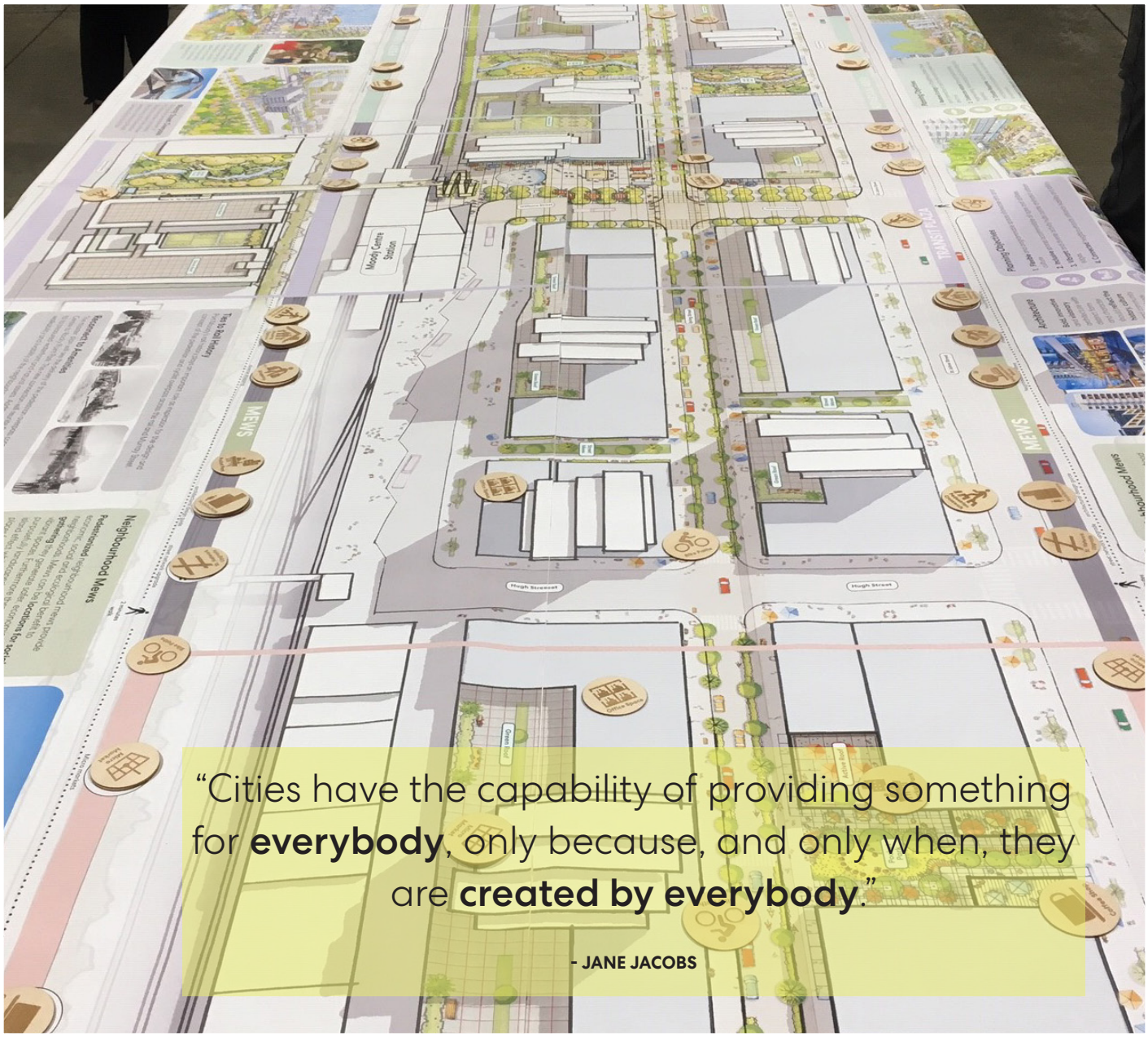
Perkins&Will

Innovation Incubator Spring 2020

Phygital-*UP* : A Co-Design Environment

Viren Kallianpur I October 2020



"Cities have the capability of providing something for **everybody**, only because, and only when, they are **created by everybody**."

- JANE JACOBS

Contents

Front Cover:
Interactive
Table Cloth- Engagement Tool

Left:
Street Room Co-Design Toolkit

“ No one can whistle a symphony. It takes a whole orchestra to play it.”

- H.E. Luccock

Phygital-*UP* is a co-design environment that supports equitable, inclusive, effective and dynamic stakeholder engagement in both physical and virtual environments.

1. Introduction

↑
Collaborative thinking is part of our culture and design process

Introduction

At Perkins and Will, in our effort to address broader social goals and create equitable cities, we strive to have strong and robust stakeholder engagements. While engagement approaches may vary and take different forms, the fundamental principle is that the stakeholders are given an opportunity to participate effectively in the decision-making process. In order to have an effective engagement, both the information and interaction needs to be clear and simple enough to empower stakeholders and provide agency for decision making.

Stakeholders for planning and development projects are wide, and encompass individuals or organizations who have influence on the outcome or are impacted by the outcome in varying degrees. Similarly, the engagement process range from visioning (values, goals, principles, issues, constraints, opportunities) to potential solutions (framework, plans, massing, architecture, landscape, sustainability).

There are various traditional and contemporary tools for engagement, however the focus for this co-design environment is on the latter part of the engagement process- to discuss and collaborate on potential massing, livability and sustainability aspects related to Urban Design, Planning and Architecture projects. It could also be effectively used for landscape & interiors projects with a few minor modifications.

Co-design requires creative and interactive ways to engage with stakeholders. This involves multiple steps including collating the needs and interests of all participants through active listening, developing a common consensus on issues, and seeking potential solutions together. In order to understand the implications and have a meaningful co-design process, there is a need to establish the relationship between choices made and related implications. In addition, people understand, engage, and

Introduction

↑
Public Open House

collaborate effectively on values, issues, opportunities, challenges, priorities but discussions regarding built form tend to be focused on density and height. Often height and density are used interchangeably, when in fact they are different aspects.

While there are physical and virtual tools for design charrettes, workshops and open houses, each have some pros and cons. Tools such as physical models, drawings and boards are effective for meaningful conversation but are relatively static as information is frozen at a certain point of time prior to the presentation. Digital tools such as presentations, videos, fly throughs or even some virtual reality tools are engaging but are also created prior to the event, with limited content produced that is actually a result of the engagement.

The uncertainties brought on by the COVID-19 pandemic, both in terms of the time and risks involved, have a huge impact on projects, especially stakeholder engagement.

Over the last six months, we have ramped up our research on virtual engagement tools for surveys, issues, priorities, values, talk series, collaboration and so on. We have embarked upon and adopted collaborative tools such as Whiteboard, Freehand by Invision, Mural, Miro and other similar tools that enable team members, clients and consultants to brainstorm. This makes one think about what it would mean for co-design platforms that offer design explorations in three dimensional environment especially with larger community groups.

There are multiple AR/VR platforms such as Sketchbox, Spatial and The Wild that provide immersive 3D environments. However most of these tools have a few limitations:

a. A passive environment to experience and respond to what they see. While the experience may be dynamic and immersive, the content is static.

b. Interacting environments require investments in both hardware and software which becomes a challenge from an equity, technology and logistics standpoint.

What if there is a co-design environment that is dynamic in allowing project teams to engage with stakeholders, empowering them to make choices, and providing a feedback loop enabling the creation of a reliable basis for decision making?

AR/VR Platforms & Dependence on Equipment
From top to bottom: AR/VR platforms: The Wild, Spatial, Sketchbox and Head Mounted Display and controllers.

Literature & Tools Review

	INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
PUBLIC PARTICIPATION GOAL	To provide the public with balanced and objective information to assist them in understanding the problem, alternatives and/or solutions.	To obtain public feedback on analysis, alternatives and/or decision.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision-making in the hands of the public.
PROMISE TO THE PUBLIC	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.

↑
IAP2 Public Participation Spectrum (Source: *IAP2)*

Collaboration and Engagement

The Public Participation Spectrum, developed by The International Association of Public Participation (IAP2) outlines five levels of participation-*Inform, consult, involve, collaborate* and *empower* with their respective goals and promises to the public (ref. Image above)

While the spectrum helps to select the level of public participation, at Perkins and Will, we strive to empower stakeholders, build consensus and co-create a solution, while providing thought and design leadership.

Co- Design

The complexity of the problems facing cities and society at large need a more holistic approach, one that takes into consideration different perspectives and is trans disciplinary in nature. The definition of the problem needs all stakeholders to come together, use different lenses and bring their individual experience and unique perspectives to the forefront.

Josh Chisholm, Senior Research Associate at Lancaster University defines Co-design as an approach that " *goes beyond consultation by building and deepening equal collaboration between citizens affected by, or attempting to, resolve a particular challenge. A key tenet of co-design is that users, as* 'experts' of their own experience*, become central to the design process*."

As designers, our role of facilitators is an essential part of a successful co-design process, where we create opportunities for participants to engage with each other, share issues, concerns, opportunities, and share insights and test ideas.

The co-design process could happen between team members, consultants, clients, stakeholders, community and City, with various agendas and outcomes. While each event might differ in the format, duration and content, the aim is to leverage the individual experience, build collective intelligence for the project and find potential solutions.

Co-Design does not mean losing the authorship and leadership, in fact it needs more effort, strategic planning, coordination and respectful dialogue to positively influence and direct the evolution of the design. Co-Design is not a way to loosen the grip on the project, but instead provide thoughtful and strong leadership.

Literature & Tools Review

SHAPE DIVER

Review

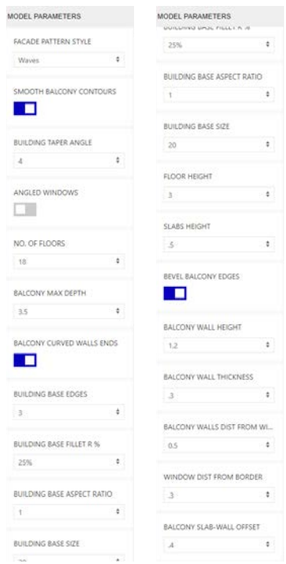
Shape diver is a subscription based, interactive web based platform that turns parametric CAD models into interactive 3D models.

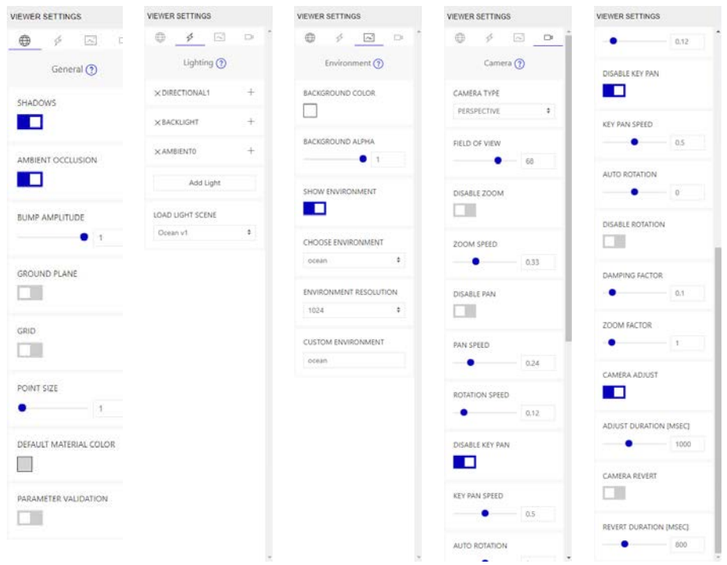
Rhino models with grasshopper can be used to customize the parameters that enable collaborators to interact with the model.

- Fast and easy to use. No coding required.
- Embed the 3D interface with websites.
- Built in, easy to use display parameters including lighting and navigation.
- Expensive (Euro 99-999/month)

Model Parameters

Customized





Viewer Settings

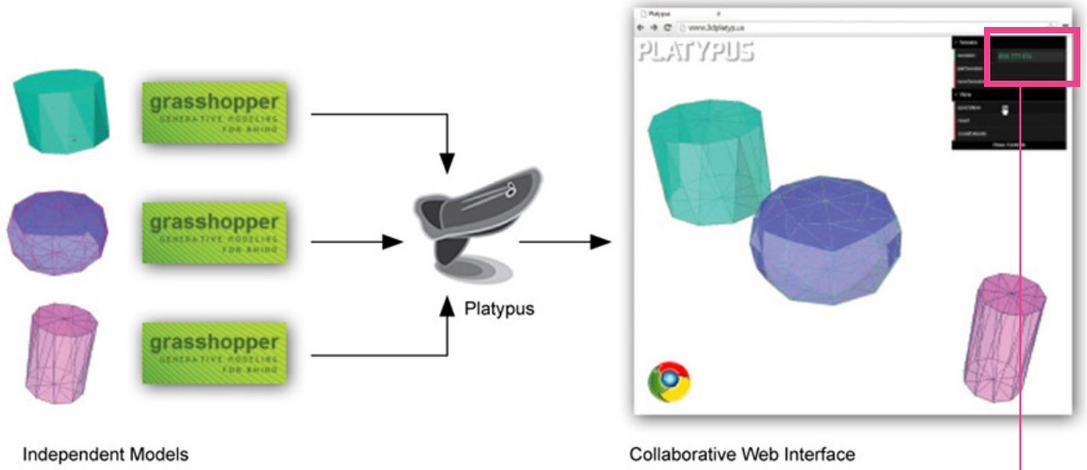
General

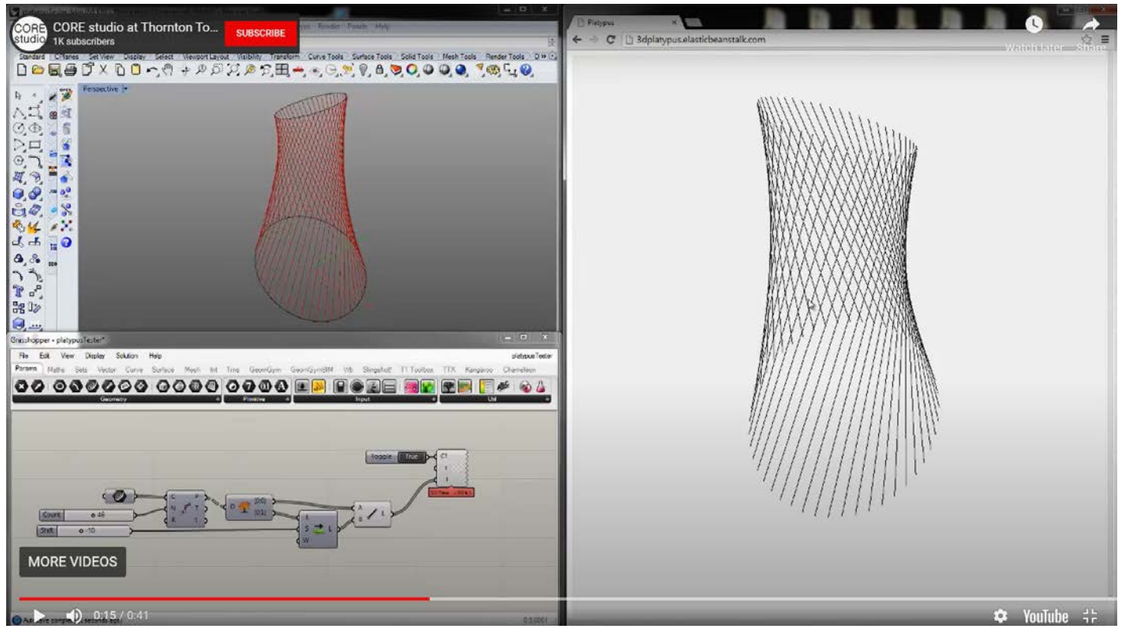
Lighting

Environment

Camera

Literature & Tools Review





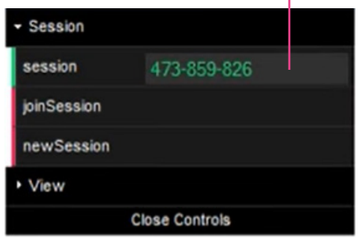
PLATYPUS

Review

Developed by Thornton Tomasetti, Platypus is a tool that allows Rhino + Grasshopper geometry to be streamed to the web live in real time.

