“It’s Dark Here Let’s Go Home”

3D Geovisualization shadow prediction models in Surrey’s Civic Plaza

The Town Square

Ah. The square. There is no place better for one to simply be a citizen. Town squares have been historically entwined with the axioms of liberty and equality. Moreover, town squares have and are, havens for democracy. They are labyrinths of public life and halls of odd, yet accepted behaviour. Great moments of social change are often linked to the town square: The 15-M movement, also known as “Take the Square” in Spain, was born in and had set up long-term encampments in town squares.[1] Said movement went on to inspire ideas in Occupy Wall Street and the Hong Kong Umbrella movements for equality.[2]

Figure 1 Plaza Mayor de Madrid, The Birthplace of 15-M

~~They~~ Democracy *needs* the town square, as seen during these movements. It can be argued that society owes many of our rights and liberties to the domain of open public space in the cores of cities and towns.

Open public spaces are the hallmark of democratized city life, yet in North America and especially newer cities herein, their importance sees not light. This may be due to their lack of heritage when compared to those of European cities, where town squares have intrinsic artifactual-historic value.[3] Nevertheless, they do exist in North American cities (albeit scarcely), including the city of Surrey, Canada where a “civic plaza” completed construction in 2016-17 (see figure 2). This plaza has since hosted many cultural events and even protests led by environmentalist David Suzuki.[4] The plaza was planned and constructed between three landmark sites of Surrey. On the West side is the Surrey Centre Library, to the North is Surrey’s City Hall, to the East is the tallest building in Surrey, the *Civic Hotel,* and on the South side lies the recently discontinued North Surrey Recreation Centre (NSRC). The City Hall, Library, Civic Hotel and the former site of the

[1] Castañeda, ‘The Indignados of Spain’.
[2] Ibid.; Díez García, ‘The “Indignados” in Space and Time’.
[3] Lennard, *Genius of the European Square.*
[4] See "Save Hawthorn Park" protests

NSRC, draw importance here: The Civic Plaza epicentres four of the most notable landmarks of Surrey. With this understood, one can assume the sheer popularity of the plaza. It is used well, and from a planning perspective, has exciting potential as the "town square" of Surrey. Preserving the popularity of this plaza is fundamental in establishing a strong public square. There are concerns, however, around the NSRC's existing plot, which is being auctioned for redevelopment. Whoever wins this bid will work with the city to determine the constitution of the entire civic plaza South side. They have called this site the "Centre Block" (Hereafter referred to as Site-CB).

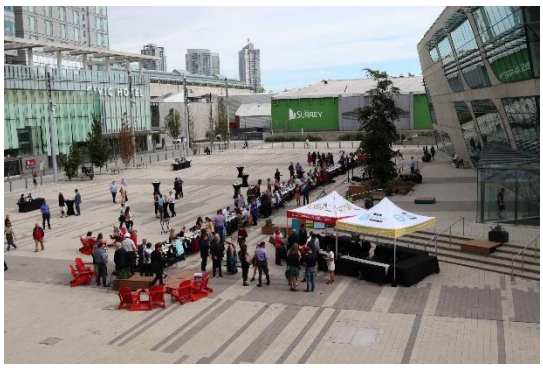

Figure 2 Surrey Civic Plaza during a February Event

Objective

The obvious contingency in terms of popularizing the Surrey's civic plaza would be the intended purpose of the site's redevelopment. The less obvious contingency, of which my research is concerned, will be the redevelopment's shadow cast. That is to say, the height of the building(s) will be a concern for planners due to problems surrounding the plaza's access to sunlight. There is plenty of literature describing the negative effects of shadows in public spaces–wherein authors argue how sunlight is an essential property when creating a sense of place and openness.[5] My research thus uses 3D Geovisualization methods to communicate the effects of shadows in possible redevelopment scenarios. I have done this by re-modelling the civic plaza in three dimensions, recreating a realistic sun using Hosek et. al.'s (2012) analytic sky model,[6] then portraying the perceived experience of a civilian standing in the plaza itself. Through a series of comparative videos, my results are purely self-interpretive. My initial desire was to quantify shadows to compare building heights, however, this nullifies any reason to use 3D geovisualizations. A means of experiencing the dullness of shade, then, is the strength and result of this study.

[5] Canadian Electronic Library (Firm) distributor, *On Shade and Shadow*; Ventura, 'Shadows and Lights on the Square. Cyclical Transformations of a Public Space. The Case of Piazza Politeama in Palermo'.
[6] Hosek and Wilkie, 'An Analytic Model for Full Spectral Sky-Dome Radiance'.

