To Light Bridge & Beyond

Custom Level- Portal 2
By Guvvy Atwal

Contents

High Level Overview:

Design Motivations:

This custom Portal 2 level was designed around the Light Bridge mechanic. In terms of structure, it utilizes the rule of 3. Introduce the mechanic, heighten challenge and then remix it in a unique way. All 5 areas come together to follow this pacing structure. Each room contains a puzzle and in terms of challenge, it provides some level of difficulty but still remains accessible for players who may not be well versed with playing puzzle games.

Key Elements:

In terms of key elements that define the level, vertically is an important component. Players will often start a new room at an elevated height to get a good view of the entire level. Processing what the level is required and calculating the steps they need to take to meet the main objective. In addition to using Light Bridges to reach new heights to solve a puzzle like accessing a Switch or Cube. Aforementioned a crucial aspect of the level design is ensuring puzzles remain accessible, but also offers a nice stretch of challenge. Hence why Sentry Turrets are introduced to ramp up difficulty in terms of physical danger, rather than mental challenge through puzzle design. This results in challenge being compromised of the same puzzle difficulty level harmonizing with a physical threat with the Sentry Turrets to create this delicious puzzle/adventure experience.

Level Goals:

- Upon introduction, Light Bridges should be used to solve puzzles and also resonate thematically (as seen with area 4, which highlights the fact that Light Bridges can be used to block Sentry Turret bullets).
- Accessible puzzles, that offers some form of challenge. Yet it can still be enjoyed by anyone.
- Due to Portal 2's custom editor only allowing for 1 exit and 1 entrance door, laser grids can function as doors. Allowing each room to operate as a mini level because they can be activated by attaching their opening condition to a Red Button.
- Players can destroy Sentry Turrets by activating a switch. Rewards the player for overcoming them.

- The final room will remix the light bridge mechanic, to afford being used as a shield.

Design Considerations:

Utilizing anti-affordances:

Non-portal walls and Goo are examples of anti-affordances. The player needs to use a limited amount of portal walls and light bridges to solve puzzles. Constraints allowed for a more focused puzzle experience because players have a limited number of items to remember and concentrate on. Thus making puzzle solutions more accessible for player.
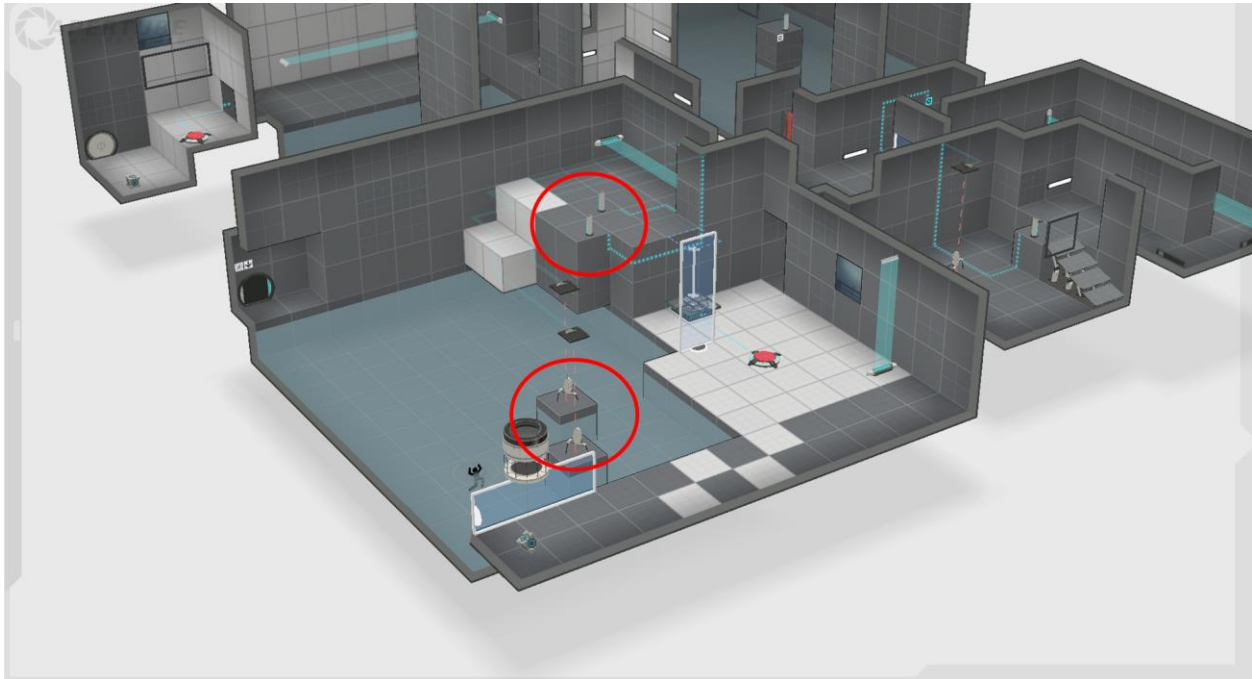
For the laser switches (as seen above), I thought it would be a good idea to have them laid out in a similar layout to the enemies from the players perspective. Since mapping layouts usually corresponds to suitable actions. This is supported by Donald A Norman's findings of Mapping, in the Design of Everyday Things Revised and Expanded (2013):
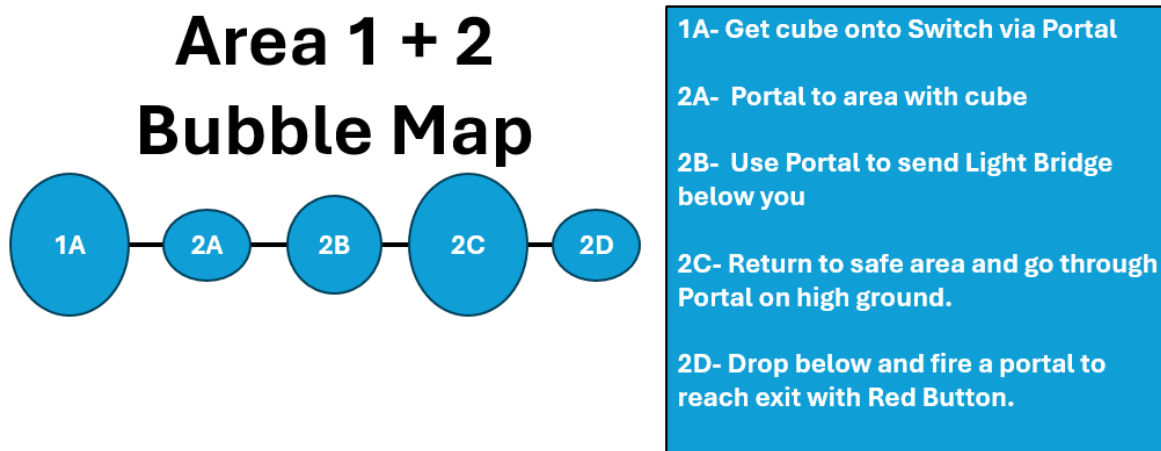
"A device is easy to use when the set of possible actions is visible, when the controls and displays exploit natural mappings"- Donald A Norman

Portal 2's Level editor has a limited physical size constraint for a level. No level can exceed the 25^3 volumes. Therefore, the level utilities corridors to ensure all 5 areas can fit within this volume. This constraint was only discovered upon making room 3, where the previous rooms had to be downscaled and future rooms scale had to be smaller sized.
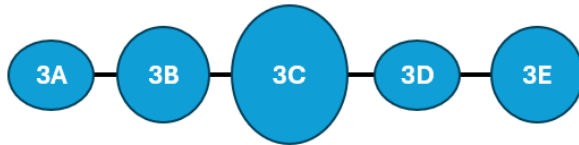
Expected Player Experience:

- A constant intrigue for solving each room's puzzle
- Enjoying different formats, a light bridge can be used to overcome challenging obstacles.
- Tricking players into feeling and thinking they are smarter after solving a room's puzzle.
- Mechanics and difficulty will be implemented through scaffolding, this way the player is not overwhelmed by cramming all the puzzles into a single room. Instead they are spread out across 5 rooms.

Bubble Maps:

Area 1 + 2
Bubble Map

1A — 2A — 2B — 2C — 2D

1A- Get cube onto Switch via Portal

2A- Portal to area with cube

2B- Use Portal to send Light Bridge below you

2C- Return to safe area and go through Portal on high ground.

2D- Drop below and fire a portal to reach exit with Red Button.

Area 3
Bubble Map

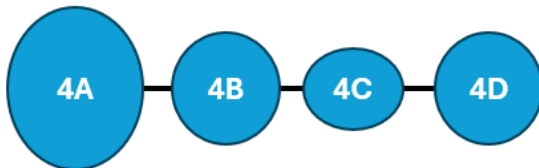3A — 3B — 3C — 3D — 3E

3A- Portal to other area

3B- Use light bridge to reach centre pedestal with Switch

3C- Hit the switch and fire portal to catch companion cube

3D- With cube, travel through portal, until you reach high ground

3E- Fire a light bridge below and travel to Red Button
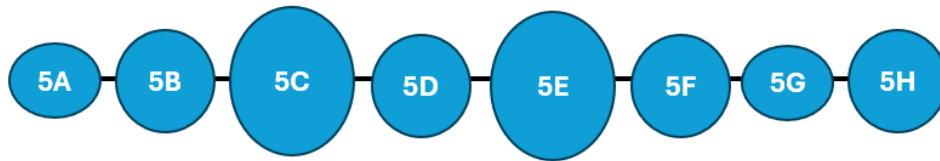
Area 4
Bubble Map

4A — 4B — 4C — 4D

4A- Sentry Turret attacks player

4B- Hit Switch to activate shield
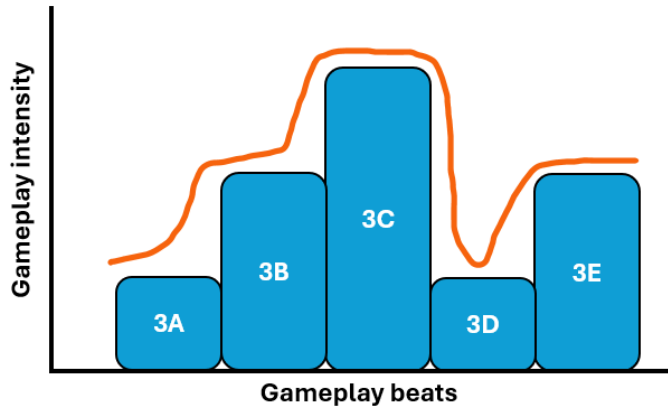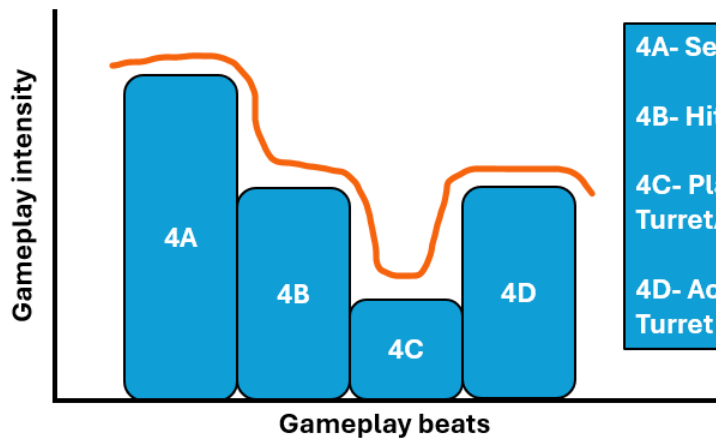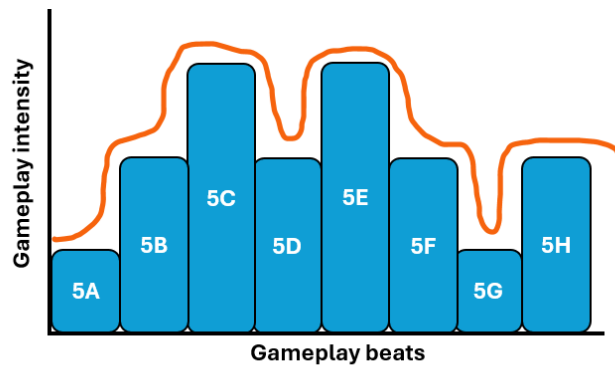
4C- Player moves across Sentry Turret/Light Bridge display

4D- Activate Switch to destroy Sentry Turret

Area 5 Bubble Map

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5A   5B   5C   5D   5E   5F   5G   5H
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5A- Player moves to glass, therefore avoiding Sentry Turret fire.

5B- Fire portal to unleash light bridges that can be used as a shield to block Sentry Turret fire.

5C- Use Light Bridge as a shield, so player can reach companion cube.

5D- Use portal to transfer location of companion cube

5E- Use light bridge-shield to reach pedestal behind glass area.

5F- Use portals to get Companion Cube to land on Red Button.

5G- Reach higher ground, activate both Switches to destroy Sentry Turrets

5H- Use secondary light bridge to reach exit and finish level!