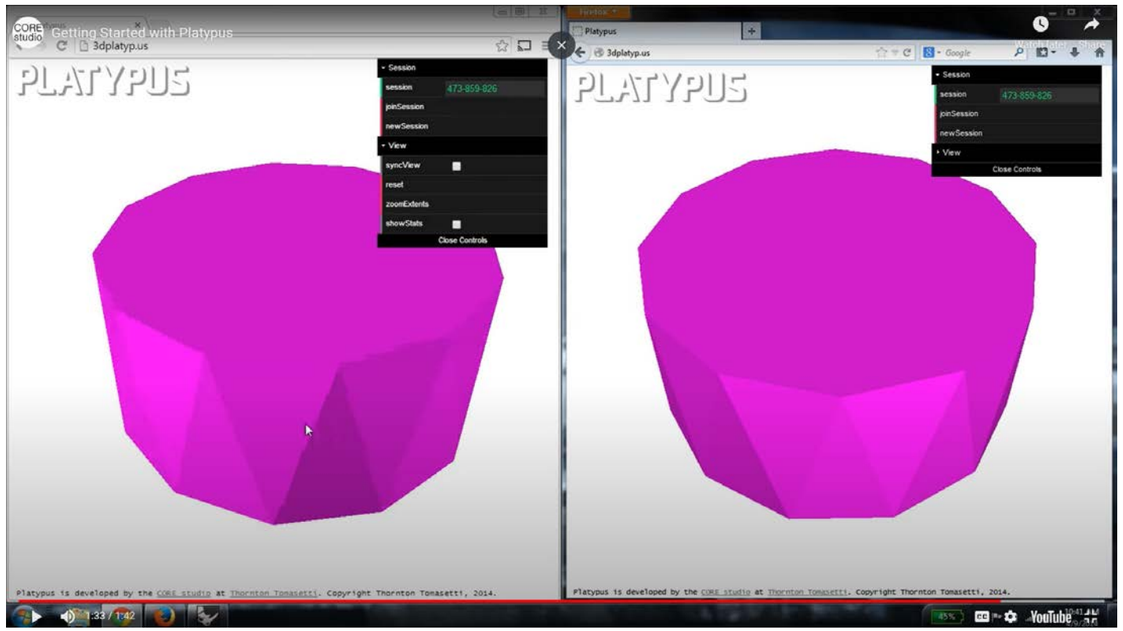
Once a Platypus session is set up, multiple grasshopper authors can stream geometry and multiple viewers can join and interact with the streamed model using the online interface.

- Fast and easy to use. No coding required.
- Easy to use and customizable
- It seems to be a more effective tool for grasshoppers to share their content. Viewers can rotate, zoom and pan the models. Viewers do not have the controls to change, amend or play with different settings (in comparison with Shape Diver)
- There is another limitation. It exports only Mesh and not any other type of geometry
- There are also limitations on the mesh faces (50,000) and line counts (10,000).
- Smaller models work better and do not cause much lag.
- Plugin was developed as part of a research project in 2014 and has been decommissioned and replaced by other plug ins.

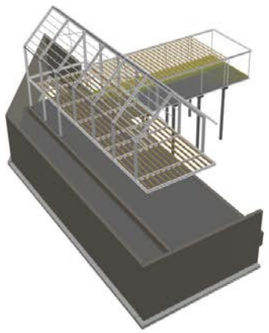


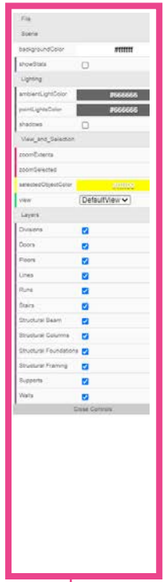
Session ID is used to connect the Grasshopper to the Web. This id needs to be copied and pasted in the GH definition to synch with the web browser.

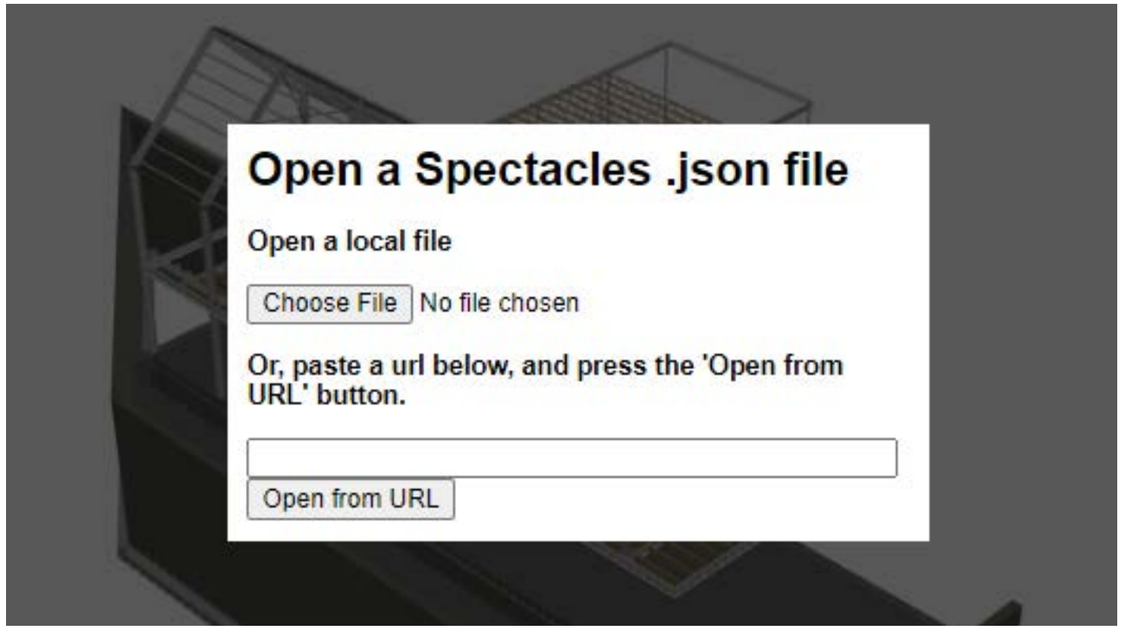
The same session ID can be shared with multiple viewers. There is a syncView option that can be toggled on and off, to enable synchronized viewing, for instance- if one user rotates the model, all other see it being rotated in real time.



Literature & Tools Review







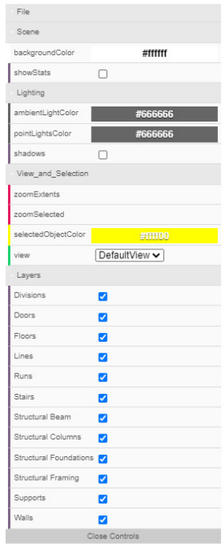
Spectacles is developed by the CORE studio. Copyright Thornton Tomasetti 2015.

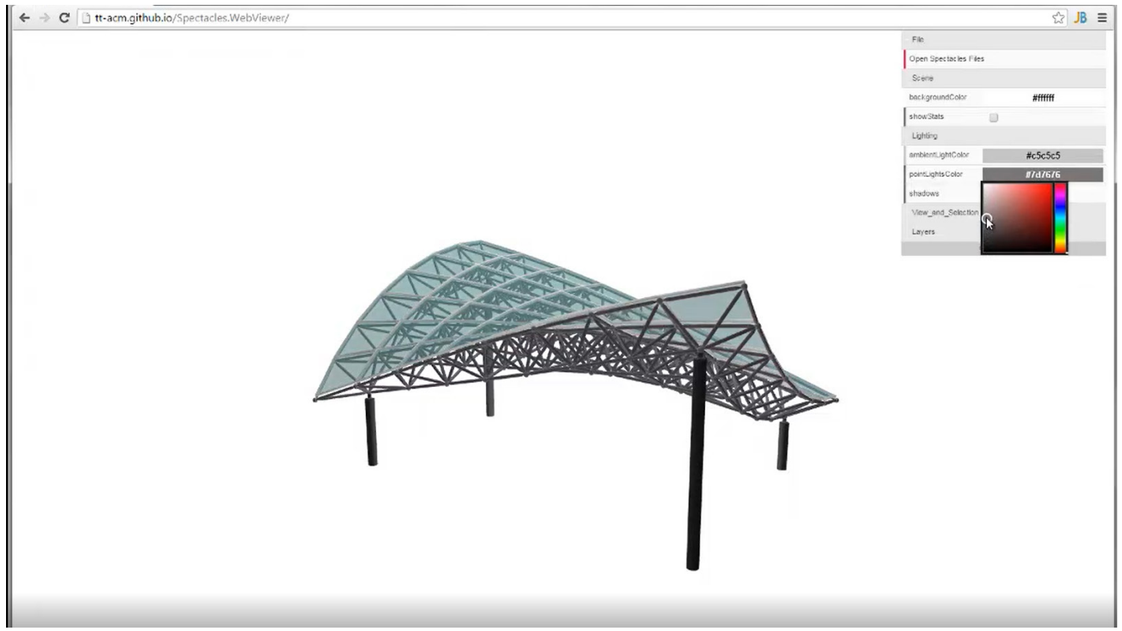
SPECTACLES

Review

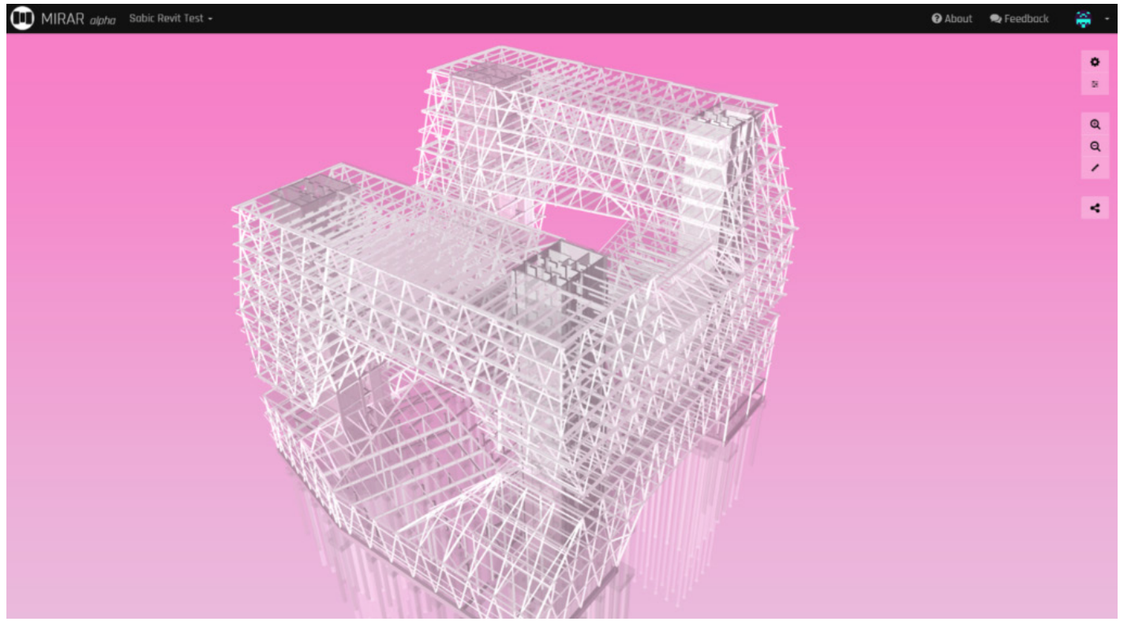
Developed by Thornton Tomasetti, Spectacles is a tool that allows Rhino + Grasshopper geometry to be streamed to the web live in real time. This is a GH definition that is included in the TT toolbox.

- Fast and easy to use. No coding required.
- Built in, easy to use display parameters including lighting and navigation.
- The model is exported with layers, which could be used by viewers to interact the model
- Viewers can also click on elements to get customized element attributes such as stats, areas, levels, volumes, elevation, layer information, element id.
- All geometry needs to be converted to spectacle meshes before being exported to the spectacles viewer.
- There are spectacle material also available within the plugin.
- Different preset views can be exported to the spectacle viewer
- After creating the spectacle file, the web viewer can be launched
- JSON (JavaScript Object Notation) file is created which can then be opened in the web browser.





