

AN EXAMINATION OF THE BIBLE FOR INFORMATION ON CONSTRUCTION

By

BRANDON MILES SHORE

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To my wife

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By

Brandon M. Shore

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Chair: Jimmy Hinze
Cochair: Leon Wetherington
Major: Building Construction

The Bible is one of the most relied on writings for information in ancient history. It is commonly regarded as an authoritative document that provides not only religious guidance and moral truth but accurate history. The history in the Bible covers a time period of about 4000 years, from approximately 4000 B.C. until shortly after the days of Jesus. A large aspect of human history, and of considerable interest, is the construction of buildings. Rather than simply relying on archaeological evidence this study uses the Bible as a source for construction related information. The Bible has proven helpful in discovering valuable information regarding building construction in ancient times. The bulk of this information is seen in the descriptions of Solomon's Palace, Solomon's Temple, and Zerubbabel's Temple. The purpose of this research was to gather information regarding the building practices and principles, labor, materials, and tools of the ancient people of the Bible. The people of ancient Israel should be viewed with great respect for their construction related accomplishments. The foundation of modern construction can be traced to the men whose leadership caused construction knowledge to excel in the distant past, setting a foundation for the present and future.

CHAPTER 1 INTRODUCTION

The Bible is widely regarded as an authoritative document that provides religious guidance for many religions. Portions of the Old Testament were written nearly 3500 years ago, and the New Testament was written during the first century after the death of Christ. Despite its acknowledged value to the religious community, the Bible may also harbor other information of interest. One pertinent topic that may be of considerable interest is the information that the Bible contains related to construction. Historical information about the construction techniques used in the past is not well documented. This is largely due to the fact that books were very expensive prior to the invention of the printing press five hundred years ago. Since the Bible also contains information that is historical in nature, it may very well be the best resource for studying the history of various topics such as health care, agriculture, international relations, construction, and so on.

By studying this historical information in the Bible, information can be gained about the lessons learned by the ages past. For those interested in construction, the Bible may prove to be a valuable resource on historical information about construction techniques, tools, materials, principles, etc. Examination of the Bible to identify information related to construction can be useful in providing an historical perspective of how modern day practices and principles relate to those of the Biblical Era.

CHAPTER 2 LITERATURE REVIEW

Ancient historical information about the construction industry is limited. There is no known document related exactly to ancient writings about construction, and no known documents describe what the Bible alone reveals about building construction. There are a number of documents that touch on different aspects of what is in the Bible regarding construction but none that focuses solely on what the Bible alone reveals about building construction. Included in this literature review are samplings of different types of books that use the Bible as a reference, combined with information about buildings or construction.

Hurowitz (1992) wrote about Temple building in the Bible in light of Mesopotamian and Northwest Semitic writings. He covers building stories in the Bible such as the tabernacle, the first temple, and the rebuilding of the Jerusalem temple along with its walls. References to the stories about temples are included in the books of the Bible such as Ezra chapters 1-6, Nehemiah, and 1 Kings chapters 5-9. The author points out that he has purposefully focused on 1 Kings to the exclusion of first and second Chronicles due to the repetition of information. The goal of Hurowitz was to compare and contrast the account of Solomon's construction of the Jerusalem Temple that appears in 1 Kings 5:15-9:25.

Schwartz (2002) shared how the temple in Jerusalem may have been built. He relies on archaeology, the Bible, and extra-Biblical writers, such as Josephus, to derive his conclusions. The focus is specifically on the Temples rather than other construction issues that are described in other chapters of the Bible. Most of his conclusions are based on archaeology and extra-Biblical information. Some of his more pertinent information is in his chapters on construction equipment, construction materials and the building of the temple mount. He mentions the use of hand tools such as the handsaw, adze, bow drill, adjustable triangle, plum bob, caliper, square,

ruler, measuring rod, and chisel. All of these tools and devices, along with machinery, must have been available in order to build large structures such as Solomon's Temple. Mr. Schwartz mentions numerous pieces of equipment from pile drivers to cranes but most of these are not mentioned in the Bible but rather in his other sources of information. He does make reference to construction materials mentioned in the Bible such as quarried limestone, stone masonry, timber, brick, and mortar. Overall this is a good source for information about how large structures were built in Biblical times based on information derived from extra-Biblical sources.

De Geus (2003) wrote about the towns in the Southern Levant between 925 B.C. and 720 B.C. The Southern Lavant consists of modern Israel, Jordan, Lebanon and the Palestinian Territories. The purpose of his book was to describe what a town was like during a Biblical period from an archaeologist's point of view. The source of information is purely archaeological and focused on the architecture of a Biblical town as opposed to Biblical cities. With the eyes of an archaeologist he reveals some interesting information about such topics as houses, sanctuaries, temples, water systems and tombs.

Thompson (1986) wrote about life in Biblical times with much information on what homes and villages, weights and measures, industry, furniture, water supply among many other topics were like during the time Jesus lived on earth. The author labels all of the information that can be found in the Bible by putting the verse with arrows pointing to the sentences that contain information from that verse. This is helpful to show that his information has a Biblical base, but since Thompson's goal was not to write only what the Bible records but rather what can be concluded through the combination of all existing sources, it is difficult to ascertain the source of the information without thoroughly checking each scripture reference.

Fritz (1995) discussed the history of Israel regarding the city and how it evolved over time. He starts in the early Bronze Age II (2950 B.C.-2650 B.C.) and ends at the beginning of the Common Era covering 3000 years. Fritz traces the location, layout, size, architecture, building materials and water supply of Israelite cities as well as their economics, social organization, administration, culture and everyday life. Fritz's book is also based on archaeological research while using the Bible to confirm the archaeological discoveries.

CHAPTER 3 METHODOLOGY

The genesis of the idea to analyze the Bible for information regarding construction lies not with the author but with two University of Florida professors. Eight years ago Dr. Hinze and Dr. Wetherington began gathering construction information contained in the Bible. The task was never completed due to varying circumstances, including the fact that the task was determined to be too daunting. The idea was dormant for eight years, and was then suggested to this researcher as a possible thesis topic. Since the subject was of particular interest to this researcher, the topic was resurrected. A literature review was conducted on the information that was available about references to construction in the Bible. Numerous books were examined, but not one was found on the subject of construction in the Bible. Each source had some information regarding buildings in the Bible, especially the Jerusalem temple, but none focused specifically on what the Bible says about construction in a broader context.

The first step taken in this study was to gather every Biblical reference relating to construction. A topical analysis was conducted by searching headings in the Bible that disclosed at least some information about construction. This method was used with approximately the first third of the Bible from Genesis to Ezekiel. This search revealed information about the Ark, the Tower of Babel, bricks, mildew, the tabernacle, the building of the temple, King Solomon's palace, and the rebuilding of the temple by Ezra. From this point onward the search was continued through the use of online searches of various versions or translations of the Bible. By use of these resources the remainder of the construction-related verses was identified through word searches.

The first source that proved useful was the International Standard Bible Encyclopedia (1913), also known as the ISBE. Successful word searches were initially conducted by using the

ISBE with the following words: metals, house, build, tools, architecture, axe, and wood. This generated ideas for further word searches as each topic listed numerous other words that related to that subject. Further word searches were conducted using another online Bible called The Blue Letter Bible at blueletterbible.org. This resource proved to be invaluable with its many search options and resources. Searches were also conducted in the New American Standard Bible (1995), also known as the NASB. The following word searches did not benefit this study, either because they were not found in the Bible or they did not refer to anything related to construction: awl, architecture, cave, construction, gutter, hinge, hatchet, knife, lock, metals, masonry, potter, stone-built, smith, threshold, upper chambers and tools. Successful word searches included; axe, brick, build, carpenter, cornerstone, craft, door, file, floor, foundation, hearth, hammer, house, line, palace, pencil, rock, roof, saw, temple, window, lintel and hewn. Some of these words led to other word searches. For example a search for the wood of trees that could be used for construction was conducted and included: cedar, cypress, fir, algaroba, box, shittah, myrtle, pine, olive, sycamore, oil, and oak. Although the word metal did not yield many successful finds for construction applications, the search for metals included gold, silver, brass, bronze, tin, iron and copper.

The next step was to analyze the gathered information to identify those verses that provided meaningful construction information. As a result of the topical searches in the ISBE and word searches in the NASB there was a surplus of references, some of which communicated the same message in multiple verses. The clearest and most concise references were chosen from each word search in order to concisely communicate the relevant construction information contained in the Bible. The aim was to also make sure that everything pertinent to construction was mentioned. Articles in the temple that were made by skilled craftsman, furniture, alters, and

items of warfare were not considered construction related items and were not included in this study. References that were included are items relating to parts of buildings, homes, boats, towers, gates and walls, along with anything that could be considered a construction practice or principle.

Another step was to organize the pertinent verses to logically present the construction information contained in the Bible. After analyzing all of the references, topics were chosen that would best incorporate all of the ideas that were communicated in the Bible verses. The following general topic areas were chosen: Laws Governing Building Construction, Building Practices, Building Principles, Building Materials, Labor, and Tools. All of the verses were then organized into these respective categories for further elaboration.

The final step was to expound upon the verses that were identified. An overview description was written for each topic area relating it to both the Biblical period and today. The verses under each topic were then discussed in terms of the general or specific contributions that the information provides in the area of construction. This was done initially on the basis of interpretations made by relying on this researcher's personal knowledge of the Bible. Henry's (1996) commentary on the Bible was helpful for further understanding where needed. Blue Letter Bible's Greek and Hebrew Lexicons were also consulted to conduct in-depth word studies to determine the meanings of certain words. As information was discovered about the topics covered, further searches were performed on words that had previously been conducted in the NASB. The result of these searches made it clear where the exact Hebrew word was used in other verses. This helped locate other references that were also useful. This resulted in a compilation of construction topics that were addressed throughout the Bible, including both the Old and New Testaments.

CHAPTER 4 BUILDING PRACTICES AND PRINCIPLES

There are many sectors of the economy where construction is vital in today's business market, ranging from residential, commercial, industrial and manufacturing facilities to water treatment plants, bridges, large ships, islands, etc. Construction covers quite a broad category in terms of the range of what is actually constructed, which has created a need for specialization in each area. The changing technologies of the modern world have catapulted construction needs to a level never before known, especially when compared to more than 2000 to 3000 years ago. The practices that are employed today have been building upon each other for hundreds of years, even as far back as Biblical times. Although much has changed over the years the Biblical builders had a way of building that worked for them and at the time would have been considered to be innovative.

The Bible contains information about a few of the aforementioned areas. The majority of the information is in regard to large buildings, with very little on residential buildings, and even less regarding sepulchers (graves hewn out of stone), and fortifications (walls for protection). There is a considerable amount of information about larger buildings such as the temple in Jerusalem, but very little information on typical residential buildings. The Hebrew word for house, bayit, occurs over 2000 times in the Old Testament. This word refers to anything from a peasant cottage, a palace, a temple, to the wider extended family or tribe (Thompson, 1986). Although "bayit" is widely used, only a few references actually tell us anything about houses of that time, since most of its uses refer to the tribe or the family.

Although today there are numerous types of buildings with different types of construction, in Biblical times there were really only a few; the main differences being the quality of materials used. There are a number of buildings mentioned in the Bible, such as the first and second

temples, Solomon's houses, houses Solomon built for others, the tower of Babel, etc. To concisely illustrate what a quality built building was like, the first temple which Solomon built along with Solomon's personal house will be most frequently used as examples. These will be contrasted with buildings constructed with lower quality materials commonly used in the typical house.

Houses

There were many changes in the physical appearance of houses from the time of the patriarchs to that of the apostles. They differed enormously from place to place and from period to period. In the time of Abraham until David most of the Israelites lived in tents until they came into the Promised Land. Abraham was a wealthy man having over 300 people in his household as servants or helpers, yet he lived in a tent. Even in the time when Israel lived in the land of Goshen outside Egypt, there is no mention of houses. When the great famine took place all the people around Egypt sold their land to Pharaoh and moved into the city to be near the food (Genesis 47:21). This event seems to indicate mobility, as tent dwellers would have. Later in the period of the Monarchy, houses were built. This switch to more permanent homes is evidenced in 1 Chronicles 17:5 as God responds to David's desire to build the Lord a house, "For I have not dwelt in an house since the day that I brought up Israel unto this day; but have gone from tent to tent, and from [one] tabernacle [to another]. Although the Israelites lived in tents for many years this was not the case for some of the surrounding countries" (Deuteronomy 3:5). The Bible does not go into any details as to what these tents were like with the exception of the tabernacle. Although there are great details recorded in the Bible about the tabernacle, it is not useful for the study of construction since such structures are not a part of construction.

The first mention of a more permanent home is recorded in the book of Job, "How much more those who dwell in houses of clay, whose foundation is in the dust, who are crushed before

the moth” (Job 4:19 NASB)! This verse seems to indicate that “mankind” dwells in houses of clay, which have no foundation but the dirt of the ground. At the time of Job, which is the earliest book in the Bible, people must have built houses from clay brick. Years later the prophet Amos said, “Therefore because you impose heavy rent on the poor And exact a tribute of grain from them, {Though} you have built houses of well-hewn stone, Yet you will not live in them; You have planted pleasant vineyards, yet you will not drink their wine” (Amos 5:11 NASB), showing a stark contrast between the rich and the poor particularly in the construction materials of their homes. This distinction is still clearly seen today, although to a lesser degree because of city codes that require a base level of standards for all new home construction. If these codes did not exist, the same stark contrast seen in Biblical times would most likely exist today.

Estimate

For which one of you, when he wants to build a tower, does not first sit down and calculate the cost to see if he has enough to complete it? [29] "Otherwise, when he has laid a foundation and is not able to finish, all who observe it begin to ridicule him, [30] saying, 'This man began to build and was not able to finish.' (Luke 14:28-30 NASB)

This verse in Luke is the only reference to estimating in the Bible. In this verse Jesus was stating that it is foolish to begin a construction project without first doing the estimate to see if one has enough money to build it. What company, or for that matter individual, would not first prepare an estimate to see if the project at hand is feasible. Jesus stated this in such a way as to indicate that it was common sense. Therefore it is logical that all construction endeavors in ancient Israel were first estimated prior to construction.

Plans and Specifications

In the days of King Ahaz, around 700-800 B.C., a sketch was drawn with enough accuracy and details to be able to replicate an altar in Damascus. Presumably, the king did not draw the sketch but rather had a professional draftsman draw it up for him. The following text in the book

of 2 Kings clearly indicates that there was an existing knowledge of what today is called “blueprinting”. It is clear that the ancient people of the Bible had a method for drawing plans for structures that were to be constructed.

Then King Ahaz went to Damascus to meet Tiglath-Pileser king of Assyria. He saw an altar in Damascus and sent to Uriah the priest a sketch of the altar, with detailed plans for its construction. [11] So Uriah the priest built an altar in accordance with all the plans that King Ahaz had sent from Damascus and finished it before King Ahaz returned (2 Kings 16:10-11 NIV).

The use of construction plans date as far back as Moses (1500 B.C.) and without question even earlier. God said to Moses, "you shall erect the tabernacle according to its plan which you have been shown in the mountain" (Exodus 26:30 NASB). It is not known how the plan was drawn. God was the one who told Moses about it, so either he memorized how it was to be constructed or he wrote it down on some parchment. It is unlikely that Moses had a writing utensil with him while he was in the mountain with God for 40 days and nights, so he must have remembered it well enough to get it put in writing. If it was written on a parchment it has not passed the test of time since it has not been preserved.

