Experimentation of Managerial Techniques for the Optimization of a Voluntary Construction Workforce

by

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ABSTRACT

Using experience, observations, data, current research, and writings in the field of volunteer management, it was determined there was a need to study the effects of leadership/management practices on the productivity outcomes of a volunteer construction workforce. A simple wood bench that would be tiled and painted was designed to test the areas of Time, Waste, Quality, Safety, and Satisfaction of different volunteer groups. The challenge was bolstered by giving the teams no power tools and limited available resources. A simple design of experiment model was used to test highs and lows in the three management techniques of Instruction, Help, and Encouragement. Each scenario was tested multiple times. Data was collected, normalized and analyzed using statistical analysis software. A few significant findings were discovered. The first; the research showed that there was no significant correlation between the management practices of the leader and the satisfaction of the volunteers. The second; the research also showed when further analyzed into specific realistic scenarios that the organizations would be better to focus on high amounts of Help and Encouragement in order to maximize the productivity of their volunteer construction workforce. This is significant as it allows NPO's and governments to focus their attention where best suited to produce results. The results were shared and the study was further validated as "significant" by conducting interviews with experts in the construction nonprofit sector.

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Chapter 1

INTRODUCTION

Volunteerism in the U.S. and abroad has received some major traction. “The nonprofit sector of the economy fulfills important social functions that would otherwise have to be performed by the government, funded through increased individual and business taxation, or not performed at all (Wymer,Walter 1997).” Committed and enthusiastic volunteers are a valuable asset to non-profit organizations and the overall society (Unger, Lynette S. 1991). In today’s unstable economy, most non-profit organizations suffering from lack of financial resources heavily rely on a volunteer workforce to make up the gap needed to succeed (Bang, Hyejin 2012; Unger, Lynette S. 1991). The same holds true with government agencies, as volunteers prove to be a valuable resource and effective cost saving measure for various projects including larger disaster relief efforts. “In one documented case in Florida, the community used unaffiliated spontaneous volunteers for cleanup after a tornado. Osceola County completed its cleanup after 35 days and $6.6 million less than initial estimates because of volunteer help (United States 2003).” In another example, Ava Stanford works for the Mayo Clinic in Phoenix, AZ where she leads the volunteer services for that campus. When discussing the topics of volunteers and how much they can provide to an organization, she quickly relayed some statistics they put together on how much volunteers help the Hospital. This included all the departments that are aided by their efforts and an overall monetary value of the hours and work that has been accomplished over each year. The number was staggering. Over one million dollars is saved every year by the hospital by using volunteers (Stanford, Ava 2011). These few examples, give a clear picture as to why volunteerism is beginning to be an integral part in many sectors and industries on a global level.

As the positive societal impacts become clearer, volunteerism is becoming more of a focus among governments and even in some research. This became more prevalent as the U.S. passed legislation pertaining to volunteering in 1997 with the *Volunteer Protection Act*. Its intent was to boost voluntary participation in the work of not-for-profit organizations and government agencies (Hash, Michael 1997). A volunteer is defined as an individual who, beyond the confines

of paid employment and normal responsibilities, contributes time and service to assist in the accomplishment of a particular mission (United States 2003). In the U.S. alone, the numbers reached a five year high in 2011 with a recorded volunteer rate of 26.8%. This is equivalent to approximately 64.3 million Americans who gave up their time and talents to participate in humanitarian and other unpaid, non-profit work, for a formal organization. When quantified, this equated to approximately 7.9 billion hours with a value of $171 billion (Corporation for National & Community Service 2012). The latest numbers in the U.S., gathered from 2012, show an increase in the number of volunteer participants to 64.5 million people. This is an increase of 0.2 million people, but the volunteer rate decreased slightly by 0.3 percent due to population growth (BLS 2013). One of the key findings from the study conducted by the Corporation for National & Community Service was that “Americans are increasing their commitment to volunteering and civic engagement and volunteers have stepped up to support recovery and relief efforts after Hurricane Sandy (Corporation for National & Community Service 2012).” The same school of thought was reiterated earlier by a manual produced by FEMA where it states that, “The United States has a long history of volunteerism – a history that has gotten even stronger since the terrorist attacks of September 11 (United States 2003).” One could easily conclude by the statistics alone that people have the desire to help others. This greatly increases as the need arises in even dire circumstances such as natural disasters or in other times of great crisis.

Purpose of Research

Research and studies of volunteerism are gaining traction and attention. This is only expected to increase as proper and effective management of volunteers is becoming essential for the success of many nonprofit and government agencies. Currently, research and writings lean towards an overall “general practices” approach for volunteer management, which typically embody retention, recruitment, and placement of volunteers. The researcher has found no specific research or data on managing volunteers for construction projects. Considering the fact that Habitat for Humanity alone, which is only one of many non-profits that focus on construction, has reached more than 3 million people globally and have repaired or built over 600,000 homes, a need is clearly present.

Getting the most out of our volunteers on these construction projects would have tremendous implications on the already large quantities of people serviced and helped around the globe.

Research Hypothesis

Productivity of a volunteer workforce will change based on the inclusion or exclusion of certain leadership/management practices.

Research Variables and Measures

The independent variable tested was the amount of leadership/management provided to volunteers. The three tested were Initial Instruction, Help, and Encouragement. *Initial Instruction* included how much information was conveyed and taught to each volunteer participant prior to starting. *Help* included how much hands-on micromanagement and aid as well as the amount of availability to answer questions during the project for each participant and group. *Encouragement* included how many times the groups were verbally encouraged during the project until completion. Each variable measurement was either represented by a high or low, creating eight different possible scenarios. The dependent variables included in this research were Time, Waste, Quality, Safety, and Satisfaction in respect to construction productivity. The measurements were quantitative normalized results for Time and Waste, with observational derived quantitative normalized measurements Quality and Safety. The final measurement for Satisfaction came directly from quantitative data received from the volunteers.

Research Objectives and Goals

The objective of this research was to determine if there were any significant correlations in the relationship to certain levels of leadership/management practices and the overall productivity of a volunteer construction workforce. The goal was twofold: test and analyze the data for findings and as a means of identifying these significant relationships between the two, and use those findings to provide direction on best practices for leaders and organizations using realistic scenarios and situations. These different scenarios and situations were created to represent some common

priorities and values embodied by different nonprofits and government entities. A clear and precise recommendation of what practices are to be focused on will be given for each case. In summation, the goal was for a leader to be able to walk away knowing what to focus on that will improve the productivity of their volunteer construction workforce by taking his/her organizational values and combing them with the results of this research.

Research Methodology

A proper experiment in the field of volunteer productivity yielded many challenges. The addition of construction and the research's relevance to work in other countries created an even further difficult and seemingly insurmountable task.

The first and most important challenge was to recruit volunteers. As many non-profit organizations experience, this can be a daunting and difficult task. Many of these organizations and disaster relief efforts are dependent upon volunteers and the ancillary resources they provide in the form of finances, knowledge, skill, labor and recruitment of others. As pointed out in over ten different presentations (all from different nonprofit organizations) to a class on Volunteer Resource Management offered by Arizona State University in the fall of 2011, without volunteers, they simply would not make nearly as great of an impact, with some confessing that they would not even exist (NLM 598). One way to recruit the necessary volunteers needed for the study would be to call in personal favors. Upon further consideration it was deemed an unviable solution. This conclusion was predicated on the verity that this would likely taint the normal mindset of the volunteers. Others would have to recruit volunteers in a customary manner. This had a small challenge in itself. In order to create an accurate mindset and feeling from each volunteer, they must believe that they were volunteering for something that was to add to the overall good of someone else or society as a whole. This would provide that 'feel good' deposit often spoken of when it comes to one's emotional bank account (Covey 1994, Jacobs 2008). Without the accurate emotional state of the volunteer, the research would be compromised and the data skewed. The project was announced at a faith-based collegiate youth gathering affiliated

with Arizona State University. Everyone was made aware that they would be building a bench for charity and that these benches were to be donated to a few non-profit groups in the Phoenix area as well as some families in Mexico. After the initial announcement, there was a signup sheet in the back of the room as well as online in the form of a Google Document. This gave the recruitment the most traction, with word of mouth finishing the job.

The next challenge was to create a project that could represent multiple facets of construction without the high cost and time consumption of many larger projects. It would also need to be something that could easily be measured for basic elements in productivity of time, quality, safety, waste, and overall satisfaction. Not every subset of the industry needed to be represented to gather data, only overall basic skills needed for universal fundamentals. After all, even in disaster relief and other non-profit organizations that deal with construction, many technical tasks are allocated out to professionals. By focusing on the fundamentals, the research provided not only the consistency needed to gather accurate data, but it gave an overall comprehensive outcome, inclusive of various differing types of organizations where it would be considered helpful and relevant. The basics included things such as measuring and using dimensions, plan reading and diagram deciphering, allocation and use of resources and materials, the process of fabrication and/or cutting of said materials, assembly of the fabricated pieces into a whole structure, use of tools and hardware to complete the assembly, teamwork and collaboration on each phase, and ease of measurability of the productivity categories and outcomes throughout each phase. The end goal and specifications needed to be the same for each group, as to provide an easy comparison along the way. Time consumption is a huge issue when it comes to not only volunteers, but people in general. As Thomas Edison said, “Time is really the only capital that any human being has, and the only thing he can’t afford to lose” (Sullivan 2009). Completion of the project needed to be attainable within a short interval, to be measured in minutes and hours, not days and months. Truncating the time of the overall project to less than one day allowed small feel good celebrations to happen amongst each individual and volunteer group at key milestones.

Those little senses of accomplishment may have begot more accuracy to a normal volunteer experience.

The final major challenge that was addressed was the universality of the results. The results needed to be efficacious at a multicultural level. Accomplishing this gave the results a greater breadth in their realm of applicability. If accomplished, this model would be more versatile and could be used by non-profit and other organizations worldwide. The project needed to be created and built using methods and practices used in other countries. Many niceties found in the United States and other first world countries would have to be limited or abolished altogether. Strategically accomplishing this created an accurate picture of building conditions across borders and cultures including the forced resourcefulness needed by each volunteer and volunteer group to complete some if not all of the tasks. In essence, a simple project had to remain simple, but the process of completing it as well as each of its parts and pieces must be challenging.

A simple bench was the solution to overcome all of these challenges. The bench was designed to be built quickly, but contain many different tasks and skills that would be universal in other building projects. The participants would not be given any power tools to help them in their build, with the exception of a cordless drill in order to simulate construction in parts of the world outside of the US.

The groups of volunteers built the benches using all of the same tools, materials, and equipment, and in the same environment. The only change was the leadership/management practices that were being tested against productivity. Data was collected on each group in respect to Time, Waste, Quality, Safety, and Satisfaction. All of the results were then documented and normalized for analysis. The analysis yielded results that equate to recommendations and suggestions for leaders and organizations based on their importance and alignment of values.

Scope and Limitations

The research scope encompasses volunteers from the college to young adult ages with nominal construction experience. The study used little technology in regards to the resources given to the groups to complete the building tasks. One limitation of the study was the lack of construction experience of the volunteers used. Despite the sample used for the study being representative of the majority of volunteers in this situation, having a seasoned professional builder in the group may cause divergence in the results. This study was also limited to a certain age group. It is possible, but unknown, that having older participants may cause varying results.

Summary of Research

Using experience, observations, data, current research, and writings in the field of volunteer management, it was determined there was a need to study the effects of leadership/management practices on the productivity outcomes of a volunteer construction workforce. A simple wood bench that would be tiled and painted was designed to test the areas of Time, Waste, Quality, Safety, and Satisfaction of different volunteer groups. The challenge was bolstered by giving the teams no power tools and limited available resources. A simple design of experiment model was used to test highs and lows in the three management techniques of Instruction, Help, and Encouragement. Each scenario was tested multiple times. Data was collected, normalized and analyzed using statistical analysis software. A few significant findings were discovered. The first; the research showed that there was no significant correlation between the management practices of the leader and the satisfaction of the volunteers. The second; the research also showed when further analyzed into specific realistic scenarios that the organizations would be better to focus on high amounts of Help and Encouragement in order to maximize the productivity of their volunteer construction workforce. This is significant as it allows NPO’s and governments to focus their attention where best suited to produce results. The results were shared and the study was further validated as “significant” by conducting interviews with experts in the construction nonprofit sector.

Chapter 2

LITERATURE REVIEW

Volunteerism

With the overwhelming innate response of people to help others, many researchers and organizations have tried to tackle the questions of why, with varying successes and results. The motivations behind ones desire to volunteer has been dissected many times. The decision to volunteer was categorized and published in the Journal of Nonprofit & Public Sector Marketing in four different areas. The four areas identified were personal, social interactions, efficacy, and contextual reasons (Wymer 1997). Mueller found a similar four pronged reasoning, with the twist of stating that this is actually a form of payment. She claims that volunteers actually do get 'paid' in four different ways: a family member will benefit on the receiving end of the organization volunteered for, people's own stock of human capital will improve based on the productive skills one might accumulate, personal prestige, and finally that altruistic motives may be satisfied (Mueller 1975). Altruism is an important driving motivation, and has even been shown to create safer habits among volunteers (Newnam 2009). However, many mistakenly assume altruistic motives are always the driving factors behind people that volunteer, but this must not be assumed. "It has been well established that volunteers have multiple motivations, with altruism only a minor factor. Other motivating factors include: fellowship, discontent with primary vocation, personal recognition, desire for marketable work experience, social interaction, and the lessening of a sense of debt or obligation (Mitchell 1996)." Recent research on motivation and influence of volunteer leaders led to even more validation of these results and findings (Emrah 2013). Answering the question to what motivates people is an important step to define, as research shows that when the opportunities are matched up and aligned correctly to fulfill the individual's needs and motives, that volunteer will have greater longevity of service to that organization (Lavelle 2010). This longevity, resulting from the sense of satisfaction from the volunteer, provides the resources that non-profit and other government agencies rely on to achieve the majority of their outcomes.

Managing and Leading Volunteers

As nonprofits and governments have recognized not only the importance, but their dependencies on volunteers, retention and management practices are starting to gain more attention. Even legislation has been passed around this subject of volunteer retention. Peter King (R-N.Y.) along with nine other sponsors put forth the Volunteer Emergency Services Recruitment and Retention Act in early 2011 (Anonymous 2011).

Volunteer Management is now offered as a course at many universities across the country. However, one should note that while increasing in its popularity, in comparison to many other areas of study, the research for volunteer management is still embryonic.

In 1998 a study showed that "the American public sees the inefficient management of volunteer time as a basic obstacle to increased volunteerism. Time is the most limiting factor in volunteering and volunteers expect the time they donate to be well managed. The findings substantiate a crisis in volunteer management. Too many potential and active volunteers are turned off by what they regard as inefficient use of their time (UPS 1998)."

Some of the more recent case studies have been comprised by the Urban Institute. In 2003 they undertook the first national study of volunteer management capacity amongst a sample of nearly 3,000 different charities. The intent was to capture and document the extent that these charities were actually using the various management techniques and practices (Hager 2004). One key finding was that many of the charities were open-minded to best practices in volunteer management, but many do not implement them to their fullest capacities. This is shown in further detail below in Figure 1.

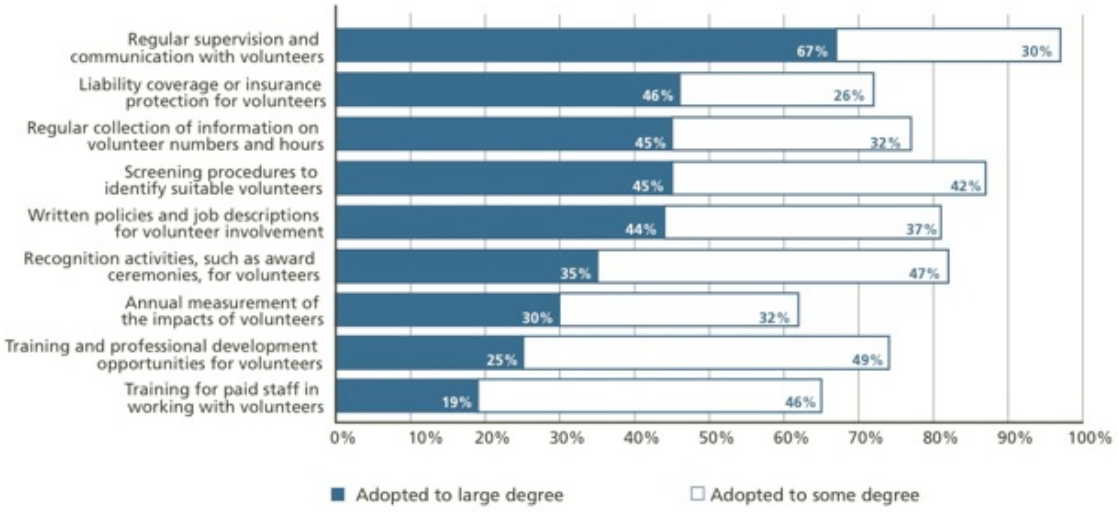


Figure 1. Management Practices that Charities Say They Practice to a Large Degree or to Some Degree

In 2007, data was collected from youth sport volunteers and it was determined that “Volunteer organizations need to focus on empowering their volunteers through the fit of the volunteer to the task, organization, and appropriate managerial treatment (Kim 2007).”

In 2008, more validation and similar results to the 1998 UPS study were found by the International Federation of Red Cross and Red Crescent Societies. They stated that ‘the retention of volunteers is closely linked to the way in which they are managed and supported. Volunteers stay when they have a sense of belonging to the organization, when they feel satisfied and recognized, and when they learn new things or see opportunities for growth. Volunteers leave when there are no meaningful activities, when they feel unappreciated or unsupported (McCurley 2011).’

In 2011, a study found that volunteers rate of retention were affected by their motivation, satisfaction, and responses to frustrating events. This seems to validate and correlate with other writings and studies’ findings as well (Forsyth 1999; Love 2009; Schwab 2011). The same study

suggests practical implications being that “nonprofit organizations should be more intentional in terms of volunteer motivations, ensure that volunteers feel supported and have opportunities to connect with other people in their volunteer work, and encourage volunteers to express their ideas using considerate voice (Garner 2011).” Another study of 2,306 emergency volunteers indicated that “supervisor support, interactional justice, recognition, and group cohesion all significantly contributed to greater volunteer satisfaction and ongoing commitment to the agency (Rice 2011).”

The findings of this current study will aid in all of these findings. By increasing the volunteers’ productivity, it is a win-win for non-profits and volunteers alike. The non-profit will essentially extract greater volume of work from their resources (volunteers), and the volunteer’s themselves will feel as they have been well managed and their time used correctly, further feeding into their satisfaction and overall retention mentioned in the studies above.

Servant leadership

“The ideal leader is visionary, practical, and inspirational, i.e., one who knows where to go, how to get there, and can motivate others to make the trip. (Graham 1991)” In the 1980s and 1990s, servant-leadership became a paramount focus and goal in leadership and management writings, and in organizational practices, which continues that way today (Spears 1996). It is said to have gained traction ever since Robert K. Greenleaf wrote an essay in 1970 entitled *The Servant as Leader*. Greenleaf went on to write other inspiring papers and was an advocate of leaders taking the interests in others to form their vision. He claimed that “Important to receiving, communicating, and responding to liberating visions are immersion in the experiences the world offers, acceptance of people involved in these experiences and learning what motivates them, and being open to receive and act upon what inspiration offers (Greenleaf 1980).”

Ken Blanchard, another prominent writer of servant leadership speaks about servant leadership and management both being part of a servant leader. He says that “leaders are not leading to

their full potential unless they are developing others (Blanchard 2007).” However, he also acknowledges that prior to developing others; effective leadership must begin at the heart level of oneself before moving outward to others (Blanchard 2000). This is why he claims that most leaders end up failing for issues of character (Blanchard 2007). In management, he believes in reversing the organizational pyramid. This puts the people on the front lines in a role of responsibility and where he claims that the leader now becomes responsive to those he leads. The leader’s role shifts to encourager, supporter, coach and facilitator, and that is where servant leadership takes over (Blanchard 1995).

“Servant leaders portray a resolute conviction and strong character by taking on not only the role of a servant, but also the nature of a servant (Vinod 2011).” Despite Greenleaf being given credit for the servant leader motif and the modern empowerment movement in leadership with regards to business (Greenleaf 1996), others point even further back in history to Jesus Christ. Jesus taught servant leadership in his life of ministry. The most detailed account is found in the book of Mark in chapter 10 versus 35-45. The passage speaks of two of Jesus’ twelve disciples (James and John) asking him to allow them to sit at his left and right side in his full glory. Scripture goes on to say that the other ten disciples became indignant with them. Jesus, seeing this verbal debacle take place, said to all of them, “You know that those who are considered rulers of the Gentiles lord it over them, and their great ones exercise authority over them. But it shall not be so among you. But whoever would be great among you must be your servant, and whoever would be first among you must be slave of all. For even the Son of Man came not to be served but to serve, and to give his life as a ransom for many. (Crossway Bibles 2008)”

The research will help the types of servant leaders described above. It is not a new theory in leadership, but will act as a tool for a leader to use. This tool will be important to craft vision, but also to save time and focus attention where necessary. With knowledge of what areas are most effective in making volunteers productive, the servant leader can shift the focus and/or fine tune it towards the individuals they are leading, creating even more responsiveness, and allowing more

time to effectively develop them along the way. This is paramount in an area with such complexities as leadership, which is affected and influenced by many factures, including culture (Wang 2012).

Construction Productivity

This research study will not only encompass volunteerism, but will graft with another huge sector of global industry; construction. "Construction industry is the largest single industrial sector in the United States, employing about 9.0 million workers in 2008. The industry accounted for an estimated annual gross domestic product (GDP) of over $1 trillion in 2007 (Paul 2009)." Construction spans the globe through different countries and cultures. "Even in the developed nations (and a fortiori in the developing ones) construction is relatively labour-intensive in the sense that it uses a larger number of workers per unit of output than most other industries, and as such is also important as an employer (Bhalla 1983)." There is not one single marketplace that the construction industry does not touch first. Prior to products being manufactured, the building as well as the machines that make the products to be produced must be constructed. Construction is truly on the cutting edge of all markets and industries.
Despite the enormity of this industry, construction productivity is in decline and is a major challenge confronting it today (Soekiman 2011). It is difficult to define the problems of productivity as the research and development in this industry has remained low in the US and the industry is very complex in form and function. One study suggests that you cannot even standardize a definition of construction productivity (Shehata 2011). It is made up of complex parts and components, and the productivity is affected by numerous stakeholders that often change with every project (Paul 2009). Productivity is simply defined as the ratio between the quantity of input to the quantity of output (Song 2008). The loss of construction productivity is usually attributed to various factors, rather than a single one (Nasirzadeh 2012). "This loss of productivity can be traced, in part, to several key factors: an increased design complexity, more rigorous governmental regulations and, most importantly, a declining trained work force (Scott 1998)." Inefficiency of management in regards to construction resources is also another key driving factor

in low productivity (Shehata 2011). Currently, the industry has adopted things such as LEAN principles, where the practice of continually identifying and eliminating waste in an organization (David 2009) becomes part of the culture. These resources and places of waste encompass varieties of items, with the largest being labor. One of the biggest challenges and concerns for this global industry is the productivity of its labor force. It is considered one of the best indicators of production efficiency (Rojas 2003). With construction's anemic rapport, based on poor performance with a track record of wastefulness and chronically low levels of customer satisfaction, a change is long overdue (Harrington 2012). Research in the construction industry has proved that utilization of quality management concepts has a great influence on achieving successful performance on any given project (Rumane 2011). The American Society for Quality defines the total quality management approach (TQM) as "a management approach to long–term success through customer satisfaction. In a TQM effort, all members of an organization participate in improving processes, products, services, and the culture in which they work (American Society for Quality)." Management tactics and strategies to increase productivity will remain in focus for today's successful construction companies, as increasing awareness starts to emerge due to the effects of their bottom line results.

As statistics on volunteerism continue to grow and receive national and global awareness and the huge US and global construction industry continues to expand and be a part of every other economic sector at some level, it is natural that the two will overlap. As academia and industry continue to have concerns and feeble attempts to study construction productivity from as early as the 1970's (Paul 2009), the focus on addressing volunteer productivity is far from in focus, and maybe not even on the radar. The reason for productivity challenges largely remains the same for both non-profits and the for-profit construction industry. The biggest challenge is the human factor. "The need to understand the strategy, structure, systems and management practices that facilitate organizational effectiveness of nonprofits has led to increased research interest in human resource management (HRM) in the sector. In particular, research on HRM in nonprofits has reinforced the human resources challenges as one of the most problematic organizational

capacity issues (Akingbola 2013).” Where the successful management of employees can bring about higher productivity resulting in bottom line profit for construction companies, the effective management of volunteers is taking on new sophistication and can ensure success for a non-profit organization and bring great satisfaction to volunteers who will work their hearts out for causes and organizations they believe in (Anderson 1992; Gray 1984). This is where another stark difference and challenge between the two arises. In the for-profit construction industry, you hire based on qualifications and skills necessary to complete the job. The employees know exactly what they are being hired to do, and are supposed to have the skills and training to accomplish it. They are compensated based on this assumption. If this turns out not to be reality, the employer can simply terminate the employee and find another who can fulfill the requirements. In the non-profit sector, this is far from being the case. As Maureen Curley, the director of the Retired Senior Volunteer Program (RSVP) stated, “Ninety-nine percent of the people who come to us don’t have a ghost of an idea of what they want to do (Nonprofit World 1994).” People are freely giving up their time and talents to an organization without monetary compensation. This results in a monumental challenge for non-profits as they must accomplish their objectives by using whoever is available and willing to join their cause. This is so vital to the success of non-profits that some suggest that in many cases, the specialized coordination or project management should be outsourced and even paid for by the organization (Babcock 2009). This line of thinking is developed because often time volunteers have little to no skill in the area they are volunteering for. This is yet another reason that increasing productivity of labor for non-profits is more challenging than the for-profit arena. The people in charge of these volunteers must strive to keep them motivated and not frustrated. This is accomplished by ensuring the volunteers understand how their work helps accomplish the mission of the organization (Valérie 2008). However, one should note that this has a tremendous effect of keeping the volunteers there and engaged, but has little to do with the productivity levels of what they are trying to accomplish.

After a thorough literature review, this researcher has found no evidence of a study conducted that aims to maximize productivity of volunteers in regards to construction related projects. With the impressive statistics of nearly 8 billion hours volunteered from the US alone, maximizing the productivity of these volunteers would have incredible results for the overall good of humanity and the world. As stated by the U.S. Agency for International Development "Volunteers form the centerpiece of international volunteer programs, providing the high quality services and specialized skills that, in turn, directly translate into measurable improvements in the lives of millions of people across the globe (Gilbert 2005)." One point of interest worth noting about this current research study is that the vast majority of the volunteers used in the study are not only of college/young adult age, but also come from a Judeo-Christian background. Recent research showed that religion plays an important role in volunteerism (Park 2000). With Christianity portraying many of the themes and central origins of volunteerism in the Bible (Keena 2006), and specifically in the life and character of Jesus Christ, who Christians are to be representative of and model their lives after, the number of religious affiliated volunteers should not be surprising but rather expected. This sample label should be noted, but in no sense discount the research as non-representative of the general population sample. In fact, it should bolster the applicability since the recent research from the Pew Forum on Religion and Public Life states that 79.5% of all people residing in the United States would identify themselves as Christian. This increases further as you expand to include the Americas where 86% of the population would self-identify the same way, accounting for more than a third of the Christians worldwide (Pew 2011). Also, 'in a national survey of charitable giving and volunteering, the third highest ranked motive was expressing religious beliefs or responding to a moral obligation based on religious beliefs (Wymer 1997).'

