

T\_CODE 2013

## Cellular buildings - Thematic Studio

Tutor: Yasha J. Grobman

מבניים תאיים באדריכלות - סטודיו תמטי

מנחה: יאשה גרובמן

T\_CODE 2013

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## נושא הסטודיו



Ervin Hauer – Church in Liesing, Vienna, Austria, 1952 Church in Erdberg, Vienna, Austria, 1954  
Sources: www.erwinhauer.com



Grimshaw Architects – Eden Project, Cornwall, United Kingdom, 2001  
Sources: www.grimshaw-architects.com

חלקים ניכרים מהעולם בו אנו חיים מבוססים על הגיון תאי. הגיון מבני זה מתקיים החל מקנה המידה המיקרוסקופי של התא החי וכלה במערכות מורכבות של מבני צמחים ובעלי חיים יבשתיים וימיים. בנוסף, ניתן להבחין בהגיון תאי גם במבנה גבישים ומבנים גאולוגיים בקנה מידה גדול יותר.

מנקודת מבט אדריכלית ניתן להבחין בהגיון תאי בסגנונות בניה ותקופות שונות לאורך ההיסטוריה, החל במבני מערות וכלה בסגנונות כגון המטבוליזם במאה העשרים וסגנונות אחרים. גם הבניה האורטוגונית המסורתית, המתבססת על חללים קובייתיים, יכולה להיתפס כבניה תאית (כלל חלל או חדר מהווה למעשה תא אחד).

למרות שהיו לאורך ההיסטוריה נסיונות לפתח מערכות גאומטריות תלת מימדיות מורכבות (לדוגמה, המבנים של יונה פרידמן או מבנים הכפופים לתאוריית "האלקסון" של פול ורליו), מרבית המבנים הבנויים מתבססים על גאומטריה אורטוגונית. עם התבססות בשימוש בכלים מבוססים מחשב לעיצוב וייצור באדריכלות ניתן לבחון מחדש את האפשרויות הגלומות בפיתוח הגיון תאי באדריכלות המתבססת על גאומטריה מורכבת יותר. גאומטריה זו מבוססת על משטחים/מסות שאינם אורטוגונאליים אלא עקומים או אלכסוניים.

ניתן לפתח תפיסה תאית באדריכלות בשני רמות עיקריות: הרמה הראשונה מתייחסת לפיתוח מערכת מבנים תאית עליה תבוסס גאומטריית המבנה כולו. הרמה השנייה מתייחסת למעטפת הבנין בלבד. במסגרת כיוון זה ניתן לנסות ולשנות את התפיסה הדו מימדית של החזית המבוססת על הגיון של שכבות.

הסטודיו ישאף להתמודד עם האתגר הטמון בפיתוח מבנה המבוסס על הגיון תאי. במסגרת זו יתבקש כל סטודנט ולעצב בנין ציבור מודרני וחדשני המבוסס על הגיון תאי בשתי רמות אלה. המחקר הראשוני, ניתוח האתר ועיצוב המבנה יעשו תוך שימוש בשיטות מתקדמות לתכנון וייצור המבוססים על השימוש במחשב. שילוב שיטות אלה בתהליך התכנון מהווה מימד נוסף לאתגר איתו יתמודדו הסטודנטים בסטודיו. הסטודיו מלווה בקורס תאורי/מעשי משלים המקנה לסטודנט הבנה של ההקשר הרחב יותר של השיח האדריכלי באדריכלות דיגיטלית בכלל ושיטות עיצוב וייצור מבוססות מחשב בפרט.

## מטרות הסטודיו

התמודדות עם פיתוח מערכת תאית בקנה מידה של בנין ומעטפת. התמודדות עם פרוגרמה ועיצוב של מבנה ציבור בנוי (בשטח של כ 3000 מ"ר). לימוד, פיתוח ויישום שיטות תכנון וייצור מבוססות מחשב. התמודדות עם סינטזה של רעיון אדריכלי (הכוונה לפתח רעיון אדריכלי החל משלב המיפוי דרך אנליזה של האינפורציה העולה מהמיפוי לכדי כיוונים אפשריים למחקר ויישום אדריכלי וכלה בסינטזה של רעיון מוביל המבוסס באופן ישיר (ורצוי אמפירי) על נתוני המיפוי.

## הפרוגרמה והאתר

הפרייקט יתוכנן על מגרש שמיועד למבנה ציבור בתב"ע החדשה למתחם שוק הכרמל בתל אביב. המיקום המדויק יוצג במפגש הראשון. התכנון יתמודד עם פרוגרמה של מרכז קהילתי לתושבי האזור השונים שיכלול גן ילדים, פעילות צהריים ואחה"צ לילדים (חוגים), פעילות מבוגרים (חוגים, ספורט, הרצאות) ומרכז לקשישים. המבנה יתוכנן באופו גמיש וורסטילי כך שיאפשר שימוש ע"י הקהילות השונות והגילאים השונים.

הסטודיו מבוסס על מחקר/תוצאות סטודיו דומה בשנה שעברה: ניתן לראות/להוריד את החומר בכתובת הבאה (55 מגביט):  
<https://www.dropbox.com/s/8yi3tjwiemb1bk3/cellular%20studio%202012%20-%20final%20general%20book-72dpi%20.pdf>

הבניין יעמוד בחוקי התב"ע המוצעת מבחינת, קו בנין, אחוזי בניה וגובה. הבנין יעמוד בחוקי הבניה בישראל. הבנין יעמוד בתקן 5281 ותקן 5282 (בניה ירוקה).

### הפונקציות הנדרשות בבנין:

גן ילדים טרום חובה וחובה - שתי כיתות של 30 ילדים + כל הפונקציות התומכות. חדרי חוגים (כולל חדרי סדנאות יצירה וחדר ספורט). אולם רב תכליתי של כ 150-200 מקומות ישיבה. אזור מולטימדיה - ספריה וירטואלית של ספרים וקלטות DVD. בית קפה. גלריה. משרדים. חדרי שרות ומחסנים. המבנה ישולב בחניון תת קרקעי של 4 קומות שישימש את תושבי השכונה, המבקרים בבנין ובאי השוק.

### ציפיות מהסטודנט:

נוכחות מלאה בכל השיעורים - חיסור לא מוצדק (עפ"י כללי הטכניון) של יותר משני מפגשים אינו מאפשר קבלת ציון. התקדמות ממפגש למפגש. השתתפות בדיונים בסטודיו. הגשת תרגילי התכנון בזמן עפי הפורמט הגרפי המופיע בנספח א'. פירוט ההנחיות לתרגילים מופיע בנספחים ג-ה. הגשת הפרוייקט הסופי בזמן בהתאם לדרישות המפורטות בהמשך. הגשת CD עם החומר של הפרוייקט בהתאם לפורמט הגרפי המתואר בנספח א'.

ומעל לכל התלהבות, סקרנות אינטלקטואלית והנאה - סטודנט המרגיש שאינו מקבל אחד או יותר מאילו כדאי שיפנה למנחה בהקדם.

דרישות להגשת פרוייקט סופי:

1. מצגת PDF עשויה לפי הפורמט הגרפי המתואר בנספח א'.
2. ספר פרוייקט המכיל את כל החומר על הפרוייקט (כולל אלטרנטיבות שלא נבחרו) וטקסט הקדמה באורך של כ 1000 מילים המציג את הפרוייקט.
3. לפחות 4 גליונות A0 המציגים את הפרוייקט.
4. מודלים פיזיים בקנ"מ 1:100 או 1:200 או 1:250 של הבנין מודל רעיוניים ומודלים נוספים יתקבלו בברכה

דרישות תנאי לקבלת ציון:

1. הגשת הפרוייקט עפ"י ההנחיות הנ"ל.
2. הגשה של חומר הפרוייקט ע"ג CD עד שבוע לאחר מועד ההגשה הסופית. החומר יוגש בהתאם לפירוט בנספח ה'.

### הערכה:

30% - תרגילים (10% לכל תרגיל)



Antoni Gaudi – Casa Mila (La Pedrera), Barcelona, Spain, 1910.  
Sources: [www.dianeobrien.wordpress.com](http://www.dianeobrien.wordpress.com), [www.planetware.com](http://www.planetware.com)



PTW Architects – Watercube – National Swimming Centre, Beijing, China, 2003.  
Sources: <http://www.flickr.com/photos/xiaming/484446352/light-box/>

30% - עבודה לאורך הסמסטר  
 30% - הגשה סופית  
 10% - תרומה לסטודיו - השתתפות בחיי הסטודיו ותרומה לדיונים

### חיי הסטודיו

העבודה בסטודיו תתחלק להנחיות אישיות והנחיות קבוצתיות. מפגש אחד בשבוע יוקדש להנחיות אישיות והמפגש השני להנחיה קבוצתית בה יציג כל סטודנט את התפתחות הפרוייקט ויתקיים דיון בנושא כיווני ההתפתחות הרצויים. במפגש זה ידונו גם נושאים תאורטיים שיהוו בסיס לפיתוח הפן התאורטי/ביקורתי של הפרוייקט האישי.

### נקודות מוצא לתכנון

התרגילים הראשונים בסטודיו יקנו כלים תאורטיים ומעשיים לסטודנטים. נקודת המוצא לתכנון בסטודיו זה מתמקדת בגילוי צורה דיגיטאלי (digital form finding) ובעיסוק במערכות גאומטריות/חומריות. שיטה זו אינה באה להחליף שיטות תכנון אחרות שנלמדו בעבר אלא מהווה נדבך נוסף באסופת הכלים ושיטות התכנון של האדריכל העכשווי.

### שימוש בכלים דיגיטאליים.

העבודה בסטודיו תעשה באמצעות הכלים הבאים:  
 כלי מידול: ריינו, מקס, רויט - ניתן לשלב תוכנות נוספות כסקטשאפ כאשר הפרוייקט המתוכנן אינו מורכב מבחינה גאומטרית.  
 כלים פרמטריים: גראסהופר, פאראקלאוד ג'ם וכלים נוספים.  
 כלים גרפיים: אילוסטרטור, פוטושופ, אין-דיזיין ואקרובט.

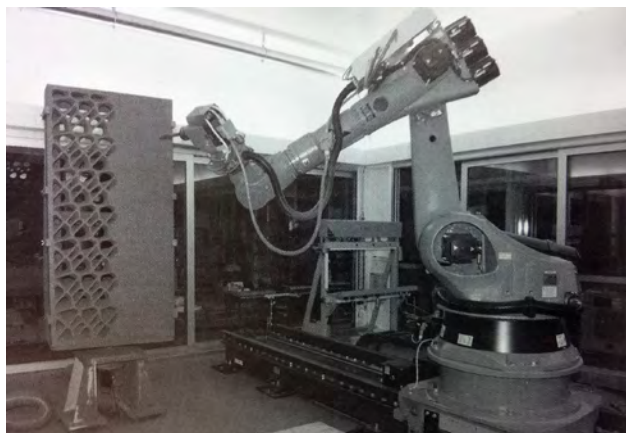
אין צורך בידיעת התוכנות לפני התחלת הסטודיו אם כי מומלץ להכיר תוכנה אחת מכל סוג.

### שעות קבלה:

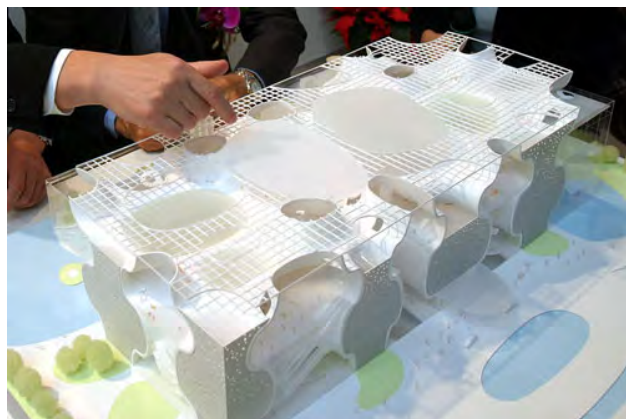
יום ראשון 13:30-14:30 בחדר 602 בנין סגו לפי תאום מראש:  
 yasha@technion.ac.il טל 04-8294041 (4041 פנימי).

### פירוט המפגשים:

שבוע 1: הצגת הסטודיו, הפרוגרמה והתרגיל הראשון - תרגיל מחקר  
 שבוע 2: הגשת בניים תרגיל מחקר



Gramazio Kohler – The Dissolved Wall/Screens, 2006-2007.  
 Source: F. Gramazio and M. Kohler, "Towards a Digital Materiality," in Manufacturing Material Effects: Rethinking Design and Making in Architecture, 1st ed., B. Kolarevic and K. Klinger, Eds. Routledge, 2008, pp. 103-118

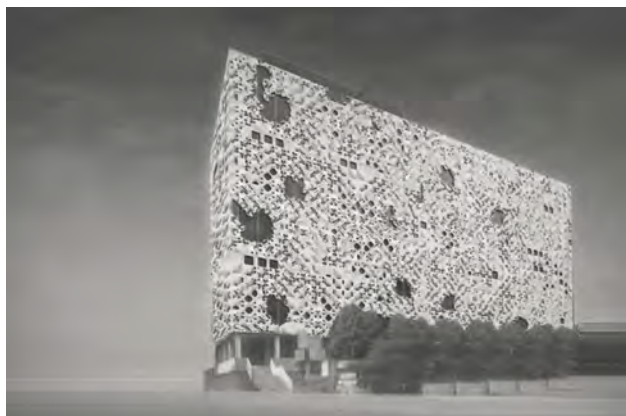


Toyoo Ito, Taichung Metropolitan Opera House. [http://www.tropo-lism.com/2006/01/toyo\\_itos\\_structural\\_awesome.php](http://www.tropo-lism.com/2006/01/toyo_itos_structural_awesome.php)

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Contemporary Architecture Practice (CAP) - Migrating Formations, New York, USA, 2008  
 Source: Y. Grobman and E. Neuman, Eds., *Performatism: Form and Performance in Digital Architecture*. Routledge, 2011. P. 97



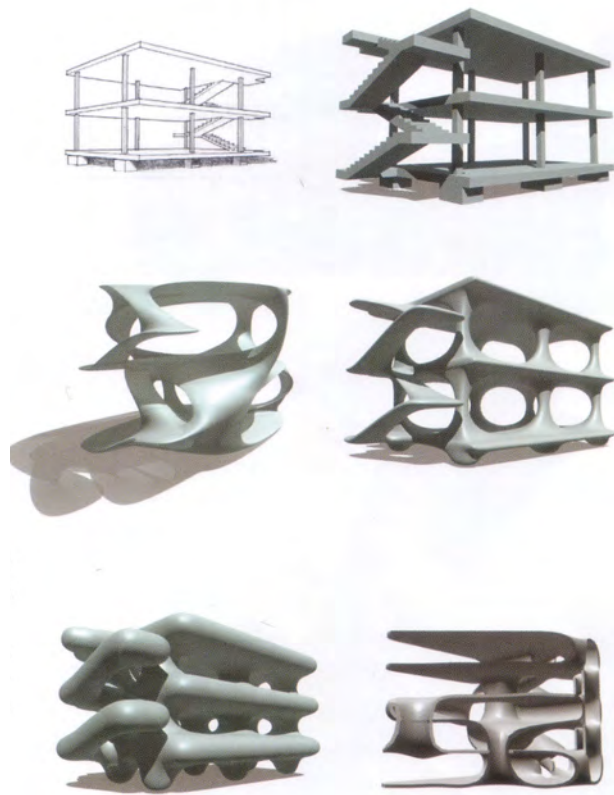
Kol/Mac architecture – INVERSAbrane - high-performance exterior building, membrane prototype, 2006.  
 Source: Y. Grobman and E. Neuman, Eds., *Performatism: Form and Performance in Digital Architecture*. Routledge, 2011. P. 120-121

- שבוע 3: הגשה סופית תרגיל מחקר והצגת תרגיל מעטפת תאית  
 שבוע 4: תרגיל מעטפת תאית - הגשת ביניים  
 שבוע 5: הגשת תרגיל מעטפת תאית והצגת תרגיל ניתוח דיאגרמטי  
 שבוע 6: הגשת ביניים ניתוח דיאגרמטי  
 שבוע 7: הגשה סופית ניתוח דיאגרמטי  
 שבוע 8: הצגת רעיון צורני/פרוגרמטי ראשון למבנה/מעטפת והתיחסות ראשונית לאתר  
 שבוע 9: פיתוח תכנון  
 שבוע 10: פיתוח תכנון  
 שבוע 11: הגשת ביניים פרוייקט  
 שבוע 12: פיתוח תכנון  
 שבוע 13: פיתוח תכנון  
 שבוע 14: הדרכה לקראת הגשה סופית - אסטרטגיות הגשה
- הגשה סופית תקבע בהתאם ללוח הזמנים השנתי.

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Dom-In(fo) by Dagmar Richter (2002-2003)  
Source: Anon, 2003. Architecture Non Standard, Centre Georges  
Pompidou Service Commercial, France. P. 81

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## נספח ב' - תרגיל ראשון - תרגיל מחקר

מטרת התרגיל היא להתנסות במחקר נקודתי ולייצר מאגר מידע משותף בנושא בניה תאית לסטודיו.

התרגיל יעשה בקבוצות של 1-2 סטודנטים. כל קבוצה תייצר מסמך המרכז מידע שימושי על סמך בבליוגרפיה ראשונית שתתקבל מהמנחה ומקורות נוספים שתמצא. תוצרי המחקר יועלו למחיצה שתשותף בין הסטודנטים בסטודיו.

נושאי הקבוצות:

מבנים תאיים בטבע - עולם החי: מציאת דוגמאות של מבנים תאיים בעולם החי (תלי תרמיטים, עור של תנין, פקעות של זחלים, קיני צרעות ועוד). חקירת התנאים בהם הם מתקיימים והאסטרטגיה הצורנית והחומרית שהביאו לפתרון זה. יצירת קטלוג של אסטרטגיות שונות שקיימות בטבע והמצבים מולם הם מתמודדים.

מבנים תאיים בטבע - עולם הצומח: מציאת דוגמאות של מבנים תאיים בעולם הצומח (מבנה עצים, עלים, פרחים, פקעות, פירות ועוד). חקירת התנאים בהם הם מתקיימים והאסטרטגיה הצורנית והחומרית שהביאו לפתרון זה. יצירת קטלוג של אסטרטגיות שונות שקיימות בטבע והמצבים מולם הם מתמודדים.

מבנים תאיים בטבע - דומם: מציאת דוגמאות של מבנים תאיים בגאולוגיה, גבישים, בועות סבון. חקירת התנאים בהם הם מתקיימים (תנאי מז"א אויר וחומר) והכוחות הפיזיקליים שיוצרים אותם. יצירת קטלוג של אסטרטגיות שונות שקיימות בטבע והמצבים מולם הם מתמודדים.

מבנים תאיים בטבע - המיקרו והננו - הסתכלות על עולם החי והצומח בקנה מידה מקרוסקופי וננסקופי. חקירת התנאים בהם הם מתקיימים והאסטרטגיה הצורנית והחומרית שהביאו לפתרון זה. יצירת קטלוג של אסטרטגיות שונות שקיימות בטבע והמצבים מולם הם מתמודדים.

מבנים תאיים בטבע - סביבה ימית: מציאת דוגמאות של מבנים תאיים החיים בסביבה מימית (ספוגים, אלמוגים ועוד). חקירת התנאים בהם הם מתקיימים והאסטרטגיה הצורנית והחומרית שהביאו לפתרון זה. יצירת קטלוג של אסטרטגיות שונות שקיימות בטבע והמצבים מולם הם מתמודדים.

גאומטריה תאית - פוליהדרלית. חקירה של סוגי גאומטריות פוליהדרליות תאיות. ניתוח וקטלוג של החוקיות היוצרת את הצורות והתאמתם למבנים.

גאומטריה תאית - ספוגית. חקירה של סוגי גאומטריות פוליהדרליות תאיות. ניתוח וקטלוג של החוקיות היוצרת את הצורות והתאמתם למבנים.

בניה תאית של מבנה - דוגמאות. מציאת תקדימים לבניה תאית/לפרוייקטים (לא בנויים)/ולתאוריות בדבר בניה תאית בהסטוריה האדריכלית.

טכנולוגיות בניה של אדריכלות תאית - מתכת ועץ. הצגת אפשרויות טכנולוגיות ליצירת מבנים תאיים במתכת ועץ תוך שימוש בטכנולוגיות ייצור בעזרת מחשב מתקדמות וטכניקות שונות (חיתוך בלייזר, הדפסה תלת מימדית, ואקום, יצירת תבניות ב CNC ועוד).



T\_CODE 2013

טכנולוגית בניה של אדריכלות תאית - בטון וחומרים מרוכבים. הצגת אפשרויות טכנולוגיות ליצירת מבנים תאיים בבטון, בטון מזויין וחומרים מרוכבים. שימוש בטכנולוגיות ייצור מסורתיות ומתקדמות בטכניקות שונות.

התרגיל יוגש תוך שימוש בפורמט הגרפי המופיע בנספח א.

**נספח ג' - תרגיל שני - מעטפת תאית**

מטרת התרגיל: התנסות בתכנון מעטפת תאית בגאומטריה מורכבת. התנסות בעבודה עם כלי מיחשוב מתקדמים.

דרישות התרגיל:

כל סטודנט יפתח חזית תלת מימדית המבוססת על גאומטריה תאית. החזית תתבסס על יחידה מודולרית/חזרתית פרמטרית שתשתנה מבחינה צורנית ויתכן גם מבחינת ביצועים כתלות במיקום הגאומטרי שלה ע"ג החזית וכתלות בפרמטרים אחרים שיוגדרו ע"י הסטודנט. החזית תאפשר חדירה מסויימת/מבוקרת של אור יום (הכוונה לשליטה אמפירית על כמות האור והזמן בו הוא חודר את החזית). בנוסף תתמודד החזית לפחות עם אחת מהדרישות הבאות:

- א. יצירת בידוד באמצעות חללי אויר.
- ב. יצירת מערכת ניקוז למי גשמים שמאפשרת אגירה של חלק מהמים ו/או עיכוב הגעת מי הגשמים למערכת העירונית.
- ג. יצירת תנאים לגידול צמחיה (באופן פסיבי או בשילוב עם מערכת השקיים אקטיבית)
- ד. שימוש במבנה התאים כחלק מהמערכת הקונסטרוקטיבית.

יוצגו תקדימים וניתוח השוואתי בין החזית הזו לחזית רגילה.

יעשה מאמץ לבחון את התוצר באופן סימולטיבי בתוכנת המחשב ובאופן פיזי. לטובת הבדיקה הפיזית יוכן קובץ STL של היחידה החזרתית ויודפס באחת ממדפסות התלת מימד בפקולטה.

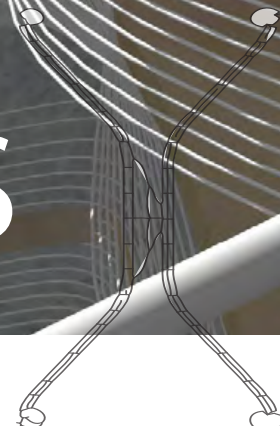
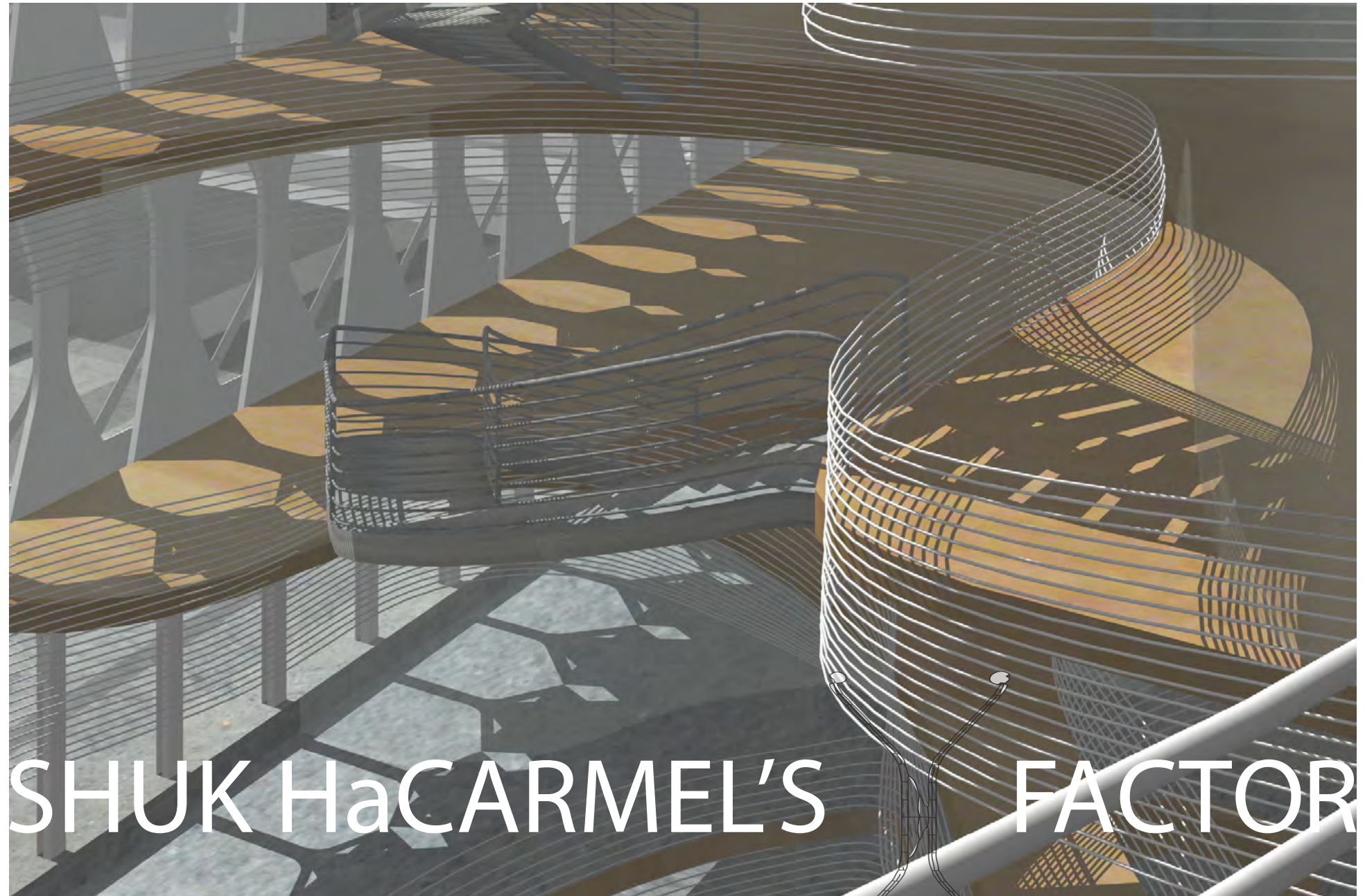
התרגיל יוגש תוך שימוש בפורמט הגרפי המופיע בנספח א.

**נספח ד' - תרגיל שלישי - ניתוח דיאגרמטי**

מטרת התרגיל: התנסות בניתוח דיאגרמטי מבוסס ביצועים דרישות התרגיל:

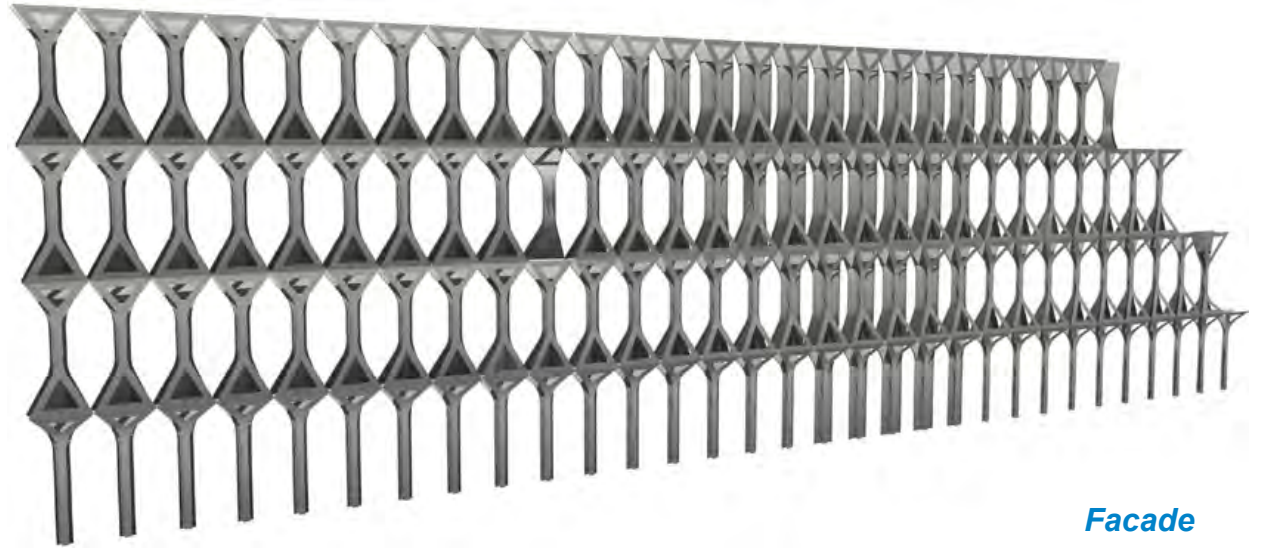
כל סטודנט יפתח מערכת דיאגמות המנתחות אספקטים ביצועיים ופרוגרמטים של הבנין הקיים. מדיאגרמות אלא יחולץ רעיון מוביל ממנו תתפתח צורת הבנין הראשונית. יוצגו תקדימים של ניתוחים דומים ותערך השוואה בין מבנים שתוכננו בשיטה זו למבנים אחרים "רגילים".

התרגיל יוגש תוך שימוש בפורמט הגרפי המופיע בנספח א.

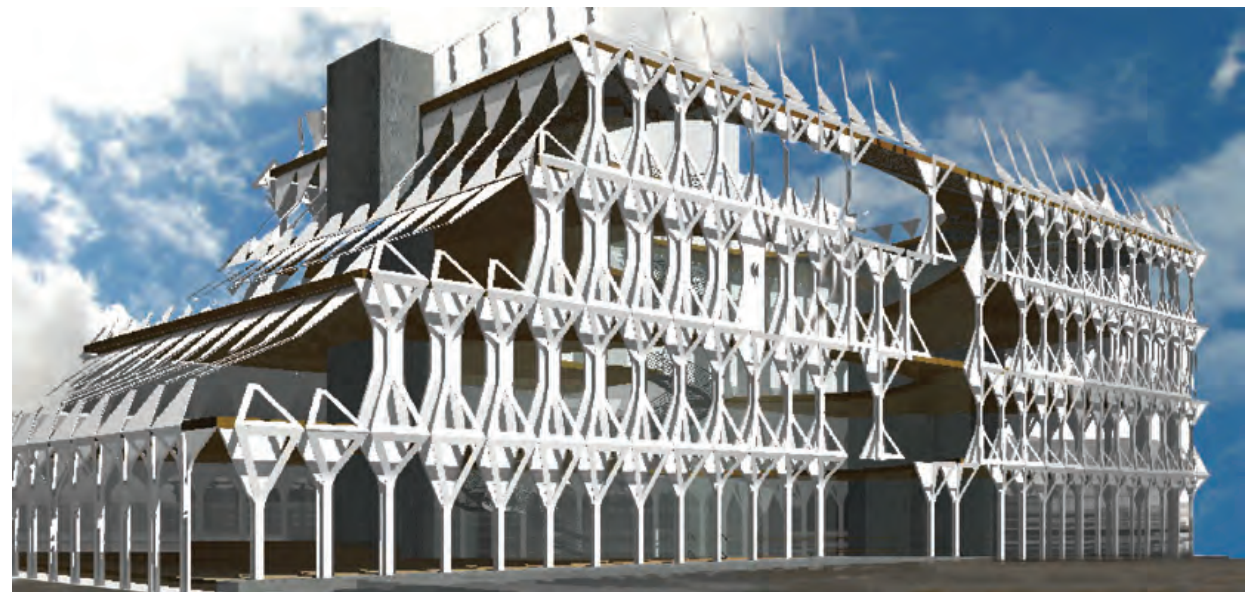




*Cell*



*Facade*

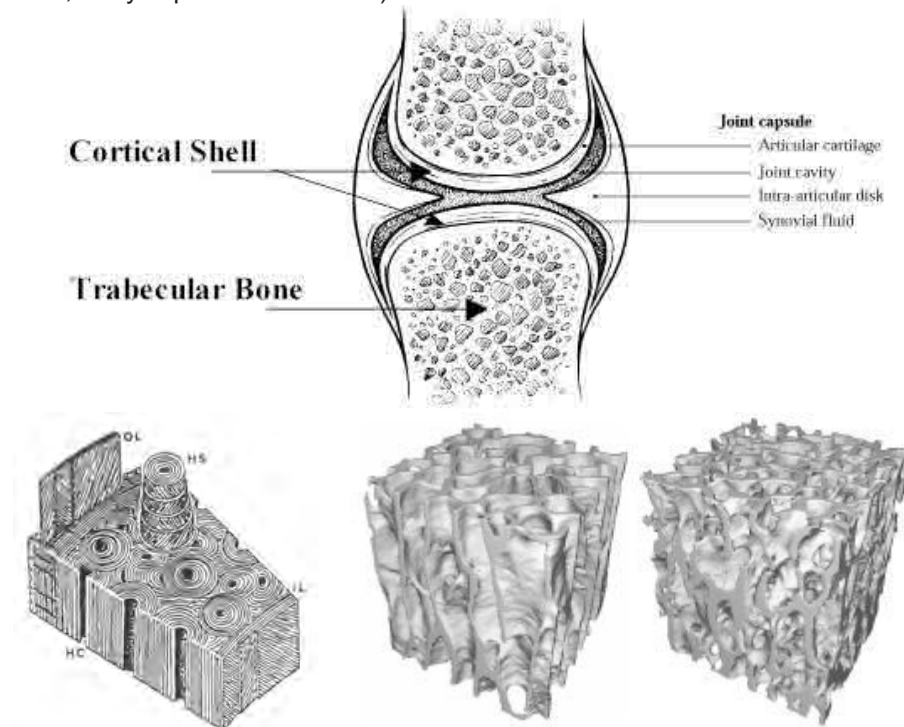


*Building*

## Spatial Structure Facade

### Bone Cell Structure

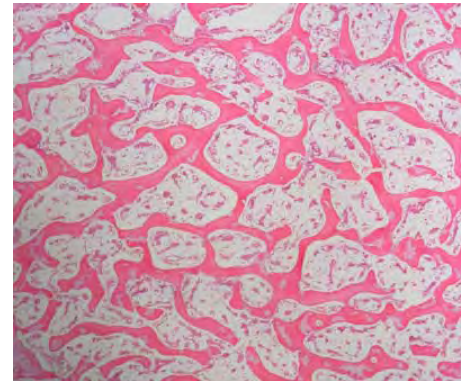
Human bone consists of two main cell types: The Cortical Shell and the Cancellous Bone. The former can be found in the outside of the bone, it is very dense (it has porosity of about 5% to 10%). The latter is a light, porous bone enclosing numerous large spaces, that give a honeycombed or spongy appearance. The bone matrix, or framework, is organized into a three-dimensional latticework of bony processes, called trabeculae, arranged along lines of stress. The spaces between are often filled with marrow. Both types are interesting for biomimetic methods, though for a building facade the Cancellous bone has more potential since it's porous, light weight and strong as well. The Transition between those two types is gradual, so one may say that porosity percentage of the spongy tissue is between 5% to 60%. (Michigan Engineering, <http://www.engin.umich.edu/>, Encyclopaedia Britannica)



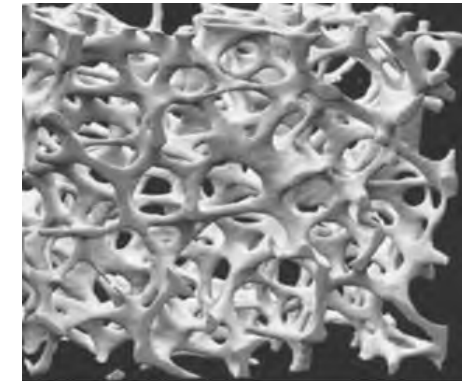
Up: the structure of a bone near the joint. Down, Left: The Cortical shell, Right: The Spongy structure of a Cancellous bone. All photos taken from <http://www.engin.umich.edu/>

### Trabecular Bone Structure

Key Element of this project is to understand the basic cellular structure of the Trabecula. When looking in the microscope, it looks like this:



Enlarged x40 <http://eugraph.com/>



Microcomputed Tomography. [phar.kufauniv.com/](http://phar.kufauniv.com/)

Researches in the 3d modeling of the Trabecula are being held all over the world, especially for the diagnosis of Osteoporosis. Here is two examples from a research which held in Germany (Published at *Acta Astronautica* in 2005 and Accessed via <http://www.ucl.ac.uk/> at 13/04/2013)



Section via the bone: Left is the Cortical Shell and to the right is the Cancellous bone. [ucl.ac.uk](http://www.ucl.ac.uk)

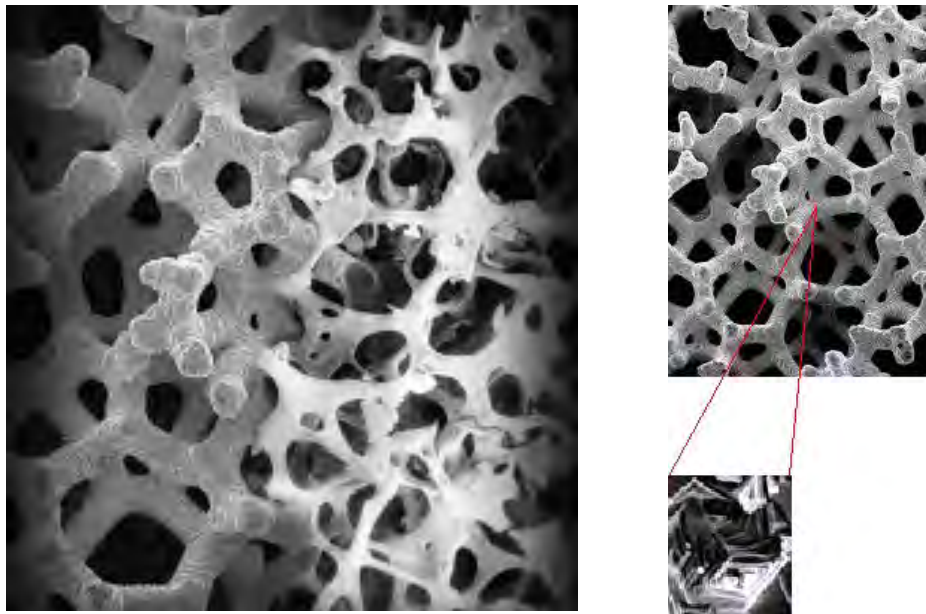
### Trabecular Bone Structure Case studies

Three Case studies Will be shown, each of every one is on a different scale.

#### Zimmer Trabecular Metal Technology

“Zimmer” is an American based firm that design and create personalized joint replacement technologies. They came with a new form of spatial structure of metal for their joints: *Trabecular metal*. *Trabecular Metal* consists of interconnecting pores resulting in a structural biomaterial that is 80% porous, and they claim that it allows approximately 2-3 times greater bone ingrowth compared to conventional porous coatings and double the interface shear strength.

Trabecular Metal implants are fabricated using elemental tantalum metal and vapor deposition techniques that create a metallic strut configuration similar to trabecular bone.



Left: Image shows trabecular metal in comparison with real trabecular bone tissue. Right: enlargement of the trabecular metal. (zimmer.com)

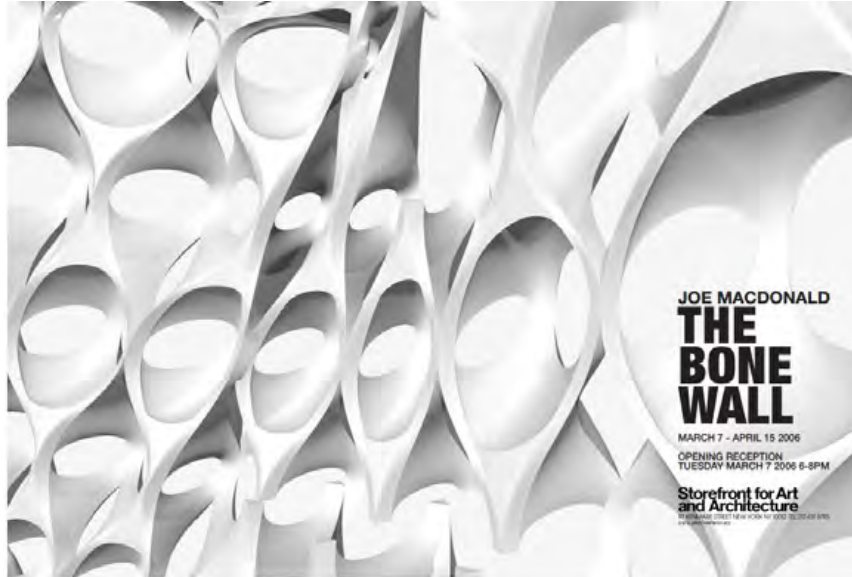
Trabecular Metal possesses a high strength-to-weight ratio, with mechanical properties capable of withstanding physiologic loading. The compressive strength and elastic modulus of Trabecular Metal are more similar to bone than are other prosthetic load-bearing materials. The material's low stiffness facilitates physiologic load transfer and helps minimize stress shielding. (zimmer.com)



Left: an image shows flexibility of the component. Right: a joint made from this material. zimmer.com

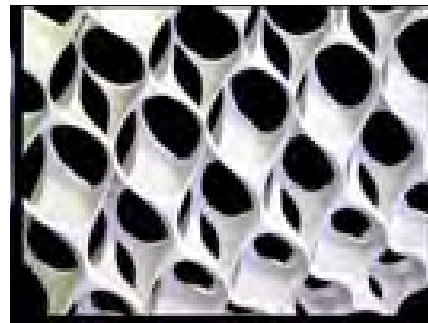
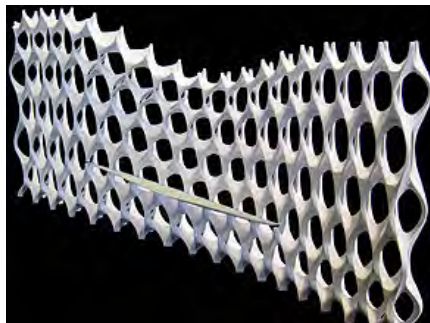
### The Bone Wall- Joe Mcdonald

This project, by studio a&o from New York, is an exhibition at the Storefront for Art and Architecture (gallery in New York) held in 2006. This exhibition featuring a full-scale prototype of a wall screen demonstrating a 4D non-recursive pattern designed with a parametric modeling program (CATIA).



From the storefront newsletter for this exhibition. <http://www.storefrontnews.org/>

Though it's called the "Bone Wall", in any of the references for this project was mentioned that this component shape is derived anyway from a biomimicry of a bone structure. It looks like the name was given afterthought.



Left: <http://wynstanwu.blogspot.co.il/>. Right: <http://urbanao.com/news/?m=200905>

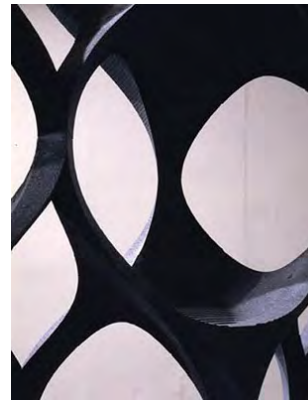


<http://urbanao.com/news/?m=200905>

Although it's not actually biomimicry, it's an interesting experiment. It's structure comprised from a base "cell", or rather, 1/2-cell, which was then inverted and rotated to combine into a complete cellular unit. The base cell has six triangular "horns", 3 up and 3 down, a total of 18 corners, or "control points". (urbanao.com, storefrontnews.com, wynstanwu.blogspot.co.il)



Left: <http://wynstanwu.blogspot.co.il/>. Right: <http://urbanao.com/news/?m=200905>



<http://arquitecturaenred02.blogspot.co.il/>



<http://urbanao.com>

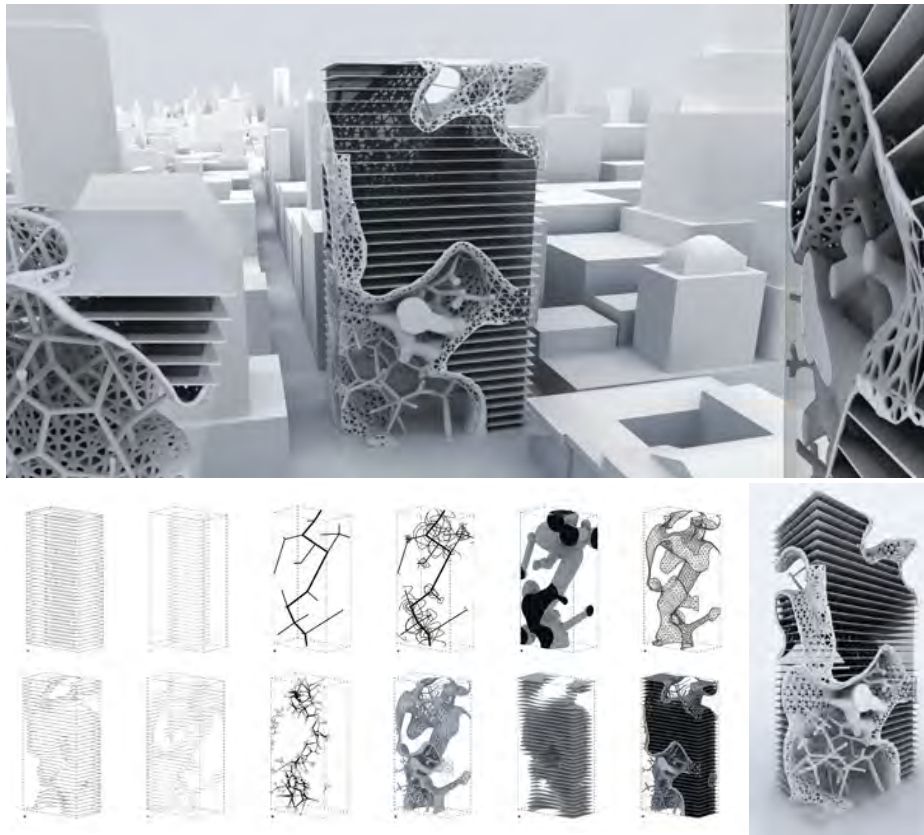


## Trabecule- Dave Pigram, Iain Maxwell, Brad Rothenberg, and Ezio Blasetti

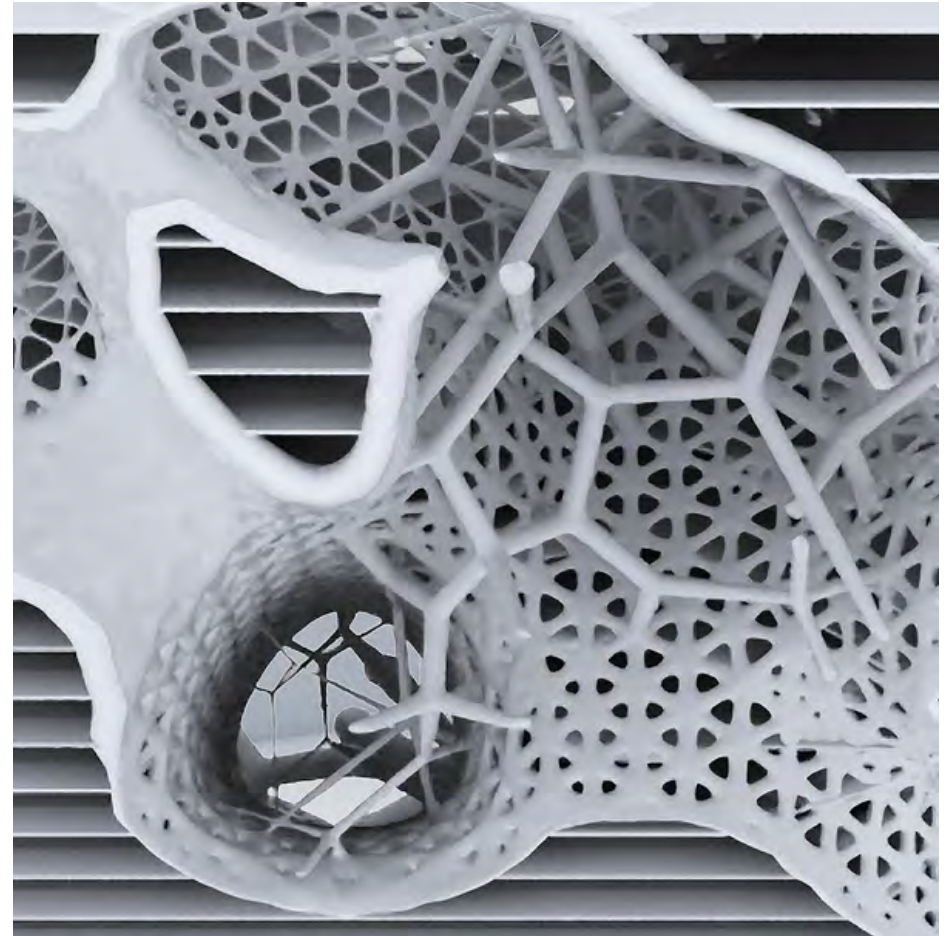
This project is more about the mimicry of an organic form, not specifically the human bone, although it's called Trabecule.

It's reference comes from a blog called Biomimetic Architecture.

Trabecule building is an office building with an atrium. It's atrium goal is to deliver as much light into the inner parts, especially in winter, and it is parametric shape based on the movement of the sun in the sky during the year, mimicking plants which moves along to get maximum sun light.



Method and orders in which the parametric form took shape into a building which resembles a trabecule bone structure. all photos from <http://www.biomimetic-architecture.com/>

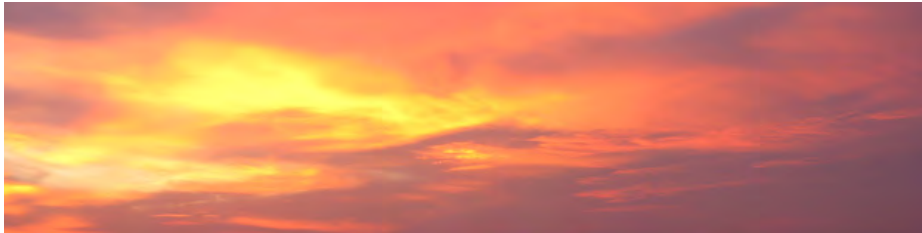


The inner spaces were used as a connectors for different places in the building and for meeting points. in the architects words:” the architectural project is no longer regarded as a passive entity, but rather a typologically-free machine of multiple possibilities more akin to the morphogenesis of an organism.”  
([biomimetic-architecture.com](http://www.biomimetic-architecture.com))

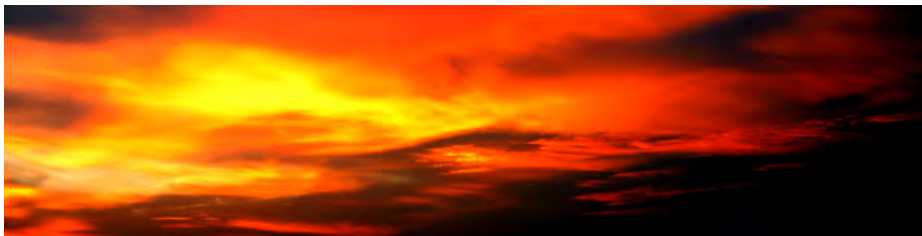
## Exercise- Making a Performance based facade in Rhino

### Performance

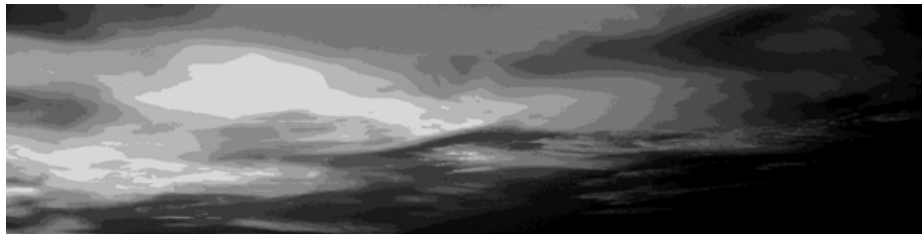
This is not actually a performance but a photo based map. At first a picture was chosen, and using Photoshop its colors were emphasized. After, using Illustrator's tracing command, a 7 color greyscale map was created.



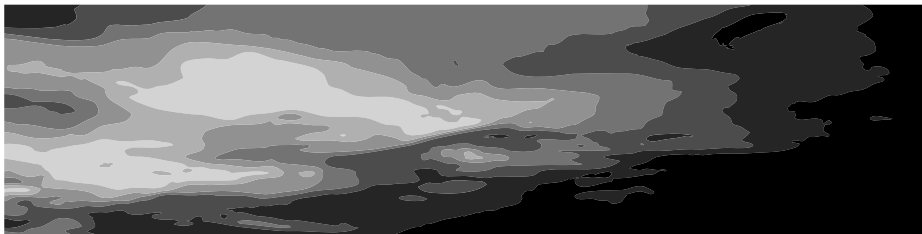
The original photo, cropped to proportions.



The colors emphasized using Photoshop levels command.



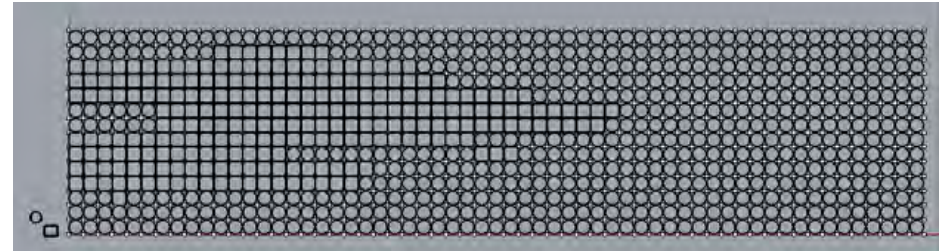
The greyscale map, a 12 color version



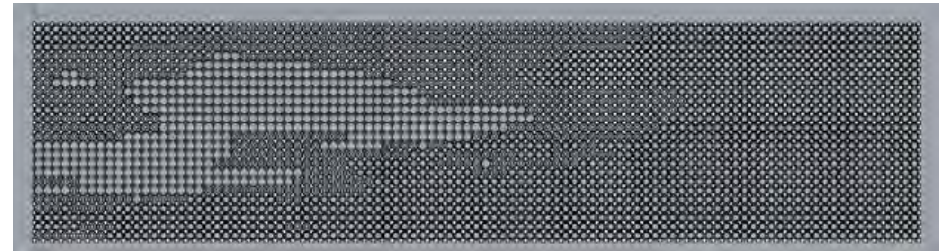
The final greyscale map with 7 colors and simplified.

## Rhino Paneling Tool experiments

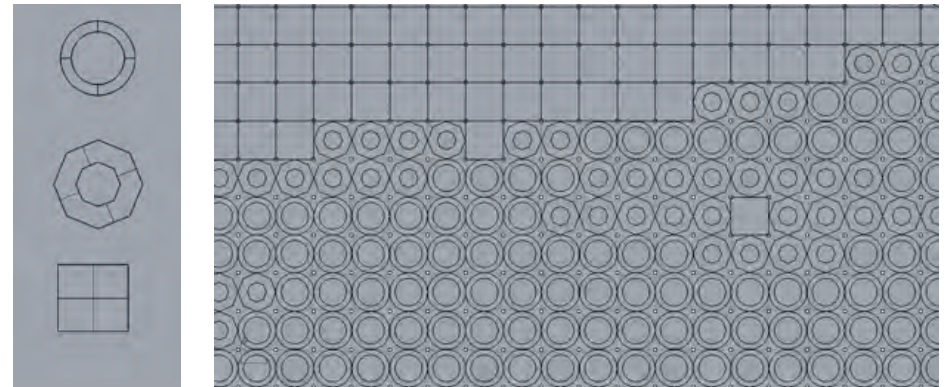
Assuming the performance map stands for sun radiation on the facade, forms were either blocked or allowed for light exposure, depending on the performance. Several tryouts were made during the process, during which the geometry was getting more and more complicated. When creating the panel, "List" and "bit-map" options were chosen.



First Step: 2d grid with only two shapes: circle and rectangular, just to understand the command.



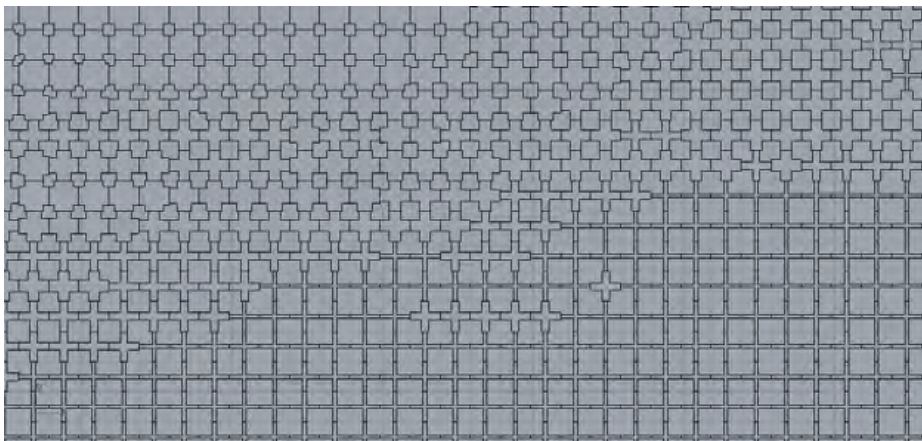
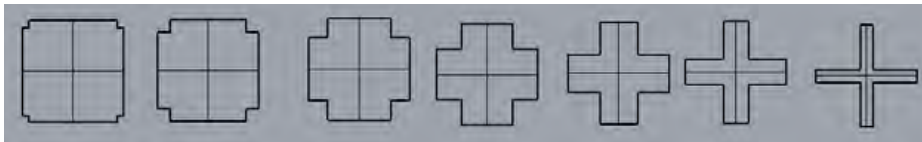
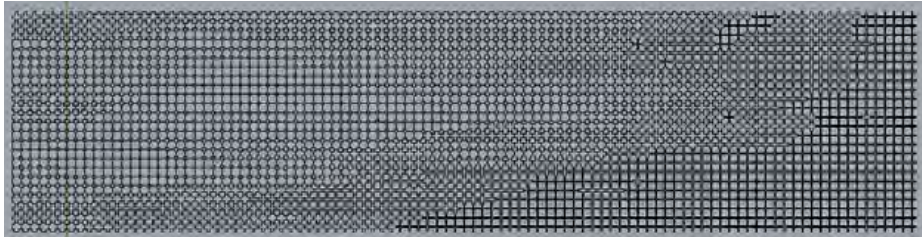
Second step: using 3 shapes, with different opacity to light, creating first light sensitive facade.



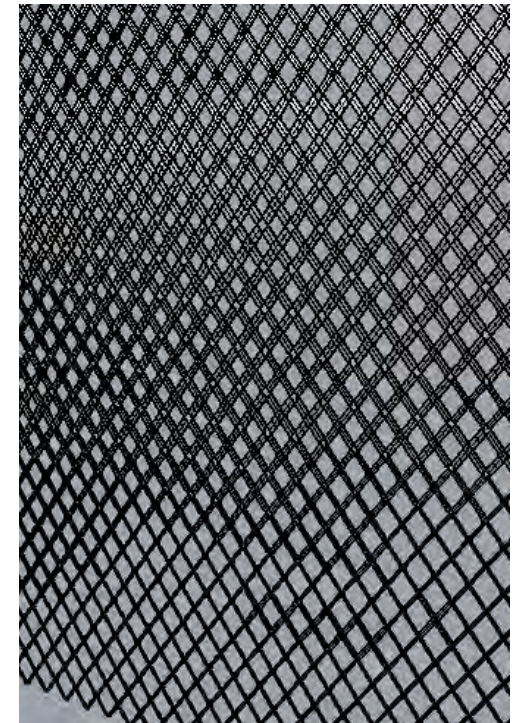
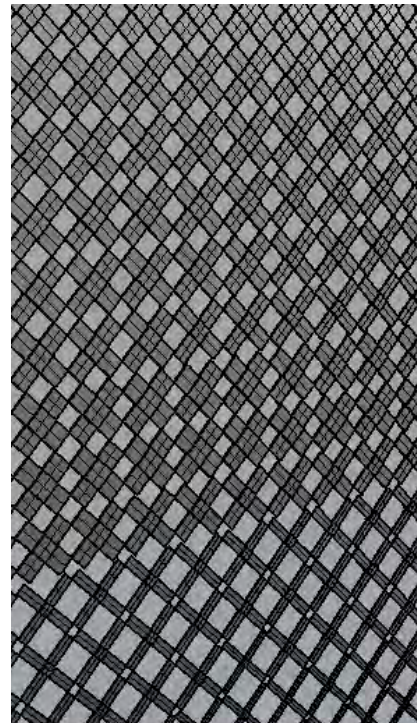
Left hand: the 3 shapes, Right hand: close-up on the transition.

### Rhino Paneling Tool experimemnts Continued

Third step is quite similar to the the second, except 7 shapes were used instead of 3, and the shapes were designed in a way they could be attached to one another.

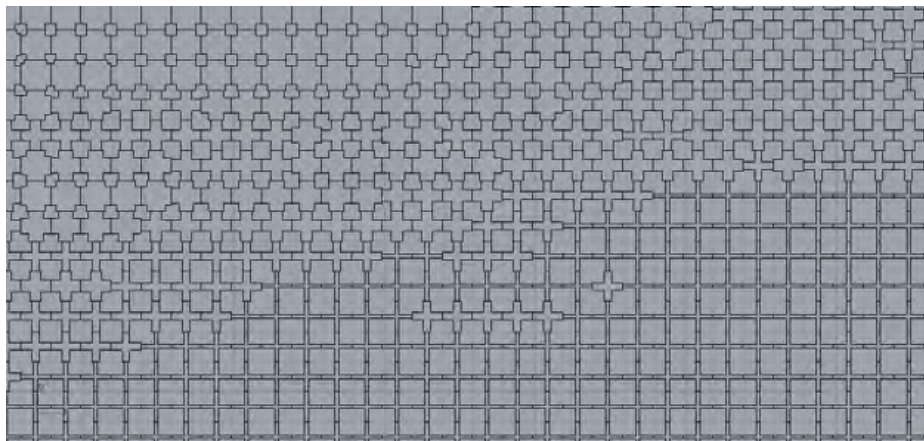
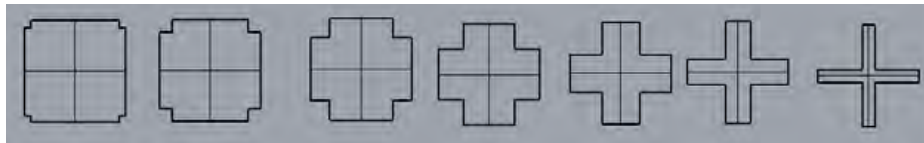
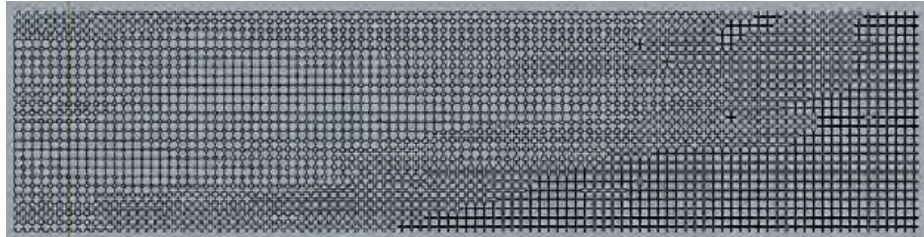


Next step uses an “x” like shape that can be attached with both sides. Still, it’s not a whole 3d shape.

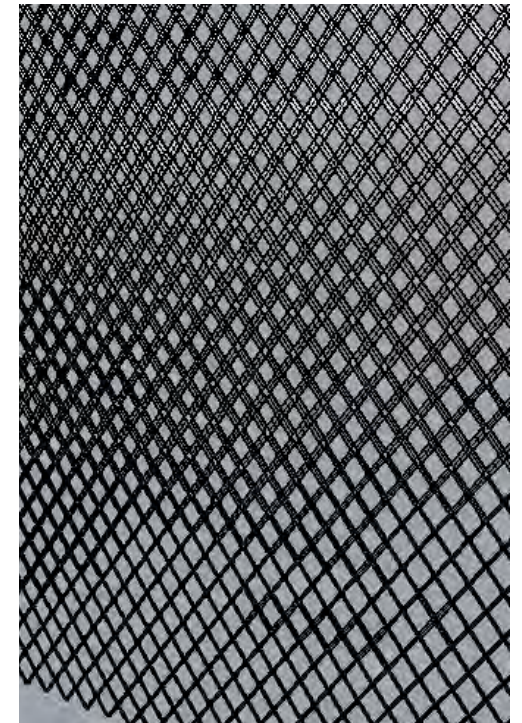
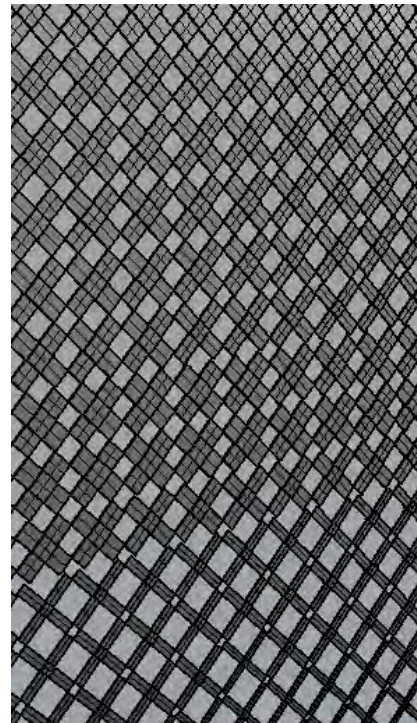


### Rhino Paneling Tool experimemnts Continued

Third step is quite similar to the the second, except 7 shapes were used instead of 3, and the shapes were designed in a way they could be attached to one another.



Next step uses an “x” like shape that can be attached with both sides. Still, it’s not a whole 3d shape.



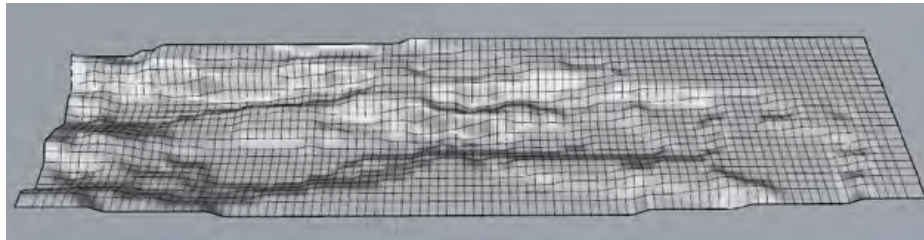
## First Model

This model is constructed of three elements: the cell, the network arrangement and the network curvature.

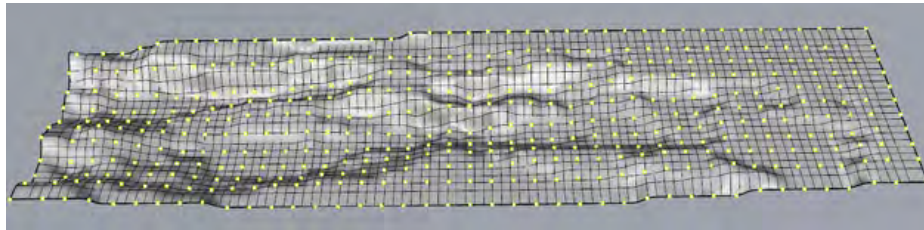
The cell- is built from the basic unit, the "arched cross". Arched cross is a tryout based on the songy bone structure. Three crosses in each of thecartez directons build one cell. There are three sizes for the cross- which supposed to effect the radiation opacity.

The network arrangement is based on the "radiation" map mentioned before, using the bitmap command in the paneling grid. More opac cells are put in the less radiated parts and vice versa.

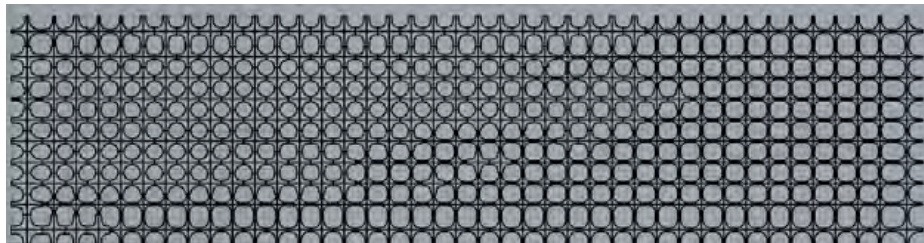
Third is the curvature of the network which built using heightfield command. Sunked parts of the net are the one more radiated and vice versa.



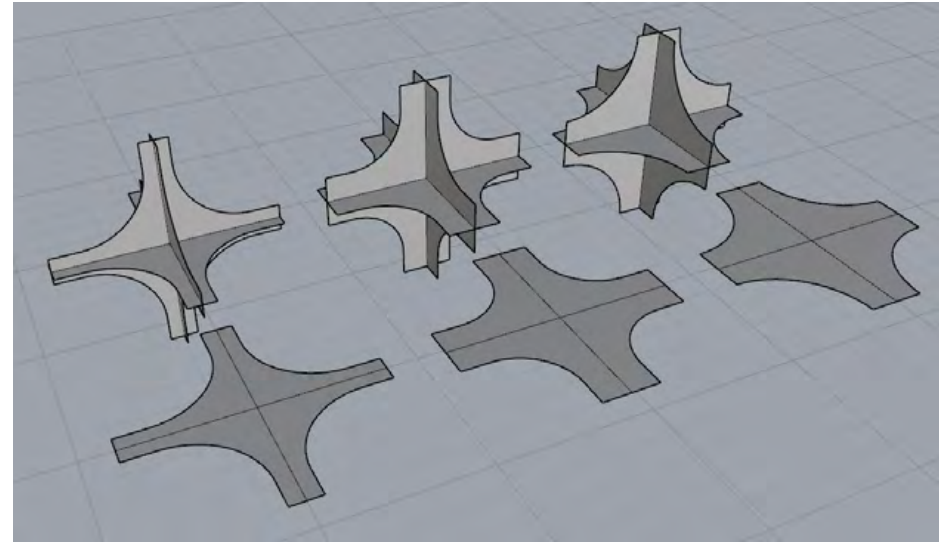
Heightfield command



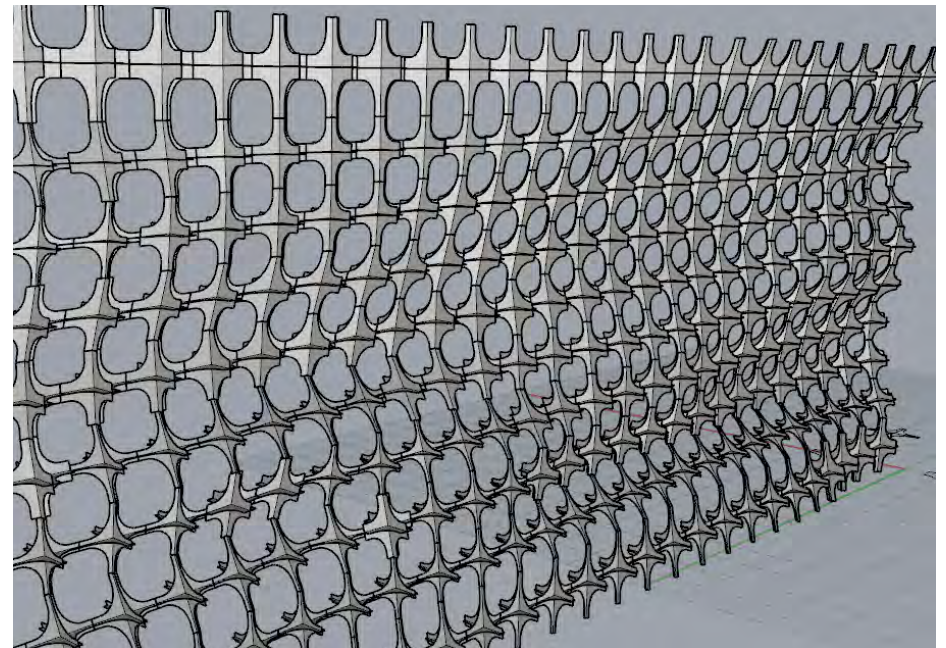
Surface Domain Number command creates an array curved like the surface.



Front view of the network after panelling command based on bitmap and lists options.



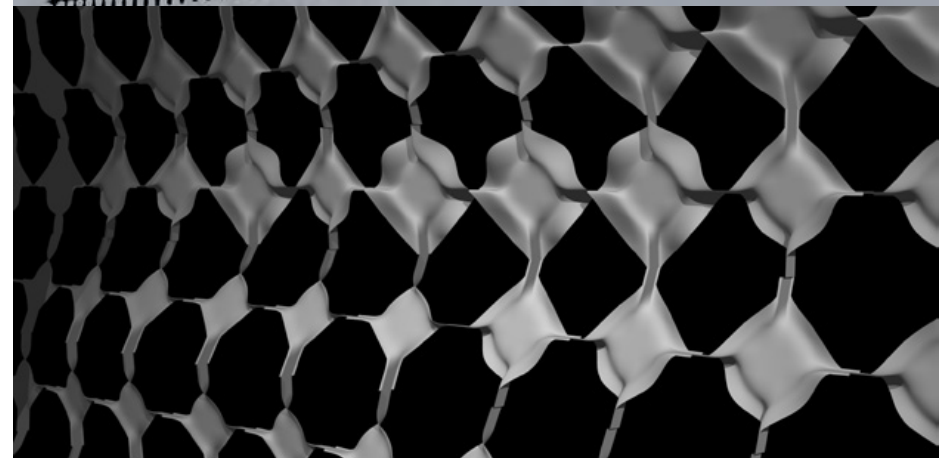
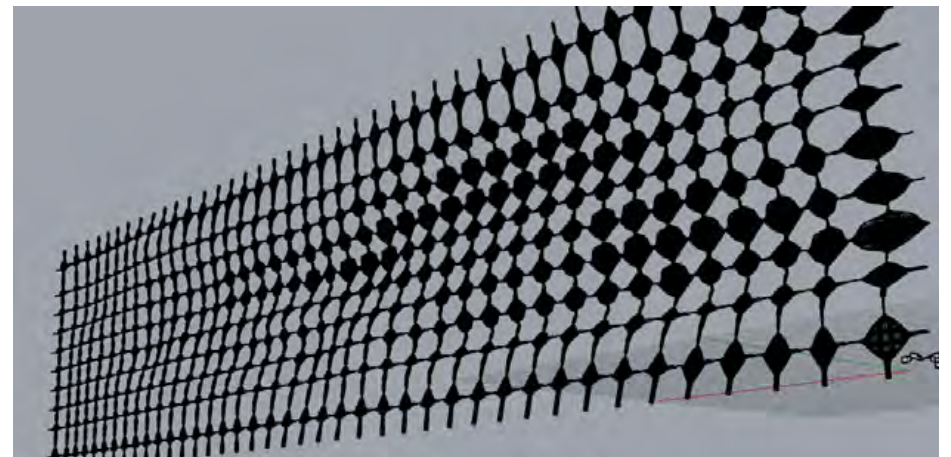
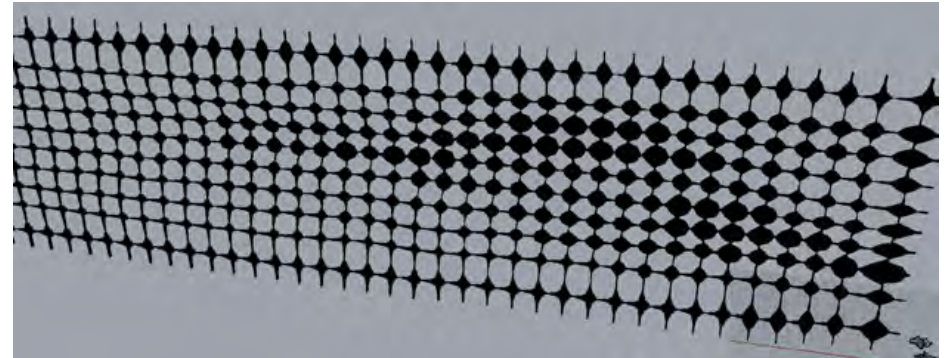
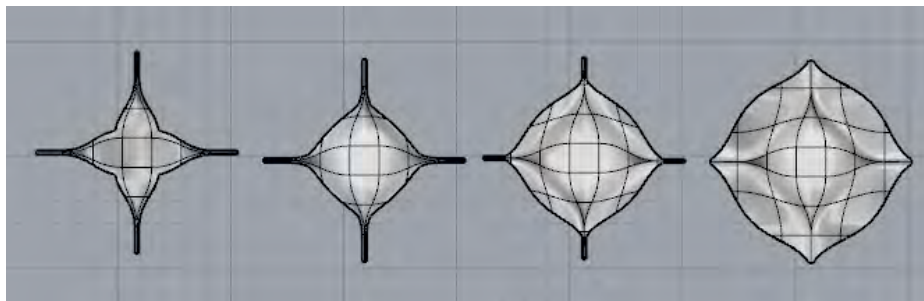
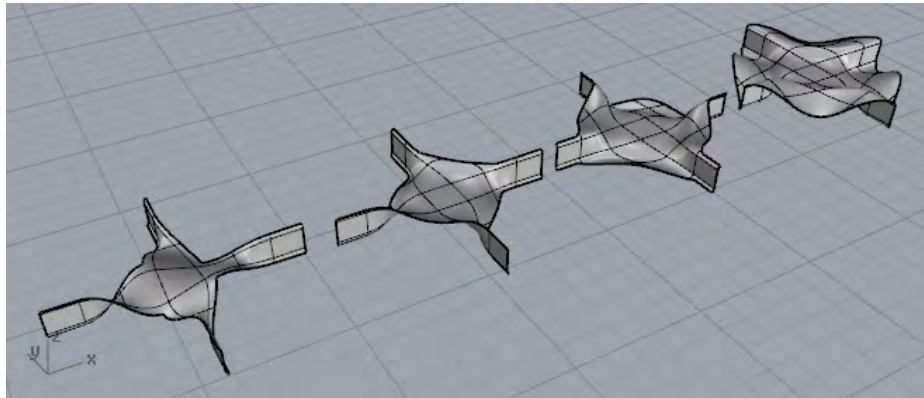
The three "Arched Crosses"



Curvature of the network

## Second Model

Second model is based on the first on the network scale (same arrangement and curvature) but with different cells. The arched crosses showed before curved themselves to get static height with less material (with assumption they've made of steel). The curvature is also tryout to be based on the spongy bone structure. Again, four different sizes were used to change opacity of the network.

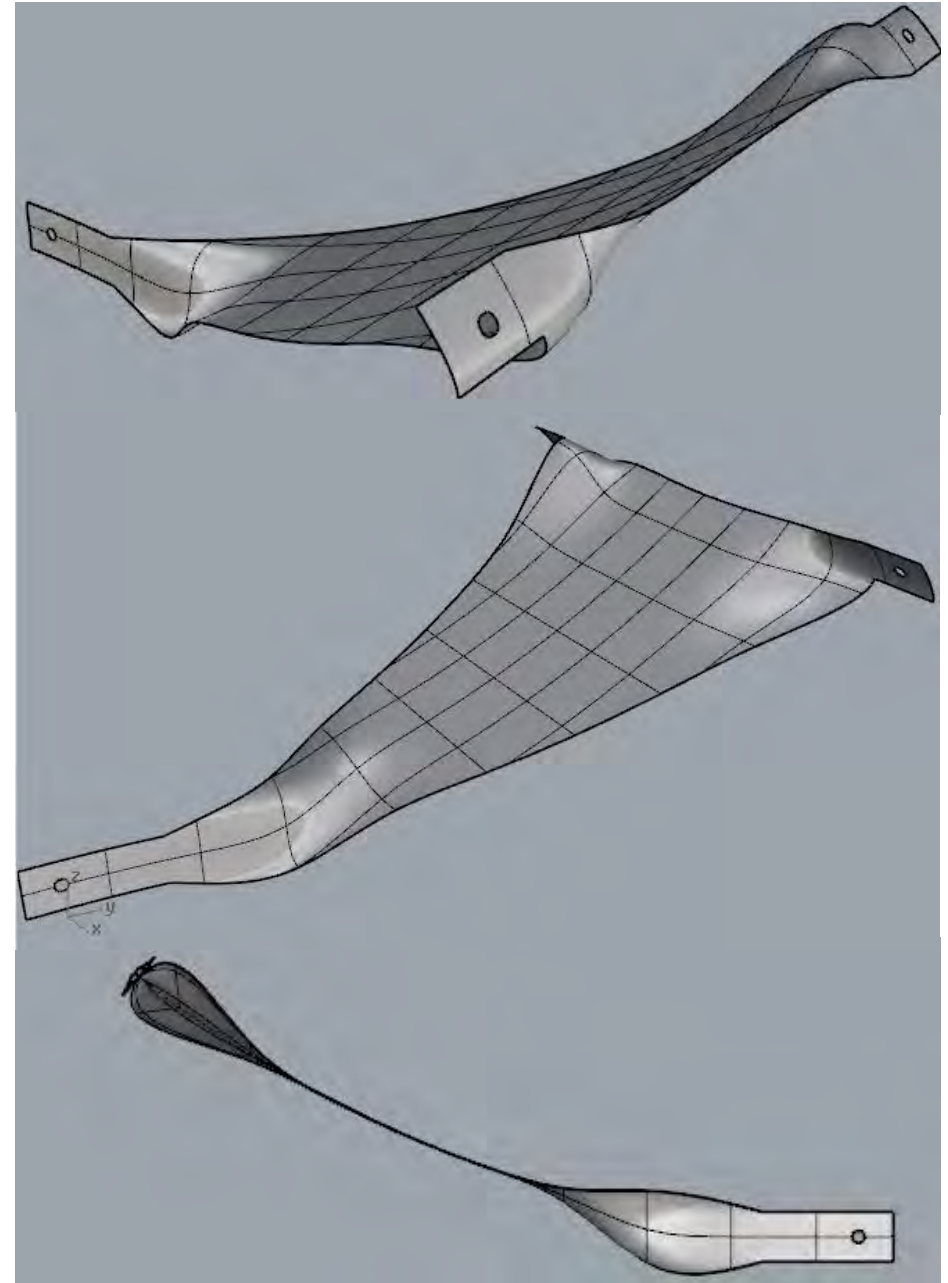
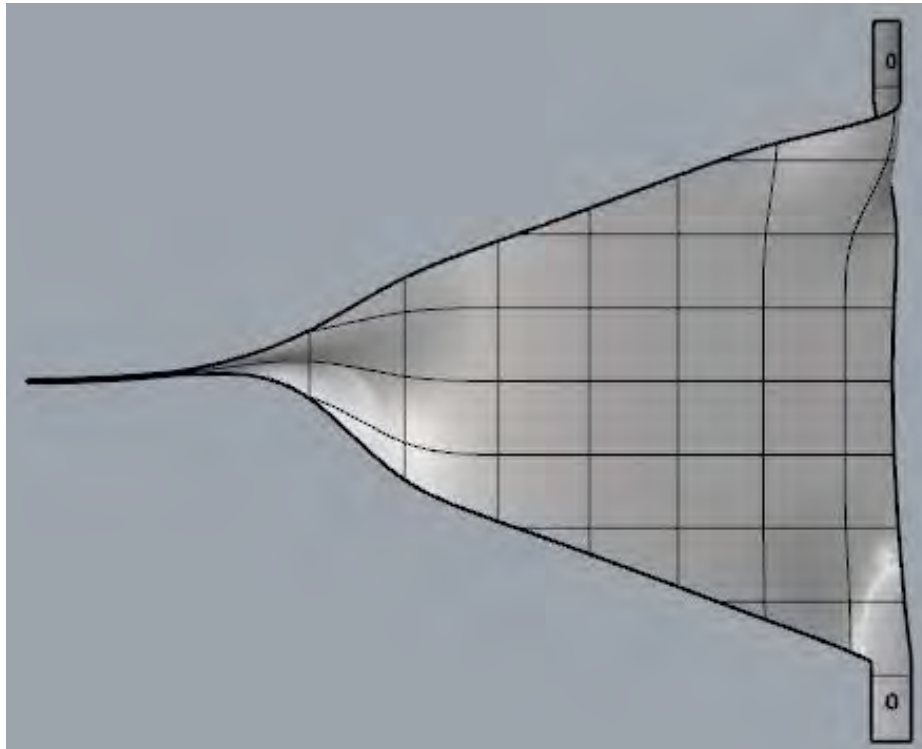


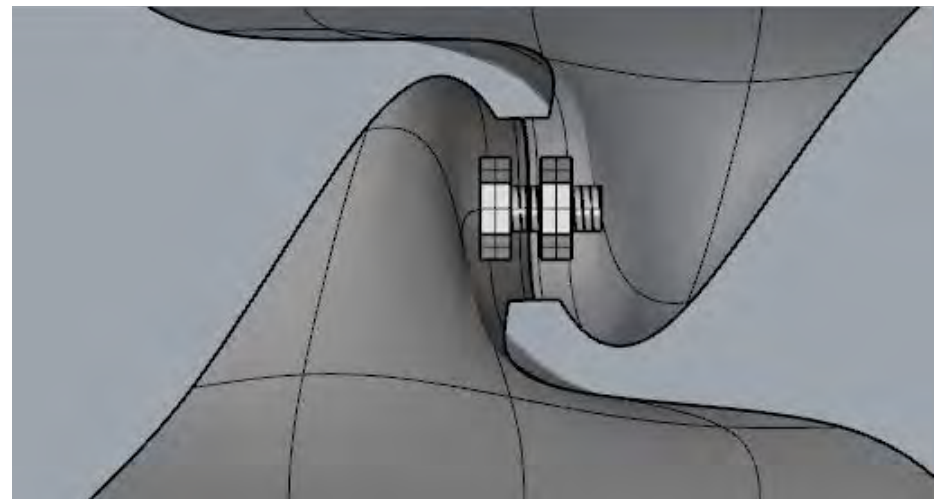
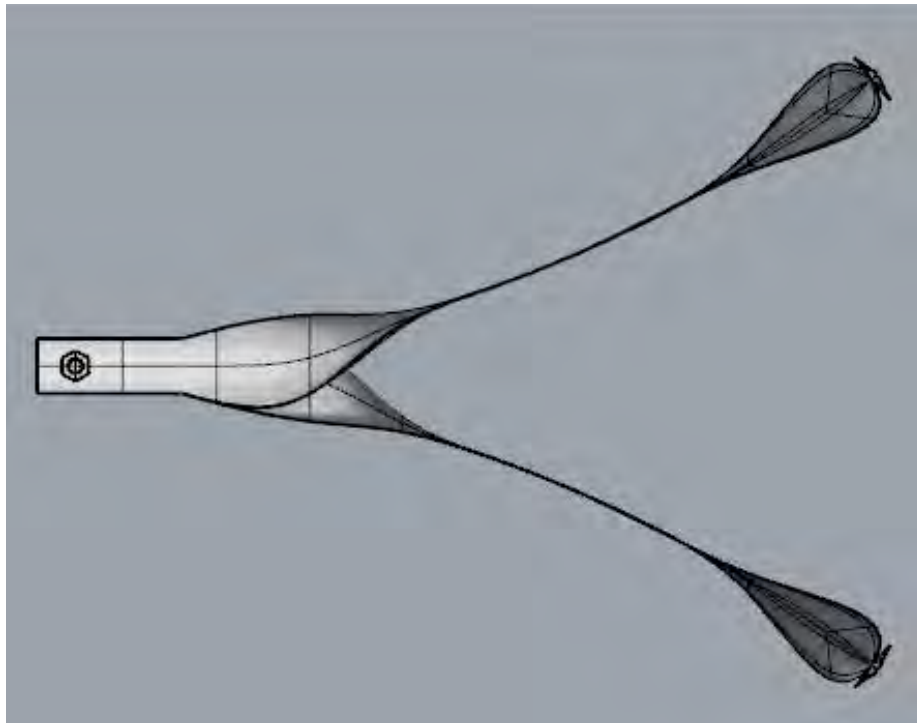
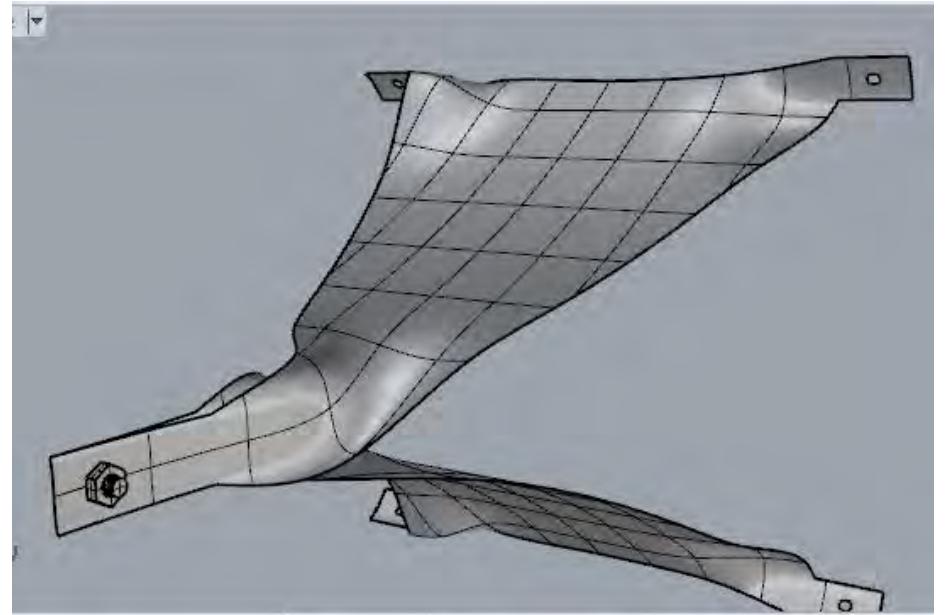
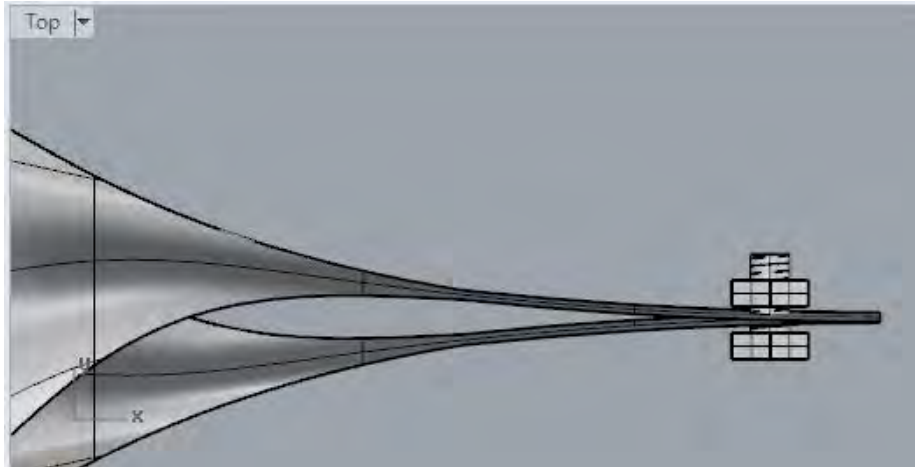
## Curved Triangle

The “Curved Triangle” is derived from the previous “Arched Cross” but also have a third dimension that allows it to form a 3d form.

The element function at first is to be as constructive and weight carry as possible while light in material. The elements will be the outer constructive shell of the building and will carry the weight as long with the inner core.

The Triangle is constructed from a steel sheet, cut by laser or water jet, curved in the edges by heat and pressure combined to each other with bolts.



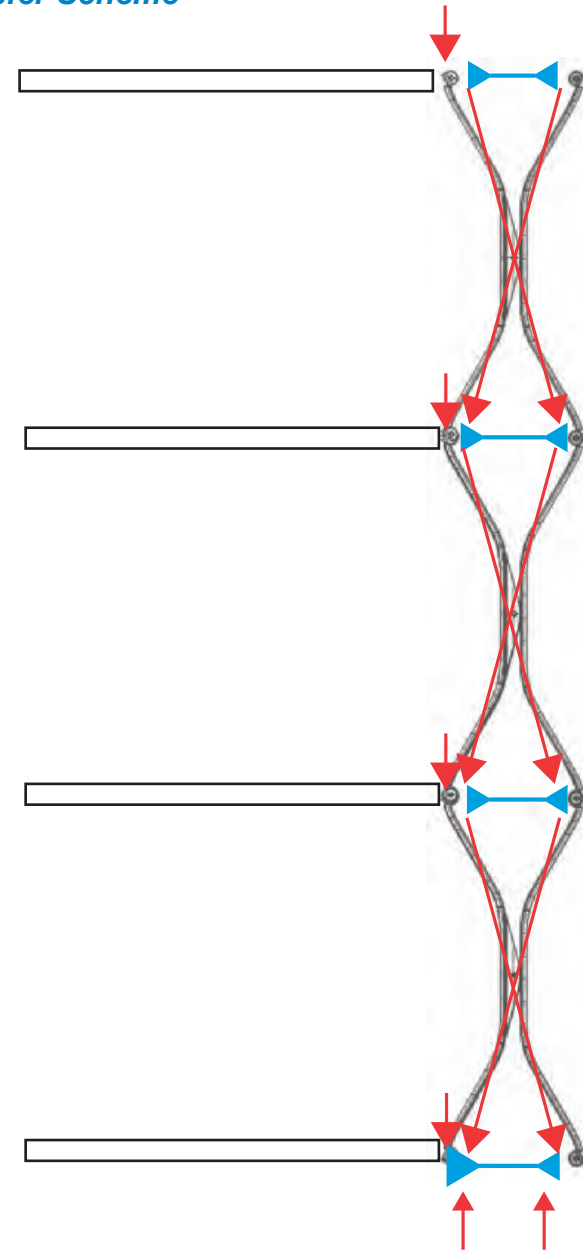




*Inspiration - Scissor Lift*



*Load Transfer Scheme*



### Production Method- Pressed Steel Sheet

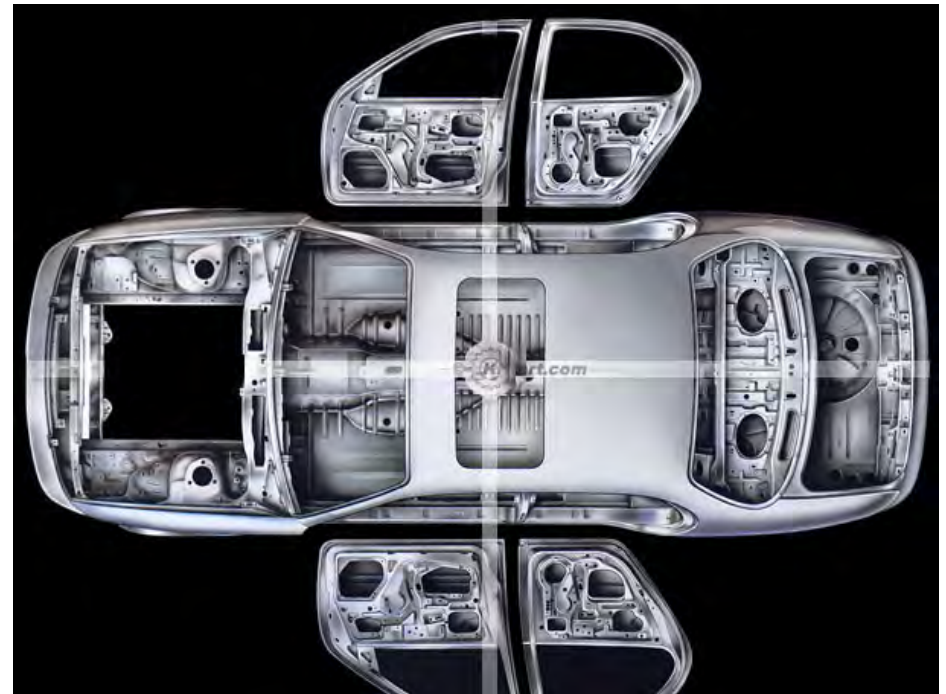
The production of the cells will be done as cars are made: large steel sheets are laser cut to shape and holes and then cold pressed into a specific mold. In car industry, those parts are welded together to create a unibody chassis. In the case of the building, they will not be welded together but bolted to each other. This is because the life span of a building is much longer than a car, and replacements will have to be made over time.



arthursclipart.com



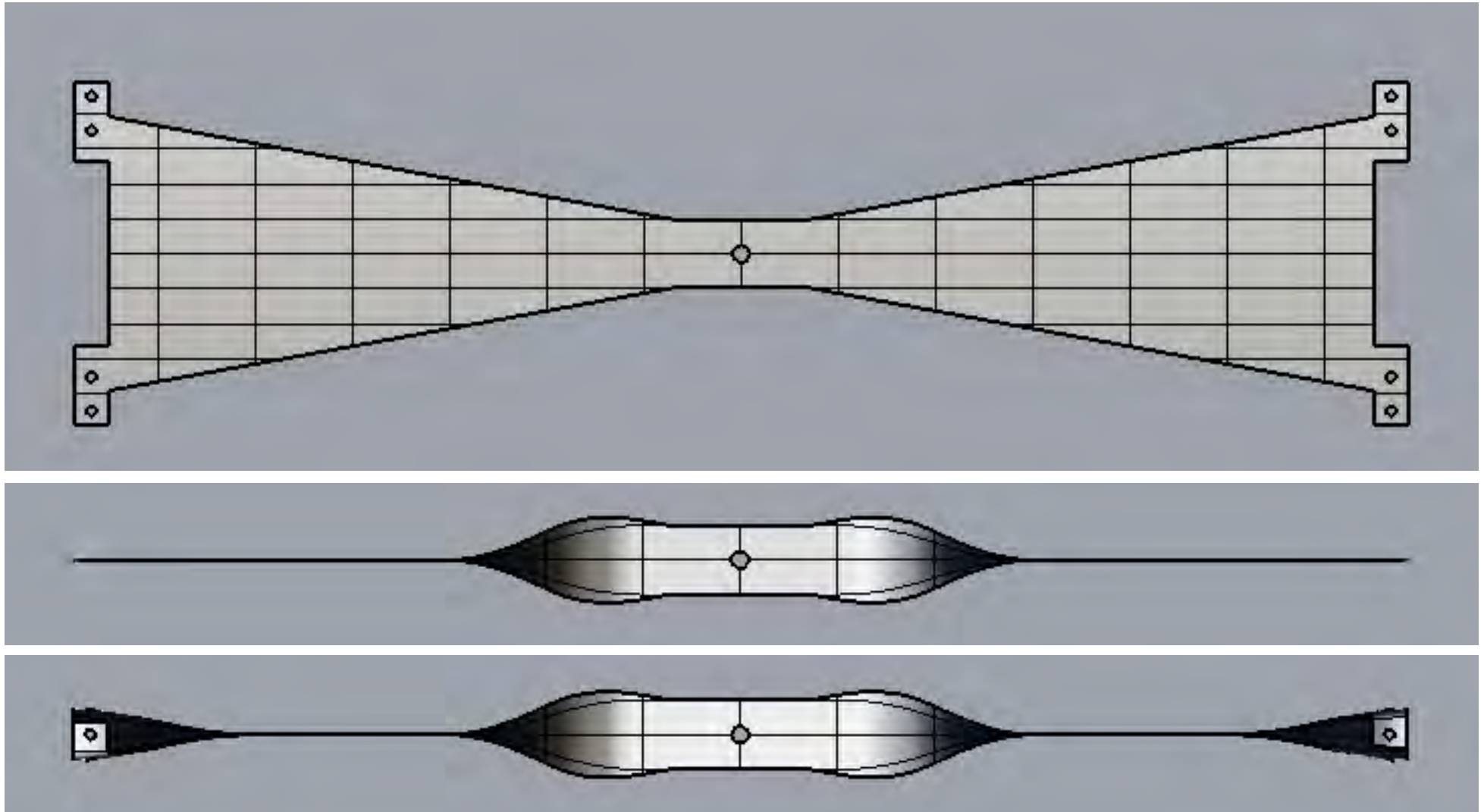
totalcarscore.com



khulsey.com

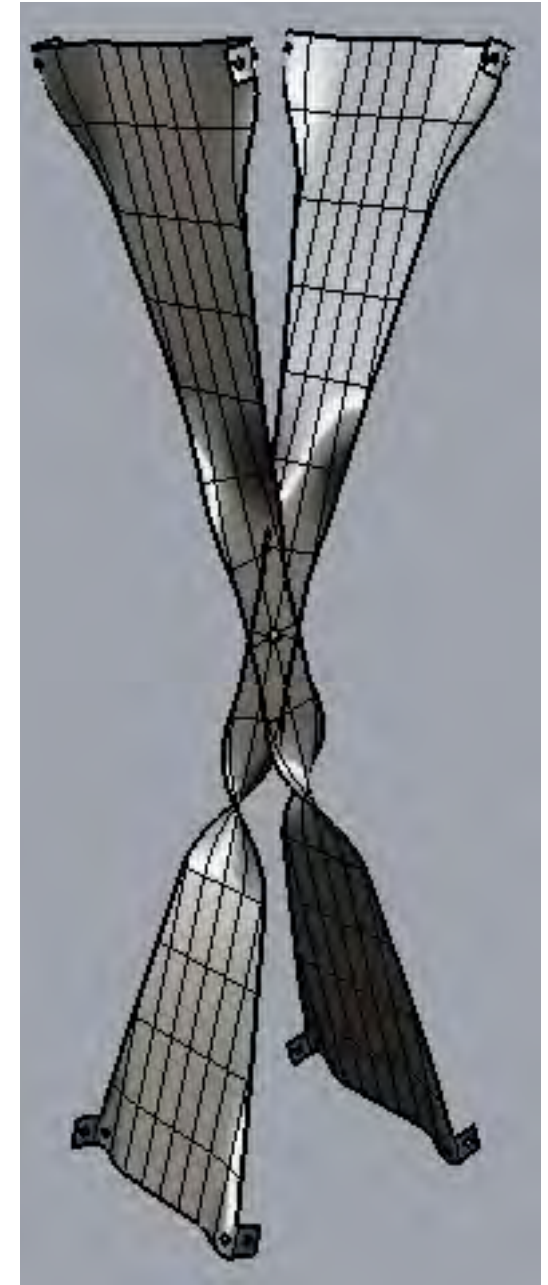
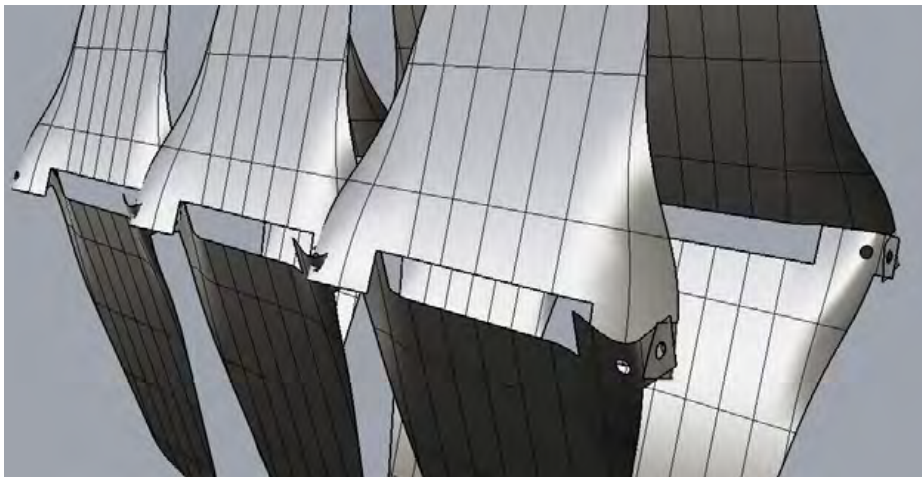
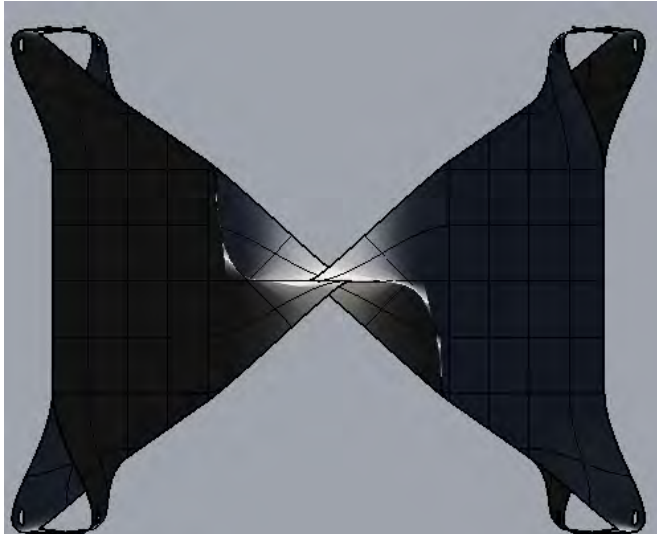
### Steel Sheet part

This part is a combination of two triangles, so loads could transfer directly. area of the steel from the whole rectangle is depends on the sun radiation on the wall.



### Cell- Sand Clock

The sand clock is two steel sheets combined to make a whole cell. At first, only one kind was made to check connectivity with other parts and ability to transfer loads.



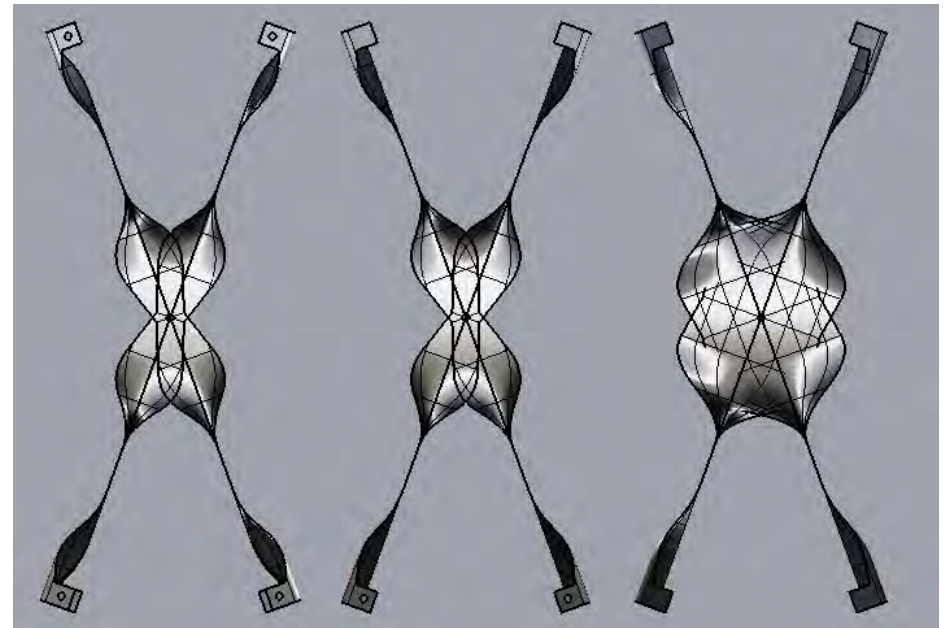
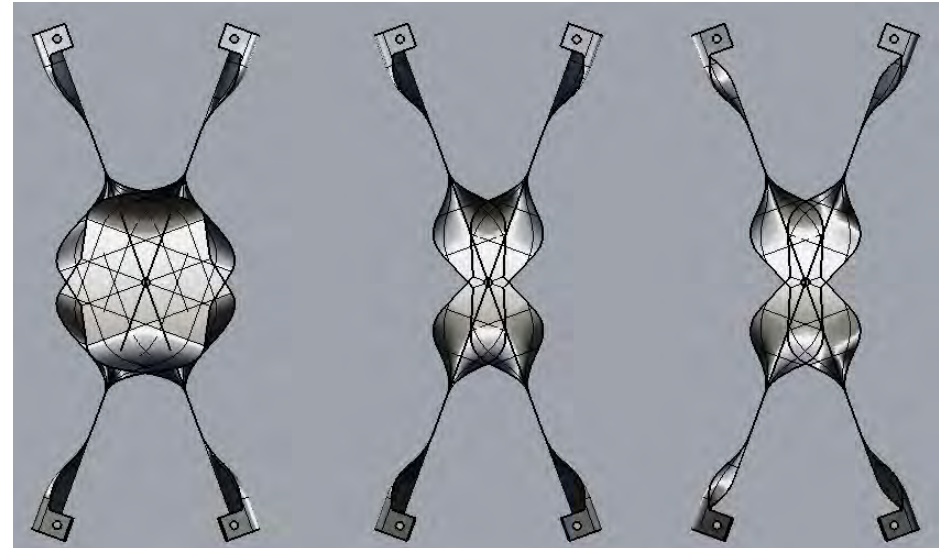
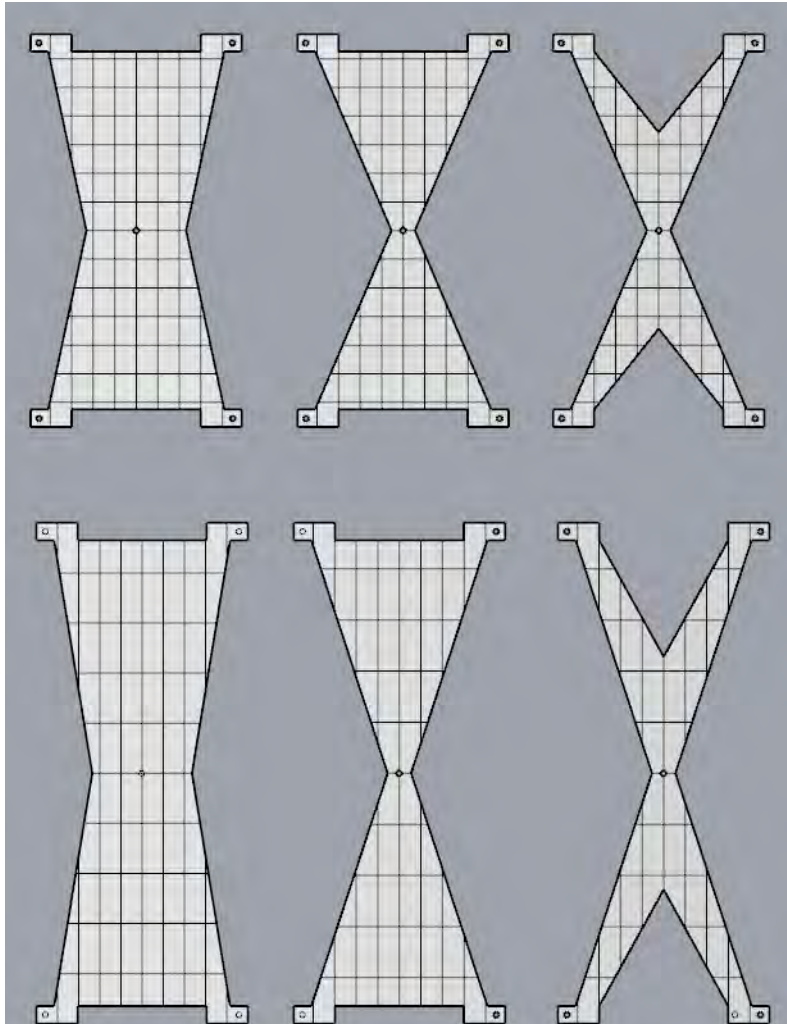


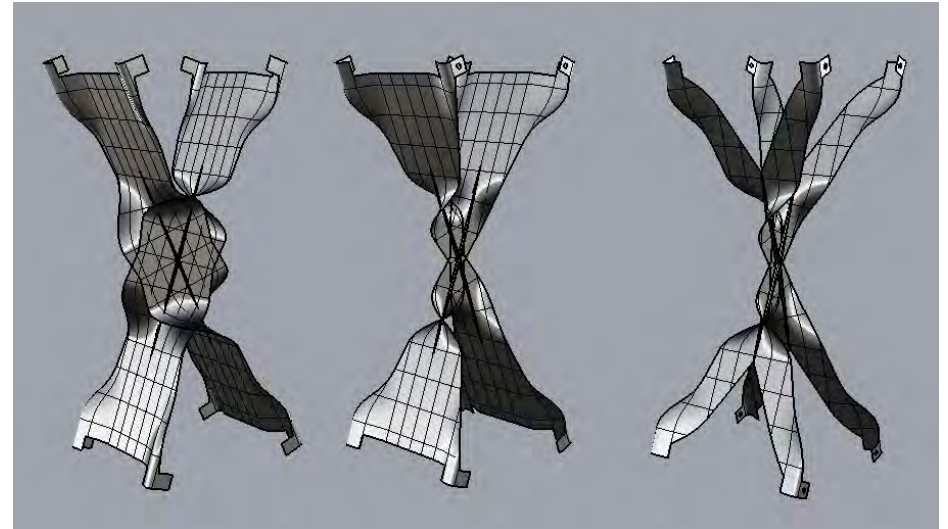
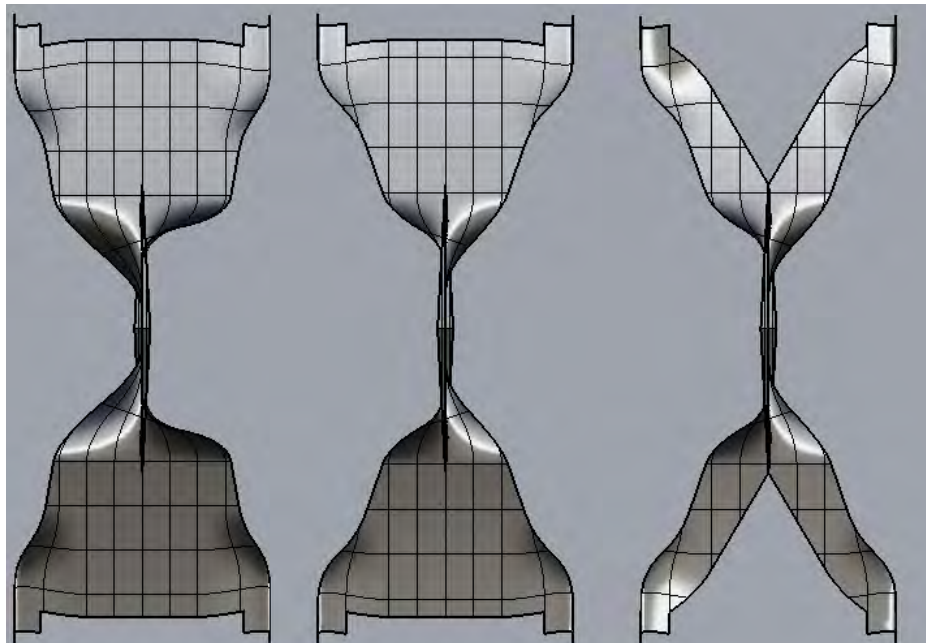
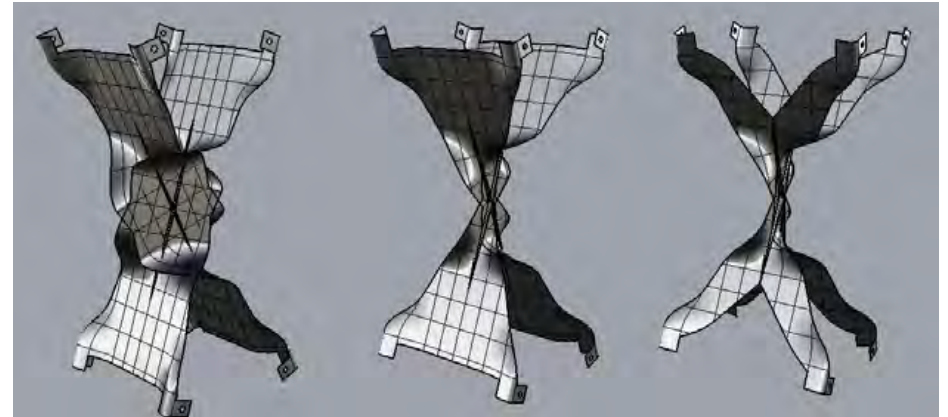
### Cell- Sand Clock

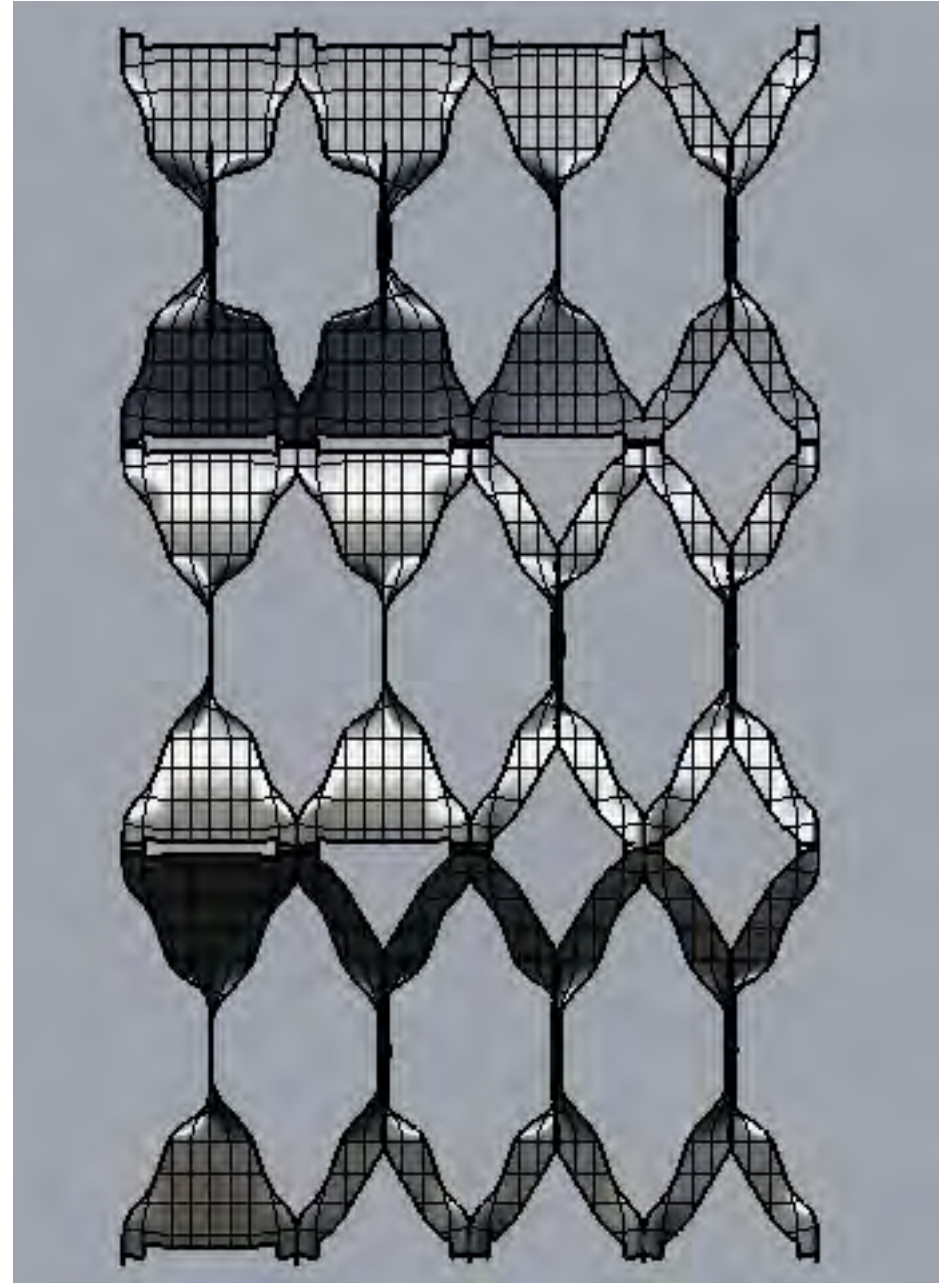
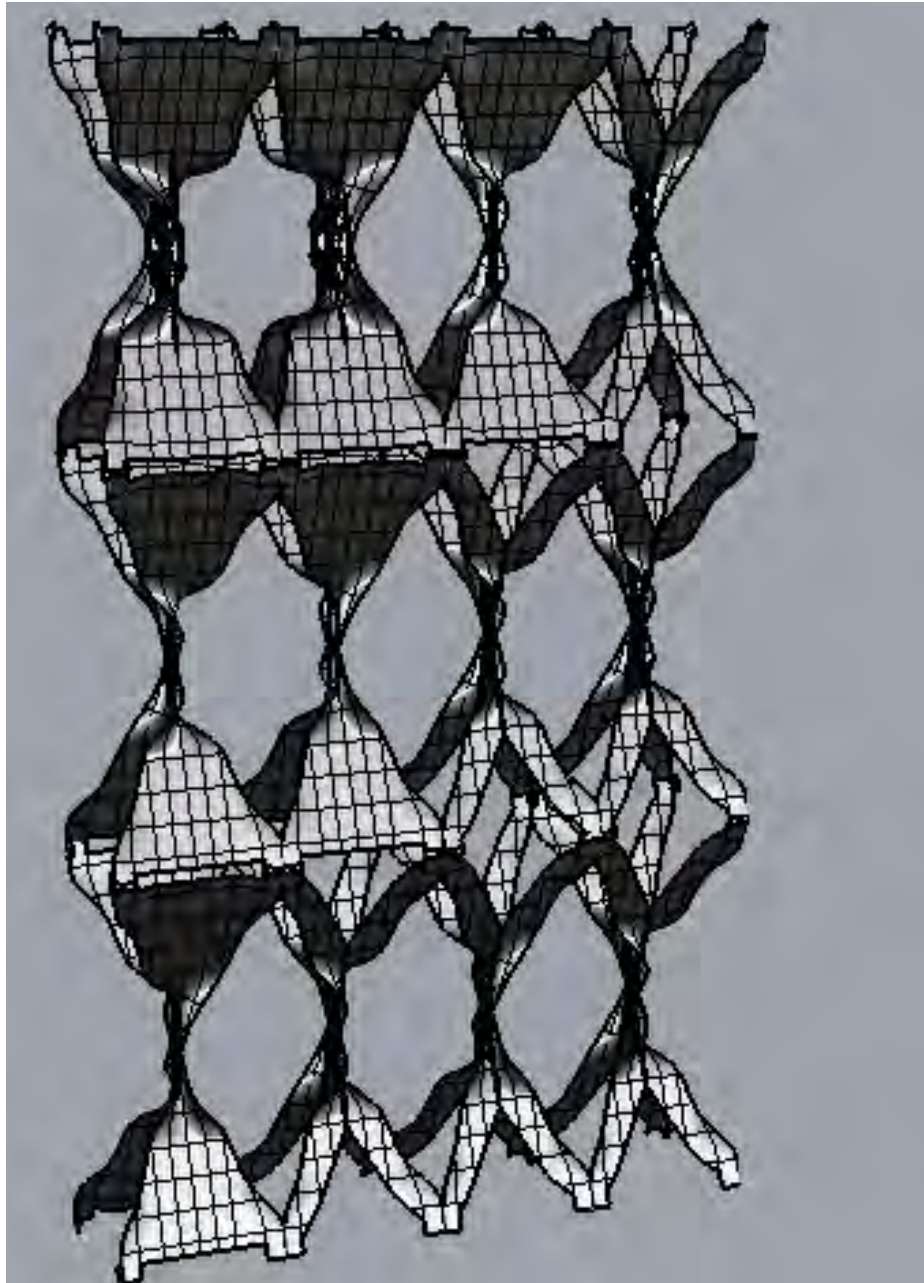
Second stage included some changes: First, a small fin was added at the middle of the cell in a matter of reducing the danger of buckling in that direction.

Second, it became wider- 150 cm instead of 100.

Third stage was making a variety of 6 sheets: divided to two floor types (high and low) and each is divided to three sheet areas.





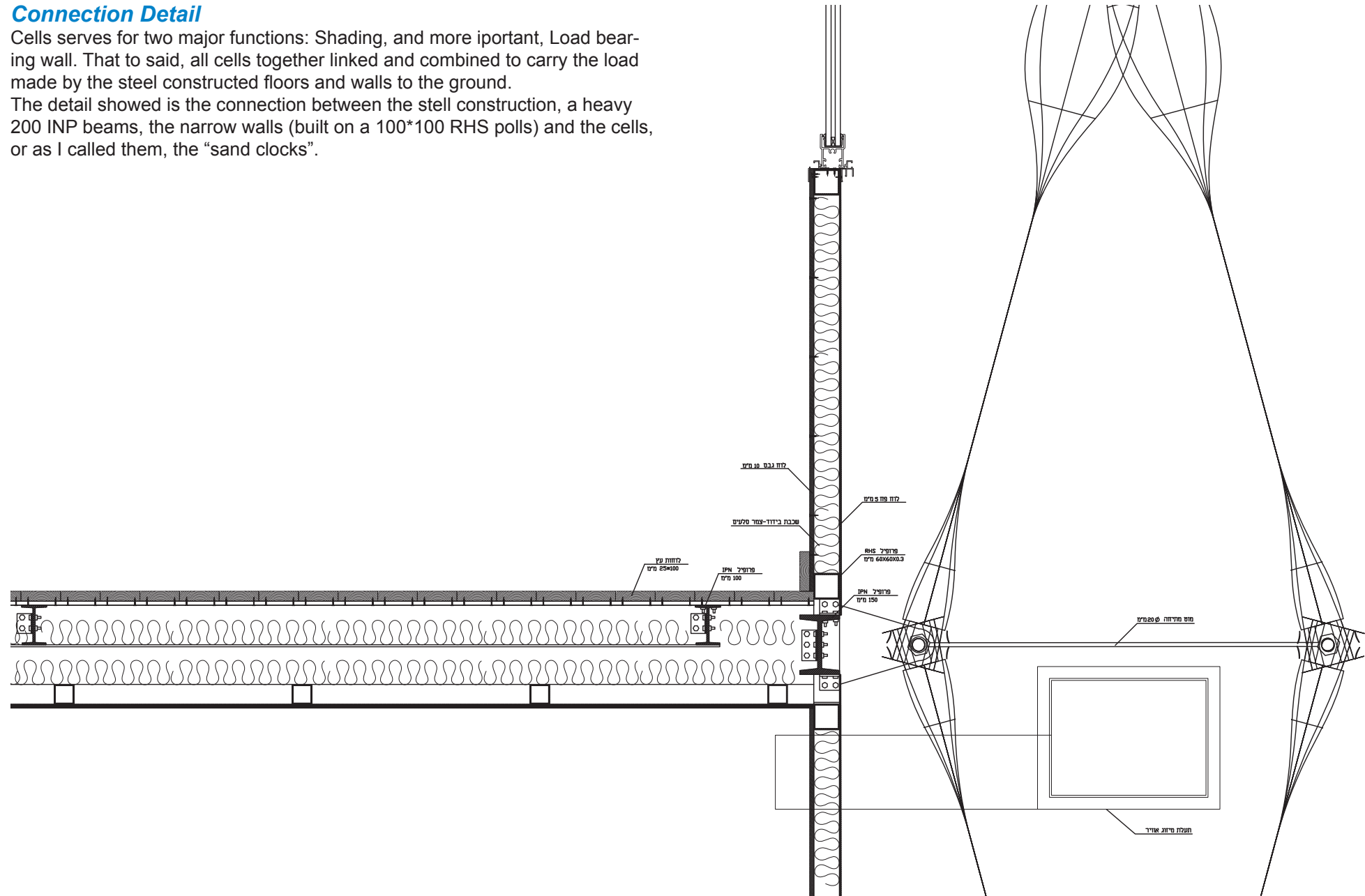




### Connection Detail

Cells serves for two major functions: Shading, and more important, Load bearing wall. That to said, all cells together linked and combined to carry the load made by the steel constructed floors and walls to the ground.

The detail showed is the connection between the steel construction, a heavy 200 INP beams, the narrow walls (built on a 100\*100 RHS polls) and the cells, or as I called them, the “sand clocks”.



## Making of a Single Cell



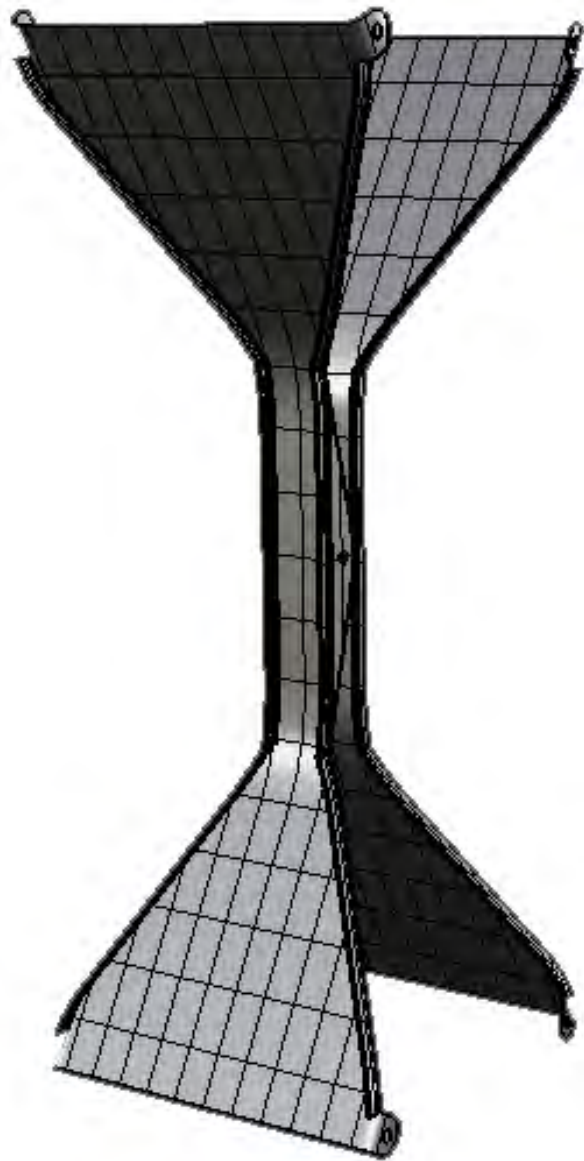
### Outer Part

Notice the central axe is thinner and have folding fins

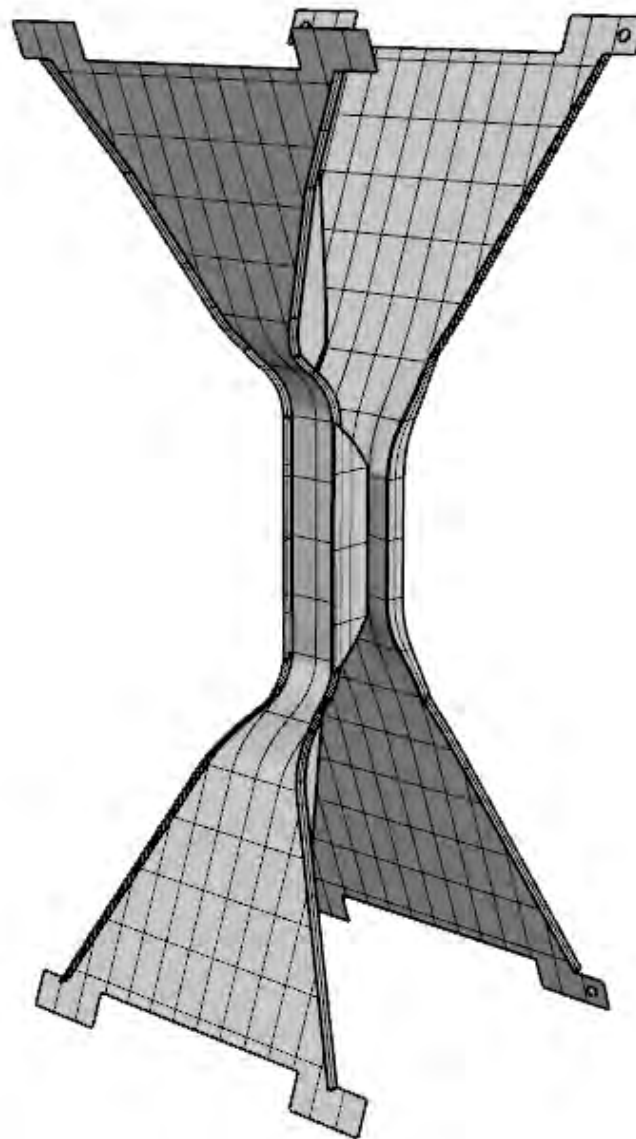
### Inner Part

Notice the small fins in the sides made to contain thermal insulation.

*Three Possible Sizes of Cells*



*Low Radiation- More Exposure*

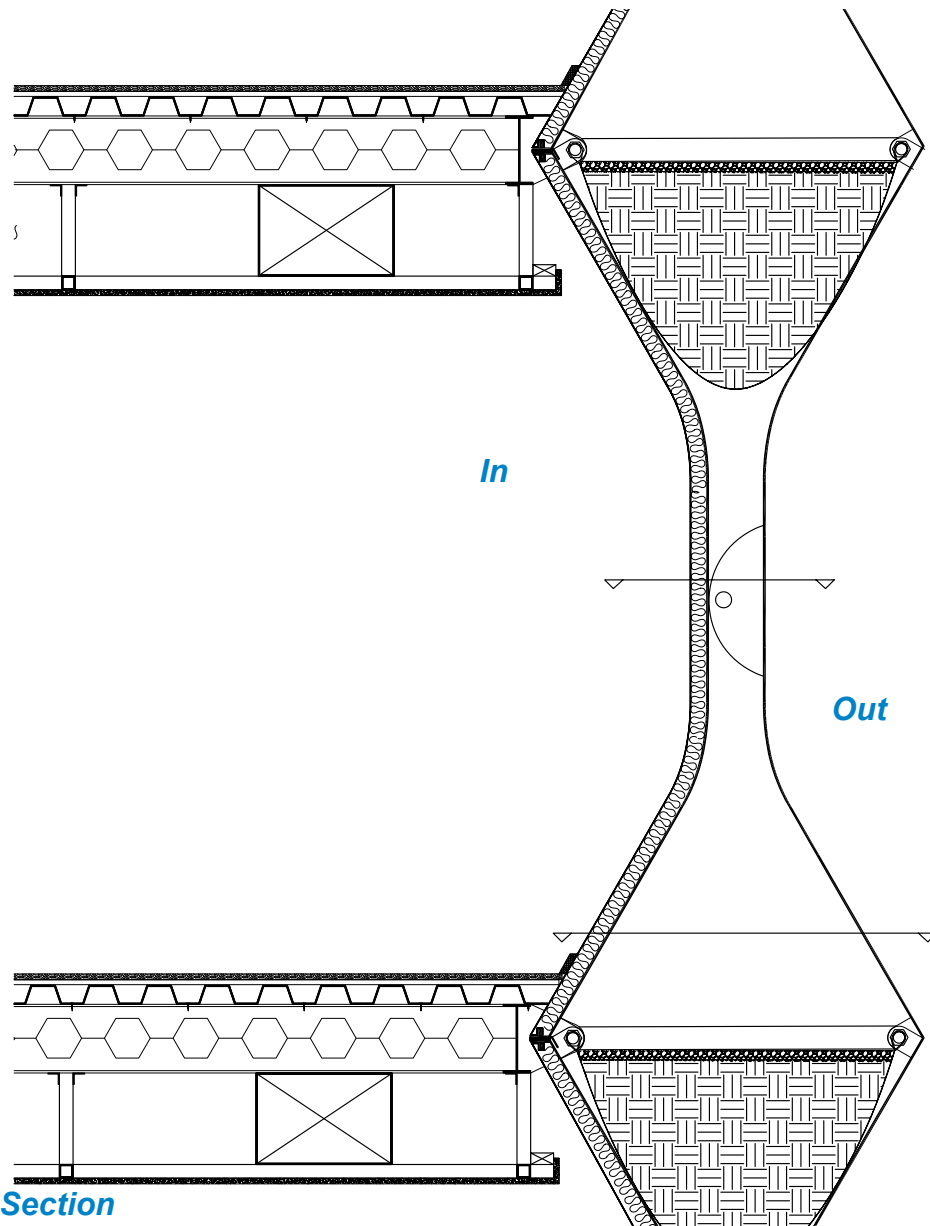


*Medium Radiation- Medium Exposure*

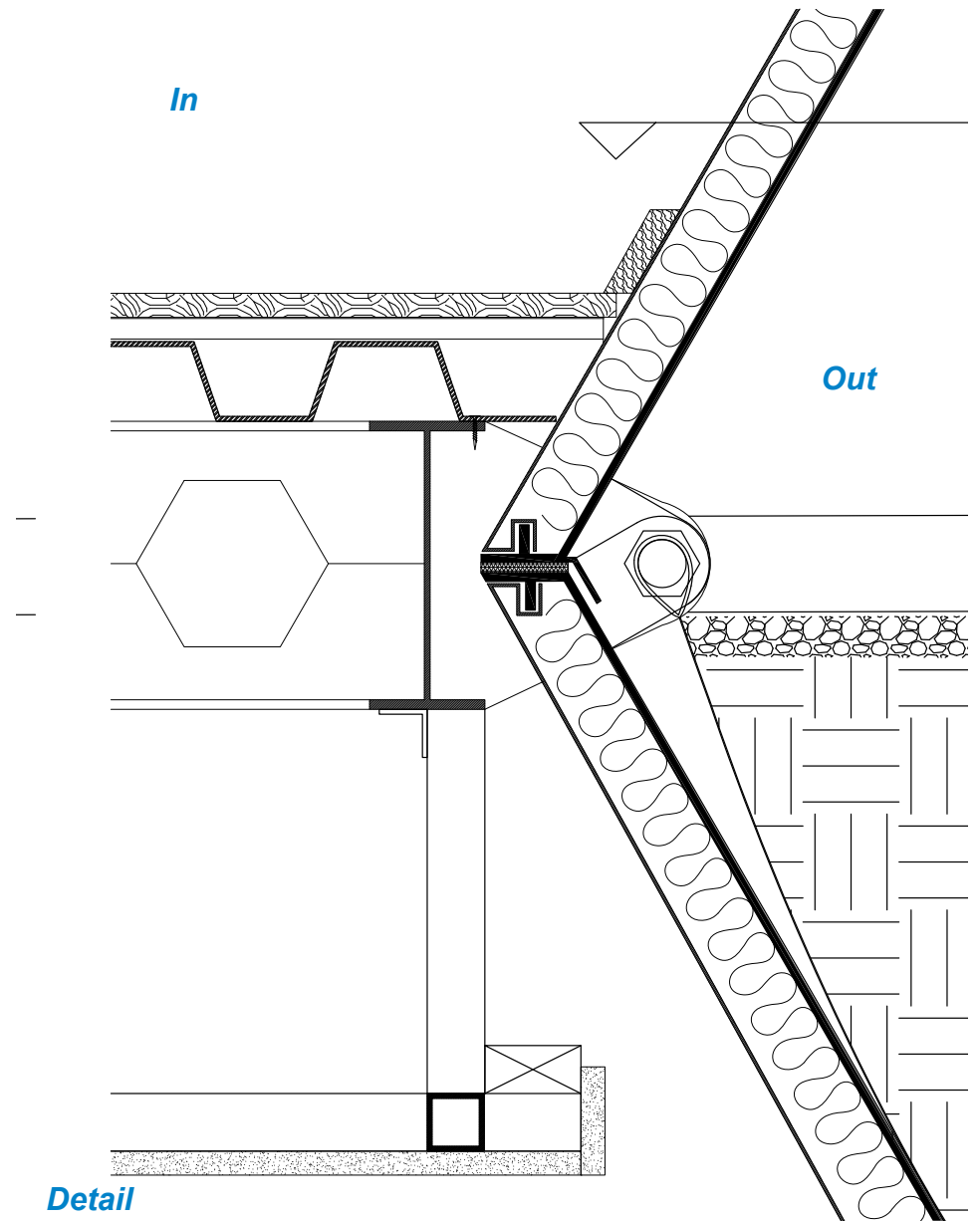


*High Radiation- Minimum Exposure*

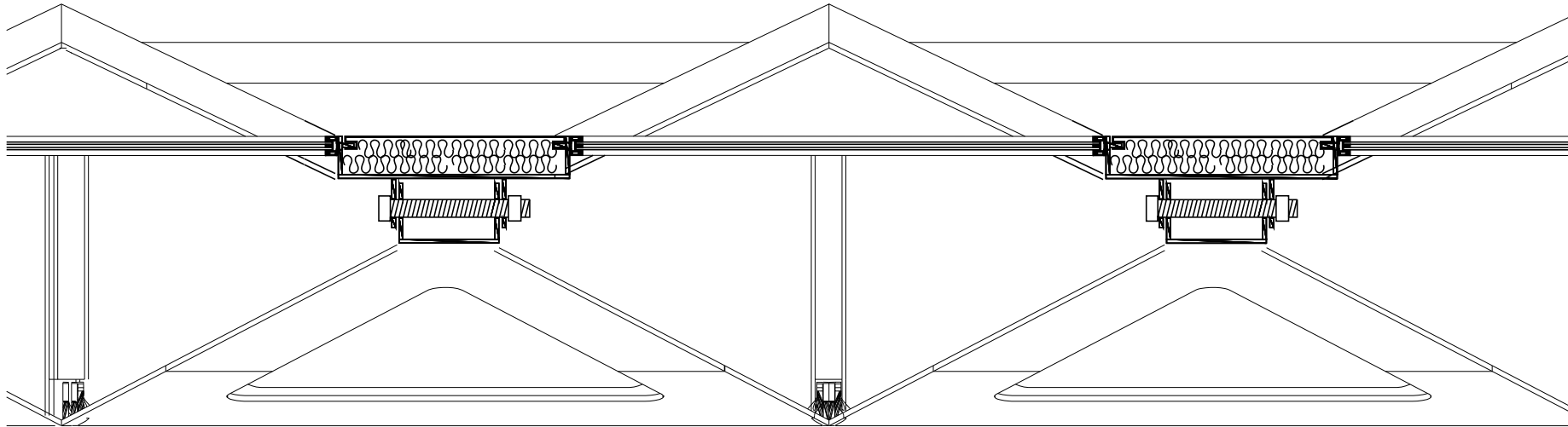
Section and Detail



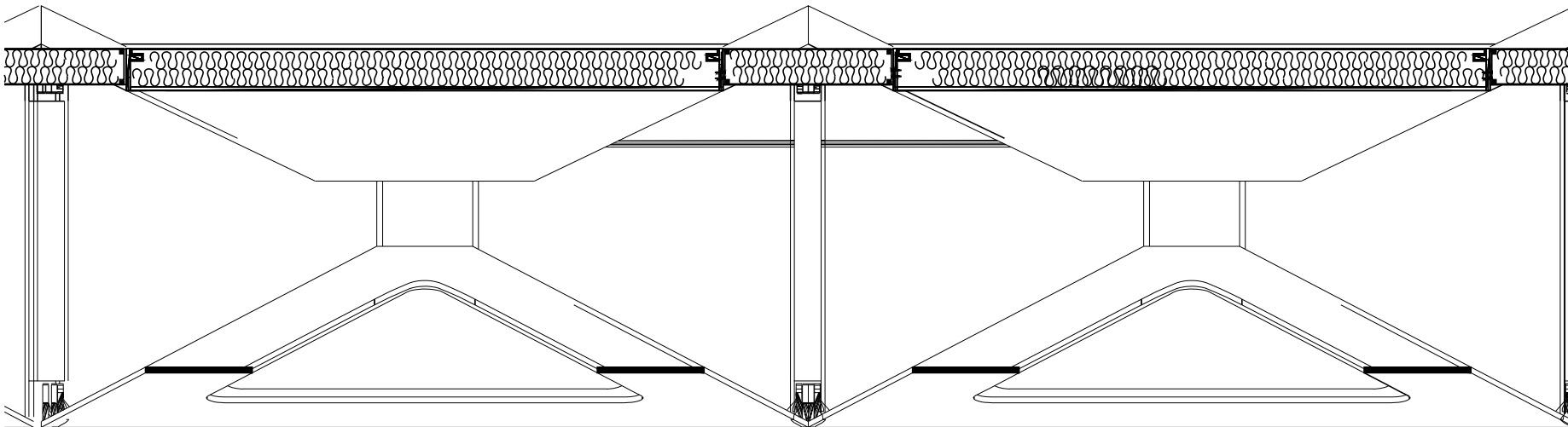
Section



Detail



*Detail Plan ,cutting through window*



*Detail Plan, cutting through wall*

**U-Value 0.453**



*Perspective Views: Front*



*Front, Cut through the wall*

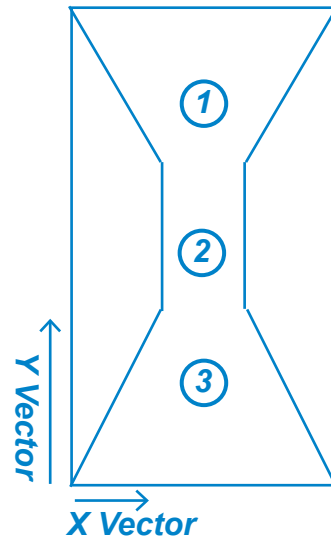


*Back, Cut through the wall*

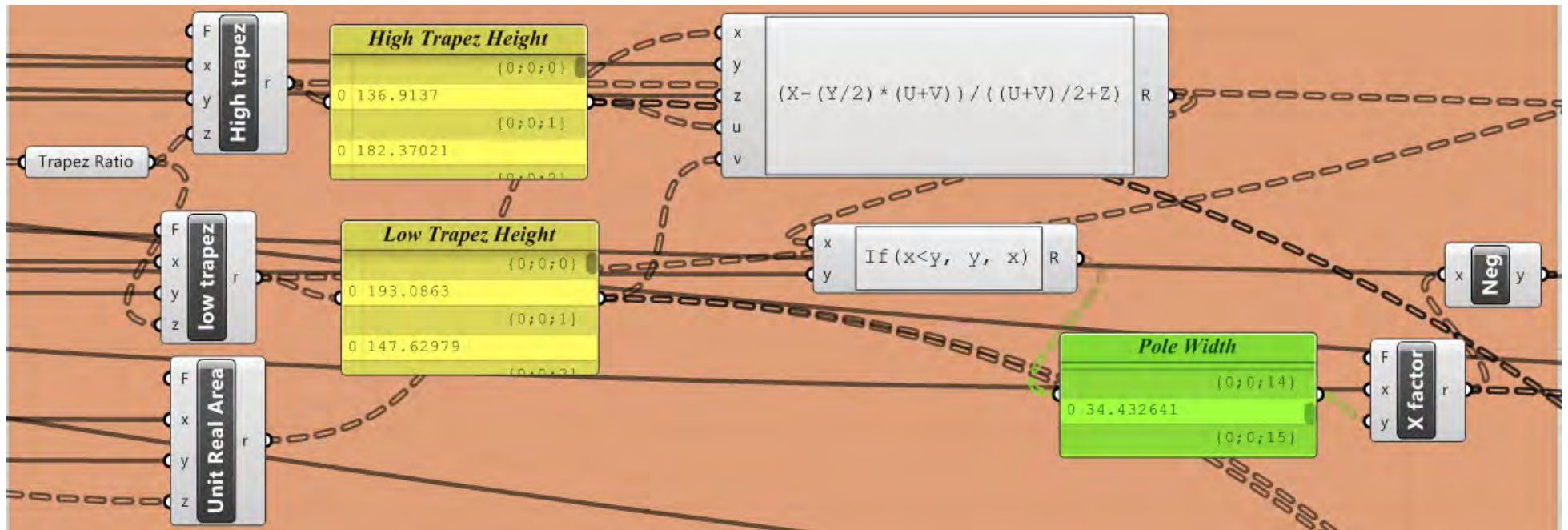
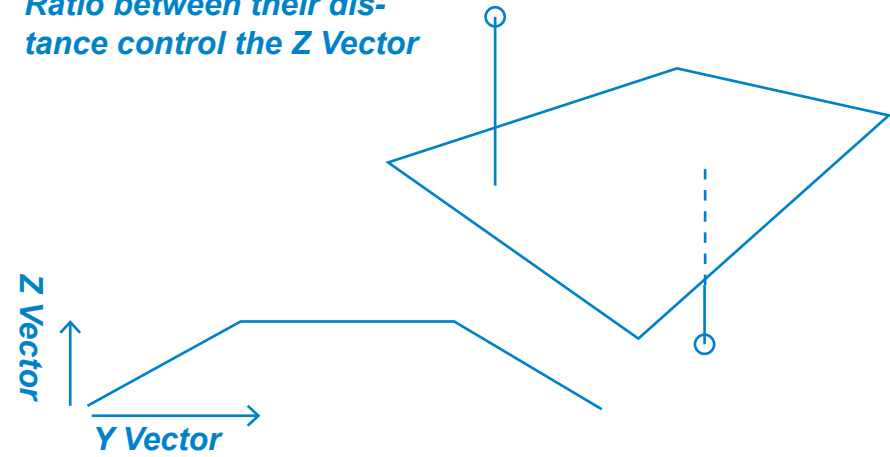
3 Sample Points for each cell

Average  $(1+2+3)/3$   
Influence X vector

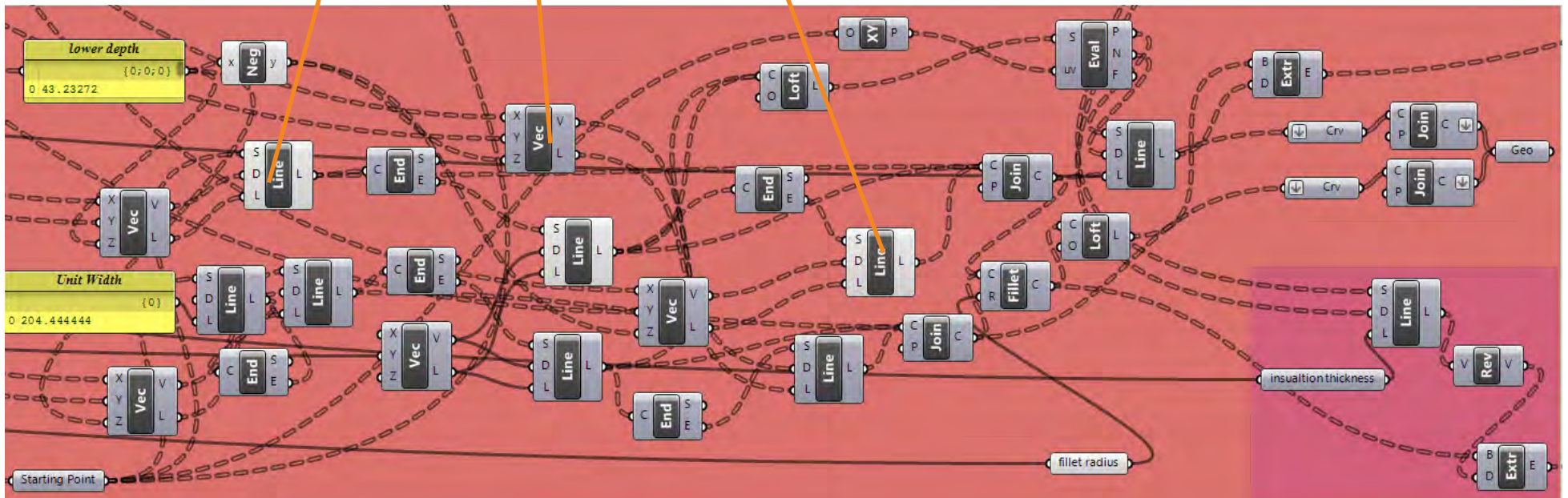
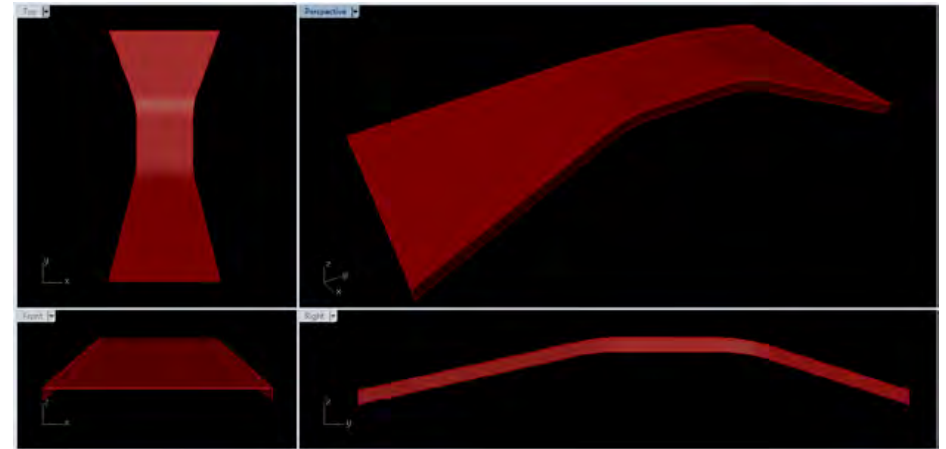
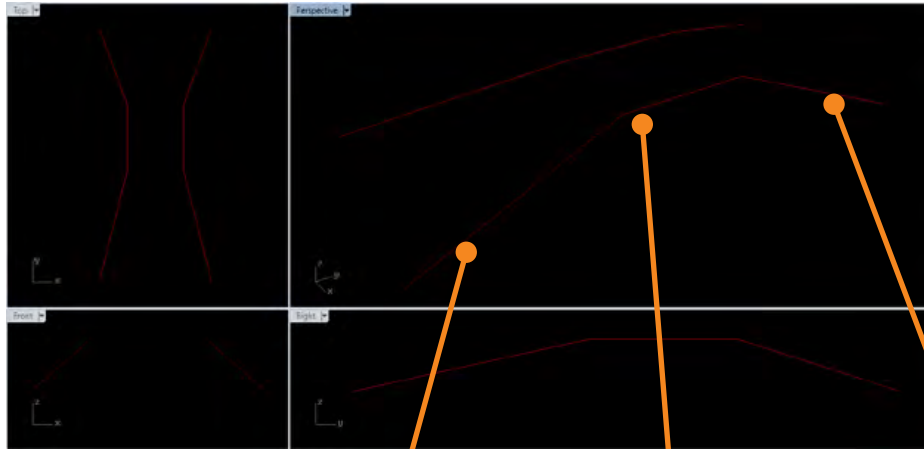
Ratio between 1 and 3  
influences over Y vector



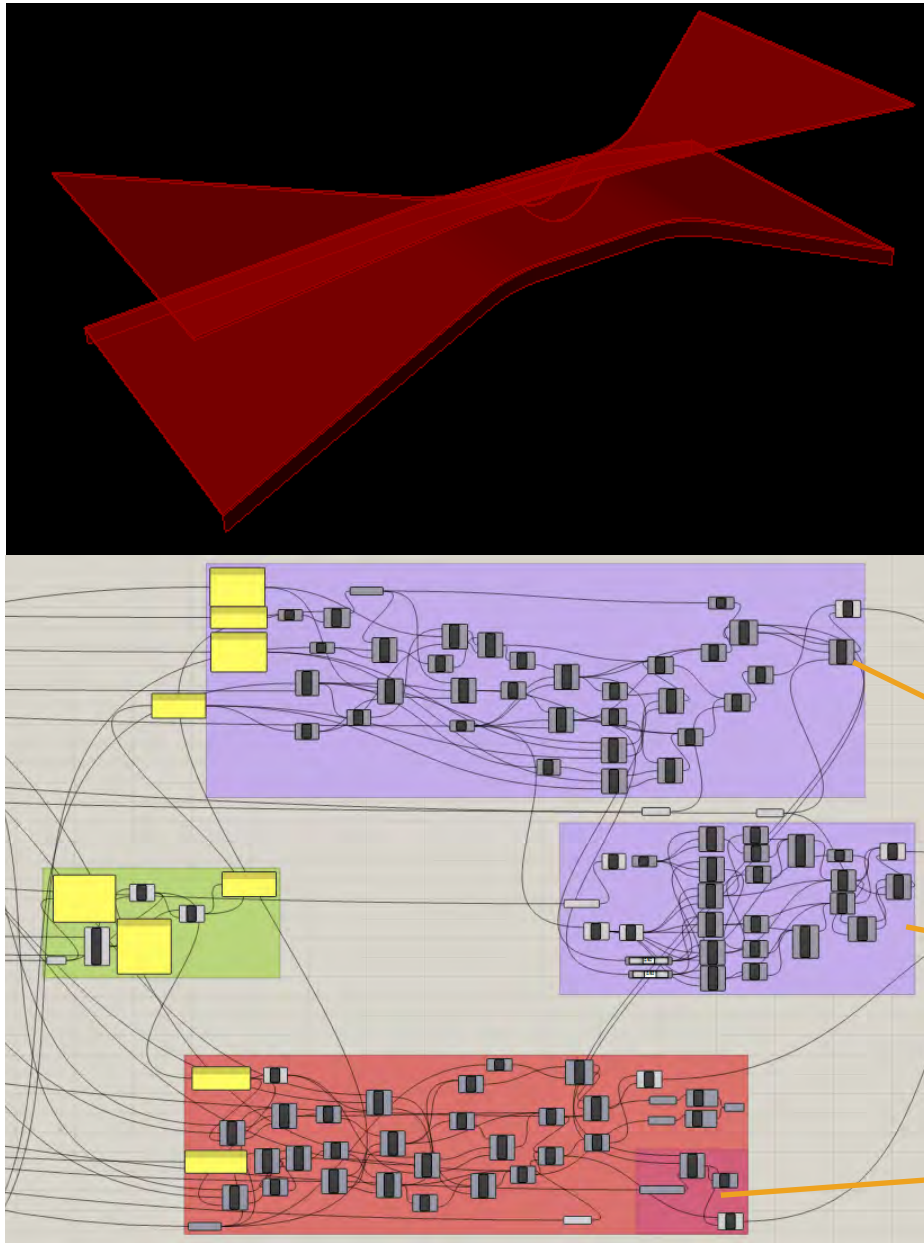
2 Attraction Point outside the plane  
Ratio between their distance control the Z Vector



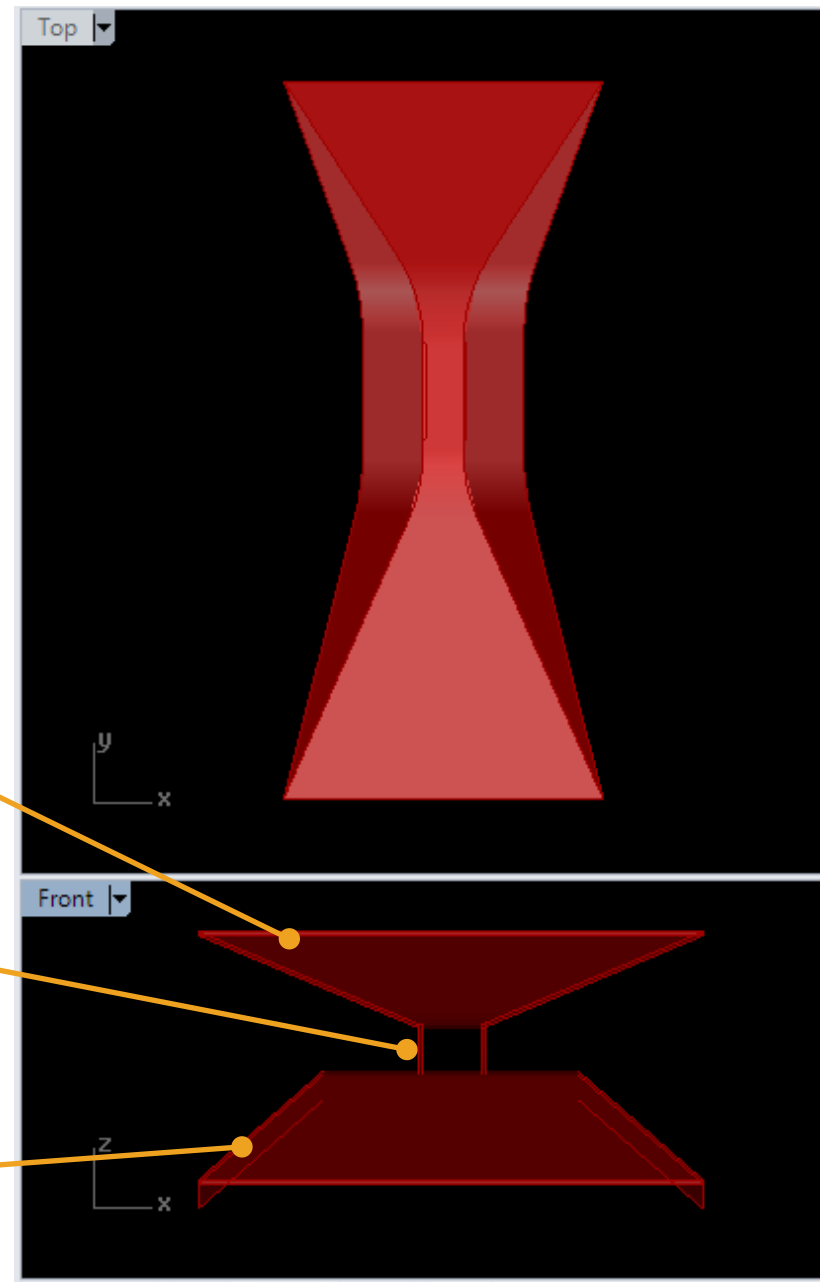
Creation of a cell- Mathematical princiles

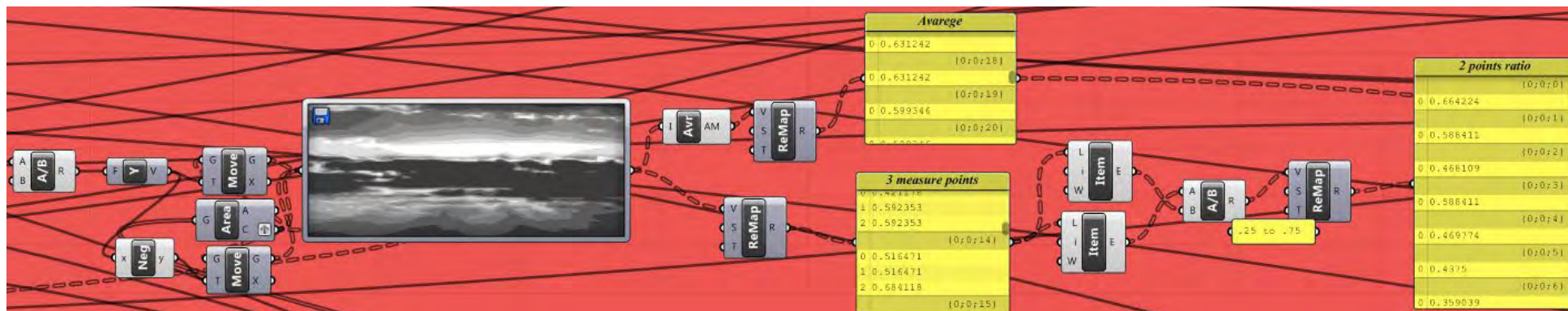






Creation of all three parts of a cell- Geometry creation





## Performance

Core of the algorithm, as one can say, is the Performance measure tool.

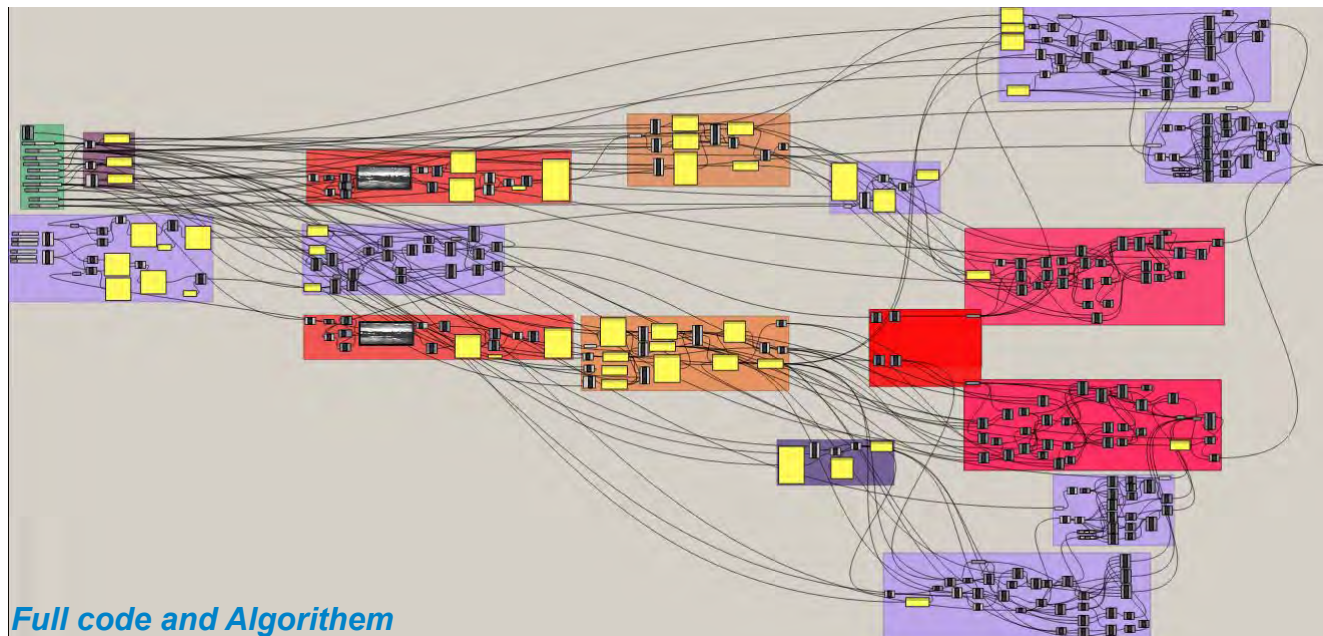
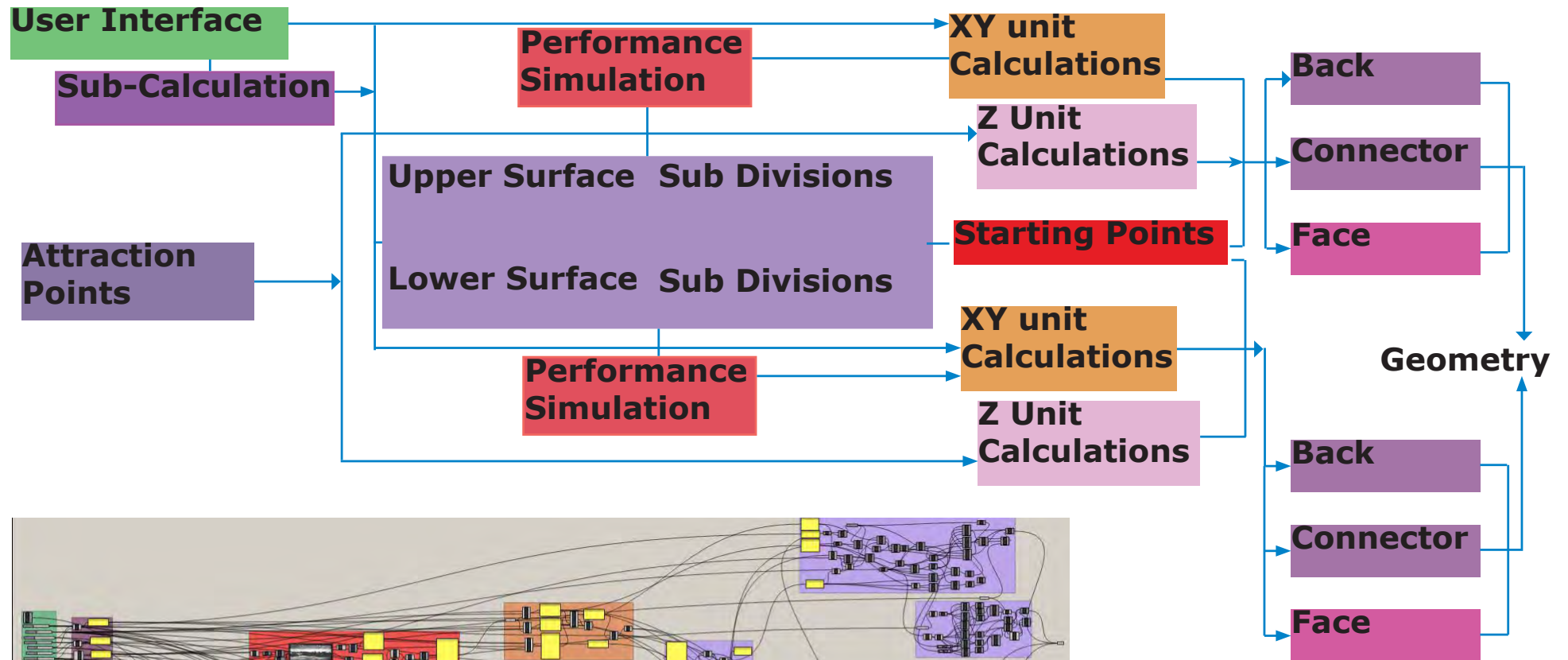
Based on an image, this command gets a gray scale image and a list of points and it will return a numerical value, between 0 to 1.

In this algorithm it used in two ways, which control the coverage of one unit. It controls both the total coverage area of one unit and the ratio of area between the upper and the lower trapezoids.

Every subsurface is covered by one unit. The code gets from every subsurface it's central point, and make another two points in the upper and the lower third of the subsurface. Those points are the inputs for the image sampler.

The values got from the sampler are calculated twice: First an avarege of those three points is given to get the total coverage of a unit, and secondly the ratio between the upper and lower sample points is to use in the trapezoid area ratio algorithm, which will be explained in the the unit chapter.

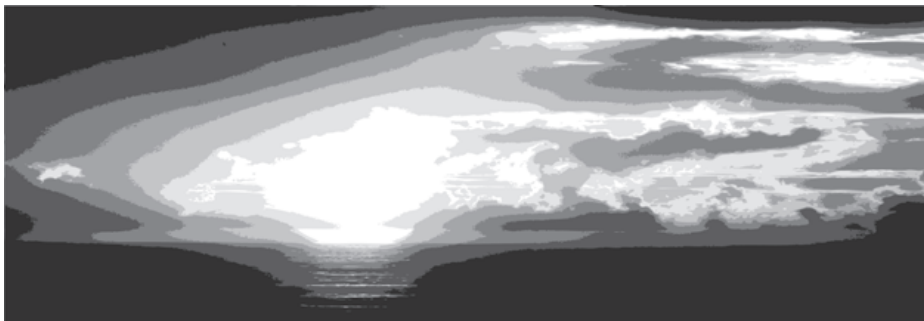
Those efforts are made because the units are quite big in comparasion to the whole surface, and sampling only one central point might give inaccurate results.



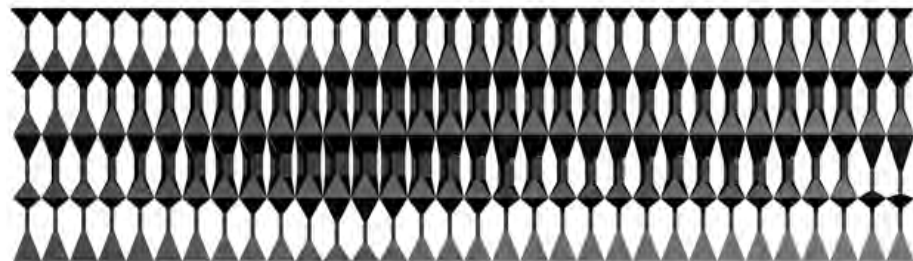
Full code and Algorithm



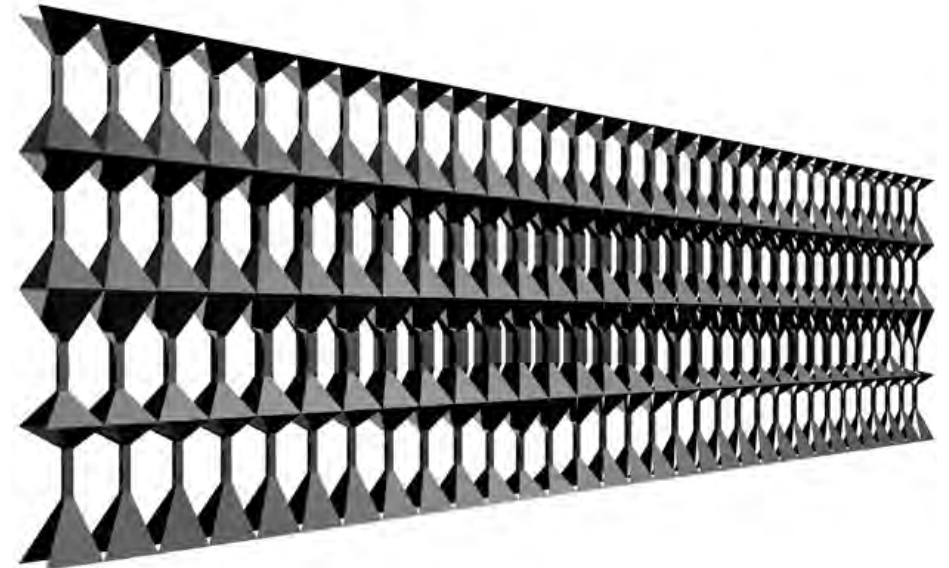
youwall.com



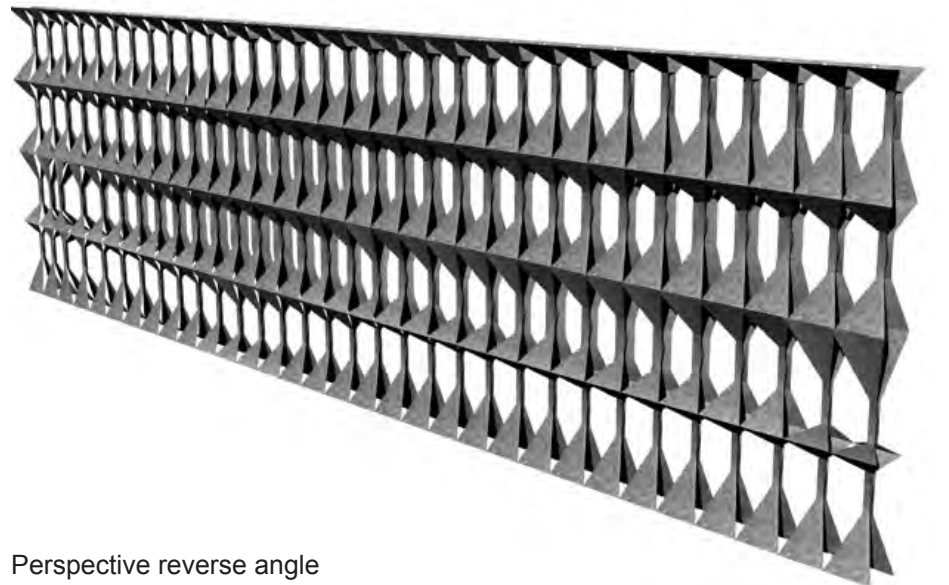
The image turned into greyscale and traced in adobe illustrator



*Facade performance tryout with illustrated jpg image*



Perspective

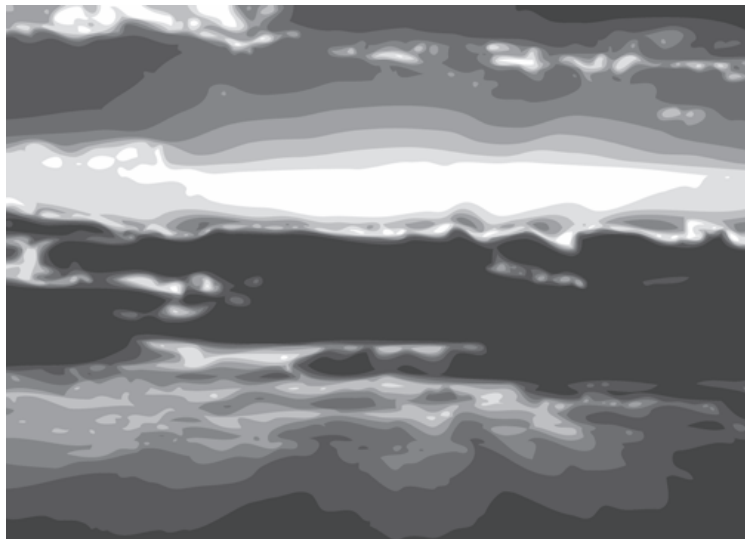


Perspective reverse angle

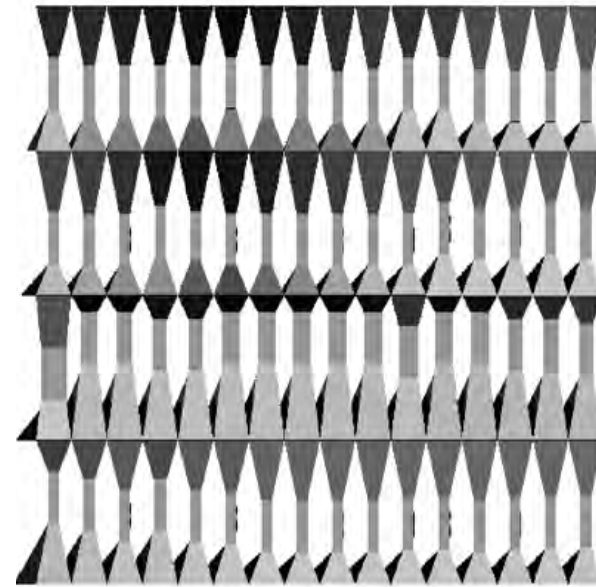
*Northern Facade- jpg illustration*



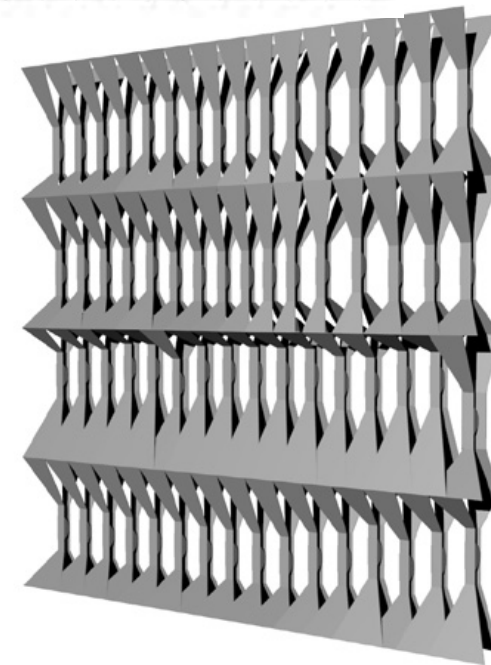
tapuz.co.il



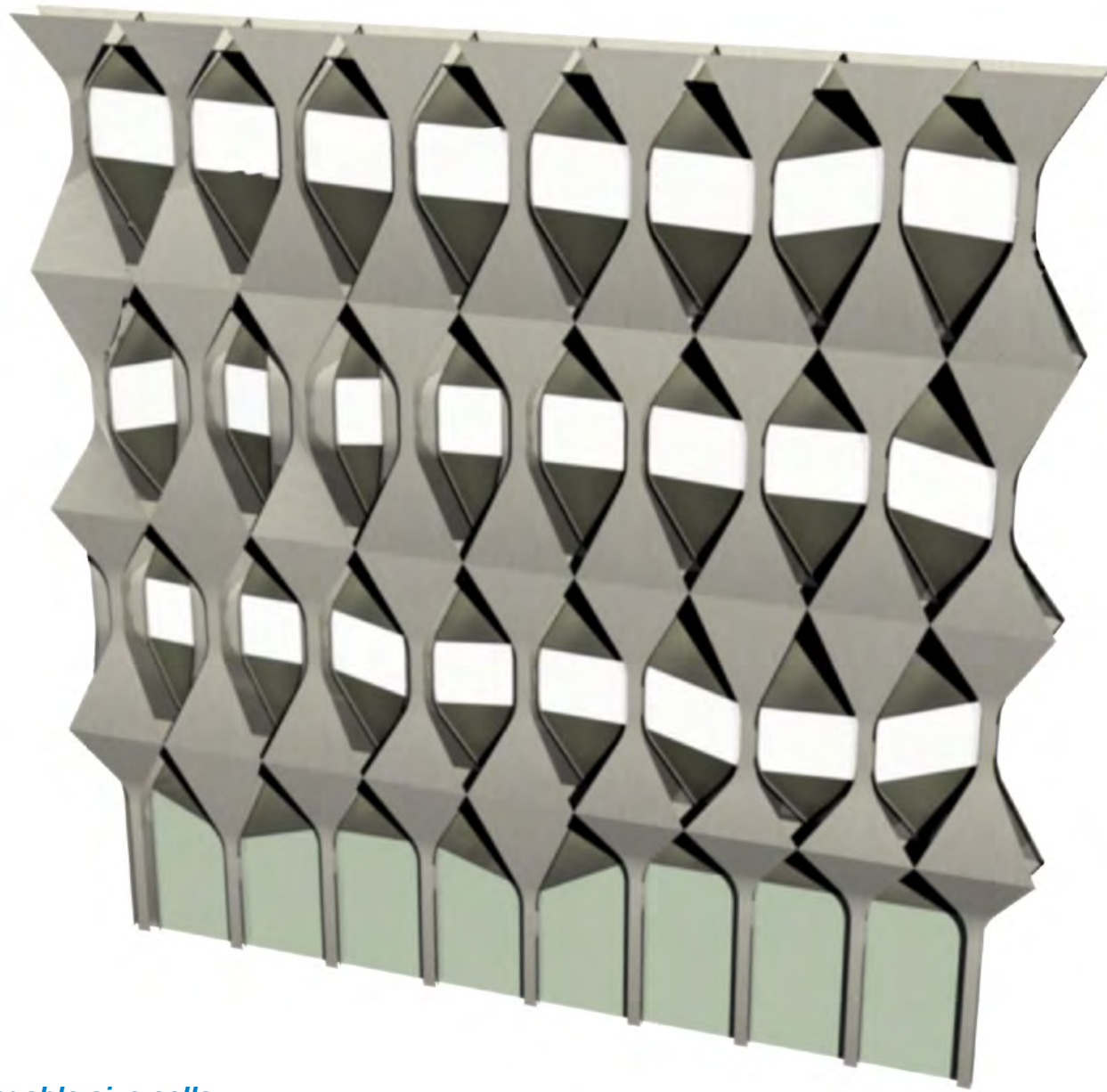
The image turned into greyscale and traced in adobe illustrator



Elevation

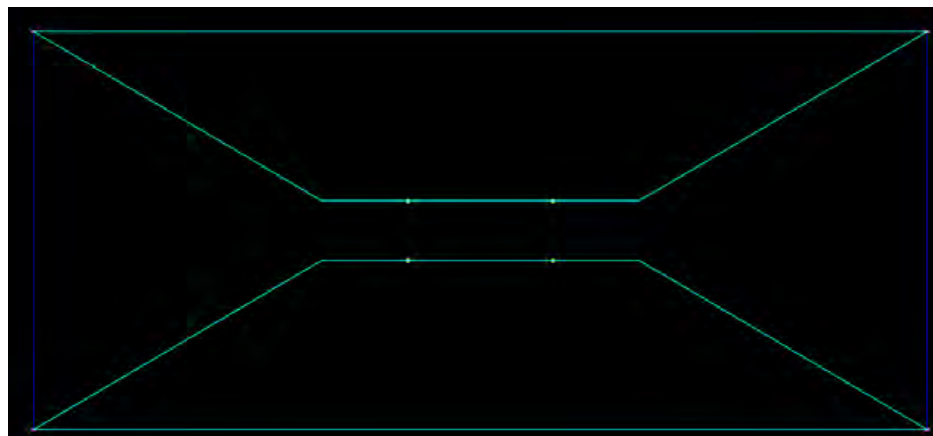
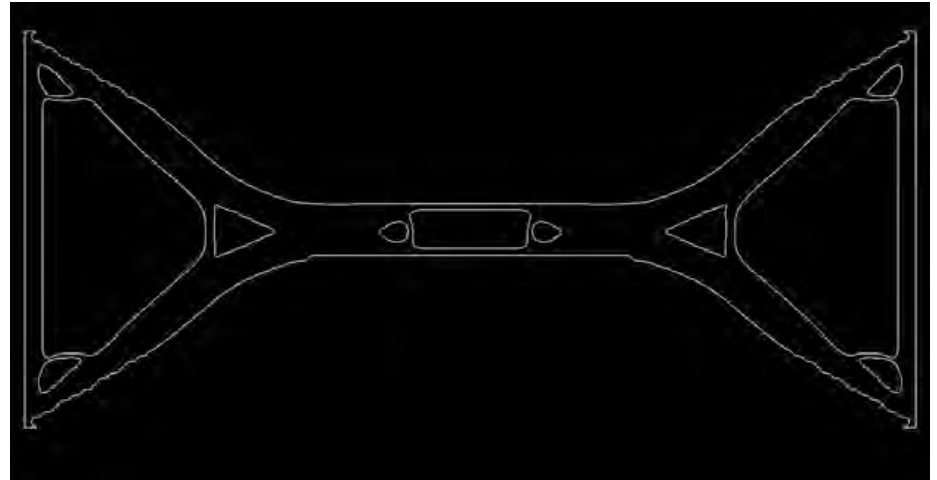
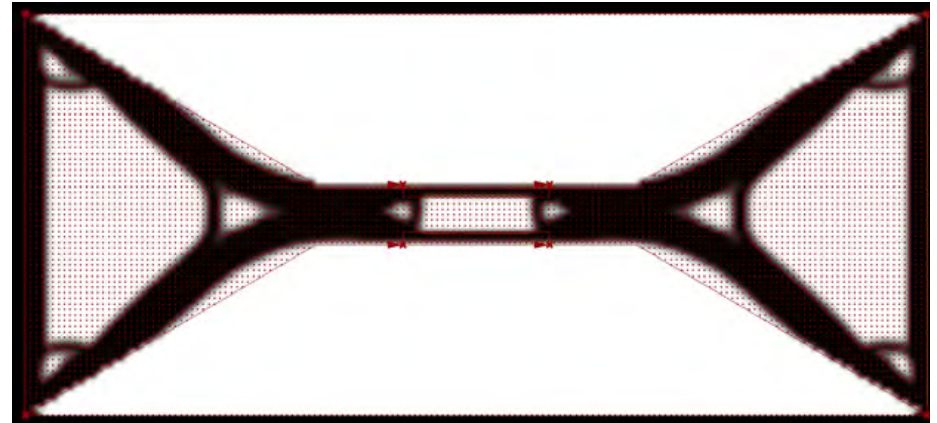
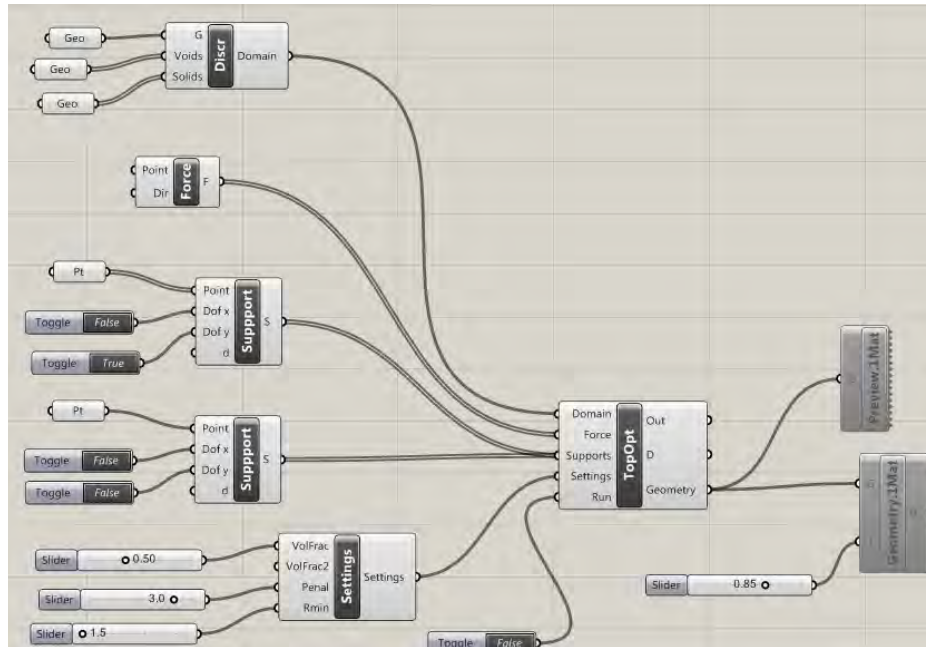


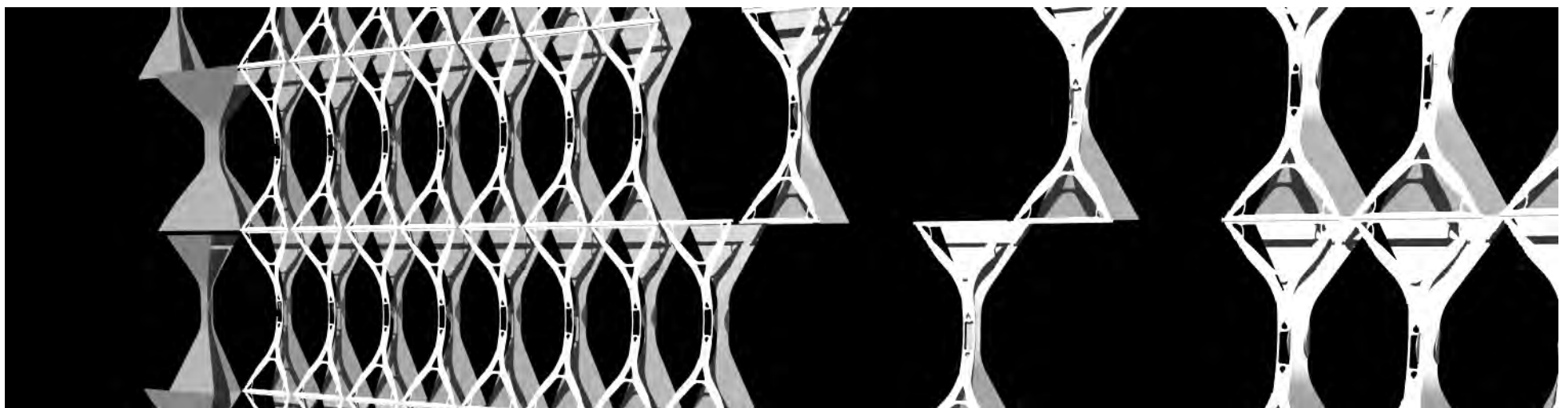
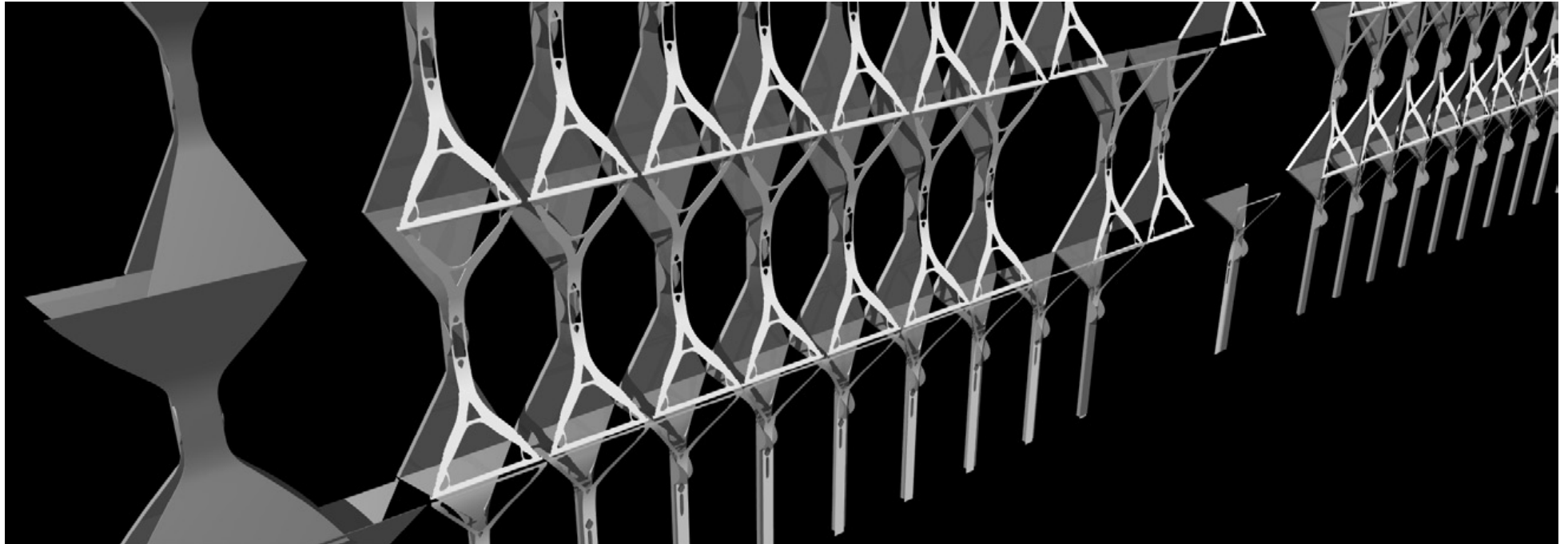
Perspective



*Facade Part with changable size cells*

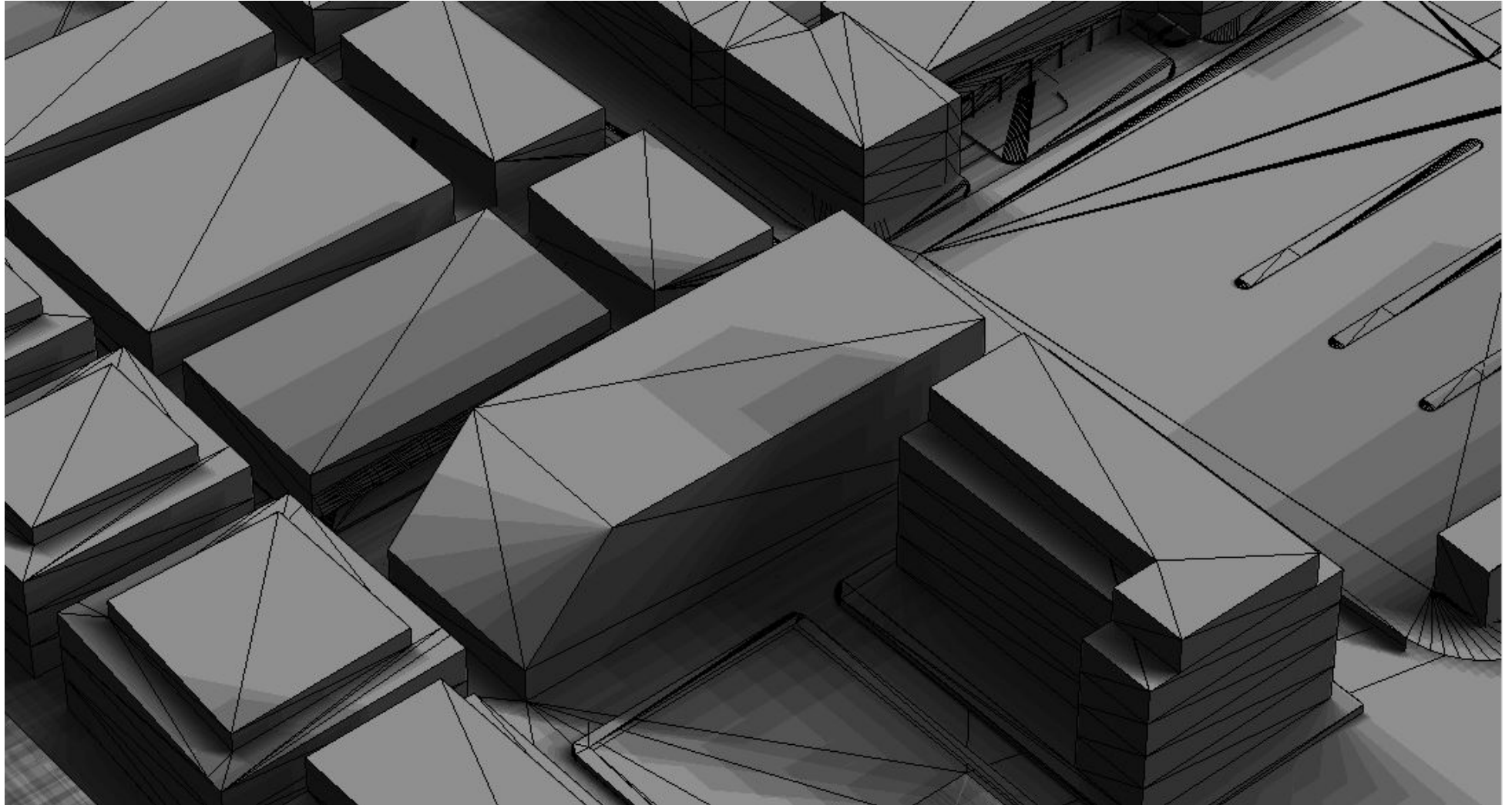
*TopOpt loads and forces check- opportunity of perforating the cells wall*





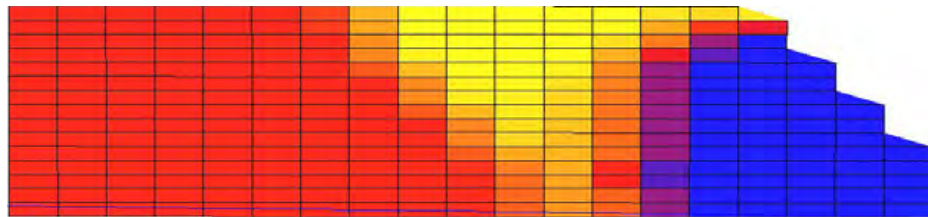
*Perforated cells- Optional composition*



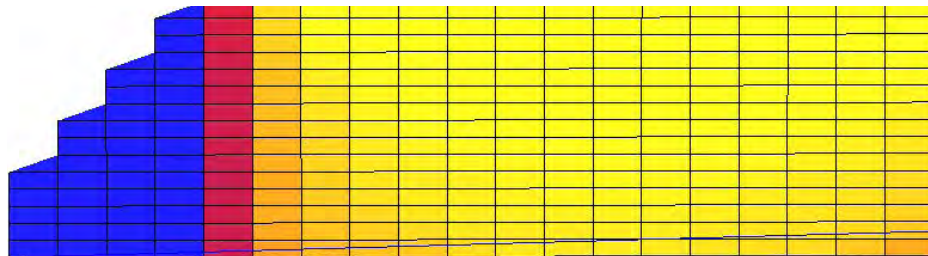


*Autodesk Ecotect  
Light simulation Program*

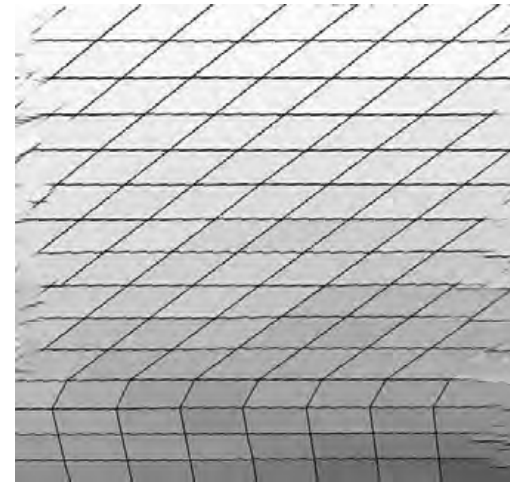
*Light Simulations*



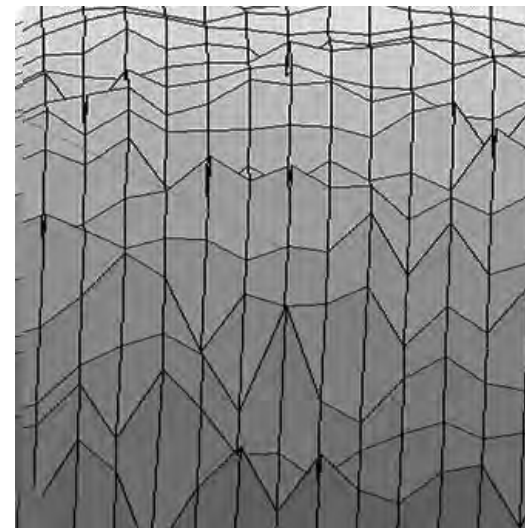
*Eastern Facade*



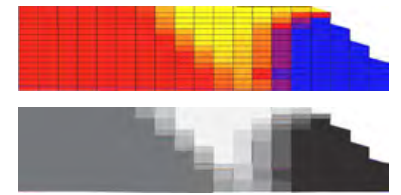
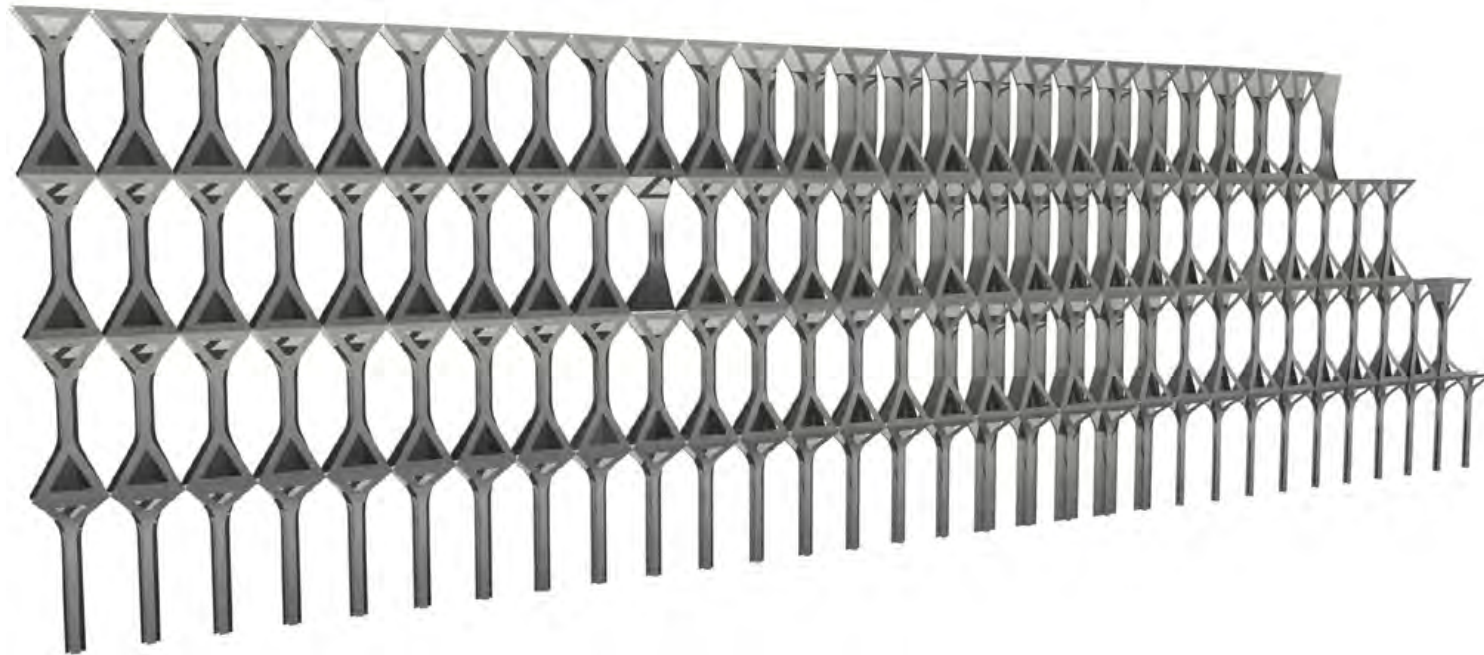
*Western Facade*



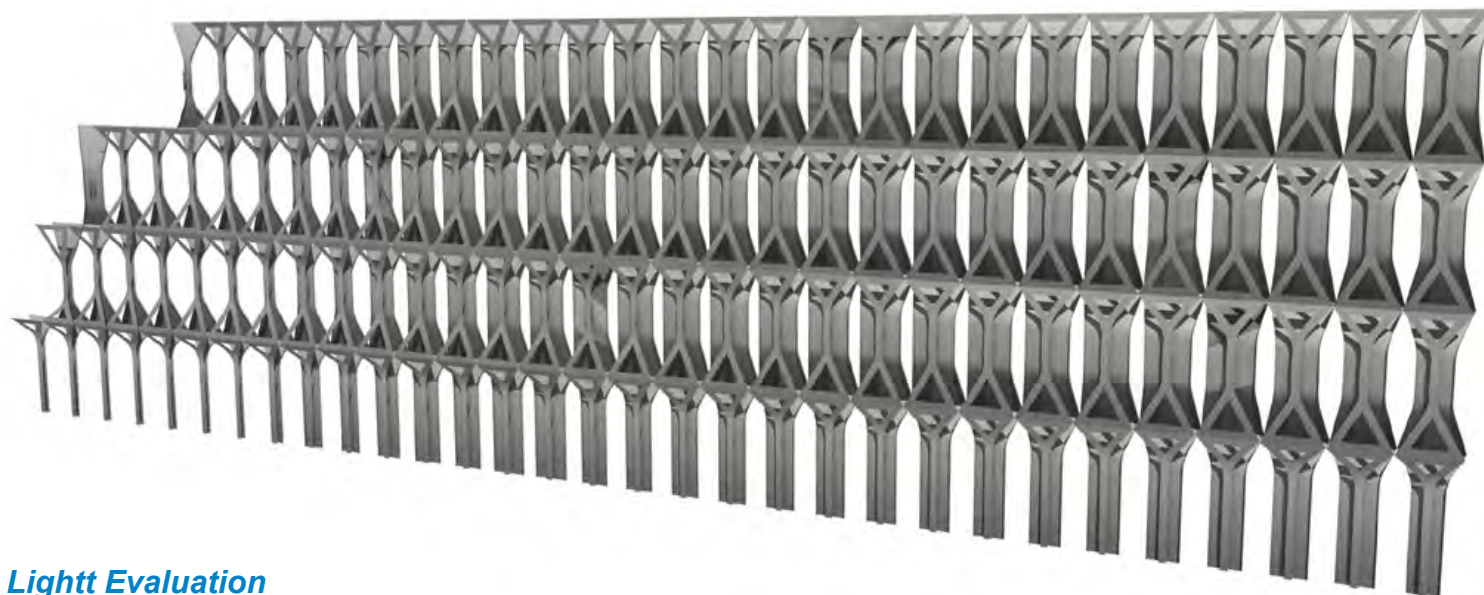
*Southern Facade*



*Northern Facade*

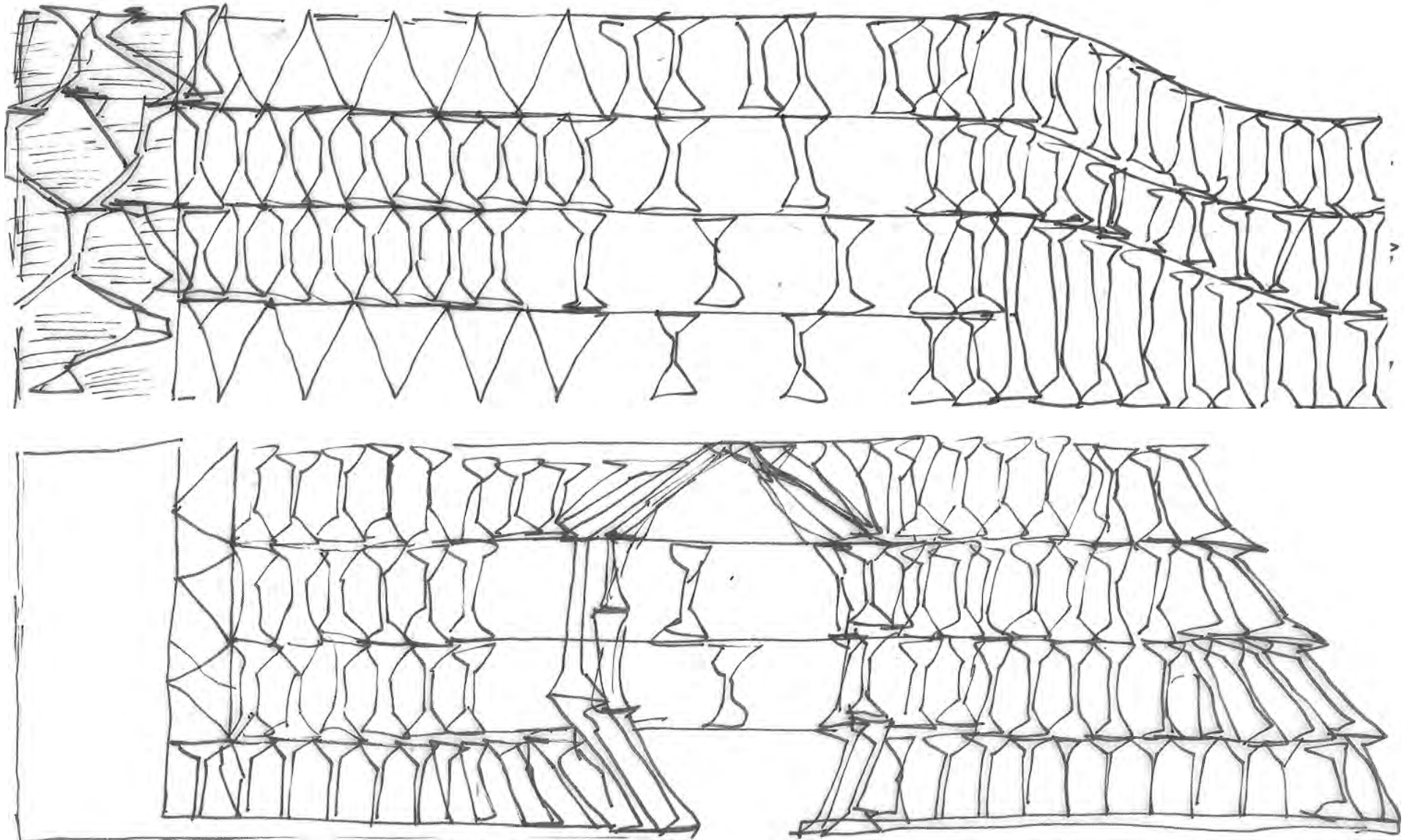


East

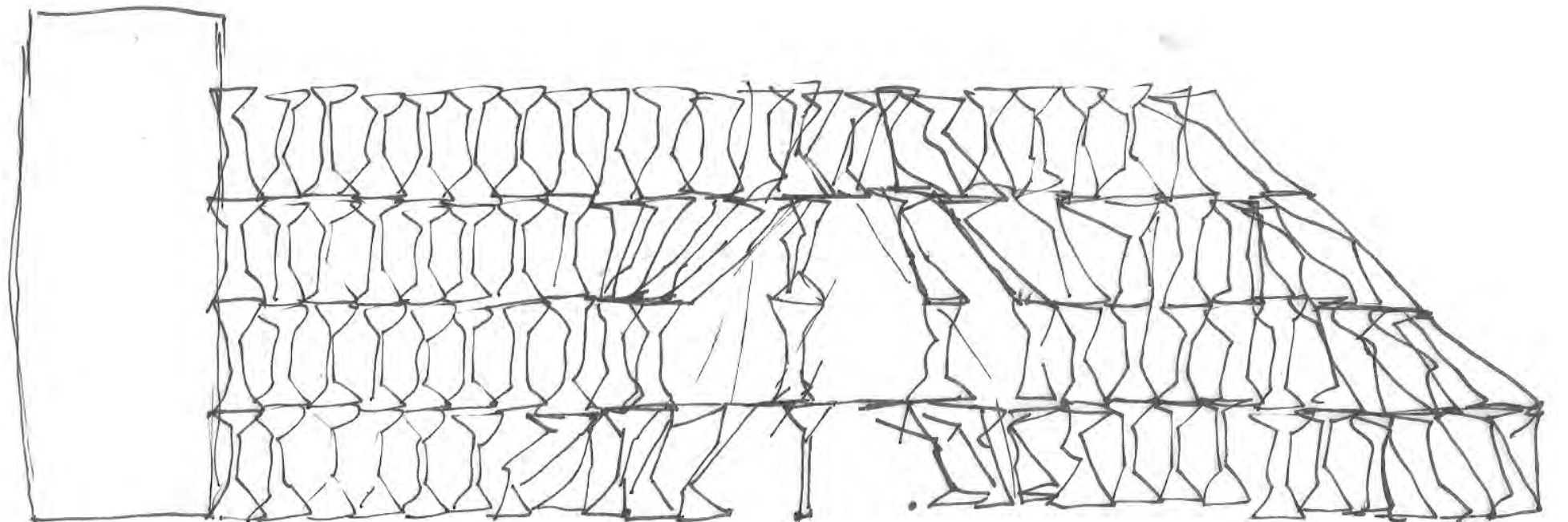
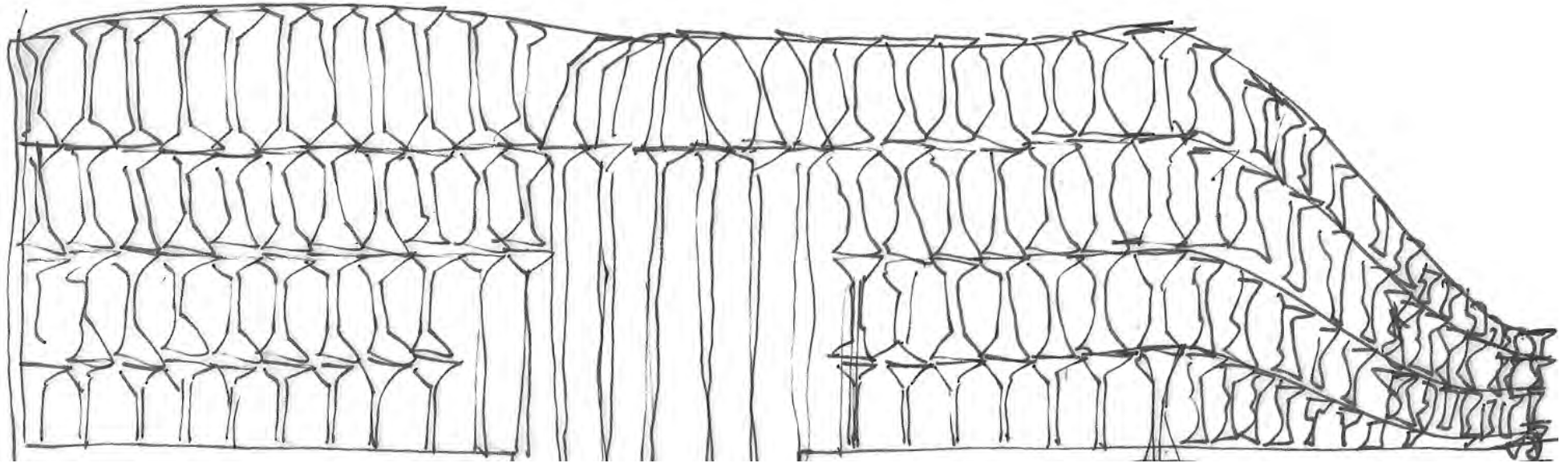


West

*Light Evaluation*



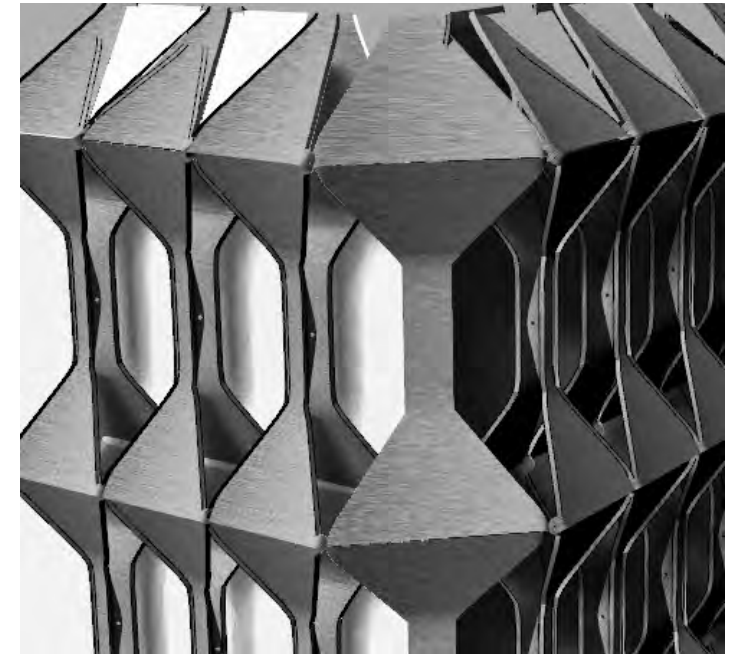
*Sketches- Brief changes to the facade*



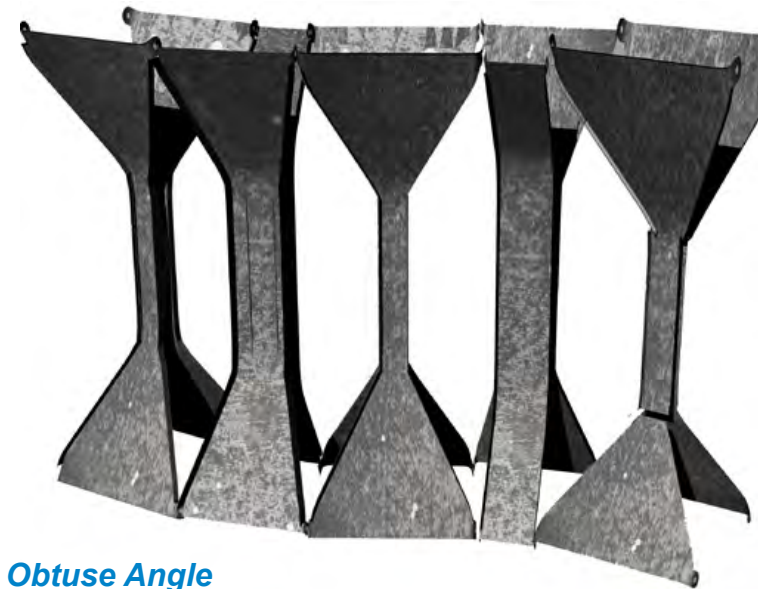
*Corners Old Catalogue*



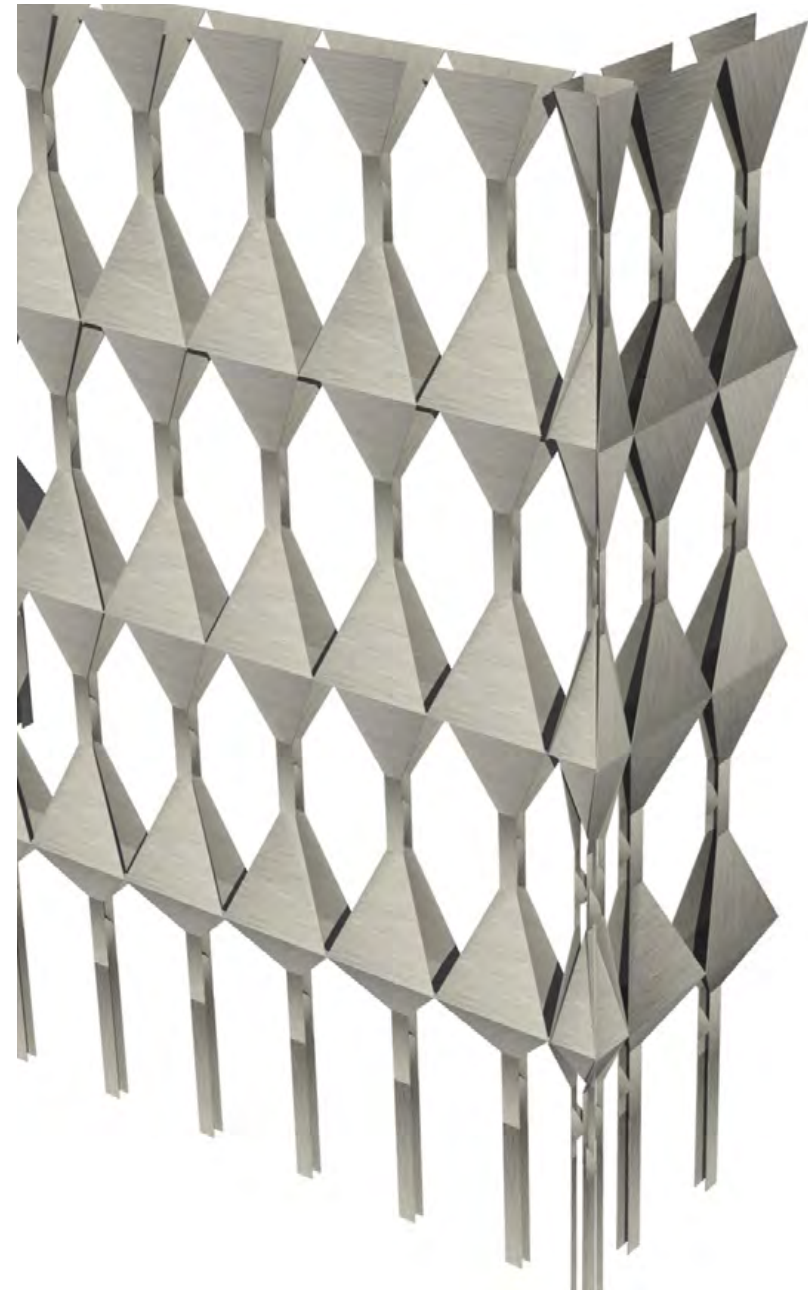
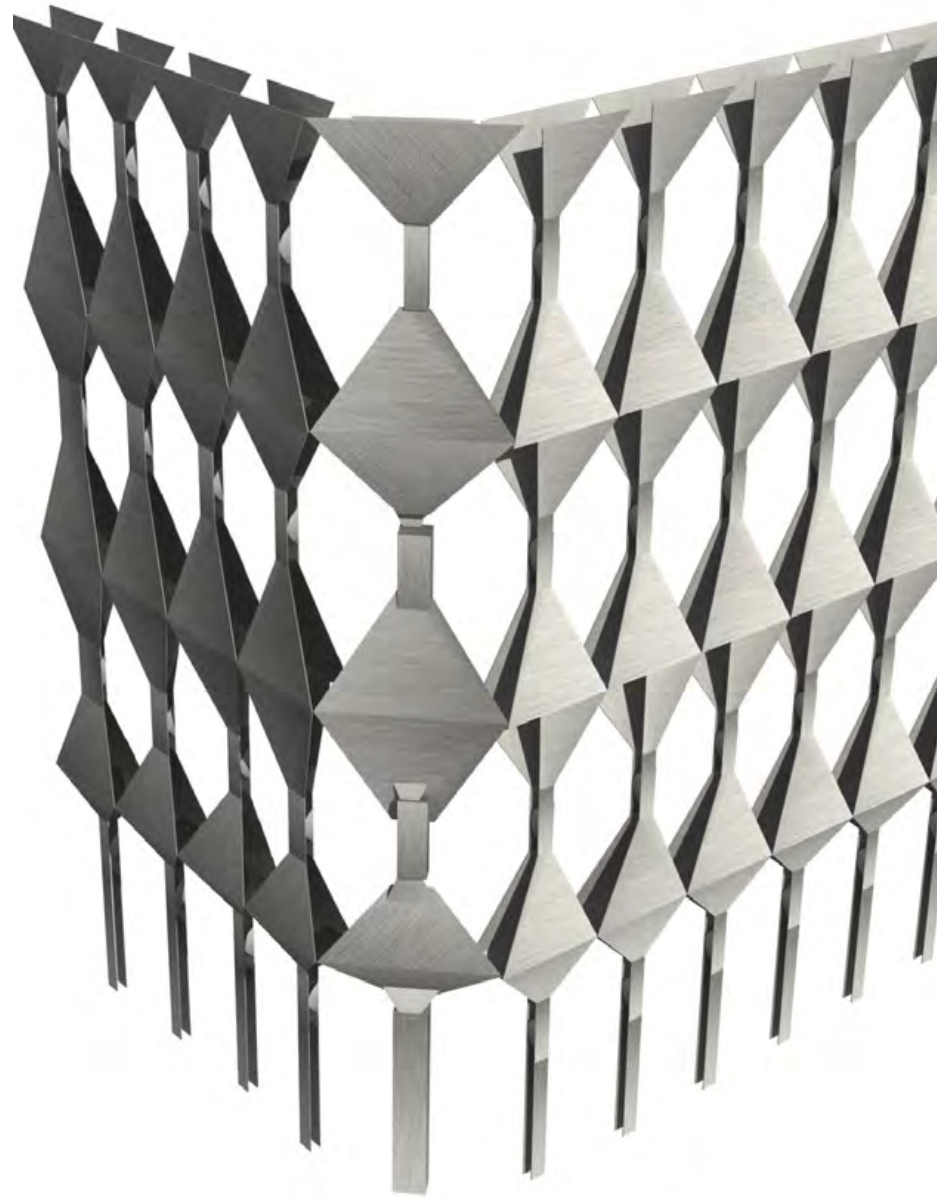
*Walls Wnd With Balcony*

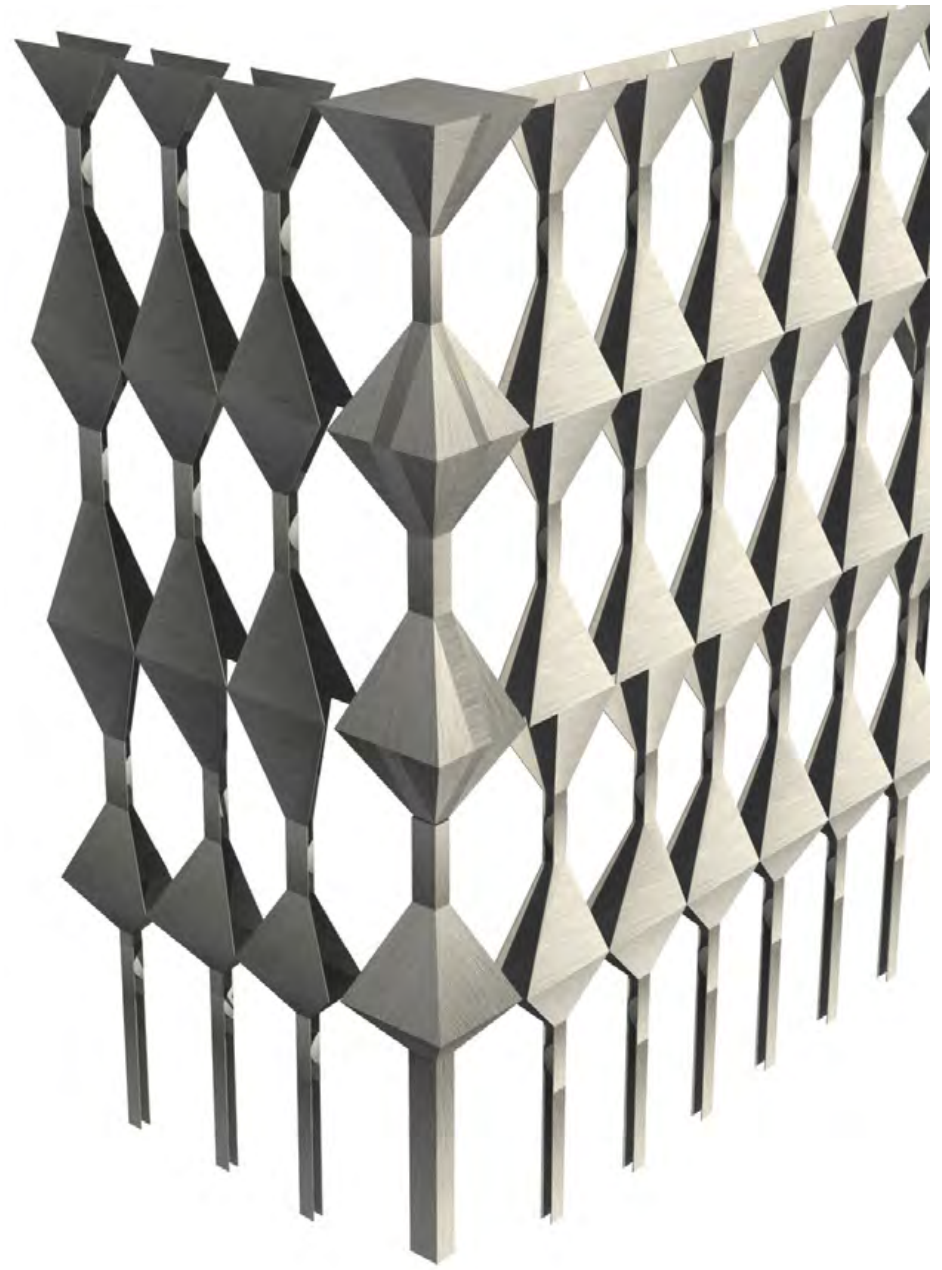
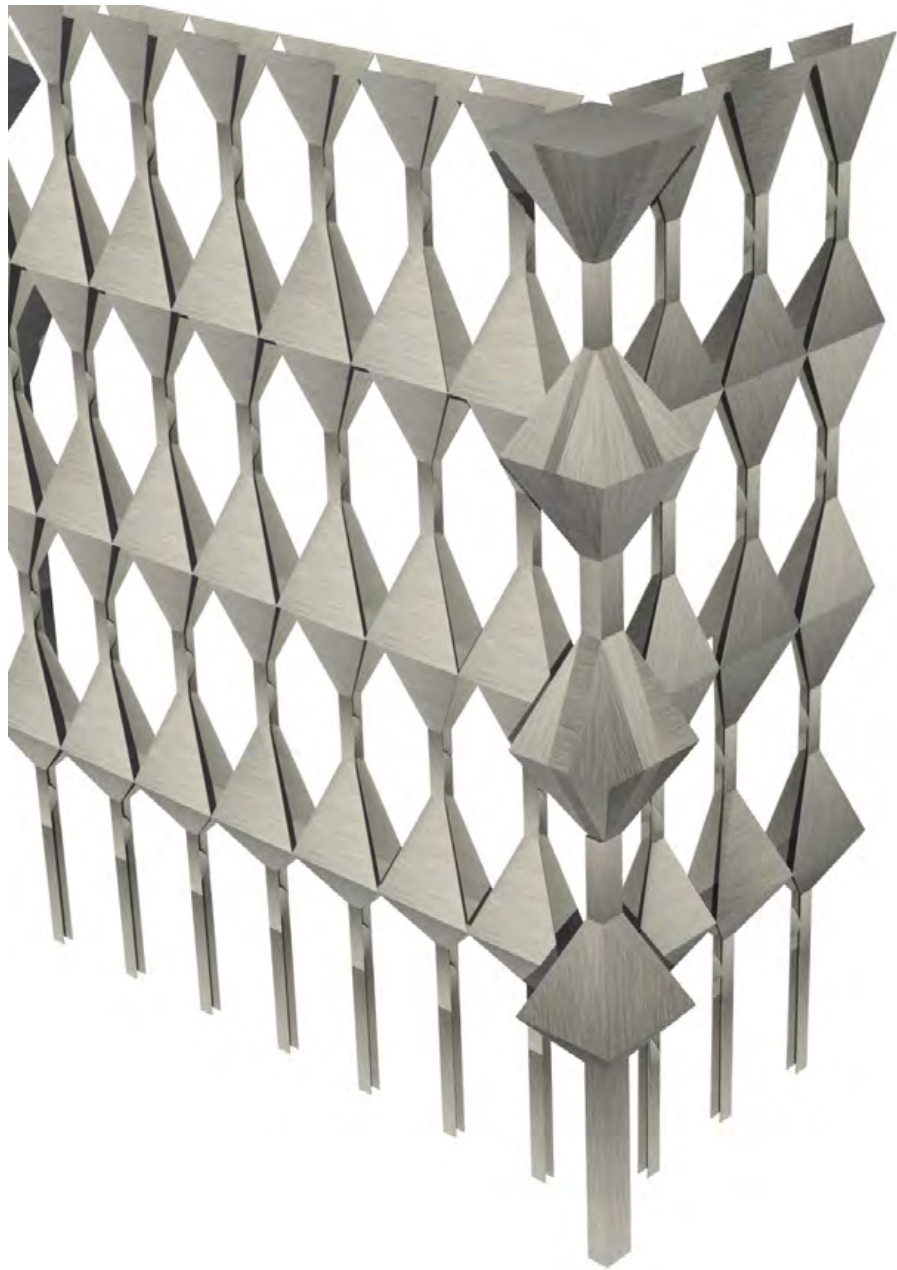


*Right Angle*

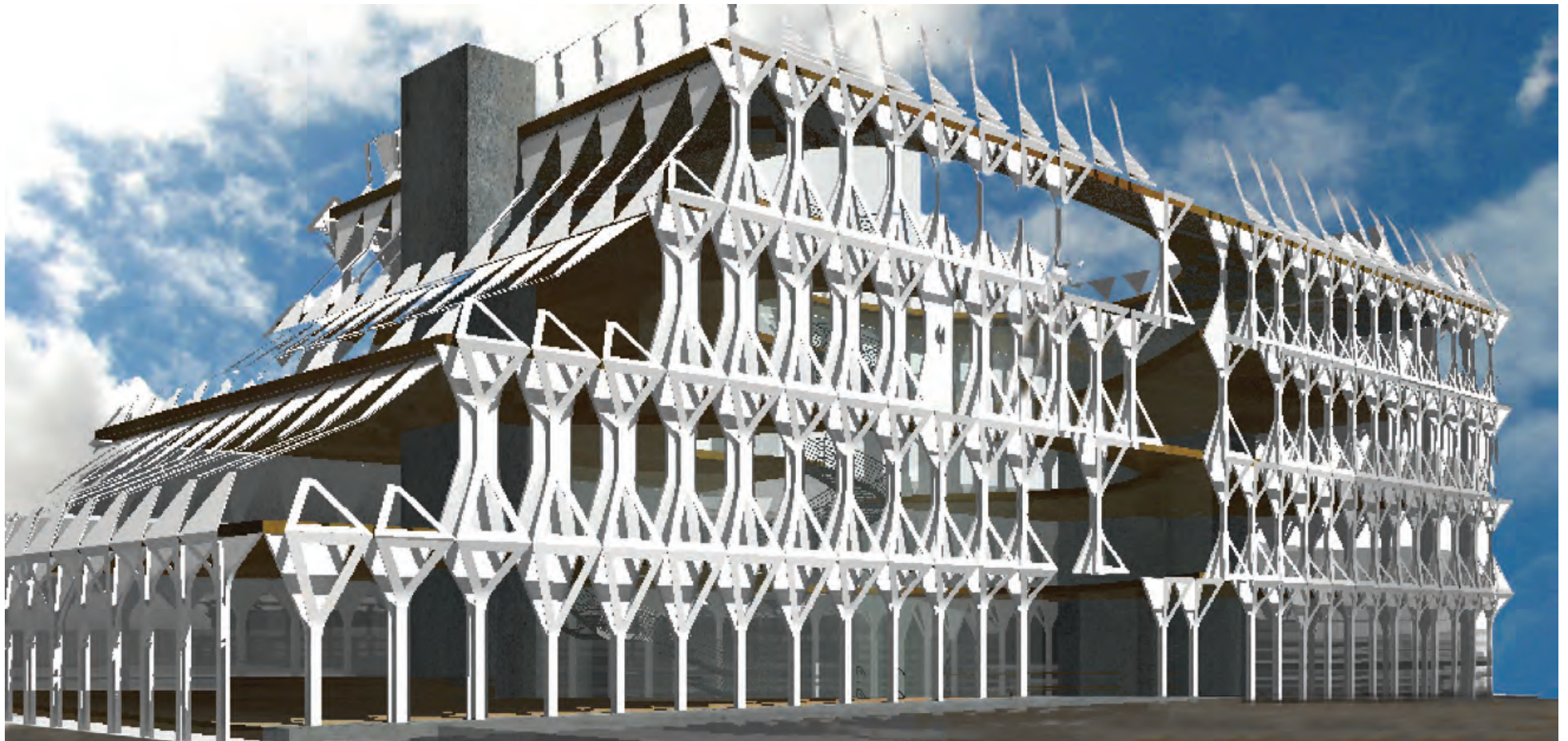


*Obtuse Angle*









*North West corner  
view of the northern facade, tapered to allow sun rights for  
.the northern neighbor building  
.The western facade with the court wall is seen as well*



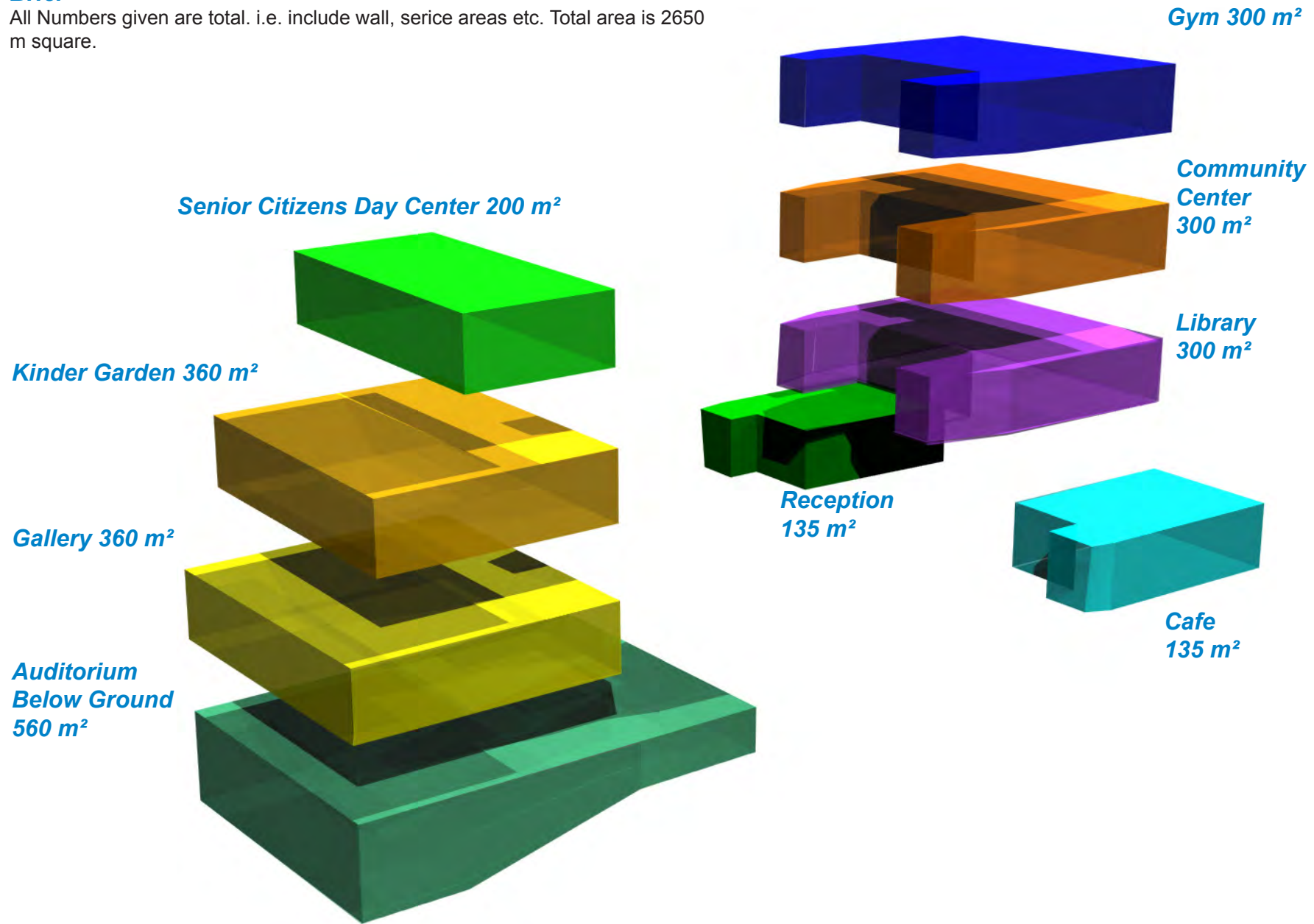
*South East corner-Stretched cells at the safety tower*



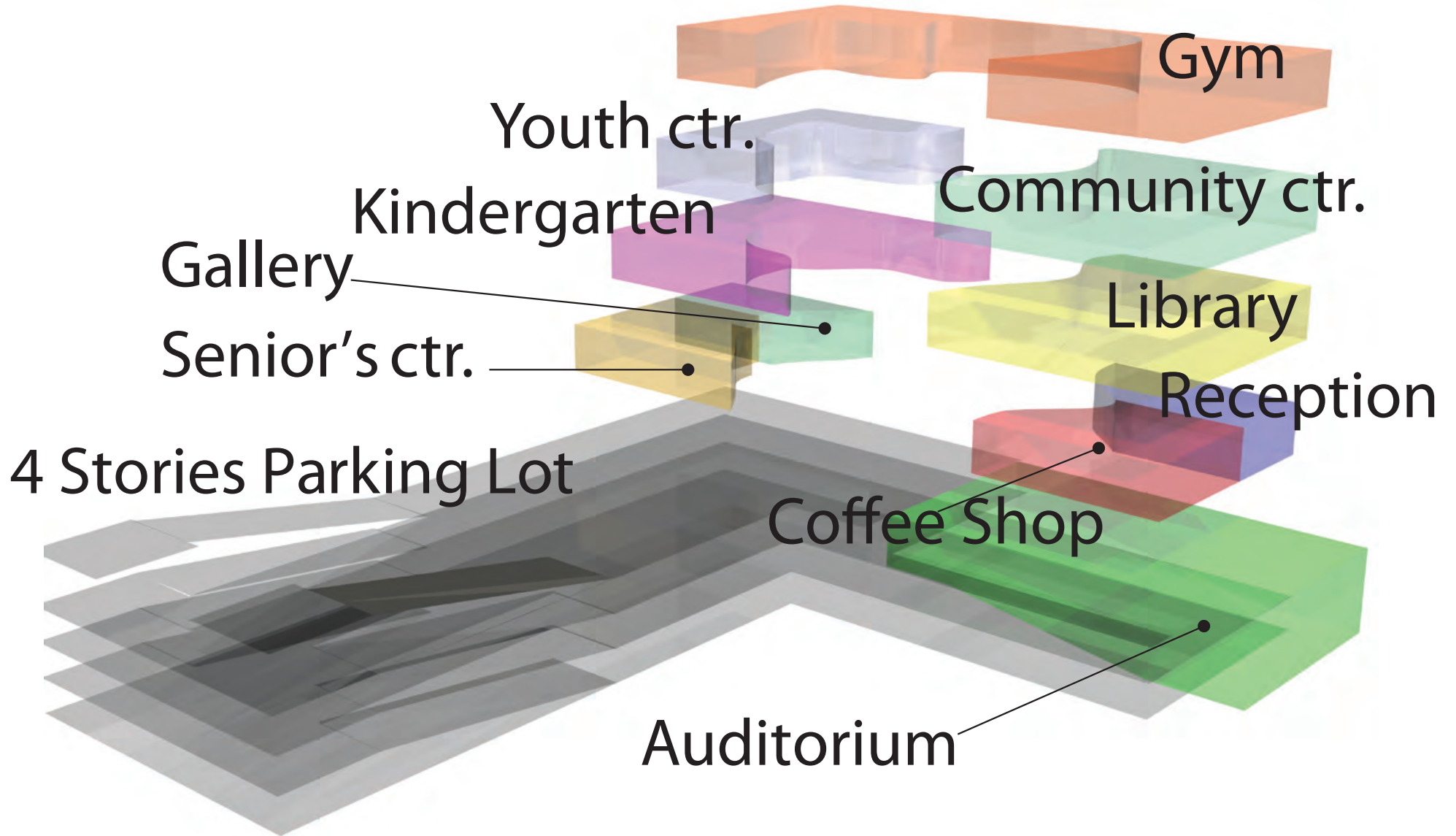
*South West corner*

**Brief**

All Numbers given are total. i.e. include wall, service areas etc. Total area is 2650 m square.



