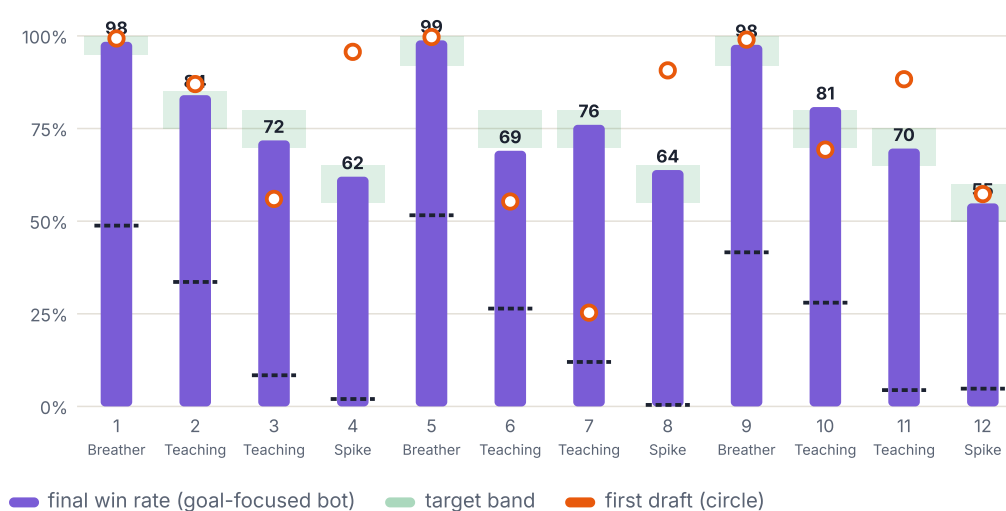




# The Tower: twelve hand-made levels, measured and tuned

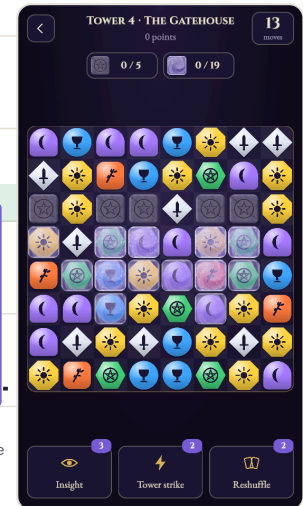
A pack I designed by hand for my match-3 game, Arcana Match: one idea per level, a sawtooth of teaching levels, spikes and breathers, and a finale that combines everything. Each level was played 500 times by a goal-focused bot and 250 times by a random one, then changed until it landed in its target band. The pack is playable in the game from the home screen.

## The difficulty curve



— final win rate (goal-focused bot) — target band — first draft (circle)

— random bot (dashed): the floor a careless player sits near



Level 4, The Gatehouse, in the game.

### 12

levels: 3 blockers, holes, 2 board sizes

### 12 / 12

within a point of their target band

### 32

logged iterations, 3 of them designer's calls

### 0

cells that never refill (checked by a test)

## How each level is built

1. **Write the intent first:** the one idea, where the pressure comes from, and where a loss *should* come from.
2. **Draw the board** in a text format the game reads directly; the parser rejects a goal the board can't meet.
3. **Measure:** win rate, moves left, near misses, which goal was unmet in each loss, and a heatmap of clears.
4. **Change one thing, re-measure.** When the numbers say the idea is wrong, not the budget, redesign.

## Reading the level pages

■ open ■ veil ■ 2 double veil ■ Stone Seal

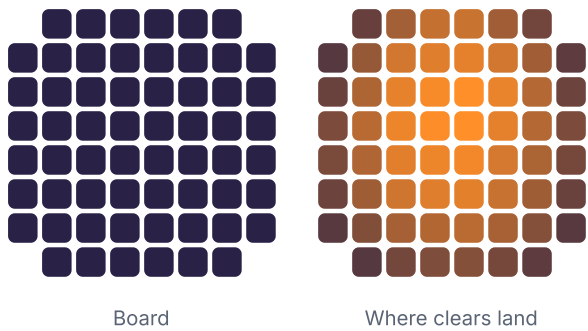
■ shackle blank: a hole

The heatmap shows where the bot's clears land, brighter is busier: dark cells are the ones a player has to work for.