In the same manner that Moses was the architect for the tabernacle, King David was the architect for the first temple in Jerusalem. David made very detailed plans for the temple as 1 Chronicles says,

Then David gave his son Solomon the plans for the portico of the temple, its buildings, its storerooms, its upper parts, its inner rooms and the place of atonement. [12] He gave him the plans of all that the Spirit had put in his mind for the courts of the temple of the Lord and all the surrounding rooms, for the treasuries of the temple of God and for the treasuries for the dedicated things (1 Chronicles 28:11-12 NIV).

There were dozens of people that were managing the temple construction. There is no possible way to have a unified understanding of the plans for the temple unless they were written in some form. Blueprints, or plans, have been necessary in building construction since the dawn of time, especially in the construction of major projects where there are many managers and

workers who need to understand the plans. The Bible is very clear that these plans were written as King David's says, "the LORD made me understand in writing by His hand upon me, all the details of this pattern." (1Chronicles 28:19 NASB)

In later years after the temple began to show wear and tear plans were made to repair it. It is interesting to note that it was restored according to its specifications, as it says in 2 Chronicles, "So the workmen labored, and the repair work progressed in their hands, and they restored the house of God according to its specifications and strengthened it" (2 Chronicles 24:4-5; 12-13 NASB). This means that the plans which were originally written were most likely preserved in an effort keep the temple preserved.

Building Schedules

Every building is unique and requires differing lengths of time to build. Each project mentioned in the Bible took varying durations to construct depending on circumstances, money, available resources, etc. There are four large projects in the Bible of particular interest that are constructed with high quality materials, along with ornate decorations; Solomon's temple, Zerubbabel's temple, Solomon's personal house, and King Herod's temple. There is another temple that is mentioned in the Bible in the book of Ezekiel referred to as "Ezekiel's temple". There are eight chapters dedicated to this temple, giving more information about it than any other temple in the Bible. Although this is true, it will not be elaborated upon because this temple was to be built in the future and has no schedule associated with it. The Bible also contains no information on schedules for building smaller homes and therefore cannot be elaborated upon.

The foundation for Solomon's temple alone took six months to construct. A modern day building could be built in the time frame it took Solomon to simply lay the foundation. An average three story project, the size of the first temple with its 90 feet by 30 feet, or approximately 2700 square foot foundation would take approximately one month to build (1

Kings 6:1-2). The temple itself was built in seven years (1 Kings 6:37-38). The temple was 45 feet high, about the height of a typical three story building today. For the sake of comparison, assuming it was comprised of three floors, the constructing of the temple would be equivalent to constructing an 8000 square foot building today. This would only take about 6 months to a year to construct, one seventh of the time that one actually required. There are no details to determine how long each component took to build, so determining an actual schedule is not possible.

The book of Ezra records the construction of Zerubbabel's temple. This temple was built because Solomon's temple was destroyed by the Babylonians. A remnant of the Israelites was allowed to come back to Israel to rebuild the temple. This temple was started 22 years before it was finished because there were complications in getting the project completed. The surrounding territories tried to keep them from rebuilding the temple which slowed them down for 18 years, then the temple was built in four years, once the foundation was laid (Ezra 6:14-15).

It is very common in construction to have a schedule that is very fast paced, because "time is money". In this case, Zerubbabel and the rest of the Israelites were in a rush, but for different reasons. They wanted to rebuild the very house where God would dwell. Another factor that influenced the schedule was the surrounding neighbors who wanted to put an end to their construction. Money was not the motivator, but rather, fear of being stopped along with a desire to worship God.

Solomon's personal house was 100 cubits long, 50 cubits wide and 30 cubits high. This is the equivalent of about 33,000 square feet. This is the largest building recorded in the Bible and took Solomon 13 years to construct (1 Kings 7:1-12). Part of the reason this structure was able to be built in a relatively short period of time is because Solomon conscripted more than 150,000

men to help, there was no threat of war and other nations were glad to trade needed materials and supplies.

King Herod built a temple, or temple buildings, just before the time of Christ. It is recorded in the Bible as taking 46 years to construct. The book of John states, "The Jews then said, "It took forty-six years to build this temple, and will You raise it up in three days" (John 2:20 NASB)? Whether this number includes any enlargements done by Herod is not certain since it is not mentioned in the Bible. This type of time frame for building construction is unheard of today, displaying how different construction actually was in Biblical times. There is no information in the Bible on the details of this temple although it is mentioned a few times in passing. Jesus' disciples mention how massive it was and well adorned with beautiful stones, "As He was going out of the temple, one of His disciples said to Him, "Teacher, behold what wonderful stones and what wonderful buildings!" [2] And Jesus said to him, "Do you see these great buildings? Not one stone will be left upon another which will not be torn down" (Mark 13:1-3 NASB). Since this verse refers to numerous buildings, it is logical to assume that it took 46 years to construct all of the buildings in the temple area. In the early Biblical period most buildings only took about 4 to 13 years to construct. It is very unlikely that the reference to Herod's temple stating that it took 46 years to build did not also include some other temple buildings as it states in the book of Mark, chapter 13.

The construction schedules in Biblical times are vastly different from current construction schedules. Using two of the four buildings to determine how long buildings took on average in the Biblical period gives some idea as to how many square feet could be built in a year. The average comes to 1840 square feet per year. The range starts at 1142 square feet per year for Solomon's temple to 2538 square feet per year for Solomon's personal house. An exact number

cannot be determined based on the information provided in the Bible. This estimate creates a rough picture of how long it took to build large buildings in Biblical times. If buildings were still built at this pace a simple 10,000 square foot three story office building would take approximately five and half years to construct.

Preparation in the Field

One of the most unusual building practices of all time was employed on the temple in Jerusalem in the days of Solomon, the King of Israel. 1 Kings 6:7 states, “The house, while it was being built, was built of stone prepared at the quarry, and there was neither hammer nor axe nor any iron tool heard in the house while it was being built.” The materials were brought in, ready for their place (v. 7), so ready that there was neither hammer nor ax heard in the house while it was being built. In the process of building his house Solomon prescribed it as a rule of prudence to prepare the work in the field, and afterwards build, Proverbs 24:27. This describes the process of prefabrication at a level that is virtually unknown today, as it seems, the preparation was more than ordinarily full and exact, to such a degree that, when the several parts came to be put together, there was nothing defective to be added, nothing amiss to be amended (Henry 1996). This construction practice seemed to be unique to Solomon as well as to the larger buildings he constructed.

This practice is very similar to steel manufacturing of today, where beams are cut to size at the mill with an allowable error tolerance as small as 1/16 of an inch. This precision is absolutely necessary so that the beams and columns, etc. will fit together in the field. It was this type of precision that was used in King Solomon’s day. The exact reason for doing things the way he did is not known but Matthew Henry (1996), a well known Bible commentator, says of the temple, “It was to be the temple of the God of peace, and therefore no iron tool must be heard in it. Quietness and silence both become and befriend religious exercises: God’s work should be

done with as much care and as little noise as possible. The temple was thrown down with axes and hammers, and those that threw it down roared in the midst of the congregation (Ps 74:4, 6); but it was built up in silence.”

Building Components

Plumbing

The first stage in the actual construction of a project is to put in the underground utilities. In Ancient times there were no electrical or cable lines but there was plumbing. The only reference to plumbing found in the Bible is in the following verse, “On that day, David said, "Anyone who conquers the Jebusites will have to use the water shaft to reach those 'lame and blind' who are David's enemies" (2Samuel 5:8 NIV). The Jebusites lived in Jerusalem, the city of David (2Samuel 5:6, 7). David and his army approached the city and the only way in was through the water shaft. This water shaft was possibly a sewage area which is why David offered a reward to the one willing to climb up through it. This indicates that there was possibly an intricate system of plumbing in Jerusalem prior to the reign of the Israelite kings. Although the Bible does not elaborate on plumbing systems, archaeology does confirm that plumbing was in use in ancient Israel.

The Foundation

The foundation of a building determines the stability of the building itself. Larger buildings require larger foundation stones because of the heavy loads that they bear. The stones of the foundation to Solomon’s house and temple were very large, up to 15 feet long in at least one of its dimensions, and were made by large numbers of workers who cut stones from the mountain sides and carried them to the building site (1 Kings 5:13-17). When constructing the first temple in Jerusalem, Solomon ordered great and costly stones to be cut for the foundation as

it states in 1 Kings, “Then the king commanded, and they quarried great stones, costly stones, to lay the foundation of the house with cut stones (1 Kings 5:17 NASB).

Most homes in the early Biblical times had no foundation except the dirt beneath their feet (Job 4:19). Those that did have a foundation were mostly wealthier Israelites who lived in the city. The absence of a foundation was not an option for the temples and other large buildings because of their size. The mere height of the temple necessitated a solid foundation. The temple was 30 cubits (45-50 feet) tall, and knowing that the materials for the walls were stone, this was a very heavy building. Without a proper foundation it would have suffered major damages in a short period of time. Jesus himself commented on the importance of a strong foundation,

Therefore everyone who hears these words of Mine and acts on them, may be compared to a wise man who built his house on the rock. [25] And the rain fell, and the floods came, and the winds blew and slammed against that house; and {yet} it did not fall, for it had been founded on the rock. [26] Everyone who hears these words of Mine and does not act on them, will be like a foolish man who built his house on the sand. [27] The rain fell, and the floods came, and the winds blew and slammed against that house; and it fell--and great was its fall (Matthew 7:24-27 NASB).

Flooring

Stone slabs were sparingly used, and are only mentioned as a part of the houses of the great, such as Solomon. There may have been tile, wood, a mixture of stone and plaster, or other materials used for floors. It is unlikely that wood was used very often as a flooring for houses, although Solomon used it for his temple floor (1 Kings 6:15). There are no other details listed in the Bible as to what was used for floors.

Cornerstones and Cap-stones

According to Job 38:6, the cornerstone was for the foundation of a building. This may have been a foundation-stone upon which the structure rested or an actual cornerstone adding stability to the rest of the building (Jeremiah 51:26). This stone was firmly placed so that it would not budge; the sturdiness of the building was dependent upon it. It is the first step in

constructing a building, the starting place for construction and the source of strength for all other foundation stones. Since the stones for the foundation “were of stone cut according to measure,...even large stones, stones of ten cubits and stones of eight cubits” (1 Kings 7:9-10 NASB) then logically the cornerstone would also be of similar size to the other foundation stones, maybe even larger.

The New Testament frequently refers to Jesus as the chief cornerstone (1Peter 2:6; Ephesians 2:20; Acts 4:11). The Old testament does the same as it says in Isaiah, “Therefore thus says the Lord GOD, "Behold, I am laying in Zion a stone, a tested stone, A costly cornerstone {for} the foundation, firmly placed. He who believes {in it} will not be disturbed” (Isaiah 28:16 NASB) The Bible compares the cornerstone to Christ, showing the great importance of the cornerstone in buildings in ancient times, and visa versa, the importance of Christ is seen because He is considered the cornerstone of the Church.

There is also another type of corner stone referred to as a cap-stone. All the passages in the Bible that refer to a cornerstone or headstone are literally referring to a stone at the corner, as in Psalm 118, “The stone [which] the builders refused is become the head [stone] of the corner” (Psalm 118:22 KJV). There appears to be two conceptions of this corner stone; the foundation stone, referred to as the cornerstone and the topmost, or cap-stone, which linked the last tier together (Psalm 118:22; Zechariah 4:7). In both cases it is an important or key-stone, and figurative of the Messiah, who is "the First and the Last."

Celebrating after laying the foundation

And all the people shouted with a great shout when they praised the LORD because the foundation of the house of the LORD was laid. [12] Yet many of the priests and Levites and heads of fathers' {households,} the old men who had seen the first temple, wept with a loud voice when the foundation of this house was laid before their eyes, while many shouted aloud for joy, [13] so that the people could not distinguish the sound of the shout of joy from the sound of the weeping of the people (Ezra 3:11-13 NASB).

The first temple in Jerusalem was a massive and ornate structure built by King Solomon. According to the Bible, King Solomon was the wisest and richest King ever (1 Kings 10:23). He was able to both afford and require the best construction materials and practices of his day. Money was no hindrance to building since he was probably equivalent to a billionaire today. It can be seen in the book of Ezra how his riches influenced the glory of the first temple in Jerusalem as compared to the second temple. It says in Ezra 3 after they had just finished laying the foundation of the second temple, that as a result of seeing the foundation, the younger Israelites celebrated the monumental moment. The older Israelites who had seen the first temple could only cry due to the realization that this new temple would not compare in glory to the first.

This practice of celebrating the laying of the foundation seems logical in the context of Biblical times. The foundation was not simply a one week job where the concrete is poured by concrete trucks or pumps. This foundation consisted of large rocks or beams put in place over a period of months. It took quite some time just to gather the wood from Lebanon, then to cut it and put it into place. When it was finally put in place, it was the first sign of real progress and a great point to celebrate to keep everyone's morale high. This practice would have only applied to large structures as opposed to typical residential homes since many of them did not even have a foundation (Job 4:19). Construction managers could benefit from emulating this practice by celebrating certain milestones in the construction of a building. The "drying in" of a building may not be celebrated when constructing buildings today, but the significance of this phase of completion is widely recognized as a key milestone accomplishment.

Walls

Typical walls for larger buildings in Israel during the Biblical period were made of cut stone. The interior of these walls were rarely, if ever, left in their raw state. They were covered with a more aesthetically pleasing material such as cedar, cypress, gold, etc., or with a simple

whitewash or plaster (Leviticus 14:41). Solomon's house was covered in so much cedar that it was referred to as a house of cedar (2 Samuel 7:2). The prophet Ezekiel said, "when anyone builds a wall, behold, they plaster it over with whitewash...[14]So I will tear down the wall which you plastered over with whitewash and bring it down to the ground, so that its foundation is laid bare; and when it falls, you will be consumed in its midst. And you will know that I am the LORD" (Ezekiel 13:10, 14 NASB). It is clear from this verse that it was a common practice among the people to plaster over their walls. It is also significant that it says, "so that its foundation is laid bare", because this seems to indicate a separate component to the wall. Archaeological evidence points to the fact that many common homes had walls with rock and mortar as the foundation (Thompson, 1986). Above the rocks were mud-bricks or some other degradable material.

The walls of the temple were made of stone but there were "narrow ledges around the outside of the temple, so that the support beams would not be fastened into the walls of the temple" (1 Kings 6:6 NKJ). It appears that the temple was structurally stronger because the beams were not inserted into the walls but rather placed on offsets as it says in the NASB, "The lowest story {was} five cubits wide, and the middle {was} six cubits wide, and the third {was} seven cubits wide; for on the outside he made offsets {in the wall} of the house all around in order that {the beams} would not be inserted in the walls of the house" (1 Kings 6:6 NASB). This is explained by the fact that the chambers were not to be built into the wall of the Temple, but were to rest on ledges in the wall, each ledge a cubit in breadth, so that the wall became thinner, and the chambers broader, by a cubit, each stage in the ascent.

The walls of other buildings, such as those of the second temple in Jerusalem had timber laid in the stone walls (Ezra 5:8). The benefit of one style of building over the other may be that

there is less labor to make ledges in the wall compared to cut outs in the stone for the timber. It is not entirely clear. Solomon had all the time and money to build this temple, so it may be that this way of building the walls was simply more aesthetically pleasing. The second temple was not lacking structurally since it lasted until it was damaged around 167 B.C. and destroyed in 70 A.D.

