

# The Show Must Go On: The Art and Technology of Virtual Set Design

**David Cohn**

Senior Content Manager | CADLearning/4D Technologies LLC





# David Cohn

- Senior Content Manager – CADLearning/4D Technologies
- Contributing Editor – *Digital Engineering*
- Former editor – *CADalyst*, *Engineering Automation Report*
- Writer – *PC Magazine*, *Computer Graphics World*
- Registered architect – 40+ years
- AutoCAD experience – 35+ years
- Revit experience – 20+ years
- Author – 12+ books
- 30<sup>th</sup> Autodesk University

**CADLearning**  
design your future

**DE**  
Digital Engineering

**cadalyst**  
Get productive with CAD  
and get the job done.

# Learning Objectives

- Learn how to use familiar tools to design unconventional objects
- Learn how to model audience seating to validate sight lines
- Discover best practices for set pieces that move
- Learn how to incorporate animation for animated backdrops and special effects.



# What is a Set and what does it do?

## *Set design*

The creation of the physical space in which the action of a performed event takes place. Primarily used to describe theater productions, it constitutes all the scenery, furniture, props, appearance, and overall look of the stage.

- Every aspect of the set design is meant to further the director's vision of the show.
- The director is my client.



# Differences between building design and set design

- Budgets for the set are extremely limited (\$1,000 - \$1,500 per show)
- Construction time frame is very short (3 hours/day, 2 days/week, 4-6 weeks)
- Rehearsals take place on stage while the set is being built
- It looks solid but it's not – BUT it still must be structurally sound
- Unless it's a static set, IT HAS TO MOVE
- All areas where action takes place MUST be visible to everyone in the audience
- It must conceal the backstage area
- Actors must be able to safely move around the set (both on-stage and backstage)
- The lighting designer must be able to light all areas where action takes place
- The entire set must be demolished within hours of the final performance (and as much material salvaged as possible)



# My rules of set design

- The set is a character
- It's not JUST community theater
- If the set moves, it better so do QUICKLY





# Where do you start?

- The script
- The director
- The theater

DIRECTOR



# **The Sound of Money**



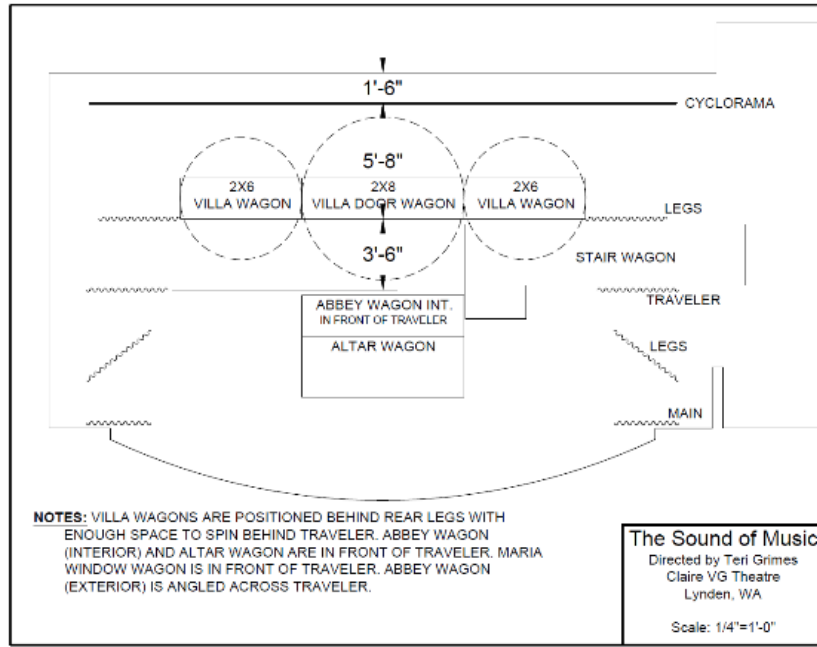
# ***The Sound of Music***

I started out using an old-style approach—building a scale model.



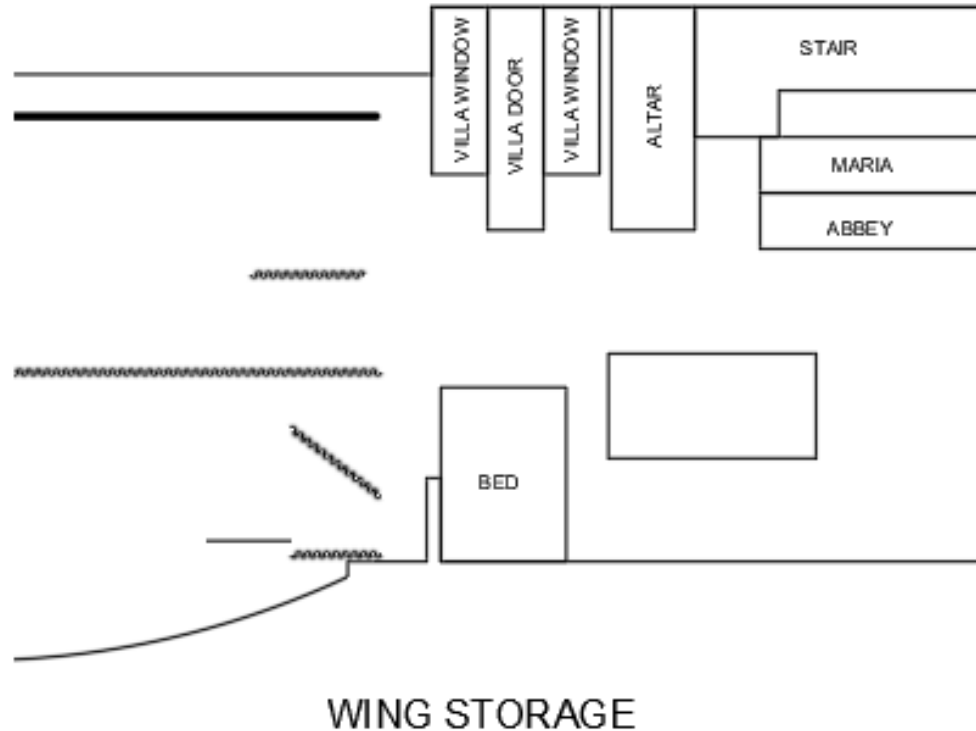
# The Sound of Music

Then, I switched to using AutoCAD.