Literature & Tools Review

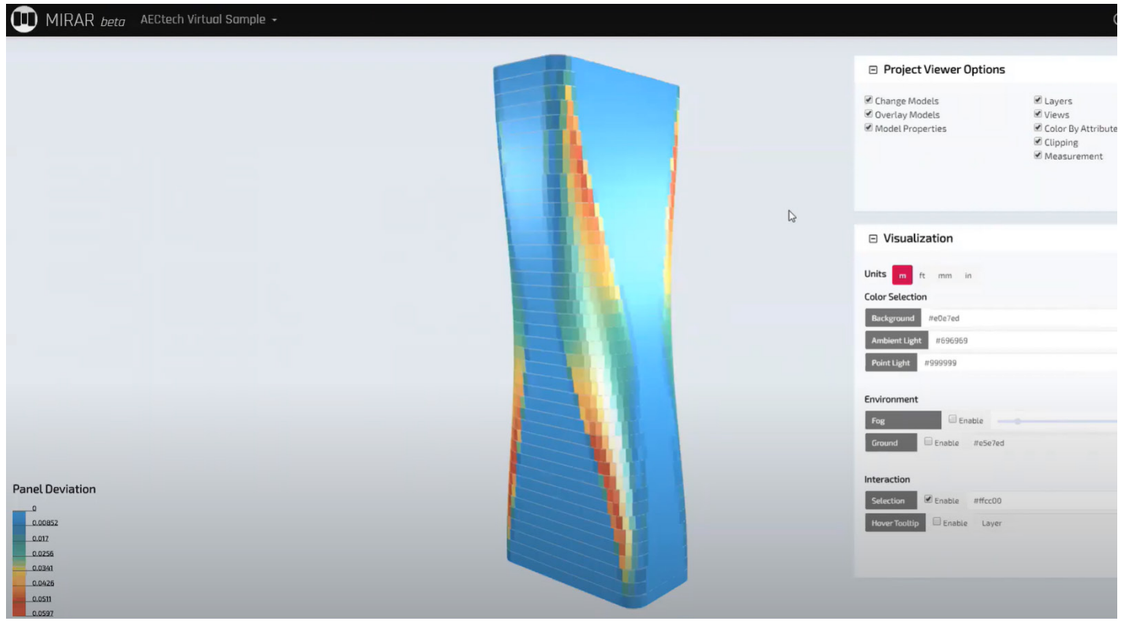


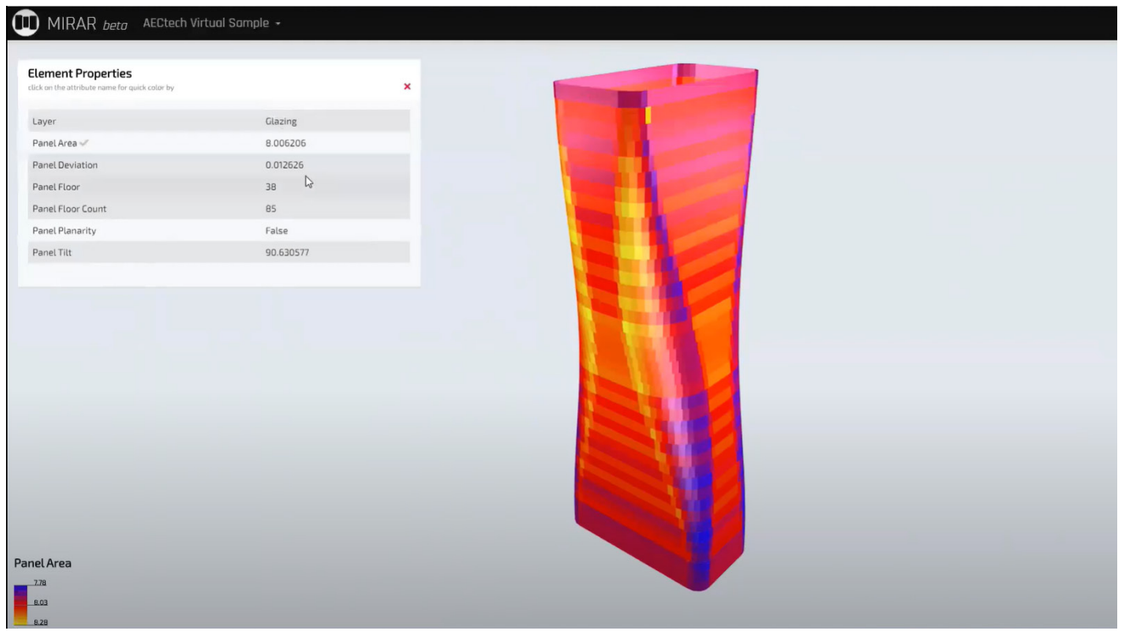
MIRAR

Review

Developed by Thornton Tomasetti, Mirar is a tool that allows Rhino + Grasshopper geometry to be streamed to the web live in real time.

- Fast and easy to use. No coding required.
- Built in, easy to use display parameters including lighting and navigation.
- The model is exported with layers, which could be used by viewers to interact with the model
- Viewers can also click on elements to get customized element attributes such as stats, areas, levels, volumes, elevation, layer information, element id.
- All geometry needs to be converted to *spectacle* (plug in) meshes before being exported to the spectacles viewer.
- There are *spectacle* material also available within the plugin.
- Different preset views can be exported to the *spectacle* viewer
- The model can be directly launched in the web browser from the GH definition
- Mirar is built using the in-house *spectacle*, is in Beta testing and is available to TT staff and project teams.





2. Basis of Design

The How?

“ We cannot always have everything our way. As co-creators of a shared reality, our free will always operates within the confines of the collective consciousness.”

- Anthon St. Maarten

Design Charrette

Concept

The conception and development of the co-design environment that enables collaboration and co-creation between designers and stakeholders is based on the following key objectives:

1. **Integrated with Design Process**: The Co-Design environment should support, enhance and be synergistic with the existing design process and tool ecosystem. Within the Urban Design and Planning practice, most of our work is done using Rhino3D, Grasshopper and Adobe softwares.
2. **Economic**: In order for the platform to be used effectively, it is ideal to be low cost and utilize existing resources to the maximum extent.
3. **Equity**: In order to reach out to everyone and get their inputs, it is critical to have a platform that has minimum thresholds to use. While there is a digital divide, especially in certain communities or areas of a city, not everyone may have access to a computer or smart phone. While this issue needs to be addressed, it is beyond the scope of the project. The project assumes everyone has access to internet or is provided one through engagement, and can participate actively through a web interface. With the intention to provide a platform that is economic and accessible to everyone, limited equipment should be needed to participate effectively.

Collaboration

Public Participation and Collaboration Events

Pre-COVID collaboration and discussion between stakeholders were planned and facilitated using different formats based on the intent, purpose and outcomes. From public open houses, design charrettes, brainstorming workshops, site walks, focused stakeholder meetings to community gathering events, effort was needed to plan, find venue, invite and maximize attendance by limiting any obstacles that prevent potential participation. These could be allowances, child care, food and beverage, and transportation.

Formats

There are multiple formats for collaboration and engagement:

	1	2	3	4
Workshop	E	E	E	E
Public Open House	E	E	O	O
Survey	O	O	O	O
Suggestion Box	O	O	O	O
Hotline/phone-in	O	O	O	O
Public Meeting	E	SR	SR	O
Online Forum	SR	SR	SR	SR
Stakeholder Meeting	E	SR	SR	SR
Focus Group Meeting	SR	SR	SR	SR
Site Tour	O	O	O	O
Dialogue	SR	SR	O	O
Speak out	O	O	O	O
Quick 1 question Online Poll	O	O	O	O
PlaceSpeak	O	O	O	O
Charrette	SR	SR	O	O
Community Mapping	O	O	O	O
Future Search Conference	O	O	O	O
Study Circle	SR	SR	O	O

E- Essential; SR- Strongly recommended; O-Optional

1- High Municipality-wide Impact ; 2- High Area and /or Group Impact;

3- Modest Municpality-wide Impact; 4. Modest Area and/or Group Impact

(Source: Community Engagement Toolkit, SparcBC, 2013)

Virtual Engagement

The New Normal

With the pandemic, the logistics for planning engagement events are different. While there is less stress on the venue and planning, there is considerable effort to plan these virtual events, there are technological and behavioural changes that need to be supported. These are new and unfamiliar to many, leading to some discomfort and unease which needs to be accommodated in the planning. While people have embraced online and virtual tools, there is much to be learned and advanced to make this transition to the new normal better, efficient, comfortable, and reliable.

There are several online engagement tools:

Library of Resources- Inform; Library of Background Information

Quick Poll- Opinions**;** Low effort; Quick snapshot of public sentiment

Surveys- Efficient, cost effective; gather large scale data; need to be unbiased

Discussion forums- more in depth look at issues

Map-based commenting- spatial approach-"where"

Social Media Integration- spread the word; build publicity

Participant Notification- build relationships; close the loop

Decision Making Surveys

Citizen Space- Manage, publicize and archive all public feedback activity : http://www.citizenspace.com/

Poll Everywhere- Engage audience in real time https://www.polleverywhere.com/

Survey Monkey- Survey ranges from simple poll to in-depth market research: https://www.surveymonkey.com/

Wecision- Capture and communicate the decision rationale of often conflicting stakeholders: http://wecision.com/

Interactive Project Sites

Consider It- Collect feedback, engage stakeholders, make group decisions, teach critical thinking; https://consider.it/

coUrbanize- Project information for development proposals and gather online feedback; http://www.courbanize.com/

Loomio- Online tool for collaborative decision making: https://www.loomio.org/

Geolocational Surveys

Community Almanac- Contribute and collect stories about your community; http://www.communityalmanac.org/

Community Remarks- Map based tool for facilitating dialogue and collecting feedback: http://www.communityremarks.com/

Crowd Map- Collaborative mapping: https://crowdmap.com/welcome

Maptionnaire- Crowdsource citizen sight on maps: https://maptionnaire.com/

Mysidewalk/ Mindmixer- Ideation platform for community projects: http://app.mysidewalk.com/

Comprehensive Sites (Mapping, Surveys, Forums)

EngagementHQ- Provide information and gathers feedback for decision making: http://engagementhq.com/

MetroQuest- Scenario planning and visualizations for public and collecting feedback: http://metroquest.com/

Public Stuff- Communication system for reporting and resolving community concerns: http://www.publicstuff.com/

Urban Interactive Studio- Information sharing and feedback forum for productive participation: http://urbaninteractivestudio.com/

Community Forum/ Crowdsourcing

All Our Ideas- Collect and prioritize ideas through a democratic, transparent and efficient process: http://allourideas.org/

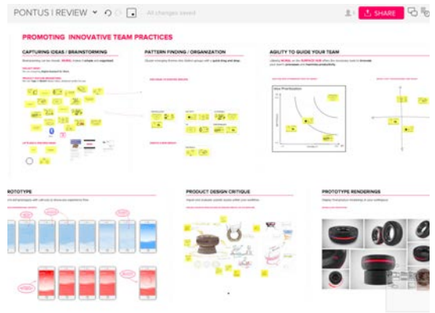
Codigital- Engaging way for large groups to generate, prioritize and refine ideas: http://www.codigital.com/

DialogueApp- Promotes dialogue to solve policy challenges with citizen input; http://www.dialogue-app.com/info

Neighborly- Private social network and forum for neighbourhoods: https://neighborly.com/

While there are number of engagement tools including some for collaboration, there are not too many tools available for collaborative and co-design for 3 Dimensional aspects for projects. **Phygital-*UP* aims to fill this gap in active collaboration with stakeholders at different stages of a project.**

Miro Virtual Collaboration



Mural Collaboration Platform (Source- Mural)

Microsoft Whiteboard Collaboration

3. Phygital-*UP*

The What and When?

Overview

What is the tool?

Phygital-*UP* is a co-design environment that supports equitable, inclusive, effective and dynamic stakeholder engagement in both physical and virtual environments. This is envisaged as a two part endeavour to create a seamless physical and digital (virtual) co design environment. With the pandemic, the effort was focussed on the Digital (virtual) environment. The intention is to create an inclusive, equitable collaborative environment to exchange ideas, ideate, and co-create.

What does the tool do?

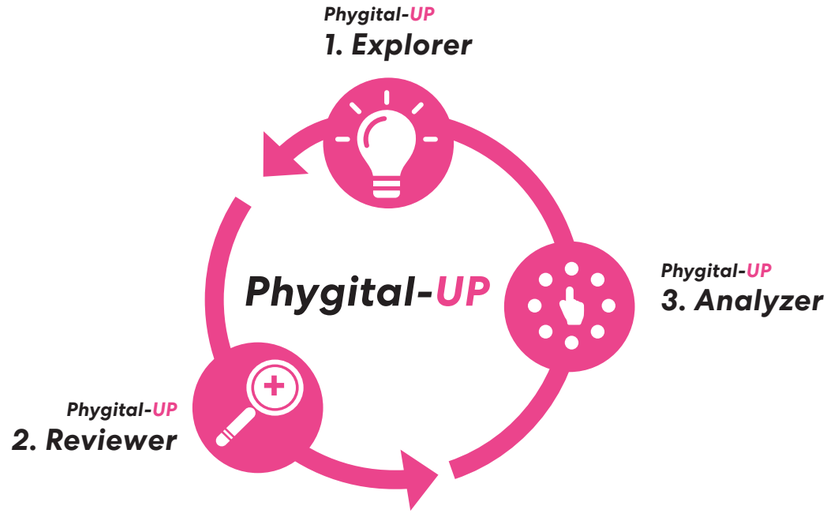
The tool serves our intention to collaborate and empower stakeholders, be it clients, community members or City staff. Considering the new normal, it provides an opportunity to co-create when there are limitations on in-person meetings due to emergency situations such as the current pandemic or a need to connect to team members or clients located in different cities or even across continents.

What Platform does it use?

The co-design environment is intentionally authored within the Rhino+GH environment as most of our work within the Urban Design and Planning Practice is created within this environment.

Three platforms, *Mirar, Swarm* and *Thread*, currently in alpha/ beta stages of development by Thornton Tomsasetti's Core Studio. These platforms were selected for their connections with the Rhino+GH and their ability to provide web based (WebGL) solutions, providing online interface.

For visualization, Enscape is used as it is easy to use, effective in communicating the ideas and is already part of the design process.



How does it work?

With a conscious effort to integrate with our design process, **Phygital-*UP*** is comprised of three primary modes-Explorer, Reviewer and Analyzer.

As the word suggests, The **Phygital-*UP* Explorer** is a web-based app and provides opportunity for stakeholders to explore massing typologies, provide feedback or even export a Rhino3D file back to the design team supporting a co-design process.

The **Phygital-*UP*** R**eviewer** allows users to access the various options discussed on a web platform and share feedback.