Beats and Pacing:

Area 1 + 2
Beats & Pacing diagram
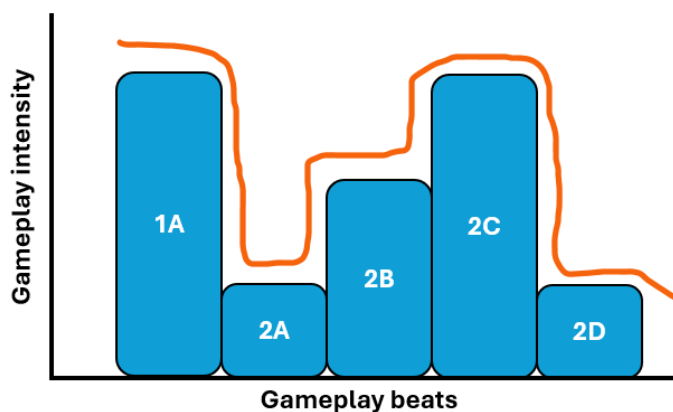
1A- Get cube onto Switch via Portal

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2C- Return to safe area and go through Portal on high ground.

2D- Drop below and fire a portal to reach exit with Red Button.

Area 3
Beats & Pacing diagram

3A- Portal to other area

3B- Use light bridge to reach centre pedestal with Switch

3C- Hit the switch and fire portal to catch companion cube

3D- With cube, travel through portal, until you reach high ground

3E- Fire a light bridge below and travel to Red Button

Area 4
Beats & Pacing diagram

4A- Sentry Turret attacks player

4B- Hit Switch to activate shield

4C- Player moves across Sentry Turret/Light Bridge display

4D- Activate Switch to destroy Sentry Turret

Area 5
Beats & Pacing diagram

5A- Player moves to glass, therefore avoiding Sentry Turret fire.

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5H- Use secondary light bridge to reach exit and finish level!

Mechanics:

Primary mechanics-

Light Bridge:

=A flat bridge can be transported using the Portal gun, both horizontally and vertically.

Companion Cube:

=Can be placed on top of a red button.

Red Button:

=If the player stands on top or drops a Companion Cube on top, it activates another gameplay component, e.g. laser grid or fixed moving platform.

Sentry Turret:

 = An enemy that fires bullets at the player, causing damage.

Secondary mechanics-
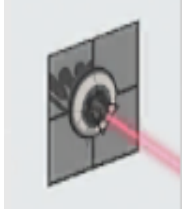
Switch:

 = Connects to another device.

Glass:

 = Can block Sentry Turret fire and contains transparent qualities.
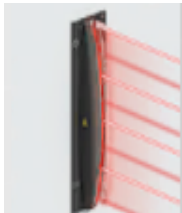
Fixed Moving platform:

 = Moves vertically up and down

Laser:

Destroys Sentry Turret upon being activated.

Laser grid (door):

= Blocks the player from accessing the next area. Can be deactivated by adding a Companion Cube.

Goo:

= If the player lands in this liquid, they are immediately eliminated. Similar to the properties of Acid.

As seen above this level features several primary and secondary gameplay mechanics that governs the flow of the experience. Most primary gameplay mechanics have direct interactions with each other, whereas secondary gameplay mechanics share indirect interactions or a single direct interaction with other gameplay mechanics. Below is a table that summaries all mechanical interactions within the level.

Mechanic resonance table:

Mechanic Resonance Table

1 = Direct interaction
0.5 = Indirect interaction
0 = No interaction

X										
	X	0	1	0.5	0	0	1	0	0.5	0
	0	X	1	0	0	1	0	1	0	0
	1	1	X	0	0	0.5	0	1	0	0.5
	0.5	0	0.5	X	0	0	0	0	1	0.5
	0	0	0	0	X	0	0	0	0.5	0
	0	1	0.5	0	0	X	0	0	0	0
	1	0	0	0	0	0	X	0	1	0
	0	1	0.5	0	0	0	0	X	0	0
	0.5	0	0	1	0.5	0	1	0	X	0
	0	0	0.5	0.5	0	0	0	0	0	X

Map Overview:

Portal 2- 2D LEVEL LAYOUT

Key:
- S = Start
- E = End
- = Goo
- = 1st floor
- = 2nd floor
- = Wall
- = Glass
- = Companion Cube
- = Red Button
- = Laser grid (door)
- = Light Bridge
- = Switch
- = Sentry Turret
- = Laser
- = Stairs
- = Fixed Moving Platform
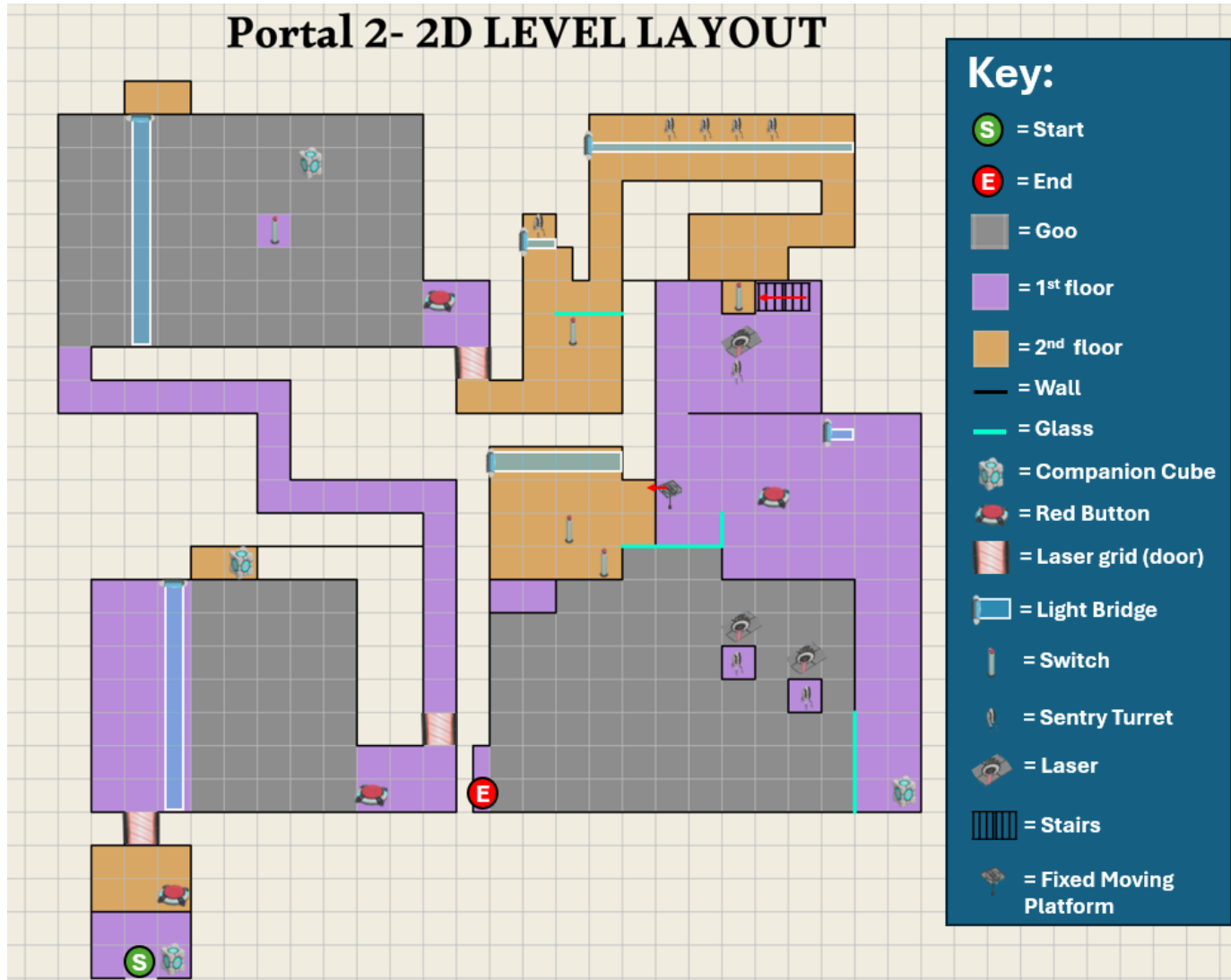
*It should be noted on the first floor, 2nd floor and 3rd floor are the same height according to the players point of view in each room. Rather than overall floor height.

Map Layout overview:
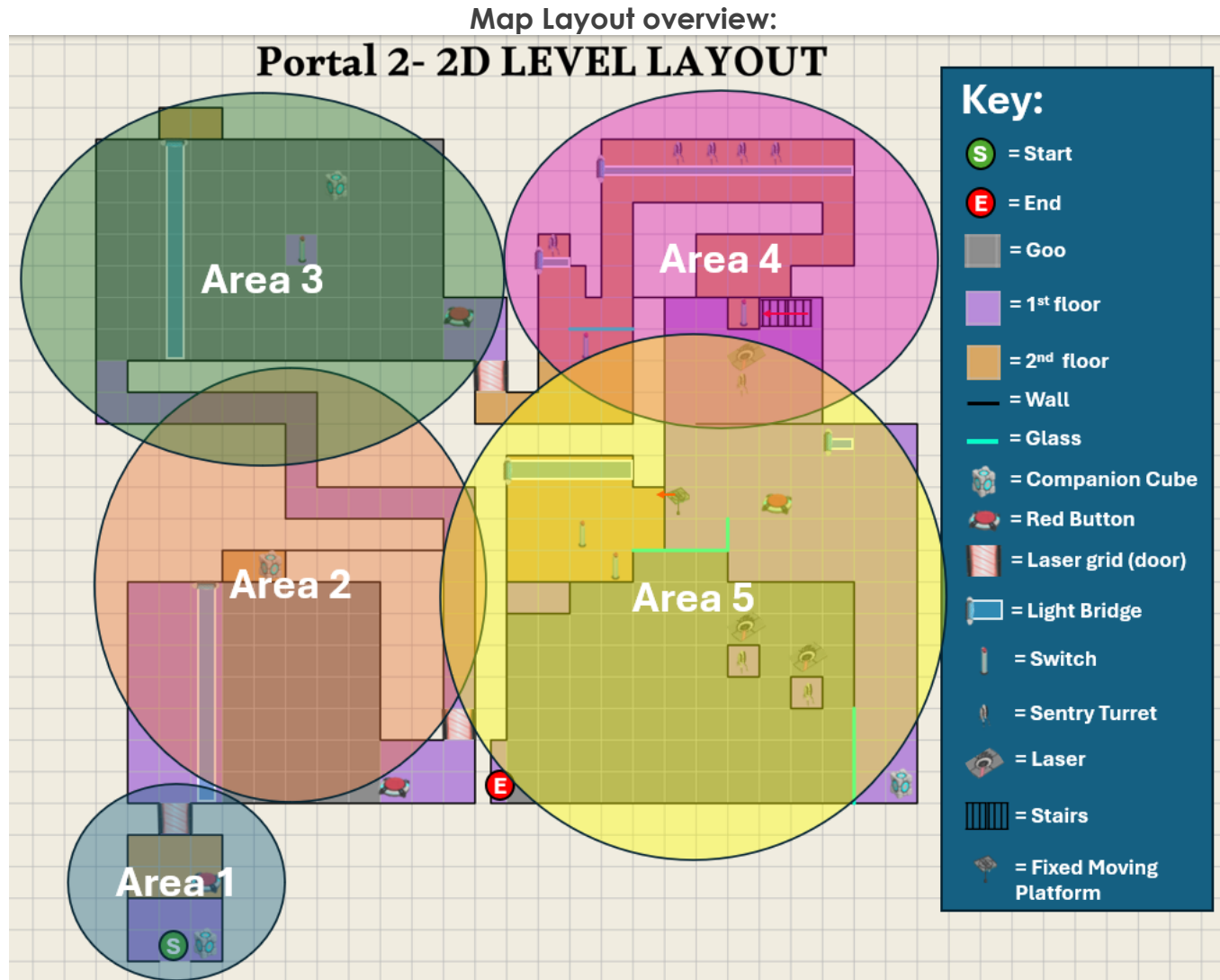
Player Paths:

Portal 2- 2D LEVEL LAYOUT

Area 1 + 2
Beats & Pacing diagram
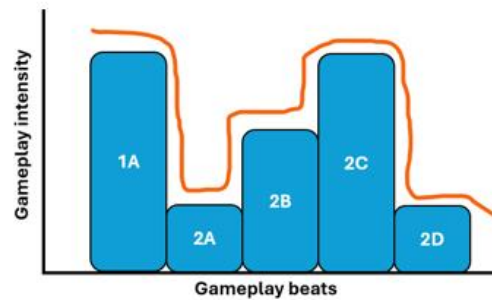
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- = Sentry Turret
- = Laser
- = Stairs
- = Fixed Moving Platform

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Portal 2- 2D LEVEL LAYOUT

Area 3
Beats & Pacing diagram

3A- Portal to other area

3B- Use light bridge to reach centre pedestal with Switch

3C- Hit the switch and fire portal to catch companion cube

3D- With cube, travel through portal, until you reach high ground

3E- Fire a light bridge below and travel to Red Button

Key:
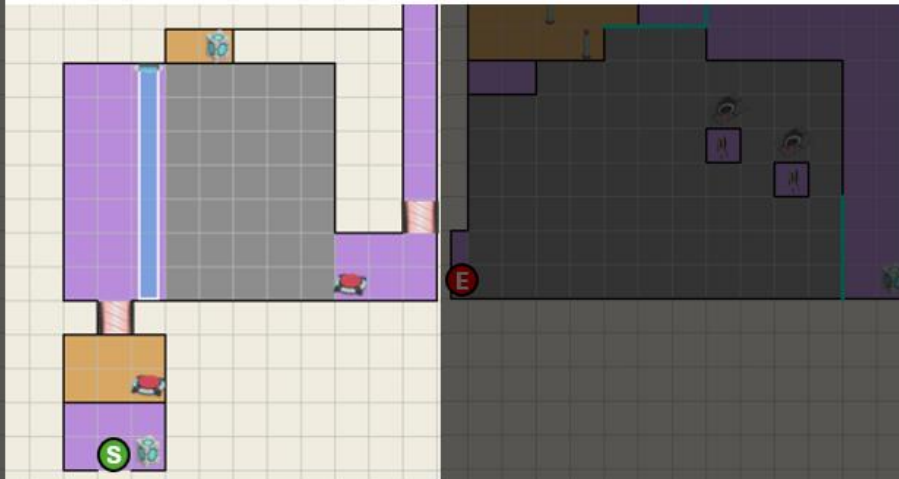
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Portal 2- 2D LEVEL LAYOUT

Key:

- **S** = Start
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Area 4
Beats & Pacing diagram

Gameplay intensity / Gameplay beats

4A, 4B, 4C, 4D

4A- Sentry Turret attacks player

4B- Hit Switch to activate shield

4C- Player moves across Sentry Turret/Light Bridge display

4D- Activate Switch to destroy Sentry Turret

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Area 5
Beats & Pacing diagram

5A- Player moves to glass, therefore avoiding Sentry Turret fire.