Folder Structure

LINK *https://vault.sfu.ca/index.php/s/ivfd1mozuVIcIJX*

/Still Images/Diwali/*.tga
Contains still image renders for the 7-Story scenario.

/Still Images/Family Day/*.tga
Contains still image renders for all scenarios.

/Video Renders/*.mp4
Contains compressed video renders of all scenarios with time logs.

/Project Files/
Contains Modo project file and Unreal Engine project zip.

Storyboards

The following pages will contain a series of storyboards which describe some of my key visualizations.

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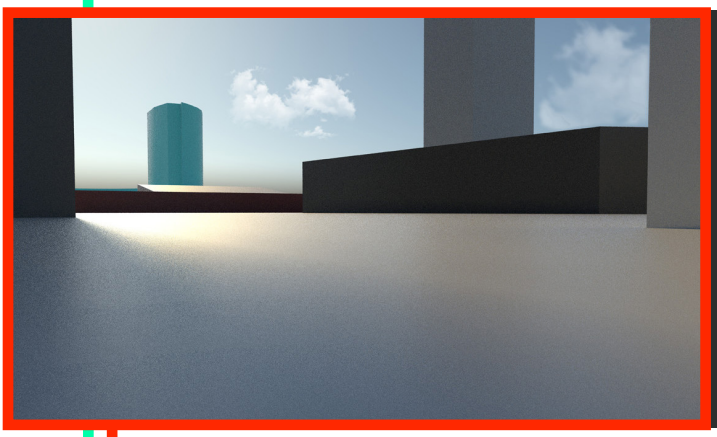
February 17th - Family Day - Original Site

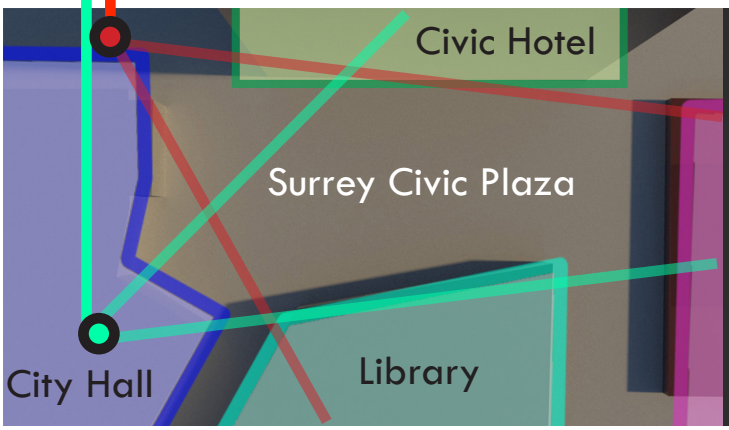
Family Day is a statuory holiday in British Columbia. These still renders and actual exposures demonstrate the vibrancy of the current site. It shows how low-rise buildings preserve sun-light. Please allow these still renders and exposures to introduce you to the plaza.



Humanoid

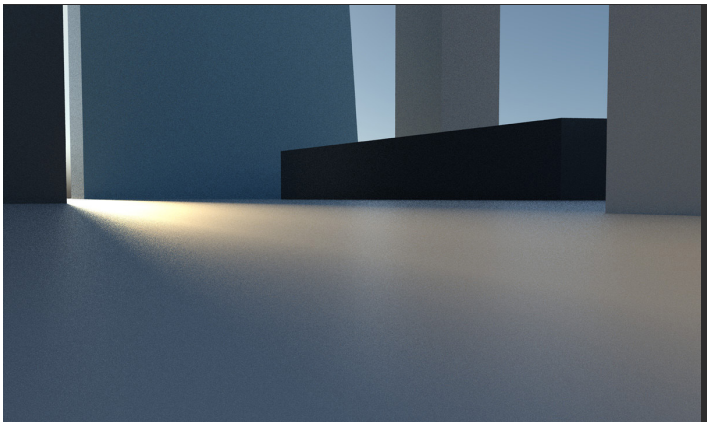
Here is the 3D interpretation of the plaza.

See the lines below to understand the view-port of the “Humanoid” render as well as the photograph above.