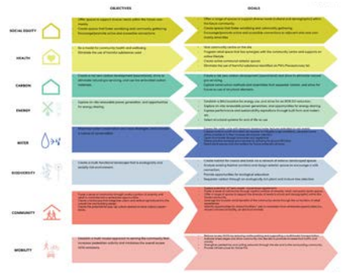
The **Phygital-*UP* analyzer** helps to analyze the various Options on the web, filtering and making informed decisions based on performance based indicators, that are mutually agreed upon prior to the workshops. The **Phygital-*UP* -** also uses Enscape for visualization enabling users to experience the spaces created by themselves and others, through still and virtual tours, easily accessible on the web.

In addition to building a common consensus and a joint ownership of the project, it also educates the stakeholders on the implications of their choices and priorities. This is really helpful in the long run as it helps to educate and empower the community in asking the right questions and take more informed decisions.

What are the inputs & outputs of the tool?

Considering that the co-design environment is meant for physical explorations, the primary inputs are the Rhino geometry, which is initiated by the design team using Rhino3D and Grasshopper. The outputs vary between the various tools within the co-design environment. Starting from exploration of typologies and export of Rhino3D model to visualizations such as renderings and self directed virtual walkthroughs, accessible via web.

* Please find Additional descriptions provided on pages 26-29.

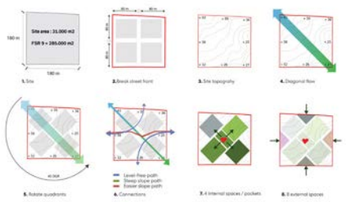


Vision & Values

At the onset of the project, envisioning workshops help develop collective values, goals, aspirations with the client and design team. This process develops a high level vision for the development and establishes some emerging guiding principles for the project.

Tools

If done virtually, *Microsoft Teams* and *Miro* with collateral developed in *Rhino + GH, Adobe Suite*

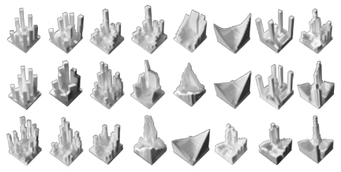


Frameworks

The values and guiding principles help to develop framework for the Master Plan in addition to analyzing the site using different perspectives and lenses. These could be '*inform*', '*consult*' and '*involve*' sessions

Tools

If done virtually, *Microsoft Teams* and *Miro* with collateral developed in *Rhino + GH, Adobe Suite*

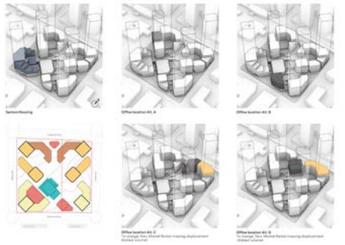


Concepts

Development of strong framework, help to evolve concepts and massing options. These could be *consult, collaborate* and *empower* sessions. Massing options could be shared to get feedback or co-create along with stakeholders to establish emerging directions for further explorations.

Tools

If done virtually, ***Phygital-UP*** along with *Microsoft Teams* would be helpful to create consensus amongst stakeholders.

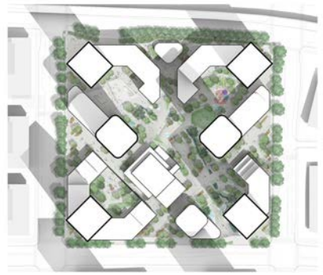


Design Development

Different concept options developed are evaluated and a preferred concept is selected to become the basis for the development of the Master Plan. The preferred option could be shared with stakeholders to get either feedback or develop the design further.

Tools

If done virtually, ***Phygital-UP*** along with *Microsoft Teams* would be helpful to create a common consensus amongst stakeholders for the preferred concept.

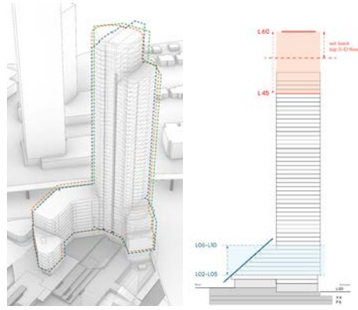


Master Plan

Once the preferred concept is selected for the development of the Master Plan. Working closely with client, consultants, city staff and stakeholders, the Master Plan is developed further.

Tools

If done virtually, ***Phygital-UP*** along with *Microsoft Teams* would be helpful to create consensus.



Design Guidelines

The Master Plan is implemented via Design Guidelines, The design guidelines also help to protect the design intent while providing the flexibility to cater to future changes including market forces

Tools

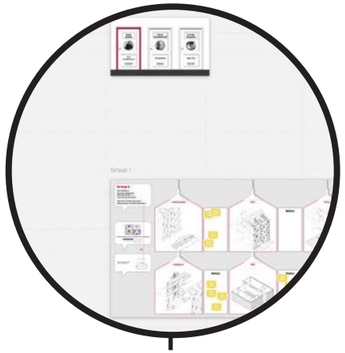
If done virtually, *Microsoft Teams* and *Miro* with collateral developed in *Rhino + GH, Adobe Suite*

Phygital-*UP* : Workflow Integration

Collaboration

co-design

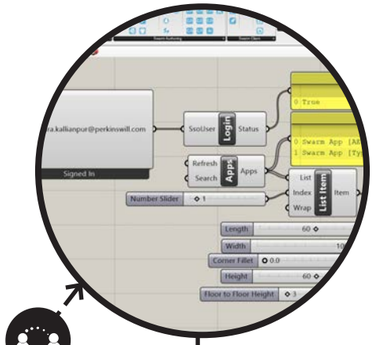
Virtual Boards to brainstorm and collaborate in establishing values, goals, objectives and guiding principles



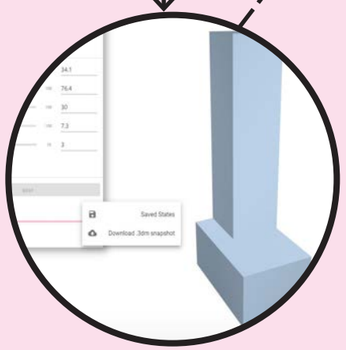
ENVISIONING WORKSHOP

Envisioning Workshop with the stakeholders help to establish the goals, objectives, guiding principles , which direct the formulation of a high level vision for the development.

A *Prepare the Virtual Engagement and expected outcomes for the next event. This includes preparation of the 3D environment and setting up* **Phygital-*UP*** *to be deployed during the virtual workshop*



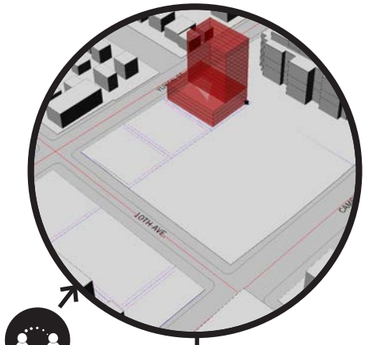
EMERGING DIRECTIONS WORKSHOP



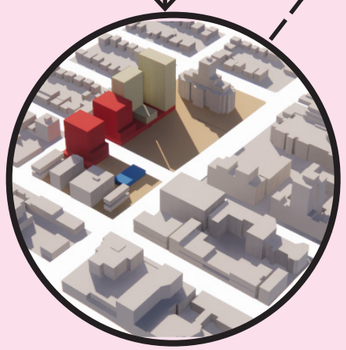
B ***Phygital-UP Explorer*** *enables stakeholders/ participants to test and evaluate different massing typologies during workshops or design charrettes. The geometry can be exported back to Rhino3D.*

Phygital-UP Explorer

C ***Phygital-UP Explorer*** *provides the Rhino geometry for continuing the design development and analysis of the various options co-designed during the workshop or feedbacks received during workshops.*



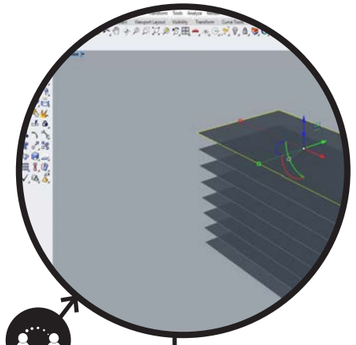
CONCEPTS WORKSHOP



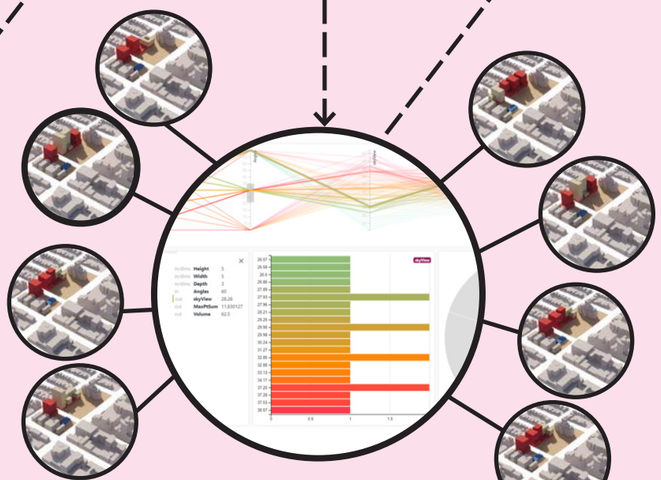
D ***Phygital-UP Reviewer*** *enables stakeholders/ participants to evaluate different massing options during workshops or design charrettes*

Phygital-UP Reviewer

E ***Phygital-UP Explorer*** *provides the geometry for continuing the design development and analysis of the various options co-designed or feedbacks received during workshops.*



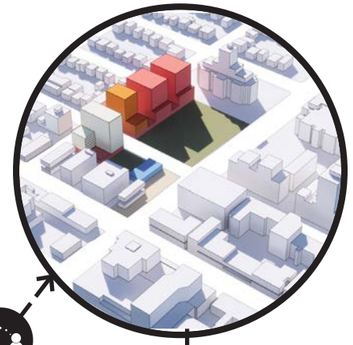
PREFERRED CONCEPT WORKSHOP



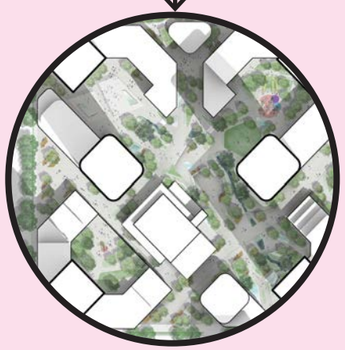
F ***Phygital-UP Analyzer*** *enables analysis of the various options to inform the implications of the choices. It helps in the selection of a preferred concept using both performance results and experience.*

Phygital-UP Analyzer

G *The preferred concept is further developed and a Master Plan is created based on feedback received during the earlier workshop. This Master Plan is then discussed in the next workshop.*



MASTER PLAN WORKSHOP

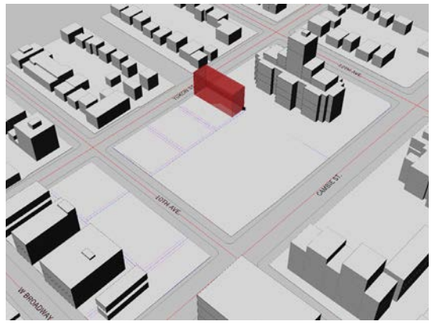


Master plan is presented and discussed with the stakeholders based on the co-design process with the stakeholders and build a collective ownership of the master plan.

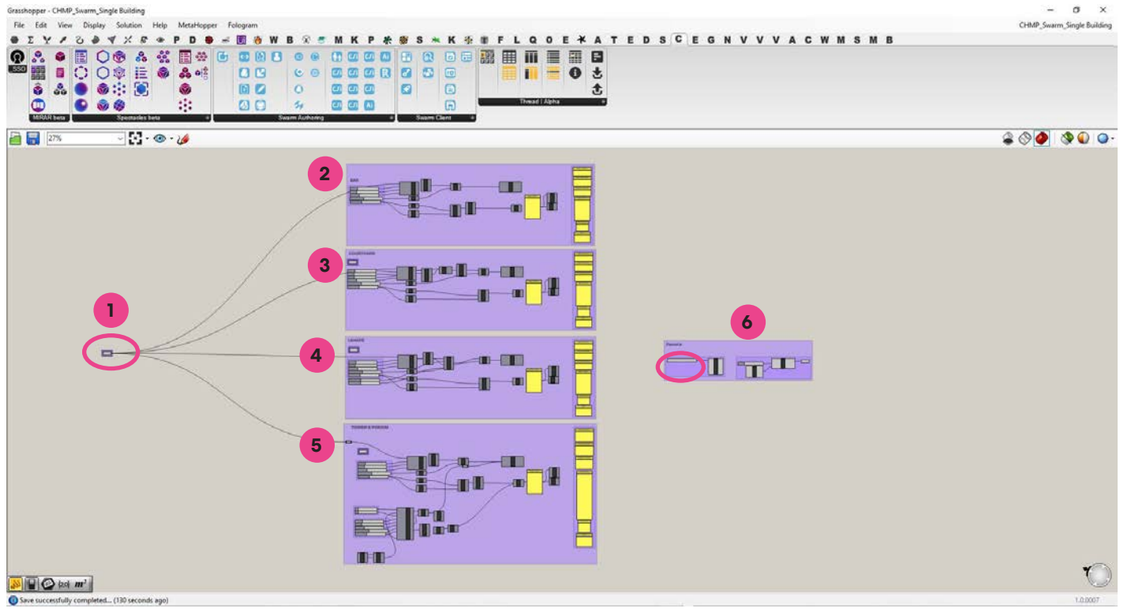
Tool: What and When?

A Phygital-*UP* Explorer

Phygital-*UP* Explorer is an app that enables participants to chose a certain typology and adjust the various parameters on the web (without the need for using Rhino/ 3D package) to explore the opportunities. The script, presented below is for the App developed using the Swarm Plugin, developed by Thornton Tomasetti.