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Key:

S = Start

E = End

= Goo

= 1st floor

= 2nd floor

= Wall

= Glass

= Companion Cube

= Red Button

= Laser grid (door)

= Light Bridge

= Switch

= Sentry Turret

= Laser

= Stairs

= Fixed Moving Platform

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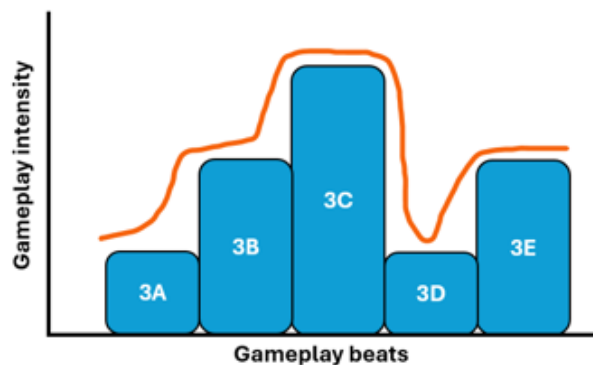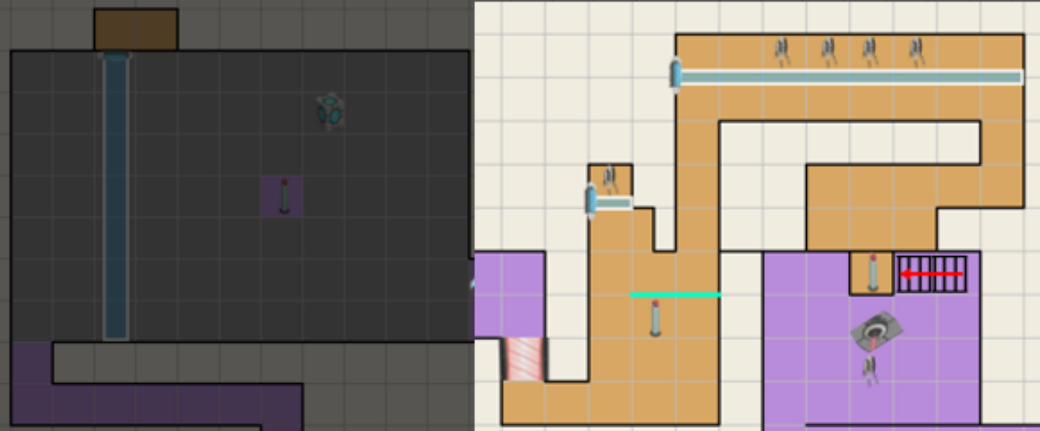# Aesthetics (Look and Feel)

Visual Development:

Here are a range of shots that showcases the overall level aesthetic:

The concept for the earlier rooms was to have a grungy atmosphere, paired with remitments of advanced technology through the Light Bridges.

The Goo, functions as an anti-affordance for players because they want to avoid landing in it. Leading the player to use the Light Bridge to catch it.
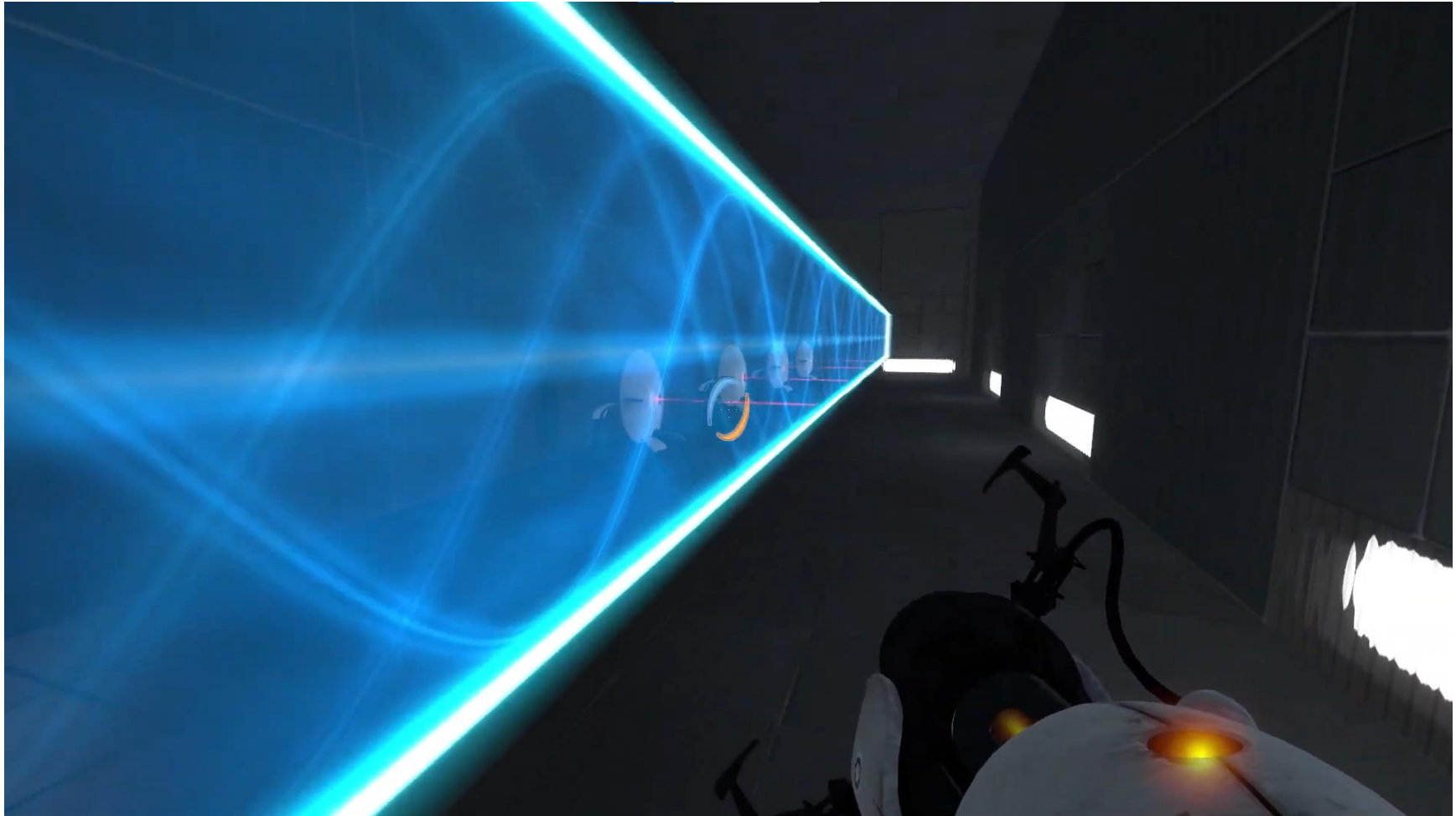
This showcase of Sentry Drones with the Light Bridge highlights the threat of the enemy. However, the Light Bridge is there to highlight there is hope for the player to 'shield' themselves from the danger they pose. As seen by the next image:

This framing highlights the advanced challenge of this area. That brings together all the previous mechanic components to truly test the players ability.
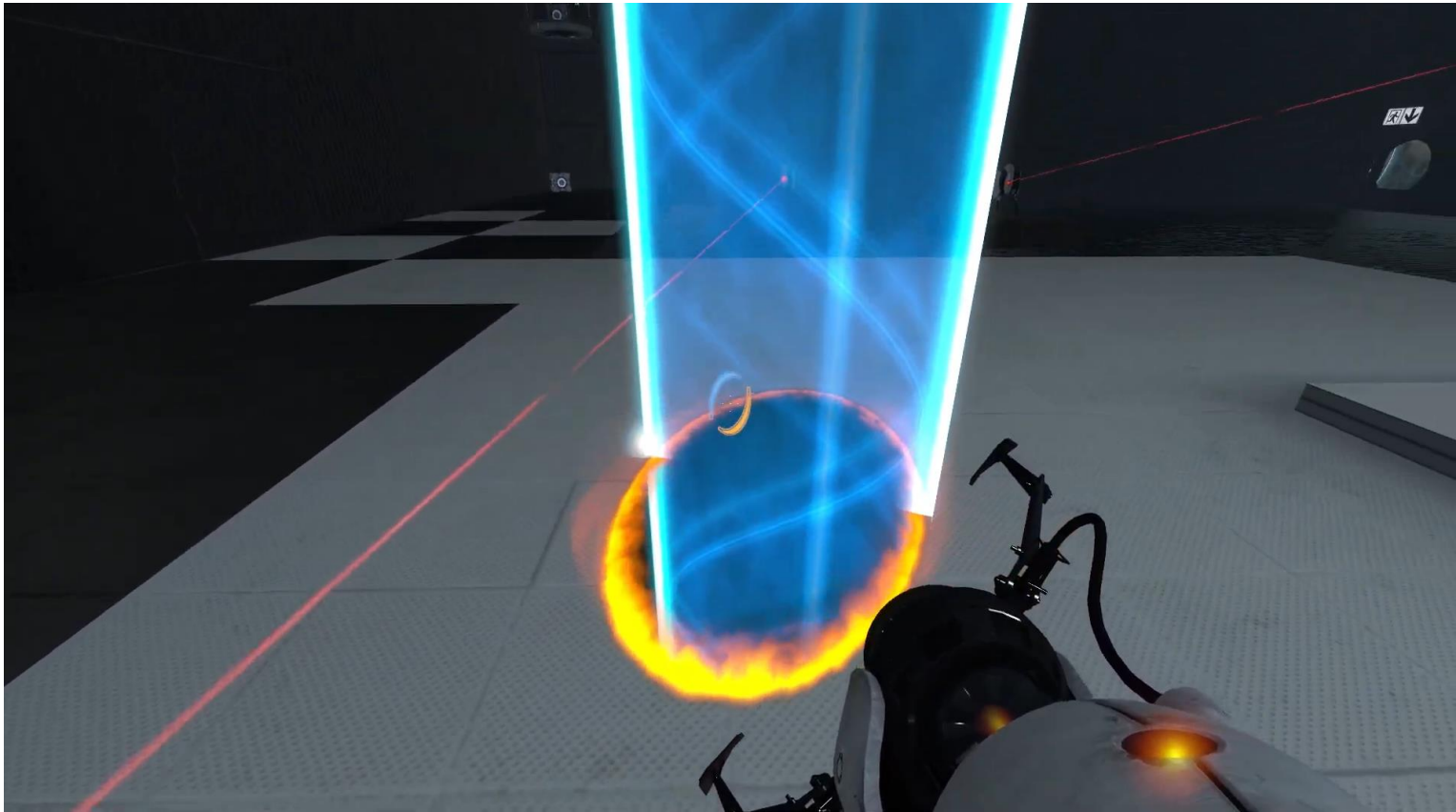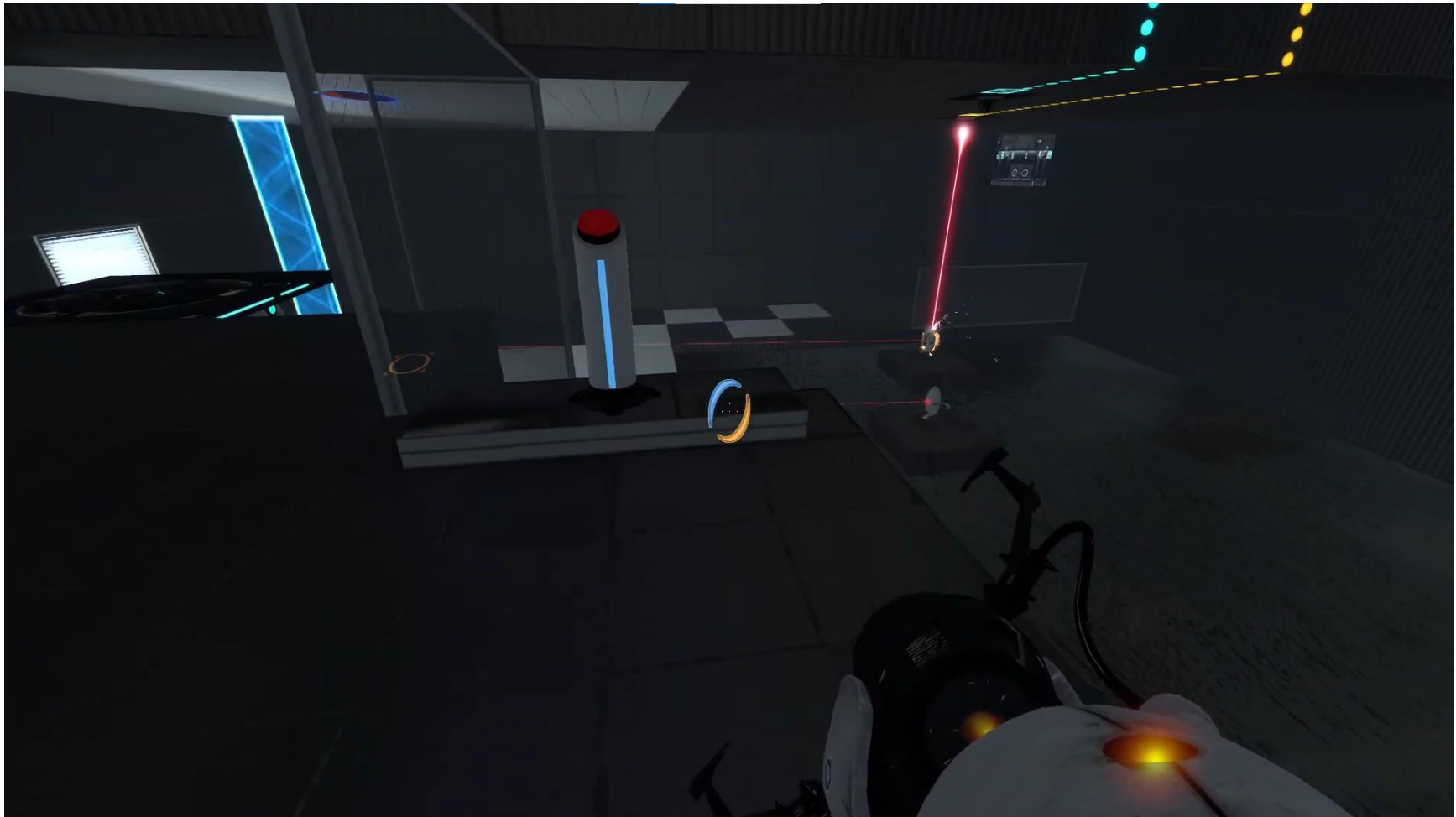
A sense of satisfaction is reached, with players feeling rewarded for their efforts of overcoming the challenge of the Sentry Turrets. Thus this moment is paid off by giving players an opportunity to watch the destruction of the Sentry Turrets.