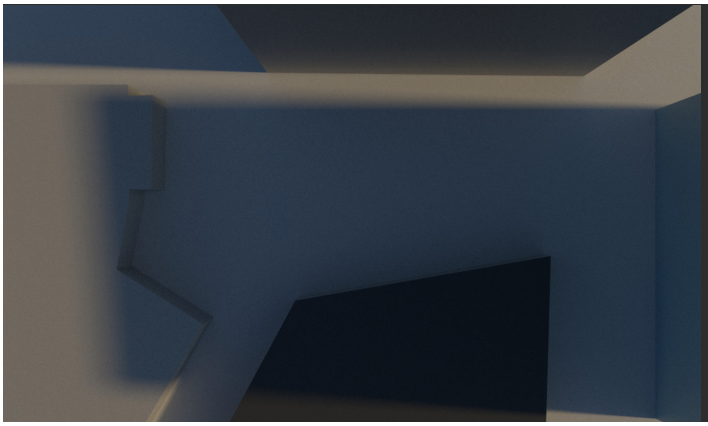
February 17th - Family Day - 100m

Family Day is a statuory holiday in British Columbia. I chose this day to expose the disastrous effects of a 100m highrise development in Site-CB on a day where family festivities could take place. This year, over four events were hosted at the plaza in the month of February. Here are some still renders in Modo.



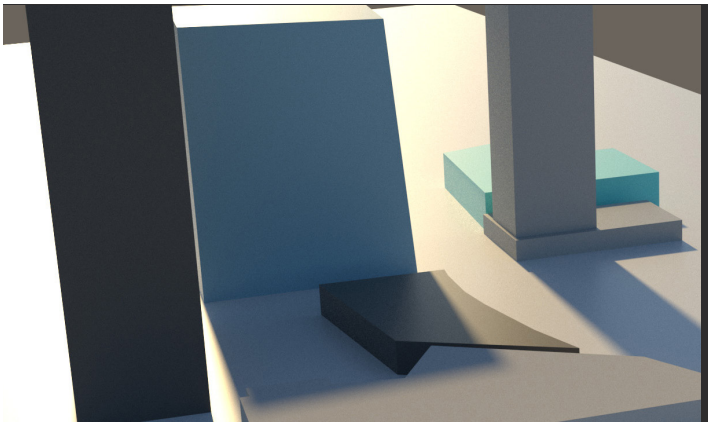
Humanoid - 1:30pm

Imagine having to walk through a cast of darkness to reach the library at 1:30 in the afternoon.



Overhead - 1:30pm

This view compellingly captures the the sheer length of a high-rise shadow–even if building width is inaccurately theorized.

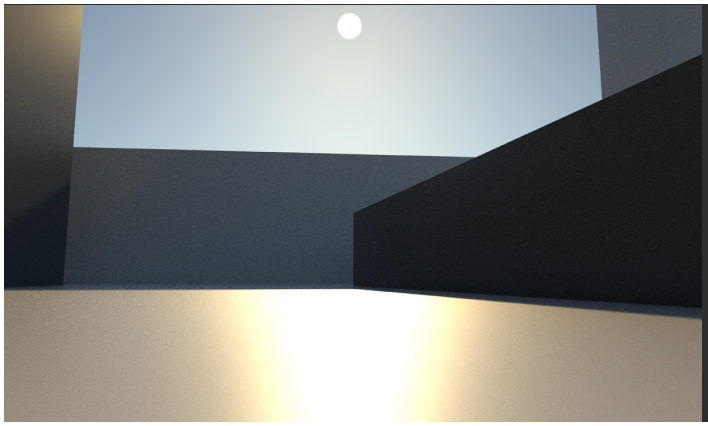


Bird - 1:30pm

A 100m tall building would end the vibrancy of the plaza during non-Summer months.

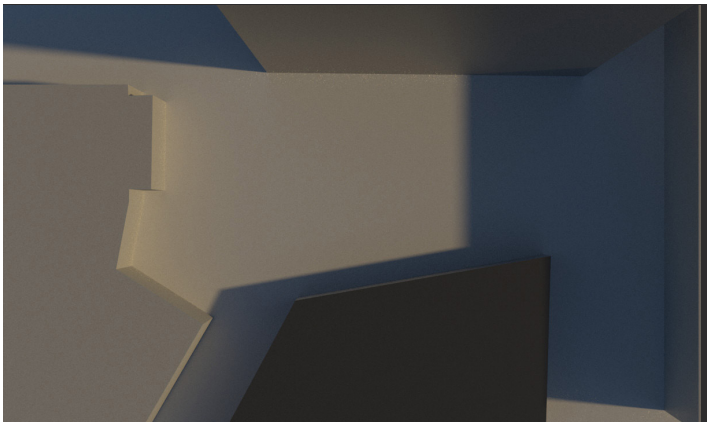
October 26th - Diwali - 7 Stories

Diwali is a largely celebrated South Asian holiday in Surrey. Every year, thousands gather in public events across the city. This year, Red FM hosted a massive celebration at the Surrey Civic Plaza. Here is the plaza rendered with a 7 story building in Modo.



