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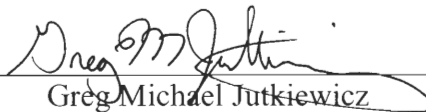
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Designing, Developing, and Building an Amphitheatre
at the Metrowest YMCA Outdoor Center
in Hopkinton, Massachusetts

An Interactive Qualifying Project
Submitted to the Faculty
of
WORCESTER POLYTECHNIC INSTITUTE
In partial fulfillment of the requirements for the
Degree of Bachelor of Science

by:
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Date: 7 October 1999


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Approved:
Professor Susan Vick, Advisor

Abstract

Designing, Developing, and Building an Amphitheatre at the Metrowest YMCA in Hopkinton, Massachusetts documents my work for my Interactive Qualifying Project during three academic terms [C-A 1999] at WPI. Through a narrative account supported by photographs I present the process I undertook to design the amphitheatre and to develop a procedure for implementing the design. My narrative concludes with an account which covers the actual building of the amphitheatre.

Table of Contents

Abstract.....	2
Executive Summary.....	4
Introduction.....	6
Design.....	7
Development.....	11
Implementation.....	16
Literature Review.....	31
Professional Résumé.....	32

Figure Listing

Fig. 1 Metrowest YMCA Outdoor Center.....	6
Fig. 2 Ancient Amphitheatre at Epidauros.....	9
Fig. 3 Spectacula.....	10
Fig. 4 Topographical Map of Metrowest YMCA Outdoor Center.....	11
Fig. 5 Selected Location for Amphitheatre.....	12
Fig. 6 Upper Entrance of Selected Site.....	13
Fig. 7 Lower Exit of Selected Site.....	13
Fig. 8 Fire Pit Near Selected Site.....	14
Fig. 9 Projected Seating Area at Selected Site.....	15
Fig. 10 Trees Felled for Rows.....	17
Fig. 11 Physics to Move Logs for Seating Configuration.....	18
Fig. 12 Rough Outline of Seating.....	19
Fig. 13 Stakes.....	20
Fig. 14 Wood Chipper.....	21
Fig. 15 Greg Crout and Greg Jutkiewicz.....	22
Fig. 16 Area Cleared for Seating Construction.....	22
Fig. 17 Excavation to Include Existing Tree.....	24
Fig. 18 Fashioning Rows by Physical Work.....	25
Fig. 19 Greg Crout on Site.....	26
Fig. 20 Steve Fisher Leveling Row Area.....	27
Fig. 21 Rows in Place.....	28
Fig. 22 Side View of Completed Seating Section.....	29

Executive Summary

Designing, Developing, and Building an Amphitheatre at the Metrowest YMCA

Outdoor Center in Hopkinton, Massachusetts documents my work for my Interactive Qualifying Project during three academic terms [C-A 1999] at WPI. Through a narrative account supported by photographs I present the process I undertook to design the amphitheatre and to develop a procedure for implementing the design. My narrative concludes with an account which covers the actual building of the amphitheatre.

The idea of an amphitheatre started at the YMCA as a proposal for the construction of a facility which they could use extensively. Although the YMCA had the need for an amphitheatre, they did not have the resources to design or build such a space. My involvement with the YMCA and my commitment to its programs led me to explore the feasibility of my designing and building this amphitheatre as my Interactive Qualifying Project. I felt qualified to execute this project for several reasons. I have worked at the Metrowest YMCA Outdoor Center for several years and have a solid understanding of the programs there as well the actual facility. My area of study at WPI is Theatre Technology, so I have taken several classes relating to theatre as well as theatrical architecture. I have worked on several theatre shows at WPI and privately for theatre companies in Worcester and Boston. I have assumed many roles in my theatre work including lighting design, sound design, and technical directing. Through my achievement in theatre I have developed a strong ability to work with and manage several systems at a time.

The first process of the design of the amphitheatre was the planning. This involved meeting with several directors at the Metrowest YMCA to determine the needs and expectations they had regarding the amphitheatre. Many considerations had to be addressed including size, location, design, and uses. I needed to understand exactly what the YMCA desired for this amphitheatre before I could initiate the design process.

Once the needs were outlined, the design and location of the amphitheatre had to be addressed. These two elements were very integrated and needed to be planned in conjunction with each other. This process involved researching amphitheatres, investigating current amphitheatres in similar environments, and searching the property for a feasible location. Approval from the YMCA directors would also be needed for the final design and location.

