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Best Practices: Implementing Dense Level Design Through Reuse of Space

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Best Practices: Implementing Dense Level Design Through Reuse of Space: Post-Mortem

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Abstract
This research explores the correlation between Dense Level Design and the Reuse of Space in video games. It provides assumptions about best practices for implementing Reuse of Space to attain Dense Level Design. To evaluate these best practices, an artifact level is developed for *Dying Light 2: Stay Human*. The practices are evaluated through an analysis of survey results.

Keywords
Level Design, Dense Level Design, Reuse of Space, *Dying Light 2: Stay Human*.

1 INTRODUCTION

"Dense Level Design" is a concept in the video game industry that offers multiple benefits in game development, including enhanced gaming experiences, increased immersion, as well as benefitting the developers as a cost-saving tactic. This study evaluates the best practices from field research literature and games, for incorporating space reuse in level design to achieve optimal density. In line with this, an artifact level for *Dying Light 2: Stay Human* is created to validate these best practices through the analysis of data collected from subsequent playtests and surveys.

2 DEFINATIONS

2.1 Dense Level Design

Dense Level Design incorporates large amounts of gameplay in a physically limited environment; Additionally, it exploits all aspects of gameplay space if possible [1]. Achieving Dense Level Design has 3 advantages.

2.1.1 Advantages

Reuse of gameplay. Player's experience is easier to predict when the player is in a familiar environment, with less variable to control. Level designers can manipulate the difficulty of repeated gameplay, or the player's skill progression, more easily to enhance the pacing of the game.

Immersive effect. Levels with more density creates a sense of realistic spaces through interactivity, constriction of movement, and aesthetic details that less densely populated spaces lack.

Reuse of assets. Less assets are needed in the limited space, which saves the development cost of not only artists but also programmers and level designers.

2.1.2 Disadvantages

Spatial confusion. Level density leads to difficulties in orientation and other spatial confusion. The patterns are too complex in player's 2D view.

Gameplay readability. When gameplay elements are dense in the environment, reasons to re-evaluate the space for gameplay should be provided. The modification and difficulty of this re-evaluation should be limited in an appropriate challenge level and cognition load.

2.2 Reuse of Space

Reuse of space is a level design technique that an environment is given multiple purposes in different stages of the entire level progression. Player visits the same space multiple times for different reasons. [2]

Reuse of space is the most common method to achieve dense level design because it adds the density of gameplay in a limited space when reusing environment and gameplay objects.

2.3 Backtracking

Backtracking is a situation in a game "where the player must return to previously encountered locations to continue advancing the game" [3] It is the bi-directional instance of reuse of space, also involved with reuse of environment and gameplay objects.

2.4 Verticality

Verticality is the use of different heights and levels in a game environment, to create variety, challenge, and exploration for the player. It is a common feature of platformer gameplay, involving jumping, climbing, or flying between platforms and obstacles. With verticality, there will be more surface area in the same space, which adds to the density of the level.

2.5 Pacing

Pacing is the order, variety, and frequency, that gameplay elements are presented to the player. It is one of the most important criteria of level design and can be improved by

controlling the timing of introducing new gameplay and the difficulty curve when reusing gameplay in dense level design.

3 BEST PRACTICES & RESEARCH

From field research in literature and video games, the researcher makes assumptions regarding the best practices of implementing dense level design through reuse of space.

3.1 Provide Motivation to re-evaluate [4]

In the artifact, the researcher created three stages with environmental changes and different gameplay, which enforced re-evaluation by the player to utilize the environment.

Players must be encouraged to re-evaluate the environment when different actions are intended by the designer. The motivation could be new objectives in different directions, and different gameplay like enemies, environmental opportunities, or hazards.

Figure 1 ***ASTLIBRA Revision [5]***

In a bi-directional level called Urugat Snow Mountain in *ASTLIBRA Revision*, the goal and the environment are different. During the uphill section, the player needs to explore forward to find an NPC and the wind pushes the player backward. During the downhill, the player needs to find quest items and the wind pushes the player forward. Even if the enemy placement is the same, the combat is different, requiring the player to select another combat style.

3.2 Increase Difficulty or Add New Gameplay [6][7]

In the artifact, the researcher added difficulties to the existing gameplay, and provided new gameplay in later stages of the level.

Dense level design provides opportunities to improve the pacing. To achieve this advantage, there should be more difficult or different gameplay so that the gameplay will not feel tedious.