Non-profits Using Construction Volunteers

1Mission

1Mission (www.1mission.org), founded in 2008 by Jason law, is a Christian based international non-profit headquartered in Glendale, Arizona. "1MISSION is a nonprofit giving people in poverty the opportunity to earn a home by serving in their community. 100% of public donations go to our

field programs (1Mission 2013).” 1Mission is getting a lot of recognition from the non-profit communities by their long-term sustainable model. They believe in transformation of communities by using their own people through volunteerism, training, education and community development programs. According to an email response by their founder Jason Law, the most recent numbers from 1Mission are:

- Yearly average of volunteers (not from native community) - 2,000
- Countries they build in - Nicaragua, El Salvador, and Mexico
- How many houses they have built – 190 (approx.. 60/year)
- Other building projects – churches and community centers (6 total to date)
- Community service hours served by home recipients in their communities – 25,000 (Law 2013)

Amor Ministries

Amor Ministries (www.amor.org), founded in 1980, is a Christian based non-profit headquartered in San Diego, California (Amor Ministries 2013). They are focused on building homes for the “poorest of the poor” in Mexico, South Africa and parts in the United States with their motto being: “Come. Build. Hope.” Amor relies on volunteer groups and participants to not only fund the majority of the houses they build, but to actually build them. Supervision and Leadership usually consists of a team leader and typically there is one Amor representative that travels around to numerous jobsites and checks in on the teams and participants. There are no power tools allowed to be used by the teams and participants. The organization feels that this shows the community and the home owners that they can still build a quality house using the materials and resources available for that area of the world. The homes are a simple. The majority of them do not have plumbing or electric. They consist of a 2x4 frame structure finished with stucco on the exterior. The house sits on a concrete slab, and has a raked roof with rolled roofing material (Figure 2).

Figure 2. Typical Amor House, built by volunteers

Amor relies heavily on an extensive building manual to guide their participants through the building process (APPENDIX). They have currently had over 330,190 short-term participants and have built 17,300 homes (Amor Ministries 2013).

Habitat for Humanity International

Habitat for Humanity International (www.habitat.org), founded in September 1976 by Millard and Linda Fuller, is an international non-profit headquartered in Americus, Georgia (Habitat for Humanity 2013). As their name reveals, they are focused on building habitations for people around the globe. The houses are “simple, decent, and affordable to low-income families around the world.” Their vision is “a world where everyone has a decent place to live.” Their building truly spans the entire globe with current building occurring in North America, Latin America and the Caribbean, Europe and Central Asia, Africa and the Middle East, and Asia and the Pacific. The homes they build are a more extensive than the previous two organizations, depending on what

area of the world they are building in. The U.S. homes include everything a normal house would include (plumbing, electrical, HVAC, etc.) and are built per local building codes. Habitat has also been engaged in Disaster Responses since 1998. Their focus is on using volunteers, as well as the home recipients, to provide not only some of the funding, but the vast majority of the labor needed to build these domiciles and other projects. Currently, Habitat has built or repaired over 600,000 homes and served more than 3 million people around the globe. (Habitat for Humanity 2013)"

This study is specifically aimed at the non-profits where the advantage of having skilled and trained workers specifically for the area of need, is often times lacking or even nonexistent. The study's aim is to provide research to organizations and leaders that will help improve the productivity of volunteers on construction related projects, in an attempt to maximize the effective time that is donated to the organization. The potential effects of having this knowledge would not only increasing the productivity level in volunteers on construction related projects, but would be a great addition to the positive impacts on the community, national, and global levels that volunteerism already provides.

Chapter 3

METHODOLOGY

The problem of volunteer productivity developed through survey data, observation, and experience of the researcher. The researcher has participated in and led volunteer construction teams for the past 12 years. This came on the back of working in the professional for-profit construction industry for the previous 10 years. As productivity studies and material abound in the for-profit construction sector, no research spilled over to the volunteer side. With the amount of construction that happens through nonprofits and government agencies across the globe, an opportunity was presented. With a previous study conducted on leadership practices and satisfaction of volunteers, the researcher hypothesized that an origination could maximize the productivity of their volunteer construction workforce by focusing in on certain leadership/management practices.

The activity of the research is building a bench. Using a simple bench design and the same quantities of tools and materials, the researcher was able to obtain a tight control on the different elements of the experiment virtually eliminating variations between groups. The study tested the effects of different leadership/management practices on the productivity of the volunteer construction workforce. This was accomplished through the use of a simple design of experiment model. The three practices tested (Instruct, Help, Encourage) were given a high and low for each category. The ‘high’ would represent abundant amounts of content for that particular category. Conversely, the ‘low’ would represent a significant deficiency in the quantity and quality of the same content category. Summation of possible different combinations results in eight. The eight different combinations were tested multiple times using different volunteer groups. This technique provided a diverse sample. The productivity variables measured were Time, Quality, Waste, Safety and Satisfaction. All results were quantified and then normalized for comparison. The results also included the survey data that was captured after each group completed their project. A study of the data was conducted using STATA statistical analysis software. This software provided the results that highlighted the significant correlations between the

leadership/management practice and corresponding productivity category. The mean variable results in each combination were taken from the analysis provided by the STATA software and then normalized. Those numbers were used in multiple scenarios that represented common values and priorities of nonprofits in regards to the productivity variables. Each of the five scenarios represented different values and priorities by using different weights for each variable. The results not only gave the best practice/s to use in each specific scenario presented, but it also showed the overall single best practice to use in any case.

The last step was to validate the research, results, and the applicability by conducting interviews with subject matter experts in the field of nonprofits that use volunteer workforces for construction projects.

Chapter 4

DATA COLLECTION

The experiment was conducted on the following three categories: Instruction, Help, and Encouragement. Each of the three was given a high and low rating based on what was provided by the leader in each category. The criteria for the high and low ratings were very precise and specific in nature to provide consistency and uniformity throughout the experiment.

Instruction

This category was to identify the instruction portion given to the participants at the beginning of the project phase. The study would test the effects of high initial instruction versus low initial instruction provided by the leader. The “high” instruction would include greater detail given prior to the group participants beginning the phase of work. This would include detailed instructions on every aspect of that phase of construction including tips, tricks, and suggestions that will ease frustration and boost productivity. The “low” instruction category would correspond with very rudimentary explanation of what the participants are building with a quick reference to the plans and where the tools and materials provided were located. Each phase instructions were scripted out so there would not be any unfair variation of the directions or lack thereof between groups and participants. The script was not given to the groups, so it could not be used as a reference. The scripts for the highs and lows in this category are given for each of the 3 phases below:

Phase I – Cut Phase

- High Instruction

  “This is the Cut phase of the project. I have given you a set of plans showing you not only what the final product will look like, but it also lays out the different pieces that you will need to cut before the next phase of assembly. These are all of the tools and materials that you will need and be able to use to complete this project (point to them). Let’s look at the plans and talk about how this should happen. The first thing that you will need to cut will be the 2x4’s.

Each of the measurements for the pieces that you will need is on the plans. (show on plans) You will need to cut all of the pieces for the frame structure which you can see here (show and read dimensions on plans). The best way to do this is to use the pencil and tape measure to mark each length, finishing the line by using the speed square to accurately continue the line across the width of the 2x4. One person can help hold the tape measure and one can do the marking. The best way to cut these in order to make sure the cuts are nice and straight is to use the plastic miter box and saw that is provided (point to it). Once you finish cutting all of the 2x4 pieces that will make up the frame portion you will then move onto the 1x6's. The 1x6's are the trim boards that will hide all of the edges of everything later and provide a clean look to our bench. You will not be able to use the plastic miter box because the material is too wide to fit. You will need to mark and cut these pieces very carefully. You may still want to cut it using the miter saw since it has more teeth, which will provide a smoother and nicer cut. One trick for cutting them straight by hand is to use a 2x4 on top as a guide to keep the saw straight. Once you have finished all four of those pieces for the trim boards you will then need to move onto the 4x4's. This is the hardest thing that you all will do in this phase and probably for the whole project, so just be aware of that. This will be challenging and time consuming. As the plans show (point to section on plans) these are the notches in the 4x4's that need to be cut out in order to receive the 2x4 frame structure for the bench. These are the legs that will hold everything up. Notice that these are not true dimensions. A 2x4 is actually 3.5" by 1.5". This is why this is marked this way on the plans. The best way is to have someone measure and mark all of these on the top and sides of the 4x4's after they are cut to length. Be aware that the 4x4 material will not fit into the plastic miter box… it is too tall, so you will have to cut them by hand using the toolbox saw (point to it). Again, you might want to use a scrap piece of 2x4 to keep the saw straight like the trim boards in order to help you make straighter cuts. Once they are cut then have one person take and mark all of the four legs. One trick is to actually put X's or even write the words "cut" and/or "save" in the corresponding areas. This will save the people later time and lessen the chance of them cutting something incorrectly. Once each piece is marked you will have to

cut, by hand, down the top here and here (show on board). You will then need to cut on two faces of the board, here and here (show on board). You might want to have one person hold the leg against something such as a pole or off something such as the low block walls in the yard in order to keep it steady so someone else can make those cuts. Once you have completed those, you will need to mark and cut the plywood and Durock. The best way to do this is by using the tape measure and pencil and the chalk line that I have provided you here (point to it). You make a mark on both sides of the plywood sheet and then two of you can stretch the string across those two lines with one of you pulling it up in the middle to snap it. This will create a straight blue chalk line that you can use to follow when you cut it. You will need to do this for both directions. Once you have marked it, you will have to cut it using the toolbox saw. The saw that comes with the miter box has a lip on the top that will keep you from cutting correctly, because it prevents the saw from traveling all the way through the cut board. Make sure you use this saw (point to it). Another key point, you need to have the material hanging off of something while you cut so that you are not binding the blade while you cut (show example). Once the piece of plywood is cut, the same size piece is needed from the Durock cement board. This is not as hard as it sounds but is a little different because of the material. This marking of the Durock is the same methods as the plywood. The only difference is in the cutting. You will use the razor knife to cut the Durock. You will need to score both sides in order to cut the fiber mesh that holds the cementitious material together on both sides. This mesh here (show mesh). So you will have to mark and score one side then flip it over and do the same on the other side. Once you have scored and cut through the mesh layer on both sides, it should break on your cut lines. All you need to do is stand it up and lightly bend it and it should break down your lines. Make sure you continue the score lines all the way to the end of the material, from edge to edge like this (show on board). This way is will break straight instead of the possibility of a jagged break where you did not score. That should be the last thing you will need to cut and this phase will be over. Try to keep everyone working and busy by spreading the tasks, such as few people working on the legs,

and the remaining people cutting the 2x4's, plywood, etc. Have fun and let me know when you are finished with cutting everything."

- Low Instruction

  "This is the Cut phase of the project. I have given you a set of plans showing you not only what the final product will look like, but it also lays out the different pieces that you will need to cut before the next phase of assembly. These are all of the tools and materials that you will need and be able to use to complete this project (point to them). Have fun and let me know when you are finished with cutting everything."

Phase II – Assembly Phase

- High Instruction

  "This is the Assembly phase of the project. You are going to take all of the pieces that you cut in the first phase and put them all together in order to make the bench. You can follow the plans as it has a picture of the bench and how it is to be assembled. The best way to do this is to assemble the 2x4 frame first. You will need to assemble the frame using the long gold screws (show screw). Before you can just screw into the frame you will need to pre-drill a hole so you will not split each edge of the 2x4. You have two drill bits and a Phillips head adapter that you will have to switch between while you assemble. The best way to do this is to have a few of you line up the corners that need to be attached, starting with one corner at a time. A few of you hold and put back pressure against the joint and corresponding pieces so the person with the drill can use some force with the drill and driver in order that the joint does not move. One person in the group can be working the drill and another can hold the bit and driver while. That same person might also want to hand screws to the person using the drill to save time and be more efficient. Whoever is running the drill, make sure that you hold the drill perpendicular to the face of the board you are screwing into (demonstrate). If you start to get at an angel you will either split the board or you will strip the head of the screw. If

you do start to strip the head of the screw, you will need to back it out and replace it with a new one or you will ruin the driver piece by rounding the edges. Continue that process all the way around the four corners, putting two screws in each corner. Then add the center support, again with two screws in each side. Once you are finished assembling the frame you will need to attach it to the legs, again using the long 3” gold screws with a pre-drilled hole. The best way to do this is to temporarily setup all of the legs so the frame is resting level on all legs and then work on attaching one leg at a time. Don’t forget that you will need to hold it tightly and allow backpressure for whoever is running the drill. After you have finished attaching all four legs, you will want to attach the plywood board to top of the frame structure. You will use the smaller 1-5/8” gold screws and you will not need to pre-drill these. Make sure you hit the center of the frame going around and then the center support (show on the plans where the screws go). Once the plywood is secure, you will attach the cement board that you cut, with these special cement board screws. They are grey like the cement board so they should be easy to remember. You do not need to worry about hitting the 2x4 frame structure with these screws since we have a plywood layer underneath. The one thing I will tell you is that you need to stay clear of screwing near the edges as it will have the tendency to crack. You want to start each screw in about this much (show on cement board). The edges of the plywood and the cement board should be lined up together and with the face of the 2x4 frame below. If you need to trim anything sticking over, now is the time to do it as it will affect the trim boards when you put them on last. Speaking of trim boards… once you are finished with everything else, you will need to nail on the trim boards using the finish nails and the hammer. These have to be sticking up above the top here (point on plans). The key to getting these correct is by using a tile thickness as a spacer (tell where the box of tiles are located). This will be the amount that these boards should be sticking up above the cement board. They will not only cover the ugly edges of the plywood and cement board but they will also stick above the cement board top that you just attached to provide coverage of the edge of the tile and grout that you will do in the last phase. You will want to start by holding one longer and one smaller trim board together at one corner (show using boards). Remember,

the smaller one goes between the two longer boards. The edges of the longer boards should be the only ones showing. While someone holds those two to form a nice joint, someone else will place two tiles on the top of the cement board and use them as a guide to judge the height that needs to stick above the cement board. Adjust one board at a time, and nail in one board at a time. Continue that same method until you have went all the way around and attached all four of the trim boards and then you are finished. Have fun and let me know when you are finished assembling everything. Get started."

- Low Instruction

  "This is the Assembly phase of the project. You are going to take all of the pieces that you cut in the first phase and put them all together in order to make the bench. You can follow the plans as it has a picture of the bench and how it is to be assembled. The best way to do this is to assemble the 2x4 frame first. You will need to assemble the frame using the long gold screws (show screw). Before you can just screw into the frame you will need to pre-drill a hole so you will not split each edge of the 2x4. You have two drill bits and a Phillips head adapter that you will have to switch between while you assemble. Once you are finished assembling the frame you will need to attach it to the legs, again using the long 3" gold screws with a pre-drilled hole. After you have finished attaching all four legs, you will want to attach the plywood board to top of the frame structure. You will use the smaller 1-5/8" gold screws and you will not need to pre-drill these. Once the plywood is secure, you will attach the cement board that you cut, with these special cement board screws. After that you will need to nail on the trim boards using the finish nails and the hammer. These have to be sticking up above the top here (point on plans). The key to getting these correct is by using a tile thickness as a spacer (tell where the box of tiles are located). Have fun and let me know when you are finished assembling everything. Get started."

Phase III – Tile and Paint Phase

- High Instruction

  “This is the tile and paint phase… the last phase! Once you are done here the bench will be complete! The first thing you want to do is have one person go and get the number of tiles you will need per the plans. In this case it will be 40 tiles total. That same person can also grab a whole bag or at least a few large handfuls of spacers and bring them back as well. A few of the other people that are left need to start mixing the thinset. The key is that you want a consistency of creamy peanut butter. You will want to scoop out the thinset powder from the larger bag (show where bags are located for both thinset and grout) into the white bucket. In this case start with 3 or 4 full scoops and go from there. Next you will want to add water and start mixing them together. You will use the drill from phase 2 and the mixing attachment in your pile of tools that were provided. Make sure you add the water slowly. It is better to not add enough as you can always add a little more water, as to adding to much right away and it being to runny and having to waste material by having to add more thinset powder. Once you have it mixed to the consistency of creamy peanut butter you will want to bring it back to your area and begin to spread it over the face of the bench. You will use the notched trowel to spread the thinset. This should leave ¼” ridges over the face of your bench. Be sure to get it near all of the edges. Scoop out any excess material so that it is nice and even. Don’t be afraid to comb over it a few times with the trowel until you get it the way you want it, and smooth out all of the areas that are high or low. When the person doing the thinset is finished with about half of the bench surface, the rest of you can start setting the tile. You don’t want to wait too long as the thinset will start to setup creating a weaker bond, and it will be difficult to maneuver the tiles while setting. Again, a few of you can start setting the tile… but make sure you start in one corner and work your way out in both directions from there. The design was made so that there would be a spacer width all the way around the edge of the bench for grout. However, if there are any discrepancies in the way you cut or assembled anything this will throw everything off. So start in one corner and work your way out. Use the spacers on

the edge between the tile and the boards in corner where you start and in those two directions that you will continue out in (show on bench). When you set the tiles and use the spacers, keep pressing them towards the corner that you started (show with hand motions on the bench top). This will make the joints nice and even. Once you have reached the end and all the tiles are set, it will be time to start prepping for paint. This will allow our thinset some extra time to dry before you grout everything in. Someone needs to clean out the white bucket and the mixing tool used for the thinset, as you will need the mixing tool later for grout. Someone can use the razor knife to cut a piece of red rosin paper to place underneath your bench to protect the ground form paint. The legs and the weight of the bench should hold it down and keep it from flying away with any gusts of wind. Someone else can open the paint can with the screw driver. Then mix the paint with the stir stick in your pile of tools. Every team has a paint tray and a paint tray liner. Dump the mixed paint in to the liner after placed in the tray. Use the small roller and brush to paint the entire surface of your bench being careful not to paint the face of the newly set tiles. One suggestion would be to have the person using the brush to paint all of the edges and corners where the roller cannot reach and then have the person with the roller make quick work of the rest. After you finish painting everything it is then time to mix the grout. Save the paint as you may need to make some touchups after the grouting portion, so don't clean it up just yet. You will mix the grout the same way I described the thinset except you will have less. Use the little blue bucket for this and I already showed you where the big bag of grout was. Scoop it out and begin mixing it again to the consistency of creamy peanut butter. Same as with the thinset, you do not want to add too much water in the beginning. It is better to have it dry and add a little bit at a time. At this point someone can be filling up the white bucket with clean water. They can also grab the sponge trowel (point to it) and the grout sponge. Once the grout is mixed, you can bring it back to the bench and start to dump it on the tiles. With the grout sponge at a 45 degree angle you can start spreading the grout around on the tiles and it will start to press into the joints. Make sure you get all of the edges. You can use both the long edge and short edge of the sponge trowel to accomplish this. Remove any excess and discard. After all of the grout

is in the joints and the excess is removed the sponging process can begin. Take the sponge, dip it in the clean water and wring it out really good. Begin to wipe the face of the tile with a swirling motion like this (show motion). Flip the sponge when it gets too dirty and use the other side. When that side gets dirty, wash the sponge in the bucket of water until it is clean again and repeat the process. Keep doing this until all of the tiles are clean and the grout lines look nice and even. If you need to change your water… change your water. Once you are finished, you can look of any areas where you might have rubbed off some of the paint and touch those up. At that point you can clean the tools, wash everything out, and you should be done. Have fun and let me know when you are finished."

- Low Instruction

"This is the tile and paint phase… the last phase! Once you are done here the bench will be complete! The first thing you want to do is have one person go and get the number of tiles you will need per the plans and grab a whole bag or at least a few large handfuls of spacers. A few of the other people that are left need to start mixing the thinset. The key is that you want a consistency of creamy peanut butter. Use the white bucket for thinset and the blue bucket for the grout (show where bags are located for both thinset and grout). You will use the drill from phase 2 and the mixing attachment in your pile of tools that were provided. You will use the notched trowel to spread the thinset. A few of you can then start setting the tiles. Once you have finished setting the tiles, it will be time to start prepping for paint. This will allow our thinset some extra time to dry before you grout everything in. Someone can use the razor knife to cut a piece of red rosin paper to place underneath your bench to protect the ground form paint. Someone else can open the paint can with the screw driver. Then mix the paint with the stir stick in your pile of tools. Every team has a paint tray and a paint tray liner. Dump the mixed paint in to the liner after placed in the tray. Use the small roller and brush to paint the entire surface of your bench being careful not to paint the face of the newly set tiles. After you finish painting everything it is then time to mix the grout. Mix it the same way as the thinset. Once the grout is mixed, you can bring it back to the bench and start to dump it on

the tiles. Use the grout sponge to spread it all. After that is finished you will want to take a wet sponge, use one of the buckets and bring water over, and begin to wipe the face of the tile. Clean off all of the excess grout until it is nice and clean. At that point you can clean the tools, wash everything out, and you should be done. Have fun and let me know when you are finished."

Help

The Help category is further defined as to how much aid is given to the teams and participants during the actual construction phase. In industry and business this would be categorized as the empowerment vs. micromanagement of the employees. The "high" in this category would be considered ample amount of help (micromanagement) given to the groups during the actual construction process. This meant that the leader, in this case the researcher, was not only available and willing to answer questions at any time during the construction, but tips and suggestions were interjected whether the teams asked for it or not. The "low" in this category meant the leader was not available or willing to answer questions and also stayed silent if there were any areas of improvement where suggestions and tips could improve productivity.

Encouragement

This category monitored the amount of encouragement each team received throughout the phase of construction. The experiment was only focused on if encouragement affected productivity. "High" encouragement was considered to be 5 or more encouraging statements given by the leader. The main concern was not the number, but the leader's focus of using encouragement. The minimum standard of 5 statements was setup in order to make sure there was a clear distinction between the high and low. Having this stipulation also made it prevalent enough to be a cognitive focus by the leader. The "low" encouragement label was given in situations where encouragement was not given at all. This made for an easy comparison as there would be no argument that even one form of encouragement at the right moment could taint the study and the categories of productivity measured, which include satisfaction.

Raw Data Collection

Prior to teams arriving to the site, all of the materials were carefully laid out and measured so that each team had the exact same tools and quantities of raw materials. This included weighing all fasteners. Each team had the same amount of screws and nails, divided into red plastic cups. To the average participant, it would look as if there was a handful of each of the different fasteners in each cup. However, every cup was weighed with precision in order to all have the same amounts. The amounts were weighed with a digital kitchen food scale that was accurate to 1/10th of an ounce. This would allow accurate quantities to be tracked to make for easy qualitative analysis after completion.

Teams were given their initial direction, based on what was scripted above. Once the teams started, the start time was recorded for that phase and the project began. During the cut phase the researcher wrote observations down and took photos of things that were noteworthy. The purpose of the photos was to highlight and justify the researcher's comments and notes to be paired at the completion. This was essential to the validation process, especially when a team was given a lower rating on the areas of productivity that dealt with non-quantitative values such as safety and quality. Another section on the observation sheet allowed the researcher to add tally marks in the category of encouragement and help in order to make sure the proper amount was given based on the study parameters assigned to that particular group. General notes about observations were also taken for future reference.

Once this phase was completed by the group, the time was noted and written down and the researcher would take the participants to a table where they were surveyed on their experience. This was where multiple data points were gathered, and specifically for this experiment, where satisfaction was measured. Other areas of productivity were also measured during this time period. Waste was measured, converted, and calculated based on board feet for the wood products, including boards and plywood. Cement board was also calculated into a board foot

measurement for waste as to provide some uniformity of the results. The only other measurement for waste was the amount of hardware used. Each team was given hardware (screws, nails, etc) separated into red plastic cups. Each cup was weighed before the project started and after its completion using a digital scale accurate to $1/10^{th}$ of an ounce. The amounts used for each different kind of hardware were then calculated and then analyzed and converted unto a percentage of waste that was used over and above the amount required.

Another key piece of data was interviews that were conducted with subject matter experts in the field of non-profit construction. The first interview was with Jason Law, the founder and CEO of 1Mission. This interview was conducted at Tempe Marketplace on January 24, 2013 from 12pm to 1:30pm. The second interview was with Dr. Tom Schleifer, the former Director of Appropriate Technology for Habitat for Humanity International. This interview was conducted at the lobby of the Hilton Hotel located at the cross-streets of Scottsdale Rd and Lincoln in Scottsdale, AZ on January 25, 2013 from 9:30am-11am. Both interviews provided validation to the need and applicability of the research methods and results.

The Bench

Design

A relatively simple bench became the solution to the seemingly impossible task of overcoming the many challenges mentioned above. The bench design started on paper and quickly moved to a mockup. This allowed for refinement to occur with minor tweaks and changes, prior to finalizing its design. It needed to have some design elements throughout that could easily be measured for quality and waste, without an abundance of extra material that would drive the cost of the experiment up. A simple bench is a relatively easy thing to build using modern technology, tools, and equipment. The challenge came from designing something that encompassed multiple elements of construction (as mentioned above) that could be accomplished in a relatively short amount of time, while using only hand tools and limited resources. Another key component in this

design was usability and strength. The benches were to be donated upon completion, so functionality was a must. The pencil sketches were adjusted during the construction of the prototype. They were sent to a local architect for creating a formal drawing/plan that could be used by each team that participated in this study. The final design is shown below in Figure 3 and Figure 4.