The next step was to implement this design at the selected site. This building process required cutting down trees, clearing the land, and finally the actual construction. The fabrication process included moving logs to specific areas, securing those logs in place, and flattening the ground behind the log. The logs used were actually the same trees cut down from the amphitheatre site. These trees were moved in place by using concepts I learned in Physics courses at WPI. Force, angles, and vectors were all factors which played an important role in this process. Slowly this procedure enabled me to fabricate each row and erect the amphitheatre.

Once all the rows were completed, finishing touches were added to the amphitheatre. This process included tidying the area in and around the actual amphitheatre as well as covering the ground surface with wood chips. Wood chips were chosen because I could make them from the pieces of the trees cut down that were not used for rows.

This project was very interactive, as I continually needed to manage and interact among several systems. I had to design an amphitheatre that met the needs of the YMCA, fit into their available budget, paralleled the existing system of the YMCA, and remained true to the natural environment. These design issues were significant as were construction considerations on the site. Putting the design in place required managing workers to help, organizing each step at a time, learning construction techniques, and problem solving obstacles as they appeared. My completed amphitheatre now stands as a testament to the success of this Interactive Qualifying Project.

Introduction

For the past six summers I have worked for the Metrowest YMCA Outdoor Center in Hopkinton, Massachusetts. The Outdoor Center is a division of the Metrowest YMCA in Framingham, Massachusetts.



Fig. 1 Metrowest YMCA Outdoor Center in Hopkinton, Massachusetts

I started as a camp counselor teaching canoeing and sailing as a way to keep busy one summer. That first summer I enjoyed my job very much. I loved working with kids, being outdoors, and getting paid for it as well. I returned year after year from then on, every year starting to work more and more. The second year I began lifeguarding on weekends and then teaching swimming lessons throughout the year at the Framingham YMCA. My involvement grew during the next few years as I worked facilitating ropes course groups, teaching environmental education, and continuing to teach canoeing and sailing. In 1998 I became employed by the YMCA part-time year round on weekends and nights. I thoroughly enjoyed working with kids, helping them learn about the environment, sports, and themselves. Even when most of my peers started getting jobs pertaining to their majors, I chose to keep my job at the Y. Throughout the years I got more and more involved with planning events and

programs at the YMCA. These ranged from developing a kayaking program, to starting a radio station, and building new ropes course elements. I have just finished my most ambitious endeavor: designing, developing, and building an amphitheatre.

Throughout the summer camp the YMCA runs what they call family nights. At these family nights parents and their children come back to camp in the evening and sit around a campfire singing songs or performing skits. Sitting around a campfire sounds familiar, but at this camp it works differently. The YMCA summer camp provides activities for approximately seven hundred and fifty kids a day! At most family nights at least two hundred parents and children will arrive to interact with around eighty staff members. Sitting around the campfire has meant sitting on a big hill with a campfire down below. At one of these family nights during the summer of 1998, one of the professional staff members and I discussed how great it would be if the Outdoor Center had an amphitheatre of some kind. As we discussed the idea, more uses for such a space became obvious. Besides the family nights, an amphitheatre could be used for many other activities: gathering camp kids in the morning, conducting preschool graduations, housing any special presentations the camp brought in, and even future possibilities like hosting local concerts, etc. The more we discussed an amphitheatre the better the idea sounded, but we ended the talk that evening.

Design

A few months later the two of us were actually working together at the Worcester YMCA helping with a ropes course group when we noticed their amphitheatre. The summer camp at the Harrington Outdoor Center branch of the Worcester YMCA has just over a hundred children in attendance each summer, so their camp is much smaller than ours and their amphitheatre fits only sixty people or so. Nevertheless, seeing their amphitheatre got us thinking again. It also got me thinking about whether it would be at all possible for me to work on an amphitheatre project as one of my projects for WPI. After working out details with my advisor this dream started to become a reality. I

was ready to take the idea to the next level, and so planned several meetings with branch and program directors at the YMCA.

Of course the YMCA, being a non-profit organization, was thrilled at the idea of me coming in and designing and planning the construction of an amphitheatre at no cost to them. Therefore, I began to finalize the logistics and determine the needs of the camp. We discussed finances and came to the conclusion that the Y did have some money they could spend on the construction. They could also get employees and other people to volunteer their time to help with the construction. They made Greg Crout, the outdoor education director, my contact at the YMCA. And since Greg had much experience at outdoor work, since he has worked on a farm and as a lumberjack among many other outdoor jobs, he would work directly with me during much of the building process. With the logistics out of the way, we began to plan what the camp officials wanted out of this multi-use space.

