Cement Mason Career Exploration via a Hands-On Concrete Activity

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Abstract

The construction industry is one of the most diversified fields due to the large number of products, systems, methods and processes that are involved to complete different types of projects. Therefore, a very wide range of expertise and skills are required for any successful business or project in this industry. People, specially students, who have interest in joining this important industry need to understand the qualifications for these different expertise areas so that they can decide which one is of more interest to them. The purpose of this paper is to introduce background of the qualifications and skills required for a cement mason, as one of the critical site jobs and to explore the relevant career potential. The paper also presents lab demonstration of concrete casting activities as one of the main tasks performed by the cement mason in addition to an interview with one of the professionals in this areas or expertise.

Introduction

Cement masons are involved with installing curbs, roads, sidewalks, and floors. Specifically, they pour material and then begin the process of finishing and smoothing the surfaces. The hands-on concrete activity described in this article is a great way to learn how to use some of the tools that some cement mason workers may use. Participating in this activity may help to determine if a career in this occupational specialty areas is something that you would enjoy doing as a career.

Responsibilities of Cement Mason Workers

Cement masons prepare a construction job site by installing forms, which will ultimately contain the concrete in one place. See Figure 1A.

Figure 1A



Once the forms are installed, metal wire mesh or rebar is used to strengthen the concrete after it is poured and after it cures. To prepare for pouring the concrete, cement masons must often direct truck drivers to the exact location of the pour site. See Figure 2A.

Figure 2A



After the concrete has been poured, the cement worker must use a trowel, float, and/or screed to smooth the concrete and guarantee that it is spread level. **See Figure 3A.**

Figure 3A



Expansion joints must also be installed during this process to prevent cracking as the concrete expands and contracts during different weather conditions. See Figure 4A.

Figure 4A



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Prior to finishing the job, the concrete curing process must be monitored so that a proper finish can be guaranteed. Finally, the cement mason must apply waterproofing or sealants on the concrete to protect it (U.S. Department of Labor, 2015).

Becoming a Cement Mason

A high school diploma is typically required for entry level employment as a cement mason; however, there are no specific requirements. For those who are thinking of entering this career field, courses in blueprint reading, math, and construction drawing are recommended. Hard working, organized and leadership on site activities are usually aspects that make a person ready for this career. This is in addition to capability of communicating with engineers, architects or inspectors for reviewing site works. On-the-job training is common, which consists of working with experienced workers who teach how to use the materials, machines, tools, and equipment used by a cement mason. As a trainee working under an experienced worker, entry level tasks might include jointing and edging concrete after it has been poured. See Figure 5A.

Figure 5A



The tasks often increase in complexity as time progresses during the training process. It is common for cement masons to enter into a formal apprenticeship program, which is three years in length. In such a program, apprentices are required to complete 144 hours of technical instruction and two thousand hours of paid on-the-job-training. The benefit of completing an apprenticeship program is earning a journey worker designation. This designation will qualify the worker to be employed by construction companies in projects, which is a very dynamic market process where contractors bid for projects and Page / 21

they normally get a percentage of what they bid for and once they are awarded any contract, the company will have to work fast on lining the qualified professional resources to complete the project tasks. Organizations such as contractor associations and unions offer apprenticeship programs (U.S. Department of Labor, 2014).

Pay and Benefits for a Cement Mason

The U.S. Department of Labor (2015) identifies details regarding the compensation for cement masons as of May 2012. The median annual pay, as of 2012, is listed as \$35,760.00 annually. Salary.com (2015) identifies the median annual salary for a concrete and terrazzo finisher as \$39,815.00 or an hourly wage of \$19.00 per hour. Additional benefits are identified by this source such as bonuses, Social Security, 401k/403B, disability insurance, healthcare, pension, and time off. Considering all of these benefits, the compensation total comes to \$59,241.00 annually.

Job Outlook for a Cement Mason

The U.S. Department of Labor (2015) specifies job outlook information, which is current as of the year 2012 for cement masons. This source specifies the number of jobs in 2012 as 144,300. When reviewing the employment outlook from 2012-2022, this field has a growth rate of 29%, which is much faster when compared to all occupations. The employment change from 2012-2022 is estimated to be 41,700. According to U.S. News & World Report Money (2015) "Job opportunities are directly linked with economic growth and building activity. After several lean years, the pace of both residential and commercial building work is picking up" (Para. 3).

