



# Masonry History Integrity: An Urban Conservation Primer | 2011-08

Tom Russack for the Abyssinian Development Corporation



National Park Service  
U.S. Department of the Interior

National Center for Preservation Technology and Training



This publication was developed under a grant from the National Park Service's National Center for Preservation Technology and Training. Its contents are solely the responsibility of the author and do not necessarily represent the official position or policies of the National Park Service or the National Center for Preservation Technology and Training.

To my grandfather, the bricklayer  
My father, our hero  
Our Father, who art in heaven  
And all fathers, everywhere.

With gratitude to my wife, Susan, and to our daughters, Nicole and Kristen, who persevered through the long year of the “boook.”

Thanks to Uncle Al for giving me a trowel and the opportunity to explore masonry.

Appreciation to the following for their assistance, encouragement and/or inspiration:

The Brothers	The Detwilers	The Whites
Steven Tinger	Stephen Varone	Anthony Watson
Diana Thurman	Lynne Funk	Melissa Franqui
Ed FitzGerald	Andrew Ferrell	Rudy Battle
Ryan Ballinger	Persuad Bheshan	Sharlene Lawrence
Michele Milano	Ian Walker	Dan Perakes
Andy deGruchy	Jay Merillat	Dan Hildebeitel
Michael Tomlan	Chester Liebs	Max Ferro
Wendy Ordemann	Joe Humann	Patrick Kennedy
Michael Langwell	Trudy Waites	Peter Scallion
Tim Keller	Lisa Sasser	John Fugleso
PTN	Eon Images	Studiohworks
HFG Group	Scott Sauls	Suzanne Weiss
Barbara Ramos	Erik Catamessa	Mike Russakowski
US DOI	NPS	NCPTT

Thanks to Abyssinian Development Corporation, Youthbuild USA, Rand Engineering & Architecture, P.C.; and especially to the ADC Workforce Development Youthbuild Masonry Preservation and Building Conservation students.

## **Prelude**

According to the United States census and the NYC Department of Buildings, there are approximately 8.2 million people and over 975,000 buildings in New York City. Many of the buildings are over one hundred years old. Most are constructed with some sort of masonry material, to meet fire code regulations, and to endure the effects of time, weather and aging.

One would think that a city full of large and aging masonry buildings might have schools or training programs for the repair and maintenance of this vast urban resource. But unfortunately, that is not the case. At this writing, there are no technical schools, trade schools or construction programs in New York City that offer basic hands-on masonry training to the general public.

It is also noted that amongst the construction trades, there is a generally accepted understanding that the preservation, repair, conservation and maintenance of older buildings requires a different set of skills than those required for new construction. Presently, there are a half dozen college programs offering specialized hand-on masonry conservation training. But, there are no schools or programs in the United States providing an introduction to masonry conservation at the high school level.

There is however, one such program in New York City, provided by the Abyssinian Development Corporation (ADC). It offers young men and women the opportunity to obtain a high school general equivalency diploma (GED) and learn about various construction careers, including masonry, masonry conservation and green building technology.

The Abyssinian Baptist Church is the oldest African-American Baptist church in the state of New York. It was organized in lower Manhattan, in 1809, by Ethiopian merchants who gave it the title Abyssinia, the ancient name of their home country. The congregation moved to Harlem in 1923 where the area became a hub for African American culture and renowned for its music during the Harlem Renaissance.

The Abyssinian Baptist Church has played a major role in American history by striving for social justice through the elimination of racial discrimination and through the leadership of its Pastors, Adam Clayton Powell Sr. and Jr., who served in the United States Congress. The church is a political, spiritual and social icon of New York City with one of the largest African American congregations in the country. It also has a world-wide reputation for its gospel music tradition.



Abyssinian Development Corporation was founded in 1989 as a not-for-profit, community and economic development corporation dedicated to improving the quality of life in Harlem. It has developed over 1,500 units of affordable housing and enhanced the delivery of social services to the families, children, elderly and homeless. ADC has also fostered economic revitalization through the development of both large and small businesses in the community.

ADC's educational and developmental programs include Literacy Build, Strengthening Families and Stronger Fathers. Its children and youth services include the award-winning Abyssinian Schools Initiative along with after-school, summer, college prep, workforce development and Youthbuild programs.

Youthbuild USA is nation-wide program, founded in New York City in 1979. It addresses truancy and substance abuse through academics, counseling, life skills training and career development. Since 1994, Youthbuild students have built 19,000 units of affordable, increasingly green, housing.

The ADC YouthBuild Program helps out-of-school young adults, between the ages of 16 and 24, obtain a GED, learn hands-on construction trade skills and pursue post-secondary education opportunities.



The (ADC) Workforce Development/Youthbuild Masonry Preservation program teaches general masonry, masonry conservation and green technology skills for students to gain pre-apprenticeship level trade skills. These basic skills enable them to enter the NYC building restoration and energy conservation work force.

To help develop the student's self-confidence, personal integrity and an appreciation for quality craftsmanship, the hands-on masonry training activities are combined with stories from U.S. history and life skill lessons.

This textbook is the culmination of the ADC training program and curriculum. It has been developed as a primer and practical teaching manual through a grant from the National Park Service and the National Center for Preservation Technology and Training. It serves as the first step of exploration for young people interested in construction, masonry preservation, green technology, building repair and the conservation of the urban environment.



## About the book

Each chapter is built around a particular masonry material, such as mortar, brick, stone, or stucco; or an aspect pertaining to the masonry trade, such as maintenance or green building technology. There is a pattern throughout the textbook which follows this general order:

### Introduction

Each chapter's opening paragraph provides an informal conversation about the featured masonry material. This helps the reader to recognize or identify this particular type of masonry by linking it to another material, a personal experience or an identifiable location.

A brief description of the masonry material is then provided, along with an explanation of its history, manufacture and use in general construction. Common reasons for the material's deterioration are explained along with a basic repair method or practice.

Word definitions, and their origins, are included throughout the chapter to provide a better understanding of masonry tools, materials, methods and practices.



### Tools

A description of a tool (or tools) most readily associated with the particular masonry material is included in each chapter. After completing the book, a student should have not only a mental understanding of these various tools, but hands-on experience in their use. (Note: A collection of all the tools featured in this primer would provide for the start of a very useful tool bag.)

### Time span for People, Places and Things

Each chapter contains a time segment, beginning at 1789, that follows in chronological order to correspond (loosely) with the featured masonry material. Each time segment cites significant historical episodes and highlights a few noteworthy people and locations. The time segments are of various lengths and proceed to the present, with a continuation into the future.

### Who?

One individual is featured in each chapter to provide a human element to the events occurring within the historical time span. The intent is to narrow the focus from a wide range of events onto one person's role or involvement. The format contains a series of dates and/or facts, designed to foster curiosity about that person, who is then identified at the conclusion of the statements. The featured person aligns with the chapter's time span but is not always associated with the masonry trade, materials or tools featured in the chapter.



A photograph, portrait or drawing of the individual, along with a quote, is included to help crystallize their character and enliven the schedule of facts.

### **Attribute**

A personal attribute of each “Who?” individual is provided as an example to be considered, admired and perhaps imitated. These traits can be used during class to promote topics of discussion amongst the students.



### **Places**

A geographic location is provided to connect a place with the events and people of the historic era. An attempt was made to provide different locales throughout the United States so that the text was not regionalized, but applicable across the country. These locations commence along the northeast coast, travel south, then westward, returning east to conclude in the mid-west.

### **Building of the Era**

A specific structure, or a type of building design, was selected to represent the era of each chapter. These provide a visual image of the life style, construction method, architectural design or advancement of technology that were touchstones of the period. An attempt was made to select a representational building within the chapter’s “Places” region, and associated with the featured masonry material.

### **Things**

Artifacts (things) help to bridge the time/distance of events long ago with the present. They also enliven historical figures that might seem ghost-like, and places that perhaps seem irrelevant or have never been heard of before.

Besides artifacts, “Things” includes significant events ranging from large movements of people (Great Migration) to political up swells (Anti-Masons).

### **Quotes and Lyrics**

A few statements relevant to the people, places and events of the era are provided in each chapter. But the quoted individual is not always featured in that section of the text. The thoughts, words and expressions are intended to be pertinent to the information provided, and more so in the context of integrity rather than masonry or history.



A few song lyrics are included throughout the book as a representation of a moment in history, a way of life or a person of notoriety. Although indigenous to a particular era, some songs transcend time and become ageless.

The featured songs in the early chapters start with a few lines from the chorus and include a historical reference. The songs then lead up to include all lyrics in later chapters. The final song features a photo essay to accompany the lyrics, along with a web link for listening.

### Sidebars

The chapters are color coded for ease in identification and each contains a few separate, qualifying items under a colored banner to provide additional information or insights about the featured material, work, tools, people or history.

### Synopsis

Nine to twelve words selected from the chapter are provided as touchstones, to help students remember or identify an aspect of the masonry explored, explained and practiced. The open space after each word is for note-taking to assist in the memorization of the term. This is done by writing a personalized way of remembering and identifying the definition.

### Testimonials

Several students who graduated from the ADC masonry preservation program provided statements pertaining to their post-trades education experience. These statements are included to offer encouragement to students in other cities.

### Activities

Each chapter has two or three activities that are associated with the featured masonry material or tools, to provide an understanding of masonry construction practices, building conservation techniques or green/sustainability technology. The activities materials and directions are explained succinctly, not to be vague, but rather to avoid confusion.

Safety is always emphasized while undertaking these activities. Concerns for time, expense, space, the conservation of materials and the reduction of waste have also been taken into consideration.

The Activities section does not require a large assortment of specialized tools. The intent was to reduce the need to purchase sophisticated equipment in order to teach the basic skills of the masonry trade in a practical, direct, and fun manner.



Three math problems were included in the text to emphasize the important association between math and masonry construction.

### Web Resources

This textbook is a free publication that can be downloaded at no expense to the reader. The Web Resources section was provided so additional books would not have to be purchased for follow-up research on a number of subjects. Numerous web resources were investigated. Those featured offer more information with a clear and understandable description of the subject.

### Photographs

Unless otherwise noted and/or documented, the photographs illustrating the text were taken by the author during the course of work, teaching or specifically for this training manual.

Credit is given to Rand Engineering & Architecture P.C. for allowing the use of photos taken during the course of work.

The release of photos of students has been provided by Abyssinian Development Corporation.

A painstaking effort was undertaken to provide credit for all other photographs and illustrations and to maintain the integrity of the work of photographers, artists, inventors, architects, craft workers, etc.

Reproducing or linking to images provided in this publication is prohibited without express permission by the rights holder as referenced in the image credits. All photographs without an image credit are copyrighted by the author, all rights reserved.

### Using this book

#### Masonry

This primer was meant to be printed and referred to during classroom teaching and trades training sessions. The general overview of construction materials, methods, tools and basic training activities provides willing learners with an opportunity to explore the building trades and discover ways to repair aging masonry structures. Many of the featured topics (e.g. “Why are bricks red?” “Terra –Whatta?”) were initiated from the student’s questions.



#### History

This book contains stories that can be read by students in a class room setting or discussed while practicing the masonry activities. Many of the stories are of people who faced great difficulties, and are not dissimilar to the problems of young people today. Students might be able to identify with these people, the situations they faced, the struggles they overcame and the fears they conquered.

## **Integrity**

Some New York City construction companies provide their best brick layers with a salary and benefits that amounts to \$60.00 an hour. That's \$120,000 for a forty hour week, fifty weeks a year—which is a lot of money. Providing masonry trades skills and an acumen in history to become a craftsman able to earn this income would be incomplete without the inclusion of some sort of moral compass. Life stories of historic and heroic individuals, words of encouragement or guidance, along with personalized testimonies of former students have been provided for that purpose.

## **Disclaimer**

This primer does not promote specific social, political or spiritual ideologies. The religious references and inspirational quotes are included for individuals to explore the means and methods of achieving personal integrity and to develop their own standards for achieving excellence in their work, home, community and city.

There are numerous ways to undertake the repair of masonry buildings, to present historical information and to provide for the development of personal character. It is understood that this book does not contain exhaustive information about the numerous topics it touches upon and that it is limited by its simplicity and brevity. Everything written in this primer is sure to have another interpretation or an easier technique as there is always a better way to do something, anything or nothing.

This book does not provide definitive answers to questions or claim to have the last word on any subject. It is merely an attempt to engage young people in the conservation of the urban environment and to provide a start for the exploration of their role in that task.

## **Beginning**

There are many young people who have not had an opportunity to fathom the mental and physical work that went into the design, construction and upkeep of the city surrounding them. Perhaps this primer will reveal the uniqueness of their neighborhood and promote an interest to undertake the repair of its aging buildings.

This realization might also awaken an admiration for the people who long ago constructed these buildings and a respect for those who now repair them.

It is hoped that this understanding would mature into an appreciation for honest and hard work, the dedication necessary to achieve excellence in craftsmanship, and the dignity of making tough, but right, decisions.

It is further hoped that a glowing spark of curiosity might grow into a light of awareness, to reveal a noble heritage and an amazing future, filled with masonry, history and integrity.



Thomas E. Russack  
September 1, 2011

The best revenge against prejudice is skill.

**TABLE OF CONTENTS**

<b>Chapter 1: What is Masonry?</b>	<b>1</b>
The city around you – its masonry	2
The work	2
Teamwork	4
Worksite Safety–What & Wear	4
The Tools Part 1: trowel, mason’s level	5
Plums and Plumbers	7
People, Places, Things: 1789 to 1820	7
Who? Solomon Willard	8
Attribute: motivation	8
Guildhall, London, England	8
Guilds	9
Coat of Arms	9
The General Society of Mechanics & Tradesmen of New York City	10
Master Craftsman	10
Mechanic	11
Building of the Era: Saint Paul’s Chapel, New York City	11
Quotes	12
Synopsis	12
Activities	13
1. Build pipe staging	13
2. Draw a personal coat of arms	14
3. Addition and attitude	15
<b>Chapter 2: Got Mortar?</b>	<b>16</b>
What’s Mortar?	17
Limestone, Quicklime and Lime Mortar	17
Natural Cement	19
Portland Cement	20
Mortar: The Art of Mixing	20
Sand	21
Water	21
Hydraulic	21
M-S-N-O-K Mortars	22
Measuring	22
Repointing: The Art of Fixing	23
The Tools Part 2: Jointers and Pointers	24
Mortar Joints	25
People, Places, and Things: 1821 to 1833	26
Who? Joseph Aspdin	26
Attribute: ingenuity	26
The Erie and Pennsylvania Canals	27

Building of the Era: The row house, Philadelphia, Pennsylvania	28
Quotes and Lyrics	29
Synopsis	29
Testimonial of Pastor V.	29
Activities	30
1. Mixing Lime Mortar	30
2. Scooping and Spreading Mortar	31
3. Mortar Joint Re-pointing	32
<b>Chapter 3: Why Are Bricks Red?</b>	<b>34</b>
Bricks: Kilns and Clinkers	35
Brick Bonds and Patterns	37
Blocks: Cement and Cinders	39
Block Parts and Names	40
Brick vs. Block: What's the Difference?	40
Fix the Bricks – Deterioration and Replacement	41
Adobe	42
The Tools Part 3: Mason's hammer, brick set	43
People, Places, and Things: 1834 to 1859	43
Who? Andrew Jackson	44
Attribute: endurance	44
Saint Louis, Missouri	45
Vitrification: Fire, Bricks, and Fire Gods	46
The Masonic Order and Anti-Masons	46
The Industrial Revolution	47
Buildings of the Era: Factories of the Industrial Revolution	48
Quotes and Lyrics	48
Synopsis	49
Activities	49
1. Spread mortar for end joints	49
2. Cut a brick with hammer and set	50
3. Build a brick wall	50
<b>Chapter 4: The city rocks!</b>	<b>52</b>
Stone Surroundings	53
Exploring City Stonework	53
Sedimentary stone	54
Metamorphic stone	55
Igneous stone	55
The Art of Stonework	56
The Art of Finishing stone	56
The Art of Repairing stone	58
The Tools Part 4: Stone carving, dressing and patching tools	60

Mohs' Minerals	61
People, Places, and Things: 1860 to 1880	61
Who? Arthur MacArthur	62
Attribute: heritage	62
Douglas MacArthur	62
Medal of Honor	63
Civil War battles and the 1860 Census	63
Some Recent Statistics	64
Reconstruction	64
Building of the Era: The U.S. Custom House	65
Charleston, South Carolina	65
Synopsis	65
Quotes and Lyrics	66
Testimonial: Richard L.	66
Activities	67
1. Carving letters in stone	67
2. Patching stone with repair mortar	68
<b>Chapter 5: Terra Whatt-a?</b>	<b>70</b>
Terra Cotta—Practical and Decorative	71
Knowing Terra Cotta	73
Repairing Terra Cotta	74
Terra Cotta Faces and Places	77
The Tools Part 5: Line, line blocks, and line pins	78
People, Places, and Things: 1881 to 1907	79
Theodore Roosevelt	80
Attribute: character	80
The City Beautiful Movement	81
Trade Schools	82
Williamson Free School of Mechanical Trades	84
Building of the Era: Union Station, Washington, DC	84
Quotes	86
Synopsis	86
Activities	87
1. Laying blocks (CMU or terra cotta) to the line	87
2. Make faux terra cotta clay	88
3. Mold making	88
<b>Chapter 6: That's Concrete?</b>	<b>90</b>
It's a Concrete World	91
Whoa! Heavy: Concrete Facts	93
Concrete: Reinforced, Precast and Cast Stone	94
Decorative Concrete	96

Pouring Concrete: The Plot Thickens	96
World of Concrete	101
The Tools Part 6: Screed and Floats	101
People, Places, and Things: 1908 to 1938	102
Thomas Edison	103
Attribute: inspiration	103
The Great Migration	103
World War One Statistics	104
Skyscrapers	104
Building of the Era: Ingalls Building, Cincinnati, OH	105
Quotes	106
Synopsis	106
Activities	107
1. Build wooden concrete forms	107
2. Concrete pour from prep to cure	107
3. Concrete calculations	110
<b>Chapter 7: It's Plaster</b>	<b>111</b>
Gypsum and Plaster	112
Plaster of Paris	113
The Traditional Three Coats	113
Ornamental and Decorative Plasterwork	115
Scagliola	116
Repairing Plaster Disasters	116
The Tools Part 7: Chalk line, plumb line	118
People, Places, and Things: 1939 to 1949	119
Winston Churchill	120
Attribute: determination	120
World War II Statistics	121
Earle Barthé	121
The Red Ball Express	122
The USS Mason	122
Buildings of the Era: WWII and Europe's cities, Warsaw, Dresden, London	123
Quotes	124
Synopsis	124
Testimonial of Christian L.	125
Activities:	125
1. Making and restoring plaster medallions	125
2. Plaster hands	126
<b>Chapter 8: Stucco and Masonry Paints – Old Coats and New Skin</b>	<b>128</b>
Old Coats – Stucco	129
The “How” of Stucco	129

A Colorful History	130
Stucco Finishes and Textures	131
EFIS	132
Cracks, Causes and Repairs	132
Faux Brownstone	133
New Skin – Limewash and Coatings That Breathe	134
Limewash	135
Breathable masonry paint	135
The Tools Part 8: The hawk and steel trowel	136
People, Places, and Things: 1950 to 1967	137
Joseph C. Rodriguez	137
Attribute: valor	137
Latino migration	138
Cavity wall construction	139
Building of the Era	140
Tract houses	140
Quotes and Lyrics	140
Synopsis	140
Testimonial of Ruth Z.	140
Activities	141
1. Parge a wall	141
2. Mix and use limewash	142
<b>Chapter 9: Clean Outside—Façade Washing, Strong Inside—Steel Structures</b>	<b>143</b>
Clean Outside – Façade Washing	144
Methods, Materials, and Machines	144
Efflorescence	145
Preparations, Precautions and Personal Procedures	148
Pressure Washing Machine	149
Façade Cleaning Outfit	149
The Tools Part 9: masonry brush, washdown brushes, and wire brush	150
Material Safety Data Sheet	148
Cleaning: Images Before, During, and After	150
People, Places, and Things: 1968 to 1984	152
Ludwig Mies van der Rohe	152
Attribute: dedication	152
Strong Inside – Steel Structures	153
Steel and masonry	153
Building of the Era: The Renaissance Center, Detroit, Michigan	153
Glass box buildings	154
Curtain Wall Construction	154
Urban Renewal	155
Quotes	156
Synopsis	156

Activities	157
1. Cleaning with bucket and brush	157
2. Pressure washing practice	158
<b>Chapter 10: Maintenance – Care and Repair</b>	<b>159</b>
Care: The Need	159
Maintenance: Practical Practices and Uncommon Sense	160
Repair: The Remedy	161
Caulking	163
The Tools Part 10: Caulking Gun	164
People, Places, and Things: 1985 to 1999	165
Who? Len Bias	166
Attribute: learning from mistakes	166
Anonymous, New York City, Local Law 10/80	166
Architects and Engineers	167
Warsaw, Dresden and London–Post-WWII and today	168
Civilian Conservation Corps and MillionTrees NYC	169
Historic Preservation	169
Buildings of the Era: Quincy Market, Boston, MA	170
Gargoyles	171
Testimonial of Eddy G.	171
Quotes and Lyrics	171
Synopsis	172
Activities	173
1. Using a caulking gun	173
2. Determining masonry hardness	174
<b>Chapter 11: Up on the Roof</b>	<b>175</b>
Roofing and Masonry	176
Roofing Materials:	176
Clay tile, standing seam metal roof, slate	176
Slate shapes	177
Bituminous Roofs	178
Built-up or hot-mopped	178
Modified bitumen or torch-down	179
EPDM	179
Cold fluid applied roofing systems	179
Roof maintenance	180
Masonry and Roofs: Parapets, flashings, coping and chimneys	180
Height Safety: Certificate of Fitness	182
Concrete Repairs:	181
Preparation, repairing cracks, repairing spalls, addressing corroded rebar	181
The tools Part 11: Mason’s ruler	183

People, Places, and Things: 2000 to 2011	184
William “Refrigerator” Perry	184
Attribute: perseverance	184
Urban Homesteading	185
Buildings of the Era: Montgomery Plaza, Fort Worth, Texas	185
Quotes and Lyrics	186
Up on the Roof	186
Synopsis	187
Activities	188
1. Repairing concrete cracks	188
2. Repairing concrete spalls	189
3. Installing a faux cold fluid applied roof membrane	189
<b>Chapter 12: Here Today, Green Tomorrow</b>	<b>191</b>
Thinking Green	192
LEED	194
Old Buildings are Friendly Buildings	194
Green = Masonry Conservation	196
G-r-e-e-n B-u-i-l-d-i-n-g-s	197
What is a Green Roof?	198
The Tools Part 12: The square	199
People, Places, and Things: Today into the future	200
Who? Easy Eddie and Butch: gangsters and heroes	200
Attribute: courage	201
Masonry methods and materials of the future	202
Roofs to farm and walls that grow	203
Building of the Era: Chicago City Hall, Chicago, Illinois	204
Quotes	205
Synopsis	205
Testimonial of Lena M.	205
Activities	206
1. Care of masonry tools	206
2. Growing sedum for green roofs	208
<b>Closing</b>	<b>209</b>
The Conclusion and the Start	209
Evensong	210
What A Wonderful World	210
Web Resources	224
Photograph and Illustration Credits	245
About the Author	252
Back cover	253

## Chapter 1: What is Masonry?

**The city around you – its masonry**

**The work**

**Teamwork**

- Worksite Safety – What & Wear

**The tools**

Part 1: trowel, mason's level

- Plums and Plumbers



**People, Places, and Things: 1789 to 1820**

Solomon Willard

Attribute: Motivation

Guildhall, London, England

Guilds

- Coat of Arms

The General Society of Mechanics & Tradesmen of New York City

Master Craftsman

Mechanic

**Building of the Era: St. Paul's Chapel, New York City**

**Quotes**

**Synopsis**

**Activities**

1. Build pipe staging
2. Draw a personal Coat of Arms
3. Addition and attitude

## **The city around you – its masonry**

If you live in or travel to a city, look around. What do you see? Buildings, buildings and more buildings. Most of them are made with some sort of masonry – bricks, blocks, stone, concrete, plaster. That’s all masonry.

Masonry is durable. It protects against fire, water, wind, weather and even time. Masonry buildings have been used for centuries. But they can also fall apart very fast if they aren’t cared for.

As you look around, you’ll see masonry buildings everywhere. You may think they’re silent, but they have stories to tell. If you learn to “listen” to them, they’ll tell you about history, geography, meteorology (the weather) and even archeology. They’ve endured the construction and destruction of neighborhoods, cities, empires and cultures.

Masonry is all around you. Open your eyes and you’ll see it. Open your ears and you’ll hear it. Open your mind and you’ll learn from it.



*The city*

## **The work**

Masonry buildings are constructed by masons, who are a proud group of talented workers practicing an ancient art. A mason is a combination athlete, artist and acrobat.

Masons work with these materials:

- brick
- block
- cement
- stone
- plaster
- concrete
- stucco
- terra cotta

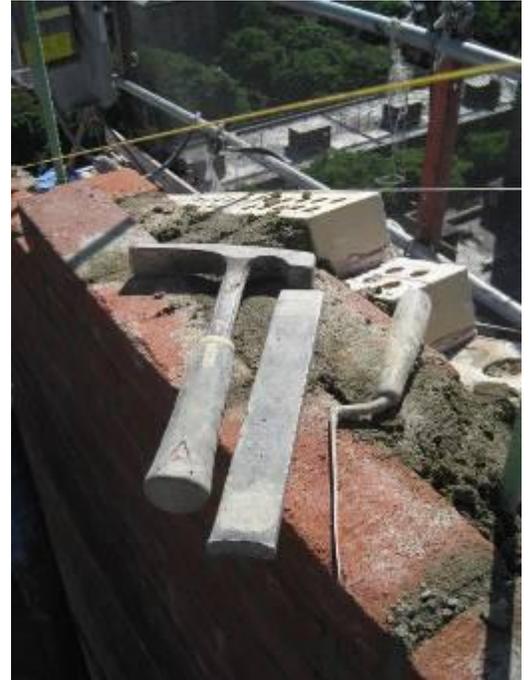
Masonry is hard, physical work. If you carry bricks or mix mortar for a day, you'll be tired on the way home. Because you're outdoors most of the time, the weather is a big factor in masonry work. You sweat in the summer, get cold in the winter, and when it rains you get wet. But your body gets healthier from hard, honest, outdoor work and that makes you a stronger person. Masonry construction also challenges your mind. It develops your math skills and requires you to think through different problems or situations. Masonry work also requires a lot of common sense and it will give you challenges you won't find in other careers.

Masonry is also dusty work. Most of the time, you'll be working with materials like cement, lime, plaster, sand, clay and gravel. These come out of the ground and that means you get dusty or dirty. Foundation work is below ground and that means your clothes can get muddy. Or you might be working on a building that's been abandoned for decades. All kinds of soot, rust and weeds might have collected on it, and that will have to be removed before you start repairs.

Masonry work is dangerous. A construction site is no place for the frightened, fearful or foolish. The work requires a combination of awareness, concentration, daring, and determination. Work at a construction site can be like a war zone. There are hazards that can trip you, equipment that'll crush you, chemicals to blind you, and tools that can cut off your hand. There are many hazards that can scare you away, if you let them. It's one of the few occupations where you wear a helmet (a hard hat). And city buildings are high, so you can't forget that gravity doesn't play favorites; it treats everybody the same way.

Masonry work is hard, dusty and dangerous, (that's why masons are generally paid very well); it takes time, patience and practice to learn the skills of a mason. But, it's worth the effort. Their work is full of pride; their methods full of tradition and their buildings are memorials to their dedication.

Hopefully you'll learn that masonry is also fun, and there's amazing satisfaction in doing masonry work. You will feel incredibly proud to see something you've built, repaired, or maybe even saved from destruction.



*Masonry tools*



*Mason at work*

## Teamwork

There are different types of masons depending on the materials they work with. But no matter how different the project, their success depends on their working together as a team. Together they use trowels, levels, hammers and other tools to construct or repair walls, buildings and cities. The work is hard but there's laughter, jokes and times when it seems like it's a big family.

Masonry is a very durable material and masonry buildings, if cared for properly, can last a lifetime, or perhaps many lifetimes. But as buildings continue to age they need repair. Learning and undertaking the proper repair of masonry buildings will take a lifetime—perhaps even more than one lifetime. If you become a mason, there's chance you might pass these valuable skills along to your children, who might pass them down to their children, who could pass them along...

Imagine looking at a building with your children, or grandchildren, and proudly telling them, "I worked on that building." Suppose sometime later, (years after you've left this world) they return to the building and see that it's been neglected and falling apart. Perhaps they'll remember what you told them and say to each other, "Let's fix it!" You might be gone from this world, but the building will be around for decades (or even centuries) and those memories you shared could be passed along to your family for many generations.



*Dangerous work*

## WORKSITE SAFETY – WHAT & WEAR

A construction worksite is like a battlefield. Worksite safety means being alert and aware at all times. That means listening, watching and thinking.

Here's **what** you need to remember so you can work safe:

- Lift heavy objects with your legs, not your back
- Don't take foolish chances, especially with heights
- Stay alert and don't horse around
- Never do drugs or drink alcohol on the job
- Never go to work high or drunk
- Don't step on covered areas; you could fall through
- Know about the materials you're working with
- Know what to do in case of an emergency
- Work smart

Here are some things to **wear** to work safe:

- Hard hat
- Safety goggles
- Gloves
- Steel-toed boots
- Dust mask, as necessary
- Safety harness, as necessary



## The tools

### Part 1: trowel and mason's level

#### Trowel

A mason's trowel has two parts: the part you hold (the handle), and the part that scoops and holds mortar (the blade). The handle is made of wood or plastic, and it can be used for tapping brick, block or stonework into place. Masons sometimes put a cap on the handle to prevent it from wearing down. The blade is made of steel. It has a pointed tip called the toe and it's connected to the handle at the wider back called the heel. A trowel is used to spread mortar and at times to cut wire, string, and even bricks.

A pointing trowel is smaller in size, with a blade about six inches long. The blade of the larger bricklayer's trowel has a rounded edge. A pointing trowel is more triangular and used for filling mortar in between bricks or stones.

The word trowel is from the Latin work *truella*, meaning a small ladle or a dipper.

A trowel is a well-balanced, highly designed tool of the craftsman. It should fit comfortably in your hand and give off a long and loud ring when you tap the blade. After holding it for several hours a day, it will feel like an extension of your body.

A trowel must never be used as a weapon. It is used only to build and repair, not to hurt or injure. Take care of your trowel and it will take care of you.

#### The right and wrong way to hold a trowel

Look at the pictures below. Which do you think is the correct way to hold a trowel?

The photo "B" on the right shows the correct way to hold a trowel. Putting your thumb on the top of the handle lets you move it with ease. It also puts less strain on your wrist and arm.



*Photo A - wrong*



*Photo B - correct*

### Mason's level

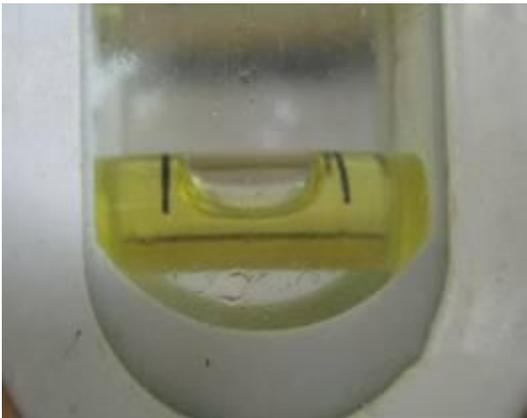
A mason's level is long, narrow and usually made of wood. Levels look like a board with long holes and small windows.

A level has three oval openings covered in glass: one at each end and one in the center. Each oval has one or two little tubes filled with liquid and a long bubble. There are lines on those little tubes and the bubble is used to tell if something is level or plumb.

Level means straight across, or horizontal.  
Plumb means straight up and down or vertical.



*Mason's levels*



You use the level by holding the narrow side against or across something. When the bubble is exactly in the middle of the two lines, everything is OK. If you're checking for level and the bubble is over to one side it means something's high on one side and low on the other.

To see if something is straight up and down, on the vertical, you check to be sure its plumb. You hold the narrow side of the level against something and look at the top or bottom glass oval. If the bubble is between the two lines on the glass tube(s), the wall is straight. If the bubble is over to one side, the wall is leaning.

The level was invented in 1661 by Melchisedech Thevenot, a French scientist, author, scholar, and traveler. It was called a spirit level because alcohol was used in the glass tubes to prevent the liquid from freezing. It is still called a spirit level by some masons.



*Checking for plumb*

## PLUM AND PLUMBERS

When you want to make sure a wall is straight up and down, you use the term plumb. But why is this named after a fruit?

It isn't. The fruit is a P-L-U-M. We want a wall that's P-L-U-M-B. Here's how it happened.

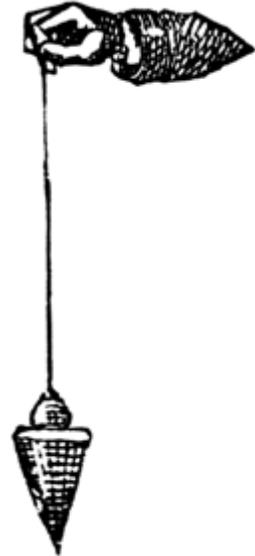
Before levels were invented, you would check a wall by hanging a string or line down the side and to keep it from flying around you'd tie a weight to the end. A weight used a lot of the time was the metal lead. It worked well because it's very heavy, easier to work with than most metals, and it was plentiful.

Thousands of years ago, when Romans built many beautiful buildings, they used this string/weight method to check for a wall's vertical straightness. In the Roman's language (Latin), the name for lead was *plumbum*.

A line with a lead weight attached checked vertical straightness, or its "plumb."

Today we still use plumb lines and plumb bobs to check for straightness, just as they did centuries ago.

The Romans also used lead for many other things. They made pipes out of lead to bring water from the countryside into their cities and homes. The men who worked with the lead pipes went by the same name we use for them today — Plumbers.