The YMCA directors informed me that they were looking for a space that held around two hundred to two hundred-fifty people. They knew that creating a space that held their entire camp was not feasible, but hoped for an amphitheatre large enough to accommodate the family nights or one to two divisions of the summer camp at a given time. They also stressed that cost must be kept to a minimum. Finally, they stressed the aesthetics of the facility: they wanted something that looked like it belonged at a summer camp, in keeping with the natural, outdoor feel. Agreeing with them on all of these guidelines, I set out to put the plan into action.

My first step was to propose a design and find a location on the one hundred-fifty acres of property that would accommodate the design. This was kind of a two way street because one depended upon the other. I would be wasting valuable time if I came up with a great design but there was not a location to accommodate that design. Likewise if I found a location first but no amphitheatre design could work there, I would face starting over again. I researched other amphitheatres and searched the vast property at the YMCA at the same time. The first questions I

asked myself were what exactly is an amphitheatre, why and how have they been used, and what kind of designs of amphitheatres are currently being used for similar applications?

I had been tossing around the word amphitheatre a lot at the time, and had studied such spaces many times in theatre classes I had taken at WPI, but I really did not know that much about the history of amphitheatres. According to my Webster's dictionary an amphitheatre was simply, "a round or oval building with an open space (arena) surrounded by rising rows of seats" (Webster's 15). Simple enough, but I still needed more information to establish what I envisioned for camp. A little more research told me that the Greek meaning of amphitheatre is a theatre with seats on all sides. As an architectural form the origins of the amphitheatre are Italic or Etrusco Campanian.

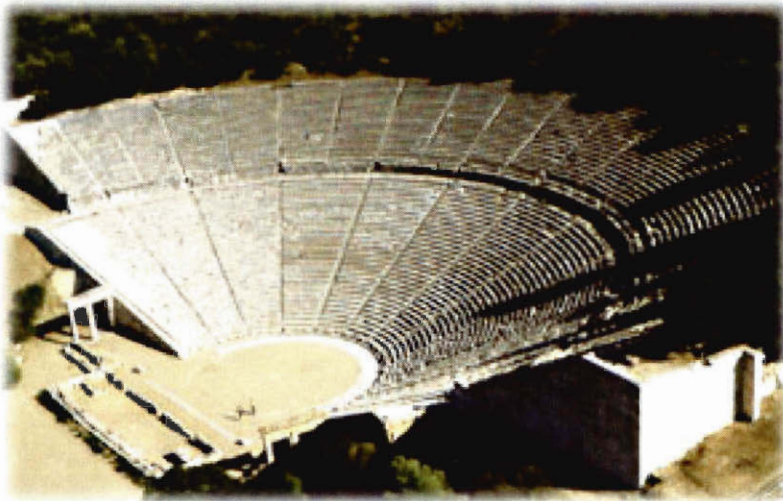


Fig. 2 Ancient Amphitheatre at Epidauros

We can read the word amphitheater first in work written in the Augustan Age, and the first amphitheatre in Rome was constructed around 59 BC by C Scribonius Curio. The earliest amphitheatre that is still in existence today is said to be in Pompeii, it is called Spectacula and was constructed after 80 BC (Encyclopedia Britannica).

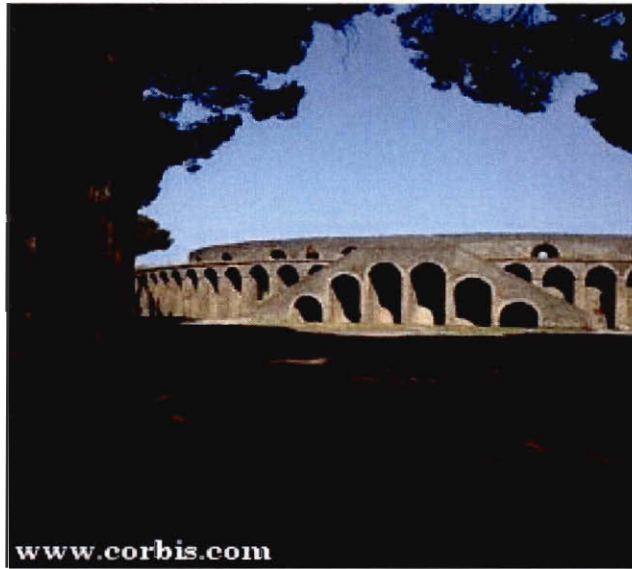


Fig. 3 Spectacula, Pompeii

Next I began my research of different amphitheatres being used today for similar purposes to those needed by the camp. I have already mentioned the Harrington YMCA Outdoor Center's amphitheatre, which looks like it was designed in two different stages. A pavilion, standard in most camps, was first constructed and then seating was built around the pavilion on three sides. The pavilion, a cement floor with a roof over head and no walls, serves as the stage. The seating looks like bleacher-style benches constructed of hardwood. I like this style a lot, for I believe it maintains a camp-like look and feel to it. Our YMCA does have several pavilions similar to the one used there, but I believe there is a limit to the maximum number of seats that could be built around any of them.

Another style commonly used and revealed in my research is very similar to the first design except without the pavilion. This would somewhat take away the limit of seats the pavilion imposes. This design looks very much like a stadium with bleachers, the kind you can find at any high school football game. This design could potentially hold many spectators, but the cost would rise tremendously. The stadium, furthermore, does not provide a natural or rustic look, so I hope to avoid this design.

The design I believed would work best at this camp can be described as giant stairs dug into the side of a hill. This amphitheatre style does require a hill that can be somewhat excavated and is the appropriate size for the desired rows, number of people, etc. This design can be kept very

natural looking, because the only materials needed for the final construction, I hoped, would be earth (dirt) and logs to hold the rows (stairs) in place. Such logs could come from trees already around camp.

Development

I decided to pursue this design. After searching the hundred-fifty acres and looking over the topographical map of the property, I found an area that seemed to work well for this amphitheatre design.



Fig. 4 Topographical Map of Metrowest YMCA (Boxed area shows proposed amphitheatre site)

This location was in the woods in a rarely used part of the property, not very far from areas that are used constantly. The location had a fairly large hill and a flat area at the bottom that would be good for the stage.



Fig. 5 Selected location for Amphitheatre

At this site, I found the potential for two entrances/exits, an upper entrance and a lower one. The upper one would enter onto the highest row, while the lower one entered onto the stage level.



Fig. 6 Upper entrance to selected site



Fig. 7 Lower exit from selected site

Nearby the stage area I found an old fire pit, which could be kept or moved if so desired.



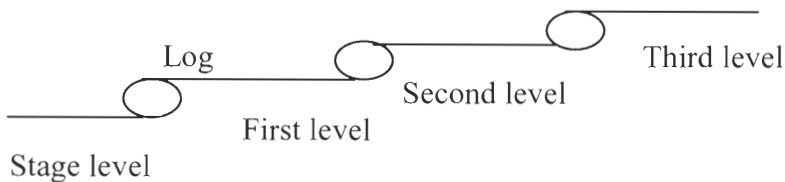
Fig. 8 Fire pit near selected site

The area did have some trees that had to be taken down, and I hoped to use those trees to hold the rows in place. I wanted to leave some trees around or in the actual amphitheatre if at all possible to help maintain the natural setting. The only other concern I had at that point in my work was, being winter and with snow on the ground, was there something unseen that might hinder construction?



Fig. 9 Projected seating area at selected site

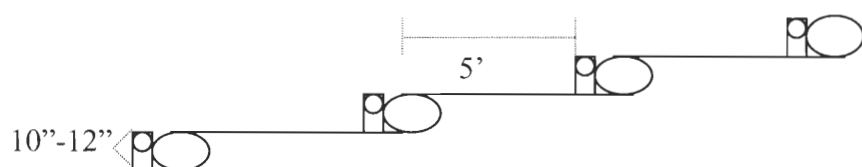
My design can be explained more clearly by thinking of placing a log on the ground, up against a hill, and then flattening the ground behind that log up against that log. Several feet back this process repeats over again.



The side view above describes this process.