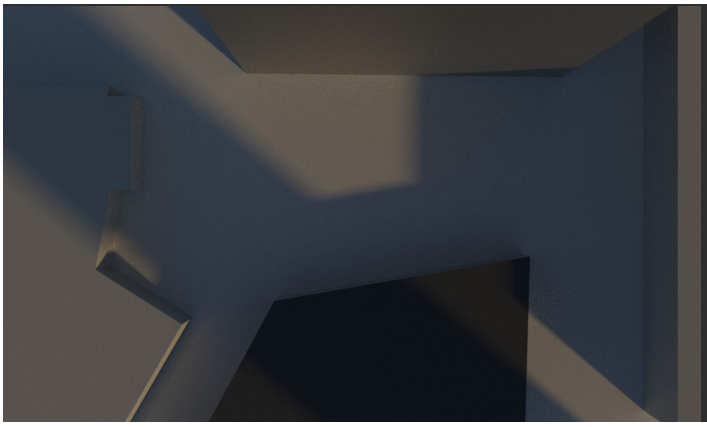
Humanoid - 1:30pm

This still render struggles to see the effect of the shadow due to its position. The shadow is less visible when the sun is visible.



Overhead - 1:30pm

This view captures the shadow ratio much more effectively. The 7 Story scenario appears to be somewhat acceptable.



Overhead - 3:30pm

I found that at 3:30pm, existing buildings began to add substantially to the shadow cast.

Unreal Engine 4.24 - Solstice and Diwali

The following video renders which can be accessed in my Vault, animate the shadows casted at all solar hours during Summer Solstice (June 22nd) and Diwali (October 26th). please observe the log on the left of the HUD to check which month and time the current frame is.

Video Render - 7 Stories

The 7 story scenario appears to be a viable solution. Note how the shadow only reaches the subject that is closer to the back of the plaza?

Video Render - 100m

The 100m scenario again appears to be disastrous. It would cast a shadow across the entire plaza during all months. Even on the solstice this scenario is heavily shadowed.

Video Renders - Village

These two renders exposed the feasibility of a village scenario. This village concept would allow adequate sunlight at most hours of the day during any month.

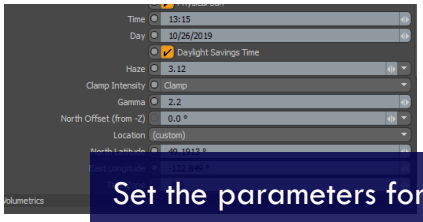
Methodology

Below is a comprehensive workflow I made for understanding shadow casts in any urban environment. I found this workflow to be effective, smooth, and very revealing of geographic reality.

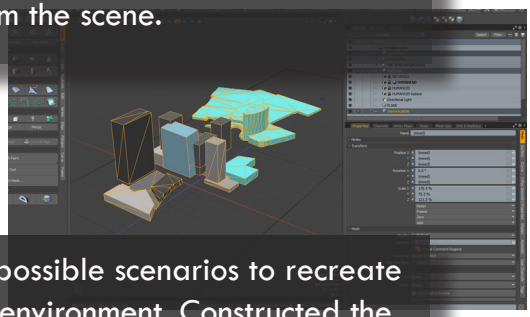
Acquired OSM data and created a 3D mesh using the OSM2World.org open source mesh generator. It creates z-valued polygons with building height data.

Researched sky-dome analytic models available in the Chaos V-Ray render tool.

Found the Hosek et. al. model to be best



Imported the mesh into Modo and aligned the environment with North. Cleaned up the environment and removed irrelevant buildings from the scene.



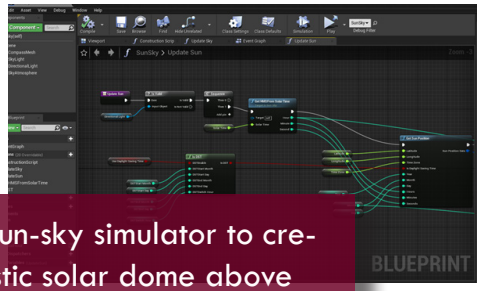
Set the parameters for the sky-dome simulator to match the exact geolocation of the plaza on my target dates which were: Diwali, Family Day and Summer Solstice.

Researched possible scenarios to recreate in the Modo environment. Constructed the four 3D scenarios: the original site, 100m highrise, 7 story midrise, and a village.

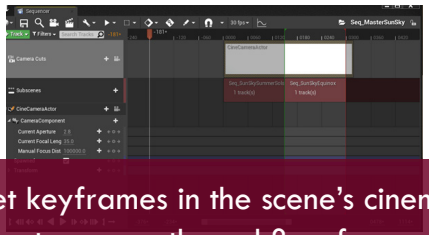
Created several still image renders on each date for each scenario from various camera angles: Overhead, bird and humanoid. Uploaded to Vault.

Rendered several animations.
2 x 10 second/solar day scenes per video.

Exported merely the structural environment as an .FXB and imported it into Unreal Engine 4.24.



Utilized Unreal's sun-sky simulator to create a hyper-realistic solar dome above Surrey on two important dates: Solstice and Diwali.



Set keyframes in the scene's cinematics to create a smooth workflow for rendering multiple scenarios. Made the key frames to only capture daylight hours.

Scenarios

Village

The least shadowed scenario was the village. It attempted to recreate the only pre-existing hypothetical rendering of the proposed redevelopment which surface on The Daily Hive earlier this year.[7] I found this scenario to be the most compelling: it would allow the most sunlight for all months of the year. The stands out from other scenarios particularly because of how low the angle could be. It has potential to improve the lighting situation if done correctly. For these reasons, the village scenario would be my first suggestion for development.

7 Story Midrise

In second place was the midrise scenario. The building dimensions were derived from the suggested floor-area-ratio and lot-area dimensions provided by the city of Surrey for future developers.[8] This allowed me to calculate a mean expected building height which would be 27 meters. I then used their setback dimensions to redraw the polygon in Modo which allowed for the recreation of the theoretical site as suggested by the city. My visualizations revealed that this scenario would be acceptable but not preferred. Often, my humanoid subjects in the center of the plaza were casted by shadows during peak daylight hours of the Spring and Fall events.

100m

The 100 meter building was creatively conceived by following the patterns of Surrey's latest developments, as well as teasing at an ambitious, recent statement from Mayor McCallum when he declined a proposal, stating that a 25-story building was "Not tall enough" for the city centre.[9] Alas, here is Mayor McCallum's wish: A very dark and gloomy Civic Plaza, as seen my visualizations.

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[7] 'Surrey Central Station Bus Loop and North Surrey Recreation Centre to Be Redeveloped | Urbanized'.
[8] 'Request for Expressions of Interest – Centreblock Project. ■ SCDC'.
[9] 'Surrey Council Sends Back 25-Storey Highrise Proposal, Asks for More Height and Density – Surrey Now-Leader'.

Discussion

The videos rendered in Unreal engine are robust visualizations. This is largely due to the rapid timestamp logging in the HUD which allows for a vigorous side by side comparison of models. It allows the viewer to analyze for themselves the perceptive differences of the various building heights and their respective shadows as the day progresses. This is key. Shadows are entirely dependant on time of day, thus, still renders can fall into biases. For example, one could choose a particularly shadowed time of day to dramatize a scenario, tricking the reader to believe something is much worse than it is. This was observed in my 7-Story rendering. In my overhead capture of the 7-story scenario at precisely 3:30pm, the reality seems much worse than at 1:30pm. This difference could greatly impact policies. Imagine if planners or councillors are to be provided that particular frame–it would inaccurately influence their understanding. Unreal Engine allowed me to simulate all daylight frames within any day of the year, which removes biases involved in the time of day. That is not to say there are no biases, so here are three that I discovered through this project: (1) Picking *which* day was particularly crucial for this analysis. I chose to respect Surrey's bi-culturalism and choose one White holiday and one South Asian holiday for comparing scenarios. Other researchers will find this to be biased, which they should. (2) I believed it was strongest to capture the scene looking southwards, towards the sun. This is not the only way to observe this plaza, however. Other viewports could provide less or more dramatic visualizations which could conclude several different ideas about the space. (3) Assumptions had to be made as to what textures, qualities, resolutions, angles, and other parameters of capture.

Spatial realities of daylight and urban shadows, as this project has discovered, are tricky to recreate in 3D. There are several implications involved . This project and corresponding methodologies have revealed a workflow for understanding theoretical urban shadows of developments using Modo and Unreal Engine. Future studies of similar nature should consider longer renders for more days of the year. They should also consider conducting a qualitative analysis into how the space is used, why, when, and what aspects of the space people value most. This would allow an even more vigorous mixed-methods approach. Unreal Engine, this project revealed, is an excellent software for daylight and shadow models and subsequent analysis.

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