Figure 2 ***Hollow Knight [8]***

In *Hollow Knight*, the enemies in the hub level are strengthened as the game progression advances. The player is experiencing combat in higher difficulty when the environment is reused.

3.3 Vertical Density [1]

The researcher scoped the artifact in a horizontally compact while vertically multi-layered space.

To add the density of the level, the level should be expanded vertically, instead of horizontally.

Figure 3 ***MINERVA [9]***

MINERVA as a modification for *Half-Life 2*, densely reinterprets gameplay of *Half-life 2* but its maps are incredibly small. The maps expand vertically instead of horizontally.

3.4 Conveyance

In the artifact, the researcher simplified the layout of the level, and applied conveyance techniques like landmarks and leading lines, to help the player orientate and navigate.

To solve the space confusion and lack of readability that density brings, conveyance techniques should be applied. Global and local landmarks facilitate orientation. Visual

contrasts and shapes like frames and leading lines, can highlight the affordance that gameplay focuses on.

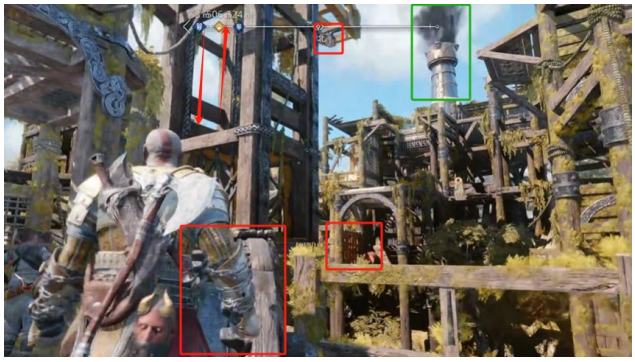

Figure 4 *God of War: Ragnarök* [10]

"Althjov's Rig" in *God of War: Ragnarök* is a very dense level. The chimney as the goal is attractive and visible most of the time. Interactable objects are consistent in game and highlighted by colours. Chains are showing the connection among the interactable.

3.5 Fully accessible space

In the artifact, the researcher placed dense interactable objects and decoration in the space. There were no inaccessible spaces in the building structure, and there were combats and rewards in rooms that are not on the critical path.

Space should be made full use of, and inaccessible space should be avoided. More game objects should be interactable.

Figure 5 *God of War: Ragnarök* [10]

In "Althjov's Rig", corner rooms not on critical path have rewards and collectables for narrative.

4 METHODOLOGY

4.1 Overview

"Made in Abyss" is a *Dying light 2* level based on C-Engine by Techland. It is set in a 5-floor electrical station. The player sneaks upstairs to turn on UV lights to drive away the Volatiles, then clears the remaining zombies to connect the cables, and finally uses parkour skills to escape from the factory in a limited time. The level involves gameplay elements of stealth, combat, puzzle, and parkour. It encourages combat styles with melee weapons, parkour skill, ranged combat, and throwables.

After the story quest Markers of Plague, the player receives the quest when getting close to the factory during exploration.

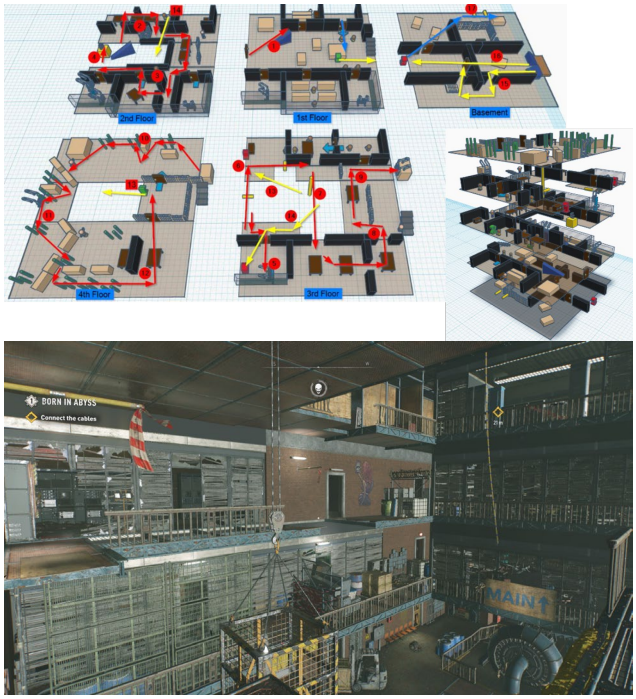

Figure 6 Artifact overview [11]

4.2 Reuse of space

The overall parkour space is reused 3 times: the player goes up, down, and up again. The highlighted parkour affordance for reuse includes the swinging cage and the swinging rope. In addition to parkour affordance, some objects serve other use in different stages, including hiding spots for stealth, cover for combat, and stepstone for parkour. The later reuses are limited by the threatening enemies in the first stage.