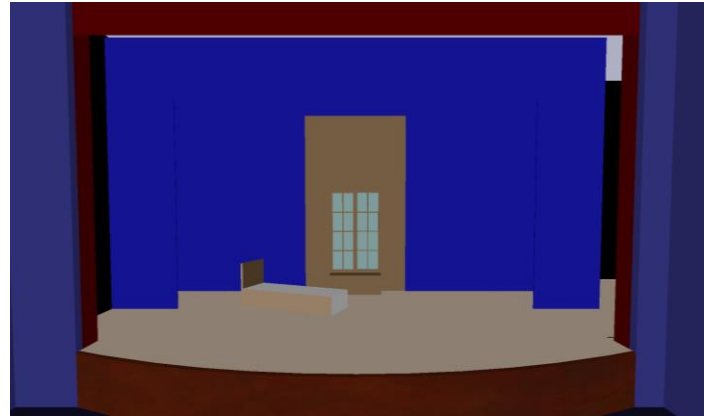
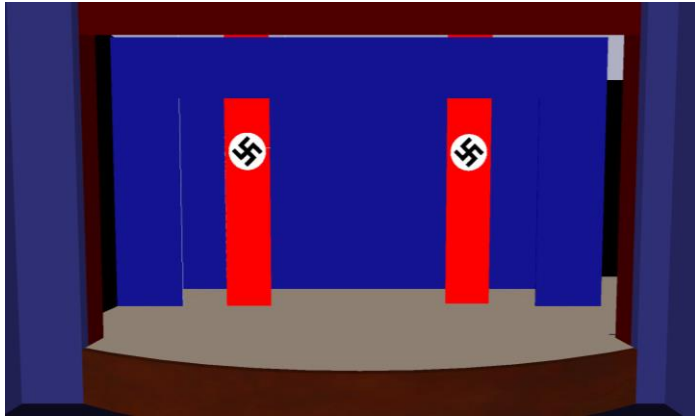
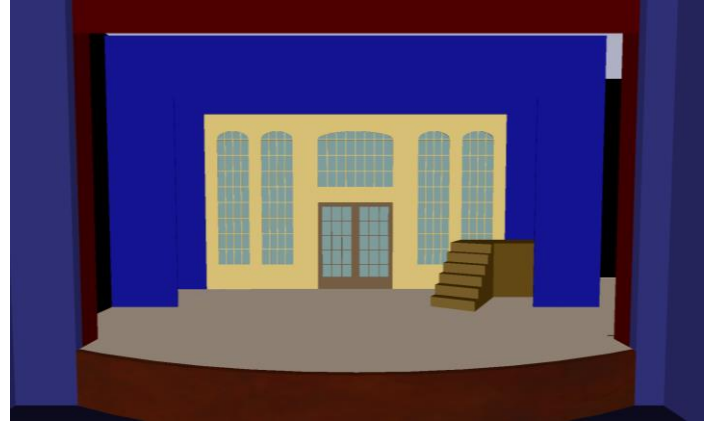
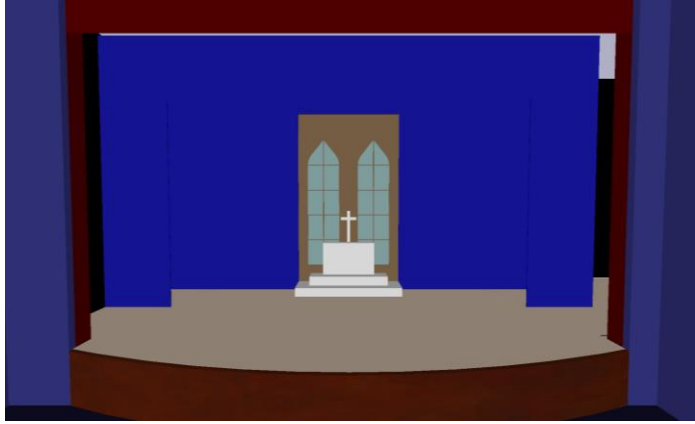


# ***The Sound of Music***

How to store the wagons



# ***The Sound of Music***



# ***The Sound of Music***



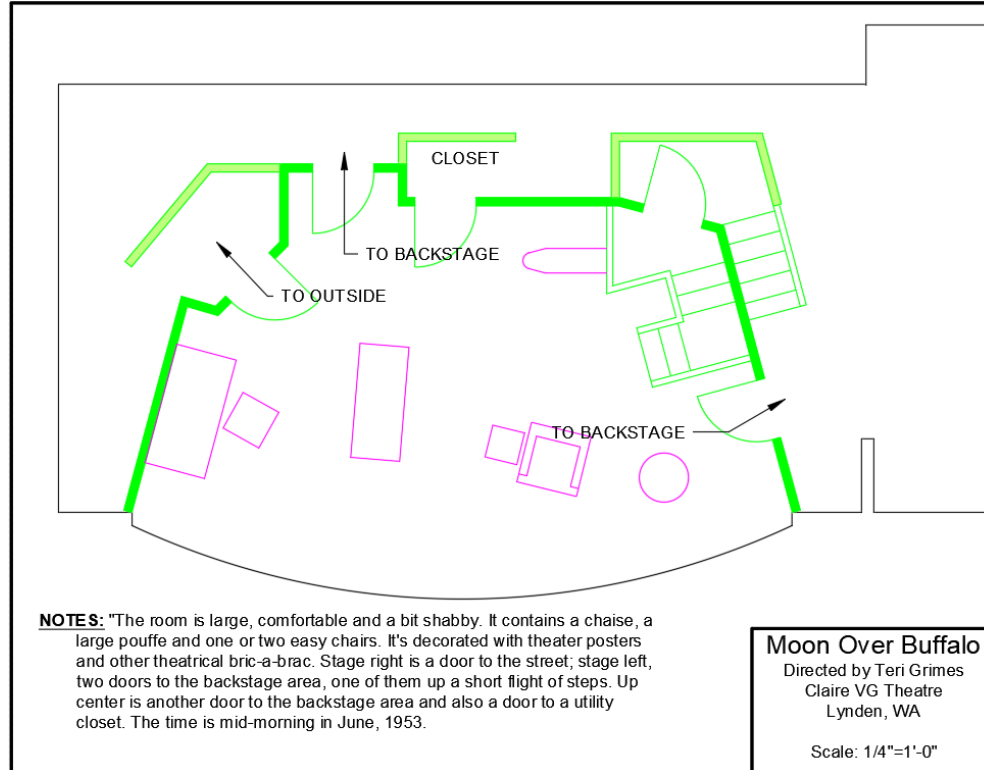


# **A 5-door Comedy**



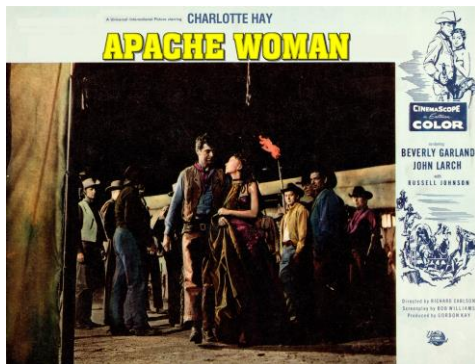
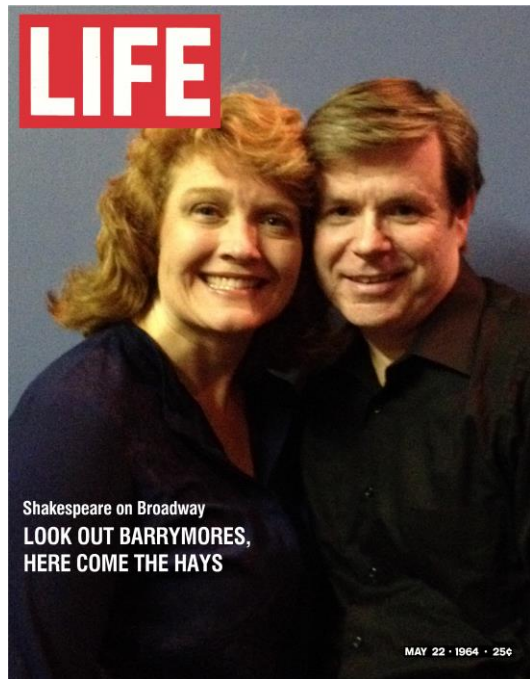
# Moon Over Buffalo

