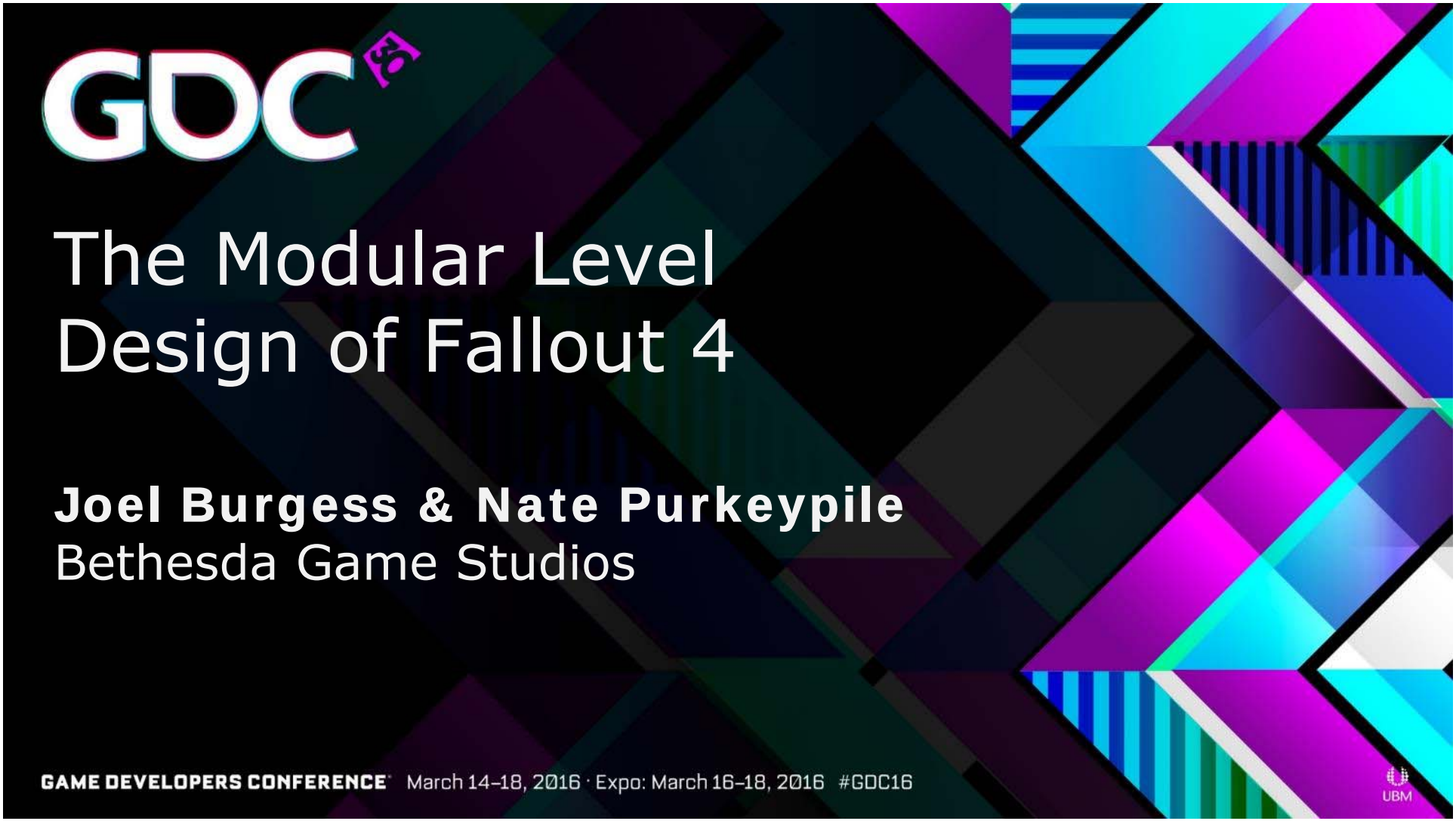
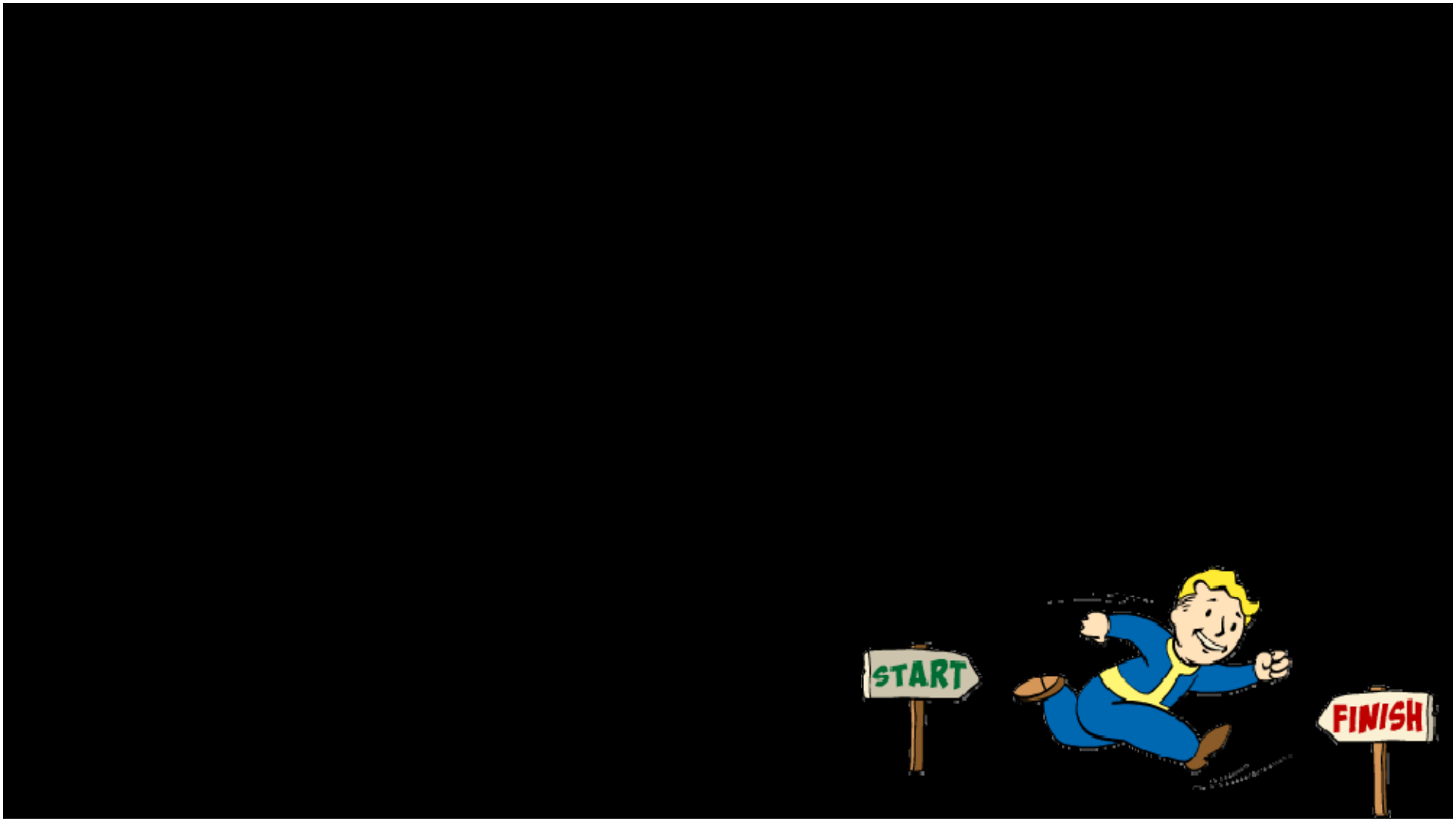

GDC
The Modular Level Design of Fallout 4
Joel Burgess & Nate Purkeypile
Bethesda Game Studios
GAME DEVELOPERS CONFERENCE March 14–18, 2016 · Expo: March 16–18, 2016 #GDC16
UBM


START
FINISH

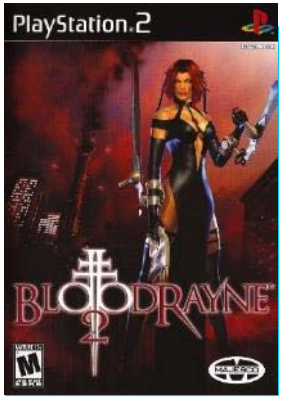
Modular Kits ~~101~~ 201

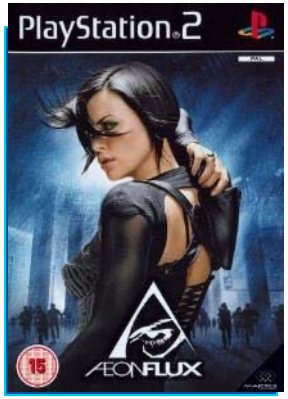
We're Doing a Sequel!

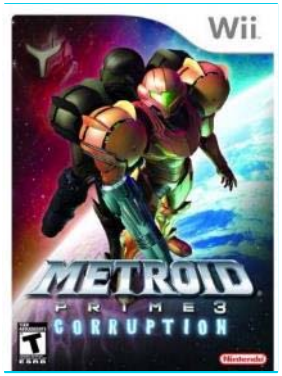
- Original Talk: 2013 @ LD in a Day
  - We'll show URL on the end slide
- Today's Talk:
  - Recap Core Ideas from 2013
  - Updates & Examples from Fallout 4

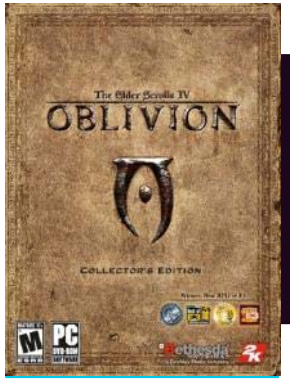
Who We Are

- Nate Purkeypile
  - Environment Artist
    - The tall one
- Joel Burgess
  - Level Design
    - The one talking right now (hi!)



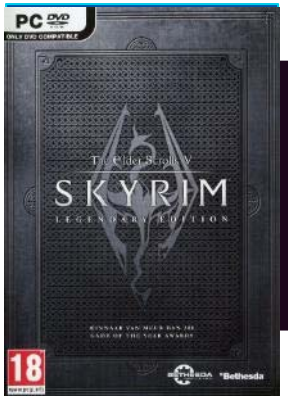






- Shivering Isles
- Mehrunes Razor

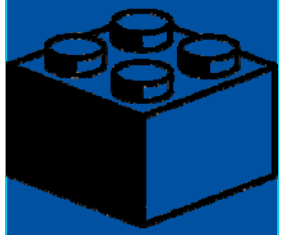
- Point Lookout
- Operation Anchorage
- The Pitt
- M. Zeta



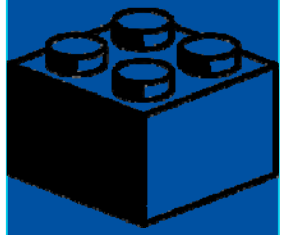
- Dawnguard
- Dragonborn

DLC

Bloodrayne 2

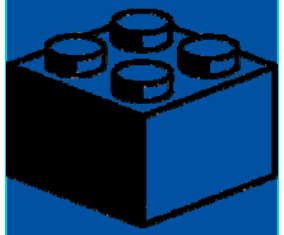


Aeon Flux



Metroid Prime 3: Corruption

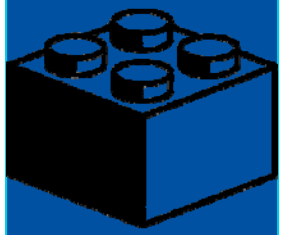
TESIV: Oblivion



Shivering Isles

Mehrunes Razor

Fallout 3



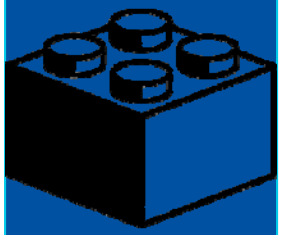
Point Lookout

Operation Anchorage

The Pitt

M. Zeta

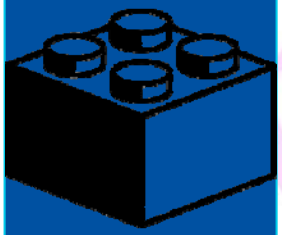
Skyrim



Dawnguard

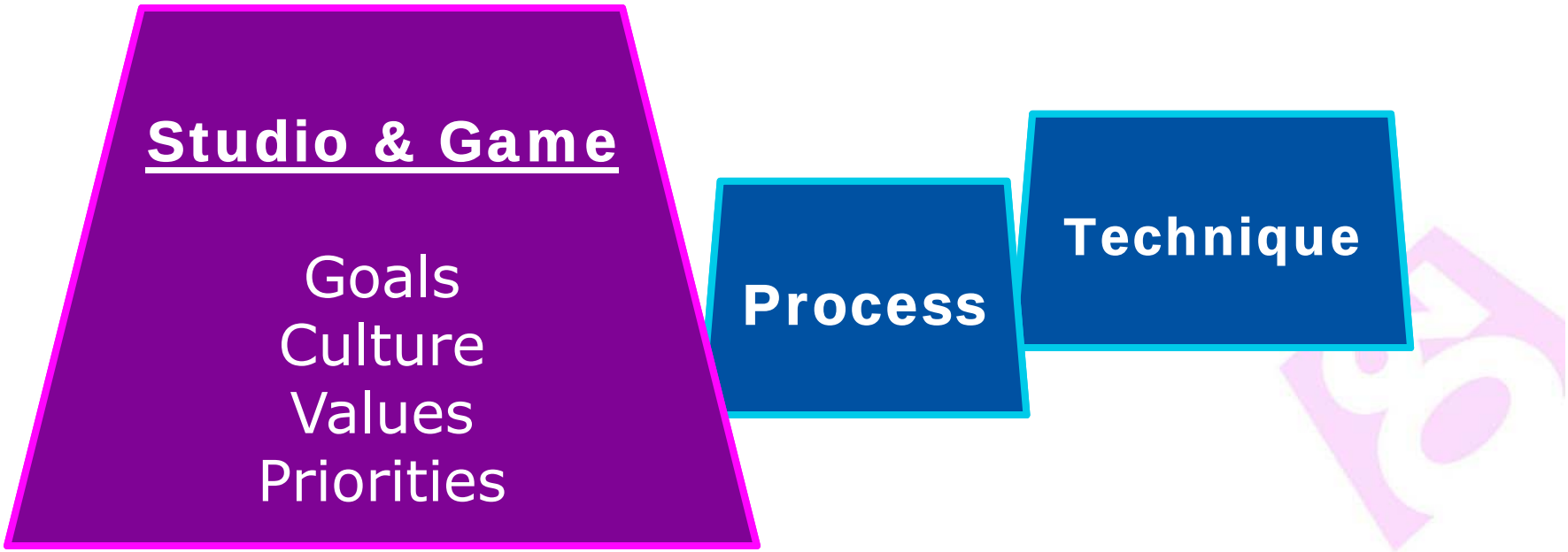
Dragonborn

Fallout 4



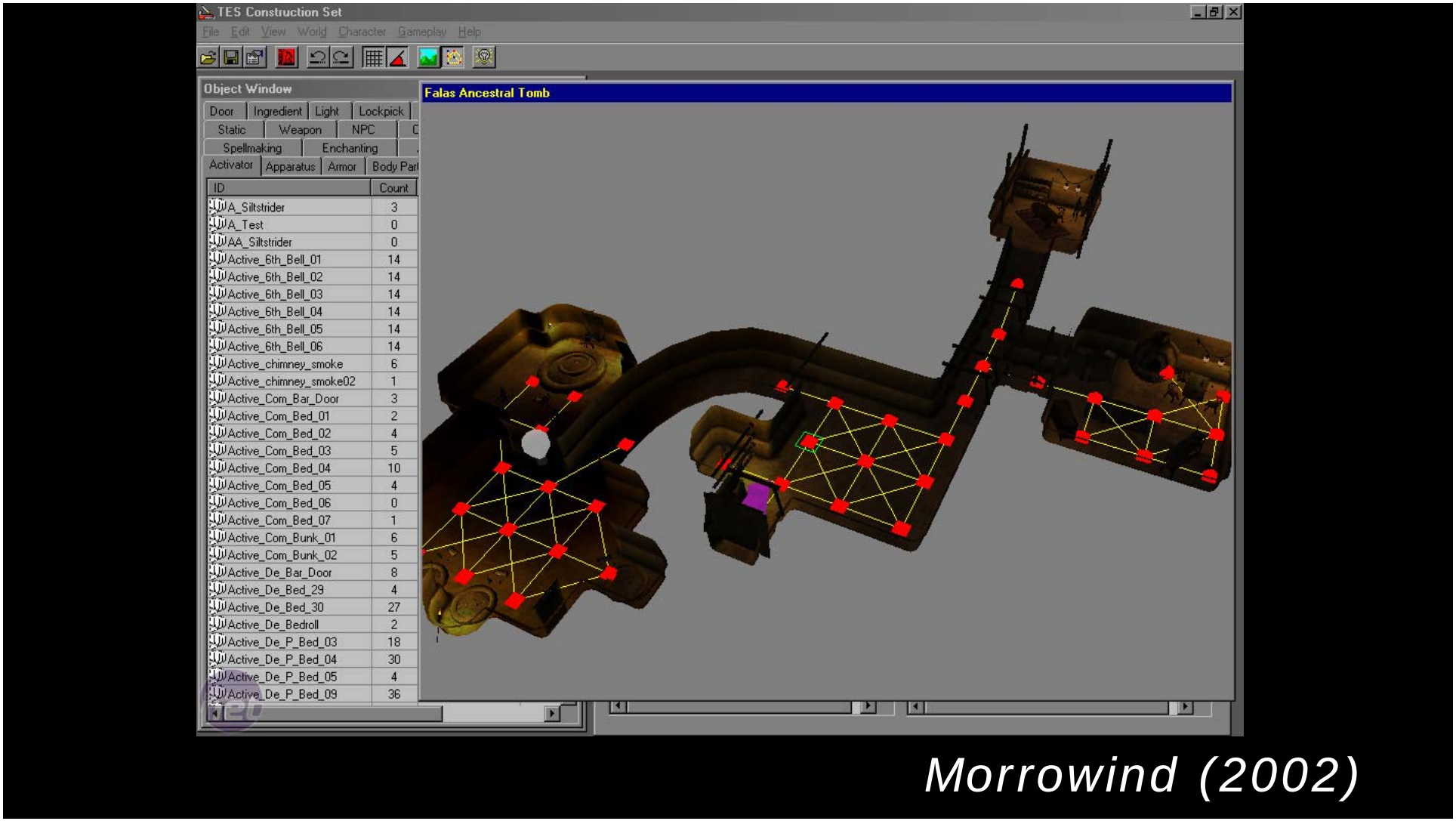
Fallout 4

Context

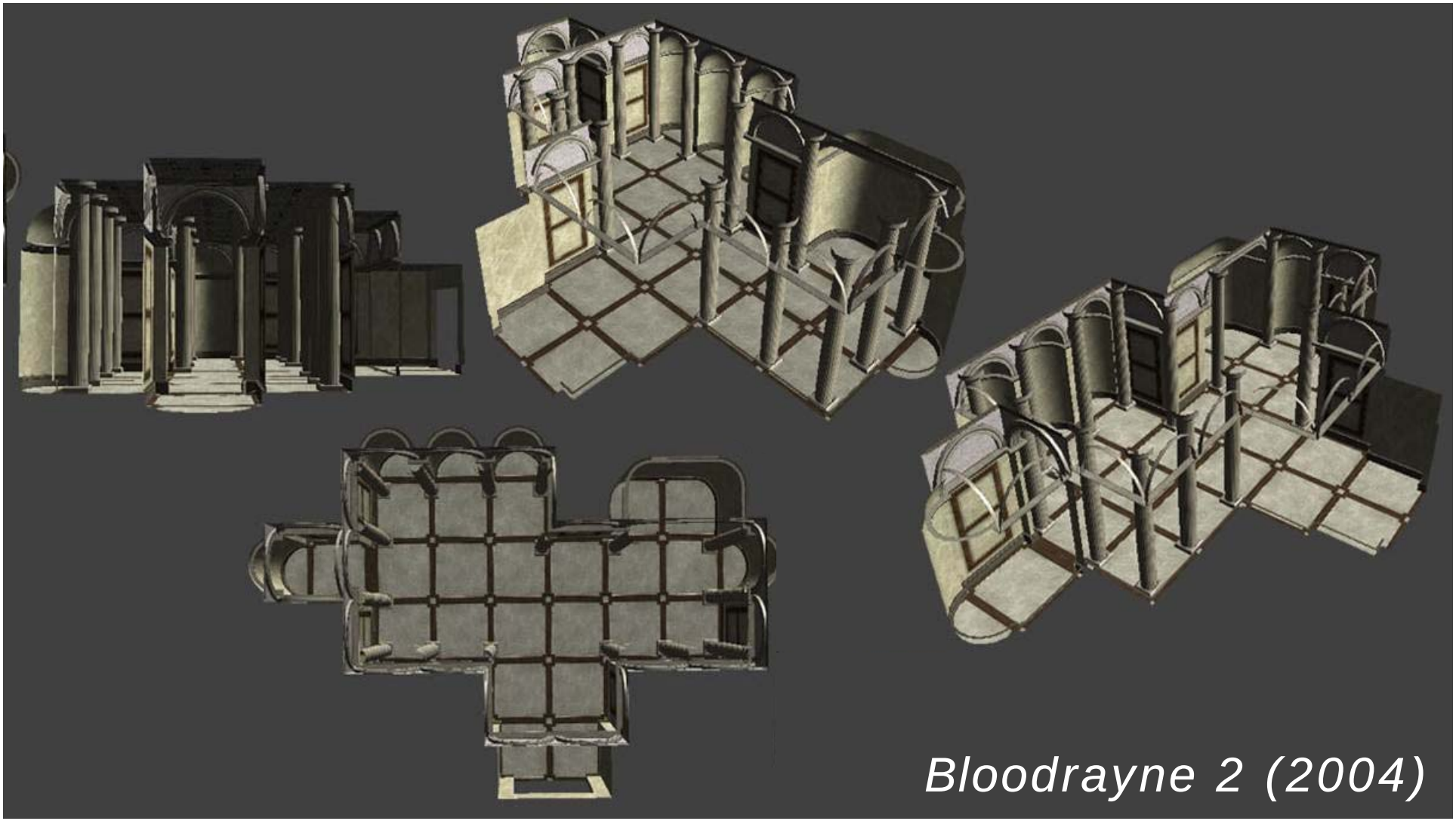

Studio & Game
Goals
Culture
Values
Priorities
Process
Technique

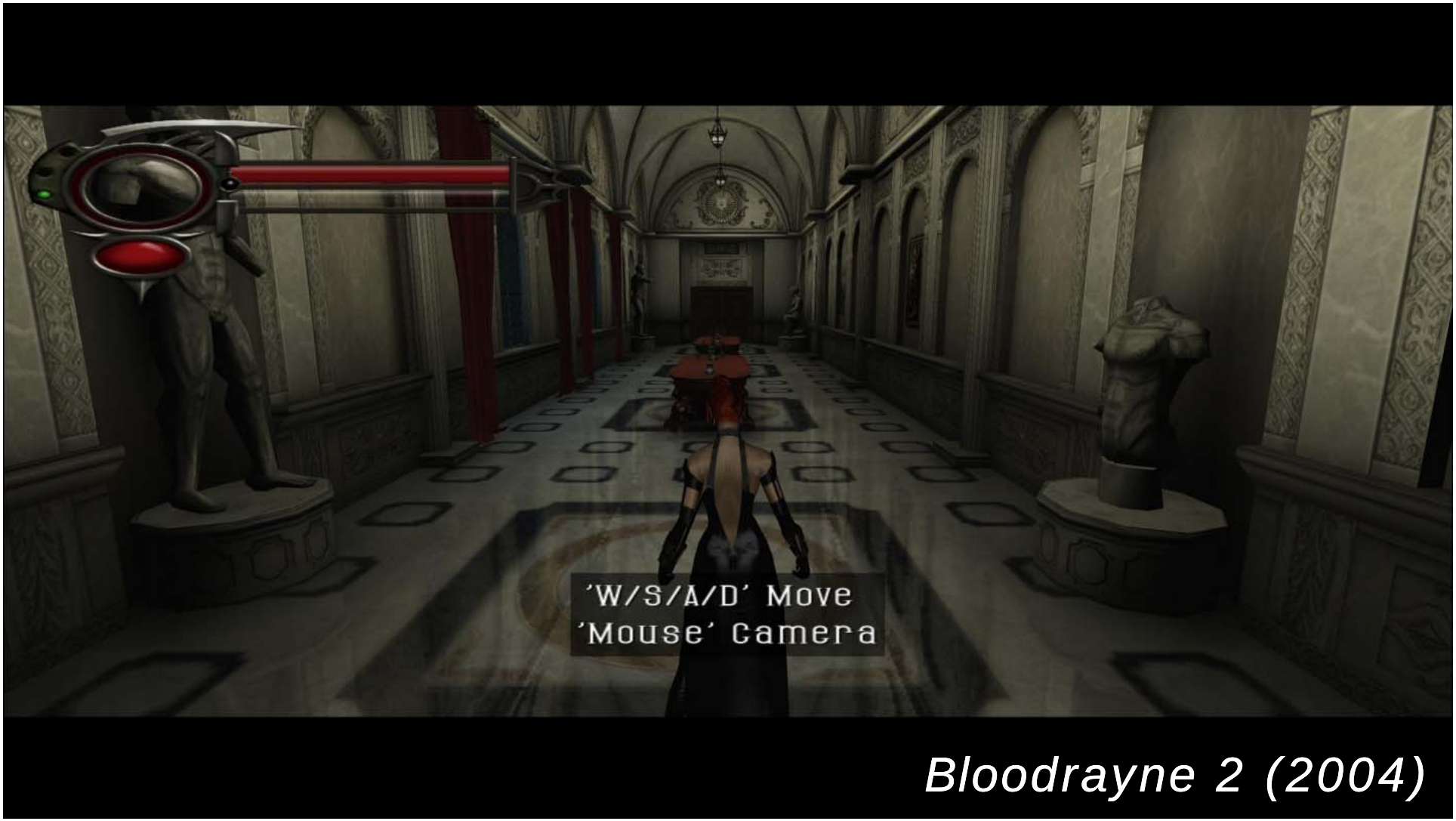
What Came Before

Daggerfall (1996)



Morrowind (2002)


Bloodrayne 2 (2004)



Bloodrayne 2 (2004)

Oblivion (2006)

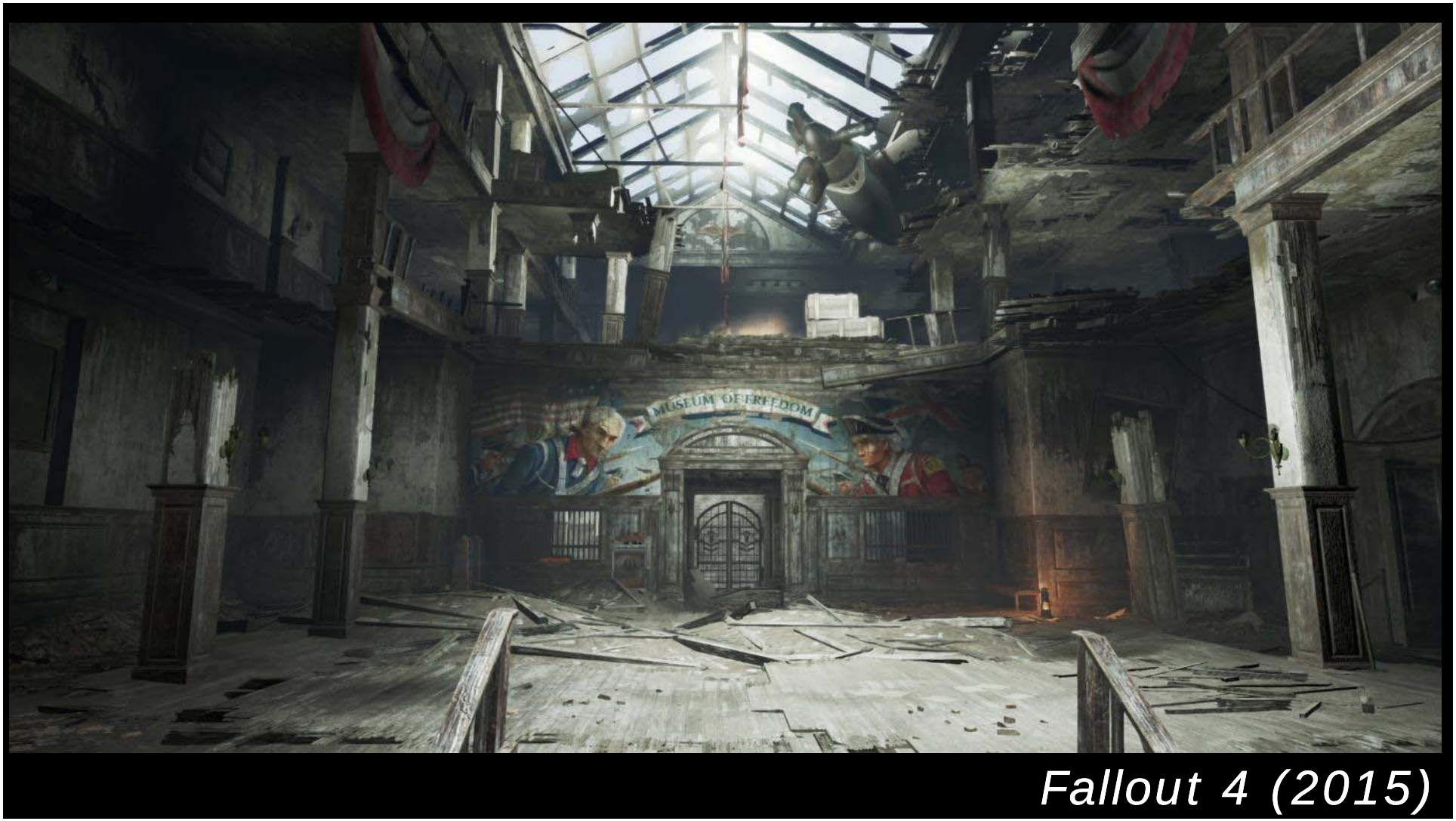
Fallout 3 (2008)

Fallout 3 (2008)

Skyrim (2011)

Skyrim (2011)

Skyrim (2011)



Fallout 4 (2015)

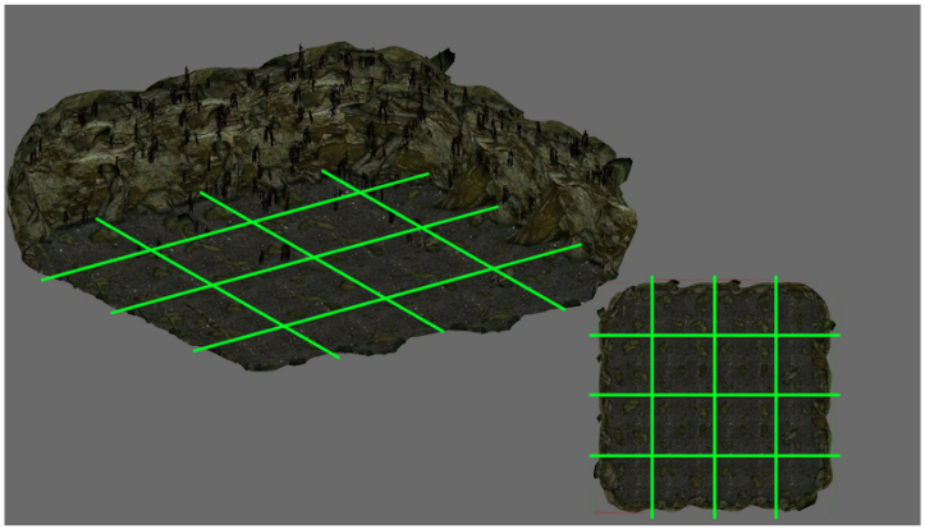
Modular Kits 101

Fundamentals

- Begin by Defining **Footprint**

Pick Your Grid Footprint

- Grid Size is the Foundation of your Kit



Slide taken from 2013 session

Oct. 24, 1961 G. K. CHRISTIANSEN 3,005,282

TOY BUILDING BRICK

Filed July 28, 1958 2 Sheets-Sheet 1

FIG. 1.

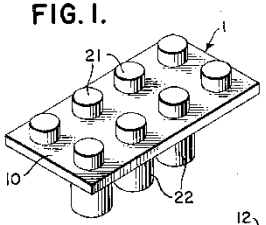


FIG. 2.

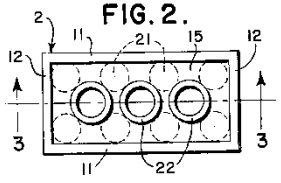


FIG. 3.

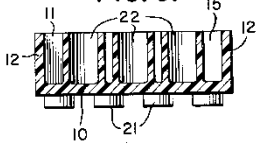


FIG. 4.

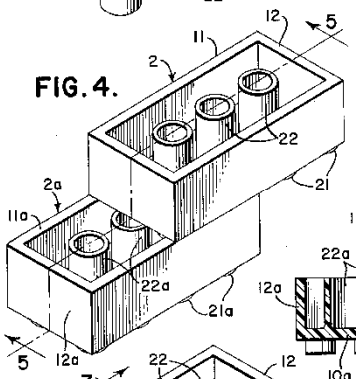


FIG. 5.

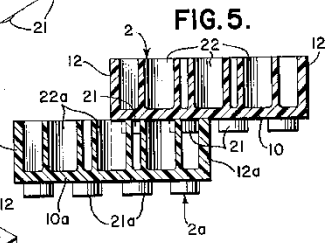


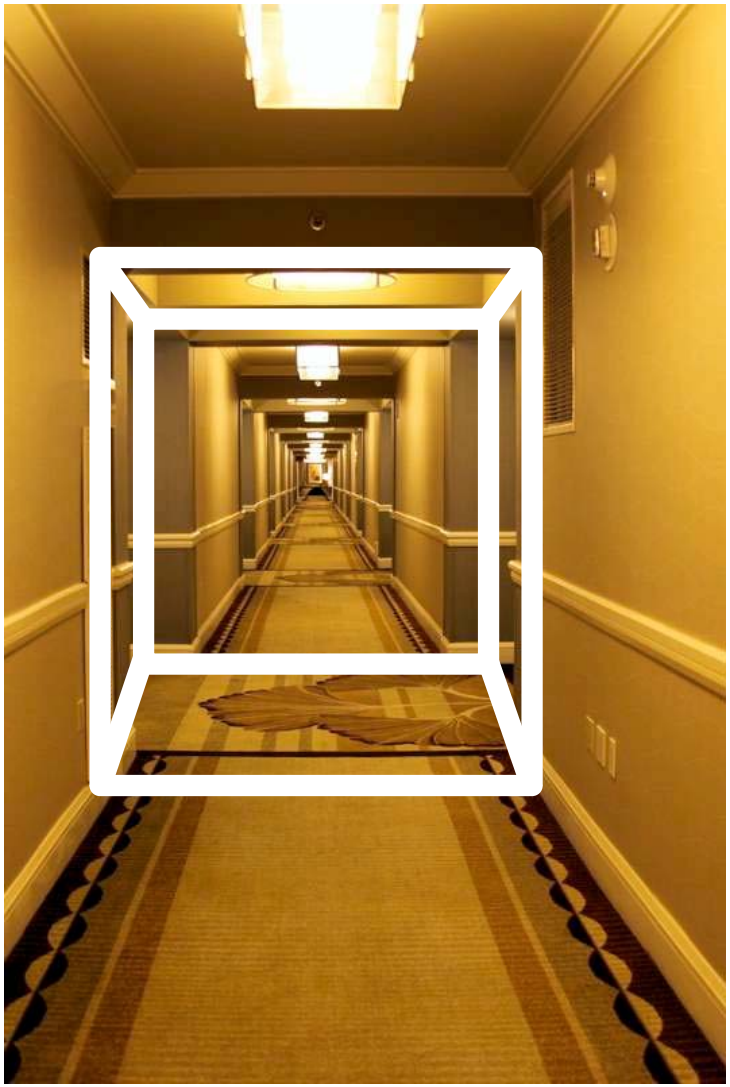
FIG. 6.

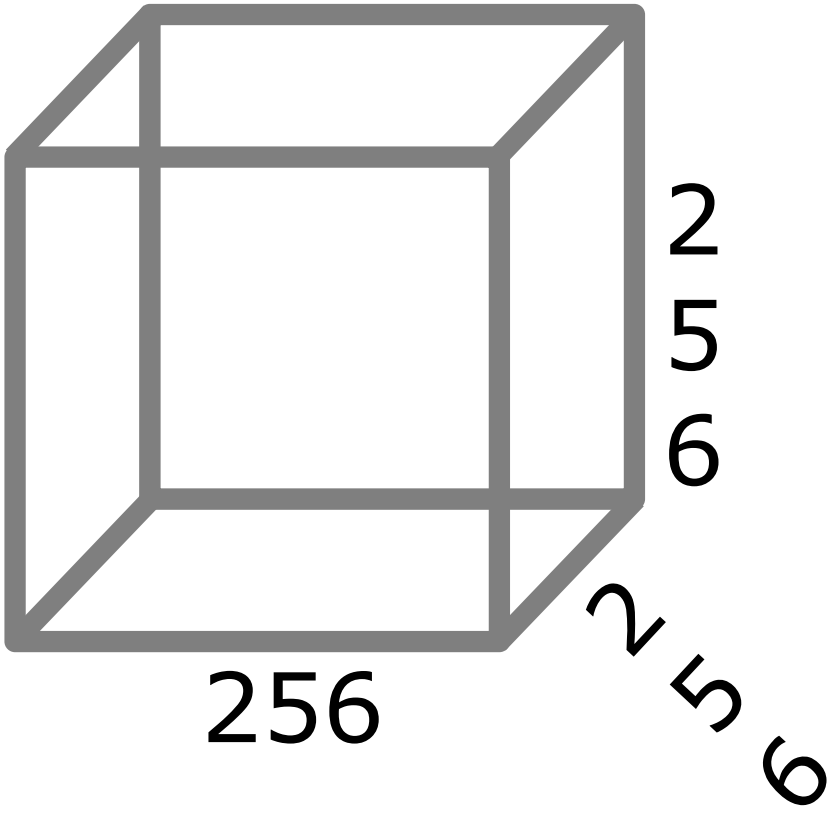
INVENTOR

Godtfred Kirk Christiansen

BY Stevens, Davis, Miller & Mosher

ATTORNEYS

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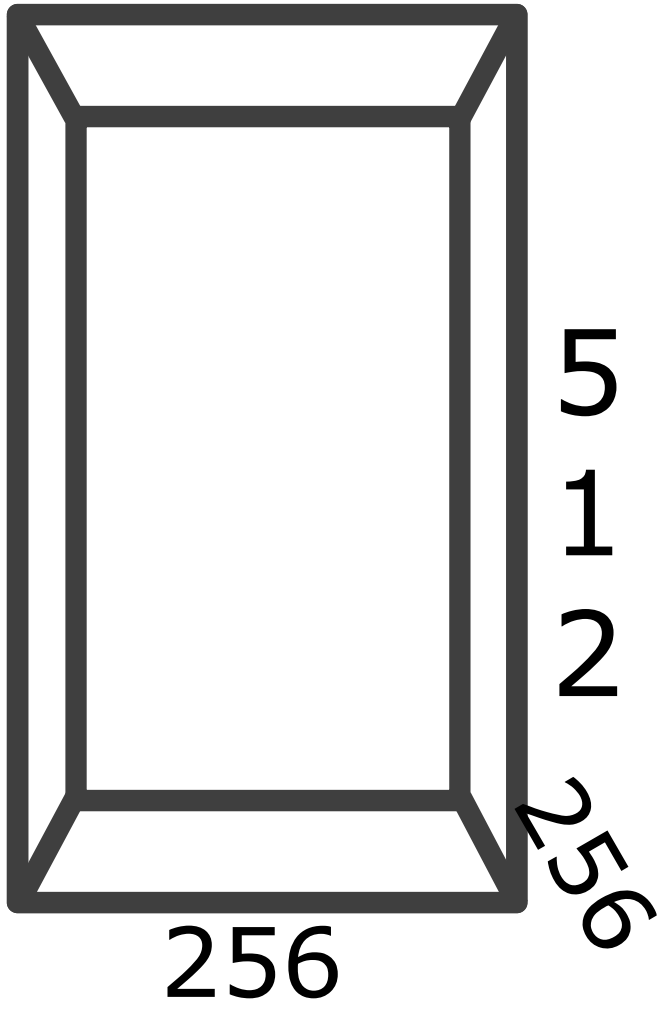
256
256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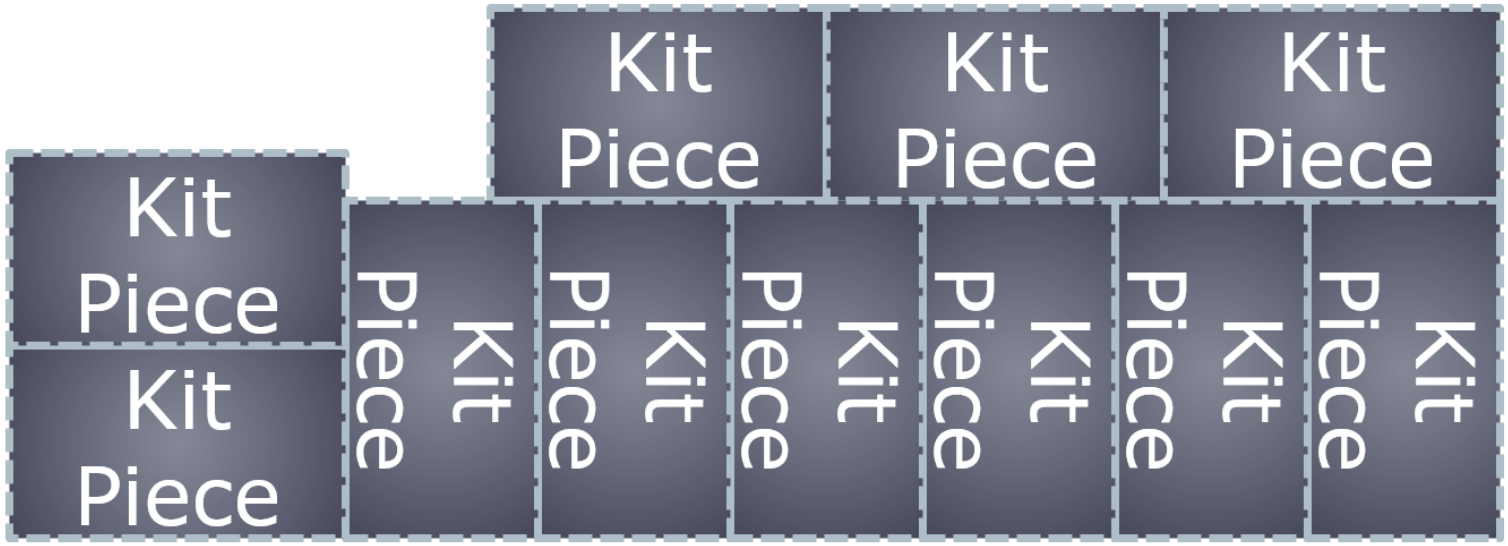
Fundamentals

- Begin by Defining Footprint
- Be cautious with **Non-Uniform Tiling**

Common Footprint Problems

- Non-uniform XY sizes – use sparingly.