**What the losses were** sets the bot's real failures beside the fail point I designed. Gold notes are tuning; violet notes are design decisions.

The bots are not players: the numbers rank levels and find walls, and real players would move every band.

# 01 The Courtyard



**Intent.** A gentle opener: one suit, a roomy board. The cut corners are the only idea: edges hold fewer matches, so the middle is where cascades happen.

**Pressure.** Almost none; this is the breather that sets the pack's tone.

**Designed to fail at.** Only a very unlucky board.

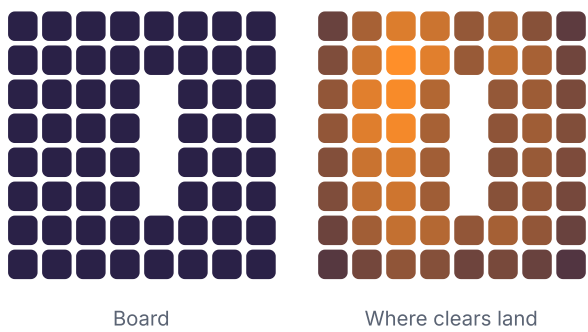
**What the losses were:** Too few losses to read (2%): the level is meant to be won.

Breather · target 95-100% · now 98%

|                       | FIRST DRAFT | FINAL    |
|-----------------------|-------------|----------|
| MOVES                 | 18          | 18       |
| GOALS                 | 22 Wands    | 24 Wands |
| GOAL-FOCUSED BOT WINS | 99%         | 98%      |
| MOVES LEFT ON A WIN   | 9.4         | 8.7      |
| RANDOM BOT WINS       | 60%         | 49%      |
| FOIL (5+ MOVES LEFT)  | 93%         | 89%      |

- Iterations**
- 1 v1 won 99% with 9 moves to spare: Wands 22 to 24.
  - 2 v2 still won 99%. Kept: the opener should be near-certain, so the target moved, not the level.

# 02 The Split Keep



**Intent.** A wall of holes splits the middle rows. Horizontal lines and cascades stop at the wall, so the player learns to read two rooms and to play the side that pays.

**Pressure.** Two goals at once on a board that can't chain across its middle.

**Designed to fail at.** Cups, the big goal: the wall halves every Cups cascade. I first expected Swords, the smaller goal, to be the fail point; the data showed the wall hurts the larger goal most.

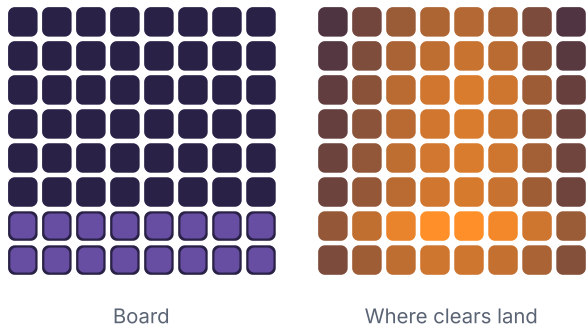
**What the losses were:** Cups unmet in 96% of losses (5.2 short); Swords unmet in 6% of losses (2.4 short). 75% of losses were near misses.

Teaching · target 75-85% · now 84%

|                       | FIRST DRAFT          | FINAL                |
|-----------------------|----------------------|----------------------|
| MOVES                 | 20                   | 20                   |
| GOALS                 | 24 Cups<br>14 Swords | 26 Cups<br>14 Swords |
| GOAL-FOCUSED BOT WINS | 87%                  | 84%                  |
| MOVES LEFT ON A WIN   | 7.7                  | 6.8                  |
| RANDOM BOT WINS       | 45%                  | 34%                  |
| FOIL (5+ MOVES LEFT)  | 66%                  | 57%                  |

- Iterations**
- 1 v1 won 87%: Cups 24 to 26. Losses were almost always Cups, the goal the wall splits.
  - 2 Designer's call: the level stays; the fail note now follows the data (Cups unmet in 96% of losses, Swords in 6%).