4.3 Motivation to re-evaluate

During the three travels in different directions, the player has different goals and is faced with different gameplay and environmental hazards, with motivation to evaluate the environment respectively.

In the first time up, patrolling Volatiles are blocking most passageways. The player without powerful weapons needs to utilize stealth while moving upstairs to avoid the zombies.

On the way down, volatiles are burnt by UV lights, so more paths are unlocked. But other zombies are awakened or spawned to attack the player. Besides combat, the player needs to plan the shortest path between cable sources and targets and executes the parkour routes. The last cable requires the player to dive into water and manage their oxygen.

In the finale, moving upward, the player is chased by poisonous gas and has to parkour in a speed run onto the highest floor and escape.

4.4 Increasing Difficulty or New Gameplay

- In the second stage, the difficulty of combat and parkour is increased.
    - Virals as more aggressive enemies are spawned.
    - The parkour route is limited in length and water serves as a new environment hazard.
- Cable puzzles are the new gameplay introduced.
- In the third stage, the parkour has a time limit as the climax of the level.

4.5 Vertical Density

The level is a 5-layered 36.48*43.04 m^2 level, which is horizontally compact and vertically expanded. The aesthetic setting is separated into industrial, office and rooftop. Gameplay is densely placed vertically.

4.6 Conveyance

Highlighted control room and other rooms with gameplay are always visible from the circular balconies when the player is travelling among floors. The circular layout is similar among floors, which is simple and easy to understand. The layers with distinct boundaries, aesthetic themes and local landmarks are easy to recognize.

The interactable objects like ropes and monkey bars are consistent with the original game. Other conveyance techniques like light contrasts and leading lines are applied.

4.7 Fully accessible space

The rooms in similar layouts among floors are fully accessible. Even some rooms not on critical path are placed with combats, rewards, and aesthetic decorations.

5 SURVEY PROCESS

Playtesters took a survey after playing with the artifact level. Some testers took a short interview by the researcher for more details about the playthrough and survey answers. The survey contained 30 questions, involved with: (1) The testers' gaming background, including their familiarity with the artifact game, game genres, and gameplay styles; (2) The extent they reused the space; (3) Their feeling about the challenge variations according to floor and stages; (4) Their sense of understanding the layout; (5) Their sense of density in the artifact and the fun.