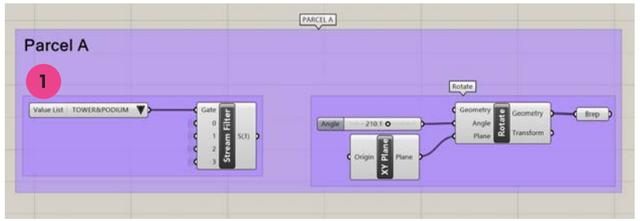


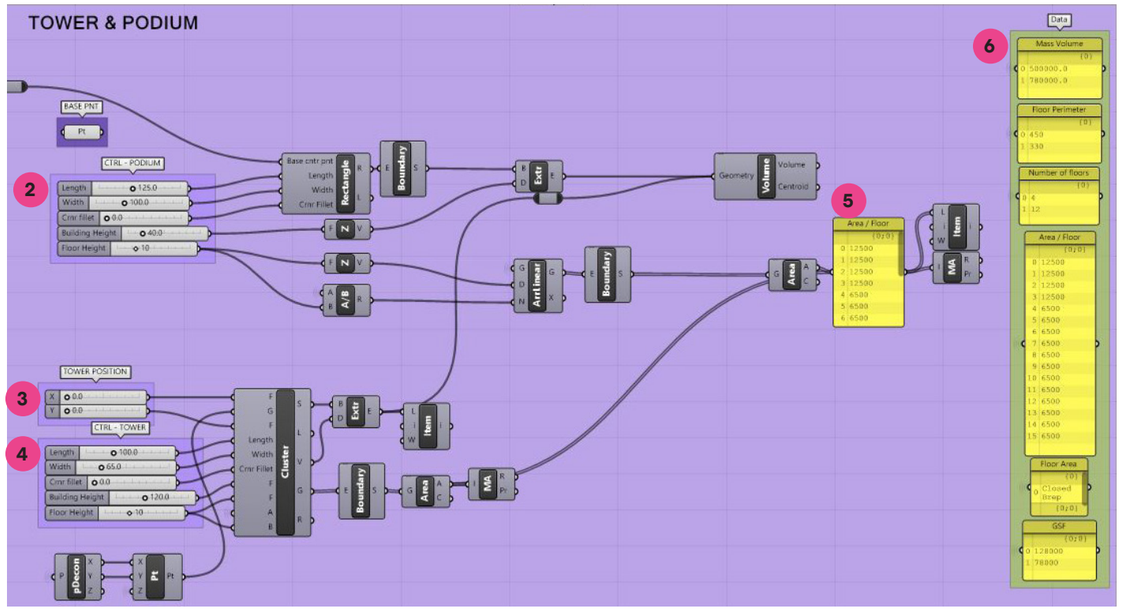
Rhino Environment responding to the GH script



GH script to connect to Rhino Environment

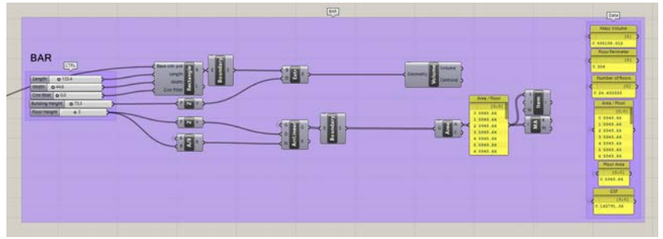
1. Establish the Point of Origin for the location of the Massing Typology
2. Bar Typology with input parameters to control the massing.
3. Courtyard Typology with input parameters to control the massing.
4. L-shaped Typology with input parameters to control the massing.
5. Tower & Podium Typology with input parameters to control the massing.
6. Select the Typology to be explored



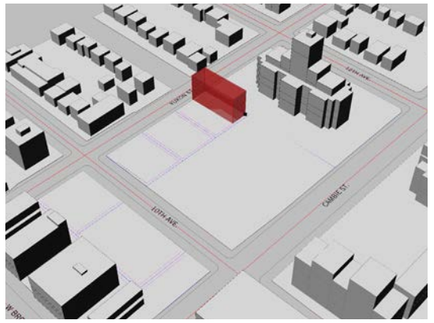


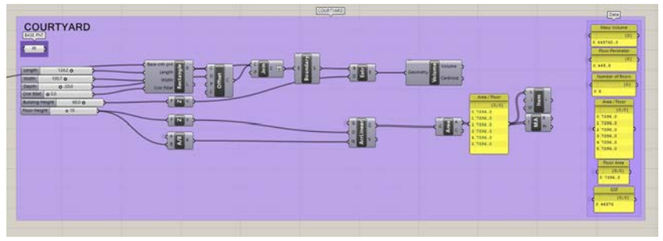
EXAMPLE: TOWER + PODIUM TYPOLOGY GH SCRIPT

1. Select the typology
2. Control the length, width, curve fillet, building height and floor to floor height for the podium.
3. Adjust the tower position in relation to the podium.
4. Control the length, width, curve fillet, building height and floor to floor height for the tower.
5. Floor GSF for each floor plates
6. Overall Data for the entire typology,

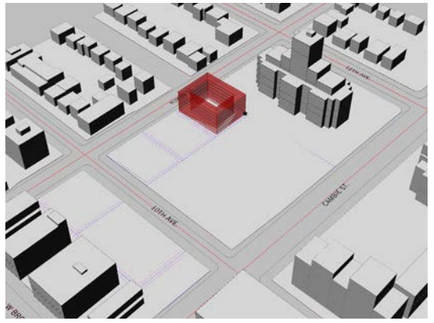


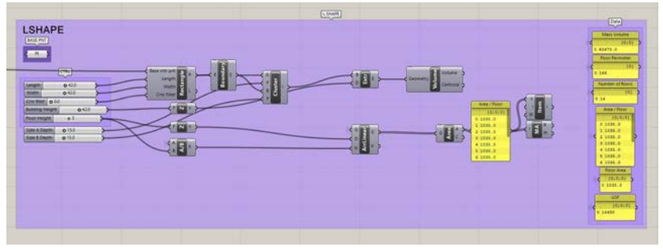
Bar Typology GH Script



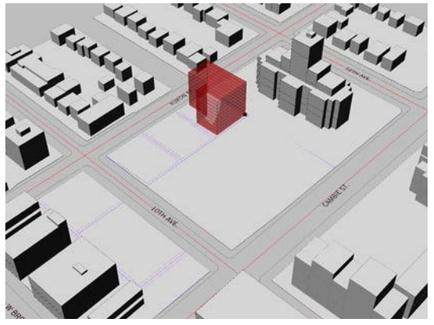


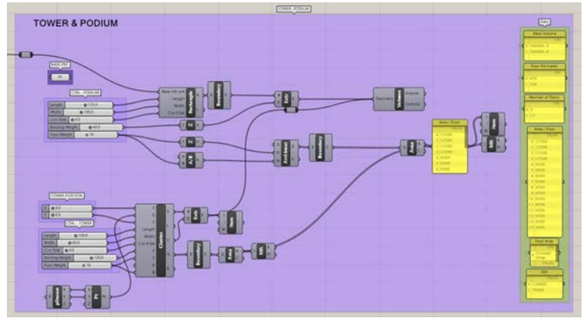
Courtyard Typology GH Script



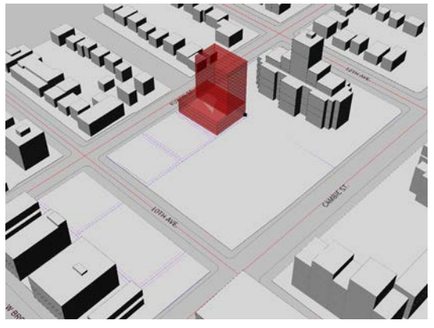


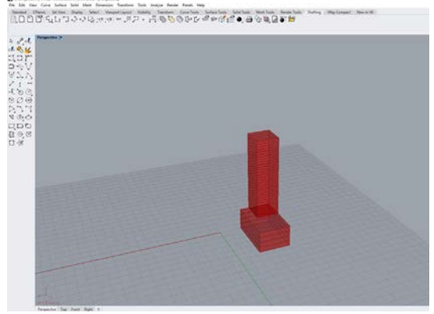
L shaped Typology GH Script





Tower & Podium Typology GH Script

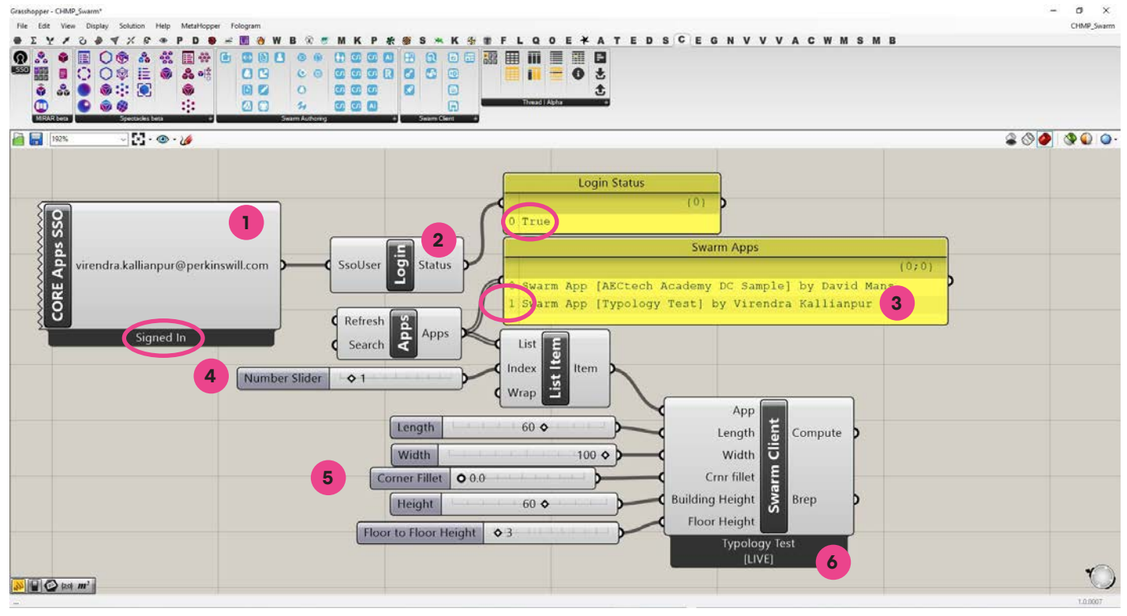




Phygital-UP Explorer App used in Rhino Environment

A. Phygital-*UP* Explorer App in Rhino Environment

Developing the Phygital-UP Explorer App in Swarm enables Rhino users to use it in the Rhino environment, leveraging the existing app, cloud computing power without having to recreate it. The GH script as shown below enables Rhino users to run on the Swarm server offering consistent, reliable performance regardless of the hardware specifications of the system.



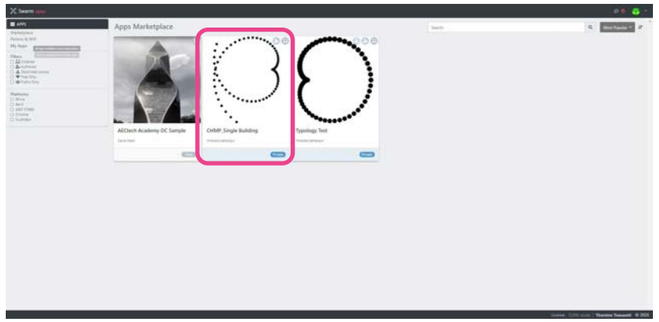
GH script to connect to Swarm to use the Phygital-UP Explorer within Rhino Environment

1. Sign in to Core App Account; Check for 'Signed in' status at the bottom of the component
2. If status is true, the user is logged in
3. Check the apps available and the related number
4. Use the number slider to reflect the correct number in order to select the correct app.
5. Input parameters to use the app.
6. Right Click on the Swarm Client Component and select "Go Live" to use the App.

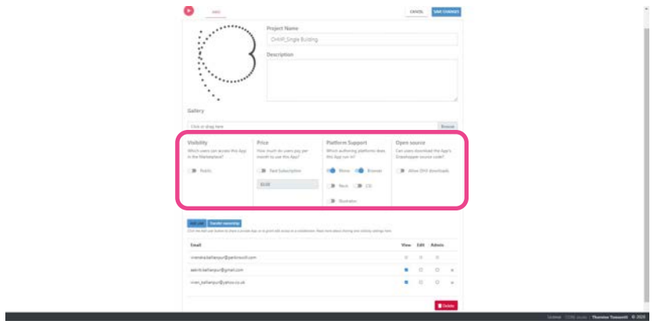
Tool: What and When?

B. Phygital-*UP* Explorer

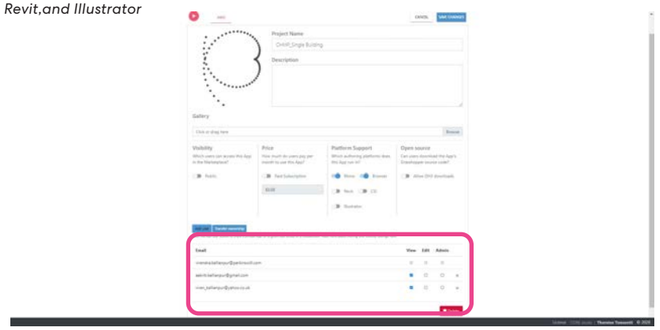
Phygital-UP Explorer is an app created and available on the Swarm App Library developed and hosted by Thornton Tomasetti. *It enables* participants to chose a certain typology and adjust the various parameters to explore the opportunities. It also exports the Rhino geometry for continuing the design development and analysis of the various options co-designed during the workshop



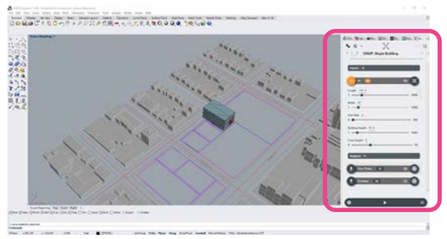
App available on Swarm



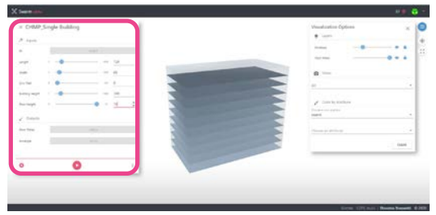
The App can be made public or private, being supported on Rhino, Internet Browser, Revit,and Illustrator



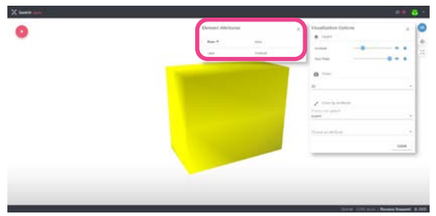
You can invite team members to participate with view, edit or admin rights.