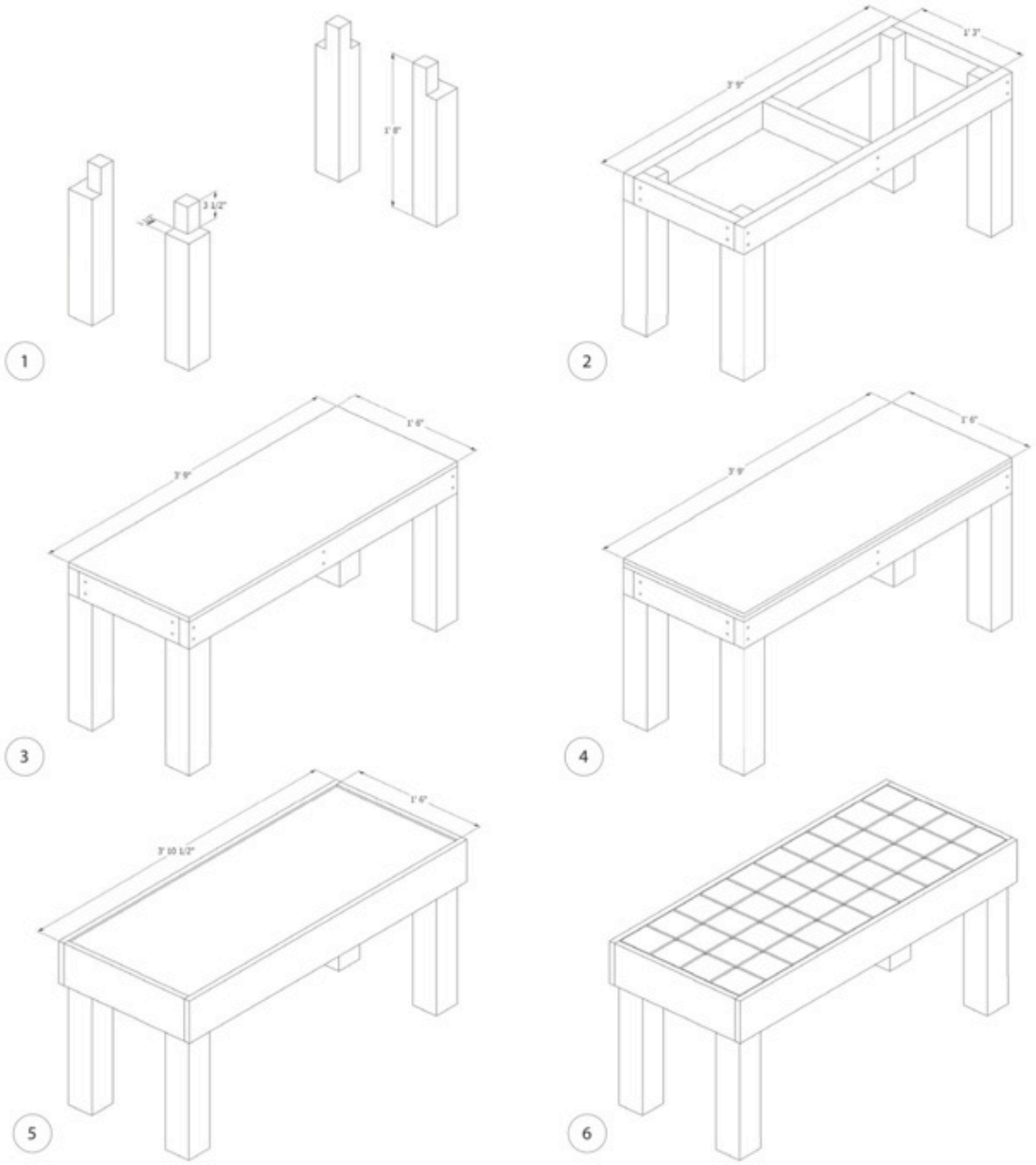
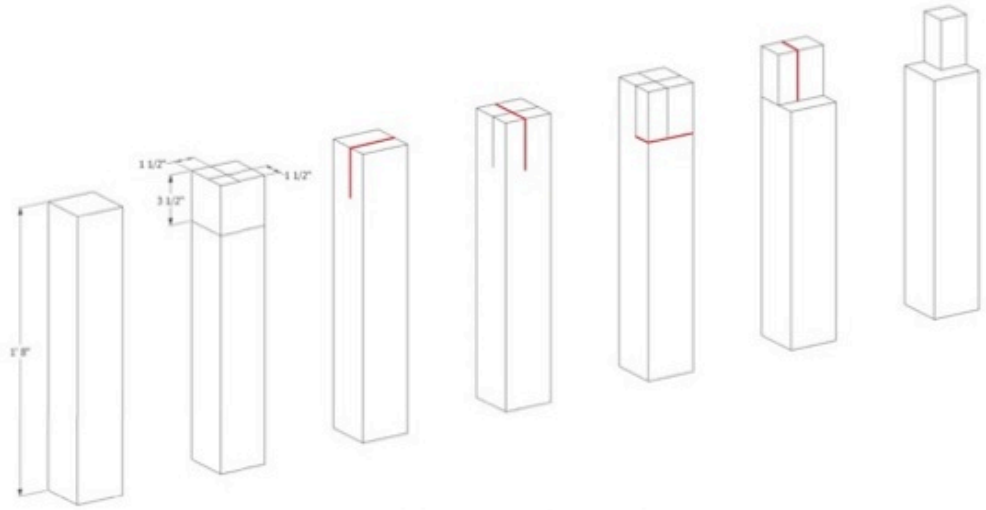
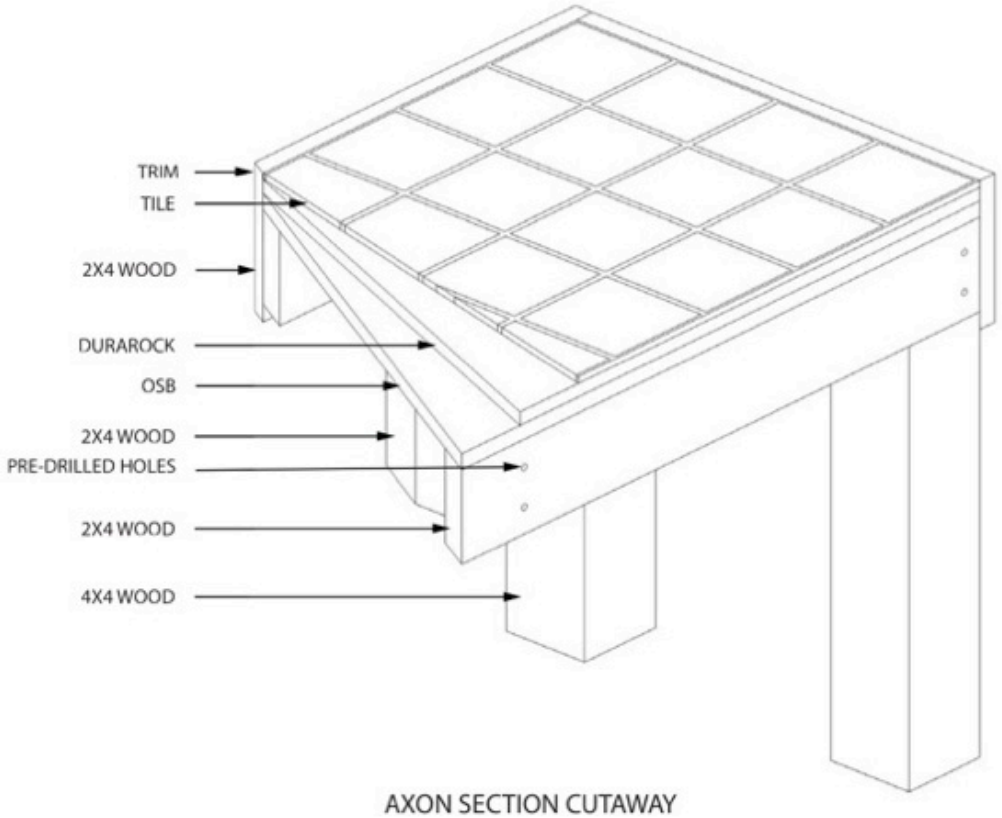


Figure 3. Final Bench Design Drawings



LEG CONTRUCTION CUT ORDER



AXON SECTION CUTAWAY

Figure 4. Final bench design continued

Phase I - Measure and Cut

As shown in the figures, each element was designed with a specific intent. The 4x4 legs were one of the most difficult and key components in the entire build. They provided strength and a sturdy support to transfer all of the dead loads of the bench components, as well as the live loads of the people using it down to the ground. The first task was to measure and cut each of the four pieces out of one larger eight foot section of material. This would include four pieces, 20 inches each. The team used the tape measure to mark each piece. They either just made a small guide mark or they used the speed square that was provided in order to make a perfectly straight line across the entire surface of the board, for each piece. To the average onlooker, cutting these pieces may seem rather easy. However, without the use of power tools, the larger width makes it impossible to use the plastic miter box that was given to achieve straight cuts. This miter box was meant strictly for use on the 2x4's, as the side walls do not extend to the vertical height needed for a 4x4 (Figure 5).

Figure 5. Miter Box (supplied) with short sides

Teams had to cut each leg as straight as possible using only a hand saw in order to achieve identical legs that did not wobble on the bottom. As seen in Figure 6, this was challenging in itself.

Figure 6. Non-uniform legs

Once the legs were cut to length, each team moved onto one of the most arduous undertakings of the entire build: cutting the notches. The larger cross section of wood on these legs provided opportunity for notches to be created in order to support and receive the frame components. This posed one of the most challenging tasks for each group. The notches to receive the frame would be 3 ½ inches in height and 1 ½ inches deep on two of the sides. This would leave an exposed corner piece with the dimensions of 2 inches square by 3 ½ inches high. This would be used not only for support, but as an attachment point during assembly (Figure 7).

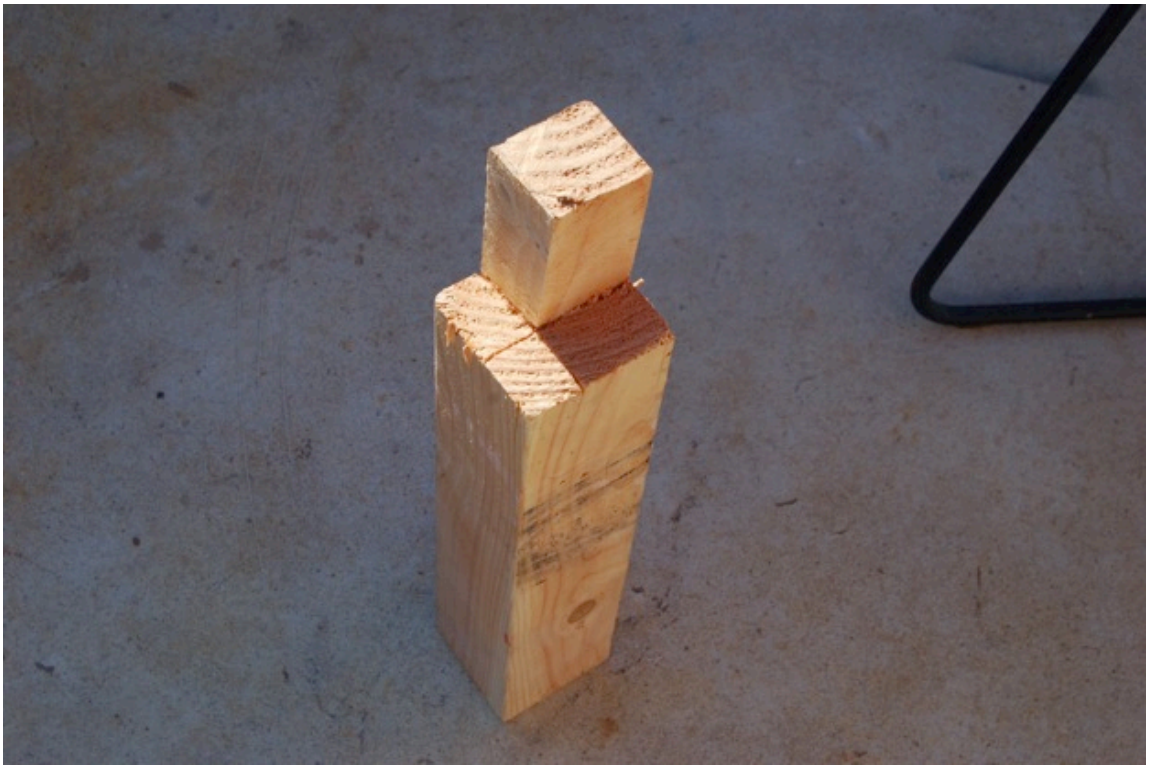


Figure 7. Final leg shape and dimensions after proper cutting

Cutting vertically and horizontally, in order to create these pockets, took some creativity and ingenuity on the part of each team. Each group was not supplied with any clamps or guides to help them with these laborious cuts. Teamwork and resourcefulness were necessary, and every team seemed to come up with their own method. Some of these primitive methods can be seen in Figure 8 and Figure 9. This on-the-fly methodology and resourcefulness represented what volunteers often face outside of the United States and other first world countries.

They are forced to complete the necessary tasks using whatever is around. This includes using whatever they could find and in whatever method and means necessary to be successful.

Figure 8. Teamwork used to accomplish cuts

Figure 9. Creativity to make challenging cuts

The measuring and cutting continued in the first phase by creating the 2x4 frame structure that would actually be the bulk support of the materials that make up the bench surface that someone would sit on. Each team member used the plans to determine the sizes of boards that they needed to cut out of the longer pieces of materials. The pieces needed in this phase are two pieces 3’ 9” in length for the sides and three pieces 1’ 3” in size for the supports in the middle and ends. Some of the groups used the plastic miter box and saw (supplied) to make precise and straight cuts, while others freehanded the cuts using a regular toolbox saw. The reason for this will be explained in detail later. Similar to the 4x4’s, the measurements were made with the tape measures (provided) and either marked with a small freehanded line or by using the plastic yellow speed square (also provided). The frame pieces were followed by the trim pieces. The trim pieces were cut from longer pieces of 1x6 materials. Again, the measurements and markings were made the by the same methods as on the 2x4s and 4x4s; however, one team used the chalk line to mark their cuts as seen in Figure 10.

Similar to the challenged faced with the 4x4’s about not fitting into the miter box; the trim board material was not too tall, but rather, too wide. This made the miter box and its ability to aid in straight and true cuts useless. The team was again forced to freehand the cuts using either the finer toothed miter saw by itself or the rougher toolbox saw.

Figure 10. Wood was marked by one team using a chalk line

The plywood came in an 8 foot by 4 foot piece of oriented strand board (OSB). This often took multiple team members just to move it around. The first major challenge was to actually get it marked for the piece that was needed. The plans called for a piece only 3’ 9” by 1’ 6” leaving a lot of material to work around. The teams first needed to determine the best way to use the material and easiest way to cut the piece out, not only maximizing efficiency but also eliminating unnecessary wasted material by cutting it out of the wrong dimension of the larger piece. Figure 11 illustrates the difference in the how the piece is laid out on the bigger sheet in order to maximize use of the entire board, gaining an extra bench top using one way versus the other.

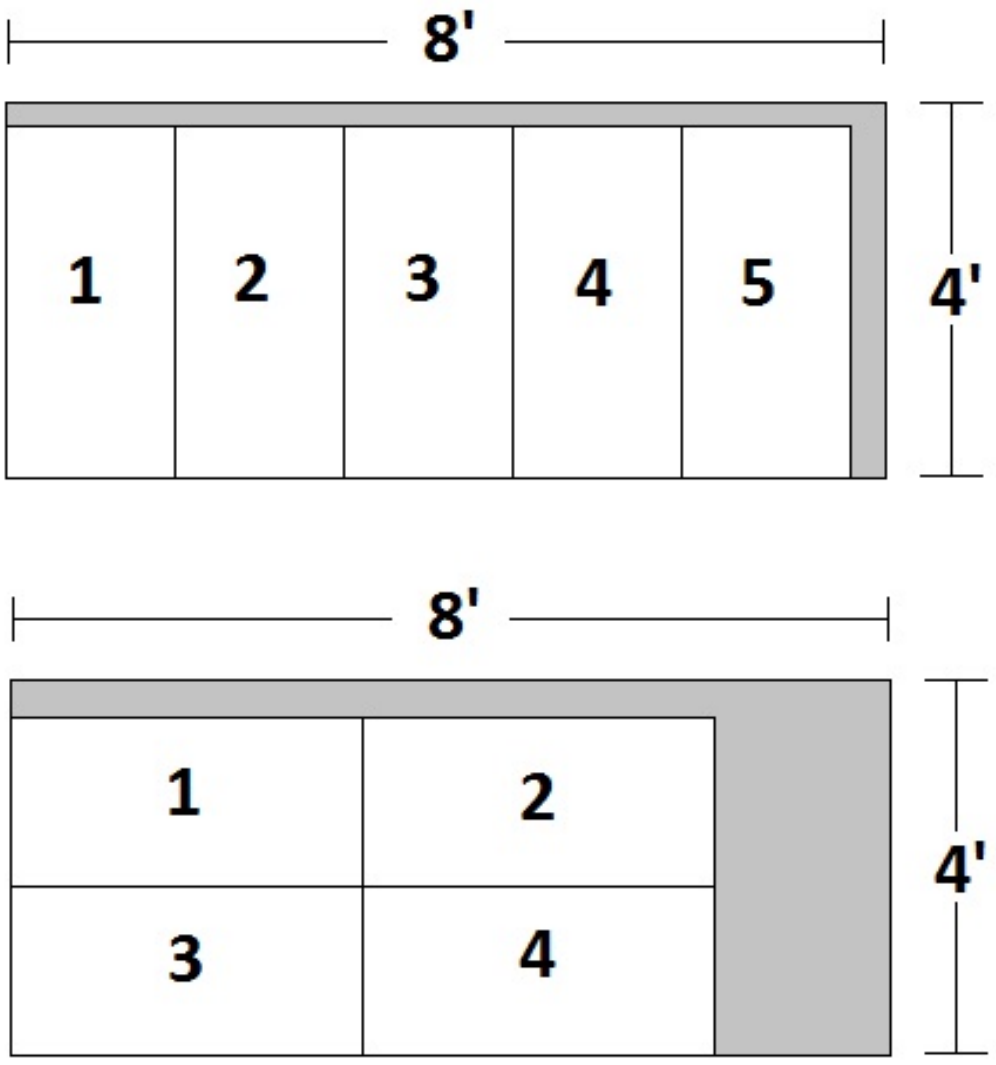


Figure 11. Maximizing use of the OSB Plywood based on different layouts

Marking the plywood was also a challenge. The team was required to measure and mark based off the layout they selected, and then mark the entire length and width of the piece needed. A chalk line was provided to help ease this task (Figure 12), but some teams chose to use other methods such as marking it with a pencil using a long 2x4 as a straight edge.

Figure 12. Team using chalk line to make long straight markings on plywood

Once the piece was marked, the large and cumbersome board needed to be cut to the correct size, again, using the choice of the toolbox saw or the saw that came with the miter box set. Teams would have to be resourceful in selecting a location where they could manage and hold the board while one person was cutting. This involved using fences, chairs, blocks, and anything else that was available around the work site. The board needed to be held steady, as well as supported on one side in order to not bind the blade while cutting. This posed a difficult task as the person cutting would frequently be in a precarious position for most of the cut, furthermore adding to the challenge of accuracy in following the line with the free-handed cut.

The last piece needed to be measured and cut was the Durock cement board. Since the overall dimensions of the cement board supplied and the required final dimensions needed, were exactly that of the plywood, the layout requirements for productivity and waste were the same as shown above in Figure 11. The methodologies for marking were also the same. The difference came in

the cutting of the material. The material was held together by two layers of mesh that were located towards each face and on each side of the cement board. Both sides of the mesh needed to be cut in order to have the material break along the desired scored lines. This required both sides to be identically marked. Once marked, one team member used the razor knife to score each line deep enough to cut the mesh on that particular side. Once that side was complete the material must be flipped, and the process repeated on the other side. Similar to drywall, once scored, the material will break along that line. The key was to extend the lines and score marks to the end of the original material. This allowed it to break all the way through the entire width of the starting dimension, keeping the remaining material straight and true, maximizing its usability for future pieces. Without scoring the lines all the way through to the edge, the possibility of a jagged break increases, causing for wasted material.

With all the pieces required to build the bench now measured and cut to the correct dimensions, Phase I was complete. After evaluations were conducted and surveys were completed, each team advanced on to Phase II.

Phase II – Assembly

In this next phase, each team assembled the entire structure of the bench, including the trim pieces. The quality or lack thereof, was carried over from Phase I and quickly became evident. The initial assembly began with the building of the 2x4 frame. Each team was given one cordless drill, a cross-point bit, and two 1/8” drill bits. All of the 2x4 assembly took place using the 3” gold screws. Each connection point required two screws. Since four of the six connection points took place at the corners, everything was pre-drilled in order to mitigate cracking and splitting, which would compromise the structural integrity of the connection. The longer screws necessary for assembly was challenging for many. Despite pre-drilling, it was still important that care was used while using the drill to screw in each screw. If the drill was used at an angle, or did not have ample force being applied to it, the drill tip slipped out of the screw head and stripped it. This

made it nearly impossible to continue to use that same screw. A new screw had to be used each time and the operation started over until it was completely sunk into the wood where the head was flush or below the surface. If there were nothing around to hold the two pieces against to create back pressure against the force of pushing the drill while screwing, one of the other team members had to apply a force to counteract the force necessary to screw in the screw.

After the frame was completed, the teams attached the legs. This task became difficult since the frame was floating in midair and rested on one leg. In order to overcome this, all four legs were temporarily placed in position while the team worked on attaching one leg at a time. The legs were attached using the same 3” screws into pre-drilled holes to avoid splitting and cracking. As more legs were attached to the frame, quality of cuts from Phase I came into consideration again. If the legs and notches were not all of the same dimensions, assembly will start to highlight this as the frame will not sit correctly on the desired areas such as shown in Figure 13 and Figure 14.

Figure 13. Poor craftsmanship in Phase I became highly visible in Phase II

Figure 14. Joints misaligned during assembly due to poor craftsmanship in Phase I

Once the group completed the attachment of all four legs to the frame structure, the bench was finally starting to take shape (Figure 15). The next task was to attach the oriented strand board to the frame. It was attached using the 1 5/8” gold screws. The teams needed to use caution in this step, as all of the screws needed to penetrate into the 2x4 frame structure below. This included the areas around all of the edges, as well as the center support brace.

Figure 15. The bench starts to take shape once the legs are all attached

The plywood provided a strong subsurface and anchor point for the rest of the bench materials. Following the plywood was the cement board. The attachment of the cement board was a little different as the plywood now provided a substructure below to screw into. This eliminated the need to hit the 2x4 structure at the bottom. Teams were able to screw in the special Durock cement screws without being precise. However, some care was still needed as to eliminate breaking near the edges. Locating the screws more towards the center of the board and leaving some space near the edges accomplished this challenge. The cement board acted as a base for the thinset and tile to adhere to in the next phase. Once the plywood and cement boards were securely attached to the frame and legs, the teams completed this assembly phase by attaching the trim boards around all four sides of the bench. These hid all edges of the plywood and the cement board, as well as the 2x4 frame structure. This gave the outside a clean and finished look. The 1x6 pine trim boards were attached using the finish nails. The spacing/alignment of these boards was crucial. The boards were attached sticking up above the Durock. A piece of tile

was used as a spacer to provide the perfect reference point in order to make sure the correct amount of trim was proud of the cement board. Laying two tiles flat and using their thickness as a guide (Figure 16), the teams attached the trim boards using the finish nails for each of the four pieces. The proper height of the 1x6 boards was important in regards to the functionality of the completed bench. If the boards were too high, the bench would not only be uncomfortable, but the end-user would scrape the back of his/her legs while getting up or sitting down on its main surface. The catch point along the edge that would have been created by this error would make it difficult to clean and also drain if it were to be used outside. A similar scenario occurs if the boards are too low, with the edge of the tile now acting as a scrape point.

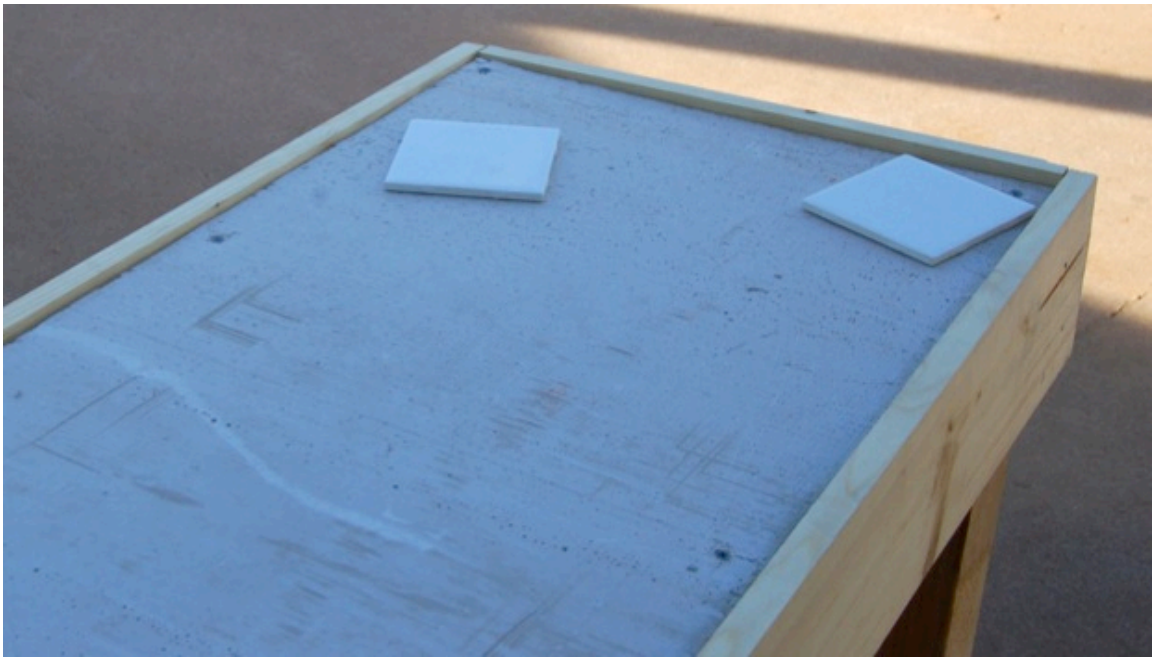


Figure 16. Tiles used as spacers to gauge trim height

Leaving the space of one tile thickness, the top edge of the trim boards was now already level with the center of the tiles. When the thinset was applied later, the tile will be raised approx. 1/8 – ¼”. This would leave the final position of the tile just above the side trim boards. With the tiles having a slight downward bevel near each edge, the outer grout joint would have a very gradual slope between the edge of the tile and the outer boards. This not only eliminated any scrape

points, making the bench more comfortable to sit on, but it allowed the bench surface to properly drain if it were to be used outside in the elements (Figure 17).

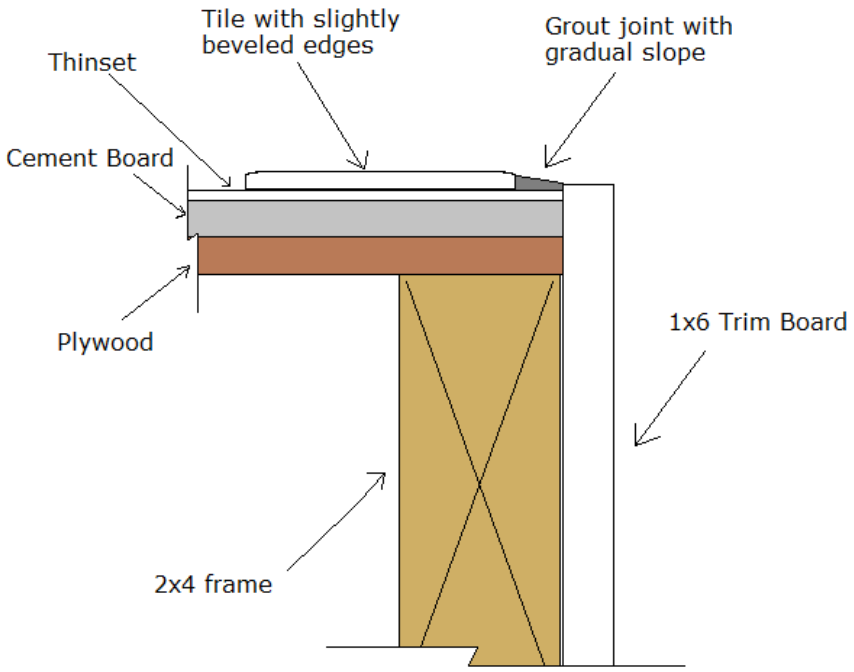


Figure 17. Side cut, showing slight bevel of outer grout joint that connects to the trim.

The final stage of this phase would again highlight the quality of cuts on both the plywood and cement boards that were completed in the first phase. If either of them was too wide, it would cause the trim boards to not sit flat against the surface of the 2x4 frame. This would cause further looseness in the joint corners where two trim boards come together as shown in Figure 18.

Figure 18. Trim Boards bowed out due to cement and plywood cut to large

The last remaining challenge in the attachment of the trim boards was to make sure and nail into the 2x4 frame structure. If teams nailed too high, the nails would not catch, or would be weak if they were driven into the side edges of the plywood or cement board. Conversely, since the dimensions of the 1x6 were much larger than the area of the frame and plywood combined, teams that nailed too low would miss the 2x4 frame completely and the nails would attach to nothing. With all of the trim boards securely fastened and attached, the assembly phase was complete and ready for tile and paint in the final phase.

Phase III – Tile and Paint

The final phase in the project combined tiling the top of the bench along with painting it. There were many key factors in obtaining success in this phase. First, in order to maximize time and efficiency, the teams used thinset to apply the tile to the Durock substrate. The teams either looked at the plans or calculated that 40 tiles were necessary to cover the top of the bench. While one team member counted out the tiles needed, the others began to measure out and mix the thinset to its correct consistency. Thinset was to be mixed in the white 3.5 gallon bucket. The powder was transferred from the larger bag of thinset to the bucket using a red cup. Once the team determined there was an adequate amount of dry material, they began mixing it slowly with water. Each team used the same cordless drill in the previous phase and was given a small paddle mixing wheel attachment. The challenge was to mix just enough water with thinset powder in order to produce an accurate ratio and consistency. The desired consistency was similar to that of creamy peanut butter. Teams that were not careful and added an excessive amount of water would need to counteract the runniness by adding more powder. The opposite applied to those teams whose mix was too dry. Once the desired consistency was achieved, the drill and attachment were cleaned and the teams went back to their bench, poured out the mix, and began to spread it in preparation of setting the tiles. A ¼" notch trowel (Figure 19) was used to spread the material around the top surface of the bench.

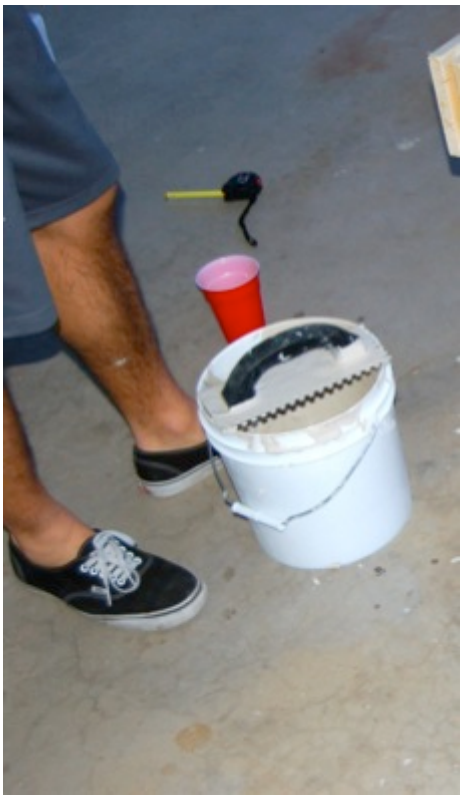


Figure 19. Bucket of mixed thinset with ¼” notched trowel

Caution needed to be taken, as often times it was difficult to apply the correct amount of thinset needed around the edges and in the corners. Simultaneously, one volunteer from the team would grab a few handfuls of plastic ¼” tile spacers and the team would begin the tiling process. The design of the bench was made so that 40 tiles (4 rows of 10 tiles) would fit perfectly while leaving a ¼” boarder around all of the sides. Since quality of cutting and assembly was a challenge with the limited tools and resources, each team’s final dimensions on the surface contained variation from the original design. This was more prevalent in some than others. In order to achieve proper tile alignment and overcome any of these discrepancies, each team must start in one corner of the bench and work out from there in both directions (Figure 20).