Function	Net area	Service area	Total per unit	Unit	Total Net	Total Service
Senior ctzn. Day ctr.	180	50	230	1	180	50
Galleries	115	20	135	1	115	20
Kinder Garden	150	40	190	2	300	80
Youth Club	250	80	330	1	250	80
Yoga Class	80	25	105	1	80	25
Reception & Shop	120	5	125	1		5
Coffee Shop	170	40	210	1	170	40
Offices	15	7	22	6	90	42
Multimedia Library	450	150	600	1	450	150
Community ctr.	230	70	300	1	230	70
Gym	500	100	600	1	500	100
Auditorium	500	200	700	1	500	200
			<b>Sum</b>		2865	862
			<b>Allowed by Regulation</b>		3840	1152
			<b>Reserve</b>		975	290



# Brief



*Brief Sensitive cell design  
Kindegarten with low windows*

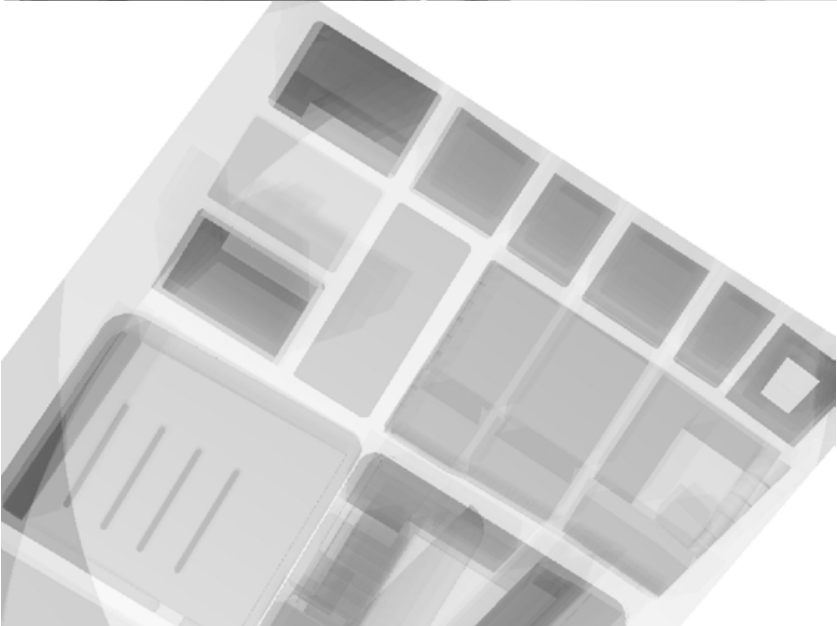
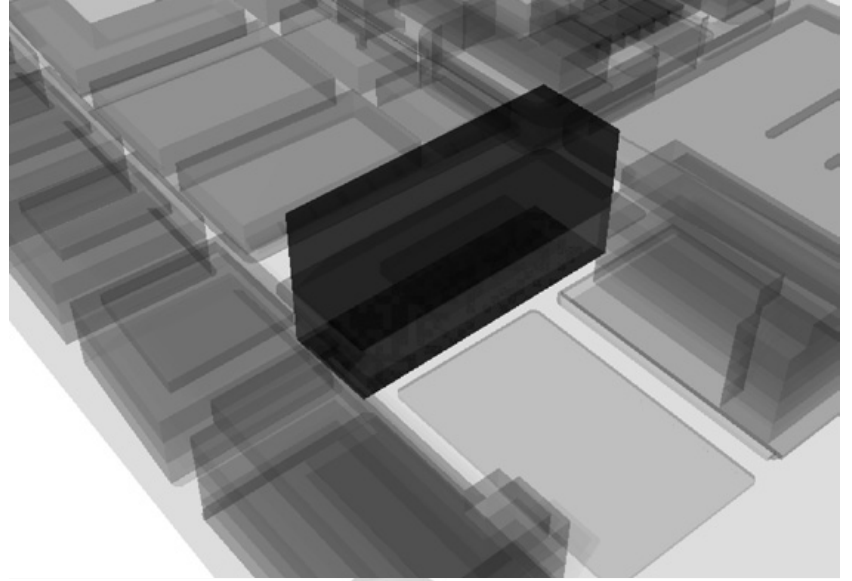
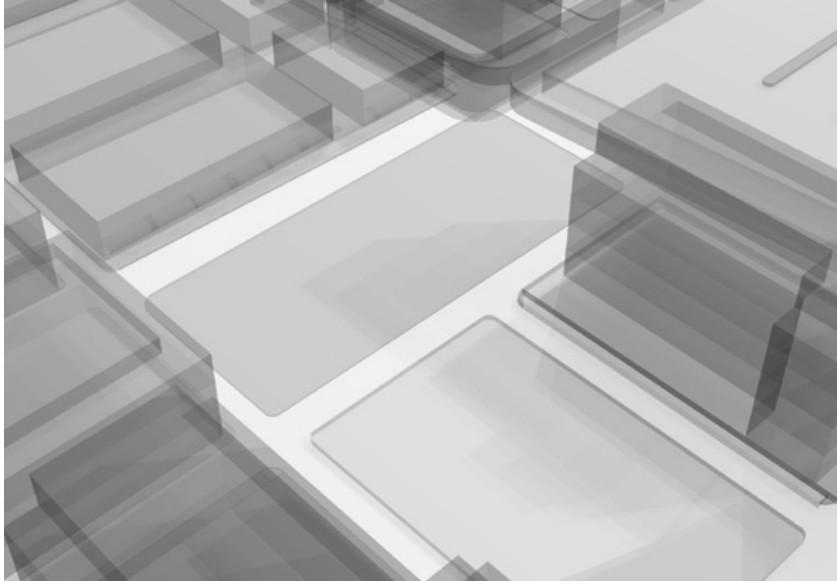


*Brief Sensitive cell design  
Gym with High windows*

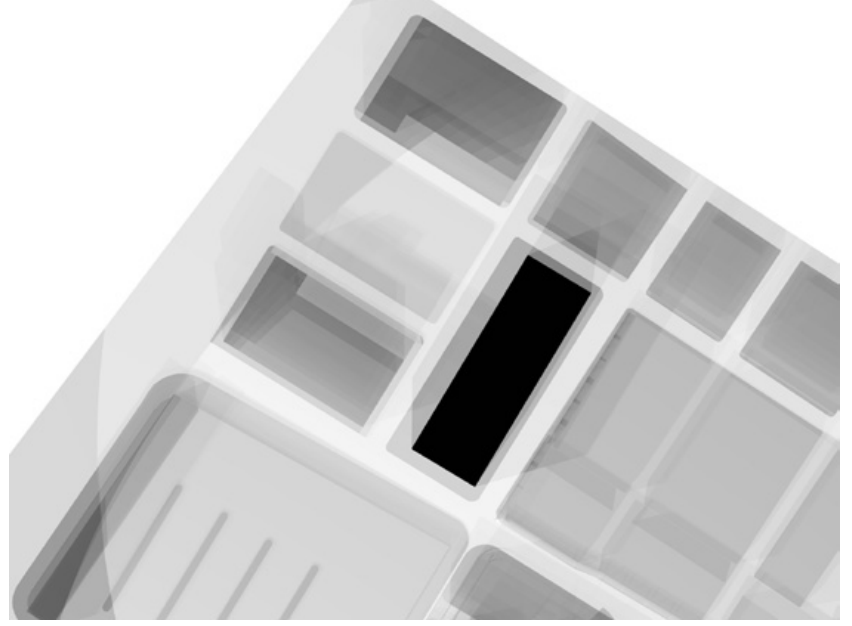




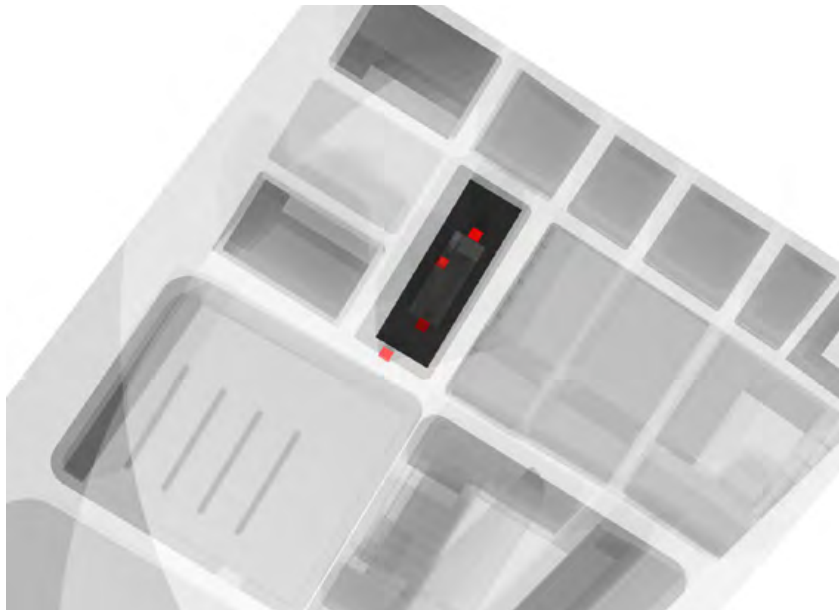
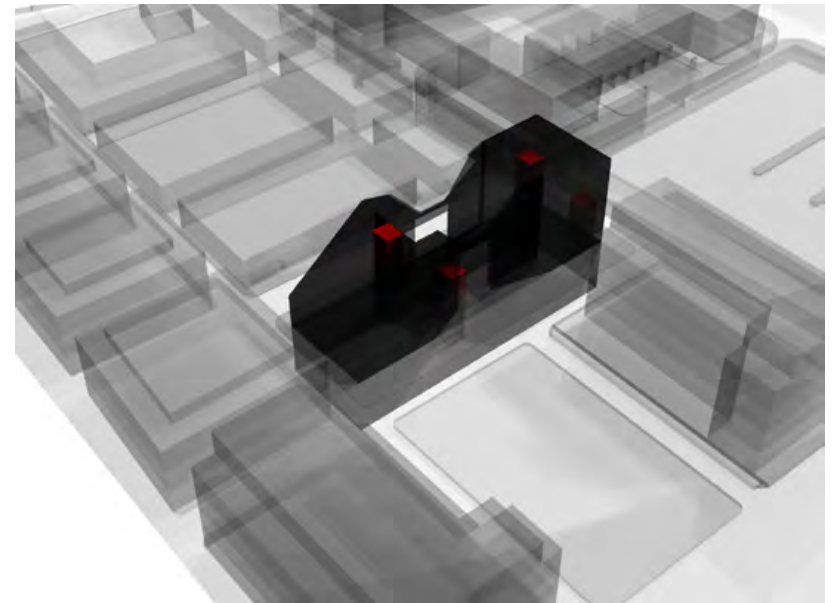
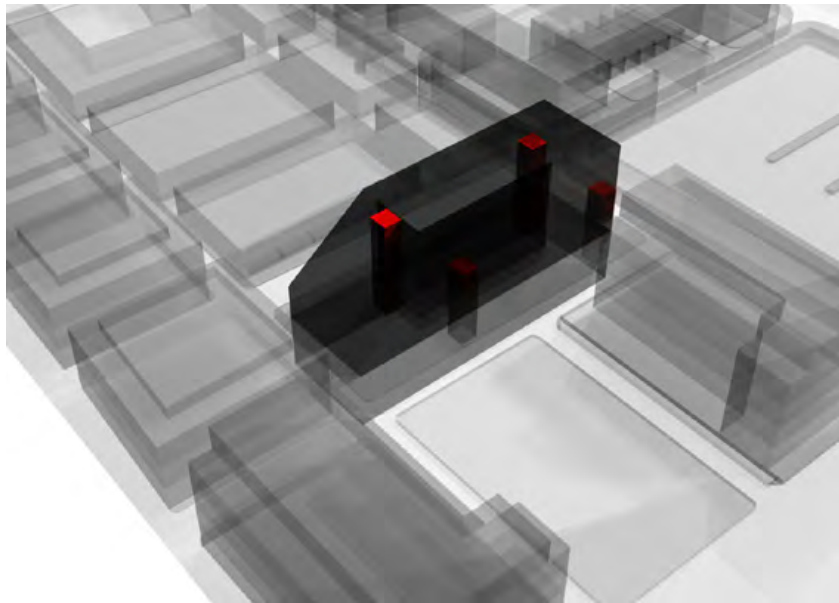
***Buildings Emergence***



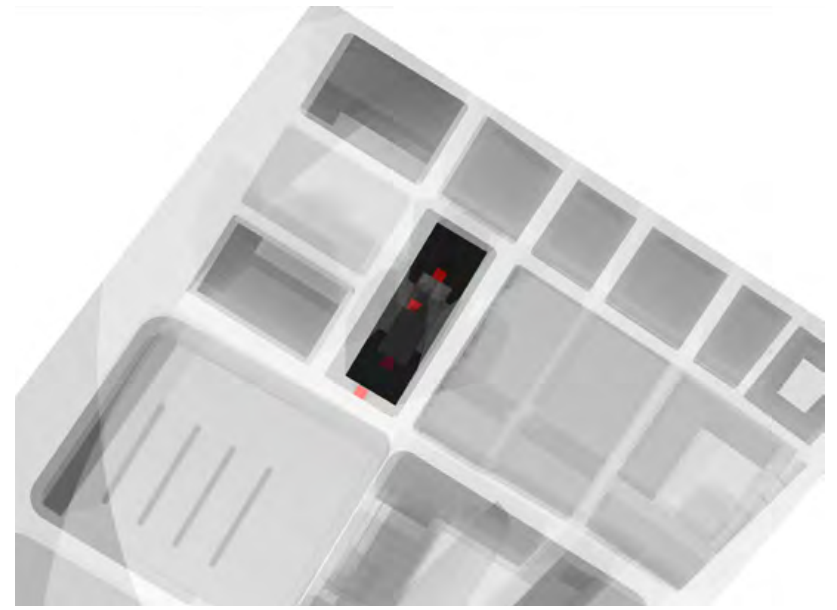
***Site***



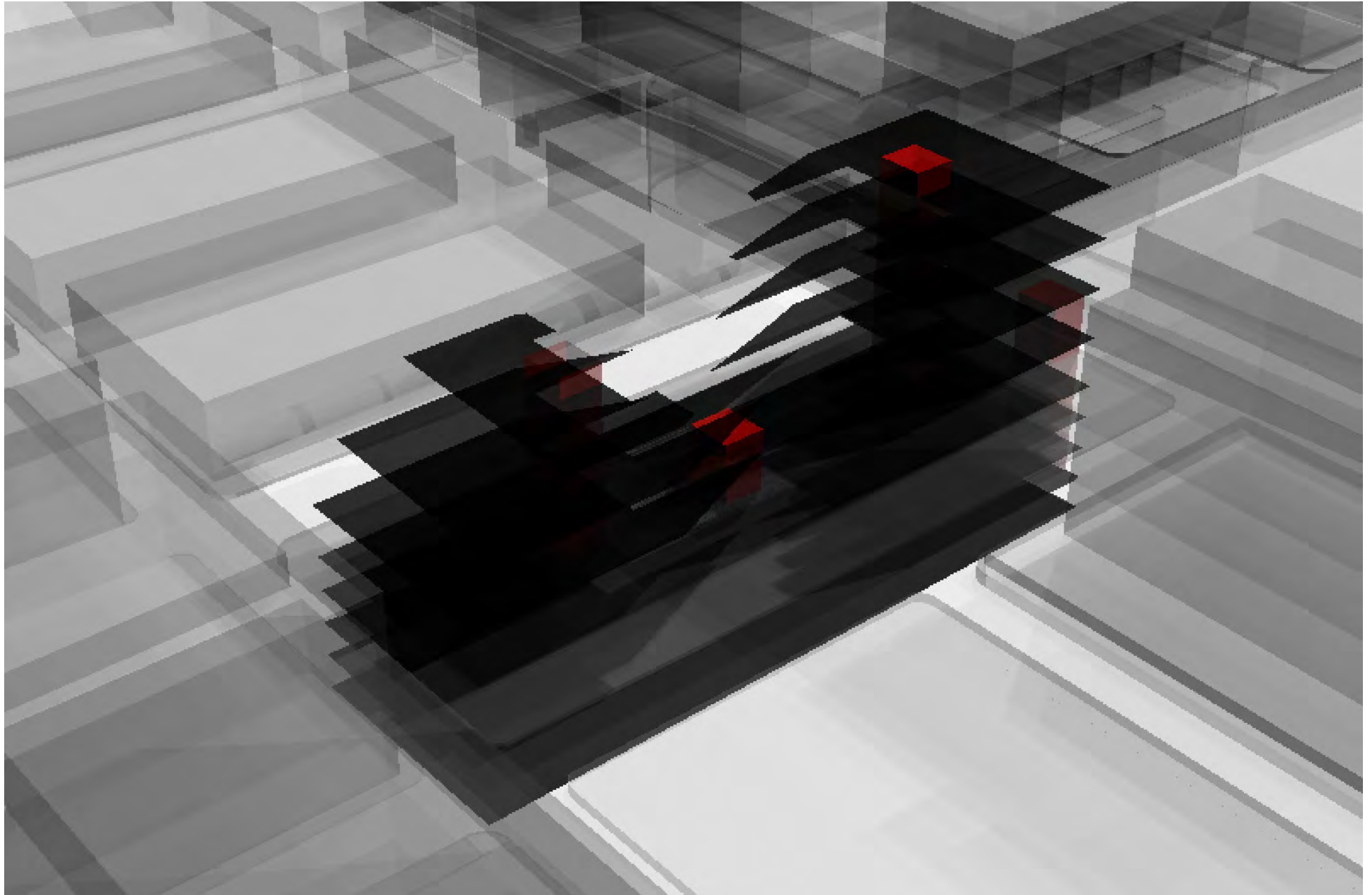
***City Block***

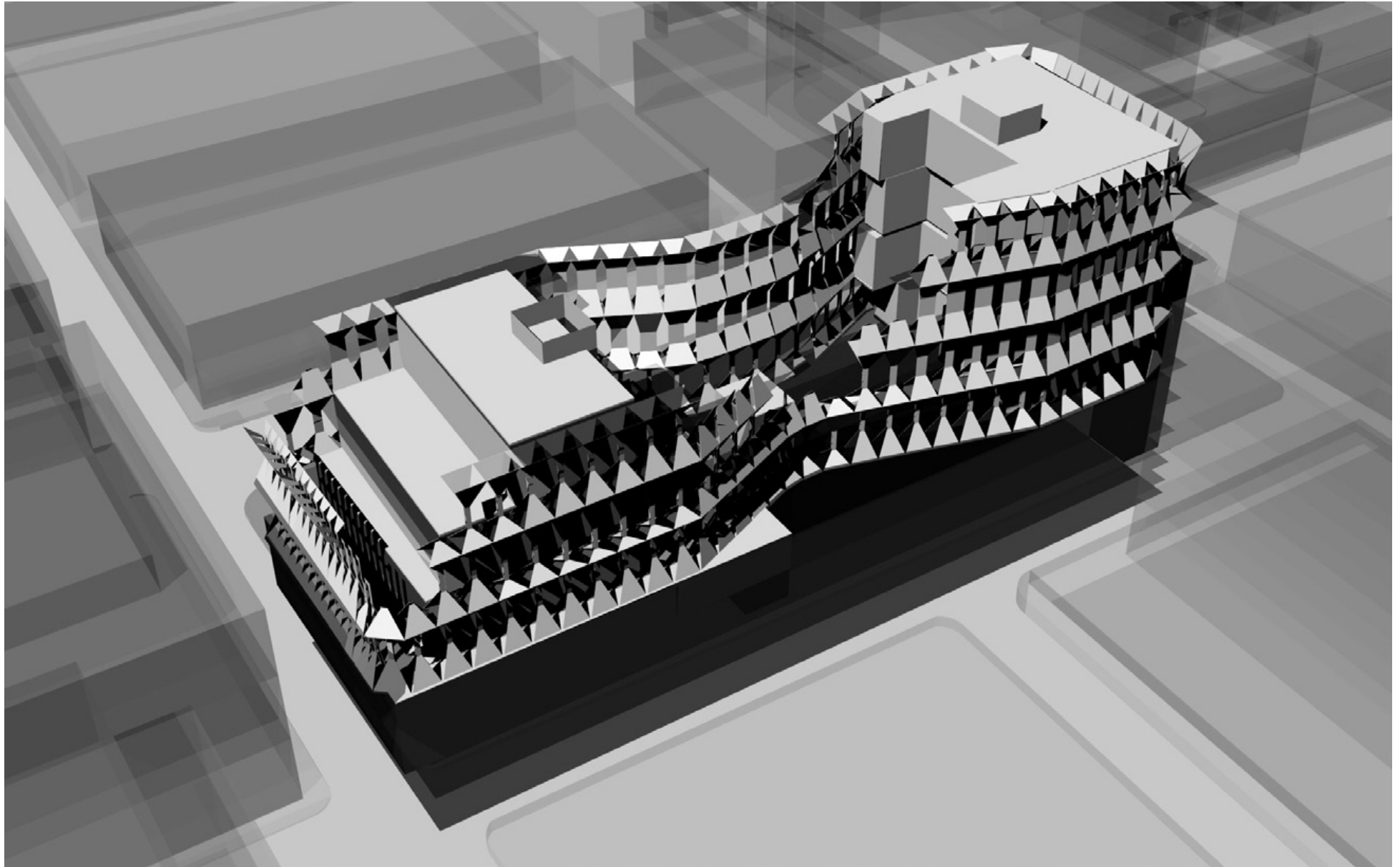


*Sun Rights , Inner Court and Elevators*

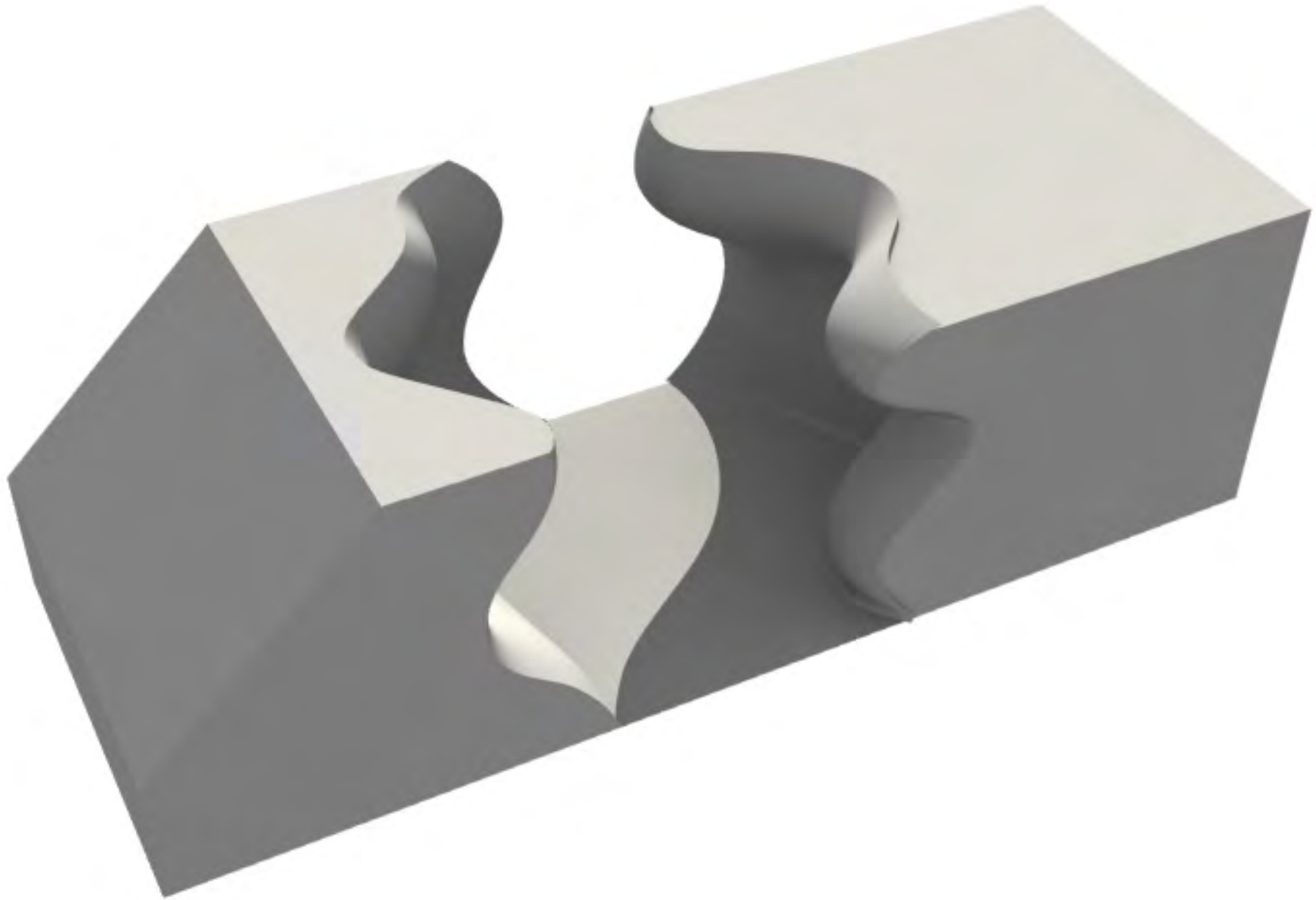


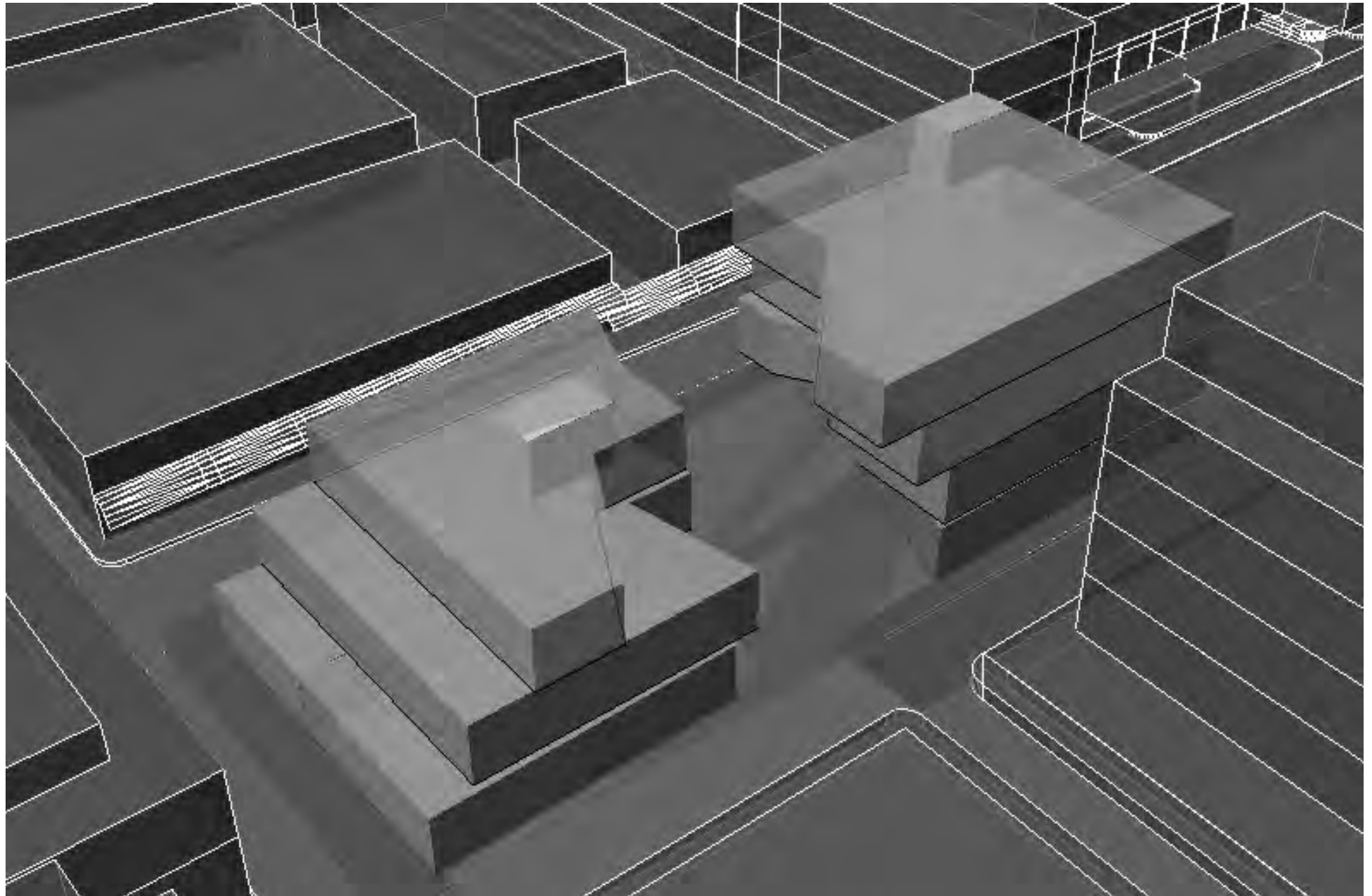
*Dividing into Two Sub-Blocks -Morning/Afternoon*

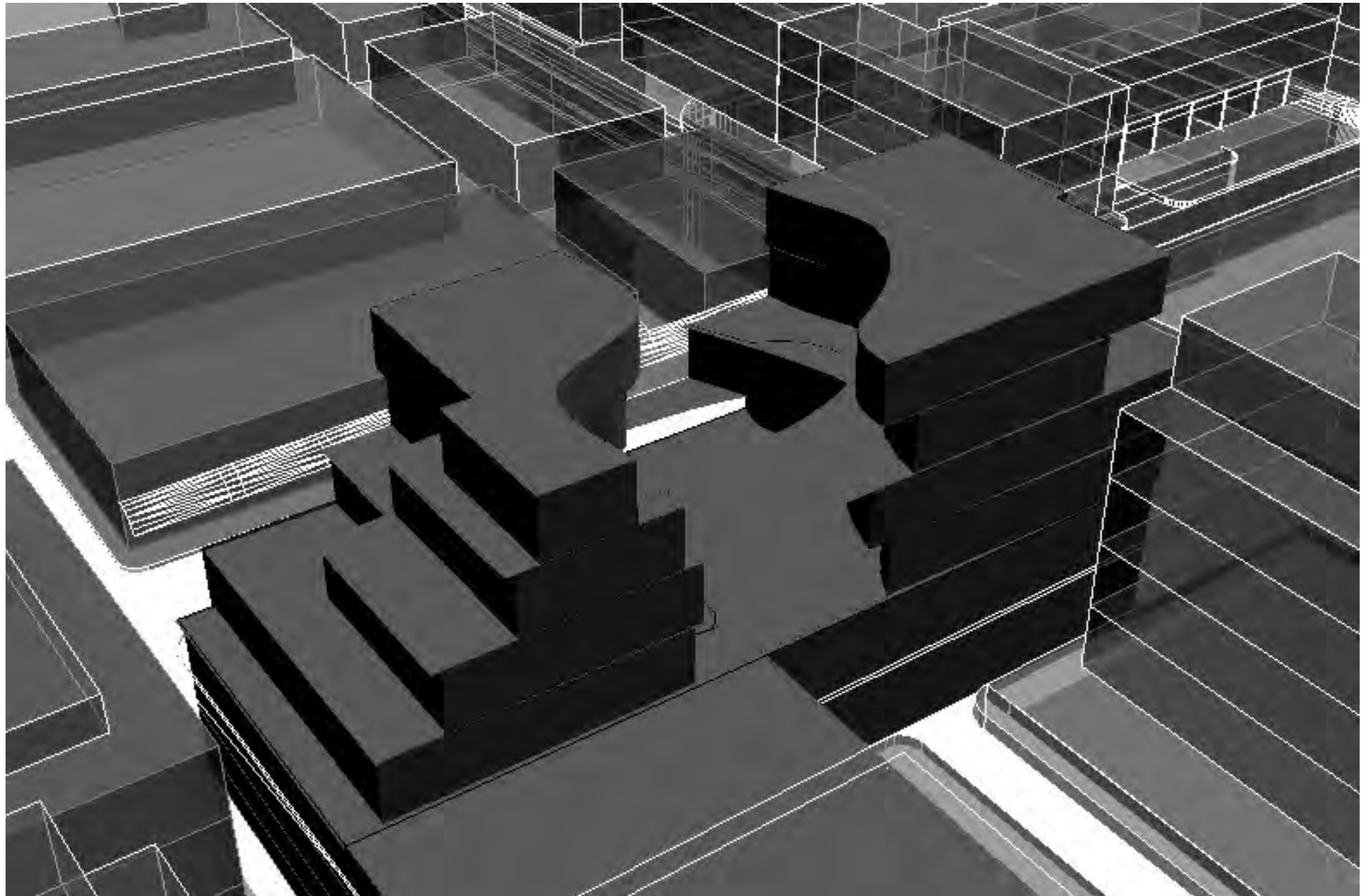


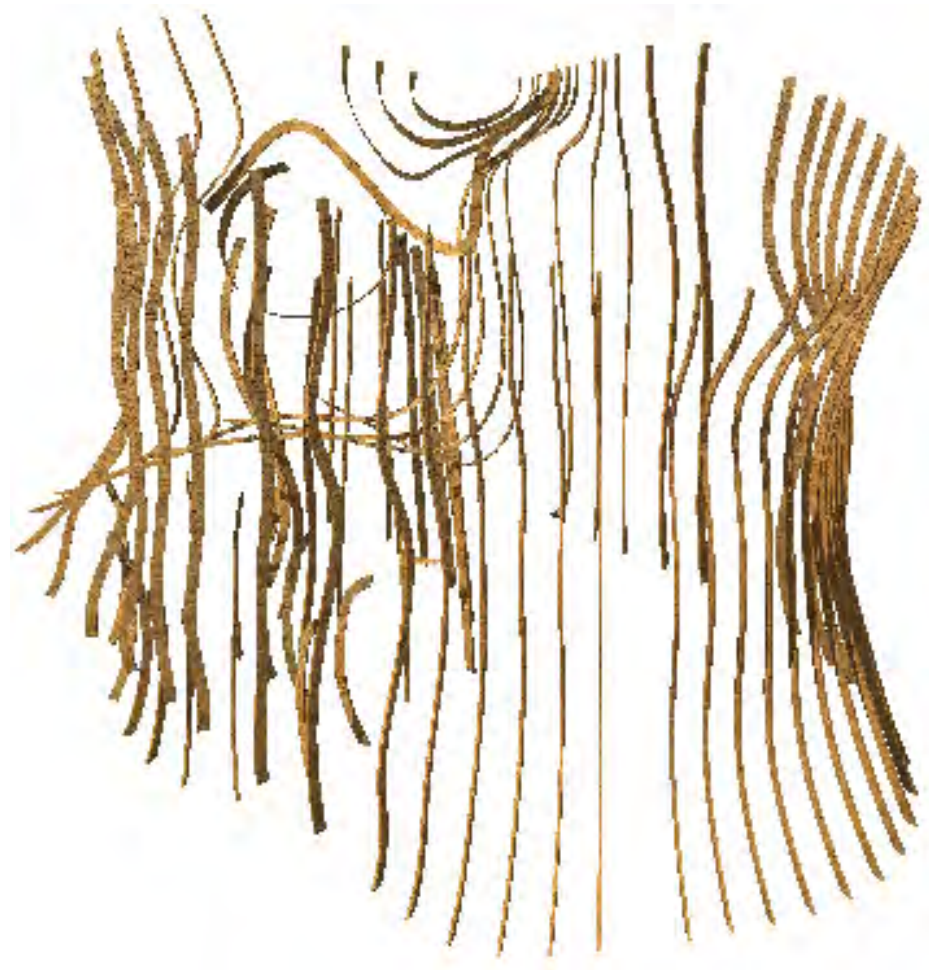


*Early Building design*

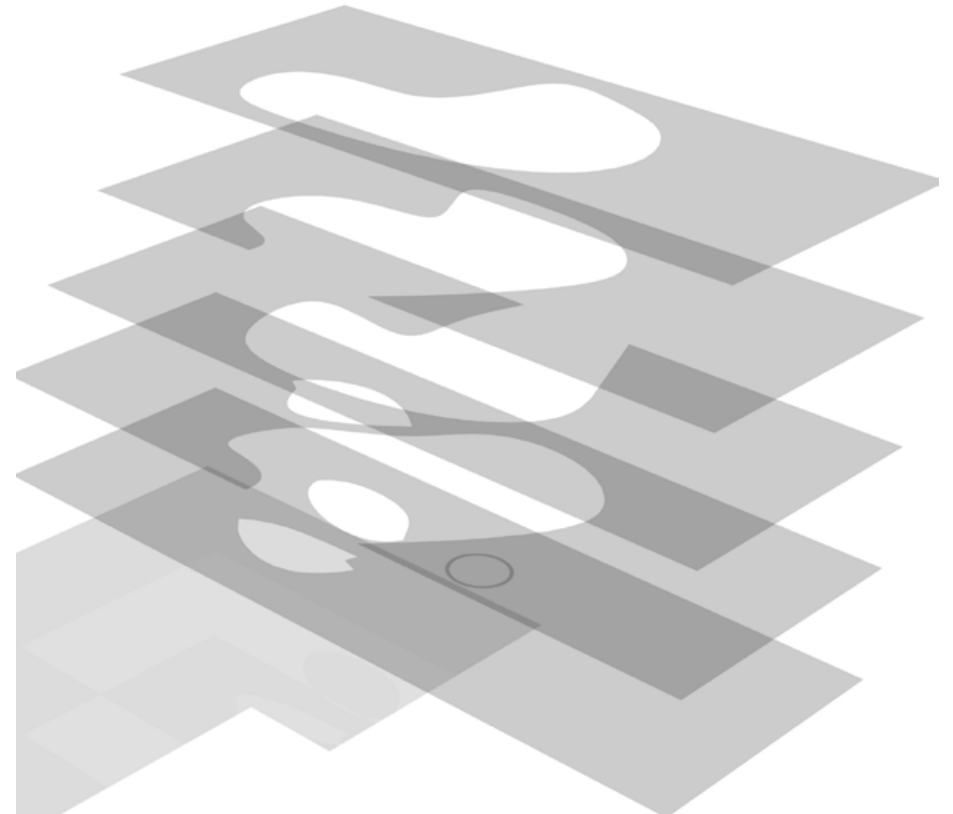






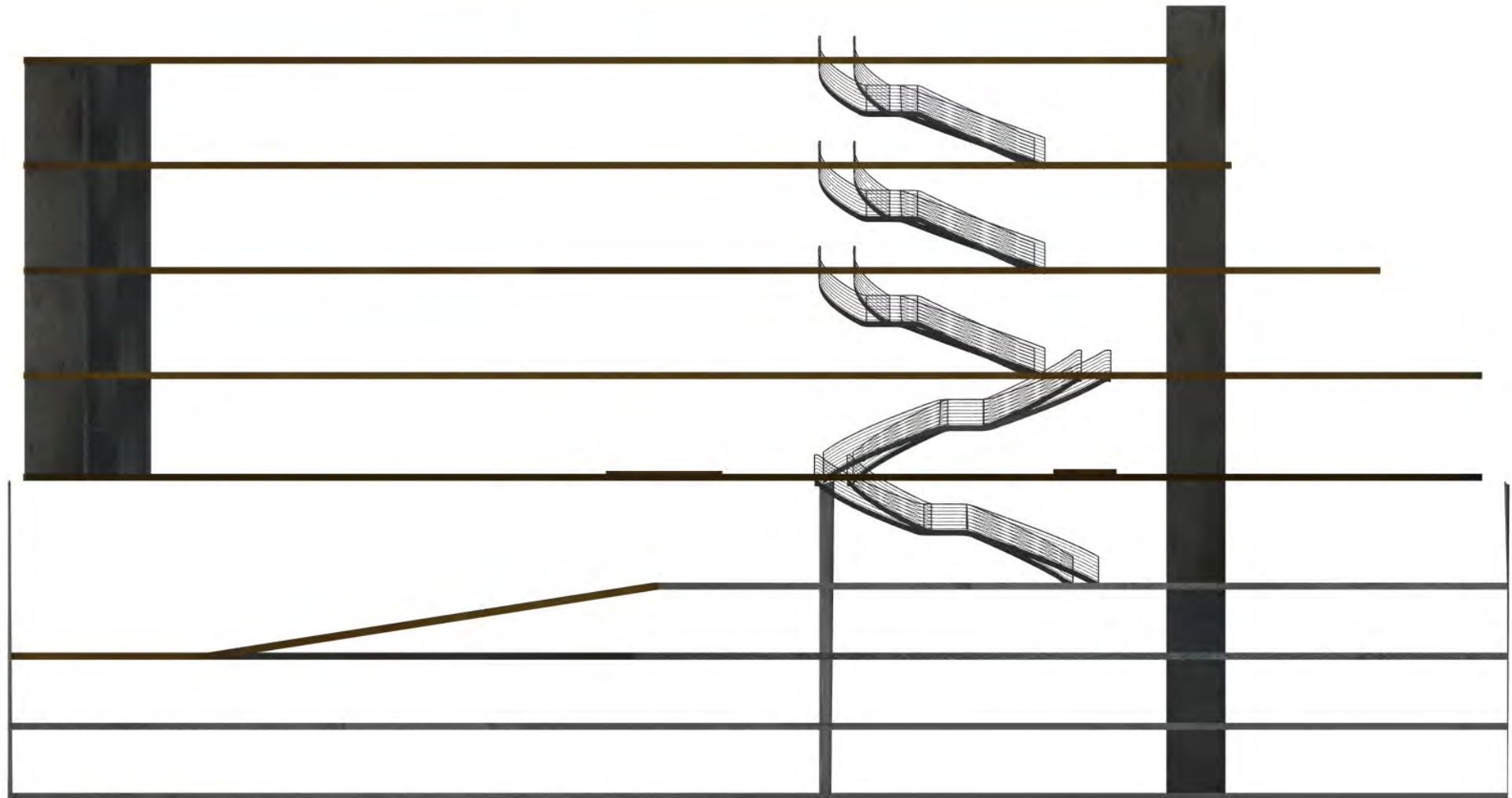


*Court Ploes Scheme*  
*curved, organic shape*

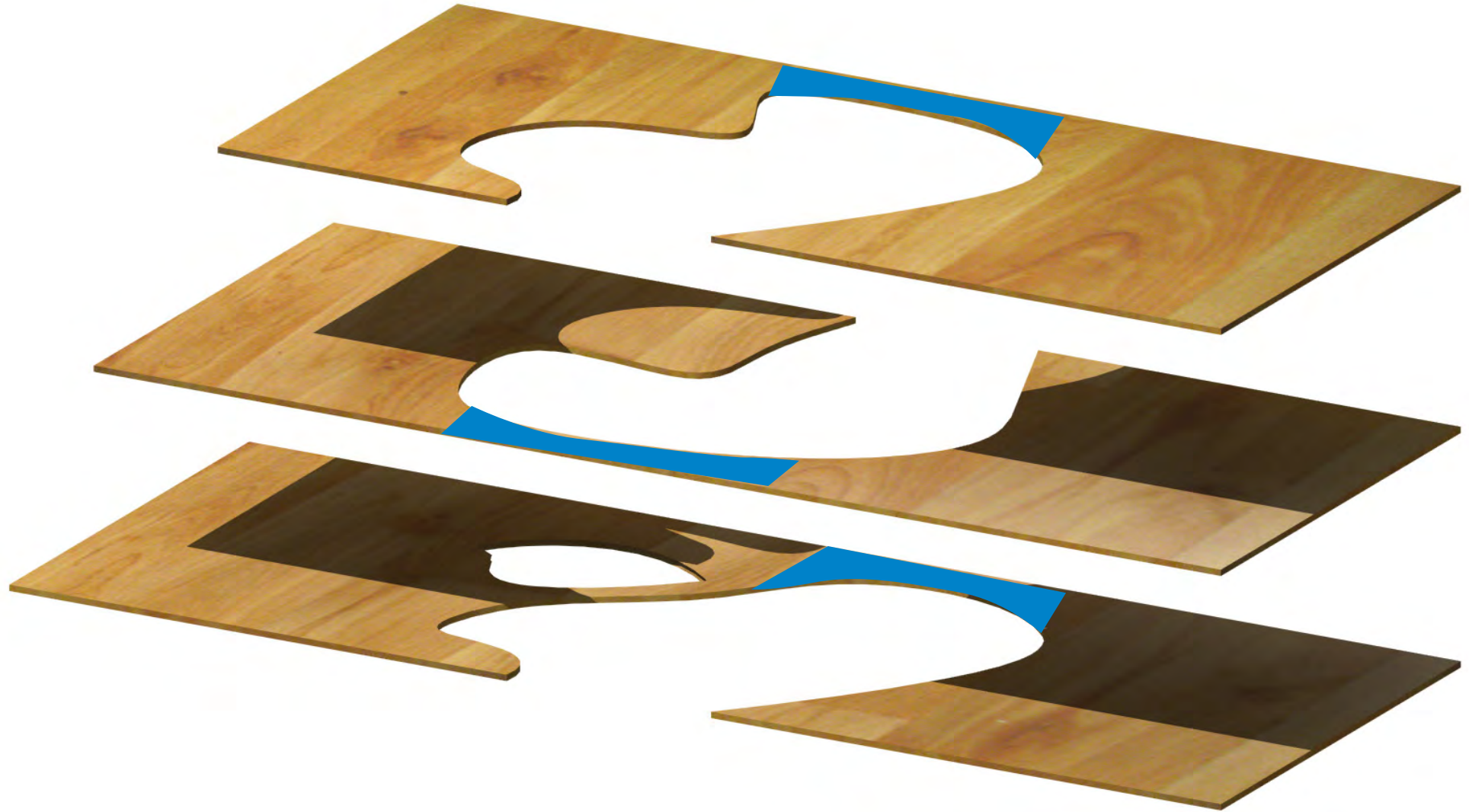


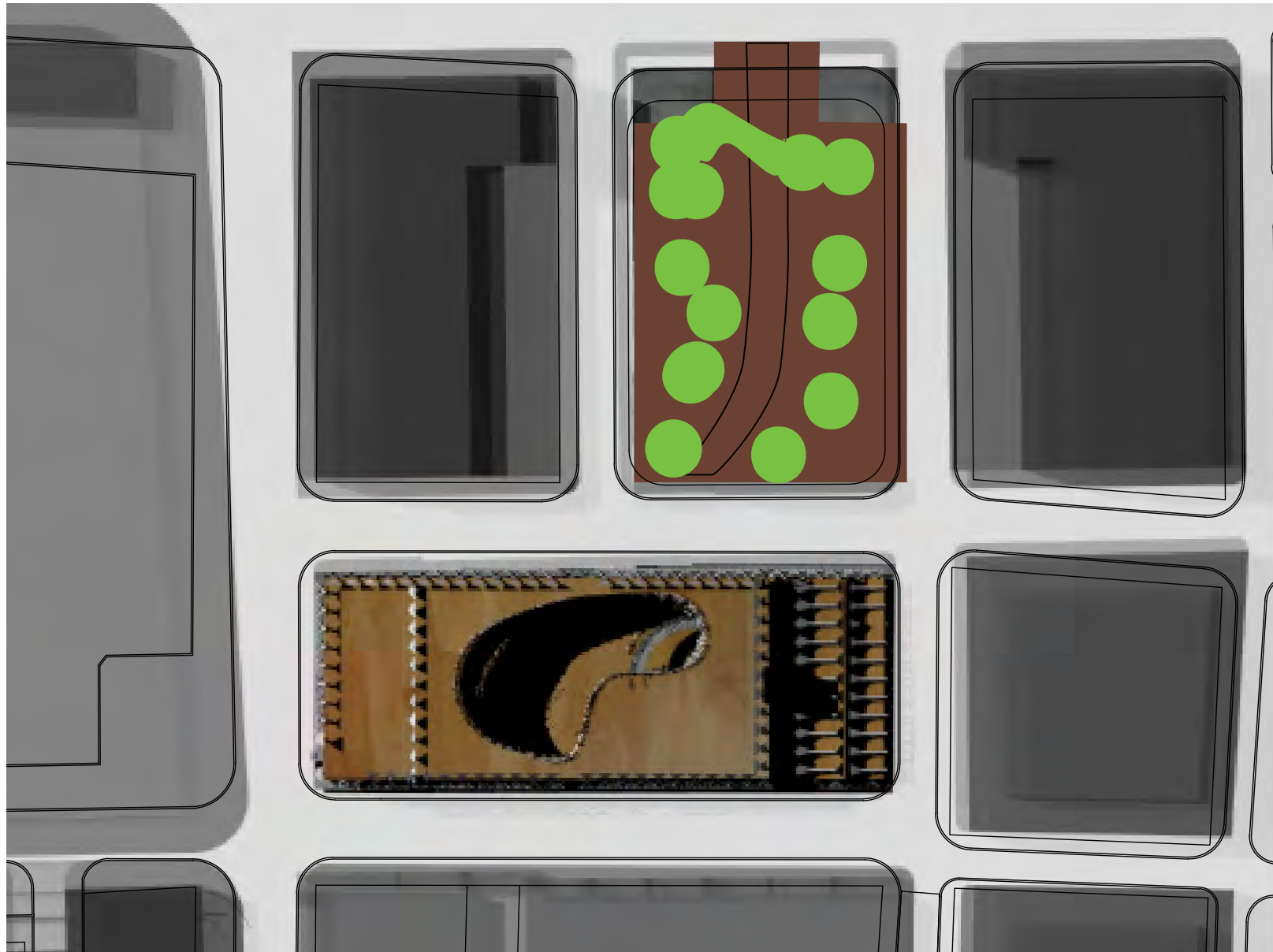
*Floors Scheme*



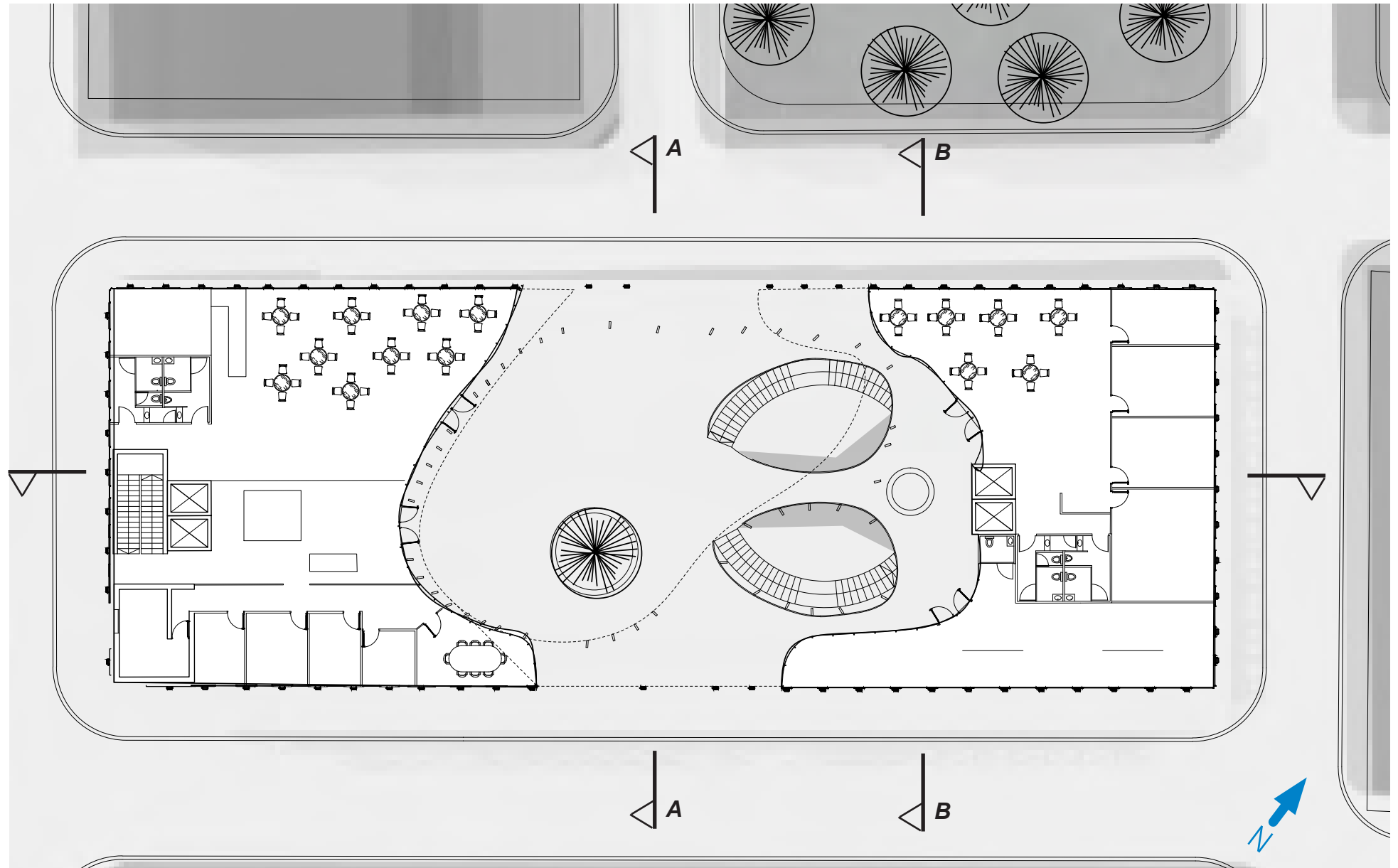


*Vertical Movement Scheme*

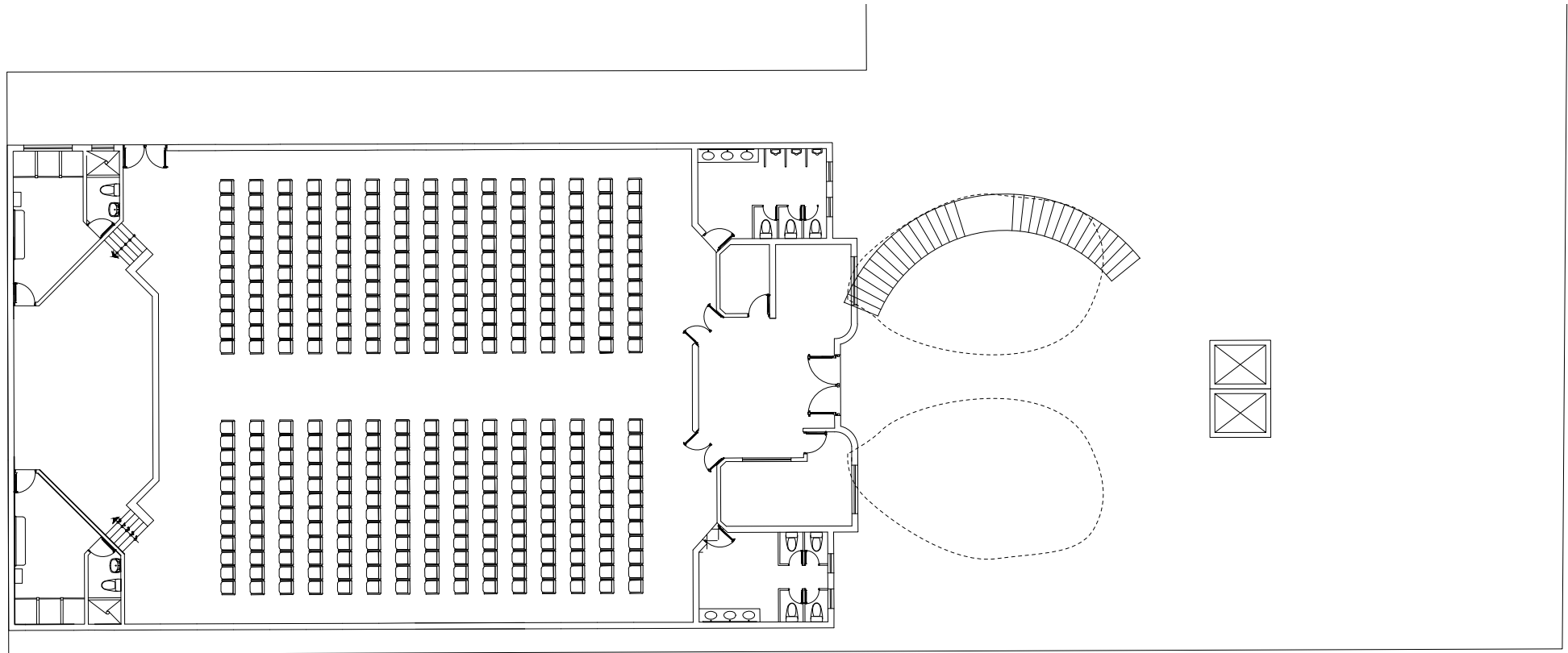


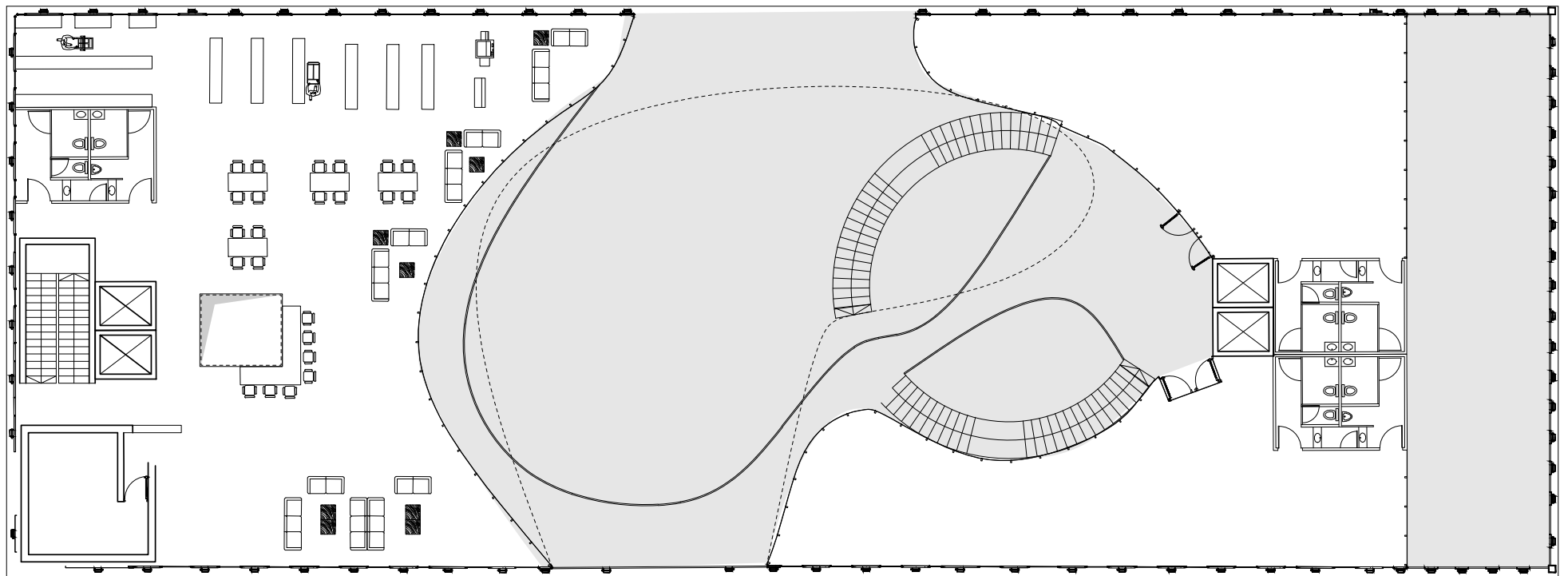


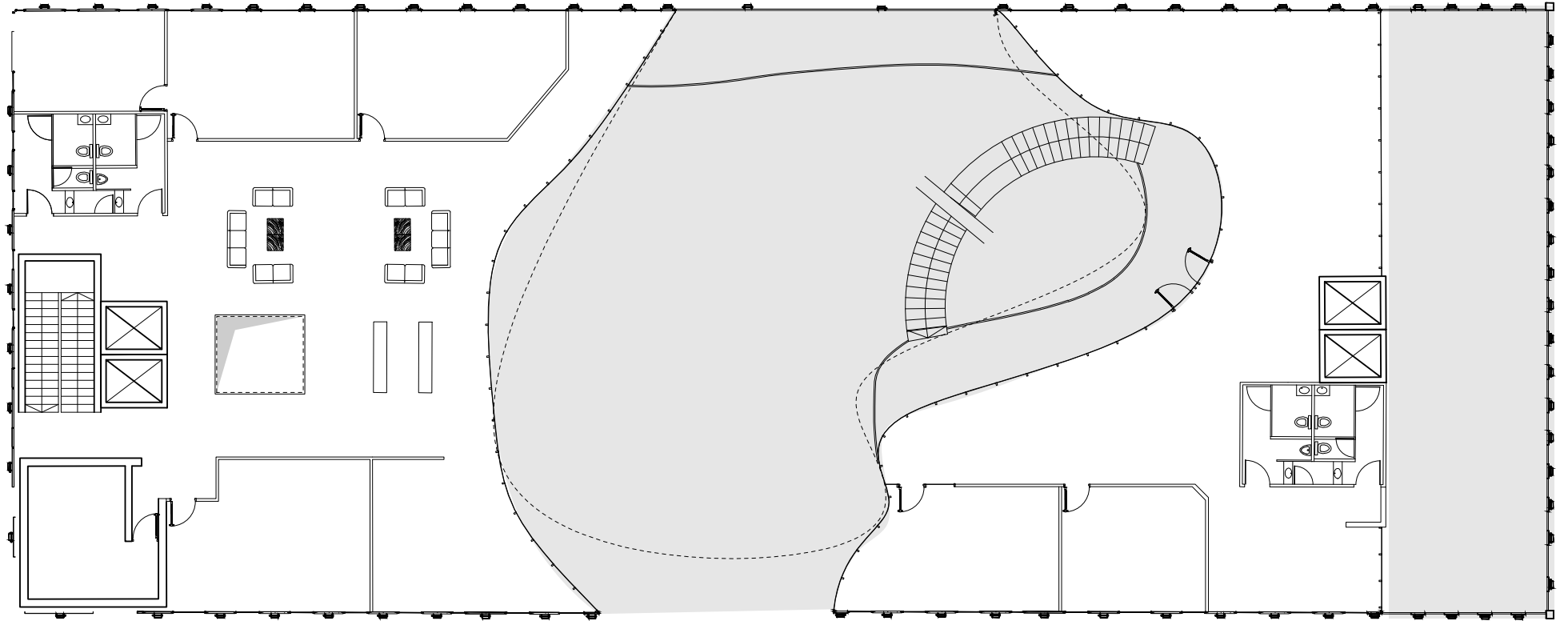
*Enveioment Plan, Includung Garden*

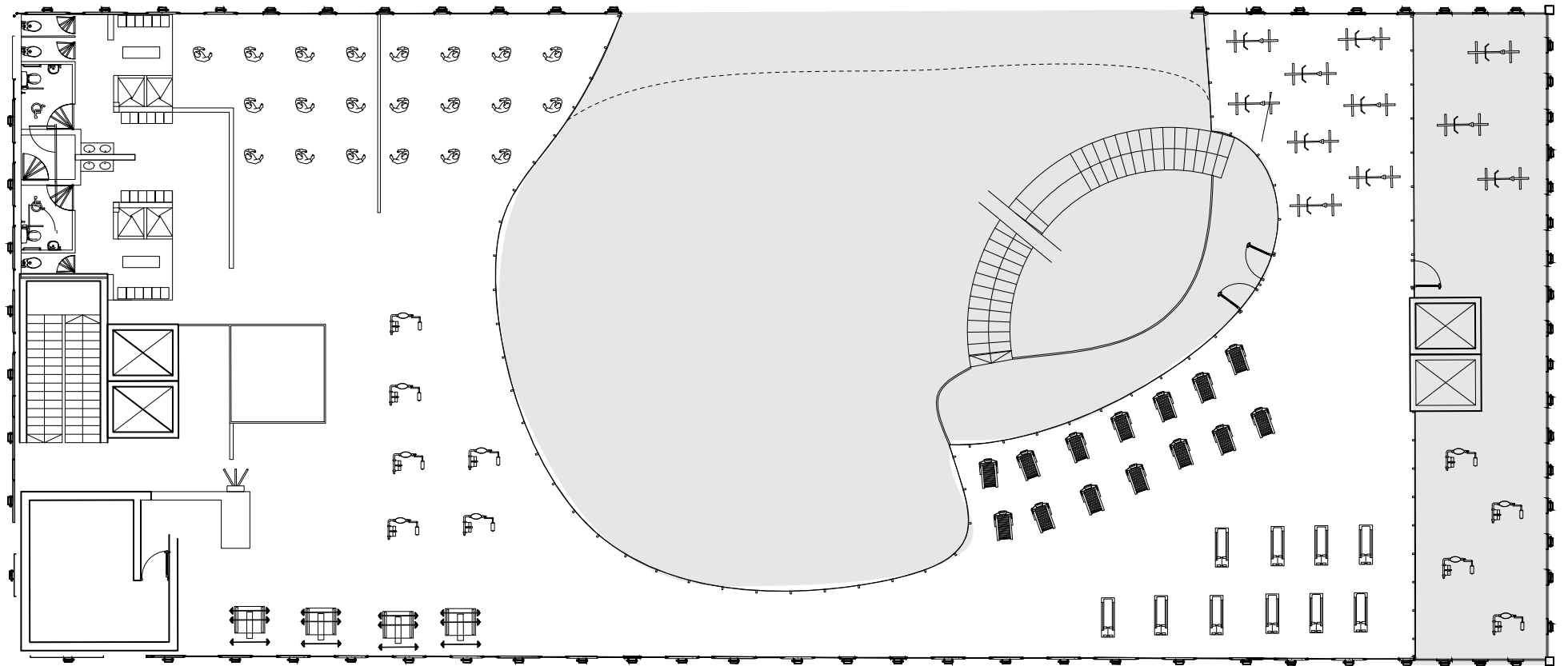


Ground Floor Plan

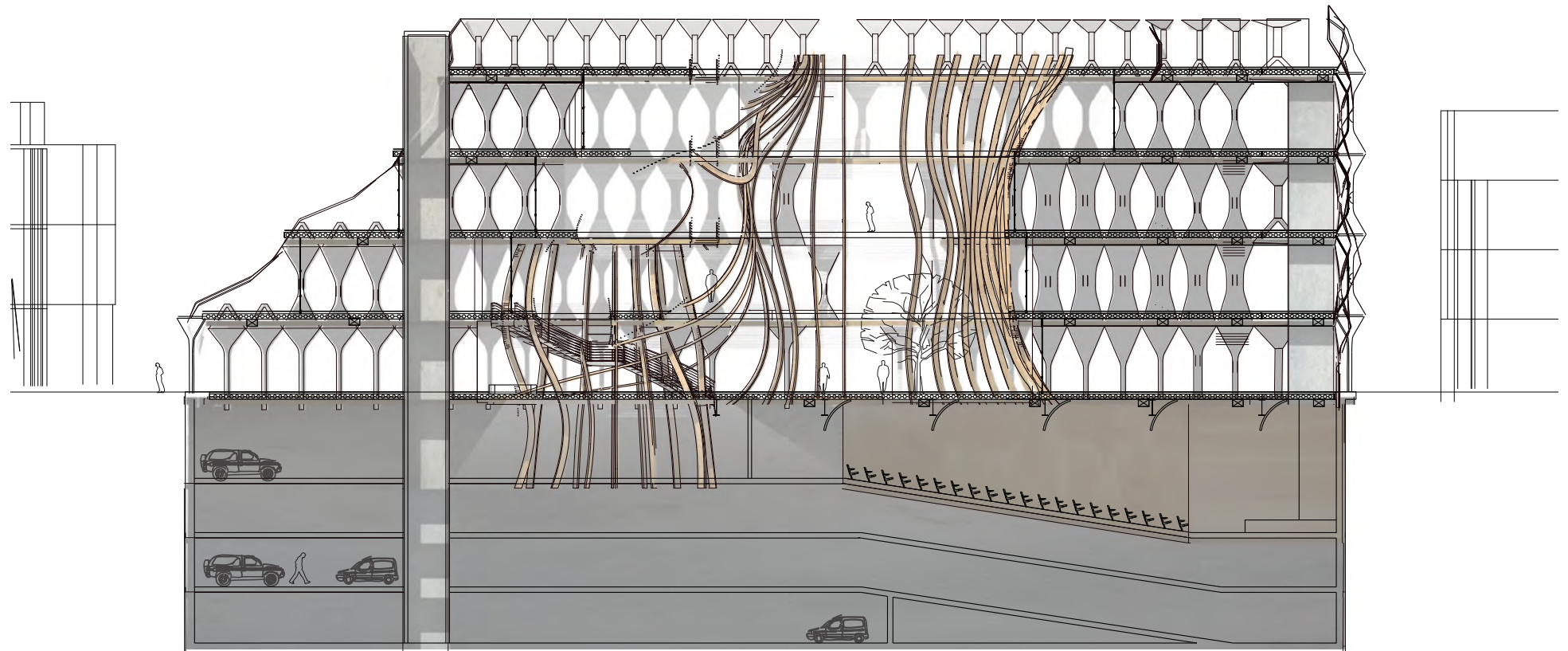




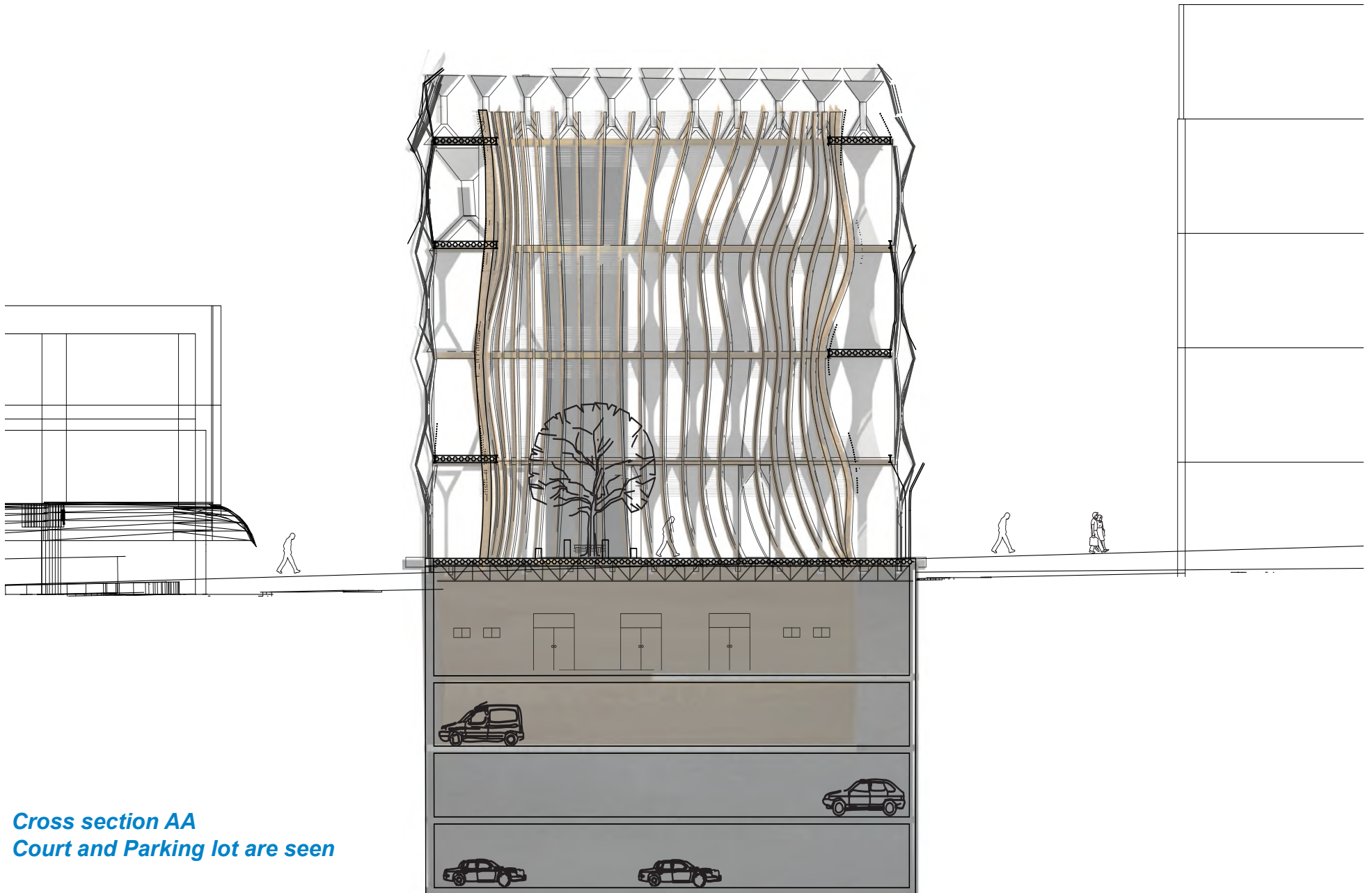




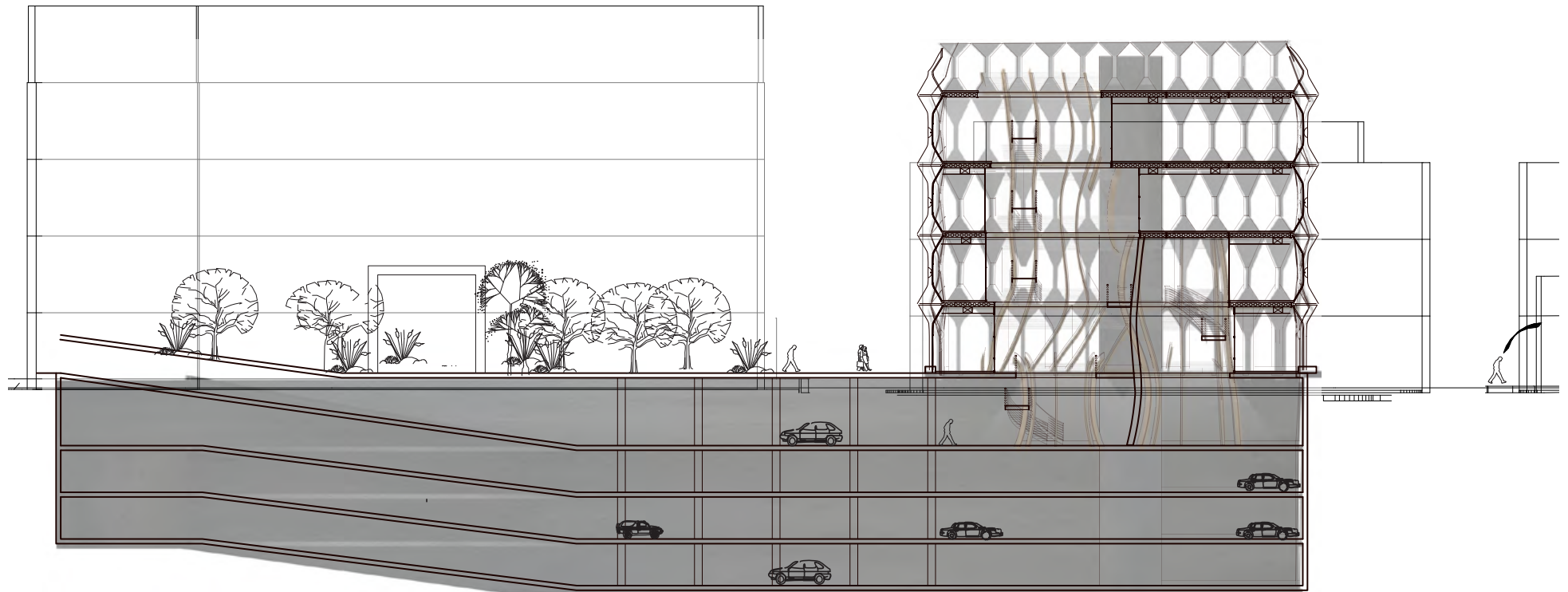




*Cross section North-South*



**Cross section AA**  
**Court and Parking lot are seen**



**Cross section BB**  
**Parking lot and Garden are seen**



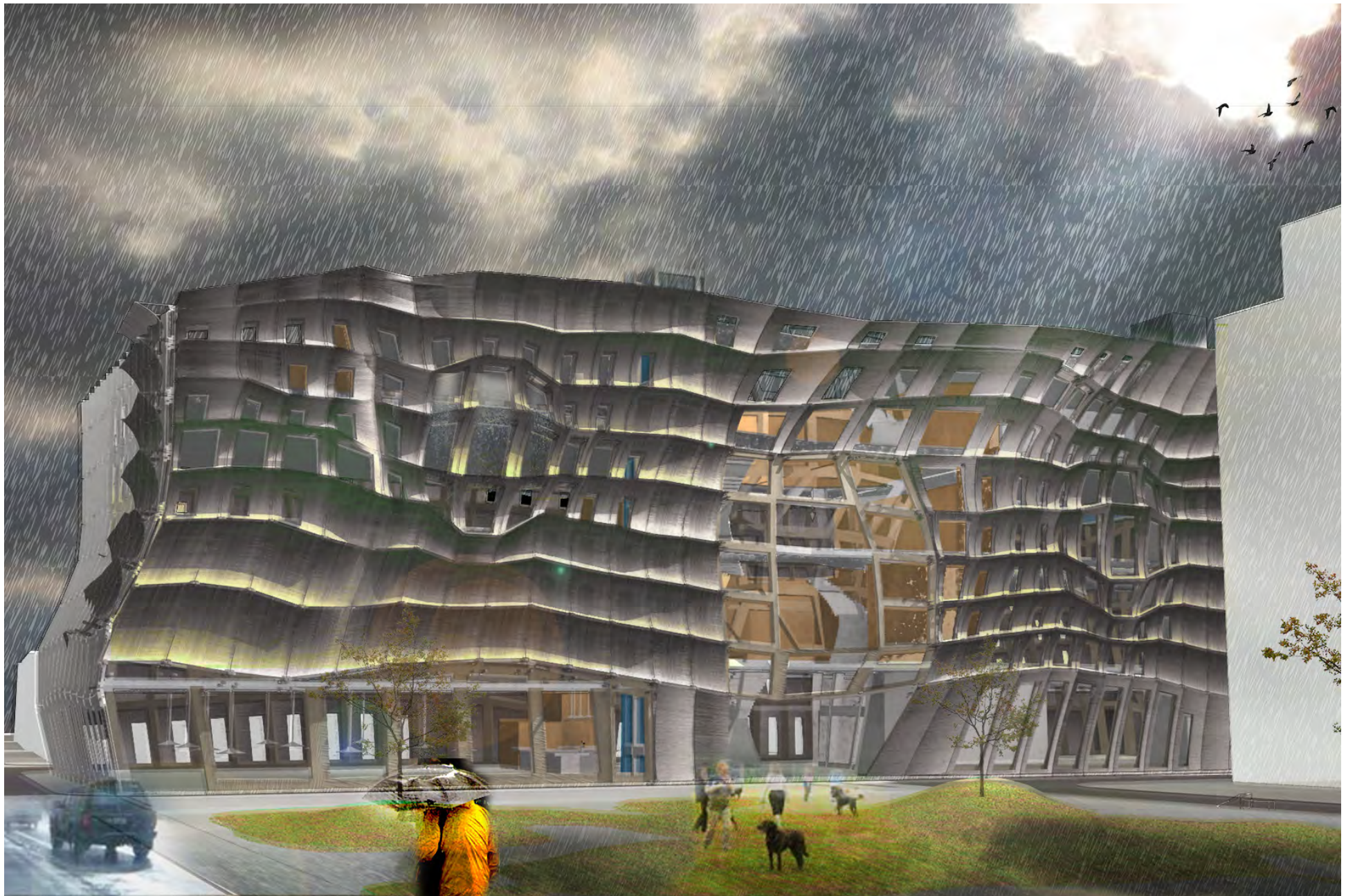
*Court Entry from East*



*Court as seen from above*



*View in the court*



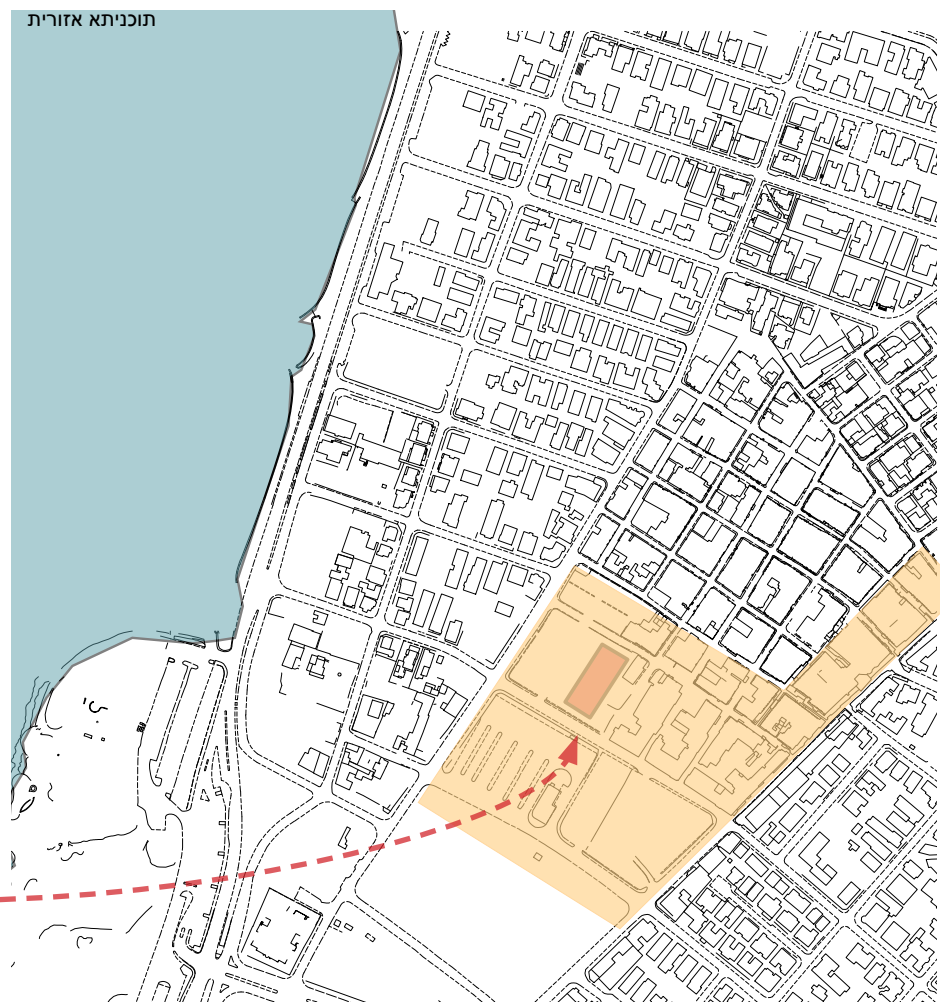
האתר

כדי לתת מענה לסביבה הים תיכונית של האתר, ובתור אקט קיומי וחינוכי הוחלט להתאים את התכנון לטובת אלמנטים תאים היודעים לאגור ולמחזר במים בנוסף להעניק הצללה עצמית אוורור וצמחייה לחזית.

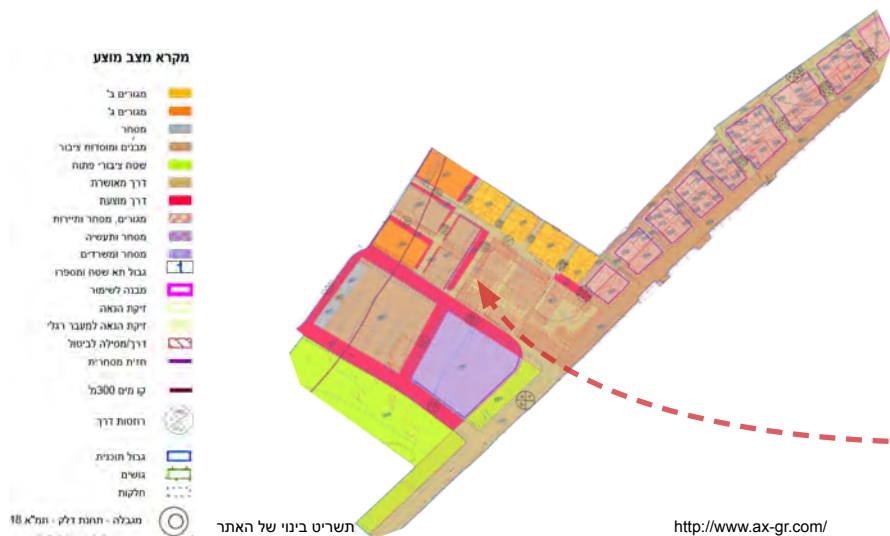
מיקום האתר, בצידו המזרחי של שוק הכרמל בתל אביב הנחשב אזור תוסס והומה אנשים הבאים בעיקר לקנות ולהתרשם מהאווירה. כמו כן האתר נמצא באזור ימי, האתר הוא חלק מפיתוח עתידי של כל מתחם השוק שילול מגורים, מסחר מחודש לשוק, משרדים, פארק, ומבנה ציבור. התכנית תתווה קשר אורבני בין כיכר מגן דוד לרחוב יצחק אלחנן ותשפר בכך את הרצף בין חלקי העיר.



http://tiv-pview.blogspot.co.il/2012\_01\_01\_archive.html שוק הכרמל



תוכנית אזורית





# 1. התחלה - כוונות ראשונות

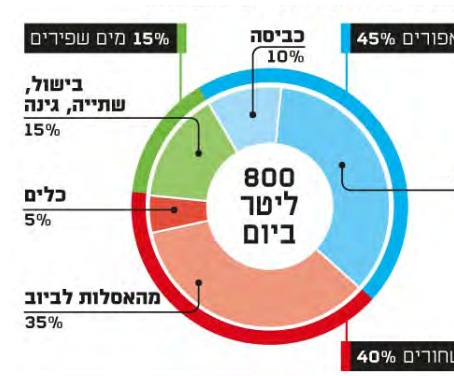
## מים / איסוף מי גשם

אספקת מים בכמות ובאיכות מספקות הופכת לבעיה אמיתית בעולמנו. משבר המים במדינה צפוי רק להחמיר ככל שתגדל אוכלוסייתה. איסוף מי גשם בישראל, עשוי לתת מענה לאובדן מיליוני מ"ק באזורים בנויים, המנגרים את רוב המים לביוב, ו/או למאגרי קולחים ו/או לים. תפעולה החינוכי של מערכת כזו מעביר מסר ערכי, וטומן תקווה לעתיד טוב יותר בתחום היחסים אדם סובב.

רק 20% אחוז מהגשם היורד בתחום המדינה מגיע לברזים  
 כ- 20% אחוז ניגרים לים או לביוב  
 כ- 60% אחוז ממי הגשם מתאדים



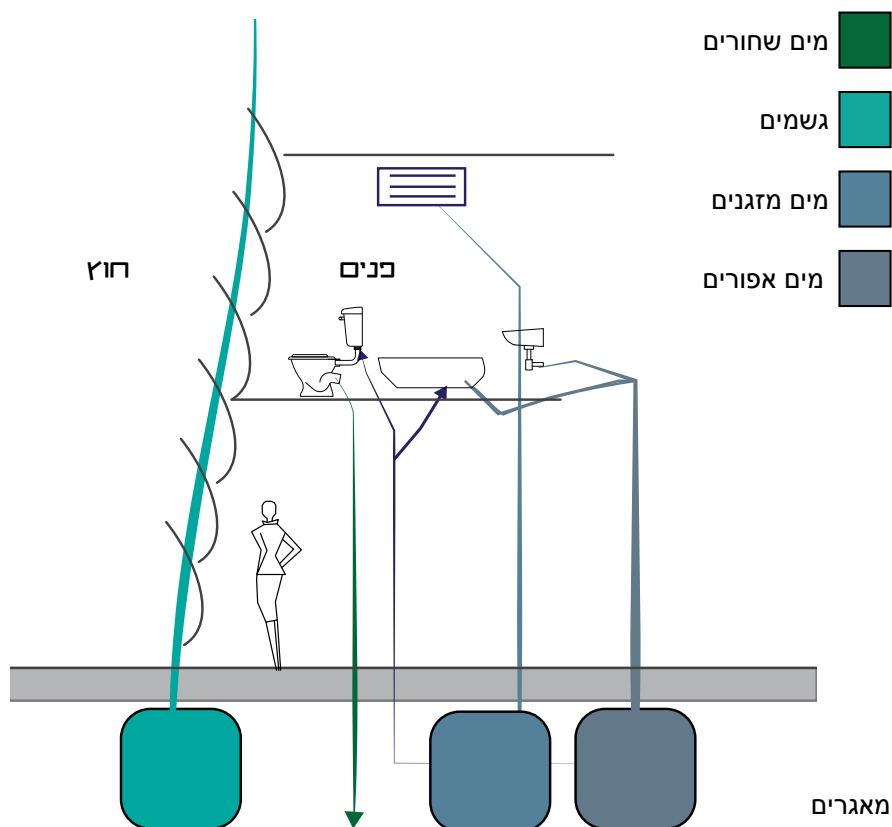
## מים אפורים



[http://greenpages.mycompage.com/index.php?page=news&news\\_id=201&indexid=](http://greenpages.mycompage.com/index.php?page=news&news_id=201&indexid=)

## מיחזור מי מיזוג אויר

מי עיבוי מזגנים הינם מים מזוקקים שאינם מתאימים לשתיה אך ניתן לנצלם לטובת הדחת אסלות, שטיפה ושאר שימושים המצריכים מים ברמת טיהור גבוהה מאוד



## 1.1 התחלה - כוונות ראשונות

## צמחייה / קירות ירוקים

קירות ירוקים ניכרים בתרומתם לתחומים רבים הבאים לידי ביטוי במספר יתרונות בולטים:

-שימוש כמבודדים אקוסטיים ותרמיים.

-**האטת מי גשמים** למערכות הניקוז העירוניות ע"י התאמת מצע גידול המסוגל לאגור כמויות מים גדולות.

-שימוש כ**מסננים ביולוגיים**, המסייעים לתהליך ספיחה וטיהור האוויר מרעלים ומזהמים.

-**חיסכון בצריכת מי השקיה** ע"י בקרה ושליטה בגידול, מיחזור תמיסת ההשקיה ושימוש בצמחים עמידים ליובש.

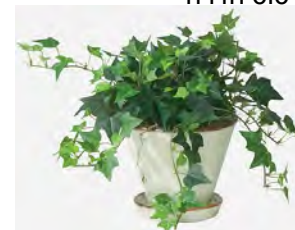
-תרומה ביצירת אפשרויות ויתרונות חדשניים לעיצוב סביבתי ואסתטי.



<http://www.greendiary.com/>

מאז שפרצה לתודעה אפשרות הגינון האנכי, נפוצו מוצרים רבים ומגוונים, עשויים חומרים וקונסטרוקציה שונים. מלבד היותם טרנדיים, הקירות הירוקים תורמים **להקטנת זיהום האוויר, להפחתת האבק והערפית, להקטנת איי החום העירוניים, מצננים את הסביבה, מהווים משטחים לחקלאות ולטבע עירוני ועוד.**

## קיסוס הדרה

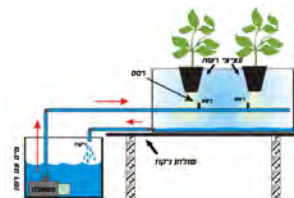


<http://www.ynet.co.il/>

זיהום האוויר בתוך מבנים נגרם מצריכת האנרגיה הגבוהה שם ומורכב בעיקר מחלקיקים וגזים אשר נלכדים בפנים עקב חוסר האוורור ותנועת אוויר מוגבגבת. מחקרים הראו שצמחים הקטינו מזהמים באוויר מסוג פורמלדהיד ובנזן וכן הורידו בעילות חלקיקים גדולים כגון אסבסט, חומרי הדברה, CO<sub>2</sub>, CO, חומרי ניקוי, דטרגנטים, בקטריות, פטריות, חיידקים ועשן סיגריות.

## שיטת גידול הידרופוביות

גידולים חקלאיים למיניהם גדלים כרגיל בקרקע, אולם כיום יש שיטות לגידול צמחים כך, שמערכת שורשיהם נמצאת במצע אחר שאינו קרקע. ובכך מאפשר גידול אנכי על חזיתות



<http://www.hydrogrow.co.il/>

הידרופוניקה הינה שיטת גידול של צמחים. מדובר על גידול צמחים על מצע מנותק כלומר על מצע שאין בו מזינים (אוכל) והצמחים זקוקים לדישון קבוע על ידי המגדל. שיטה הידרופונית אומרת ששורשי הצמח יושבים במצע גידול שאין בו מזינים זמינים באופן טבעי אלא מתבצעת השקיה והזנה על ידי המגדל.



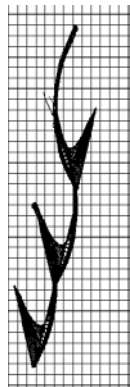
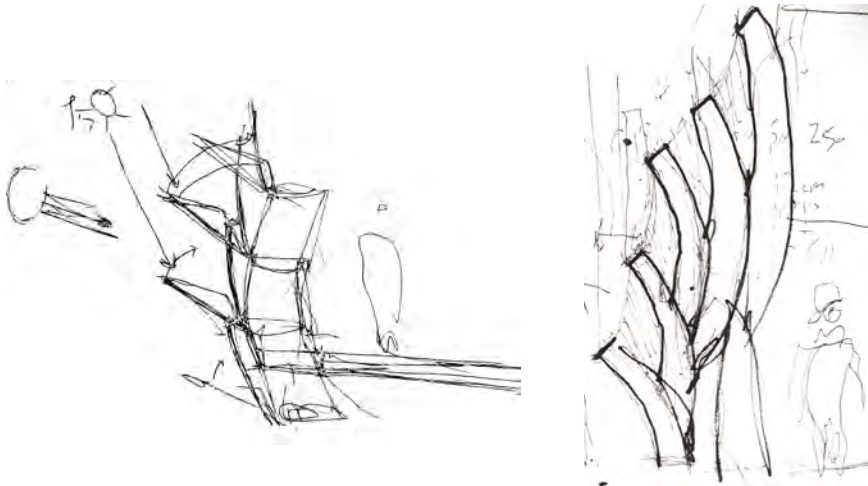
<http://www.hydrogrow.co.il/>

## 1.2 מקור השראה

### צמח הסוקלנטי

סוקולנטים הם צמחים בעלי עלים וגבעולים עבים ובשרניים המכילים תאים אוגרי מים. בנוסף ע"י פריסת עלים רחבה הם מאפשרים מגע יותר גדול עם מי הגשם, בנוסף פריסתם הרחבה מאפשרת מתן הצללה לצמח.

### סקיצות התחלה



[http://greenpages.mycompage.com/index.php?page=news&news\\_id=201&indexid=](http://greenpages.mycompage.com/index.php?page=news&news_id=201&indexid=)

## 2. מחקר לעיצוב התא

### מים כמות גשמים

ממוצע גשמים בתל אביב 550 מ"מ בשנה = 0.55 מ  
שטח התא A = 0.125

$$0.125 * 0.55 = 0.07 \text{ מ"ק}$$

$$70L * 800 \text{ units} = 56,000 \text{ L/year}$$

שטח התא B = 0.48

$$0.48/2 * 0.55 = 0.13 \text{ מ"ק}$$

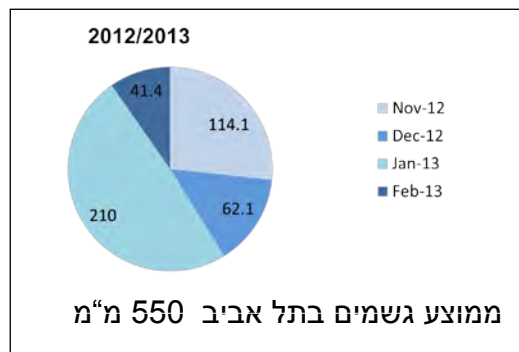
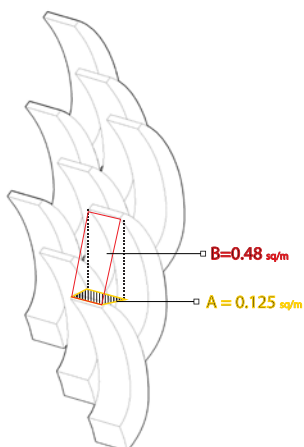
$$130L * 800 \text{ units} = 104,000 \text{ L/year}$$

### מיזוג אוויר

מי עיבוי מזגנים הינם מים מזוקקים שאינם מתאימים לשתייה אך ניתן לנצלם לטובת הדחת אסלות, שטיפה ושאר שימושים המצריכים מים ברמת טיהור גבוהה מאוד (שלישונית). במפעלים ומוסדות בהם מותקנת מערכת מיזוג מרכזית מדובר בכמויות אדירות של מים הפוטנציאל לחסכון הוא עצום. לנו יש את הידע והנסיון לתכנן ולבנות מערכת שתמחזר את המים הללו בצורה אופטימלית תוך החזר השקעה מהיר של בין שנה לשלוש שנים

10 מזגנים בייתים = 48 קוב לשנה

48,000 ליטר



### מחשבון השקיה

איזור בארץ: מרכז

צמחיה	שטח	ינואר	פברואר	מרץ	אפריל	מאי	יוני	יולי	אוגוסט	ספטמבר	אוקטובר	נובמבר	דצמבר	סה"כ
מדשאה	300 מ"ר	X	X	X	21.3	26.3	28.6	30.4	27.5	23.9	19.7	13.6	X	191.3
שיחים ועצים	300 מ"ר	X	X	X	14.2	17.6	19.1	20.3	18.4	15.9	13.1	9.1	X	127.7
פרחים וורדים	300 מ"ר	X	X	X	26.1	32.2	35.0	37.1	33.7	29.2	24.1	16.7	X	234.1

X = ההשקיה מצפון לקו מיעוט משקעים מותרת בין אפריל לנובמבר בלבד (8 חודשים בשנה).  
\* היחידות הן במטר קוב (1 מטר קוב = 1000 ליטר).

[http://greenpages.mycompage.com/index.php?page=news&news\\_id=201&indexid=](http://greenpages.mycompage.com/index.php?page=news&news_id=201&indexid=)

### דוגמה למיחזור של מיזוג אוויר

מערכת שהותקנה בבית דפוס גדול במרכז הארץ רשמה תוך חודש חסכון של כ 100 קוב. המערכת חסכה במהלך שנתיים 5000 קוב מים



קוב 104 + קוב 100

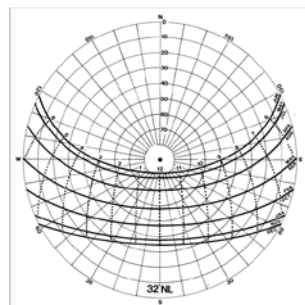
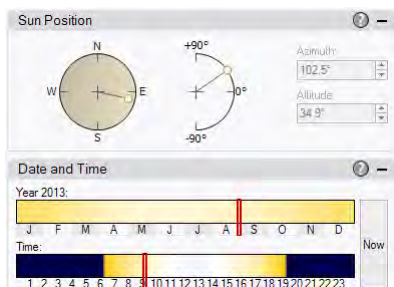
קוב <200

## 2.2 מחקר לעיצוב התא

### אוורור

### הצלה

מסלול השמש שונה בין ימות החורף לימות הקיץ. שוני זה מתבטא בכמות שעות האור ובזוויות פגיעת קרני השמש בארץ. תכנון נכון מאפשר ניצול שוני זה לטובת חימום המבנה בחורף והקטנת חימומו בקיץ.



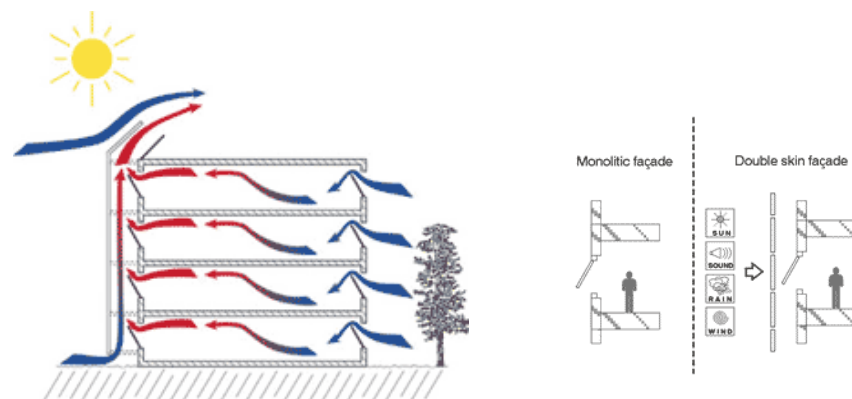
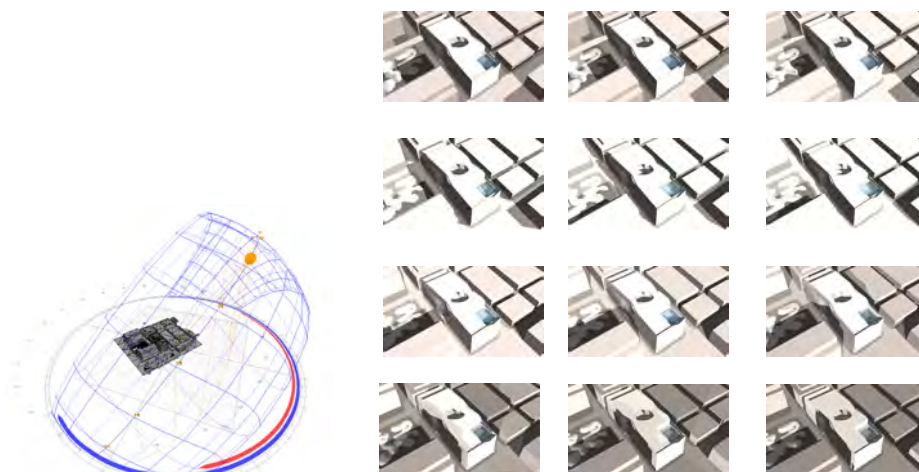
חזית כפולה היא מערכת של שתי חזיתות המופרדות ע"י רווח אוויר משמעותי, המערכת נוצרת ע"י הצמדת חזית חיצונית במרחק מסוים מהחזית המקורית. שתי החזיתות מתפקדות כבידוד תרמי ואקוסטי בין החוץ לפנים, ומאפשרות כניסת אוויר אופטימאלית ליצירת נוחות מרבית בחללים הפנימיים. לרוב החזית הפנימית תהיה חזית קונבנציונאלית עם פתחים, והחזית החיצונית משתנה בהתאם לתנאי המקום, ויכולה להיות מזכוכית, צמחיה או מערכת של רפפות ומדפים.

### אוורור טבעי

הרווח בין שתי החזיתות יוצר "מסדרון רוח" ובכך אוורור טבעי וסירקולציה טובה לחללי הפנים. החזית החיצונית מגנה על הבניין כולו מתנאי אקלים שונים (רוח, גשם וכו') ובכך מאפשרת להשאיר את החלונות פתוחים 24 שעות מבלי להתפשר על הנוחות בפנים הבניין.

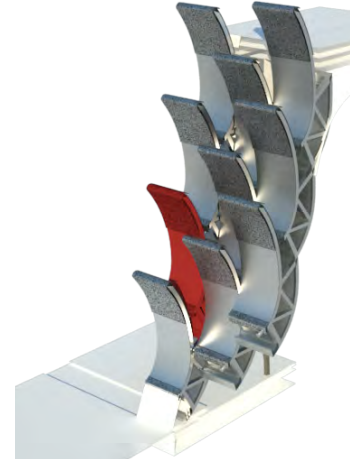
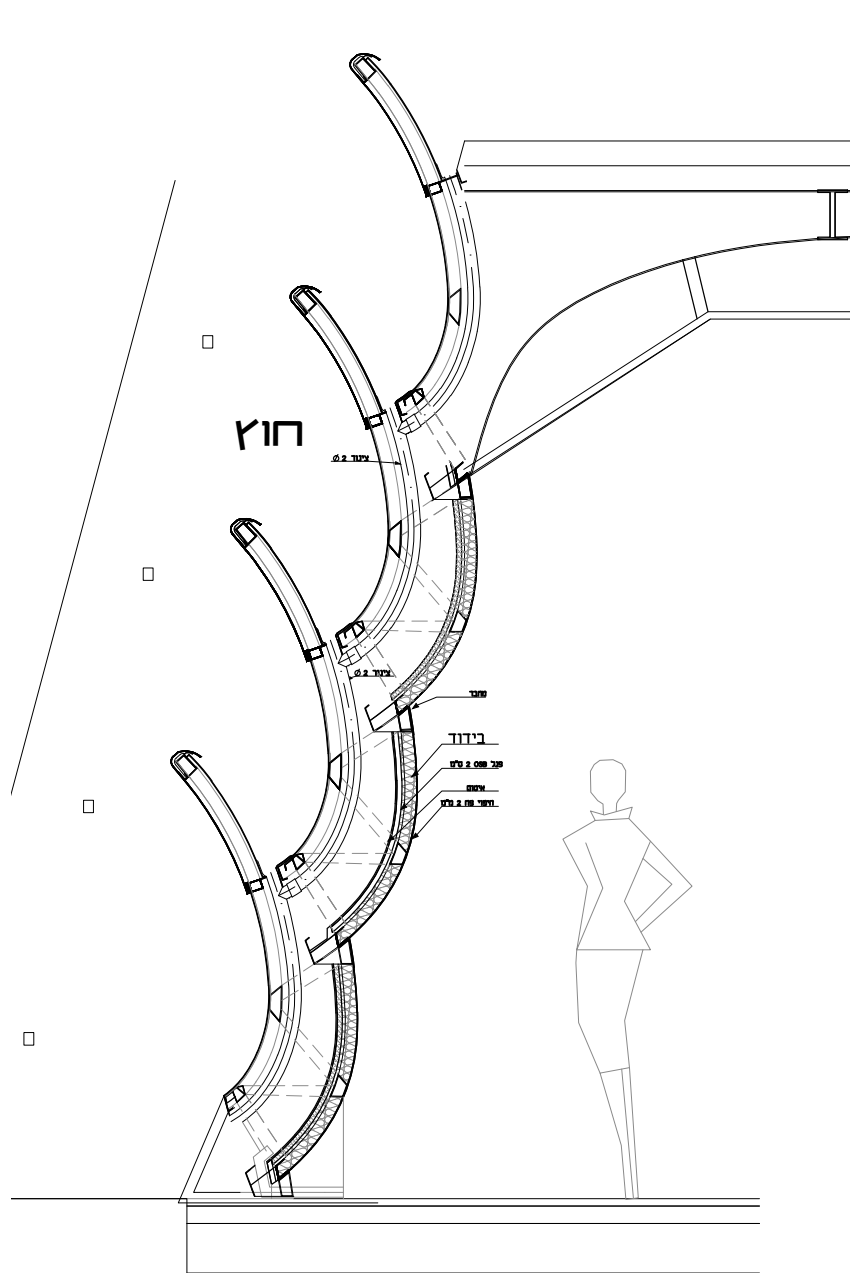
### בידוד אקוסטי

החזית הכפולה משפרת את ההגנה מפני רעש חיצוני. כך למשל במקרה של חזית זכוכית כפולה. נוכל לקבל עם חלון פתוח את אותו בידוד אקוסטי של חלון סגור בחזית רגילה.



arc.asat.org.il/wp-content/uploads/.../תקדים-אקלים.pptx

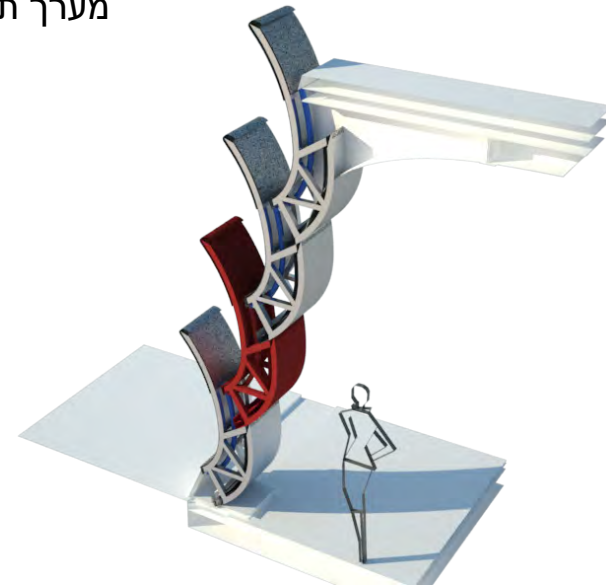
3. התא-התחלה-חיפוש...



מערך תאים

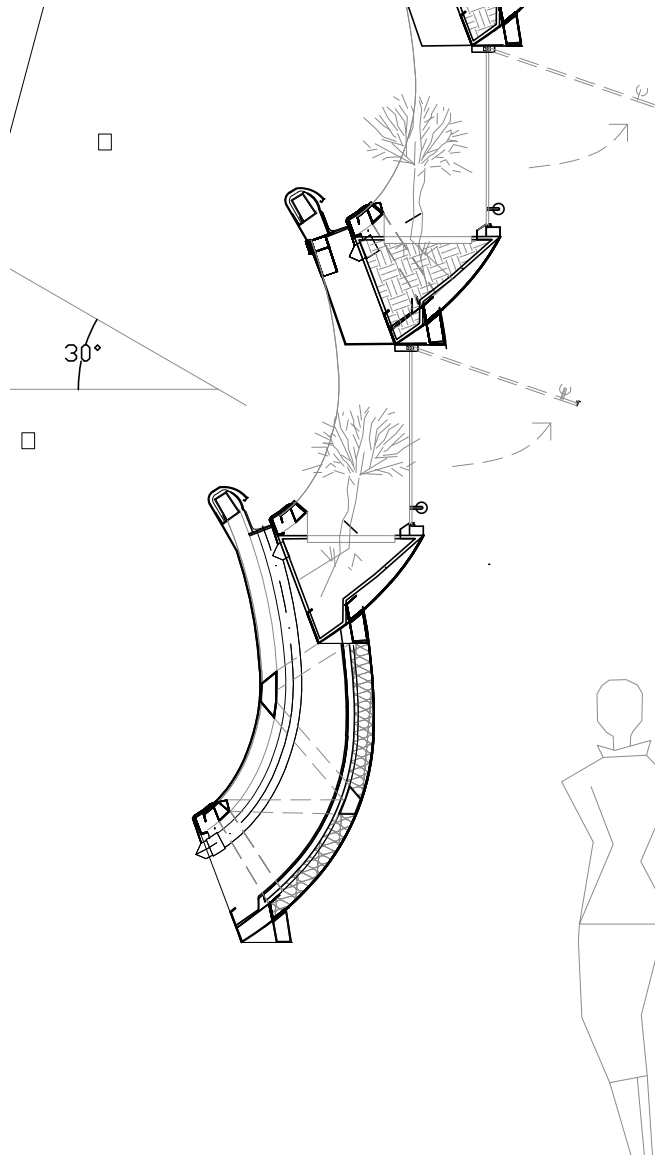


תא בסיסי

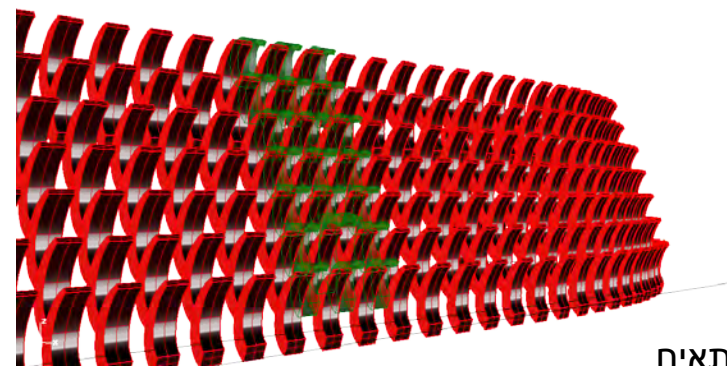


חיבור למפלסים

3.1 התא-התחלה-חיפוש...



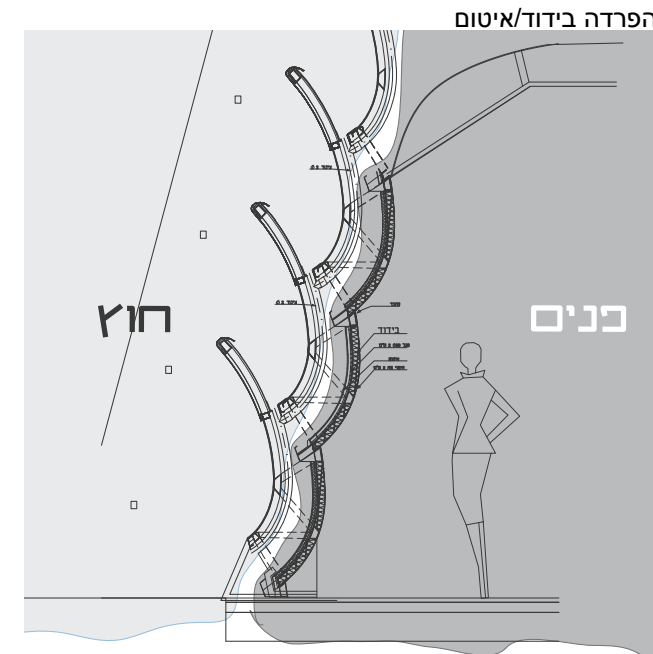
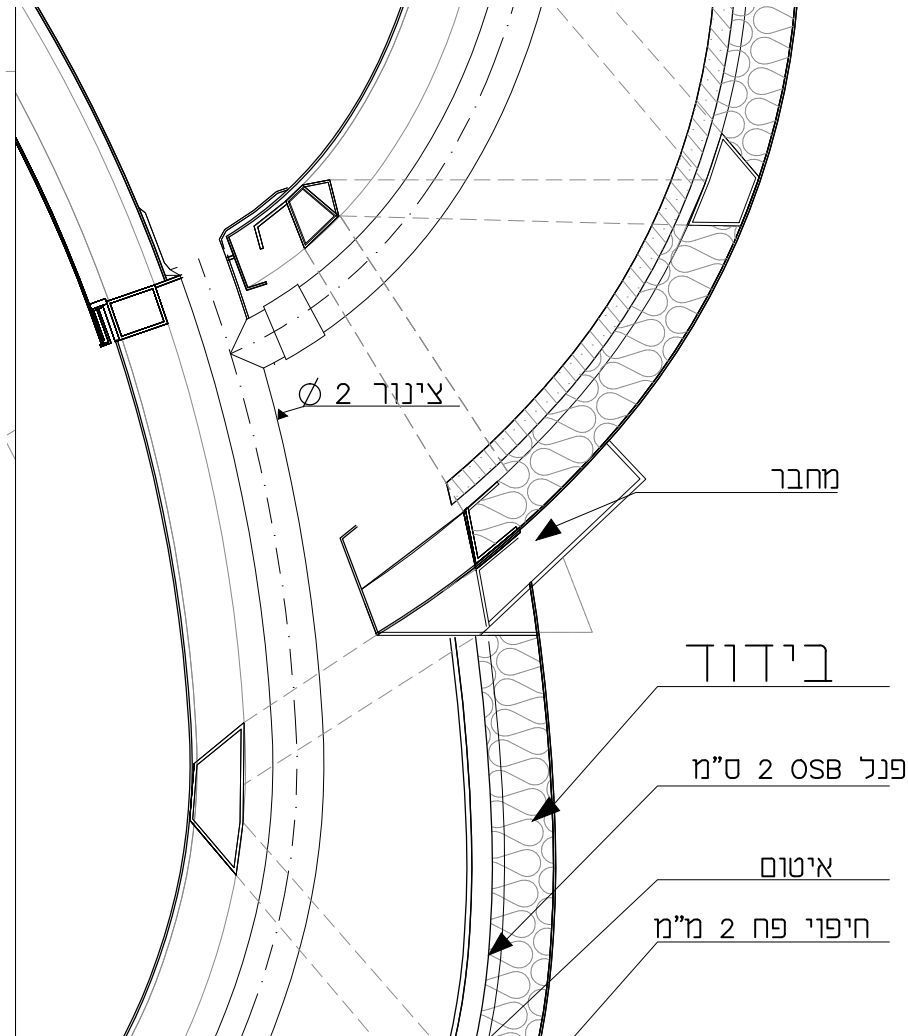
צמחייה



"קיר" תאים

3.2 התא-התחלה- חיפוש...

התא מורכב משני שכבות פח , אחריו בידוד תרמי 6 ס"מ , פנל OSB ויריות איטום



U Value

רצונו להמסן משטוח בטבדיתו

New [38] רשימת חומרים ל:

חומר	תיאור	עובי
1	Aluminium [800]	0.008
2	Rock Wool and Glass Wools-12_16 [144]	0.06
3	AirGap100mm-Downwards [220]	0.2
4	Aluminium [800]	0.008

U Value: 0.58C (<= 1.0! + X ↑)

שמור שינויים

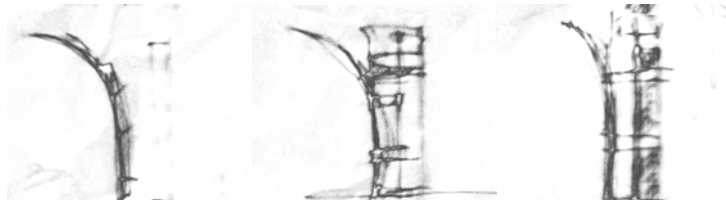
אלמנט מערכת - לא ניתן לשינוי חומר לא נמצא בספריית החומרים  
אלמנט משתמש - ניתן לשינוי



### 3.3 תהליך תכנוני לעיצוב התא

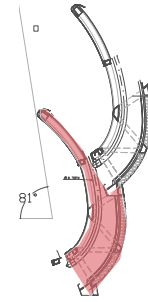


השראה

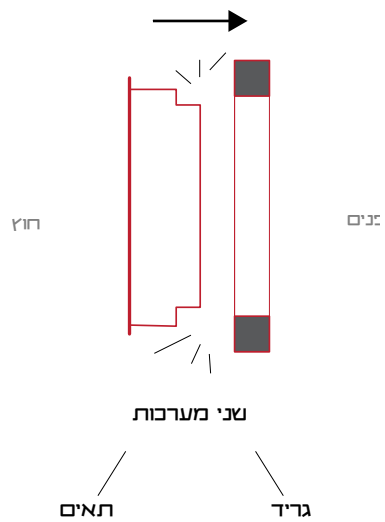


#### התחלה

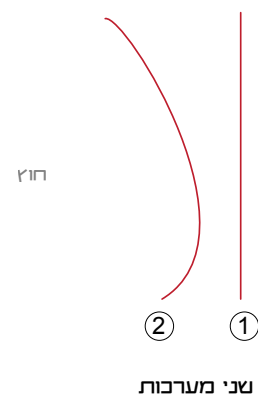
בשל מורכבות המערכת הקודמת וחוסר הטעמה לתב"ע הוחלט לשנות את התא ממערכת רחת לשני מערכות של " הדבקה" של התא לגריד .



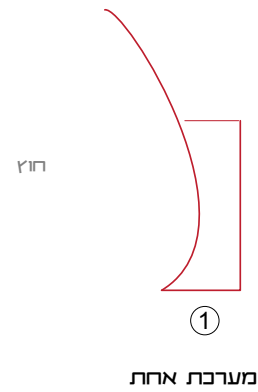
סקמה חתך/תוכנית של המערכות



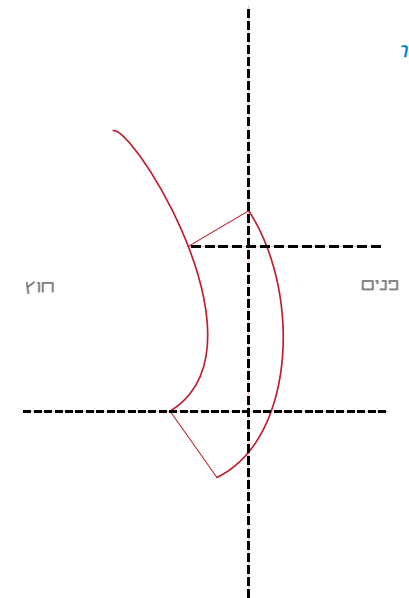
שני מערכות



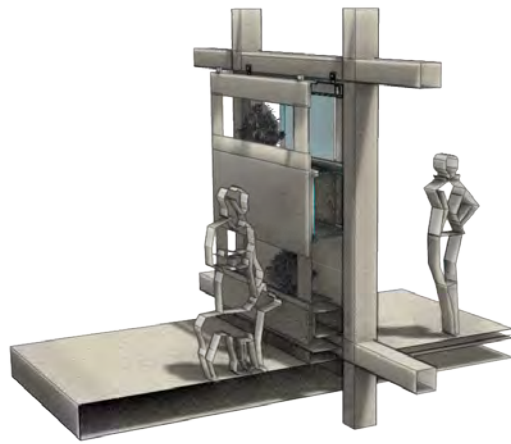
מערכת אחת



חיתוך



4. התא הבסיסי



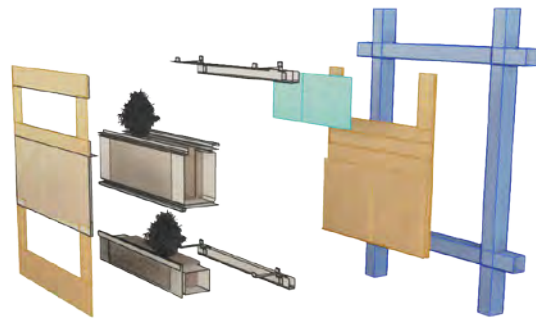
תא מישור



התא הבסיסי

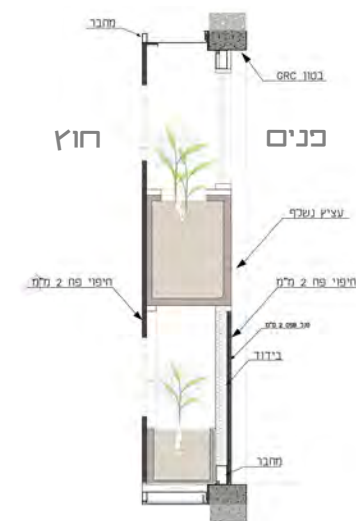
תוכנית

מבט מפורק



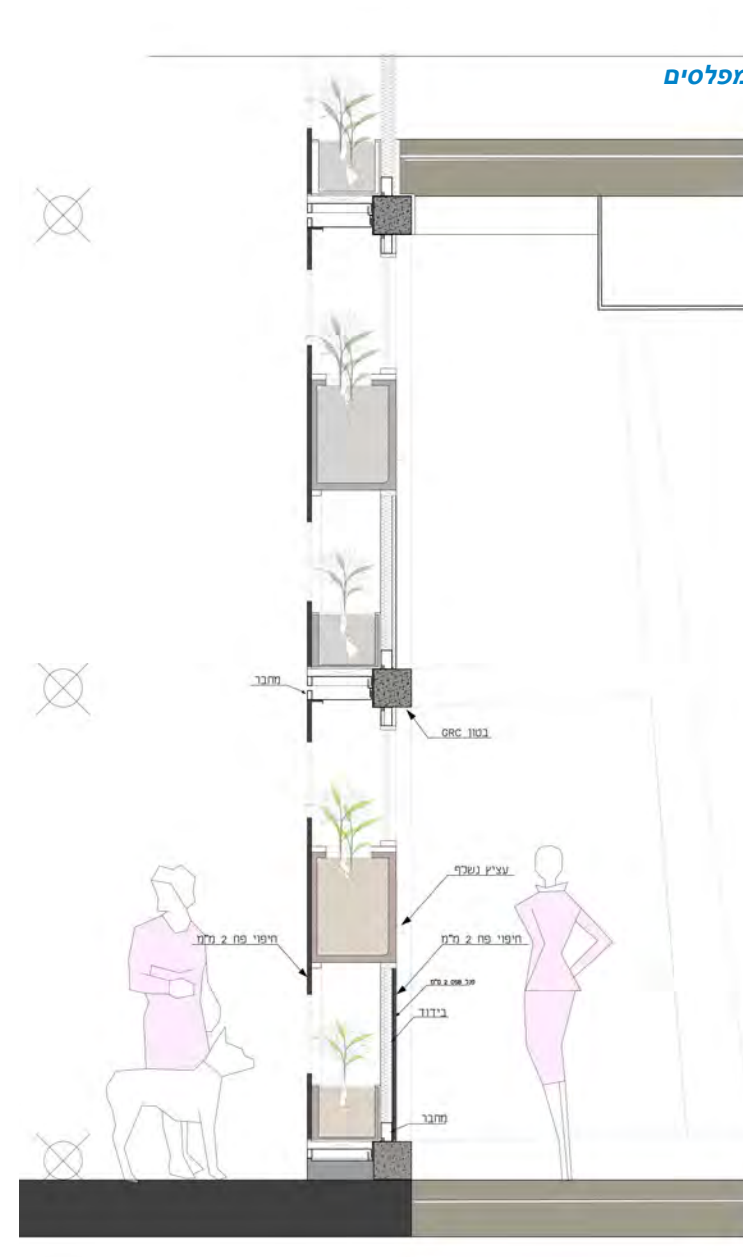
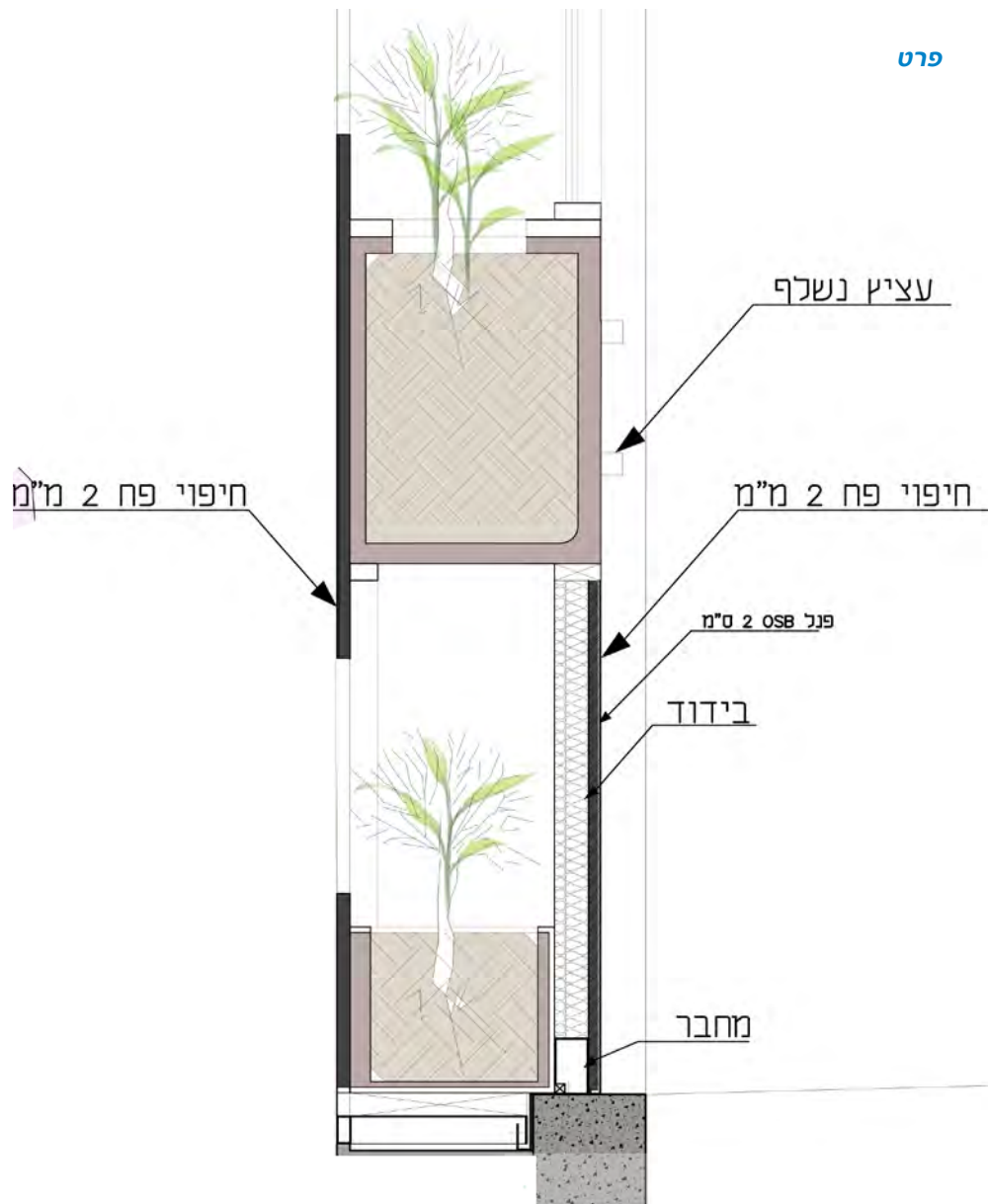
בטון GRC

- חיפוי פנימי ( בידוד, פח, OSB, איטום, חילון )
- פרופילים
- צמחיה
- חיפוי חיצוני, פח



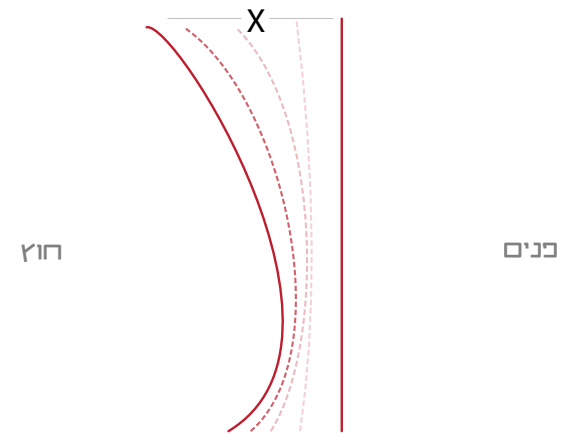
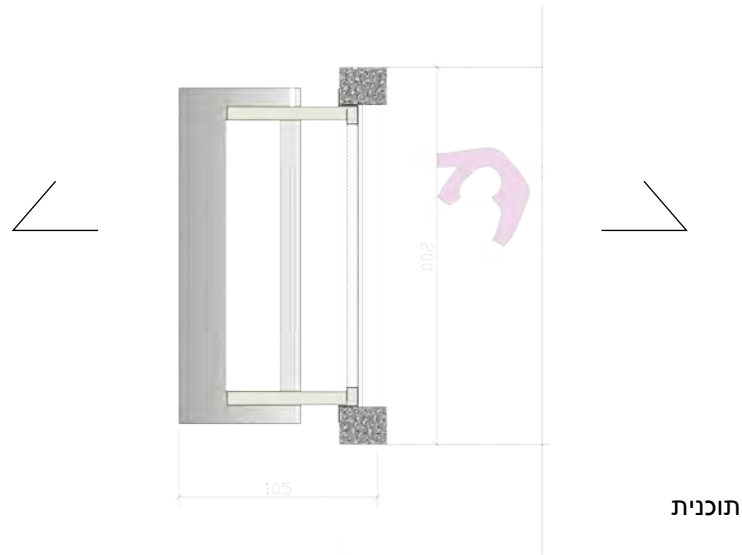
חתך

4.1 התא הבסיסי

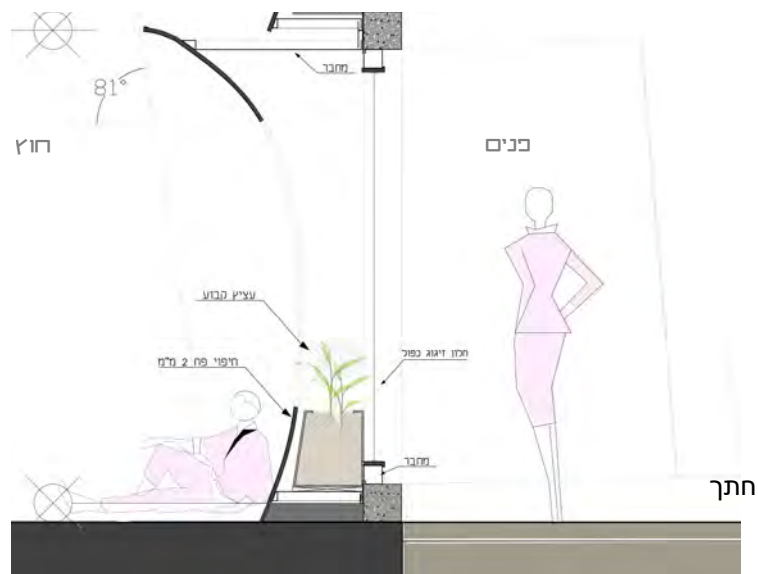


5 תא מכופף

פתיחת ה"כנף"



שינוי כנף כתלות בקרינה

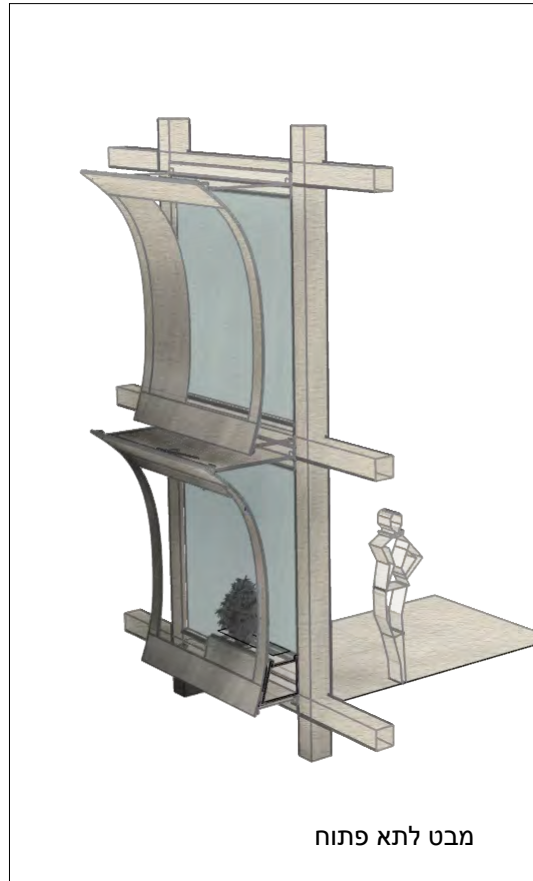


U - Value

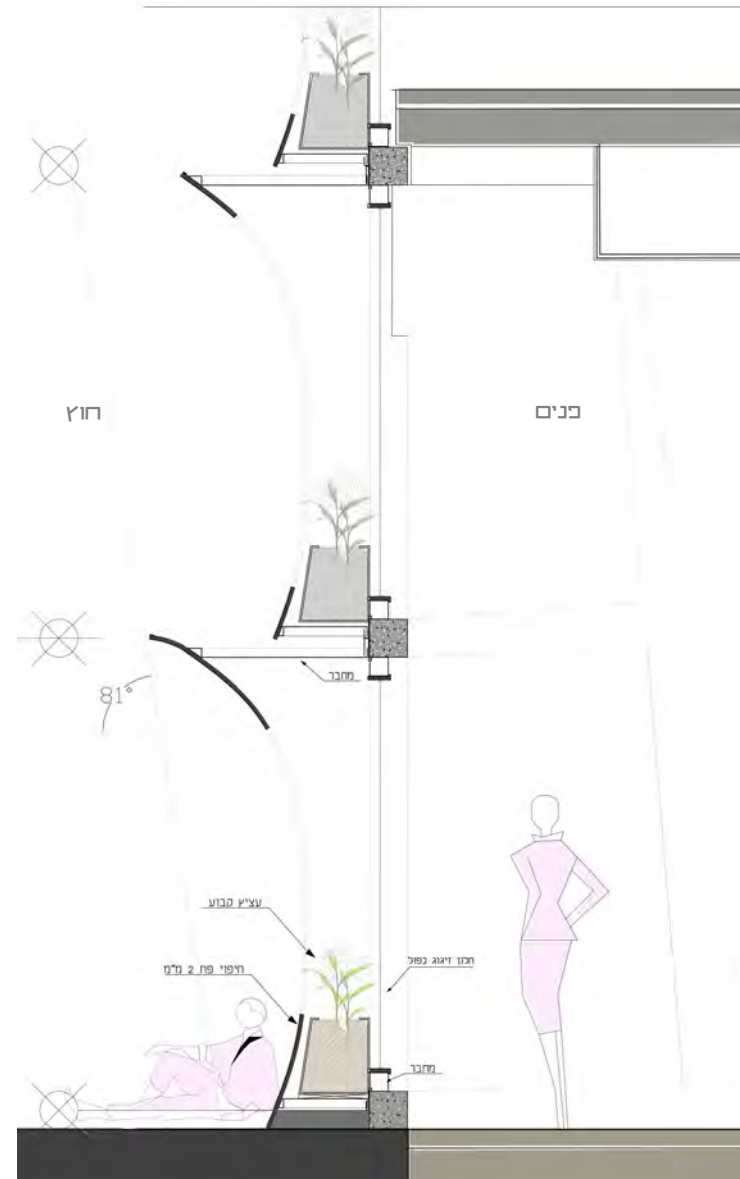
Aqua Wall		רשימת חומרים ל:	
חוץ	1	Aluminium [248]	0.008
	2	Oak	0.02
	3	Rock Wool and Glass Wools-10_12 [33]	0.06
	4	AirGap25mm [646]	0.025
	5	Aluminium [248]	0.008
כנים			
		שמור שינויים	U Value: 0.5791
			+ X ↑

### 5.1 תא מכופף

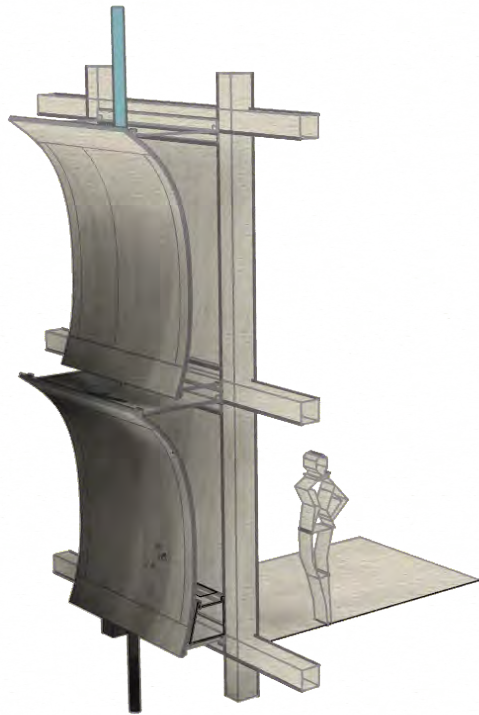
חתך של תא פתוח



שינוי התא כתלות בפרמטרים שונים  
שמפורטים בהמשך



5.2 תא מכופף (סגור)

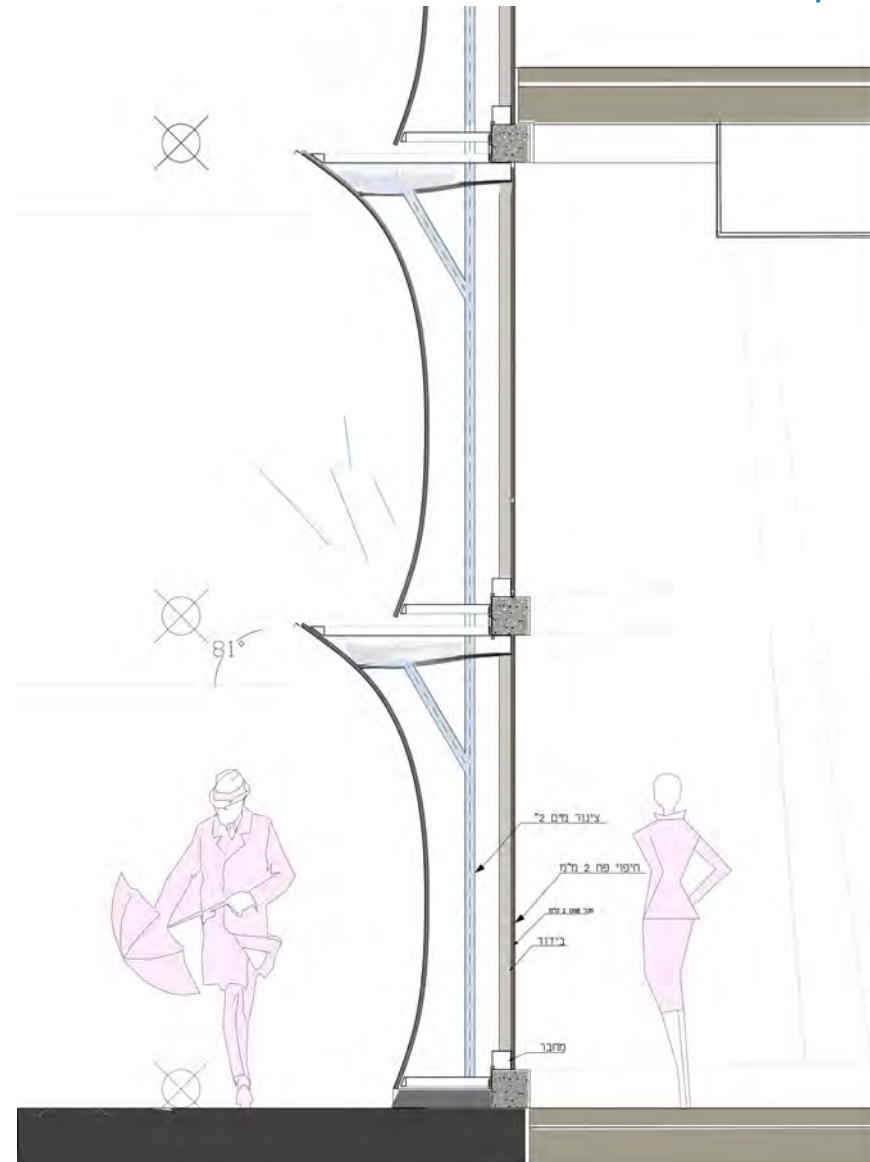


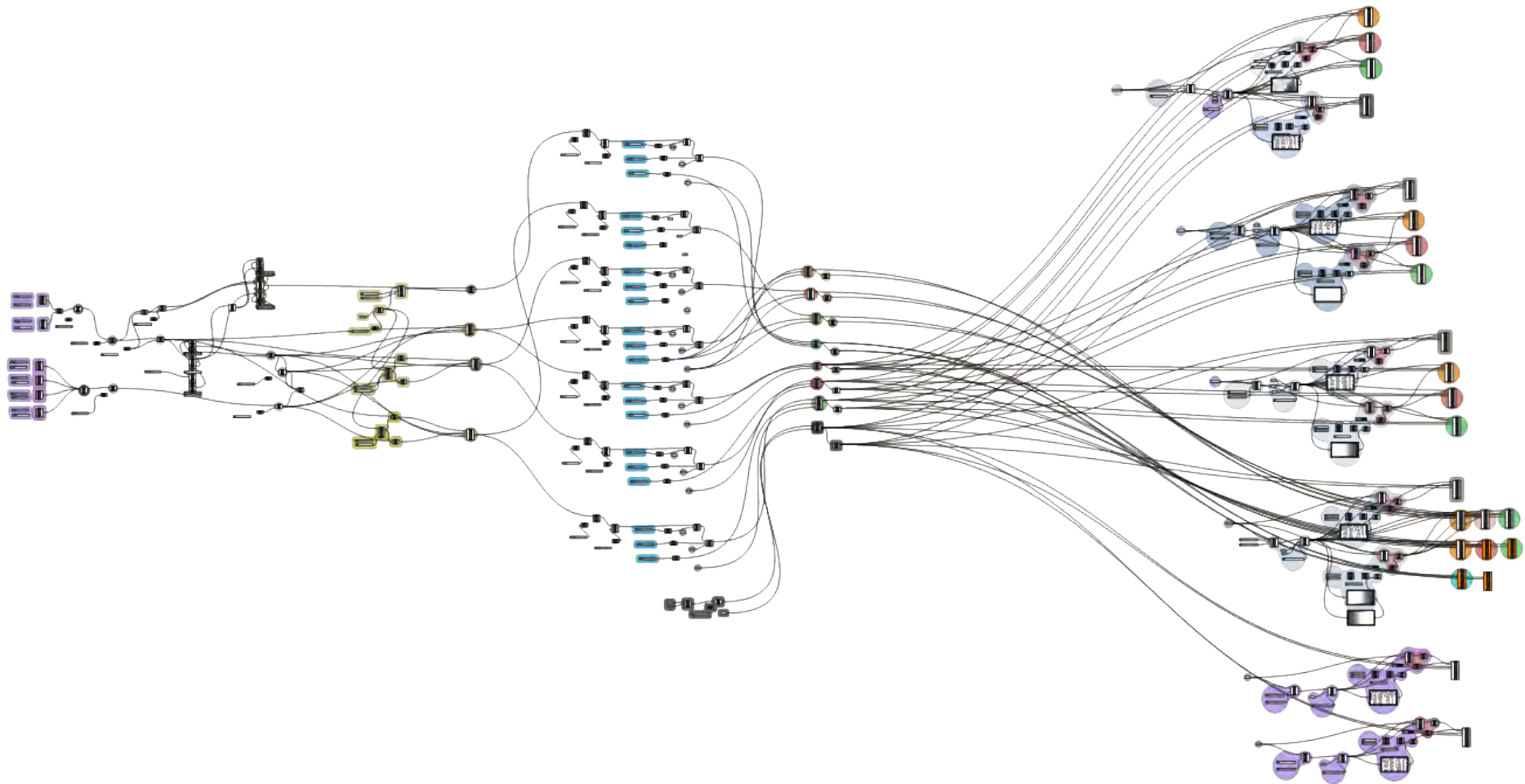
מבט לתא סגור



תא משולב

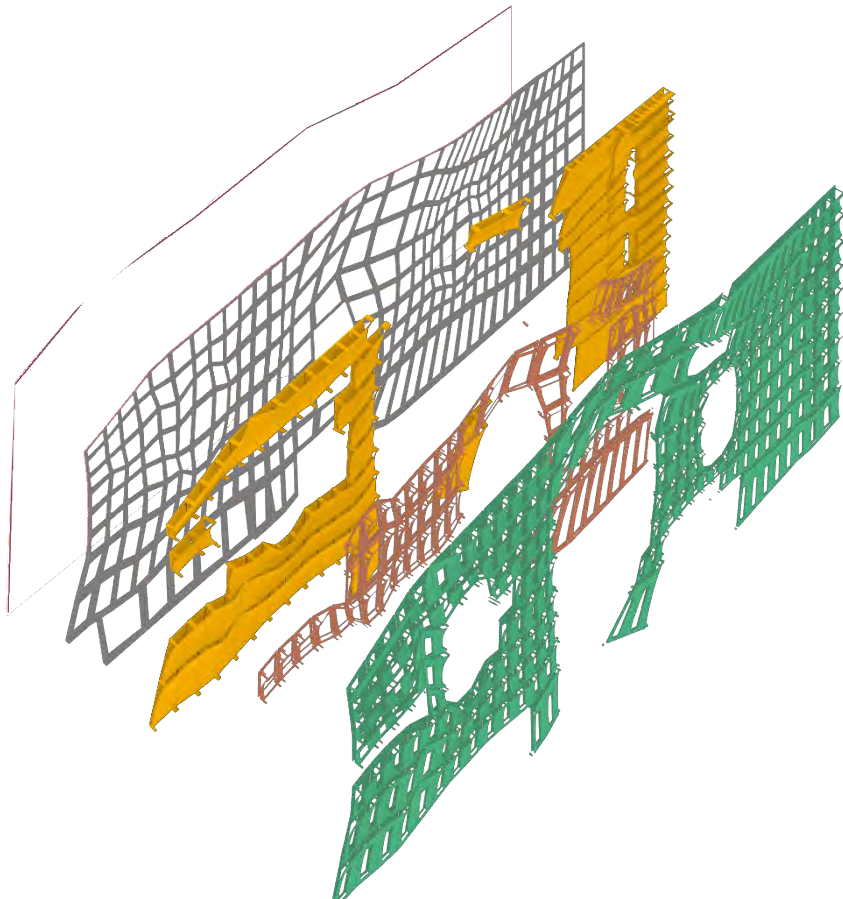
איסוף מים





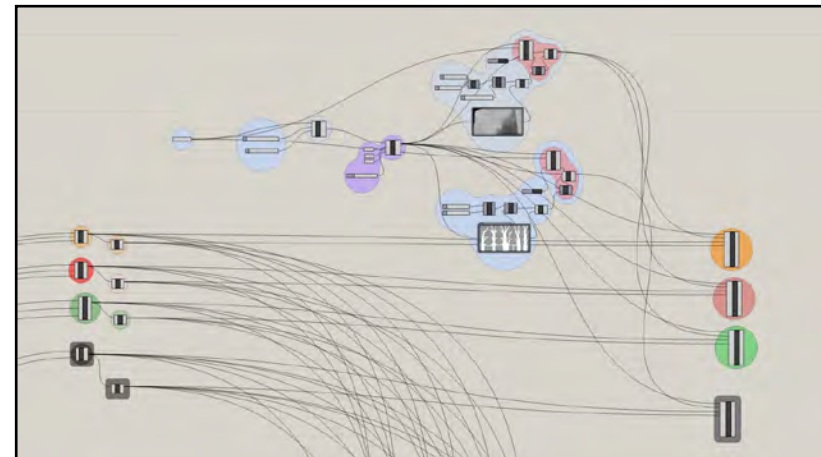
6.1 חזיתות

חזית צפון מערבית



- מערכת 1 - גריד
- מערכת 2 - תאית
- תא 1 - מכופף אטום
- תא 2 - פתיחה מלאה
- תא 3 - פתיחה חלקית

שימוש בגראסהופר לשינוי תכונות המערכות שנראה בהמשך

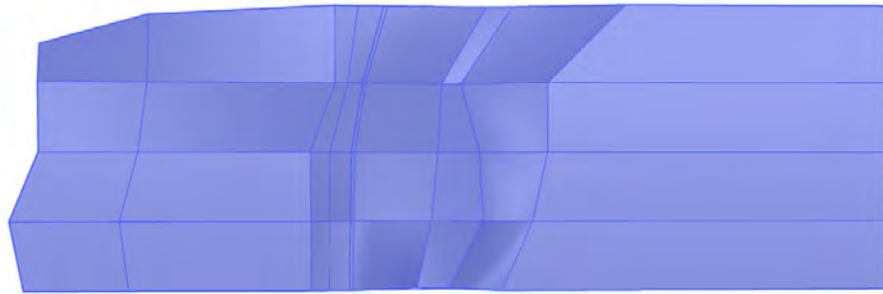




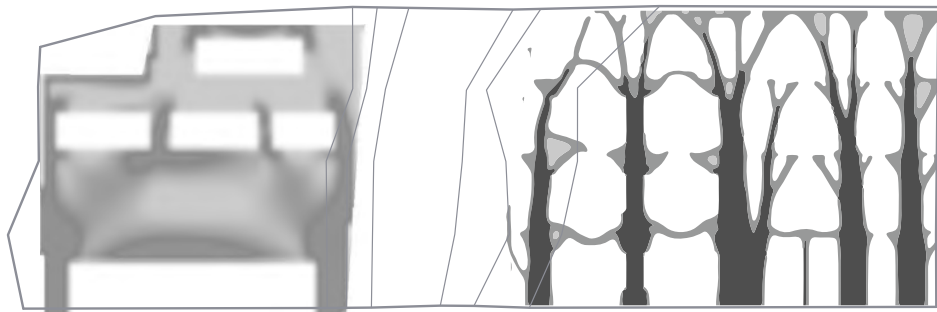
חזיתות 6.2

חזית לבדיקה - חזית צפון מערבית

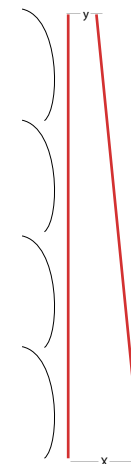
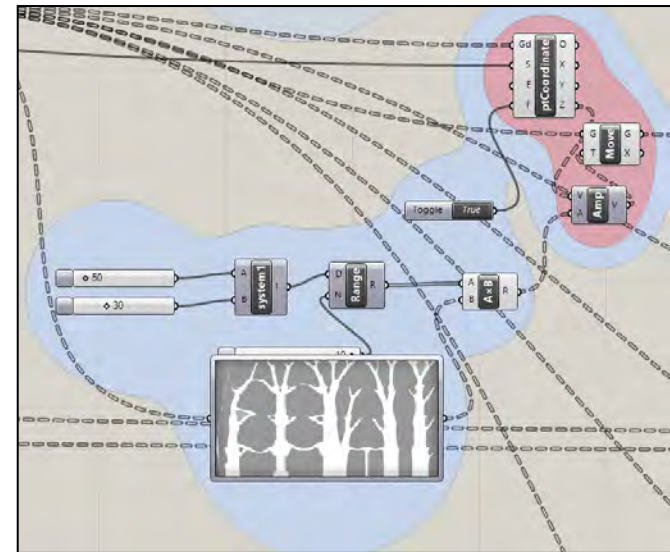
מערכת 1



קונסטרוקציה



צפיפות הגריד + אובי משתנה

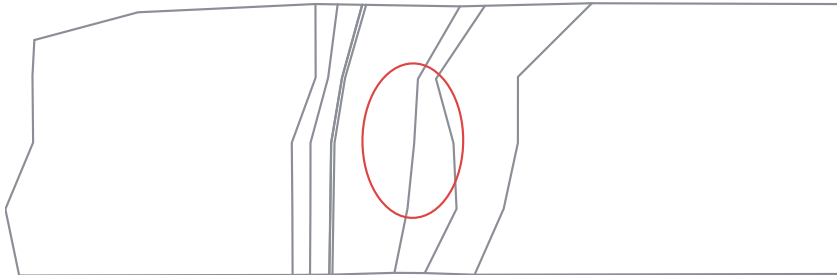


### 6.3 חזיתות

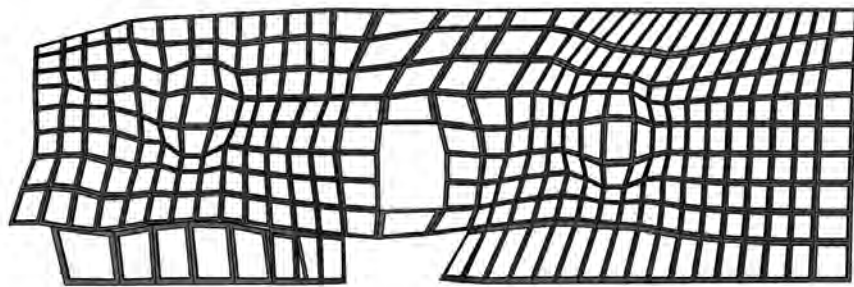
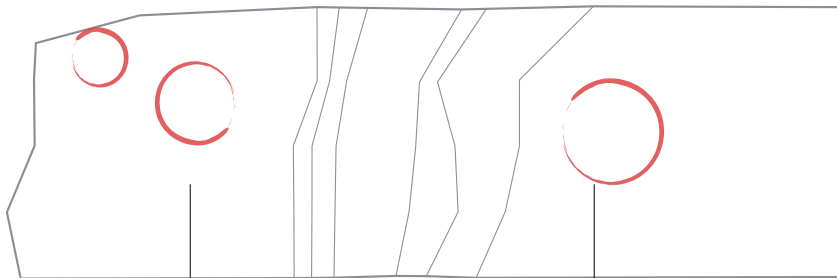
#### מערכת 1

סכמת אופטימזציה לחזית הדרום מערבית, מראה את זרימת הכוחות היעילה

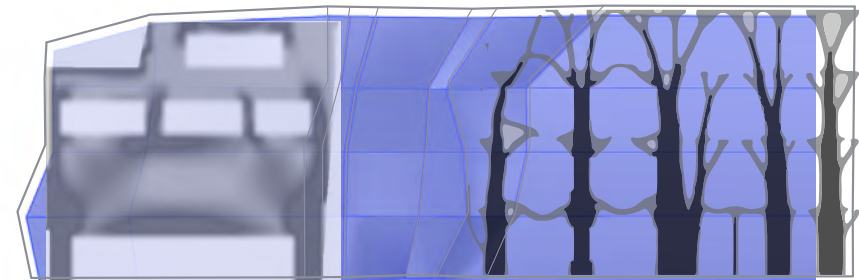
ארובת אור, תנועה



כרוגרמה, התרחבות התא

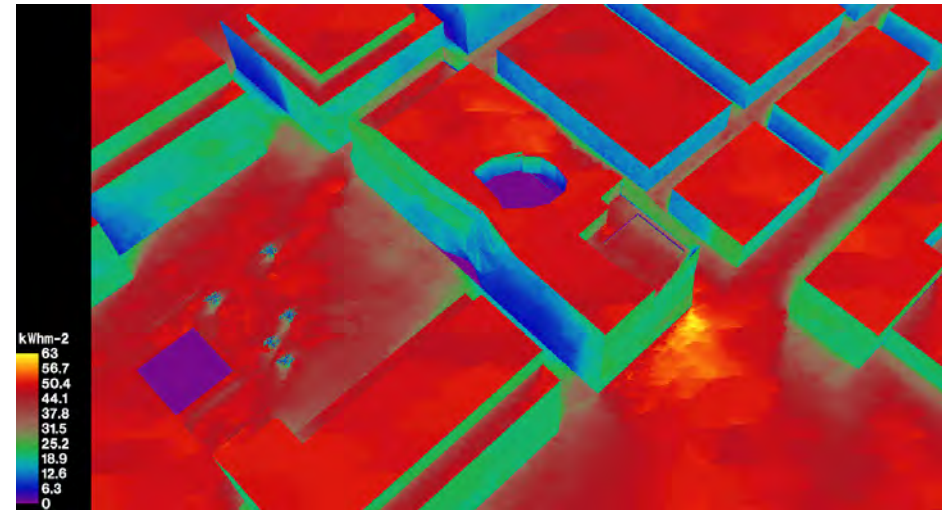


קונסטרוקציה



חזיתות 6.4

מערכת 2 - תאים, קרינת שמש.

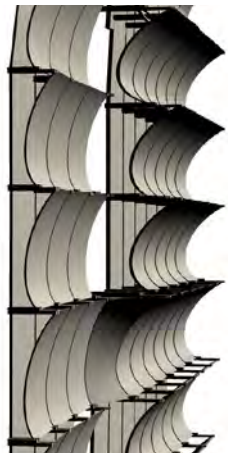
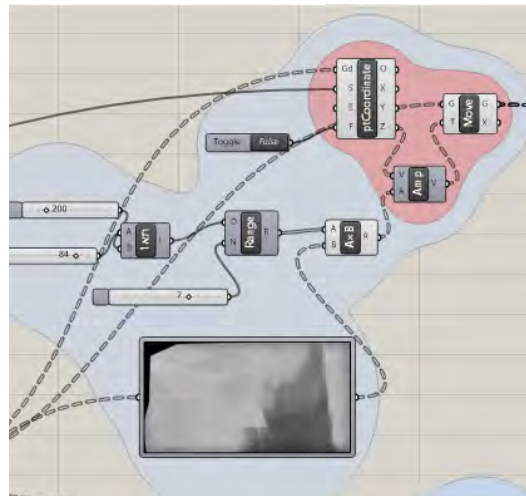
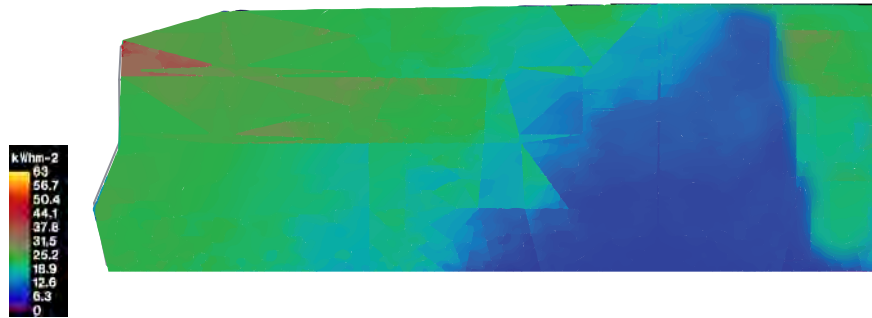


בדיקת כמות קרינה של שמש ביום קיץ טיפוסי באוגוסט



בדיקת צל על חזית ביום קיף טיפוסי באוגוסט

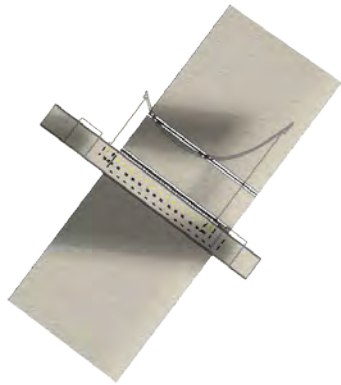
קרינה שמש חזית דרום מערבית



6.5 חזיתות

1

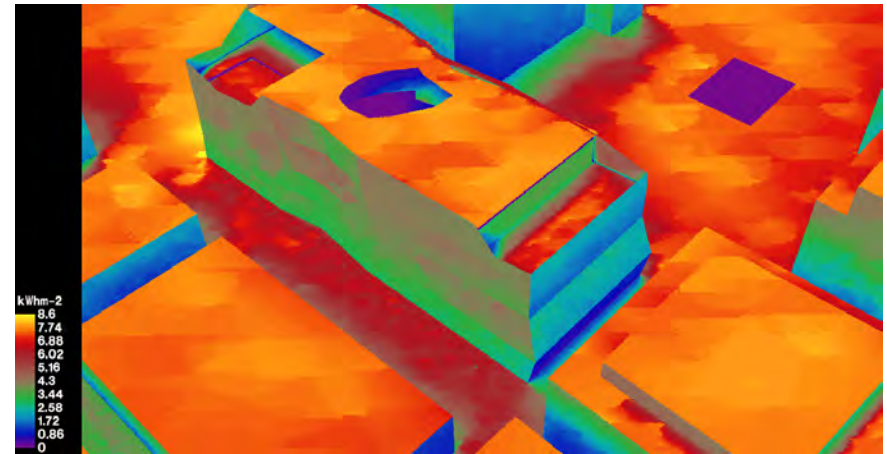
מבט על



מבט



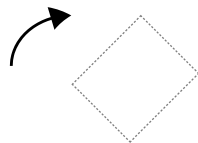
מערכת 2 - תאים, קרינת שמש



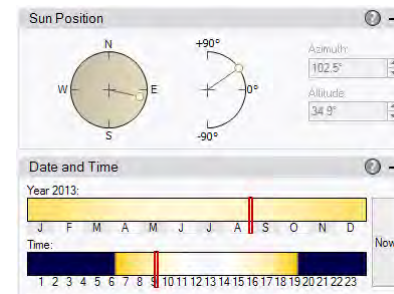
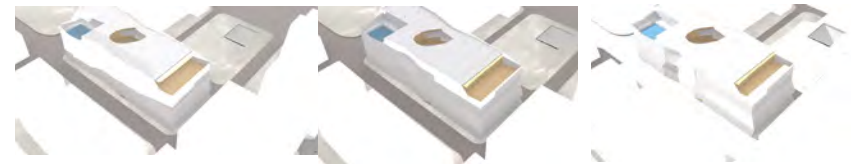
בדיקת עוצמת קרינה שמש על החזיתות ביום קיץ



לתא המולבש על הגריד יכולת גם להיות מסובב



שינוי זווית, היפוך התא בתלות בזווית שמש (חזית)



7. חתך ב-ב

מערב \





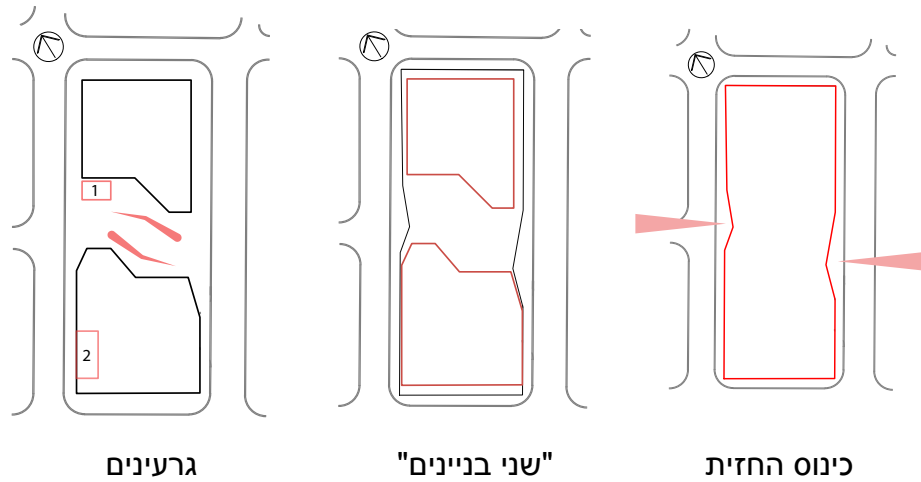
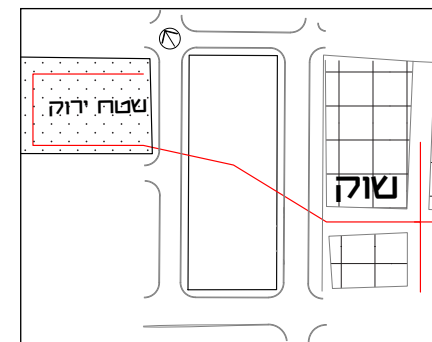
חזרה לבט העירוני קיים ציר אורבני שמתחיל בככר מגן דוד שזו הכניסה לשוק הכרמל ורוב הבאים באים מהכיוון הזה, הציר הזה נגמר בצד הזמרחי של השוק ומגיע לבניין כנקודת שיא ורכן היה דרוש המשכיות סיפור הזה.

8. בניין

סביבה קרובה



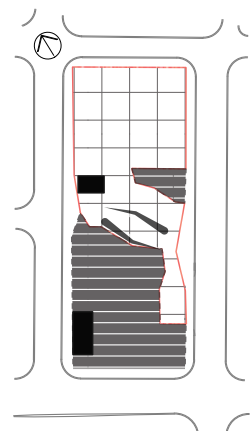
ציר הולכי רגל



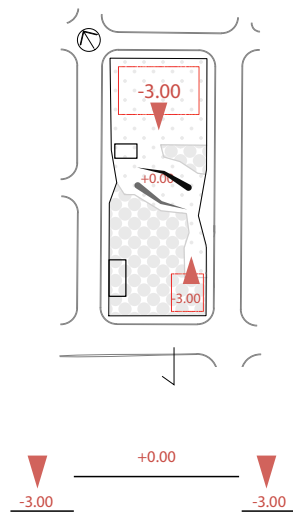
גרעינים

"שני בניינים"

כינוס החזית



חוץ פנים (+0.00)

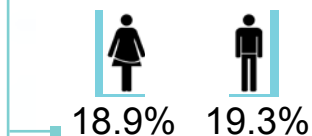
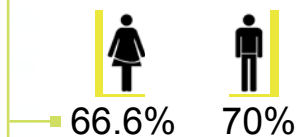
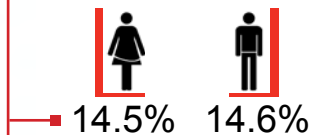


שינוי מפלס +0.00\_

9. פרוגרמה אוכלוסייה

אוכלוסייה, לפי גיל ומין (אלפים ואחוזים), יחס תלות (לארף)

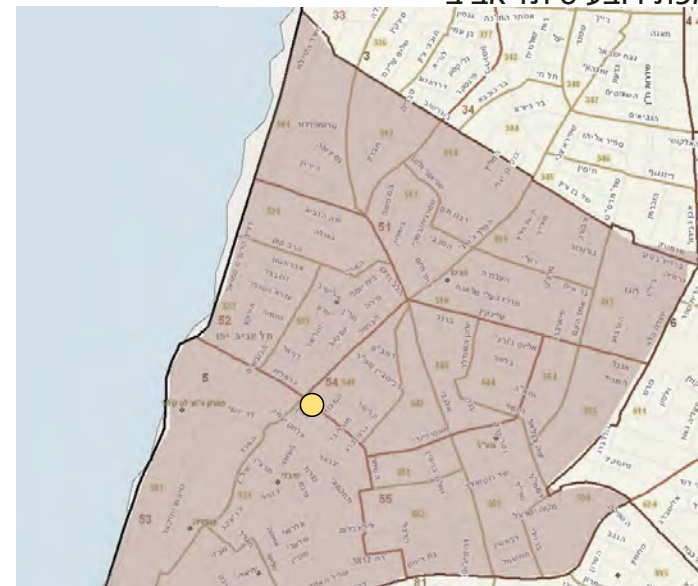
גיל	זכרים אלפים	נקבות אלפים	זכרים אחוזים	נקבות אחוזים
סך הכל	18.8	18.7	100.0	100.0
04-00	1.1	1.1	5.9	6.0
09-05	0.7	0.6	3.6	3.3
14-10	0.5	0.5	2.7	2.8
19-15	0.4	0.4	2.4	2.4
24-20	1.3	1.4	6.8	7.6
29-25	3.9	4.0	20.7	21.3
34-30	3.3	3.0	17.5	15.9
39-35	2.1	1.7	11.0	9.3
44-40	1.1	0.9	5.9	4.8
49-45	0.8	0.8	4.4	4.0
54-50	0.7	0.7	4.0	3.7
59-55	0.7	0.7	3.9	3.9
64-60	0.5	0.6	2.9	3.4
69-65	0.4	0.4	1.9	2.3
74-70	0.4	0.5	1.9	2.4
79-75	0.3	0.4	1.7	2.3
84-80	0.3	0.4	1.4	2.1
+85	0.3	0.5	1.6	2.5



יחס תלות	325.8	לארף
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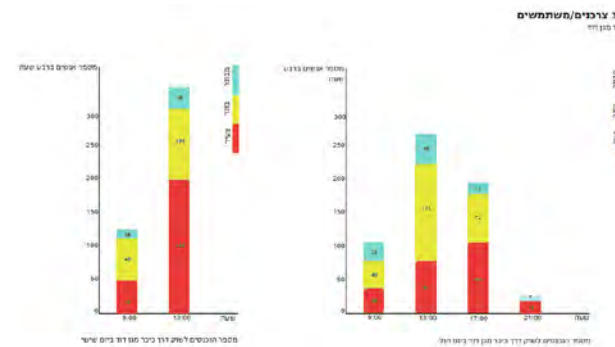
[http://www.cbs.gov.il/census/census/main\\_mifkad08.html](http://www.cbs.gov.il/census/census/main_mifkad08.html)

מפת רובע 5 תל אביב



[http://www.cbs.gov.il/census/census/main\\_mifkad08.html](http://www.cbs.gov.il/census/census/main_mifkad08.html)

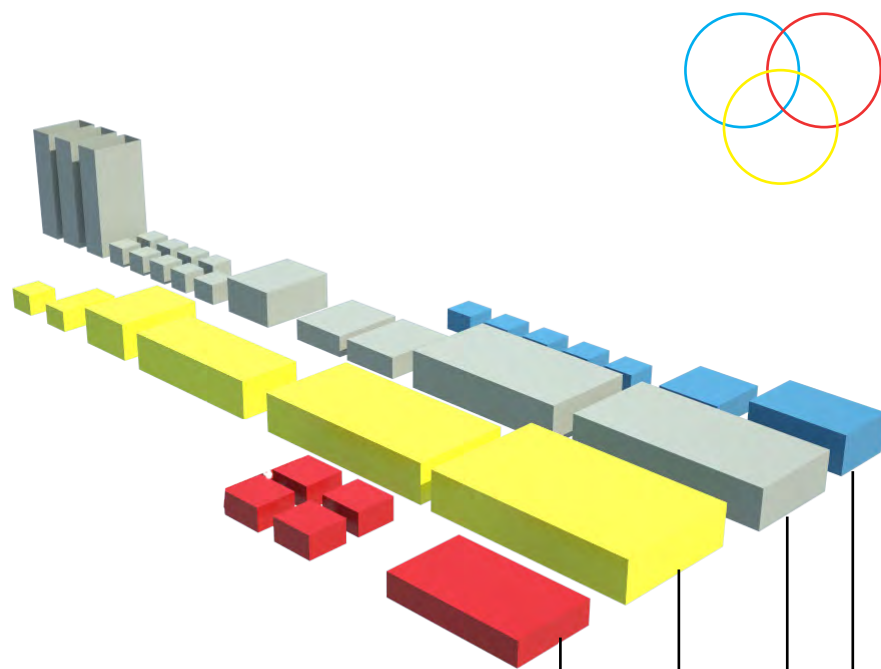
התפלגות אוכלוסייה



<http://www.ax-gr.com/about-heb.php>



9.1 פרוגרמה



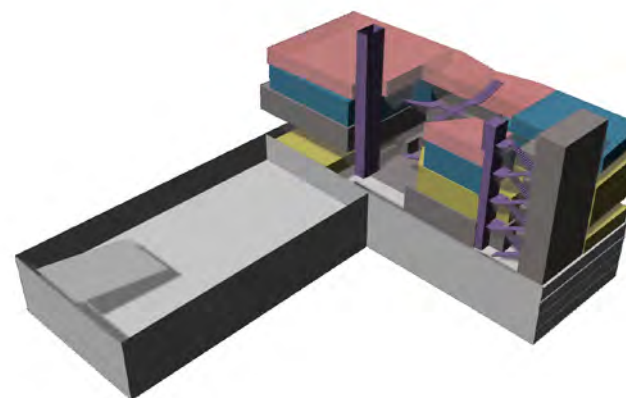
ילדים/נוער - גן ילדים, חוגים

צעירים/מבוגרים - אולם כדורסל/אטלטיקה, אזור אירובי, אזור כוח, סקווש סאונה,

כללי - ספרייה, אולם, בית קפה, ספרים עיון ומכירה, גלריה, משרדים, תנועה

מבוגרים - בריכה טיפולית, פיזיותרפיה, ג'קוזי, סאונה,

פונקציה	שטח נטו	שטח שירות	שטח כולל ליח'	מספר יח'	שטח כולל נטו	שטח כולל לשירות
בריכה טיפולית	100	50	150	1	100	50
סאונה רטובה	30	20	50	1	30	20
חדר פיזיותרפיה	100	20	120	1	100	20
סאונה יבשה	25	20	45	1	25	20
ג'קוזי	10	5	15	1	10	5
ספרייה מולטימדי	300	75	375	1	300	75
עיון והשאלה	100	100	100	1	100	1
גלריה	100	50	150	2	100	50
משרדים	12	4	16	8	96	32
אולם קבלה	25	5	30	1	25	5
בית קפה	120	80	200	1	120	80
אולם רב תכליתי	400	125	525	1	400	125
תנועה ורטיקלית	50			3	150	
סקווש	60	10	70	2	120	20
מקלחות	50			2	100	
משרדי מנהלה	50			1	50	
קבלה	25			1	25	
אזור אירובי	200	50	500	1	200	50
אזור כוח	200	50	300	1	200	50
מגרש כדורסל	510	80	590	1	510	80
גן ילדים	100	20	120	2	200	40
חדרי חוגים א'	40	8	48	2	80	16
חדרי חוגים ב'	30	6	36	1	30	6



10 ניתוח אתר רוחות

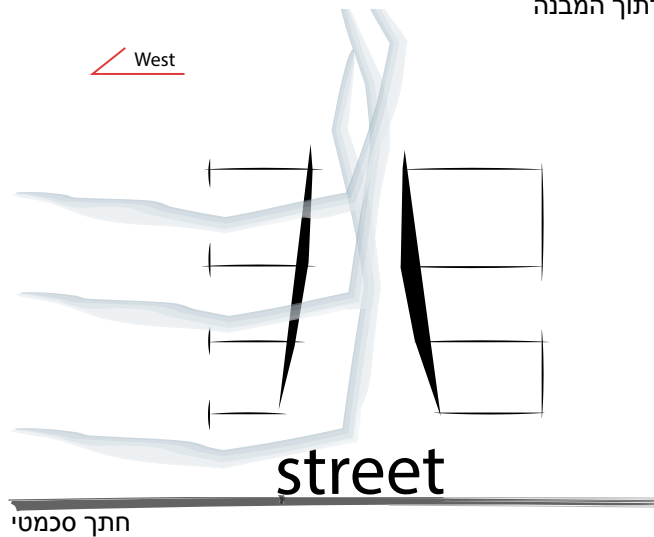


קיץ בוקר

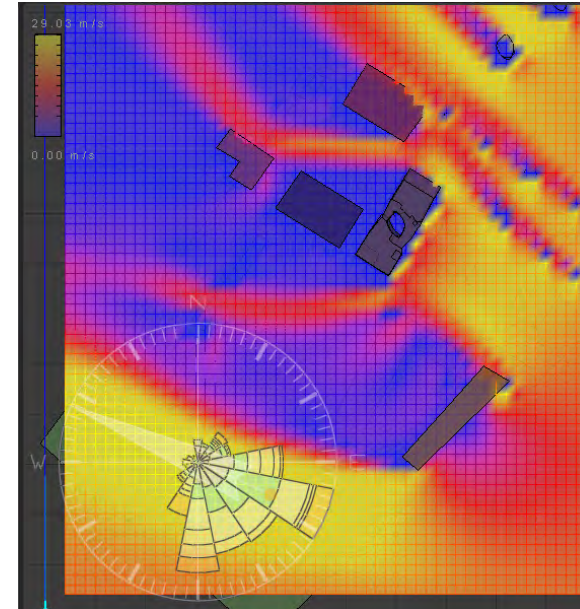


חורף בוקר

בריזת קיצית לתוך המבנה



חתך סכמטי

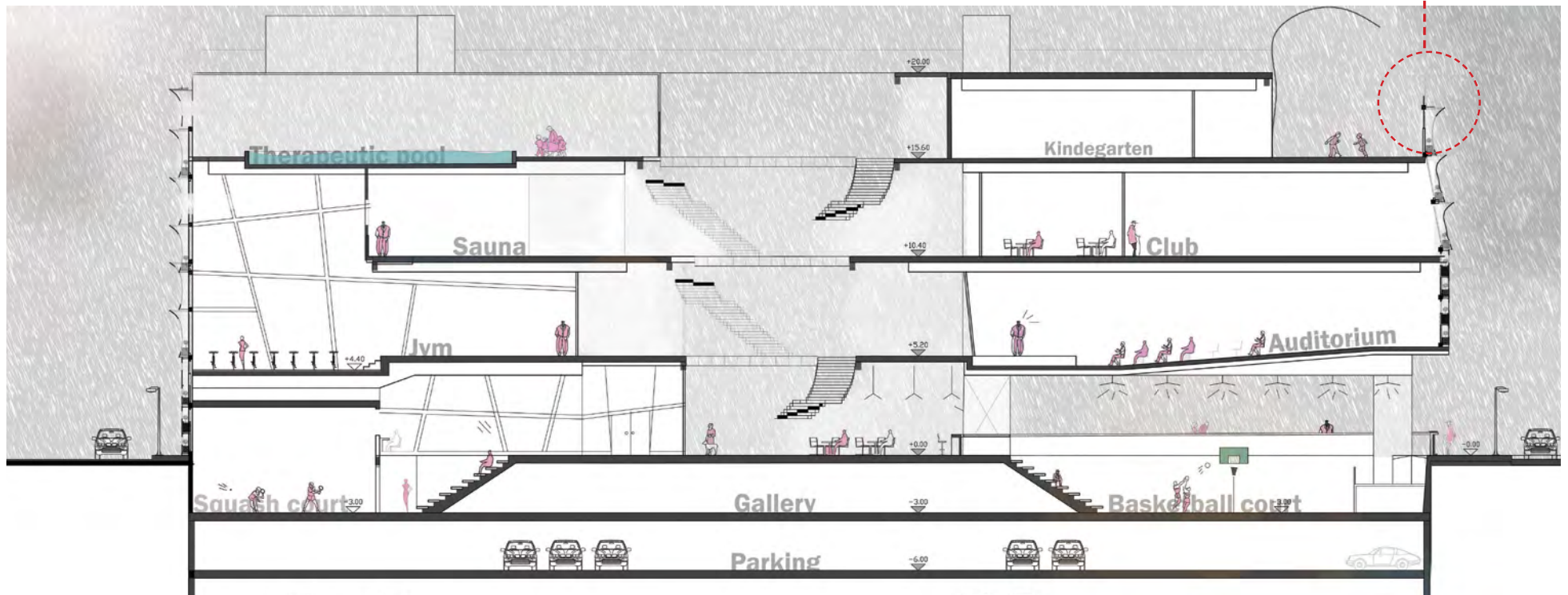
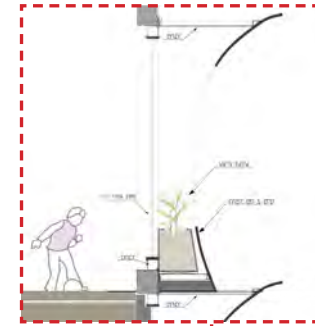
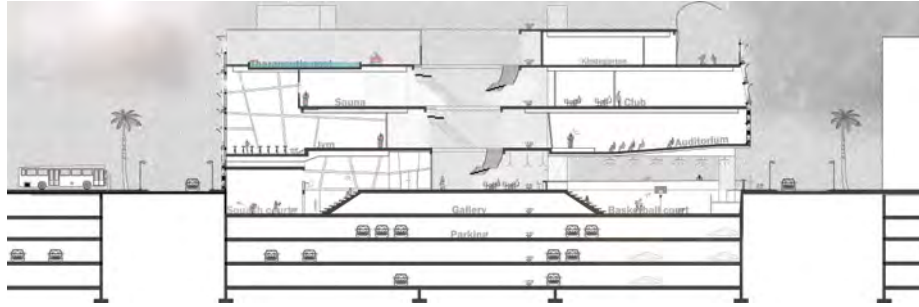


חורף בוקר

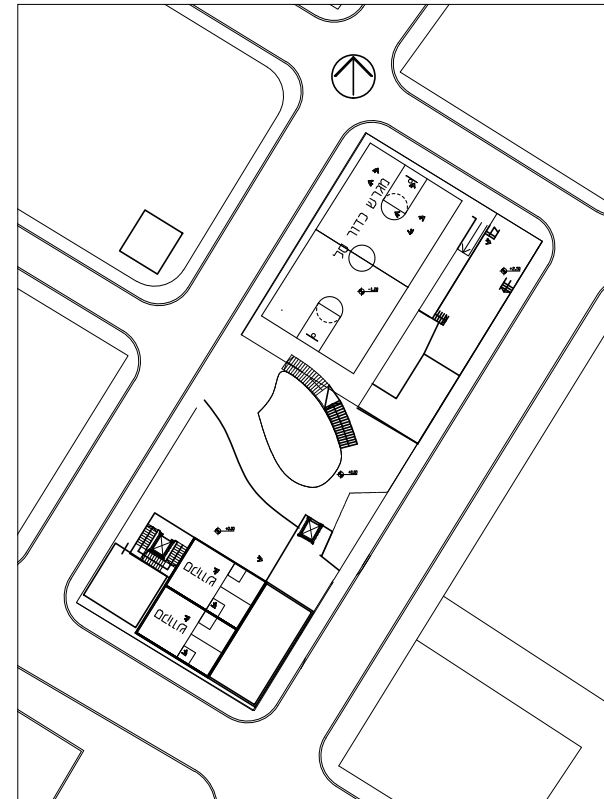
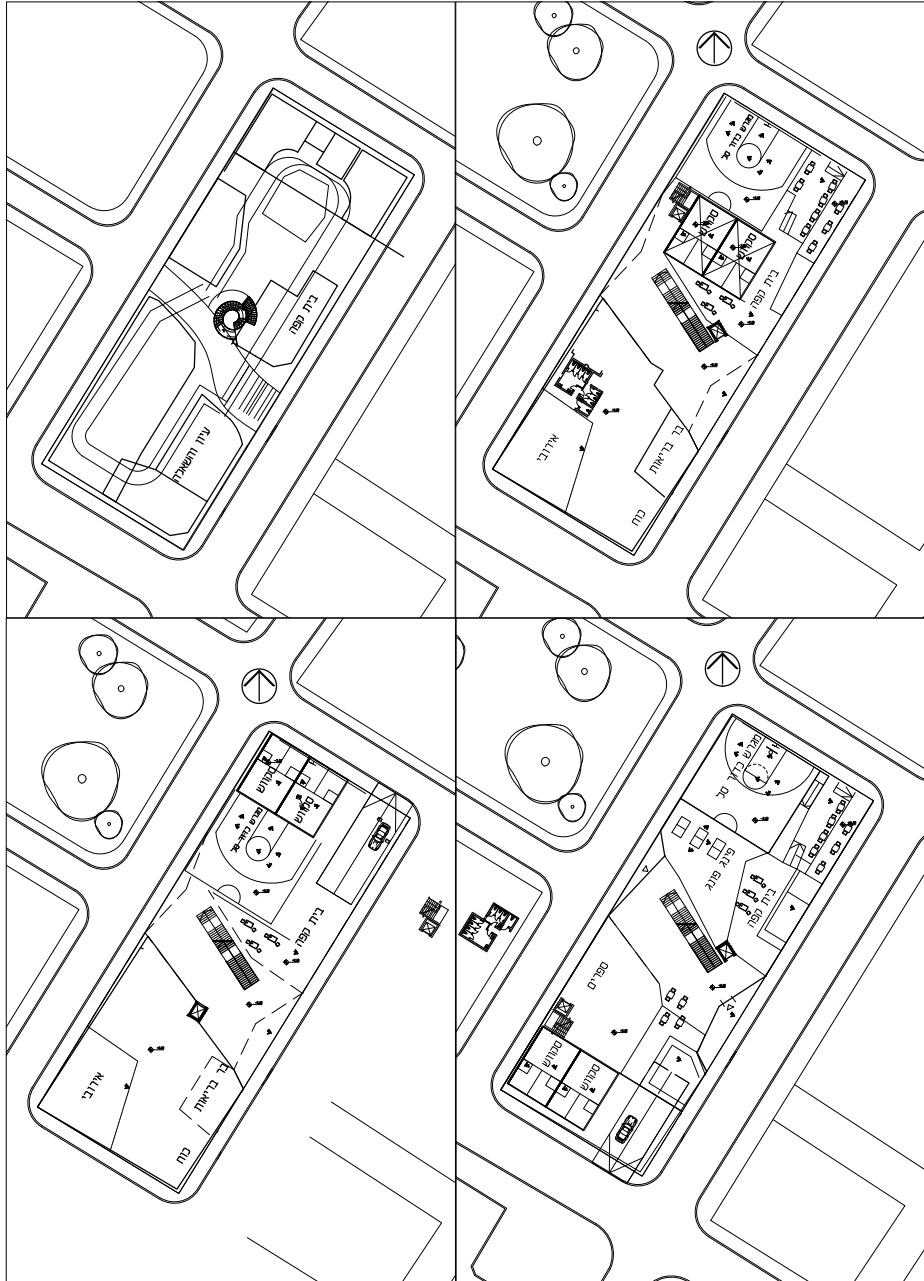
סימולציה של רוח על האתר בחורף

נעשו בדיקות של רוחות באתר כדי להגיב בקנה מידה של הסביבה

11. חתך א-א



- תוכנית מפלס קרקע-תהליך

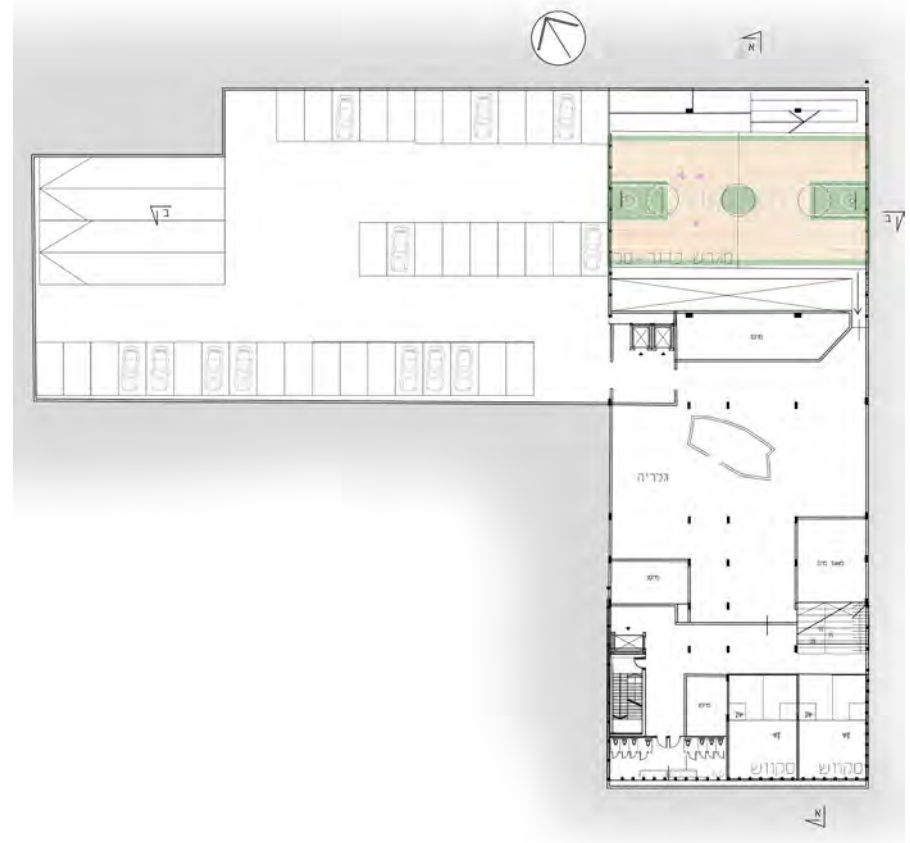


12. תוכניות

תוכנית קרקע מפלס +0.00

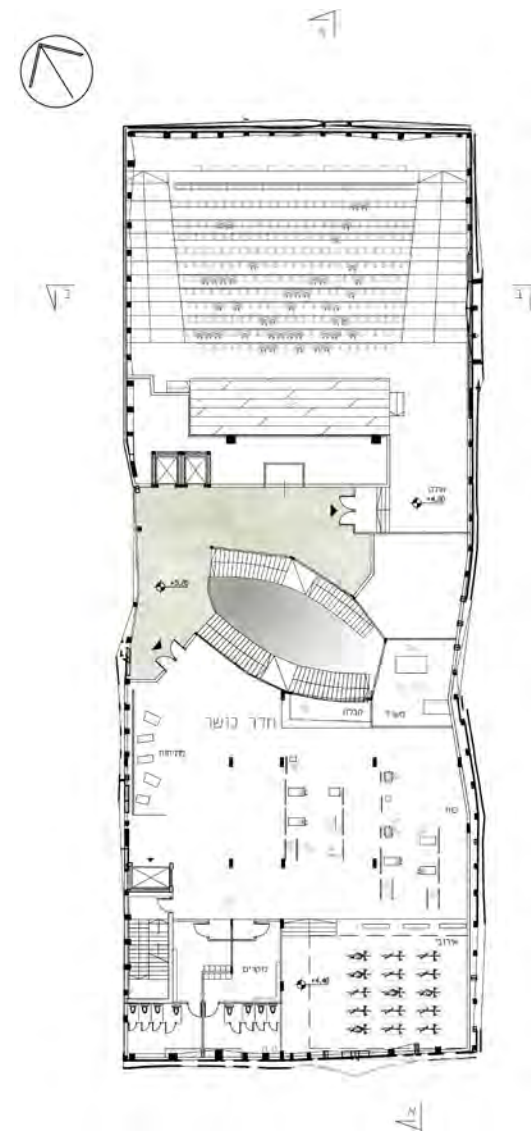
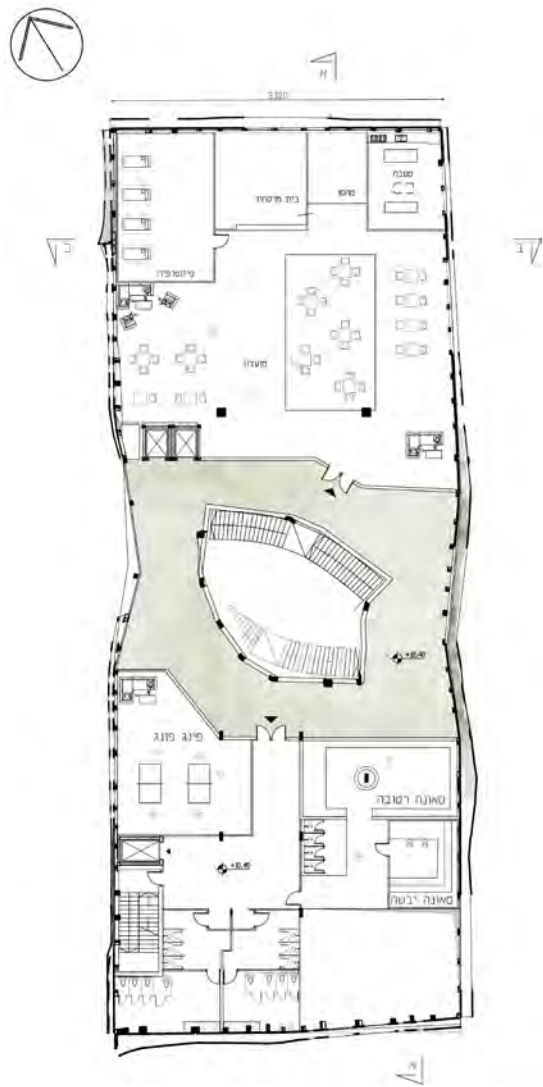


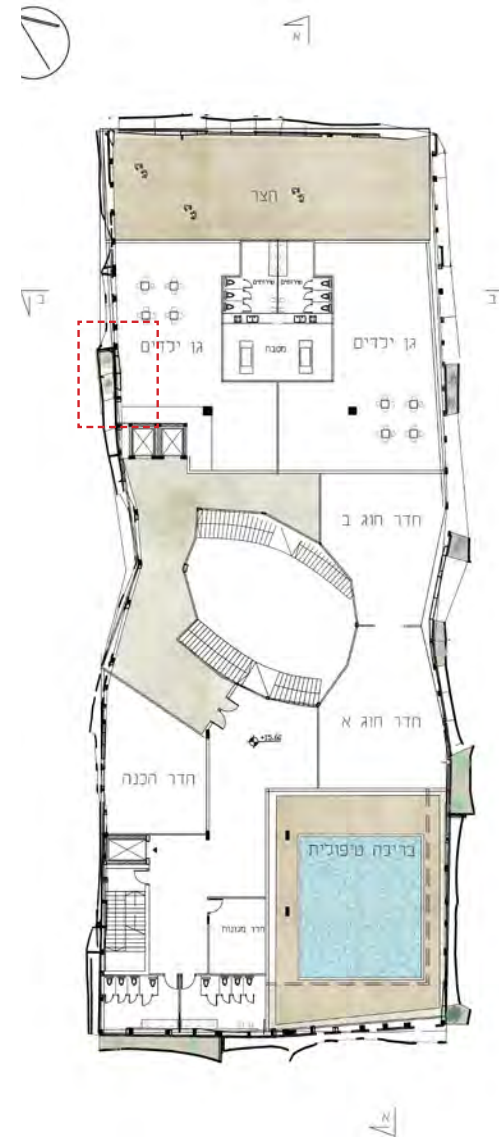
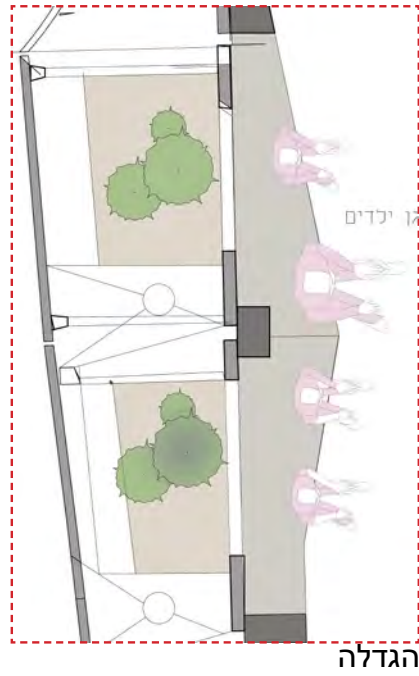
תוכנית חניה מפלס -3.00



תוכניות קומה 3 מפלס +10.40

תוכניות קומה 2 מפלס +5.20





# Final Presentation

# Cellular Buildings - Thematic Studio

By Lior hadar

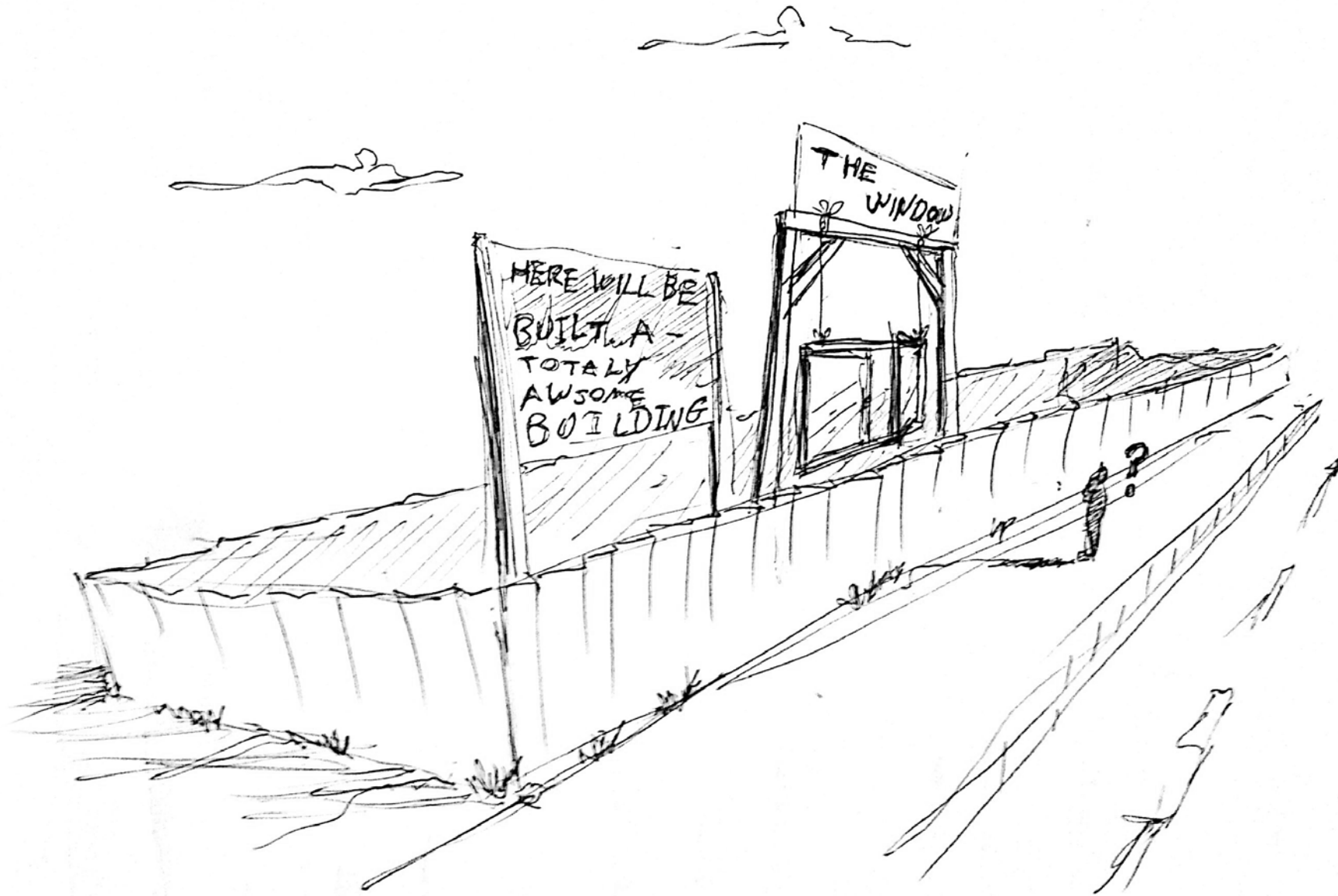
Teacher: Dr. Yasha Grobman



Technion - Israeli Institute of Technology

Faculty of Architecture and Town planning





## *The Cell / The Envelope / Massing / Atrium / The Building*

### Formal Criteria of the ground cell



## *The Cell / The Envelope / Massing / Atrium / The Building*

### Formal Criteria of the ground cell

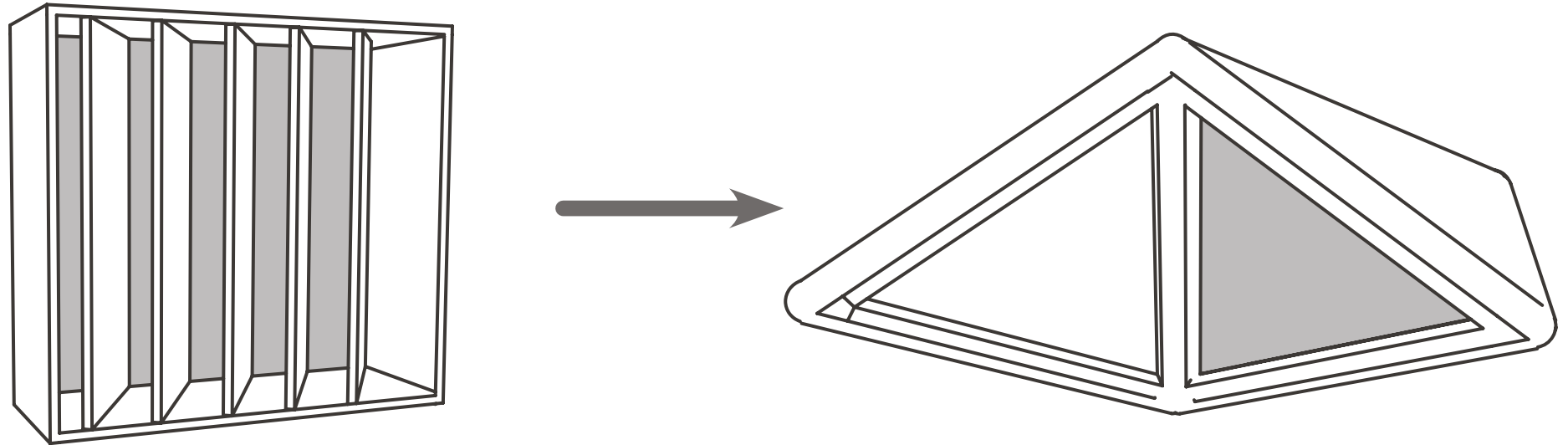
School building in Barcelona,  
Spain \ BAAS Architecture

<http://filt3rs.net/case/vertical-pivoting-louvers-school-baas-328>



## *The Cell / The Envelope / Massing / Atrium / The Building*

### Formal Criteria of the ground cell



## *The Cell / The Envelope / Massing / Atrium / The Building*

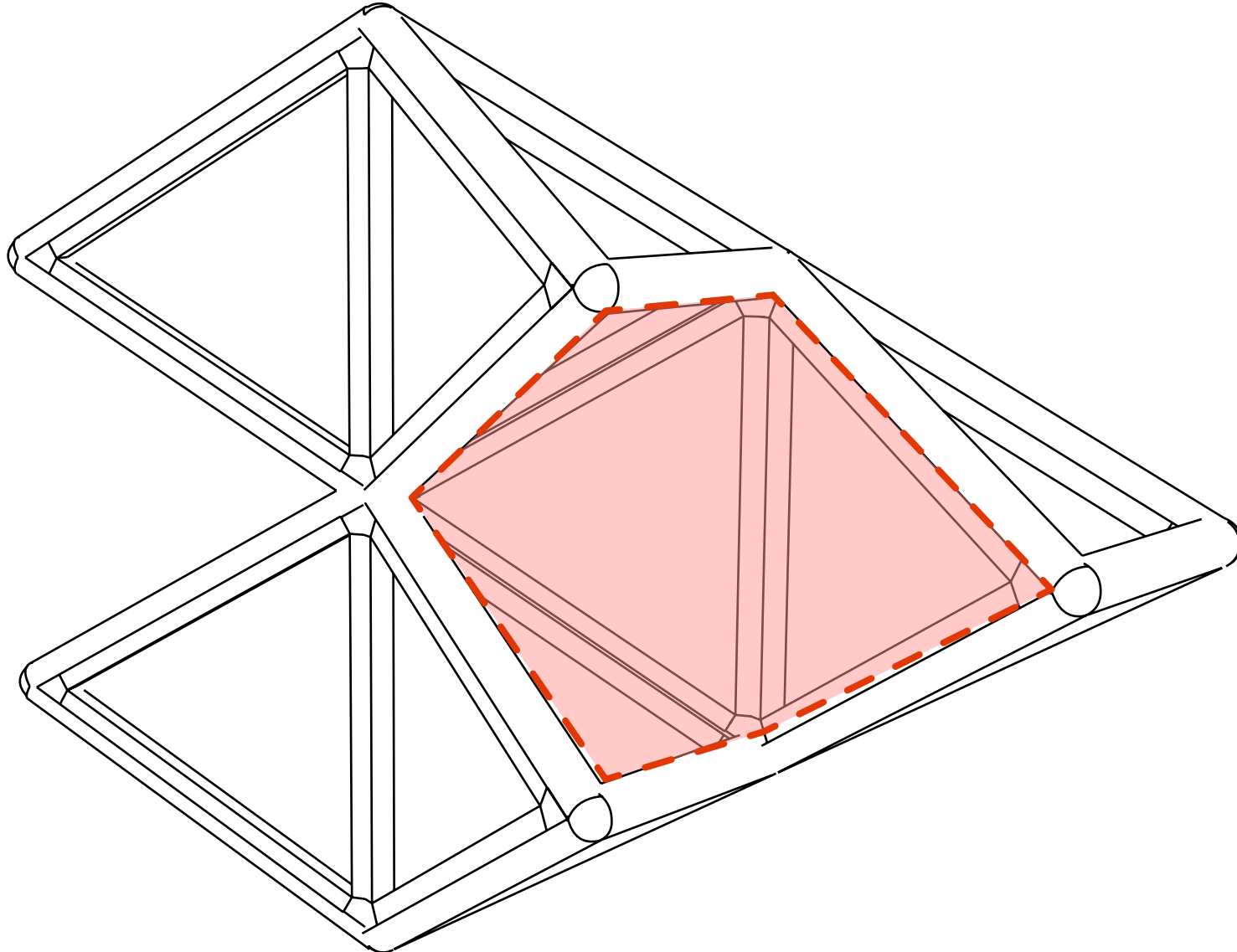
### Formal Criteria of the ground cell



Nano-engineering center's facade in barcelona university \\ Pere Joan RavellatCarme Ribas  
<http://fit3rs.net/case/glass-louvers-upc-building-179>

# *The Cell / The Envelope / Massing / Atrium / The Building*

## **Additional cell usage**



# The Cell / The Envelope / Massing / Atrium / The Building

## Additional cell usage



Grobman Axlrod



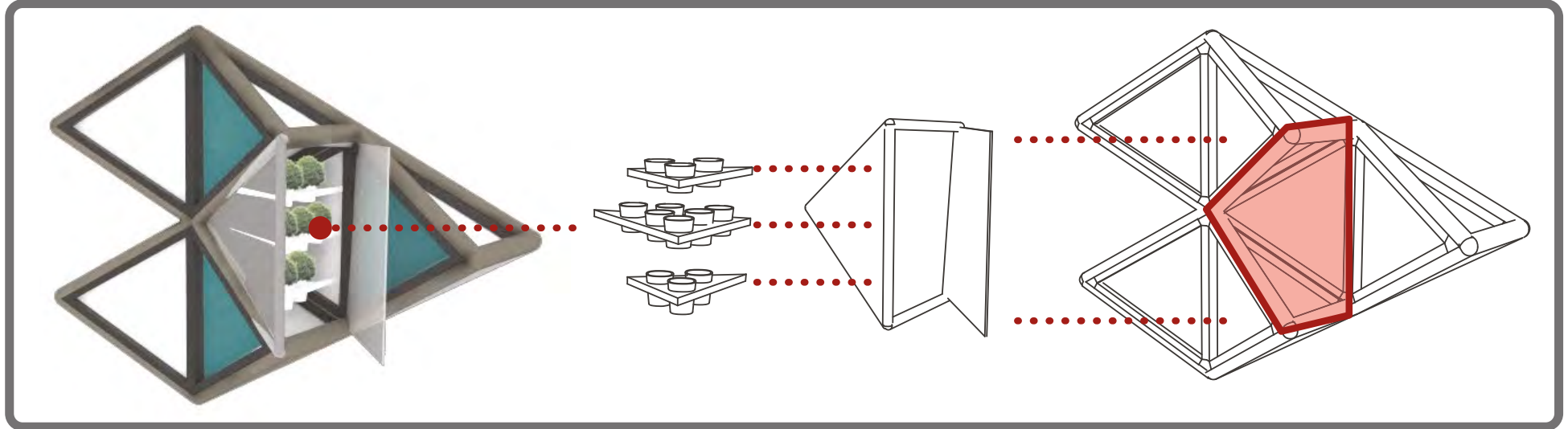
www.mouse.co.il



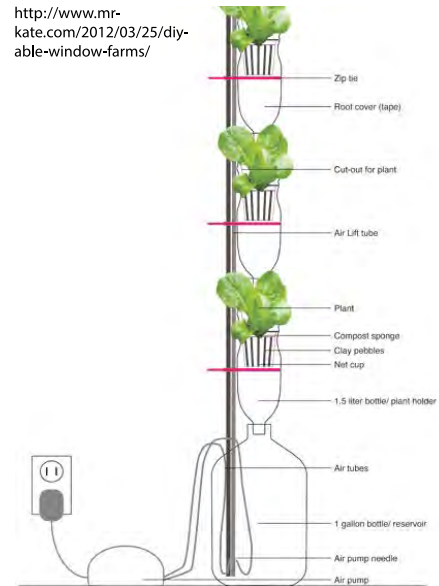
Grobman Axlrod

# The Cell / The Envelope / Massing / Atrium / The Building

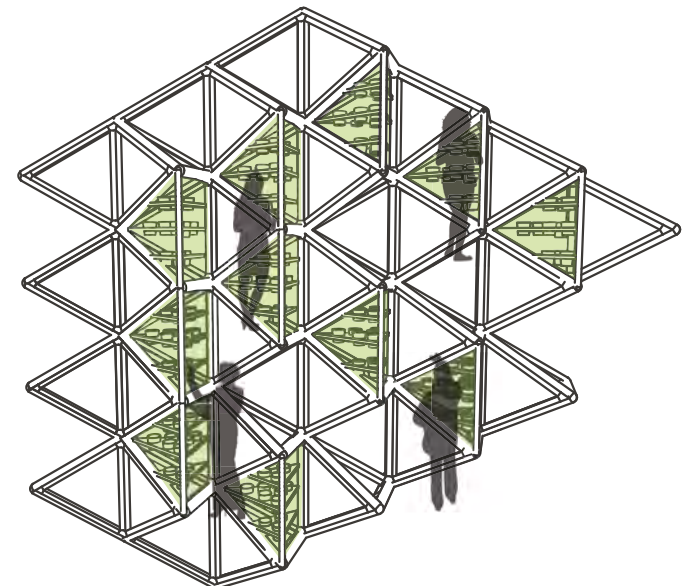
## Additional cell usage



<http://www.npr.org/.../plates/story/story.php?storyId=125504307>



<http://www.mr-kate.com/2012/03/25/diy-able-window-farms/>

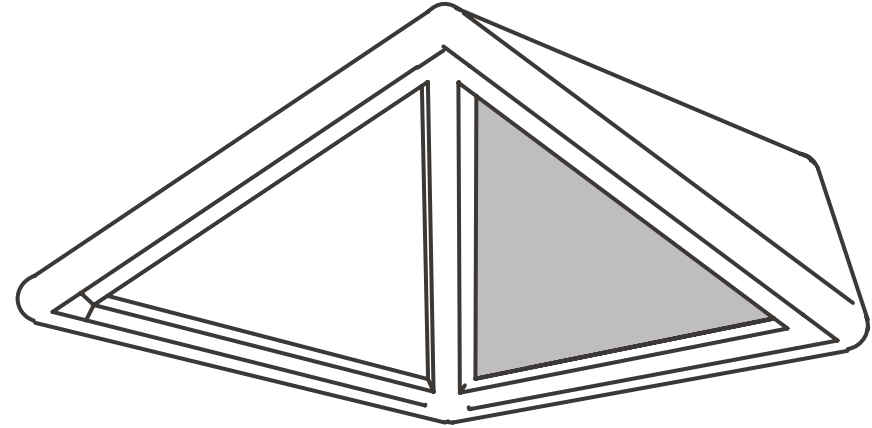
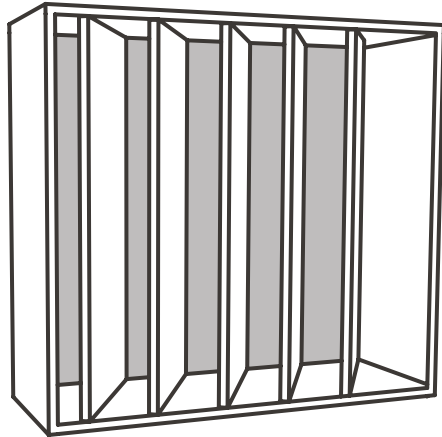




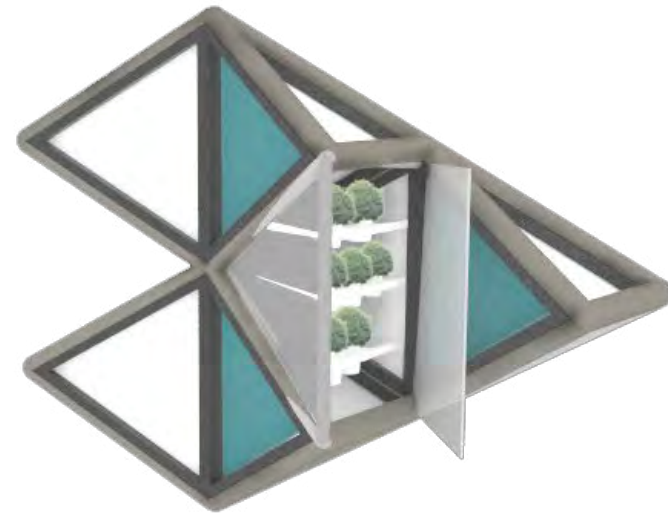
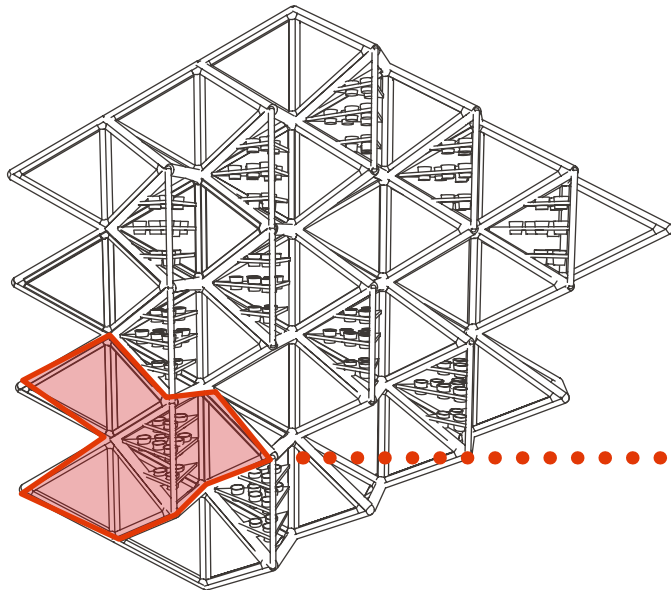
# The Cell / The Envelope / Massing / Atrium / The Building

Final criterias

**Vertical shading**

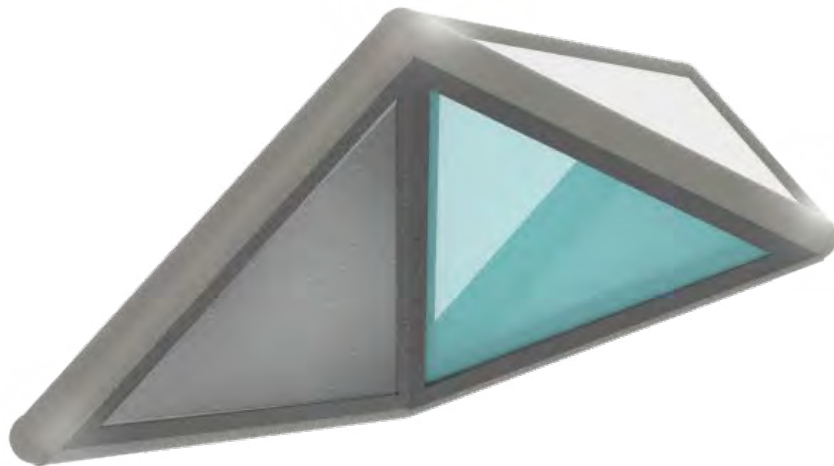


**Providing ground for vegetation growth.**

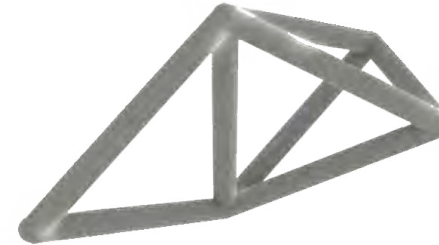


## The Cell / The Envelope / Massing / Atrium / The Building

### Details

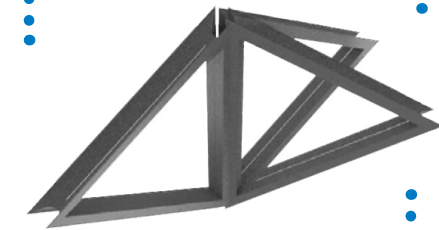


#### Structure



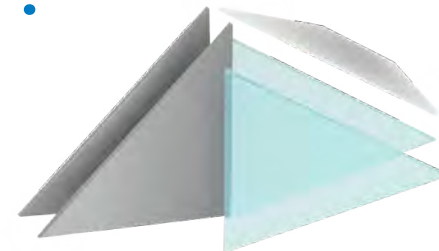
Main facade structural system is made of a **spatial truss system composed of 100 m<sup>2</sup>m tubes.**

#### Mediation



As the cell contains all of the partitions and windows it required a **mediation system between the tubed section and the partitioning systems.** The mediation system also serves a part of the isolation system.

#### Partitioning



The partitioning system composed of two types of tailings - **Double layered isolation boards** and a **Quad layered glazing system.**

# The Cell / The Envelope / Massing / Atrium / The Building

## Details

**Structure Isolation**

LIOR1		רשימת חומרים ל:
1	Aluminium [341]	0.008
2	Rigid Polystyrene Foam made by extrusion [429]	0.1
3	Aluminium [341]	0.008

U Value: 0.3689

**Isolating Boards**

LIOR1		רשימת חומרים ל:
1	isolation board	0.025
2	AirGap15mm-Upwards [646] [42]	0.05
3	isolation board	0.025

U Value: 0.4500

**Glazing isolation**

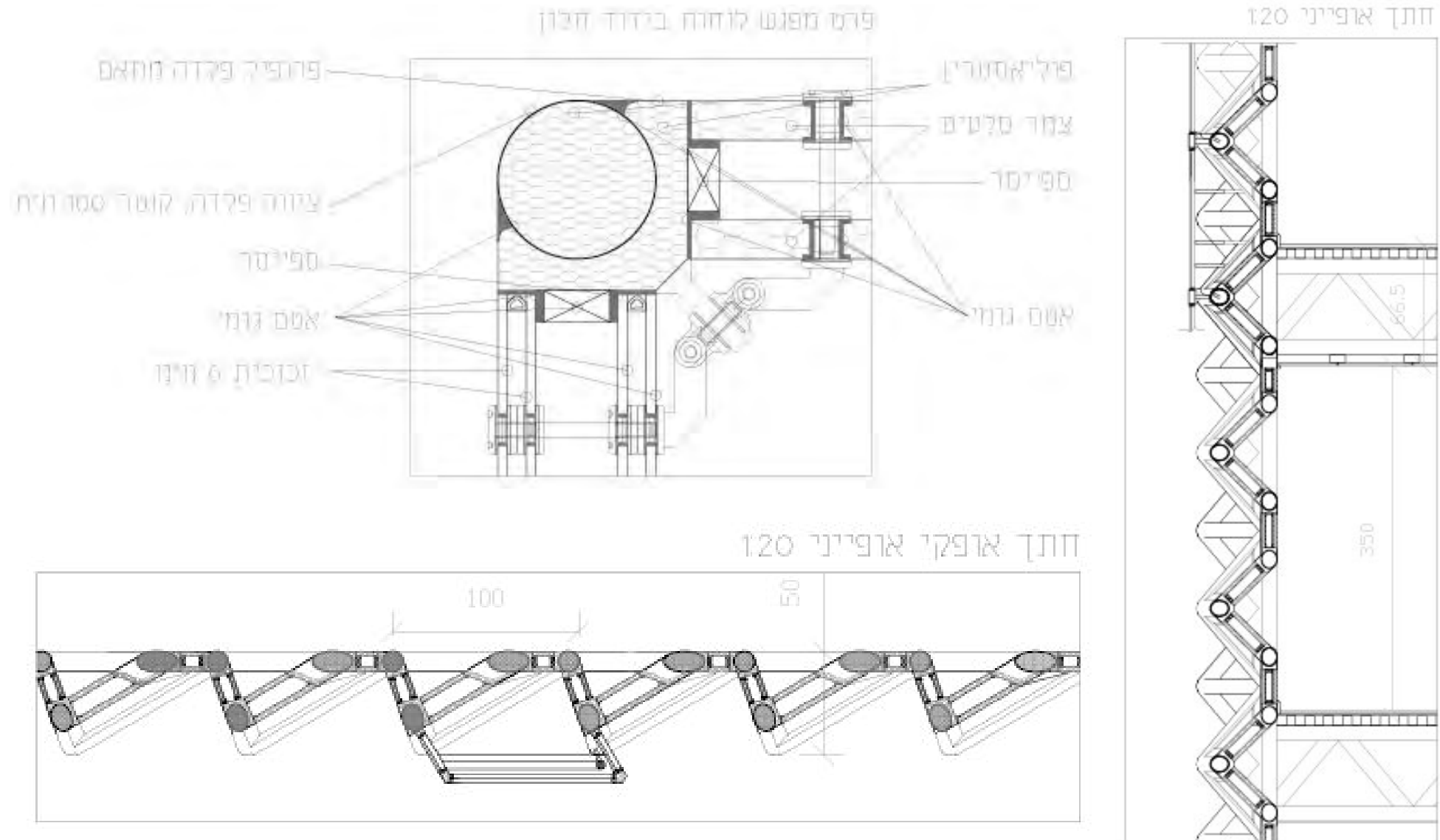
LIOR1		רשימת חומרים ל:
1	Glass [1517]	0.006
2	AirGap15mm-Upwards [646]	0.012
3	Glass [1517]	0.006
4	AirGap15mm-Upwards [646] [42]	0.05
5	Glass [1517]	0.006
7	Glass [1517]	0.006

U Value: 1.3888

Using EnergyUI TM

# The Cell / The Envelope / Massing / Atrium / The Building

## Details



*The Cell / The Envelope / Massing / Atrium / The Building*

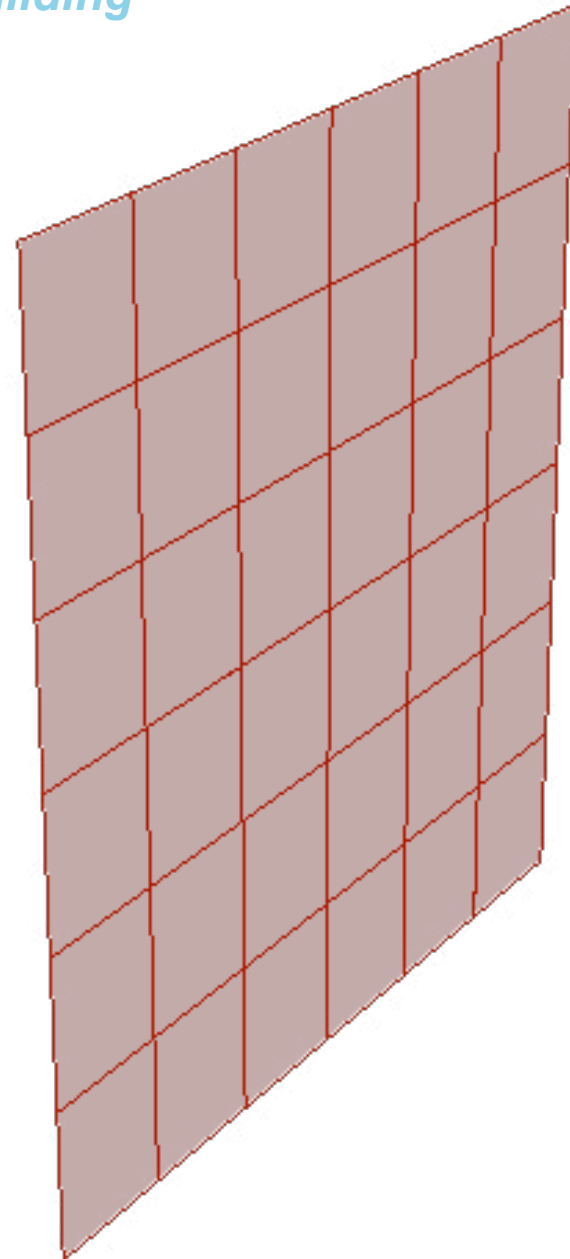
The analog result



## *The Cell / The Envelope / Massing / Atrium / The Building*

### **Parametric Population & Responsiveness**

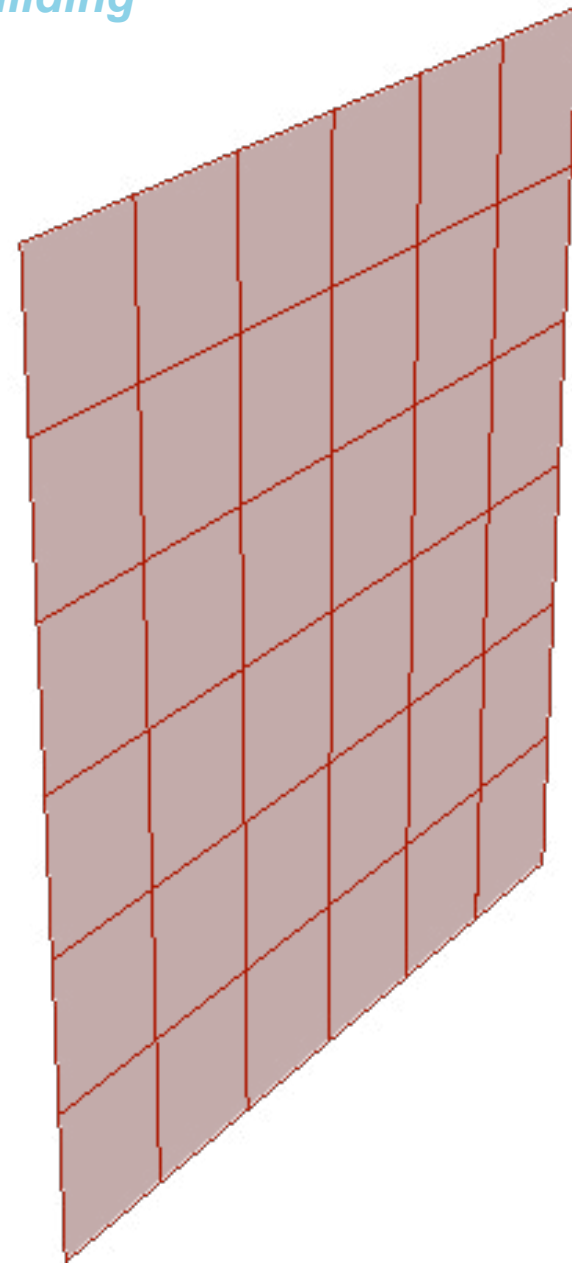
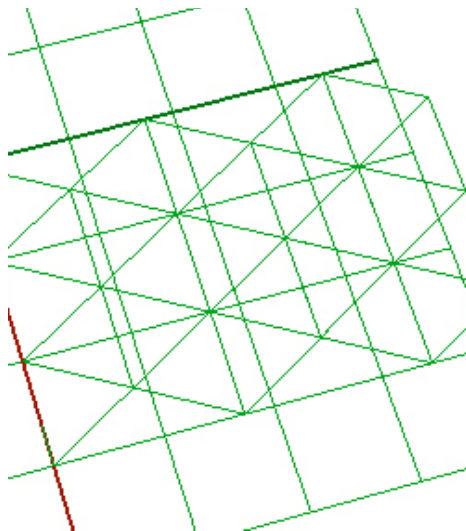
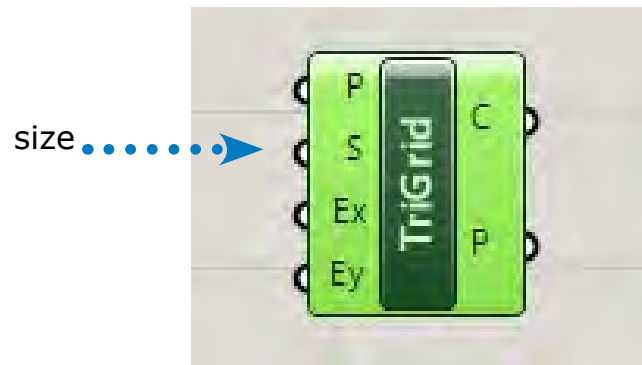
How to Populate a triangular grid on a given surface?



## *The Cell / The Envelope / Massing / Atrium / The Building*

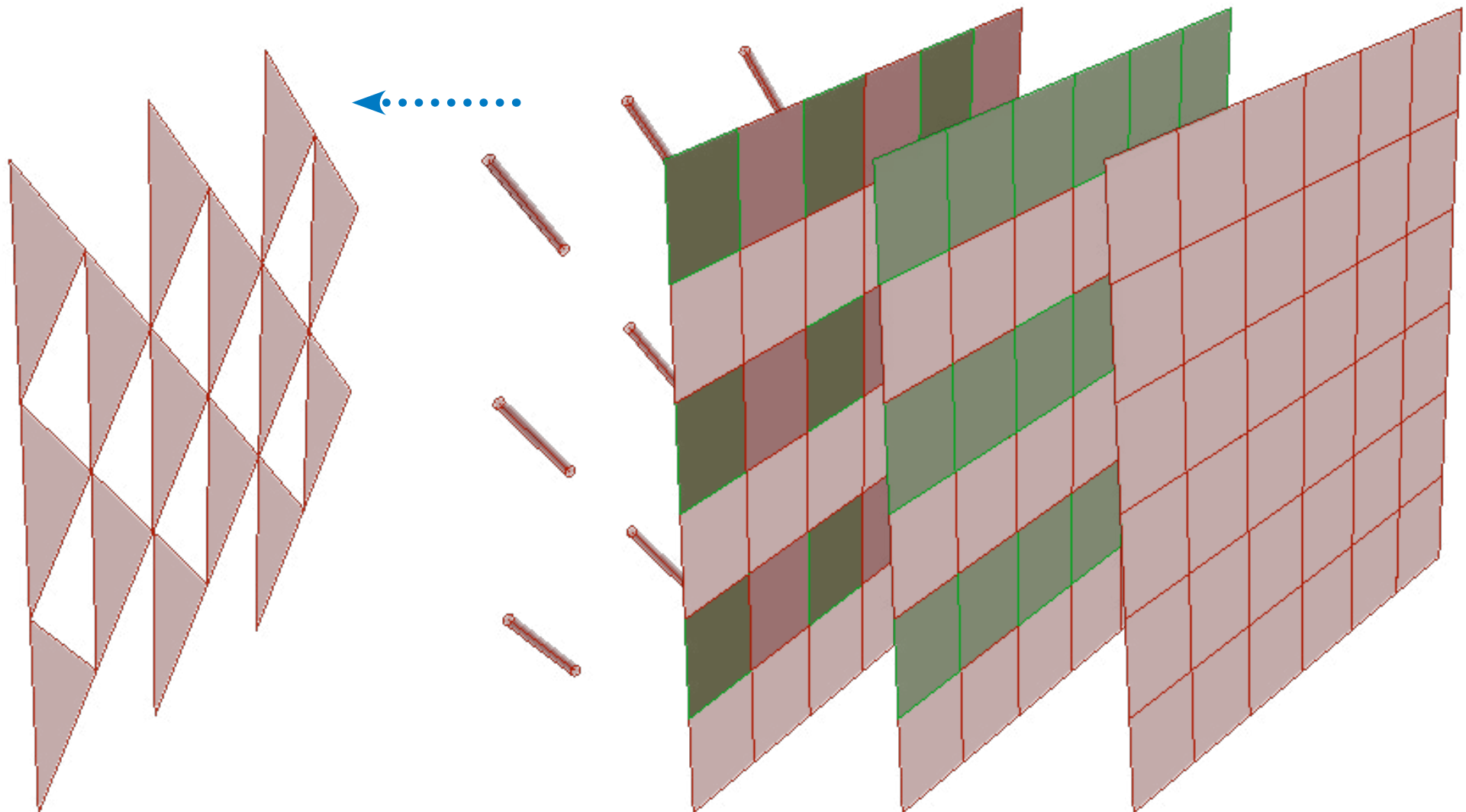
### Parametric Population & Responsiveness

How to Populate a triangular grid on a given surface?



# The Cell / The Envelope / Massing / Atrium / The Building

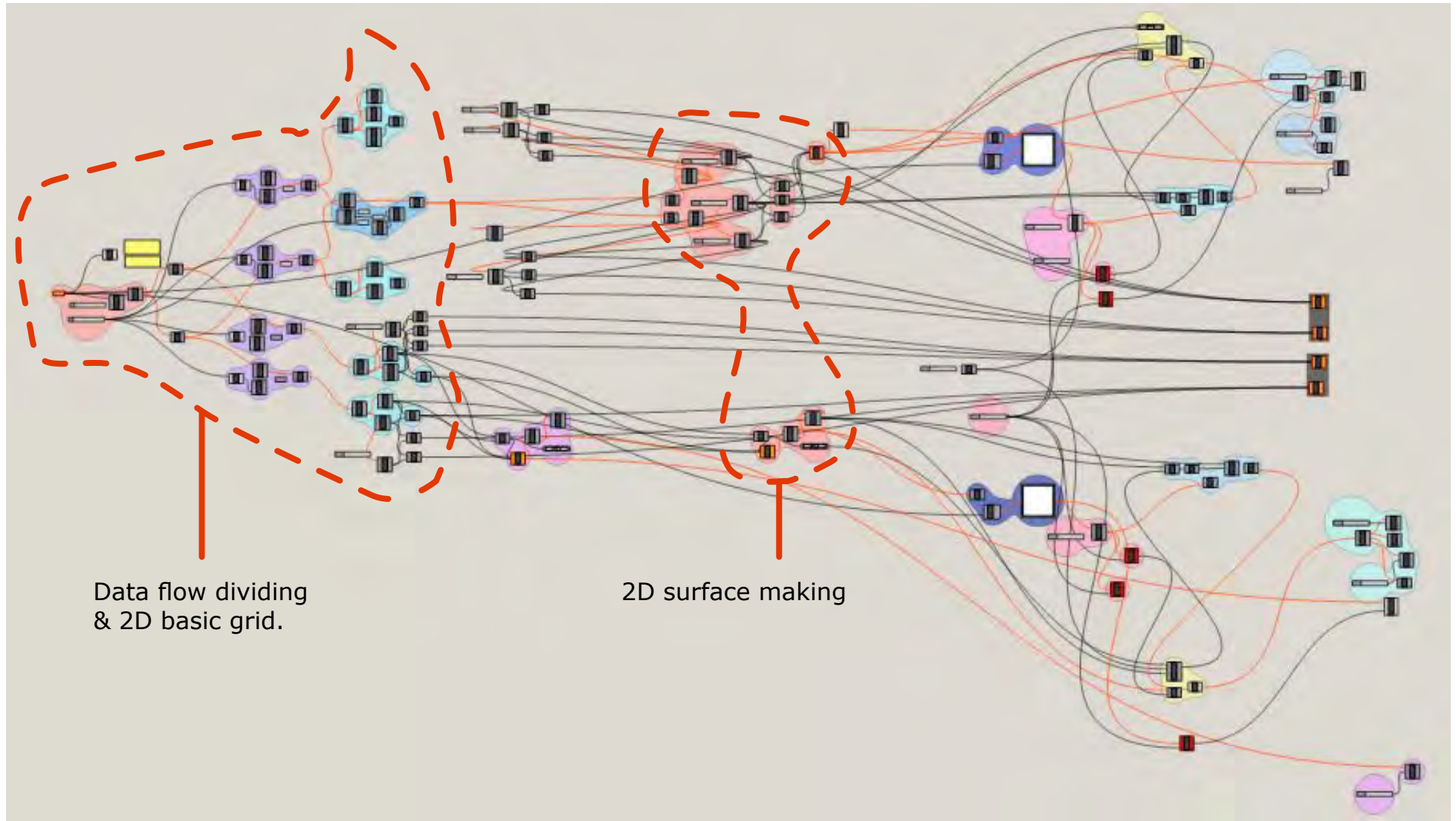
## Parametric Population & Responsiveness





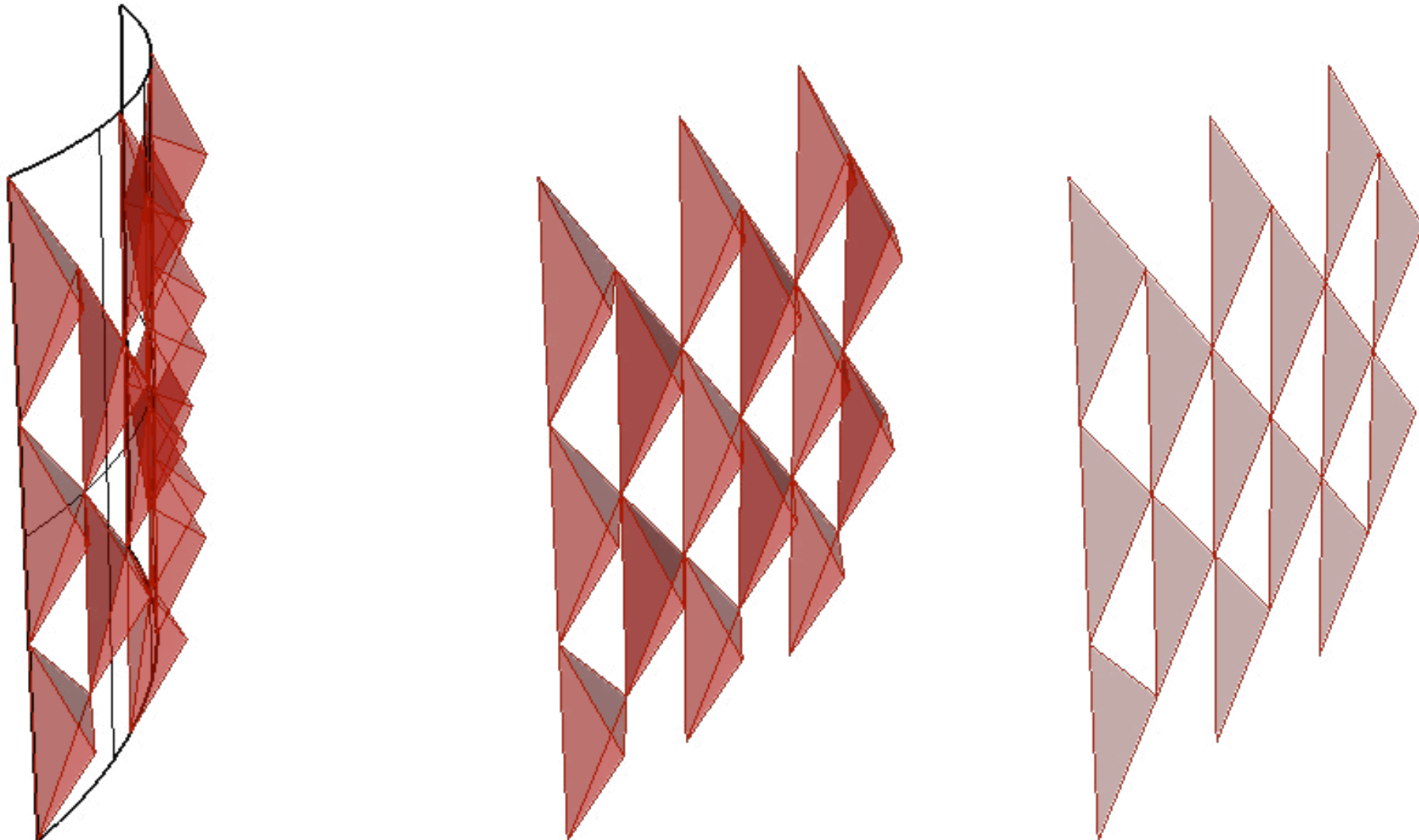
## *The Cell / The Envelope / Massing / Atrium / The Building*

### Parametric Population & Responsiveness



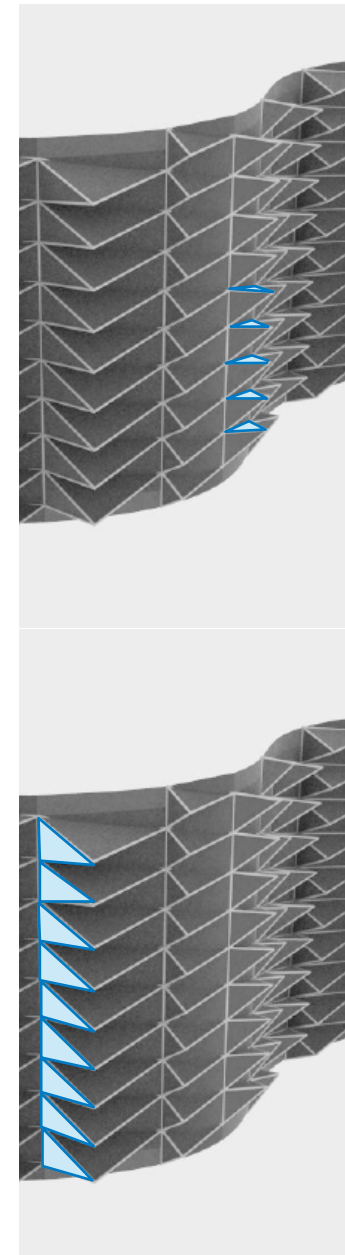
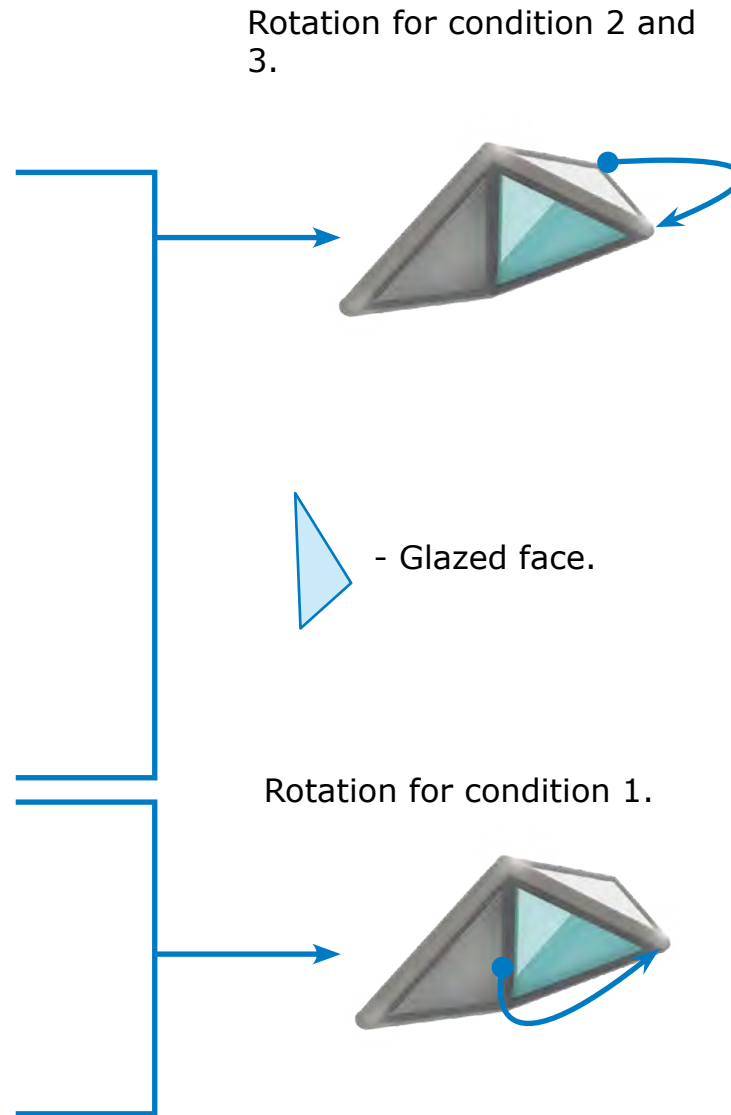
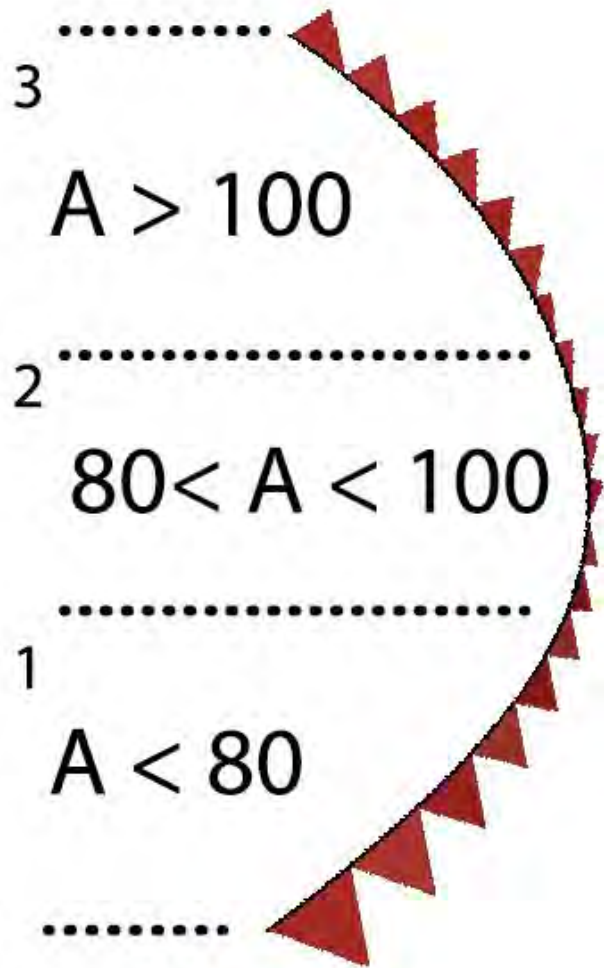
# *The Cell / The Envelope / Massing / Atrium / The Building*

## **Parametric Population & Responsiveness**



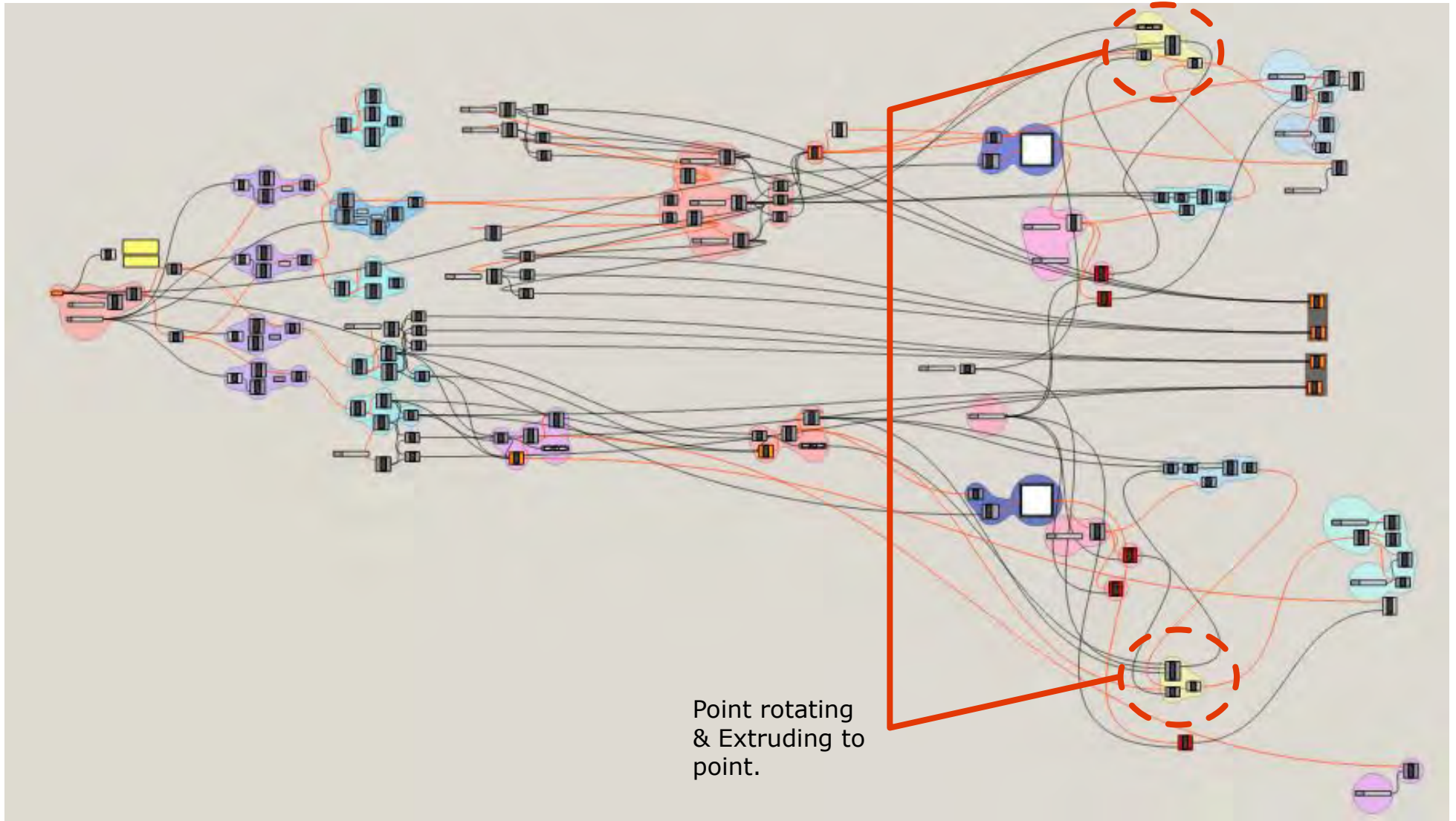
# The Cell / The Envelope / Massing / Atrium / The Building

## Parametric Population & Responsiveness



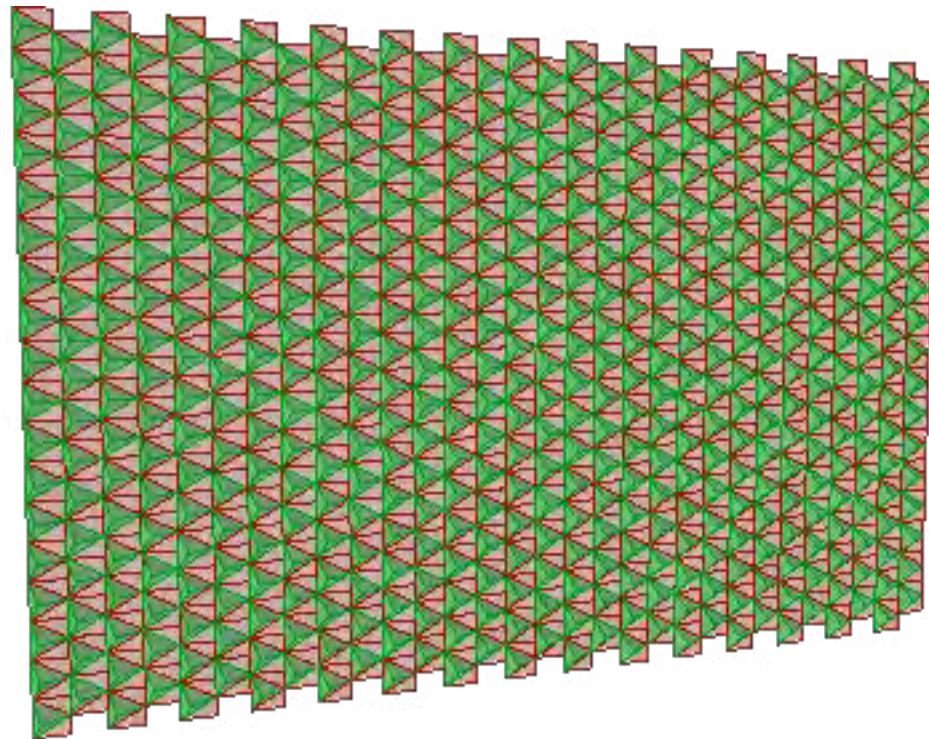
# The Cell / The Envelope / Massing / Atrium / The Building

## Parametric Population & Responsiveness



# *The Cell / The Envelope / Massing / Atrium / The Building*

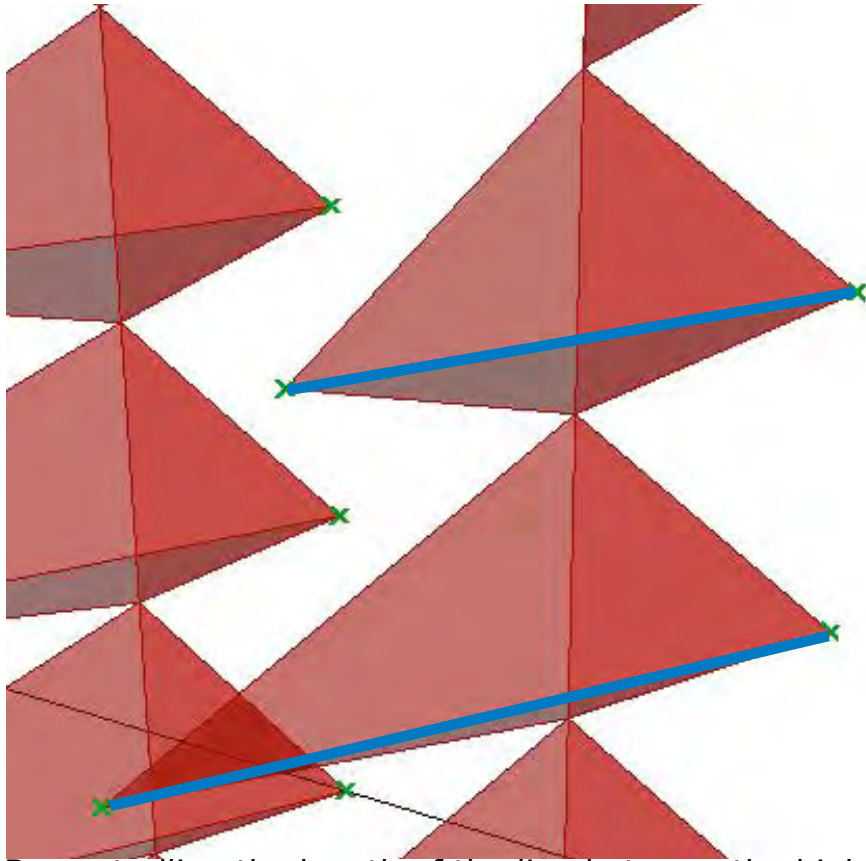
## Parametric Population & Responsiveness



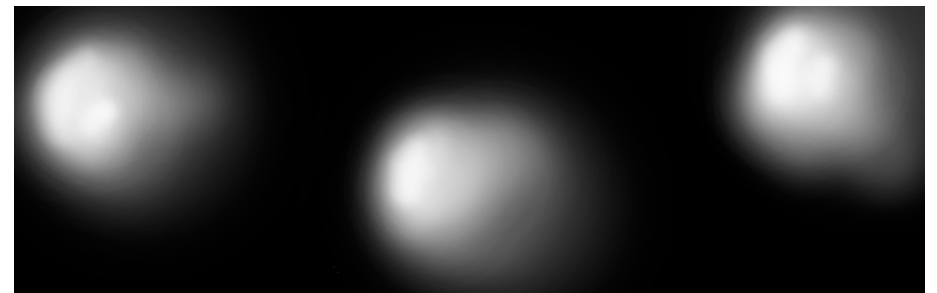
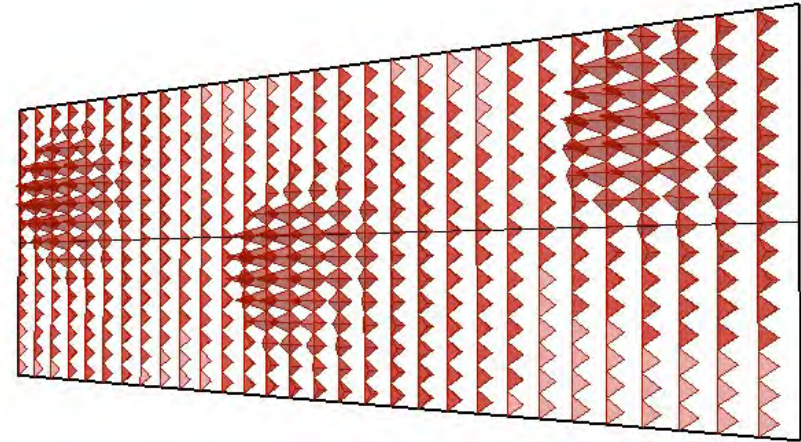
## *The Cell / The Envelope / Massing / Atrium / The Building*

### Parametric Population & Responsiveness

Another level of complexity was add to the system - using image sampling in grasshopper.