Interview with Chris Cutshaw who is a superintendent at Bowen Engineering (General Contractor) and works extensively with cement

In the following section, you can read the questions that Chris Cutshaw was asked about his career, and you can read his responses:

- What do you like best about your job?
 "I would have to say what I like best about my job is that my job is always changing. And what I mean by that is there are always new challenges. Every project is different in some way or shape or form and it keeps things interesting" (C. Cutshaw, personal communication, November 29, 2015).
- 2. What is your advice for high school student looking to get into this industry? "My advice for high school student looking to get into this industry is to figure out which path they would like to take in regards to this industry. There are many roles that need to be filled from the design aspect, the engineering side, the actual putting work in place side of it, or as in my case I get to do a little bit of all of them" (C. Cutshaw, personal communication, November 29, 2015).

- 3. What type of activities you do on a typical working day? "For what I do every day, as far as concrete forming is concerned, is we have a set of plans that we are required to follow on dimensions and sizing of walls, footers, concrete decks, so on and so forth. Now as far as the forming side of that goes, there are many choices to choose from as far as which form system, wall tie system, or even decking and shoring system and each has their advantages and disadvantages. In a lot of cases it is up to the foreman to decide which form system is better for each application" (C. Cutshaw, personal communication, November 29, 2015).
- 4. What type of fun technology do you get to use on your daily work? "Some of the fun technologies that I get to use in my daily work consist of a few newer programs that have made my position a lot more fun and easier as well. First off is PlanGrid which is a program for our ipads on site that have all 1500 pages of our current blueprints at the swipe of your finger. The next would have to be Navisworks Freedom which is a is a 3D Design review program that we use to get a better look at what we are building in 3 dimensions. And lastly would be our robotic total station which is a layout tool we use to layout very complex jobs such as the site we are currently working on here at the Southport waste water expansion project. This system basically works off of predetermined control points to triangulate its position and set points such as footer lines, wall lines, and building lines" (C. Cutshaw, personal communication, November 29, 2015).
- 5. What are the main challenges you have in your daily work? "My main challenges in my daily work are communicating my preplanned work with my crew and making sure that the group as a whole is all on the same page which makes us function better as a team. Communication and Information are the driving factors for what makes a good concrete forming team. Not far behind these two are material, from ordering the material for a certain task and making sure it is onsite prior to starting the work to managing it efficiently and not wasting it" (C. Cutshaw, personal communication, November 29, 2015).
- 6. What would you like to see as an improvement in the area of concrete casting? "What I would like to see as an improvement in the area of concrete casting is cold weather concrete. We face it every year and with the amount of technology and engineering that is out there I feel that there has got to be a better solution for handling cold weather concrete. And what I mean by that is currently when temperatures start dipping down to just above freezing and lower we are required to start heating our substrate temperatures to be able to pour on. Now once the concrete has been placed and the forms have been wrecked we have to continue to insulate the concrete with blankets and sometimes even introduce heat to keep the concrete from freezing, which would be detrimental to achieve the strength of the concrete. There are some add mixtures currently on the market such as "Freezeguard", which allows you to pour in colder temps as long as the concrete Page | 23

is poured onto a substrate that is above freezing and the temperature while pouring the concrete is 25 degrees and rising. With this admixture there is no need to insulate or heat the concrete to keep it from freezing because the chemicals in this mixture do so internally. The only problem with this product is it's not intended for structural use. So it's perfect for sidewalks, approaches, or driveways but it is not intended for use in vertical structural concrete which is the majority of our work" (C. Cutshaw, personal communication, November 29, 2015).

 How did you get involved in the world of concrete?
 "I've been in the concrete construction industry for quite some time. I actually started with Bowen Engineering right out of high school. My father also has been in the industry for many years. And I knew at a very young age that I would also someday follow in his footsteps. Construction is a passion of mine and always has been" (C. Cutshaw, personal communication, November 29, 2015).

Activity Involving the Process of Mixing, Placing, Testing, and Curing of Concrete

Materials and Equipment Required

The materials and tools that are used in the activity include the following:

- 1- Type I Normal Portland Cement
- 2- Aggregate #11 stone or #12 gravel for the 5 bag mix.
- 3- Pea gravel.
- 4- Masons sand.
- 5- Electric concrete mixer such as the Kobalt 4.0CF 0.5HP.
- 6- For screed, use 2X4 to strike off the excess concrete so that the concrete is level with the top of the form.
- 7- Float made of wood or magnesium.
- 8- Steel trowel
- 9- Broom

Activity Procedure

A) Safety

Before work starts sufficient personal protection equipment (PPE) should be used in order to avoid body injuries. Common PPE for the cement mason include glasses, hard hats, hard boots and gloves.

B) Preparation

1- Determine the mix that is appropriate for the project. For typical flatwork such as a concrete slab or sidewalk a 6 bag mix with a compressive strength of 400 psi to 500 psi would by typical. Concrete consists of portland cement, gravel, sand, and water.