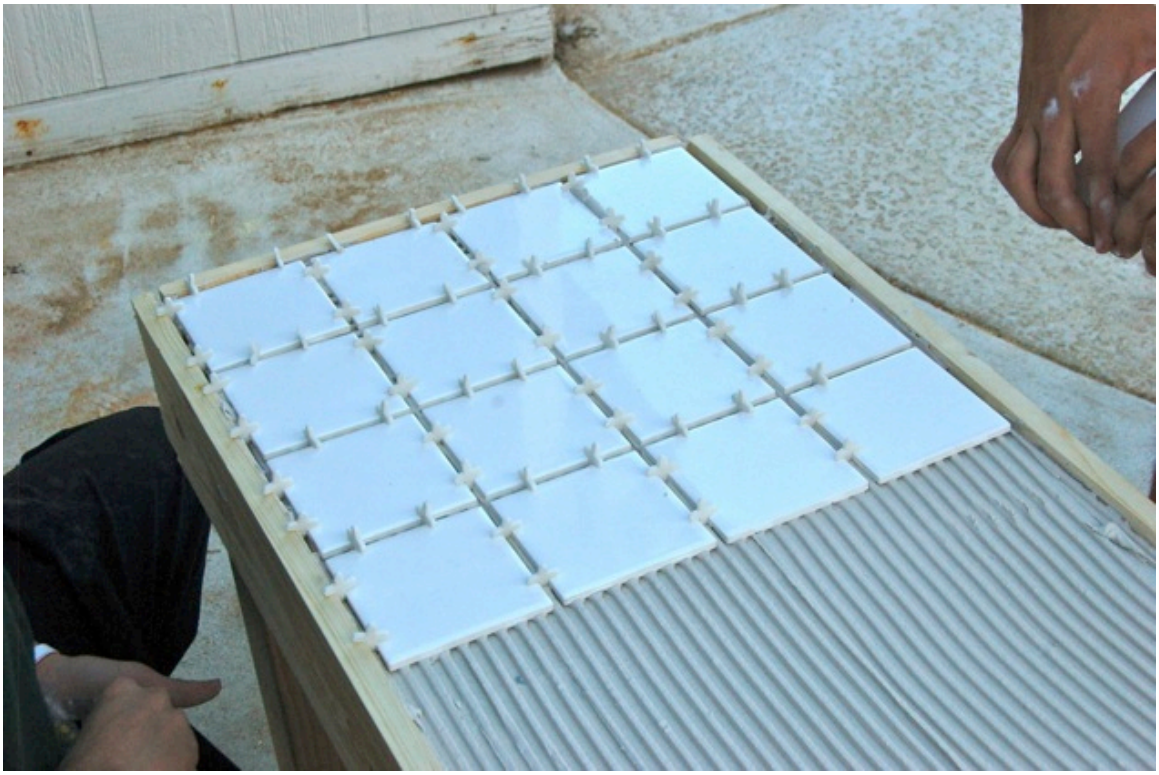


Figure 20. Tile started in one corner and continued out in both directions

This was challenging as space was limited for multiple hands and arms. Each tile was set and spaced accordingly with the provided tile spacers. Every tile needed to be checked for not only alignment, but also for height. This check eliminated protruding tiles in the finish product, which would have been uncomfortable or even dangerous if someone were to scratch themselves on it. This entire process was repeated until all 40 tiles were set and aligned correctly (Figure 21).

Figure 21. Completed tile setting

The team continued onto painting, allowing ample time for tiles to set prior to grout. One team member rolled out the required amount of red rosin paper (supplied) in order to protect the surface below the bench from getting paint stains and other excess materials on it. They cut the appropriate piece using the same razor knife in utilized phase 2. After they placed the piece of protective paper flat on the ground, the bench was moved on top of it, holding it down with its weight and 4 legs. Another team member removed the lid to the can of paint and began to stir it

with the provided stir stick. Each team was also provided with a paint tray and plastic liner. Once thoroughly mixed, the paint was poured into the tray in preparation for painting. The team was also provided with one small roller and one brush. The person using the brush began to paint all of the corners, edges, and other detailed areas, while the one with the roller made quick work of the larger flatter surfaces (Figure 22).

Figure 22. Painting the bench

In order to paint the top edge of the trim boards, the tile spacers needed to be removed and caution was taken as to not paint the top surface of the tiles. Once the painting was complete, the tile thinset was dry. They would now not be moved during the final grout and cleaning portion in this phase. Grout was mixed in a smaller 1 ½ gallon blue bucket in the same manner as the thinset, with the same desired consistency (Figure 23).

Figure 23. Mixing the grout using the cordless drill and paddle mixing attachment

The team then removed all of the tile spacers and the grout mix was poured over the surface of the bench. Using the provided sponge grout trowel, the grout mixture was spread over all of the joints. Using mild pressure and by holding the trowel at a 45 degree angle to the surface, the grout was forced into all of the remaining space between the tiles and along the outer edges. After cleaning the larger white bucket used for thinset, it was filled with water. Using the provided tile sponge, the team soaked the sponge in the clean water, wrung it out, and began cleaning the remaining grout from the surface of the bench top. A circular pattern was used to evenly remove large amounts of excess material without removing it from the spaces between the tiles. The sponge was constantly flipped and rinsed to provide cleaner surfaces. This process was repeated until all of the grout was cleaned up off the surface of the tiles and the adjoining wood trim board edges. Final, touch ups with the small paint brush were completed for any area that was

compromised during the grout process. All of the tools were cleaned, put away, and the bench was now complete (Figure 24).

Figure 24. Completed Bench

Chapter 5

DATA ANALYSIS

The data from the research experiment was collected and further analyzed using a joint effort between the researcher and the statistical department at Arizona State University. This section describes the results and their findings.

Introduction

A research study was conducted in the construction department to investigate the relationship between the satisfaction, time, waste, quality, safety and eight groups of volunteers who have received or haven't received any encouragements, any help, and/or any instructions.

There were three different methods used to validate the data analysis portion of the experiment providing the quantitative results assigned to each individual group and participant. The three methods included rating through observation, a before and after quantitative data analysis, and individual participant surveys.

Ratings through Observation and Analysis

The ratings through observations method was used on the two productivity categories of Safety and Quality. With these ratings being the easiest to compromise with biased results, it was important to make the ratings uniform throughout and back them up. With multiple groups building at any one given time, the researcher was hindered by the fact that it was impossible to be at multiple locations, observing each and every task completed by the different group, all at the same time. Despite this fact, personal observations of the results were still very accurate. This was mainly because the ratings were given after the completion of each of the three phases, based on the work that was completed. It should be noted that none of the groups finished any of the phases at the same time, making valid observations and specific ratings of each group possible. Only the category of safety was rated throughout each building phase. In order to overcome the challenge during the safety analysis portion, as well as validate other observations,

each team was videotaped throughout the entire building phases by the use of high definition GoPro cameras (Figure 25). These cameras provided a tremendous resource for the research.

Figure 25. GoPro Camera used to record each build

The videos not only captured and supplied validation of the observations and ratings, but also included everything that was not seen by the observer, because of the constant traveling between the groups that were located in different areas. The use of high quality photography was also a major validation piece. This enabled the researcher to capture detailed still photos showing various observation points that were used in the analysis and ratings.

The researcher also carried an observation sheet, which allowed notes and observations to be written down throughout the process. This same sheet was filled out for each group during the quantitative data analysis portion of the experiment as well. The observation sheet included categories for all areas of productivity that were measured; Time, Waste, Quality, and Safety. This made it easy to capture notes and observations that were not only written down in regards to the observations and ratings, but also the quantitative data such as waste amounts that were measured, times recorded, etc. A sample observation sheet can be found in the APPENDIX.

The final analysis portion collected was through individual participant surveys. These surveys included a variety of questions about demographics and other questions relevant to the non-profit industry. The only question used in this survey for this current research was the satisfaction ratings given by each participant. The surveys were much more extensive as a sample survey can be seen in APPENDIX. The reasoning for all of the extra questions was for future research. The researcher is aware that volunteer data is hard to come by and wanted to capture as much as possible to aid in future studies and research in the same field.

Methods

Eighty observations were collected. Six observations were removed. They were removed because that team wrote notes during instruction and used them as extra help. After deleting the six observations, the sample size of the data set is 74. Time and waste variables are percentages, where time was normalized and waste is the percent of materials that should have been used.

Statistical methods

Seventy four observations were analyzed using STATA software. Sample means and standard deviations were calculated for each treatment group and used to construct 95% confidence intervals around the mean for each group. Two-sample t-tests with unequal variance were used to compare groups.

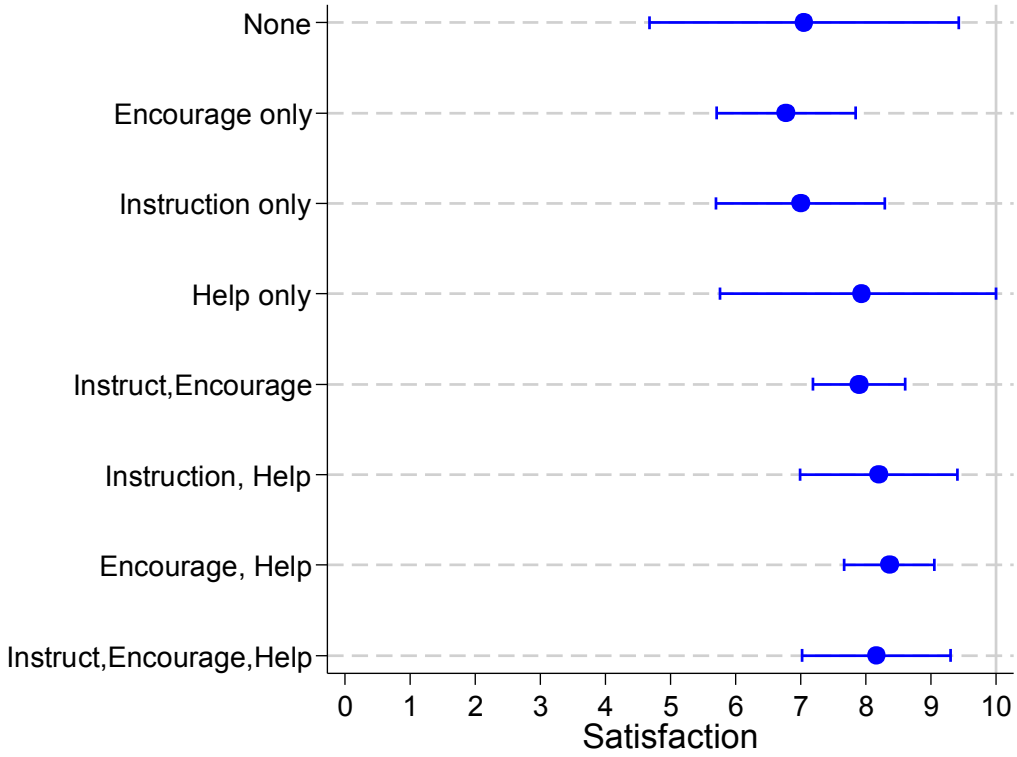
Results

Table 1 presents the six observations that were deleted from the original data set. They consist of 6 subjects who were given instruction only.

Group	Satisfaction	Time	Waste	Quality	Safety
Instruct only	8	81%	1%	7	9
Instruct only	8	81%	1%	7	9
Instruct only	10	81%	1%	7	9
Instruct only	9	58%	95%	9.5	9
Instruct only	10	58%	95%	9.5	9
Instruct only	10	58%	95%	9.5	9

Table 1: Deleted observations

Satisfaction



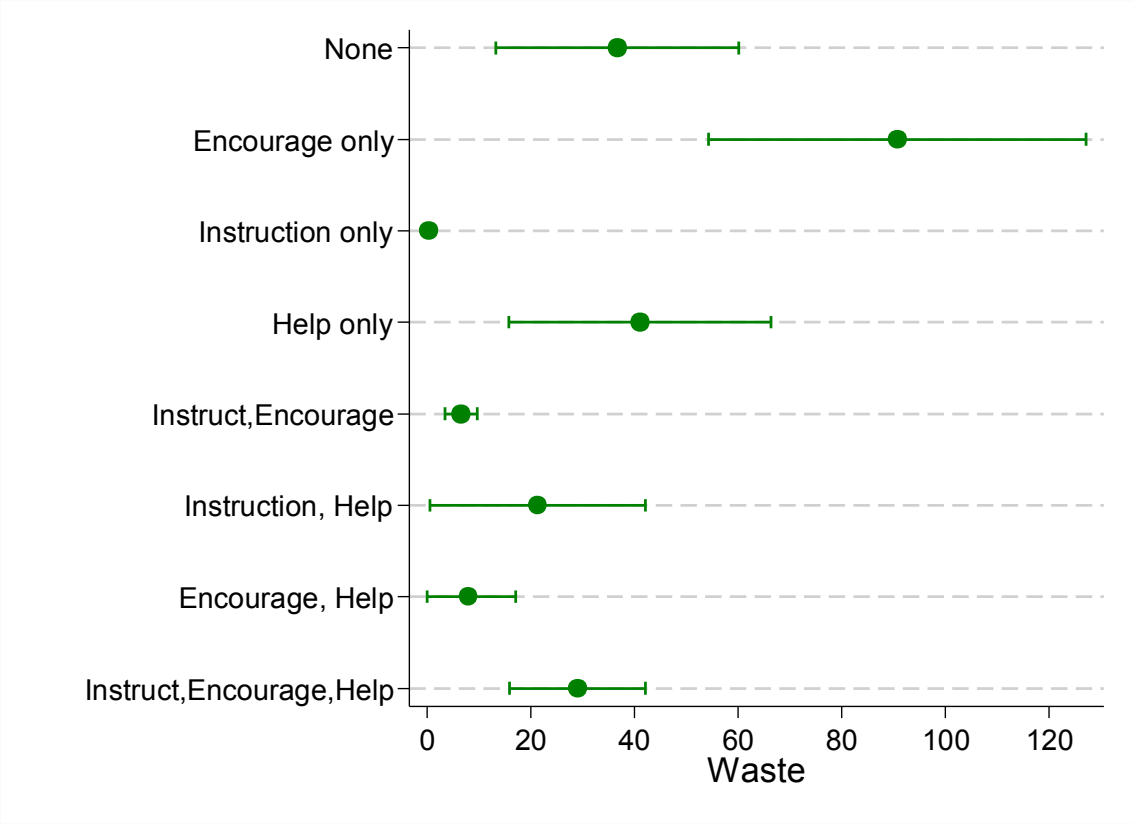
Graph 1: Satisfaction by Treatment Groups

Group	Satisfaction		95% Confidence intervals	
	N	Mean	Lower bound	Upper bound
Instruct, help, encourage	12	8.17	7.02	9.31
Encourage, help	11	8.36	7.67	9.05
Instruct, help	10	8.2	6.99	9.41
Instruct, encourage	10	7.9	7.19	8.61
Help only	9	7.94	5.77	10.12
Instruct only	4	7	5.7	8.3
Encourage only	9	6.78	5.71	7.85
None	9	7.06	4.68	9.43

Table 2: Mean satisfaction with 95% confidence intervals.

Graph 1 shows that there is no significant difference between treatment groups since all the confidence intervals overlap. From Table 2, one can observe that the 95% confidence intervals varied from short lengths such as Encourage and Help and Instruct and Encourage. Wide intervals, indicating greater variability, were observed in the Help only group and the group with no treatments (none).

Waste



Graph 2: Waste by Treatment group

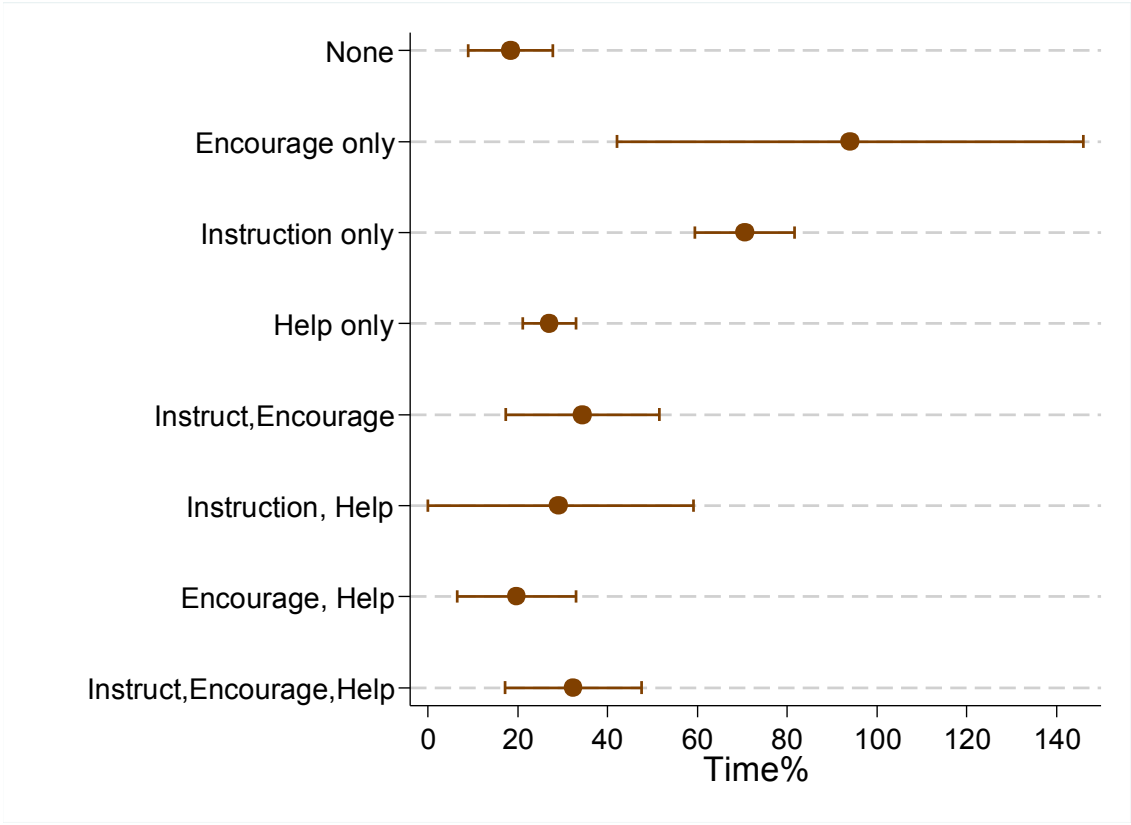
Group	N	Waste% Mean	95% Confidence intervals Lower bound	Upper bound
Instruct, help, encourage	12	29	15.86	42.14
Encourage, help	11	7.91	0	17.01
Instruct, help	10	21.3	0.56	42.04
Instruct, encourage	10	6.5	3.37	9.63
Help only	9	41	15.71	66.29
Instruct only	4	0.25	0	1.05
Encourage only	9	90.67	54.3	127.03
None	9	36.67	13.21	60.12

Table 3: Mean waste with 95% confidence intervals.

Graph 2 shows that there are significant differences between various groups (those with non-overlapping confidence intervals) such as Instruct, Encourage, and Encourage only. Notice that Encourage only distinguishes itself from the other groups with the highest waste score (91%) and is significantly different compared to the groups that have received either Help or/and Encouragement. The Waste was small except for Encourage only. Table 3 shows that the mean

varied between 6.5% and 91% with variations in the width of the confidence intervals between groups. Instruct, Encourage has the smallest confidence interval whereas Encourage only has the largest confidence interval.

Time



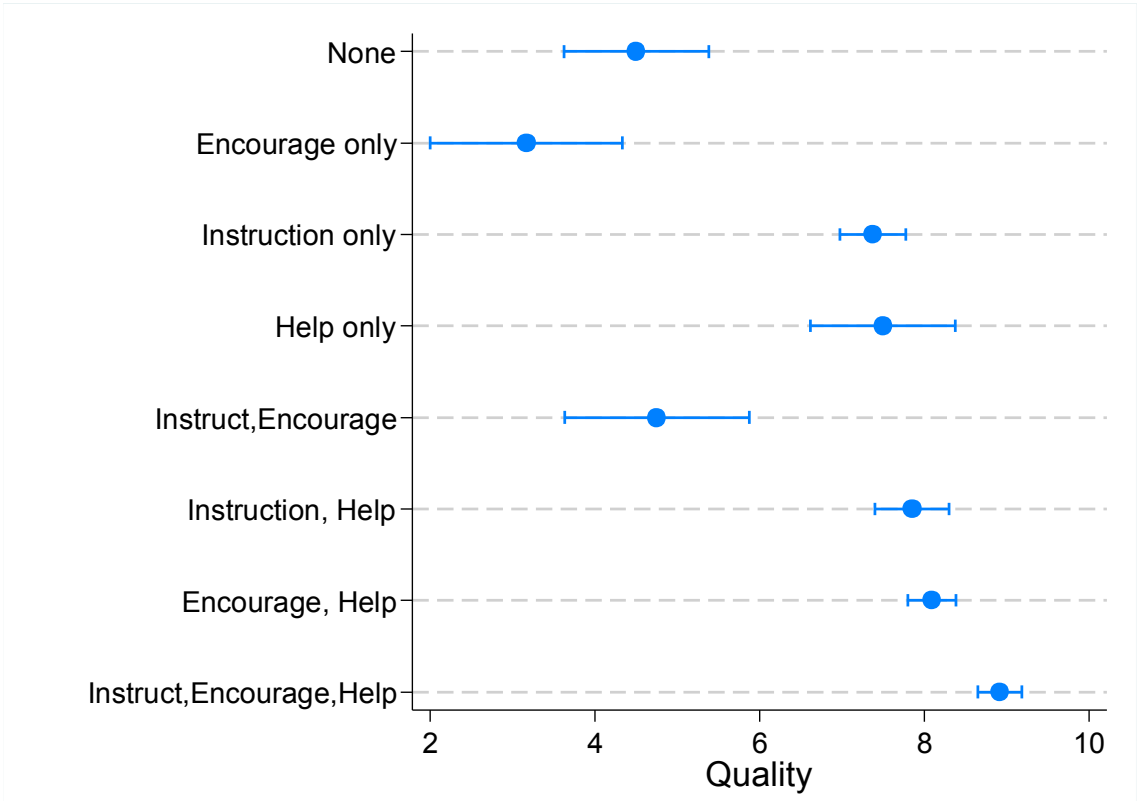
Graph 3: Time% by treatment group

Group	N	Time% Mean	95% Confidence intervals Lower bound	Upper bound
Instruct, help, encourage	12	32.33	17.14	47.52
Encourage, help	11	19.73	6.46	33
Instruct, help	10	29	0	59.15
Instruct, encourage	10	34.4	17.35	51.45
Help only	9	27	21.08	32.92
Instruct only	4	70.5	59.36	81.64
Encourage only	9	94	42.11	145.89
None	9	18.33	8.91	27.76

Table 4: Mean time with 95% confidence intervals

Graph 3 shows significant difference between Instruct only, Encourage only and all other groups. It is interesting to notice that three groups have similar means and confidence intervals. Interestingly, the group with no help, no instructions, and no encouragements has the second shortest time with 18%.

Quality



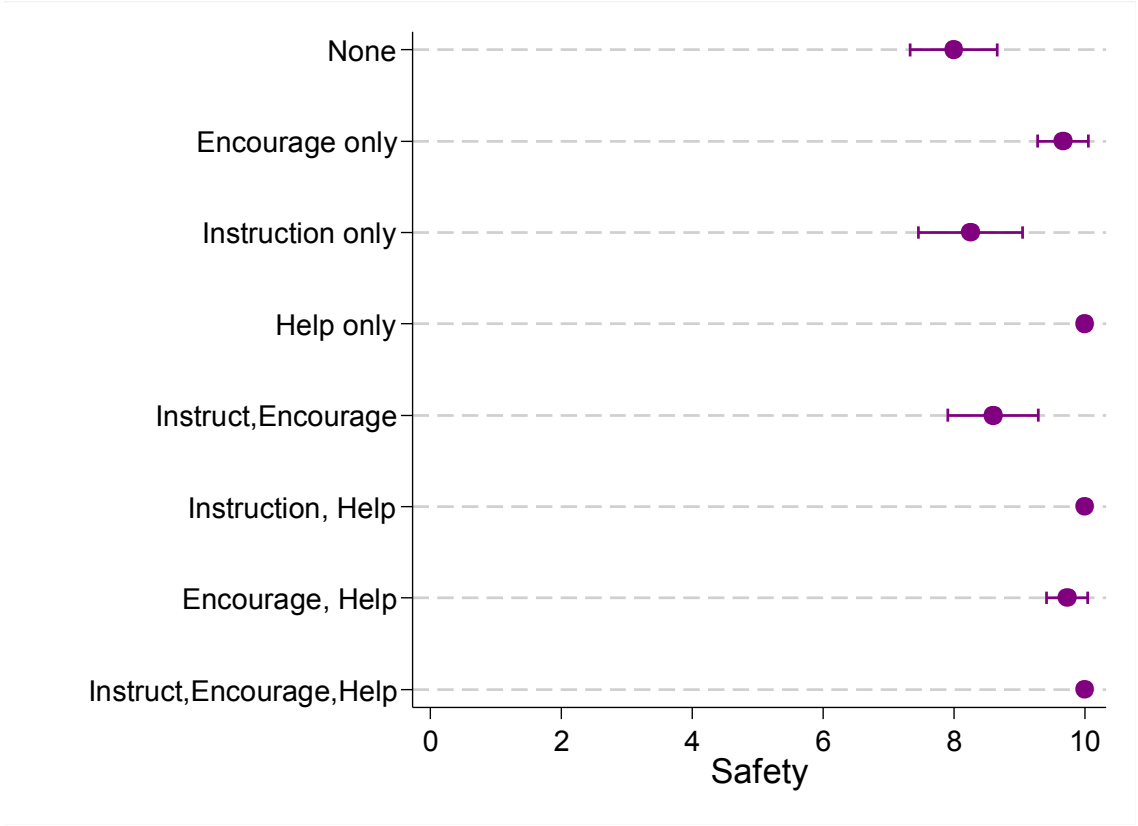
Graph 4: Quality by treatment group

Group	N	Quality Mean	95% Confidence intervals Lower bound	Upper bound
Instruct, help, encourage	12	8.92	8.65	9.18
Encourage, help	11	8.09	7.8	8.38
Instruct, help	10	7.85	7.4	8.3
Instruct, encourage	10	4.75	3.63	5.87
Help only	9	7.5	6.62	8.38
Instruct only	4	7.38	6.98	7.77
Encourage only	9	3.17	2	4.34
None	9	4.5	3.62	5.38

Table 5: Mean quality with 95% confidence intervals

Graph 4 shows significant differences between groups. When volunteers received Instruction, Help, and Encourage they produced the best quality work, whereas when they received Encouragement only the Quality was the lowest. The lengths of the confidence intervals are relatively short meaning that there not great variations in the observed values.

Safety



Graph 5: Safety by treatment group

Group	N	Safety Mean	95% Confidence intervals Lower bound	Upper bound
Instruct, help, encourage	12	10	10	10
Encourage, help	11	9.73	9.41	10.04
Instruct, help	10	10	10	10
Instruct, encourage	10	8.6	7.91	9.29
Help only	9	10	10	10
Instruct only	4	8.25	7.45	9.05
Encourage only	9	9.67	9.28	10.05
None	9	8	7.33	8.67

Table 6: Mean safety with 95% confidence intervals

Graph 5 shows that there are significant differences between groups, for instance, the group that did not received any Help, Instruction, and Encouragement was less safe than some other

groups. Most groups had high safety scores. Table 7 presents the means and the standard deviation by group for each outcome variable. One can notice that the standard deviations of the time variables are large corresponding to the long 95% confidence intervals on the Graph 3 and Table 4.

	Satisfaction		Time%		Waste%		Quality		Safety	
	N	M(sd)	N	M(sd)	N	M(sd)	N	M(sd)	N	Mean(sd)
Instruct, Help, Encourage	12	8.2(1.8)	12	32.3(23.9)	12	29.0(20.7)	12	8.9(0.4)	12	10.0(0.0)
Help, Encourage	11	8.4(1.0)	11	19.7(19.8)	11	7.9(13.5)	11	8.1(0.4)	11	9.7(0.5)
Instruct, Help	10	8.2(1.7)	10	29.0(42.2)	10	21.3(29.0)	10	7.8(0.6)	10	10.0(0.0)
Instruct, Encourage	10	7.9(1.0)	10	34.4(23.8)	10	6.5(4.4)	10	4.8(1.6)	10	8.6(1.0)
Help	9	7.9(2.8)	9	27.0(7.7)	9	41.0(32.9)	9	7.5(1.1)	9	10.0(0.0)
Instruct	4	7.0(0.8)	4	70.5(7.0)	4	0.3(0.5)	4	7.4(0.3)	4	8.3(0.5)
Encourage	9	6.8(1.4)	9	94.0(67.5)	9	90.7(47.3)	9	3.2(1.5)	9	9.7(0.5)
None	9	7.1(3.1)	9	18.3(12.3)	9	36.7(30.5)	9	4.5(1.1)	9	8.0(0.9)

Table 7: Mean and standard deviation of outcomes by treatment group

Table 8 lists p-values via t-test with unequal variances from group comparisons for each outcome variable. From Graph 5 and Table 6 for safety, one could see that the group that has not received any Help, Instruction or Encouragement is significantly different from Encourage only and from the group Instruction and Help. Table 8 shows a p-value = 0 for Safety that supports and concurs with our graph and the mean table with 95 % confidence intervals. Since the p-value is less than 0.05 there is sufficient evidence to conclude that there are significant differences between groups 8, 2, and 7.

From Graph 4 and Table 5 for Quality, one could see that group 8 that has not received any Help, Instruction, and Encouragement is significant with groups 1 that had received Encouragement, Instruction and Help. Table 8 shows a p-value = 0 for quality that supports and concurs with our graph and the mean table with 95 % confidence intervals. Since p-value is less than 0.05 there

are sufficient evidence to reject the null hypothesis and to conclude that there are significant differences between groups 8, and 1.

The significant p-values are highlighted in table 8.

		Satisf	Time	Waste	Quality	Safety
Instruct, Help, Encourage	Help, Encourage	0.75	0.18	0.01	0.00	0.08
Instruct, Help, Encourage	Instruct, Help	0.96	0.83	0.49	0.00	.
Instruct, Help, Encourage	Instruct, Encourage	0.67	0.84	0.00	0.00	0.00
Instruct, Help, Encourage	Help	0.84	0.48	0.35	0.01	.
Instruct, Help, Encourage	Instruct	0.10	0.00	0.00	0.00	0.01
Instruct, Help, Encourage	Encourage	0.06	0.03	0.00	0.00	0.08
Instruct, Help, Encourage	None	0.35	0.10	0.53	0.00	0.00
Help, Encourage	Instruct, Help	0.79	0.54	0.21	0.33	0.08
Help, Encourage	Instruct, Encourage	0.31	0.14	0.75	0.00	0.01
Help, Encourage	Help	0.68	0.28	0.02	0.17	0.08
Help, Encourage	Instruct	0.03	0.00	0.09	0.00	0.00
Help, Encourage	Encourage	0.01	0.01	0.00	0.00	0.78
Help, Encourage	None	0.25	0.85	0.02	0.00	0.00
Instruct, Help	Instruct, Encourage	0.64	0.73	0.14	0.00	0.00
Instruct, Help	Help	0.82	0.89	0.19	0.43	.
Instruct, Help	Instruct	0.10	0.01	0.05	0.07	0.01
Instruct, Help	Encourage	0.06	0.03	0.00	0.00	0.08
Instruct, Help	None	0.34	0.46	0.28	0.00	0.00
Instruct, Encourage	Help	0.97	0.37	0.01	0.00	0.00
Instruct, Encourage	Instruct	0.13	0.00	0.00	0.00	0.39
Instruct, Encourage	Encourage	0.06	0.03	0.00	0.04	0.01
Instruct, Encourage	None	0.45	0.08	0.02	0.69	0.17
Help	Instruct	0.38	0.00	0.01	0.76	0.01
Help	Encourage	0.29	0.02	0.02	0.00	0.08
Help	None	0.53	0.09	0.78	0.00	0.00
Instruct	Encourage	0.73	0.33	0.00	0.00	0.00
Instruct	None	0.96	0.00	0.01	0.00	0.53
Encourage	None	0.81	0.01	0.01	0.05	0.00

Table 8: p-values from group comparison via t-test with unequal variances

One key finding (shown above) is that leadership/management practices tested showed no significant effect on the volunteers' satisfaction levels with any of the combinations. As shown above in Table 8, statistically, only one combination was found significant out of every possible

combination. This one statistical significance of 'Help, Encourage' further validates the rest of our findings as discussed in more detail below.

Table 3 is further analyzed to show the individual categories with the corresponding results to the significant situational variables. Each of the tables of significance were further simplified to highlight the best and worst that a leader can do in respect to that particular productivity factor. Since no significant correlations were found with the category of satisfaction, it was left out. The remaining four are shown below in the next tables:

TIME

Better		**Worse**		ABS(Diff)
Instruct, Help, Encourage	32.33	Instruct	70.5	38.17
Instruct, Help, Encourage	32.33	Encourage	94	61.67
Help, Encourage	19.73	Instruct	70.5	50.77
Help, Encourage	19.73	Encourage	94	74.27
Instruct, Help	29	Instruct	70.5	41.5
Instruct, Help	29	Encourage	94	65
Instruct, Encourage	34.4	Instruct	70.5	36.1
Instruct, Encourage	34.4	Encourage	94	59.6
Help	27	Instruct	70.5	43.5
Help	27	Encourage	94	67
None	18.33	Instruct	70.5	52.17
None	18.33	Encourage	94	75.67

Best Options	**Worst Options**
1. Help, Encourage	1. Encourage Only
2. Help	2. Instruct Only

Table 9: Significant situational variables for the Time category

As Table 9 illustrates, there were 9 different situations that were significant in the category of Time. After calculating the absolute values of the differences between the best and the worst in those situations, one can clearly start to see a pattern in the best and worst practices to engage

in. According to this research data, an organization or government entity solely and specifically focused on accomplishing projects the quickest, the best practice would be to provide the teams with both Help and Encouragement throughout the project. If only one area could be the primary of focus and attention to create the best results in this area it would be Helping the volunteers throughout the project.

WASTE

Better		Worse		ABS(Diff)
Help, Encourage	7.91	Instruct, Help, Encourage	29	21.09
Instruct, Encourage	6.5	Instruct, Help, Encourage	29	22.5
Instruct	0.25	Instruct, Help, Encourage	29	28.75
Instruct, Help, Encourage	29	Encourage	90.67	61.67
Help, Encourage	7.91	Help	41	33.09
Help, Encourage	7.91	Encourage	90.67	82.76
None	36.67	Encourage	90.67	54
Instruct, Help	21.3	Encourage	90.67	69.37
Instruct, Encourage	6.5	Help	41	34.5
Instruct	0.25	Instruct, Encourage	6.5	6.25
Instruct, Encourage	6.5	Encourage	90.67	84.17
Instruct	0.25	Help	41	40.75
Help	41	Encourage	90.67	49.67
Instruct	0.25	Encourage	90.67	90.42
Instruct	0.25	None	36.67	36.42
None	36.67	Encourage	90.67	54

Best Options

1. Instruct, Encourage
2. Instruct, Help, Encourage

Worst Option

1. Encourage Only

Table 10: Significant variables for the Waste category

As Table 10 illustrates, there were 16 different situations that were significant in the category of Waste. After calculating the absolute values of the differences between the best and the worst in those situations, one can clearly start to see a pattern in the best and worst practices to engage in. According to this research data, an organization or government entity solely and specifically

focused on accomplishing the least amount of Waste during a project, the best practice for the leader would be to provide the teams with good initial Instruction followed by lots of Encouragement throughout the project.

QUALITY

Better		Worse		ABS(Diff)
Instruct, Help, Encourage	8.92	Help, Encourage	8.09	0.83
Instruct, Help, Encourage	8.92	Instruct, Help	7.85	1.07
Instruct, Help, Encourage	8.92	Instruct, Encourage	4.75	4.17
Instruct, Help, Encourage	8.92	Help	7.5	1.42
Instruct, Help, Encourage	8.92	Instruct	7.38	1.54
Instruct, Help, Encourage	8.92	Encourage	3.17	5.75
Instruct, Help, Encourage	8.92	None	4.5	4.42
Help, Encourage	8.09	Instruct, Encourage	4.75	3.34
Help, Encourage	8.09	Instruct	7.38	0.71
Help, Encourage	8.09	Encourage	3.17	4.92
Help, Encourage	8.09	None	4.5	3.59
Instruct, Help	7.85	Instruct, Encourage	4.75	3.1
Instruct, Help	7.85	Encourage	3.17	4.68
Instruct, Help	7.85	None	4.5	3.35
Help	7.5	Instruct, Encourage	4.75	2.75
Instruct	7.38	Instruct, Encourage	4.75	2.63
Instruct, Encourage	4.75	Encourage	3.17	1.58
Help	7.5	Encourage	3.17	4.33
Help	7.5	None	4.5	3
Instruct	7.38	Encourage	3.17	4.21
Instruct	7.38	None	4.5	2.88

Best Options

1. Instruct, Help, Encourage
2. Help, Encourage

Worst Options

1. Instruct Only
2. Encourage Only

Table 11: Significant variables for the Waste category

As Table 11 illustrates, there were 21 different situations that were significant in the category of Quality. After calculating the absolute values of the differences between the best and the worst in those situations, one can clearly start to see a pattern in the best and worst practices to engage

in. According to this research data, an organization or government entity solely and specifically focused on maximizing the best Quality project, the best practice for the leader would be to provide the teams with good initial Instruction followed by large quantities of Help and Encouragement throughout the project.

SAFETY

Better		Worse		ABS(Diff)
Instruct, Help, Encourage	10	Instruct, Encourage	8.6	1.4
Instruct, Help, Encourage	10	Instruct	8.25	1.75
Instruct, Help, Encourage	10	None	8	2
Help, Encourage	9.73	Instruct, Encourage	8.6	1.13
Help, Encourage	9.73	Instruct	8.25	1.48
Help, Encourage	9.73	None	8	1.73
Instruct, Help	10	Instruct, Encourage	8.6	1.4
Instruct, Help	10	None	8	2
Help	10	Instruct, Encourage	8.6	1.4
Encourage	9.67	Instruct, Encourage	8.6	1.07
Help	10	Instruct	8.25	1.75
Help	10	None	8	2
Encourage	9.67	Instruct	8.25	1.42
Encourage	9.67	None	8	1.67

Best Options	Worst Options
1. Instruct, Help, Encourage	1. Instruct, Encourage
2. Help Only	2. Instruct

Table 12: Significant variables for the Safety category

As Table 12 illustrates, there were 14 different situations that were significant in the category of Safety. After calculating the absolute values of the differences between the best and the worst in those situations, one can clearly start to see a pattern in the best and worst practices to engage in as well. According to this research data, an organization or government entity solely and specifically focused on having the safest projects, the best practice for the leader would be to provide the teams with good initial Instruction followed by large quantities of Help and

Encouragement throughout the project. If only one must be the focus, the leader should focus on Helping the team throughout the project including suggestions and tips.

Scenarios

As the research findings and recommendations above are noteworthy, they often times do not represent reality of projects. To further provide applicability of the results, the researcher has normalized all of the mean variables (Table 13) for each category and then used these normalized results to calculate real-life scenarios and values of nonprofits and government agencies.

WASTE		
Instruct, help, encourage	29	0.008621
Encourage, help	7.91	0.031606
Instruct, help	21.3	0.011737
Instruct, encourage	6.5	0.038462
Help only	41	0.006098
Instruct only	0.25	1
Encourage only	90.67	0.002757

TIME		
Instruct, help, encourage	32.33	0.610269
Encourage, help	19.73	1
Instruct, help	29	0.680345
Instruct, encourage	34.4	0.573547
Help only	27	0.730741
Instruct only	70.5	0.279858
Encourage only	94	0.209894

QUALITY		
Instruct, help, encourage	8.92	1
Encourage, help	8.09	0.906951
Instruct, help	7.85	0.880045
Instruct, encourage	4.75	0.532511
Help only	7.5	0.840807
Instruct only	7.38	0.827354
Encourage only	3.17	0.355381

SAFETY		
Instruct, help, encourage	10	1
Encourage, help	9.73	0.973
Instruct, help	10	1
Instruct, encourage	8.6	0.86
Help only	10	1
Instruct only	8.25	0.825
Encourage only	9.67	0.967

Table 13: Normalized mean variables for the Waste Category

Scenario 1 = .4(Q)+.3(T)+.2(W)+.1(S)	
Option 1 - Instruct, help, encourage	0.684805
Option 2 - Encourage, help	0.766401
Option 3 - Instruct, help	0.658469
Option 4 - Instruct, encourage	0.478761
Option 5 - Help only	0.656765
Option 6 - Instruct only	0.697399
Option 7 - Encourage only	0.302372
Scenario 2 = .6(Q)+.2(T)+.1(W)+.1(S)	
Option 1 - Instruct, help, encourage	0.822916
Option 2 - Encourage, help	0.844631
Option 3 - Instruct, help	0.76527
Option 4 - Instruct, encourage	0.524062
Option 5 - Help only	0.751242
Option 6 - Instruct only	0.734884
Option 7 - Encourage only	0.352183
Scenario 3 = .3(Q)+.4(T)+.2(W)+.1(S)	
Option 1 - Instruct, help, encourage	0.645832
Option 2 - Encourage, help	0.775706
Option 3 - Instruct, help	0.638499
Option 4 - Instruct, encourage	0.482864
Option 5 - Help only	0.645758
Option 6 - Instruct only	0.64265
Option 7 - Encourage only	0.287823
Scenario 4 = .3(Q)+.2(T)+.4(W)+.1(S)	
Option 1 - Instruct, help, encourage	0.525502
Option 2 - Encourage, help	0.582027
Option 3 - Instruct, help	0.504777
Option 4 - Instruct, encourage	0.375847
Option 5 - Help only	0.500829
Option 6 - Instruct only	0.786678
Option 7 - Encourage only	0.246396
Scenario 5 = .2(Q)+.1(T)+.1(W)+.6(S)	
Option 1 - Instruct, help, encourage	0.861889
Option 2 - Encourage, help	0.868351
Option 3 - Instruct, help	0.845217
Option 4 - Instruct, encourage	0.683703
Option 5 - Help only	0.841845
Option 6 - Instruct only	0.788457
Option 7 - Encourage only	0.672541

Table 14. Realistic scenarios shown with recommended results

Five scenarios were created and ran based on specific and realistic values of many different organizations. These five cover a wide range of different values and foci of nonprofits in this field, and yet they all yield the same result. Help and Encouragement were the best solutions to 4 of the 5 scenarios and came in 2nd in the only other remaining scenario.

Chapter 6

RESULTS

Discussion

The comparisons from Table 8 showed all of the significant relationships in each category. This showed only that there was significance and did not tell which one was the significant or 'better' of the two, nor the weight of that significance. Since only one of twenty eight combinations was shown to be significant in the category of Satisfaction, this revealed a significant finding. The research suggests that no leadership/management practices had any significant change on the volunteers' overall satisfaction level. As mentioned previously, the sole statistically significant finding still validated the overall finding of best practices. The reason that this category was even included in the research was because of its overwhelming weight given by other research, writings, and nonprofit's focus and attention. The research suggests that leaders, while running groups during projects, can more narrowly focus on leadership and management techniques that bolster productivity rather than worry and divert attention and resources to promote volunteer satisfaction.

Going back to the results found on Table 8 that were indeed significant, helped to further explore how to improve the results of productivity. Those significant correlations were categorized into best and worst scenarios including the corresponding absolute value of their differences. It was with each of these main productivity categories (Time, Waste, Quality, and Safety) where the results started to show best practices. One should note this would only being accurate if the organization was focused solely on that one category. This, however, is not realistic. No organization is focused solely on one aspect of productivity. Scenarios were then created in order to weight all of the four remaining productivity categories, creating a realistic model of an organization and its priorities. Each of the five scenarios represented different priorities that a nonprofit or government agency may have. Scenario 1 was thought to have been the most accurate of all the scenarios. Quality was given a 40% weight with 30% going to Time, 20% to Waste, and 10% to Safety. One may argue that Safety should be higher if thought to represent

the most likely scenario (it is the highest in Scenario 5) however, there is minimal time and resources allocated for proper safety training available for short-term volunteers and even more so in disaster relief efforts(Miller 2009). Interestingly enough though, is that the argument goes away when one looks at the remainder of the scenarios. Nearly all the results remain the same. They show that the most positive combination for a leader to practice in order to maximize productivity of the volunteer construction workforce is 'Help, Encourage'. To break those two words down further, a leader must focus on providing high amounts of help and hands on micromanagement during the project coupled with high amounts of encouragement. The only scenario out of the five where this was not the result was Scenario 4 where Waste was a large concern. However, one should note that 'Help, Encourage' was still the second best choice in that scenario.

The results also showed the single most important practice by the leader, if two (Help, Encourage) is not possible, is Help. Meaning, the research showed that providing high quantities of Help, or hands on micromanagement, to the volunteer groups throughout the building project would maximize the productivity of their volunteer construction workforce.

Relation to Previous Work

The researcher can find no previous work related to the study conducted. The closest relatable work would be construction productivity. However, adding the volunteer workforce component makes the comparison a stretch at best.

Implementation

The results shown by this research should be implemented at the organizational and individual levels. The organization should take the knowledge from these findings and create better ways to provide the necessary help to the volunteers needed. This could look and be accomplished in many different ways. For instance, a nonprofit may survey or conduct its own internal research in order to find out what type of Help is best suited to the volunteers that are specific to their

organization. This knowledge would further define and shape the specificities of the Help given to their volunteer demographic, which is unique to that organization. At an individual level, the leader would be able to focus their attention to what would produce the best return on investment. With this knowledge the leader would focus attention to helping more often with the volunteers during construction while providing encouragement along the way. In short, this would maximize the productivity of the leader with *their* time and resources.

Limitations

The research was conducted using a certain age demographic with nominal to no prior construction experience. It is possible that the results may change by using older volunteers with more construction experience or a combination of the two. The construction was also conducted using minimal 'niceties' found in construction technology today. The reason behind this choice was to make the results more applicable to a larger variety of organizations across the globe. Using the latest technology and tools may have an effect on the results and outcome. Another limitation to the results is their broadness. There are no results as to the minute details of each of the categories tested. For example: the specific type of encouragement, rather than general comments, may give different results within themselves. This research does not speculate or delve further into those intricacies.

Chapter 7

CONCLUSION

Summary

With an increase in social justice and volunteerism not only in the US, but across the globe, the study of data on rates of volunteering and volunteer management has become more of a focus (Musick 2007). As data pours in on rates and hours served, little in depth research has been performed on specifics. It is surprising how little attention has been given, especially with numbers estimated at 64.3 million people volunteering in US alone (Corporation for National & Community Service 2012). One particular area that has received little attention, if any, is in the volunteer sector of construction. The research conducted focused on leadership/management strategies and productivity of a volunteer construction workforce and significant relations between the two. The study focused on a simple design of experiment (DOE) approach using highs and lows in the categories of Instruction, Help, and Encouragement by the leader. The productivity outcomes that were measured in comparison were Time, Waste, Quality, Safety, and Satisfaction. The results showed Encouragement and Help (as previously defined) to be the leader's best opportunity to maximize a volunteer construction workforces' productivity. This research also showed no significant correlation between the management practices of the leader and the satisfaction of the volunteers. Further simplified, the research showed that if a leader or nonprofit organization that uses volunteers for construction wanted to focus on one specific practice to maximize productivity of their volunteer workforce it would be high amounts of Help (hands on micromanagement).

Validation

The researcher chose to interview two experts in the field of nonprofits who use volunteer construction workforces.

The first interview conducted was with Jason Law, founder of 1Mission. 1Mission uses volunteers to build houses in Mexico, Nicaragua, and El Salvador. When speaking with Jason about this

research, he said it would be a major contribution to the types of projects that his organization and others do across the globe. Jason shared that 1Mission initially grabs the volunteers with its vision and then empowers them while they are actually working on the project. This empowerment creates ownership for the volunteer. He said that “inspiration is equivalent to motivation” for volunteers. However, with inspiration comes expectations, and the volunteers expect to accomplish something. This accomplishment is the “win” as Jason described it. For the majority of 1Mission’s volunteers, the win is finishing a house and presenting it to the family. To be successful in these types of organizations, Jason says you must “identify or quantify the win and focus on it.” As you capture what the win is, it helps to not only craft your vision to hook your volunteers, but it helps to specifically identify where the volunteers fit into that vision, and their role, creating an even bigger win. He also spoke of direction and a clear plan. He said, without it, there is a “ton of waste.” Jason spoke of the dangers of not having a clear plan, as volunteers actually begin becoming consumers and start to get in the way rather than contribute. He reiterated that by having knowledge of what to focus on (results from this research) would be a huge contribution in making the plan more effective as well as the productivity of their volunteers (Law 2013).

The second interview conducted was with Dr. Tom Schleifer, who is currently the Assistant Professor of Research for the Alliance for Construction Excellence (ACE) at Arizona State University. In addition to being a leading expert in construction, Dr. Schleifer had also held the position of Director of Appropriate Technology for Habitat for Humanity International. After selling his own business at a fairly young age and writing a book, he started volunteering for a local Habitat for Humanity in Morristown, New Jersey. He was asked to help design and build the four-family unit for Habitat. He was a quasi-superintendent with no manual. He was teaching on the fly. Dr. Schleifer mentioned that one of his greatest challenges was building with volunteers who “come and go as they please.” He even used the word “flabbergasted” when speaking of the differences and challenges he faced coming from industry to the world of volunteerism where the vast majority of the workers are non-skilled. He described the difference as night and day from

the industry, and that there was “no comparison.” After accomplishing the design and building of the four-family unit, and with his extensive credentials in the industry, Tom was approached by Millard Fuller the founder and former president of Habitat for Humanity. At that time, former President of the United States Jimmy Carter was sitting on the board of directors. The former President saw needs to not only understand, but to write a manual on what appropriate technology is for the numerous other countries around the world where Habitat for Humanity International builds. Mr. Fuller asked Dr. Schleifer to fill this role and commit to working fulltime for Habitat for the duration of one year. In that year, Tom was charged with the tasks of writing the manual on appropriate technology for Habitat for Humanity International and then to find and hire his replacement. His travels took him to over 19 different 3rd world countries on nearly every continent. He explained the challenges faced with using volunteers in construction and how they compound when you go to other countries. When the researcher described the current study in the area of increasing the productivity of volunteer construction workforces Dr. Schleifer said, “They can really use it.” He spoke about a lack of preplanning that goes on in the system he observed and how research results found in this study could help with the proficiency and preparedness by the organization (Schleifer 2013).

Significance of the Research

As global nonprofit names such as Amor Ministries, 1Mission, and Habitat for Humanity International continue to help millions of people across the world with basic needs of shelter, specific research and studies aimed at maximizing productivity of their volunteer workforce would result in furthering the global good. For instance, by simply improving the productivity of volunteers by 20% you would increase the already staggering numbers of a nonprofit like Habitat for Humanity International from over 600,000 homes built and serving more than 3 million people to adding an additional 120,000 homes and servicing another 600,000 people. This equates to numbers that rival the entire city population of Portland or Milwaukee. The other positive implication of this research and its findings is that it acts as a win-win for both the organization and the volunteers. As research showed in 1998 that “too many potential and active volunteers

are turned off by what they regard as inefficient use of their time (UPS 1998).” The results of this research would help to combat that reality. Volunteers that are more productive, accomplish more. The more sense of accomplishment they feel, the greater the satisfaction. With increased satisfaction, studies show that volunteers are more loyal to the organizations with which they volunteer (McCurley 2011). The research results also aid in boosting the productivity of both the organization and the leader who managing the volunteers for the project, by allowing them to focus their efforts on what is the most effective at maximizing results. If implemented throughout, the positive change and results would stretch across the entire globe adding significantly to the already dire impact that volunteerism contributes to the global good of humanity.

Recommendations for Future Research

Despite the large contributions in volunteerism that this research accomplished, its boundaries are broad and some of the scope is limited. Each of the three management areas tested could be further broken down and studied at greater depths. For instance, using different types of encouragement given to volunteers and measuring the results/impacts would be a great contribution. This would give the leader more insight on *how to* encourage, based on the demographic they are managing, or if specific encouragement and frequency is even a factor at all. Additional demographics such as older or mixed age groups and varying degrees and combinations of construction experience would also be a great addition to this research. Would adding a professional to the group of non-experienced volunteers change the productivity or the satisfaction of the others? Or would it create chaos by having two people trying to lead the group? The research should also be adapted by individual organizations in order to shape and mold it to their own needs and volunteer base. This type of in-house study would further add to its relevance. The last major recommendation for future research, and possibly the most significant, would be to test the ‘Help’ given to the volunteers. One of the groups was removed from the data set because they took detailed notes during the ‘high instruction’ portion of the experiment. These notes were then reviewed along the way by the team when they were supposed to be given ‘low help.’ There results were actually substantially better than the other teams that were tested with

the same combinations. This made them an outlier since they had different resources than the other groups. However, the fact that they had better outcomes than the other teams in their same categories suggests that having a detailed manual to reference by the team throughout the project may actually aid or take the place of high quality help needed from the leader. This would be a tremendous contribution to this research and the sector itself, as a manual can be reproduced and handed out where a leader can only be in one place at one time.

Final Thoughts

The world of volunteerism is a conundrum. Often times it is overlooked by research attention and allocated funds simply because it helps nonprofits or government agencies. In short, there is no money in it. The research conducted and its results may not help organizations increase bottom line figures in the capital marketplace, however, if the definition of *profit* remains the same; “a valuable return (Merriam-Webster),” then finding results that increase productivity of volunteers that perform construction projects that help people across the globe is truly profitable in the bottom line of the greater good of humanity.

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APPENDIX A

SAMPLE AMOR HOUSE PLAN (SINGLE)

TABLE OF CONTENTS

Before You Begin

INVENTORY AND SORT

Welcome to your Amor Ministries building project! This is your guide to the construction process. It is continually updated, so even if this is not your first project, please read these instructions to familiarize yourself with recent changes. If this is your first project, we recommend that you keep this entire manual handy, along with the tri-fold Site Foreman's Guide, which contains good tips for getting your entire build crew involved. They are both designed to help you progress step-by-step through the construction process.

STEP 1 AT THE SITE

The homeowner has already determined where the home is to be built. They have taken into consideration their neighbors, existing structures, and their family's needs. Please make every effort to honor their requests. It's always helpful to sketch out the floor plan, including the positioning of doors and windows in accordance with the family's wishes. They have already worked to level the work site. Clear the area for the slab. Don't assume anything; ask where to place all items cleared from the work area.

Verify with your Amor Team Member that you have the most current design plans. Check for a water source in case the family is relying on deliveries or borrowed barrels.

STEP 2 MATERIAL INVENTORY

In the days prior to your arrival, all the materials for the project were delivered to the work site. Using the material checklist provided below, locate and inventory everything necessary to complete the project.

- ❑ 38 – 12 ft. two-by-fours (Barrotes)
- ❑ 100 – 8 ft. two-by-fours (Barrotes)
- ❑ 11 – 10 ft. one-by-fours (Latilla)
- ❑ 9 – Plywood (Petatillo)
- ❑ 4 rolls – Felt paper (Felpa)
- ❑ 4 rolls – Roll roofing (Arenado)
- ❑ 2 rolls – Chicken wire (Alambre de pollo)
- ❑ 8 kgs. – Bailing wire (Alambre recosido)
- ❑ 30 – 42.7 kg. Bags cement (Cemento) or 25 – 50 kg. Bags
- ❑ 18 – Mud sill anchors (Anclas)
- ❑ 8 – Hurricane straps (Soportes del techo)
- ❑ 3 bags – High Tech fibers (Fibra)
- ❑ 14 kgs. - 1 bag 16-penny nails (Clavos grandes)
- ❑ 5 kgs. - 1 bag 8-penny nails (Clavos medianas)
- ❑ 10 kgs. - 1 bag 1 ¼ in. Roofing nails (Tachuelas)
- ❑ 1 – Brush (Brocha)
- ❑ 1 gallon – Roofing tar (Brea en frio)
- ❑ 6 meters – Sand and gravel (Arena y grava)
- ❑ 2 – Windows (Ventanas)
- ❑ 1 – Door (Puerta)
- ❑ 3 – Hinges (Visagras)
- ❑ 1 – Door knob (Chapa)
- ❑ 6 – Family provides water barrels (La familia proporciona tambos de agua)

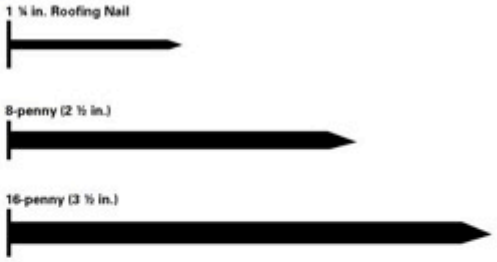
STEP 3 SEPARATE AND SORT THE LUMBER

The most common mistake occurs when cutting lumber and plywood. **It is very important to avoid cutting the 12 ft. 2x4s needed for the roof. Find 18 straight and strong 12 ft. boards for the roof** (no large knots or splits). Mark and set them aside so that they won't be cut or used for anything else.