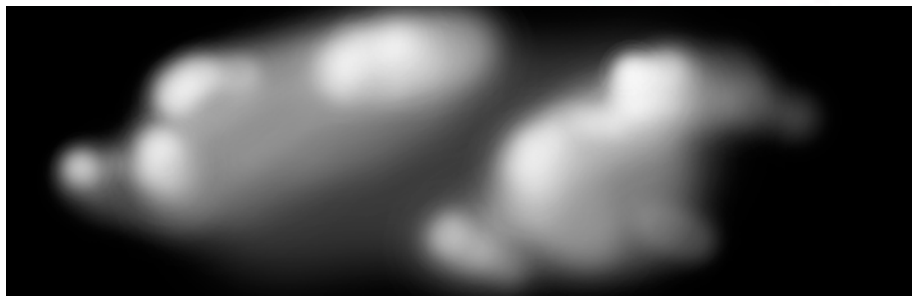
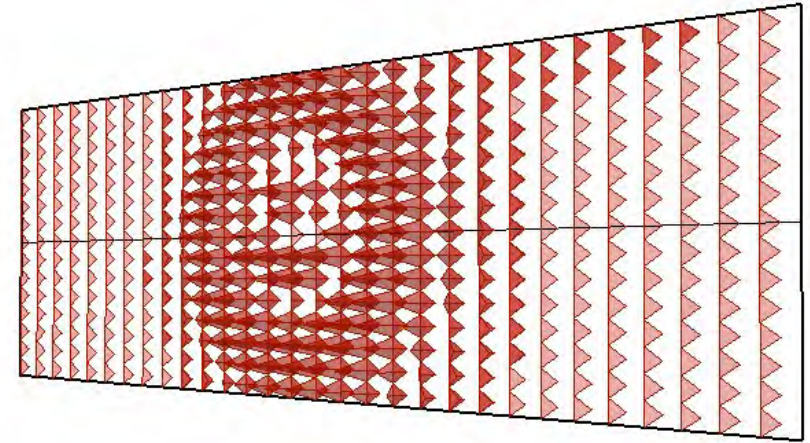
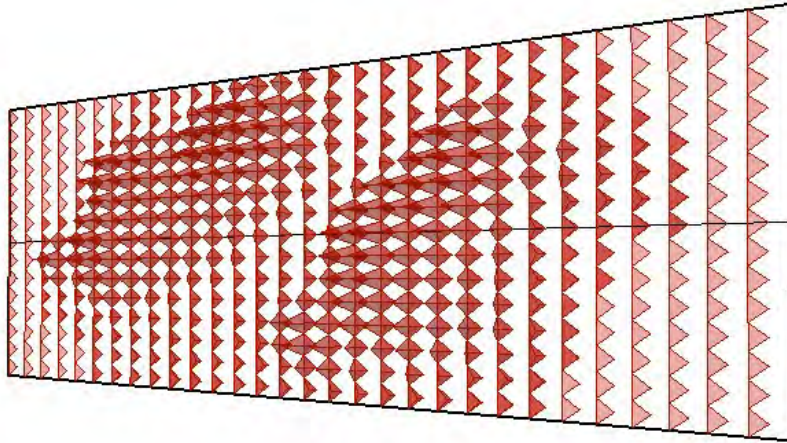


By controlling the length of the line between the high lightened points in a performance based code of sampling radiation levels analysis - a more fluidic transformation could be achieved.



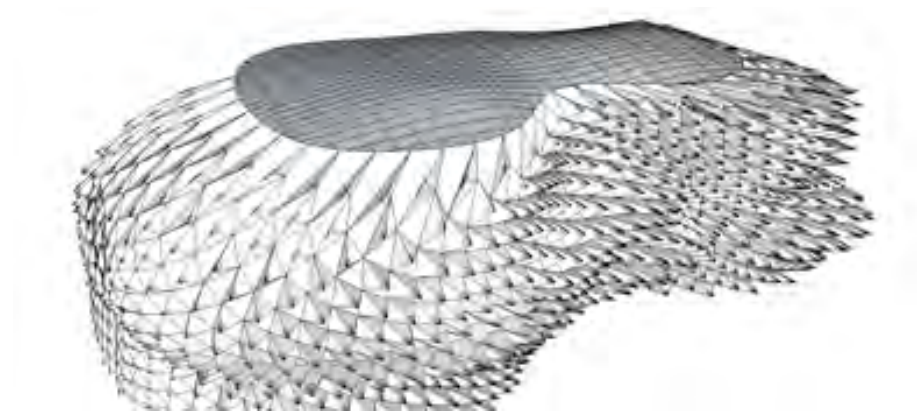
# The Cell / The Envelope / Massing / Atrium / The Building

## Parametric Population & Responsiveness

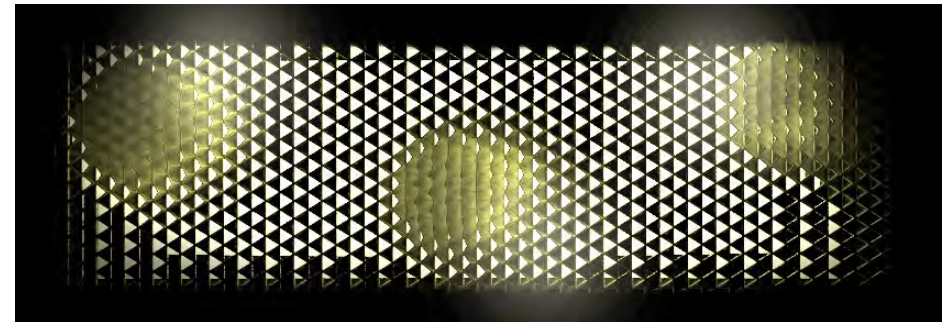


## The Cell / The Envelope / Massing / Atrium / The Building

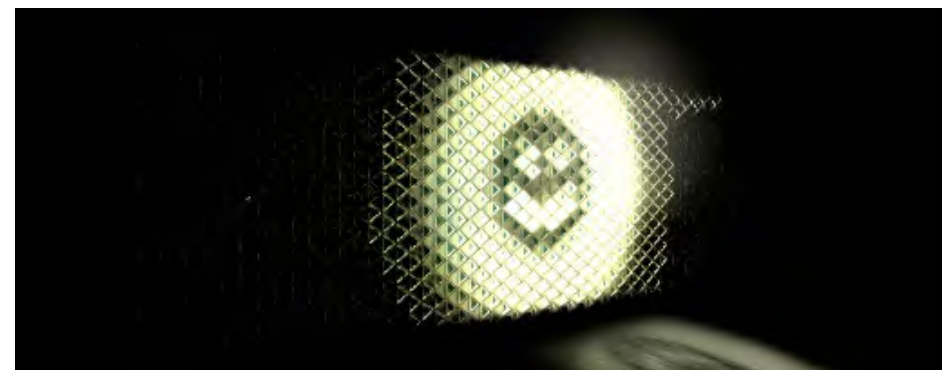
### Parametric Population & Responsiveness



Using the image sampling to distinguish areas which are less exposed.



Using image sampling to emphasize exposure of certain areas .



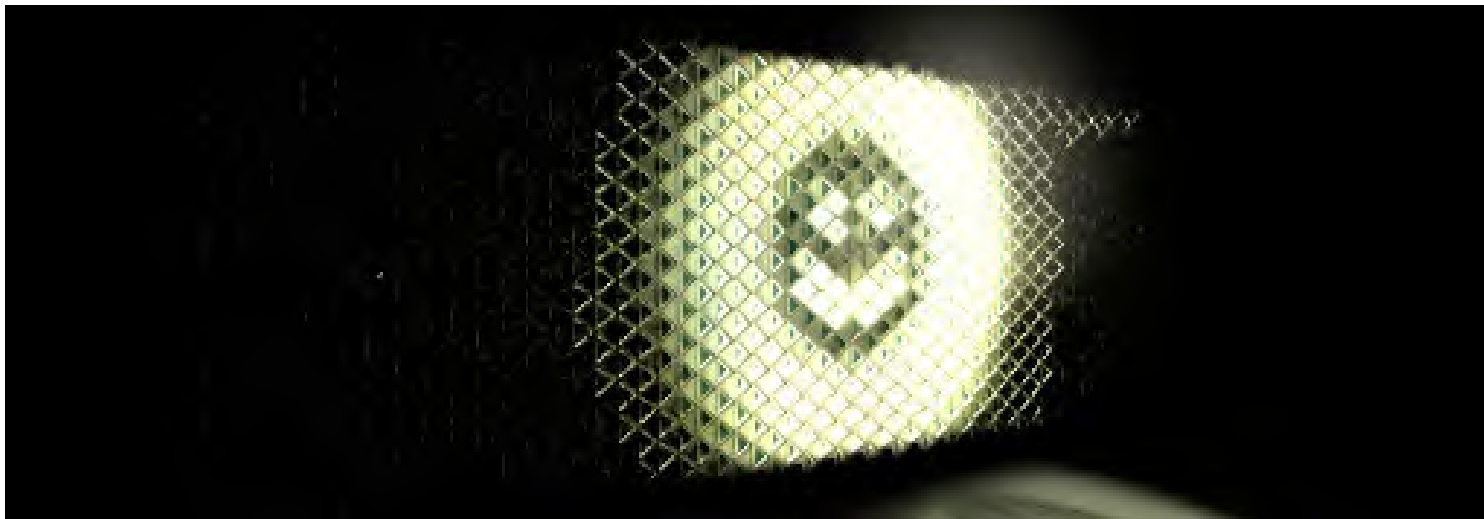
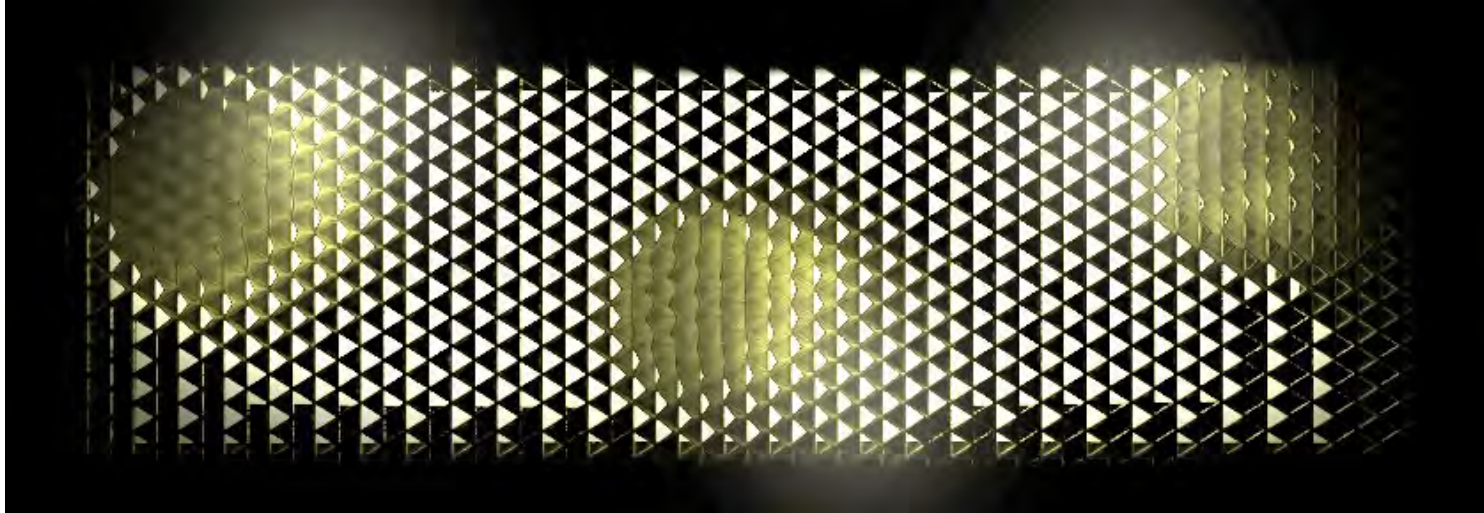
By adding additional levels, layers of information the envelope could respond to other parameters such as privacy, hierarchy, function, directional views and more.

Thus making the building, through the envelope, more **readable and coherent to his environment** - and by that even more **responsive!**



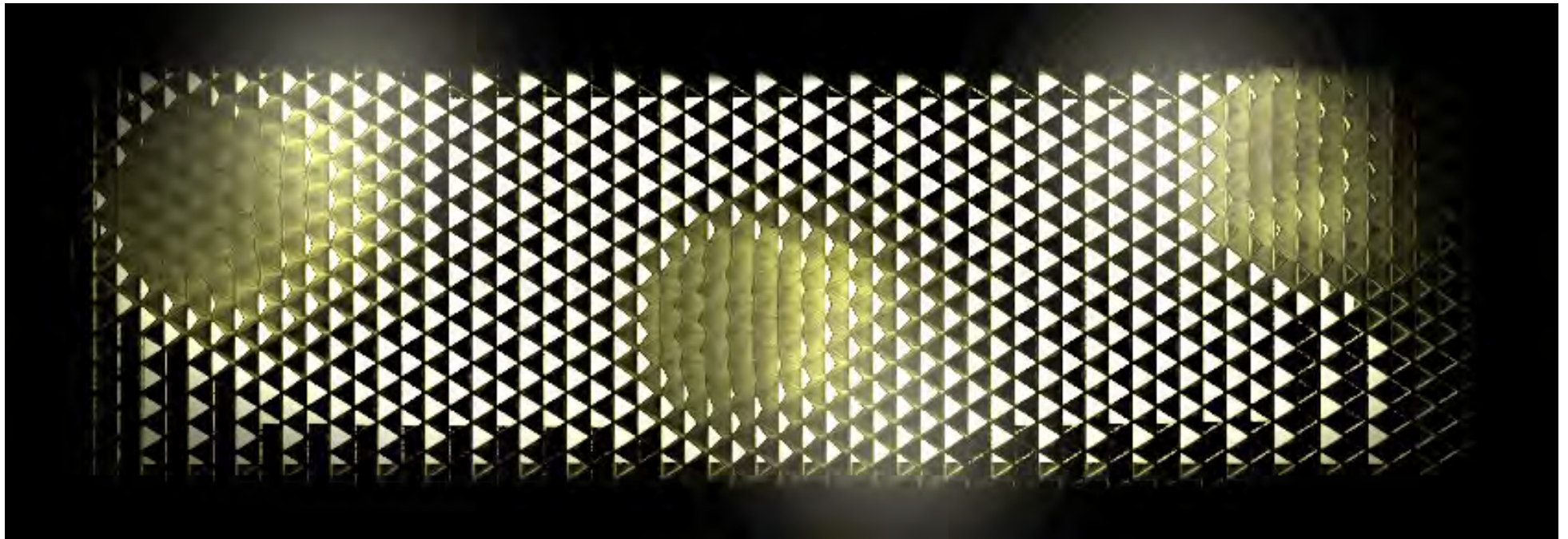
# *The Cell / The Envelope / Massing / Atrium / The Building*

## Parametric Population & Responsiveness



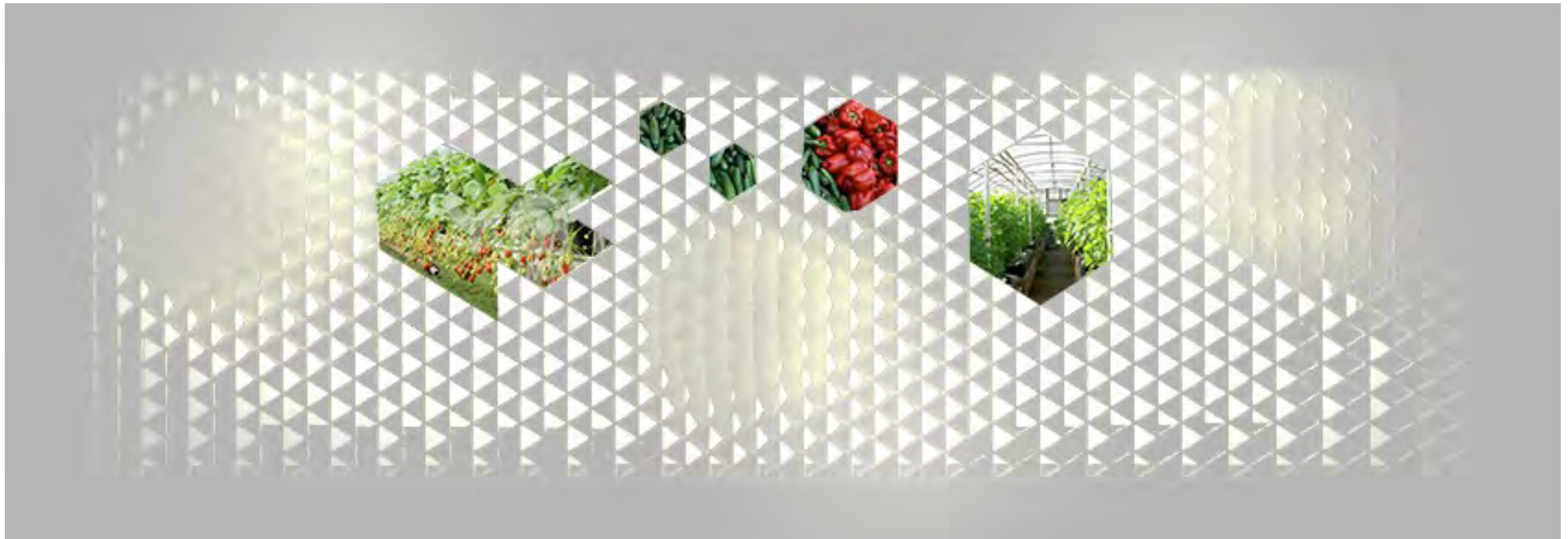
*The Cell / The Envelope / Massing / Atrium / The Building*

**Parametric Population & Responsiveness**

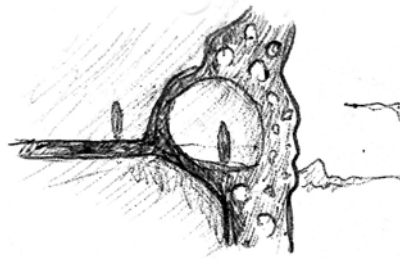


## *The Cell / The Envelope / Massing / Atrium / The Building*

### Parametric Population & Responsiveness



By using the fractal abilities of the triangle several cell could be joined together in order to create envelope elements in a higher hierarchy. Elements that could fade the difference between envelope and building.

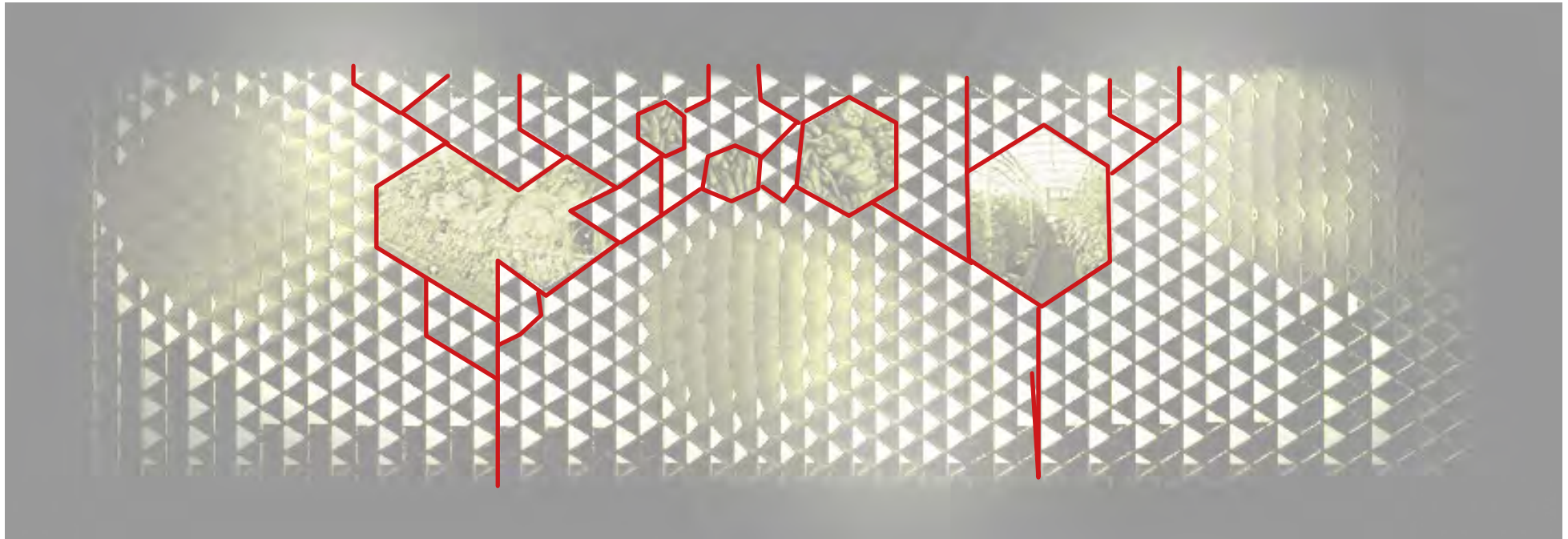


Using those new elements or even new volumes for urban agriculture adding a new use for the building with relatively low floor area being consumed for it.

**CITY** SUSTAINABILITY  
**COMMUNITY**

## *The Cell / The Envelope / Massing / Atrium / The Building*

### Parametric Population & Responsiveness

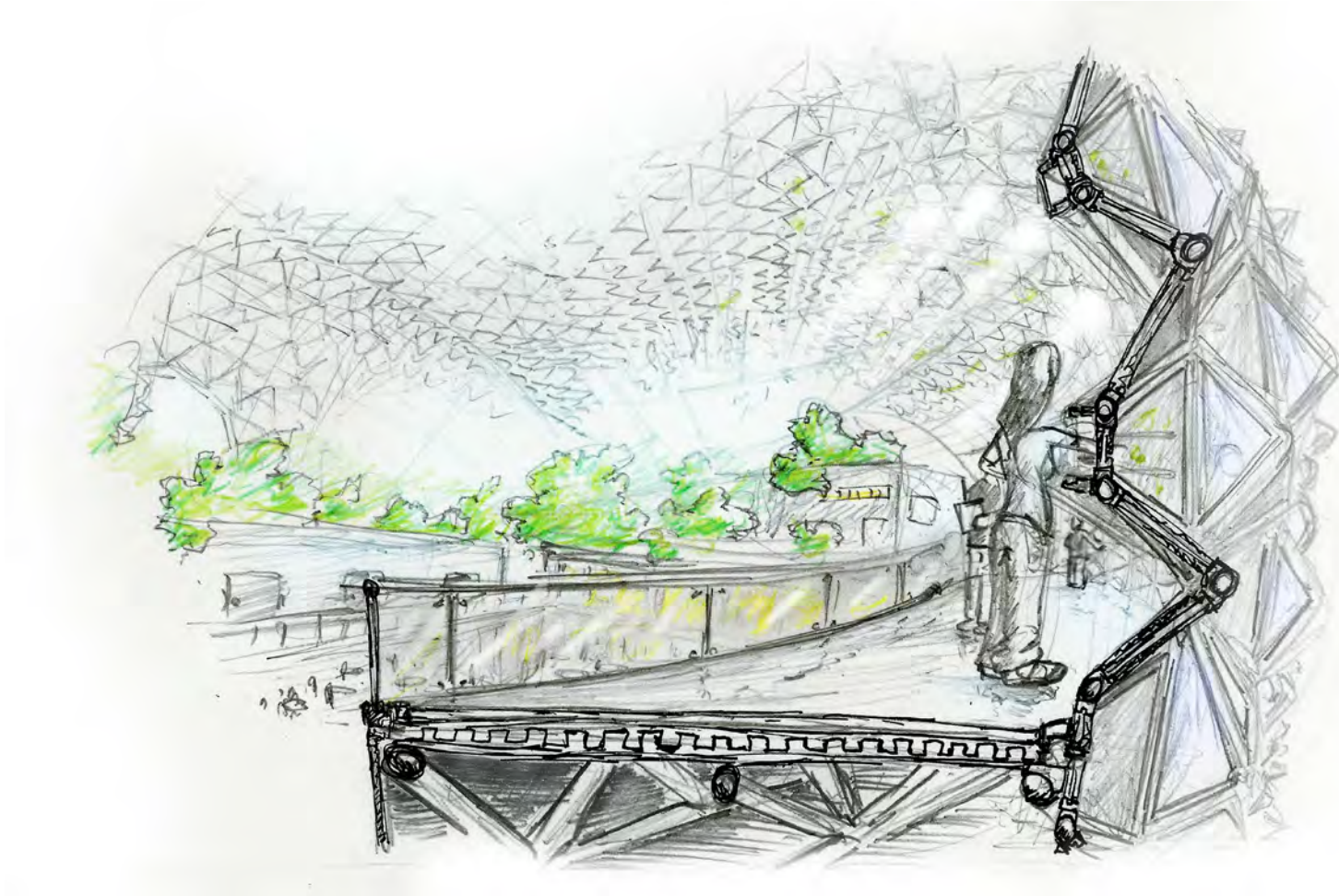


The merging of several cells into a unified volume means adding additional constrains: The structural loads are now greater and will require a thickening of structural elements, drainage - the cell size to drain is significantly bigger now and that will also require an enlargement of pipes ex...

Those additional constrains could be a new level of hierarchy! Contributing to the further understanding of the building and further emphasizing important functions and concepts.

## *The Cell / The Envelope / Massing / Atrium / The Building*

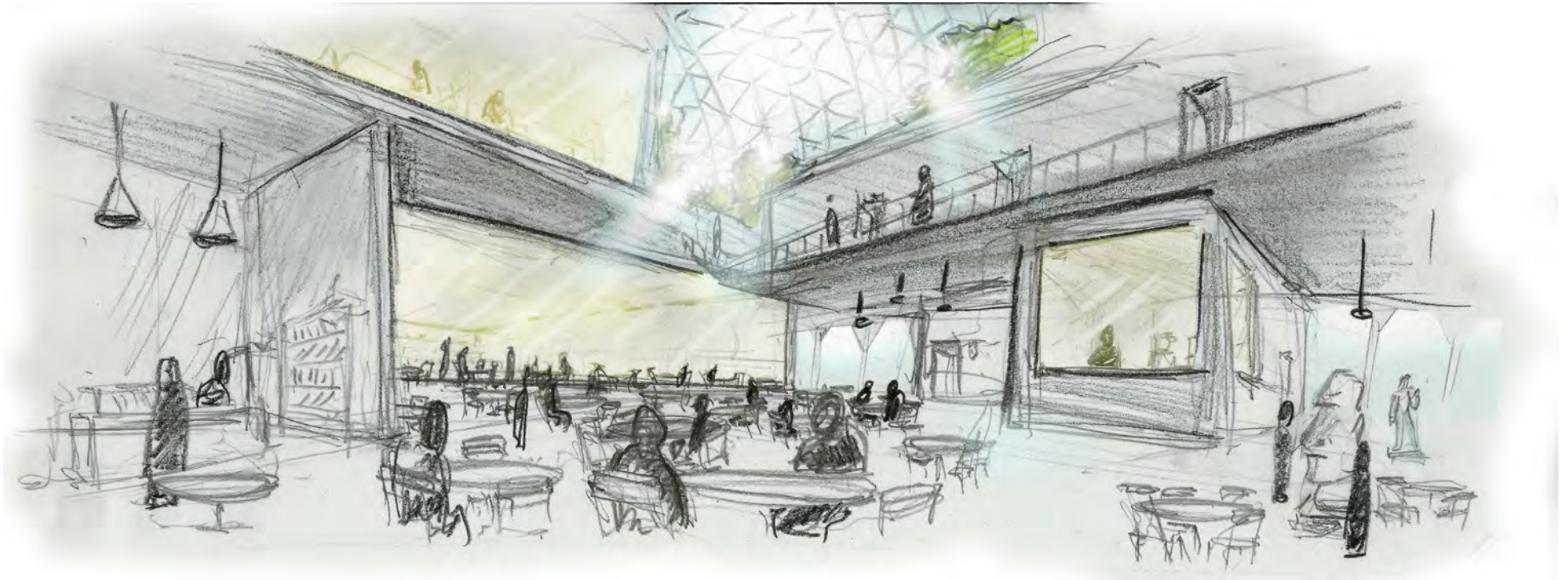
### Parametric Population & Responsiveness



Sketches from the early stage of the project

## *The Cell / The Envelope / Massing / Atrium / The Building*

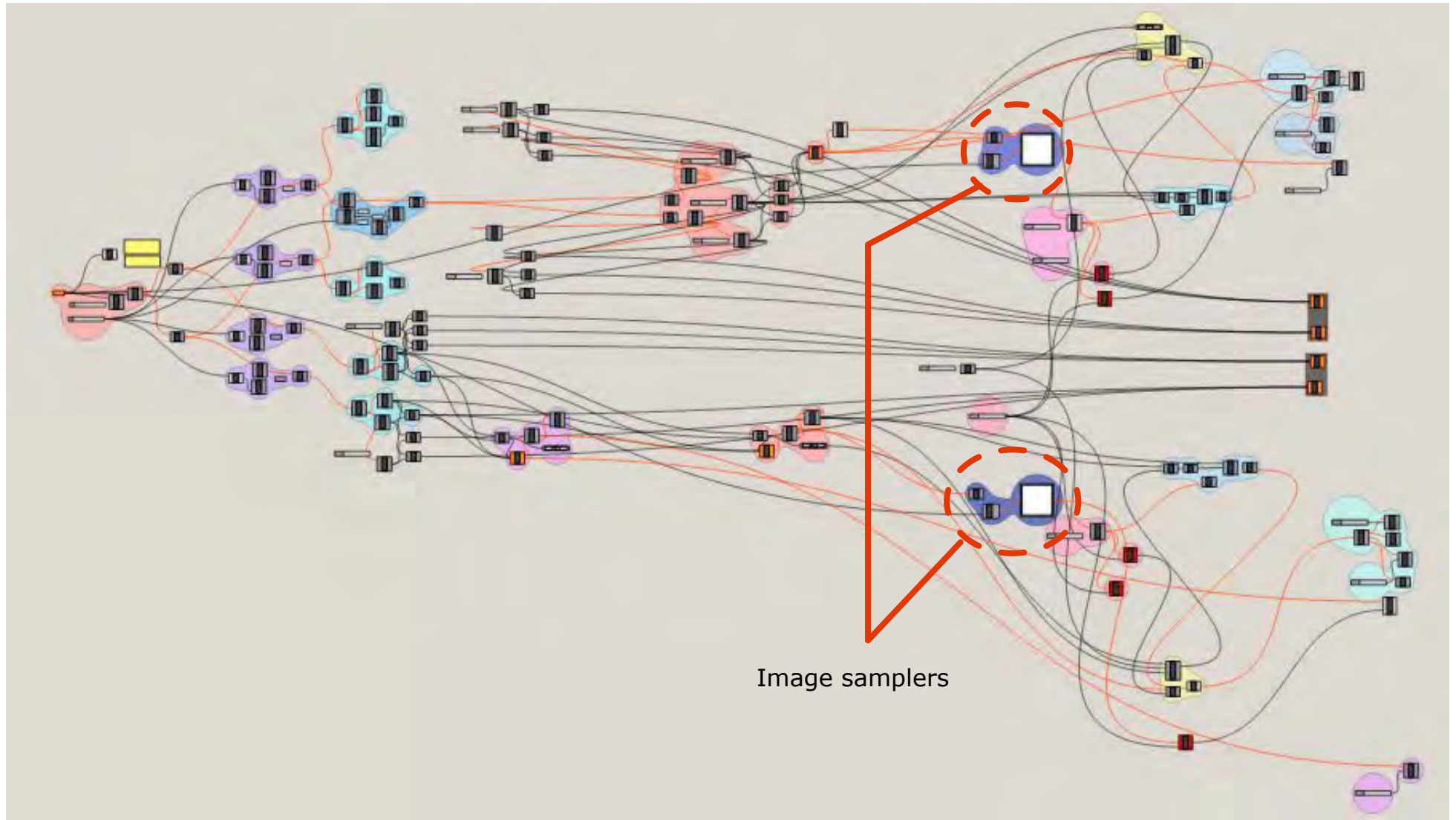
### Parametric Population & Responsiveness



Sketches from the early stage of the project

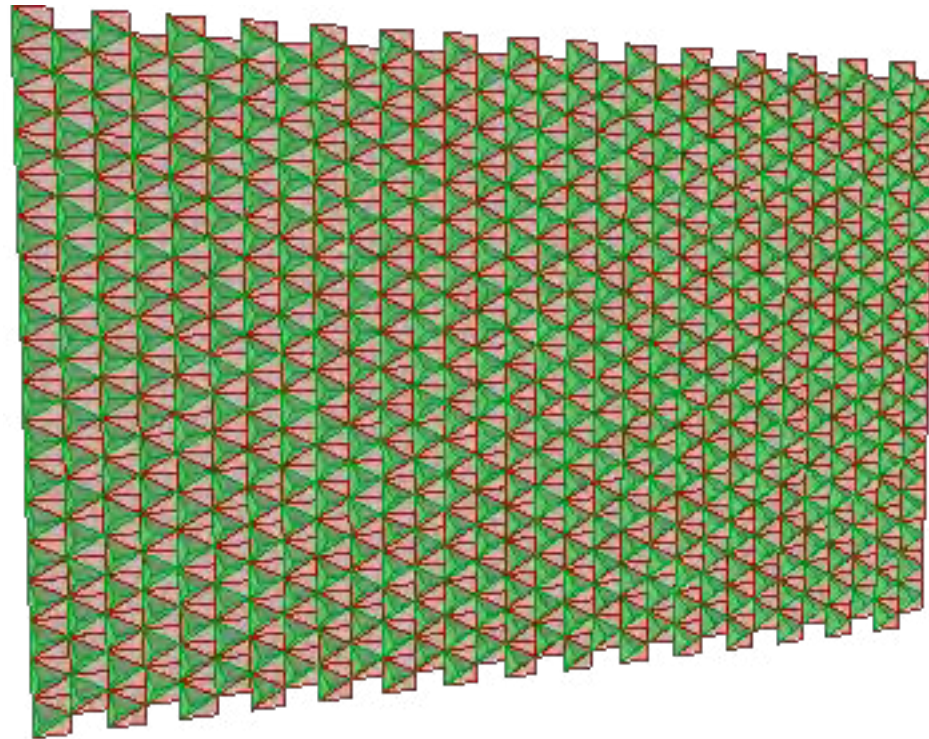
# The Cell / The Envelope / Massing / Atrium / The Building

## Parametric Population & Responsiveness



# *The Cell / The Envelope / Massing / Atrium / The Building*

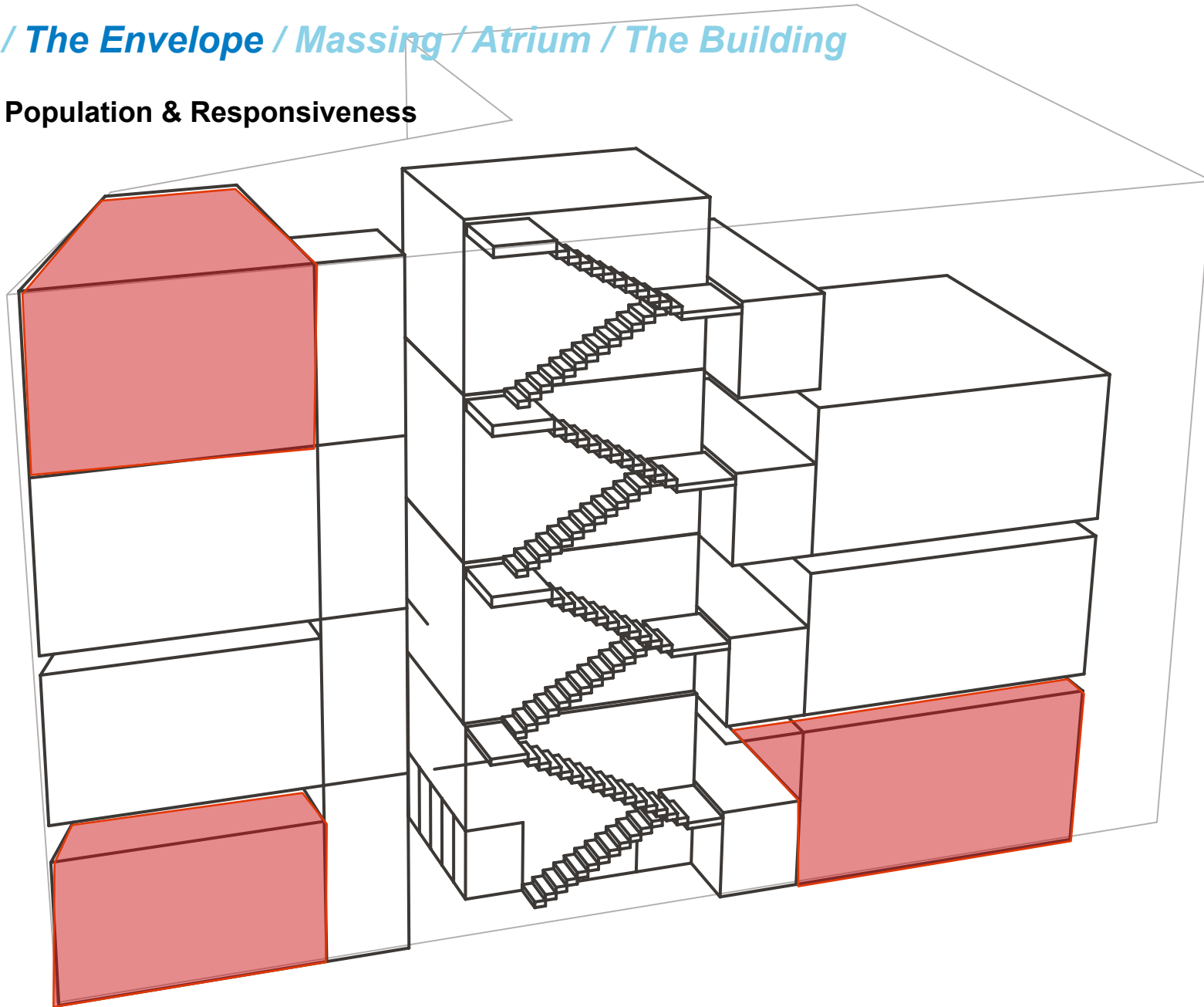
## Parametric Population & Responsiveness





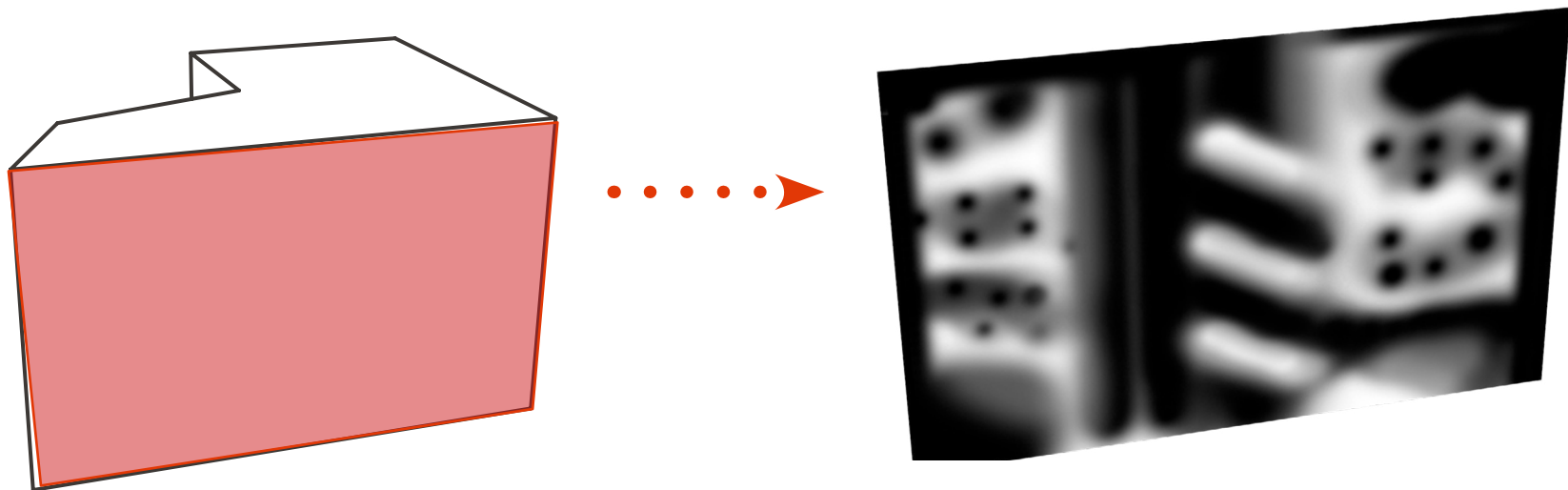
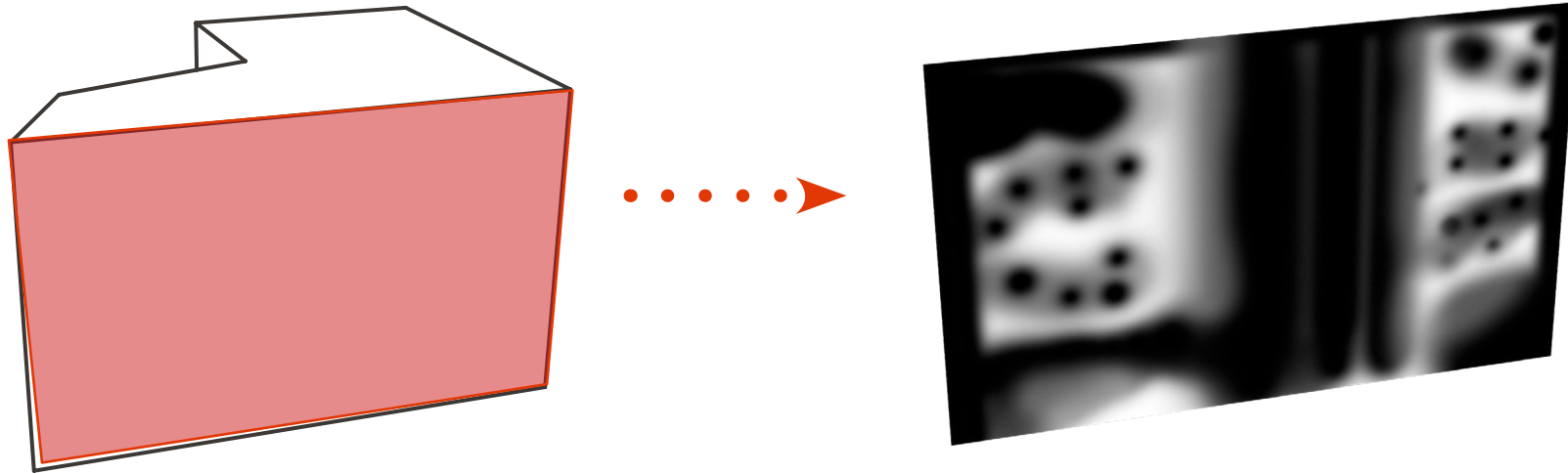
# *The Cell / The Envelope / Massing / Atrium / The Building*

## **Parametric Population & Responsiveness**



# The Cell / The Envelope / Massing / Atrium / The Building

## Parametric Population & Responsiveness

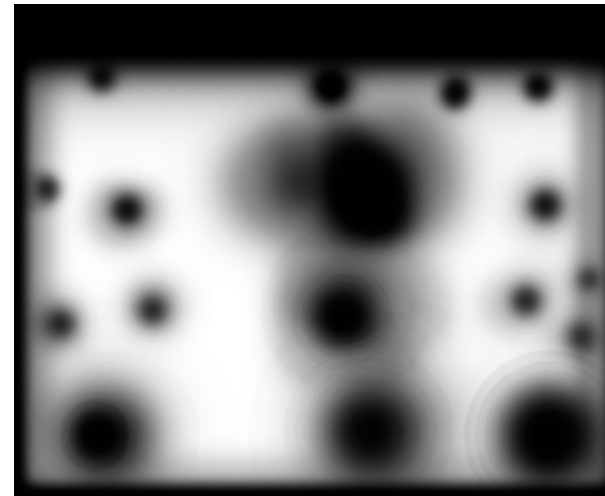


## *The Cell / The Envelope / Massing / Atrium / The Building*

### Parametric Population & Responsiveness



north map a



south map a



north map b



south map b

# *The Cell / The Envelope / Massing / Atrium / The Building*

## Parametric Population & Responsiveness



east map a



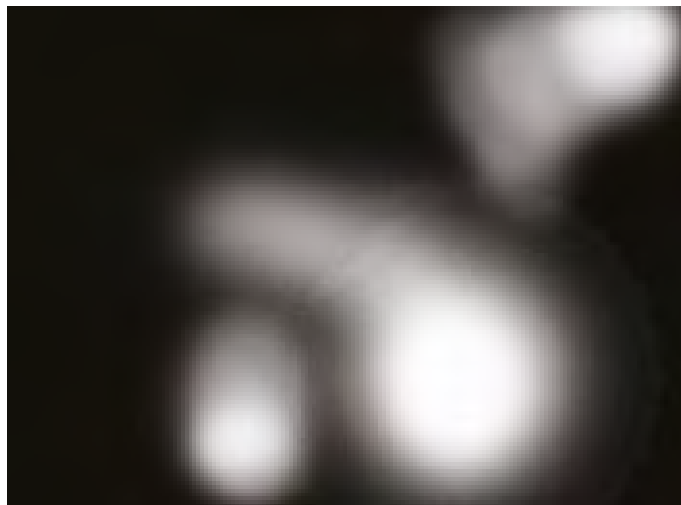
east map b

# The Cell / The Envelope / Massing / Atrium / The Building

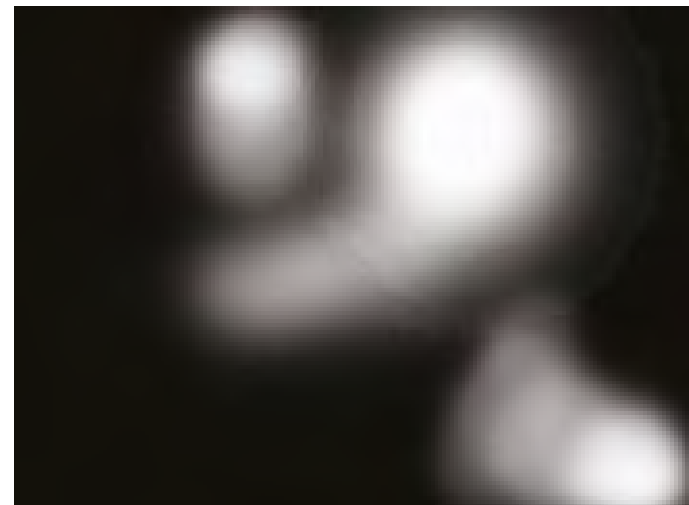
## Parametric Population & Responsiveness



west map a



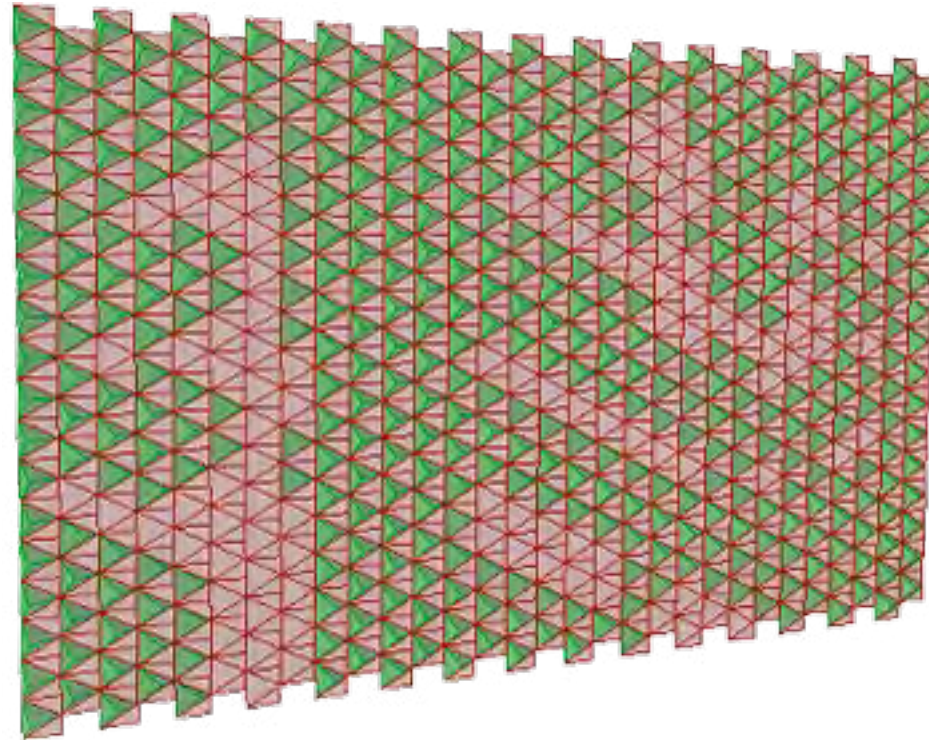
roof map a



roof map b

# *The Cell / The Envelope / Massing / Atrium / The Building*

## Parametric Population & Responsiveness

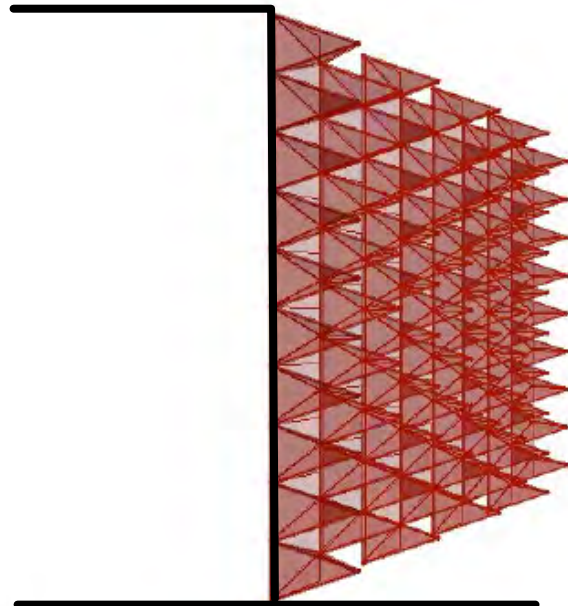
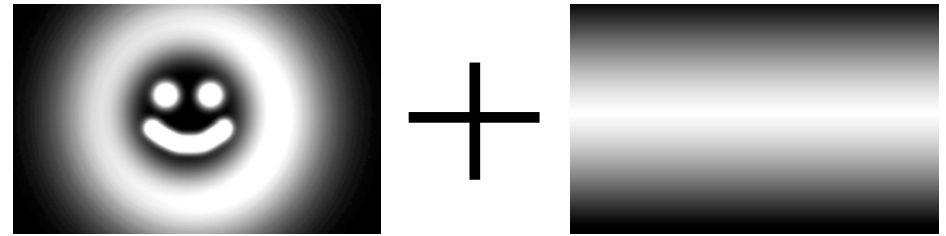


# The Cell / The Envelope / Massing / Atrium / The Building

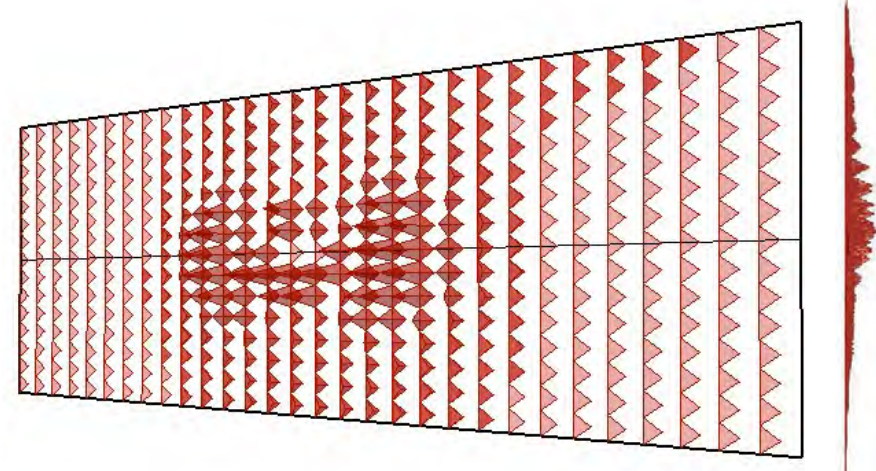
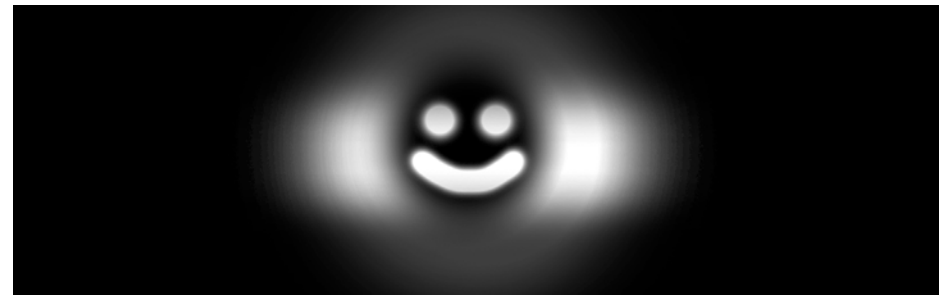
## Parametric Population & Responsiveness

### Edge Detail

How to meet the roof?



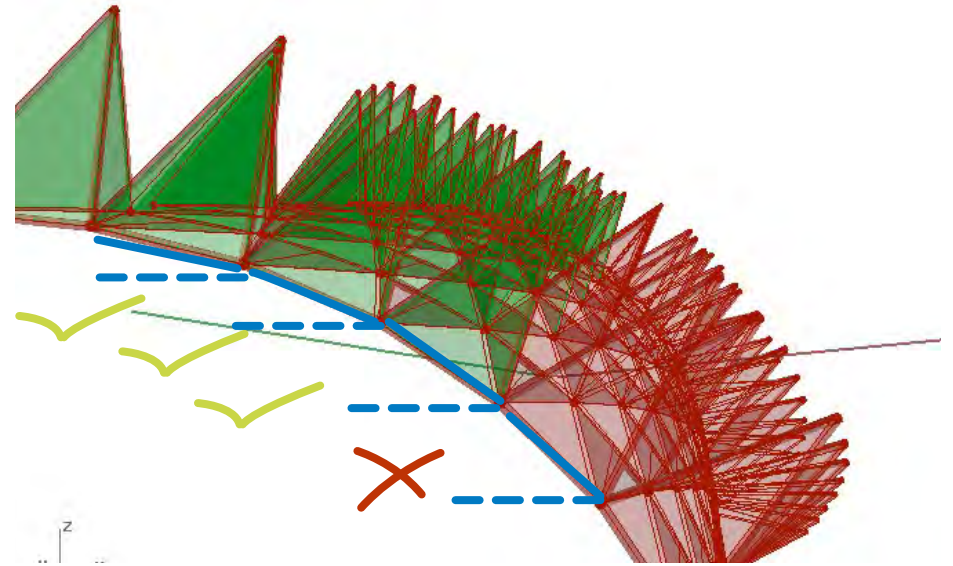
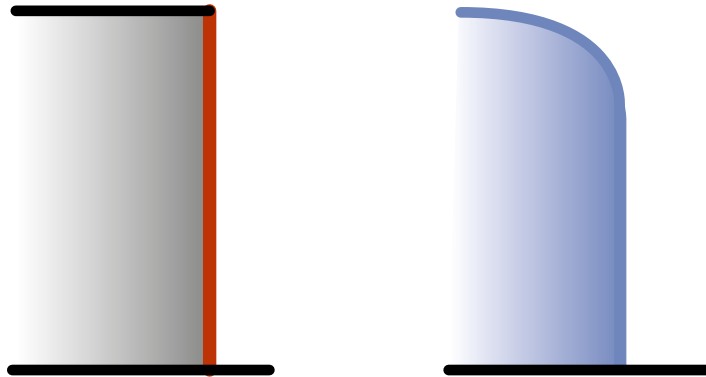
How to meet the floor?



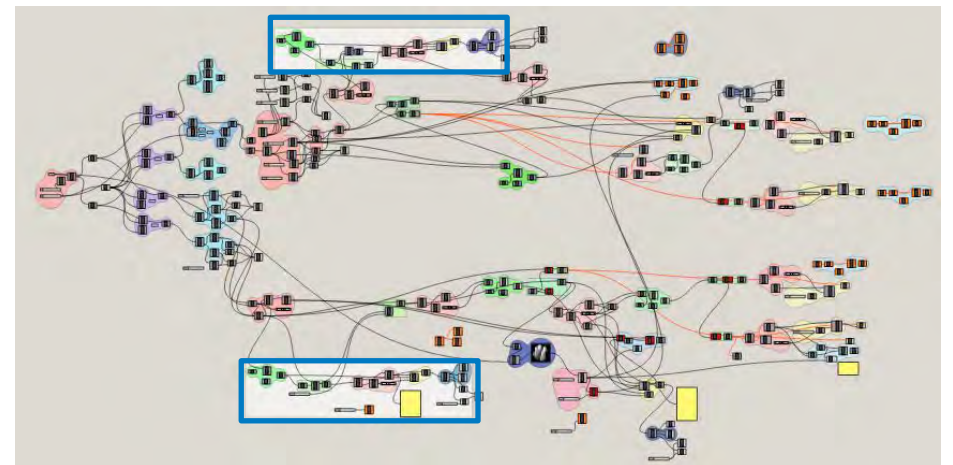
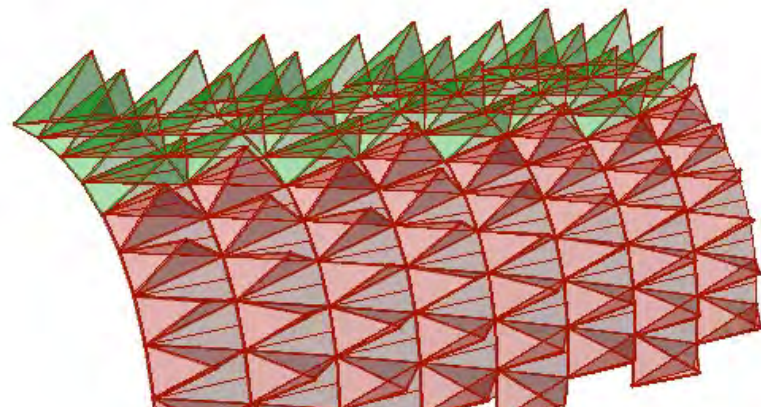
# The Cell / The Envelope / Massing / Atrium / The Building

## Parametric Population & Responsiveness

Should the facade stop at the roof meeting ?



Additional IF





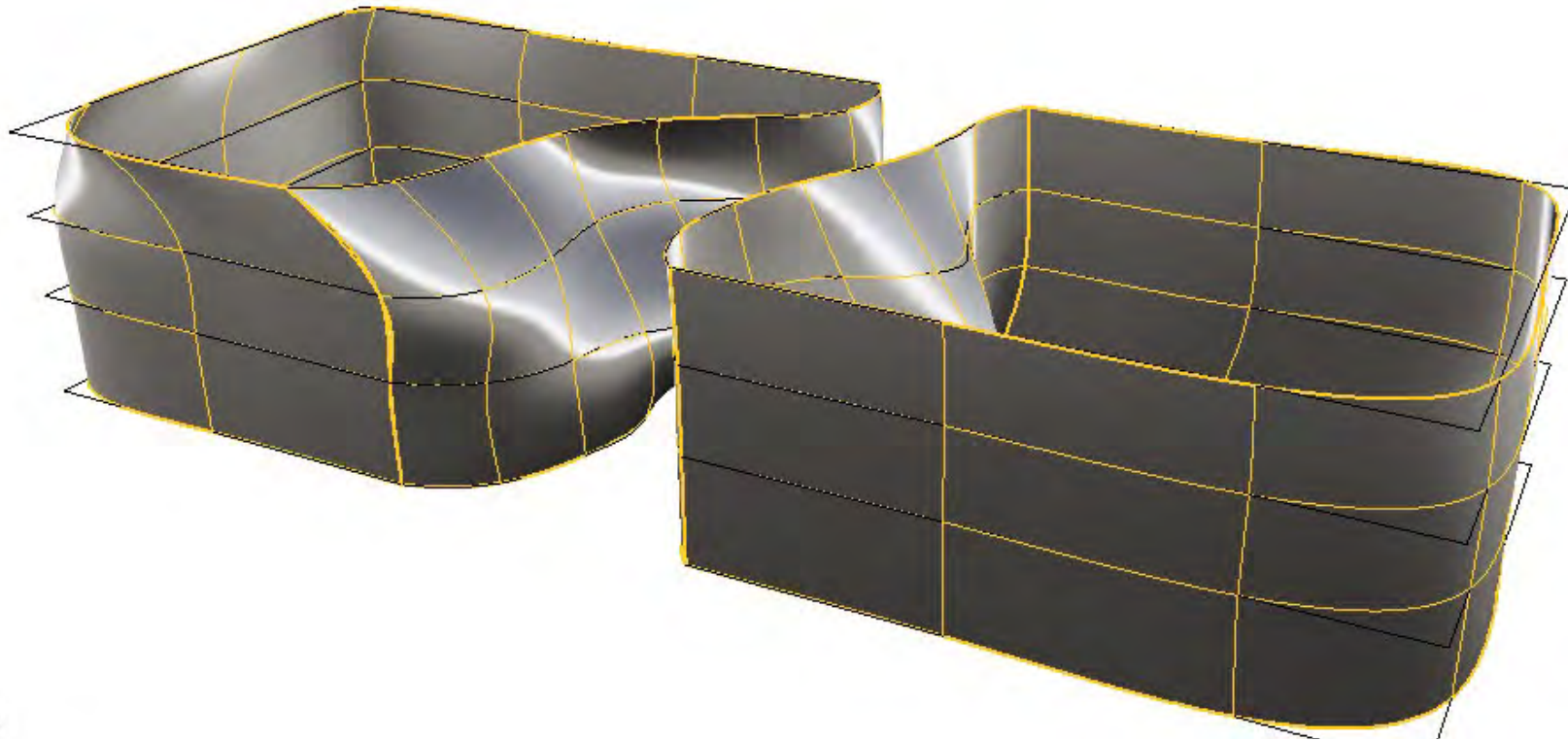
*The Cell / The Envelope / Massing / Atrium / The Building*

**Parametric Population & Responsiveness**



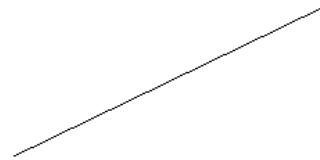
## *The Cell / The Envelope / Massing / Atrium / The Building*

### Parametric Downsides

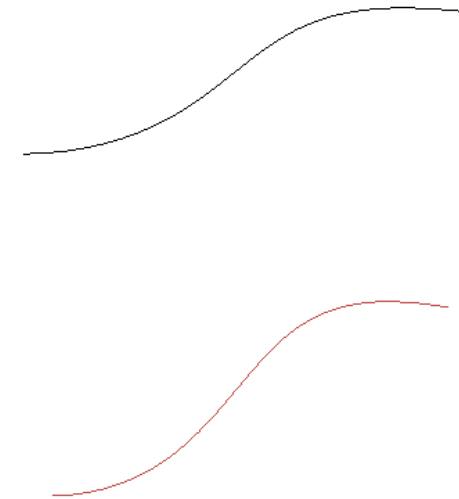


# The Cell / The Envelope / Massing / Atrium / The Building

## Parametric Downsides



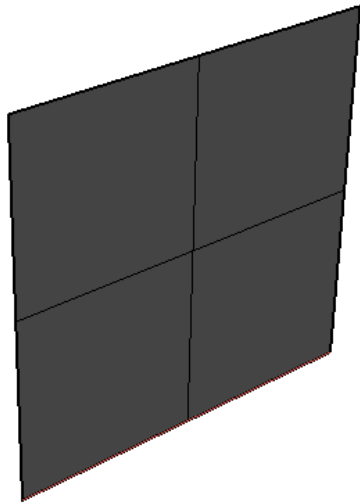
Lab conditions



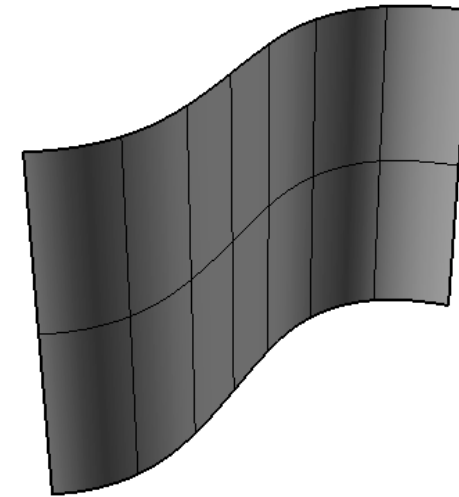
Design conditions

# *The Cell / The Envelope / Massing / Atrium / The Building*

## Parametric Downsides



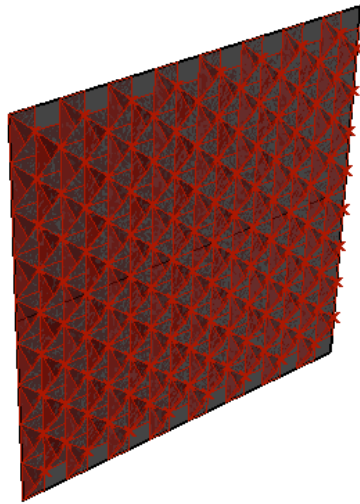
**Lab conditions**



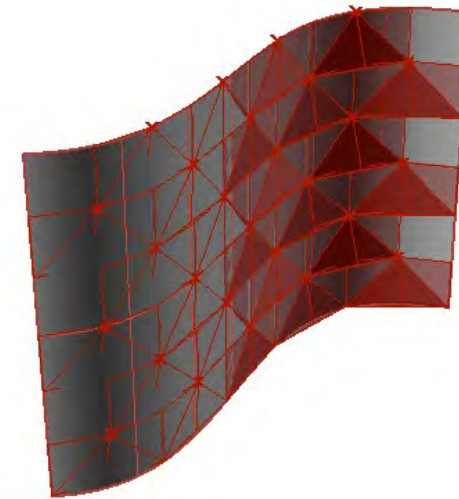
**Design conditions**

# The Cell / The Envelope / Massing / Atrium / The Building

## Parametric Downsides



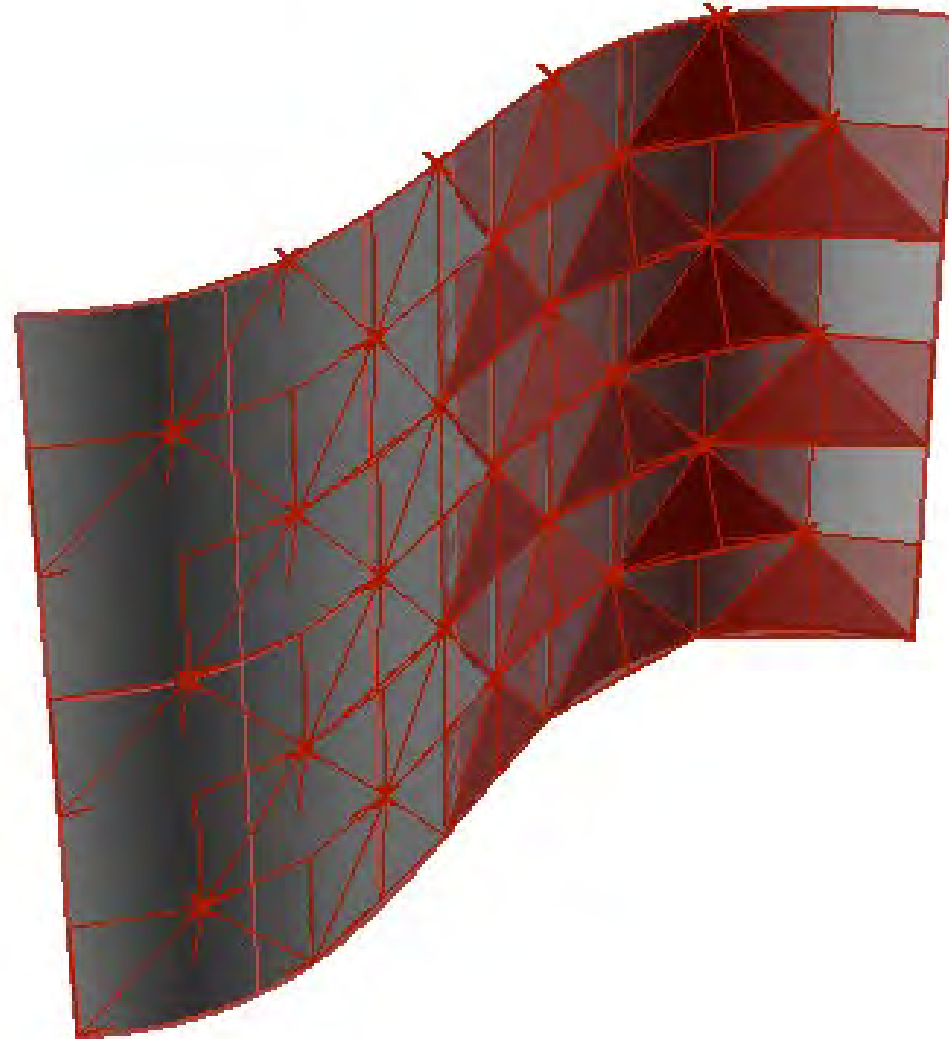
Lab conditions



Design conditions

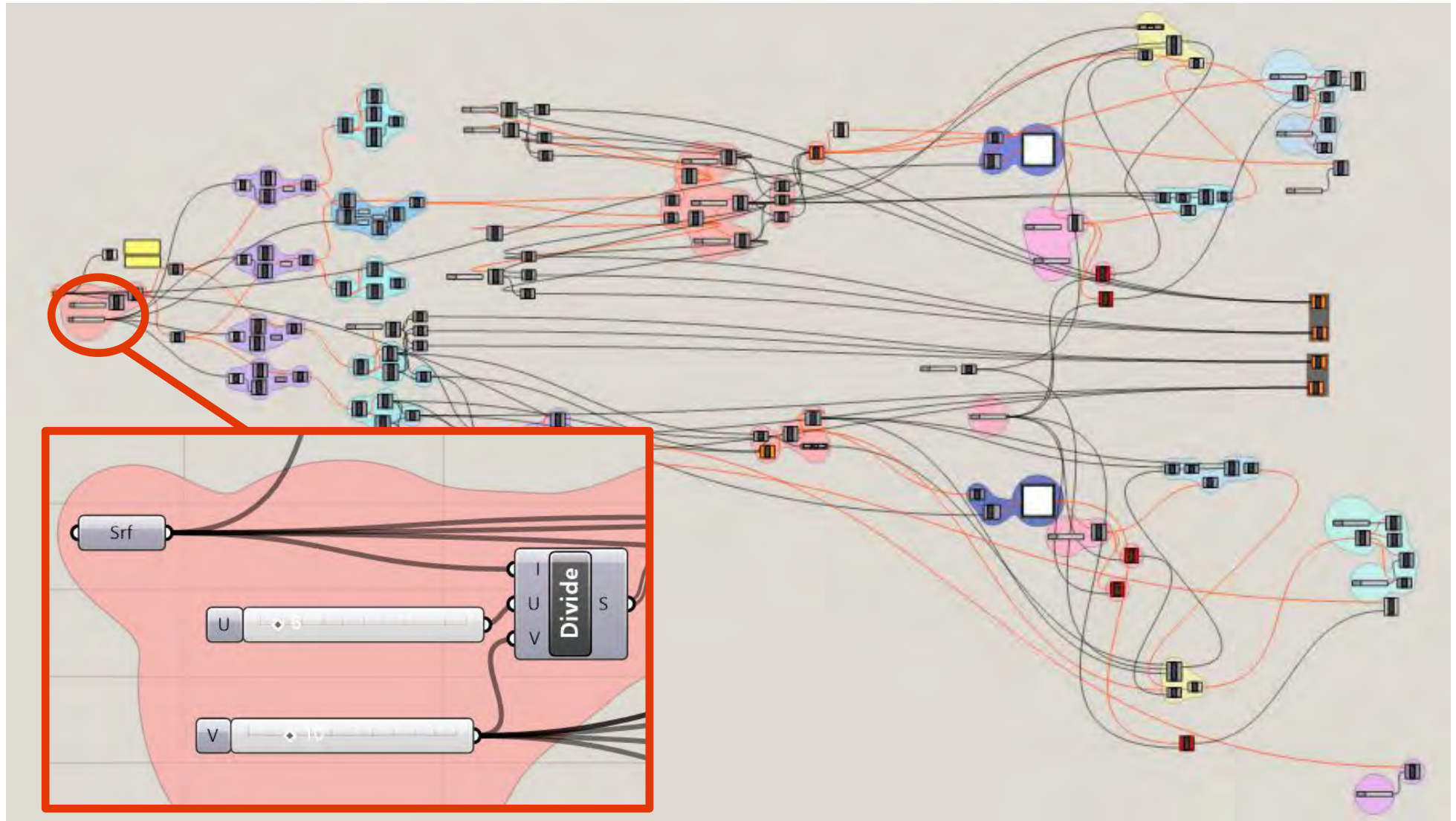
*The Cell / The Envelope / Massing / Atrium / The Building*

**Parametric Downsides**



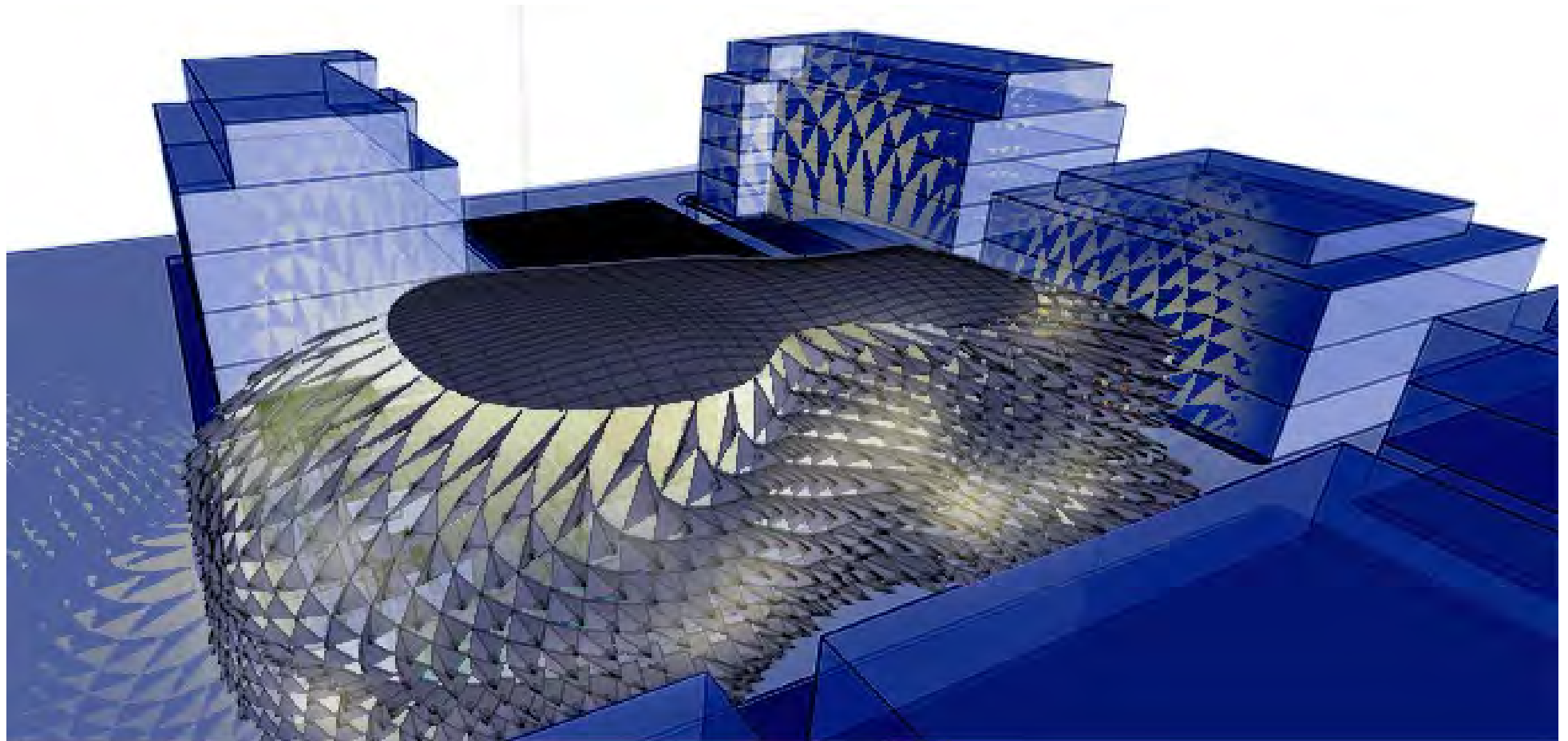
## The Cell / The Envelope / Massing / Atrium / The Building

### Parametric Downsides



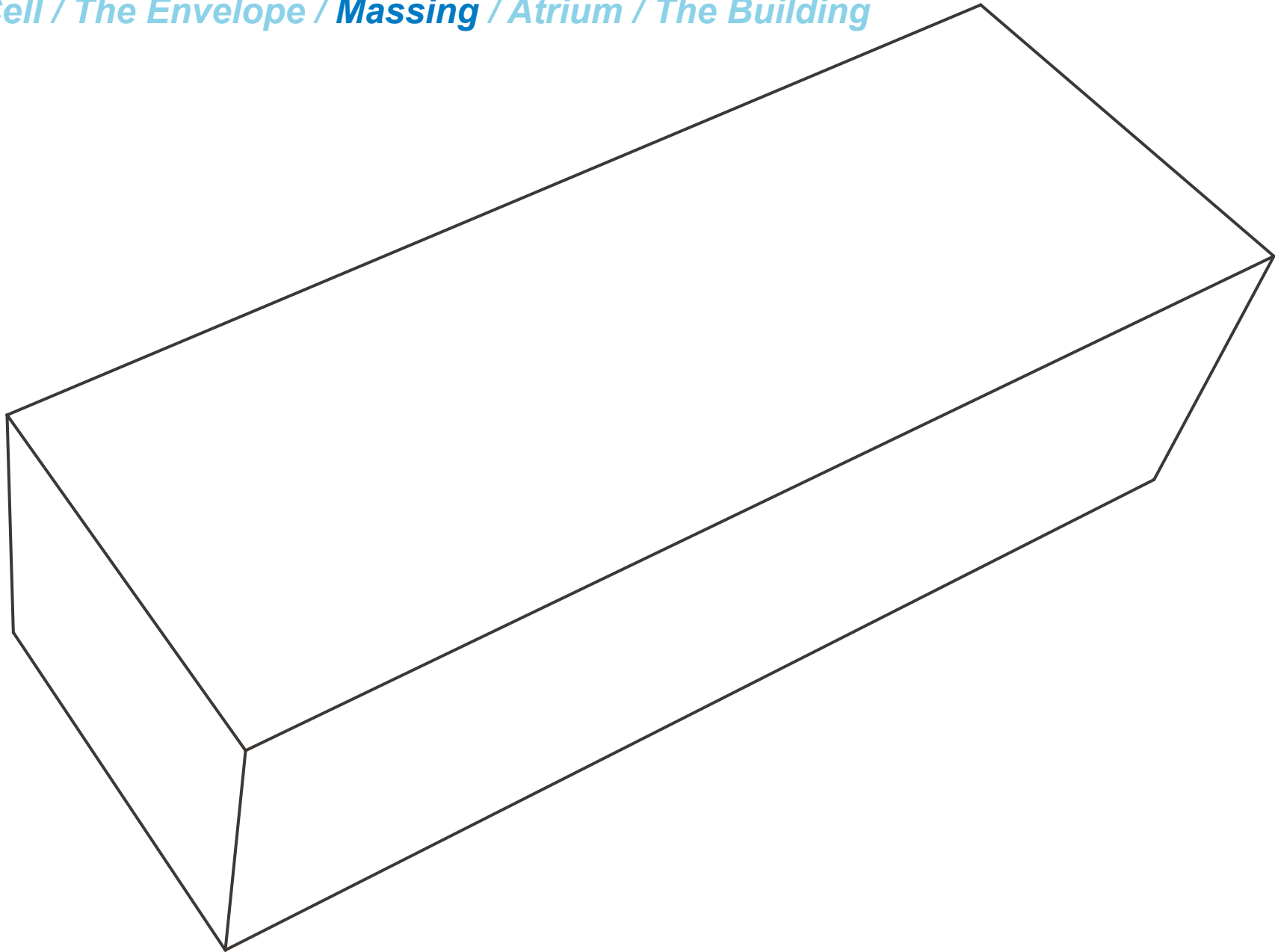
*The Cell / The Envelope / Massing / Atrium / The Building*

**v**

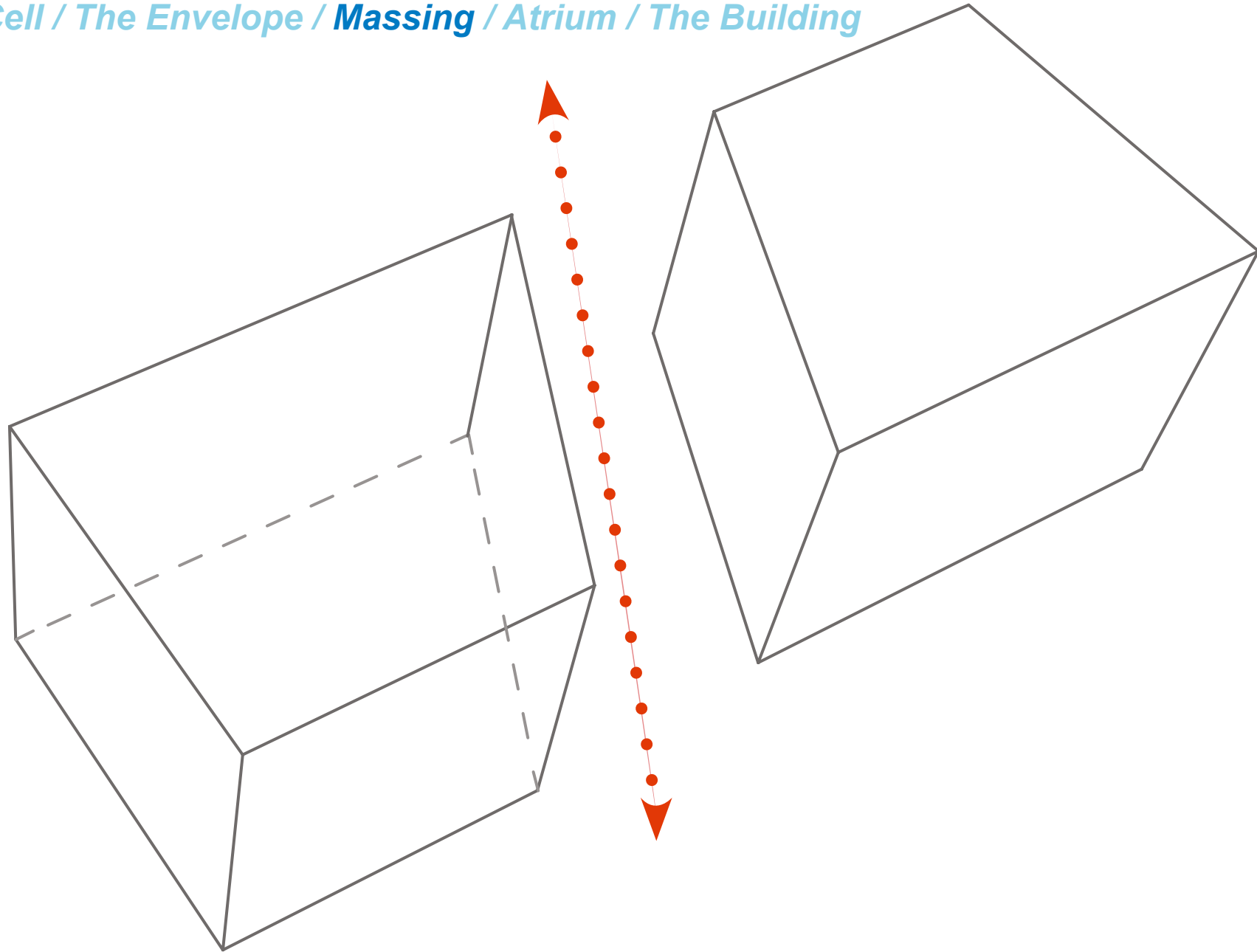




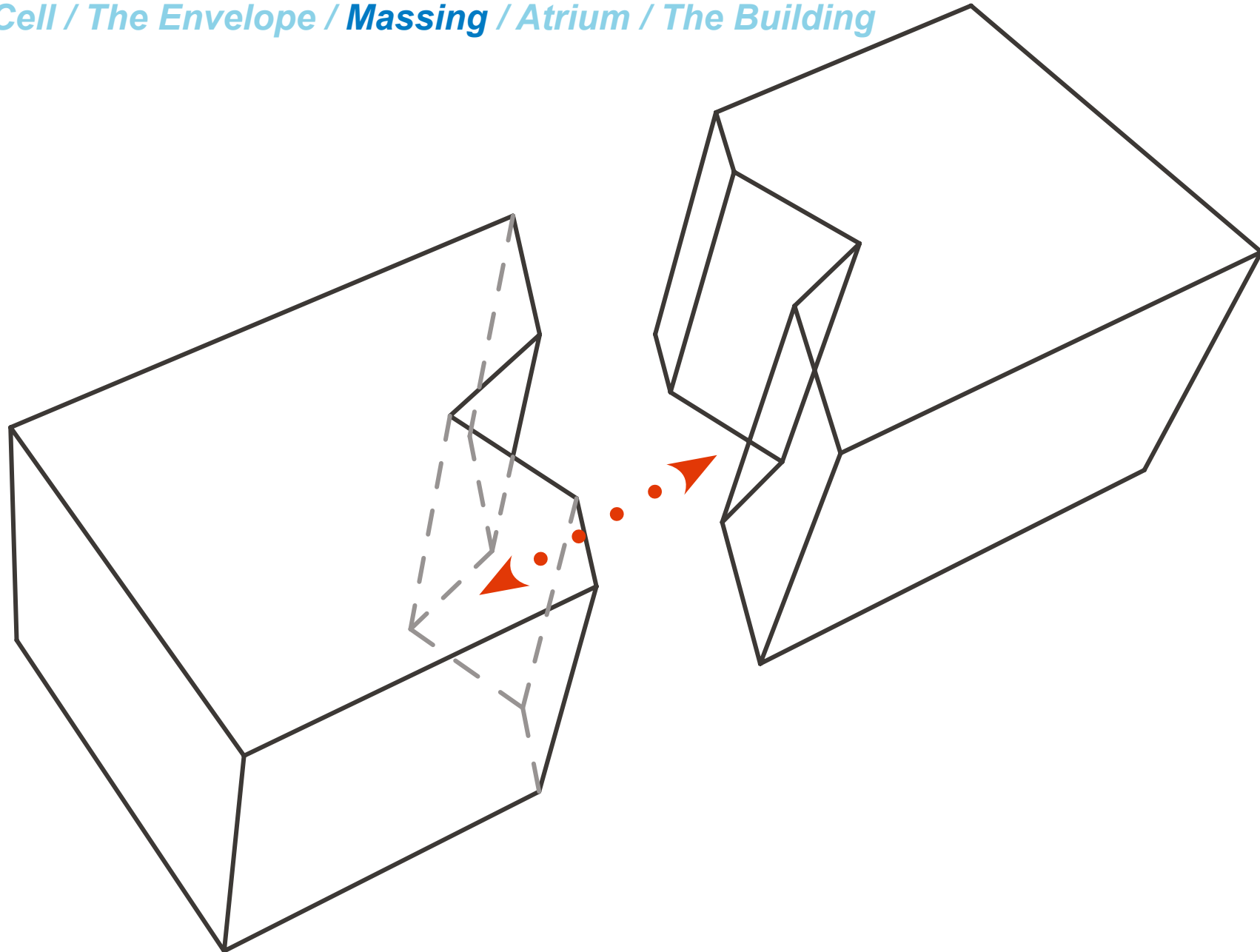
*The Cell / The Envelope / **Massing** / Atrium / The Building*



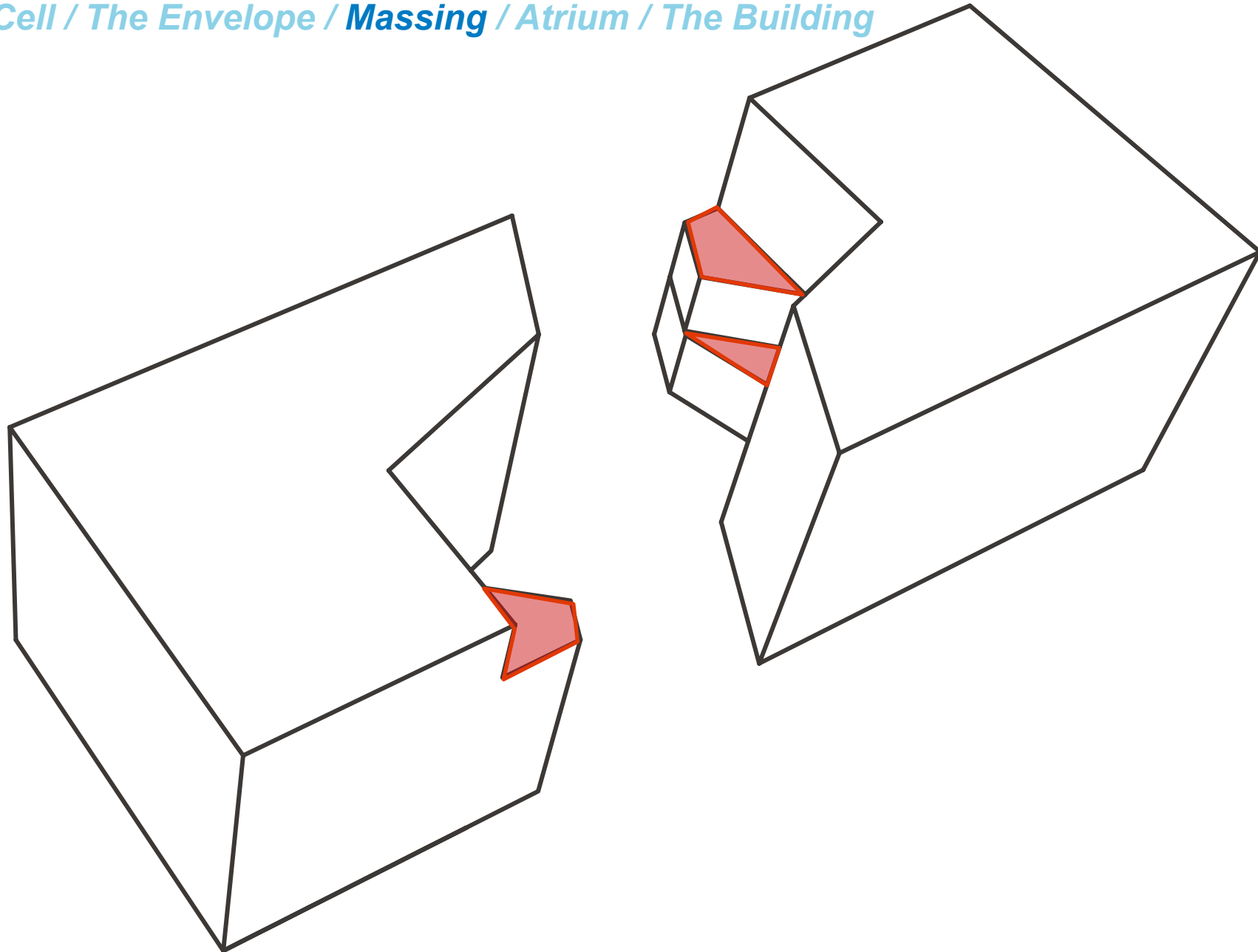
*The Cell / The Envelope / Massing / Atrium / The Building*



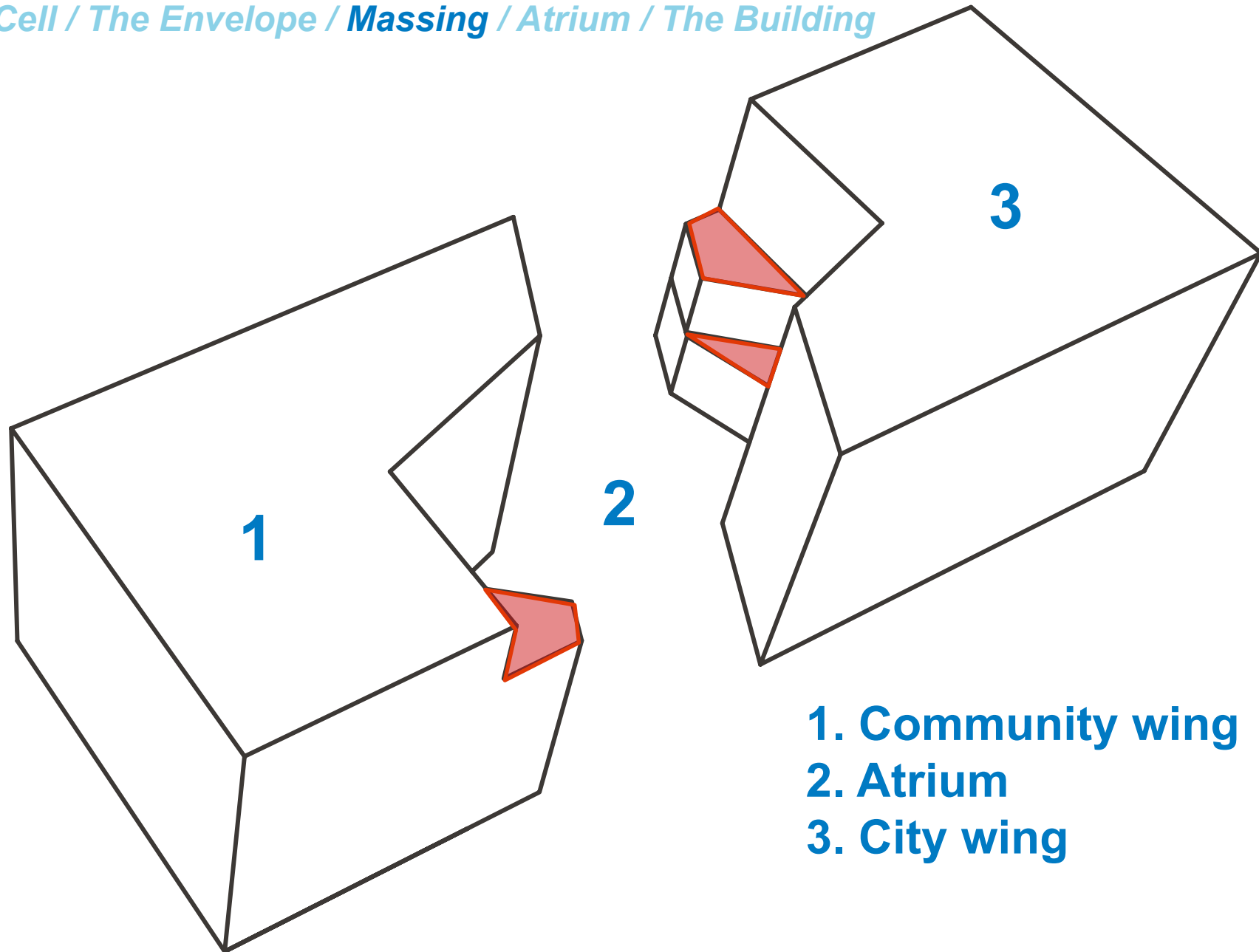
*The Cell / The Envelope / Massing / Atrium / The Building*



*The Cell / The Envelope / Massing / Atrium / The Building*

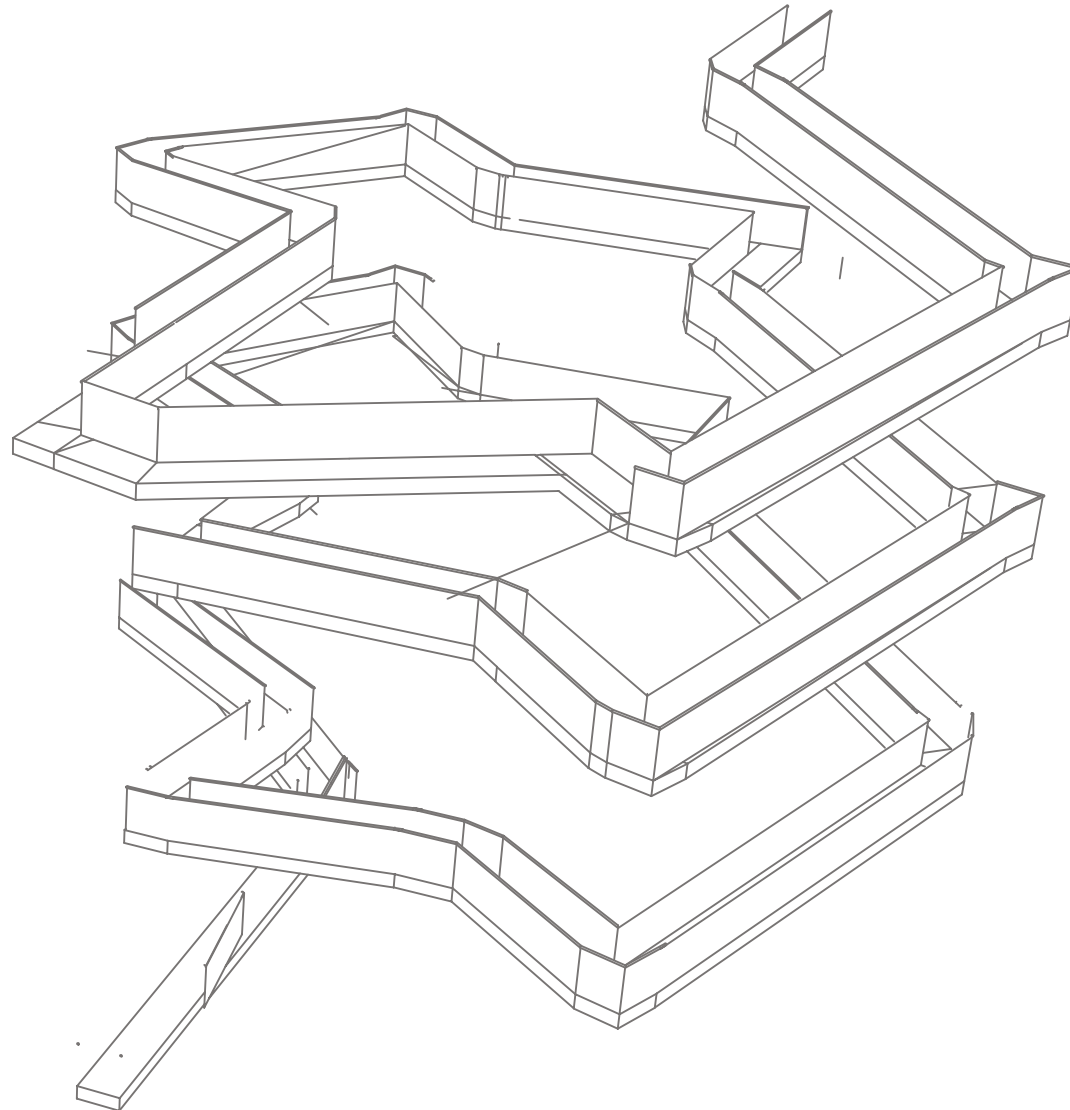


*The Cell / The Envelope / Massing / Atrium / The Building*



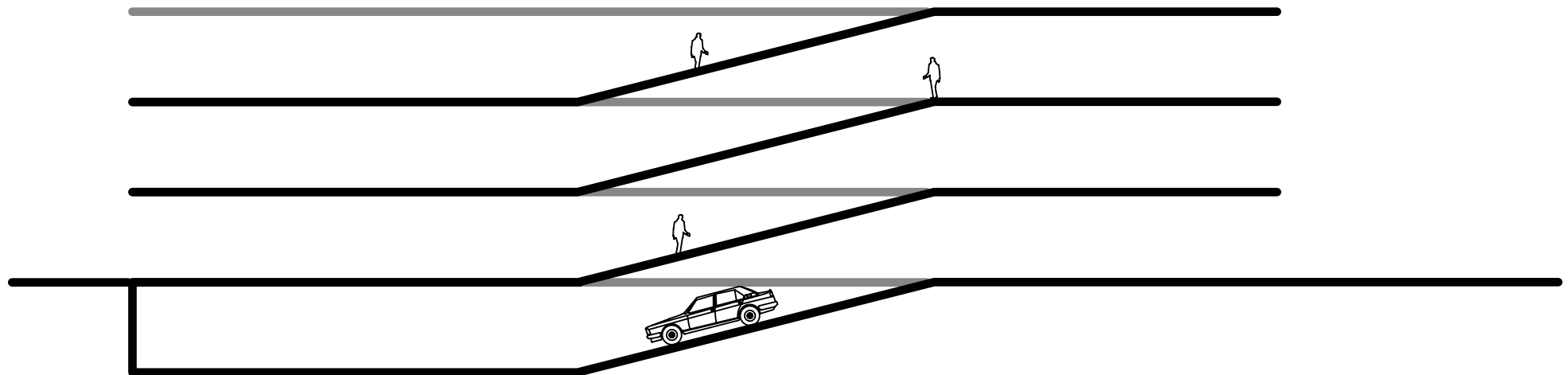
- 1. Community wing**
- 2. Atrium**
- 3. City wing**

*The Cell / The Envelope / Massing / **Atrium** / The Building*



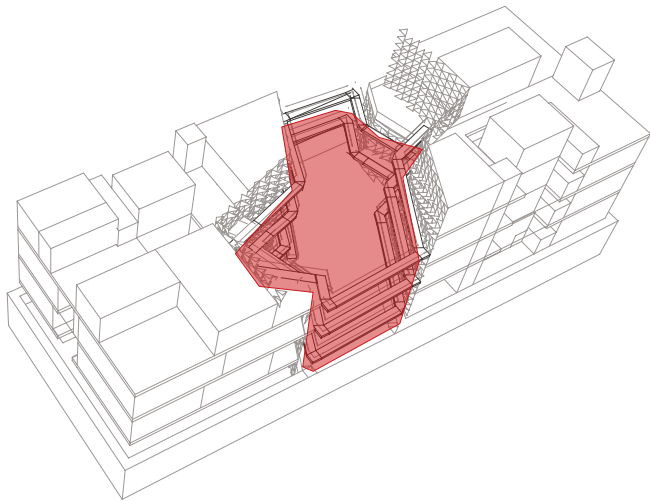
# *The Cell / The Envelope / Massing / Atrium / The Building*

## **The Original Concept**

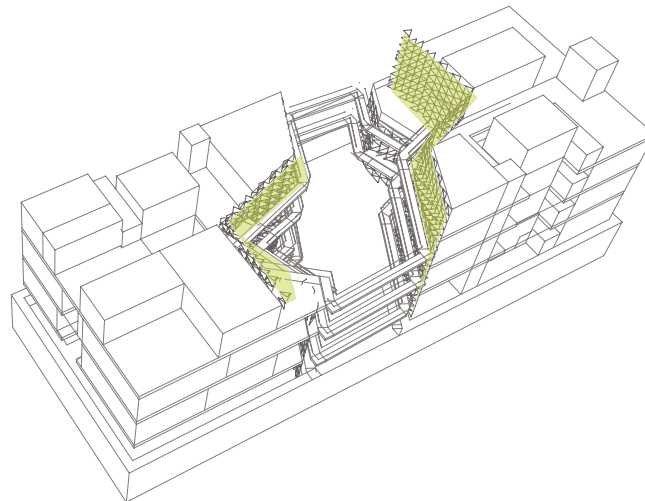


# The Cell / The Envelope / Massing / Atrium / The Building

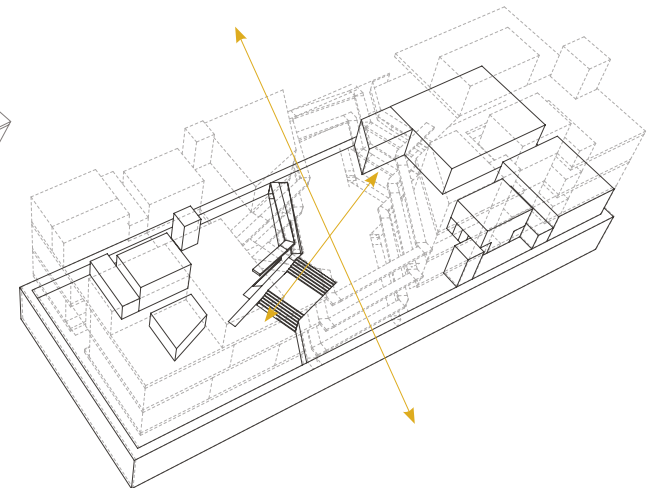
## Amplifying the atrium experience



**Accessible public lane**



**Vertical community garden**



**Central Entrance point**



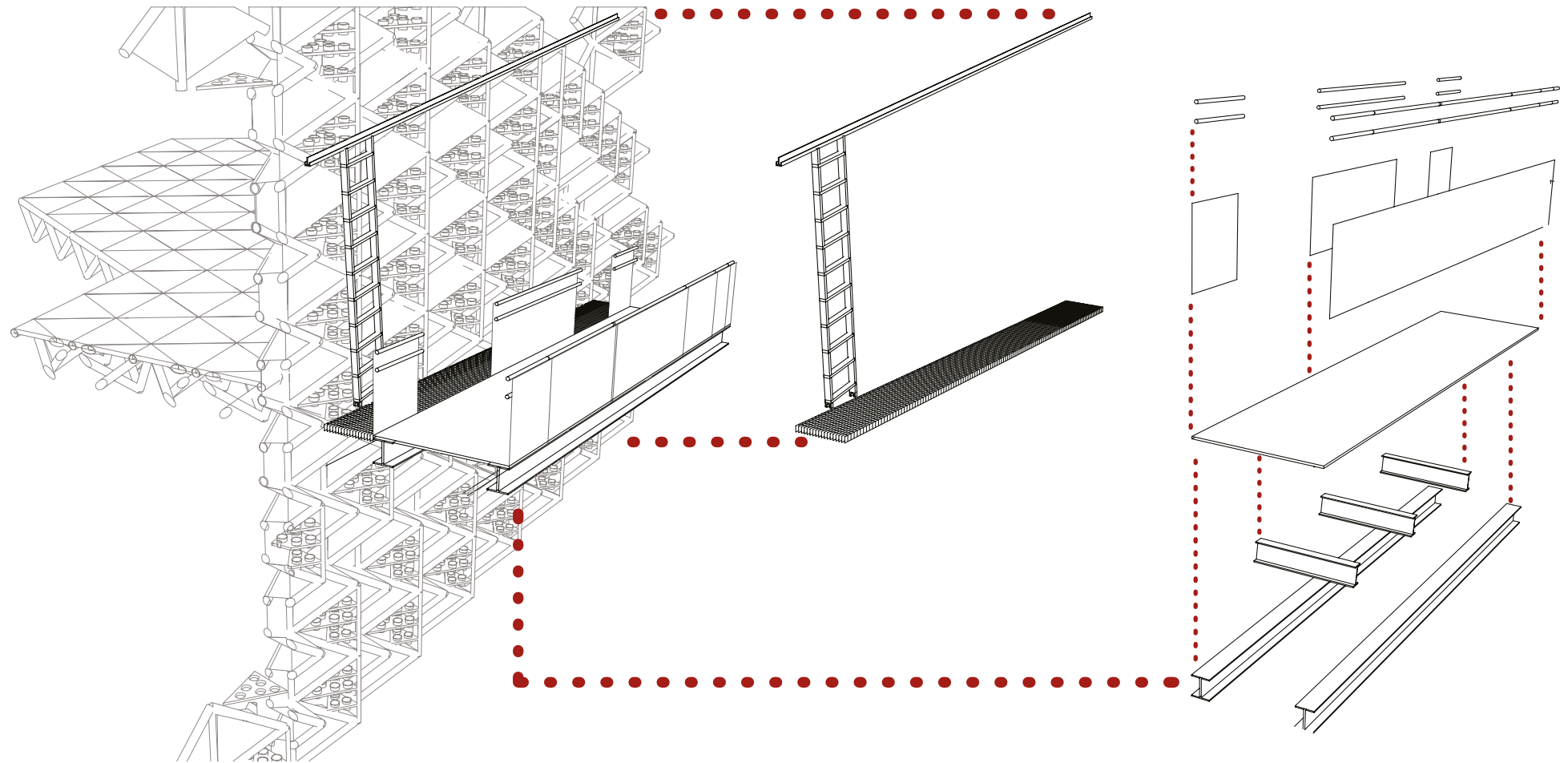
# *The Cell / The Envelope / Massing / Atrium / The Building*

**Amplifying the atrium experience**



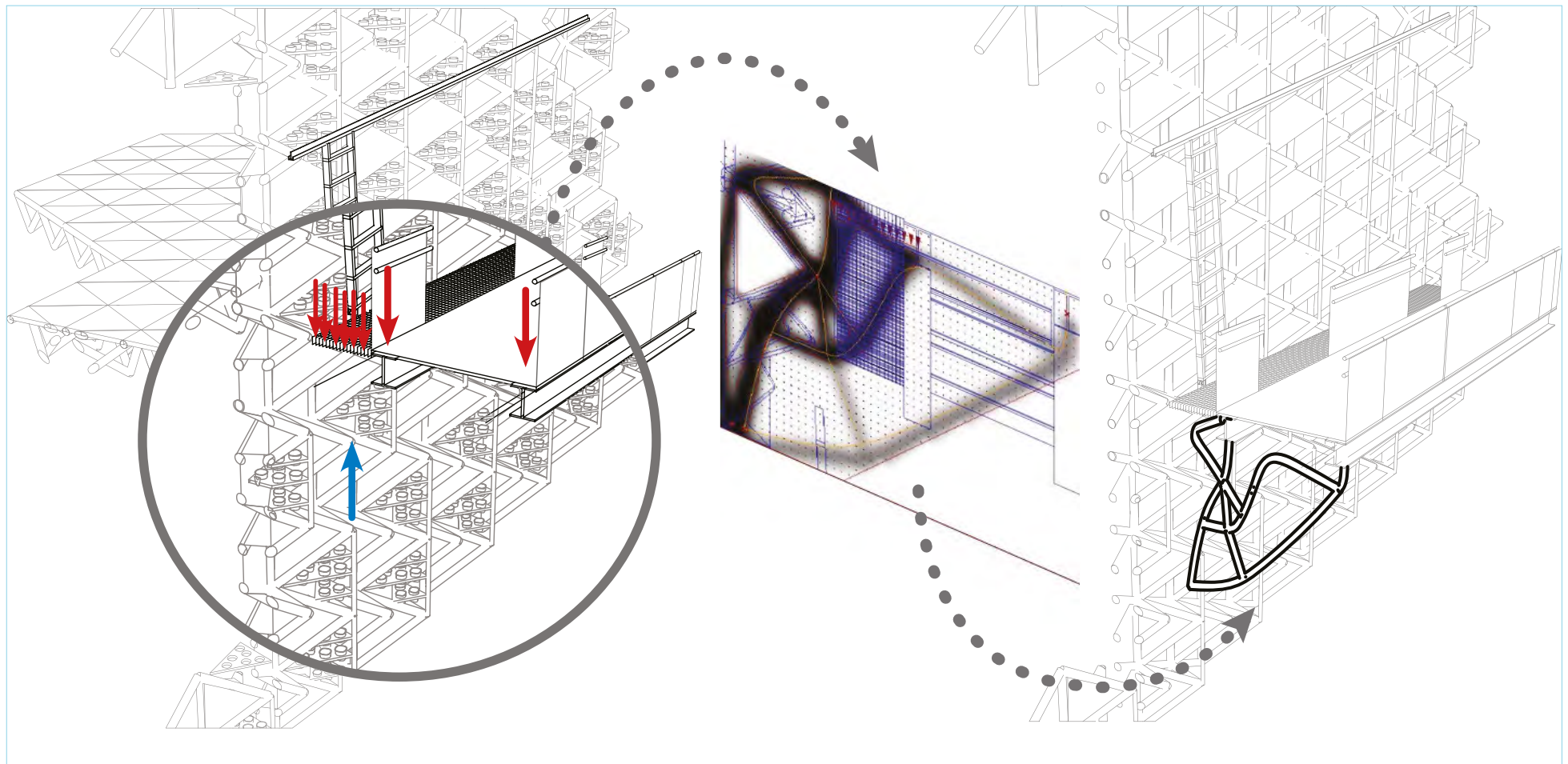
# The Cell / The Envelope / Massing / Atrium / The Building

## Vertical garden interface



# The Cell / The Envelope / Massing / Atrium / The Building

## Vertical garden interface



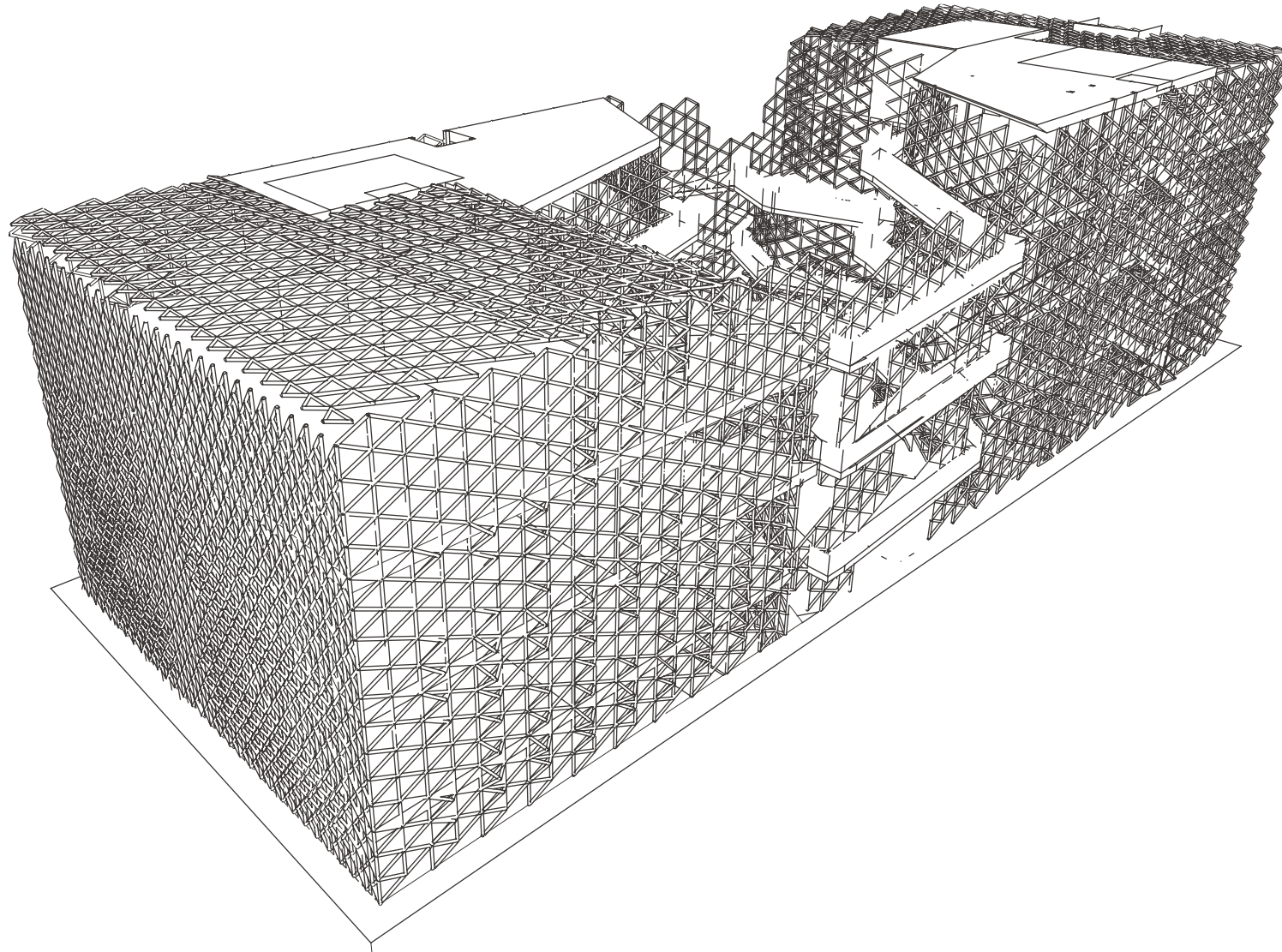
# *The Cell / The Envelope / Massing / Atrium / The Building*

## **Vertical garden interface**



*The Cell / The Envelope / Massing / Atrium / The Building*

**Go Trough Layers**



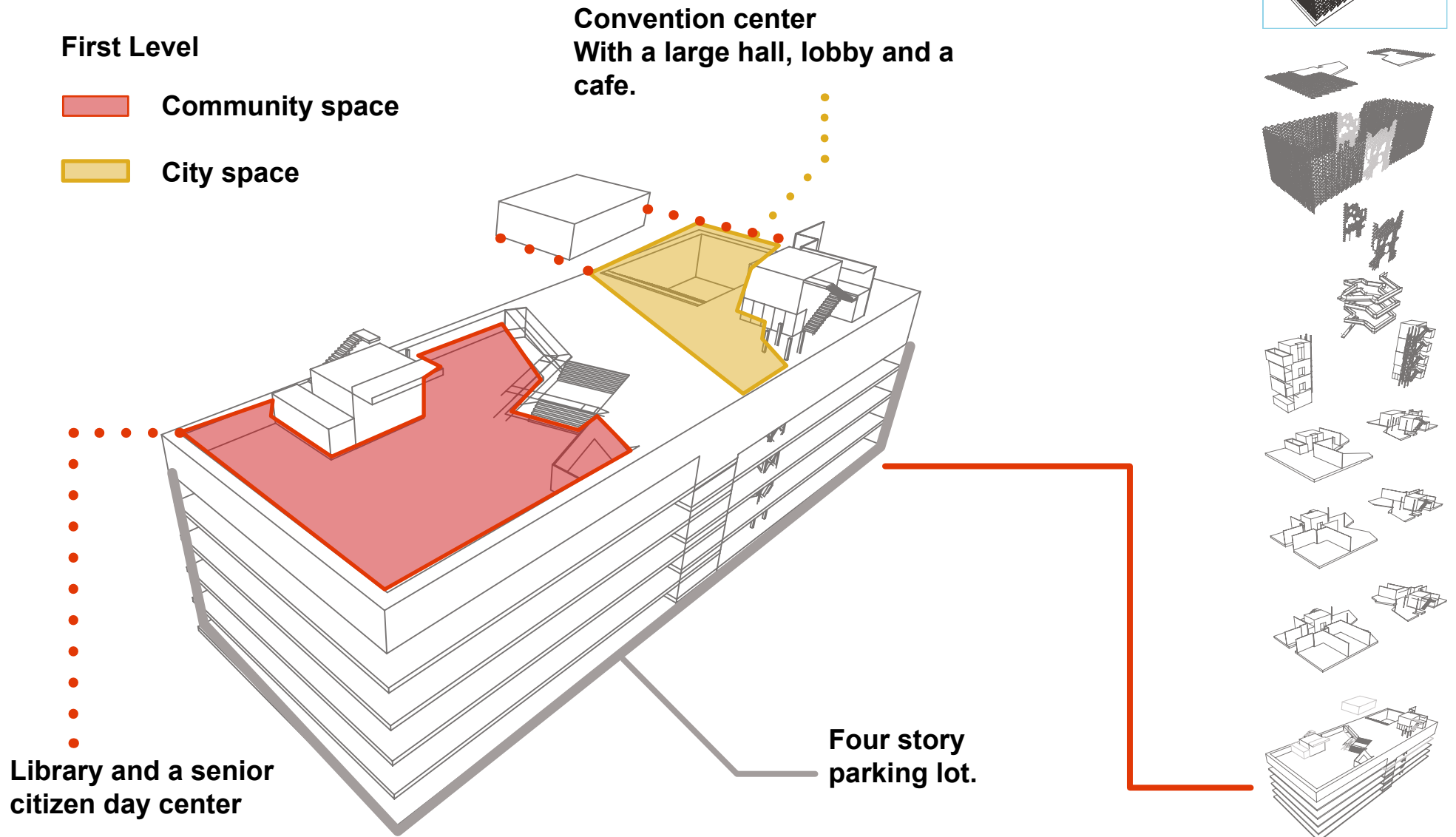
# The Cell / The Envelope / Massing / Atrium / The Building

## Go Trough Layers

### First Level

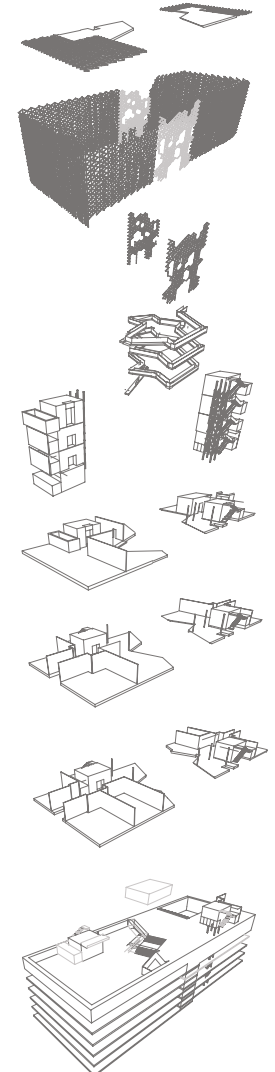
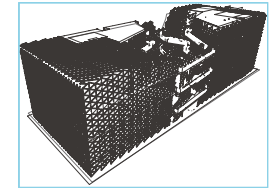
 Community space

 City space



# The Cell / The Envelope / Massing / Atrium / The Building

## Go Trough Layers



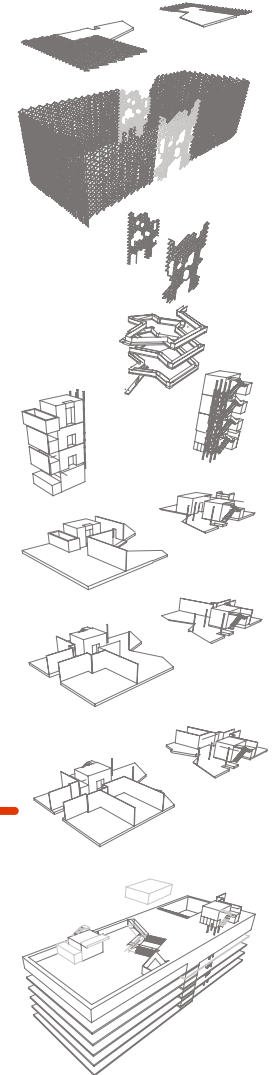
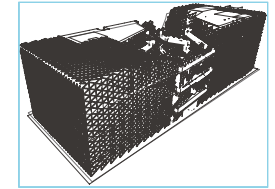
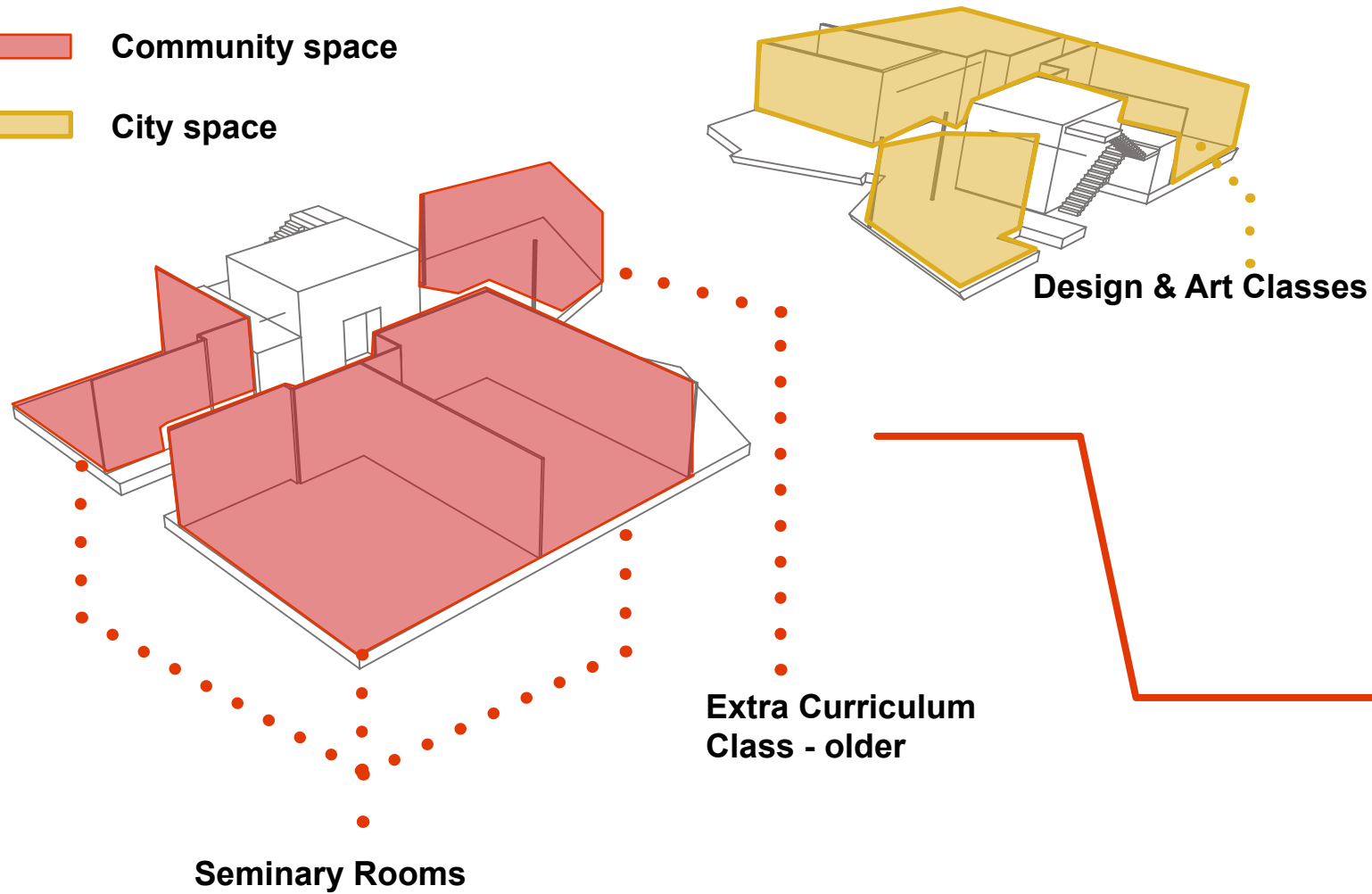
# The Cell / The Envelope / Massing / Atrium / The Building

## Go Trough Layers

### Second Level

 Community space

 City space





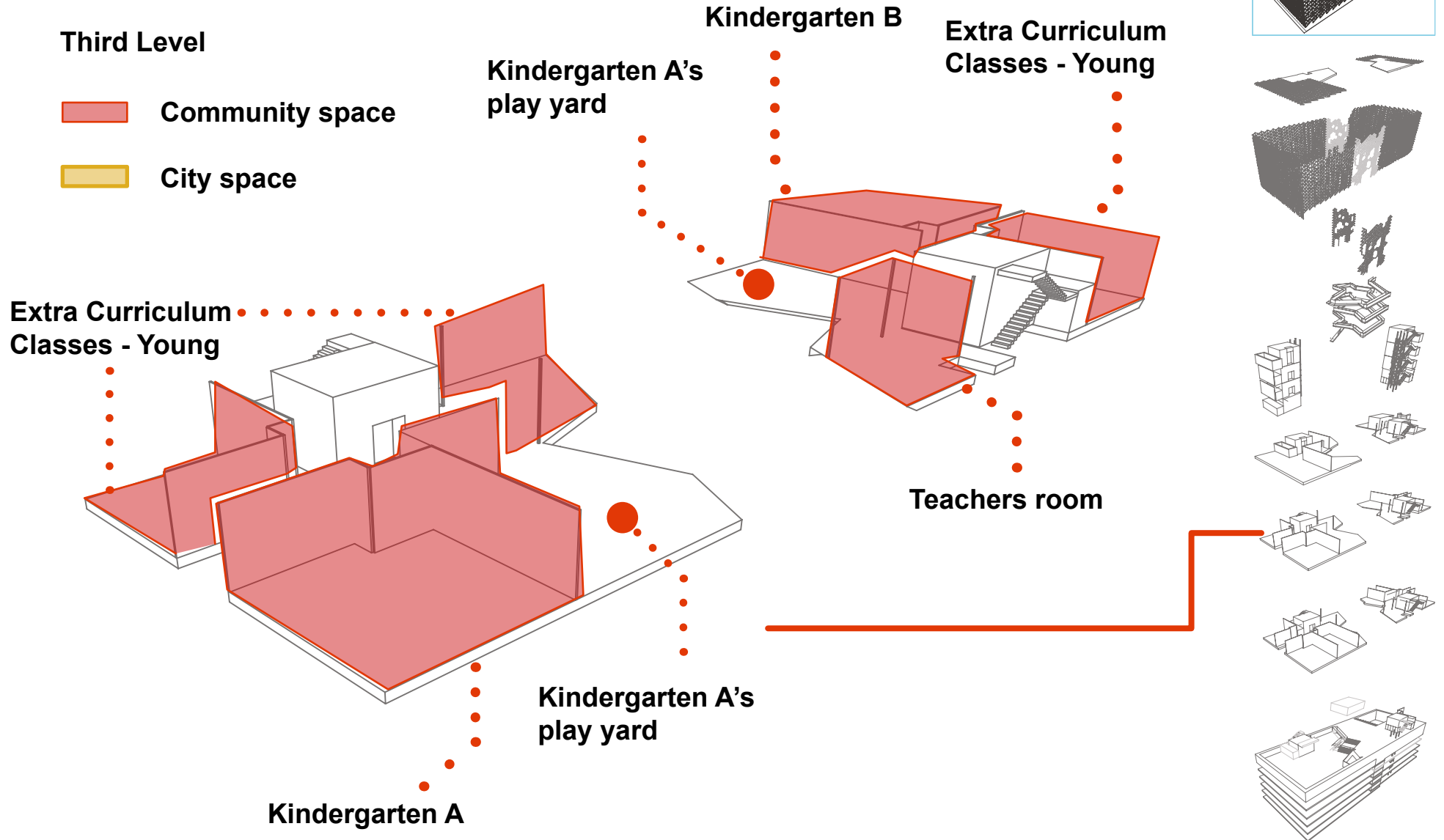
# The Cell / The Envelope / Massing / Atrium / The Building

## Go Trough Layers

Third Level

 Community space

 City space



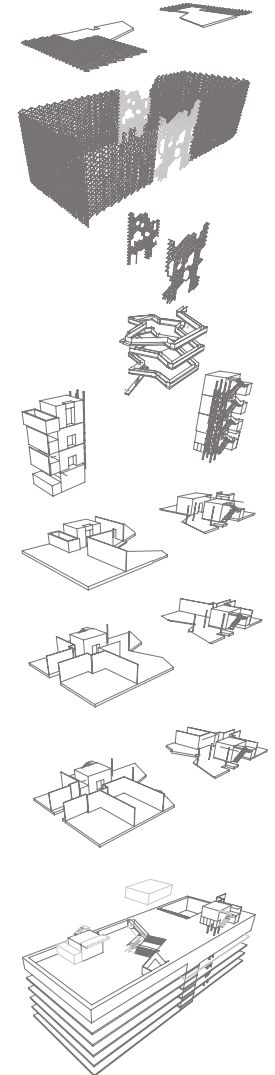
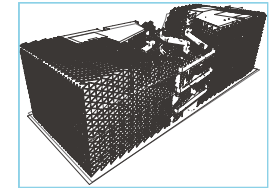
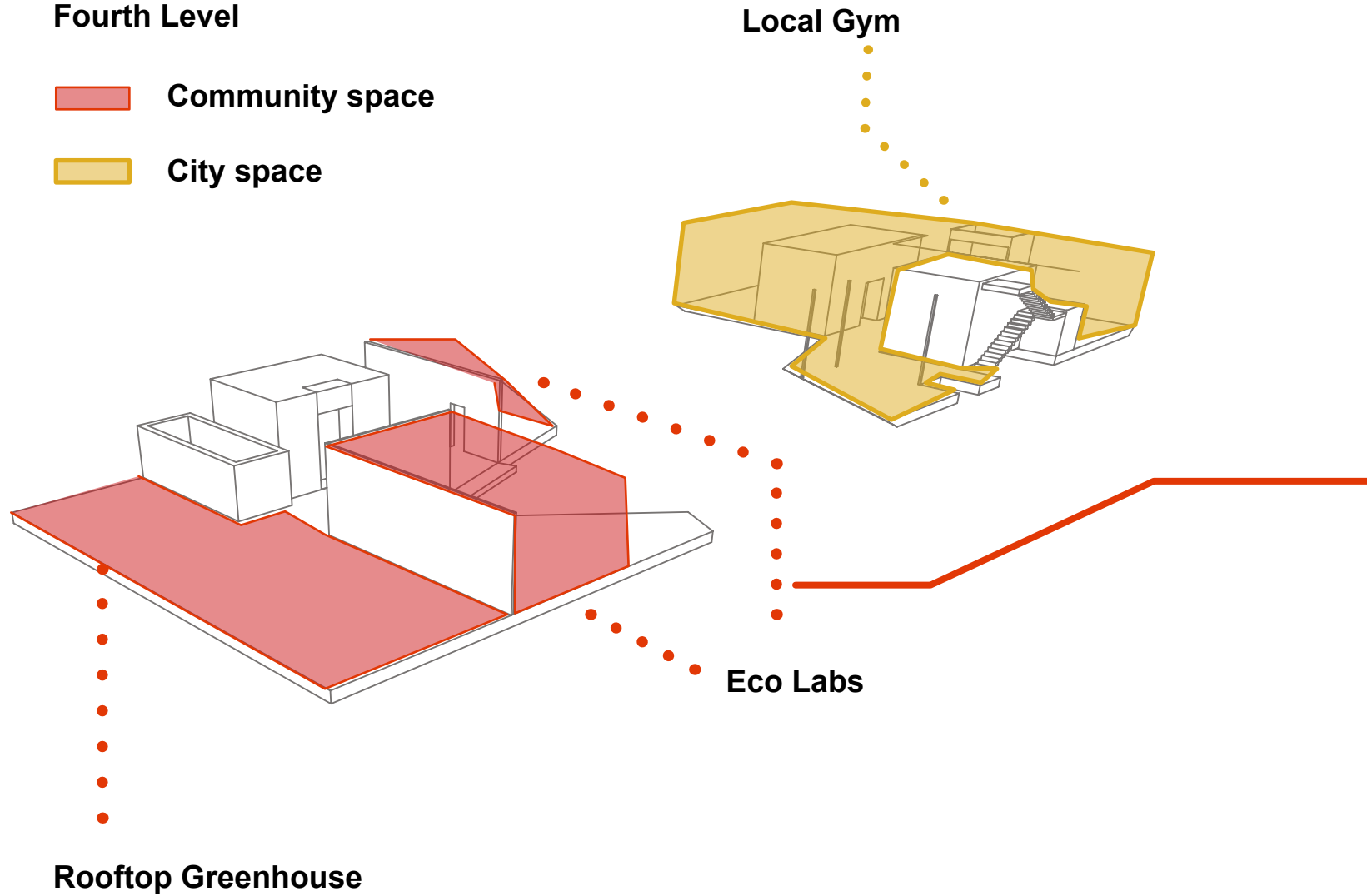
# The Cell / The Envelope / Massing / Atrium / The Building

## Go Trough Layers

### Fourth Level

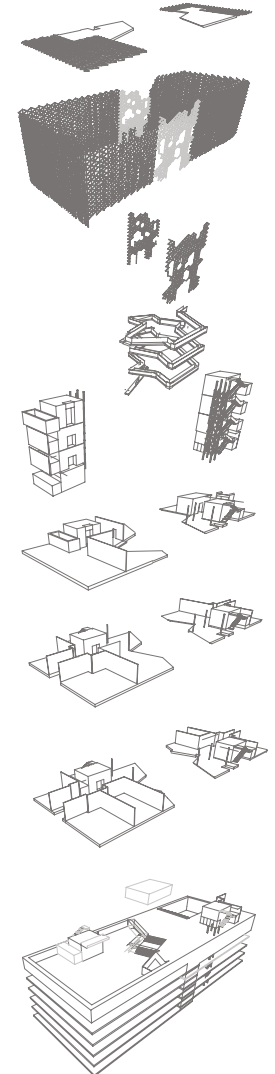
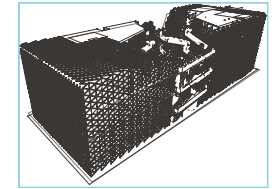
 Community space

 City space



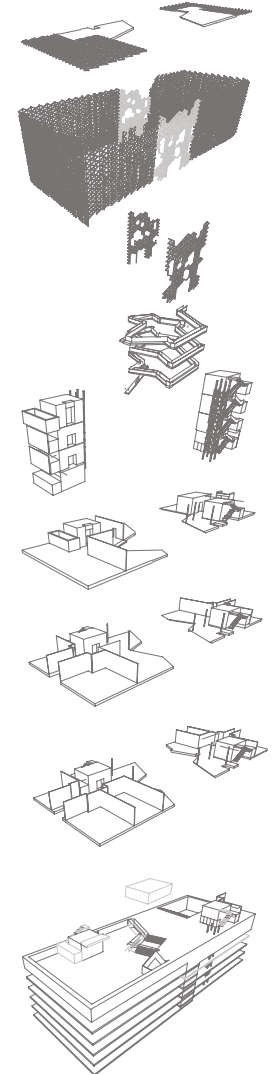
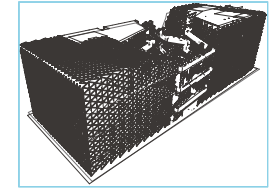
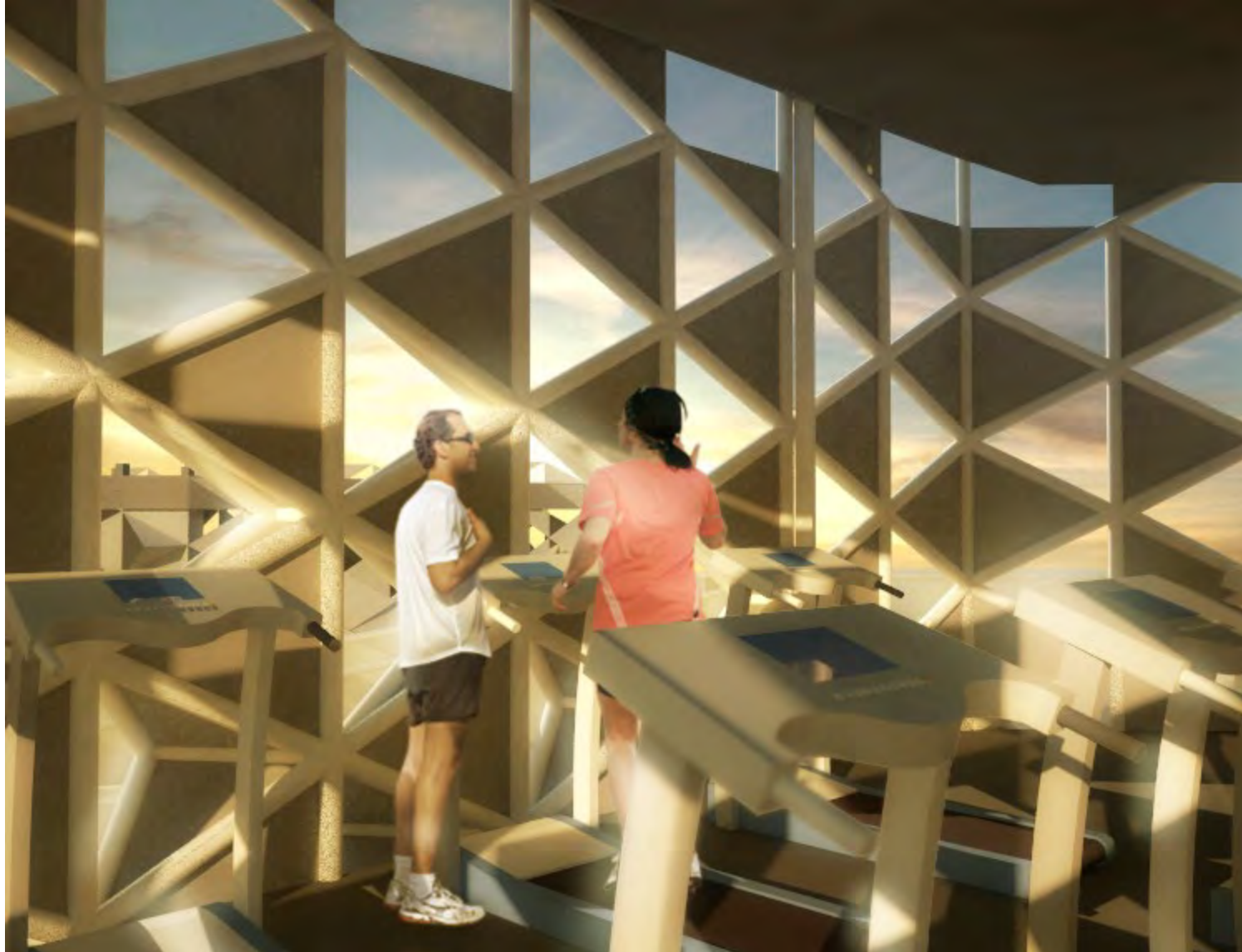
# The Cell / The Envelope / Massing / Atrium / The Building

## Go Trough Layers



*The Cell / The Envelope / Massing / Atrium / The Building*

**Go Trough Layers**



*The Cell / The Envelope / Massing / Atrium / The Building*

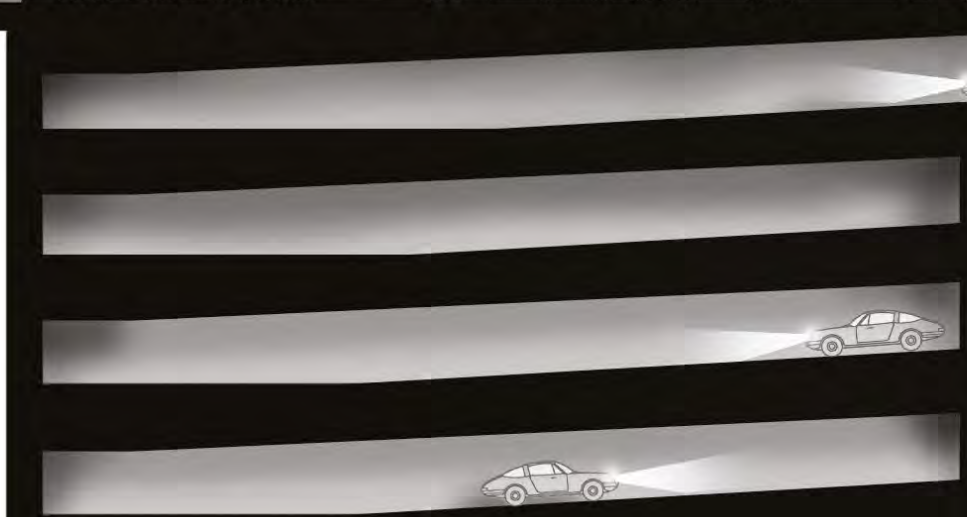
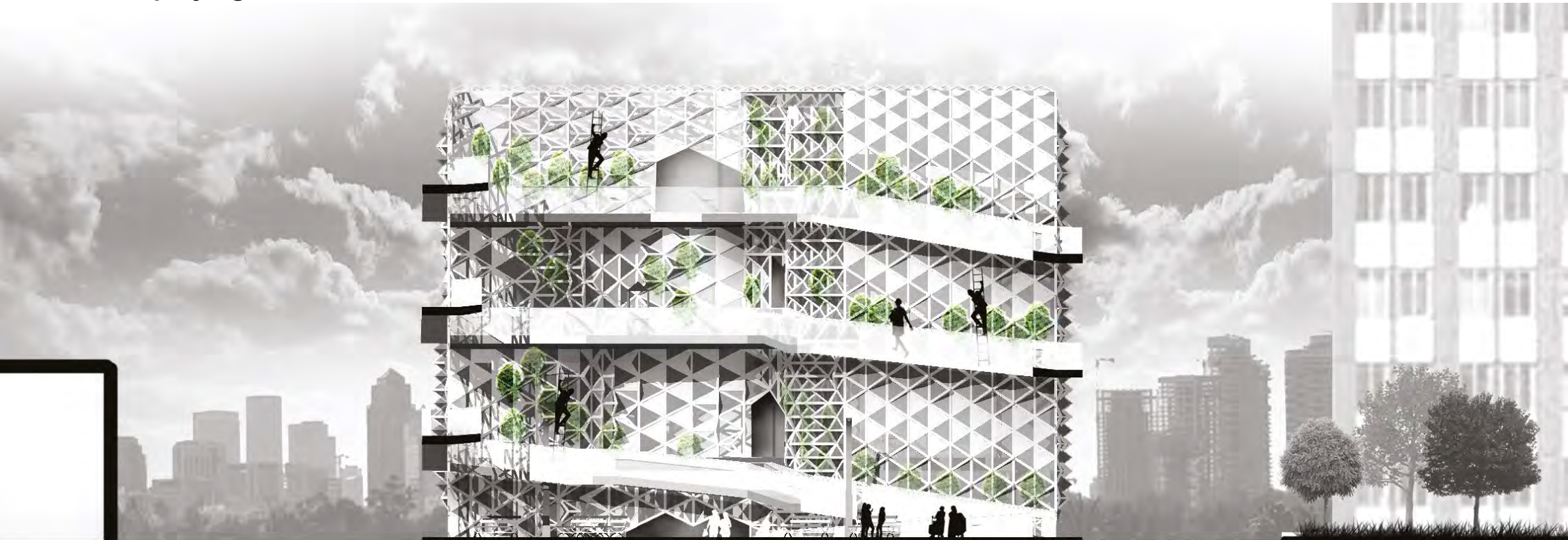
**Simplifying the sections**



**Section A-A, 1:200**

*The Cell / The Envelope / Massing / Atrium / The Building*

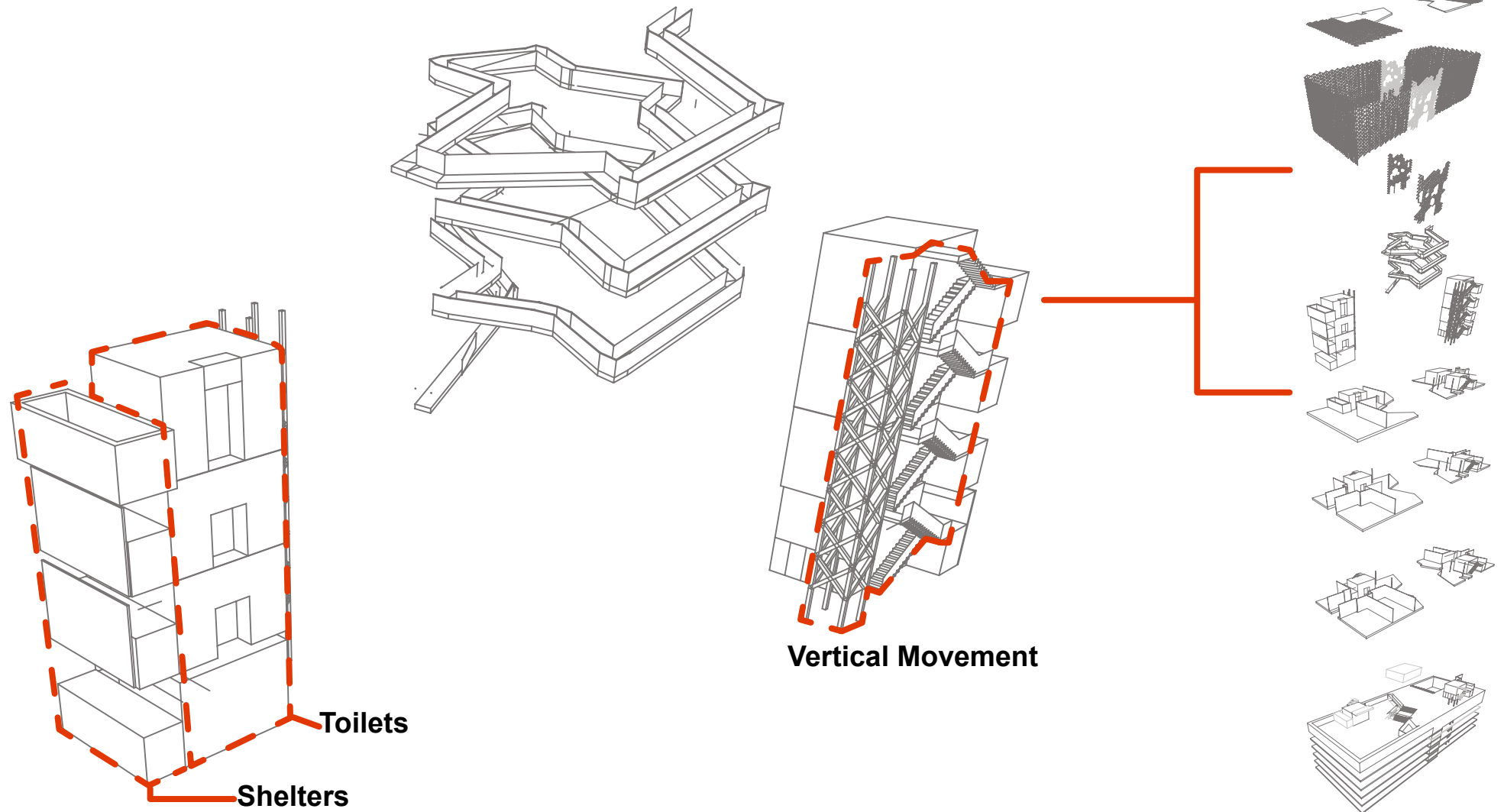
**Simplifying the sections**



**Section B-B, 1:200**

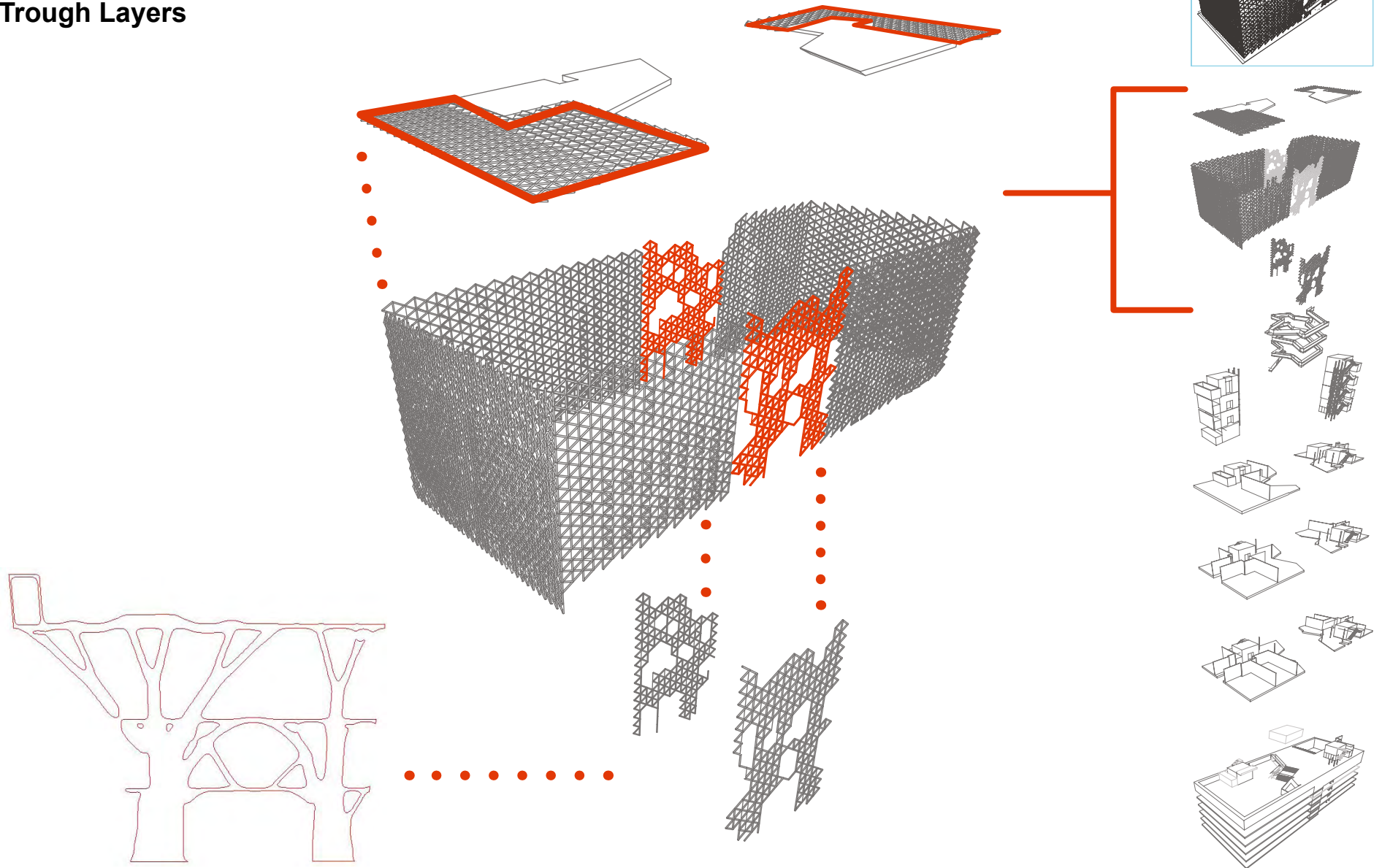
# The Cell / The Envelope / Massing / Atrium / The Building

## Go Trough Layers



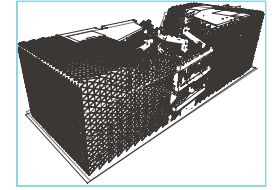
# The Cell / The Envelope / Massing / Atrium / The Building

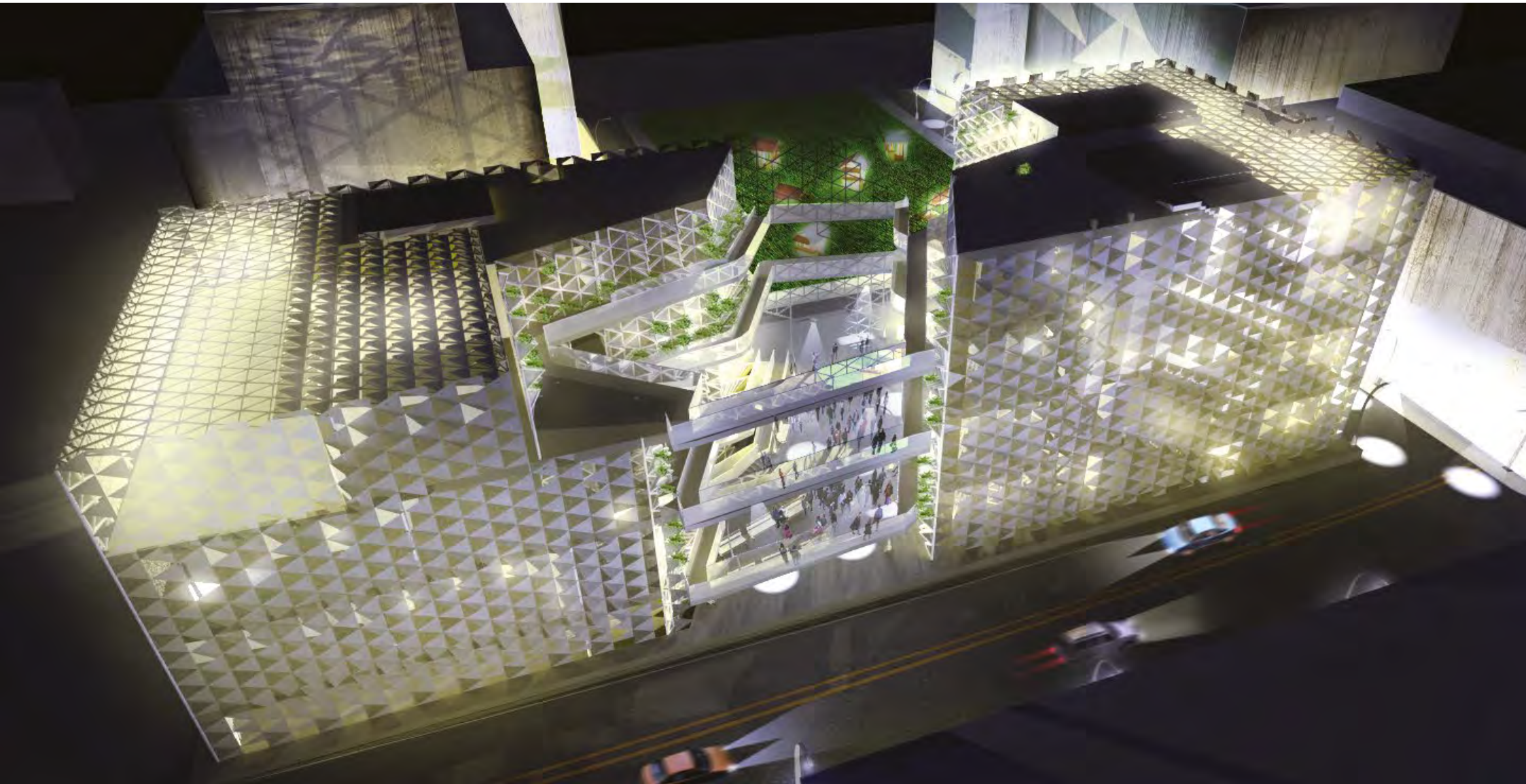
## Go Trough Layers





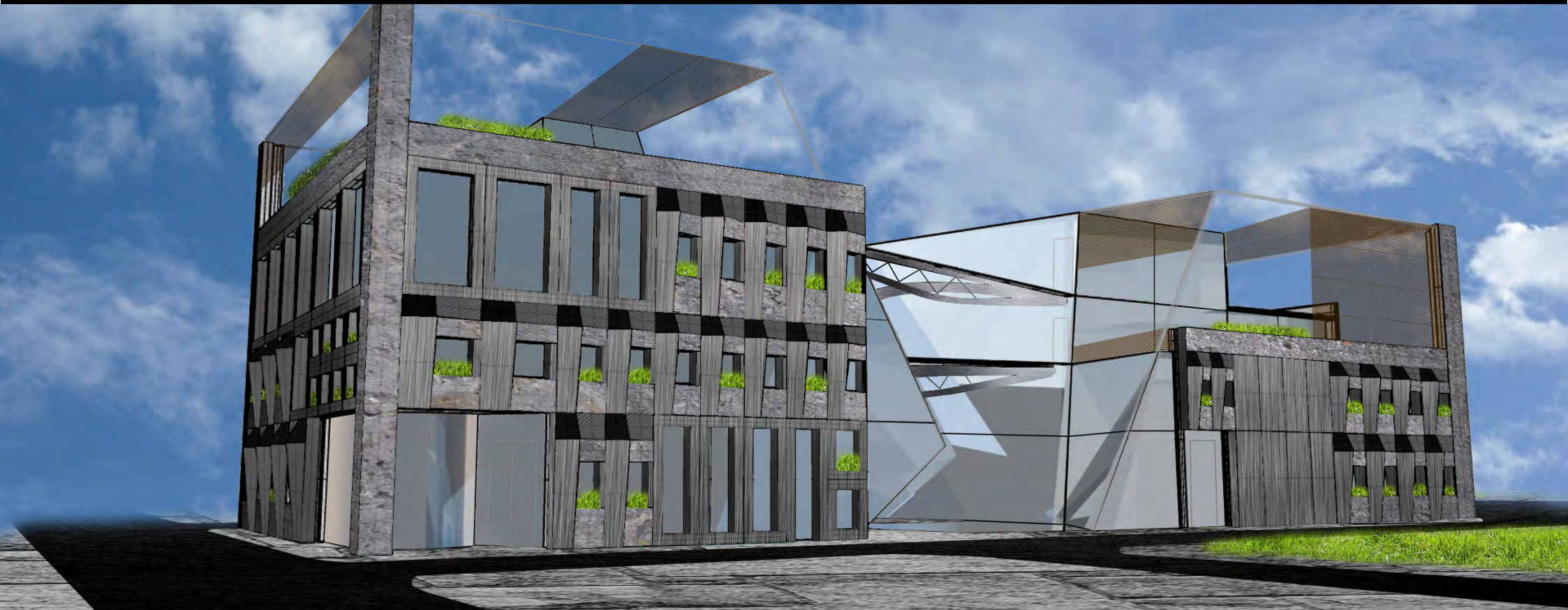
*The Cell / The Envelope / Massing / Atrium / The Building*





# מרחב ביניים ספר פרוייקט

מגיש: עידן כהן  
מנחה: ד"ר יאשה גרובמן



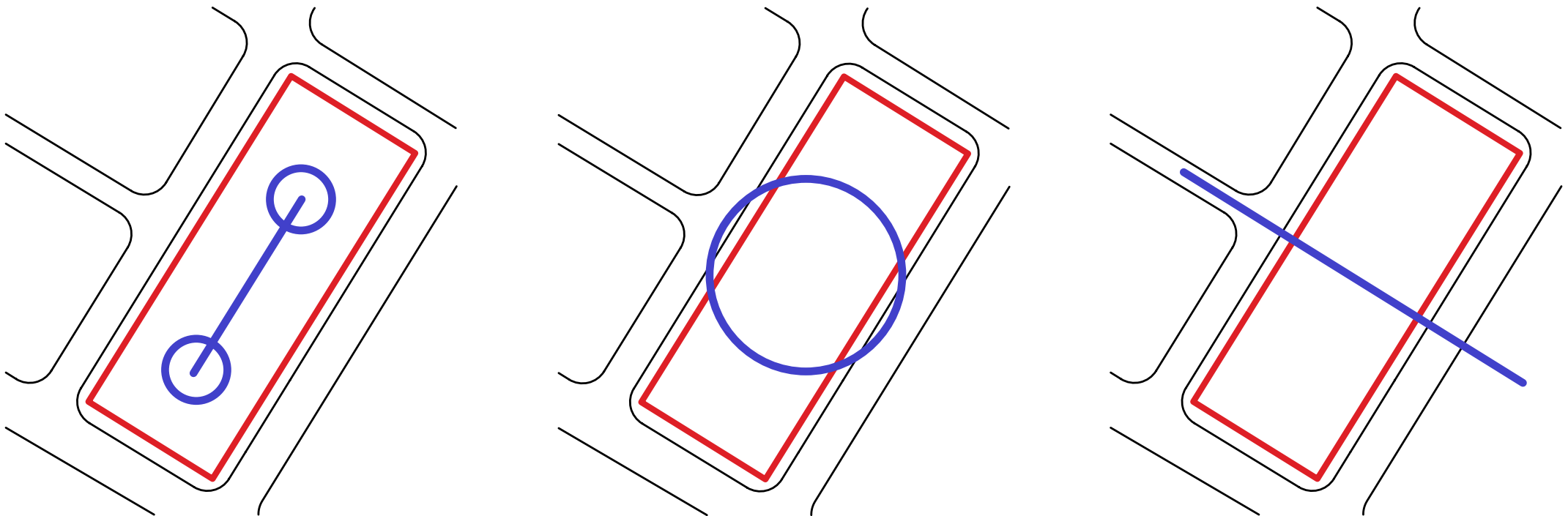


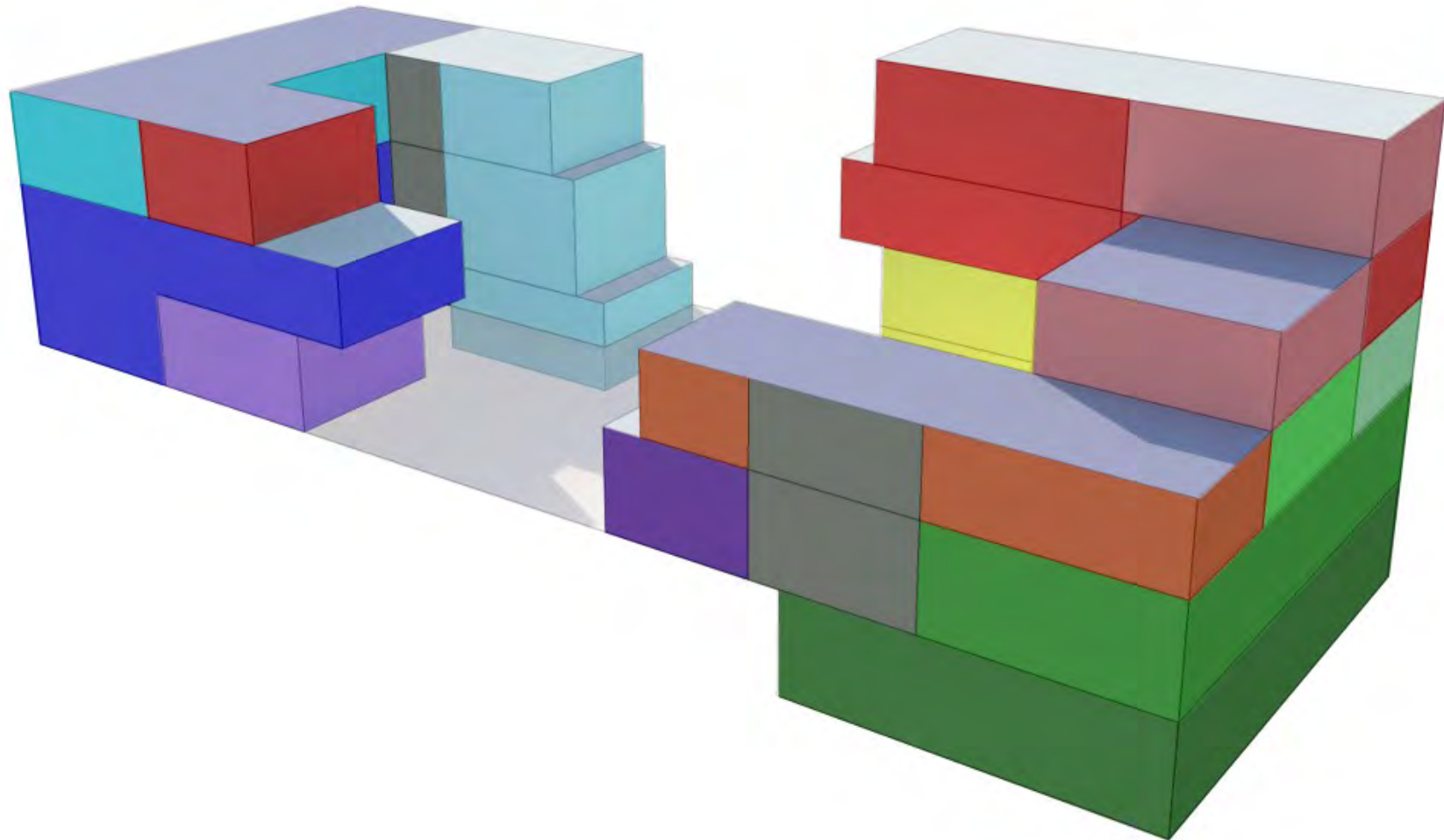
# פרוגרמה 2

אורכו הגדול של המגרש (65 מ'), מיקומו של הפרוייקט והדרכים הקיימות בסביבתו, הביאו להחלטה לחלק את האתר לשני חלקים, ולאפשר חצייה של המגרש במרכזו מבלי להכנס למבנה (1). כל אחד מחלקי המגרש יכליל מבנה בעל אופי שונה. המבנה הצפוני, הגובל בשכונת המגורים, יהיה בעל אופי קהילתי ויכלול מרכז מדיה, גני ילדים, חדרי חוגים וגלריות, ואילו המבנה הדרומי יהווה מרכז ספורט ויכלול חדר כושר גדול, אולם ספורט וחדרי סטודיו.

לפי דרישות התב"ע, החזית החיצונית של המבנה תשב על גבול המגרש. הוחלט ליצור ניגוד בין החזית החיצונית לבין החזיתות שבין המבנים, על ידי הקצנה של הנוקשות של החזית החיצונית, ושימוש בחומרים שונים ובגאומטריות שונות בחזיתות הפנימיות (2).

לכל אחד מהמבנים מערכת תנועה עצמאית שהפונקציות מאורגנות סביבה, כאשר קיים קשר של גשרים בין מערכות התנועה של שני המבנים (3).



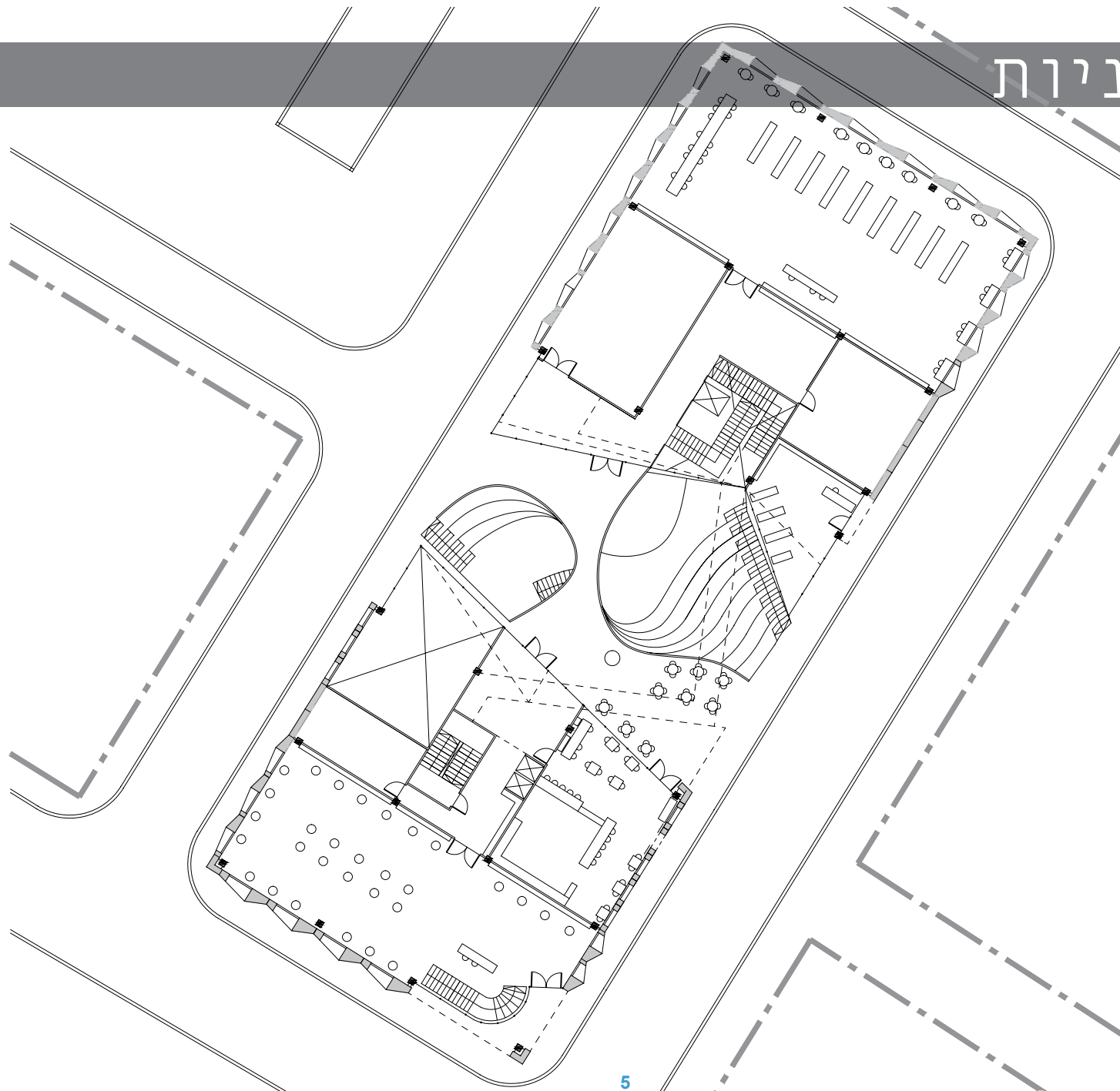


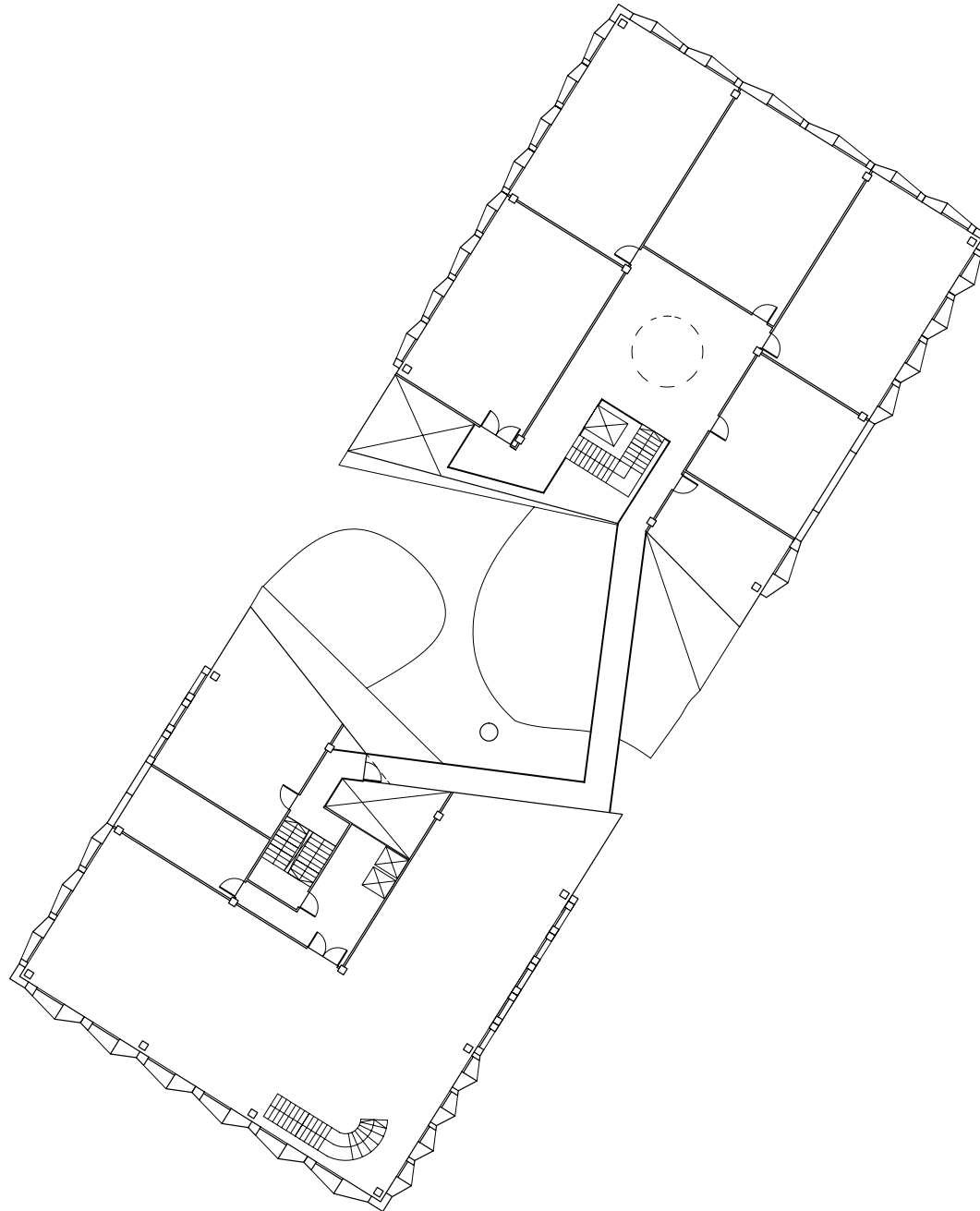
### ארגון הפונקציות בפרוייקט

11. חדר כושר	6. חדרי פעילות	1. אודיטוריום
12. אולם ספורט	7. גני ילדים	2. ספריית מדיה
13. חדרי סטודיו	8. משרדים	3. חדר הרצאות
14. שירותים	9. חנות ספרים	4. מרכז מחשבים
15. גגות בשימוש	10. בית קפה	5. גלריות

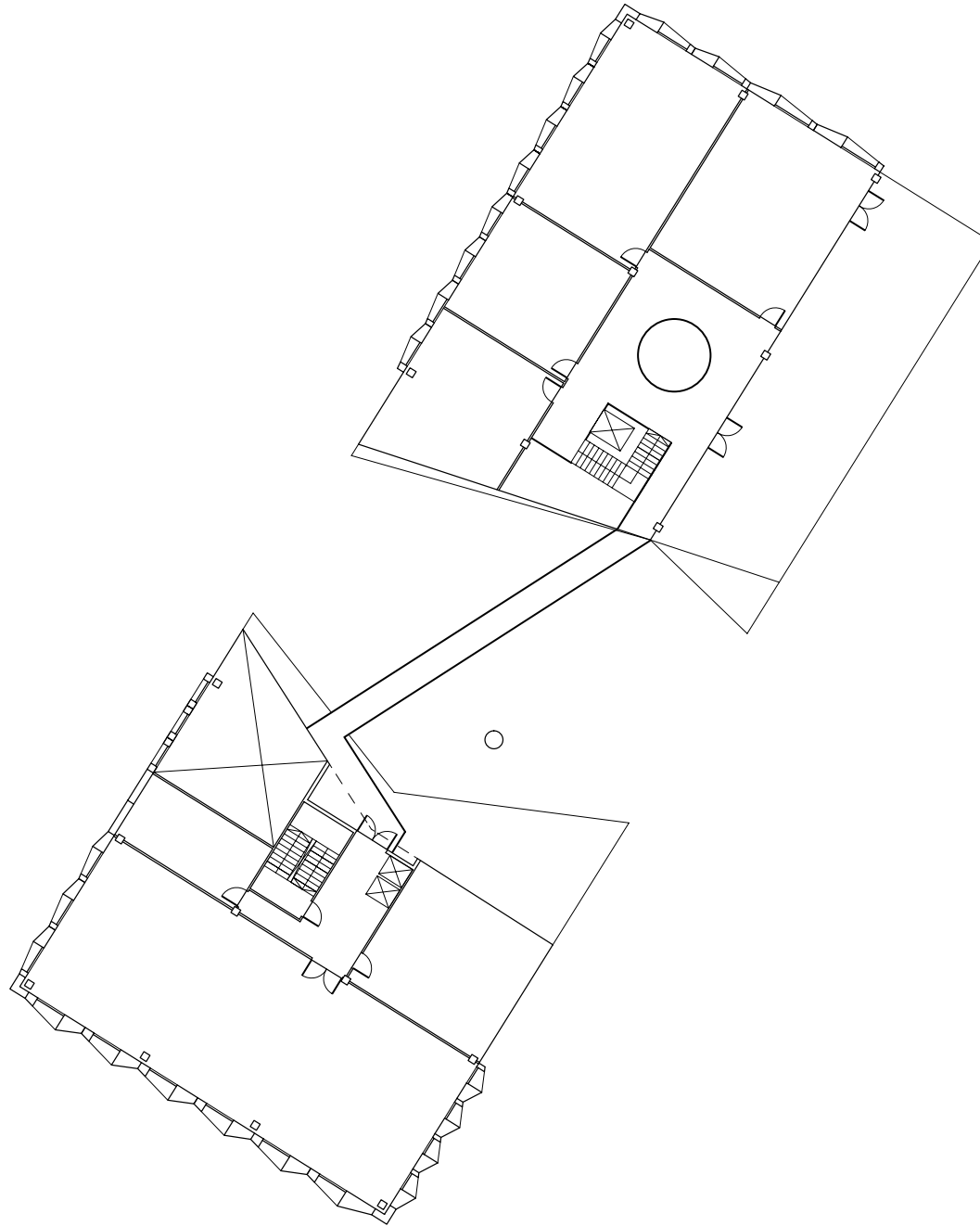
# תוכניות

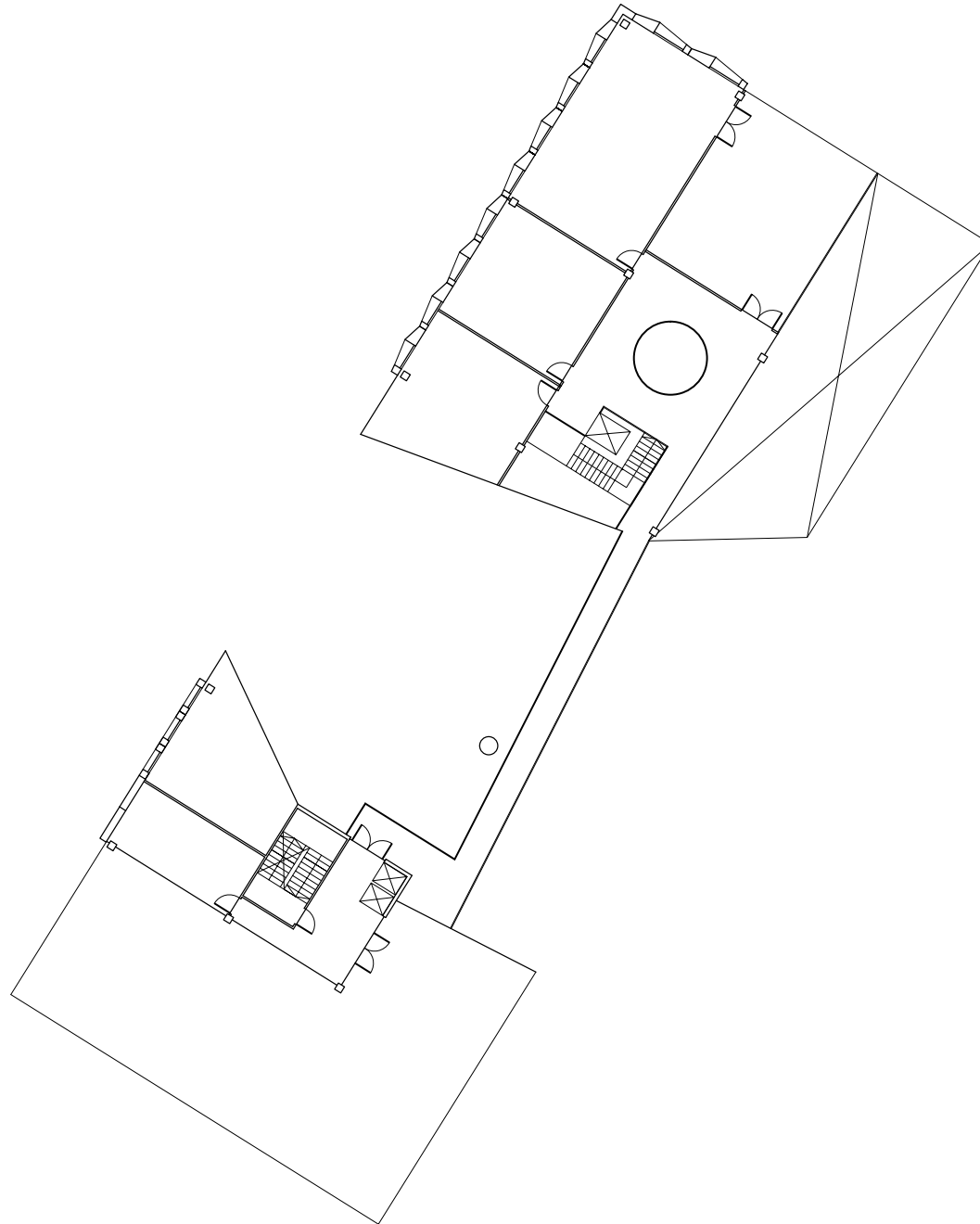
# 3

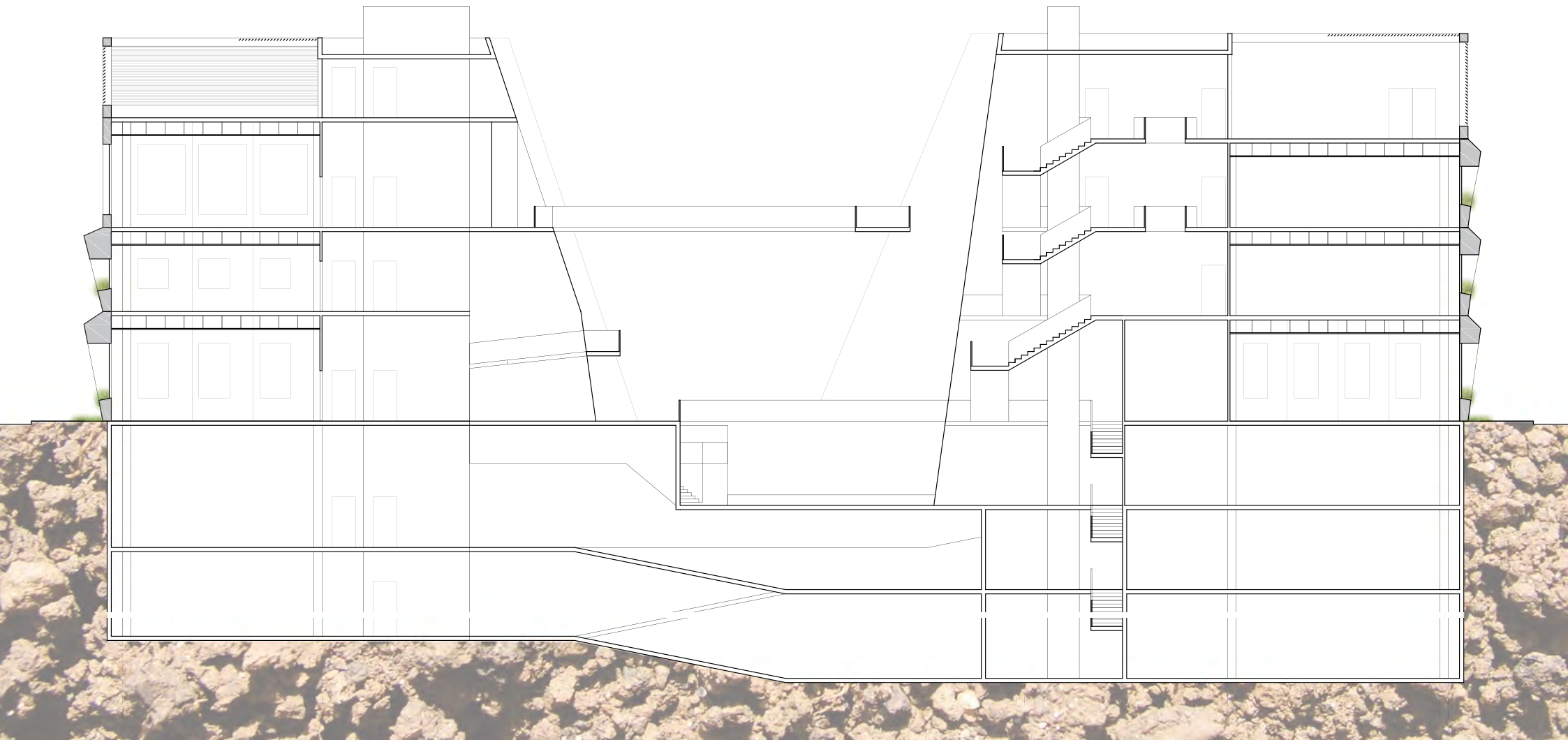








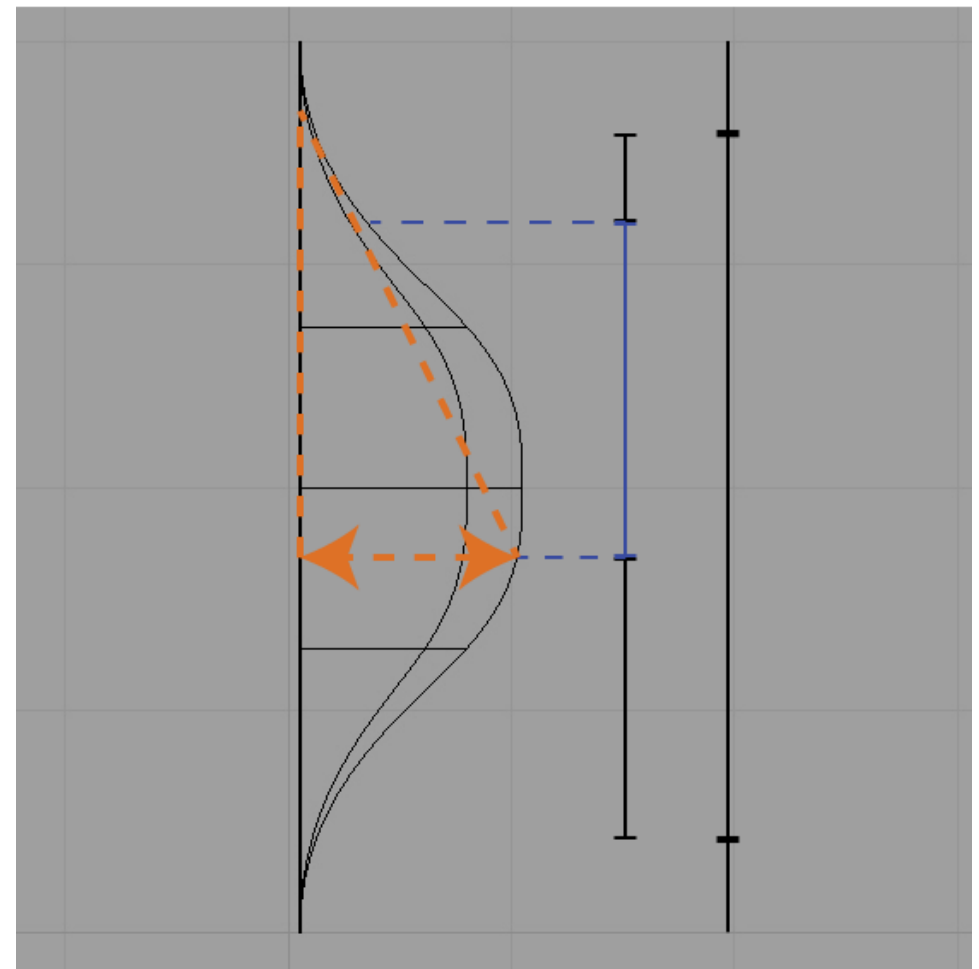
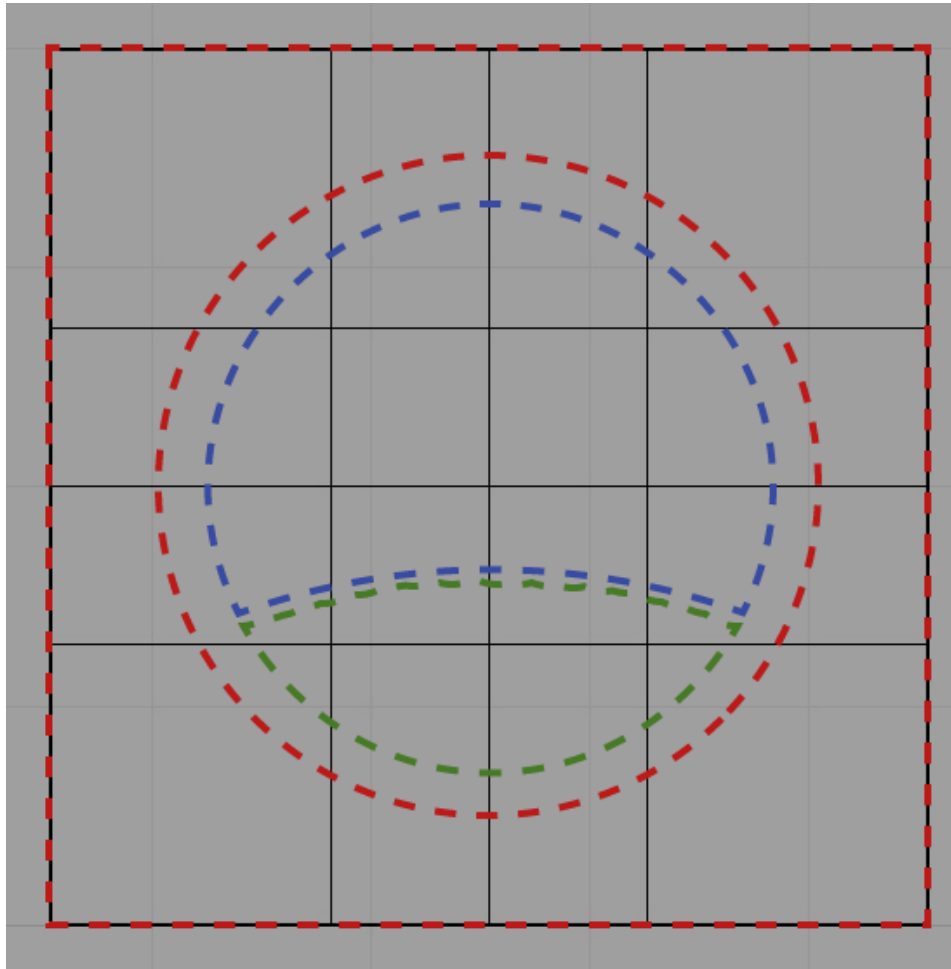




# 4 תא חזית

תא החזית תוכנן כך שהביצוע העיקרי שלו הוא סינון קרינת השמש אשר תחזור על הבניין. במהלך התפתחותו הוחלט על שילוב ביצועים נוספים, כמו גידול צמחיה, אוורור טבעי ומערכת אגירת מים (שעליה מבוססת גם מערכת ההשקיה של הצמחיה).

בעקבות ההבדלים בזווית השמש בין חזית לחזית, ובעקבות דרישות לסוגי פתיחות שונים של תאים אשר נובעים מהפונקציות השונות שהבניין מכיל, הותאמו 6 גרסאות של התא, אשר ישולבו בחזית לפי קריטריונים שונים, כמו מידת הפתיחות הדרושה או כמות האור הטבעי הנחוץ לתפקוד המבנה.



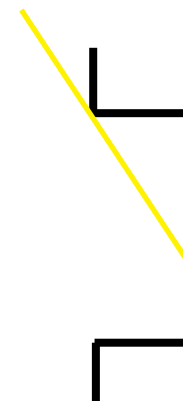
**תכנון חזית**

תכנון התא הבודד ותכנון הקונספט הכללי של החזית נעשו במקביל, והשפיעו זה על זה.

הוחלט לתכנן חזית אשר תכיל את הקונסטרוקציה, ותגיב לקרינת השמש. בשלב הראשון הוגדרה קונסטרוקציה לא אורטוגונלית, על מנת לבחון את השתנות התא לאורך החזית.

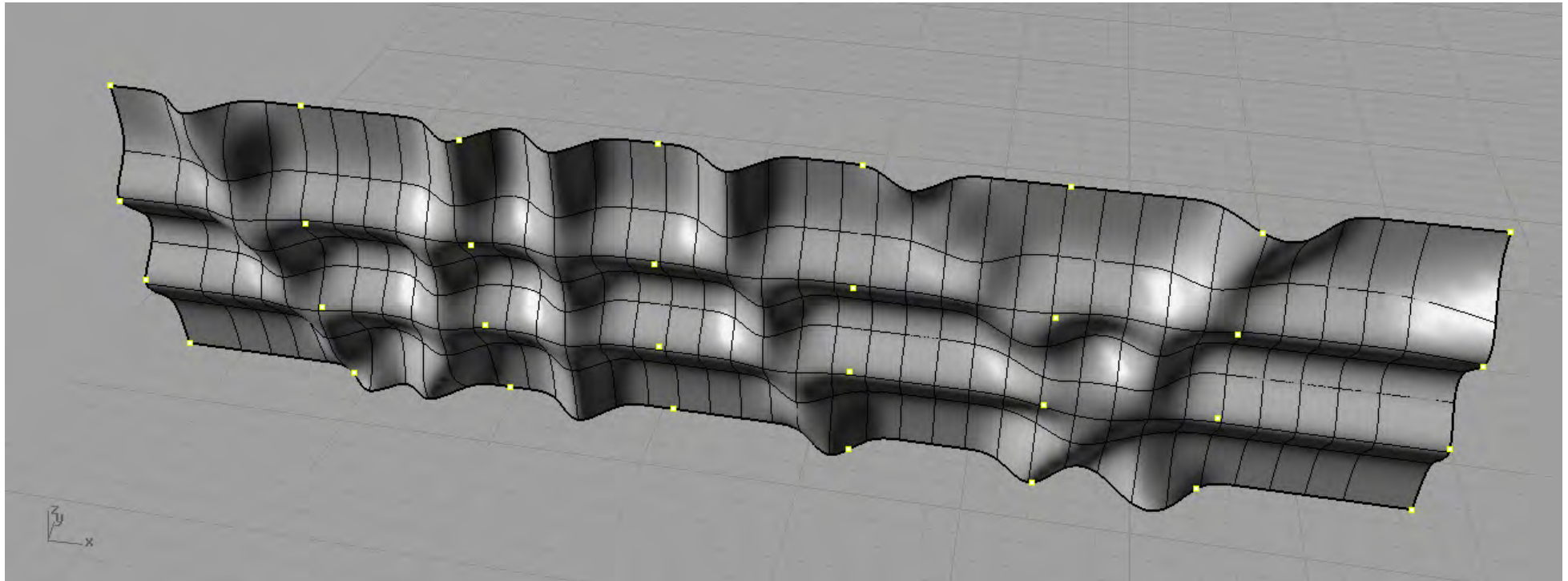


הכוונה הייתה לייצר מצב שבו גריד הקונסטרוקציה בולט משאר החזית, ובכך מאפשר דרגות שונות של חשיפה לקרינת השמש, כך שניתן יהיה להגדיר פתחים שמוצלים בתקופות החמות, ולנצל את קרינת השמש בשאר החזית.



## תכנון חזית

בשלב הראשון הוגדר משטח החזית באמצעות פעולת Heightfield. הוגדר גריד על המשטח, מתוך כוונה לחלק אותו לשדות על פי נקודות המפגש בקונסטרוקציה, ובהמשך לאכלס כל שדה כזה בתא.

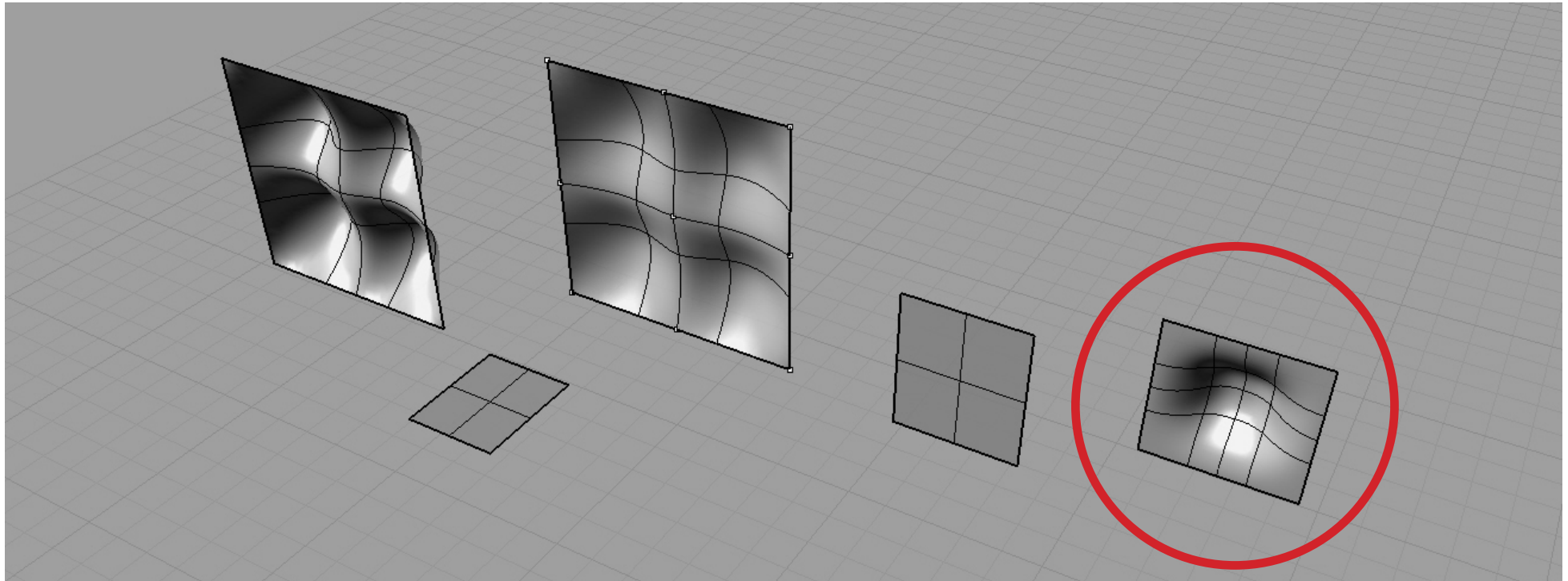


החסרונות:

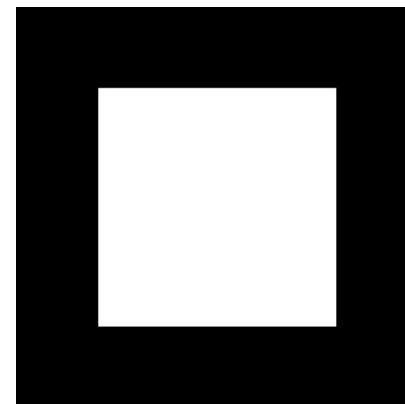
1. לא מדויק.
2. גבהים לא אחידים, יש שליטה מסויימת אך היא מוגבלת.
3. נתקלתי בבעיה בסנכרון נקודות הגריד עם התמונה.
4. גם במצב אופטימלי שבו הגבהים יהיו אחידים והגריד יהיה מסודר בהתאם לקונסטרוקציה, בסופו של דבר הגריד יהיה שטוח.

## תכנון חזית

נעשו מספר נסיונות להגיע לתא שיהיה ניתן לשלוט בעומקו.



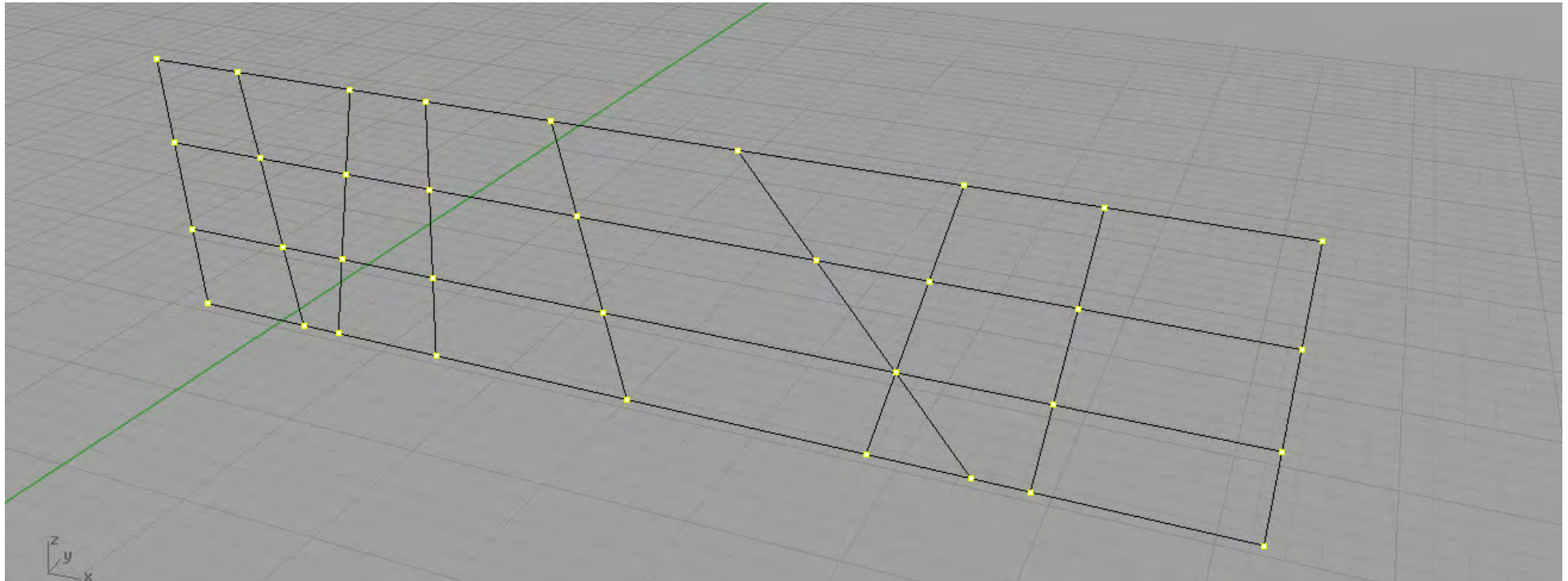
בסופו של דבר נבחרה הסכמה הבאה שדרכה הוגדר התא בפעולת Heightfield.



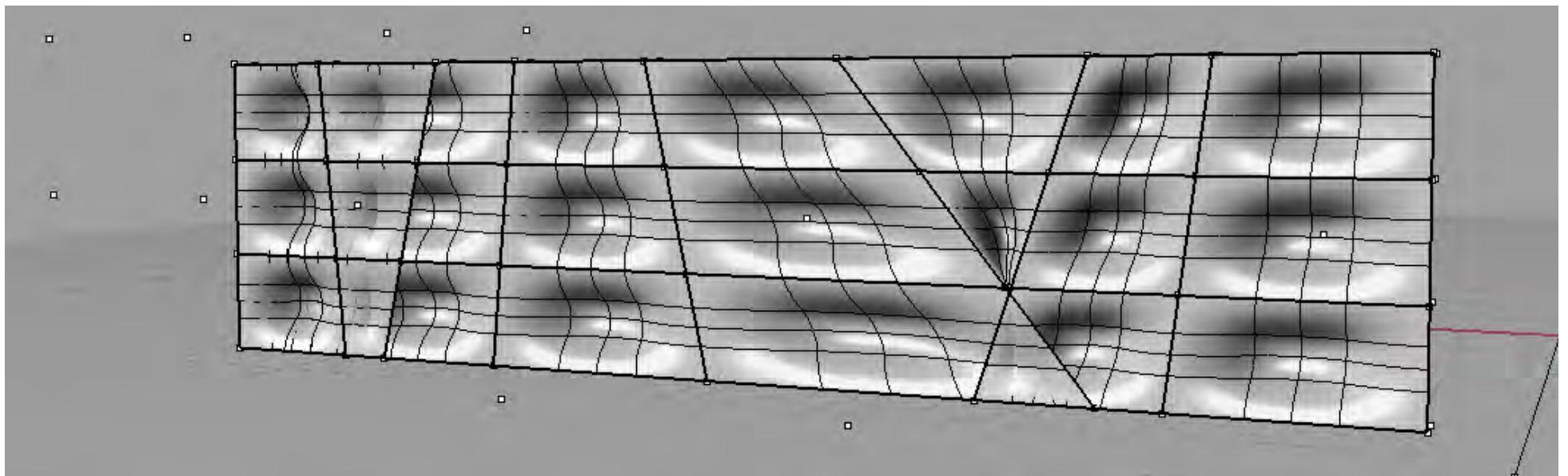
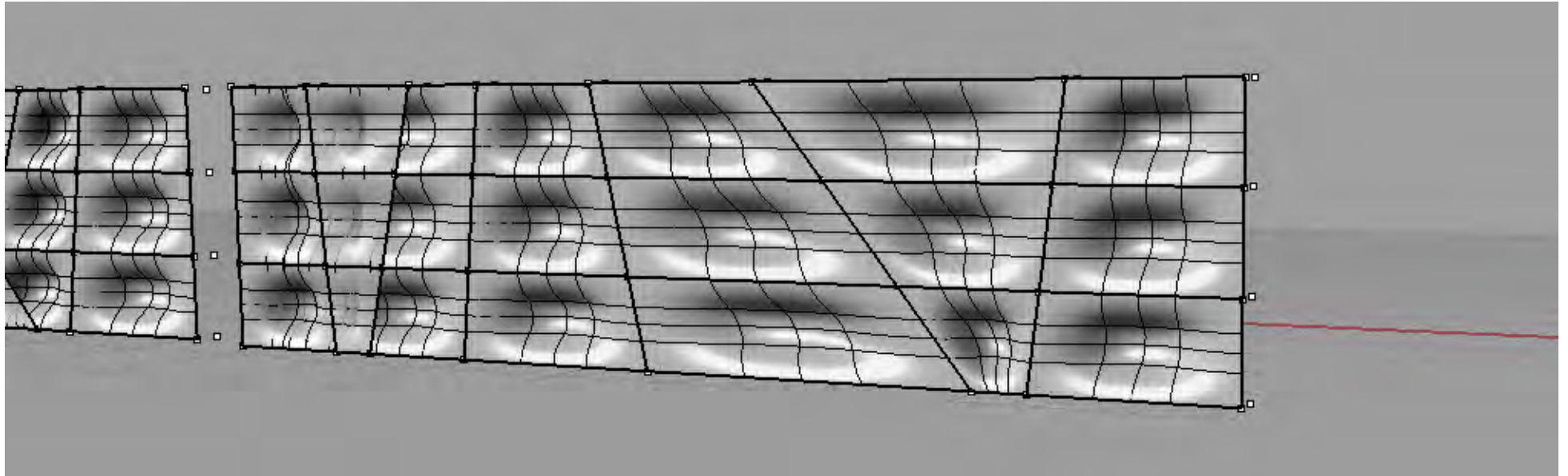
## תכנון חזית

השלב הבא היה למצוא דרך שתאפשר להגדיר גריד מדוייק לפי סכמה קונסטרוקטיבית, שבו יהיה ניתן לאכלס את התא.

הפעולה ptGridUVCurves מאפשרת לקחת רשת של קווים פשוטים, ולהגדיר עליה גריד, כך שכל נקודה בגריד תהיה בעצם נקודת מפגש ברשת הקווים. בעצם ניתן לקחת את הנתונים הקונסטרוקטיביים של החזית, להעביר קווים במיקום המדוייק של מרכזי העמודים והקורות, ובכך לקבל גריד מדוייק התואם את הקונסטרוקציה.

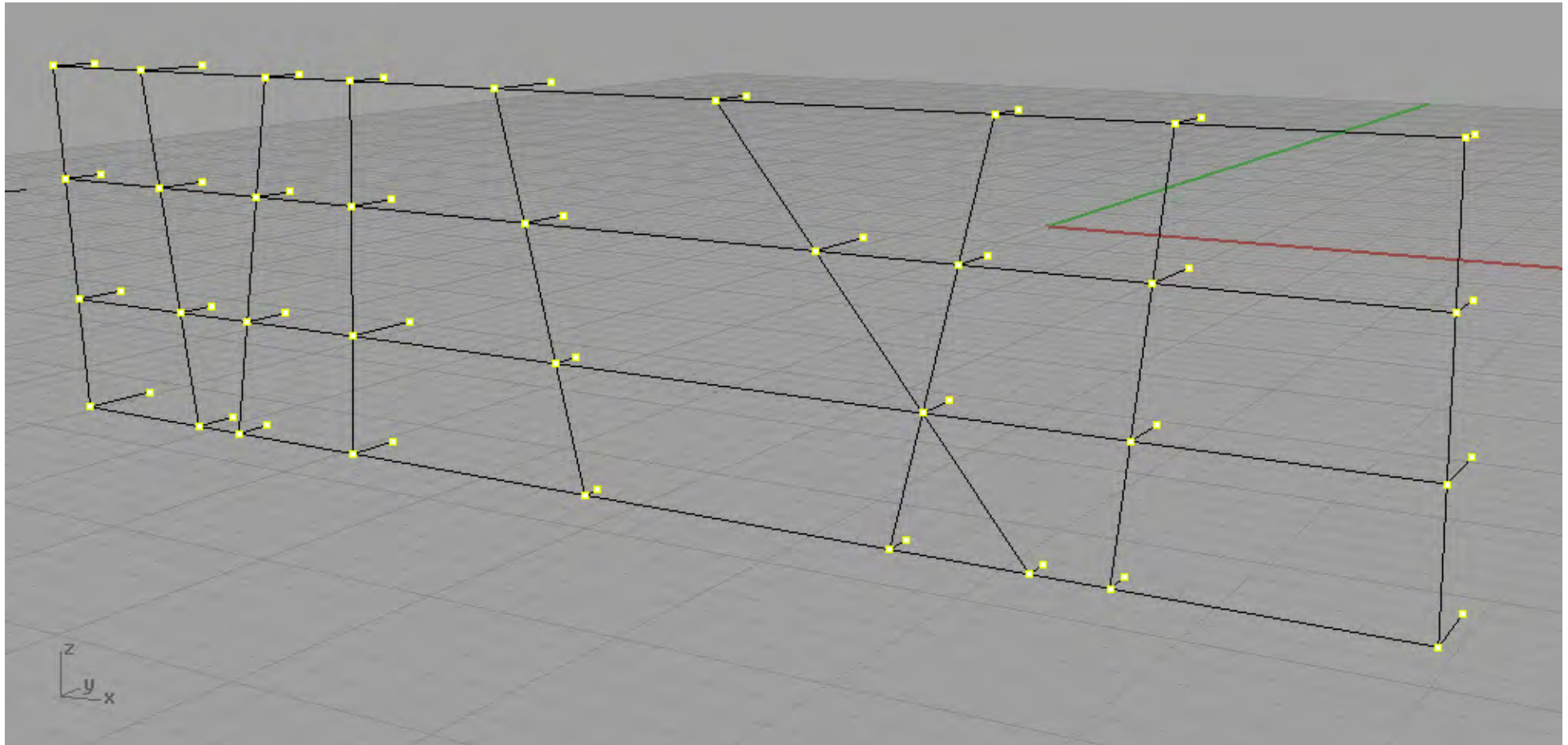


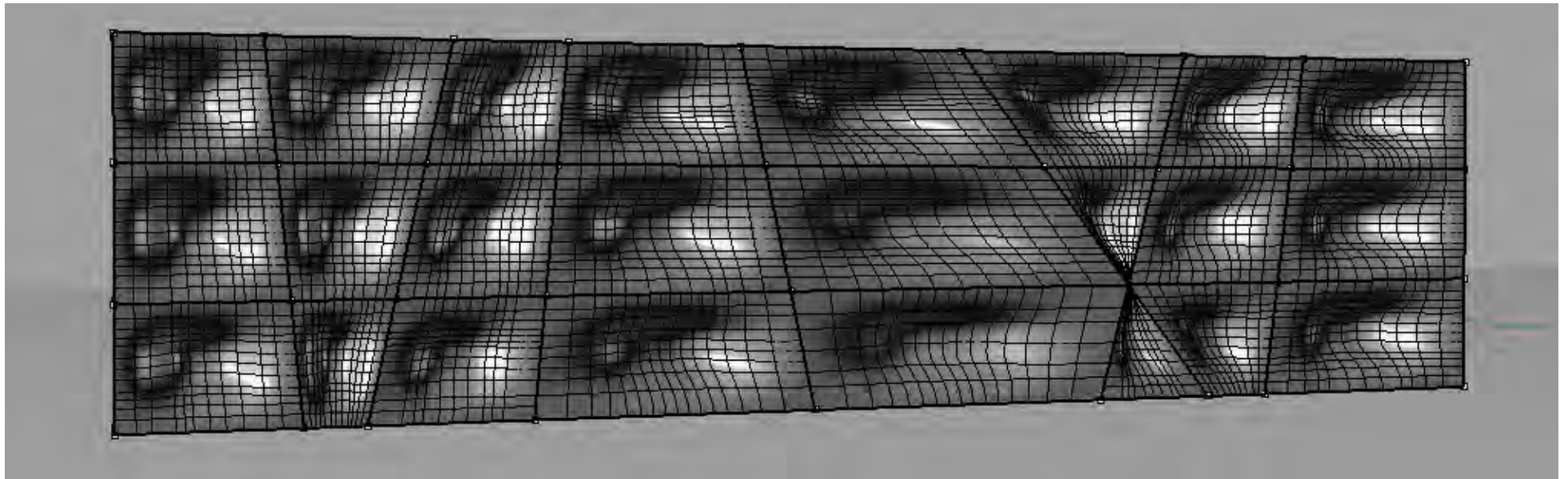




**תכנון חזית**

ptOffsetPoints > PointAttractors  
אמצעי לשליטה על עומק התא ועל השתנות בעומק התא לאורך החזית. עומק התא למעשה נובע מהמרחק בין שתי הרשתות.





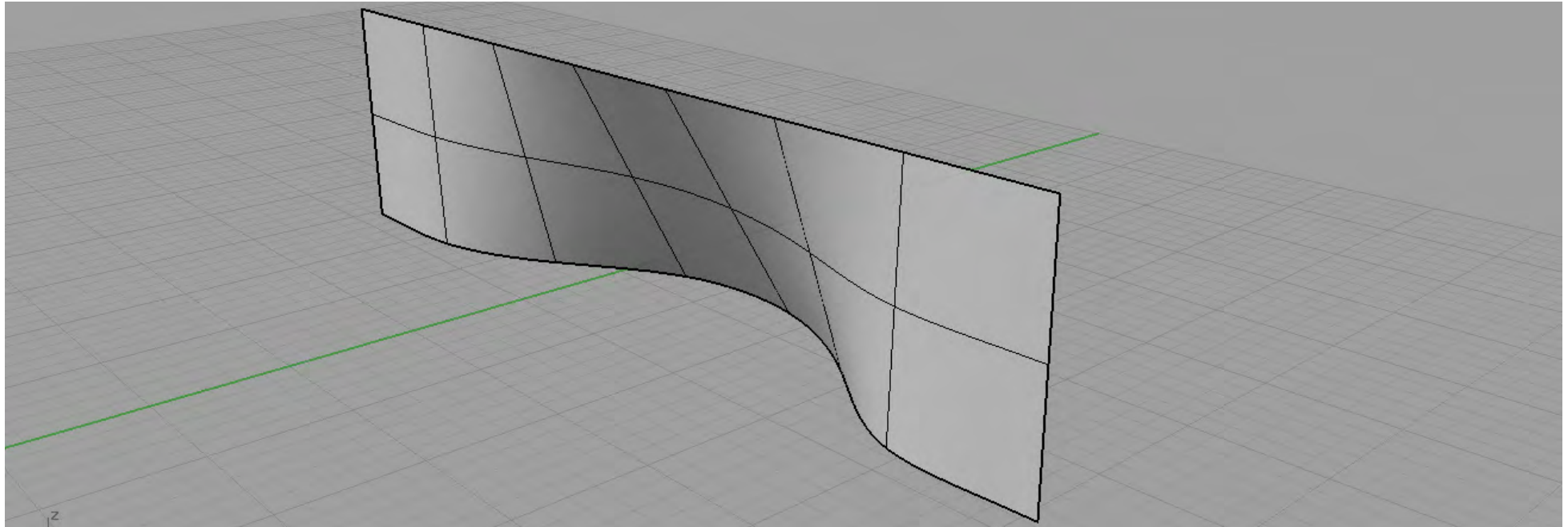
## תכנון חזית

אורך הצל ביחס לגובה האלמנט המצל	זווית הצל עם ציר הצפון	
		קיץ (4:35-18:45)
115%	95 מעלות לכיוון מערב	8:00
45%	75 מעלות לכיוון מערב	10:00
20%	25 מעלות לכיוון מזרח	12:00
65%	80 מעלות לכיוון מזרח	14:00
160%	100 מעלות לכיוון מזרח	16:00
		חורף (6:40-16:30)
690%	50 מעלות לכיוון מערב	8:00
180%	25 מעלות לכיוון מערב	10:00
150%	4 מעלות לכיוון מזרח	12:00
220%	35 מעלות לכיוון מזרח	14:00
960%	56 מעלות לכיוון מזרח	16:00
		מעבר (5:45-17:45)
190%	70 מעלות לכיוון מערב	8:00
85%	45 מעלות לכיוון מערב	10:00
60%	4 מעלות לכיוון מזרח	12:00
100%	50 מעלות לכיוון מזרח	14:00
240%	75 מעלות לכיוון מזרח	16:00

נתונים המאפשרים לחשב את עומק קרני השמש על פי גובה הפתח. השעות המסומנות - השעות המשמעותיות ביותר להצללת פתחים, כאשר השעה 14:00 היא הדומיננטית ביותר, לוא דווקא בגלל עוצמת השמש, אלא בגלל שבשעה זו זווית השמש היא הקריטית ביותר.

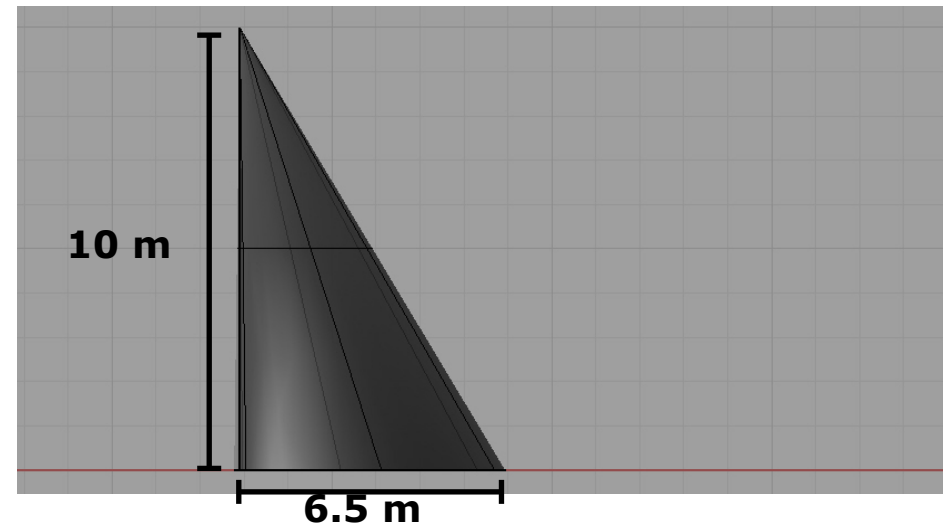
## תכנון חזית

ע"מ לבדוק סוגים שונים של יחידות הוגדר משטח שבחלק מהמקומות מצל על עצמו, כך חלק מהיחידות יוכלו להיות חשופות יותר.



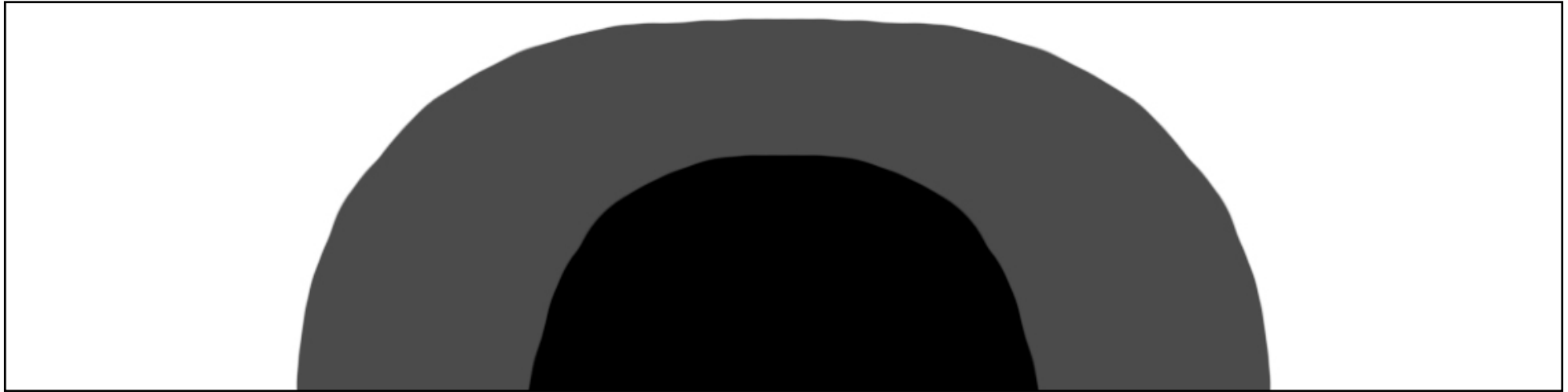
45%	75 מעלות לכיוון מערב	10:00
20%	25 מעלות לכיוון מזרח	12:00
65%	80 מעלות לכיוון מזרח	14:00

זווית המשטח נקבעה בהתאם לזווית הקיצונית ביותר של השמש.



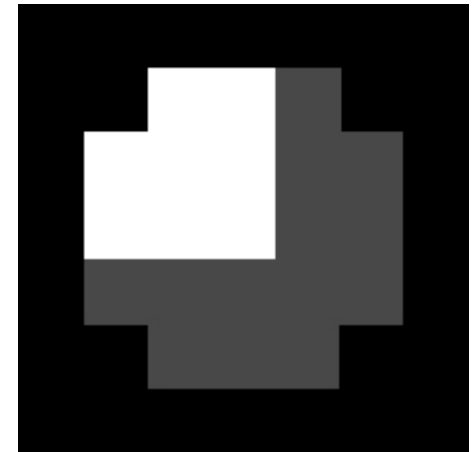
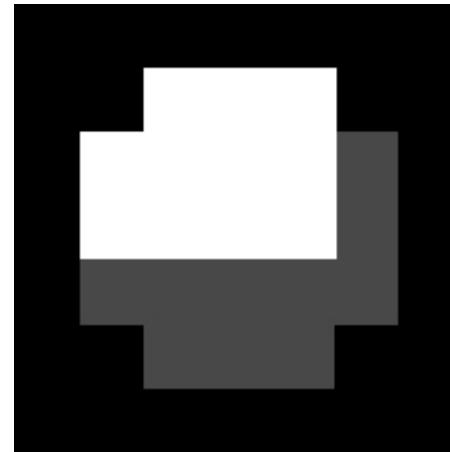
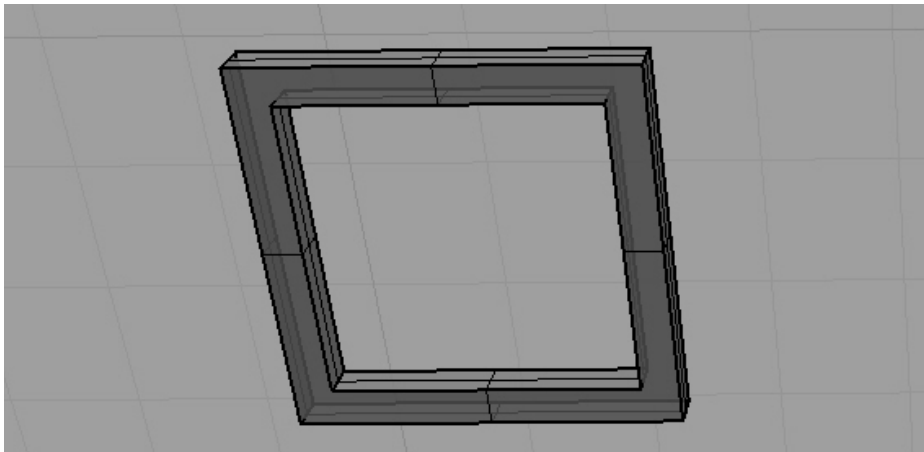
**תכנון חזית**

פיזור קרינת השמש על המשטח.



בנוסף הוגדר סוג תא נוסף לאיזור שבו הגאומטריה הכללית של החזית גורמת להצללה עצמית.

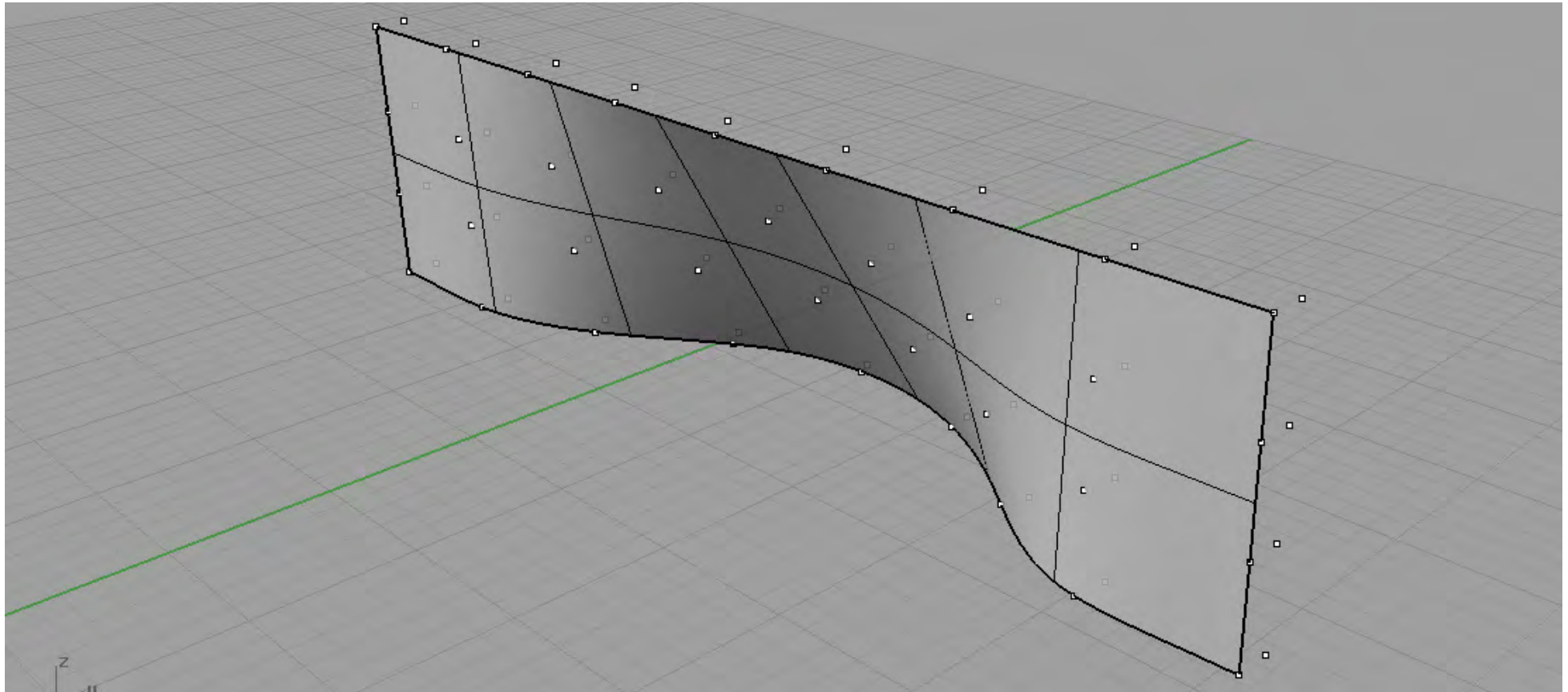
ע"מ לחלק את התא הבסיסי למרכיביו הוגדר גם בו גריד. הוגדרו שני סוגי תאים, בהתאם לפגיעת השמש באיזורים המוארים של החזית.



לבן - מוצל ביותר - מתאים לפתחים  
 אפור - מוצל חלקית - מתאים לצמחייה  
 שחור - חשוף ביותר - מתאים לאלמנטים שינצלו את קרינת השמש

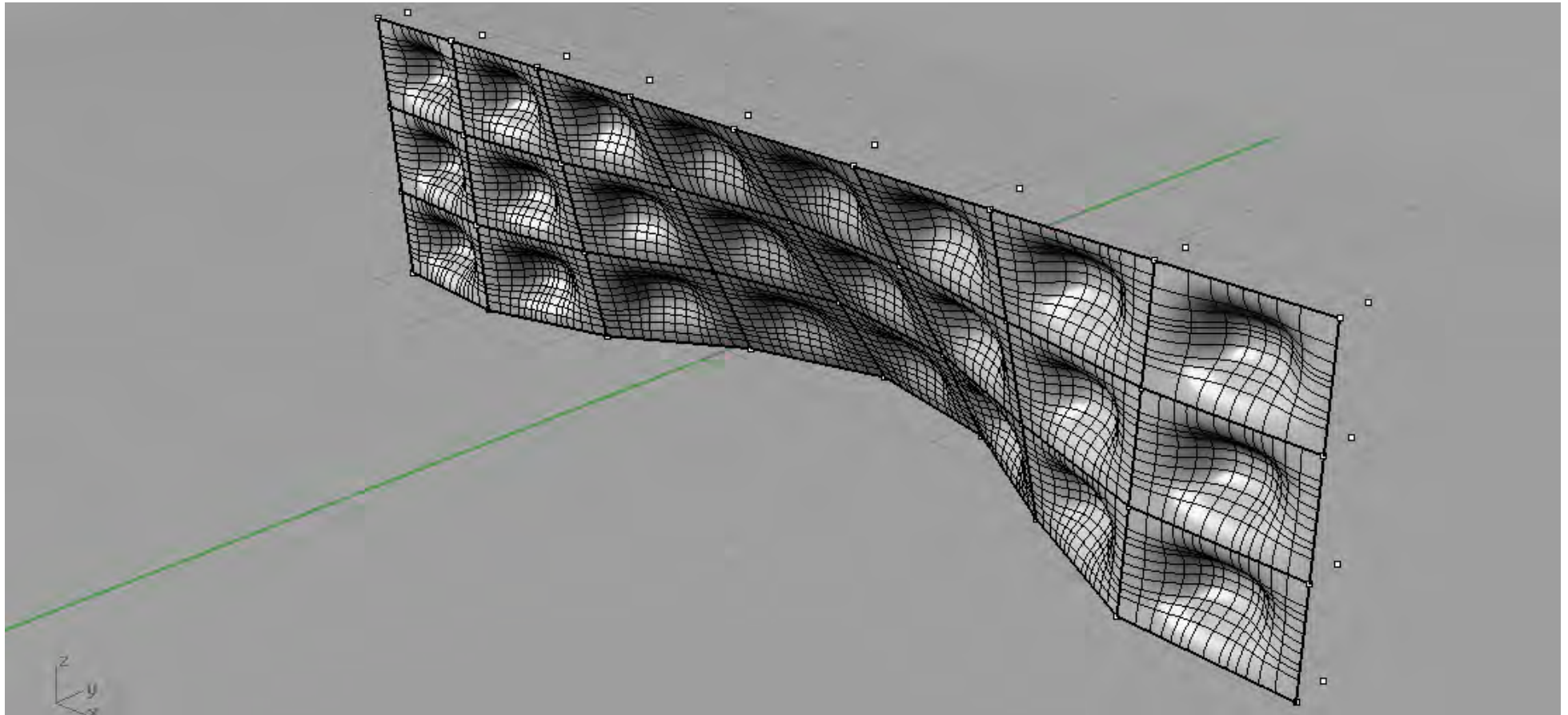
**תכנון חזית**

הגדרת גריד על משטח החזית (והגדרת גריד נוסף ע"י פעולת `ptOffsetPoints`, כאשר המרחק בין שתי הרשתות נע בין 0.3 מ' ל 1.2 מ').



**תכנון חזית**

ע"מ לקבל משטח חלק ולא שבור יש להשתמש במשטחים תוחמים.





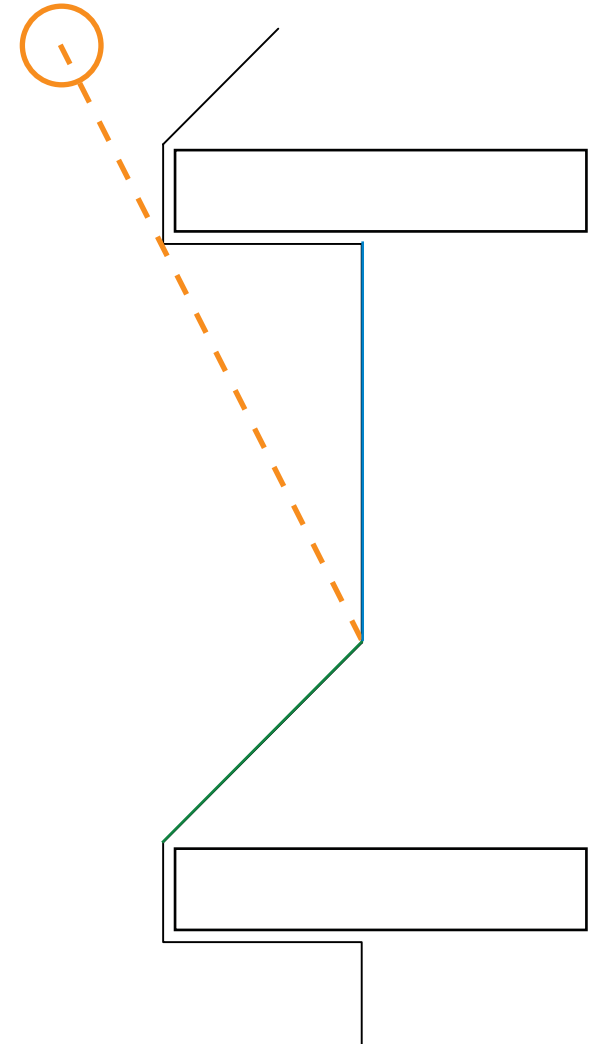
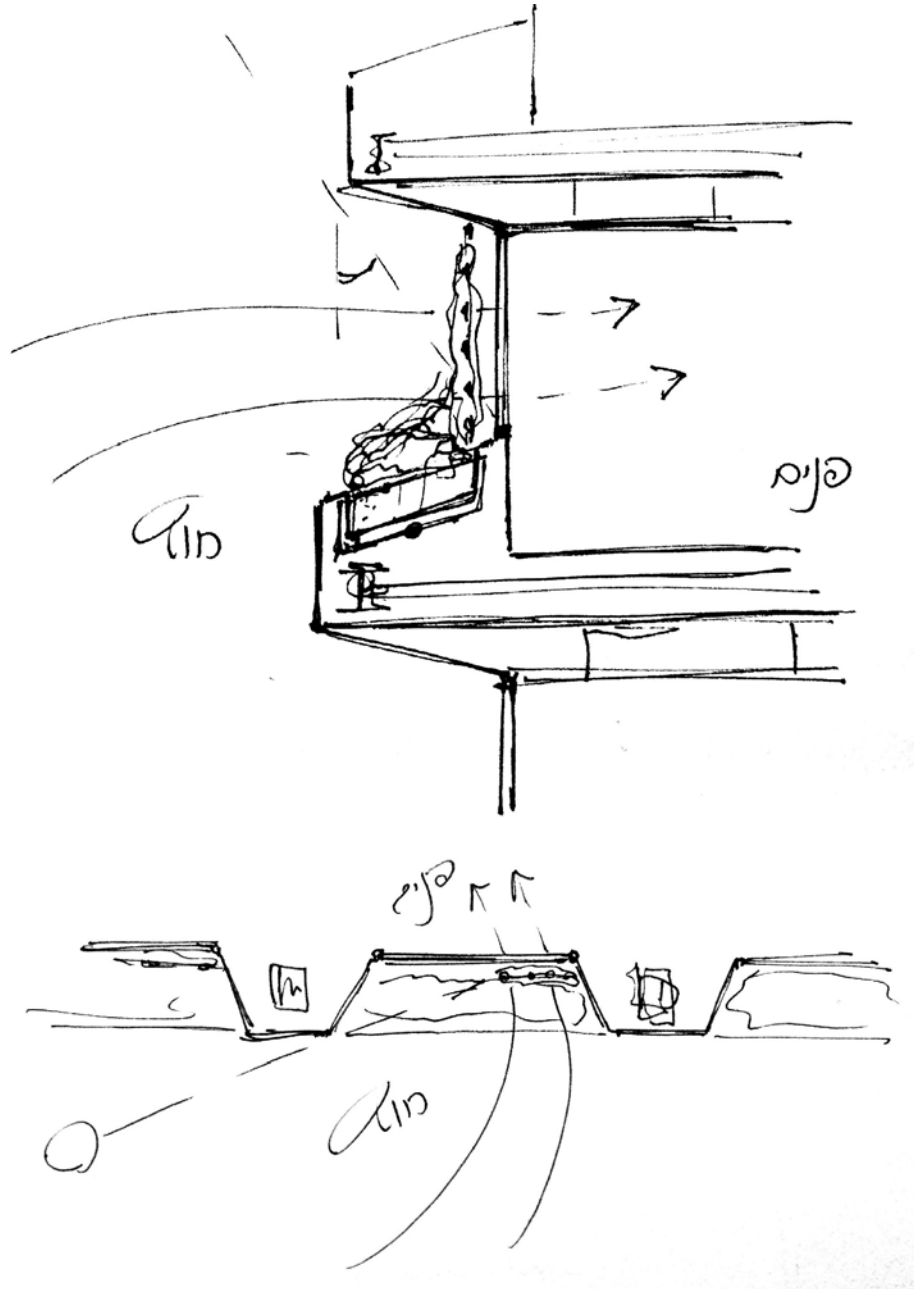
**תכנון חזית - פרטים**

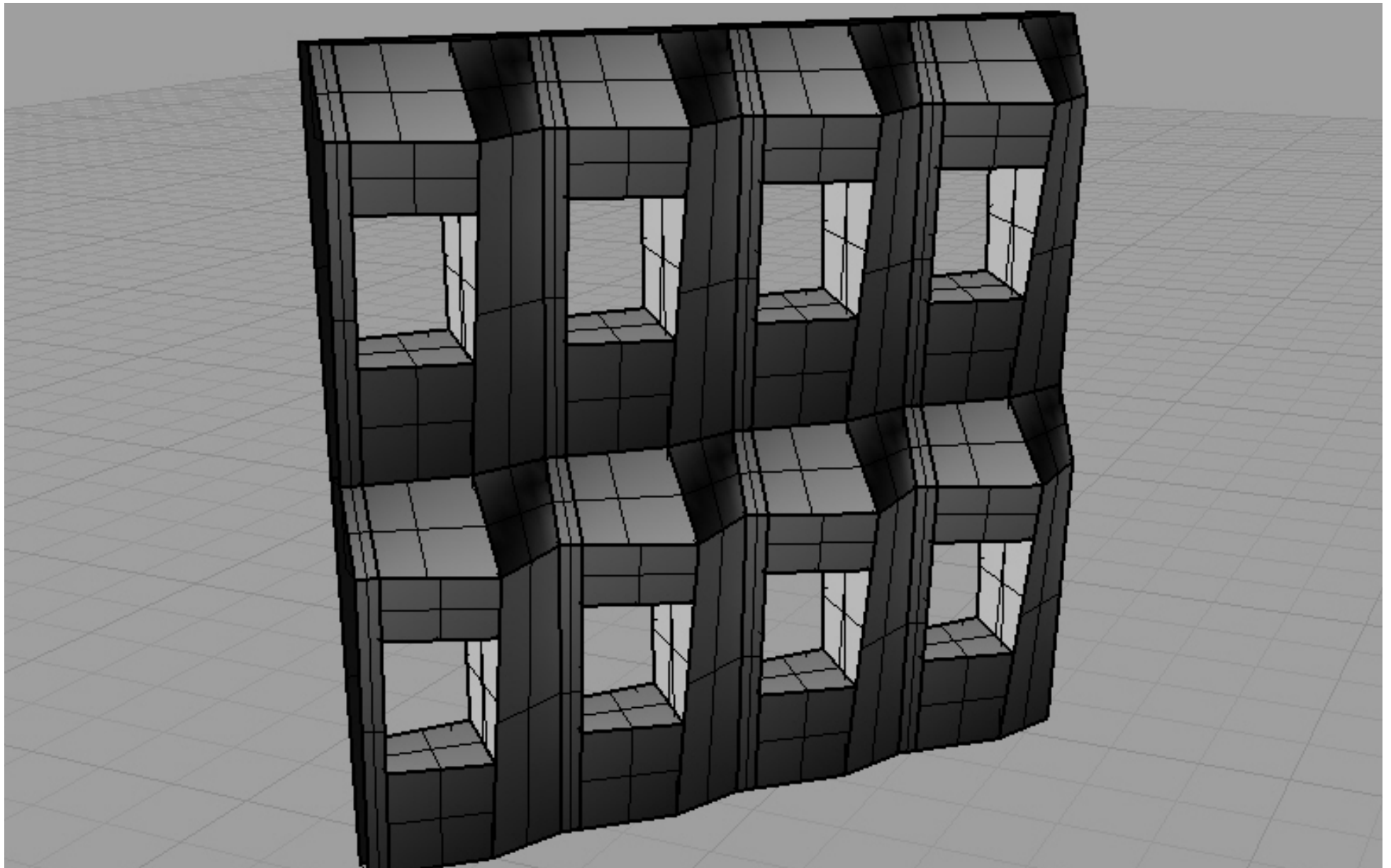
פרט המאפשר סינון של האוויר החיצוני ואוורור של הבניין באוויר נקי יותר, באמצעות שימוש בצמחייה. המערכת ממחזרת את עודפי המים שנספגו באדמה ומעלה אותם לשימוש חוזר.

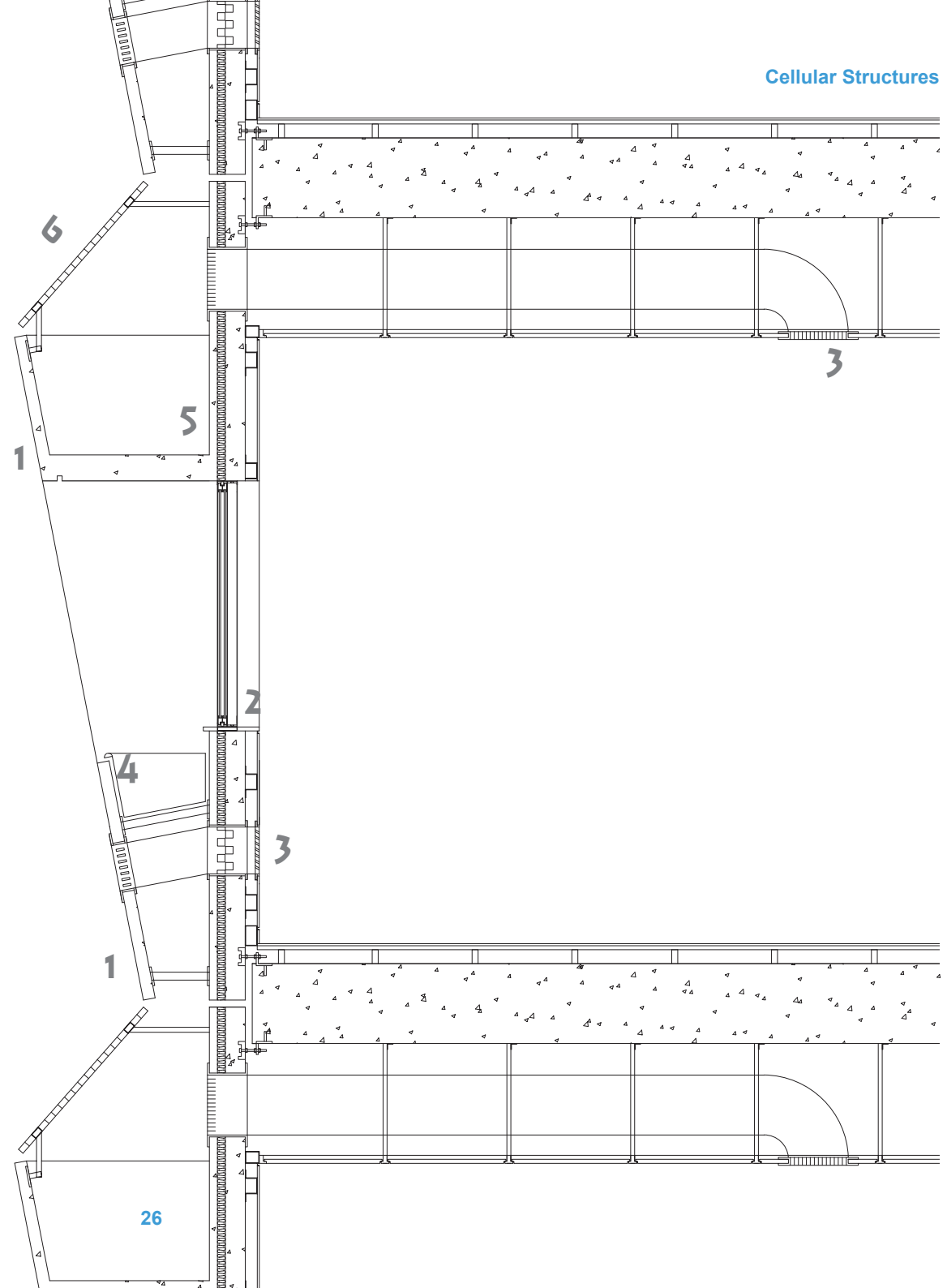


[www.greenscreen.com](http://www.greenscreen.com)

כיצד הצמחים תורמים לנקיון האוויר?  
 אוויר במכיל פחמן דו חמצני ורעלים מזרם על הצמח, אשר קולט את הרעלים ומשחרר חמצן. האוויר הנקי מזרם אל תוך הבניין.







### חתך תא חזית, קנ"מ 1:5

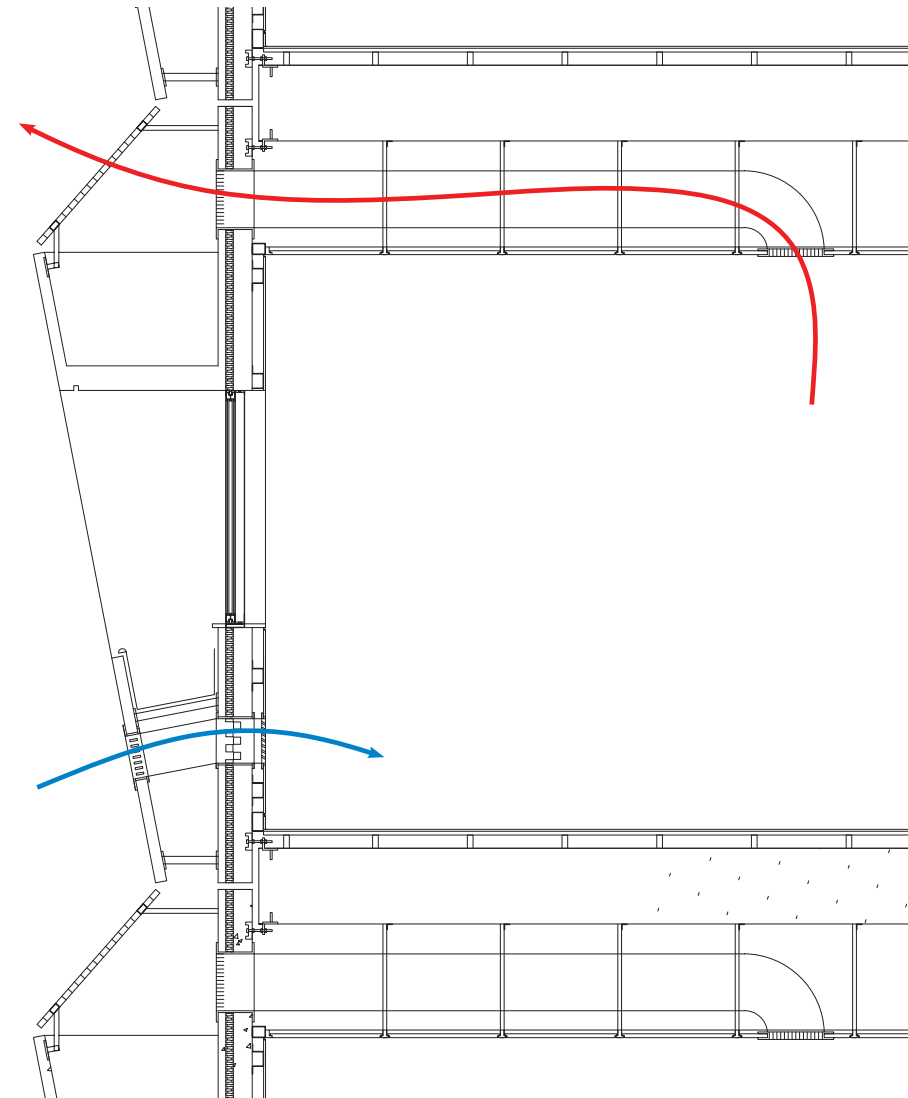
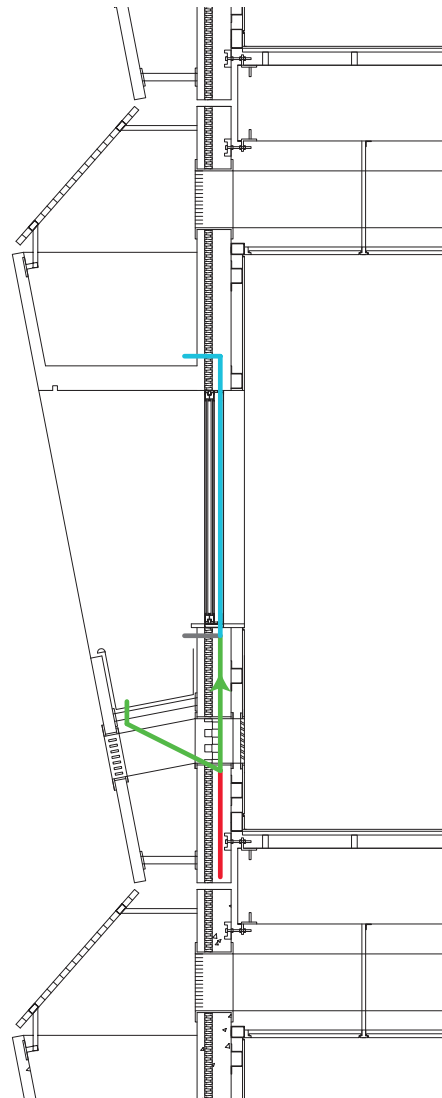
1. אלמנטים מבטון טרומי
2. חלון הזזה
3. פתחי אוורור טבעי
4. אדנית נשלפת
5. מיכל לאגירת מי גשמים
6. פנלים סולריים / רשתות פלדה

### זרימת אוויר טבעית (ימין)

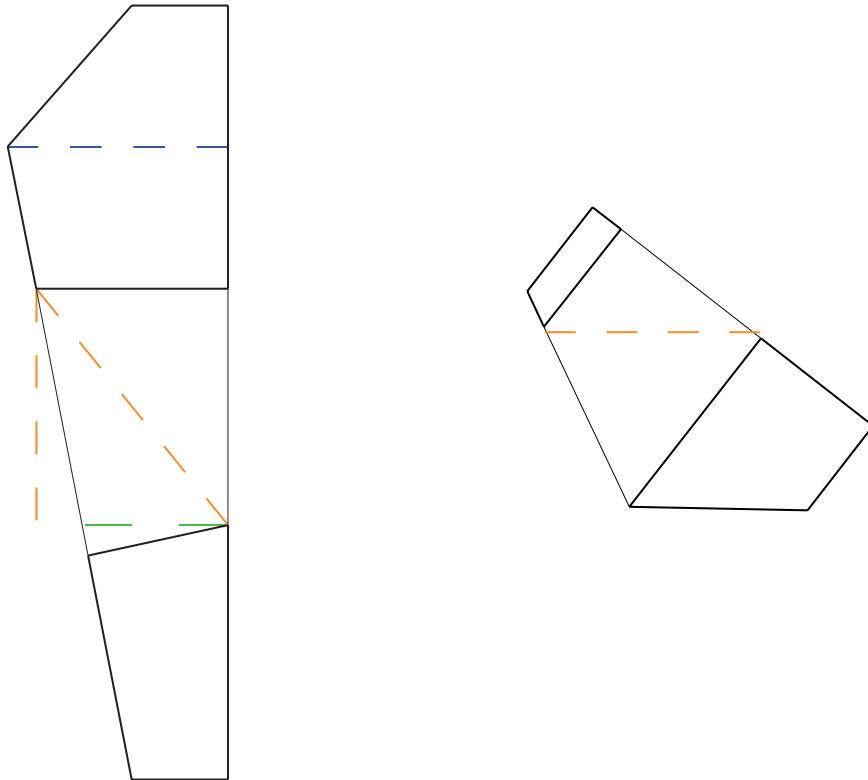
- אוויר חם
- אוויר קר

### מערכת השקיה (שמאל)

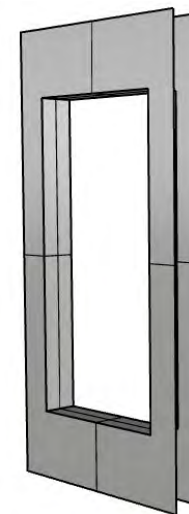
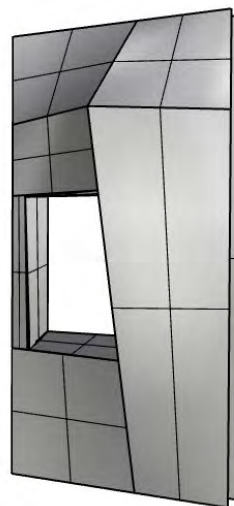
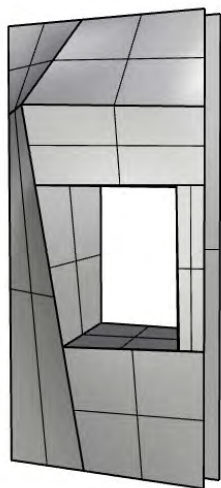
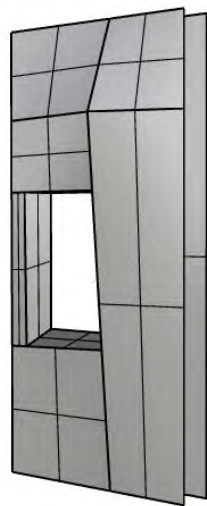
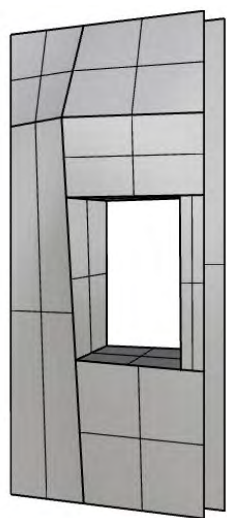
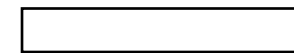
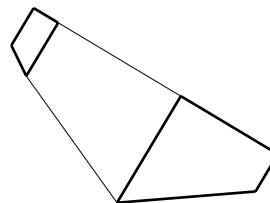
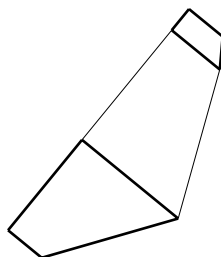
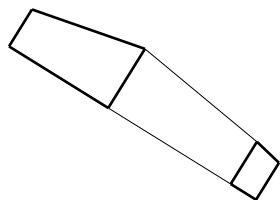
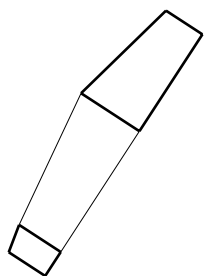
- השקיה ממאגר המים
- שימוש חוזר במים
- ניקוז



פרט המאפשר סינון של האוויר החיצוני ואורור של הבניין באוויר נקי יותר, באמצעות שימוש בצמחייה. המערכת ממחזרת את עודפי המים שנספגו באדמה ומעלה אותם לשימוש חוזר.



# קטלוג סוגי תאים



חזית צפון מערבית

חזית צפון מזרחית

חזית דרום מזרחית

חזית דרום מערבית

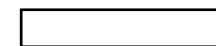
תאי הצללה



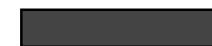
רמת פתיחות

חדירת אור טבעי

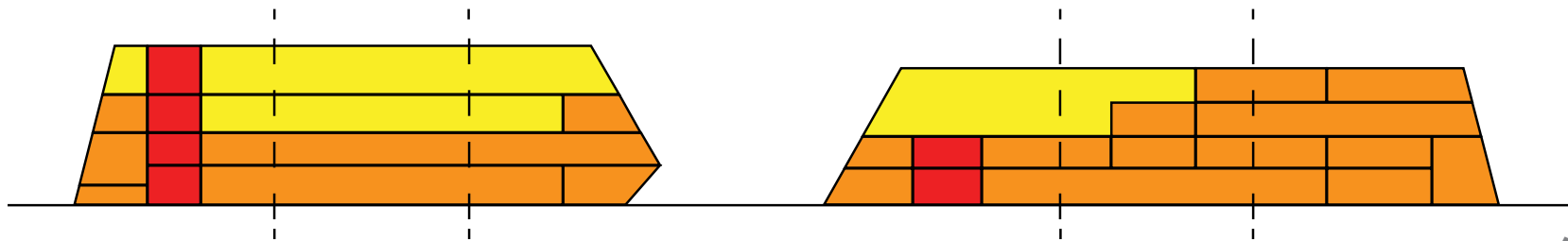
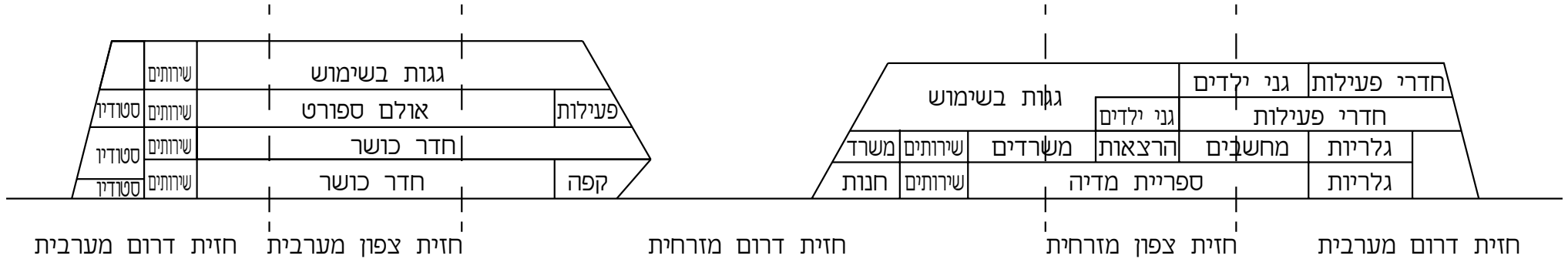
תא חזית פתוח



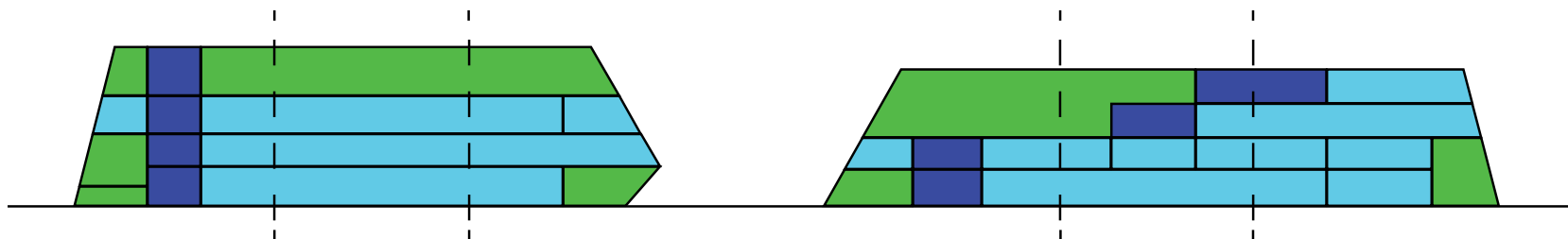
תא חזית סגור



# חזית 5

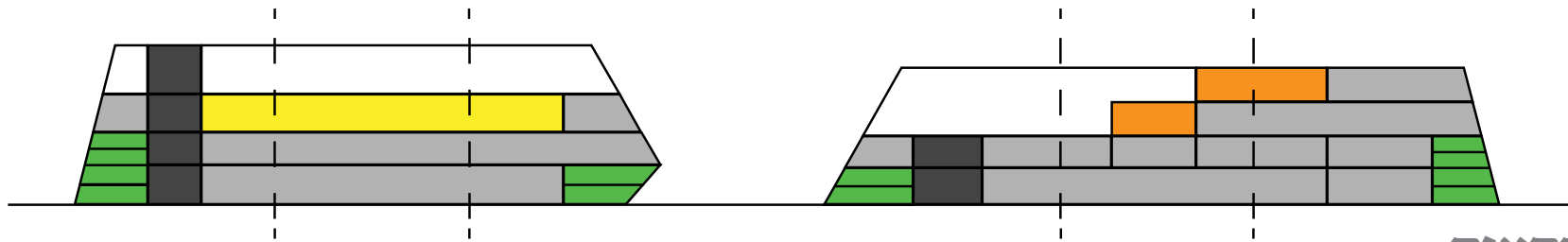


חדירת אור טבעי

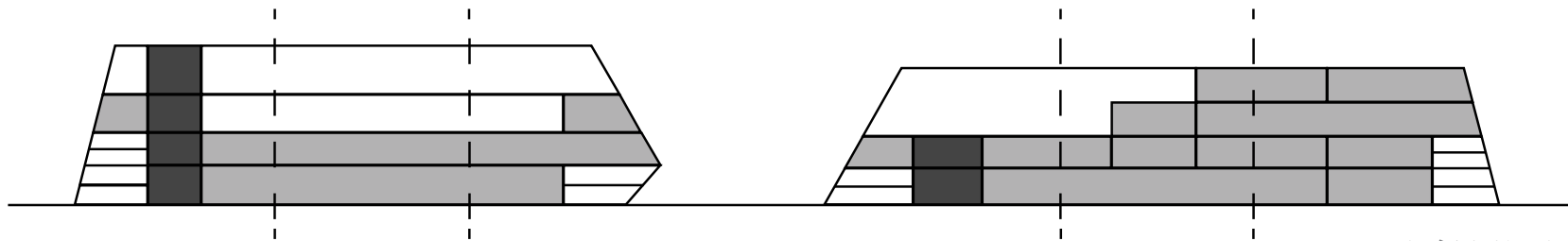


רמת פתיחות

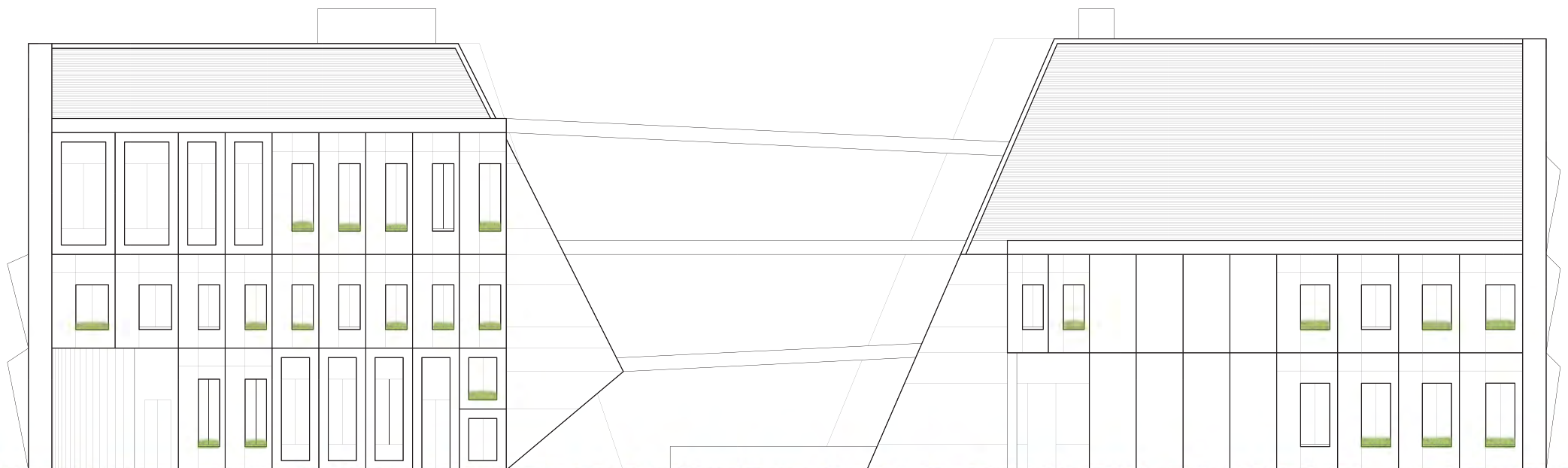




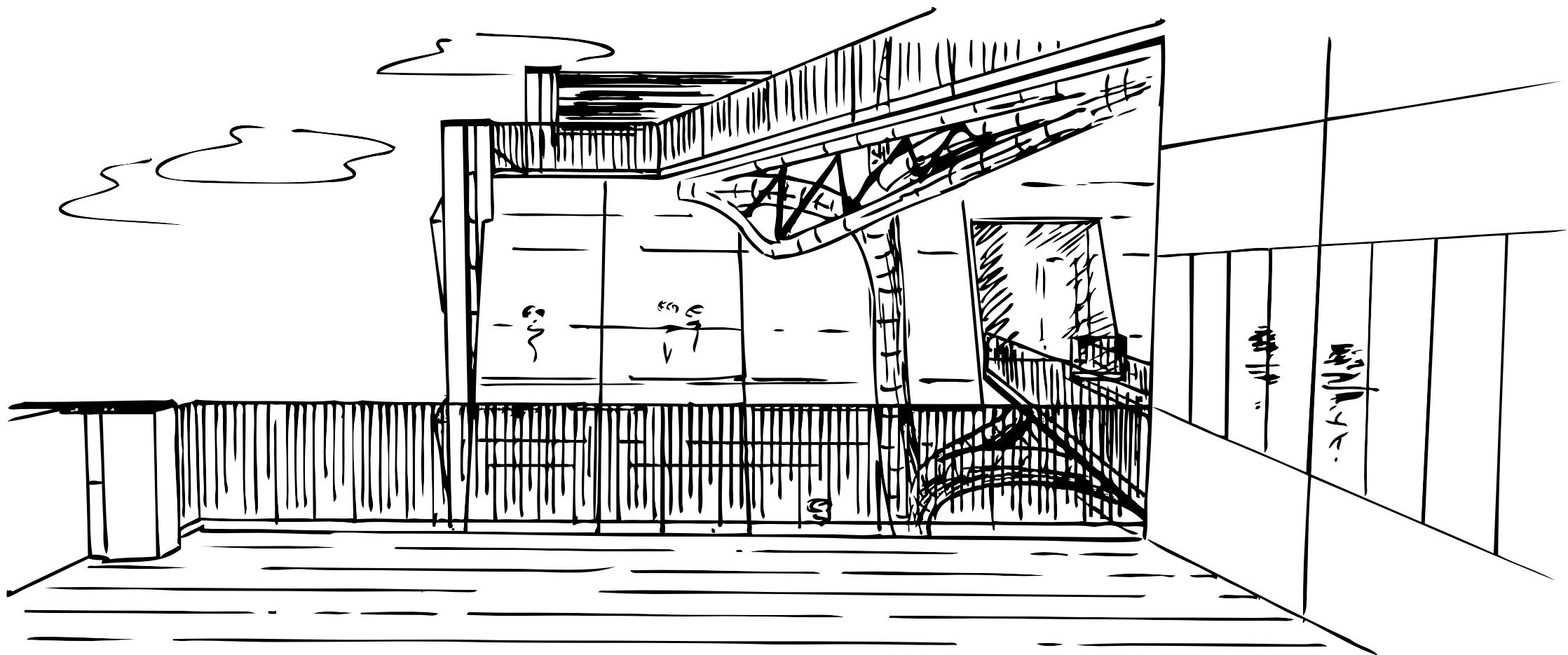
חפיפה בתפקוד התאים



מיפוי סוגי התאים בחזית



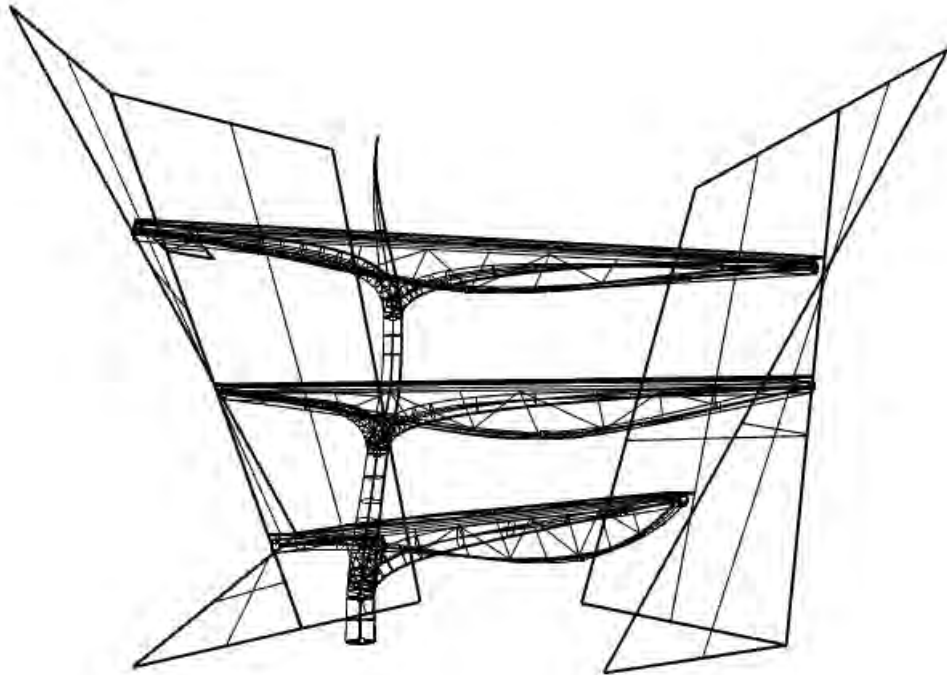
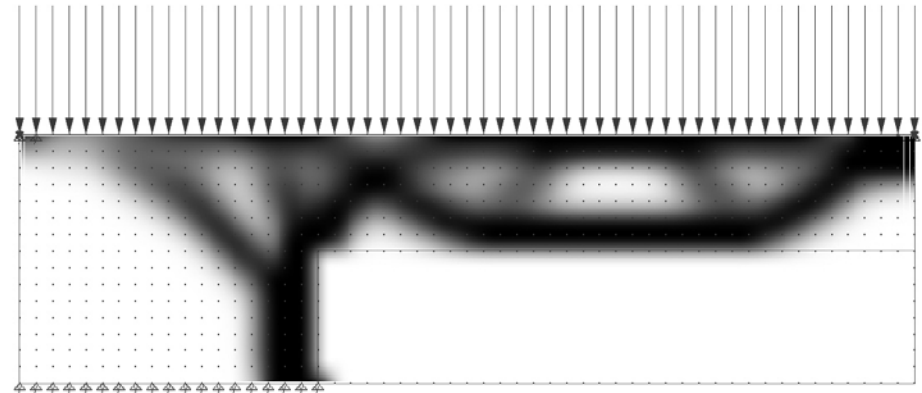
# חלל ביניים

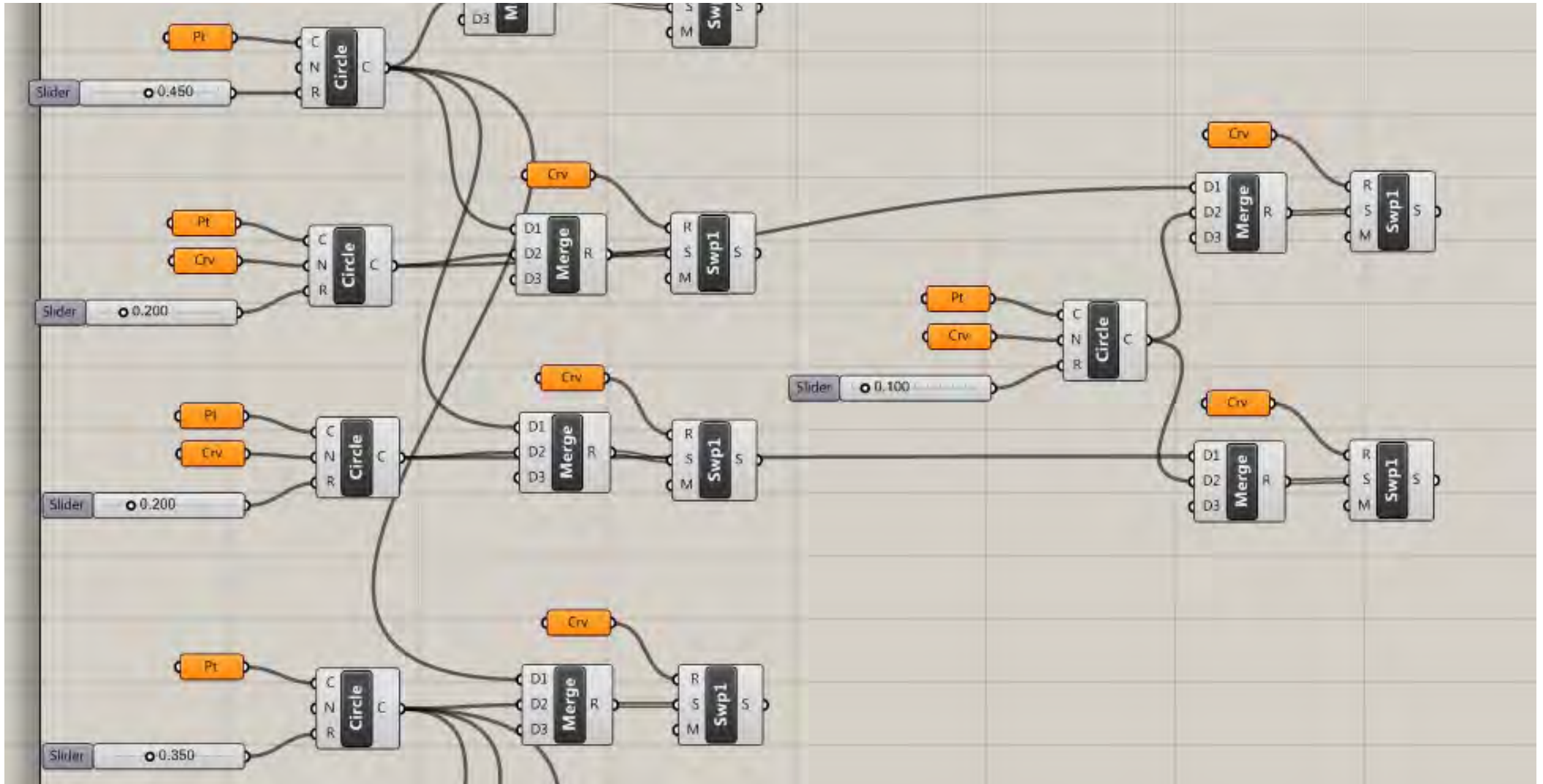


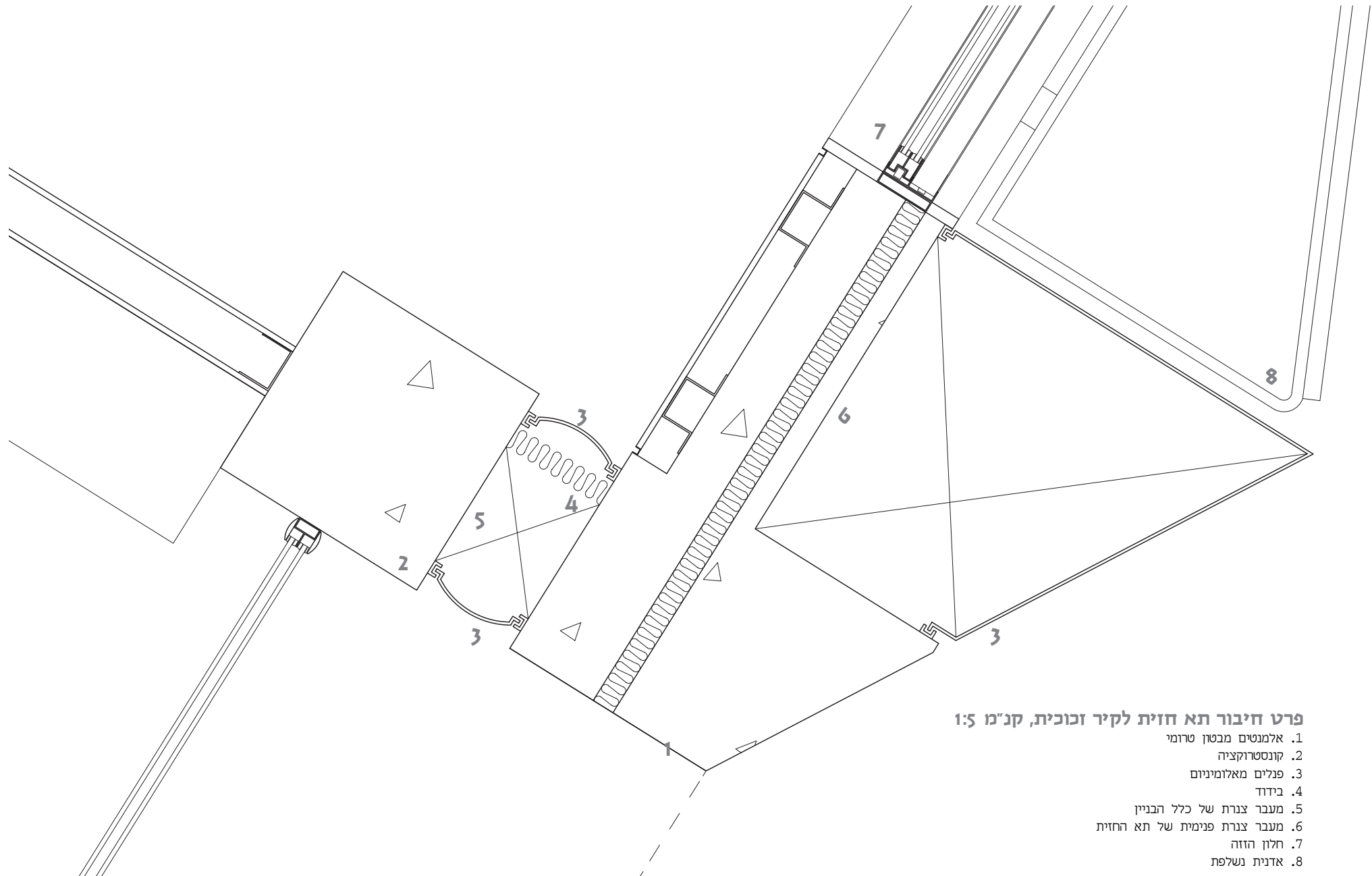
החלל שבין שני המבנים מאופיין בגאומטריה חופשית. על מנת למצוא את הגאומטריה המתאימה ביותר לגשרים המקשרים בין שני המבנים, נעשה שימוש בתוכנה אשר מציגה את אופי הקונסטרוקציה האופטימלית, בהתאם לתנאים שמוזנים בה.

מפתח הגשר והאיזורים אשר הוגדרו כאיזורים מלעבר תחתיו, הביאו לקבלת תרשים קונסטרוקציה עקרוני (1). התרשים שהתקבל מתאים לגשר בודד, והשלב הבא היה תכנון שלושת הגשרים כמערכת אחת.

בסופו של דבר, המערכת הקונסטרוקטיבית כוללת שלושה סוגים של אלמנטים עיקריים (2). שילוב שלושת האלמנטים האלה עם הקונסטרוקציה הראשית של המבנים, יוצר למעשה את המערכת הקונסטרוקטיבית האופטימלית הנושאת את שלושת הגשרים ומעניקה לחלל הביניים את התחושה החופשית שלו (3).

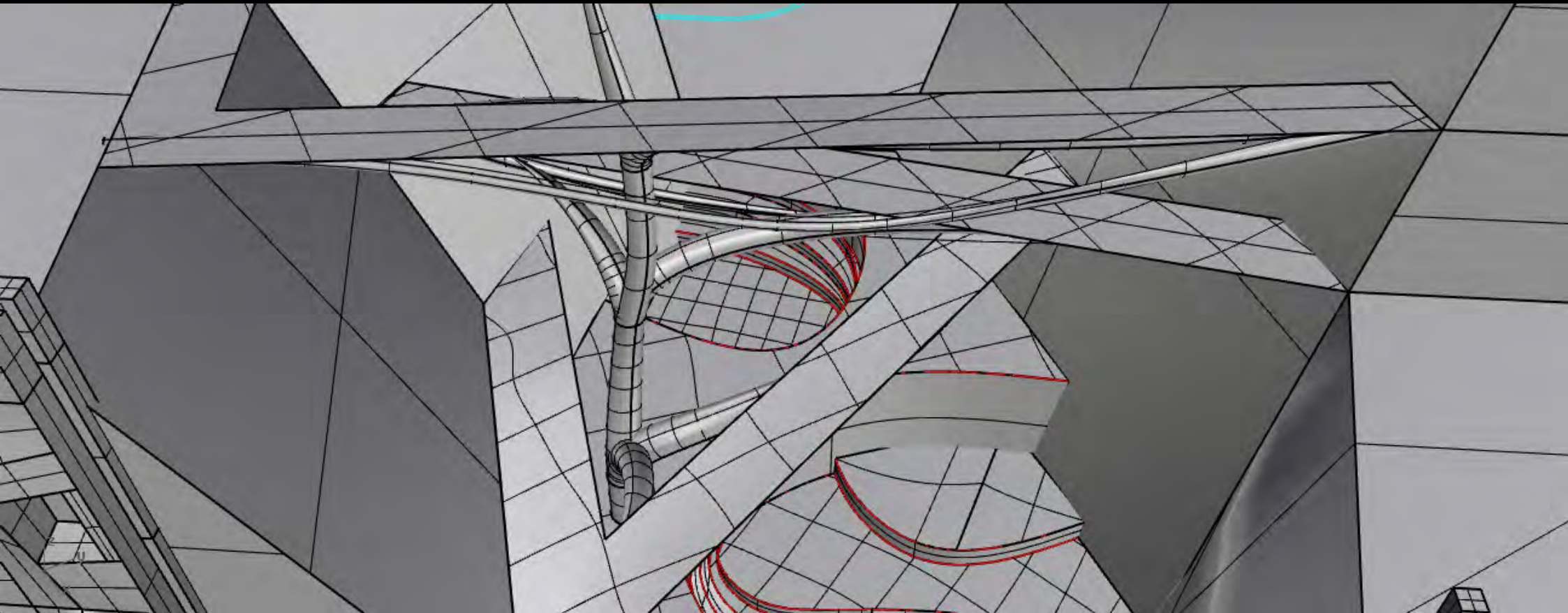






**פרט חיבור תא חזית לקיר זכוכית, קנ"מ 1:5**

1. אלמנטים מבטון טרומי
2. קונסטרוקציה
3. פנלים מאלומיניום
4. בידוד
5. מעבר צנרת של כלל הבניין
6. מעבר צנרת פנימית של תא החזית
7. חלון הזזה
8. אדנית נשלפת



T\_CODE 2013

# *Attractor Points*

*// Noam Yom tov*

*Tutor: Dr. Yasha J. Grobman*

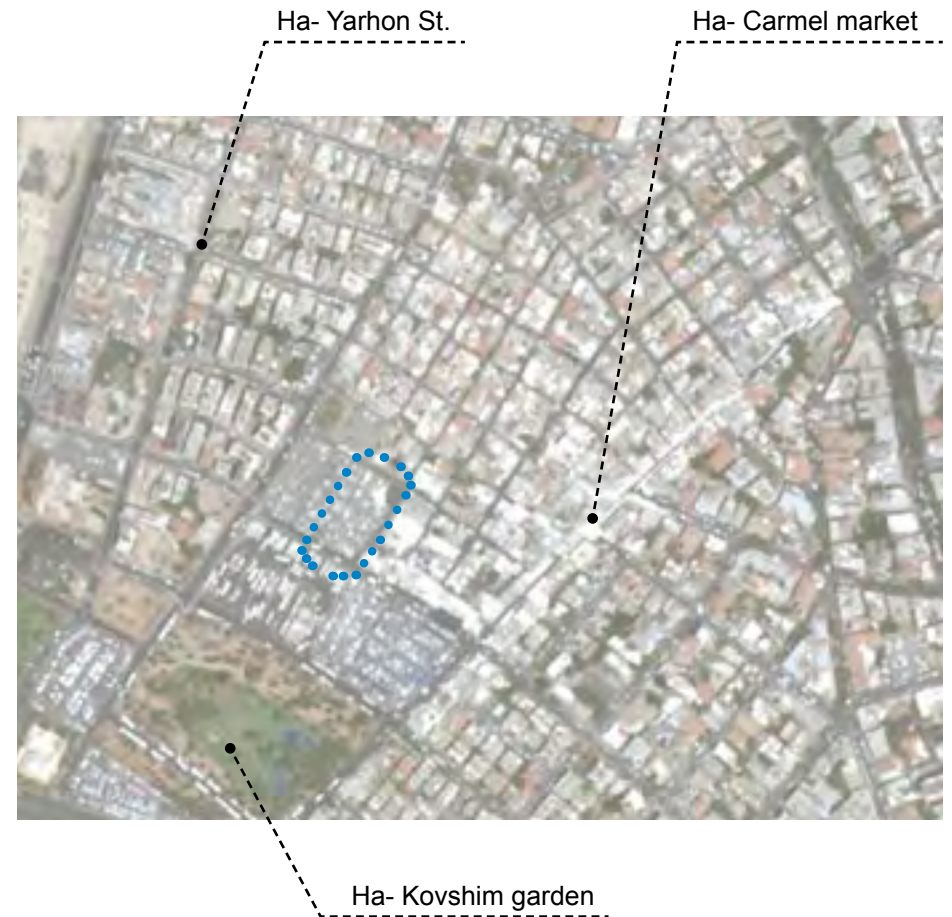




## Public Building



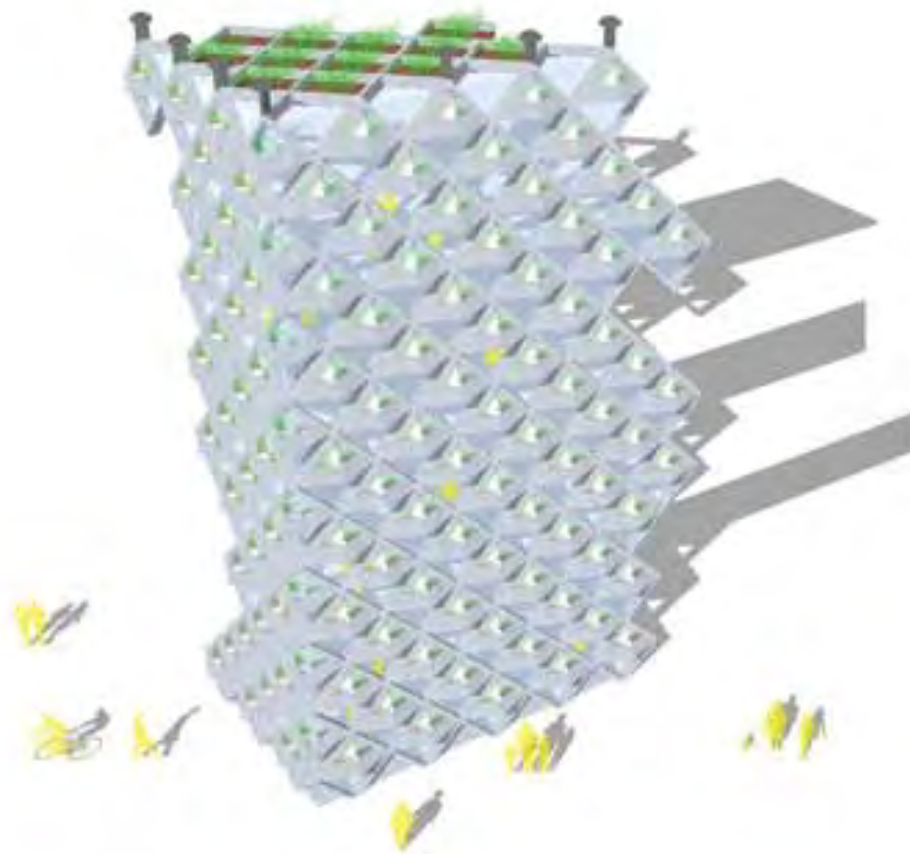
<http://www.shuktlv.co.il>  
<http://www.tapuz.co.il>



<https://maps.google.com>

## Public Building

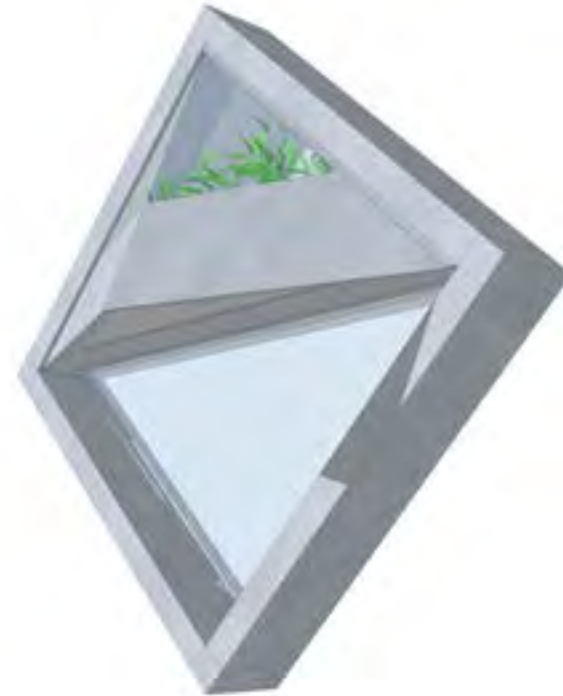
- >> Accessibility
- >> Availability
- >> Flexibility
- >> Contribution



## Cell Design

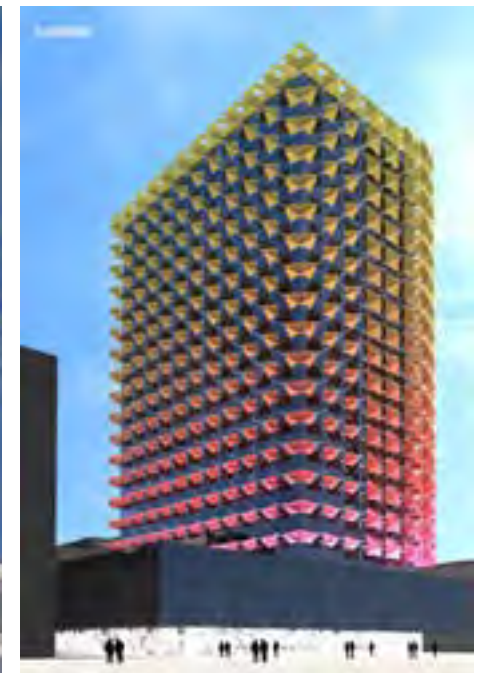
The cell shape and structure will vary depending on the cell location on the facade building and the function it meets.

- >> Filtering air pollution
- >> Shading
- >> Natural ventilation
- >> Construction



## Shading Facade

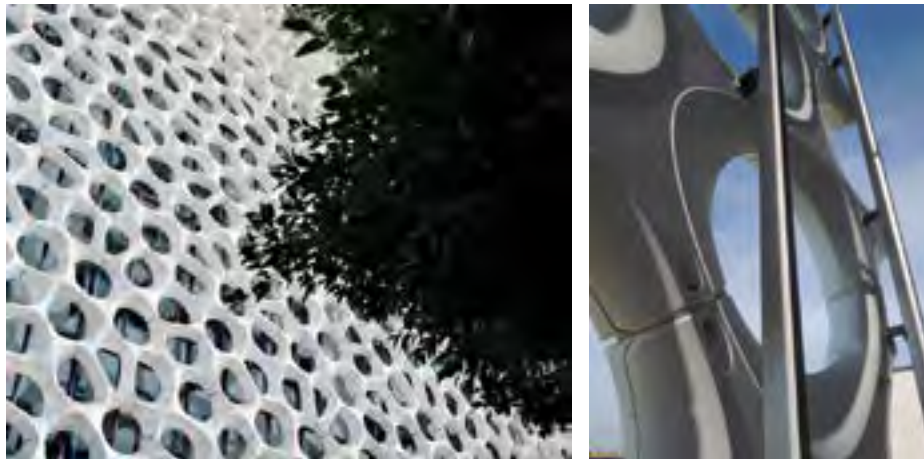
The umbrellas are fixed to a new high performance glass facade and Corian panels and according to the sun position the umbrellas mechanically open or close to provide shadows to the internal spaces. The ever changing sun creates an ever changing facade and at night, when all the umbrellas are open and are flooded with artificial light, the building continues to be a true and new city landmark.



Piraeus Tower in Athens, Greece by Marco Acerbis Studio. source: <http://www10.aeccafe.com/blogs/arch-showcase/2011/05/10/piraeus-tower-in-athens-greece-by-marco-acerbis-studio/>

## Depolluting Facade

The modules contain superfine titanium dioxide (TiO<sub>2</sub>), a pollution-fighting technology that is activated by ambient daylight. When positioned near pollution sources, the modules break down and neutralize NO<sub>x</sub> (nitrogen oxides), VOCs (volatile organic compounds), SO<sub>2</sub>, and FPM directly where they are generated. Inspired by fractals in nature, the undulating shapes maximize the surface area of active coating to diffuse light, air turbulence and pollution.

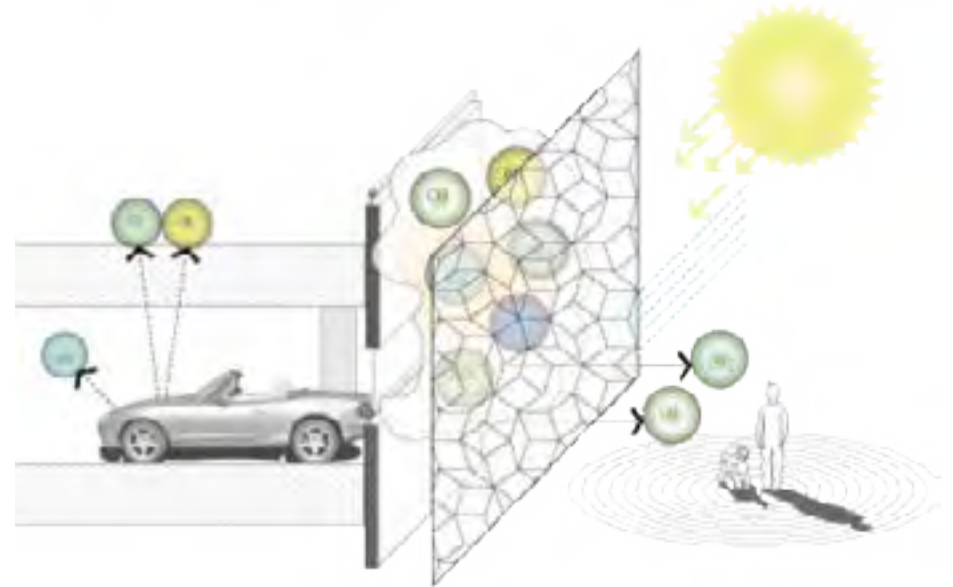
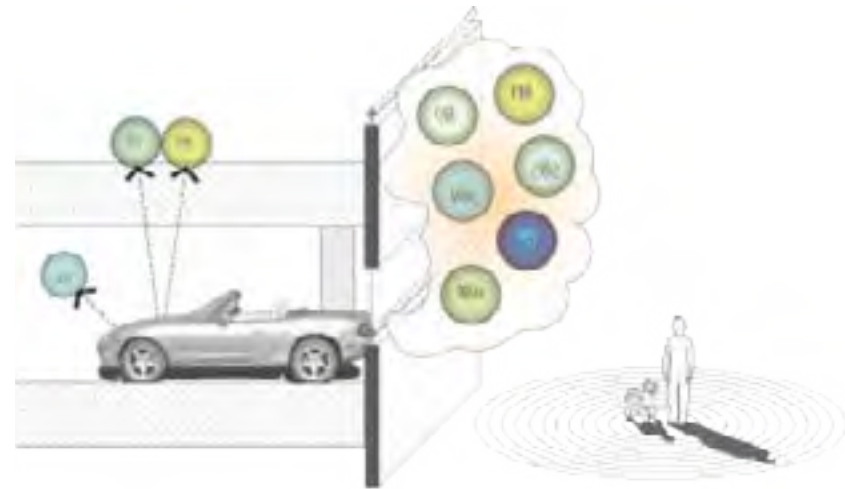
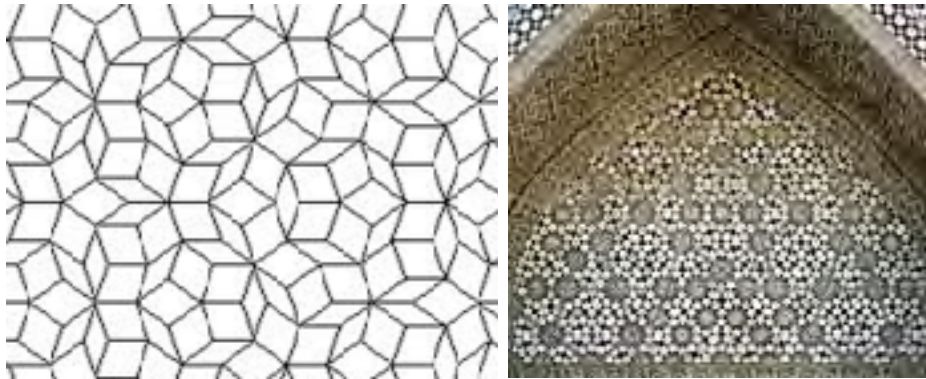


Experts estimate that the 10-meter Torre de Especialidades wall will be able to neutralize the equivalent of smog produced by 8,750 cars on a daily basis. The best part is that the titanium oxide itself remains unaffected, so the tiles do not have to be constantly re-coated.



Torre de Especialidades at the Hospital Manuel Gea Gonzalez, Mexico City. source: <http://www.evolo.us/category/news/>

The Prosolve370oe's quasi-crystalline shape is not only designed to look good, but to also, help slow down the wind speed and create a turbulence, allowing the air pollutants to be exposed to a greater surface area.



<http://www.dogonews.com/2013/4/6/revolutionary-mexico-city-hospital-facade-absorbs-toxins-from-the-environment>

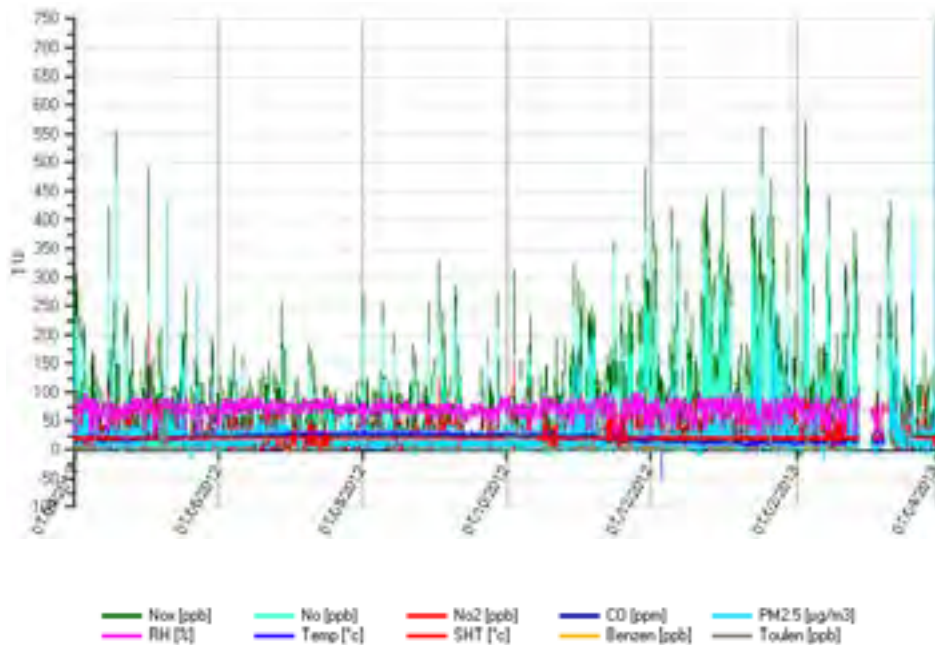
The idea behind this skyscraper is to recycle the old cars and use them as building material for the new structure. The building is designed as a giant lung that would clean New Delhi's air through a series of large-scale greenhouses that serve as filters. Another set of rotating filters capture the suspended particles in the air while the waste heat and carbon dioxide from the recycling center are used to grow plants that in turn produce bio-fuels.



Delhi Recycling Center. source: <http://www.evolo.us/competition/lo2p-delhi-recycling-center/>

### Air Pollution Data

“Ironi D” schhol station  
 Period- 1.4.2012 - 1.4.2013  
 Location- 24 Weizman Street, Tel Aviv  
 Gush Dan Region  
 Owner- Ministry of the Environment  
 Purpose- Air Quality  
 Longitude- 34.789206  
 Latitude- 32.083847  
 Height Station- 0



<http://www.sivvaaqm.net/Default.rtl.aspx>

The source of infection is low (passing cars) and therefore a massive filtering is needed in the lower parts of the building.  
 Gasoline vehicles tend to emit mostly carbon monoxide (CO), hydrocarbons (HC) and nitrogen oxides (NOx). Diesel vehicles tend to emit mainly particles (PM 2.5), some of which look like black smoke and nitrogen oxides.

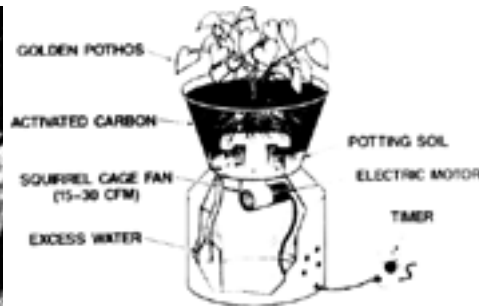


<http://www.kerem-israel.info/plans/acarmel-market>

### Filtering Plants

At the end of the 80s, NASA and Landscape Architects Association of America, conducted a study on the best purification plants common contaminants. The plant root-soil zone appears to be the most effective area for removing volatile organic chemicals. Therefore, maximizing air exposure to the plant root-soil area should be considered when placing plants in buildings for best air filtration.

The recommendation of NASA is to use 15 to 18 good-sized houseplants in six- to eight-inch (203 mm) diameter containers in a 1,800-square-foot (170 m<sup>2</sup>) house.



[http://www.sandiegobotanicals.com/var/m\\_0/0b/0b0/227138/305867-nasareport.pdf](http://www.sandiegobotanicals.com/var/m_0/0b/0b0/227138/305867-nasareport.pdf)



Chrysanthemum // Peace lily. source: [en.wikipedia.org/wiki/List\\_of\\_air-filtering\\_plants](http://en.wikipedia.org/wiki/List_of_air-filtering_plants)

**Table 2. Benzene Removed from a Sealed Experimental Chamber by Houseplants During a 24-h Exposure Period**

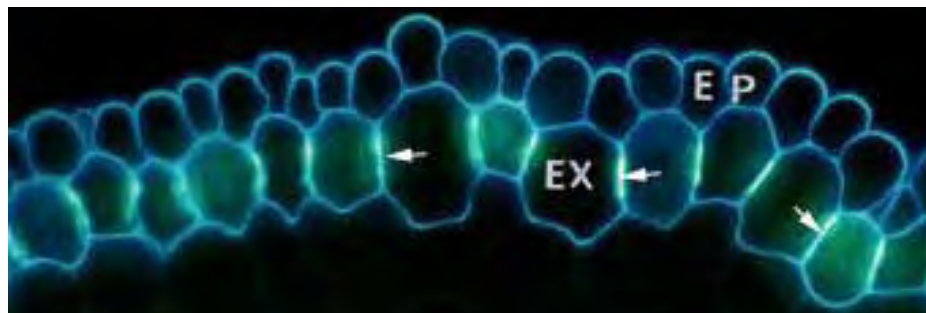
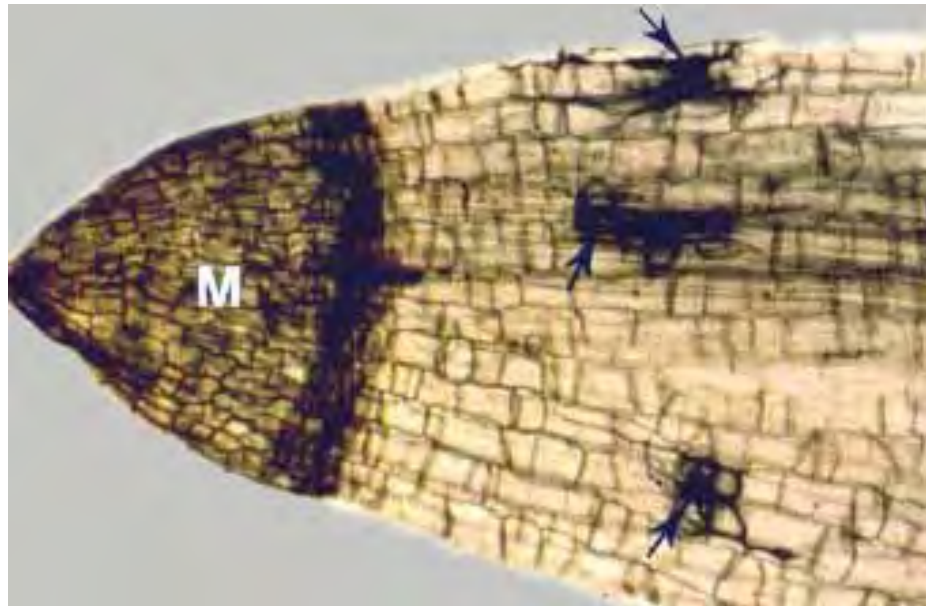
	Total Plant Leaf Surface Area (cm <sup>2</sup> )	Total Micrograms Removed per Plant
Gerbera daisy ( <i>Gerbera jamesonii</i> )	4,581	107,653
Pot mum ( <i>Chrysanthemum morifolium</i> )	4,227	76,931
English ivy ( <i>Hedera helix</i> )	1,306	13,894
Mother-in-law's tongue ( <i>Sansevieria laurentii</i> )	2,871	28,710
Warnecker ( <i>Dracaena deremensis</i> "Warnecker")	7,242	39,107
Peace lily ( <i>Spathiphyllum</i> "Mauna Loa")	7,960	41,382
Chinese evergreen ( <i>Aglaonema</i> "Silver Queen")	3,085	14,500
Marginata ( <i>Dracaena marginata</i> )	7,581	30,324
Bamboo palm ( <i>Chamaedorea seifritzii</i> )	10,325	34,073
Janet Craig ( <i>Dracaena deremensis</i> "Janet Craig")	15,275	25,968

[http://www.sandiegobotanicals.com/var/m\\_0/0b/0b0/227138/305867-nasareport.pdf](http://www.sandiegobotanicals.com/var/m_0/0b/0b0/227138/305867-nasareport.pdf)



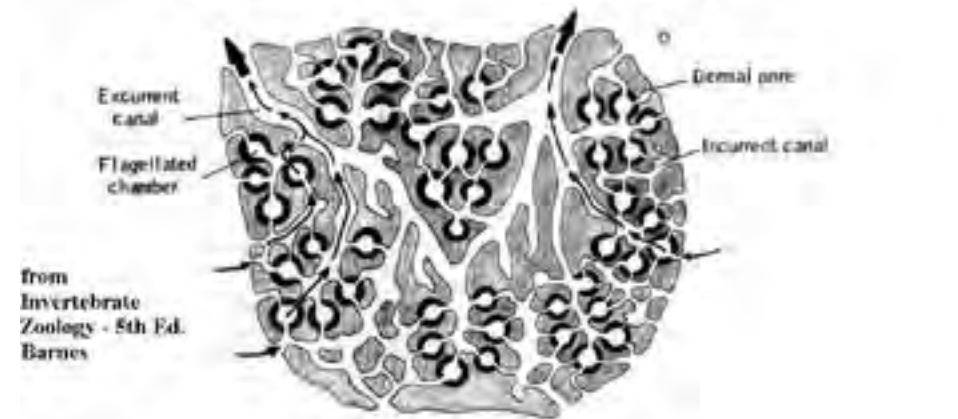
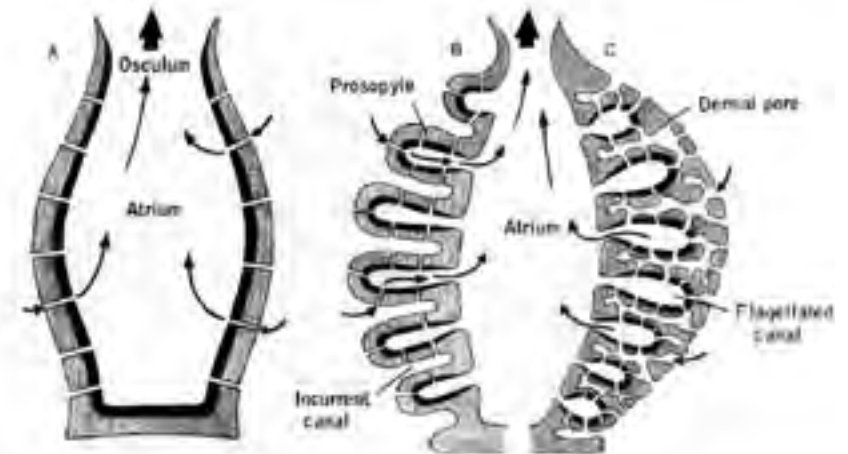
**Structure and Function**

The cells in the root cap are much smaller than the cells in body of the root, which allows filtering of water and minerals from the soil. There are dark staining suberin in the root cap, functions as an extension of the exodermis to completely encase the root for protection during periods of inactivity.



<http://mycorrhizas.info/root.html>

The holes collectively take on the role of a sieve, a two-way filtration mechanism across which water and nutrient molecules permeate the cell. The holes can range from several micrometres down to 100 nanometres in diameter.

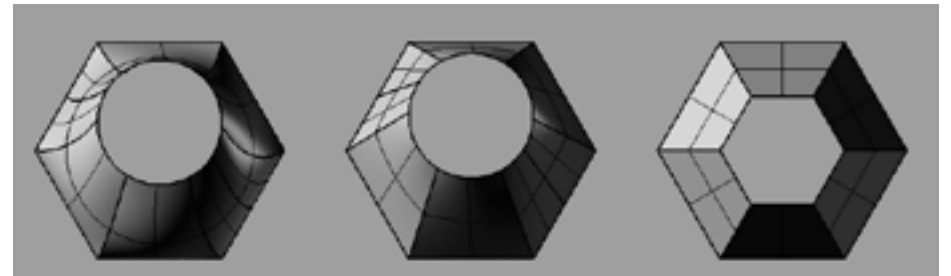
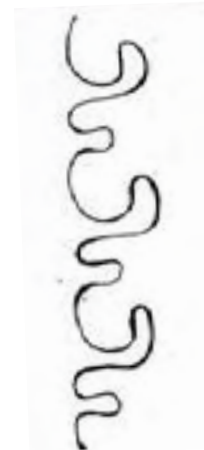
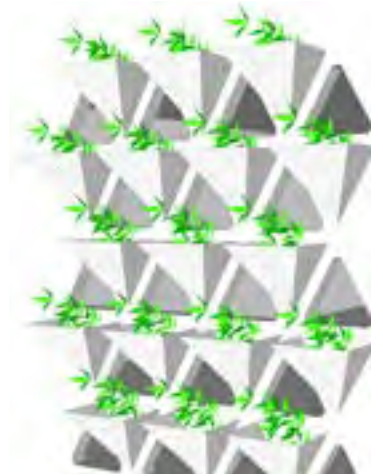
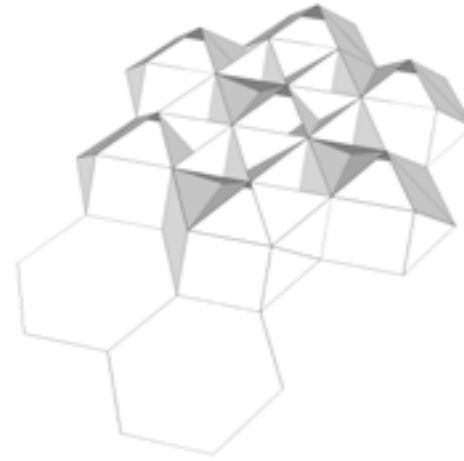
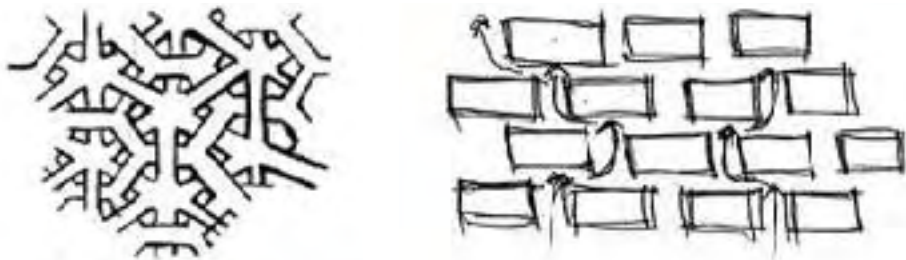
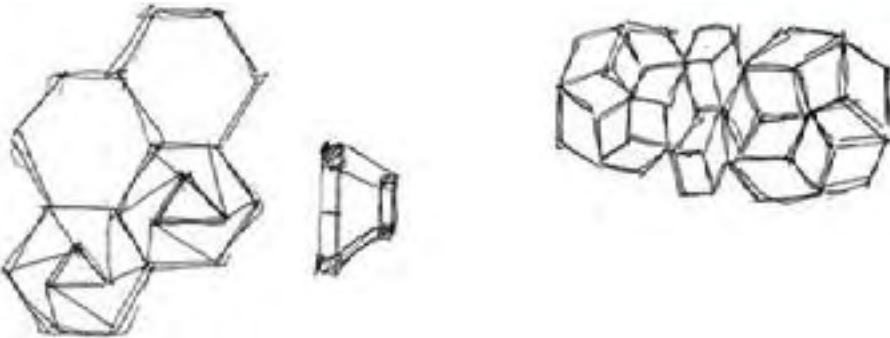
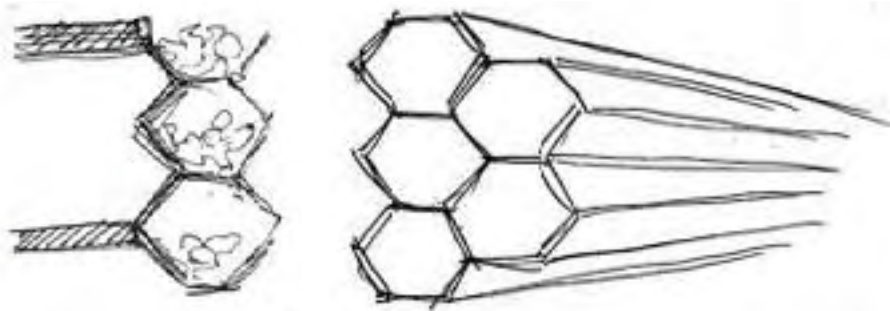


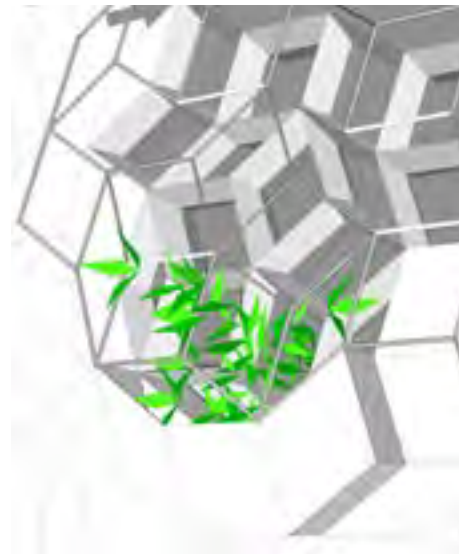
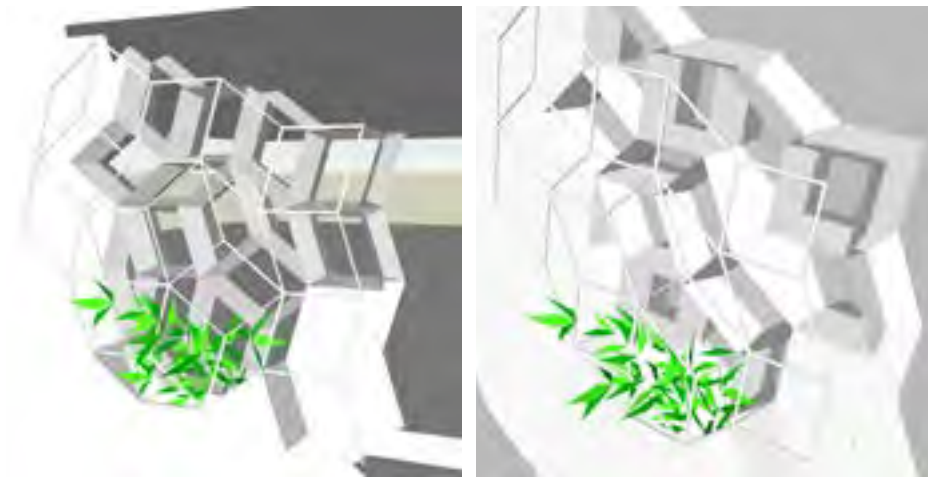
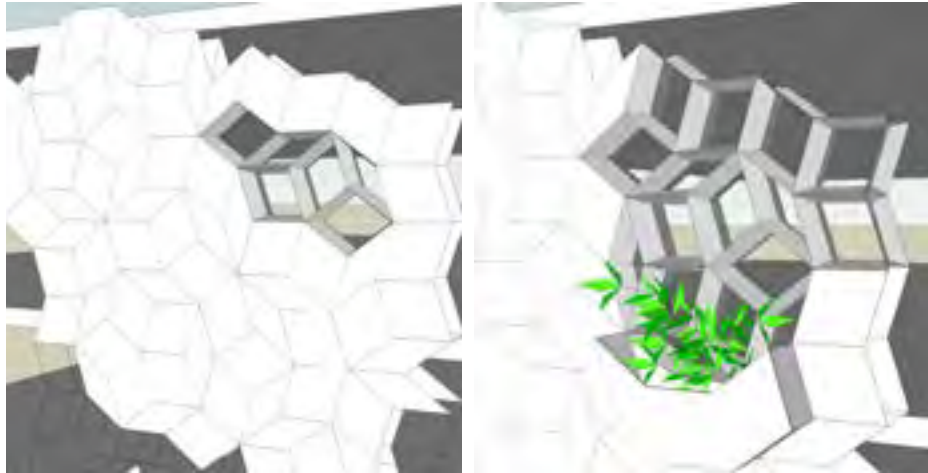
from Invertebrate Zoology - 5th Ed. Barnes

<http://paws.wcu.edu/dperlmutr/sponges.html>

### Design Principles

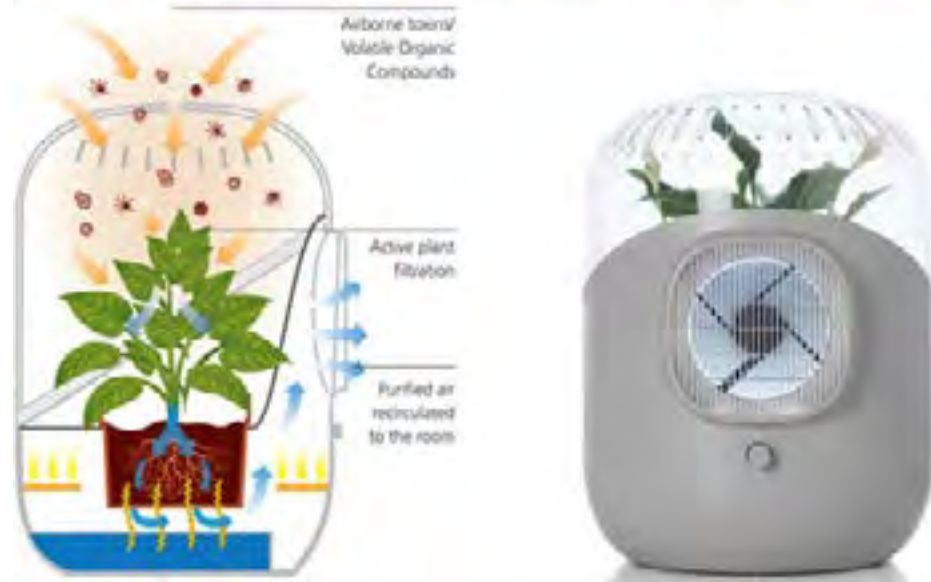
- >> Close packing
- >> Maximize surface area
- >> Plants growing
- >> Maximize soil exposure
- >> Variable density





### Fitering Plants

French designer Mathieu Lehanneur and Harvard professor David Edwards employed the power of plants to create Andrea, the eco-friendly air purifier. The idea is simple – air is sucked into the device, where it gets filtered through the plant, soil and water. After that it gets recirculated back into the room. No filters to change and no components to clean are required. Andrea is low on energy consumption and works with any plant.



<http://shoebxdwelling.com/tag/appliance/page/2/>

### Spatifilus

Weekly shade and irrigation are the things Shsftiphilium need to live comfortably. He reached the top list of NASA for removing the three main pollutants - formaldehyde, benzene and ethylene tri - chloride. He also fought toluene and xylene.

### Chrysanthemum

The colorful flowers of the plant helps to filter benzene, which is common glue, paint, plastics and detergents. This plant needs bright light, so to encourage the buds to bloom it has to be placed near a window with direct sunlight.

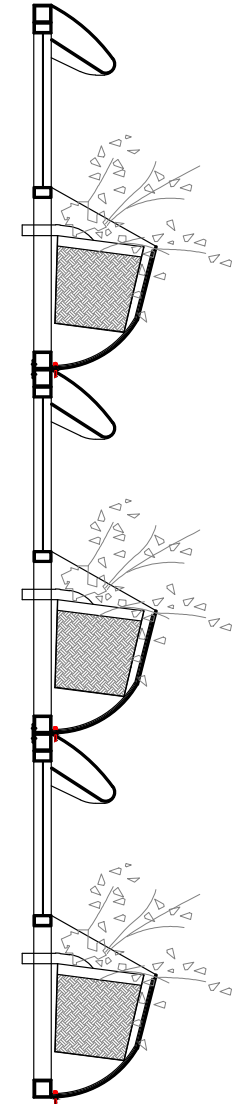
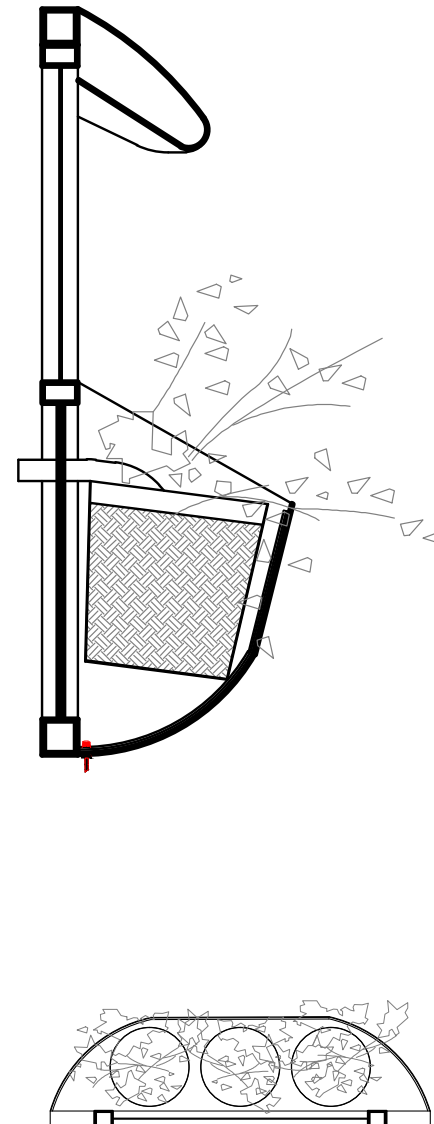
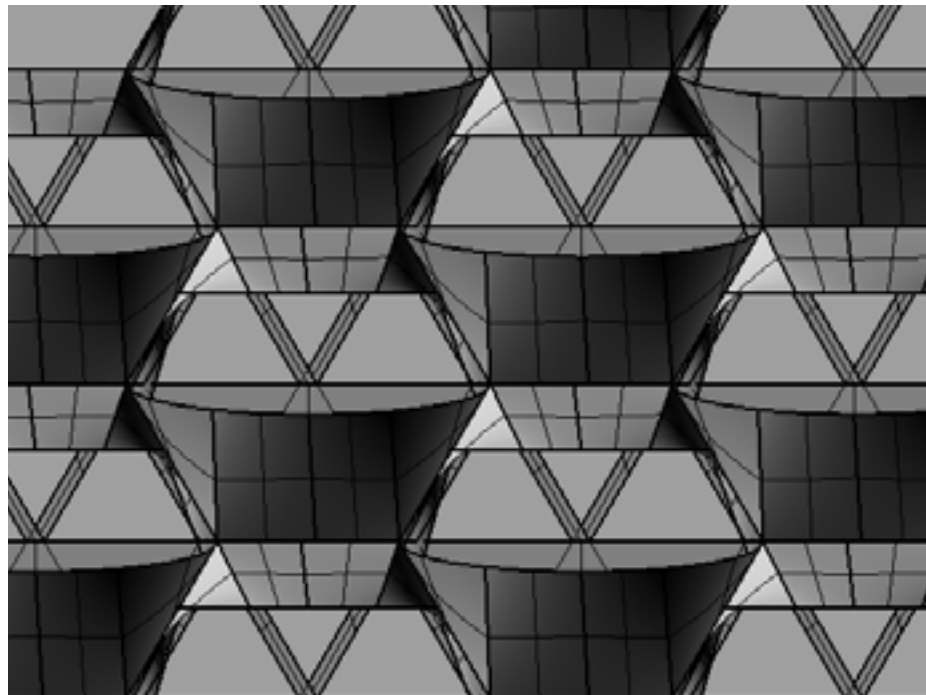
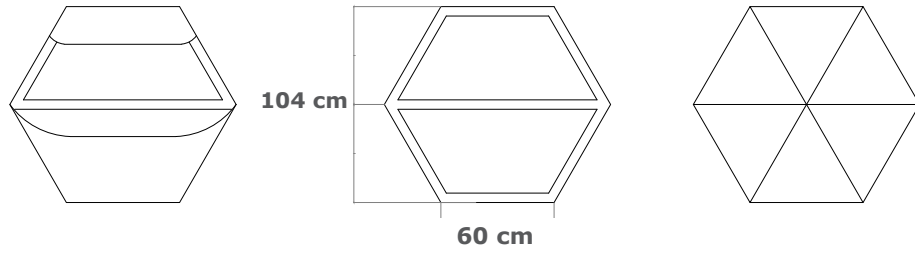
### Gerbera daisy

Blooms bright and effective plant in removing ethylene tri - chloride, which may have brought you home with dry cleaning. Gerbera also good filters cartridge that comes with benzene.

Plant, Top remover of	Benzene (NASA)†	Formaldehyde (NASA)† (Trivetral)†	Trichloroethylene (NASA)†	Xylene and Toluene†	Ammonia†
Olive dracaena (Phoenix roebelinii)	No	Wolveton	No	Yes	No
Areca palm (Chrysalidocarpus lutescens)	No	No	No	Yes	No
Boston fern (Nephtrolepis exaltata 'Bostoniensis')	No	Wolveton	No	Yes	No
Kimberly queen fern (Nephtrolepis obliterata)	No	Wolveton	No	Yes	No
English ivy (Hedera helix)	Yes	Wolveton	No	Yes	No
Lilyturf (Liriodie spicata)	No	Yes	No	Yes	Yes
Soldier plant (Chlorophytum comosum)	Yes	NASA	No	Yes	No
Golden pothos or Devil's ivy (Epipheum aureum)	Yes	NASA	Yes	Yes	No
Peace lily (Spathophyllum Mauna Loa)	Yes	Wolveton	Yes	Yes	Yes
Flemingia lily (Anthurium andraeanum)	No	Yes	No	Yes	Yes
Chinese evergreen (Aglaonema modestum)	Wolveton†	Wolveton†	No	No	No
Bamboo palm or reed palm (Phaneximea sabilii)	No	NASA, Wolveton	No	Yes	No
Swedish Lady Palm (Rhaphidophora)	No	Yes	No	Yes	Yes
Snake plant or mother-in-law's tongue (Sansevieria trifasciata Laurentii)	Wolveton	NASA	Wolveton	Yes	No
Heartleaf philodendron (Philodendron oxandatum, syn. Philodendron oxaleucum)	No	NASA	No	No	No
Bellium philodendron (Philodendron bipinnatifidum, syn. Philodendron zellouei)	No	NASA	No	No	No
Elephant ear philodendron (Philodendron eleocharum)	No	NASA	No	No	No
Red-tipped dracaena (Dracaena marginata)	Yes	NASA	Yes	Yes	No
Comballi dracaena (Dracaena fragrans Massangeana)	No	NASA	No	No	No
Jewel Dragg dracaena (Dracaena deremensis 'Jewel Dragg')	Yes	Wolveton	No	Yes	No
Variegated dracaena (Dracaena deremensis 'Variegata')	Yes	No	Yes	Yes	No
weeping fig (Ficus benjamina)†	No	Wolveton	No	Yes	No
Gerbera Daisy or Barberton daisy (Gerbera jamesonii)	Yes	Wolveton	Yes	No	Yes
Philodendron (Philodendron spathulatum, Philodendron cordatum)	Yes	Wolveton	Yes	No	No
Rubber Plant (Ficus elastica)	No	Wolveton	No	No	No

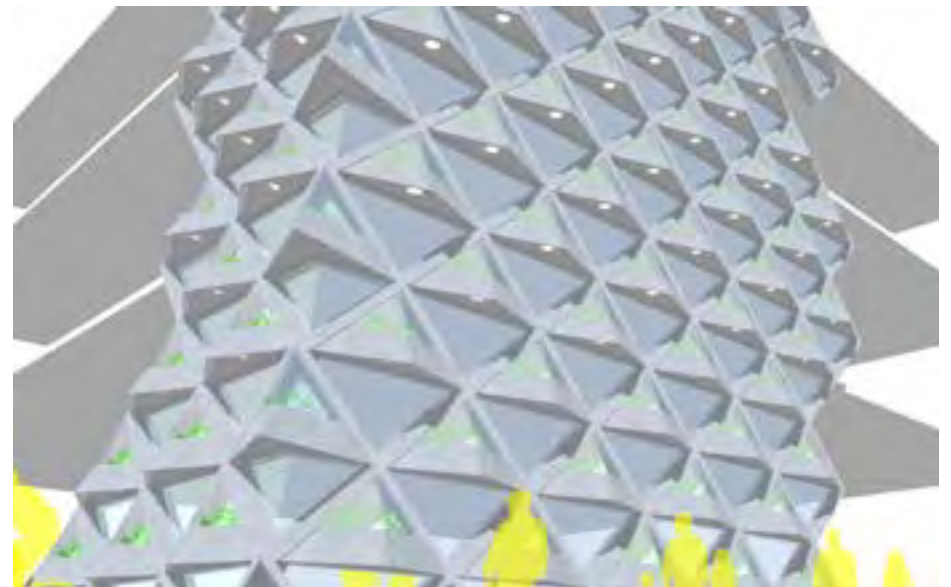
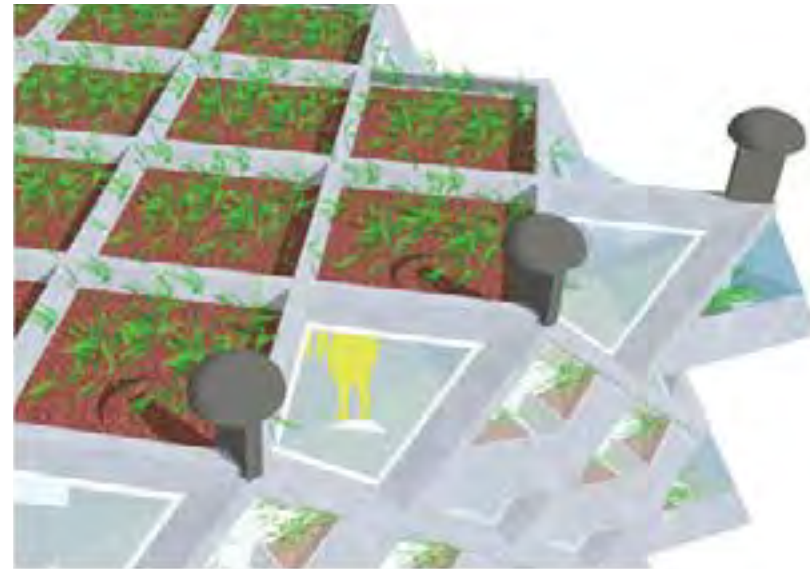
[http://en.wikipedia.org/wiki/List\\_of\\_air-filtering\\_plants](http://en.wikipedia.org/wiki/List_of_air-filtering_plants)

Cell Design



## Construction

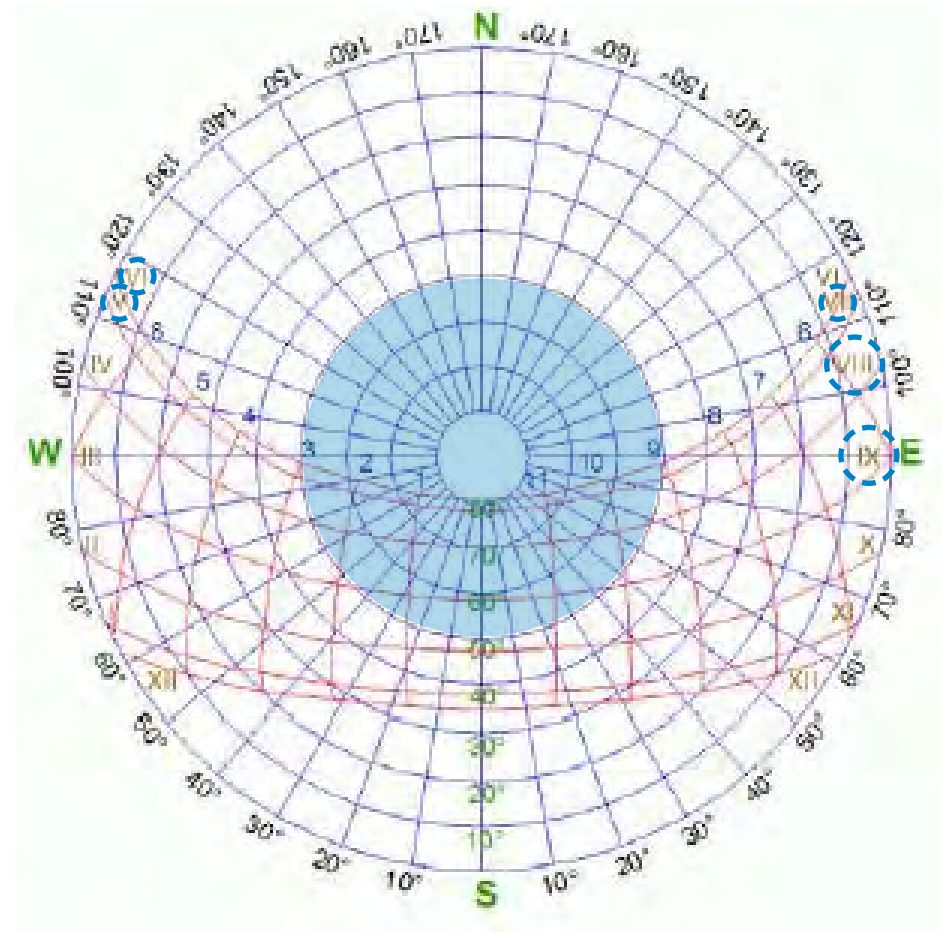
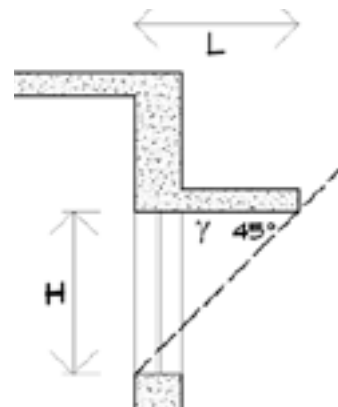
Triangle geometry is stable and resistant to side forces. Cellular system consists a diagonal steel columns that create diamonds, which are divided into two triangles.



## Shading

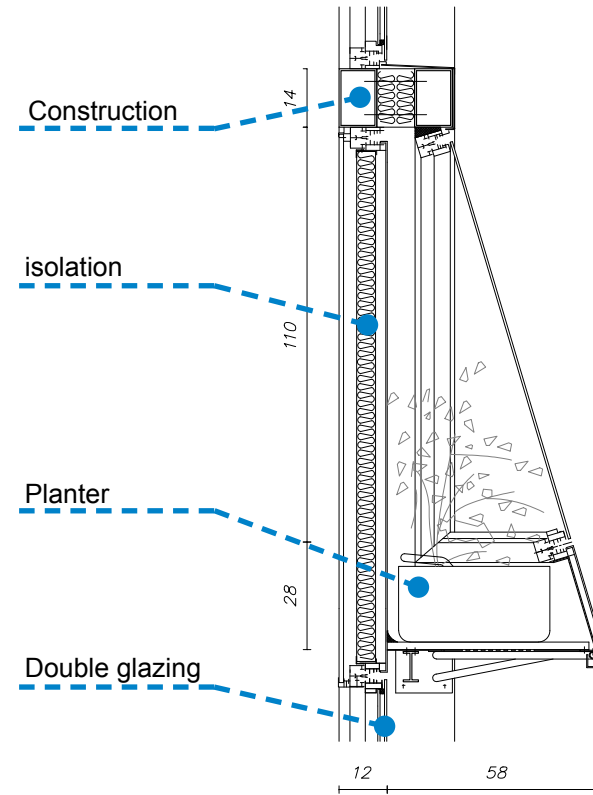
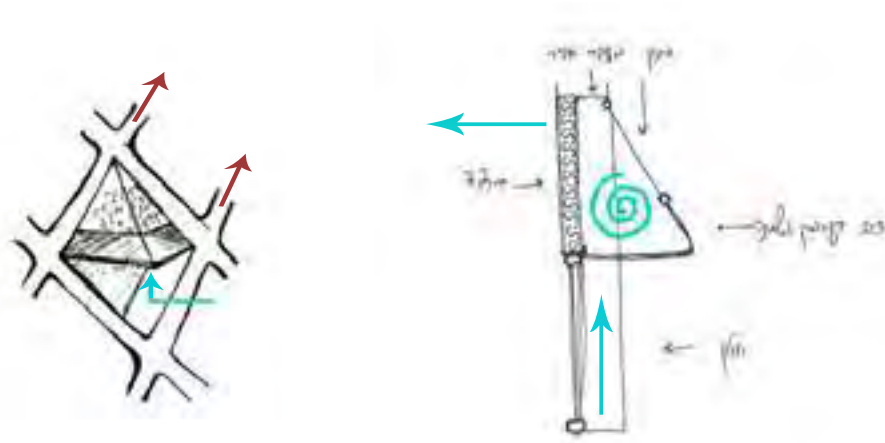
Southeastern facade is exposed to direct rays during the morning hours until 12:30 p.m, when shading is required- May to October. According to a simulation, a projection is necessary. Its depth varies depending on the length of the window, so that the resulting angle is 50 degrees.

$$L = H / \tan \gamma$$

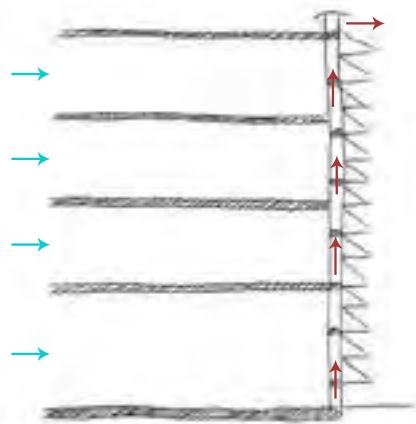


### Natural Ventilation

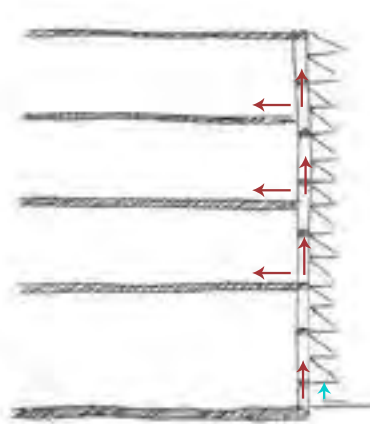
Southeastern facade is exposed to direct rays during the morning hours until 12:30 p.m, when shading is required- May to October. According to a simulation, a projection is necessary. Its depth varies depending on the length of the window, so that the resulting angle is 50 degrees.



### Summer



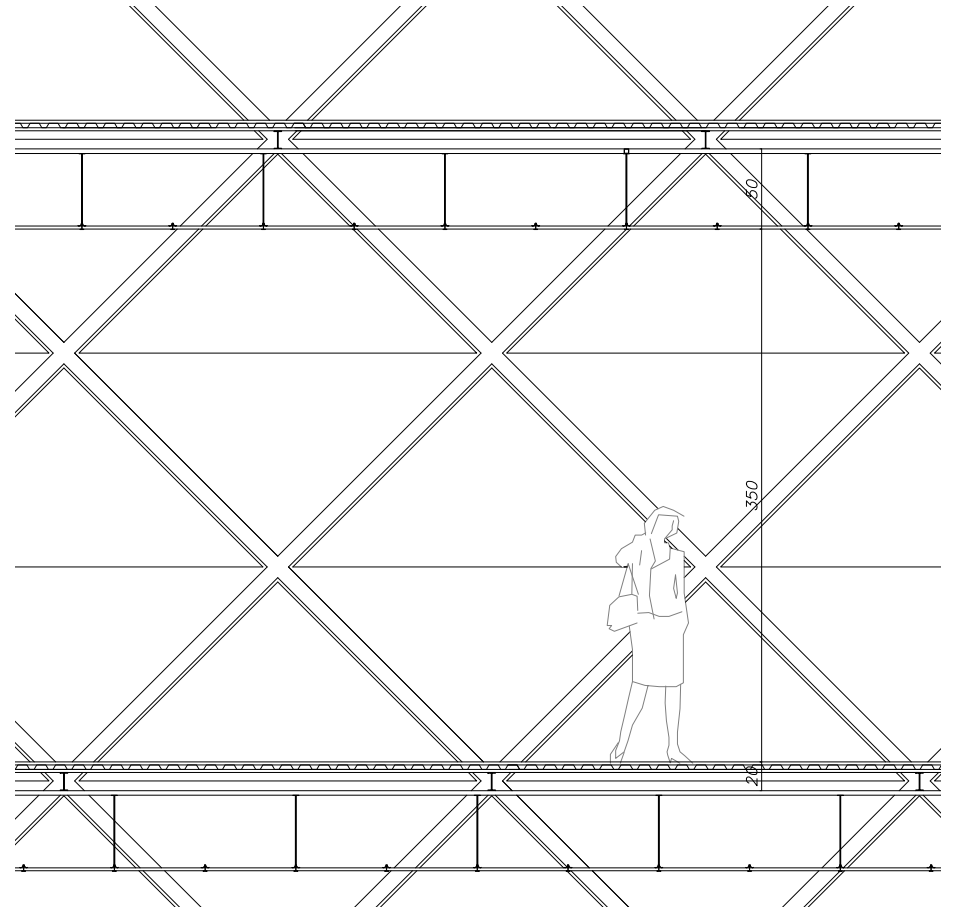
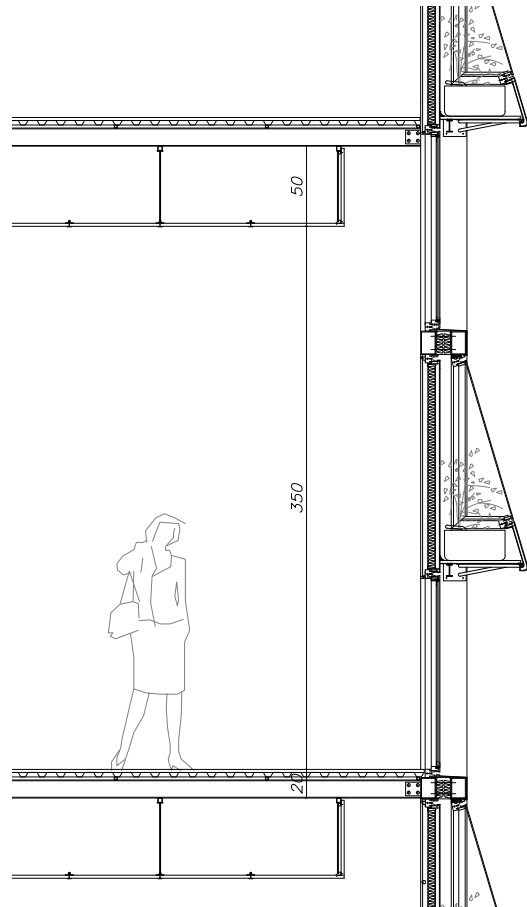
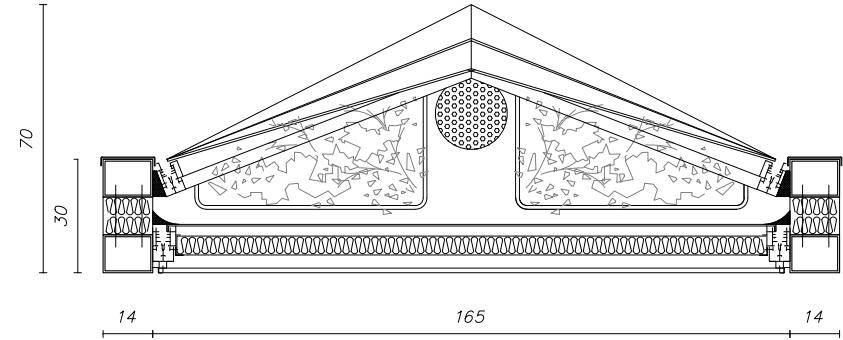
### Winter



שני כיוונים הנפוצים ביותר Second most frequent direction			כיוון הנפוץ Most frequent direction			מהירות אמצעיתית Average Velocity km/hr	שעות Hour	חודש month
מהירות אמצעיתית Average Velocity km/hr	%	כיוון Dir.	מהירות אמצעיתית Average Velocity km/hr	%	כיוון Dir.			
7	11	SE	6	36	S	3.3	02	יולי July
8	15	SE	8	41	S	4.6	05	
10	20	SW	10	55	S	6.5	05	
17	26	SW	14	63	W	14.5	11	
16	34	NW	16	64	W	15.8	14	
13	39	NW	11	44	W	12.4	17	
6	13	N	6	17	N	3.2	20	

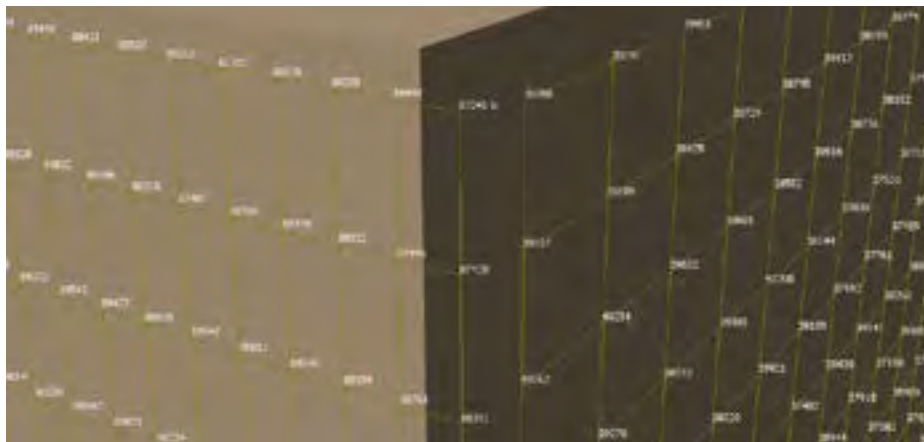
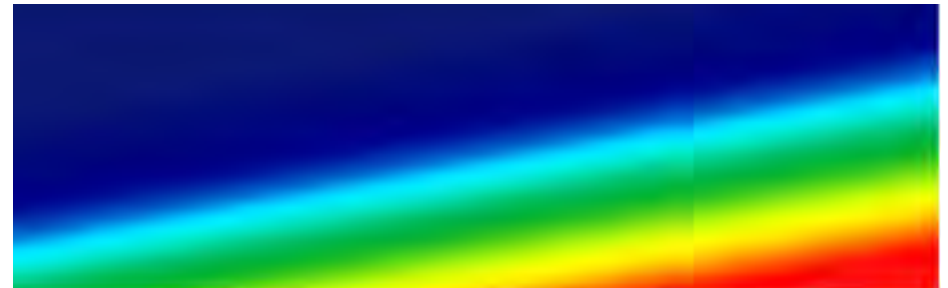
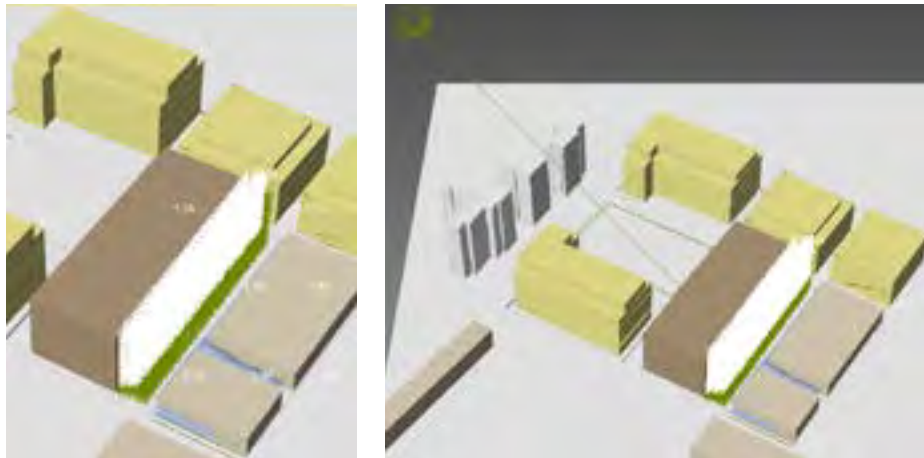


Typical Cell



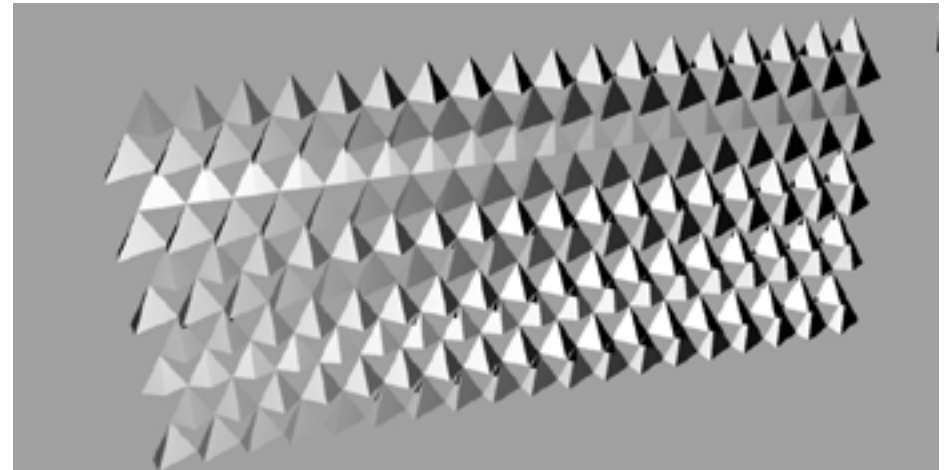
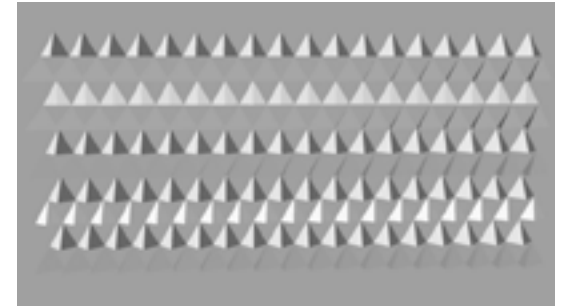
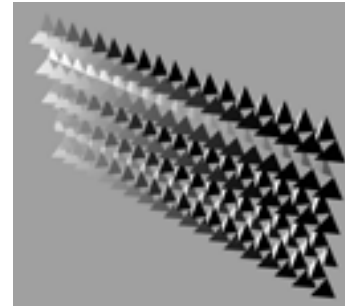
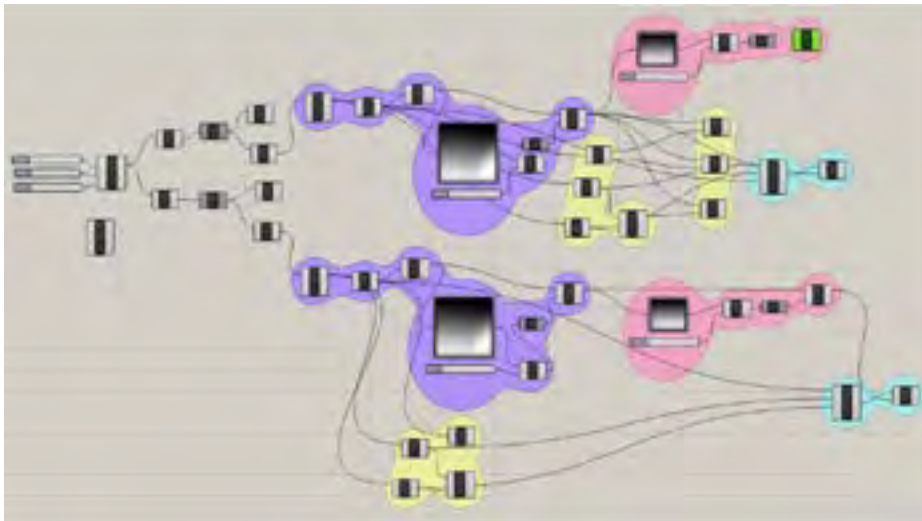
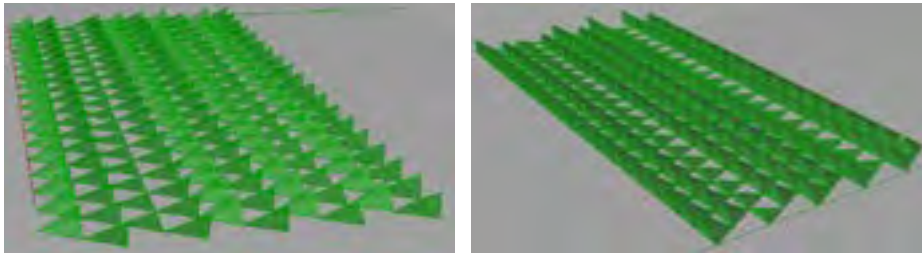
## Light Simulation

Simulation of the light rays shows that exposure varies along the building facade, so custom shading is required.

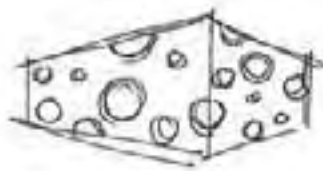
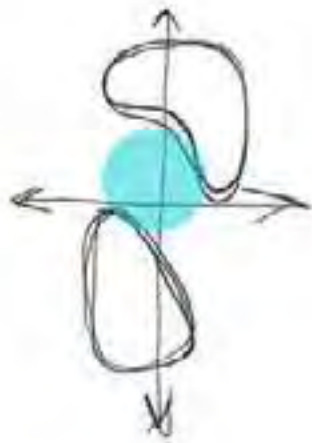
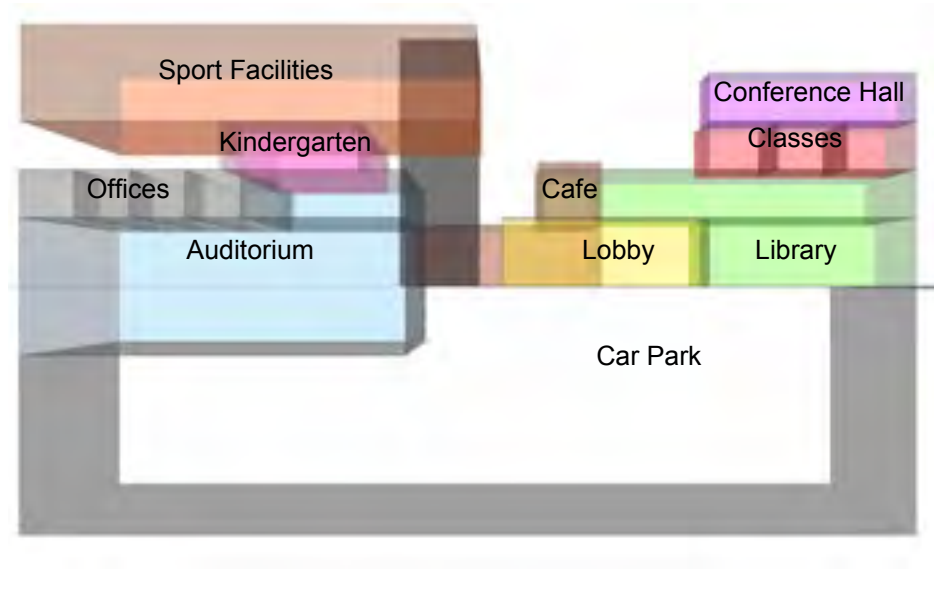
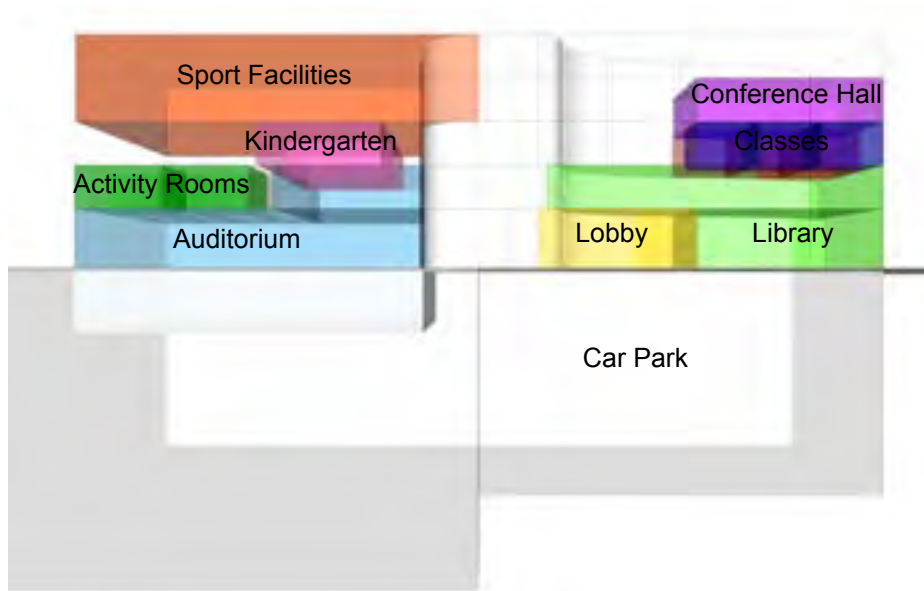


### Parametric performance

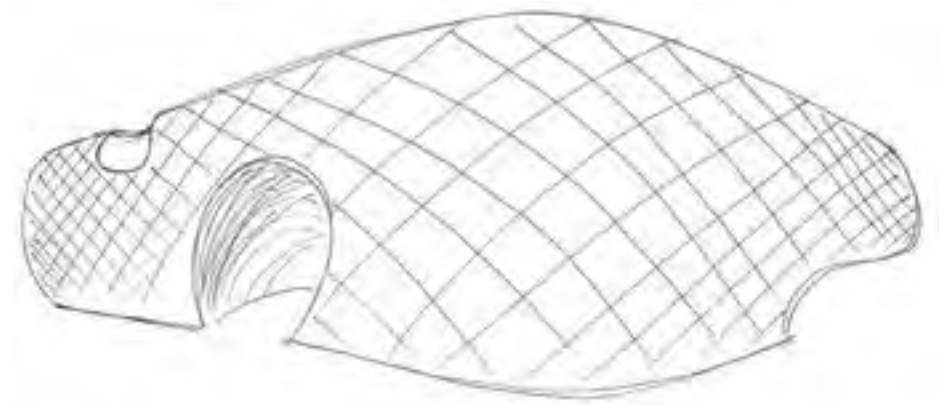
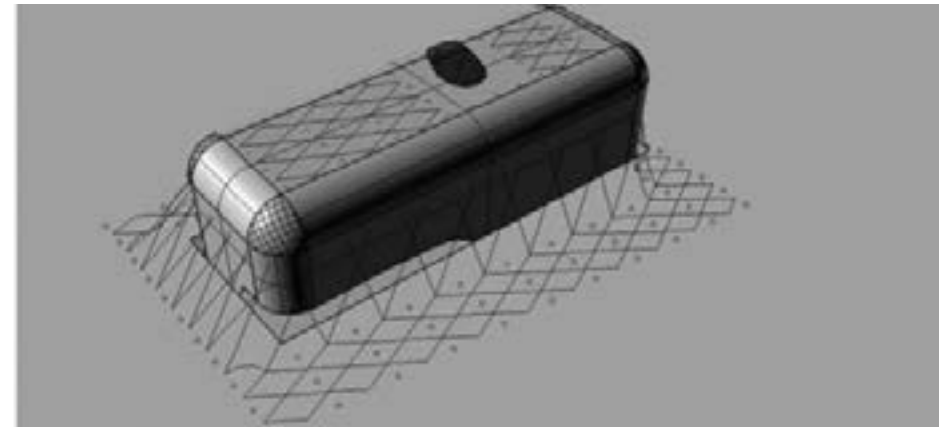
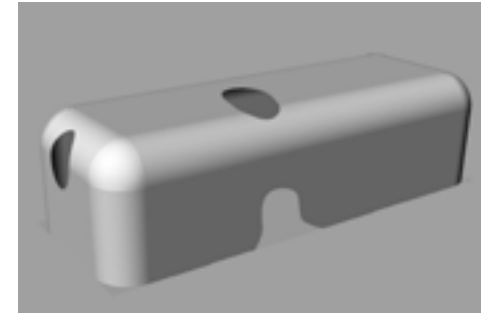
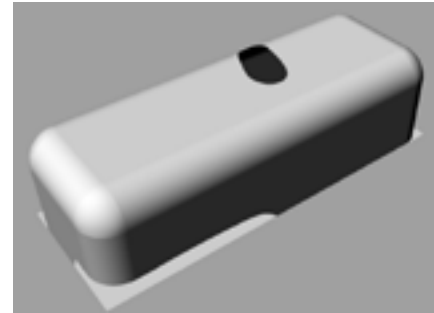
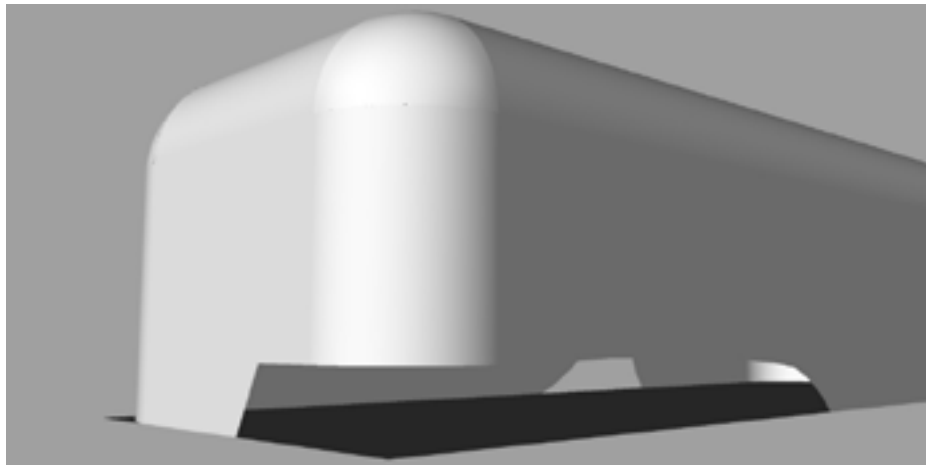
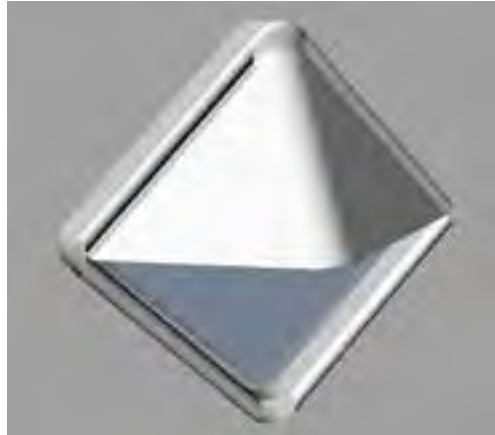
The cell was built using Grasshopper software, while the cell shape changes depending on the image simulation.



### Structure Organization



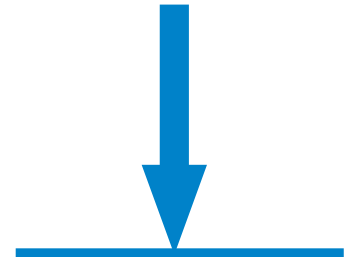
*Organic System*



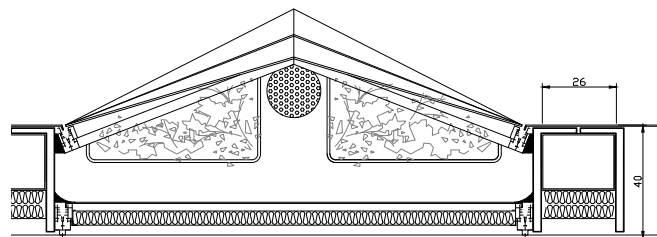
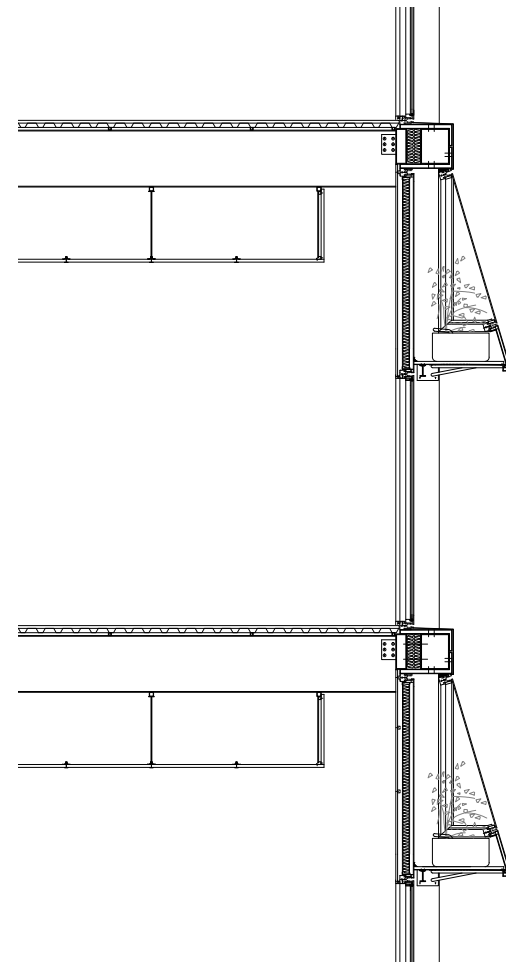
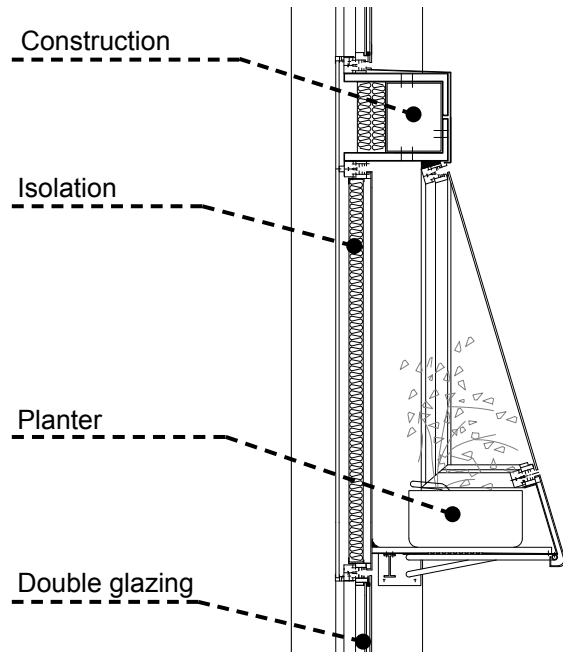
## *Cell Design*

- >> Filtering air pollution
- >> Shading
- >> Natural ventilation
- >> Construction

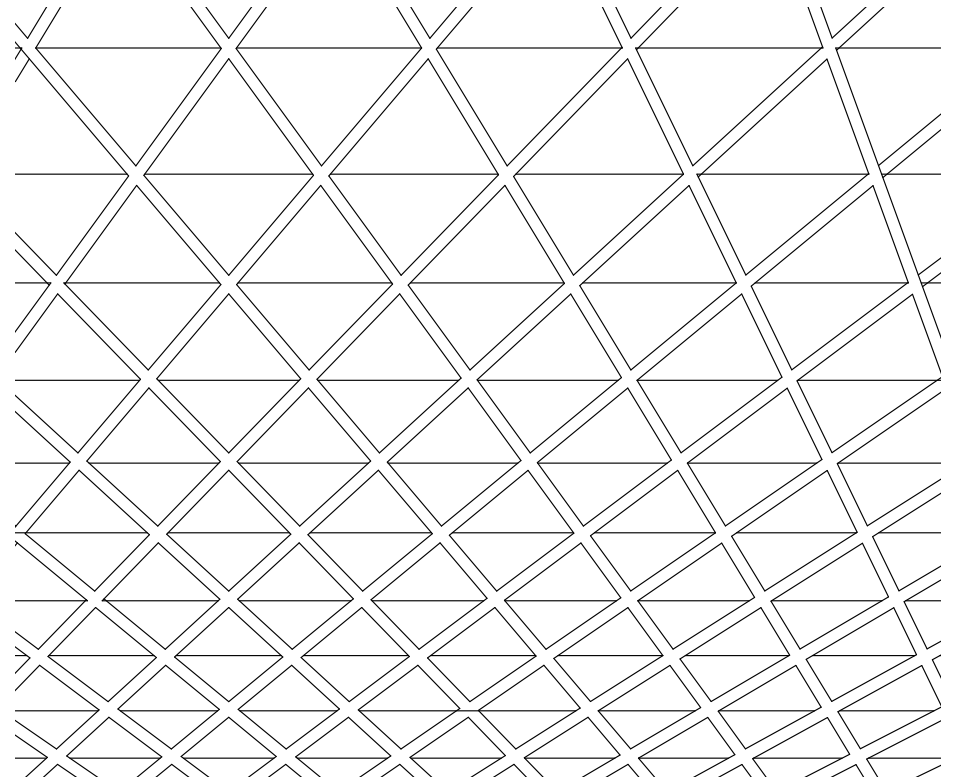
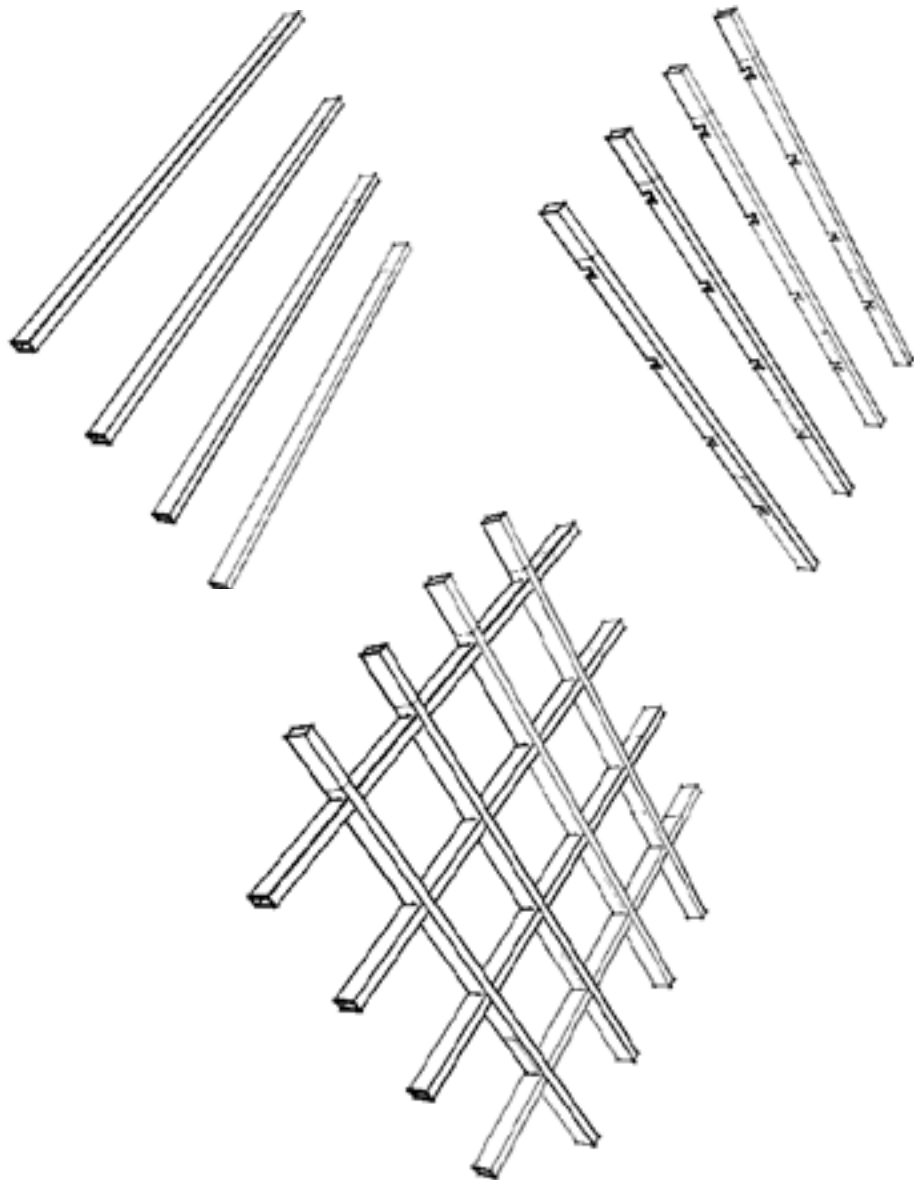
The cell shape and structure will vary depending on the cell location on the facade building and the function it meets.



Function



*Production*

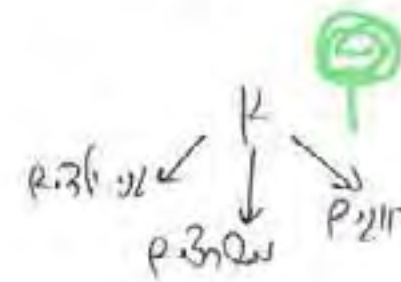




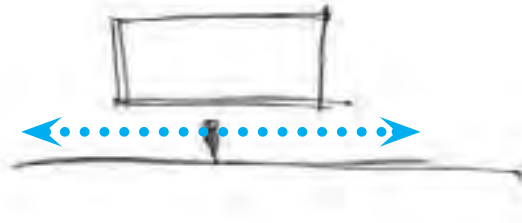
Program



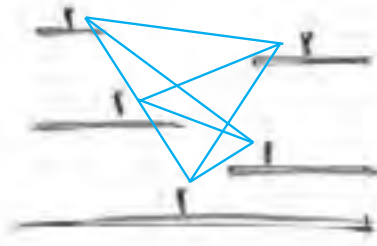
	Gross Area Per Unit	Units Amount	Total Gross Area
Lobby	70		70
Kindergarten	120	2	240
Library	850		850
Conference Hall	150		150
Sports Facilities	800		800
Café	200		200
Activity Room	50	2	100
Auditorium	1,000		1,000
Classes A	35	3	105
Classes B	25	3	75
Offices	10	15	150
Total			3740



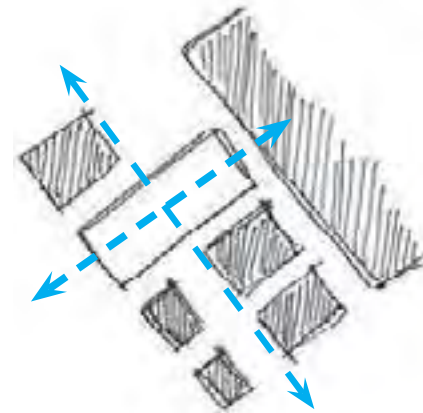
## Structure Design Principles



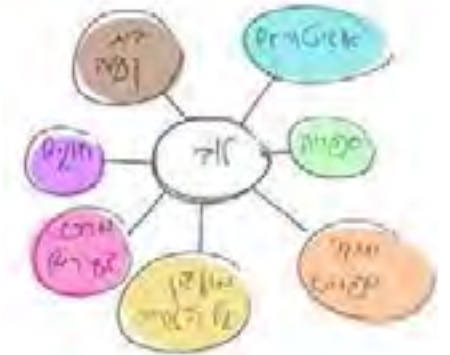
*Internal Street*



*Views*



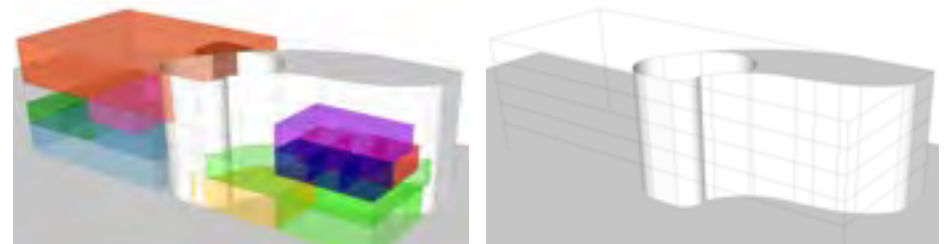
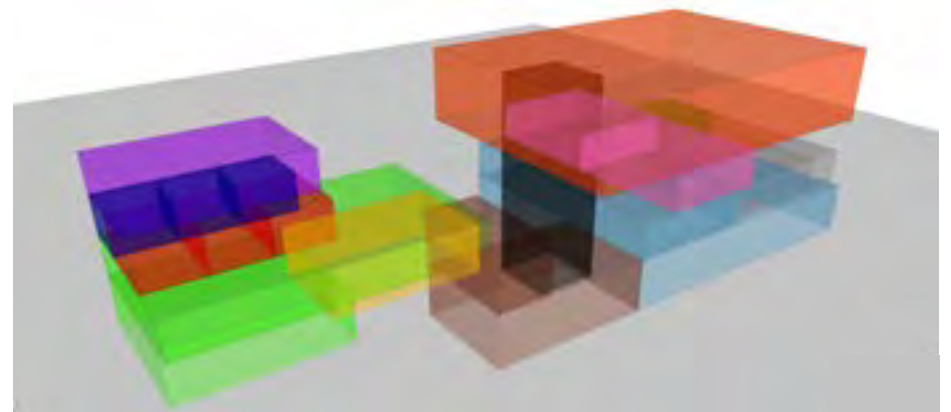
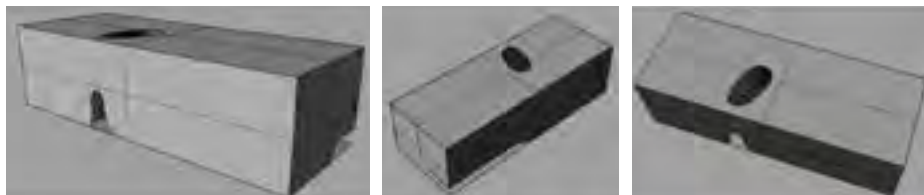
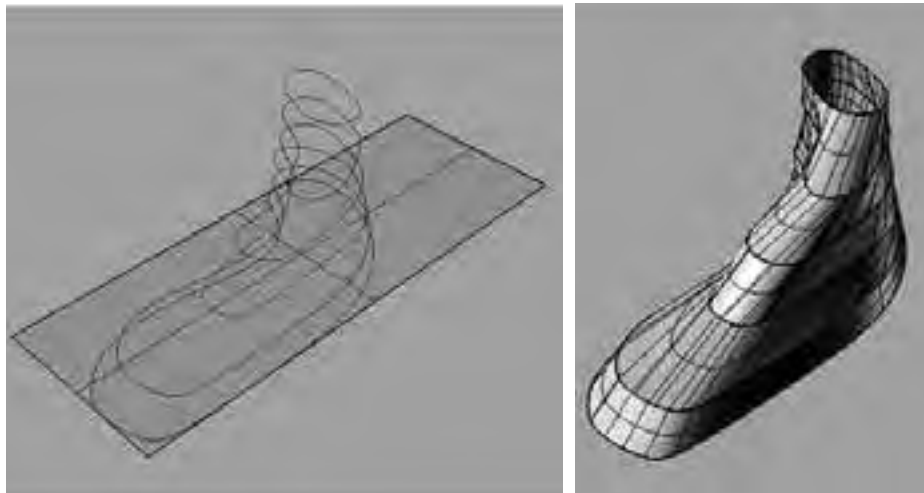
*Axis*



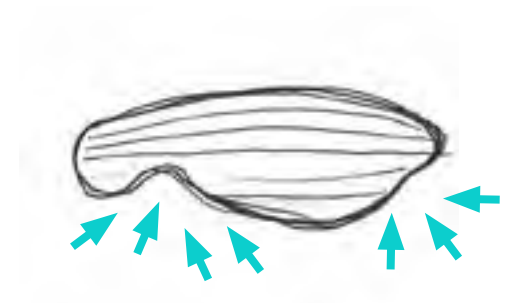
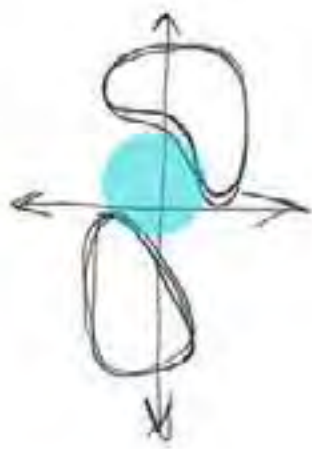
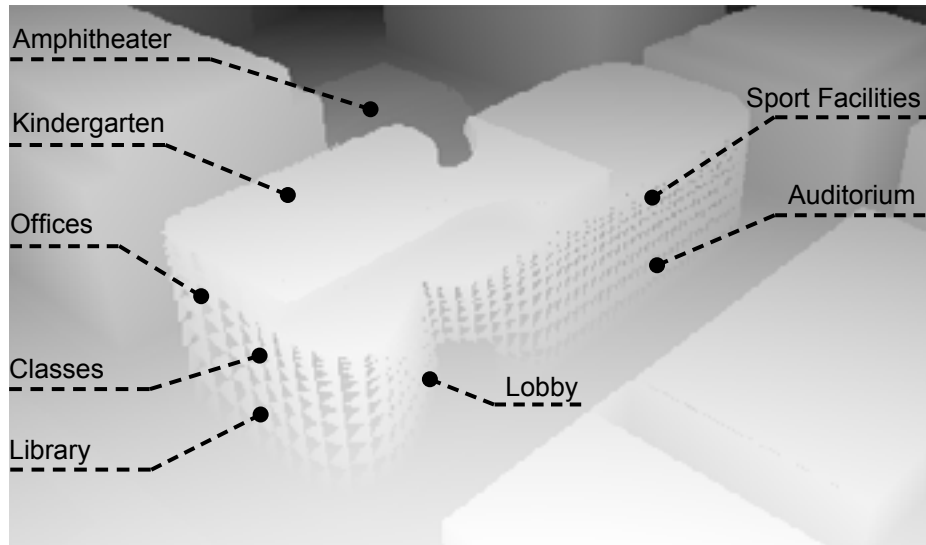
*Central Hall*

## Structure Organization

A central void was designed by the design principles and the main axis. The volumes of the different functions are placed according to the void silhouette and the contexts between them.

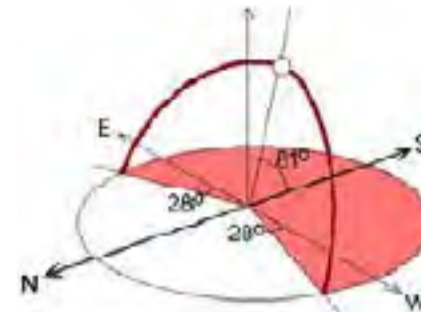
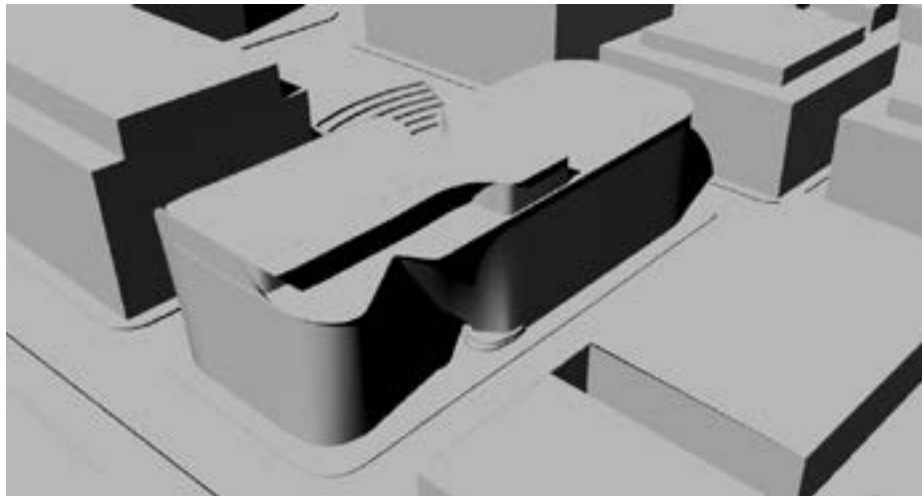


## Structure Organization

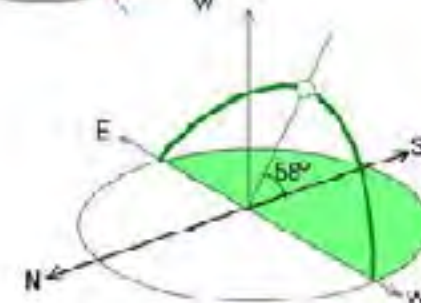


**Geometry**

The building facade is diverted in 58 degrees angle, so the passage through the building will be shaded in summer (June - September) and exposed to the sun during the winter.

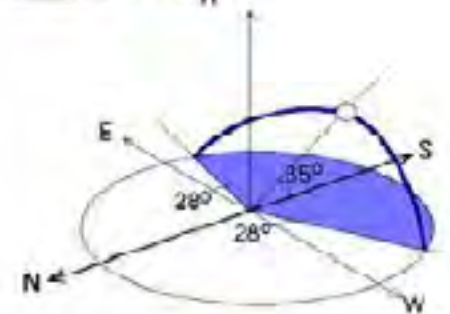


June 21th



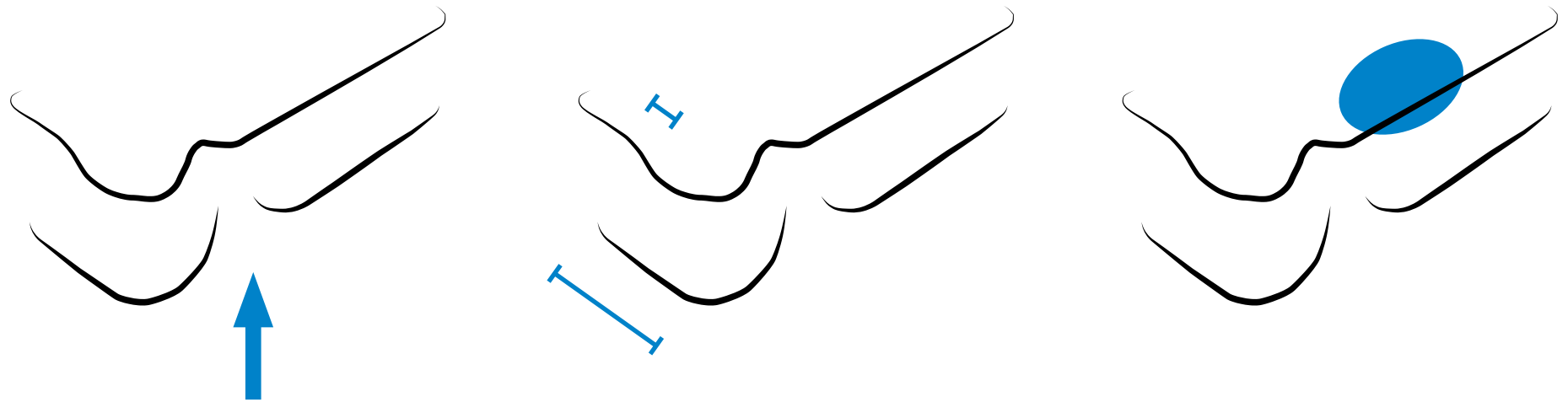
September /  
March 21th

December 21th



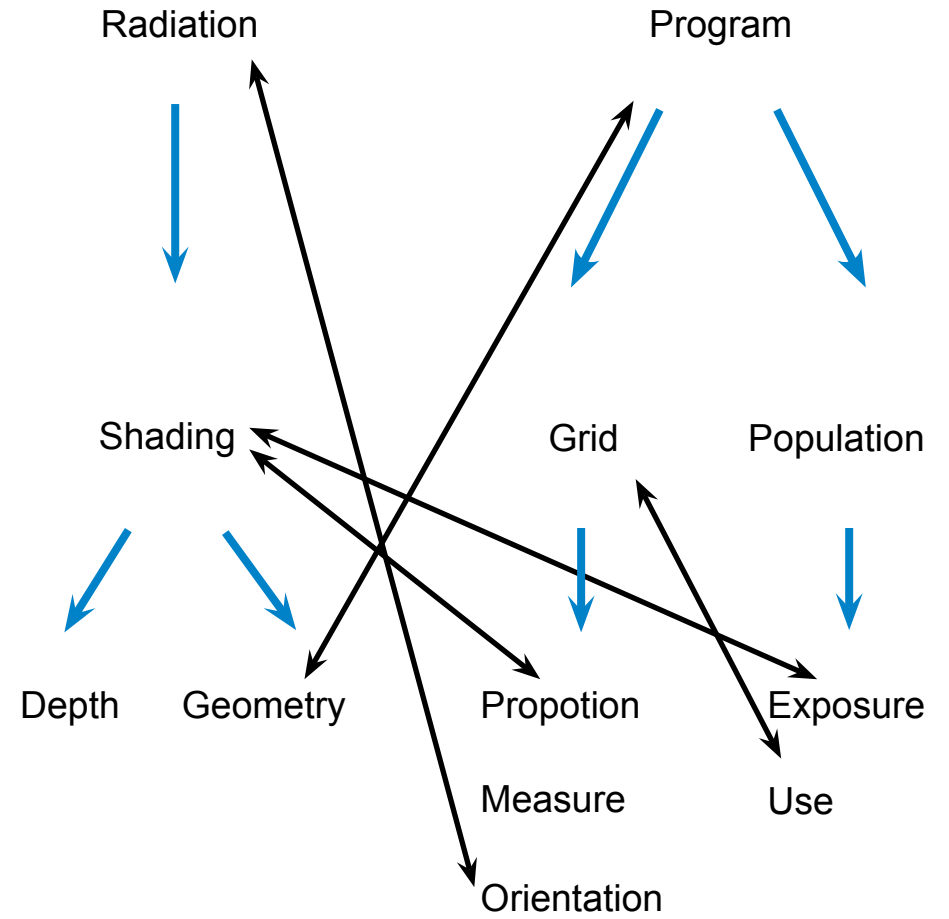
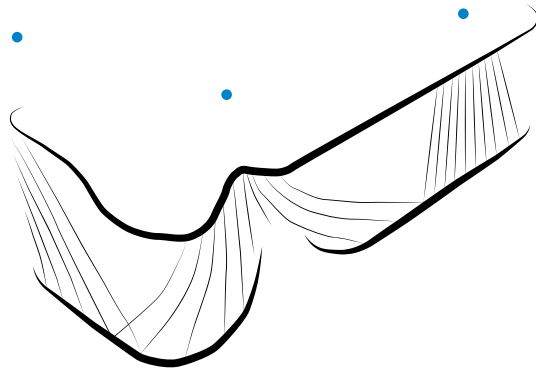
[http://www.srh.noaa.gov/abq/?n=clifeatures\\_summersolstice2010](http://www.srh.noaa.gov/abq/?n=clifeatures_summersolstice2010)

**Grid**



### Grid

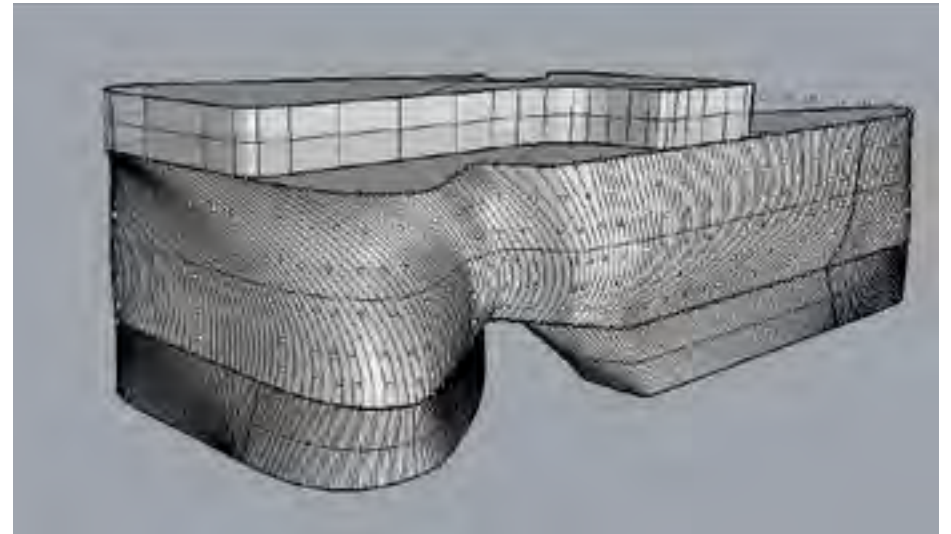
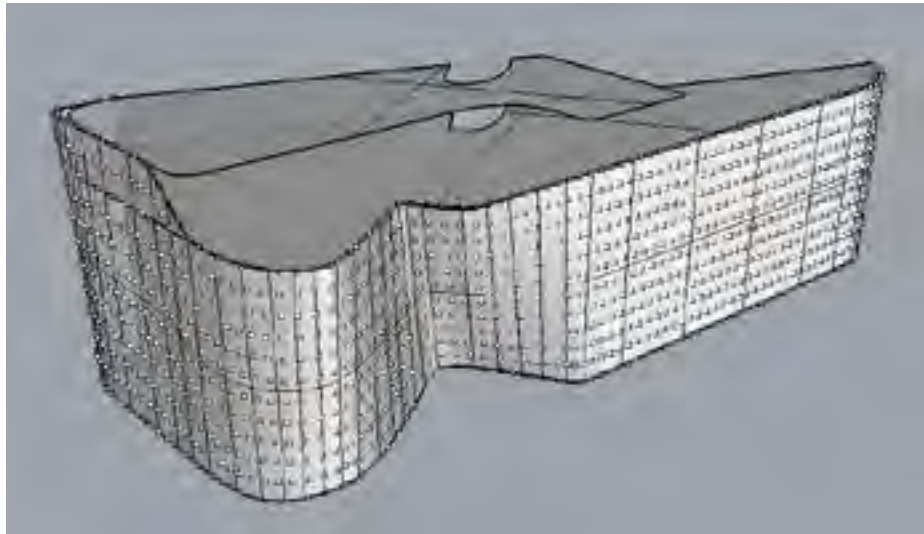
The character of the envelope is determined by vanishing points in space, which affect the grid along the building circumference.



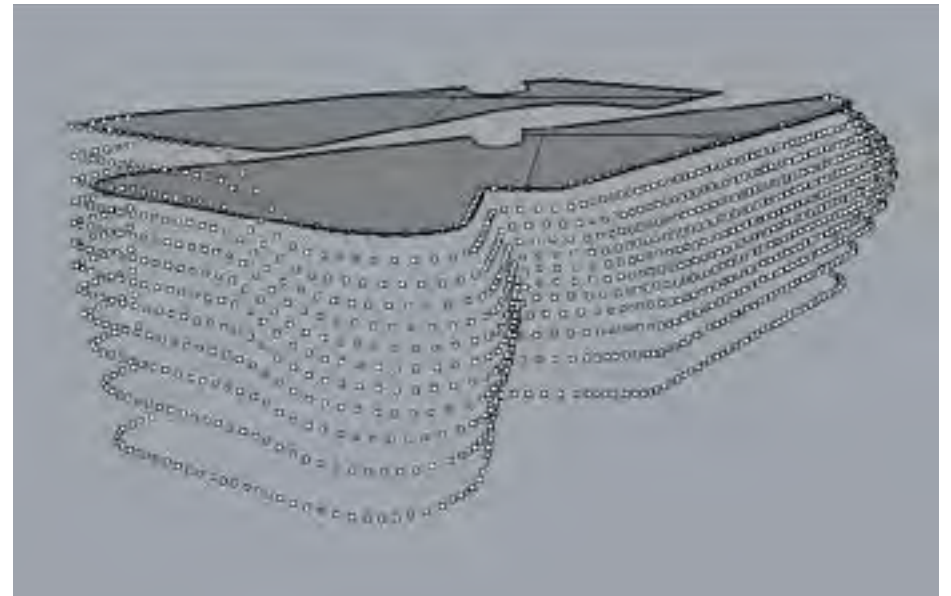
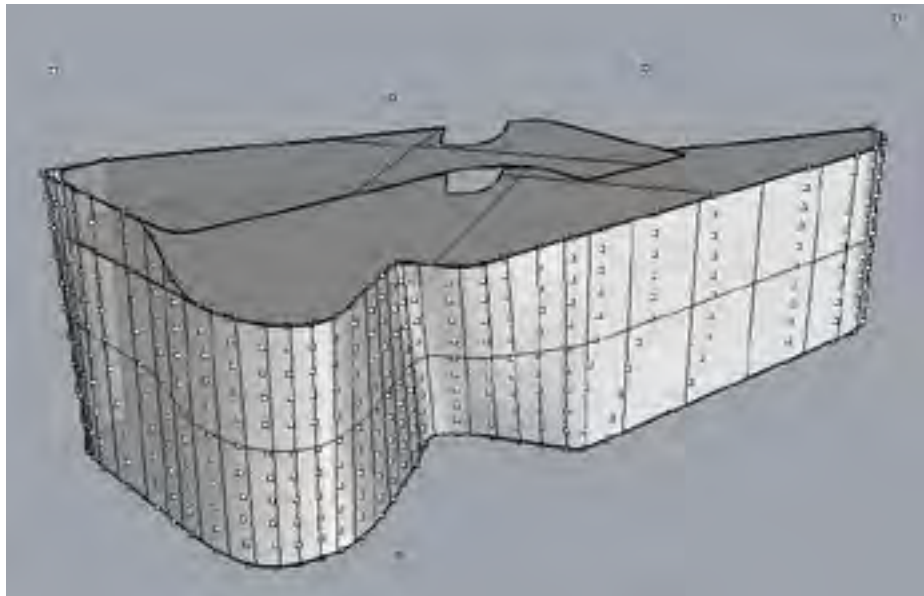




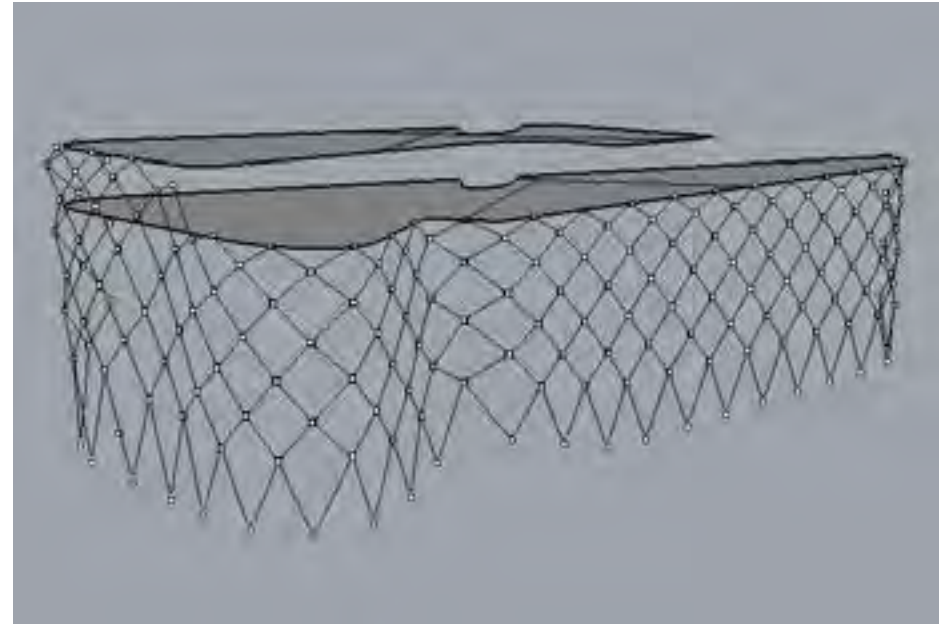
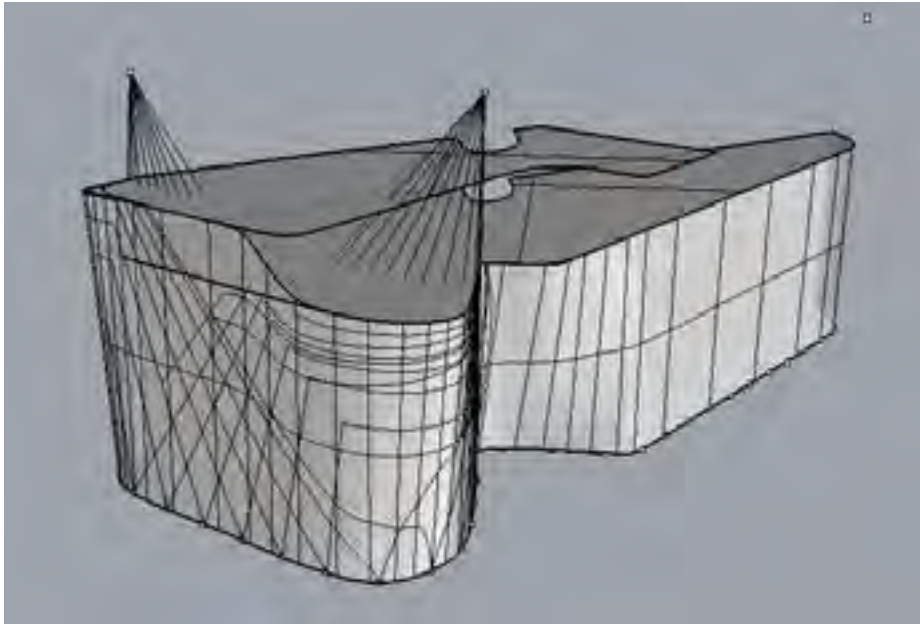
*Paneling Tool*



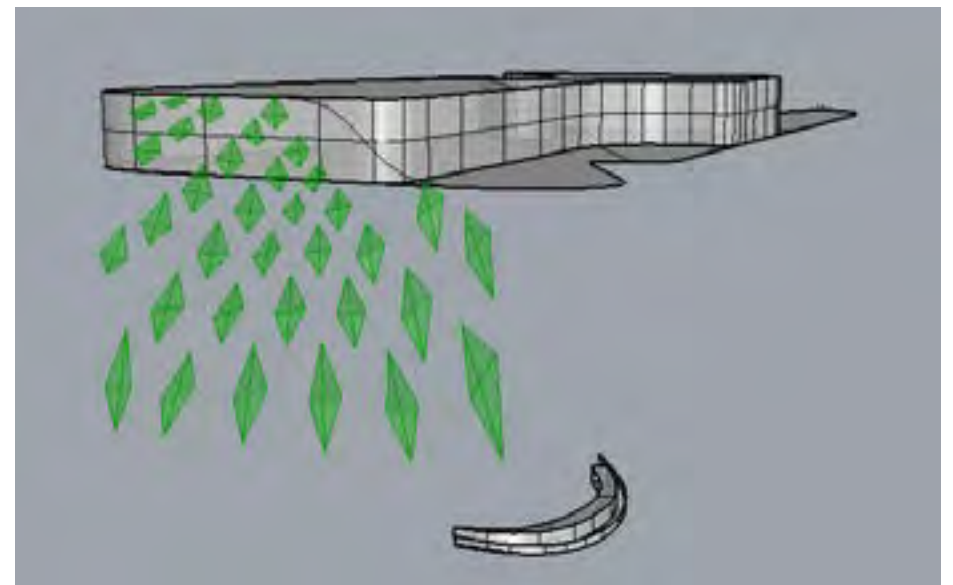
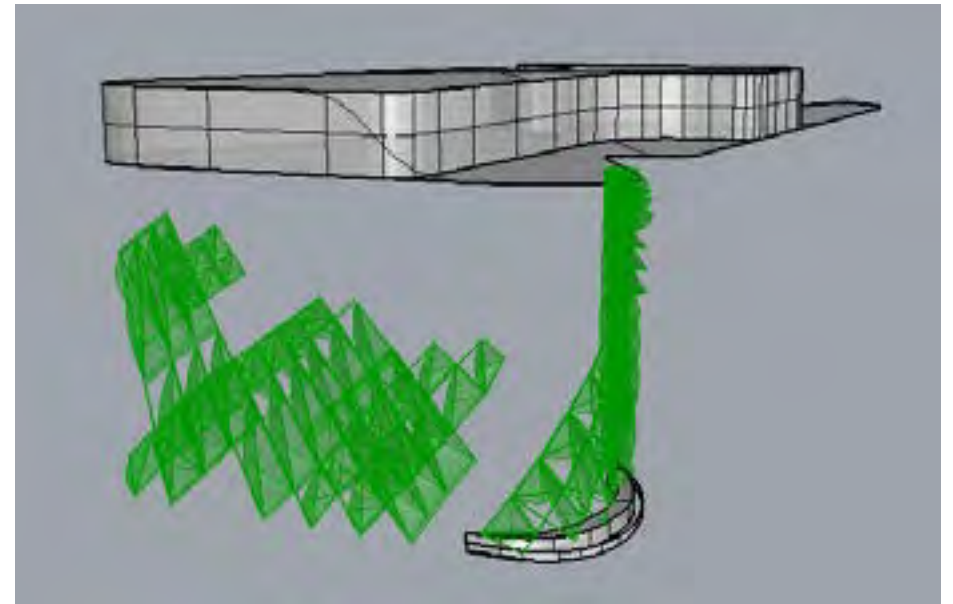
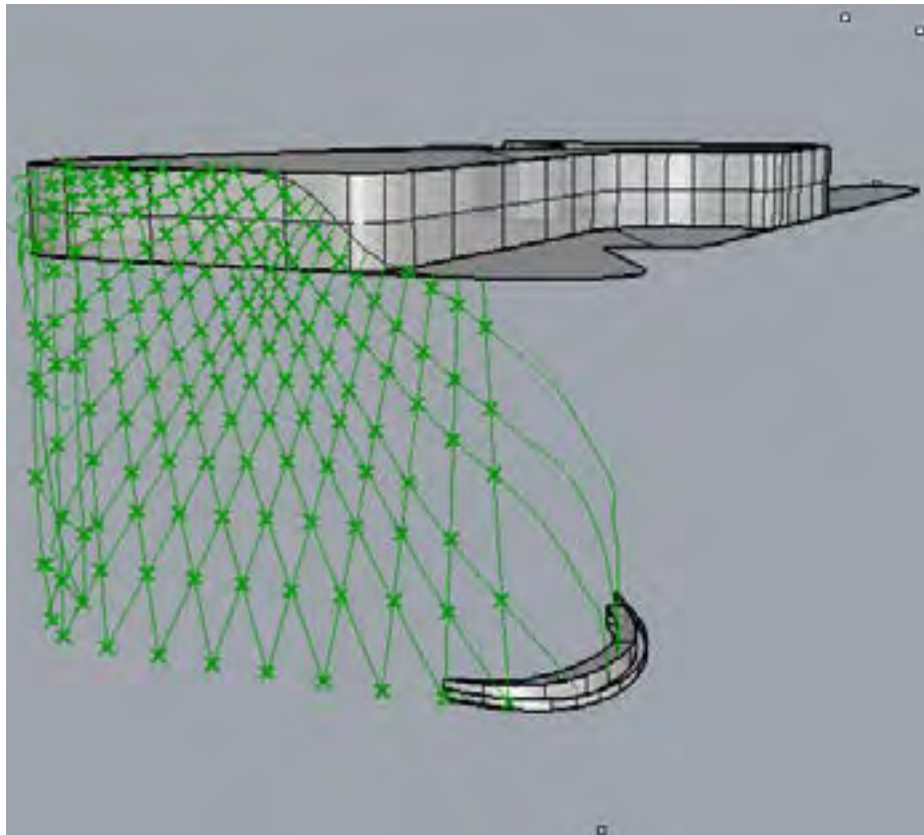
*Paneling Tool*



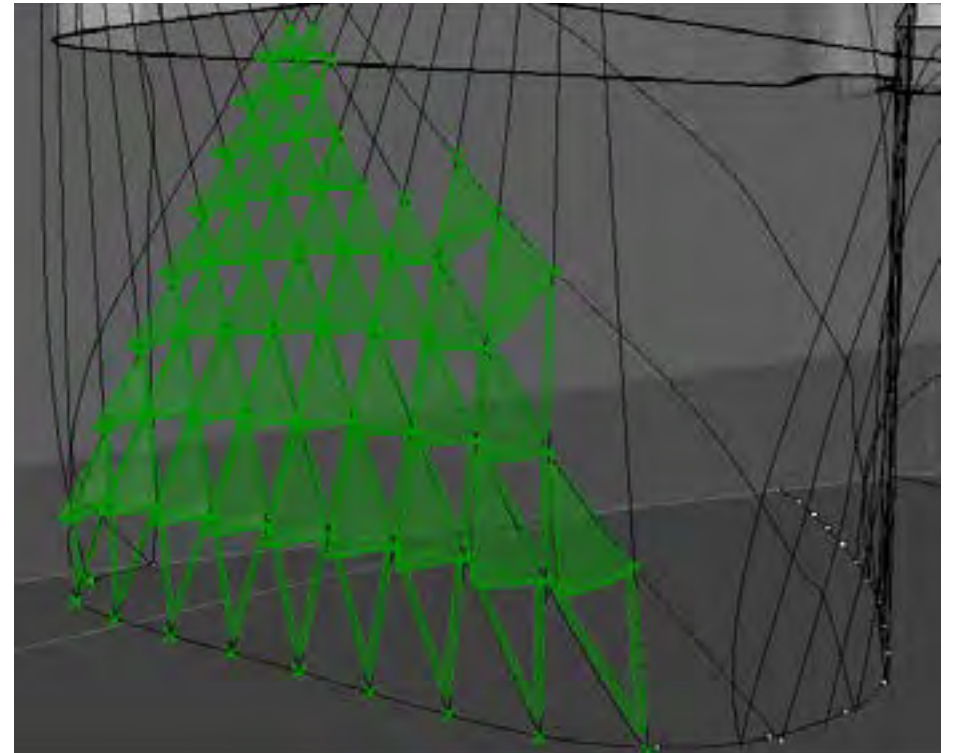
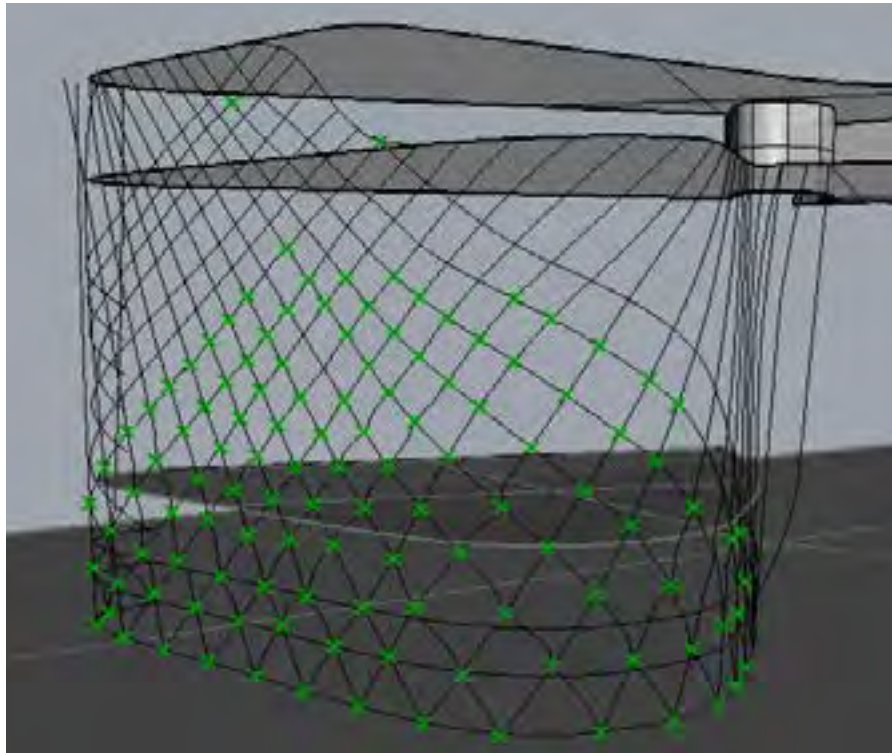
*Attraction points*



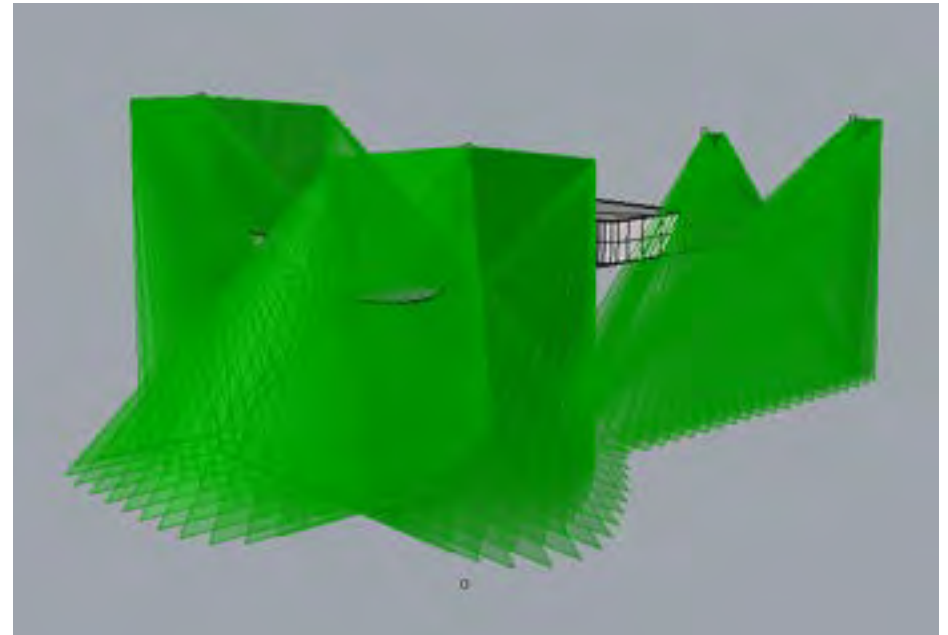
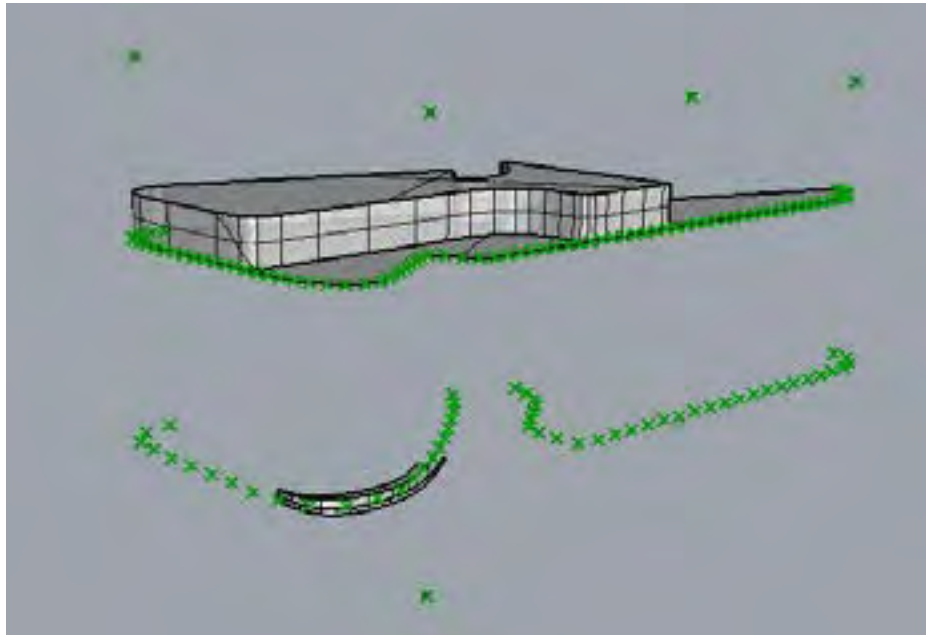
*Manual / parametric Design*



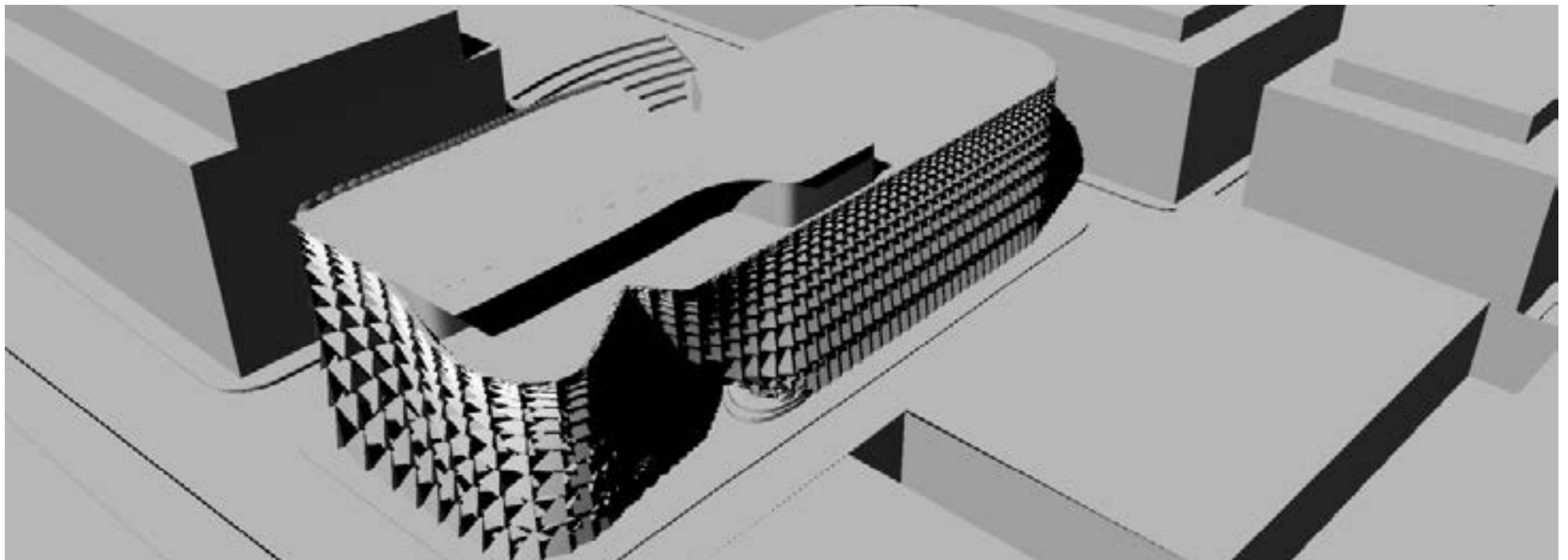
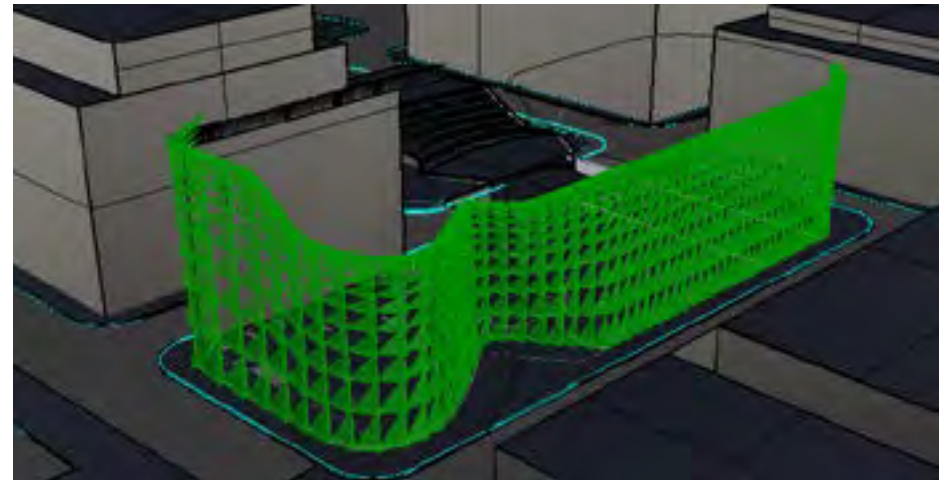
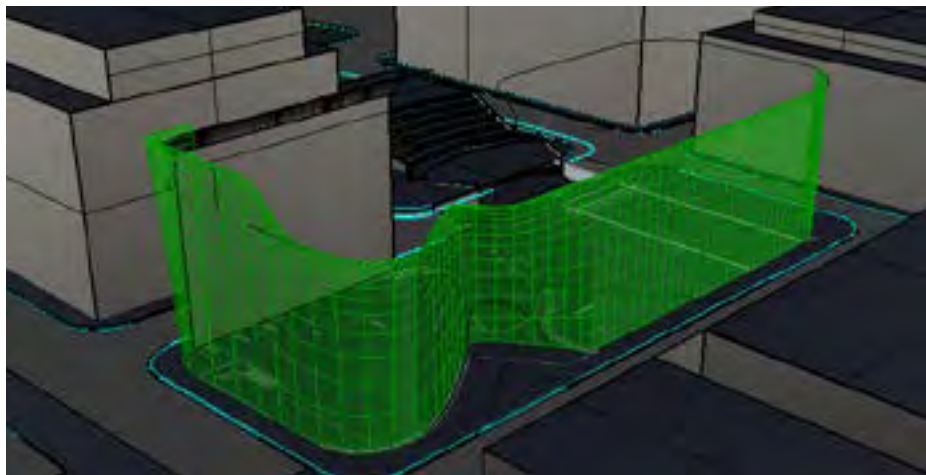
*Manual / parametric Design*



*Manual / parametric Design*



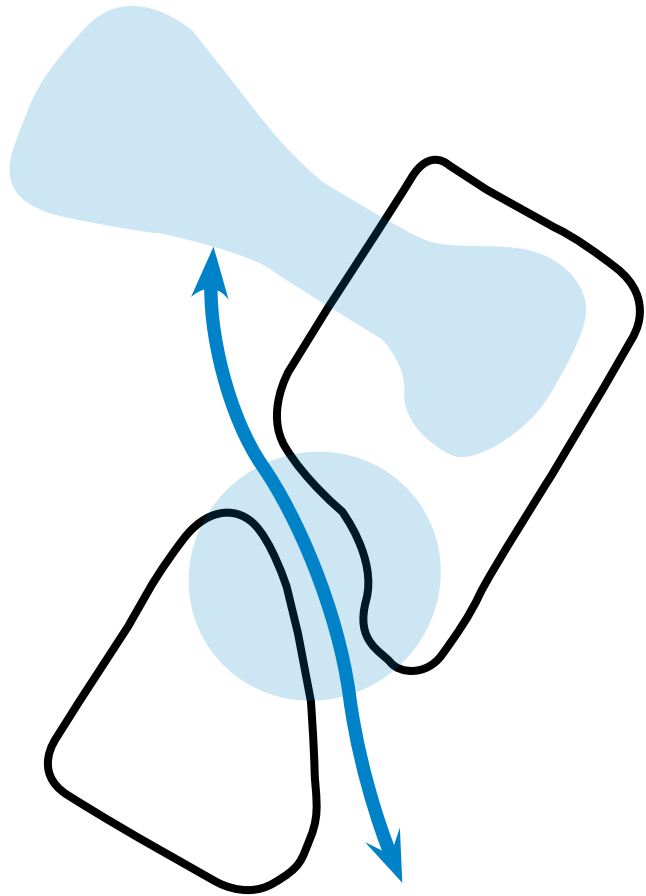
*Manual / parametric Design*





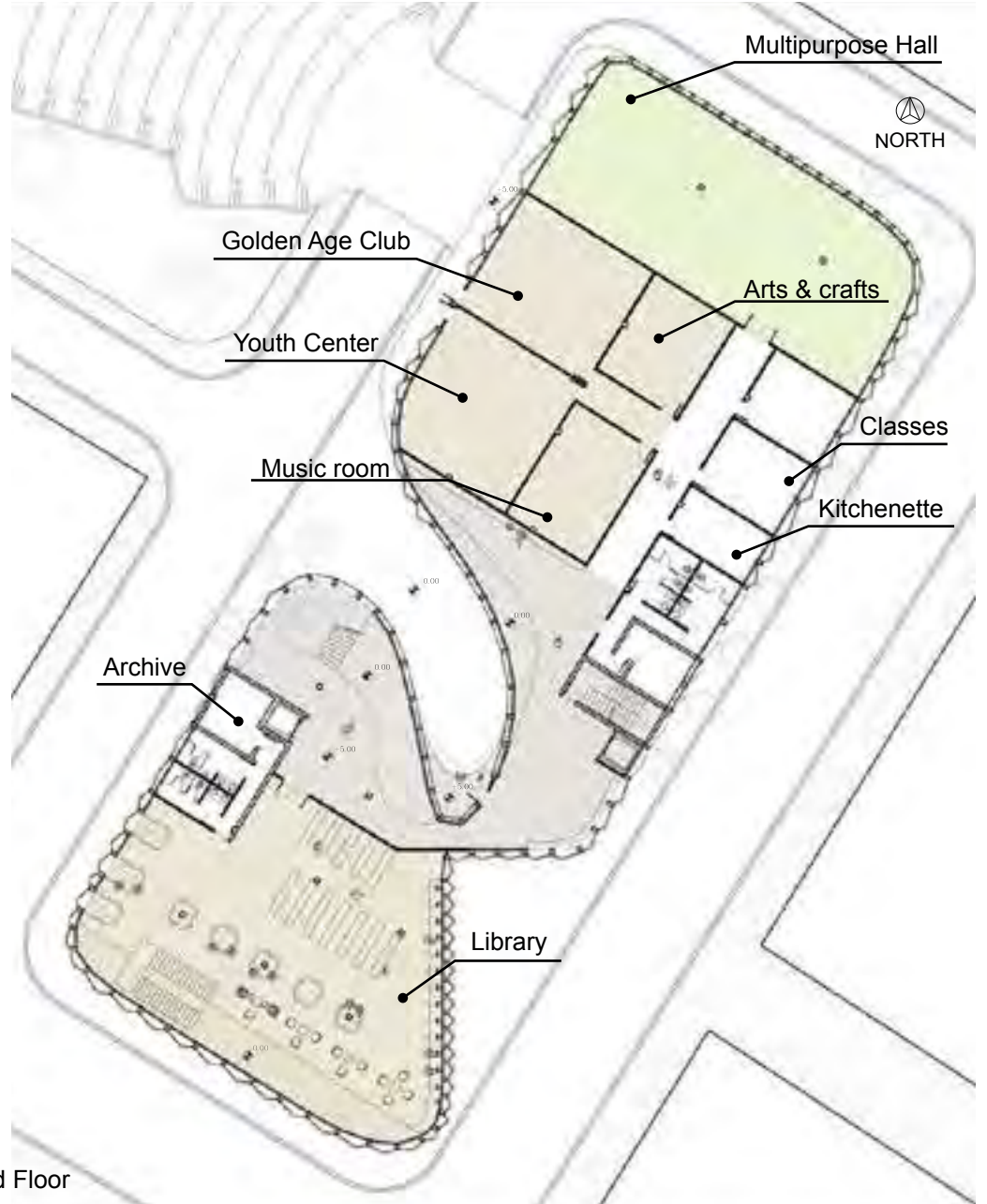
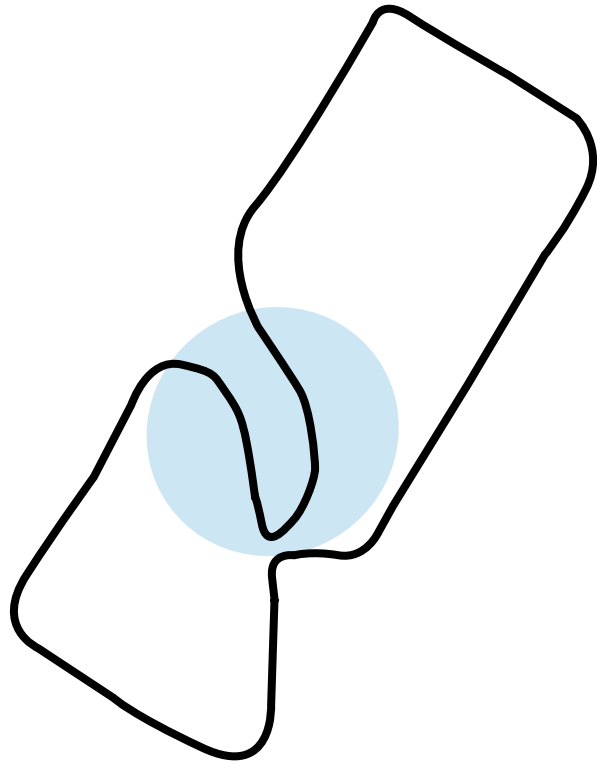


### Surroundings



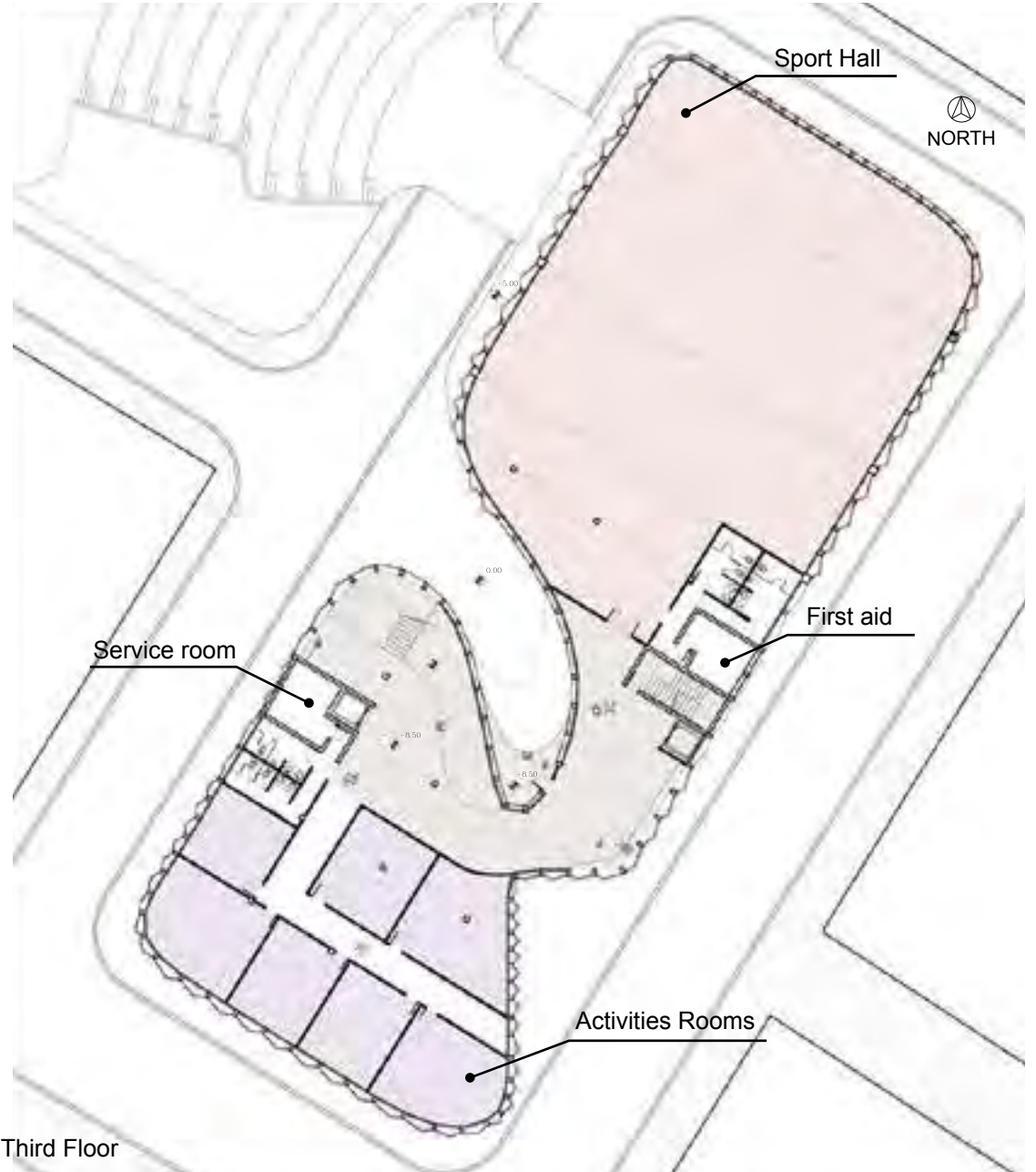
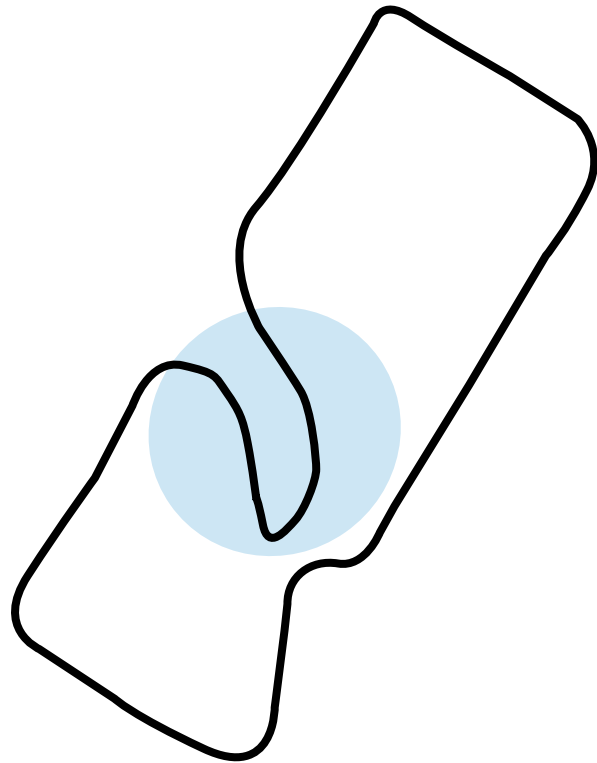
First Floor

Atrium



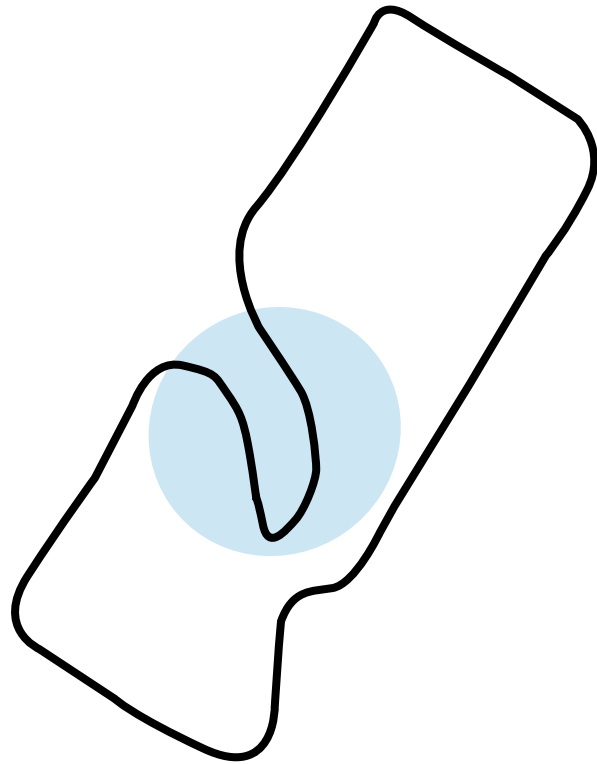
Second Floor

Atrium



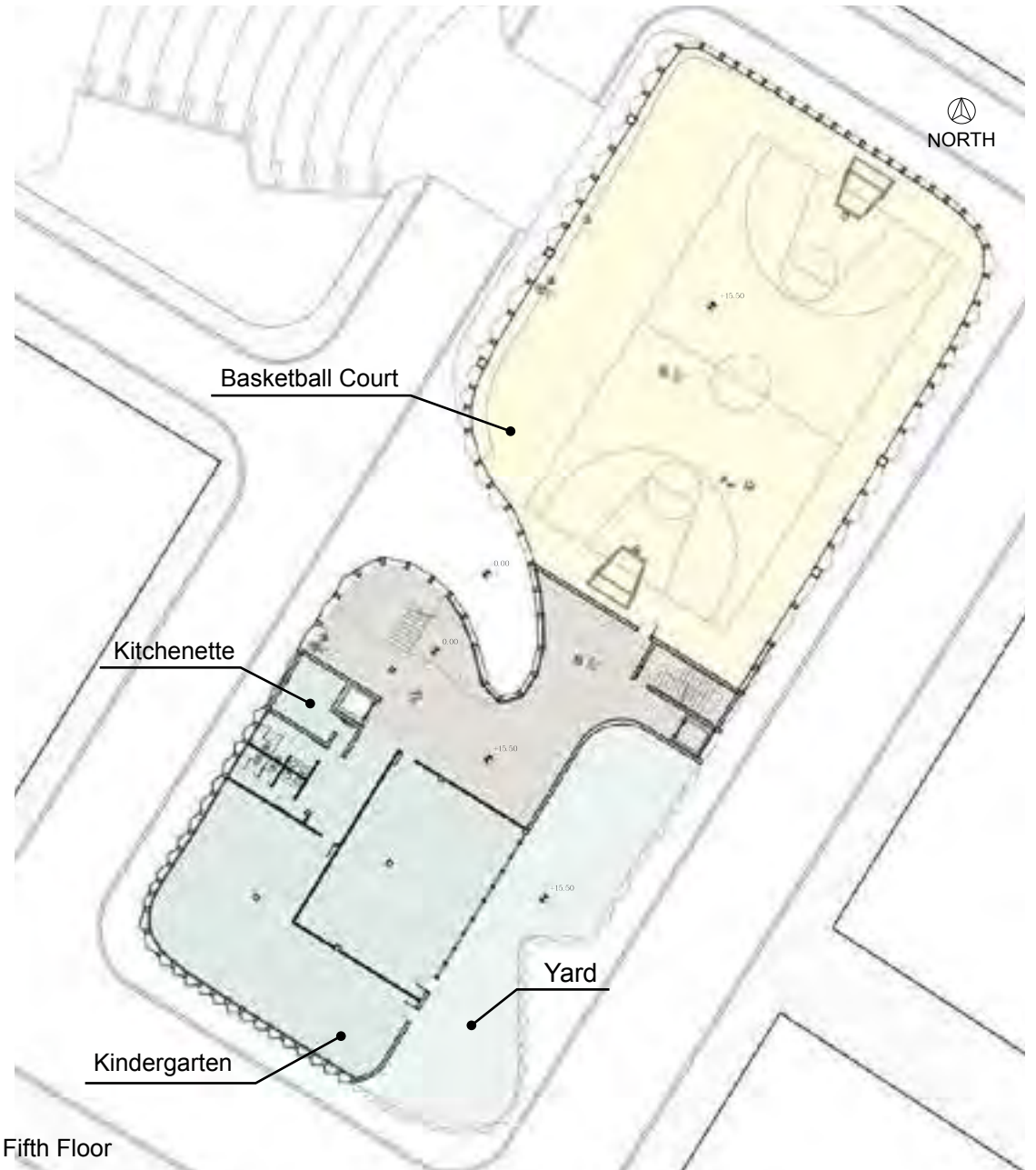
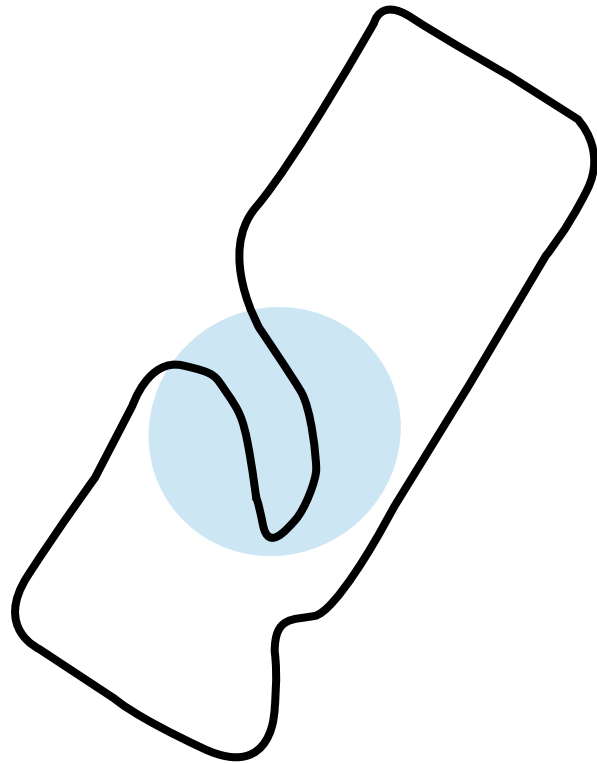
Third Floor

Atrium

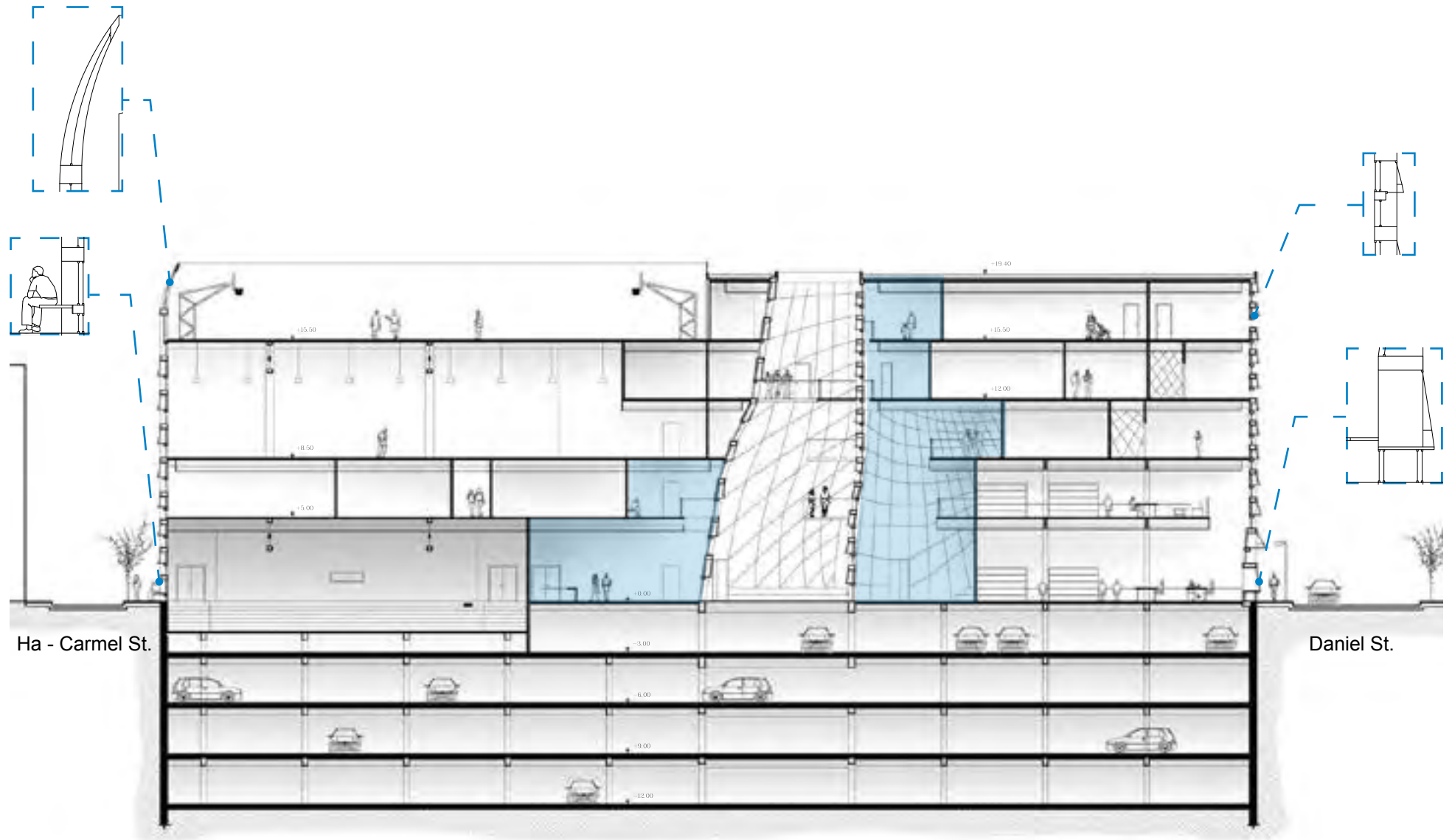


Forth Floor

Atrium



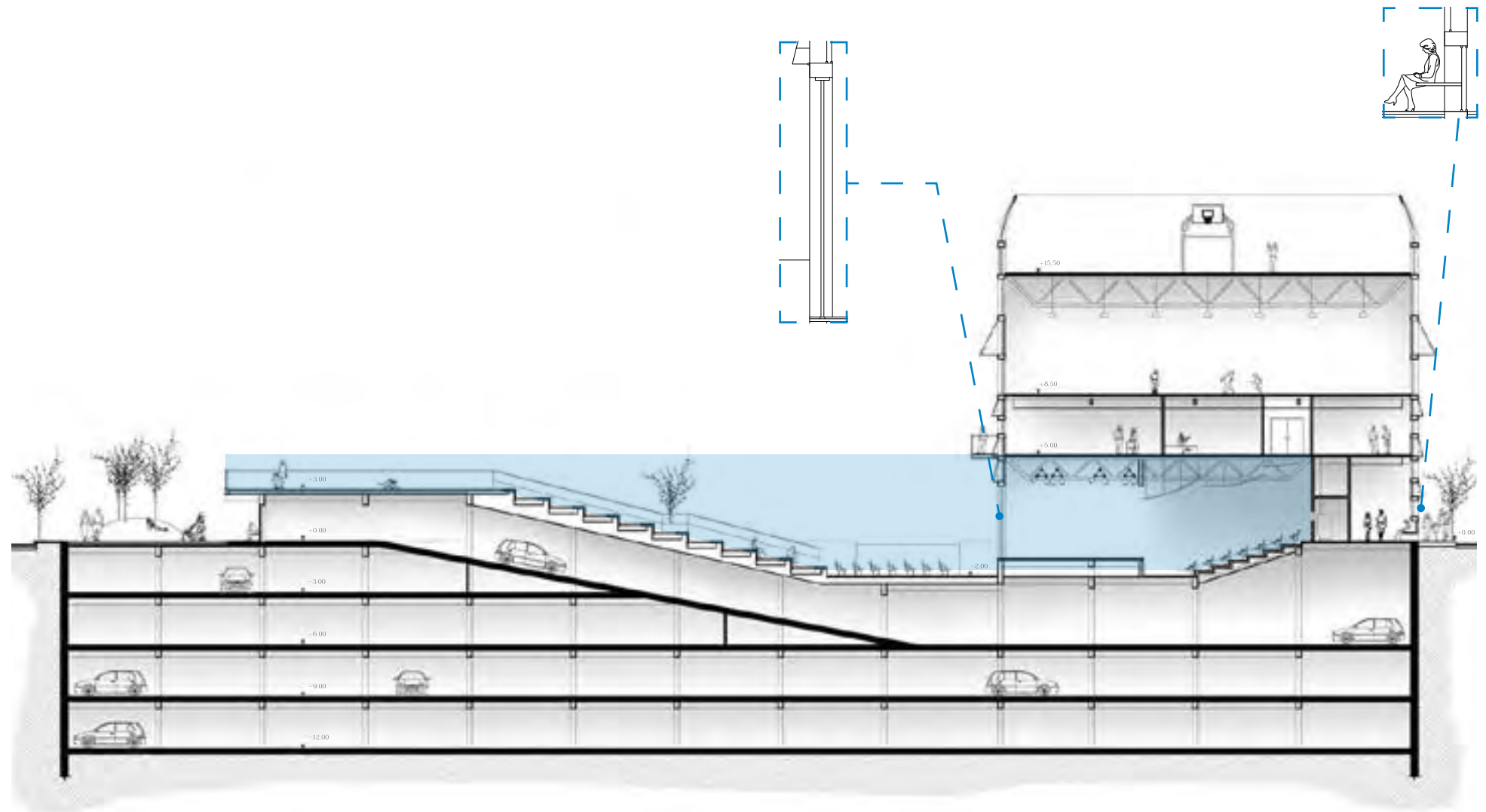
Atrium



*Atrium*

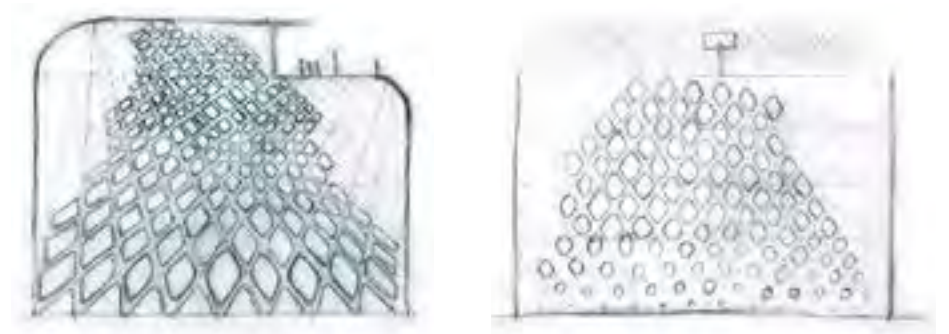
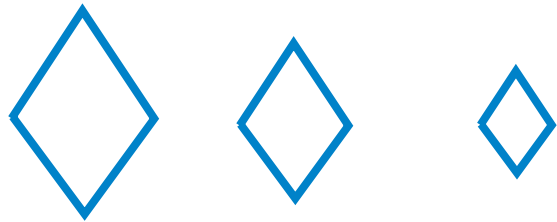
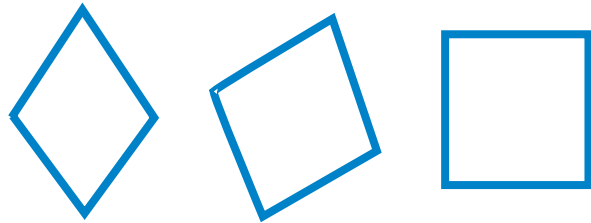


*Double Use*

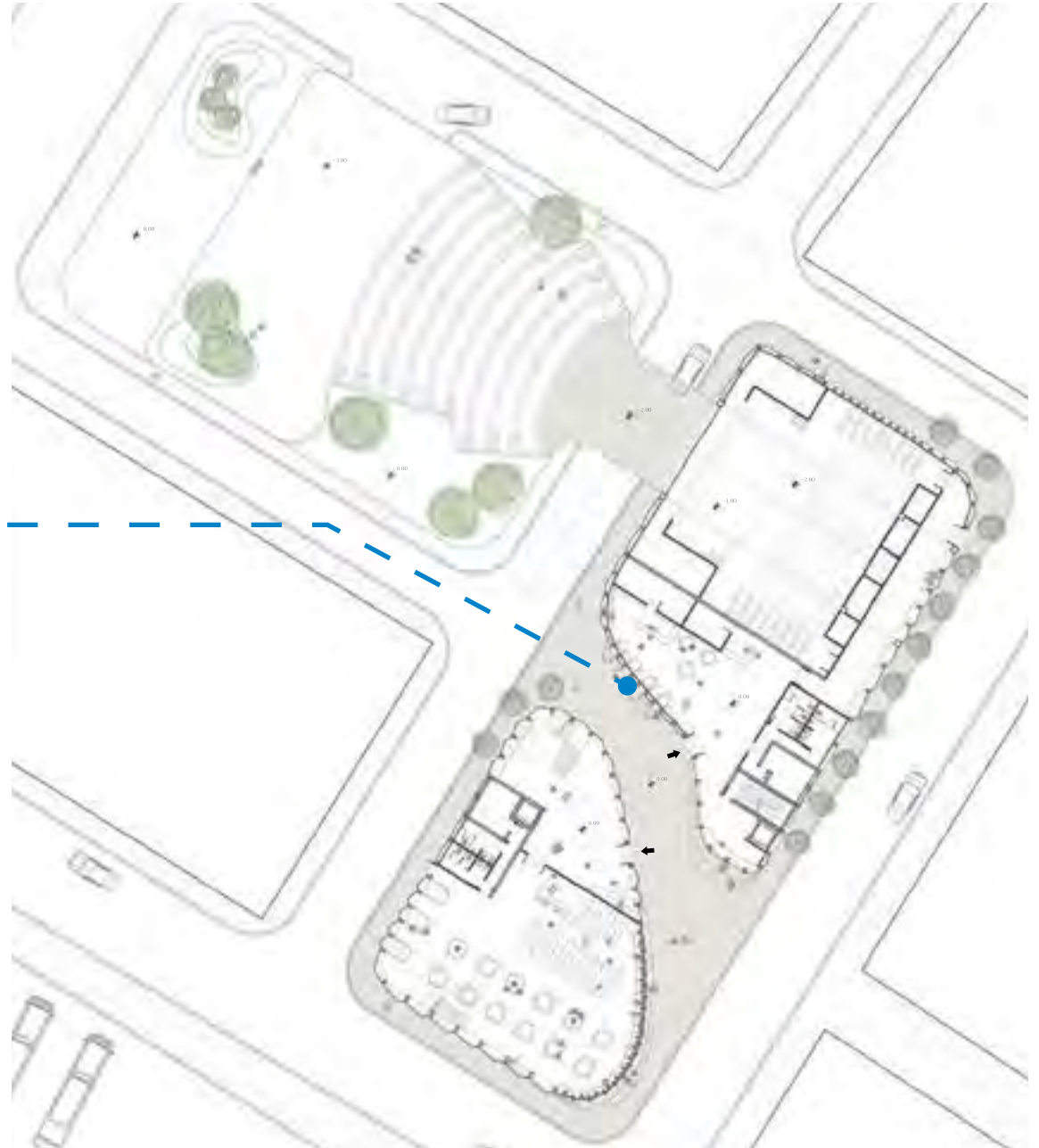




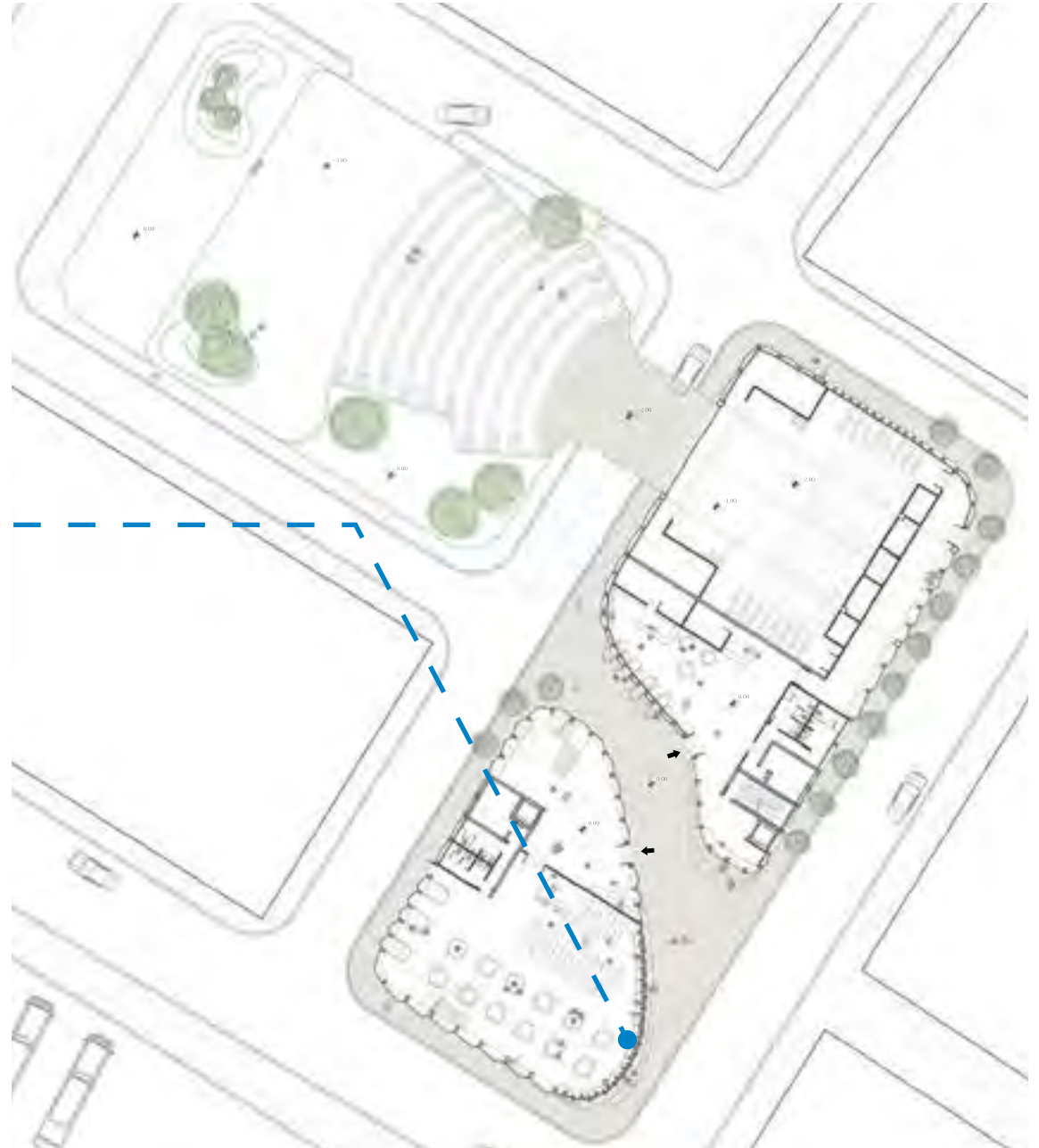
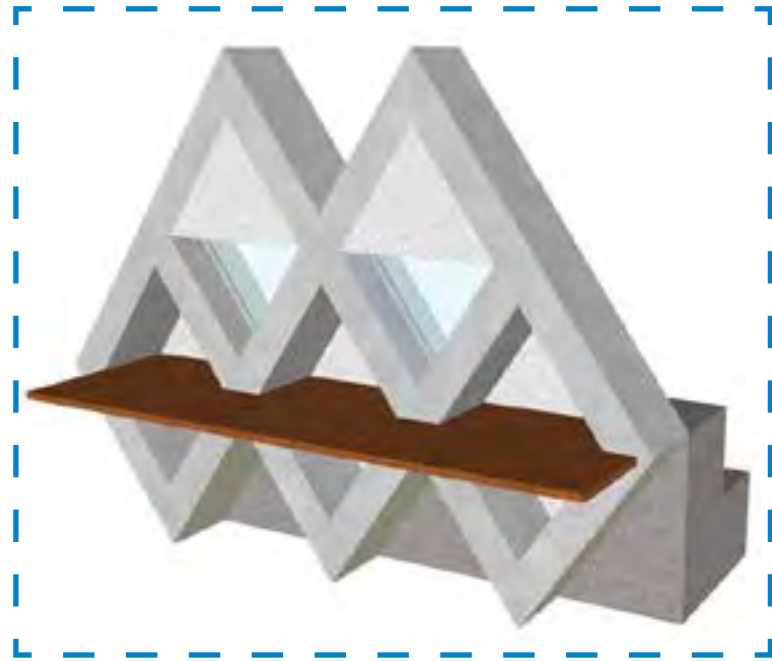
Cell / Program



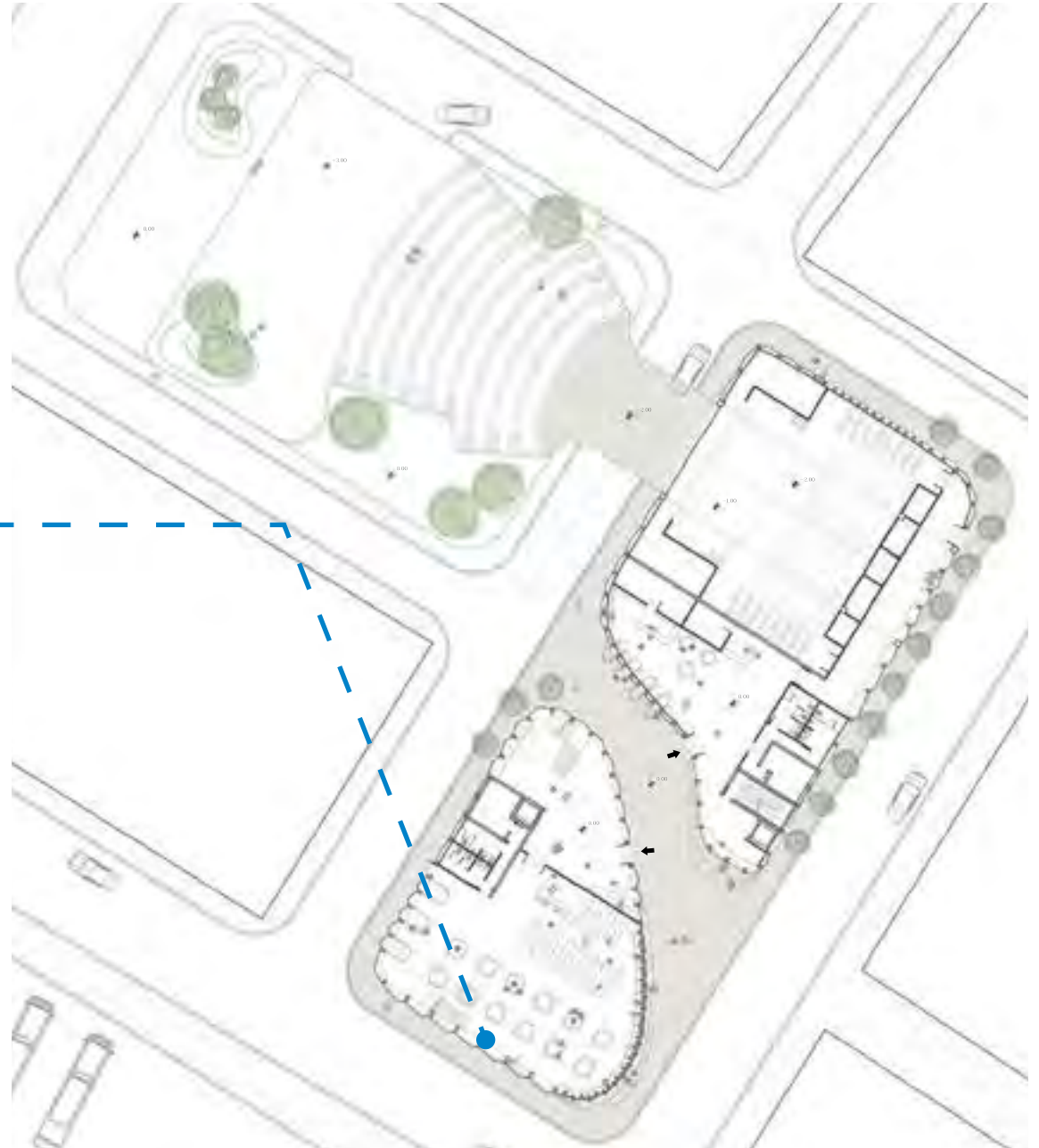
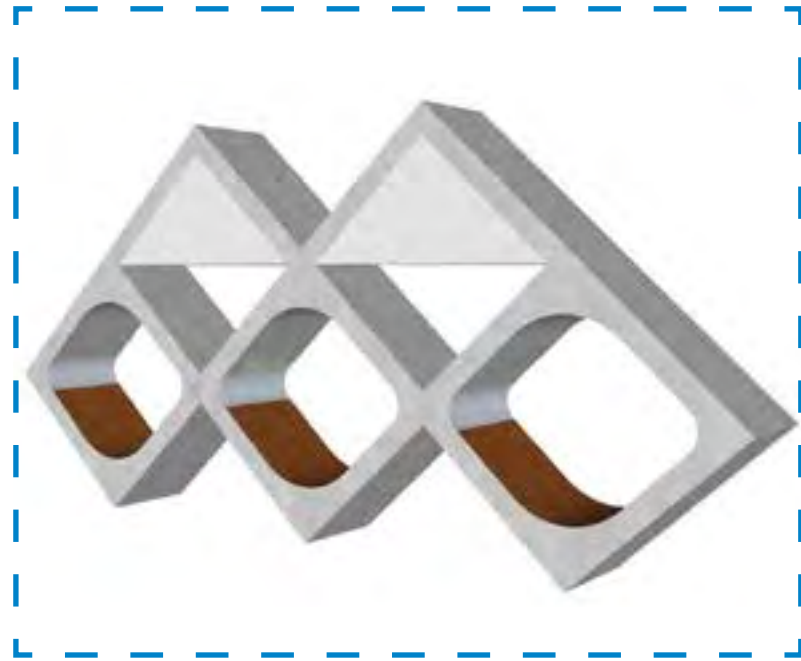
Cell / Program



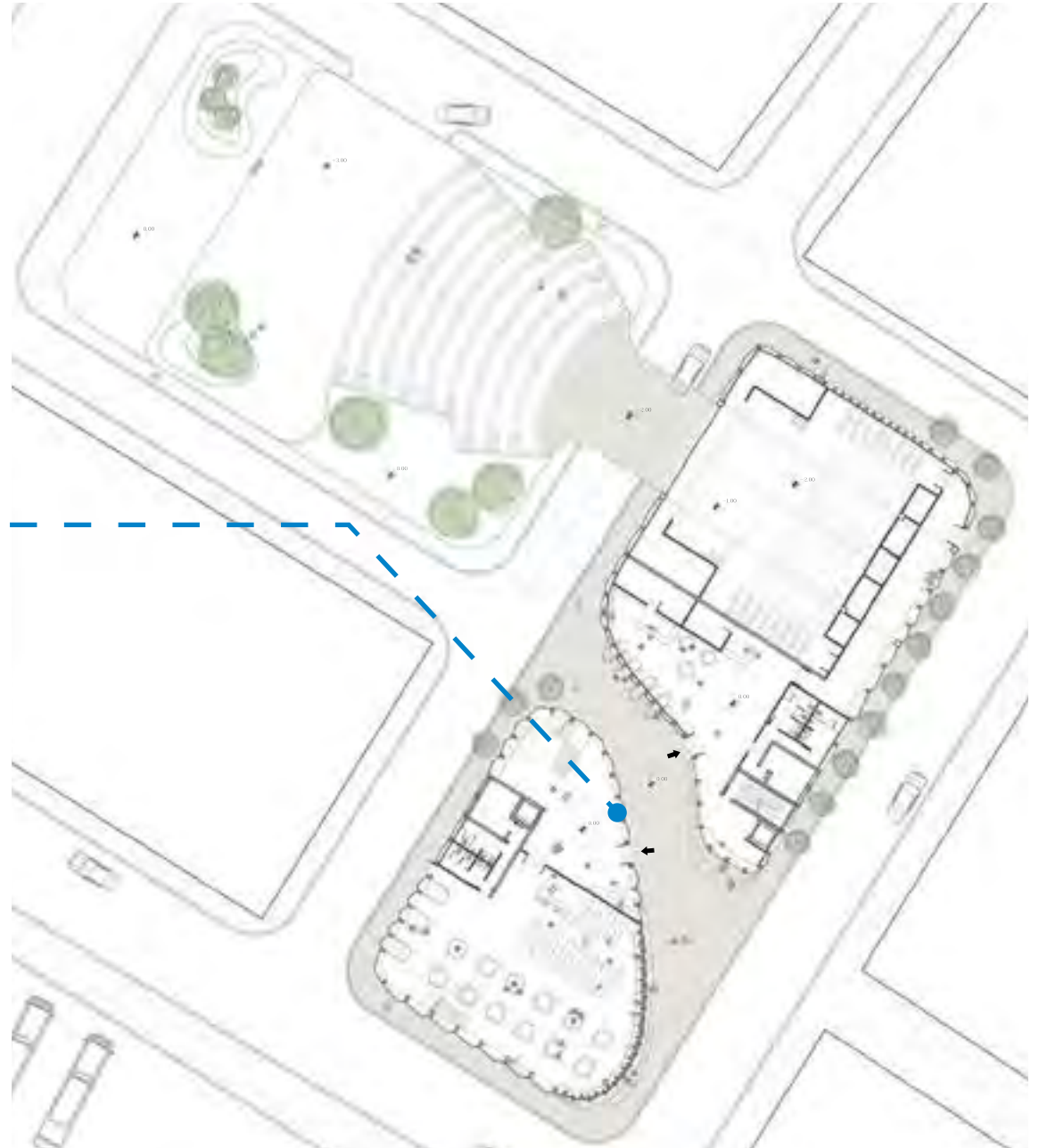
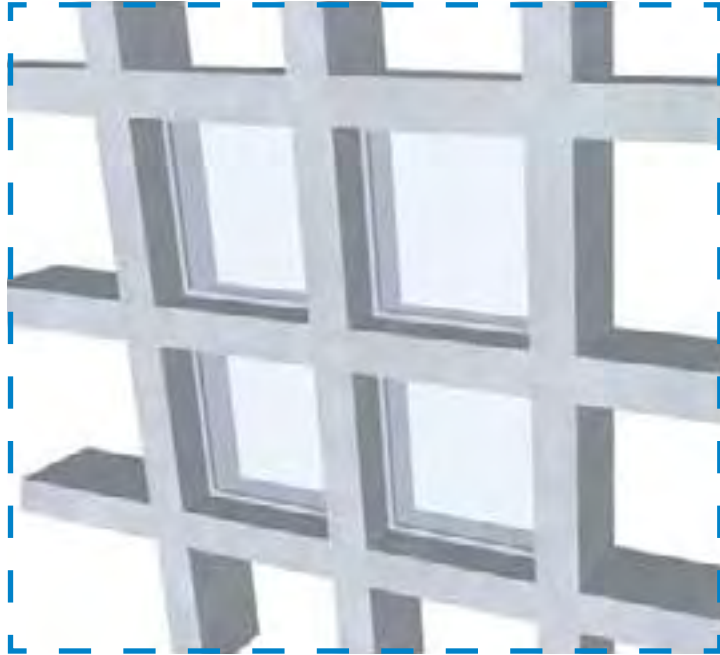
Cell / Program



Cell / Program



Cell / Program



Cell / Program









**BOOK PROJECT**  
**CELLULAR BUILDINGS - THEMATIC STUDIO**



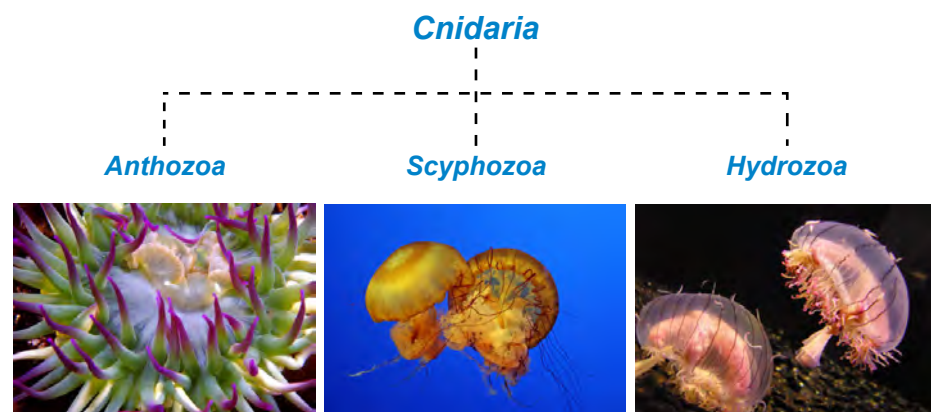
## Cnidaria

The colorful, radially symmetric cnidarians are the flowers of the sea. There are about 10,000 species of cnidarians which classified into three main groups:

Anthozoa: sea anemones, corals, sea pens, sea fans and sea pansies

Scyphozoa: box jellies, stalked jellies, flag-mouth jellies and root-mouth jellies.

Hydrozoa: hydra, seaweedlike hydroids, portuguese and reef-building corals.



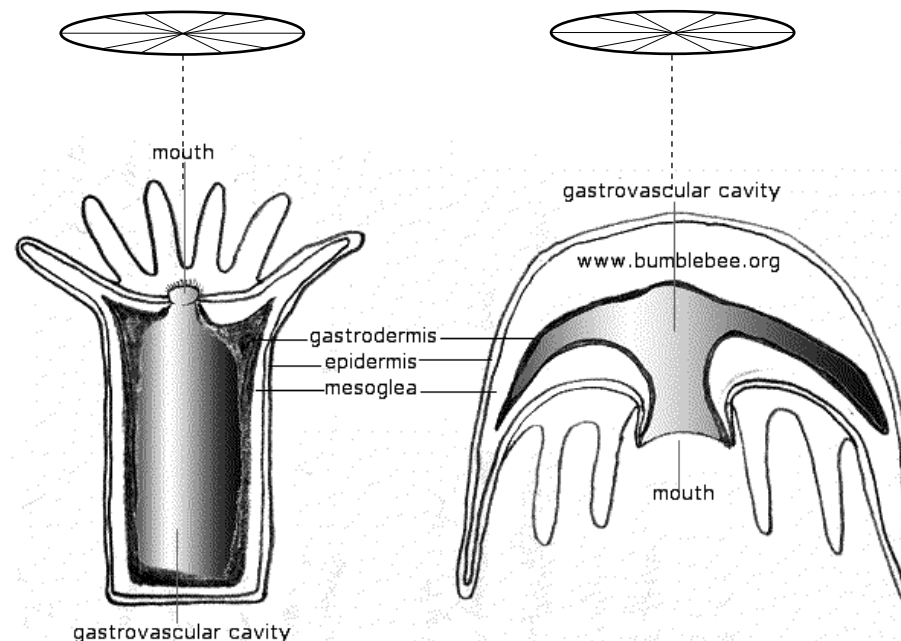
Sea anemones, jellyfish, hydrozoa  
(source: [http://animals.about.com/od/cnidarians/ss/cnidarians\\_7.htm](http://animals.about.com/od/cnidarians/ss/cnidarians_7.htm))

Cnidarians are invertebrate animals which live mainly in the ocean at a wide range of depths and temperatures. Their name comes from the Greek word for stinging nettles, 'cnidos', because they have thousands of stinger cells on their tentacles. Although their beauty, the cnidarians catch prey or discourage aggressors with tubules fired from uniquely specialized stinger cells called cnidocytes. To humans, venomous cnidarian stings feel like injection or hot needles.

## Form and symmetry

Cnidarians are diverse and come in many shapes and sizes but there are some basic features of their anatomy that most share in common. The cnidarian body as a shape of saccate. In basic form the body consists of a cavity enclosed by a solid body wall. The cavity, called the coelenteron opens to the exterior with a mouth surrounded by whorls of tentacles.

The cnidarian body exhibits radial symmetry around one axis, that extends from mouth to base. Radially symmetric animals simultaneously face all compass directions with their sensory organs and tentacles. Radial symmetry may be useful when a resource- plankton, light or danger has an equal probability of arriving from any directions.

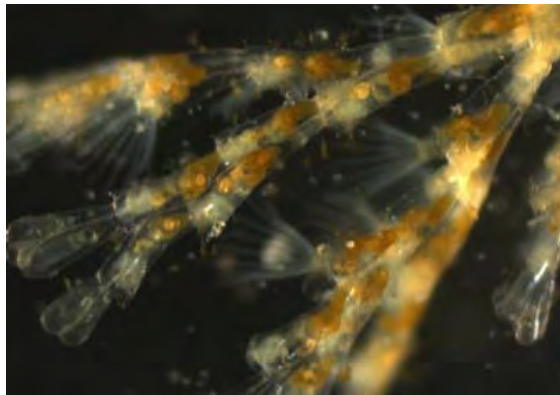
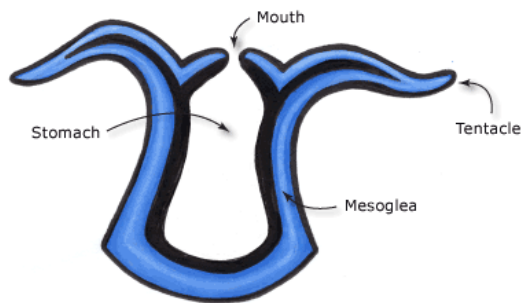


Radially symmetric polyp, radially symmetric medusa. The diagrams above indicate their radial symmetry. (source: <http://www.bumblebee.org/invertebrates/Cnidaria.htm>)

## Body forms

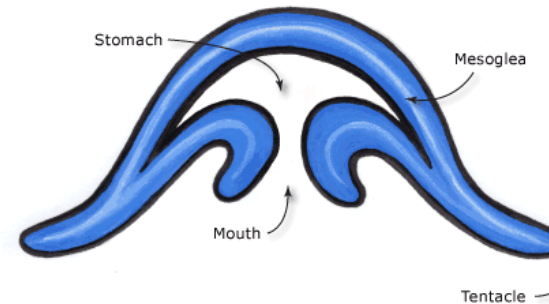
Two different body forms occur in cindarians the polyp and the medusa.

**Polyps** - resembles a flower and its stalk. The stalk form is a cylindrical colum, at the end of the colum, an elevation with the mouth that situated in the center of the oral disc. The oral disc is surrounded by tentacles. Polyps are sessile animals with a mouth-up orientation.



Polyp and medusa body shapes  
(source: <http://www.teara.govt.nz/en/diagram/4721/polyp-and-medusa-body-shapes>,  
[http://animals.about.com/od/cnidarians/ss/cnidarians\\_3.htm](http://animals.about.com/od/cnidarians/ss/cnidarians_3.htm))

**Medusa** - the shape of an umbrella or a bell. The oral disc is called the subumbrella and the opposite side is the exumbrella. The mouth is at the tip of a mobile appendage - the manubrium with a form of elephant's trunk. The tentacles surrounded the mouth. Medusa are known as jellyfish because their connective tissue is thin.

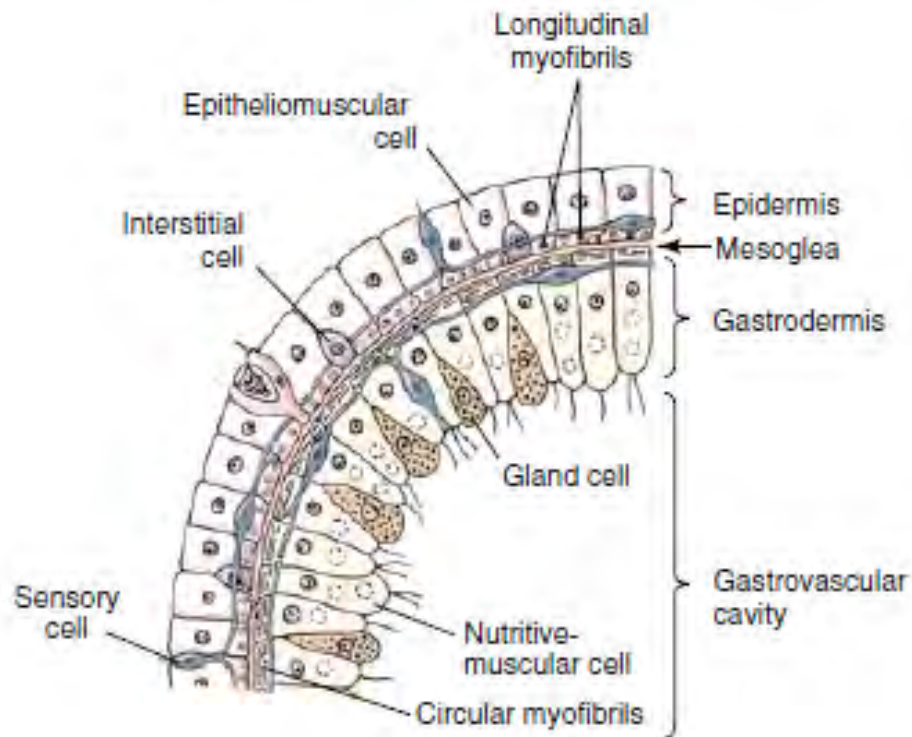


Polyp and medusa body shapes  
(source: <http://www.teara.govt.nz/en/diagram/4721/polyp-and-medusa-body-shapes>,  
[http://animals.about.com/od/cnidarians/ss/cnidarians\\_3.htm](http://animals.about.com/od/cnidarians/ss/cnidarians_3.htm))

## The cnidarian body wall

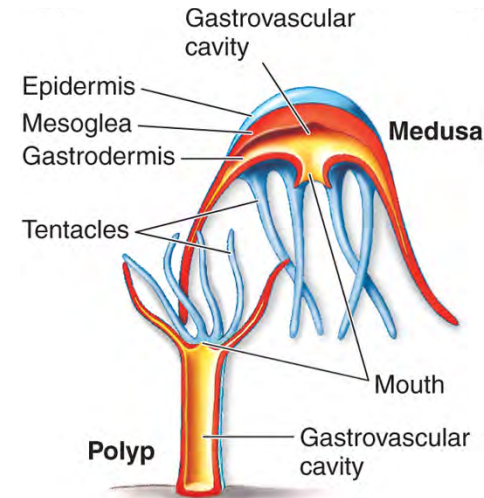
The cnidarian body wall is composed of three layers:

1. Epidermis - outer layer
2. Mesoglea - middle layer
3. Gastrodermis - inner layer



1. Body wall of a polyp - Hydra
  2. Body forma - polyp and medusa
- (source:[http://www.biocyclopedia.com/index/general\\_zoology/phylum\\_cnidaria.php](http://www.biocyclopedia.com/index/general_zoology/phylum_cnidaria.php))

The body is organized around a functionally diverse connective tissue. The epidermis and gastrodermis layer called epithelia, between these two a gelatinous matrix - mesoglea layer is a connective tissue. Most cells of the cnidarians body confined to the epithelia, both epidermis and gastrodermis contain cnidocytes, muscle, nerve, glandular, interstitial and ciliated cells: sensory cells occur in the epidermis and germ cells in the gastrodermis.



Cnidarians were the first animals to exploit a body design based primarily on two-dimensional sheets of epithelial tissue. Although they have a connective tissue, the mesoglea, its function is chiefly structural. Cells concerned with communication, movement, digestion, internal transport and reproduction are part of the epithelia, not the connective tissue.

Mesoglea is enclosed by epithelia and can be extracellular compartments physiologically tuned for distinct functions. Therefore, mesoglea is multifunctional compartments. The mesoglea has a skeletal function, may be important in buoyancy, and may provide a stable or nutritive milieu for the proper operation of muscles and nerves. as well as the growth of germ cells.

### Form of colonial

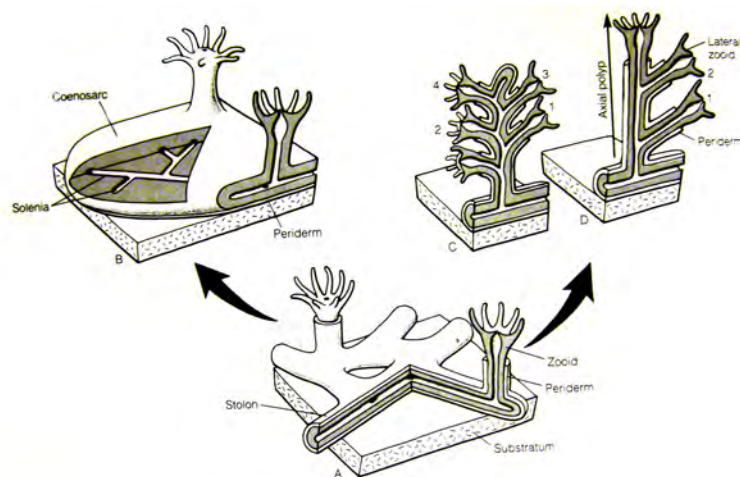
Many cnidarian species adopt a colonial growth form and live in colonies made up of large numbers of individuals joined together in some way. These individuals, called zooids, can either be directly connected by tissues or share a common exoskeleton made from chiton or calcium carbonate.

Colonial growth forms can be divided to three themes:

**A stolonate colony:** like a strawberry runner, consists of a prostrate stolon - a tubular body wall outgrowth from which zooids bud at intervals along its length. The stolon is enclosed by periderm.

**Coenosarc colony:** colony of several taxa consist of zooids that arise from the surface of a continuous sheet of tissue.

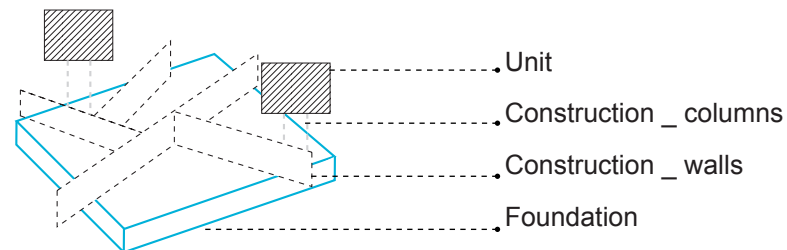
**Fruticose colony:** more complex colony that may be grassy, bushy, shrubby or feathery in appearance, because the zooidal budding produces an upright, plant like form.



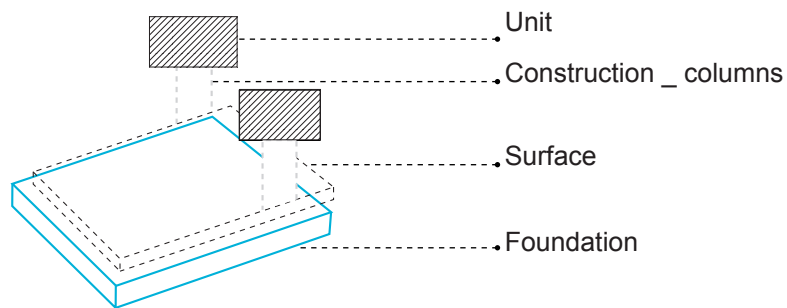
Colonial body forms.  
 A - Stolonate colony  
 B - Coenosarc colony  
 C, D - Fruticose colony  
 (Ruppert, E.E., 2004, Invertebrate Zoology: A Functional Approach 7th ed.)

### Colonial forms analyze - architecture

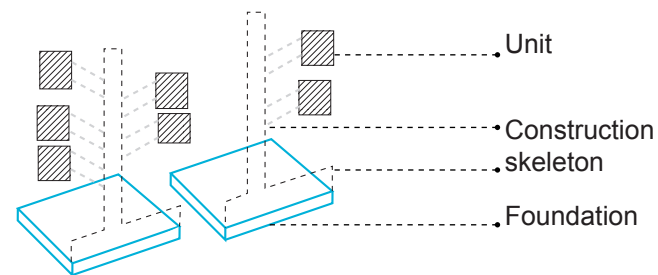
**A stolonate colony:**



**Coenosarc colony:**



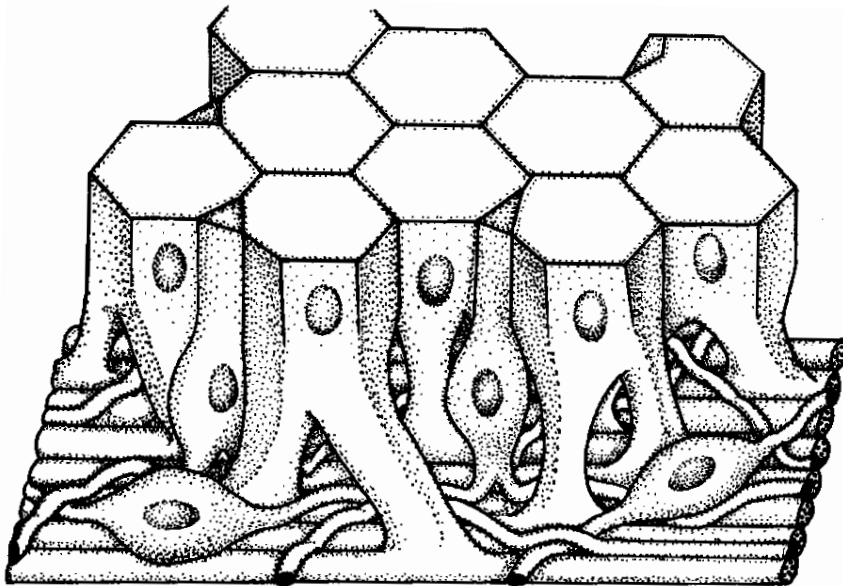
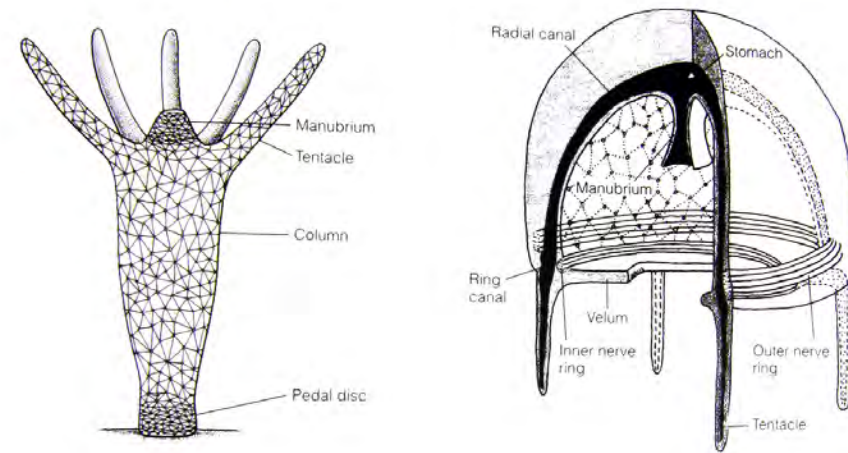
**Fruticose colony:**



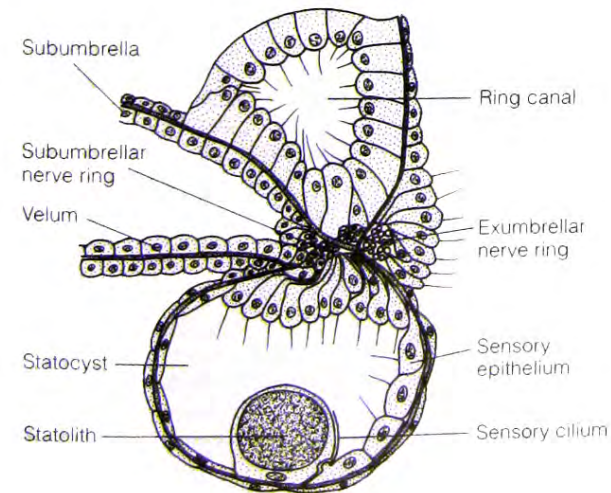
## Nervous system

The cnidarian nervous system consists of superficial sensory neurons that monitor the environment, motorneurons that activate effectors and interneurons that join the sensory receptors to the motorneurons. In cnidarians, sensory neurons are usually bipolar, having a receptive dendrite at one end and a transmitting axon at the other.

In cnidaria, interconnected neurons form a pair of complex, two-dimensional nerve nets. One net lies in the base of the epidermis, and the other one in the base of the gastrodermis. The two nets are joined by neurons that bridge the mesoglea. Each nerve net resembles a map of city streets, the nervous impulses can travel in any direction through the net, because the synapses of some neurons conduct in both directions like two-way streets. If they conduct in one direction only, they are paralleled by opposing one-way streets.



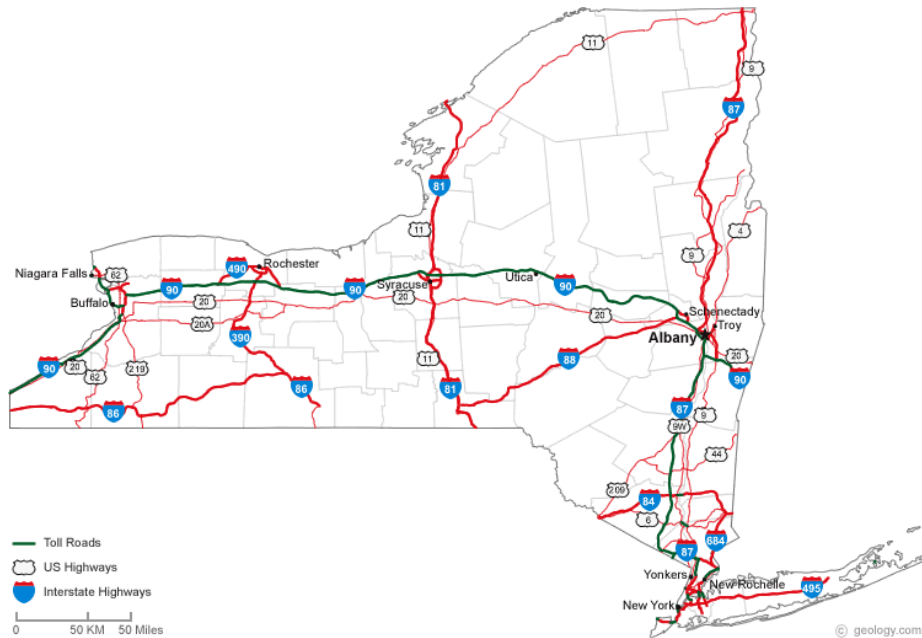
Epithelial layer of a cnidarian showing the epitheliomuscular cells with the myonemes. (source: <http://biodidac.bio.uottawa.ca/thumbnails/filedet.htm>)



1. Nerve net of a polyp
  2. Nervous system of medusa
  3. Statocyst on the bell margin of hydromedusa
- (Ruppert, E.E., 2004, Invertebrate Zoology: A Functional Approach 7th ed.)

**Conclusion**

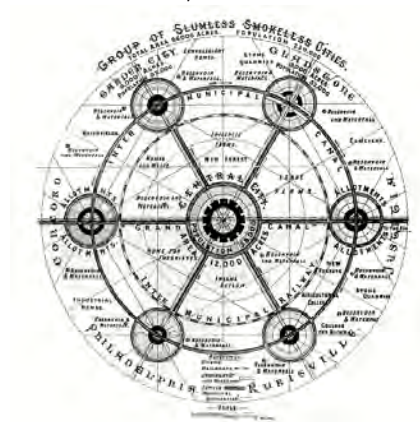
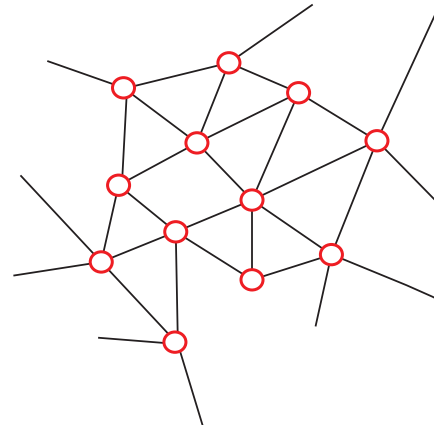
The cnidarian nervous system, the nerve nets resembles a map of a city streets. Analyze the nervous impulses, create a travel like a drawing of a city lines.



City could grow and become part of an integrated network like the idea of Garden Cies. The off-shoot city would grow organically, a ward at a time. Eventually a central city would be surrounded by a number of smaller off-shoot cities, conected by railroad and canal infrastructure.

New york roads map  
(surce: <http://geology.com/state-map/new-york.shtml>)

The nervous system as a parcellation of the City. Net of nodes, connected with a roads, each road start and ends at the node center. If we look on a city, this is a way for distribution and urban development. In this city growth model, unlike the Garden city, there is no central point, and the growth can be organically to any direction, influenced by environmental conditions.



City Growth Model  
(surce: <http://lukebutcher.blogspot.co.il/2010/11/book-review-garden-cities-of-to-morrow.html>)

## Anthozoa

Anthozoa is the scientific name of corals. The “flower animals” includes many species and they are the largest cnidarian taxon. Anthozoa is the largest cnidarian taxon, polyps only, and the body volume is variable.

Anthozoa is divided into two main groups which are externally distinguished by the number and form of a polyp's tentacles.

**Zoantharia:** includes 4000 species of sea anemones, stony corals, coral anemones and black or thorny corals. Zoantharians have a hexamerous plan (of six or multiples of six) or polymerous symmetry and have simple tubular tentacles arranged in one or more circlets on the oral disc.

**Alcyonaria:** includes the colorful sea plumes, fans, pens and pansies as well as organ-pipe coral, red coral, blue coral and soft corals. Alcyonarians are octomerous (built on a plan of eight) and always have eight tentacles arranged around the margin of the oral disc



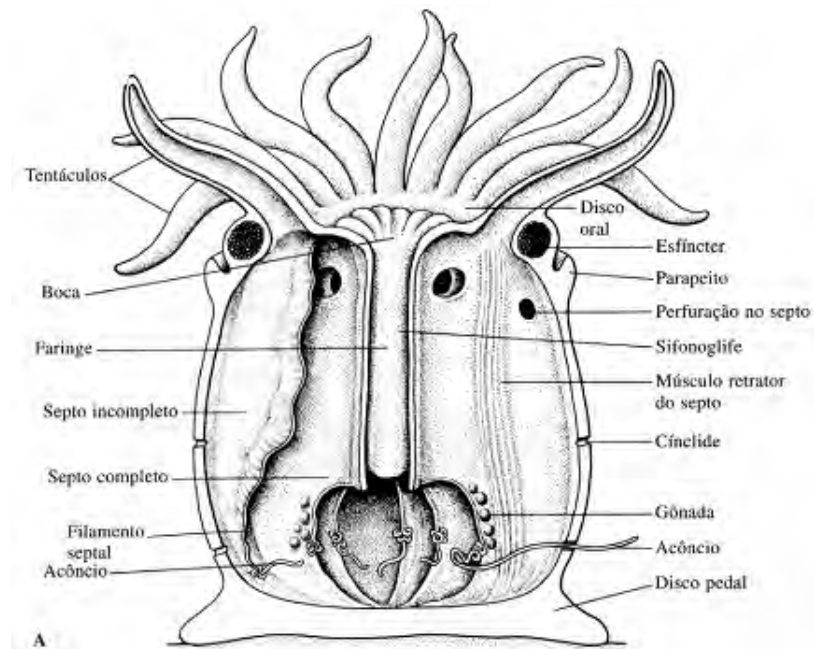
1. Zoantharia - *Anthopleura xanthogrammica*, *Urticina lofotensis*  
(source: [http://seanet.stanford.edu/Anthozoa/index.html#Anthopleura\\_xanthogrammica](http://seanet.stanford.edu/Anthozoa/index.html#Anthopleura_xanthogrammica))
2. Alcyonaria - *Alcyonium glomeratum*  
(source: [tolweb.org/Alcyonaria/17642](http://tolweb.org/Alcyonaria/17642))

## Polyp form

The body consists of a tubular column surmounted by a wide plateau' which is named the oral disc. In the center of the oral disc there is an oval mouth, the mouth surrounded by a whorl of tentacles on its margin. The mouth leads into a pharynx that opens into the actual body. The compressed pharynx and the ciliated grooves called siphonoglyphs, confer symmetry on the anthozoan body.

The coelenteron is divided by vertical partitions called septa, each septum is an out fold layer.

In Zoantharia, the septa are not only coupled, they are also paired. The muscular arrangement varies among the different groups, but usually features circular muscles in the body wall and longitudinal and transverse muscles in the septa.



<http://www.google.com/imgres?um=1&hl=en&client=firefox-a&sa=N&rls=org.mozilla:he:official&biw=1366&bih=612&tbn=isch&tbnid=XxKPjknBEeiJrM:&imgrefurl=http://www.marlin.ac.uk/>

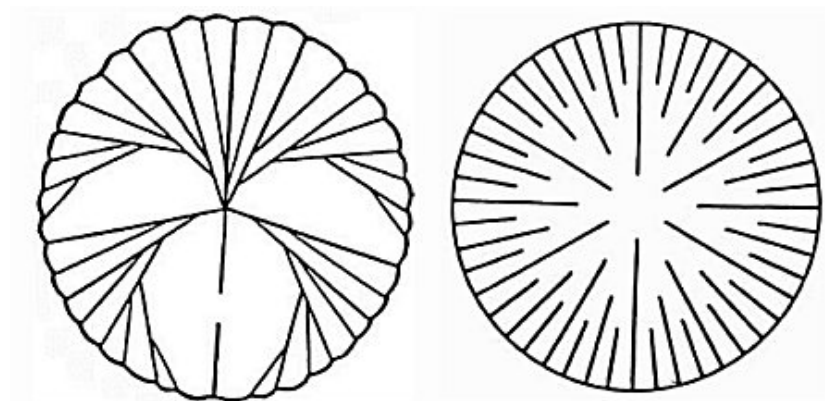


## Analyze anthozoa form

### Zoantharia

This is a small solitary Zoantharian which lives embedded in sand. Its body is divisible into three portions, an upper capitulum bearing the mouth and tentacles, a median scapus covered by a friable cuticle, and a terminal physa which is rounded.

Zoantharian symmetry usually is hexamerous- the septa occurring in multiples of six. Septa typically are not single but instead set in doubles called pairs. As the polyp increases in size, a second round of six paired septa added along with an additional 12 tentacles.



Septal arrangements in zoantharians corals: left, serial; right, cyclic.  
(source: <http://tolweb.org/zoantharia>)

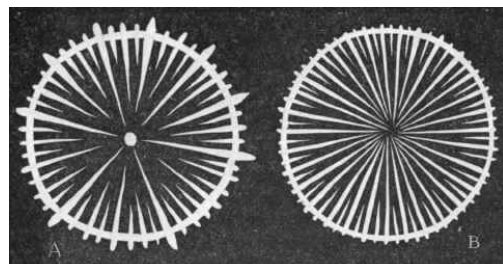


Diagram of the arrangement of the septa  
(source: <http://chestofbooks.com/animals/Manual-Of-Zoology/Family-III-Zoanthidae>)



Anthozoa, Subclass Zoantharia, Order Zoanthidea  
(source: <http://www.marinelifeuk.com/caring-for-zoanthids.html>)

A group of cnidarians known as the Zoantharia, take on numerous different forms and colors. Some live as individual polyps while others form large colonies. Zoantharians are represented by colonial and solitary species. Most Zoantharia species have tentacles that are arranged in two rows.



Button polyp corals  
(source: [http://animals.about.com/od/cnidarians/ss/cnidarianpictures\\_5.htm](http://animals.about.com/od/cnidarians/ss/cnidarianpictures_5.htm))

**Alcyonaria - Octocorallia**

As a group, the colonial alcyonarians have widely diverse growth forms, but they have similar polyps.

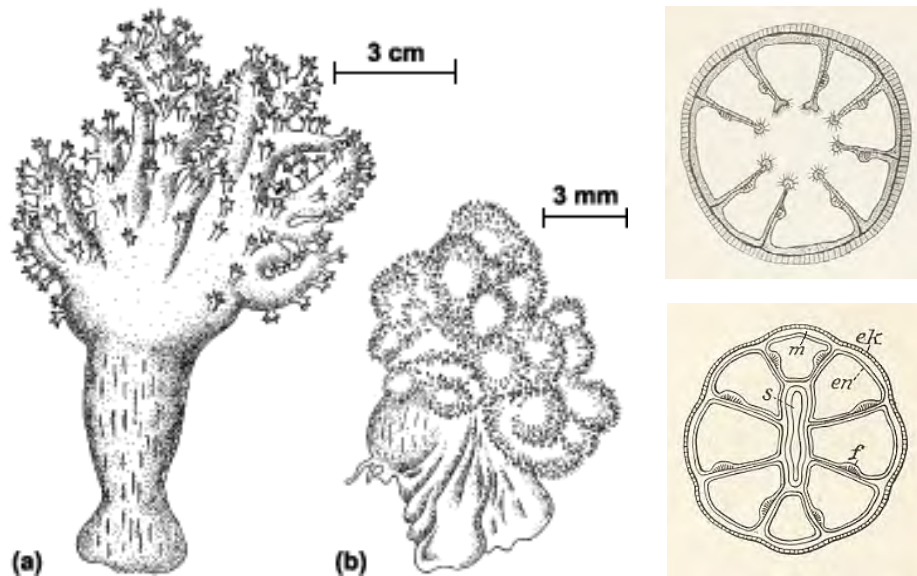
Octocorals have eightfold radial symmetry, as in all anthozoans, the adult form is a polyp—a cylindrical organism that has, at its free end, the single body opening, the mouth, which is surrounded by eight tentacles.

Alcyonacea, the soft corals, are littoral anthozoans, which form massive or dendriform colonies with yellowish, brown, or olive colors. Most attach to some solid substratum, however, some remain free in sandy or muddy places.

The only skeletal structures are small, elongated, spindle-shaped or rod-like, warty sclerites which are scattered over the mesoglea. The colony is supple and leathery.



Octocorals - Octocorallia - Achtstrahlige Koralle  
(source: <http://www.starfish.ch/c-invertebrates/octocorallia.html>)



1. Alcyonaceans  
2. Arrangement of septa in Octocorallia, Transverse section through an octocorallium  
(source: <http://www.answers.com/topic/alcyonacea> , [www.metafysica.nl/turing/octactinota.html](http://www.metafysica.nl/turing/octactinota.html))

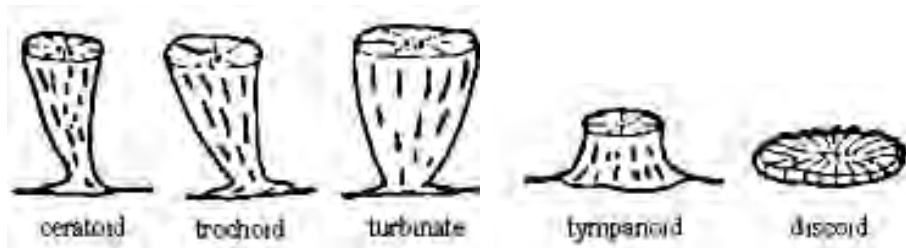


Octocorallia of Bonaire - white telesto  
(source: <http://www.cryptosula.nl/soorten/Carijoariisei.html>)

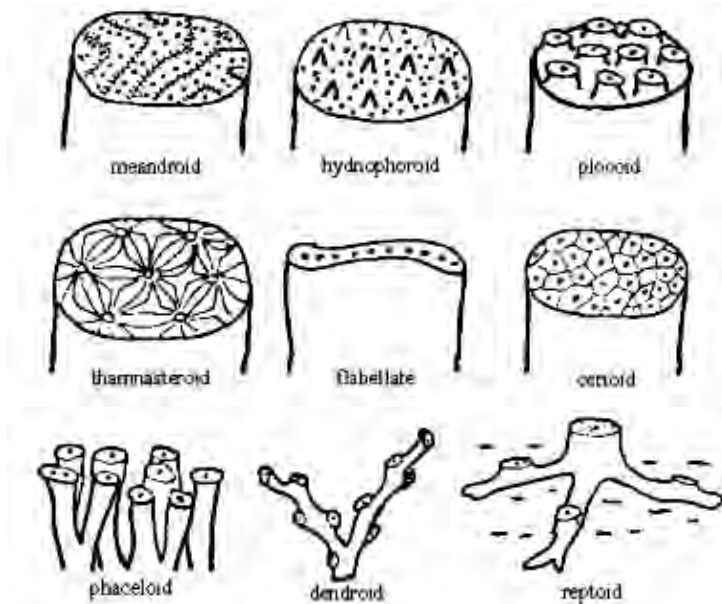
**Conclusion**

**Anatomy and morphology**

**Solitary forms**

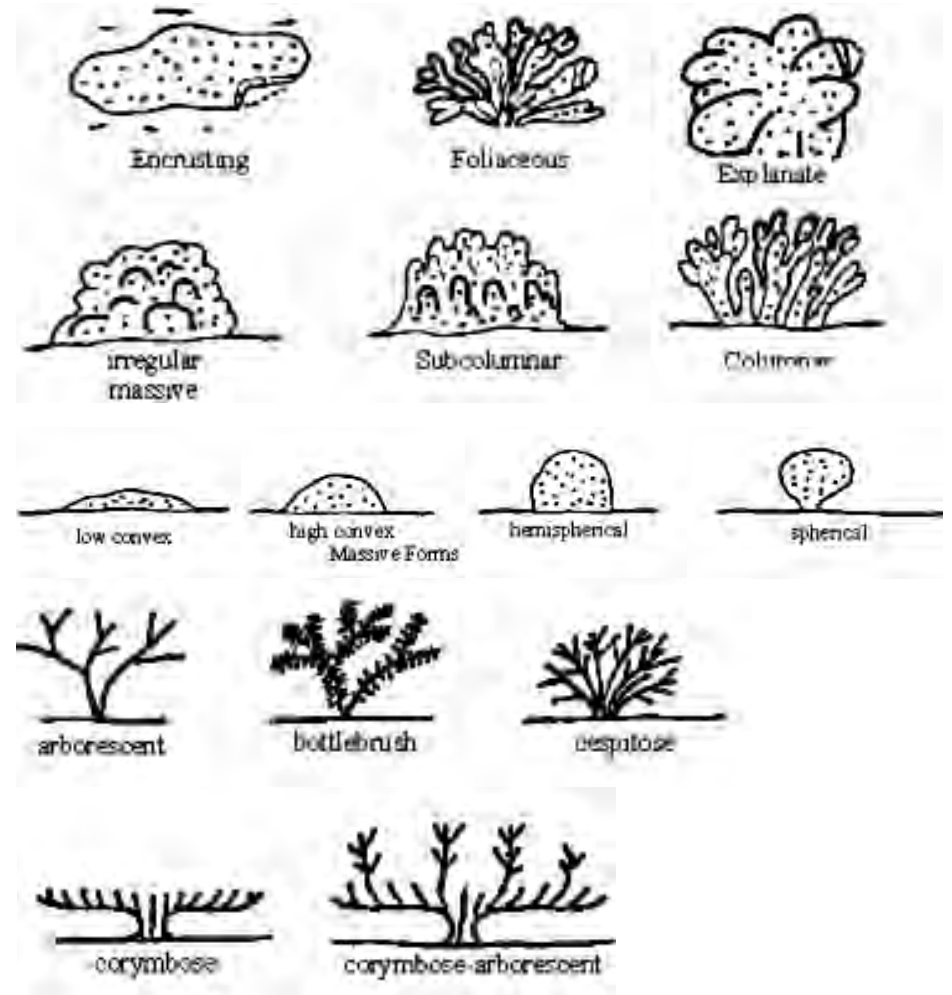


**Modes of colony formation**



Anatomy and morphology of corals  
 (source: <http://www.guammarinelab.com/coral/textfig-a.html>)

**Gross morphology**



**Conclusion**

**Anatomy and morphology**

Comparison between the structure of an urban building to a corals form.



Coral structure - city form  
(surce: Bnaya baur resarch, Comparative morphology study, technion)

The coral's colony structure can be compar with an urban building.



Coral structure - city building  
(surce: Bnaya baur resarch, Comparative morphology study, technion)

**Air flow**

Variety of growth forms - body structure effect on the air flow system.



Coral growth forms  
(surce:Bnaya baur resarch, Comparative morphology study, technion)

Coral growth forms  
(surce:Bnaya baur resarch, Comparative morphology study, technion)

### Structure features

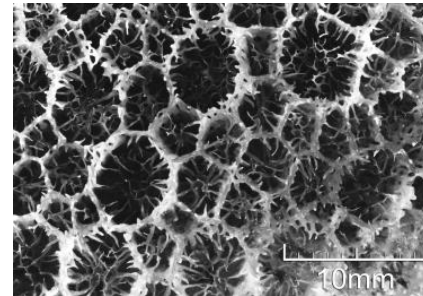
The structure features of the coral can be divided to three main group. This distribution as an effect on the air flow, this way of distribution teaching as about the structure of cities and air quality.

In a study in graduate studies at the Technion, tested the three forms, by mathematical calculations, to compare the quality of the air flow.

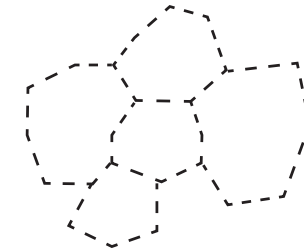
1. Porous
2. Warped
3. Equal diameter

Another observation is an examination of the building within a building, how the distribution and internal structure affects airflow or organization system. Thus three features as an influence on the morphology and arrangement of architectural program.

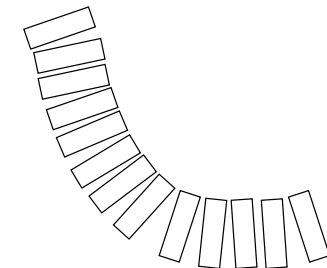
Each features reflects a different scale, the internal division, the arrangement of multiple objects and their size reference.



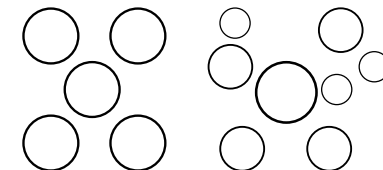
Internal division / program



Stationing



Sizes



1. Alveopora gigas. Skeleton. Great Barrier Reef, Australia
  2. Structure of coral found on Baracoa beach
  3. Coral tentacles
- (source: <http://www.e-cigarette-forum.com/forum/modding-forum.html>, <http://www.shutterstock.com/pic.html>, <http://tidechaser.blogspot.co.il/2008/03/exploring-semakau-with-duke-university.html>)

## Biomimicry

Biomimicry or biomimetics is the examination of nature, its models, systems, processes, and elements to emulate or take inspiration from in order to solve human problems. The term biomimicry and biomimetics come from the Greek words bios, meaning life, and mimesis, meaning to imitate. Other terms often used are bionics, bio-inspiration, and biognosis.

The term biomimicry appeared as early as 1982, the scientist and author Janine Benyus in her 1997 book *Biomimicry: Innovation Inspired by Nature*, is defined biomimicry “new science that studies nature’s models and then imitates or takes inspiration from these designs and processes to solve human problems”.

The architectural profession is rapidly embracing digital design technologies developed and applied in the framework of biologically inspired processes. The nature is the largest laboratory that ever existed and biomimicry may provide design methodologies and techniques to optimize engineering products and systems.



Gecko feet  
(source: <http://www.designboom.com/contemporary/biomimicry.html>)

A chair whose design is modeled on the cellular formation of human bone.



**Mathias Bengtsson** had the idea of creating a chair based on the cellular structure of bone tissue. The result of his intensive work is the 'Cellular chair' that not only is very funky in appearance, but also interesting from a technical point of view.

Cellular chair  
(source: <http://createyourcosmos.blogspot.co.il/2011/03/cellular-chair.html>)

## Biomimicry in architecture

### nonLin/Lin Pavilion

Project part of the permanent collection of the FRAC Centre, Orleans.

Design: MARC FORNES & THEVERYMANY, 2011

nonLin/Lin Pavilion – is a prototype which engages in a series of architectural experiments referred to as text based morphologies. Beyond its visual perception of sculptural and formal qualities, the prototypes are built forms developed through custom computational protocols.



(source: <http://www.dezeen.com/2011/08/02/nonlinlin-pavilion-by-marc-fornestheverymany/>)

The cohesive morphology of the pavilion originates from a “Y” model referred to as the basic representation and lowest level of multi-directionality. In order to resolve such an issue, it is required to address morphological models of change and introduce split or recombination – or in other words, how can one become two and two become one.

Custom computational protocols are describing the structure of the pavilion as a set of linear developable elements. Those singular elements can then be unrolled and cut out of flat sheets of material.



(source: <http://www.dezeen.com/2011/08/02/nonlinlin-pavilion-by-marc-fornestheverymany/>)





(source: <http://www.dezeen.com/2011/08/02/nonlinlin-pavilion-by-marc-fornestheverymany/>)

The project is conceived as a resultant product of a very explicit research line, investigating the design and build component of a coherent environment. It is considered to be self-supporting and to affect its participants, while engaging basic notions of limitation, filtration, and spatial depth. The structure is forming a eccentric universe where familiar elements such as openings or dimensional measurements turn out of model or scale. This visual phenomenon is allowing spectators to suspend disbelief while assigning cultural references or analogies from nature - corals, flowers



(source: <http://www.dezeen.com/2011/08/02/nonlinlin-pavilion-by-marc-fornestheverymany/>)

**Size and production**

- 10+ m long, 6m large, 4.5m high ( 30' \* 18' \*15' )
- 269,991 square inches (1875 square feet) Surface Area
- 155 780 holes (CNC drilled)
- 9 325 texts (CNC engraved)
- 6 367 stripes (CNC cut)
- 570 single components (CNC cut)
- 75 000 white aluminum rivets
- 145 sheets 4\*8 (2/2.5 hours machining)
- 40 modules pre-assembled
- 4 weeks pre-assembly



Production  
 (source: <http://theverymany.com/constructs/10-frac-centre/>)



Production  
 (source: <http://theverymany.com/constructs/10-frac-centre/>)

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<http://www.dezeen.com/2011/08/02/nonlinlin-pavilion-by-marc-fornesthevery-many>

<http://theverymany.com/constructs/10-frac-centre>

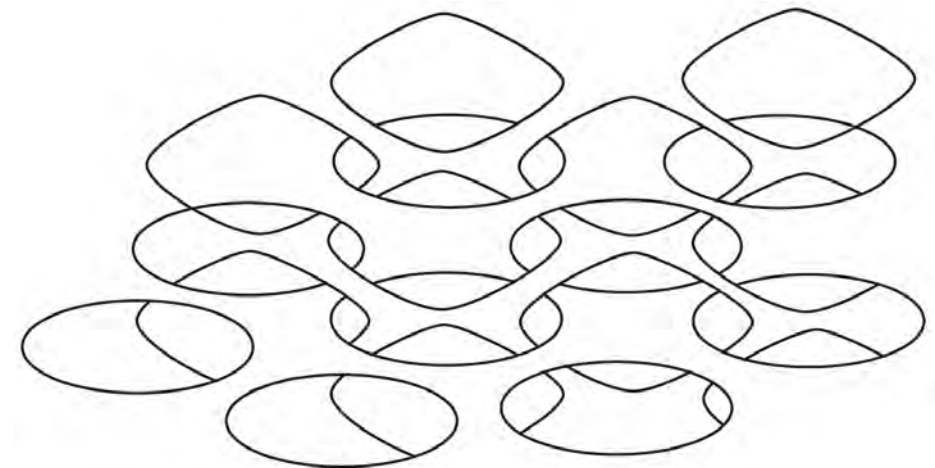
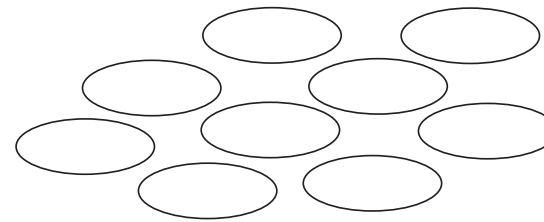
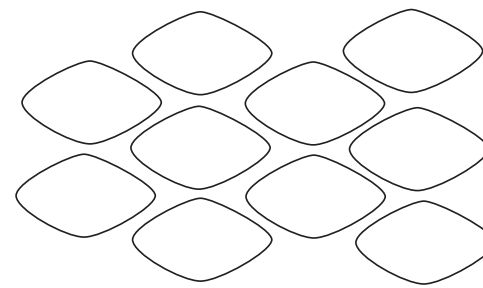
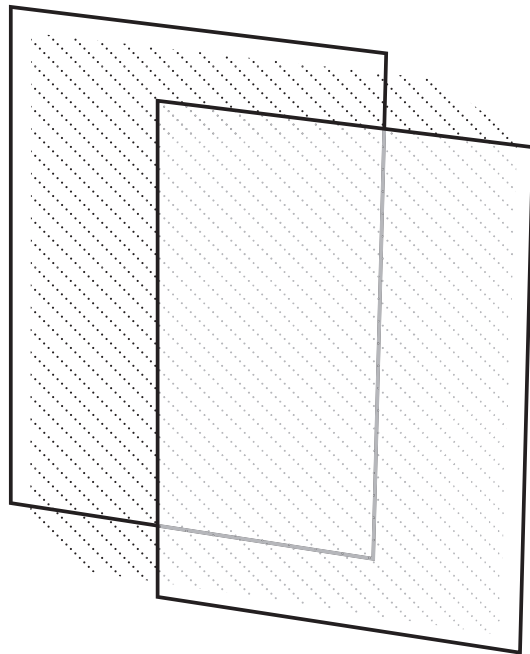
<http://www.morfae.com/1197-marc-fornes-theverymany>

### The concept

The initial planning first step was to think about several components, Principles of the cell concept:

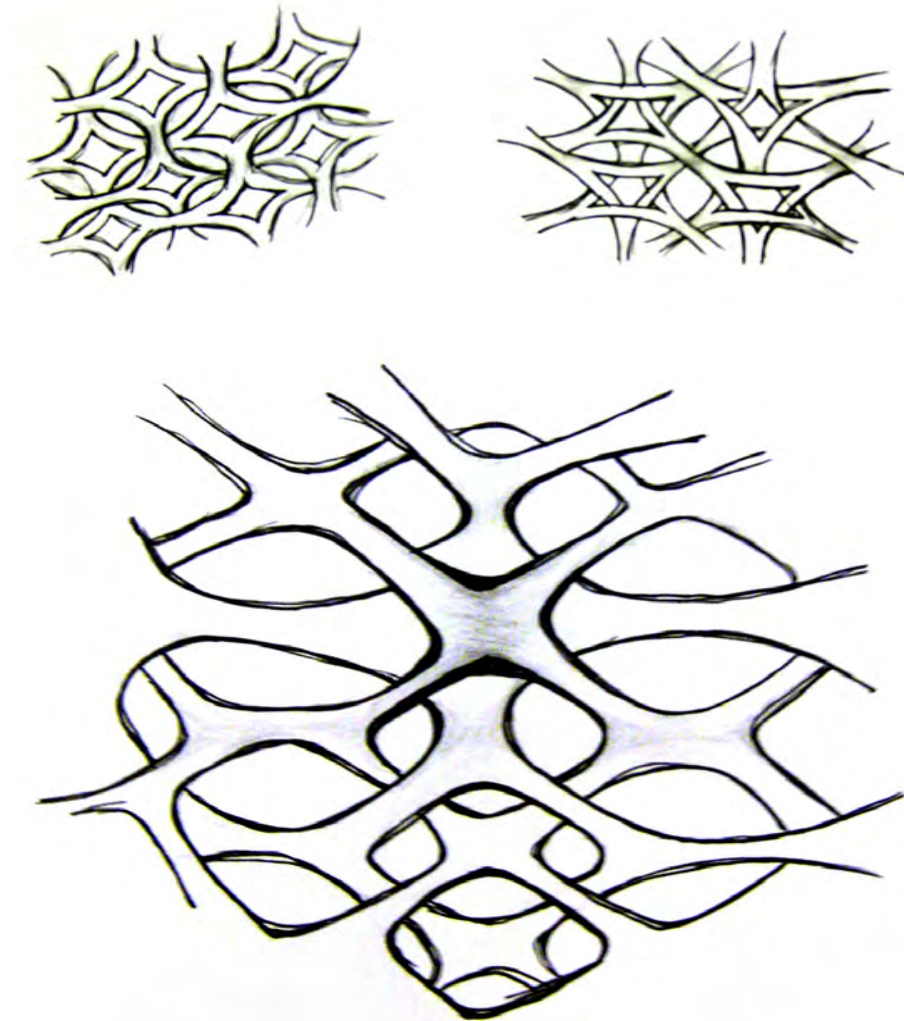
- Creation of two layers
- Increasing the surface area
- Variability / flexibility of form
- Fabric Structure - Principle of a lengthwise and crosswise grid

The Double-skin facade is a system of building consisting of two skins placed in such a way that air flows in the intermediate cavity. The ventilation of the cavity can be natural, fan supported or mechanical.



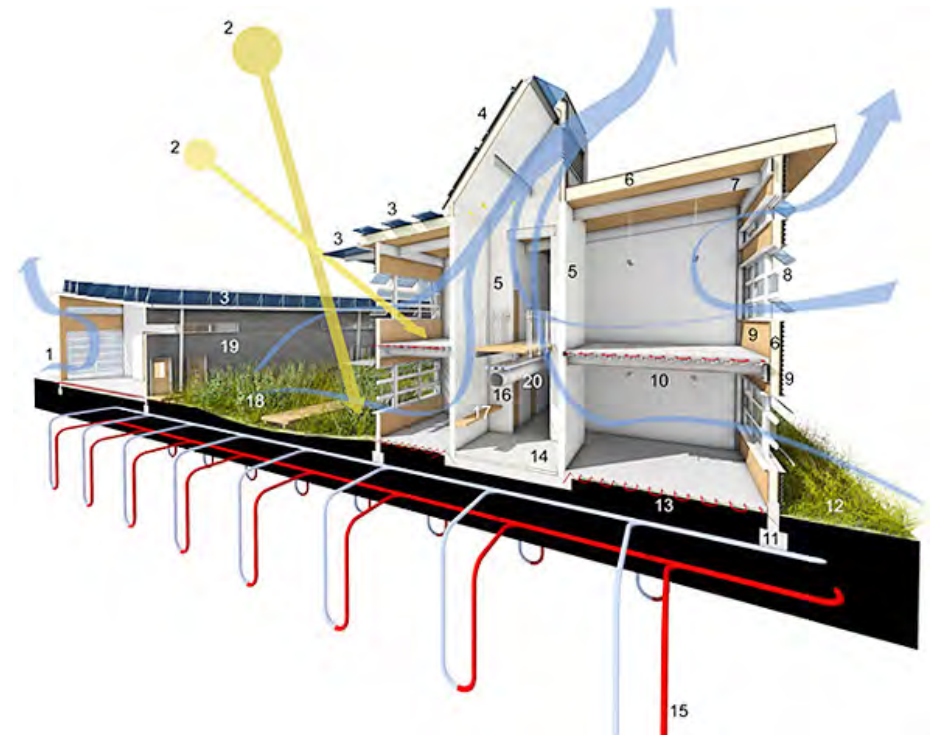
### The concept

Attempt to create double skin, there is some morphology experiences.



### Passive cooling principles

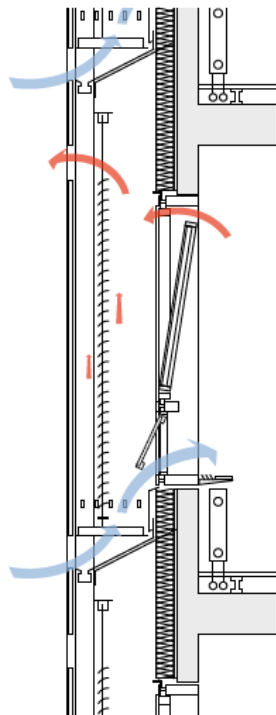
According to the principle, a double skin is suitable and can be effective for a passive cooling and natural ventilation.



Passive building cooling  
(source: <http://www.openideo.com/open>)

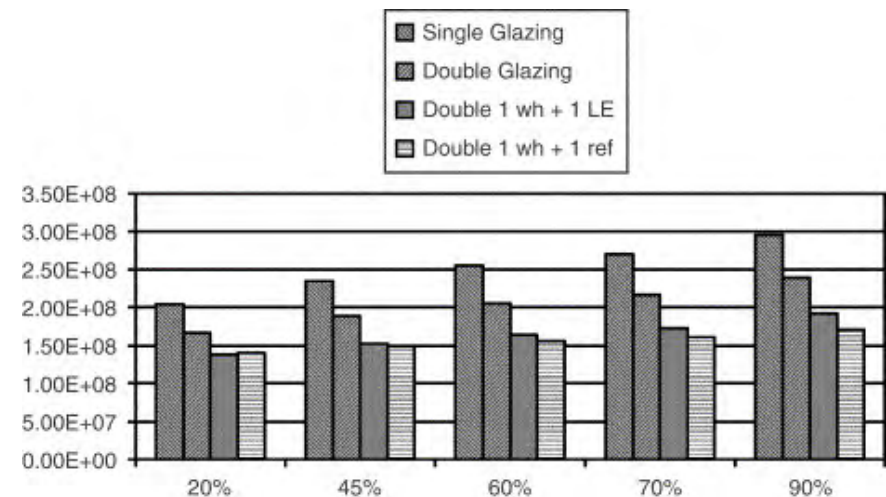
### Double skin facades

The double skin facades also called double ventilated facade consist generally of two glass facades separated by a cavity of a few centimetres to several meters in some cases. The natural ventilation effect created by the double skin is obtained by the air circulation within the wall, thanks to the phenomenon of thermal draft. The greenhouse effect in the front creates a temperature difference between the outside and the cavity or between the building and the cavity. It is possible to create this movement artificially through air extractors if the natural ventilation is not sufficient. The air circulation within the cavity will determine the ventilation and thermal behaviour of the double skin facade and therefore its influence on the building.



Detail of a glass double skin facade  
 (source: [http://www.no21.org/site/images/stories/Noe21/pdf/report\\_jps\\_2012RF.pdf](http://www.no21.org/site/images/stories/Noe21/pdf/report_jps_2012RF.pdf))

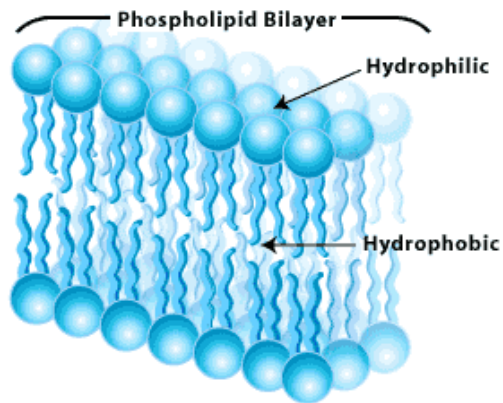
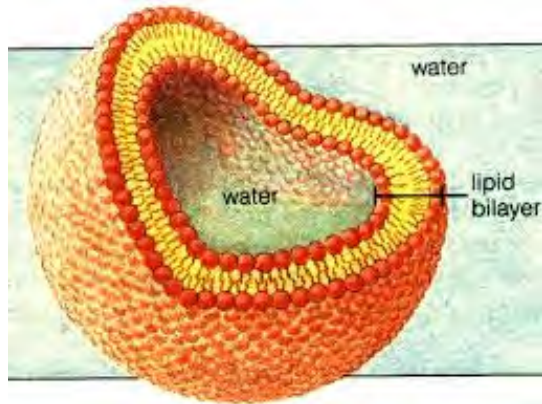
The results indicate that a double skin façade system with single clear glazing as the inner pane and double reflective glazing as the outer pane can provide an annual saving of around 26% in building cooling energy, as compared to a conventional single skin facade with single absorptive glazing. However, the long payback period of 81 years makes the double skin facade system economically infeasible. Support and motivation are needed from the local government in order to foster successful and widespread application of the double skin facade system in buildings.



Overall energy consumption  
 (source: <http://www.sciencedirect.com/science/article/pii/S0960148106000474>)

### Biological membrane

A biological membrane is an enclosing or separating membrane that acts as a selective barrier, within or around a cell. It consists of a lipid bilayer with embedded proteins that may constitute close to 50% of membrane content. The cellular membranes should not be confused with isolating tissues formed by layers of cells, such as mucous and basement membranes.



Phospholipid bilayer membrane  
(source: [aecbio11.wikia.com/wiki/1.2\\_Cell\\_Membrane\\_Structure](http://aecbio11.wikia.com/wiki/1.2_Cell_Membrane_Structure))

### Animels skin structure and texture



Snake skin  
(source: <http://www.materialsgate.de/en/mcard/64215/Snakeskin.html>)

## Minimal surfaces

Minimal surfaces are defined within the language of differential geometry as surfaces of zero mean curvature. This means they are equally convex and concave at all points and their form is therefore saddle-like, or hyperbolic.

They are called minimal because given a fixed boundary curve the area of a “minimal surface” is extremal with respect to other surfaces with the same boundary. A soap film minimizes its area under surface tension, so dipping a wire frame into soapy water produces a minimal surface geometry, as the following example illustrates.

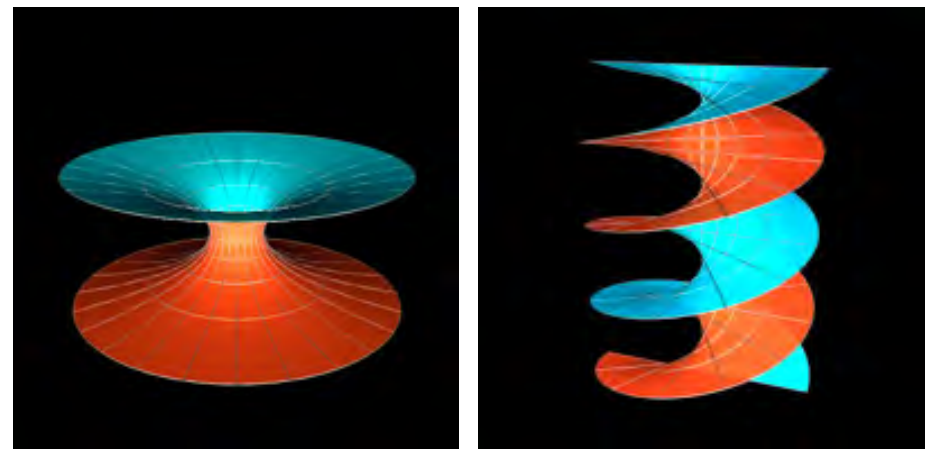
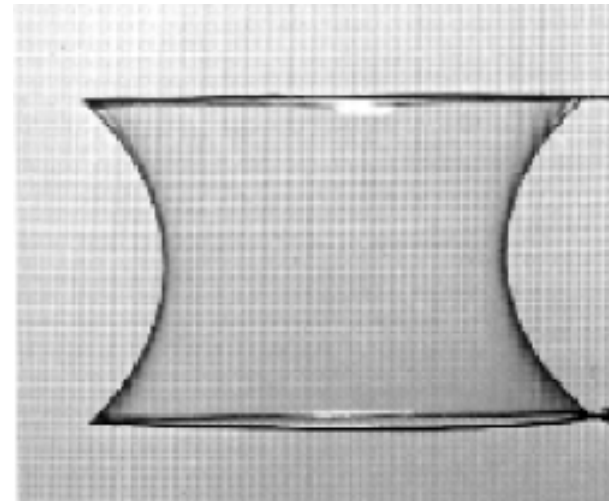
### Triply periodic minimal surface

Three-periodic minimal surfaces have three lattice vectors, i.e., they are invariant under translation along three independent directions. They are also called triply-periodic or infinite periodic minimal surfaces, abbreviated to TPMS and IPMS, respectively. Numerous examples are now known with cubic, tetragonal, rhombohedral, and orthorhombic symmetries. Monoclinic and triclinic examples are certain to exist, though difficult to parametrise. An interesting open question is the existence of “glassy” infinite genus minimal surfaces without any exact translational symmetry.

The symmetries of a TPMS allow the surface to be constructed from a single asymmetric surface patch, which extends to the entire surface under the action of the symmetry group. The most important local symmetries of minimal surfaces are euclidean reflections (in mirror planes) and two-fold rotations.

These symmetries are readily detected from the geometry of a minimal surface. Mirror planes result in plane lines of curvature on the surface (with the jargon of differential geometry this means the principal directions on the surface lie in a plane). Two-fold rotation axes lying in the surface are necessarily straight lines (linear asymptotes). These symmetries, and special properties of the Gauss map of minimal surfaces can be used to parametrise and exhaustively enumerate the simpler “regular” TPMS.

(source: [http://epinet.anu.edu.au/mathematics/minimal\\_surfaces](http://epinet.anu.edu.au/mathematics/minimal_surfaces))



1. Minimal surface soap film
2. Catenoid minimal surface, Helicoid minimal surface  
(source: [http://epinet.anu.edu.au/mathematics/minimal\\_surfaces](http://epinet.anu.edu.au/mathematics/minimal_surfaces))



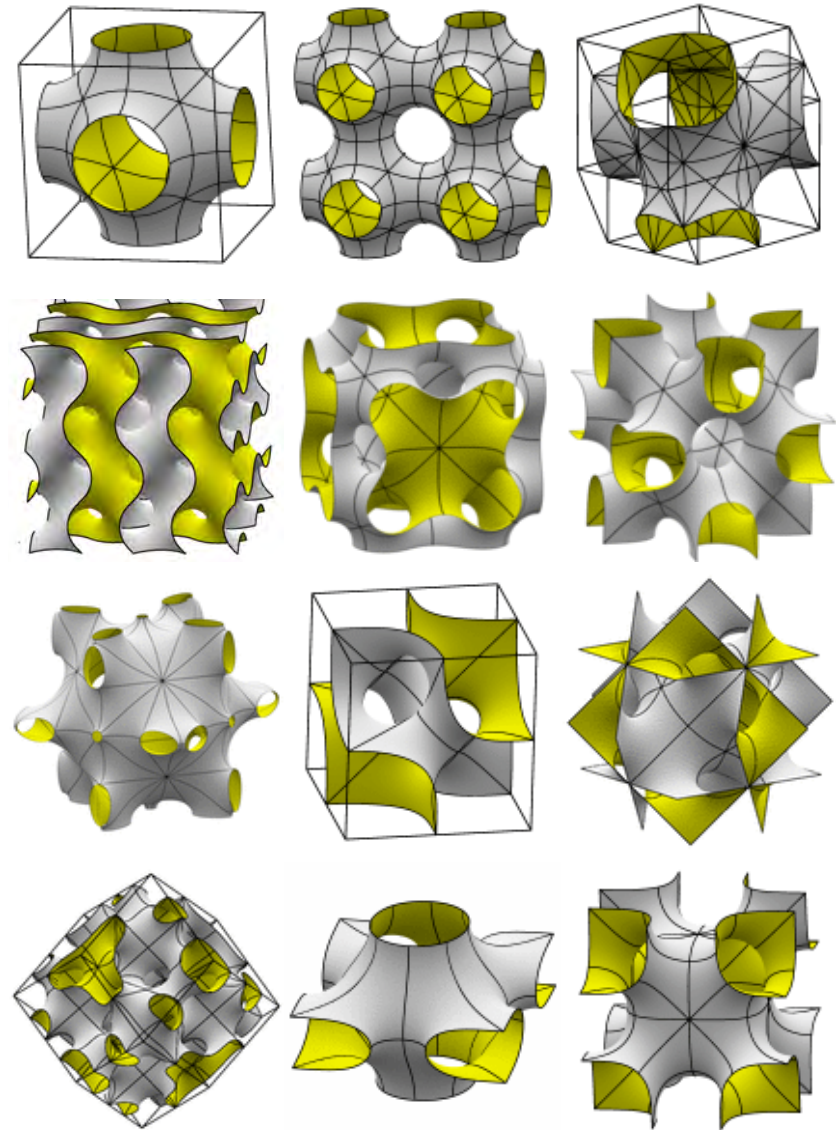
### *Triply periodic minimal surface - architecture*

One area of mathematics which has advanced dramatically since the advent of computers is the study of minimal surfaces = surfaces with zero mean curvature, as approximated by soap films. Images of these surfaces have naturally caught the attention of architects, and attempts to use them in the design of buildings go at least as far back as the 1970s.

When analyzing the properties of surfaces with minimal area it immediately turns out that smaller pieces of the surface also have minimal area with respect to their own smaller boundary. Minimal surface saddles are even more special: they look the same from both their sides.

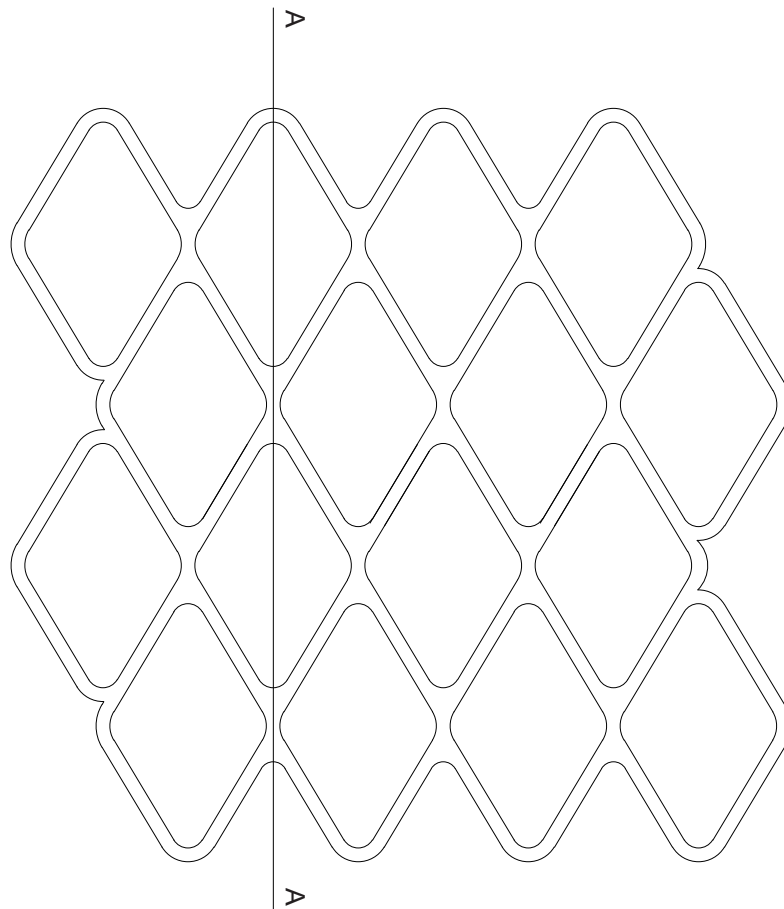


Triply Periodic Minimal Surfaces  
(source: <http://synth-e-techmorph.blogspot.co.il/triply-periodic-minimal-surfaces.html>)

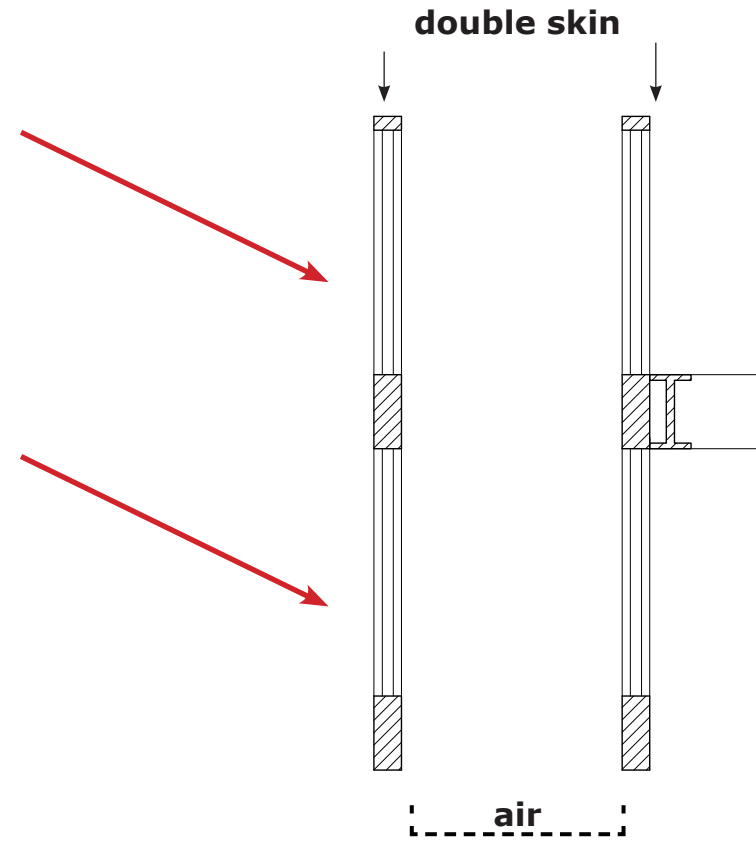


Triply Periodic Minimal Surfaces  
(source: <http://www.susqu.edu/brakke/evolver/examples/periodic/periodic.html#psurface>)

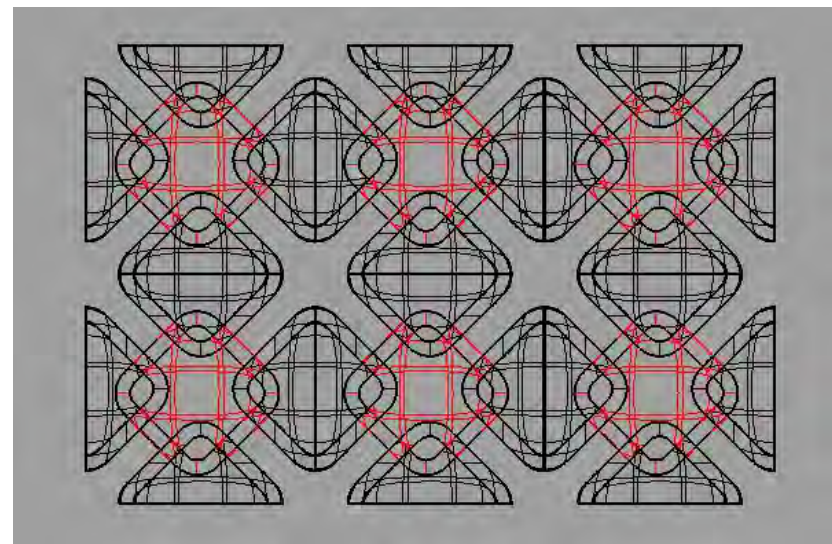
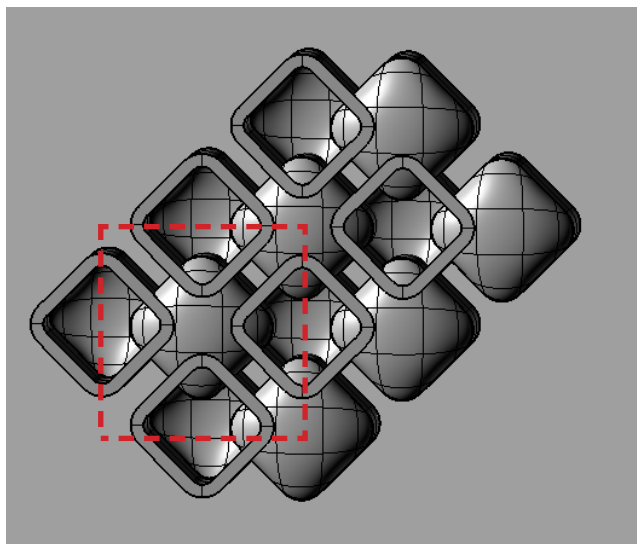
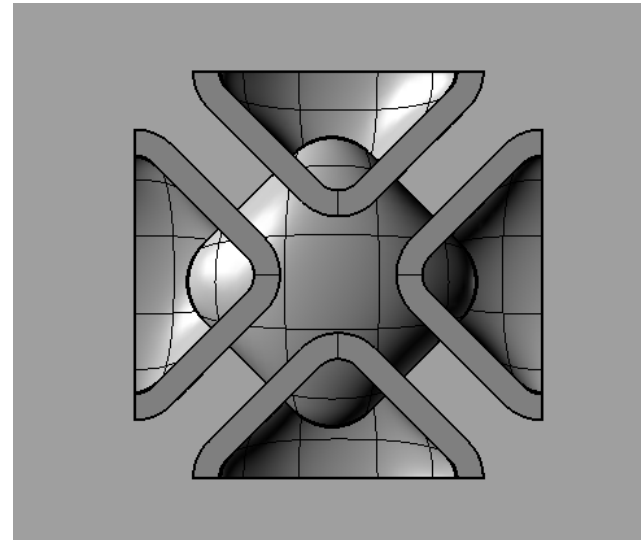
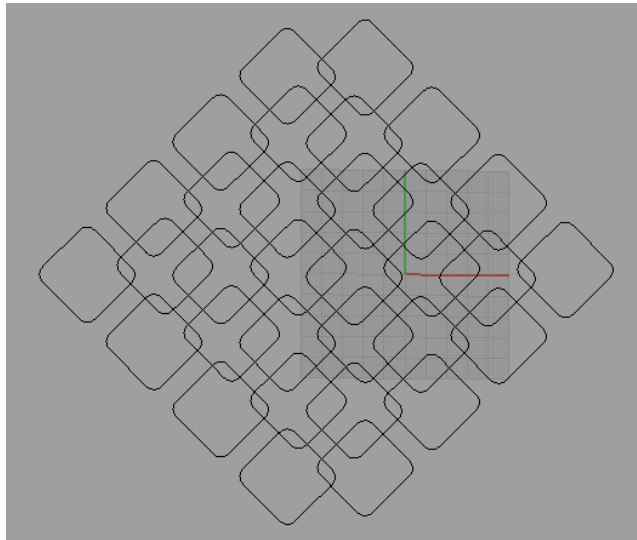
The cell design - detail



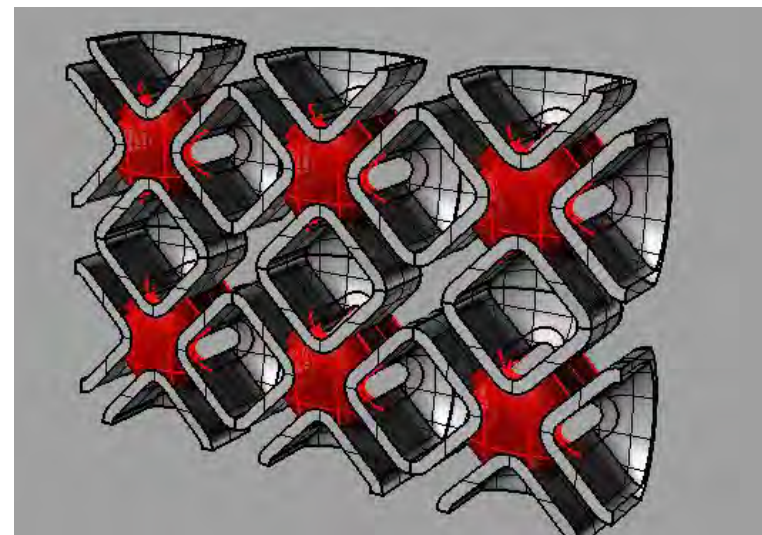
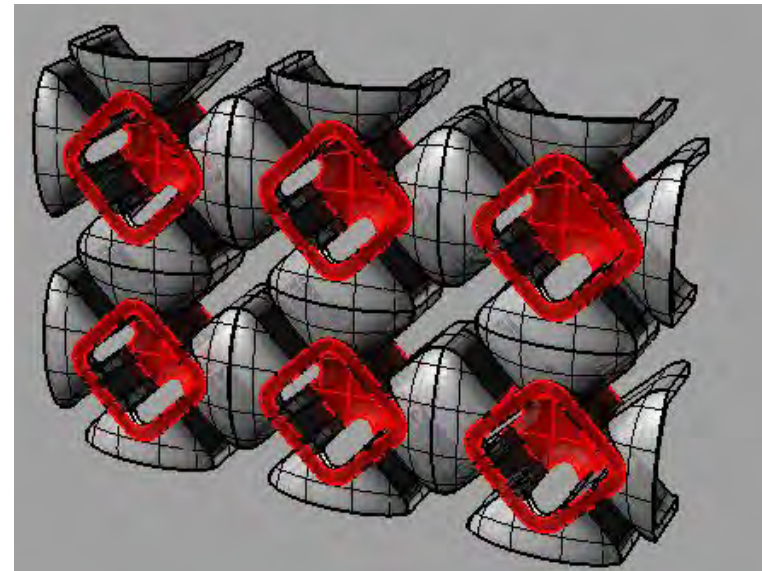
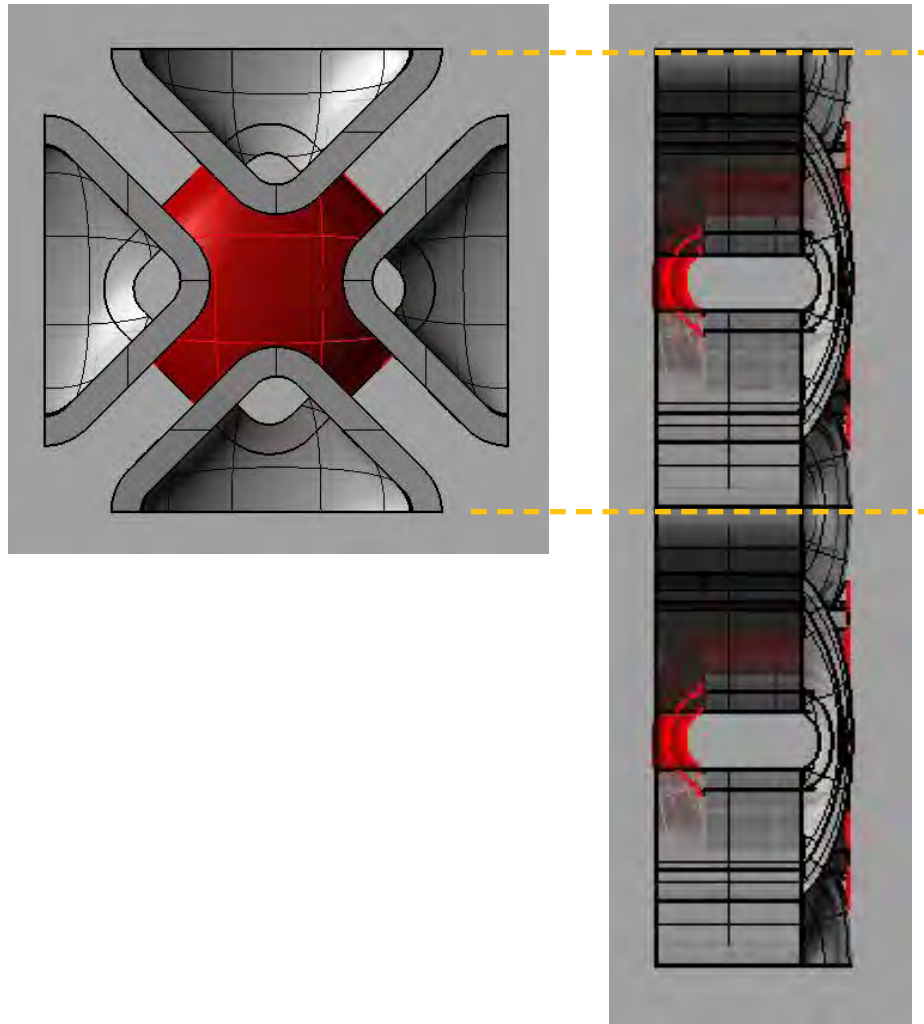
A-A section



*The cell design - facade*

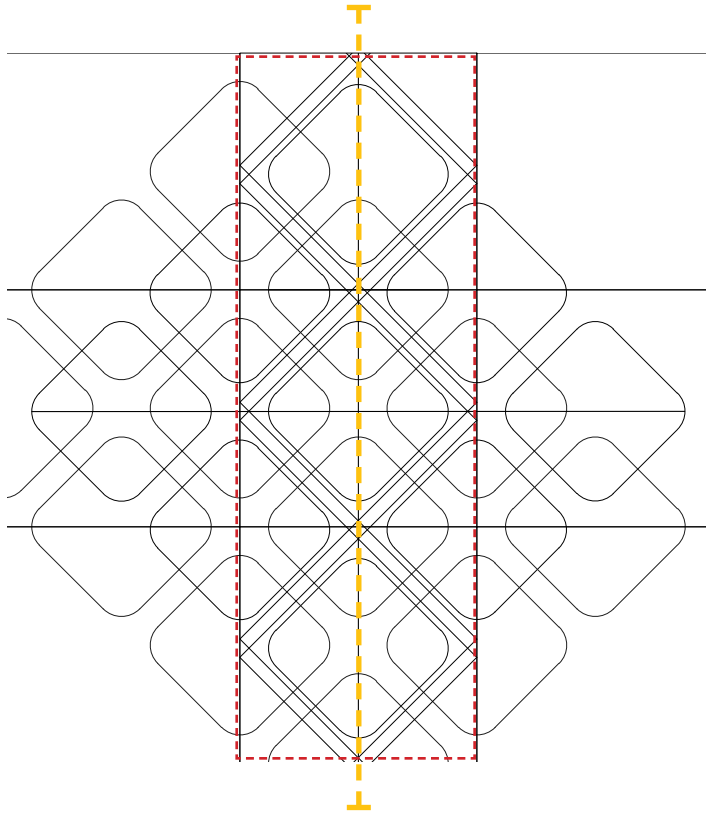


*The cell design - facade*

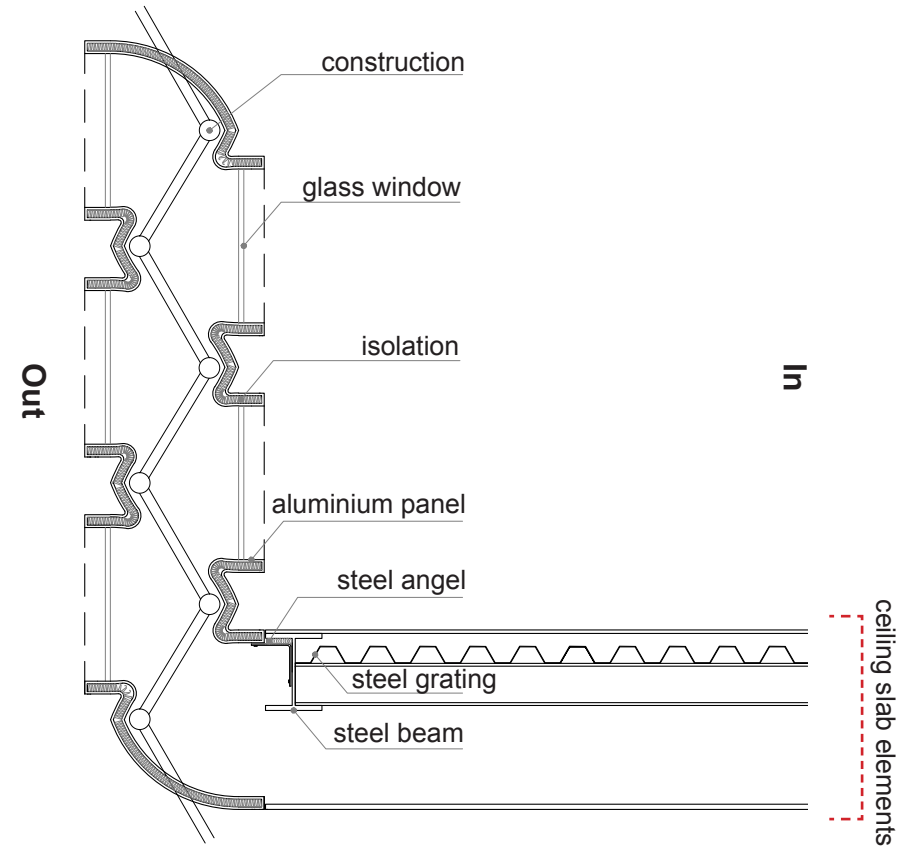


### The facade structural detail

Front



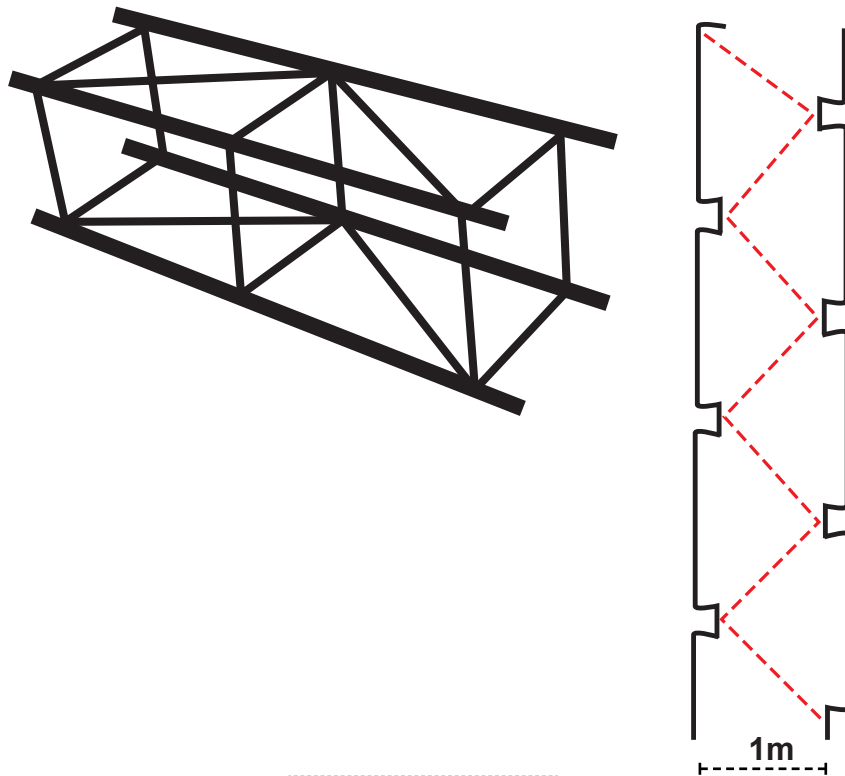
Section



**The facade structural detail**

A simulation demands for the facade structure:

1. Construction - a spatial truss structure, creating a construction facade that carried all the structure stress.

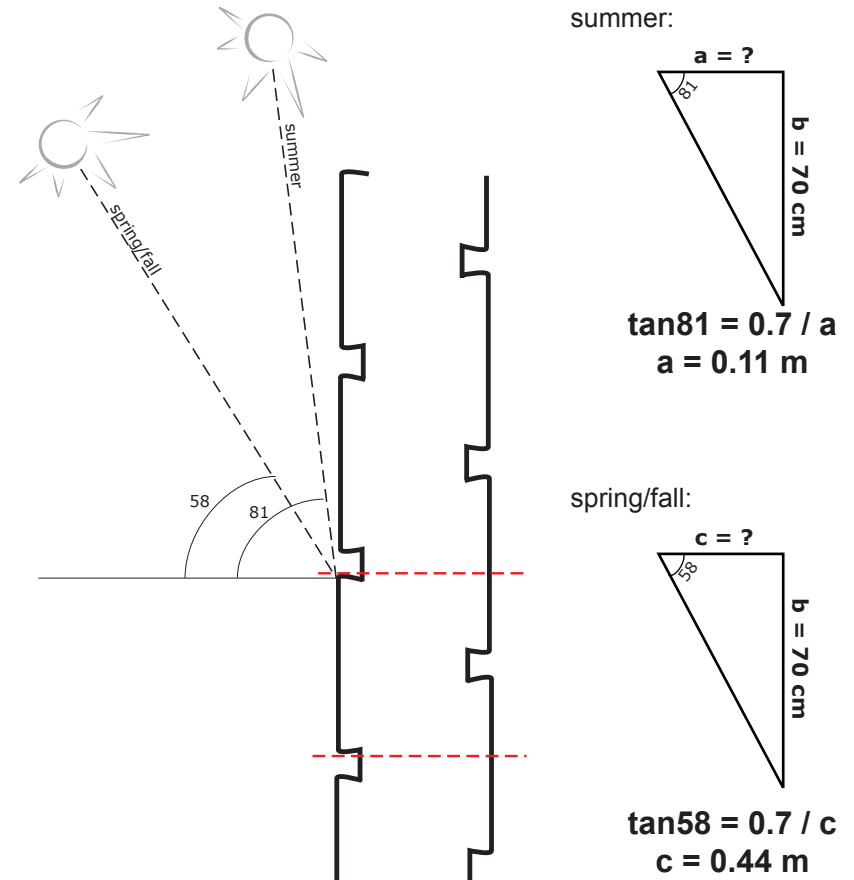


$$l / h = 20 - 40$$

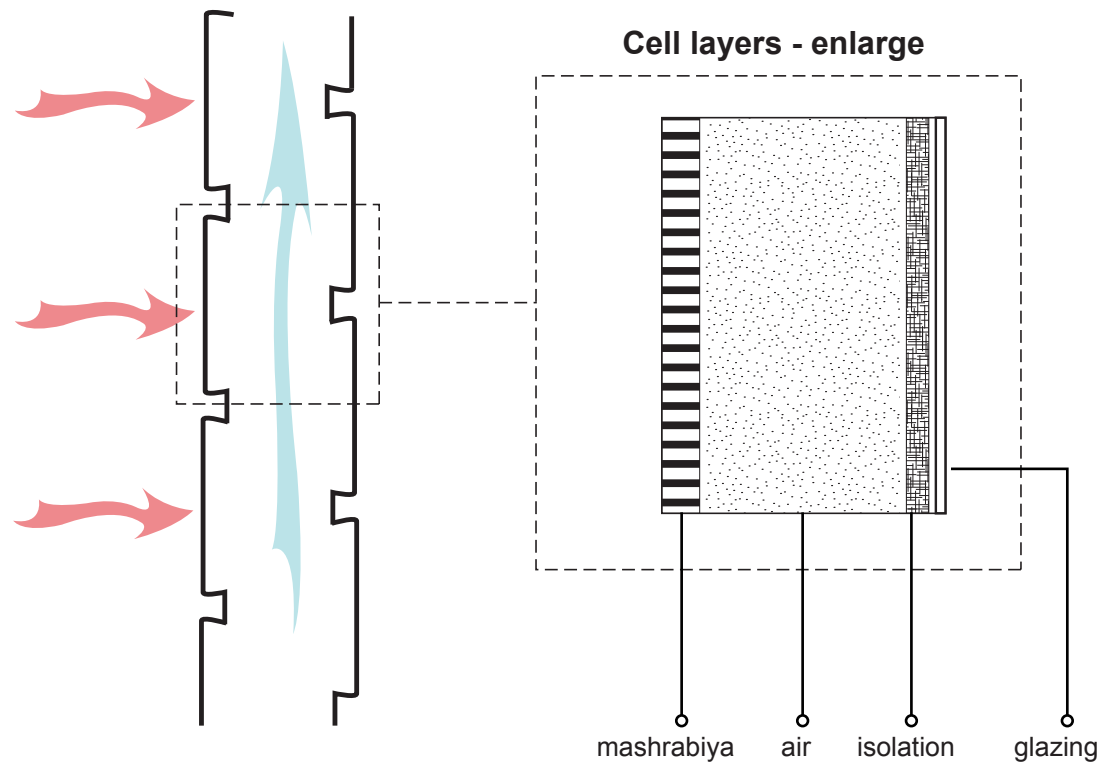
$$h = l/20 - l/40$$

$$l_{max} = 20 \longrightarrow h = 20/20 = 1m$$

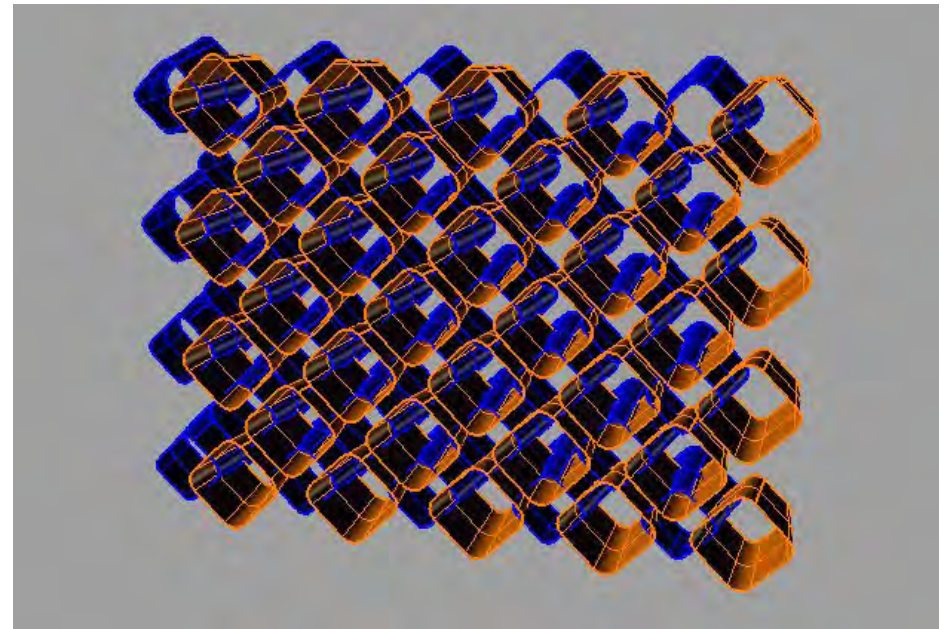
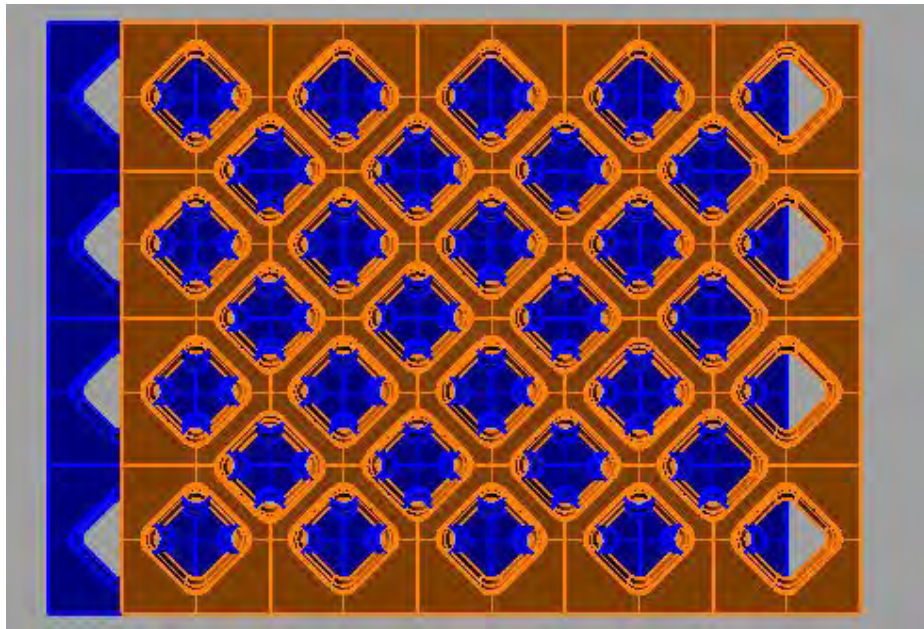
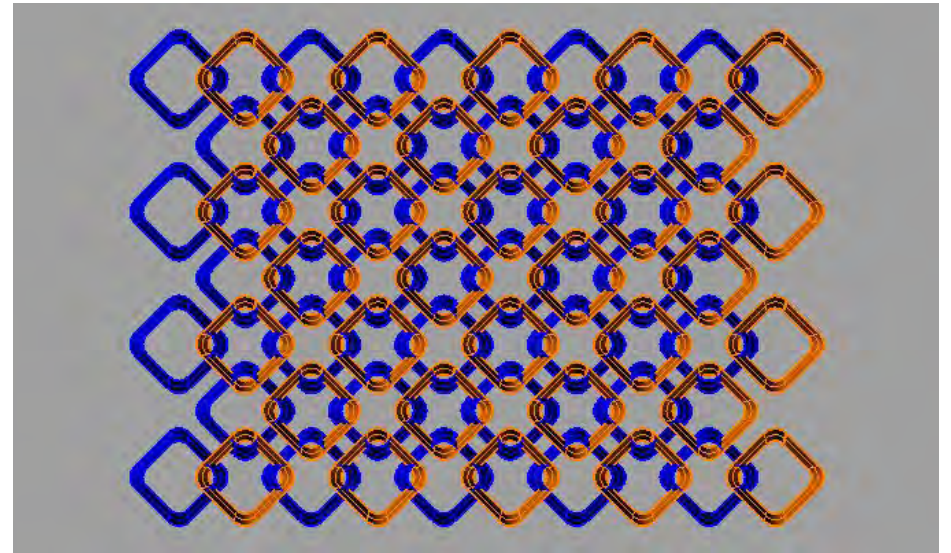
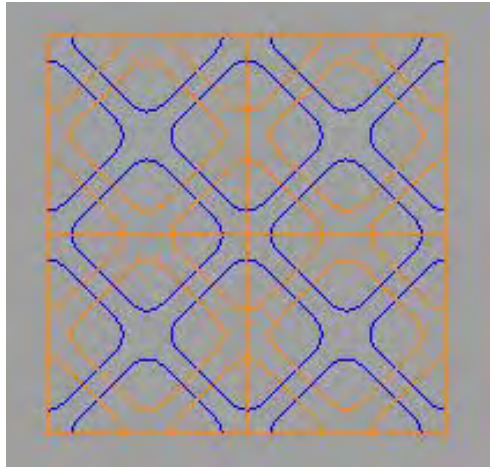
2. Self shading - the width between the edges used for the construction demand, achieve the demand for shading according to the sun max angle at summer time, and at the transition seasons.



3. Passive cooling - a doubled skin facade, the air is going up. The use of mashrabiya gives shade and protection from the hot summer sun while allowing the cool air from the street to flow through.

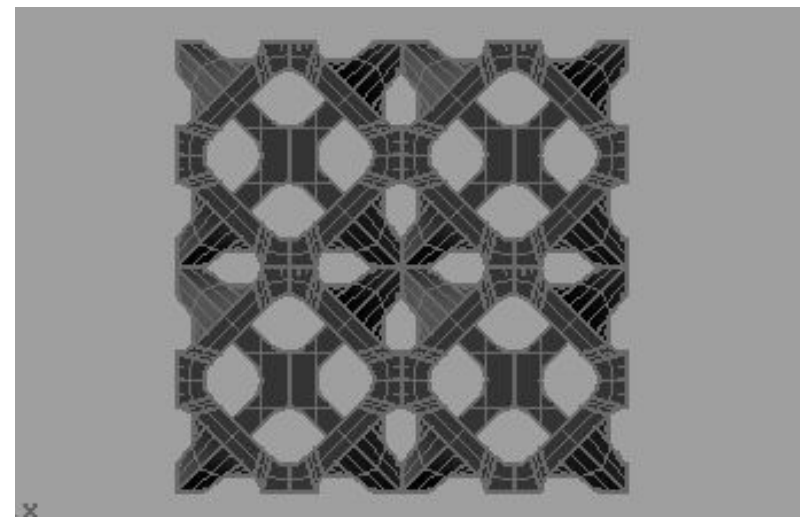
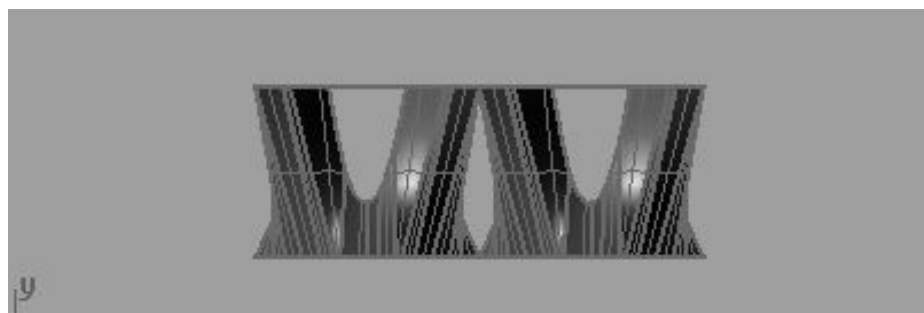
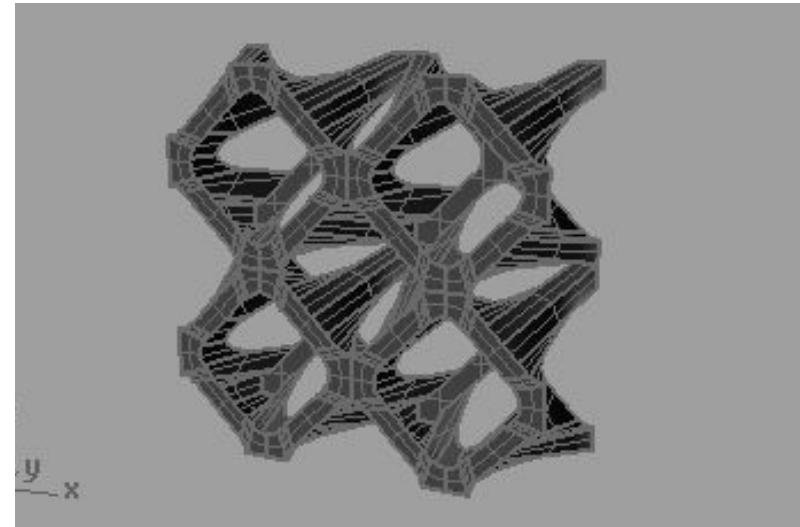
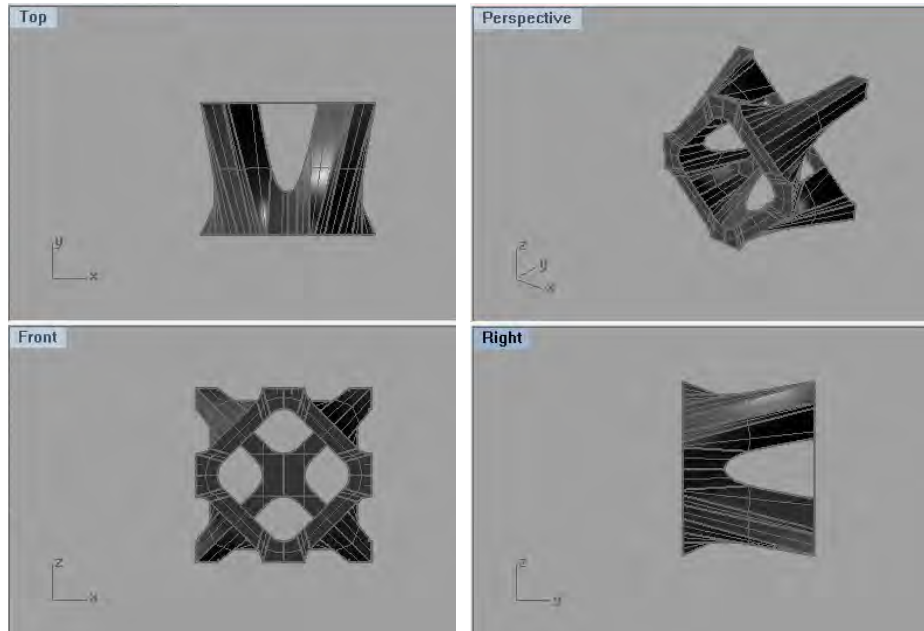


*The cell - creating the form*

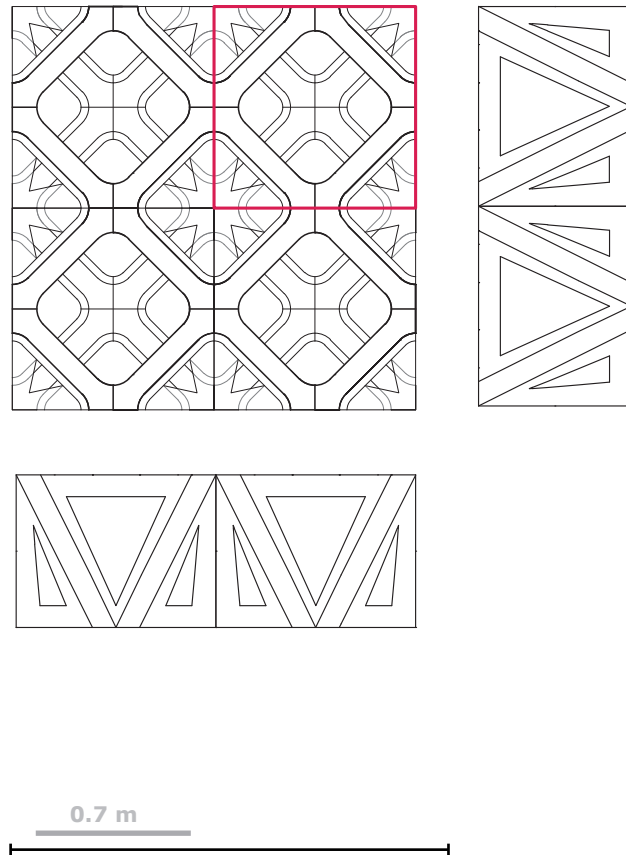




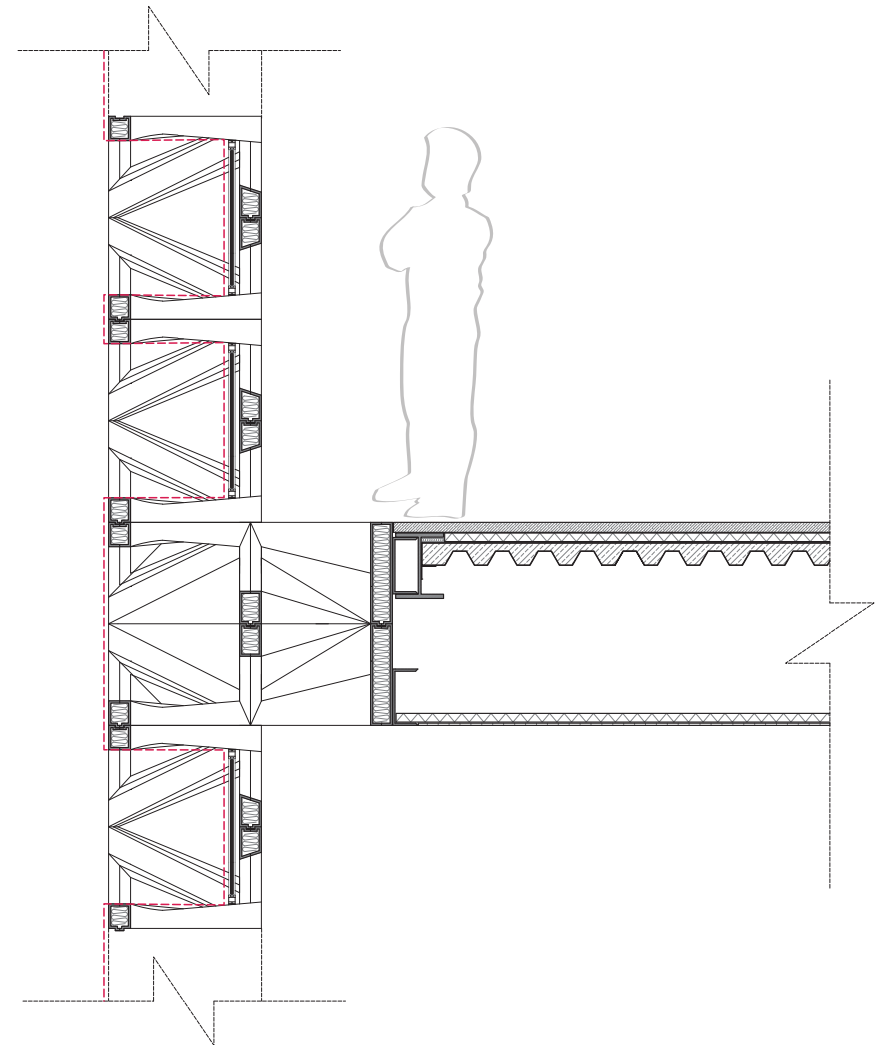
*The cell - creating the form*



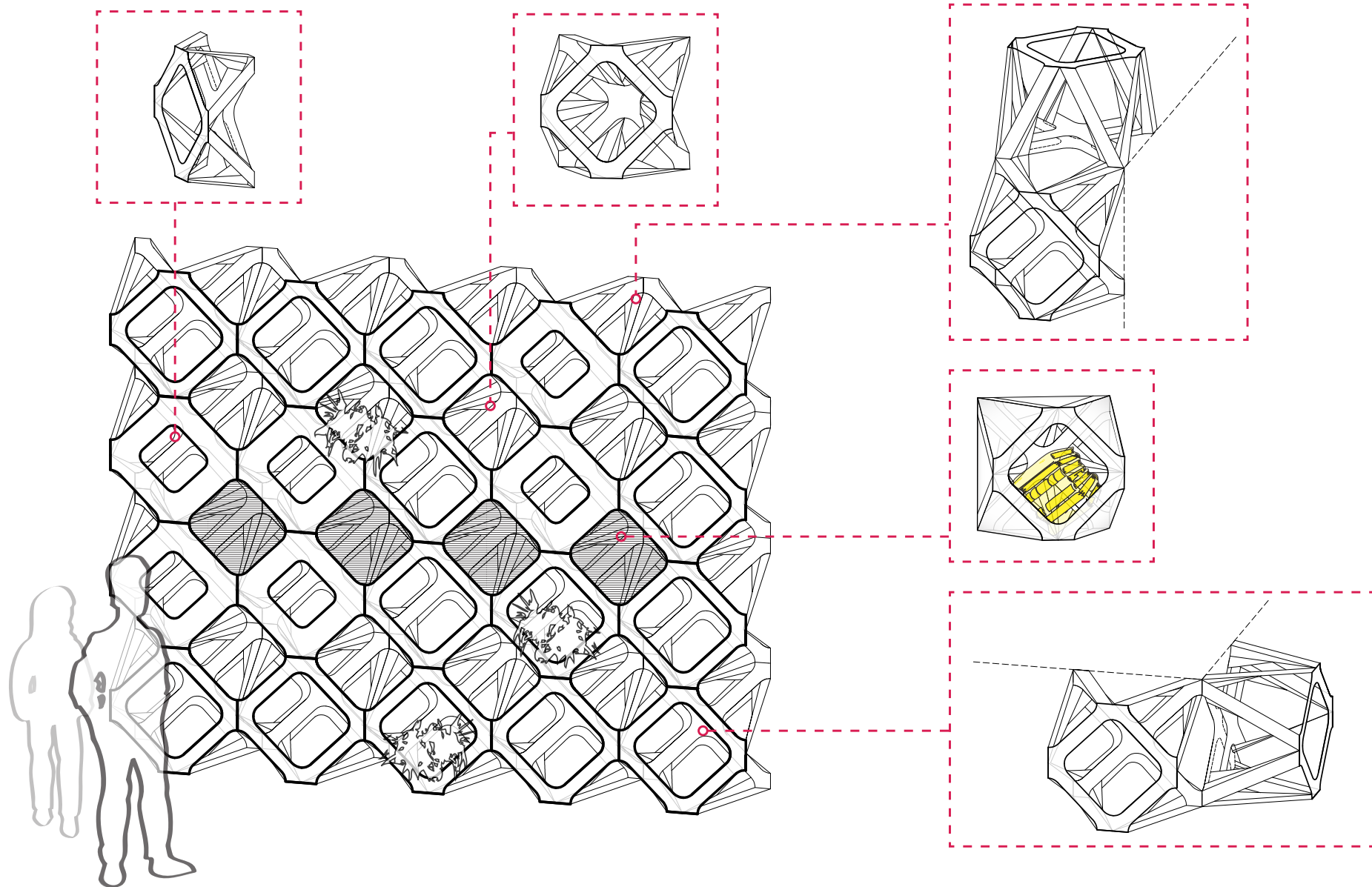
*Skin detail*  
*front view*



*Skin detail*  
*section view*

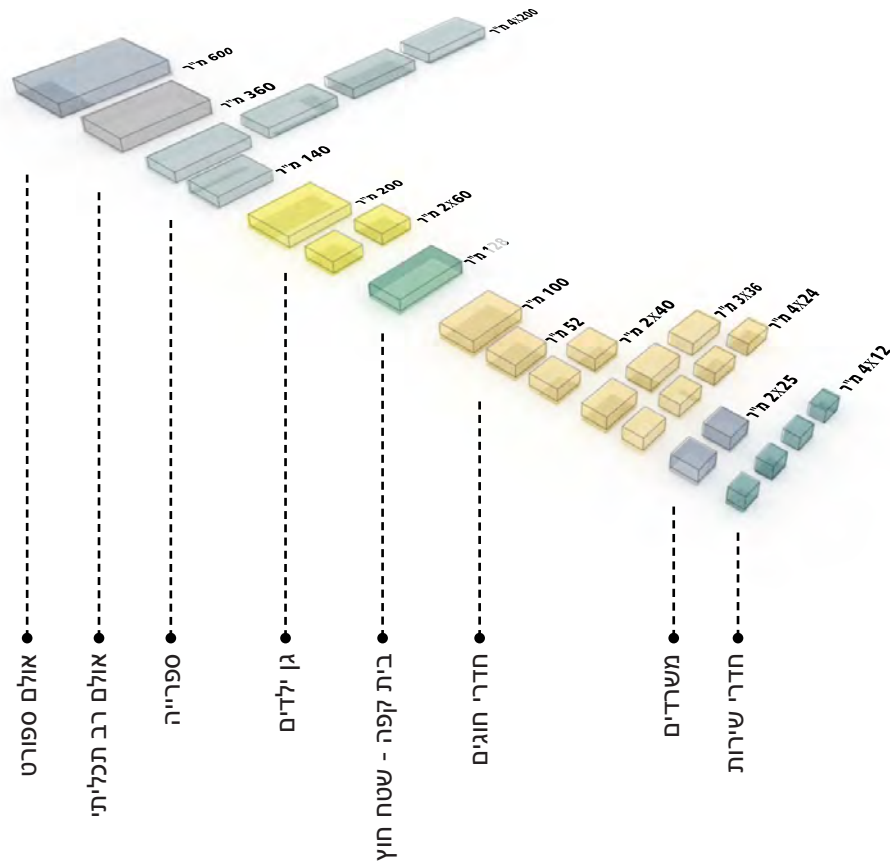


Detail catalog



### Building arrangement

Design and calculate the building spaces according to the area regulations for public building.

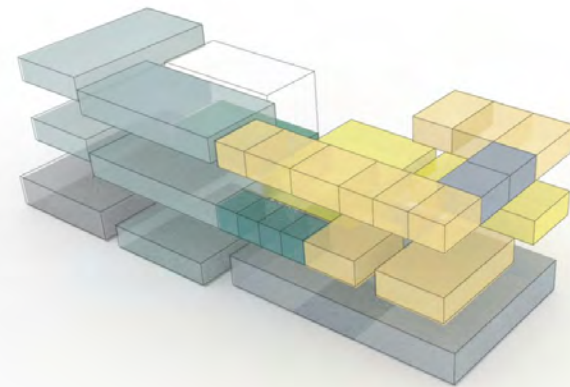
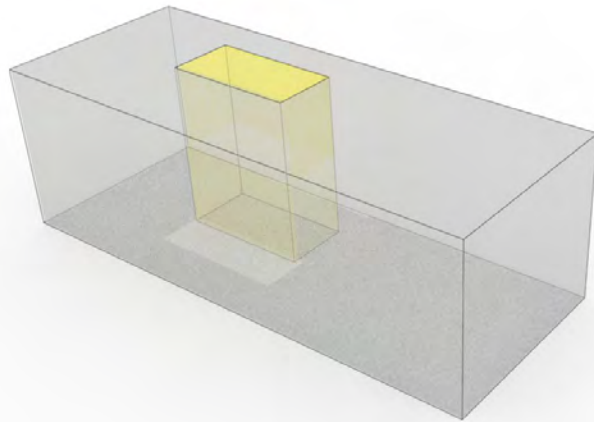
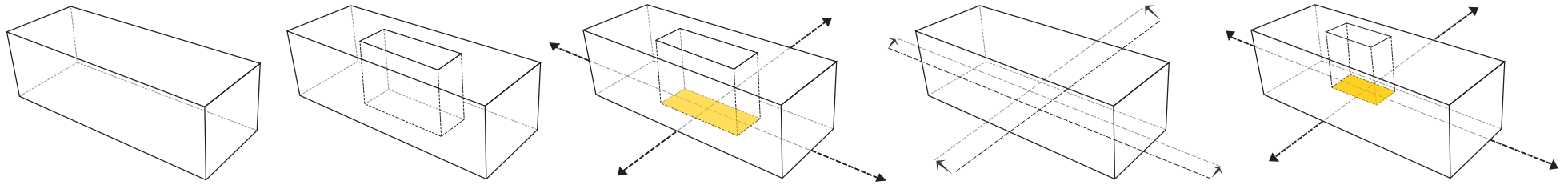


<b>גן ילדים</b>					
120	2	60	8	7.5	כיתה
200	1	200	16	12.5	שטחי חוץ
24	2	12	4	3	חדרי שירות
<b>344</b>					
<b>ספרייה</b>					
800	4	200	20	10	חללי קריאה
140	1	140	14	10	מוליטמדיה
<b>940</b>					
<b>אולם ספורט</b>					
600	1	600	30	20	מגרש
<b>600</b>					
<b>אולם רב תכליתי</b>					
360	1	360	24	15	אולם
<b>360</b>					
<b>חדרי חוגים</b>					
100	1	100	12.5	8	א
52	1	52	8	6.5	ב
120	3	40	8	5	ג
72	2	36	6	6	ד
96	4	24	6	4	ה
24	2	12	4	3	חדרי שירות
<b>464</b>					
<b>משרדים</b>					
50	2	25	5	5	חדר שירות
<b>50</b>					
<b>בית קפה</b>					
128	1	128	16	8	חלל מרכזי
<b>128</b>					
<b>2886</b>					

954 -----> Total floor area (m2)

## Building arrangement

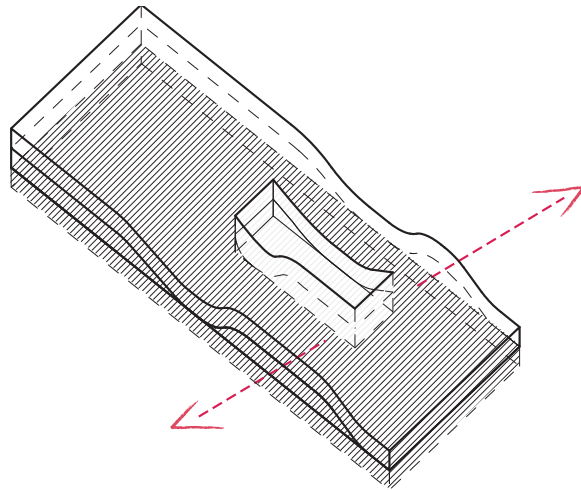
From a one block to interior court. The building is organized around a main core, when the main axis are meeting.



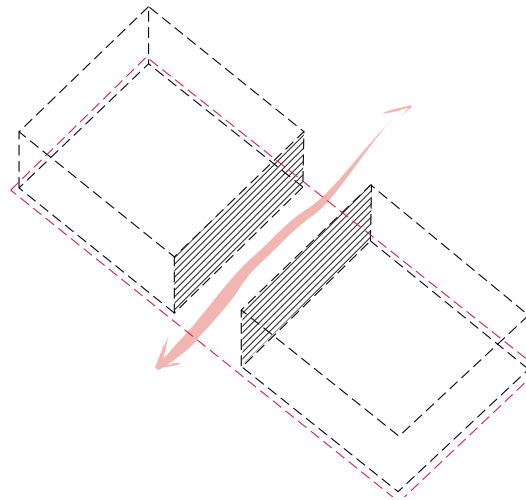
Moving the core from the middle make a variable width of the building space.

**The building schame**

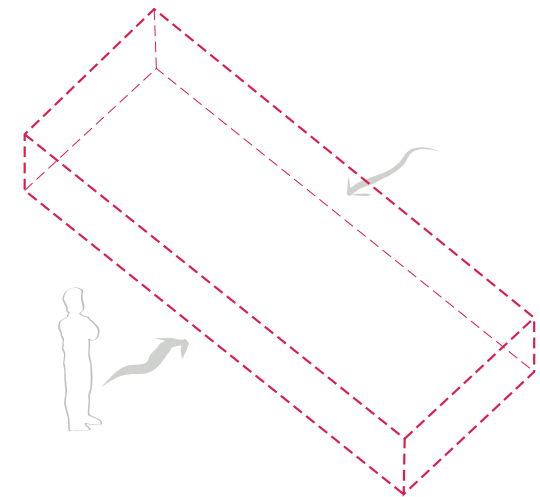
הגיאומטריה הנתונה מאפשרת מעבר של הולכי רגל דרך המבנה ללא חצייה שלו לחלקים נפרדים.



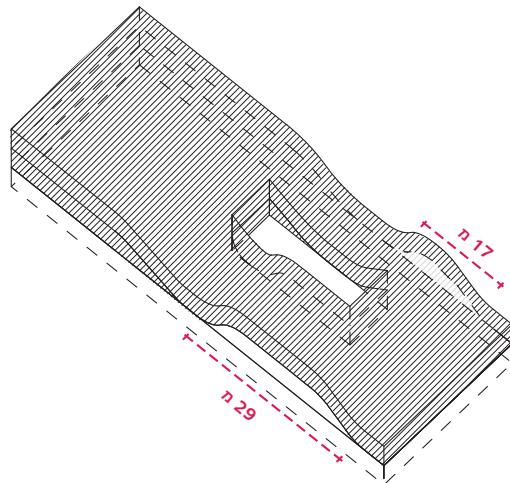
מעבר של דרך בתא השטח, מצריך חלוקה של המבנה לשני חלקים.



הסכמה הכללית של הבניין דורשת על פי התקנון מעבר של דרך בתא השטח הנתון.

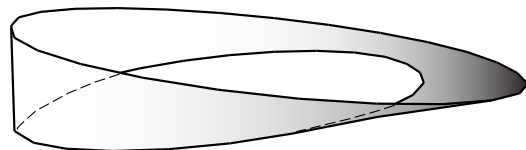


במסגרת התקנון, המבנה יכול לחרוג מקו האפס של תא השטח עד 35%



$$\begin{aligned}
 & 48 \text{ מ} = 29 \text{ מ} + 17 \text{ מ} \\
 & 61.6 \leftarrow 176 = (24+24+64+64) \text{ מ} \cdot 35\% \\
 & \boxed{35\% < 61.6/48}
 \end{aligned}$$

## The building scheme

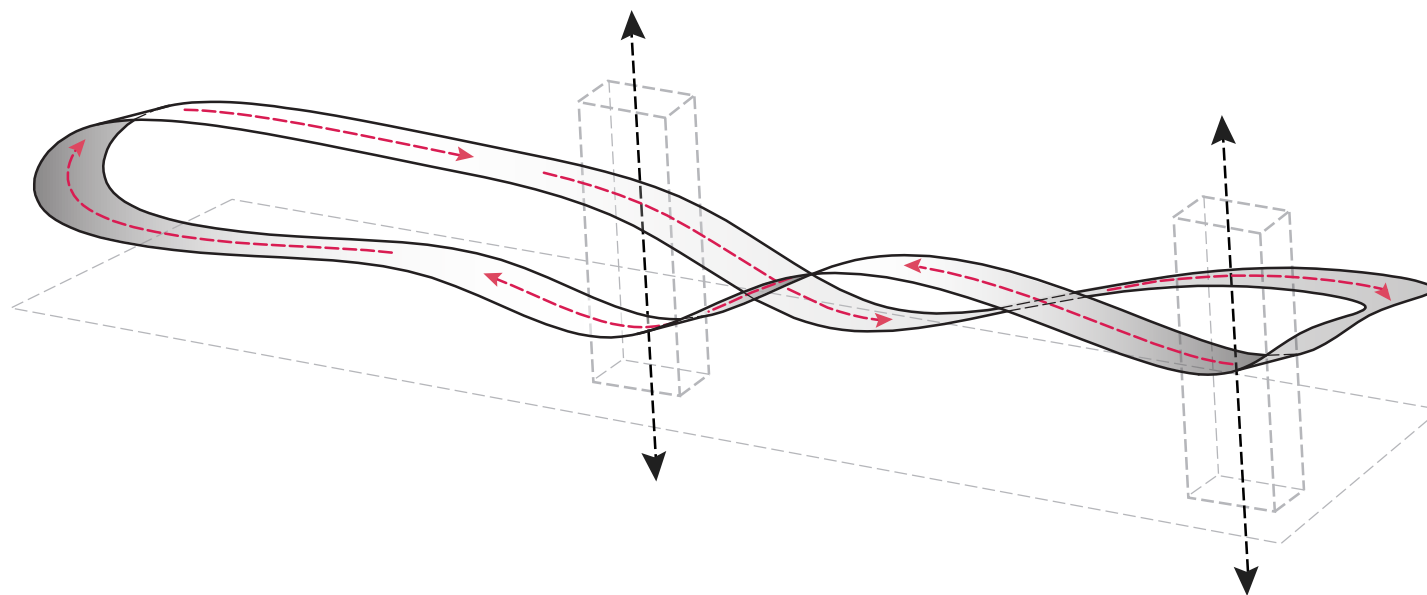


הגיאומטריה של המבנה מאפשרת קיום של דרך ציבורית ומעבר לרוחבו ללא חלוקה לשני מבנים נפרדים.

הסטרוקטורה מאופיינת על ידי גרעין תנועה מרכזי וארגון של החללים מסביב, כך שמתקבלים חללים שלמים הנראים אחד כלפי האחרים.

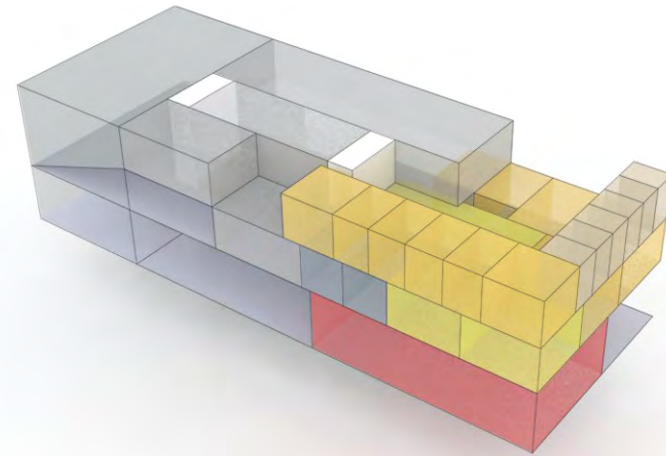
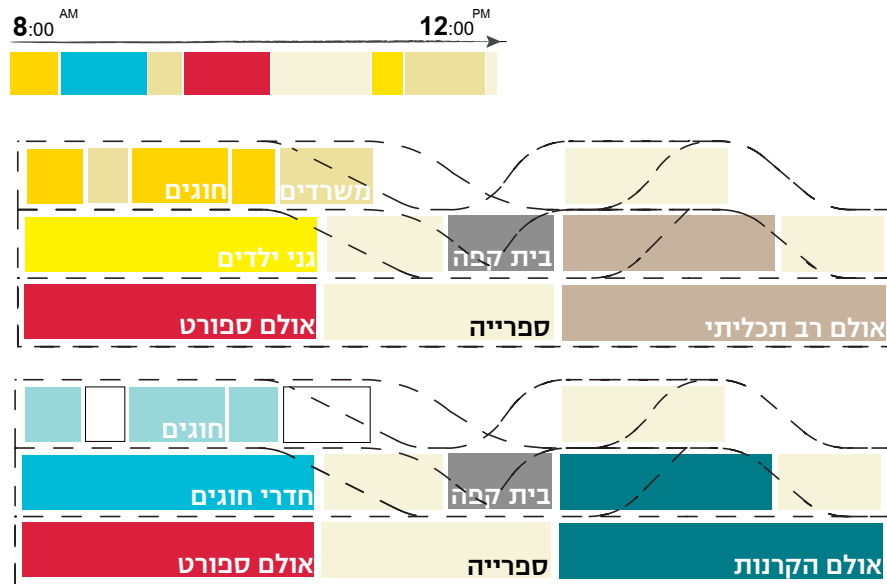
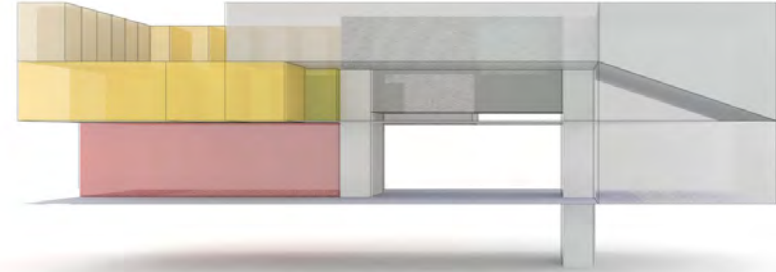
הסכמה לוקחת השראה מהעקרון של טבעת מביוס צורה דו-ממדית שיש לה צד אחד בלבד. מבחינה מתמטית, זהו משטח עם שפה, שאינו ניתן לכיוון.

הצורה מאפשרת יצירה של חצר פנימית ורצועה המשכית של תנועה ופעילות החולשת על כל המבנה.



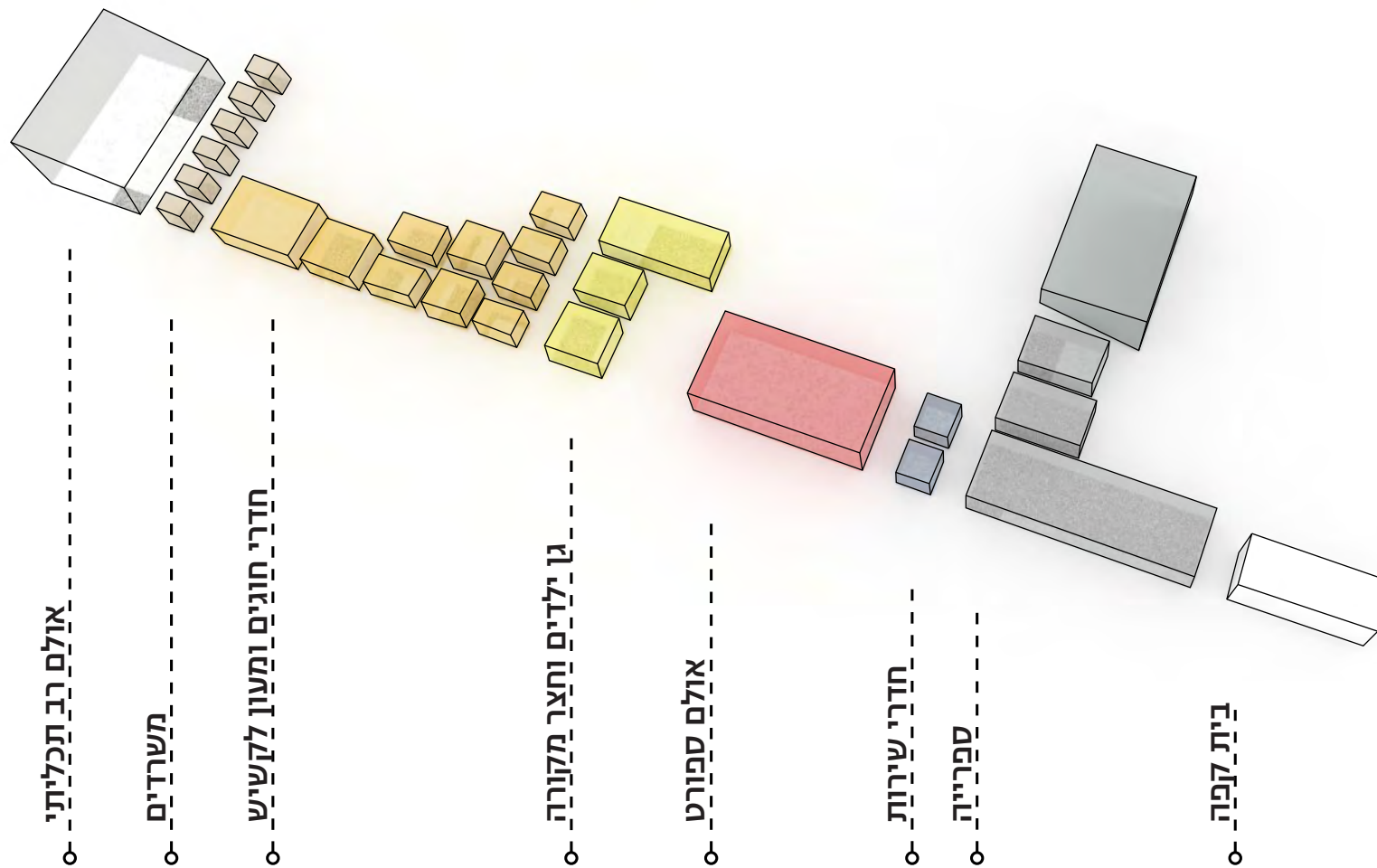
### The cavity arrangement

The building is attempting to be occupied all day, and there for the functions suitable for a different activity in every part of the day. Some of the spaces can be function as aW day activity such as kindergarten and be a class room for an afternoon activity.



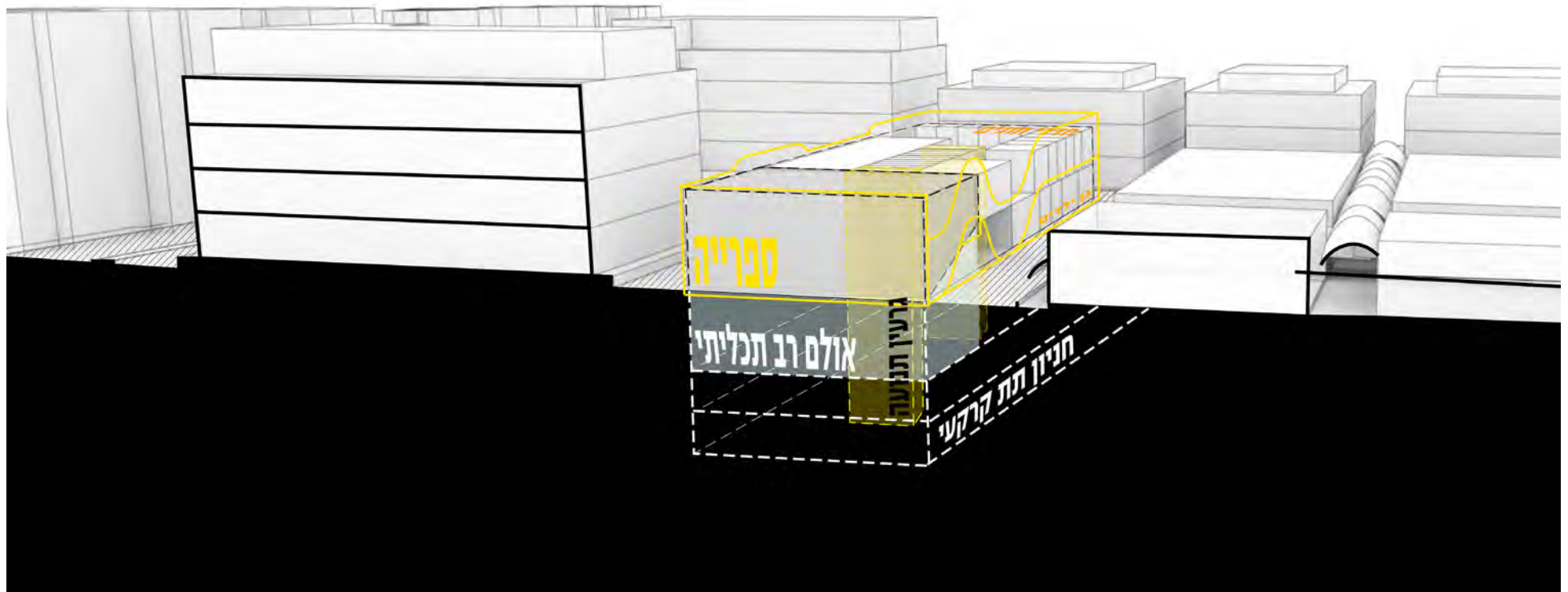


Building arrangement - step two



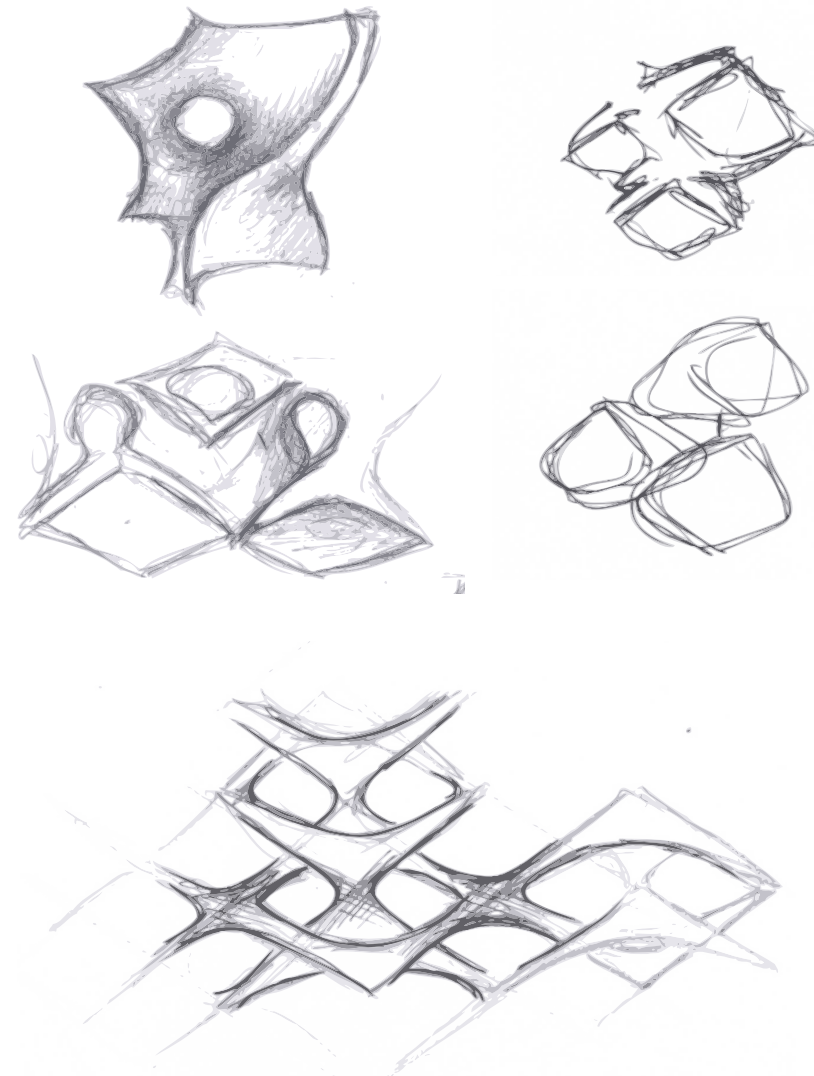
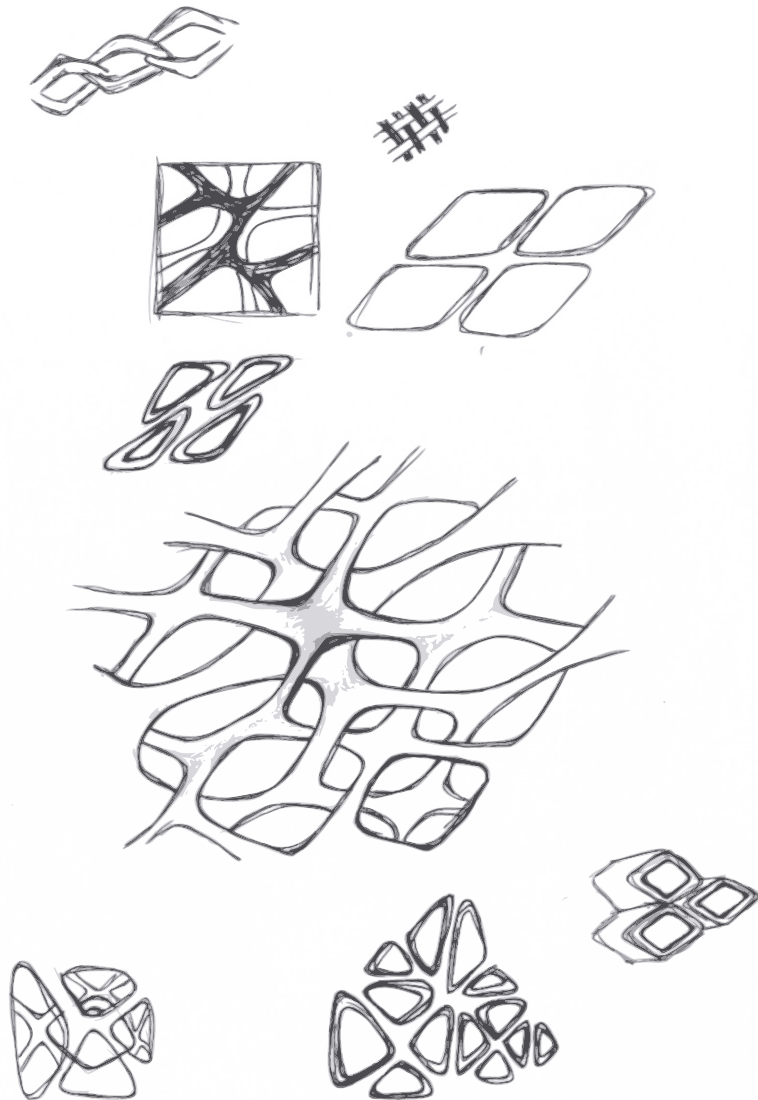
Total floor area (m2) - **2817.5**

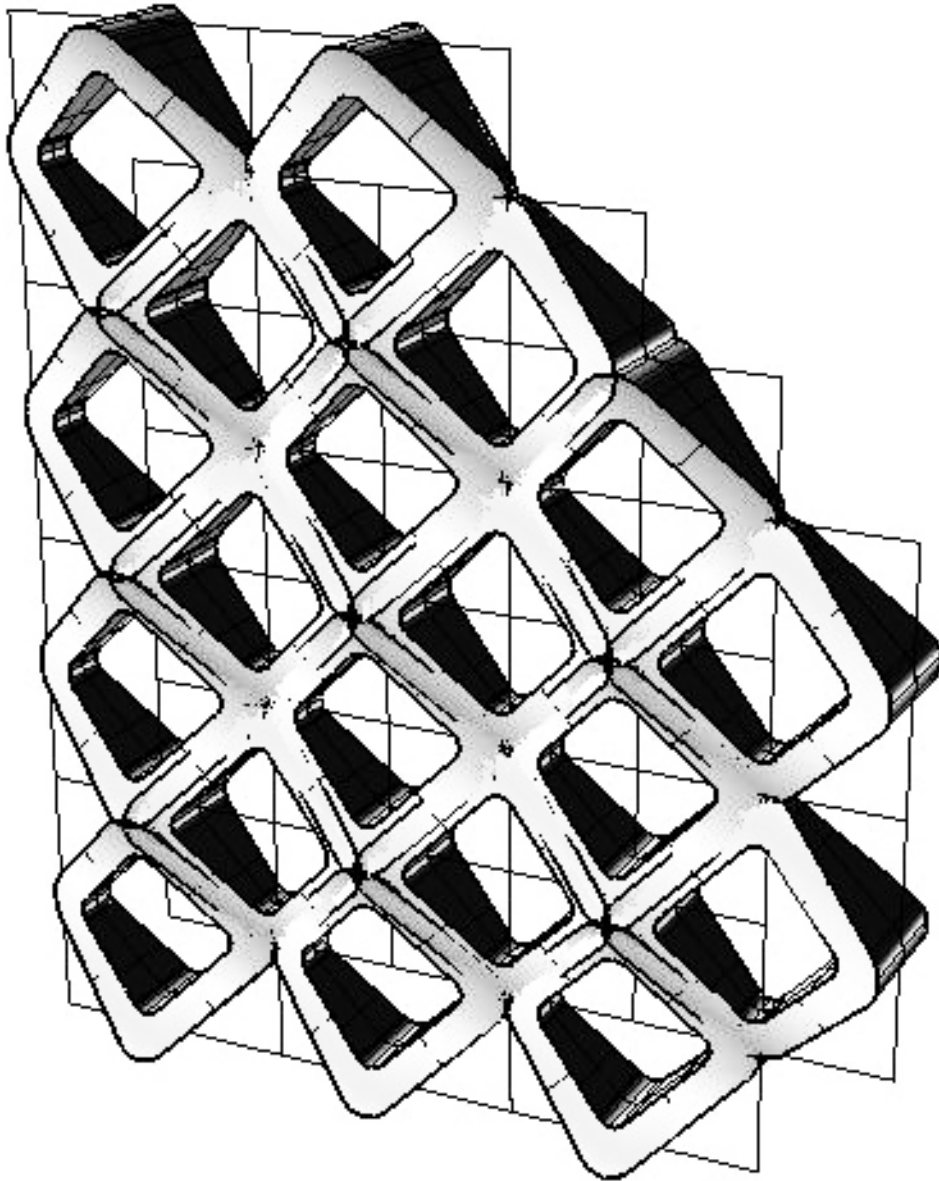
*A street section  
Daniel street*



Trying different forms of cell, make the shape less complicated

Some sketches





## The idea

First step of the Grasshopper assignment, was to analyze and decided which performances I liked to investigate and integrated to the facade creation.

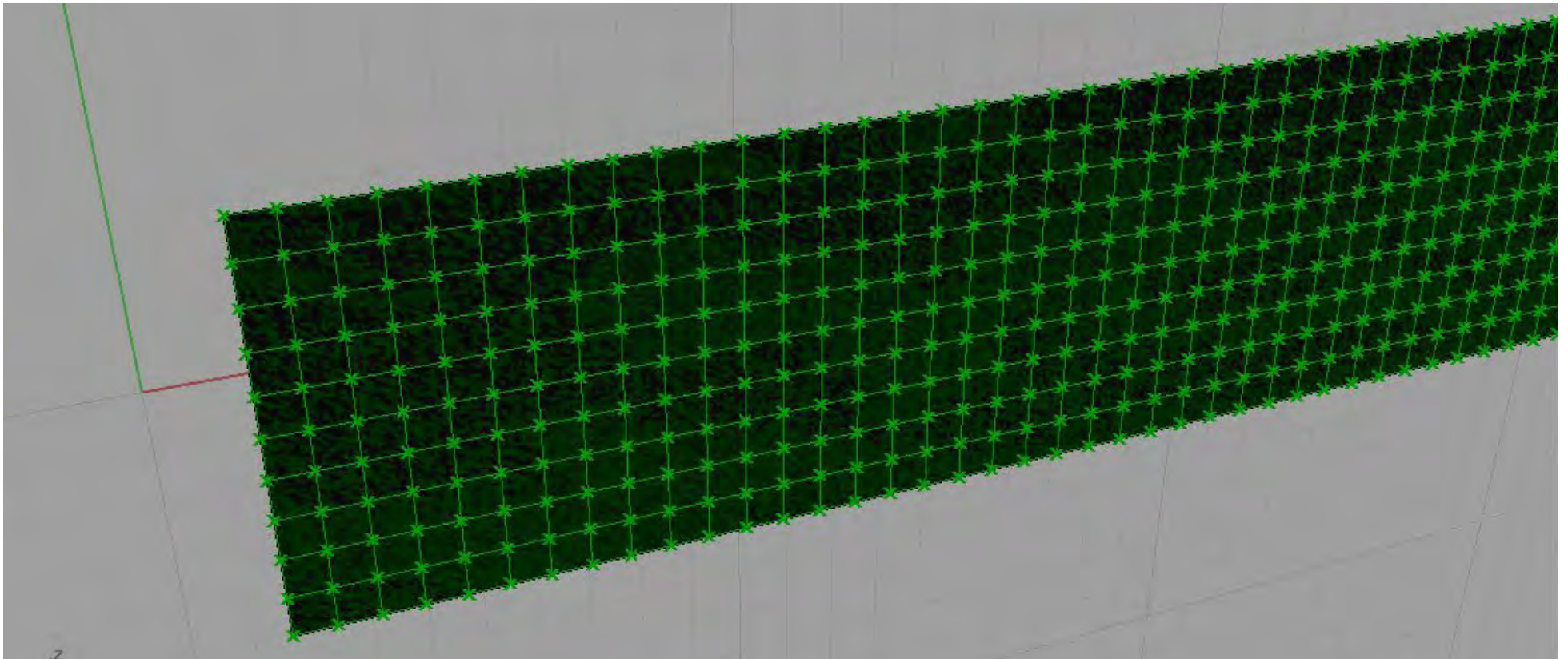
The two main performances which chosen, are two of the three I used in my studio project:

- Constructor
- Self shading

This tow performances have a dichotomous connection, in one hand there is a need for thickness according to the constructor analyze, in the other hand the need for sun lighting or shading according to the facade directing and the period of time.

## Steps - part one

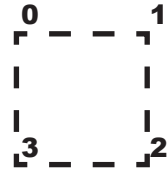
1. Creating the facade geometry



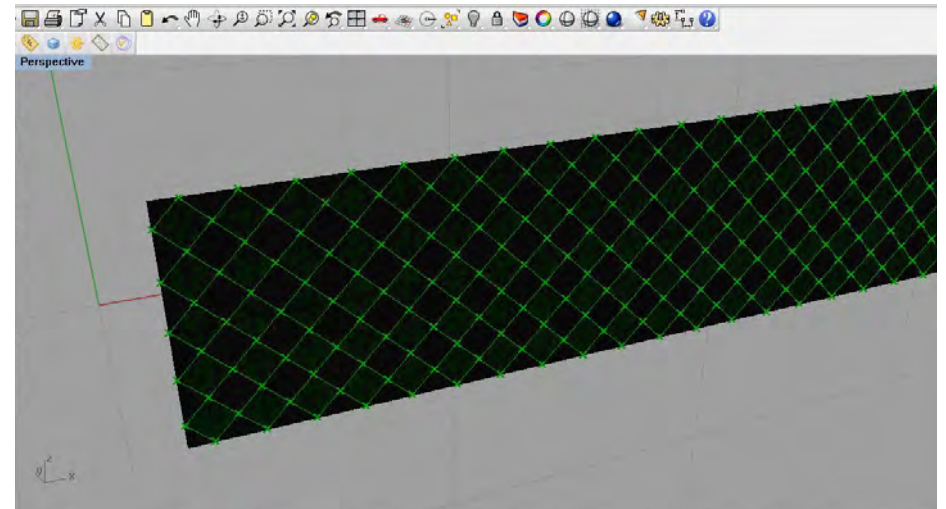
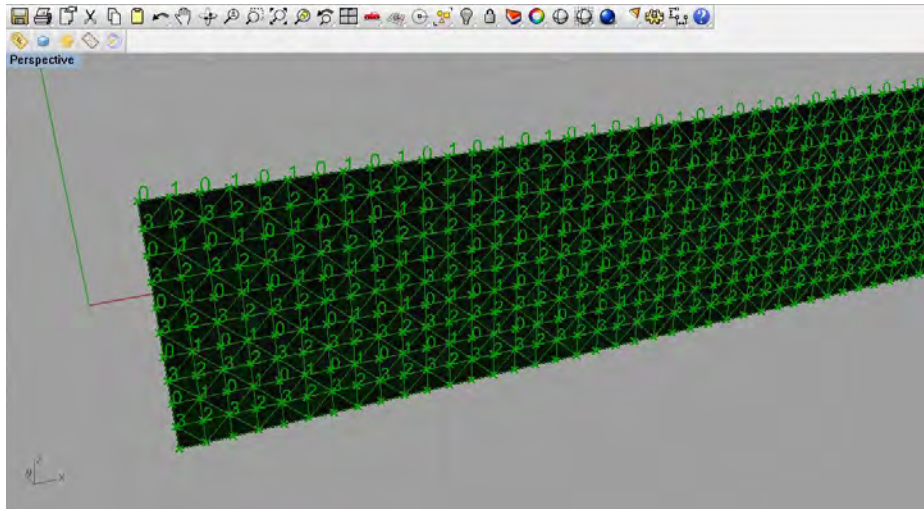
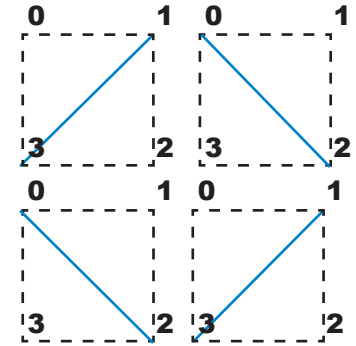
**Steps - part one**

2. Definition of each point on the rectangular grid

Using **Item + line + end points** orders

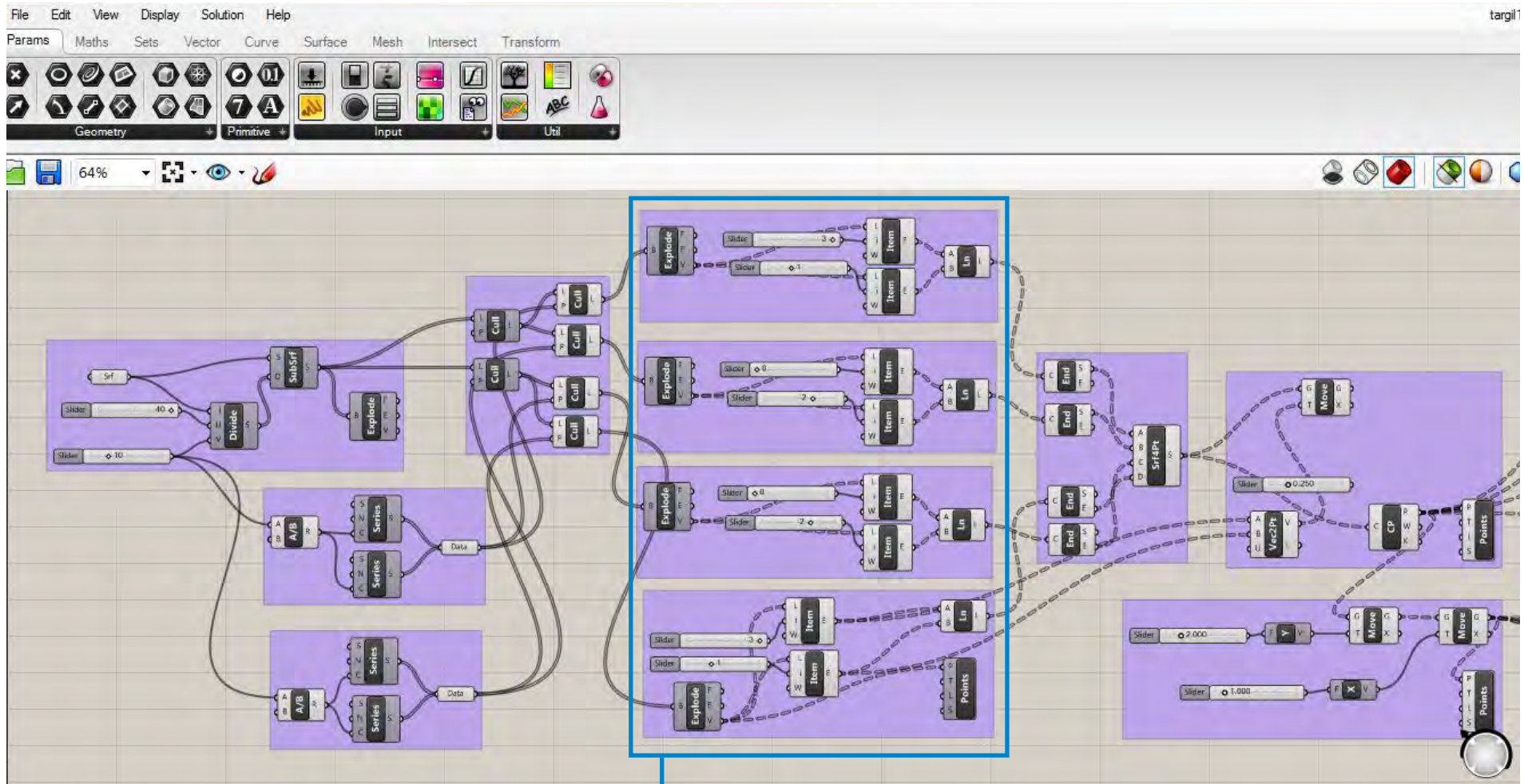


3. Make a diamond grid, by connected the relevant point together.



Steps - part one

- The code:

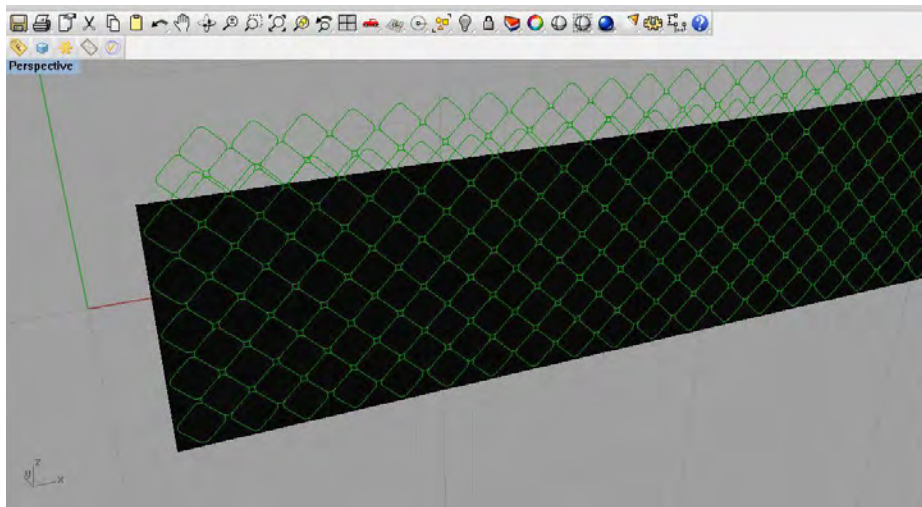
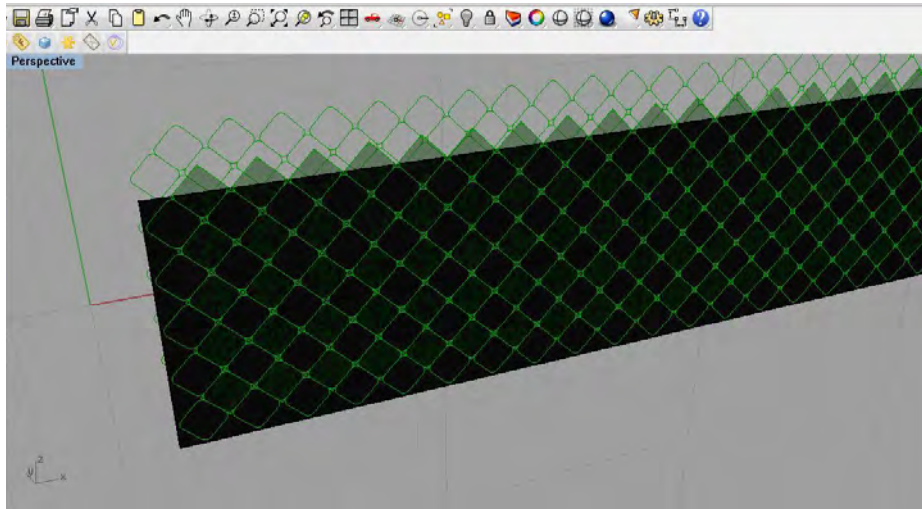


Make a diamond grid, by connected the relevant point together.

**Steps - part one**

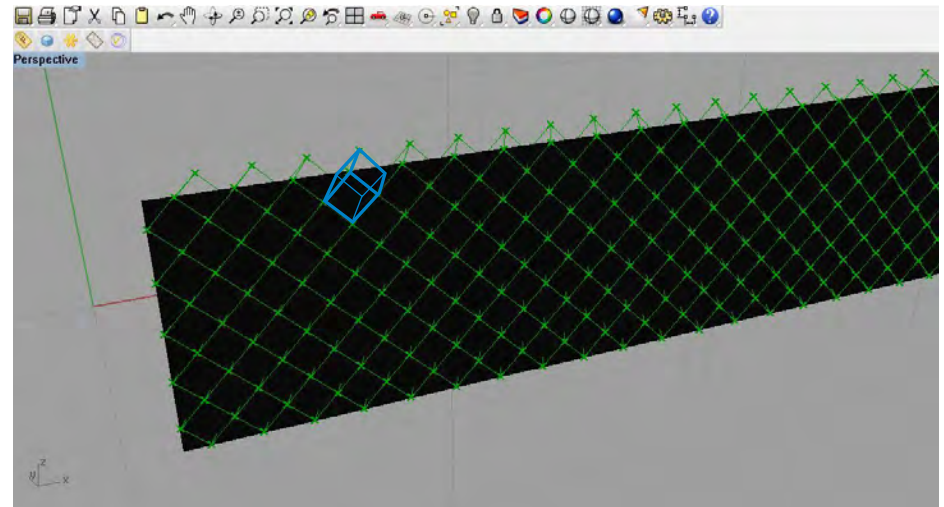
4. Some of the experiences of bubble grid creation:

Using **Fillet + Move** orders



5. Double grid facade

Using **Item + line + Move** orders

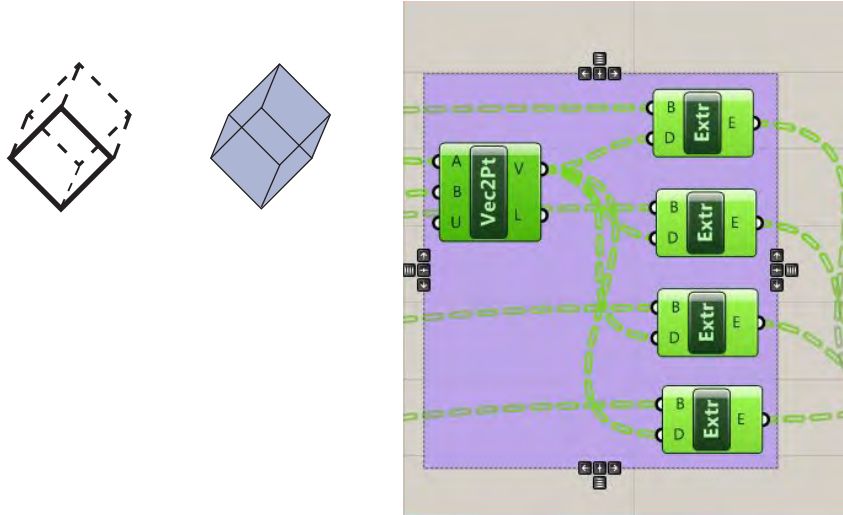




### Steps - part one

6. Convert to solid

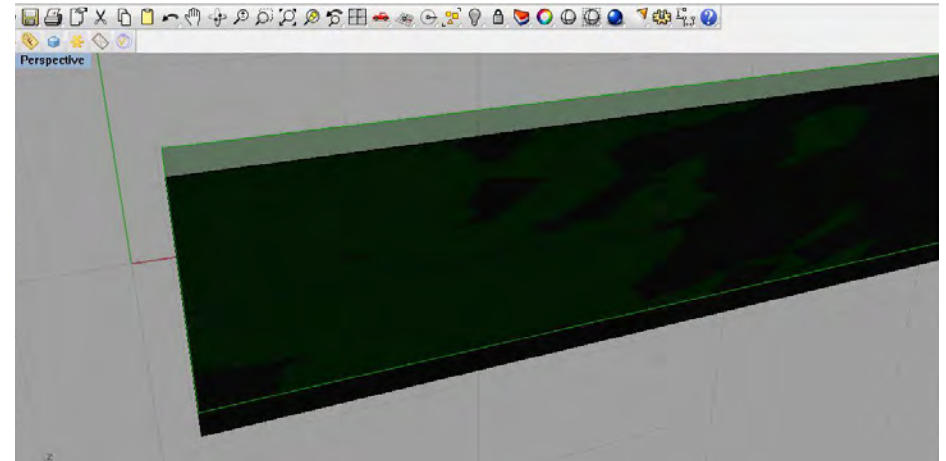
Using **Extrude + 2 point vector** orders



### Steps - part two

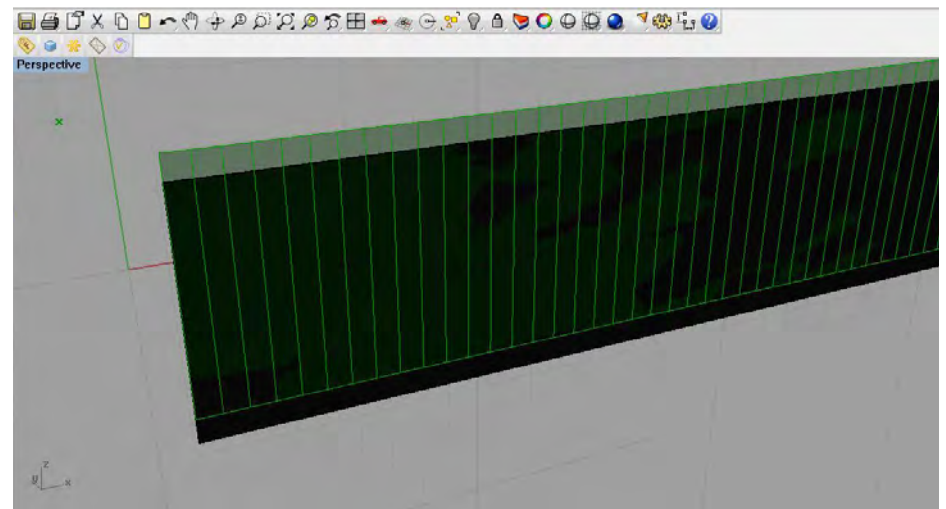
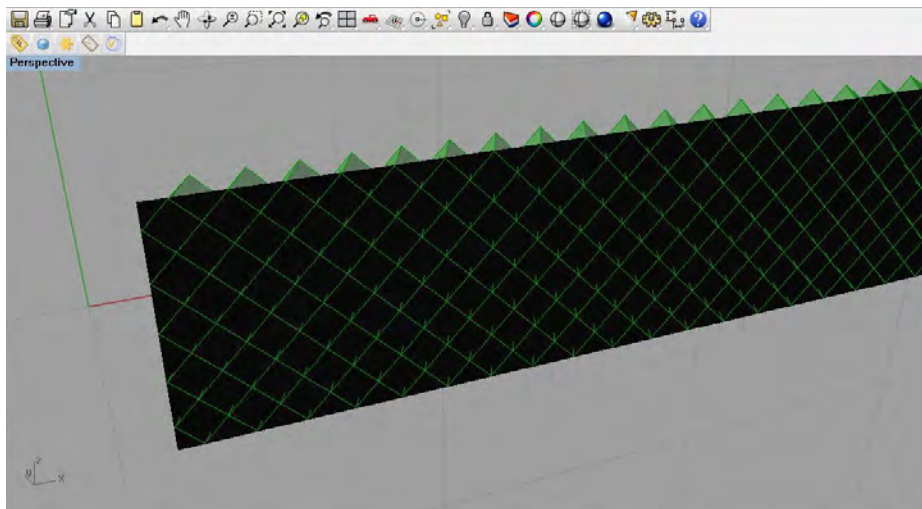
7. Making a new surface

Using **4 points surface + move** orders



8. Dividing the surface

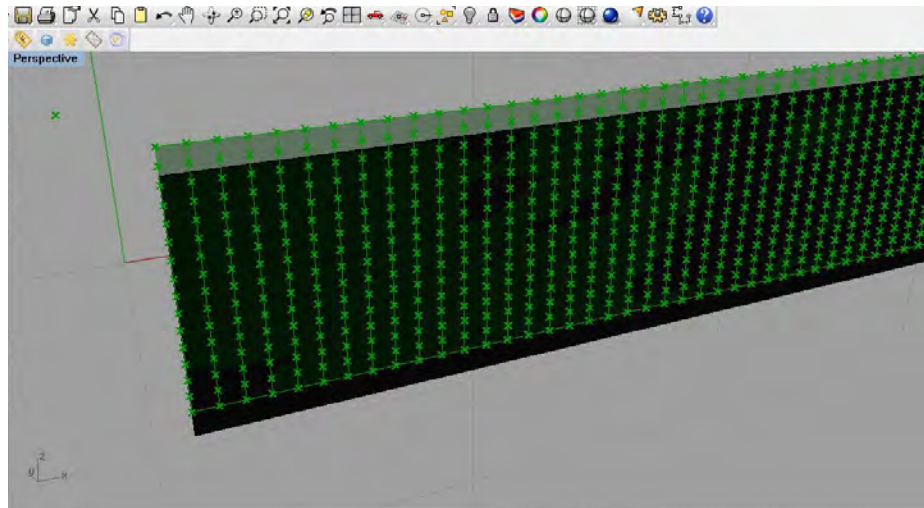
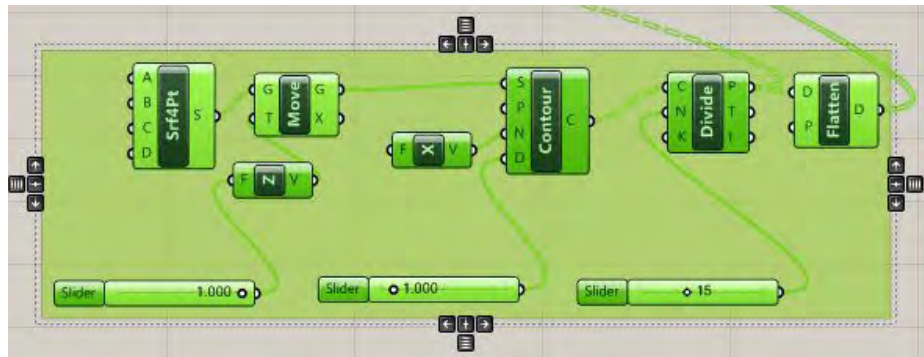
Using **Contour** order



Steps - part two

9. Dividing the contour lines to points

Using **Divide** order



10. Create a transformation on the points grid we get from the dividing step.

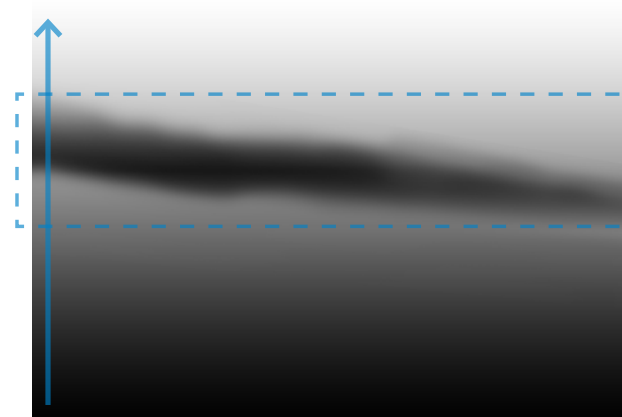
Using **Image sample + move** orders



The parametric transformation, is according to a constructor principles, changing the facade thickness, wider when we need more construction - and there is a larger index, and the opposite for the narrow parts.

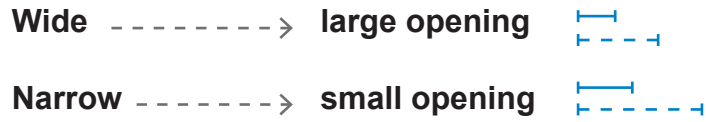
The image -

Getting narrow to the top  
Disturbance - connecting to a floor/ceiling

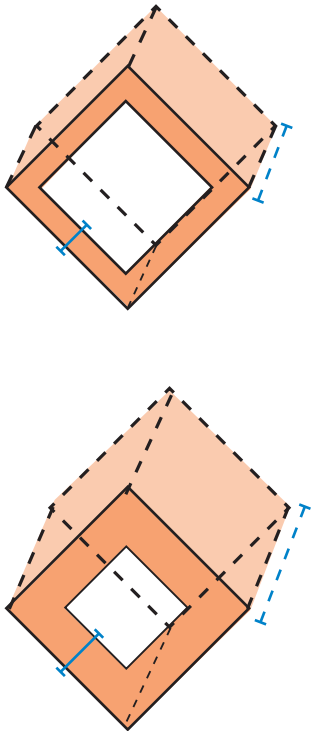


**Steps - part three**

13. Create opening in the solid facade according to thickness



Using **Remap numbers + offset** orders

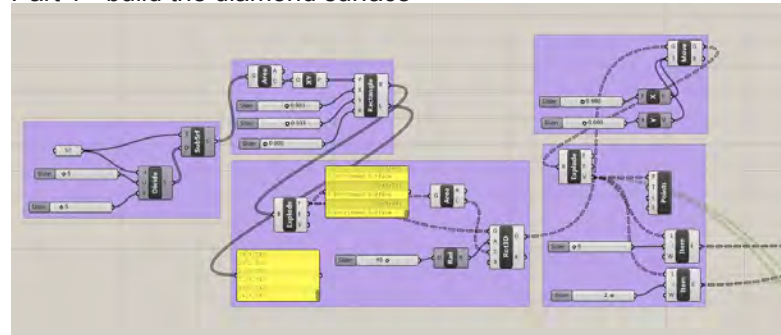


**Steps - part four**

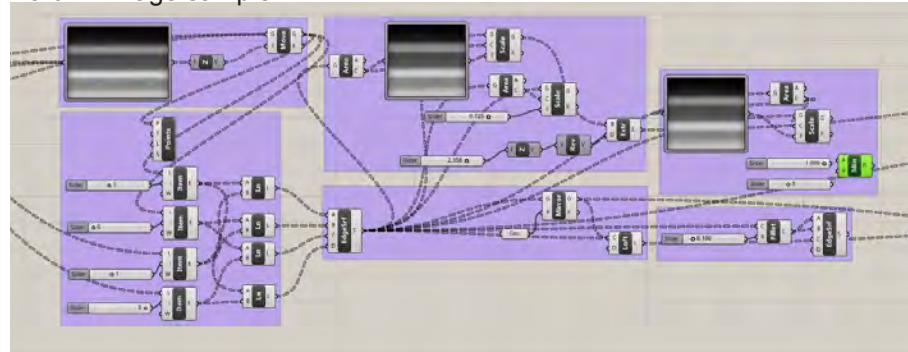
1. Rebuild a new code in grasshopper, using image sampler for both construction and opening.

**The code:**

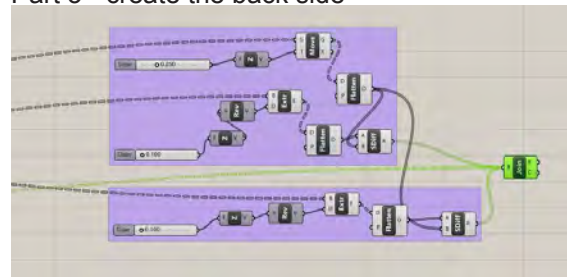
Part 1 - build the diamond surface



Part 2 - image sampler

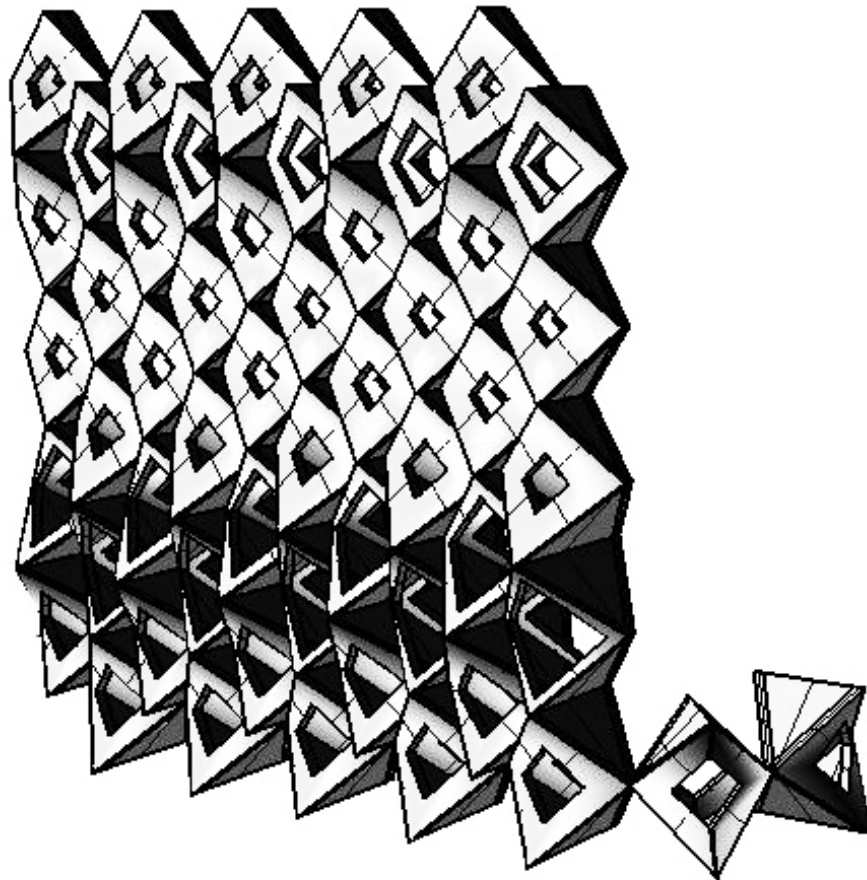


Part 3 - create the back side

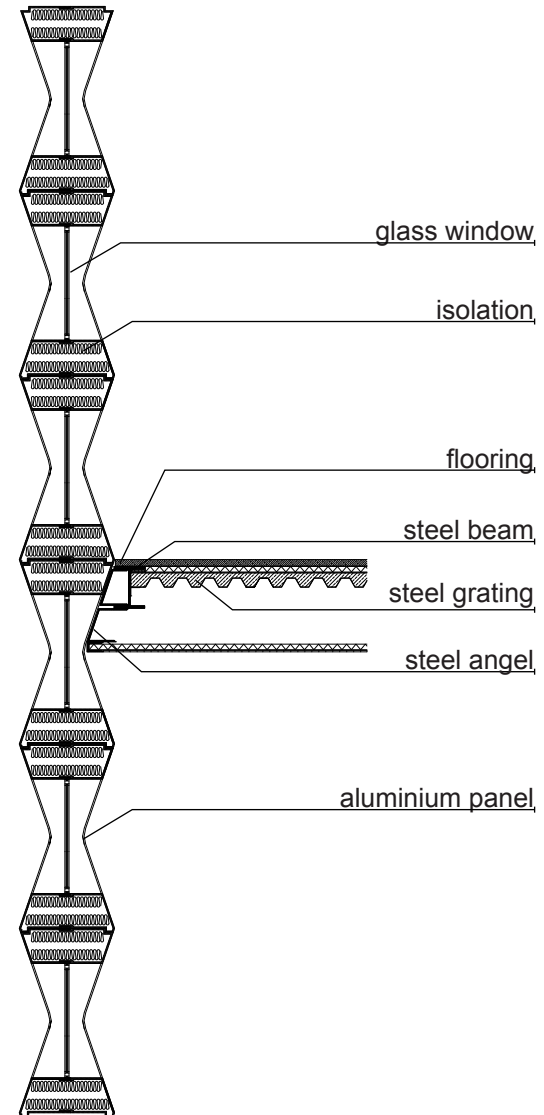


*Steps - part four*

2. The result

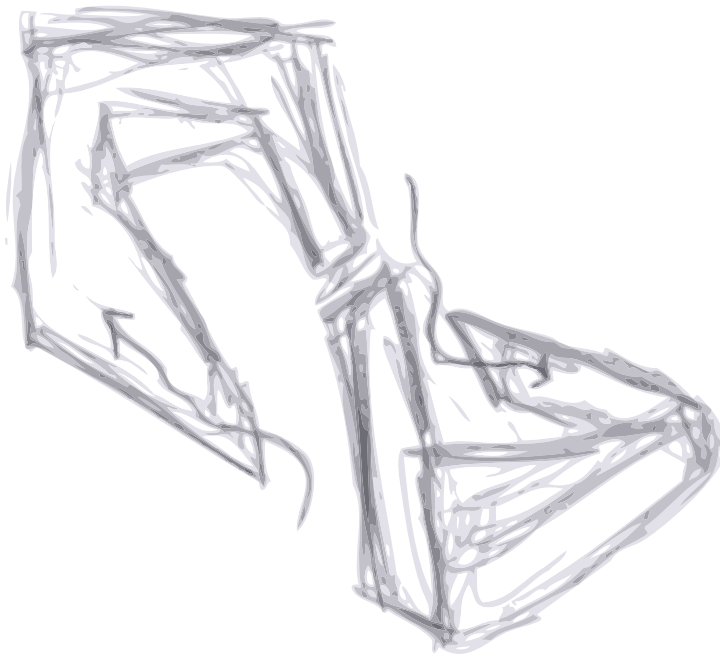


2. Facade section



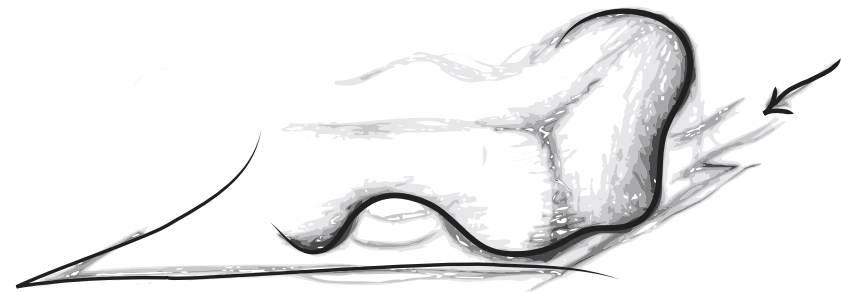
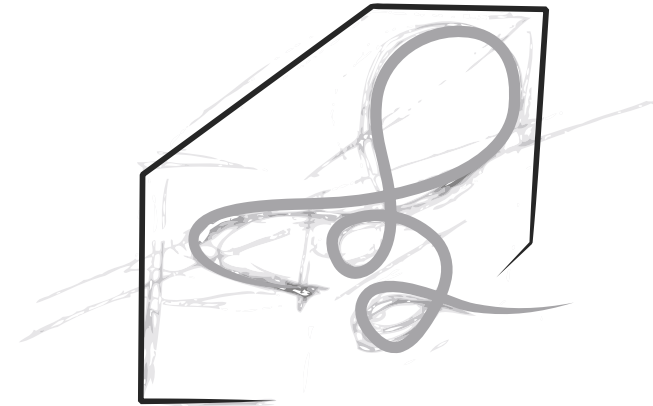
### Building form

Create a continuous building, using the main principle of a public space - accessible building 24 hours. Having structural complexity of relations between inside and outside spaces.

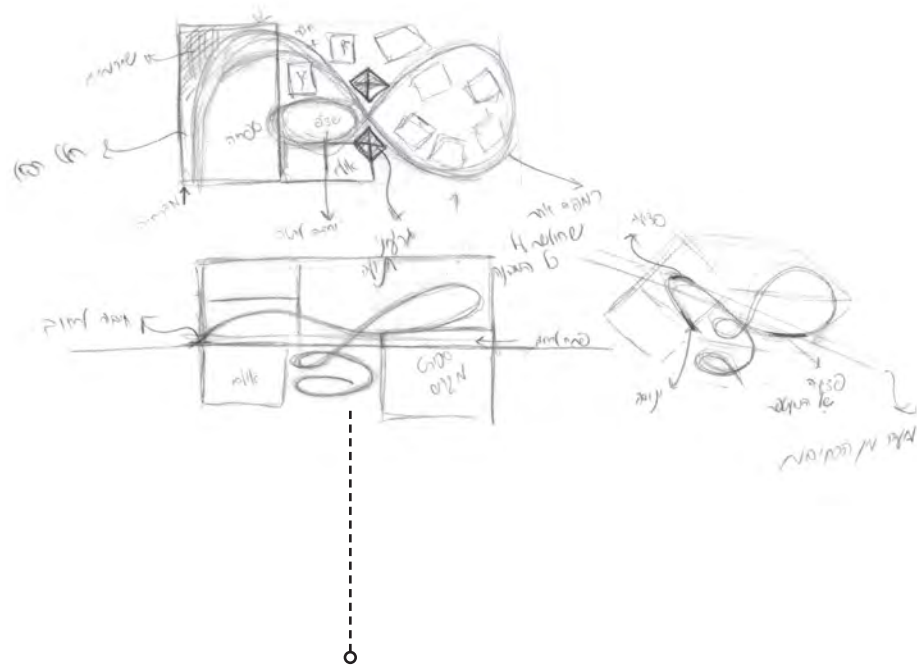


### The ramp

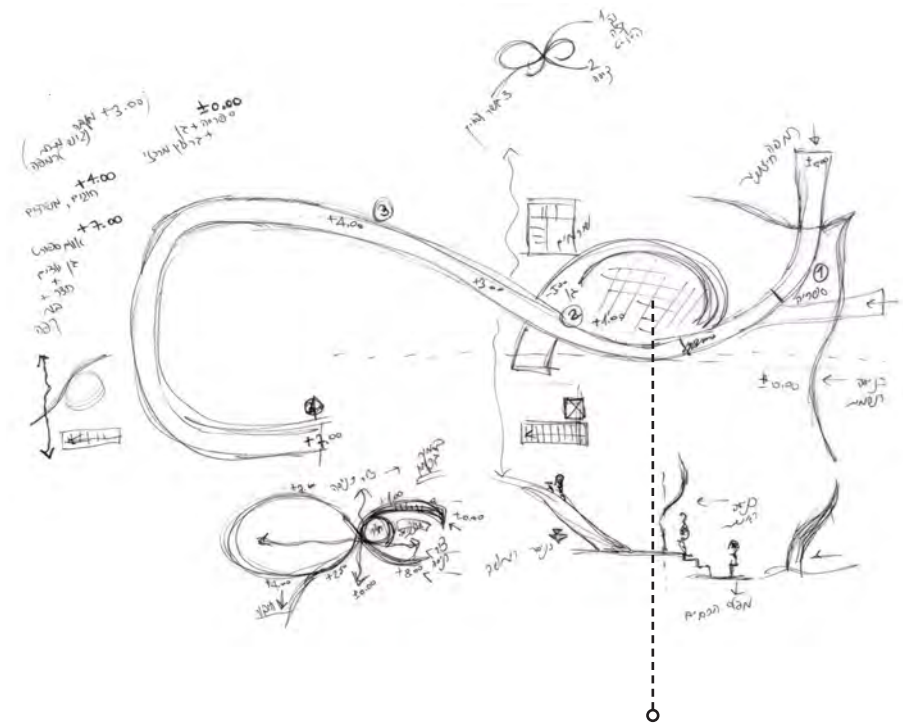
Development of a continuous ramp, all over the building volume. The ramp cross every function and lead you through the building experience.



Plans

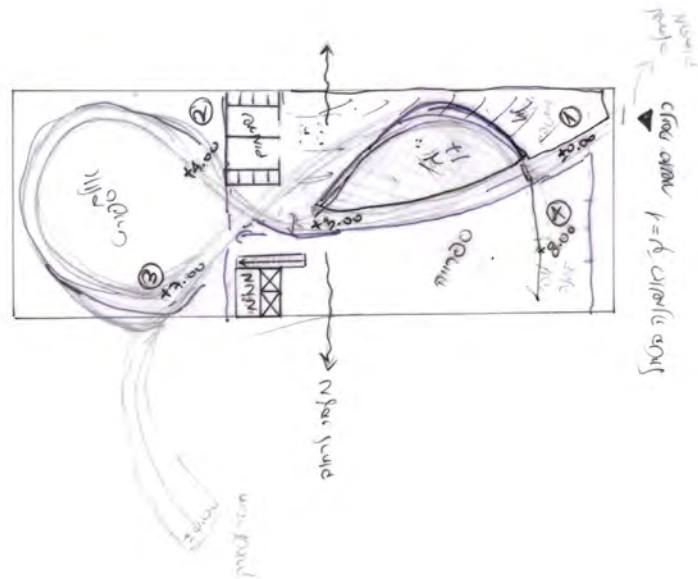


The ramp create different levels inside the building

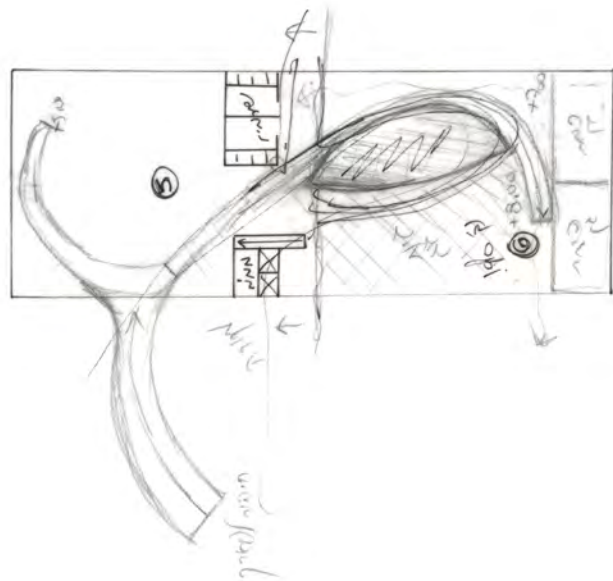


Keep the main core, the idea of inside open space - at the center of the circulation

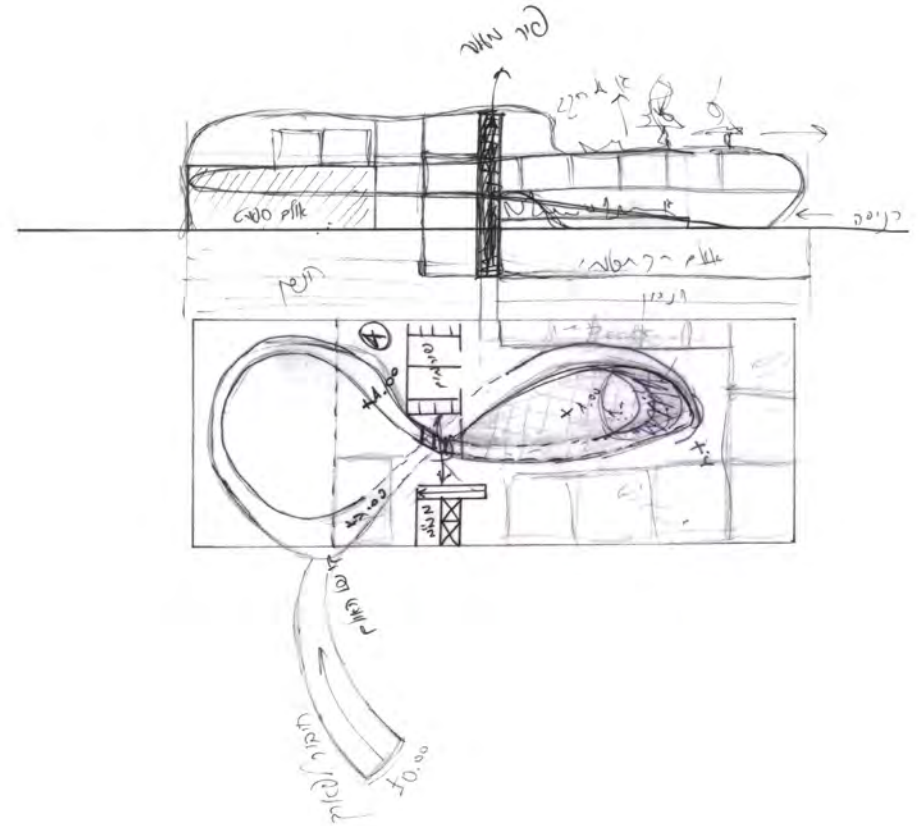
Ground floor plan



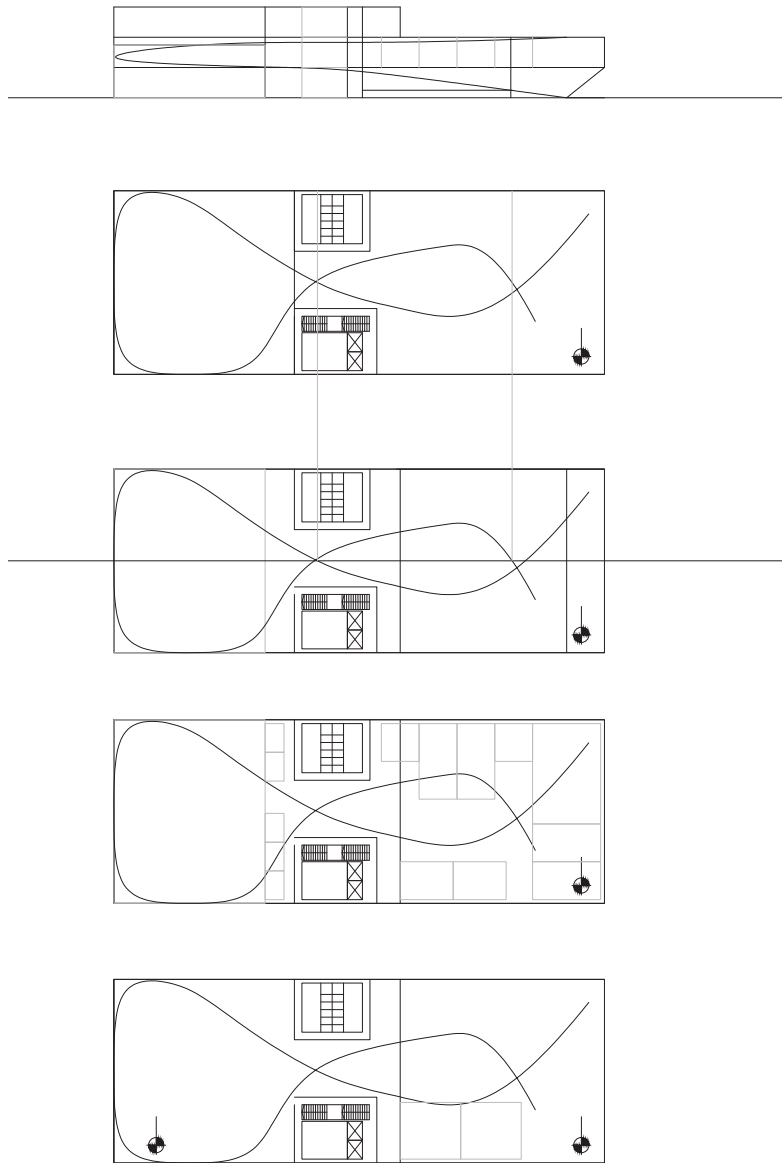
Second floor plan



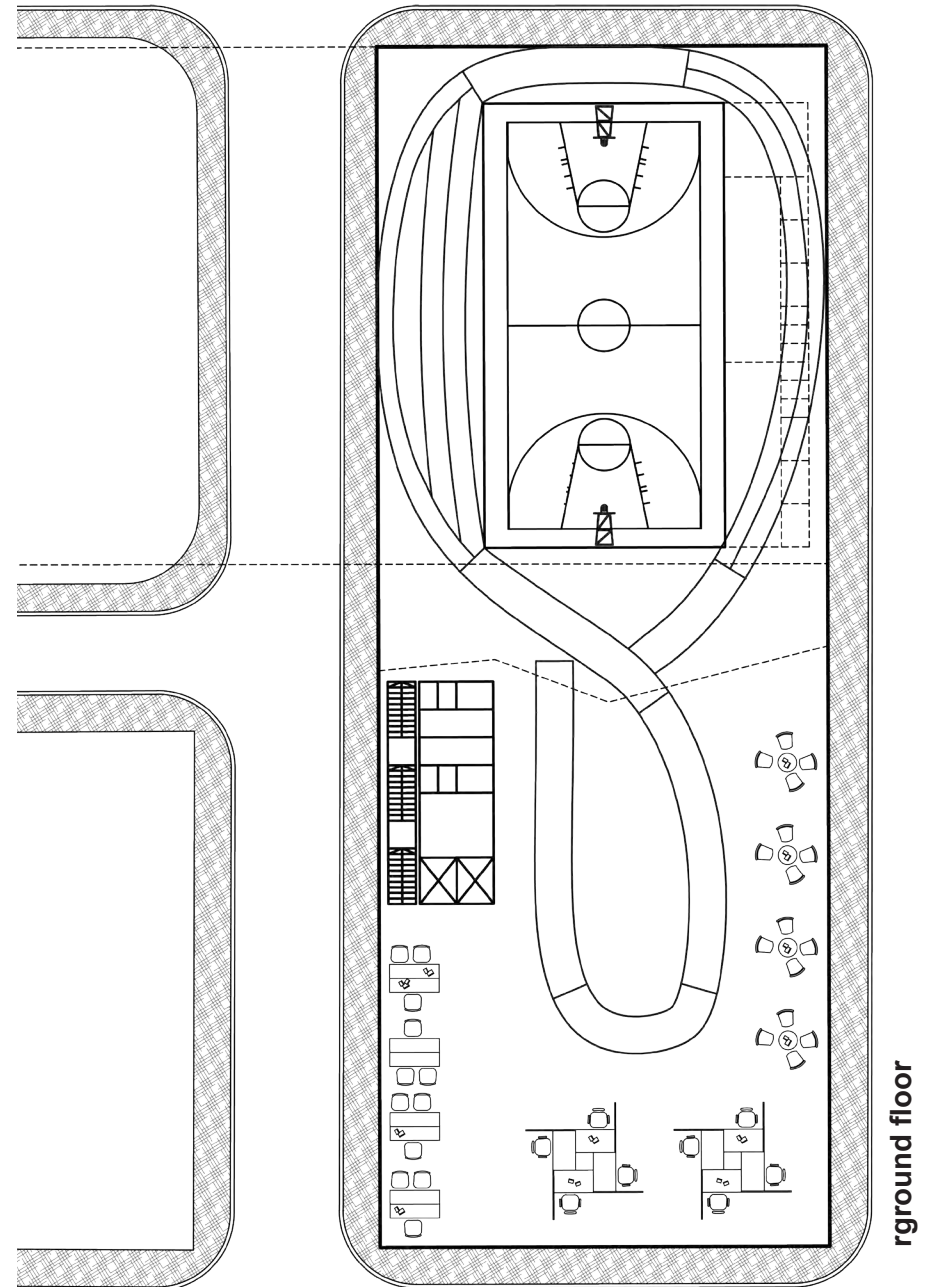
First floor plan



Plans and section 1:1000

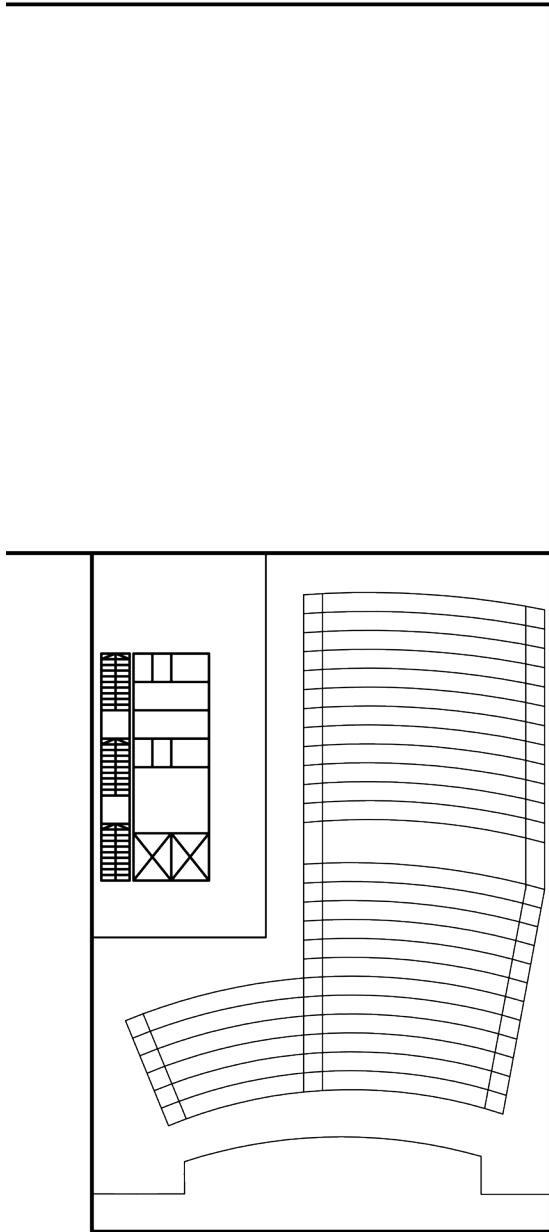


Plans 1:500

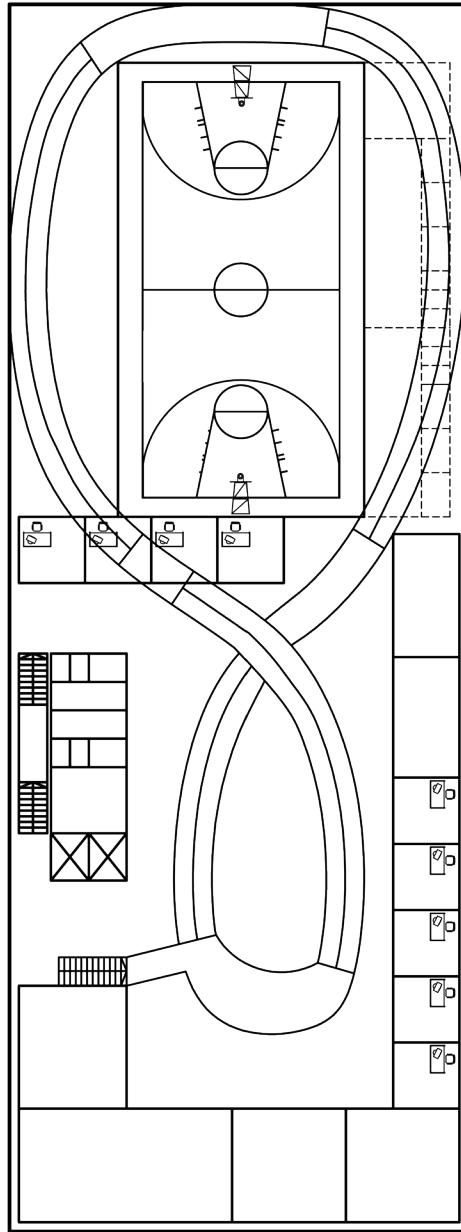




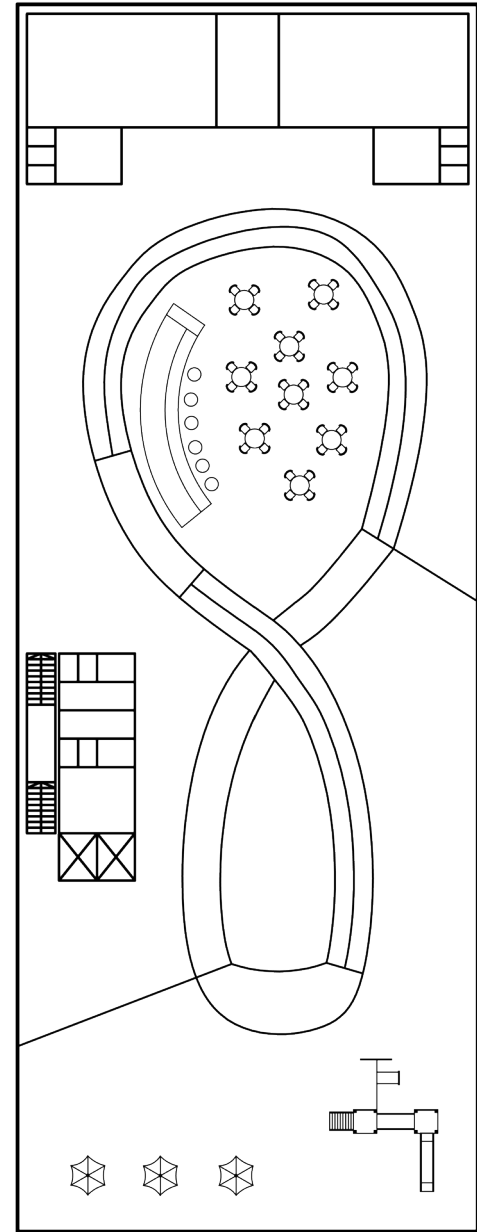
Plans 1:500



underground floor



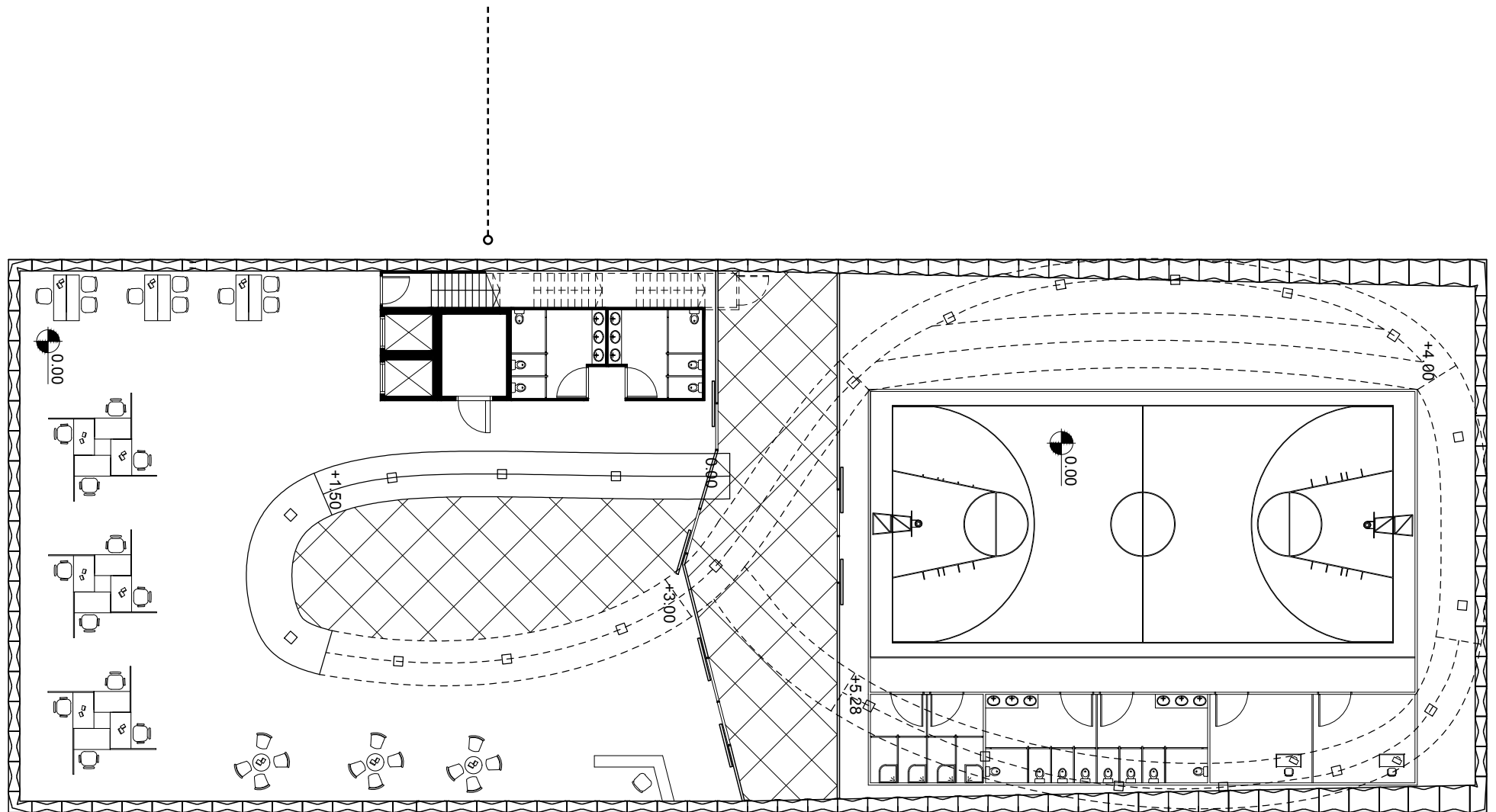
first floor



second floor

### Plan ground floor

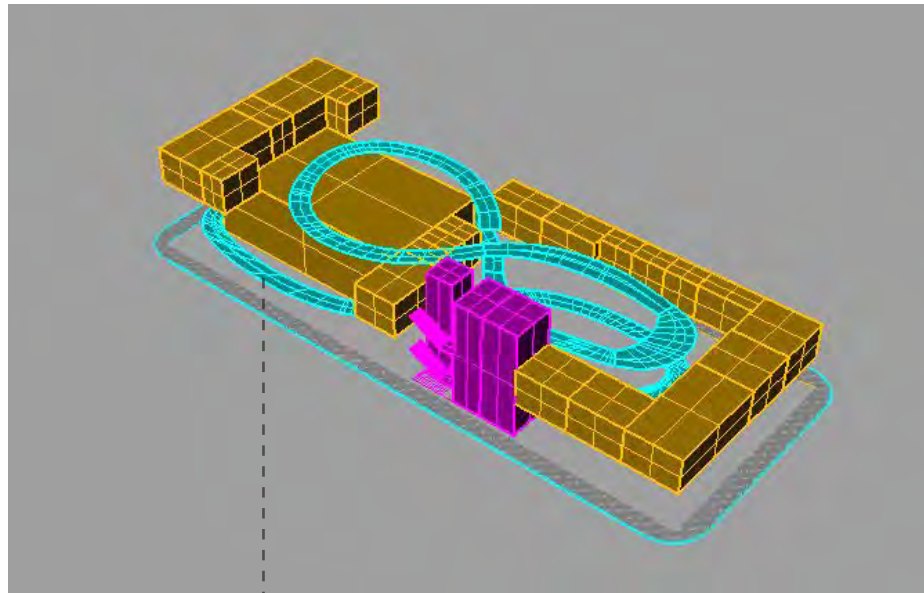
The connection between the plan and the building shell



### The idea

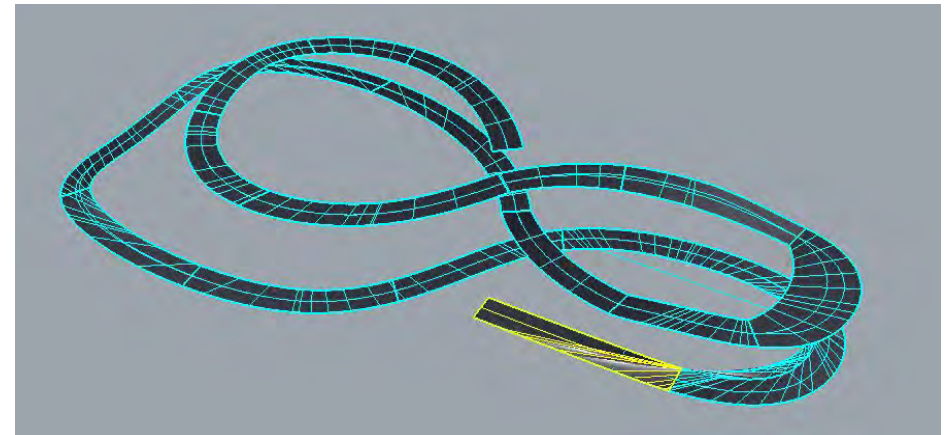
The idea for this exercise was taking the main element in the building, and try the topology optimization on it.

The ramp construction was planing with the grasshopper tool, in purpose for creating a separate element that stand alone at the building space.



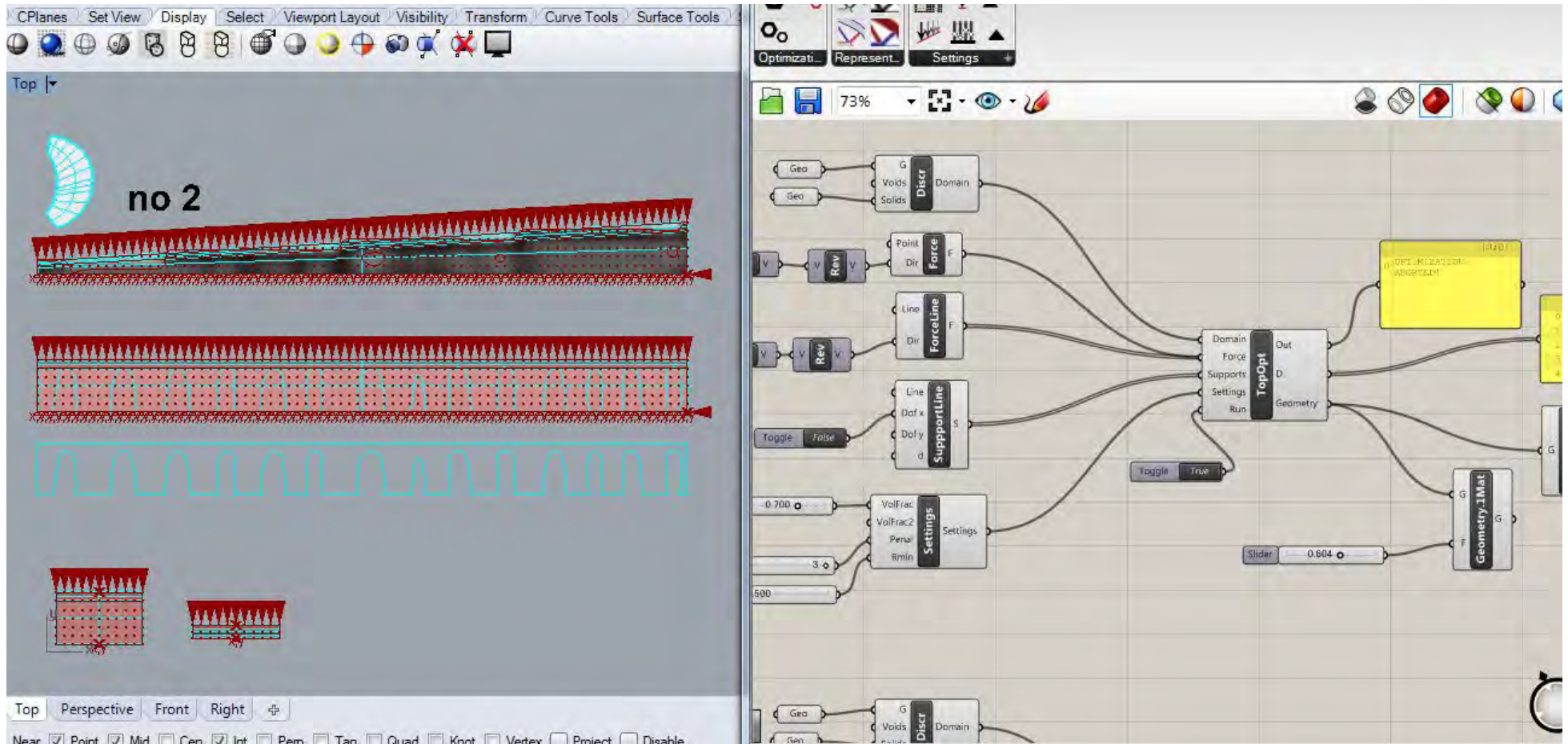
The ramp

For making it work in the grasshopper tools, I had to split the ramp to parts, and take each of the parts as a simple rectangle.



Steps - part one

1. The first try was taking the heights of each part, and create simple trap-zoid. This shape cant be translate with the tool, therefor the next steps are with rectangles.

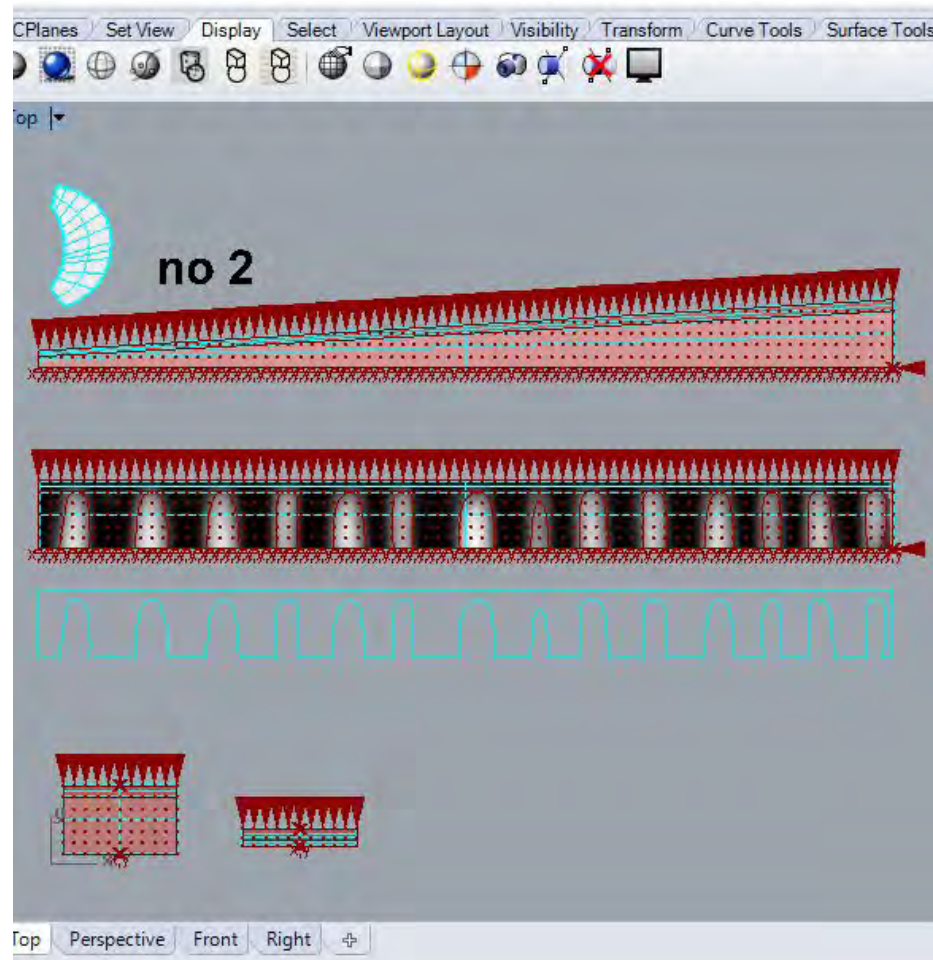


Using **TopOpt** plugin orders

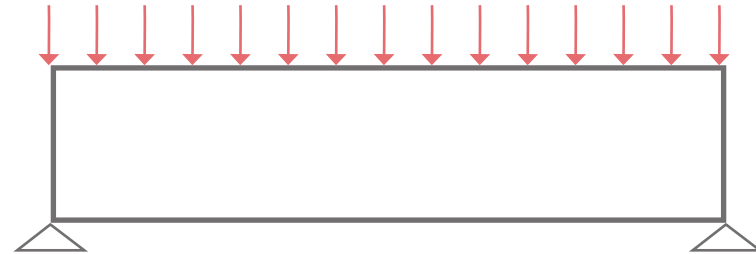


**Steps - part one**

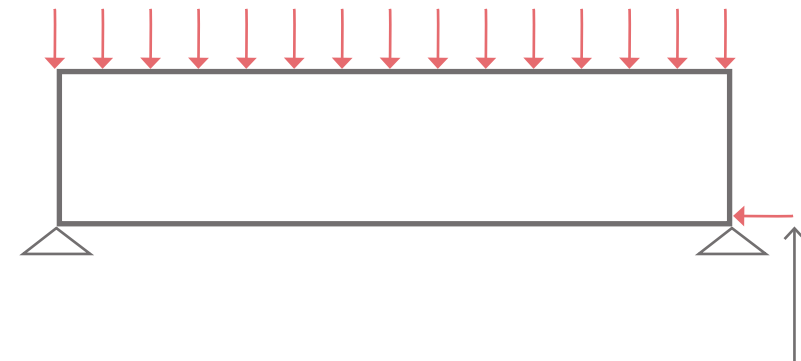
2. Making a simple scheme of the forces, one is for a straight parts, and one for the rounded.



**Straight parts**



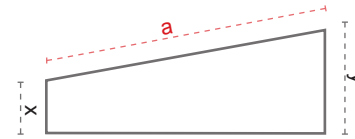
**Rounded parts**



Put one more force, from the side in X direction

Steps - part one

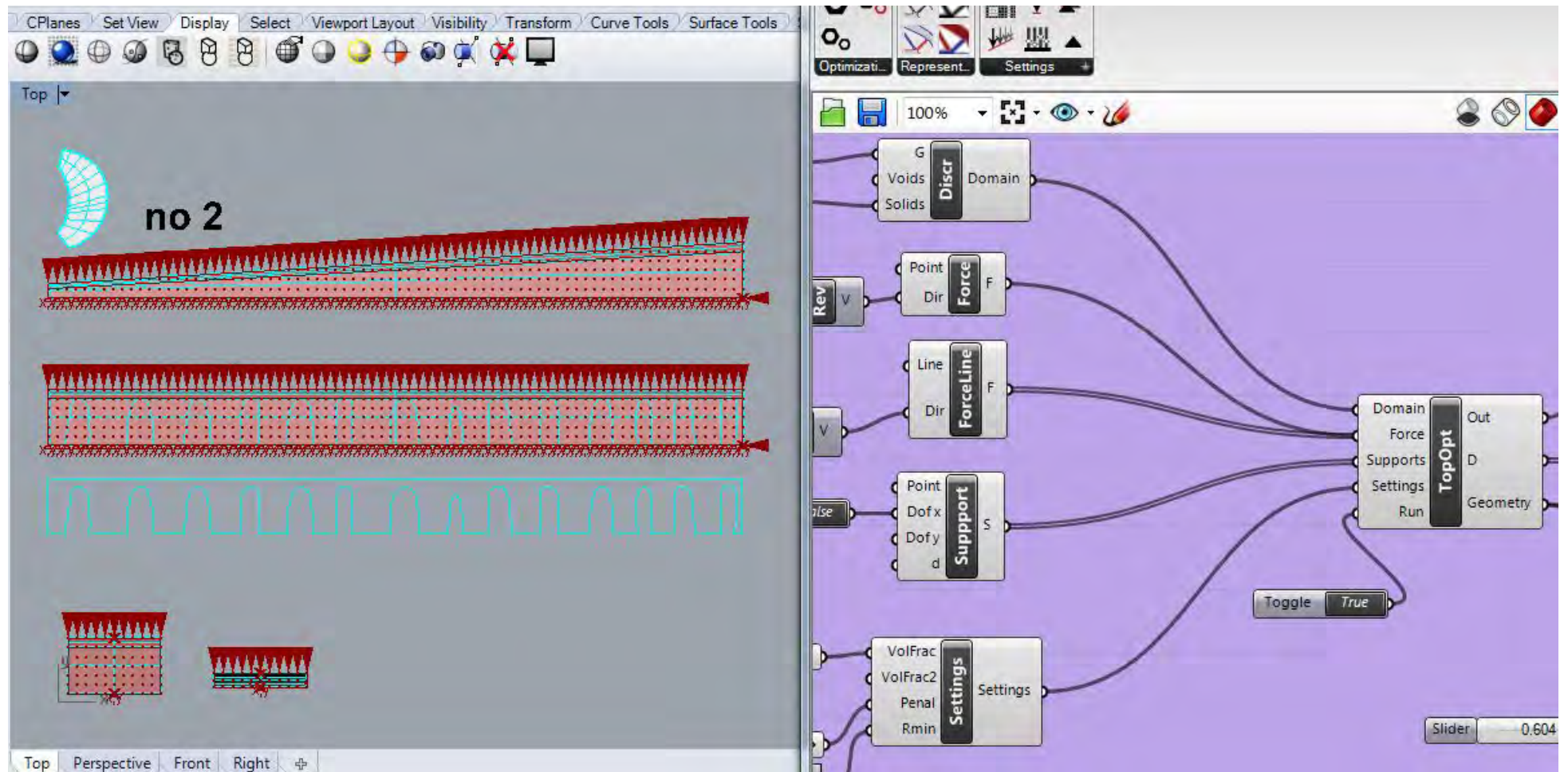
4. Create a stand section for part no. 2.



The screenshot displays a software interface with two main panels. The left panel shows a 3D model of a cellular structure, labeled 'no 2', which is a trapezoidal stand with a blue grid of cells inside. The right panel shows a Grasshopper script with various components connected to a central 'TopOpt' component. The script includes components for 'Domain', 'Force', 'Support', and 'Settings'. The 'Domain' component is connected to 'Geo' and 'Discr'. The 'Force' component is connected to 'Point' and 'Dir'. The 'Support' component is connected to 'Point' and 'Dof'. The 'Settings' component is connected to 'VolFrac', 'VolFrac2', 'Penal', and 'Rmin'. The 'TopOpt' component is connected to 'Domain', 'Force', 'Support', and 'Settings'. The 'TopOpt' component has a 'Toggle' set to 'True' and a 'Slider' set to '0.604'. The 'TopOpt' component outputs 'Out', 'D', and 'Geometry'. The 'Geometry' output is connected to a yellow box containing text: 'no. of cells: 6, cost: 3.643e, constraint: 0.0, 0.0100:'. The interface also shows a toolbar with various tools and a status bar at the bottom.

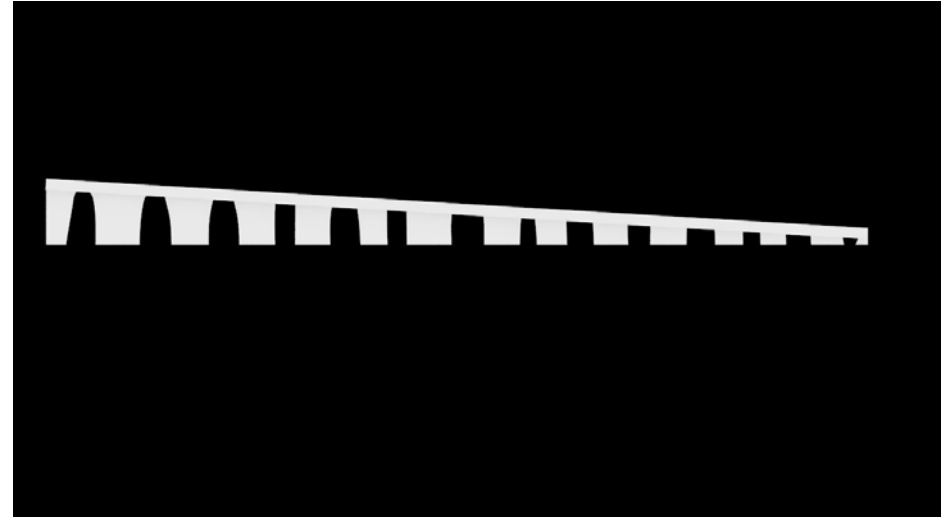
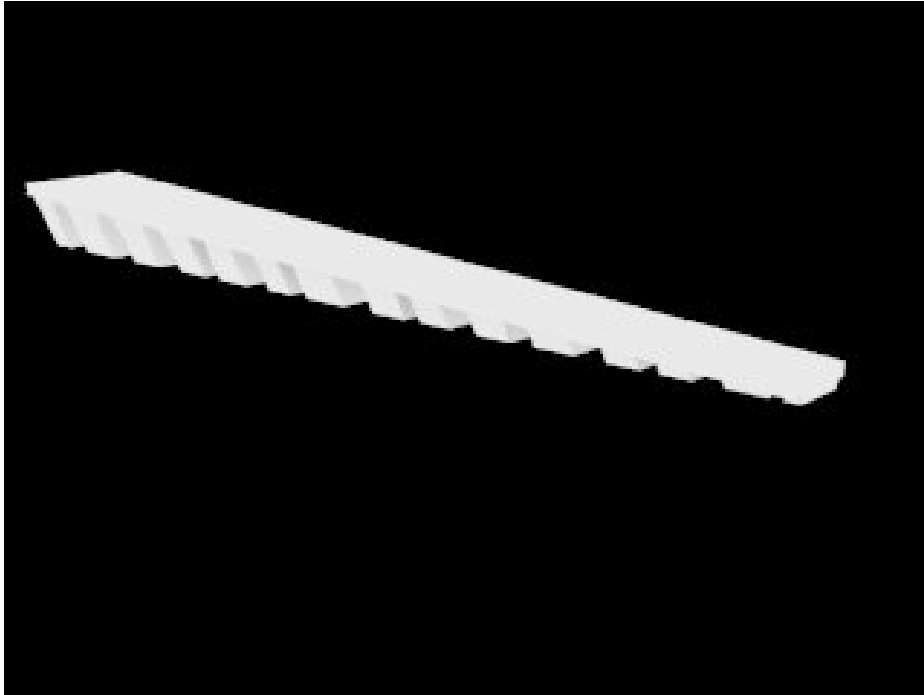
Steps - part one

4. One section in the beginning and one section at the end on this part.



*Steps - part one*

5. Join the three section, for creating 3-D ramp.

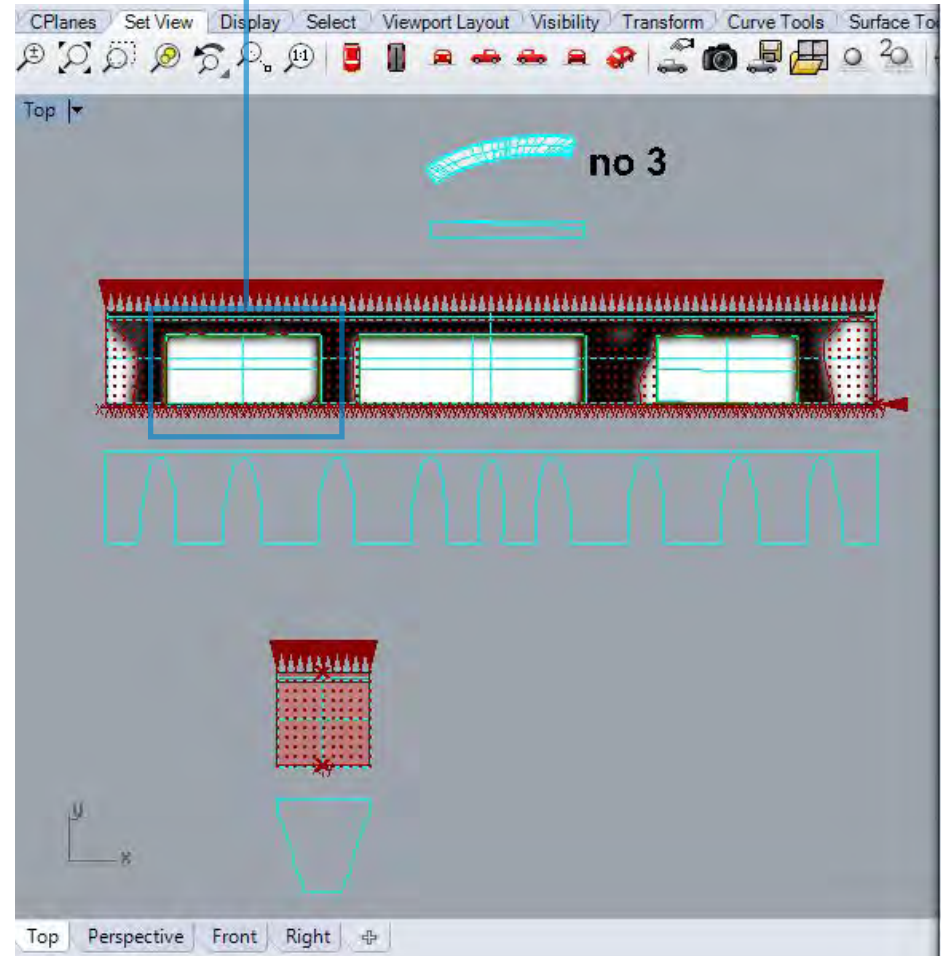
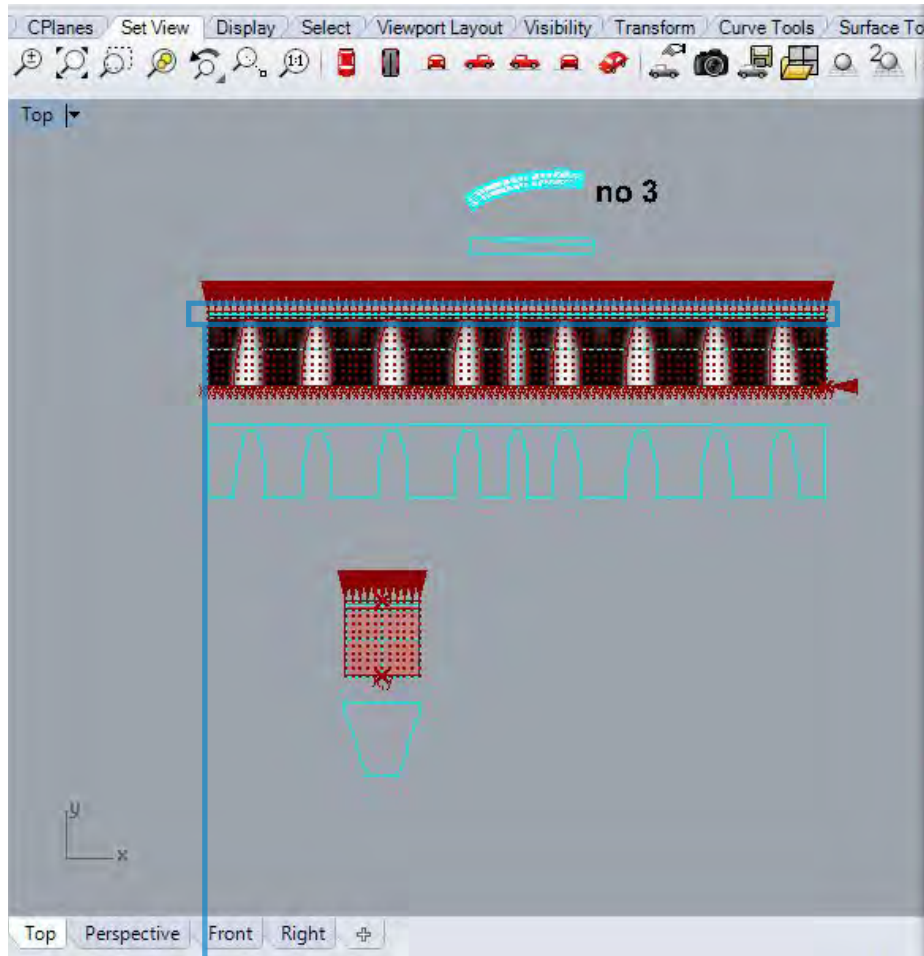




### Steps - part two

6. Changing the setting by the building program.

Using **Solids + Voids** orders

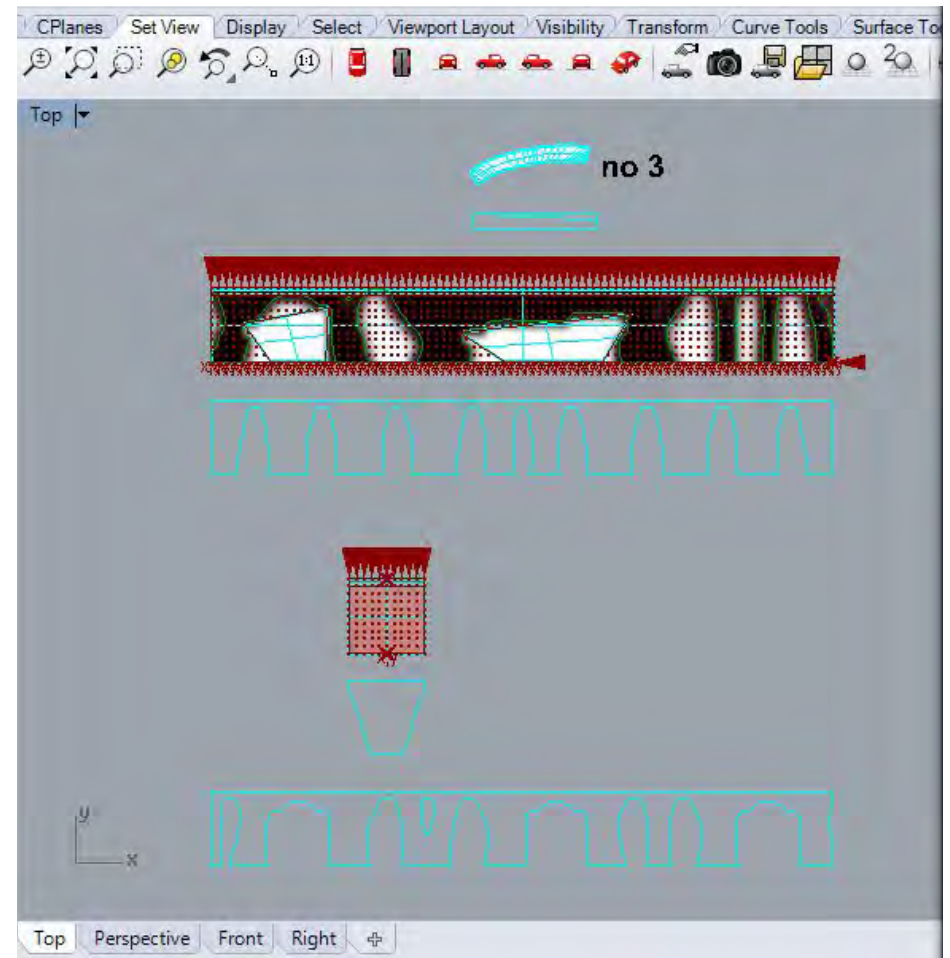
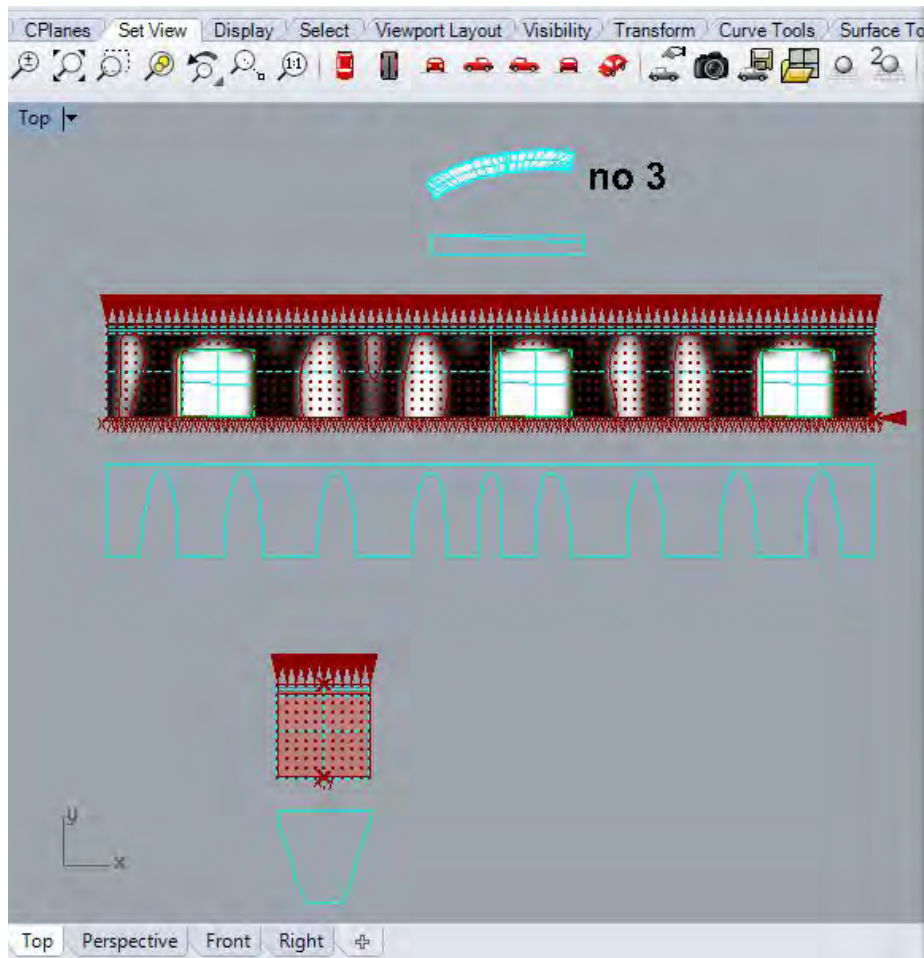


Keeping a 20 cm of solid

## Steps - part two

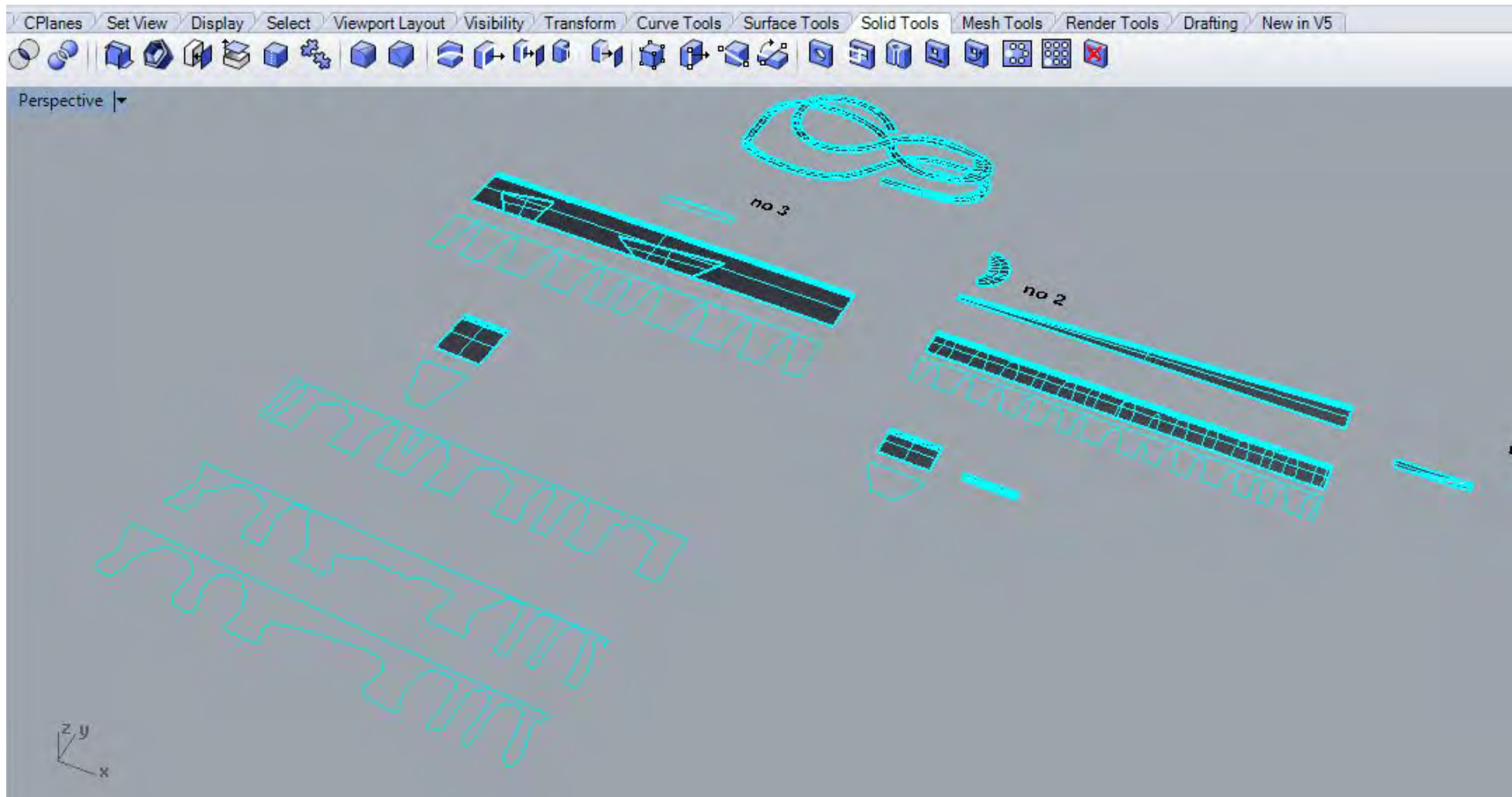
6. Changing the setting by the building program.

Using **Solids + Voids** orders



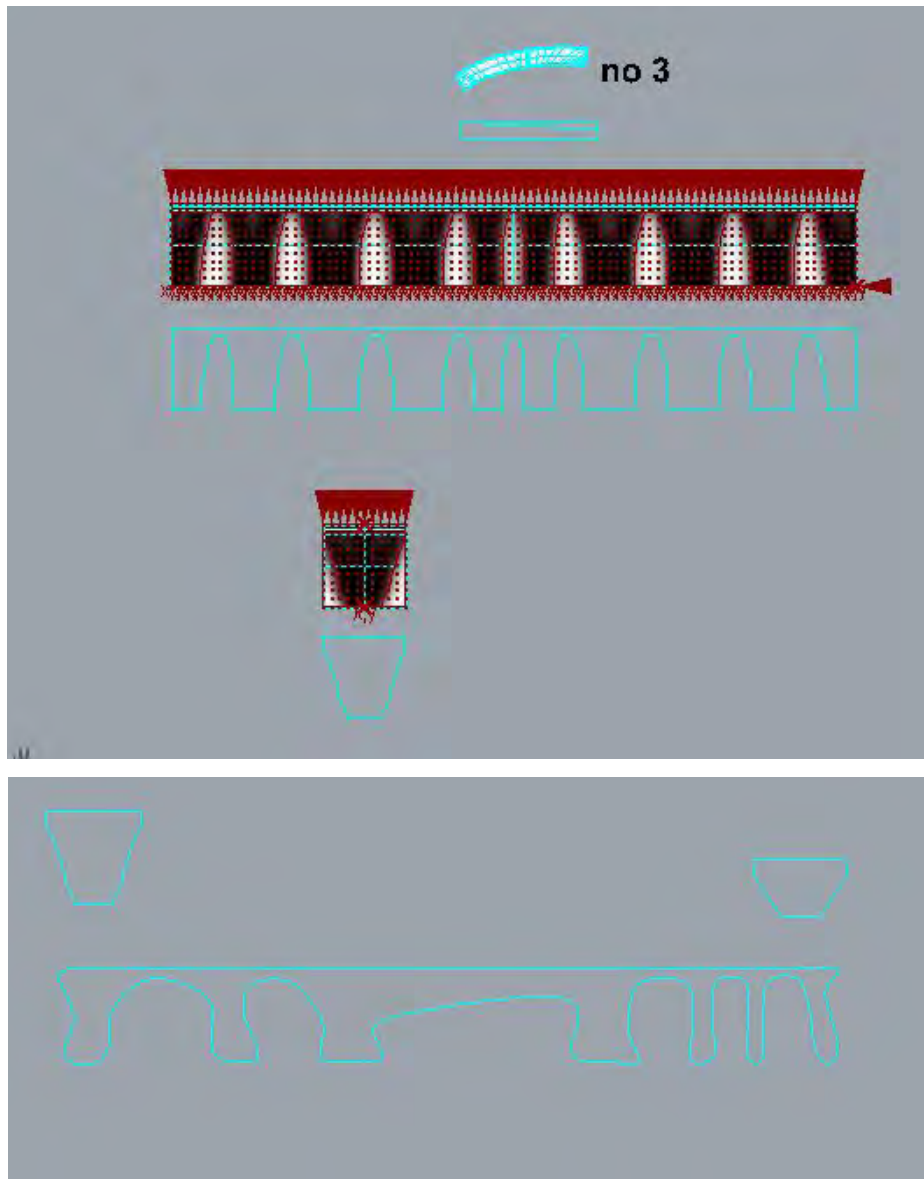
## Steps - part two

7. Select the best of the experience, fixed it and join to the other section.



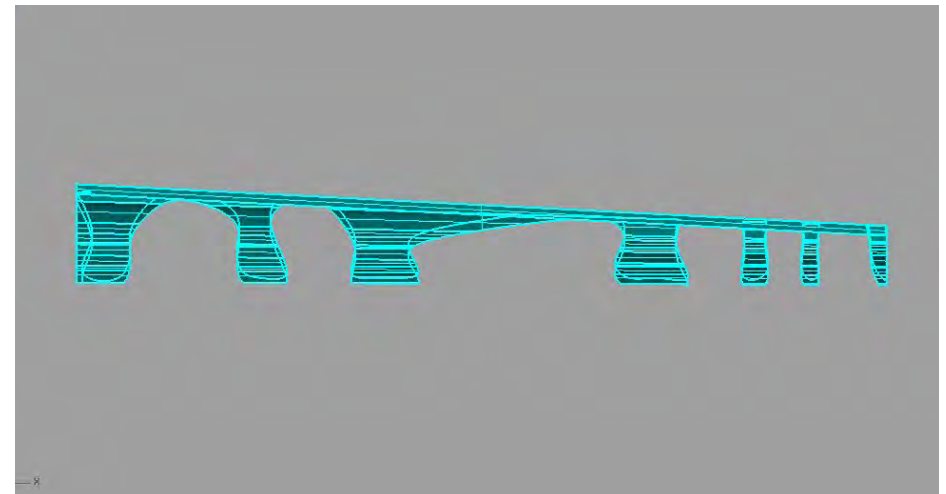
### Steps - part two

7. Select the best of the experience, fixed it and join to the other section.



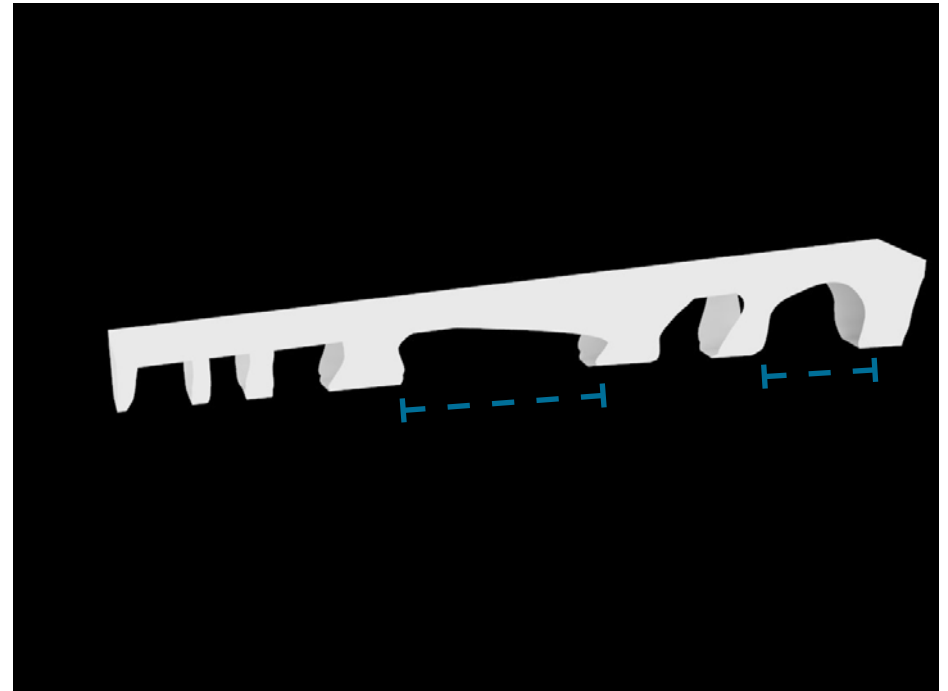
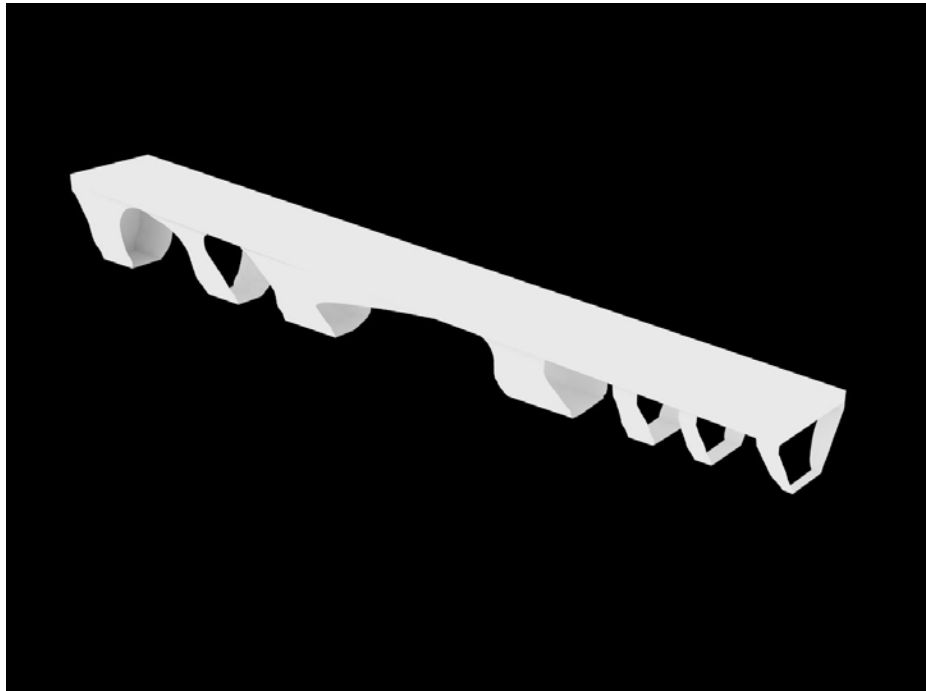
### Steps - part two

8. Join the three section, for creating 3-D ramp.



*Steps - part two*

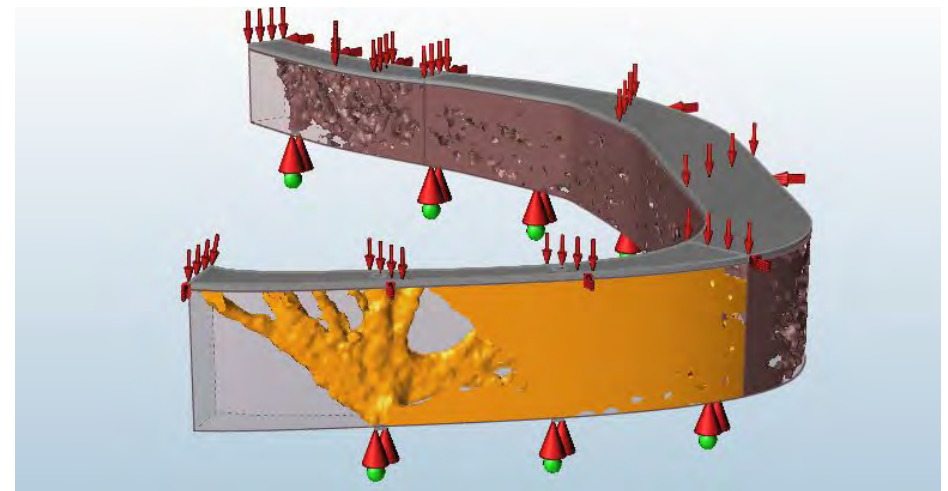
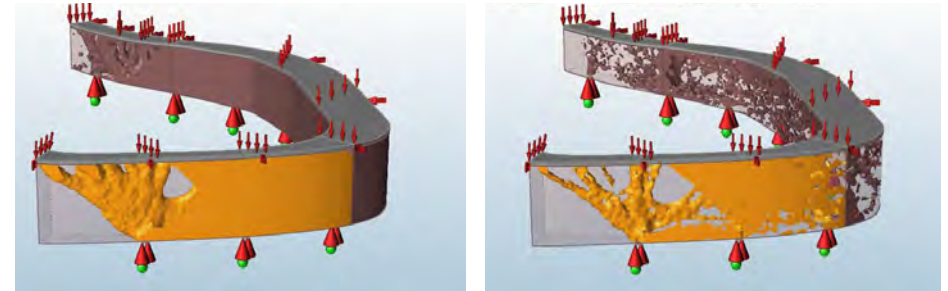
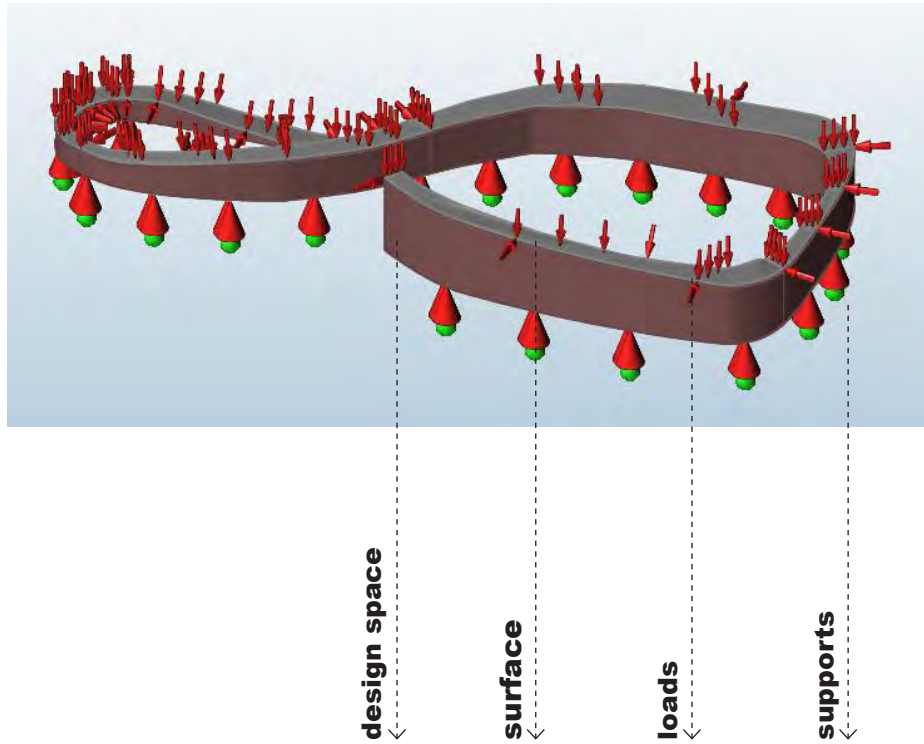
8. Join the three section, for creating 3-D ramp.



### Design the ramp in 3d

Use inspire - solid thinking software, to create a 3-D form of the ramp. The form of the ramp, is resulting the topology optimization, by defining the loads and supports.

The best result at **30%** of the design space volume

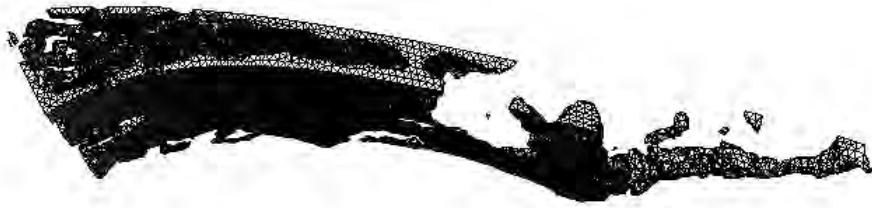


Using **Solid thinking**



*Design the ramp in 3d*

Rebuild the meshes in rhino.



**Perspective**

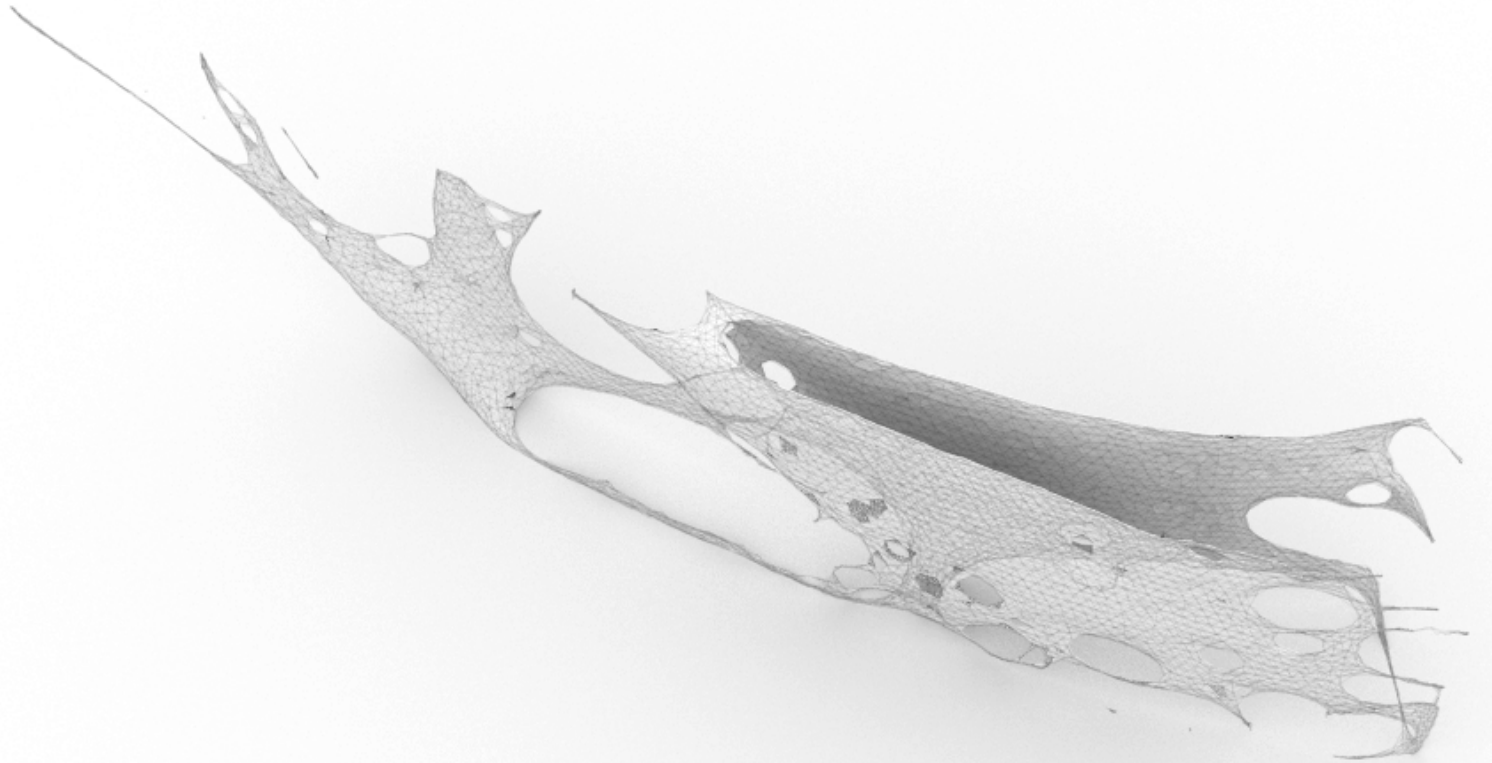


**Top**



**Front**

*Design the ramp in 3d*



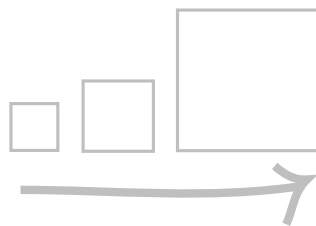
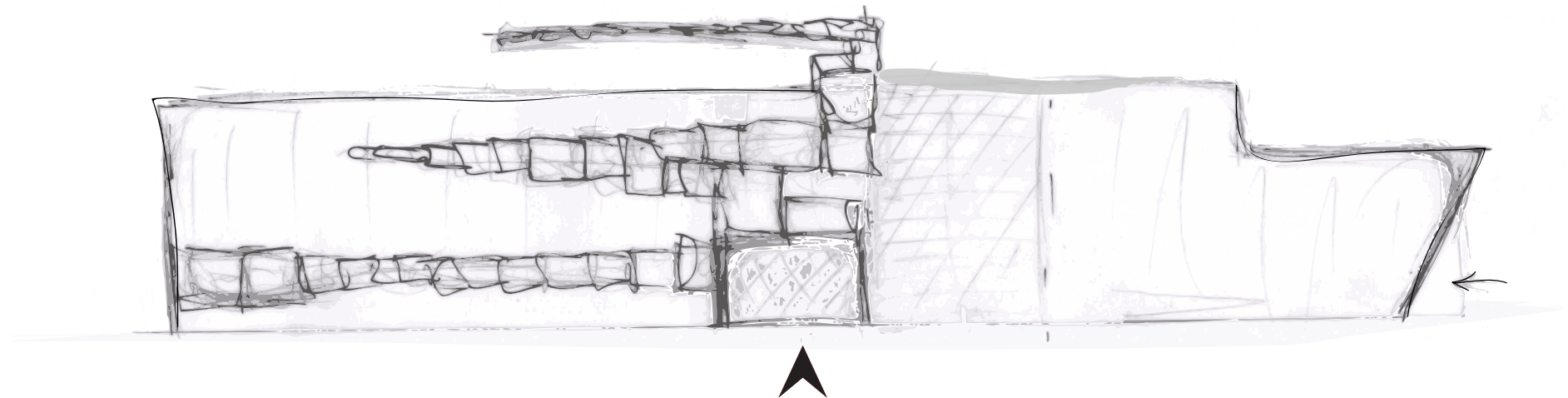
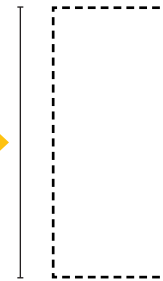


## Design the facade

The facade of the building caused by the cell design. The creation of the facade has to consider either the cell form and the building form, specially the ramp.

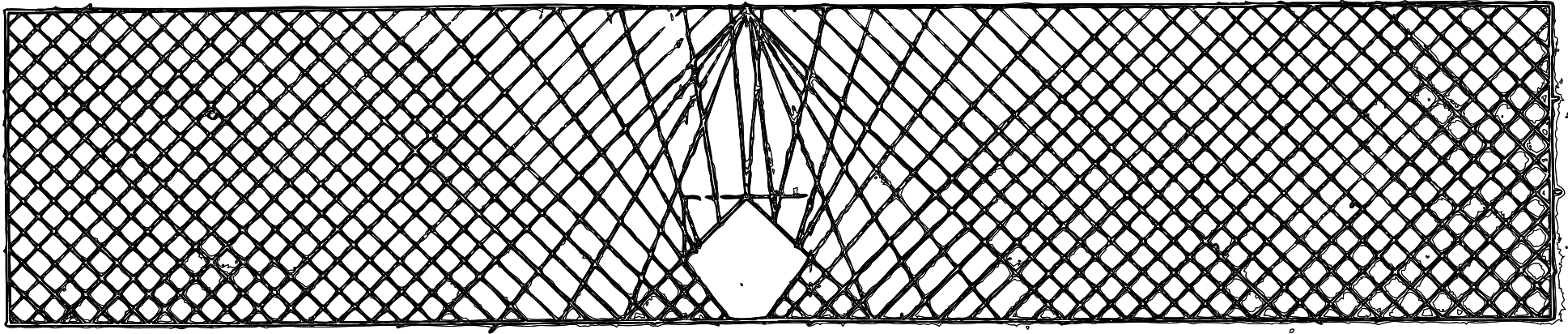
**01.** In the first sketch, the size of the cell influenced by the entrance and the ramp way. The idea was to focus on the entrance - the passage through the building, and to emphasize the main element.

The facade →

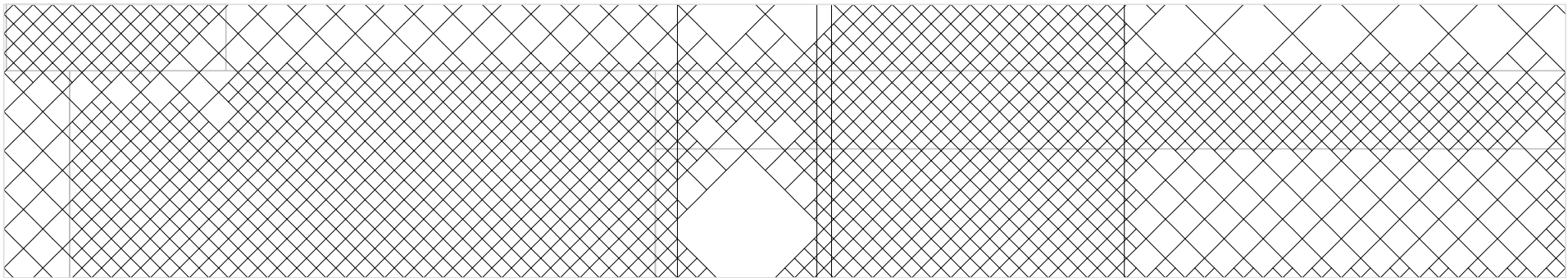


### *Design the facade*

**02.** This facade, changing the grid form. In this case, again, the entrance to the building become a attraction point to the all changing.

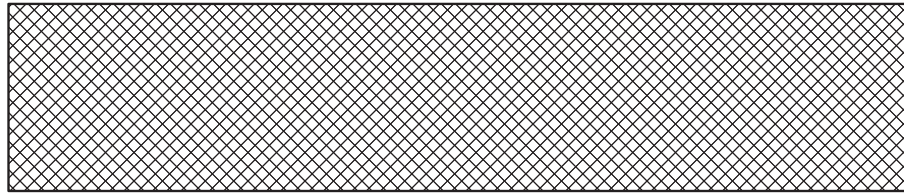


**03.** The main factor in this facade is the program. Functions and spaces that can be open to the street, get a bigger cell size, and spaces like the main core or private offices gets a smaller cell size.

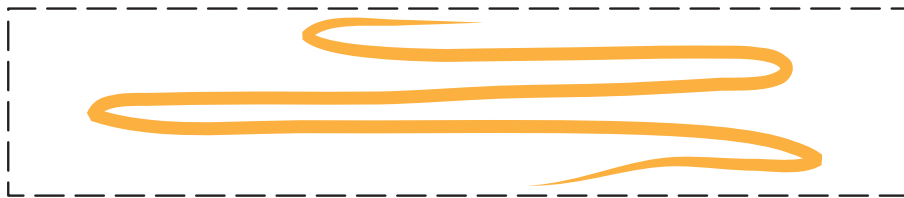


*Design the facade*

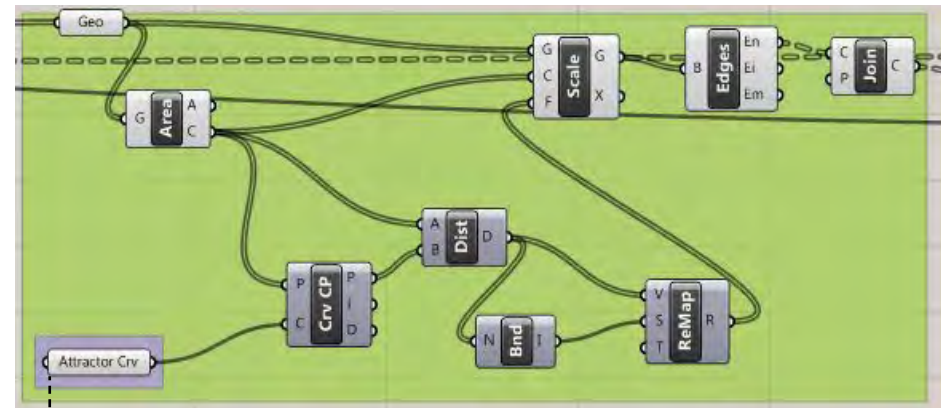
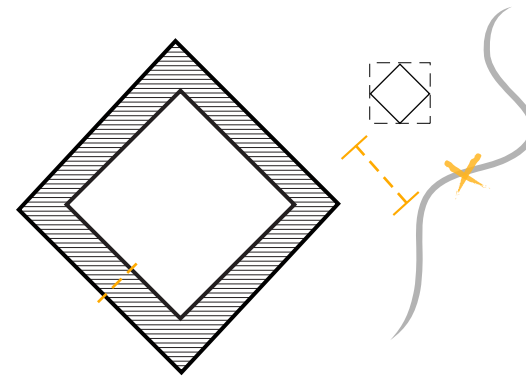
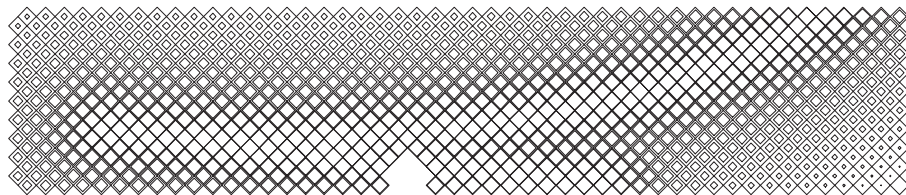
04. The final facade created by using the grasshopper - make the ramp way the attractor curve to changing in the cells opening size.



+



=

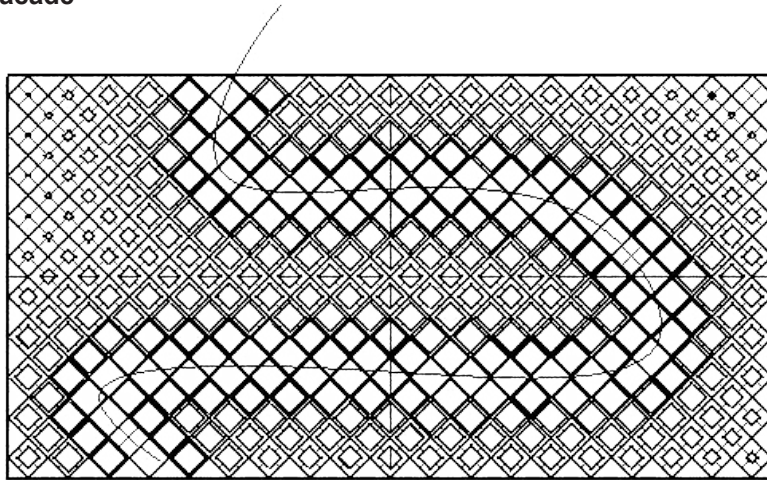


->Using **Attractor curve + scale** orders

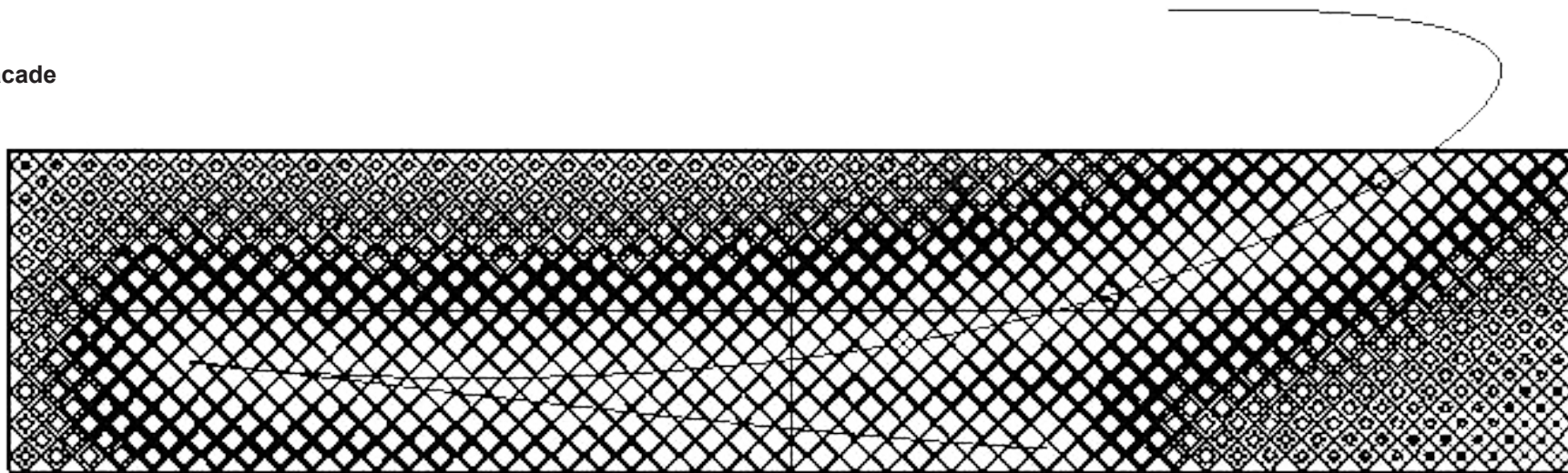


*Design the facade*

South facade

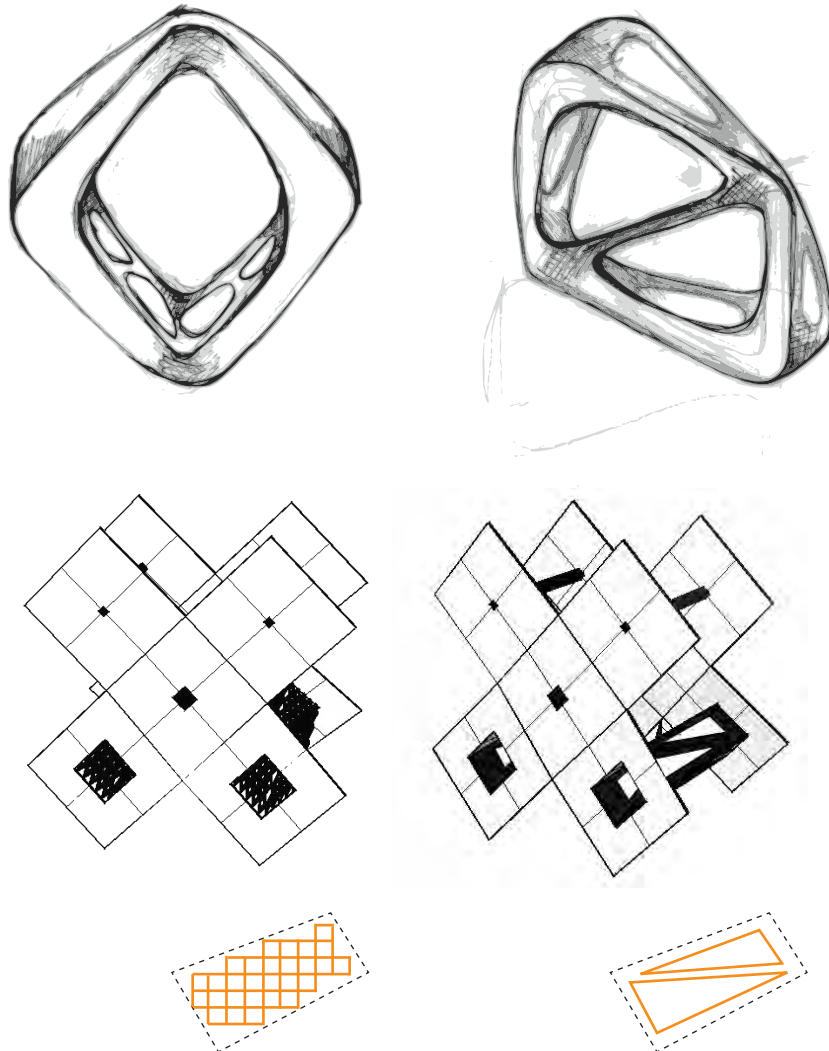


West facade

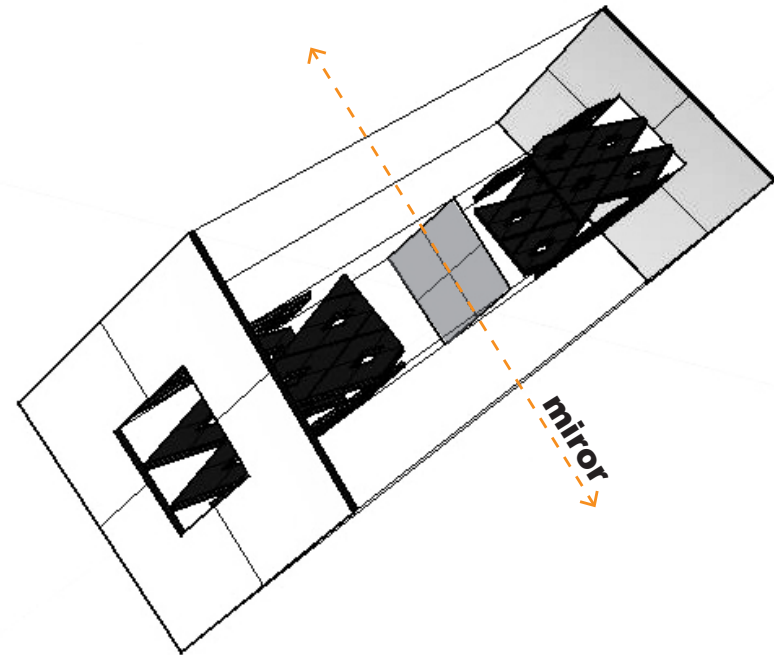


### Passive ventilation

The last step in the cell development, was to improve ventilation through the cell, by taking care of the inner side. Different ways of perforation the inner side, would make a free path for cool air getting inside the building, and hot air can be released at the top.



There are two examples of making the perforation, one by using the diamond grid, and the other was making triangle.



1. Using **Diamond srf + scale** orders
2. Using **Polyline + scale + split** orders



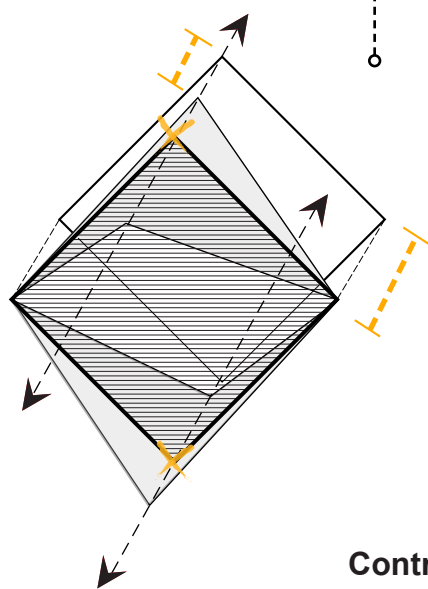


ממשק אדריכלי המאפשר מעבר בין רקמות שונות ואזור פעילות המהווה נקודת משיכה מטרופולינית. במקביל להתחדשות העירונית, מבנה ציבור המאזן את הפעילות ואופי השוק עם סביבת המגורים והמסחר במרכז תל אביב. הפרויקט מביא לידי ביטוי ציבוריות יומיומית חיה בתוך המארג ההסרגני של המתחם. המבנה מאפשר פעילות ציבורית גלויה, מעבר בין פנים וחץ דרך פרוגראמה משתנה לאורך כל שעות היום.

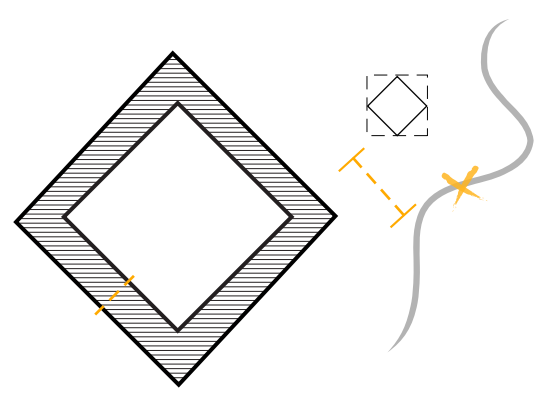


המעטפת | קוד סופי לתכנון החזית

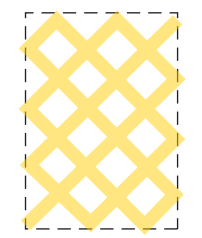
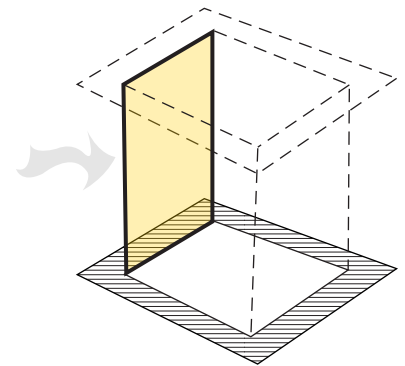
- חלוקה של הקוד לארבעה חלקים עיקריים:  
 01. יצירת משטח - גריד מעויינים  
 02. קונסטרוקציה - קבלת נפח משתנה  
 03. פתחים - כפונקציה של המרחק מן הרמפה  
 04. אזור טבעי - חירור של הדופן הפנימית



Contraction

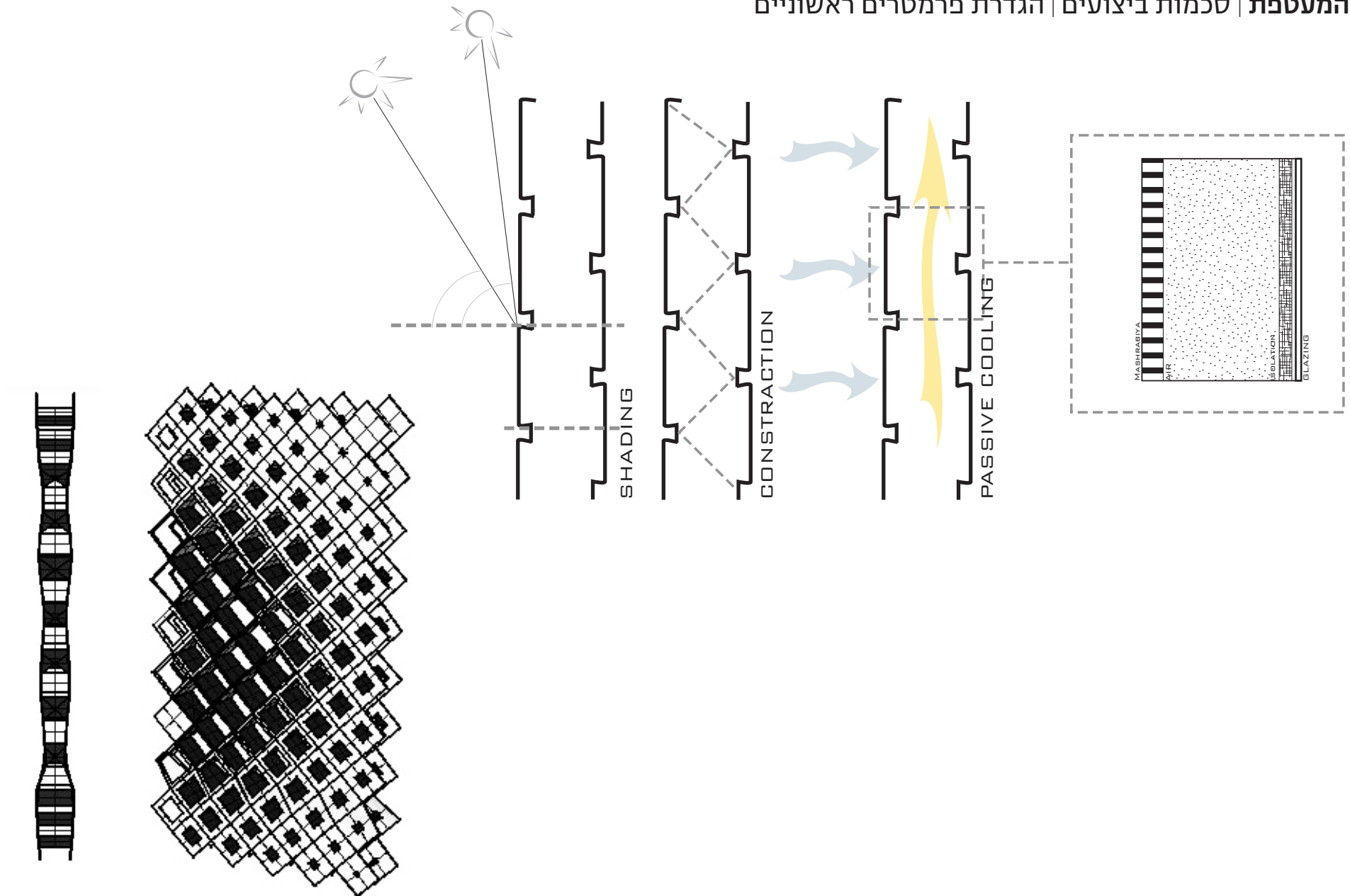


Opening



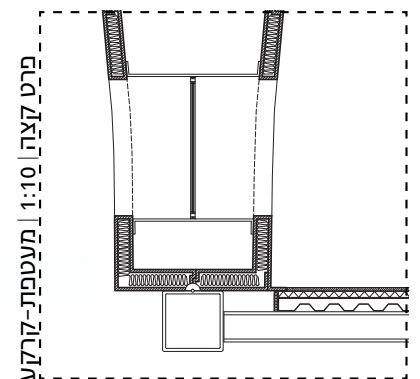
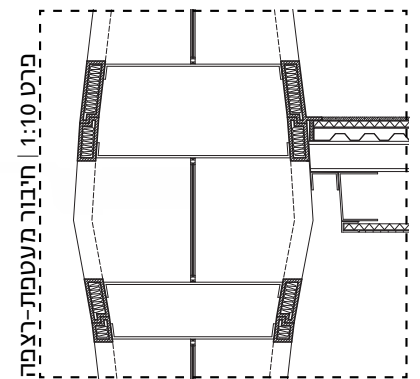
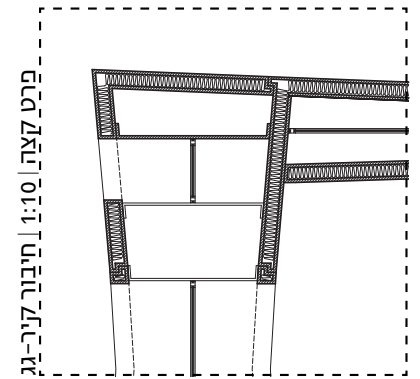
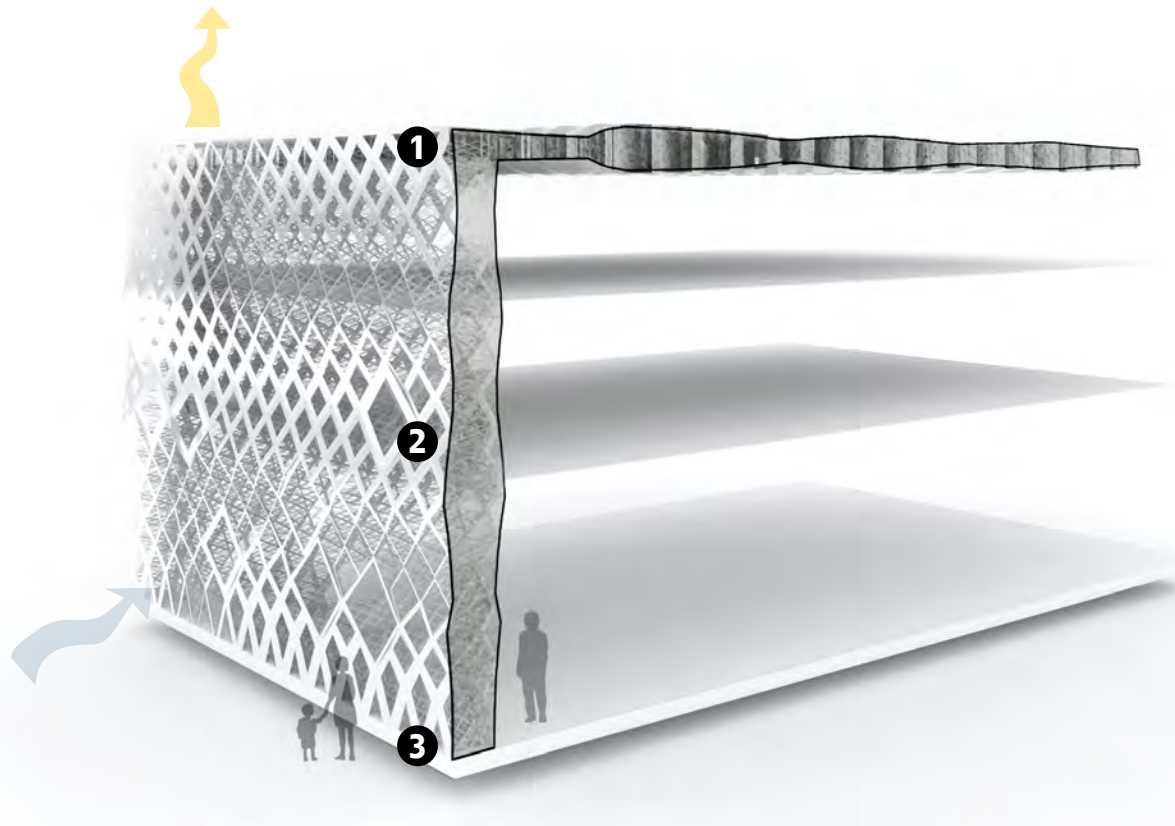
Ventilation

המעטפת | סכמות ביצועים | הגדרת פרמטרים ראשוניים





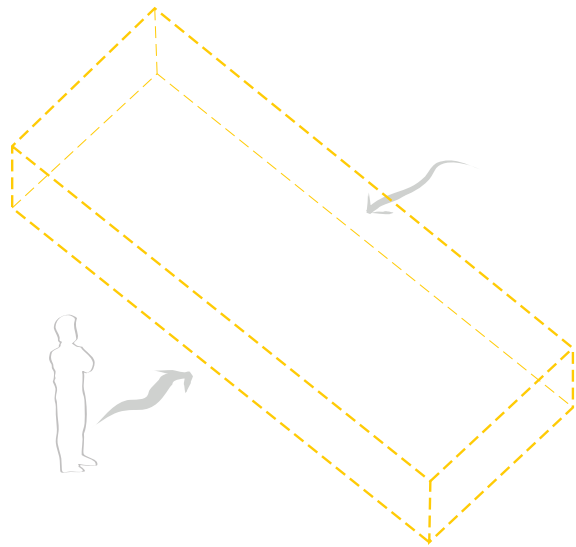
המעטפת | קלטלוג פרטים



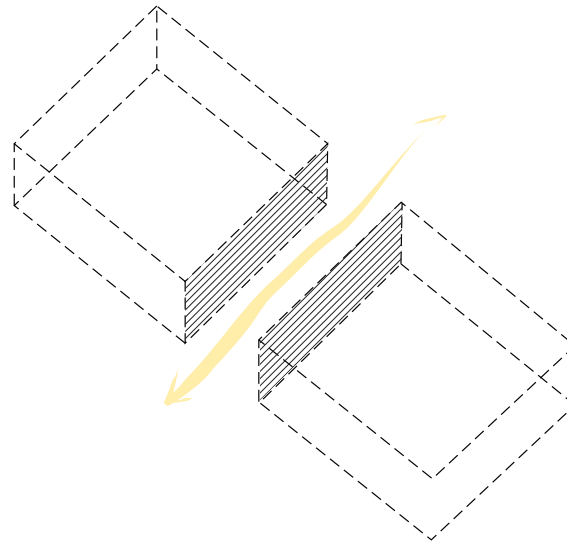
# המבנה | סכמות תכנון ראשוניות

תכנון מבנה ציבור על גבי תא שטח נתון

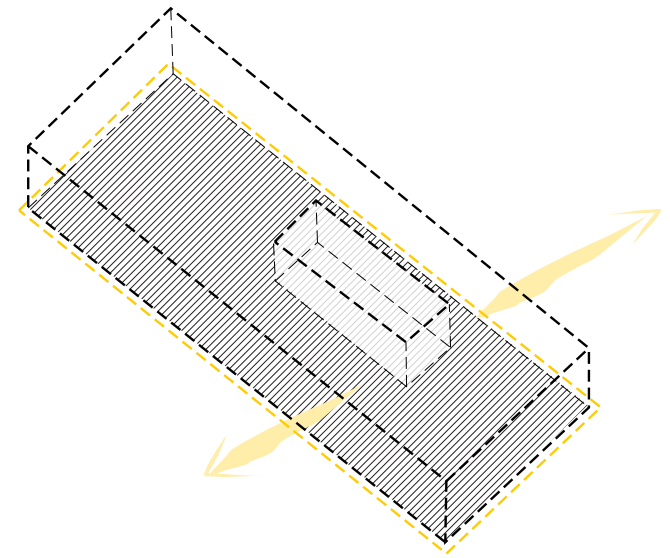
דרישה לדרך בתא השטח



חציה של המבנה לשני מבנים

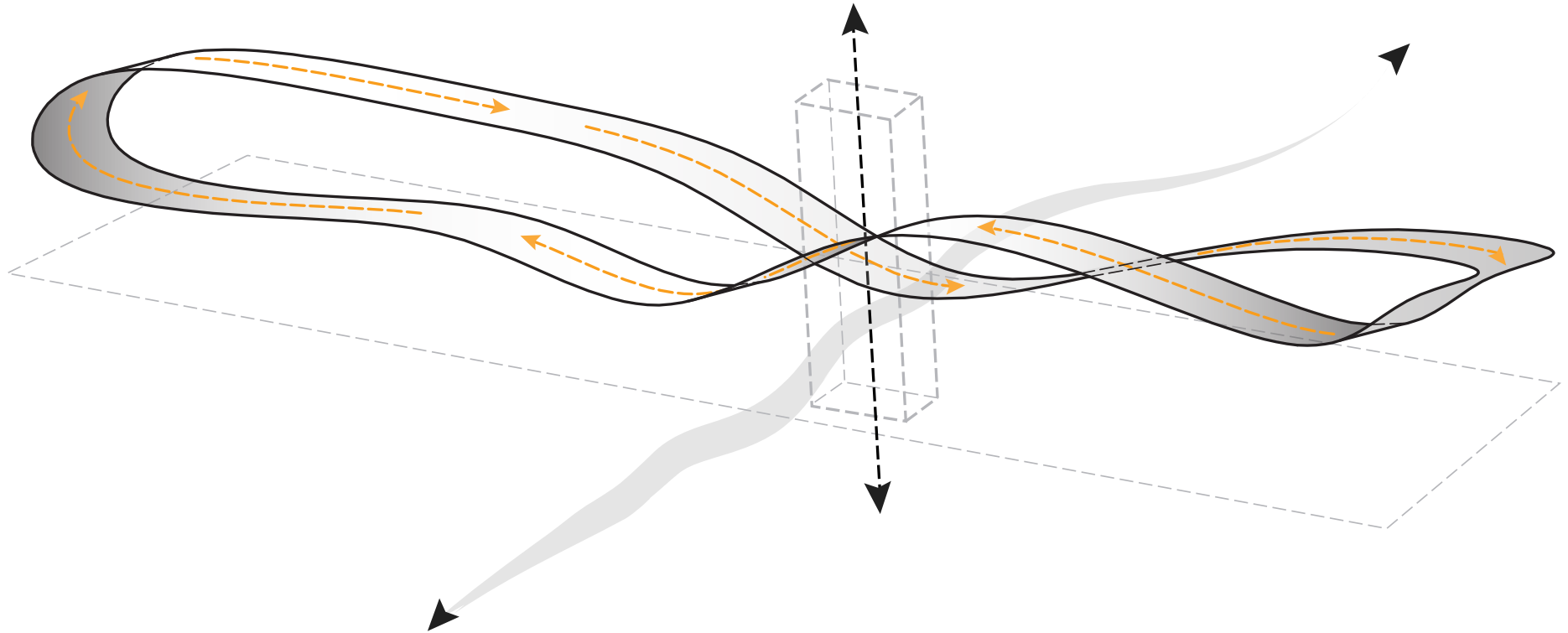


גיאומטריה המאפשרת מעבר



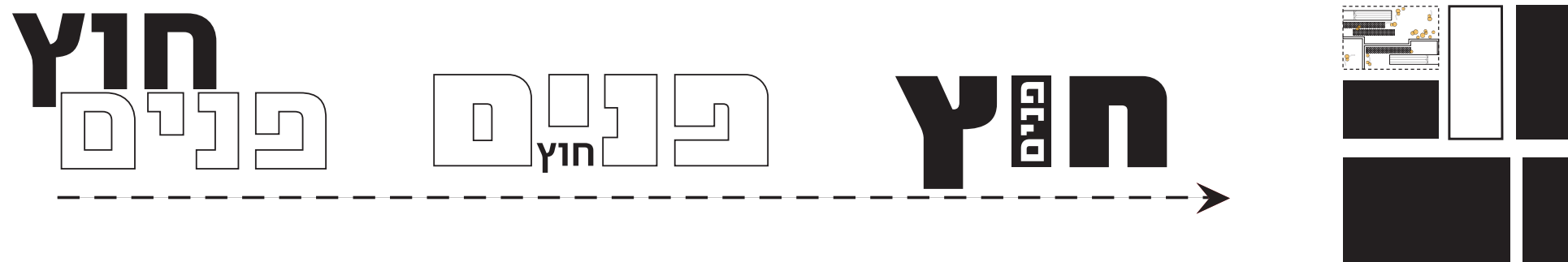
המבנה | עקרונות תכנון | סרקולציה

דרך חווייתית מהווה את נתיב התנועה המרכזי במבנה



המבנה | פעילות 24 שעות ביממה

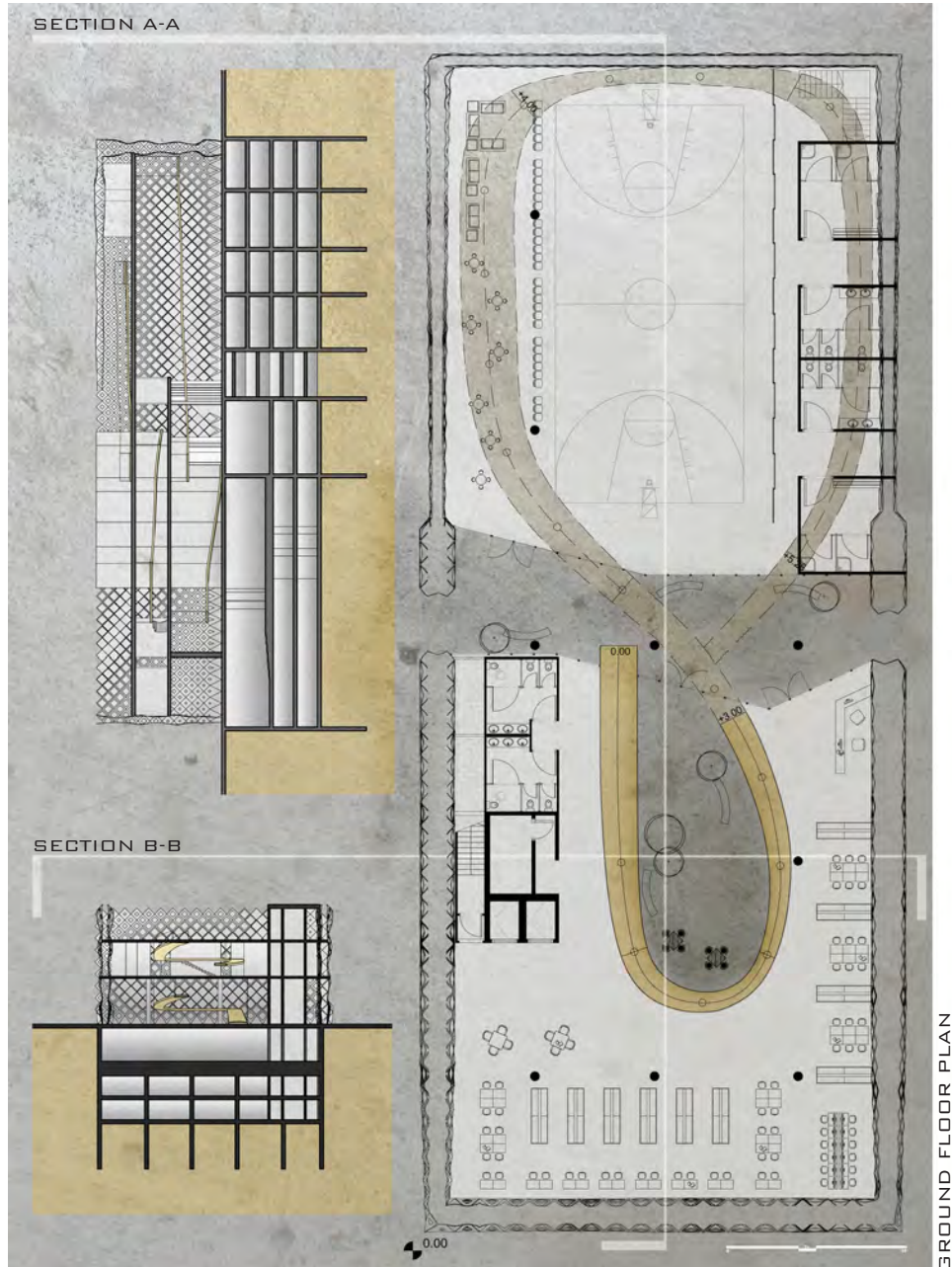


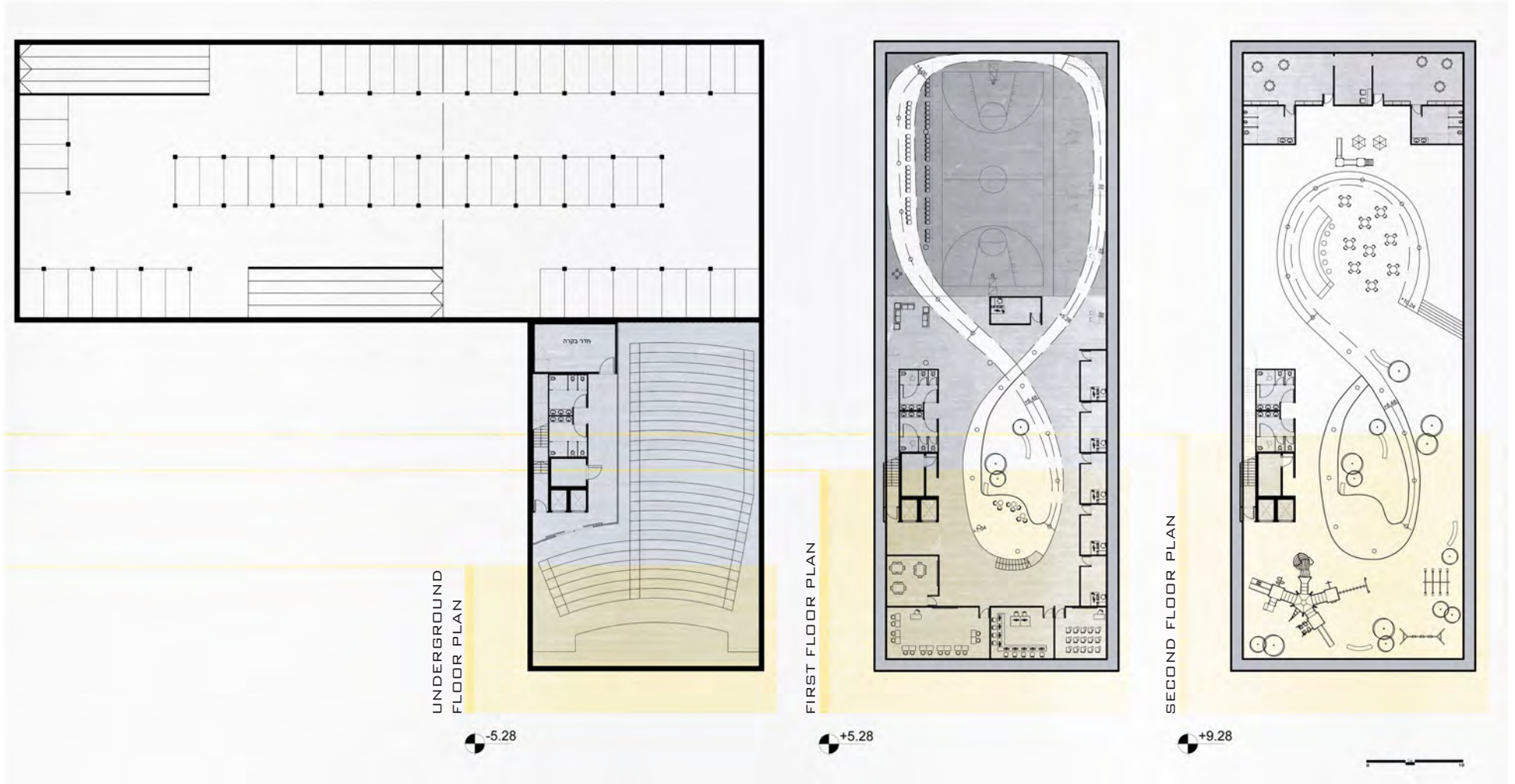


הפרויקט משלב בין תכנון **רמפה** למעטפת המבנה. הרמפה מהווה את גרעין התנועה המרכזי ולאורכה שזורים החללים השונים. המבנה מייצר חוויית משתמש כפולה, מצד אחד פונקציות ציבוריות סגורות ומצד שני מסלול פתוח 24 שעות ביממה המוביל לגן משחקים בגג. הפרויקט מייצר נגישות וציבוריות חדשה, תוך שמירה על דו קיום בין החוץ והפנים.

המבנה | פעילות | חתך פרספקטיבי





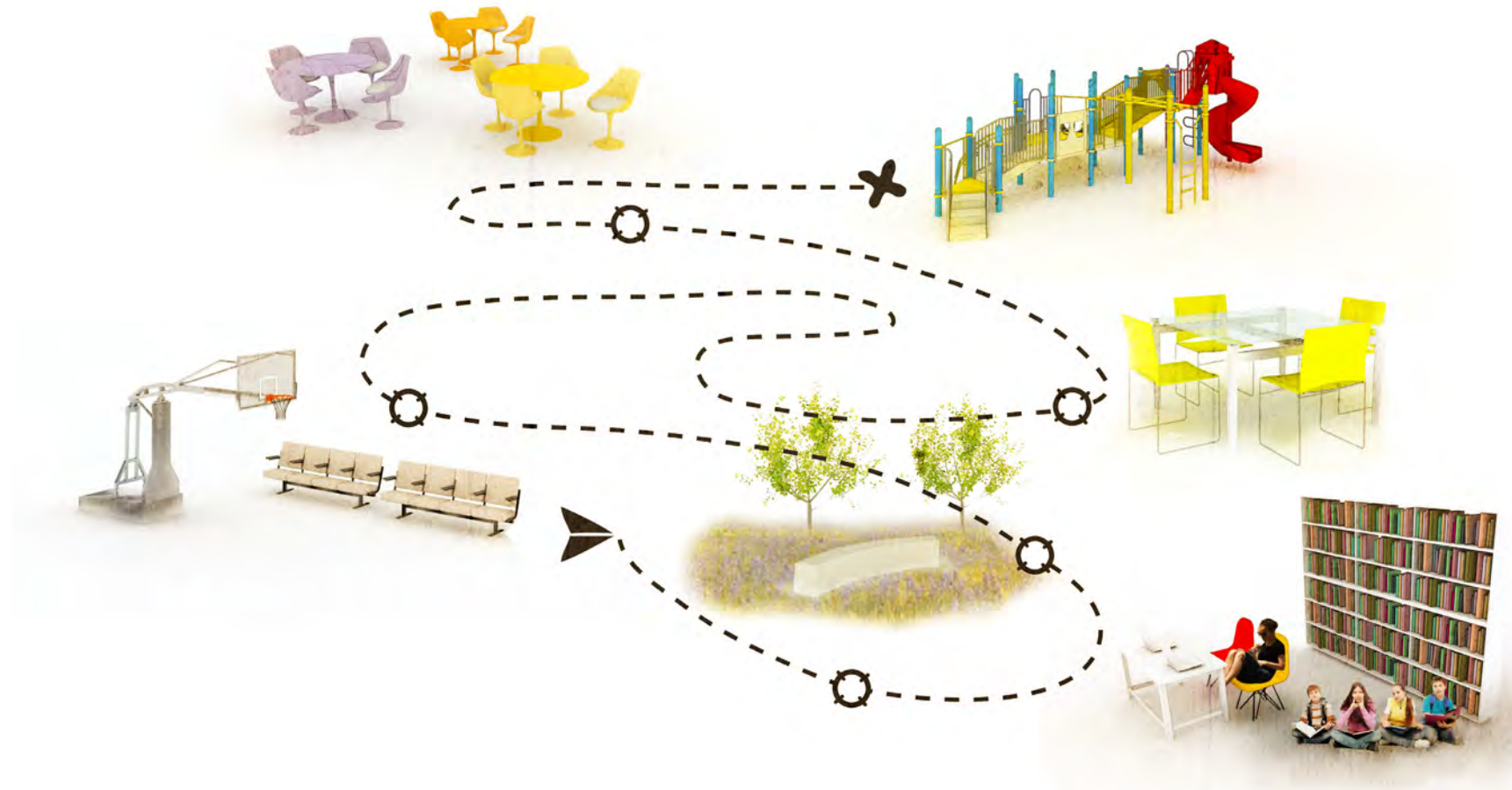


זום אין | מבט מתוך הספרייה | חצר פנימית | כניסה למבנה

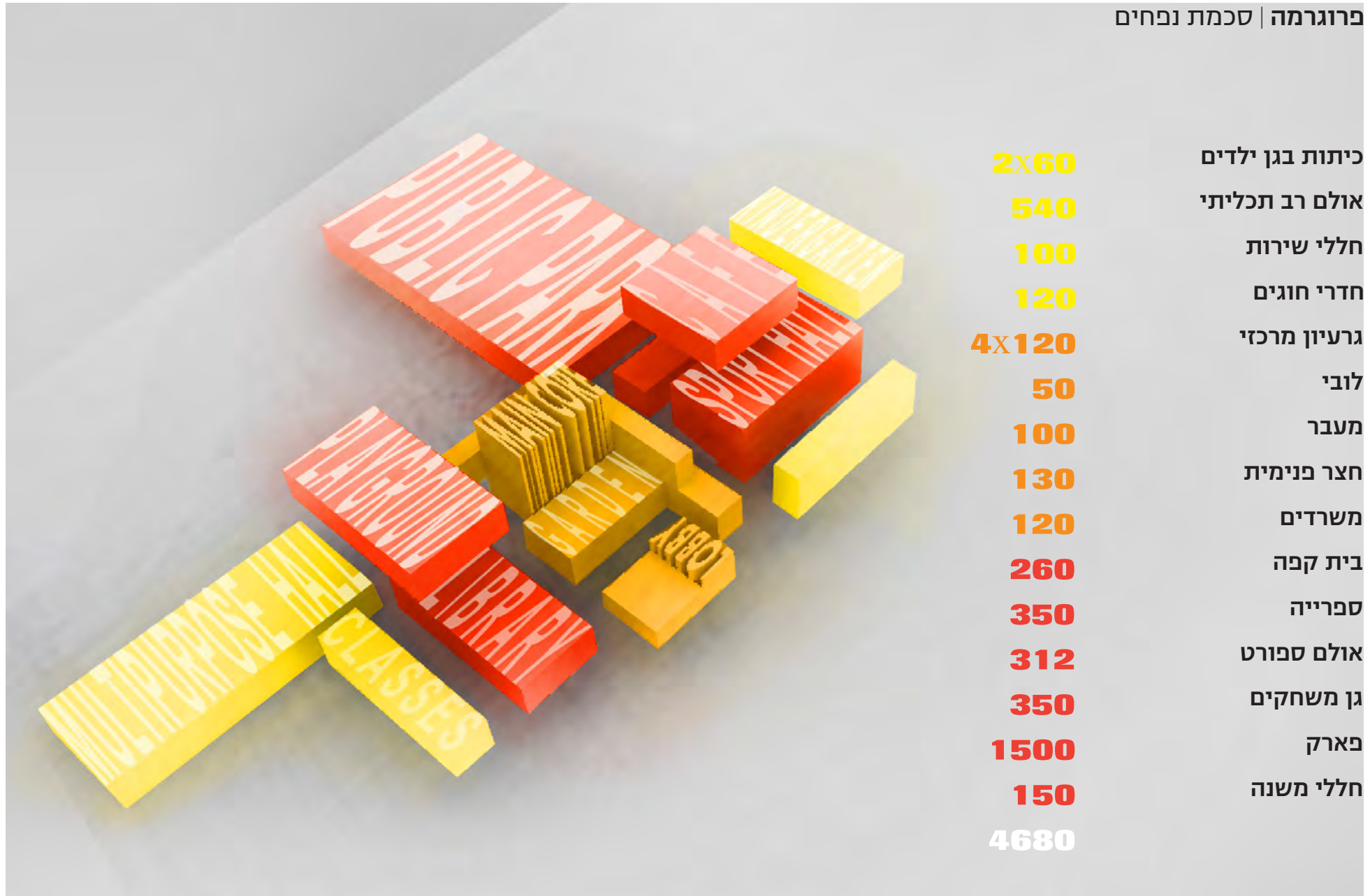




פרוגרמה | רמפה | מסלול חווייתי | מגוון פעילויות לאורכו



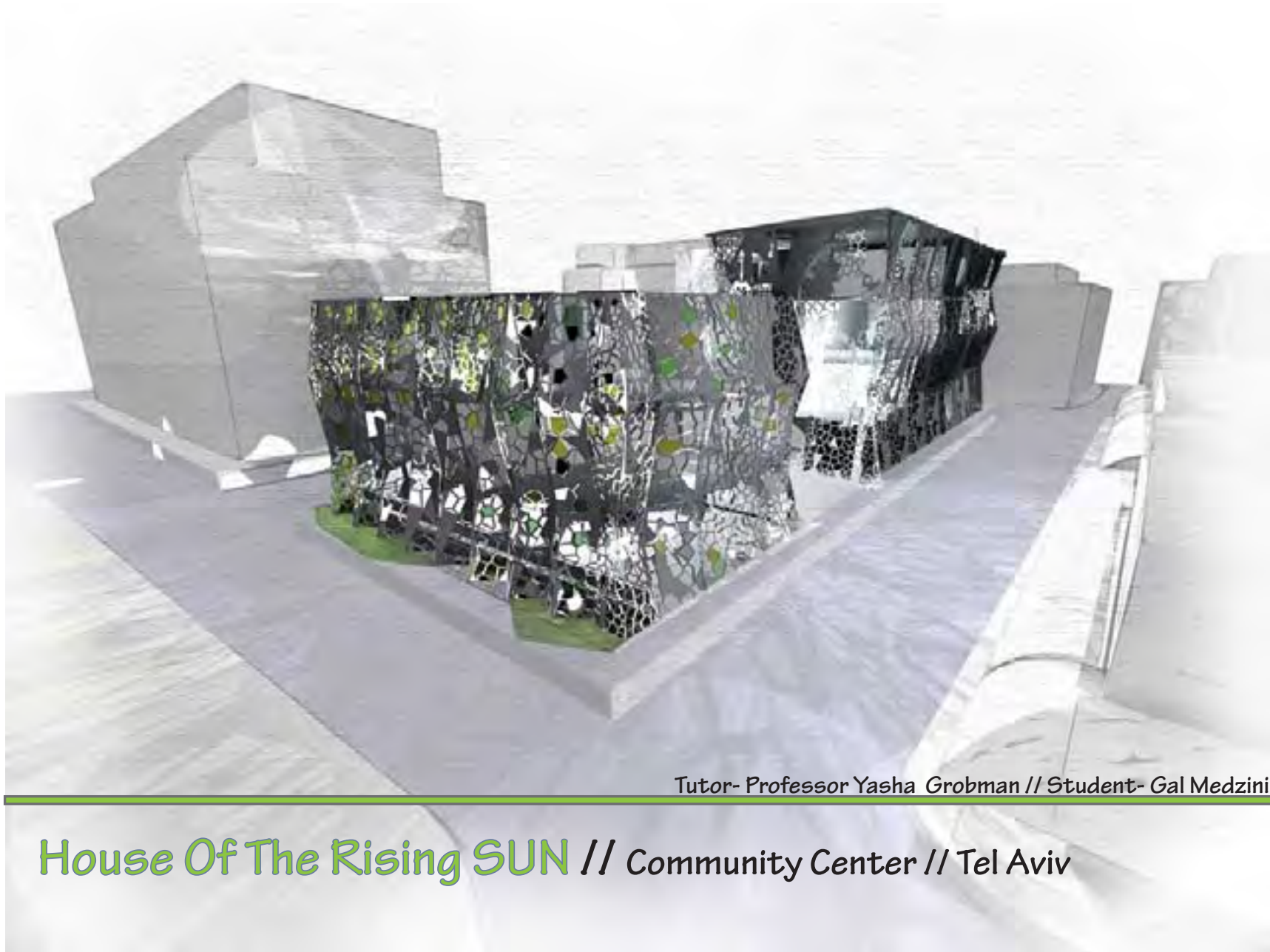
פרוגרמה | סכמת נפחים





# MARKET STRIP

SHUK HACARMEL TEL AVIV

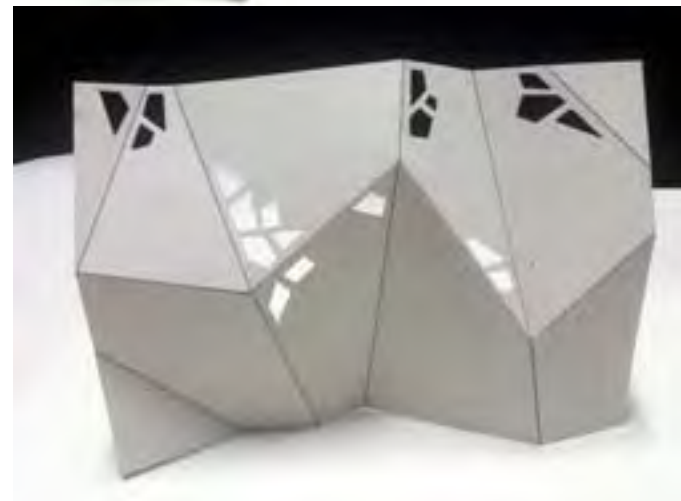


Tutor- Professor Yasha Grobman // Student- Gal Medzini

## House Of The Rising SUN // Community Center // Tel Aviv

### *Folded Structured Wall*

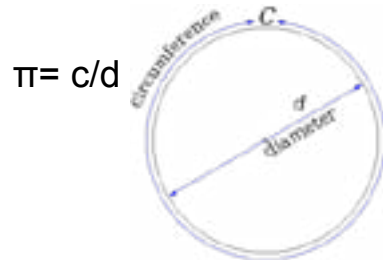
This paper model is supposed to show how the flat non constructive pice of paper, hs becom self standing by giving it surtain folds.



**This is the font you use for title - use paragraph styles**

The number pi (symbol:  $\pi$ ) is a mathematical constant that is the ratio of a circle's circumference to its diameter. The number pi is a mathematical constant that is the ratio of a circle's circumference to its diameter, and is approximately equal to 3.14159....

$\pi$  is an irrational number, which means that it cannot be expressed exactly as a ratio of two integers (such as 22/7 or other fractions that are commonly used to approximate  $\pi$ ); consequently, its decimal representation never ends and never settles into a permanent repeating pattern.



source: <http://en.wikipedia.org/wiki/Pi>

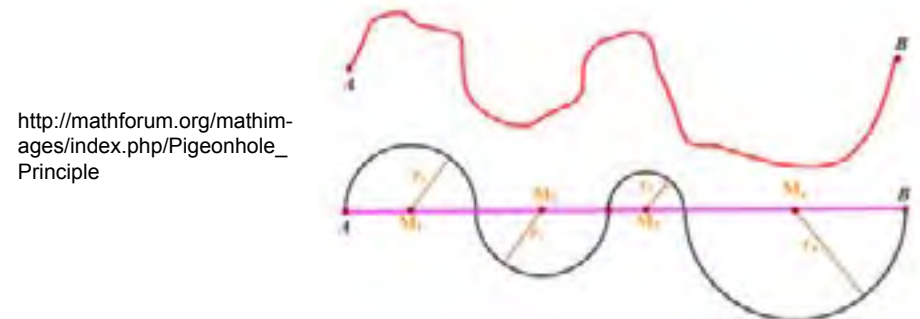
Throughout history, scholars have been trying to figure out the value of  $\pi$ . The polygon approximation era, infinite series, computer era and iterative algorithms have brought scholars closer and closer to the true value of the mysterious constant

The first recorded algorithm for rigorously calculating the value of  $\pi$  was a geometrical approach using polygons. It was devised around 250 BC by the Greek mathematician Archimedes. Since  $\pi$  is the ratio of any circle's circumference and its diameter, it will be greater than the circumference of any inscribed regular polygon and less than that of any circumscribed regular polygon. the more sides such a polygon has, the closer it will resemble an actual circle, and thus the closer the length of its perimeter will be to that of the circle



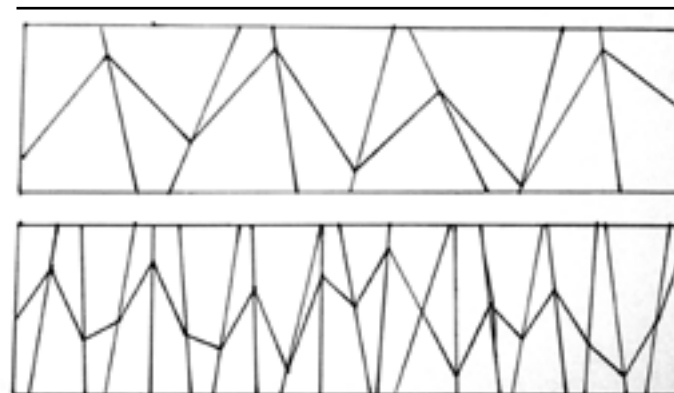
[http://mathforum.org/mathimages/index.php/Pigeonhole\\_Principle](http://mathforum.org/mathimages/index.php/Pigeonhole_Principle)

$\pi$  also appears as the average ratio of the actual length and the direct distance between source and mouth in a meandering river. Hans-Henrik Stolum, a geologist at Cambridge University, calculated the ratio between the total length of a river to the direct distance between its source and end point. He found the average ratio to be a bit larger than 3. It is actually around 3.14, which we recognize as an approximation of  $\pi$ . Rivers have a tendency toward a loopy path. A slight bend will lead to faster currents on the outside shores, and the river will begin to erode and create a curved path. The sharper the bend, the more strongly the water flows to the outside, and in the consequence the erosion is in turn the faster. The meanders get increasingly more circular, and the river turns around and around in semi-circles. It then runs straight ahead again, and the meander becomes a bleak branch. Between the two reverse effects a balance adapts.



[http://mathforum.org/mathimages/index.php/Pigeonhole\\_Principle](http://mathforum.org/mathimages/index.php/Pigeonhole_Principle)

40



10

$$d\pi = c$$

$$40\pi = c$$

$$c = 125.663\dots$$

$$c/2 = 62.831\dots$$

## Origami inspired architectural designs

Origami is an ancient art of Japan. It is a creative method of folding paper to develop beautiful structures. These Japanese origami structures are made from paper folding and feature chiseled cones achieved by making multiple folds and layers of a single paper. The resultants are beautiful shapes and forms resembling animals shapes like boar head, birds, etc. This splendid art has inspired artists from all over the world. This form has also inspired creative brains from the world of architecture to use this idea in architectural structures too. Thus, the attempts to make architectural designs on the concept of origami designs can be all over the world, ranging from residential buildings to hotels, amusement centers, offices, etc.

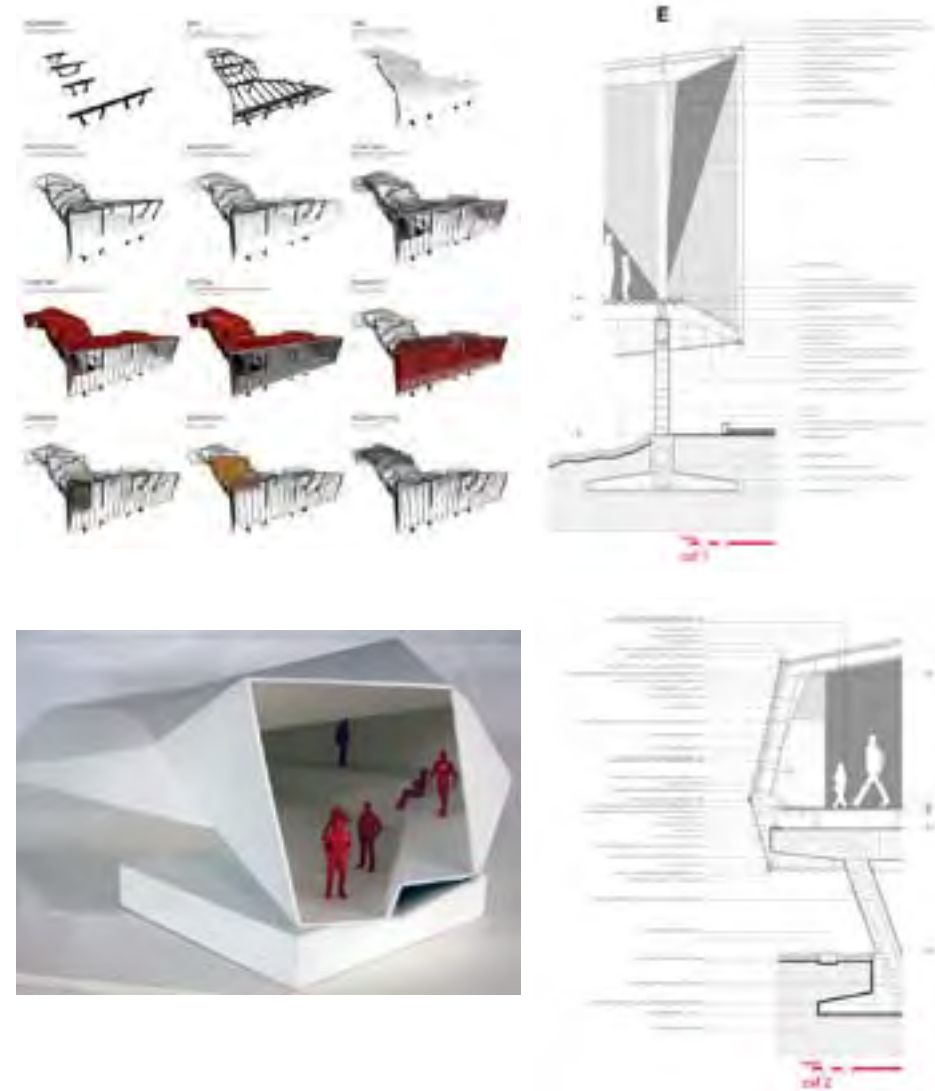


The Nestle Chocolate Museum ,Rojkind Arquitectos, Mexico City, 2007  
<http://europaconcorsi.com/projects/17370-Nestle-Chocolate-Museum>

### **The Nestle Chocolate Museum // Rojkind Arquitectos**

Created by the Rojkind Arquitectos, the Nestle Chocolate Museum in Mexico is also a worth mentioning architectural structure inspired by origami. The company had an intention of exhibiting the process of chocolate production to its viewers. So it suggested a two story building that would be perfect for the purpose. But the construction company in charge of this project found out a more innovative plan. Therefore, in an area of 634 sqm. the factory was built, which had a 300 meter long facade. This long corridor would lead the spectators on a pleasure tour through the production unit and help them witness how cocoa turns into dark, rich, tempting chocolate. The project took 2.5 months to get completed and presents the look of origami bird or a spaceship

An architectural experience. sensorial architecture, from the surprises, the twists and folds. An architectural challenge. As much the forms and the spaces they contain, like the times are taken to the limit. Foldings and record time: 2.5 months to finish and that included design and construction!



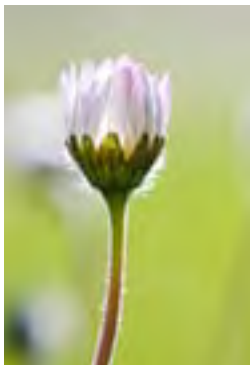
The Nestle Chocolate Museum ,Rojkind Arquitectos, Mexico City, 2007  
<http://europaconcorsi.com/projects/17370-Nestle-Chocolate-Museum>



<http://www.life123.com/home-garden/flower-guides/flower-meanings/what-do-daisies-symbolize.shtml>



[http://commons.wikimedia.org/wiki/File:African\\_daisy\\_sept2006.jpg](http://commons.wikimedia.org/wiki/File:African_daisy_sept2006.jpg)



<http://www.flickrriver.com/photos/72516920@N00/2438680813/>

### Nature way of Self-preservation

Bellis is a genus of 15 species of flowering plants in the family Asteraceae. Bellis perennis is a common European species of daisy, of the Asteraceae family, often considered the archetypal species of that name. The name "daisy" was derived from "daes eage," an Anglo Saxon term which mean "day's eye" because these flowers open during the day and close during

the night. It is an herbaceous perennial plant with short creeping rhizomes and small rounded or spoon-shaped rosettes of leaves that are approx. 2-5 cm long, and grow flat to the ground. The species habitually colonises lawns, and is difficult to eradicate by mowing - hence the term 'lawn daisy'. Wherever it appears it is often considered an invasive weed.

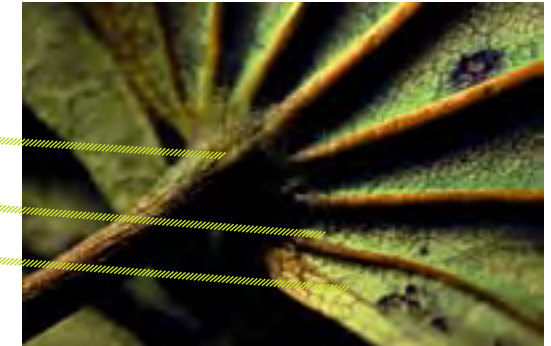
During the afternoon, when the light intensity is weakened, the flowers bend to the center within the scope of linguistic scalp. In this way they form an umbrella over linguistic and protected the flowers tiny pollen grains from getting wet by rain or moisture.

### Nature Construction in Leaves

MidRib

Veins

Mysophyll



Natural construction by noistromo  
<http://noistromo.deviantart.com/art/Natural-construction-183454114>

The leaf is formed from a hierarchy of elements which provides the leaf organ the structure and function that it needs in order to ideally function.

The main goal in this project is to create a building that has the ability to

- 1) carry its own weight.
- 2) confront the Israeli weather, by letting the sunbeam enter the building during the winter and avoid direct hit from the sunbeam during the summer.
- 3) allows sunlight in, creating a productive surroundings.



Taro Leaf  
[http://en.wikipedia.org/wiki/File:Taro\\_leaf\\_underside,\\_backlit\\_by\\_sun.jpg](http://en.wikipedia.org/wiki/File:Taro_leaf_underside,_backlit_by_sun.jpg)

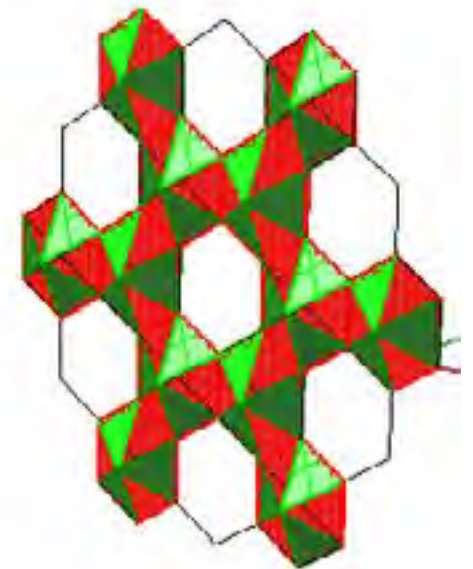
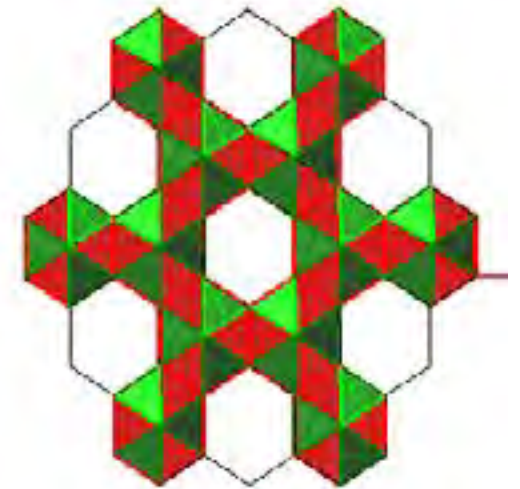
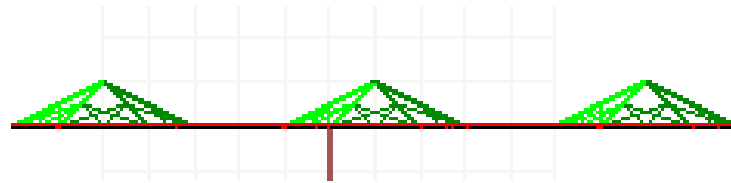
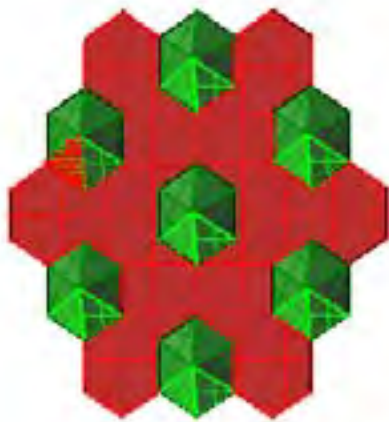


<http://www.sunipix.com/plants/plants05.htm>



***Daisies - Leafs as means of protection against the sun, heat,  
.wind, and humid***

Dynamic Facade that can protect itself

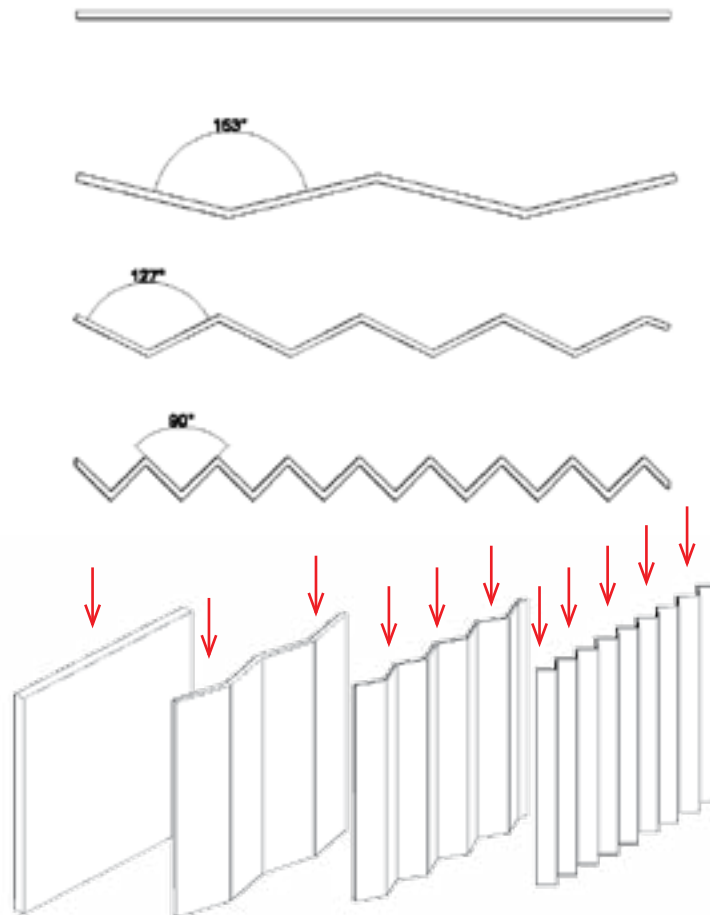


### ***Folded Structured and light Performance Facade***

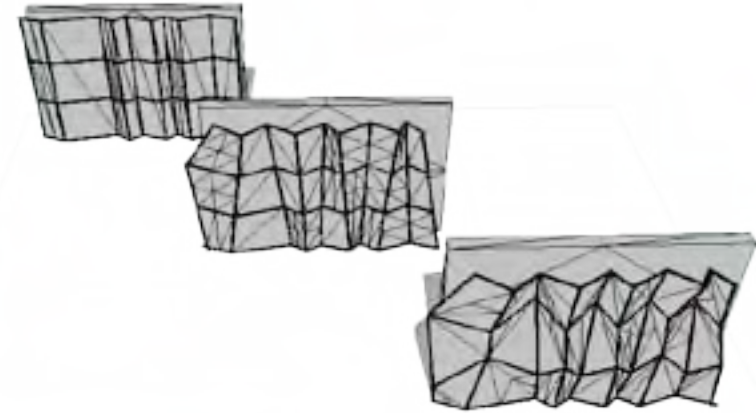
**Thumb Rules** for the folded Facade - The folding of the wall gives it Constructive force

The more acute the wall angles are, the more pressure it can bear, and the more obtuse the wall angles are it can carry less pressure.

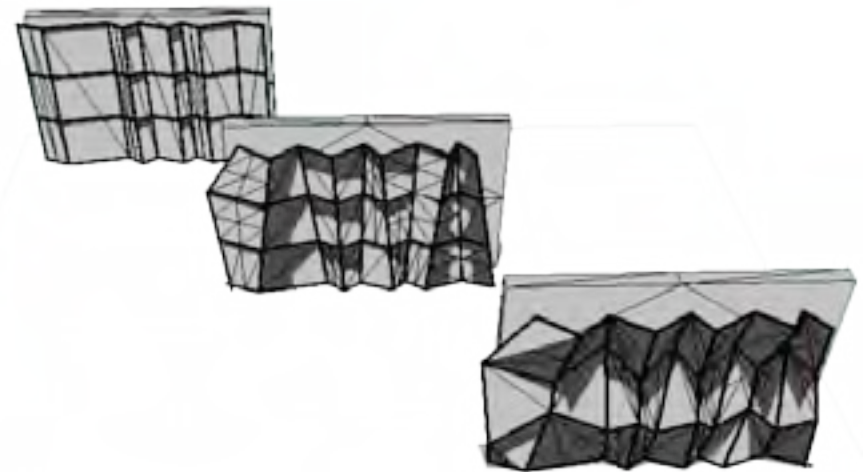
The more acute the wall angles are, the thinner it will be, and the more obtuse the wall angles are the thicker they will be.



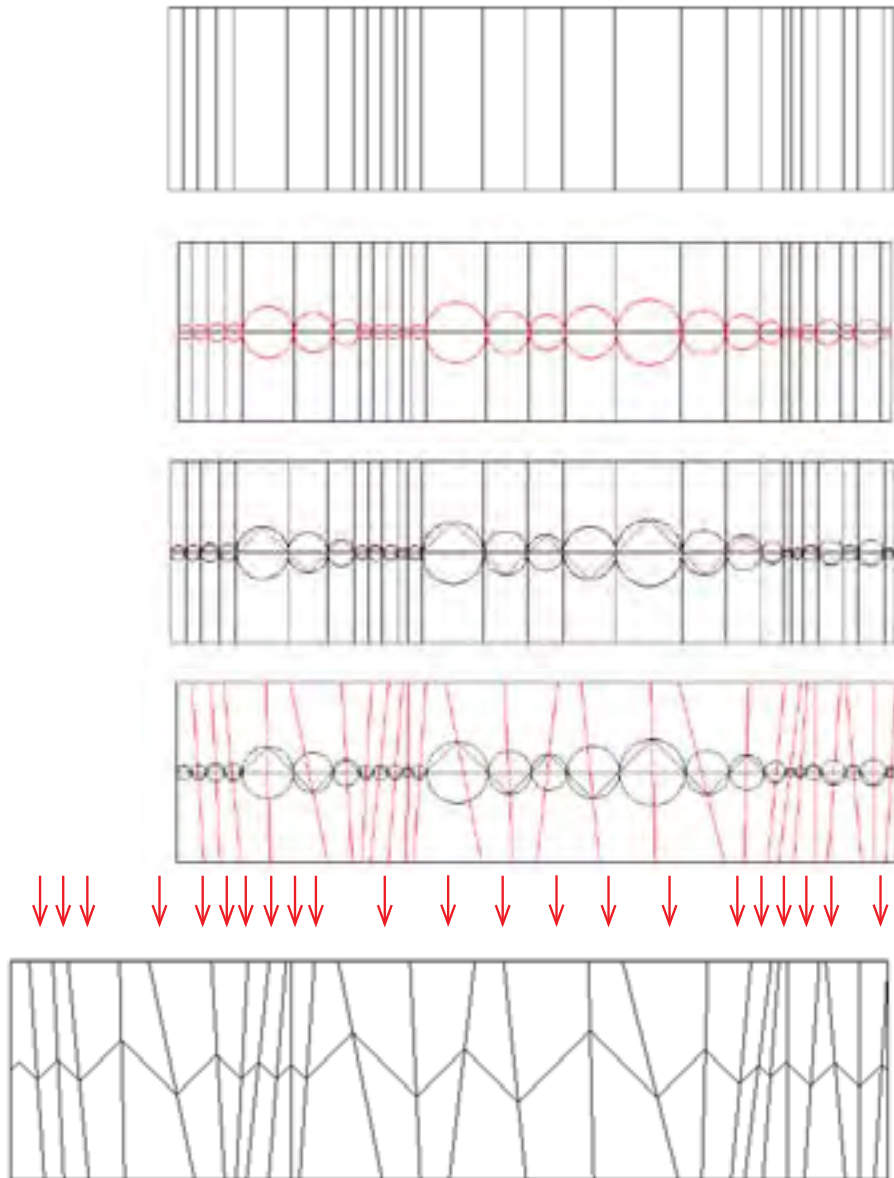
**12 :00 pm 1/7 July**



**12 :00 pm 1/3 march**



In order to allow the facade to self-shading, a change in the wall direction is needed- a mid fold, and a change in the folded line angles, will allow the facade to perform in the way chosen.

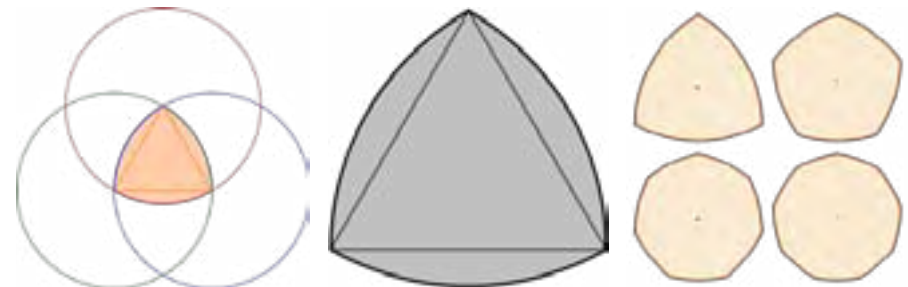


STUDENT NAME

### Reuleaux Triangle- by Wikipedia

A Reuleaux triangle is the simplest and best known Reuleaux polygon. It is a curve of constant width, meaning that the separation of two parallel lines tangent to the curve is independent of their orientation. Because all diameters are the same, the Reuleaux triangle is one answer to the question "Other than a circle, what shape can a manhole cover be made so that it cannot fall down through the hole?" The term derives from Franz Reuleaux, a 19th-century German engineer who did pioneering work on ways that machines translate one type of motion into another, although the concept was known before his time.

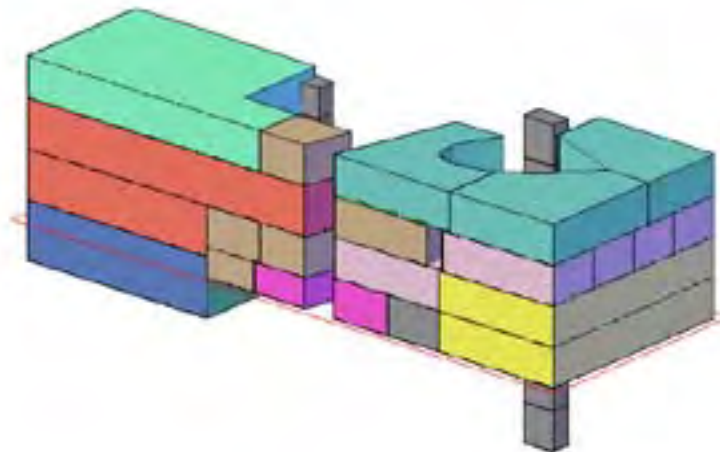
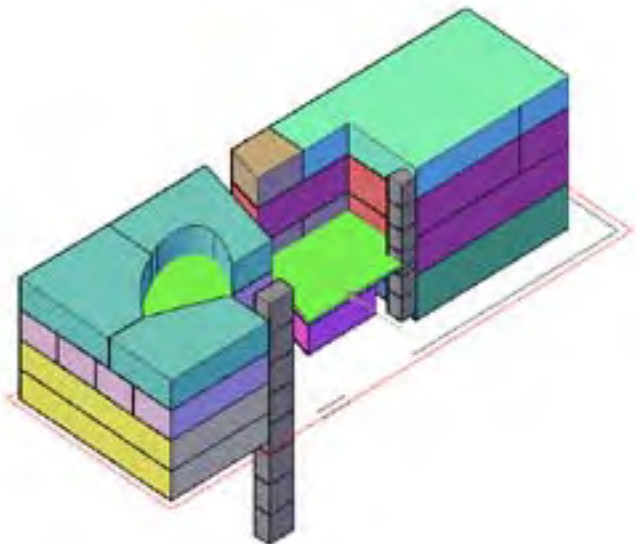
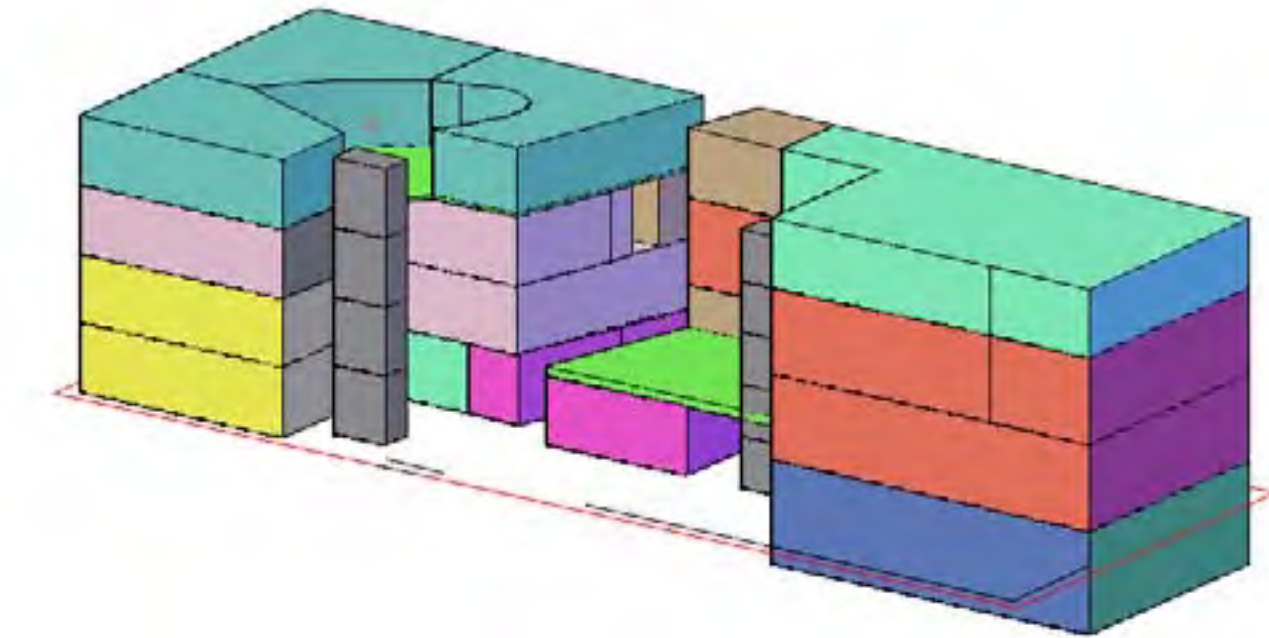
With a compass, sweep an arc sufficient to enclose the desired figure. With radius unchanged, sweep a sufficient arc centred at a point on the first arc to intersect that arc. With the same radius and the centre at that intersection sweep a third arc to intersect the other arcs. The result is a curve of constant width. Equivalently, given an equilateral triangle T of side length s, take the boundary of the intersection of the disks with radius s centered at the vertices of T.



Reuleaux Triangle - by Wikipedia  
[http://en.wikipedia.org/wiki/Reuleaux\\_triangle](http://en.wikipedia.org/wiki/Reuleaux_triangle)

The ratio of the perimeter Reuleaux triangle to its "distant across" (the line segment AB, BC, or AC) is equal to  $\pi$ :





**Comunity Center in Tel-Aviv Program**

**First Floor**



**Third Floor**



- Two story high 300 m2 indoor sport filed.
- 300 m2 small theater
- small 15 m2 office
- man and weman bath-room 20 m2 each
- 60 m2 car entrance and exit from parking-lot. operataed by elevator
- 4 small 35 m2 stores, and 1 40 m2 coffee shop/ resturant.
- 2 elevatores- 1st 2x2, the 2nd 2x3.4
- Three story high entrance

- 5 65 m2 Work-shops
- man and weman bath-room 15 m2 each
- 540 m2 Subscribers only liber-ary second floor
- 2 elevatores- 1st 2x2, the 2nd 2x3.4
- two bridges

**Second Floor**



**Forth Floor**



- 300 m2 open to public library first floor
- man and weman bath-room 20 m2 each
- 140 m2 roof garden
- 2 elevatores- 1st 2x2, the 2nd 2x3.4
- 150 m2 dancing hall- with bridge to second building part
- two bridges

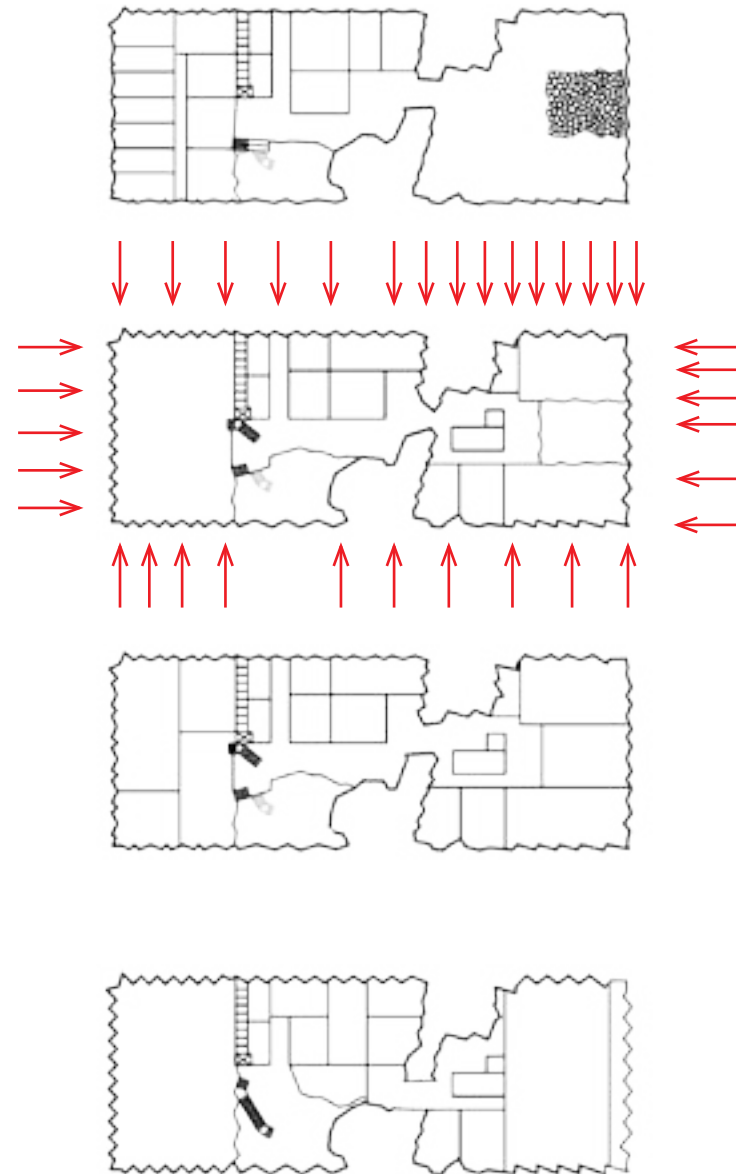
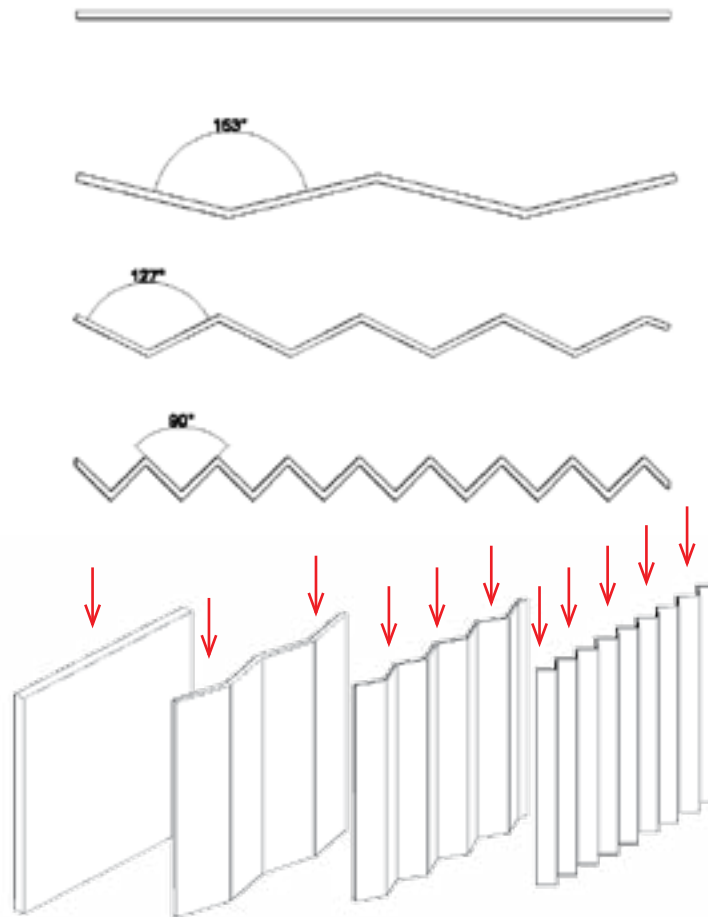
- 500 m2 offices area
- man and weman bath-room 15 m2 each
- 2 100 m2 kinder Garden classes a facilities space and a 100 m2 closed roof garden
- 2 elevatores- 1st 2x2, the 2nd 2x3.4

### Folded Structured and light Performance Facade

**Thumb Rules** for the folded Facade - The folding of the wall gives it Constructive force

The more acute the wall angles are, the more pressure it can bear, and the more obtuse the wall angles are it can carry less pressure.

The more acute the wall angles are, the thinner it will be, and the more obtuse the wall angles are the thicker they will be.



### Folded Architecture - chapel for the deaconesses of st-loup

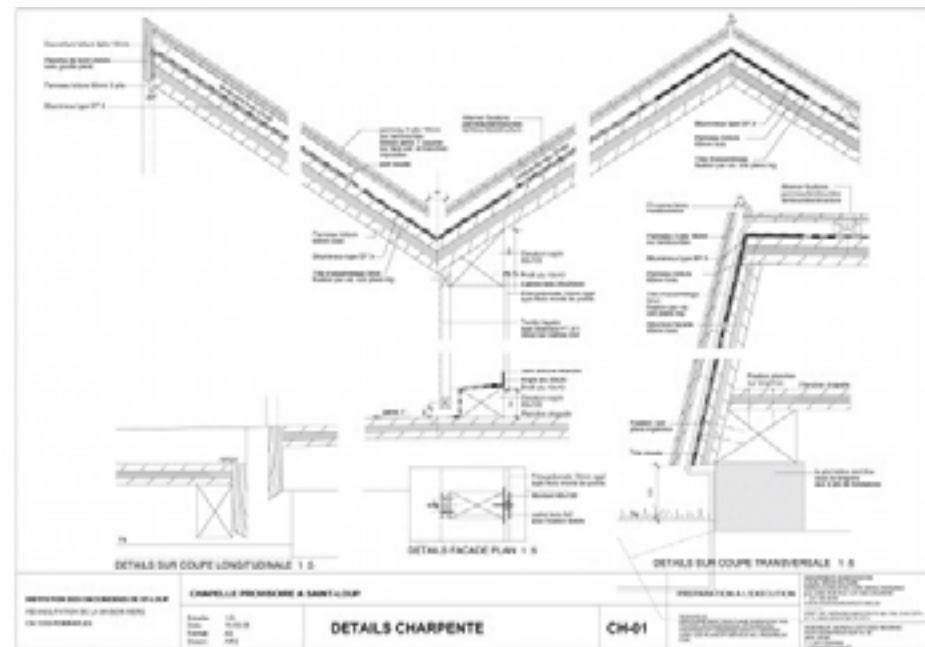
In the summer of 2007, Localarchitecture and Danilo Mondada renovated the mother house of the Deaconess Community of St-Loup. The architects, had an ongoing research in folded structures, which seemed particularly interesting and appropriate for this project. The team developed a structure using timber panels, which makes it possible to cover large areas with fine sections. The shape was generated using computer software that calculates the load-bearing structure, determines the dimensions and transmits this information to the machine that cuts out the 6-cm thick timber panels.



Built directly on the ground, the new chapel blends subtly and delicately with the landscape. The structure, which lies along the axis of the east-west valley and is open at each end, lets in plenty of natural light. Interpreting the traditional layout of protestant churches with their variations in width and height between transept and nave, the design creates a space whose horizontal and vertical dimensions vary via a series of origami-like folds, which give rhythm to the interior and exterior of the building. The folded volume generates a wide horizontal space at the entrance, before closing in and rising up to become vertical towards the centre of the chapel. Each fold in the facade reflects the light differently and thus emphasizes the progression and elongation of the volume. The structure punctuates the interior space, while creating an atmosphere conducive to reflection.



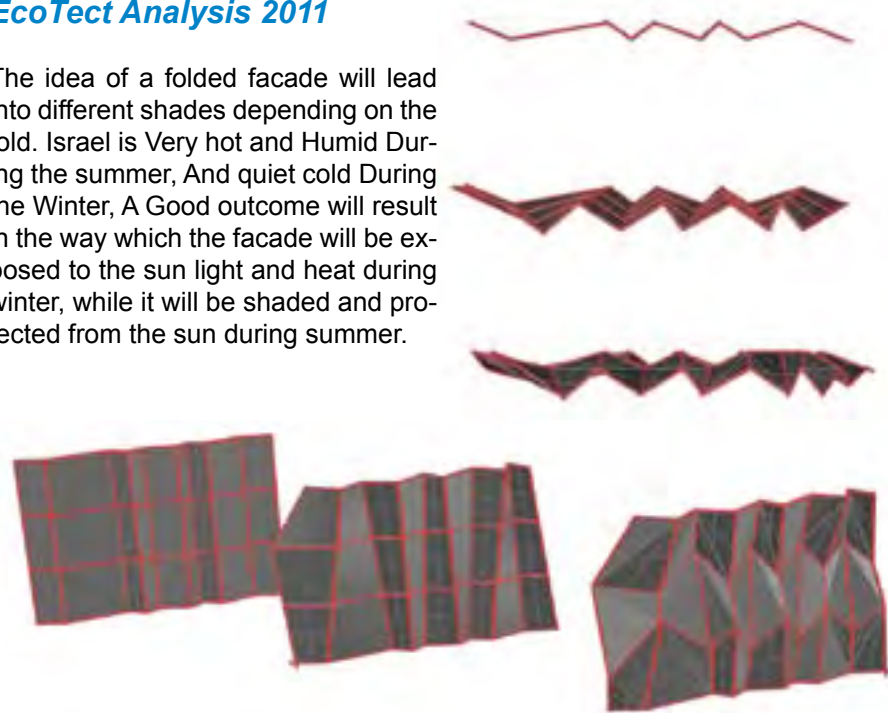
Hôpital de St-Loup ,Localarchitecture & Danilo Mondada, Switzerland, 2008  
<http://www.archdaily.com/9201/temporary-chapel-for-the-deaconesses-of-st-loup-localarchitecture/>



Hôpital de St-Loup ,Localarchitecture & Danilo Mondada, Switzerland, 2008  
<http://www.archdaily.com/9201/temporary-chapel-for-the-deaconesses-of-st-loup-localarchitecture/>

**EcoTect Analysis 2011**

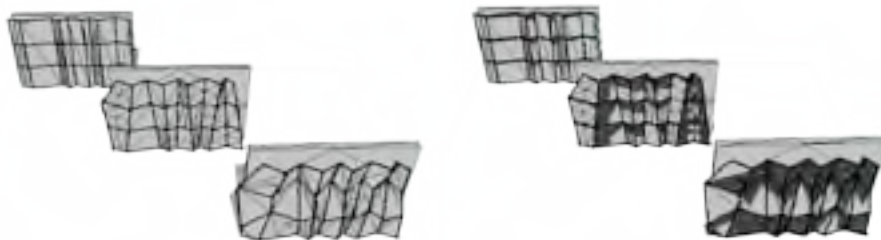
The idea of a folded facade will lead into different shades depending on the fold. Israel is Very hot and Humid During the summer, And quiet cold During the Winter, A Good outcome will result in the way which the facade will be exposed to the sun light and heat during winter, while it will be shaded and protected from the sun during summer.



Using Auto Desk -Ecotect program, Three kinds of Facade (different from one another by the folding types) were entered to the program environment, and checked to see the self shades they impose at noon during the mid summer and winter while the facade is facing the south. as it seems, the third facade kind is exposed to the sun during winter and protected from the sun during the summer.

**12:00 PM  
March**

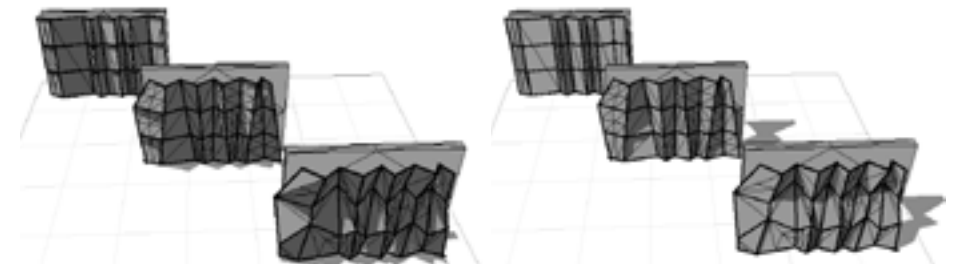
**12:00 PM  
June**



The Community Center longest Facade is posited 58° from the North, meaning it is faced mostly to the south east. Taking the same three facade models with the thumb rules, and locating them to the specific position, we are able to check if the sustainable ideas are still affective. and also to see their exposure to the sun during the morning and evening.

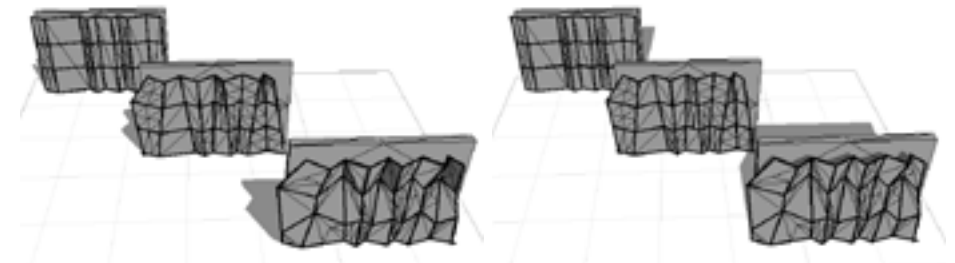
**12:00 PM  
March**

**12:00 PM  
June**



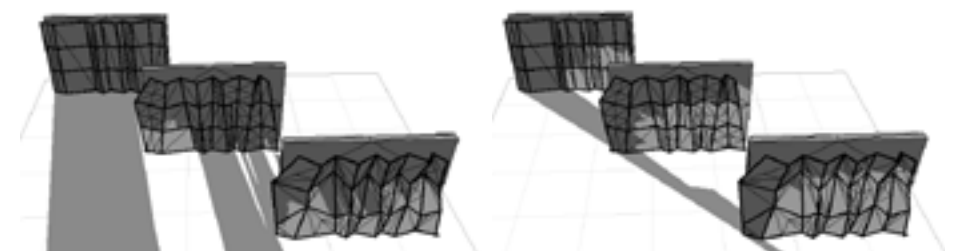
**09:00 PM  
March**

**09:00 PM  
June**

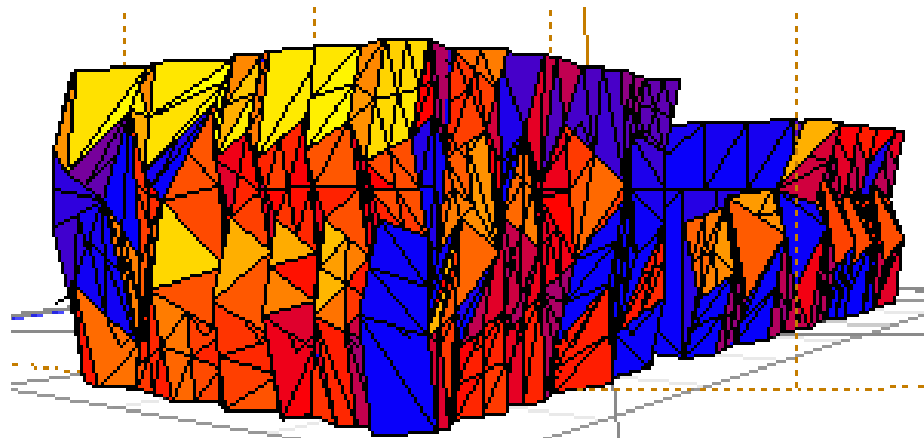


**17:00 PM  
March**

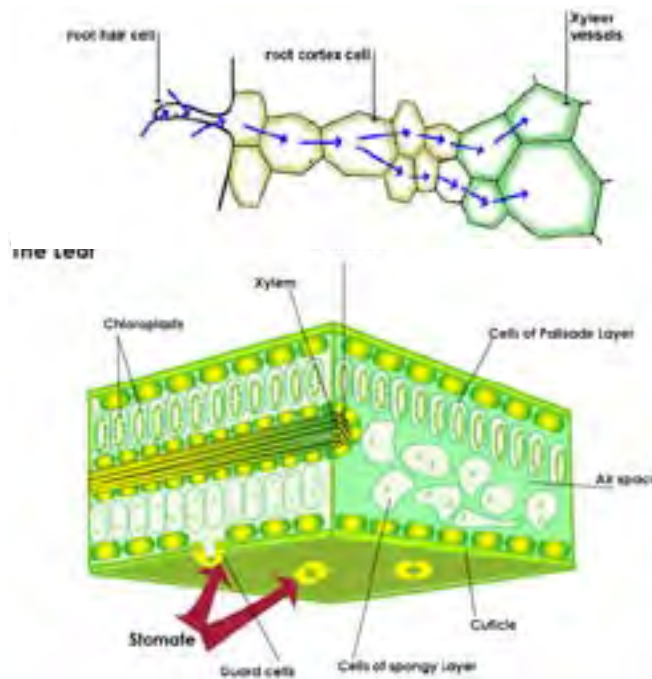
**18:00 PM  
June**







מכיוון שהתאים מסודרים באיברי הצמח בסכמה טבעתית, הם חייבים לאפשר לנזלים לחלחל ולזרום דרכם. רק כך יוכלו הנזלים להגיע מגרעין התאים האנכיים ועד לדפנות הצמח.



מעבר נזלים ומינרלים משערות השורש ועד לתאים האנכיים שמזרימים אותם לשריר הצמח

<http://www.bbc.co.uk/bitesize/higher/biology/>

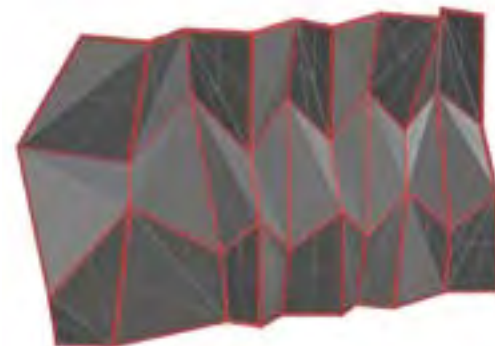
[http://alevelnotes.com/content\\_images/i91\\_leaf.gif](http://alevelnotes.com/content_images/i91_leaf.gif)

מעבר חומרים בין התאים שבעלים

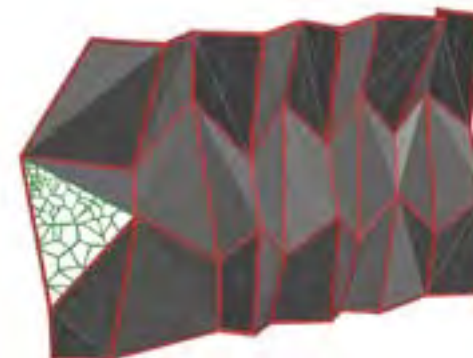
Solar power offices in Ljubljana, Slovenia by OFIS architects



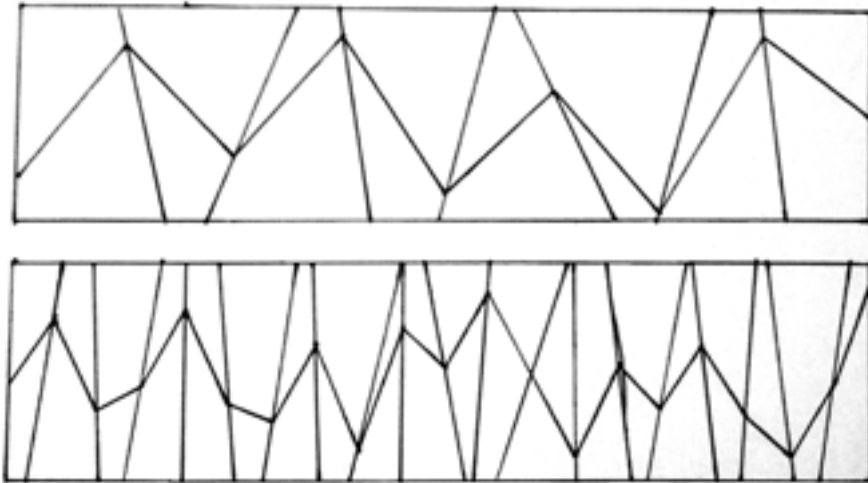
Solar power offices, OFIS architects, Ljubljana, Slovenia, 2010  
<http://www10.aecafe.com/blogs/arch-showcase/2011/05/20/solar-power-offices-in->



Leaf Structure by ~endprocess83  
<http://endprocess83.deviantart.com/art/Leaf-Structure-326943468>



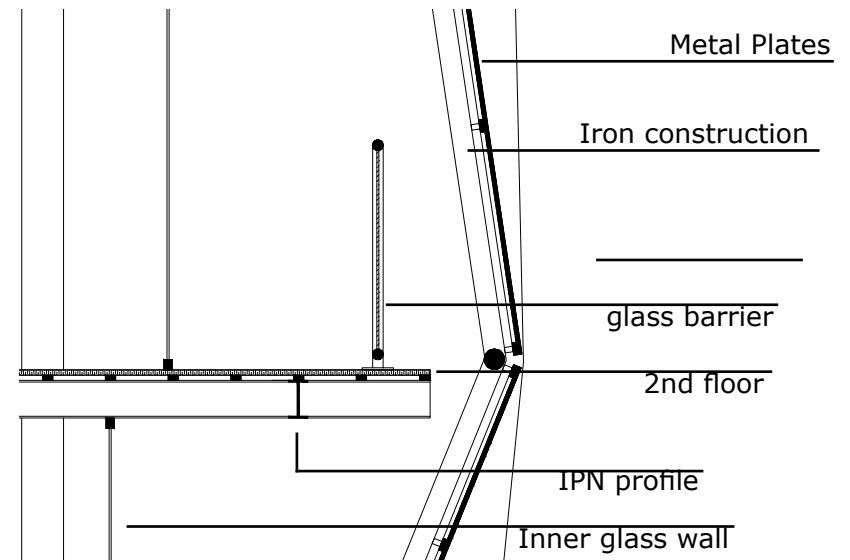
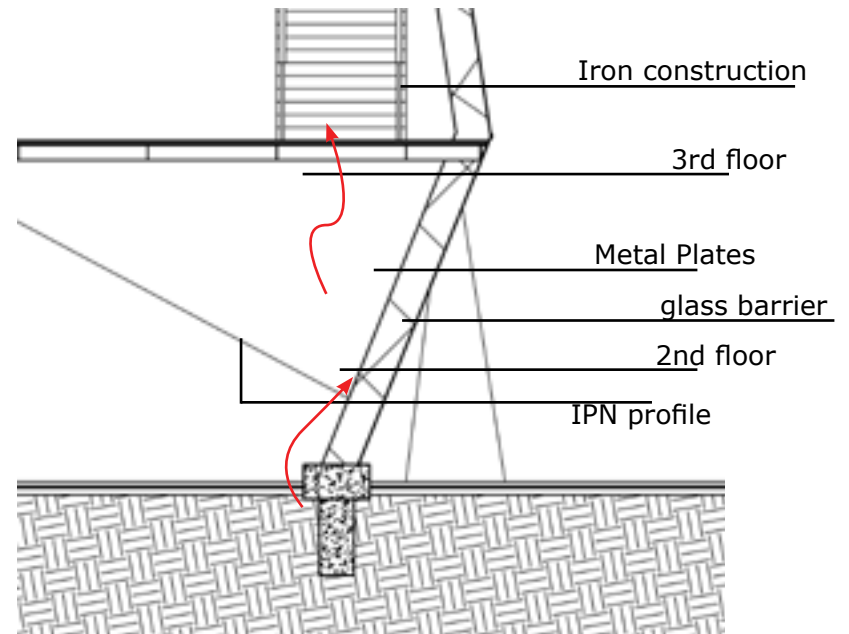
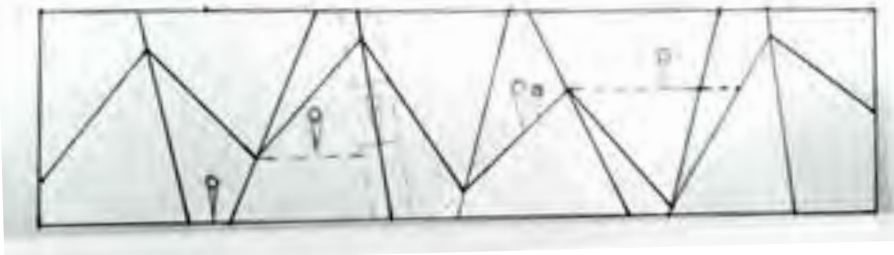
[https://www.123rf.com/photo\\_17693699\\_illustration-wallpaper--vascular-structure-of-a-leaf.html](https://www.123rf.com/photo_17693699_illustration-wallpaper--vascular-structure-of-a-leaf.html)

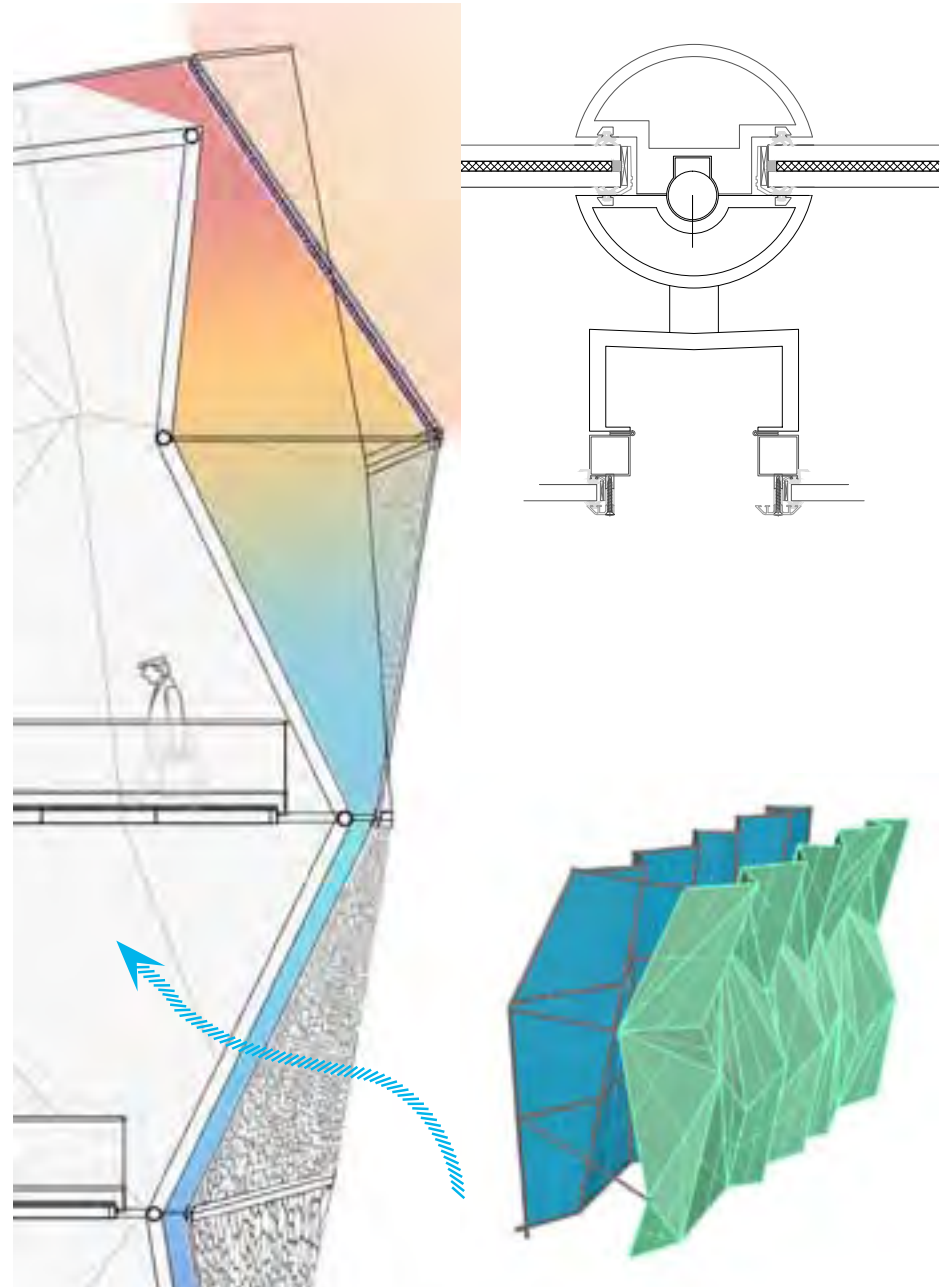
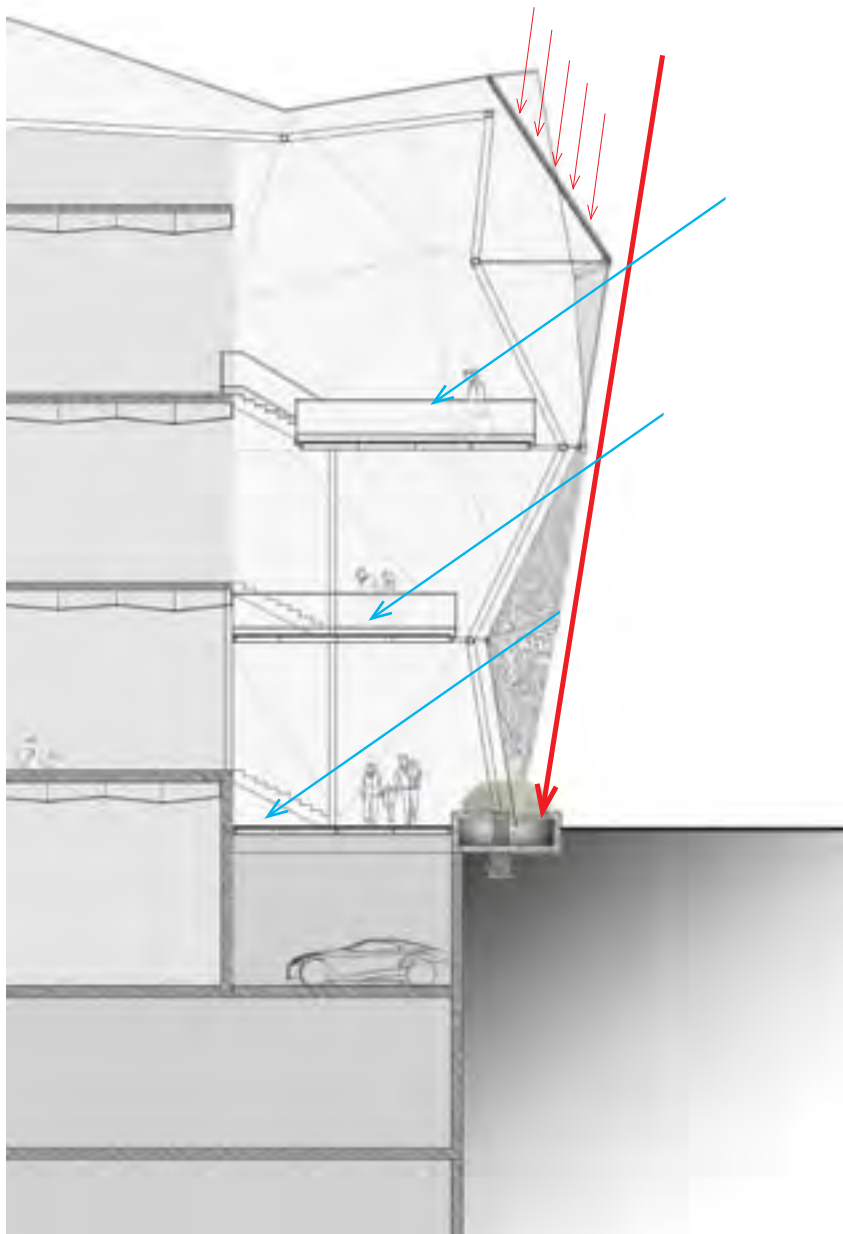


Pompidou Centre, Renzo Piano and Richard Rogers, Paris, France, 1977  
<http://i-love-architecture.tumblr.com>

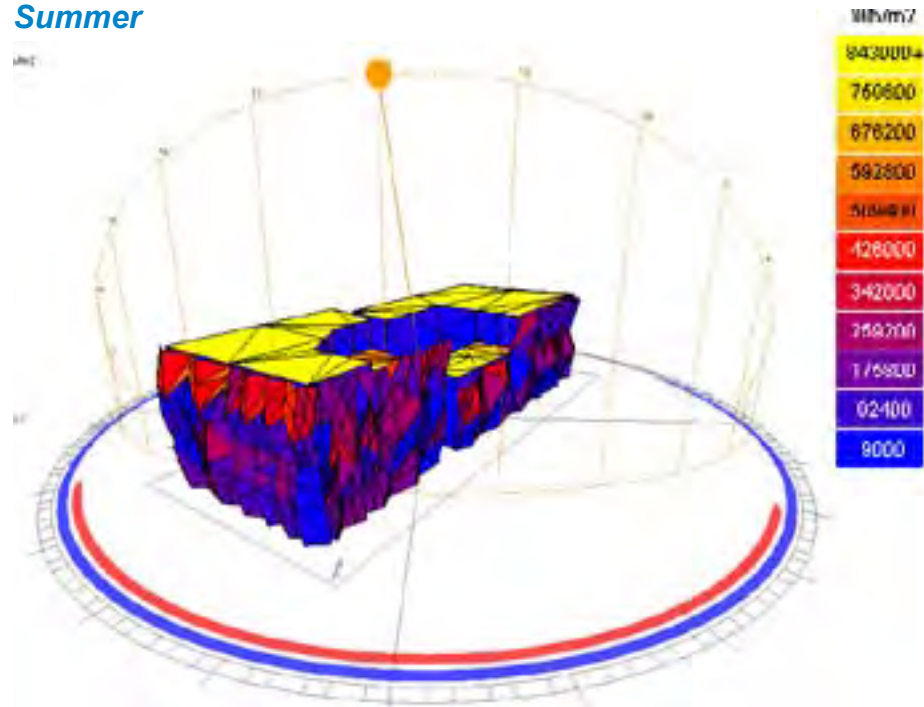


Digital Beijing Building, Studio Pei-Zhu, Building, 2008  
<http://www.designbuild-network.com/projects/digital-beijing/digital-beijing3.html>

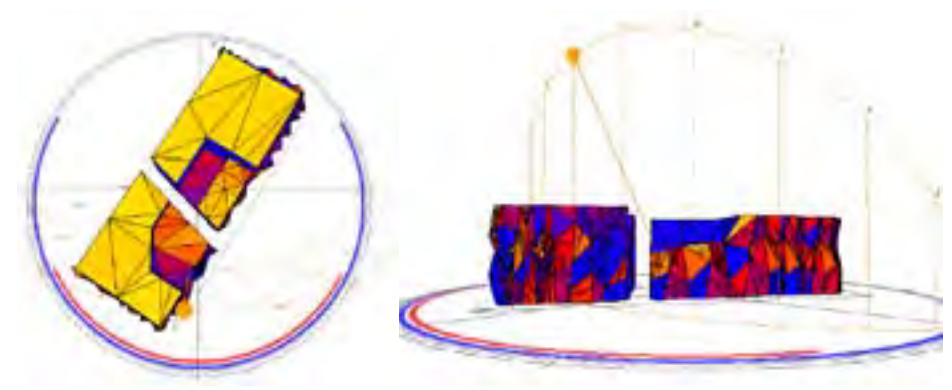
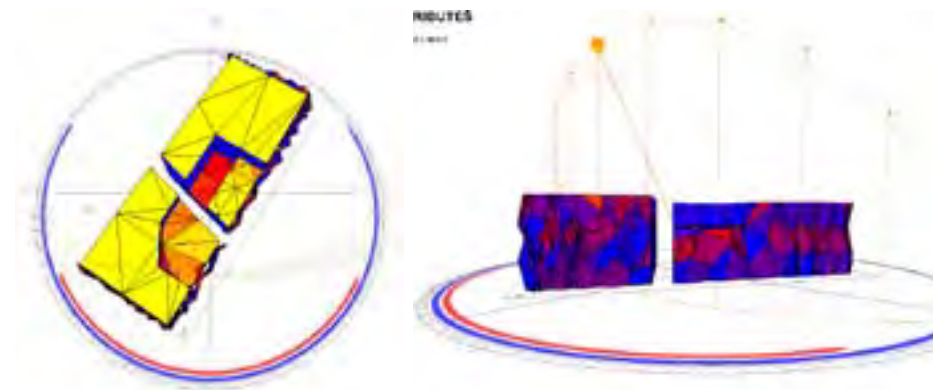
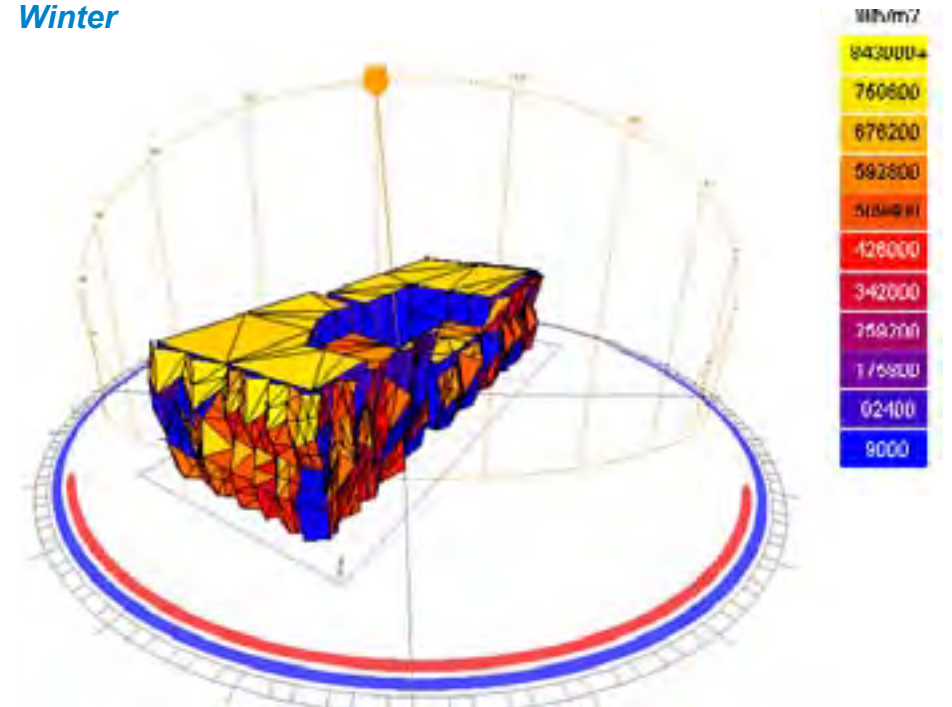




**EcoTect Analysis- Sun Contact with the Building Durin the Summer**

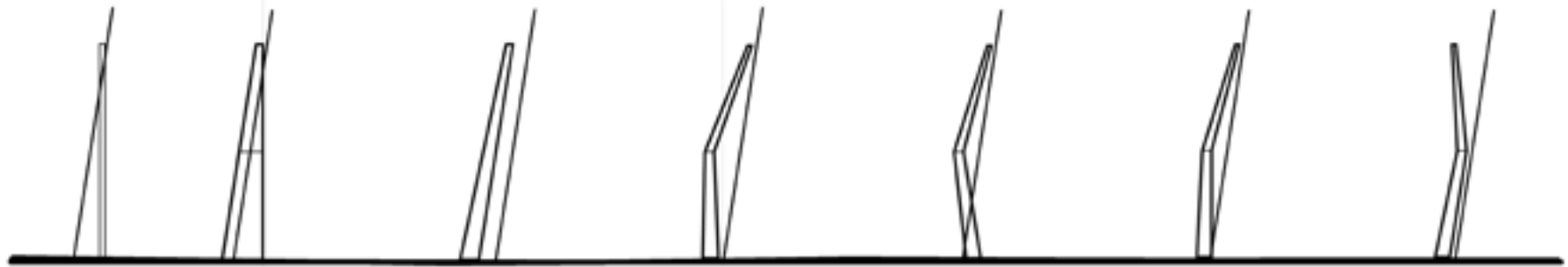
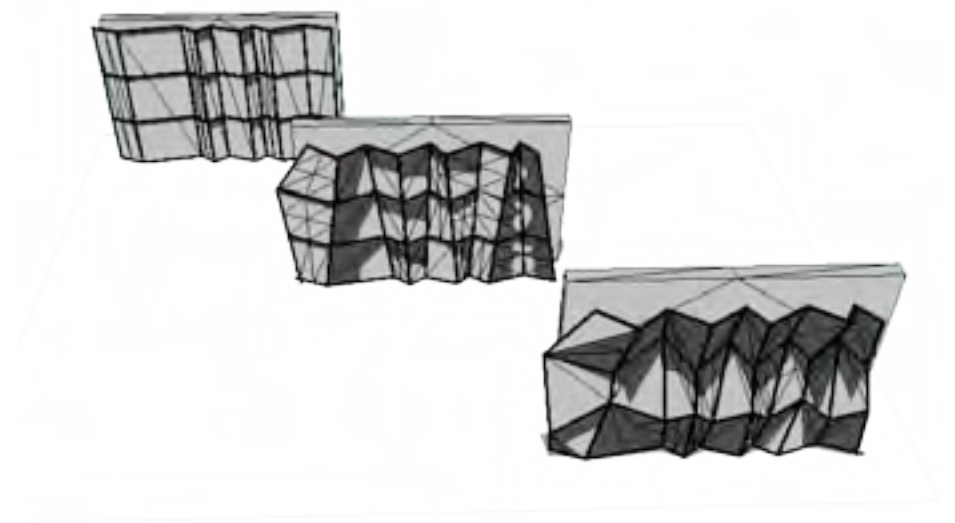
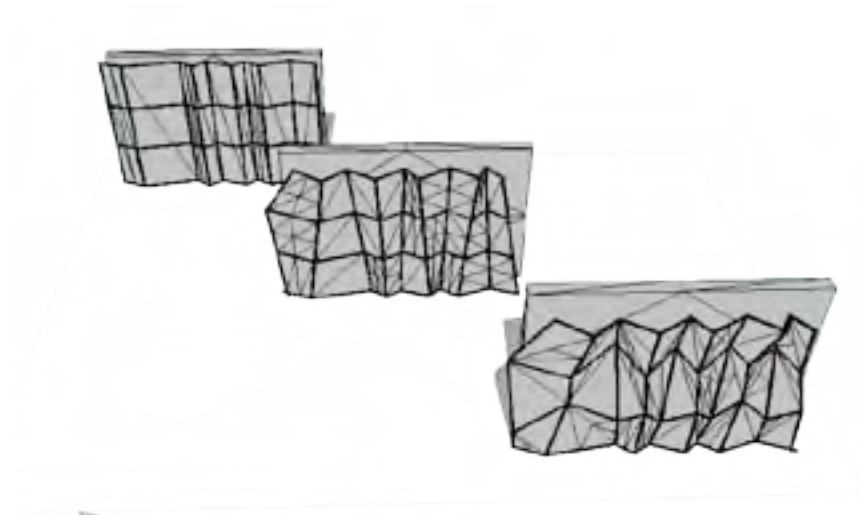


**EcoTect Analysis- Sun Contact with the Building Durin the Winter**



12 :00 pm 1/7 July

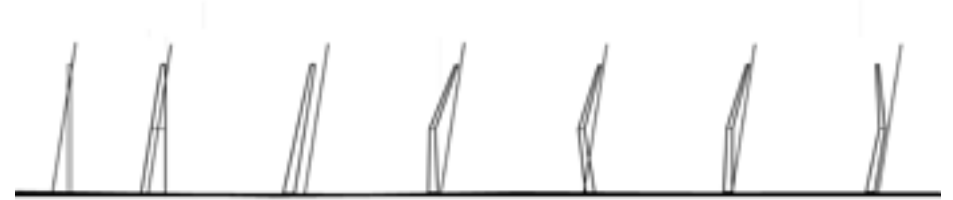
12 :00 pm 1/3 march





### The columns foundations

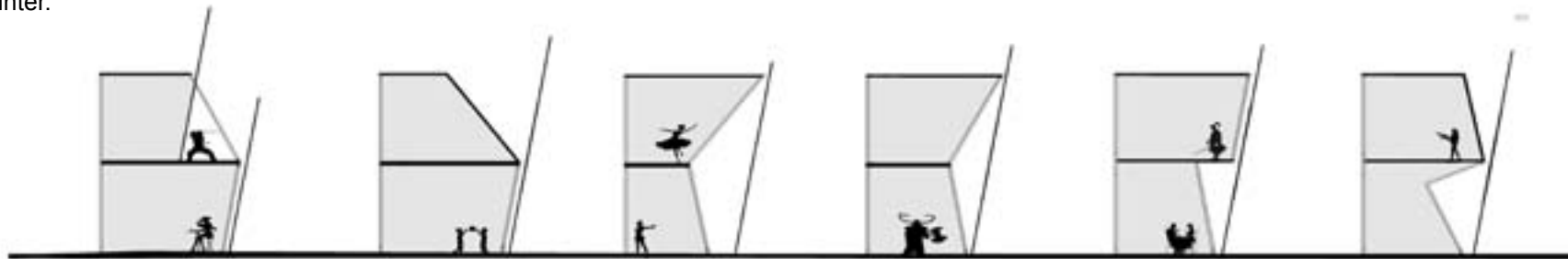
The columns foundations imitates The MIDRIB function by absorbing all of the leaf weight or in this case all of the Building forces.



### Thumb rules for the folded Facade- Light Performances

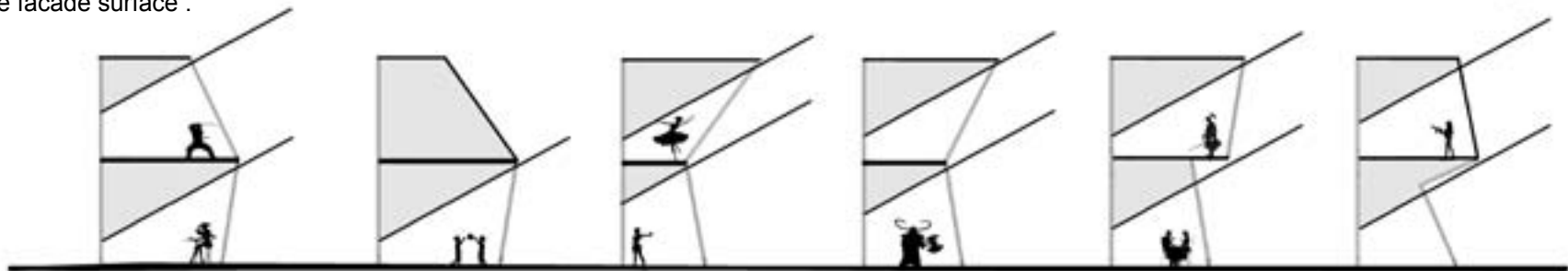
The wall are bent into or out of the inner building, in angels that enters or prevent direct sun light. the sketches are correct to a south facing wall in mid summer or winter.

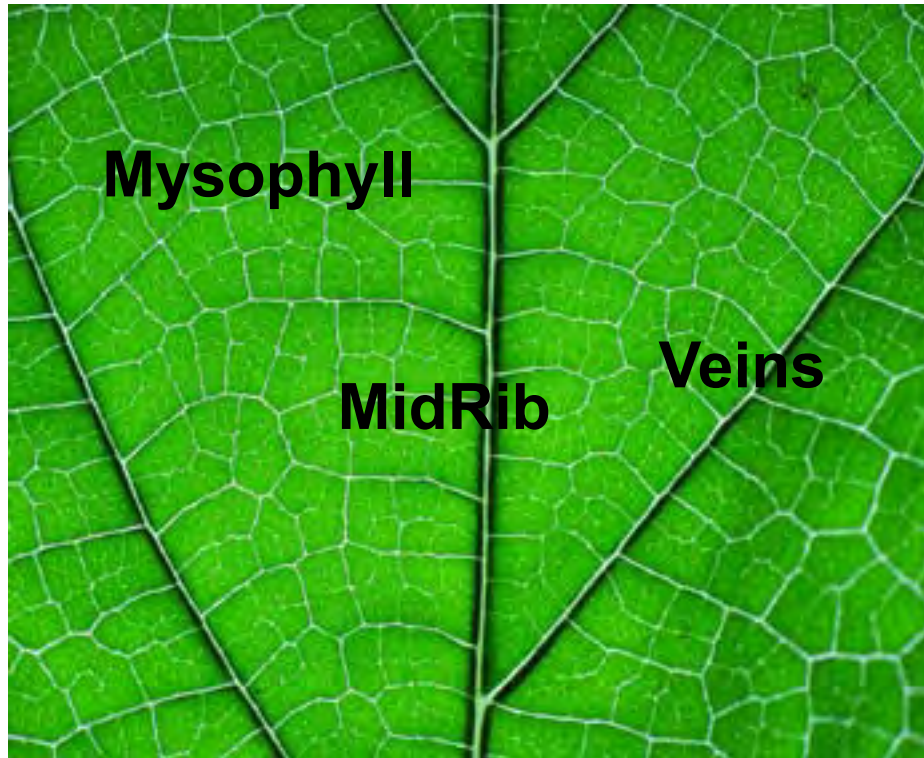
The angels for the wall are calculated for the longest day in summer, which the sun beam reaches earth in 81 degrees, and for the shortest day in winter, which the sun beam reaches earth in 35 degrees.



### The Columns

The columns imitates The leaf veins by absorbing the leaf weight and allow providing the leaf the nutrition it needs. or in this case control the amount of direct sun that fit the facade surface .



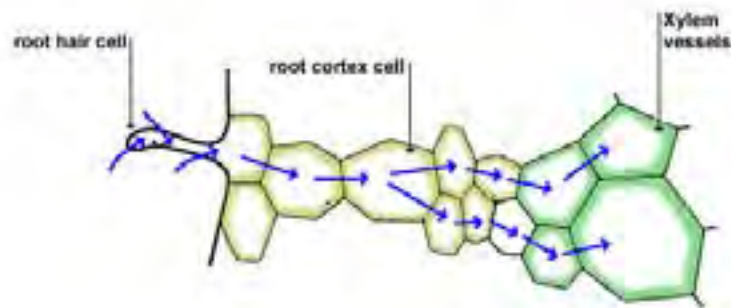


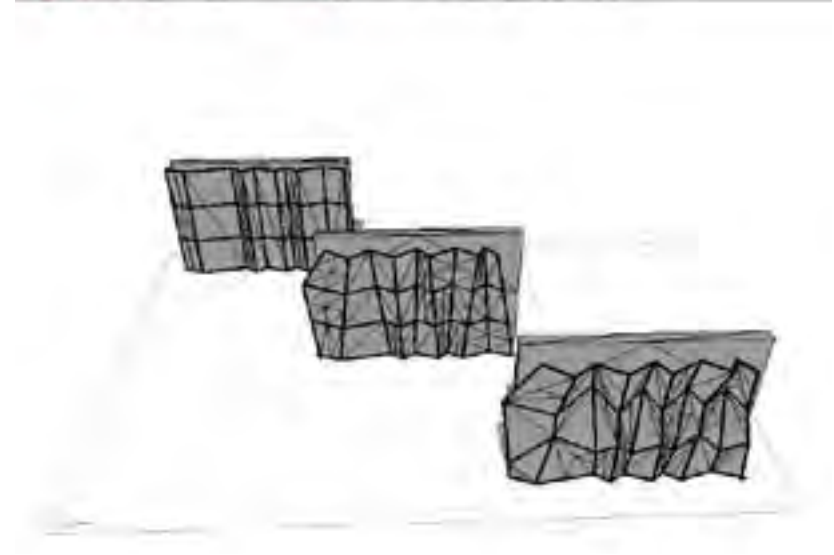
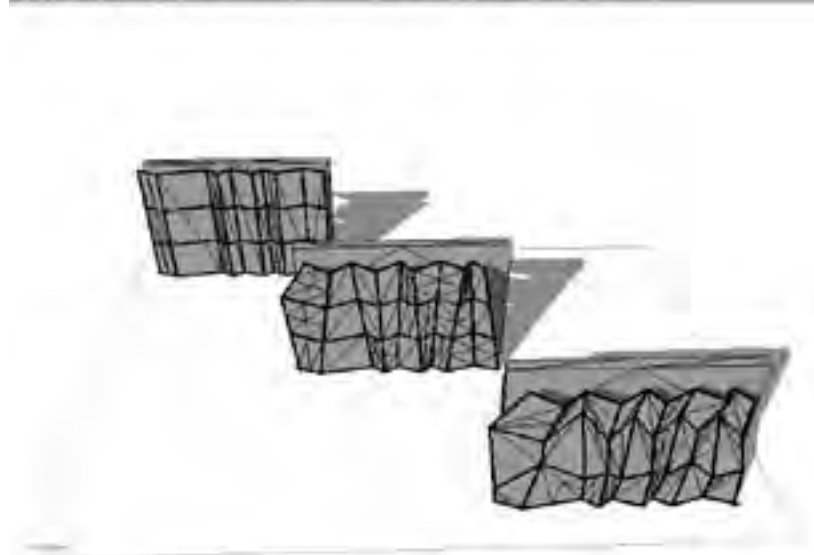
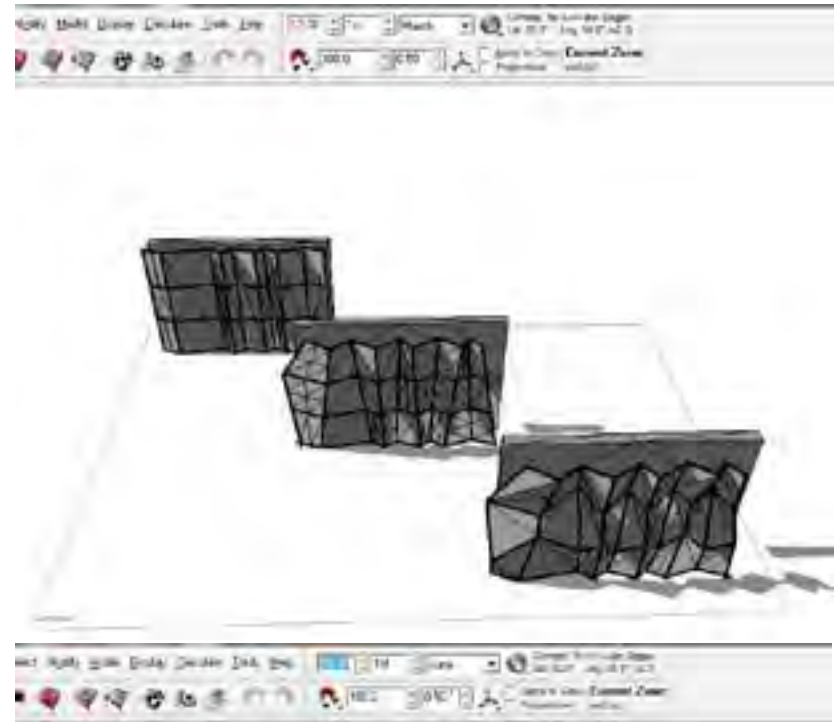
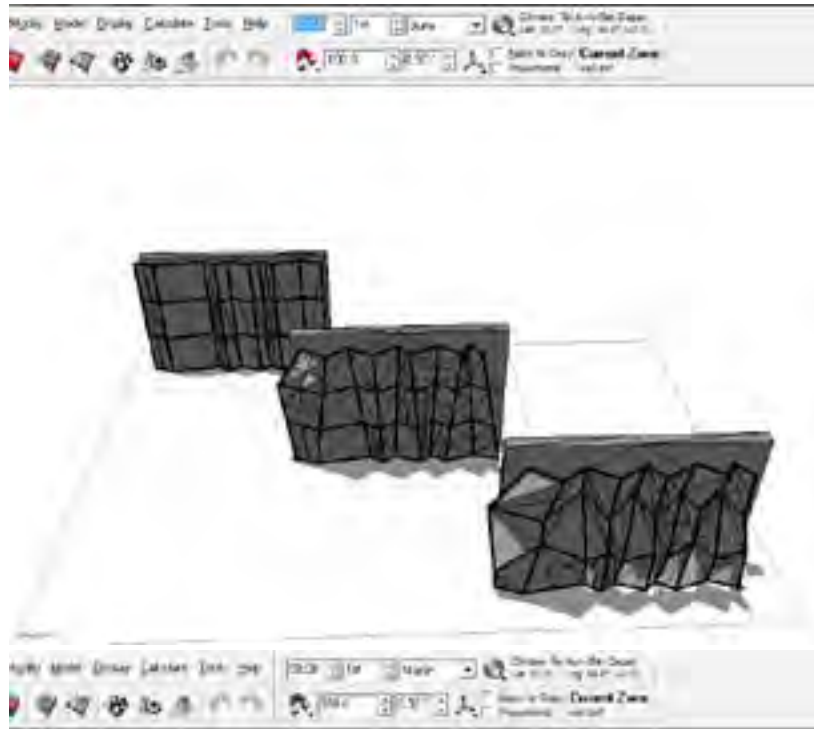
### *The Facade surface*

The Facade surface imitates The MYSOPHYLL function dividing the leaf into a complex system weach control verious kinds of the leaf needs. or in this case, the surface is divided into voroni based openings wich controls the amount of sun light that enters the building.



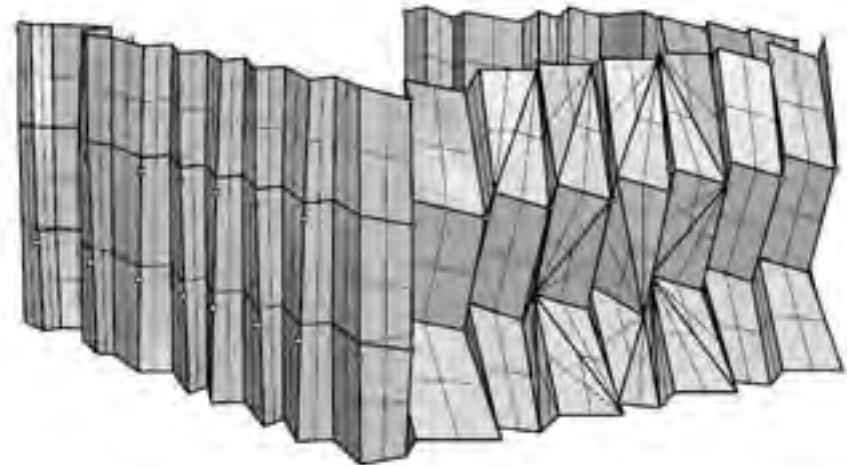
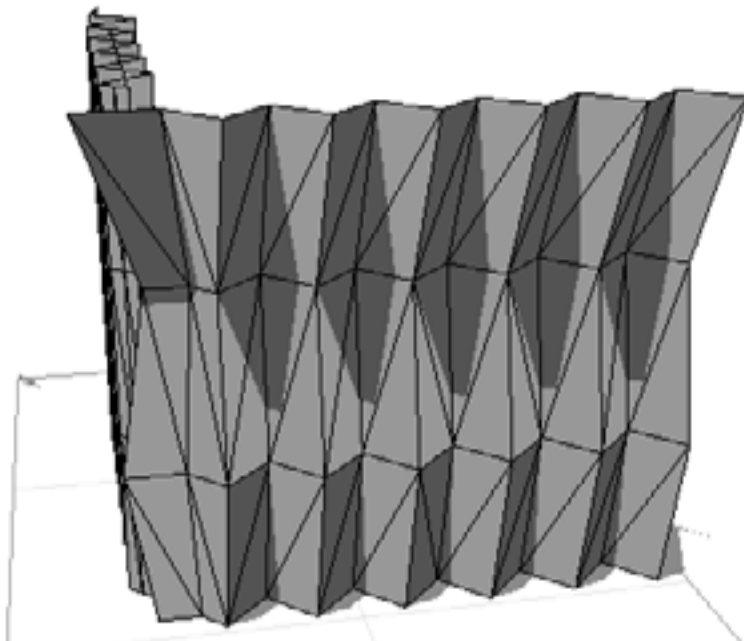
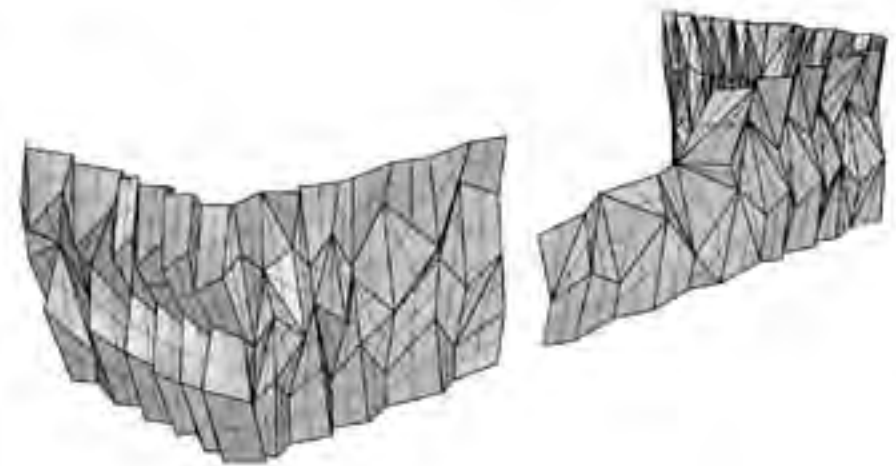
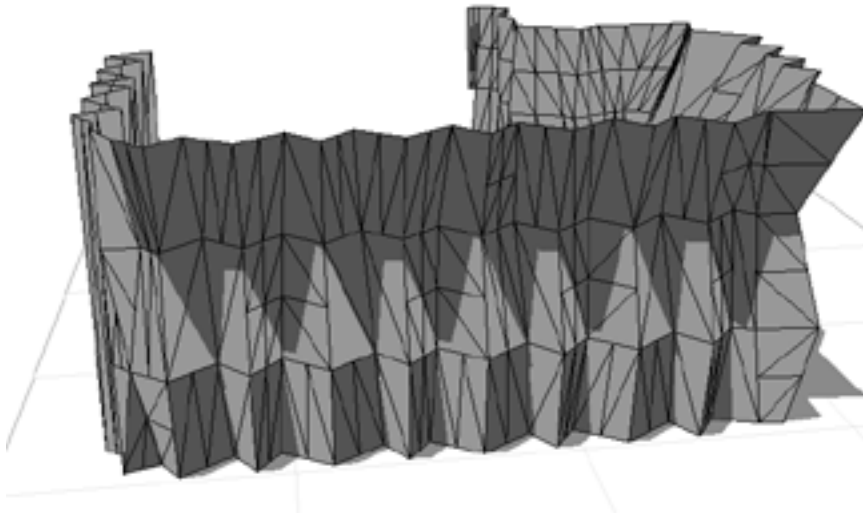
Marc Newson \* Unique Pieces  
<http://designgallerist.wordpress.com/2010/12/23/marc-newson-unique-pieces/>

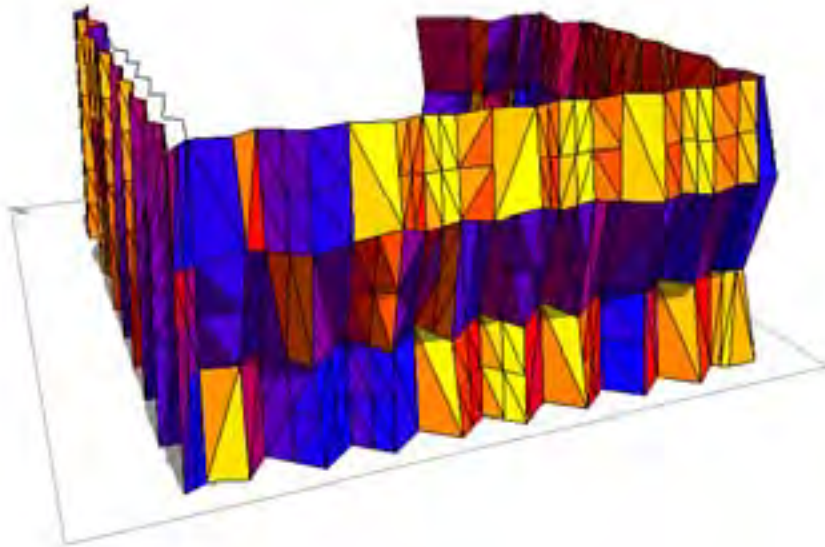
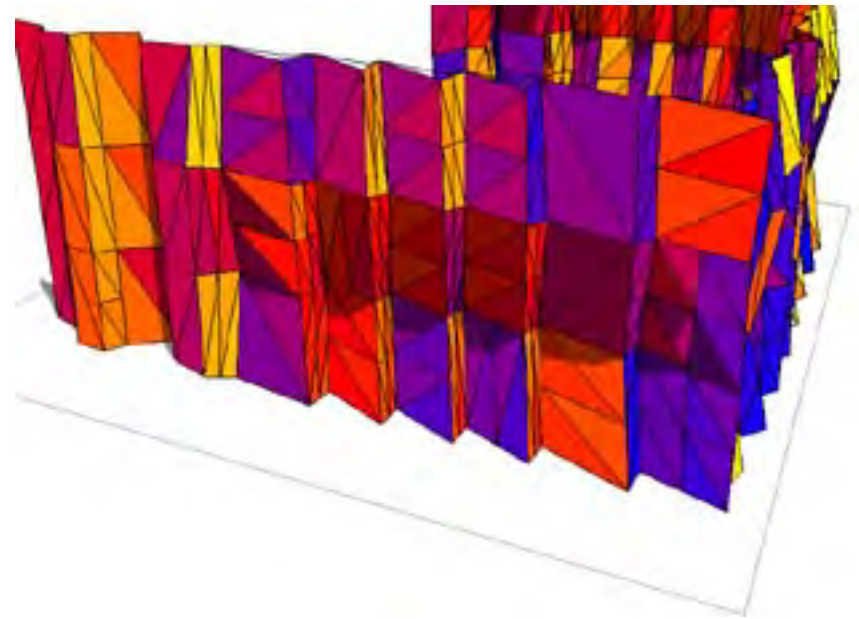
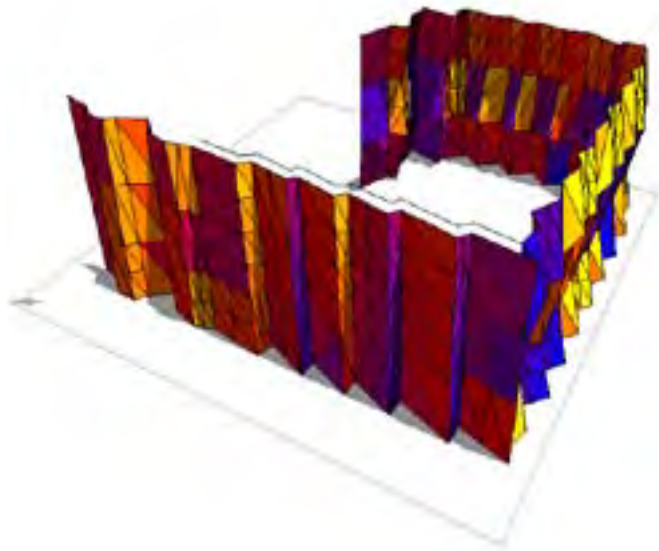




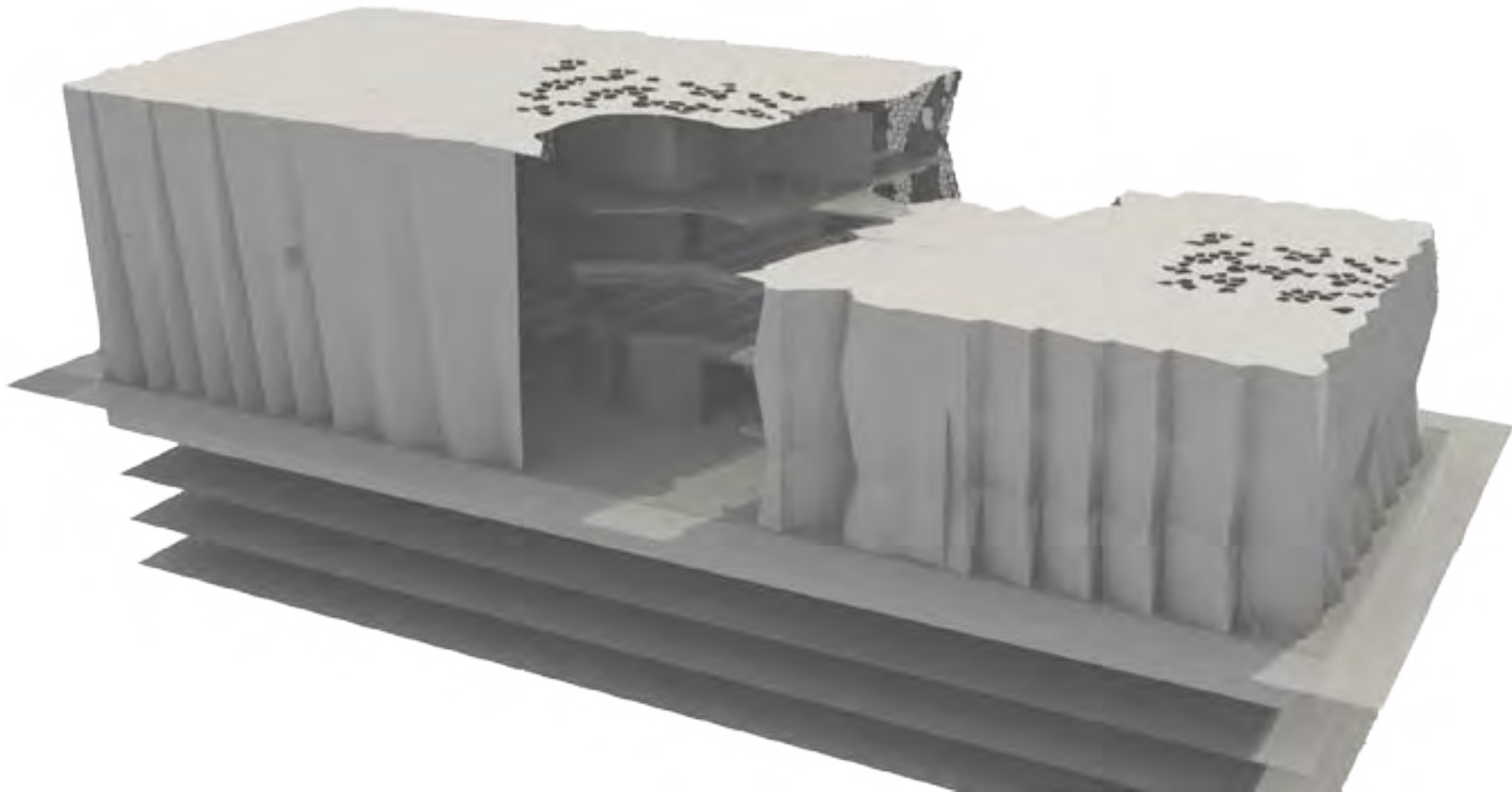


## Facade Options

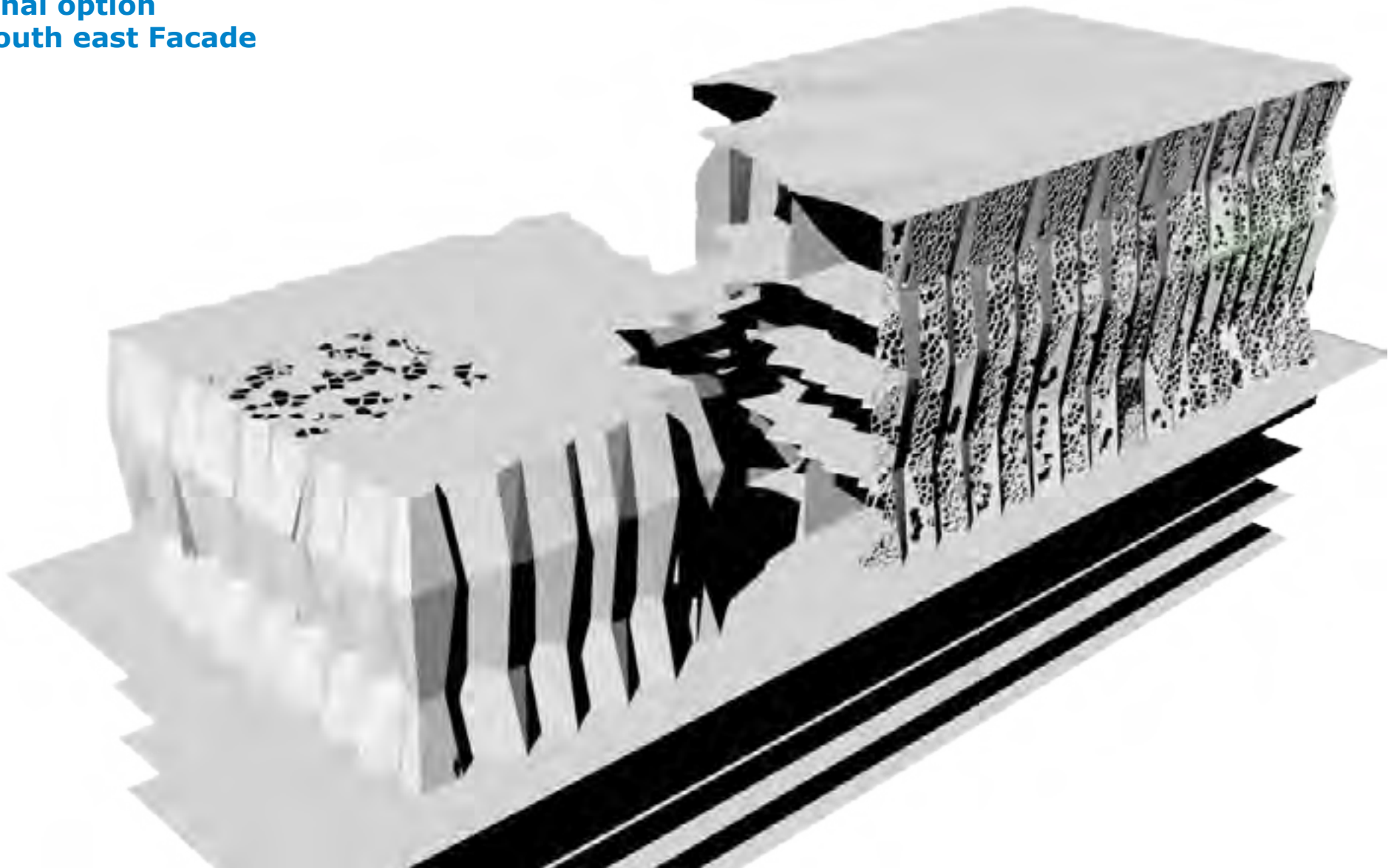


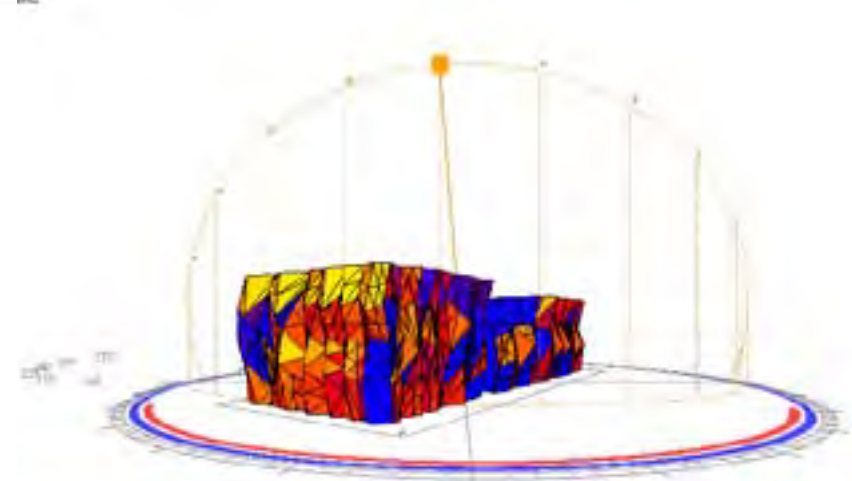
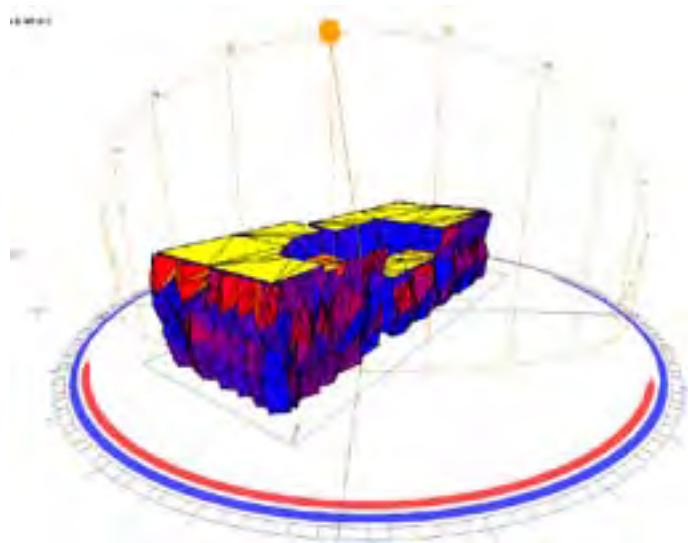
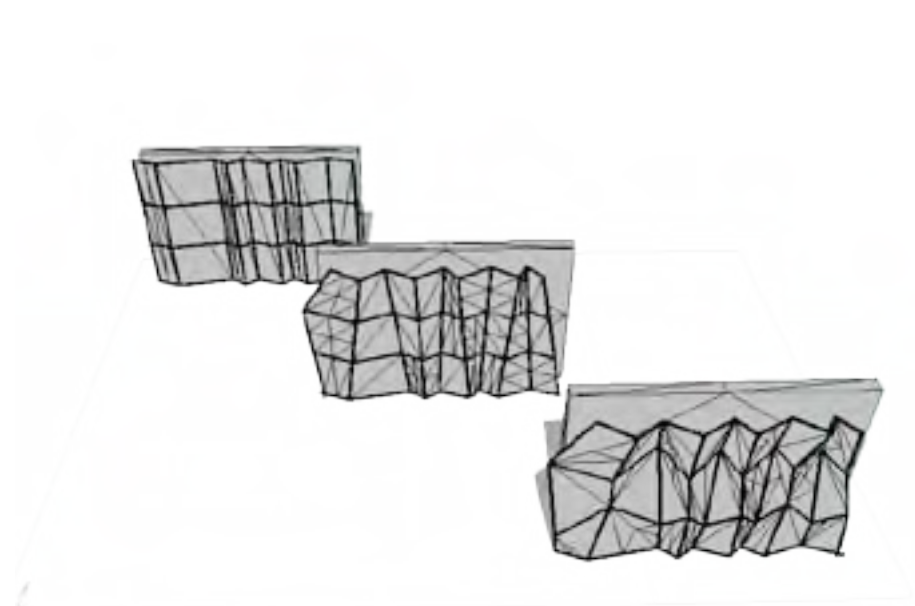
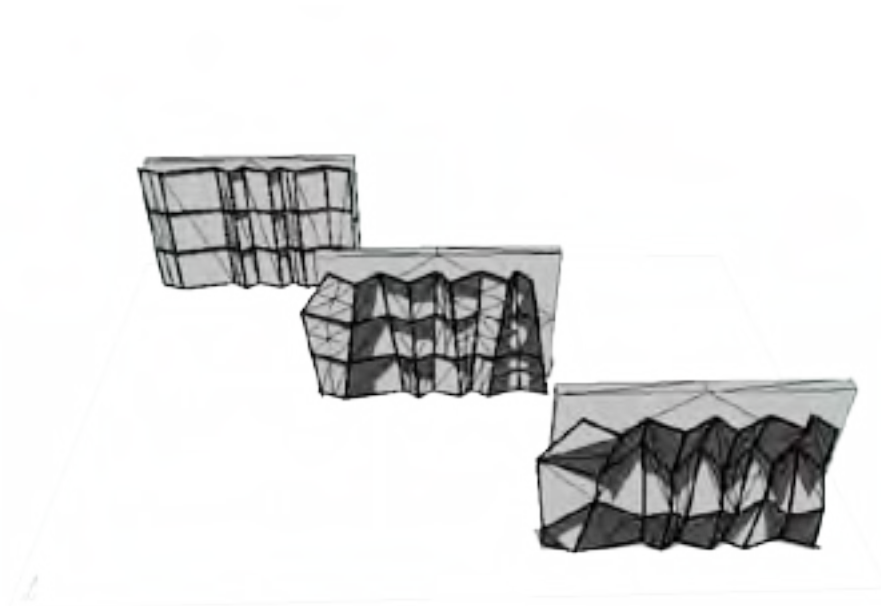
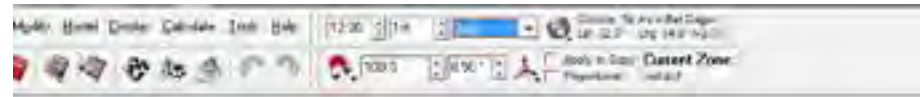


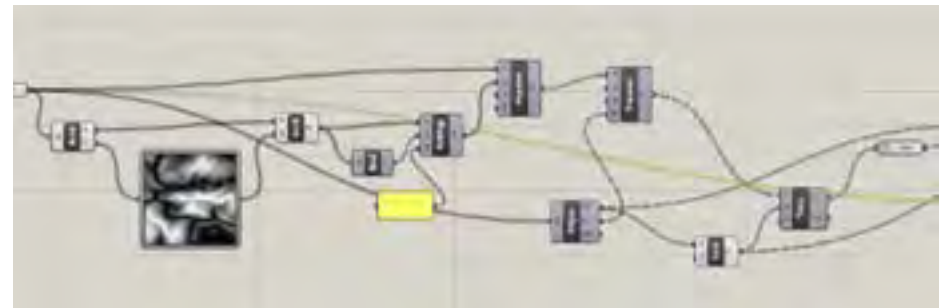
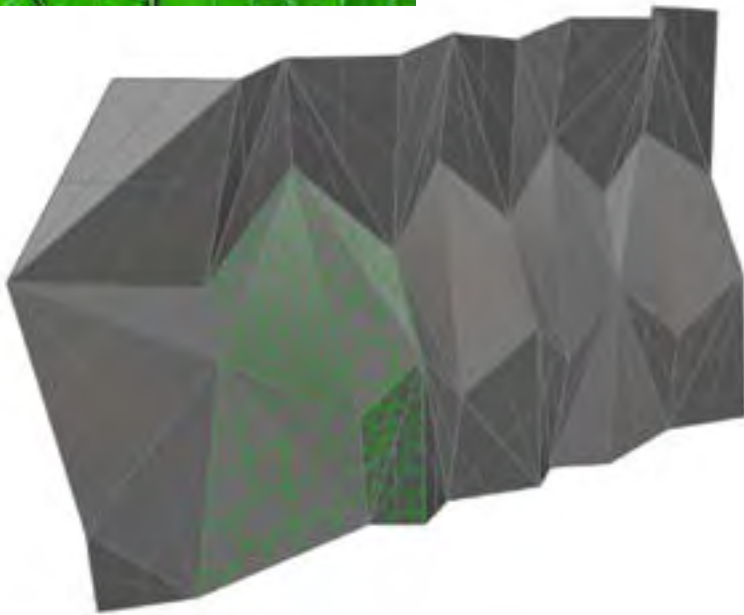
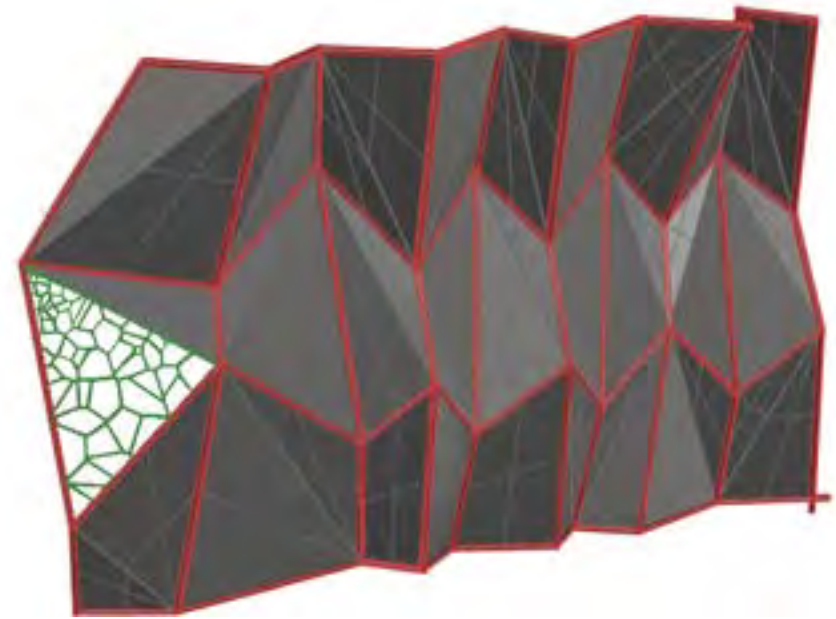
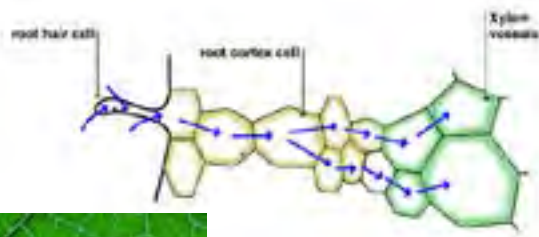
## Final Option North west facade



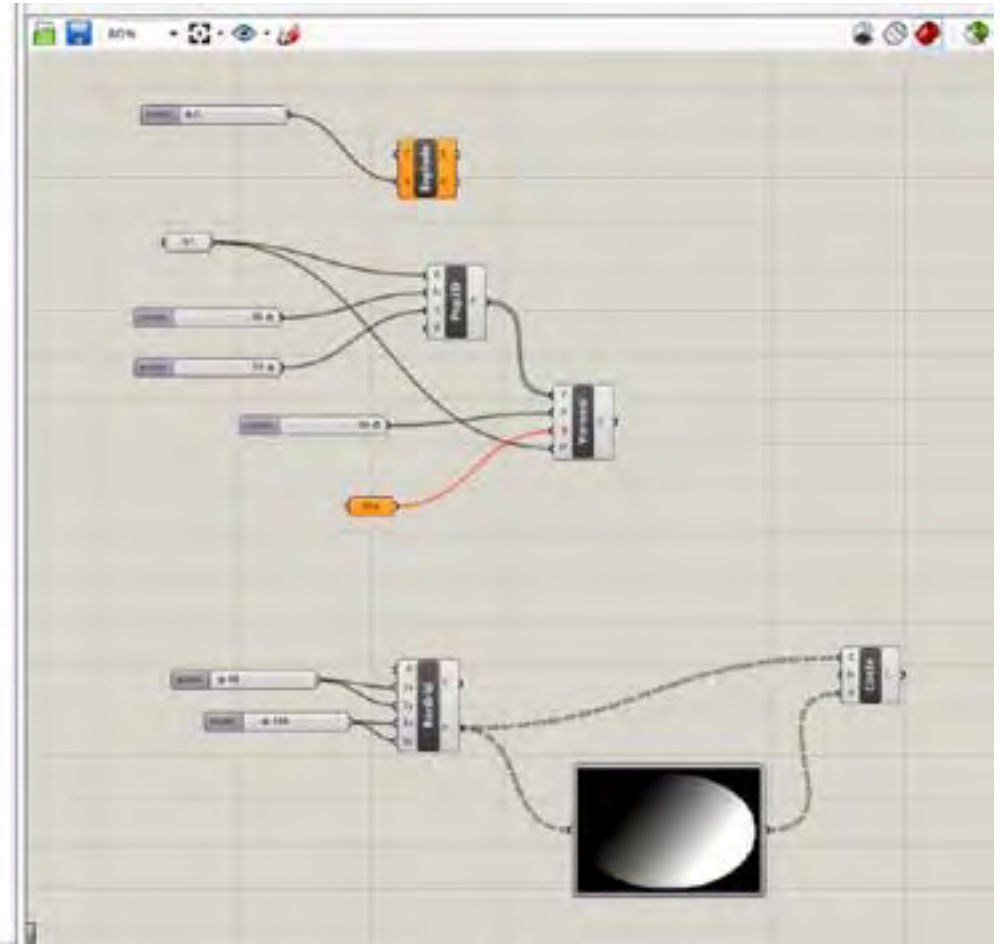
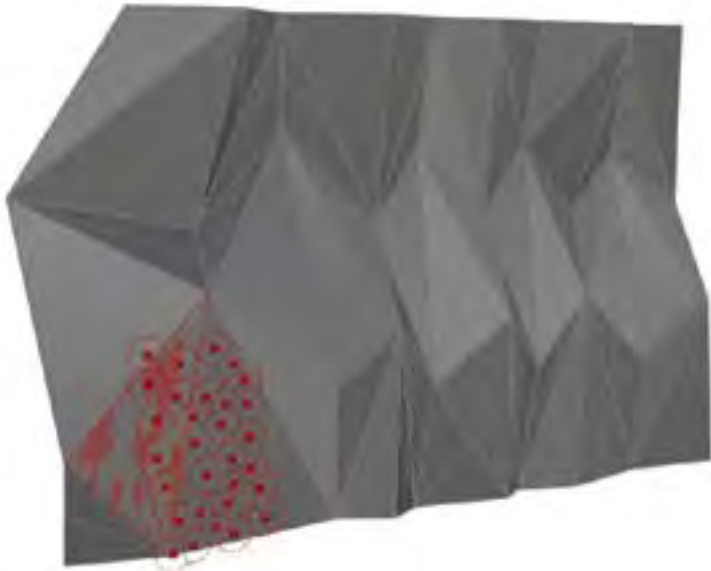
**Final option  
South east Facade**



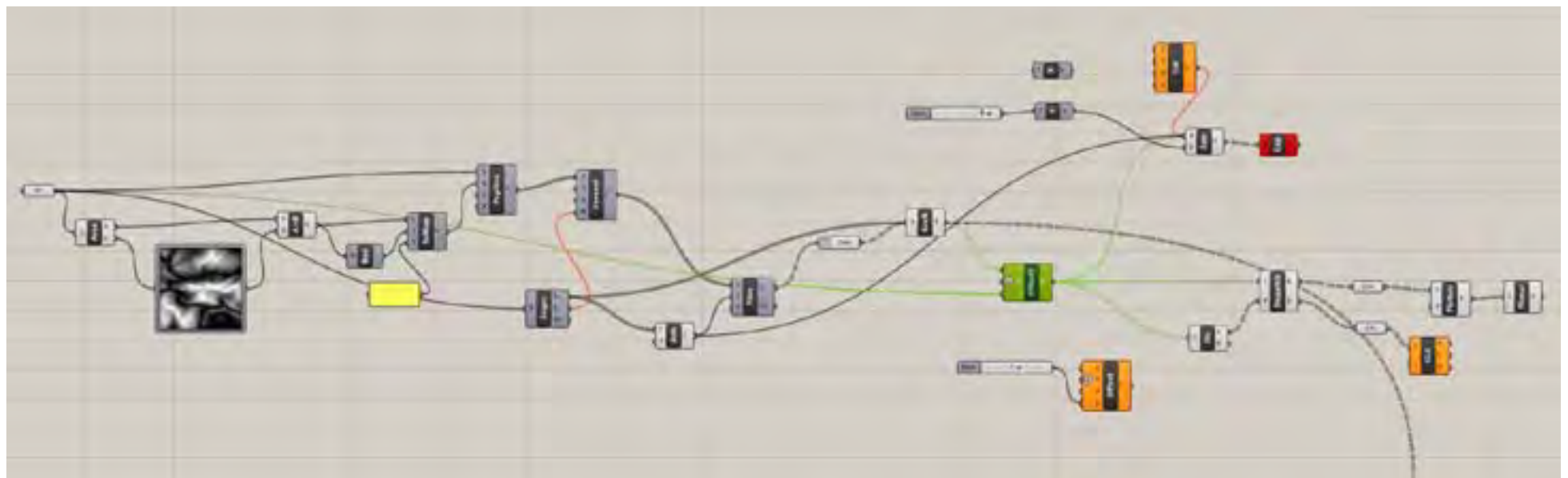
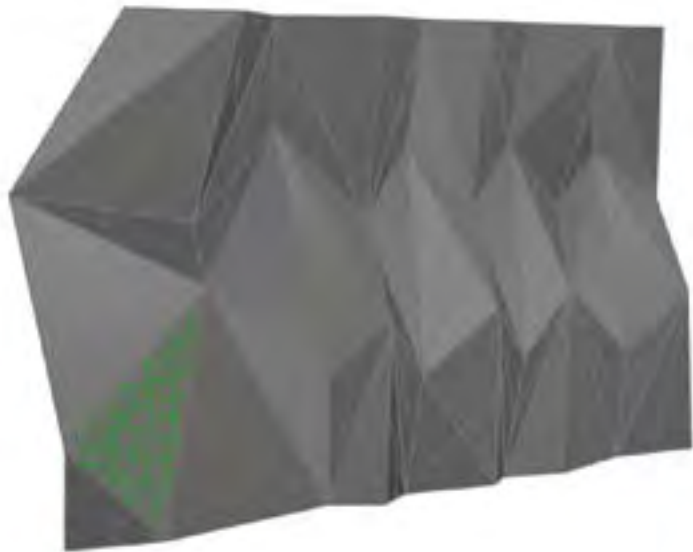




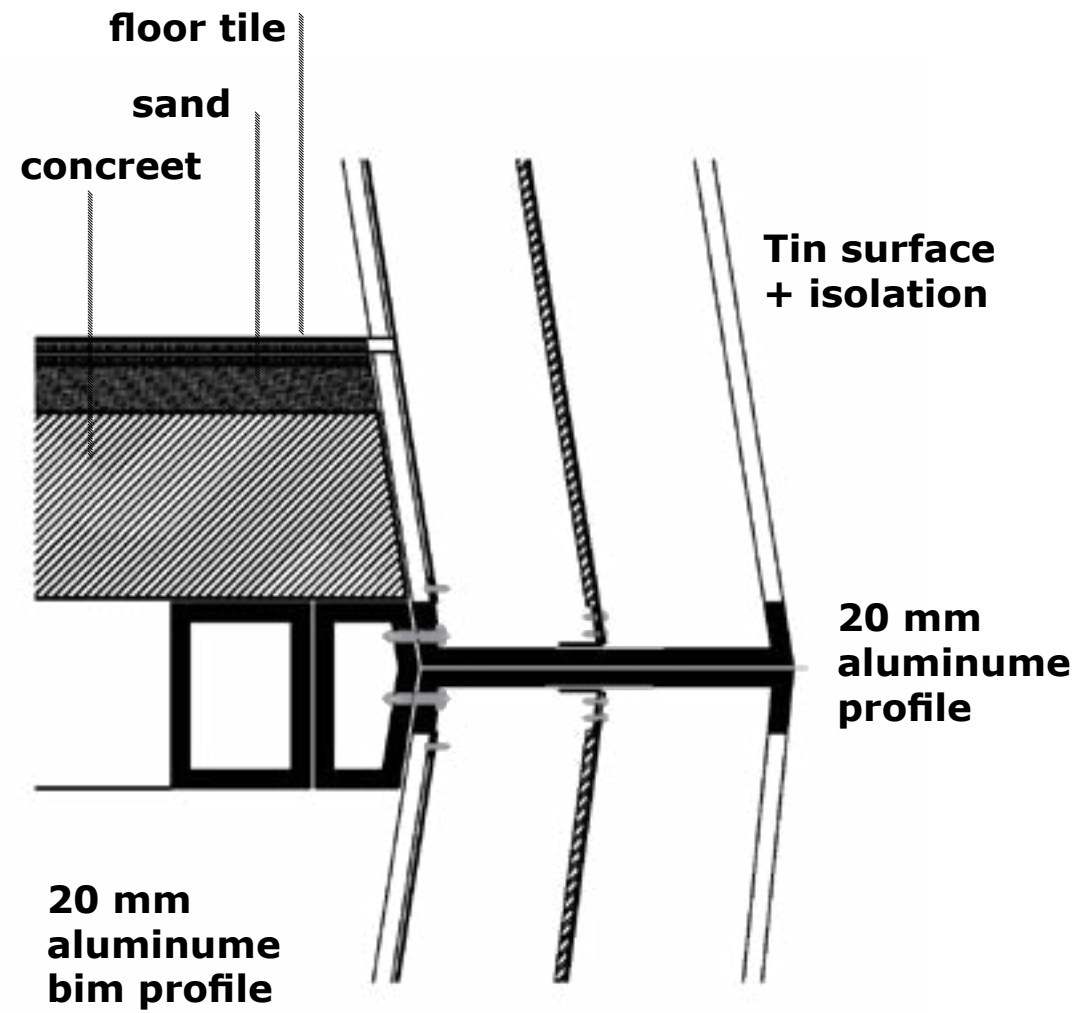
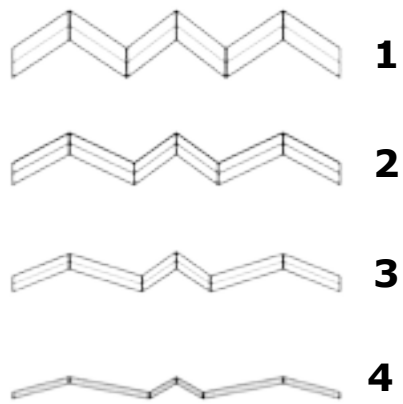
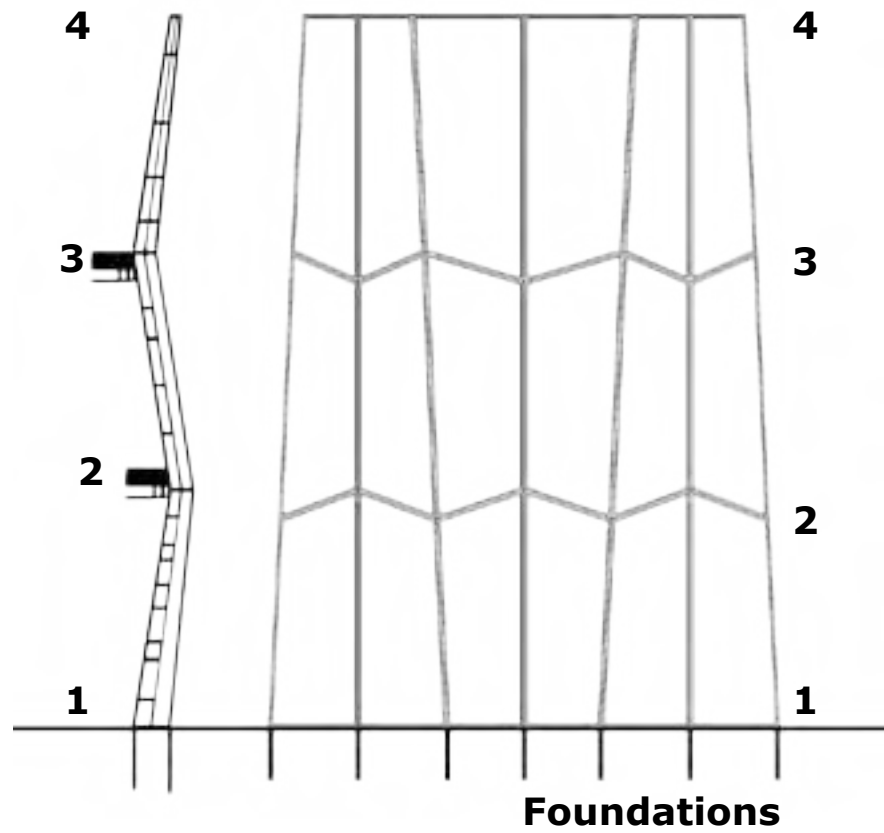
# Try 1

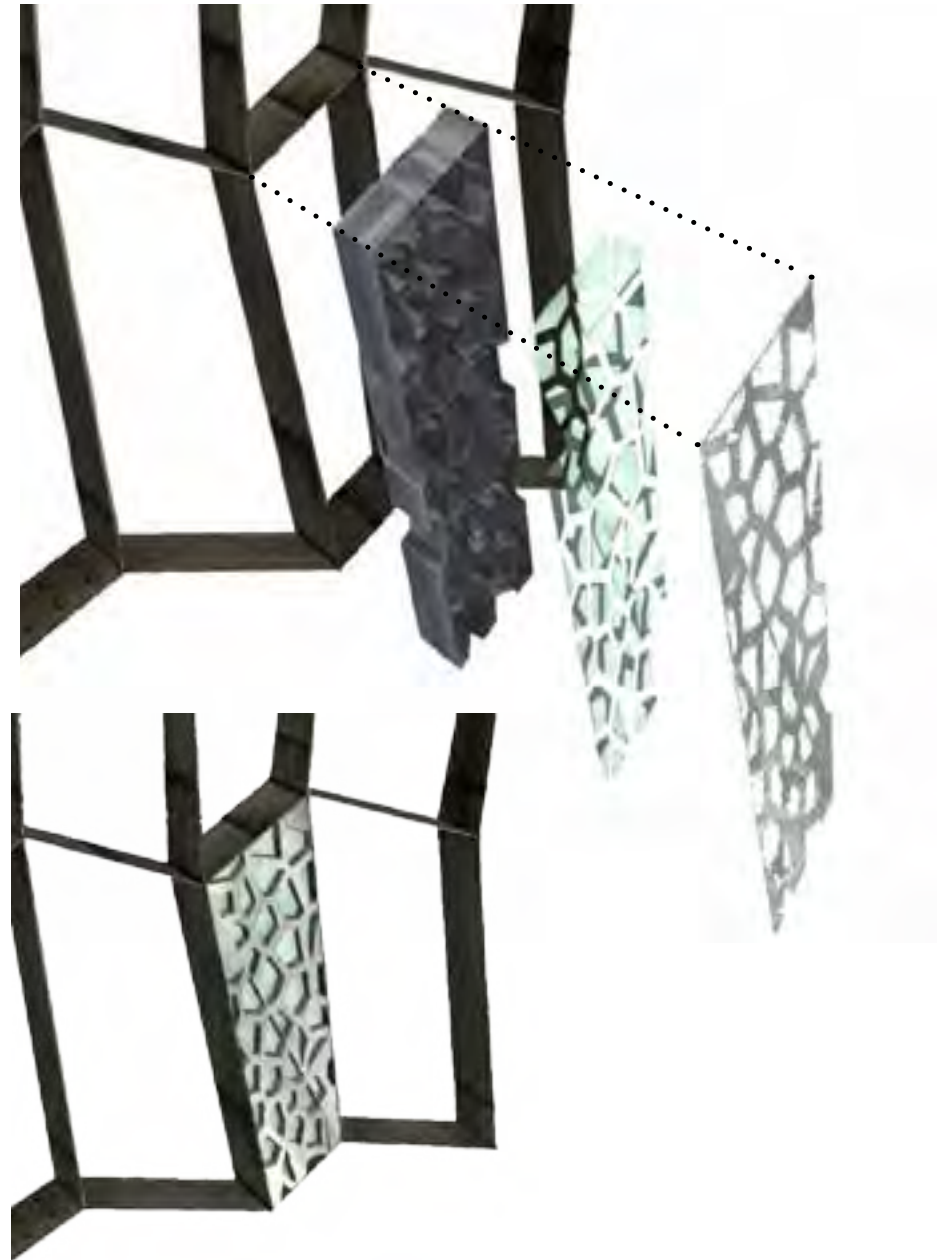


# Try 2







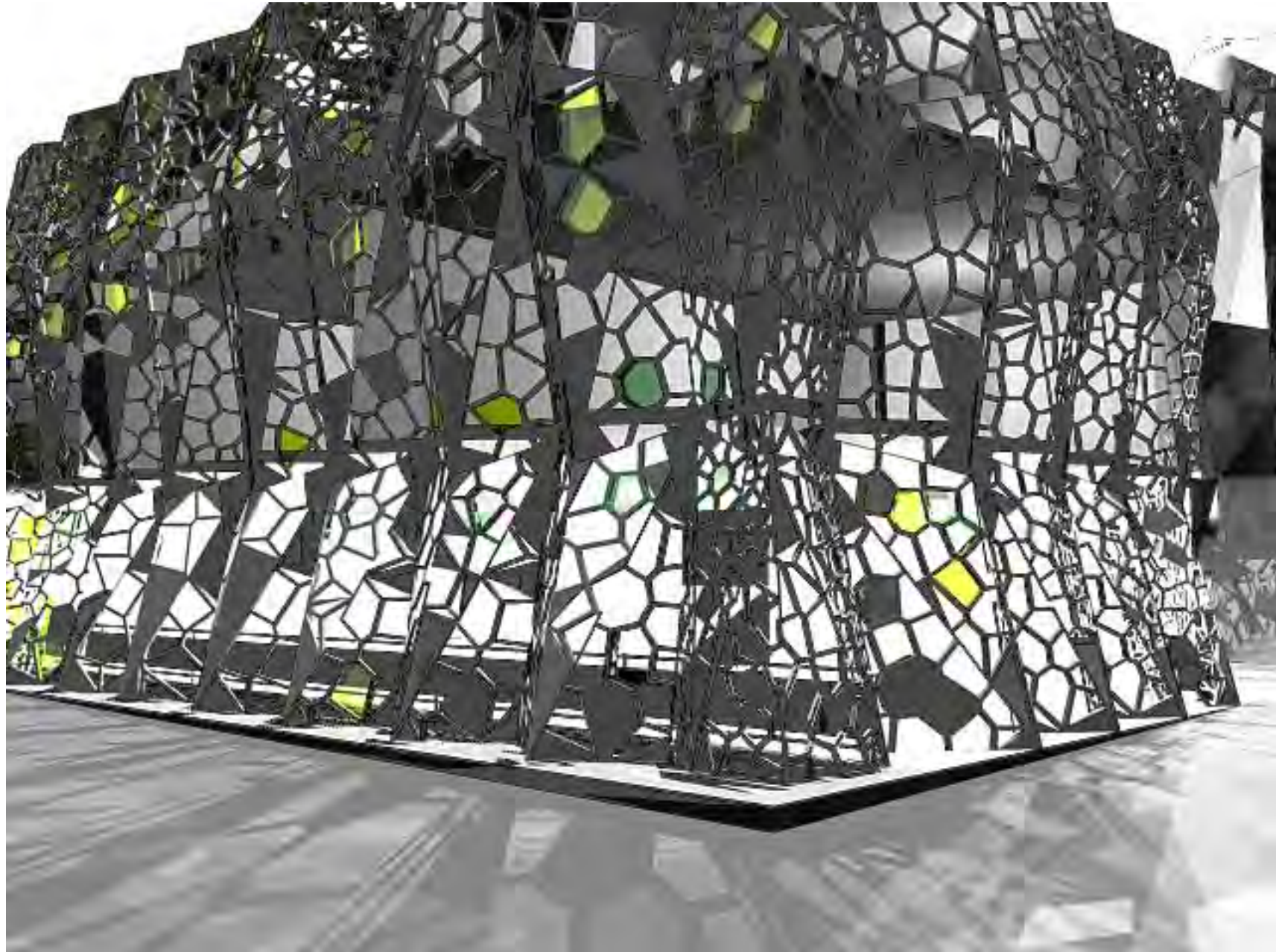


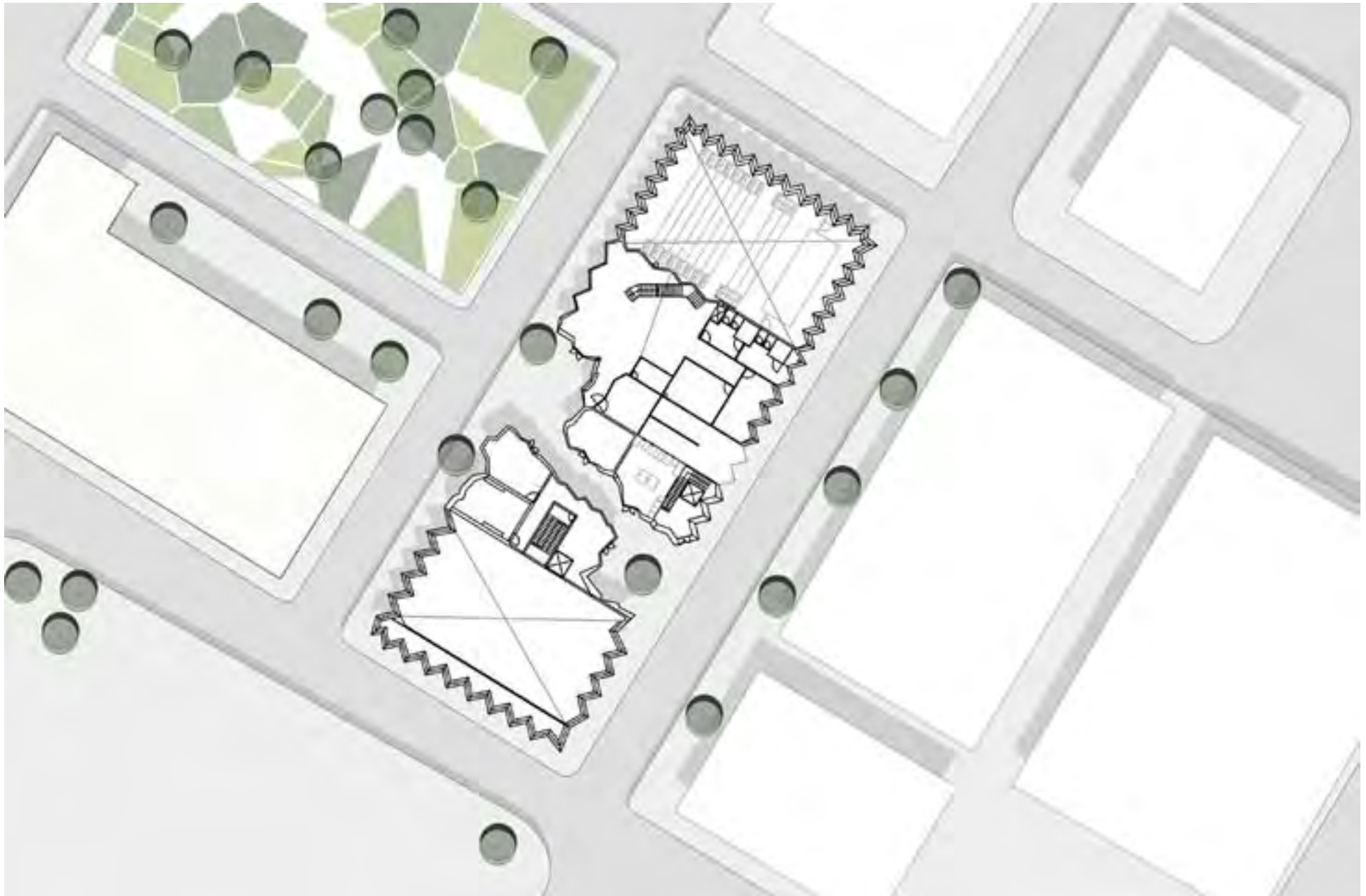
## facade Surfaces types

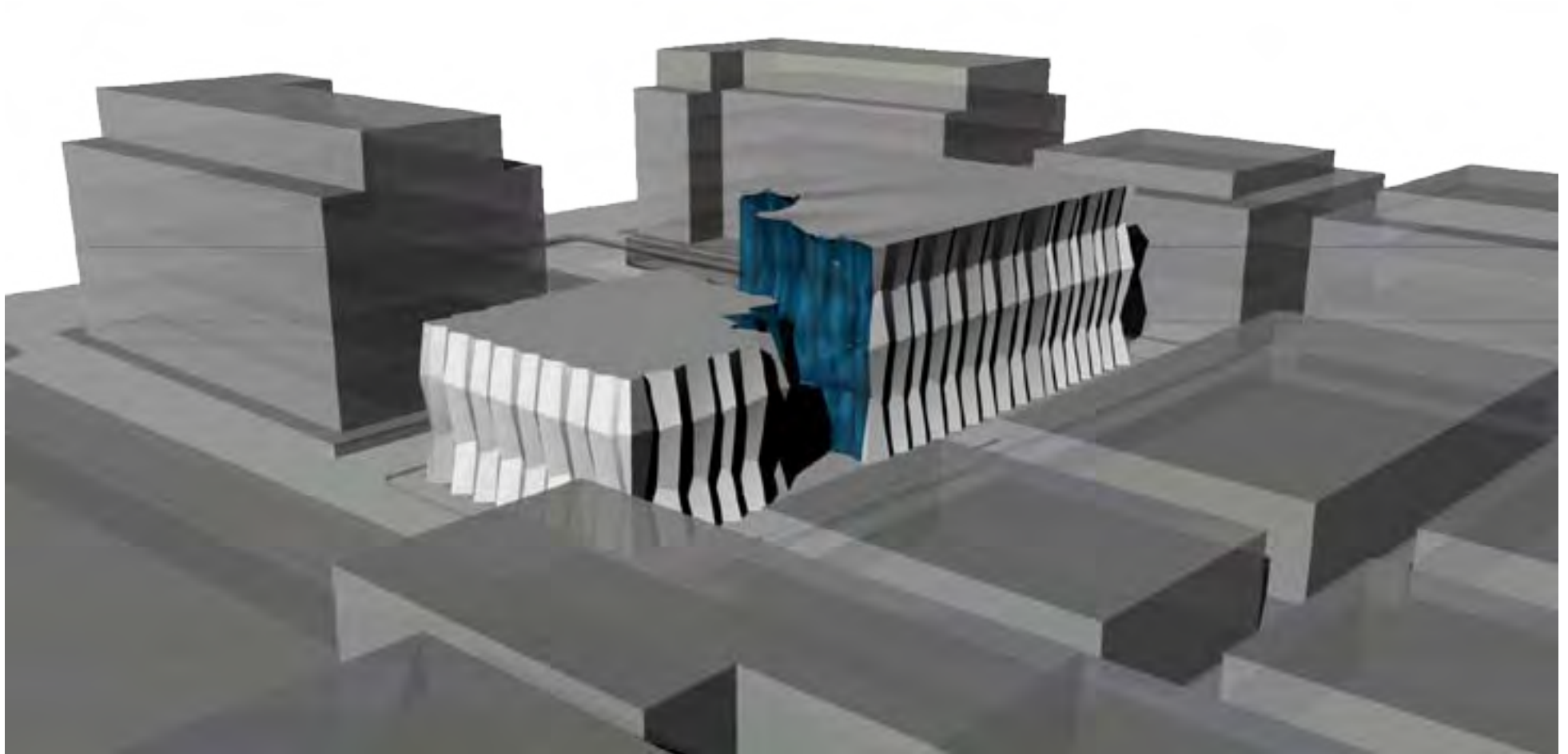
Fully closed- doesn't let any of the sunbeam in.  
(places like the Theater)  
small size openings- let only a small amount of light in.

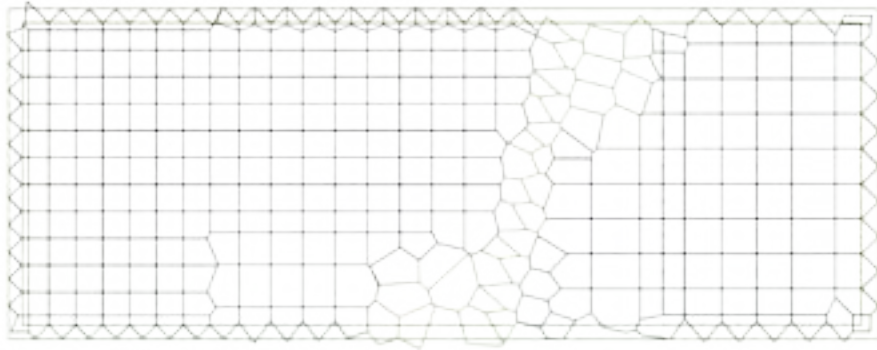
Big size opening- let a large amount of light in.  
With door or window opening.