03 Veiled Floor



**Intent.** The High Priestess's veils return along the floor. Cascades start at the top and rarely reach the bottom, so the player has to match low on purpose and use specials that strike downward.

**Pressure.** The bottom two rows, especially the corners.

**Designed to fail at.** The last veils in the bottom corners.

**What the losses were:** Veils unmet in 100% of losses (1.8 short). 81% of losses were near misses.

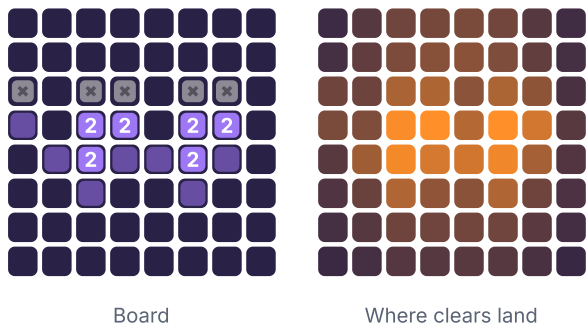
Teaching · target 70-80% · now 72%

|                       | FIRST DRAFT | FINAL    |
|-----------------------|-------------|----------|
| MOVES                 | 18          | 23       |
| GOALS                 | 16 Veils    | 16 Veils |
| GOAL-FOCUSED BOT WINS | 56%         | 72%      |
| MOVES LEFT ON A WIN   | 6.8         | 9.8      |
| RANDOM BOT WINS       | 3%          | 8%       |
| FOIL (5+ MOVES LEFT)  | 36%         | 57%      |

Iterations

- 1 v1 won 56%, below the band: 18 to 21 moves. Every loss was 2-3 veils short in the floor, so the fix is time, not fewer veils.
- 2 v2 won 64%: 21 to 23 moves.

04 The Gatehouse



**Intent.** The first spike. A wall of five Stone Seals with three gaps guards a veiled yard. Until a seal breaks, the yard is fed only through the gaps, one tile at a time: the player chooses between cracking the gate and working the veils through it.

**Pressure.** Double veils right under the seals, fed only diagonally until their seal breaks.

**Designed to fail at.** Two or three veils left under an unbroken seal.

**What the losses were:** Veils unmet in 100% of losses (1.9 short); Seals unmet in 7% of losses (1 short). 88% of losses were near misses.

Spike · target 55-65% · now 62%

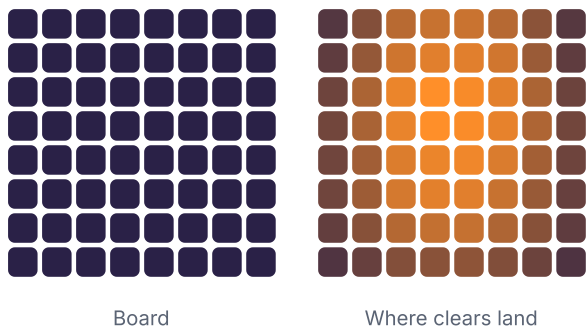
|                       | FIRST DRAFT         | FINAL               |
|-----------------------|---------------------|---------------------|
| MOVES                 | 20                  | 13                  |
| GOALS                 | 4 Seals<br>11 Veils | 5 Seals<br>19 Veils |
| GOAL-FOCUSED BOT WINS | 96%                 | 62%                 |
| MOVES LEFT ON A WIN   | 11.3                | 3.4                 |
| RANDOM BOT WINS       | 23%                 | 2%                  |
| FOIL (5+ MOVES LEFT)  | 88%                 | 21%                 |

The board was redrawn too: the first draft column is the old layout.