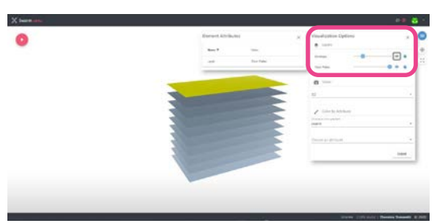
App can be used within Rhino3D as well as online using internet browser.



Inputs such as Length, width, Corner Fillet, Building Height and Fl-Fl Height) create Massing and Floor Plates. Further input and output parameters can be added.



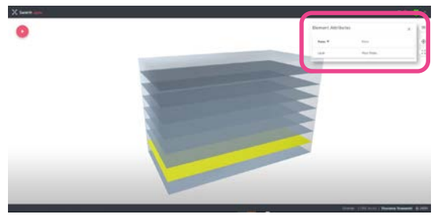
Each element provides attributes such as volume and area.



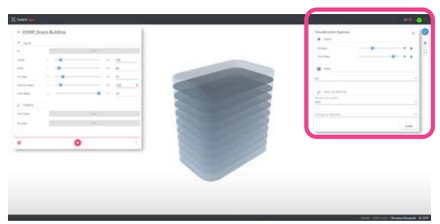
Courtyard Typology GH Script

Layers such as Envelope and Floor plates are available. Additional layers can be created.

Users can use different forms of representation to view the typology such as 3D, top, bottom, left, right, front and back.

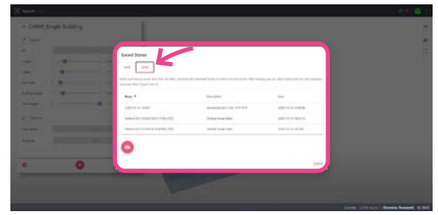


Each element can be selected to view the related attributes such as area to understand the typology and opportunity

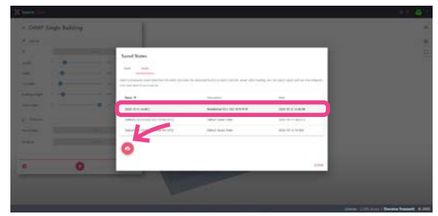


Visibility options are available via layers for users to customize the graphics, including turning on/off layers, change transparency and locking layers.

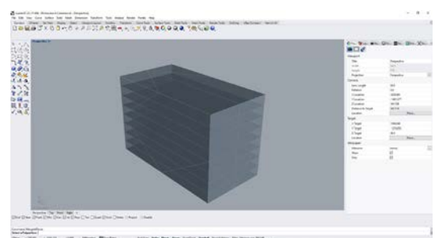
Users can share different configurations as "States", which can be downloaded as Rhino3D (.3dm) files.*



Users can load saved "States" which enable studying different options and saving these for later use.



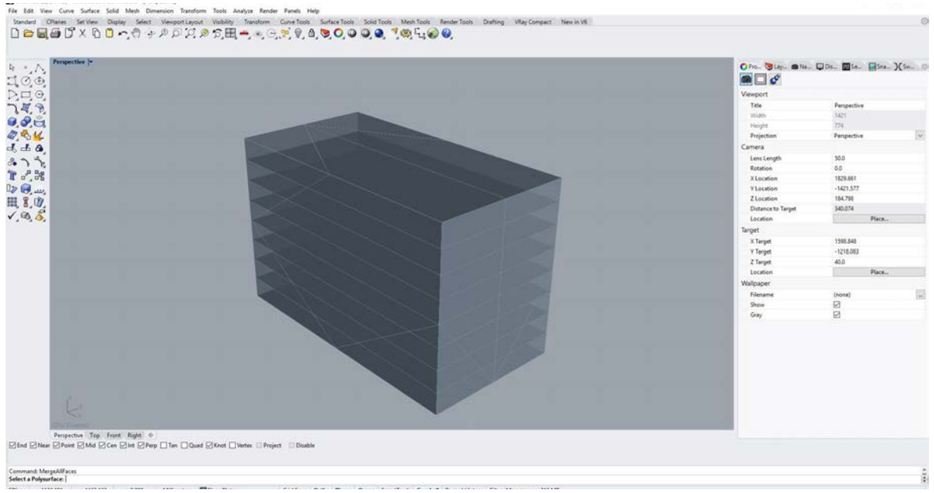
Users can select a specific "State", and download it to the browser to explore further.

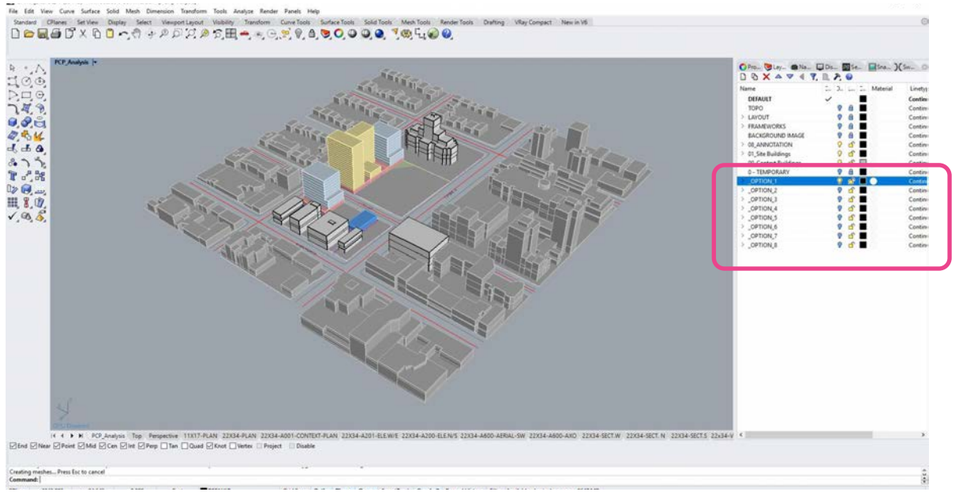


Exported geometry from the App enables the design team to explore the typology proposed by other users and run different analysis and integrate in the design process.

C/E. Phygital-*UP* Explorer

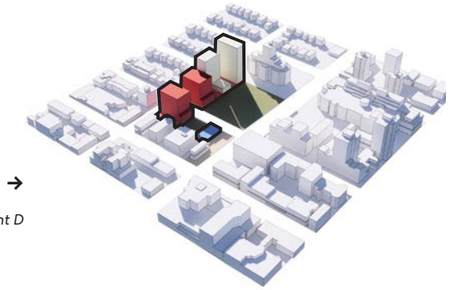
Phygital-*UP* provides the geometry for continuing the design development and analysis of the various options co-designed during the workshop or feedbacks received during workshops. The ability to harness the creativity and not lose any information is critical for the co-design process and while bringing efficiency in the overall project schedule and process.



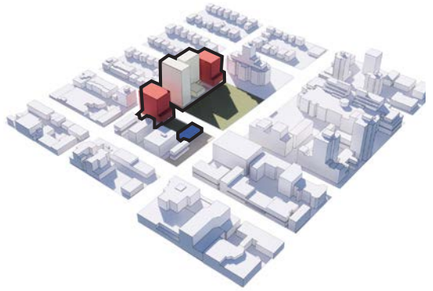


D. Design Options

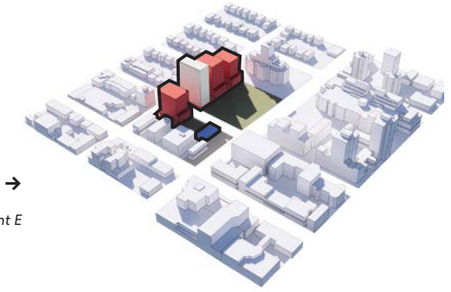
The various options explored by the participants in B and further design development by team in C are presented and discussed. This could be presented using either the Miro or the Mirar web interface.



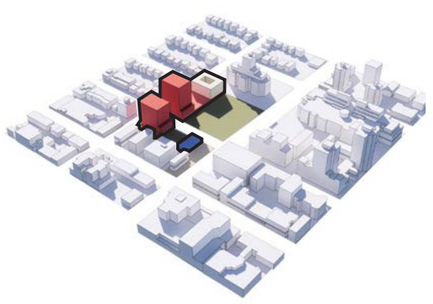
Participant D →



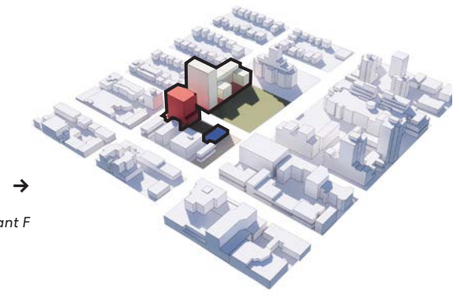
← *Participant A*



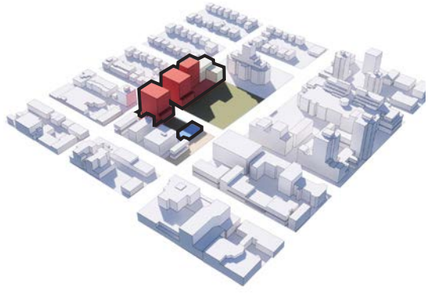
→ *Participant E*



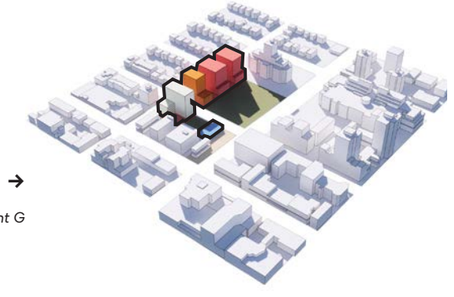
← *Participant B*



→ *Participant F*



← *Participant C*

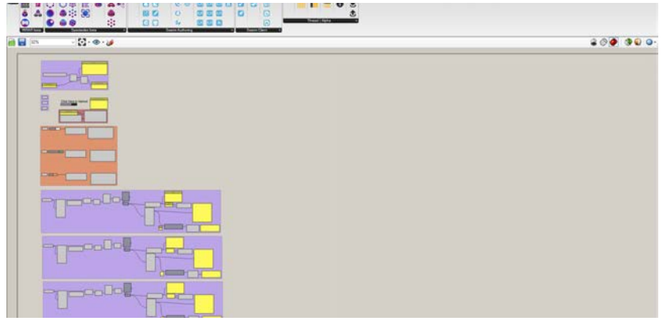


→ *Participant G*

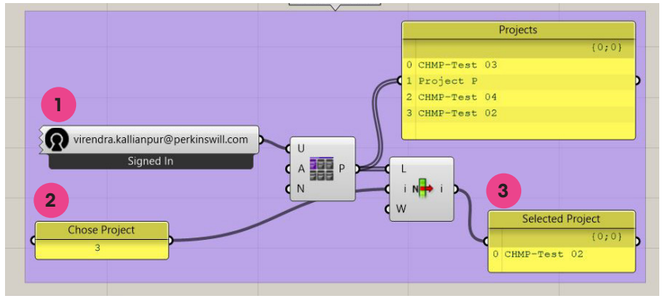
Tool: What and When?

D. Phygital-*UP* Reviewer

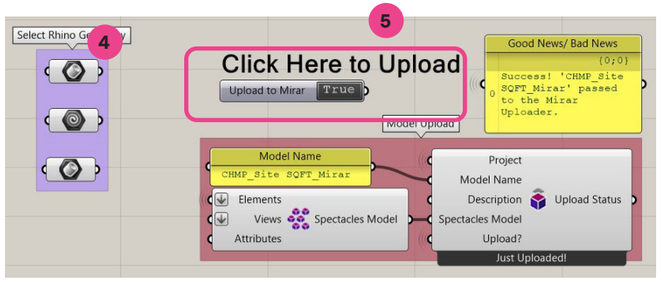
Phygital-UP Reviewer is developed as an online interface available for anyone with a link and internet, hosted by Thornton Tomasetti on the Mirar Platform. *It enables* participants to look at options developed. The interface is simple and provides different controls and tools. The *Phygital-UP Reviewer* enables users to check the various options following the Concepts Workshop (Ref. p 28-29).



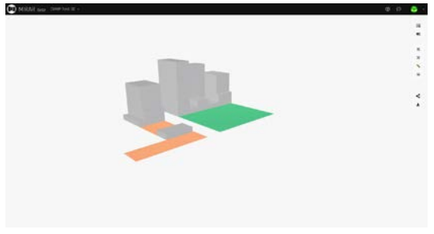
Phygital-UP Reviewer script



Signing in to Mirar



Model Upload to Mirar



The Phygital-UP Reviewer accessible via an internet browser.

The script is developed to make it easy and simple for design teams to use with only 6 inputs. The script is flexible and can be developed further to add more functionality.

1. Create an account for Mirar, developed by Thornton Tomasetti and is in Beta stage. This is required only for hosting, participants or users can just click on the share link to connect to Mirar using an internet browser. Create a project in Mirar.

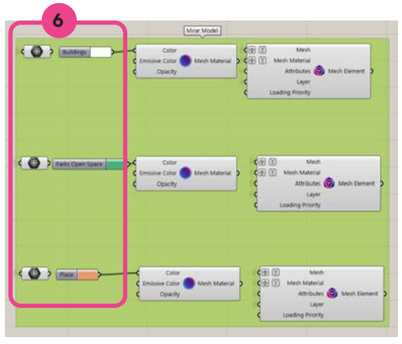
2, Select the project you want to create an online version from the list of projects.

3. Ensure that this is the correct Mirar project that will host your online model.

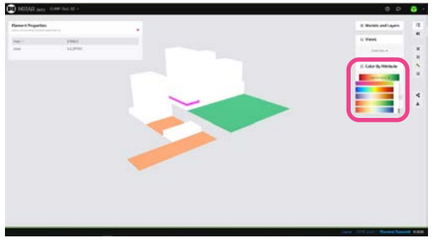
4. Select the geometry from the Rhino model. For the demonstration project, three categories were used- buildings, park and plaza. More categories could be added as per the needs of the project.

5. Double Click the Toggle button to make it "True" to run the script.

6. Change the colour swatches to represent the categories, in this case, buildings, park and plaza.



Colour swatches to represent the geometry on the online platform.



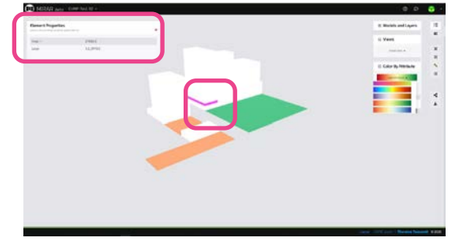
Different colour schemes could be selected to represent the massing.

Users can filter the massing based on program.

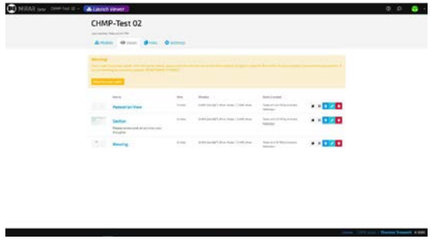
Users can filter the massing based on areas.

Exported geometry and related attributes to be displayed online

Users can use different views to review the massing



Each element can be selected to view the related attributes such as program and area

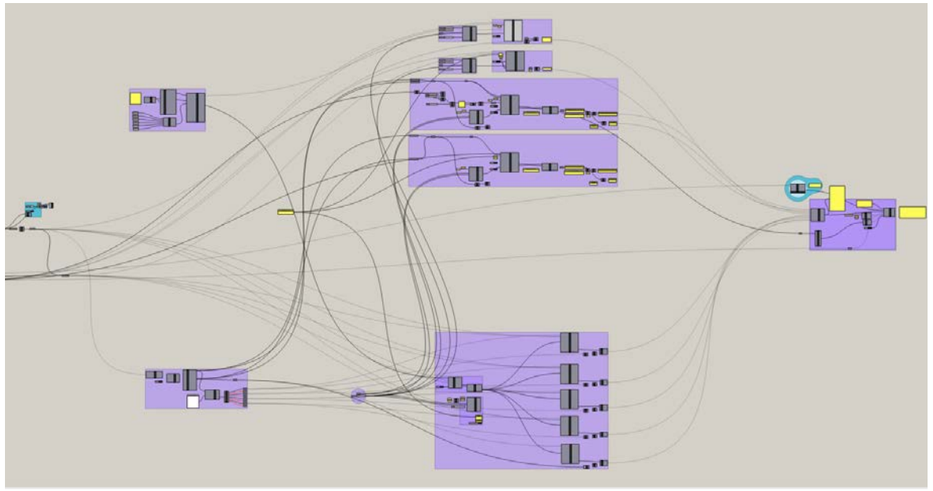


Views can be saved and shared with others. The entire project can be made public, which will make it accessible by everyone, if required and appropriate.

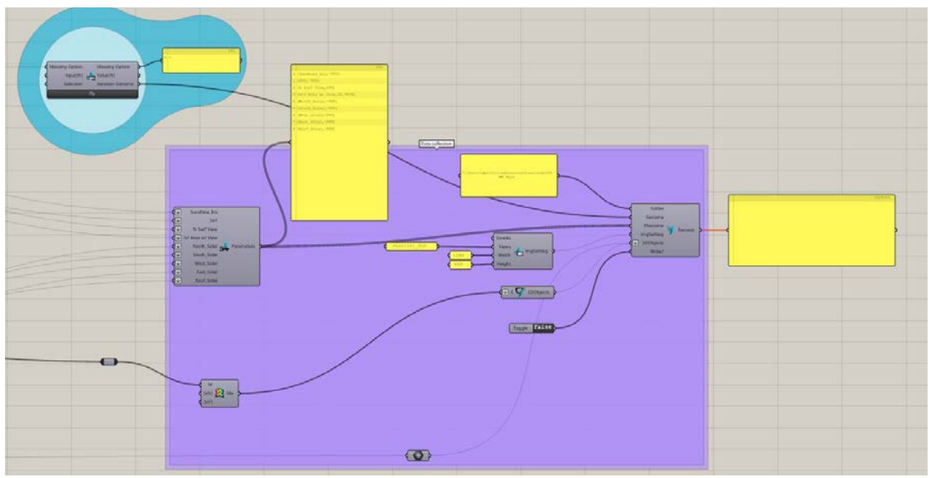
Tool: What and When?

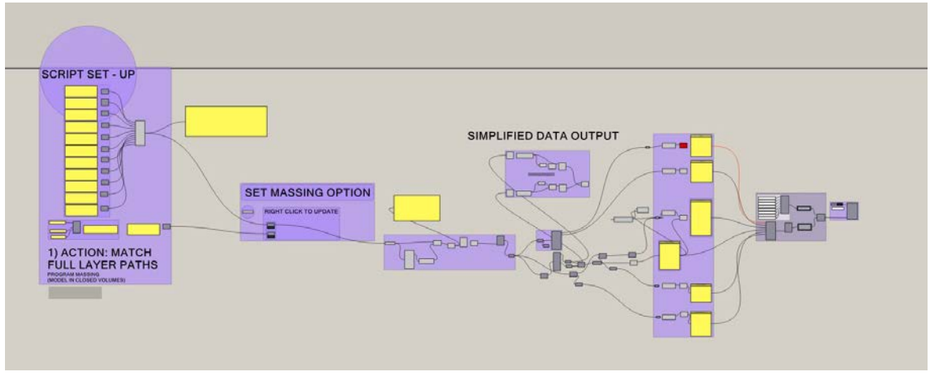
F. Phygital-*UP* Analyzer

Phygital-*UP* Analyzer helps in the analysis of the various options to inform the implications of the choices. It helps in the selection of a preferred concept using both performance results and proposed experience in the designed environment. This is based on two scripts, which are being used by Vancouver Urban Design Group. These have been developed over a period of time. The data generated from these two scripts are then used on the Thread Platform to create data visualization, filtering & selection.

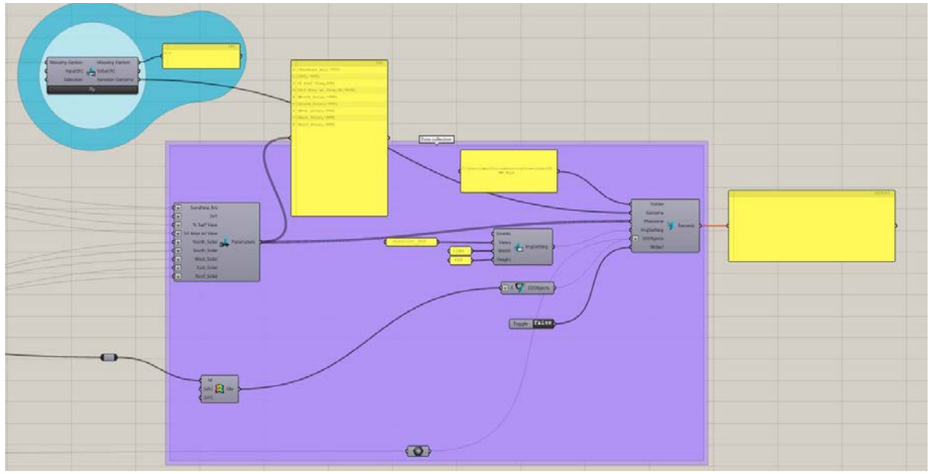


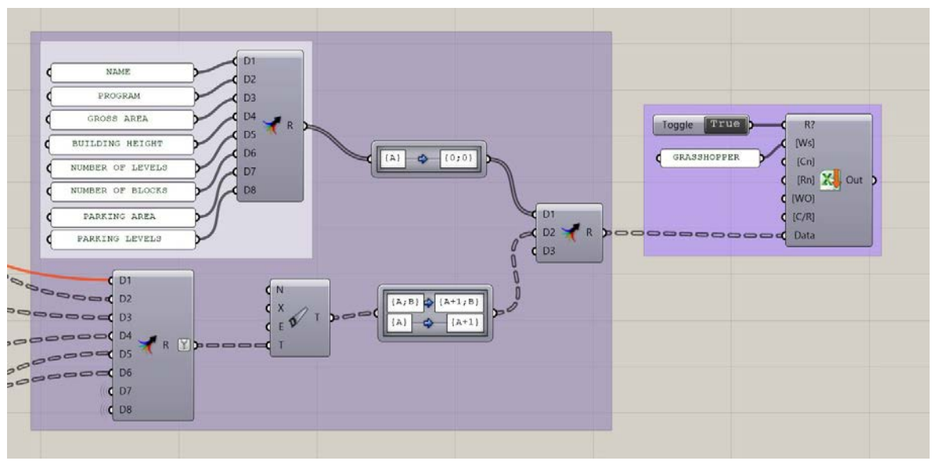
This is a script being used for analysis of the urban form from multiple criteria such as solar, compactness ratio, facades with view. Additional parameters can be easily added and removed depending upon the needs of the project. The script uses different plugins including ladybug, honeybee, daylight Sim. The outputs are analysis images and data. This current script has been developed and curated by Mahdiar Ghaffarian.





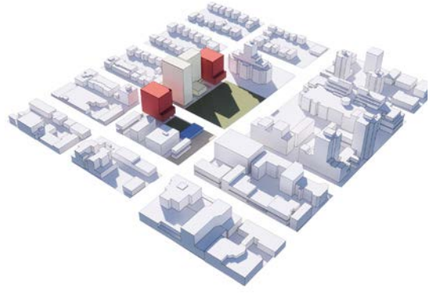
This is the second script being used to collate program data for massing options. The GH script exports the data directly into excel.





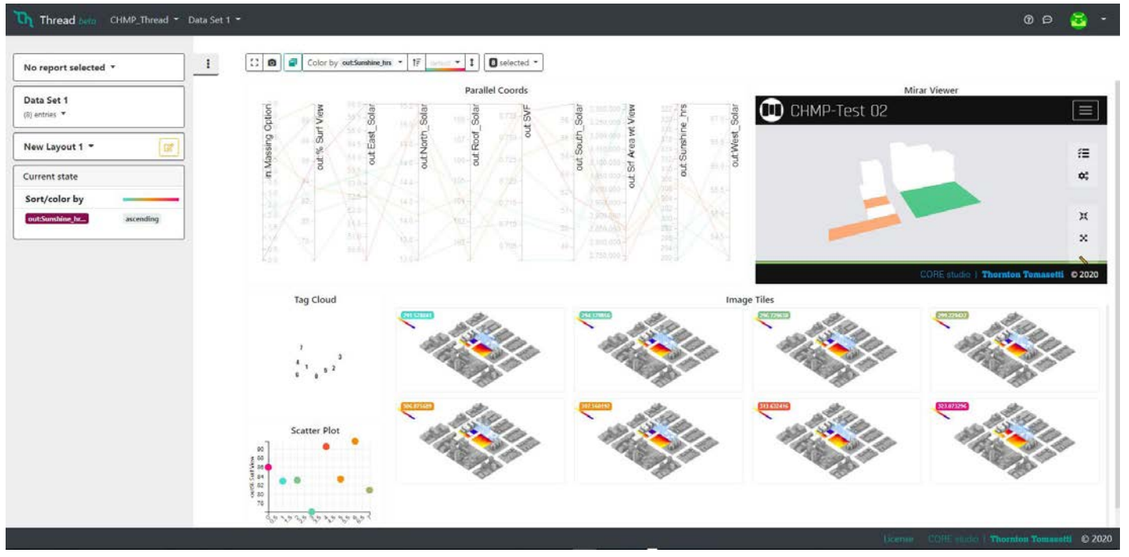
The data generated using the two previous GH scripts is used in the Thread Platform, developed by Thornton Tomasetti. The files required include the primary data file as a CSV file, json and image files.