The directors at the YMCA liked this proposal site and approved my design. My next step was to measure out the area, and finalize the design plans. The snow had cleared which helped us to see the area a little better. I used caution tape to outline the sides of the amphitheatre going up the hill, this helped us visualize the actual space we would be working with. The first row would be approximately thirty-five feet and each row will get slightly bigger. Each row (step) would be around four to five feet wide (side view). This would allow comfortable sitting room and allow for easy

walking down from the top, since most people stride about four and a half feet for every two steps. The logs holding the rows in place were made of trees that were cleared during construction. The plan was to leave a couple of trees in the middle of the amphitheatre space as well as the ones outside the space to maintain an outdoors-like feel. The other part of the design originally left unexplained is the stakes. I decided that the logs, holding the rows, needed to be staked down into the ground. These stakes were made of natural hardwood branches found around the property.



Since the hill is almost fifty-five feet from top to bottom, I planned for ten rows. Approximating the average length of a row at fifty feet, and considering that one person takes up a generous two and a half feet, the amphitheatre should more than accommodate two hundred adults comfortably.

My planning then needed to consider what to put on the surface of the rows. Since people will sit right on the ground, and with the intent to keep it natural looking, I would love to grow grass on every row. That might get expensive for grass seed, and could potentially not work out for sun/shade, watering, and mowing reasons. Yet the plan remained grass, with woodchips as a plausible backup. Woodchips would not provide the comfort of grass but would not be too uncomfortable and would keep a rustic look to the amphitheatre.

Implementation

My first step of actual work on the amphitheatre was to mark trees I knew would have to come down, and to start clearing the hill of all shrubbery and leaves. I wanted to keep the number of trees cut down to a minimum, so I marked only trees I felt necessary at this point of the process.

Clearing the hill sounded easier than it was. Steel rakes helped pull leaves and many layers of pine needles down, but it took two days to clear the entire hill. Pine needles definitely accumulate over the years. Clearing the shrubbery involved pulling up as much as I could by hand, cutting what I could not pull up, and eventually yanking up big roots with some rope and a four-wheel drive truck. After clearing the hill, Greg Crout and I worked on cutting down the trees. This process took a lot less time than I thought, since Greg was definitely skilled in this.



Fig 10 Trees felled for use as rows

Once the trees were cut down we moved them into a rough estimate of where they would eventually be placed. Moving the trees was an interesting challenge. These trees, I imagine, weighed several thousand pounds, so to move them I turned to some physics. We tied a tree to one end of an old ropes course rope, then ran the rope through a pulley we connected around a tree, at the angle

and direction we wanted to move the tree. The other end of the rope was connected to the YMCA's very old four-wheel drive truck.



Fig. 11 Example of physics used to move logs into seating configuration

This process was very slow, as we had to move each tree several times in different directions in order to get it where we wanted it. During this process I gained a new respect for the strength of the ropes and steel carabiners we use on the ropes course. After moving six of these trees the rope had broken once, a scary experience, and several carabiners had bent but were still usable. After tying the ends of the rope together and adjusting where the force was applied to the carabiner there were no more problems with this process throughout the construction. Once these initial trees

were moved into the vicinity they would eventually occupy, the amphitheatre started to take shape.

Anyone that did not understand the plan, began to see what the final design would look like.



Fig. 12 Rough outline of seating

Next we cut some stakes from hardwood trees around the property. We cut four-foot logs out of straight branches and small trees, then sharpened one end to a point to be able to drive them into the ground.



Fig. 13 Trees felled and fashioned into stakes to secure seating area

At about this time the Executive Branch Director of the YMCA, Jon Simons, stopped by to see how everything was going. He was impressed with the progress and offered to rent a wood chipper if we wanted one. Since we had cut down many trees and cleared many shrubs from the amphitheatre site, we had plenty of tree branches in the way. The very next day we had our wood chipper for \$275 a day.



Fig. 14 Wood chipper in service of project

Even though it was the coldest day of the month Greg, some other YMCA employees, and I were there at the crack of dawn and worked until it got dark chopping up the left over trees pieces.



Fig. 15 On site! Greg Crout and Greg Jutkiewicz after wood chipping

After a long day of chipping wood, the area around the amphitheatre started to look very sharp, and it was a lot easier to work around.



Fig 16 Area cleared for seating construction

I was ready to put the first row in, finally. We moved a thirty-five foot tree, only four inches in diameter, in place by hand. The first row I wanted to be shorter in height than most, because the bottom of the hill was more gradual than the rest. After placing the tree in place, three stakes were placed in front of the tree to hold it in place. To put the stakes in we dug a hole with a post-hole digger, placed the stake in the ground, drove it in further with a sledge-hammer, and then packed in dirt around it. The log was now secure so we flattened the ground behind the log. Since this was a small log, we were finished quickly and felt ambitious to get the second log in immediately. This log was a little harder because we had to drag it in place with the rope-pulley-truck system. When we finished the second row, it started to look like an amphitheatre.