Visual Affordances:
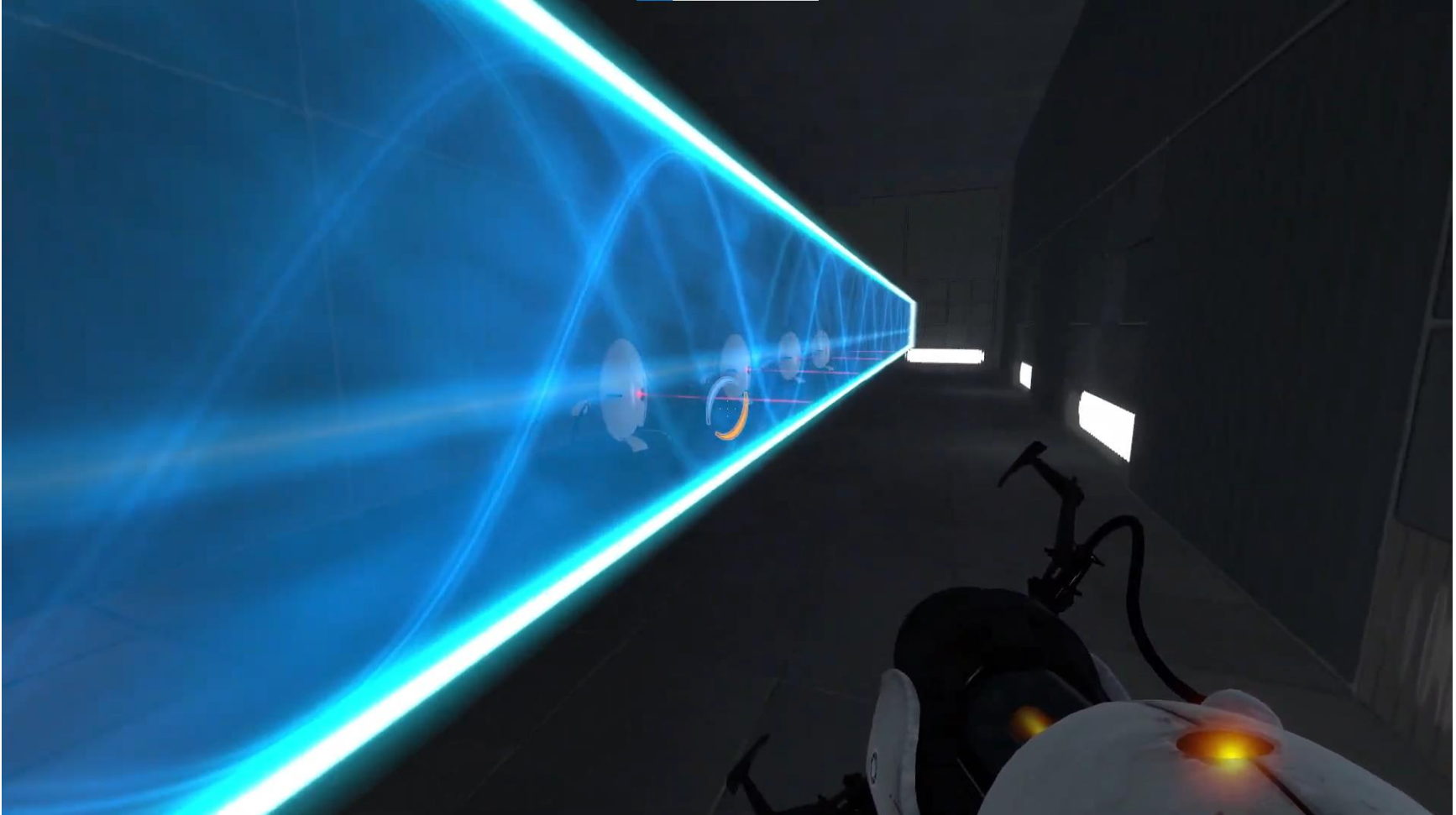
Using lights as substitutes for arrows to afford being used as directions through the level. In addition to brightening the surrounding area because there are many dark surfaces.
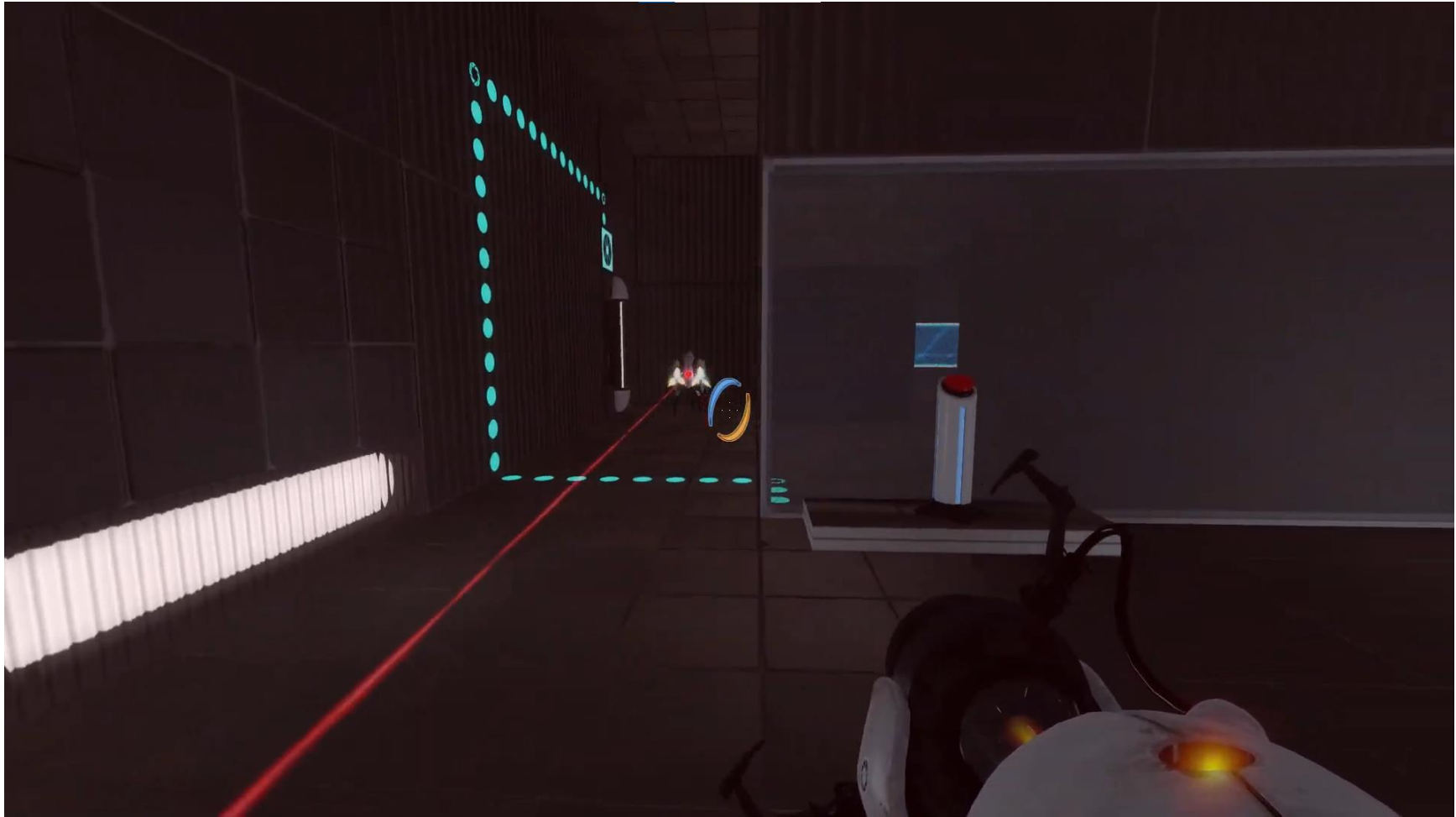
Switches have a connection pattern. Thus, becoming a leading line, for the player to follow, to view the object the Switch connects to. Furthermore, this guides players to the most important gameplay feature in the foreground. In this example, it is the Sentry Turret and Light Bridge interaction, as afforded by the Switch.

Using multiple Portal and non-portal floor mesh's creates a Zig Zag patten. Through this visual contrast communicates to the player where they should fire their light-bridge shield! Whilst also affording a noticeable area to catch the player's eye and realize they need to go that way to reach the Companion Cube.

Mapping controls corresponding to appropriate player actions:
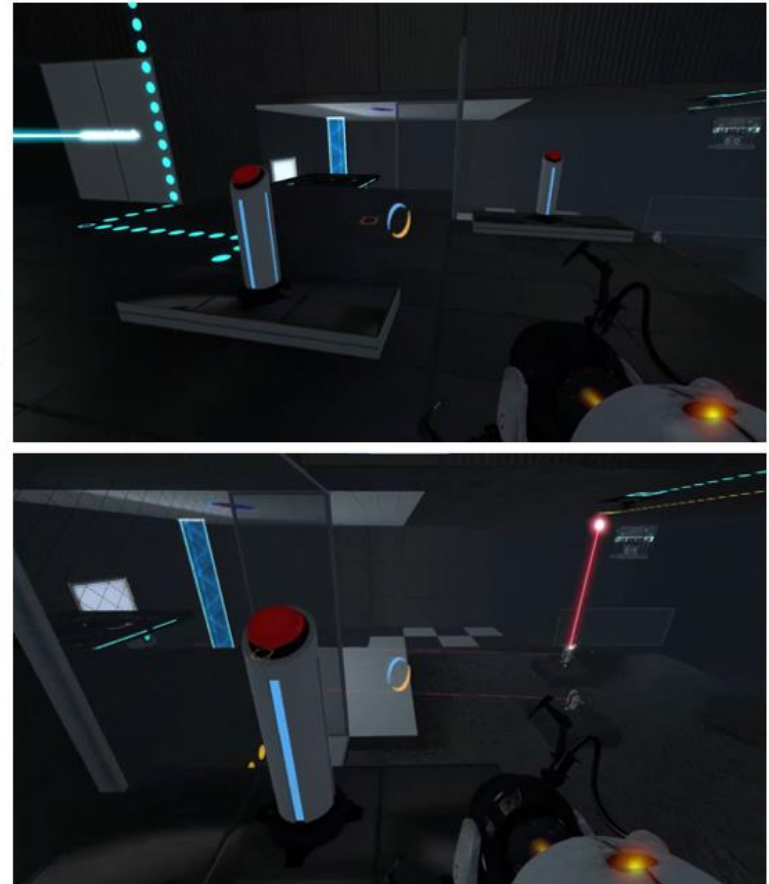
For the laser switches, I thought it would be a good idea to have them laid out in a similar layout to the enemies from the players perspective. Since mapping layouts usually corresponds to suitable actions. This is supported by Donald A Norman's findings of Mapping, in the Design of Everyday Things Revised and Expanded (2013):

"A device is easy to use when the set of possible actions is visible, when the controls and displays exploit natural mappings"- Donald A Norman

Balance

Considerations:

- **Limited number of Portal surfaces**- one balance consideration was to ensure players had a limited amount of Portal surfaces they could interact with. This is because it allows the player to focus on a few key areas and come up with a solution faster. Whereas conventional Portal levels are designed to offer a vast array of Portal surfaces for the player to access. But it does increase challenge because the player's working memory might be overwhelmed with choice with how they should approach a puzzle.