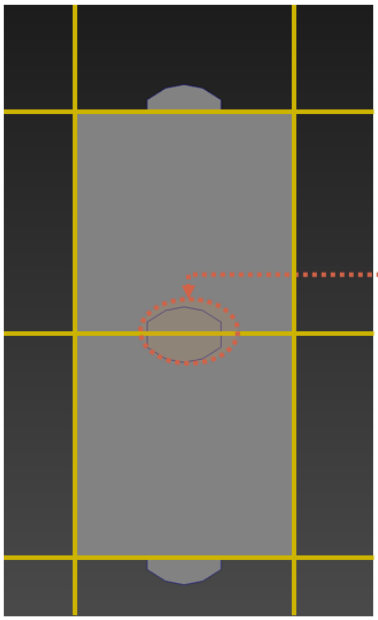


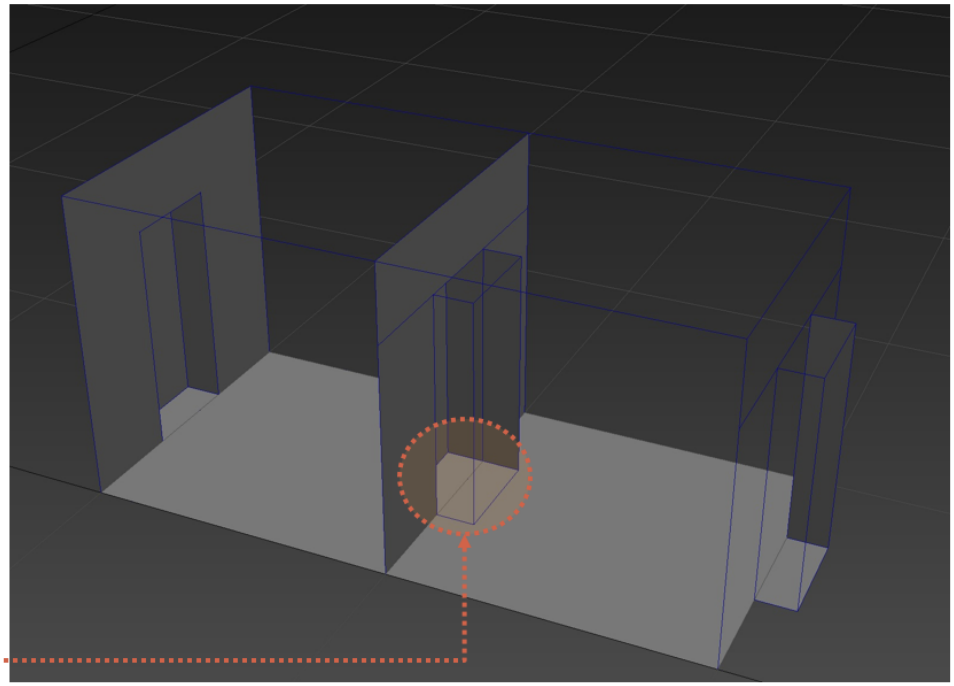
Slide taken from 2013 session

Fundamentals

- Begin by Defining Footprint
- Be cautious with Non-Uniform Tiling
- Build **Within Footprint** extents

Stay Inside the Footprint



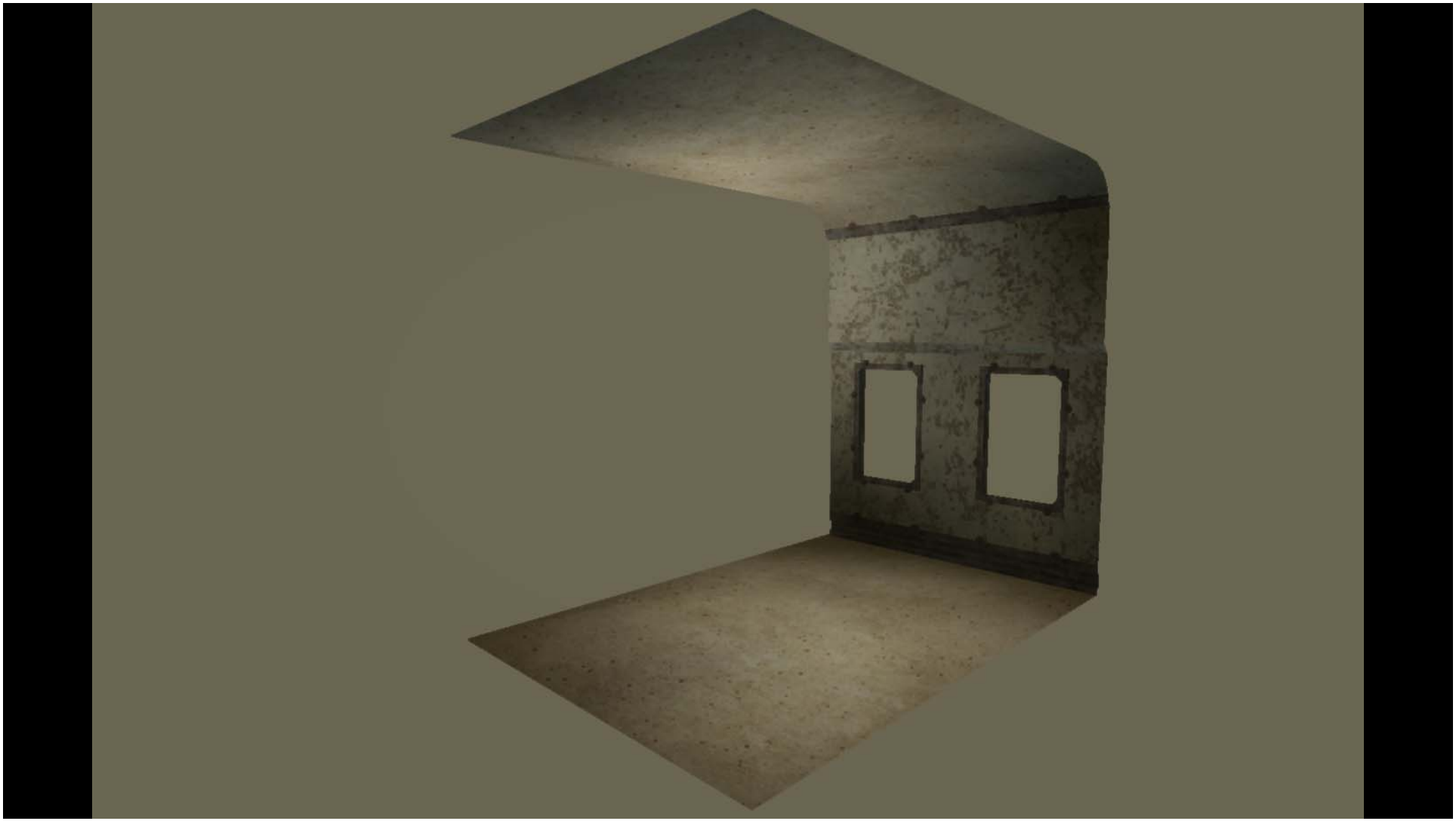


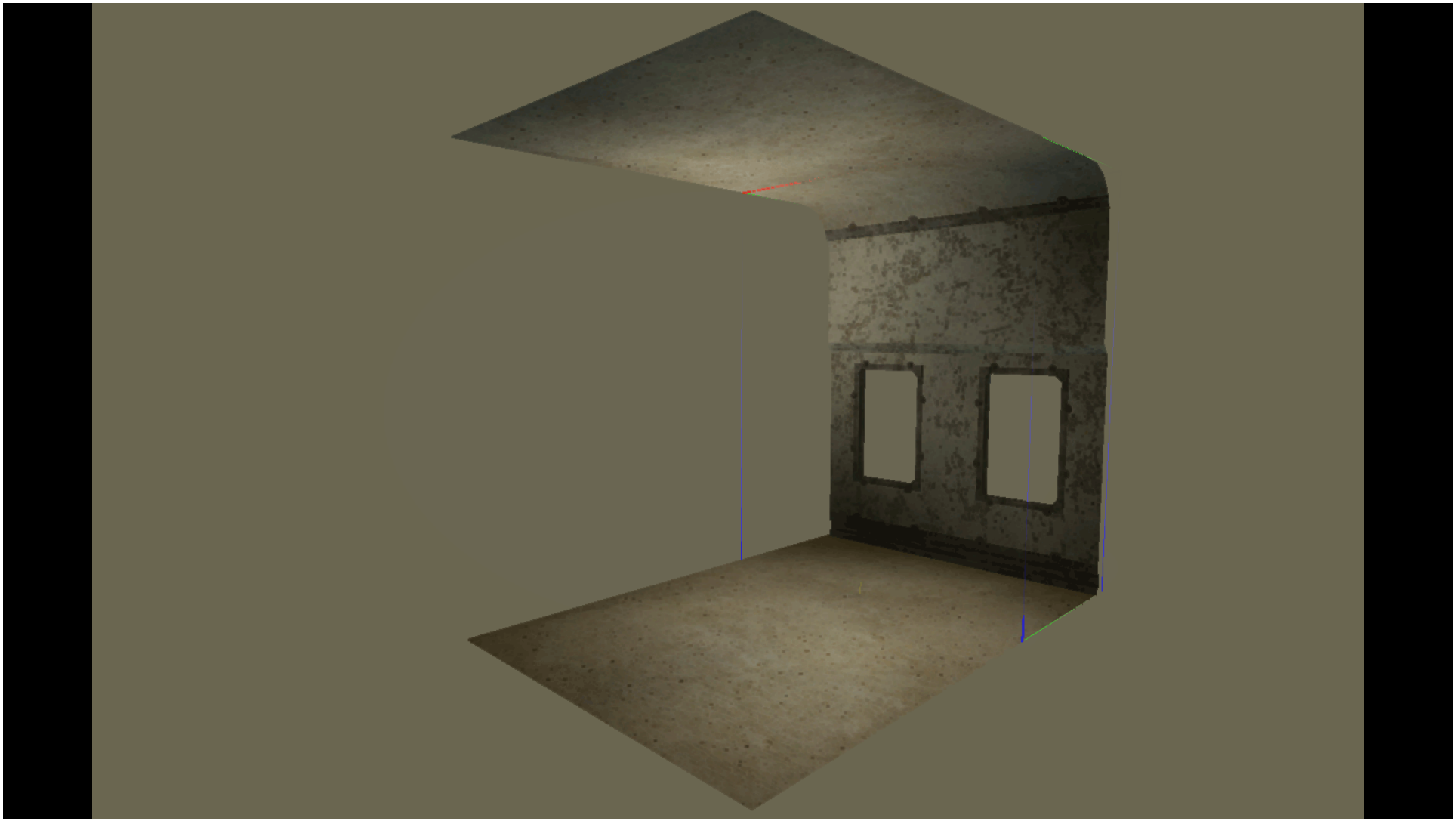
Overlapping Parts

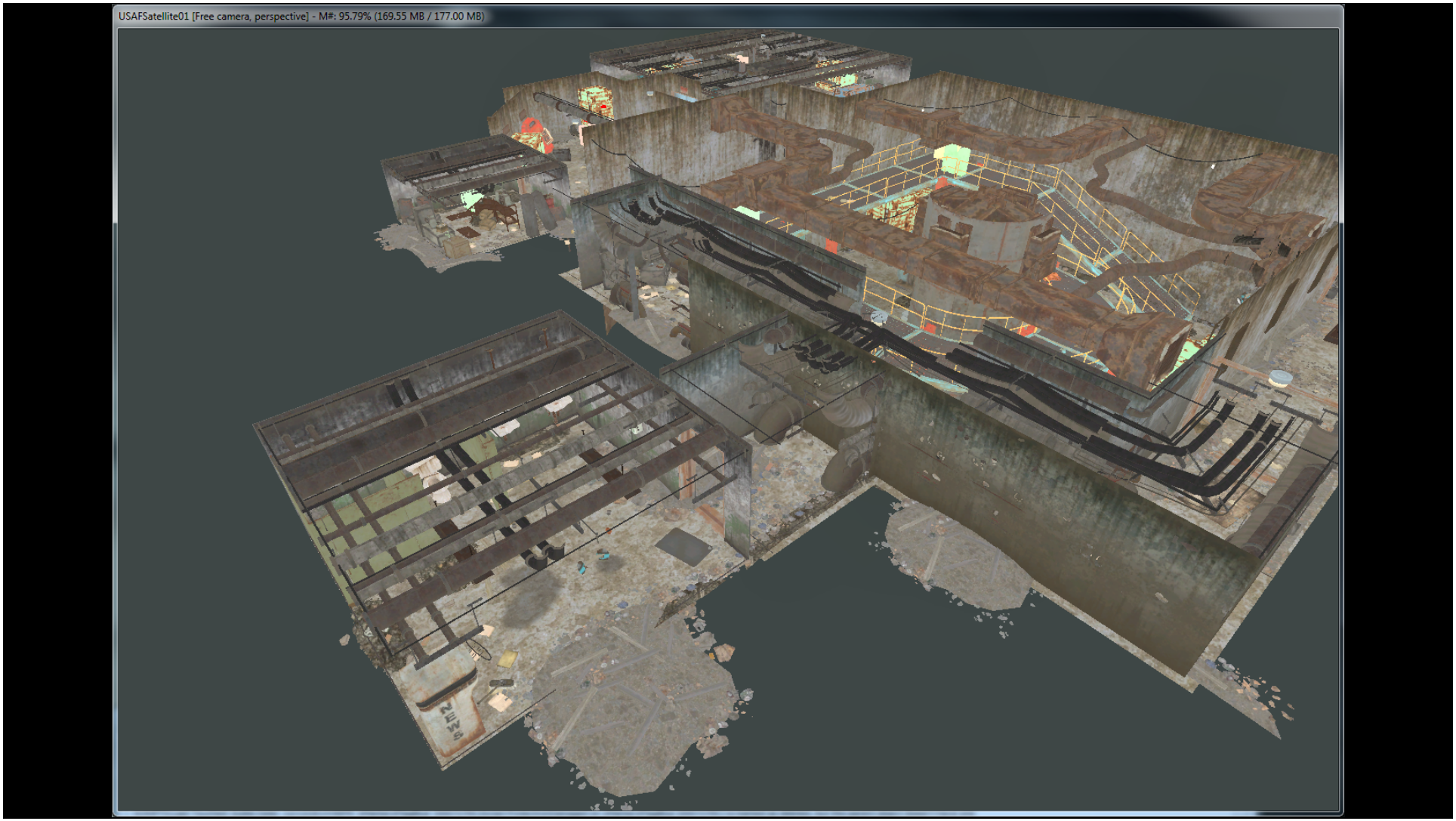
Slide taken from 2013 session

Fundamentals

- Begin by Defining Footprint
- Be cautious with Non-Uniform Tiling
- Build Within Footprint extents
- **Pick a Pivot,** and stick with it.



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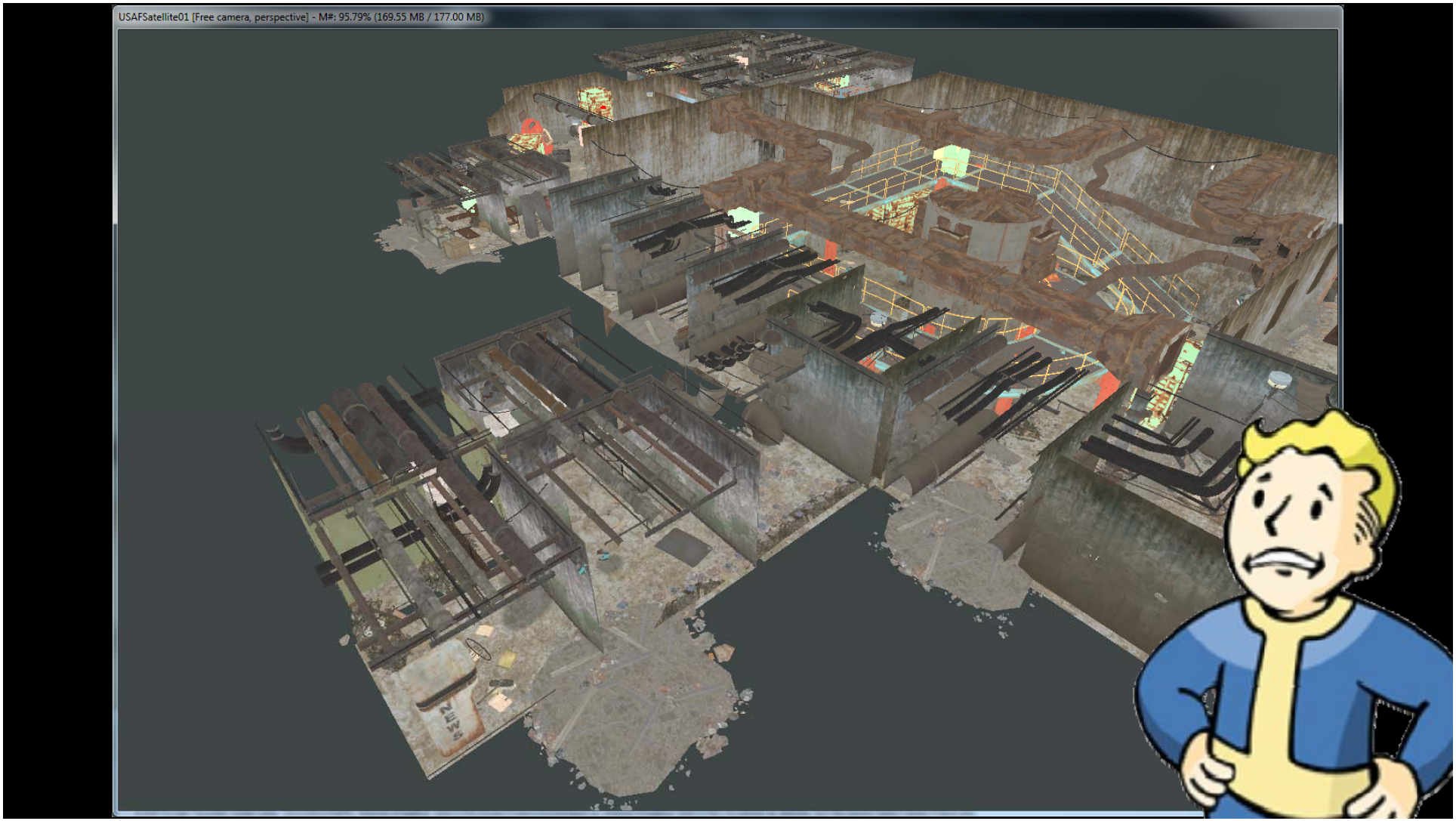
NEWS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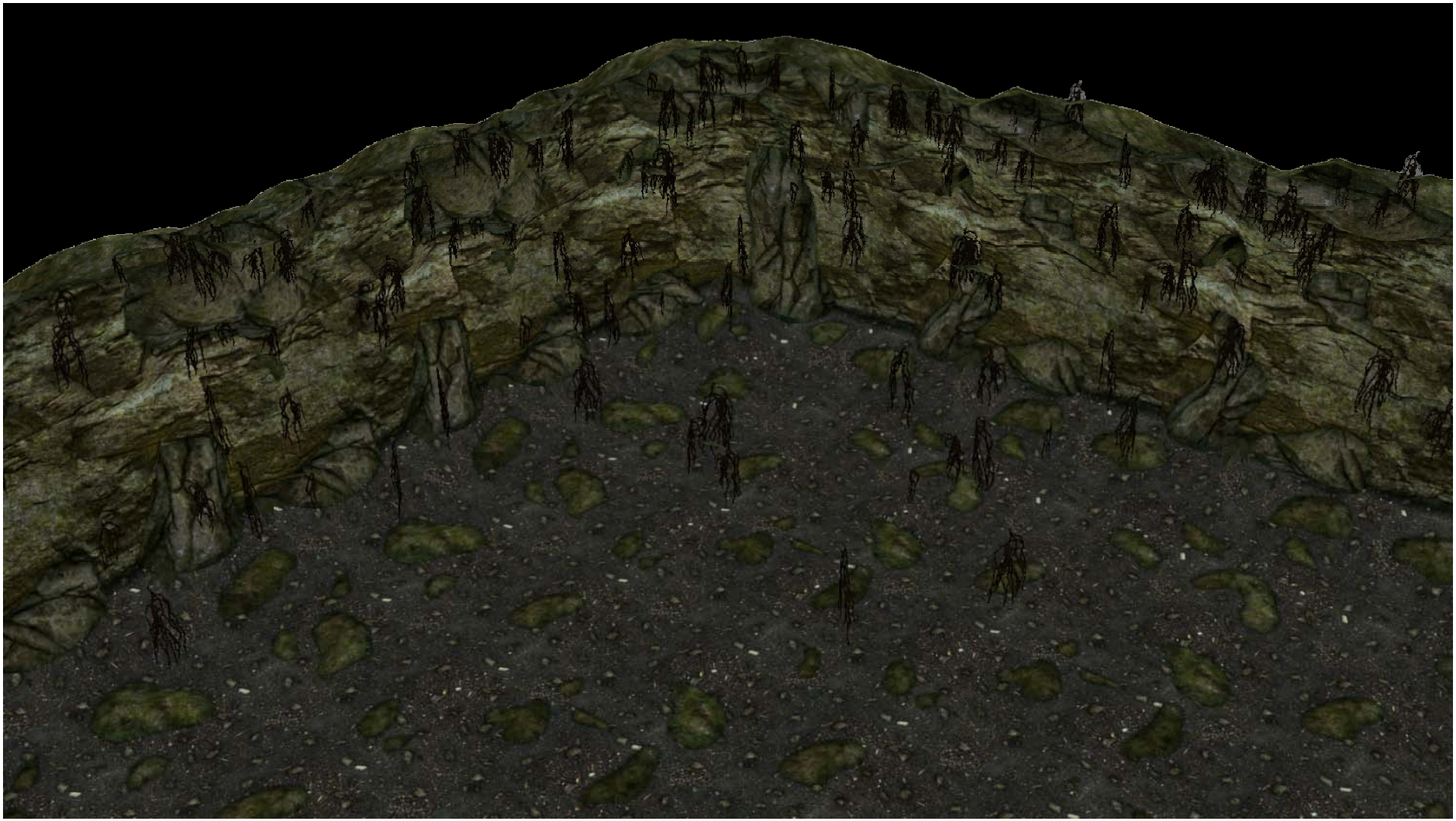
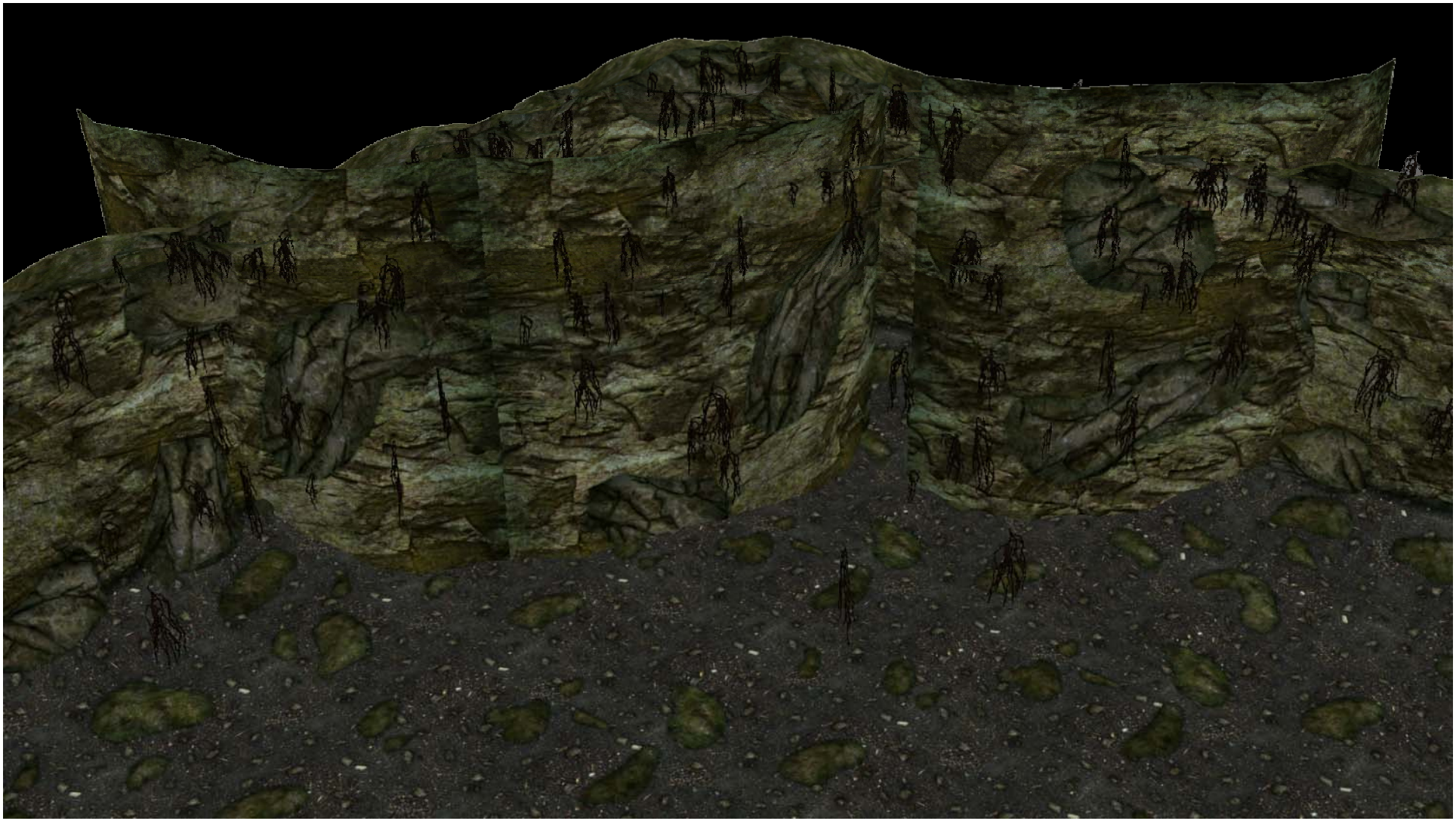
Fundamentals

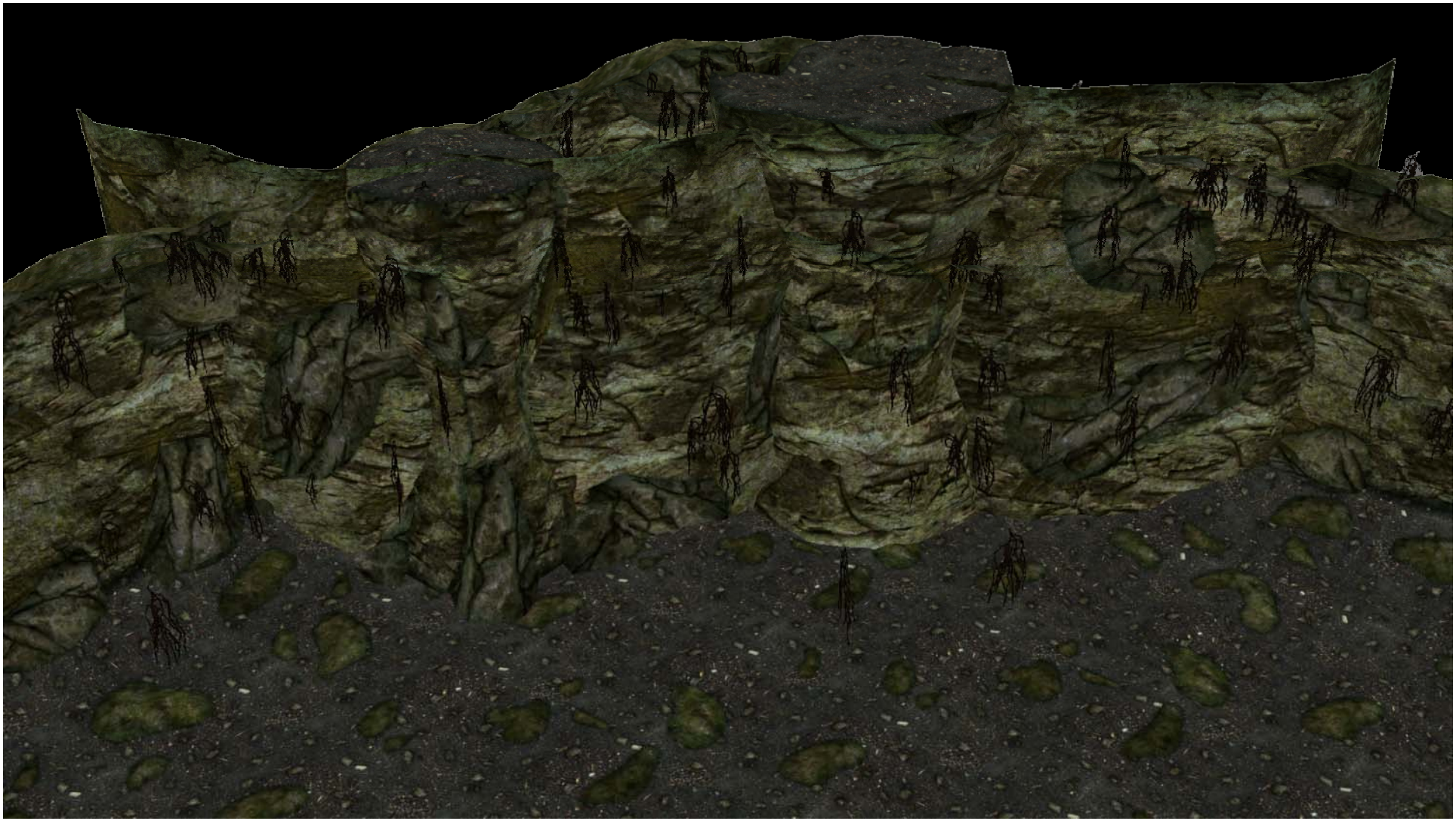
- Begin by Defining Footprint
- Be cautious with Non-Uniform Tiling
- Build Within Footprint extents
- Pick a Pivot, and stick with it.
- Use **Standardized Transitions**

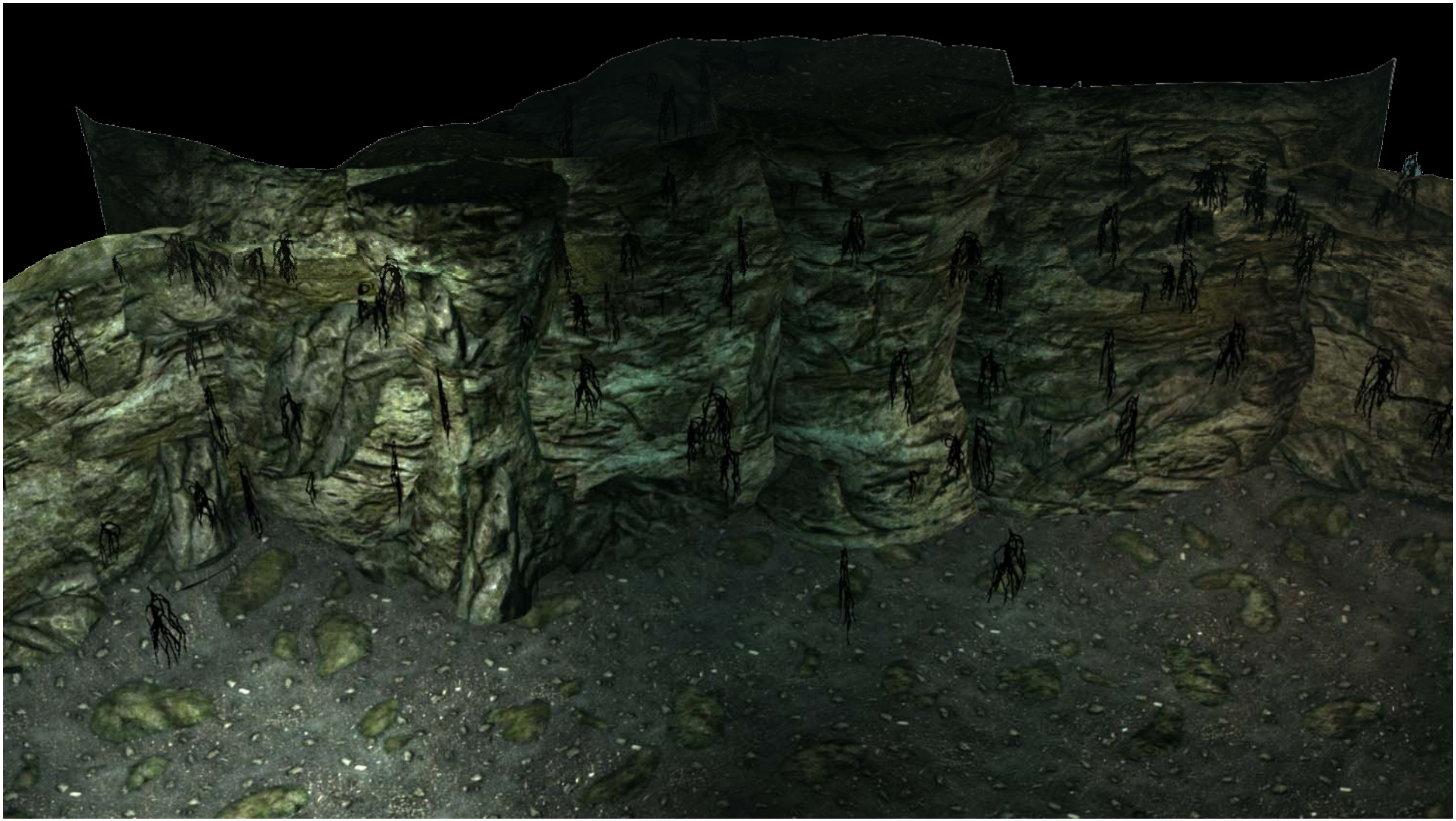
Techniques

- Use **Layered Inserts** w/Base Kits







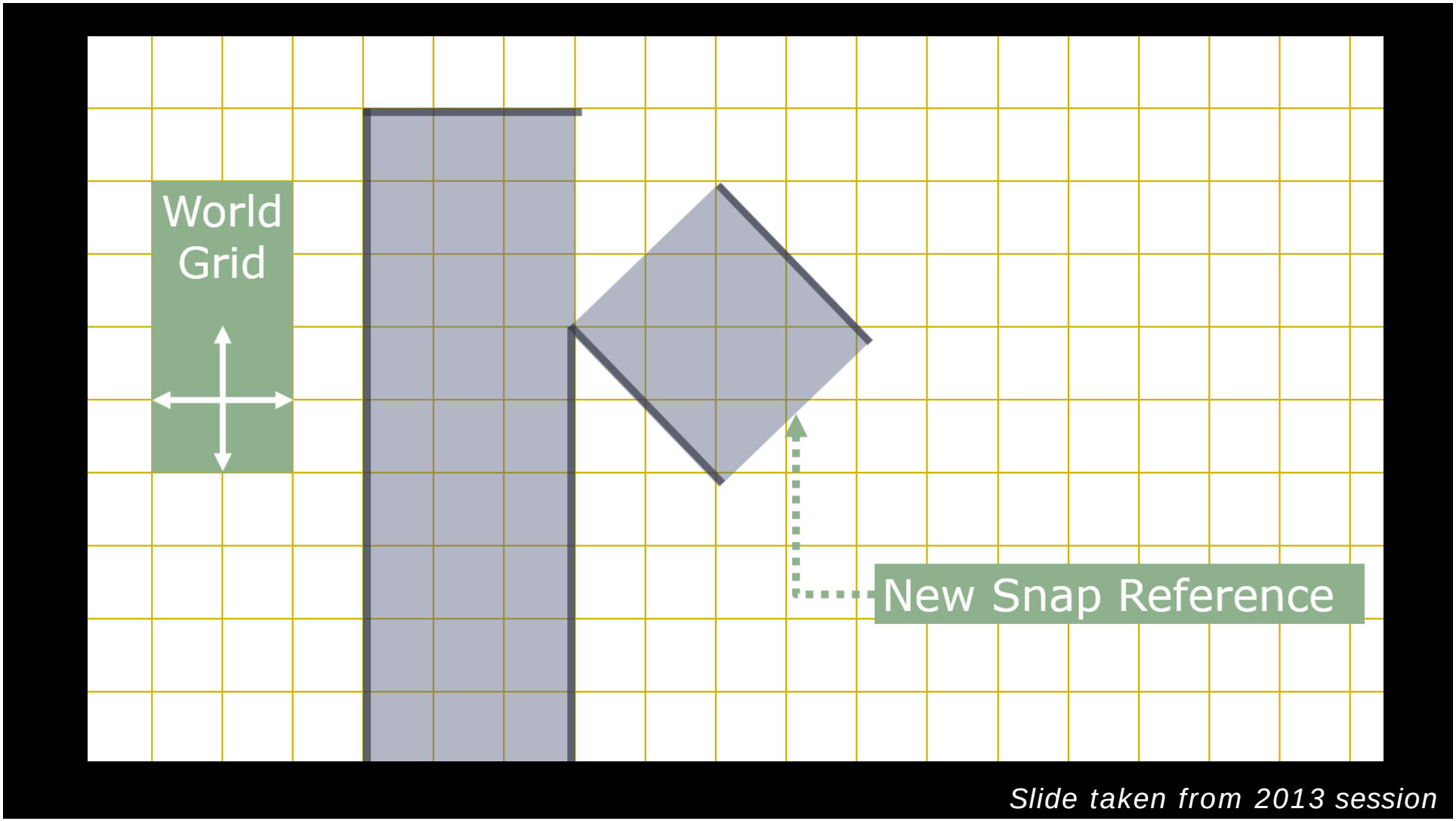


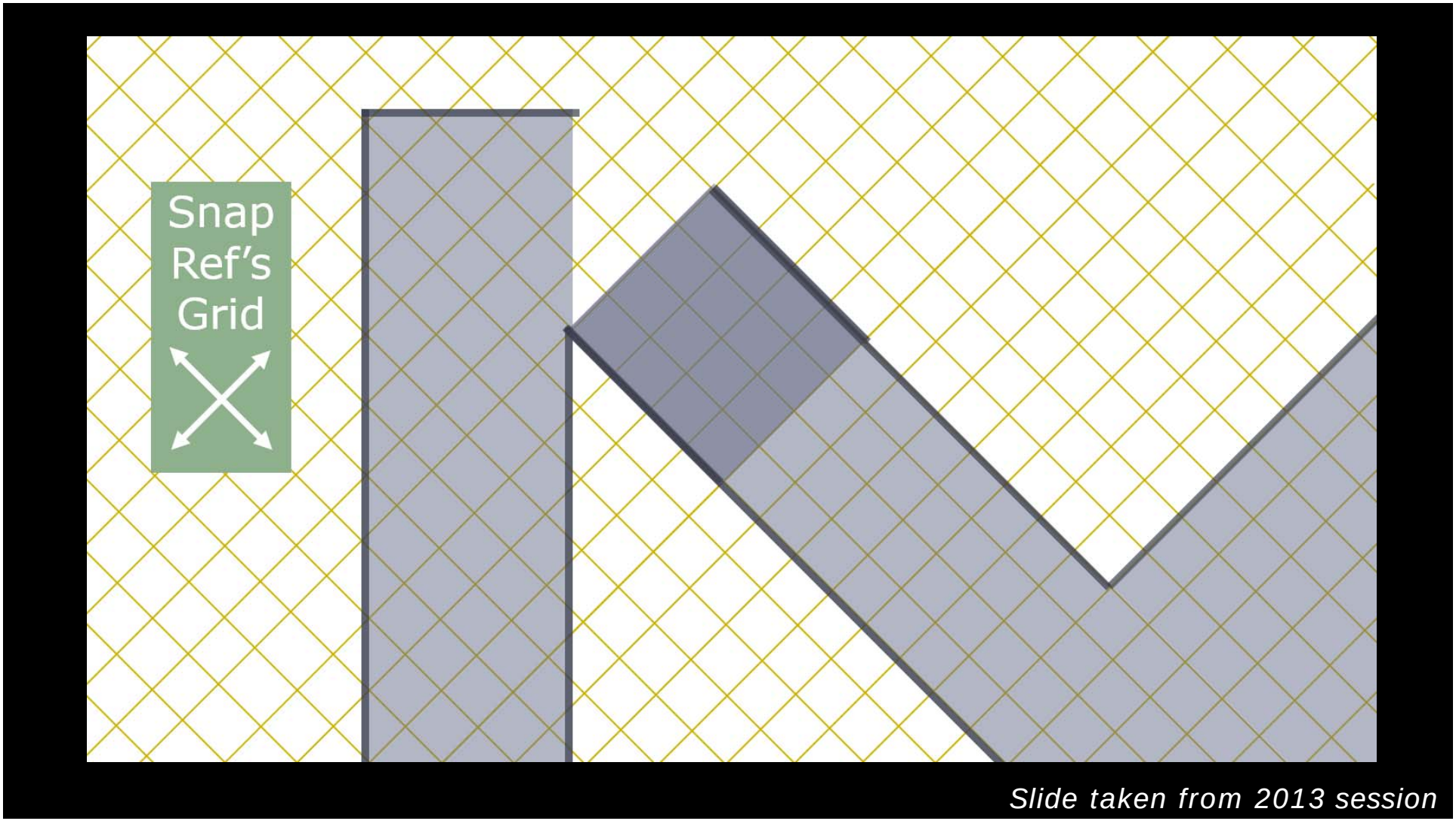
Slide taken from 2013 session

Fallout 4 – GNN Plaza

Techniques

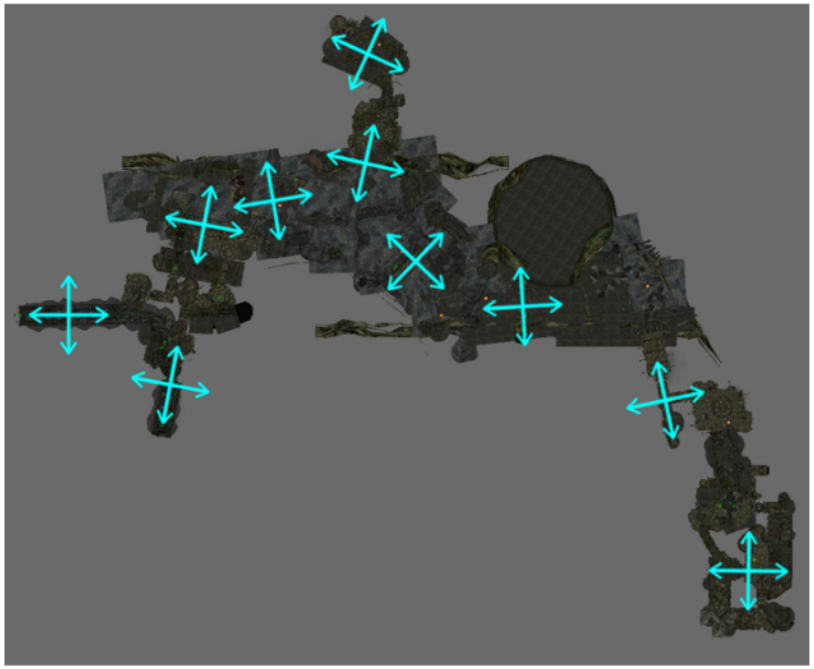
- Use Layered Inserts w/Base Kits
- **Local Snap Parents** aka Custom Grids