This same process continued row by row as we got several rows completed in the next few weeks. Each row was longer than next as planned, but eventually that created some problems. First of all, the trees we cut down were not long enough to go from one side of the amphitheatre all the way to the other side. The other problem was logs that were even close to being long enough were so heavy that even dragging them with the truck was starting to be almost impossible. These very long logs would dig into the ground instead of pulling up and over the ground. This was a result of the heaviness of the log and the length, since the ground was not even, the ends of the log would be on the ground while the middle was up several inches off the ground. To remedy both problems we started cutting the logs into smaller sections. Even though this did not look as neat as one log making up a row, it was easier and enabled us more flexibility. This new idea did bring some problems of its own, though. First, it necessitated that we make the ends of the two adjacent logs look perfectly symmetrical, so as not to destroy the consistency. Secondly, it required us to put in more stakes, as every section of the log needed two or three stakes each.

Placing these stakes in the ground got harder and harder as the farther up the hill we got the more rocks were in the ground. At the bottom of the hill, digging the hole for each stake took no more than five minutes. By the fourth row, each stake hole was taking forty-five minutes to an hour.

The reason for this drastic increase in time was every inch I dug I had to stop and dig out several rocks from the ground. Another problem I ran into around the fourth row was the huge tree I had decided to leave growing in the dead center of the amphitheatre. I wanted to keep that tree for several reasons. One reason was that it is huge and beautiful, and I thought it would be cool to have a tree in the middle of an amphitheatre. Keeping the tree would keep it true to the environment that the amphitheatre was built out from, and it could provide some shade on really hot days. Now the tree presented me with some interesting challenges. I knew it was not healthy for a tree to dig around it and expose areas of the base that were originally covered. Likewise, it is not healthy to cover areas with dirt that were originally uncovered and exposed to air. In order to keep the tree alive and healthy I decided to leave the area around the tree alone. This meant I had to leave a hump in the ground around the tree and divide the row, so half was on one side of the tree and half was on the other side of the tree.



Fig. 17 Excavation to include existing tree

The other major complication I ran into was how uneven the ground was across the amphitheatre. I noticed even before I began any construction that while looking at the hill the left side was higher than the right. At the time I did not think this would be a problem, because I would be digging into the hill, so I thought it would even out. The further up the hill I got the more I had to dig into the left side of the hill and the more I had to fill in dirt on the right side of the hill. The right side was so low I started filling in the rows with rocks and then dirt on top of the rocks, because there was just not enough dirt to fill into the right half. This process got worse and worse the higher I got up the hill and will eventually be one of the reasons the final amphitheatre has less rows than initially planned.



Fig. 18 Fashioning rows by physical work

Throughout the building of the amphitheatre many changes occurred at the YMCA which hindered the progress as well. The first change that occurred was that the youth and camping director, who was the director of the day camp and a good friend of mine, left the YMCA to take another job. This slowed down the building process because Greg Crout and other employees of the YMCA had to fill in with responsibilities and help to hire a new director. Another change was that the closer the time came for camp to start the more work we all needed to direct towards our jobs, which meant less time each day spent at the ampitheatre. The beloved truck that we used to pull the trees in place also died. This meant that the trees more often had to be cut into smaller pieces so that the logs could be moved by hand. The toughest change that occurred was that Greg Crout also left the YMCA. Greg knew so much about cutting down trees, digging holes, and just about everything else that I needed to know during this project. He had worked directly with me in the design and almost every day of construction. Greg was definitely a huge help and the project would not have gotten off the ground without his influence at the YMCA.



Fig. 19 Greg Crout on site

After he left I brought some other YMCA employees to volunteer some time digging and moving logs. It was not the same, and when there was a question I had to come up with a solution by myself. While Greg was there I was able to debate with him the best way to solve the problem. Throughout all of these changes and setbacks, I had to continue and still build the best amphitheatre I could.



Fig. 20 Steve Fisher leveling row area

The final amphitheatre is a modified version of the initial design. The number of rows has been reduced to five. This change is due to the differing ground levels and amount of excavating on the left side that was needed and the amount of fill in dirt that was needed on the right side.



