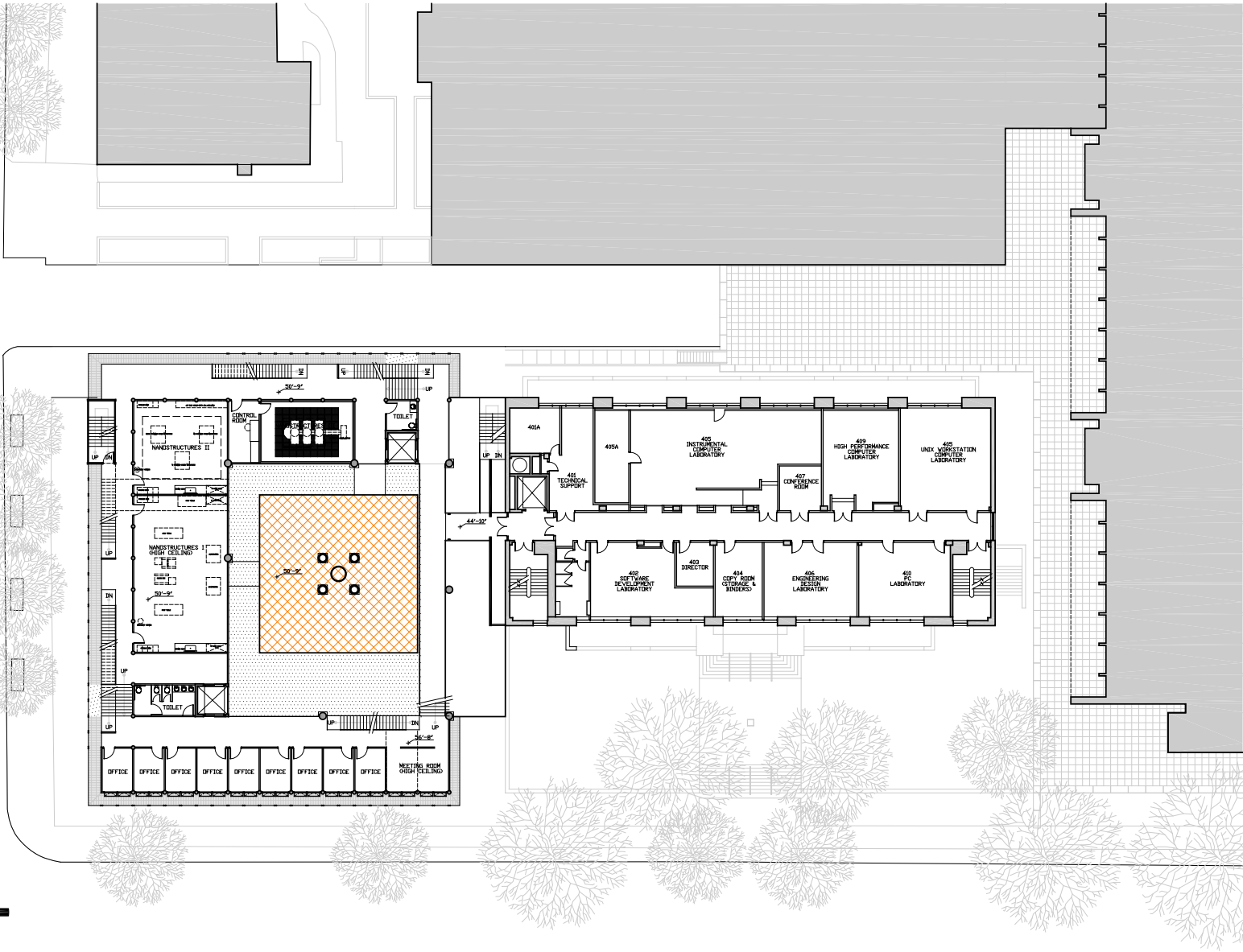
SECOND, THIRD AND FORTH LEVELS

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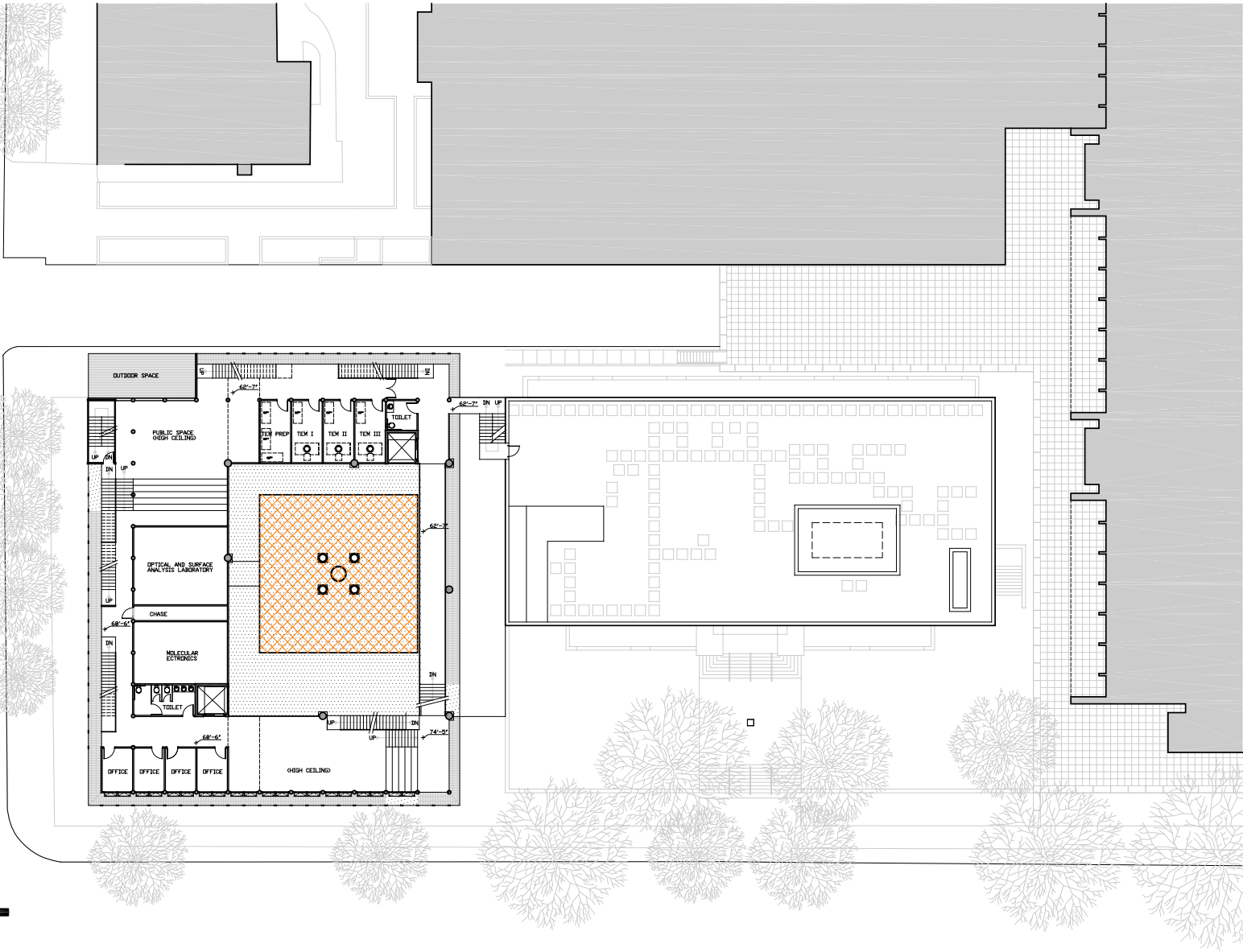
FOURTH, FIFTH AND SIXTH LEVELS

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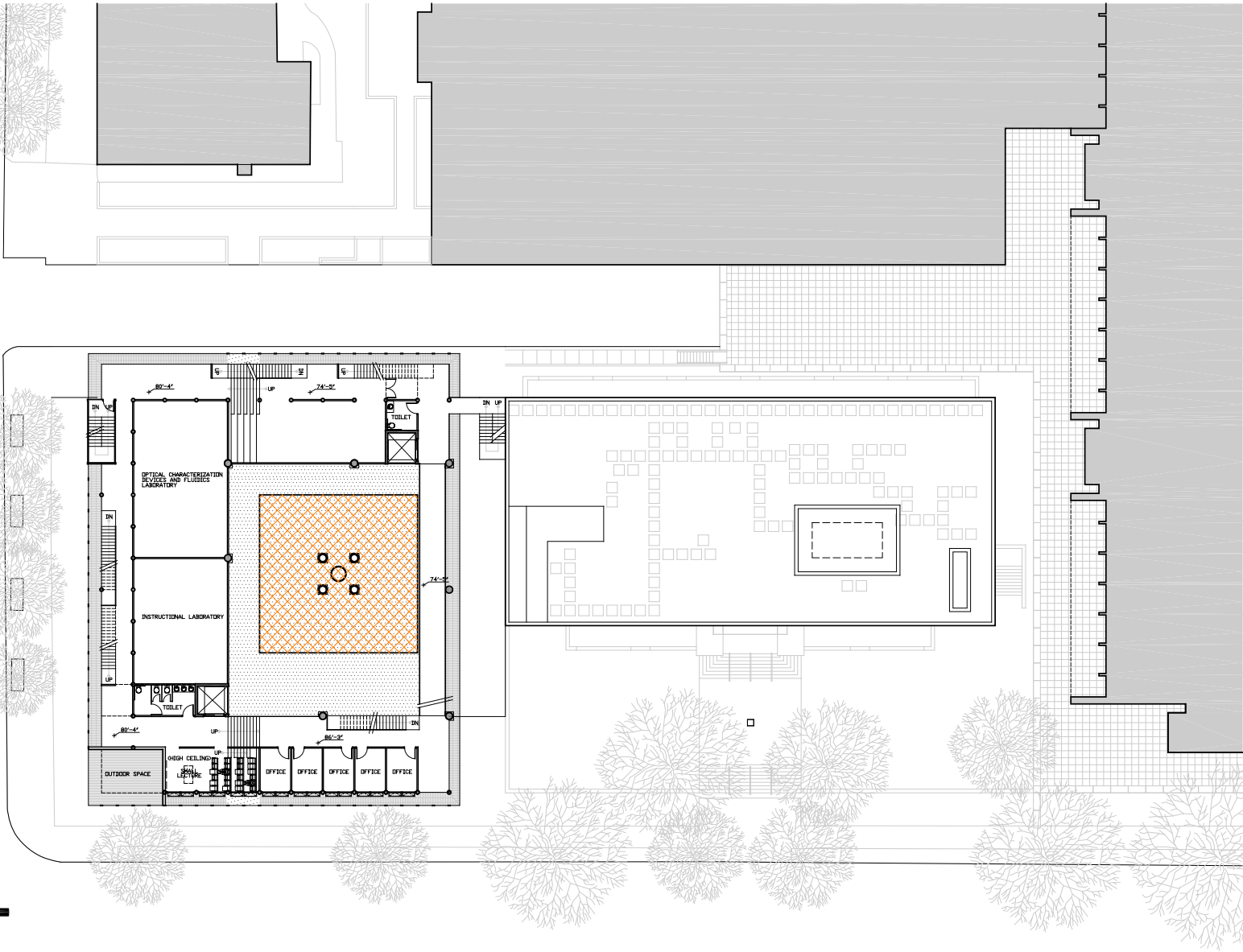


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SIXTH, SEVENTH AND EIGHTH LEVELS