World
Grid
New Snap Reference
Slide taken from 2013 session



Slide taken from 2013 session

Snap-to-Reference

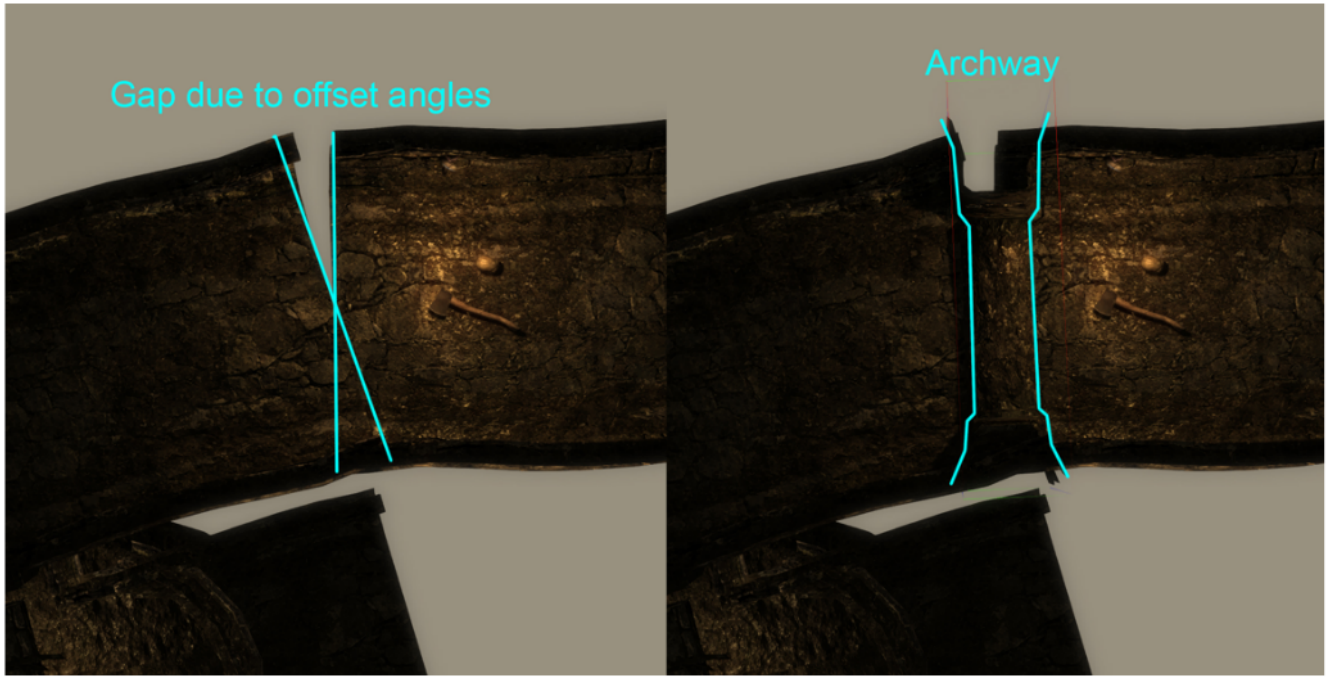


Slide taken from 2013 session

Techniques

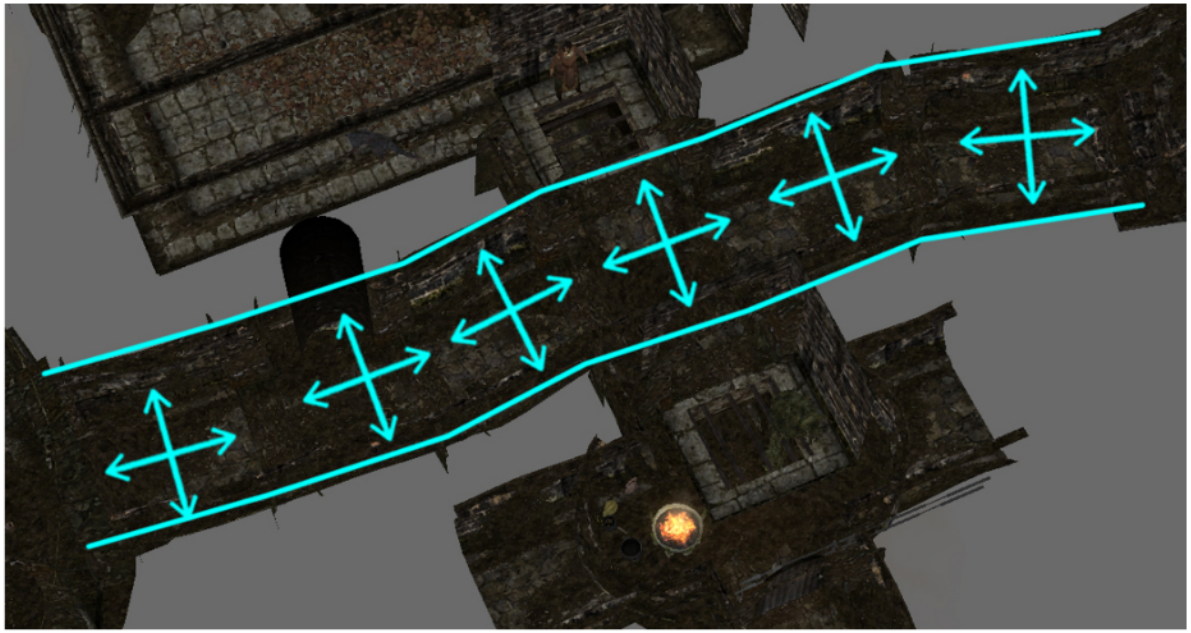
- Use Layered Inserts w/Base Kits
- Local Snap Parents aka Custom Grids
- Pivot-And-Flange kits for organic areas

Pivot and Flange - Archway



Slide taken from 2013 session

Pivot and Flange - Organic Flow



Slide taken from 2013 session

GDC 13

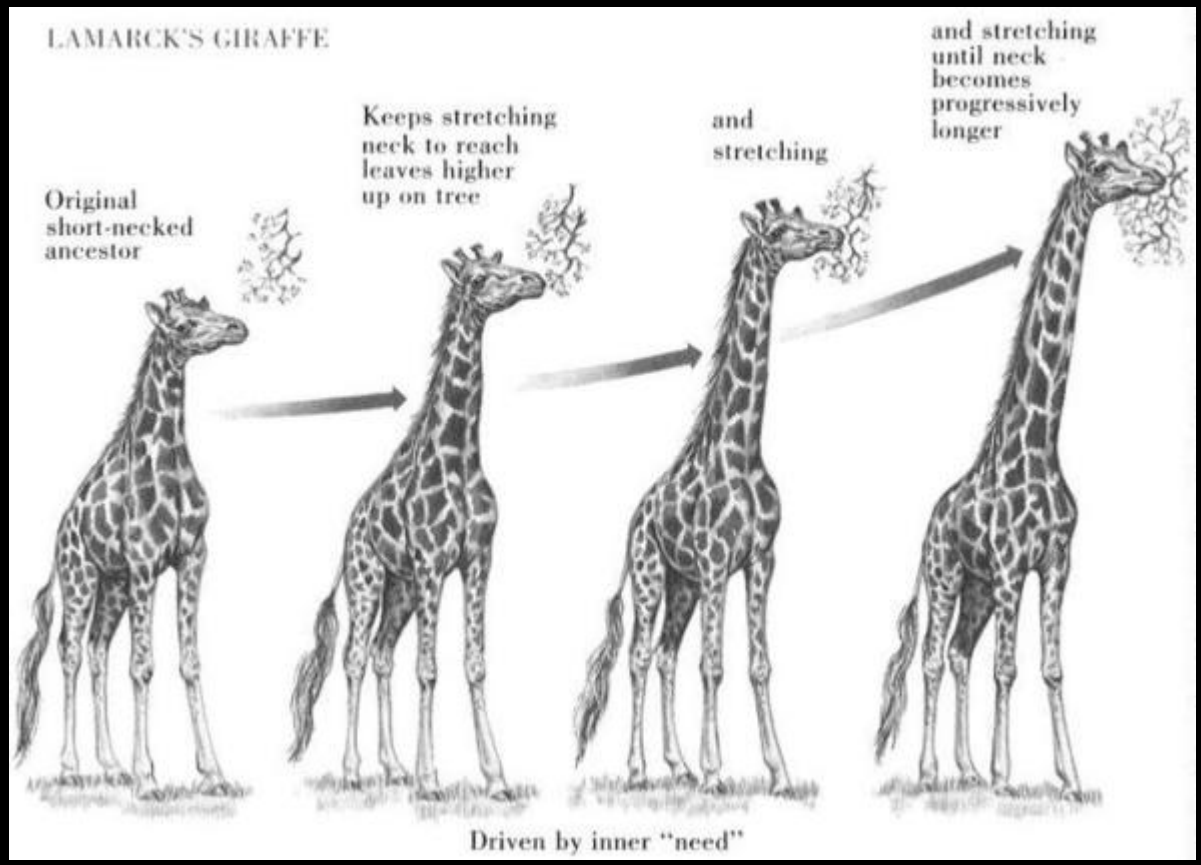
Modular Level Design for Skyrim

Joel Burgess
Nathan Purkeypile
Bethesda Game Studios

GAME DEVELOPERS CONFERENCE
SAN FRANCISCO, CA
MARCH 25-29, 2013
EXPO DATES: MARCH 27-29
2013

Always Look Forward

- Be willing to experiment w/Process
  - ...but be deliberate.


LAMARCK'S GIRAFFE
Original short-necked ancestor
Keeps stretching neck to reach leaves higher up on tree
and stretching
and stretching until neck becomes progressively longer
Driven by inner "need"

Preparing for the Future

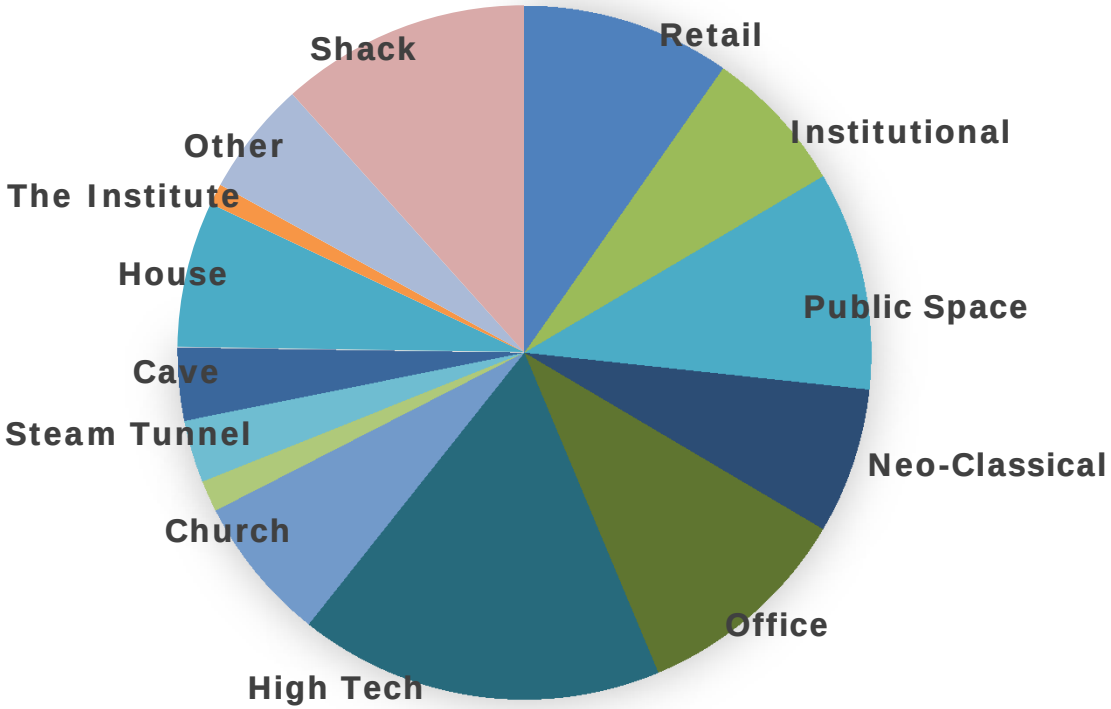
N

COMBAT
ZONE

Fallout 4 Family of Kits

- Retail
- Institutional
- Church
- High-Tech
- Industrial
- Public Space
- Steam Tunnel
- Cave
- House
- The Institute
- Neo-Classical
- Office
- Vault
- Quarry

Allocating Time & Attention



Kit-Building Overhead

- Each Kit is time-consuming to create
  - Lead Time
  - On-boarding
  - Iteration & Maintenance

Studio Allergies

- Identify Time Sinks
- Avoid Redundant Work
- Get to Playable Faster

Consolidating Like Kits

- Retail
- Institutional
- Church
- High-Tech
- Industrial
- Public Space
- Steam Tunnel
- Cave
- House
- The Institute
- Neo-Classical
- Office
- Vault
- Quarry

Consolidating Like Kits

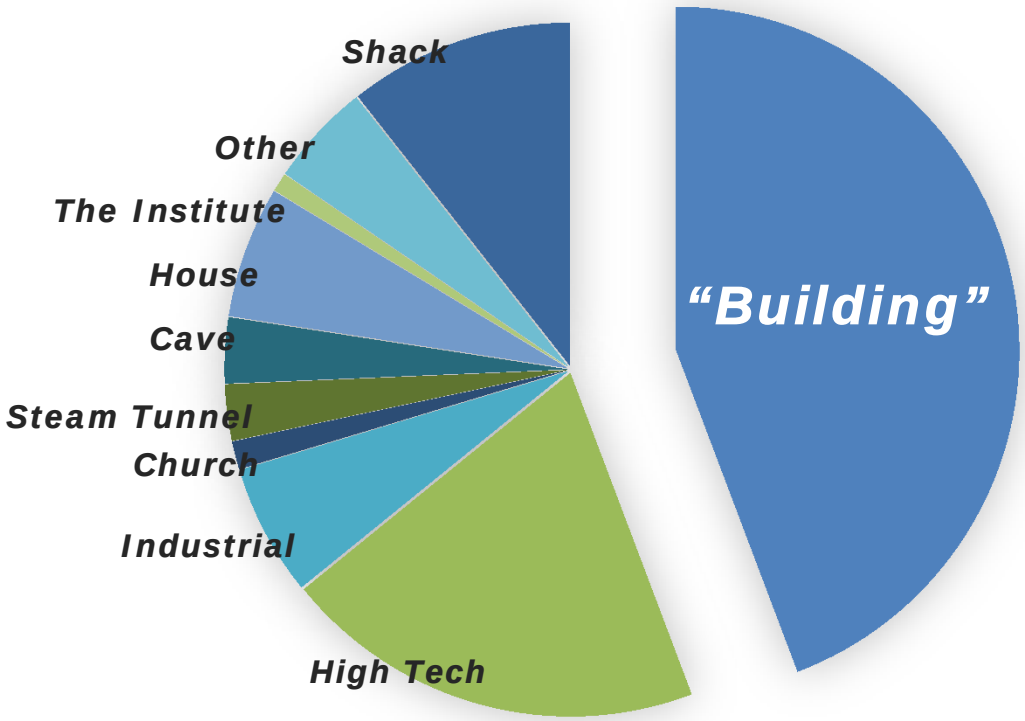
- Retail
- Institutional
- Church
- High-Tech
- Industrial
- Public Space
- Steam Tunnel
- Cave
- House
- The Institute
- Neo-Classical
- Office
- Vault
- Quarry

WELCHER

Kits as Solutions

- What problem does a kit solve?

Allocating Time & Attention



The Building Kit

Fallout 3 Office Kit (2008)

The Building Kit

- Traditional Construction of Varying Types
- Unified Workflow across kits
- Standard Sub-Kit Types
  - Rooms
  - Halls
  - Stairs, Railings, Platforms, etc.

Small Hall

Medium Hall

Large Hall

Small Room

Medium Room

Large Room

Piece Granularity

Breakdown: A Corner Piece

- Old System: Export from 3DS Max
- Lots of redundant work

BldWoodPSmHall2Way01

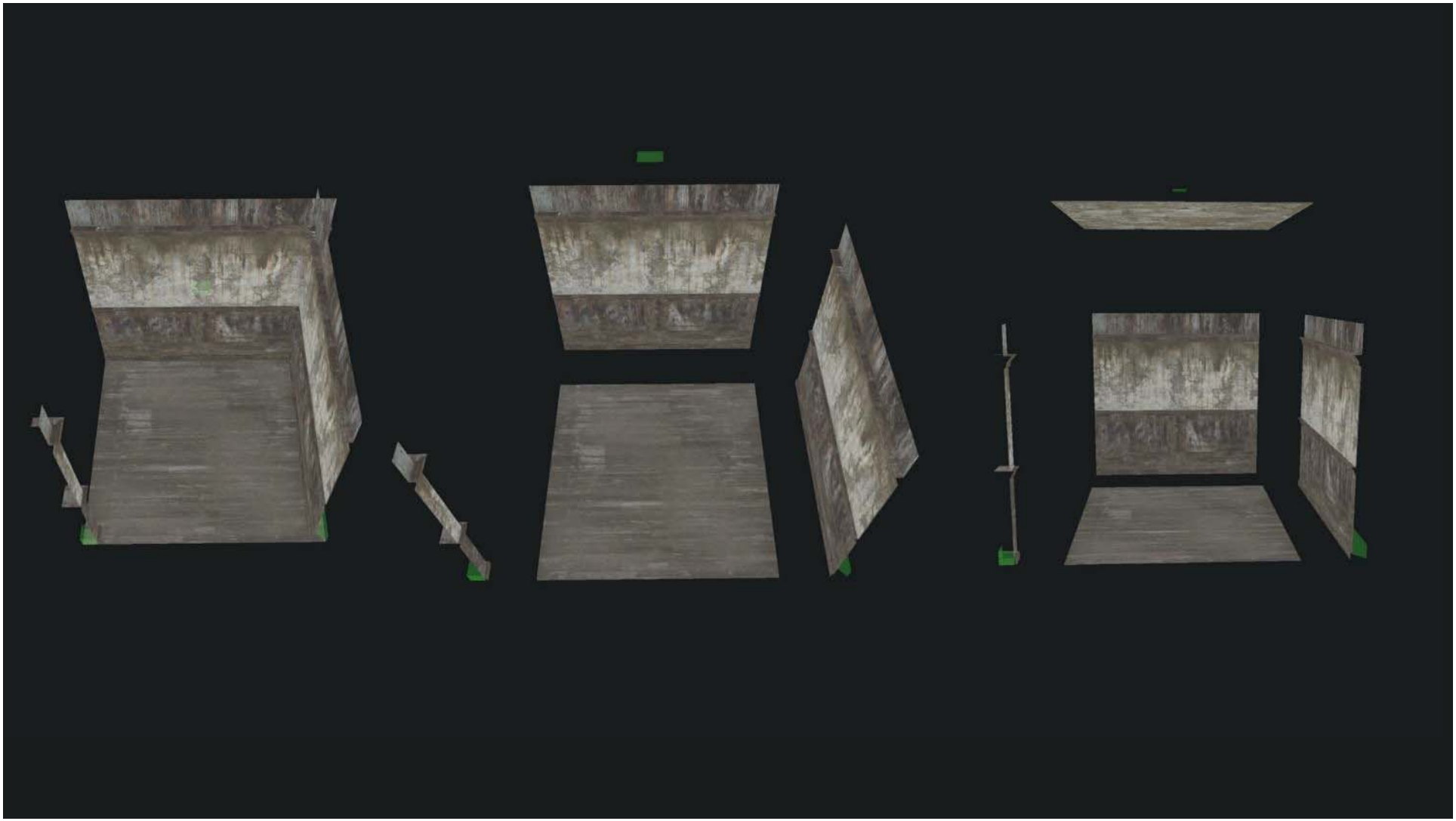
Building Kit
Wood Panel Variant
Small (height)
Hallway
2-Way (corner)
Variant #1

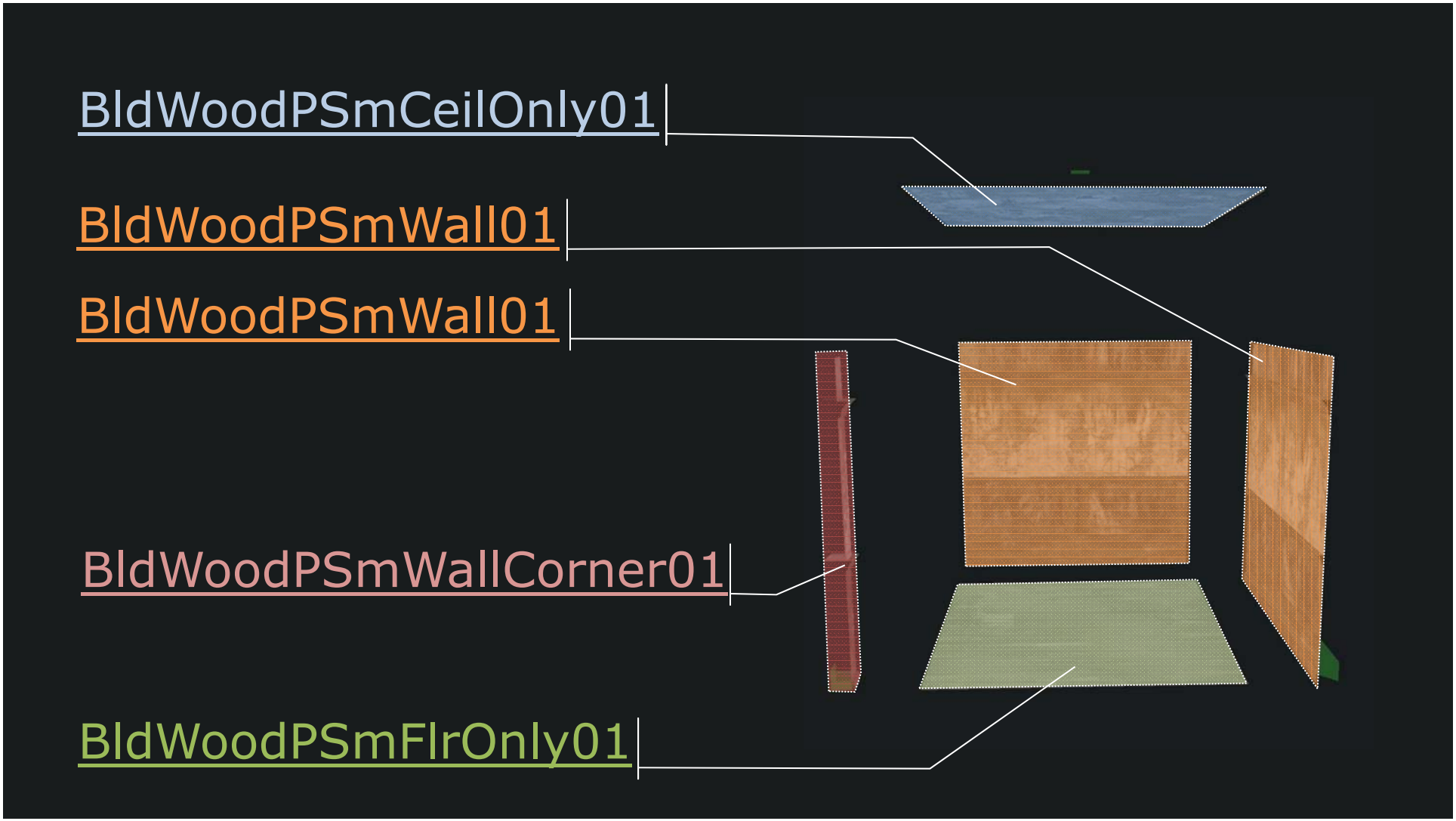
BldWoodPSmHall2Way01

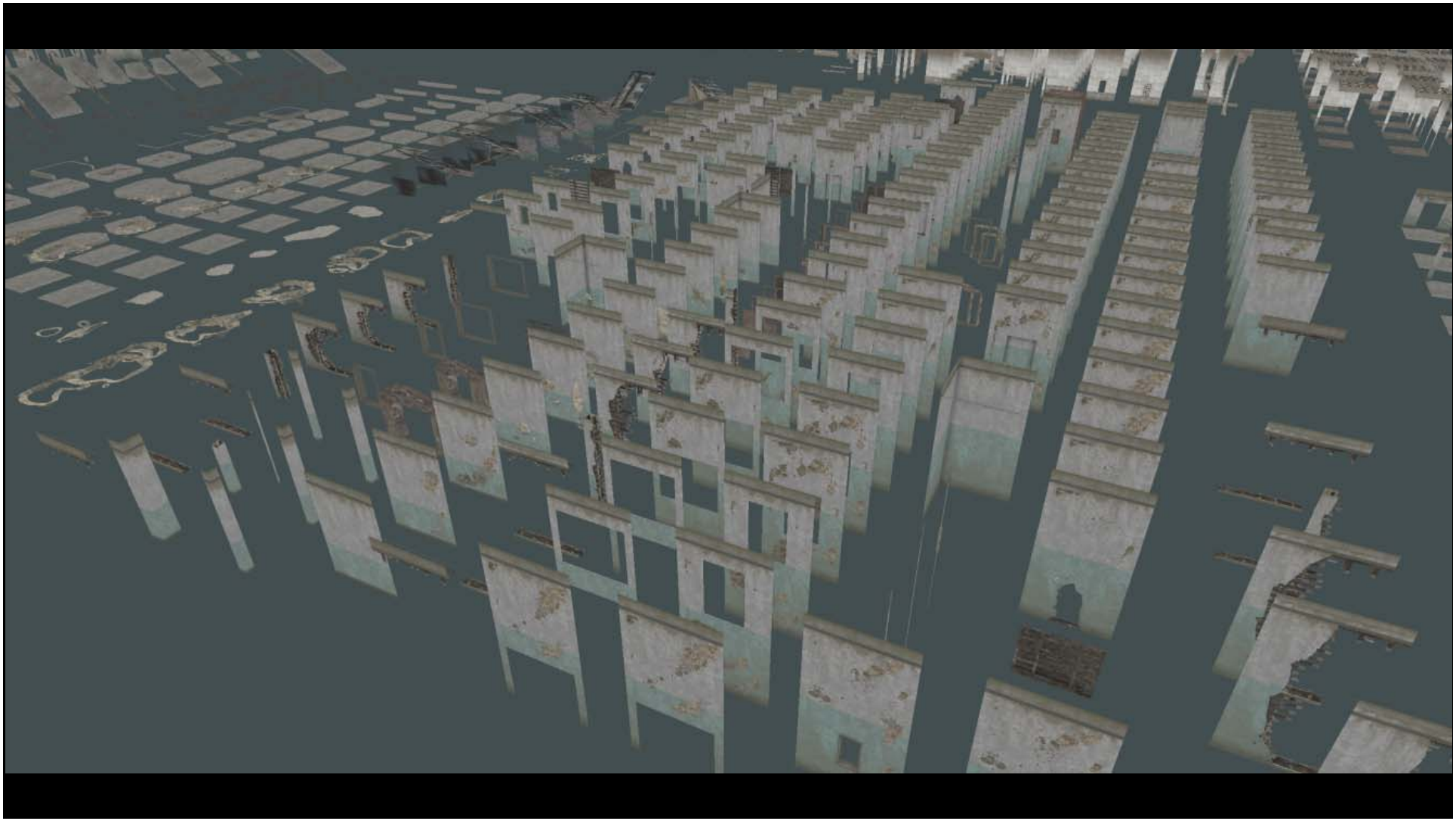
See 2013 talk for more on naming conventions

Breakdown: A Corner Piece

- ~~Old System: Export from 3DS Max~~
- New System: Editor/Pack-In

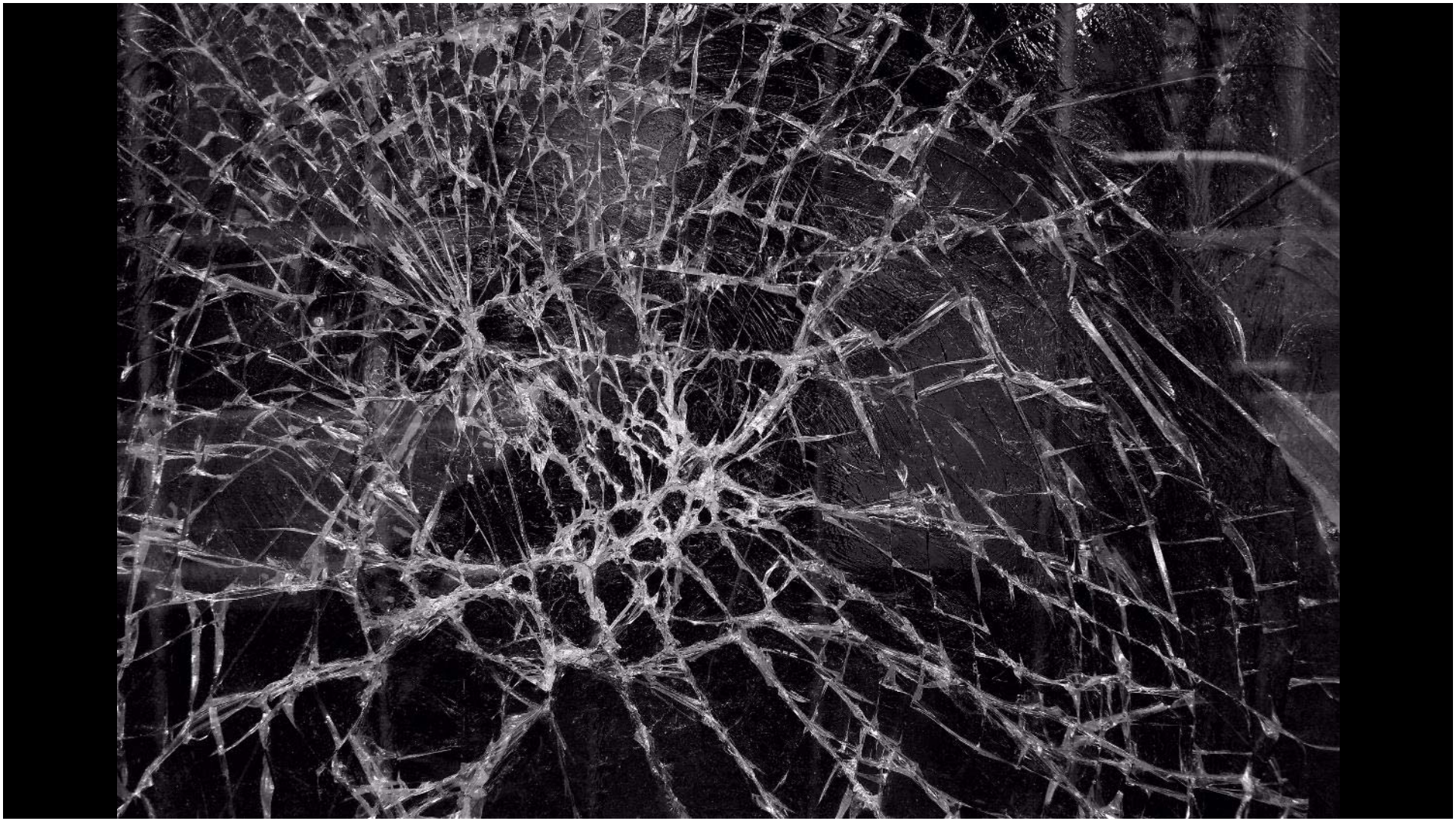



BldWoodPSmCeilOnly01
BldWoodPSmWall01
BldWoodPSmWall01
BldWoodPSmWallCorner01
BldWoodPSmFlrOnly01



Higher Granularity

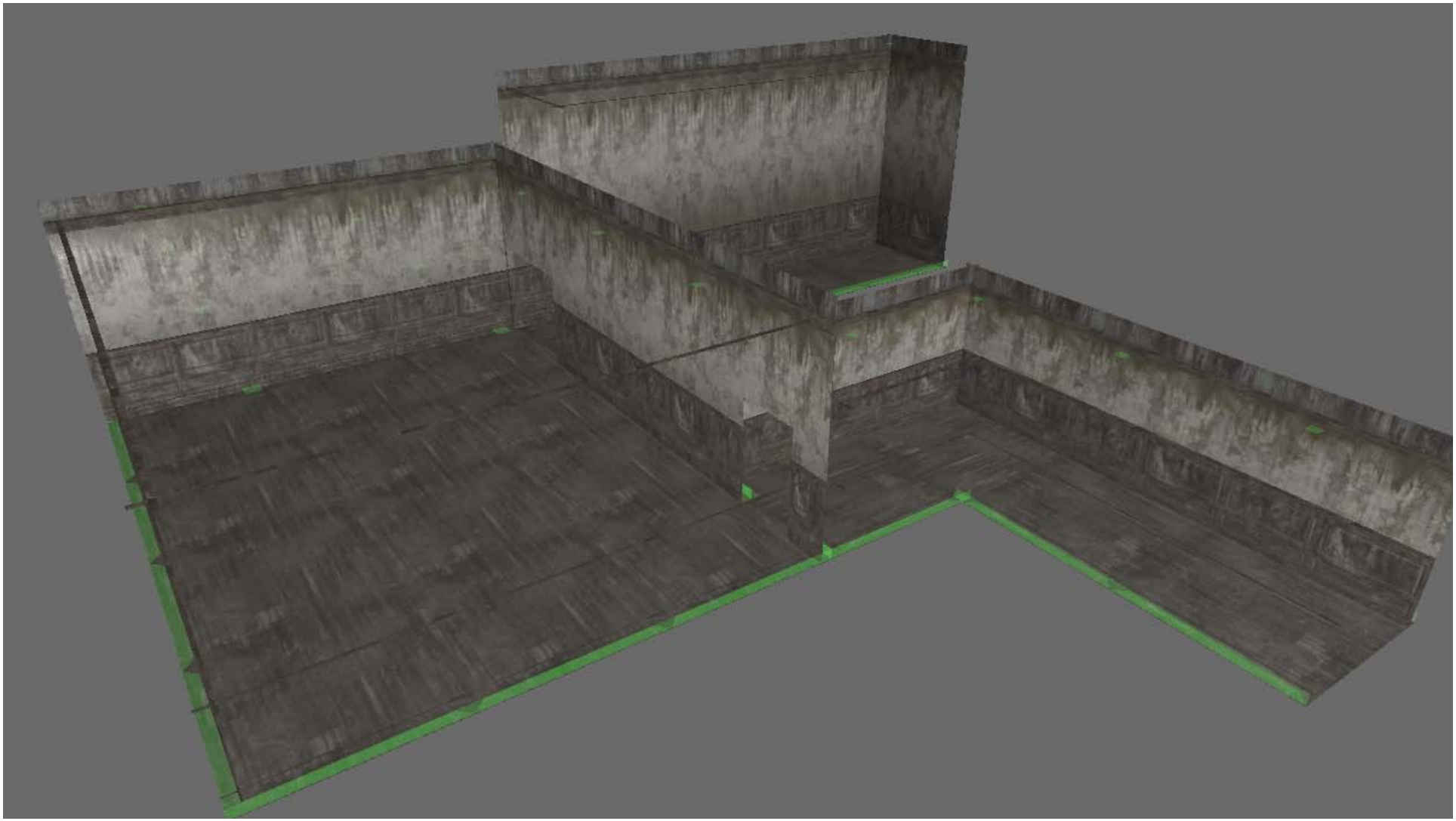
- Break Wall/Floor/Ceiling Groupings
  - More Destruction Flexibility
  - Kit Interchangeability
  - Flexible layouts
  - Less Dependence on pre-determined combos