*A plumb line*

## People, Places, and Things

1789 to 1820

### People: Who?

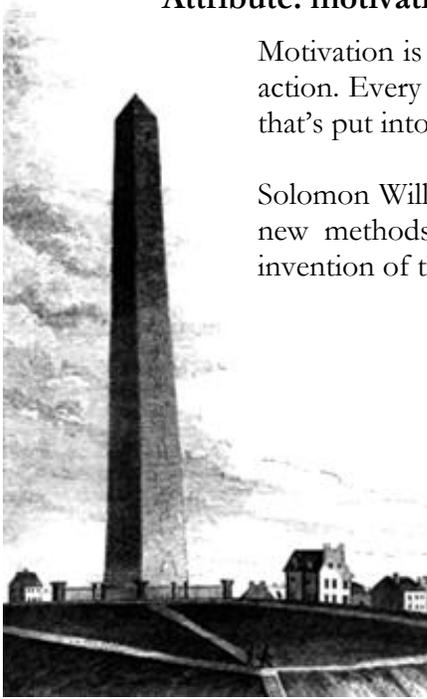
- The son of a carpenter, he was born in Massachusetts in 1783.
- He became a well-known artist and learned the art of carving stone.
- He became the designer, architect and construction superintendent for the Bunker Hill Memorial. The monument was designed as an obelisk, something never before constructed in the United States.
- He found a nearby site for the stone, opened a granite quarry and invented new ways to cut and extract the stone.
- To transport it to the site, he helped design and build the Granite Railway, the first commercial railroad in the country.
- To lift the stones, he designed a simple hoist with a wood pole and movable beam. The device is called a derrick or crane.
- He died in Quincy, Massachusetts in 1865.

**Solomon Willard: stone carver, monument builder, inventor**

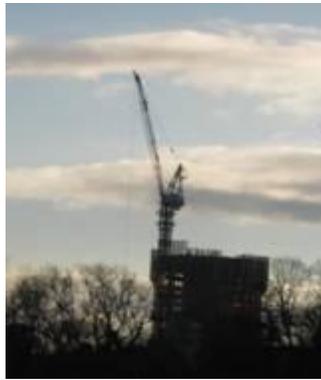
**Attribute: motivation**

Motivation is an internal decision making process that determines a person's daily course of action. Every activity, and the degree to which it is accomplished, is based on the motivation that's put into it. Success in life is often considered an attribute of a person's motivation.

Solomon Willard's motivation to build the Bunker Hill Memorial led to the development of new methods for quarrying, construction of the nation's first railroad system, and the invention of the hoisting crane.



*Bunker Hill Memorial*



*The crane*



*The railroad*

“The three great essentials to achieve anything worth while are: hard work, stick-to-itiveness, and common sense.”

**Thomas A. Edison**

**Places: Guildhall, London, England**

Construction of the Guildhall in London was started in 1411 and has survived catastrophes like the Great Fire of 1666 and the Blitz bombing during World War II. Its Great Hall is one of the largest in England, where royalty and state visitors have been entertained for centuries. Its Old Library is used as a reception room and the New Library holds rare collections that are considered a national treasure.



*Guildhall, London*

## Things: Guilds

Guilds were groups of workers with common goals and beliefs. They existed in Europe from the Fifth to the Fifteenth Century (the Middle Ages).

There were three types of guilds:

- Religious/social guilds that built and repaired churches, bridges and houses for the poor
- Merchant guilds that operated businesses
- Craft guilds that were organized according to crafts or trades such as masons, bakers or barrel makers

Members of craft guilds lived in the same part of town, ate together on holidays and cared for one another when sick. Almost all guild members gathered together at church on Sunday and many guilds were known as “Worshipful Companies.”

Guilds worked hard to keep wages fair and to maintain a reputation for quality craftsmanship. Being honest and respectable was important because the members’ lives were closely linked together. The guild’s success depended on each individual and their unified efforts.

Trade skills were handed down through centuries and generations by family members. Some family names refer back to these origins: “Coopers” were barrel makers, “Fletchers” made arrows, and “Smiths” worked with metal.



*Worshipful Company of Masons of London*

## COAT OF ARMS

A coat of arms is a colorful blend of symbols and designs that is used to identify a person or group of people. Each guild had a distinctive, decorative and easily recognizable Coat of Arms. This was an important form of identification because so many people were illiterate.

A coat of arms consists of several different parts such as: mantling, shield, helm, and crest. They have been used for centuries in Europe to express not only trade skills, but also heritage and status.

Above is the Coat of Arms for The Worshipful Company of Masons of London.

## Places: The General Society of Mechanics & Tradesmen of New York City

In 1785, the 23,000 people of New York City were struggling through a bad economy after the Revolutionary War. The poor houses and debtor's prisons were full, while the federal, state, and city treasuries were empty. With this solemn backdrop, twenty-two tradesmen including a blacksmith, silversmith, sail maker, and bell hanger met at a tavern on Pine Street to form a society to "... provide mutual help in sickness and distress, to aid fellow member's widows and orphans, and to encourage the mechanic interests of the city." Thus, the General Society of Mechanics & Tradesmen was born. In the following years the small group succeeded, grew, and prospered, just like the young country.

In 1820, New York City had no public schools, so "The Society," as it was known, opened a school for its members' children and called it "The Mechanics Institute School." Today "The Institute" continues to provide instruction to those interested in building construction and skilled craftsmanship.

The General Society of Mechanics & Tradesmen building and library is located at 20 West 44th Street in New York City.



*The General Society of Mechanics & Tradesmen*

## People: Master Craftsman and Mechanic

### Master Craftsman

What is a Master Craftsman? He is the most experienced expert in a certain trade or handicraft. Historically, before a new employee could become a Master Craftsman he had to go through a training period that started as an apprenticeship. Usually an apprentice didn't learn more than just the basic techniques, but after several years would rise to the level of journeyman. A journeyman traveled to other towns or countries to learn the skills of other masters. After several years of experience, a journeyman could be elected to become a Master Craftsman. It would require a donation of money or other goods, the approval of all masters of that guild and usually the production of a so-called "masterpiece" to showcase his abilities and skills. This was all part of the training system of guilds.

## Mechanic

When you hear the word “mechanic” you most likely think of someone who wears overalls, works in a gas station or garage and fixes cars. But that’s not what the term meant during the 18<sup>th</sup> and 19<sup>th</sup> centuries. Here in the United States, long before there were automobiles, there were “mechanics.” A mechanic was the most skilled and knowledgeable person working in a shop or at a trade. Whatever the work or craft, the mechanic was the one able to do the best work. To be called “a mechanic” was a title of honor and respect, like “Master Craftsman.”



*Mechanic*

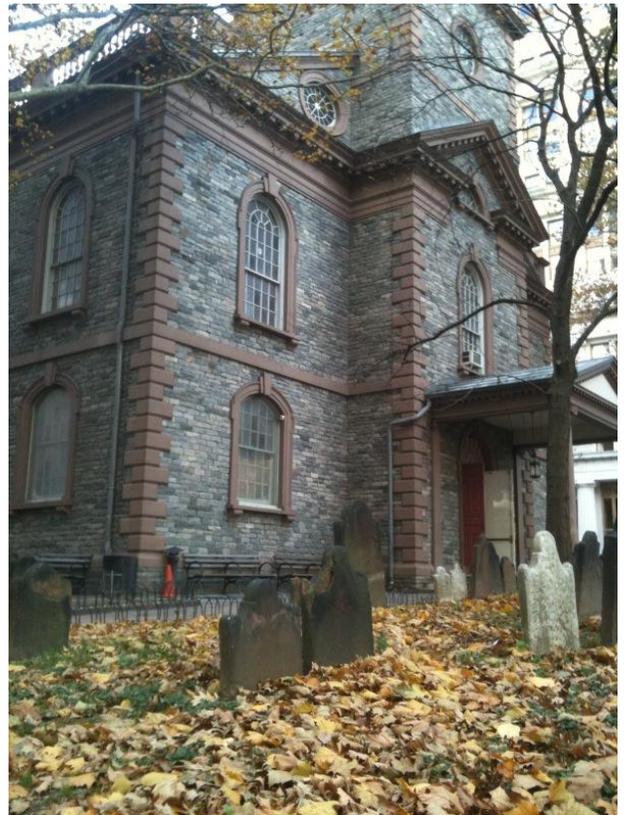
## Building of the Era

### Saint Paul’s Chapel, New York City

Saint Paul’s Chapel was built on a wheat field that sloped down to the Hudson River. The masonry was completed in 1766 and a wooden spire was added in 1794. George Washington worshiped here with members of the United States Congress on his Inauguration Day, April 30, 1789.

Although threatened several times by fires and other disasters, it is the oldest building in continual public use in New York City.

On September 11, 2001 both towers of The World Trade Center were destroyed during a terrorist attack. St. Paul's Chapel, located only a block away from Ground Zero, was covered in dust but remained standing. It was a refuge for rescue workers and firefighters that became a symbol of hope for the rest of the country.



*Saint Paul's Chapel, NYC*

## Quotes

“God is our guide”

**Motto**

The Worshipful Company of Masons of the City of London

“When we build ... let it not be for present delights nor for present use alone. Let it be such work as our descendants will thank us for, and let us think ... that a time is to come when these stones will be held sacred because our hands have touched them, and that men will say as they look upon the labor, and the wrought substance of them, See! This our fathers did for us!”

**John Ruskin**

Seven Lamps of Architecture

“Gung ho!”

This phrase is used to describe an enthusiastic person or an overly aggressive activity. It’s actually a Chinese slogan that became popular during World War II. A United States military officer saw workers in China re-building towns and cities that had been destroyed by the Japanese. They used a phrase that he borrowed to build up the spirit of his Raider Battalion. He would tell them over and over again: “Gung Ho! Gung Ho!” It means: “work together.”



**Lt. Col. Evans Carlson**

Unofficial motto of the U.S. Marine Corps

## Synopsis

After reading this chapter you should now have a better understanding of or be able to identify the following:

- masonry
- trowel
- level
- plumb
- scaffolding
- safety
- guild
- coat of arms
- mechanic
- motivation
- gung ho

## ACTIVITIES

### 1. Build pipe staging

#### Materials:

- 2 pipe staging frames
- 2 cross braces
- 4 couplers
- 4 pins
- 4 base plates
- 6 planks
- 2 safety rails
- 1 toe board
- Netting and ties



#### Procedures:

- Identify and explain the different scaffolding components.
- With students working as a team, demonstrate how the pieces are assembled.
- Make sure the sections are assembled safely.
- Demonstrate how to safely walk on, and climb upon, the scaffolding.
- Emphasize being mindful of defects like cracked, split or warped planks and the dangers of setting plank ends on a frame without enough over hang for support. If not positioned correctly, the planks will collapse.
- Show how staging planks can be positioned and stocked with materials so masons have them close by for building a wall.
- Explain why protective netting is important and how it is tied to the frame.
- Explain proper storage methods and how this prevents rusting metal, cracked or warped planks, and damaged locks and couplers.
- Review again the pipe staging parts. Ask if everyone understands how to build pipe staging, and answer all questions.
- Have the students take the staging apart.
- Have the students build staging back again – safely, and as a team.
- Check the assembled pieces and discuss the student's performance.
- Have the students disassemble and store all sections, properly.

## PIPE STAGING

Pipe staging parts:

- Frame – A large square made of metal tubes that look like a picture frame with hollow posts at the corners
- Cross brace – A collapsible X with holes on each end
- Lock – A movable cover or a removable wire that holds the cross brace to the frame
- Coupler – A short pipe with holes that attaches the top of one frame to the bottom of the next frame
- Pin – A long bolt that holds the coupler in place
- Plank – Wide wood boards you walk on and store materials
- Base plates – Attaches to the bottom of the frame to prevent it from sinking
- Outrigger (or Bicycle) – A side bracket that looks like a bicycle without the wheels. It attaches to the side of the frame to install more planks along side the staging
- Safety mesh – A protective net-like covering
- Safety rails – Connect to frames to prevent falling
- Toe board – Prevents accidental slipping off of planks



## 2. Draw a personal coat of arms

### Materials:

- examples of guild and family coat of arms
- paper
- color pencils
- imagination



### Procedures:

- Ask students to draw their own personal coat of arms.
- Have students include symbols to represent either who they are now or what they hope to achieve after completing the program.
- Have students include a motto or statement of purpose.
- Have students write a definition or explanation on the back of the paper.
- If comfortable doing so, students can show and share their work with the rest of the class.

### 3. Addition and attitude

#### Materials

- pencil
- paper
- NO calculators

#### Procedures

If A=1, B=2, C=3

Add up the letters for: H-A-R-D W-O-R-K (98)

Add up the letters for: K-N-O-W-L-E-D-G-E (96)

Add up the letters for: A-T-T-I-T-U-D-E (100)



Working hard is important, learning and gaining knowledge likewise, but attitude, the *right* attitude, gives you the highest total.



## Chapter 2: Got Mortar?

### What's Mortar?

#### Limestone, Quicklime and Lime Mortar

#### Natural Cement

#### Portland Cement

#### Mortar: The Art of Mixing

Sand

Water

- Hydraulic Measuring
- M-S-N-O-K mortars

#### Repointing: The Art of Fixing

#### The Tools

Part 2: Jointers and Pointers

- Mortar joints

#### People, Places, and Things: 1821 to 1833

Joseph Aspdin

Attribute: ingenuity

The Erie and Pennsylvania Canals

#### Building of the Era: The row house

Philadelphia, Pennsylvania

#### Quotes and Lyrics

#### Synopsis

#### Testimony

Pastor V., a Masonry Preservation graduate now working as a NYC restoration mason

#### Activities

1. Mixing Lime Mortar
2. Scooping and Spreading Mortar
3. Mortar Joint Re-pointing



## What's Mortar?

Mortar is the material you see in walls surrounding bricks, blocks or stones. It's what holds them together. It looks and feels like soft mud when it's being used, but it dries rock hard and lasts for decades. Mortar has been a part of masonry construction for tens of thousands of years, and is not expected to be replaced any time in the near future.

The word "mortar" comes from the Latin word *mortarium* or the Old French word *mortier* meaning "something that is crushed or mixed in a bowl."

Sometimes mortar is called "cement" but that's not 100% correct. Cement is a powder that's usually sold in bags and is one of several ingredients used to make mortar. Think of cement as a bag of flour, the kind used for baking. Flour is also a powder that's usually sold in bags. A cake has flour, eggs, milk and other ingredients. But it's a mixture; it's not just flour. The same holds true in masonry. Mortar is a mixture of ingredients and not just cement.

The word "cement" comes from the Roman word *caementum* meaning rough stone and chips of stone.

There are basically three types of mortar that correspond to the history of the United States from the 17<sup>th</sup> century to the present. Each is named for a main ingredient used in the mixture. They are: Lime mortar, Natural cement mortar and Portland cement mortar.

## Limestone, Quicklime and Lime Mortar

### Limestone

Limestone is a common and plentiful type of stone. It was formed eons ago when layers of decayed sea animals, mud and shells dried up and solidified. Limestone is made of calcium carbonate combined with other minerals and impurities that give it beautiful texture and variations in color. It's usually a light tan, but can vary from off-white to light brown. Besides being abundant, limestone is fairly durable and easy to work with. It's been used as a building material for thousands of years.



*Mortar*



*Portland cement*



*Limestone*

## Quicklime

Quicklime is a basic ingredient for mortar that has been used for centuries and is still used today. This is the process for making quicklime:

Limestone is dug out of mines or cut from quarries. The stones are crushed and burned for hours or even days in large ovens (called kilns) at temperatures around 2,000 degrees Fahrenheit. The heat removes carbon dioxide and turns the stone into small white lumps, which are called “quicklime.”

## Slaked Lime

To make lime mortar, the quicklime is crushed into a fine powder and put into a vat or open pit dug in the ground. Water is added, and in a few minutes the mix starts to get hot. It bubbles and lets off steam, then acts like a small volcano spitting up boiling hot, white lava. This is a chemical reaction generated by the water’s hydrogen and oxygen replacing the carbon dioxide that was burned off when the limestone became quicklime.

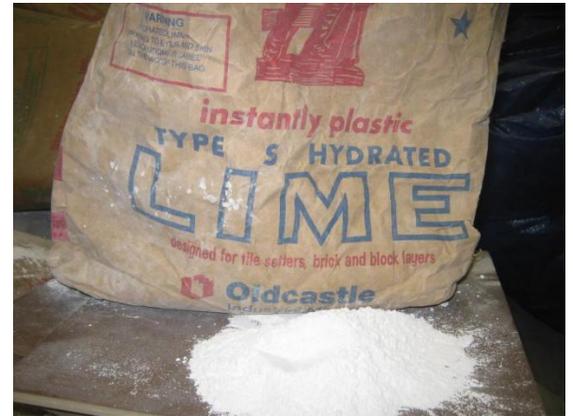
The process of adding water and the dramatic effects that follow are called “slaking.” After several days, the slaked lime cools down and the water evaporates. It eventually turns into a white powder called calcium hydroxide; or hydrated lime. Hydrated lime is sold in large sacks that weigh approximately 50 pounds, and it’s usually just called “lime.”

If you add a lot of water to quicklime during the slaking process, it will form a smooth, white paste called “lime putty.” Lime putty is very practical because if it’s stored in a tightly sealed container it will stay flexible and remain useful for years. The word “plasticity” describes a material that remains flexible and doesn’t get hard. Lime putty will slowly lose its plasticity and harden when exposed to moisture and gases in the air. This is a chemical reaction that occurs with lime mortar.

## Lime Mortar

Lime mortar is made by mixing lime putty with “clean” sand and water. Clean sand has no salt, dirt, roots or other organic matter; and its grains are consistent in size and texture.

When a lime mortar is used to build a wall, the mortar hardens by a process called “carbonation.” This chemical reaction occurs slowly as the mortar absorbs and evaporates water. The mortar might look like it’s hard, or has “set” after only a few hours; but it actually takes years for the carbonic process to finally harden the mortar completely.



*Hydrated Lime*



*Lime mortar*

Lime mortars are very flexible and able to absorb the slight movements that always occur in buildings. If a hairline crack opens, rainwater enters and dissolves some of the mortar to fill the opening. When a mortar does this, it's called a "self-healing" mortar.

**Note:** All of these lime-based materials—quicklime, slaked lime, hydrated lime, lime putty and lime mortar—are to be handled with care. They can burn your eyes and skin, so it's important to know basic safety procedures. Wear safety glasses. If an accident occurs, wash the area immediately with plenty of clean, cold water; and do not rub the eyes.

## Natural Cement

The construction of The Erie Canal was the nation's biggest public building project during the first half of the 19<sup>th</sup> century. It allowed for innovative technology and advancements to trade and travel. But one of its most significant benefits was its contribution to masonry.

In the early 1800's, little was known about canal construction. If built of wood, it would rot in a few years. If built of masonry and lime mortar, it leaked. To solve the problem a mortar that was durable and waterproof was needed. The answer was discovered (or re-discovered) in upstate New York in 1818. A contractor digging along the canal route found a type of stone that seemed peculiar. When ground into a powder, heated and mixed with water it turned into a paste that could harden under water. It was natural, waterproof cement! What made the stone so special was its very specific mixture of lime and clay.

The process of turning this stone into cement was developed by a young engineer/surveyor working on the canal. His name was Canvass White and he had just returned from England where he was researching experiments for making "underwater" cement. He used the stone to make a kind of cement far superior to any other produced in the United States. In 1820 he received a patent for "Natural Cement." It was processed and packed into wooden barrels that weighed about 320 pounds each. Thousands of barrels were produced to build the Erie Canal.

Natural cement's abundance and waterproofing abilities were exactly what the young and fast-growing nation needed. Soon it was being dug out of mines in the Catskill Mountains, burned in kilns, ground into powder, and transported by barrel across the country. It was mixed with water and sand to make mortar and used to construct buildings, bridges, monuments and water systems throughout the rest of the century. By 1899, nearly 10 million barrels of natural cement were being produced each year in the United States and Canada.

At the turn of the 20<sup>th</sup> century, stronger and faster setting Portland cement greatly reduced the demand for natural cement and most of the manufacturing plants stopped production. Recently, the Rosendale Cement facility in upstate New York re-opened to provide natural cement for masonry repair and restoration projects.



*Rosendale cement mines*

## Portland Cement

The most popular type of cement in use today is Portland cement. It is used to make a mortar that has four basic ingredients: Portland cement, hydrated lime, clean sand and clean water. Portland cement gives mortar its strength, lime makes it flexible, sand gives it volume and water blends it all together so it can be spread and tooled. The strength and durability of a mortar made with Portland cement depends on the proportions of the ingredients in the mix:



*Portland cement*

- If there is more cement, the mortar will be stronger, harder and more durable
- If there is more lime the mortar will be weaker, softer and more flexible
- If there is more sand it will reduce the strength of the lime and cement, weakening the mortar
- If there is too much water it will reduce the strength and workability of the mortar

There is a type of premixed mortar called “Masonry cement” or “Mason’s Cement”. It has the Portland cement and lime already mixed together and only needs sand and water to make mortar.

## Mortar: The Art of Mixing

Each type of mortar has a certain proportion of Portland cement, hydrated lime and clean sand. The ratio is given by three numbers that are always listed in this order:

- Portland cement
- hydrated lime
- clean sand

Therefore a “3/1/12” mix for “Type M” mortar would be:



*Mortar and mortar pan*

- 3 parts Portland cement
- 1 part hydrated lime
- 12 parts sand

## Sand

Sand is measured by the pound or ton and delivered to the site in bags or by the truckload. There are three basic varieties of sand: coarse, fine and medium.

- Coarse sand has large grains and feels bulky. It's used mostly for drainage ditches or gardening.
- Fine sand has small grains and feels soft. It's like beach sand or play box sand.
- Medium sand is what you want for mixing mortar. It's not too coarse, not too fine, and has uniform grains that make for smooth working.

## Water

Water for making mortar should be clean, free of debris or contaminants and drinkable or "potable." The word potable is from the Latin word *pōtabilis* meaning drinkable.

### HYDRAULIC

Hydraulic refers to fluids in motion or something controlled by water pressure. Pumps, clocks and even pipe organs can be hydraulic. The word hydraulic is from the Greek word *hydraulikos* meaning water organ.

"Hydraulic cement" is a combination of cooked and ground minerals that undergoes a chemical reaction, called hydration, when mixed with sand and water. It hardens under water. Portland cement, used to make mortar and concrete hardens, or cures, under water and is therefore hydraulic.



*Mortar made with Portland cement*

The ingredients of mortar can be combined in different proportions to give it different strengths. The types of mortar from strongest to weakest are designated by letters: M, S, N, O and K. Those letters were selected from the words: **M**-a-**S**-o-**N** w-**O**-r-**K**.

A standard rule for mixing mortar is: The amount of sand should be between a minimum of 2.25 and a maximum of 3 times the total of the cement and lime, combined.

In other words, for Type M mortar with a 3/1/12 ratio, the cement and lime combined equals 4; and the maximum amount of sand to be used would be 12, (4 x 3).

A general mix ratio for mortar has been designated by The American Society for Testing and Materials (ASTM) according to the density of the materials. It is noted however that the proportions of lime, cement and sand tend to vary by geographic regions, the contractor or mason's doing the work or by the person mixing the mortar.

### M-S-N-O-K MORTARS

Mortars can be mixed for different strengths. A mortar's strength is measured in "PSI." PSI means pound per square inch. It is the measurement of pressure that results from the force of one pound applied to an area of one square inch.

Here are the types of mortar, the ratio of ingredients, PSI, and their common use in construction or restoration according to The American Society for Testing and Materials.

<u>TYPE</u>	<u>RATIO</u>	<u>PSI</u>	<u>USE</u>
M	3/1/12	2,500	below ground walls, manholes
S	2/1/9	1,800	foundation walls, sewers
N	1/1/6	750	above ground, load bearing walls
O	1/2/9	350	above ground non-load bearing walls
K	1/3/10	75	re-pointing very old brickwork



*M-S-N-O-K mortar samples*

The softer the brickwork being restored, the weaker the mortar to be used in the restoration.

### Measuring

When mixing mortar, it is best to use a box or container to get the correct measurement of sand; and the sand should always be clean, without pebbles or vegetation. Never use sand from an ocean beach unless the salt is washed off with fresh water.

If a box or container is not used for measuring, a shovel or a spade is the tool of choice. Both are used at the mortar mixing area, and are usually called by the same name. But there is a difference between a shovel and spade.



*Sand measuring box*

Shovel comes from the Old English word *scofl*, meaning a wide scoop on a long-handle that used for lifting loose material.

Spade comes from the Old English word *spadu*, meaning a wide, pointed blade on a long-handle that's pressed with the foot and used for digging.

You shift stuff with a shovel and you dig deep with a spade.

There are also gasoline or electric powered machines used to mix mortar. They look like a small concrete truck and might be easier and faster; but the simplest tools used to mix mortar have been, and continue to be, a mason's hoe and a mixing trough.



*Shovels*



*Spades*

### Repointing: The Art of Fixing

When you look at a brick wall you see two parts—the bricks and the lines around the bricks. Those lines are called “mortar joints.” Mortar joints should be softer than the bricks. They wear out faster and have to be replaced sooner. This is done by a process called “repointing.”



*Deteriorated mortar joints*



*Grinder*

Re-pointing starts by carefully cutting out the old mortar joints.

This is usually done with a powerful, little electric saw called a “grinder.” A grinder should always be used with caution as the fast spinning blade could damage brick or cause injury to the mason or others, if not used properly. After cutting, the open joints are swept clean, moistened with water and packed with new mortar. The mortar is installed in layers, which are called “lifts” using a tool called a “pointer.”

Properly re-pointed mortar joints are expected to last fifty years, or more, before needing to be cut out and re-pointed again.

But it is important that the correct mortar, with the right strength for the brick, be used for repointing. If the mortar is too hard, it will crack and destroy the bricks. A field test to help determine brick and mortar strength is provided in Chapter 10.

## The Tools

### Part 2: Jointers and Pointers

#### Jointers

A jointer is a steel hand tool that looks like a stretched letter “s”. It’s used to press or “tool” new mortar joints as they start to harden.

Jointers are sometimes called “strickers,” as masons use them to “strike up” mortar joints. They give a wall a neat, uniform, finished appearance.

The most popular jointers have two different widths. This is for striking up narrow and wide joints. The most popular jointer has  $\frac{1}{2}$  inch and  $\frac{5}{8}$  inch widths. It’s also good to have a wider jointer handy for joints that are  $\frac{3}{4}$  inch and  $\frac{7}{8}$  inch wide.



*Jointers*

A jointer is used this way:

- Gently push it into the center of the joint
- Then while keeping the end a little up and away from the mortar, slowly push it in one direction
- Then pulling it back to smooth and seal the mortar
- First you strike up all the vertical joints (also called “end” or “head” joints)
- Then strike up the horizontal, or “bed” joints

#### Pointers

A pointer is a flat strip of steel about 7 inches long  $\frac{1}{4}$  to  $\frac{7}{8}$  inch wide, offset and attached to a wooden handle.” Different widths of a pointer allow for the installation of new mortar into different sized open joints.

The most popular sizes are  $\frac{3}{8}$  inch,  $\frac{1}{2}$  inch, and  $\frac{3}{4}$  inch—and it’s good to have pointers of various widths handy.



*Pointers*

## MORTAR JOINTS

Mortar joints can be tooled with a trowel or a jointer. Jointers can press mortar in, shape it, put a line through the center or remove some from the face of the brick. These are the most common types of joints found on urban buildings:



*Concave*

*A tooled joint indented to a half round shape*



*Butter*

*Thin and usually found on older buildings*



*Grapevine*

*A special jointer is used to press a thin line into a flush joint*



*Beaded*

*Extends out and given a rope like shape with a special jointer. Used mostly on stone work.*



*Flush*

*Cut flat with a trowel and not tooled*



*Raked*

*Some of the mortar is scraped away with a tool called a rake or a skate.*

## People, Places, and Things

### 1821 to 1833

#### People: Who?

- Born in Leeds, England, in December, 1778
- The son of a bricklayer, he became a brick and stone mason and set up his own masonry business.
- He experimented at home on his kitchen stove, mixing crushed stones with clay, heating them, grinding them into powder and adding water.
- With no chemical training or knowledge, he came up with the exact mixture and process for a masonry product that would dry solid *and* could harden (or set) underwater, without dissolving.
- He named the product “Portland cement” because it had the color of a well-known, high-quality stone quarried on the Isle of Portland.
- He was granted British Patent BP 5022, entitled “An Improvement in the Mode of Producing an Artificial Stone.”
- He died in Wakefield, England on March 20, 1855.

#### Joseph Aspdin: brick layer, inventor, cement manufacturer

#### Attribute: ingenuity

Ingenuity means comprehending a situation quickly and developing a clever solution or new invention that provides solutions. It’s the ability to think and work at the same time.

Joseph Aspdin saw the need for reliable cement that could be made quickly and cheaply and would cure fast. He invented one that did all that—*and* it could harden under water. By mixing the right combination of ingredients for Portland cement, he literally laid the foundation for today’s multi-billion-dollar masonry industry.

Inventing Portland cement was an absolutely amazing achievement. But naming it after the most popular building stone of the day— that was a stroke of marketing genius.



*Joseph Aspdin*

“Necessity... is the mother of invention.”  
Plato “The Republic”

## Places, Things: The Erie and Pennsylvania Canals

Before there were trains or trucks, canal boats were the chief method of transporting people and materials. Canals are man-made waterways built along specific routes, and many of them, both large and small, were built in the early 19<sup>th</sup> century.

After the War of 1812, Philadelphia and New York were the nation's two largest cities and a rivalry grew between them for control of the nation's trade and commerce.

A competition started to build a canal that would connect either city on the Atlantic coast with the vast inland marketplace in the Ohio Valley and Great Lakes. In 1815, Pennsylvania jumped ahead with a major canal building project along the Schuylkill River, near Philadelphia.



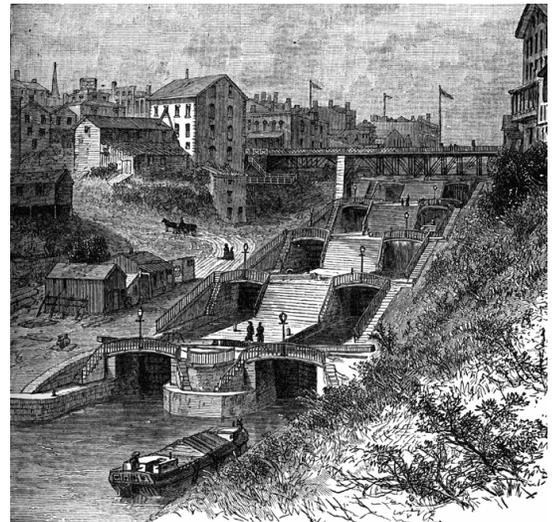
*Canal boat and mule team*

New York responded in July of 1817 by starting a more ambitious project to connect Lake Erie on its western border with Albany, and the Hudson River, in the east.

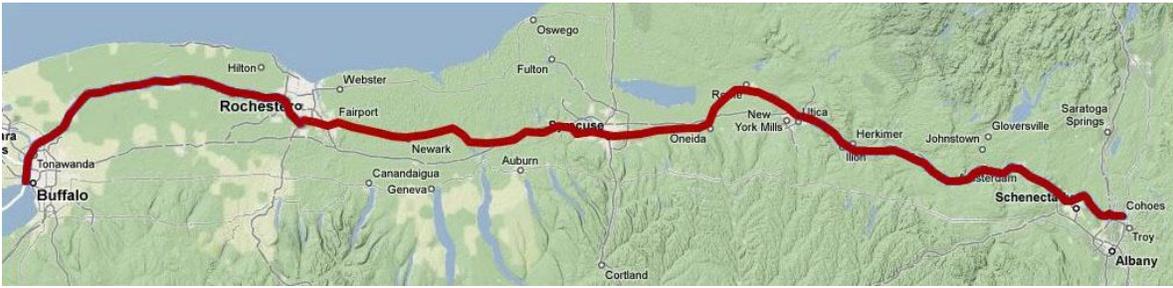
Eight years, three months and seven million dollars later, the Erie Canal was completed on October 26, 1825. It was 363 miles long, 40 feet wide, and 4 feet deep, with new and amazing engineering feats. It had aqueducts built above it for streams to cross and “locks” blocking short sections of the waterway to raise or lower boats over hills.

The construction of the Erie Canal brought many European immigrants seeking better wages to the United States. Canal contractors (actually farmers along the route building small sections of the canal) hired thousands of British, German, and Irish men to dig with picks and shovels. The laborers were paid as much as three times what they could earn in their home countries.

The new water highway reduced shipping costs from \$100 to \$10 per ton and reduced the travel time from weeks to days. It increased trade, travel migration, and prosperity to the Great Lakes, Upper Midwest, and to New York City.



*Erie Canal locks*



*The Erie Canal across New York State*

As New York City became the nation's leader in commerce, trade and finance, Philadelphia's business and political leaders realized that they had literally "missed the boat." In 1826, the Main Line of the Pennsylvania Canal began in earnest, to connect Philadelphia with Pittsburgh. When it was finally finished in 1834, the canal was 395 miles long at a cost of 25 million. But, in spite of its name, it was not 100 per cent canal. To get over mountains, canal boats had to be carried up inclines by horses, and transported over long, flat areas by railroad. Even though the 21-day trip from Pittsburgh to Philadelphia was reduced to four days, the Pennsylvania Canal was never profitable. It was sold in 1857 and abandoned three years later. New York had won this contest against Philadelphia—but others were soon to follow. Between 1835 and 1850, more railroads were built in Pennsylvania than in any other state in the nation. It soon became a powerhouse for transportation, trade and travel. (The Pennsylvania Railroad bought the Pennsylvania Canal and abandoned it. Years later, they built a huge train depot, called Penn Station, right in the center of New York City.) As for the Erie Canal, railroads, and then automobiles, eventually sealed its fate—but it was not abandoned. It is still intact today, and used mostly for pleasure boating, bike trails and hiking. With increasing fuel and energy prices, The Erie Canal could have a comeback as an inexpensive, less polluting, and economical transportation system: this contest between New York and Pennsylvania may not yet be finished.

## **Building of the Era**

### **The Row house, Philadelphia, Pennsylvania**

If you lined up several identical houses side by side, what would you call them? In Europe during the 1700's they were called "terraced houses." But when they started sprouting up in the United States during the early 19<sup>th</sup> century, they were called "row houses."

A row house is a series of several single family houses built next to each other that are almost identical in shape, design, and appearance. They're usually narrow and three to five stories high.



*Philadelphia row houses*

Philadelphia holds claim to building the first row houses in the United States, and many were constructed throughout the city in the 1800's. Philadelphia is famous for its numerous and varied row houses; they are still the most plentiful style of housing in the city.

## Quotes and Lyrics

“Work and play are the same. When you’re following your energy and doing what you want all the time, the distinction between work and play dissolves.”

**Shakti Gawain**

“Opportunity is missed by most people because it is dressed in overalls and looks like work.”

**Thomas Edison**

“Low bridge, everybody down. Low bridge for we’re coming to a town.  
And you’ll always know your neighbor, you’ll always know your pal.  
If you’ve ever navigated on the Erie Canal.”