6 SURVEY RESULTS & DATA ANALYSIS

6.1 Gaming background

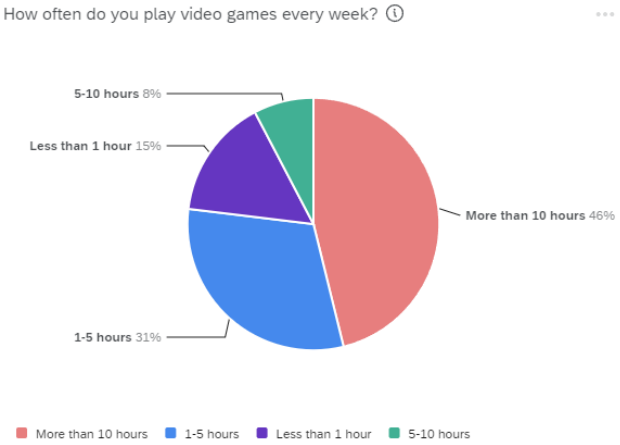

Figure 7 Survey result: how often the tester played video games

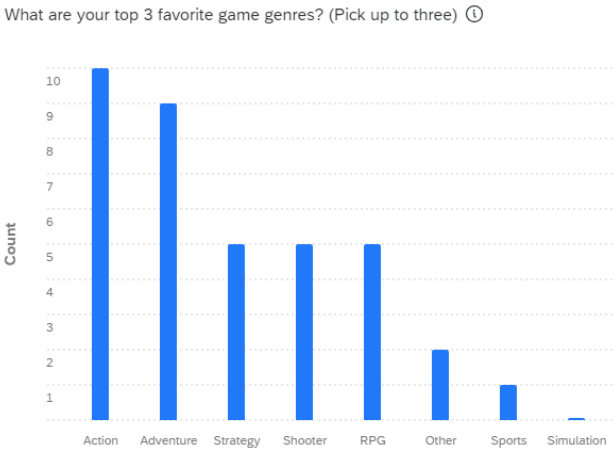

Figure 8 Survey result: the tester's favourite game genres

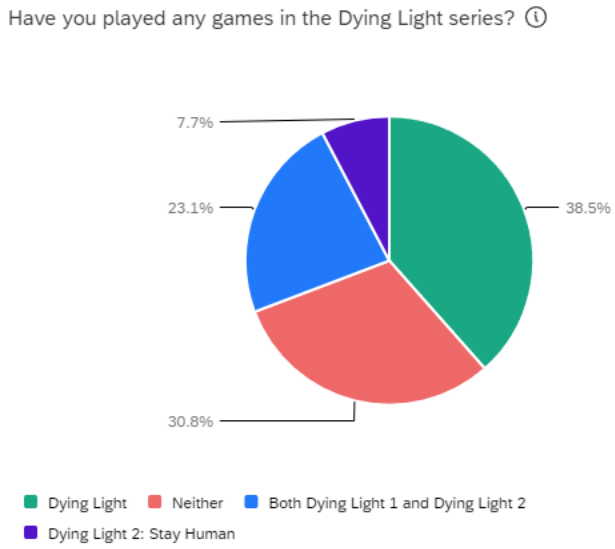

Figure 9 Survey result: the tester's experience *of Dying Light* series

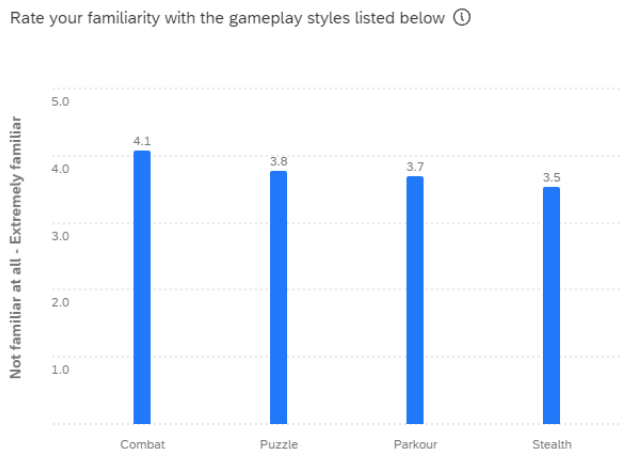

Figure 10 Survey result: the tester's familiarity with gameplay style involved in the artifact

For the gaming background of the researcher's 13 playtesters, most of them were action and adventure fans.

Most of them were familiar with the *Dying Light* franchise, and gameplay including combat, puzzle, parkour, and stealth.

6.2 Reuse of space and variation among floors

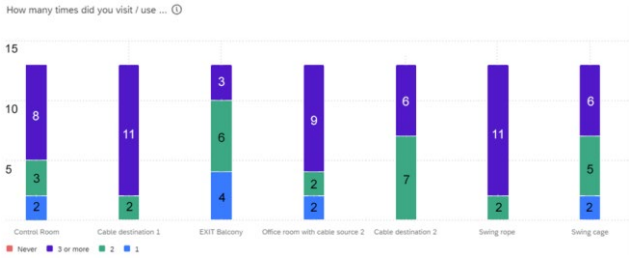

Figure 11 Survey result: reuse of space at specified spot

According to the results of the survey, many of the key locations, as set by the researcher, had been visited three times or more. Notably, the exit balcony and swing cage offered alternative paths, allowing players to opt for other routes, resulting in fewer reuses for these areas.

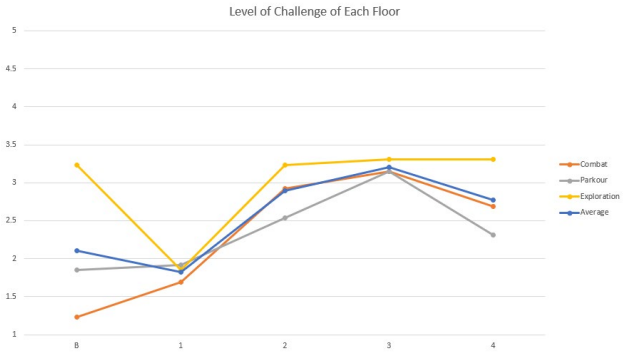

Figure 12 Survey result: level of challenge on floors

According to the survey, the researcher successfully built the variation of difficulty among floors in terms of all gameplay styles.