- **Lowering difficulty of Sentry Drones**- by placing them further away from player. Since it gives players longer to find cover or flee because bullets take longer to hit the player from the extra distance.

Expected Issues:

- **Reducing scope** because Portal 2's level editor has a physical volume limitation of no more than 25^3 volume. As a result, I downscaled the level significantly to ensure all 5 areas could fit into this constrained volume. Whilst maximizing the limited amount of space through multiple corridors. As seen by the resizing of areas 1 & 2:

Before	After
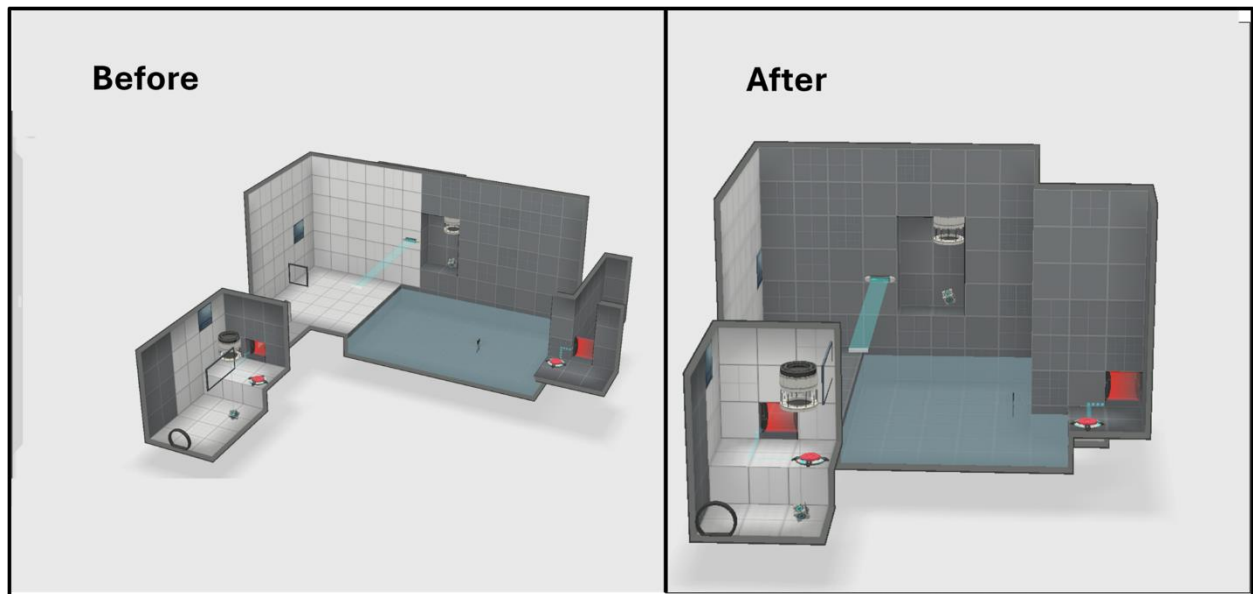
- **Players potentially become overwhelmed** with danger that Sentry Turrets pose. To plan ahead for this issue, instead of teasing the player with the concept of Sentry Turrets being a threat (as seen by 2D layout below). I decided to have players experience their threat and highlight how light bridges can be used to protect the player. Which foreshadows their future use during the 5th and final area of the level

Initial concept for area 4:
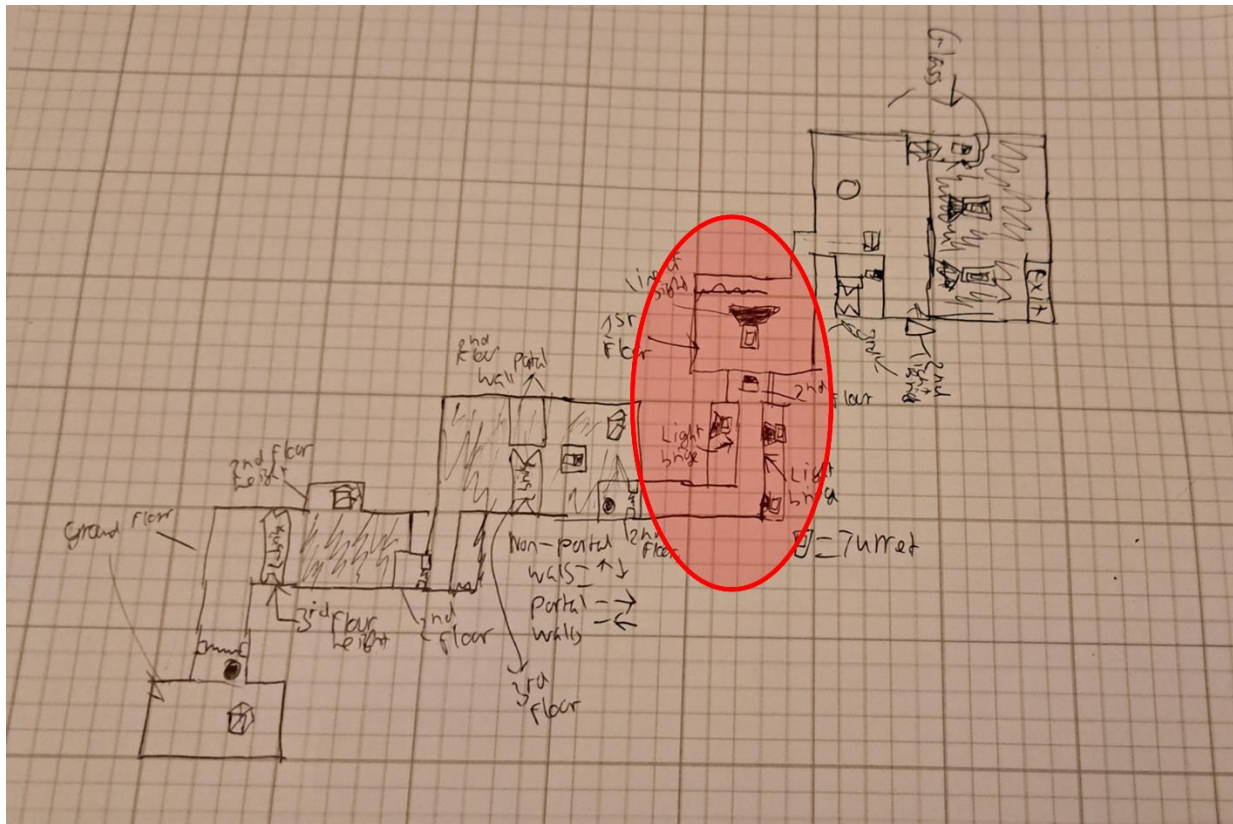
Revised version:
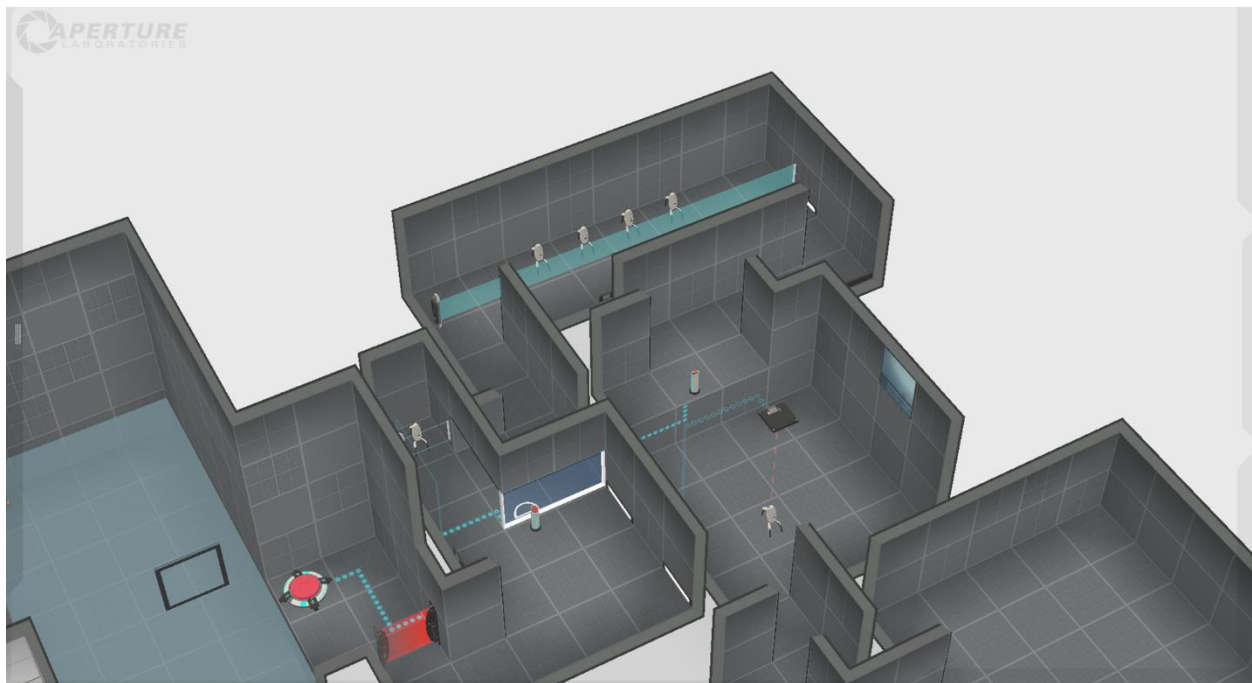
Testing

Testing Plan:

Created a survey to playtest the level. This survey is mostly examining the difficulty of puzzles and evaluating how effective the level was designed around the Light Bridge mechanic. In terms of data gathered, this is mostly qualitative data gathered from participants who have either none, some or lots of experience with playing Portal.

To Light Bridge and Beyond Playtesting survey

Guvvy's custom level (Portal 2)

1. Please explain why or why not the Light Bridge mechanic was engaging to use?

Enter your answer

2. How difficult were puzzles that used light bridges (1= Easy-peasy, 2= Not too difficult, 3= Good level of challenge, 4= Hard, 5=Very hard!!

☆ ☆ ☆ ☆ ☆

3. Did you enjoy using a light bridge as a shield against the Sentry Turrets? If not please explain why?

Enter your answer

4. In regards to pacing, did you feel the difficulty of puzzles scaled accordingly. Or did pacing difficulty feel more sporadic?

Enter your answer

5. Which puzzles did you enjoy solving?

Enter your answer

6. Did you feel the puzzle mechanics were introduced at a reasonable pace?

Enter your answer

7. What could be added to improve the polish of the level?
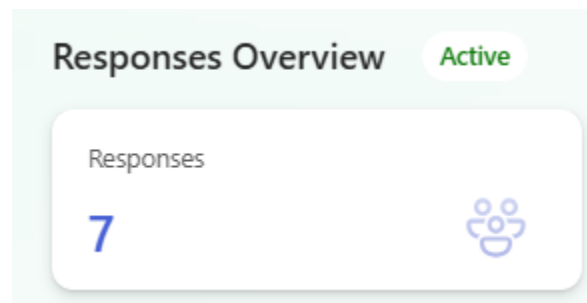
Enter your answer

8. How would you rate your experience?

○ Poor

○ Okay

○ Good

○ Splendid

○ Excellent

9. Any final comments or feedback?

Enter your answer

## Evidence of Testing:

Responses Overview Active

Responses

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1. Please explain why or why not the Light Bridge mechanic was engaging to use?

7 Responses

ID ↑	Name	Responses
1	anonymous	It was engaging because it felt like a fair challenge. As a more puzzle oriented player, I like that they didn't require me to do crazy jumps or difficult manœuvres.
2	anonymous	it allowed for a creative run through the puzzles
3	anonymous	It was engaging because I was able to use it effectively to traverse the rooms. However, I didn't use it to block the gunshots because it was easier to portal to dodge them.
4	anonymous	it just was fun
5	anonymous	It was engaging to use since it allowed you to think vertically and create paths across the level
6	anonymous	they can be used in multiple ways to form creative solutions to puzzles
7	anonymous	It have a lot of interesting way to use the mechanics

A majority of participants thought the Light Bridge mechanic was engaging to use and enjoyed utilizing it "Multiple ways to form creative solutions to puzzles."