Iterations

- 1 v1 won 96% with 11 moves left: the gate was no spike. 20 to 16 moves; losses are the yard veils, as intended.
- 2 v2 won 90%: 16 to 14 moves.
- 3 v3 still won 87% at 14 moves: moves were the wrong lever. The yard was too easy to reach, so the gate didn't matter. The veils right under the seals are now double, which only a broken seal or a special reaches quickly; moves back to 16.
- 4 v4 won 84%: the double veils mattered less than expected, because tiles slide around single seals easily (a finding about the seal itself). 16 to 13 moves: the gate's pressure has to come from time.
- 5 v5 won 72% at 13 moves: 13 to 12.
- 6 Redesign (designer's call): the four scattered seals never gated anything. Now a wall of five seals with three gaps; every seal keeps an open neighbour, so the yard is slow to refill but never stranded. Moves back to 16 to re-tune.
- 7 The new gate won 77% at 16 moves (the old layout won 84% at 16): the wall gates. 16 to 14 moves.
- 8 Won 68% at 14: 14 to 13.

## 05 Market Day



**Intent.** A breather after the spike: an open board, two generous goals and moves to spare. Every match feels useful; foil is within reach.

**Pressure.** Light; the player can play for specials.

**Designed to fail at.** Rare: the two suits not appearing together.

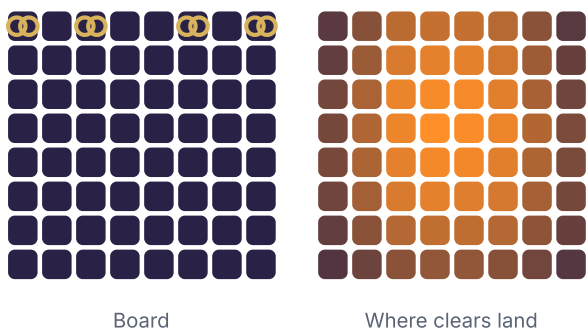
**What the losses were:** Too few losses to read (1%): the level is meant to be won.

Breather · target 92-100% · now 99%

|                       | FIRST DRAFT                                                         | FINAL                                                               |
|-----------------------|---------------------------------------------------------------------|---------------------------------------------------------------------|
| MOVES                 | 22                                                                  | 22                                                                  |
| GOALS                 | <div><div></div> 20 Pentacles</div> <div><div></div> 20 Wands</div> | <div><div></div> 26 Pentacles</div> <div><div></div> 26 Wands</div> |
| GOAL-FOCUSED BOT WINS | 100%                                                                | 99%                                                                 |
| MOVES LEFT ON A WIN   | 12.4                                                                | 9.9                                                                 |
| RANDOM BOT WINS       | 84%                                                                 | 52%                                                                 |
| FOIL (5+ MOVES LEFT)  | 98%                                                                 | 90%                                                                 |

- Iterations**
- 1 v1 won 100%: both goals 20 to 24, still a breather.
  - 2 v2 won 99%: both goals 24 to 26.
  - 3 v3 won 99%. Kept as the pack's easiest breather; the target moved instead of the level.

## 06 Chained Battlements



**Intent.** The Hierophant's chains on the battlements. A shackled top cell is also where its column's new tiles come in, so a chained column is starved until the chain breaks: freeing it changes how the whole board refills.

**Pressure.** Matching along the top edge, where few matches form.

**Designed to fail at.** One chain left on the top row.

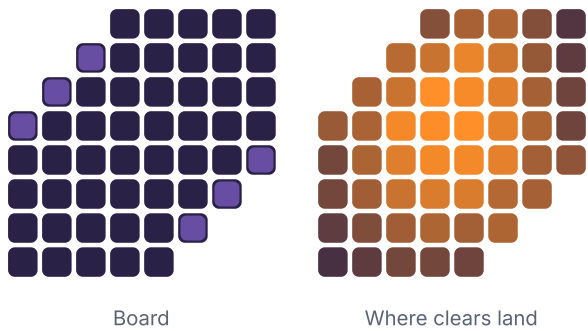
**What the losses were:** Shackles unmet in 100% of losses (1.1 short). 100% of losses were near misses.