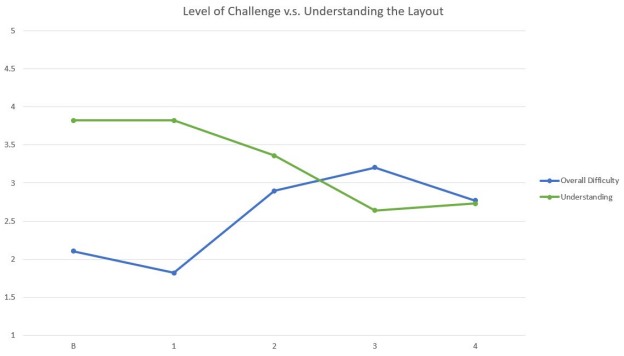

Figure 13 Survey result: Comparation between the difficulty and how players understood the layout

The researcher compared the overall difficulty and how the players felt they understood the layout. There negative correlation between them. When the floor was more difficult, the player felt less understanding the space.

When the player understood the space better, they felt the space was easier.

The researcher fit the extent of reusing space into the graph according to which floors they are on. The 2nd floor and 4th floor were with similar level of challenge. But according to the design, the 2nd floor's layout was much more complicated than the 4th's, because the 2nd floor had more rooms and more hallways were blocked. There were more gameplay objects. However, players understood the 2nd floor better than the 4th. There were lots of reuse on the 2nd floor.

From the comparison of the changes in slope in the graph, the reuse of space on the 3rd level helped maintain the player's understanding of space when the difficulty increased significantly.

The researcher verified that, reuse of space helped the player to understand the space. The application of resue of space took the advantage of dense level design, and avoided the disadvantages of it, concerning the readability.

6.3 Variation among stages

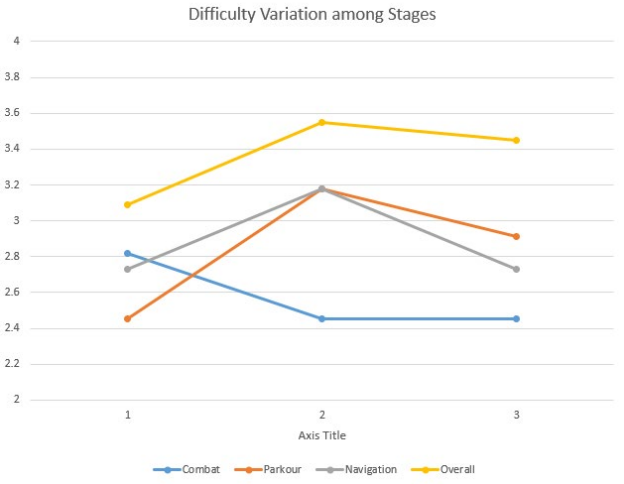

Figure 14 Survey result: difficulty variation among stages

According to the survey results, the difficulty varied among stages, in terms of all the gameplay types.

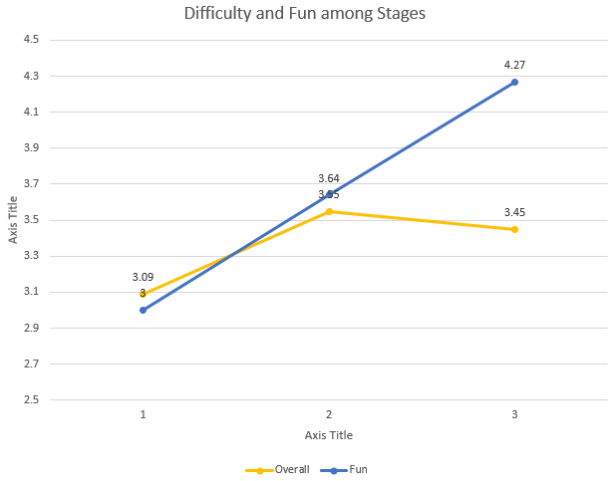

Figure 15 Survey result: difficulty and fun variation among stages

The overall difficulty was not increasing linearly, but players felt more and more enjoyment. This provided a good pacing with different gameplay and difficulties. In addition, the mastery of space made the player feel confident after re-entering the space.