Thread Interface

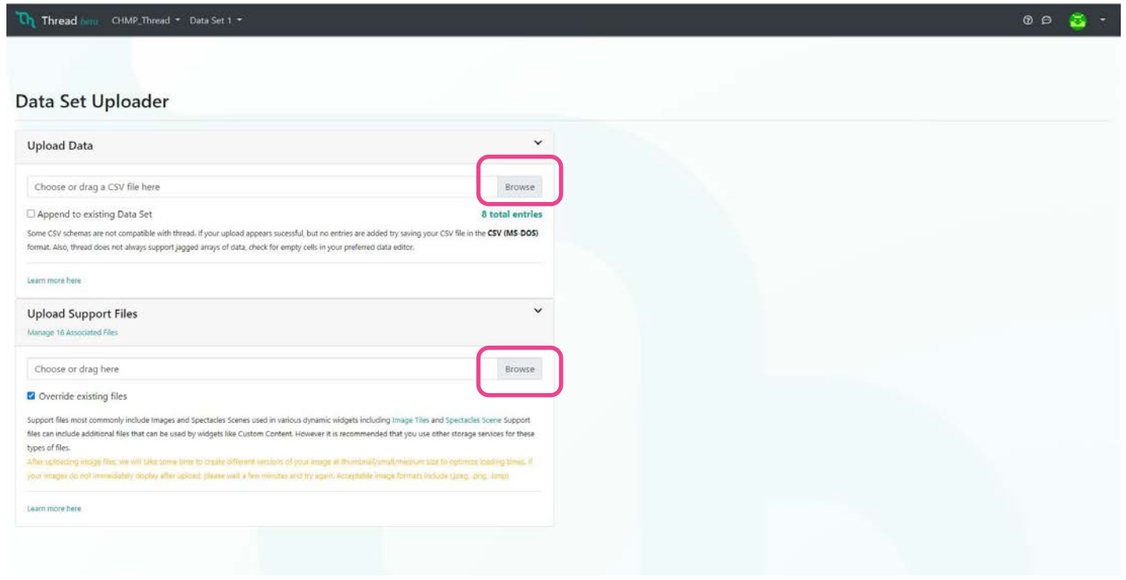


→

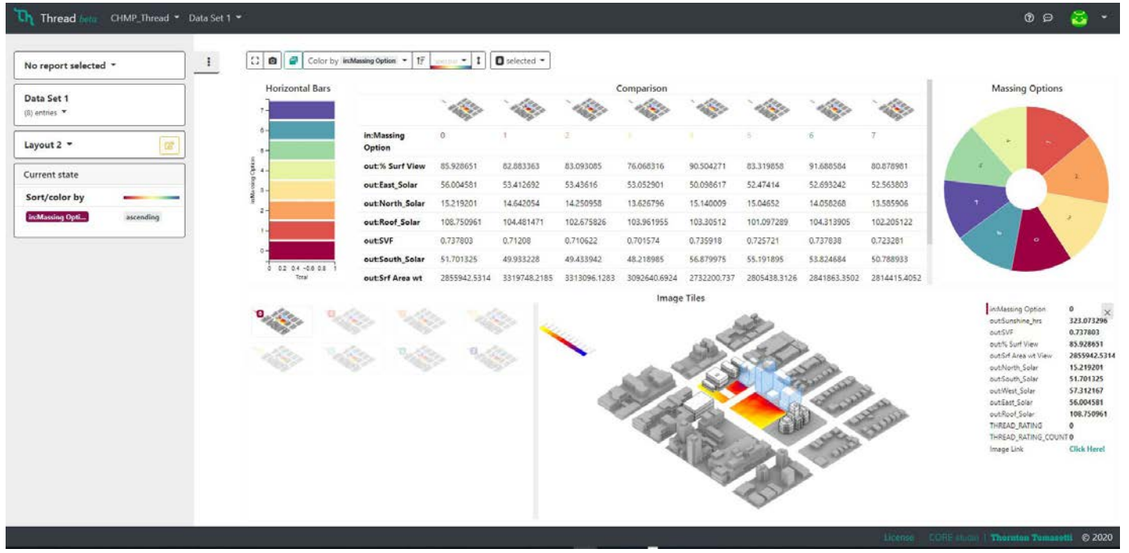
Participant A



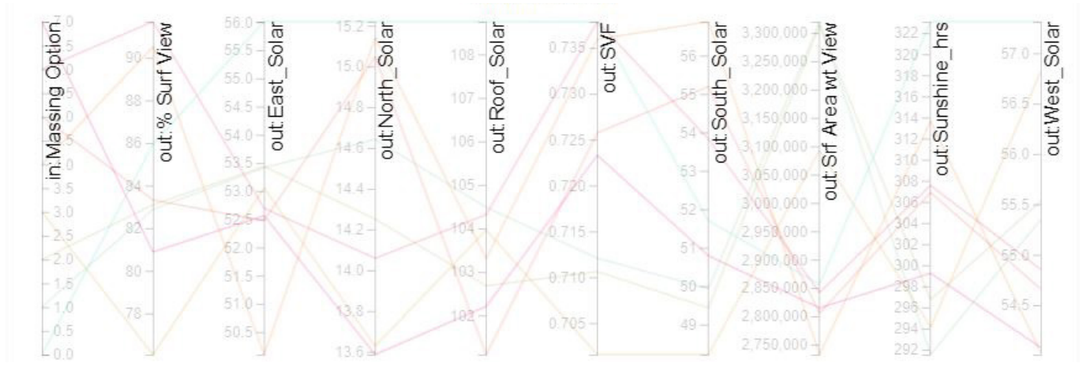
Different Dashboards to display the data and filter, analyze the options and how they perform against the design criterion.



Upload data and support files into the Thread Platform



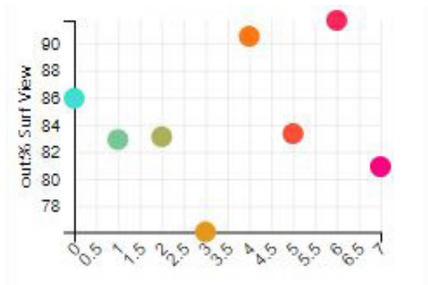
Different colour schemes could be selected to represent the massing.



Parallel Coordinate Plot (PCP) enables users to filter options that meet the criterion and related parameters.

								
in:Massing Option	0	1	2	3	4	5	6	7
out:% Surf View	85.928651	82.883363	83.093085	76.068316	90.504271	83.319858	91.688584	80.878981
out:East_Solar	56.004581	53.412692	53.43616	53.052901	50.098617	52.47414	52.693242	52.563803
out:North_Solar	15.219201	14.642054	14.250958	13.626796	15.140009	15.04652	14.058268	13.585906
out:Roof_Solar	108.750961	104.481471	102.675826	103.961955	103.30512	101.097289	104.313905	102.205122
out:SVF	0.737803	0.71208	0.710622	0.701574	0.735918	0.725721	0.737838	0.723281
out:South_Solar	51.701325	49.933228	49.433942	48.218985	56.879975	55.191895	53.824684	50.788933
out:Srf Area wt	2855942.5314	3319748.2185	3313096.1283	3092640.6924	2732200.737	2805438.3126	2841863.3502	2814415.4052

Comparison chart to have an overview of the options and related performance indicators.



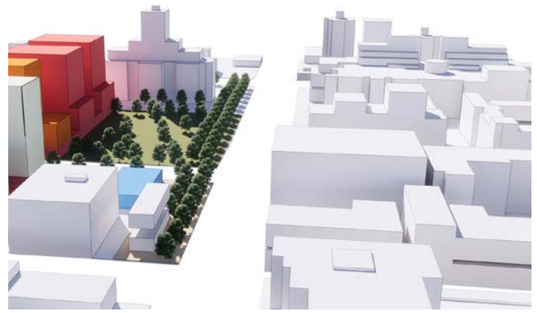
Scattered plot to provide opportunity for users to know which option performs well compared to others and select options visually to see more details.

Reports can be developed and shared with stakeholders to review. Developing a report helps to preserve the different view settings so collaborators can see it in the best way.

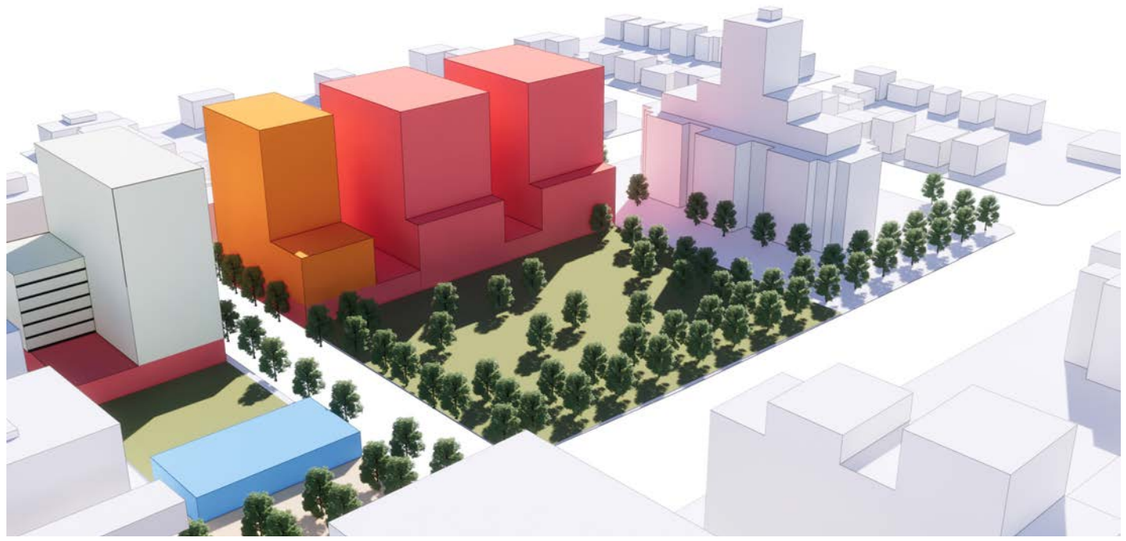
Tool: What and When?

F. Phygital-*UP* Analyzer

The various options explored by the participants in B and further design development by team in C are presented and discussed. Using Enscape to generate virtual walkthroughs that people can experience using their own phones or tablets.



Online Virtual Tool: *Just a link is needed for users to access the virtual model*



Visualisations can be shared with the stakeholders before, during or after the workshop. The direct connection between Rhino and Enscape is helpful and could be leveraged to have a productive stakeholder engagement.

4. Summary & Findings

“ An individual can’t create anything itself. All of our dreams come true with the cooperation and co-creation of other souls.”

- Hina Hashmi

↑
Collaborative thinking is part of our culture and design process.

Summary

In our endeavour to build equitable, inclusive and resilient communities, collaboration and collective ownership of design is key. In the present day and age, the complexities arising out of various global and local forces at play need a inter disciplinary approach, which is vital to ensure that the problem is well defined and the solution is holistic and robust.

Phygital-*UP* offers both the design team and the stakeholders the ability to work together in a synergistic and harmonious way. It enables both quiet and solitary work using a web-interface and an engaging and active collaboration with the larger team.

This tool also brings into play the business aspect of the practice. In a highly competitive market, our comparatively higher hourly rates, our standards and aspirations held close to our heart, with design excellence on top of our mind, creates a challenging situation to remain competitive. Having strong design processes and incorporating efficient ways to design and engage with stakeholders enable us to stay competitive, while upholding our levels of service and commitment to address broader goals of our society.

The co-design environment was envisioned with three primary objectives, stated previously-

1. **Integrated with Design Process-** If we do not use it, we lose it. Same is true with design tools and processes.
2. **Economic**: low cost and use existing resources to the maximum extent.
3. **Equity**: A platform with minimum thresholds to use from all aspects

Next Steps

Phygital-UP was conceived as a two sided platform, dissolving the boundary between physical and digital (virtual) domains of engagement and collaboration. The current effort has been focussed more on the virtual tools to address the current pandemic and the new normal. Since there is still uncertainty on how long the pandemic will last, it is imperative to learn and build resilience in our practice, daily lives and the cities we live and work in.

Few next steps for the further development of the co-design environment:

1. Work with Digital Practice Group to create a set of snippets and integrate it as a template for Rhino and Grasshopper for our projects.
2. Work with the Digital Practice Group to explore the potential of creating a platform for WebGL apps. Currently Phygital-*UP* is using third party, web and server platform in an alpha/beta version. From a resilience perspective, it would be good to have our own system.
3. Alternatively, collaborate with Thornton Tomasetti on further development of the platform. This will entail gauging their Interest to collaborate, discuss IP rights and other logistics.
4. Start using Phygital-*UP* for existing and future projects, to sharpen the tools, while sharpening our minds.

“ The role of the designer is that of a good, thoughtful host anticipating the needs of his guests”

- Charles Eames

Image Credits

Page	Credits
Coverpage	Perkins and Will, Vancouver
2,5,6,9	Perkins and Will, Vancouver
7	The Wild (https://thewild.com); spatial (https://spatial.io/); sketchbox (https://www.sketchbox3d.com/); oculus (https://www.oculus.com)
8	International Association of Public Participation (IAP2)
10,11	ShapeDiver (https://www.shapediver.com)
12-17	Core Studio, Thornton Tomasetti (http://core.thorntontomasetti.com)
19-21	Perkins and Will, Vancouver
23	Perkins and Will, Vancouver
23	Mural (https://www.mural.co)
47-49	Perkins and Will, Vancouver

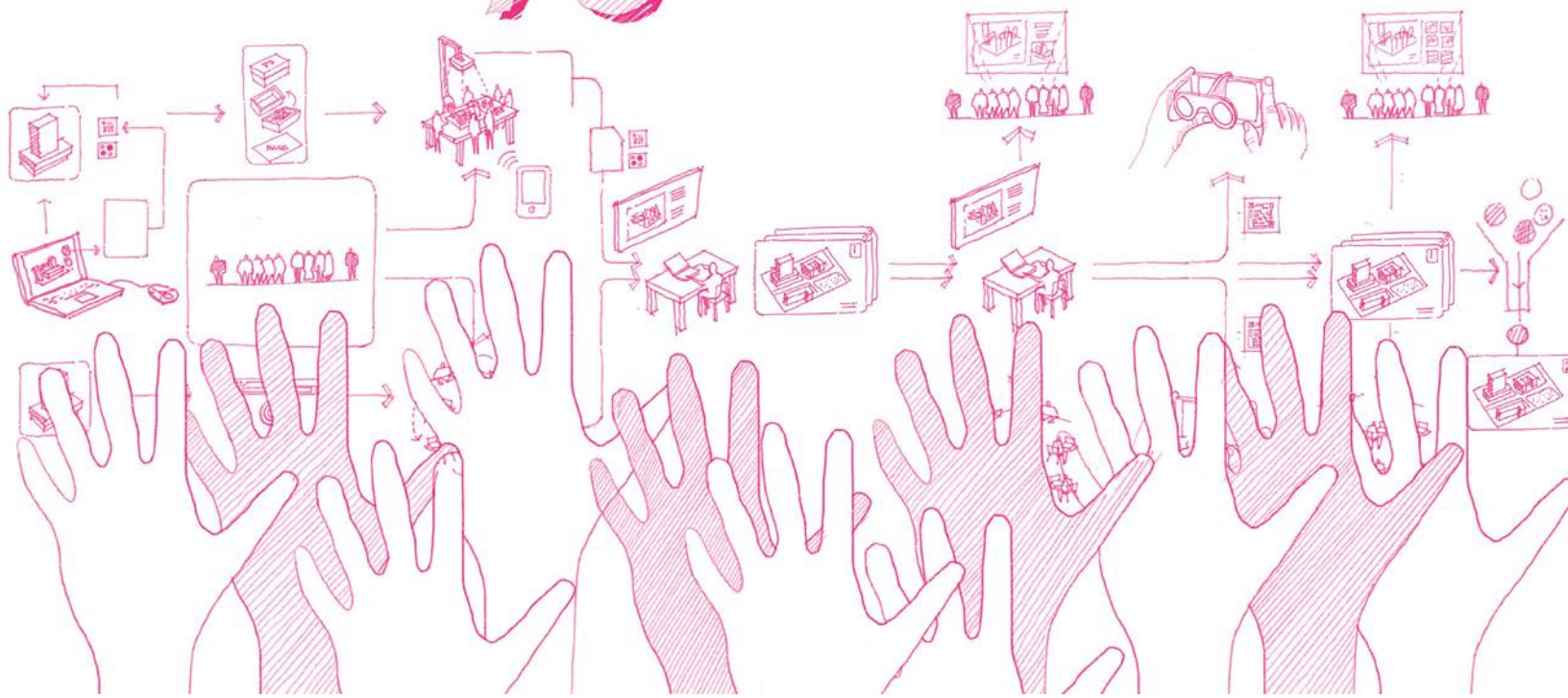
Acknowledgements

Acknowledgements:

A big thank you to my family for giving me space and time for chipping away on the research and for bearing my chatter about grasshopper scripts, WebGL, and stakeholder engagement. I would also like to thank Mo, Maryam, Hannah, Andy and Mario for their help, without which this project would be less than ideal. A special shout out to Ben and David from Thornton Tomasetti's Core Studio, in developing the Mirar, Swarm and Thread platforms and for providing access to Beta test these platforms.

Last but not the least, thank you to the Innovation Incubator Committee for the opportunity to research and start developing a tool that would be very helpful for our practice, studio and firm in creating resilient, sustainable, equitable and inclusive communities and cities.

Phygital-UP



Perkins&Will