Fig. 21 Rows in place

The initial plan called for ten rows, but ten rows would not have been feasible anyway. Looking at the final amphitheatre, I believe the maximum number of rows possible is eight. My original measurement and plan was off because I did not consider that digging into the ground changes the distance from the front to the back of the hill. I planned on ten rows because each row was supposed to be around five feet deep, and the hill was fifty feet from top to bottom. Each row ended up being more than five feet, because the log adds almost another foot to most rows. The final amphitheatre does not continue all the way up the hill, but sitting on the hill above the rows is always possible. This would allow more audience to fit in the amphitheatre, and provides almost “bleacher” seating at the back.

The final amphitheatre is by no means something that cannot be upgraded or continued. The YMCA can add more rows and continue construction at any time, if they desire.

The ground of the finished amphitheatre is also covered with woodchips instead of grass. This change in plans came about for many reasons. The woodchips were free, since we had chipped them ourselves months earlier, while it would have cost a significant amount to purchase grass seed. Grass requires a large commitment to maintain, including watering and mowing. This commitment was not feasible for the YMCA especially since there is no water source near the amphitheatre. Grass also needs sun to grow, but the amphitheatre is in the woods and gets limited amounts of sun. Replacing the woodchips with grass is also something the Y could choose to do later.



Fig. 22 Side view of completed seating section of amphitheatre

The last modification to the initial plan is the tree stumps. I had originally hoped to trim the tree stumps down to ground level or even to below ground level. Time restraints kept me from doing this,

so throughout the amphitheatre there are four or five tree stumps that stick up a couple of inches. Since the woodchips cover the ground completely, these stumps are barely noticeable and appear merely as bumps in the ground. The Y could dig around the stumps and cut them lower at any point, if they wished to do so.

The final amphitheatre does have two qualities I really did not count on during the planning. The amphitheatre is part of that hill. It belongs there. Even with wood chips covering the rows, the amphitheatre looks more natural than I ever expected it to look. The second unexpected quality is the acoustics. Through my research of amphitheatres I learned that acoustics were always perfect and were taken very seriously in the design of amphitheatres. I did not worry about acoustics while designing my amphitheatre. I knew that naturally the acoustics would be at least acceptable because the hill started right at the edge of the stage area. The acoustics in the finished amphitheatre are excellent. Any seat in the house can easily hear every word spoken at the stage area. Both qualities very pleasantly surprised me upon completion of the amphitheatre. The Metrowest YMCA Outdoor Center now has a fully functional amphitheatre to use as they wish.

Literature Review

Designing, Developing, and Building an Amphitheatre at the Metrowest YMCA

Outdoor Center in Hopkinton, Massachusetts required me to investigate and examine many sources of information about amphitheatres. These sources include some books and many web sites that involve amphitheatres and their uses. I also surveyed a brochure of programs offered at the Metrowest YMCA Outdoor Center to more fully interpret the needs of the facility.

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Hypertext Links

<http://www.unc.edu/depts/outdoor>

<http://search.yahoo.com/bin/search?p=amphitheatres>

http://www.lyq.org.au/lhyc/cr_cha.jpg

<http://www.kinsey.demon.co.uk/Homepage/index.html>

http://babel oulu.fi/~mpi/Photos_athe.html

<http://www.corbis.com>

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Highlights of Qualifications:

- /// Highly motivated and committed.
- /// Strong verbal and presentation skills
- /// Work well under pressure; able to meet strict deadlines.
- /// Ability to work well independently and as a cooperative team member.
- /// Enthusiastic and energetic.
- /// Quick to learn new ideas and methods.
- /// Enjoy learning new skills.

Education:

Worcester Polytechnic Institute
Theatre Technology/Electrical Engineering

Worcester, MA
May, 2000

Experience:

Uptown Sounds
Mobile Disc Jockey
Owner/Operator

Framingham, MA
1992-Present

Suzanne's Dance Connection
Technical Director

Burlington, MA
1996-Present

Duties include: music editing, sound design, lighting design, master electrician, special effects including intelligent lighting and pyrotechnics.

Suzanne Perdue Dance Center
Sound & Lighting Design

Framingham, MA
1995-Present

Threshold Theatre
Resident Lighting Designer

Boston, MA
1996-1998

Forum Theatre
Sound Engineer

Worcester, MA
1997

Extracurricular Activities:

/// Lens & Lights
WPI

Technical Director
1997-1998

- /// Sound design and sound engineering for various on-campus theater shows and music concerts at Worcester Polytechnic Institute.