Drawn in 2D using AutoCAD



# Moon Over Buffalo

I took advantage of the fact that I was currently reviewing a wide-format Epson printer



# ***Moon Over Buffalo***



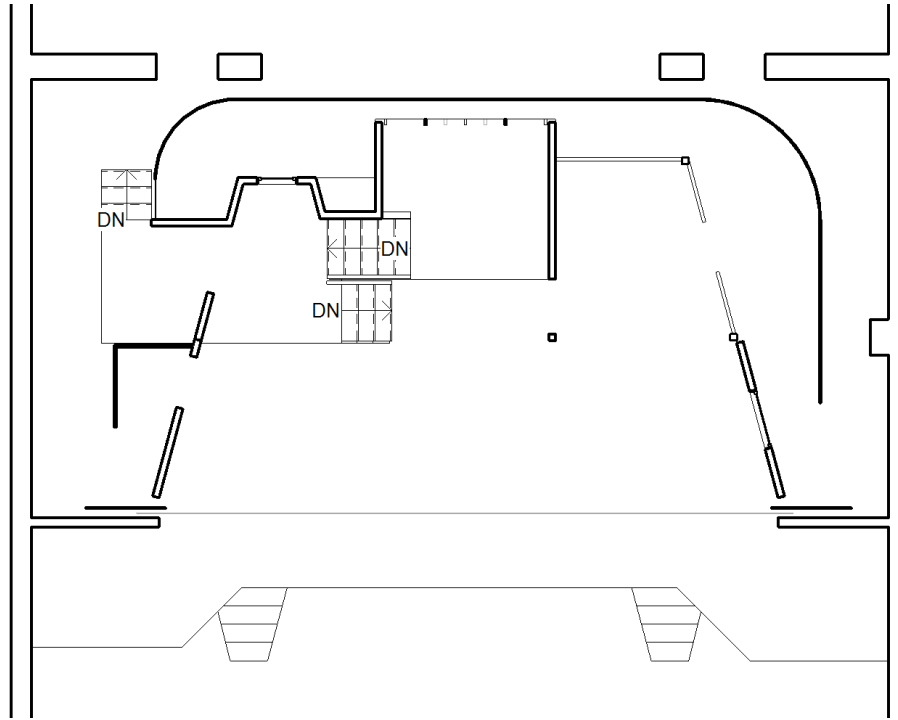


# **Building a House on Stage**

# ***August: Osage County***

A rambling country house outside Pawhuska, Oklahoma. The house must be 2-stories plus an attic and an outside porch

- A challenge on a small stage with a proscenium that measures only 12'-3" high

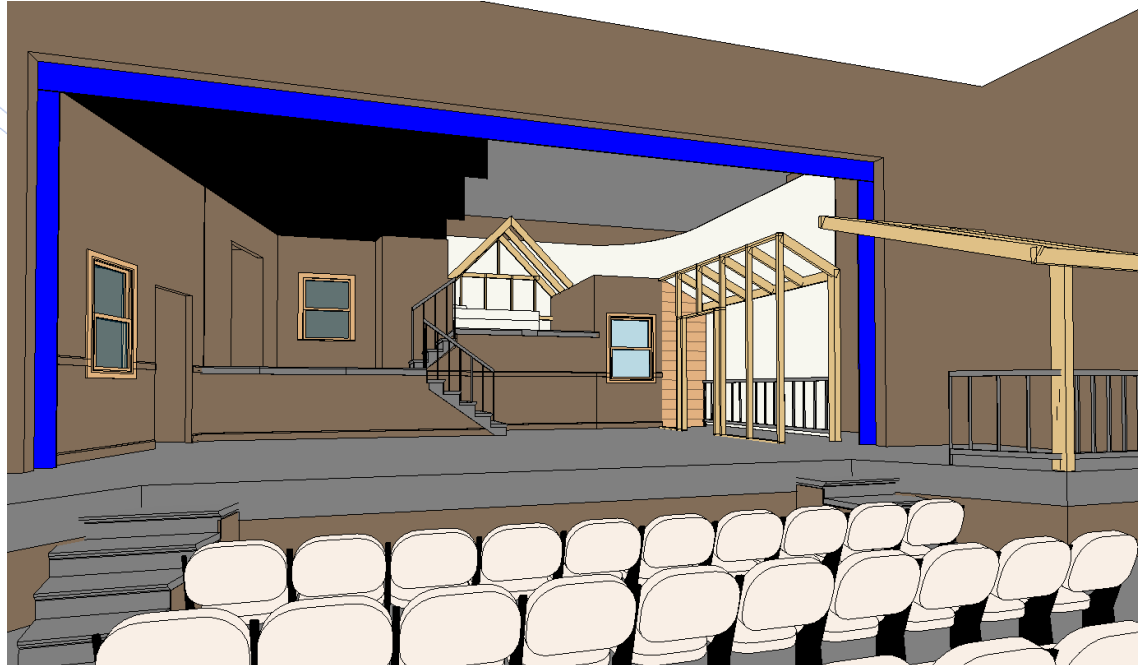


# ***August: Osage County***

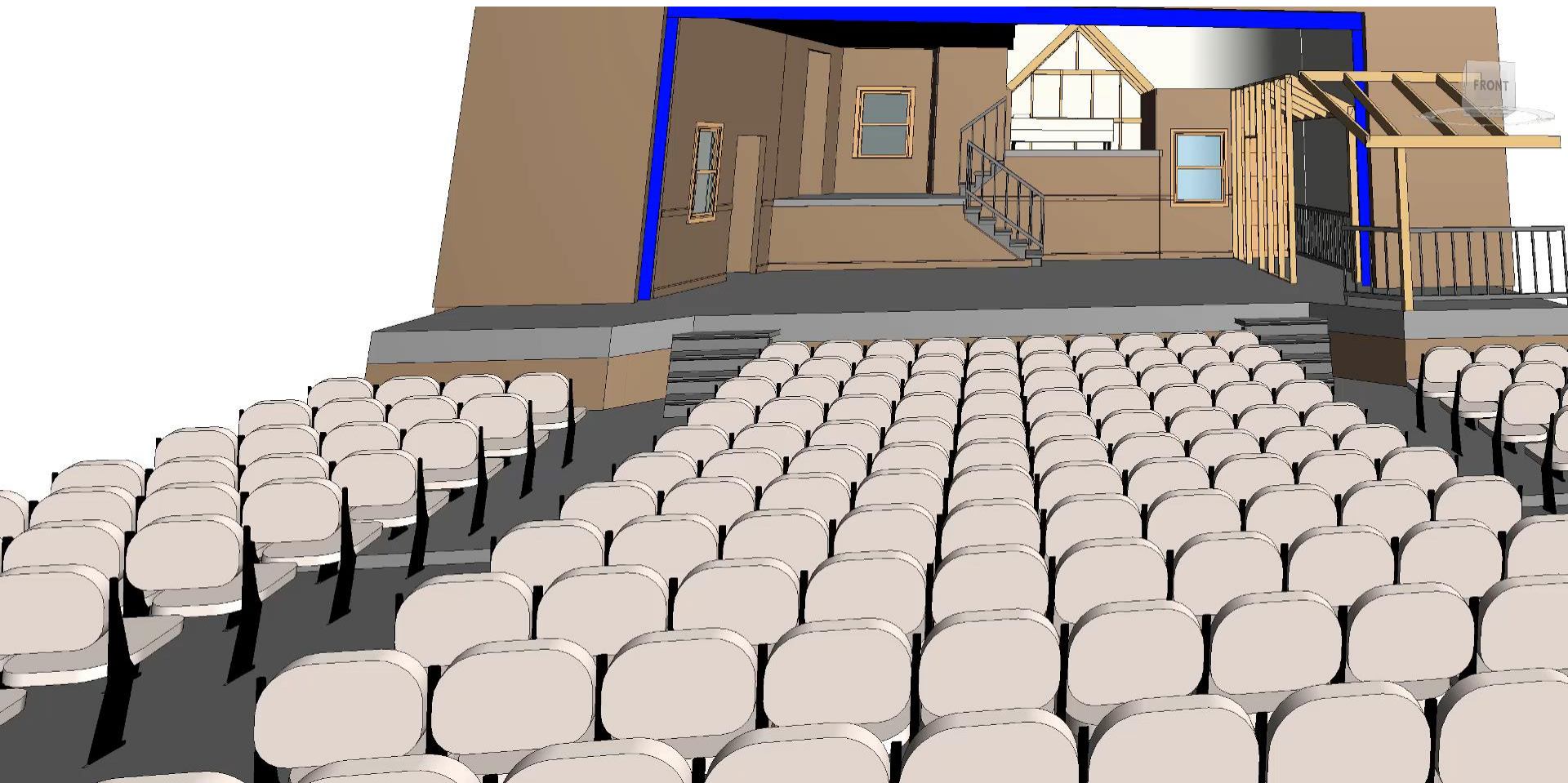
The director was concerned about site lines.

Solution:

- Model every seat in the auditorium
- Place a camera in any seat location







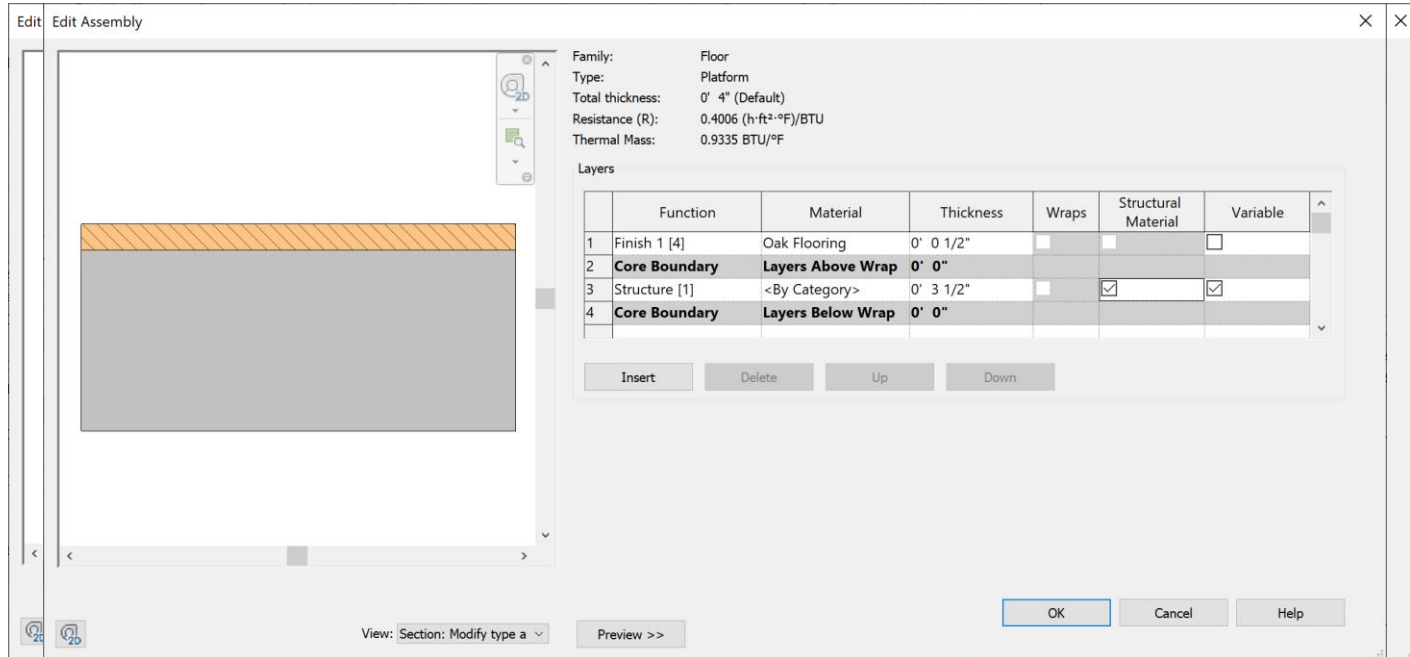
# August: Osage County

Set walls are **still** Revit walls.

- Flats: 3/4" lumber with 1/4" plywood

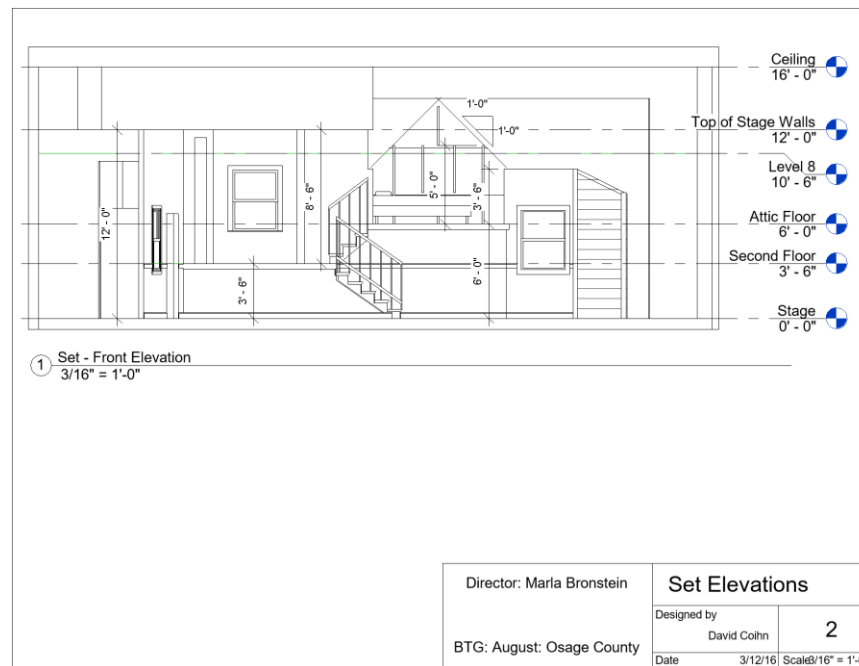
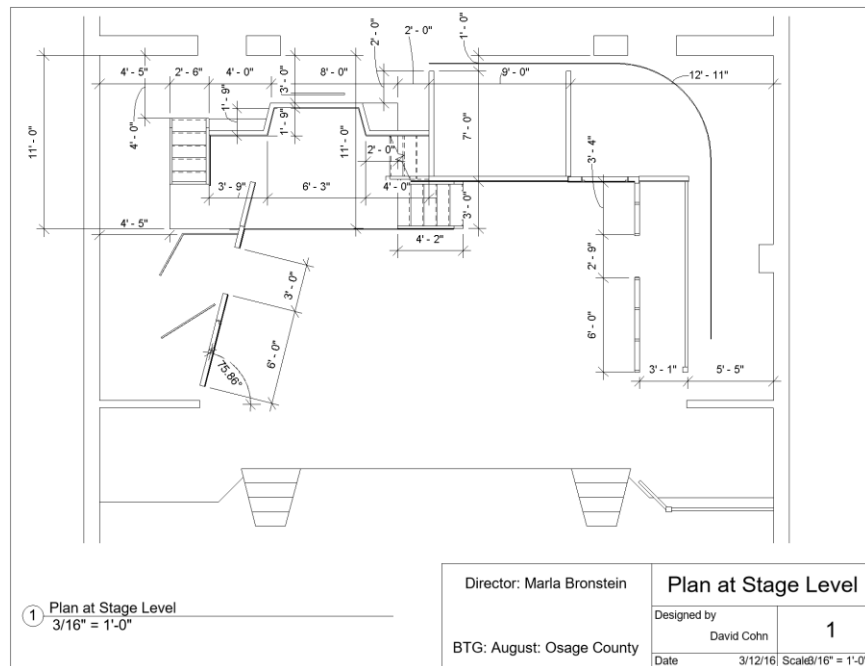
Floors are **still** Revit floors.

- Modules: 4'x8' units consisting of 1/2" plywood on 2x4 frames

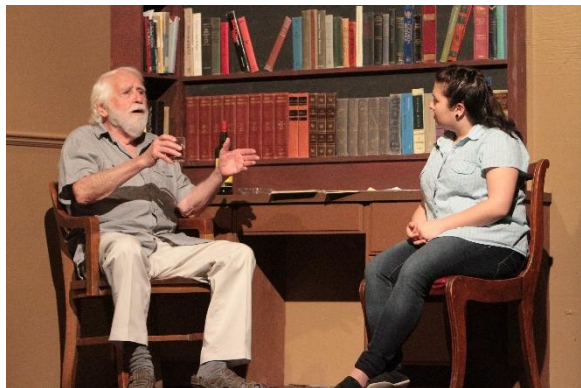


# August: Osage County

Quickly produce a complete set of dimensioned construction documents for the set construction crew.



# ***August: Osage County***



# **Making a Set Disappear**

# A Shayna Maidel

The interior of an apartment on New York's West Side

- Dream sequences led me to a design featuring a *raked* (sloped) floor and cutaway walls



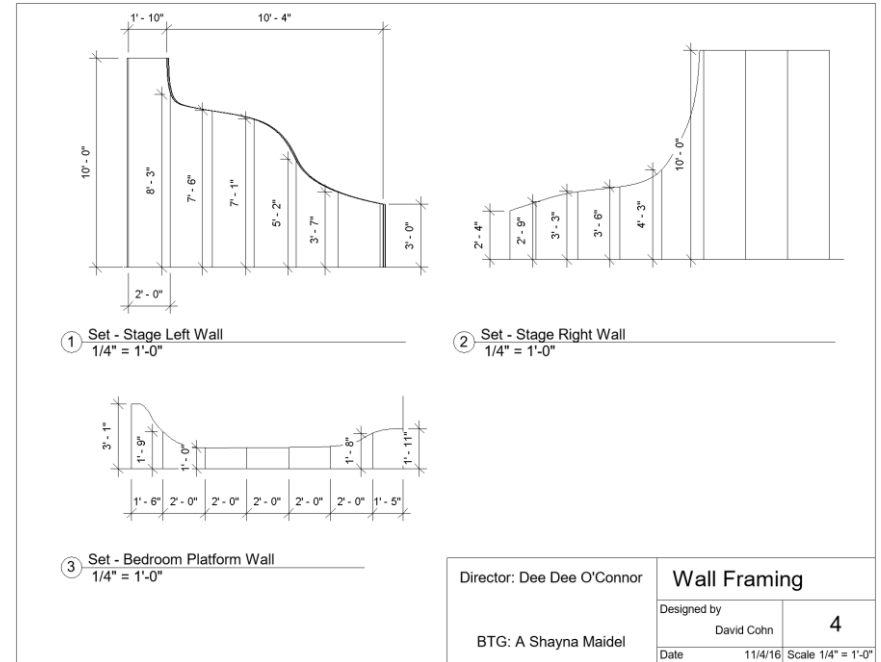
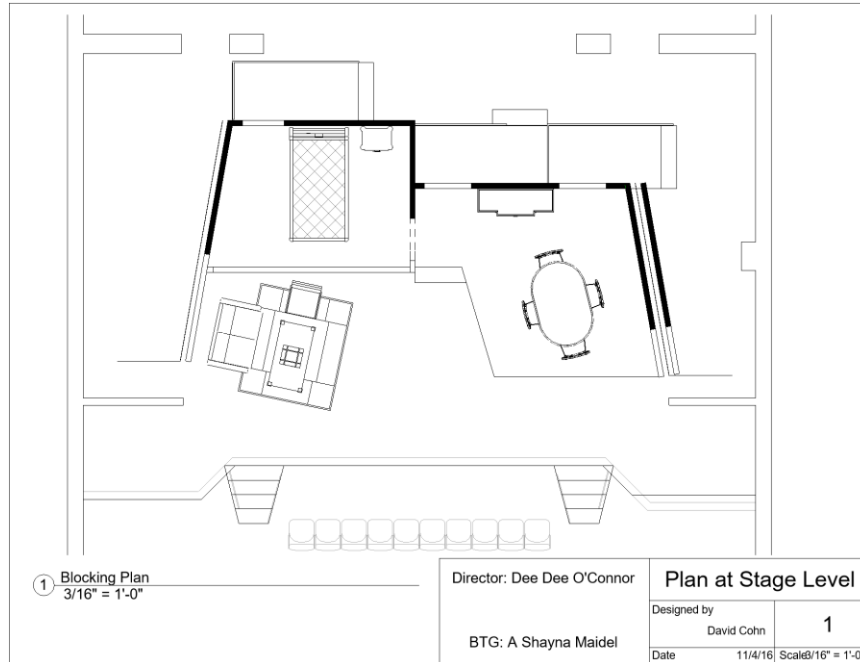


# ***A Shayna Maidel***



# A Shayna Maidel

Revit enabled me to again deliver dimensioned plans and elevations.



# A Shayna Maidel





# **Building a House that Moves**



# Noises Off

A house that is truly 2-stories:

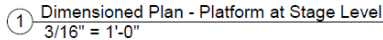
- Upstairs doors stacked over those below
- Three stairs (one facing the audience and two backstage escape stairs)
- **The entire set must revolve 180-degrees**

And a challenge:

- Can I turn the entire set as a single unit?



- I first used AutoCAD to work out the geometry
- I then used Revit to model the set in 3D





# ***Noises Off***



# Noises Off

- It took 500 man-hours to build “the beast”
- Actors rehearsed in a separate space until it was complete
- The set weighed approximately 2 tons
- It took five stagehands less than 30 seconds to rotate the set



# ***Noises Off***





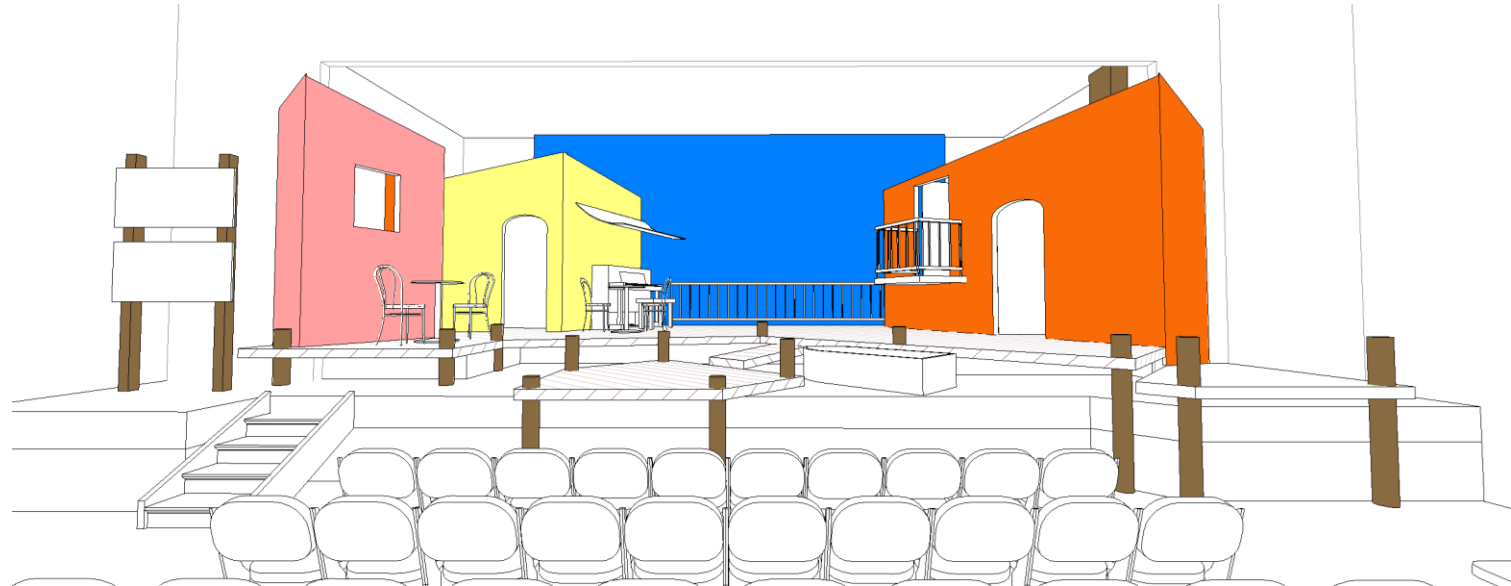
# **Adding VR to the Mix**

# Scapino

A zany farce (in the *commedia dell'arte* style)

My concept:

- A cartoon rendition of a small Italian fishing village
- Break the “fourth wall” by extending the set into the audience space
- All the walls slope (before Revit supported sloping walls)



# ***Scapino***





# Scapino







# **When Sets Must Move**

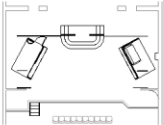
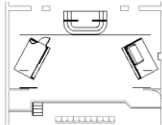
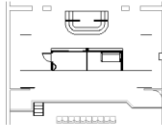
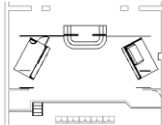
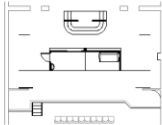
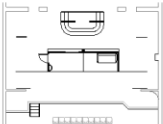
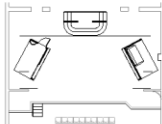
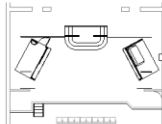
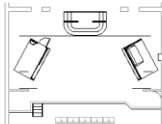
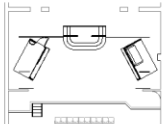
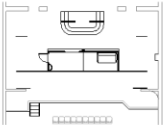
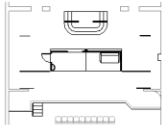
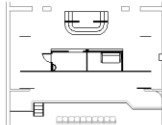
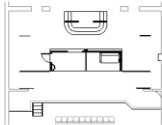
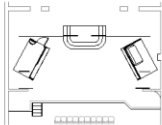
# La Cage Aux Folles

Musicals often have scene changes between—or sometimes during—musical numbers.

- Five different set configurations
- A total of 15 scene changes

The solution:

- **Design Options**

				
① p1 (Theatre) A1s1 1" = 30'-0"	② p15 (Backstg) A1s1 1" = 30'-0"	③ p18 (Apt) A1s2 1" = 30'-0"	④ p23 (Theatre) A1s2 1" = 30'-0"	⑤ p25 (Apt) A1s3a 1" = 30'-0"
				
⑥ p37 (Prom) A1s4 1" = 30'-0"	⑦ p43 (Backstg) A1s5 1" = 30'-0"	⑧ p48 (Theatre) A1s5a 1" = 30'-0"	⑨ p55 (Backstg) A1s6 1" = 30'-0"	⑩ p57 (Theatre) A1s6a 1" = 30'-0"
				
⑪ p59 (Prom) A2s1 1" = 30'-0"	⑫ p68 (Apt) A2s2 1" = 30'-0"	⑬ p82 (Prom) A2s3 1" = 30'-0"	⑭ p89 (Apt) A2s4 1" = 30'-0"	⑮ p94 (Theatre) A2s5 1" = 30'-0"

Notes:  
This page shows the sequence of scene changes so that the production crew can better understand how the platforms and traveler curtains will need to move.

Director: Zoe Bronstein and Kathy Peacock		Scene Changes	
BTG: La Cage aux Folles		Designed by David Cohn and David Duncan	13
Date	7/10/18	Scale 1" = 30'-0"	

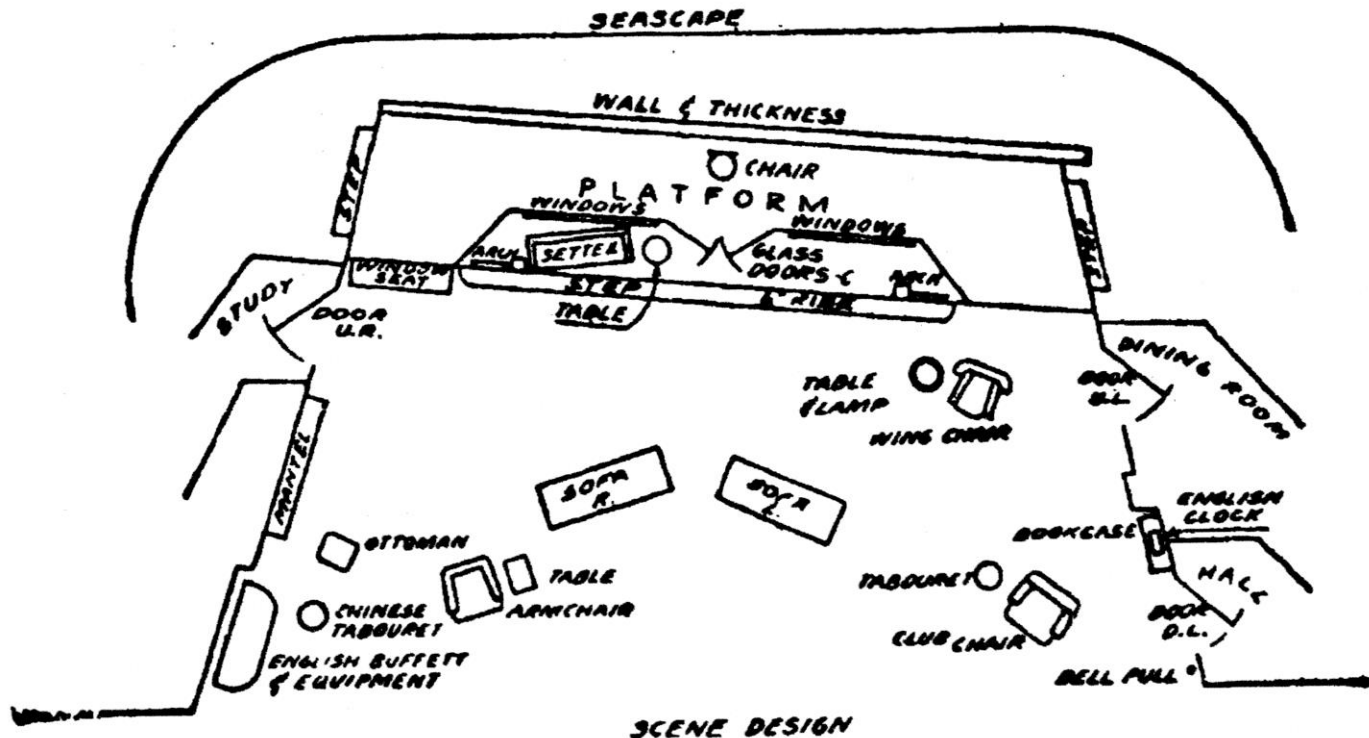
# ***La Cage Aux Folles***



**And Then There Was Rain**

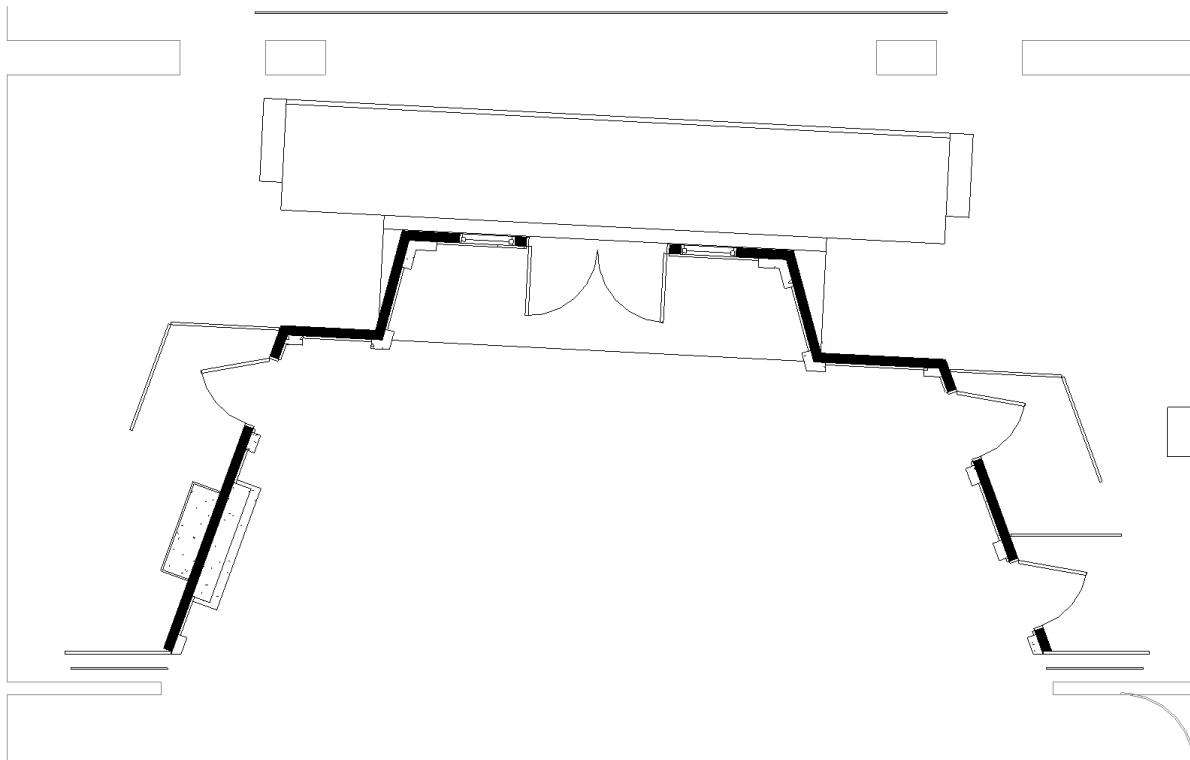
# And Then There Were None

The script included a detailed plan, showing exactly where doors needed to be located and their direction of swing.



## ***And Then There Were None***

I matched my design to this as closely as possible



# ***And Then There Were None***

But came up with a design style calling for lots of marble





# ***And Then There Were None***

I also got my 4D co-worker, Steve Schain, to create a series of animations and projected them onto a screen visible through the windows and French doors.



# ***And Then There Were None***

I also created a system to make it rain real water onto those windows and doors.



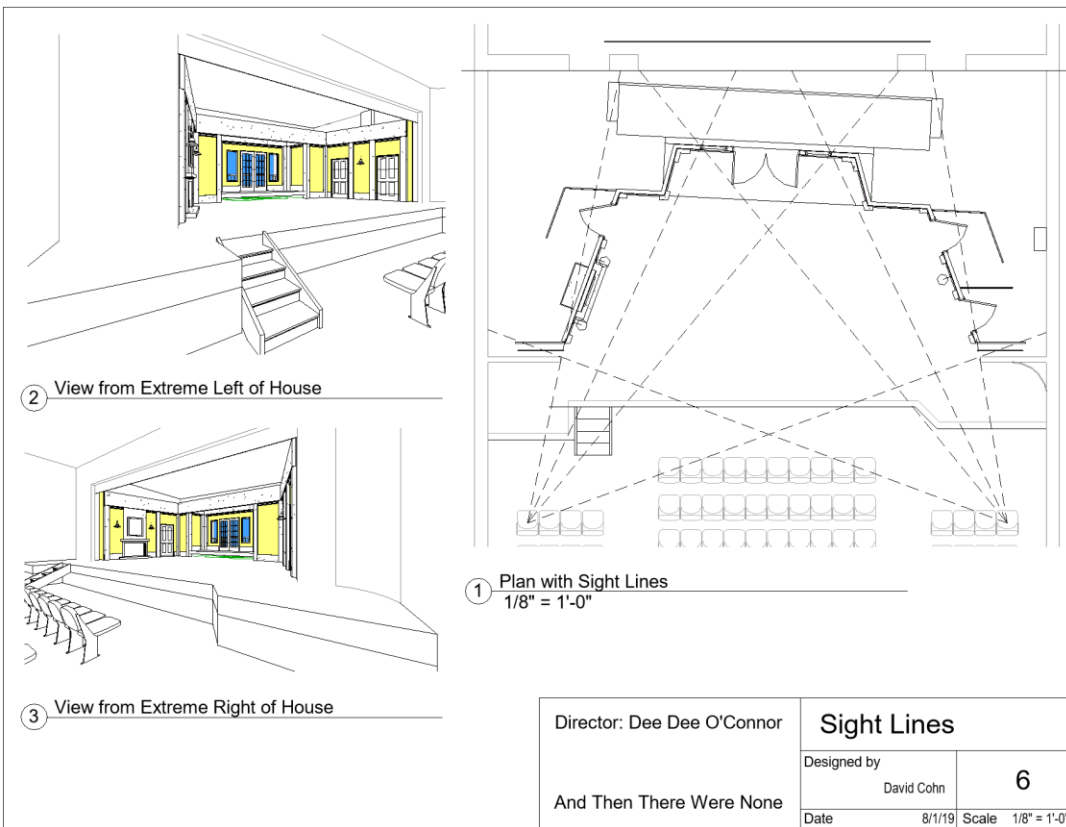
# ***And Then There Were None***

The combination of animated weather and real rain was incredible effective.



# And Then There Were None

Again, sight lines were very important. You don't want any ticket holder to feel that they're missing a clue because they can't see what's happening in a scene.





# ***And Then There Were None***

And just to make things interesting, the final character to die hangs herself on stage.



# ***And Then There Were None***



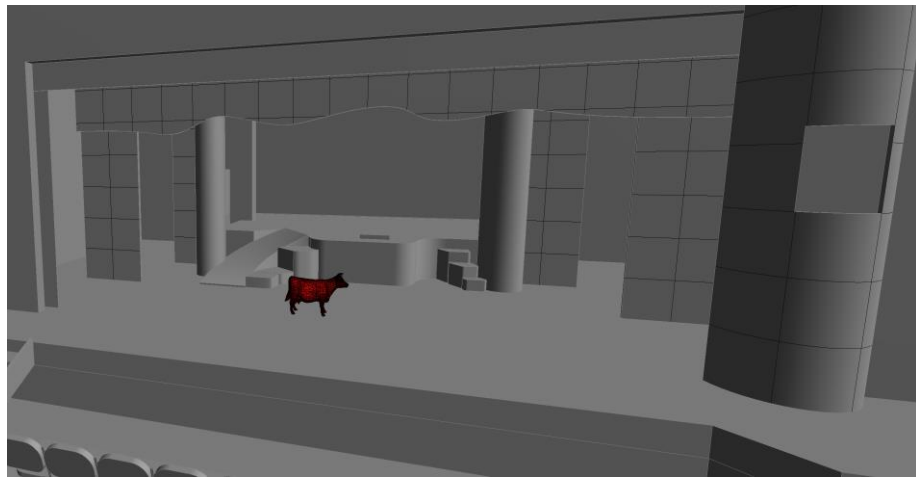




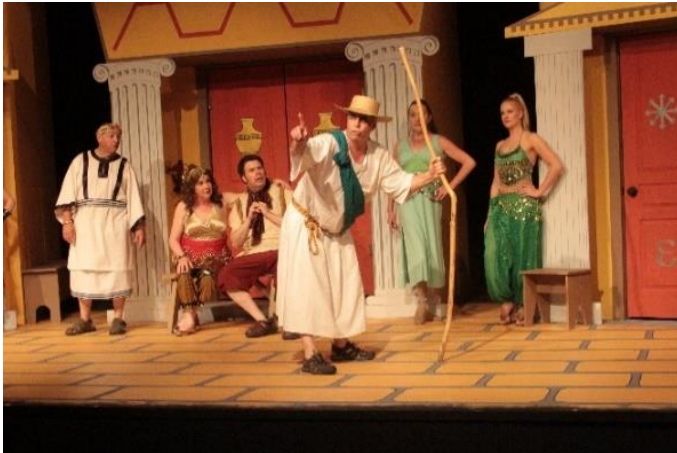
**What Happens Next?**

# 2021 – 2022 Season

- ***Proof*** – a static set (the back porch of a mathematician's house in Chicago)
- ***Scarecrow for Hire*** – 1930's film noire (entirely rear-screen projection)
- ***Vino Veritas*** – a static set (a living room in an upscale house)
- ***Into the Woods*** – rear-screen projection, front projection, raked set platforms, Rapunzel's tower, fairy tale cottages, a castle, giants, bean stalks, Milky White cows, hens that lay golden eggs, Little Red Riding Hood and a wolf who eats her, levitating witches—all set to an amazing score by Steven Soundheim



# And occasionally...I act



The background of the slide features four abstract, dark gray, three-dimensional geometric shapes in the corners. These shapes resemble stylized, faceted crystals or architectural elements, each with sharp edges and reflective surfaces that catch the light, creating bright highlights and deep shadows. They are positioned in the top-left, top-right, bottom-left, and bottom-right corners, framing the central text.

# AUTODESK UNIVERSITY

Autodesk and the Autodesk logo are registered trademarks or trademarks of Autodesk, Inc., and/or its subsidiaries and/or affiliates in the USA and/or other countries. All other brand names, product names, or trademarks belong to their respective holders. Autodesk reserves the right to alter product offerings, specifications and pricing at any time without notice, and is not responsible for typographical or graphical errors that may appear in this document.

© 2021 Autodesk. All rights reserved.