Teaching · target 70-80% · now 69%

|                       | FIRST DRAFT                                                      | FINAL                                                            |
|-----------------------|------------------------------------------------------------------|------------------------------------------------------------------|
| MOVES                 | 20                                                               | 25                                                               |
| GOALS                 | <div><div></div> 4 Shackles</div> <div><div></div> 16 Cups</div> | <div><div></div> 4 Shackles</div> <div><div></div> 16 Cups</div> |
| GOAL-FOCUSED BOT WINS | 55%                                                              | 69%                                                              |
| MOVES LEFT ON A WIN   | 7.6                                                              | 10.6                                                             |
| RANDOM BOT WINS       | 18%                                                              | 26%                                                              |
| FOIL (5+ MOVES LEFT)  | 40%                                                              | 55%                                                              |

- Iterations**
- 1 v1 won 55%: 20 to 23 moves. Every loss was short by about one chain (1.1 on average): the idea works, the budget was tight.
  - 2 v2 won 63%: 23 to 25 moves.

07 The Stair



**Intent.** A staircase of holes from both corners. Double veils sit on the steps, where tiles slide in diagonally: the player learns that shapes change where tiles go.

**Pressure.** The double veils on the narrow steps.

**Designed to fail at.** A veil left on an outer step, where the board's edge and a hole block two of its four sides.

**What the losses were:** Veils unmet in 100% of losses (1.2 short). 100% of losses were near misses.

Teaching · target 70-80% · now 76%

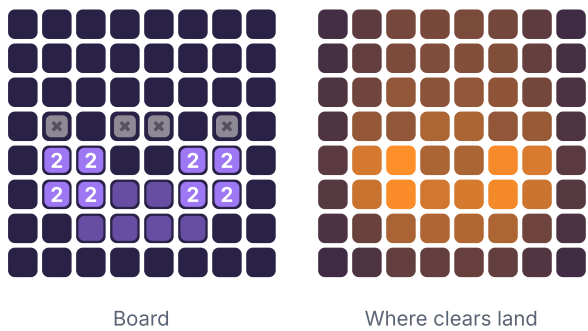
|                       | FIRST DRAFT                                                      | FINAL                                                           |
|-----------------------|------------------------------------------------------------------|-----------------------------------------------------------------|
| MOVES                 | 21                                                               | 22                                                              |
| GOALS                 | <div><div></div> 12 Veils</div> <div><div></div> 18 Swords</div> | <div><div></div> 6 Veils</div> <div><div></div> 18 Swords</div> |
| GOAL-FOCUSED BOT WINS | 25%                                                              | 76%                                                             |
| MOVES LEFT ON A WIN   | 3.4                                                              | 7.8                                                             |
| RANDOM BOT WINS       | 1%                                                               | 12%                                                             |
| FOIL (5+ MOVES LEFT)  | 8%                                                               | 55%                                                             |

The board was redrawn too: the first draft column is the old layout.

Iterations

- 1 v1 won 25%: double veils on the narrow steps were nearly unreachable. Single veils and 22 moves.
- 2 Fail-map audit: losses sat on the outermost steps (39% and 29% of losses), not the top step (7%). The fail note still described v1's double veils; it now follows the data.

08 The Vault



**Intent.** The second spike: a vault of double veils under a seal wall with gaps. Combines the Gatehouse's lesson with the Floor's: open the wall, then dig.