### **The Erie Canal song lyrics**

The Erie Canal Song was written in 1905 to commemorate the way of life along the Erie Canal. The song is about the travelers who would typically ride on the roof of boats when conditions allowed, but would have to duck or get down to fit under bridges.



*Erie Canal boat*

## Synopsis

After reading this chapter you should now have a better understanding or be able to identify the following:

- mortar
- quicklime
- hydraulic
- Portland cement
- re-point
- bed joint
- jointer
- pointer
- strike
- row house
- ingenuity

## Testimonial of Pastor V.

A Masonry Preservation graduate, class of 2008-09, he is now employed as a restoration mason with a NYC construction company.

*I am succeeding in my three life goals:*

- 1.) *I have a job and I'm learning craftsmanship.*
- 2.) *I'm continuing my studies and now have certificates in scaffolding and safety.*
- 3.) *I found respect.*

## ACTIVITIES

### 1. Mixing Lime Mortar

#### Materials:

- hydrated lime
- sand
- water
- mason's hoe (with holes)
- shovel
- measuring box
- mortar mixing trough



#### Procedures:

The following procedure is for mixing “Straight Lime” mortar. Since Portland cement is not used, it is not an M, S, N, O, or K type of mortar, but is sometimes called “Type “L” mortar. This mortar can be saved and used for all future practice work. It will keep for months, even years, as long as Portland cement is not added. Periodically it will need to be tempered (by adding water) to bring it back to a workable consistency.

Straight lime mortar uses a 0/1/3 ratio.

That's 0 shovels of Portland cement, 1 shovel of lime, and 3 shovels of sand.

- Use the measuring box to get the correct measurements of lime and sand.
- Put the sand and lime in the trough—carefully. Don't plop them in.
- Use the hoe to mix them together. Be sure to get the sand and lime in the corners and bottom of the trough. Break up or remove any lumps. The trough is long to help you mix the ingredients completely by pushing them back and forth.
- When they're all blended together, make a volcano.
- Start adding water into the crater of the volcano.
- Add too much water and it will turn into soup; not enough water and the mix will be “stiff” and you'll need to add more.
- You will know it is mixed completely when it's smooth, creamy, and looks like soft ice cream.
- Pull the mortar into a pile in the middle of the tub.
- Clean off the hoe.
- Using a shovel, put the mortar into mortar pans.

## 2. Scooping and Spreading Mortar

### Materials:

- trowel
- lime mortar
- mortar tub and stand
- bench or board 2 to 3 feet long, 1 foot wide, and approximately 2 feet off the ground

### Procedures:

A mason gets mortar onto the wall by scooping it from the mortar pan then spreading it along the top of the brick or block.

#### How to scoop mortar:

- Holding your trowel in your strong hand, stand over the mortar tub and take a swipe at the mortar.
- Angle the trowel and aim deep to get a full trowel.
- Scoop up the mortar.
- Snap it. You do this by flicking your wrist. This is important. This “wakes up” the mortar and keeps it on your trowel. You have to snap every trowel full of mortar you pick up.



#### How to spread mortar:

- Holding the trowel with mortar, stand about one foot away from the practice bench.
- Stretch your arm out and put the trowel and mortar about 6 inches above the bench.
- Aim the near edge of the trowel at the center of the board.
- Slowly twist your hand toward you so the mortar starts to slide off the trowel, and pull your elbow in towards your hip.
- Direct the mortar along the bench and let it slide off in a narrow strip.
- Keep twisting your trowel until the mortar is all off and you’ve got a line that looks like a mountain range stretching along the board.
- Try to get as much mortar as possible onto the board, and not on the floor.
- Now, twist your trowel in your hand so the bottom of the blade faces the sky.
- Use the trowel tip to tap the mortar at about every 6 inches. Start at the front of the mortar line and work the trowel to the bottom. This is called “furrowing” or “frogging” the mortar. It spreads it out for an even setting bed and lets you make sure there are no rocks or lumps in the mortar.
- Continue these motions until they become smooth and easy. Practice will build arm and hand muscles while increasing accuracy and speed.

### 3. Mortar Joint Re-pointing

#### Materials:

- trowels
- pointer
- Type L mortar
- brick sample panel

#### Procedures:

- Scoop a half trowel full of mortar and snap it.
- Put the trowel/mortar in your other hand.
- Pick up your pointer.
- Use it to scrape mortar off the sides & toe of the trowel, leave a mound on its heel.
- Stand in front of the brick panel.
- Hold the trowel next to the brick panel so the long part of the blade is touching the bricks right near the top of one course.



#### **To get the horizontal (bed) joints:**

- Push mortar into the opening between bricks using the entire, wide part of the pointer blade, not just the tip.
- Keep pressing the mortar in mortar till the opening is full all the way across.
- When you get to the end brick put the mortar in and pull the pointer towards the center of the panel. Pushing the mortar to the outer edge will break it off.
- Fill all the horizontal mortar joints and refill your trowel as necessary.
- Scrape off any mortar by holding the joiner on an angle and whisking it over the bricks
- Cut off any excess along the outside perimeter of the panel using the tip of the pointer
- Catch the excess with your trowel and re-use it by mixing it with the mortar already on it



**To get the vertical (also called a cross or head) joints:**

- Hold the trowel in front of you chest high, and point the toe almost straight up in the air. Mortar should be near the heel, and since you already snapped it, the mortar shouldn't fall off.
- Hold the pointer as you would a trowel and twist your hand so your thumb is facing down near the handle of the trowel.
- Push the pointer into about 1/2" of mortar at the top or toe of the trowel.
- Scrape the mortar upwards and onto the pointer blade, and keep pushing it upwards till it's off the trowel and onto the pointer.
- Keep the mortar on the pointer and turn it so you can fill the short vertical openings between the bricks.

**Finishing**

- Make sure all the joints are filled evenly and scrape off all excess.
- Pull the long pointer blade across the joints to flatten and smooth them.
- Practice these motions until they become smooth and easy.



## Chapter 3: Why Are Bricks Red?

### Bricks: Kilns and Clinkers

- Brick Bonds and Patterns

### Blocks: Cement and Cinders

- Block Parts and Names

### Brick vs. Block: What's the Difference?

### Fix the Bricks – Deterioration and Replacement

- Adobe

### The Tools

Part 3: Mason's hammer, brick set

### People, Places, and Things: 1834 to 1859

Andrew Jackson

Attribute: endurance

St. Louis, Missouri

Vitrification – Fire, Bricks and Fire Gods

The Masonic Order and Anti-Masons

The Industrial Revolution

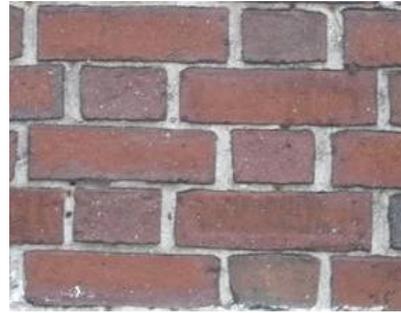
### Buildings of the Era: Factories of the Industrial Revolution

### Quotes and Lyrics

### Synopsis

### Activities

1. Spread mortar for end joints
2. Cut a brick with hammer and set
3. Build a brick wall



## Bricks: Kilns and Clinkers

Bricks are one of the oldest man-made building materials on the face of the earth. A brick estimated to be 8,000 years old was found in the ancient city of Jericho, and bricks were used to build the Tower of Babel. When Roman soldiers fought their way across Europe, they brought their own portable brick kilns with them. A kiln is a type of oven that can stay very hot for a long period of time.

Bricks are fireproof and were the most common building material in England after 1666. That was the year The Great Fire of London burned down 80 per cent of the city.

The word brick evolved from an Old French word *brique* meaning a piece of clay baked like a loaf of bread.

One of the most popular methods for making bricks in the United States during the 1800s was the soft mud process. These are the procedures for making bricks with the soft mud process:

### 1. Mining the clay or Winning

Clay, having a certain combination of minerals, would be dug from mines or riverbanks. It was dried, pushed through sturdy screens to remove rocks, then mixed with other ingredients, including shale and sand, in a process called winning. It was then ground up by a crushing machine.

### 2. Preparing the clay or Pugging

The clay was then delivered to a pug mill where it was mixed with water, and then pushed, pulled and kneaded by large augers, or wooden paddles, until it became a heavy dough-like material. When it reached the right consistency, the clay was delivered to the molding area. Pug mill work was hard and heavy, so horses were often used to drive the augers or paddles.

### 3. Molding or Dashing

Every brick was made by a man called a brick molder. He would take a handful of wet clay, roll it in sand, and then throw (or dash it) into a wooden mold. Then he'd press it down and scrape any excess from the top with a flat stick. The inside of the mold was coated with sand to prevent the wet clay from sticking so the brick would pop out of the mold (the same way a cake flops out of a pan that's dusted with flour). Sometimes water was used instead of sand in a process called slop molding. Either way, a brick molder would work twelve to fourteen hours a day to make 3,500 to 5,000 bricks.



*Bricks*



*Brick molder*

#### 4. Drying or Green Bricks

The bricks were then dried in the open air or covered sheds. Sometimes they were put in tunnels to protect them from foul weather. These dried brick were called “green.” They would sit for three days, get a final coat of sand to keep them from sticking together, and then be moved to the kiln.



*Drying bricks*

#### 5. Firing in Beehives, Clamps or Scoves

The earliest kilns were huge ovens made with the green bricks. The bricks were carefully arranged to allow heat to flow around them and formed into a large round mound called a beehive. Kilns built into different shapes had different names, such as clamps or scoves. Then the huge pile would be coated with clay and a low fire set inside to complete the drying process for a day or two. Then, intense fires were stoked and kept going for a week, with temperatures reaching 1800 degrees. The fires were then allowed to burn down for about another week.

#### 6. Sorting Clinkers and Salmons

After cooling, the kilns were disassembled and the bricks sorted according to their hardness. Those along the outermost walls that didn’t cook completely were kept to be burned again. Some closest to the center turned black from the intense heat and were set aside for specialized brick pattern work. The bricks that had baked to a deep red color were called face brick because they were selected for use in exterior walls. Those that weren’t as hard were used for interior walls and were called salmon brick because of their red-orange color. Bricks that were twisted or warped were called “clinkers” and they were used for decorative work.



*Clinker*

#### 7. Packing, Loading, and Transporting

The bricks were then packed for shipping. A single brick could weigh as much as 8 pounds, and a brick factory might ship 80,000 bricks a day. Because of the weight, railroads were the primary means of transportation. Freight cars were loaded by hand. Two men could load one car each day, with each car holding between 8,000 and 10,000 bricks.

In the mid-1800s the hand-made method of brick manufacturing was replaced by steam powered machines. Stiff clay was rammed through a long brick-shaped tube, and then cut to brick shapes by a revolving wire that worked like a giant cheese slicer. These nearly perfect bricks are called extruded, or wire-cut, bricks.

Technology continues to develop new brick manufacturing methods. Many bricks today have two or three holes through them to make them lighter and to attach, or key, into the mortar. Kilns that originally burned wood were replaced by coal then oil burning furnaces. Today bricks are fired in electric kilns with a conveyer belt system that moves them through the huge ovens.

You might think all bricks are red—but they can be yellow, tan, brown and many other colors, depending on the ingredients originally in the clay, or added during mixing. Sometimes bricks are coated before firing to give them a certain look or texture. But why *are* bricks red? There are two main reasons. If the clay contains iron oxide, a very common mineral, the bricks will be a red or red-orange color. The second reason starts with a question. What color is a lobster? Red? Is a lobster *always* red? No, it's actually a greenish-brown color when alive. It only turns red after it's been boiled or cooked. The same holds true for bricks. A green brick is about the same color as a live lobster, but after cooking...



Red bricks

### BRICK BONDS AND PATTERNS

STRETCHER

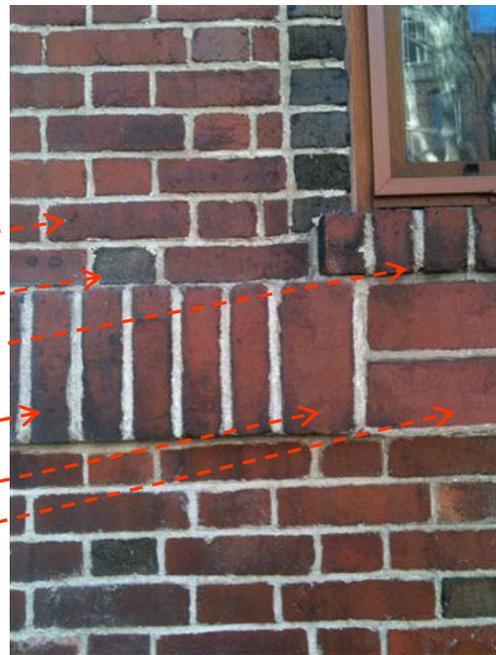
HEADER

ROWLOCK

SOLDIER

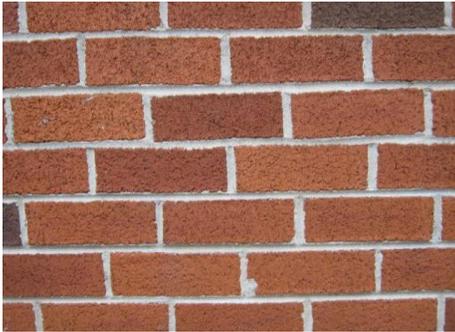
SAILOR

SHINER

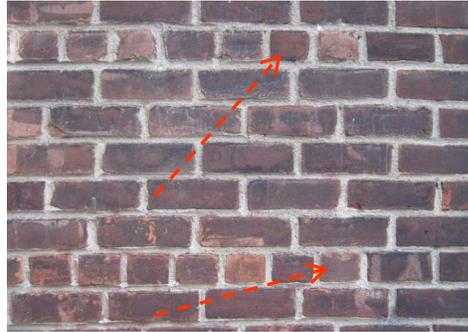


## BRICK BONDS AND PATTERNS (continued)

Bond means the way bricks are positioned in a wall so they overlap and interlock. This ties the wall together and gives the building more strength and stability. There is a name for each way a brick can be placed or laid in a wall. The bond makes a pattern that is not just decorative, but functional. Some of the patterns were named after their country of origin or popular use. Here are six popular bond patterns: Running, Common, English, Flemish, Stack, and Basket Weave:



**Running Bond:** A simple and frequently-used pattern that consists of all stretchers.



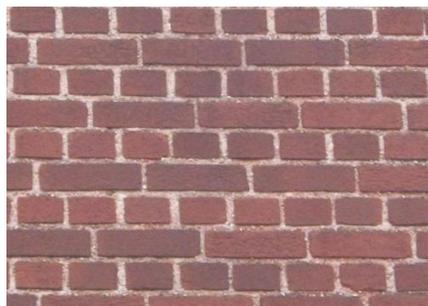
**Common Bond:** Also called "American Bond," has a course of headers (noted by arrows) every fifth or sixth course.



**Flemish Bond:** A header, then stretcher, a header, then stretcher along each course.



**Stack Bond:** Brick courses directly atop each other with no overlapping.



**English Bond:** A course of headers with courses of stretchers above and below.



**Basket Weave:** A decorative pattern with two, three or more bricks laid perpendicular to each other.

## Blocks: Cement and Cinders

Blocks are different from bricks. Blocks are larger and have two or three large holes in the center. These holes are called cores, and they make block lighter and easier to handle. The cores also provide openings to be filled with concrete and long steel rods called rebar. These give a wall more strength and stability. A block wall is less expensive to build than one made of brick or concrete, but generally it's not as durable.



*Block walls*

Blocks are called CMU's, which is an abbreviation for concrete masonry units. They are made of Portland cement, sand, and fine gravel. There are four steps in the CMU block-making process:

- mixing
- molding
- curing
- drying

Cement, sand, and gravel are blended together in large mixing machines. Chemicals, coloring, and water are added. The resulting mix looks like the concrete used for sidewalks, but has more sand, less gravel, and less water.

The mix is then poured into molds. Fifteen blocks can be made at one time, which are then pressed and pushed out of the molds onto movable racks. The racks transport the blocks into a curing room where they sit for a couple of hours to firm up. Then they are slowly cured as low-pressure steam fills the room. When the temperature reaches 185 degrees Fahrenheit, the steam is shut off and the blocks soak up the hot, moist air for another 12 to 18 hours. Then they are air dried for several hours and sent to the shipping area for packaging. This entire process takes about one day from start to finish.

There are other types of blocks besides CMU's. A cinder block is made from Portland cement, sand, and the remnants of burned coal, which are called cinders. Cinder blocks look like cement blocks but have a rougher finish and are lighter. An average concrete block weighs about 40 pounds while cinder blocks weigh 25 to 33 pounds.

There are blocks made entirely of glass. These use a totally different process that allows them to be shaped into many different forms, designs, sizes, and colors. Glass blocks provide a practical way to let natural daylight into dark rooms, and are used mostly for windows and non-load bearing walls—meaning walls that don't support the weight of walls directly above them.



*Glass block*

## BLOCK PARTS AND NAMES

The width of a block determines its name and size.

There are 4 inch, 6 inch and 12 inch blocks. But the most common is the 8-inch block. Besides being 8 inches wide, it is also 8 inches high and 16 inches long. A block is always  $\frac{3}{8}$  of an inch smaller along all its dimensions. This allows for mortar joints and makes measuring easier.

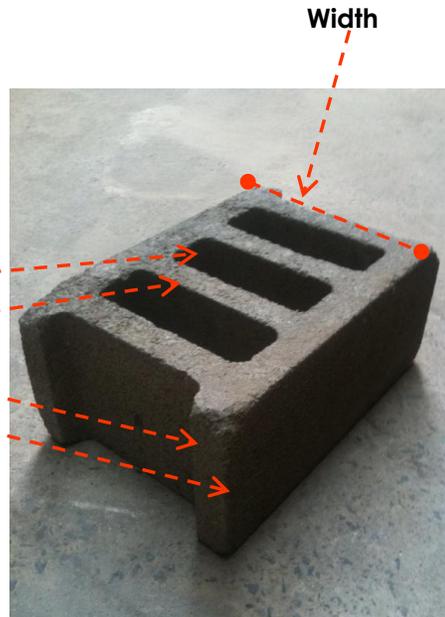
These are the parts of a block:

**Core**

**Web**

**Ears**

**Face**



### Brick vs. Block: What's the Difference?

Let's not confuse bricks with blocks. Generally:

- Bricks are red. Blocks are grey.
- Bricks are more solid. Blocks are more hollow.
- A brick is about as wide as your hand. Most blocks are wider.
- Bricks are made mostly with clay. Blocks are made mostly with concrete.
- Bricks have been fired in kilns. Blocks have been pressed and steamed.

Bricks and blocks are sold in large quantities. They are wrapped with thin, steel bands and stacked onto wooden platforms, called pallets. Bricks are sold in quantities of 500 that are called cubes. One cube of bricks weighs about one ton. Blocks are of various sizes and have different weights, so their number per cube varies.

Bricks and blocks are held differently. Bricks are about 4 inches wide—a bricklayer can easily hold it across the top with one hand. Blocks, if they are a lighter type, can be picked up with one hand along the center web. But generally their size and weight requires both hands for lifting.



*Brick & block*

Some bricks have holes through them, but you don't carry them by sticking your fingers in the holes. You stack them side-by-side on their narrow edge and lift them with a device called brick tongs.

Tongs have a pipe-like handle connected to a vice-like apparatus below it. You fit the vice part over the bricks, and lift the handle, pressing the bricks together. If arranged correctly, up to a dozen bricks can be carried with one hand.



*Brick tongs*

The word tong is from an old German word *tanguz*, which itself comes from the ancient Greek word *dáknein*, meaning, “bite.”

Because blocks are large and bulky, they are carried individually by hand. To move a lot of them, they are stacked on pallets and carried by a forklift. A forklift is a motorized vehicle that picks up heavy materials stacked on wooden pallets. Wooden pallets are designed for a forklift's “forks” to get under the stack and move it where needed.



*Pallets*

### Fix the Bricks – Deterioration and Replacement

Water, wind and weather are not friendly to masonry. If brickwork is not cared for properly, it has a difficult time keeping intruding elements on the outside of a building. Water will get blown into thin openings, called hairline cracks. In cold weather, the water freezes, becomes ice, and expands. The ice spreads out and opens the hairline crack a little more. When the temperature rises above 32°F, the ice thaws and the water goes deeper into the masonry. When the temperature drops again, the ice expands again and causes more damage. This ongoing process is called the “freeze-thaw cycle.” If the cracks aren't repaired, the deterioration will continue until the bricks crack, crumble, or shift out of place and cause damage to the wall or building.



*Cracked brick*

Perhaps you have seen walls that look like someone, or something, took away the front part of the brick. When that deterioration happens to a brick or other masonry material, it's called “spalling.”



*Spalled brick*



*Brick matching*

match the old brickwork in color, size (length, width, and height), and surface marks.

You might think it's not worth the effort to search for the right matching brick—but it is. A good repair, that you don't notice, is like a whispered “thank you.” But a poor repair that you can see from far away will swear at you every time you walk by.

To replace these bricks, an electric grinder is used to cut out the mortar joints, and a small jackhammer, which is a combination hammer and chisel, is used to remove them.

Then, the right replacement brick and mortar are installed. The correct matching of replacement brick and mortar is a blend of art and science. New bricks are expected to be durable, but they also need to



*Mis-matching brick*

## ADOBE

Adobe is a building style and type of construction using handmade bricks that are dried in the sun rather than fired in a kiln. The large bricks are made with a combination of dirt, sand, clay, and straw. Water is added and the mud-mix is packed into molds. The bricks dry for weeks in the hot sunlight, and then buildings are constructed using wet adobe mud for mortar. They are coated with adobe mud for a stucco-like coating.

Adobe is not as durable as kiln-fired bricks, but it is popular in warmer climates where buildings are not greatly affected by freezing weather.



*Adobe construction*

## The Tools

### Part 3: Mason's hammer and brick set

#### Mason's Hammer

Hammer is an ancient word. It comes from the Old Norse word *hamarr*, meaning stone crag, describing a tool with a stone head that is used for hitting.

A mason's hammer looks like something you would use for mountain climbing. It is different from a claw (or carpenter's) hammer in several ways. Instead of having a round front for hitting the top of a nail, it has a square head for cutting and chipping masonry materials. The back does not curve down and fork for pulling nails. It is long, like a chisel, with a slight curve and a solid end (for splitting and trimming masonry).



*Hammer and set*

A mason's hammer is generally heavier than a carpenter's hammer; however, the weight is distributed so that it can be aimed accurately. That is necessary to hit thin pencil lines marking masonry to be cut, or to chip away ragged edges needing to be trimmed.

#### Brick Set

A brick set is a heavy chisel with a wide blade that has an angled (or beveled) edge. It is used to shape bricks to a desired size, and to give them a straight, clean edge. According to the Oxford English Dictionary, the word *set* has 192 definitions, which is the highest number of definitions for any word in the English language.

Note: When using these cutting tools, chips will fly off in unexpected directions. Wear goggles and keep working on your aim. Practice will help bring the entire cutting process together.

## People, Places, and Things

### 1834 to 1859

#### People: Who?

**1767, March 15:** Born in Waxhaw settlement, South Carolina

**1781:** Working as a message carrier for the patriots during the American Revolution, he is captured by the enemy. After refusing to shine a British officer's boots, he is struck across the face and hand with a saber, leaving him scarred for life.

**1802:** Elected Major General of the Tennessee Militia. (A militia is a small military force that is not part of the regular army.)

**1804:** Purchases his homestead, called The Hermitage, near Nashville.

**1813:** In the War of 1812, his militia fights the Creek Indians who sided with the British. Because of his age and toughness, he's given the nickname "Old Hickory."

**1815:** Fights and wins the Battle of New Orleans. Over two thousand British soldiers are killed, with a loss of only thirteen Americans. He becomes a national hero.

**1824:** Campaigns for President of the United States. Receives more popular votes, *and* more electoral votes. However, because he did not receive a majority of either, the House of Representatives chooses the other candidate, John Quincy Adams, to be president.

**1825-28:** Runs for president again. His opponents stage a vicious campaign saying his wife was not yet divorced at the time of their marriage.

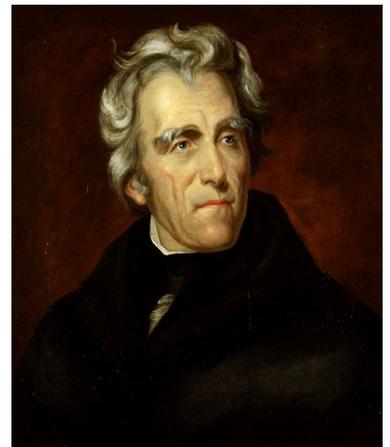
**1828:** Elected President of the United States. His wife dies six weeks later.

**1830:** Enforces the notorious Indian Removal Act, relocating Native American tribes (Cherokee, Seminole, Choctaw, Creek, and Chickasaw) from their homelands in the south to the Indian Territory, or what is now the state of Oklahoma. Many Native Americans died along the way on the infamous "Trail of Tears."

**1832, November:** Re-elected President. Reduces import taxes, and the state of South Carolina threatens to leave the Union. He counter-threatens that state with treason, and for the time being, keeps the United States united.

**1835:** An attempted assassination fails when the murderer's two pistols misfire. The president nearly beats the assassin to death with his walking stick.

**1845, June 8:** After leaving the Presidency, retires to his home, and dies at The Hermitage.



"One man with courage makes a majority."  
**Andrew Jackson**

**Andrew Jackson: soldier, leader, president**

**Attribute: endurance**

Endurance is the ability to bear suffering and pain and continue on without stopping. It's finding inner strength during times of turmoil to overcome adversity and doubt.

Andrew Jackson was the first President who did not come from a wealthy family. He was persecuted because of circumstances concerning his marriage and continually ridiculed for his lack of formal education and culture. But on the battlefield, he proved he was tough and intelligent. As a politician, he didn't quit after his presidential victory was taken from him. When he did become President, he battled Congress, angry states, and assassins. Throughout his life he often suffered from disease, depression, and the wounds of war. It was said that the bullets in his body would rattle like tin cans when he walked by. But no matter the tragedy or trouble, Andrew Jackson showed that he was as tough as "old hickory," and the growing country he led became tough also—able to endure hard times.

### Places: Saint Louis, Missouri



*St. Louis 1855*

In 1850, St. Louis, Missouri had the eighth largest population in the nation, and was the biggest city west of the Mississippi River. It was built over huge clay deposits. Fifty brick companies made over 20 million bricks per year. Huge deposits of coal nearby kept the kilns firing, while local iron deposits opened a booming industry for manufacturing pipes, plows, stoves, and tools.

St. Louis was also the new home to a variety of immigrants and tradesmen. Italian artisans made decorative brick and terra cotta. Irish builders came to escape famine; one, Joseph Murphy, built many of the wagons heading west on the Santa Fe Trail. German brewers came and built a large beer-brewing industry that is still famous today.

There were also slaves and freed African Americans in Missouri. One slave, Dred Scott, sued to gain his freedom; however, in 1857 the Supreme Court declared that Blacks were not citizens and had no rights under the law. Dred Scott's owner did set him free later that year, but the decision of the Supreme Court pulled the nation closer toward a civil war.

## Things

### Vitrification: Fire, Bricks, and Fire Gods

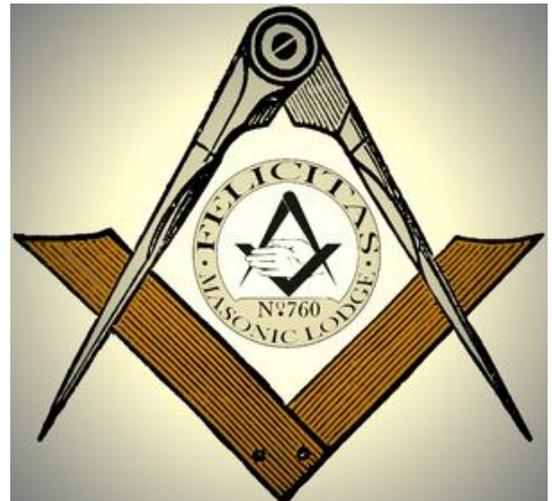
When clay, shale, and sand melt to solidify together in the intense heat of a kiln, the transformation is called vitrification. The Latin word for glass is *vitrum*. It means changing something into glass by heating it. Later known as Vulcan to the Romans, Hephaistos was the ancient Greek god of fire, metalworking, sculpture *and* stonemasonry.



*Hephaistos*

### The Masonic Order and Anti-Masons

In Europe during the Middle Ages (the 12-15th centuries) an elite class of masons traveled freely between cities. Their lack of restrictions earned them the title “free masons.” Today, when people discuss masons, they sometimes confuse those who work with mortar and bricks with the men belonging to an organization called The Free Masons of the Masonic Lodge, or simply, Masons. These Masons are a group of men who share common goals through an organization that maintains strict privacy about their practices, rituals, symbols, and history; however, they don’t build or repair masonry buildings. These Masons have certain rules for initiations and membership; once admitted, a person promises to keep secret passwords, signs, and handshakes to allow him to recognize other members. Many prominent figures in American history have been members of the Masons, including Benjamin Franklin, George Washington, and Andrew Jackson.



*Masonic symbol*

In the 1830s the first group to challenge the two-party political system was officially organized. It was called The Anti-Masonic Party. Its primary purpose was to eliminate Freemasonry in the United States. In 1832 the Anti-Masons nominated William Wirt as their candidate for President. Wirt had been the nation’s Attorney General for 12 years and was a former Mason. He said Freemasonry was a threat to the country; subsequently, thousands of Masons resigned from the organization, while hundreds of Masonic Lodges disbanded. Although the Anti-Masons did not win the election, they felt they had accomplished their purpose; they disbanded and joined the other political parties. But the Free Masons were not eliminated. They kept a low profile and have evolved into more of a social group than a national threat. The Anti-Masonic Party, though short lived, started a continuing political tradition. Single-issue parties have promoted causes such as Prohibition, women’s suffrage and the Right to Life.

## The Industrial Revolution

Industry is the process of turning raw materials into a product, and then selling it.

The word industry is from the French word *industrie*, meaning activity, ability, and a trade or occupation.

A revolution is a sudden and dramatic overthrow of the established order. The word revolution is from the Latin word *revolution*, meaning to turn around.

The Industrial Revolution was a period in history when nations turned from an agricultural society to one that was produced industry. This shift from farms to cities caused massive changes in the way things were made, transported, bought, sold, and used.



*Night view of a city during the 1800s*

The Industrial Revolution affected different countries at different times, with the first waves swelling in England around 1780, and then crashing full force into the United States during the late 1830s.

Here is a thumbnail sketch of what the Industrial Revolution brought:

### Industry

- Steam-powered mills and factories
- New machines for the cloth and textile industries
- Faster transportation systems such as canals and railroads

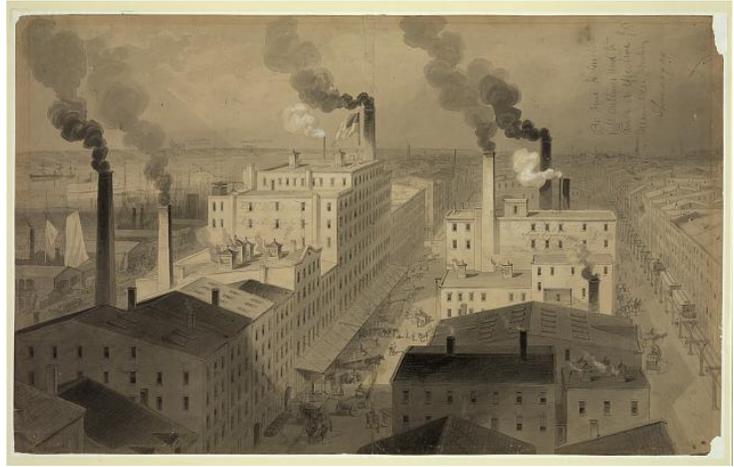
### Socially

- Rapid urban growth, causing cramped, unhealthy living conditions
- Influx of new ethnic groups to cities and factories
- Deadly working conditions for men, women, and children
- New laws for child labor, public health, and workplace safety
- An emphasis on time and money (time means money and time is not to be wasted)
- A culture based on hard work and risk taking
- The promise of a better life and success through hard work (The American Dream)

## Buildings of the Era

### Factories of the Industrial Revolution

The Industrial Revolution brought the ideas and machines of progress to the American nation. Buildings were needed to keep that progress going. Huge factory buildings with chimneys firing and yards clogged with materials, railroads, and freight symbolized an era when farmers left the fields for a new life in the city.



*Industrial Revolution factory buildings*

## Quotes and Lyrics

“The highest reward for man’s toil is not what he gets for it, but what he becomes by it.”

**John Ruskin**

“When you have a connection to your history, you have a perspective that gives you a lot of confidence. It gives you an idea of where you need to go from here.”

**Kareem Abdul-Jabbar**

“John Henry told his captain: ‘Lord a man ain’t nothing but a man.  
But before I’d let your steam drill beat me down, I’d die with a hammer in my hand.’”

**John Henry song lyrics**

To build railroads, thousands of men would cut through whatever stood in their way. One such obstacle for the workers on the Big Bend Tunnel was over a mile of West Virginia mountainside. The railroad company, eager to reduce expenses and speed-up production, started using a steam-powered drill. Legend has it that John Henry, a slave born in Missouri during the 1840s, heard about the machine stealing the men’s jobs on the tunnel; so, he challenged the machine to a contest. The winner would be the first to get through the mountain: steam power and drill versus sledgehammer and muscle. It was a tough and bitter fight—but John Henry won. He made it through the mountain, and then died from exhaustion. Some versions of the story have his wife telling their little boy about his father’s victory, thereby passing along the legend, and the inspiration.



*Locomotive tunnel*

## Synopsis

After reading this chapter you should now have a better understanding of the following:

- clinker
- vitrification
- stretcher
- spalling
- freeze-thaw cycle
- tongs
- Industrial Revolution
- free mason
- adobe
- endurance

## ACTIVITIES

### 1. Spread mortar for end joints

Spreading mortar to make an end joint on a brick is called “buttering” a brick.

#### Materials:

- lime mortar
- mortar tub
- trowel
- bricks

#### Procedures:

- Hold a brick in the center, straight up with your thumb and fingers along the narrow part.
- Scoop up a trowel full of mortar and snap it.
- Scrape the mortar along the top of the brick.
- Scrape the trowel along all four brick sides so that the mortar looks like a pyramid. This is a head joint.
- Practice until this process becomes smooth and comfortable.
- Now turn the brick upside-down so the head joint is facing the ground. Swipe mortar on it and make a pyramid on the bottom of the brick. This is an end joint.
- Practice making head and end joints until you can do it smoothly, cleanly, and accurately.