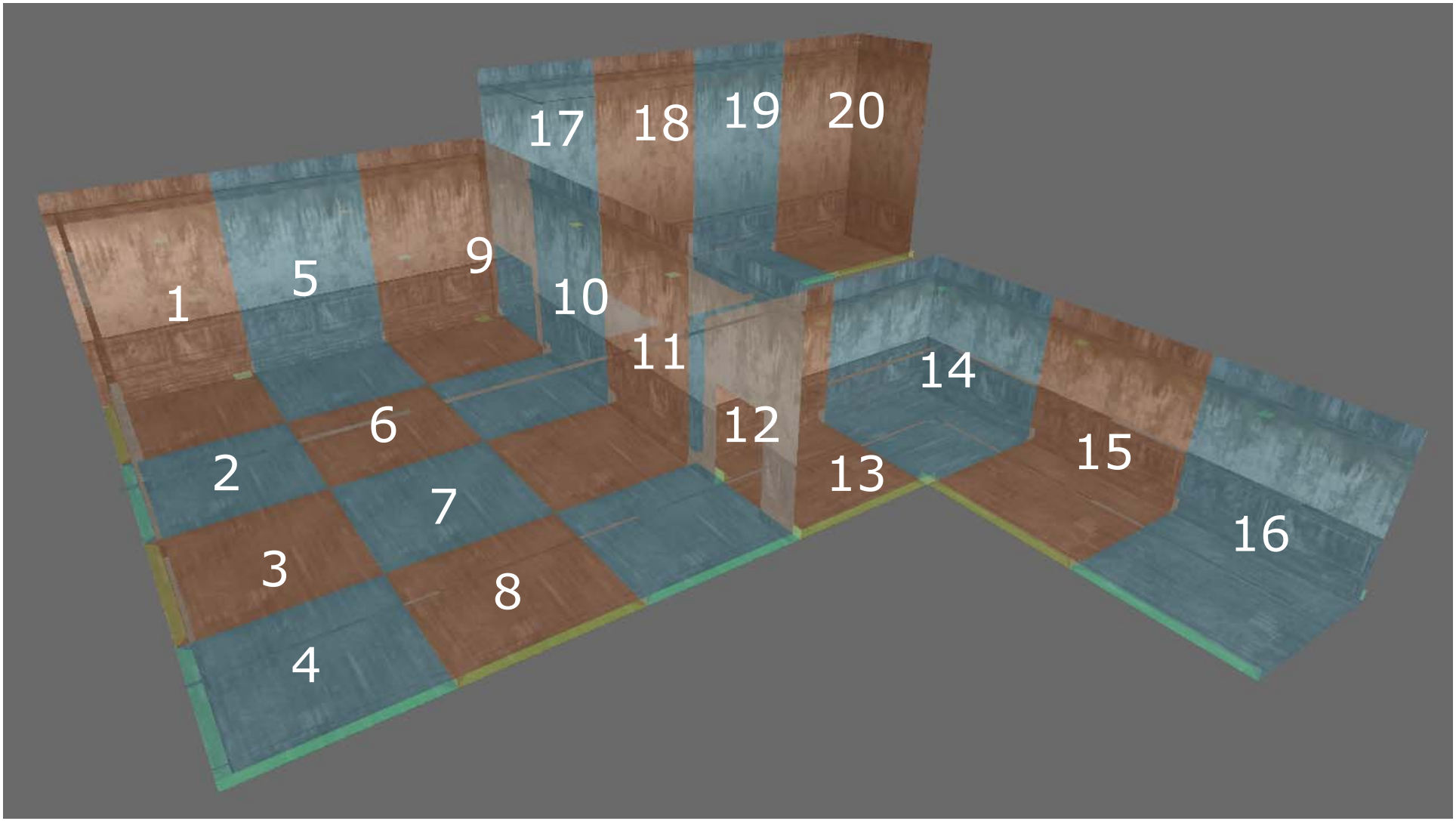


Workflow For LDs

Granularity & LD Workflow

- More Flexibility
- More Time-Consuming




17
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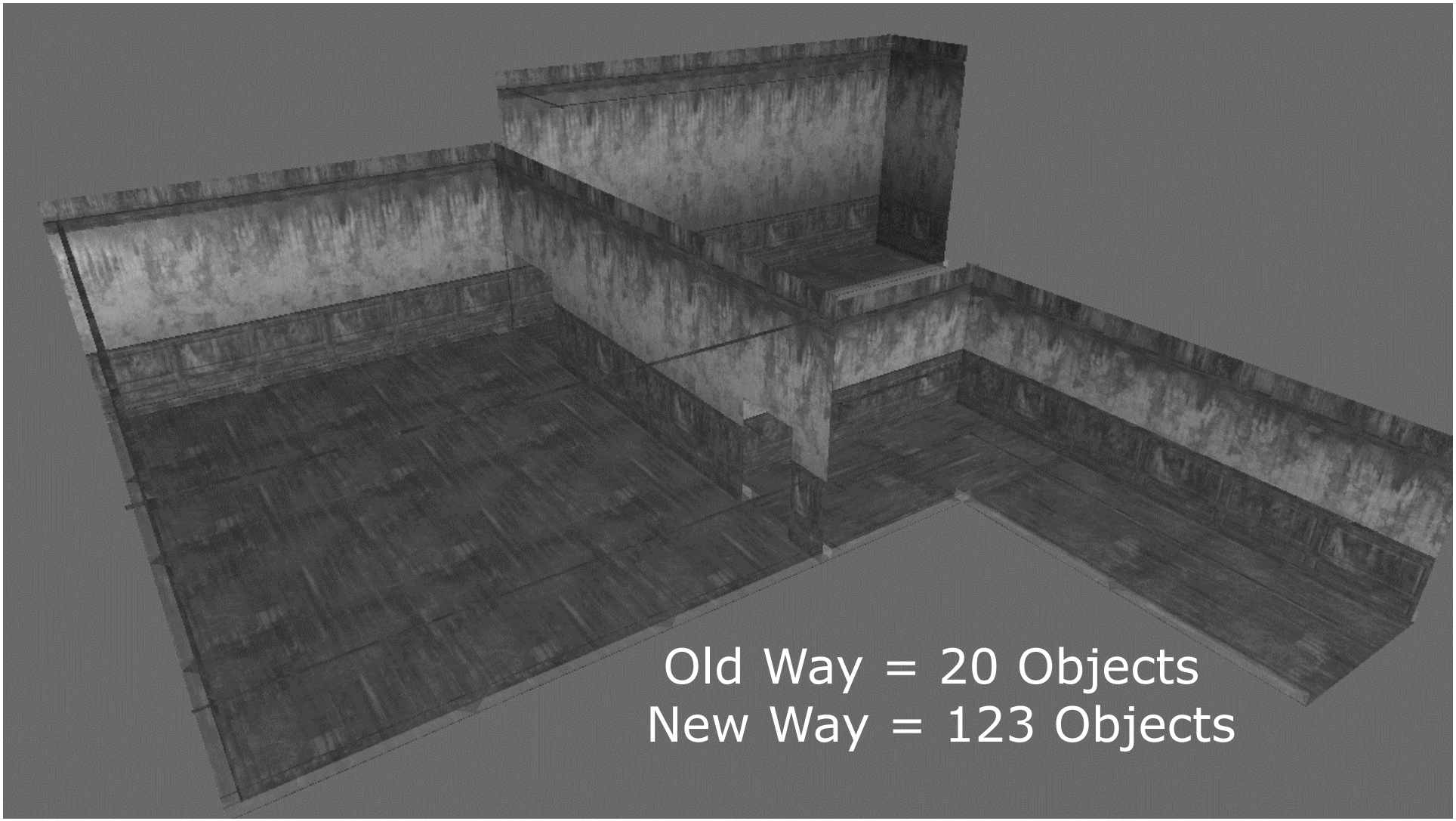
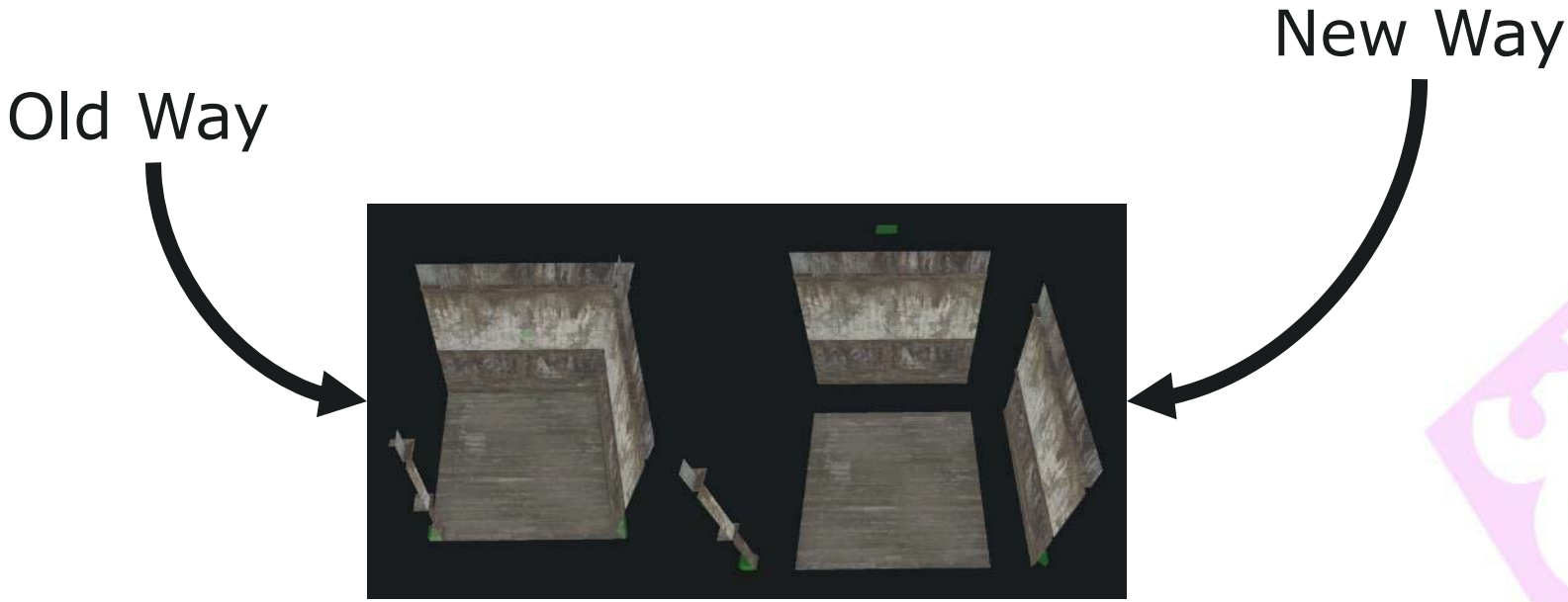

Old Way = 20 Objects
New Way = 123 Objects

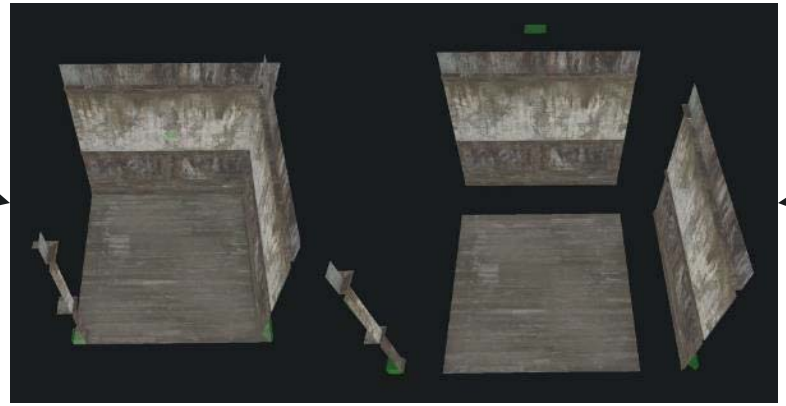
Preserving Workflow



Preserving Workflow

Exploded Granular

Pack-In Prefab

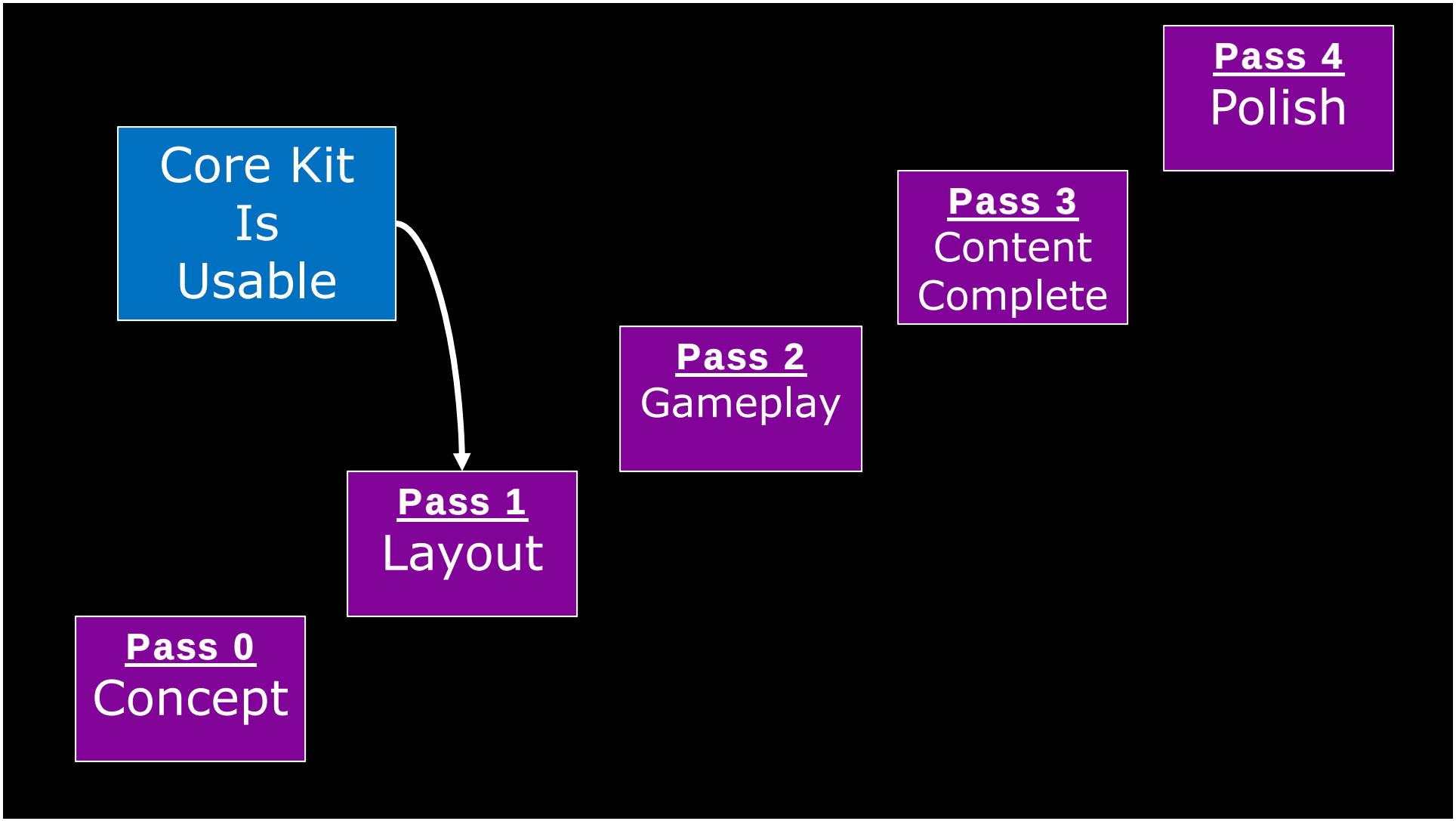


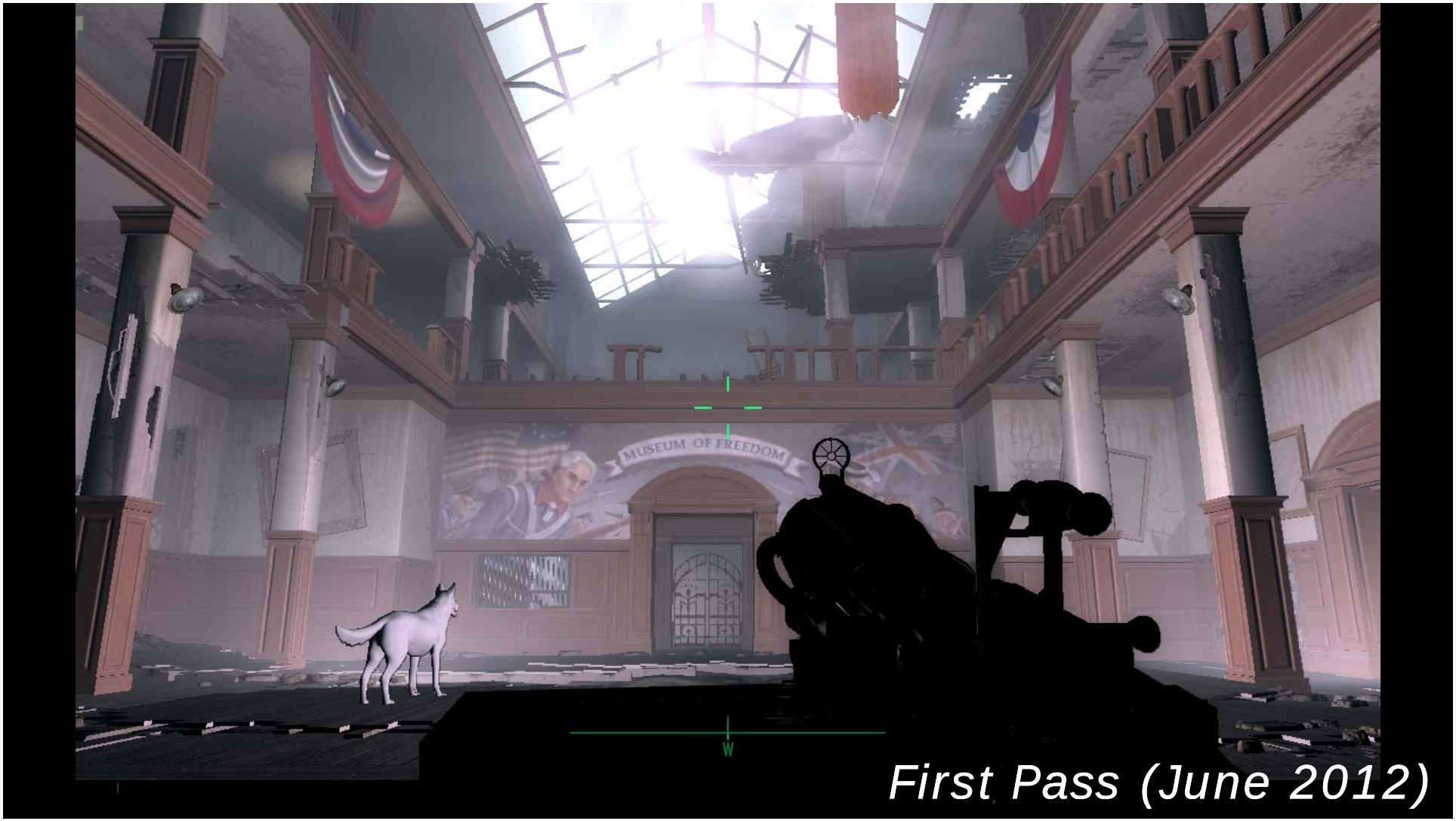
Importance of Kit Readiness

- Kits are cornerstone
- Front-loaded in art schedule
  - Graybox quality early
  - Visual Iteration throughout dev
- Focus on “Trustworthy” Kit functionality

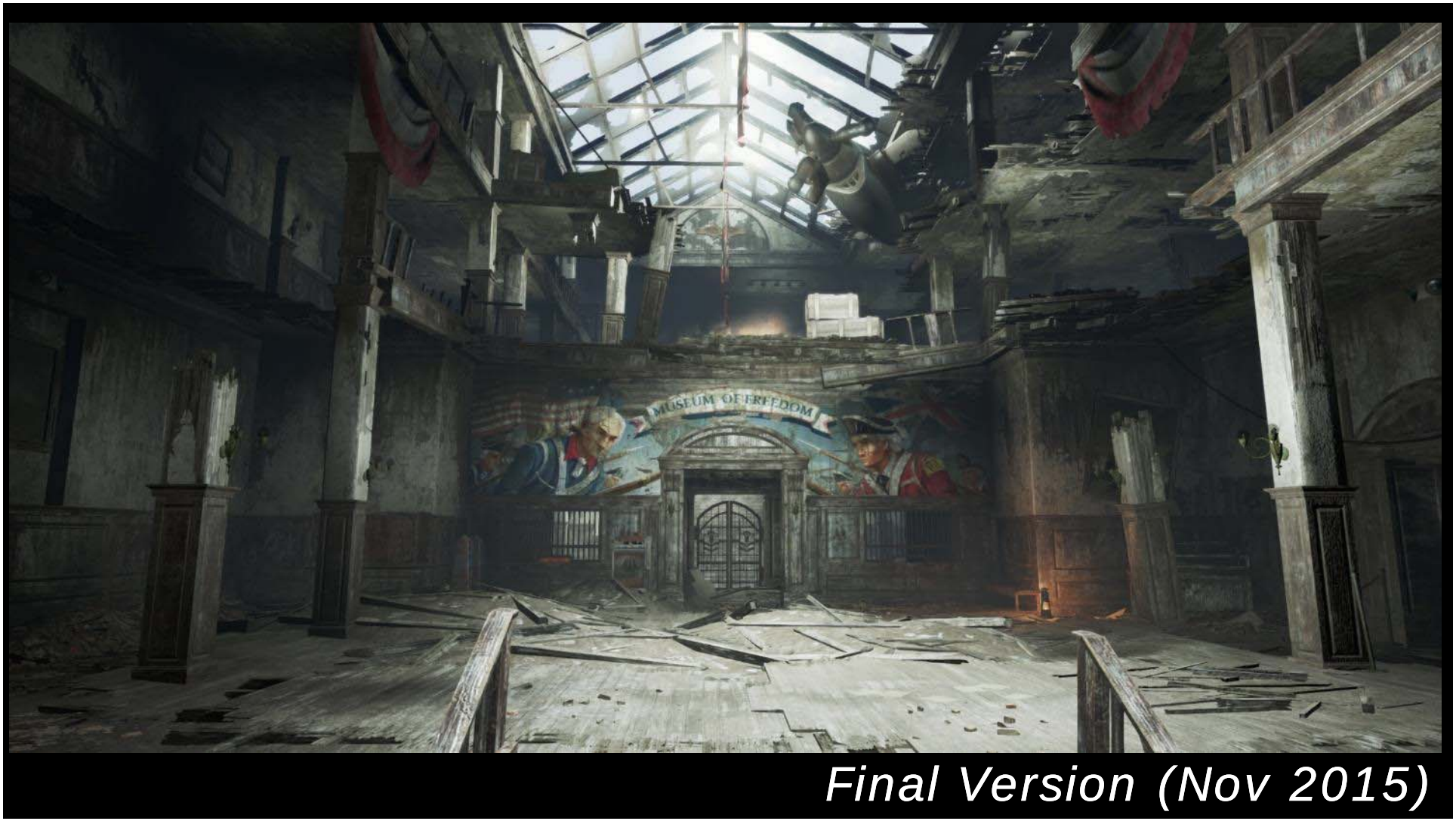
Intelligent Dependencies

- Iterate Accordingly
- Level Design 5-Pass Iterations
  - Discussed in 2014


Core Kit Is Usable
Pass 0 Concept
Pass 1 Layout
Pass 2 Gameplay
Pass 3 Content Complete
Pass 4 Polish



First Pass (June 2012)



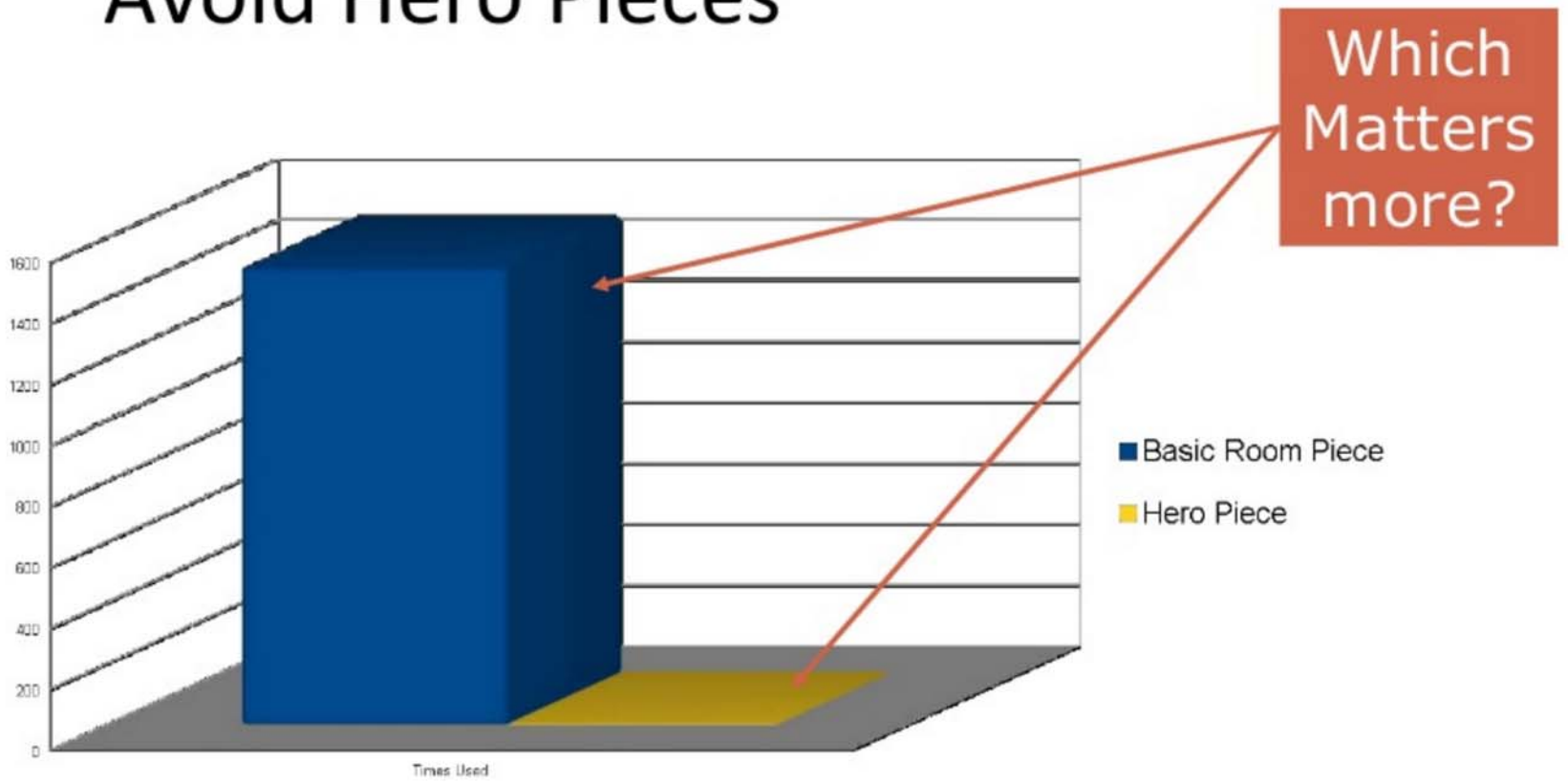
Final Version (Nov 2015)

Kit Priorities

Kit Elements

- Hero Pieces
- Utilitarian Core
- Variants

Avoid Hero Pieces



Taken From 2013 Talk

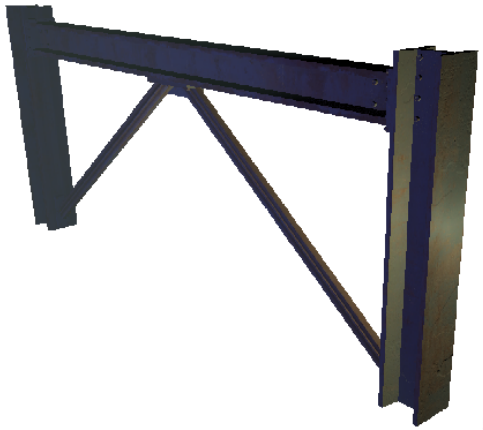
GENERIC

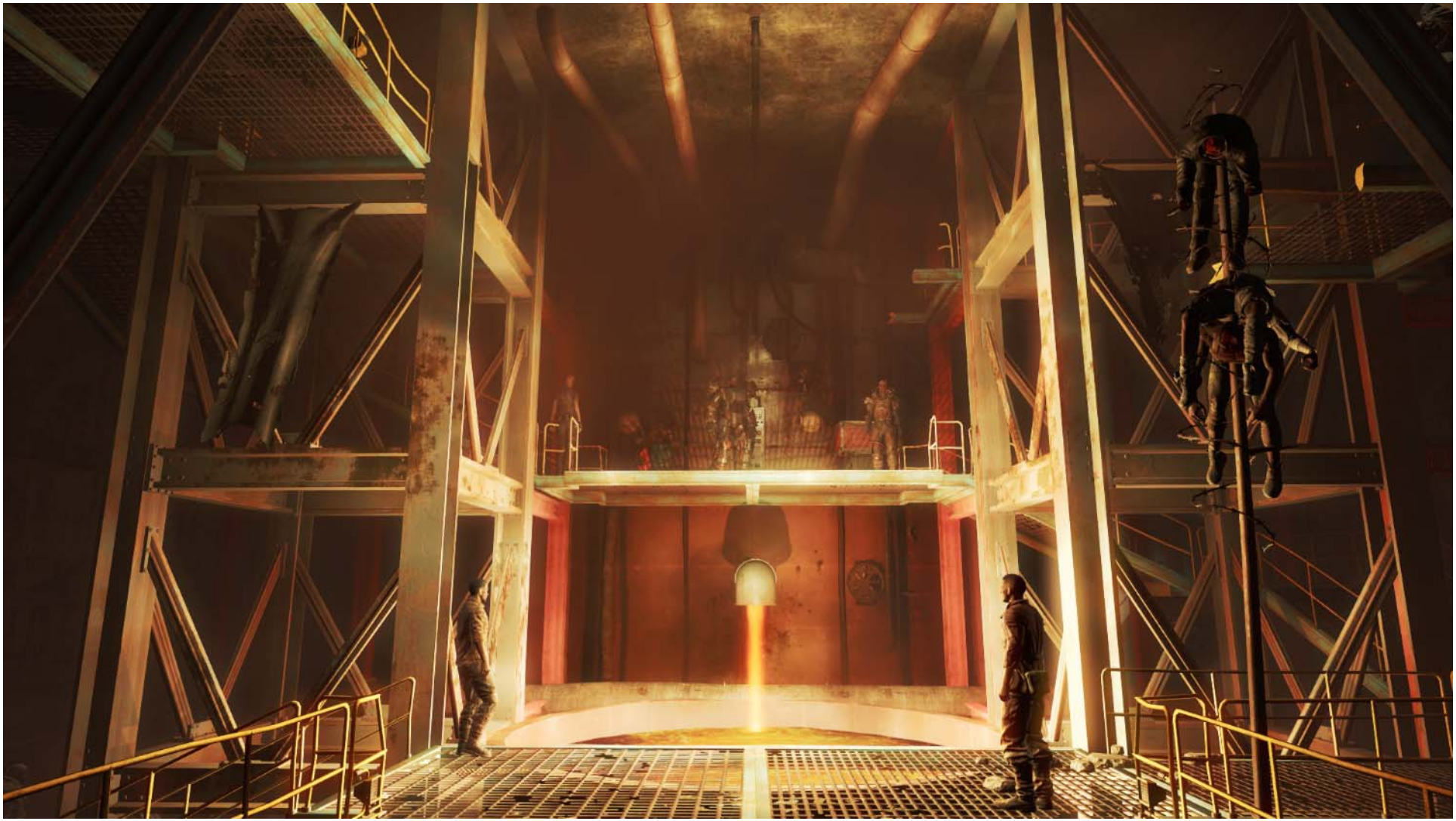
REPEATED

Generic = Versatile

- Common pieces are flexible

Your Unsung Heroes:





Prioritizing Pieces

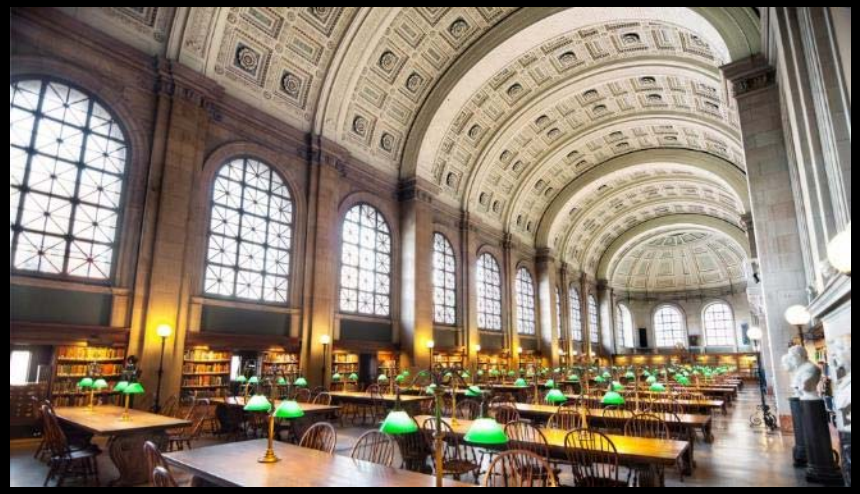
1. Utilitarian Core
2. Variants
3. “Hero” Pieces

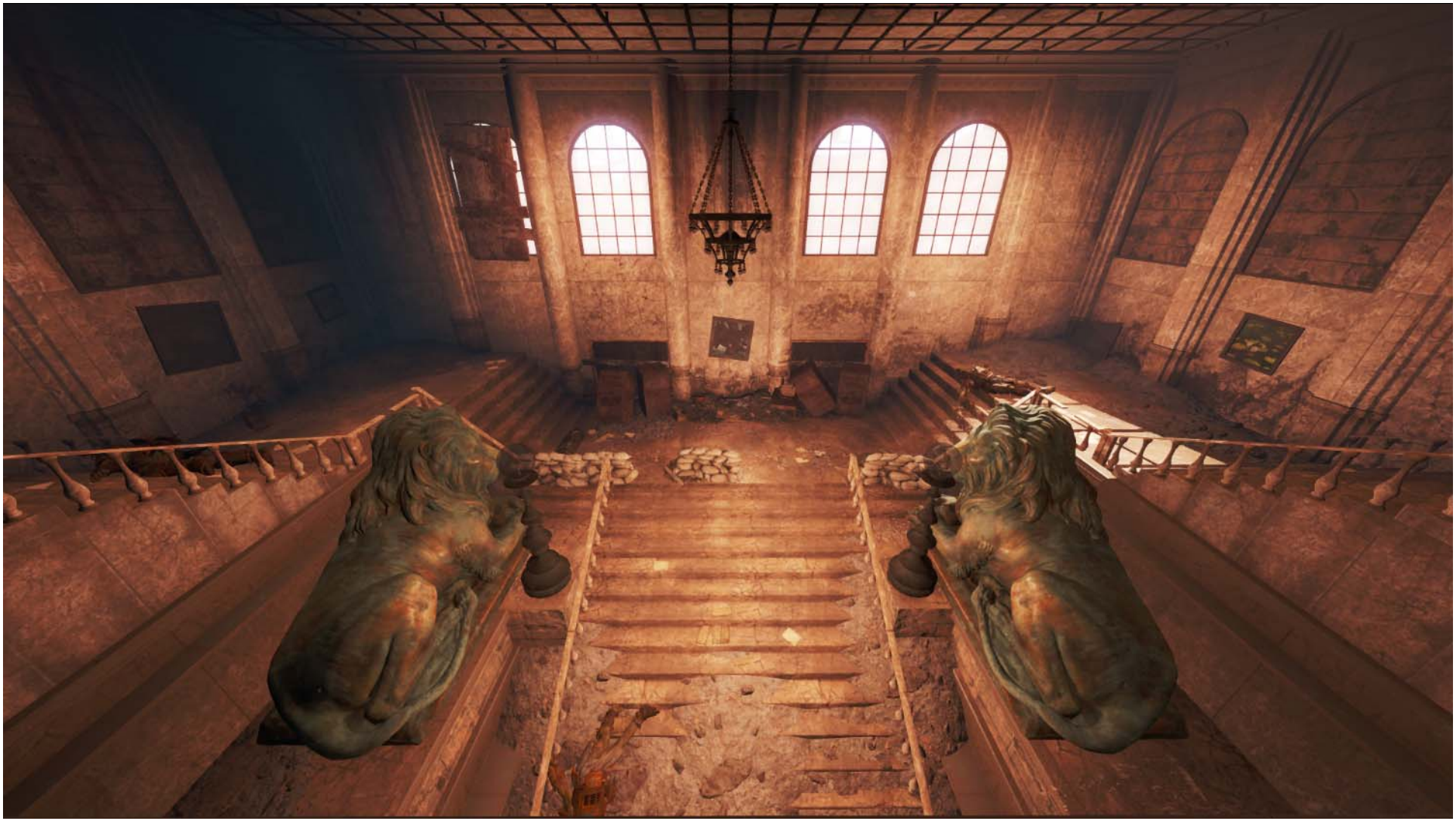
Unblocking Work

- Minimize LD roadblocks
- Get Real Use Cases ASAP

- Allow Maximum Time for Visual Iteration

- LD: Use Placeholders to Prove Need

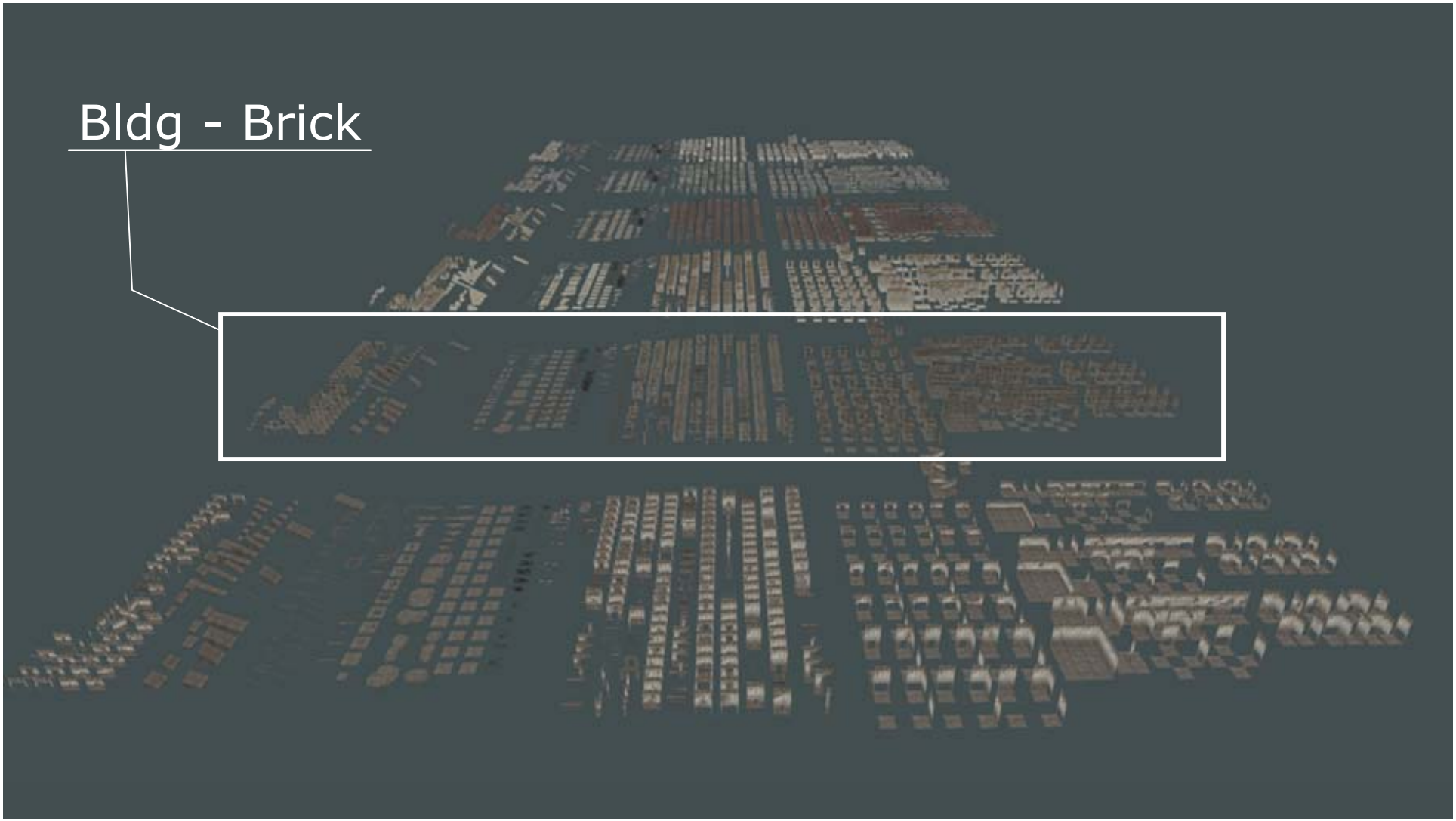




Kit Variation

Building Kit Variants

- Brick
- Colonial
- Wallpaper
- Wood Panel
- Bare Wood
- Deco
- Concrete
- Unique


Bldg - Brick

Bldg – Bare Wood
Bldg - Brick
Bldg - Concrete

Material Swaps

- Only changes the textures.
- Not an architecture change.

Material Swaps

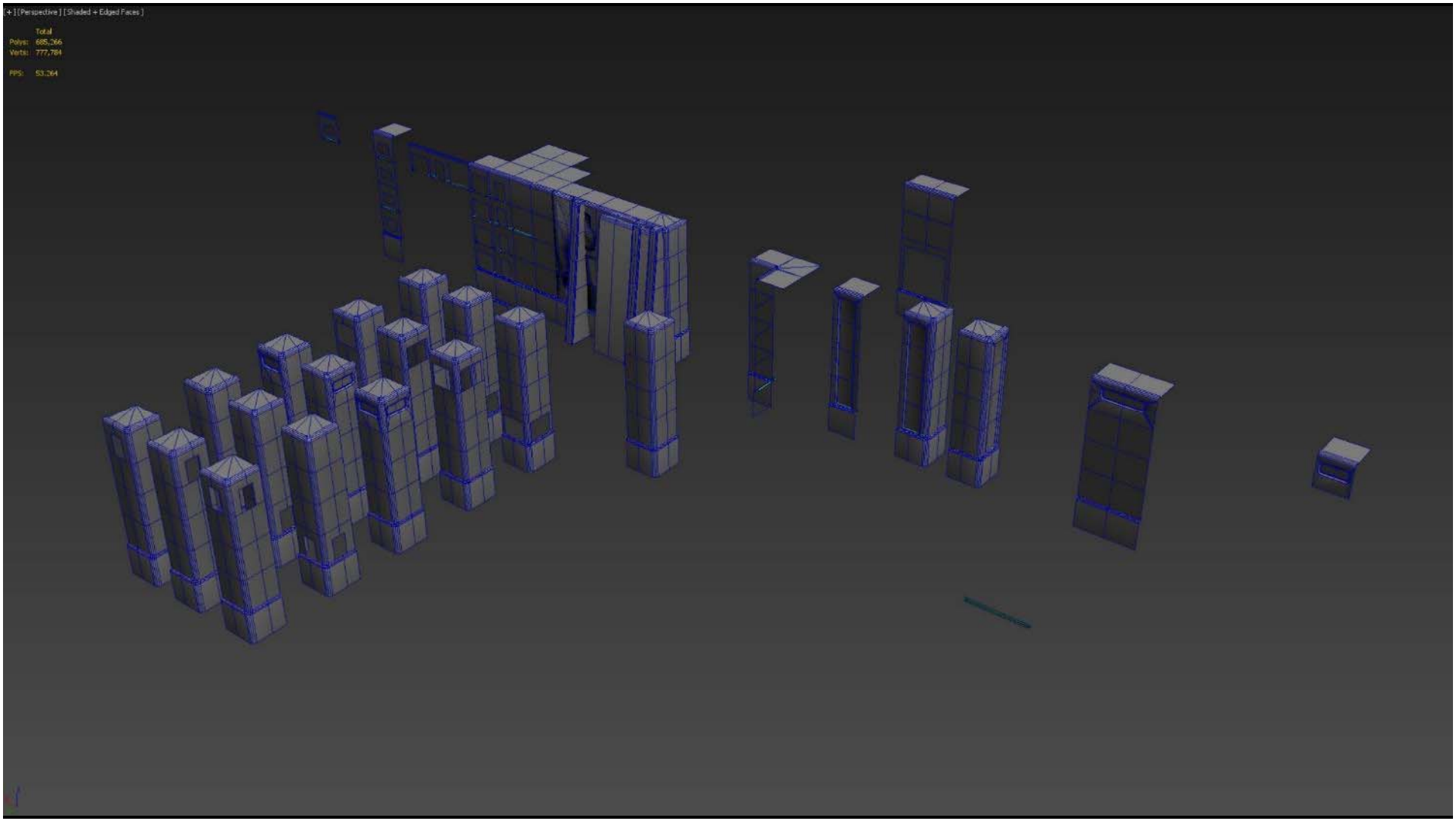
- Even more mix-n-match
- Takes very little time to make new ones

Other Kits

Let's Create Kit X

- What is unique feature/problem of X?
- How Does it solve this?
- How Does it compliment other kits?