**Pressure.** Double veils packed low, behind seals.

**Designed to fail at.** Veil layers left in the vault's lower corners.

**What the losses were:** Veils unmet in 100% of losses (2.5 short). 77% of losses were near misses.

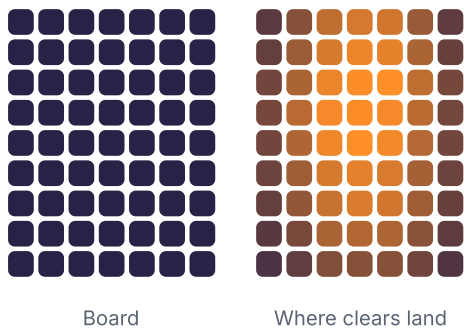
Spike · target 55-65% · now 64%

|                       | FIRST DRAFT                                                    | FINAL                                                          |
|-----------------------|----------------------------------------------------------------|----------------------------------------------------------------|
| MOVES                 | 22                                                             | 15                                                             |
| GOALS                 | <div><div></div> 4 Seals</div> <div><div></div> 22 Veils</div> | <div><div></div> 4 Seals</div> <div><div></div> 22 Veils</div> |
| GOAL-FOCUSED BOT WINS | 91%                                                            | 64%                                                            |
| MOVES LEFT ON A WIN   | 9.2                                                            | 4.2                                                            |
| RANDOM BOT WINS       | 7%                                                             | 0%                                                             |
| FOIL (5+ MOVES LEFT)  | 75%                                                            | 30%                                                            |

Iterations

- 1 v1 won 91% with 9 moves left: 22 to 17 moves, so the vault is the spike it should be.
- 2 v2 won 75%: 17 to 15 moves.

09 Open Sky



**Intent.** A tall, narrow board after the vault. Tall boards make long vertical lines, so line clearers come easily; a breather that shows off specials.

**Pressure.** Light.

**Designed to fail at.** Rare.

**What the losses were:** Too few losses to read (2%): the level is meant to be won.

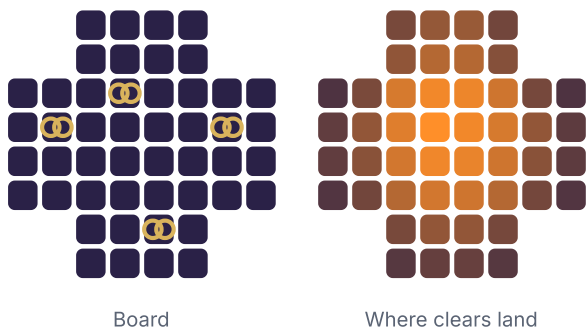
Breather · target 92-100% · now 98%

|                       | FIRST DRAFT | FINAL   |
|-----------------------|-------------|---------|
| MOVES                 | 20          | 20      |
| GOALS                 | 26 Cups     | 31 Cups |
| GOAL-FOCUSED BOT WINS | 99%         | 98%     |
| MOVES LEFT ON A WIN   | 10.4        | 8.8     |
| RANDOM BOT WINS       | 64%         | 42%     |
| FOIL (5+ MOVES LEFT)  | 94%         | 83%     |

Iterations

- 1 v1 won 99%: Cups 26 to 28.
- 2 v2 won 99%: Cups 28 to 31.
- 3 v3 won 98%. Kept: a breather that shows off specials after the vault.

10 Crossed Chains



**Intent.** A cross-shaped board with a chain at the end of each arm. The arms are the hardest places to make matches, so the player plans moves toward the edges instead of playing the middle.

**Pressure.** Chains one cell in from the ends of the arms: still away from the busy middle, but no longer on the very last cell.

**Designed to fail at.** An arm's chain left because the middle was more tempting.

**What the losses were:** Shackles unmet in 92% of losses (1.2 short); Pentacles unmet in 20% of losses (2.7 short). 93% of losses were near misses.