It says in 2 Chronicles, “For he said to Judah, ‘Let us build these cities and surround {them} with walls and towers, gates and bars” (2 Chronicles 14:7 NASB). Major cities in ancient times protected themselves against attack from enemies by building a large wall around the city. It was of great importance to build the wall even before building anything else. These walls contained towers to keep a lookout, gates to allow entry and exit, and bars of iron to create strong gates. The materials required for these walls are mentioned in 2 Chronicles, “When Baasha heard {of it,} he ceased fortifying Ramah and stopped his work. [6] Then King Asa brought all Judah, and they carried away the stones of Ramah and its timber with which Baasha had been building, and with them he fortified Geba and Mizpah. (2 Chronicles 16:5-6 NASB). These walls needed to be strong enough to keep out the enemy and were therefore composed of stone, along with gates of timber and iron. Thus, in Biblical times, in regard to construction, there were three types of walls; city walls, luxury home walls and common walls. City walls and luxury home walls were walls of stone (Nehemiah 4:3), whereas common walls were brick walls or a mixture of brick and stone.

Windows

The first mention of a window in the Bible is in regard to Noah’s Ark around 2285 B.C. Over time the design of windows improved and has become more varied. Great advances must have taken place in the time of Solomon because of his wisdom and the lack of war time. Unique windows were one of many advances. In the early ninth century B.C., Solomon’s house

not only had regular windows but also windows with beveled or artistic frames (1 Kings 7:4 NKJ). The Hebrew word for window, shaquph {shaw-koof}, used only in two places in the Bible indicates the uniqueness of this type of frame (1 Kings 6:4; 7:4). The definition of the word “shaquph” is narrow lights or windows with closed beams. In Solomon’s house, “[there were] windows [in] three rows, and light [was] against light [in] three ranks” (1 Kings 7:4 KJV). There were three tiers of windows on each side, creating the image of light against light. This was no doubt an architectural touch of beauty.

Solomon’s wife said, “My beloved is like a gazelle or a young stag. Behold, he is standing behind our wall, He is looking through the windows, He is peering through the lattice (Song of Songs 2:9 NASB). The Hebrew word for lattice is ‘eshnab, which implies a window closed with lattices, through which cold air passes. These windows were also able to be opened and closed as modern day windows are (2 Kings 13:17) and were generally big enough for a grown man to pass through (1 Samuel 19:12). Since glass windows had not yet been invented at this time, Solomon’s personal house actually had something like jalousie windows made out of a non glass material to allow air flow, and to keep the rain and sun out, it is likely that the same type of windows were used, or were beginning to be used in other buildings. Even in Ezekiel’s temple, prophesied about 381 years after the first temple was completed, contained shuttered windows (Ezekiel 40:16).

Winding Stairs

The doorway for the lowest side chamber {was} on the right side of the house; and they would go up by winding stairs to the middle {story,} and from the middle to the third (1 Kings 6:8 NASB).

Stairs were in use as far back as the building of the Tower of Babel. Many homes in Israel used ladders or stairs to get up to the roof for various purposes (Nehemiah 8:16). In larger buildings, such as Solomon’s home, stairs were necessary since there were multiple floors.

Since everything Solomon had built was very ornate, the stairways in Solomon's house were likely very beautiful winding stairs rising up to the third floor. There is no other mention in the Bible of winding stairs, but this was clearly a practice in the time of King Solomon.

Doors

So also he made for the entrance of the nave four-sided doorposts of olive wood [34] and two doors of cypress wood; the two leaves of the one door turned on pivots, and the two leaves of the other door turned on pivots. [35] He carved {on it} cherubim, palm trees, and open flowers; and he overlaid {them} with gold evenly applied on the engraved work (1 Kings 6:33-35 NASB)

Doors are now constructed by using hinges connected to the door frame which is connected to a structural part of the building, but not so in Biblical times. According to the book of Kings the doorway was constructed of four sided doorposts made of wood such as olive wood (1 Kings 6:33-34). Rather than using hinges, these posts rested on some sort of pivot hard enough to keep the posts from sinking as they turned to open and close the door. These pivots must have been designed by carving out a place for the pivot to sit to prevent lateral movement. The pivots were most likely a part of the stone foundation in the temple. The top of the posts must have also been held in place by a pivot. It was likely a similar pivot system as the floor. Another possible option was that the four sided posts were deep enough in the base or ground that there was no need for an upper pivot. It is not entirely clear from the Bible what the actual construction was like, although through archaeology there is evidence of pivots being in the ground for homes. The Hebrew word translated as "hinge" in Proverbs 26:14 is "tsiyr" {tseer}, has to do with pain, like a twisting pain, from grinding on the pivot. Although the word "hinge" can be found in the Bible it is not referring to a hinge the way we know of it today, but rather to this pivot system.

In homes where the foundation was dirt, stones could have been buried underground and designed similar to the pivot in a rock foundation. Although there is no description of this in the

Bible, Thompson (1986) describes it this way, “The door is fixed to a wooden post which turns with it. The bottom of the post is tipped with stone and turns on a hollowed stone below threshold level. The top is held between the beams of the lintel“. In Solomon’s temple the hinges for the doors for the inner room, the Most Holy Place, and for the main hall of the temple were made of gold (1 Kings 7:50).

Doors were not only used in buildings but also for the gates of the city walls. Entire cities were surrounded by these walls, many of which had only one way in and out. The description of the gates for the new wall that was built around Jerusalem after the Israelites were released from the Babylonian captivity (around 537 B.C.) is recorded in Nehemiah, “Then Eliashib the high priest arose with his brothers the priests and built the Sheep Gate; they consecrated it and hung its doors. [3] Now the sons of Hassenaah built the Fish Gate; they laid its beams and hung its doors with its bolts and bars” (Nehemiah 3:1, 3 NASB). The components of the gate doors are laid out in this verse as being beams, bolts and bars. Since the walls around the city were built of stone, the gates would be the weakest point of entry. In order to protect the city from invaders the wooden doors were strengthened by bolted bars of iron. The doors most likely used the same pivot system to open and close, using iron for pivot bars, rather than wood or gold.

Lintel

The lintel is the upper part of a doorway. This is made clear in Exodus where the Israelites, while in Egypt, were commanded to put the blood of a lamb on the two door posts and the lintel, “And ye shall take a bunch of hyssop, and dip [it] in the blood that [is] in the bason, and strike the lintel and the two side posts with the blood that [is] in the bason; and none of you shall go out at the door of his house until the morning” (Exodus 12:22 KJV). The lintel was a structural part of the doorway even in the days of Moses around 1275 B.C. to possibly 1500 B.C.

(Robinson, 1992). There are other references to the lintel that only repeat the fact that it was a structural part of the doorway.

Roof

Most roofs in Biblical times were flat, having little to no pitch. Since they were practically flat, God directly stated that rooftops were to be constructed in such a way that they would be safe for anyone who might be on the roof, "When you build a new house, you shall make a parapet for your roof, so that you will not bring bloodguilt on your house if anyone falls from it" (Deuteronomy 22:8 NASB). It was common practice to utilize the roof as an extension of the home (Matthew 24:17). It was used for sleeping (Acts 10), for relaxing (2Samuel 11:2), for celebrating the Feast of Booths (Nehemiah 8:16), for storage (Joshua 2:6) and for various other reasons. The parapet was built to keep people from falling off of the roof while it was in use. The height of the parapet is not mentioned but it was probably at least 36 inches high, otherwise it would not have increased safety very much.

The structural components of roofs varied depending on how wealthy the owner was. Solomon's houses were constructed of rafters of cypress and beams of cedar (Song of Songs 1:17). What actually created a water barrier is not certain. There is mention of roof tiles in Matthew 5:19, but no mention of the material they were made of. There is no mention of any other types of covering such as thatch, tar, tar paper or any other water proofing components. The material used to make the tiles in Matthew is not mentioned but was likely clay. The roof system was most likely quite simple. Mark told the story of some men who dug through a roof while Jesus was inside in order to get their paralytic friend into the house, "Being unable to get to Him because of the crowd, they removed the roof above Him; and when they had dug an opening, they let down the pallet on which the paralytic was lying" (Mark 2:4 NASB). The construction of the roof must have been of some material that could be dug through or loosely

placed components that could be removed with relative ease. At the same time the material must have been strong enough to hold people without falling in. To learn more about what they used one would have to turn to archaeology, but that is beyond the scope of this study.

Heating and Air Conditioning

There is no evidence in the Bible of any construction related heating and air conditioning other than the structure itself. There is reference to a brazier, or hearth,

Now the king was sitting in the winter house in the ninth month, with {a fire} burning in the brazier before him. [23] When Jehudi had read three or four columns, {the king} cut it with a scribe's knife and threw {it} into the fire that was in the brazier, until all the scroll was consumed in the fire that was in the brazier (Jeremiah 36:22-23 NASB).

In Biblical times the heating system was very simple, yet very necessary. What Jeremiah was referring to here is a great pot, in which a fire was kept burning in the king's winter apartment. Asians still use pots of this kind for warming, similar to the use of fireplaces. They have the form of a large pitcher, and they are usually placed in a cavity in the middle of the room. When the fire is out, a frame like table is put over the pot, covered with a carpet; and those who wished to warm themselves, sat on the ground, and covered their feet, legs, and even their belly, with the carpet.

Air conditioning in its modern form did not exist in Biblical times. The means for conditioning air inside a building was through the use of windows and shade. As mentioned in the windows section of this chapter, there were lattices on windows that could possibly open and close to control temperature, light, and water infiltration. On a hot day without wind to cool the inside of the house, the roof was the only protection from the sun's heat. Shade was likely the best form of air conditioning in Biblical times.

Mildew

Today mold or mildew is a serious concern in building construction. Sometimes lawsuits result from mistakes contractors make that lead to mold or mildew growth. Whenever organic materials are in constant contact with moisture there is a viable atmosphere for mold to grow. In the Bible the word for Mildew is the rendering of a Hebrew word meaning "to be yellow," or "yellowness" (Masterman 1913), the result of cutting east winds rendering the grain in Arabia unproductive (Deuteronomy 28:22; 1 Kings 8:37; 2 Chronicles 6:28). The only example mentioned in the Bible of a home being threatened by mold is in the following passage in the book of Leviticus. The word translated as mildew is here translated as "a mark of leprosy" or "something like a mark of leprosy".

The LORD further spoke to Moses and to Aaron, saying: [34] 'When you enter the land of Canaan, which I give you for a possession, and I put a mark of leprosy on a house in the land of your possession, [35] then the one who owns the house shall come and tell the priest, saying, '{Something} like a mark {of leprosy} has become visible to me in the house.' [36] 'The priest shall then command that they empty the house before the priest goes in to look at the mark, so that everything in the house need not become unclean; and afterward the priest shall go in to look at the house. [37] 'So he shall look at the mark, and if the mark on the walls of the house has greenish or reddish depressions and appears deeper than the surface, [38] then the priest shall come out of the house, to the doorway, and quarantine the house for seven days. [39] 'The priest shall return on the seventh day and make an inspection. If the mark has indeed spread in the walls of the house, [40] then the priest shall order them to tear out the stones with the mark in them and throw them away at an unclean place outside the city. [41] 'He shall have the house scraped all around inside, and they shall dump the plaster that they scrape off at an unclean place outside the city. [42] 'Then they shall take other stones and replace {those} stones, and he shall take other plaster and replaster the house. [43] 'If, however, the mark breaks out again in the house after he has torn out the stones and scraped the house, and after it has been replastered, [44] then the priest shall come in and make an inspection. If he sees that the mark has indeed spread in the house, it is a malignant mark in the house; it is unclean. [45] 'He shall therefore tear down the house, its stones, and its timbers, and all the plaster of the house, and he shall take {them} outside the city to an unclean place. [46] 'Moreover, whoever goes into the house during the time that he has quarantined it, becomes unclean until evening. [47] 'Likewise, whoever lies down in the house shall wash his clothes, and whoever eats in the house shall wash his clothes. [48] 'If, on the other hand, the priest comes in and makes an inspection and the mark has not indeed spread in the house after the house has been replastered, then the priest shall pronounce the house clean because the mark has not reappeared. [49] 'To cleanse the house then, he shall take two birds and

cedar wood and a scarlet string and hyssop, [50] and he shall slaughter the one bird in an earthenware vessel over running water. [51] 'Then he shall take the cedar wood and the hyssop and the scarlet string, with the live bird, and dip them in the blood of the slain bird as well as in the running water, and sprinkle the house seven times. [52] 'He shall thus cleanse the house with the blood of the bird and with the running water, along with the live bird and with the cedar wood and with the hyssop and with the scarlet string. [53] 'However, he shall let the live bird go free outside the city into the open field. So he shall make atonement for the house, and it will be clean.' [54] This is the law for any mark of leprosy--even for a scale, [55] and for the leprous garment or house (Leviticus 14:33-55 NASB).

The Biblical procedure to follow in the case of a mildew problem in a house was to act immediately by getting a priest to make sure that the house was quarantined and scraped of all mildew if it was spreading. Then the parts that were affected were to be removed such as the stones and the plaster. If the mildew did not go away it was no small matter, the entire house was to be taken down stone by stone and carried to an unclean place outside the city. Whoever took the house apart was to make sure that his clothing was washed by evening, so that he would be considered clean the next day. Mildew was taken very seriously in Israel because it was associated with God's judgment since He used mildew as one of his tools, among many other ailments, to bring Israel to repentance. For example, in Deuteronomy 28:22 Moses says, "The LORD will smite you with consumption and with fever and with inflammation and with fiery heat and with the sword and with blight and with mildew, and they will pursue you until you perish." Therefore mildew was a cause of great grief even beyond its natural effects.

Maintenance

Now it came about after this that Joash decided to restore the house of the LORD. [5] He gathered the priests and Levites and said to them, "Go out to the cities of Judah and collect money from all Israel to repair the house of your God annually, [12] The king and Jehoiada gave it to those who did the work of the service of the house of the LORD; and they hired masons and carpenters to restore the house of the LORD, and also workers in iron and bronze to repair the house of the LORD. [13] So the workmen labored, and the repair work progressed in their hands, and they restored the house of God according to its specifications and strengthened it (2 Chronicles 24:4-5, 12-13).

According to 2 Chronicles 24:4, 5 it is clear that maintenance was necessary for the temple's masonry, carpentry, iron and bronze components. The approximate time for this repair work was 820 B.C. (Robinson, 1992). The maintenance was to take place annually, revealing either the fast pace of deterioration of buildings in that time or the evidence of enemy attack on buildings. Repairing existing buildings was common practice evidenced by the recurrent mention of repairs in the Bible, such as in the following verses:

In the first year of his reign, in the first month, he opened the doors of the house of the LORD and repaired them. [4] He brought in the priests and the Levites and gathered them into the square on the east (2 Chronicles 29:3-4 NASB).

Now in the eighteenth year of his reign, when he had purged the land and the house, he sent Shaphan the son of Azaliah, and Maaseiah an official of the city, and Joah the son of Joahaz the recorder, to repair the house of the LORD his God. [9] They came to Hilkiah the high priest and delivered the money that was brought into the house of God, which the Levites, the doorkeepers, had collected from Manasseh and Ephraim, and from all the remnant of Israel, and from all Judah and Benjamin and the inhabitants of Jerusalem. [10] Then they gave {it} into the hands of the workmen who had the oversight of the house of the LORD, and the workmen who were working in the house of the LORD used it to restore and repair the house (2 Chronicles 34:8-10 NASB).

Not only did the temple and other large buildings need to have regular maintenance, but common homes needed maintenance, possibly even more. Solomon says in Ecclesiastes, "Because of laziness the building decays, And through idleness of hands the house leaks" (Ecclesiastes 10:18 NKJV). Maintenance was a given because of the fast pace of decay in Biblical times, those who did not keep up with it were foolish.