## 2. Cut a brick with a hammer and set

### Materials:

- mason's hammer
- brick set
- bricks
- pencil
- goggles

### Procedures:

- Mark a pencil line all around on the center of a brick. This line designates where it is to be cut.
- Place the brick on a sandbag, or on soft ground. This helps prevent the brick from snapping in the wrong place and deadens the ringing sound.
- Score the brick with the set along the cut line. Continue the score line along all sides of the brick. Make a groove about 1/16" in the brick.
- The set has a flat side and an angled side. Place the angled side toward the scrap part of the brick. The flat side should also be facing you.
- Tilt the set slightly away from you.
- Give the set a quick, hard, hit with the hammer. If at first you don't succeed—hit it again. The brick should break along the score line.
- Trim the brick with the hammer as much as necessary to ensure that the cut is straight and without jagged edges.



## 3. Build a brick wall

Build a brick wall 5 courses high in a Running Bond pattern. Make sure it is level and plumb. Tool all mortar joints with a concave jointer

### Materials:

- bricks
- lime mortar
- trowel
- 4-foot level
- hammer
- jointer



**Procedures:**

- Spread out mortar for the first course. This is called a bed joint.
- Set a brick into the mortar at one end and cut away excess mortar from below it.
- “Butter” the end of a brick, press it into the mortar, and then squeeze it against the first brick.
- Scrape off excess mortar and “eyeball” it—meaning, look to see that it is the same height as the first brick. If it’s high, tap it down with the blade or heel of your trowel.
- Continue the process with the next brick, and the next, and the next until the bed joint is covered.
- Put the level on top. Tap the bricks to get them level. There should be no space between the top of the brick and the bottom of the level.
- Use the level to plumb the bricks at both ends.
- Use the level as a straight edge and tap the bricks straight with your trowel.
- Continue with the second course in the same way—spread mortar for a bed joint, butter the bricks, use the level, etc.
- Be sure to “break bond,” meaning that a half brick sticks out at the end of every other course. This allows you to come back and lay another course that will interlock with this one like the fingers on your hand.
- Always cut away excess mortar with the trowel blade held at a slight angle away from the bricks to prevent smearing mortar on the brick face.
- At every other course make sure to fill openings in mortar joints by taking some mortar on the tip of your trowel and pushing it into the opening. You can also use a pointer to fill the openings
- Use the concave jointer to “tool” the mortar joints.



## Chapter 4: The city rocks!

### Stone Surroundings

#### Exploring City Stonework

Sedimentary stone

Metamorphic stone

Igneous stone

#### The Art of Stonework

#### The Art of Finishing Stone

#### The Art of Repairing Stone

#### The Tools

Part 4: Stone carving, dressing and patching tools

- Mohs' Minerals

#### People, Places, and Things: 1860 to 1880

Arthur MacArthur

Attribute: heritage

Douglas MacArthur

- Medal of Honor

Civil War battles and the 1860 Census

- Some Recent Statistics

Reconstruction

#### Building of the Era: The U.S. Custom House

Charleston, South Carolina

#### Synopsis

#### Quotes and Lyrics

#### Testimonial

Richard L., former Masonry Preservation student, now working as a NYC restoration mason

#### Activities

1. Carving letters in stone
2. Patching stone with repair mortar



## Stone Surroundings

Close your eyes and think of a place where you're surrounded by stone. But you are not in a cave. You are not in a tunnel. You are not in a castle, or a cathedral.

Open your eyes and look around. You are in a city, and there is stonework all around you. Along the buildings there are different types of stone; each has its own appearance, function, and beauty. Knowing about stone's use and purpose will help you to appreciate a building's qualities and better understand a city's personality.

Stone is categorized according to the way it was formed. There are three basic stone groups: Sedimentary, Metamorphic, and Igneous.

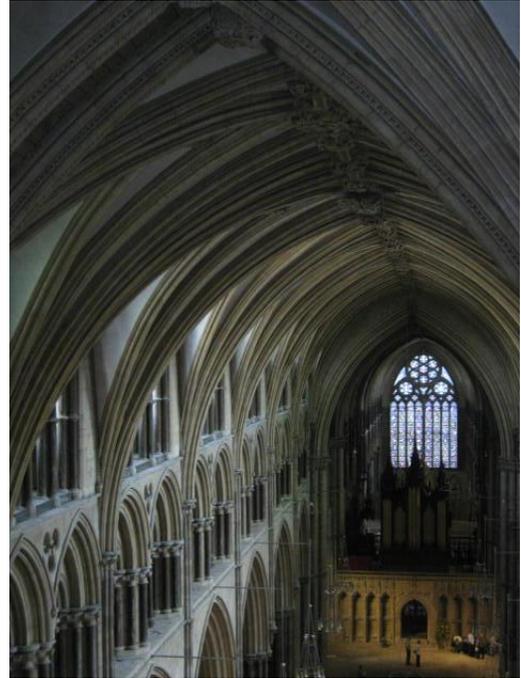
**Sedimentary** stones are made of minerals, shells, clay, and organic matter (like marine animals and plants), that settled in layers on the bottom of huge oceans or lakes. Over time, erosion and evaporation dried up the water and bonded the layers together to make a solid but malleable stone. Sedimentary stones are more plentiful, less expensive, and easier to work with than other types of stone. Limestone, brownstone, and sandstone are types of sedimentary stones.

**Metamorphic** stones were once sedimentary stones that underwent a dramatic change through intense heat and pressure under the earth's surface. The Greek word *metamórfhōsis* means transformation. Some types of metamorphic stones you'll find in a city are marble, which was once limestone; and slate, which was once shale.

**Igneous** stones come from the lava of volcanoes. They solidified either above ground or below the earth's surface to form some of the hardest stones used in construction. The word igneous is from the Latin word *igneus* meaning fiery. Granite is the most common igneous building stone. It can be recognized by the characteristic speckles, dots, and spots that formed as the lava cooled and hardened. The larger the speckles (crystals), the longer it took the lava to harden, and the older the stone.

## Exploring City Stonework

Here are some of the more recognizable types of stonework you'll find on the outside, or inside, of urban buildings.



*Lincoln Cathedral*



*Discovering stone*

## Sedimentary stone

**Limestone** is one of the most common and popular materials used in building construction. Its color varies from grayish tan to yellowish white; there are also pink and rose-colored varieties. Limestone is a good example of sea sediment turning to stone. If you look closely at buildings made of limestone, you can sometimes find shell fragments or pieces of fossil imbedded in the surface. Limestone is the superstar of sedimentary stones because it is abundant, easy to carve and inexpensive.



*Limestone*



*Travertine*

**Travertine** is a porous type of limestone recognized by the dark-colored stripes and bands of tiny holes across its surface. It forms near mineral hot springs or underground waterways, and is used mostly for decorative floors or walls.

**Sandstone** is a combination of quartz, sand, and small rocks that mixed together and became eroded by water or wind. The stones can be tan, cream, gray, brown, red, or green. Sandstone is a common building stone, favored for its workability and beautiful appearance.



*Sandstone*



*Brownstone*

**Brownstone** is a type of sandstone that was tinted a reddish-brown color when the mineral iron oxide, diluted in water, soaked into the rock formation. This gave the stone rich, dark, and varied hues. Brownstone was a popular choice for the row houses built in East Coast cities during the mid-to-late 19<sup>th</sup> century.

## Metamorphic stone

**Marble** has been a favored stone of builders, artisans, and sculptors for hundreds of centuries. It is hard and durable, but can be carved with great detail or polished to give a smooth, glowing surface. Marble has many varieties of colors, and is recognized by the beautiful lines, called veins, that run across and through the stone.



*Marble*



*Slate*

**Slate** is a durable stone that can withstand heat, water and adverse weather. It splits easily along its layers and is a versatile construction material commonly used for windowsills and roof shingles. Slate colors are black, gray, green, blue, and red.

**Bluestone** is a durable type of slate that was often used in the 1800s for sidewalks, curbs, and windowsills. It is grayish-blue to blue-black in color. Weathered or worn examples can be found along older streets in many cities.



*Bluestone*

## Igneous stone

**Granite** is, and has been since antiquity, the most plentiful volcanic rock used in building construction. The Italian word *granito* means grainy, and identifies the granular, multi-speckled appearance. Granite's durability makes it a highly favored building stone. It can be finished with a rough texture or polished to be as smooth as glass. However, it is very hard and heavy, making it difficult to carve and transport. Granite is commonly found along building foundations, entryways, and on kitchen countertops.



*Granite*

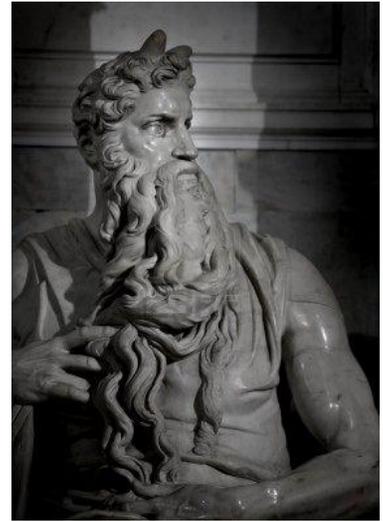
## The Art of Stonework

Stone masonry is different from stone carving, even though both use the same basic materials and require many of the same tools.

**Stone masonry** is a way of finishing (or dressing) stone so a building will have a distinct, stately, and uniform appearance.

**Stone carving** is shaping stone so it can express emotion.

Both methods require artistic abilities that can only be developed through training, practice, endurance, and patience.



*Moses-the art of Michelangelo*

## The Art of Finishing Stone

**Ashlar** is a stone that has been cut, shaped or tooled along four sides. Buildings constructed with ashlar stonework convey a sense of importance, stability, power, and permanence. You'll often see churches, banks, government buildings, and schools built with some type of ashlar stonework. Below are some of the details you'll find on city buildings constructed with stone.



*The art of stone masonry*

**Rock-Faced** stone has a rough and jagged appearance, like it just came from the quarry. It can have any number of finishes, depending on the type of stone used and the desired effect.

**Margins** are the ribbon-like strips chiseled around the perimeter of a stone block, distinguishing it from the other blocks surrounding it.



**Pointed Work** is made with a pointed chisel to give the stone a rough, but uniform, effect. The stone below on the left is rough-pointed; the one on the right is fine-pointed.



**Tooled Work** has a series of close, parallel lines cut vertically along the stone's face.



**Vermiculated Work** is deeply carved to resemble tunnels that look like an ant colony. The word *vermiculārī* is Latin for worm-eaten. This work is highly decorative and quite expensive.

**Rusticated Work** has long, deeply recessed lines cut along the horizontal joints. The stones can have rounded edges such as those on the below left, or square edges like those on the right.



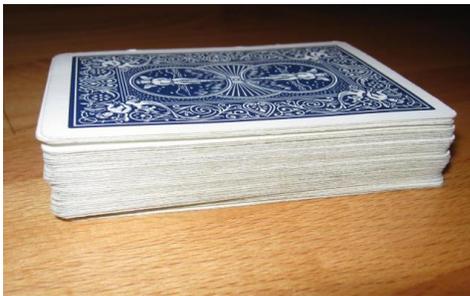
## The Art of Repairing Stone

### The Cause

One of the most common problems with softer sedimentary stones, such as brownstone, is that they were doomed for failure before they left the quarry. Often, when segments of the stone were cut and carved at the quarry workshop, the wrong side was dressed. When the stones were installed on a building, with the weaker side facing out, the layers started separating and falling off. This deterioration is called spalling.



*Deteriorated brownstone*



*Horizontal layers*

If you put a deck of playing cards on a table you'll have what could be imagined as a sedimentary stone.

The cards represent the stone's layers of mud, shells, and other materials stacked together.

Now, if you stand the deck upright, you can imagine the stone as it was installed on a building. If you weaken your grip on the cards, (which is what time and weather do to the stone layers) you'll see the cards start to fall off.

That's what happened to the brownstone used to build thousands of urban row houses. Years of water, pollution, neglect, and poor maintenance just peeled off the layers.



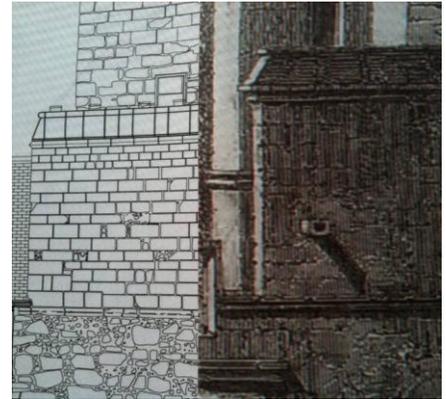
*Vertical layers*

### The Remedy

There are various ways of repairing damaged stonework (if it *can* be saved). These depend on the type of stone, how advanced the damage is, and the amount of money available to undertake the repair. If done correctly, stone repairs are inconspicuous, meaning almost invisible.

The following are a few stone repair methods and materials. Each requires a certain amount of expertise and professionalism to achieve the best results.

***Dismantle and Rebuild*** – If a masonry wall is badly deteriorated, it loses structural integrity. It is unsafe. To make it safe again, one method is to carefully take it apart and rebuild it. This process can be done with new stone, or by salvaging the good original stones and mixing them with new stones of the same color, size, and texture. The wall should be rebuilt in the same manner, and in the same pattern, as the original. When undertaking this repair method, it is important to number and record each stone to ensure an accurate reconstruction. Scale drawings and photographic documentation help to provide a reference during the rebuilding process, and to ensure the finished work looks like the original.



*Drawing of stone wall and historic etching*

***Dutchman*** – Sometimes only a part of a stone is damaged. Repairing that small area is possible by cutting out the damaged section and installing a “dutchman.” A dutchman is a piece of stone with the color and characteristics of the original that is cut to fit the space of the removed, damaged section. The dutchman is securely set into place, often with metal anchors to secure it, and the very narrow perimeter joint is re-pointed to prevent moisture from entering the repaired stone.



*Dutchman repair*

***Patching*** – There are special repair materials that can be mixed like mortar and applied to damaged or deteriorated stone. These repair mortars can be manufactured to match the original stone in color, texture and durability. The process requires specialized training and a certain amount of artistic skill.



*Before patching*



*After patching*

## The Tools

### Part 4: Stone carving, dressing and patching tools

#### Stone carving tools

There are many types of mallets and chisels for carving or dressing stonework. Selecting the correct one depends on the type of stone being worked on and the mason's personal preference. Here are a few basic types of stone carving tools, and their usage. Top to bottom, they are:

Mallet (1) – A hammer-like tool with a round cone-shaped head. The cone shape gives more striking area to hit the chisel head. Mallets are made with heads of steel, wood, or plastic, and come in many sizes and weights.

Point chisel (2) – Also known as a “punch,” it is used to shape the stone.

Toothed chisel (3) – Has thick, comb-like teeth of various widths. It is used to smooth out rough spots left on the stone by the point chisel.

Cold Chisels (4) – Are used for cutting, trimming, shaping, forming, smoothing, carving, and almost any other job that involves using brute force to shape stone. They are called “cold chisels” because they were used by blacksmiths to cut cold metal, as compared with other chisels used for cutting hot metal coming out of the fire.

Pitching Chisel (5) – Is used to remove large areas of stone during the first stage of dressing. It has a broad flat end shaped like a wedge or square.



*Stone carving tools*

#### Stone patching tools

An entirely different set of tools are necessary for patching stone. These are some of the tools used with stone restoration mortar:

Trowel & Squares (1) – Have pointed and a flat ends and are used for mixing, applying, or detailing patches.

Miter Rod (2) – A stiff, wide and thin metal blade with one pointed end that is used for scraping mortar and finishing patches.

Margin Trowel (3) – Flat ended; used for mixing and applying mortar.

Detail/Carving Tool (4) – Used for ornamental carving and fine detailing.



*Stone patching tools*

## MOHS' MINERALS

In 1812, Friedrich Mohs, a German geologist, invented a classification of stones, gems and minerals according to their hardness. According to his scale, 1 is the softest, and 10 is the hardest. The following is the classification number, its corresponding stone, gem or mineral, and a brief description of each:

<u>Hardness</u>	<u>Mineral</u>	<u>Associations and Uses</u>
1	Talc	Talcum powder
2	Gypsum	Plaster
3	Calcite	Limestone and most shells
4	Fluorite	Fluorine in fluorite prevents tooth decay
5	Apatite	From the Greek word <i>apate</i> , meaning deceit
6	Orthoclase	Orthoclase is feldspar; in German, <i>feld</i> means field
7	Quartz	A very common crystal
8	Topaz	Emeralds also have a hardness of 8
9	Corundum	Rubies are made of corundum, and are twice as hard as topaz
10	Diamond	Diamond is four times harder than corundum



*apatite*

## People, Places, and Things

### 1860 to 1880

#### People: Who?

- Born June 2, 1845.
- Living in Wisconsin when the Civil War started, he immediately joined the 24th Wisconsin Volunteer Infantry.
- Fought at the battles of Chickamauga, Stone River, Chattanooga, Atlanta and Franklin.
- During The Battle of Missionary Ridge, in the midst of a deadly uphill charge, he grabbed the flag that had dropped when its carriers were killed by bayonet and cannon ball.
- The battle had been all but lost when he charged through fierce combat to the top of the hill and shouted to his comrades below: "On Wisconsin!" When they looked up and saw their flag, they charged forward and turned disaster into a victory.
- He was awarded the Congressional Medal of Honor for his bravery and became a career soldier.



- During the Spanish-American War he was promoted to general and took part in the capture of Manila in the Philippines.
- Years later, he was sent to China during the Russo-Japanese War and served at the U.S. Embassy in Tokyo, Japan.
- He returned to the U.S. and retired as Chief of Staff, the highest-ranking officer in the United States Army.
- On September 5, 1912, he was the honorary speaker at a reunion of his Civil War comrades. As he was about to give his speech, he suffered a massive heart attack. A surgeon for the 24th Wisconsin rushed forward and announced that the general was dying.
- Solemnly the aged veterans gathered around the frail body and recited a prayer as he passed away. On the wall behind the podium hung an old, tattered flag, which they removed and placed over him. It was the flag he had carried in battle, to the top of Missionary Ridge.



*Arthur MacArthur at 19*

### **Arthur MacArthur: soldier, hero, father**

Arthur MacArthur is most famous for his courage in battle and for being the father of General Douglas MacArthur, the Supreme Commander of Allied forces in the South Pacific, during World War II.

“Americans never quit.”  
**Douglas MacArthur**



*Heritage*

### **Attribute: heritage**

The word *heritage* encompasses all the time-honored traditions that are handed down from generation to generation. They are a family’s most valuable possession, even though they can’t be bought or sold. They are inherited from ancestors of centuries past, and kept alive by passing them along (respectfully) to future generations.

## MEDAL OF HONOR

The Medal of Honor is the highest award for valor in the U.S. It is awarded to an individual serving in the Armed Services of the United States for courageous action against an enemy force. It is usually presented by the president of the United States in the name of Congress, and is therefore referred to as the Congressional Medal of Honor.

Medals of Honor are awarded sparingly and are bestowed only to the bravest and most courageous soldiers.



*Congressional Medal of Honor*

## Places, Things

### Civil War battles and the 1860 Census

It is difficult to imagine a crowd of fifty thousand, one hundred thousand, or a half million people. Yet these large numbers are often given as statistics without something to measure against as a comparison. To comprehend a half million people, you might get a better idea if you picture a city, such as Washington, DC or Las Vegas, Nevada, both of which are in the 500,000 range (according to the 2010 Census).



*Civil War battle*

The figures for cities from the 1860 census, just prior to the Civil War, are given here as a comparison to help comprehend the magnitude of sacrifice, loss, and suffering that took place during the “War Between the States.”

- About 2.1 million men fought for the Union. That was more than the combined population of the country’s five largest cities: **New York, Philadelphia, Brooklyn, Baltimore, and Boston.**
- More than 900,000 men fought for the Confederacy. That was more than the combined population of the next eight largest cities: **New Orleans, Cincinnati, St. Louis, Chicago, Buffalo, Newark, Louisville, and Albany.**
- More than 620,000 people died in the Civil War. That was more than the total combined population of **Boston, St. Louis, Chicago, Washington, D.C., San Francisco, and Detroit.**

The bloodiest battles of the Civil War were:

- Gettysburg: 51,116 casualties—more than the entire population of **Pittsburgh**
- Seven Days Battle: 36,463 casualties—more than the entire population of **Mobile**
- Antietam: 22,726 casualties in one day—more than the population of **Memphis**

Approximately 180,000 black men enlisted in the Union Army. That is more than more than 85% of those who were eligible, and more than the entire population of **New Orleans**. Forty thousand black soldiers in the Union Army died in the war—more than the entire populations of **Nashville** and **Atlanta** combined.

### SOME RECENT STATISTICS

- The United States is the world leader in fatherless families.
- Each night 24 million children (approximately 34 percent of the nation's children) go to bed in a home where their father does not reside. According to the 2010 census, that's more than the combined populations of **New York, Los Angeles, Chicago, Houston, Phoenix, Philadelphia, San Antonio, San Diego, and Dallas**.
- Nearly 40 percent of children in father-absent homes have not seen their father during the past year.

## Things

### Reconstruction

On January 1, 1863 President Abraham Lincoln issued The Emancipation Proclamation. The word “emancipate” means to free someone from the power or control of another. A proclamation is a formal declaration announcing a government act.

The Emancipation Proclamation freed slaves in the Deep South about halfway through the Civil War. Although the Confederate states did not accept Lincoln’s order, a statement was made to the world that the war was now being fought to end slavery.



*Reconstruction-era political cartoon*

The Reconstruction Era started in 1865 after the Civil War ended, and continued until approximately 1877. It was a tense, volatile time of slow healing for the nation. Three amendments to the Constitution were added during the Reconstruction period: the 13th Amendment officially abolished slavery; the 14th Amendment gave former slaves more rights under the law; and the 15<sup>th</sup> Amendment barred discrimination and guaranteed former slaves the right to vote.

## Building of the Era

### The U.S. Custom House, Charleston, SC

The United States Custom House in Charleston, South Carolina, is a massive stone structure of the Civil War Era. Built of New York and New Jersey granite, it has limestone entrance columns and a marble interior and floors. Construction started in 1853, but stopped eight years later at the outbreak of the Civil War. It was badly damaged and unfinished until 1870, when the U.S. Congress supplied funds for its completion.



*The U.S. Custom House*

In 1879, after twenty-six years, and a total cost of nearly 3 million dollars, the U.S Custom House finally opened for business. Having survived the Civil War and years of neglect, it was threatened with demolition during the 1950s. However, local citizens and government officials managed to save and restore it in 1968. It stands today at the foot of Market Street in historic Charleston—solid as rock!

## Synopsis

After reading this chapter you should now have a better understanding or be able to identify the following:

- igneous
- metamorphic
- sedimentary
- ashlar
- spalling
- maul
- punch
- dutchman
- heritage
- Emancipation Proclamation
- Reconstruction

## Quotes and Lyrics

“A people without the knowledge of their past history, origin and culture is like a tree without roots.”

**Marcus Garvey**

“Solomon had seventy thousand carriers (laborers) and eighty thousand stonecutters in the hills, as well as thirty-three hundred foremen who supervised the project and directed the workmen. At the king’s command they removed from the quarry large blocks of quality stone to provide a foundation of dressed stone for the temple.”

Building Solomon’s Temple  
Attributed to the prophet Jeremiah

“ ‘Mid pleasures and palaces though we may roam, Be it ever so humble there’s no place like home!”

**“Home Sweet Home”**  
**John Howard Payne (lyrics)**  
**Henry Bishop (music)**

One evening during the Civil War, the Federal bands started playing “Home, Sweet Home.” The Confederate bands across the river joined in and soon everyone in both camps stopped what they were doing. Then men started cheering, jumping up and down and throwing their hats into the air. One soldier later said, “Had there not been a river between them, the two armies would have met face to face, shaken hands, and ended the war on the spot.”



*A Confederate Camp*

### **Testimonial: Richard L.**

Class of 2007-08 masonry preservation student of the year, now working with a New York City restoration masonry company:

*I am grateful for the learning opportunity. I learned about craftsmanship. It has made me a better individual and father. Now my son will now have an opportunity to learn a trade.*



## ACTIVITIES

### 1. Carving letters in stone

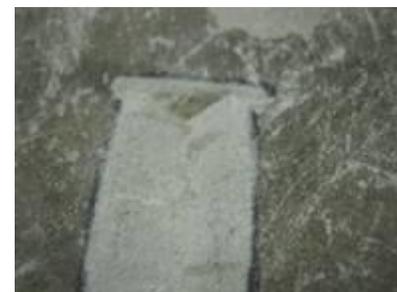
Carving letters in stone requires patience, practice, and determination. The letters to be carved in this exercise will be “V-sunk,” or angled at the outer edges to form a deep line along the center. Limestone is recommended for this activity, as it is easier to carve than marble, granite, or brownstone. The work should be done outdoors, or in a well-ventilated area, to clear the air of dust.

#### Materials:

- limestone slab
- charcoal pencil
- straight chisel
- mallet
- sandbags
- goggles and face mask

#### Procedures:

- Choose a flat stone without cracks or other defects.
- Position the stone on a sturdy workbench, or “banker,” as it’s called, so that it is stable. You can also stack blocks and use sandbags to prevent the stone from moving or shifting.
- Start with straight-line letters such as “T,” “L,” or “V.” Draw the outline of a letter of choice with a charcoal pencil, and include a center line. The outlined edges should be at least a ½-inch apart. The center line will be a temporary guideline as it will become the deepest part of the carving.
- Use a narrow chisel and start on the outside perimeter line, holding the chisel at a 45-degree angle.
- Tap the chisel with the mallet. Watch the chisel cutting the stone, not the mallet hitting the chisel. Keep the chisel at a 45-degree angle moving along the stone outline.
- Working from the perimeter of your pencil outline, start cutting toward the center at a 45-degree angle. Make a V-shaped groove and repeat this procedure until there is a deep straight line down the center.
- Use the flat part of the chisel to carve out the wide parts. Use the corner edge of the chisel on corners, angles, and deeper parts.
- Finish off the end of your letters by making a Y-shaped triangular ending (as seen in picture to the right).



## 2. Patching stone with repair mortar

### Materials:

- repair mortar
- water
- spray bottle
- measuring cup
- stone repair tool
- straight edge
- brush
- sponge
- plastic covering

### Procedures:

#### **Preparation**

- The stone has to be free of dust, dirt, grease, or coatings.
- Clean out all loose and deteriorated masonry from the repair area.
- Carve out repair area to provide a minimum ¼-inch depth.
- Wash the prepared surface with clean water and a bristle brush to remove dust.

#### **Mixing**

- The mix ratio is approximately 4 ½ or 5 parts powder to 1 part water.
- Add the water to the powder slowly.
- Stir until the mortar is thoroughly mixed.
- The mortar should be moist, a bit stiff, and without lumps.

#### **Application**

- Wet the stone with cold, clean water. The stone must be damp.
- Mix a small amount of the wet mortar with more water. This will act like glue. This glue should have the feel of creamy peanut butter.
- Coat the wet patch area approximately ⅛-inch thick. The peanut butter coat must not dry out.
- Take a handful of repair mortar and push it into the repair area with the stone-patching tool. Keep adding more to build up the mortar over and above the top surface of the stone.
- Use the straight edge to scrape away excess repair mortar from the top of the patch. Move slowly and use the edge of the original parts of the stone as a guide.



- Continue scraping away along all sides and angles of the patch until it is even with the stone. If you can see daylight along the bottom of the straight edge, the patch has shallow parts that need more mortar applied, and scraped down.
- Keep checking, scraping, and adding mortar as necessary.
- Use the spray bottle to wet the patch if it gets too dry while working
- Be sure to collect and reuse all mortar that is scraped off. Add a spray of water to re-temper or rejuvenate it, if necessary
- When the patch is completed, mist it with a fine spray or cover the stone with plastic to prevent it from drying too quickly.

### **Clean Up**

- Use a brush to remove loose mortar fragments from the perimeter of the repair area.
- Before the patch dries, use clean water and a damp sponge to remove any staining along the side of the patch.

### **Safety**

- It is recommended that safety goggles, gloves, and a dust mask be worn while mixing mortar. Use skin moisturizer on your hands after washing up at the end of class since mortar can dry out your skin.



## Chapter 5: Terra Whatt-a?

### Terra Cotta—Practical and Decorative

#### Knowing Terra Cotta

#### Repairing Terra Cotta

- Terra Cotta Faces and Places



#### The Tools

Part 5: Line, line blocks, and line pins

#### People, Places, and Things: 1881 to 1907

Theodore Roosevelt

Attribute: character

The City Beautiful Movement

Trade Schools

- Williamson Free School of Mechanical Trades

#### Building of the Era: Union Station

Washington, DC

#### Quotes

#### Synopsis

#### Activities

1. Laying blocks (CMU or terra cotta) to the line
2. Making faux terra cotta clay
3. Mold making

## Terra Whatt-a?

### Terra Cotta—Practical and Decorative

If you're not familiar with terra cotta, think of an ordinary flower pot—it is the reddish color of a brick, hollow and not too heavy, its sides are thin, and it feels like pottery—all of which are true, because it's terra cotta!

Terra cotta is a masonry material that's practical like brick, yet as decorative as pottery. Like brick, it's made of clay, durable, and baked in a kiln. But, it's also like pottery because it can be sculpted into statues, formed into ornamental shapes and coated with almost any color imaginable.



*Chinese terra-cotta figurine*

The word terra cotta is the combination of two Latin words, terra meaning earth, and cotta meaning cooked. Terra cotta is cooked earth. It was used thousands of years ago by sculptors and artisans in China, Egypt, and the Middle East. Because it's so durable, many of these ancient sculptures are still in excellent shape today.

In ancient times, terra cotta was also used as a construction material. The Romans used terra cotta to make tiles for roofing and pipes for their sewers. Although it wasn't popular in Europe during the Middle Ages (from about the 5<sup>th</sup> to the 15<sup>th</sup> centuries), terra cotta was revived for sculpture and building decorations during the Renaissance (from the 14<sup>th</sup> to the 16<sup>th</sup> centuries).

During the late 19th century, terra cotta became a popular building material in the United States. It was used for the same reason artisans and builders worked with it thousands of years ago. Besides being functional and practical, terra cotta is also:

- waterproof
- fire-resistant
- inexpensive to make
- light in weight
- worked easily
- manufactured quickly
- able to be formed to almost any shape
- able to be coated to almost any color



*Terra cotta*



*Architectural terra cotta*

These features were invaluable as taller buildings were being constructed across the country. Terra cotta was molded into square or rectangular blocks with thin interior walls. The walls, called webbing, reduce the block's weight without compromising its strength. Although it's durable, terra cotta is also brittle and the blocks can't support a lot of weight on their own. For this reason, they were used mainly as in-fill between steel support beams.



*Webbing in terra cotta block*

From about 1870 to 1930, terra cotta was the marvel of building construction materials. It was used in decorative and practical ways, and its production employed thousands of workers for mining, firing, molding, sculpting, and transporting the clay-based material.

During the 20<sup>th</sup> century, terra cotta was replaced by cheaper, less ornate materials, and now most terra cotta manufacturing facilities have closed. Still, the legacy of terra cotta remains obvious throughout many older city buildings.



*Terra cotta blocks*



*Glazed terra cotta*



*Unglazed terra cotta*

## Knowing Terra Cotta

Terra cotta can be found along older city buildings, but because it is shaped and coated to look like almost anything, it's often hard to recognize. The following are a few ways to help identify terra:

- crazing
- biscuit
- chunking



*Crazing*

The golden age for terra cotta spanned from approximately 1880 to 1920. After a century of water, wind, and weather, most building materials will show some sign of aging. One of the aging problems of terra cotta is the deterioration of the glazing. Its exterior coating will crack into a crazy pattern of little squares that looks like the underside of an alligator. This defect is appropriately called “crazing.” These little squares will eventually spall (which means pop off), and expose the unprotected surface of the terra cotta to the elements.

Sometimes small pieces of terra cotta's outer crust or glazing will fall off and open up what is called the terra cotta's “biscuit.” The biscuit usually has a cream, yellow or tan color and can actually look like the color of a biscuit. Besides the appearance, *biscuit* correctly describes the softer material inside of terra cotta, which is vulnerable after losing its protective outer crust. Terra cotta biscuit can be identified no matter the shape or the surface color of terra cotta.



*Terra cotta's exposed biscuit*

Another problem of aging terra cotta is cracking and the after effects of cracking. A terra cotta segment might split open due to the freeze-thaw cycle. Similar to the deterioration affecting bricks in cold weather, water enters into a surface crack and penetrates inside the terra cotta. When temperatures drop below freezing, the water turns into ice. The ice expands and opens the crack a little more. When the temperature rises above freezing, the ice melts and the water travels deeper into the material. This cycle continues and provides a damaging process that can slowly destroy terra cotta.



*Effects of freeze-thaw cycles*

Freeze-thaw causes more severe problems for terra cotta, because it is mostly hollow with only an inch or so of a pottery-like shell. If that outer shell opens and water gets inside, it will eventually deteriorate the terra cotta support system. Water will work its way onto the metal attachments holding the terra cotta onto the building and rust through the pins, straps or anchors. This can progress into a dangerous condition as large pieces, or sections, of terra cotta (or any masonry material) dislodge and fall from a building.



*Dislodged masonry on sidewalk*

Recognizing surface crazing, the exposed biscuit, or interior webbing are three ways to identify terra cotta and differentiate it from other building materials.

### Repairing Terra Cotta

Terra cotta deterioration such as crazing, spalling, or cracking needs to be repaired before the material becomes too weak and detaches from the building.

Crazing can be repaired by first cleaning the surface of the terra cotta with water and soft bristle (not wire) brushes. The deteriorated glazing is then scraped away with hand tools that won't damage the interior biscuit or good sections of the terra cotta glaze. The biscuit can then be coated with a special masonry paint that matches the existing or surrounding glaze color.



*Terra cotta patches*

Spalled terra cotta can be repaired by the same methods used to repair damaged stonework. There are special mortars made specifically for repairing terra cotta. The mortar is applied, shaped, and allowed to dry. Then it is coated to match the original terra cotta color. Some damaged parts of terra cotta can be removed, stabilized with stainless steel rods, and then rebuilt with special repair mortar. After a new coating is applied, the repair should match the original in shape and color. Rebuilding terra cotta can be compared to the careful work of a dentist or a sculptor.



*Terra cotta patch, finished*



*Stainless steel rods installed*



*Rebuilding with repair mortar*



*Terra cotta repaired and coated*



*A crack in need of stitching*

The repair of a cracked piece of terra cotta depends on the seriousness of the crack. One method is called “stitching.” Stitching is drilling holes along both sides of the crack and inserting stainless steel rods coated in epoxy to hold, or stitch, the sections together. Afterwards, the crack and drill holes are patched with repair mortar to make the piece look good as new.