2. How difficult were puzzles that used light bridges (1= Easy-peasy, 2= Not too difficult, 3= Good level of challenge, 4= Hard, 5=Very hard!!

3.29
Average Rating
★ ★ ★ ☆ ☆

Level 5	
Level 4	2
Level 3	5
Level 2	
Level 1	
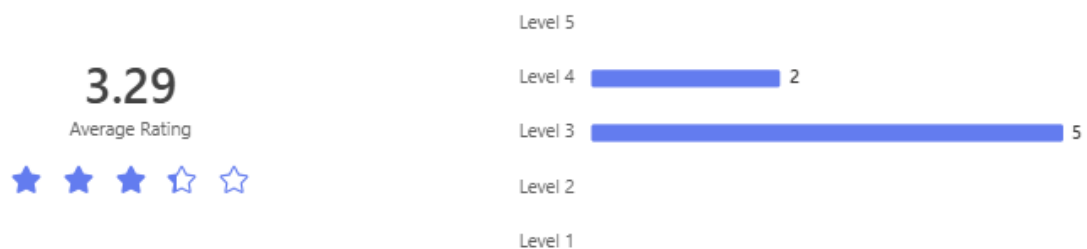
Average rating of 3.29. In this case an average median rating is a positive result because the scale has minor/severe difficulty rating from 1-5. Therefore meaning an average rating illustrates the puzzle is hitting a balanced difficulty amongst a majority of participants.

3. Did you enjoy using a light bridge as a shield against the Sentry Turrets? If not please explain why?

7 Responses

ID ↑	Name	Responses
1	anonymous	I enjoyed it, but felt I had to move it too many times in order to progress. I'm not sure if the cube needed to that far away.
2	anonymous	yes
3	anonymous	I felt that it was slightly awkward to keep replacing the bridge because the bridge isn't wide enough to block both turrets, so I didn't use it and instead just portal-ed behind the turrets.
4	anonymous	yes i had fun pulling my hair out
5	anonymous	Yes I enjoyed it although it was a bit janky to use
6	anonymous	the bridge is narrow and I get scared, I found another way around
7	anonymous	Yes

Overall, remixing the Light Bridge mechanic into a shield appears to have been a good design choice as supported by the above results. Interesting to see some participants found other solutions around using the Light Bridge using the Portal gun.

4. In regards to pacing, did you feel the difficulty of puzzles scaled accordingly. Or did pacing difficulty feel more sporadic?

7 Responses

ID ↑	Name	Responses
1	anonymous	I felt like it was paced well overall, but I'd say that the 3rd room was easier on the puzzle, but didn't feel out of place because the increased danger.
2	anonymous	it was paced very nicely, forced you to use your brain
3	anonymous	I think the pacing was good, the mechanics were shown well before the puzzle room
4	anonymous	felt good
5	anonymous	Yes I liked how each puzzle got more difficult as it went on
6	anonymous	pacing was good, i would lower the roof in the final area as the cube tends to bounce from big drops
7	anonymous	It's fine

The level appears to be appropriately paced, with challenge slowly ramping. Including examples of using scaffolding techniques because "mechanics were shown well before the puzzle room", thus giving players an opportunity to understand the mechanic before exploring it further.

5. Which puzzles did you enjoy solving?

7 Responses

ID ↑	Name	Responses
1	anonymous	I most enjoyed the second one as I felt like it made me feel creative in the way I used the bridge mechanic. I wasn't sure it was the intended way but it didn't matter to me as my theory ended up working.
2	anonymous	the last one
3	anonymous	I enjoyed the first and second ones where you use the bridge as movement
4	anonymous	3rd one
5	anonymous	Although it was a challenge I enjoyed figuring out how to shield myself from the turrets
6	anonymous	all of them
7	anonymous	Turrets

A wide range of results for participants favorite puzzles. Since the data has such a large range, suggests most of the puzzles are fairly engaging experiences.

6. Did you feel the puzzle mechanics were introduced at a reasonable pace?

7 Responses

ID ↑	Name	Responses
1	anonymous	Having not played portal in a while, the first puzzle felt a bit too challenging, but it is meant to appear in the middle of the game, that would totally fine.
2	anonymous	yes
3	anonymous	I do think that they were added at a reasonable pace.
4	anonymous	yes
5	anonymous	Yes they were
6	anonymous	each level led into the next well, I always felt like the most difficult part of a puzzle had been introduced in the area before it so it was not unfamiliar
7	anonymous	yes

A follow up question about pacing in regards to puzzle mechanics, has fairly positive feedback from participants. So no major changes need to be made because puzzles are introduced at a goof pace.

7. What could be added to improve the polish of the level?

6 Responses

ID ↑	Name	Responses
1	anonymous	felt a little bit empty, but overall was a very nice play through
2	anonymous	The traversal between rooms was a slightly long walk. This could be changed through mini portal puzzles to change rooms, or just making the corridors shorter.
3	anonymous	nohting
4	anonymous	Nothing I think the level was perfect as it was
5	anonymous	checkpoints
6	anonymous	maybe more puzzle

Overall, only minor changes could be added to add extra polish. Unfortunately, Portal 2's level editor doesn't have built-in checkpoints. But if that was possible, that would be a great feature to have because it would prevent the player from having to restart the entire level.

8. How would you rate your experience?

● Poor	0
● Okay	0
● Good	1
● Splendid	4
● Excellent	2

14%
29%
57%
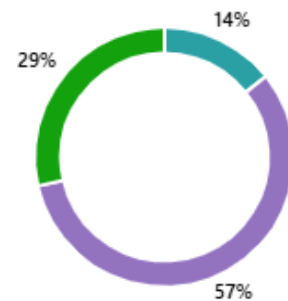
Overwhelming positive ratings from participants. Highlighting, no major changes need to be made to the core design of the level.

9. Any final comments or feedback?

6 Responses

| ID ↑	Name	Responses
1	anonymous	I think for the 3rd room, it is diff out to manage 2 turrets at once. Taking cover from both with one narrow shield felt a bit unfair. Could it be one at the time?
2	anonymous	i love portal 2
3	anonymous	I enjoyed this a lot, good map! One thing to note would be that I could use the portals from the previous rooms. If this isn't intentional, maybe add the blue barrier wall things that remove your portals when you enter a new room.
4	anonymous	goo djob king
5	anonymous	I luv it - Psy 2017
6	anonymous	was good :)

Most participants emphasized their enjoyment for the level. While some commented that the difficulty could be lowered. However, it could be argued there needs to be some challenge or else the level runs the risk of being too easy for players who may be well versed in puzzles games. This level walks the tightline of being accessible for players with little experience in Puzzle games, whilst also being satisfying for players experienced in puzzle games.

Testing Evaluation:

Following from the above testing results and critically analysing the data. There are major changes that need to be applied to the level. Since an overwhelming majority of the data praises the core level design and puzzle implementation. Any changes would be very minor and not change the level significantly.

Level Development Log:

**2D Layout 1 - with initial ideas for puzzles:**
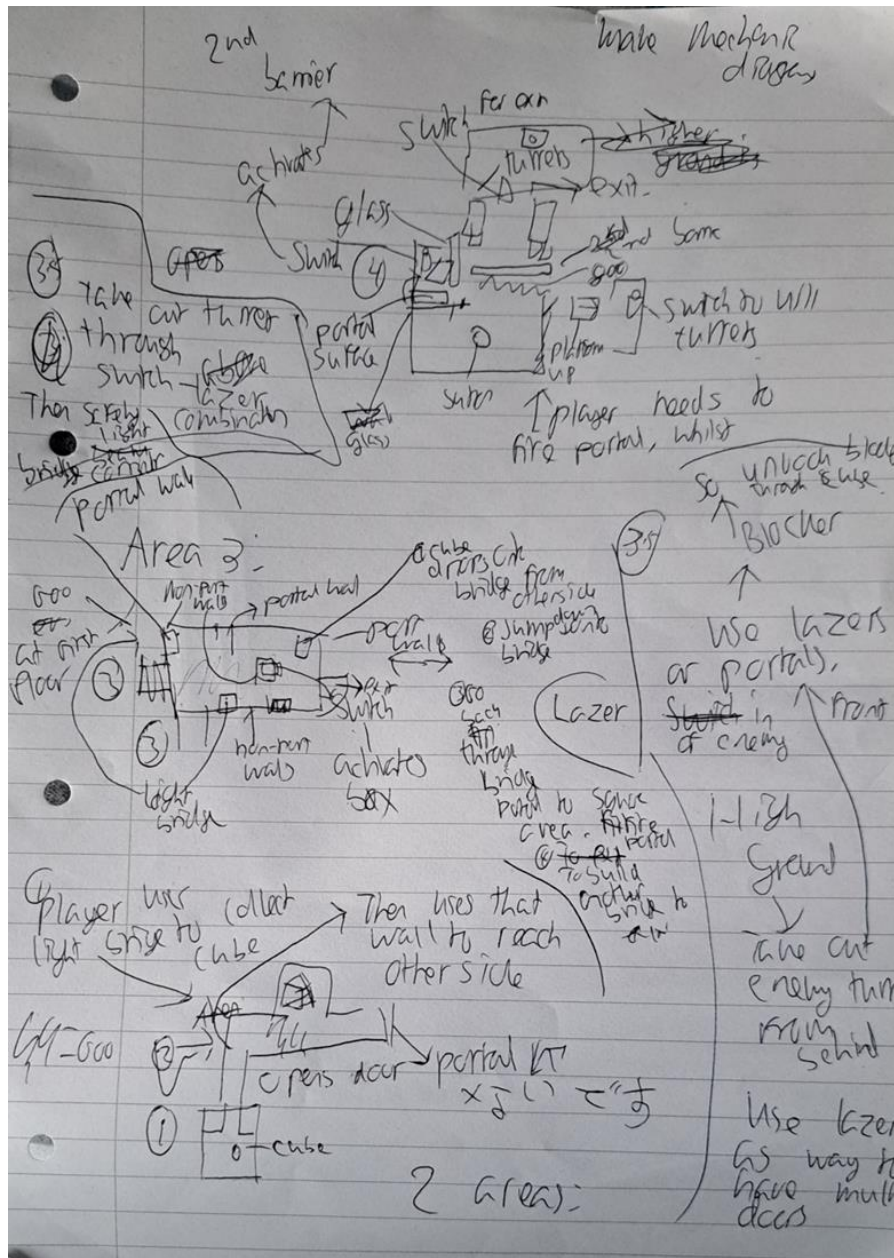
This initial layouts highlights my ideas for making puzzles for the Light Bridge mechanic. Some key areas was using verticality to add depth to level and also provide the player a better chance of viewing the level as a whole. Before calculating the necessary steps to solve the puzzle. Furthermore, the idea of using Sentry Turrets to ramp up difficulty in terms of physical threat was introduced here.

Gameplay viability testing:
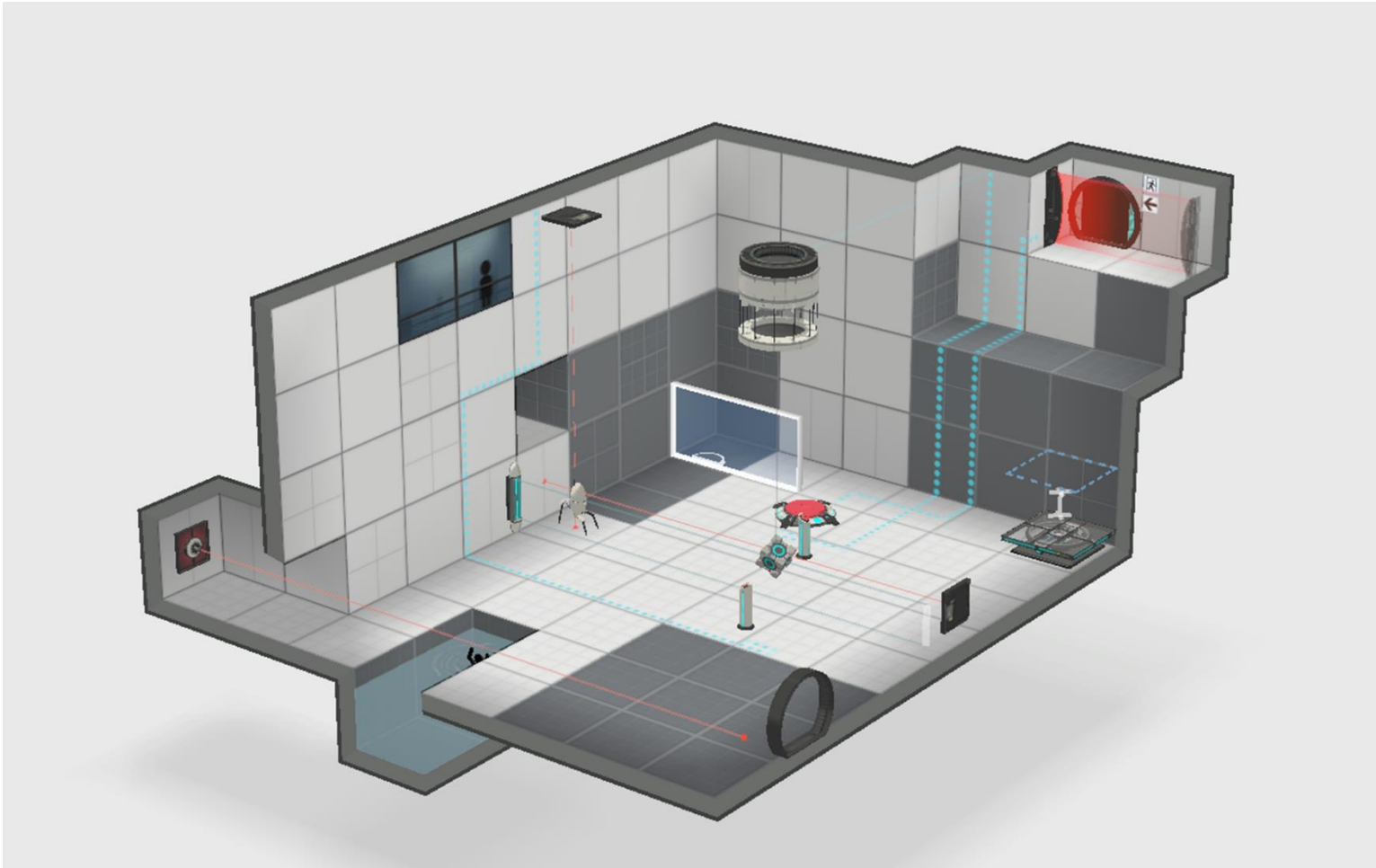
As a result of completing early testing, the puzzle ideas are achievable and can be executed as planned.