For one cubic yard, mix the following materials: 6 bags of Portland cement at 94lb/bag or 564 lb 1600 lb gravel 1400 lb sand 31 gal of water at 8.33lb/gal or 258 lb

2- Calculate the weight of each component for the volume required. For one cubic foot divide the weight of each component by 27 as there are 27 cubic feet in one cubic yard.

For one cubic foot, use the following quantities: 21 lb Portland cement 60 lb gravel 54 lb sand 1.15 gallons of water which equals 10 lb

C) Mixing

- 1- Start the mixer empty
- 2- Add half of all components with water added first. See Figure 1B and 2B

Figure 1 B



Figure 2B



3- Mix for 5 minutes. See Figure 3B

Figure 3B



4- Add the remaining components. See Figure 4B

Figure 4B



5- Mix for 10 minutes or until desired consistency is obtained. This is verified with a slump test.

D) Slump Test

The slump test verifies that the mix has the proper amount of water. Conduct this test before any concrete is placed. This test is conducted by a licensed engineer per ASTM C143.

1- Fill the slump test cone 1/3 full. See Figure 5B

Figure 5B



- 2- Use a metal rod to consolidate the concrete 20 times.
- 3- Fill the slump test cone 2/3 full
- 4- Use a metal rod to consolidate the concrete 20 times.
- 5- Fill the slump test cone and repeat the consolidation.
- 6- Strike of the top so the concrete is level with the top of the cone.
- 7- Lift the cone and measure how much the concrete has slumped. A 3" to 4" slump would be typical. See Figure 6B

Figure 6B



If the slump exceeds the required value, there is too much water and the concrete must be discarded. If the slump is too low, water can be added. In other words, if the measured vertical distance between the horizontal bar and the top of the concrete cone is large, this means that the concrete is unable to be intact or hold itself as required due to higher water content, which means the mix was not done properly and the concrete should be discarded.

E) Placement

- 1- Before placing concrete all steel reinforcement must be in place and forms treated with form oil so that the concrete does not adhere to the form.
- 2- Place concrete directly from the chute of the truck, by wheelbarrow, using a pump truck, or a crane and bucket. **See Figure 7B**

Figure 7B



3- Fill the forms and consolidate the concrete by using a vibrator, rod, or tapping on the sides of the form. This ensures that the concrete completely fills the forms and there are no voids. See Figure 8B

Figure 8B



- 4- Strike off excess concrete so that the concrete is level with the top of the form.
- 5- Use a float to bring the cement paste to the top for a smooth finish. See Figure 9B

Figure 9B



- 6- For interior work use a steel trowel for a smooth finish.
- 7- For exterior work finish the surface with a broom to provide texture and a nonslip surface.

F) Curing

The reaction between Portland cement and water is called the hydration reaction. As this process takes place it is very important to prevent evaporation from the surface of the concrete. Proper curing is achieved by spraying the surface with a curing compound, covering the surface with plastic sheeting, or covering the surface with burlap and keeping it wet for at least seven days. Failure to achieve proper curing will result in a weakened concrete that will have to be replaced. Therefore, it's critical to plan for the curing activity and leave the concrete for sufficient time before exposure to loads so that it can perform as required. Otherwise, the concrete may fail to carry the loads its designed for. **See Figure 10B**

Figure 10B



G) Cylinder Test

The cylinder test verifies that the concrete mix meets the required compressive strength. This test is conducted by a licensed engineer per ASTM C31.

- 1- Fill the cylinder $\frac{1}{2}$ full and rod the concrete 25 times to consolidate the mix.
- 2- Fill the cylinder and rod 25 times. See Figure 11B



Figure 11B

3- Strike off the top so the concrete is level with the cylinder. See Figure 12B

Figure 12B



- 4- Cover the cylinder to prevent evaporation.
- 5- The following day the engineer will transport the cylinders to the lab for proper curing.
- 6- The compressive strength of the concrete will be tested at 7 days and 28 days by applying pressure until the cylinder fails.
- 7- At 7 days the concrete should be within 60% to 67% of design strength.
- 8- At 28 days the concrete should be within 80% of design strength.
- 9- If the concrete does not meet these requirements, it may have to be demolished and poured again.
- 10- Standards similar to ASTM C39 (2015) are issued by the American Society for Testing and materials (ASTM) and followed by quality control teams to ensure quality of the concrete produced.

Conclusion

Students who have an interest in being part of the construction industry and also like working with their hands and basic tools and equipment, may want consider a career as a cement mason. Given the impressive growth rate of 29% from 2012-2022 and a median annual salary ranging from \$35,760.00 to \$59,241.00 (depending on the source), this career may be the right choice for some to consider.

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