**** Note: Check 8 footers and 12 footers for uniform length!***

**** See site Foreman's Guide for more time saving tips.***

NAIL DIAGRAMS



***Standard Measurment Abbreviations**

8 Feet = 8 ft. = 8'

8 Inches = 8 in. = 8"

two-by-four = 2x4

one-by-four = 1x4

YOU WILL NEED:

- ❑ 7 – 12 ft. two-by-fours
- ❑ 2 – 8 ft. two-by-fours
- ❑ 18 – Stakes
- ❑ 15 – 42.7 kg. Bags of cement or 13 – 50 kg. Bags
- ❑ 18 – Mud sill anchors
- ❑ 1 – Large pile of sand and gravel
- ❑ 4 – Barrels of water (or more)
- ❑ 3 – Bags of High Tech fiber
- ❑ 50 – 16-penny nails

STEP 1 LEVEL THE GROUND (DIAGRAM 1 = D1)

It is wise to level an area at least 6 in. larger than the 11 ft. x 22 ft. foundation. Allow 2 ft. of work space around the outside of the foundation so that you have room for working. If you don't have enough room, consult your Amor Team Member.

STEP 2 BUILD THE FOUNDATION FORM (D1)

Use six 12 ft. 2x4s to construct the form. If at all possible, do not cut these! They will be used later in the building process. Following Diagram 1, put the form together, using two 16-penny nails in each corner joint. The interior dimension should equal 11 ft. x 22 ft., so that the finished slab will equal 11 ft. x 22 ft. Use an 8 ft. 2x4 to connect the 12 footers together for the two 22 ft. sides. **If you must cut a 12 footer to fit job circumstances, use the piece later as the top or bottom plate for a rake wall.**

STEP 3 SQUARE, STRAIGHTEN, AND LEVEL THE FORM (D1)

Measure diagonally from corner to corner, as shown in Diagram 1. The form is square when the two cross-measurements are equal. After the two cross measurements are equal, stake around the outside of each corner of the form to hold it in place. **Do not put any nails in the stakes at this point.**

After your form boards are square, the boards need to be straightened. Use a string line from end to end as a guide. Secure a stake on the outside of the form where the board is even and straight with the string line. You will need at least three secured stakes for each 11 ft. section. **Do not put any nails in the stakes at this point.**

To level the form, it helps to establish one corner at permanent height. Set a level in that corner section and nail the stakes to the form when it is level. From there work your way around the form with the level in each 11 ft. section, corner and splice. Nail the stakes to the form when that area is level.

NOTES

STEP 4 DIG A FOOTING TRENCH AROUND THE INSIDE OF THE FORM (D2)

The footing anchors the foundation to the ground and keeps it from shifting. The trench should be **NO LARGER THAN 8 in. WIDE X 10 in. DEEP** measured from the top of the form. Use a round shovel for this step. Square tip shovels make the trenches too big.

STEP 5 LEVEL THE SOIL (D2)

Place a 12 ft. 2x4 on edge across the top of the form, and measure the distance from the bottom of the 2x4 to the leveled ground. This will show how thick the cement will be. Add or remove dirt until the distance is between 3 and 4 inches. Note: Soft ground will compact when you walk on it. Make sure the ground is compact when measuring the slab depth so the slab will not be too thick.

You can use a 2x4 (actually 3½ in. wide) on edge to measure the gap underneath. You can nail an 8ft. 2x4 on edge to the bottom of the 12 ft. board to create a depth gauge for leveling the pad area. An inverted steel rake whose points are approximately 3 ½ in. high can also be dragged under the 12 footer as a depth gauge for leveling the dirt.

STEP 6 MIX THE CONCRETE

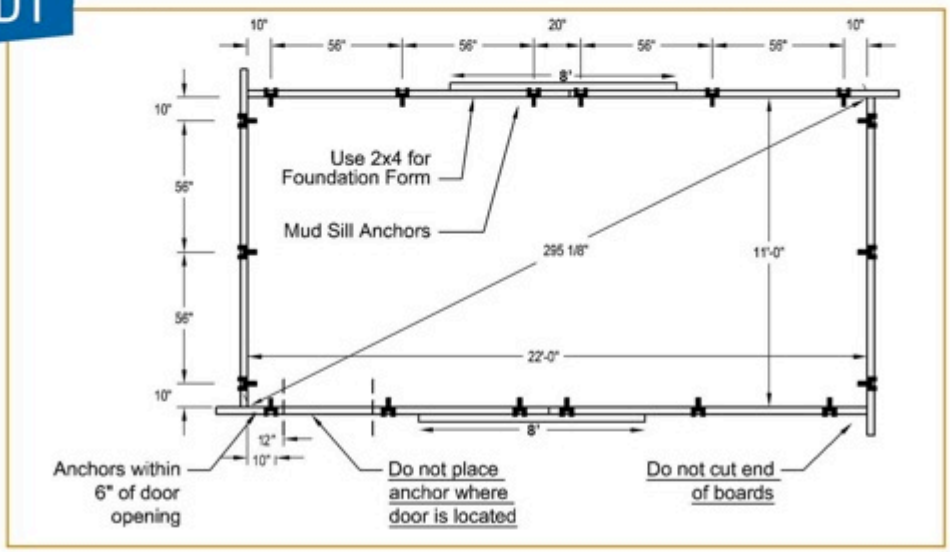
When the form is level and square, it's time to mix. Mix in a wheelbarrow, or in a mixing bin. The ratio is: five shovels of sand and gravel to every one shovel of cement; make sure to be consistent with the size of scoops. Larger amounts can be mixed as long as the ratio is 5:1. If rocks and sand are separate or if the pile is unevenly mixed, try to use three sand and two rock to every one cement. Add the High Tech fibers at 1/5 bag of fiber to one sack of cement. Use all three bags to complete the slab. This means you should have used one bag of fiber by the time you complete 1/3 of the slab. If not, increase the amount of fiber you're adding to the mix. **Completely mix the dry materials before adding water, achieving an even color and texture.** Add water gradually and mix until a consistency of oatmeal is attained. Pour the concrete into the form, working from one end to the other, leveling as you go. **Don't bump the form out of square or level!**

Concrete can get pretty hectic. It helps to lay a 12 ft. board across the form (starting perhaps 2 ft. away from one end) and instruct workers to dump concrete only on the opposite side.

STEP 7A TAMP AND SCREED THE CONCRETE (D2)

This is the process which creates a flat, level surface of concrete. Once you have poured a couple feet of concrete, take a straight 12 ft. x4 (this is your screed board) and place it on edge at the

D1



beginning of your slab. Tamp the concrete by lifting one end of the screed board and striking the concrete (alternate sides). This forces rocks down from the surface and brings water up. Tamp rhythmically (and firmly), working from the beginning to the leading edge of the poured concrete. Make sure that both ends of the screed board touch the form; if they don't, you must remove concrete to make it level.

After tamping, screed the surface as follows: two people should take the same board, start again at the beginning, and "saw" the board back and forth between them, moving slowly toward the leading edge of concrete (See Diagram 2). Keep the board in contact with the form. This will push a lot of concrete off the top, and may require another person to help pull concrete away. It may take several passes to make the surface smooth, and you may need to screed it again later if it is disturbed, or puddles of water form on the surface.

STEP 7B PLACE THE MUD SILL ANCHORS (D1 & D3)

Anchors are used to secure the walls of the house to the foundation (Diagram 1). As you pour concrete down the form, you can place anchors in the area already tamped and screeded. The mud sill anchors are placed 10 in. from each corner and equally spaced along the edge of the slab, three anchors in each 11 ft. section (See Diagrams 1 & 2).

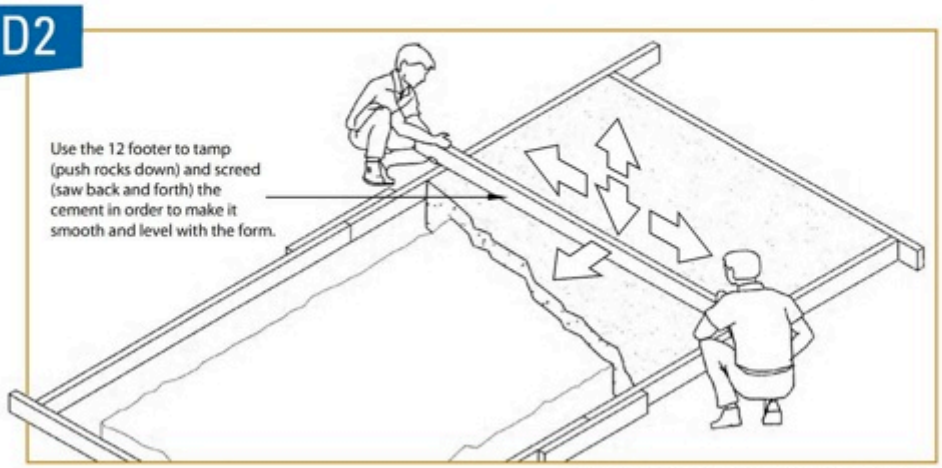
DO NOT PLACE AN ANCHOR IN YOUR DOORWAY!

STEP 7C TROWEL THE CONCRETE

Concrete at this point can be very different depending on quality and coarseness of materials, timing and quality of screeding, and time of day and temperature. If the surface after screeding is still rocky, tamp it again and more firmly! Next, you will need to trowel it with floats (trowels made of wood or magnesium) to get an even surface. Once the surface is fairly smooth, it is best to leave it alone for 20 to 30 minutes. **The best finish is obtained when the concrete has been allowed to dry until it is no longer shiny.** When you are ready, use finish trowels (large, smooth metal trowels) to make the surface completely smooth. Using scrap wood to stand on, begin from the center of the slab and work your way out, smoothing over your own board marks as you move. Apply a little water where necessary (spray bottles are handy). Tip up the leading edge of the trowel and use lots of downward pressure. This is the secret to good finish troweling. Use the trowel as you would a butter knife: more angle for scraping, less angle for smearing.

D3 **PROPER ANCHOR PLACEMENT!**

D2



Phase Two - A
FRAMING

YOU WILL NEED:

- ❑ 32 – 12 ft. two-by-fours
- ❑ 83 – 8 ft. two-by-fours
- ❑ ½ box – 16-penny nails

The house is built using seven separate wall sections. Four walls are 11 ft. long with straight tops. Three walls are 10 ft. 5 in. long and have sloping tops; these are called rake walls. After the materials are sorted, you may build the walls in any order. Try to develop a system that works best for your team. Follow the basic design so that you do not run short of materials.

STEP 1 BUILDING A STANDARD WALL

Sketch out a floor plan with the family for the location of doors, windows, and pitch of the roof. Of the four standard walls, two will be built with 8 ft. studs and two with 7 ft. studs.

Note: Always use 16-penny nails to connect 2x4s!

STEP 2A STANDARD 8-FOOT WALL WITHOUT DOORS OR WINDOWS (D4 & D5)

Two 11 ft. 2x4s will be used as plates and nine 8 ft. 2x4s are needed for studs. Place the two 11 ft. boards face-to-face on edge, flush on both ends. Measure along the boards and make a mark on both boards every 2 ft. On the right side of each mark place an "X". Place an "X" on each end of both boards, as well. The 8 ft. studs are placed between the 11 ft. plates, on the "X" and next to the 2 ft. mark. Nail the studs to the plates using 16-penny nails (the largest), two nails in every joint (See Diagrams 4 & 5). Repeat the process to build another 8 ft. wall and two 7 ft. walls. Some studs have only three corners. Make sure the good side of the studs face out for the normal studs. For the California corners, the good side should face the inside of the house **Only use 2x4s with complete or square edges for the rough openings of the door or windows.**

STEP 2B TO ADD A DOOR TO A WALL (D6 & D7)

Measure the outside dimensions of your door. Make your doorway is 2 in. wider than the door and ¾ in. taller than the door, remember you will cut the bottom plate out of the doorway after the walls are up, so measure accordingly. This will make the doorway approximately 37 ¾ in. wide to allow the door to be hinged to a 80 ¾ in. 2x4 that will be nailed directly into the rough opening. The header should be placed approximately 80 ¾ in. **from the bottom of the bottom plate** (See Diagrams 6 & 7). If the family wants a door centered in a wall section, center it within the section, using whatever method seems best, but make sure that the rough opening for the door is the proper width and the proper height.

NOTES

STEP 2C TO ADD A WINDOW OPENING TO A WALL (D8 & D9)

First, verify the size of your project's windows. Make note that the 1 in. flange around the window frame does not insert into the rough opening of the window, but instead mounts to the outside wall of the house - for this reason, do not measure the flange of the window, but rather the body. Most windows currently used by Amor Ministries will measure 47 in. wide and 23 in. tall in this area. Size the rough opening of your window ½ in. larger than both dimensions — 47 ½ in. wide and 23 ½ in. tall. Place two studs outside of 47 ½ in. marks to form the opening in the wall.

Measuring from the bottom of the bottom plate, mark the two studs at 4 ft. and 5 ft. 11 ½ in.; nail a 47 ½ in. board below and above these marks, respectively, to form the window opening (See Diagram 8 & 9).

STEP 3 ADD THE CALIFORNIA CORNERS (D11 & D4–D10)

On both ends of each 11 ft. straight wall section, add a California corner. This is done by placing a 2x4 at right angles to the outside stud. Nail into the 11 ft. plate at both ends and to the outside stud in at least three places (See Diagram 11 or Diagrams 4 through Diagram 10 — shaded areas indicate California corners). **When the walls are raised, the California corners must be flush to the inside of the house.**

STEP 4 BUILD THREE RAKE WALLS (D12-D17)

Consult with the family regarding the placement of any doors (especially the interior rake wall doorway) or windows in the rake walls and then refer to Steps 2b and 2c. Start with a 10 ft. 5 in. 2x4, a 10 ft. 5 5/8 in. 2x4, an 8 footer, and a 7 footer. The 10 ft. 5 5/8 in. board will be the top plate of the wall and the 10 ft. 5 in. will be the bottom plate. Nail these together (Diagram 12 – 17).Square the two bottom corners and nail a block diagonally across each to keep it square. Make marks every 2 ft. on the 10 ft. 5 in. side, as you did for the 11 ft. walls. Select one very straight 8 ft. 2x4 and place one end on each mark in turn. Square this board with the bottom plate, than mark it at the top plate to indicate where the stud should be nailed. Then measure the distance between top and bottom and cut a different board to fit. Keep the straight board for measuring each stud. Repeat to build two more walls. **Rake walls do not need California corners.**

STEP 5 ADD FIRE BLOCKS TO THE WALLS (D4–D17)

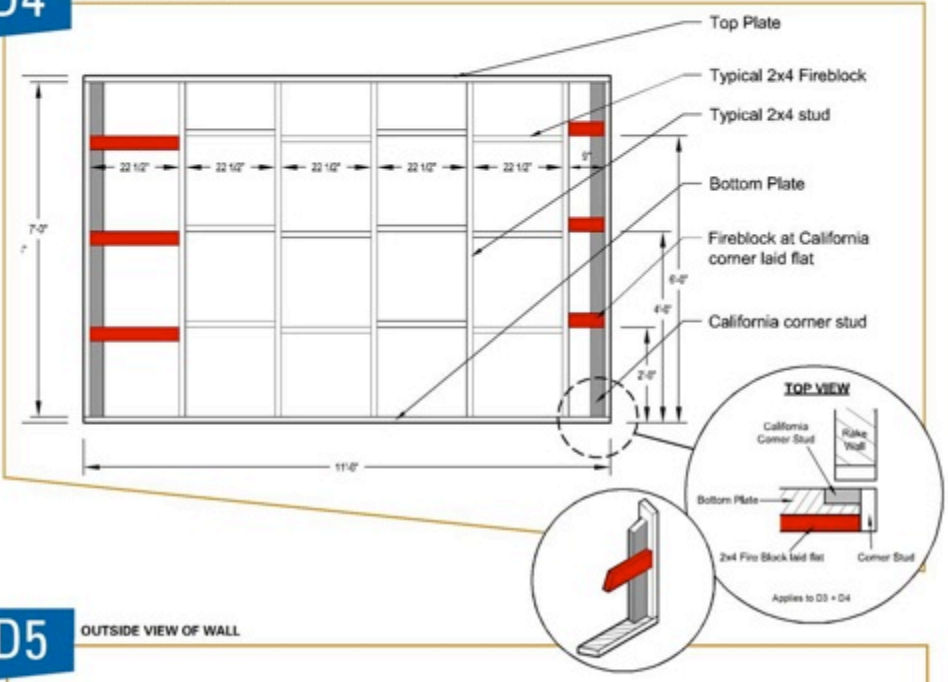
Fire blocks are necessary to make the house more rigid, and to provide a place to nail the outer covering of the house to the walls. Put three fire blocks between every two studs in every wall, **except for the interior (center) rake wall**. The fire blocks should be spaced 2 ft. apart and staggered slightly for easier nailing. Mark at the 2 ft., 4 ft., 6 ft. levels, and alternate nailing the fire blocks on the top or bottom of the line giving a staggered difference of 1¾ in. on each block (See Diagram 4-10). **Do not allow fire blocks that are too long to bulge end wall studs or door and window openings. Also, there are two exceptions where four fire blocks are needed (See Diagrams 12 & 16).**

STEP 6 BUILD THE ROOF SECTIONS (D18)

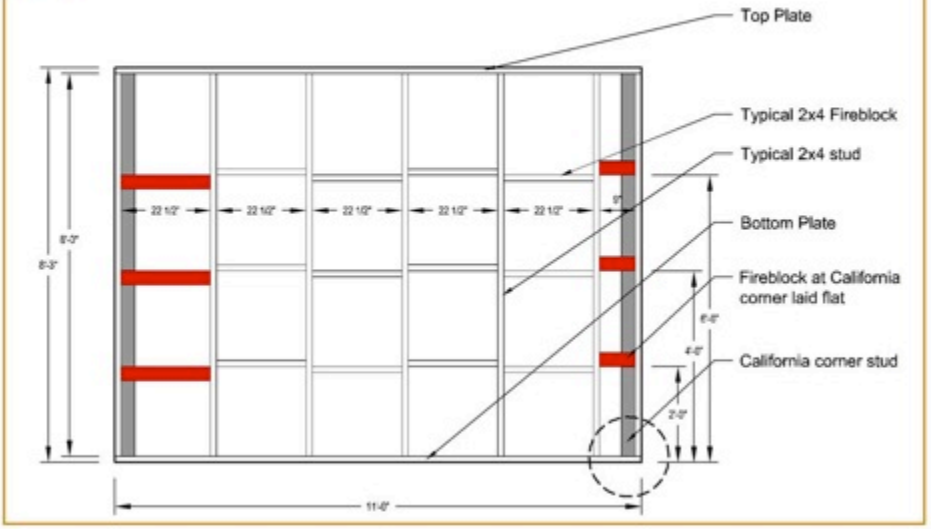
Take the 18 12 ft. 2x4s that were laid aside earlier and cut 14 boards to 11 ft. 9 in. Make sure the remaining four 2x4s are exactly 12 ft. If you have less than 18 of the 12 ft. boards or if all were cut to 11 ft. 9 in. in error, consult your Amor Team Member. Take two of the 12 ft. 2x4s and place them face-to-face on edge, flush on both ends. Measuring from one end, make a mark every 2 ft. on both 12 ft. boards. **Nail an 11 ft. 9 in. 2x4 CENTERED on each mark. This is different than the walls, and is absolutely crucial if the plywood is to fit the roof well.** Finally, nail three 21¾ in. 2x4s between the first and second rafters, spaced 3 ft. apart on one end only of each roof square. These are called outriggers and are for the support of the outside rafter. No fire blocks are needed on the roof, only bird blocks (Phase Two-B, Step 5) and outriggers. Build two identical sections at these specifications (See Diagram 18). Bird blocks may be pre-measured, pre-cut and numbered to each opening to speed up later assembly. **Do not install bird blocks until the roof sections have been placed on the walls, squared, and nailed down.**