Metal straps called “hangers” or “wall ties,” are attached to the webbing of terra cotta sections to secure them onto the building. Metal rusts (or oxidizes) and can expand up to ten times its original size. When rusted steel expands in an enclosed area it can crack and shift the surrounding masonry. This can deteriorate a terra cotta segment to the point where it is beyond repair and has to be completely removed and replaced. The best procedure for replacement is to have duplicate pieces made of new terra cotta to match the old and install it with new metal reinforcements on to solid back-up masonry.

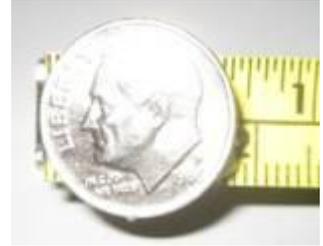


*Terra cotta and GFRC*

There are also materials like glass fiber reinforced concrete, called GFRC, that are now used to make replacement pieces to substitute for terra cotta. GFRC is a mixture of cement, aggregates, and fiberglass. These materials need to match the original terra cotta in color, shape, and size, with particular attention paid to how this new replacement material will work in place of the old.

Think of it as an operation in which a patient with a bad heart gets a different one through transplant surgery. There has to be a good match with no complications so that the patient's body won't reject the new heart. It's the same with replacing terra cotta. New materials have to match the abilities of the old.

Addressing deteriorated mortar joints is also part of terra cotta repair. Care must be taken when cutting out mortar around terra cotta. If an electric handheld grinder is used, it should not nick or cut into the terra cotta: that will damage the surface and allow water to enter. When cutting deteriorated mortar joints, the depth has to be at least  $\frac{3}{4}$  of an inch. Similar to cutting brick mortar joints, a penny or dime should fit all the way into a mortar joint that is cut to the right depth.



*Span of a dime*

The joints around terra cotta should be re-pointed with mortar that is softer than the terra cotta to allow for flexibility, expansion, and contraction. The joints should not be caulked, because caulking traps moisture inside the terra cotta and can start the processes of freeze-thaw, cracking, metal oxidation, and possibly greater deterioration.

When terra cotta and its surrounding mortar joints are well maintained, the building will continue to keep its dignity and beauty for several decades, or perhaps another century.



*Improper cutting depth*



*Restored terra cotta*

TERRA COTTA FACES AND PLACES



## The Tools

### Part 5: Line, line blocks, and line pins

#### Line

If you've ever wondered how the bricks in a wall line up straight across, you're half way to the answer. A line is the tool used to keep bricks and other masonry materials straight. A line is one of the oldest, most basic tools in the history of masonry construction. It is never called a string, and is usually made of durable nylon.

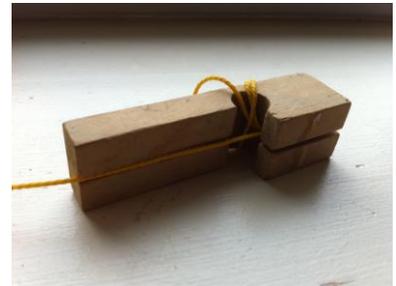
When building a wall, a mason will attach a line to a stationary location, such as the end of a wall or a corner being built. The line is then pulled tight and fastened to a partially built corner at the other end of the wall. Masons in between then lay the block, brick, etc., using the line as a guide to keep their work level, plumb and straight. This is called, "laying it to the line." Care is taken not to hit the line; otherwise the wall will be crooked.



*Line*

#### Line block

A line block is a cube of wood about 1 inch wide and 4 inches long that looks like a big whistle. There's a groove along the center, which is used to secure a masonry line. Line blocks are attached to corners or ends of a wall being built. These are called leads (rhymes with reeds) and they are built by "lead men" who work ahead of the rest of the crew. They use levels to make sure their work is correct, and then raise the line for masons to build the wall between the leads. The line blocks are adjusted carefully so that the line does not sag in the middle or, if pulled too tight, loosen the corner that was just built.



*Line block*

#### Line pin

A line pin is a flat piece of metal about 4 inches long and shaped like an ice cream cone. Line pins serve the same purpose as line blocks except that they are pushed into a new mortar joint or hammered into dry ones. The line is then tied to the pin, stretched tight, and adjusted to line up with the top edge of a brick or block already set in place. This edge is called the arris. It is the sharp corner at the angle of the top and side surfaces. The word arris is from the Old French word *arête*, meaning a sharp ridge.



*Line pin*

These ancient tools are still used today, as the standard equipment to build walls straight, level, and plumb.

## People, Places, and Things

### 1881 to 1907

#### People: Who?

**1858:** Born in New York City. A weak and sick boy, he spends much of his time in bed, and makes friends with the birds on his windowsill.

**1880:** Graduates from Harvard College and marries Alice Hathaway Lee.

**1884:** After the birth of his first daughter, his wife and mother die on the same day.

**1884- 1886:** Filled with grief, he goes to the Dakota Territory and becomes a cowboy/cattle rancher.

**1886:** Returns to New York, marries Edith Kermit, and resides at his farm, Sagamore Hill, in Oyster Bay, Long Island, New York.

**1889-1895:** Becomes a member of the U.S. Civil Service Commission, overseeing care for New York City's poverty-stricken masses.

**1897-1898:** Becomes the Assistant Secretary of the United States Navy.

**1898:** During the Spanish-American War he organizes the 1<sup>st</sup> U.S. Volunteer Cavalry Regiment. Known as "The Rough Riders," the group is mainly Dakota cowboys from his ranching days. He becomes a colonel (and is later awarded the Medal of Honor for leading an uphill charge at San Juan Hill).

**1898-1900:** Elected Governor of New York State.

**1900:** Elected Vice President of the United States.

**1900-1909:** Following the assassination of President William McKinley, he becomes the youngest president.

During his Presidency he:

- Is awarded the Nobel Peace Prize for negotiating the peace treaty ending the Russo-Japanese War.
- Leads the drive for the U.S. to complete the Panama Canal.
- Creates 150 national forests, 51 bird reservations,
- 18 national monuments, 5 national parks, and 4 national game preserves. This protects over 230 million acres of
- land and water. All put together, this would equal all the states from Maine to South Carolina, and as far west as Ohio.
- Refuses, while on a hunting trip, to shoot a bear that had been chained to a tree as an easy target. Admiring this kind act, a toy maker made a children's toy and named it the "Teddy bear."



*The Rough Riders at San Juan Hill*

**1910:** After his Presidency, he travels the world on exploration and safari.

**1912:** Decides to run for President again, and is shot in the chest during a campaign rally. The bullet lodges next to his lung. But he continues the speech, which lasts an hour and a half.

**1913-1914:** Loses the election, and sets off to explore the jungles of South America.

**1918:** Dies in his sleep at Sagamore Hill.

### **Theodore Roosevelt: invalid, soldier, president, adventurer, conservator**

Theodore Roosevelt was an extraordinary man, exhibiting a combination of adventure, humor, enthusiasm, and high moral purpose. He was greatly admired for his courage, and remembered for his varied accomplishments—such as being awarded The Nobel Peace Prize and the Congressional Medal of Honor. He was also a man of thought and reflection. He wrote over 30 books, many essays on subjects like history and travel, and journals of his personal adventures.

Similar to the country he led, Theodore Roosevelt brought himself up from weakness and isolation into greatness and worldwide respect.

With so much power at his command, he was not an overbearing bully, although he used that word with gusto. He was kind and sympathetic to those worse off than himself, and he was always thankful for the talents he had been given.



*Theodore Roosevelt*

“Character, in the long run, is the decisive factor in the life of an individual and of nations alike.”

**Theodore Roosevelt**

### **Attribute: character**

Character is a decision to always do what is right, just, and true. It is a noble virtue based on a personal commitment to live a life of honor. The word character comes from the Latin word *character*, meaning a distinguishing mark. It is derived from the Greek word *charassein*, which means to engrave.

Above the entrance to the Museum of Natural History in New York City, these distinguished words are engraved in stone:

**STATE OF NEW YORK MEMORIAL  
THEODORE ROOSEVELT**

A GREAT LEADER OF THE YOUTH OF AMERICA  
IN ENERGY AND FORTITUDE IN THE FAITH OF OUR FATHERS  
IN THE DEFENSE OF THE RIGHTS OF THE PEOPLE  
IN THE LOVE AND CONSERVATION OF NATURE  
AND OF THE BEST OF LIFE AND IN MAN

**Places, Things**

**The City Beautiful Movement**

In the forty years between 1840 and 1910, the population of the United States tripled. It grew from 31.4 million to 91.9 million, with cities bearing the worst of the strain. Nearly half the country's population lived in urban areas; severe overcrowding caused terrible violence, disease, political unrest, and social problems.

At the close of the 19<sup>th</sup> century, the City Beautiful Movement confronted these conditions with the belief that a beautiful city would lower crime rates and improve moral behavior. It grew into a nationwide movement for open, orderly metropolitan areas and beautiful buildings, with land set aside for parks. It was a search for a perfect place to live—a utopia. Utopia is pronounced “you-toh-pee-uh” and comes from two Greek words: *ou* meaning not and *topos* meaning place. Utopia originally meant no place or location unknown, but evolved to mean a place of idealistic and visionary perfection.



*Washington Mall*

City Beautiful members convinced the political and economic powers of the day to improve urban education and transportation systems, and to develop better water supplies and methods for sewage removal. Many cities promoted the City Beautiful Movement, and Washington D.C. became the model, showcasing its new Mall. It tore down depleted houses and replaced them with impressive monuments, attractive buildings, and beautiful landscaping.

Throughout large and small urban areas across the nation, uncultivated lots were turned into elegant parks, and unused land was transformed into gardens, flowered walkways, and promenades. A promenade is an area built especially for walking or public display. It comes from the French word *promener*, meaning, to take a walk.

School children were taught how to grow fruits and vegetables, and enjoyed working outside of the classroom in local gardens. In Minneapolis, the city's Garden Club turned so many vacant lots into gardens that local stores began carrying their vegetables and fruits.

The influence of the City Beautiful movement eventually started a framework for urban planning. This guided cities toward a more of functional way of organizing, coordinating, and managing its main resources—people and buildings.



*Children's garden, early 1900s*

### Trade Schools

As the nation's farmers were transformed into factory workers, a movement arose in various industries to provide better education for their laborers. The idea was based on European schools of industry. These schools combined classroom study with manufacturing work. The work included spinning, knitting, or sewing for girls, and woodcarving or furniture making for boys. The goal of this type of education was to develop good workers and good citizens who were also well versed in other subjects.

During the latter part of the nineteenth century, several types of vocational schools were started in the United States as secondary (high) schools, or post-secondary schools. They offered an introduction to skilled trades like masonry, carpentry, and plumbing, along with practical instruction in math, science, and English.



*Students learning bricklaying, circa 1900*

One of the earliest schools was Hampton Institute in Virginia, founded in 1868 by General Samuel Chapman Armstrong. Hampton Institute provided both liberal arts and trades training to African-American students.

Another was The New York Trade School, founded in 1881 by Colonel Richard Tylden Auchtmuty. It offered trades training as preparation for employment and academic studies that related to each trade.

The Williamson Free School of Mechanical Trades was founded in 1888 by the philanthropist Isaiah V. Williamson. The school was chartered to provide young men with a place to live, meals and clothing, and academic and trades instruction—all at no charge to the student. It is still in existence today, and because of its outstanding reputation for producing exceptional craftsmen, it is considered by many to be the Harvard of trade schools.

In the early twentieth century, the nation's citizens demanded that state and federal funds provide public schools with vocational education programs. In 1917, President Woodrow Wilson finally passed The Smith-Hughes Act that provided funding for the teaching of trades, agriculture, and home economics in public schools. High schools began including hands-on training for industrial arts and vocational/technical or “vo-tech” programs. These courses taught students how to construct buildings, repair machines, and support a family.

Through the twentieth century, vocational training programs were a standard part of a public high school education in many parts of the country. Even the smallest of schools offered courses in auto shop, carpentry, or home economics; many of the programs also incorporated useful studies such as math, science, history, and ethics. But vocational education in public schools began to decline in the last quarter of the 20<sup>th</sup> century. Today, schools focus on preparing young people for college degrees and creating workers for the electronic age. This new emphasis has led to the near extinction of vocational training in urban schools.



*Isaiab Williamson*



*Hampton Institute, circa 1900*

## WILLIAMSON FREE SCHOOL OF MECHANICAL TRADES

The Williamson Free School of Mechanical Trades has earned a national reputation for training expert craftsmen. It remains the only free school of its kind in the nation.

The 220-acre campus outside of Philadelphia provides programs in masonry, painting, carpentry, machine shop, horticulture/landscaping, and power plant technology.

The Williamson Free School has been a standard bearer of excellent craftsmanship since 1888. Its accomplishments and longevity are credited to the founder's establishment of the school's Core Values. These are the practice of faith, integrity, diligence, excellence, and service.



*Williamson masonry shop*

## Building of the Era

### Union Station, Washington, DC

On October 27, 1907, Washington, D.C. opened its impressive new railroad terminal. The United States finally had a transportation hub that showed the world it was an international power. Union Station was the largest train station on the face of the earth, and it covered more space than any other building in the country at the time.

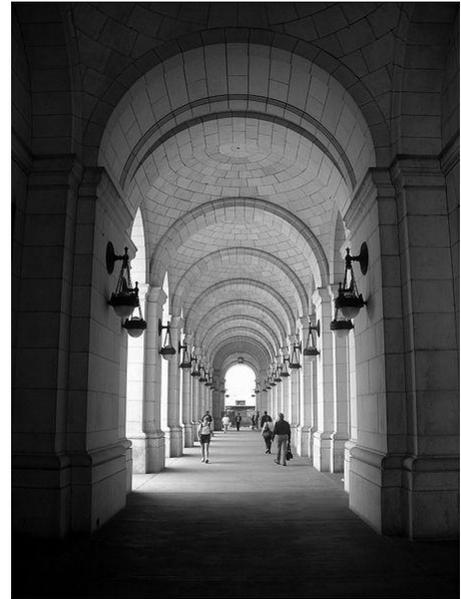


*Union Station*

It included a bowling alley, YMCA, hotel, ice house, mortuary, bakery, butcher shop, liquor store, Turkish baths, first-class restaurant, nursery, police station, and a silver-monogramming shop. It was built with the finest materials of the day, including marble, gold leaf, and terra cotta.

Union Station's impressive dome was constructed of terra cotta. This was an excellent choice of building material, because the lightweight terra cotta, combined with steel reinforcement, was able to cover a large span. It also protected the interior decorations from water damage and provided reasonable fire proofing.

Union Station underwent an extensive \$160-million renovation that was completed in 1988. At that time, it was the largest, most complex, public/private restoration project ever attempted in the United States.



*Union Station terra cotta*



*Union Station, Washington DC*

## Quotes

“The first condition of education is being able to put someone to wholesome and meaningful work.”

**John Ruskin**

“Son, get an education and a trade and you’ll always put food on the table.”

**Anthony E. Russack**

“Civilization is one long, anxious search for just such individuals... He is wanted in every city, town and village—in every office, shop, store and factory. The world cries out for such: he is needed and needed badly—the man who can ‘Carry a Message to Garcia.’”

**Elbert Hubbard**  
**“A Message to Garcia”**

In 1898, during the midst of the Spanish American War, U.S. Army Lieutenant, Andrew Summers Rowan was told to deliver a letter to an ally, General Calixto Garcia, who was hiding in the jungles of Cuba. Without asking “Who is he?” or “Where is he?” Rowan set out on his mission. Though nearly killed or captured several times, Rowan found Garcia, delivered the message, and then returned successfully to bring the General’s response back to the President of the United States.



*Gen. Calixto Garcia*

The essay “A Message to Garcia” was written about Lieutenant Rowan, but it didn’t describe the mission or any of his adventures. It simply explained how Rowan took orders, and without asking questions or making excuses, completed the task set before him. It told of his dependability. Over 100 million copies of the essay have been distributed. It is one of the most printed documents in the history of the written word.

## Synopsis

After reading this Chapter you should now have a better understanding or a mental image of the following:

- terra cotta
- webbing
- biscuit
- glaze
- crazing
- utopia
- arris
- character
- dependability

## ACTIVITIES

### 1. Laying blocks (CMU or terra cotta) to the line

#### Materials:

- 22 blocks – concrete, cinder, or terra cotta
- mason's line, line blocks
- trowels
- four foot level

#### Procedures:

- Place two blocks apart from one another with enough space between to accommodate four more blocks in between.
- Tie the mason's line-to-line blocks and position them on the two end blocks. Make sure the line is tight and secured so it does not slip off. Secure with a brick or a block positioned sideways, if necessary.
- Lay the blocks as close to the line as possible. (You should be able to run a dollar bill between the line and the block.) Keep the trowel in your hand at all times.
- You can set the blocks tight against one another or with an opening to represent a mortar joint.
- After completing the first course, look down the line to see that each is aligned straight. Use the level as a straight edge to make adjustments and get the blocks straight.
- Move the line up for the next course by tightening and fastening the line to the two end blocks. The end blocks should be set atop the lower course to break bond. They should be set first "by eye," meaning trying to position them correctly atop the first course by aligning them by sight before being plumbed with a level.
- This course will have 5 blocks. The line should be tight at the top edge of the block. Use the level to tap the blocks into place and to make necessary adjustments.
- Continue these steps, laying blocks to the line and aligning them with the level. Run the back side of the trowel over the face of the blocks to feel for edges or corners that are out of place. Adjust by tapping them into place.
- Build a 6-course pyramid of block in running bond pattern.



## 2. Make faux terra cotta clay

This recipe makes a softball size amount of clay for making faux terra cotta-like objects.

### **Materials:**

- ½ cup salt
- 1 cup flour
- 2 tablespoons cream of tartar
- 1 cup water
- 1 ½ tablespoons cooking oil
- 1 cup masonry sand
- Food coloring – green, yellow, blue, and red

### **Procedures:**

- Mix dry ingredients, except the sand.
- Add wet ingredients and mix thoroughly.
- Cook in a saucepan over medium/low heat.
- Stir continuously: the dough will firm up in a few minutes.
- Remove from pan and slowly sift/knead in the sand.
- Refrigerated in an airtight container, the clay keeps for 3 months.

### **Note:**

You can use more or less sand and/or oil for different clay consistencies. Whole wheat flour makes a tan color clay (bottom photo). A combination of food colors will make a greenish-brown color of clay to replicate real terra cotta clay (top photo).



## 3. Mold making

Perhaps you've had a mold of your teeth made at a dentist's office. The material used is called dental impression material. It has replaced plaster, which was used for centuries to make dental molds. Terra cotta also requires molds to make reproductions. But plaster molds dry slowly and it is sometimes difficult to remove, or release, the object from a plaster mold. This project makes a rubbery/plastic mold, which is now the standard material for manufacturing architectural reproductions.



**Note:** Follow the manufacturer’s instructions explicitly. Keep in mind that once mixed, there is a very brief amount of working time. It is strongly suggested that the procedures be practiced beforehand so everyone understands their task, and uses every second efficiently. Students with dust allergies should not participate in mixing the product.

**Materials:**

- dental impression material
- petroleum jelly
- dust masks
- electric drill
- paddle-type mixing attachment for drill
- 5-gallon bucket
- container of cool water
- pointing trowel
- scissors
- the hand of a volunteer
- flat tray (optional)
- sand (optional)



**Procedures:**

- Make sure the room is well ventilated and participants wear dust masks when mixing the impression material.
- Coat the volunteer’s hand with petroleum jelly to ease in the mold release.
- Place the volunteers hand on a flat surface.
- Pour the dental impression material slowly into the bottom of the 5-gallon bucket.
- Add water while mixing with the drill and paddle attachment at a slow speed.
- Slowly and thoroughly mix the impression material.
- Use the trowel and quickly pour material over hand up to the wrist.
- The material might feel cool or cold as it dries.
- In only a few minutes it will become rubbery.
- Gently remove the hand (release it) from the mold.
- The volunteer can clean up with soap and water.
- Use a pair of scissors to trim excess material from the mold.
- Observe the imprint of the hand lines and creases in the mold.



## Chapter 6: That's Concrete?

### It's a Concrete World

- Whoa! Heavy: Concrete Facts

### Concrete: Reinforced, Pre-cast and Cast Stone

### Decorative Concrete

### Pouring Concrete: The Plot Thickens

- World of Concrete

### The Tools

Part 6: Screed and Floats

### People, Places, and Things: 1908 to 1938

Thomas Edison

Attribute: inspiration

The Great Migration

- World War One Statistics

Skyscrapers

### Building of the Era: Ingalls Building

Cincinnati, Ohio

### Quotes

### Synopsis

### Activities

1. Build wooden concrete forms
2. Concrete pour from prep to cure
3. Concrete calculations



## It's a Concrete World

If you were asked to name something made of concrete, you'd most likely say, "a sidewalk." And you would be correct. But even though you can't see it or recognize it, concrete is everywhere in the city. It's in ceilings, floors, behind walls, and underneath streets. It is also used to make building materials that look like stone, terra cotta, or wood.

Concrete is inexpensive, easy to produce and made from some of the most abundant materials on earth. That's why it's the most widely used building material in the world. Approximately six billion cubic yards of concrete are manufactured each year. Translated into pounds and people, that's about one ton of concrete for every person in the world.

Over two thousand years ago, the Romans developed a special type of concrete made with lime and ash from volcanoes. It hardened underwater and was most likely the world's first hydraulic masonry material. Their name for it is a Latin word, *concretus*, meaning grow together and harden.

The Coliseum in Rome is a huge amphitheater that looks like a football stadium. It was used for sporting events or other large public gatherings and could hold 50,000 spectators. Constructed with concrete nearly two thousand years ago, it is still standing today.

After the fall of the Roman Empire in the 5<sup>th</sup> century, the use of concrete went into hibernation and did not re-awaken until the late 19<sup>th</sup> century. Several advancements occurred in the cement manufacturing industry to help rejuvenate its use. Equipment for crushing and grinding the raw materials that make Portland cement improved, and new types of kilns helped to increase its production. In 1902, Thomas Edison patented the first long kiln. It was 150 feet long, about three times longer than those previously used. This and other innovations brought concrete back from the era of ancient catacombs and into the lives and homes of nearly everyone in the world.

Concrete is made with four basic ingredients: Portland cement, water, sand, and gravel.

- Portland cement contains mostly limestone mixed with other minerals that act like glue to bind it with the sand and gravel when water is added.
- The mixture of water and Portland cement coats the other ingredients, and gives concrete its workability. It also creates a chemical reaction called "hydration" for fast curing.



*Stone made of concrete*



*The Coliseum*

- Gravel is crushed stone the size of pebbles that has angular edges. It is a coarse aggregate.
- Sand is a fine aggregate. It blends with the cement and water to give concrete volume.

The word aggregate comes from the Latin word *aggregates*, meaning a closely gathered flock or herd. The combination of large and small aggregates helps make concrete bind together.

To summarize how these four simple ingredients work together: Portland cement mixed with water becomes a paste that coats fine and coarse aggregates that harden through a chemical process called hydration to become concrete.

The ingredients can be mixed with a hoe in a trough for very small projects, and with an electric or gasoline powered cement mixer for larger projects. Care is given to the mixing because an error in measuring the ratio of ingredients can ruin an entire batch of concrete.



*Cement mixer*



*Concrete truck*

For city work, concrete is usually delivered by trucks. These vehicles have huge barrels filled with wet concrete. Because concrete sets quickly, the large barrel-shaped drum has to keep revolving to prevent the mix from hardening. Concrete can be poured out of the hopper onto the back of the truck, into chutes, and transported up several stories through long tubes using special pumps.



*Concrete pump*



*Spalled concrete*

Besides being convenient, concrete trucks provide already mixed or ready-mixed concrete. Ready-mixed concrete is ordered from a local supplier who can custom blend the ingredients to suit the project's needs. Ready-mixed concrete companies are called concrete yards and are usually located in industrial sections in or around cities. They have huge piles of sand and gravel, along with concrete trucks and, usually, earth moving equipment.

Concrete is a strong, durable and inexpensive building material with a rich history and a long life. But it does

have its flaws. It can spall, crack or even disintegrate with age, rough weather or bad workmanship. We can actually damage concrete when we put salt on sidewalks in the winter. Using salt to melt ice accelerates its deterioration, whereas using sand or calcium chloride causes less damage.

When serious deterioration occurs and concrete has lost its structural stability, it has to be removed and replaced. Demolished concrete has re-usable qualities. It can be crushed and recycled, which gives it an environmentally friendly reputation. But, the manufacturing process of concrete creates a lot of carbon dioxide. This gas released into the atmosphere promotes earth-warming effects that are not considered environmentally friendly.

### WHOA! HEAVY: CONCRETE FACTS

Concrete is:

- 41% gravel or crushed stone
- 26% sand
- 16% water
- 11% cement
- 6% air

A typical bag of Portland cement weighs about 94 pounds.

A square foot is 12 inches x 12 inches or 144 inches.

Concrete weighs about 150 pounds per square foot, a little more than 1 pound per square inch.

One ton is 2,000 pounds. Course aggregates vary in weight, but on the average 1 cubic yard of course aggregate weighs about 1 ton.

Concrete is measured by the cubic yard.

A cubic yard is three feet by three feet by three feet, or 27 cubic feet.

One cubic yard covers an area 8 feet by 10 feet by 4 inches and weighs about 4000 pounds.



*Concrete*

## Concrete: Reinforced, Precast and Cast Stone

### Reinforced concrete

The hardness of concrete is one of its best qualities, but it's also one of its greatest faults. While concrete is strong, it is also brittle and cannot be extended far without reinforcing. That's why concrete has a skeleton-like frame of bars and wires. These are made into shapes for walls, or laid flat for sidewalks before the concrete is poured around them.



*Rebar reinforcement*

The reinforcement bars are called rebar. They are rigid lengths of steel that look like rope. They are either straight or curved and sometimes have a green coating to prevent rust. It's the rebar inside concrete that give it shape and reinforcement—hence the name “reinforced concrete.”

Reinforced concrete is a relatively recent invention. Credit is given to Joseph Monier, a French gardener who patented a design for reinforced concrete garden tubs in 1867. Later he patented reinforced concrete beams and posts that were first used for guard rails along roads and railroad tracks.

The use of reinforced concrete for building construction was perfected by the American concrete innovator, Ernest L. Ransome. In 1884, Ransome patented the method of installing twisted square steel bars inside concrete slabs and beams. In 1889, he designed and supervised the construction of the world's first reinforced concrete bridge—the Alvord Lake Bridge in San Francisco.



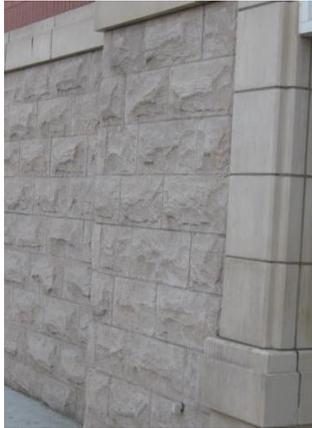
*Rebar*

### Precast concrete

Sections of a building that are made of concrete manufactured at a site other than where it's installed are called “precast concrete.” Precast concrete is usually a high quality product because the process is controlled and inspected. The disadvantages of precast concrete are the trouble of transporting large and heavy sections, and then lifting them into position on the face of a building.



*Precast concrete*



*Cast stone*

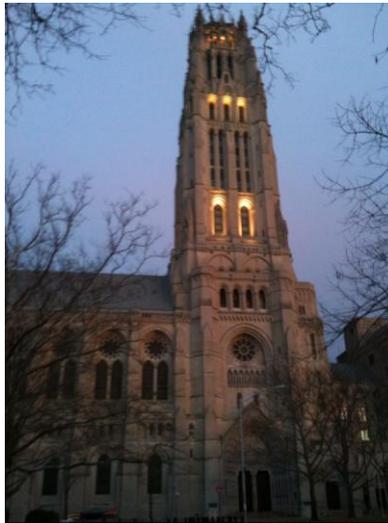
### Cast stone

Concrete can be formed into almost any shape, tinted almost any color, or finished to any texture. This opens an uncountable number of possibilities for building construction and restoration. Very often it is used to replicate stonework on a building. Fine aggregate and realistic molds can be used to reproduce rough cut or finished “stone” that is often hard to distinguish from the real thing. But its materials and mass production often give away its true identity. If stonework looks too uniform in shape and color, or if it has tiny air-bubble holes on the surface, it’s more than likely a type of concrete called cast stone.

Cast stone can also be used for ornamental items or building details and can be as different as the various types of buildings in a city.



*Cast stone angel*



*Cast stone cathedral*



*Cast stone urns*

## DECORATIVE CONCRETE

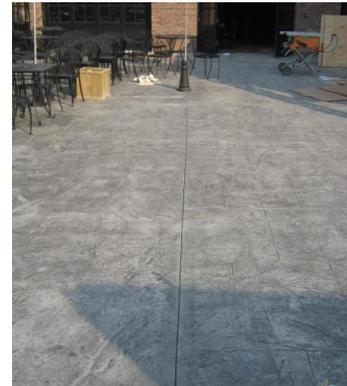
**Glass-fiber-reinforced concrete (GFRC)** is a lightweight concrete that uses glass fibers instead of a coarse aggregate. The glass fibers look like long, thin needles and remove about  $\frac{2}{3}$  the weight of conventional precast concrete. This makes GFRC easier to cast into ornate shapes and to obtain a high degree of detail. GFRC is used as a replacement for terra cotta and carved stone, but it does not have the ability to hold heavy loads like traditional concrete. It looks so much like terra cotta you might wonder, "Is that really concrete?"



*Glass-fiber-reinforced concrete*

**Stamped concrete**, also known as pattern concrete or imprinted concrete, has patterned designs pressed onto the wet concrete. These patterns can resemble bricks, stone, or tile, making stamped concrete popular in patios and walkways.

**Stained concrete** uses additives that give the mix deep or vivid colors. The staining permeates the entire mix so it can't flake or spall off.



*Stamped and stained concrete*



*Concrete log*

**Molded concrete** that is stained and painted to look like logs is used to build inexpensive houses. They are fireproof, insect proof, and don't rot. They look so realistic people often say, "That's concrete?"

### Pouring Concrete: The Plot Thickens

Pouring concrete is something like an opera performance—lots of running around in what appears to be controlled confusion. But if it's rehearsed, and everybody does their part as directed, it's a thing of beauty. Done wrong, be it in timing, choreography, or spontaneous ad-libbing, it is a tragedy. The following are some general guidelines for pouring concrete:

- Preparation
- Form

- Reinforcement
- Pour
- Spread & Tamp or Vibrate
- Screed
- Float
- Finish
- Edge
- Cure



*The art of finishing concrete*

### Preparation

Before concrete can be poured, the amount of materials has to be calculated; the time, labor, and sequence of events have to be determined; and everything has to be ready at the site, including tools, equipment, materials, and workers. For premixed concrete, the coordination of access and parking for the delivery trucks is vital. Site preparation also includes:

- Demolition - Breaking up the old concrete for removal
- Excavation - Digging and removing soil for below-ground work like foundations
- Compacting - Tamping down the soil to prevent the new concrete from settling
- Base installation - Usually a layer of gravel that helps water drain away
- Clearing passageways - To keep the site free from possible accidents
- Debris removal - Prevents possible hazards

Note: Weather is an important factor to take into consideration. It is difficult to pour concrete when it is extremely hot, cold, or wet.

### Form

Forms give concrete its shape. Plywood is a typical forming material for small projects. Larger projects have wood or metal forms that are re-usable and interchangeable. For pouring sidewalks, “slope” and “pitch” have to be calculated beforehand. These terms describe the height and level at which concrete is poured so the flow of rain water can be directed into a gutter or drain. A transit is used to determine the right heights according to set points marked along the area where concrete is being poured. A transit looks like a telescope and is mounted on a three-legged base called a tripod. It folds up for compact and portable traveling, which it does often.

Concrete is poured over compacted earth and tamped gravel. The gravel is shoveled and raked into position to provide the slope, then tamped or flattened, with hand tools on small jobs, or with heavy gas-powered tampers that also vibrate as they compact.



*Concrete form*

After the height of the concrete is determined it is marked along the form with a chalk line that serves as the guideline.

For pouring of concrete walls it is important that the inside of all the forms are coated with a release agent that allows them to separate, or release, easily from the hardened concrete. It is also very important that all the connections and braces, (either re-usable or used one time only) are secure. It's good practice to have a supply of extra supports such as plywood and wood stakes on site to hold together weakened areas if necessary.

### Reinforcement

Concrete poured along a flat, horizontal surface is called a slab. Concrete slabs are held together with wire mesh reinforcement. Wire mesh looks like a fence that has large square openings. The openings are usually 6 inches apart. It is delivered to the site in sheets or rolls then placed on the gravel and tied together with short strands of wire.



*Reinforcement wire*

For vertical projects, rebar is set in place and tied together with wire to form a grid-patterned skeleton that the concrete will adhere to, and thus create the designed shape. Rebar has different thicknesses: #3 rebar is  $\frac{3}{8}$ -inch in diameter, #4 is  $\frac{1}{2}$ -inch in diameter, and #5 is  $\frac{5}{8}$ -inch in diameter. The thickness varies according to the type of structure being built and the stresses it will undergo.

### Mix

Sand and gravel aggregates usually make up from  $\frac{2}{3}$  to  $\frac{3}{4}$  of the volume of concrete. They have to be clean from any salt, dirt or organic matter like plants and roots. Water used for mixing concrete should be clean and free of acids, oils, and salts. The amount of water measured, along with the amount of cement in concrete is called the “water/cement” ratio. The lower the water/cement ratio, the stronger the concrete. A standard concrete mix is:

- 1 part Portland cement
- 2 parts sand
- 3 parts gravel

If using bags of concrete mix, about  $5\frac{3}{4}$  gallons of water is necessary per each 90 lb. bag, or about 5 gallons if the sand is wet.



*Mixing*

### Pour

As the concrete flows from wheel barrows, pumps, or buckets, there should be rakes and shovels ready to spread it. Sturdy rubber boots are necessary to walk through and distribute it quickly.



*Pouring*

### Spread and Tamp or Vibrate

After the form is filled with concrete, it is gently tamped with a tamper to make sure it has filled-in the edges and corners of the form. A tamper is a short, thick pole with a flat metal attachment at the bottom. It can also be used in preparation on small jobs to compact the soil and gravel. Vertical work needs to be vibrated to prevent the concrete from getting “honeycombed.” Honeycombed concrete has holes from trapped air and is weaker than solid concrete.



*Vibrating*



*Screeding*

### Screed

After the concrete has been tamped, a straight-edge is used as a screed for leveling the concrete. The screed, usually a straight 2 x 4, is laid along one end of the fresh concrete, and then pushed back and forth in a sawing motion across the top. The sides of the form or the surrounding pavement are used as a guide for the screed as it makes its way across the new concrete. A trowel is used to gather the excess concrete that collects in front of the screed.

### Float

Smoothing the surface of concrete is done with tools called “floats,” which are long flat trowels with handles in the middle. Floating concrete is a race where artistry and agility try to beat time and chemistry. Various floats are used to prepare the surface before it hardens. If not floated properly, the concrete can easily be ruined. By floating it too much, water will rise to the surface and weaken the concrete. Practice and experience teaches the right timing, technique, and touch to get concrete right.



*Floating*

### Finish

There are still a few final touches to be done before the concrete sets up. Sometimes a decorative look is provided with sponge, rubber or wooden floats.

For a uniform appearance and better traction a broom is lightly brushed across the surface to give thin parallel lines. This also allows water to run off rather than collect, and makes the concrete surface safer when wet.



*Finishing*

### Edge

When the concrete has set a short while longer, a plank or board is used as a straight edge. This guides a small hand tool called an edger that cuts a groove into the concrete. These grooves are either control or expansion joints. A different type of edger is used around the perimeter to give each square of concrete a uniform edge. A square of concrete is sometimes called a flag.



*Edging*

### Cure

The last act of a concrete performance is its curing. All concrete must be given the proper time and conditions to cure. The concrete surface should be kept cool and moist, but not wet. It should be protected from intense heat, rain, and snow and the surface cannot be damaged in any way.

New concrete is to be blocked off, and even guarded, to prevent vandalism. Fresh concrete is sometimes covered with damp burlap to prevent it from drying too fast, or with large heated blankets to keep it from freezing.



*Curing*

After it has cured properly the forms are removed, debris cleaned, edges smoothed, and expansion joints caulked.

Note: There are two things about concrete to always keep in mind. 1. It gets hard, and 2. It cracks. Control joints are grooves about one inch deep in the concrete that are intended to control the location and direction of cracks. Expansion joints are deeper and wider and are later filled with a tough but flexible caulk. Expansion joints allow the concrete to expand in hot weather and contract in cold weather without cracking.

## WORLD OF CONCRETE

The World of Concrete is one of the largest events in the world held especially for the concrete industry.

It is held every year in Las Vegas, Nevada, during early winter months, and has grown to mammoth proportions.

Approximately 1,500 different exhibitors showcase all types of masonry construction materials, products, and equipment. Upwards of 70,000 visitors attend to see new masonry related products, attend seminars or lectures, and keep informed as to what the masonry industry is doing, around the world.



## The Tools

### Part 6: Screeds and Floats

#### Screed

The word screed comes from the Old English word *screade*, meaning a piece of cloth. It's the same root word for our modern English words shred, scroll, and shroud.

A screed is a straight board pushed and pulled along the top of freshly poured concrete to level the surface. The process allows for the collection of excess concrete and its distribution to low areas. A screed can be a simple 2 x 4, but professional concrete masons use long aluminum screeds.



*A screed*

#### Floats

Floats are specialized hand tools used for finishing concrete, stucco, or plaster. The name float describes the way that the tool glides across the surface of the material being smoothed out, almost as if it were floating on air.

Floats vary in size, length and shape and are made of different materials. The flat surface can be metal, wood, sponge rubber or hard plastic to provide a specialized surface texture. Sometimes the handle is connected at both ends to provide mobile use in all directions.



*Floats*

## **People, Places, and Things**

### **1908 to 1938**

#### **People: Who?**

**1847:** Born in Milan, Ohio.

**1862:** Rescued a child from an oncoming train. The child's father was a train station agent, who, in gratitude, taught the hero how to work a telegraph.

**1869:** Arrived in New York City, poor and in debt. Fixed a stock market ticker tape machine and became the company's superintendent.

**1870:** Received a patent for his first invention—the electric vote recorder. Developed the quadruplex, which could send four telegraph messages at the same time.

**1872:** Invented the electric pen, which is now used for tattoos.

**1876-1877:** Invented the phonograph.

**1879:** Invented the incandescent electric lamp. Gave the first public demonstration of electric street lights and buildings in Menlo Park, NJ.

**1880:** Invented and installed the first electric freight and passenger railway.

**1881-1887:** Invented a system of wireless telegraphy.

**1891:** Invented and patented the motion picture camera.

**1900-1909:** Started a Portland cement manufacturing company. Patented several inventions that transformed the concrete industry.

**1900-1910:** Invented the steel alkaline storage battery.

**1907:** Invented the Universal Electric Motor.

**1912:** Invented the Kinetophone, commonly known as the talking motion picture.

**1923:** Supplied the cement for concrete to build Yankee Stadium.

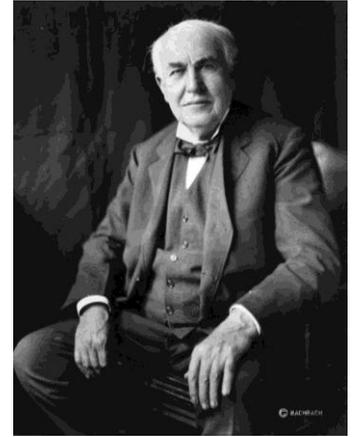
**1931:** Died on the same day that 52 years earlier he invented the incandescent electric light bulb.

## Thomas Alva Edison: inventor, entrepreneur, concrete contractor

Thomas Edison was awarded 1,368 separate and distinct patents. The life we now know (and enjoy) would not be possible without the numerous innovations born from his creative genius. The world of masonry is indebted to him for the advancements he brought to the industry. His Portland cement was shipped throughout the country for concrete buildings, roads, dams, and other structures, many of which are still in use today.

“Genius is 1 percent inspiration and 99 percent perspiration.”

**Thomas A. Edison**



*Thomas A. Edison*

### Attribute: inspiration

The word inspiration is from the Latin word *inspiratus* meaning to inflame, or to inhale the breath and life from the spirit. Today, the word inspiration is used to describe something that suddenly moves within us to spark a brilliant idea or a creative action. Inspiration is the emotion of a motivational person or a work of art that has special meaning.

Perspiration is another word for sweat. It is a wonderful, natural product made by the body to keep it cool while working. The ratio of 99 to 1 provides an estimate of how much work is required to produce a small but glorious amount of inspiration.

## People, Places

### The Great Migration

The Great Migration was the mass movement of nearly five million African Americans from the South to the North, starting around 1916. Prior to this exodus, approximately 90 percent had lived in former slave states. They moved from farms in those states to major northern cities like Chicago, Detroit, Pittsburgh, and New York.

When five million U.S. soldiers went to Europe during World War I, a huge demand for factory workers provided opportunities for meaningful employment.



*The Great Migration*

In 1924, the passage of the Immigration Act restricted foreign immigration; entire sections of cities became African American. This initiated a new urban black culture and fostered cultural and artistic movements such as The Harlem Renaissance.

The Great Migration was one of the largest population shifts in the history of the United States. It forever changed the urban north, the rural south, and the entire nation by creating large urban black communities. Some historians believe this movement helped to diversify the country, leading to the civil rights movement and allowing African Americans to rise to middle and upper class status.

### WORLD WAR ONE STATISTICS

The First World War, also known as the Great War or The War to End All Wars, began on July 28, 1914. Great Britain, France, Italy, Russia, the United States, and other countries known as The Allies, battled Germany, Austria-Hungary, Turkey, and other countries, known as The Central Powers. Over seventeen million people died, with Russia, Britain, France, Germany and Austria-Hungary suffering the greatest loss of lives. Much of the war was fought in muddy, cold, disease-filled trenches. New weaponry such as the airplane, machine guns, tanks, poisonous gas, and submarines contributed to the massive destruction.



*World War I*

	<u>Troops Deployed</u>	<u>Killed</u>	<u>Wounded</u>
<b>Allied Powers</b>	42,188,810	5,152,115	12,831,000
<b>Central Powers</b>	22,850,000	3,386,200	8,388,448
<b>Total</b>	65,038,810	8,538,315	21,219,448
<b>Civilian</b>		8,865,650	
<b>Total deaths</b>		<b>17,403,965</b>	

If the 17, 403, 965 World War I deaths were all from the United States, it would have completely wiped out the nation's 28 largest cities.

## Things

### Skyscrapers

Chicago started the era of tall buildings in 1885 with the construction of the 10-story-high (136 feet) Home Insurance Building. New York soon followed the trend, and by the end of the decade there were more than three hundred buildings that were nine stories, or taller, in Manhattan.

At the turn of the 20<sup>th</sup> century, the widespread use of concrete, along with elevators, steel frame construction, central heating, and the telephone, allowed skyscrapers to dominate American cities.

Corporations soon began building skyscrapers to promote name recognition. The Metropolitan Life Building was 50 stories (700 feet), and the Woolworth Building, at 60 stories (792 feet), was the world's tallest building from 1913-1930.

The Chrysler Building was briefly the world's tallest building at 77 stories (1,046 feet), until the Empire State Building reached 102 stories (1,250 feet). It remained the world's tallest skyscraper for 41 years until surpassed by the World Trade Center, at 110 stories (1,368 feet).

Today, the world's tallest building is the Burj Khalifa (formerly called the Burj Dubai), in Dubai, United Arab Emirates, at 2,716 feet or 160 stories.



*Empire State Building*

## **Building of the Era**

### **Ingalls Building, Cincinnati, OH**

Up until 1903, the tallest building in the United States made of reinforced concrete was only six stories high. Then, a skyscraper that was 210 feet tall was built in Cincinnati, Ohio. It was constructed in only 8 months. Legend has it that after the concrete forms were removed, a local reporter waited beside it all night, expecting it to fall over—it didn't, and has been in constant use ever since.

The Ingalls Building has twisted steel rebar inside the reinforced concrete slabs and beams. The building's exterior is covered with white marble on the first three stories, glazed gray brick along the next eleven stories, and glazed white terra cotta on the top story and cornice.

The Ingalls Building, the first 15-story concrete skyscraper, still stands at the corner of East 4<sup>th</sup> and Vine Streets, in Cincinnati, Ohio. It was added to the National Register of Historic Places in 1975, and was the tallest reinforced concrete building in the world until 1923, when the Medical Arts Building (281 feet) was built in Dallas, Texas.



*The Ingalls Building*

## Quotes

“Great ideas originate in the muscles.”

**Thomas Edison**

“We shape our buildings; thereafter they shape us.”

**Winston Churchill**

“...he that will not work shall not eat.”

**Captain John Smith**



*Captain John Smith*

Captain Smith was the governor of the young colony of Jamestown, Virginia, in 1608. One of the settlers claimed to have discovered gold nearby and nearly every man went searching for it. This kept them away from their crops, causing a food shortage. Captain Smith ordered everyone back to their farms with a command to either plant corn or starve. The men returned and planted corn.

## Synopsis

After reading this chapter you should now have a better understanding or be able to identify the following:

- aggregate
- form
- screed
- slab
- rebar
- cubic yard
- precast
- GFRC
- inspiration

## ACTIVITIES

### 1. Build wooden concrete forms

#### Materials:

- 2 x 4 lumber
- hand saw
- measuring tape
- one box of 6-penny nails
- metal corner angles (optional)

#### Procedures:

- Measure and mark lumber.
- Cut into desired form.
- Nail support angles into corners.



### 2. Concrete pour from prep to cure

#### Materials:

- bagged concrete mix
- six 4-inch blocks
- plastic tarp
- mortar pan
- mason's hoe
- trowels
- rebar and wire mesh
- 3 feet long 2 x 4
- floats
- broom
- edger
- level
- water
- 5-gallon pail
- clean up brush



**Procedures:**

**Preparation**

- Assemble tools and materials.
- Review procedures.
- Assign work responsibilities.

**Form**

- Assemble 4-inch blocks, as illustrated, atop a plastic tarp to protect floors.
- Coat inside of form (blocks) with liquid soap for a release agent.
- Lightly spray water to moisten all surfaces that will have contact with the concrete.



**Mix**

- Pour the dry, premixed concrete from the bag into a trough or mortar pan.
- Slowly add water while mixing with a hoe or trowels.

**Add reinforcement**

- Use rebar or wire prepared before pour.



**Pour**

- Carefully pour wet concrete into form.
- Scrape excess off of form with the trowel, and put it back into the mixing pan.

### Tamp

- Lightly tamp down the concrete with steel trowels or floats.



### Screed

- Two students use a 2 x 4 longer than the form
- Put the screed, its' narrow side up, at one end and work it across to the other with a sawing motion.
- Scrape off the excess mortar that collects in front of the screed with a trowel and place it in low spots. Low spots are areas where the concrete does not touch screed.

### Float

- Using the flat trowel, flatten the top of the concrete.



### Finish

- Use sponge, rubber, wood, and other floats to experiment with different effects and results.

### Edge

- Use edger to make grooves along frame perimeter.



### Cure

- Clean and store away tools.
- Sweep work area.
- Allow concrete to dry overnight.



### Cleanup

- Remove concrete form.
- Inspect concrete.
- Demolish concrete and bag for removal.
- Salvage reinforcement.
- Wash blocks.
- Save or discard floor tarps/protection.
- Sweep floor and clean work area.



### 3. Concrete calculations

**Question: How many cubic yards of concrete will you need to pour a foundation slab 20 feet long, 20 feet wide, and 6 inches deep?**

- First, put all the dimensions in the same units, using measurements of feet.
- The slab would be 20 by 20 by  $\frac{1}{2}$
- The volume is calculated this way:  $20 \times 20 \times \frac{1}{2} = 200$  cubic feet.
- One yard = three feet

To calculate a cubic yard, multiply one yard x one yard x one yard.

Or, in feet, that's 3 ft.  $\times$  3 ft.  $\times$  3ft. = 27

- So, 1 cubic yard = 27 cubic feet
- Divide the cubic feet (200) by the cubic yards (27)
- This gives you the total of cubic yards in the slab
- $\frac{200}{27} = 7.4$  cubic yards

**Answer: 7.4 cubic yards of concrete will be needed for the slab.**



## Chapter 7: It's Plaster

### Gypsum and Plaster

#### Plaster of Paris

#### The Traditional Three Coats

#### Ornamental and Decorative Plasterwork

- Scagliola

#### Repairing Plaster Disasters

#### The Tools

Part 7: Chalk line, plumb line

#### People, Places, and Things: 1939 to 1949

Winston Churchill

Attribute: determination

- World War II Statistics

Earle Barthé

The Red Ball Express

The USS Mason

#### Buildings of the Era

WWII and Europe's cities

Warsaw, Dresden, London

#### Quotes

#### Synopsis

#### Testimonial of Christian L.

Former Masonry Preservation student Christian L. is now working as an apprentice with an art and plaster restoration company in NYC.

#### Activities

1. Making and restoring plaster medallions
2. Plaster hands



## Gypsum and Plaster

There's a good possibility that the walls and ceiling around the room in which you are sitting are made of a masonry material. That material is probably drywall or plaster. Plaster is made of gypsum, a mineral also known as calcium sulphate dihydroxide. Gypsum forms when water evaporates from saturated limestone. It is abundant and very soft; ranking #2 on the Mohs' Scale of Mineral Hardness.

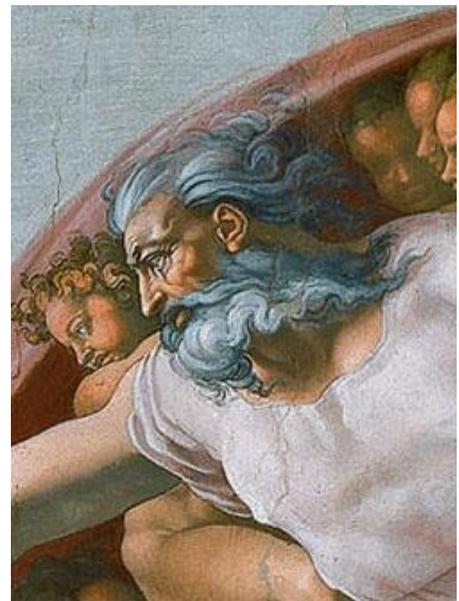
Over 5,000 years ago, the Egyptians added gypsum to the mortar they used while building large monuments like the Great Pyramid of Giza at Cheops. Centuries later, the Greeks used gypsum to make plaster for their buildings and statues, and then the Romans used it to make plaster replicas of the Greek statues.



*Plastering class, Hampton Institute, circa 1900*

The name gypsum is from the Greek word *gypsos* meaning chalk or plaster. Gypsum is mined, heated to about 300 degrees Fahrenheit and cooled to make a very light, white-colored powder. When mixed with water, it turns into a paste that hardens quickly into a relatively soft and brittle material. This is plaster. Besides curing fast, other notable attributes of plaster are its ability to sand down to a very smooth surface, and its usefulness for making identical duplicates in mold casting. But, because plaster dissolves in water, it is strictly an interior construction material.

The art of plastering is well known for its use with paints in a technique called fresco, which became popular during the Renaissance. The word *fresco* is Italian for fresh. It refers to the art of applying paint to fresh, damp plaster. The plaster is made of very fine sand, lime, and marble dust, and applied to a small section of a wall or ceiling. It is then painted with pigments that penetrate into the plaster and absorb the rich colors. A large fresco consists of many small sections, each painted in a single day and planned carefully to make the joining invisible. Many Renaissance frescoes still have their vibrant colors even though the plaster is over six hundred years old. Besides fresco and sculpting, plaster was also historically used in toothpaste, beer brewing, and for fertilizers (since small quantities are not harmful to the digestive system).



*Sistine Chapel fresco*

However, the most common use for plaster today is for drywall panels. Drywall consists of plaster sandwiched between sheets of thick paper and is popular because it provides a smooth surface without the trouble of the traditional three-coat plastering technique (discussed below). Sometimes called by the brand name “sheet rock,” it is manufactured in 4 foot by 8 foot sheets that range in thickness from  $\frac{1}{4}$  to  $\frac{5}{8}$  inches. The sheets are brought to the job site, and nailed or screwed into wood or metal studs that are evenly spaced along walls and ceilings. The thin openings between the panels are called joints or seams. They are sealed with a specially formulated type of plaster called joint compound. Joint compound is most commonly packaged in five-gallon plastic buckets. It is scooped out and applied with a flat tool called a knife over a 2-inch wide strip of paper or durable gauze mesh. After this dries, it is finished smooth with sandpaper or a damp sponge, and then gets two more coats of compound.



*Drywall panel*

### Plaster of Paris

Plaster was used throughout Europe for centuries and became very popular after the Great Fire of London in 1666. The fire almost destroyed the entire city, which was full of closely packed buildings that allowed the flames to spread. Plaster, being fireproof, was used to replace the combustible or non-fireproof building materials. In the 1700s, large deposits of gypsum were mined from quarries near Paris. The French king decreed that Paris' interior walls had to be coated with plaster for fire protection. The city became the center of plaster manufacturing and artwork, and the term “Plaster of Paris” became a common name for any type of fast-setting gypsum or plaster-like material.

### The Traditional Three Coats

The interior walls of a building are supported by vertical floor-to-ceiling framing members made of wood or metal, called studs. The word stud comes from the Old English *studu*, Old Norse *stoth*, and German *stud*—all meaning post.

The openings between studs are usually wide enough to walk through and are covered by nailing thin strips of wood, about 1 inch wide and  $\frac{1}{4}$  inch thick, to the studs. These wood strips are called lath. The word lath is from an Old High German word *latta* meaning a slat, or strip of wood. There is an opening about  $\frac{1}{2}$ -inch wide between the lath. When wet plaster is pressed onto the lath, some of it squeezes into the gaps and wraps over the backside of the strips. The overhanging plaster is called a key. When dried, the key is locked onto the lath.



*Plaster keys*

At the turn of the 20<sup>th</sup> century a metal mesh that looked like a heavy screen was used instead of wood lath. The plaster would ooze through the small openings and key onto the back of the mesh.

Plaster is applied in three separate layers called coats: scratch coat, brown coat, and finish coat. The scratch coat is applied against the lath and provides structure, the brown coat provides strength, and the final coat gives the surface a smooth finish.

### Scratch coat

The first coat of plaster, called a scratch coat, is a mixture of lime or gypsum, fine sand, and water. This is applied in a thick layer, about  $\frac{3}{8}$  inches over the wood or metal lath. After it is applied it is “scratched,” or marked with grooves, so that the second coat of plaster will bond to it. The scratches can be made with a trowel, a scrap piece of metal lath, or a metal tool that looks like a large comb.



*Scratch coat*

### Brown coat

After the scratch coat dries, the wall or ceiling gets moistened with water and a second coat (about  $\frac{3}{8}$  inches thick) is applied. It is the same mixture as the scratch coat, but pressed flat to give a smooth, uniform, brown-colored surface. It is then lightly brushed to roughen the surface for the final coat of plaster.



*Brown coat*

### Finish coat

After the brown coat has dried, the surface is moistened and a final, or finish, coat is applied. This is a creamier mixture made with white gypsum. A  $\frac{1}{8}$ - to  $\frac{1}{4}$ -inch coat is troweled on and smoothed out quickly, because gypsum sets up very fast. As the plaster begins drying it is sprayed with mists of water, and the trowel is pressed hard against the surface to give it a very smooth finish. Depending on the temperature and humidity, it takes about a week for plaster to dry thoroughly enough to be primed and painted.



*Finish coat*

Buildings constructed before 1890 used a plaster made with lime, sand, and water with fiber added to prevent cracking. The lime came from burned limestone or shells, and the fiber came from the hair of cattle, horses, or hogs. At the beginning of the 20th century, gypsum became the most common plastering material for the finish coat.

During the early 1900s, the use of rock lath, plaster board, or gypsum-board started to gain popularity. This was a large sheet of compressed gypsum covered with heavy paper that had uniform round holes throughout that allowed for the plaster to form a key. It took the place of lath and the first coat of plaster. Because rooms could be completed faster and cheaper with plaster board, it

became the material of choice by the 1930s, effectively ending the traditional three coat system of plastering.

### Ornamental and Decorative Plasterwork

Plaster is also used to make creative designs along walls and ceilings. Decorations around ceiling light fixtures are called rosettes or medallions. They often include artistic depictions of leaves, flowers, fruit, and other assorted designs.

Plaster decorations are also installed along the top of a wall where it meets the ceiling. This decoration is called a cornice or crown molding. A common decorative pattern used for crown moldings is the dentil. The word dentil comes from the Latin word *dens*, meaning tooth. Dentils are small squares along the bottom of the molding that look like straight and uniform teeth.



*A large rosette*



*Dentils with egg and dart*



*Coffered ceiling*

Another type of decoration is called egg-and-dart. This design consists of an oval, or egg-shaped, object, positioned between shapes that look like arrows, anchors, or darts. Dentils and egg-and-dart decorations were a part of ancient Greek and Roman architecture that became popular again during the Renaissance.

Yet another type of decoration in plaster work is the coffered ceiling. Coffers are a series of beautiful sunken panels that are lined with decorations. The word coffer is from the Latin word *copbinus*, meaning basket, and is also the root of the word coffin.



*Running a cornice*

Ornamental plasterwork is a hallmark of craftsmanship, and can be installed along ceilings or walls in two different ways.

The first method is called “run in place.” This is done by applying the plaster along the top of a wall and sliding a tool with a carved outline and handle across the plaster to give it a shape. The tool is called a profile. This method is correctly called run in place because the plaster dries quickly and a plasterer has to move fast to shape it before it hardens.

The second method is called the “cast” method. This is the installation of an ornamentation made on site or in a plaster shop. Cast ornaments are attached to a wall or ceiling after it has dried. This requires strong adhesives and the installing of supportive fasteners to hold the decorations in place.



*Cast plaster ornaments*

## SCAGLIOLA

Scagliola, (pronounced scag-lee-oh-la) is an imitation of decorative marble. The word *scaglia* is Italian for stone chips. It was developed by monks in Italy during the 17<sup>th</sup> century when they were restoring their monastery. They mixed stone chips, marble dust, bonding agents, and mineral pigments together, then applied the mixture to a wall. After it dried, they polished it with finer and finer grades of polishing stones (and water) until it produced a hard, shiny replica that looked like marble.

For many centuries scagliola was the highest form of decorative plasterwork. It is still practiced today, with results so natural that it's difficult to identify them as a man-made imitation.



*Plaster scagliola restoration*

## Repairing Plaster Disasters

Plaster is fairly durable and fireproof, but it does have its problems. It dissolves when it gets wet, and cracks from movement, causing keys to fall off. Behind the scenes, wood lath rots, or gets infested with insects, and metal lath rusts. If you add in the effects of time, neglect, and poor maintenance, you have a general idea of what will cause plaster to crumble.

If plaster damage is limited to only the top coat, the surface can sometimes be carefully removed down to the brown or scratch coat, and repaired with joint compound. After the compound dries it resembles gypsum plaster in color and texture, and can be sanded or sponged to match the original plaster.

Plaster cracks can sometimes be repaired by cutting along the opening to remove loose material, and then mending it with joint compound applied over a layer of gauze sheetrock tape. This particular type of sheetrock tape looks like a wide gauze bandage, but it is thicker and more durable because it's made of flexible fiberglass.

To ensure a good repair, the joint compound should be applied in separate applications with each thin layer having enough time to dry thoroughly. This thin layer method is better than attempting a crack repair with one thick coat.



*Plaster repairs*

If keys have broken along sections of walls or ceiling, you will notice the plaster has pulled away from the lath and bulged out. It bounces back when pushed in, and usually has cracks along the surface. This damage can be repaired by drilling holes into the loose area, squeezing in a liquid adhesive, and then pushing the plaster back into its original position on the lath. The wall is braced with plywood, pressed tight and secured until the adhesive dries. After the plaster is attached to its original position, the plywood is removed and joint compound can be used to fill in the cracks, drill holes, and other surface damage.



*Ceiling repairs*

If large areas of plaster are defective they should be removed and replaced with new plaster. The old lath should be repaired or replaced if necessary, and the new plaster needs to be carefully feathered. Feathering means blending the area where the new plaster meets the old so there are no bumps or ridges. Getting a smooth surface might require a few additional applications of joint compound, each finished with sandpaper or a damp sponge. It is time-consuming work, but the finished results are worth the effort.

Sometimes only the surface of an entire wall will need to be repaired. This can be accomplished by a process called skim coating. Skim coating is covering a large area with a sheet of gauze-like cloth, and coating it with gypsum or joint compound. This gives the entire wall a smooth and uniform surface.

There is a plaster repair product called spackle. This is a trademark name for a type of powder that is mixed with water and used to fill small holes in plaster. Spackle dries quickly, and cannot be spread over large areas like joint compound.

Repairing badly damaged decorative plaster elements, such as medallions or moldings, usually requires the reproduction of new pieces. This is done by making molds from the original pieces, forming new plaster replicas, and firmly attaching them to their original setting. The replaced pieces are then prepared and painted to match their surroundings.

The careful reproduction of damaged or missing plaster pieces can be undertaken throughout an entire room. This work requires patience, care, and determination. The process of duplicating and attaching new replicas cannot be rushed; otherwise, pieces may not fit into the original setting, or could fall from the wall or ceiling. Although this might take a long time and require a lot of careful work, the amazing results are very much worth all of the effort and expense.



*Making a plaster replica*



*New Amsterdam Theater before restoration*



*New Amsterdam Theater after restoration*

## The Tools

### Part 7: Chalk line, plumb line

#### Chalk line

A chalk line is used to make straight lines on flat surfaces. A string coated with powdered chalk is pulled tightly across the surface to be marked, then the line is “snapped” by pulling it up and releasing it. The string hits the surface and the chalk marks a straight line.



*Snapping a chalk line*

#### Plumb bob

A plumb bob is a small, cone-shaped weight, usually made of steel or brass. The weight is attached to a string or line that is fastened onto a wall to give a vertical reference. The plumb bob has been in use since ancient times. A sixth-century quote referred to the rebuilding of the Jerusalem Temple: “Men will rejoice when they see the plumb line in the hand of Zerubbabel.”

Sometimes plumb bobs have a compartment for powdered chalk, and serve as either a chalk line or a plumb bob.



*A combination chalk line & plumb bob*

## People, Places, and Things

### 1939 - 1949

#### People: Who?

**1874:** Born in Oxfordshire, England, on November 30<sup>th</sup>.

**1893:** Enrolled in the Royal Military Academy.

**1897:** As a cavalry officer, he battles local tribesmen in India.

**1898:** Participates in a cavalry charge in the Sudan.

**1899:** Travels as a journalist to the Boer War, is captured, and escapes.

**1900:** Returns to England, and is elected to Parliament.

**1911:** Becomes the First Lord of the Admiralty and modernizes the Royal Navy.

**1914:** First World War begins.

**1915:** Following a British naval disaster in Turkey, he resigns from his office in the navy and rejoins the army.

**1916:** Leads the 6th Battalion Royal Scots in the trenches of France.

**1919:** After the war, he becomes Secretary of State for War and Air.

**1924:** Is re-elected to Parliament.

**1930s:** Loses popularity and is without a military or government position. Spends the years writing, and building brick walls around his home and gardens.

**1931:** While crossing Fifth Avenue in New York City, he is hit by a taxi, cracking two ribs and banging his head on the pavement. He is hospitalized for weeks, but recovers.

**1939:** He becomes First Lord of the Admiralty as the Second World War begins.

**1940:** Becomes Prime Minister. He leads his country during the darkest months of lost battles and air attacks against Britain.

**1941:** The US enters the war as a British ally against Japan, Germany, and Italy.

**1945:** As World War II comes to a victorious end, he is defeated in a general election.

**1946:** Coins the term “Iron Curtain” in describing the Communist takeover in Europe.

**1951:** Becomes Prime minister again.

**1953:** Wins the Nobel Prize for Literature.

**1955:** Resigns as Prime Minister.

**1964:** Leaves the House of Commons.

**1965:** Dies in London on January 24.



“Never, never, never give up.”  
**Winston Churchill**

### **Winston Churchill: leader, hero, part-time bricklayer**

#### **Attribute: determination**

Determination means making up your mind and following through on that decision no matter how difficult the circumstances. Determination builds character and defeats discouragement. It also makes a person reliable, trustworthy, and confident.

Winston Churchill was a gifted leader with an ability to channel his determination to the British people while they were in the midst of turmoil. His confidence inspired people around the world to “never give up.” It was this man’s determination that stopped the Nazi conquest of Europe and led the way to an Allied victory in the Second World War.

## WWII STATISTICS

In 1936, Italy conquered Ethiopia. In 1938, Japan invaded China, and Germany captured Austria. On September 1, 1939, Germany invaded Poland, and within a week the "Allies" of Britain, France, Australia, New Zealand, Canada, and South Africa plunged into the Second World War against the "Axis" powers of Germany, Italy, and Japan. Then Russia was betrayed by the Nazis and switched sides to join the Allies.

When the Japanese attacked the naval fleet at Pearl Harbor in 1941, the United States joined the fight. A savage and brutal war raged—from the mountains of Norway to the deserts of Egypt, from the jungles of Burma to the frozen islands of Alaska.

When it ended in 1945, the Second World War was the most deadly and destructive conflict in the history of mankind, leaving most of Europe and a large part of Asia in absolute ruins. An estimated 59,577,527 people died in the Second World War. If those casualties were to occur in the United States today, it would completely wipe out the 91 largest cities and urban centers.



*World War II*

### People, Places: Earle Barthé

Earle Barthé (pronounced bar-*thay*) worked in New Orleans as a plasterer his entire life. His moldings and ceiling medallions were so beautiful that the Smithsonian Institution acknowledged them as works of art. Mr. Barthé was admired for his talent as an artisan, and appreciated for his love of plastering. He would sing an opera or a Muddy Waters song while working, and often used musical terms to describe his craft. He would say: "It all have to be in tune."



*Earle Barthé*

Plastering is the Barthé family trade, passed down from Earle's great-great-grandfather—who started the business in 1850. Mr. Barthé passed his trade skills along to his own children before he died in January 2010, at the age of 87. When Hurricane Katrina hit New Orleans in 2005, Mr. Barthé fled to Texas with only a change of clothes. When he returned, he resumed work and realized that all of his tools were gone...that is, all except for one. In the back of his truck he found his favorite trowel—it had belonged to his grandfather.

### People, Places, and Things: The Red Ball Express

During World War II, the Allies started landing on the beaches of France on June 6, 1944: D-Day. Gen. George Patton's Third Army broke through the German lines and pushed the enemy back, but they went ahead too fast and were as far as 50 miles away from their supplies. Tanks were stalled without gasoline, soldiers were without ammunition, and the troops were vulnerable to a counter attack.

Trucks from every available unit were quickly put into action to get supplies to the front lines. The convoy was called the Red Ball Express. "Red Ball" is a railroad term for priority freight. Six thousand trucks with mostly African-American drivers drove as fast as they could on a 700-mile round trip to deliver the supplies. If a truck broke down, it was shoved to the side of the road, repaired, and then put back into the convoy to continue the trip.



*Red Ball Express*

The Red Ball Express rolled nonstop, 24 hours a day, for 81 days. It carried 12,342 tons of fuel, ammunition, and vital supplies to the front line troops. This was the push the Americans needed to keep their momentum going through France and all the way into Germany. After finishing their mission, the Red Ball Express was disbanded and the drivers/soldiers returned to their units. Their emergency service, vital at a critical time of war, has been all but forgotten today.

### People, Things

#### The USS Mason

Over 150,000 African Americans were in the U.S. Navy during WWII. The first ship they served on as sailors, and not as cooks or stewards, was the USS Mason. It was named in honor of Ensign Newton Henry Mason, a Navy pilot killed during the Battle of Coral Sea in 1942.

Although crewed by black sailors, the USS Mason did not have an African-American captain. The captain of the ship was "Big Bill" Blackford. He was the great-grandson of Mary Berkeley Minor Blackford, a well-known abolitionist in Virginia who wrote articles before the Civil War describing the horrors of slavery, and raised funds to free slaves.



*USS Mason*

## Buildings of the Era

### WWII and Europe's cities, 1934-1949: Warsaw, Dresden, London



*Warsaw*

#### Warsaw, Poland

Attacked in September 1939 by the Nazis, Warsaw was systematically annihilated before being liberated by the Soviets in January 1945. Of the original population of over 1 million, only 150,000 survived the war.

#### Dresden, Germany

A city filled with museums, palaces, cathedrals, and historic buildings, Dresden was leveled in February 1945 by one of the greatest aerial bombardments of all time. A mixture of high-explosives and fire bombs destroyed more than 90 percent of the city center.



*Dresden*



*London*

#### London, England

Britain's center for government was severely bombed from August to October 1940. Over 10,000 casualties were sustained, and significant landmark buildings were damaged or destroyed. Though heavily outnumbered, the British Royal Air Force defended their homeland during "The Battle of Britain" and gave Germany its first major defeat of World War II.