Integrity in Construction

The Bible makes it very clear, as the God of the Bible deals with His people Israel, that there is a reward for those who obey God and walk in integrity and a curse for those who do not (Deut 28 & 29). Promises of blessings and curses for Israel were specifically stated to the Israelites and applied directly to them, such as:

If you diligently obey the voice of the Lord your God...The Lord will send a blessing on your barns and on everything you put your hand to. The Lord your God will bless you in the land he is giving you. [12] The Lord will open the heavens, the storehouse of his bounty, to send rain on your land in season and to bless all the work of your hands. You will lend to many nations but will borrow from none (Deuteronomy 28:1, 8, 12 NIV).

If you do not obey the voice of the Lord your God... [20] The Lord will send on you curses, confusion and rebuke in everything you put your hand to, until you are destroyed and come to sudden ruin because of the evil you have done in forsaking him (Deuteronomy 28:15, 20 NIV).

Cursed is the man who carves an image or casts an idol--a thing detestable to the Lord, the work of the craftsman's hands--and sets it up in secret (Deuteronomy 27:15 NIV).

It is interesting to note how the skilled labor of the craftsman can be corrupted and used for purposes that are detestable to God. The Israelite that began to do things in secret was a man who lost his integrity. The benefit of being a man or woman of integrity cannot be underestimated. According to the Bible it made all the difference. God would either bless the work of their hands (construction projects included) or curse the work of their hands.

Though this applied only to Israel, there is a similar promise, or principle, that applies to all human beings. The principle that blessings will result from living a moral life, especially one with faith in God (John 3:16), and destruction will result from rebellion against the moral principles in the Bible (Rom 1:27; 1Thessalonian 1; 8, 9; Proverbs). The prophet Jeremiah says it this way,

Woe to him who builds his house without righteousness And his upper rooms without justice, Who uses his neighbor's services without pay And does not give him his wages (Jeremiah 22:13 NASB).

A “woe” in the Bible is not to be taken lightly. It is the equivalent to the terrible curses that were pronounced against Israel in Deuteronomy if they did not obey God. Isaiah said, “Woe to the wicked! Disaster is upon them! They will be paid back for what their hands have done” (Isaiah 3:11). David says, “Many are the woes of the wicked, but the Lord’s unfailing love surrounds the man who trusts in him” (Psalm 32:10). The conclusion of the matter is that the

Bible clearly indicates that Integrity in all aspects of life including building construction is necessary for success and blessing.

CHAPTER 5 BUILDING MATERIALS

Since buildings are essentially made up of various materials, their basic component properties are of extreme importance. In Biblical times buildings were generally constructed from materials that were in close proximity. This concept of restricting construction materials to those that are nearby is mostly foreign in modern day construction. It is only to a limited extent that the availability of local products influences the choices of building materials. There is an element of increased cost when certain products need to be delivered long distances and may be a deterrent to using them. The limitations in choice of materials for building construction have greatly decreased since Biblical times due to innovations in transportation and materials science. There are numerous products available for modern day construction that were unimaginable in Biblical times, such as plastic, aluminum, steel, glass, Portland cement, fiberglass, asphalt roofing, metal roofing, rubber, etc. Although modern construction seems considerably more advanced when compared to Biblical times in terms of the materials used, most would be surprised at how advanced some of the materials were in Biblical times.

Tar

Around 2,243 B.C. the people of Babel in Mesopotamia had already discovered a material they called “tar”. It was used for mortar to build a brick Tower, called the Tower of Babel. There are no other details of what constituted tar other than what Genesis 11:3 reveals: “They said to one another, ‘Come, let us make bricks and burn {them} thoroughly.’ And they used brick for stone, and they used tar for mortar” (Genesis 11:3 NASB). Today tar is known as a dark, oily, viscous material, consisting mainly of hydrocarbons, produced by the destructive distillation of organic substances such as wood, coal, or peat. Where they obtained the tar is merely conjecture. Although there is no mention in the Bible as to where it came from, there is a

verse that refers to a byproduct of tar called “pitch” in Genesis 6:14, "Make for yourself an ark of gopher wood; you shall make the ark with rooms, and shall cover it inside and out with pitch” (Genesis6:14-16 NASB). This statement was made approximately 221 years prior to the verse in Genesis11:3. This means that if the pitch in Genesis 6:14 was a by product of tar then tar was in existence prior to the flood which took place some time around 2344 B.C. The “pitch” that made the ark waterproof is derived from the Hebrew word kopher, equivalent to kaphar, which was “frequently translated later as 'atonement' (Leviticus 17:11). In providing a protective covering against the waters of judgment, it thus becomes a type of Christ (Henry 1996).”

There are a few ideas as to where this “tar” or “bitumen” originated. Tacitus, a Jewish historian, stated that “bitumen”, boiled up from subterranean fountains like oil or hot pitch, in the vicinity of Babylon, and also near the Dead Sea. Afterwards, the tar hardened and was collected on the surface of the Dead Sea (Hebrew Lexicon). Since this was in the vicinity of Babylon it was a possibility that the tar mentioned in Genesis11:3 was not created but found. On the other hand, it is possible that the source of this tar was wood. After all, for thousands of years wood tar was used to waterproof sails and boats and could possibly have been in existence when the Babel builders were building the tower of Babel. Regardless of where it came from, the builders were using a new and better material for mortar to build a building that had no contemporary equal. This exemplifies the innovative spirit that still exists today.

Tar was used in the day of Moses, by his own mother as this verse states, “But when she could hide him no longer, she got him a wicker basket and covered it over with tar and pitch. Then she put the child into it and set {it} among the reeds by the bank of the Nile” (Exodus 2:3 NASB). Tar here is used for the same purpose pitch was used; to waterproof. Tar continues to be a foundational product today, even for the construction industry after roughly 4350 years. Tar

has taken on new forms since ancient times and its ancient uses have inspired the use of other natural sources of tar such as wood and, more recently, the creation of various synthetic waterproofing materials that do not contain tar. The fact that tar was discovered and used so long ago gives credit to the people of that time as being innovative.

Brick

In the Near East and India, bricks have been in use for more than five thousand years. Genesis 11:3 records the first reference to bricks being made and used, “they said to one another, ‘Come, let us make bricks and burn {them} thoroughly.’ And they used brick for stone, and they used tar for mortar”. Since the word “burn” is used in this verse, it can be assumed that they made use of some sort of heat to dry the bricks. The use of this word does not necessarily indicate that a fire kiln was used. Although this is a possibility, there is no archaeological evidence of any fire kilns being used in Mesopotamia or in Palestine (Bullinger 1990).

The ancient mechanism for “burning” these bricks is unknown but it was likely to be sun drying. Sun drying bricks is still a common practice in Palestine (Unger 1988). There are “brick kilns” mentioned in Jeremiah 43:9 and Nahum 3:14, but the word “brickkiln”, (Hebrew malben) is more appropriately translated as brick-work or brick pavement meaning a paved area (Unger 1988). Jeremiah the prophet said “Take great stones in thine hand, and hide them in the clay in the brickkiln, which [is] at the entry of Pharaoh's house in Tahpanhes, in the sight of the men of Judah” (Jeremiah 43:9 KJV). This verse points out that the “brickkiln” was at the entrance to the Pharaohs house. It would be very strange to have an actual brick kiln at the entrance to a palace, so the only logical conclusion would be that Jeremiah 43:9 refers to brick pavement. The other verse in question is Nahum 3:14 “Draw for your self water for the siege! Strengthen your fortifications! Go into the clay and tread the mortar! Take hold of the brick mold” (NASB)! The King James Version of the Bible uses the word “brick-kiln” in lieu of the term “brick mold”.

The point of this verse is to make bricks so as to have a supply of bricks for repairing breaches in the ramparts, or to build new fortifications inside when the outer ones are taken by the foe.

Although the King James Bible translates the Hebrew word “Malben” as brick-kiln the proper translation is more likely brick mold in Nahum 3:14 and brick pavement in Jeremiah 43:9.

Although there is no mention of any fire kilns in the Bible and there is no archaeological evidence of such kilns in Israel, the wording of Genesis 11:3, “They said to one another, ‘Come, let us make bricks and burn {them} thoroughly’” (NASB), gives the impression that fire was used as a part of burning the brick thoroughly, possibly with a kiln of some sort. Since the wording is not only “Come, let us make bricks” but also “and burn them thoroughly” it indicates that this was a unique way of making bricks because these bricks were used to build the Tower of Babel, which was no ordinary building. This tower construction was undertaken with the intention of reaching the heavens and thus required more structurally sound construction. This was going to be the tallest building ever built, “Come, let us build for ourselves a city, and a tower whose top {will reach} into heaven” (Genesis 11:4). Because of the specific mention of burning them thoroughly it can be assumed that the bricks used for this tower were intentionally made to be strong, possibly stronger than the common bricks used at the time.

Mud-bricks are unfired bricks made of clay that were commonly used in Biblical times. This can be ascertained by a verse in Exodus where the Egyptian Pharaoh said, “You are no longer to give the people straw to make brick as previously; let them go and gather straw for themselves” (Exodus 5:7 NASB). Since straw was a common material used in mud-bricks, it can be concluded that even the Egyptians and Israelites used mud bricks in the early 1300’s B.C., prior to the Exodus in 1335 B.C. If there was any previous knowledge of brick kilns the Israelites would presumably have used them. The Tower of Babel bricks referred to in

Genesis 11:3 were produced a little over 800 years before the bricks referred to in Exodus 5:7. The logical conclusion as to the type of bricks that were used would be mud-bricks in both verses. It is unlikely that an advanced way of making bricks would have been forgotten, although it is possible especially considering the confusion that happened during the construction of the Tower of Babel. The entire project was abandoned by God as he changed the people's languages and dispersed them to different locations. The people who were scattered may very well have known why God scattered them and would not ever attempt to build such an edifice again, thereby negating the need to make the same type of bricks again. This is one possibility among many, but the evidence weighs heavier toward the idea that mud bricks were used in both verses.

In the book of Isaiah, the prophet says that Ephraim and the inhabitants of Samaria, in the pride of their heart said, "The bricks have fallen down, But we will rebuild with smooth stones; the sycamores have been cut down, but we will replace {them} with cedars" (Isaiah 9:10 NASB). Bricks must have been in common use in the time of Isaiah which was around 800 B.C. Since Ephraim wanted to replace the brick with the hewn stones, which are much more costly to make, it can be assumed that the stones were stronger than brick. Since modern day bricks are almost as solid as a rock there would be no need to tear down bricks to build with stone. This being the case, it would seem logical that the bricks in Isaiah's day were not nearly as strong as kiln fired bricks of today.

Clay

There are two Hebrew words for clay, *tit* and *homer*. *Tit*, rendered "mire", or "mud", for the fine deposit left from the evaporation of water (Psalm 69:14; Jeremiah 38:6) or in the sense of clay for bricks or pottery (Isaiah 41:25, 57:20; Nahum 3:4; Unger 1988). The Hebrew word "homer" is properly translated clay for bricks or pottery (Isaiah 29:16; 45:9; Jeremiah 18:4). In

Job 4:19 homer seems to indicate a mud hut, from the idea of being perishable (Unger 1988). Job says, “How much more those who dwell in houses of clay, whose foundation is in the dust, who are crushed before the moth” (Job 4:19 NASB)! Clearly clay was used to build houses in the time of Job. This use of the word “homer” does not clearly indicate whether it was clay-bricks or compacted clay.

Job is thought to be the earliest biblical author, prior even to the time of Moses. Genung (1913) states, “The story of the Book of Job is laid in the far-off patriarchal age, such a time as we find elsewhere represented only in the Book of Genesis; a time long before the Israelite state, with its religious, social and political organization, existed. Its place is ‘the land of Uz,’ a little-known region Southeast of Palestine, on the borders of Edom; a place remote from the ways of thinking peculiar to Israelite lawgivers, priests and prophets.” The statement in Job 4:19 could be dated as far back as hundreds of years before Moses whose life spanned approximately from 1550 to 1430 B.C. The assumption in this verse is that the people in that time lived in houses of clay. This is evident when considering the context, “Can mankind be just before God? Can a man be pure before his Maker? [18] He puts no trust even in His servants; and against His angels He charges error. [19] How much more those who dwell in houses of clay” (Job 4:19 NASB). Mankind is equated with those who dwell in houses of clay, suggesting the commonality of such huts.

Wood

There are numerous types of wood mentioned in the Bible, other than acacia and gopher wood, only four are mentioned as being used for construction, namely cedar, cypress, olive and algum. Cedar, the most common type of wood, is mentioned 51 times. In 1 Kings 5:6 King Solomon asked for cedar trees from Lebanon to build the temple and his personal house. In the Temple, cedar was used for the floors, walls, ceiling, and various articles that were to be placed

inside the Temple. In 1 Kings, it is stated, “The inside of the temple was cedar, carved with gourds and open flowers. Everything was cedar; no stone was to be seen” (1 Kings 6:18 NIV). In the temple, wood especially cedar was used to cover all structural stone. Not only was cedar used as a wall covering, it was used as structural timber, such as beams for the ceiling (1 Kings 7:12) and as pillars (1 Kings 7:3), and for the altar and various other instruments.

Cypress is another wood that was used for timber as well as a floor covering. There is some confusion as to what cypress really is. The Hebrew word “b@rowsh” is translated as fir in the King James Version of the Bible, whereas the New American Standard refers to this word as cypress. The Hebrew Lexicon (1996) defines the fir tree, Hebrew “b@rowsh”, as including cypress, fir, juniper, or pine because it literally means a noble tree. This wood was used for floor and wall planks of the temple of Jerusalem (1 Kings 5:22; 6:15, 34; 2 Chronicles 2:7; 3:5); for the decks of ships (Ezekiel 27:5); as well as for spears (Nahum 2:4); and instruments of music (2 Samuel 6:5). The only word translated as cypress in the KJV is the Hebrew word “tirzah” in Isaiah 44:14, but in the NASB it is translated as pine. Tirzah is not used in the context of building anything and therefore will not be necessary to discuss further. Cypress was used specifically as planks for floor covering in the temple (1 Kings 6:15), and as doors for the temple (1 Kings 6:34), and as rafters (Song of Solomon 1:17).

The Olive tree was like a staple for the Israelite community, not only did it produce olives to eat but olive oil was used for cooking, as fuel for lanterns, and even the wood of olive trees was used for building construction. There are a few verses in 1 Kings 6 that mention olive trees in connection with building construction, as follows:

Also in the inner sanctuary he made two cherubim of olive wood, each ten cubits high.
[31] For the entrance of the inner sanctuary he made doors of olive wood, the lintel {and} five-

sided doorposts. [32] So {he made} two doors of olive wood, and he carved on them carvings of cherubim, palm trees, and open flowers, and overlaid them with gold; and he spread the gold on the cherubim and on the palm trees. [33] So also he made for the entrance of the nave four-sided doorposts of olive wood (1 Kings 6:31-33 NASB).

The olive wood may have been used in other ways in construction but the only mention of it is in the verses just quoted. The cherubim are angelic figures that stood on the Ark of the Covenant with outstretched arms each five cubits long. The total span with the four wings was 20 cubits or about 30 to 32 feet. They were then overlaid with pure gold. The other use of olive wood was for the five sided door posts. Why olive wood was used for these is uncertain, but it may have had something to do with the contact with the dirt. Since pressure treated lumber was not in existence at that time, wood that was more resistant to weathering was preferred over others in such cases.