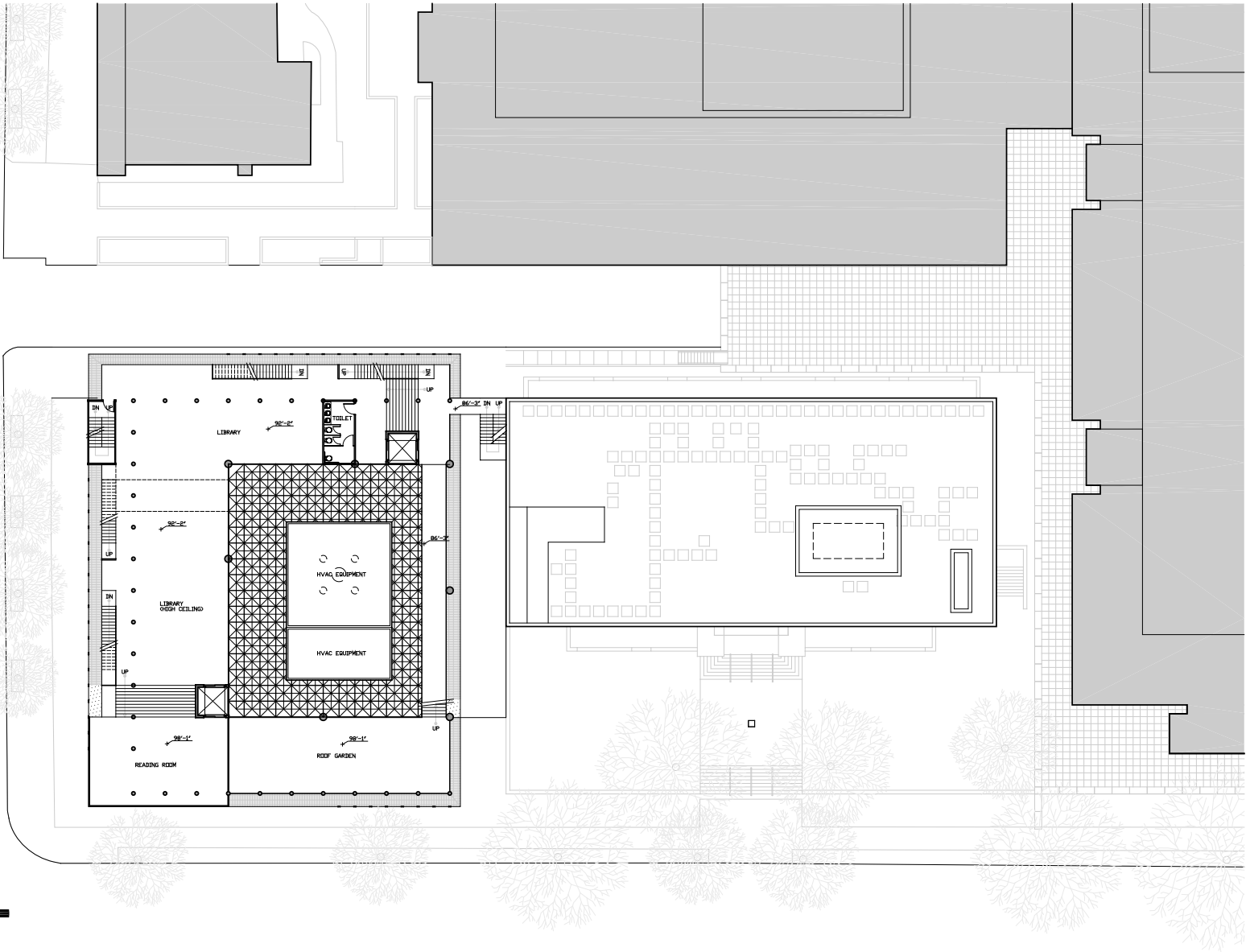


NINTH, TENTH AND ELEVENTH LEVELS

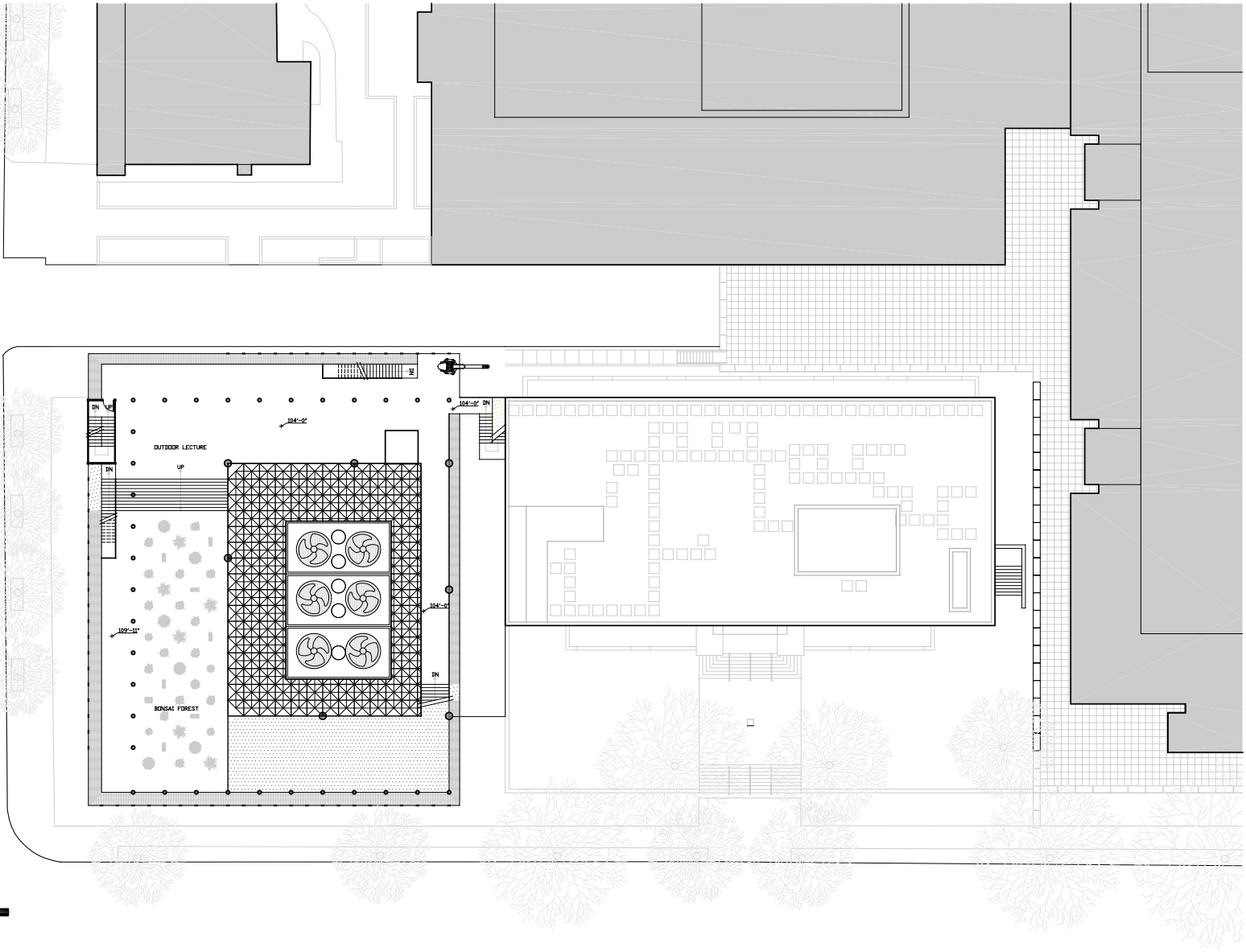


ELEVENTH, TWELFTH THIRTEENTH LEVELS

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THIRTEENTH, FOURTEENTH AND FIFTEENTH LEVELS



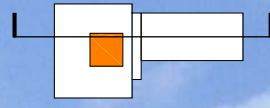
URBAN ROOF GARDEN AND BONSAI FOREST

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MY BUILDING REMINDS ME OF THE
ARCHITECTURE OF A MICROPROCESSOR:
INFORMATION HANDLING IN THE CORE,
AND CONNECTION AROUND THE
EXTERIOR. WHEN ONE CUTS THROUGH
THE PROCESSOR, ONE SEES MANY
LAYERS, THAT DON'T EASILY REVEAL
THEIR ORGANIZATION.



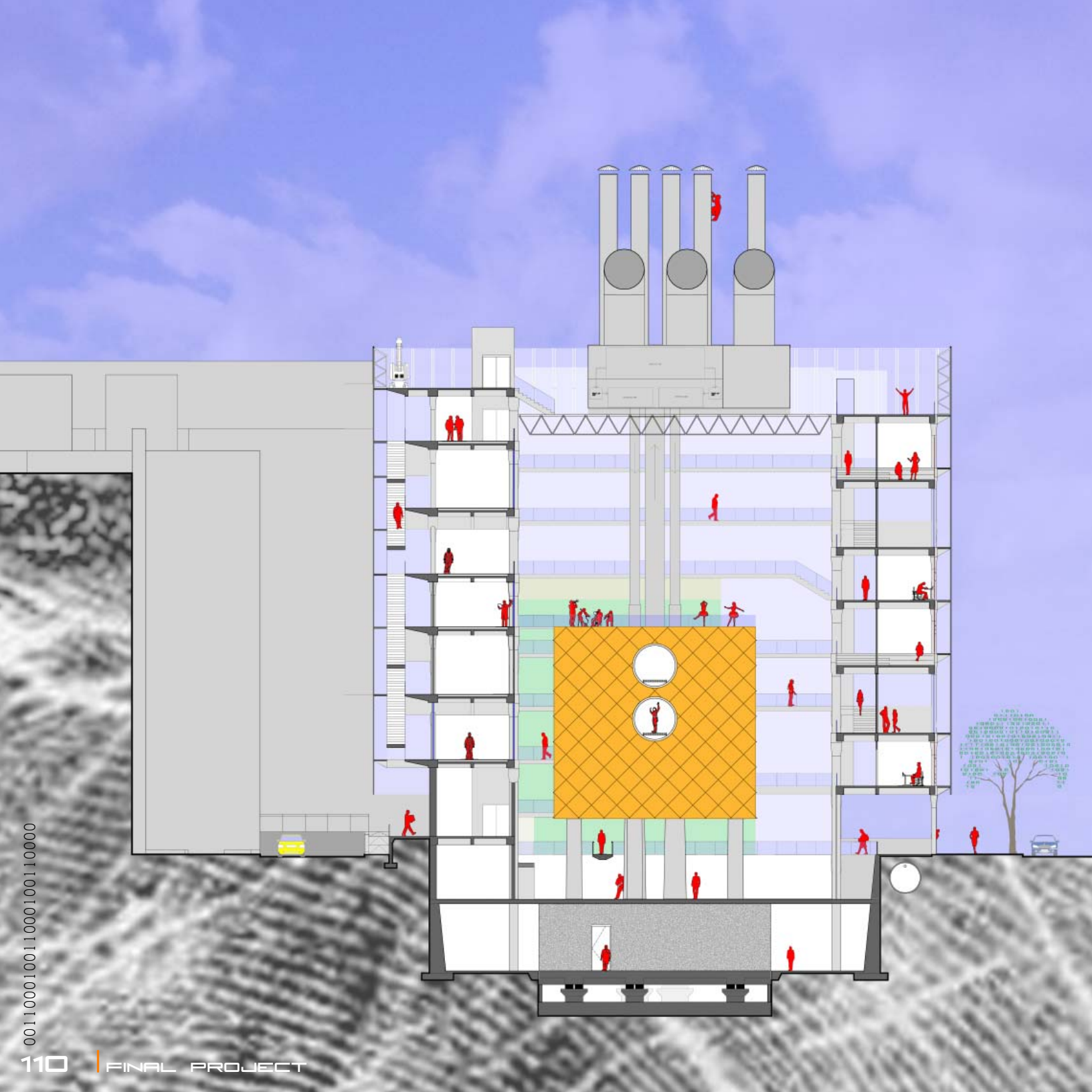
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"THESIS IS ABOUT LIFE.
IF YOU WANT THE
PEOPLE TO DANCE,
YOU LET THEM DANCE"