## Quotes

“We shall fight on the seas and oceans, we shall fight with growing confidence and growing strength in the air, we shall defend our island, whatever the cost may be, we shall fight on the beaches, we shall fight on the landing grounds, we shall fight in the fields and in the streets, we shall fight in the hills; we shall never surrender.”

**Winston Churchill**

“What counts is not necessarily the size of the dog in the fight—it’s the size of the fight in the dog.”

**Dwight D. Eisenhower**

“We have nothing to fear...but fear itself”

**Franklin D. Roosevelt**

### *Sisu*

The word “sisu” (pronounced “SIH-soo”) expresses the Finnish concept of “what must be done, will be done; no matter what it takes.” It describes an inner strength the Finns have to endure unbearable hardships and adversity. In the U.S. we would say “be brave;” in Finland they have *sisu*.

Sisu came to the world’s attention during the early years of World War II. When a large and powerful Russian Army attacked Finland, it was reported: “*The Finns have something they call sisu. It is the ability to keep fighting after most people would have quit, and to fight with the will to win. In the wilderness that forms most of the Russo-Finnish frontier... the Finns definitely gained the upper hand.*”

## Synopsis

After reading this chapter you should now have a better understanding or be able to identify the following:

- gypsum
- fresco
- lath
- key
- scratch coat
- rosette
- dentils
- egg and dart
- determination
- *sisu*

## Testimonial of Christian L.

A former Masonry Preservation student, Christian now works as an apprentice with an art and plaster restoration company in New York City.

*"It's hard work but I'm learning a lot and I love it. I can only grow. Progress begins as a mineral grain and grows into a mountain."*

## ACTIVITIES

### 1. Making and restoring plaster medallions

#### Materials:

- 2-piece plastic containers (like those used for take-out meals)
- plaster
- water
- chopsticks
- colored beads
- stone patching tools or flattened spoons
- white glue
- broom
- sheetrock gauze tape
- non-toxic paint
- paint brushes
- dust masks
- masonry hammer



#### Procedures:

- Set out materials for individuals or group activity.
- Set colored beads into lid (shallow half) of the 2-piece takeout container. Note: Using fewer beads is better for this project.
- Mix plaster in the bottom (deep) portion of takeout container using stone patching tools, chopsticks, or flattened spoons. Remember—plaster sets up fast!
- Pour the plaster onto the beads in the shallow part of the container.
- Allow medallion to dry ½ hour or more. Carve initials into the back of the drying plaster for identification.
- Release the new plaster medallion from the container lid and set it back inside, face up, to observe the details and bead configurations.
- With a slight, (perhaps unexpected) tap of the hammer, break (but do not pulverize), the medallions.

- Mix a small amount of plaster and use it as a repair adhesive to put the pieces back together. Glue can also be used in the repair process.
- Plaster or glue the broken edges and arrange them back in the tray. You can also set them onto a bed of wet plaster to form a new medallion face, or, reassemble the pieces in the container lid and pour a new plaster backing over the top, adding strips of sheetrock tape for reinforcement.
- Allow adequate drying time, release from lid, and paint the medallion
- Clean up.



## 2. Plaster hands

This activity is a follow-up to the procedures described in Chapter 5 for mold making and uses the dental impression molds to make plaster hands.

### Materials:

- hand mold made with dental impression material
- plaster
- water
- flat tray
- sheetrock gauze tape
- bricks
- electric drill
- paddle-type mixing attachment for drill
- 5-gallon bucket
- container of cool water
- release agent (spray cooking oil)
- utility knife
- trowels
- dust mask
- broom



**Procedures:**

- Make sure the room is well ventilated and participants wear dust masks while mixing plaster and cleaning up.
- Place the hand mold in the tray, palm side up, and make sure there is no sand or debris in the mold.
- Spray the mold with release agent.
- Use the utility knife to cut the sheetrock gauze tape into strips that will fit into the hand mold.
- Block the opening at the wrist with a brick.
- Place plaster in the bottom of the bucket, pouring slowly to prevent dust.
- Add water slowly while mixing with the drill and paddle attachment.
- Gradually increase the drill speed to mix plaster thoroughly.
- Quickly pour the plaster into the mold using the trowel as a guide.
- Fill half way and place a few strips of gauze into the wet plaster.
- Pour more wet plaster to fill the mold; additional gauze strips can be added and topped with plaster.
- Tap the mold to release air bubbles.
- The plaster will begin to set in a few minutes and initials can be carved for identification.
- Plaster set time varies on conditions such as mixture proportions, temperature, and humidity; but, allow a few hours before removing the plaster from the mold.
- The dental material will peel off from the plaster hand and can be discarded.
- Use the utility knife to dig out material between the fingers in the casting.
- You'll notice the reproduction is an exact duplicate of the hand.
- The finished work can be left raw, coated with furniture spray wax for a protective finish, or painted.



## Chapter 8: Stucco and Masonry Paints – Old Coats and New Skin

### Old Coats – Stucco

The “How” of Stucco  
A Colorful History

### Stucco Finishes and Textures

- EFIS
- Cracks, Causes and Repairs  
Faux Brownstone



### New Skin – Limewash and Coatings That Breathe

Limewash  
Breathable masonry paint

### The Tools

Part 8: The hawk and steel trowel

### People, Places, and Things: 1950 to 1967

Joseph C. Rodriguez  
Attribute: valor

Latino migration

Cavity wall construction

### Building of the Era

Tract houses

### Quotes and Lyrics

### Synopsis

#### Testimonial of Ruth Z.

Ruth Z., a former Masonry Preservation student who attended masonry preservation college, now working for a restoration masonry company

#### Activities:

1. Parge a wall
2. Mix and use limewash

## Old Coats – Stucco

Stucco is another masonry building material that has been used for thousands of years and is still used today all over the world.

Stucco is often mistakenly called plaster (and likewise plaster is called stucco)—but plaster isn't waterproof and stucco is. So stucco better describes a cement-based exterior covering that provides protection against rain, snow, sleet and to some extent, fire.

The word stucco is from the ancient Italian word *stucchi* meaning crust, bark (as in tree bark), or skin.

Historically, stucco was used to cover cheaper construction materials like fieldstone, soft bricks and even logs. An influential American architect of the mid-19<sup>th</sup> century, Andrew Jackson Downing, recommended stucco as an exterior covering because it was inexpensive and could be tinted various colors to give buildings a rich-looking appearance. Following his advice, stucco became a fashionable building material across the fast-growing nation from about 1840 to 1880. Then it lost favor until the start of the 20<sup>th</sup> century when architectural styles like Tudor Revival and Spanish Colonial Revival brought back its popularity. Revival styles were designed to resemble early European and colonial American buildings.

Traditional stucco was made from a mixture of mud, clay, and lime. Sometimes pebbles, marble dust, straw, or animal hair would be mixed in to add color, texture, or durability. These were the standard ingredients until the 1820s when natural cement was added to the stucco mixture. Starting around 1900, stucco was made of Portland cement, lime, sand, and coloring pigments. Sometimes gravel was added for a particular surface effect.



*Hawk and trowel for parge coat*



*Stucco*

## The “How” of Stucco

Stucco is applied over lath made of wood or wire mesh using tools and methods like interior plastering. Stucco can also be troweled directly onto bricks, stone, or other masonry materials without lath. This is called parging, or a parge coat.



*Wire mesh*

However, stucco is usually applied in three separate coats. The first is called the scratch coat because it is scraped with lines which create a better bonding surface for the next coat.

After the scratch coat has dried thoroughly, the second coat, called the brown coat or leveling coat, is applied. The surface of the scratch coat is first misted with water to get better adhesion and slow the drying process. The stucco is then troweled on and finished so that it has a flat surface. Then it is lightly brushed to give it fine grooves or a “tooth” for the final coat to key into. Sometimes only two coats of stucco are applied, and the brown coat is worked smooth or textured to provide a finished appearance. But typically a third and final finish coat is applied.



*Scratch coat*

The first two coats have more cement for stiffness, and the third coat has more lime for a smoother surface. It is applied over a dampened brown coat and pressed hard with a flat steel or wooden trowel for a smooth surface. It can also be finished with sponges, trowels, brushes and other special tools or, splattered with sand or gravel to achieve different types of surface textures. The final coating mixture can also be tinted with powdered dyes for a colorful surface finish.

### **A Colorful History**

Traditionally, the color of stucco was determined by the color of the sand used in the mix. Often mineral pigments were added to give a wall the appearance of dressed stone. Early tints were made from organic materials to provide natural-looking colors. Then, in 1927, O.A. Malone, the “man who put color into California,” founded the California Stone Products Corporation. His pre-packaged “Jazz Plaster” pigments developed a huge spectrum that opened stucco to a new world of vibrant colors.

Today various types of pigments (typically concentrated powders) are used for coloring. Expertise is required to achieve a uniform color that doesn’t vary from batch to batch. The slightest difference in the mixing of materials, especially the pigment, will change the color of the stucco dramatically. In restoration work, it takes a talented and gifted mason to match new stucco to the original color.

If color matching provides results that are unsuccessful or disastrous, there are basically two ways to solve the problem: The first comes from a famous 20<sup>th</sup> century American architect, Frank Lloyd Wright, who said you could always plant vines to cover a mistake. But, every situation can’t be remedied with vines, so the second option is probably more reasonable—to paint the surface with a breathable masonry coating.

## Stucco Finishes and Textures

Basic stuccowork is applied using a hawk and trowel and often resembles the flat, smooth appearance of a plaster wall. However, stucco is a versatile material and is well suited to a wide variety of decorative styles and finishes. For example, a steel float can be pressed into the final coat for a smooth finish, or pulled up quickly for a multi-peaked, stipple effect. Sponge or rubber floats can be used to give it a rough or grainy surface. Sometimes stuccowork can be highly artistic, with shapes and figures pressed into the surface.



*Decorative stuccowork*

**Scored stucco:** An often-used method for dressing up a building with stucco is to make a wall appear as if it is made of stone. This is done by finishing fresh stucco smooth and scoring the surface. Scoring refers to cutting in thin vertical and horizontal lines that resemble mortar joints. This gives the appearance that the building is constructed with finished blocks of stone. Sometimes the lines are cut out and re-pointed with mortar, or painted the color of mortar, to add further detail.



*Scored stucco*

**Rough cast or pebble dash:** This effect is obtained by throwing a wet, loose mixture of cement, water, and pebbles or gravel (about  $\frac{1}{8}$  to  $\frac{1}{4}$  inches in size) against a coat of freshly applied stucco, with a paddle. The pebbles must be thrown at the wall with sufficient force and skill to stick to the stucco in an even pattern. The stones can also be pressed-in firmly with a wooden float.

**Broom finish:** This effect is achieved by mixing a loose or liquid batch of cement, lime, and water, then applying it with a long fiber broom. The broom is dipped into the mix and worked into the stucco to give a sweeping, textured look.

**Tudor style:** This effect resembles wattle and daub construction used in Tudor style architecture in Medieval Europe. Wattle refers to thin wood branches or rods interwoven along interior or exterior walls. It's then covered with daub, which is made with clay, mud, and plant fibers. Today, this effect is reproduced using cement stucco over a rigid underlayment. It is usually painted white or whitewashed to brighten it and make it more weather resistant.



*Tudor-style building*

## EFIS

Synthetic stucco products are known as exterior finish insulation systems (EFIS).

EFIS is a type of surface coating that combines a Styrofoam-like insulation material with a cement-type covering that is finished to look like stucco.

EFIS is a European product that started making its way onto American construction sites during the 1970s. Because it is porous, it requires monitoring to assure that the outer skin does not puncture, crack or open, allowing moisture to penetrate and soak the underlying insulation.



*EFIS*

## Cracks, Causes and Repairs

Stucco's ability to protect against water can't compare to the durability of stone or brick, so it deteriorates faster from age, weather, and movement of the building. Hairline cracks start to appear, especially around doors or windows, and water finds its way in, opening the cracks wider and deeper during the freeze-thaw cycle.

Cracking also occurs along large areas of stucco that did not have expansion joints installed. Expansion joints in stucco serve the same purpose as those installed into concrete. They allow the stiff material room to expand when hot and contract when cold.



*Cracked stucco*

If the stucco can be salvaged, there are several repair options available depending on the type and extent of the damage. Hairline cracks can be sealed with a diluted slurry coat of Portland cement, sand, and water, applied with a brush. The cracks allow the mix to soak in and seal the openings, providing protection like a new covering of skin.

A short-term method of crack repair used to limit damage from moisture is caulking. Caulk can be applied to cracks in stucco, but it is not a long-lasting repair because it dries up and deteriorates in sunlight and will eventually fail.

Once water finds its way behind the stucco it causes wooden lath to rot, metal lath (and nails) to rust, and the stucco to lose its bond to the wall surface. It then increases cracking or cause bulges in the surface. To repair this problem, the stucco needs to first be “sounded out” to determine the extent of the damage. When the deteriorated sections are confirmed, they are cut out and new stucco is applied. The new stucco mix should be compatible with the old; neither too soft, nor too strong. The hardness of the repair stucco is controlled by the ratio of lime to Portland cement used in the mix.

### HOLLOW vs. THE RING OF TRUTH

Can you hear when something is deteriorated? The answer is, “Yes you can.” By sounding out stucco, you can determine if it's solid and secure; or loose and defective.

This is done by gently tapping the stucco with a hammer or rubber mallet while listening to the sound. There is a distinct difference between a material that “rings out” solid, and the hollow thud of something that isn't. Areas with cracks, bulges or discolored patches are good locations for sounding. If defective, the sections are marked off with paint or crayon, sometimes called “keel,” for removal and repair.

Sounding can also be used to determine defects in terra cotta and plaster work.



*Sounding out*

### Faux Brownstone

Many of the brownstone row houses you see today are actually wearing a disguise. The real brownstone has spalled, or worn off, and been replaced with a coating of stucco tinted to look like brownstone.

Brownstone is a type of sedimentary sandstone with a reddish brown color that comes from dissolved iron oxide that seeped into the formation. Iron oxide is the mineral that gives bricks their red color. In the late 1800s brownstone was considered stylish and prestigious by the growing middle and upper classes of New York and Boston. Ships or railroads transported cut and carved stone from quarries in Massachusetts, Connecticut, and New Jersey.



*New stucco on an old brownstone building*

Row houses were built quickly as the stone slabs, less than a foot thick, were attached onto building façades made of a cheaper back-up materials like brick or local stone. New immigrants, including craftsmen who were stone artisans in Europe, would assemble the pre-cut pieces on site. They had the skill to make buildings appear to be carved from a single block of stone.



*Spalling brownstone*

The demand for brownstone lasted about thirty years, but as the 19th century drew to a close, different building styles became more popular and the brownstone era ended. After a few decades, the stone aged, weathered and began deteriorating. Layers of the sedimentary stone became victim to pollution and the freeze-thaw cycle. Ornate decorations started cracking, melting, and peeling away.

To repair the damage, many brownstone owners started re-facing their buildings. They would have masons remove the deteriorated stone, sometimes all the way down to the back-up wall. The masons would then use homemade mixes of tinted mortars for repairs. Sometimes this new mortar worked well; other times, it wouldn't adhere properly, or the workmanship was inferior and the patches would eventually fall off. Many times the color wasn't correct or soon faded. Eventually, what was once a brownstone wasn't brown or a stone anymore.

Today, there are repair mortars that provide the right color and dependable durability. Also, because of a rising demand, a few of the inactive brownstone quarries have reopened. These once busy and prosperous industries are again providing jobs for depressed rural economies and supplying a wanted product to a new market of urban homeowners who admire and want to preserve true brownstone.

### **New Skin – Limewash and Coatings That Breathe**

The outermost covering of a building is called the envelope. It's supposed to protect the interior of the building from unwanted moisture. Masonry does a good job of this on its own, but sometimes it is given a coating to provide additional protection. Bricks, blocks, stucco or any other type of masonry can't be coated with just anything. They can only be covered with a special type of coating that can "breathe."

The term "breathable" refers to the ability of a paint-like coating to stop water from getting in to the masonry surface, but it also allows moisture that might have soaked into the masonry from elsewhere (like the top or back of the wall) to escape out through the coating. Two common breathable coatings for masonry are limewash and breathable paint.



*Limewash*

## Limewash

Limewash has been one of the most popular and plentiful coatings for centuries. It's also one of the most natural and basic. Limewash is made with slaked lime, water, and sometimes, other additives. As it dries, the lime reacts with carbon dioxide in the air creating a tough, rock-like coating. After curing, it can acquire a unique, glimmering finish. This is due to the formation of calcite crystals that catch light and appear to give off a slight glow. The calcite crystals are calcium carbonate ( $\text{CaCO}_3$ ) in mineral form.

Limewash works best on porous materials, like masonry, because of its ability to wick, (or pull) moisture away from the underlying brick, block, or stone.

Limewash is applied like paint, but with a wide and thick bristle brush instead of a regular paint brush. The thick bristles help to pick up and apply the lime to the surface being coated. Limewash actually acts more like a stain than a paint. Paints just lie on the surface they're applied to, but stains soak into the material that's being treated. Like lime-based mortars, limewash is self healing, meaning that it will fill in hairline cracks when it gets wet.

Limewash is most easily identified by its natural pale white or cream color. But it can also be tinted with mineral pigments. Whitewash is a limewash with chalk added to give the coating a bright white appearance. Over the years, people have added salt, milk, egg whites, flour, and crushed rice to make the limewash stronger or give it a different appearance.

Limewash has advantages of wicking away moisture and providing some protection to the masonry beneath; but, it needs to be re-applied every year and usually requires multiple coats with 24 hours of drying time in between each application.

A well built and maintained masonry wall usually does not need a protective coating, but if a coating is to be applied, it's important to select one that is compatible with the masonry. Some modern masonry coatings require less labor and maintenance. They can also be more durable and better at repelling water. But, the best masonry coating is one that maintains the masonry's performance without causing it to spall, peel, or deteriorate—and by allowing it to “breathe.”

## Breathable masonry paint

It may sound like magic or science fiction, but there are coatings that really have this ability. If a masonry wall is painted with an impervious coating (such as latex paint which can't be penetrated by light or water) moisture that wicks up from the ground, or rainwater seeping in from cracks, can get trapped inside the wall and cause all sorts of problems. Coatings that “breathe” allow the water to escape and help to keep the underlying masonry dry.



*Limewash brush*



*Tinted limewash*

Not all masonry coating have this ability. There are some “maintenance-free” products that actually trap moisture behind their surface and cause the paint, (and sometimes the weak surface of the masonry) to peel off. Breathable masonry coatings are designed to prevent that from occurring. Limewash is a natural breathable coating.

If for some reason masonry does need to be painted, the correct breathable coating will accommodate the desire, or necessity, in a wide variety of colors.



*Breathable masonry paint*

## The Tools

### Part 8: The hawk and steel trowel

#### Hawk

A hawk is a flat, square metal tool with a short post handle attached at the center of the underside. Sometimes a rubber donut is placed around the handle to cushion a hand from the weight of the material balanced on the hawk.

A mason holds a hawk, filled with plaster or stucco, in one hand, and a steel trowel in the other.



*Hawk & steel trowel*

The word hawk is from a Middle English word that is a variation of the work *hache*, as in hatchet or battle axe.

#### Steel Trowel

A steel trowel looks like a concrete float except that the blade is not as wide and the handle is attached to the blade in one place, not two. Steel trowels are used to give a smooth surface to masonry materials such as concrete, plaster, and stucco. Most have stainless steel blades which are lightweight and will flex under a small amount of arm pressure. Steel trowels range from 10 to 24 inches in length, and 3 to 5 inches in width. A mason will have several different sizes for various types of work materials, effects, and situations.

## People, Places, and Things

### 1950 to 1967

#### People: Who?

- Born and raised in San Bernardino, California.
- Graduated from San Bernardino Valley College.
- Was drafted into the U.S. Army and was a combat infantryman in the Korean War.
- In May 1951, while attacking enemy forces in well-fortified positions in rugged terrain, his squad was halted by gunfire from five separate places, and by grenades rolling down the hill toward them. Aware of the odds, he dashed 60 yards up the slope, throwing grenades into the first foxhole with deadly accuracy.
- He then ran to the left, silencing an automatic weapon with two grenades, and continued to the top of the peak, wiping out 2 more foxholes.
- Then, reaching the final gun pit, he annihilated its crew. After witnessing this, the enemy fled and the strategic hilltop was secured.
- For unflinching courage under fire, and inspirational devotion to duty, he was awarded the Congressional Medal of Honor.
- He remained in the U.S. Army for 30 years, earning numerous medals and awards for valor.
- During his military career, he took university courses and earned a degree in architecture.
- Assigned to various U.S. Army Corp of Engineers projects in the United States and around the world, he became the Engineer of the largest military facility in the country.
- After retiring as a Colonel, he became Director of the University of Texas, El Paso, Physical Plant, responsible for construction management and maintenance of all campus facilities and supervising a large team of technicians and other personnel.
- He died on November 1, 2005.

#### Colonel Joseph C. Rodriguez: soldier, hero, construction manager

“Valor grows by daring, fear by holding back.”

**Publius Syrus**

#### Attribute: valor

The word valor is from the Latin word *valere* meaning to be strong or valiant. It means being bold, brave, and determined while facing danger or death, especially in combat.

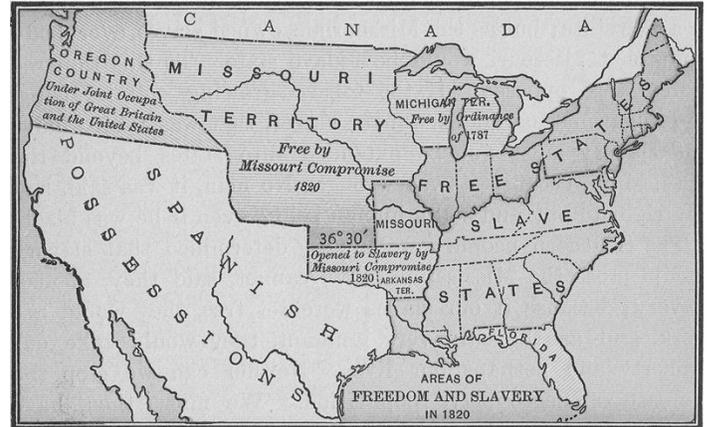
No other ethnic group has been awarded the Medal of Honor more frequently than United States soldiers of Latino descent.



*Colonel Joseph C. Rodriguez*

## People, Places: Latino Migration

From the 1500s to the mid 1800s, Spain claimed all the land in from Texas west to the Pacific Ocean, and north to Oregon. It was an immense Spanish-speaking territory with its own heritage, culture, and customs. But after its victory over Spain in the Mexican-American War in 1848, the land became part of the United States, and everyone within its borders became citizens of the English speaking nation. In the United States, Spanish-speaking people, known as Latinos or Hispanics, are mostly from Mexico, Cuba, the Dominican Republic, and Puerto Rico, with smaller numbers from Central and South America.



*The United States in 1820*

The demographics are as follows:

- Eighty-six percent of Mexican Americans reside in the southwestern states of Texas, California, New Mexico, Arizona, and Colorado.
- About two-thirds of Puerto Ricans residing in the United States live in New York City.
- About 60 percent of Cuban Hispanics reside in Florida, with another 20 percent in New York and New Jersey.



*Latino mason*

## Places: Los Angeles, CA

### Quickly built, inexpensive houses and urban sprawl

In 1950, Los Angeles was an industrial and financial giant due to migration and WWII military production. L.A. was making more cars than any city other than Detroit, stitched more clothes than any other city except New York, and was the nation's capital for motion pictures, radio programs, and television shows. Construction boomed as inexpensive houses were built quickly in ever-expanding suburbs.



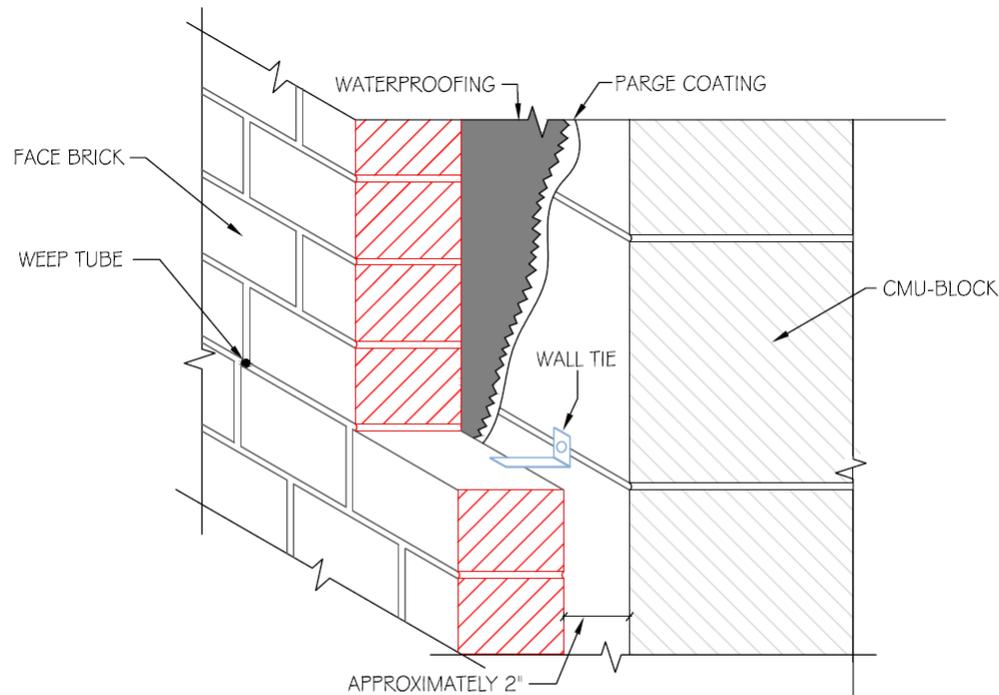
*Los Angeles urban sprawl*

As Los Angeles continued to spread out, the city's antiquated street cars were no longer effective and the city became an automobile metropolis. L.A. benefited, from the speed and convenience that cars provided, but it suffered from the social, health, and political problems associated with automotive transportation. Its recognition as a national leader in industry and entertainment was lost to a reputation for smog, air pollution and traffic jams.

### Things: Cavity wall construction

A cavity wall is really two separate walls built close together with an open space in between. The walls are connected by thin strips of metal called wall ties. This two-wall configuration allows moisture to penetrate the outer wall and drain back out through holes or tubes along the base of the wall. These drains are called weep holes or weep tubes. The inner wall is covered with a parge coating and a layer of waterproofing material to prevent moisture from passing through into the interior living spaces. The air space between provides some insulation, but it can be filled with foam, fiberglass or other types of materials to decrease the transfer of heat or cold.

A cavity wall can be constructed with different types of masonry. It is faster and cheaper to build than a solid wall, but the open space and dependence on wall ties makes it less durable. The success of a cavity wall depends on the effectiveness of the waterproofing, weep drains, and the wall ties that hold it all together. Cavity walls became the most popular type of masonry construction in the United States after the Second World War.



CAVITY WALL DETAIL (SIMPLIFIED)

*Cavity wall detail*

## Building of the Era

### Tract houses

The word tract is from the Latin word *tractus* meaning space or duration. In the 16<sup>th</sup> century, tract was used to describe a plot of land used for development. In the United States during the 1950s, many small houses were built close together on plots of land outside large urban areas. The houses had a similar, or identical, design so builders would save money on materials and labor. They were called tract houses.



*Tract houses*

## Quotes and Lyrics

“And so, my fellow Americans, ask not what your country can do for you - ask what you can do for your country.”

**John F. Kennedy**

“Do what you can, with what you have, where you are.”

**Theodore Roosevelt**

“Now let the music keep our spirits high. And let the buildings keep our children dry. Let creation reveal its secrets by and by. By and by...”

**Jackson Browne**

Lyrics: *Before The Deluge*

## Synopsis

After reading this chapter you should now have a better understanding or be able to identify the following:

- stucco
- hawk
- parge
- score
- sounding out
- whitewash
- breathability
- cavity wall
- valor

## Testimonial of Ruth Z.

A 2008-09 Masonry preservation student of the year, Ruth is now employed as a restoration mason with a NYC construction company. Her graduation address included the following statement: “I know what I want as a career. I want to be a restoration mason.”

## ACTIVITIES

### 1. Parge a section of wall

Parging is applying a coat of stucco onto a wall that does not have lath. The word *parging* is from the Old French word *porgeter*, meaning to throw against a wall. Parge can be used as a verb to explain the application, or as a noun to describe the mixture. Remember—lime burns the skin and eyes, so take all necessary safety precautions and follow first aid procedures, as necessary.

#### Materials:

- lime (stucco) mortar
- hawk
- flat trowel
- regular masonry trowel
- spray bottle
- water



#### Procedures:

- Moisten the wall by spraying water from a hose or spray bottle, or by flicking a wet, wide masonry brush at the wall. Wetting the surface is mandatory for adhesion and to prevent the stucco from drying too quickly.
- Use a regular trowel to scoop the stucco onto the hawk. Tilt the hawk slightly toward you.
- Push the long edge of the trowel into the front of the pile of stucco mortar. Keep pushing, and twist the wrist upward to carry the mortar onto the trowel - the flat side without the handle.
- Push the stucco onto the wall and move the trowel around to flatten it. Push against the left side of the trowel when you are moving the stucco to the right; push against the right side of the trowel when pushing the stucco to the left.
- Spread the stucco around and flatten it. Push and flatten the trowel against the wall to give the stucco a flat finish. Mist areas of stucco that feel like they drag against the trowel.
- Continue this applying and spreading process with trowel after trowel full of stucco across the entire area to be covered.
- Flatten out the entire area and check your work by looking at the wall from the side. Flatten out the high spots and fill in low spots. Keep the trowel wet and the handle clean. Remove lumps or pebbles from the stucco by flicking them out with the edge of the trowel and pushing stucco into the dent.
- Give the entire area one final flat finish with the trowel.



## 2. Mix and use limewash

Limewash is a mixture of lime and water. Other ingredients are added for durability or color. The basic recipe for limewash is one part lime (hydrated lime or lime putty) to four parts water. If using hydrated lime, it is recommended to soak the lime for at least 24 hours before mixing. Good practice dictates that you create enough limewash for the job at hand (this is especially important when mixing in color pigment to achieve consistent color). The recipe below will cover approximately 25 to 30 square feet. Adjust the amounts to cover the surface you are coating.

### Materials:

- safety goggles
- gloves
- 4 cups water
- 1 cup lime
- mixing container
- masonry trowel
- limewash brushes
- colored chalk dust for tinting (optional)



### Procedures:

**Note:** Work carefully as lime can burn your skin and eyes! Wear safety goggles and use common sense when working with lime.

- Prepare limewash in well-ventilated area (outdoors if possible) to prevent inhaling lime dust.
- Work slowly while mixing.
- Do not splash the limewash when applying as it can stain floors and other surfaces.
- The mixture should be thin, like the consistency of skim milk.
- Pour into containers or buckets for individual use.
- Work on a wall at a safe distance from one another in case splashing occurs.
- Wet the wall surface before applying the limewash.
- Stir the limewash with the brush frequently while applying to ensure that lime and pigments are suspended in the water.
- Wash, rinse, and clean tools thoroughly; dry and store them properly.
- Limewash begins to carbonate in 12 to 24 hours then continues to cure over time.



## Chapter 9: Clean Outside—Façade Washing, Strong Inside—Steel Structures

### Clean Outside – Façade Washing

Methods, Materials, and Machines

- Efflorescence

Preparations, Precautions, and Personal Procedures

- Pressure Washing Machine

Façade Cleaning Outfit



### The Tools

Part 9: masonry brush, washdown brushes, and wire brush

- Material Safety Data Sheet

Cleaning: Images Before, During, and After

### People, Places, and Things: 1968 to 1984

Ludwig Mies van der Rohe

Attribute: dedication

Strong Inside – Steel Structures

Steel and masonry

### Building of the Era

The Renaissance Center

Detroit, Michigan

Glass box buildings

- Curtain Wall Construction

Urban Renewal



### Quotes

### Synopsis

#### Activities:

1. Cleaning with bucket and brush
2. Pressure washing practice

## Clean Outside – Façade Washing

### Methods, Materials, and Machines

A façade is the front of a building. The word façade is from the Italian word *facciata* meaning face. A building's façade, like a person's face, needs a good cleaning every now and again. But there are many different types of dirt and grime that accumulate on buildings, and each requires a different cleaning treatment, process, chemical or detergent.

There are many questions to be asked, (and answered) before starting a façade-cleaning project. Such as: What type of masonry is to be cleaned? What's its present condition? What's the best cleaning method? What is the best detergent or chemical for this building? And, what accidents or damages could happen while cleaning this building?

With all of these questions one important phrase to keep in mind is: "Safe, slow, and low."

- Work **safe**. That means the thinking about the safety of yourself, other workers, pedestrians, vehicles, nearby buildings, and the materials on the building.
- Go **slow** with power washing machines. Start at a low psi and increase pressure slowly.
- Start with a **low** strength of chemicals or cleaners. Dilute them as designated by the manufacturer and work up to stronger solutions, as necessary.

That's "safe, slow, and low."

These are some of the more common types of cleaning problems you'll encounter while cleaning urban masonry buildings:

**Soot** - carbon deposits from, automobile exhaust, manufacturing fumes, furnace or fire smoke, and atmospheric pollution

**Carbonization** - crusty accumulation of carbon deposits

**Staining** - discoloration from water, diluted minerals or rusting metal.

**Guano** - bird excrement



*Paint removal from limestone*



*Cleaned limestone*



*Soot and carbon*

**Graffiti** - unwanted markings.

**Organic growth** - mold and vegetation

**Efflorescence** - powdery salt deposits

## EFFLORESCENCE

Patches of white powder on a masonry building that look like snow might be efflorescence. Pronounced "ef-luh-res-uhns," it is a crystallized mixture of salts. Some salts occur naturally in masonry materials; others are introduced by man (by salting icy sidewalks, for example). Efflorescence occurs when a building gets very wet and the water dilutes salts in the construction materials. When sunlight warms the masonry, the heat pulls the salty liquid to the surface of the building, creating the white powder. The word efflorescence is from the Latin word *efflōrēscere*, meaning to blossom or bloom like a flower. Efflorescence can sometimes be removed by using a dry brush. Other times it's necessary to wash it off. But adding more water could actually cause greater problems, including more efflorescence. Before attempting any method of removal, the water infiltration first needs to be determined and eliminated.



*Efflorescence*

The four most common methods to clean the exterior of a building are:

- water soaking
- pressure washing
- power washing
- paint stripping

### Water Soaking

This cleaning method is used on softer types of stone such as limestone and sandstone. It does not use cleaners or chemicals, only the continual soaking with clean water to rinse away the dirt. This saturation process could take days, or even longer. Usually, a metal bar with holes is connected to a water hose and placed by a wall to provide a continuous spray along a specific wall area. This is a mild cleaning method, but damage can occur if the building envelope has cracks or openings that allow water to seep in and soak interior walls, floors, and ceilings.