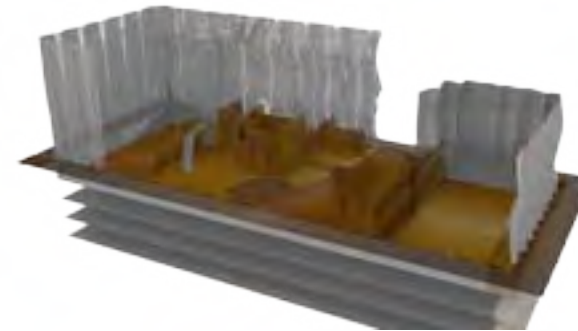
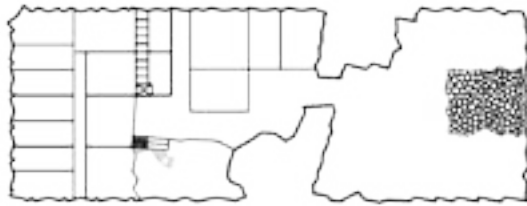




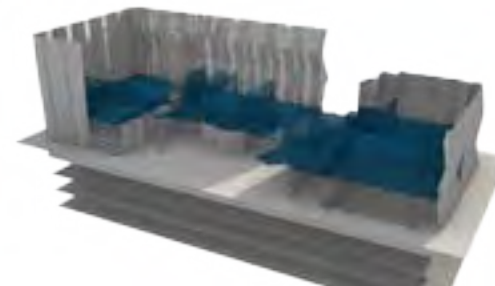
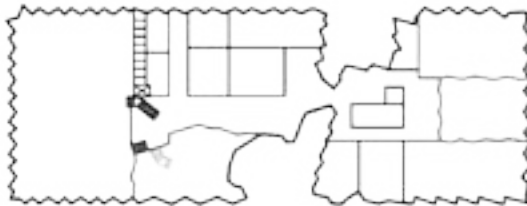




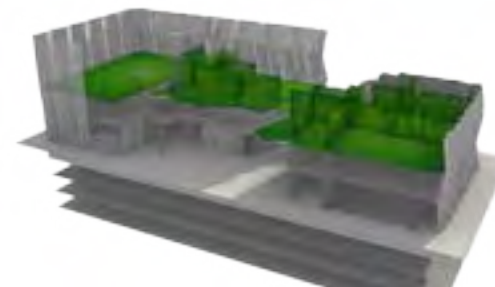
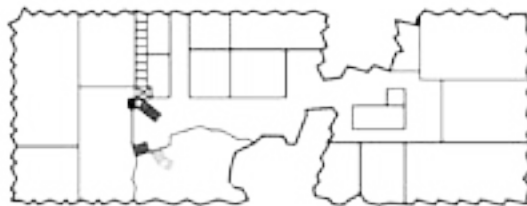
**First Floor**



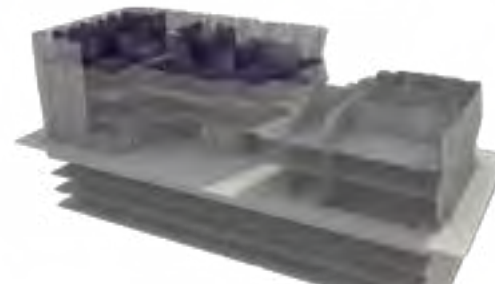
**Second Floor**



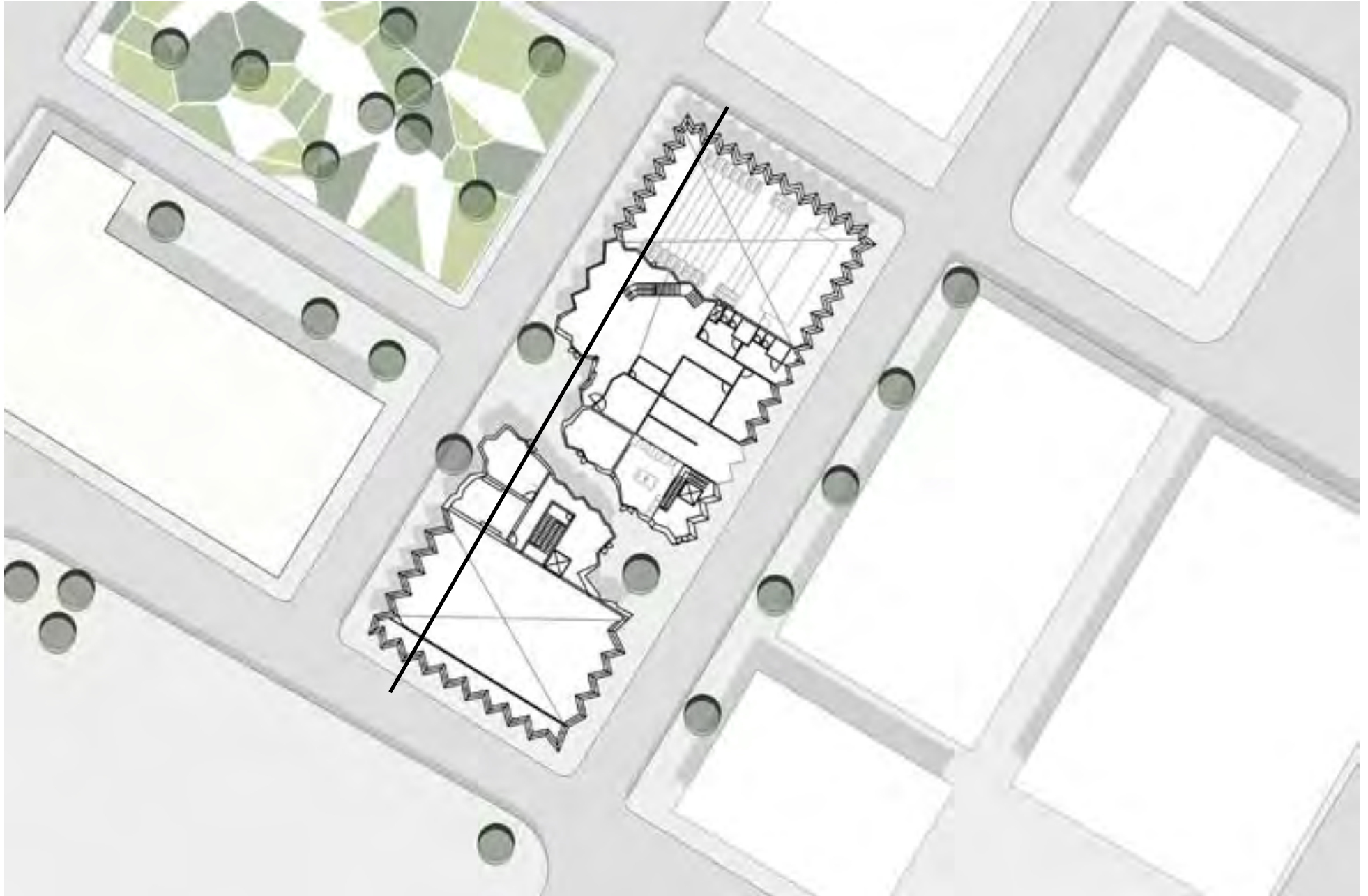
**third Floor**

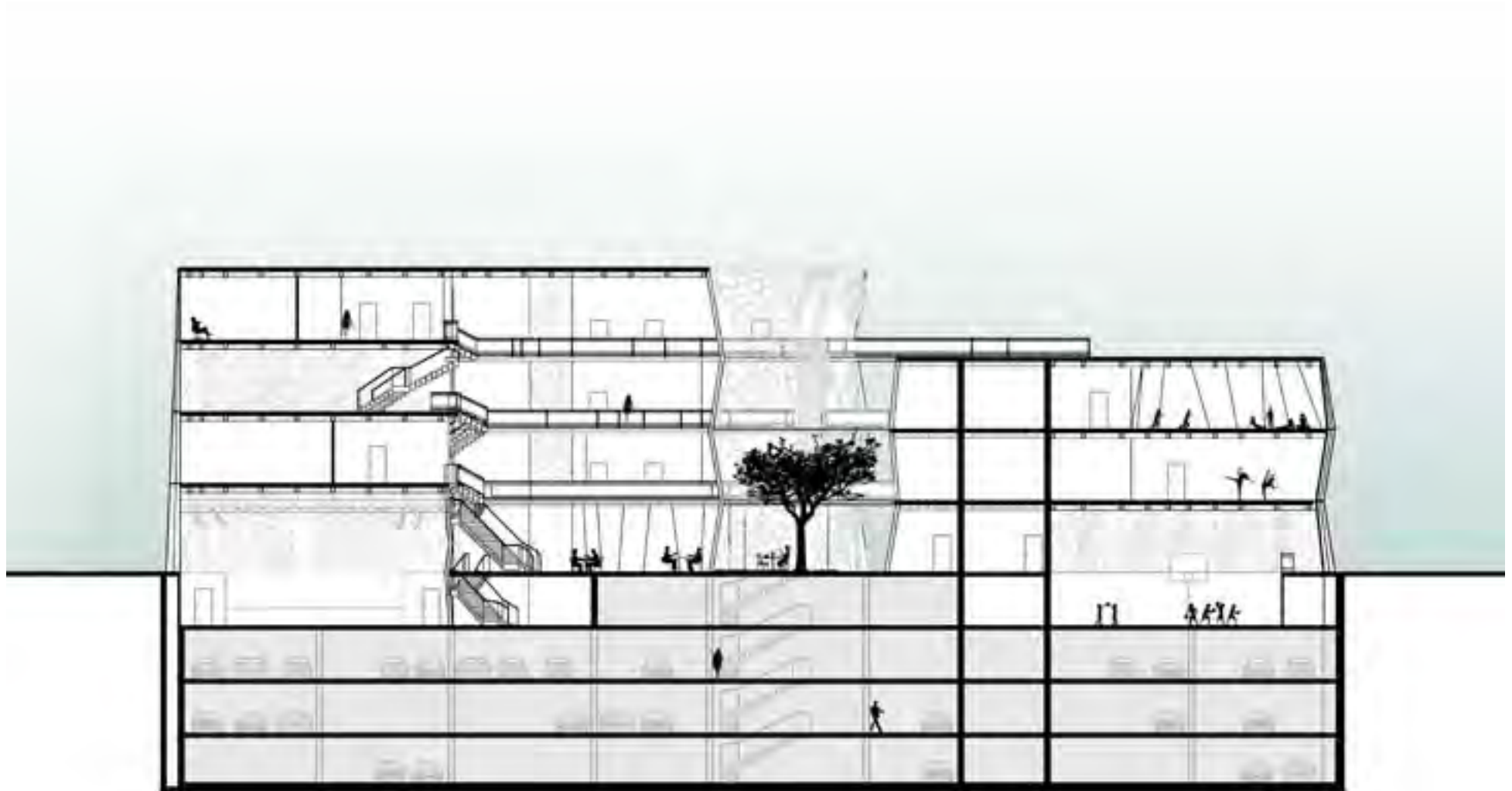


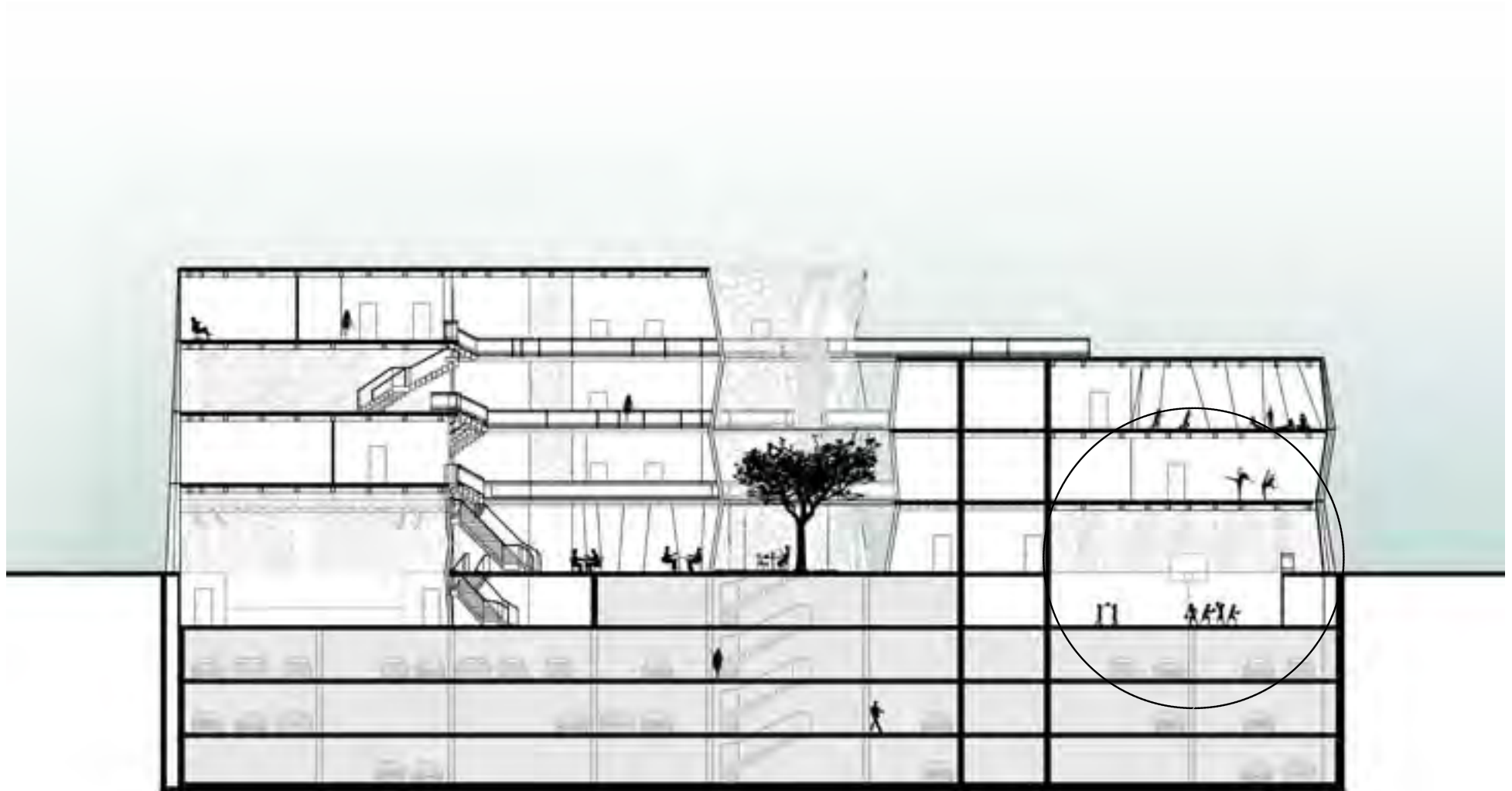
**Fourth Floor**



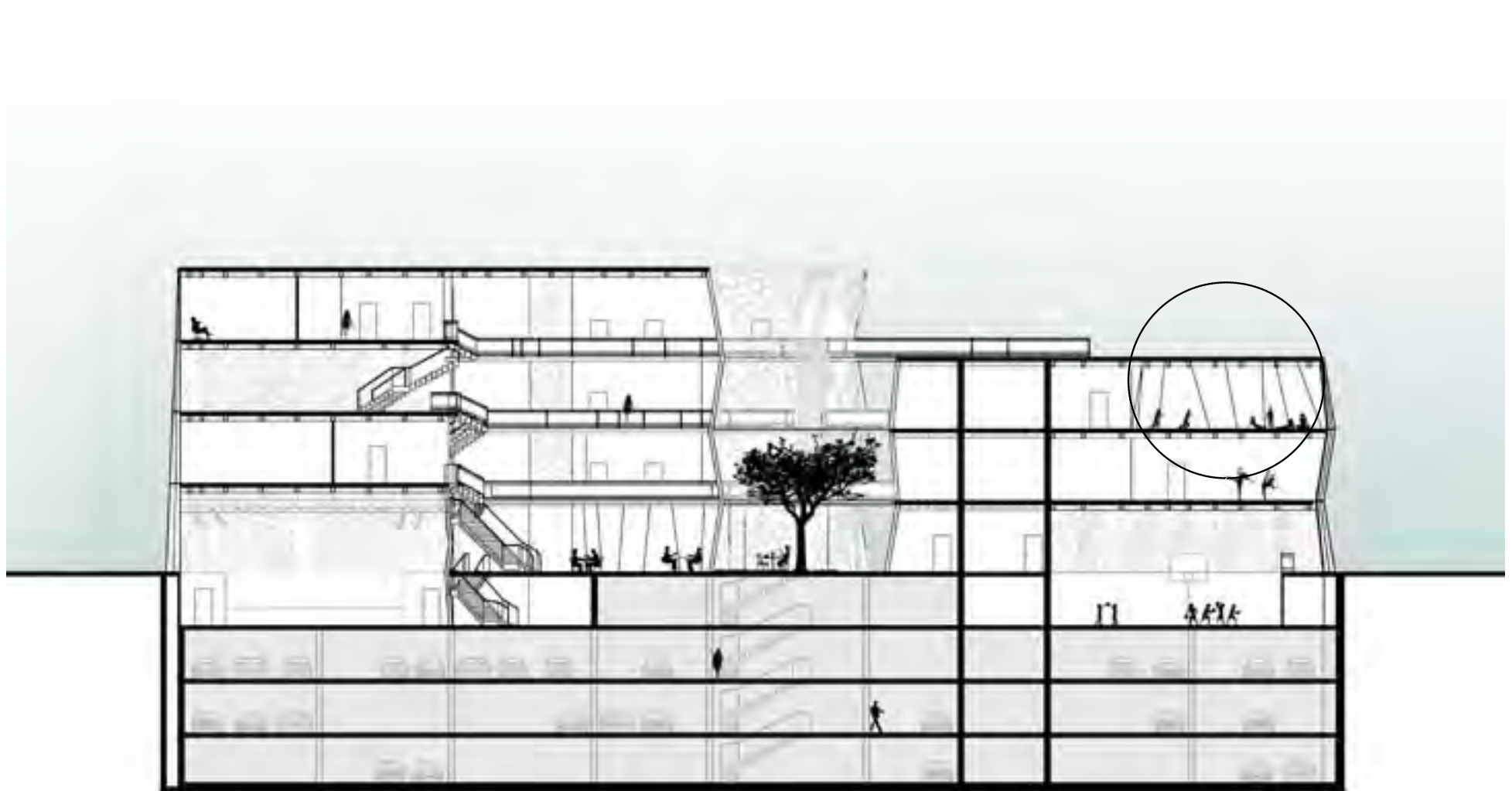




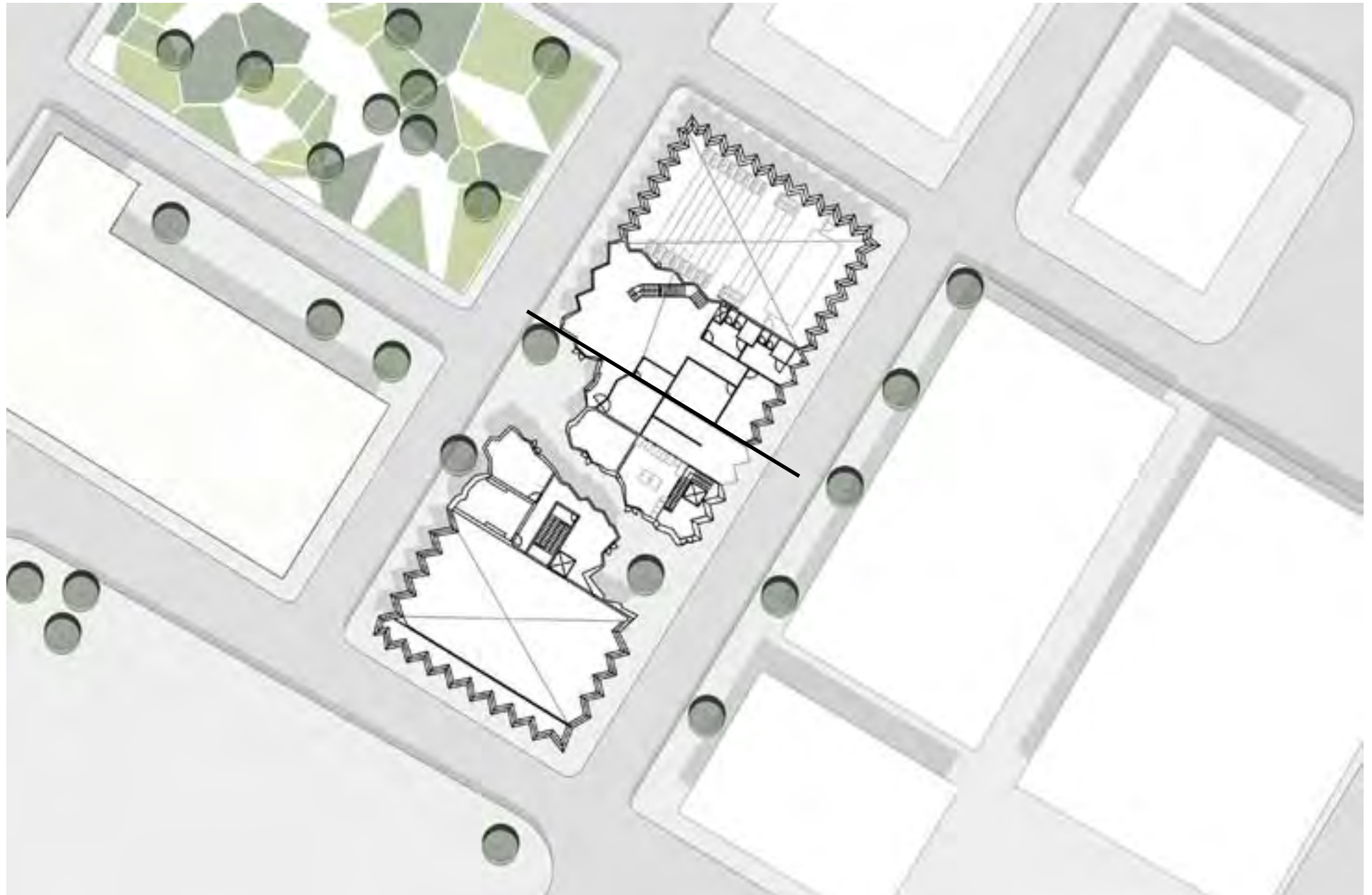


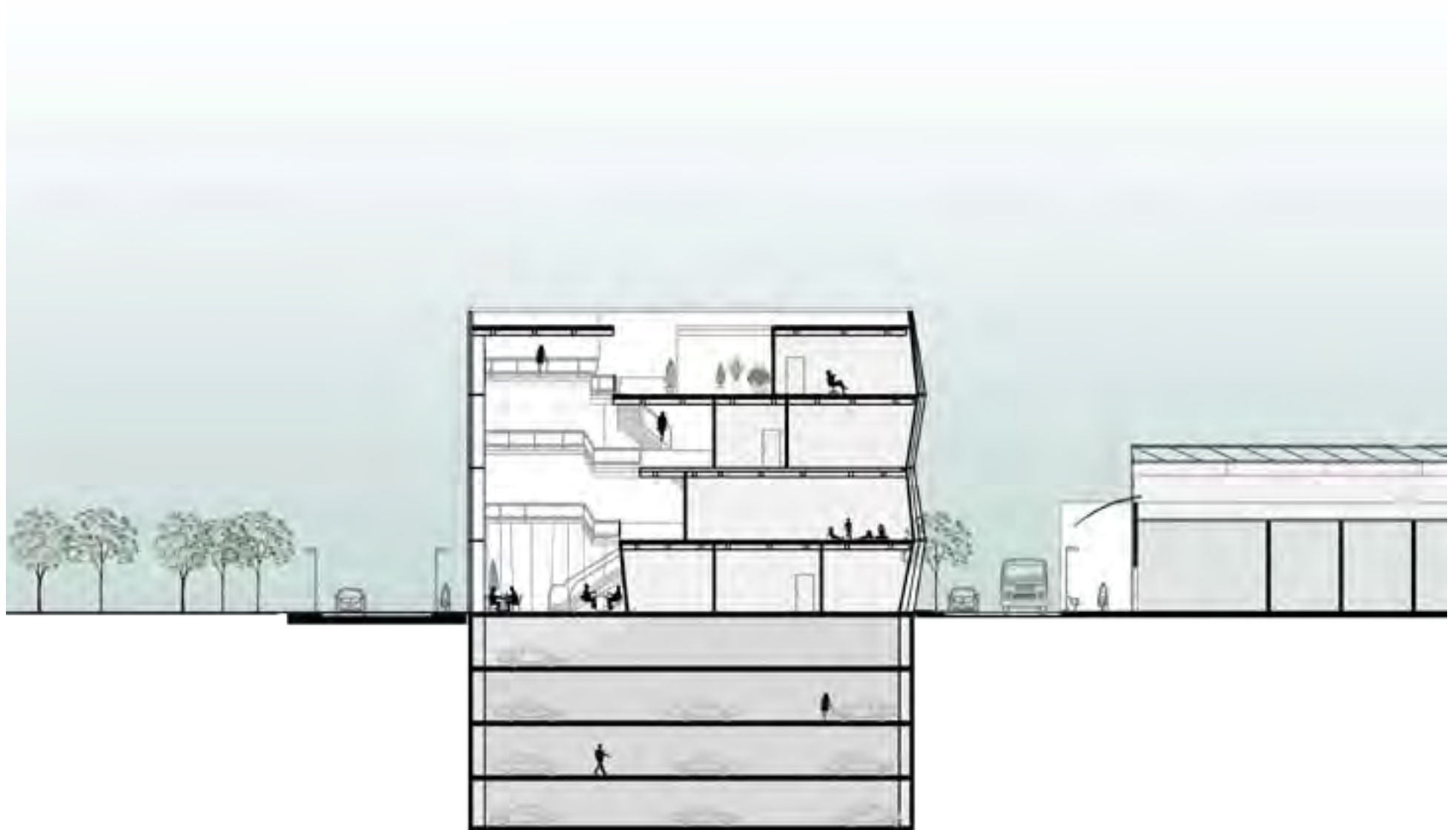




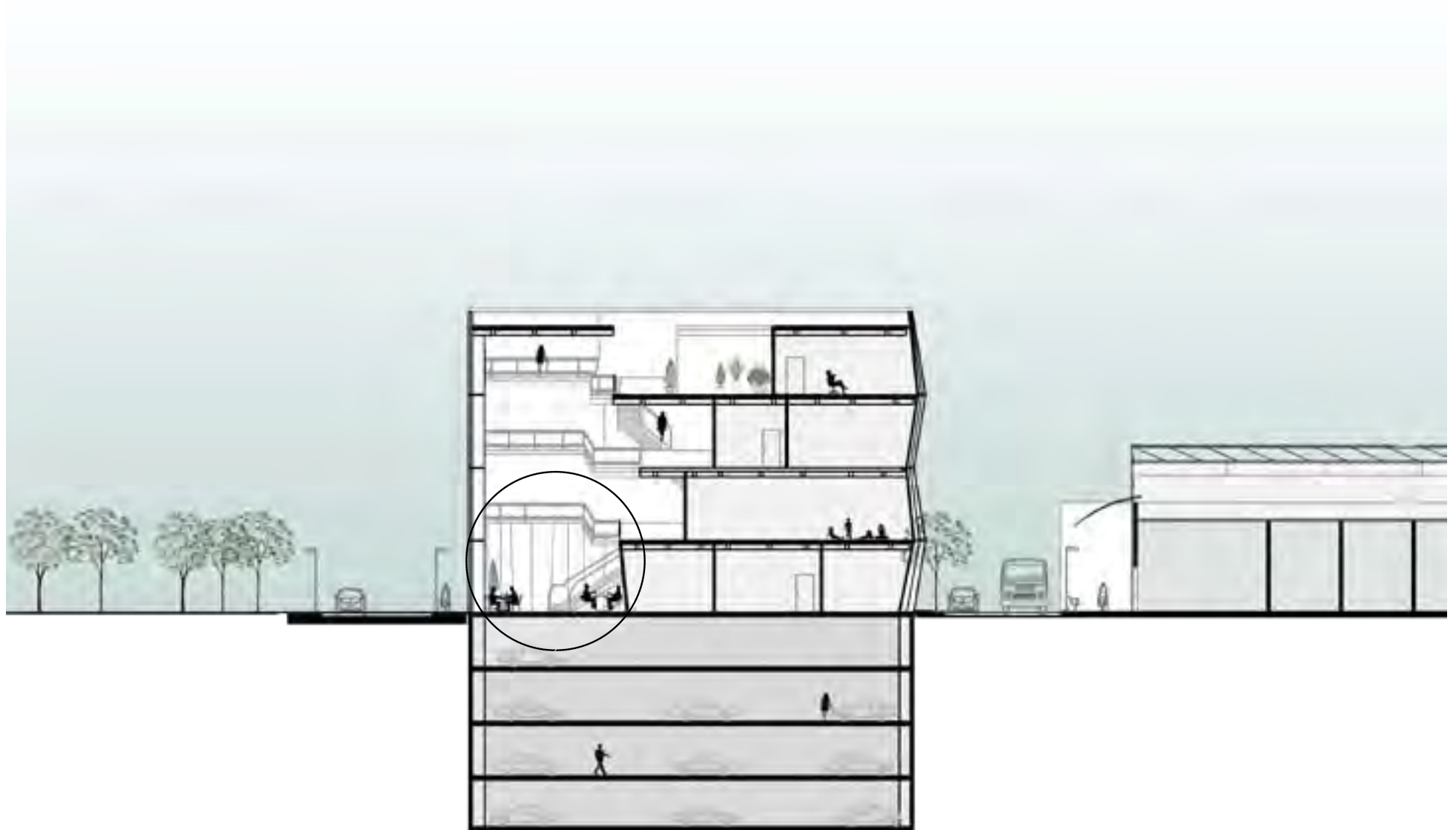




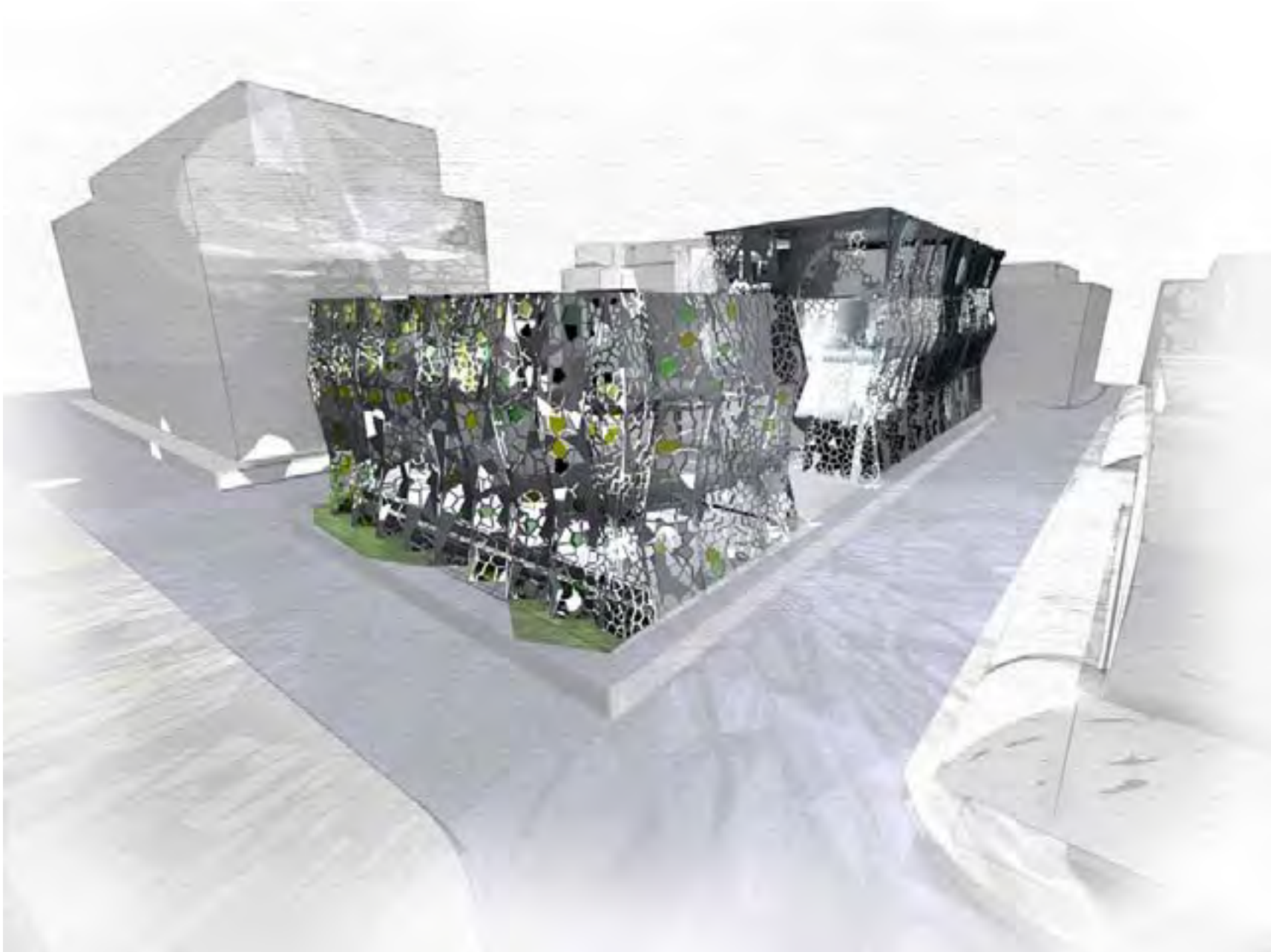










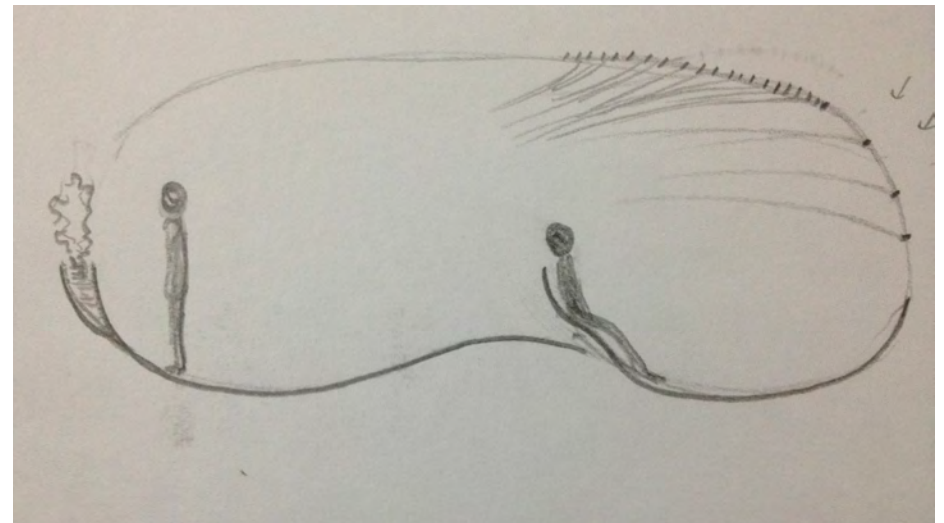
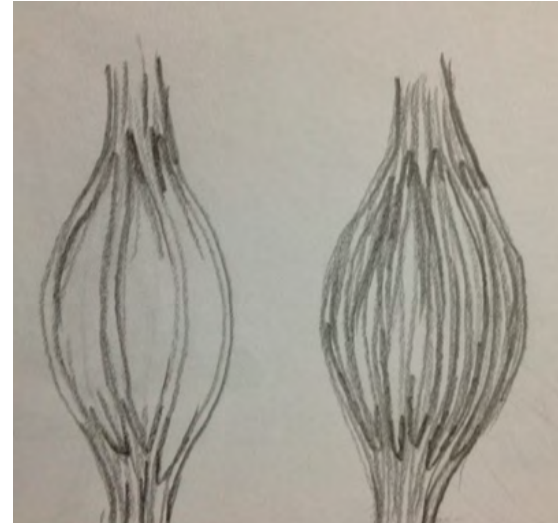
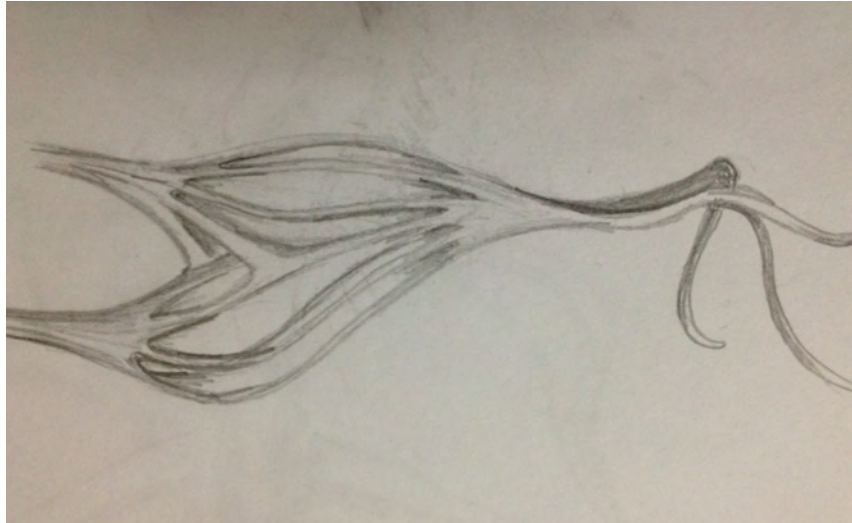


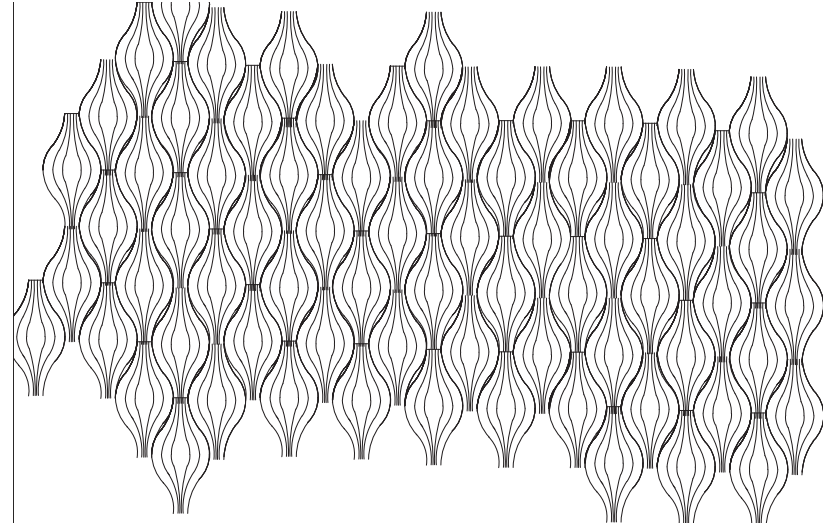
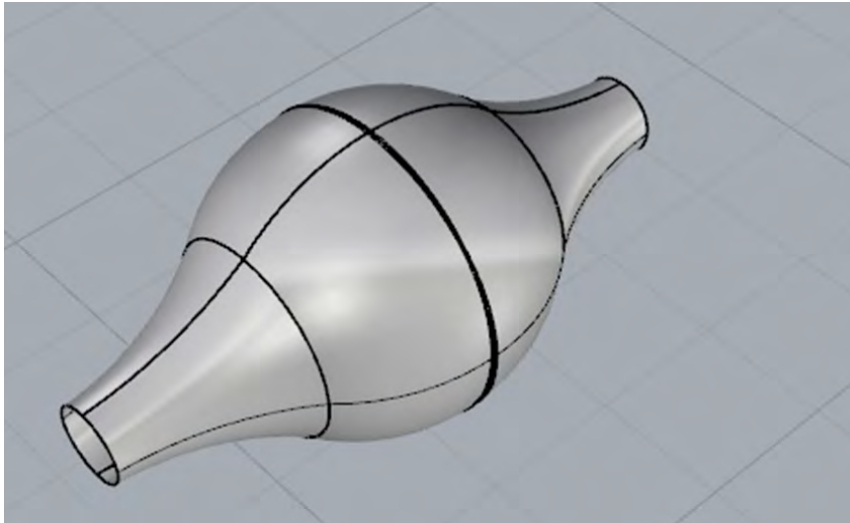


# ***THE MUSCLE CELL***

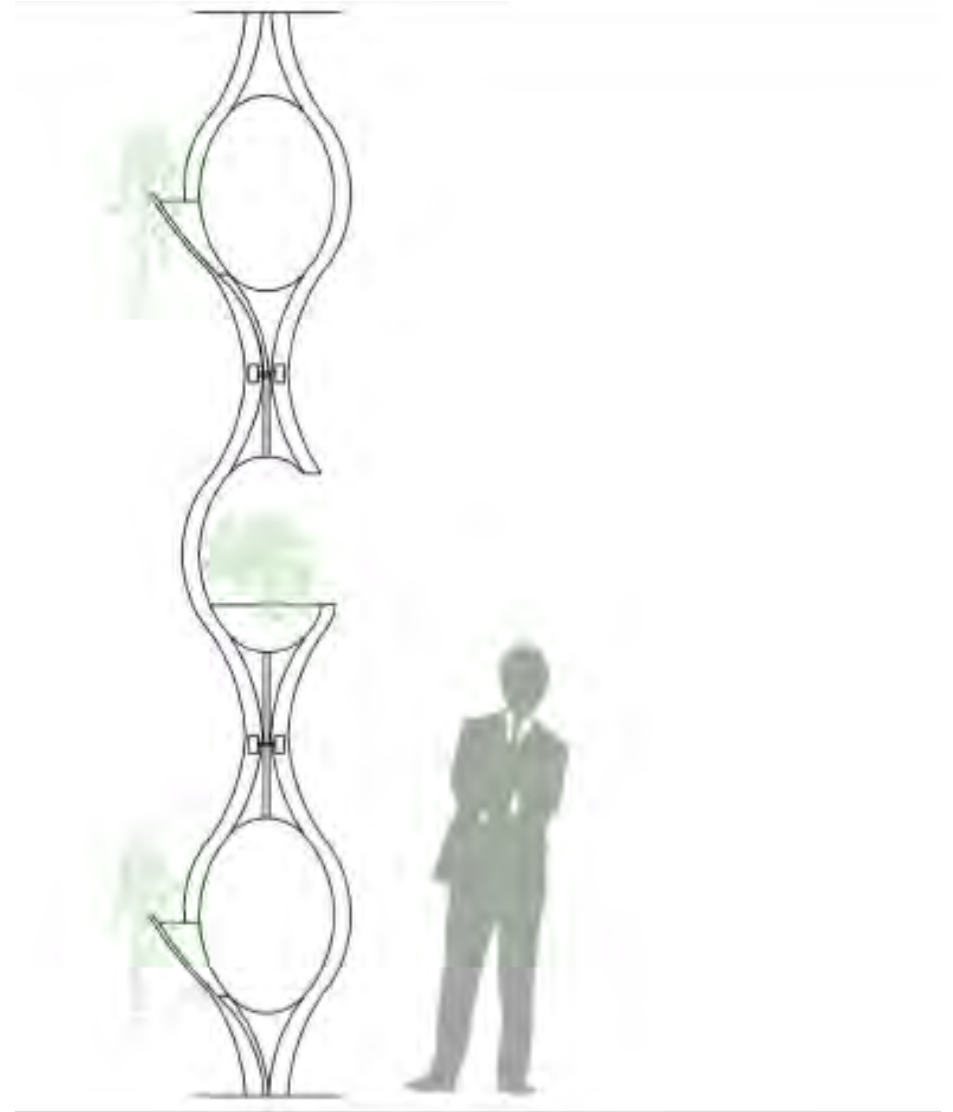
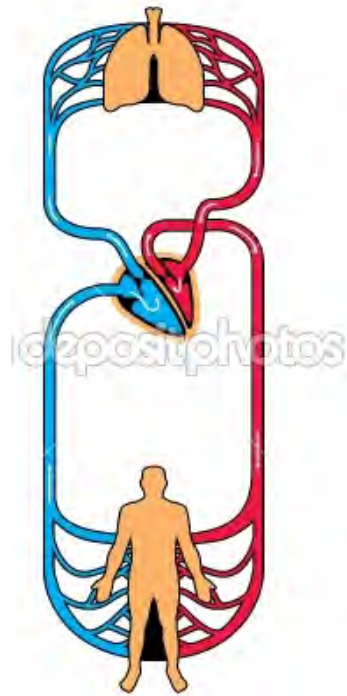
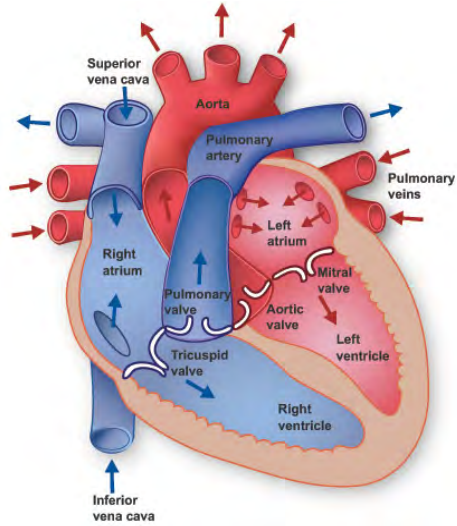


# Cellular Structure



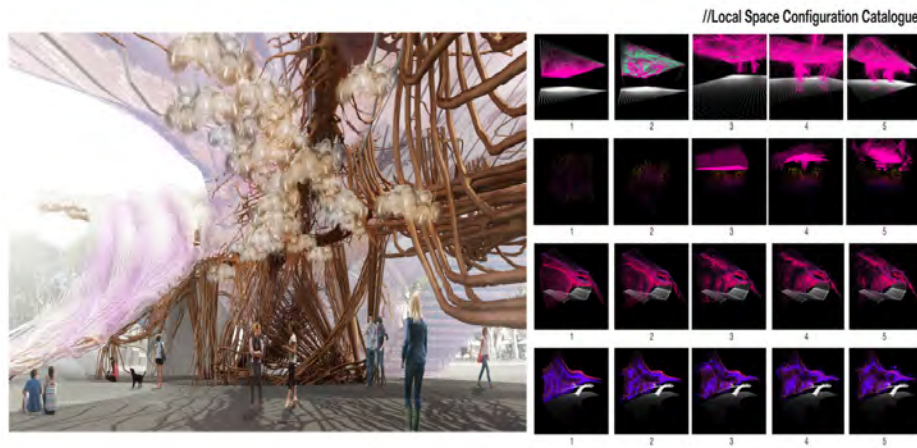
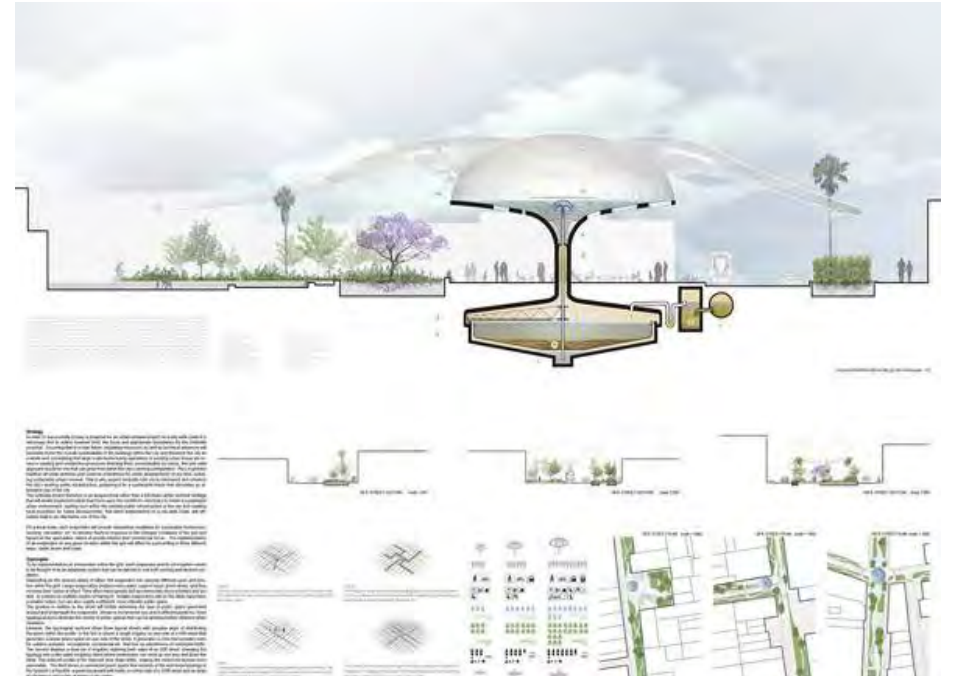
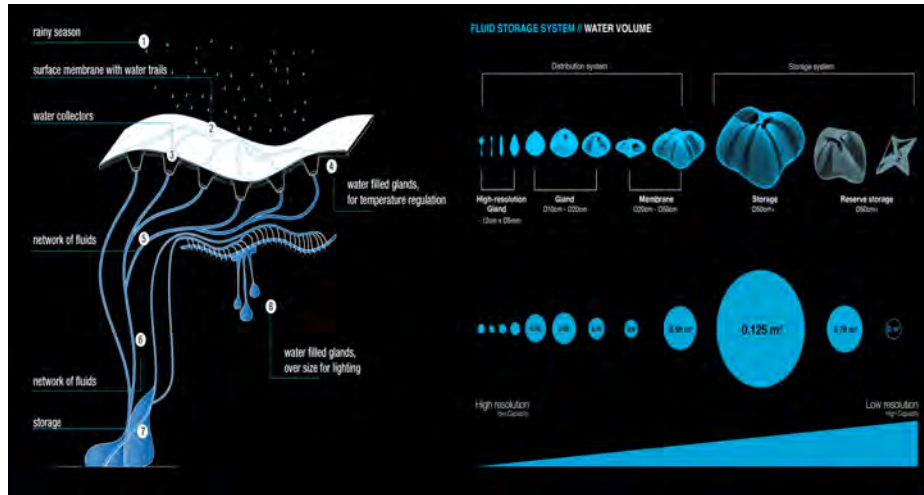


# 01 *water collecting*

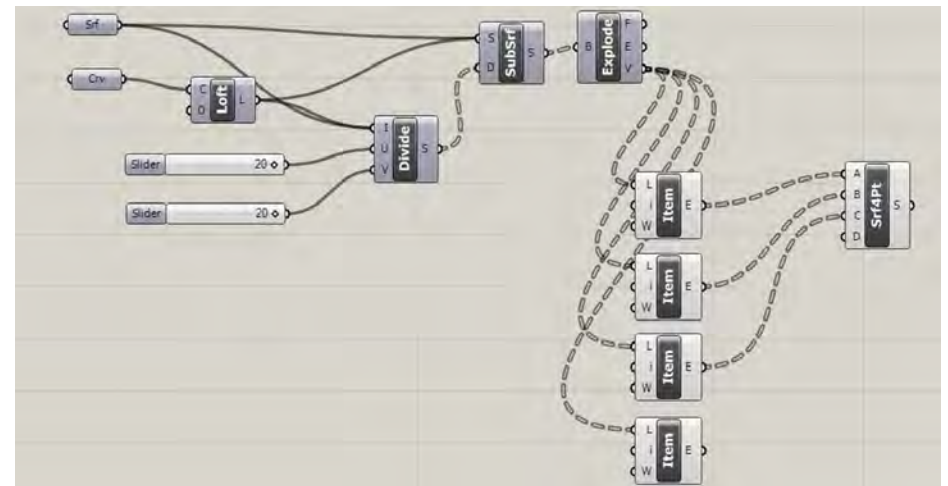
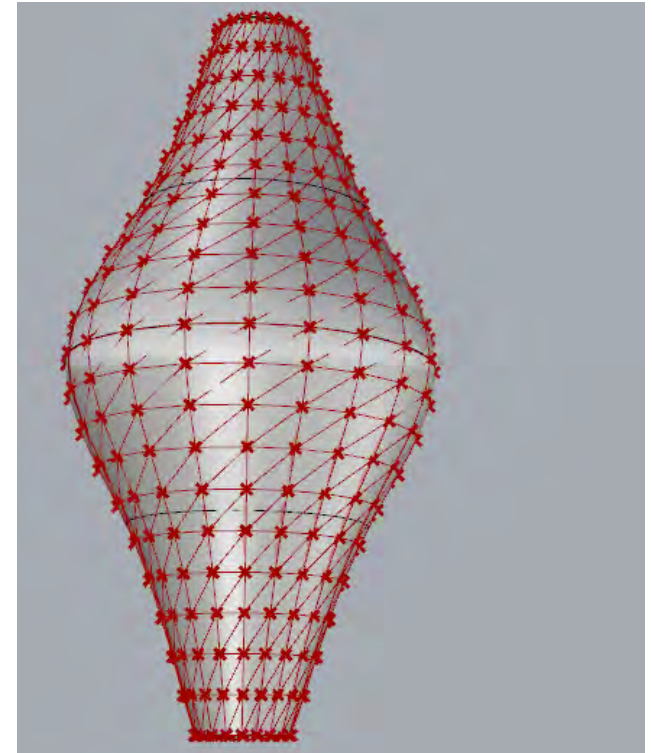
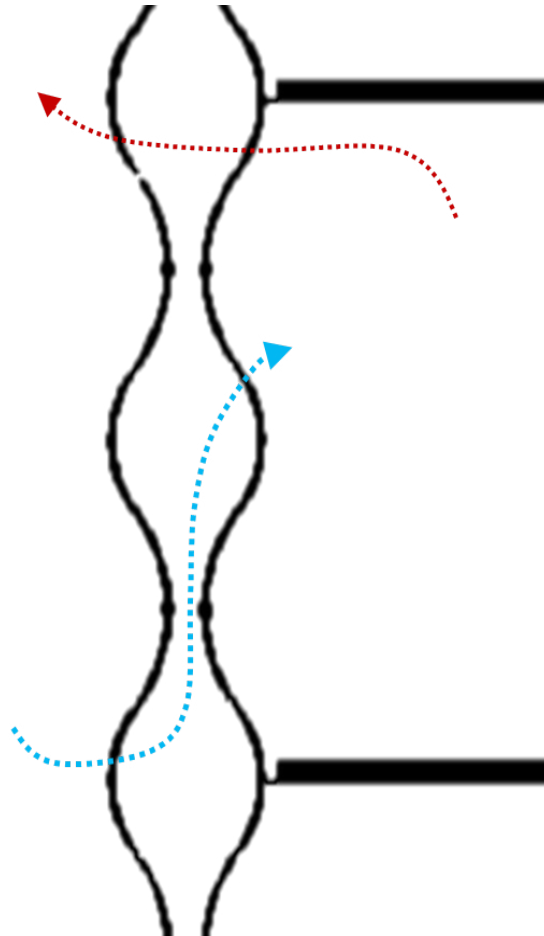
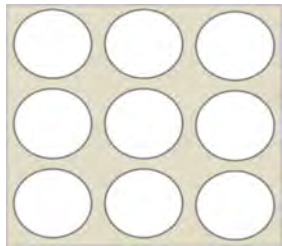
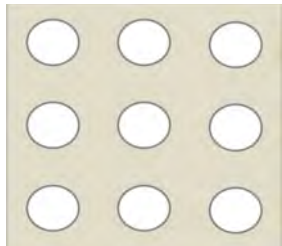




# Keystudy



# 02 Sunlight control



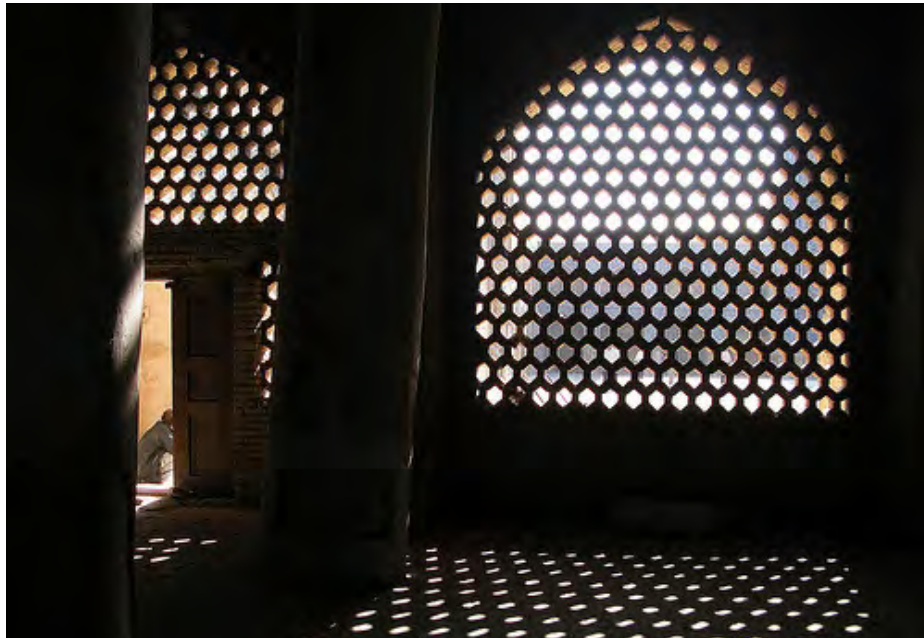
# Keystudy

## Sunlight control

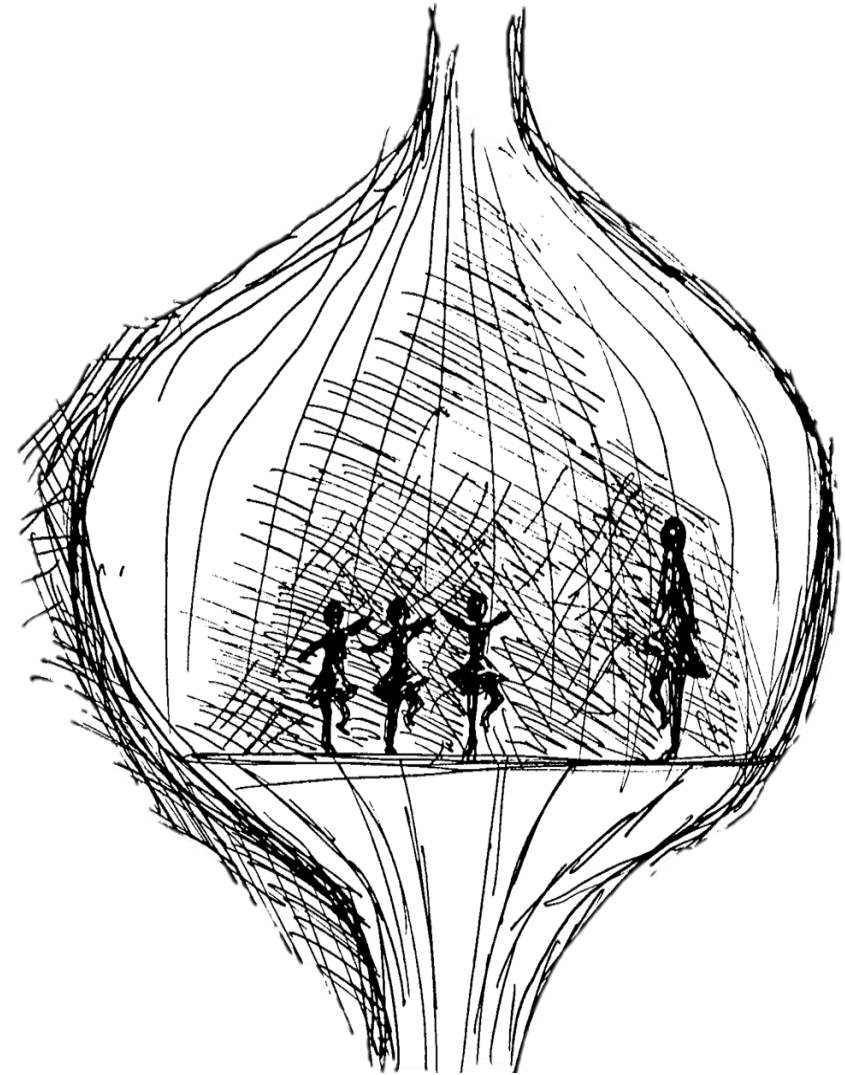
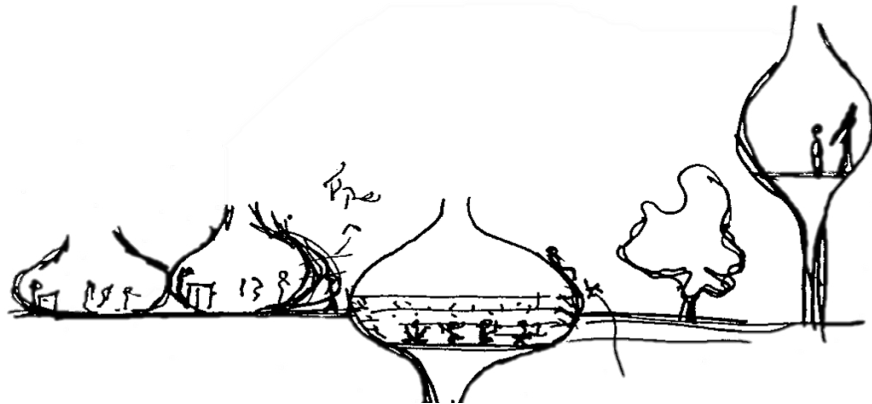
### Mashrabiyya

wooden screen with openable windows gives shade and protection from the hot summer sun while allowing the cool air from the street to flow through. The designs of the latticework are usually with smaller opening in the bottom part and larger openings in the higher parts, hence causing the draft to be fast above the head and slow in lower parts. This provides a significant amount of air moving in the room without causing it to be uncomfortable.

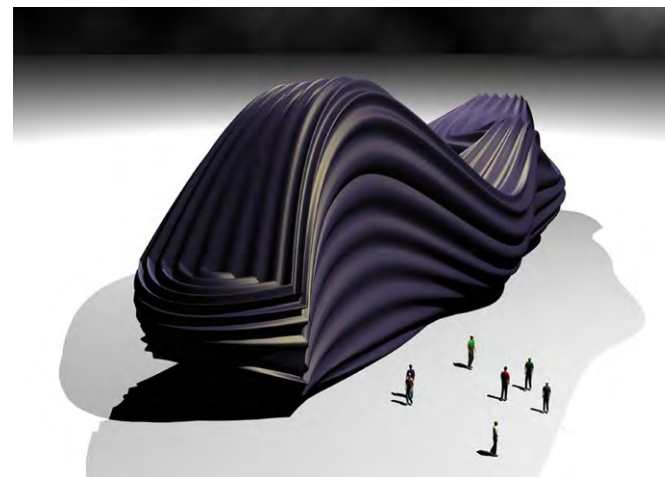
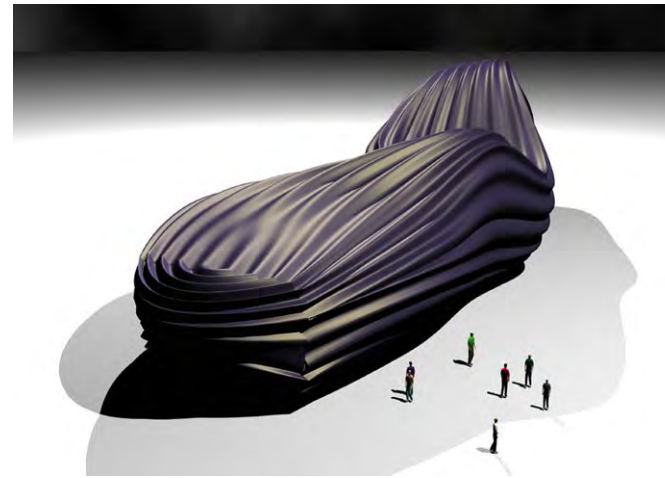
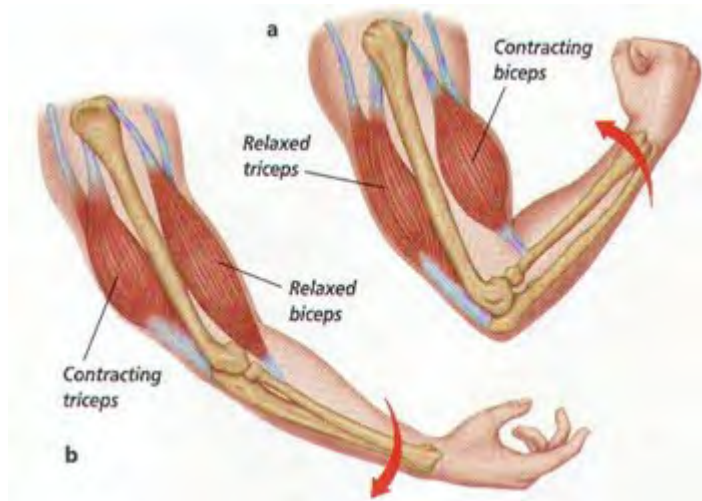
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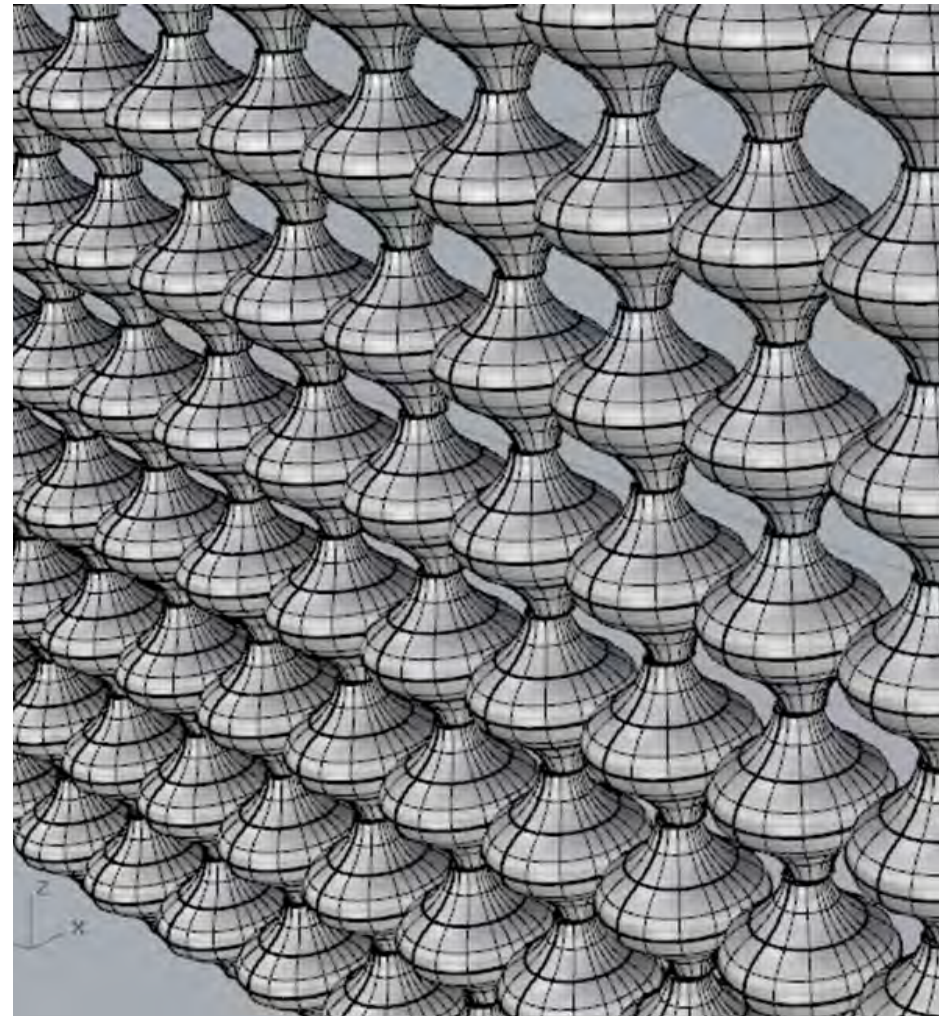
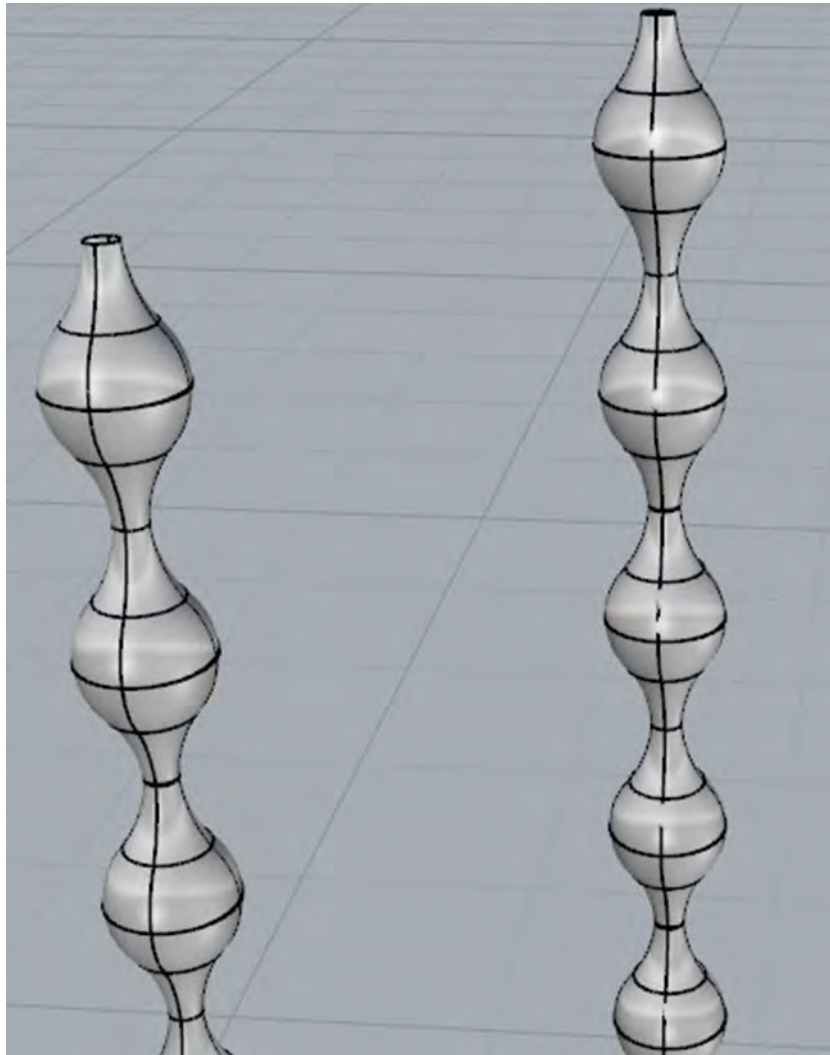


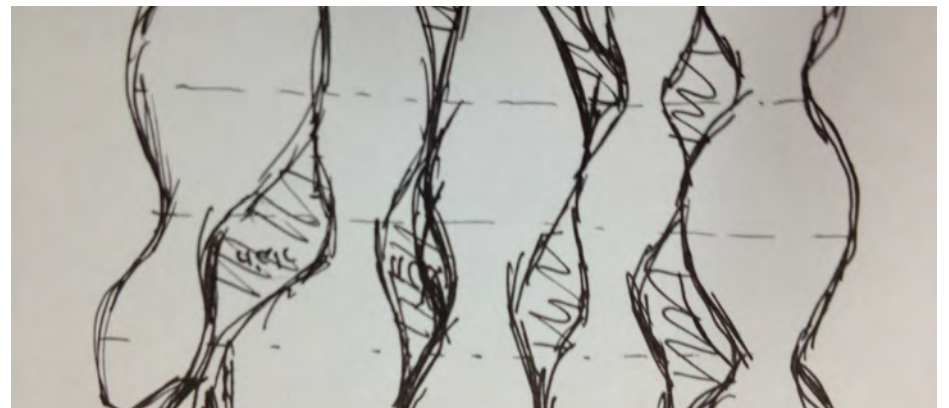
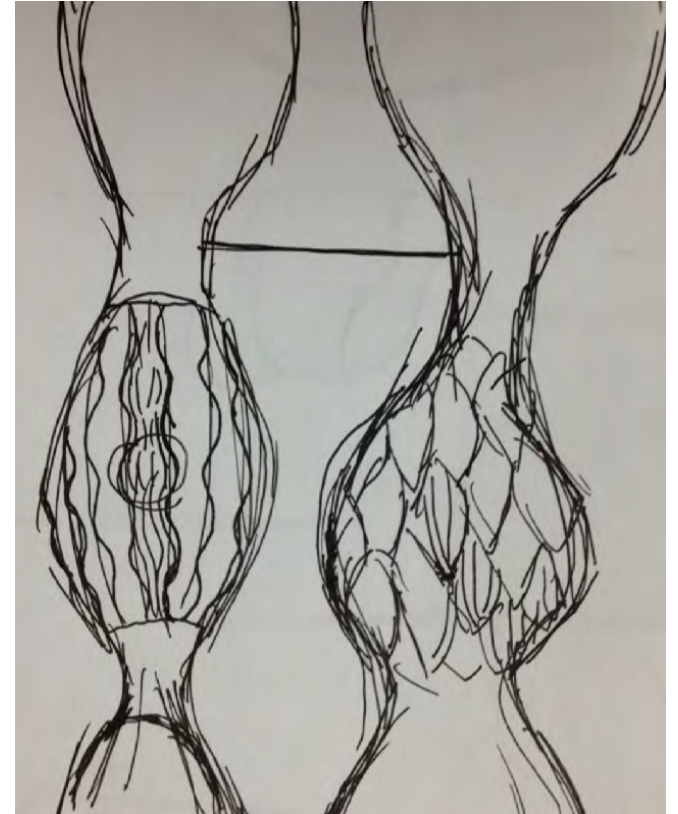
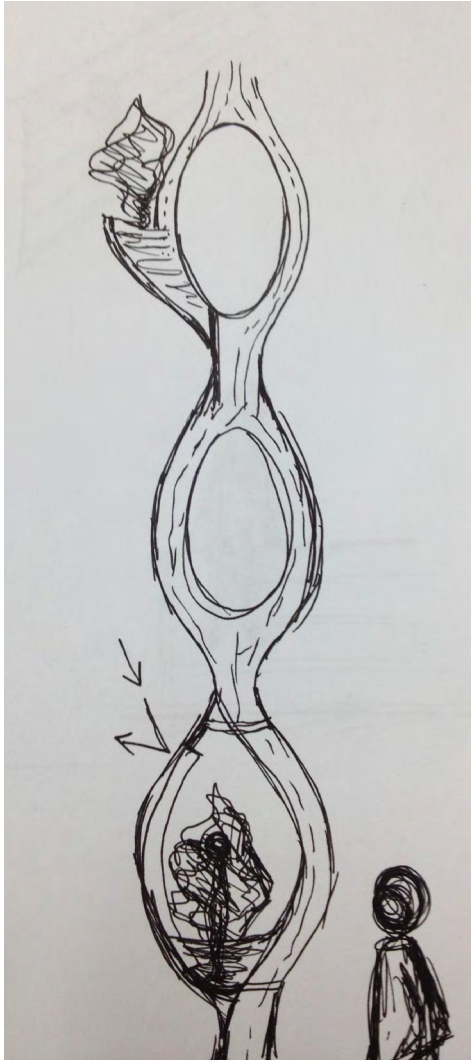
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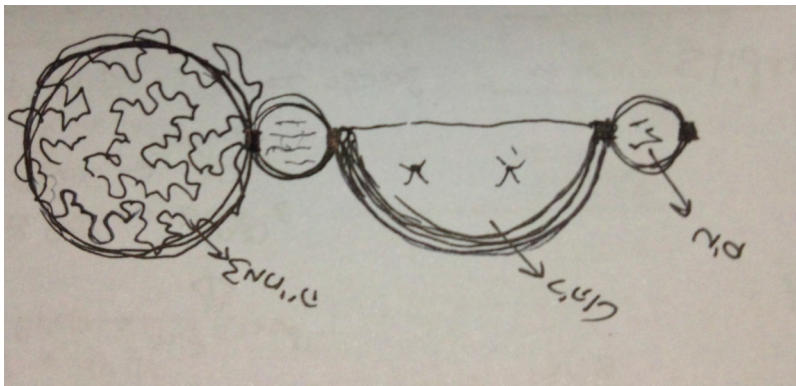
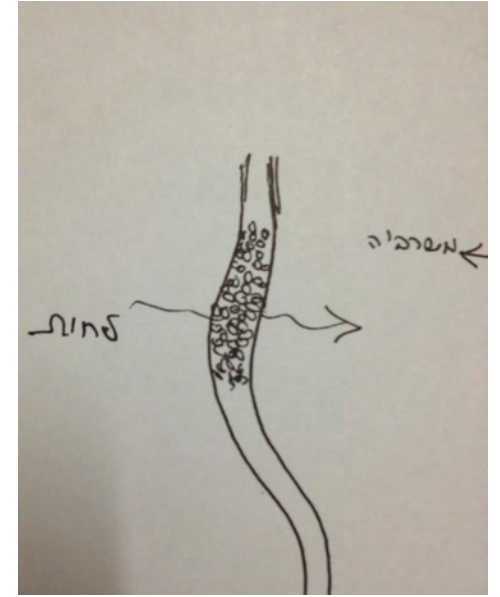
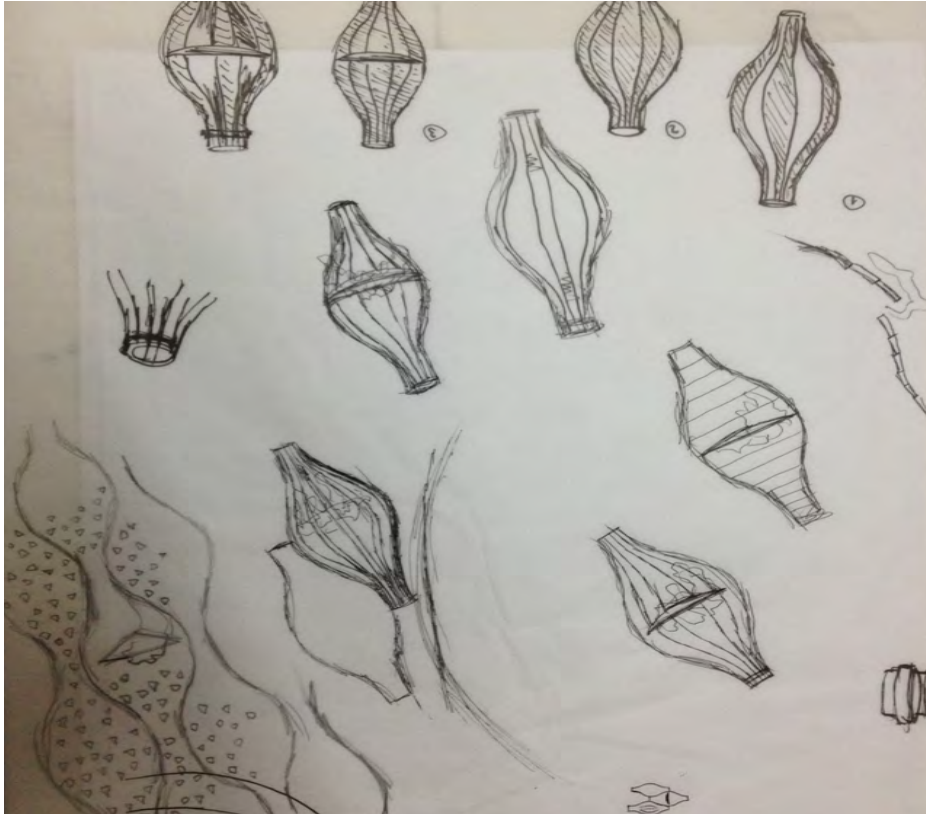


# Keystudy



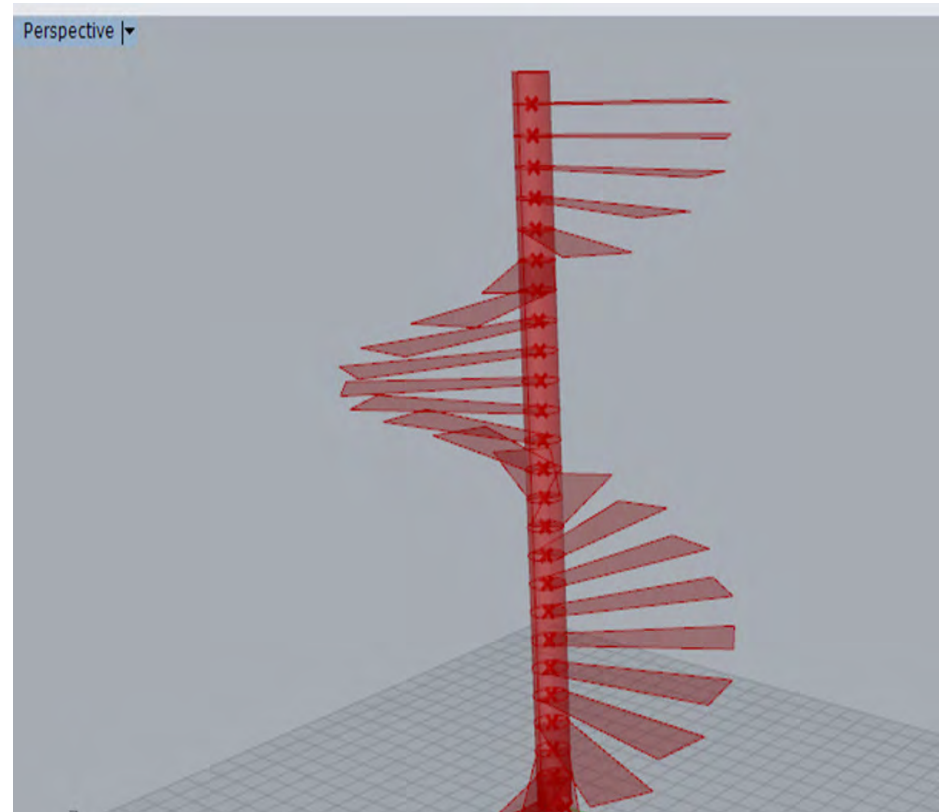
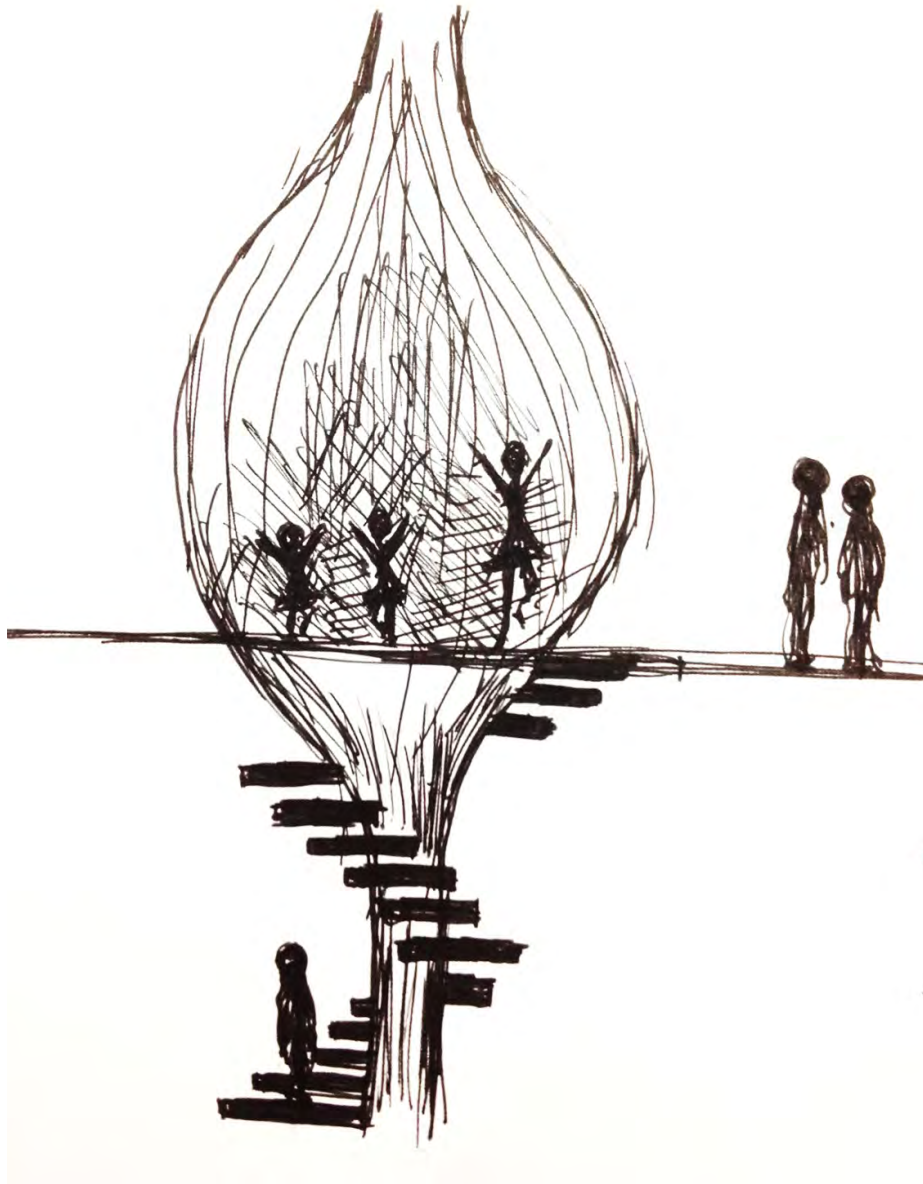








# circulation





Doaa' Sowan



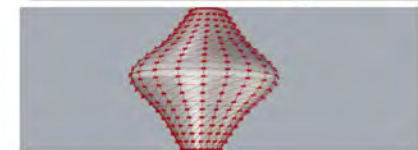
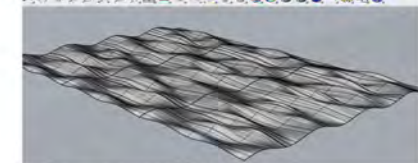
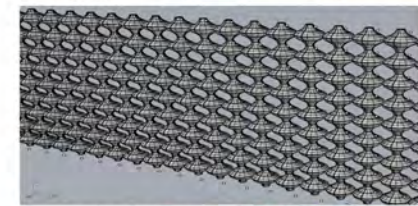
THE MUSCLE



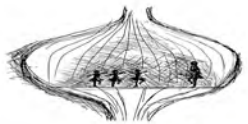
Unchosen cell



chosen cell



Building circulation



The eastern part



Vertical structure



Building program



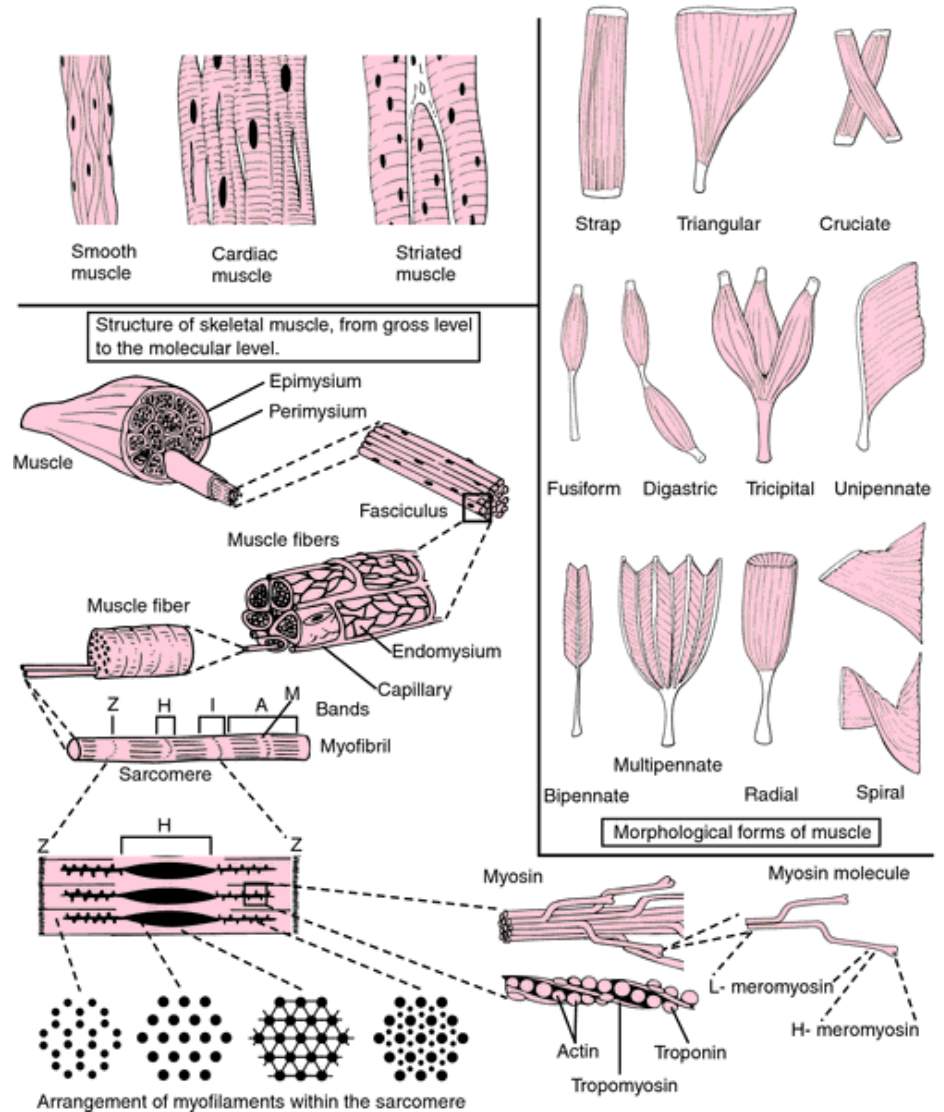
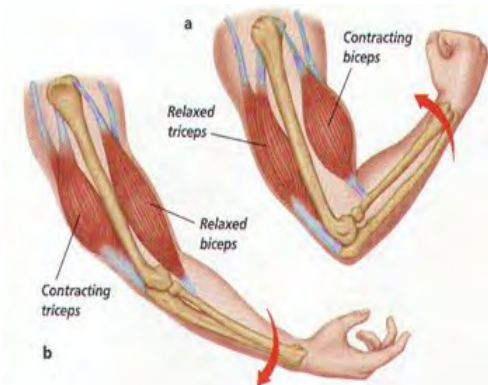
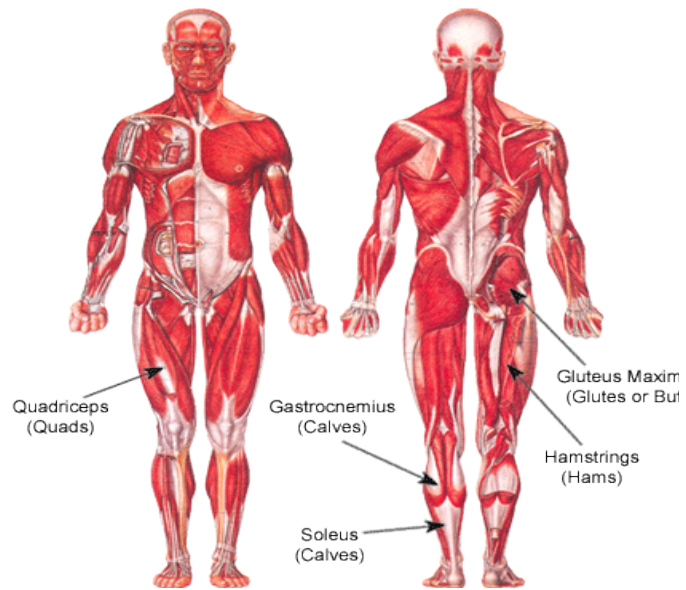
Building concept





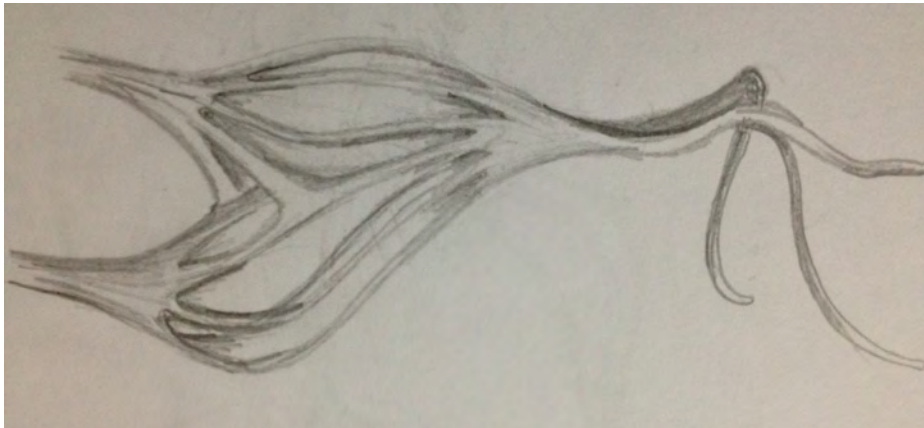
# A Inspiration

## THE MUSCLE

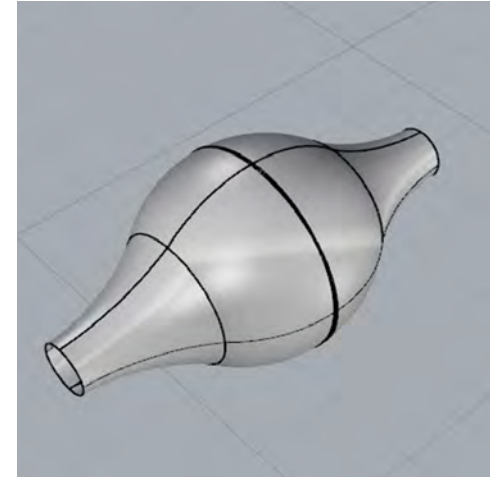


# B Cell

*Unchosen cell*

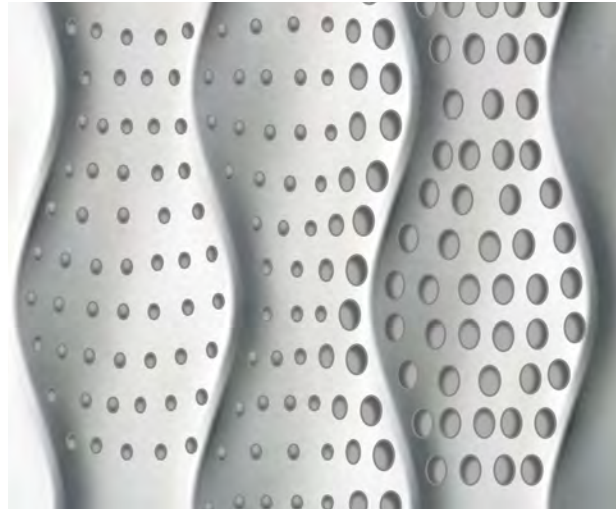


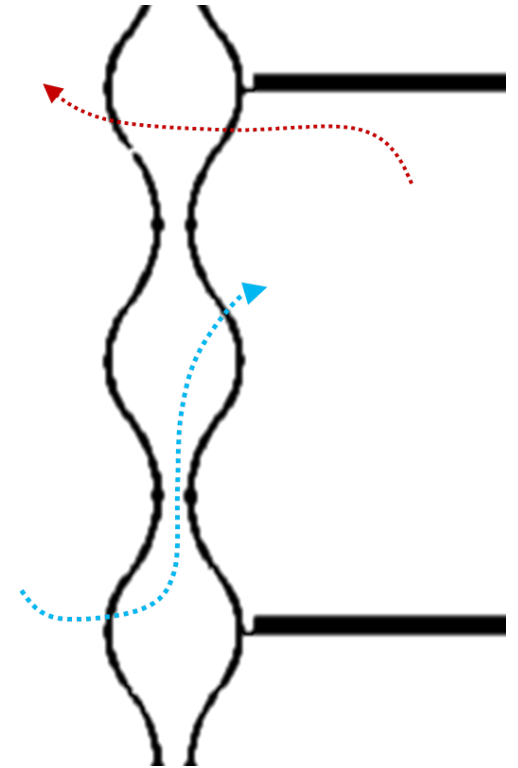
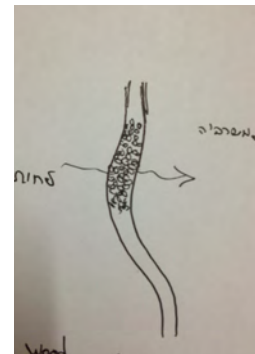
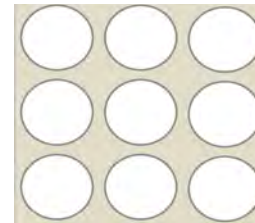
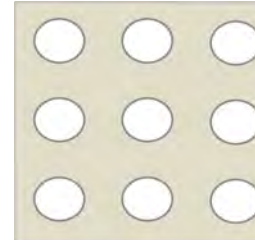
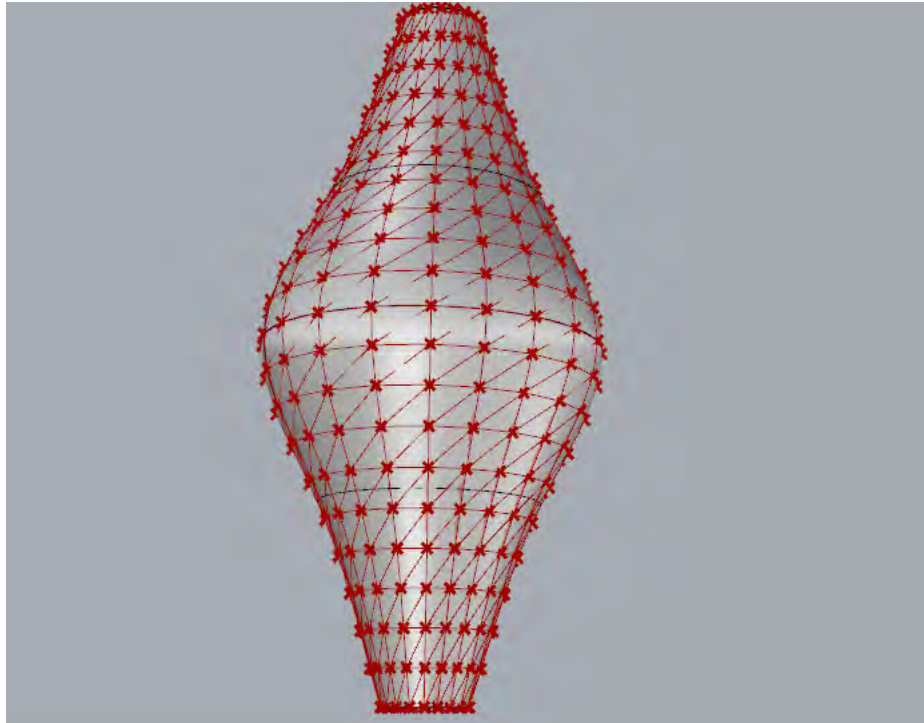
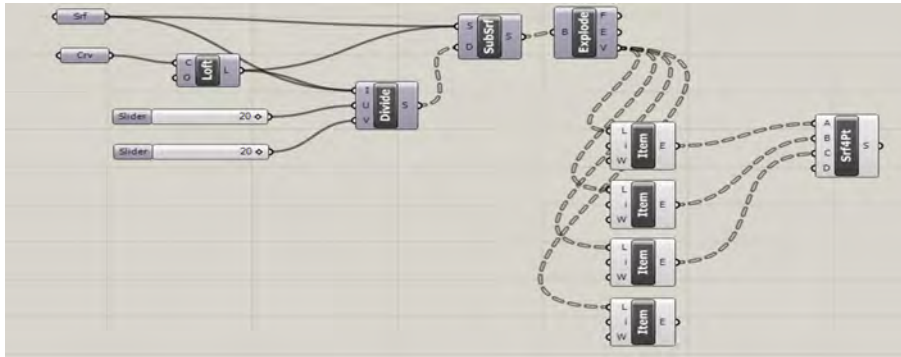
*chosen cell*



# C *Cell tybes*

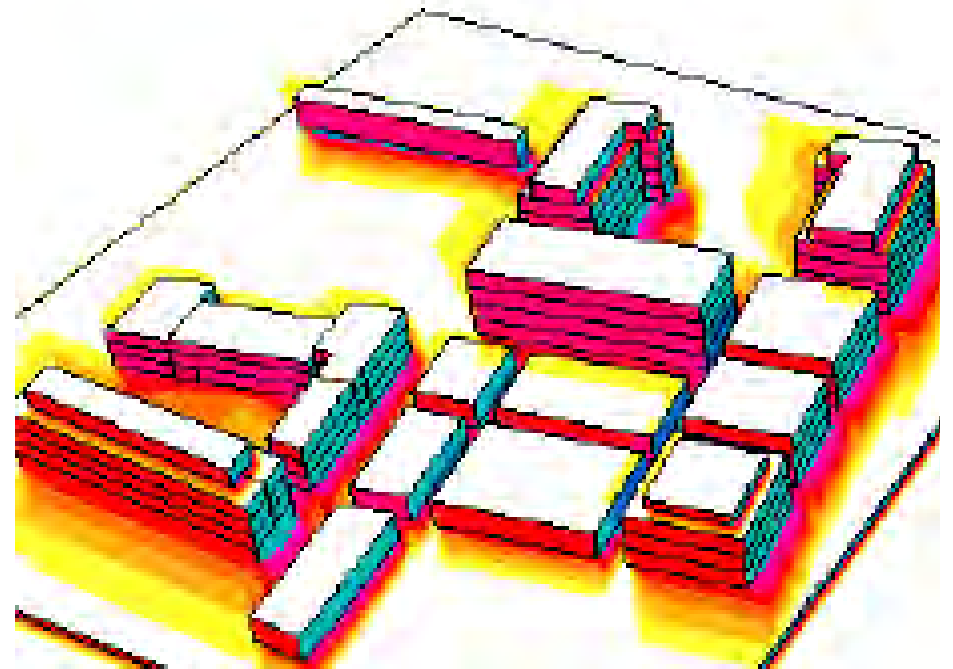
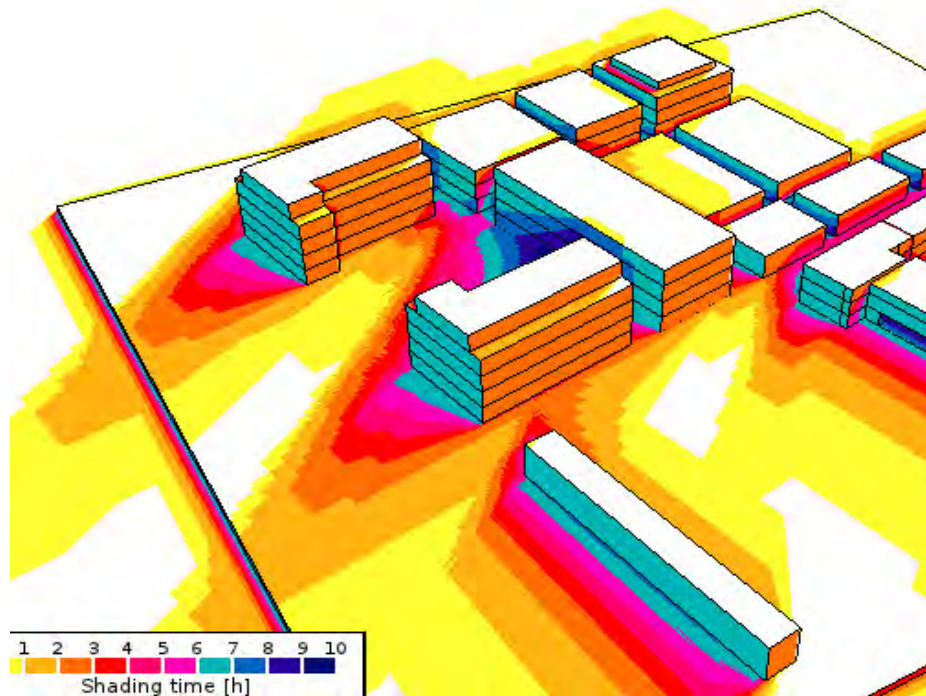
## 01 *Sunlight control*



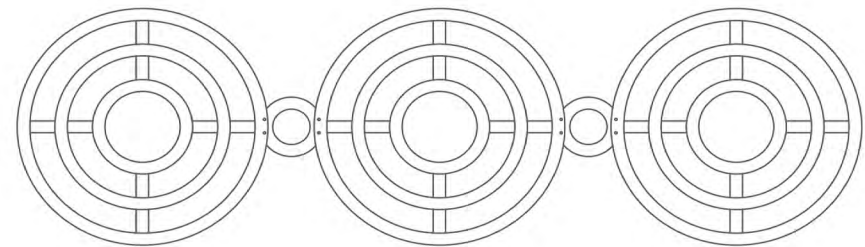
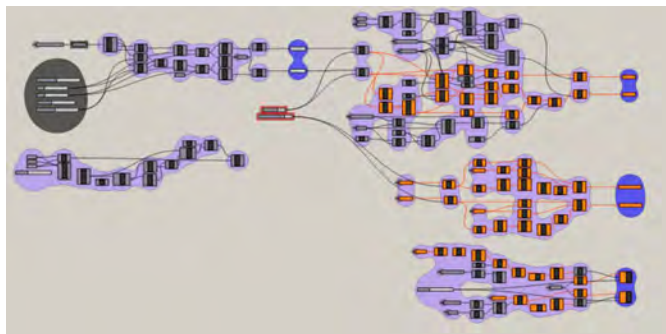
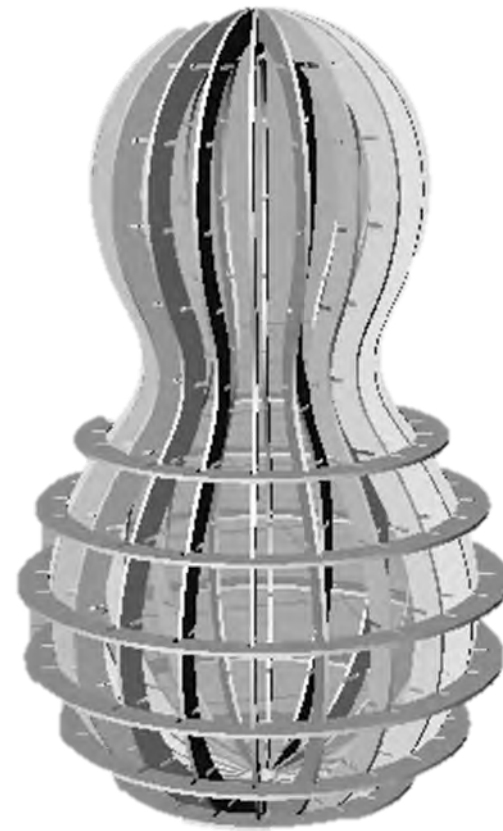
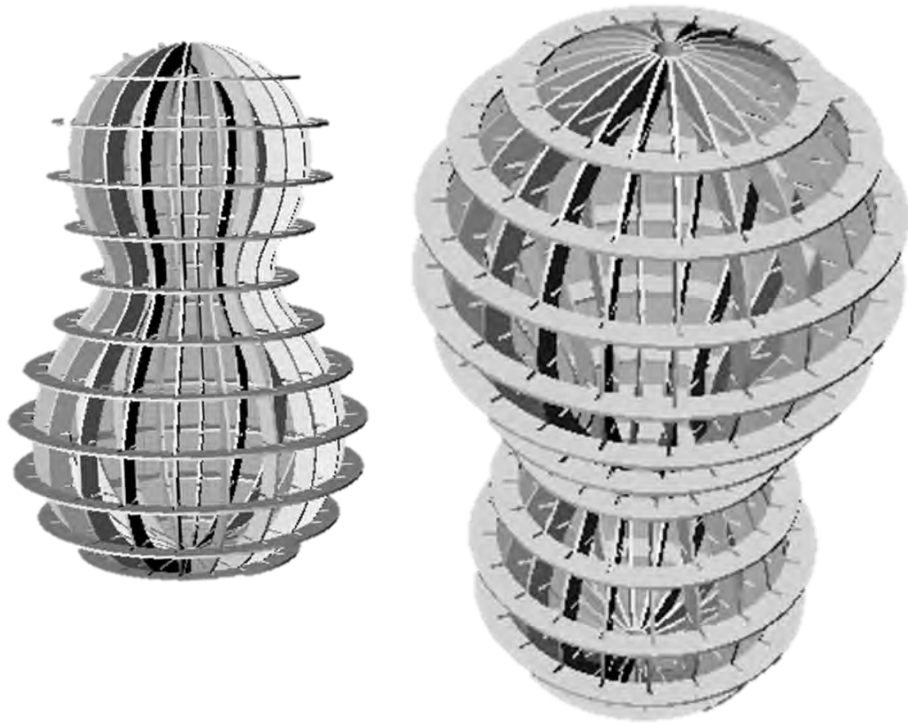


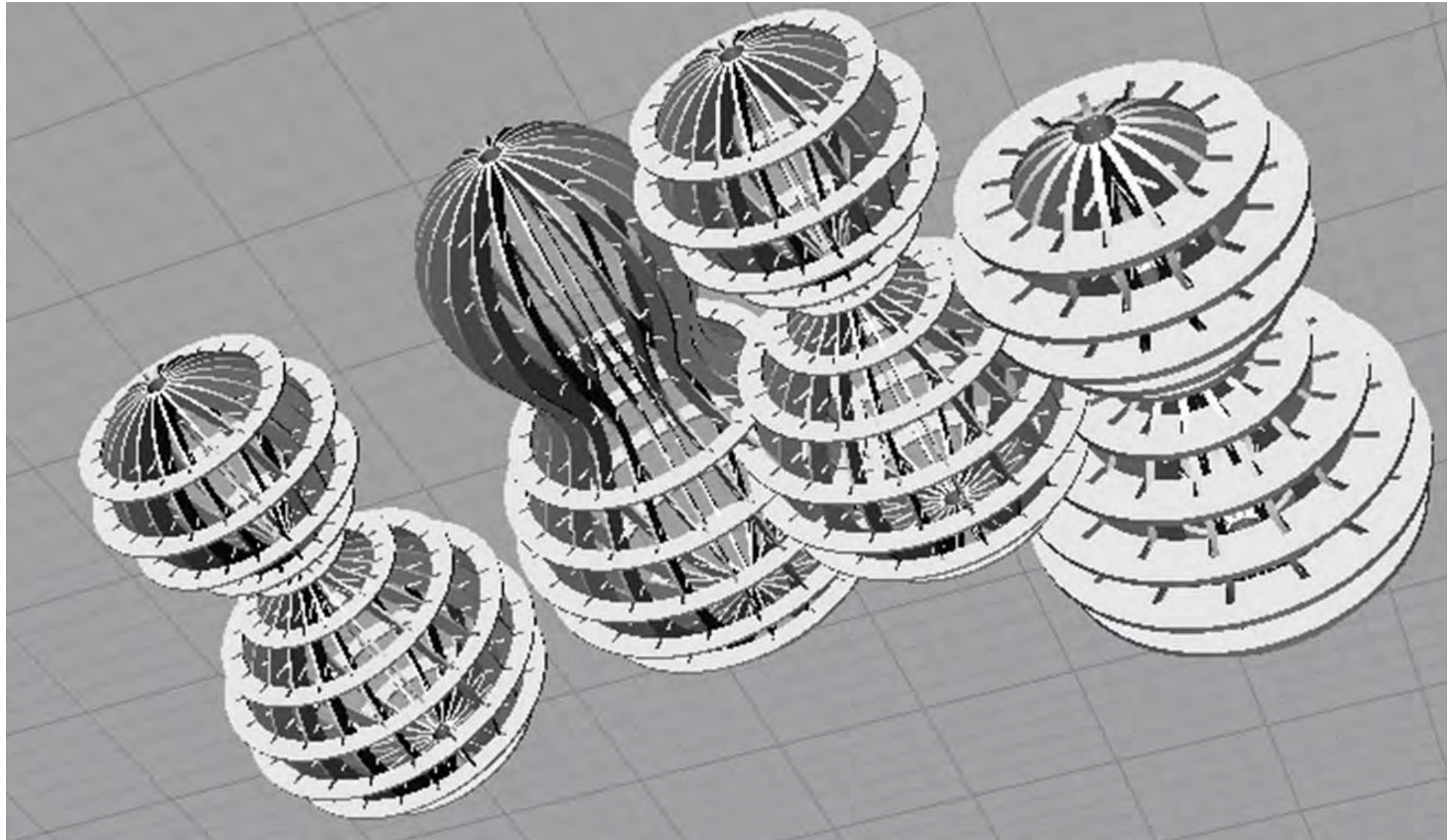


*Sun analysis*



# 02 construction





## Cell material

### Wood

#### Thermal Properties

Wood does not practically expand against heat.  
The coefficient of thermal conductivity of the wood is very low.

#### Acoustic Properties

Sound isolation is based on the mass of the surface. Wood, as a light material, is not very perfect for sound isolation; But it is ideal for sound absorption. Wood prevents echo and noise by absorbing sound. For this reason it is extensively used in concert halls.  
Sound velocity is faster in woods than gases and liquids, and it is close to that of metals. Sound energy loss as a result of friction is also significantly low in woods due to its lightness and structure. Because of such properties, wood is extensively used in musical instruments.

#### Electrical Properties

Sound isolation is based on the mass of the surface. Wood, as a light material, is not very perfect for sound isolation; But it is ideal for sound absorption. Wood prevents echo and noise by absorbing sound. For this reason it is extensively used in concert halls.  
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#### Mechanical Properties

Although wood is a light material, its strength is quite high. For instance, while the tensile strength of wood with 0,6/cm<sup>3</sup> specific gravity is 100 N/mm<sup>2</sup>, the tensile strength of steel with 7,89/cm<sup>3</sup> specific gravity is 500 N/mm<sup>2</sup>. Dividing tensile strength by specific gravity gives the breaking length and quality of material. This figure means the breaking length of the material, when hung as a result of its own weight. While the breaking length of steel is used for construction is 5.4 km, chrome mobile steel is 6.8 km, hardened bow steel is 17.5 km, breaking length of spruce wood is 19.8 km, and laminated wood made of beech is 28.3 km. For this kind of properties, wood and laminated wood is used in wide-gap constructions like health centers and sport halls.

#### Aesthetic Properties

Wood is a decorative material when considered as an aesthetic material. Each tree has its own color, design and smell the design of a tree does change according to the way it is sliced. It is possible to find different wooden materials according to color and design preference. It can be painted to darker colors of varnished, and can be given bright or mat touches.

#### Working Properties

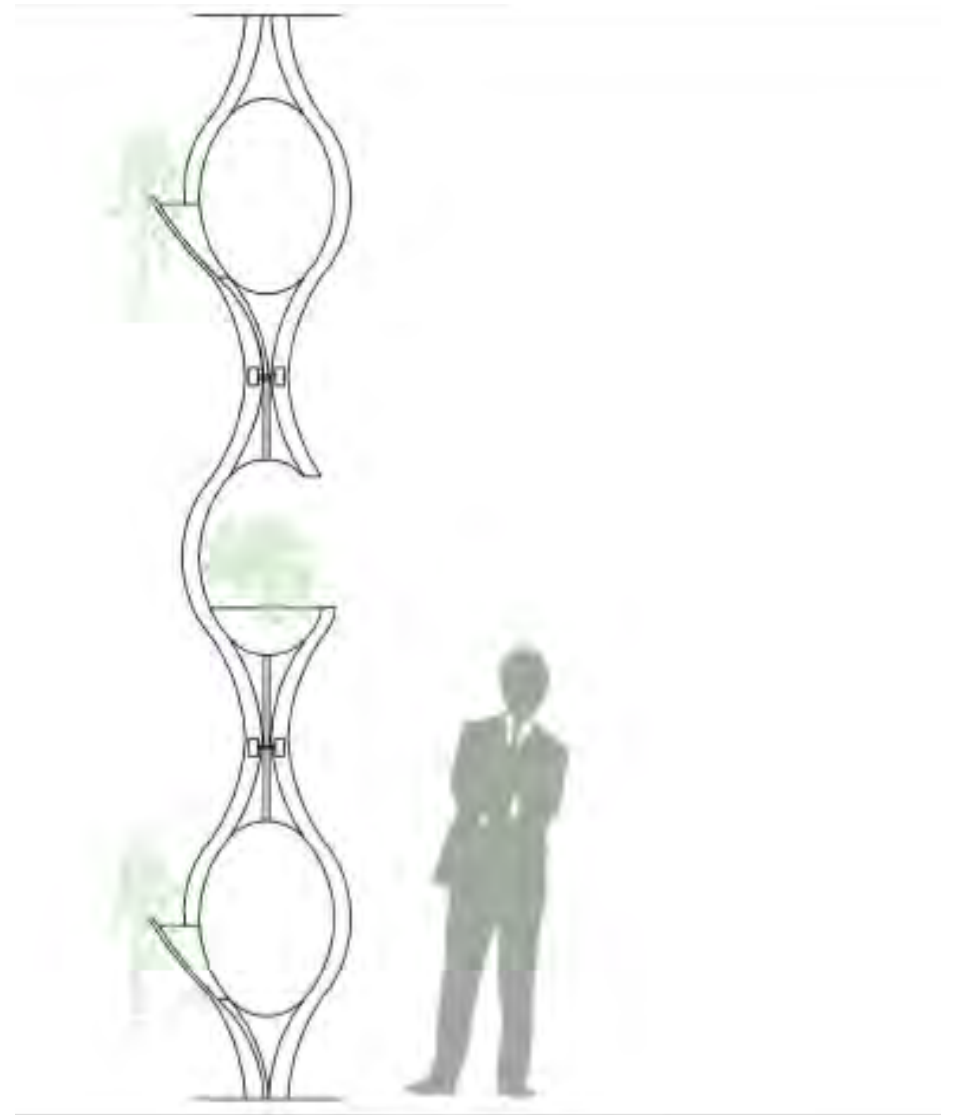
It is easy to repair and maintain wood. While old woods can be renewed by special touches other materials are highly difficult and costly to maintain and to repair. Therefore they are usually disposed of.

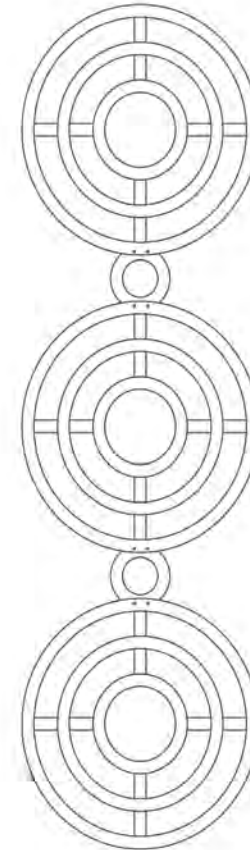
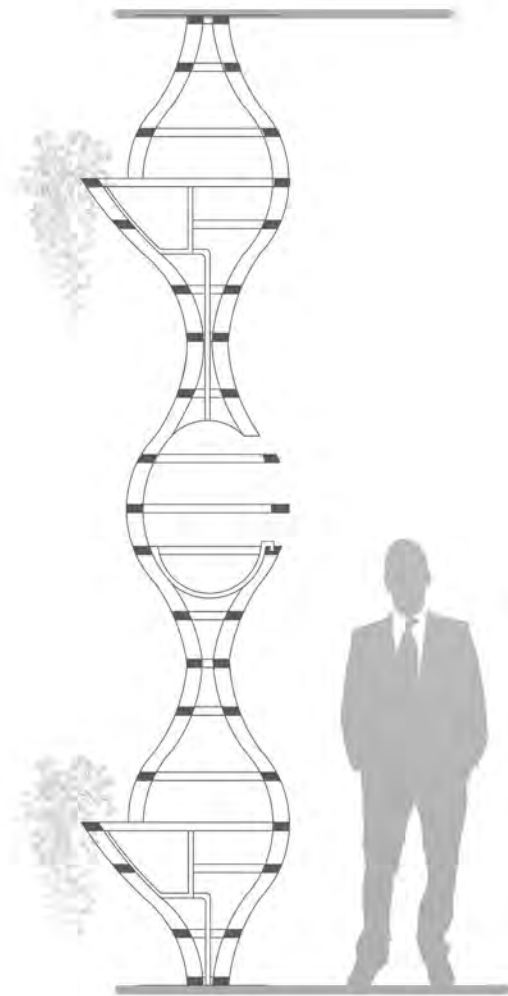
#### Oxidation Properties

Although wood has oxidation characteristics in some way, it is not the kind of oxidation seen in metals. Metals get rust, wood doesn't. For such characteristics, use of wood is preferred to avoid rust when necessary.

<http://www.kultur.gov.tr/EN,35285/wood-as-a-building-material-its-benefits-and-disadvanta-.html>

# 03 *water collecting*





## ***water collecting***

The water of air conditioner is known as it's high quality, These waters can be collected and referal to other uses. conditioners water are without minerals. On average, domestic air conditioner in thee coastal plain during summer months can produce in 10 hours of work between 30-50 liters a day. Office buildings and places with more than one air conditioner or air conditioner that works long hours during the summer months, the amount of water daily can add up to hundreds of liters up to thousands. This water can be reused in existing buildings and buildings under construction

Every year, 200 million cubic meters of rainwater are wasted and washed into the sea. An in-novative project in Kfar Saba will make it possible to store rainwater and purify it with the help of various plants, using biofilter technology.

## ***Rainwater recycling***

Rainfall Average in Tel Aviv : 0.55 m , 550 mm/year .

Roof size : 25\*65 = 1625 m<sup>2</sup>

1625 m<sup>2</sup>\* 0.55m= 893m<sup>3</sup>

facade size: 40\*10 = 400 m<sup>2</sup>

400\*0.55=220 m<sup>3</sup>

## ***Air conditioners water recycling***

1000 lit/h \* 24 h = 24000 lit/day

24000 \* 365 = 876\*10<sup>4</sup> lit/year

Total: 8761113 lit/year

## ***Water uses***

### ***portable water***

human consumption

drinking

cooking

### ***gray water***

domestic water

washing

bathing

### ***black water***

low risk water

toilet

irrigation

טבלה 1. תצרוכת מים בגינה קטנה (ליטרים ליום למ"ר)

אביב וסתיו		קיץ			האזור	
שיחים	פרחים וירקות	דשא	שיחים ועצי נוי**	פרחים וירקות	דשא ועצי פרי*	
1.0	3.0	2.0	1.5	4.5	3.0	רצועת החוף
1.0	3.0	2.5	1.5	5.0	3.5	מישור החוף והשפלה
1.5	4.5	3.0	2.0	6.0	4.0	אזור ההר
1.5	4.5	3.0	2.0	6.5	4.5	הנגב והעמקים החמים
2.5	8.0	5.0	3.5	11.0	7.0	הערבה ואילת

\* עצי פרי, הניצבים בגן בשטח מושקה אחר, יקבלו תוספת יחסית.  
 \*\* השטח, המחושב להשקיית עצים, הוא שטח היטל נוף העץ (גם אם העץ מושקה במקומות נקודתיים מצומצמים).

טבלה 2. רווחי זמן להשקיית גינות בקיץ (ימים), לפי סוג הקרקע

שיחים ועצים	פרחים	דשא	סוג הקרקע
7-14	5-3	7-3	קלה
7-21	3-5	7-10	בינונית-כבדה
14-28	5-7	7-21	כבדה

**Plants That Save Water**

**Trees**

- Terebinth
- Christ's Thorn Jujube
- Acacia
- Atlantic Pistacia
- Mt. Tabor Oak
- Twisted acacia
- Palestine Oak

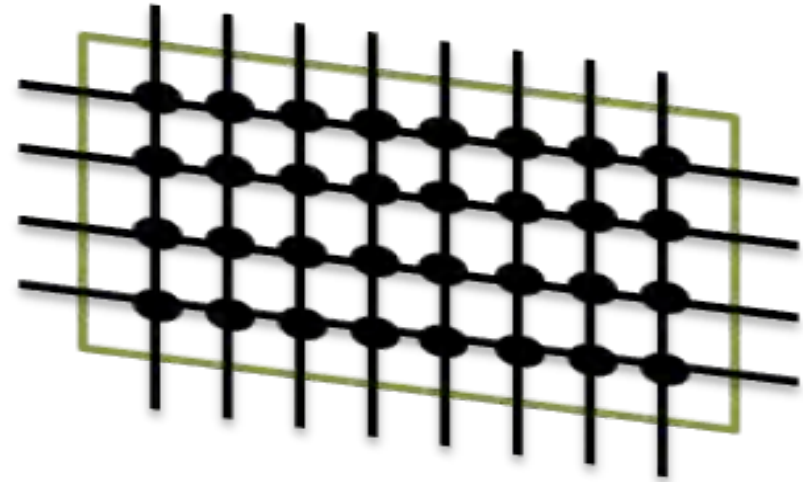
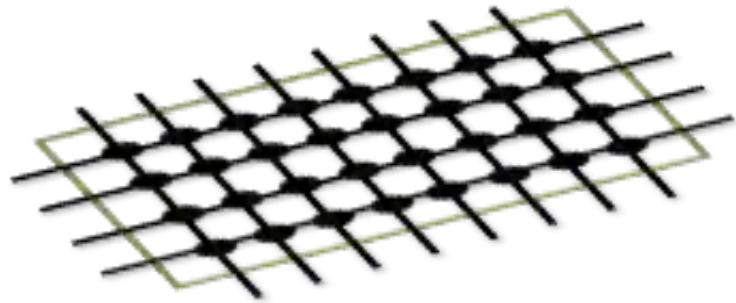


**Shrubbery**

- Mastic tree, Lentisk



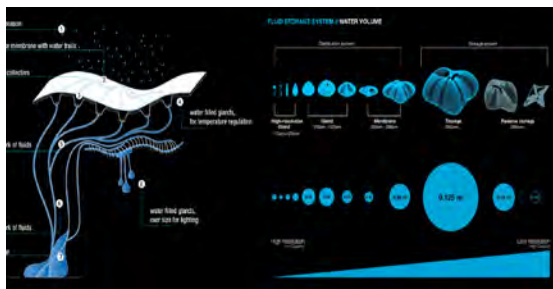




# D Keystudy

## water collecting

### Solar Umbrella Project by Constantin Boincean, Ralph Bertram, Aleksandra Danielak



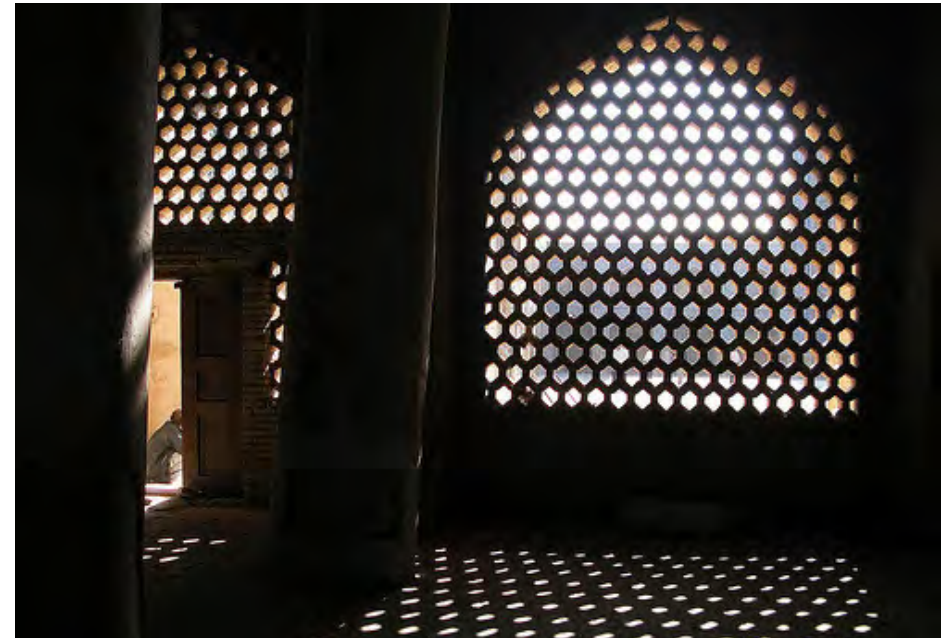
<http://cubeme.com/blog/2010/10/12/solar-umbrella-project-by-constantin-boincean-ralph-bertram-aleksandra-danielak/>

## Sunlight control

### Mashrabiyya

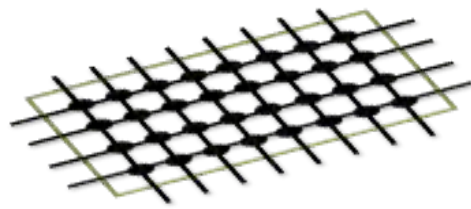
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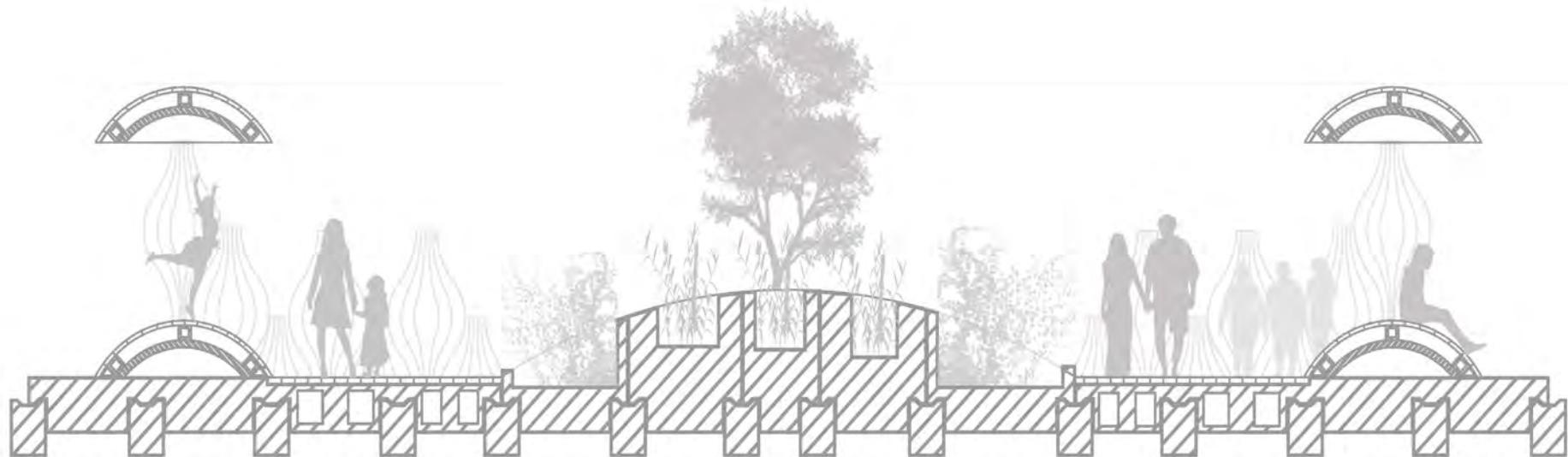
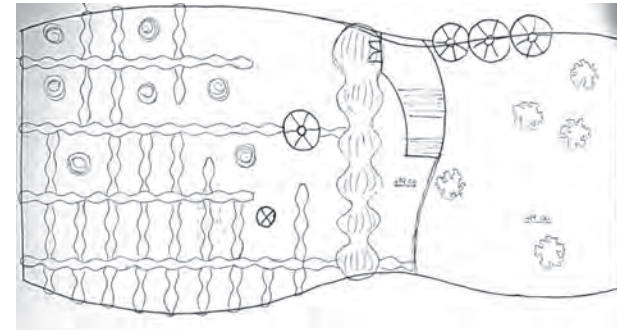
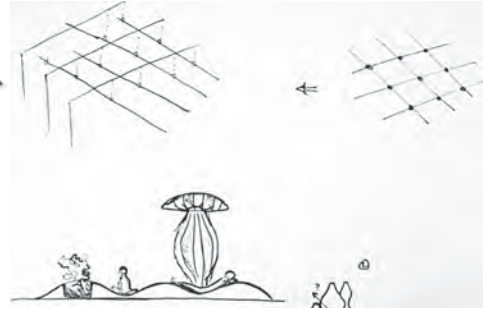


# E Connecting to the building

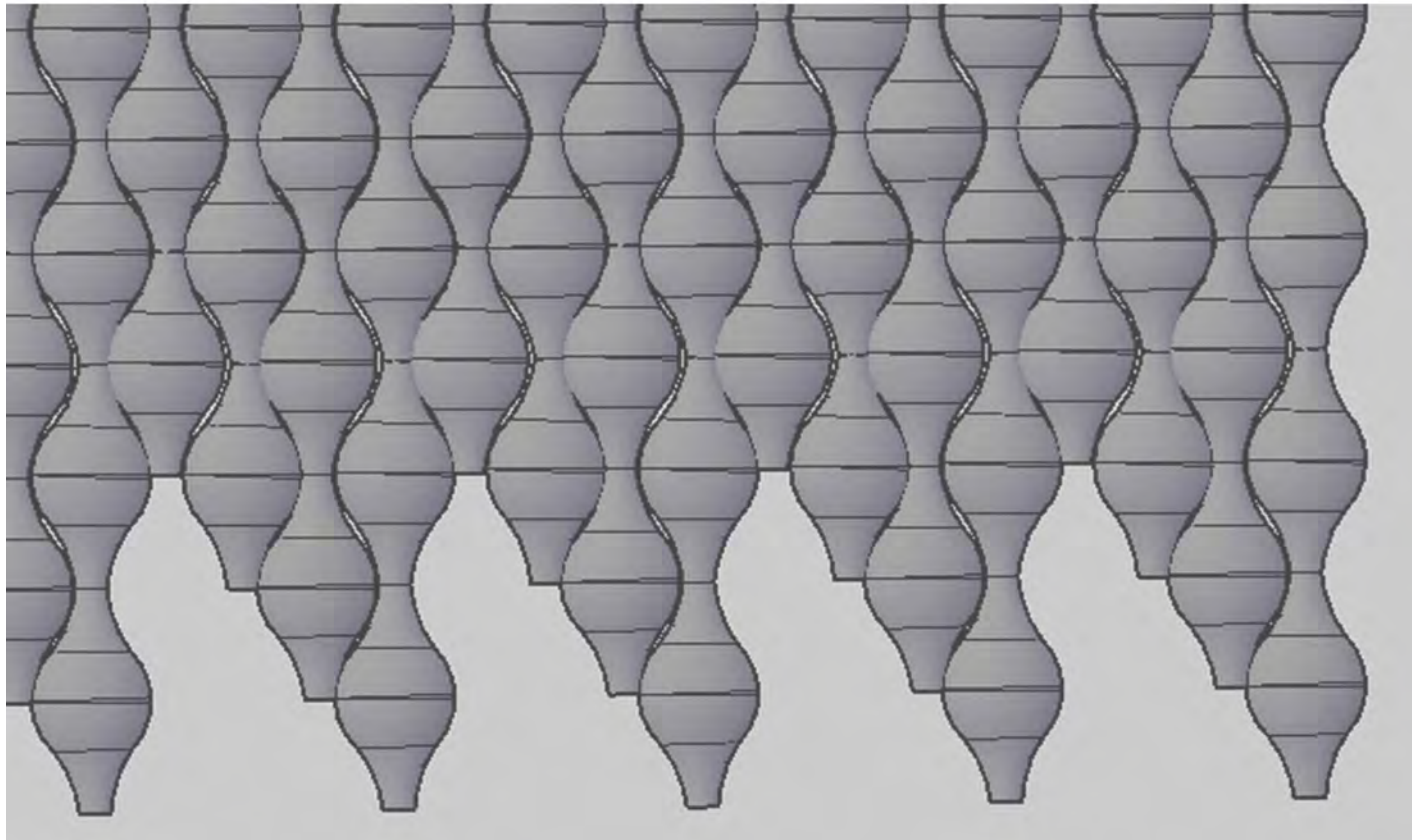
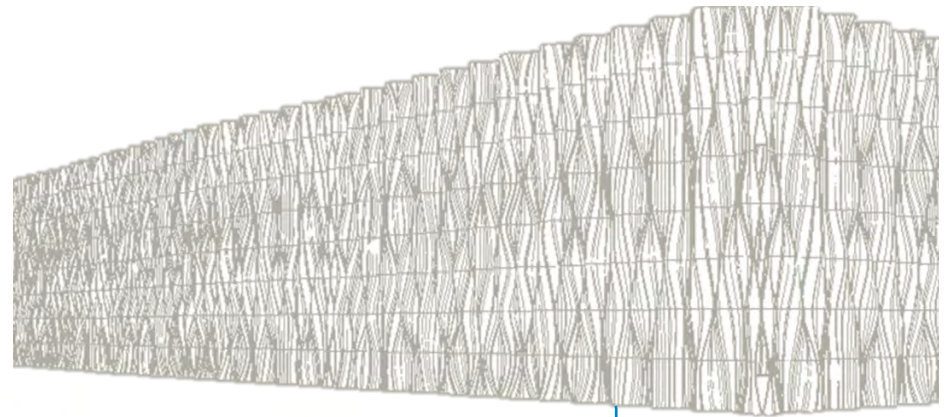
## Roof



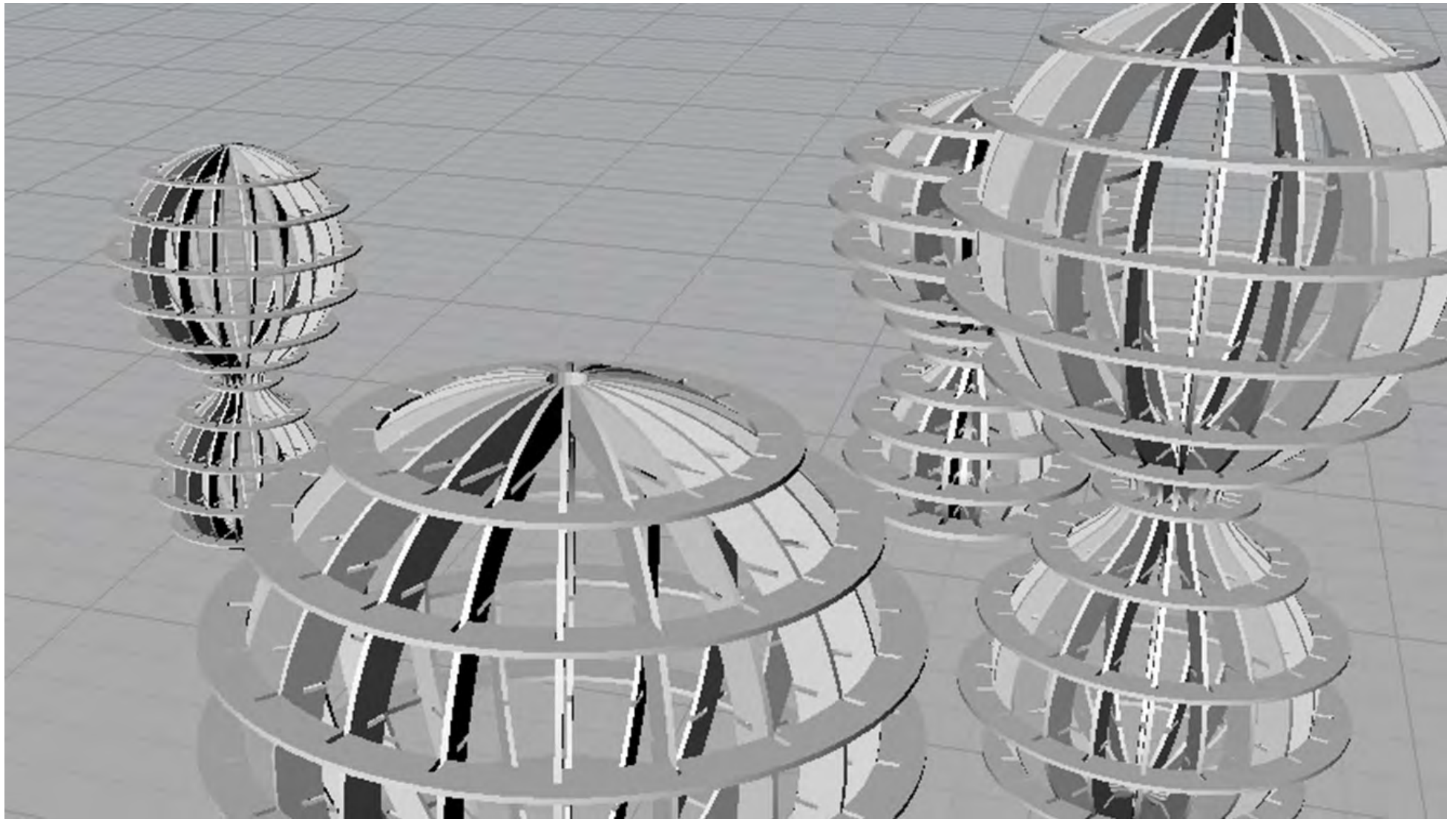
The bustan plan

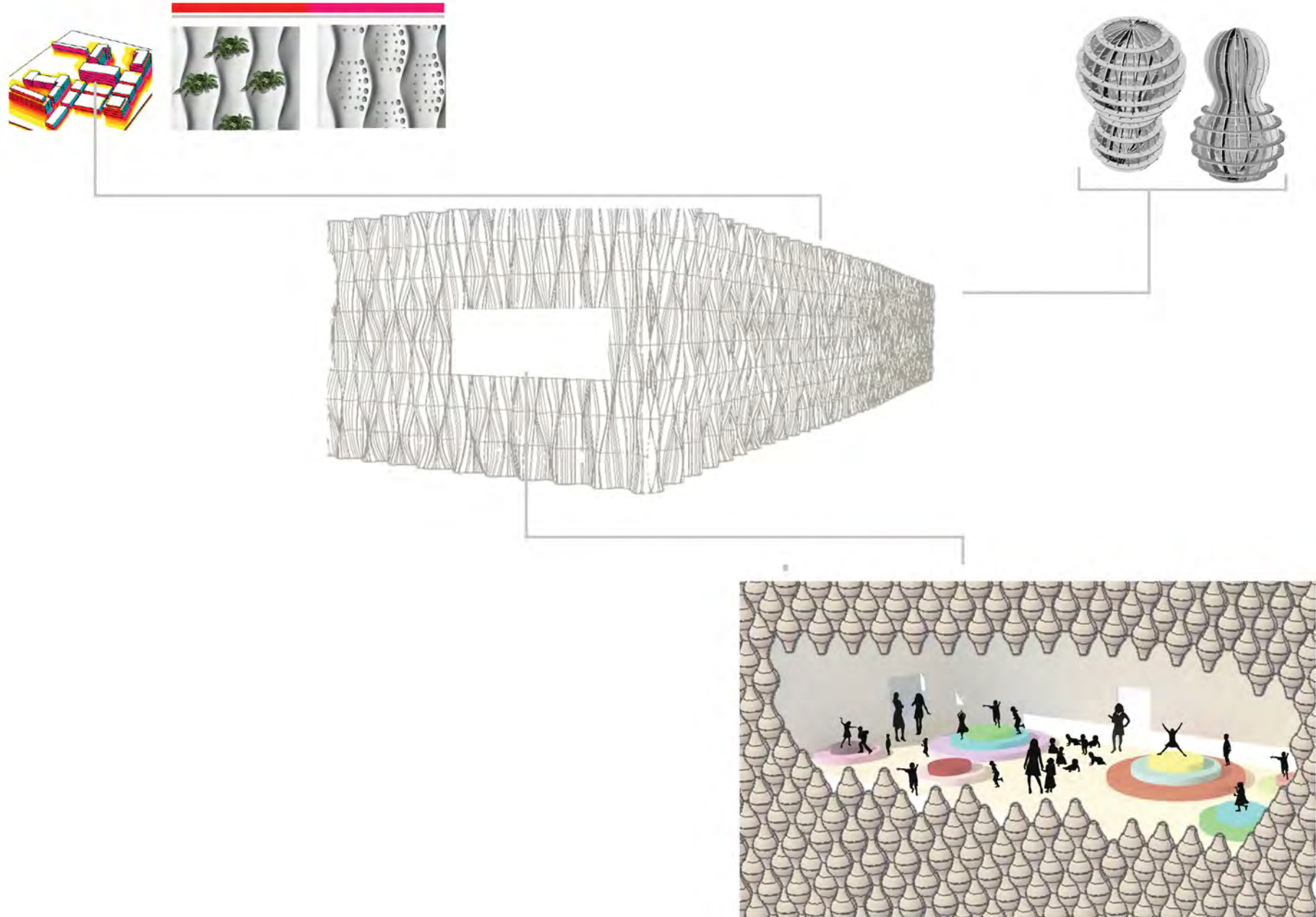


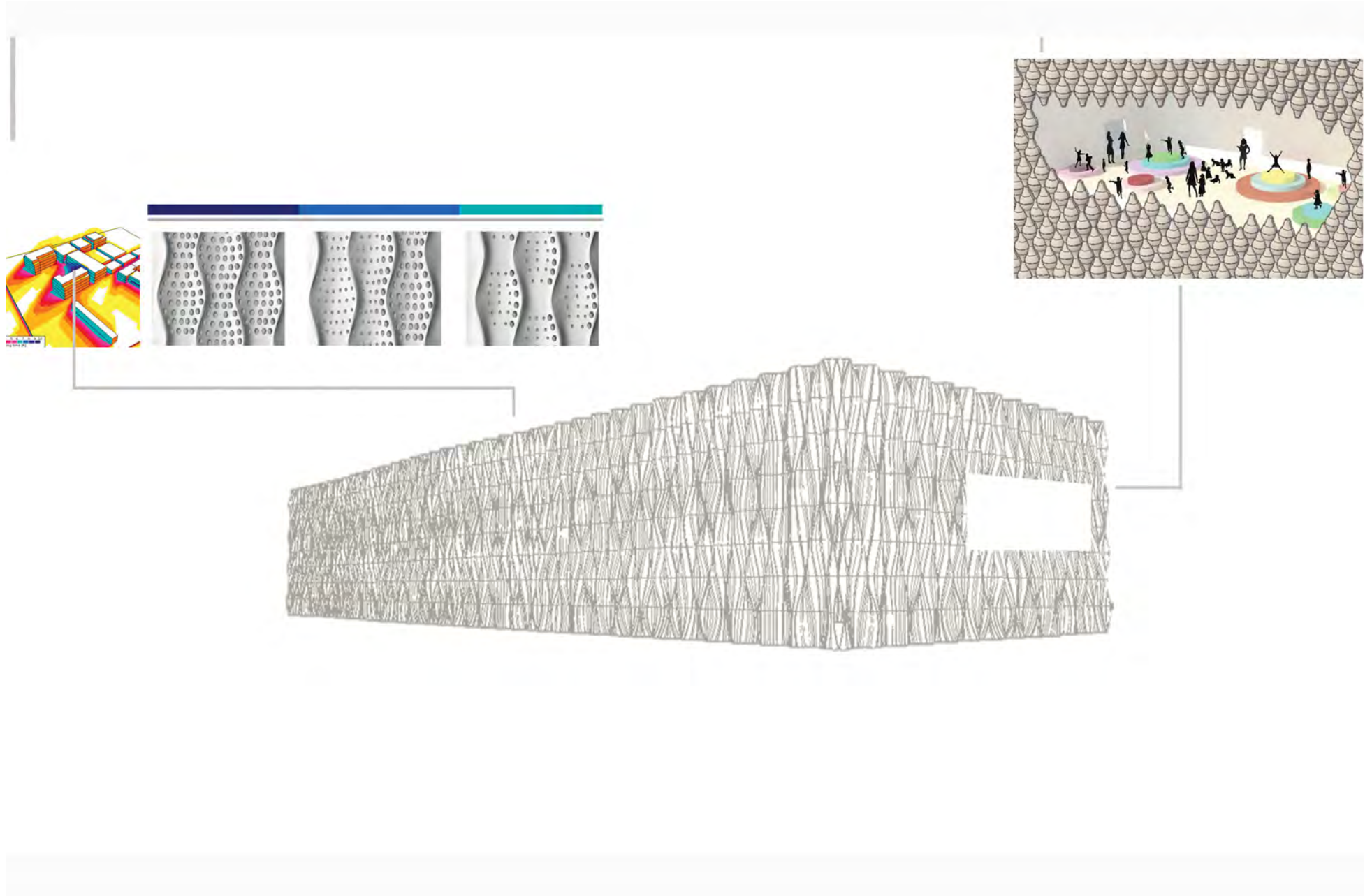
*Floor Connection*



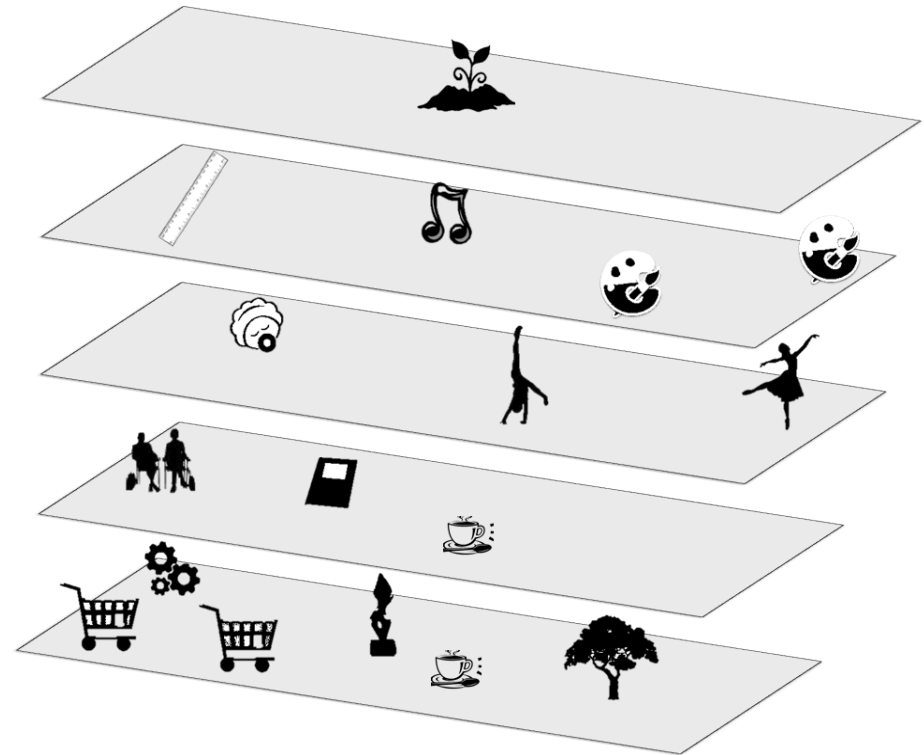
Space



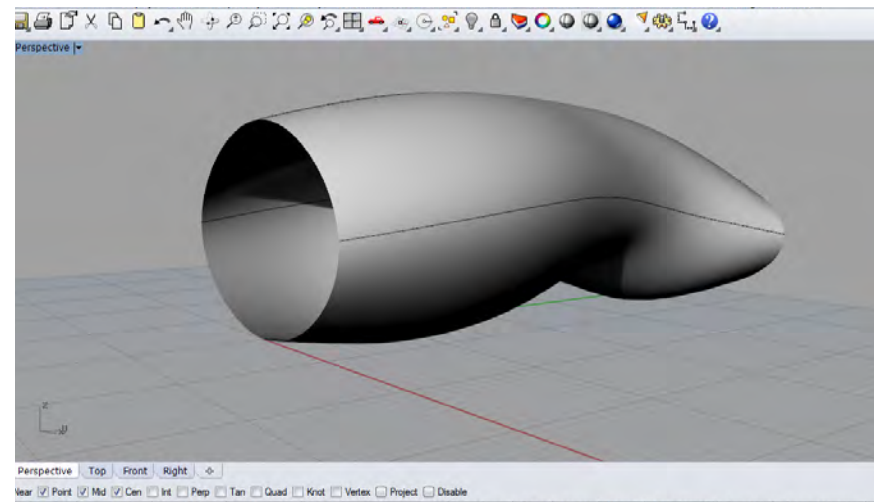




# G Building program

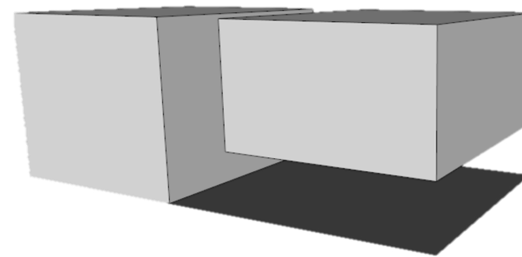
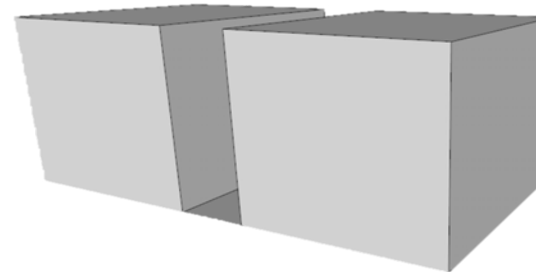
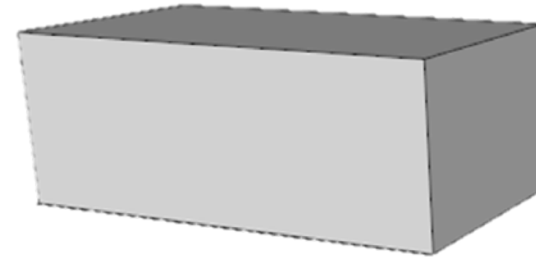


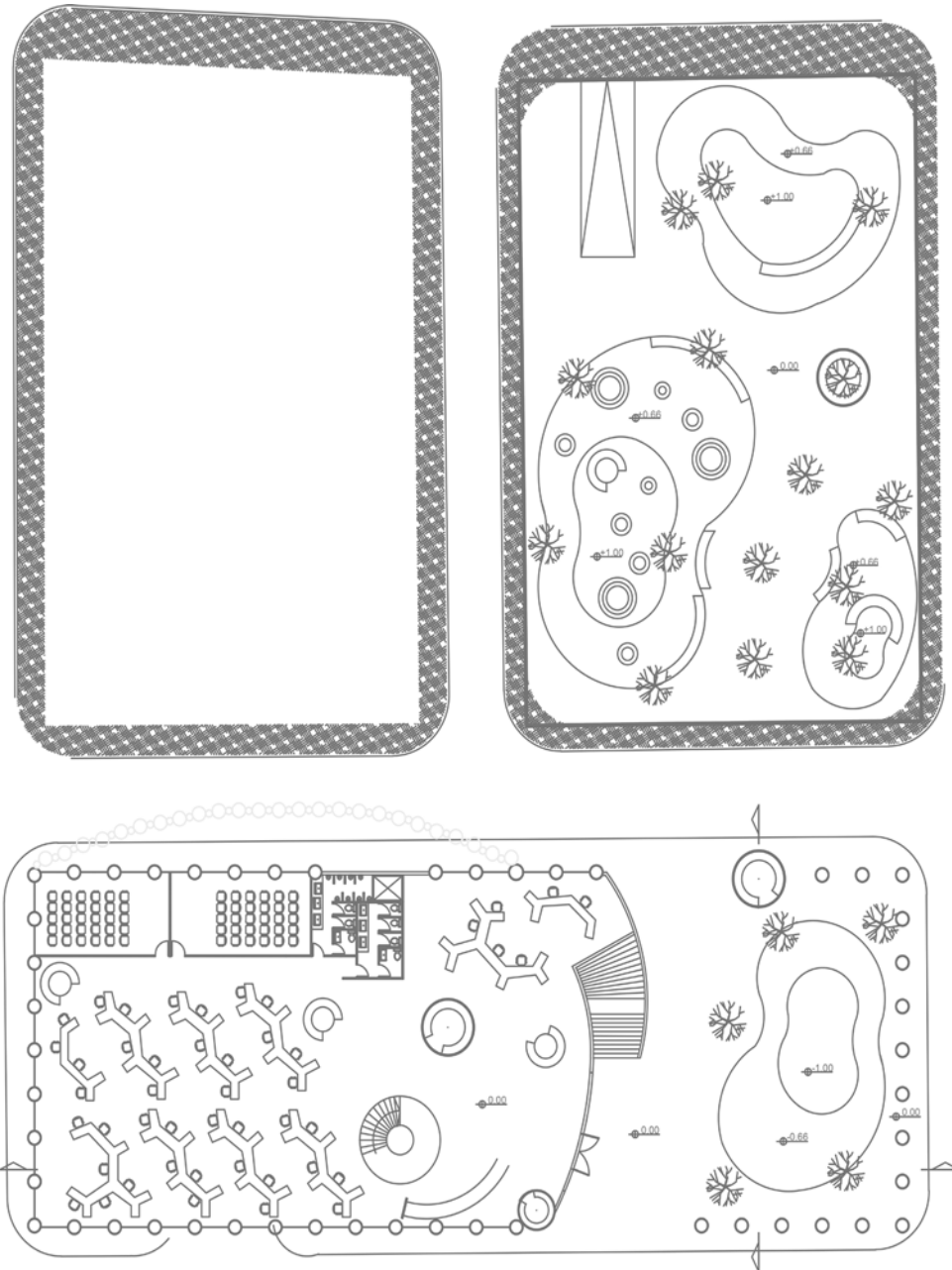
פונקציה	שטח נטו	שטח שירות	שטח כולל ליחידה	מספר יחידות	שטח כולל נטו	שטח כולל לשיר
גן ילדים	100	20	120	2	200	40
סטודיו	100	50	150	2	200	100
חדרי חוגים א	40	8	48	3	120	24
חדרי חוגים ב'	30	6	36	3	90	18
תיאטרון	700	200	900	1	700	200
חדר ספורט	150	30	180	2	300	60
ספרייה מולטימדיה	700	150	850	1	700	150
חדרי אמנים	10	4	14	10	100	40
גלריה	100	50	150	2	200	100
משרדים	12	4	16	8	96	32
אולם קבלה	25	5	30	1	25	5
בית קפה	120	80	200	1	120	80
אולם רב תכליתי	700	200	900	1	700	200
שירותים	30	6	36	2	60	12
חנויות	12	4	16	19	228	76
סה"כ					3839	1137
מתוך					3840	1152
נשאר עוד				1	1	15

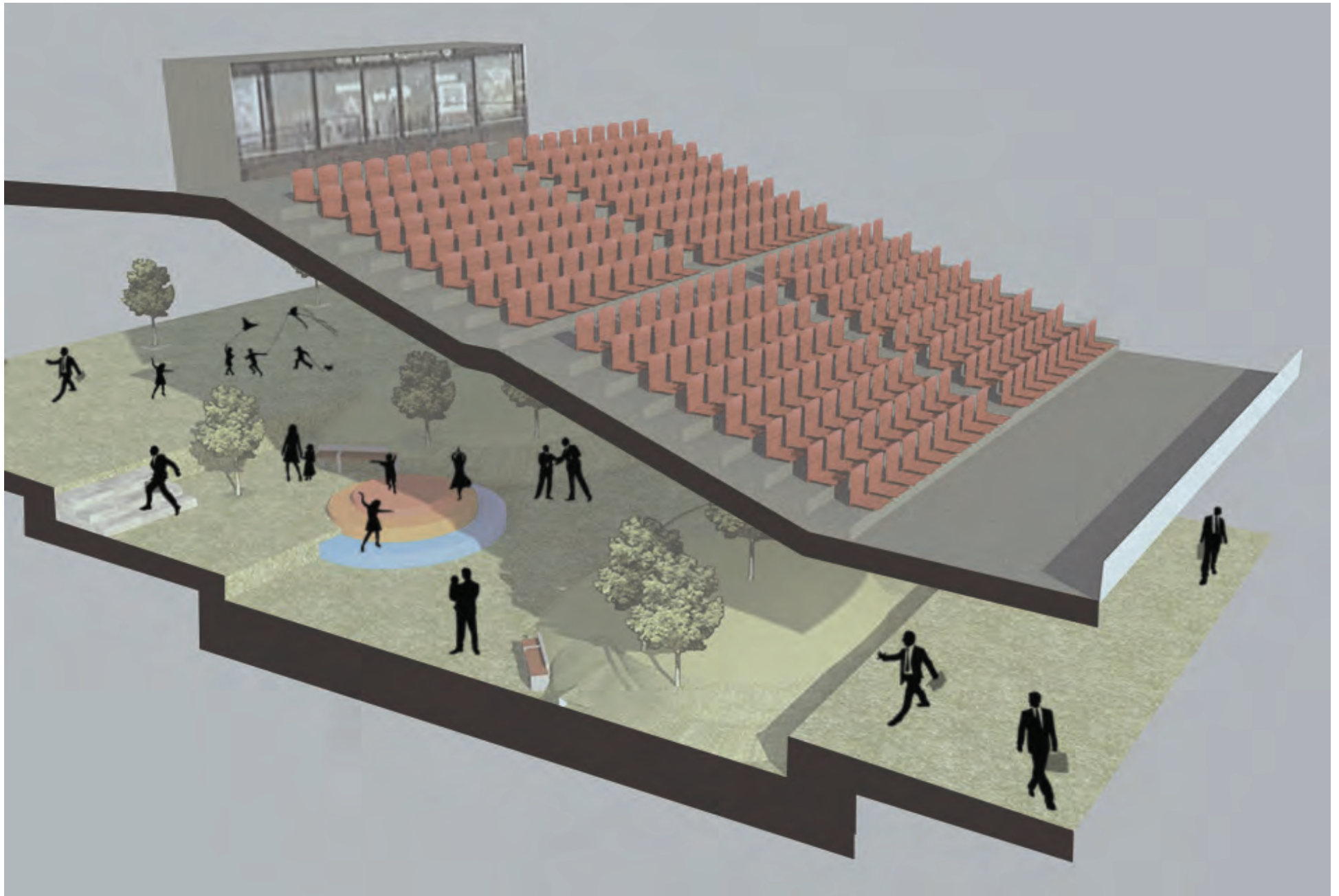


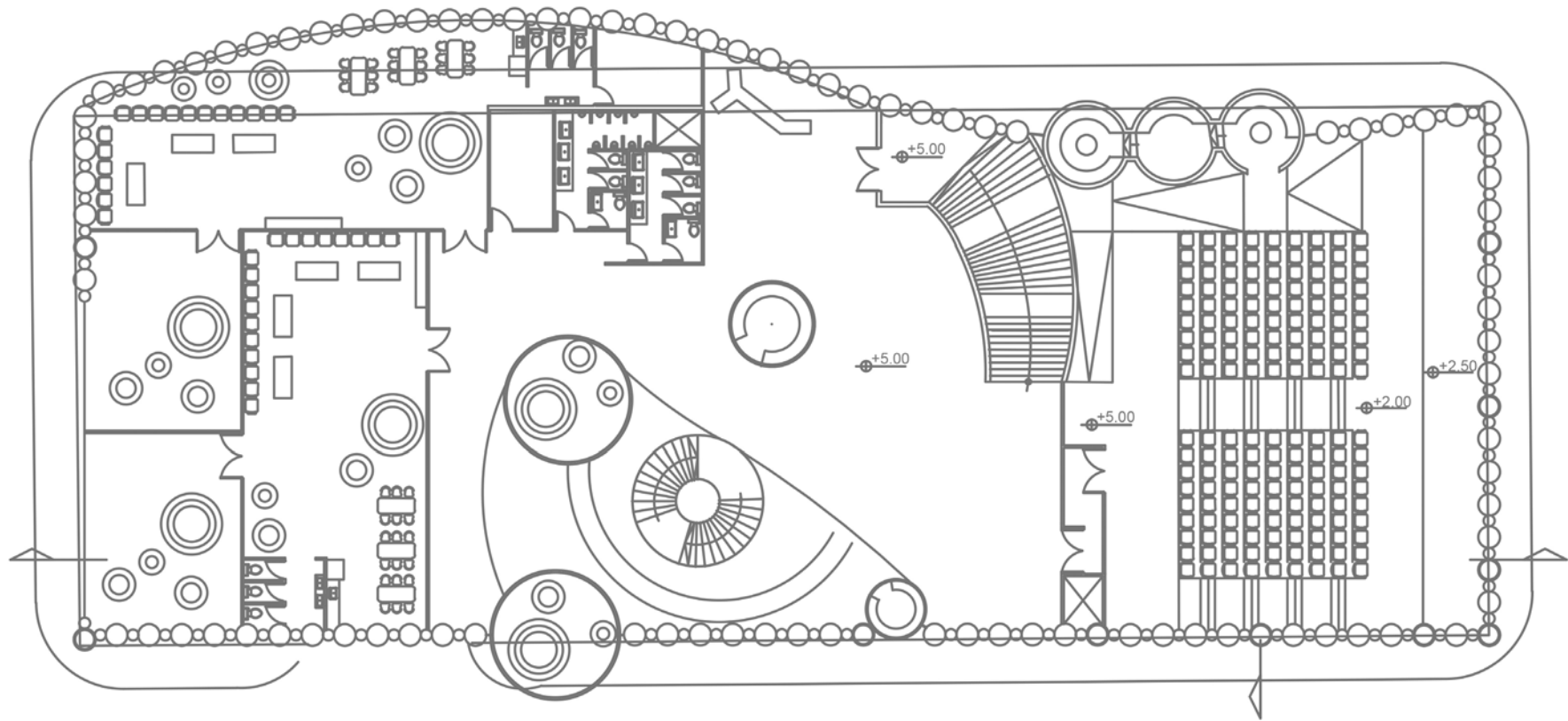


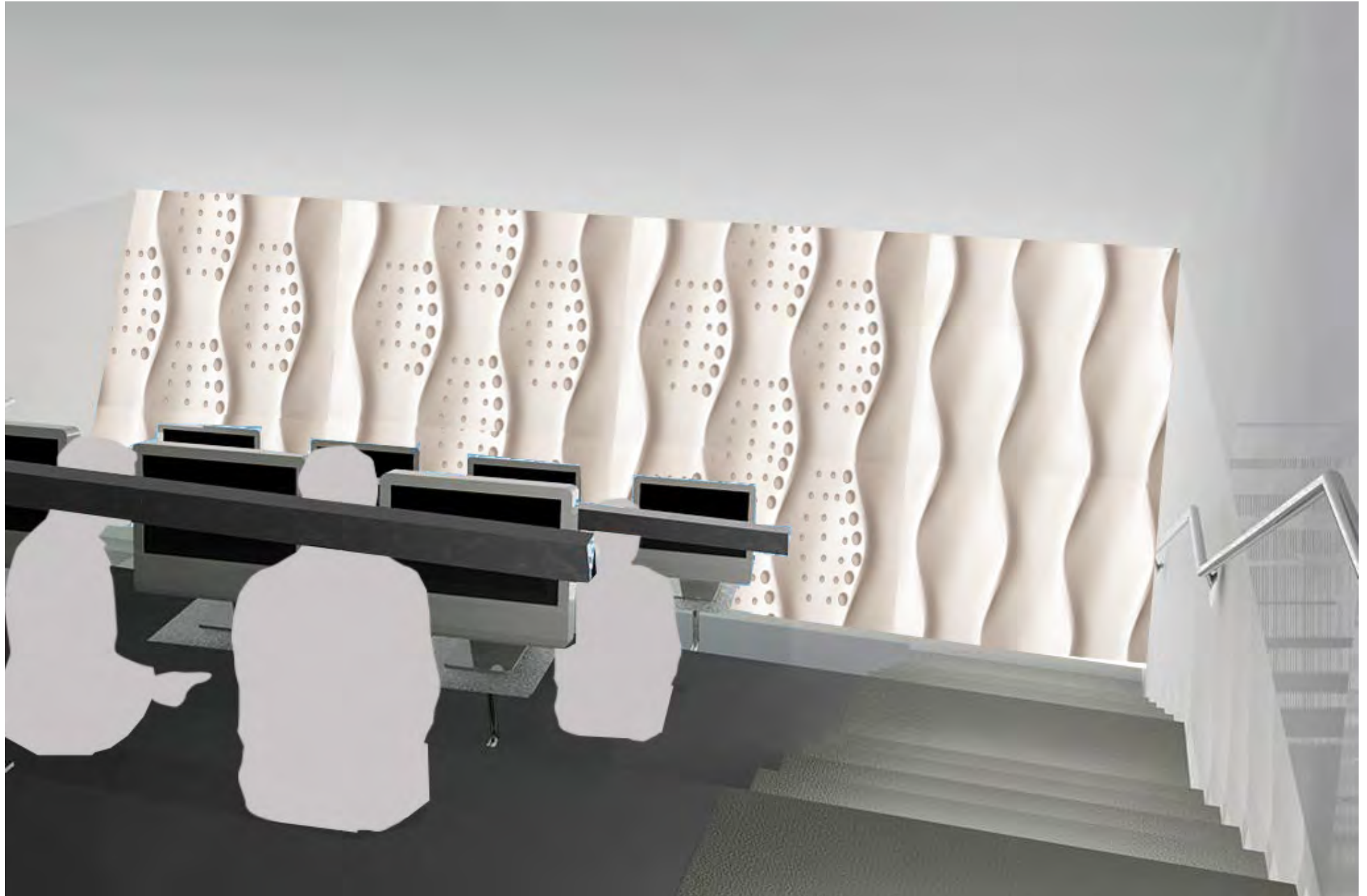
# F Building concept



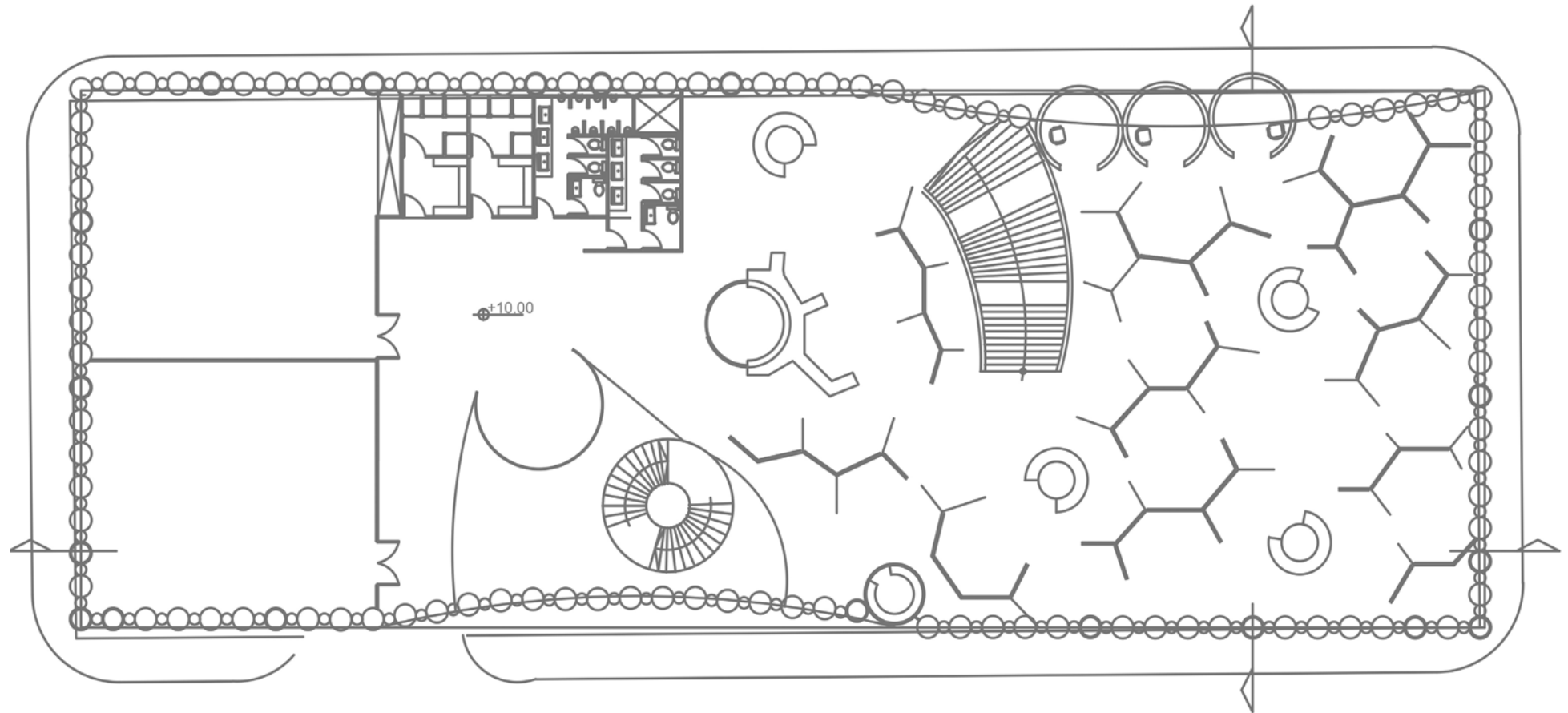






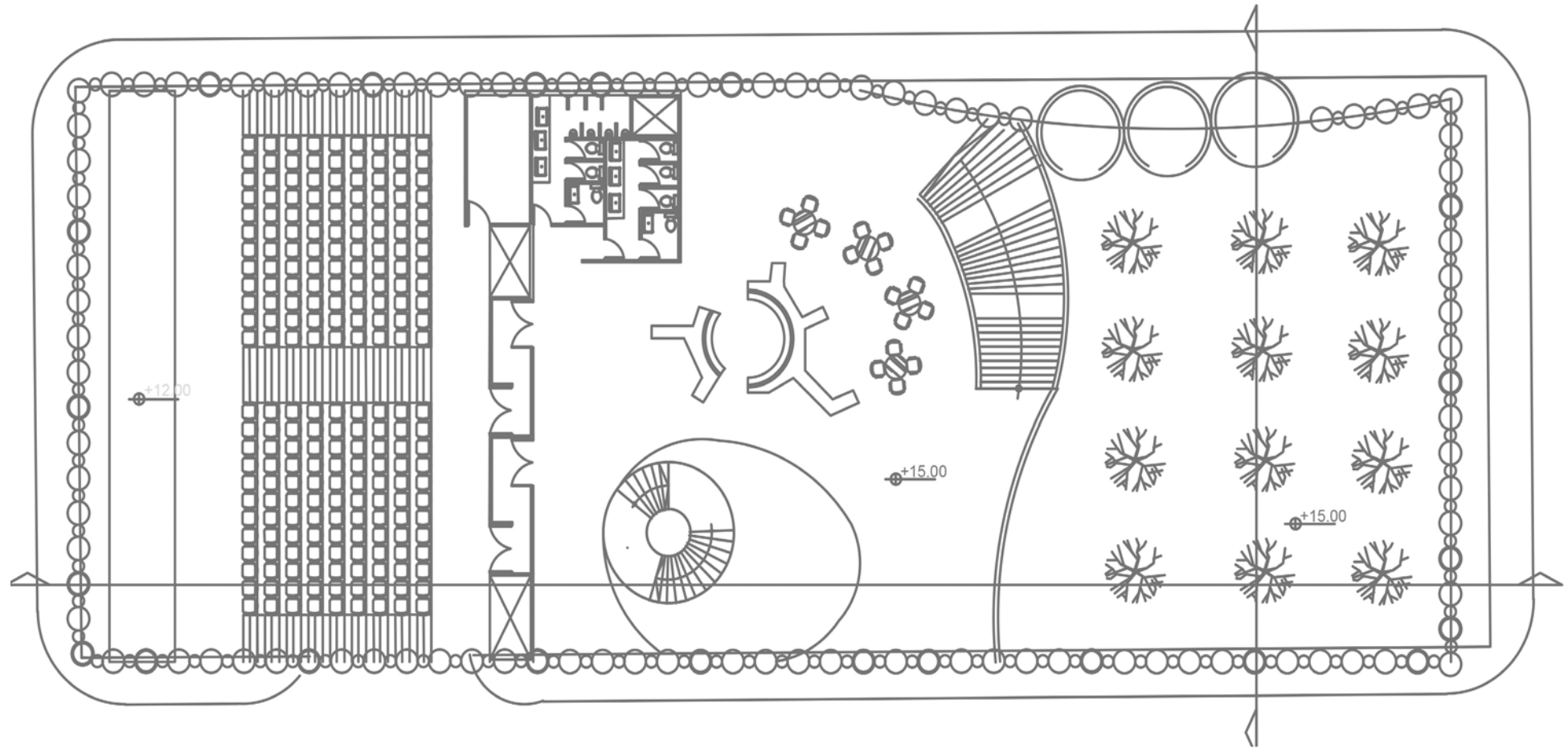


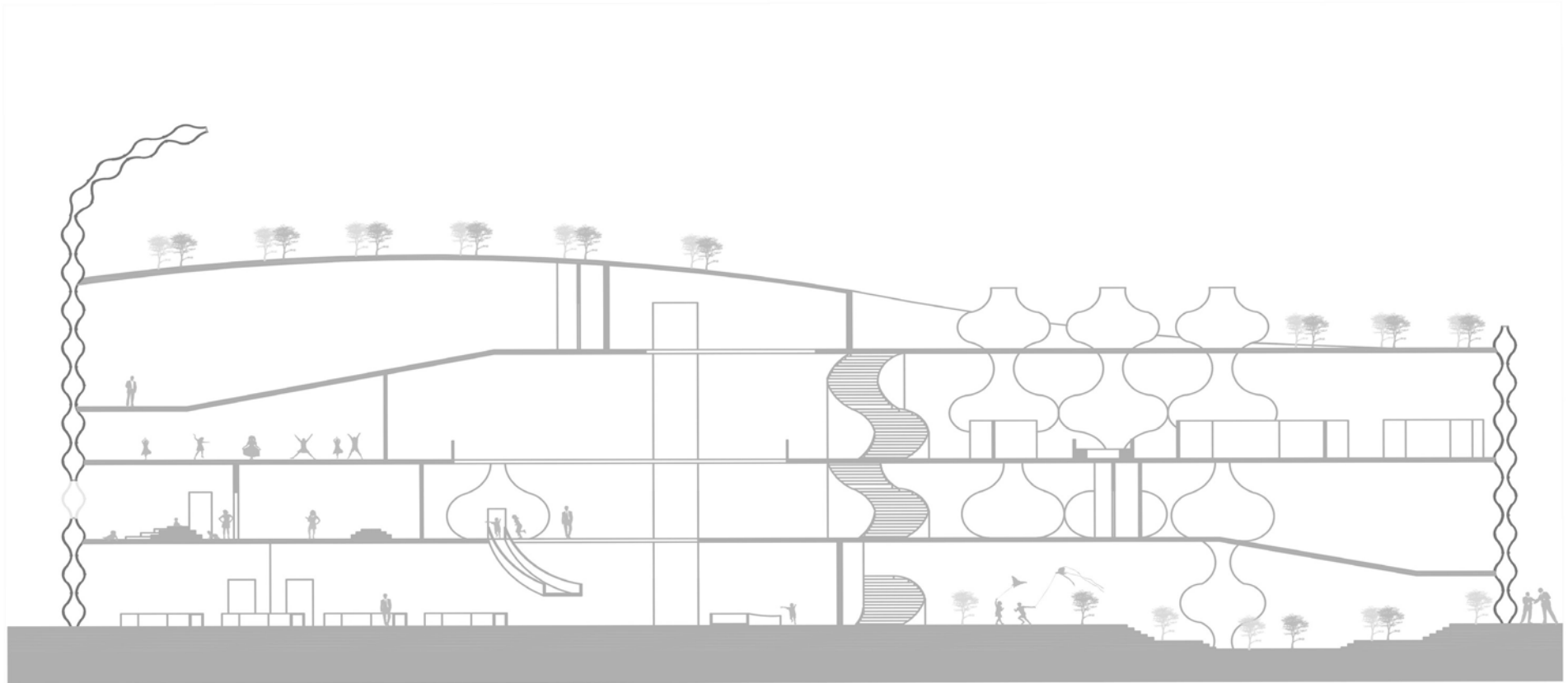


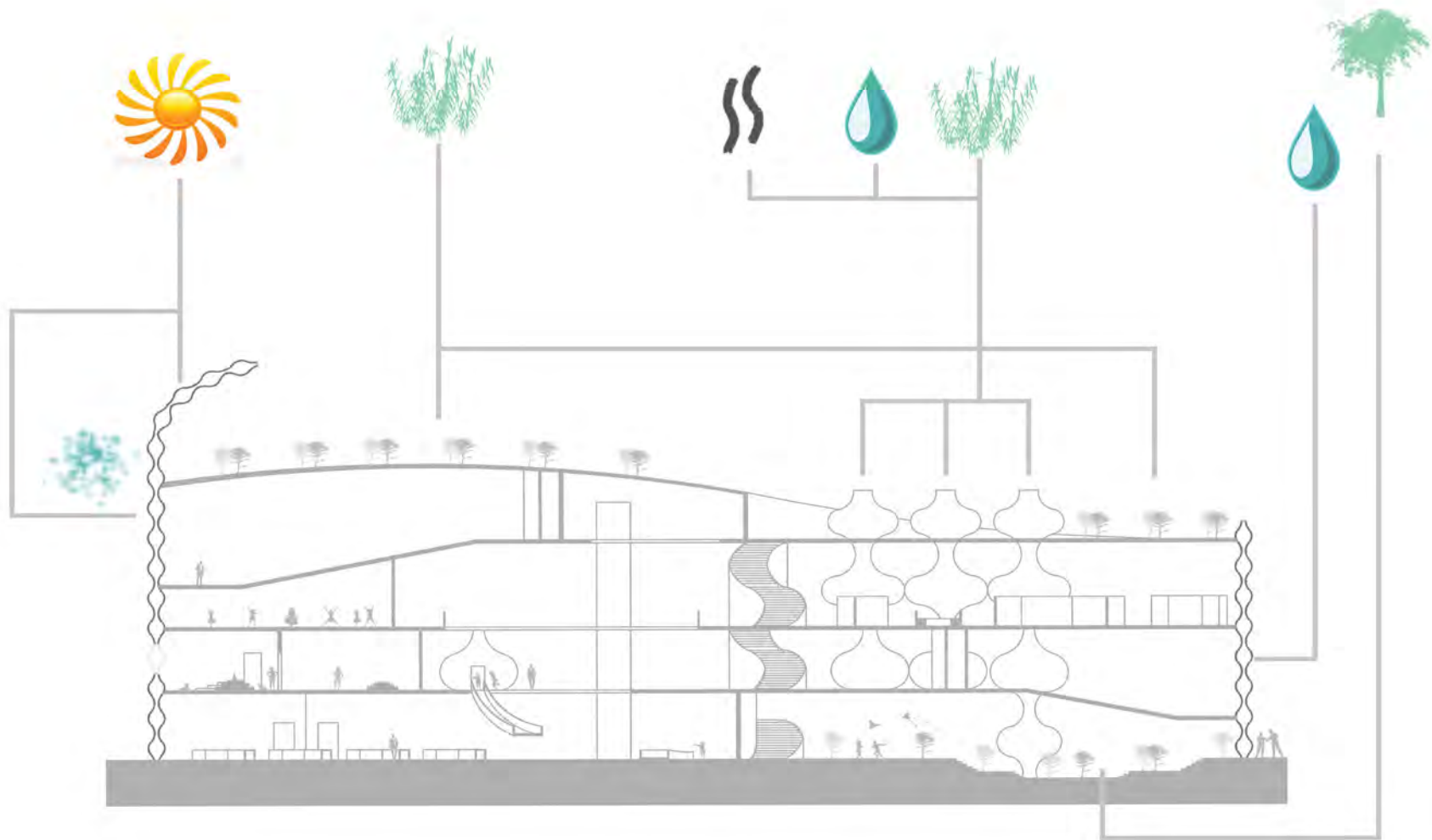


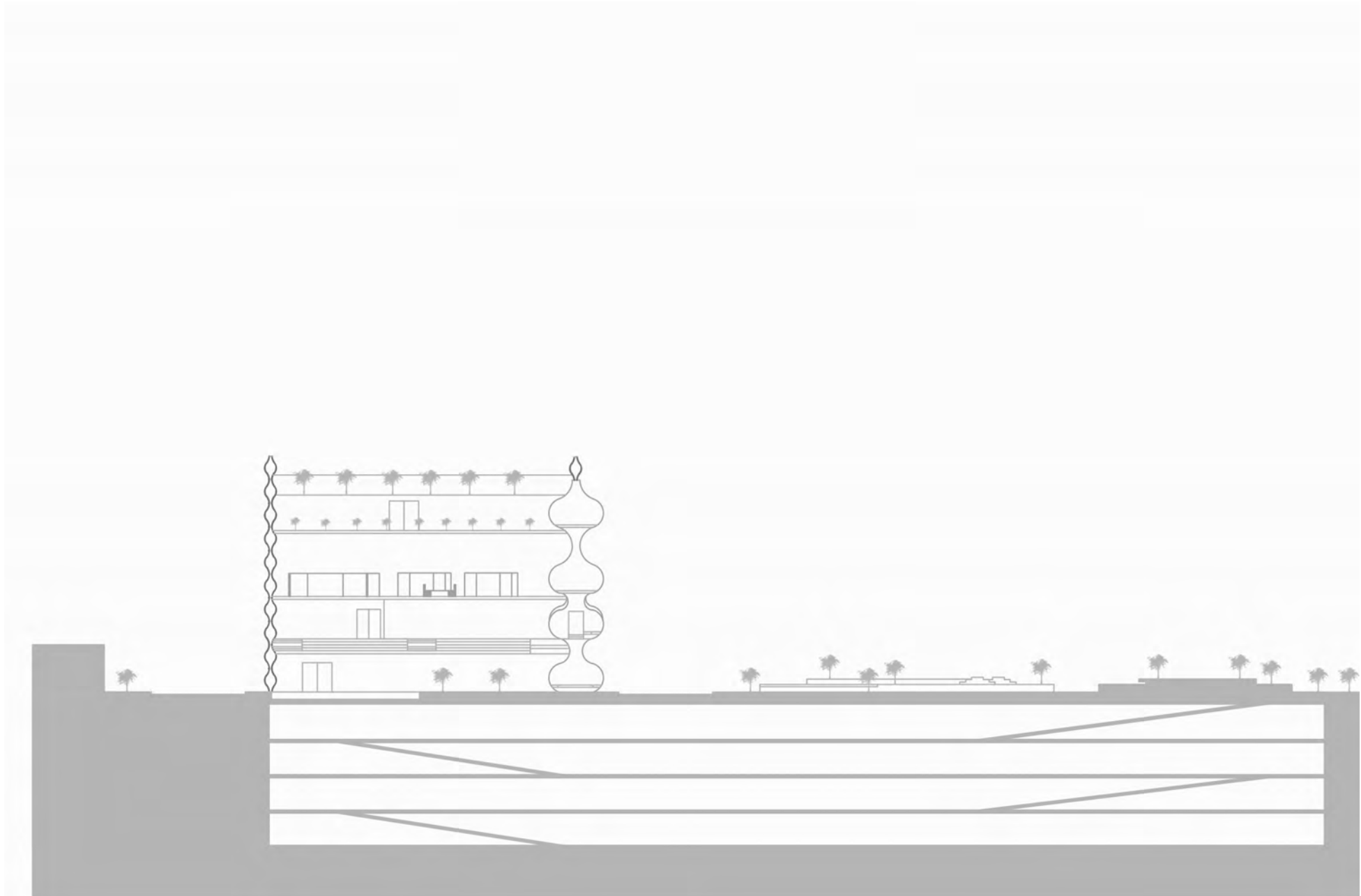














# Ha'Carmel Community Center

Cellular Structures Studio

Chen Zirinski \ Teacher: Arch. Yasha J. Grobman

פרויקט - "HaCarmel community center"  
הפרויקט נעשה כחלק מסטודיו תכנון בשנה רביעית העוסק במבנים תאיים.

הפרוייקט עוסק בתכנון מעטפת תאית למבנה ציבור המתוכנן לקום באזור שוק הכרמל בתל אביב. מעטפת תאית הינה מעטפת למבנה המספקת ערך מוסף מלבד היותה חוצץ בין פנים וחוף המבנה. במהלך הפרוייקט התנסתי בדרך תכנון המעטפת. החל מפיתוח אנלוגי, שניסה לאתר באופן ידני ושכלתני כיצד צריכים התאים לשבת בגריד, ובהמשך בכלים פרמטרים שהביאו לתוצאות שאינן ניתנות לצפיה מראש. הביצועים אותם מנסה המעטפת לבצע הם שליטה בכמות התאורה הנכנסת למבנה, שליטה שגודל הפתחים הפונים לחוף המבנה, וכן, יכולת קונסטרוקטיבית עצמאית.

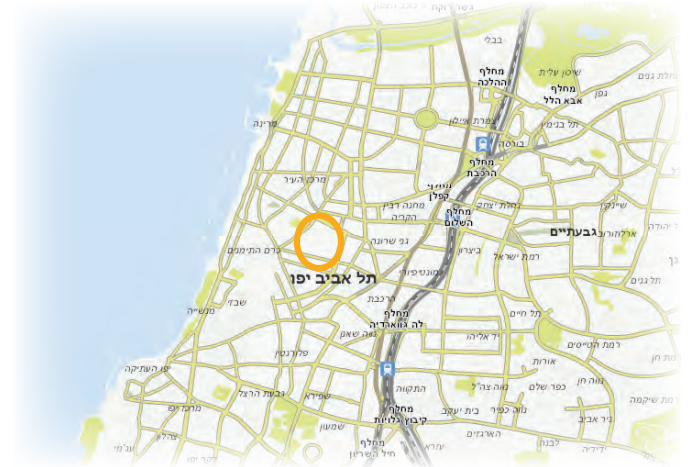
טכנולוגיות ייצור עכשוויות, שנסקרו בין היתר במהלך השיעורים בסטודיו הביאו אותי לידי הבנה כי ניתן ליצר כיום כל דבר בעזרת תכנון ממוחשב. ניתן לשלוח הוראות הכנה מדויקות, ובכך לחסוך הרבה מאוד טעויות אנוש. המעטפת מורכבת מתאים המשתנים בגודלם, בגודל הפתיחה שלהם ובהטייה שלהם, בהתאם למיפויים שונים שמופעלים עליהם. הדבר מביא לתוצאה של מאות תאים שאינם חזרתיים, אבל בעלי גרעין רעיוני דומה. הודות לטכנולוגיה המפותחת ניתן לייצר תאים כאלו, הבנה זו מקלה על תכנון התאים, מאחר והדבר אינו בדיוני.

התאים בפרוייקט הם תאים המבוססים על גריד משולש, שהינה הצורה הקונסטרוקטיבית הבסיסית ביותר. המשולש מספק יציבות גיאומטרית וקשיחות, ולכן בחרתי להתעסק בחקר התא המשולש. נושאים נוספים שעלו תוך כדי תכנון התא הם אופן תמיכת המעטפת, החומרים מהם עשוי התא, אפשרויות תפקוד של התא ופנים המבנה ועוד. מאחר ומדובר בתא שאינו חזרתי, החומרים הנוחים ביותר לייצור יהיו פאנלים של חומר מרוכב המחוזק בעזרת סיבי זכוכית, אותם ניתן ליצור בעזרת תבניות. הפאנלים, אשר ביניהם חומר מבודד, יושבים על מערכת תמיכה של צינורות, המהווים את הגריד עליהם יושבת החזית. במהלך הפרוייקט היו רבה רגעים של נסיגה ממבוי סתום או ממקום שלא מצאתי בו את פוטנציאל ההתפתחות הנכון. הפרוייקט הינו פרויקט מחקר, שאינו קובע עובדה בסופו, אלא מנסה להתוות דרך החלטה לעיצוב חזית המבנה בעזרת שימוש בכלים ממוחשבים לצורך בדיקה.

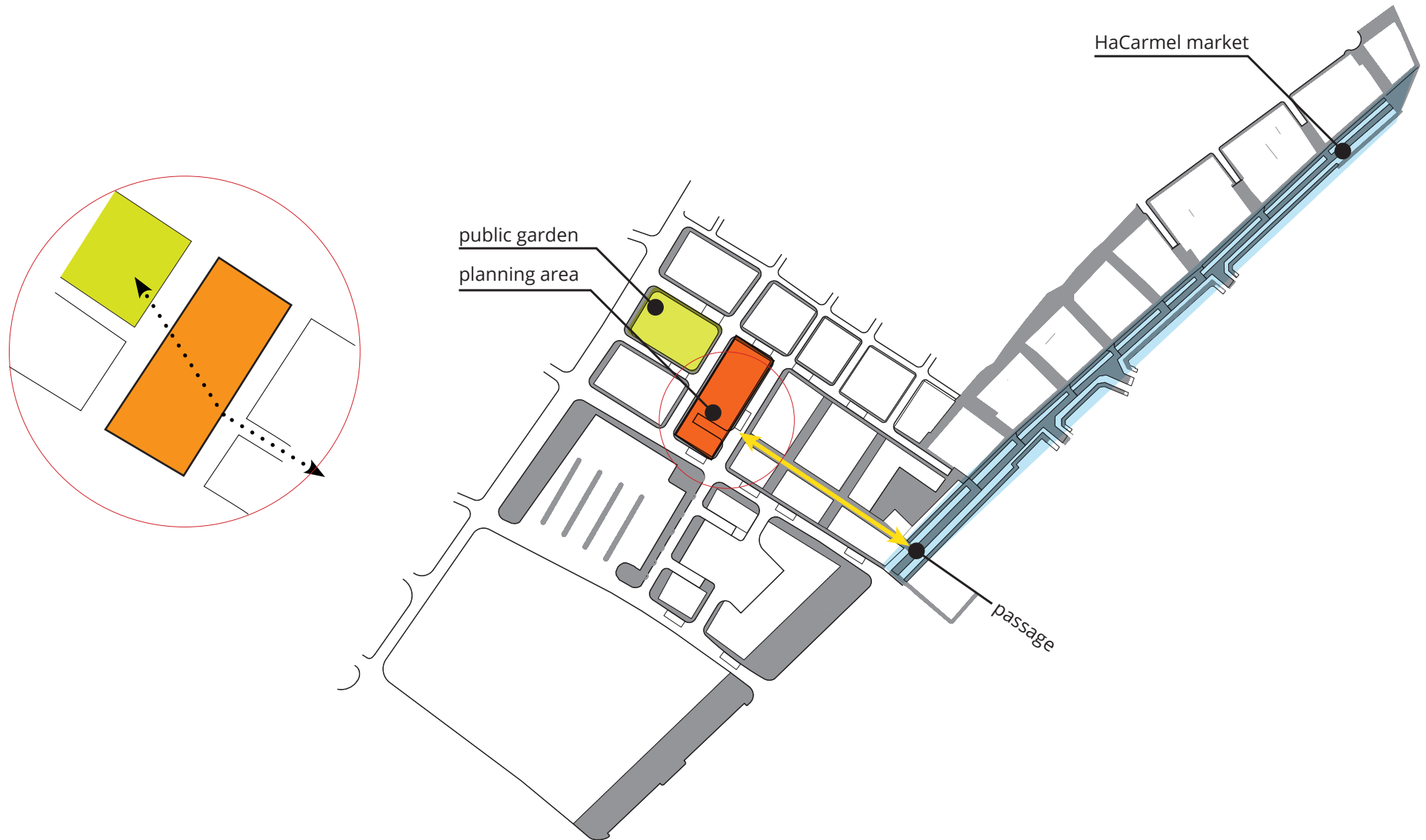
מבנה הציבור כולל בתוכו פונקציות שיתאימו לדיירי האיזור. הקומה התחתונה מכילה פונקציות ציבוריות: בית קפה, לובי כניסה, גלידריה, חלל ספריה וגלריה להצגת עבודות. ככל שעולים בקומות המבנה נעשות הפונקציות יותר ויותר יעודיות עבור ציבור מסוים. החלל המרכזי בכל קומה מוקף במעבר היקפי המתחבר לציר התנועה הורטיקלי הראשי – מדרגות אזור צפות במרחב הכניסה למבנה. בקומת הקרקע של המבנה שקיים מעבר עירוני המוביל את המגיעים מכיוון שוק הכרמל לעבר גן ציבורי פתוח הנמצא ממערב למבנה. הפרוייקט כולל התנסויות רבות, תהיות וגילויים, ובעיקר תהליך למידה רחב אודות מהותה של החזית התאית.

### Site location

The site is located in the southern area of Tel Aviv, near HaCarmel market.  
 The site currently facilitates a bus parking lot. A new city plan by Axelrod Grobman Architects designates the site for public and commercial use.  
 This Studio's goal is the planning of a public building which will be located at the site.



In the area's new plan, as offered by Axelrod Grobman Architects, we can see the public building borders marked in orange. one of the main facts is that there is an open public garden west to the building site, and a passage leads from the market to the building. in order to allow people to pass the building and reach to the garden there should be an open path at the building's ground floor.

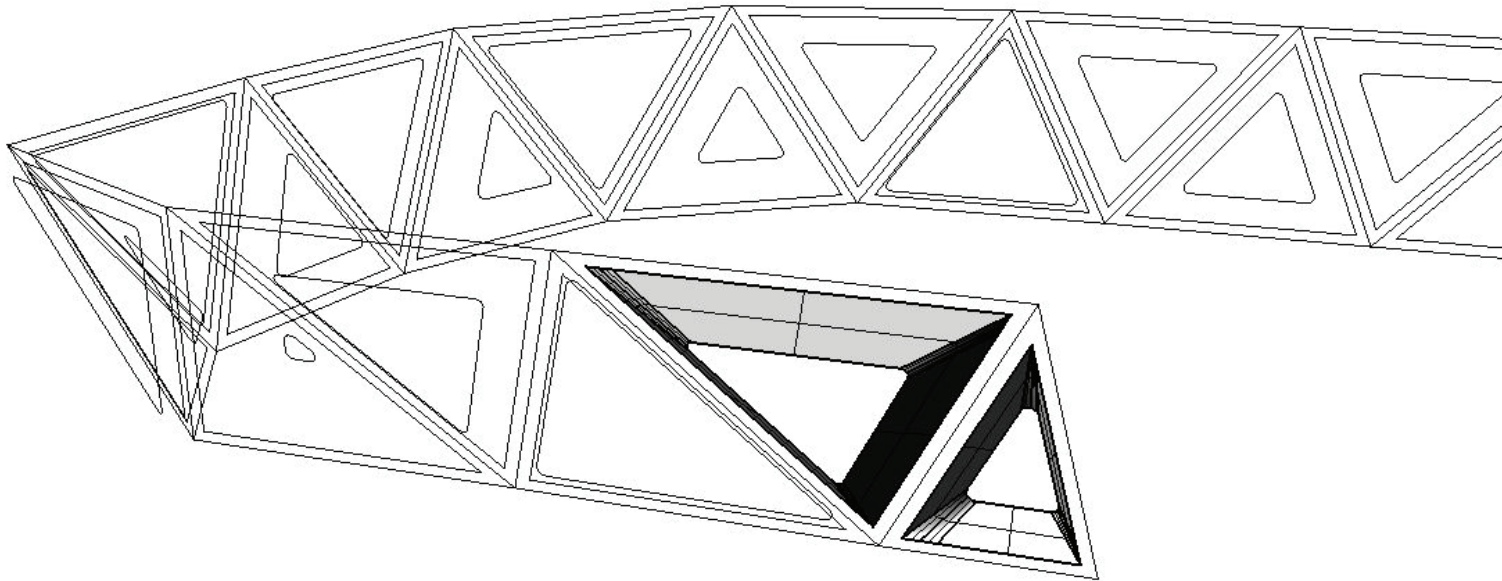


base plan by Axelrod Grobman Architects



## *the cell*

The first stage of the studio's exercise was to develop a generic unit in the form of a repetitive cell that will eventually form the basis for the structure's enveloping facade. In order to do so, it was necessary to develop a certain concept, according to which, the cell must demonstrate some desired performance and qualities.



## *The meaning of "Public" to me*

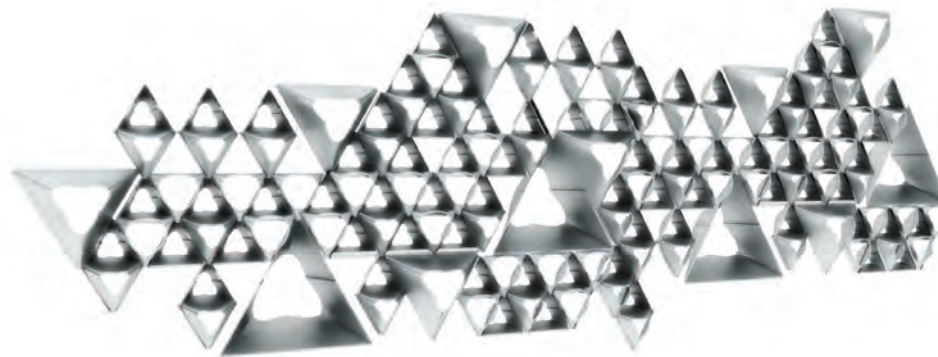
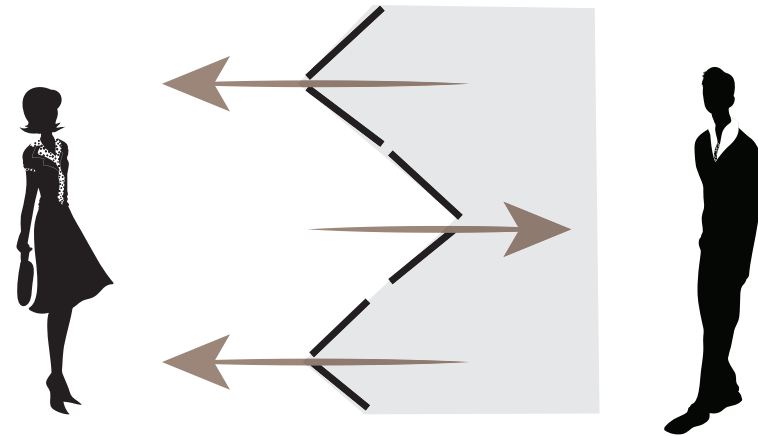
"Public" is when you can see people wandering around, dancing, reading and talking while you drink your coffee.

"Public" is when you decide whether to be observed or the observer. or maybe both.

"Public" is when the border between you and the surrounding get's softer. it is the scale between stiffer and softer, wide and narrow.

**observed observer**

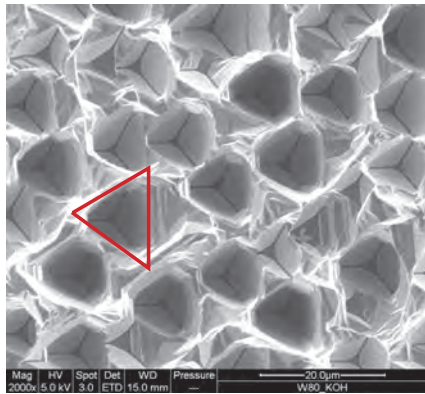
**inside >> out**



## cell development

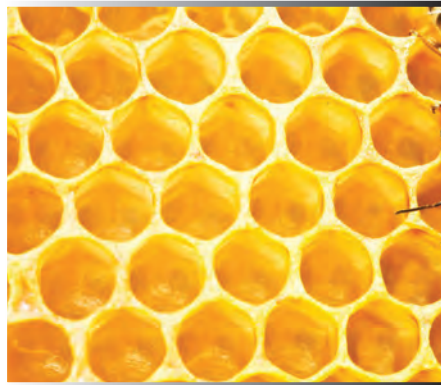
The starting point I selected was developing a cell with a rigid geometry, which, when populated into a grid, will form a self-supporting stable constructive structure. Inspired by the bee hive, I began my search with the hexagon. Hexagons can be close-packed, allowing a perfect use of space if arranged together, thus creating a cellular stable system.

Porous silicon

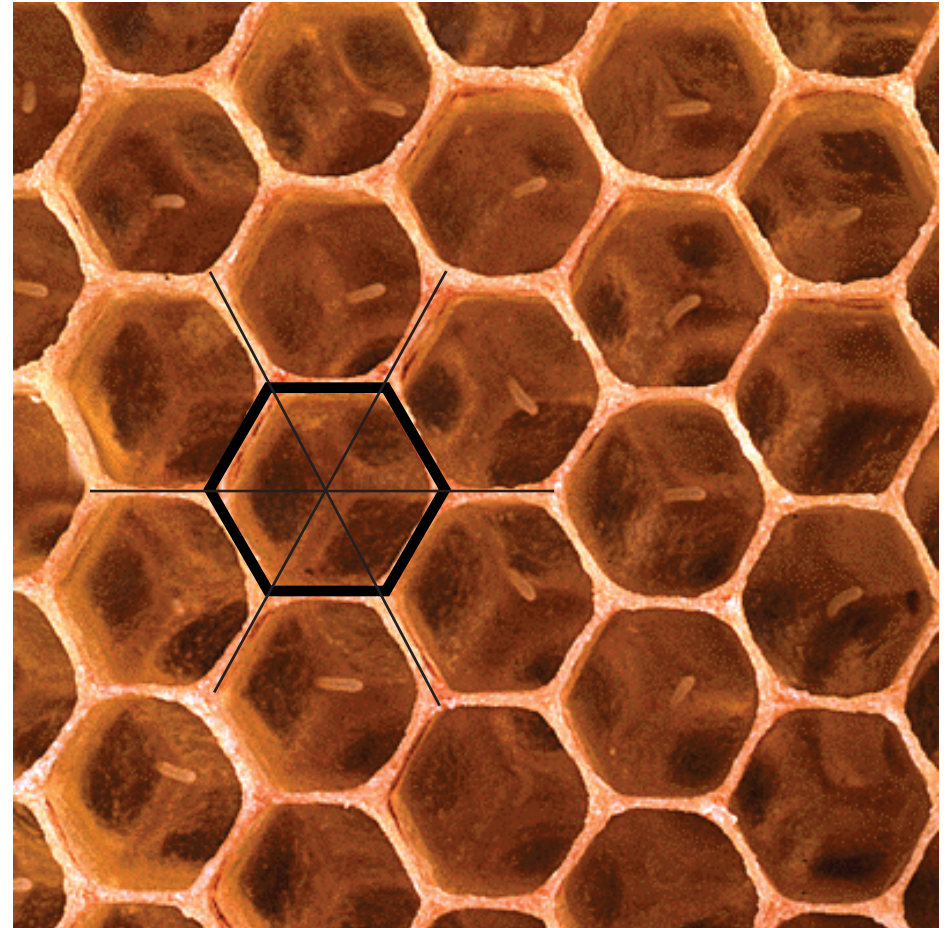


<http://oasys2.confex.com/acs/234nm/techprogram/P1108074.HTM>

honeycombs

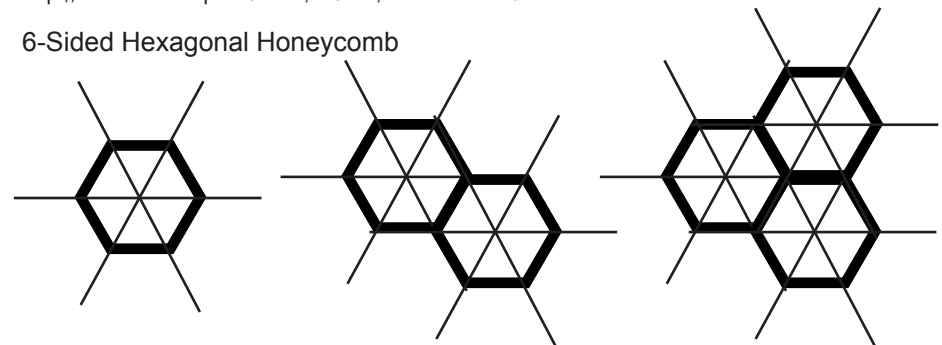


Bees and honeycomb 21462 - Animal Collection - Animal [WWW Document], n.d. . URL <http://www.freegreatpicture.com/animal-collection/bees-and-honeycomb-21462>

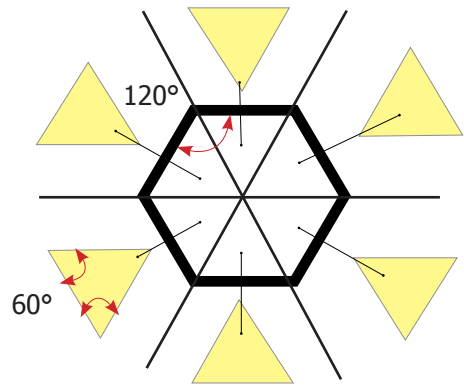


<http://www.wisdomportal.com/Haikus/Number6inNature.html>

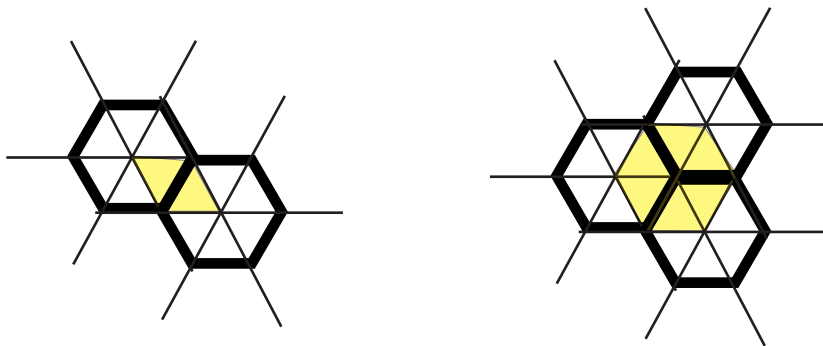
6-Sided Hexagonal Honeycomb



When observing a hexagonal grid, one can note that every hexagon on the grid touches six other hexagons, and every two of them have a mutual edge, and every vertex of a hexagon is mutual to a total and maximum of three hexagons. Between the three hexagons sharing the same vertex there are three angles, each of  $120^\circ$ .



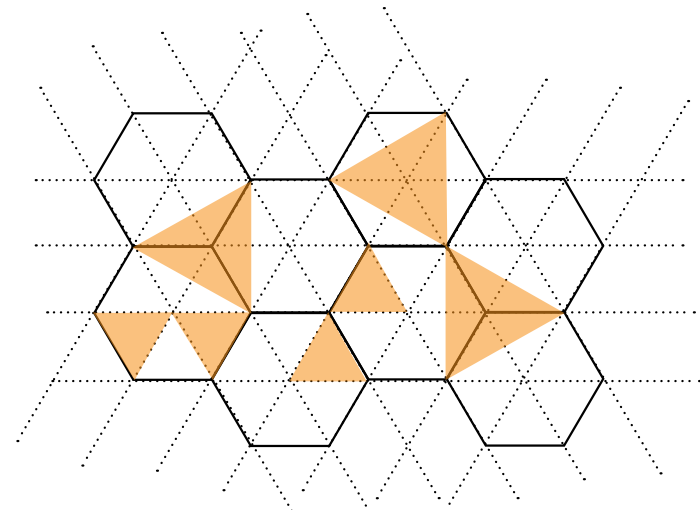
A single Hexagon.



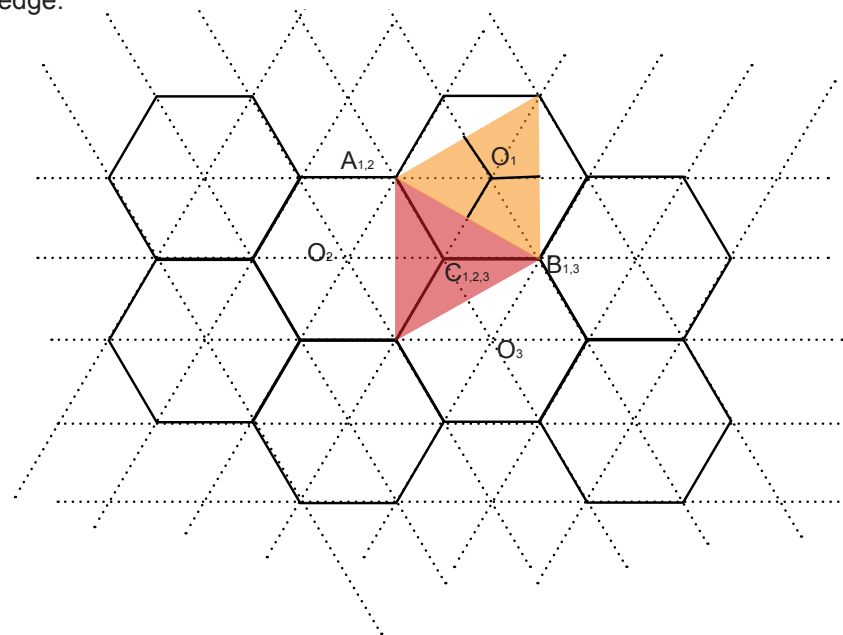
Two hexagons sharing a mutual edge. The edge is the base of two equilateral triangles.

Three adjoined hexagons, sharing three common edges. It can be noticed that a new hexagon, made of six triangles, can be drawn around the common vertex.

Here are some products of my explorations with sub-geometries within the hexagonal grid.

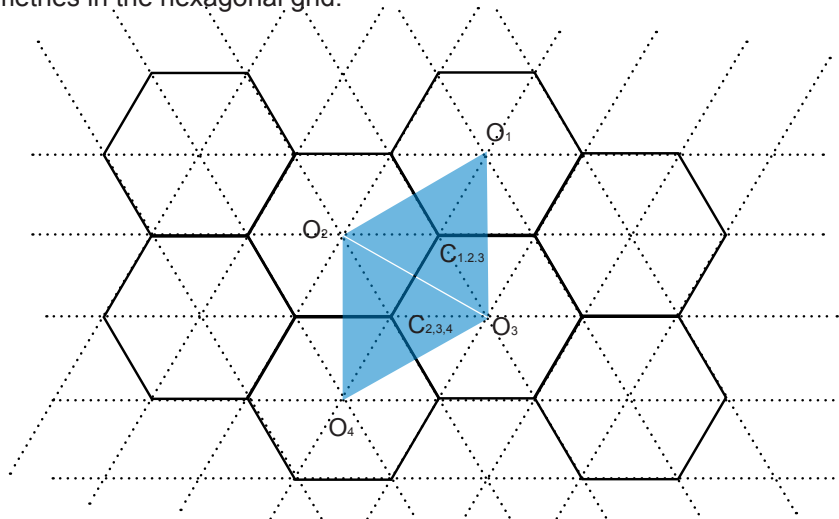


Eventually, two triangles stood out: (1) around the point where one hexagon meets two adjoined hexagons on the grid (the pink triangle); and (2) the center of a single hexagon (the orange triangle). The two triangles have a mutual edge.



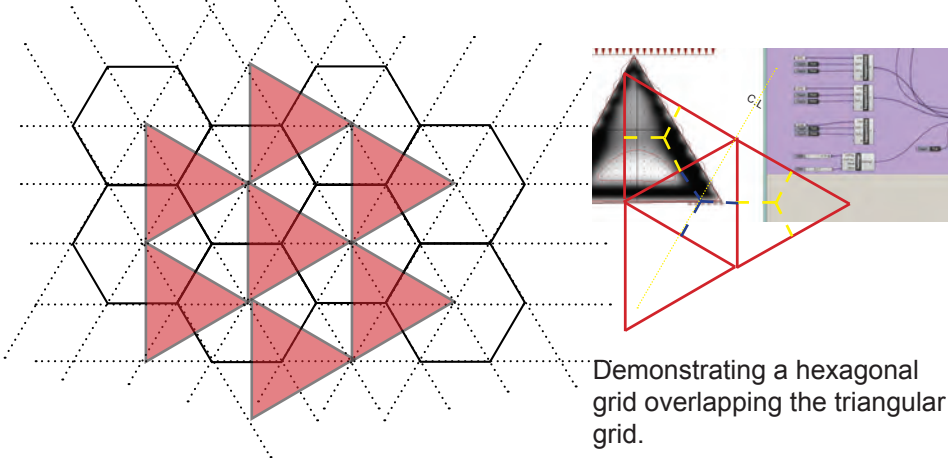
**triangles**

Here are some more results of the continuation of my explorations with sub-geometries in the hexagonal grid.



By connecting the centers of three adjoined hexagons (the blue triangle) an equilateral triangle is formed. This triangle is identical in size to every triangle made in the same way on the grid, and also has the same size as the pink and orange triangles. It is noticeable that the basic unit forming the hexagonal grid is thus the triangle (and not the hexagon).

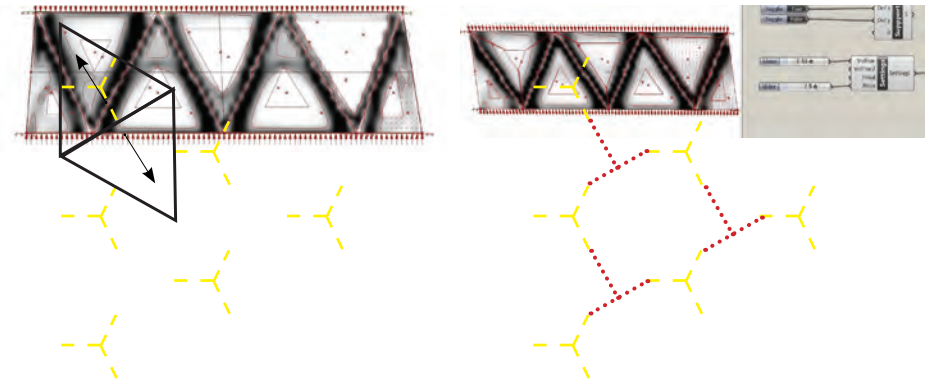
I resumed by creating a new grid, made of triangles.



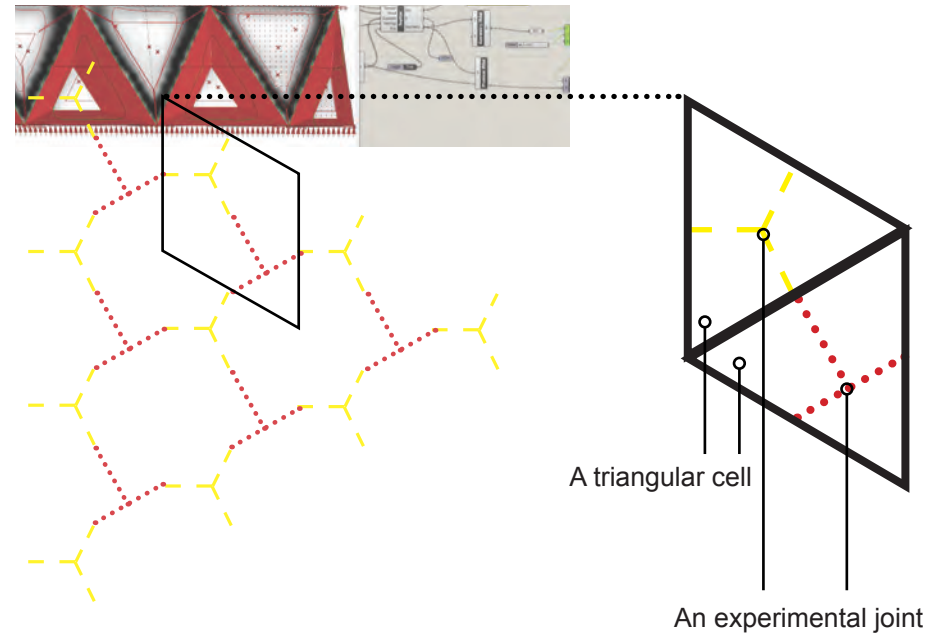
Demonstrating a hexagonal grid overlapping the triangular grid.

**A triangular grid**

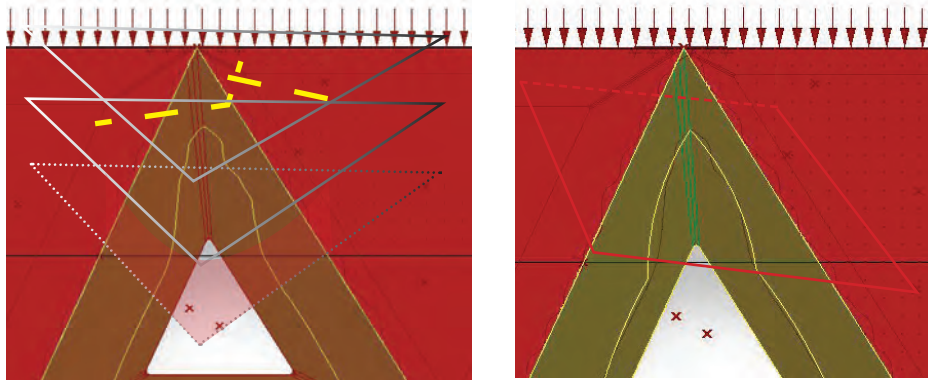
The grid is made of "Top Up" ("TU") triangles and "Top Down" ("TD") triangles.



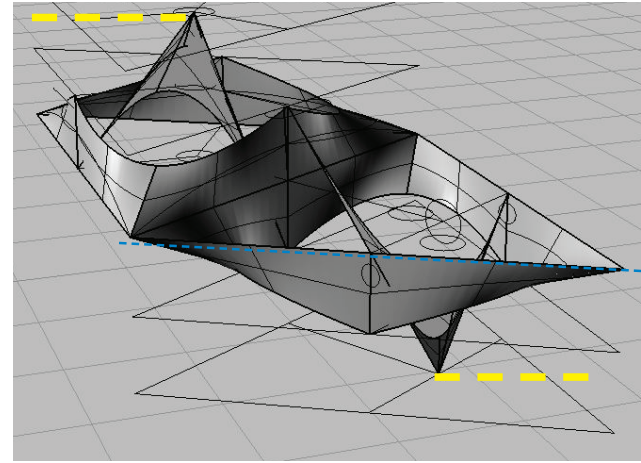
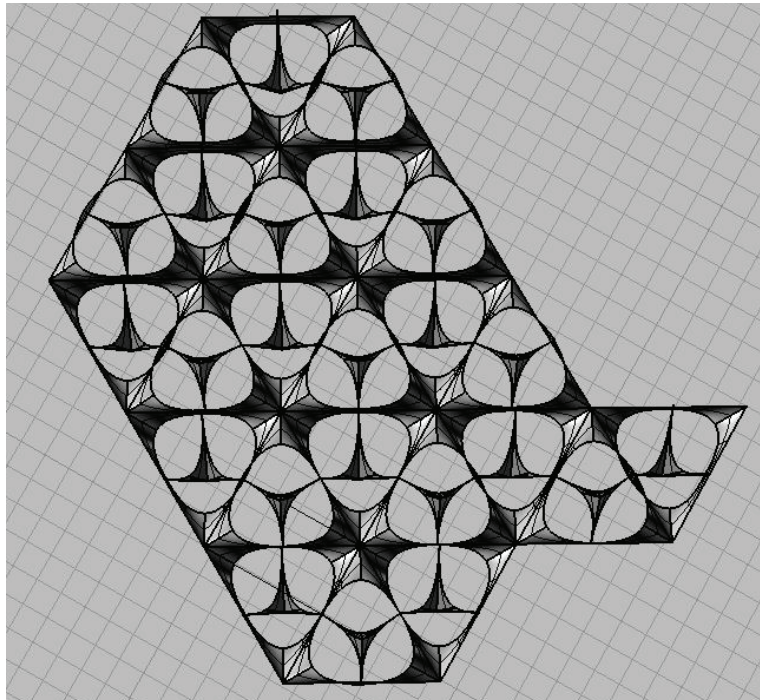
Experimenting with converting the inner lines of the TD triangles with perpendicular lines.



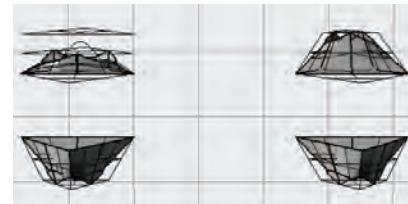
A 3D model of the TD joint concept. The inner lines were transformed to an "exoskeleton" that will hold the TU and TD cells.



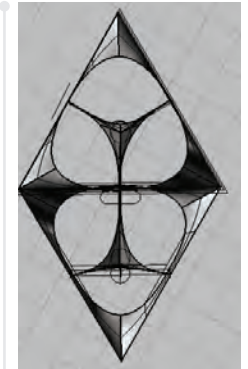
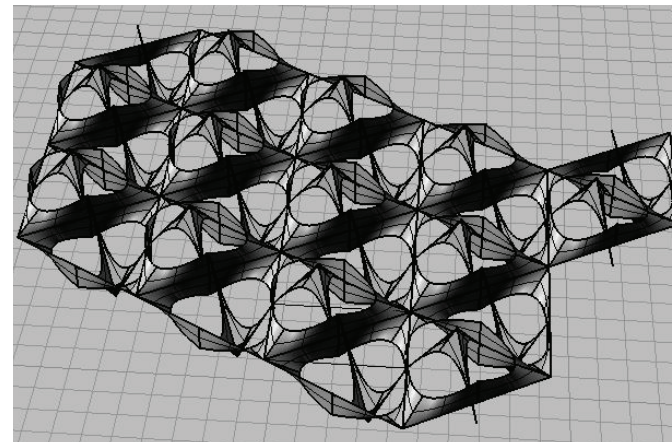
The consequent grid is built with TU inner joint facing inwards and the TD inner joint facing outwards – to create balance.



Extracting the joints to the two the front and to the back of the grid allows the grid better static stability.



The height of a single cell may be changed, according to needed performance: shading, visibility, exposure.



FRONT



SIDE VIEW

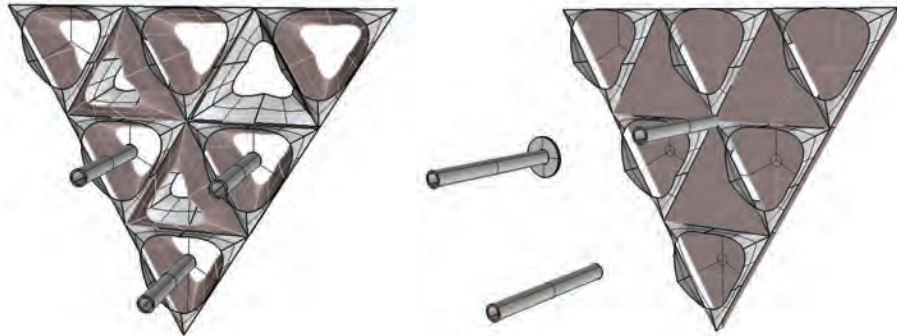


TOP VIEW

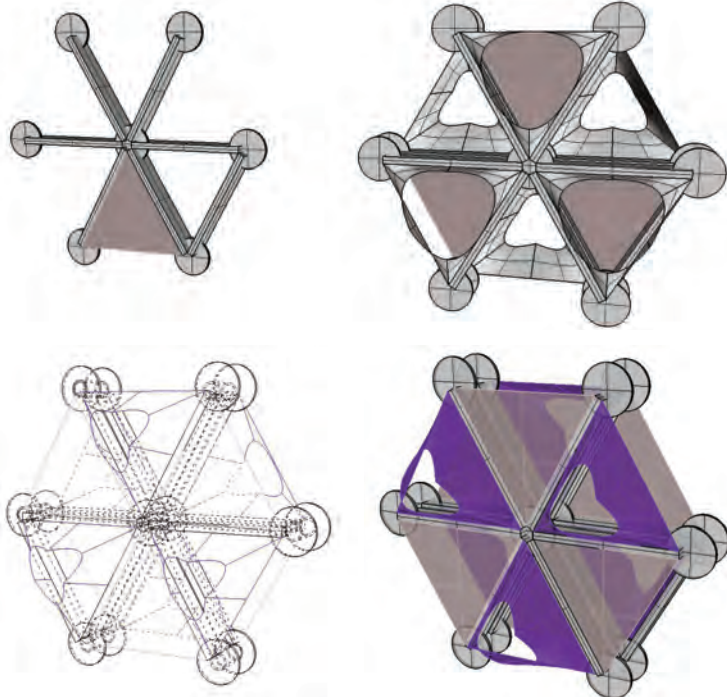


**.Translations for possible constructions**

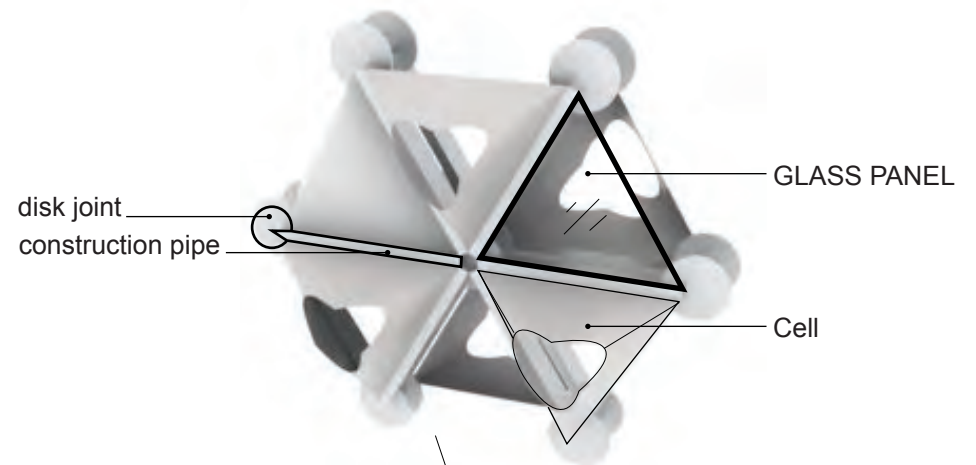
Problem: connecting cells by their centers may interrupt natural lighting and visibility.



Supportive triangular construction built of small RHS beams, connected by discs.



The result is a dual unit, made of TU cells facing outwards and TD cells covered with glass panels (or vice versa).

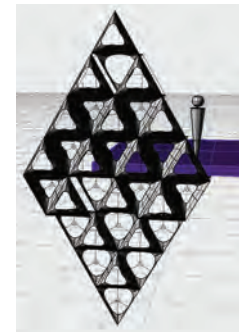
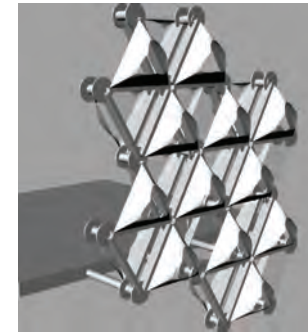
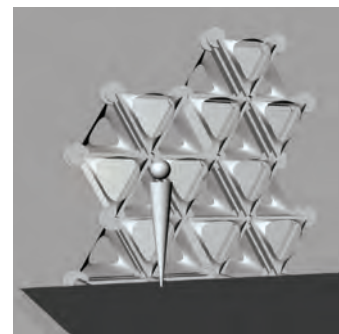
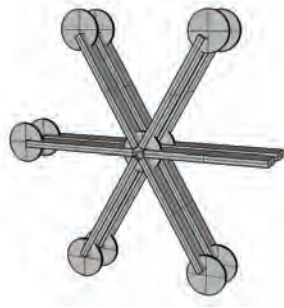
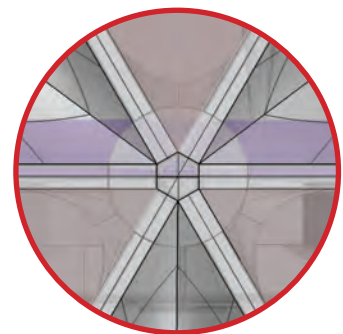
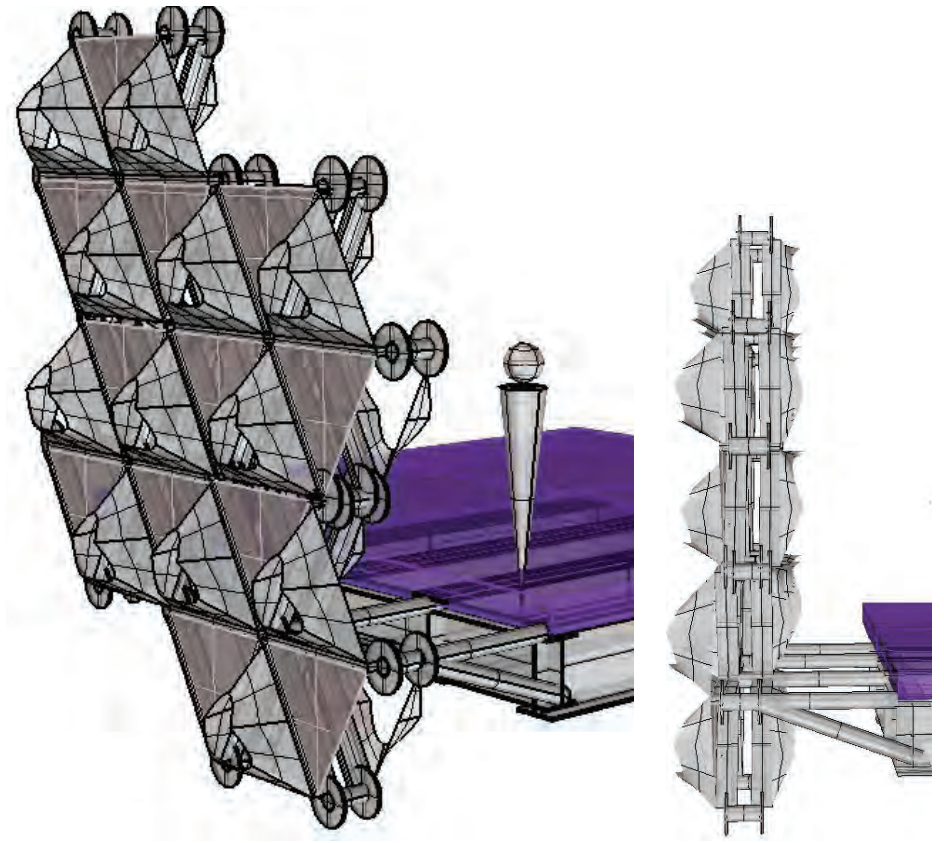
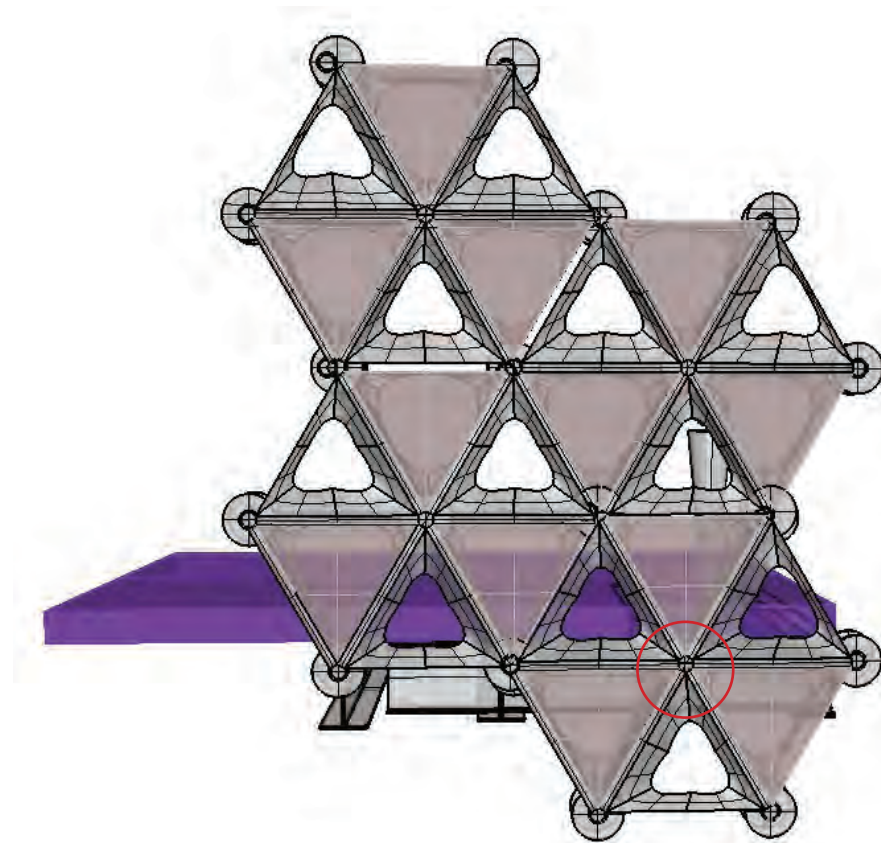


A view from the top reveals a gap between two independent cells, not on the same plane.

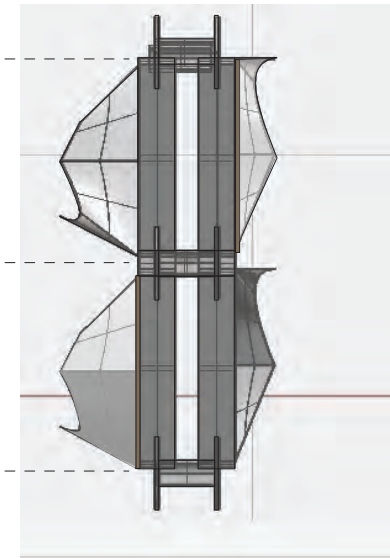
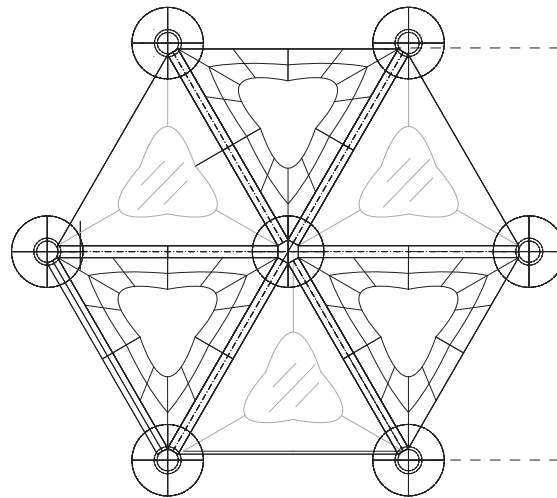
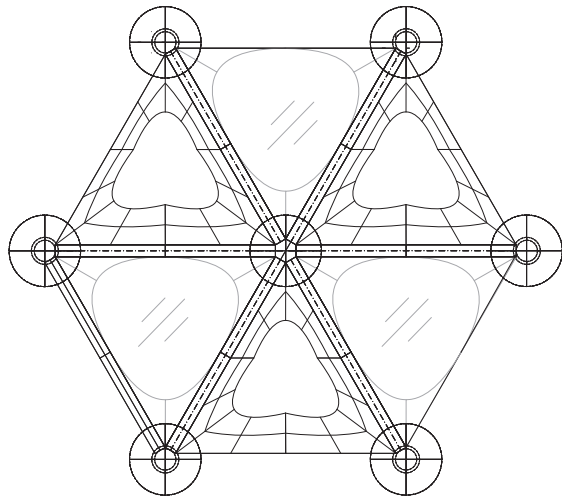
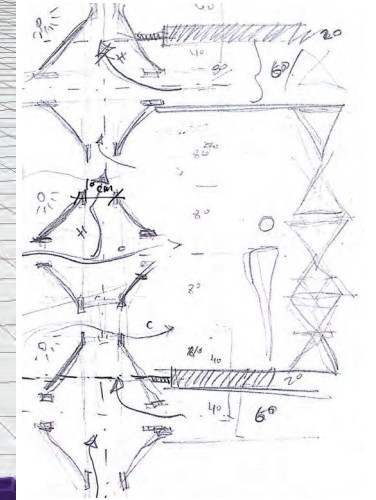
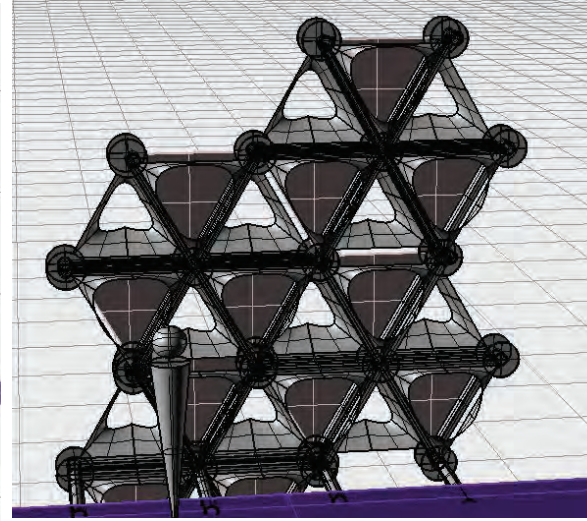
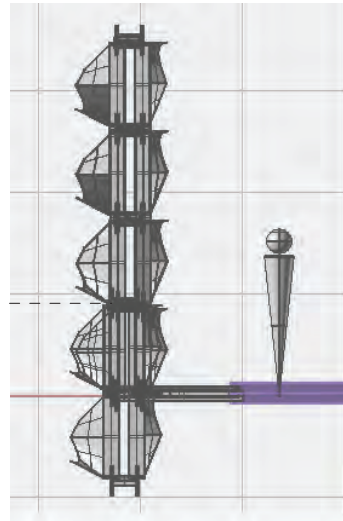
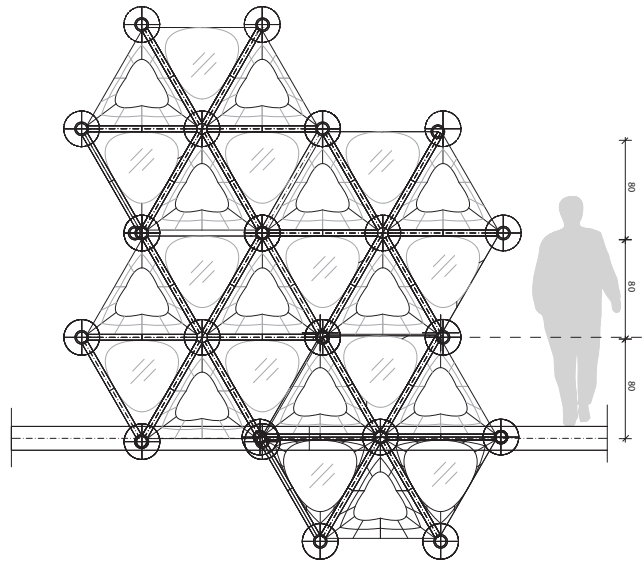


Combining the TU and TD cells to a continuous façade. The clear glass panels allow the viewer to see the continuation of the TD cells facing inwards.

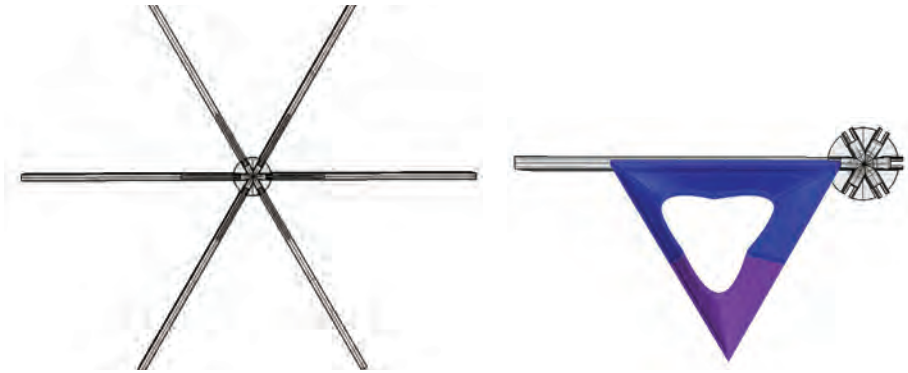
Experimenting with the option of connecting the façade to a level floor. The connection is made by steel tubes that connect to beams in the floor.



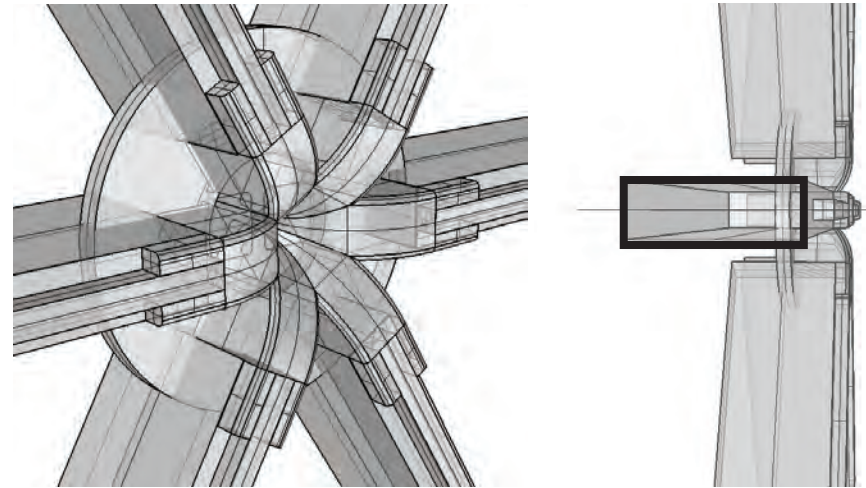
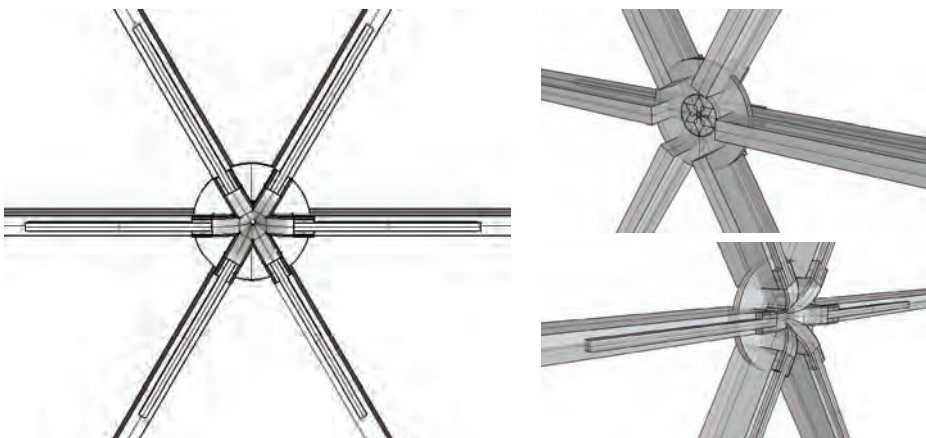
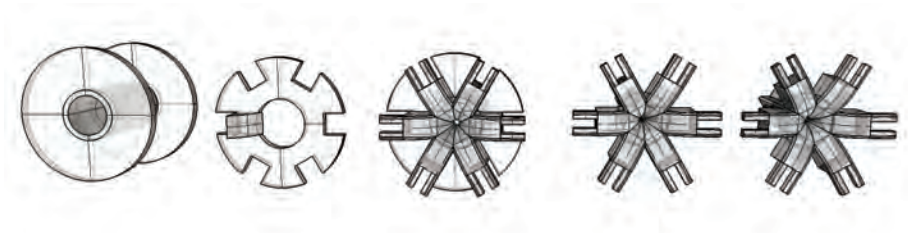




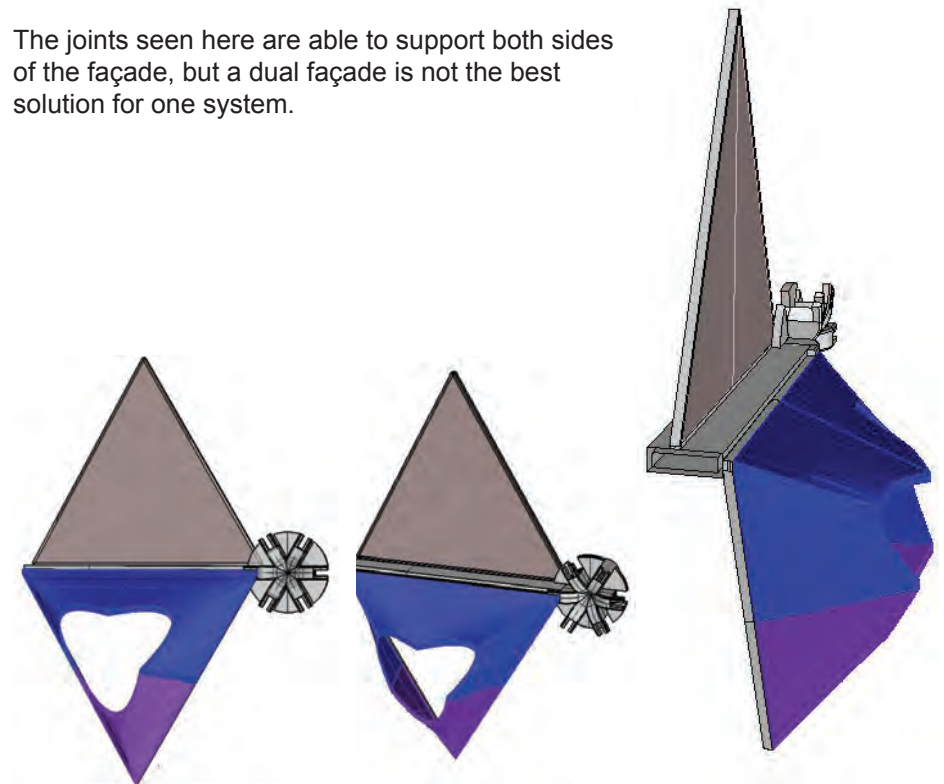
*Experimenting with joints*



Evolution of the joint from two discs to a complex system.



The joints seen here are able to support both sides of the façade, but a dual façade is not the best solution for one system.



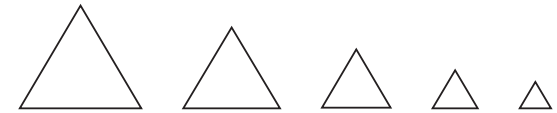
הרעיון מאחורי אופן תפקוד התא:

פיתוח תא משולש, שלו דפנות המתיישרות קדימה לכדי פתח מסוים. גודל הפתח יקבע ע"י הגדרה ביצועית דוגמת כמות התאורה הרצויה בחלל. נקודת המוצא - תאים בעלי שלוש צלעות שיתחברו יחדיו לכדי חזית אחת.

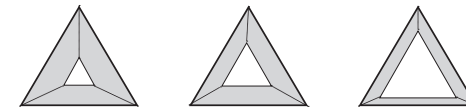
דרגות החופש האפשריות:

גודל התאים

יקבע בהתאם לפרוגרמה, יקבע על-פי רמת החשיפה הרצויה בהתאם לפונקציה הנמצאת מאחורי אזור זה בחזית המבנה.

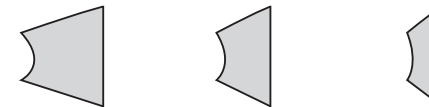


גודל פתח התא + כיוון הפניית פתח התא: יקבע על פי כמות כניסת האור הרצויה.



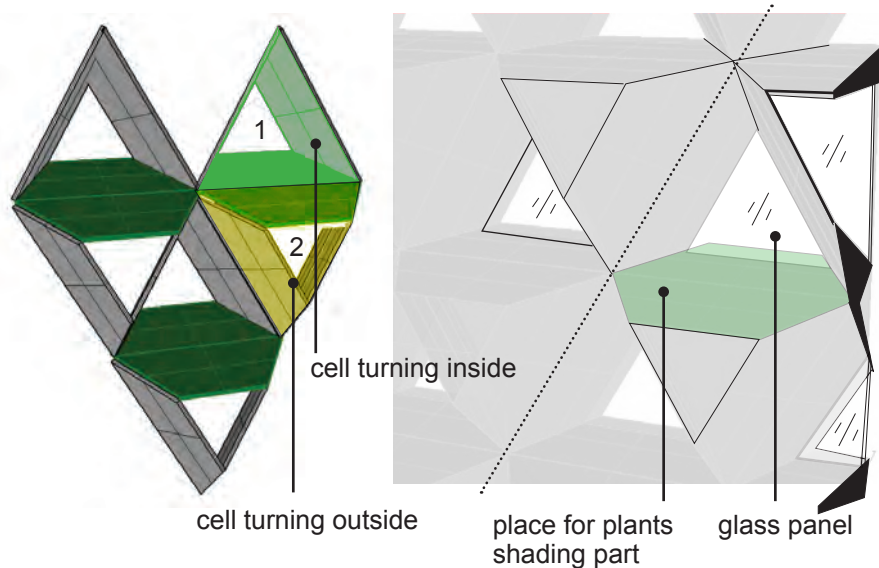
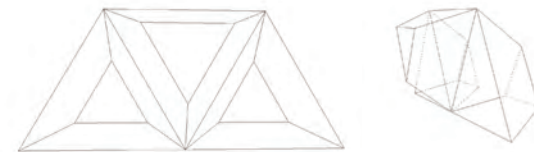
עומק התא:

יקבע על פי רמת הצללה רצויה

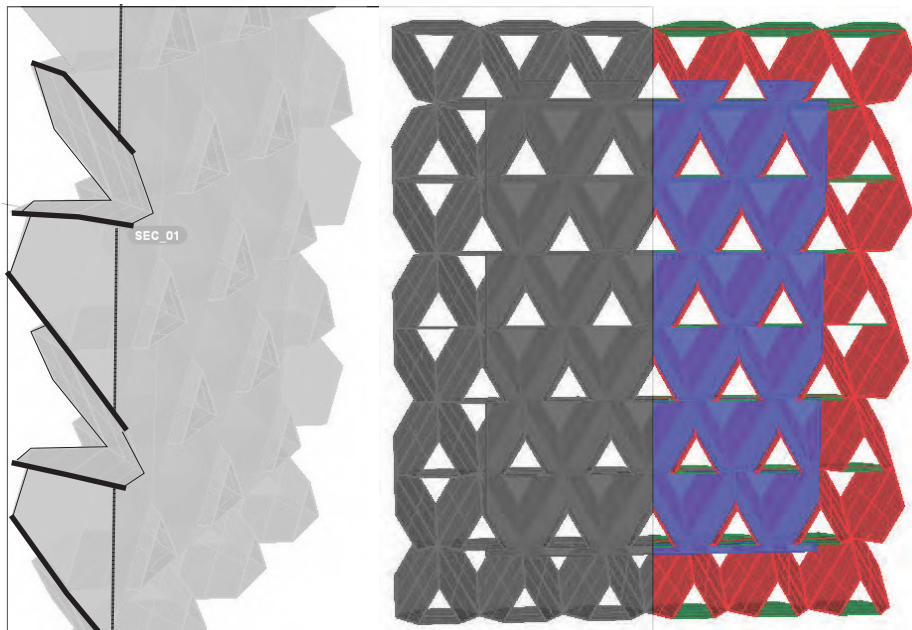


כיוון פנית התא:

חלוקה למשולשים שכנים שהם top up - 1 top down. כל משולש פונה לכיוון הנגדי לו פונה שכנו, אחת לפנים המבנה ואחד לחוץ. זאת על מנת: לשמור על יציבות החזית \* לאפשר איזון בין הפנים לחוץ \* להעמיק את חתך החזית \* לאפשר מקומות עתידיים לגידול צמחיה / ישיבה

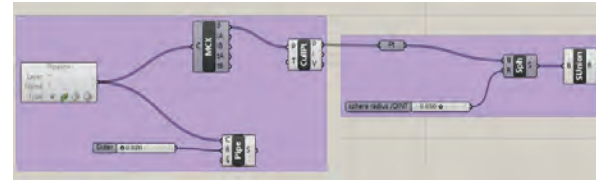
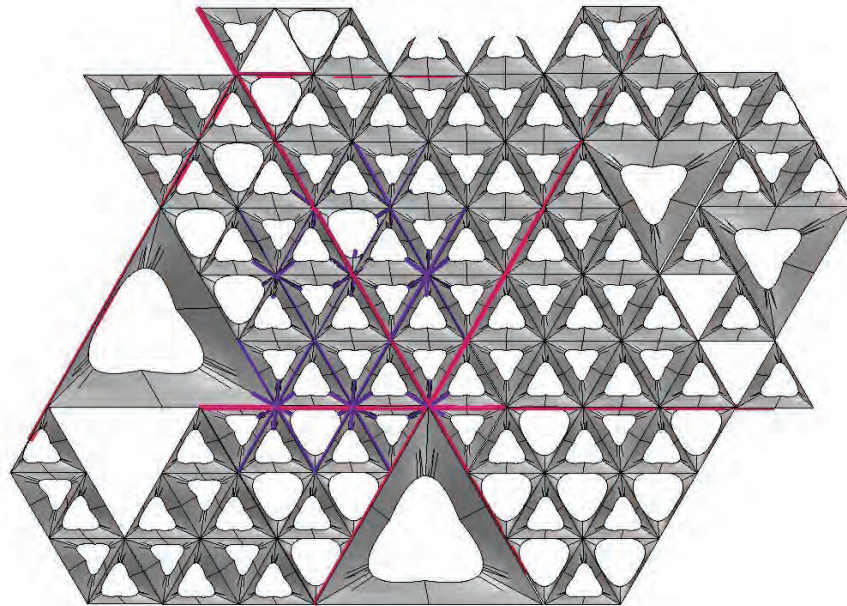


Exterminating with overlapping cells, without the separation to two different constructive systems, allowing continuation. Experiment faced difficulties concerning constructive support and finishing.

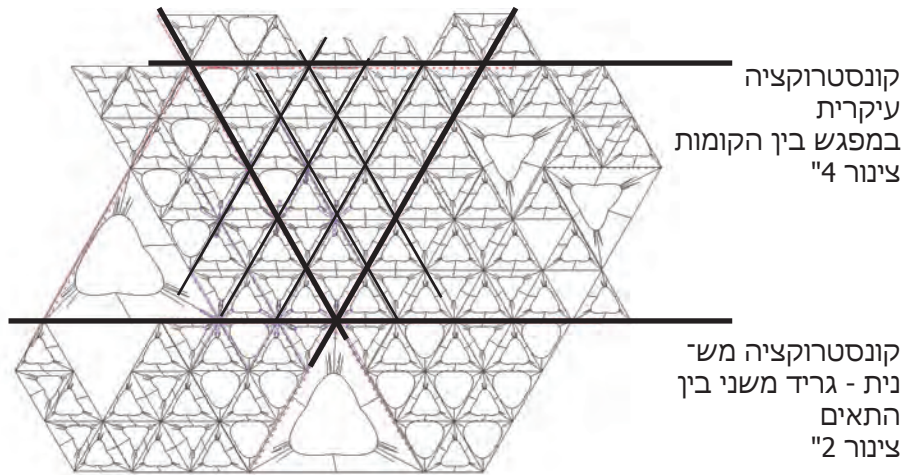
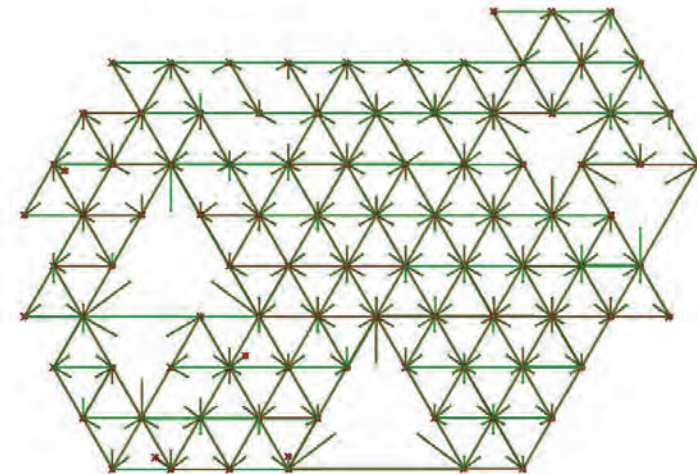
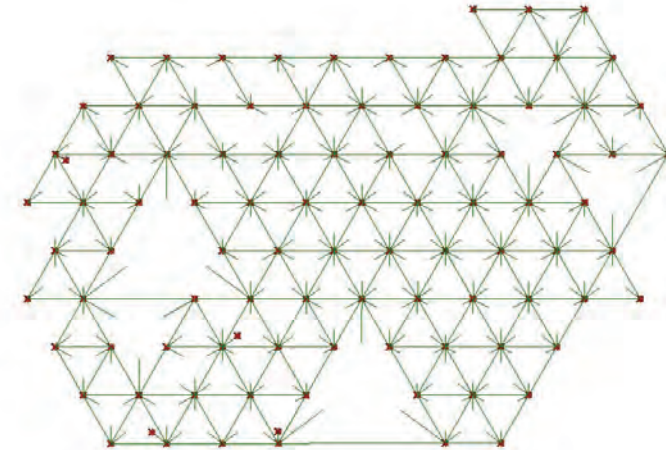


שימוש בגראסהופר על-מנת לייצר צינורות התואמים לגריד ולמפתח התאים.

המשך חיפוש אחר קונסטרוקציה ומחברים לתאים



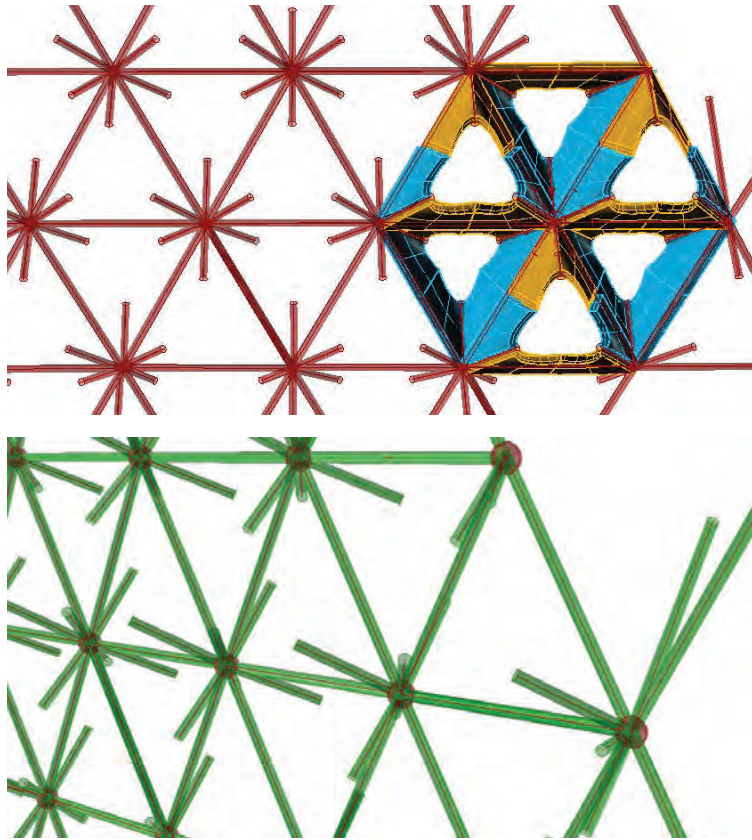
יצירת ספרה במפגש בין הצינורות  
זיהוי הקווים הנמצאים במסמך  
הפיכת הקווים לצינורות בקוטר רצוי



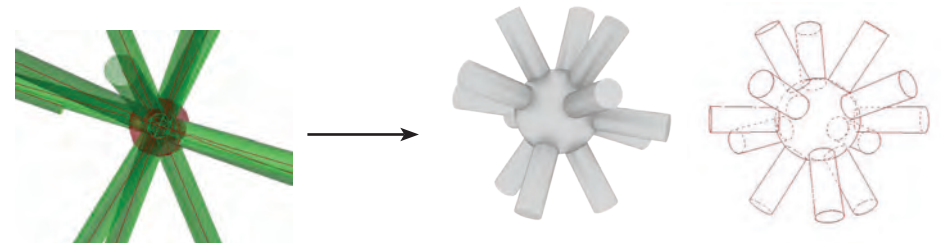
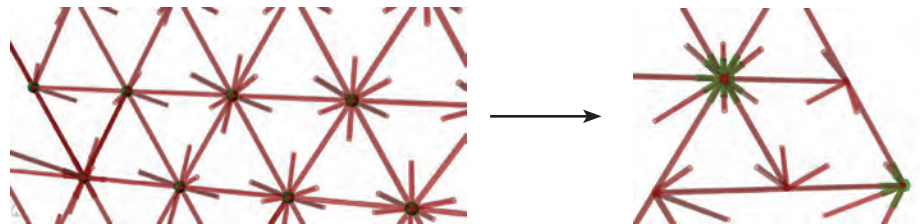
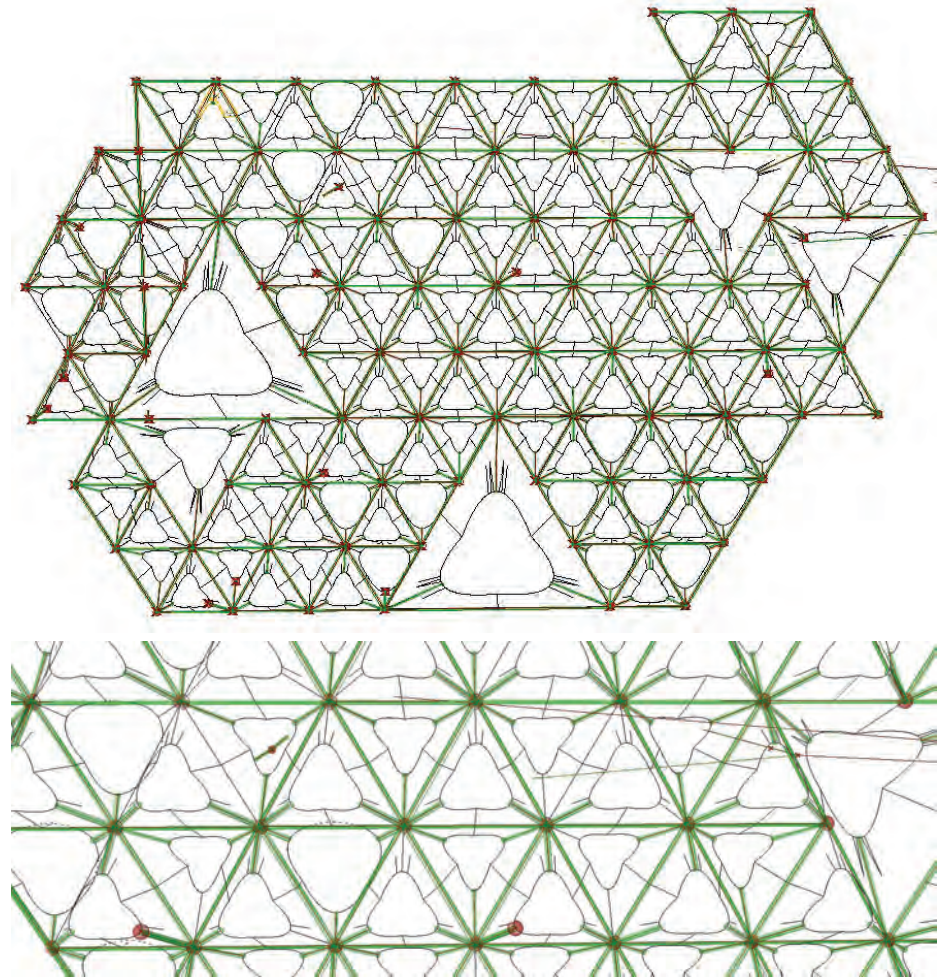
קונסטרוקציה עיקרית במפגש בין הקומות צינור "4"

קונסטרוקציה משני - נית - גריד משני בין התאים צינור "2"

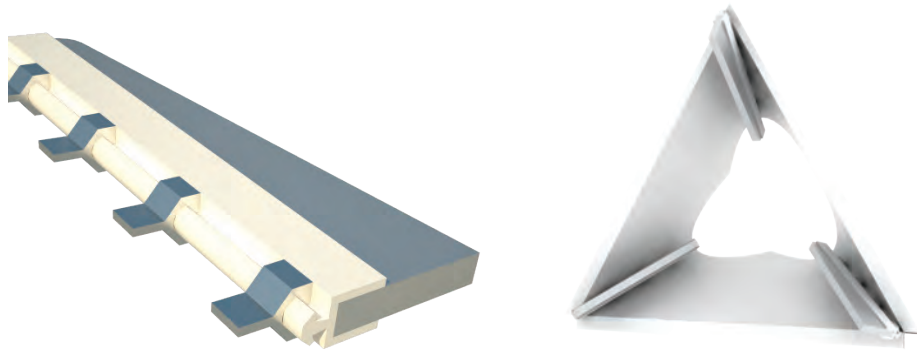
יתרונות התהליך - אפשרות לייצר מחברים בקודתיים עבור כל צומת, בהתאם לזוויות הנדרשות עבור כל תא.