Industrial Kit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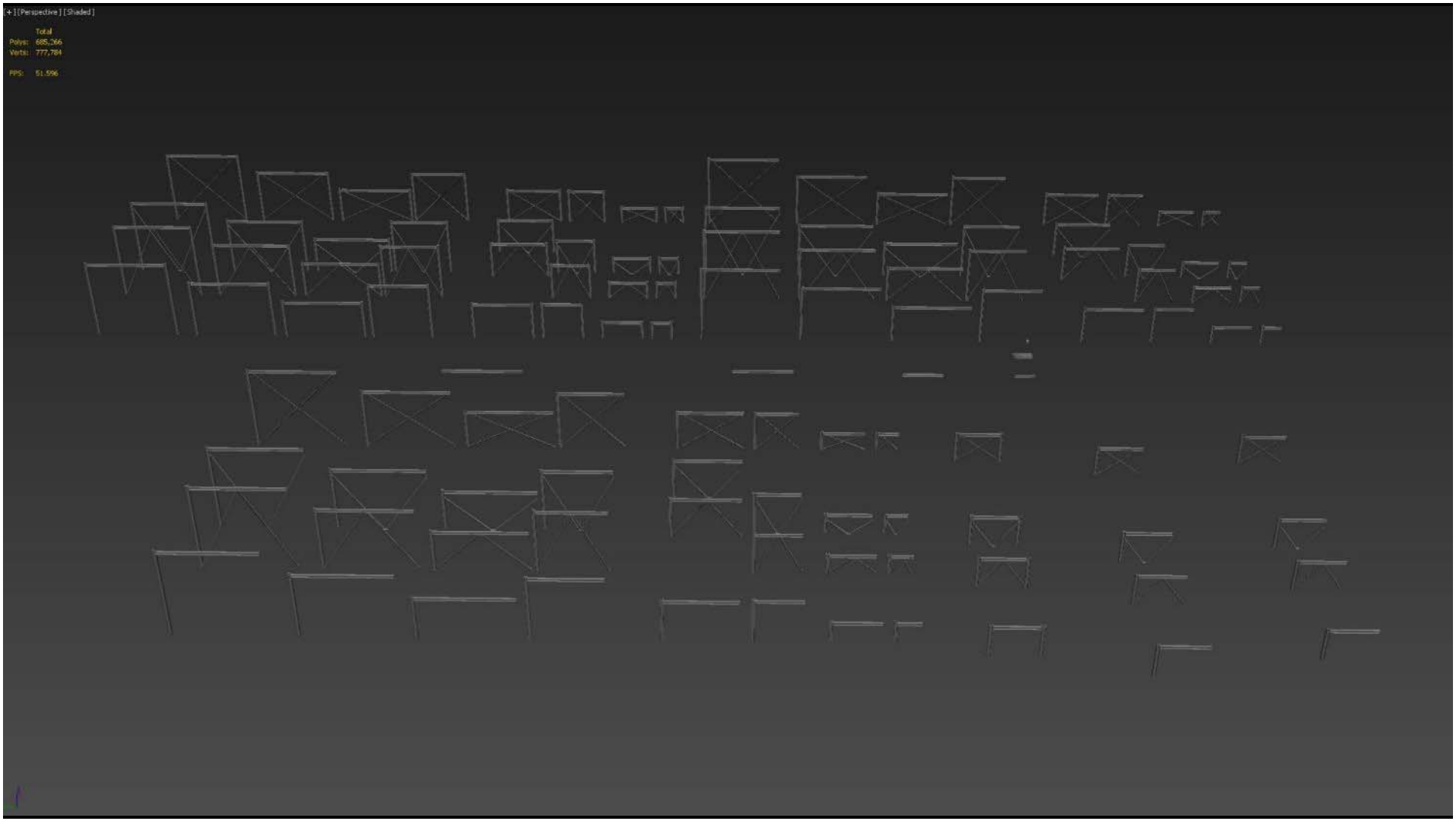
Total
Polys: 685,266
Verts: 777,784
FPS: 53.264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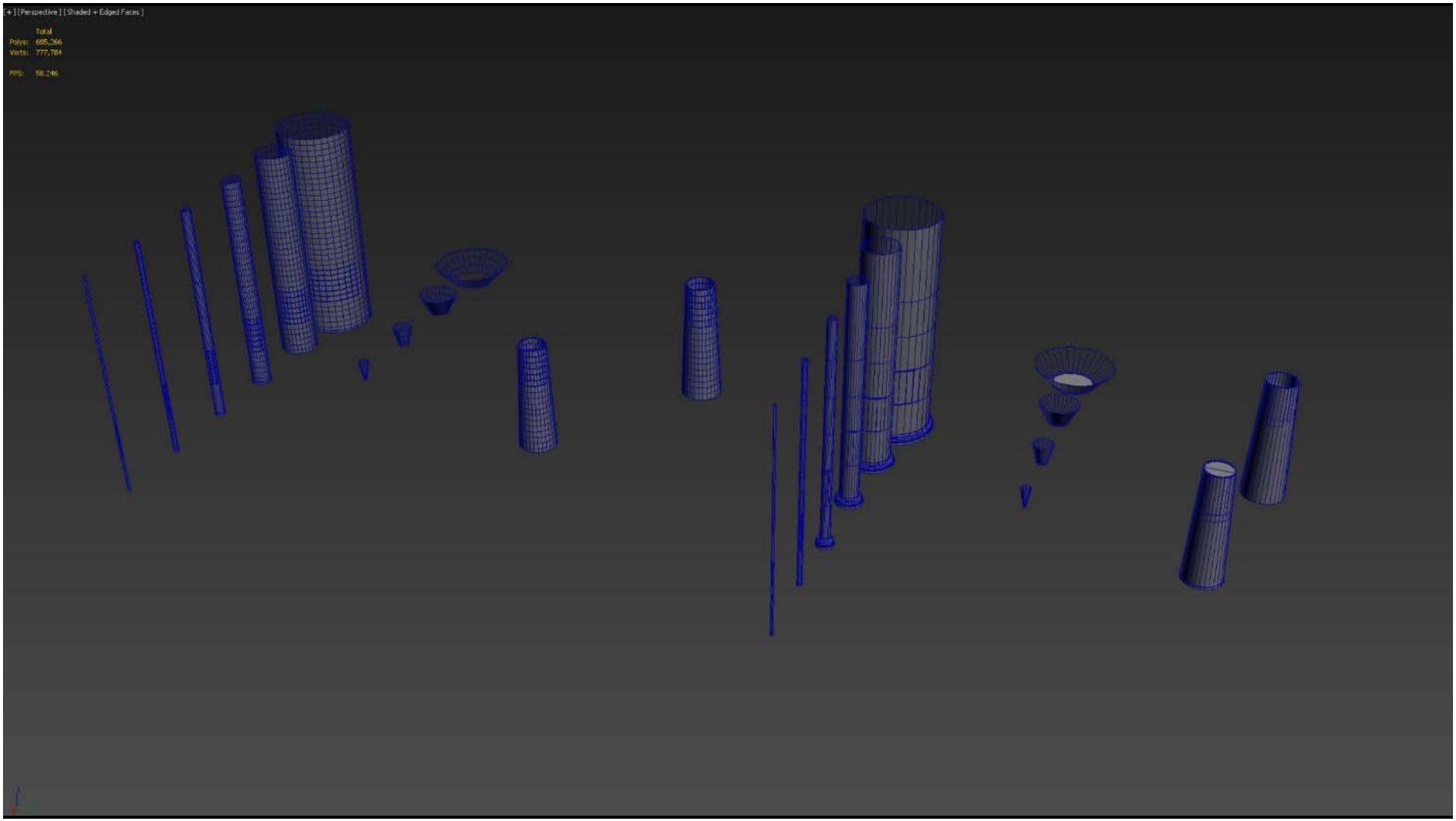
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Verts: 777,784
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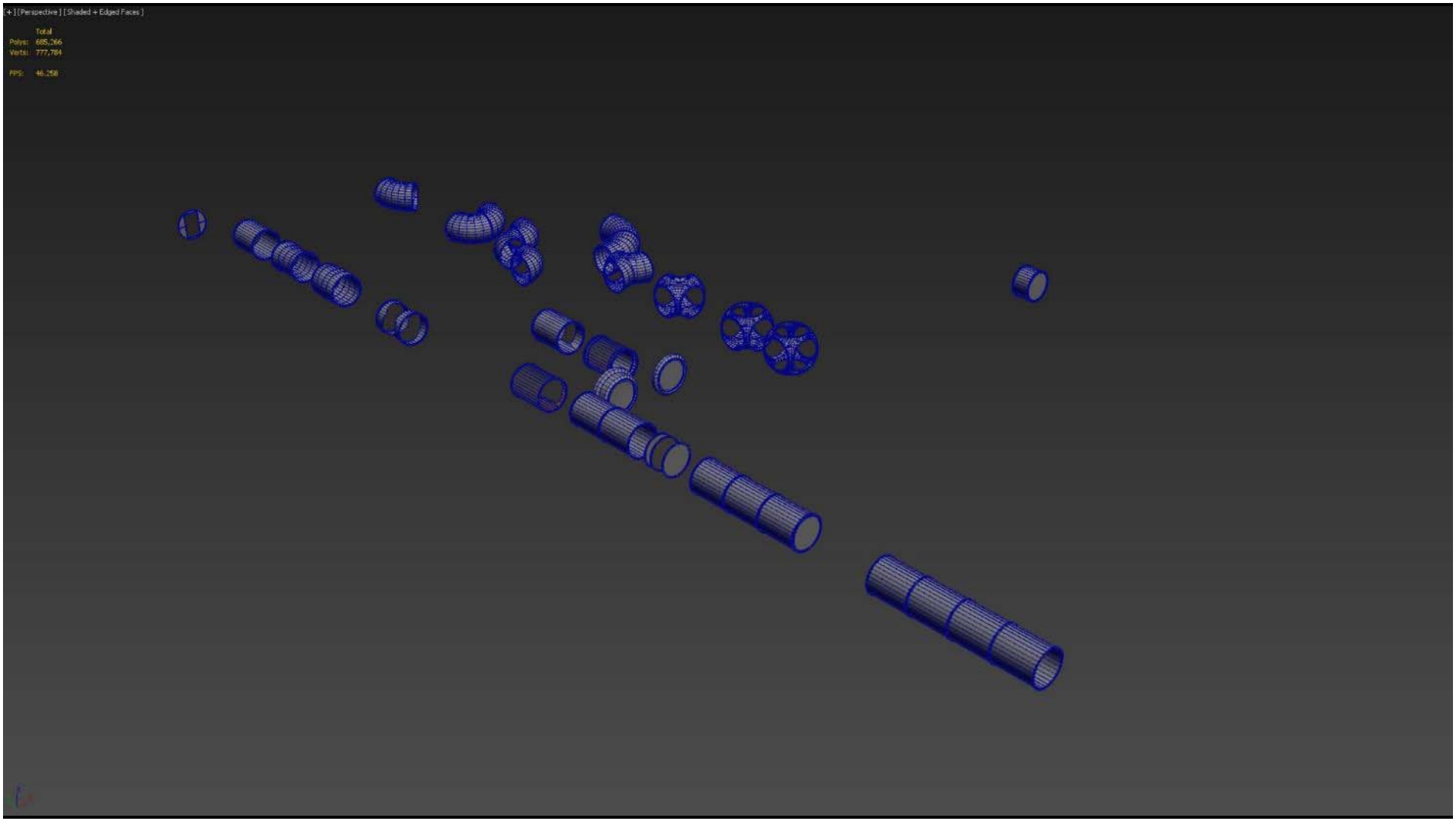
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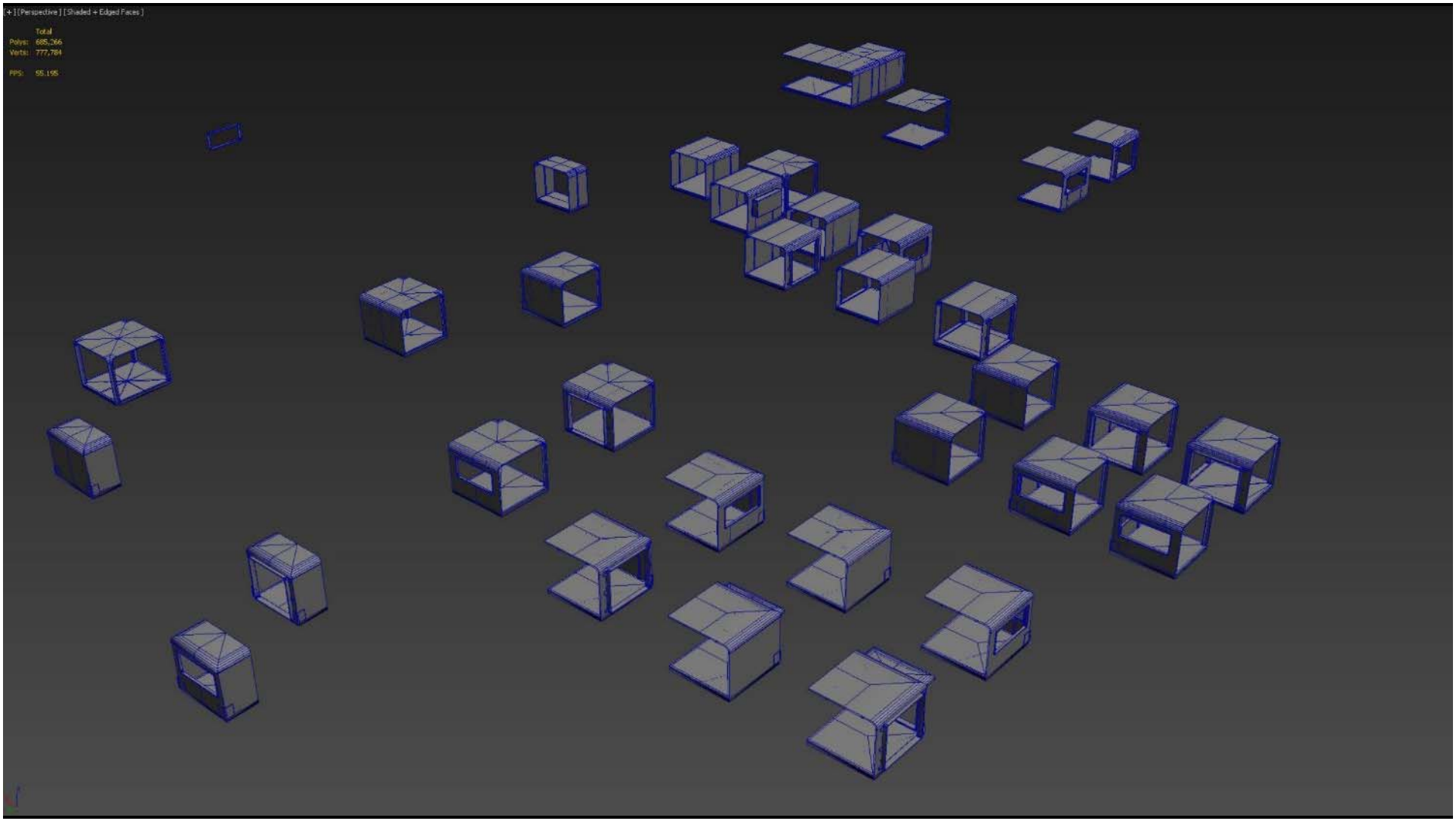
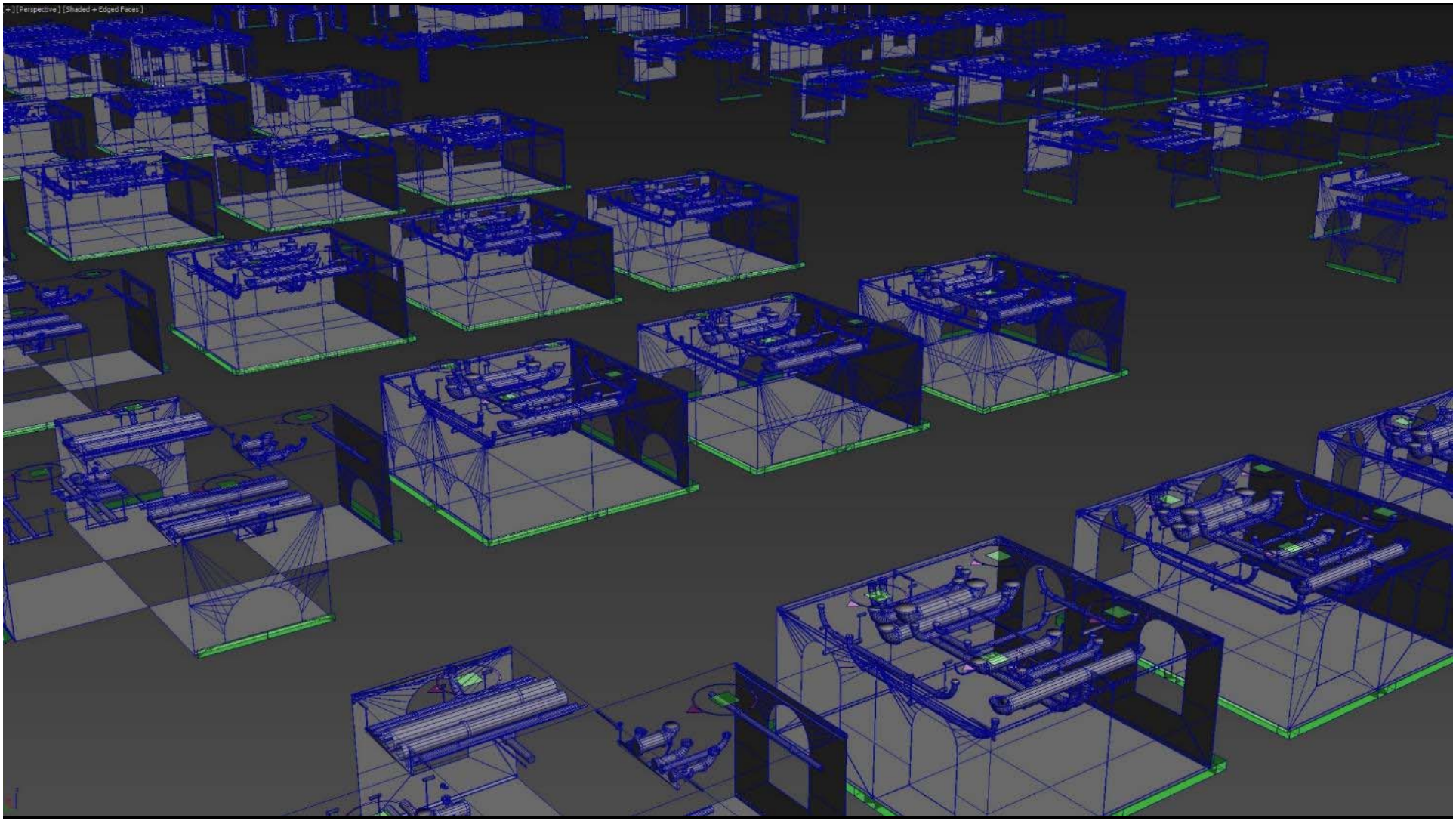
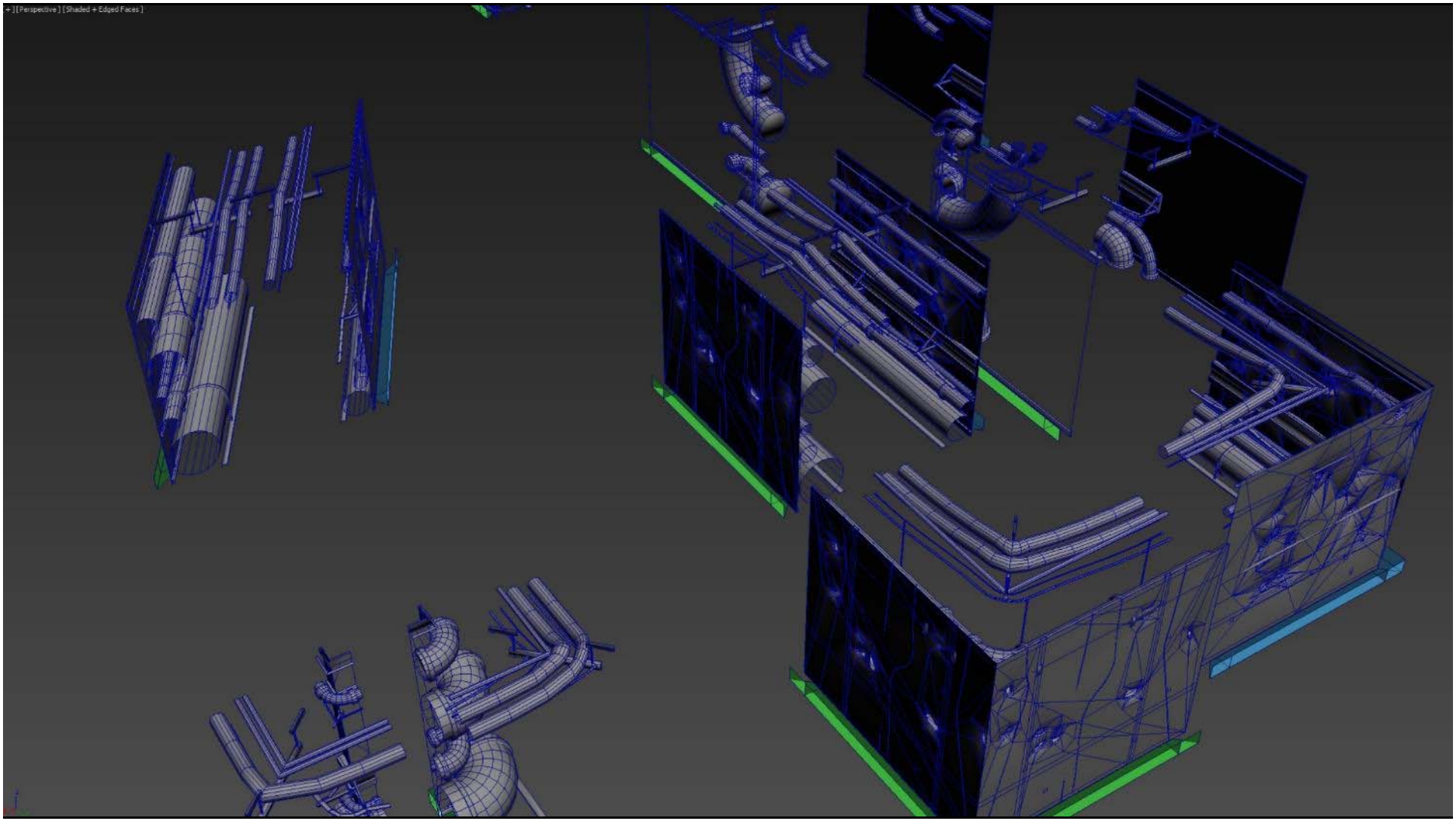
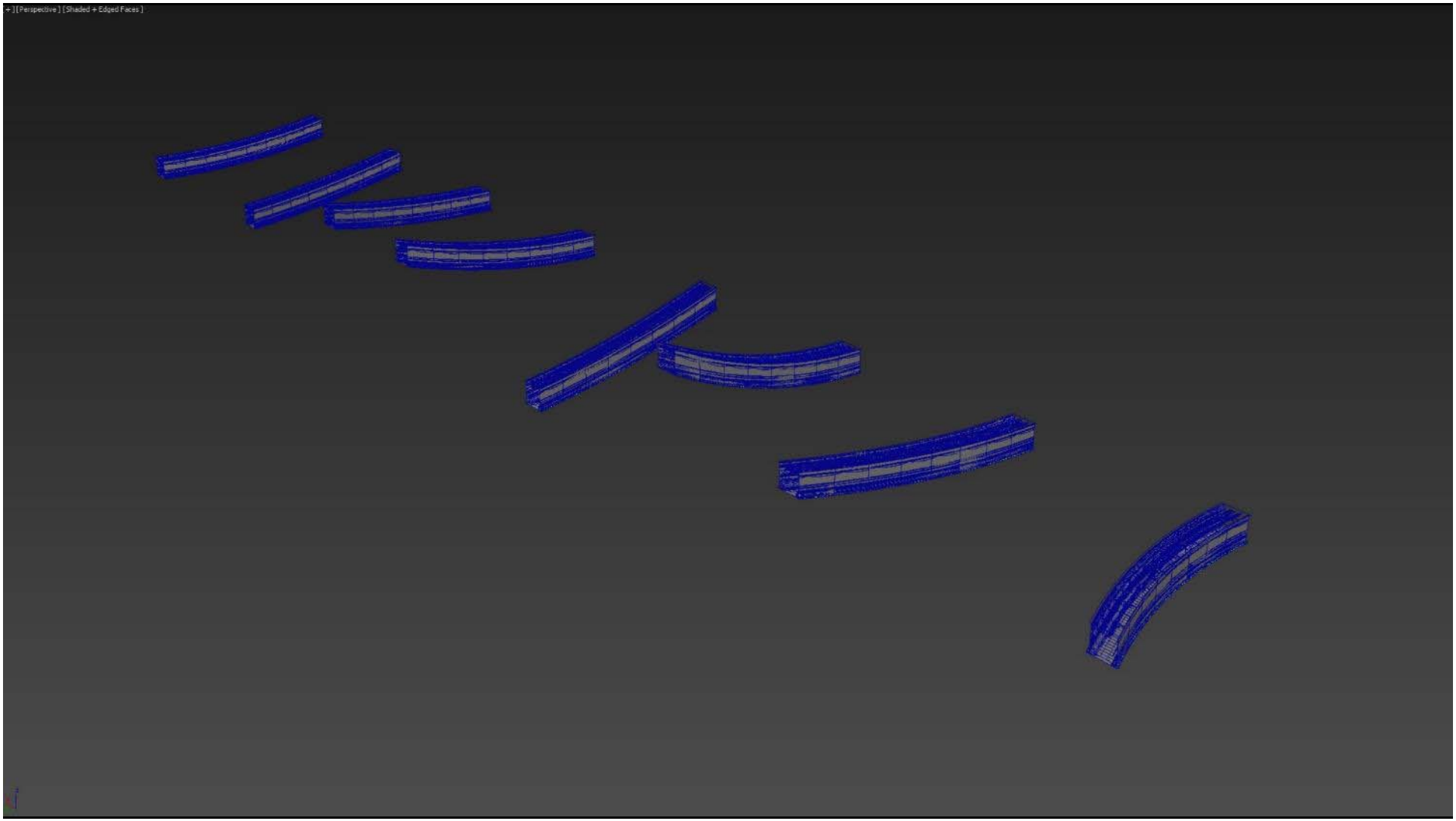

[+] [Perspective] [Shaded + Edged Faces]
Total
Polys: 685,266
Verts: 777,784
FPS: 55.195

EXIT

Utility Kit


+] [Perspective] [Shaded + Edged Faces]


+] [Perspective] [Shaded + Edged Faces]


+] [Perspective] [Shaded + Edged Faces]

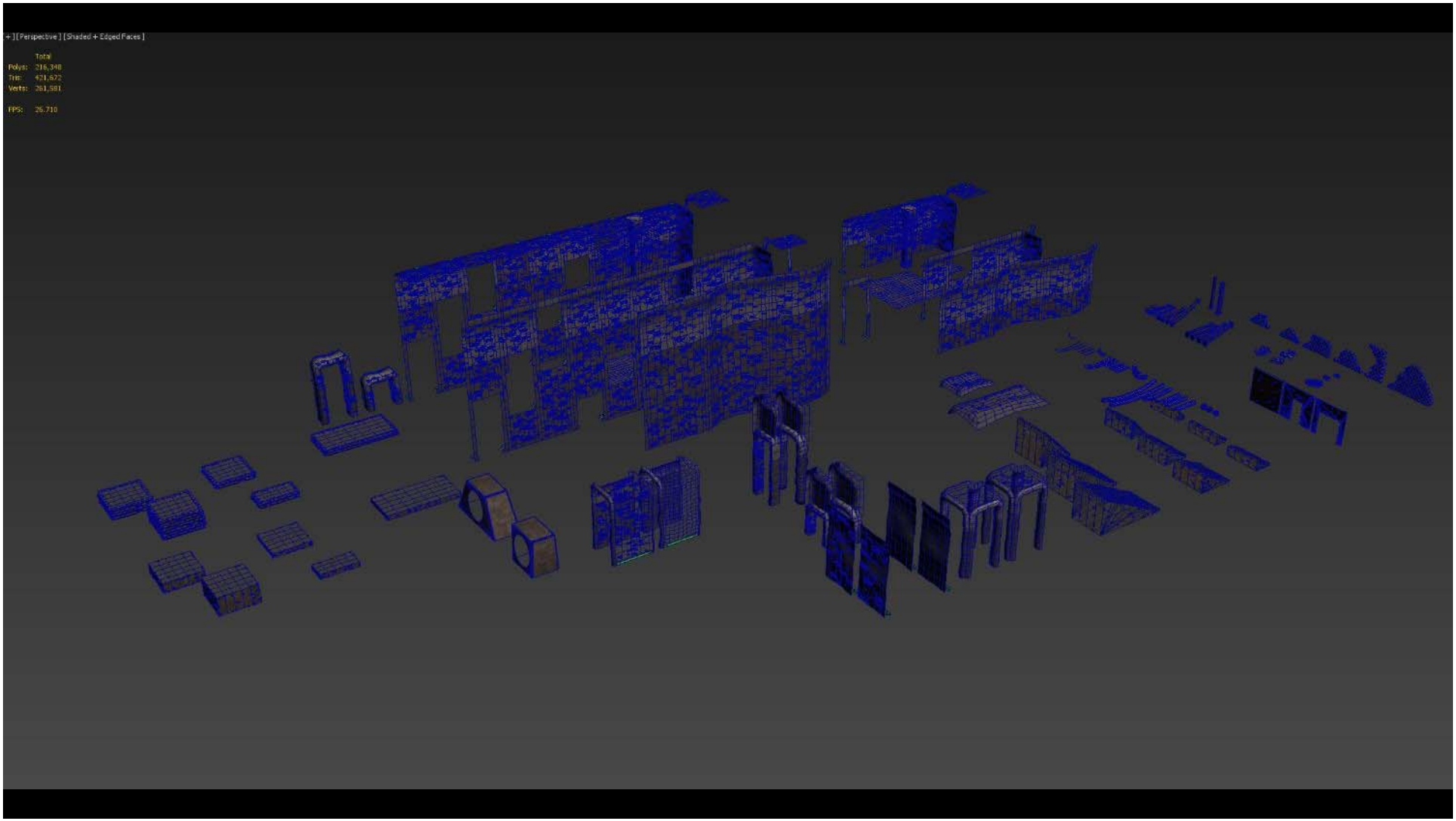
Wasn’t really worth it

- All that we cared about were the pipes

"Glue" Kit

- Mix-and-Match kit usage
- Utility kit as "Glue"
  - Works well to join separate kits
  - Fictionally, Functionally, Cosmetically

Steam Tunnel Kit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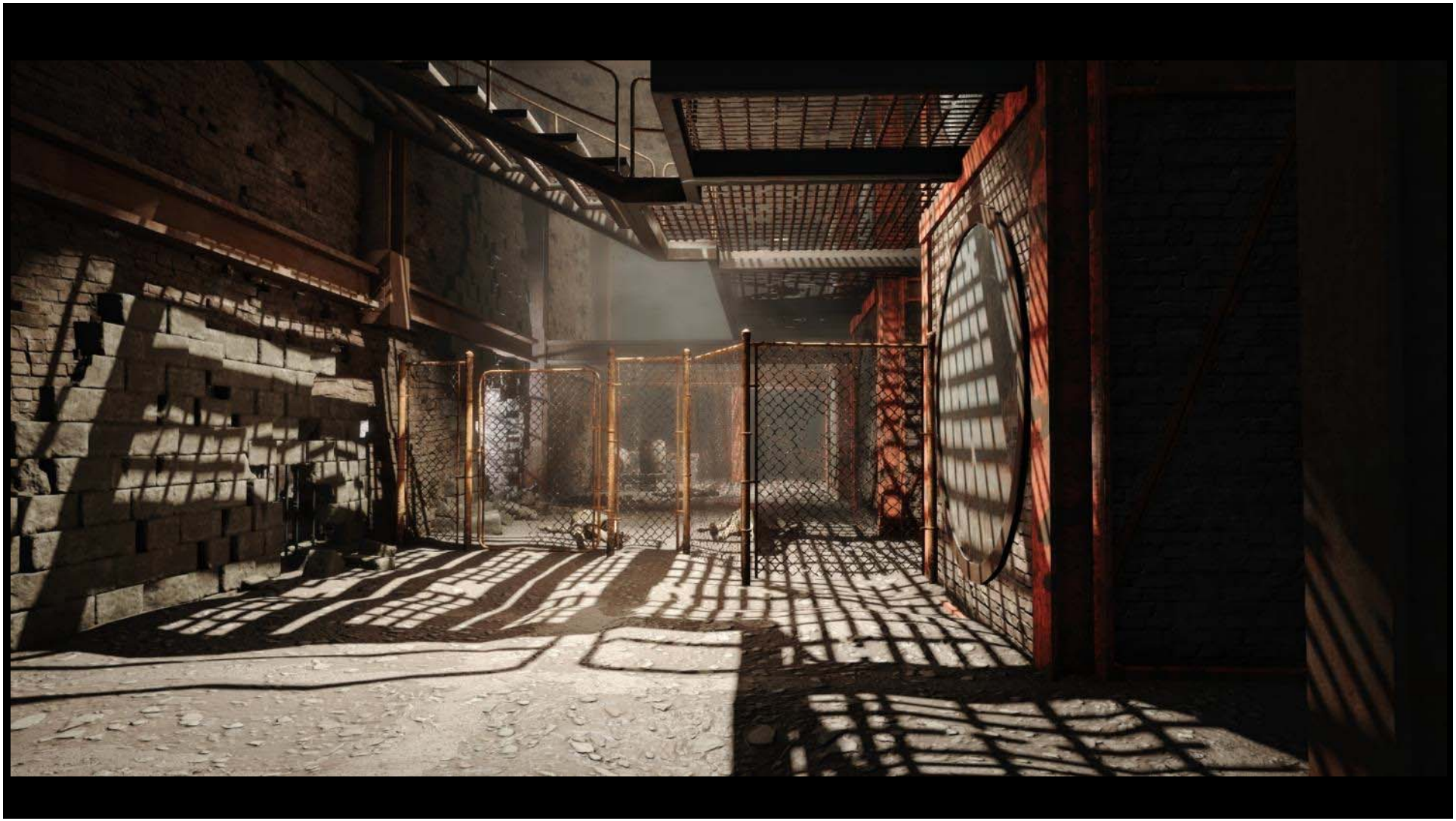
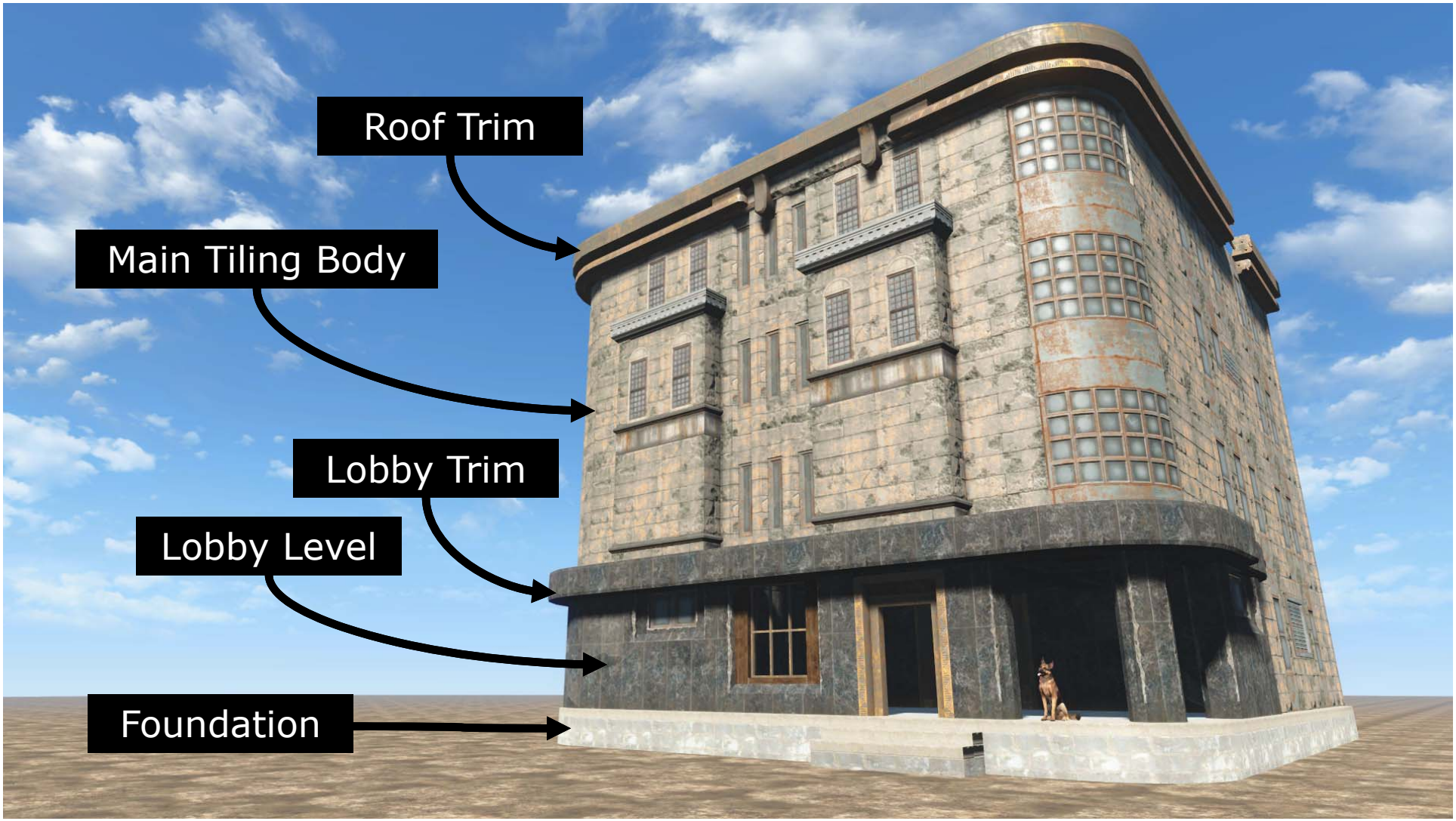


Deco Kit


Roof Trim
Main Tiling Body
Lobby Trim
Lobby Level
Foundation

Interior/Exterior Transitions

- Able to move freely between the two
- No longer a load

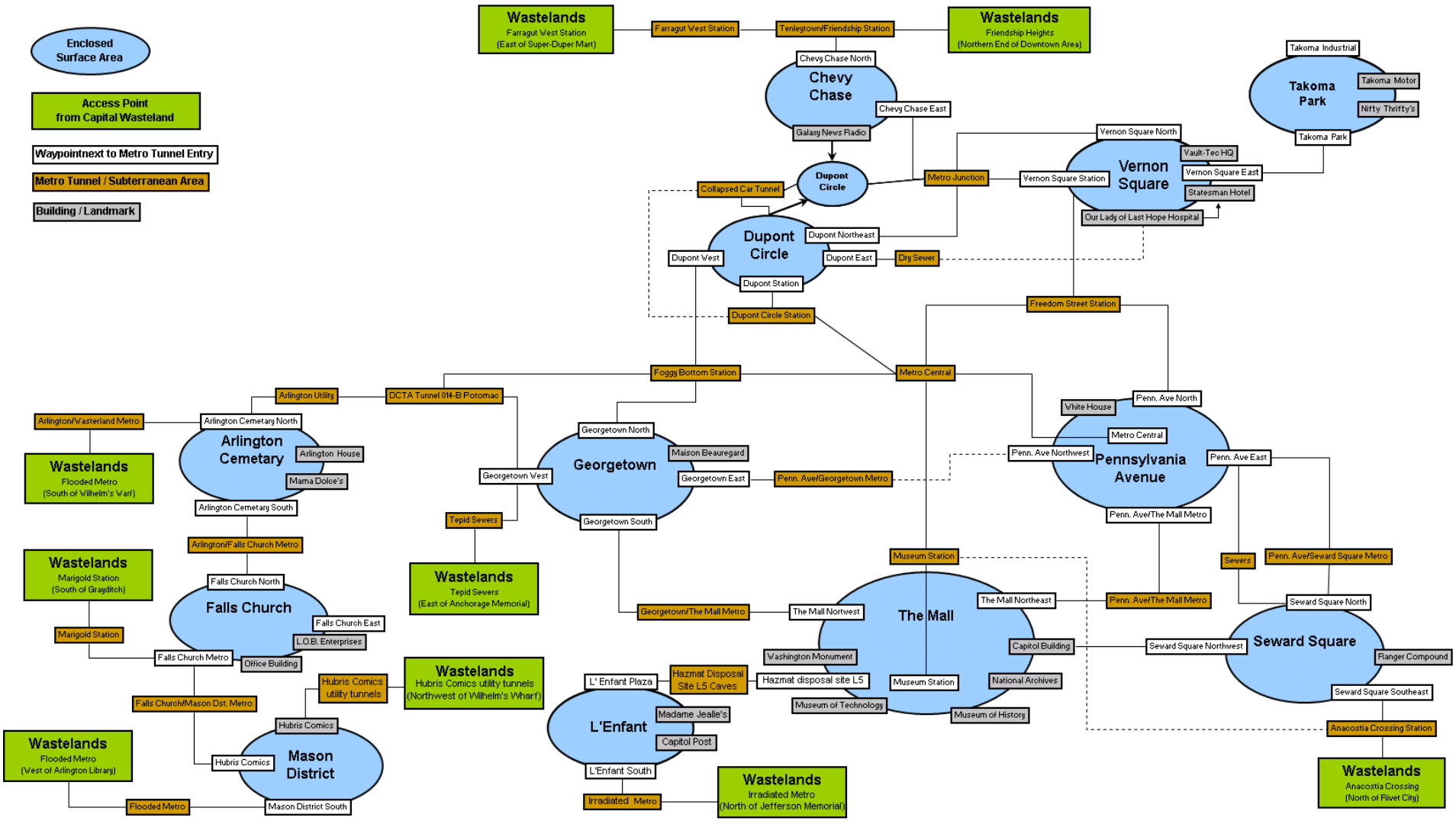
Nuka
Cola

Building Boston

Modular Workflow & Boston

- Fallout 3's Washington DC
  - Cloistered Neighborhoods
  - Separate from Capital Wasteland