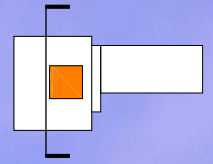
- RAMONA SONNTAG

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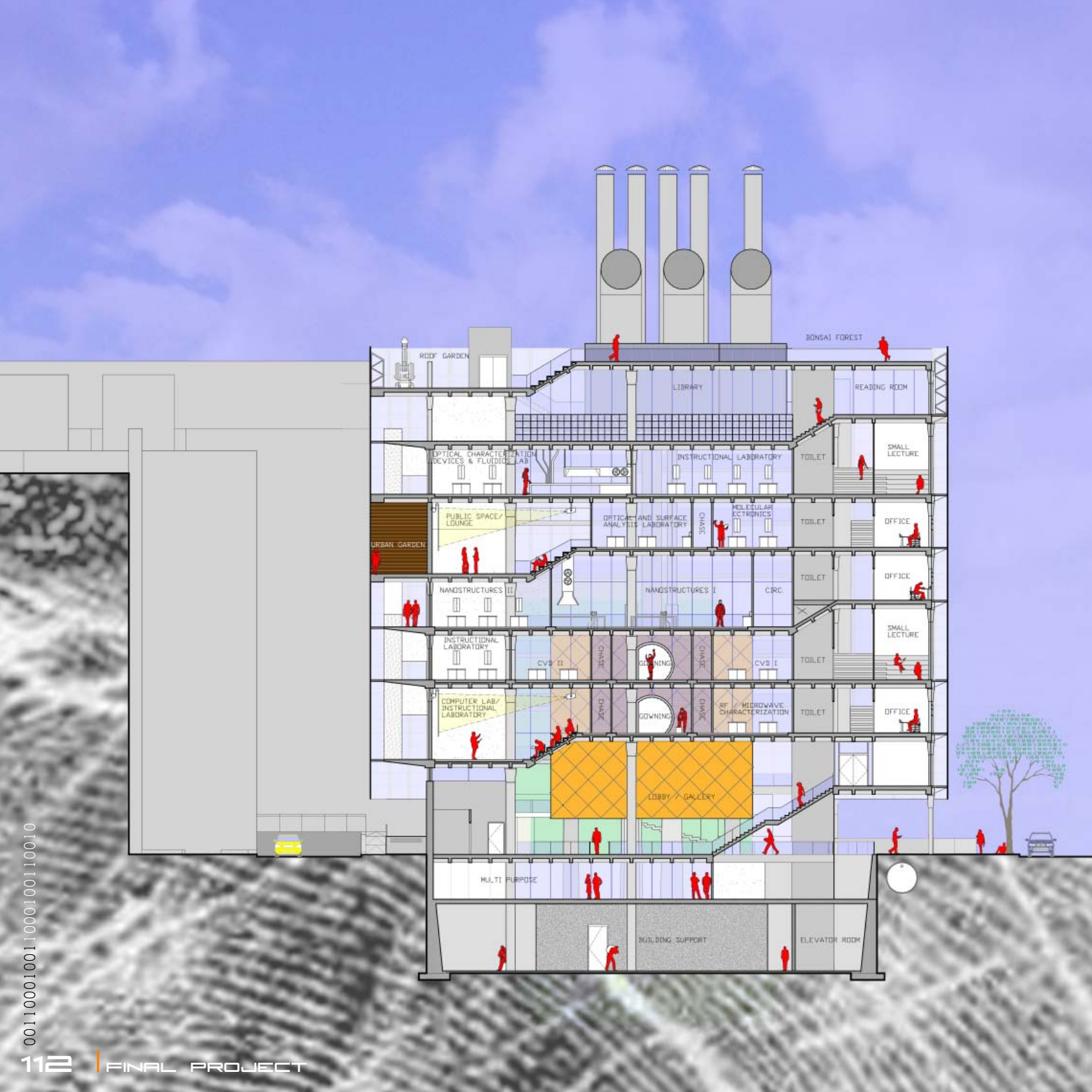


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5' 25' 50'

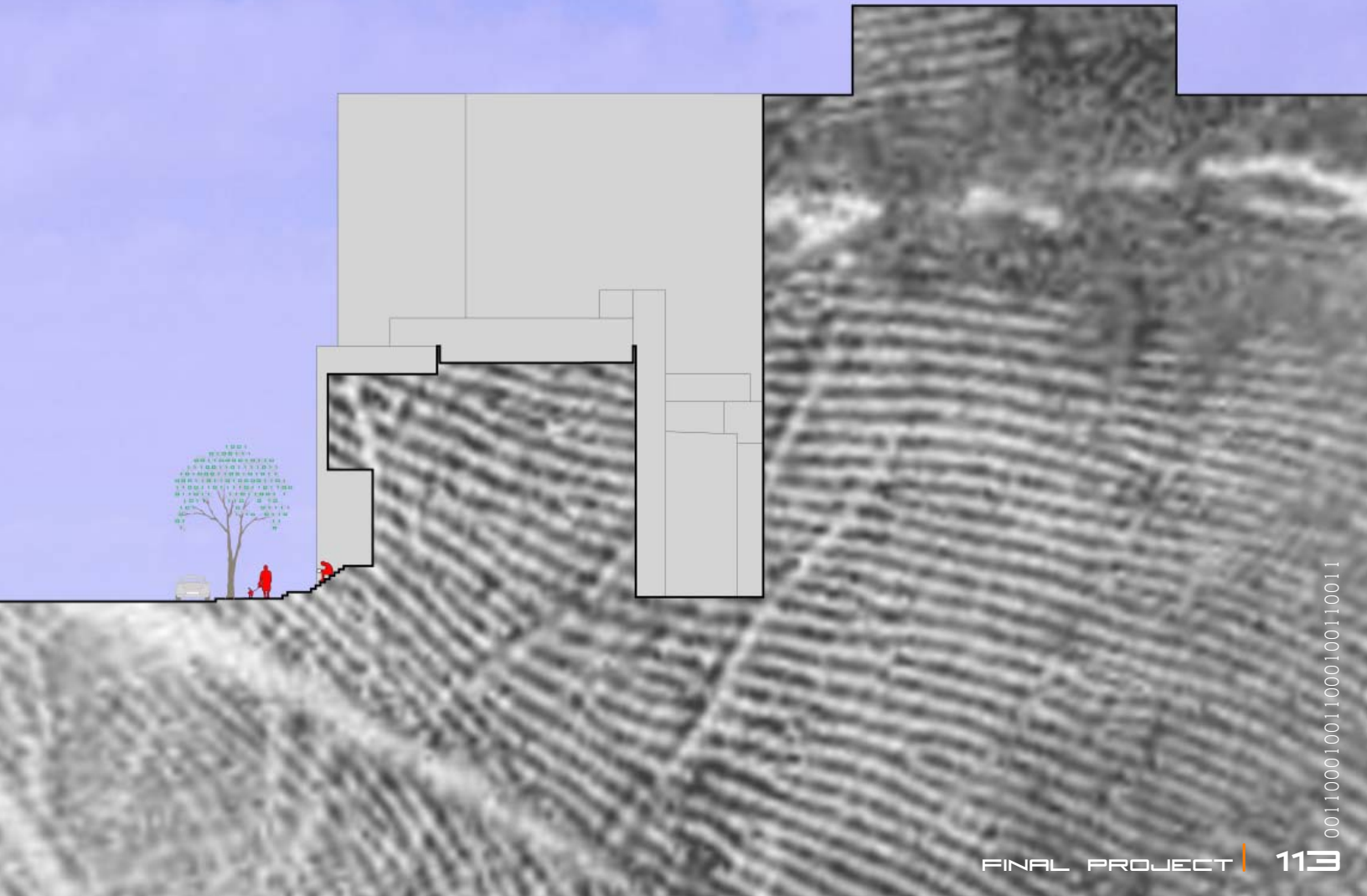
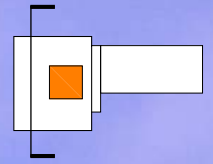


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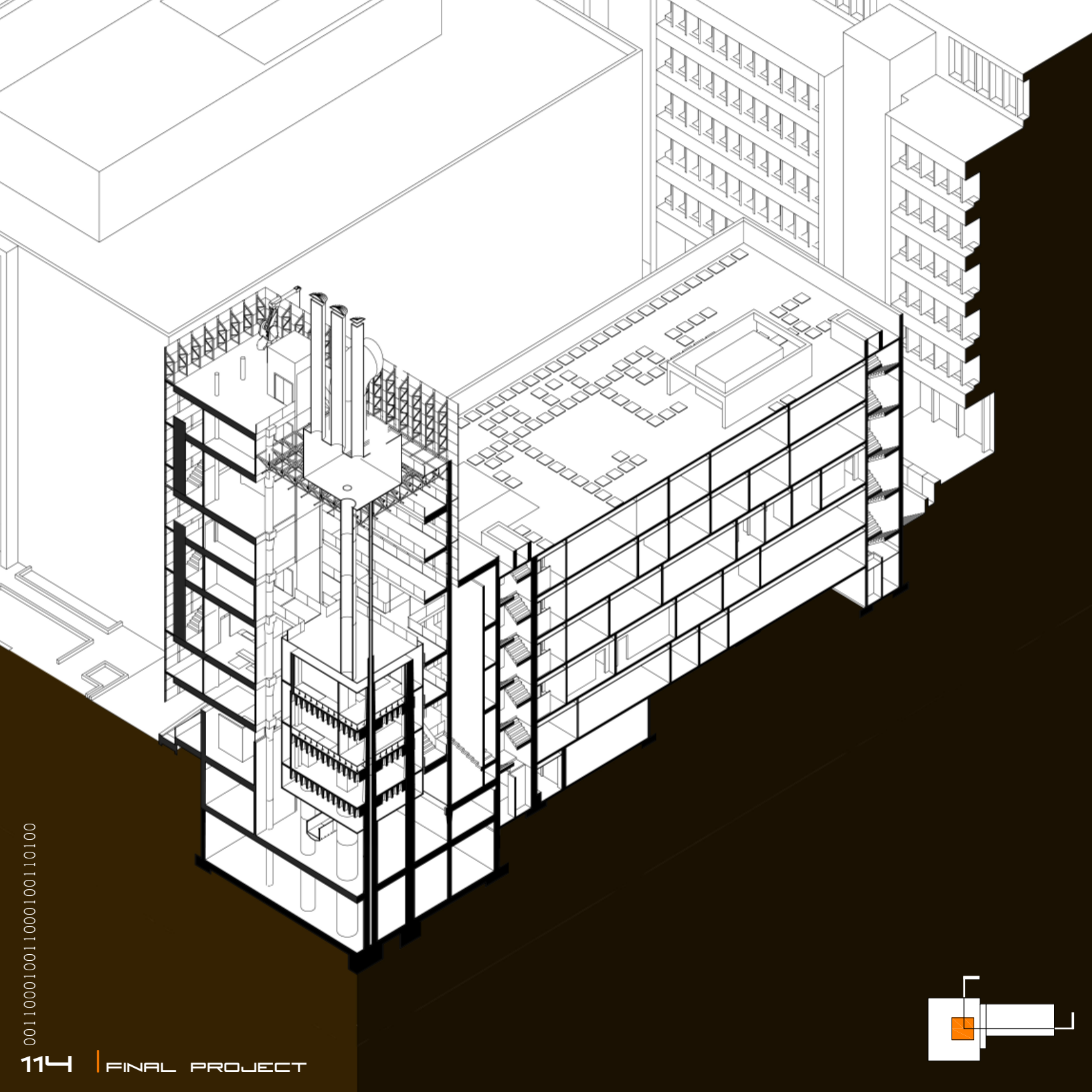
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5' 25' 50'