The Algom tree is only mentioned once in relation to building construction in the Bible, “From the algum trees the king made steps for the house of the LORD and for the king's palace, and lyres and harps for the singers; and none like that was seen before in the land of Judah” (2 Chronicles 9:11 NASB). One source of trees was in Lebanon as it says in 2 Chronicles, "Send me also cedar, cypress and algum timber from Lebanon” (2 Chronicles 2:8 NASB).

There are two more types of wood mentioned in the Bible that were used to make structures other than buildings, namely acacia wood and gopher wood. Acacia wood was used to make the Ark of the Covenant, a unique box used to hold Aarons rod that budded, the Ten Commandments and a jar of manna. Acacia wood was probably similar to oak or maple. According to the Hebrew lexicon it was a large tree growing in Egypt and Arabia, having very hard wood. Other items such as the table of showbread along with its poles to carry it, the

boards for the tabernacle and the altar of burnt offering were made of this wood and are recorded in the following verses:

Now Bezalel made the ark of acacia wood; its length was two and a half cubits, and its width one and a half cubits, and its height one and a half cubits (Exodus 37:1 NASB).

You shall make a table of acacia wood, two cubits long and one cubit wide and one and a half cubits high (Exodus 25:23 NASB).

You shall make the poles of acacia wood and overlay them with gold, so that with them the table may be carried (Exodus 25:28 NASB).

Then you shall make the boards for the tabernacle of acacia wood, standing upright. [16] Ten cubits {shall be} the length of each board and one and a half cubits the width of each board. [17] {There shall be} two tenons for each board, fitted to one another; thus you shall do for all the boards of the tabernacle (Exodus 26:15-17 NASB).

And you shall make the altar of acacia wood, five cubits long and five cubits wide; the altar shall be square, and its height shall be three cubits (Exodus 27:1 NASB).

Gopher wood was the building material Noah used to build the ark (Genesis 6:14), the first large ship. There is little information available to give an indication of what type of wood this was or if it is still in existence. Gopher is a word unknown elsewhere in Hebrew or allied languages. Some consider it to be connected with gophrith, meaning "brimstone," or "pitch," while others connect it with kopher, also meaning "pitch"; hence, along both lines, one reaches the probability of some resinous wood, such as pine, cedar, or cypress. A more probable explanation is that which connects gopher with the modern Arabic kufa, a name given to the boats made of interwoven willow branches and palm leaves with a coating of bitumen outside, used today on the rivers and canals of Mesopotamia (Masterman 1913).

Stone

Let it be known to the king that we have gone to the province of Judah, to the house of the great God, which is being built with huge stones (Ezra 5:8 NASB).

The main structural components of large buildings in biblical times were of hewn stone.

The hewn stones used to construct the temple were not little stones, they were huge, as large as

10 cubits square which would be equivalent to 15 square feet (1 Kings 7:10). They were used to lay the foundation, as well as the walls of the two temples and Solomon's houses. These large stone were said to be costly as it says in 1 Kings, "they quarried great stones, costly stones, to lay the foundation of the house with cut stone" (1 Kings 5:17 NASB). A stone cutter or wood cutter would hew, or cut out, a section of what they were working on. In Solomon's day he had vast amounts of hewers in the mountains of Israel hewing stone for the temple (2 Chronicles 2:1; 1 Kings 5:15). They brought back pieces ready to be put into place with flat surfaces. The majority of the references to hewing are in regard to stone as opposed to wood. Solomon had all of the buildings he had constructed made from hewn stone from the mountains. According to this verse it is better to build with hewn stone than to build with brick, "The bricks are fallen down, but we will build with hewn stones: the sycamores are cut down, but we will change [them into] cedars" (Isaiah 9:10 KJV). The use of stones was not limited to the construction of walls hewn from stone. Pillars were hewn from stone according to Proverbs 9:1, tombs were hewn from stone to bury the dead (Mark 15:46), and resting places were hewn from stone, "What right do you have here, And whom do you have here, That you have hewn a tomb for yourself here, You who hew a tomb on the height, You who carve a resting place for yourself in the rock" (Isaiah 22:16 NASB)?

The main structural components of smaller buildings were made of small stones plastered together at the base of the walls (Thompson 1986). Small stones were likely easier to find and were used by the poor to build their houses (Proverbs 24:31). The use of stone in construction, especially hewn stone, was a sign of wealth. Not only were large buildings built with hewn stones but also homes for the wealthy were built with hewn stones. Amos prophesied against the people of Israel saying, "Therefore because you impose heavy rent on the poor And exact a

tribute of grain from them, {Though} you have built houses of well-hewn stone, Yet you will not live in them; You have planted pleasant vineyards, yet you will not drink their wine” (Amos 5:11 NASB). There was seemingly a distinction between the types of stones used by the wealthy compared to the poor. Hewn stones required great effort to hew; a luxury only the wealthy could afford.

Metal

Archaeology verifies what the Bible conveys about the time periods in which different types of metals were in use. The “Copper-Stone age” lasted 1500 years (4500-3000 B.C.), then came the “Bronze Age” which lasted 1800 years (3000-1200 B.C.) in three different phases, then came the “Iron age” which lasted 900 years (1200-300 B.C.). The metals available to people in Biblical times were tin, copper, lead, gold, silver, bronze, brass, and iron. In 1 Chronicles David sums up what precious metals were available in his time and useful for building construction: "Now behold, with great pains I have prepared for the house of the LORD 100,000 talents of gold and 1,000,000 talents of silver, and bronze and iron beyond weight, for they are in great quantity; also timber and stone I have prepared..." (1 Chronicles 22:14). Around 1000 B.C. David said in 1 Chronicles 29:7 that iron was more abundant than Bronze because the people gave 100,000 talents of Iron but only 18,000 talents of bronze. This may verify that a shift had already taken place from the “Bronze Age” to the “Iron age”.

In the KJV It appears that copper was not mentioned until the time of Ezra, about 530 B.C., but the word used for copper, *nachosheth* {nekh-o'-sheth}, in that verse is translated bronze or brass 141 times in the NASB. Bronze is an alloy of copper and tin and was used to create utensils and to overlay items like the lamp stand in the tabernacle (Exodus 27:3, 17). Gold and silver were used in the same way. Gold was the most precious of these metals and was used

extensively in Solomon's temple, both for overlaying the actual structure as well as for overlaying many of the articles inside it (Exodus 25).

There were also other parts of the building that used metals such as bolts and bars for doors as seen in this verse regarding the second temple in Jerusalem: "Now the sons of Haseanaah built the Fish Gate; they laid its beams and hung its doors with its bolts and bars" (Nehemiah 3:3 NASB). Many other articles were either made or covered with precious metal as the following verses describe:

Now Bezalel made the ark of acacia wood; its length was two and a half cubits, and its width one and a half cubits, and its height one and a half cubits; [2] and he overlaid it with pure gold inside and out, and made a gold molding for it all around. [10] They shall construct an ark of acacia wood two and a half cubits long, and one and a half cubits wide, and one and a half cubits high (Exodus 25:1-2,10 NASB).

Then you shall make a lamp stand of pure gold. The lamp stand {and} its base and its shaft are to be made of hammered work; its cups, its bulbs and its flowers shall be {of one piece} with it (Exodus 25:31 NASB).

And you shall make the altar of acacia wood, five cubits long and five cubits wide; the altar shall be square, and its height shall be three cubits. [2] You shall make its horns on its four corners; its horns shall be of one piece with it, and you shall overlay it with bronze. [3] You shall make its pails for removing its ashes, and its shovels and its basins and its forks and its fire pans; you shall make all its utensils of bronze. [4] their bands {shall be} of silver. [17] All the pillars around the court shall be furnished with silver bands {with} their hooks of silver and their sockets of bronze. [18] The length of the court {shall be} one hundred cubits, and the width fifty throughout, and the height five cubits of fine twisted linen, and their sockets of bronze. [19] All the utensils of the tabernacle {used} in all its service, and all its pegs, and all the pegs of the court, {shall be} of bronze (Exodus 27:1-4, 17-19 NASB).

David prepared large quantities of iron to make the nails for the doors of the gates and for the clamps, and more bronze than could be weighed (1 Chronicles 22:3 NASB).

Plaster

Ever since the beginning of time people have desired to make their homes beautiful on the inside and out. In the book of Leviticus it is revealed that the interior walls were covered with plaster. The actual material used was most likely lime. According to Unger (1988) several

Hebrew terms are given as “plaster” in the KJV, NIV and NAS. In Deut. 27:2, 4 the noun “sid”, meaning “to cover with lime,” is rendered “plaster” in the KJV and NIV, but it is plainly lime, from Isaiah 33:12 and Amos 2:1, and is so translated in the NASB. In Ezekiel 13:12, “tiah”, is translated as “plaster” in the NASB, as “daubing” in the KJV, and as “whitewash” in the NIV (Unger 1988). The word, apar, is also rendered “plaster” in the NASB and NIV, although it literally means “powdered” (Unger 1988). Regardless of how these words are translated, all three indicate that there was a substance used upon the walls to cover the stone, wood or brick.

Plasters main purpose was, not to protect from the elements but, to simply beautify the insides of buildings. There is no way to determine how long it lasted once applied, but the Bible, in the book of Leviticus, makes it clear that plaster was placed upon stones and possibly timbers. Since it is referred to as whitewash, it was most likely the color white, but it could have been other colors as well. Plaster is mentioned in Leviticus in conjunction with the presence of mold or mildew. The process of successfully addressing the mold problem is described:

He shall have the house scraped all around inside, and they shall dump the plaster and replaster the house. [43] If, however, the mark breaks out again in the house after he has torn out the stones and scraped the house, and after it has been replastered, [44] then the priest shall come in and make an inspection. If he sees that the mark has indeed spread in the house, it is a malignant mark in the house; it is unclean. [45] He shall therefore tear down the house, its stones, and its timbers, and all the plaster of the house, and he shall take {them} outside the city to an unclean place (Leviticus 14:41-45 NASB).

The following verse in Ezekiel makes it clear that the plastered whitewash was not able to withstand the elements. This verse also seems to indicate that the people in ancient Israel may have used this whitewash to cover their exterior walls in hopes of protecting the walls from the effects of the elements:

It is definitely because they have misled My people by saying, 'Peace!' when there is no peace. And when anyone builds a wall, behold, they plaster it over with whitewash; [11] {so} tell those who plaster {it} over with whitewash, that it will fall. A flooding rain will come, and you, O hailstones, will fall; and a violent wind will break out. [12] Behold, when the wall has fallen, will you not be asked, 'Where is the plaster with which you

plastered {it?}' [13] Therefore, thus says the Lord GOD, I will make a violent wind break out in My wrath. There will also be in My anger a flooding rain and hailstones to consume {it} in wrath. [14] So I will tear down the wall which you plastered over with whitewash and bring it down to the ground, so that its foundation is laid bare; and when it falls, you will be consumed in its midst. And you will know that I am the LORD (Ezekiel 13:10-14 NASB).

Jesus commented on how whitewash was used in his day, “Woe to you, teachers of the law and Pharisees, you hypocrites! You are like whitewashed tombs, which look beautiful on the outside but on the inside are full of dead men's bones and everything unclean” (Matthew 23:27 NIV).

Whitewash seems to be similar to paint that covers up what is ugly to make it more attractive.

Paul uses the word “whitewash” in the same way as Jesus used it, “Then Paul said to him, ‘God will strike you, you whitewashed wall! You sit there to judge me according to the law, yet you yourself violate the law by commanding that I be struck’” (Acts 23:3 NIV)! Paul’s use of the word “whitewash” indicated that he thought the Jewish high priest he was speaking to was not what he appeared to be on the outside. He looked like a righteous man but was in fact a hypocritical law breaker. Plaster, or whitewash, was therefore useful for covering things up, but not for protecting structures from the elements.

Other Construction Related Materials

There were many different materials available in the earliest biblical times/late Bronze age. The construction of the Tabernacle is of interest in determining what most houses were like in that time period. Since most of the people of Israel lived in tents, and the Tabernacle was a tent, there is, no doubt, some resemblance in terms of materials. Exodus 35:6 mentions the use of such materials as “fine twisted linen, goats' {hair}, rams' skins, porpoise skins, acacia wood, blue and purple and scarlet {material}”. The following passages from Exodus discuss how these materials were used for the Tabernacle:

Moreover you shall make the tabernacle with ten curtains of fine twisted linen and blue and purple and scarlet {material;} you shall make them with cherubim, the work of a skillful workman. [2] The length of each curtain shall be twenty-eight cubits, and the width of each curtain four cubits; all the curtains shall have the same measurements. [7] Then you shall make curtains of goats' {hair} for a tent over the tabernacle; you shall make eleven curtains in all. [16] Ten cubits {shall be} the length of each board and one and a half cubits the width of each board. [17] {There shall be} two tenons for each board, fitted to one another; thus you shall do for all the boards of the tabernacle. Then you shall erect the tabernacle according to its plan which you have been shown in the mountain. [31] You shall make a veil of blue and purple and scarlet {material} and fine twisted linen (Exodus 26:1-2, 7, 15-17, 31).

CHAPTER 6 LABOR

There are very few sources in ancient times that reveal much about skilled construction labor. In fact, there is a great mystery as to how great structures such as the Pyramids, Stone Henge and others were built. Archaeologists studying ancient civilizations often report being “amazed” or “surprised” at the level of man’s skill in the distant past. In some ancient cultures there was a vast amount of knowledge and skill. For example, “in the ancient city of Sacsahuaman, near the city of Cuzco, Peru, there is a magnificent wall built by the Incas, deliberately using irregularly shaped blocks of stone. Some of the blocks weigh as much as 100 tons and are so accurately fitted together that still today it is not possible to insert a piece of paper in the joints between the blocks. Even more incredible, however, is a larger stone block in the area. The size of a five-storey house and weighing an estimated 20,000 tons, the builders of Sacsahuamán could, and somehow did, move this block! The feat of moving such a staggering weight has never been attempted, let alone duplicated, with modern machinery. Even the largest crane in the world today is capable of lifting only about 7,000 tons” (Cardno 1998).

Construction labor is typically referred to as either skilled or non skilled. Skilled labor includes such professions as; carpenters/framers, masons, cement masons, iron-workers, equipment operators, cabinet makers, electricians, plumbers, tile-setters, engineers, architects, mechanical engineers, etc. Non-skilled workers are either helpers for each of the trades, day laborers who only help temporarily on job sites, or low skill positions such as roofers, painters, and dry wall crews. In Biblical times there were also both skilled labor and non skilled labor, but there was a greater need for non skilled labor to perform duties such as carrying or moving large stones and logs (1 Kings 5:18). In Solomon’s time he forced the foreign captives of war to do these undesirable, menial tasks. This allowed the Israelites to do the more desirable skillful tasks

of working with gold, brass, silver, managing, etc. This division, between skilled and non skilled work, is still very evident today among different construction trades, the main difference being that there is freedom for people to excel and move on to more enjoyable jobs.

The events described in this chapter took place between 900 B.C. and 90 AD. Much of the information available in the Bible regarding the topic of “labor” is in relation to Solomon’s Palace and Solomon’s Temple, which were built in the latter half of the 9th century B.C. Therefore the majority of the information regarding labor in the Bible dates back to Solomon’s time, who reigned as King between 965-926 B.C.

Management

Construction projects are completed on time, within budget, with quality, and with safety as a result of good management. Management can either make or break a company. In Biblical times, management was a huge part of each project. In references to the construction of buildings there is frequent mention of management. For example, when Solomon had numerous building projects with thousands of workers, 1 Kings says that “There were also the chief officials in charge of Solomon's projects—550 officials supervising the men who did the work” (1 Kings 9:15-23). A workforce of 24,000 men, over the age of 30, was assigned to oversee the work of the house of the LORD (1 Ch 23:1-5 NASB). Zerubbabel had men who were labeled “chief among them” while constructing the second temple (Ezra 5:10). Sharing the responsibility of leading through management positions was a concept that greatly benefited Moses when his uncle suggested that he have leaders of ten, of fifty, of one hundred, and of one thousand. Once Moses instituted management roles, issues with the people were resolved much quicker.