NOTES

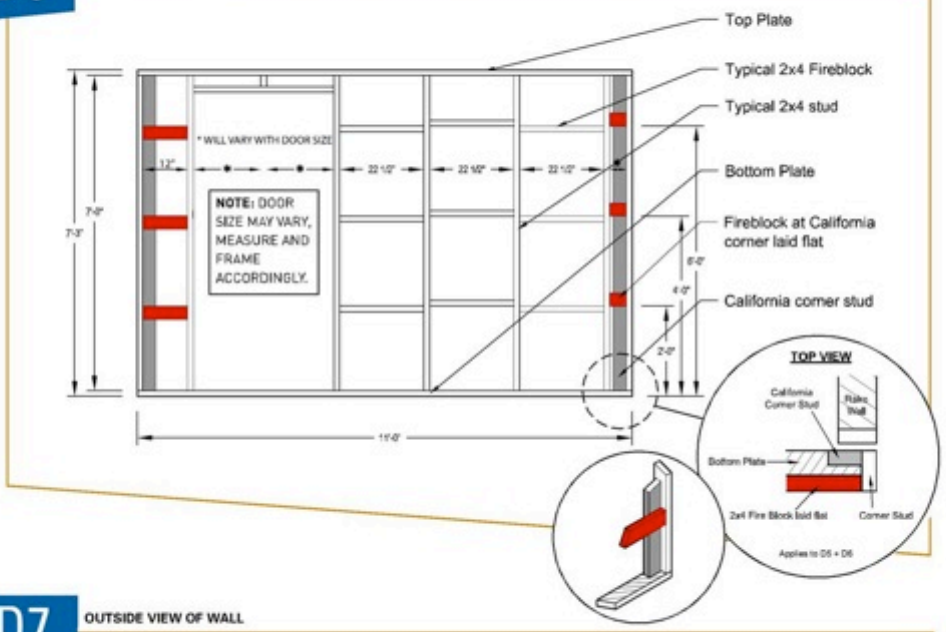
D4 OUTSIDE VIEW OF WALL



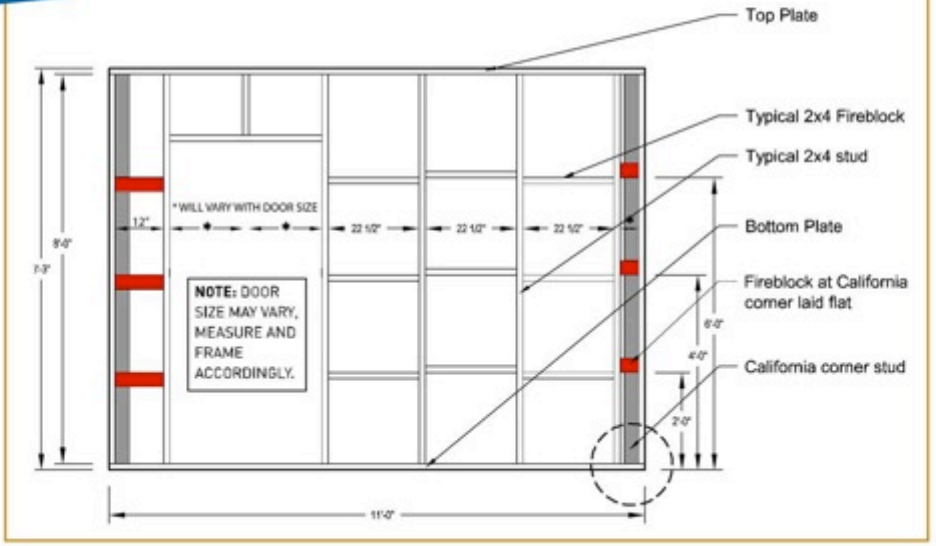
D5 OUTSIDE VIEW OF WALL



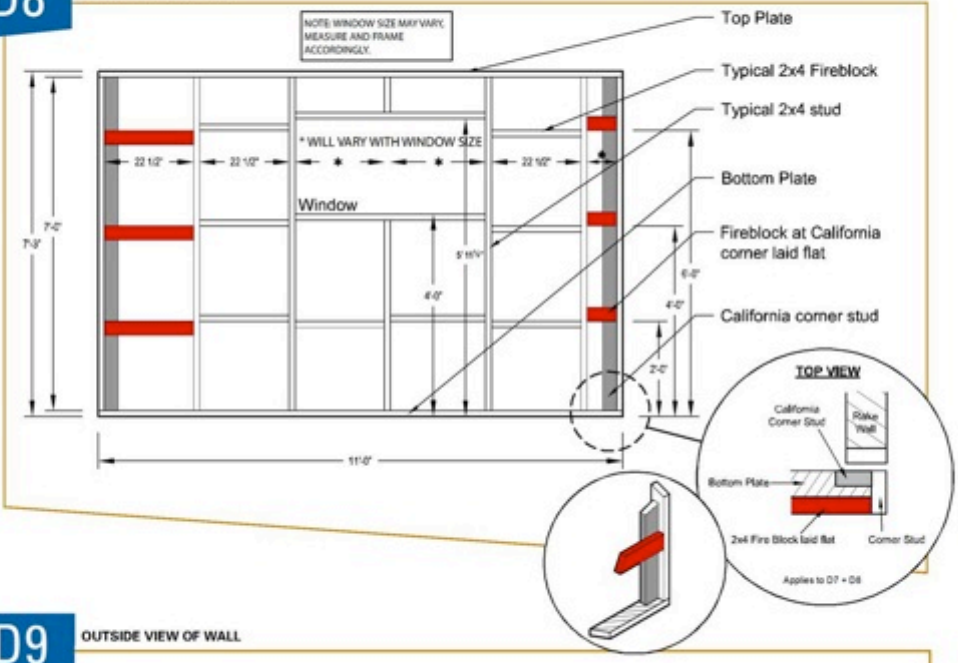
D6 OUTSIDE VIEW OF WALL



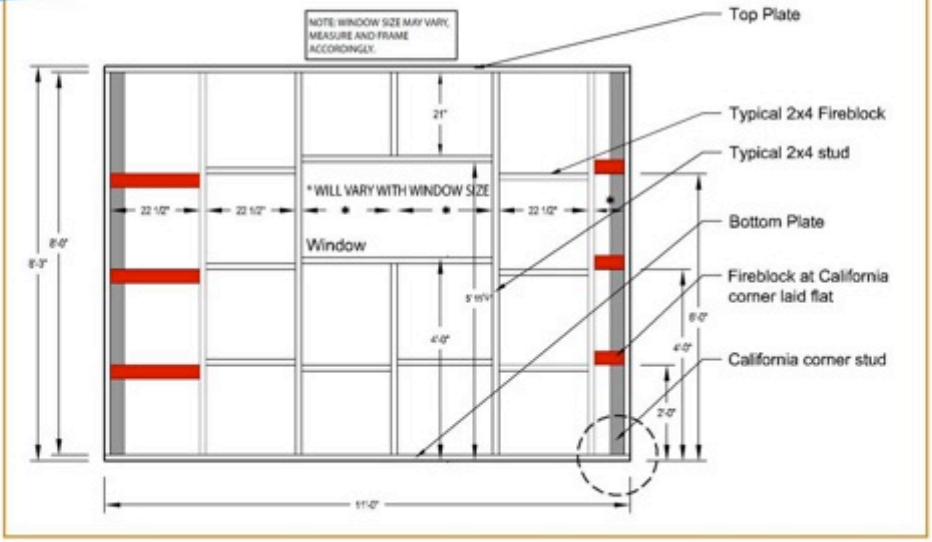
D7 OUTSIDE VIEW OF WALL



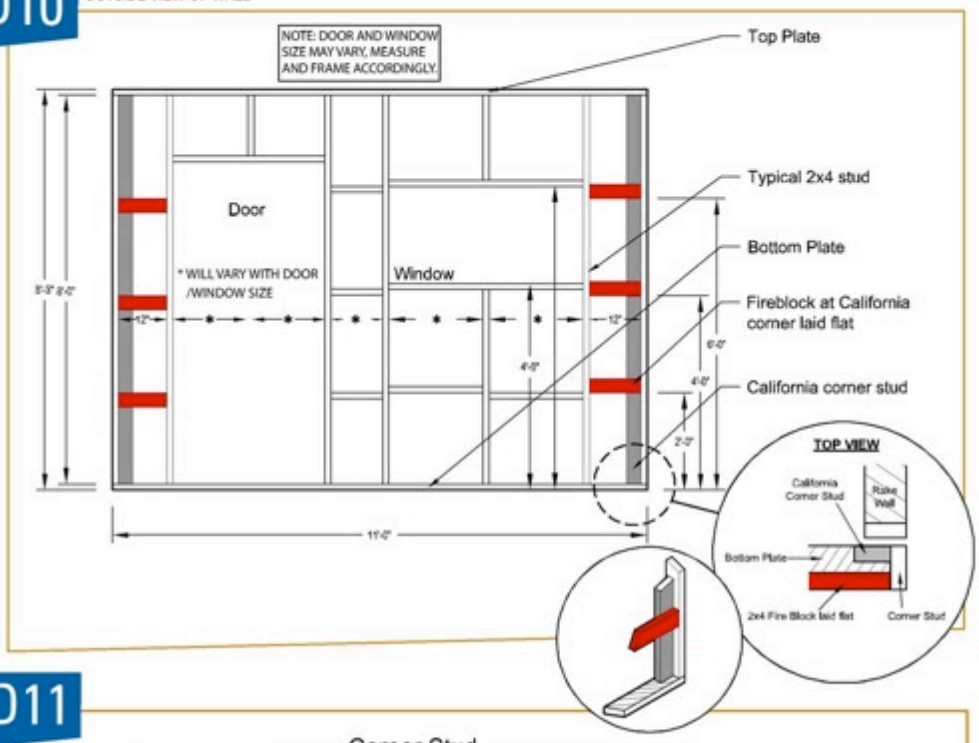
D8 OUTSIDE VIEW OF WALL



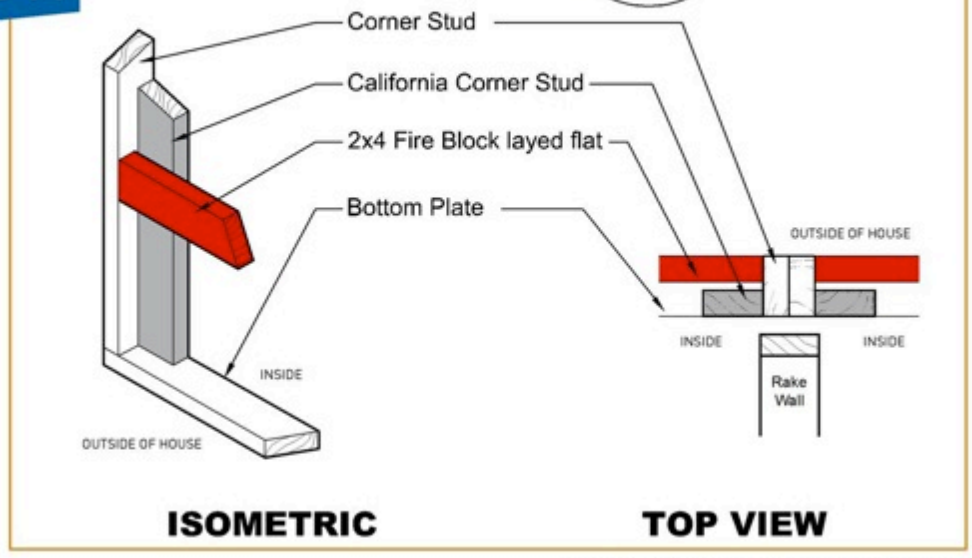
D9 OUTSIDE VIEW OF WALL



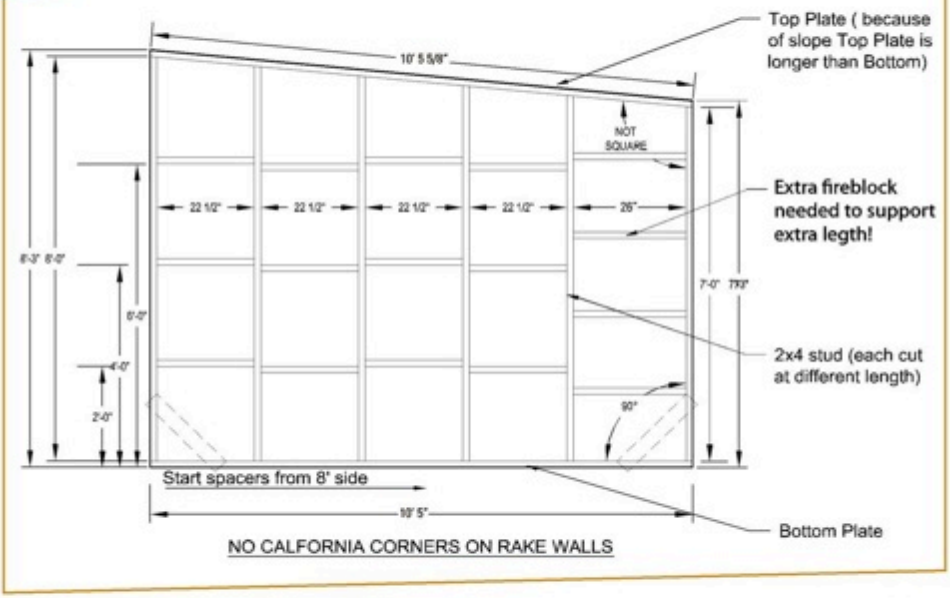
D10 OUTSIDE VIEW OF WALL



D11

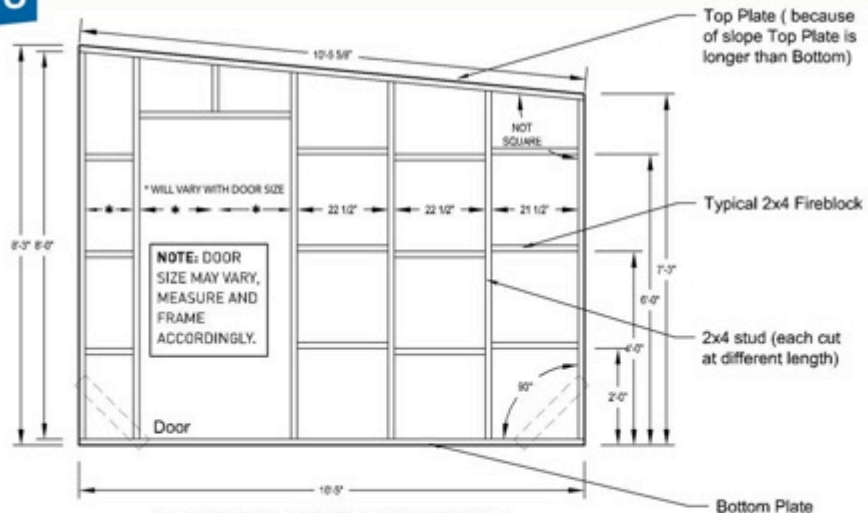


D12



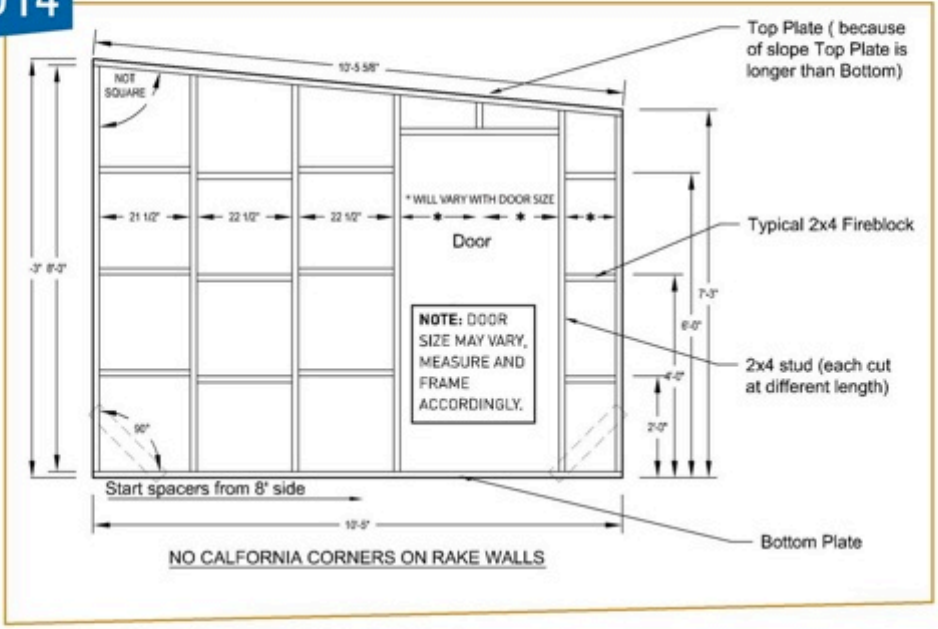
NO CALFORNIA CORNERS ON RAKE WALLS

D13

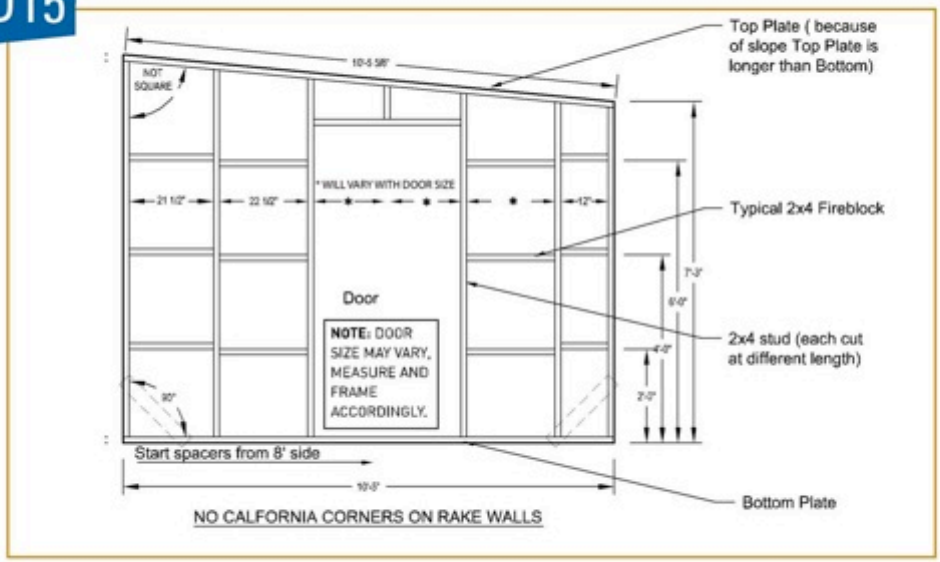


NO CALFORNIA CORNERS ON RAKE WALLS

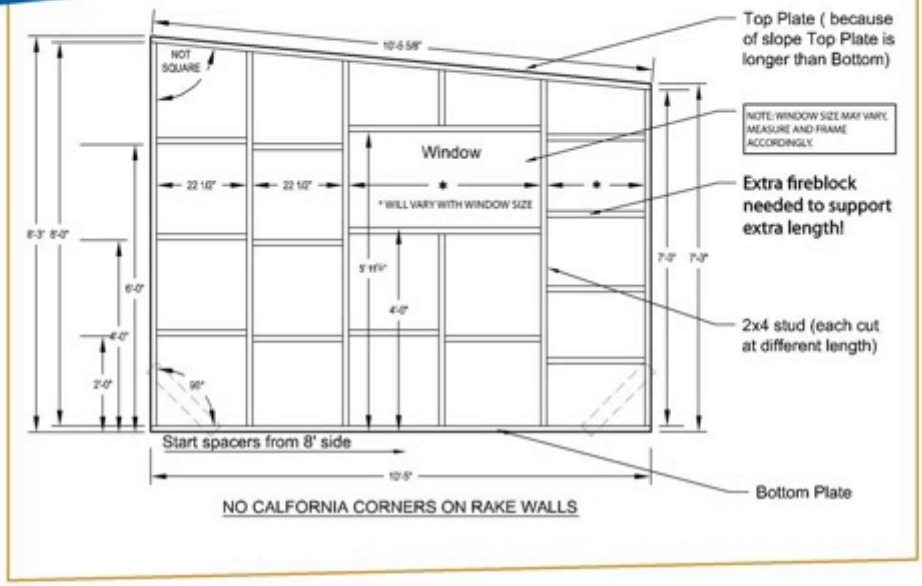
D14


Top Plate (because of slope Top Plate is longer than Bottom)
10'-5 5/8"
NOT SQUARE
* WILL VARY WITH DOOR SIZE
21 1/2"
22 1/2"
22 1/2"
Door
NOTE: DOOR SIZE MAY VARY, MEASURE AND FRAME ACCORDINGLY.
Typical 2x4 Fireblock
2x4 stud (each cut at different length)
7'-3"
6'-0"
4'-0"
2'-0"
90°
Start spacers from 8' side
10'-5"
Bottom Plate
NO CALFORNIA CORNERS ON RAKE WALLS

D15

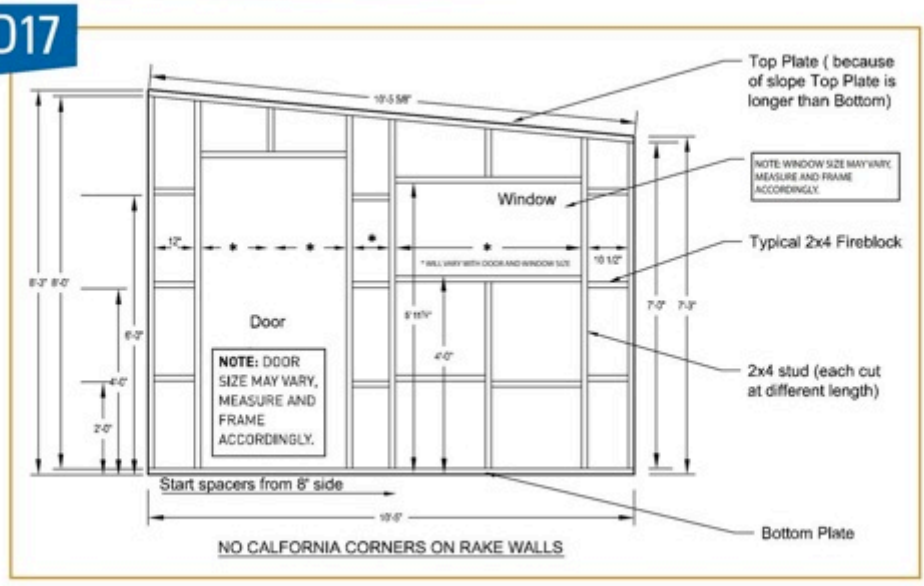

Top Plate (because of slope Top Plate is longer than Bottom)
10'-5 5/8"
NOT SQUARE
* WILL VARY WITH DOOR SIZE
21 1/2"
22 1/2"
12"
Door
NOTE: DOOR SIZE MAY VARY, MEASURE AND FRAME ACCORDINGLY.
Typical 2x4 Fireblock
2x4 stud (each cut at different length)
7'-3"
6'-0"
4'-0"
2'-0"
90°
Start spacers from 8' side
10'-5"
Bottom Plate
NO CALFORNIA CORNERS ON RAKE WALLS

D16



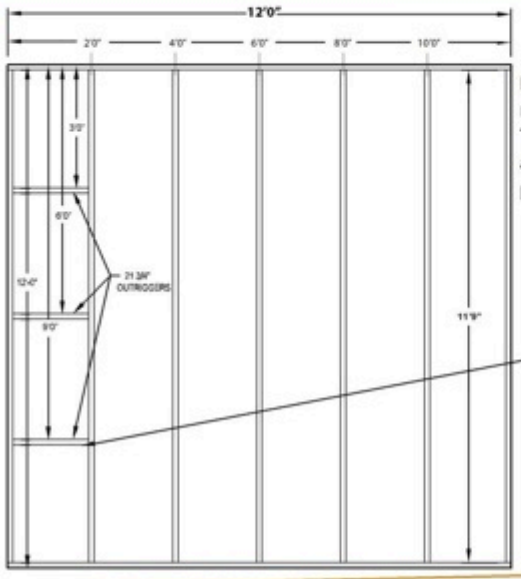
NO CALFORNIA CORNERS ON RAKE WALLS

D17



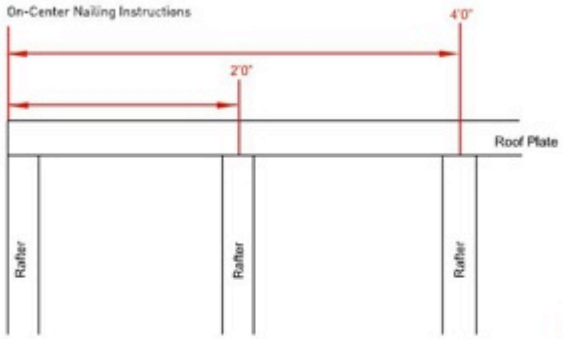
NO CALFORNIA CORNERS ON RAKE WALLS

D18



Nail an 11ft. 9 in. two-by-four rafter centered on each mark. This is different than the walls, and is absolutely crucial if the plywood is to fit the roof well.

Typical Outrigger



STEP 7 ENDING AT PHASE TWO-A

If stopping here, stack the finished walls on the slab and secure all remaining materials with the family.

PHASE TWO-B

YOU WILL NEED:

- ❑ 11 – 10 ft. one-by-fours
- ❑ 9 – 4 ft. x 8 ft. sheets of plywood
- ❑ 4 rolls – Black felt paper
- ❑ 4 rolls – Sand and tar roofing paper
- ❑ ½ box – 1½ in. roofing nails
- ❑ ¼ box – 8-penny nails
- ❑ 2 rolls – Bailing wire
- ❑ 2 rolls – Chicken wire
- ❑ 1 gal – Cold tar & brush
- ❑ 100 – 16-penny nails
- ❑ 16 – 8 in. two-by-fours
- ❑ 8 – Hurricane Straps

STEP 1 STANDING UP THE WALLS

To ensure that the walls will be straight, you can make straight lines on the slab with a chalk line. Go to each corner of the foundation. Mark 3½ in. in from the outside edge of the slab in both directions. Use the marks to snap chalk lines around the slab. Take one of the 11 ft. walls and stand it on the slab along the 22 ft. chalk line. Consult your floor plan again to make sure it is in the correct position. **The California corners should be on the inside of the house.** Line up the end of the wall with the outside edge of the foundation. **Do not nail any anchors until all walls are in place.** The next wall to stand is an end rake wall. This will also be lined up with the chalk line, and between the inside edges of the 11 ft. walls (See Diagram 4, TOP VIEW). This is why the rake walls are built with a 10 ft. 5 in. bottom plate, so that it will fit between the 11 ft. walls. Stand the rake wall and nail it to the first wall, using two 16-penny nails (side-by-side) every 2 ft. Make sure to nail into studs whenever possible, as well as California corners. Stand and nail the rest of the walls. Be certain that the interior center wall is in place prior to getting all of the outside walls stood. Nail the center rake wall so that it is centered on the joint where two 11 ft. walls meet (See Diagram 11, TOP VIEW).

STEP 2 NAIL IN THE MUD SILL ANCHORS

Once all walls are up, finish centering the structure on the slab. When the final position is assured, fold the mud sill anchors over the plates and nail them in with **8-penny nails. CAUTION! Anchors can have sharp edges.** Except for the threshold, drive a few 16-penny nails through the bottom plate in to the slab to secure the rake wall to the floor.

STEP 3 PLUMB AND BRACE ALL WALLS

To plumb a wall, place a level vertically on the outside of the wall at a corner and check to see if it is straight. With the bottom of the wall secured, move the top of the wall back and forth until it is plumb. Brace the wall by nailing an 8 ft. 2x4 from the corner stud

NOTES

to the bottom plate diagonally across the **inside of the wall**. Do this on all seven walls. **It is essential for safety. Double check window and door openings for accuracy.**

STEP 4 DOOR INSTALLATION

Determine which way the homeowner would like the door to swing and pre-hang the door on a 1x4 or 2x4 hinge plate depending on your door opening with the pins on top. Cut out the bottom plate. Center the door in the rough opening and nail the stud directly to the adjacent stud in the rough opening using only a couple of 16-penny nails. Check the full swing of the door and be sure there is ¼ in. of clearance all the way around. If the door swings properly finish the installation by installing the lock set. **Do not install 1x4 trim until step 17!**

STEP 5 PLACE THE ROOF SECTIONS ON TOP OF THE WALLS (D19)

The outriggers rest over the outside rake walls. Once the two sections are resting on top, nail them only to each other so that they are even. Center this joint above the middle rake wall. Leave an equal overhang on the 22 ft. sides of the house. Use a string line or a good eye to make sure your roof line is straight, and don't trust the top of the wall to be straight! Nail the high side of each rafter into the top plate of the wall in both directions (toenail), using two 16-penny nails per rafter. Finish squaring the roof by cross-measuring before nailing down the low side of the roof. When the roof is square, nail the outriggers and the low side of each rafter to the house in the same manner. If you do not have 30 ft. tape measures, measure from the top outside corners to the furthest rafter on the opposite edge. **The roof should not be more than ½ in. out of square.**

Locate all 8 hurricane srtaps in your materials. The straps are installed inside the house with 8-penny nails. A single house has two roof panels. The hurricane straps should be placed in all four corners of each roof panel (See Diagram 19).

STEP 6 PLACE BIRD-BLOCKS ON THE ROOF (D20)

Nail blocks between each of the roof rafters and each of the outriggers directly over the top of the wall **flush with the outside of the wall** (See Diagram 20). This is to prevent wind and birds from getting into the house after the plywood is on the roof.

This step must be well under way before starting Step 7. **The blocks are much harder to add after the plywood is on.** Since only a few people will be working on bird blocks, this is a great time for the rest of the crew to make tar squares (Step 14) and to start the bailing wire process (Step 11).

STEP 7 POSITION THE PLYWOOD ON THE ROOF (D21)

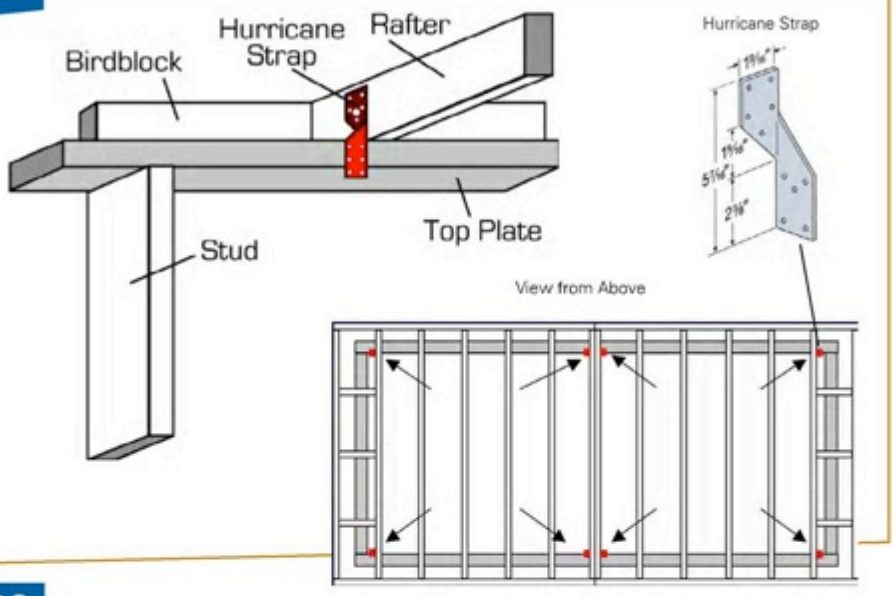
Stagger the plywood on the roof (Diagram 21). The ends of each sheet should meet together in the middle of a rafter. Cut a sheet of plywood in half for the ends of the middle row (Place cut edge out). **Pre-nail the corners of the plywood leaving the nail sticking up ¼ in. Do not completely sink any nails until the three rows of plywood are installed.** This allows warped rafters to be adjusted as each row falls into place. Nail four 8-penny nails in each **rafter** per sheet. **Never have more than 1000 lbs. or five people on the roof, and avoid standing in a group.**

It helps to use a chalk line when laying plywood. This ensures that the plywood will fit the roof squarely. Make chalk lines horizontally across the rafters at four and eight feet (the long horizontal lines in Diagram 21).

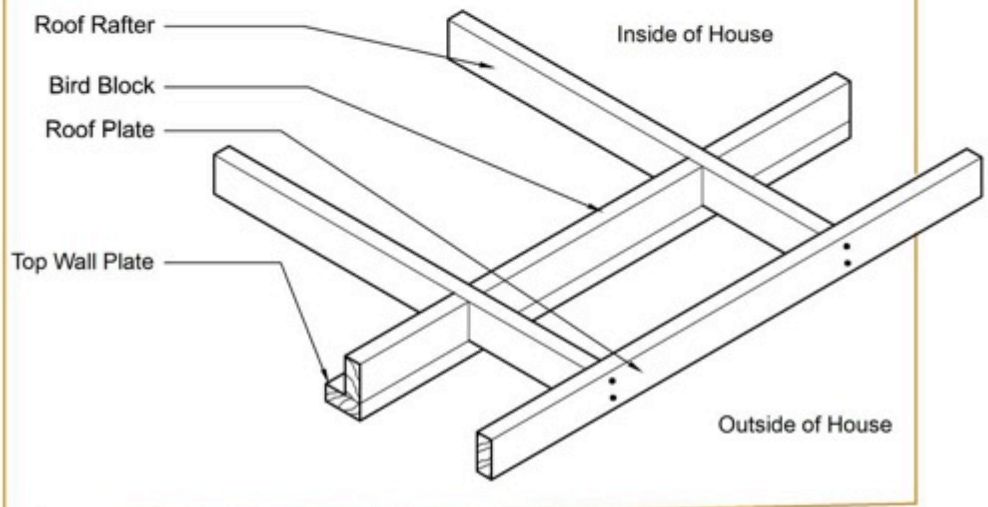
If plywood sheets don't meet on a rafter, it is often because of warped rafters. You should correct the rafter, straightening it while your partner nails. In cases where this is not enough, you should measure and cut a second rafter to be nailed adjacent to the rafter in question. This should also be done to rafters which are split or have knots.

NOTES

D19


Hurricane Strap
Rafter
Birdblock
Hurricane Strap
Top Plate
Stud
Hurricane Strap
View from Above

D20


Roof Rafter
Bird Block
Roof Plate
Top Wall Plate
Inside of House
Outside of House

STEP 8 LAY THE FELT PAPER ON THE ROOF (D22)

After the plywood is securely nailed down, lay the black felt paper on the roof. Begin on the low side of the roof. Allow no more than 3 in. of paper to overhang each edge of the roof. Anything longer than 3 in. will need to be trimmed later. Once the row is straight and as flat as possible, nail the overhang down every one foot along the outside edges of the roof frame and every 2 ft. into a rafter along the top edge of the paper, using the 1 ½ in. roofing nails. **Do not nail the overhang through the plywood but rather through the side of the 2x4 roof frame** (Diagram 22). The next row overlaps the first by 3 in. On some rows, the paper roll will run out before the row is completed. Simply continue with a new roll and overlap the old section by 1 ft.

If you think you are behind you can do this step at any other point of the building process – even while you are stuccoing.