Teaching · target 70-80% · now 81%

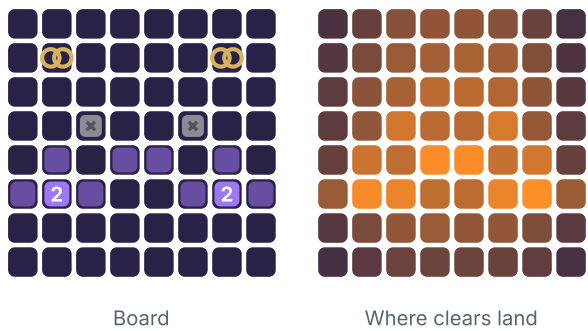
|                       | FIRST DRAFT                | FINAL                      |
|-----------------------|----------------------------|----------------------------|
| MOVES                 | 21                         | 17                         |
| GOALS                 | 4 Shackles<br>18 Pentacles | 4 Shackles<br>18 Pentacles |
| GOAL-FOCUSED BOT WINS | 69%                        | 81%                        |
| MOVES LEFT ON A WIN   | 8.2                        | 6.4                        |
| RANDOM BOT WINS       | 26%                        | 28%                        |
| FOIL (5+ MOVES LEFT)  | 55%                        | 56%                        |

The board was redrawn too: the first draft column is the old layout.

Iterations

- 1 v1 won 69%, just under the band: 21 to 22 moves.
- 2 Designer's call: 100% of losses were near misses, exactly one chain short, a coin flip on the arm-end cells. Each chain moved one cell inward.
- 3 Inner chains won 94% at 22 moves: 22 to 18.
- 4 Won 84% at 18: 18 to 17.

# 11 Siege Lines



Teaching · target 65-75% · now 70%

|                       | FIRST DRAFT                       | FINAL                             |
|-----------------------|-----------------------------------|-----------------------------------|
| MOVES                 | 22                                | 17                                |
| GOALS                 | 2 Shackles<br>2 Seals<br>12 Veils | 2 Shackles<br>2 Seals<br>12 Veils |
| GOAL-FOCUSED BOT WINS | 88%                               | 70%                               |
| MOVES LEFT ON A WIN   | 9.2                               | 5.8                               |
| RANDOM BOT WINS       | 10%                               | 4%                                |
| FOIL (5+ MOVES LEFT)  | 72%                               | 44%                               |

**Intent.** Every blocker of the chapter at once, each in the place it is hardest: chains high, seals in the middle, veils low. A rehearsal for the finale.

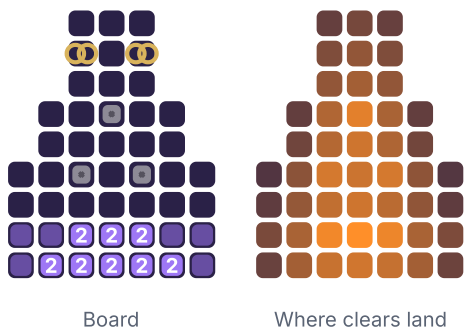
**Pressure.** Three goals pulling to three parts of the board.

**Designed to fail at.** Usually the veils, because they are last in reach.

**What the losses were:** Veils unmet in 78% of losses (1.8 short); Shackles unmet in 39% of losses (1 short). 78% of losses were near misses.

- Iterations**
- 1 v1 won 88% with 9 moves left: 22 to 18 moves.
  - 2 v2 won 76%, a point over the band: 18 to 17 moves.

# 12 The Tower Falls



Spike · target 50-60% · now 55%

|                       | FIRST DRAFT                    | FINAL                          |
|-----------------------|--------------------------------|--------------------------------|
| MOVES                 | 24                             | 24                             |
| GOALS                 | 2 Shackles<br>3 Seals 22 Veils | 2 Shackles<br>3 Seals 22 Veils |
| GOAL-FOCUSED BOT WINS | 57%                            | 55%                            |
| MOVES LEFT ON A WIN   | 7.5                            | 7.7                            |
| RANDOM BOT WINS       | 4%                             | 5%                             |
| FOIL (5+ MOVES LEFT)  | 40%                            | 39%                            |

**Intent.** The finale, shaped like the tower: a narrow crown with chains, sealed windows in the walls, and a base of double veils. Breaking the crown starves nothing anymore and the tower comes down from the top.