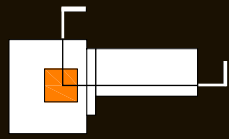


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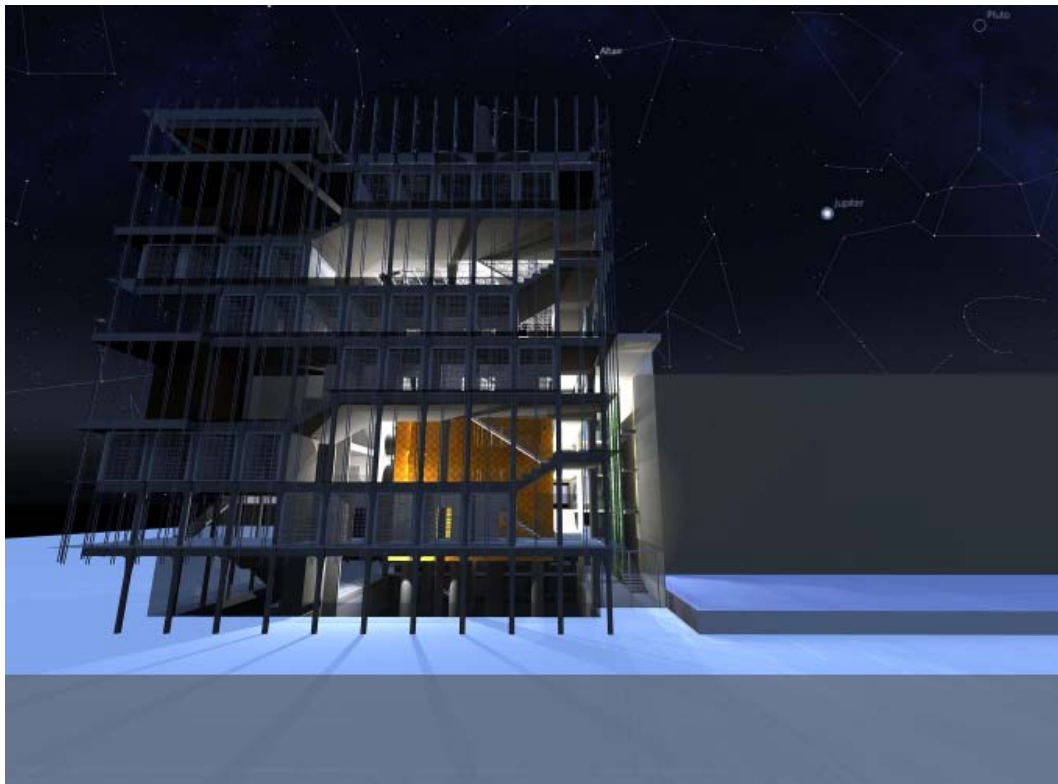
THINGS CAN BE REVELED IN ONE
DIRECTION THAT CAN NOT BE IN
OTHERS

NIGHT TIME RENDERINGS

THE NIGHTTIME RENDERINGS WERE IMPORTANT TOOLS TO LOOK AT HOW THE BUILDING COULD APPEAR AT NIGHTTIME, BUT IT IS ALSO A WAY TO PUT THE BUILDING INTO CONTEXT.

THE CLEANROOM CAN BE SEEN THROUGH THE LAYERS OF THE FACADE, AND IS A CONSTANT REMINDER OF THE ATOMIC SCALE, AND THE WORK THAT OCCURS WITHIN THIS BUILDING. IN CONTRAST, THE BUILDING IS SET WITHIN THE CITY, AND IS SURROUNDED BY A SKY OF CONSTELLATIONS. THE SKY SHOWS THE HUMAN INFLUENCE APPLIED TO THE COSMOS, TO HELP US RELATE AND TO ALSO GIVE A SCALE TO THE VASTNESS OF SPACE.

IN A WAY THESE WERE SOME OF MY MOST REWARDING AND MEANFUL IMAGES, AS THEY REPRESENT SCALE FROM THE FAR REACHES OF SPACE, ALL THE WAY TO THE ATOM.



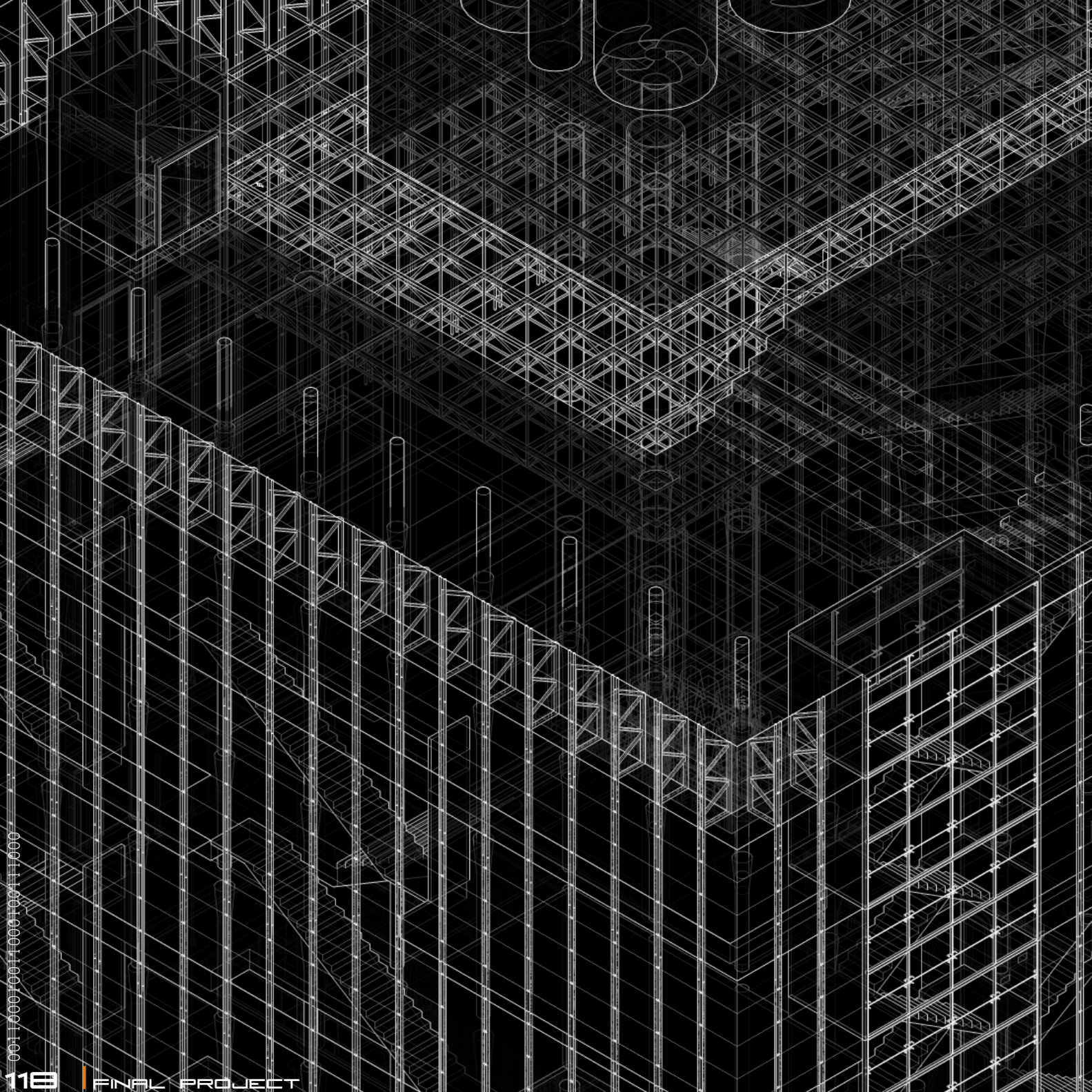


Altair

Juno

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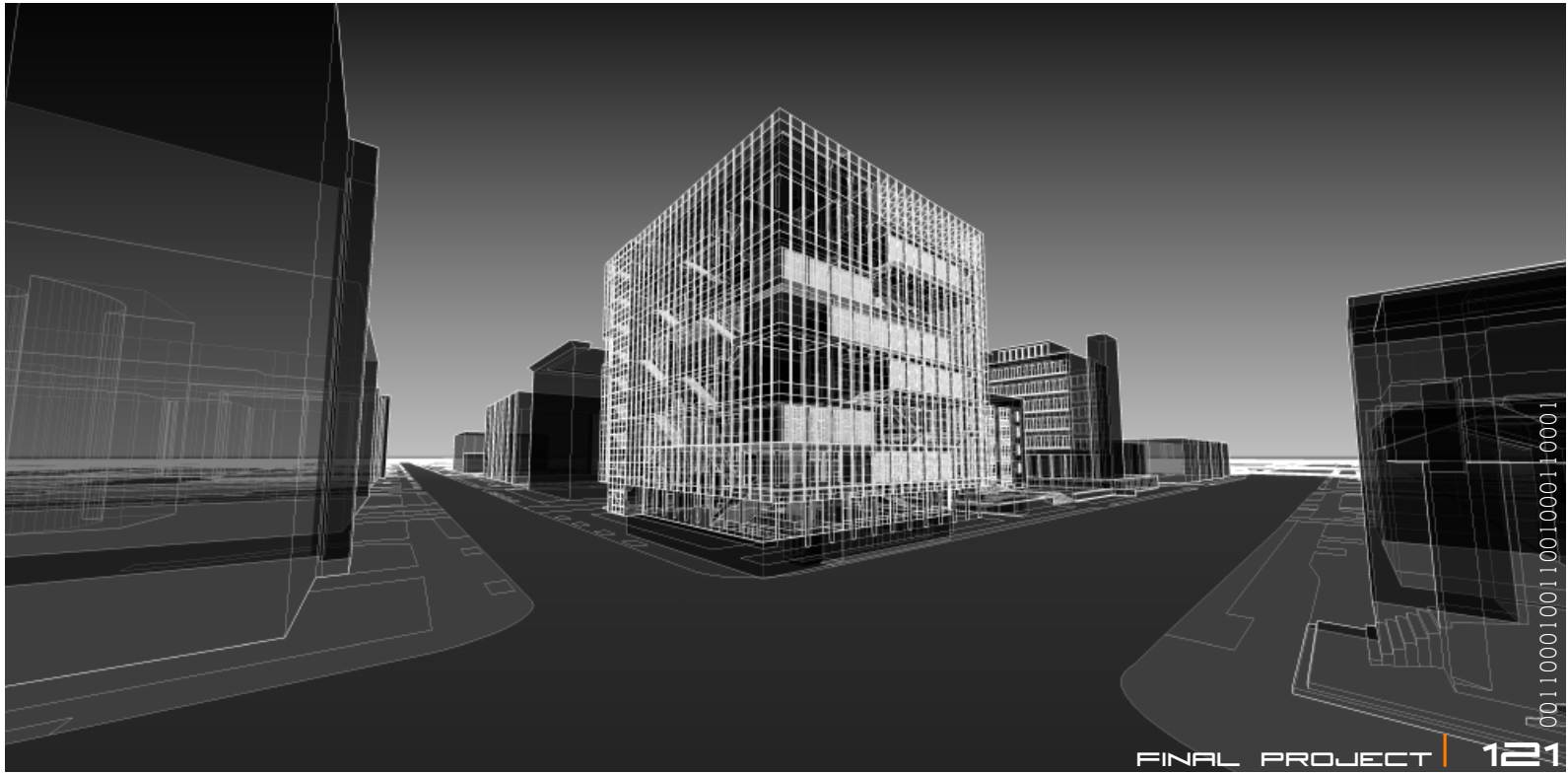
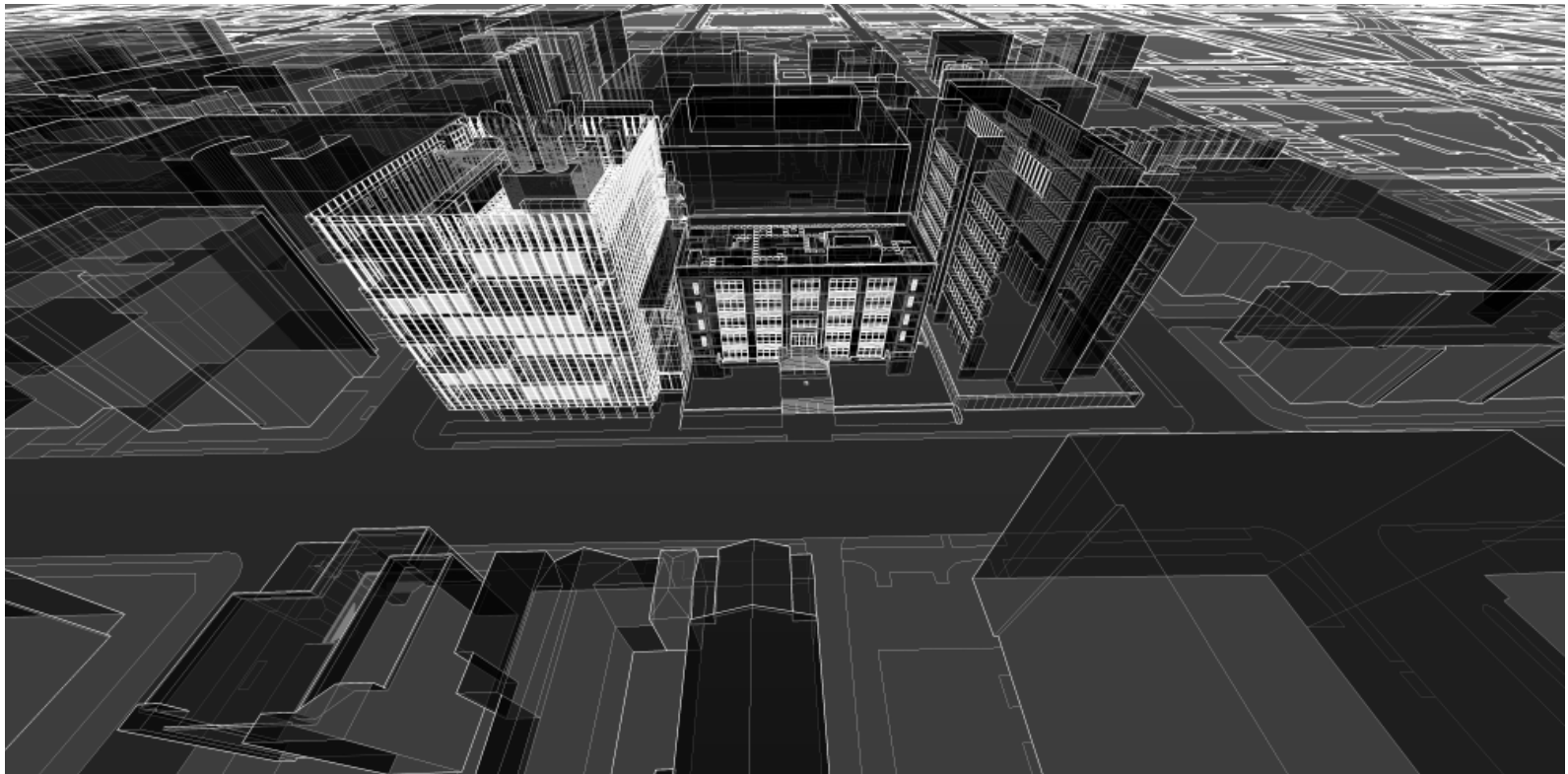