STEP 9 LAY THE ROLLED SAND-AND-TAR ROOFING PAPER ON THE ROOF (D23)

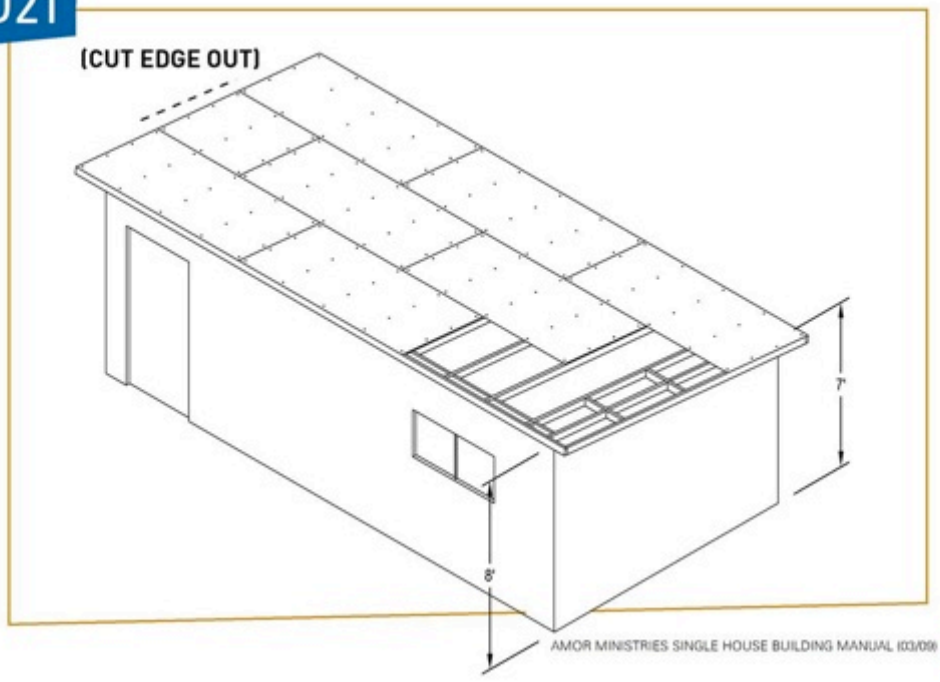
Follow the same pattern used for the felt, but nail the lower edge of the first row of paper every 1 ft. on the outside edges of the roof frame and the top edge every 2 ft. Make sure there are no waves or bubbles in the roofing paper, or else water will build up on the roof and cause leaks. Roofing paper has a lot of sand glued to the front. It's easiest to cut from the back of the paper. Carefully drive the nails with a smooth face hammer so they don't rip the paper. Unlike the felt paper, the sand and tar paper requires some cold tar. After laying down each row, tar the top 2 in. of the paper so that the next row will cover it. Use a stick to pull the tar out of the can. A brush is provided to smooth out the tar. Nail along the tar line overlap every **2-3** in. **Make sure to use an unbroken roll of paper on each row.**

STEP 10 TRIM THE ROOF EDGE

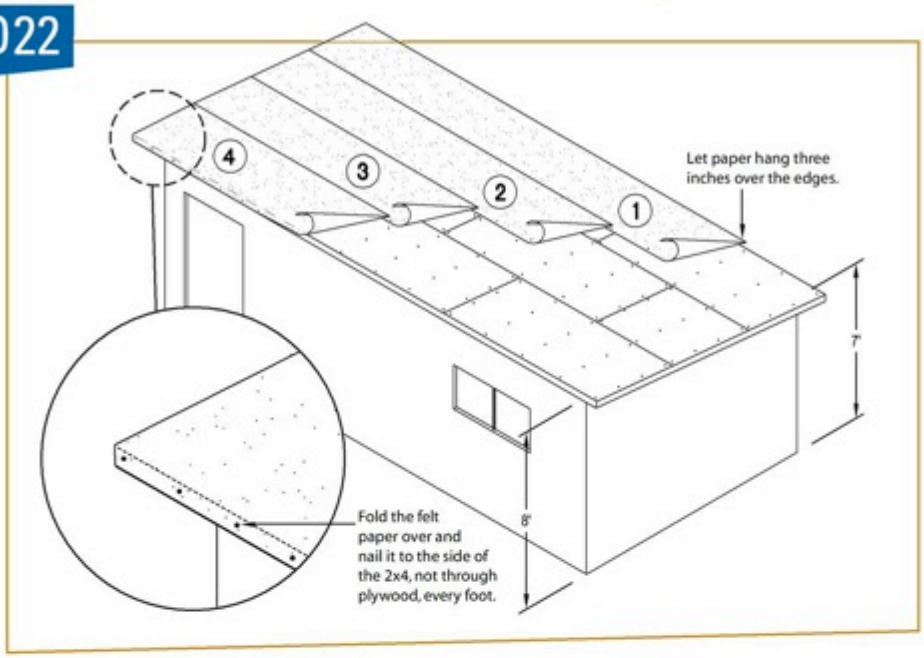
Overlap the 1x4 so it meets flush at the corners of the roof. Take the 1x4 boards and nail them with 8-penny nails, two nails every two feet, around the face of the roof edge, covering the overlap of paper. Flush the 1x4 with the bottom of the outside rafter. This will prevent the paper from being weathered off the edges of the roof. Use smooth face hammers! Cut off any paper which protrudes beneath the 1x4.

After the roof is trimmed and everyone is off the roof, tar the nail heads on the roofing paper with the extra tar.

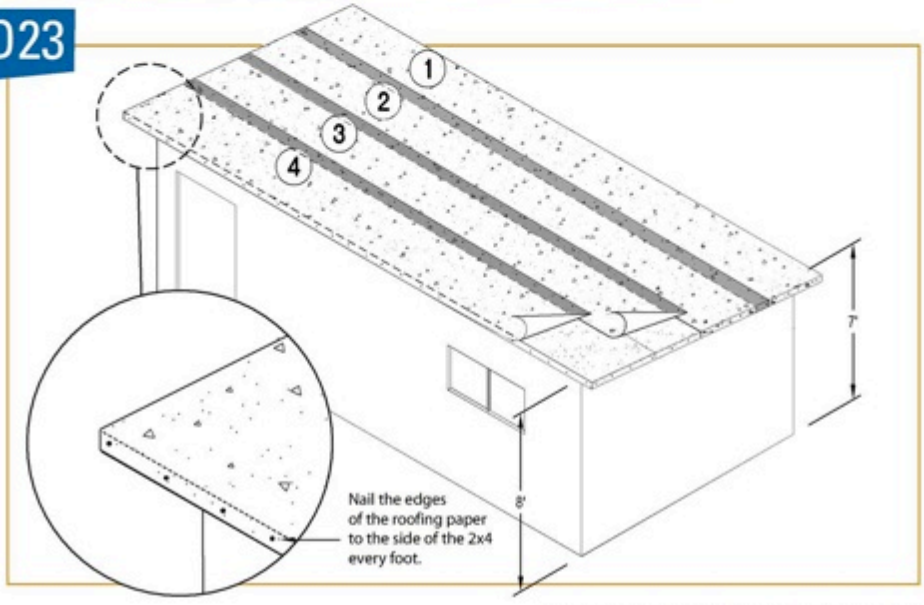
D21



D22


4
3
2
1
Let paper hang three inches over the edges.
7'
8'
Fold the felt paper over and nail it to the side of the 2x4, not through plywood, every foot.

D23


1
2
3
4
7'
8'
Nail the edges of the roofing paper to the side of the 2x4 every foot.

STEP 11 PREPARE BAILING WIRE

Bailing wire is needed as backing for the felt paper on the walls. Using roofing nails drive the nails in halfway to allow the wire to be wrapped around them. **The nails should be placed vertically in a line, 5 in. apart, on the end studs of every exterior wall section (six sections total) and vertically on the sides of window and door openings.** Do not wire across door or window openings. Wire should be strung tightly, and as free of kinks and bends as possible.

This step definitely calls for obeying the spirit of the technique, not the letter. What you're trying to achieve is a wall covered with wire with **no vertical gaps greater than 5 in.** This step can be done before the walls are stood, however, do not tighten (Step 12) the bailing wire until the wall section is plumbed and braced.

STEP 12 TIGHTEN THE BAILING WIRE (D24)

Tighten the wire by pulling up, close to the stud, on each wire and nail the wire into place. Move to the first stud which has not been nailed. Tighten the wire by pulling up on each wire that crosses the stud and nail the wire into place. Go to the next stud and push down on each wire and nail. Alternate this pattern until you reach the end of the wall. Do not overstretch the wire, and do not pull with hammers (See Diagram 24).

STEP 13 MAKING THE TAR SQUARES

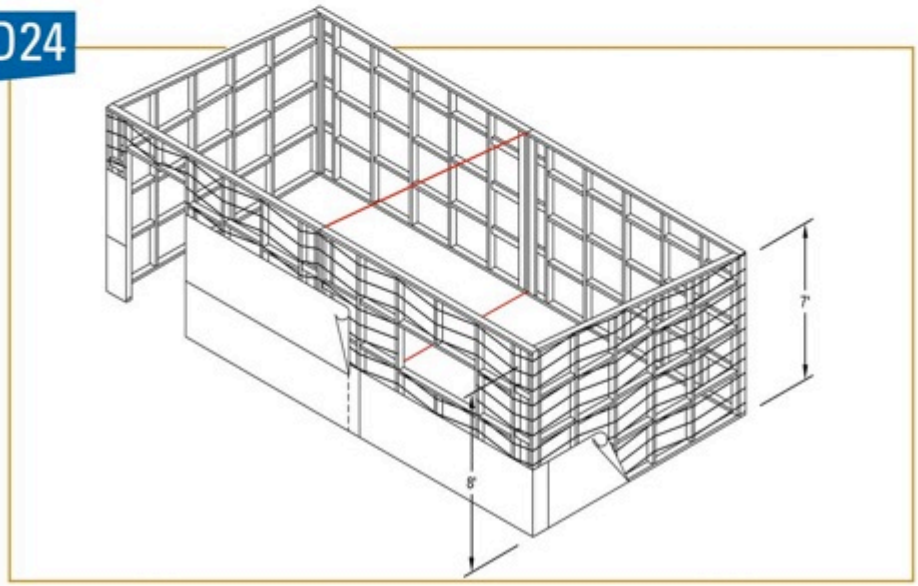
Your group does not need to make or use tar squares unless you believe wind might blow the tar paper off, or if you plan to leave the paper up overnight without installing chicken wire. Plain roofing nails or a staple gun can be used instead of tar squares.

Tar squares are made from narrow strips of black felt paper and roofing nails and will be used later to secure the felt paper to the outside of the walls. Cut a strip of felt paper about 1 in. wide. Fold it over itself twice so that you have a 1 in. square of felt paper three layers thick and push the tip of a roofing nail through the center of it. This is known as a tar square and you will need about one full bucket.

STEP 14 PUT FELT PAPER ON THE WALLS (D24)

An easy method of applying felt paper is to pre-cut 18 11 ft. 6 in. pieces. **Start on the bottom and work your way up. Be sure to cover the top and bottom plates.** Align one of the precut pieces with the lower edge of the bottom plate and run it full length. Make sure there are no bubbles or rips and nail with tar squares, one per foot on each stud. Overlap the bottom row by NO MORE THAN 3 IN. with the next row up. Nail each row the same way. If the paper has guidelines or other ink on one side, be sure to place that side facing the outside of the house, as the inside of the walls may not be finished. Three rows of paper should cover a wall. On the rake walls, hang the top piece of felt paper at an angle, flush

D24



with upper edge of the top plate. If you do each wall separately, be sure one-side wraps around the corner to avoid open seams.

It helps to nail the top edge of a row of paper first, and let gravity help you with the rest as you nail across the middle and bottom of the paper. Cut paper flush from window and door openings.

You can repair holes in the paper quite easily. Just slip a scrap piece of tar paper behind the hole, between the paper and the bailing wire. Some teams prefer duct tape and bring their own.

Loose bailing wire can leave deep pockets in the felt paper for stucco. Rolled scraps of felt paper can be worked into slack areas between bailing wire and paper to push out bubbles for flatter stucco surface.

STEP 15 STRETCHING THE CHICKEN WIRE (D25)

Two rows of chicken wire will cover every wall section. The wire should be as tight as possible, with no bubbles, or gaps larger than a normal (hexagonal) chicken wire hole.

This is the most efficient method we have found for stretching chicken wire:

Prepare the top and bottom of all the walls with a row of roofing nails in the top and bottom plates, 6 in. apart; leave the nail heads sticking out ¼ in.

Beginning in the doorway leaving 1 ft. of extra material, wrap the house with one continuous piece ending at the same doorway with the same amount of extra material. Tightly (be sure it's straight too) hook the bottom (double-strand) wire to the nails and finish the nails in the bottom plate all the way around the house. The wire will be sagging off the house. Do not worry.

Go to the four corners of the house and stretch the wire up the wall as far as possible and nail it. Once the corners have been stretched, move onto the door opening. Stretch the wire in the same way and finish nailing the door frame every 4 in.

Now, working your way from stud to stud, starting in the middle of each wall section, estimate the distance you can stretch the wire. Place a nail in the stud, ¼ in. exposed, then stretch the wire and hook the top (double-strand) wire onto the nail. Finish the nail off before moving to the next stud. You will find bubbles under a stretched stud can be removed when stretching at the next stud. After the entire wall is stretched, add nails, one every foot vertically on each stud, and two nails on each fire block.

With a new roll of wire, in the same way hang the second row of chicken wire from the top plate, beginning in the middle of the door. Leave enough extra material to overlap the seam at the door. Follow the same procedure as before in stretching the wire down the wall. Before cutting the wire out of the doorways and windows, thoroughly nail chicken wire every 4 in. around openings to maintain the tension in the wire.

If you still have bubbles in the chicken wire after your best stretching efforts ask an Amor Team Member for guidance.

STEP 16 WINDOW INSTALLATION

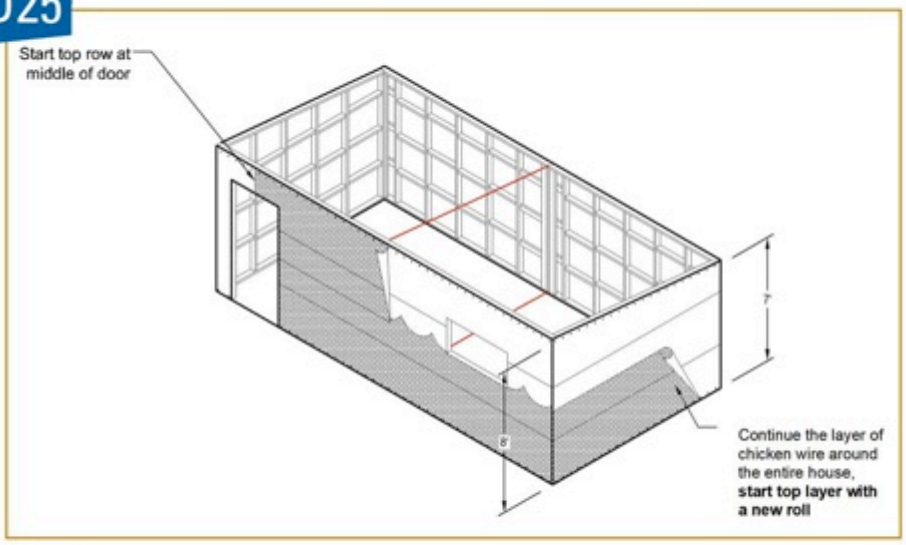
Be sure to check and see that the window is placed right side up with the latch locking down and on the inside. Then slide the window into place from the outside of the house. Finally, nail the window into place with the short, green 8-penny nails; drive the nails through the flange and into the studs that frame the rough opening. Be sure to remove the sliding portion of the window while you do this. You may find that it's hard to drive the nail all the way in due to the way the window is built. Take a 16-penny nail and turn it upside down to be used as a nail punch.

STEP 17 TRIM THE DOOR (D26)

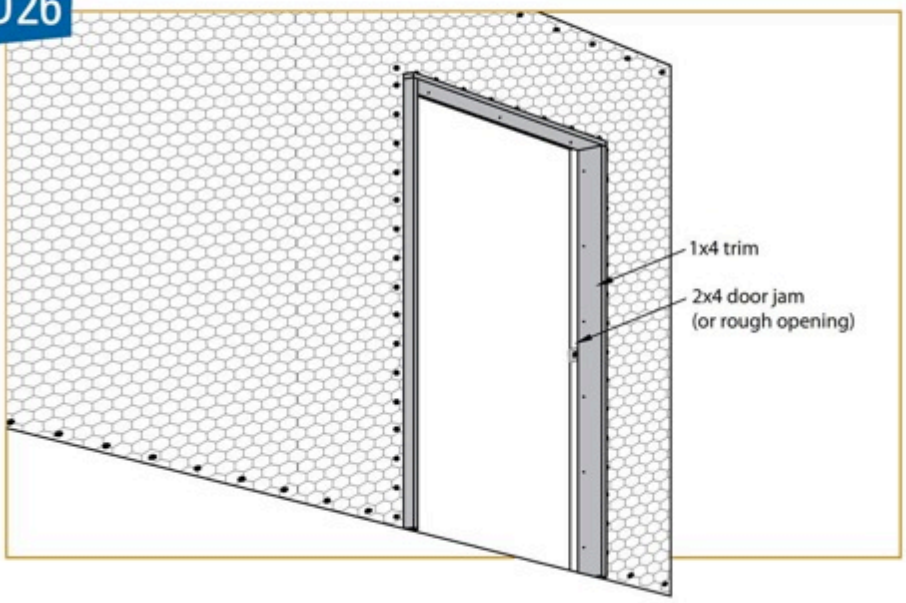
The 1x4 acts as a doorstop. Using 8-penny nails, surround the inside of the door jam with 1x4 trim. This will also act as a place for the stucco to end at the door. Cut and fit the 1x4 such that it slides sideways into the door jamb, the 1 in. side butting up against the door (See Diagram 26). Use a smooth face hammer when nailing the trim.

NOTES

D25


Start top row at middle of door
7'
6'
Continue the layer of chicken wire around the entire house, **start top layer with a new roll**

D26


1x4 trim
2x4 door jam
(or rough opening)

YOU WILL NEED:

- ❑ 7 – 42.7 kg. Bags of cement (first coat) or 6 – 50 kg. Bags
- ❑ 6 – 42.7 kg. Bags of cement (second coat) or 5 50 kg. Bags
- ❑ 2 – Barrels of water (minimum)
- ❑ Remaining sifted sand

STEP 1 SIFT THE SAND

Using a screen, sift the rocks out of the remaining sand.

Even if you built the house yourself, this is a good time to perform a final check of the walls. Remove any chicken-wire bubbles (See Two-B, Step 13), check for thorough nailing of each stud and fire block, and repair any tar paper (See Two-B, Step 12) or bailing wire problems before you start stuccoing.

STEP 2 MIX SAND AND CEMENT

14 (16 if you have 50 kg. bags of cement) round shovels of sifted sand with ½ bag of cement. Mix sand and cement dry before adding water. Add water to the mixture until it reaches the consistency of mashed potatoes. Rocks are bad!

STEP 3 APPLY THE FIRST COAT OF STUCCO

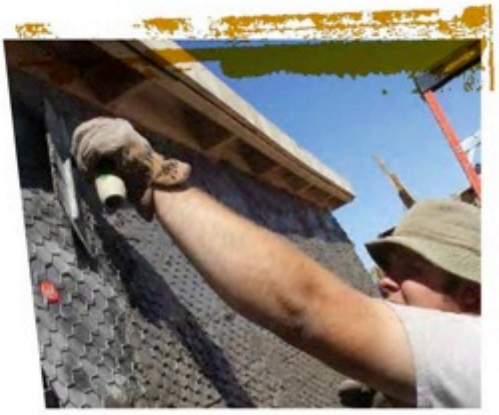
Beginning at the bottom of a wall, use a trowel or stucco hawk to put stucco on the wall, always working in an upward direction. Make sure that the finish is grooved or rough so the second coat of stucco has something to hold on to. Cover the walls completely, bottom to top, but allow the chicken wire to show overall on the first coat. Start on the shady side of the house at one corner and work around the house. By the time you get around the house, the first coat should be dry enough to begin the second.

STEP 4 APPLY THE SECOND COAT OF STUCCO

Apply a second coat when the first is completely dry and has begun to change color. If the first coat of succo dried overnight, wet the first coat down before you begin the second coat. This will prevent the second coat from drying before you can spread it properly. The mix for the second coat is just a little bit more cement-rich (a consistency like frosting): about 12 (14 if you have 50 kg. bags of cement) round shovels of sand to ½ bag of cement. The second coat will be smooth, with no wire showing. Finish with wood or metal trowels.

Automotive sponges, rubber gloves, and high-volume spray bottles are handy finishing tools.

NOTES



Tool Inventory

- When finished with your rental tools each group should…

1. Empty out your tool bin COMPLETELY (please no trash, loose nails, etc.)
2. Clean ALL tools! Ladders, Mixing Bins, Wheelbarrows, Cement Tools)
3. Inventory ALL your tools on this sheet and tell us what is missing.
4. Place the inventory sheet inside the tool bin, on top of the small tools.
5. Groups renting only large tools should tape the list to a Wheelbarrow

Date Delivered_____Large All Box #_____Staff_ _____

Large Tools	You Should Have	Items You are Missing
Wheel barrows	2	
Mixing Tubs, Large	3	
Five-Gallon Buckets	5	
Shovels, Round	6	
Shovels, Square	2	
Hoes	6	
Rakes	2	
Picks	2	
Ladders	2	
Sand Sifter	1	
4' Level	1	
Group Name _____ Family Name _____ Project ID# _____		

Small Tools	You Should Have	Items You Are Missing
Saws	6	
Hammers	15	
Pry Bars	1	
Utility Knives	4	
Wire Snips	4	
Tape Measurers	6	
Squares, Large	1	
Squares, Speed/Tri	4	
Chalk Lines	1	
Nail Pullers	1	
Trowels	10	
Pencils	5	
Clamps	2	
Wire Brush	1	
WD40	1	
Hand Sledge	1	
Wood Chisel	1	
Phillips Screw Driver	1	
Hawks	10	
2' Level	1	

Herramientas Grande	Deben	Faltar
Carretillas	2	
Cajas para mezclar	3	
Cubetas	5	
Palas redondo	6	
Palas cuadrada	2	
Azadones	6	
Rastillos	2	
Pico	2	
Escaleras	2	
Cernidor	1	
Nivel de 4'	1	
Group Name _____ Family Name _____ Project ID# _____		

Herramientas Pequeña	Deben	Faltar
Serruchos	6	
Martillos	15	
Barreta	1	
Navajas	4	
Corte de Alambre	4	
Flexómetros	6	
Escuadras, Grande	1	
Escuadras, Chica	4	
Hilo de Chalk	1	
Pata de Chiva	1	
Llanas	10	
Lapis	5	
Sargentos rápido	2	
Cepillo de Alambre	1	
WD40	1	
Marro	1	
Formones	1	
Desarmador	1	
Charolas con Mango	10	
Nivel de 2'	1	

APPENDIX B

SAMPLE VOLUNTEER SURVEY

VOLUNTEER SURVEY PHASE 1

This survey serves a dual purpose. It was created by Diedrich Prigge V to aid in research dealing with volunteer workforces and will be used in his Doctorate thesis at Arizona State University. The results will help determine strategies and techniques needed to help in the overall volunteer experience while maximizing productivity of the workforce. This research and results will be available to help non-profits, disaster relief efforts, and various other users of volunteer workforces. Your honest feedback is greatly appreciated. **There are no wrong answers.**

1. Gender
   - ☐ Male Female
2. Age
   - ☐ 12 & Under 13-19 20-30
   - ☐ 31-40 41-50 51+
3. Ethnicity
   - ☐ American Indian Asian
   - ☐ African American Hispanic
   - ☐ White Other _____
4. Rate your construction experience
   - ☐ None Minimal Average
   - ☐ Above Average Professional
5. How often do you volunteer (ANY Organization)?
   - ☐ This is my 1st time 1-2 times per year
   - ☐ 3-4 times per year 5+ times per year
6. What would you recommend for the leader to help improve the experience (rank and rate)? Rank: 1-6 - 1 being the most important recommendation and 6 being the least. Rate: Your satisfaction of that particular element with 1 being poor and 10 being excellent.

   - ☐ Initial Directions prior to starting – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
   - ☐ Time Management of your team – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
     Comments:_____
   - ☐ Knowledge of Construction – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
     Comments:_____
   - ☐ Availability for questions during construction – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
     Comments:_____
   - ☐ Encouragement – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
     Comments:_____
   - ☐ Feedback during construction – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
     Comments:_____

7. Difficulty of Phase 1
   Easy Extremely Difficult
   1 2 3 4 5 6 7 8 9 10
   Comments:_____
8. Rate your Overall Satisfaction of Phase 1
   Poor (Rate Overall Satisfaction) Excellent
   1 2 3 4 5 6 7 8 9 10
   Comments:_____

Additional Comments to Help Improve the Process/Experience (use back if needed)

Thank you for your participation!

VOLUNTEER SURVEY PHASE 2

This survey serves a dual purpose. It was created by Diedrich Prigge V to aid in research dealing with volunteer workforces and will be used in his Doctorate thesis at Arizona State University. The results will help determine strategies and techniques needed to help in the overall volunteer experience while maximizing productivity of the workforce. This research and results will be available to help non-profits, disaster relief efforts, and various other users of volunteer workforces. Your honest feedback is greatly appreciated. **There are no wrong answers.**

1. What would you recommend for the leader to help improve the experience (rank and rate)? Rank: 1-6 - 1 being the most important recommendation and 6 being the least. Rate: Your satisfaction of that particular element with 1 being poor and 10 being excellent.

   - ☐ Initial Directions prior to starting – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
   - ☐ Time Management of your team – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
     Comments:_____
   - ☐ Knowledge of Construction – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
     Comments:_____
   - ☐ Availability for questions during construction – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9
     Comments:_____
   - ☐ Encouragement – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
     Comments:_____
   - ☐ Feedback during construction – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
     Comments:_____

2. Difficulty of Phase 2
   Easy Extremely Difficult
   1 2 3 4 5 6 7 8 9 10
   Comments:_____

3. Rate your Overall Satisfaction of Phase 2
   Poor (Rate Overall Satisfaction) Excellent
   1 2 3 4 5 6 7 8 9 10
   Comments:_____

Additional Comments to Help Improve the Process/Experience (use back if needed)

Thank you for your participation!

VOLUNTEER SURVEY PHASE 3

This survey serves a dual purpose. It was created by Diedrich Prigge V to aid in research dealing with volunteer workforces and will be used in his Doctorate thesis at Arizona State University. The results will help determine strategies and techniques needed to help in the overall volunteer experience while maximizing productivity of the workforce. This research and results will be available to help non-profits, disaster relief efforts, and various other users of volunteer workforces. Your honest feedback is greatly appreciated. **There are no wrong answers.**

1. What would you recommend for the leader to help improve the experience (rank and rate)? Rank: 1-6 - 1 being the most important recommendation and 6 being the least. Rate: Your satisfaction of that particular element with 1 being poor and 10 being excellent.

   - ☐ Initial Directions prior to starting – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
   - ☐ Time Management of your team – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
     Comments:_____
   - ☐ Knowledge of Construction – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
     Comments:_____
   - ☐ Availability for questions during construction – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9
     Comments:_____
   - ☐ Encouragement – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
     Comments:_____
   - ☐ Feedback during construction – Rank (1-6) ___
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
     Comments:_____
   - ☐ Difficulty of Phase 3
     Easy Extremely Difficult
     1 2 3 4 5 6 7 8 9 10
     Comments:_____
   - ☐ Rate your Overall Satisfaction of Phase 3
     Poor (Rate Overall Satisfaction) Excellent
     1 2 3 4 5 6 7 8 9 10
     Comments:_____

2. How would you rate your **overall** experience building the bench?
   Poor Excellent
   1 2 3 4 5 6 7 8 9 10
3. After this experience, would you most likely (check and rate):
   - ☐ Tell others and encourage them to come with you next time __
   - ☐ Share with others and tell them not to go __
   - ☐ Volunteer more often (in general) __
   - ☐ Do nothing __

Additional Comments to Help Improve the Process/Experience (use back if needed)

Thank you for your participation!

APPENDIX C

SAMPLE GROUP OBSERVATION SHEET

BENCH BUILDING RESEARCH DATA

Date:

	TEAM 1				TEAM 2		
PHASE 1			NOTES	PHASE 1			NOTES
	START				START		
	FINISH				FINISH		
	QUALITY				QUALITY		
	WASTE				WASTE		
	SAFETY				SAFETY		
	SATISFACTION				SATISFACTION		
PHASE 2				PHASE 2			
	START				START		
	FINISH				FINISH		
	QUALITY				QUALITY		
	WASTE				WASTE		
	SAFETY				SAFETY		
	SATISFACTION				SATISFACTION		
PHASE 3				PHASE 3			
	START				START		
	FINISH				FINISH		
	QUALITY				QUALITY		
	WASTE				WASTE		
	SAFETY				SAFETY		
	SATISFACTION				SATISFACTION		