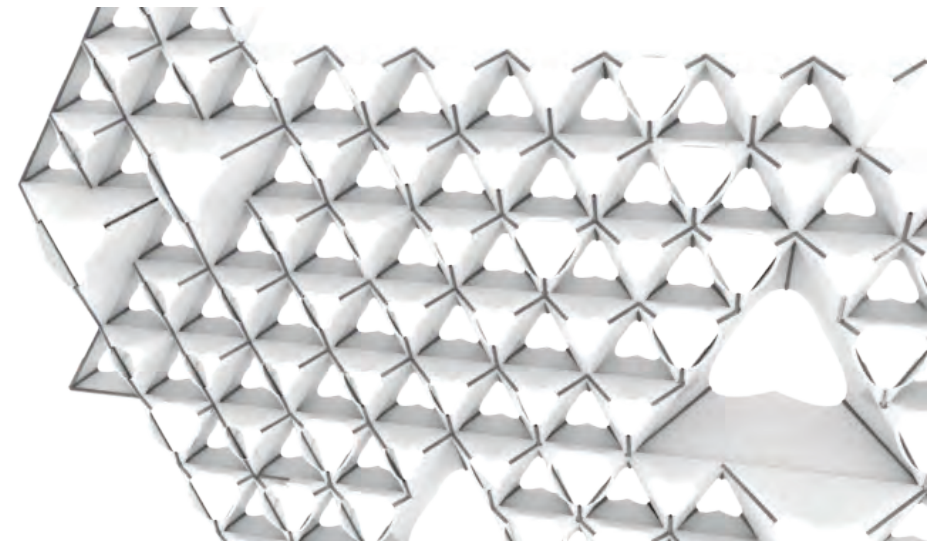
חסרונות התהליך - צמתים כדוריים ובולטים לעין, מפריטים ליצירת מרא אחד של חיבור בין התאים.



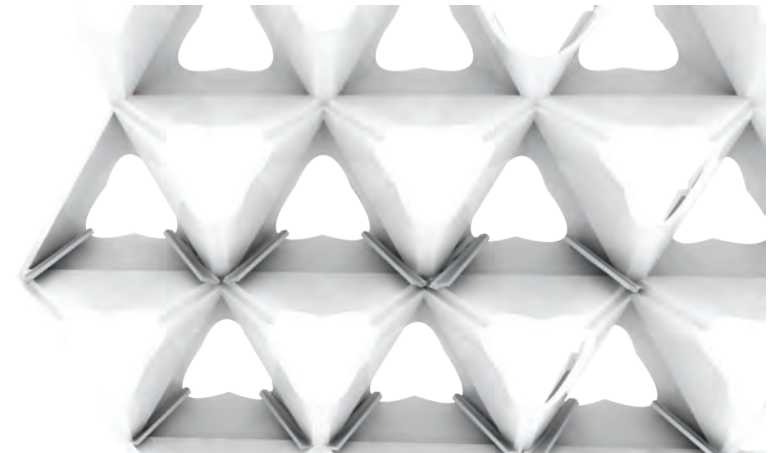
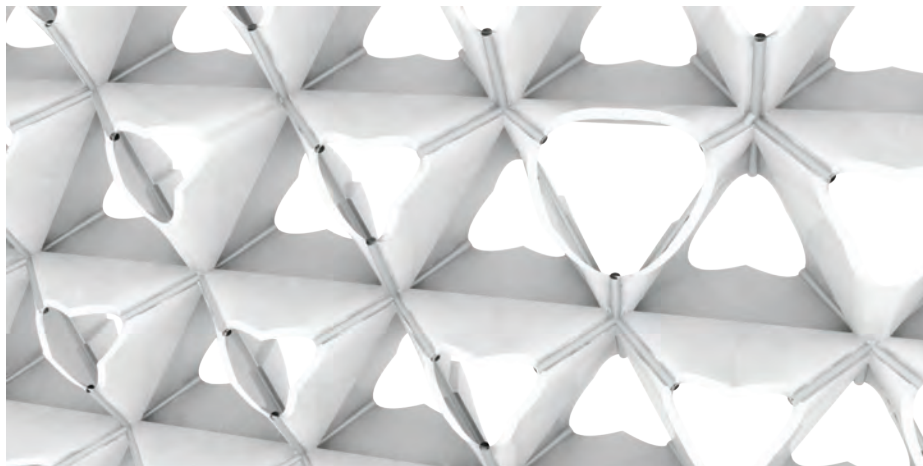
פיתוח מחבר זוויתי פנימי לתאים.

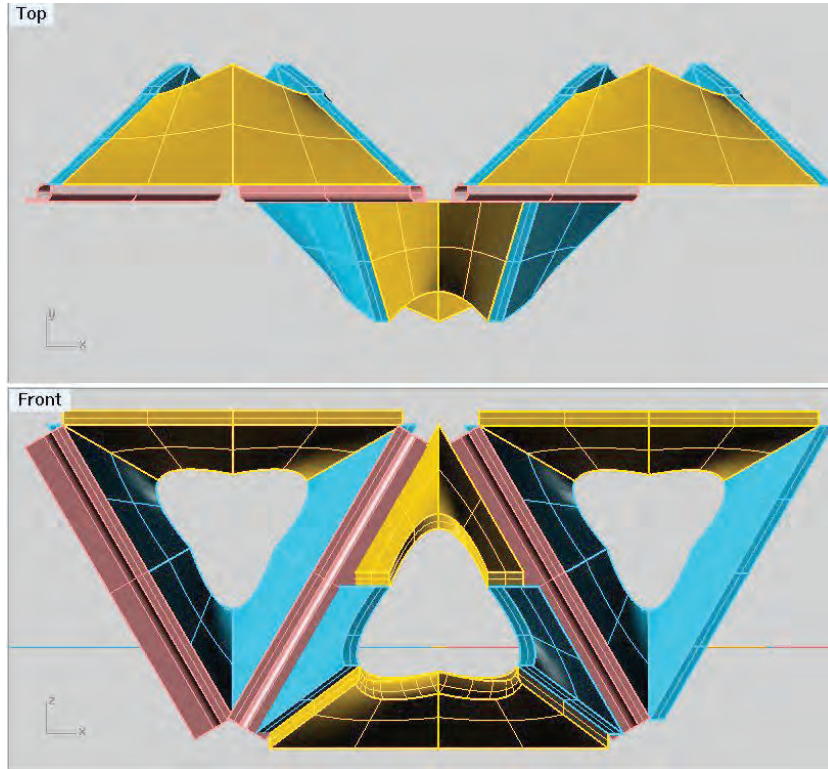


המחבר הוא מעין כנף המתיישבת בחיבור בין הפאנלים המרכיבים את התא. לאחר שולוב התאים יחדיו ה"כנפיים" יתחברו לקונסטרוקציה צינורות משנית התומכת את מסגרת התאים.

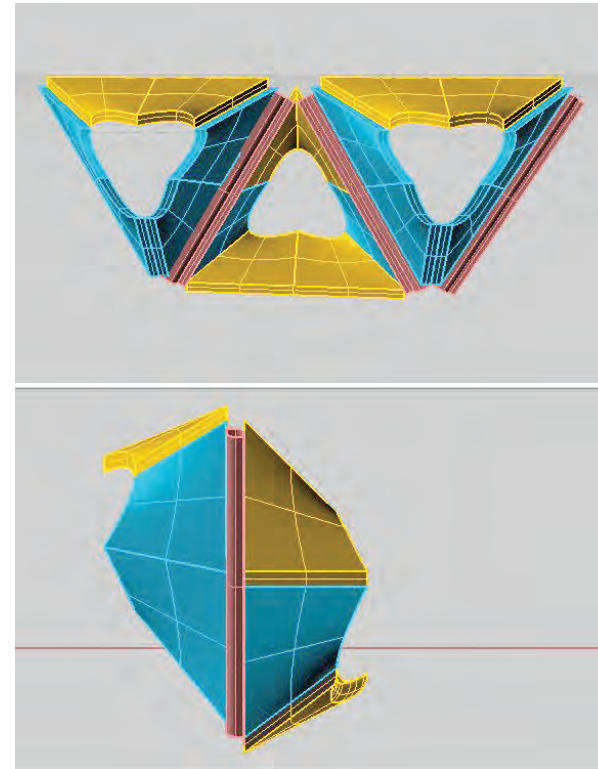
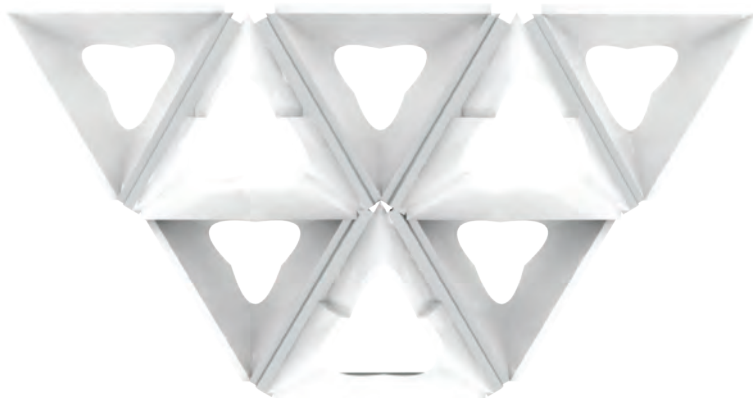


פיתוח מחבר זוויתי פנימי לתאים.  
החסרון - בולט מדי פנימה.



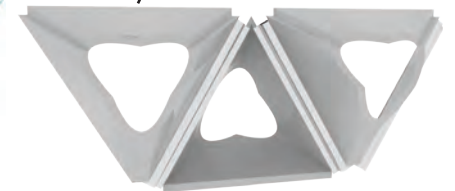
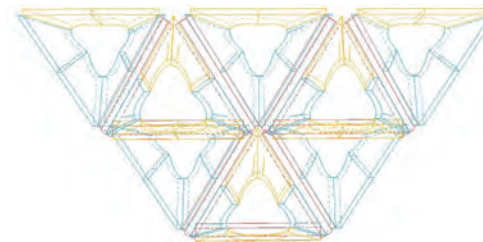
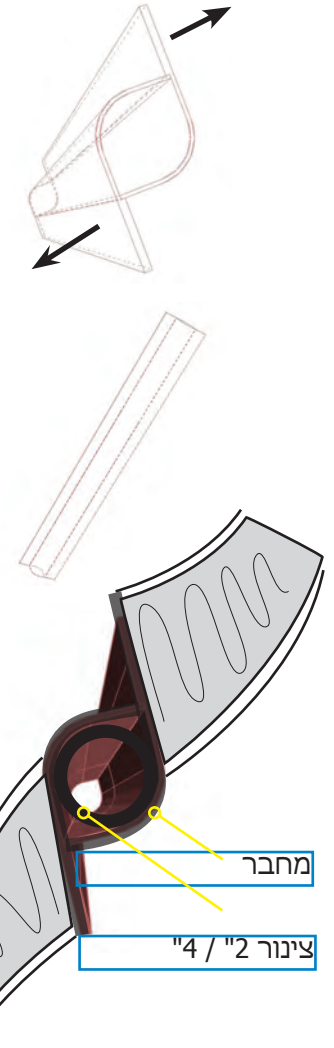


פרט חיבור זה הוא מודולרי, מתחבר לקוטר הצינור הקונסטרוקטיבי הדרוש, בנוסף מאפשר חיבור נקי מבחינה ויזואלית בין התאים.



פרט חיבור - מעטפות פלדה מכופפת העוטפות את הצינור הקונסטרוקטיבי המחבר. חיבור התאים נעשה לחלק המישורי של הפלדה

לוח חיפוי חיצוני של התא  
בידוד פנימי





conceptual inside view



facade

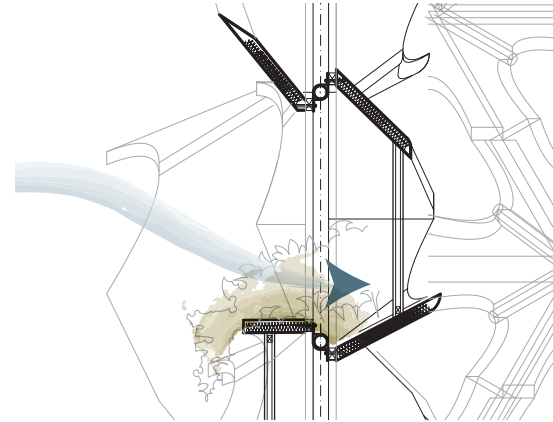
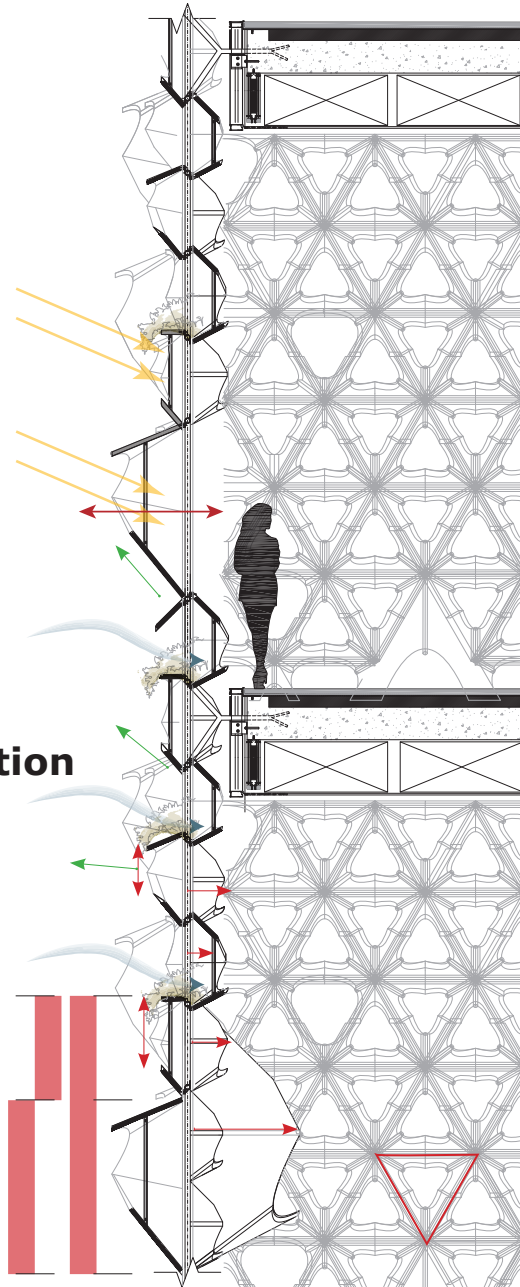
exposure to sun

cell diraction

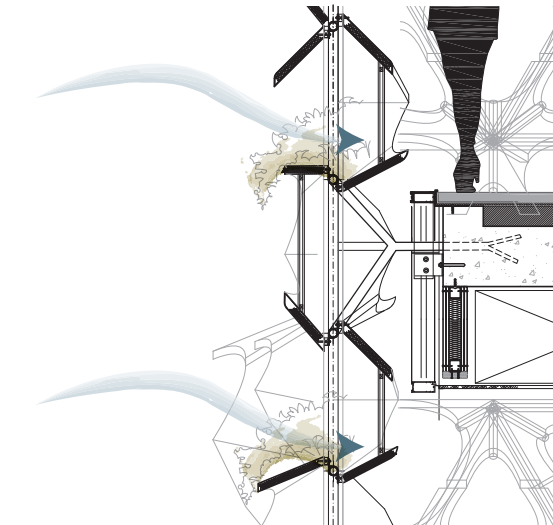
natural illumination

cell freedom degree

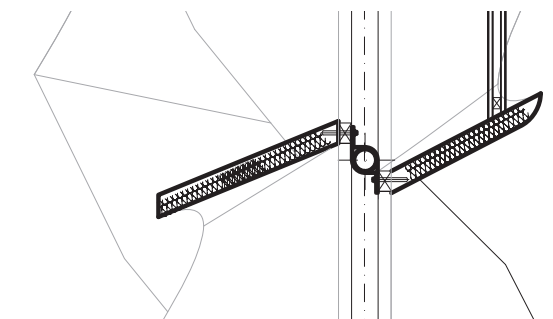
cell size



natural vantilation  
air flow



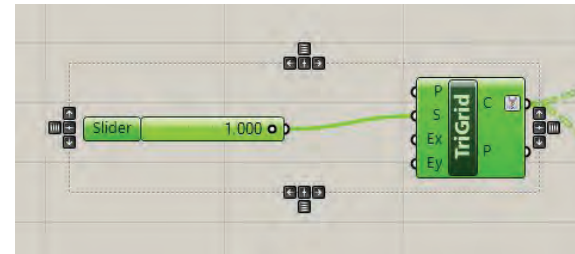
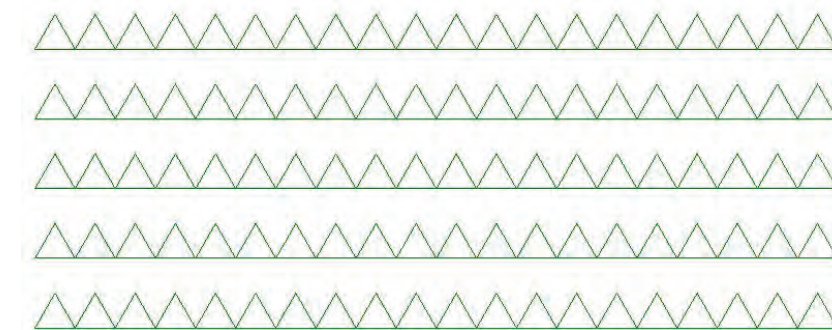
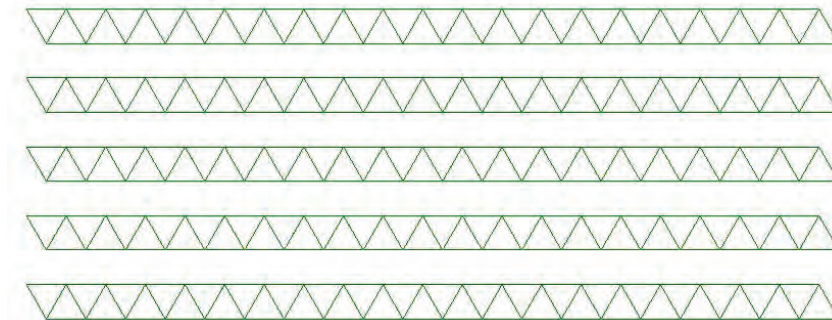
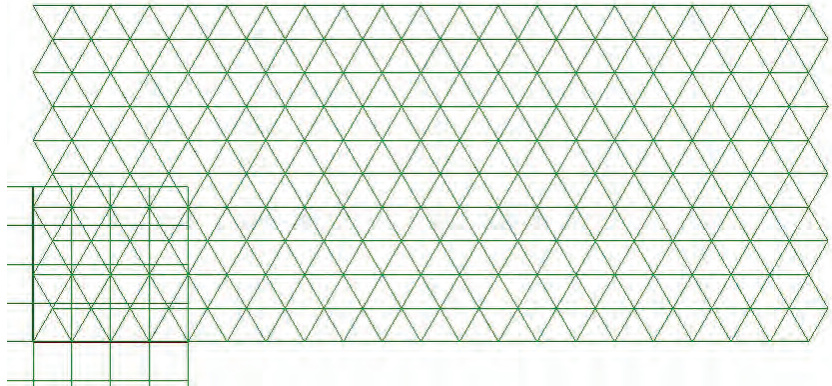
plants  
cleaning the air  
Tel aviv co2 emission



cooling?

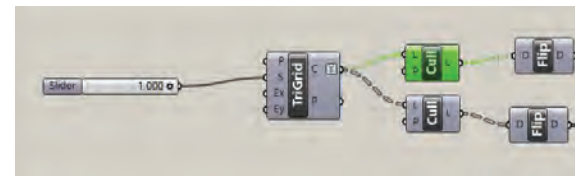
Cell opening size - preformance

פיתוח הקוד - עקרונות תחילת התהליך



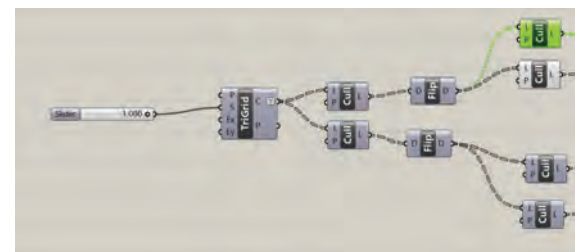
הגדרת גריד משולש, גודל יחידה אחת = 1

תחילת התהליך - הגדרת גריד משולשים



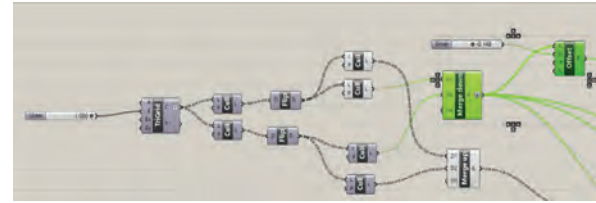
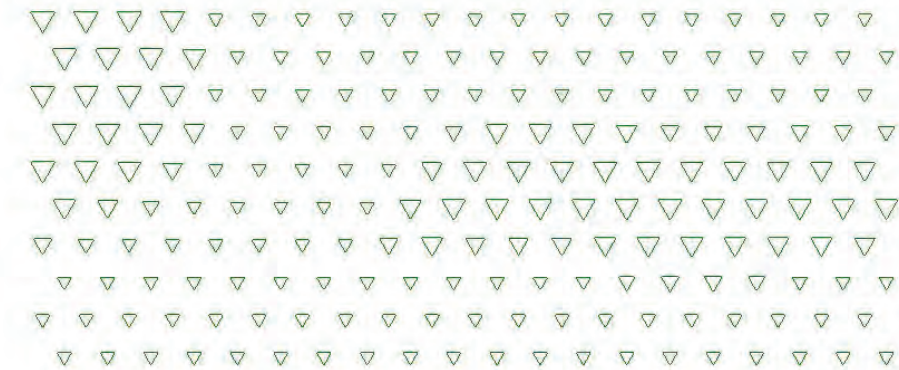
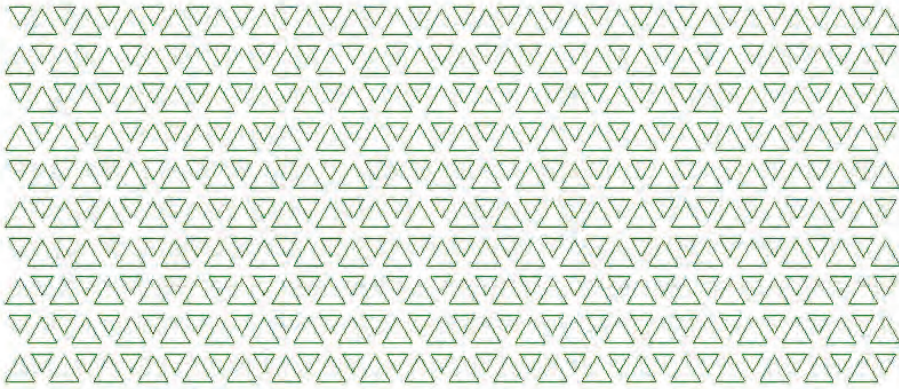
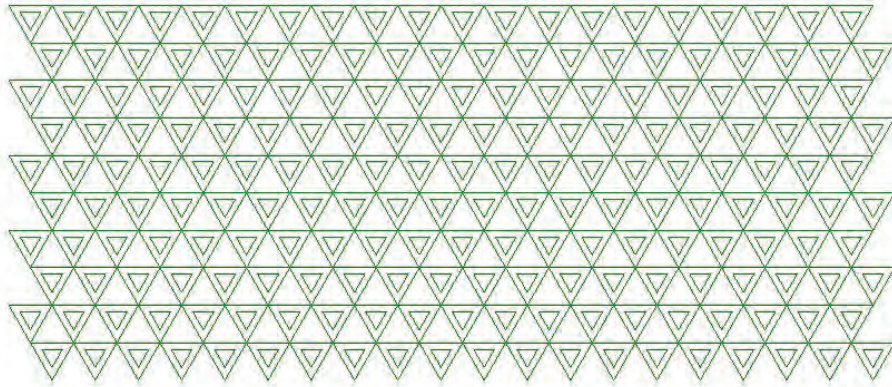
הפרדה ראשונה

על מנת להשיר את התאים הפונים מעלה לחוד, ואת התאים הפונים מטה לחוד, עלינו ליצור הפרדה בעזרת .cull pattern



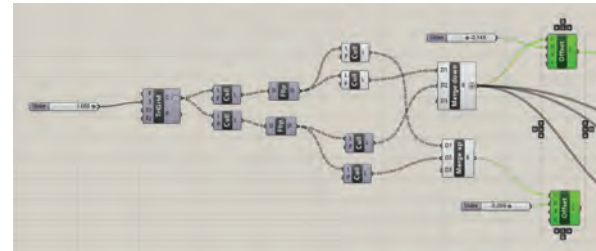
הפרדה שניה

בהמשך להפרדת השרות - הפרדת יחידות הנמצאות בכל שורה.  
cull pattern : true, false



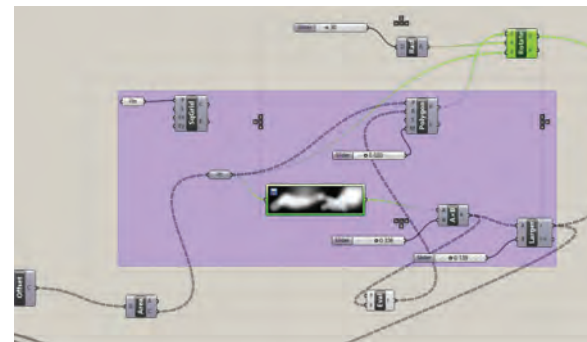
איחוד

איחוד כל המשושים הפונים מטה לקבוצה אחת. בדיקה ע"י שימוש בפקודת offset



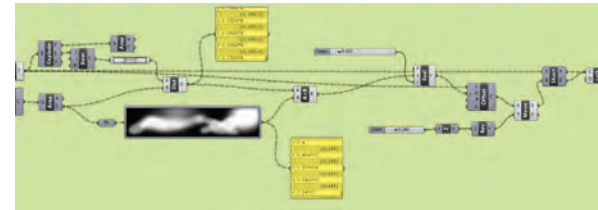
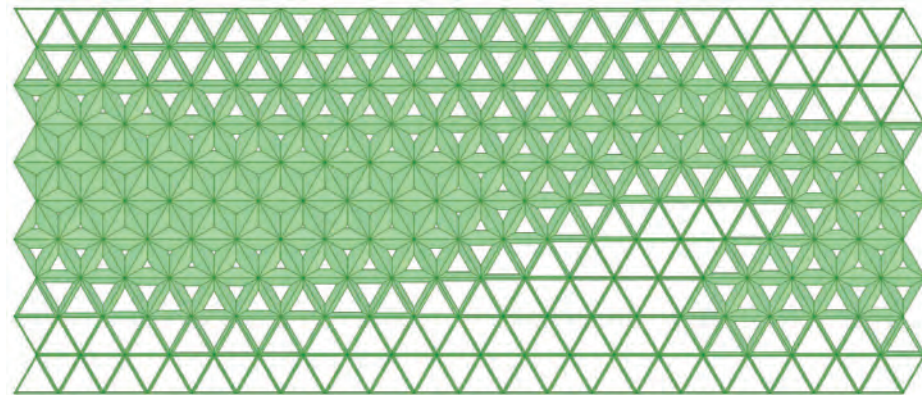
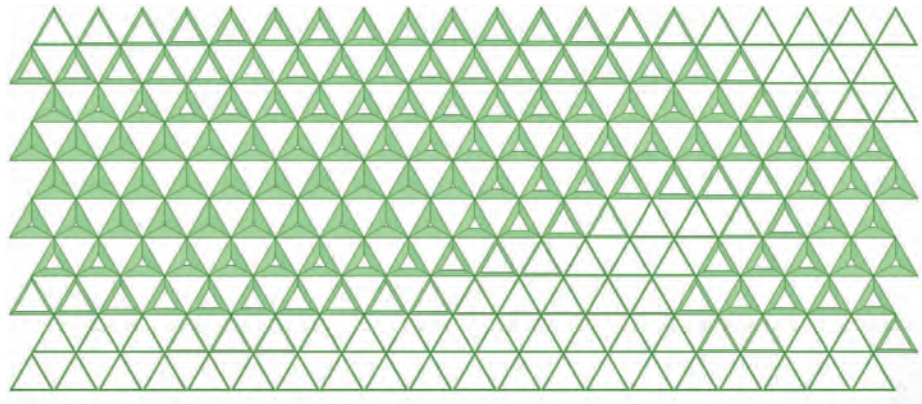
בדיקת תקינות הפרדת התאים

בשלב זה יש שתי קבוצות של תאים: אלו הפונים מעלה ואלו הפונים מטה. ניתן לצור מניפולציות על כל אחד מהתאים בנפרד.

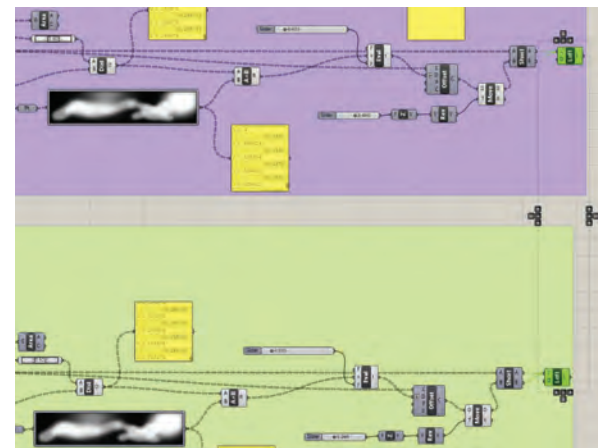


לאחר פונקציית offset: הגדרת גודל לכל אחד מהתאים בהתאם למיפוי בעזרת image sampler





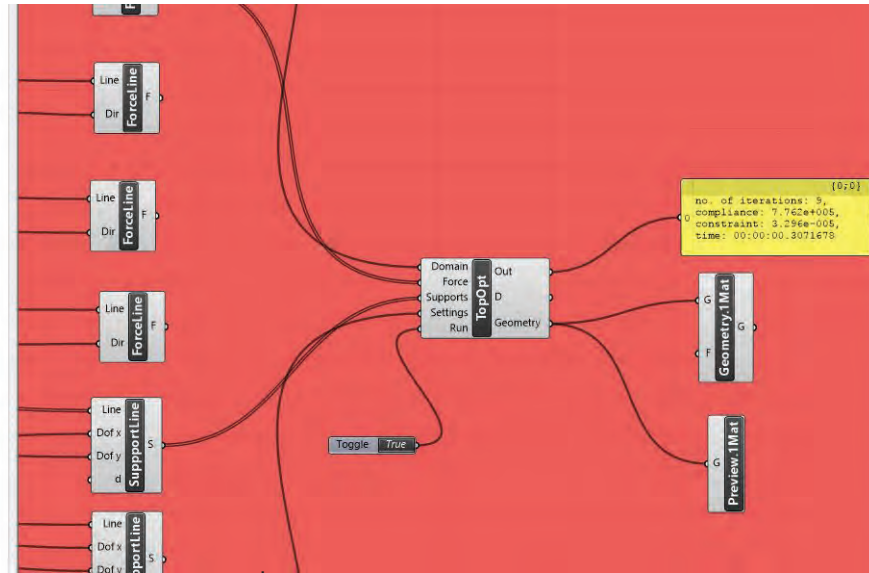
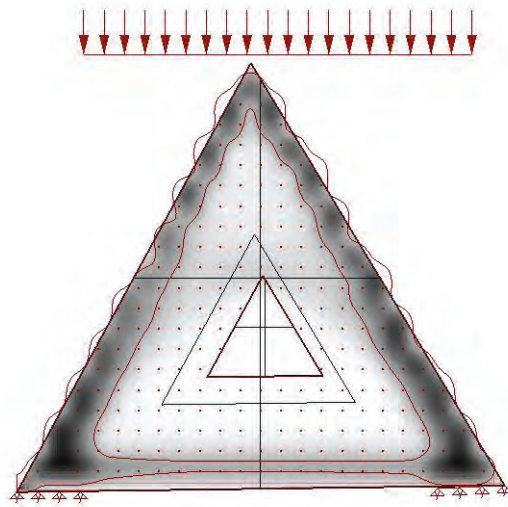
לאחר המיפוי של התאים הפנימיים, שליחת התאים הפנימיים למרחק מסוים ו loft בין תאי הגריד המקור רי המופרדים ובין התאים החדשים.



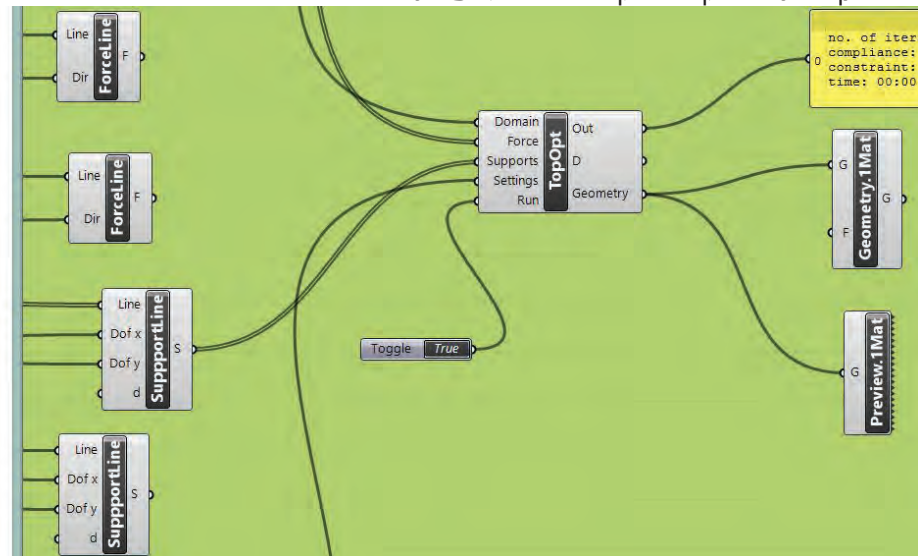
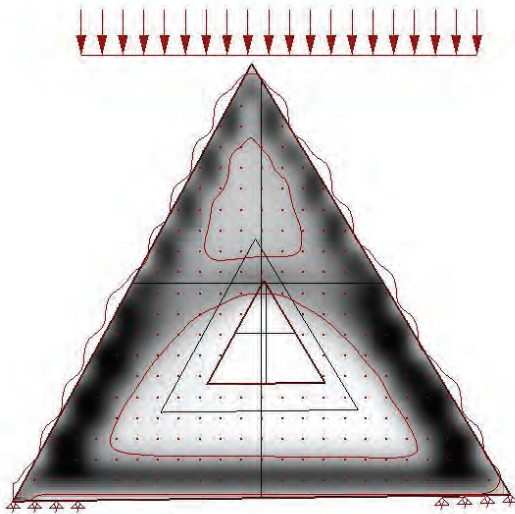
השלמה של פעילות המיפוי, offset ו Loft למקבץ המשולשים השני - הפונה מטה ופנימה.

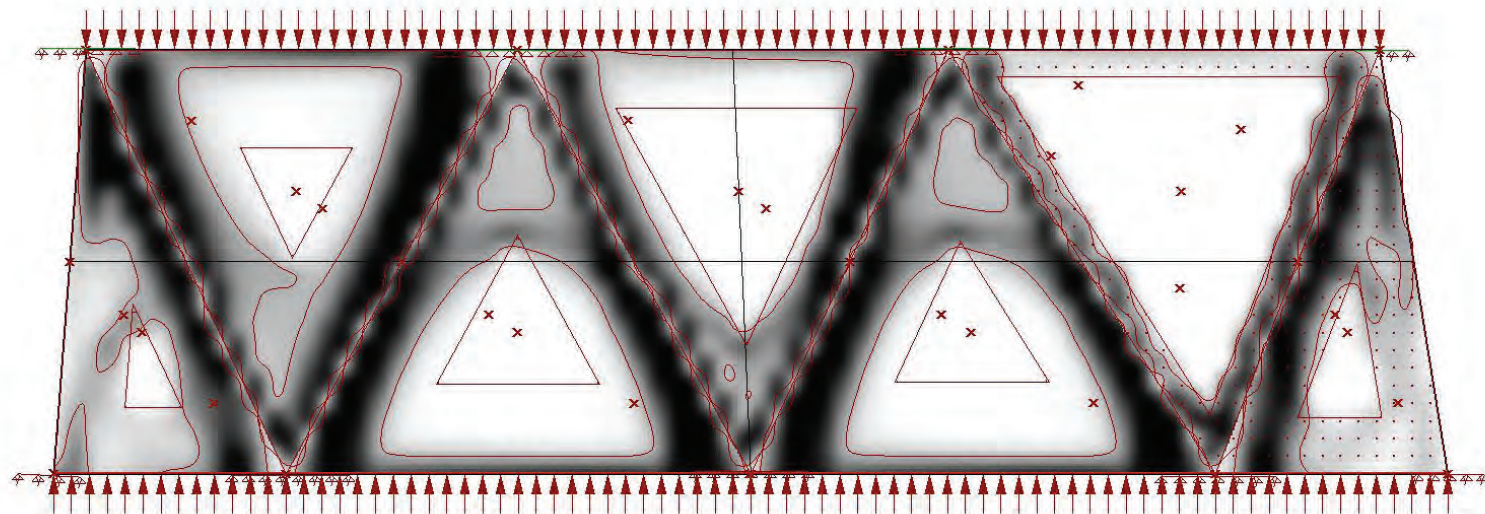
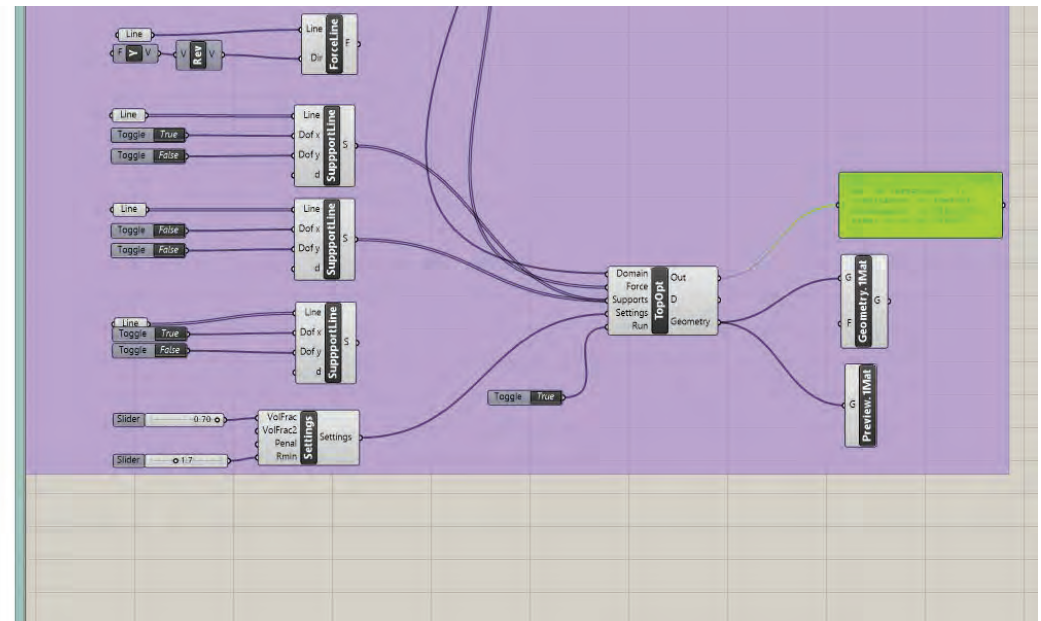
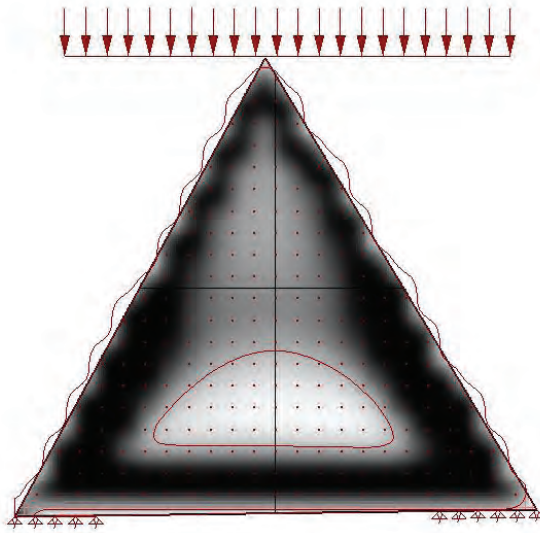
optimization

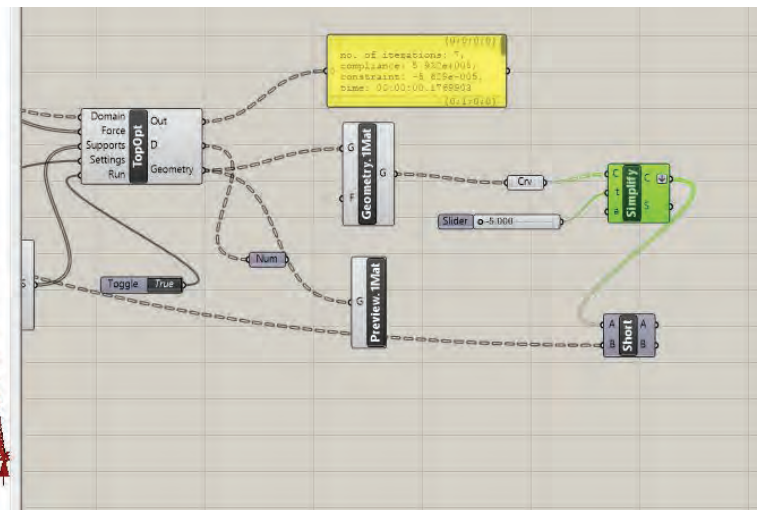
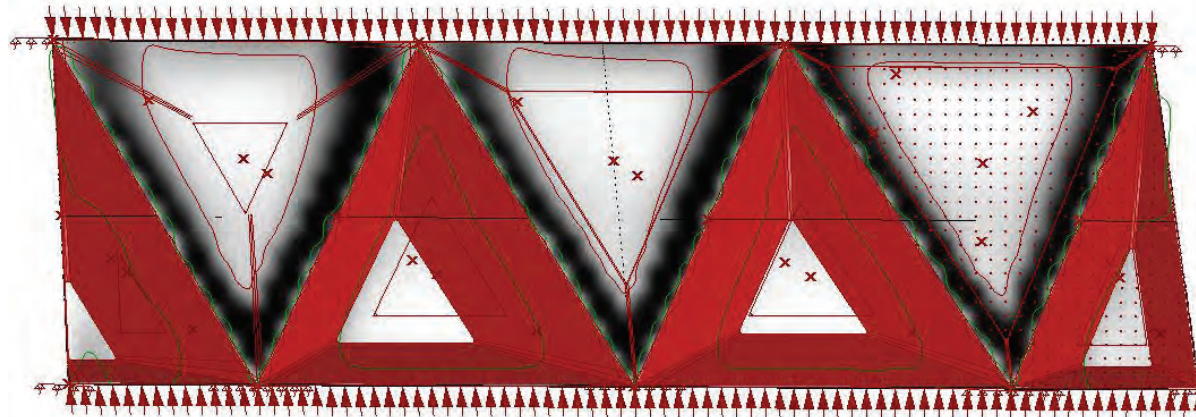
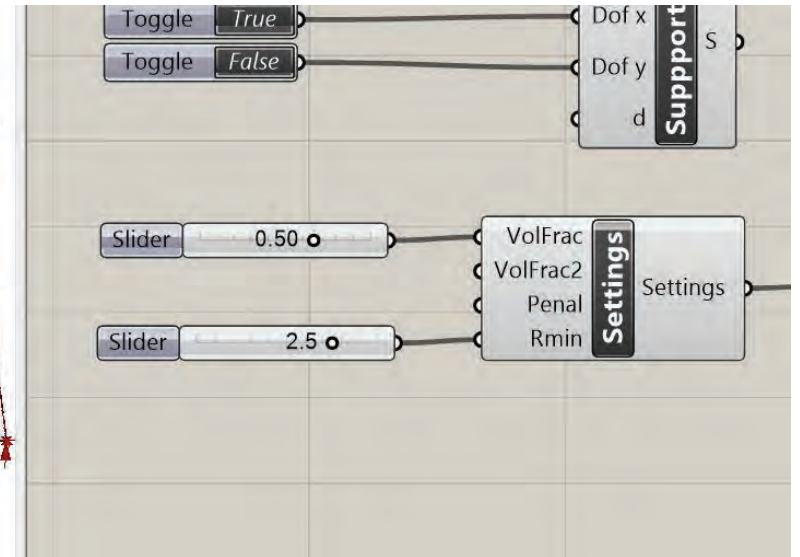
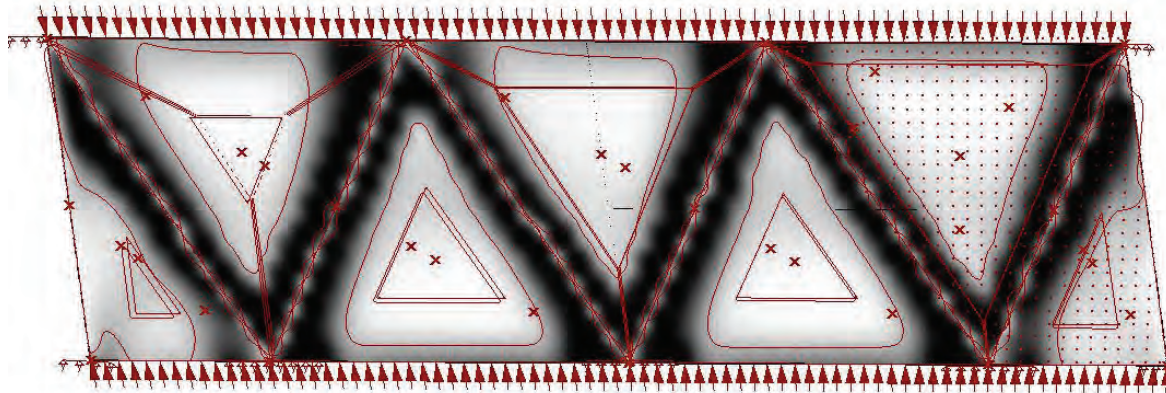
בדיקה של מעבר הכוחות בתוך תא יחיד, על מנת להבין טוב יותר את אופי זרימת הכוחות בתא.



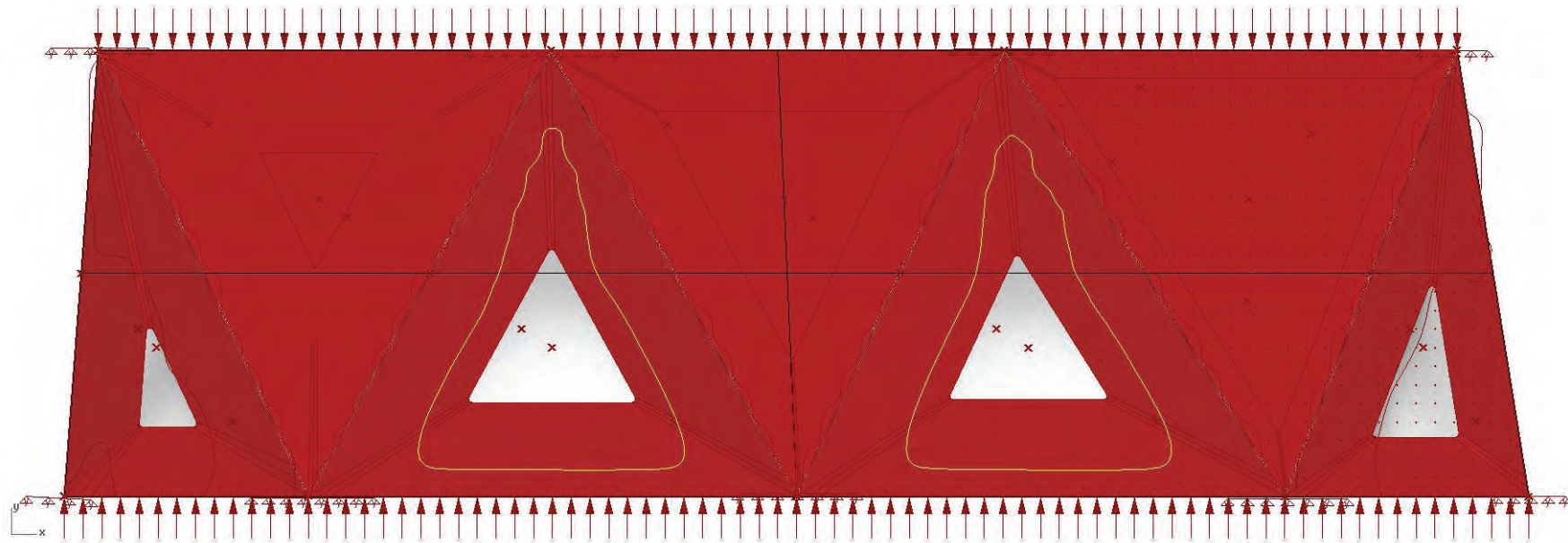
ניתן לראות כי המקום העיקרי בו זורמים הכוחות הוא דופן התא. ניתן לפרש זאת ע"י הגדלת עובי חתך התא במקום בו קיים חיבור לדפנות.



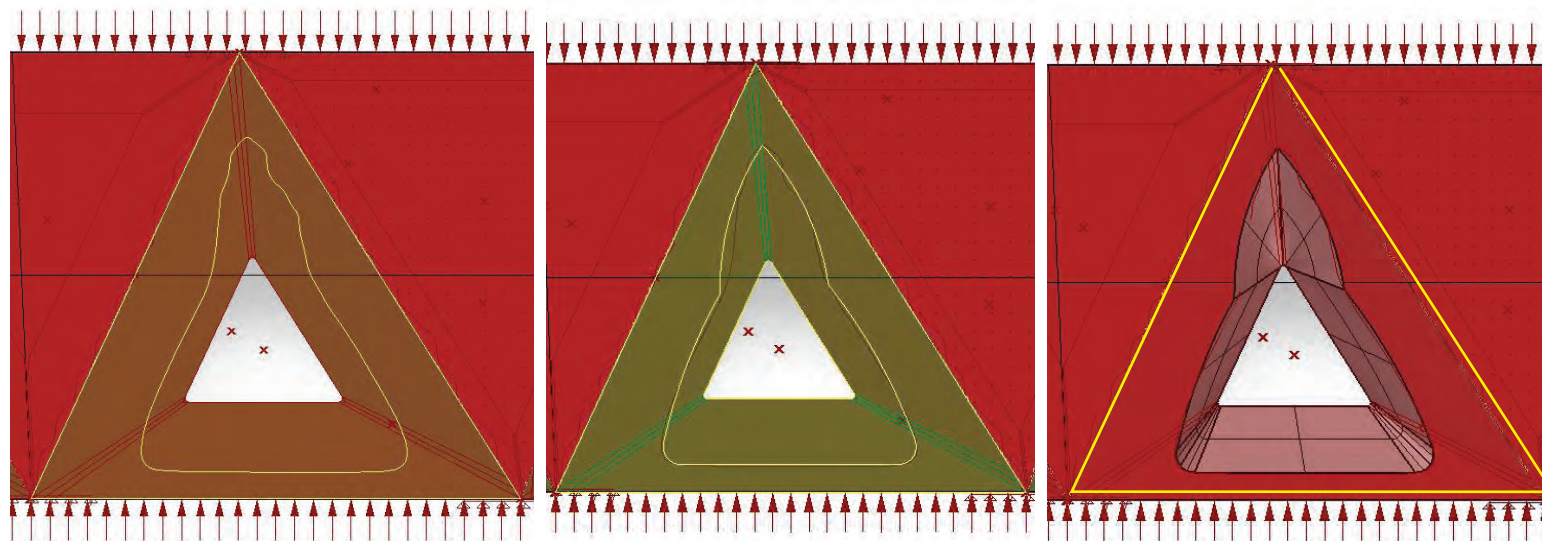


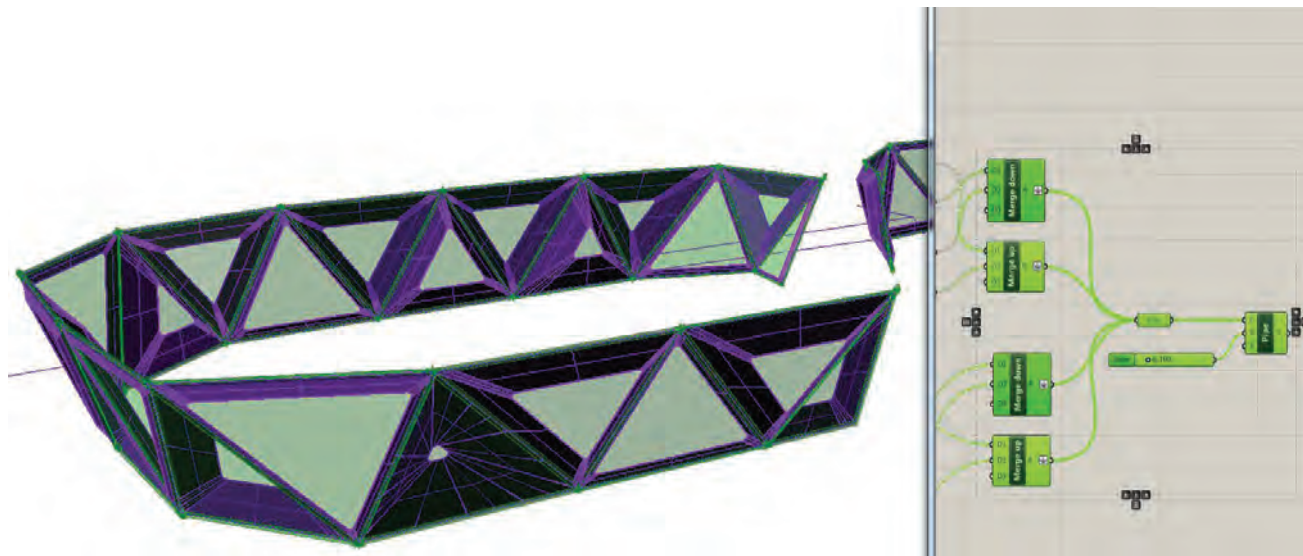
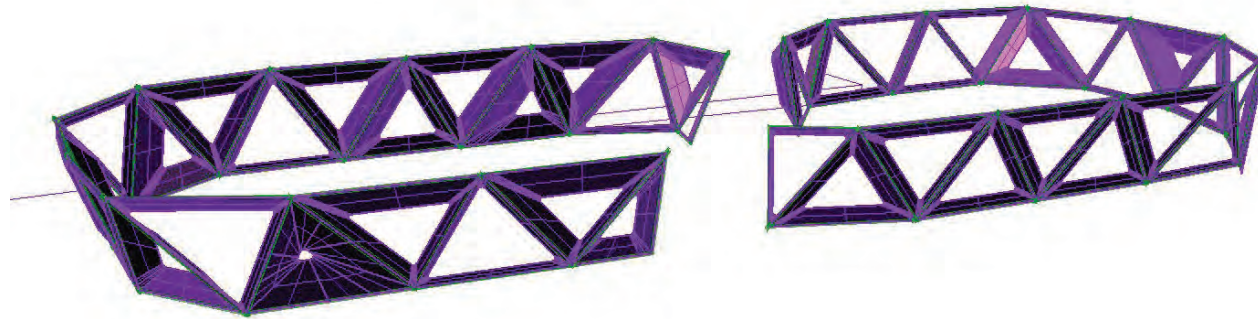


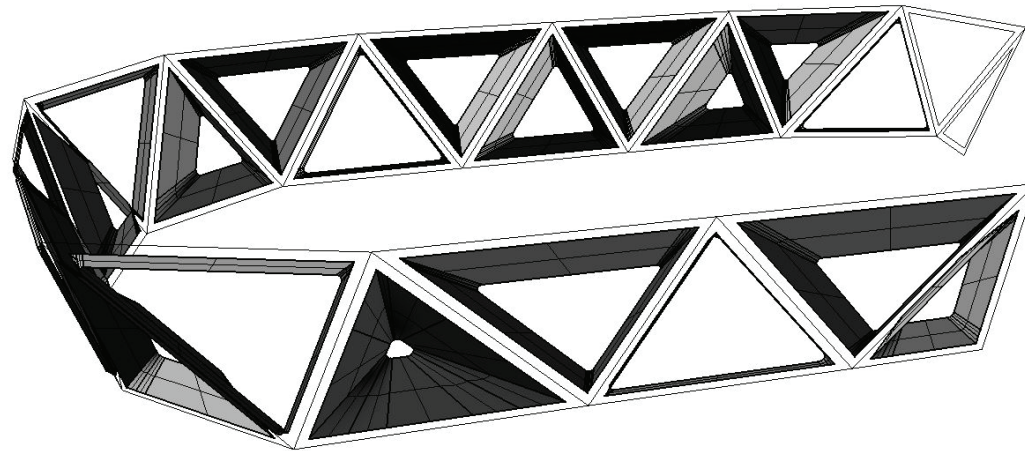
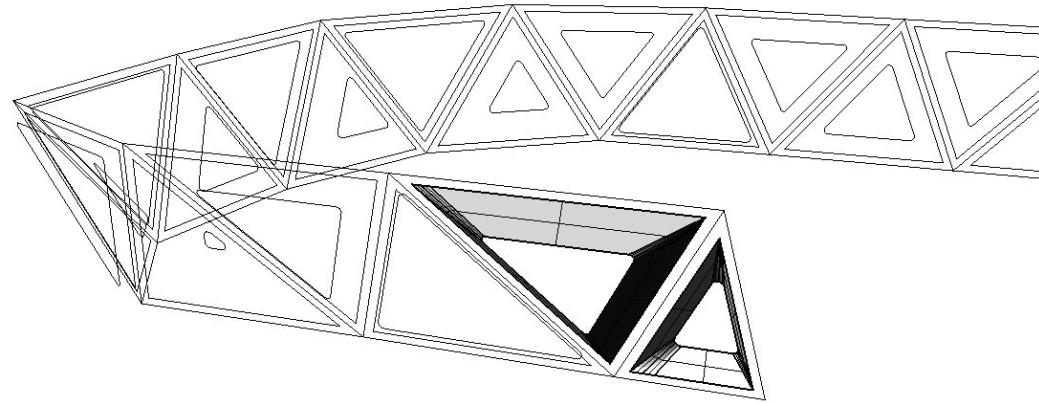


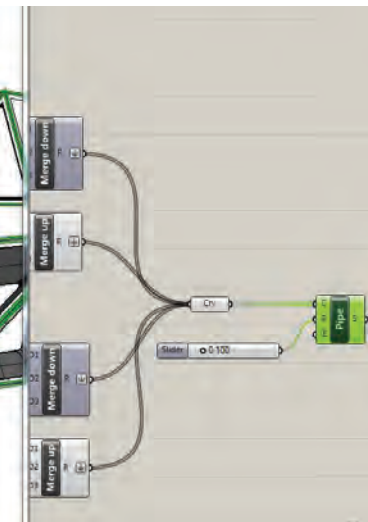
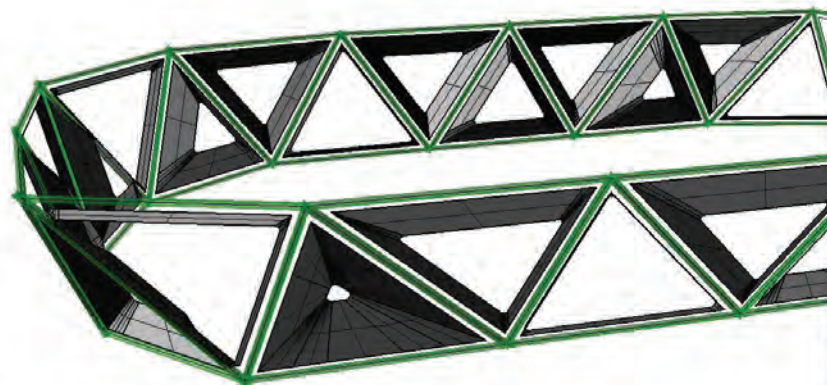
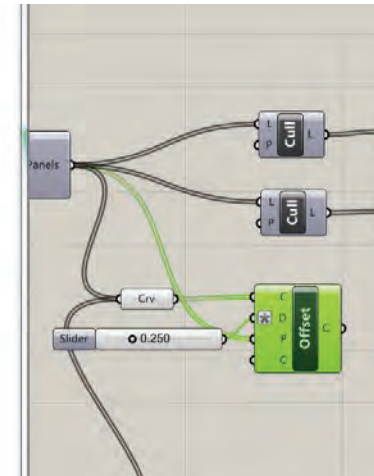
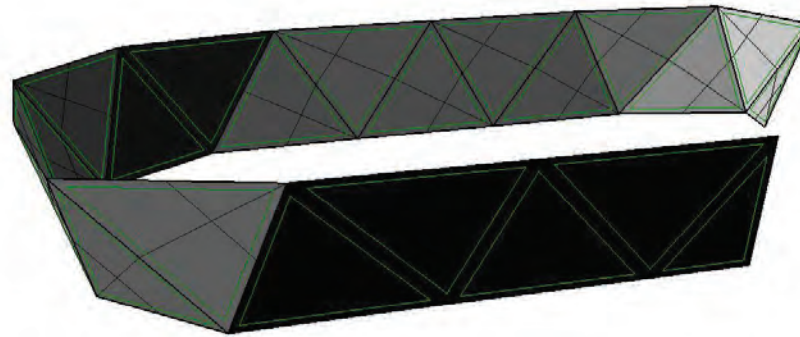


עיבוי דופן התא היושבת על קונסטרוקצית המבנה







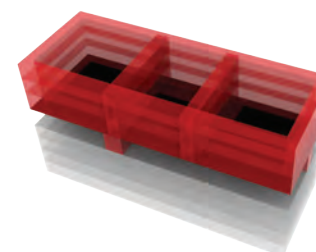


**פיתוח פרוגרמה**

המבנה הוא מבנה ציבורי השוכן באזור בו יהיה בינוי מחדש. קיימות שכונות מגורים קרובות לאזור, ולכן נקצה את הפרוגרמה למגוון אוכלוסיות החיות באזור.

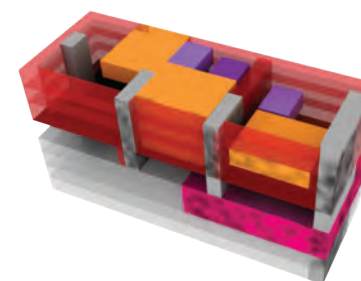
פונקציה	שטח נטו	שטח שירות	שטח כולל ליחידה	מספר יחידות	שטח כולל נטו	שטח כולל לשירות	שטח ברוטו	אחוז שירות משטח נטו
גן ילדים	100	80	180	2	200	160	360	80.0%
חדרי חוגים א	40	8	48	3	120	24	144	20.0%
חדרי חוגים ב'	30	6	36	3	90	18	108	20.0%
אולם מחול	150	30	180	5	750	150	900	20.0%
חדר ספורט רב תכליתי	150	30	180	2	300	60	360	20.0%
אולם רב תכליתי	700	300	1000	1	700	300	1000	42.9%
מלתחות	76		76	4	304	0	304	0.0%
שירותים	1.5	0.5	2	32	48	16	64	33.3%
ספרייה מולטימדיה	500	150	650	1	500	150	650	30.0%
גלריה	150	50	200	1	150	50	200	33.3%
משרדים	12	4	16	8	96	32	128	33.3%
אולם קבלה	100		100	1	100	0	100	0.0%
גלדריה	25	15	40	1	25	15	40	60.0%
בית קפה	120	24	144	1	120	24	144	20.0%
סה"כ					3503	999	4502	28.52%
מתוך					3840	1152	4992	30.00%
נשאר עוד					337	153	490	

נסיונות להרכבת פרוגרמה גושנית, על מנת להבין את מימדי הבנין.



מערכת תנועה היקפית

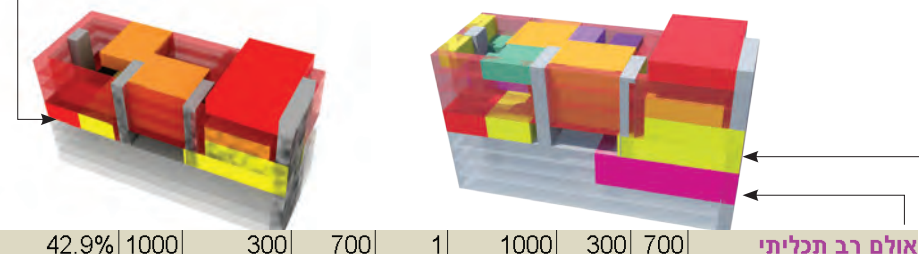
20.0%	144	24	120	3	48	8	40	חדרי חוגים א
20.0%	108	18	90	3	36	6	30	חדרי חוגים ב'
20.0%	900	150	750	5	180	30	150	אולם מחול
20.0%	360	60	300	2	180	30	150	חדר ספורט רב תכליתי



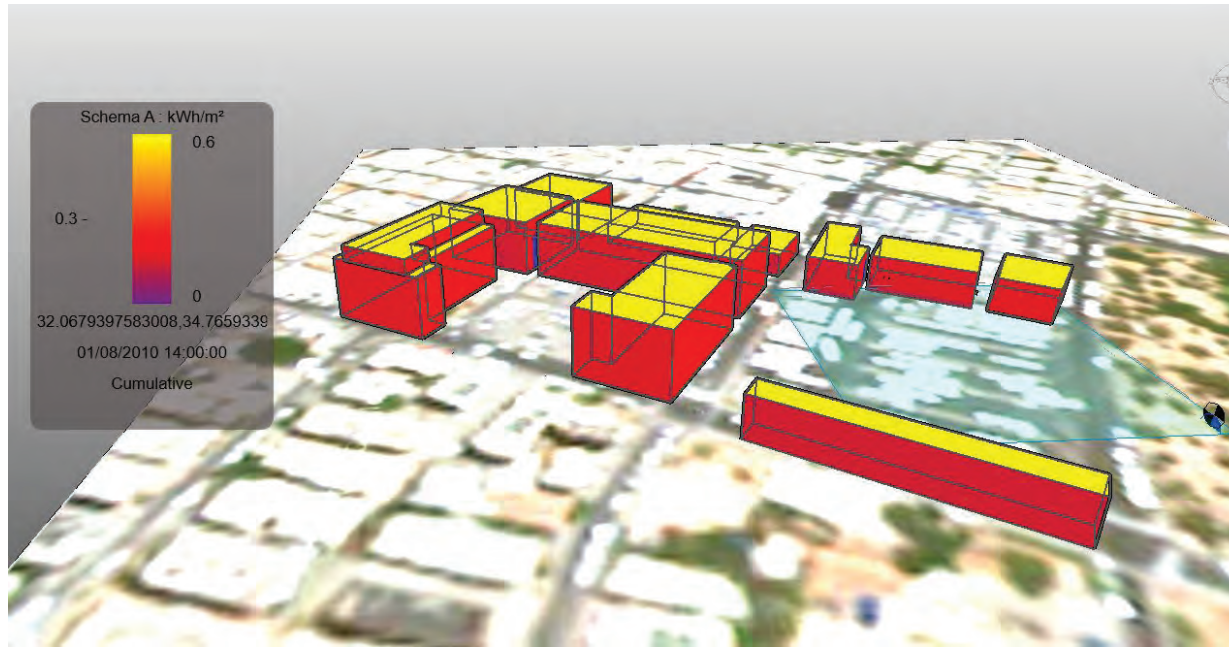
האולמות הגדולים - שוכנים בין מערכות התנועה.

30.0%	650	150	500	1	650	150	500	ספרייה מולטימדיה
33.3%	200	50	150	1	200	50	150	גלריה
33.3%	128	32	96	8	16	4	12	משרדים
0.0%	100	0	100	1	100		100	אולם קבלה
60.0%	40	15	25	1	40	15	25	גלדריה
20.0%	144	24	120	1	144	24	120	בית קפה

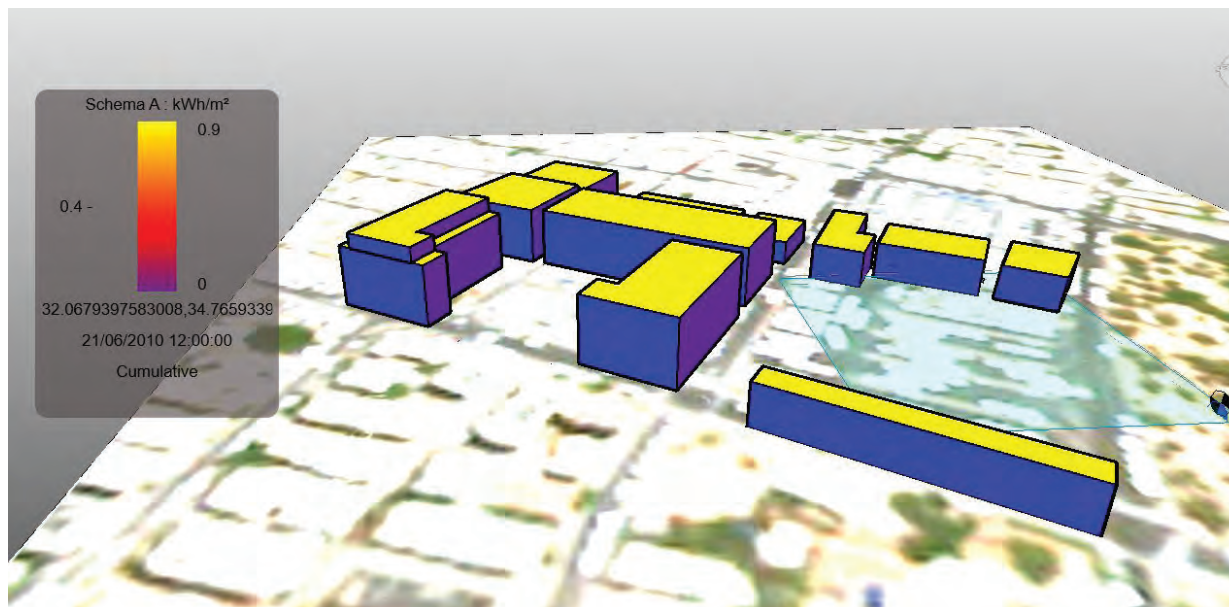
הפונקציות הציבוריות - בעיקר בקומה התחתונה



42.9%	1000	300	700	1	1000	300	700	אולם רב תכליתי
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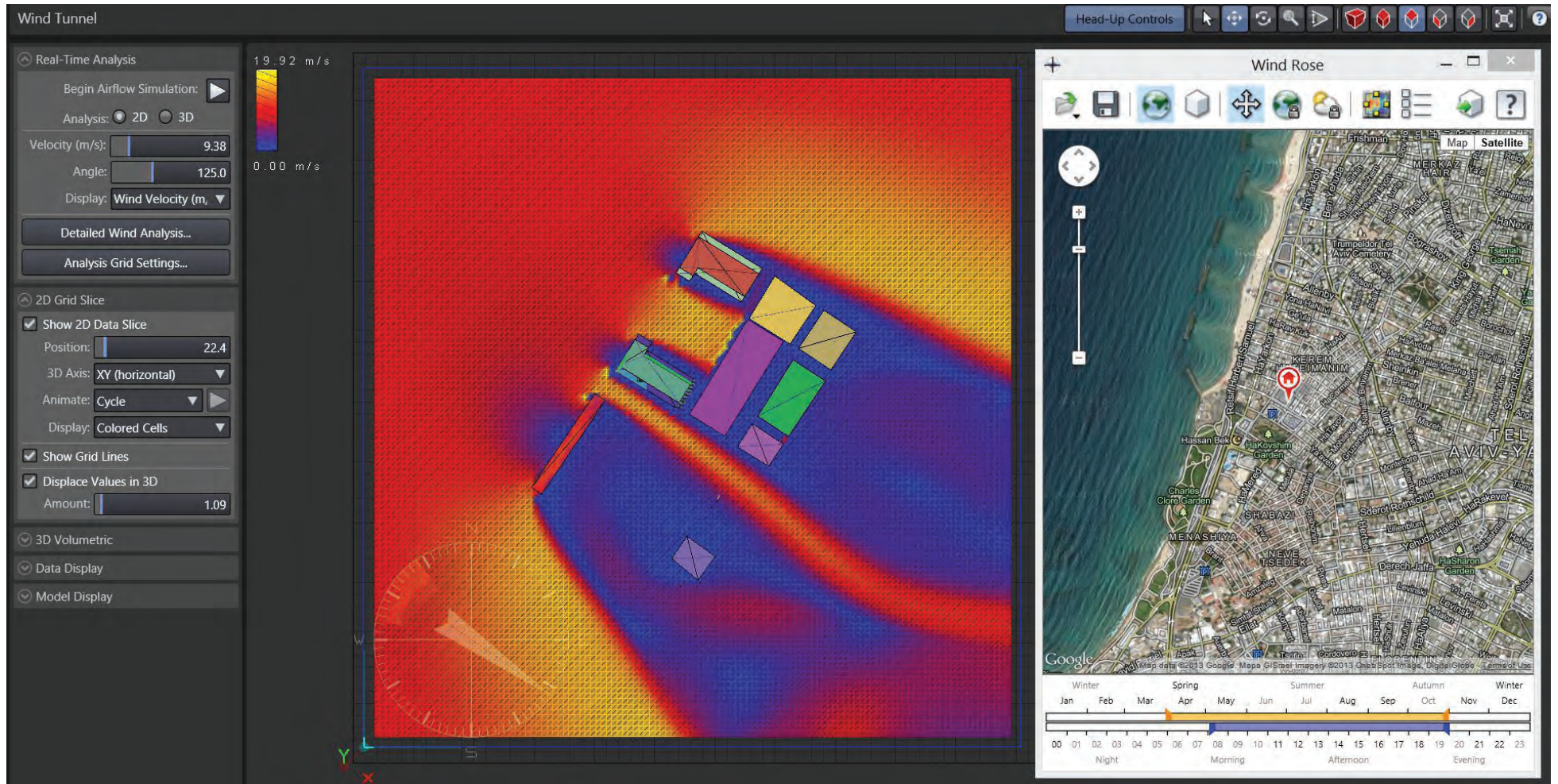
יום נבחר באמצע אוגוסט, שעה 14:00



21 ביוני, שעה 12:00

wind tunnel

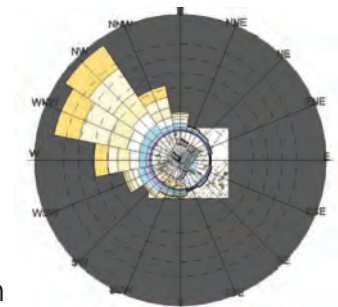
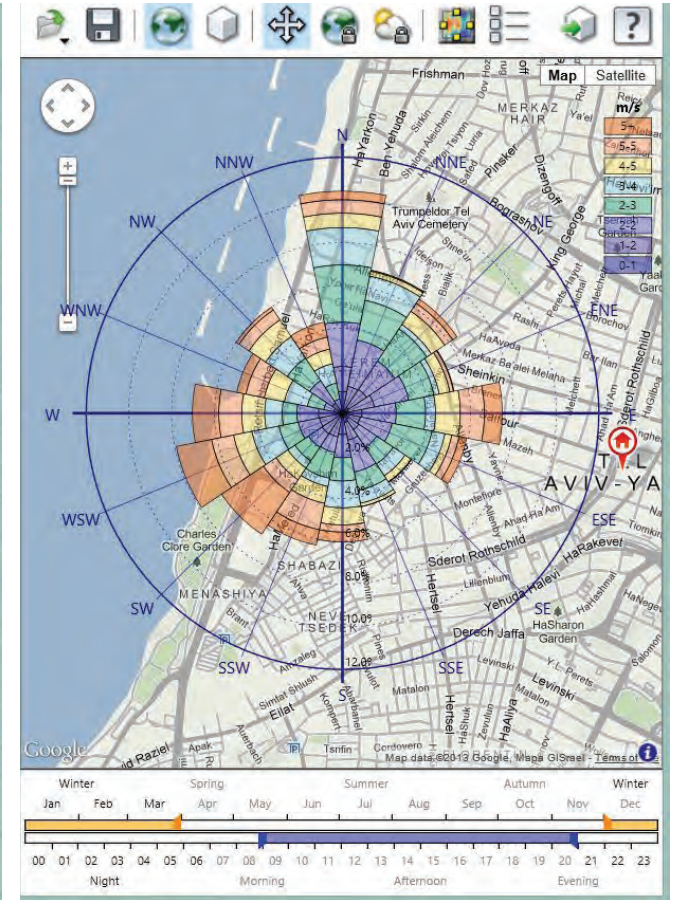
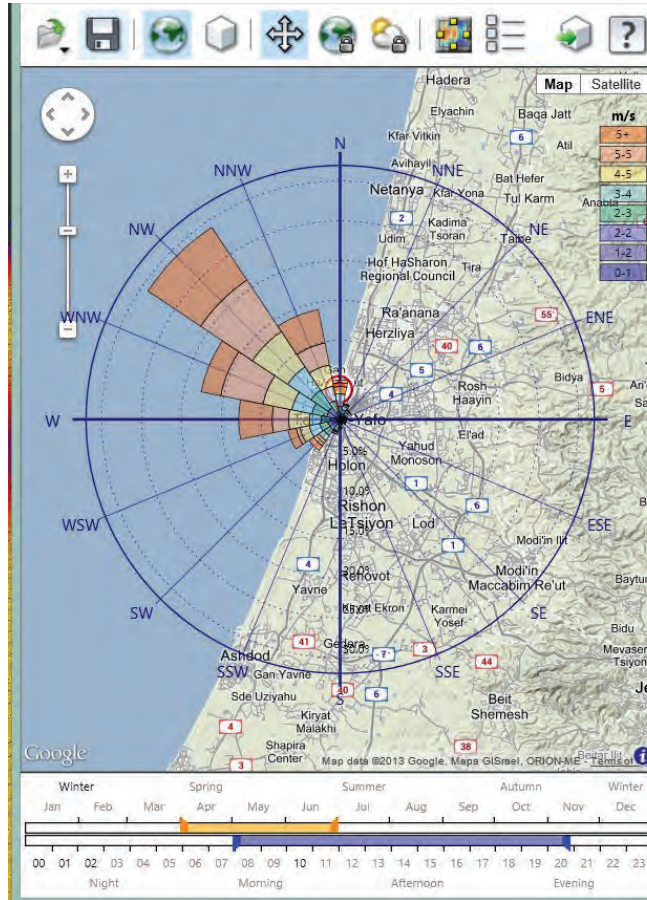
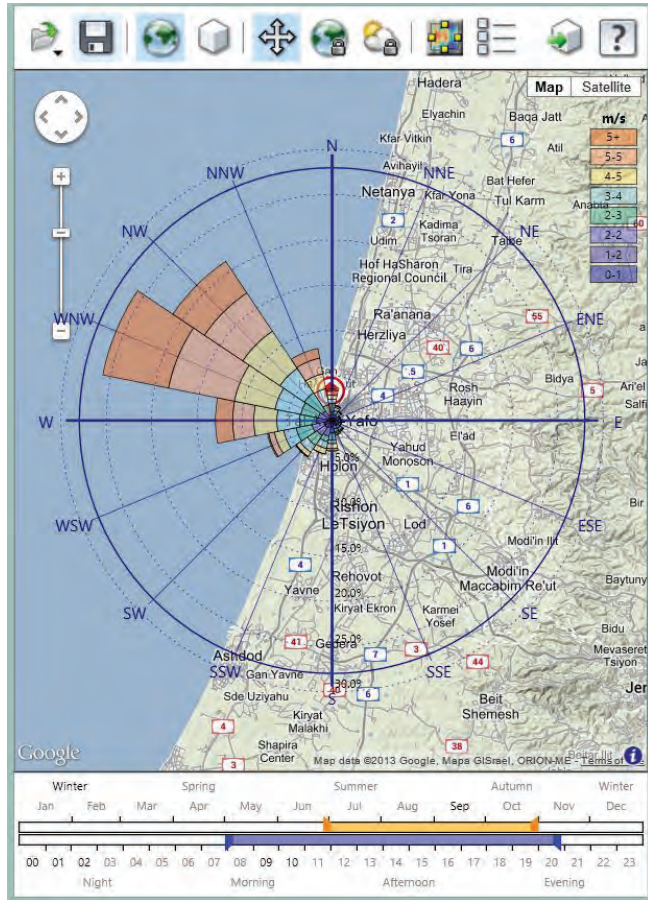
ניתוח האתר - בדיקה של עצמת וכיווני הרוח באתר בעזרת תכנת vasari



משטר הרוחות באתר - יולי - אוקטובר  
בשעות 20:00 - 07:30

משטר הרוחות באתר - אפריל - יוני  
בשעות 20:00 - 07:30

משטר הרוחות באתר - דצמבר - מרץ  
בשעות 20:00 - 08:00



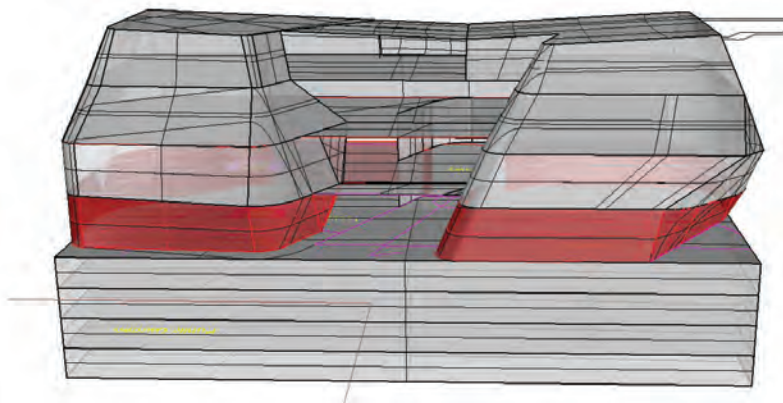
רוח רצויה



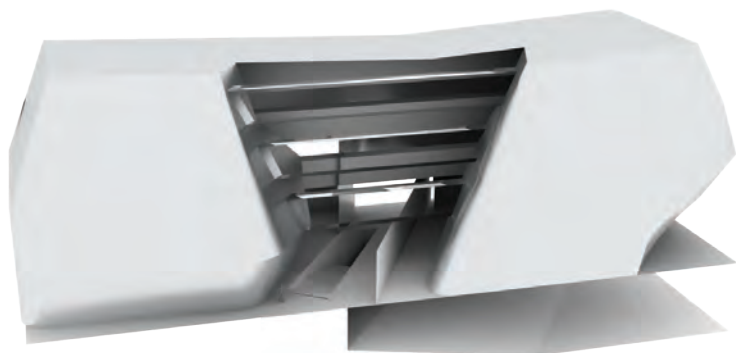
נסיונות פיתוח - גאומטרית מעטפת המבנה. עקרונות כלליים:

אחד התהליכים המתגרים היה הניסיון לפתח את גאומטריית המעטפת. רציתי שהגאומטריה תהיה המשכית, זורמת, מזמינה. לא רציתי שבדופן הפונה לרחוב תהיה קשיחה. קטימת הפינות בצדדים על מנת לאפשר המשך מבט לעוברים ברחוב.

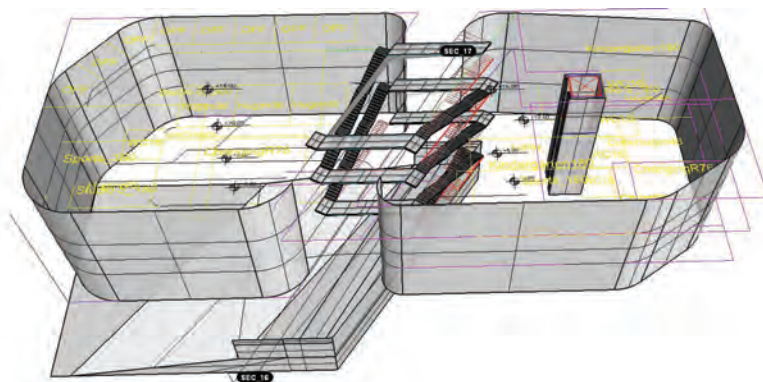
פתיחה לכיוון הגינה הציבורית הנמצאת ממערב.



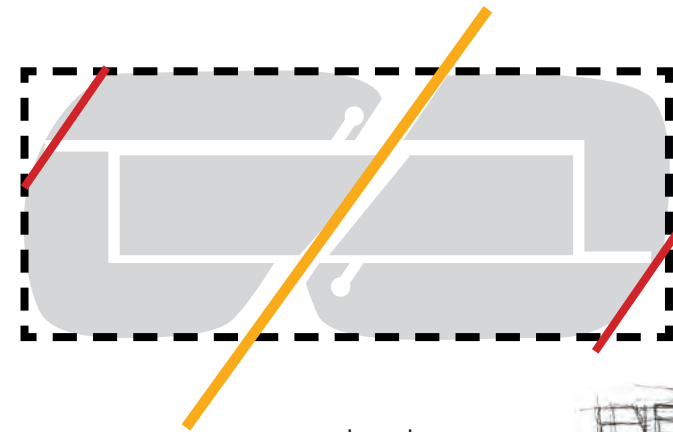
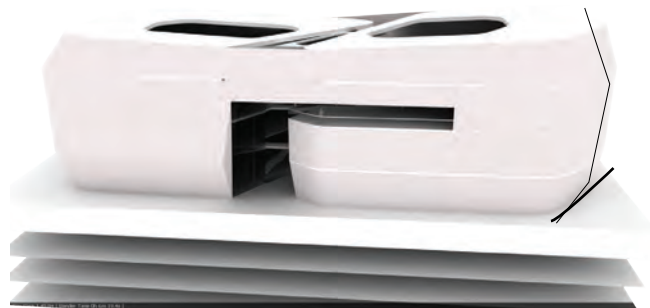
נסיון להציג את המבנה כשני חלקים מנותקים המחוברים יחדיו ע"י המעטפת וצירי התנועה.



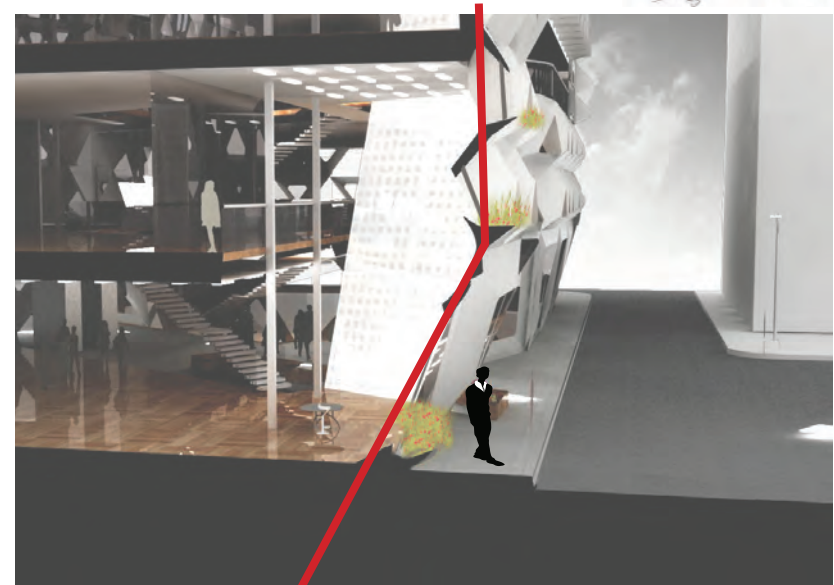
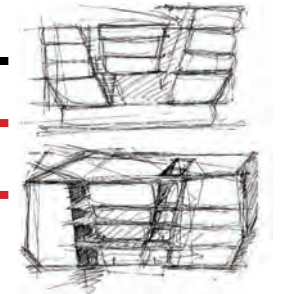
אלמנט מרכזי וחשוב - מעבר תחתי המקשר בין הגינה לשוק, ומעליו ספירלת התנועה הורטיקלית במבנה. מדובר באזור שרוב תנועת המבנה מתרחשת בו - המעבר התחתי, המעבר בין הקומות.



Envelope development



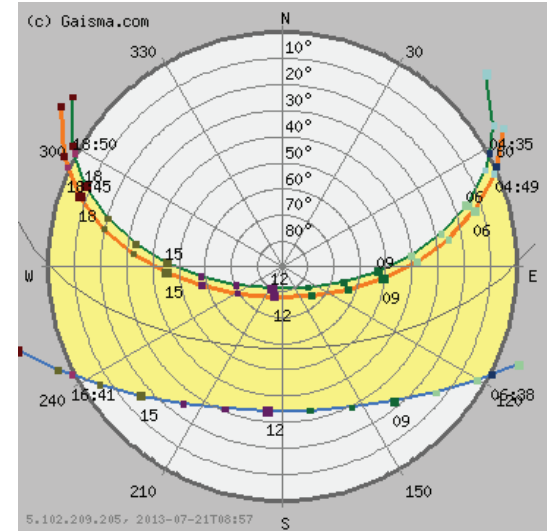
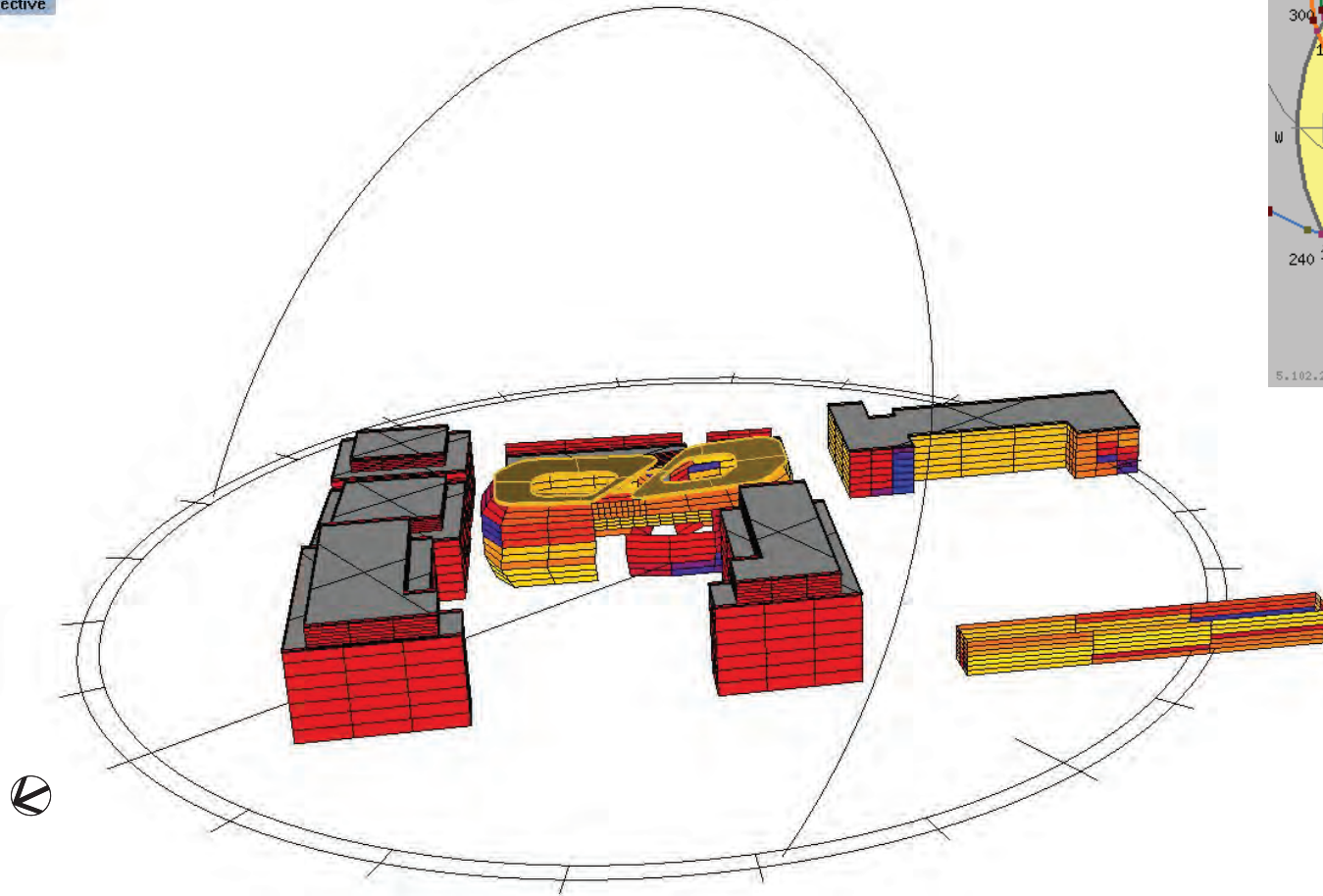
גבול הבלוק בו יושב המבנה. ---  
 קטימת הקצוות על-מנת לאפשר המשך מבט לעוברים קרנות הרחוב. ---  
 מעבר המקשר בין המשך השוק והגינה הציבורית ---  
 רית





solar trajectory

ective



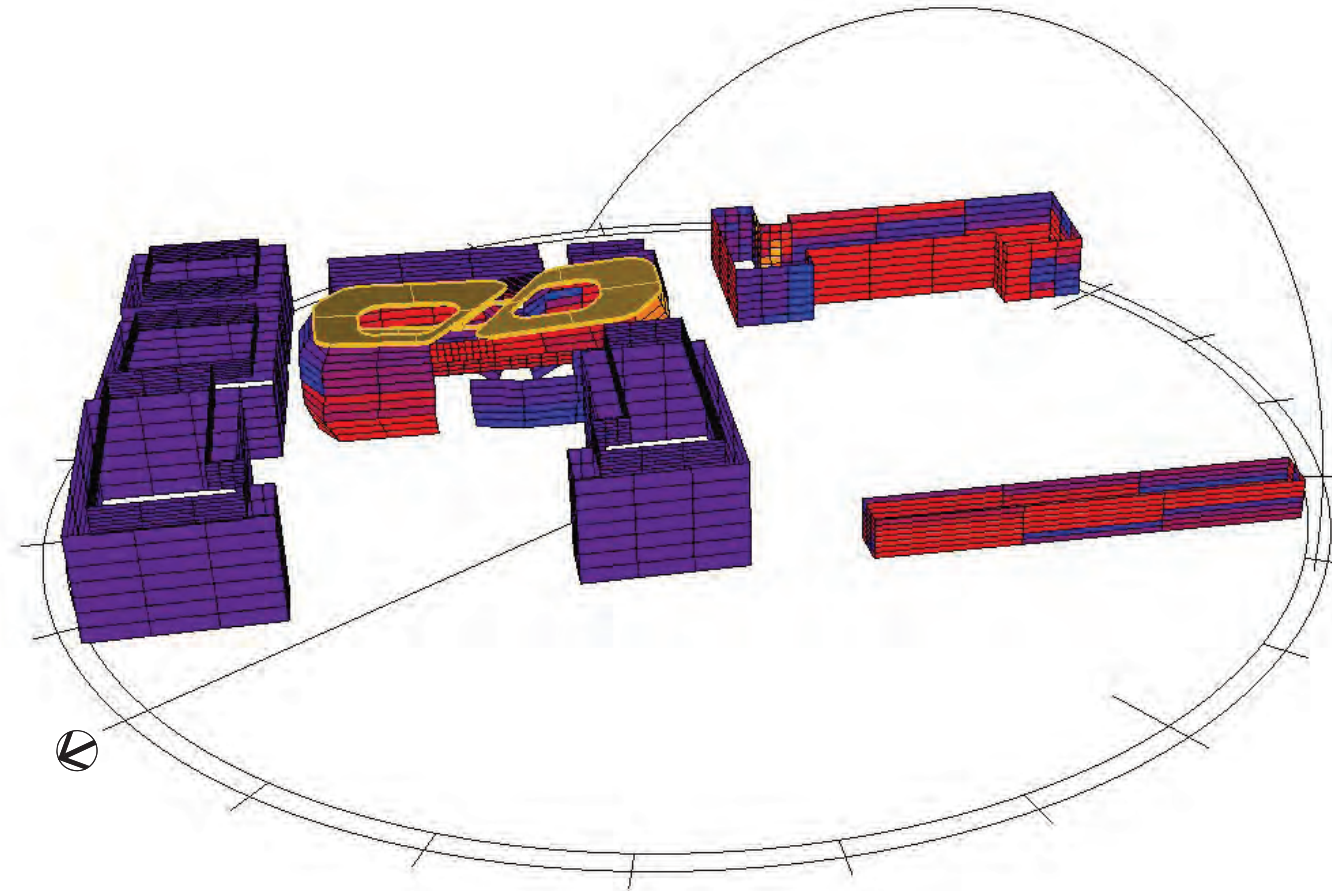
<http://www.gaisma.com/en/location/tel-aviv-yafo.html>: Tel Aviv-Yafo, Israel - Sun path diagram

- Sun path**
  - Today
  - June 21
  - December 21
  - Annual variation
  - Equinox (March and September)
- Sunrise/sunset**
  - Sunrise
  - Sunset
- Time**
  - 00-02
  - 03-05
  - 06-08
  - 09-11
  - 12-14
  - 15-17
  - 18-20
  - 21-23

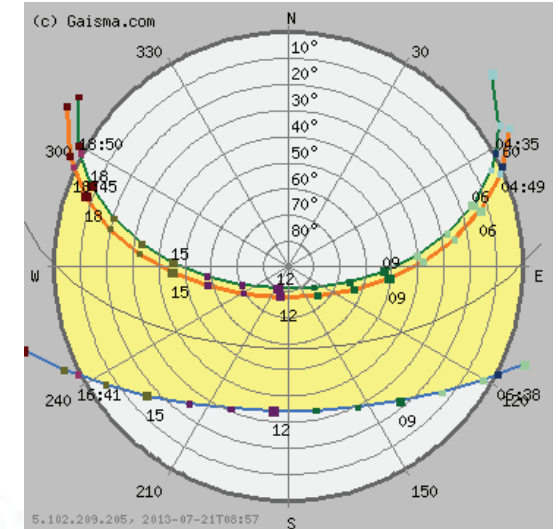
solar trajectory June 21st

<http://www.gaisma.com/en/location/tel-aviv-yafo.html>: Tel Aviv-Yafo, Israel - Sun path diagram

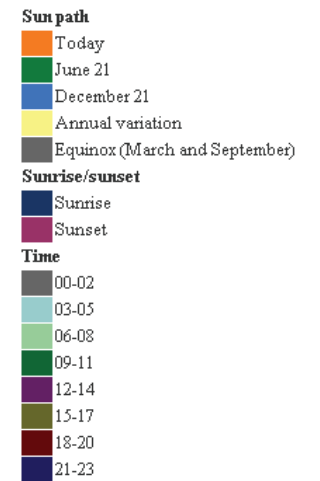
solar trajectory



solar trajectory December 21st

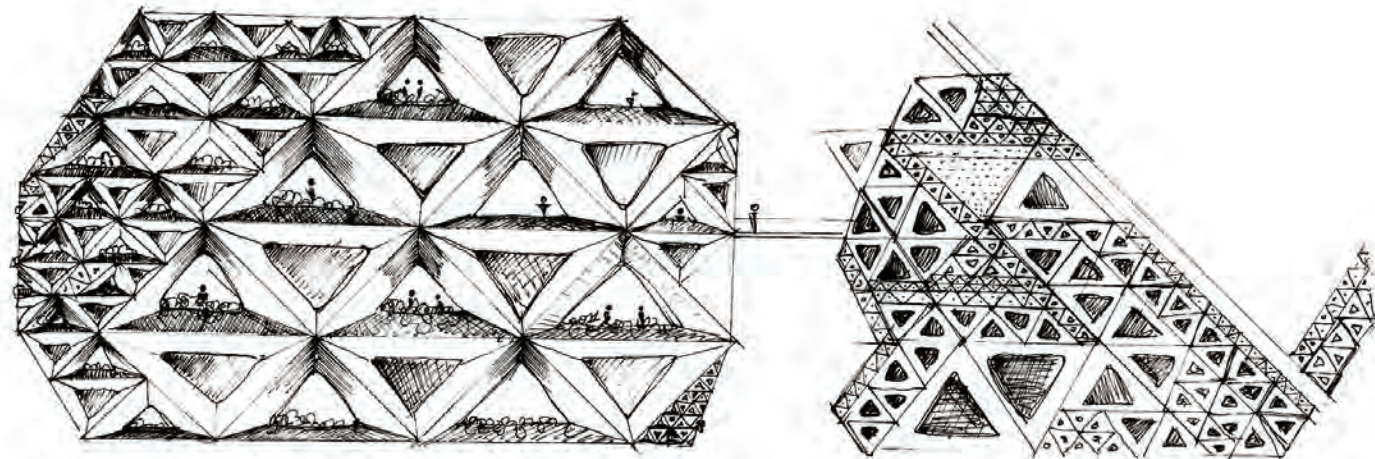
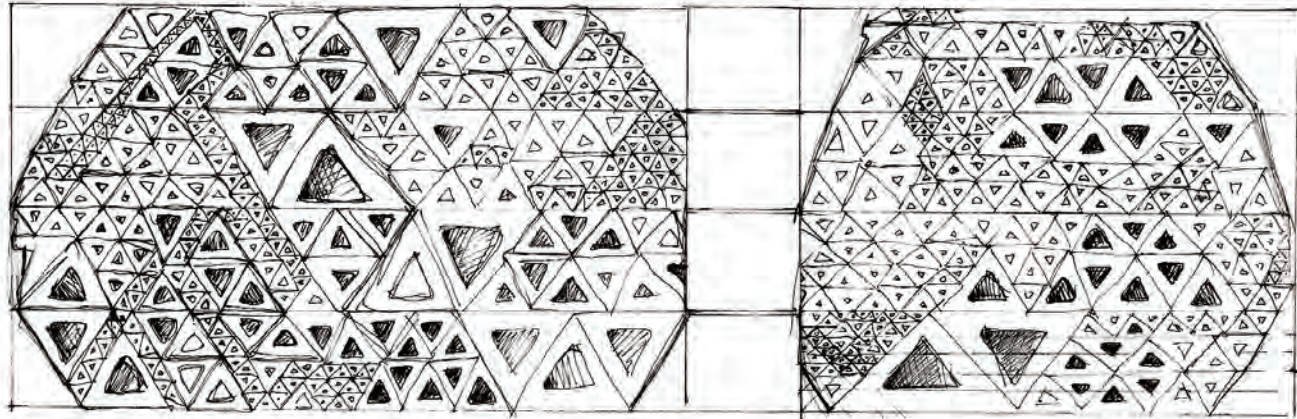


<http://www.gaisma.com/en/location/tel-aviv-yafo.html>: Tel Aviv-Yafo, Israel - Sun path diagram

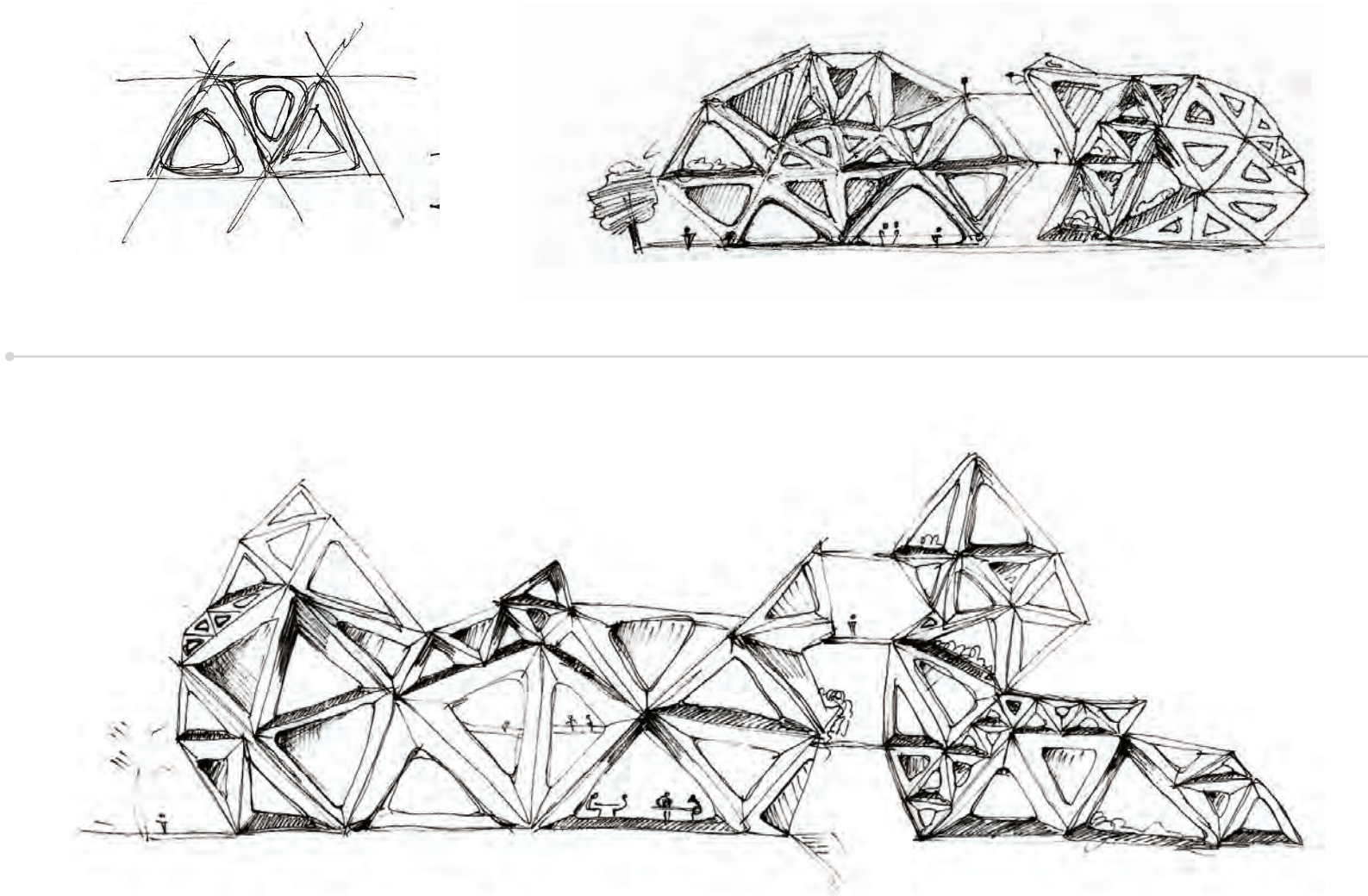


<http://www.gaisma.com/en/location/tel-aviv-yafo.html>: Tel Aviv-Yafo, Israel - Sun path diagram

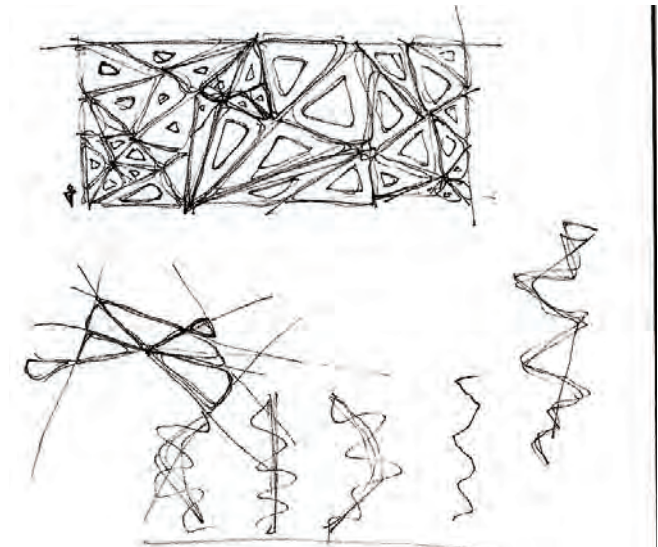
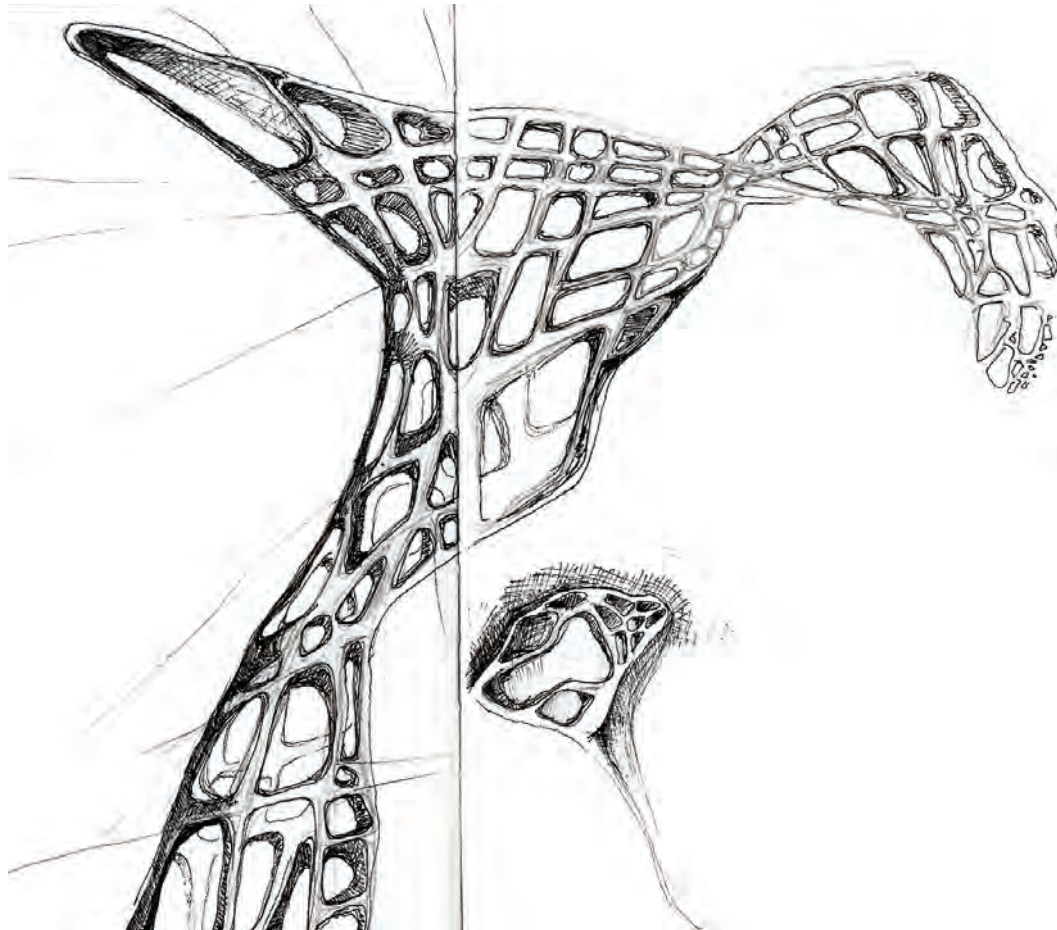
*Facade conceptual sketches*



*Facade conceptual sketches*

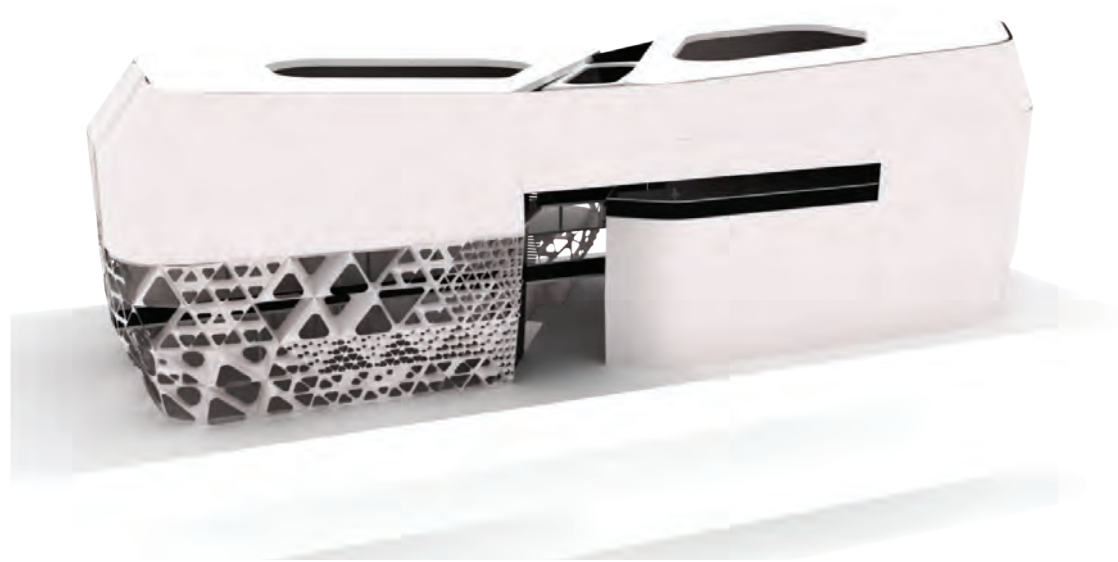


*Facade conceptual sketches*





*Facade \_grid tests*



### Desired performance mappings

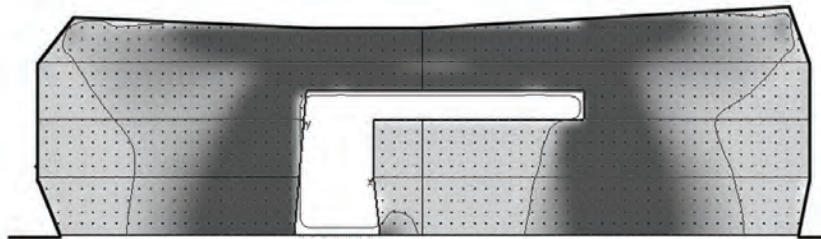
illumination Mapping



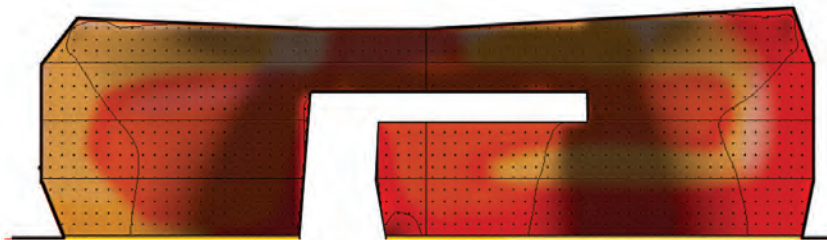
visibility Mapping



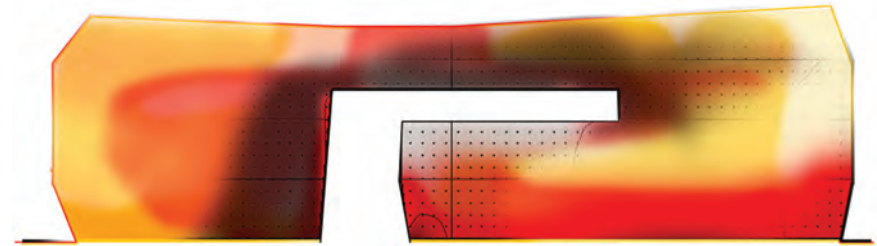
Facade force flow Mapping



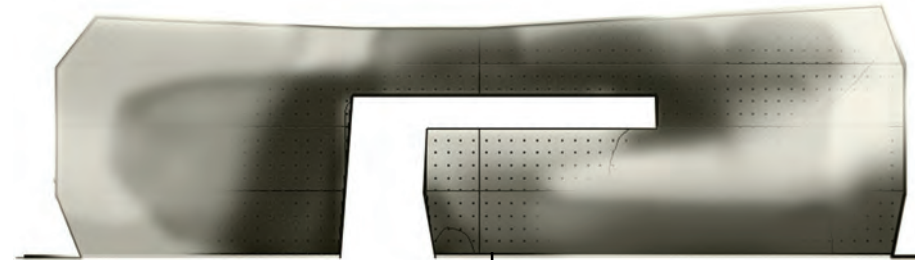
superposition



superposition

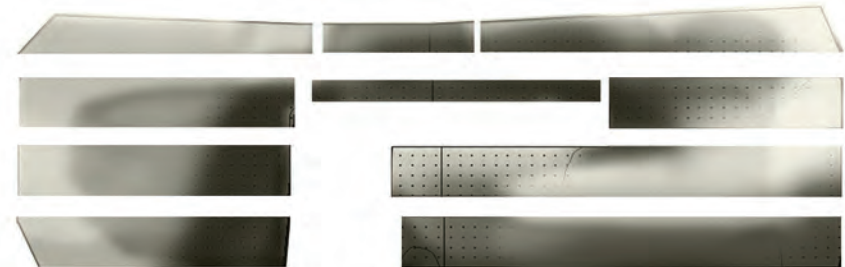


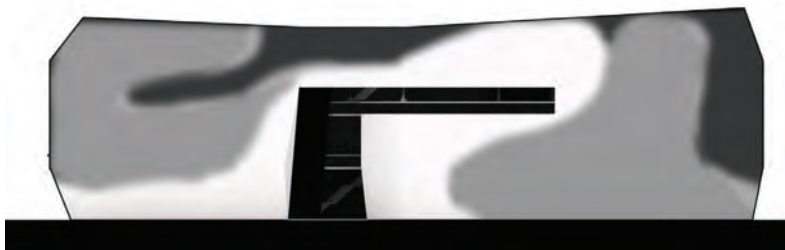
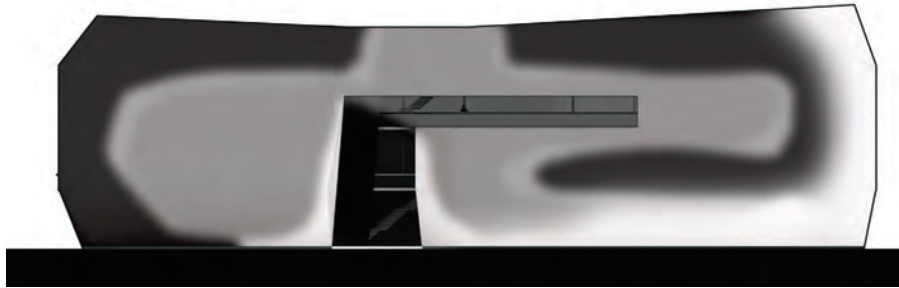
greyscaled superposition



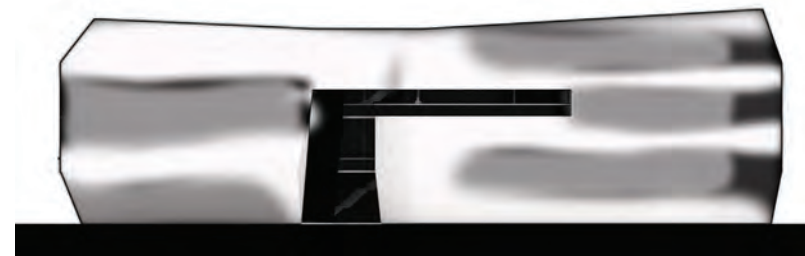
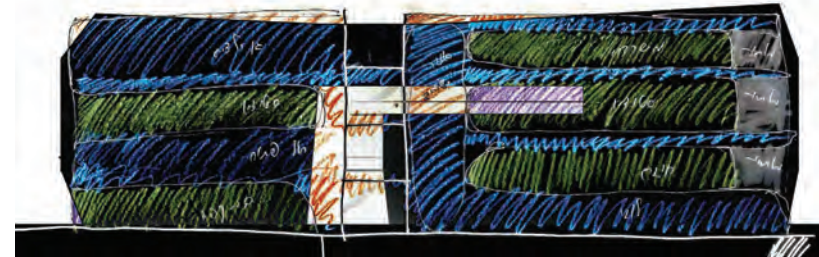
Tiling

I've decided to try the technique of tiling in order to get an accurate outcome concerning to a certain floor. eventually It wasn't a good decision because it destroyed the "flow" on the facade.



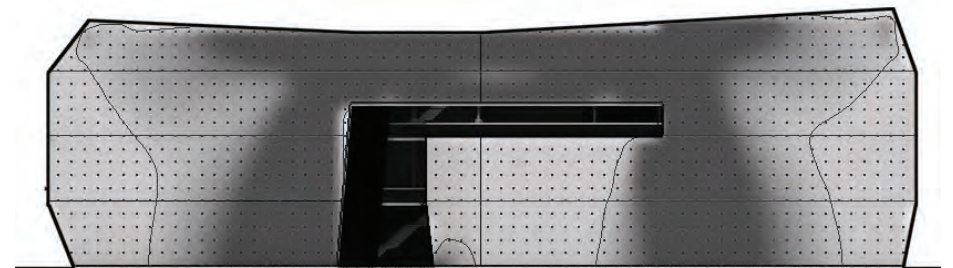
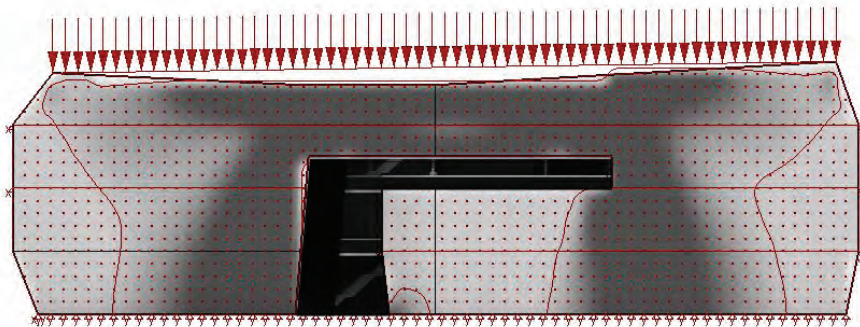
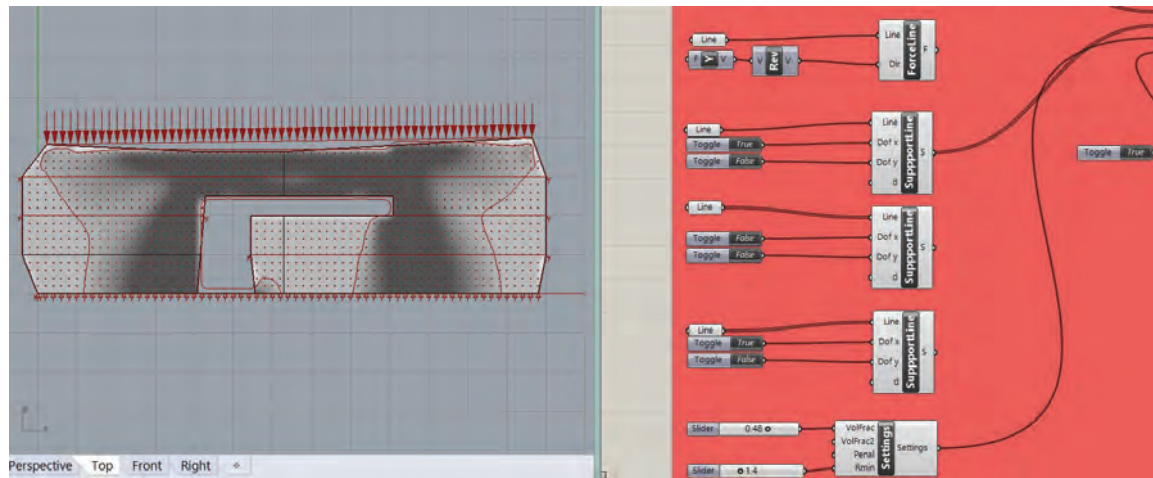


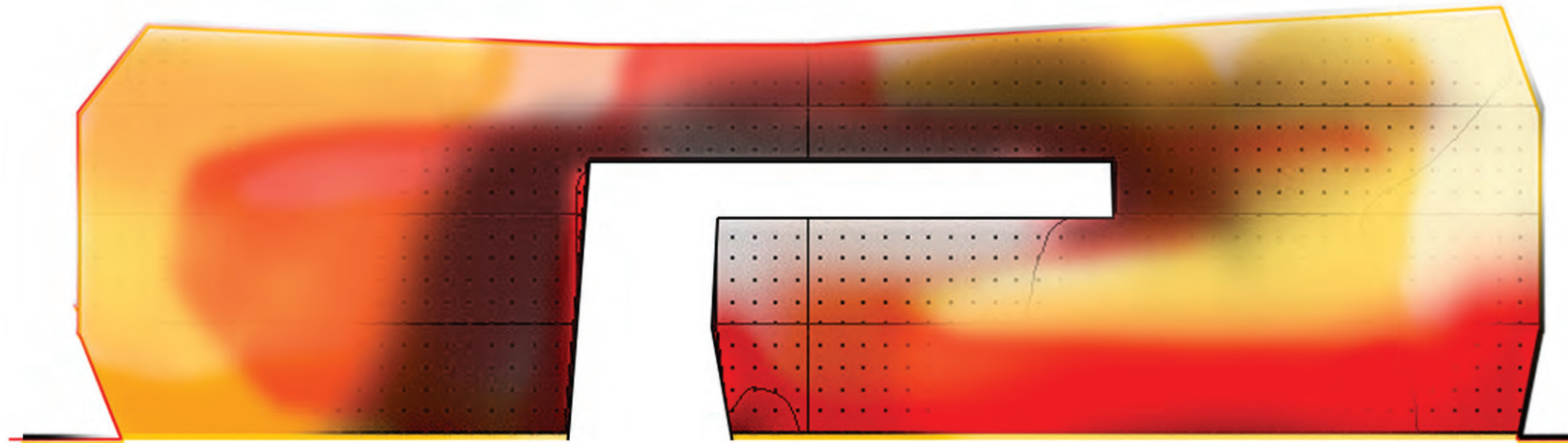
Converting each mapping to a grey scale makes the mapping clearer. the grasshopper image sampler sample the image for bright and dark points, and gives an outcome of series of numbers between 0 - 1. these will determine the cell size.



*mappings*

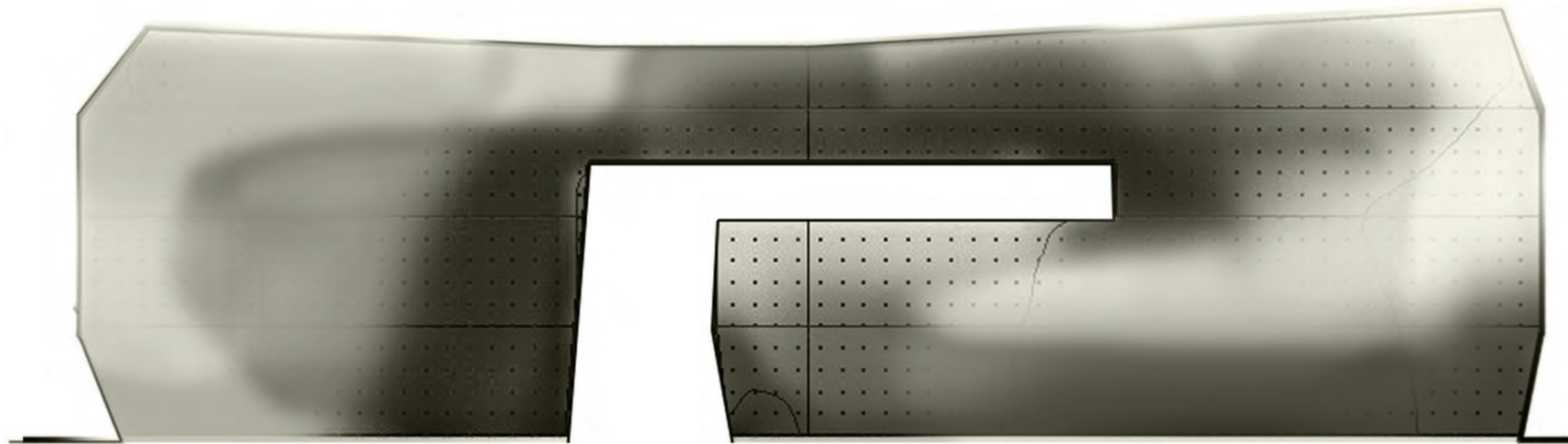
*force flow along the facade*



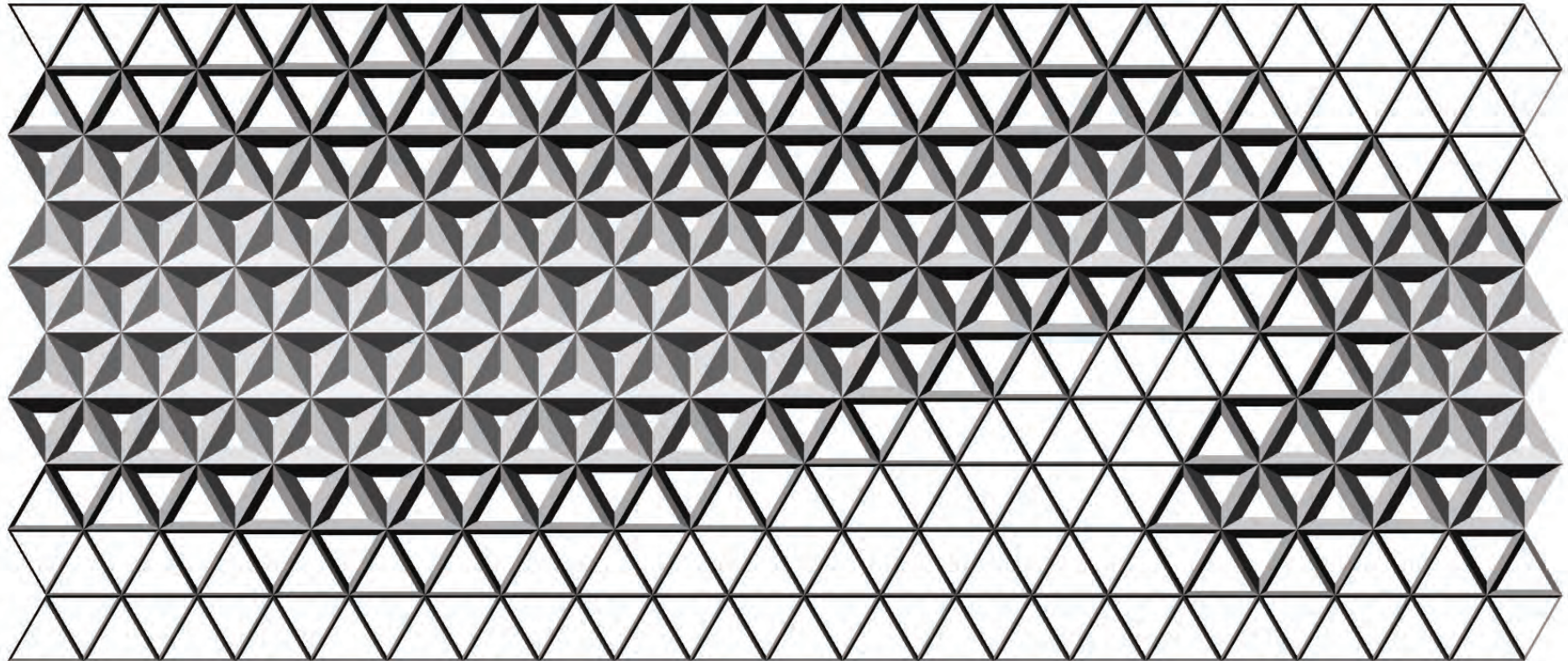


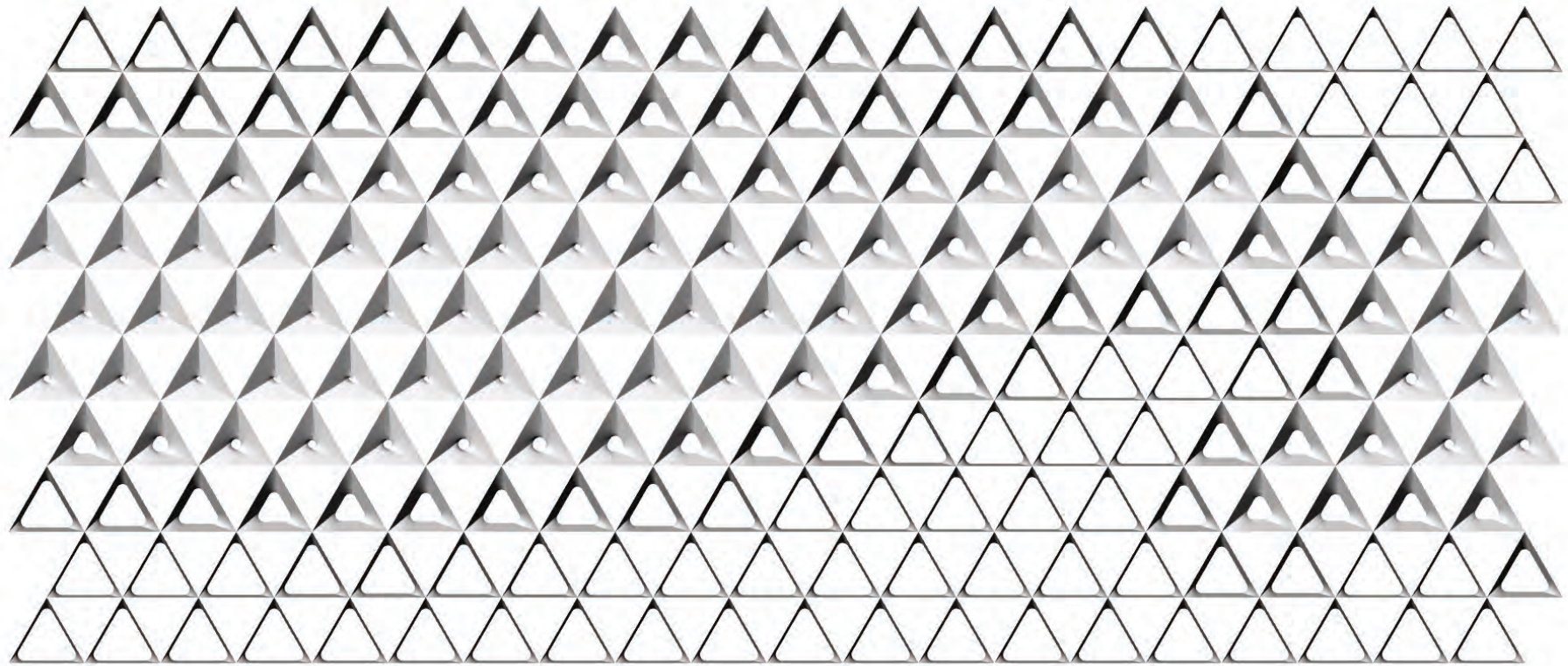
superposition : illumination + construction + function

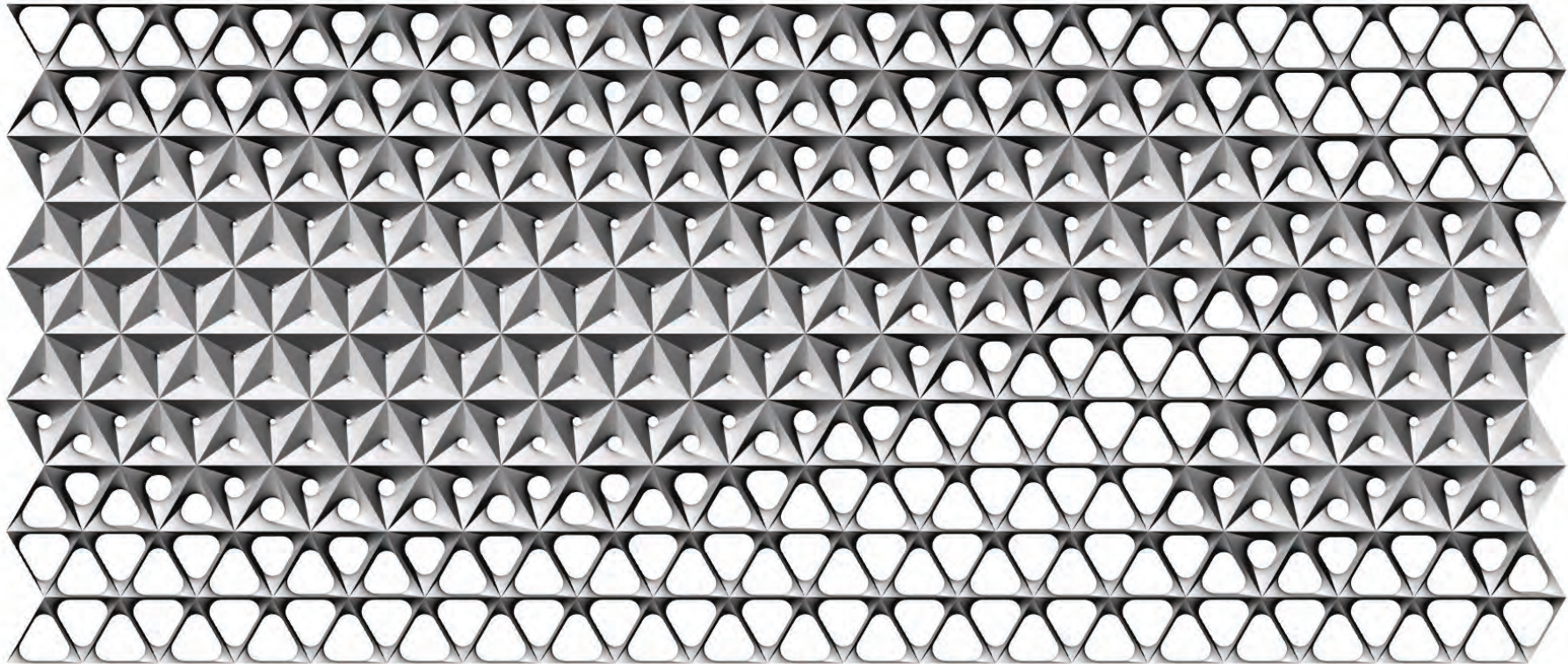
superposition : in grey scale



testink mappings outcomes.

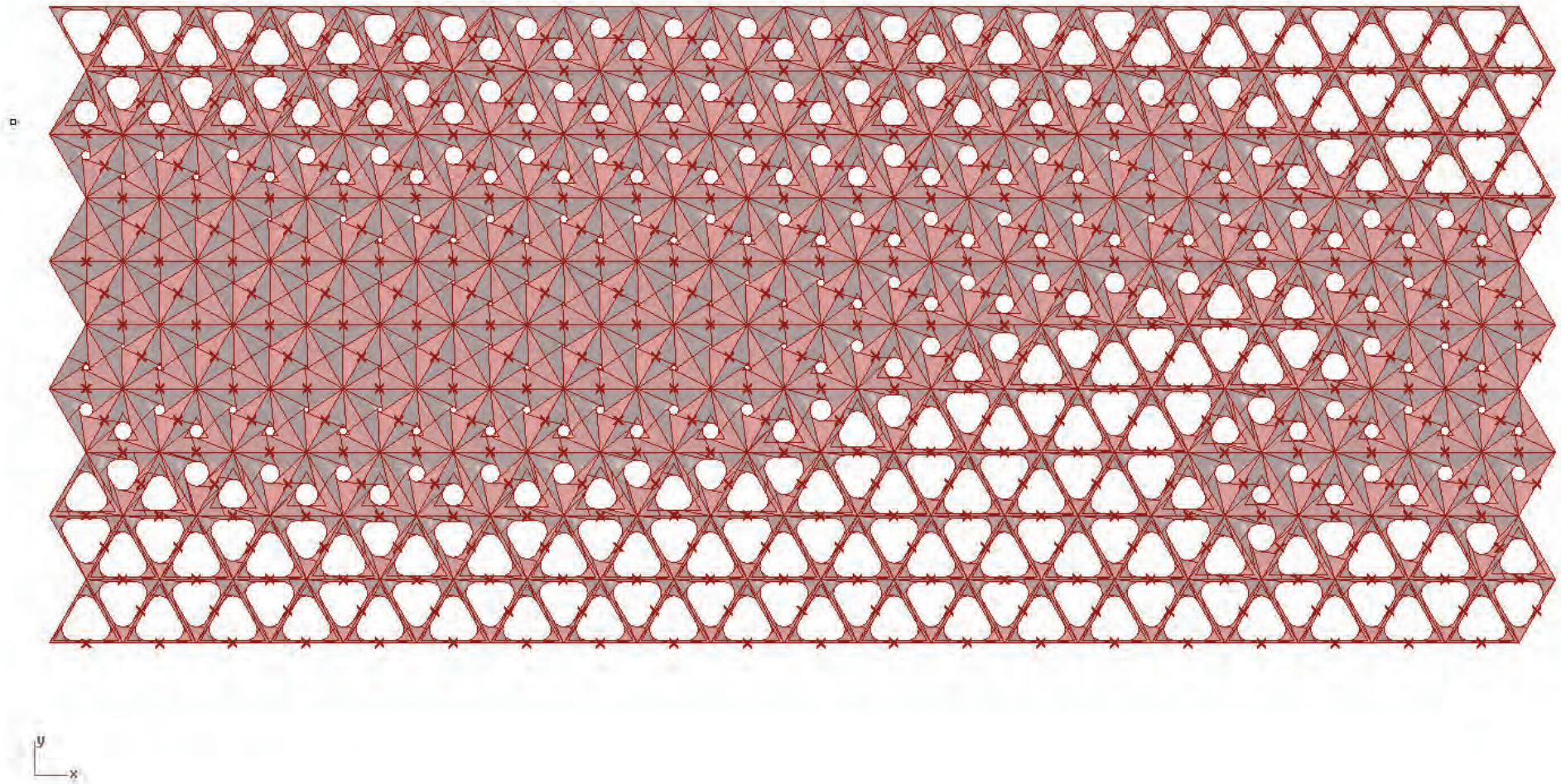


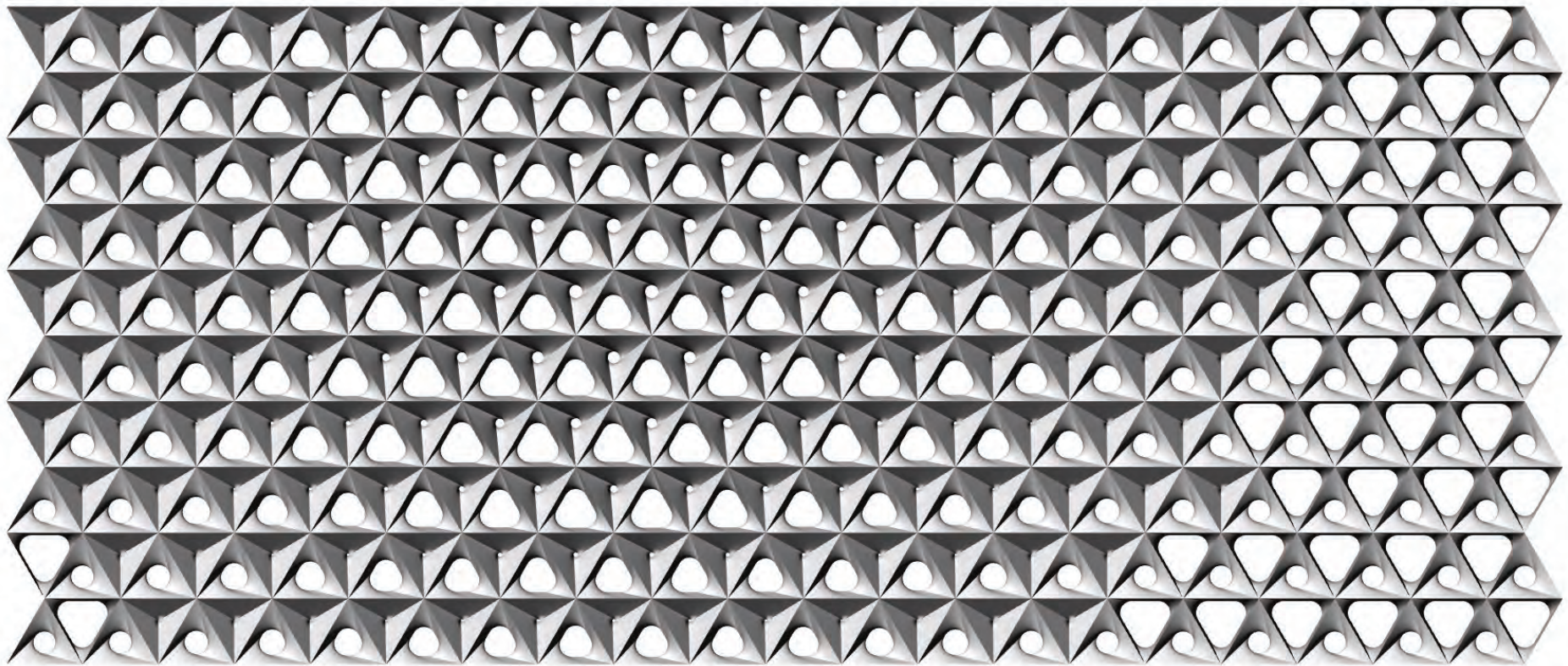




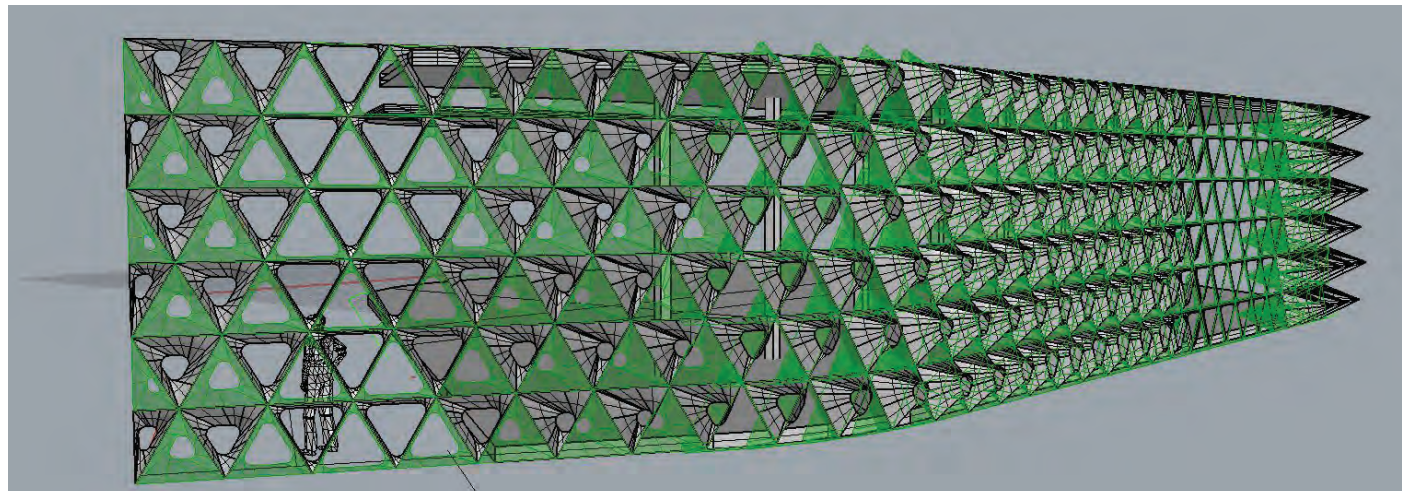
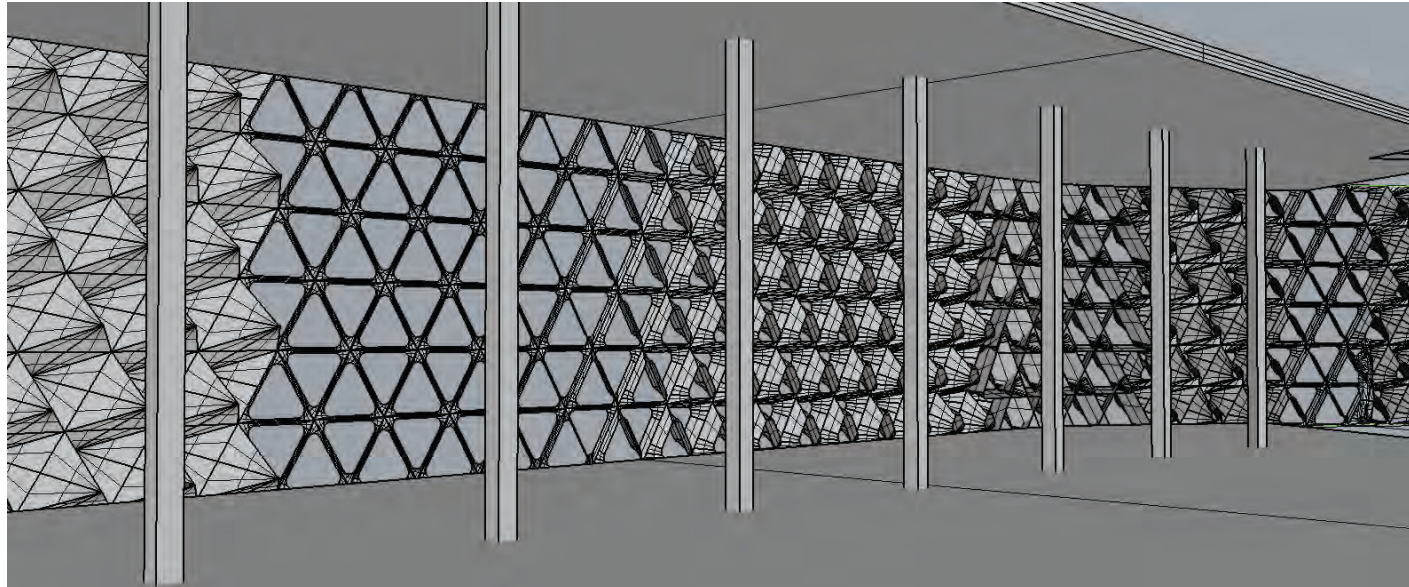


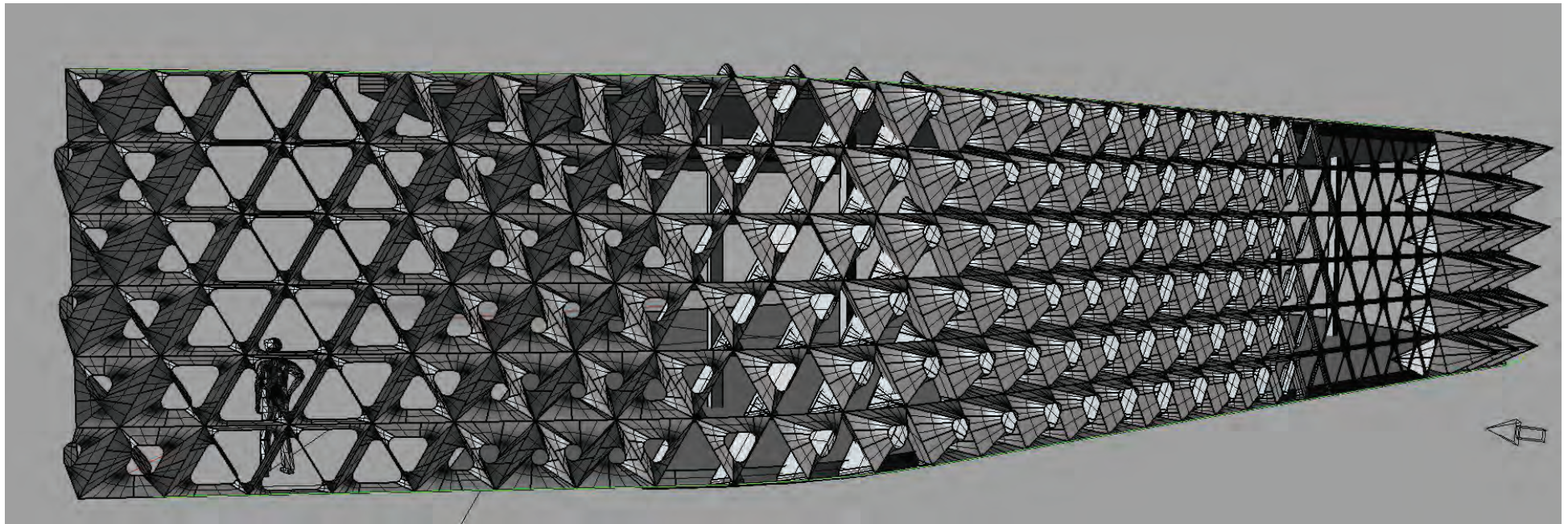
a grasshopper printscreen.



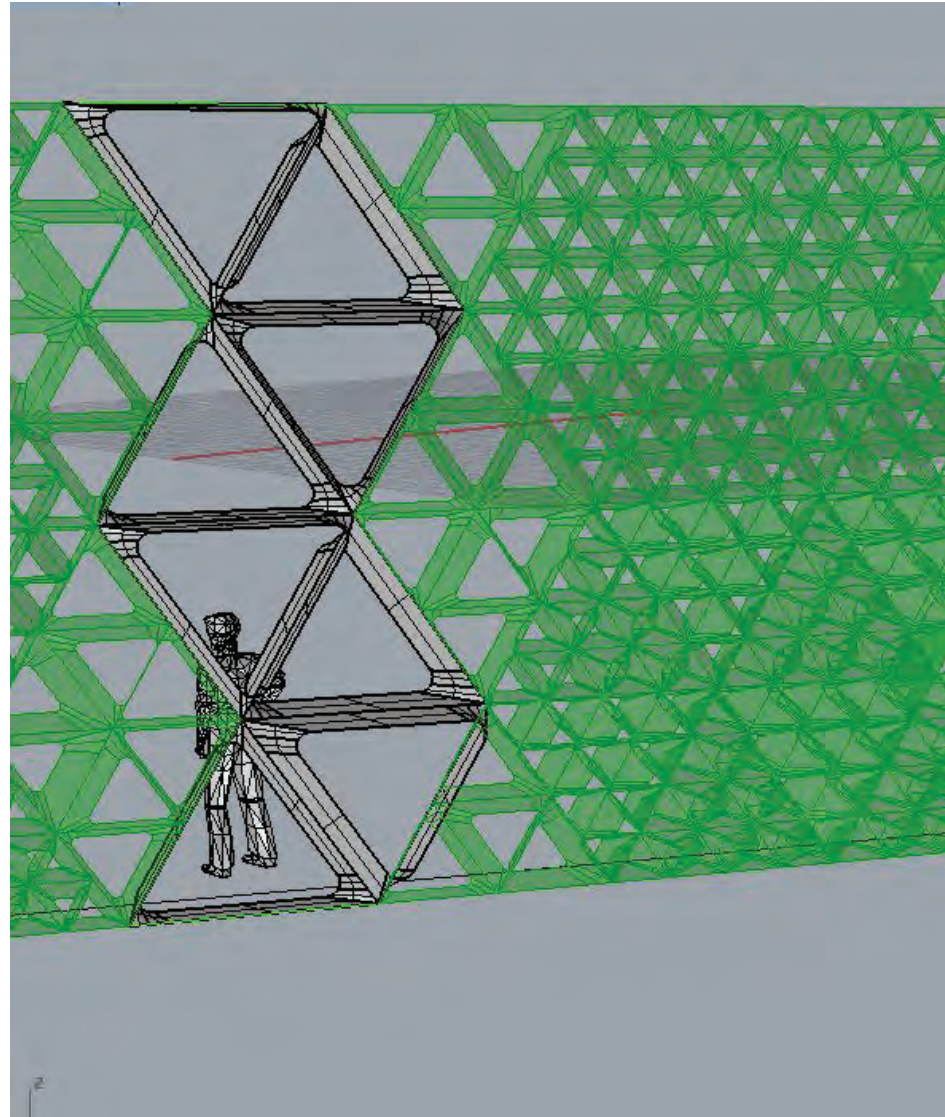


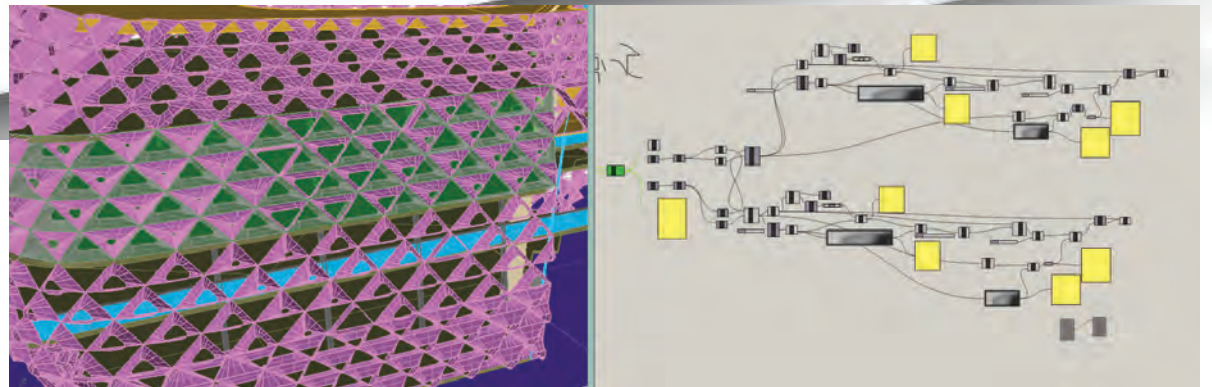
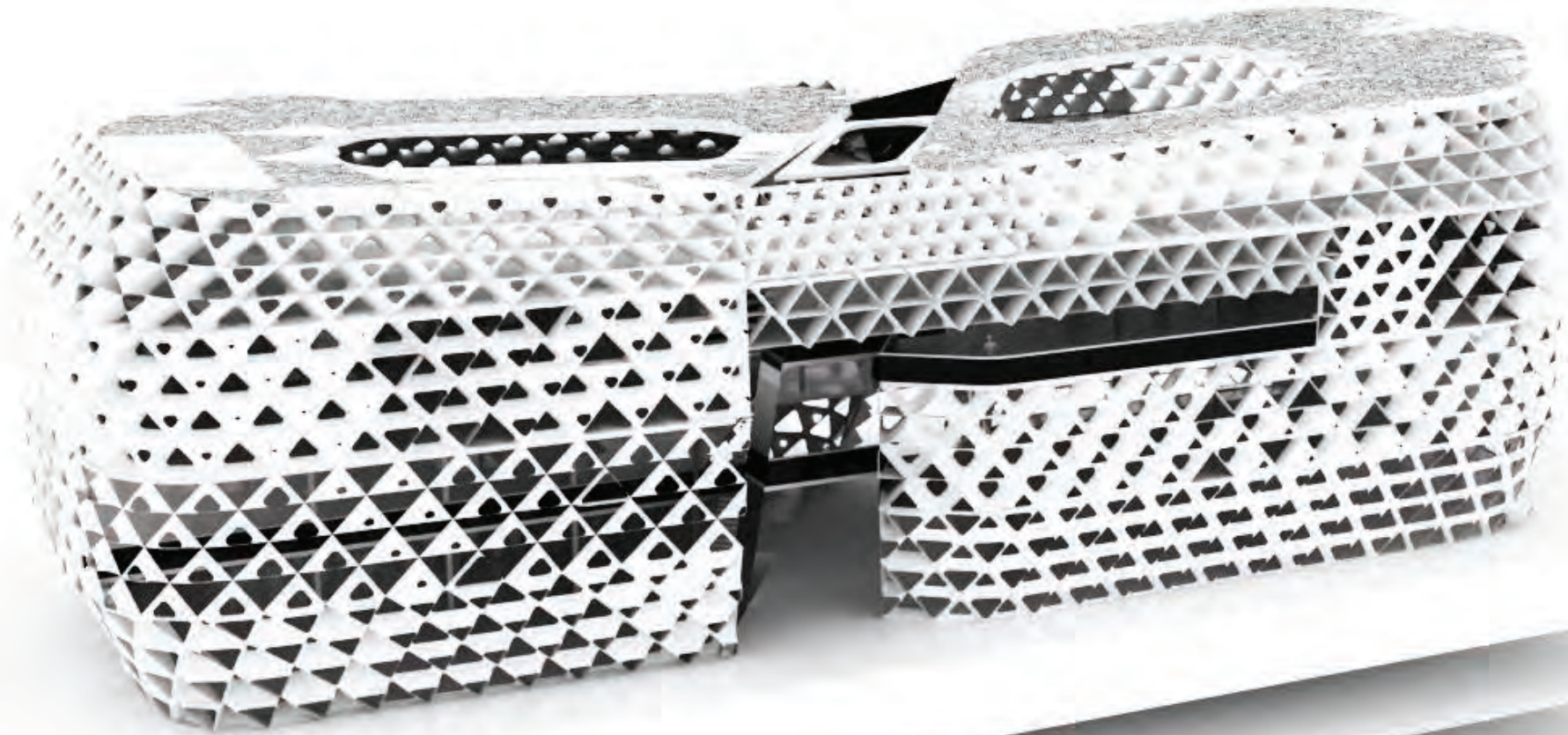
applying the first option - triangular iso-grid on part of the facade.





applying the second option - triangular sub tessellated grid on part of the facade. the sub tessellation happens according to the mapping color scale



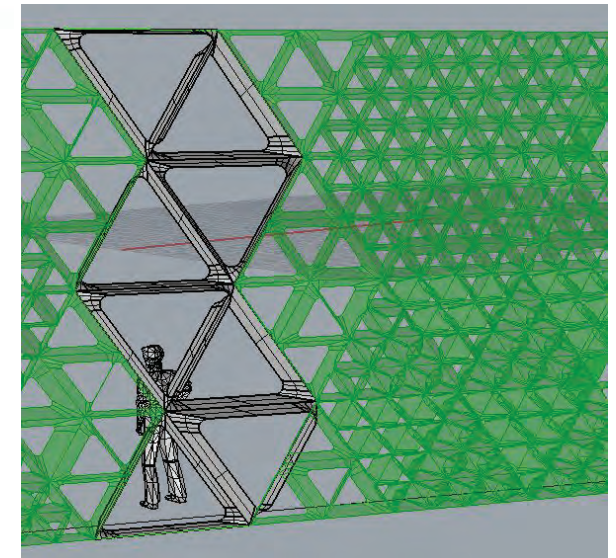


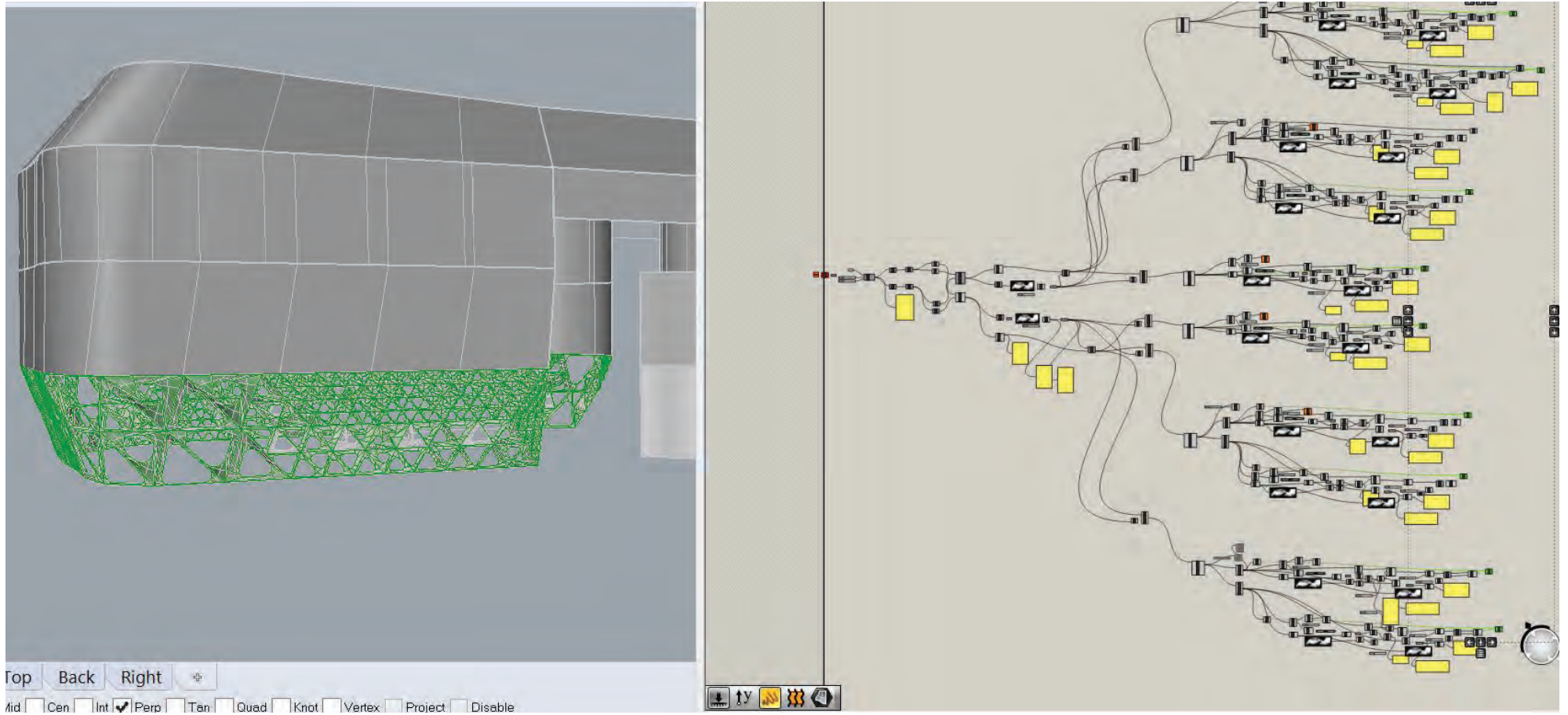


Sierpinski triangle evolution; [https://en.wikipedia.org/wiki/Sierpinski\\_triangle](https://en.wikipedia.org/wiki/Sierpinski_triangle)

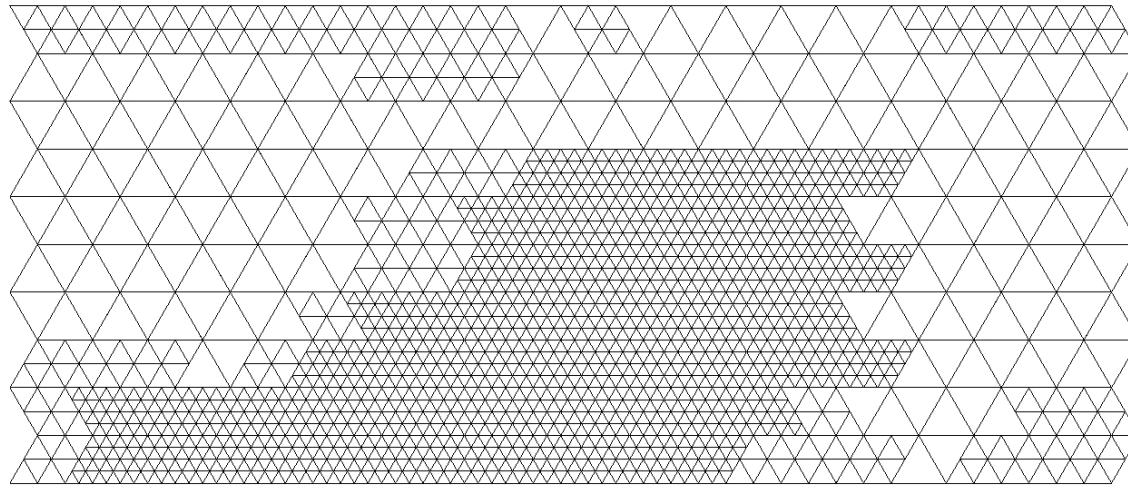
The Sierpinski triangle is a fractal and attractive fixed set named after the Polish mathematician Waclaw Sierpinski who described it in 1915. this is one of the basic examples of self-similar sets, i.e. it is a mathematically generated pattern that can be reproducible at any magnification or reduction.

[https://en.wikipedia.org/wiki/Sierpinski\\_triangle](https://en.wikipedia.org/wiki/Sierpinski_triangle)

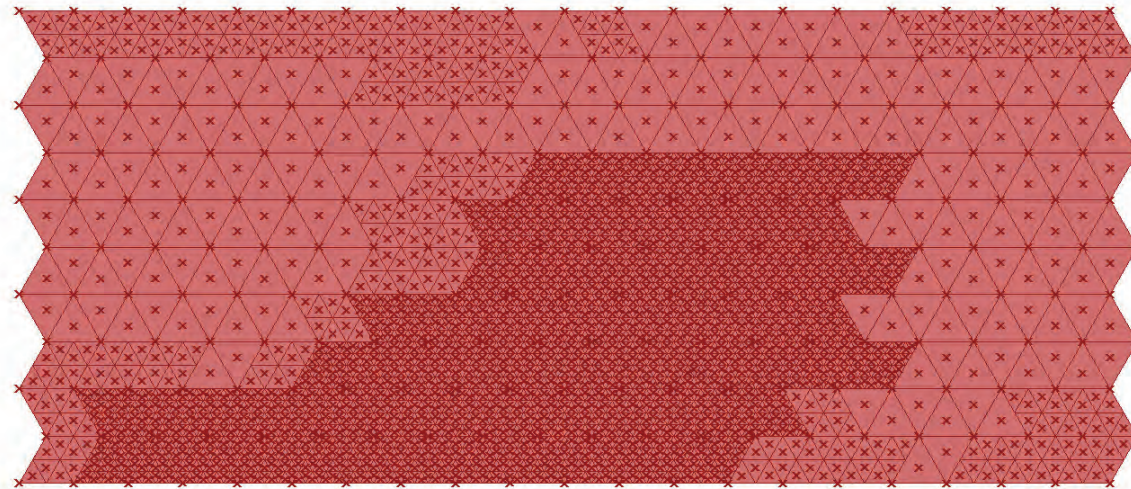






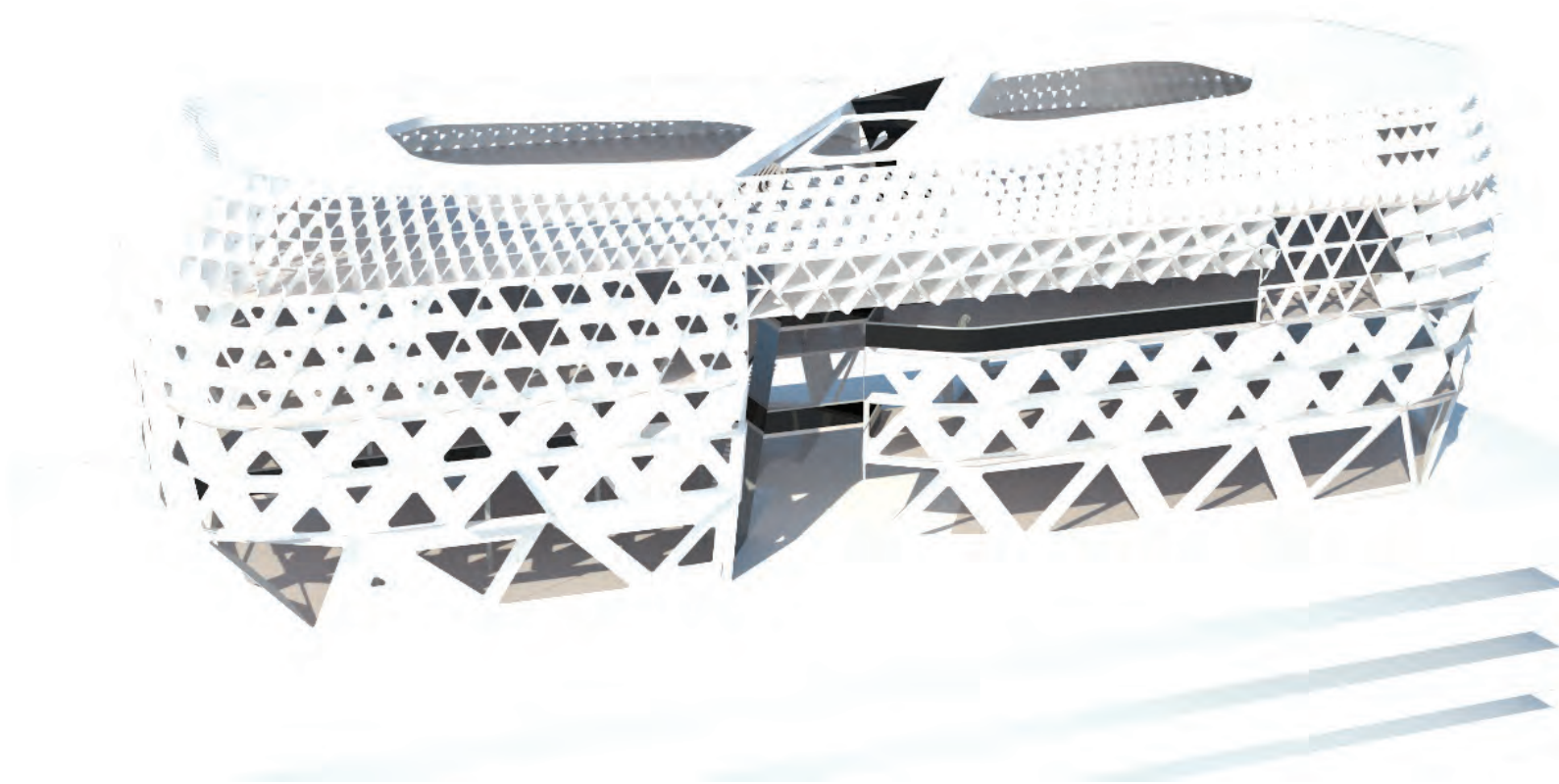


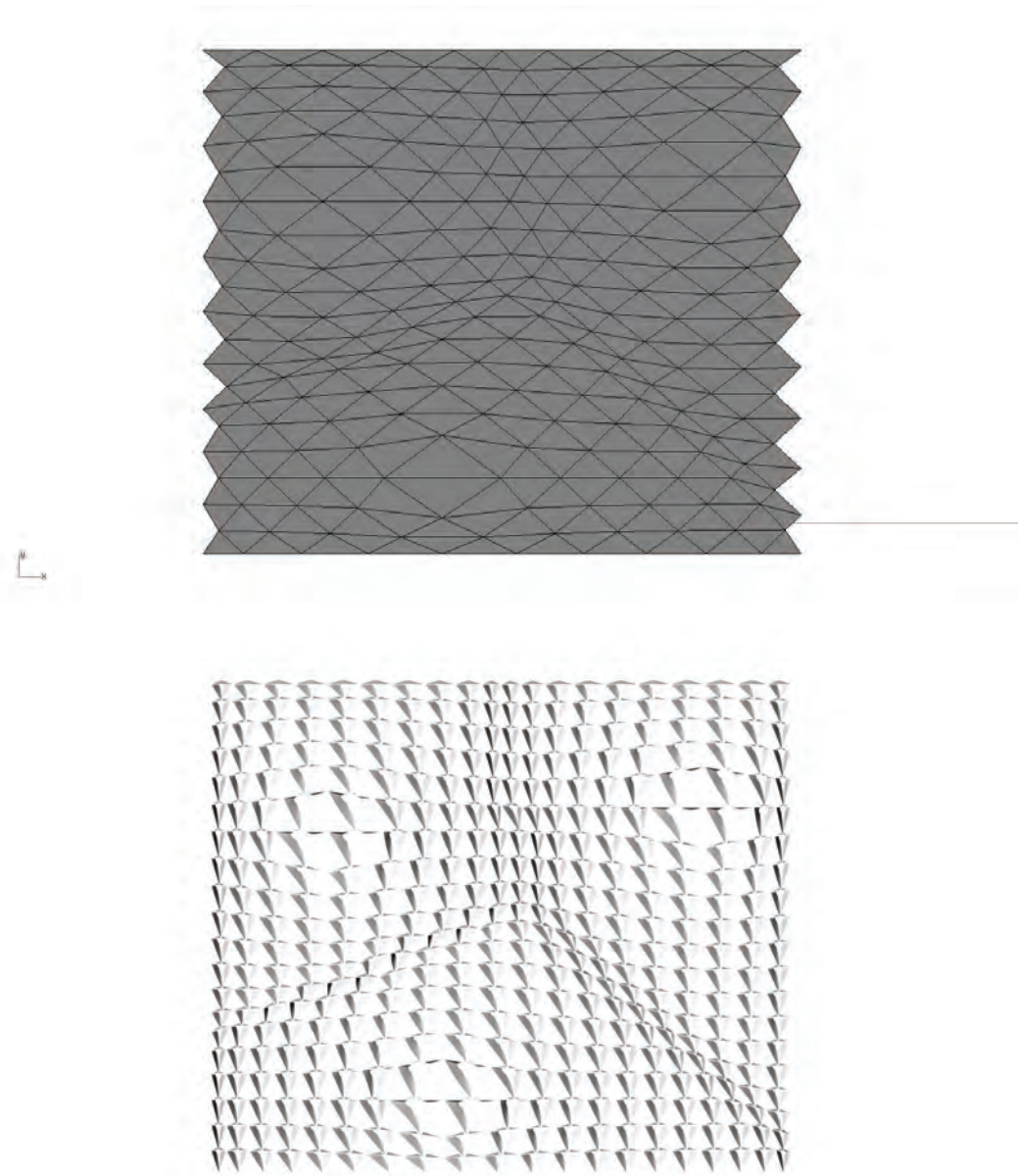
y

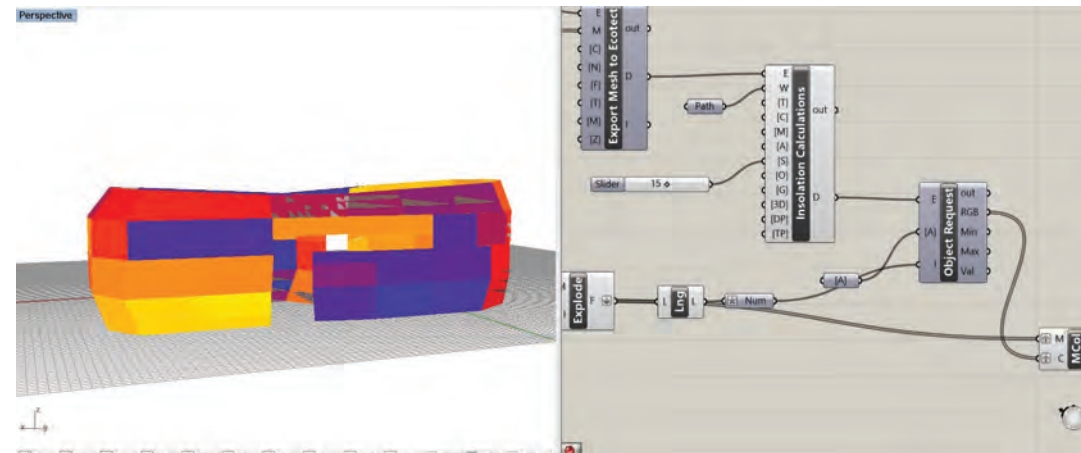
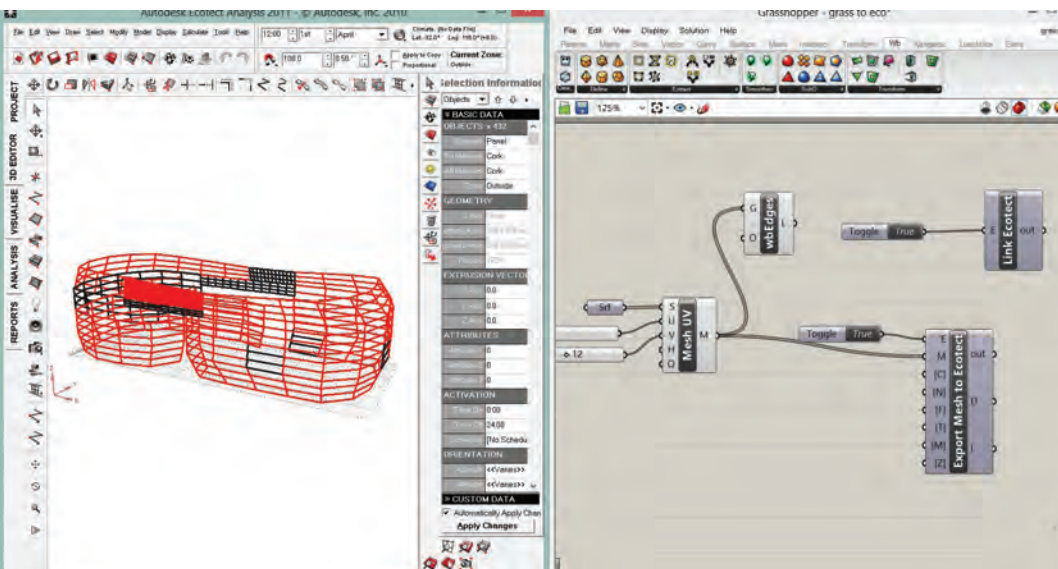
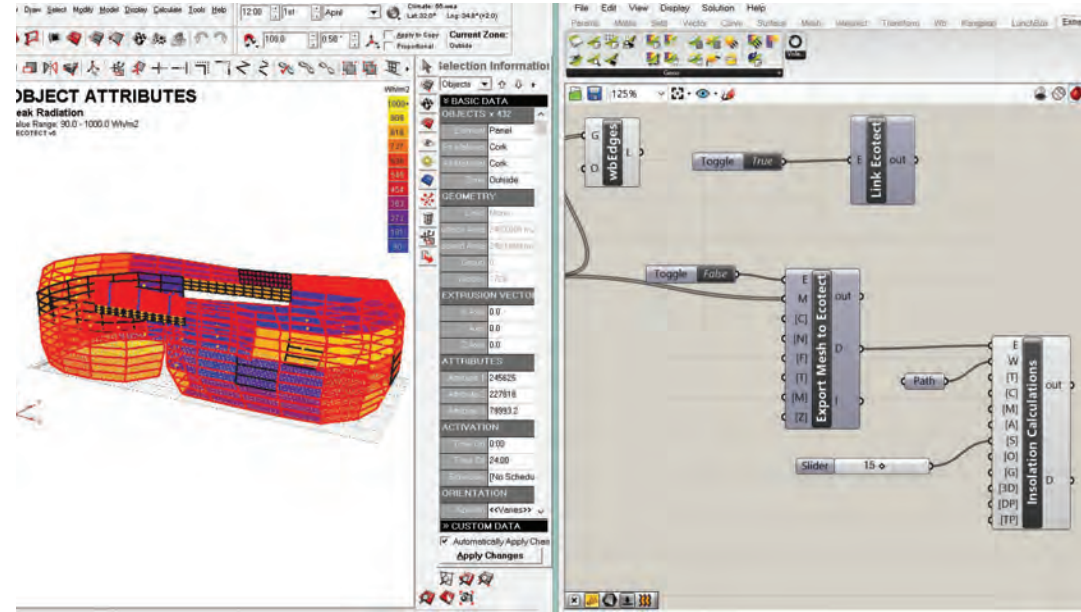
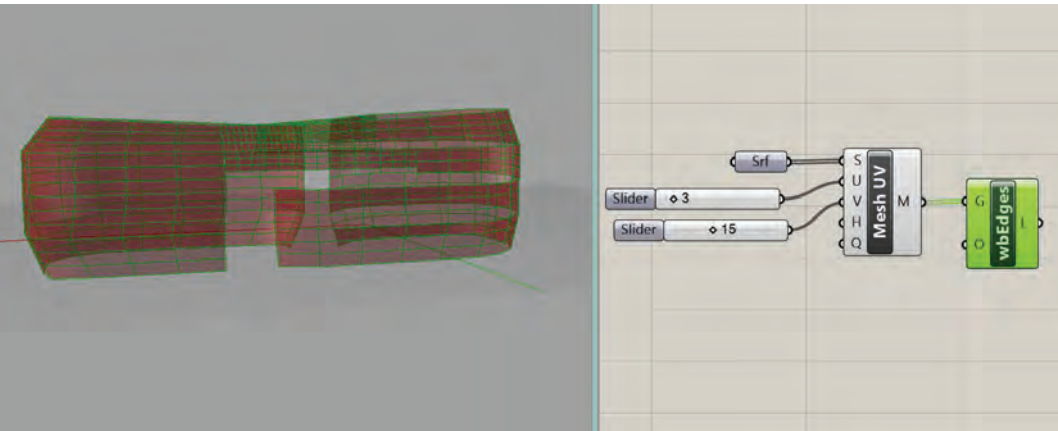


y  
x

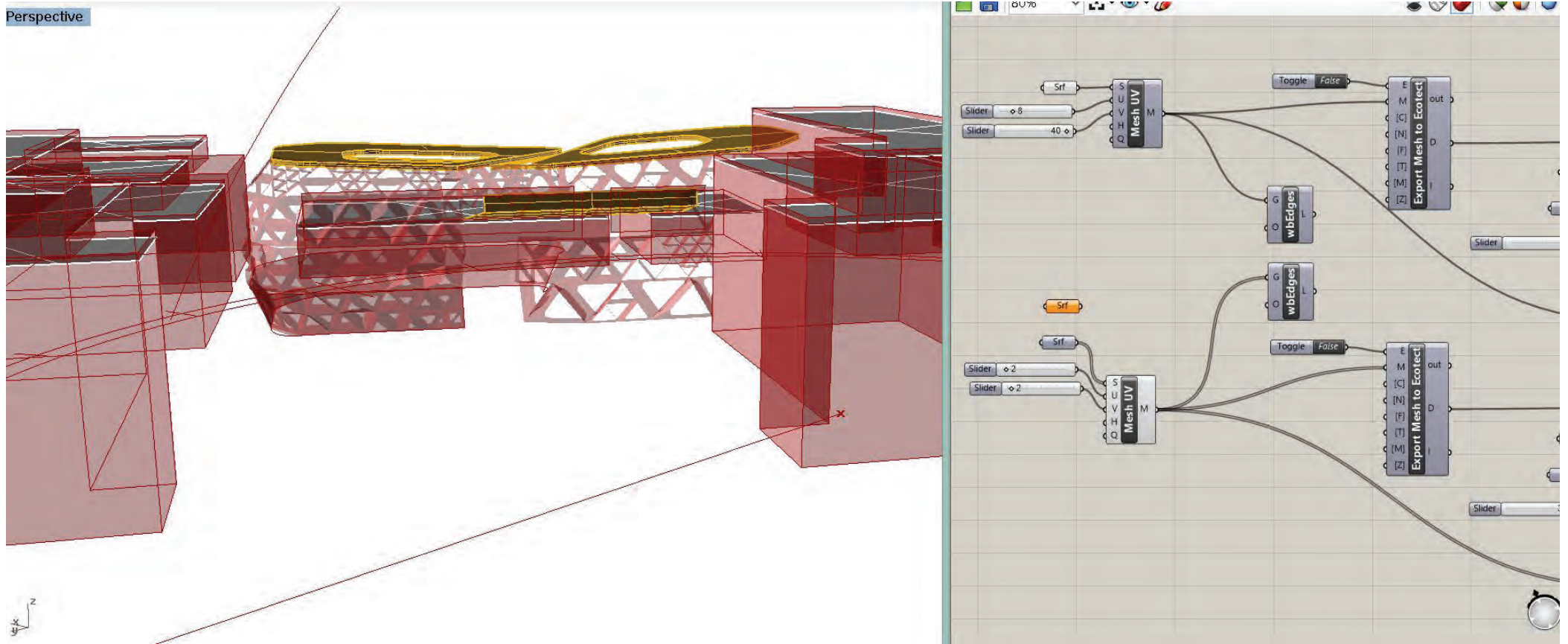
the third suggestion - the grid size of the cells depends on the public - private scale. the ground floor has the most public functions, as so it has the larger cell sized grid. the 3rd floor has specific functions, which are not public, as so it has the smallest grid size. the cells opening size and depend on the mappings.

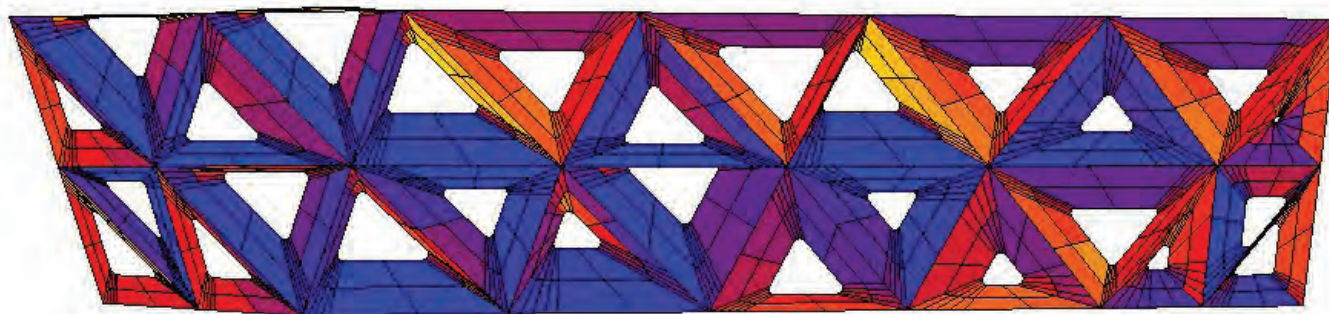
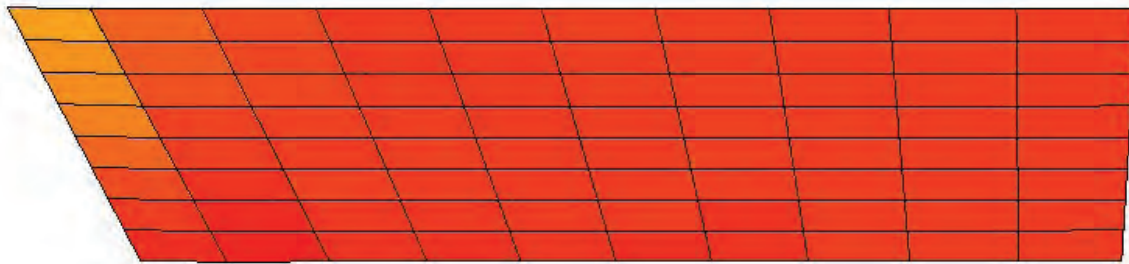


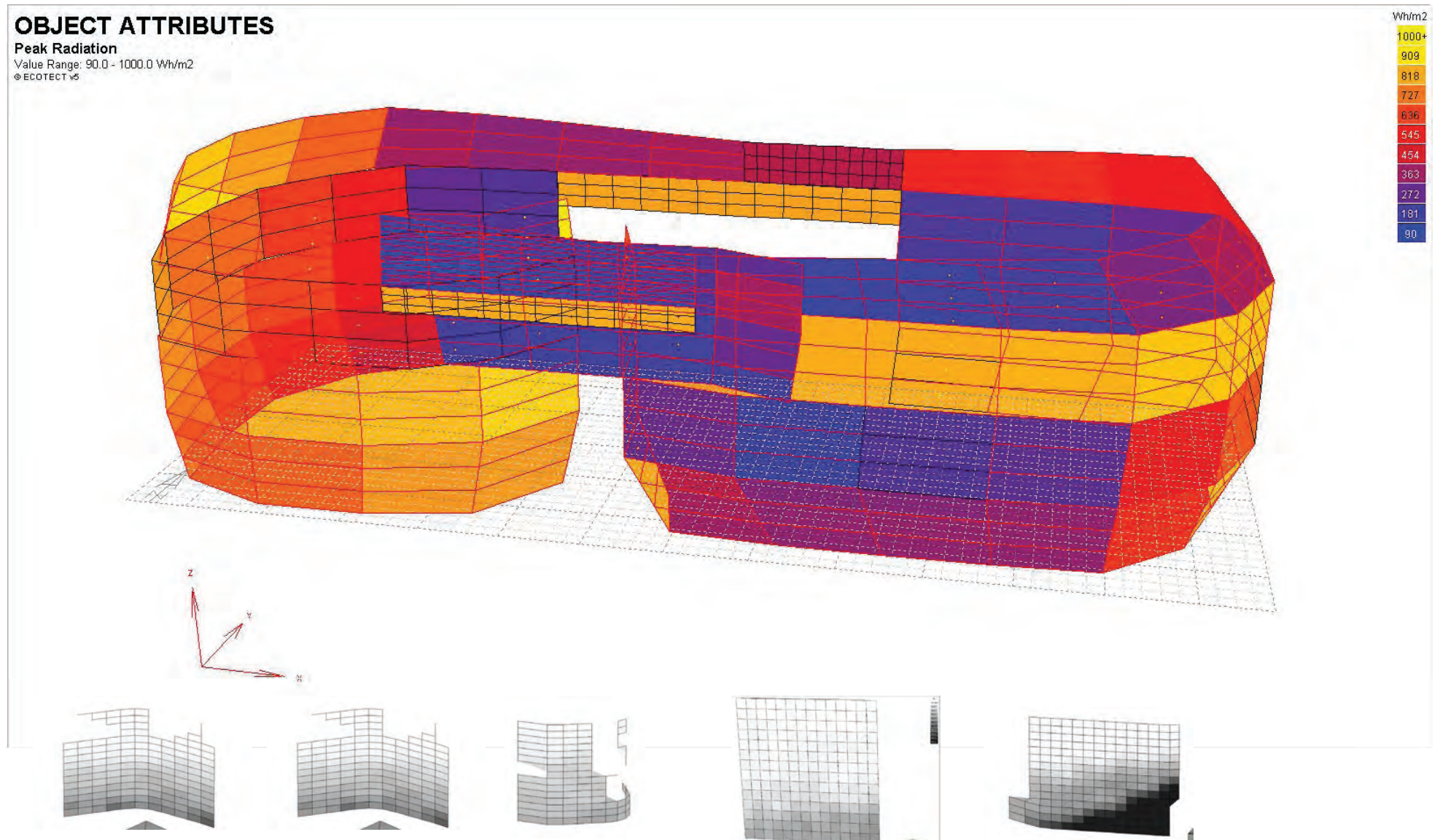




ecotect test for the facade' using Geco plug-in





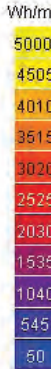
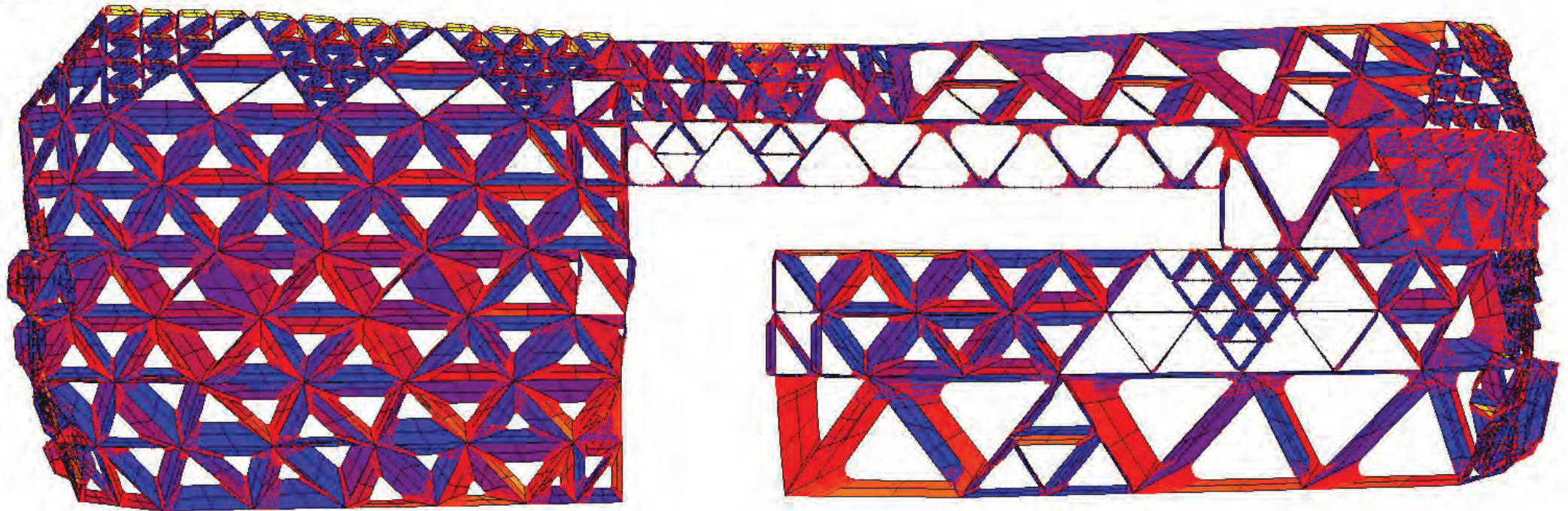


## OBJECT ATTRIBUTES

### Avg. Daily Radiation

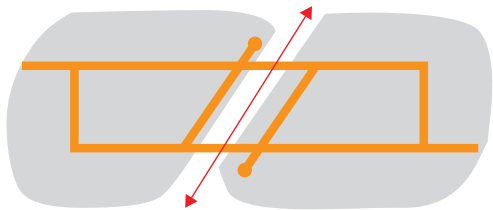
Value Range: 50.0 - 5000.0 Wh/m<sup>2</sup>

© ECOTECT v5

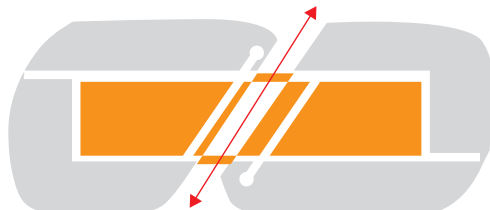




planning scheme - main ideas



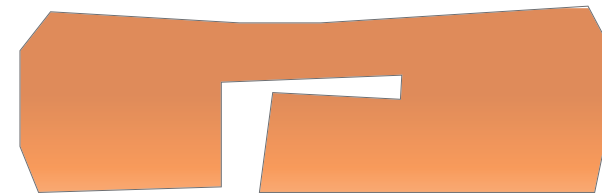
main path and central crossing



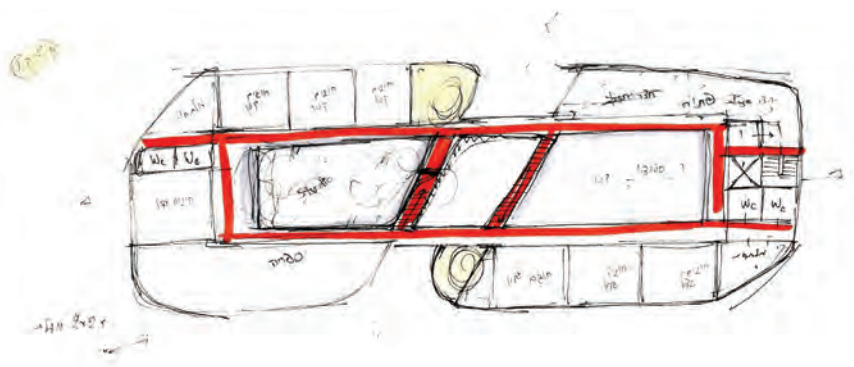
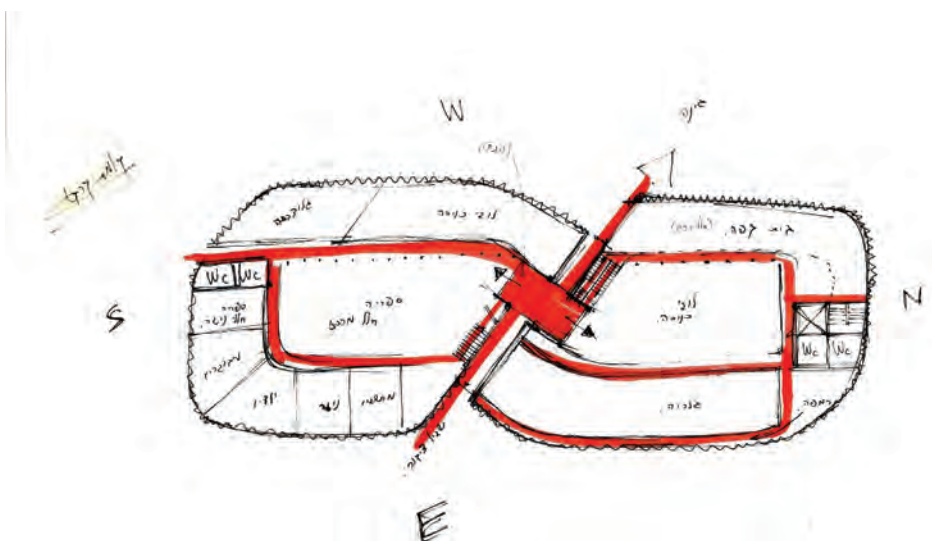
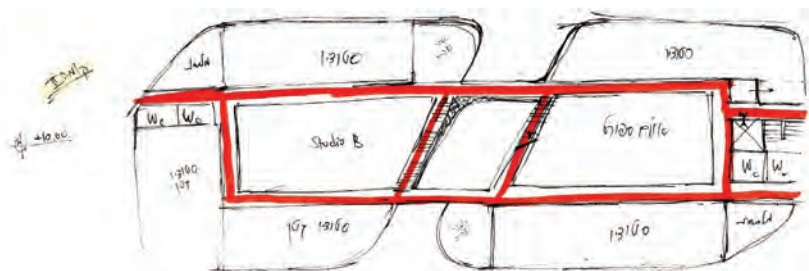
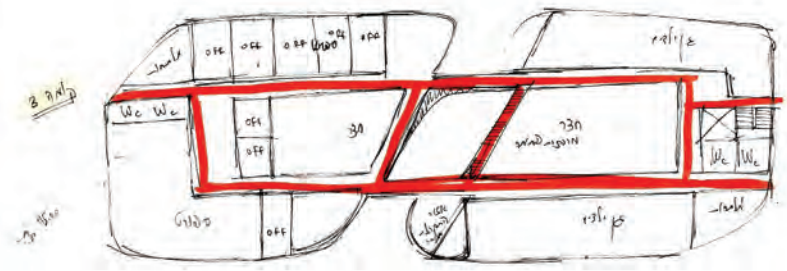
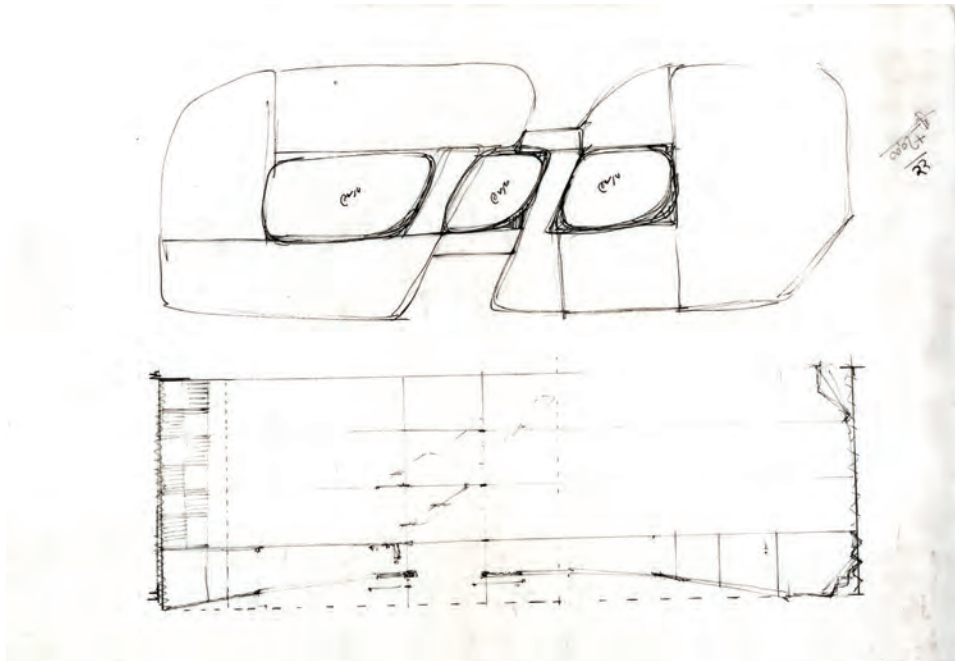
central hall

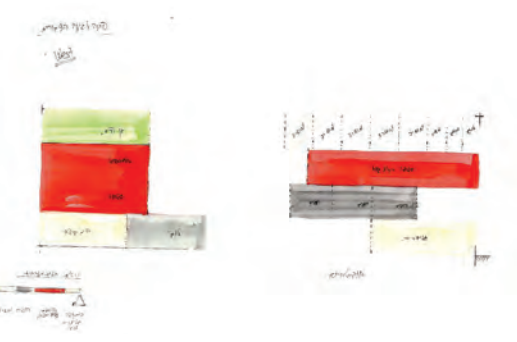
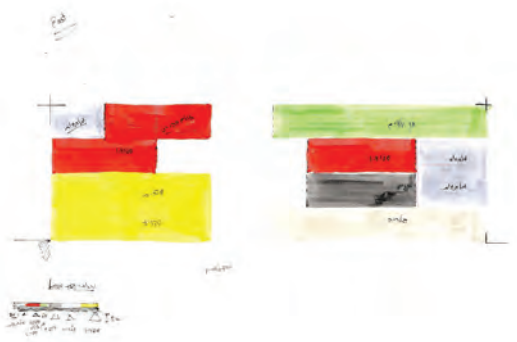
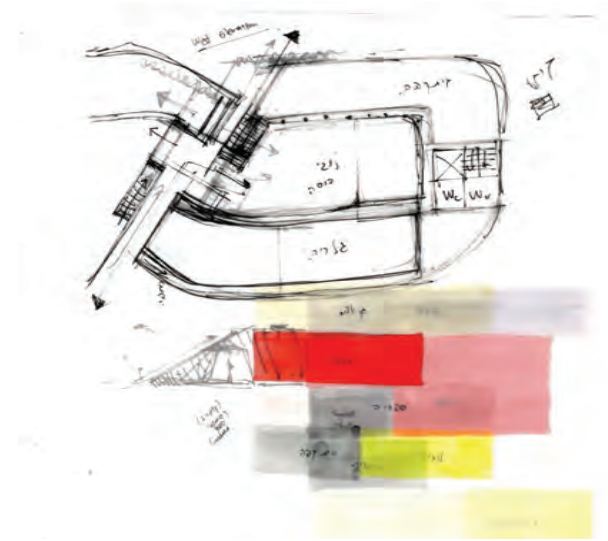
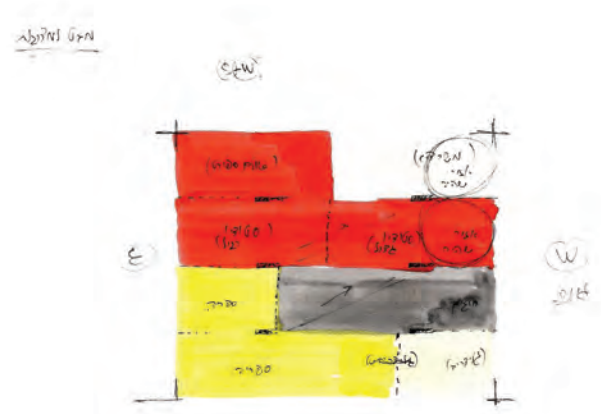
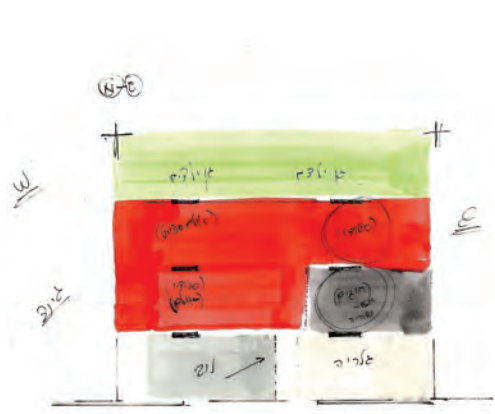


circulation

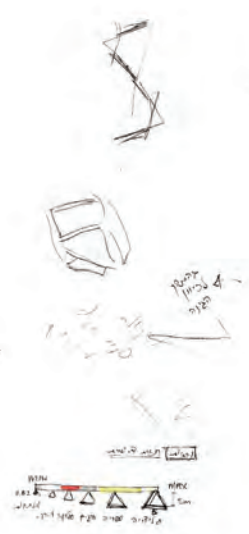
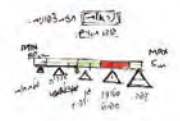
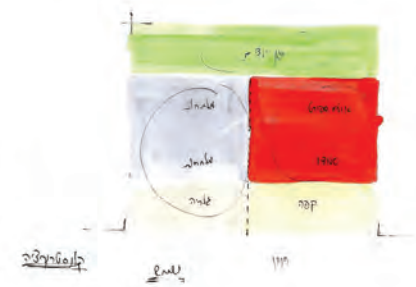


public to private scale

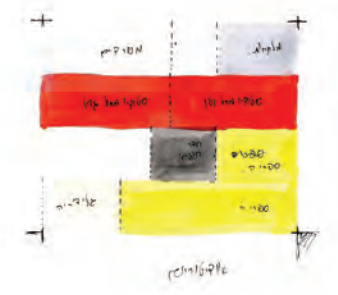


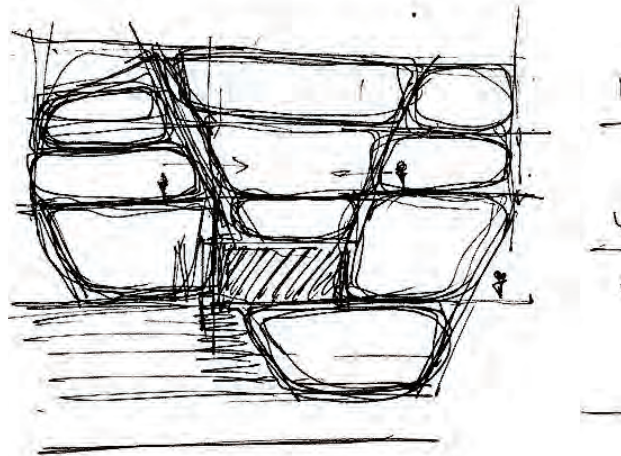
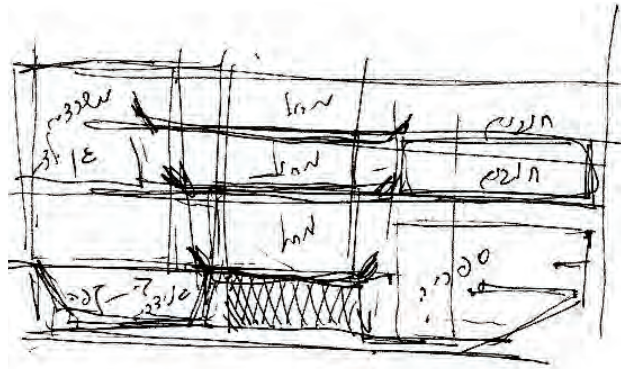


Handwritten text: "Balkon über [North]"

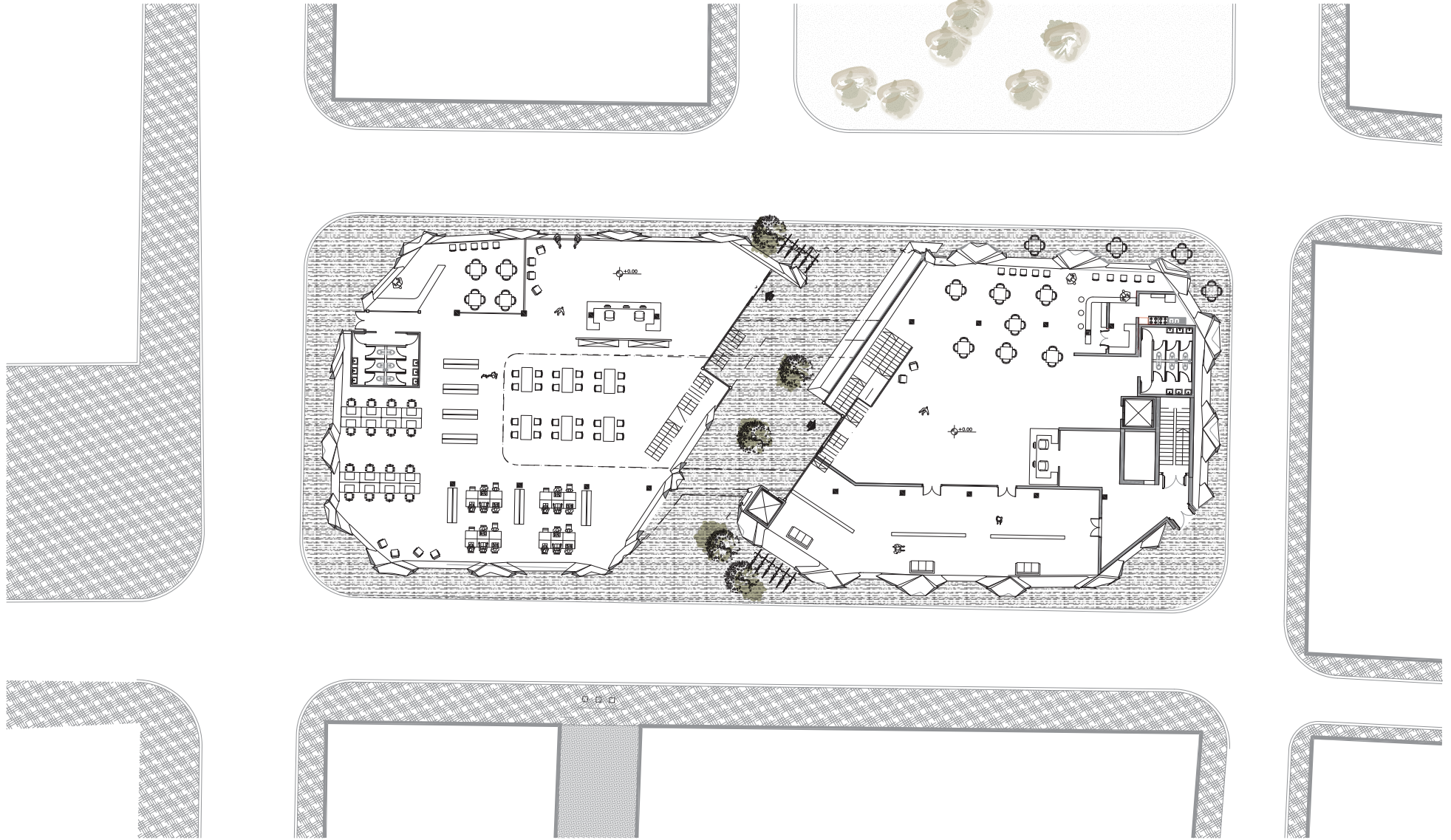


Handwritten text: "South elev"





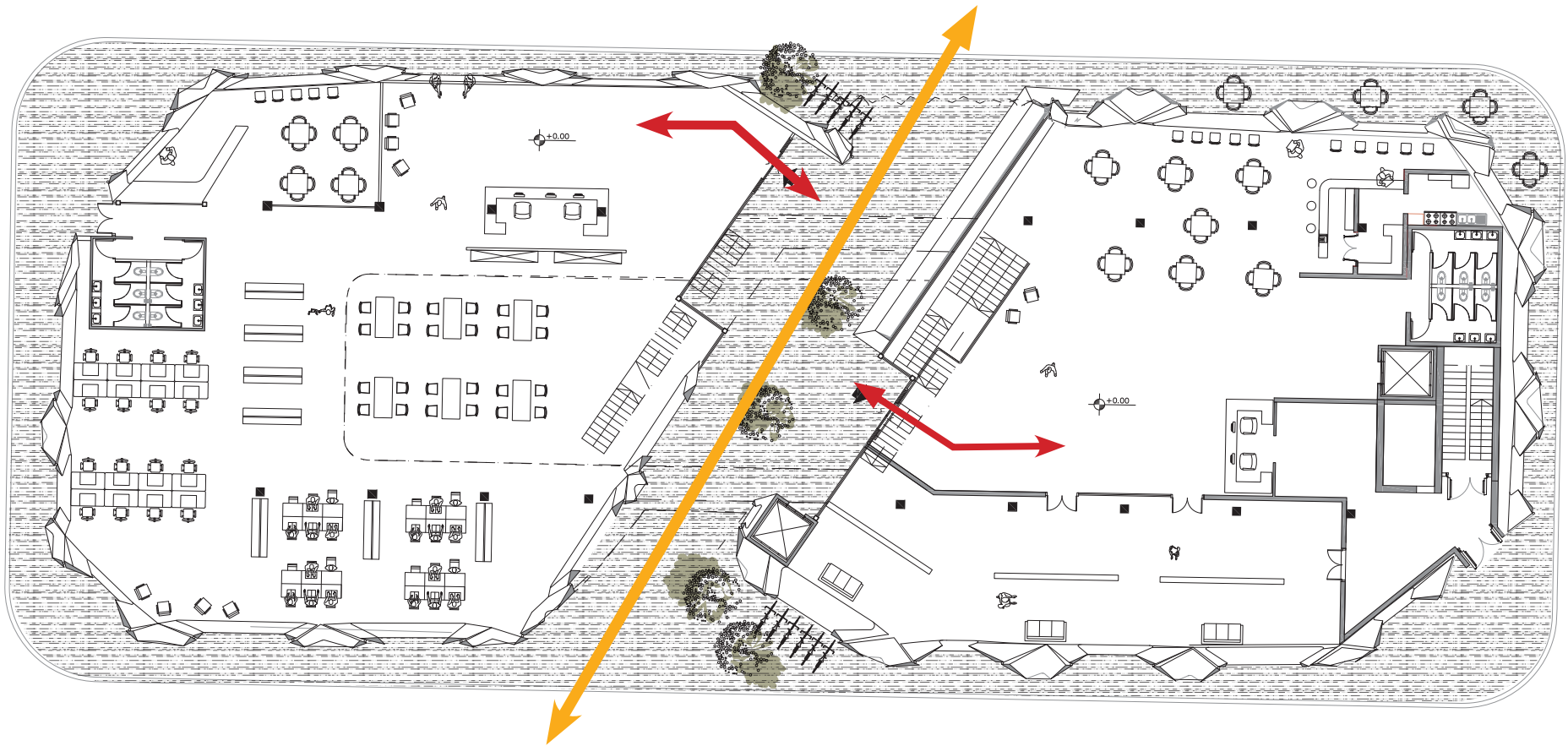
area +ground floor



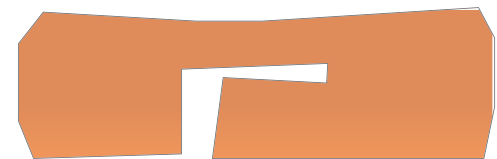
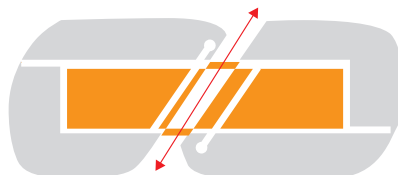
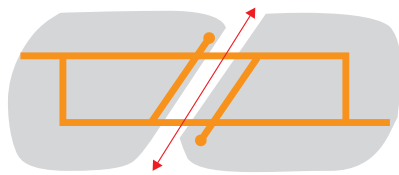
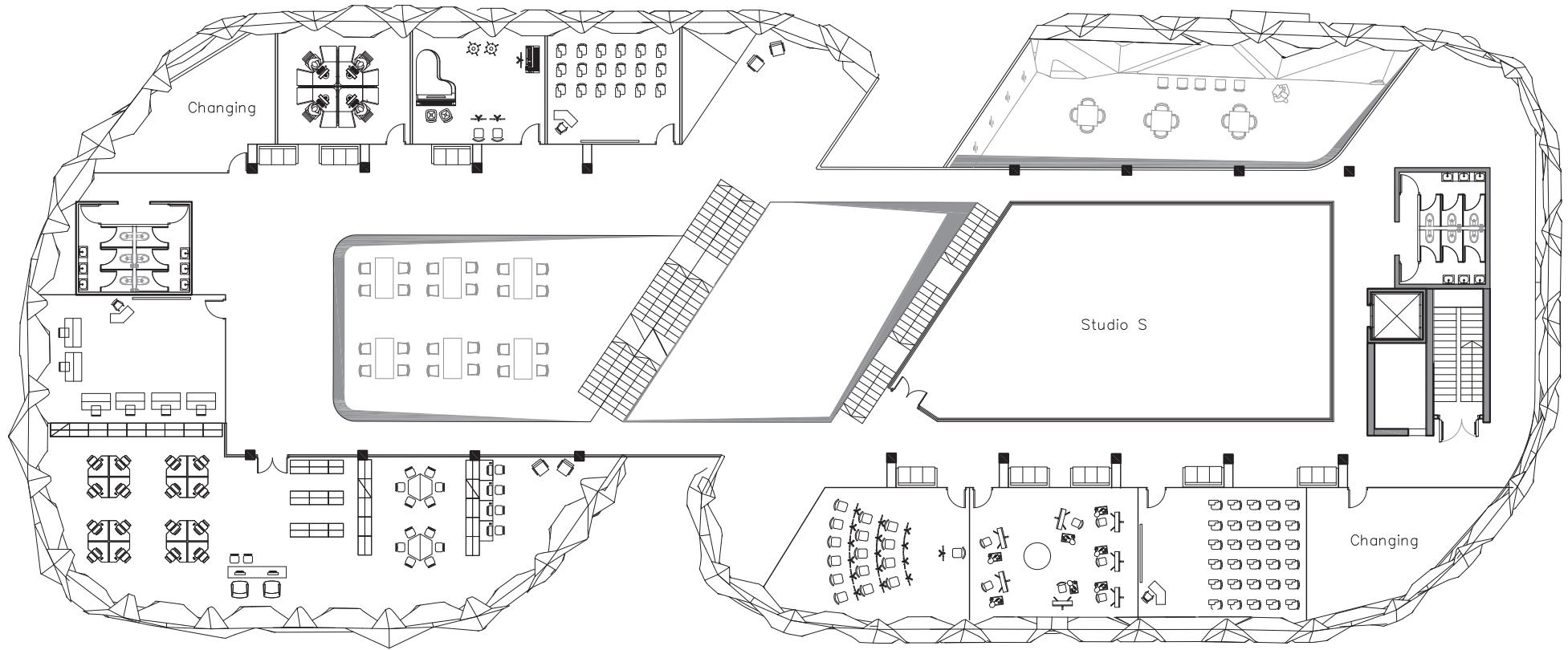
SCBAR\_100 0 1 2 3 4 5 METRES



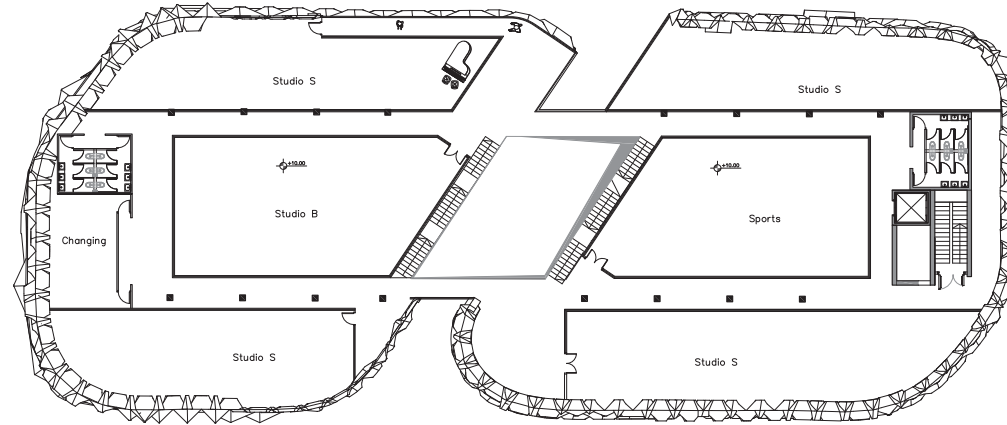
ground floor



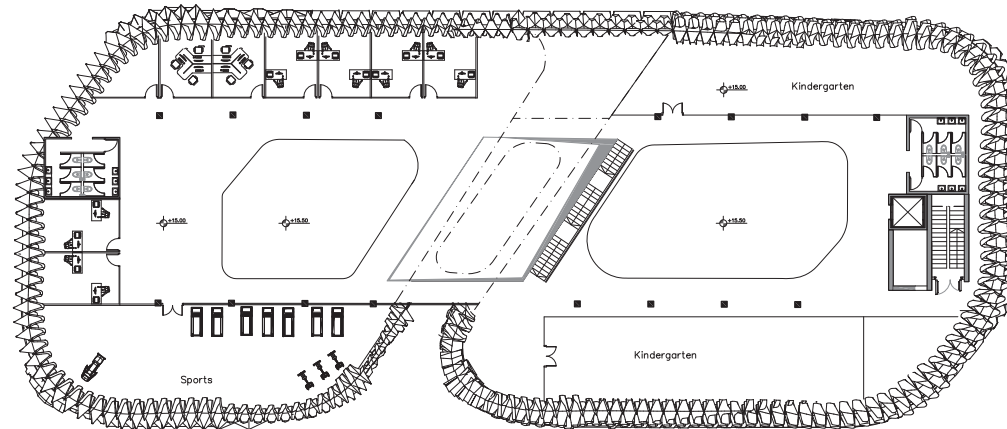
1st floor



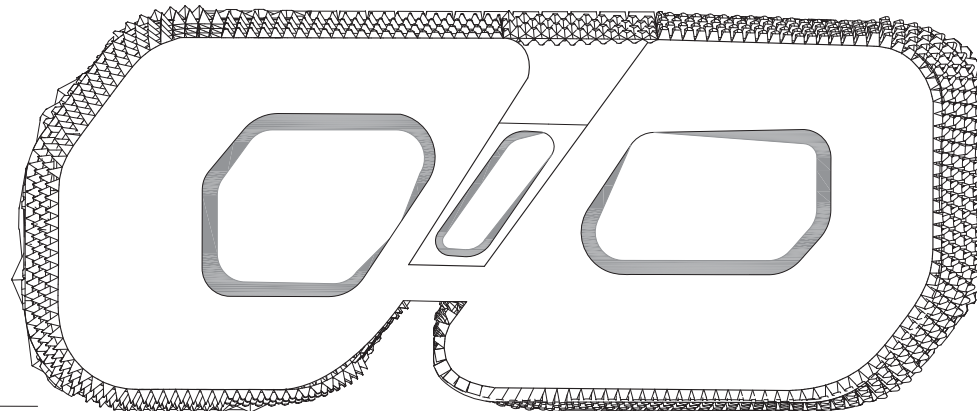
2nd floor



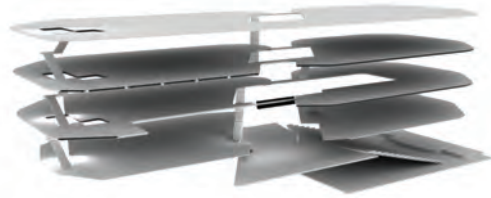
3rd floor



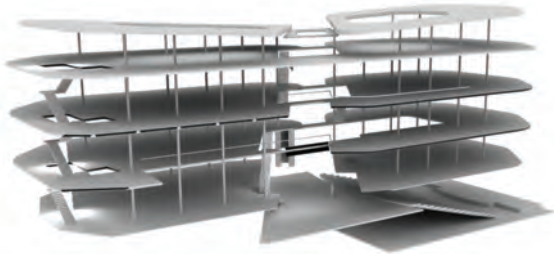
roof plan



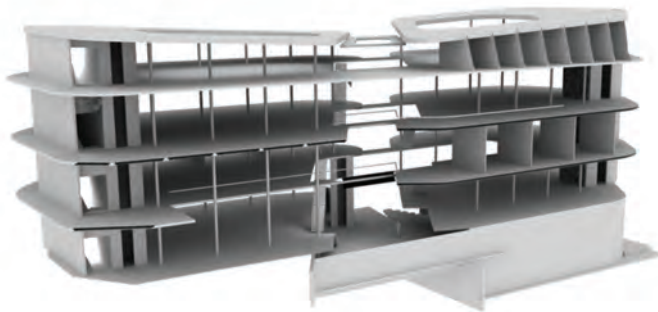




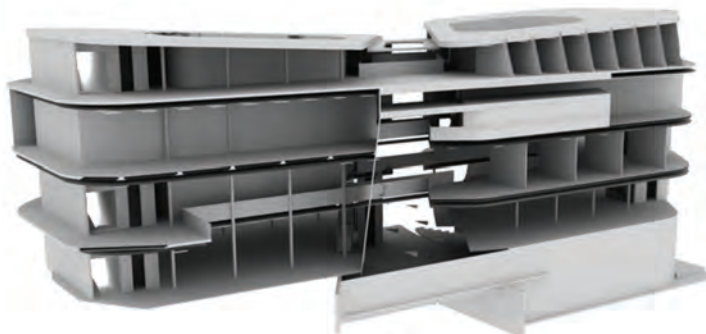
floors



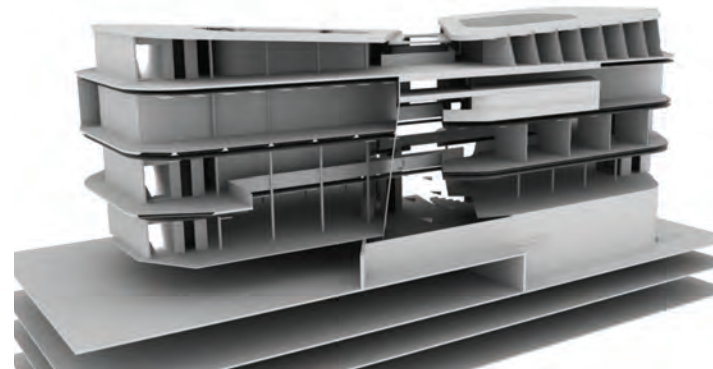
construction



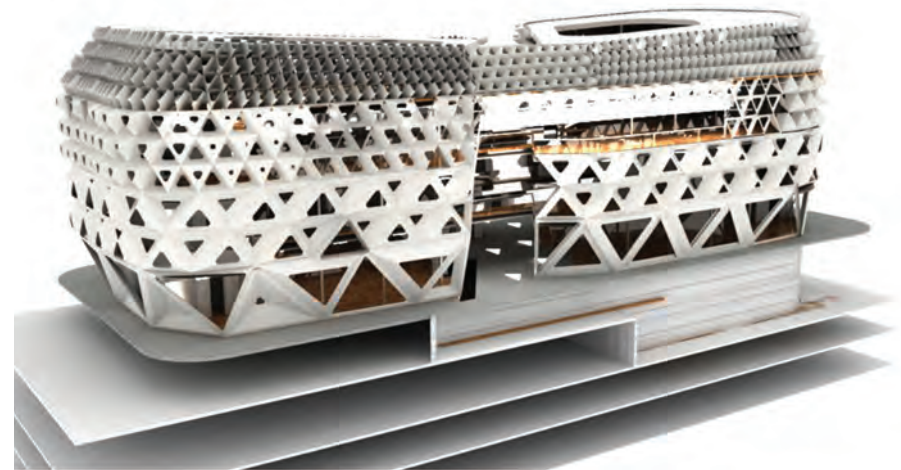
core



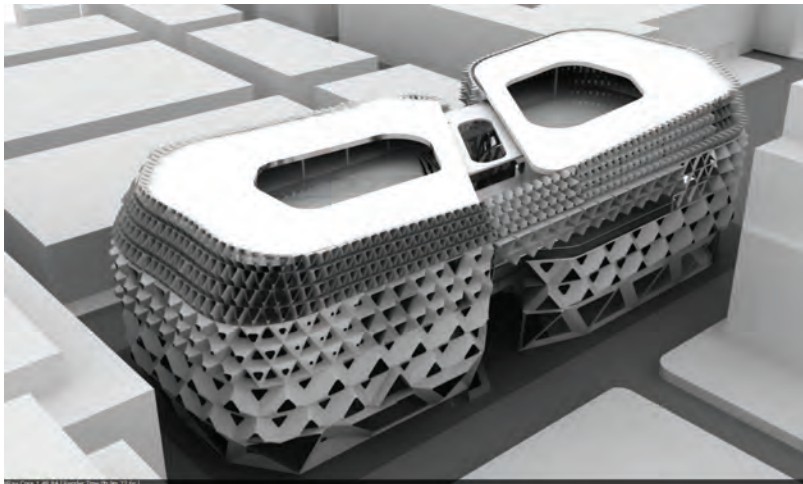
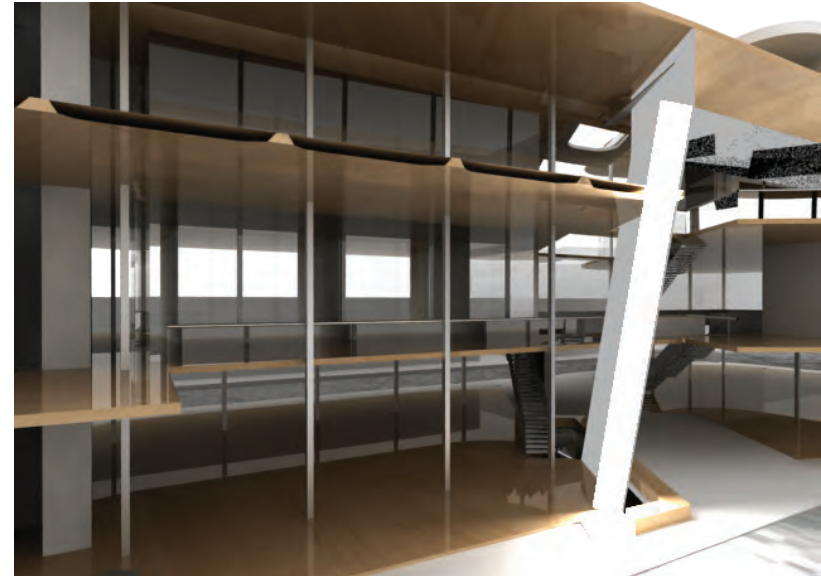
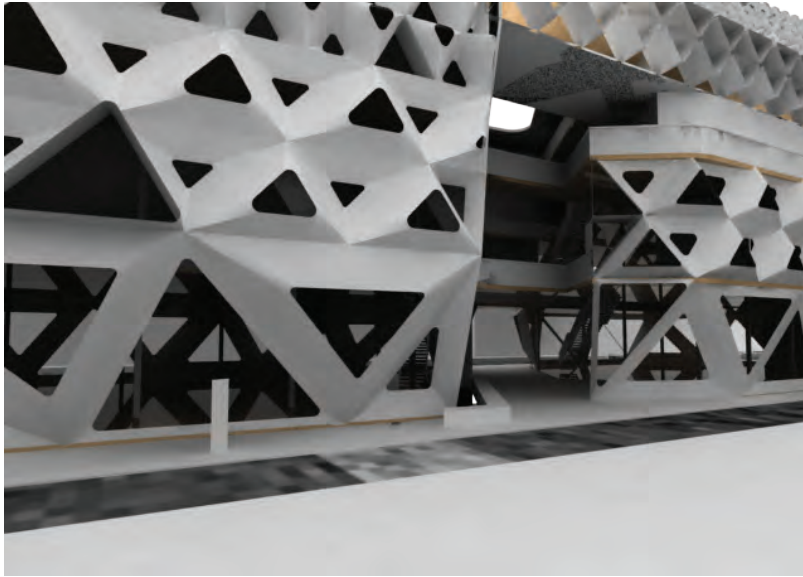
walls and partitions

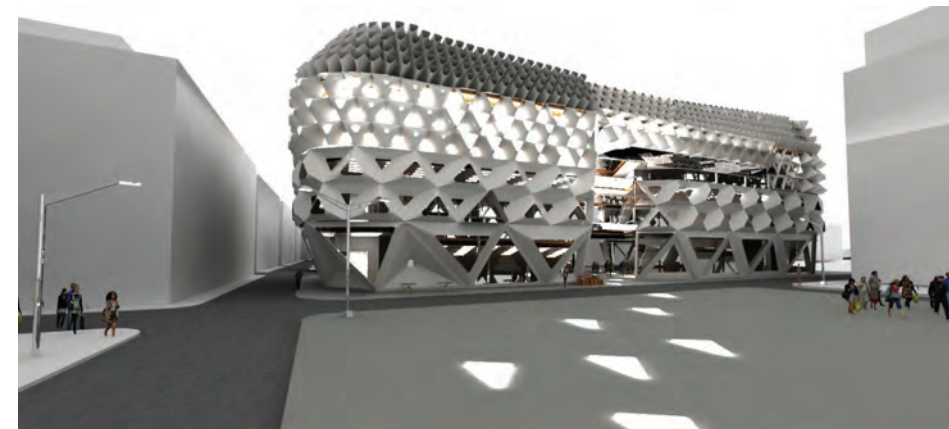
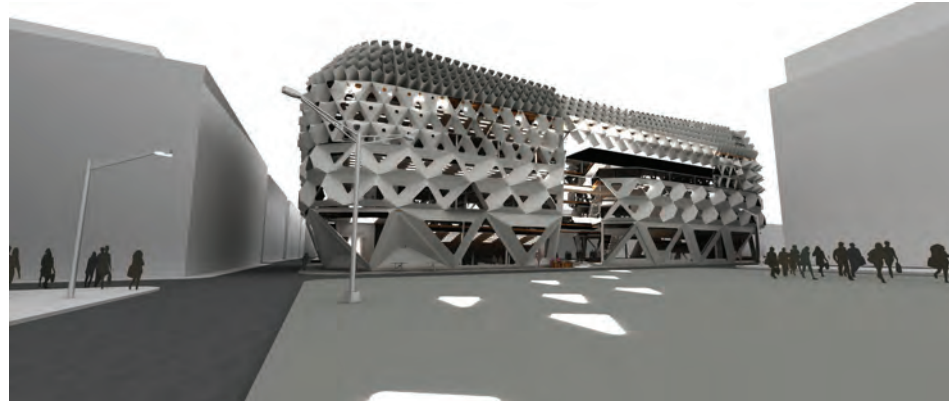
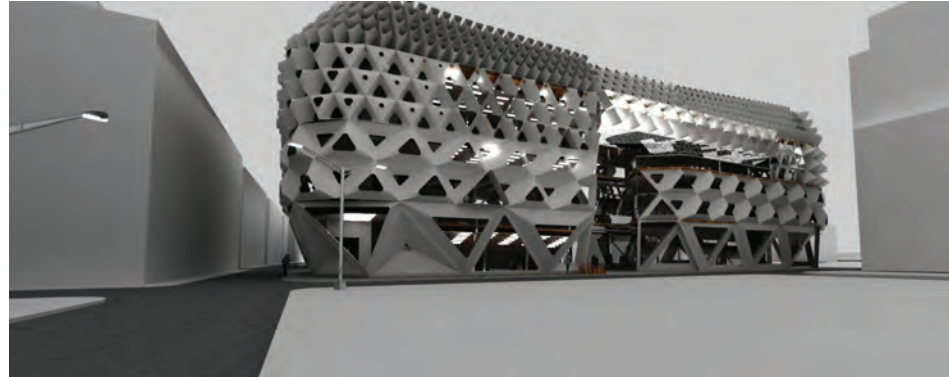


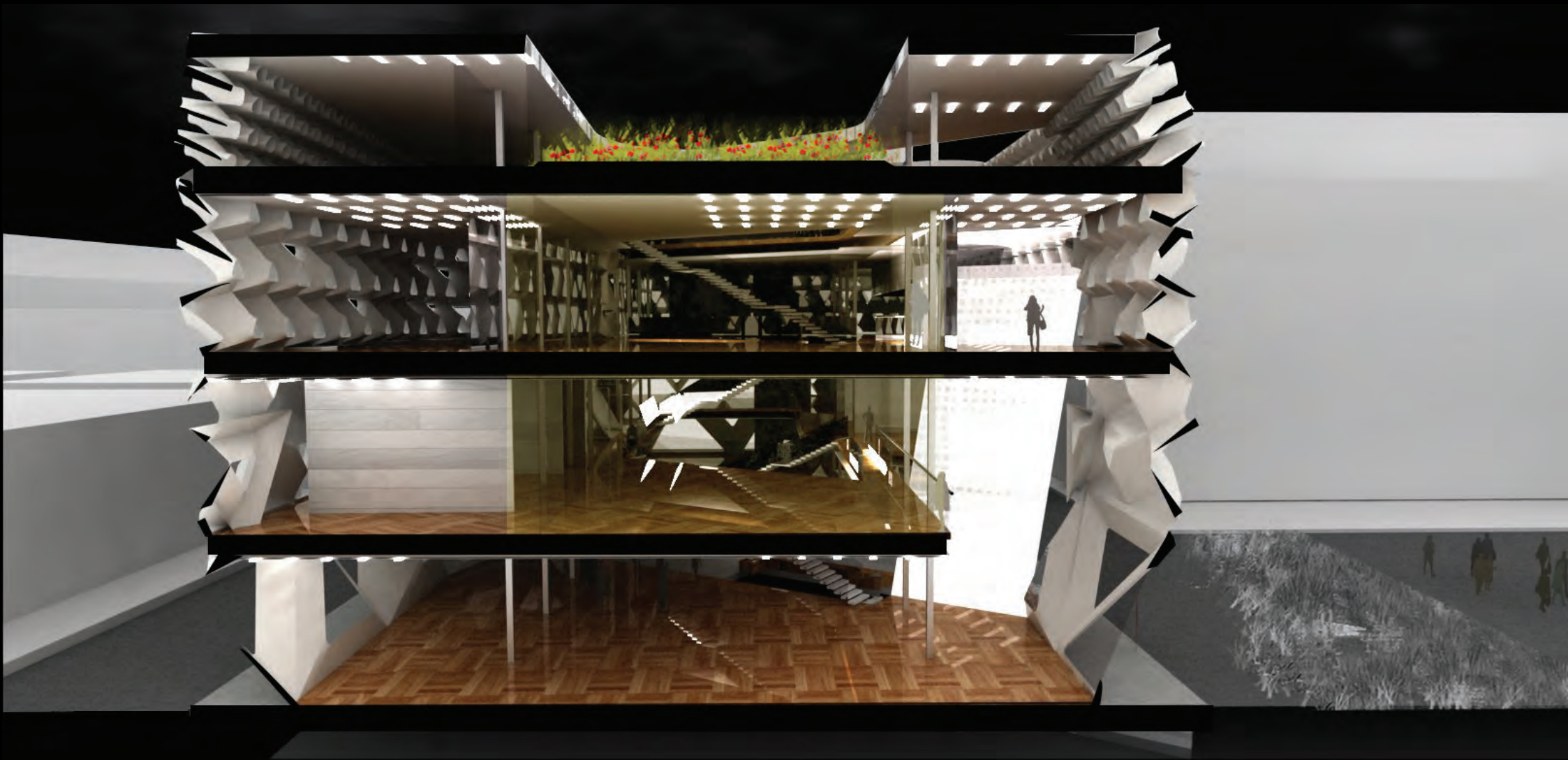
parking & theater

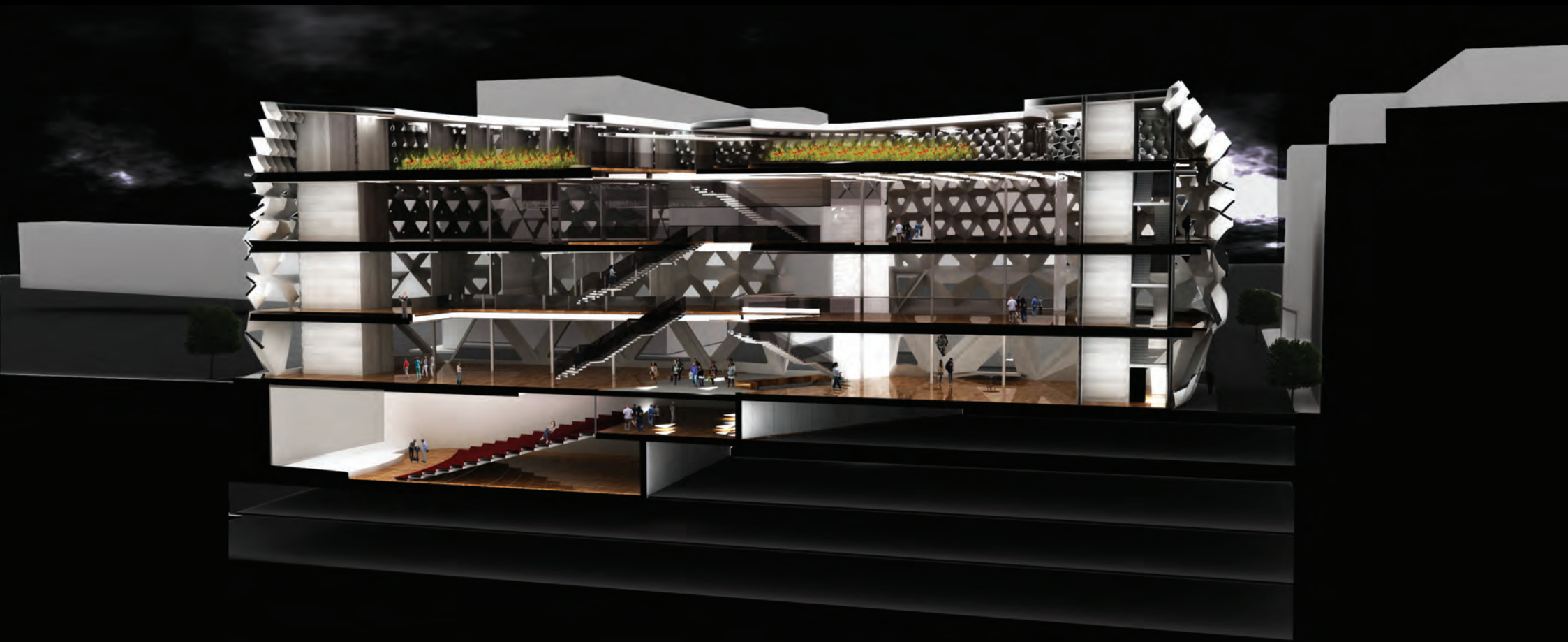


cellular enveloped facade















# Ha'Carmel Community Center

Cellular Structures Studio

Chen Zirinski \ Teacher: Arch. Yasha J. Grobman