EXTERIOR PERSPECTIVES

THESE EXTERIOR PERSPECTIVES HELP TO SHOW THE RELATIONSHIP OF THE NANOTECHNOLOGY RESEARCH LABORATORY WHILE ALSO ALLOWING ADDITIONAL LAYERS OF INFORMATION TO BE REVEALED THROUGH THE TRANSPARENT NATURE OF THE DRAWINGS. THE DRAWING ON THE LEFT SHOWS A VIEW FROM THE RAISED CONCRETE PATIO, LOCATED ON THE BACK SIDE OF TOMPKINS HALL, LOOKING NORTH TOWARDS H STREET NW.

THE IMAGE ON THE TOP RIGHT IS AN AERIAL PERSPECTIVE SHOWING THE SURROUNDING URBAN LANDSCAPE, AND HOW THIS BUILDING FITS IN CONTEXTUALLY. THE FINAL IMAGE ON THE BOTTOM RIGHT SHOWS A VIEW OF THE BUILDING FROM THE INTERSECTION OF 23RD STREET NW AND H STREET NW, LOOKING SOUTH EAST.

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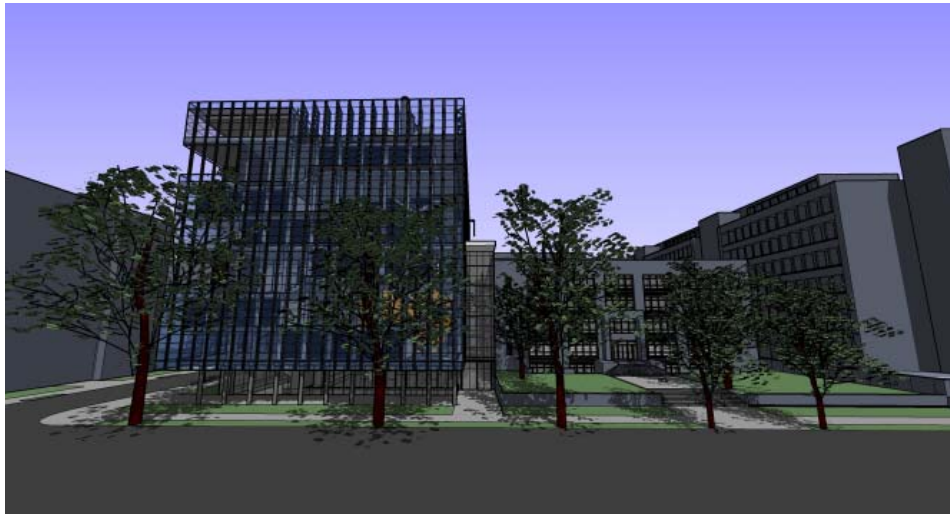
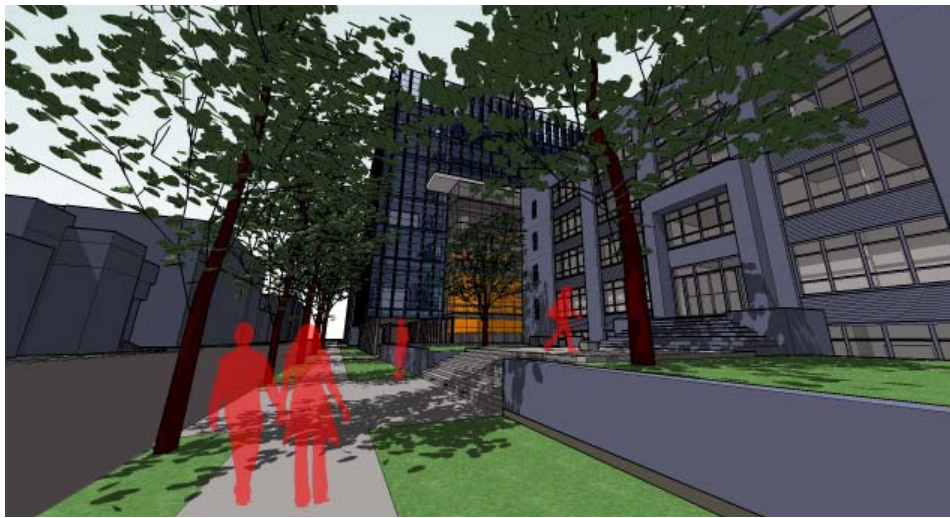


EXTERIOR PERSPECTIVE - DAYTIME

TOP LEFT:
THE PERSPECTIVE SHOWS PEDESTRIAN CIRCULATION ON THE SIDEWALK IN FRONT OF TOMPKINS HALL, LOOKING NORTH TOWARDS THE NANOTECHNOLOGY RESEARCH LABORATORY.

MIDDLE LEFT:
THE PERSPECTIVE SHOW THE CONTEXT AND RELATIONSHIP BETWEEN THE NEW NANOTECH BUILDING AND TOMPKINS HALL. THE ATRIUM SPACE BETWEEN THE TWO BUILDINGS IS THE LOCATION OF THE MAIN ENTRANCE.

BOTTOM LEFT:
THIS PERSPECTIVE SHOWS A CLOSER VIEW OF THE MAIN ENTRANCE. THROUGH THE ENTRANCE, ONE CAN SEE THE OFFICES TO THE UPPER RIGHT, THE CLEAN-ROOM IN THE CENTER OF THE BUILDING, AND THE GARDEN WALL AS THEY ENTER THE ATRIUM.





THIS RENDERED EXTERIOR PERSPECTIVE SHOWS THE EXISTING TREES IN THE FRONT OF THE BUILDING, AND HOW THEY RELATE TO THE SURROUNDINGS. THIS HELPS TO GIVE A GOOD IDEA OF WHAT IT WOULD FEEL LIKE AT THE ENTRANCE TO THE BUILDING.



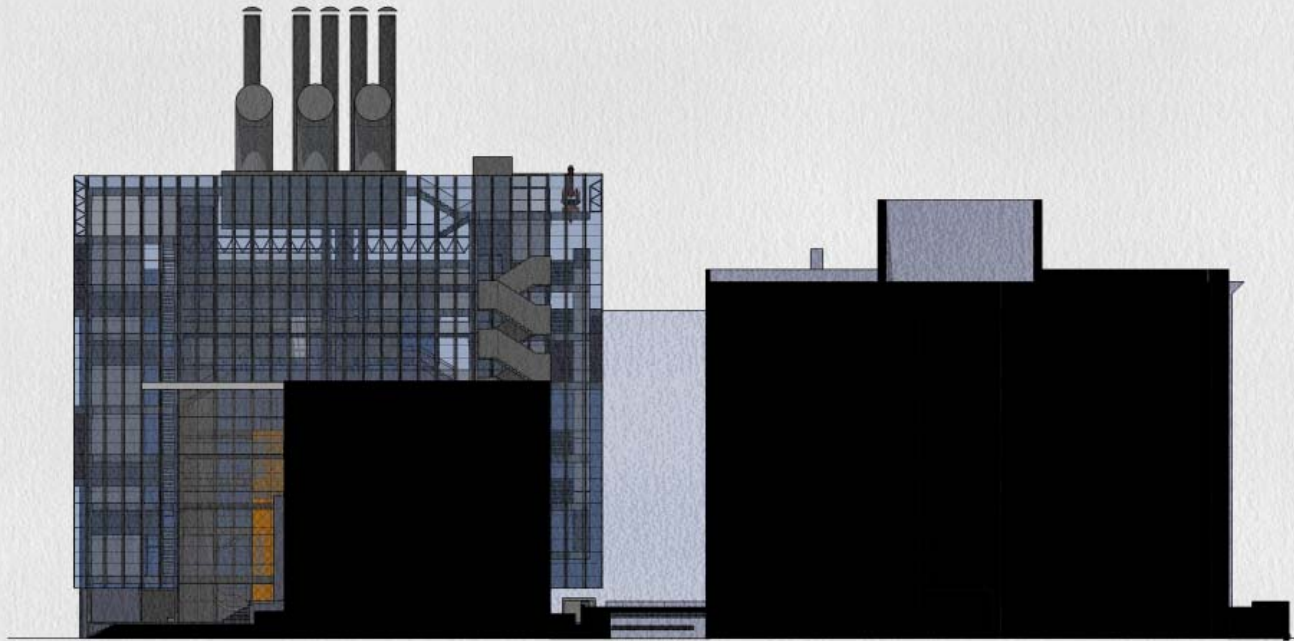
EAST ELEVATION



WEST ELEVATION

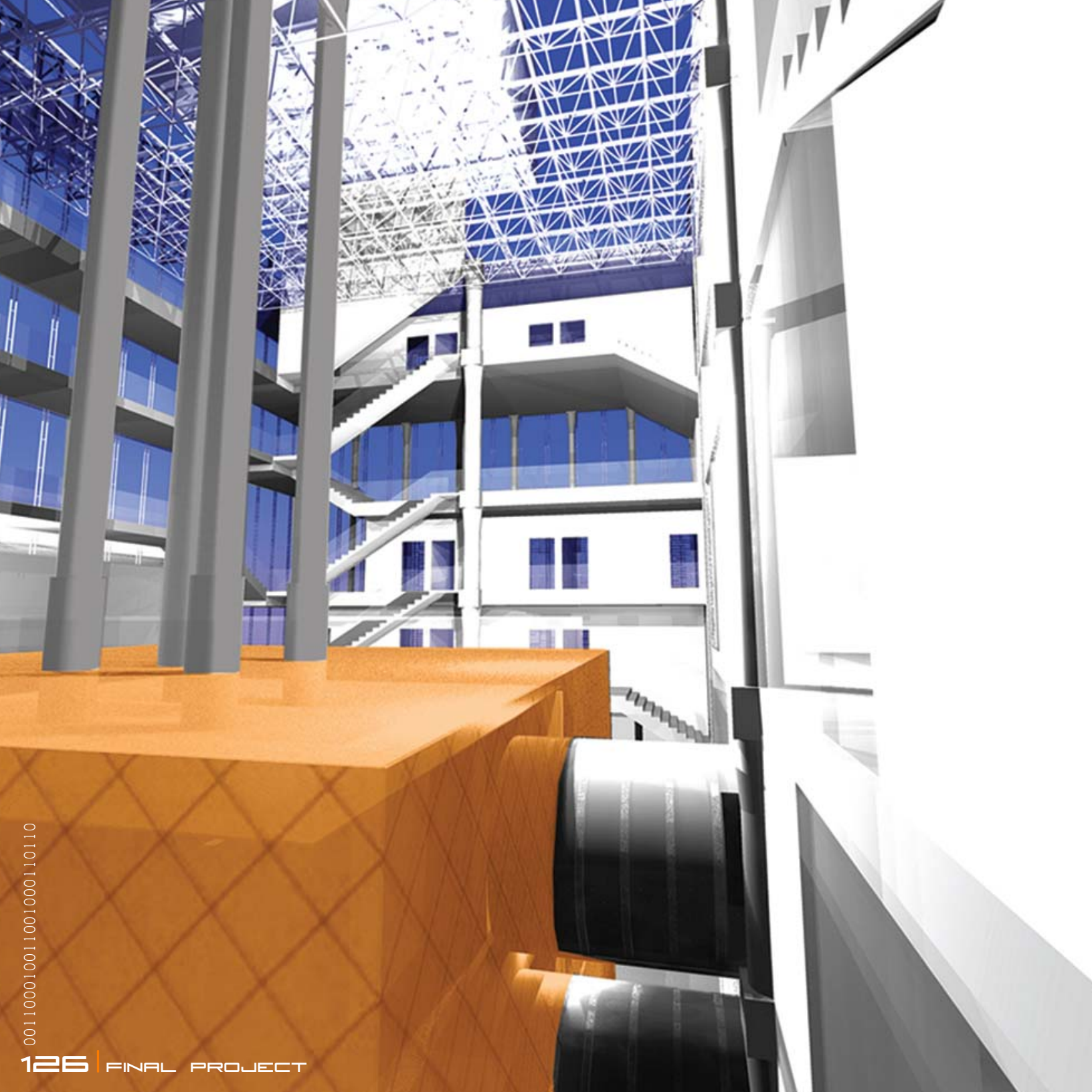


NORTH ELEVATION

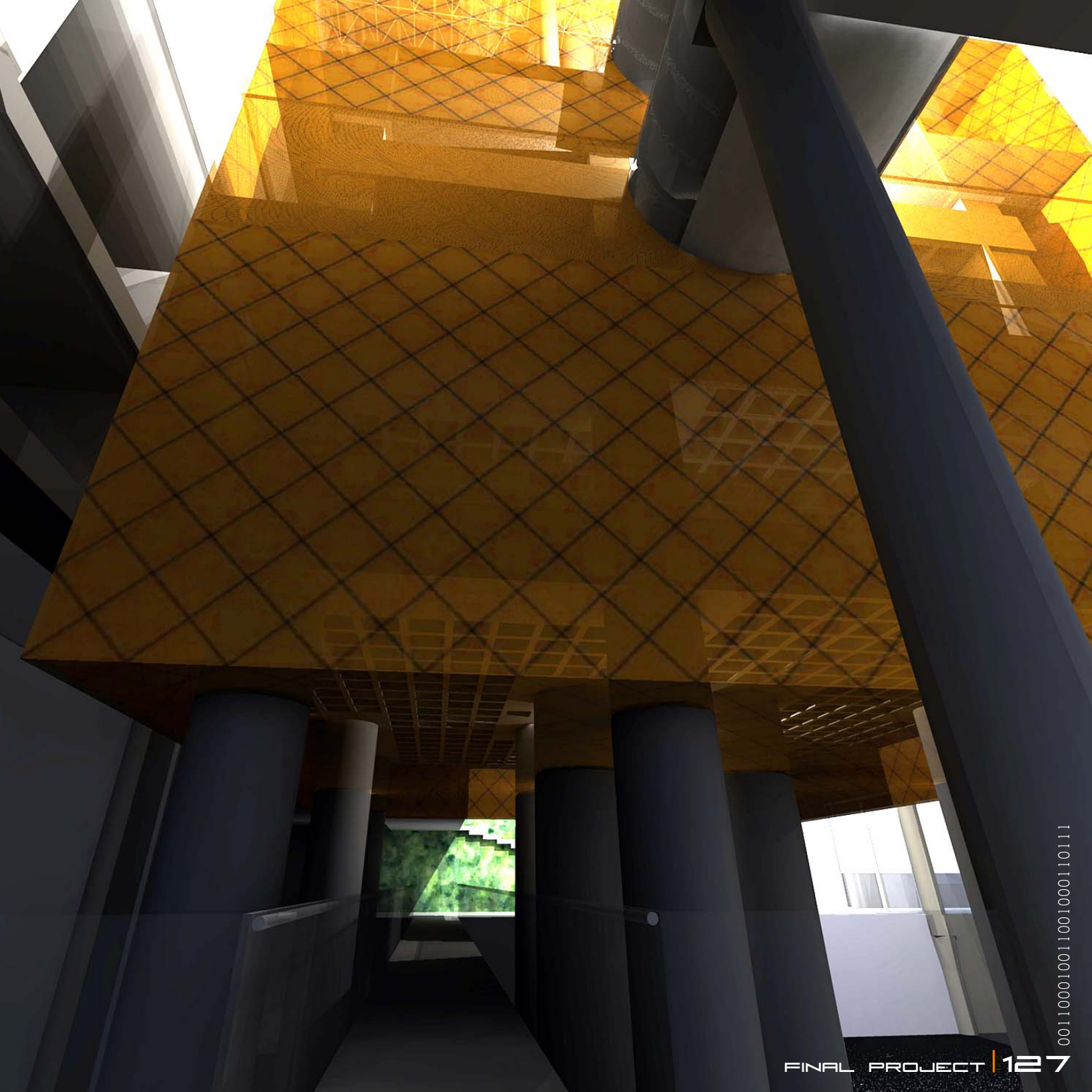


SOUTH ELEVATION

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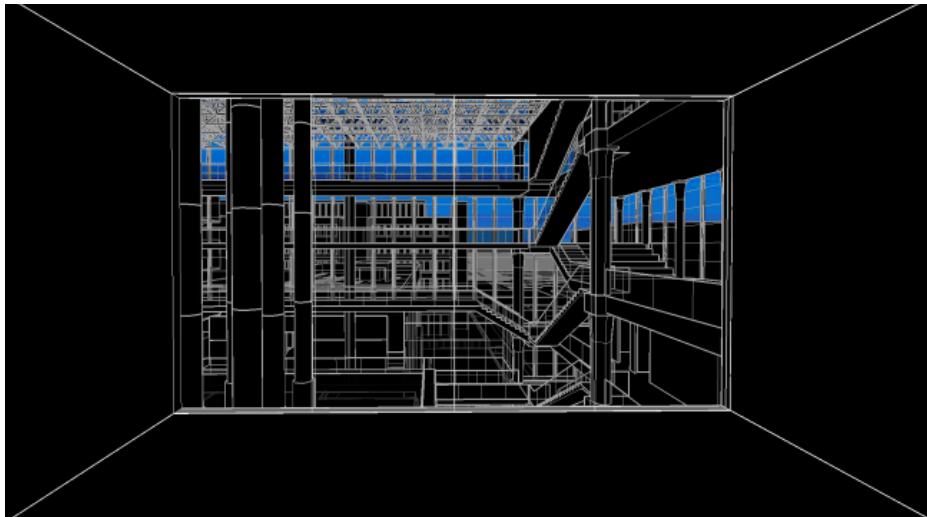
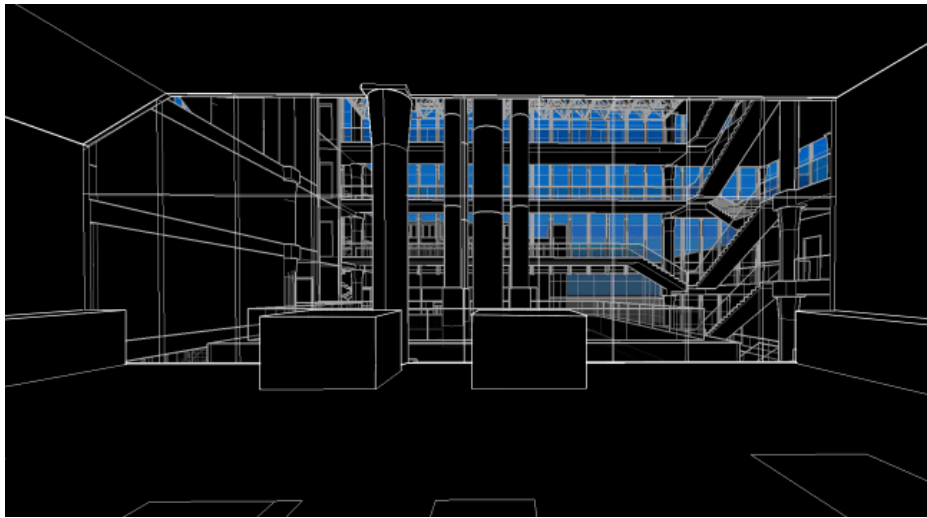
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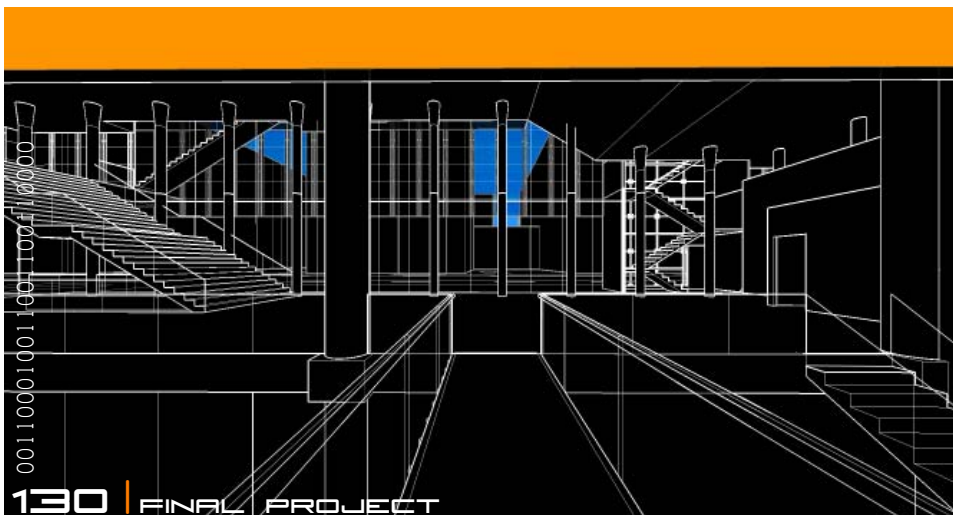
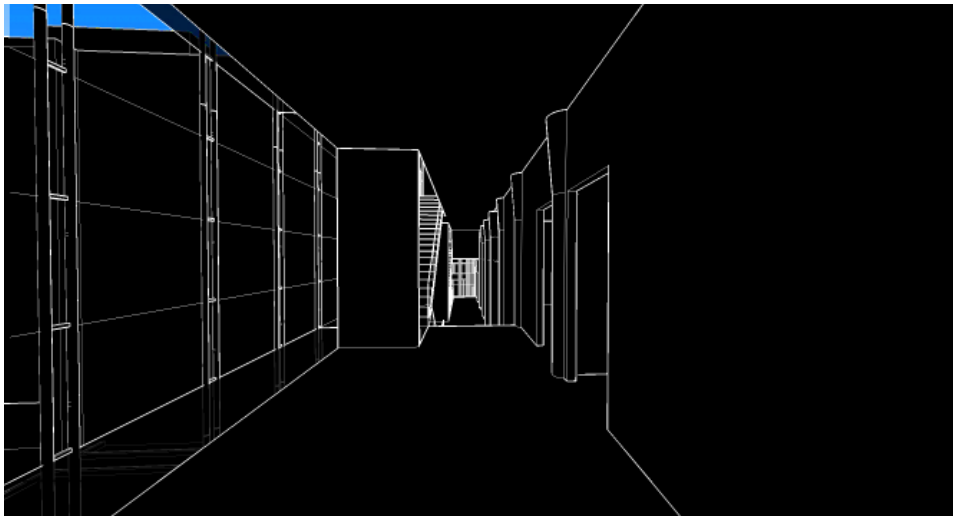
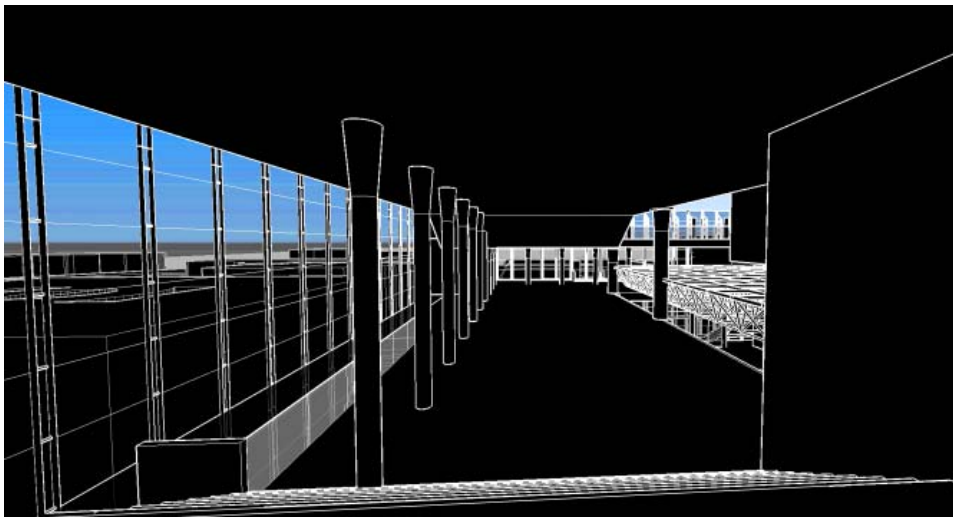
LABORATORY INTERIOR PERSPECTIVES

THESE INTERIOR PERSPECTIVES HELP TO DEFINE THE LABORATORIES ARCHITECTURALLY AND HELP TO SHOW HOW EACH OF THE LABORATORIES LOOKS INTO THE ATRIUM. THIS ALLOWS VIEWS OF THE CLEANROOM, THE CIRCULATION OF FRIENDS AND COLLEAGUES ON THE BRIDGES AND STAIRS, AND OF THE CITY BEYOND.





INTERIOR RENDERING OF THE
CENTER ATRIUM FROM ONE OF THE
INTRODUCTORY LABORATORIES.

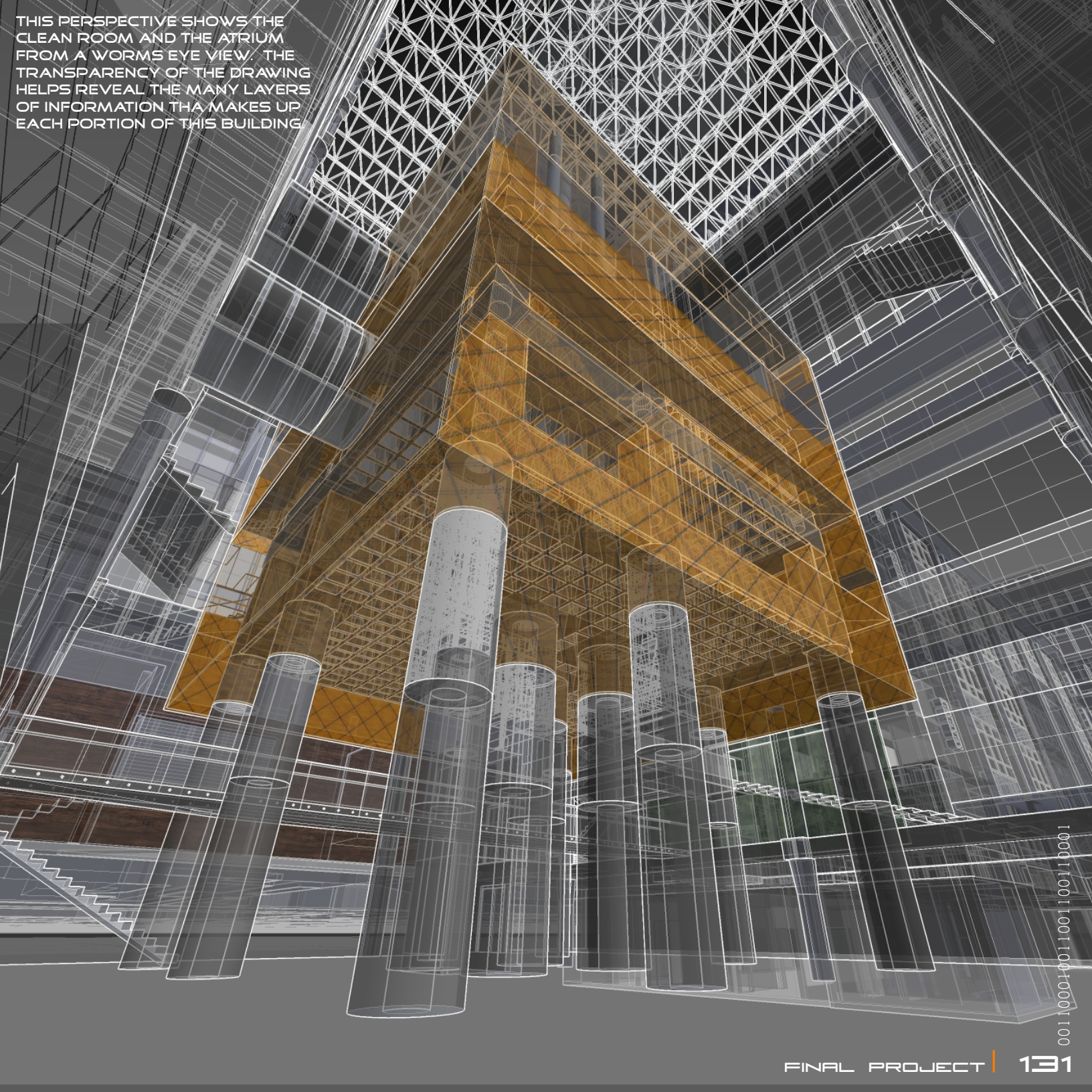


TOP LEFT:
THIS PERSPECTIVE IS OF
THE LIBRARY, WITHOUT
ANY OF ITS FURNITURE.

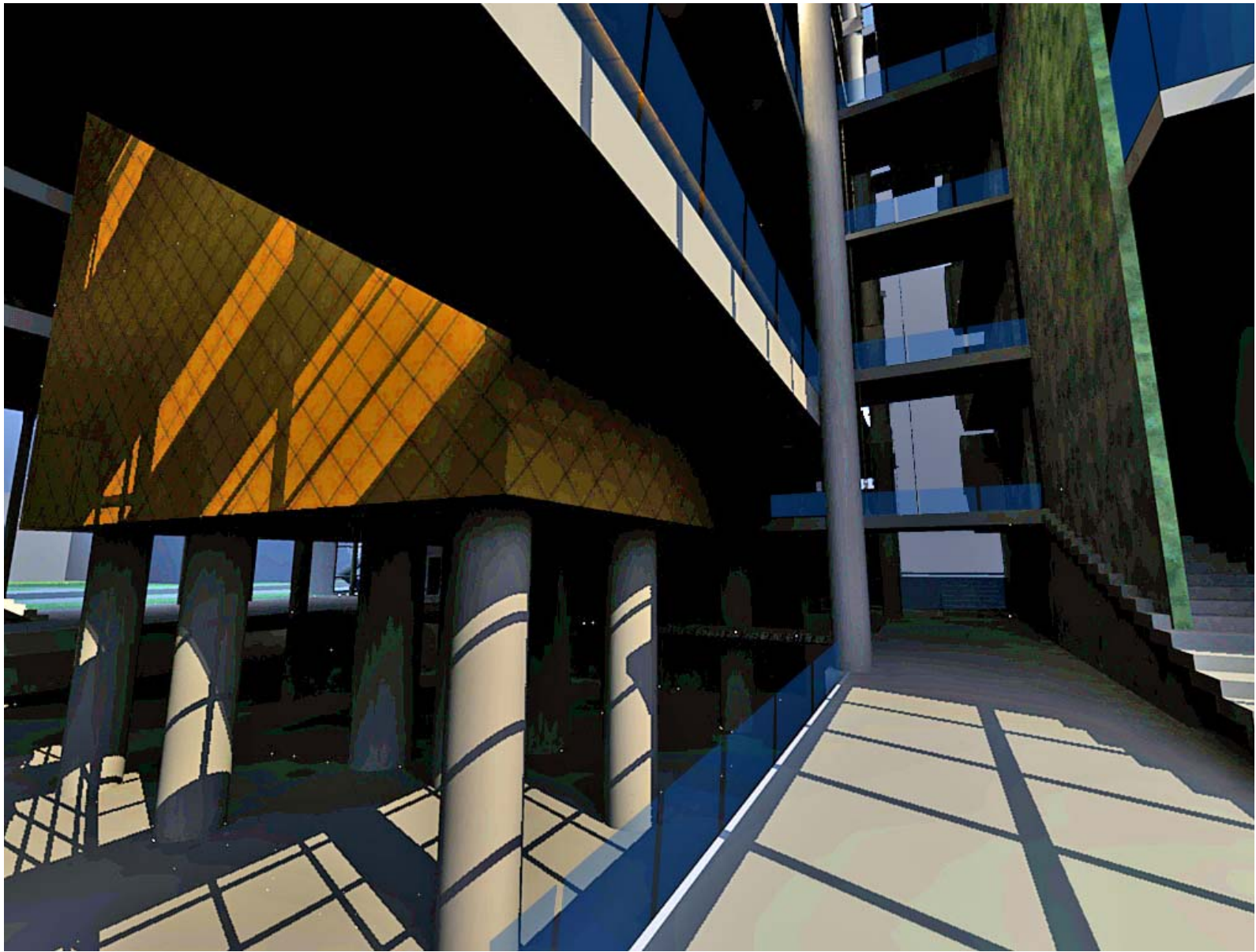
MIDDLE LEFT:
THIS PERSPECTIVE IS OF
THE EASTERN CIRCULATION,
NEXT TO THE LABORATORIES.

BOTTOM RIGHT:
PERSPECTIVE OF THE BRIDGE
UNDER THE CLEANROOM. THIS
BRIDGE ALLOWS FOR EXPANSION
AND COMPRESSION OF SPACE,
WHILE ALLOWING THE USER TO
FEEL THE PRESENCE OF THE CLEAN
ROOM ABOVE. THIS IS THE MAIN
WAY THAT PEOPLE ENTERING THE
BUILDING WILL USE TO START ON
THE SPIRAL CIRCULATION, AND
ACCESS THE REMAINING
PORTIONS OF THE BUILDING.

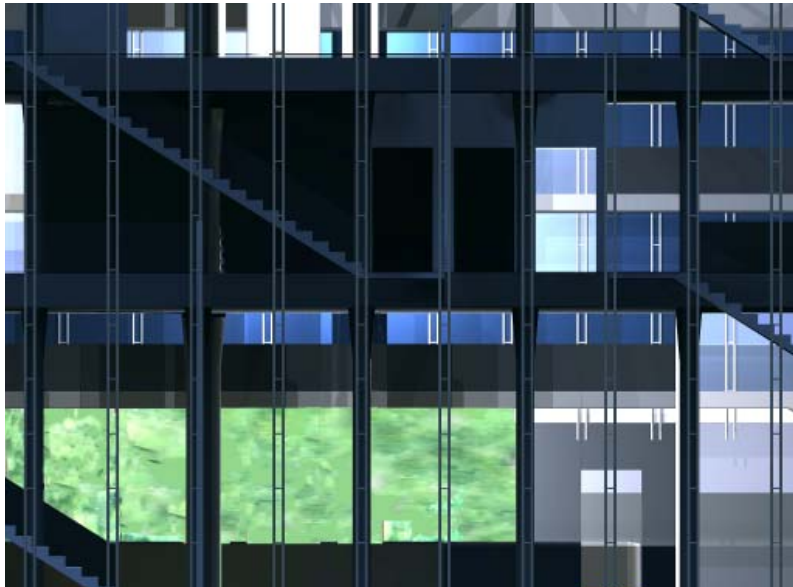
THIS PERSPECTIVE SHOWS THE CLEAN ROOM AND THE ATRIUM FROM A WORMS EYE VIEW. THE TRANSPARENCY OF THE DRAWING HELPS REVEAL THE MANY LAYERS OF INFORMATION THAT MAKES UP EACH PORTION OF THIS BUILDING



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RENDERINGS

LEFT IMAGE:

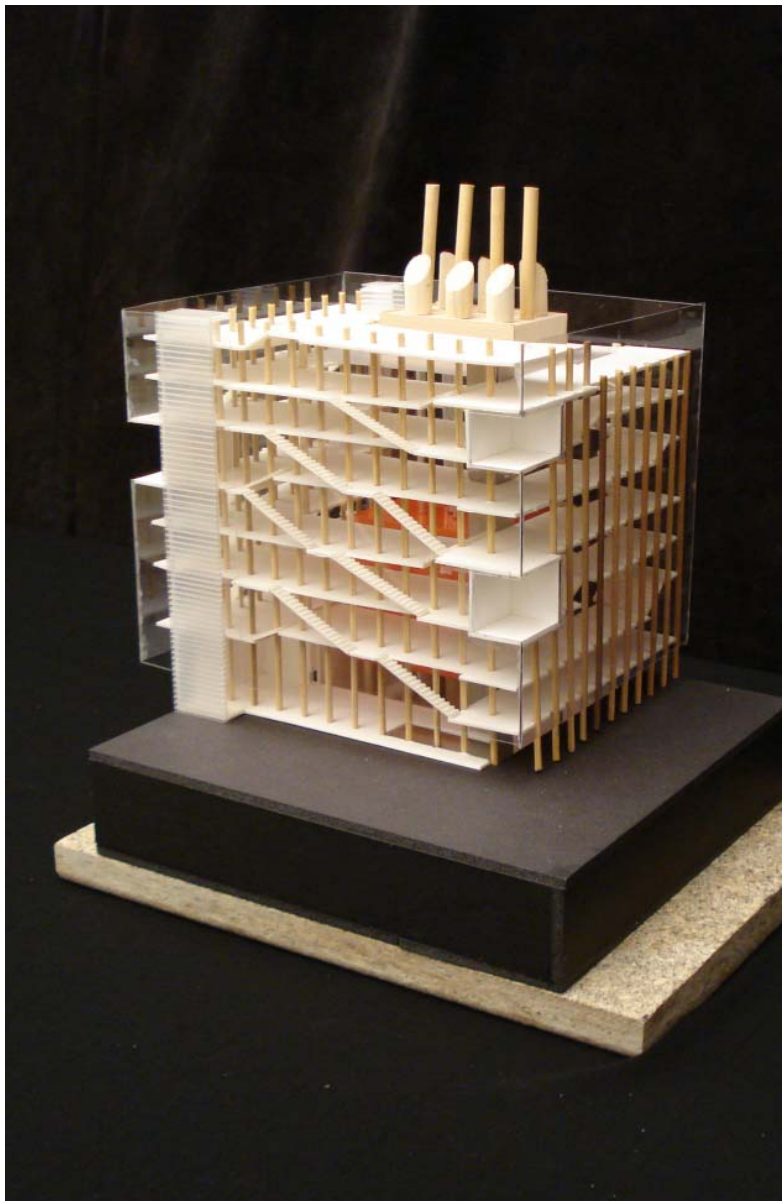
RENDERING OF THE ENTRANCE ATRIUM. THIS IMAGE SHOWS THE BIO-FILTER GARDEN WALL, THE CLEANROOM AND LOWER LOUNGE TO THE LEFT, AND THE BRIDGES ABOVE. THIS IS THE MAIN ENTRANCE, AND VISITORS HAVE THREE OPTIONS OF WHERE TO GO. TURN LEFT AND TAKE THE BRIDGE UNDER THE CLEANROOM TO START ON THE SPIRAL CIRCULATION PATH THROUGH THE BUILDING, STRAIGHT AHEAD TO THE ELEVATION, OR UP THE STAIRS TO TOMPKINS HALL.

TOP RIGHT IMAGE:

RENDERING OF EXTERIOR FACADE DETAILS. THIS IMAGE SHOWS STRUCTURAL MULLIONS THAT SUPPORT THE GLASS EXTERIOR, THE METAL GRATES WITHIN THE DOUBLE WALL SYSTEM, THE CONCRETE COLUMNS AND SLABS, AND ALSO THE URBAN ROOF GARDEN DECK.

BOTTOM RIGHT IMAGE:

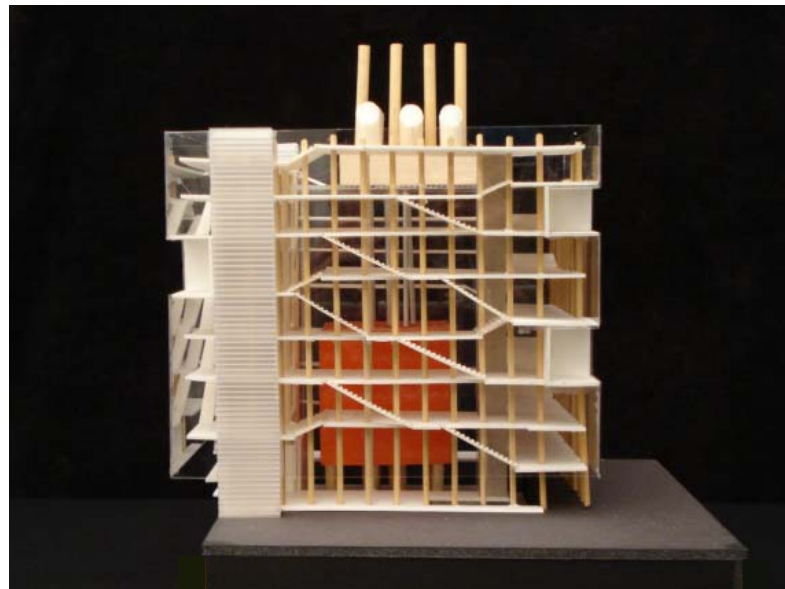
RENDERING SHOWS AN ELEVATION OF THE EXTERIOR FACADE AT NIGHTTIME. THIS SHOWS MANY LAYERS INCLUDING THE GLASS DOUBLE WALL, THE STRUCTURAL MULLIONS, THE CIRCULATION STAIRS, THE CONCRETE SLABS AND COLUMNS, AND THE GARDEN WALL BEYOND.



1/16" = 1'-0" MODEL
LOOKING SOUTHEAST



TOP: 1/16" = 1'-0" MODEL
LOOKING SOUTHWEST



BOTTOM: 1/16" = 1'-0" MODEL
LOOKING SOUTH



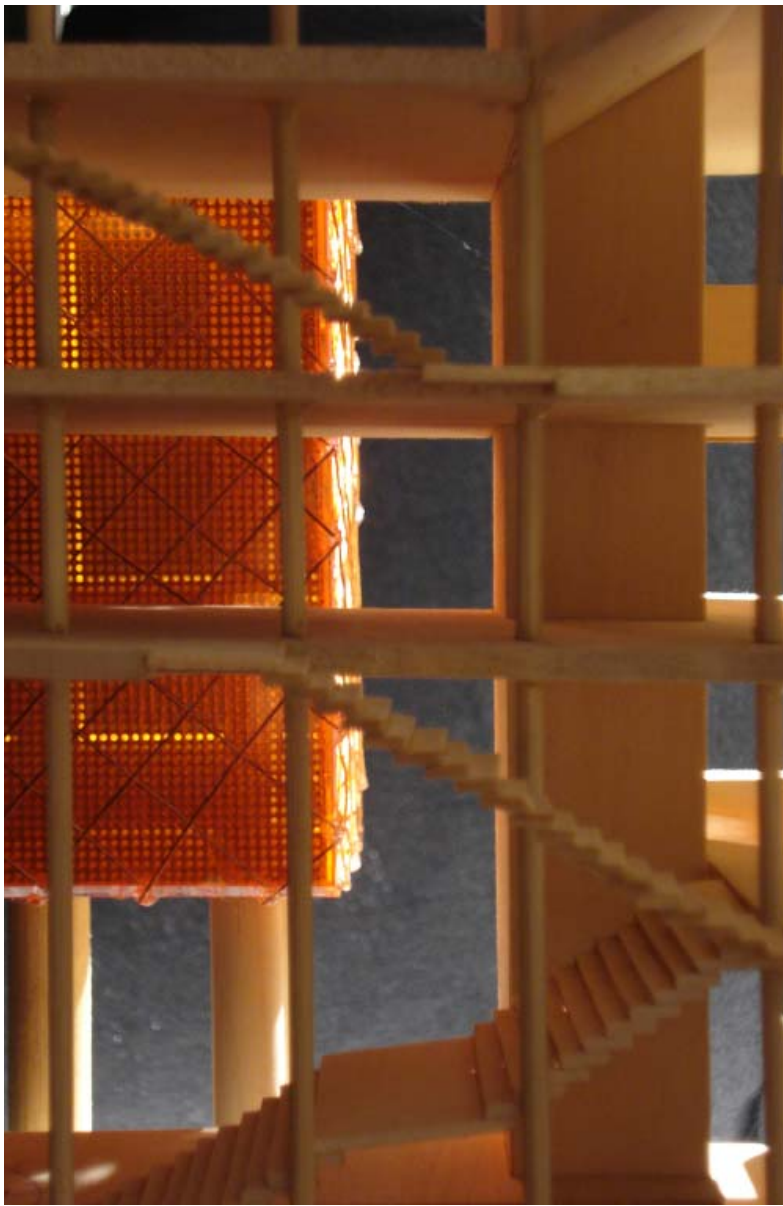
1" = 30'-0" MODEL
LOOKING SOUTHEAST

THE 3D MODEL HELPS
BRIDGE THE GAP
BETWEEN THE
IMAGINED AND
THE REAL WORLD.
FORM GIVES SHAPE
TO AN IDEA.

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1/4" = 1'-0" MODEL
INTERIOR VIEW OF MODEL, FROM
ATRIUM LOOKING TOWARD THE
LABORATORIES AND LIBRARIES



1/4" = 1'-0" MODEL
PARTIAL ELEVATION OF THE NORTH
SIDE OF THE BUILDING LOOKING
SOUTH INTO THE ATRIUM TOWARD
THE CLEANROOM.

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1/4" = 1'-0" MODEL
PARTIAL SECTION CUT THROUGH
OFFICE WING AND PART OF THE
CLEANROOM. THE LABORATORIES,
LIBRARY AND ELEVATOR CAN BE
SEEN IN THE BACKGROUND.



1/4" = 1'-0" MODEL
PARTIAL ELEVATION OF THE WEST
SIDE OF THE BUILDING, LOOKING
TOWARD THE OFFICE WING, AND
THE CLEANROOM.

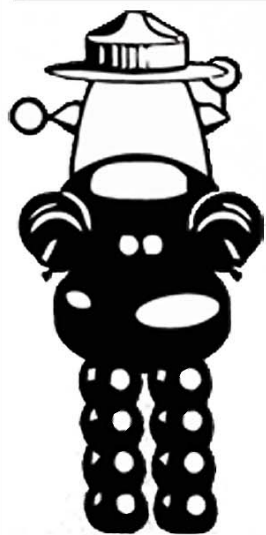


NANOTECHNOLOGY IS THE WILLFUL MANIPULATION OF ATOMS...



ARCHITECTURE IS THE WILLFUL MANIPULATION OF SPACE...

REMEMBER



**ONLY YOU
CAN PREVENT GRAY GOO**

**NEVER RELEASE NANOBOT ASSEMBLERS
WITHOUT REPLICATION LIMITING CODE**

SMOKY THE NANOBOT
JIM LEFTWICH
1995

SELECTED READINGS:

- Bradley, Betsy Hunter. *The Works: The Industrial Architecture of the United States*.
New York: Oxford University Press, USA, 1998.
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