6.4 Sense of difficulty among stages

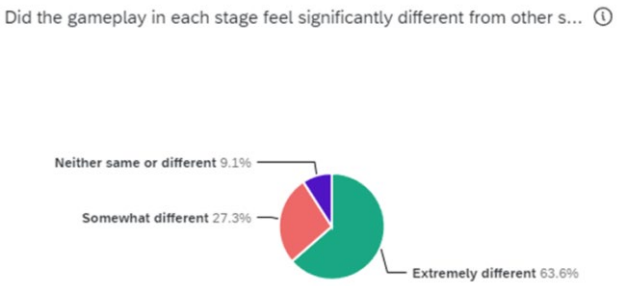

Figure 16 Survey result: sense of difference among stages

According to the survey results, players felt provided with very different gameplay so they didn't feel tedium when re-entering the space.

6.5 Sense of density

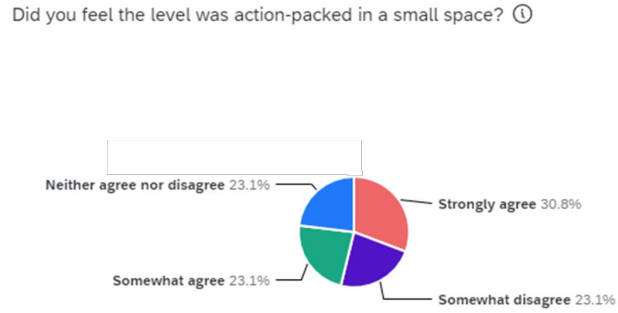

Figure 17 Survey Result: sense of density

More than half of the player thought the artifact level was action packed in a small space. In this question the researcher intended to verify that the level was dense. The result was lower than exected because the question was not clear. According to post-survey interview, the testers thought the space extended a lot vertically so not in a small space.

6.6 Sense of overall fun

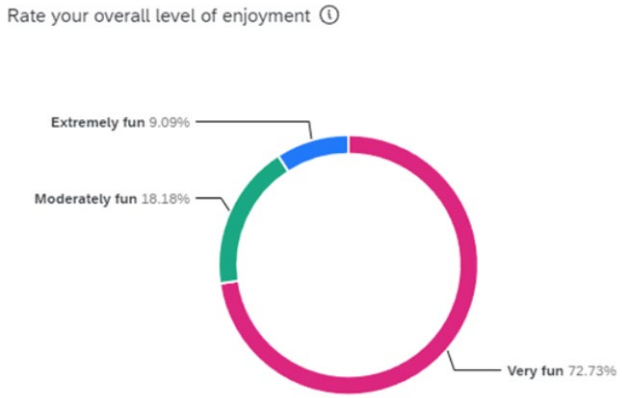

Figure 18 Survey result: sense of fun

According to the survey results, players were engaged in the level. The artfact successfully applied the best practices to achieve the fun of a dense level.

7 CONCLUSIONS

7.1 Achieved dense level design

By applying Reuse of Space in the artifact, the researcher successfully added the density of the level and achieved Dense Level Design.

7.2 Provided familiarity

Reuse of space helps the player to understand the space. The application takes the advantage of dense level design, and avoids the disadvantages concerning readability.

7.3 Improved pacing

Reuse of Space with increased difficulty and new gameplay improves the pacing in the level, keeping the player in a flow state.

7.4 Provided engagement & fun

In consideration of reused spaces, the players were engaged and expressed that the level was fun.

7.5 Lessons Learned

7.5.1 With significant verticality, conveyance is challenging

When the affordance was out of the players' line of sight, even providing leading lines like hanging cables, players were still likely to miss the affordance.

7.5.2 Shortcuts should also be considered in sightline arrangement

The researcher highlighted the direction to the goal too much, and the player missed the unlockable shortcuts, which made the level feel tedious after making mistakes. The conveyance on critical path and shortcuts should be balanced better.

7.5.3 Conveyance changed over stages helps

During the early testing phase, some players, due to the guidance of the lights leading to the basement intended for the third stage, directly entered the basement instead of approaching the quest goal. As a solution, I adjusted the lights to be activated only in the third stage, which effectively prevented the players from being distracted. Thus, conveyance that changes with progress can help guide players to execute the correct objectives during reuse of space.

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