Summary of beats and pacing:
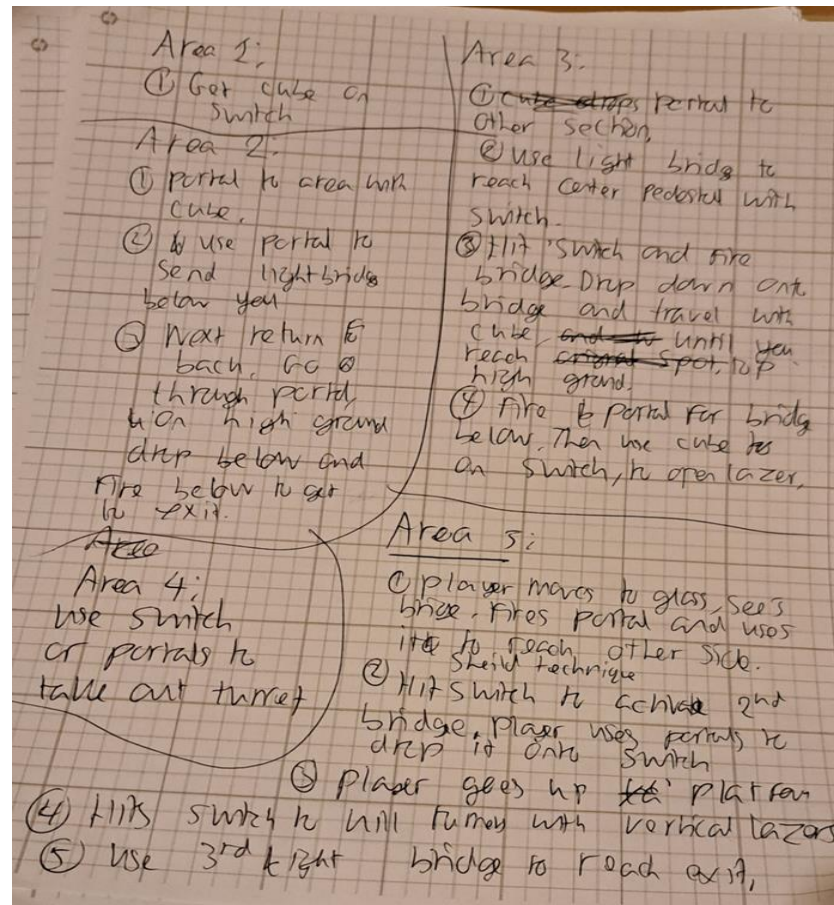
Here is a summary of the key beats in the level, for the player to solve each puzzle. As well as describing the player journey across all 5 areas. This was useful to write because it helped inform the final layout of the level and create the beats & pacing diagram.

2D Layout 2:
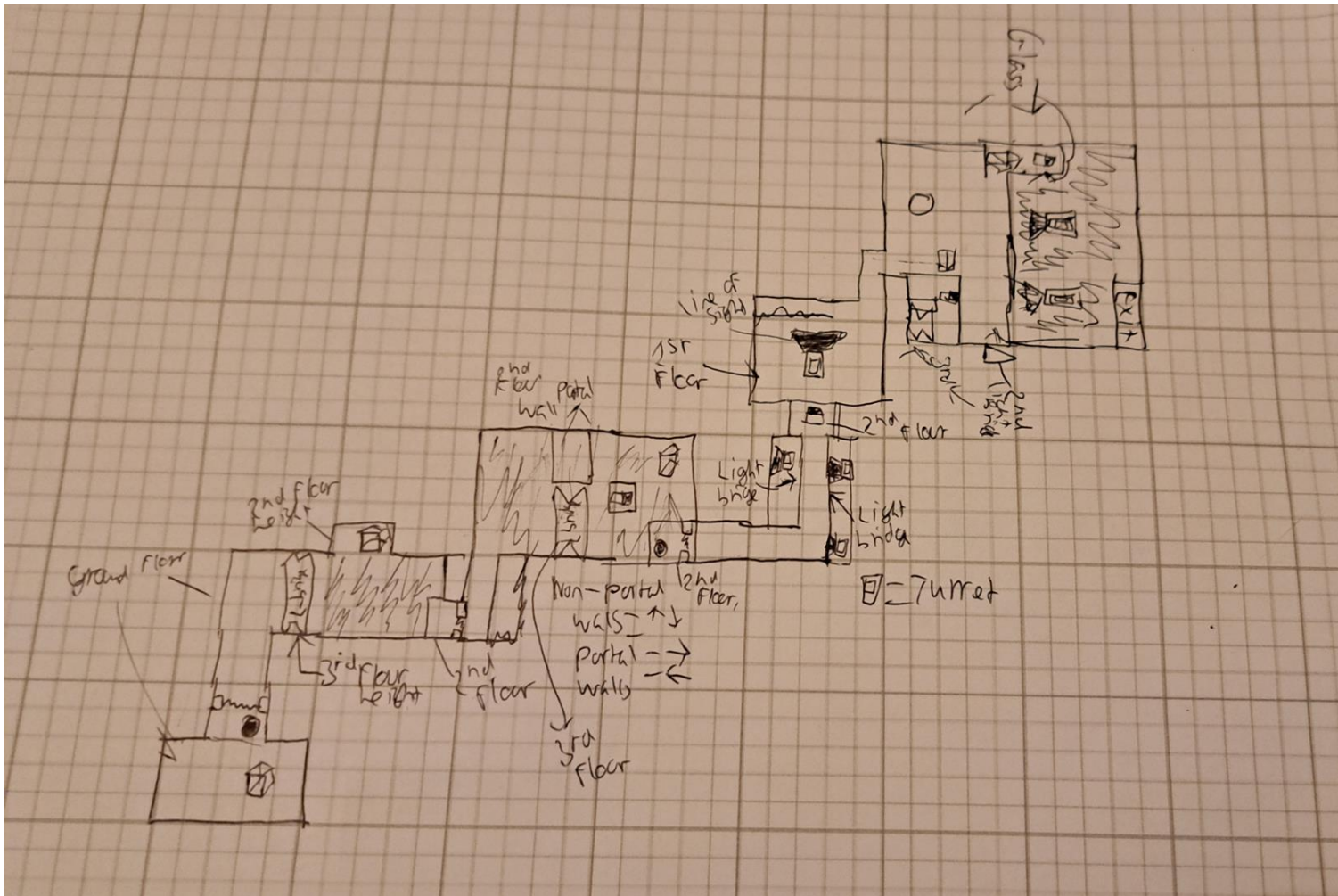
This layout was made before discovering Portal 2's level editor has a 25³ volume size limit for a level. As you can see, the layout utilizes scaffolding in regard to mechanic implementation. Layering mechanics on top of each other, after being introduced to the player.
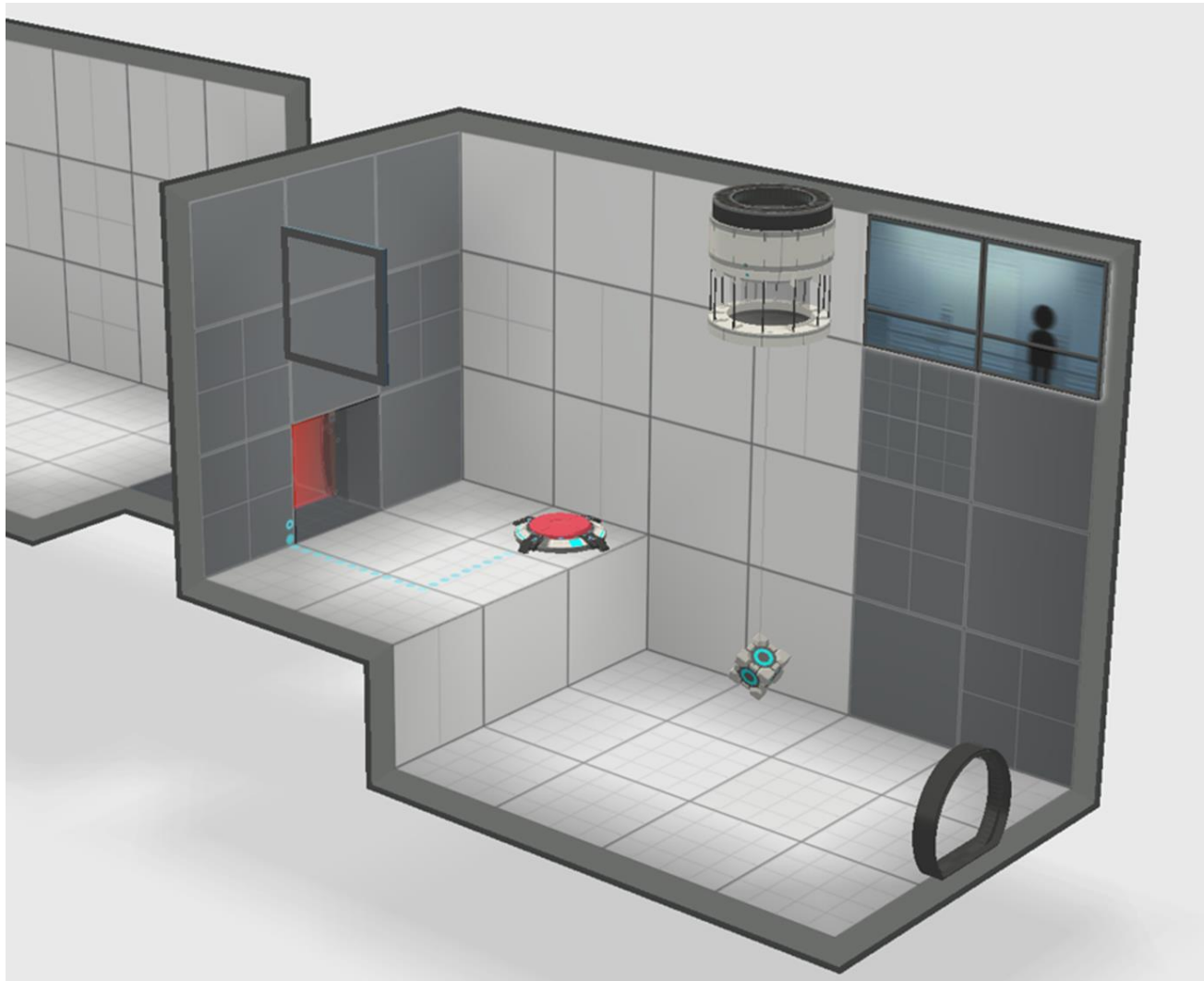
Introduces the concept of Portal gun and conditioning the player into the player needing a companion cube to open the laser grid door.