Fallout 3


Enclosed Surface Area
Access Point from Capital Wasteland
Waypointnext to Metro Tunnel Entry
Metro Tunnel / Subterranean Area
Building / Landmark
Wastelands
Farragut West Station (East of Super-Duper Mart)
Farragut West Station
Tenleytown/Friendship Station
Wastelands
Friendship Heights (Northern End of Downtown Area)
Chevy Chase North
Chevy Chase
Chevy Chase East
Galaxy News Radio
Takoma Industrial
Takoma Park
Takoma Motor
Nifty Thrifty's
Takoma Park
Vernon Square North
Vault-Tec HQ
Vernon Square
Vernon Square East
Statesman Hotel
Vernon Square Station
Our Lady of Last Hope Hospital
Dupont Circle
Collapsed Car Tunnel
Metro Junction
Dupont Circle
Dupont Northeast
Dupont West
Dupont East
Dry Sewer
Dupont Station
Dupont Circle Station
Freedom Street Station
Foggy Bottom Station
Metro Central
Arlington Utility
DCTA Tunnel 014-B Potomac
Arlington/Wasteland Metro
Arlington Cemetary North
Arlington Cemetary
Arlington House
Mama Dolce's
Arlington Cemetary South
Wastelands
Flooded Metro (South of Wilhelm's Warf)
Georgetown North
Georgetown
Maison Beauregard
Georgetown East
Georgetown West
Georgetown South
Penn. Ave/Georgetown Metro
Tepid Sewers
Wastelands
Tepid Sewers (East of Anchorage Memorial)
White House
Penn. Ave North
Metro Central
Penn. Ave Northwest
Pennsylvania Avenue
Penn. Ave East
Penn. Ave/The Mall Metro
Arlington/Falls Church Metro
Wastelands
Marigold Station (South of Grayditch)
Falls Church North
Falls Church
Falls Church East
L.O.B. Enterprises
Marigold Station
Falls Church Metro
Office Building
Museum Station
Georgetown/The Mall Metro
The Mall Northwest
The Mall
The Mall Northeast
Penn. Ave/The Mall Metro
Sewers
Penn. Ave/Seward Square Metro
Seward Square North
Seward Square
Capitol Building
Seward Square Northwest
Ranger Compound
Seward Square Southeast
Washington Monument
Hazmat disposal site L5
Museum Station
National Archives
Museum of Technology
Museum of History
Anacostia Crossing Station
Wastelands
Anacostia Crossing (North of Rivet City)
Hubris Comics utility tunnels
Wastelands
Hubris Comics utility tunnels (Northwest of Wilhelm's Wharf)
L' Enfant Plaza
Hazmat Disposal Site L5 Caves
L'Enfant
Madame Jealle's
Capitol Post
L'Enfant South
Irradiated Metro
Wastelands
Irradiated Metro (North of Jefferson Memorial)
Falls Church/Mason Dst. Metro
Hubris Comics
Mason District
Hubris Comics
Wastelands
Flooded Metro (West of Arlington Library)
Flooded Metro
Mason District South

HP
W

Authenticity vs Accuracy

Authenticity > Accuracy

Priorities for Downtown

- Capture *Feel* of Exploring Boston
  - Building Heights
  - Street Widths
  - Architectural Styles
  - Navigational Flow

Process

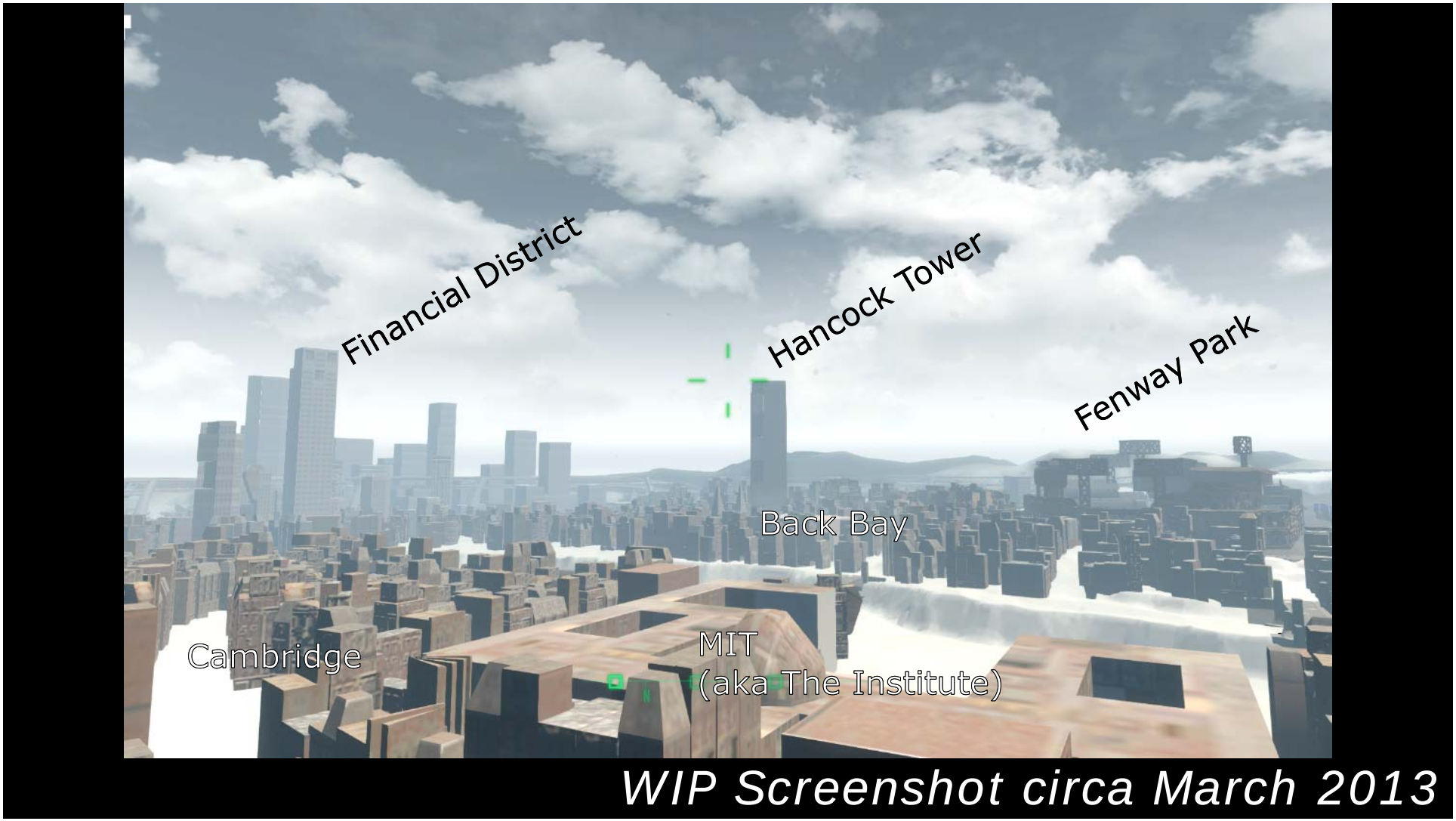
- Coastline & Scale

Process

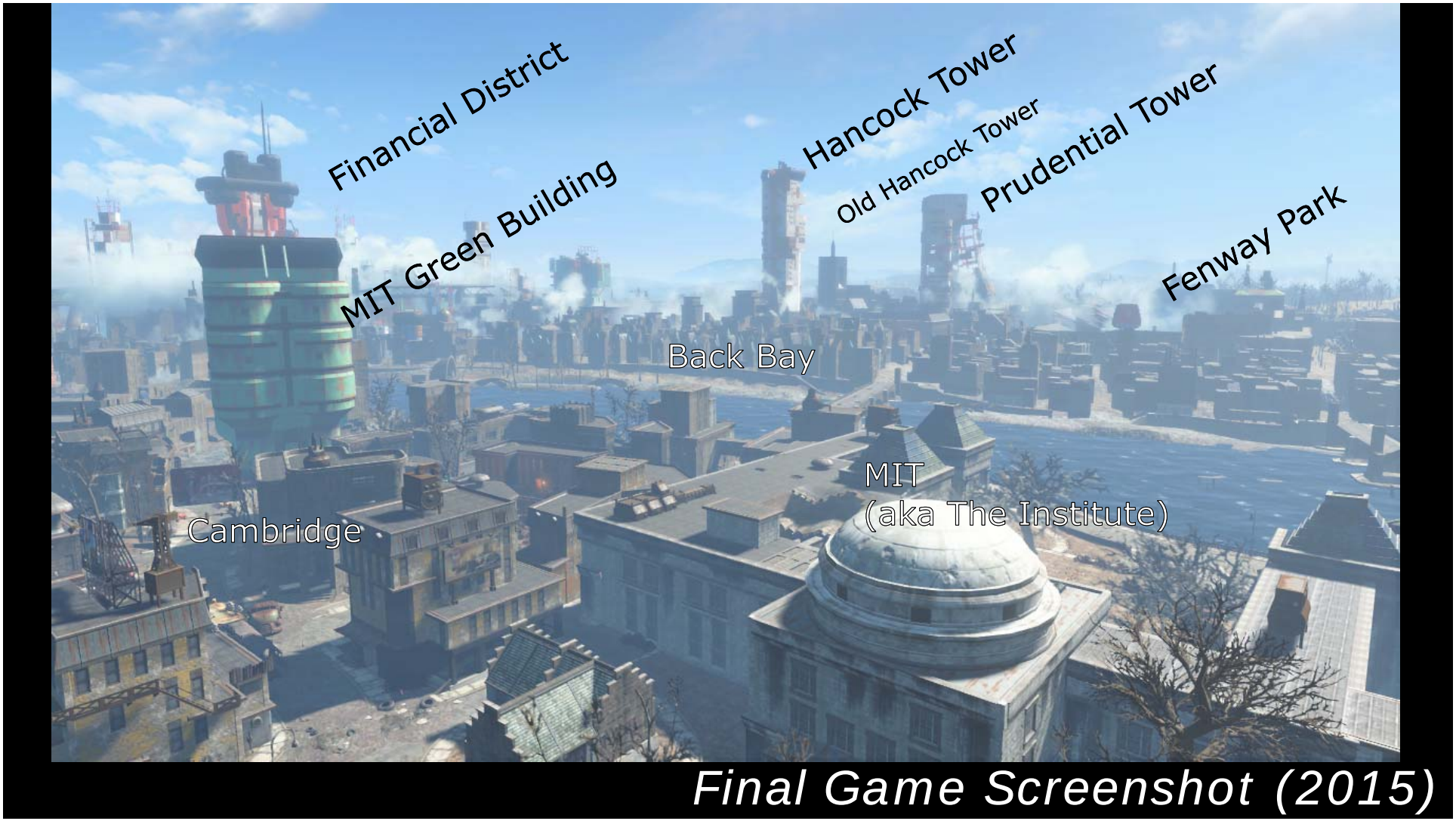
- *Coastline & Scale*
- Skyline

Importance of Skyline

- General Skyline Shape
  - Establish Anchor Buildings
  - Determine Relative Placement
  - Provide Orienting Elements



WIP Screenshot circa March 2013



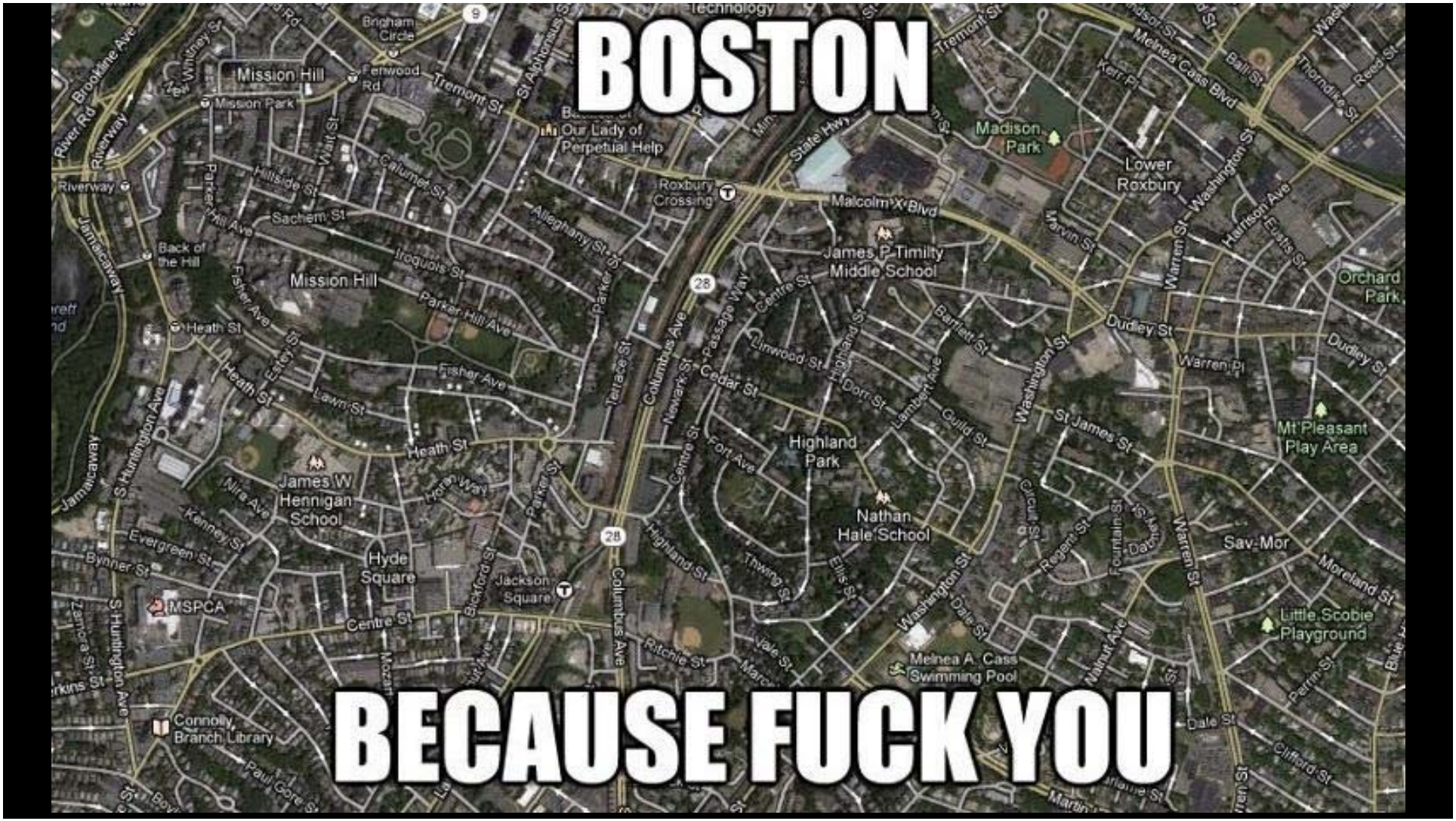
Final Game Screenshot (2015)

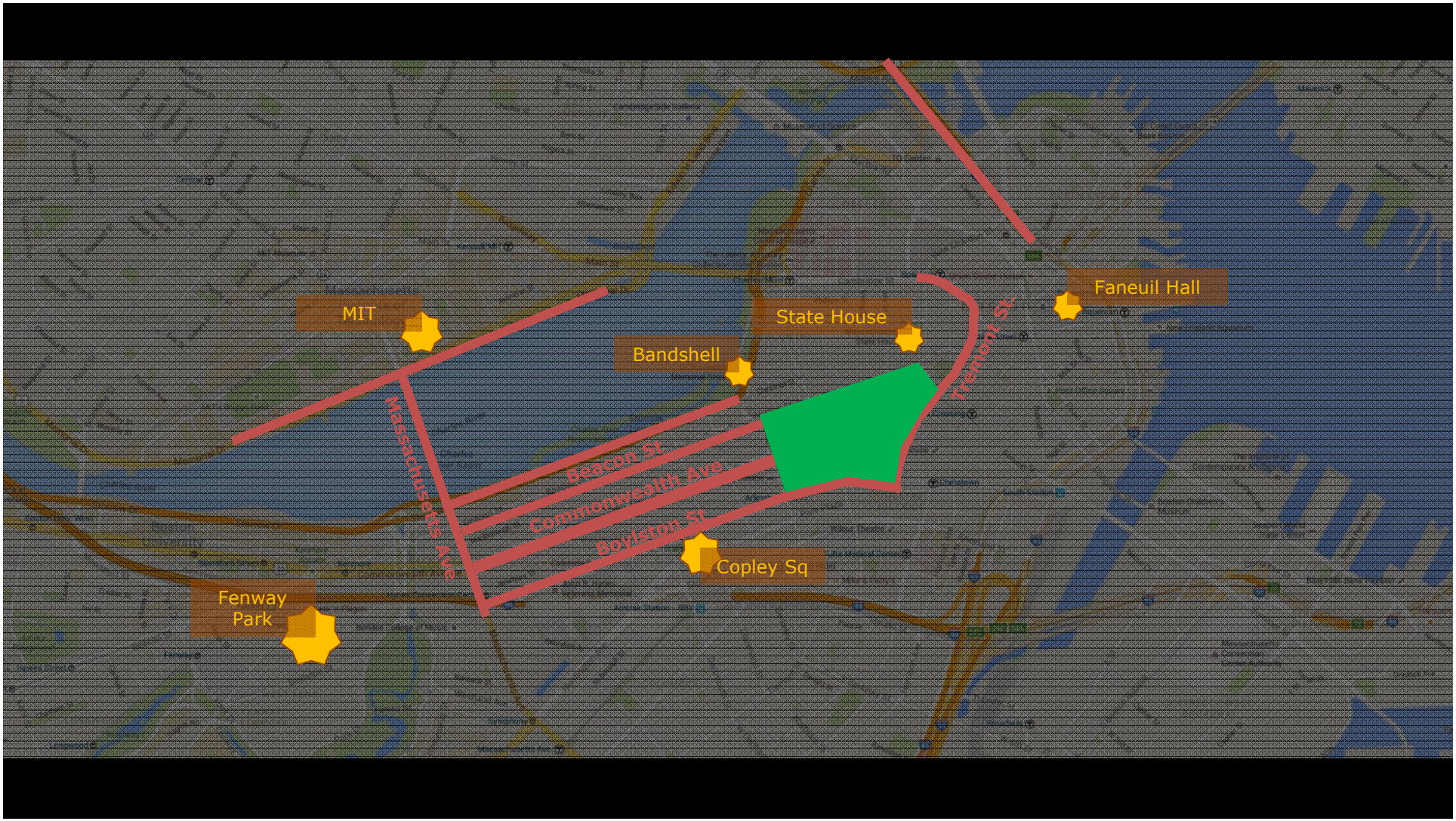
Pre-Launch Fan Analysis (2015)

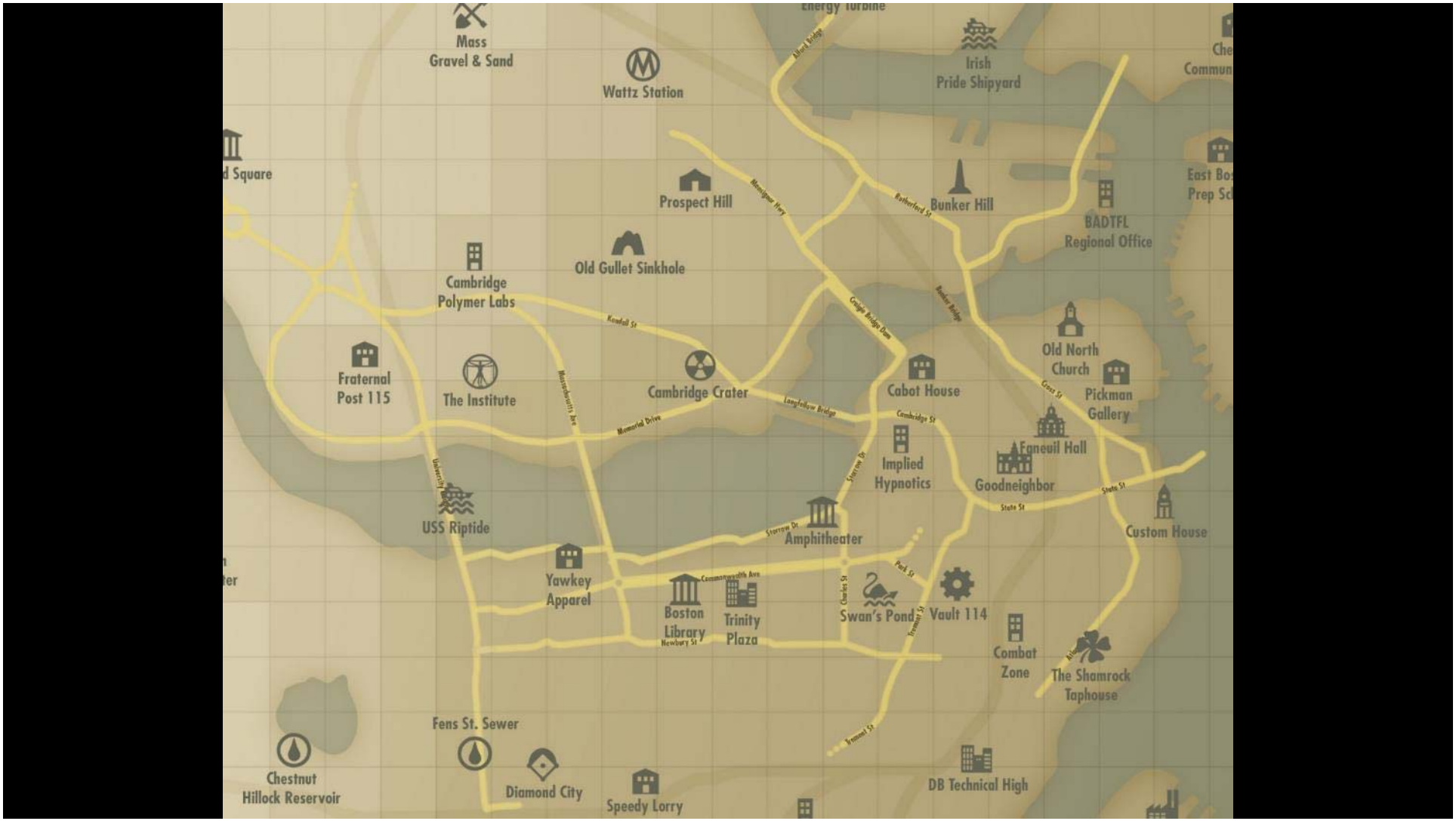
Process

- *Coastline & Scale*
- *Skyline*
- Thoroughfares

NEW YORK
BECAUSE WE WANT YOU TO KNOW WHERE YOU ARE
AND HOW TO GET WHERE YOU'RE GOING


BOSTON
BECAUSE FUCK YOU
Mission Hill
Mission Park
Fenwood Rd
Brigham Circle
Tremont St
Our Lady of Perpetual Help
Madison Park
Lower Roxbury
Roxbury Crossing
Malcolm X Blvd
James P Timilty Middle School
Orchard Park
Mission Hill
Back of the Hill
Heath St
Parker Hill Ave
Hillside St
Calumet St
Sachem St
Iroquois St
Allegheny St
Fisher Ave
Lawn St
Terrace St
Columbus Ave
Newark St
Centre St
Passage Way
Cedar St
Highland St
Dorr St
Lambert Ave
Guild St
Dudley St
Warren Pl
Washington St
St James St
Mt Pleasant Play Area
Highland Park
Fort Ave
Nathan Hale School
James W Hennigan School
Horan Way
Parker St
Kenney St
Evergreen St
Bynner St
Hyde Square
Jackson Square
MSPCA
Centre St
Sickford St
Ritchie St
Vale St
Melnea A. Cass Swimming Pool
Sav-Mor
Little Scobie Playground
Moreland St
Dale St
Connolly Branch Library
Paul Gore St
Clifford St
Martin
Jamaicaway
S Huntington Ave
Riverway
Brookline Ave
River Rd
Whitney St
Vail St
Parker Hill Ave
Tyler Ave
Eustis St
Harrison Ave
Warren St
Washington St
Melnea Cass Blvd
Keff Pl
Ball St
Thorndike St
Reed St
Marvin St
Barnett St
Limwood St
Circuit St
Regent St
Fountain St
Dacia St
Walnut Ave
Warren St
Perrin St
Ellis St
Thwing St
Highland St
Columbus Ave
Centre St
Newark St
Terrace St
Parker St
Allegheny St
Parker Hill Ave
Fisher Ave
Lawn St
Heath St
Evergreen St
Kenney St
Nira Ave
Bynner St
Sickford St
Ritchie St
Vale St
Dale St
Centre St
Jackson Square
Hyde Square
Highland Park
Nathan Hale School
James W Hennigan School
Mt Pleasant Play Area
Sav-Mor
Little Scobie Playground
Melnea A. Cass Swimming Pool
Connolly Branch Library
MSPCA
Back of the Hill
Mission Hill
Mission Park
Fenwood Rd
Brigham Circle
Our Lady of Perpetual Help
Madison Park
Lower Roxbury
Roxbury Crossing
Malcolm X Blvd
James P Timilty Middle School
Orchard Park
Dudley St
Warren Pl
Washington St
St James St
Mt Pleasant Play Area
Highland Park
Nathan Hale School
James W Hennigan School


MIT
Bandshell
State House
Faneuil Hall
Tremont St.
Massachusetts Ave
Beacon St
Commonwealth Ave
Boylston St
Copley Sq
Fenway Park


Mass
Gravel & Sand
Wattz Station
Irish
Pride Shipyard
Prospect Hill
Bunker Hill
BADTFL
Regional Office
Old Gullet Sinkhole
Cambridge
Polymer Labs
Fraternal
Post 115
The Institute
Cambridge Crater
Cabot House
Old North
Church
Pickman
Gallery
Faneuil Hall
Implied
Hypnotics
Goodneighbor
Custom House
USS Riptide
Amphitheater
Yawkey
Apparel
Boston
Library
Trinity
Plaza
Swan's Pond
Vault 114
Combat
Zone
The Shamrock
Taphouse
Fens St. Sewer
Chestnut
Hillock Reservoir
Diamond City
Speedy Lorry
DB Technical High
Kendall St
Memorial Drive
Longfellow Bridge
Cambridge St
State St
Storrow Dr
Park St
Commonwealth Ave
Newbury St
Charles St
Tremont St

Process

- *Coastline & Scale*
- *Skyline*
- *Thoroughfares*
- Neighborhoods

05 -08 -07 -06 -05 -04 -03 -02 -01 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14
04
03
02
01
00
-01
-02
-03
-04
-05
-06
-07
-08
-09
-10
-11
-12
-13
-14
CHARLESTOWN
CAMBRIDGE
NORTH END
BEACON HILL
FINANCIAL DISTRICT
BACK BAY
WATERFRONT
BOSTON COMMON
THEATER DISTRICT
NEWBURY
THE FENS
SOUTH BOSTON

Process

- *Coastline & Scale*
- *Skyline*
- *Thoroughfares*
- *Neighborhoods*
- Ownership

CAMBRIDGE
DREW + DARYL + CLARA
HARVARD SQUARE
MASSACHUSETTS AVE
KENDALL
CIT
HARVARD BRIDGE
UNIVERSITY BRIDGE
LONGFELLOW BRIDGE
CHARLESTOWN
RYAN + CLARA
BUNKER HILL
CLARA
AIRPORT
NORTH END
JEFF + CLARA
OLD NORTH CHURCH
BEACON HILL
RYAN + CLARA
FINANCIAL DISTRICT
STEVE + RAF
ESPLANADE
CHRIS + LEE
COMMONWEALTH
BACK BAY
DANE + RAF
NEWBURY
THE FENS
JEFF + RAF
BOSTON COMMON
STEVE + CLARA
THEATER DISTRICT
DREW + RAF
BOSTON HARBOR WATERFRONT
JUSTIN + RAF
SOUTH BOSTON
JUSTIN + RAF
(SOUTH END?)
?

Process

- *Coastline & Scale*
- *Skyline*
- *Thoroughfares*
- *Neighborhoods*
- *Ownership*
- Iteration

GDC 14

The
Iterative Level Design Process
which helped us ship
Fallout 3 & Skyrim
(on time)

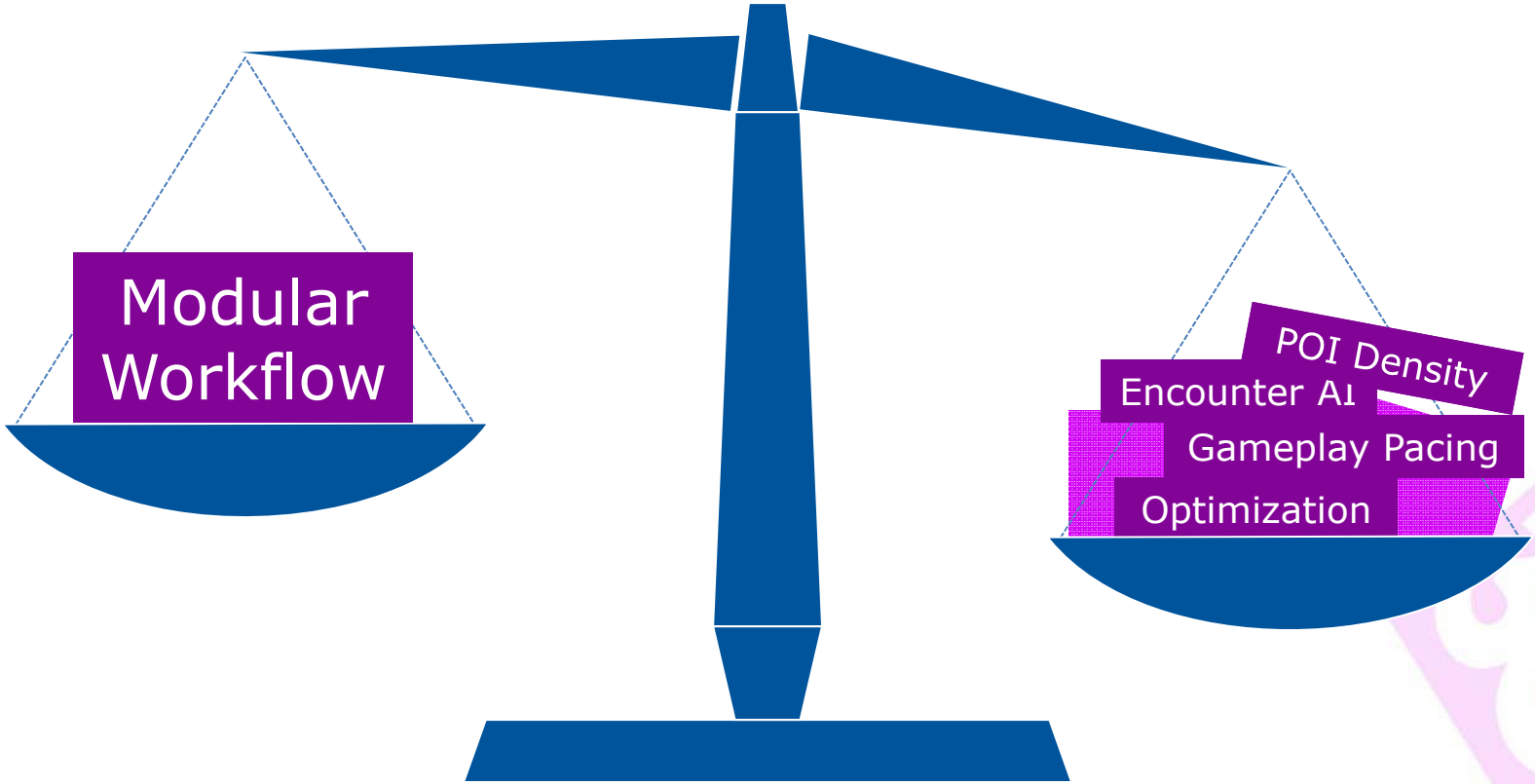
Joel Burgess
Senior Designer, Bethesda Game Studios

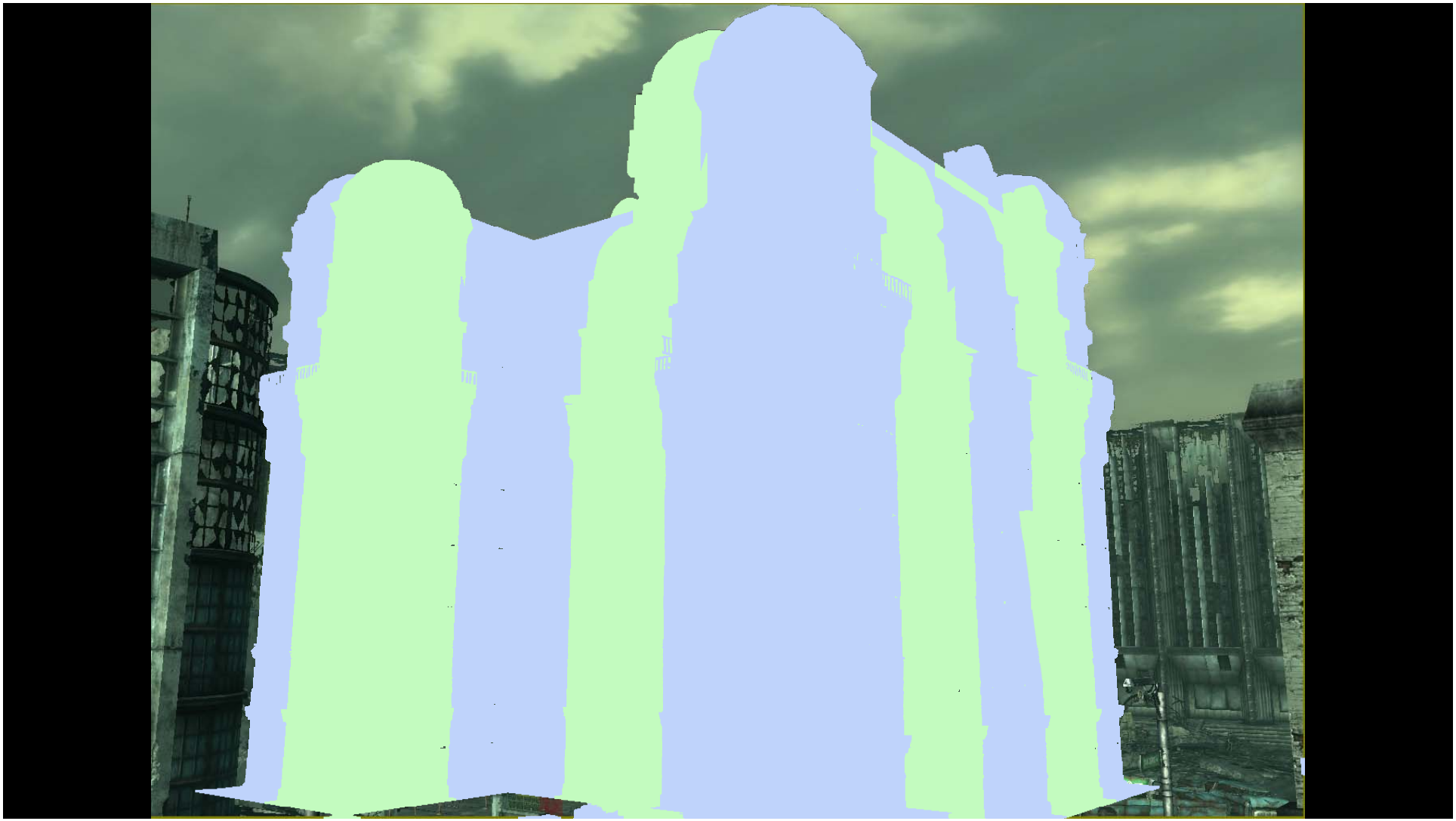
GAME DEVELOPERS CONFERENCE
SAN FRANCISCO, CA
MARCH 17-21, 2014
EXPO DATES: MARCH 19-21
2014

1

Hard Living

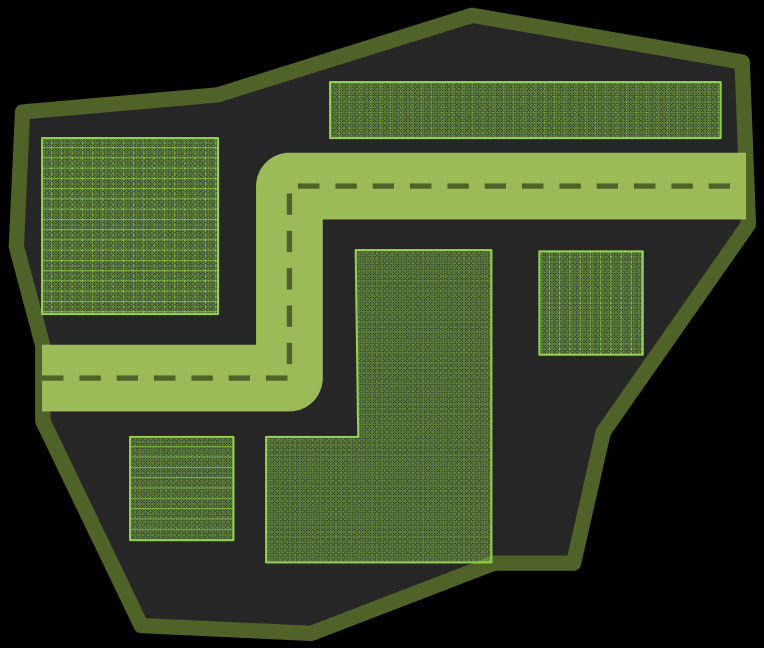
- Tons of hurdles had to be overcome
  - Encounter Pacing
  - POI/Exploration Density
  - Combat and Detection, Enemy AI
  - Performance, Occlusion, Sightlines
  - Iteration and Metrics
- Everything took longer than expected


Modular Workflow
POI Density
Encounter AI
Gameplay Pacing
Optimization

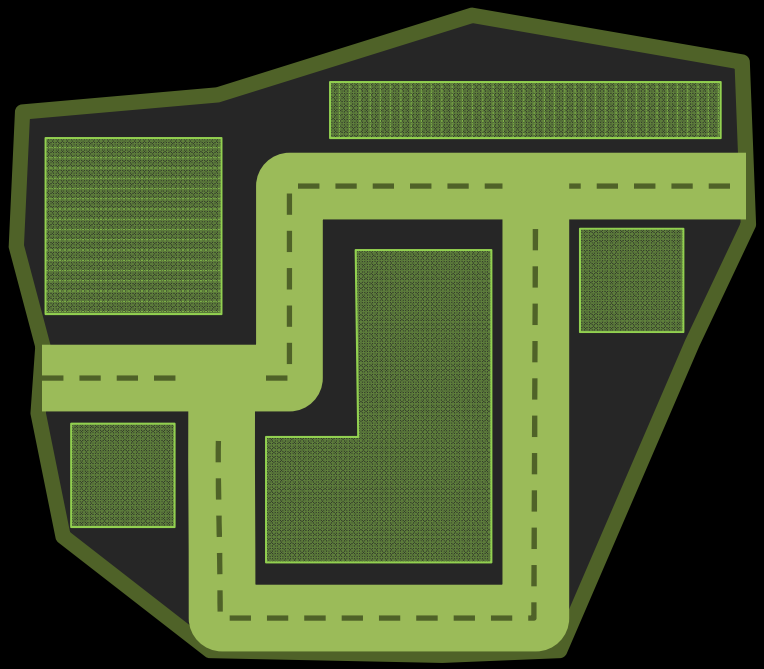


Ability to React

- Fallout 3: Isolated
  - Easy to Reshape & Adapt



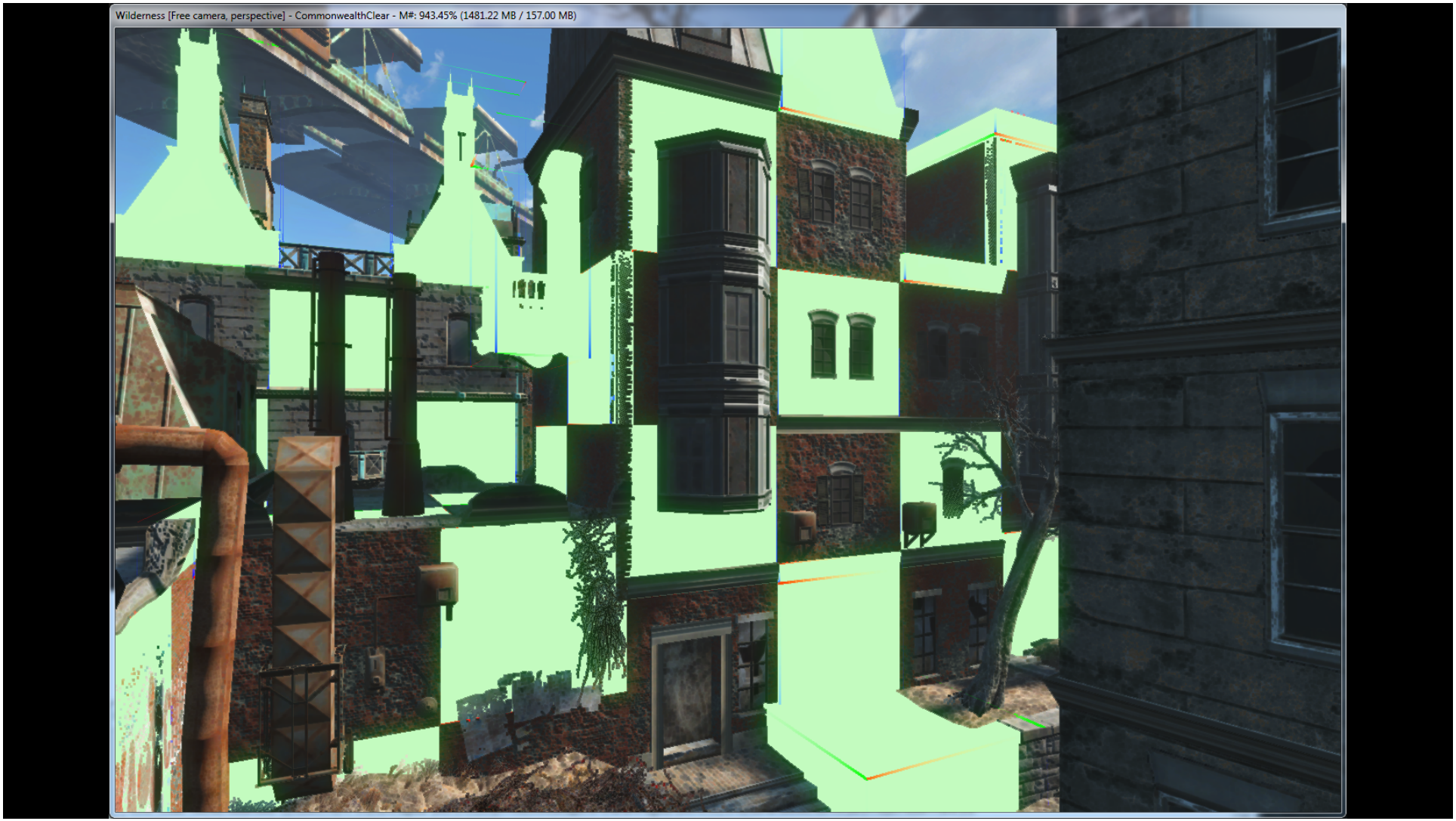
Can we support an alternate route?