**Pressure.** The base of double veils, reachable only through the tower's narrow body.

**Designed to fail at.** Veils left at the base.

**What the losses were:** Veils unmet in 96% of losses (2.6 short); Shackles unmet in 10% of losses (1.1 short). 85% of losses were near misses.

- Iterations**
- 1 No change: the first draft landed in the band (57%).

# Five things the numbers taught me

Most tuning was a move budget. The useful moments were the ones where the data said the idea itself was wrong.

**Moves were the wrong lever for the Gatehouse.** Four scattered seals won 96%; cutting moves to 13 got it to 72%, but the seals still didn't gate anything, because tiles slid around single seals. A spike made only of a tight move budget feels unfair, not hard. I redesigned it as a wall of five seals with three gaps: at the same 16 moves the new gate won 77% against the old 84%, so the wall itself was doing the work. Then the budget came down to 13.

**The fail point I wrote was wrong.** On the Split Keep I expected the small Swords goal to cause the losses. The data said Cups, the big goal, was unmet in 96% of losses: the wall halves every big cascade. The level was fine, so the note changed, not the board.

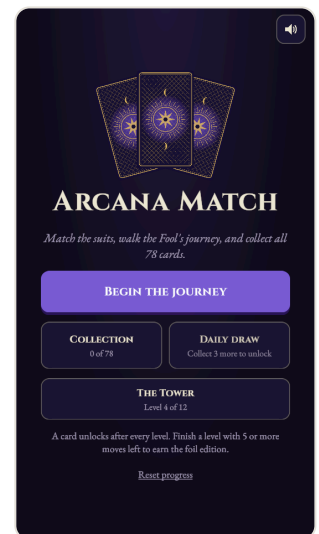
**A loss should be a decision, not a coin flip.** Every loss on Crossed Chains was exactly one chain short, on the arm-end cells where matches rarely form. Moving each chain one cell inward made them reachable by intent, and the budget came down from 22 to 17 to keep the level in band.

**Breathers keep their generosity.** The Courtyard, Market Day and Open Sky stayed near 100% even with tighter goals. I moved their targets instead of the levels: a sawtooth needs real rests after the spikes.

**Shapes can strand cells.** Seal walls and holes block the refill from above. The simulator flags any cell left empty after a move, and an EditMode test plays every level and fails if one appears, so a layout edit can't ship a dead pocket.

## The pack's rhythm

| #  | LEVEL               | ROLE     | WHAT IS NEW                              |
|----|---------------------|----------|------------------------------------------|
| 1  | The Courtyard       | Breather | Cut corners: cascades live in the middle |
| 2  | The Split Keep      | Teaching | A wall of holes: two rooms               |
| 3  | Veiled Floor        | Teaching | Veils along the floor                    |
| 4  | The Gatehouse       | Spike    | Stone Seals as a gate                    |
| 5  | Market Day          | Breather | Two generous goals, room for specials    |
| 6  | Chained Battlements | Teaching | Shackles on the refill row               |
| 7  | The Stair           | Teaching | Diagonal steps, double veils             |
| 8  | The Vault           | Spike    | Seals and double veils together          |
| 9  | Open Sky            | Breather | A tall 7 × 9 board                       |
| 10 | Crossed Chains      | Teaching | A cross: chains on the arms              |
| 11 | Siege Lines         | Teaching | Every blocker at once                    |
| 12 | The Tower Falls     | Spike    | The finale: the tower's shape            |



The Tower tile on the home screen, remembering the next level.

### Play it

Arcana Match on itch.io: the home screen's **The Tower** tile plays the pack in order and remembers the next level. The pack is a text file the game reads at start.

### Next steps

Ten real players per level to set the bot's numbers against human ones, then retune the bands; a visual editor in Unity so a level can be drawn and measured in one place.