Area 2 (before adding non-portal walls):
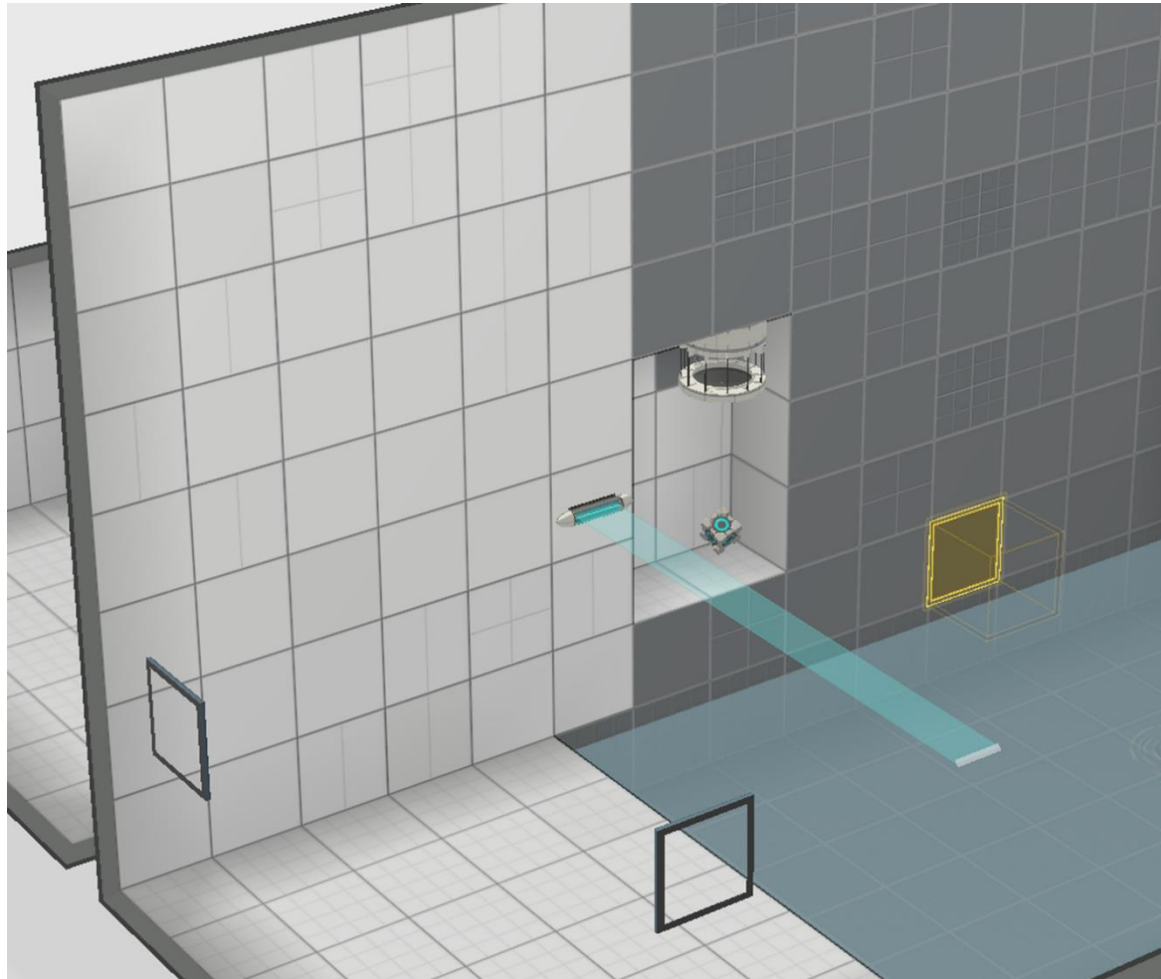
Area 2 (with non-portal walls):

Major development:

At this point, I ran into a problem into being unable to drag a wall any further. After some Googling, I found out that Portal 2's level editor has a physical volume limitation for each level. Each level must be no larger than 25^3 volume. As a result, I downscaled the level significantly to ensure all 5 areas could fit into this constrained volume. Whilst maximizing the limited amount of space.

## Areas 1 & 2- post-resizing according to new scale comparison:
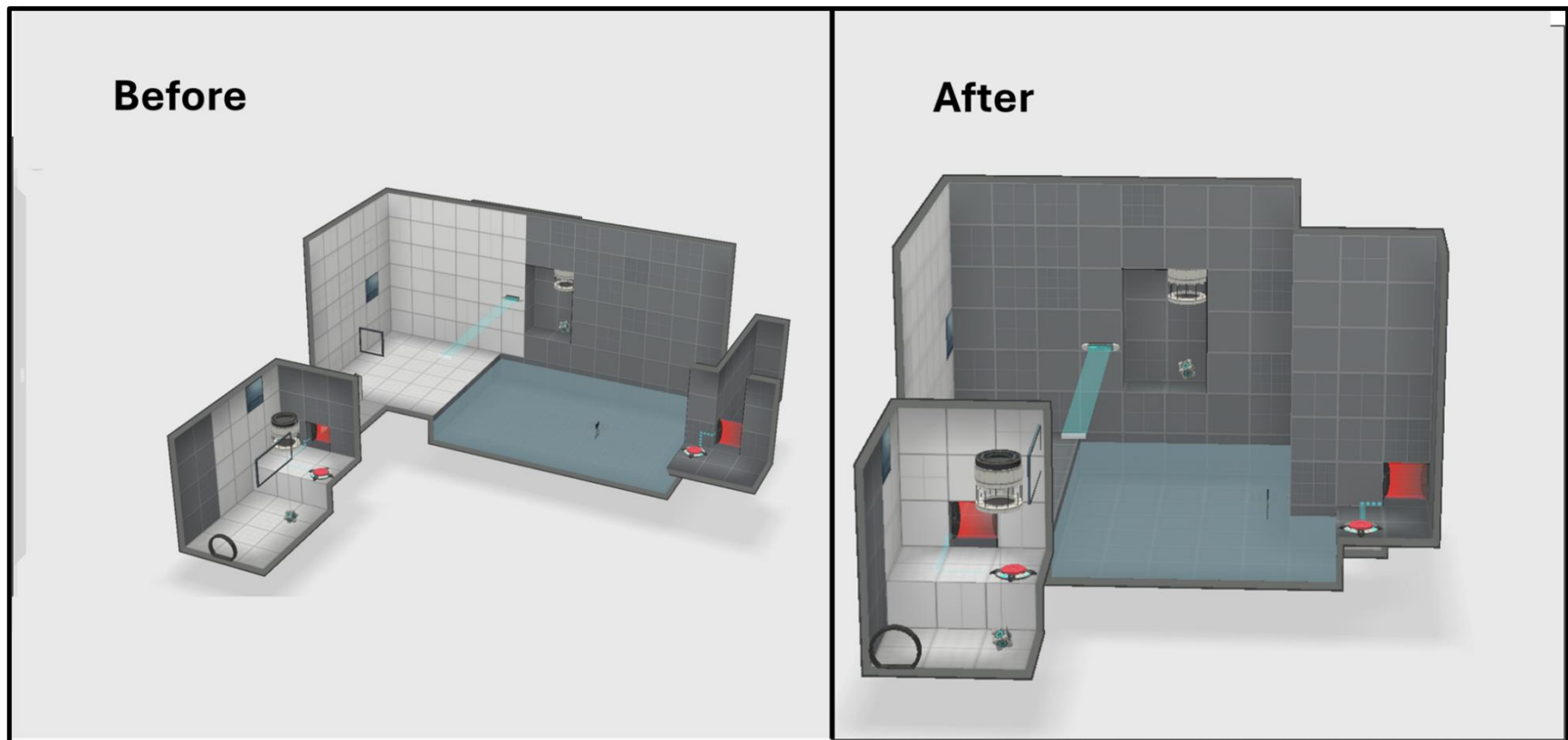
Area 3:
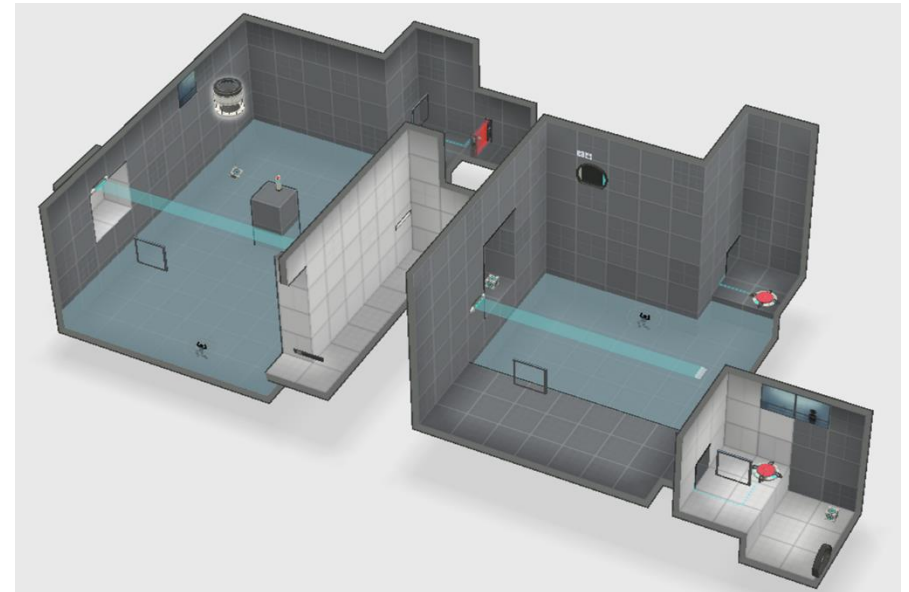
To ensure player is gained full mastery of utilizing the Light Bridge, challenge has been ramped up by making the entire floor Good. Forcing the player to be more considerate about where they place their Light Bridge. Including a unique idea of using the Light Bridge to catch a falling Companion Cube.

Area 4- a slight deviation from 2D layout:
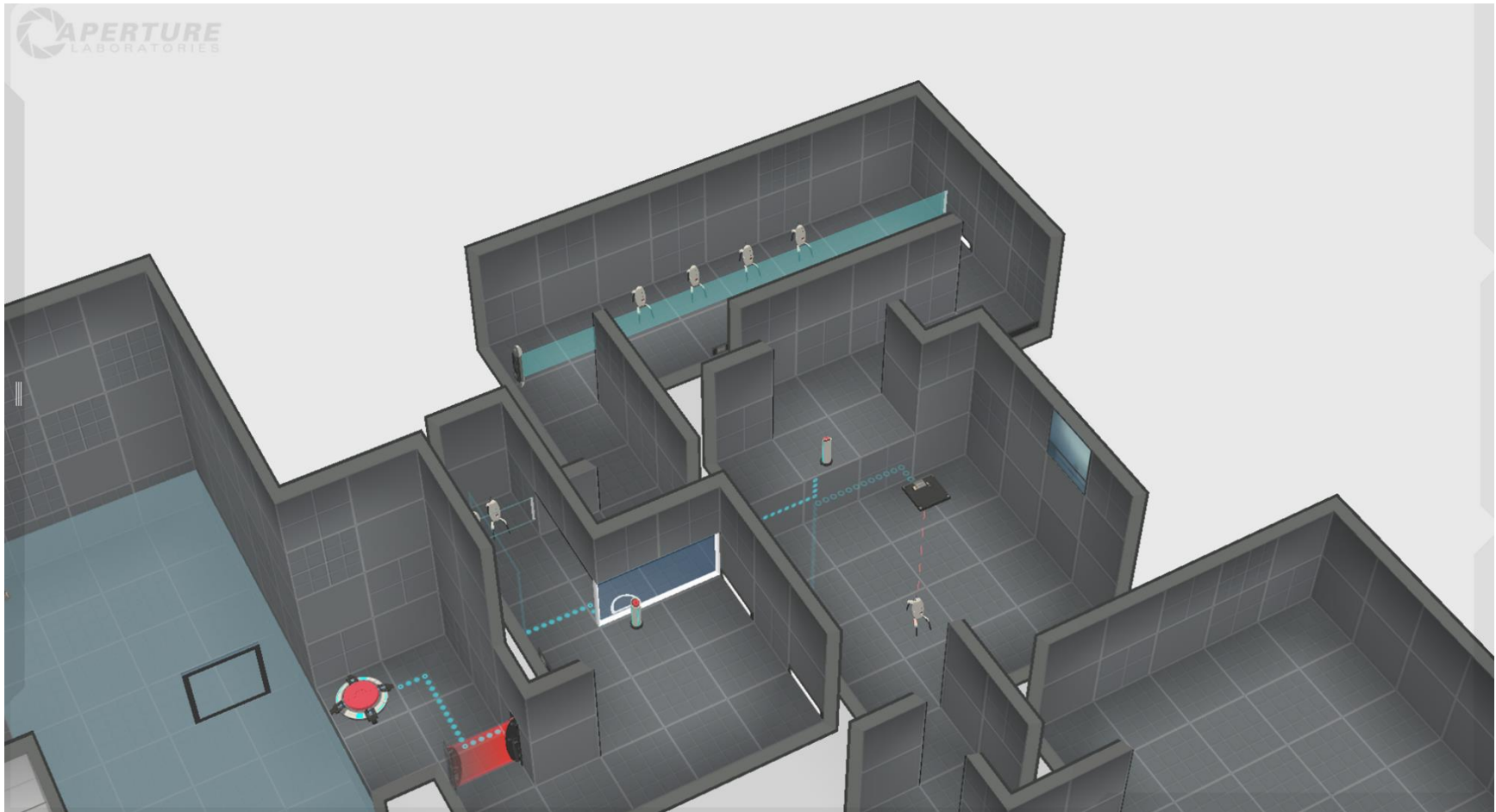
Instead of teasing the player, the concept of Sentry Turrets being a threat. I decided to have players experience their threat and highlighting how light bridges can be used to protect the player. Which foreshadows their future use during the 5th and final area of the level

This final area remixes the Light Bridge to be used as a shield against Sentry Turret fire. Thanks to the vertical placement. Finally challenge is ramped up through the puzzle requiring the player to bring the cube to the red button, whilst using Portals to ensure it lands on the button whilst they stand on the Fixed Moving Platform.

Level complete:

Progression Gif: