A POST-MORTEM ANALYSIS OF PRODUCTION PROCESS:

THE BRICKLAYER'S DISASTER

A Thesis

by

NATHAN THOMAS BAJANDAS

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2011

Major Subject: Visualization Science

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Approved by:

Chair of Committee,	Frederic Parke
Committee Members,	John Keyser
	Ann McNamara
Head of Department,	Tim McLaughlin

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ABSTRACT

A Post-Mortem Analysis of Production Process:

The Bricklayer's Disaster. (December 2011)

Nathan Thomas Bajandas, B.S., Texas A&M University

Chair of Advisory Committee: Dr. Frederic Parke

This thesis is focused on the worthwhile lessons learned while creating a short animated film. The conventional way of teaching related to practice is to have students work on projects and learn from their own experience. This thesis strives to save the reader some of the pain, time, and effort required of this learning style, by presenting the hard learned lessons from this project. An overview of the project is provided, along with a reconstructed time-line. Also, each member of the team recounted their own dilemmas and successes on the project, and proposed potential solutions to problems encountered along the way. The findings are presented in the spirit of a post-mortem analysis, which acts to collect the knowledge obtained by those involved with a project in order to increase productivity for the next time a similar task is attempted. The post-mortem approach was found to be effective in identifying, illuminating, and articulating the lessons learned concerning general, practical, team-related and problem solving issues encountered while working on a short animated film.

DEDICATION

To my pneumatic mom

ACKNOWLEDGEMENTS

I would like to take a moment to thank my committee chair, Dr. Fred Parke, for all his help throughout the discovery, development and delivery of this thesis. I would also like to thank the *Bricklayer* team for all of their help and feedback during the post-mortem. Finally, I would like to thank the brothers in College Station for praying and bearing the burden of this thesis along with me.

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CHAPTER I

INTRODUCTION

Students being educated in visualization learn many lessons not taught in the classroom. But year after year, they relearn many of these same lessons for themselves on their projects, typically by trial and error. My thesis is an attempt to teach the lessons we learned on a specific project, so that the reader may learn such lessons from our mistakes and successes without having to go through the pain that taught us. This resulting document is intended to pass on the knowledge we gained while creating *The Bricklayer's Disaster*. As such, the lessons that are taught are on the side of practice rather than theory. Additionally, this document is able to perform its function when we are no longer present in the program. My hope is that those following after us can utilize what is passed on as a basis to go on to learn things we could not.

When a project is finished many of the lessons that were observed and learned are left disorganized and vague as those who worked on the project move forward to their next project. As those of us who worked on *The Bricklayer's Disaster* discussed and analyzed the problems and solutions of the project for the post-mortem analysis, the lessons we learned were clarified in our own understanding. This clarification of what we learned was an auxiliary benefit of this thesis.

I.1. Prior Work

The most similar work I found relating to my thesis was a document that

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This thesis follows the style of *IEEE Transactions on Visualization and Computer Graphics*.

Rochester Institute of Technology (RIT) requires, along with the thesis, for their MFA in the school of Film and Animation. Students are required to produce a short film and then write a report which describes their process, in a post-mortem-like format[1]. The required document has little prescribed structure but contains similar information. RIT maintains a library of all of their previous thesis reports that is available to enrolled MFA students.

Post-mortems are a widely accepted form of education within the ranks of the electronic gaming industry. The Game Developers Conference (GDC) in 2011 had a special keynote presenting post-mortems of some of the most important games ever made, including *Pac-Man* and *Doom*[2]. *Gamasutra* and *Machinima*, two websites providing news and resources to the gaming community, both conduct post-mortems and publish their findings. *Gamasutra* publishes post-mortems several times a year in their "features"[3]. *Machinima* has a *youtube* channel dedicated to post-mortems as well[4].

Post-mortems of a more academic nature do exist. In 1996, Collier, DeMarco and Fearey proposed a formalized method for organizing post-mortems to provide guidance on how they are to be conducted[5]. Torgeir Dingsøyr has multiple publications based on his research on practical implementation in software development[6][7][8]. Dingsøyr explores post-mortem methodologies as well as reasons for conducting them, including learning from success, recovering from failure[6], and harvesting and organizing knowledge[8]. His main method for collecting data is the implementation of "The KJ Method" as expounded by Scupin[9]. Simply put, the KJ Method is a group-oriented brainstorming technique. Dingsøyr actualizes the KJ Method in an exercise

described in his paper on lightweight post-mortems[8]. He proposes that the group meet with two researchers, the person conducting the post-mortem and one who is acting as a secretary. Each person who worked on the project is given three to five post-it notes, depending on how many people are involved. Each participant is asked to write down one problem that arose during the project. Going around in a circle, each person presents an issue from one of his or her post-it notes and places it on a marker board. Once all of the post-its are up, the group categorizes them. Finally, they utilize a Root Cause Analysis technique called Ishikawa or fishbone diagrams. Below is the Ishikawa diagram for the issue "changing requirements" from the same paper[8].

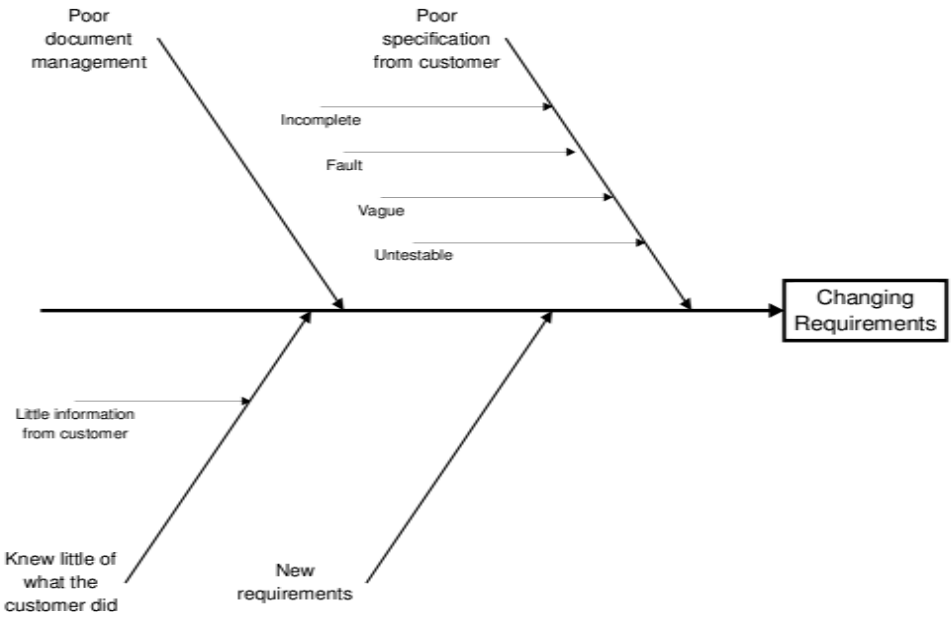


Fig. 1. Fishbone diagram from [8].

In Fig. 1, issues on post-it notes might be "changing requirements during development" and "unclear customer requirements." The category the group puts them

into is “changing requirements.” The goal here is to determine the root cause of a problem. Once it is identified, appropriate action can then be taken as a solution. Dingsøyr's approach is not to deal with “symptoms” but with the deeper underlying factors. His method seeks to cast light in that direction. The final step is to produce a document that contains two sections. It begins with an “introduction and description of the project” and then describes problems with proposed solutions [8].

I.2. Methodology

The methodology for this thesis is an adaptation of Post Mortem Analysis (PMA) as discussed above. As many of the methods and examples used in describing formalized post-mortem analysis are aimed specifically at software development, I applied the spirit of what is conveyed in this approach to our animated film production. The post-mortem as applied to software development is a tool used to iteratively increase productivity within a team. Since we will likely never work together as a team in the way we did on *The Bricklayer's Disaster*, the resulting document is not so much for our benefit, but for those aspiring to attempt similar tasks.

Similar to the post-mortem methodology is the *case study*. According to the Oxford English Dictionary, a case study is a record of “the attempt to understand a particular person, institution, society, etc., by assembling information about his or its development”[10]. The case study and the post-mortem are similar in that they both work to document a particular case or set of experiences in order to shed light on that topic. As such, they may take advantage of surveys, interviews, and collecting artifacts as a

means of data collection. Another similarity between the case study and the post-mortem is that data collected may be idiosyncratic to the case itself and not generalizable. For both the post-mortem and the case study, after the data is collected and analyzed, a determination of whether or not each conclusion drawn from the data is idiosyncratic to the case itself or can be generalized must take place.

In a case study, those conducting the research are third parties in relation to the subject matter, whereas a post-mortem is conducted by those directly involved with the project. The post-mortem's goal is to collect "explicit data." It is not so much to come up with ideas during the process, but to gather what has already been perceived by those directly related to the matter as a result of their experience. The residue of a project is the lessons learned along the way and a post-mortem analysis works to harvest this information.

The general components of PMA are data collection, data analysis, and publication. Data can be collected by way of surveys, group discussions, documents, sketches, interviews, etc. It is helpful to gather objective, measurable information, along with opinions of group members. The analysis can happen in the same session as the data collection because the people you are collecting the data from are also the best people to analyze the data. The publication of the data is for the purpose of clearly laying out the lessons learned so that future readers may easily access the knowledge you wish to pass along.

When we set out to make *Bricklayer*, our goal was simply to make a short film, not to learn. We did however pick up useful information by the time we finished. This

post-mortem is designed to gather, distill and present what was learned while working on *The Bricklayer's Disaster*. Data was collected from the participants in the project through informal talks and meetings. Also, artifacts from the project, any work done which was not part of the final piece, was collected. Afterwards, the group discussed the data to find insights worth passing on, either things to avoid or things worth repeating. Finally, this thesis was produced publishing the lessons deemed worthwhile.

CHAPTER II

POST-MORTEM CONTEXT

This chapter provides history and background that will help put the post-mortem into context. The context given in this chapter will help the reader fully understand the *Lessons Learned* chapter.

To familiarize the reader with the persons involved in this project, a description of each major contributor's roles is given. There are additional people who were auxiliary to the project who will be mentioned in the post-mortem discussion along with the roles they played.

A time line of the events relating to *The Bricklayer's Disaster* has been reconstructed, starting from the inception of the project and ending with the decision to make it my thesis. Undoubtedly there are events or aspects of the project that have been forgotten. But all major events as well as all details that could be remembered by myself or anyone else in the group are recorded.

Also included is an overview of the *Bricklayer* itself. It describes the story idea, character, props and setting of the story for those who may not be familiar with the piece.

Artifacts of the project, any items which were created in the of making this animation, were gathered. These objects are mainly in the form of images, video files, and documents, with an occasional photo or sound file. Many of these artifacts are displayed and described as a means to help the reader further understand what is being discussed. Others are appended at the end as additional material relating to *Bricklayer*

generally.

Discussions were conducted, formally ands informally, in groups or one on one, in efforts to glean information and thoughts from the various team members. These discussions relate to several sections of this document and therefore do not have their own dedicated section. The content in the *Lessons Learned* chapter of the post-mortem was especially bolstered by these discussions.

II.1. Story Idea

The plot of *The Bricklayer's Disaster* is based upon the urban legend *The Bricklayer's Lament.* In the story, a bricklayer is clarifying to a third party the events which followed his "poor planning" as he attempts to move 500 pounds of bricks down from the roof of a tall building. His plan is to fasten a rope to a tree, loop it through a pulley and tie it to a barrel. He then was to swing the barrel out, fill the barrel with the bricks, and then lower the barrel slowly to the ground. The story starts to become interesting when the bricklayer unties the rope from the tree. At this point, the bricklayer calmly reminds the audience that he only weighs 135 pounds. Not having the presence of mind to let go of the rope, he rockets up the side of the building. His journey to the top is only briefly deterred by his collision with the barrel which is plummeting downward. As he reaches the pulley, he manages to hold tightly to the rope. Unfortunately, as the barrel collides with the ground, it shatters leaving the bricklayer outweighing the brickless barrel. As the bricklayer plummets downward towards the ground he again meets the barrel coming up before landing on the pile of

bricks. At this point the bricklayer loses his composure and lets go of the rope. The story ends as the barrel rapidly descends towards the pile of bricks, upon which is a very unfortunate bricklayer.

II.2. Crew

Table 1 shows the main contributors and their most important roles. This is followed by detailed descriptions of who contributed to the project and what their contributions were. Task assignments evolved over time, were interwoven, and were not always clearly delineated.

Table 1 – Roles.

Name	Major Roles
Nathan Bajandas	Animation, Project Lead
Jose “Joe” Guinea Montalvo	Modeling, Shading and Rendering
Bobby Huebel	Layout, Sound and Compositing
Ariel Chisholm	Additional Layout
Megha Davalath	Rope Simulation
Mathew “Mat” Sanford	Brick and Barrel Simulation
Robert “Bob” Graf	Additional Shading

II.2.1. Nathan

- Assembled the team and coordinated the team's efforts, including scheduling meetings, etc.
- Made all final decisions on the project.
- Animated everything that was not a physical simulation.

- Drew initial storyboards and recorded the initial sound pass. (Both of these were later replaced by better versions done by Bobby.)
- Simulated the bricks when the character hits the brick pile and the barrel breaking (both were later replaced by Mat's simulation).
- Animated ropes when Megha's rope simulation proved impractical.
- Helped apply Megha's rope simulation solution on a shot by shot basis for most shots.
- Cached rope simulations (saving out simulation data so that it can be used later).
- Laid out UV texture coordinates for the barrel.
- Helped Bobby remove scene elements that were never seen by the camera so that the scene files would be more efficient to render.
- Added Norman's shirt to the existing rig and modified the rig very slightly.
- Tweaked layout minimally and assisted Bobby and Ariel with layout/animation changes.
- Illustrated the form with Norman's skeleton and its progressive breaking.
- Worked on one page of the credits sequence.
- Helped Joe with final rendering.

II.2.2. Joe

- Modeling and shading lead.
- Modeled everything except the bricks and the character.
- UV layout on everything except the barrel.
- Shaded everything except the machete, tree and the butterfly.
- Researched how to put leaves on the tree and have them fit into the aesthetic of the piece.
- In charge of rendering and solving rendering related problems.
- Provided the lighting solution.
- Made every shot renderable from a lighting standpoint.
- Helped trouble shoot problems along the way. Far too many to remember or list.

- Contributed significantly to original story and design decisions, and decisions thereafter.
- Helped direct voice acting.
- Created the first accident report form.
- Researched and implemented the writing of the numbers for the math scenes.
- Came up with the solution for how to break the barrel for Mat to use.

II.2.3. Bobby

- Layout lead.
- Layout for the entire short for the first semester.
- All layout up to the scene when Norman hits the pile of bricks.
- In charge of all compositing, editing, and sound effects.
- Helped direct the original voice actors.
- Performed the final voice acting.
- Made the final animatic.
- Involved with most, if not all, major story and design decisions.
- Doctored up the "section 3" form to make it more form-like.
- Cleaned up scenes for rendering by deleting unused assets.
- General handy-work and other small jobs that no one had on their plate but needed to happen.

II.2.4. Ariel

- Layout for the last 11 shots, from when Norman hits the bricks to the end.
- Bobby also consulted with Ariel on some of his layout work.
- Contributed significantly to story and other major design issues.
- Helped direct voice acting.

II.2.5. Megha

- Developed a general rope solution.

- Implemented her rope solution on every shot required.
- Simulation caching and other rope related problem solving.
- Helped Joe find a texturing solution for the ropes.

II.2.6. Mat

- Barrel breaking simulation and the brick simulation in that shot.

II.2.7. Bob

- Shaded the butterfly, tree, and machete.
- Wrote a mel script that rendered frames locally, saved them, and advanced to the next frame until everything was rendered, which made use of the render farm possible as it was breaking under typical operation.

II.3. Time-line

Each summer, the Visualization program offers a class, VIZA 627, in which an animation studio sends artists to Texas A&M who lead the students through the accelerated production of a short animation using small teams. Artists from Walt Disney Animation Studios came the summer I took the class. I was the animation lead for my group. At the end of the course, I asked the animator from Disney, Doug Bennett, "if in your estimation, you thought I had what it takes to be a feature film animator." In his response was a suggestion that I "get [my] hands on a decent rig, preferably with good basic facial controls, and start doing tests." I took his advice and started looking for a suitable model. The model I decided to use is called Norman[11] (pictured in Fig. 2). The statement related to the rig on the official site is as follows:

Norman is a Maya puppet built unofficially for the Academy of Art University Pixar classes. Since those classes disbanded, we decided he should finally be set loose. Anyone should feel free to use the rig for non-commercial purposes, to edit him and pass him along to your heart's content.
This work is licensed under a Creative Commons Attribution-Noncommercial-Share Alike 3.0 Unported License.

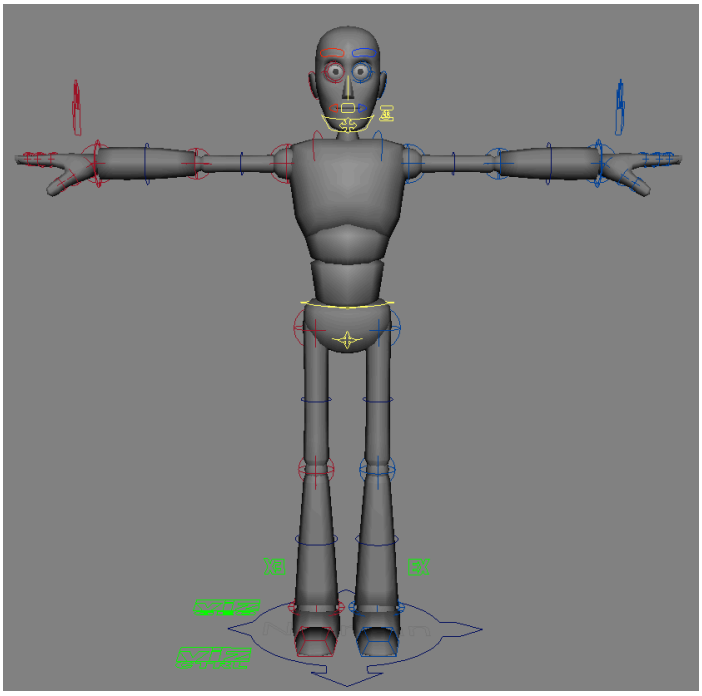


Fig. 2. Norman in his original form in a Maya viewport.

I heard *The Bricklayer's Lament*, a kind of urban legend with enigmatic origins, a few years before. Since that time, the thought to do an animation based on it had crossed my mind a few times. The dialogue for *The Bricklayer's Disaster* is based upon and holds very close to the original text of *The Bricklayer's Lament*.

I was wary of taking on a project of this size for a number of reasons. Most prominent of which was the time commitment involved. Before the Fall semester of 2009 started, I ran the idea past Joe and Bobby about them possibly working on it with

me. Both of them responded quite positively. Bobby officially joined me as layout help in an advanced animation course I was enrolled in which was taught by Dr. Parke. It was decided that I would do one minute of animation with no dialogue for my final project for the class, attempting to tell the story with only visuals.

Concerning the formation of the team itself, Joe, Bobby and I were the primary workers on the project that first semester. The main thing the three of us were doing was working out how the story was going to be told. Joe also modeled some of the final assets during this time. Ariel gave minor feedback to Bobby regarding layout during that semester, but his official joining the project would happen early in the second semester, officially for additional layout. Megha also agreed to do ropes, but on the condition that I animate for her rigging independent study project. I also knew that I would need simulation for the barrel breaking shot, but I didn't ask Mat about doing it until late in the second semester. I also asked Bob near that same time if he could contribute to shading. He worked on the project for two days at the very end, taking a number of shading tasks from Joe's list. This allowed Joe to focus on rendering.

Concerning the barrel breaking, I knew that it would be better if it was simulated rather than animated. It was originally assigned to Joe. As the project progressed, we acknowledged that there was not going to be enough time for him to do everything we originally assigned to him. I began to look for another grad student in the Visualization program who we thought could do it. There was a first year graduate student, Mat Sanford, I knew to be interested in effects and seemed like he would do his job if he agreed to it. I was apprehensive however because he had little experience in simulation.

Once he agreed to do it, I gave him the shot and he gave me back a simulation a week or so later.

For the dialogue, we initially were planning to have Dr. Woodcock, a professor in the Architecture Department with an exquisite British accent, do it. The more we discussed the voice over, the more we realized that there were specific things we wanted it to contain. I asked another student in the Visualization Department, Austin Hines, to do a preliminary reading. I quickly learned that I did not know how to direct voice acting, so for the next session Ariel, Bobby, and Joe directed him. Keeping assumed accents consistent for three minutes seemed to be problematic, so we steered away from that shortly after we started. Many times the reading had too much energy and enthusiasm injected into it. Austin's reading helped us realize that a large portion of the humor of this piece is that it is an articulate description of events caused by ill thought out actions. In the end, as Bobby put it, it needed to sound like he didn't know he was being funny. Finally, Bobby tried it and, at least in my opinion, ended up being the best candidate for the job. Much effort and consideration was involved in arriving at a reading which worked for the piece.

Our initial goal was to finish the piece for Viz-a-gogo, the Visualization Program's annual show which is entirely comprised of student work. To be accepted into the show, the piece needed to pass a jury. For the Viz-a-gogo jury, we only submitted a playblast (a low quality Maya render) with no sound, since that was all we had. Since we still weren't done, our next goal was to have a final version on the Viz-a-gogo DVD that went out to Pixar, DreamWorks, and ILM for them to review for

scholarship purposes. It was at this point that the renderfarm stopped working. So for the DVD, we had a version that was playblasted, but with final sound and music. Our last deadline was for the show final show DVD, which was seven days later. Fortunately, the person in charge of making the show DVD was my roommate, Jerry Chang. He gave us until 24 hours before the show to finish. We actually finished everything at about noon on the day of the show.

I initially had no thought that B*ricklayer* was going to be the topic of my thesis. At SIGGRAPH, a colleague of mine, Lars Doucet, was thanking the head of the Visualization Department, Tim McLaughlin, for suggesting to him to use an existing project for his thesis. Tim then turned to me, looked me in the face and told me very directly that I needed to finish my thesis and graduate. Lars's response was similar to "Do what I did. You should use the *Bricklayer* for your thesis." That was the first time such a thought had crossed my mind. I spent ten or fifteen minutes giving Lars reasons as to why it wouldn't work, but he kept refuting my arguments. After SIGGRAPH, I posed the idea to my chair, Dr. Parke, and his thought was to do a post-mortem of *The Bricklayer's Disaster* production.

In Feb. 2011, *The Bricklayer's Disaster* won an award entitled "best and most innovative use of a 3D animation application for the production of a film, video or game sequence" at the 2011 ANIMEX International Festival of Animation and Computer Games. Fig. 3 shows the *Bricklayer* team with the trophy.

Fig. 3. The *Bricklayer* team with the ANIMEX 2011 3D Animation Award.

II.4. Working Dynamic

I thought I was going to be mostly animating and then managing on the side, even after I was warned multiple times by Dr. Parke that team coordination would take much of my time. He turned out to be correct. After everything was finished, one of my classmates said that the piece was to her more about story telling than the animation. Looking back, I feel the same. Some of my animation is alright, some of it is bad, and some of it I don't even like to watch. As far as my time was concerned, I had the intention of this being all about animation. Actually, I spent the most time coordinating the team and in meetings with Joe, Bobby, and Ariel where we solved layout, story and other issues for the sake of making the piece clear to the viewer. As it turned out, my time was spent secondarily on animation.

It wasn't my plan to lead the project, per se. In my head, it was simply another group project and everyone was going to have equal say. I told Bobby, “you do layout, I don't care, and whatever you say is final,” and I told Joe the same thing about shading. Towards the end though, I remember being in somewhat heated discussions with Ariel and Bobby about how we were going to layout a shot. Eventually, I assume because I was the one who's grade was on the line, I became the “project lead.” I'm not sure when that happened exactly, but I'm happy it did. I think as far as the team dynamic was concerned, having a definitive lead was a good thing. People seemed to be in one of two categories. Either they would tell me to my face if they didn't like something, or they didn't care. That's what made it nice. There *were* times where I wanted one thing and most people wanted another thing, and I had to agree. That being said, I don't think I stuck my nose too far into other people's work. I may be wrong, but I remember Joe and Bobby meeting together separately and making decisions about certain aspects of *Bricklayer* that I had no part in. This is what I wanted in the beginning so that I could stay on animation.

II.5. Overview of *The Bricklayer's Disaster*

II.5.1. Storyboards

The storyboards (Fig. 4) were the first visual element created for *Bricklayer*. It generally conveyed the story, though much changed between this version and the final.

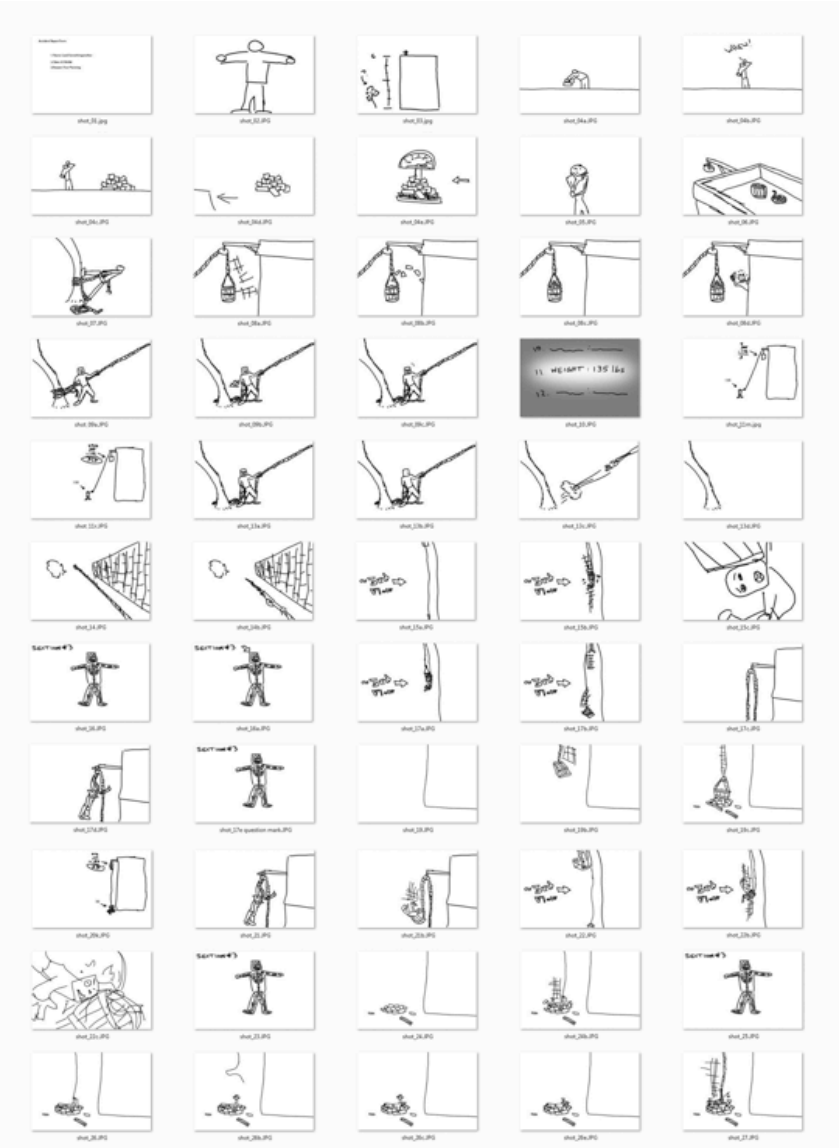


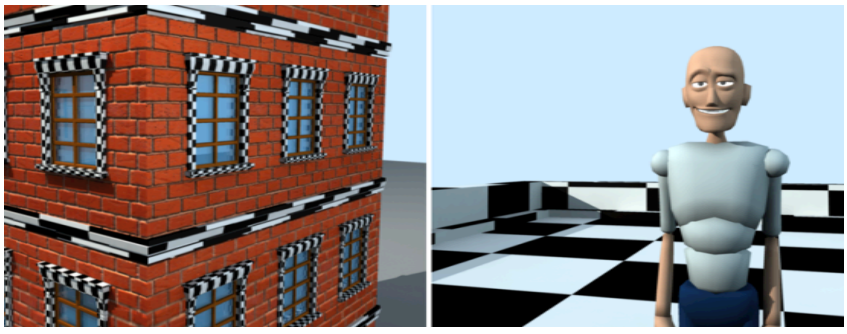
Fig. 4. Original storyboards for *The Bricklayer's Disaster*.

II.5.2. Character

Bobby named the bricklayer character Norman Brickwell on the forms, giving us a triple entendre pointing to the name chosen by the character's creators which was "Norman"[11], Norman Rockwell, and the fact that as a bricklayer he didn't "brick" very well. Part of the humor of this piece is the fact that the same person could so articulately describe something he so poorly thought through. The disparity between Norman's thought process and his actions adds an entertaining paradox to the story.

II.5.3. Setting, Look, and Props

Since I wanted to stress animation in this piece, I wanted simple solutions to everything else. From the outset, I was pushing a set that comprised a building and a tree on a white plane. I told everyone up front that I was OK with simple lighting and shading (Fig. 5). Ariel and Joe at different times did experiment with different lighting styles, both very simple. We eventually stuck with the original plan since we didn't have anyone who was dedicated specifically to lighting and we ran out of time.



(a) shading test (b) lighting test

Fig. 5. Initial shading and lighting renders.

In the beginning of the 617 class, it was required of each student that they make a list of the props they thought would be required for their piece. Figures 6-7 are my original prop proposal sheets.

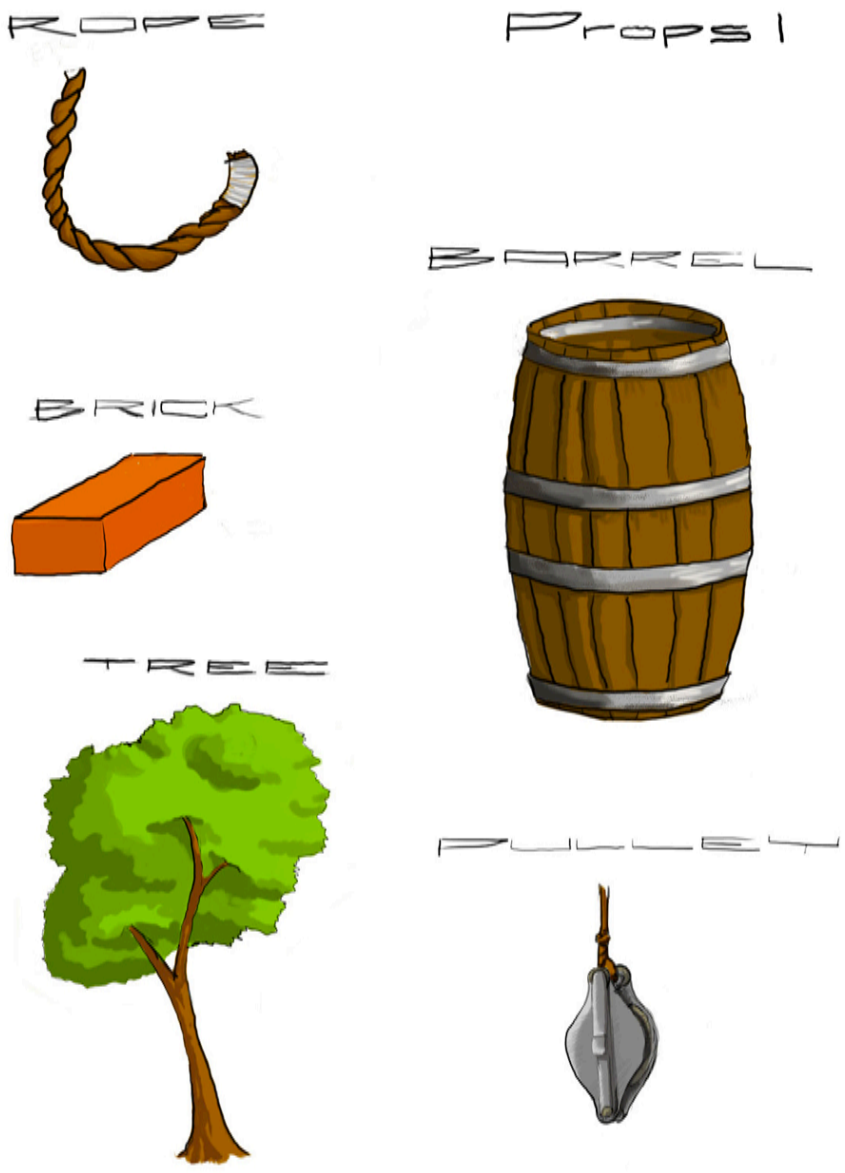


Fig. 6. The first set of the original proposed props.

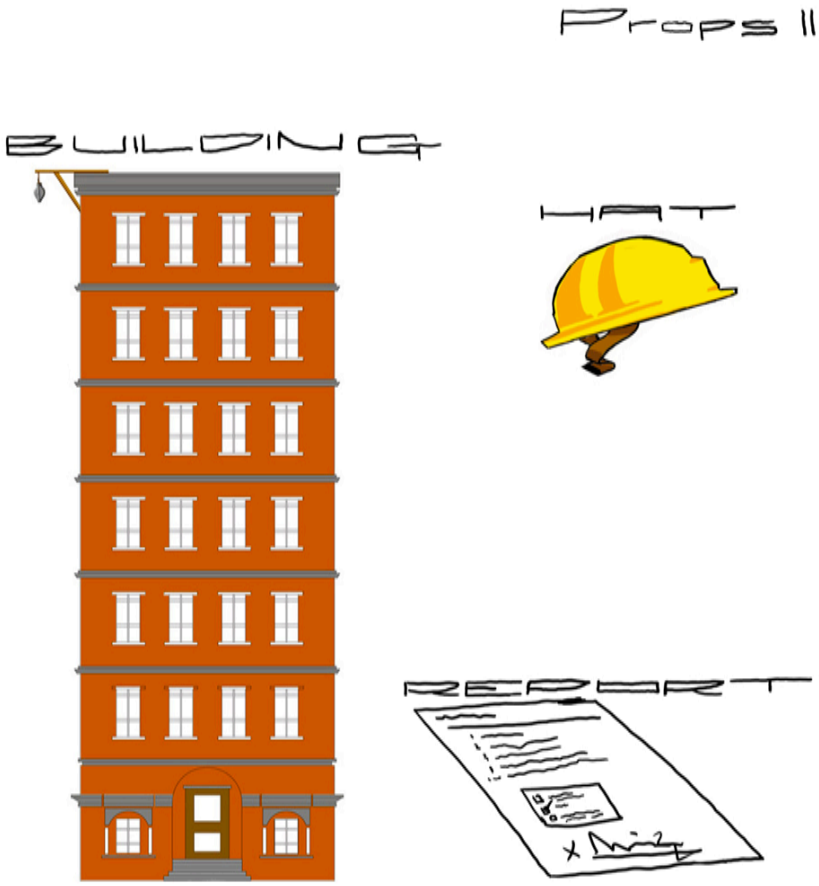
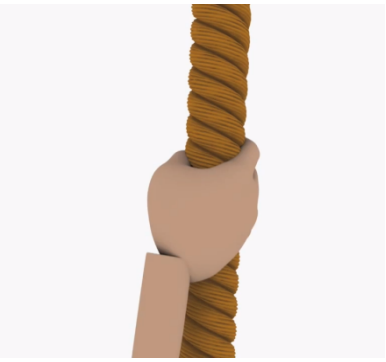


Fig. 7. The second set of the original proposed props.

The accident report form was originally going to be in 3D, but that changed. We ended up doing it in 2D using Adobe After Effects. We added a few additional props at the end: the butterfly, the machete, the wallet, the baseball bat, a shirt for Norman and a knot in the rope. Also, there was something that we knew we needed but we didn't plan for, which was the broken barrel and the fragments from it breaking. All the assets shown in Figures 8-11 are in their final form except for the hardhat and the original pulley. They were cut before they were ever shaded or rendered.

(a) bricks



(b) rope

(c) butterfly

(d) tree, rope loop, and rope knot

(e) wallet

Fig. 8. Assorted props.

(f) building

(g) machete

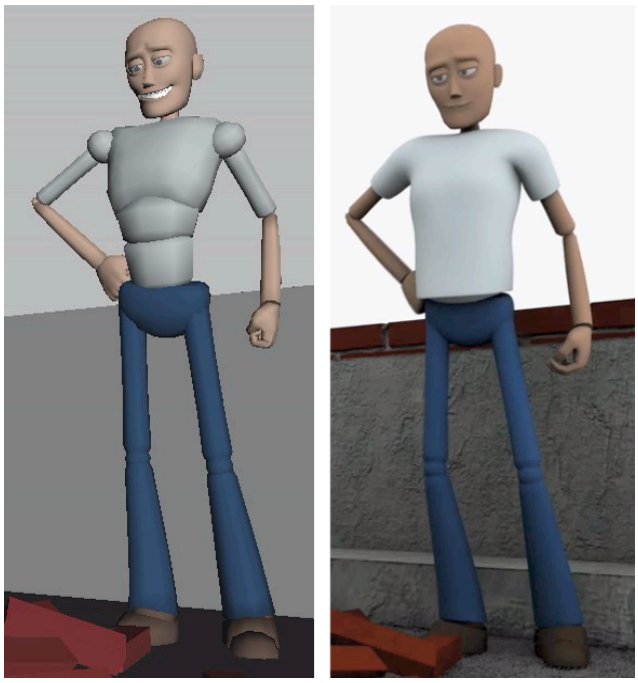
(h) baseball bat

(i) hardhat

Fig. 8 Continued.

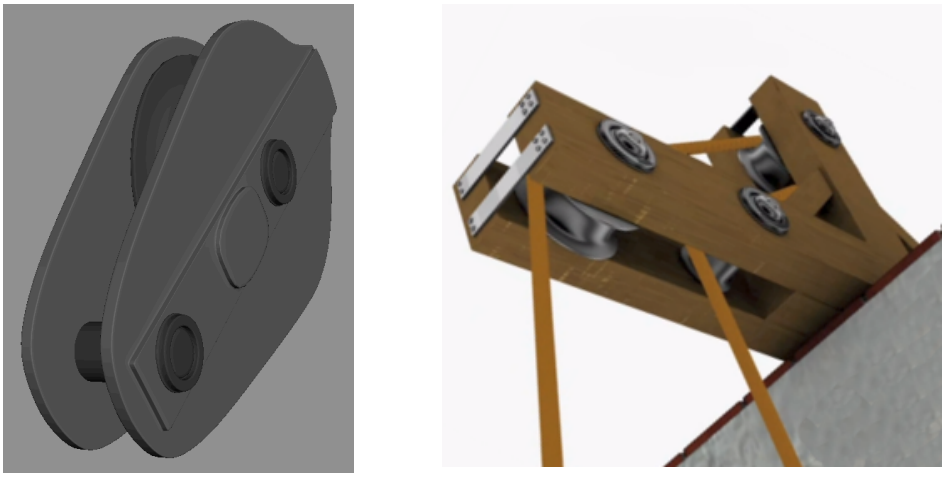
(a) Barrel whole (b) Barrel broken

Fig. 9. A comparison between the whole barrel and the broken barrel.



(a) Norman with no shirt (b) Norman with the shirt

Fig. 10. A comparison between what Norman looks like with and without the shirt.



(a) original pulley (b) final pulley

Fig. 11. A comparison between the original pulley and the pulley in its final form.

For surfacing, were a little more complicated, but not much. We used painted texture maps on everything but the bricks, this necessitated UV unwrapping those objects. For the metal pieces on the barrel and pulley, we wanted them to have specular reflections. Since our scenes didn't have any lights, typical specular reflections were not possible, so Joe generated the specular highlights by using a predefined vector where the light vector would have gone in the calculation.

CHAPTER III

LESSONS LEARNED

There were a number of specific problems we encountered which resulted in our learning lessons. These lessons are broken into four main categories. The first category relates to lessons that relate specifically to the people in the team. The next category contains lessons pertaining to solving problems. Many of these problems relate specifically to how we designed our storytelling approach. The third category's lessons are practical advice about specific aspects of 3D animation production. The final category contains general lessons. Below is a full list of the lessons that will be discussed in this chapter, divided by category.

Team
- team member's motivations
- picking the team

Practice
- establishing a pipeline
- not animating or simulating with layout assets
- layout to final audio
- perform render tests early

Problem Solving
- pragmatic economics
- letting go
- clear storytelling
- real solutions
- taking liberties

General
- serendipity
- being conscientiously objective

III.1. Team

III.1.1. Team Member's Motivations

People are motivated to work on a project for different reasons. In an environment where a particular team member isn't motivated by a salary, it is important, especially for the team lead, to know what is motivating each member of the group. This applies not only to their joining the project in the first place, but also to their commitment to the project.

I believe that one of the most important pieces of advice I can offer is related to people joining the project. For sure, a tantalizing perk of working on a project like this is that you make more content for your demo reel. Most likely, this was at the back of everyone's mind. However, the three most important people on the project joined and stayed because they liked the concept of *The Bricklayer's Lament*. They were willing to commit a significant amount of time even though it was not for a class. I couldn't have known this at the outset, but the fact that Joe, Bobby and Ariel really liked the idea and wanted to see it happen was a huge reason the project was completed. Their dedication to the project was based on their desire to see it finished, because they liked the concept.

Others joined for different reasons. For Mat, it was to be on a team and have that kind of experience before he took the summer course. Bob helped us out because he had the time and saw that we needed the help; it's possible that he never even saw the entire piece before Viz-a-gogo. For Megha, it was a pure work exchange - I animated for her, and she did ropes for me. I don’t think she necessarily liked *Bricklayer*, it was business. I needed each of these people to finish *Bricklayer*. Without any one of them, it would

have failed.

In assembling and maintaining a team for a project, the team lead should be aware of why his team is working on the project and to make sure to take care of each member related to what is motivating them. If I unilaterally decided to dramatically change an element of the story without talking to Bobby, Joe and Ariel, I would have compromised the whole project by possibly causing them to lose their motivation towards the project.

A person's motivation may cause them to join a project, but it is also related to their dedication to the project until it's finished. I encountered several examples of this, however I'll only discuss one. A few days before the first deadline, Bobby finished all of his work. Mind you, this is at the end, after he had delivered everything he said he was going to do. He could have easily stepped away from the project. He has a wife and hadn't been home that much while he was crunching to finish his work. However, he stayed and helped with other things to see the project through. He ended up doing all of the compositing and sound by the time everything was done. These were monumental tasks. Had he left, it's possible we wouldn't have finished and it's definite that *Bricklayer* wouldn't have been as good. His sound and music selection was superb. His interests are in lighting and layout, so audio and the simple compositing he was doing could not go on his reel, and none of it did. He possessed a willingness to work on things to finish up the project, even though none of it would give a boost to his career.

III.1.2. Picking the Team

The essence of this lesson is to choose your team carefully. Related to team motivation, you, of course, do not have complete control over anyone on your team. Work ethic, disposition, and how they get along with people are all beyond your control. Those I asked to work on the project were people who I thought were (in order of what I considered important) easy to get along with, dependable, and capable. Having worked with Joe, Bobby, and Megha on past projects, I knew that I liked working with them and that I could count on them. I had seen Ariel and Bob's work and knew them a little from classes we had together. Even though I hadn't seen much of Mat's work since he was in his first year in the grad program, I don't consider my picking him a complete gamble because of my interactions with him in the lab.

The project had six people beside myself and everyone delivered what they said they would and many delivered more. I believe most of this can be attributed to a combination of what motivated each person on the project, how the motivations were handled and the kind of people they are.

III.2. Practice

III.2.1. Establishing a Pipeline

Establish a pipeline for your project. By pipeline, I mean a set, defined and understood way of doing things. This includes file-naming conventions, file directory structures, established and maintained paths within your files, etc. My advice is to establish a pipeline early on, because sooner or later the project will grow to be big

enough to need one.

When we started the project our scope and goals were considerably smaller than when we finished. A major problem we encountered while working on *Bricklayer* was a lack of organization, specifically, the lack of an organized, thought out and well defined production pipeline. We initially had the entire animation in a single file. Each shot was represented by its own camera in the scene. In order to render at the end of the first semester, I was forced to break the shots out into different files. The task was unmanageable otherwise. The resulting files were cluttered with objects from other shots, and started at arbitrary frame numbers since they started where the previous shot ended. Towards the end, Bobby and I had go through these files to remove the unused assets to make the files smaller for the sake of rendering. It was so bad that when Ariel came onto the project, to make any sense of what was happening, he had to make new files and import assets from our shots. He put everything he was working on in a separate directory space while he worked and then placed his finished files back in our file structure when he was done. If we had a pipeline, he could have easily jumped into the project and started.

Since we started working without planning anything related to pipeline, we wasted an inordinate amount of time later on trying to make sense of a disorganized mess. I actually don't remember it being that bad, but several people mentioned in our group discussion that they didn't know what was going on, who was working on what, what shot was what, etc. After our post-mortem discussion, we determined that the ideal case would have been a separate person designated specifically to the pipeline. I know

that this is almost unreasonable to ask, because no artist is going to want to focus that much time on the pipeline. However, I believe that if we had a separate person doing this, our result would have been at a substantially higher level and we would have saved time in the long run.

III.2.2. Not Animating or Simulating with Layout Models

Replace layout models with final models before animation or simulation needs them. If not, the result will be one of two things. One possibility is that you will be stuck with bad models, assuming the layout models are rudimentary, which they typically are. Otherwise, your models will change resulting in animation or simulation changes. Depending on how significant the model changes are, animation and simulation may simply need tweaks or may need to be completely re-done. Both of these cases can be avoided by having significant props in their final form when animation and simulation starts. Specifically those props which move or with which the characters interact.

When I asked Bobby to do layout, there were certain models needed which we didn't have yet, so he made stand-in layout versions. This is typical, accepted, even an expected convention as I understand it in the industry. However, his animator didn't think to animate to what he knew the final model would be. Neither did the team lead think about replacing those assets until the *very end of the project*. As a result: 1) the pulley had to be completely re-modeled, otherwise animation would have to change in every pulley scene. 2) The stand-in brick actually became the final brick, even though

the dimensions were chosen arbitrarily and it wasn't very brick shaped (Fig. 12). 3) The building ledge in the opening shot was matched to what Bobby did for that scene, also because of animation. 4) Finally, stand-in ropes also, were *mostly* replaced. The cases where we changed the ropes, only the thickness changed, which only affected the fingers and the palm of the hand.

I highly recommend replacing little things like this that are important to animation and simulation early on. Joe had to model three different pulleys and change the roof of the building because of this issue. At one point the bricks were going to change, but as soon as I used them in the first simulation, they had to be final assets or the simulation needed to be redone. We never redid the simulation.

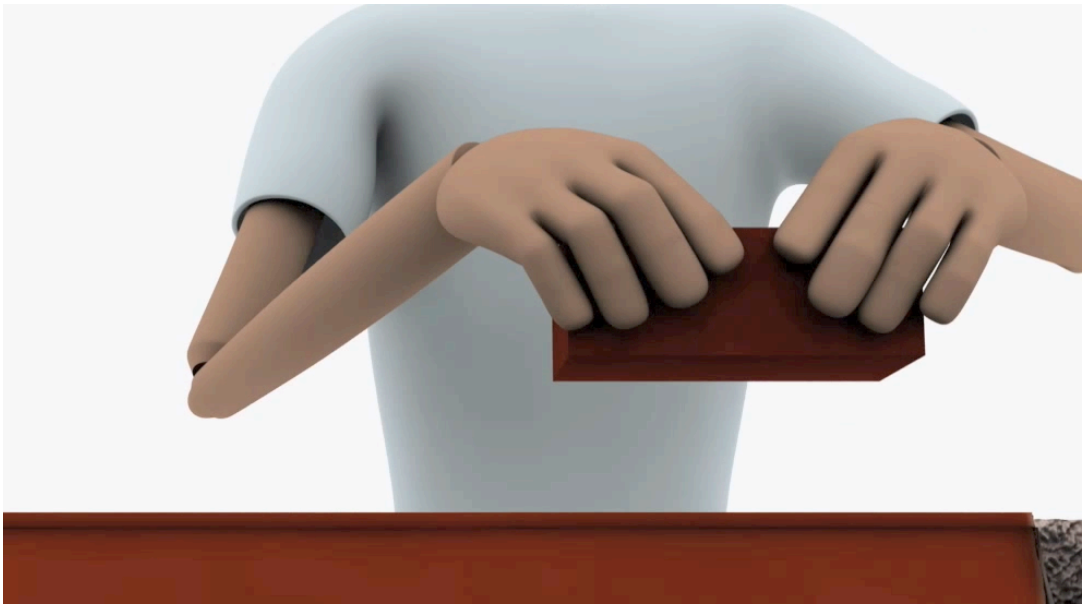


Fig. 12. The layout brick used as a final asset.

III.2.3. Layout to Final Audio

Do layout to the final version of the audio. Especially in a case like ours where each shot was cut to a line of dialogue. This may not be as important to animation pieces where the audio is not as important, but in cases like ours, it will definitely save you time.

For example there is a shot matched up with the dialogue "...securing the rope at ground level..." in which Norman ties the rope to a tree. Since we were not doing layout to final audio we were guessing on the lengths of the shots. As you may imagine, many of our guesses were incorrect. The visuals were typically shorter then we planned. For this reason we had to add shots much later into production than anyone would like. This could have been avoided if we had the final voice track before layout started. As it turns out, our final voice dialogue was completed only five days before we finished. This resulted in our needing to add shots up until the very end. The last, I'm fairly sure, added only two days before we finished. If we had final audio for layout, we would have had those shots done much sooner.

(a) length of the final animation

(b) the length of the animation at the end of the first semester

(c) first semester animation separated and timed to correspondingly to the final piece

Fig. 13. A comparison between various stages of the project.

In Fig. 13, Fig. 13.c, the yellow portions are segments that we knew we needed visuals for, but had not created the visuals. For all of these, we already had a plan worked out. The red segments are areas we didn't know we needed visuals for until the final audio was available. These added segments account for 62 seconds, over a quarter of the length of the final animation.

Performing layout to final audio may be idealistic in some cases. If final audio is not possible or unreasonable to expect when layout starts, at least have some audio for layout to use. Even if it is changed later, you will be able to catch many of the problems. The shots will most likely have to be re-timed once the final audio is in place, but major problems can likely be caught.

III.2.4. Perform Render Tests Early

Do render tests within your final render environment early. That means do hundred plus frame, non-local renders at full resolution with animation on deforming characters with shaders attached as soon as you can. You will catch errors with your test renders that would otherwise be propagated to all your files. Also, if everything is tested and proven to work, your renders will come out the way you expected on your first try, which is what many people assume will happen but rarely does.

There are a few reasons why Joe’s name hasn’t come up more. The main reason is that he spent an inordinate amount of time fighting our render farm. One of our huge mistakes was that we made an assumption that once we finished everything we could push 'render' and it would all work the way we wanted it to. That would have meant

sending huge batch render files over the network to the render farm and seeing what came out the other side. To illuminate the kinds of problems we encountered, I'll relate one specific difficulty we had. Typically, once a job is sent to the render farm, the render farm sends the rendered images to a predefined location. Our problem was that the rendered images were not being saved in any location we could find. The data was correct, but we weren't able to locate it. Bob Graf wrote a script that circumvented this problem. It forced the render farm to send the images back to the machine that sent the job, in an accessible format. The script then manually saved the image that was sent by the render farm and proceeded to the next frame. This was slower, but hacks were necessary to utilize our render farm at all.

My suggestion is, once you have final assets, try rendering turntable tests using your final render environment. Once you have a first animation pass, render animated sequences, and once you have shading, do the same. The idea here is to catch rendering problems early. It's important to do these renders in your final render environment. Our problem was that we were doing test renders locally but when it was time to do final renders we started running into render farm issues.

Another factor that contributed to our lack of rendering preparedness may have been that in our minds this was an animation piece, so everything else took a back seat. Because of this attitude we didn't spend much time on lighting or rendering. This caused us problems later.

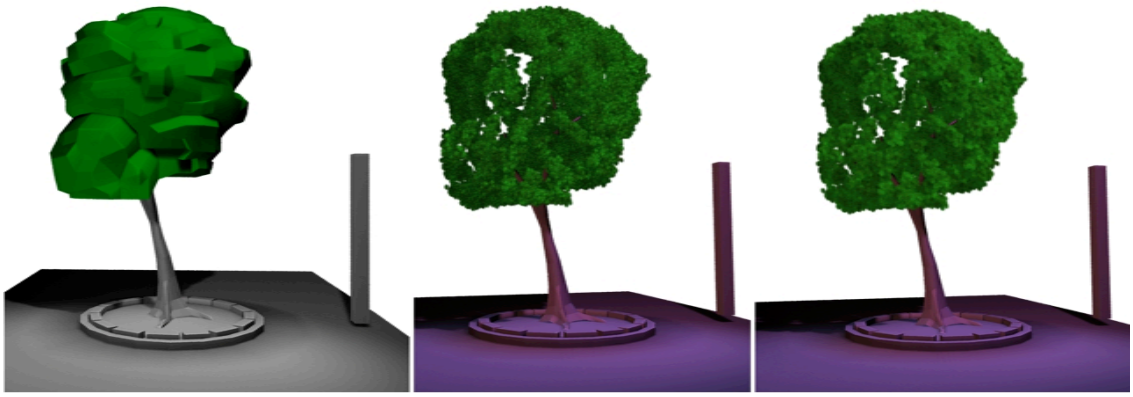
These problems could have been avoided if we had tested the render farm earlier and if we had put more emphasis on rendering early on. Since we were low on time, our

options were limited. It worked out in the end, but it cost us time that could have been spent elsewhere.

III.3. Problem Solving

III.3.1 Letting Go

You will have to cut things. This is a fact of life for a project of significant size. Some of these decisions will be harder than others. Scheduling issues, poor planning, team dynamic, or any number of other factors will cause changes. Don't be too surprised when you're faced with the need to take something out that you liked. For example, we initially planned on having leaves on the tree.



(a) geometry used to emit particles | (b) the first leaf particles | (c) a later style of leaf particles

Fig. 14. Progression of leaf development for the tree leaves.

Figure 14 contains development images for our tree leaf solution. The tall block is the size of Norman. Joe spent considerable time researching how best to do this and make it fit into our style. His final solution was to create a piece of geometry (Fig. 14.a),

from which we would emit leaf particles (Fig. 14.b and c). The problem we ran into was that our leaf particles were not receiving any light. From Fig. 14.b and 14.c, you can see a strong purple light affecting everything in the scene except for the leaves. We even considered rendering the leaves separately and putting them on a 2D plane and seeing how that would work. It seemed like a plausible solution because we didn't have any camera moves that would reveal that it was flat. As Joe was busy tackling the other rendering issues, we let the leaves go. We later cut lighting all together, so I assume that we could have put them in as they were. However, since things were so hectic at that point, I think we forgot to consider adding them back into the piece.

The leaves didn't make a difference story wise. I liked the way they looked, but it wasn't a problem removing them. Being able to delete elements you like, but don't need, because of time, isn't really that hard. But it is something you probably will encounter.

III.3.2. Clear Storytelling

Sometimes it is required to relate uninteresting information for the sake of the narrative. Be creative but simple in solving these problems. As a storyteller, you must walk a fine line between boring the audience by saying too much for too long and confusing them by saying it too quickly.

We had so much trouble simply moving our character up and down the building for the part where the dialogue says, “securing the rope at ground level, I went up to the roof... Then I went down and untied the rope.” These three shots are pictured in Fig. 15.

Fig. 15. Norman going to the roof of the building and then back down the building.

In those two sentences, we have Norman on the ground, then on the roof and then back on the ground. It was difficult moving the camera up and down the building that fast without losing or boring our viewers. There was even another shot, prompted by the original dialogue, which we later cut, of Norman tying the rope to the barrel.

Initially, we had several ideas of how to solve this problem: we had the camera actually go up and down the side of the building, we even discussed having Norman go up and down the building and seeing him go into the door, and a few others. All of these ideas would have added time to the piece but nothing else. They would have detracted from the piece.

Bobby came up with the simple camera moves that we used for that sequence. In between each of these shots, the camera goes “up” out of the shot and then “down” into the next shot. If you think about it, it seems counter intuitive to have the camera going “down” into all the shots, even though sometimes he's going up and sometimes he's going down. However, when viewing the piece, the camera moves maintain clarity, and to my knowledge no one has had any trouble understanding where Norman is at any given point in the sequence. Between Norman tying the rope and the camera going up to the top of the building, we added him looking up. This prepares the viewer for that

camera move. I thought this solution was brilliant because it didn't add any time. It was simple, yet elegantly clear.

III.3.3. Pragmatic Economics

The lesson of this section is to be pragmatically economical. There are times when a certain solution to a problem may simply be too difficult or take too much time. Several times throughout the production of *Bricklayer*, we were forced to rethink or redesign an aspect of our piece for the sake of time.

There is a line of dialogue which says "...then I went down and untied the rope" (Fig. 16). I first relegated this to the rope simulation team and left it at that. But, as the end of the first semester was approaching, a rope team had yet to be seen. We knew that this particular simulation would be both difficult and time consuming so we tossed around different ideas to address this issue. We eventually settled on the idea of having Norman simply cut the rope rather than untie it. This ended up saving huge amounts of work and simulation time, while still nicely conveyed the story point.

This is an example of pragmatic economics. The fact that he cuts the rope and doesn't untie it has no significance to the story whatsoever. We didn't change the dialogue here to say "I went down and cut the rope," we simply left it. The idea was to show some disconnect between what he was saying and what actually happened. I believe we were planning at some point to have more of this happen, but we never did.

Fig. 16. Norman “unties” the rope.

A detail, that I don’t think most viewers caught, was the fact that for him to lower the barrel using the rope, he needed a length of rope equal to the height of the building behind him on the ground. This would have been a humongous simulation task as we would have to simulate an additional length of rope the height of the building trailing behind him as he was going up and down the building. We didn’t know it at the time, but the decision to make him cut the rope instead of untie it saved us massive amounts of effort.

III.3.4. Realistic Solutions

What you think will happen in many cases is not what actually will happen. As a

result, one needs to be flexible. You may think that you will have some awesome solution to a problem, but when the time comes, what you actually have to solve your problem with is much less robust then what you hoped for. In such cases, you may need to find a way to make your solution work, rather then come up with a different solution.

I knew at the outset of the project that the ropes were going to be difficult to manage. I also knew that they also were going to be very important to the piece. In this example, I really did not understand the complexity of what we were asking for. What I was expecting was a single solution that would work for all of our rope needs. As unrealistic as that sounds, it was in fact what I was hoping for. I have to re-iterate that Megha's simulation system was really solid, but not as unrealistic as I had hoped for at the beginning.

There is no way that I could have asked her to make her solution better, given the time constraints. As a result, we ended up with a hodgepodge of solutions to choose from for any given segment of rope. Either the rope was geometry, skinned to fk joint chains, or simulated using Megha's system. Megha's system was able to handle simulations differently depending on what we needed. They could be constrained at one end and freely move on the other end, constrained in multiple places and simulate in between the constraints, or the simulation could be influenced by control curves. When Megha completed writing the system, in between working on her other projects, she also worked to incorporate her system into the more difficult shots. Either Joe or myself put ropes in the easier shots. One problem we ran into was that the simulations were not completely repeatable. You could run a rope simulation on a shot and depending on the

machine or what was going on in the background, the simulation results would vary. As a result, Joe and I would run rope simulations on shots until we arrived at something we liked and then saved out the simulation data. Below are examples of these different cases with descriptions for each shot.

Fig. 17. Colored rope segments indicating different solutions for different rope segments.

In Fig. 17, the red segments are skinned to fk joint chains, which I animated, and the green segments are geometry. The colorings are consistent in the following subsequent images.

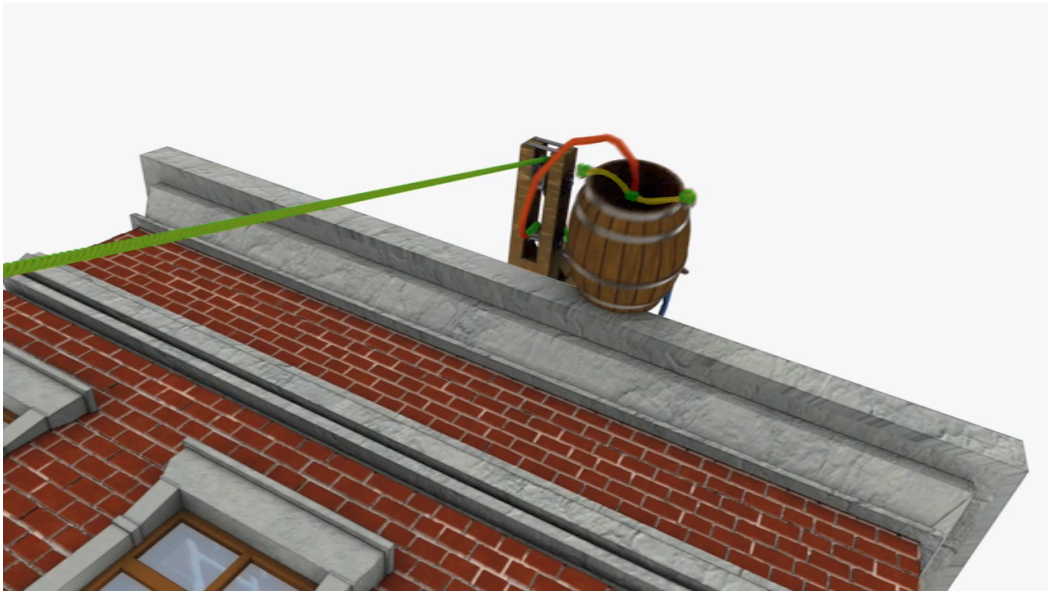


Fig. 18. An additional solution for the ropes connecting the barrel to the rope coming from the pulley.

In Fig. 18, the yellow segments are simulated chains attached on both ends. I animated the barrel so that it would appear to be attached to the rope. Since the animation wasn't exact, the simulated ropes in yellow would stretch and compress to compensate.

Fig. 19. An additional solution for the rope trailing behind the barrel.

In Fig. 19, the blue segment was simulated but the simulation was influenced by an animated control curve.

Fig. 20. An additional solution for the rope in Norman's hand.

In Fig. 20, the purple portion is constrained above the camera and also at the hand, while the portion below the hand is unconstrained.

Fig. 21. Additional rope solutions for the rope segments coming out of the tree knot.

In Fig. 21, the orange segment is simulated with a constraint at Normans left hand. The dark portion of the rope is skinned to two joints, one parented to Norman's left hand, and the other joint to the knot on the tree. The approaches in the image above are shot specific solutions that I needed to quickly implement before Megha had joined the project. They ended up staying in because they served their purpose, even though Megha's system would have been much cleaner.

As can be seen from the various solutions that were used for the ropes, a clean solution may not always be reasonable. Don't be afraid to have slightly dirty solutions. In my opinion, a done project is better than a clean unfinished one.

III.3.5 Taking Liberties

To tell the story the way you intend, certain liberties may be taken. In telling *The*

Bricklayer's Disaster, we exaggerated several elements related to scale to tell a more entertaining story.

In the original script of *The Bricklayer's Lament,* the building is said to be 6 stories. Because we wanted Norman to collide with the barrel in the middle floor, we wanted the building to have an odd number of floors.

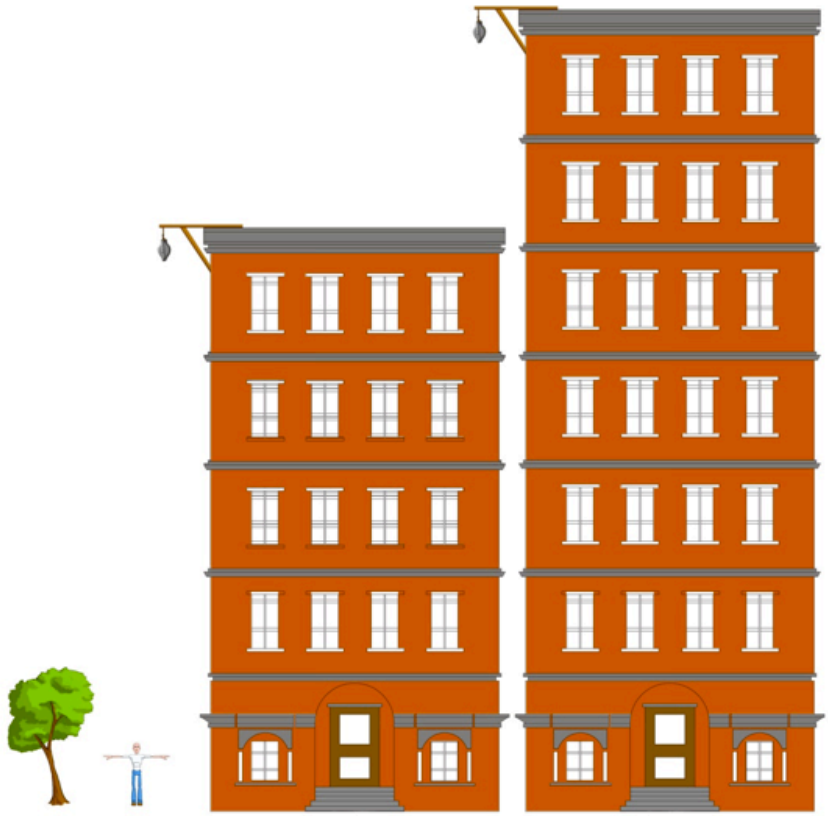
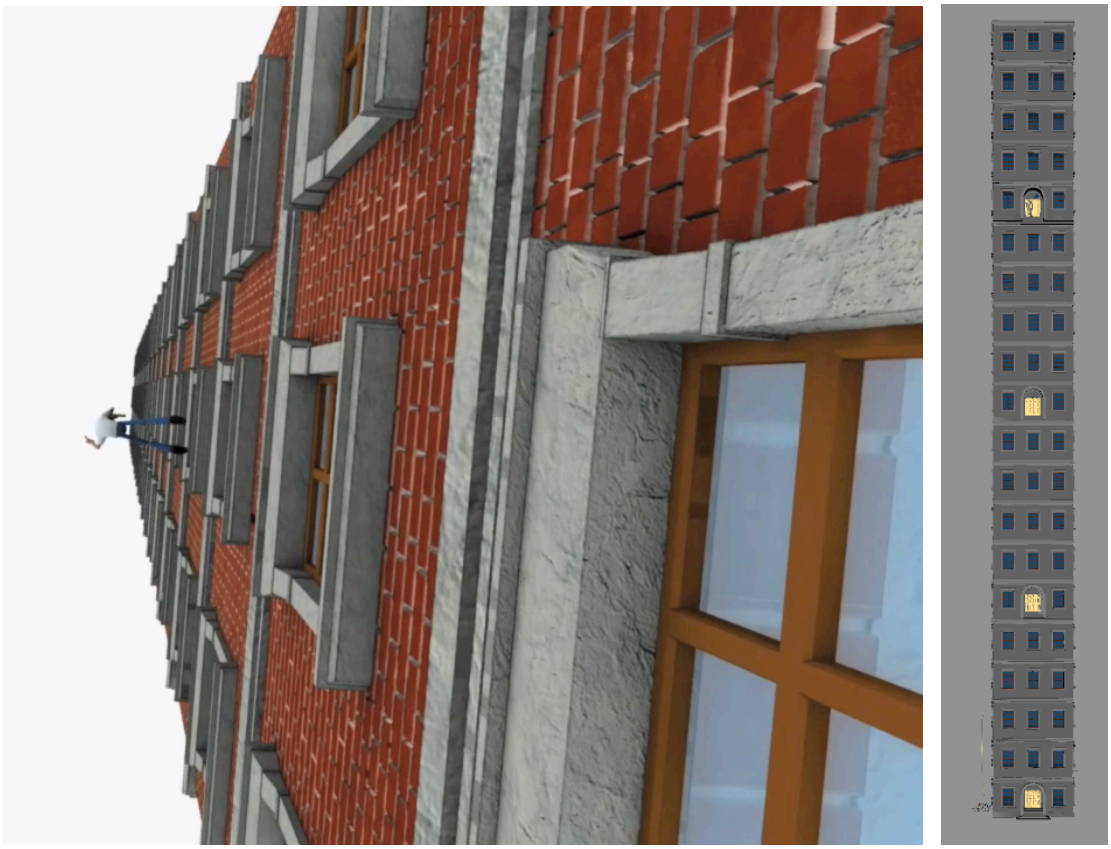


Fig. 22. Initial height comparisons for the five-story and seven-story building.

After comparing the scale of a five-story version to seven (Fig. 22), we ended up settling on five for the final, formal height of the building. However, in many shots, to exaggerate the tale, we made the building quite a bit higher as seen in Figures 23-25.



(a) camera view (b) side view

Fig. 23. Norman's rapid decent to the pile of bricks as viewed from multiple angles.

One such example is the shot where Norman plummets downward after the bottom of the barrel falls out. We stacked four buildings on top of each other, making a twenty-story structure for this shot. My original view was that the building would be very much taller, converging to a single pixel, but this was what Ariel did, so we left it.

Fig. 24. The barrel passes fifteen stories in a single shot.

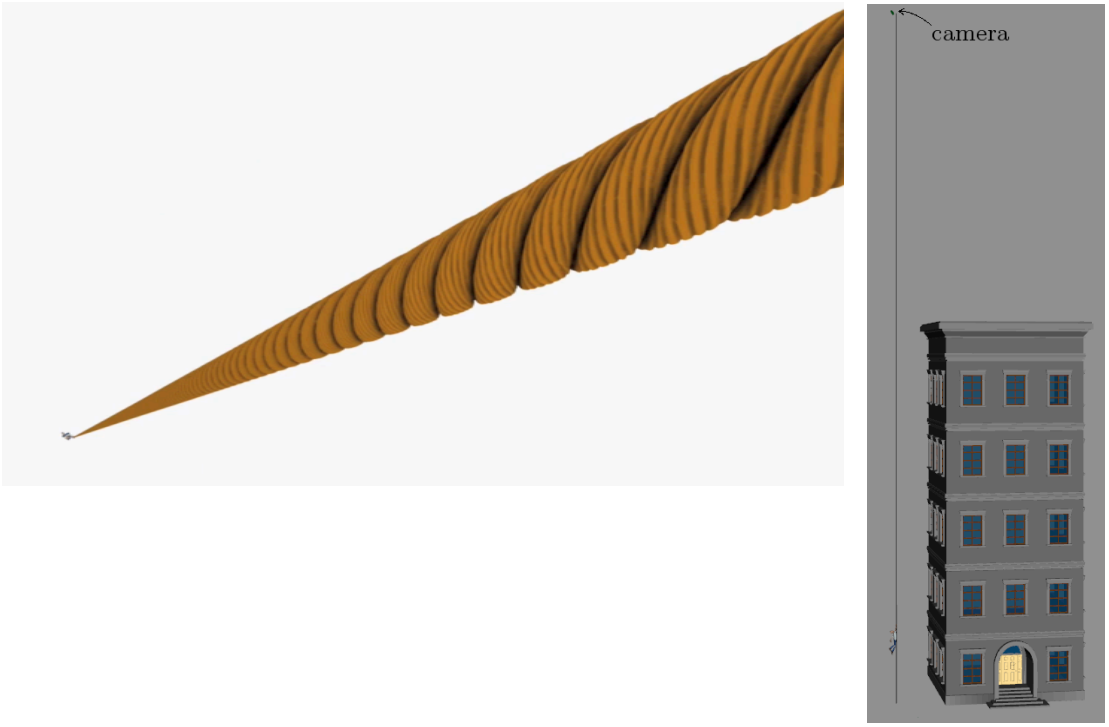


Fig. 25. Norman rapidly ascends the side of the building.
The two views are from the same moment, from the camera (left)
and from the side view (right).

In Fig. 25, where Norman is depicted rocketing up the side of the building, the

distance he travels is nearly double that of the height of the building (added here for scale). This is all before he collides with the barrel half way up the building.

We made these kinds of decisions to tell the story in a more entertaining fashion. I thought about doing this kind of exaggeration at the outset, but I didn't give much consideration to its implementation. Our solution was to copy the building multiple times and then stack the copies on top of each other. This seemed to work well; it told the story and didn't require any new assets.

III.4. General

III.4.1. Being Conscientiously Objective

There are things that you may put into your piece that don't turn out the way you thought they would, namely they're not as good or functional as you had planned. First be willing to admit that they don't do their job. Second, try to find a solution to fix the problem rather than giving in to the urge to axe the thing that isn't doing its job.

The first time I saw the whole piece with the math scenes (Fig. 26), they did not have audio. My impression of these scenes was that they were falling flat. It took me until I saw the whole piece to admit to myself that it wasn't working. I should have noticed it sooner, and maybe other people did, but it wasn't until we were near our first deadline that it occurred to me. My initial reaction was to cut these scenes. I told Bobby what I was thinking, but after some discussion one of us had the idea for Bobby to do some additional recording of Norman mumbling thoughts to accompany the visuals. This additional audio made a huge difference. So, those shots stayed in.

The lesson here is to be conscientiously objective about as many different aspects of your piece as possible. Make sure each piece is functioning as planned. We decided to add the math scenes only because of the humor. After the math scenes were implemented, we assumed they would work, so we were not actively objective about them.

Make sure that all aspects of your piece are serving their intended purpose. If not, make an effort to determine why. My original solution was to cut out the math scenes since I thought they were bad. Avoid making rash decisions without first trying to find a solution. Likely, there is something worthwhile in the original idea or it wouldn't have been included in the first place. I realize that you simply may not have time to rethink everything in your piece, but if something isn't working and there is a quick fix to be found, don't be afraid to be objective. It will make your piece stronger.

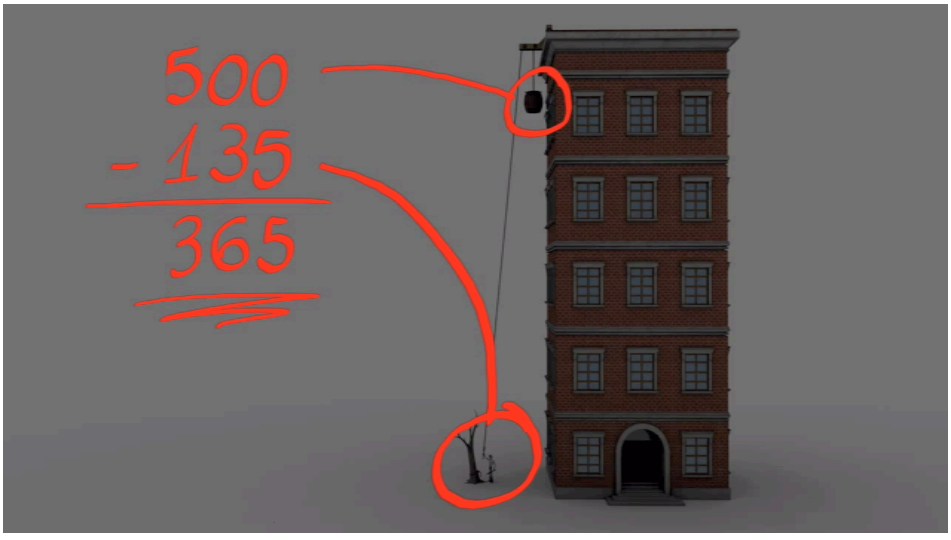


Fig. 26. The first math scene.

III.4.2. Serendipity

In student run productions, there are a lot of things going on that are beyond your control. Sometimes you're lucky. We were fortunate on multiple counts. I'll recount one of the more substantial moments where we benefited from serendipity. Along with the unexpected bad things that happen, good things also unexpectedly occur.

The adding of the butterfly represented a huge shift in the project. Joe, Bobby, and myself were having a meeting and Ariel asked to sit in. He "didn't have time to work on it," but was still was interested and wanted to see how the planning stages were going. We were discussing several places where we had audio but no visuals, and observed that many such cases had the phrase "presence of mind" or "state of mind" in them. As we were batting around possible solutions to this, Ariel started laughing to himself. We ask him what he had in mind, but he responded "oh, never mind, it's stupid." After some prodding, he said that he thought it would be funny if in his head he was doing something stupid like chasing a butterfly or something like that. The butterfly became a metaphor for his presence of mind, and therefore a solution to these phrases that lacked visuals. The idea of him seeing the butterfly in real life quickly followed (Fig. 27), further prompting his letting go of the rope in the final sequence. I asked if we could show the butterfly in the beginning so that it would be easier to introduce it later.

Fig. 27. Norman sees the butterfly at the end.

Before we had the butterfly our piece didn't have an ending. If you look at what we had at the end of the first semester, the piece abruptly ends unsatisfactorily. The second semester, after the butterfly was added, we re-designed the entire ending sequence with the butterfly in mind. The butterfly gave us a solid ending bit that really made the piece. Ariel was in charge of laying it out.

CHAPTER IV

EVALUATION

Related to my adaptation of a post-mortem analysis as conducted in software engineering, various aspects of my approach were successful while others were not. In this chapter I will discuss what I would have improved in my process of conducting the post-mortem and what I thought worked well.

IV.1. Successful Aspects

As the first visualization masters thesis of which I am aware which is a post-mortem, I believe that the project was worthwhile. Surely, there are multiple ways in which the post-mortem could have been improved, but as a first time case, I believe it succeeded.

The group meeting we conducted to discuss what we learned while working on *Bricklayer* was the strongest and most important part of the post-mortem analysis. Many things, which I had forgotten, was not aware of, or misunderstood, were corrected in this document as a result of that meeting. Many useful lessons were uncovered in our dissection of what we observed while working on *Bricklayer*. We analyzed every aspect which we could think of related to any part of the project. As a result, I feel the *Lessons Learned* chapter comprises a very complete list of lessons worth passing on to students desiring to attempt a similar task.

Also, much of my writing was done in the lab where Joe was often present. I was able to ask him to clarify various aspects of *Bricklayer* that I could not remember or did

not fully understand. Many times he remembered things I didn't or was able to explain them better than I. Also, there were many one-on-one discussions with other members of the group to fact check and clarify a particular section I was working on.

Since I was the project lead, I had my hands in almost every part of what happened on the project in some form or fashion. As a result, I believe I was the best person to undertake the bulk of the work for composing this document. Also as a result, I was able to remember quite a bit related to what happened during the production. I was able to fill out much of the document before we had our group discussion, which helped jog all of our memories about the different tasks, problems, and changes we faced while working on this animation.

Dr. Parke, my thesis committee chair helped me very much in the structure and design of this document. Much of the clarity conveyed through the structure of this document can be attributed to his guidance throughout the thesis writing process.

IV.2. Unsuccessful Aspects

IV.2.1. Not Knowing a Post-mortem Was Going to be Conducted

The fact that I wasn't aware that I was going to be doing a post-mortem at the outset of the production of *The Bricklayer's Disaster* is the most significant unsuccessful aspect of my post-mortem. Much data was lost. There are versions of the project that I didn't think to keep, that I would have saved had I known I was going to be investigating the entire project in detail once we were finished. If I had been writing while I was working on the project, some of the history and many details related to the project's

development wouldn't have been lost. I also believe that all of us on the team would have been more attentive during the project to identify different aspects we would change.

Another problem was that Bob, Bobby, and Megha were not physically present while I was conducting the bulk of my investigation, research, and collection of artifacts related to the post-mortem. This introduced a lag and lack of availability when I needed information from them. Our group discussion was extremely hard to schedule. Megha came back to College Station from San Antonio, Bobby Skyped with us from California, and Bob was not available for the meeting. Many of the details had been forgotten. This could have been remedied had we known the process awaiting the project's completion. I also noticed that many of us had different memories of the same aspects. Relying on memory is not at all ideal. I believe that if my intention was to conduct a post-mortem from the outset, many of the chapters, especially the *Post-mortem Context* chapter would be much more complete. However, since that decision was made after the project was completed, some data has been lost or forgotten. Future students seeking to conduct a post-mortem would be wise to heed this observation.

Also related to not knowing we were going to be conducting a post-mortem, was that we could have been conducting similar types of meetings throughout the duration of the project, further improving the *Post-mortem Context* and *Lessons Learned* chapters.

IV.2.2. Not Having a Post-mortem Pattern

Along with us not knowing that a post-mortem was going to be conducted, is the

fact that neither my advisor nor myself had seen a post-mortem as a masters thesis. Once we had the idea of conducting a post-mortem, the task of finding out if it was an academically accepted research methodology lay before us. This further lengthened the period of time between the completion of the project and the beginning of the post-mortem process. Not only so, but the fact that I had no predefined structure from which to base my work made the task all the more time consuming.

CHAPTER V

CONCLUSION

I found the post-mortem approach to be effective in identifying, illuminating, and articulating the problems encountered and identifying the lessons learned. I believe that the lessons discussed here are essentially true, and that sooner or later they must be learned. I also believe that the *Lessons Learned* chapter clearly articulates the essence of what we discovered while working on this project. My hope is that this document will be utilized by upcoming students to facilitate their learning in the field of animation.

To summarize, we discussed lessons we learned in four main categories: the team, practice, problem solving, and general. For the team, we discussed motivating and assembling the team. For practice, we gave suggestions related to pipeline, rendering solutions, not using layout assets for animation or simulation, and having final audio done before layout starts so that the piece's length can be fine tuned. The problem solving discussion contained points about being pragmatically economic on certain design choices, having to let go of things because of time, being clear in telling the story, not having unrealistic goals for solving problems, and taking liberties to tell the story you want to tell. Finally, we discussed serendipity and being conscientiously objective as general principles that accompany any project.

We made some smart decisions such as having Norman cut the rope instead of untie it and picking good people to work with that really helped us later, in ways we didn't expect. We made some mistakes like not doing render tests early enough and not having a solid pipeline before we started, but we trudged through. The render farm

failing was the worst thing that happened. Considering everything, it seems that there were more positive unexpected events then negative ones. People stepping up to help at the end and others being willing to jump in on a partially completed project really counteracted the problems we faced. When I look back, I feel really fortunate. We had a solid team, so we had a solid final product.

I do believe that if we had known that a post-mortem was going to follow the project, the project itself may have been improved as well. I believe that ideas for improvement would have been more readily identified and may have been addressed during the production of the animation. The post-mortem itself may improve a production, simply because people will be more aware of what is and is not working.

V.1. Future Work

The post-mortem itself is an underutilized research methodology. Any discipline, not only visualization, can potentially benefit from post-mortem analysis.

A body of future work which might be inspired as a result of this thesis are:

- Additional master's theses which are post-mortems of student projects.
- Verifying, augmenting, or challenging any lessons presented here
- Discovering more lessons for future readers to learn.
- Honing and fine-tuning the post-mortem approach to animation projects specifically.
- Building upon the structure of a formalized post-mortem document for animation projects.

- Addressing specific problems identified, for which we did not find all the answers.

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