Completed on Time

When building the temple, Solomon had 150,000 workers being managed by 3,600 supervisors “to make the people work” (2 Ch 2:18 NASB). When doing hard labor workers naturally have a desire for relief, pleasure, rest, or leisure. Solomon understood this and in order to increase the productivity of his workers he had approximately one supervisor for every 42 workers. His tool to keep workers productive on the job was the whip (2 Chronicles 10:11). This would ensure that tasks were completed in a timely fashion.

The time pressures that come from deadlines set into contracts create the need to get things done in a timely fashion. There are no Biblical references to contracts in construction that would create this type time pressure. The only pressures originated from the desires of the owner. Most large structures were constructed by kings who had the authority to force workers to work on a specific schedule without the need for a contract. According to Jeremiah, houses were sometimes built by hiring neighbors to do the work (Jeremiah 22:13). These agreements were most likely based on verbal contracts without time restraints.

Completed within Budget

Even though Solomon was extremely wealthy there is reason to believe he had concerns about the budget. He wrote in Proverbs that the righteous save up for their children’s children (Proverbs 13:22), that wisdom is to be desired above riches (Proverbs 16:16), and that the first part of a person’s income is to be given to the Lord (Proverbs 3:9, 10). All of these principles would indicate a practice of being wise with finances, as opposed to flagrantly spending. He may not have spared any expense on the temple, but the other houses that he had built were not quite as ornate and costly. The inside of Solomon’s personal house could have been layered with gold like the Temple or Donald Trump’s house but he decided against it, indicating restraint in

spending. Whether he had a budget is uncertain, but it is certain that decisions were made in light of the cost.

Solomon made a deal with Hiram, king of Tyre to get the wood needed for his construction projects. Solomon asked for cedar, cypress, and algum wood and promised to pay wages for the workers. The exchange between these two kings went back and forth. They came to an agreement where Solomon would provide Hiram's household and the woodsmen who cut the timber, 20,000 kors of crushed wheat and 20,000 kors of barley, and 20,000 baths of wine and 20,000 baths of oil year by year in exchange for all the cypress, cedar and algum Solomon needed, along with a master craftsman to work with Solomon's skilled men (2 Chronicles 2:7-10). Trees take about 20 to 30 years to replace themselves, so Hiram thought that it would be fair to have food each year for at least that long. This deal was pleasing to both Solomon and Hiram. The cost to Solomon for the wheat and oil was probably minimal because Canaan/Israel was a land of wheat and barley (Deuteronomy 8:8). Olive trees were also in abundance just as Cedar and Cypress trees were in abundance in Tyre. This interaction between Hiram and Solomon is one example of how financial decisions regarding construction were made in Biblical times.

The financial decisions that were made regarding the second temple, in the days of Zerubbabel were quite different. The Israelites had been in captivity for many years when Cyrus, king of Persia, issued a decree for the Jews to rebuild the temple (Ezra 1:1). He supplied them with the confiscated materials that were originally in the first temple, "Now this {was} their number: 30 gold dishes, 1,000 silver dishes, 29 duplicates; [10] 30 gold bowls, 410 silver bowls of a second {kind and} 1,000 other articles" (Ezra 1:9-10 NASB). More finances were gathered through the generous freewill offerings of the people the Jews lived among, "All those

about them encouraged them with articles of silver, with gold, with goods, with cattle and with valuables, aside from all that was given as a freewill offering” (Ezra 1:6 NASB). Because the Israelite nation was starting over they only had what was given to them. Therefore they were on a fixed budget which was determined by whatever they received through the freewill offerings of others. The difference in the budget is clearly seen in the differences between the first and second temples. They were so different that the people who had seen the first temple wept about the less glorious second temple.

Completed Safely

There is no shortage of conflict on construction sites today, nor was there 3000 years ago. Exodus 21:18-19 says, "If men have a quarrel and one strikes the other with a stone or with {his} fist, and he does not die but remains in bed, [19] if he gets up and walks around outside on his staff, then he who struck him shall go unpunished; he shall only pay for his loss of time, and shall take care of him until he is completely healed” (NASB). There were very precise instructions on how to deal with an injury caused by another. In this case where one man injures another with sufficient severity to cause him to need to be bed ridden for a time, the offender must take care of him until he is thoroughly healed and pay for his lost time at work. If the man dies the offender would be put to death as it says in Exodus 21:12 "He who strikes a man so that he dies shall surely be put to death.”

The issue of construction safety is not directly dealt with in the Bible, but there are guiding principles that were most likely followed. For example, the 150,000 workers which were made up of 70,000 who bore burdens and 80,000 stonemasons were aliens. The 3,600 supervisors were also aliens. Solomon was generally obedient to God and would be familiar with this scripture in Exodus regarding aliens:

You shall not wrong a stranger or oppress him, for you were strangers in the land of Egypt. [22] "You shall not afflict any widow or orphan. [23] "If you afflict him at all, {and} if he does cry out to Me, I will surely hear his cry; [24] and My anger will be kindled, and I will kill you with the sword, and your wives shall become widows and your children fatherless (Exodus 22:21-24).

Solomon, being a man of God, thought about the safety of these workers in different ways. He had set work hours that were bearable, and supervisors who did not inflict unnecessary harm, although the whip was the tool to keep workers working (2 Chronicles 10:11).

In order to bring back all the wood that was delivered part way by King Hiram of Tyre, the book of Kings says, "King Solomon levied forced laborers from all Israel; and the forced laborers numbered 30,000 men. [14] He sent them to Lebanon, 10,000 a month in relays; they were in Lebanon a month {and} two months at home" (1 Kings 5:13 NASB). Solomon was concerned about the well being of his workers. Having two months off gave time for workers to be with their families as well as sufficient rest to energize them for their next work period. Solomon was not a man given to extremes as he says, "the man who fears God will avoid all extremes" (Ecclesiastes 7:18 NIV). Therefore he did not subject other men to unbearable extremes.

Rehoboam, Solomon's son, did not follow the decrees of God and increased the burdens laid on the workers saying, "and now, whereas my father put a heavy yoke on you, I will add to your yoke; my father chastised you with whips, but I [will chastise you] with scourges" (2 Chronicles 10:11 NKJV)! The scourging referred to in this verse tears the skin much quicker than whipping which in turn causes more severe lacerations. This action of King Rehoboam led to a revolt by the people, proving that Solomon's treatment, although hard, was humane. Today there are still positions in construction companies which require supervision to keep workers working. The whip has been replaced with yelling, fear of getting fired, reduction in work status, or another form of punishment that is not physical.

Completed with Quality

At times there are shortages of skilled labor due to the rising numbers of new construction projects or the public's decreased interest in building trades. This transition into increased construction needs was seen in King David's time. "Hiram king of Tyre sent messengers to David with cedar trees and carpenters and stonemasons; and they built a house for David" (2 Samuel 5:11 NASB). There was a need for both carpenters and stonemasons and this need was met through a trade agreement with Hiram, king of Tyre. King David could have used the knowledge and labor of the native Jews in Jerusalem but he wanted the highest quality building possible and sought the most qualified builders.

King Solomon had every single stone block which was used for his construction projects cut in the field so that no hammer was heard on site (1 Kings 6:7). This style of building, which was not practiced by other nations required meticulous attention to detail. Solomon also made sure that all of the materials used were of the best quality. He gathered materials from other nations and spared no expense when building the temple of God in Jerusalem (1 Kings 5:17). His buildings were uniquely constructed with the best quality materials he could find.

This emphasis on quality is also seen in the construction of the second temple, which was built with great care as it says in the book of Ezra, "Let it be known to the king that we have gone to the province of Judah, to the house of the great God, which is being built with huge stones, and beams are being laid in the walls; and this work is going on with **great care** and is succeeding in their hands" (Ezra 5:8 NASB). Building with quality products and quality workmanship in construction produces longer lasting structures. Each of the two temples built in Jerusalem lasted over 400 years. Both of them would have lasted centuries longer, possibly even until now, if they had not been destroyed by Israeli adversaries. One lesson that can be gained from this history regarding ancient builders is that the benefit of building with quality far

outweighs that of building cheaply. “Quality built” construction may cost more upfront but it is less expensive in the long run.

Forced Labor

Forced labor is labor where individuals are forced to do work at the will of their task master. The type of labor people were forced to do was generally the physically exhausting work that people were not very willing to do for pay. According to the 1 Kings 9, Solomon used only foreigners as forced laborers. These laborers were the people who; quarried stone, carried stone, cut logs, and carried logs. These tasks were not punishment given to the people but rather necessary tasks to carry on construction. The following passage details who the forced laborers were and what they built:

Now this is the account of the forced labor which King Solomon levied to build the house of the LORD, his own house, the Millo, the wall of Jerusalem, Hazor, Megiddo, and Gezer. [16] {For} Pharaoh king of Egypt had gone up and captured Gezer and burned it with fire, and killed the Canaanites who lived in the city, and had given it {as} a dowry to his daughter, Solomon's wife. [17] So Solomon rebuilt Gezer and the lower Beth-horon [18] and Baalath and Tamar in the wilderness, in the land {of Judah,} [19] and all the storage cities which Solomon had, even the cities for his chariots and the cities for his horsemen, and all that it pleased Solomon to build in Jerusalem, in Lebanon, and in all the land under his rule. [20] {As for} all the people who were left of the Amorites, the Hittites, the Perizzites, the Hivites and the Jebusites, who were not of the sons of Israel, [21] their descendants who were left after them in the land whom the sons of Israel were unable to destroy utterly, from them Solomon levied forced laborers, even to this day. [22] But Solomon did not make slaves of the sons of Israel; for they were men of war, his servants, his princes, his captains, his chariot commanders, and his horsemen. [23] These {were} the chief officers who {were} over Solomon's work, five hundred and fifty, who ruled over the people doing the work (1 Kings 9:15-23 NASB).

“The Hebrew slaves fared far better than the Grecian, Roman and other slaves of later years. In general, the treatment they received and the rights they could claim made their lot reasonably good. Of course a slave was a slave, and there were masters who disobeyed God and even abused their ‘brothers in bonds’” (Rafferty 1913). Though the treatment of the Israelite slaves was better than some other cultures it was still difficult and unappealing.

Skilled Labor

He has filled them with skill to perform every work of an engraver and of a designer and of an embroiderer, in blue and in purple {and} in scarlet {material,} and in fine linen, and of a weaver, as performers of every work and makers of designs (Exodus 35:35 NASB).

The ancient Israelites understood that those who possessed artistic skills received them from God. They used these skills in construction, just as modern day architects use their artistic and creative mind to design buildings. Buildings would not have evolved into what they are today if it had not been for individuals that utilized their skill and creativity in construction. One lesson that can be learned from the Bible is that all skill comes from God and is to be used for His purposes (Exodus 31:1-6). He desires diligence and productivity in the use of the skills he has given mankind (Proverbs 6:6-8; 12:24).

The Ancient Israelites valued hard work and the skill it produced. The Bible does not include every detail about skilled tradesmen, but it is clear that being a skilled tradesman was a noble goal. As Solomon stated, “Do you see a man skilled in his work? He will stand before kings; He will not stand before obscure men” (Proverbs 22:29 NASB). Though not all skilled men will stand before kings, those who are skilled are worthy of such an honor. This wisdom, from the lips of Solomon, although ancient, applies to everyone everywhere. It transcends differences in culture, geography, language, gender, technology, and is never outdated. It has proven pertinent throughout history. What was true then is still true today.

Conversely, Solomon also said, “Poor is he who works with a negligent hand, But the hand of the diligent makes rich” (Proverbs 10:4 NASB). Solomon believed in hard work not only for others but also for himself. Given the chance to ask for anything from God, Solomon asked for wisdom to rule the people well. This incident revealed Solomon’s heart, the heart of a diligent worker, who only wanted to be able to do his job well. He was greatly rewarded with power, riches and peace for his country.

Payment of Workers

Biblically a laborer is worthy of his wages (1Timothy 5:18). If a worker completes work for another, the righteous thing to do is to make prompt payment to the worker. If a worker does not receive payment, the Bible relates this to muzzling an ox while it is threshing; meaning that without the nourishment from food the ox would not be able to continue threshing. The following verses make it clear that not only should laborers be paid but that prompt payment was required of the Jews in all trades including construction.

You shall give him his wages on his day before the sun sets, for he is poor and sets his heart on it; so that he will not cry against you to the LORD and it become sin in you” (Deuteronomy 24:15 NASB).

You shall not oppress your neighbor, nor rob {him.} The wages of a hired man are not to remain with you all night until morning (Leviticus 19:13 NASB).

The law of God was that a man, who worked, was to be rewarded for his work. It was considered sinful and unrighteous to withhold payment from a worker. This may have been far too common a practice in Israel since the prophet Jeremiah addressed it this way,

Woe to him who builds his house without righteousness And his upper rooms without justice, Who uses his neighbor's services without pay And does not give him his wages, [14] Who says, 'I will build myself a roomy house With spacious upper rooms, And cut out its windows, Paneling {it} with cedar and painting {it} bright red.' (Jeremiah 22:13-14 NASB).

Jeremiah addressed the temptation to cheat others in construction. There are many companies that have violated this Biblical law by not paying the subcontractors after contractual duties were accomplished. Jeremiah says, “Woe to him who builds his house without righteousness”. There are natural consequences that take place when unrighteousness is committed. Proverbs says it this way, “he who sows iniquity will reap sorrow” (Proverbs 22:8 NKJV), or “He who digs a pit will fall into it, and he who rolls a stone, it will come back on him” (Proverbs 26:27 NASB).

Day Laborers

In Ancient Israel there were times where jobs were scarce and people waited on street corners for jobs similar to the day laborers of today. Jesus shared the following parable about fair payment of these day laborers, "For the kingdom of heaven is like a landowner who went out early in the morning to hire laborers for his vineyard. [2] "When he had agreed with the laborers for a denarius for the day, he sent them into his vineyard. [3] "And he went out about the third hour and saw others standing idle in the market place; [4] and to those he said, 'You also go into the vineyard, and whatever is right I will give you.' And {so} they went" (Matthew 20:1-4 NASB). All of the men that were hired, although hired at different times of the day, received the same pay. Jesus made the point that if you received what you were promised that it was a fair payment.

Trades

The trades that were in existence in Biblical times are not all mentioned in the Bible. For example the architects, engineers and plumbers for the various buildings are not mentioned. Except for one verse alluding to a water shaft, plumbing is not mentioned at all, although archaeology has validated that plumbing was in existence in ancient Minoa, Inca, Israel and many other places. Every building has an architect but the only architects mentioned in the Bible are God (Exodus 25:9) and Paul, who compares himself to an architect (1 Corinthians 3:10). It is evident that someone fulfilled the role of architect and engineer in order to create such massive and long lasting buildings, such as Solomon's houses and the temple in Jerusalem. The various construction related trades and tradesmen that are mentioned in the Bible are as follows: brickmaking, plastering, glass-making, carpentry, builders, masons, hewers, coppersmiths (2 Timothy 4:14), goldsmiths, silversmiths, and iron smiths, workers in bronze, stone-cutters; and engravers (2 Kings 22:6; 2 Chronicles 2:14). There are other trades that have some relation to

construction such as workers in purple, violet, linen and crimson fabrics, but these are mostly for decorative purposes. Another semi construction related trade is that of tent making. Though today it is unheard of to live in a tent, many ancient people did (Acts 18:3), hence the need for tent makers. Just as the ancients had trades, today many subcontractors choose to specialize in one particular area of construction.