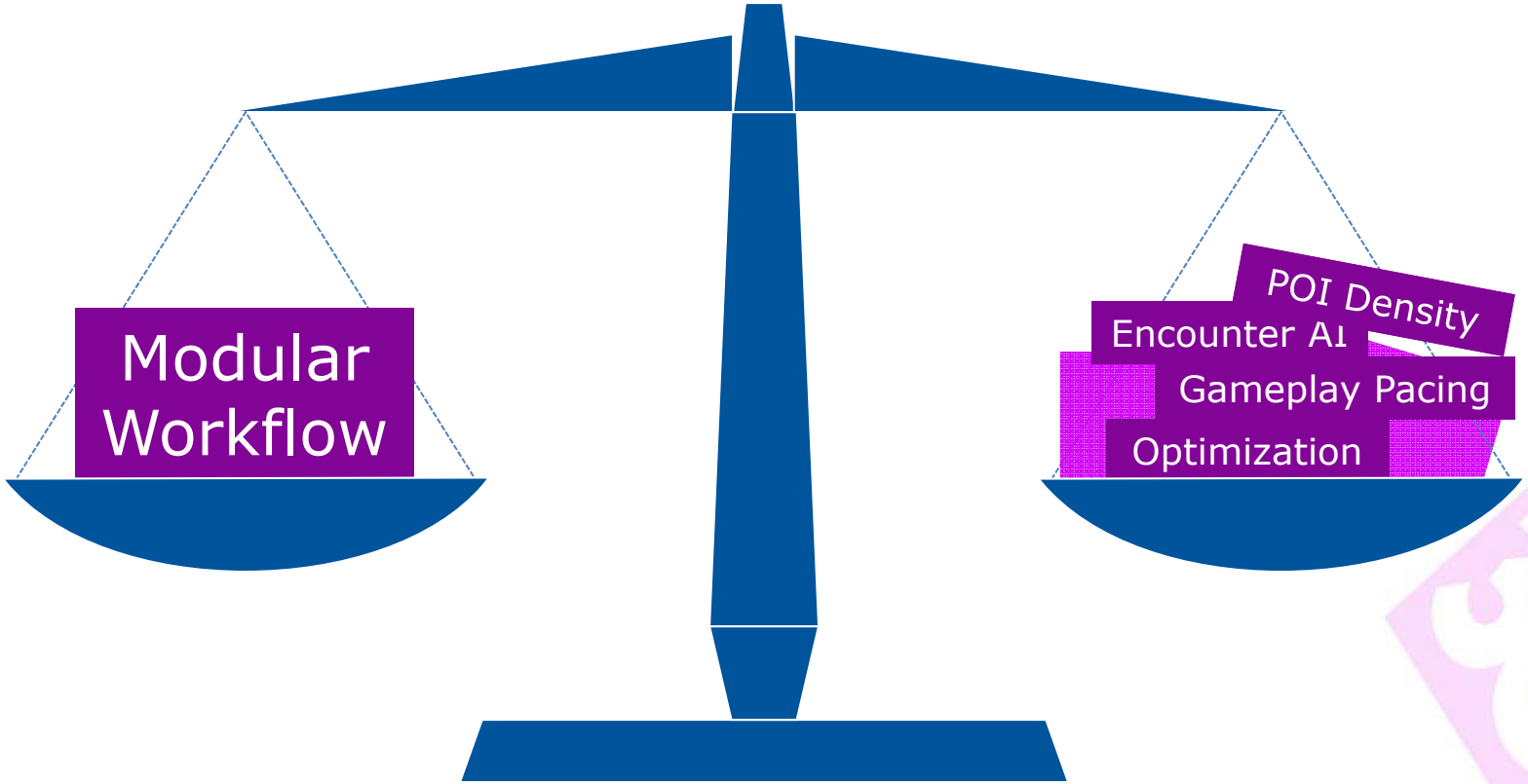
Sure.

Ability to React

- Fallout 3: Isolated
  - Easy to Cut & Reshape
- Fallout 4: Interconnected
  - Everything Had to Fit
  - Required More Layout Flexibility


Wilderness [Free camera, perspective] - CommonwealthClear - M#: 943.45% (1481.22 MB / 157.00 MB)

Nuka
Cola

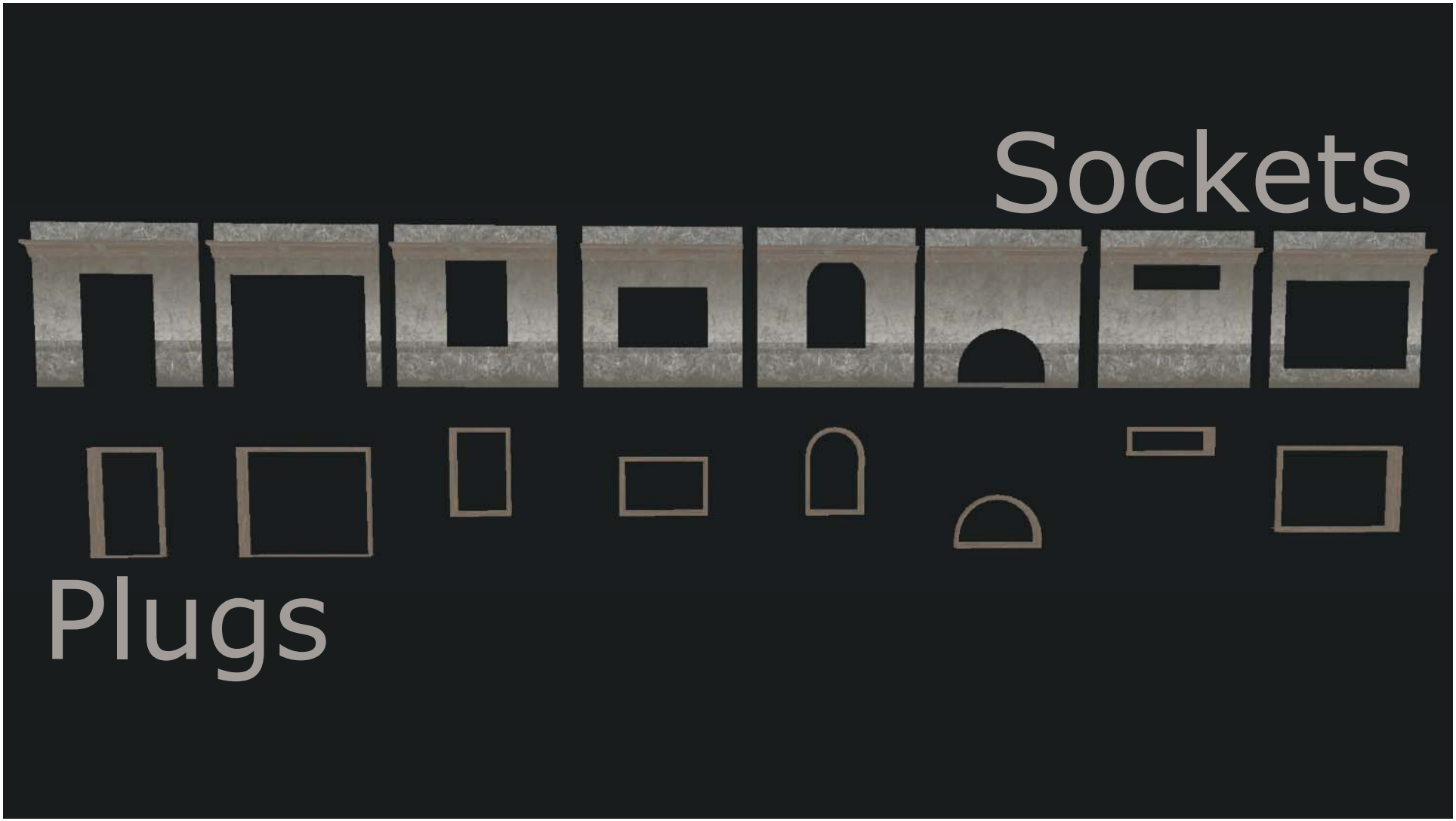

Modular Workflow
POI Density
Encounter AI
Gameplay Pacing
Optimization

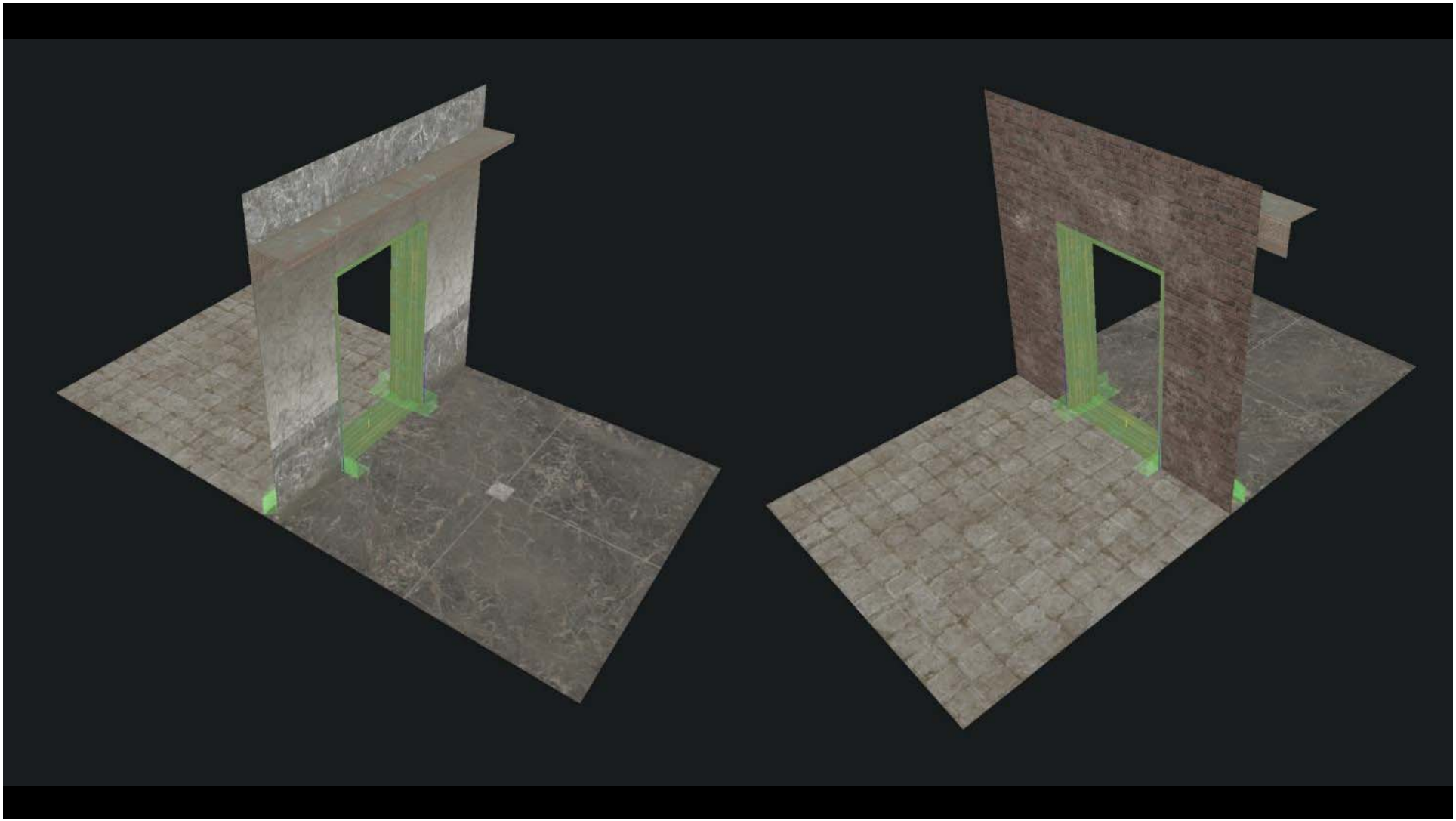
Grab Bag!

Plug & Socket System

Plug & Socket System

- Predefined “Socket” holes
- Compatible with several “Plug” pieces
- Maximize Flexibility for transitions

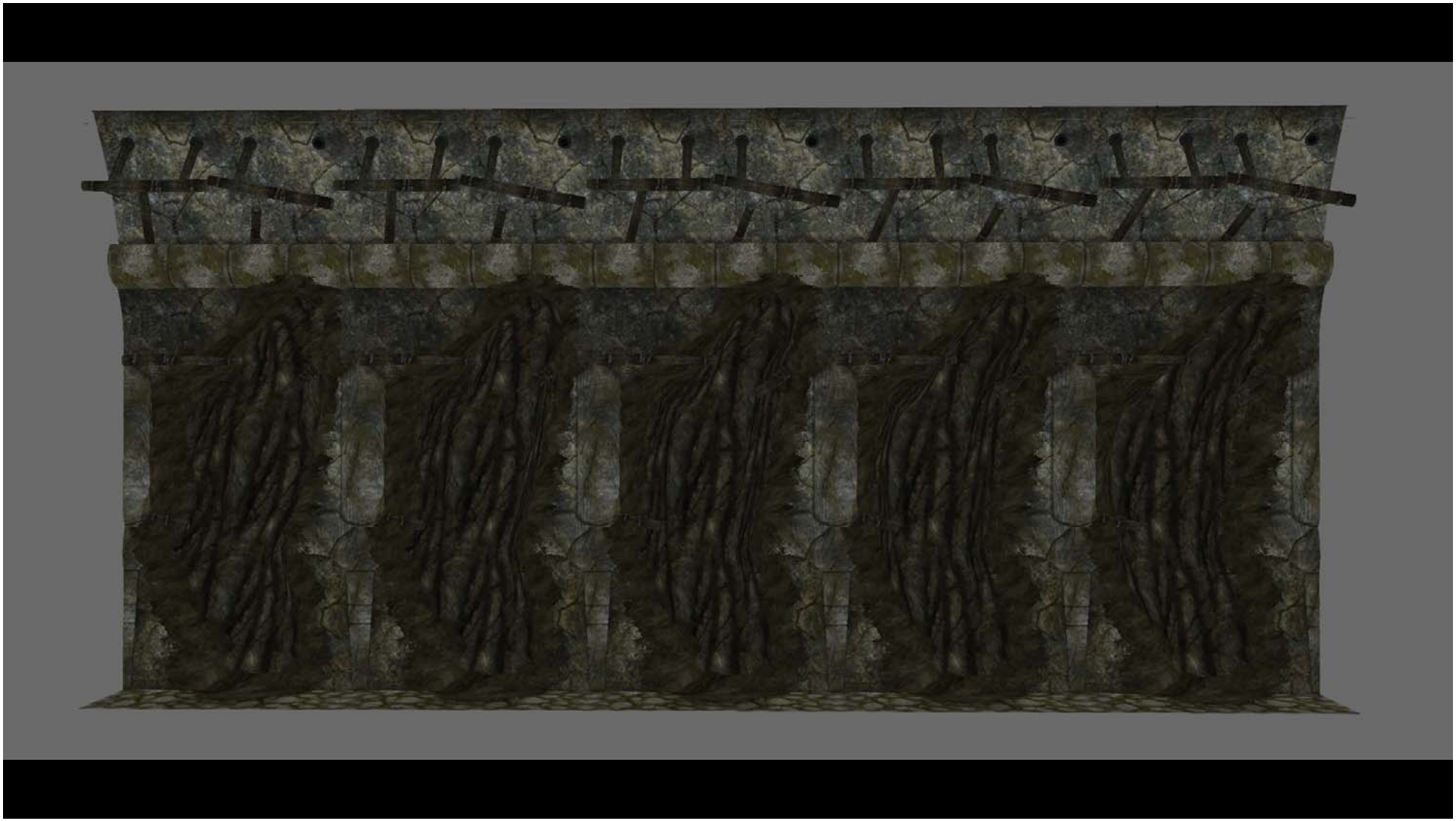

Sockets
Plugs



Kit-Based Destruction

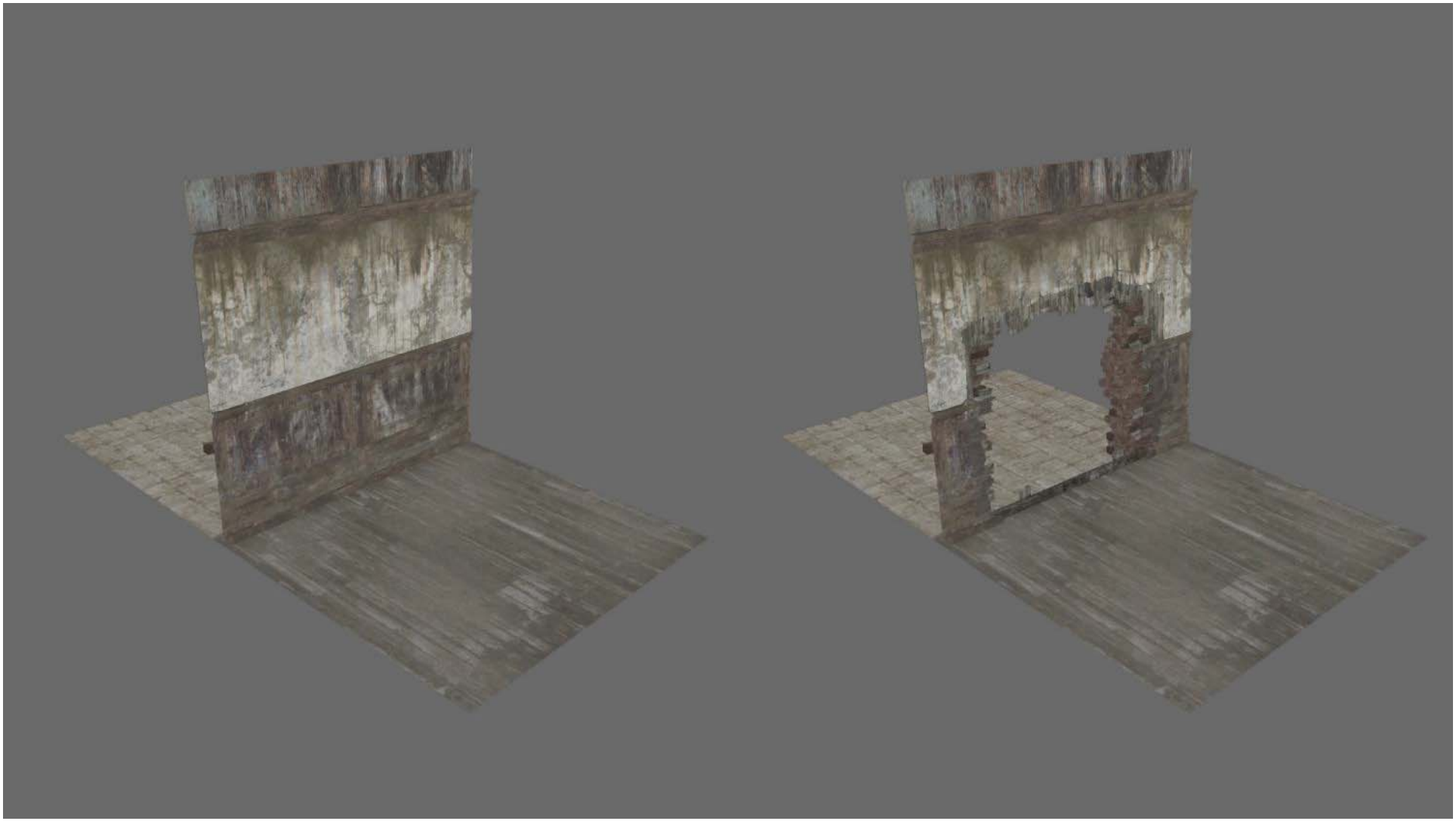
Wall Holes

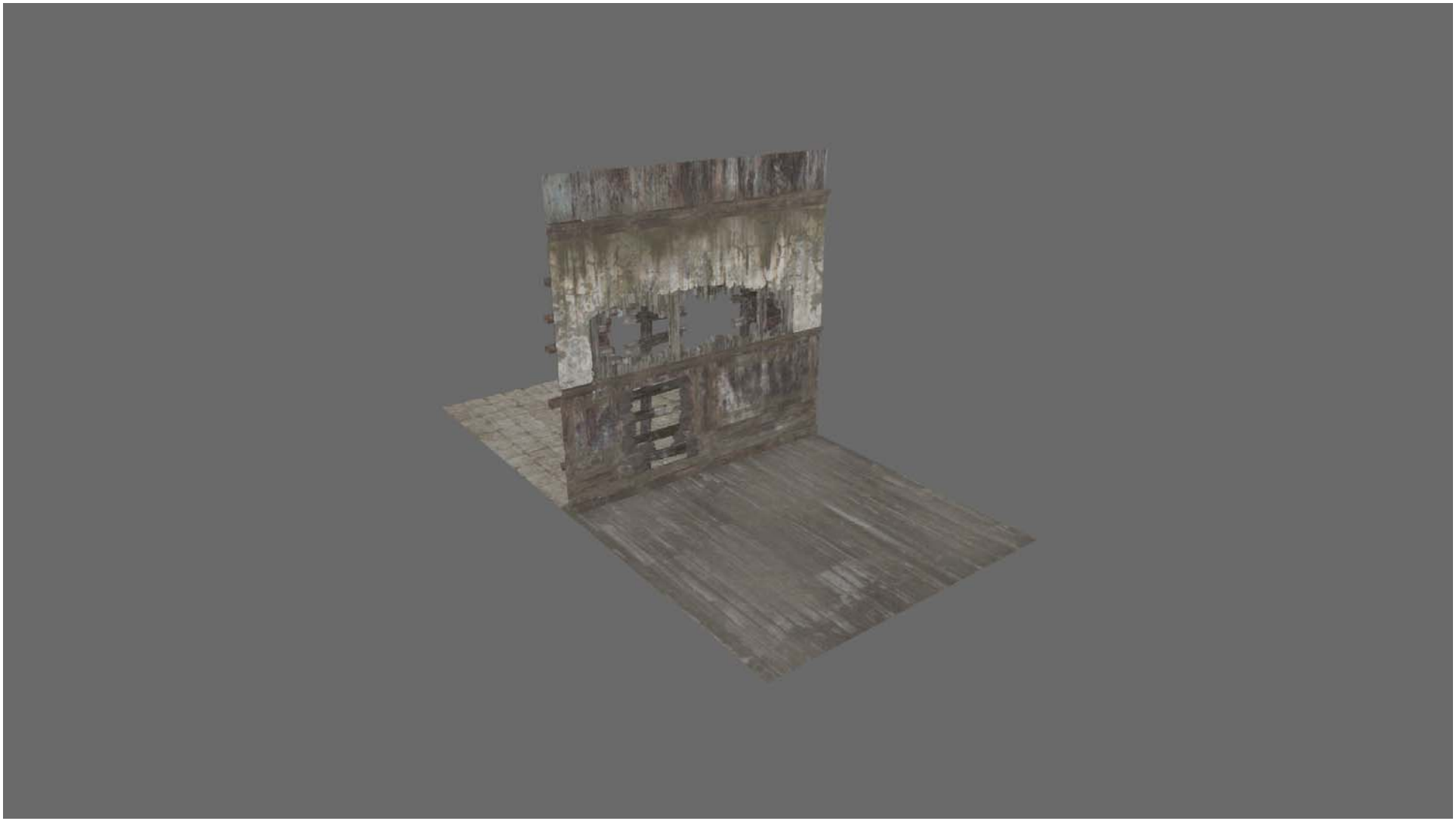
- Problem: Visual Quality vs Repetition

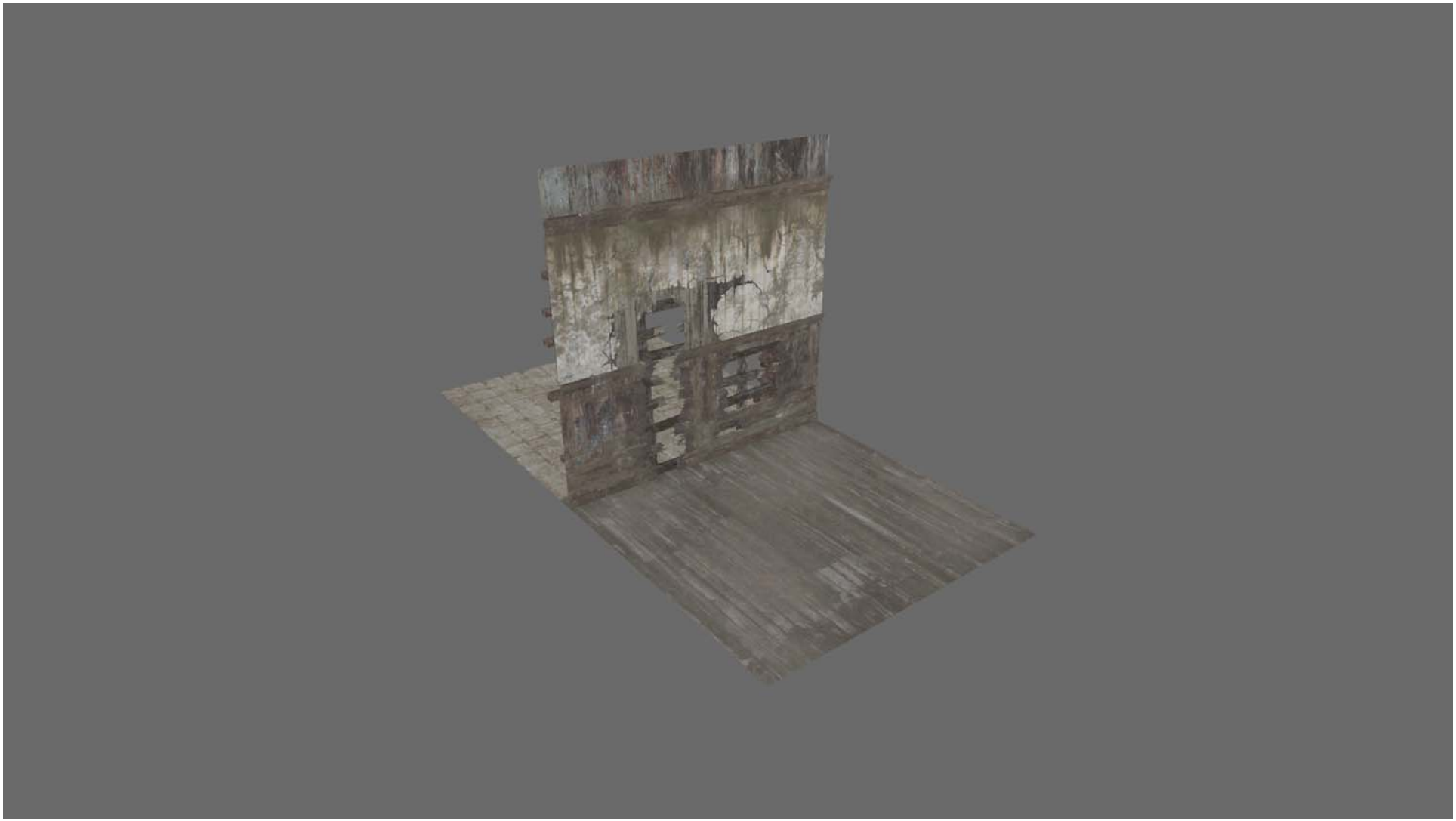


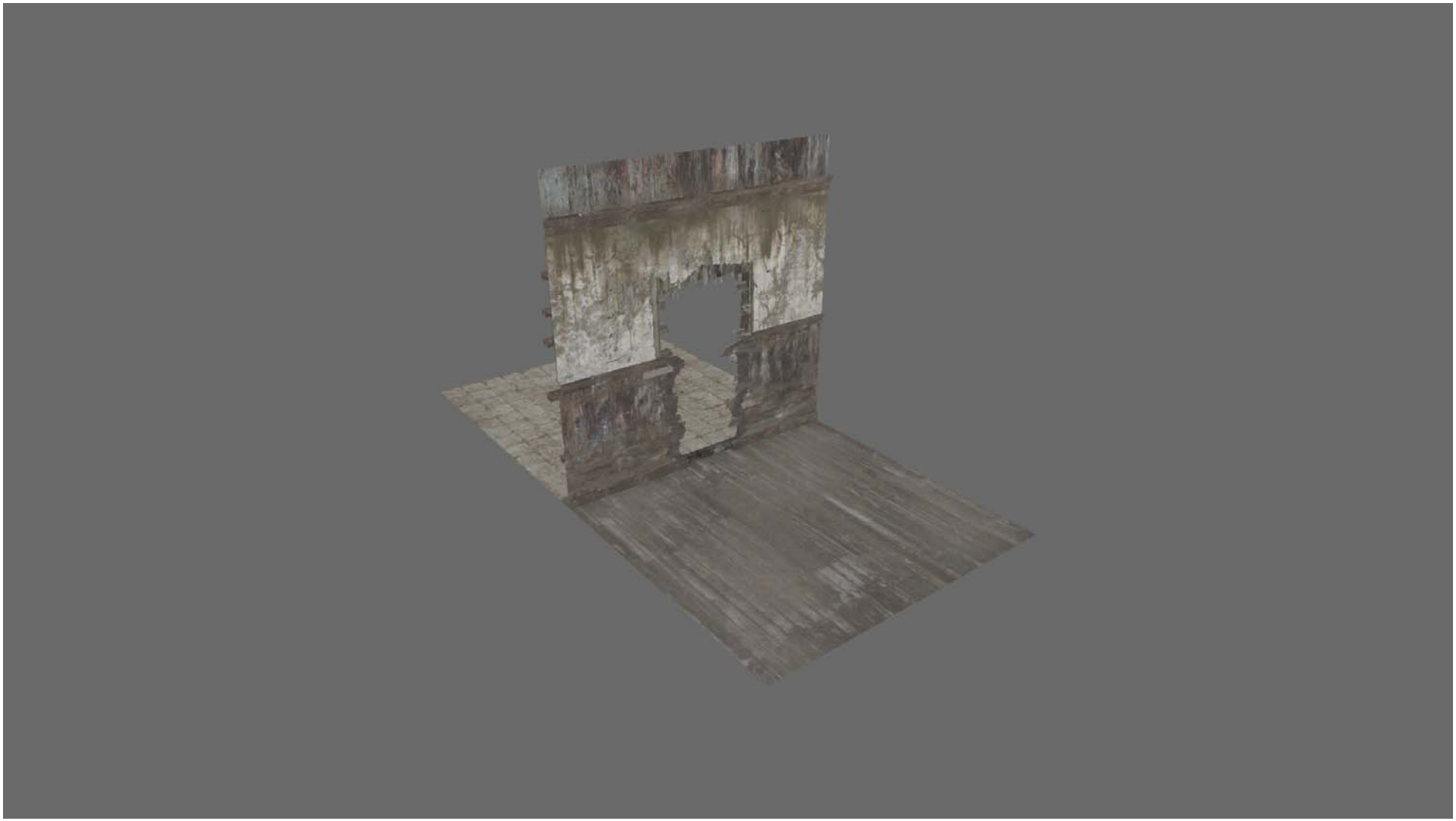
Wall Holes

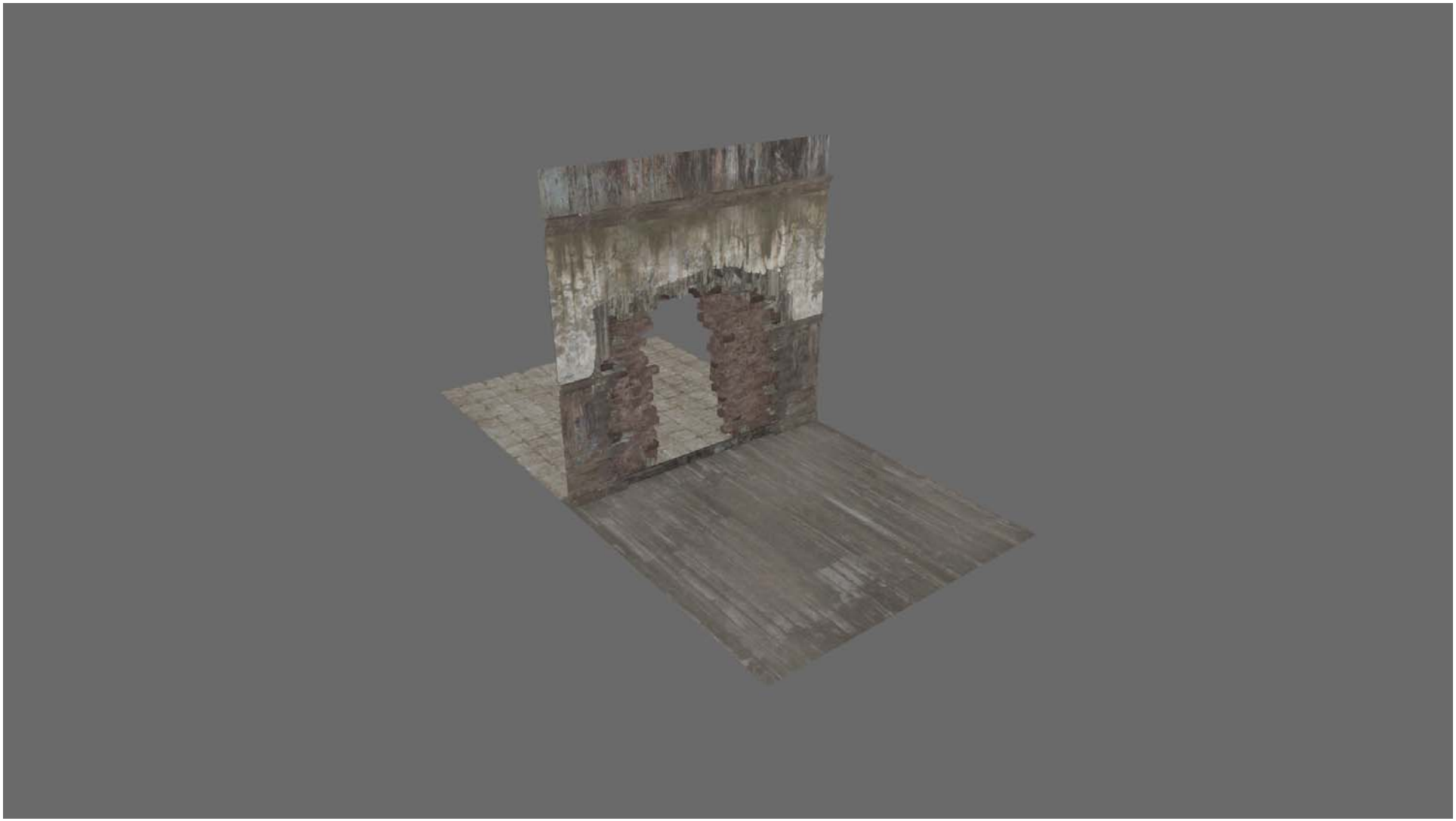
- Solution: Mix/Match
  - Lots of small pieces
  - Multiplicative effect