Builders

The term builder has differing meanings. In some verses it appears that the builders are the workers such as the hewers and the stone cutters (Ezra 3:10). 1 Kings reveals the same thing, “Then the king commanded, and they quarried great stones, costly stones, to lay the foundation of the house with cut stones. [18] So Solomon's builders and Hiram's builders and the Gebalites cut them, and prepared the timbers and the stones to build the house” (1 Kings 5:17-18 NASB). In 2 Kings, builders are described as separate and different from carpenters and masons, “to the carpenters and the builders and the masons and for buying timber and hewn stone to repair the house” (2 Kings 22:6 NASB). According to this verse carpenters and masons are not considered builders. The task these trades are associated with is “buying timber and hewn stone”, possibly linking “builders” with the tasks of stone cutters and hewers. This leaves room for the possibility that the builders are hewers, stone cutters and carriers as in Ezra 3 and 1 Kings 5. The Hebrew word translated as builder in 2 Kings 22:6 is *banah* {baw-naw'}, which refers to one who builds walls, houses, temples, defenses, etc.. The term “builder” may also have been used as a generic term to describe anyone who built buildings.

The term builder may also refer to the construction manager. 1 Kings 5:17 refers to what was done by the stonecutters and hewers as done by builders: Whenever project managers or superintendents complete projects under their management, they take ownership of them as if they built them themselves. For example, Zerubbabel was credited with laying the foundation of

the second temple in Jerusalem (Zechariah 4:9). The group that gets the credit for completing a building is management. Therefore “Solomon's builders and Hiram's builders” may have been the managers or builders of the work as opposed to the actual laborers. As mentioned previously, the word builder is distinct from carpenters and masons (2 Kings 22:6), allowing for the interpretation that the builders were the agents who made things happen.

Another use of the word “builder” is from the Greek word “technites”. The term is associated with artificer or architect. In the book of Hebrews, God himself is referred to as the architect and builder of the New Jerusalem (Hebrews 11:10). Paul refers to himself as a wise master-builder (1 Corinthians 3:10-15), which comes from the Greek word, “architekton” or **ἀρχιτεκτων**. Therefore there are a three possible uses of the word builder in the Bible, stone cutters and hewers, managers, and architects.

Brickmaking

The skill of laying bricks is one of the oldest known construction trades. “This industry probably originated in Babylonia, but the knowledge of the process was carried to Egypt early on (Patch 1913), where the Hebrews, along with other captives, were later driven to making the bricks for the Egyptian kings (Exodus 5). It is clear that making bricks was a more undesirable task otherwise Egypt would not have employed slaves to do this work. The bricks they were making were a made of a mixture of clay and straw. Another name for these bricks is sun-dried bricks. Patch (1913) states that “The making of sun-dried bricks called for little skill, but the firing and glazing of bricks required trained workmen.” Therefore brickmaking incorporated both skilled and unskilled labor.

Carpentry

The carpenter stretcheth out [his] rule; he marketh it out with a line; he fitteth it with planes, and he marketh it out with the compass, and maketh it after the figure of a man, according to the beauty of a man; that it may remain in the house (Isaiah 44:13 KJV).

{Another} shapes wood, he extends a measuring line; he outlines it with red chalk. He works it with planes and outlines it with a compass, and makes it like the form of a man, like the beauty of man, so that it may sit in a house (Isaiah 44:13 NASB).

A carpenter was a skilled wood-worker. Wood was extensively used by ancient builders because of its availability and strength. Numerous references are made to the carpenters work in building the temple and the subsequent repairing of the temple (1 Kings 5:6; 2 Chronicles 2:3; 2 Kings 12:11; 2 Chronicles 24:12; 2 Kings 22:6; Ezra 3:7; 4:1). Carpentry or wood-working was needed in the construction of the tabernacle (Exodus 25). There were numerous other uses for the skills of a wood-worker in Biblical times, such items include idols carved from wood (Deuteronomy 29:17, 2 Kings 19:18, Isaiah 37:19), ships of cypress, with masts of cedar wood and oars of oak (Ezekiel 27:5,6), threshing instruments and yokes made of wood (2 Samuel 24:22), pulpits made of wood (Nehemiah 8:4), chariots made of wood (Song of Solomon 3:9), and wooden carts to carry things (1 Samuel 6:7). The carpenter was an essential trade with a wide range of uses. What was known as the carpenter in ancient times has been divided up into separate specialized trades today.

Hewing

The Hebrew word for hewer is “chatsbh” from the root “to cut” or “to carve”. The word is used for both hewers of stone (1 Kings 5:15, 2 Kings 12:12; 1 Chronicles 22:15; 2 Chronicles 2:18), and hewers of wood (Joshua 9:17, 21, 23; 2 Chronicles 2:10; Jeremiah 46:22). As it says in Joshua, "Now therefore, you are cursed, and you shall never cease being slaves, both hewers of wood and drawers of water for the house of my God" (Joshua 9:17, 21, 23 NASB), gathering wood was a menial task that did not require much skill.

Engraving

Among the peoples with whom the Jews came in contact, stone-cutting had reached a high degree of perfection. No stone proved too hard for their tools. In Egyptian and Phoenician tombs the carving was often done on plastered surfaces (Patch 1913). Solomon had the interior walls of the temple engraved with cherubim (1 Kings 6:8). This makes it evident that the skillful art of engraving was in use during the building of the temple.

Glass-Making

In Deuteronomy 33:19, "hidden treasures of the sand" is interpreted by some to mean the making of glass objects from the sand (Patch 1913). There can be no question about the Hebrews being acquainted with glass-making, as its history extends back to very early times (Job 37:18). Glass is mentioned a number of times in the Bible. The Biblical writer, Paul, indicates that glass was used as a mirror and only reflected things dimly (1 Corinthians 13:12). Another Biblical writer, John, says that glass was transparent (Revelation 21:21). Other references refer to glass in the context of a mirror (2 Corinthians 3:18; James 1:23). There is no Biblical reference to connect glass making with construction except a passage in the book of Revelation which states, "and before the throne {there was something} like a sea of glass, like crystal (Revelation 4:6 NASB). This "sea of glass" was a foundation or floor of some material like glass, that will be created in the future but it was not glass. Although glass was in use in Biblical times, there is no Biblical evidence of its use in construction.

Masons

The word mason comes from the translation of four Hebrew words: charash 'ebhen, "graver of stone" (2 Samuel 5:11); gadhar (2 Kings 12:12) and charash qur (1 Chronicles 14:1); "maker of a wall (or hedge)" and chatsabh, "a hewer or digger (of stones)" (1 Chronicles 22:2; Ezra 3:7; Patch 1913). Archaeology has revealed that random rubble masonry, unskillfully laid,

was the prevailing characteristic in Israel. Occasionally a piece of carefully dressed masonry is found, but it is the exception and is often a re-use of an earlier type akin to "sawed stone" from the time of Solomon (Patch 1913). The unskillfully laid rubble masonry discovered in archaeology may have been the work of individual home owners rather than the masons described in the time of the Kings of Israel. In the time of King David, stonemasons were sent from Tyre to help build his personal house (2 Samuel 5:11). During King Solomon's reign as king, masons were used for building the walls of cut stone (1 Chronicles 22:15). In the Bible masons are mentioned in conjunction with the construction of the walls of large buildings and city walls, but no reference in connection with smaller houses, although it is very likely that masons were involved with helping build many of the walls of houses that existed in Israel.

Stonecutting

Stonecutters were hewers of stone. King Solomon had 80,000 hewers of stone go into the mountains to hew or quarry large stones to build the temple and his houses. These men were foreigners who were captives of war working as forced laborers (1 Chronicles 22:2; 2 Chronicles 2:17, 18). Stonecutters had the difficult task of cutting blocks from mountain sides or large boulders. This task required the skill to cut perfectly flat sides from hard to cut rounded objects. In King David's and King Solomon's reign the stones were to be cut to size without any modifications done on site. This could only be accomplished with the greatest care and skill. Although this work required skill it was done by forced labor because of its laborious nature. There are no trades that compare to the stonecutters in Biblical times because we now use machinery to accomplish what they once did by hand.

Metal-Working (Smith)

Among the oldest objects that have been preserved from ancient times are those of silver, gold and bronze. These are proof that the ancients understood the various processes of mining,

smelting, refining and working metals (Patch 1913). The Bible makes reference to the smith in the following passage,

The smith with the tongs both worketh in the coals, and fashioneth it with hammers, and worketh it with the strength of his arms: yea, he is hungry, and his strength faileth: he drinketh no water, and is faint (Isaiah 44:12 KJV).

So the craftsman encourages the smelter, {And} he who smooths {metal} with the hammer {encourages} him who beats the anvil, Saying of the soldering, It is good; And he fastens it with nails, {So that} it will not totter (Isaiah 41:7 NASB).

{As for} the idol, a craftsman casts it, A goldsmith plates it with gold, and a silversmith {fashions} chains of silver (Isaiah 40:19 NASB).

According to these verses the job of a smith or smelter required long hours of focused attention. Timing is certainly important when working with liquid metals. Every part of the process has to take place within the proper lengths of time. Smiths formed a number of metals such as gold, silver, brass, copper, iron and bronze. Smith's created tools, weapons, and building components of beaten or turned work (Exodus 25:18). The Bible records that smith's not only refined impure metals (Proverbs 17:3;25:4;27:21) and shaped items, they also performed such skills as soldering (Isaiah 41:7), and plating or overlaying (Exodus 25:11; 1 Kings 6:20). The temple Solomon built was completely overlaid with gold on the inside because of the skillful art of the gold smith (Patch 1913).

Plastering

According to James A. Patch (1913) The ancients preferred plastered surfaces for decorating, and even the finest granite was covered with stucco on which to paint or carve the decorations (Deuteronomy 27:2; Daniel 5:5). Columns were often first stuccoed and then painted. The job of a plasterer was to create the proper mixture that would not only stick to the building and protect it from the elements, but provide a more attractive surface than the one

covered. There is no evidence that there was a tradesman called a plasterer but plastering certainly was a task performed in Biblical times.

CHAPTER 7 TOOLS

Since the beginning of time men have been inventing ways to accomplish tasks easier. This was mainly done through the use of tools. The earliest recorded tool-maker in history is in the Bible. It says in Genesis, “Zillah also had a son, Tubal-Cain, who forged all kinds of tools out of bronze and iron” (Genesis 4:22). Tubal Cain lived somewhere between 3850-2500 B.C. Without tools many of the tasks humans have undertaken would not have been possible. From simple tasks like cutting a tree down, to extremely complicated ones like open heart surgery would never take place if it were not for the invention of various tools.

Today, the use of tools is an essential part of almost every construction task accomplished. Most industries are dependent upon tools and machinery of some sort to do business, especially the computer. As technological advances are made, tools are improved and productivity is increased. A surveyor now uses tools that have digital readout combined with laser accuracy. Newer cranes are digitally controlled to avoid overload, some new models of heavy machinery have devices that communicate by satellite to reveal maintenance needs, etc. The expectations on production are a product of the tools used. The better a tool is, the greater the productivity. Man has been creating more efficient ways to accomplish the tasks since Tubal Cain. In Biblical times there may have been some mechanical inventions to accommodate building large structures. Such inventions include pulleys, wheels, wedges, derricks, cranes, and scaffolding, but the Bible does not record such things. The Bible does record that large buildings were constructed through, at least, the use of raw human power, along with the hammer, axe, plum line, file, measuring line and various bronze and iron tools.

The material of the Hebrew tools was either iron or bronze. Iron was more commonly used in the time of David (2 Samuel 12:31), but the mention of iron as a material is often made in

such a way as to show that it was possibly more rare (Amos 1:3). In fact, iron was hard to work and expensive, while bronze probably persisted for a while as a cheaper material. Stone tools were also used but mainly by the very poor or as occasional makeshifts or for sacred purposes (Joshua 5:2; Easton 1913).

Carpentry Tools

Plumb-Line

The Hebrew word translated “plumb-line” is “anakh”, and is used in the following verse: “Thus He showed me, and behold, the Lord was standing by a vertical wall with a plumb line in His hand. The LORD said to me, ‘what do you see, Amos?’ and I said, ‘A plumb line.’ Then the Lord said, ‘behold I am about to put a plumb line in the midst of my people Israel. I will spare them no longer’” (Amos 7:7-8 NASB). The plumb line was some sort of measuring device used to not only layout walls but to check to see if they are level and straight. The Lord seems to be saying in Amos 7:8 that he is going to hold up the plumb line against the people to see if their actions are consistent with and measure up to what he has asked of them.

There are other Hebrew words that are translated as “plumb-line” in some versions of the Bible, “plummet” in another, and “level” in others. For example, the Hebrew words translated as “plummet” in the KJV are both “mishkoleth” and “ebhen bedhil”. The former is used in the following two verses:

I will stretch over Jerusalem the line of Samaria and the plummet of the house of Ahab, and I will wipe Jerusalem as one wipes a dish, wiping it and turning it upside down (2 Kings 21:13 NASB).

I will make justice the measuring line and righteousness the level (or plummet in the KJV); Then hail will sweep away the refuge of lies and the waters will overflow the secret place (Isaiah 28:17 NASB).

The different translations of these words give more than adequate clues as to what a plummet, or plumb-line, was used for, namely, to level. The manner in which each of these

verses is used indicates that the plummet or level was used with great accuracy. If they were not the Lord would not have compared their use with justice and righteousness. God's justice is perfect, his righteousness is without fault. The Hebrew word "ebhen bedhil" is used in the following verse in a similar manner to the previous two verses, verifying the accuracy with which the plumb-line was used in the construction of the temple under Zerubbabel's leadership.

For who has despised the day of small things? But these seven will be glad when they see the plumb line (or plummet in the KJV) in the hand of Zerubbabel--{these are} the eyes of the LORD which range to and fro throughout the earth (Zechariah 4:10 NASB).

In reference to this verse, Matthew Henry (1996) says:

Those that despaired of the finishing of the work shall rejoice when they see the plummet in the hand of Zerubbabel, when they see him busy among the builders, giving orders and directions what to do, and taking care that the work be done with great exactness, that it may be both fine and firm. Note, it is matter of great rejoicing to all good people to see magistrates careful and active for the edifying of the house of God, to see the plummet in the hand of those who have power to do much, if they have but a heart according to it; we see not Zerubbabel with the trowel in his hand (that is left to the workmen, the ministers), but we see him with the plummet in his hand, and it is no disparagement, but an honor to him. Magistrates are to inspect ministers' work, and to speak comfortably to the Levites that do their duty." Those seven eyes that run through the earth are all upon the stone that Zerubbabel is laying straight with his plummet, to see that it be well laid. And those that have the plummet in their hand must look up to those eyes of the Lord, must have a constant regard to divine Providence, and act in dependence upon its guidance and submission to its disposals

Matthew Henry eloquently points out that Zerubbabel was motivated to accurately layout the house of the living God. The human eye is not accurate enough to level walls; therefore the ancients were dependent upon the tools available. The tool used to accomplish the leveling was the plumb-line or plummet. This tool in the hands of the right person was adequate in ancient times to level walls with accuracy.

Measuring Line, Rod and Compass

{Another} shapes wood, he extends a measuring line; he outlines it with red chalk. He works it with planes and outlines it with a compass, and makes it like the form of a man, like the beauty of man, so that it may sit in a house (Isaiah 44:13 NASB).