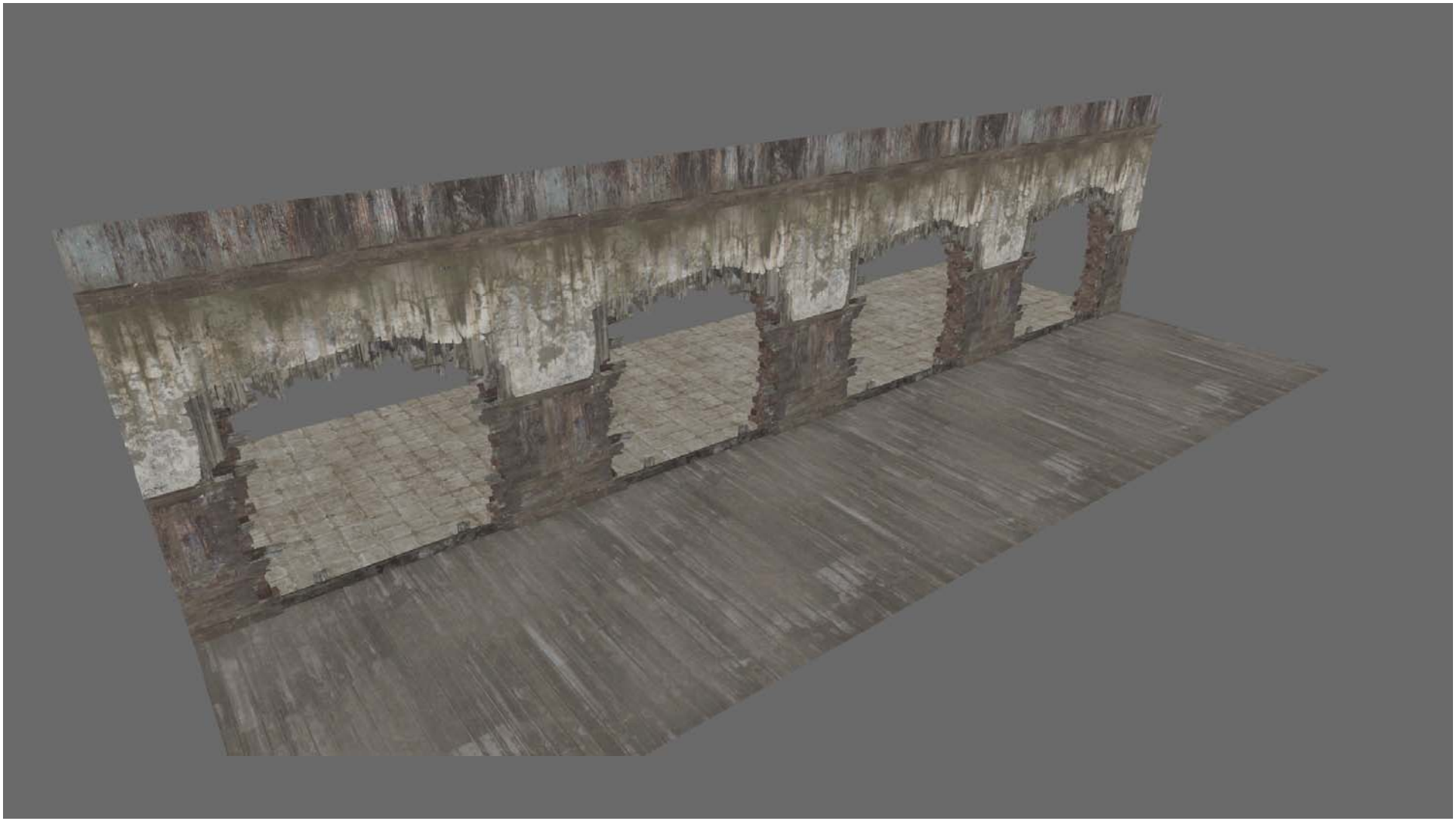


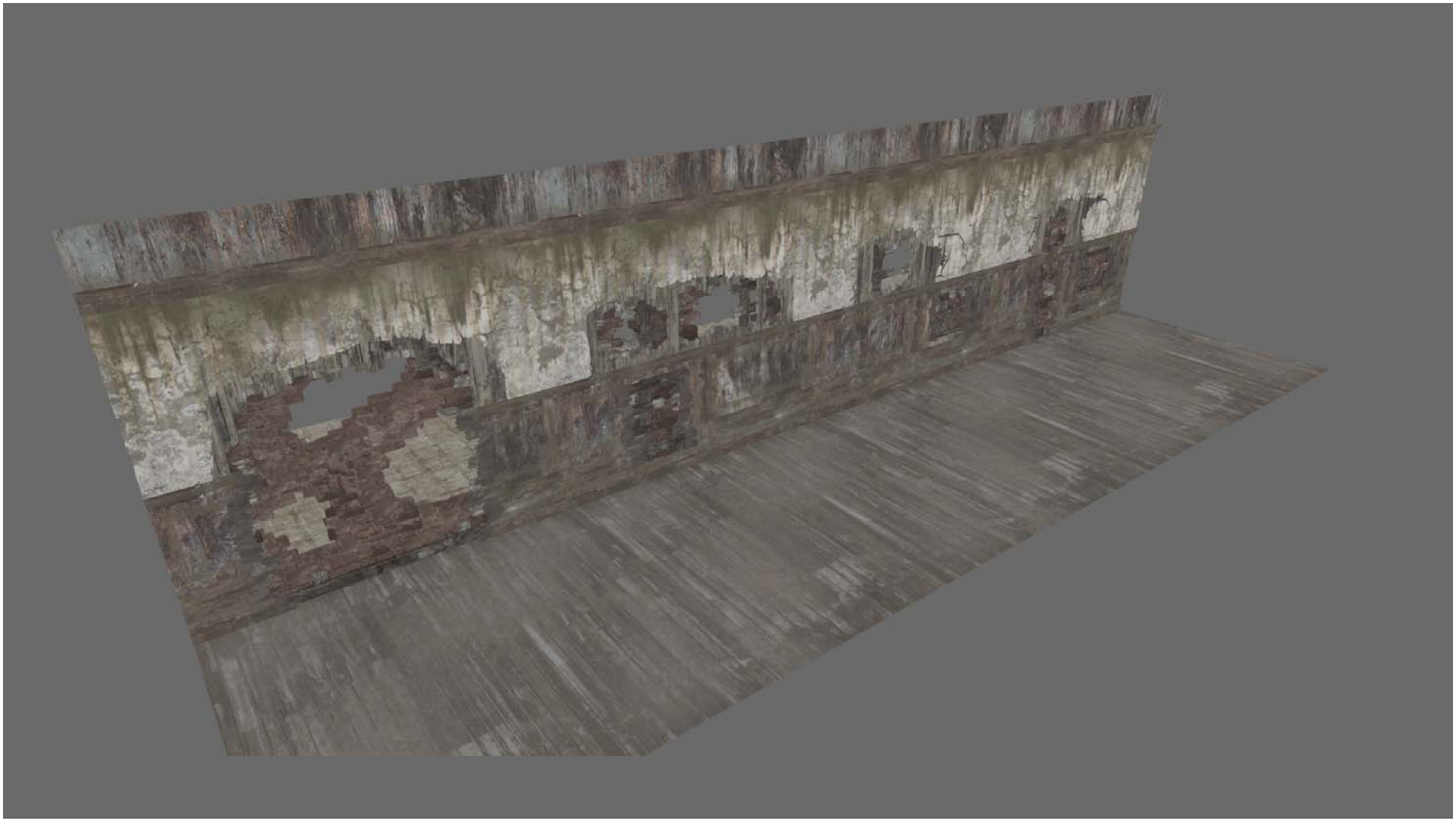






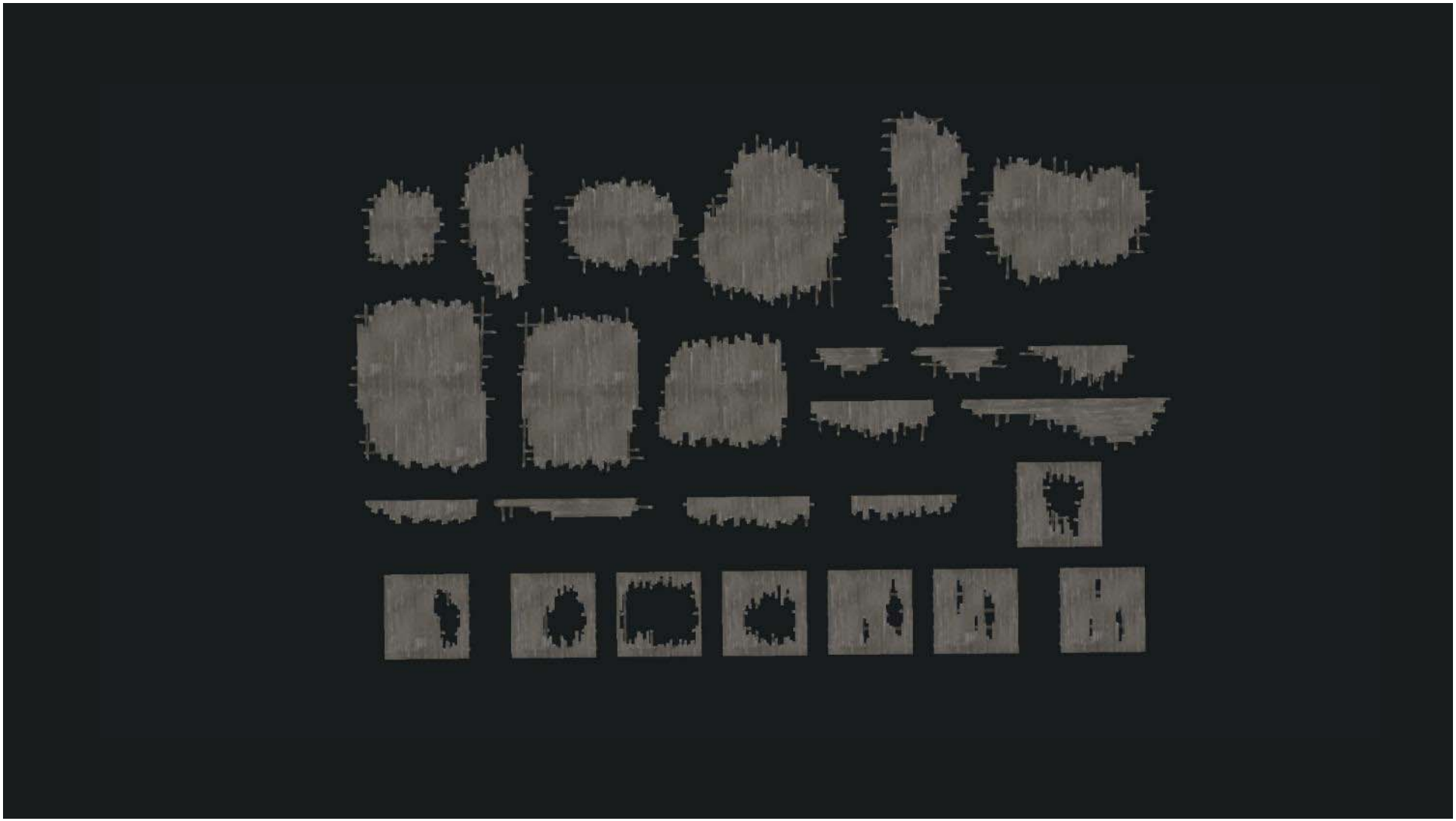


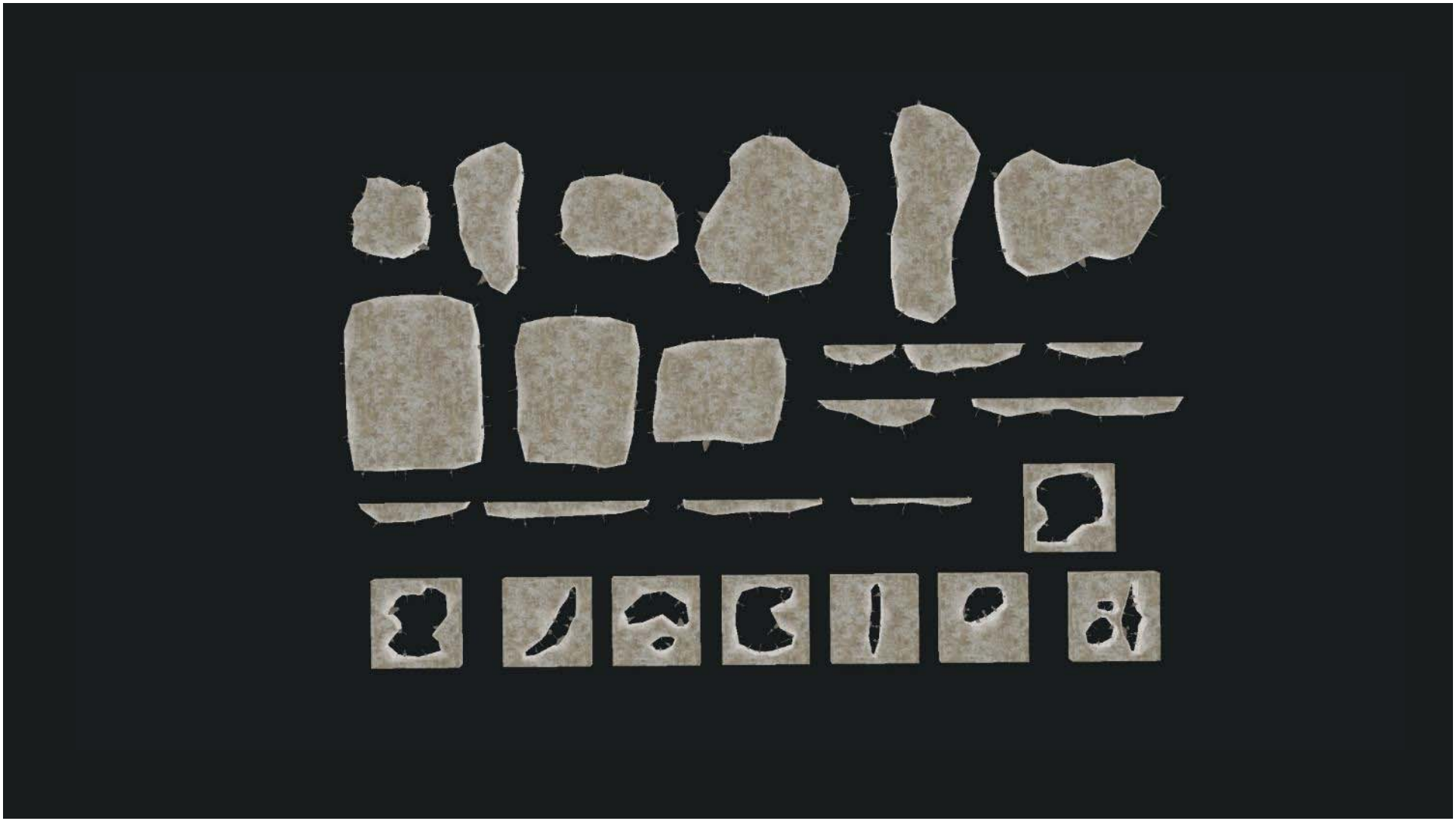


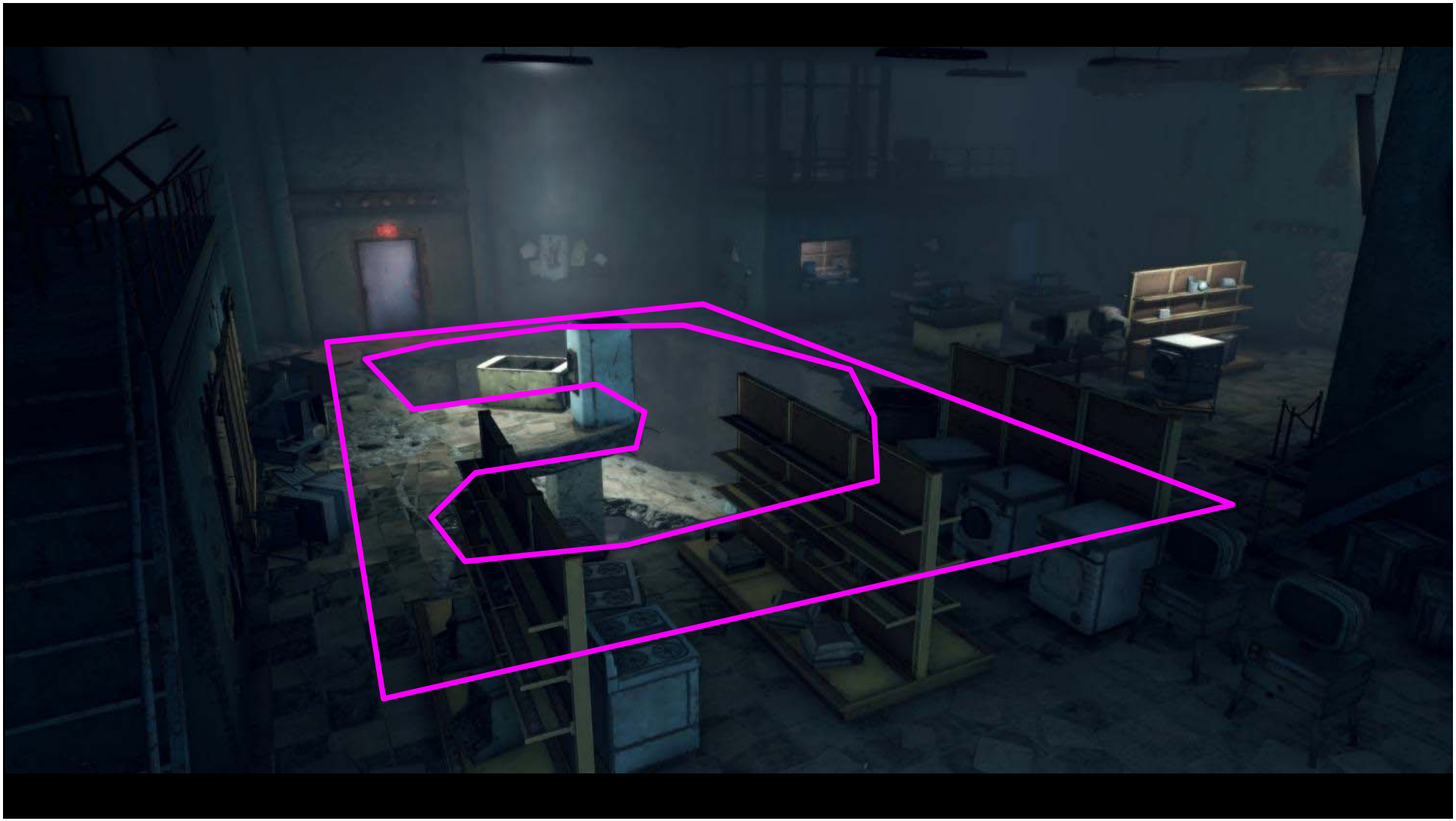


Platforms

- Problem: Ceiling/Floor Damage
- Solution: Tile-friendly “Free” platforms
  - Useful option for demanding cases
  - Highly Flexible

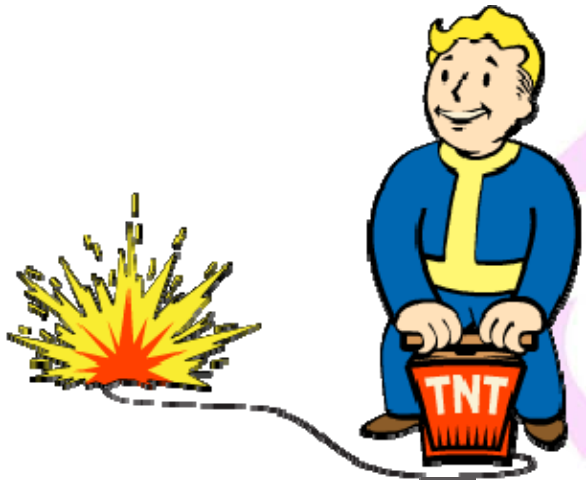






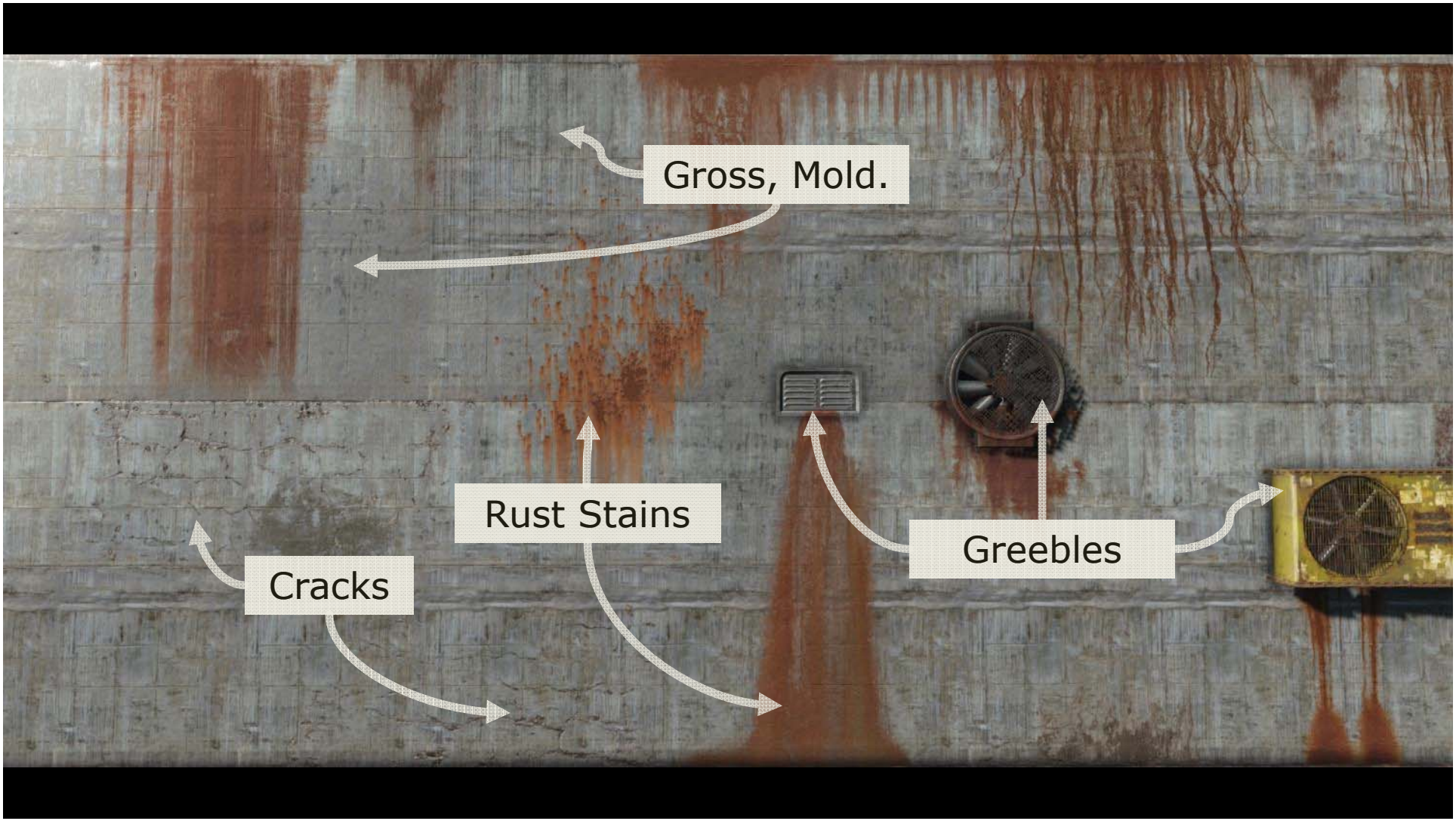
Dynamic Destruction

- Per-Piece Destructibles
  - Kit-Compatible
  - Location Specific Damage
  - Simple Physics Simulation



Decals and Greebles

- Large “Gross” Decals
- Simple but very useful tricks
- Useful to obscure kit patterns


Gross, Mold.
Rust Stains
Cracks
Greebles

Tool: Layers

- Just like Photoshop
- Very useful, especially in complex scenes
- Huge time saver

Layers
New Layer
Add Selection to Layer
Filter
Name
#
V
F
A
Default 0
Corvega_CanAttachFX 1
Corvega_Lightbox 6
CorvegaGobos 67
DN024_BlackPlanes 17
DN024_ConveyorBeltParts01 38
DN024_CorvegaCarLine 136
DN024_FX 107
DN024_Markers 90
DN024_Offices 147
DN024_SpotLightMarkers 13
NewLayerCorvega 7419

Layers
New Layer
Add Selection to Layer
Filter
Name
#
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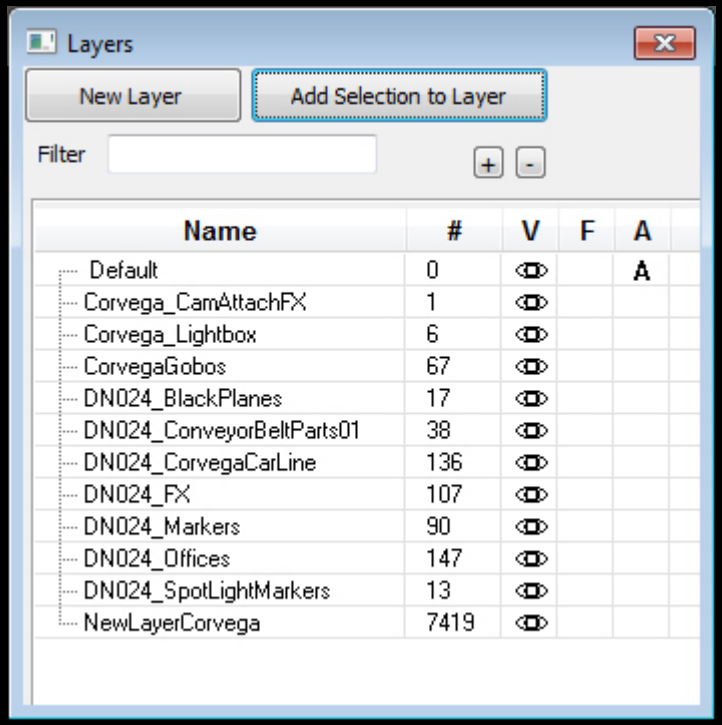
F
A
Default 0
Corvega_CanAttachFX 1
Corvega_Lightbox 6
CorvegaGobos 67
DN024_BlackPlanes 17
DN024_ConveyorBeltParts01 38
DN024_CorvegaCarLine 136
DN024_FX 107
DN024_Markers 90
DN024_Offices 147
DN024_SpotLightMarkers 13
NewLayerCorvega 7419


Layers
New Layer
Add Selection to Layer
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Corvega_CamAttachFX
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CorvegaGobos
67
DN024_BlackPlanes
17
DN024_ConveyorBeltParts01
38
DN024_CorvegaCarLine
136
DN024_FX
107
DN024_Markers
90
DN024_Offices
147
DN024_SpotLightMarkers
13
NewLayerCorvega
7419

Tool: Mouse Wheel Swap

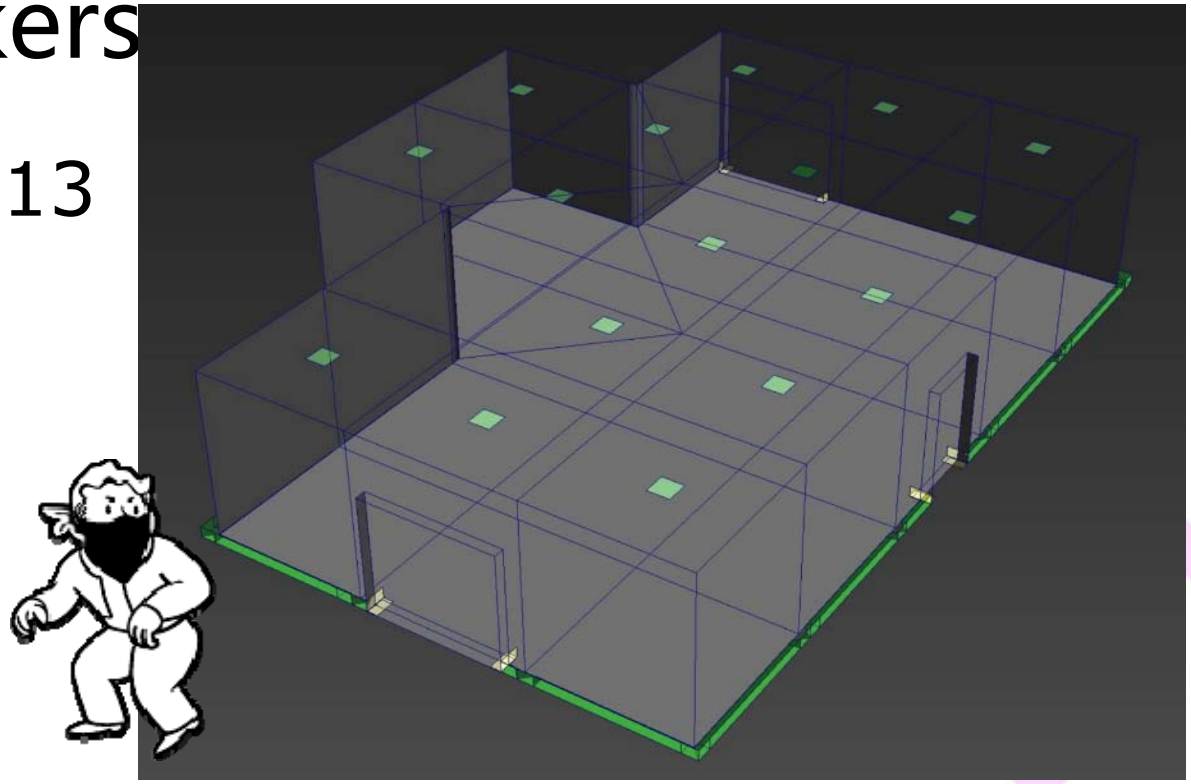
- Ctrl+Wheel: Quickly Replace Selection
  - Embracing Existing Workflow
  - Another huge time saver

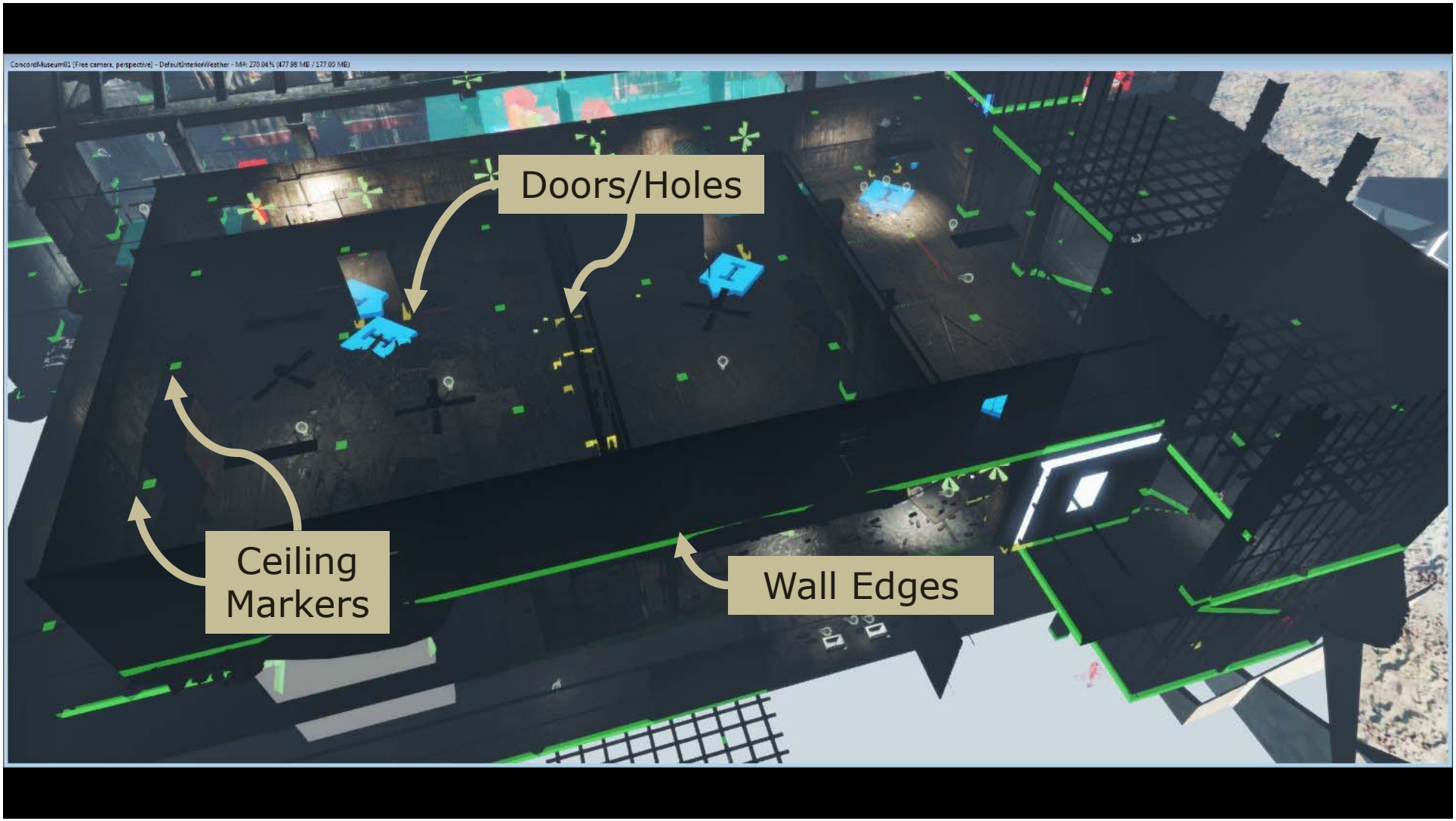
Wilderness [Free camera, perspective] - CommonwealthClear - M#: 827.59% (1299.31 MB / 157.00 MB)
LIFE IS

Wilderness [Free camera, perspective] - CommonwealthClear - M#: 827.59% (1299.31 MB / 157.00 MB)

Helper Markers

- Alluded in 2013

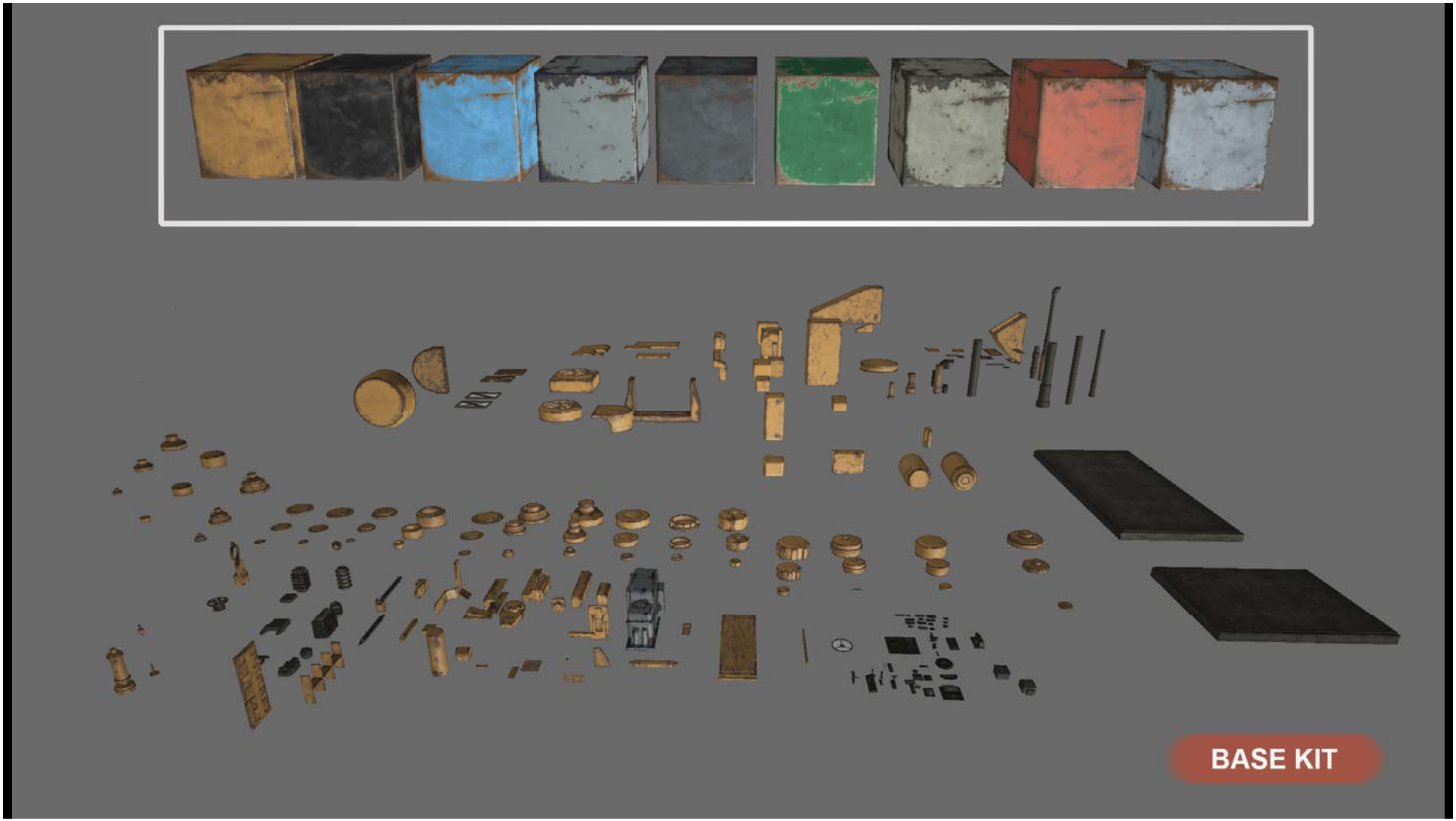



Doors/Holes
Ceiling Markers
Wall Edges

Prop Kits

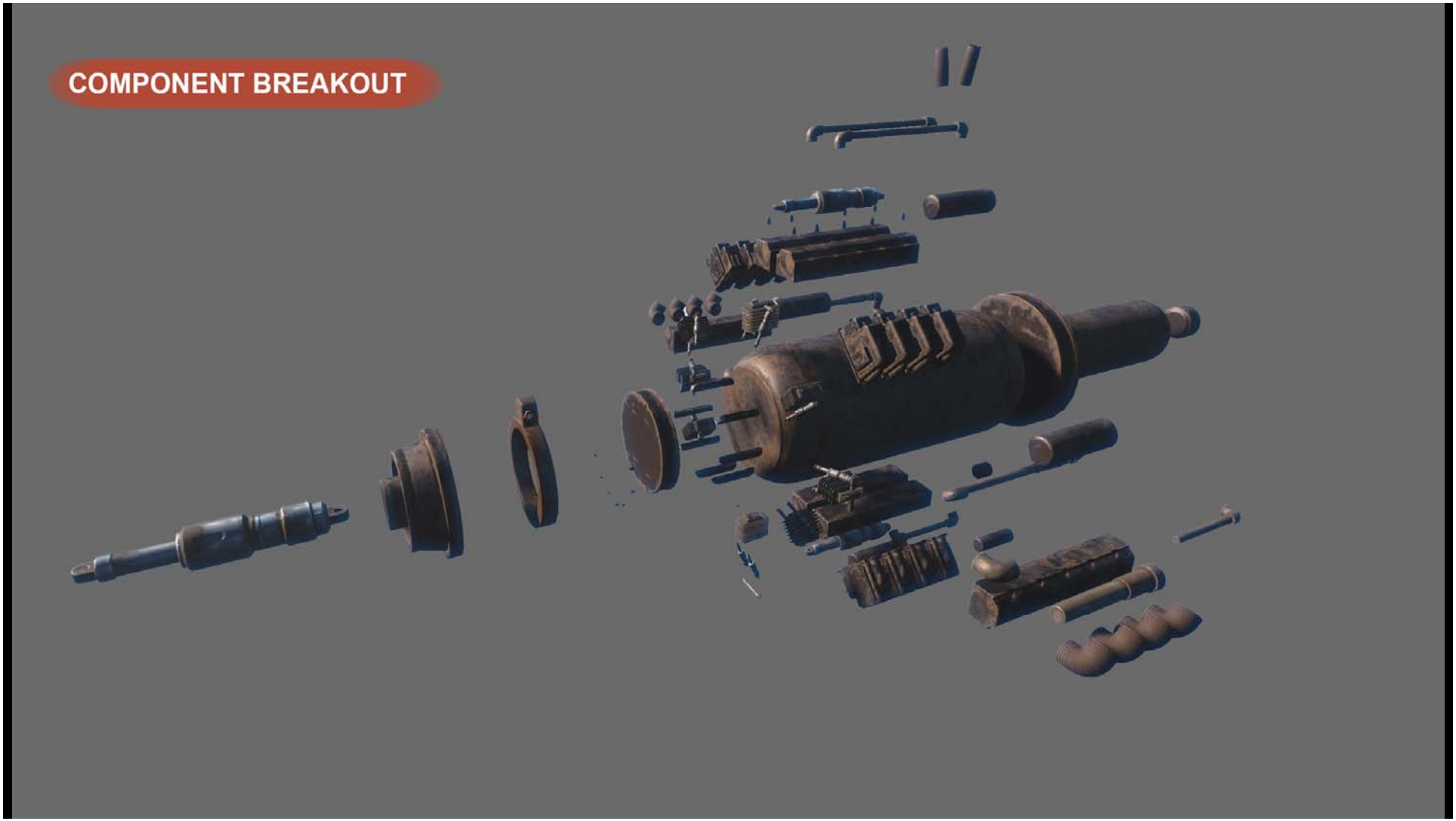
The Machine Kit

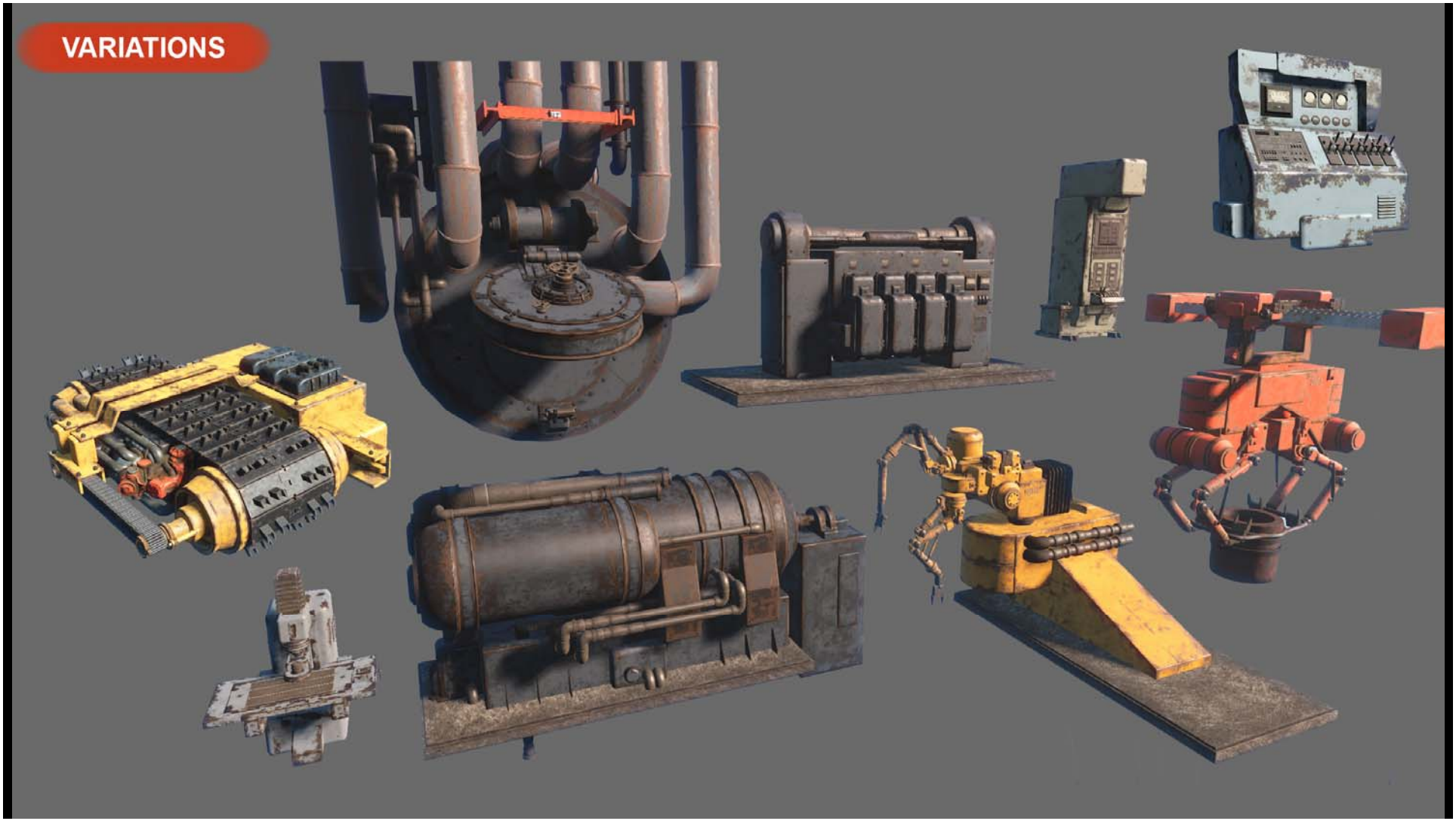
- Large core library
  - Greebles, Fins, Tanks, etc
- LD Blocks Space Functionally
- Artist Handcrafts Machine Swap


BASE KIT

MACHINE PROP

COMPONENT BREAKOUT

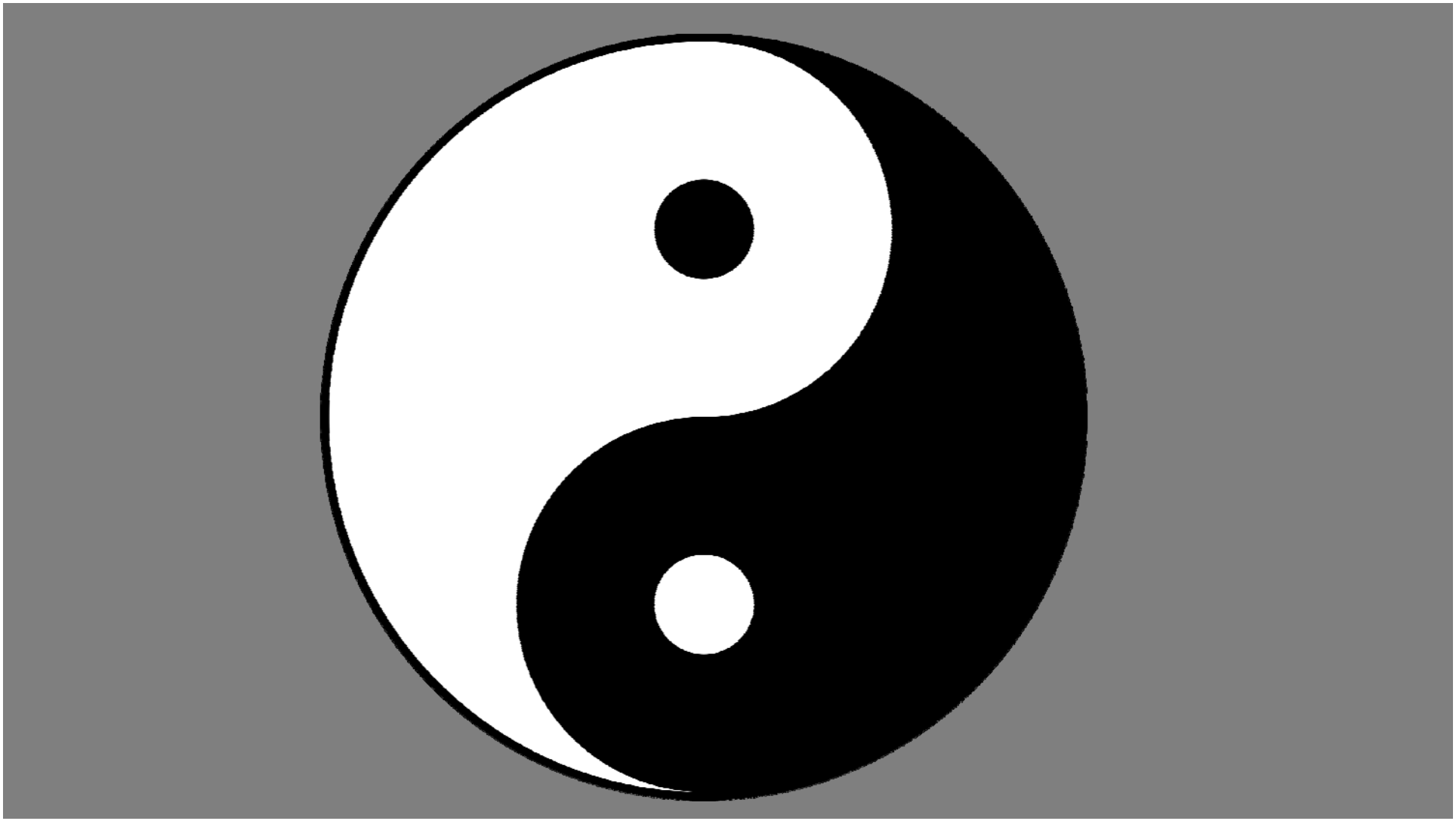



VARIATIONS

VERSATILITY

EXISTING ASSET
ADD-ONS
GASOLINE
DIESEL
FUSION
Shell

Conclusion



Understand Your Team Priorities

Understand Your Game Priorities

Thanks!

Prior Talks

- Modular Level Design of Skyrim (2013)

http://blog.joelburgess.com/2013/04/skyrims-modular-level-design-gdc-2013.html

- Iterative Level Design Process (2014)

http://blog.joelburgess.com/2014/07/gdc-2014-transcript-iterative-level.html