The main measuring tools used in ancient Israel were the line and the rod, also referred to as a reed (Ezekiel 41:8). The compass was used as a measuring device but that was not its prime purpose (Isaiah 44:13). The prime purpose of the compass was to draw circles. The line had a dual purpose being used for both measuring as well as a straight edge as Isaiah states, “he extends a measuring line; he outlines it with red chalk” (Isaiah 44:13). The measuring line was used as a straight edge to outline with red chalk.

The measuring line was not only used to measure walls and to do the layout of buildings, but also to measure long distances (Ezekiel 47:3; Jeremiah 31:39). The size of the measuring line is not certain, but the following verse in Jeremiah indicates that it was a very long, pre-measured, string or line, “The measuring line will go out farther straight ahead to the hill Gareb; then it will turn to Goah” (Jeremiah 31:39 NASB). The measuring line was a very useful tool for long distances, allowing greater accuracy than using a reed many times.

The size of the reed, also translated as rod, is mentioned in Ezekiel 41:8 as being six great (long) cubits. Since this “long cubit” was probably the ancient “building” cubit, a long cubit was most likely 19 or 20 inches (see units of measurement). Therefore the great reed was approximately ten feet long. In Ezekiel 45:1 the reed was used to measure a distance 25,000 times its length. Apparently this was the longest instrument of measurement, other than the measuring line, used in ancient Israel. .

Units of measurement

The base unit of measurement in ancient Israel was the cubit. There is much debate on the actual length of the cubit. Different cultures like the Egyptians, Palestinians, and Babylonians used a unit of measure called the cubit (Porter 1913). Archaeological evidence indicates that these cubits were not all the same length. The basis for the length of the cubit is the human arm, originally the length of the forearm. Many scholars believe that the oldest cubit used in Israel

was about 18 inches. Ancient Israelis seem to have employed, however, two cubits, of different lengths, one for commercial purposes and one for building. There are no concrete examples of either, but judging by the dimensions of some ancient square building-bricks in Israel, which are regarded as being two-thirds of a cubit on a side, it can be concluded that the cubit used in building was about 19 or 20 inches. A similar cubit, with which the Jews were no doubt familiar, was employed in Egypt, measuring between 20.6 to 20.77 inches (Porter 1913). There were also smaller units of measure such as the span, the palm and the digit, or finger-breadth. These were very important to the ancient Israelis but will not be elaborated upon in this study due to lack of pertinence.

Pencil

The pencil of Isaiah 44:13 is probably a stylus, for engraving as well as for marking out lines. For engraving on gems as it says in Exodus, "You shall take two onyx stones and engrave on them the names of the sons of Israel" (Exodus 28:9 NASB). Particularly delicate instruments of this kind must have been used (Easton 1913). There is no Biblical reference, but pencils were probably used to draw up plans or blue prints for major construction projects.

Chisel

Chisels are almost as old as humanity, and were used on both wood and stone (Exodus 20:25) and possibly also on metals. In particular, with a broad chisel and an adz the surface of wood may be finished very smoothly (Easton 1913). The plane (maqtsō'ah) of Isaiah 44:13 should be translated chisel (Easton 1913). The literal meaning of the word is a graving tool, or carving tool. The word "maqabāh", translated as axe in KJV and NASB is translated as chisel in the NIV, "In building the temple, only blocks dressed at the quarry were used, and no hammer, chisel or any other iron tool was heard at the temple site while it was being built" (1 Kings 6:7 NIV). The translation of chisel as opposed to axe makes more sense looking at what it

was used on, namely, stone. It seems odd that an axe would be used to cut or chisel stone. Therefore chisels were, though nearly left out of the Bibles translations, used by the ancient carpenters and stonecutters. Today the chisel is still a common tool for the carpenter.

Hewing Tools

Axe: Ax, Pickax

There are various words employed for “axe” in ways that are quite obscure and apparently with meanings that are not fixed (Easton 1913). What is clear is that an axe was employed for use in cutting trees down, “When you besiege a city a long time, to make war against it in order to capture it, you shall not destroy its trees by swinging an axe against them; for you may eat from them, and you shall not cut them down” (Deuteronomy 20:19 NASB). Another verse makes it clear what an axe was made of, “as when {a man} goes into the forest with his friend to cut wood, and his hand swings the axe to cut down the tree, and the iron {head} slips off the handle and strikes his friend so that he dies...” (Deuteronomy 19:5 NASB). The handle of an axe was most likely made of wood, with a head of iron slipped onto it. Today axes and hammers are made in the exact same way, although with advances in material science there are axes of a uniform material.

The axe was probably in use as early as humans had a need for shelter, fire wood, and furniture. Without having tools like the axe or saw, cutting trees down is nearly impossible. Tubal-Cain, who was the first inventor of tools, may have invented the iron axe head out of a need to cut trees down. The first reference in the Bible to the axe in Deuteronomy 19 dates back to approximately 1405 B.C. Archaeology may prove an earlier date for the use of the axe, but by using the Bible it can be certain that axes were in existence at least by 1405 B.C.

Hammer

Is not my word like fire? Declares the LORD, and like a hammer which shatters a rock? (Jeremiah 23:29 NASB)

The hammer was used for splitting or trimming stone, beating metals, and in wood-carving, as well as for driving nails, tent pins, etc. Four words are translated "hammer," but the distinction between them is very vague and in some cases the propriety of the translation is questionable (Easton 1913). The Hebrew words for "hammer" are halmut, kelap, pattish, and maqqaba.

- "halmut" was a heavy wooden mallet used for driving in tent pegs (Judges 5:26) (Unger 1988).
- "kelap" was another type of heavy mallet, or possibly an axe (Psalm 74:6); this word is also translated "hatchet" in the NIV (Unger 1988).
- A smaller tool suitable for the gold beater (Isaiah 41:7) and the quarrymen (Jeremiah 23:29) was call a pattish (Unger 1988).
- A similar tool to the "pattish", having more of a point was the "maqqabah". This was used by the stonecutters and smiths (1 Kings 6:7; Isaiah 44:12). This was the workman's hammer or even possibly a chisel (Unger 1988).

Saw

All these were of costly stones, of stone cut according to measure, sawed with saws, inside and outside; even from the foundation to the coping, and so on the outside to the great court (1 Kings 7:9 NASB).

The saw was used both for wood and for stone (1 Kings 7:9) in the latter case being employed in connection with water and sand (Easton 1913). Sawing stone was a very laborious process, and this was one reason why the ancients preferred stone in large blocks. There is no indication in the Bible of the size of the saws that were in use, but some must have been of a fairly large size to cut some of the large stones for the temple.

Sharpening Tools

Yet they had a file for the mattocks, and for the coulters, and for the forks, and for the axes, and to sharpen the goads (1 Samuel 13:21 KJV).

A file was a sharpening instrument of some sort (1 Samuel 13:21). Blunted tools were sharpened on stones, as everywhere. Most translations except the NASB speak of sharpening with a file, but the text of the verse is corrupt and the exact translation mere guesswork. But files of some sort must of course have been used by metal-workers (Easton 1913). Proverbs indicates that iron was used to sharpen objects, “Iron sharpens iron, So one man sharpens another” (Proverbs 27:17 NASB). The Israelites may have discovered the file from the Philistines since they went there to have their tools sharpened, “So all Israel went down to the Philistines, each to sharpen his plowshare, his mattock, his axe, and his hoe” (1 Sa 13:20 NASB).

CHAPTER 8 CONCLUSIONS

After searching diligently through the Bible, the first and most significant conclusion reached is that the Bible has proved to be a valuable source of information regarding building construction in ancient times. The Bible was not written with the intent of communicating how buildings were constructed and with what materials, or what trades were in existence in ancient Israel. Knowing this, this researcher did not expect to find much information not previously discovered. However, there was much to glean from the Bible. Much information that is generally overlooked or ignored by regular Bible readers was discovered.

This research revealed some unexpected findings. For instance, there were many references to unexpected topics such as door posts, building maintenance, heating and air conditioning, plaster, and glass-making. The varieties of topics covered in the Bible were also of some surprise; covering everything from the building plans, through most of the components of buildings, to maintenance of buildings, and integrity in construction. Some of these topics, such as heating and air conditioning, estimating, preparation in the field, plumbing, celebrating after laying the foundation, and flooring had only one verse to glean from. Some topics chosen had no direct verses correlated with them but because of references in the Bible to other similar topics it was deemed necessary to mention. Examples of this are with some of the trades like brick-making, glass-making, and the plasterer, which were not specifically mentioned, but the product of their work was mentioned. Other topics had an abundance of verses referring to them, such as foundations, the cornerstone, bricks, stone cutters, carpentry and the carpenters' tools.

This analysis of the Bible for information on building construction led to a few conclusions. Some things have not changed since ancient times. The problems in construction faced in ancient times are similar to the problems faced in modern construction. Mildew was an

issue that plagued some homes in ancient times, just as today, when buildings are poorly built or poorly designed. In either case major rework will result. Determining an accurate estimate was alluded to as a problem in ancient times. Estimating remains to be a challenge for many construction companies. Workers, who had physically draining tasks to perform such as quarrying stone and transporting trees, were difficult to keep productive in ancient times. In modern times hard labor is about 50 to 60 percent productive. In order to increase productivity in ancient times, workers were whipped, and in modern times, workers are verbally whipped or fired. The ancient approach probably worked better. In ancient times buildings decayed, walls cracked, components wore out with use, etc. creating a need for maintenance. In modern times the construction industry has attempted to create longer lasting quality built buildings but they still require regular maintenance after years of use. The maintenance free building has not yet been created, still being subject to the elements. Just as in ancient times not everyone was full of integrity. The need for integrity in construction, which is very obvious in the modern construction industry, is great. Contractors have a reputation for deceiving or lying about costs upfront to get jobs from individual home owners. Many construction companies would be able to avoid costly litigation if they treated everyone with the utmost integrity.

Some construction materials, tools and components have not changed since ancient times. Brick, tar, clay, wood, metal, plaster and stone are all still in use today. The main difference being that each one's uses have been improved upon and altered. Bricks are still being made, although with higher quality, and then used to build walls in the same manner as the ancients, having mortar between bricks. Wall coverings, such as whitewash and plaster are still used. Iron is still used for bars in gates, as well as in many tools and nails. Whitewash has been replaced with modern day paint, and plaster has been replaced with gypsum board. Carpentry,

hewing and sharpening tools are still in use today. The main difference being that some of them have been altered and improved. For example, hammers and axe's are still made with wooden handles and iron heads, as well as out of other modern materials.

Many differences between that of ancient construction and modern times have been noted in the uses of materials, types of tools and building practices, and with labor. In order to build large buildings, the ancient builders used very large stones for the foundations and walls. This created a need for a very large workforce to quarry, transport and place stones weighing 100's of tons. The cost to pay 150,000 workers, as Solomon had conscripted, would be astronomical in today's market. Requiring a similar size workforce in modern times would render the constructing of large buildings impractical and unfeasible. Better methods of constructing large buildings had to be discovered; and have been thanks to good engineering and the invention of concrete, steel and various other materials. The methods used in ancient times to quarry and transport stones and logs are entirely unrelated to how it is done today. Quarrying stone is generally only necessary in mining for metals, providing stones for concrete aggregate and decorative stone for non structural components of buildings. Stone can now be blasted apart using dynamite; then large equipment is utilized to pick up and load the stones, and trucks are used to haul them. Homes in ancient Israel were mostly built with brick from clay, had flat roofs with parapets, and were quite small. Today homes are not built with brick but rather CMU blocks or wood studs. Most roofs are pitched without parapets. Large buildings are no longer constructed from large stones but rather steel or reinforced concrete. Except with manufactured homes, buildings are not put together in such a way that no hammer or iron tool be heard on site as in the days of Solomon. Celebrating milestones such as the foundation are not seen on any construction projects except for maybe when the entire project is completed. Cornerstones are

no longer necessary due to the design of the foundations in modern buildings. Plumbing pipes in modern buildings are made of new materials such as PVC, whereas ancient buildings were likely to have stone or holes in the ground. Windows now have glass to shield the interior of buildings from unwanted air flow and heat. Doors now turn on hinges, whereas in ancient times doors turned on posts. Construction related heating and air conditioning did not exist in ancient times except when windows were used for allowing cooler air to enter a dwelling.

CHAPTER 9 RECOMMENDATIONS

For The Industry

The Bible is a document that has been in existence more than 2000 years. Countless people have studied it and learned from its teachings. It could even be said that everything the Bible has to offer has been discovered by people throughout history, though it may not be common knowledge. In regard to construction, most lessons, if not all, have been well learned. Based on the construction information presented in the Bible, no specific recommendations can be offered for the construction industry. The only real benefit the Bible adds to today's construction industry is its moral recommendations and the historical information it shares. Even those recommendations are often adopted in the industry by large companies because they offer great reward to the companies that apply them, even if top management is not aware that it is applying Biblical moral recommendations.

For The Future Researchers

For the researcher looking to expound on the Bible as it relates to construction, this study could be conducted in a more thorough fashion. A more exhaustive study could be done adding other elements not studied, including building design, the tabernacle, a more exhaustive study of Solomon's temple, Noah's Ark and so on. Noah's Ark is a particularly interesting topic, since it was the most ancient record of home construction. After all, it was a home to not only Noah and his family but also all the animals in existence at that time. Also, other sources such as archaeology could be researched, using illustrations to add clarity about the appearance of ancient structures.

This type of study could be repeated, but with a focus on other industries. A study of education in Biblical times could be conducted. For example, Paul, the apostle, encountered the

Greek style of teaching in public areas when he went to Athens to preach. Jews used the synagogues to teach about the Holy Scriptures. There are references to Timothy being taught by his grandmother, possibly indicating some sort of home-schooling. There are numerous references that could shed light on this subject and make a very interesting study.

Another topic area to consider would be to use the Bible to research health care in Biblical times. How were people treated when they were sick? How common were doctors? What diseases were the ancient Israelites and surrounding cities susceptible to? This study might be extended to the foods that were common in Biblical times. The Law of God in the Old Testament gives much dietary instruction. The reasons behind these laws could be researched from a health perspective. One that has become common knowledge is why pigs were considered unclean. What about other animals and foods? There are various ways to approach this subject and each with a treasure waiting to be discovered.

Another topic area to study using the Bible would be related to agricultural practices. The Biblical people had to live off the land surrounding them. They did not fly or truck produce into stores to sell in bulk. How did they survive and with what foods? Are there any secrets to farming that could help modern day farmers in any way? Jesus shared a parable about a sower of seed. Some of the seed fell on the road, some on the rocks, some in the weeds, and some in the good soil. There are clues throughout the Bible on this and various other topics that may reveal treasures of knowledge. Other researchers could simply view the Bible as an historical document that might enlighten them about other practices employed in ancient times. For example, research might be conducted on clothing worn in Biblical times, the role of family in ancient cultures, the institution of marriage, and many more.

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BIOGRAPHICAL SKETCH

Brandon Shore began his college career in 1991 at Palm Beach Community College in Lake Worth Florida. After receiving an Associate of Arts degree in 1994, he transferred to the University of Florida with the intended major of architecture. He changed his major after one semester and graduated with a Bachelors Degree in Classical Studies in 1997. He went on staff with a church planting movement called “Great Commission Ministries”. Through this organization Brandon has been helping bring college students to Jesus Christ on the University of Florida campus. Though his passion for God continues strong, his passion for designing and building eventually lured him back to college. With the encouragement of his wife and friends he decided to pursue a master’s degree in building construction at the University of Florida. He will be searching for a job as an assistant superintendent with a home builder or commercial contractor in Gainesville, Florida.