*Water soaking*

## Pressure Washing

A common method used to clean city buildings is called pressure washing. This requires a machine that pressurizes tap water and sends it through a hose and an attachment that looks like a rifle. This attachment is called a “wand.” The velocity of water spraying out of a pressure washer is measured in pounds per square inch (psi). Commercial gas powered washers produce up to 3,500 psi, which is considered high pressure. For reference, the water pressure from an average garden hose is about 60 psi. Cleaning starts out at low pressure and increases, as needed. A general rule is that pressure washing should not exceed 300 psi.



*Pressure washing wand*

Care has to be taken by the person operating the wand so as not to damage the building by using too strong a water pressure or holding the wand too close to the masonry surface. This could cause scarring of the surface with etched lines called wand marks.

Pressure washing usually includes a chemical cleaner or detergent that is applied with non-metal “wash down” brushes. Some cleaning materials are caustic: if used incorrectly they are harmful to people and buildings. There are other types that are made of more organic materials and they are considered environmentally friendly. The best cleaning material for the work at hand needs to be selected and used properly.



*Wand mark*

Many types of cleaners are diluted with water at specific ratios. They are then applied to a wet surface, allowed to sit and activate for a specific amount of time before being rinsed off. This time is called a “dwell time,” and it varies according to factors such as temperature, the toughness of the dirt, or the type of staining to be removed.

After the chemical has had sufficient time to work, it is rinsed off and sometimes a neutralizer is applied to counteract the chemicals in the detergent.

Neglecting to use a neutralizer, using the wrong cleaner, or not adding enough water to the cleaner will cause a distinctive discoloration to the masonry which is called a burn. Chemical burning of masonry is not a pretty sight, and it can accelerate the building’s deterioration.



*Chemical burns*

## Power Washing

Power washing and pressure washing are used interchangeably, but some sources use the term power washing to mean cleaning with high velocity hot water or steam instead of tap water. Hot water or steam can remove grease or difficult stains. But this method is not commonly used because of the specialized equipment and the safety precautions required for the use of hot, pressurized water.

## Paint Stripping

The removal of paint from masonry is usually done using chemicals called paint strippers. These come in two basic forms. One type uses a liquid, or gel, that you paint or spray onto the masonry surface, allow to dwell, and then scrub off. The other type involves coating the masonry with a thick gel or paste of stripper that is covered with a sheet of fabric-like paper. The paper remains in place (usually 12 to 24 hours), softening the paint. Then it is peeled off along with layers of old paint. For both types of strippers, the masonry is neutralized with a liquid cleaner, and the loosened paint and excess stripping chemicals are washed off. If the layers of paint are not completely removed, another, or even several, applications are undertaken until the paint is gone.

Most paints used before 1970 contained lead, a substance that is poisonous to humans, and their removal is a potential safety/environmental hazard. The removal of lead-based paint requires the paint and materials removed to be disposed of safely in a special refuse center. Some paint-stripping chemicals are biodegradable or non-toxic, but their use for the removal of lead paint still requires good personal safety practices and proper disposal.



*Paint stripping*

## But Not Sandblasting

Sandblasting uses a pressurized machine to shoot sand at a high speed for stripping or cleaning. It is used to remove paint and corrosion from metals, but it is not recommended for masonry. Sandblasting removes the protective outer surface of brick and stone along with the dirt or paint. This removal exposes the masonry to weather and can accelerate deterioration. Materials such as walnut shells or plastic beads are sometimes used instead of sand. This cleaning method requires care and control, along with special protective wear and additional safety precautions.

When using any of these methods, one question you will continually be asking yourself is, “How clean is clean?” Meaning, at what point do you stop before you start to cause damage? That answer comes with patience, practice, and experience and is learned by always cleaning “safe, slow, and low.”

## Preparations, Precautions and Personal Procedures

Here are a few basic guidelines to consider before starting the cleaning process:

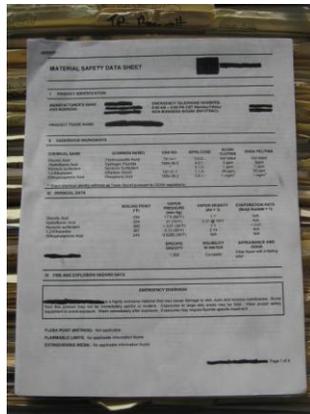
- Safety first. Make sure all precautions are taken to prevent harm to yourself, other workers, pedestrians, vehicles, and the building. Know the cleaners being used and how to operate the cleaning equipment. Some chemicals might corrode or etch metal or window glass. Materials near the cleaning area that might get damaged need to be protected beforehand.
- Read the MSDS and know where this information is stored on site. Read all directions for diluting and mixing chemicals before using them and follow all manufacturers' recommendations carefully. Before starting, a small area should be cleaned as a test panel, to see final results.
- Do not hold the pressure washing wand too close to the building. This will scar and damage masonry with lines called wand marks.
- Be mindful of dwell time requirements
- Cleaning should be done in good weather with temperatures above 40 degrees Fahrenheit. Do not clean in dangerous weather, and never clean alone.



*Test panel*

## MATERIAL SAFETY DATA SHEET

A Material Safety Data Sheet, commonly known as an MSDS, is a one or two page document that describes a product, explains its ingredients, and tells how to use it properly. An MSDS also has safety and first-aid information which is vital in case of an emergency or accident. It is an important document to read and understand if working with potentially dangerous substances. These documents should be stored on the work site in a binder for fast and easy access.



*MSDS*

### Façade Cleaning Outfit

Cleaning a building requires proper protection from water and chemicals. Typical personal protection equipment (PPE) for cleaning includes:

- helmet
- goggles/face shield
- jacket
- pants
- gloves
- boots



*Waterproof clothing*

### PRESSURE WASHING MACHINE

These are the parts of a pressure washing machine:

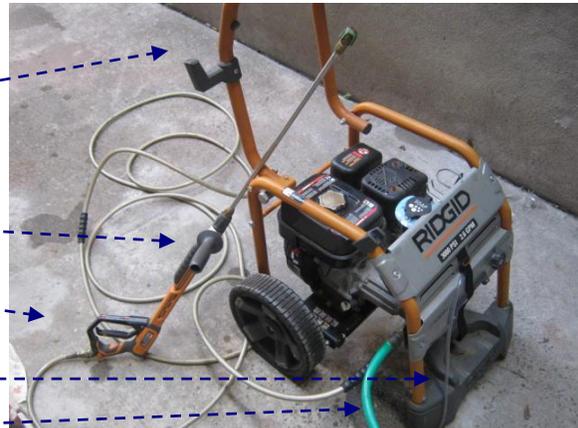
Handle frame for mobility

Wand with pistol-grip

Quick-release connectors for the hose/wand

A chemical injector to apply liquid cleaners

Water hose connection



*Pressure washing machine*

Most pressure washers come with a set of wand tips that control the shape and angle of the water stream.

## The Tools

### Part 9: masonry brush, washdown brushes, and wire brush

These are standard brushes used in masonry work.

Masonry brushes are for sweeping mortar off of brick, block, stone etc. and should be carried in the tool bag at all times.



These are nylon bristle washdown brushes used for cleaning masonry.

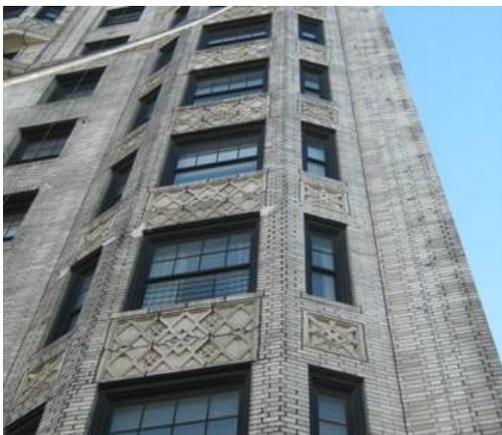


A wire brush is used to remove paint, clean metal, and to scrape mortar off tools and hard surfaces.



### Cleaning: Images Before, During, and After





## People, Places, and Things

### 1968 to 1984

#### People: Who?

- Born in Aachen, Germany, in March 1886.
- Learned the masonry trade from his father, a master stonemason.
- Moved to Berlin, where he worked for an architect and furniture designer.
- Opened his own office and designed one of his most famous structures. Known as the Barcelona Pavilion, it was displayed at the International Exposition in Barcelona, Spain.
- Became director of architecture and design at the Bauhaus school in Germany until it was shut down by the Nazi government.
- Moved to the United States and became head of the Architecture Department at the Armour Institute of Technology in Chicago (later renamed the Illinois Institute of Technology).
- Developed a structural system for skyscrapers that used mostly glass and steel.
- Designed and built many “glass box” buildings, including New York City’s Seagram’s Building (considered a masterpiece of skyscraper design).
- Died in Chicago on August 17, 1969.

#### **Ludwig Mies van der Rohe: stone mason, architect, teacher**

Ludwig Mies (he later added his mother’s name van der Rohe) learned the elements of architecture from his father, a master mason, and by studying medieval churches in Germany. He instructed his architecture students to learn the fundamentals of buildings before trying to design them. He taught them how to build with wood, stone, brick, concrete and steel. Saying “less is more,” he created a minimalist skyscraper design that set the standard for modern cities around the world.



*Ludwig Mies van der Rohe*

#### **Attribute: dedication**

Dedication means the complete and wholehearted devotion to a leader, belief, cause, or career. The word dedication comes from the Latin word *dedicationem*, meaning the giving of oneself to some purpose. But, dedication to whom or to what? How can you be dedicated to your country or its leaders when they are opposed to your ideas and work? How can you be dedicated to your family’s trade and traditions when they are in conflict with your own goals and professional training? As a builder, teacher, and architect, Mies van der Rohe faced these difficult decisions about dedication.

## Strong Inside – Steel Structures

### Steel and masonry

How can city buildings reach such unbelievable heights? In one word: steel. Steel is the most common metal alloy in the world. An alloy is a mixture of minerals or elements. Steel is a combination of iron and carbon forged at great heat. Steel provides a building's structural strength through vertical members (columns) and horizontal members (spandrels or girders). This frame holds up everything built around it, just like a skeleton supports everything in a human body.

Steel girders and columns are designed with great precision into a configuration called an I-beam. An I-beam looks like the capital letter “I” with the horizontal top and bottom parts, called flanges, set atop the vertical center section, called the web.

I-beams are available in numerous sizes, and thicknesses of steel depending on the amount of weight they need to support and the stress they will encounter from wind, snow, and the weight inside the structure. Columns and girders were originally connected by matching holes at the ends, and secured with hot plugs of steel called rivets. The word rivet is from the Old French word *river*, which means to fasten. The rivets were then hammered into place with a gun powered by compressed air. After World War II, rivets were no longer used as steel beams were either welded together or secured with bolts. Both of these methods are faster and require less labor.



*Woolworth Building, New York City*



*I-beam column with rivets*

### Building of the Era

#### The Renaissance Center, Detroit, Michigan

In 1976, Henry Ford II built a new city in the heart of deteriorating Detroit. Called The Renaissance Center, it is a central 73-story tower with four surrounding towers of 39-stories and two with 21 stories. It is the home of General Motors (GM), GM University, a hotel, restaurants, stores and shops.

Critics of the project questioned the wisdom of concentrating so much activity in one part of town. But crowds of people visiting the Renaissance Center have made it a popular tourist attraction.



*The Renaissance Center, Detroit*

### Things: Glass box buildings

Millions of craftsmen were killed during the First World War. Then, before nations could recover from the loss, even more men were killed in the Second World War. When it came time to rebuild Europe again in the late 1940s, generations of talent and experienced tradesmen were gone. Although cities were decimated, the building industry made up for the loss through modern technology. The glass box building was born, and skills required for constructing the buildings of the past, became a thing of the past. The main components of a glass box building, steel and glass, were relatively inexpensive to manufacture, easy to assemble, and did not require apprenticeship training. The buildings could be constructed quickly to speed up recovery from the wars; and for everyone wanting to forget the tragedy of the past, these buildings had a beautiful, sleek and modern look. They became an international symbol of post-war progress and were built by the hundreds in cities around the world. Architects named the design of glass box buildings The International Style, and coined the phrase “form follows function” to describe the idea that the shape of a building should be based on its use, rather than its decoration. But the new function-based design was not without its problems. Though simple in form, glass box buildings were found to be complicated to maintain. Sunlight streaming through huge glass windows required large amounts of energy for heating and cooling. Sometimes one room in an office would be too hot for its occupants, while workers in the adjacent rooms shivered in the cold.



*Glass box building*

### CURTAIN WALL CONSTRUCTION

International Style Architects admired the simplicity and beauty of supporting large glass windows on steel frames along building façades. They used the strength of steel rather than the bulk of masonry to suspend the glass panes “like a curtain wall,” and curtain wall construction became the standard for tall buildings erected after World War II.

But, clear glass offers no protection from viewers, needs to be cleaned often, and the delicate connectors securing the huge, heavy slabs of glass are not as durable as bricks, blocks, stone, and mortar.

Beauty brings its own adversity, or, to use a French term, “vous avez à souffrir pour la beauté,” meaning, “you have to suffer for beauty.”



*Seagrams Building, New York City*

### Things: Waterproofing membranes

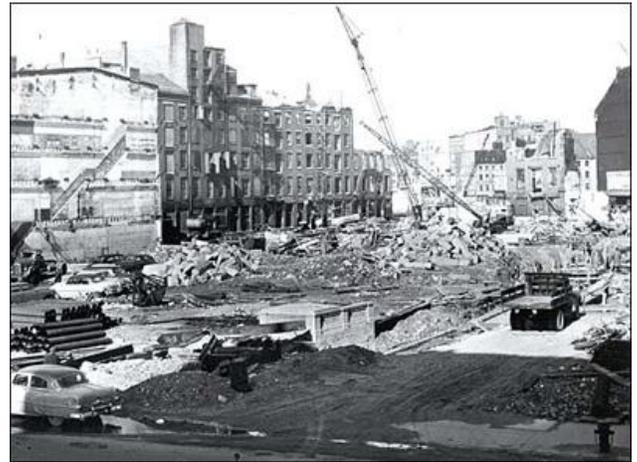
A waterproofing membrane is a sheet of rubber-like material that covers building parts and prevents moisture from affecting steel beams, concrete foundations or other water sensitive building materials. Membranes are attached with a glue-like material called mastic that seals along edges. Waterproof membranes give a uniform layer of protection and are available in a range of colors and thicknesses. It is only noticeable when a building is being constructed or repaired.



*Waterproofing*

### People, Places, and Things: Urban Renewal

In the 1950s and early 1960s, government programs called “urban renewal” spent hundreds of millions of dollars clearing away old inner-city buildings and communities. People were moved from their homes or apartments as the buildings were torn down to be replaced with large housing complexes or interstate highways. Thousands of families were moved into the new high-rise buildings called public housing developments. Public housing means apartments with rent paid in part or whole by the government. It was thought that this “renewal” would improve an individual’s living conditions, self image, self esteem, and behavior to the benefit of the entire city. But it didn’t work out as planned.



*Urban renewal*

One active and vocal critic, Jane Jacobs, wrote a bestselling book entitled, *The Death and Life of Great American Cities*. Using insightful descriptions of the day-to-day workings of a city and its people, she told how the displacement of residents and the destruction of their communities actually increased the problems that urban renewal had tried to solve. It wasn’t long after the book’s publication that urban renewal programs ended.

## Quotes

“Success is going from failure to failure without loss of enthusiasm.”

**Winston Churchill**

“Ask the former generations and find out what their fathers learned, for we were born only yesterday and know nothing, and our days on earth are but a shadow. Will they not instruct you and tell you? Will they not bring forth words from their understanding?”

**Bildad the Shuhite**

“I never see a filthy yard that I do not want to clean it... or a button off one’s clothes, or a grease spot on them or on a floor that I do not want to call attention to it.”

**Booker T. Washington**



## Synopsis

After reading this chapter, you should now have a better understanding or a mental image of the following:

- façade
- water soaking
- pressure washing
- power washing
- dwell time
- efflorescence
- material safety data sheet (MSDS)
- curtain wall
- urban renewal
- dedication

## ACTIVITIES

### 1. Cleaning with bucket and brush

Standard bucket and brush methods are the most popular ways to clean masonry, and can produce excellent results. Here are the steps to follow:

#### Materials:

- safety gear
- waterproof clothing
- wash down brush with long handle
- bucket
- masonry cleaning detergent

#### Procedures:

- Safety First—Read the MSDS product sheet.
- Wear proper protective clothing and safety gear.
- Check the work area: protect or cover metal, glass, or wood surfaces that might be affected by detergent overspray.
- Use a broom to brush the wall surface while it is dry to remove mortar particles.
- Pour measured amount of environmentally friendly cleaning detergent in plastic bucket and dilute with clean, cool water according to the manufacturer's instructions.
- Wet the wall with clean water using a hose or the wash down brush.
- Starting at the top of the wall, apply the cleaning solution with the wash down brush.
- Follow the cleaning manufacturer's recommendation for the amount of dwell time that the solution is to remain on the wall. Scrub heavily soiled areas as necessary.
- Rinse the wall thoroughly with clean water from top to bottom, and make sure all the cleaning solution has been removed.
- Rinse the adjoining sidewalk and direct any runoff away from the wall.



## 2. Pressure washing practice (without detergent)

### Materials:

- pressure washing machine
- waterproof gear

### Procedures:

- Know and follow all safety procedures.
- Always have someone for assistance nearby.
- Read and understand power washing machine operating instructions.
- Attach a low-pressure spray tip on the wand nozzle.
- Attach water hose, turn on water, and keep hose free from kinks.
- Adjust the power washing machine for a low psi.
- Start the pressure washing machine and adjust motor for steady running.
- Never point the pressure washer wand nozzle at anyone for any reason.
- Keep the nozzle at least one foot from masonry surface.
- The wand can stretch 20, 50 or 100 feet from the motor, but it will lose pressure with great lengths.
- Start with the wand inactive and pointing away from the building or sidewalk.
- Keep the gun perpendicular to the wall or sidewalk.
- Pull the trigger and rinse the wall. Start at the top of the wall or end of the sidewalk, working from a cleaned surface to dirty.



## Chapter 10: Maintenance – Care and Repair

### Care: The Need

### Maintenance: Practical Practices and Uncommon Sense

### Repair: The Remedy

### Caulking

### The Tools

Part 10: Caulking Gun

### People, Places, and Things: 1985 to 1999

Len Bias

Attribute: learning from mistakes

Anonymous, New York City, Local Law 10/80

- Architects and Engineers

Warsaw, Dresden and London–Post-WWII and today

Civilian Conservation Corps and MillionTrees NYC

Historic Preservation

### Buildings of the Era

Quincy Market

Boston, MA

- Gargoyles

### Testimonial of Eddy G.

Eddy G., a former Masonry Preservation student, now serving in an internship with the Central Park Conservancy

### Quotes and Lyrics

### Synopsis

### Activities

1. Using a caulking gun
2. Determining masonry hardness



## Care: The Need

*“Public housing is falling apart around the country, as federal money has been unable to keep up with the repair needs of buildings more than half a century old. Over the last 15 years, 150,000 of the nation’s public housing units have been lost, officials said, as agencies have sold or torn down decrepit properties...“The buildings are already there. It’s just a matter of renovation.”*

“Public Housing Repairs Can’t Keep Pace With Need”  
*New York Times*, October 24, 2010



*A city-owned building awaits repair or demolition*

Time, age and weather are some of the causes that contribute to the deterioration, damage or destruction of masonry buildings. These are forces beyond our control to change. But another reason buildings are destroyed is because of “deferred maintenance.” Deferred maintenance means somebody could have taken care of a building, but nobody did.

Having consideration for buildings and respect for the urban environment are meaningful personal attributes. Combining these with the knowledge of construction trade skills and building repair methods provides powerful ways to overcome the deterioration of time and weather. Instead of buildings being neglected for years until they need to be demolished and replaced, they can be maintained regularly and kept indefinitely, with care and repair.

## Maintenance: Practical Practices and Uncommon Sense

In many parts of the world there are buildings that have been around for hundreds or even thousands of years; and they’re still in good condition. That’s because people cared for them, one day at a time, throughout the centuries. They cared for them by maintaining them. The word maintenance is from an Old French word *maintenir*, which means upholding, or providing the necessities of life.



*Maintenance and preservation*

Many countries in Europe have well equipped facilities with training programs and talented teachers to provide instruction for the proper care and maintenance of older buildings. Students, starting at an early age, learn to understand building construction and to respect the people who repair them. Young people have opportunities to explore trades, such as masonry or carpentry, and can choose such a profession as their life long career. Unfortunately, these programs, facilities, experiences and opportunities are almost non-existent for grade school or high school students in the United States. There are no Heritage Centers.



*A Master bricklayer (Mechanic) teaching the trade*

### Repair: The Remedy

The following is a partial list of masonry maintenance items that will help to keep a building healthy and prevent it from suffering a slow, early death. Some of these procedures have been discussed previously. Most of them require nothing more than concern and compassion for the built environment, along with a small amount of common sense.



Don't sandblast bricks.



Re-point open or defective mortar joints.



Use the correct mortar for re-pointing.

Repair cracks before they grow larger and wider.



Re-point or caulk open coping stone joints.

Caulk openings around steel penetrations.



Re-point, but don't caulk, terra cotta mortar joints.

Don't paint above-ground masonry.



Don't let birds damage your building.

Don't use salt to melt ice on masonry.





Keep gutters clean of vegetation and ice.

Check your building often and do maintenance frequently.



Ask a professional about difficult repairs.

## Caulking

One of the fastest, cheapest and easiest repair materials to use is caulk. Caulk is a type of putty packaged in a tube with a long nozzle that is applied with a caulking gun. It is used to fill cracks, prevent water penetration and bond different materials together with a flexible seal. It is also used for weatherproofing and preventing heat loss throughout the building envelope.

Caulking is also a part of the masonry trade, the same as bricklaying and stone setting. “Pointer-Cleaners-Caulkers” are members of The International Masonry Institute. They belong to the Brotherhood of Bricklayers and Allied Craftworkers union. Their work involves cutting and re-pointing mortar joints, cleaning facades and caulking masonry buildings.

Although caulk doesn’t last as long as masonry materials such as concrete or terra cotta, it is an effective way to repair them—even if the repair is only temporary. These are some of the more popular types of caulk used in the construction trades:



*Caulk tubes*

### Acrylic latex

Also known as “painter’s caulk” because it is considered the best type of caulk for filling cracks around woodwork before painting. It is easy to use, cleans up with water, and cures quickly.

### Polyurethane caulk

Highly durable and recommended for sealing different materials such as plastic, glass, concrete or metal. It is used to fill expansion joints along sidewalks and walls, or to fill cracks in masonry. It cures to a tough, yet flexible, rubber-like consistency and is a very durable waterproofing sealant. It is, however, not considered

easy to work with because it strongly adheres to almost anything. It is available in many colors because it cannot be painted and requires a solvent such as paint thinner for cleanup.

### Silicone caulk

Durable, flexible, mildew-resistant, and bonds well with glass, wood, metal or plastic. It is ideal for sealing around bathtubs or sinks. There are two types of silicone caulk. The first, “tub and tile,” or bathroom caulk, has chemicals to prevent mold and mildew and should not be used around areas where food is prepared or stored. The second type is generally considered safe for use on countertops or other food-preparation areas. Silicone caulk is also favored for sealing around doors or windows for weatherproofing. It is usually applied clear but is also available in various colors because it can’t be painted. Silicone caulk is very durable and clean up requires a solvent.



*Caulking*

## **The Tools**

### **Part 10: Caulking Gun**

In 1894, Theodore Witte was issued a U.S. patent for a “puttying tool” to improve the application of putty on window sashes. This was the first caulking gun. It featured the ratcheted plunger rod that is standard on all caulking guns today. Despite its practicality, the invention wasn’t immediately accepted. Today, however, the caulking gun is known and used throughout the construction industry as an invaluable tool to dispense caulk and glue.



*Caulking gun*

These are the parts of a caulking gun:

- barrel
- trigger
- safety
- piston
- cutter
- tube-piercer
- metal ratcheted lever-operated piston

## People, Places, and Things

### 1985 to 1999

#### People: Who?

- Born on November 18, 1963 in Landover, Maryland.
- In high school, at a height of 6' 8", he was considered one of the most dynamic young basketball players in the nation.
- Graduated Northwestern High School in Hyattsville, MD, and attended the University of Maryland on a basketball scholarship.
- An All-American college basketball player, he was the Atlantic Coast Conference Player of the Year in both 1985 and 1986, and considered by many to be one of the greatest college basketball players of the modern era.
- Chosen by the Boston Celtics in their first round of the 1986 NBA draft.
- Attended a contract signing ceremony with the Celtics' coaches and management at Madison Square Garden, New York City.
- Signed a three-million-dollar contract with Reebok Sports.
- Drove his new sports car back to the University of Maryland to celebrate.
- In the early hours of the morning of June 1, 1986, he was pronounced dead after a massive heart attack caused by a cocaine overdose.

## Len Bias: outstanding college basketball player

### Attribute: learning from mistakes

During both the 1985 and 1986 college basketball seasons, Len Bias was compared to Michael Jordan of the Chicago Bulls. Bias was drafted by the defending NBA champions, the Boston Celtics, and was expected to build his own legend with the team.

Three days after being drafted, Bias spent the night partying and snorting cocaine until his heart failed. Len Bias is considered by sportswriters to be one of the greatest basketball players to never play at the professional level.



*Remembering Len Bias*

“From errors of others, a wise man corrects his own.”

**Publilius Syrus**

## Decision

A decision is the act of reaching a conclusion or making up one’s mind. It also implies a firmness of character. It is from the Latin word *decide*, meaning to cut off. Making a decision is selecting a course of action amongst several alternatives. Every decision will produce a final choice. Sometimes it is a life or death decision.

## People: Anonymous

### New York City, Local Law 10/80

In the spring of 1980 a young New York City college student (anonymous) was walking down the street when a piece of a building fell and struck her on the head. She died instantly and the City Council enacted a law that required the street façade of all buildings, six stories or taller, be inspected every ten years. It was called Local Law 10/80 and it required an Architect or Engineer to file a report on the condition of the building with the New York City's Department of Buildings. If any hazardous conditions were found during the inspection, they had to be addressed immediately. Other less hazardous defects identified also had to be corrected before the next cycle of inspection.



*Result of a hazardous condition*

In the years following, the law was revised to require an inspection every five years of all façades; including a “hands-on” review of the street facade from scaffolding. Boston, Chicago and Philadelphia have similar laws requiring routine building inspections, but many cities still have no such safety requirement for a mandatory building inspection.

## ARCHITECTS & ENGINEERS

Architects are usually thought of as being concerned with the design, style, and appearance of a building. Engineers are considered the experts in plumbing, heating, electrical, and structural components. However, they both evaluate, design, and maintain buildings and building systems. It is their professional responsibility to provide safe, visually pleasing, and well-functioning spaces for working, playing, and living.

Civil engineers specialize in the construction or repair of large-scale projects that benefit the public, such as tunnels, bridges, highways, water treatment facilities, and sewage plants. Mechanical and electrical engineers design or improve mechanical systems such as heating, air conditioning, and elevators. Structural engineers design or improve buildings, focusing on beams, columns, floors, and the exterior envelope.

The title “Civil Engineer” was first used by an 18<sup>th</sup>-century British inventor, builder, and engineer, John Smeaton. Since ancient times, the design and construction of forts or other large defense centers had been undertaken by professional military engineers. Then, in 1768, Smeaton, who was not in the military, used a term to identify his profession as different from that of the military engineers. Because he was a civilian working on public projects, he began calling himself a ‘civil engineer.’

One of Smeaton’s most famous projects was the Eddystone Lighthouse in the English Channel, constructed in 1757-1759. It was recognized for its remarkable design, innovative use of materials, and structural engineering. On a clear day, its light was visible for 17-and-a-half miles.



*Eddystone Lighthouse*

Places: Warsaw, Dresden and London—Post-WWII and today



*Destroyed in 1945*

**Warsaw, Poland**



*Old Market, rebuilt*



*Frauenkirche ruins, 1990*

**Dresden, Germany**



*Frauenkirche, reconstructed*



*The Blitz of 1940*

**London, England**



*Revitalized buildings at St. Paul's Cathedral*

## Things

### Civilian Conservation Corps

The Civilian Conservation Corps (CCC) was a government program put into action to combat unemployment and poverty during The Great Depression. From 1933 to 1942, the CCC planted an estimated three billion trees to renew decimated forests. They also built new roads, strung telephone lines, constructed buildings, bridges and dams, and improved millions of acres of government-owned parks. They provided communities with flood control, fire protection and community safety, and bolstered local economies. More than three million men, including over a quarter million African Americans, served in the Civilian Conservation Corps. It was one of the most successful programs of the Great Depression and left a legacy across the United States that still remains today, in forests, roads, bridges and preserved historic buildings.



*Civilian Conservation Corps*

### MillionTreesNYC

An effort of local government agencies, neighborhood groups, corporations and citizens, MillionTreesNYC aims to plant and maintain one million new trees throughout New York City. By planting one million trees, the city will grow an urban forest to will help cool streets and sidewalks, clean the air and encourage neighborhood revitalization. The program provides education and training for students interested in learning more about urban agriculture.



*MillionTrees*

### Historic Preservation

New York City's Penn Station was a palace-like structure of carved stonework that was built as a showpiece for the Pennsylvania Railroad. It was demolished in 1964 to make room for a building that looked "more modern." After it was gone, people realized they had lost a treasure that could not be replaced. Concern grew into distress as other important buildings were being threatened with demolition.



*Penn Station*

This event is what many believe sparked a nation-wide effort in the United States for “historic preservation.” Historic preservation is a way to protect buildings, objects, and artifacts that have historical significance. Sometimes older parts of a city are designated as “historic districts,” and are protected by law to maintain their historic character. This in turn encourages revitalization, which brings in new businesses, tourists, and visitors to stimulate economies that otherwise would have remained stagnant.

History is a part of remembering. When a city’s older buildings are neglected or allowed to deteriorate and have to be torn down, part of our past and a piece of our collective memory disappears. Older buildings that are maintained and survive show a worth that only age and endurance can exhibit. The loss of aged buildings allows us to forget the sacrifice and hardships of the people who lived in them. The profound lesson learned from the destruction of Penn Station is that elderly buildings are to be remembered, not discarded. They deserve the honor and respect they earned through their years of survival.

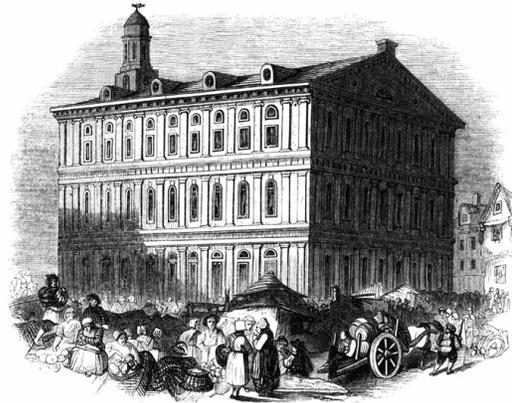
## Building of the Era

### Quincy Market, Boston, MA

In 1826, Quincy Market was built along the Boston waterfront for merchants and shoppers. It was designed in the popular Greek Revival style and named for the Mayor, Josiah Quincy. The market was a vital business hub until the mid-1900s, when the deteriorated buildings were neglected, then abandoned.

In the early 1970s, Quincy Market was scheduled for demolition, but a committed group of Bostonians sought to preserve the dilapidated structures. The renovation was the first commercial urban restoration project of its kind and it changed the entire city of Boston. Its success also spawned imitations that changed and preserved older sections of cities across the United States.

Known today as Faneuil Hall Marketplace, it is still a central gathering place with unique shops, restaurants and outdoor entertainment areas that attract more than 18 million visitors annually.



*Faneuil Hall*



*Quincy Market*

## GARGOYLES

Gargoyles are imaginative carved figurines positioned around the tops of buildings. They are a prominent architectural fixture along European cathedrals. Gargoyles are more than mythical figures; they are an integral part of the structure's design as they direct water off the roof, out of their mouths and away from the building.

The word gargoyle comes from the Old French word *gargouille* meaning throat. It is the same word origin for the word gargle.



*A gargoyle*

### Testimonial of Eddy G.

A Masonry preservation student of the year 2011, Eddy G. is an intern at the Central Park Conservancy in New York City.

*“Masonry preservation taught me things I would have never known about. Things like history and integrity. History is important to learn with masonry. It gives you a complete background of what masonry is all about.”*

### Quotes and Lyrics

“A man can do nothing better than to eat and drink and find satisfaction in his work.”

**King Solomon**

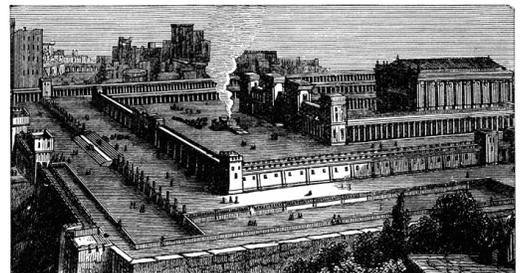
“If a man is lazy, the rafters sag; if his hands are idle, the house leaks.”

**King Solomon**

A description of workers repairing Solomon’s Temple:

“They purchased timber and dressed stone for the repair of the temple of the Lord, and met all the other expenses of restoring the temple... They did not require an accounting from those to whom they gave the money to pay the workers, because they acted with complete honesty.”

**The Prophet Jeremiah**



*Solomon's Temple*

“I’m Working on a Building”

**Lillian M. Bowleses (lyrics) Winifred O. Hoyle (music)**

In the long, rich tradition of African-American Gospel music, the theme of some songs can have multiple meanings. This one, recorded by The Blackwood Brothers, The Carter family, Elvis Presley, BB King, and many others, tells about the construction or repair of a building...or does it?

I’m a working on building  
I’m a working on building  
I’m a working on building  
For my Lord, for my Lord

It’s a Holy Ghost building  
It’s a Holy Ghost building  
It’s a Holy Ghost building  
For my Lord, for my Lord

If I was a liar I tell you what I would do  
I’d quit my lying and work on a building too

If I was a drunkard I tell you what I would do  
I’d quit my drinking and work on a building too

If I was a gambler I tell you what I would do  
I’d quit my gambling and work on a building too

If I was a preacher I tell you what I would do  
I would keep on preaching and work on a building too



*Working on a building*

## Synopsis

After reading this chapter you should now have a better understanding or be able to identify the following:

- maintenance
- caulk
- historic preservation
- reconstruction
- The Great Depression
- CCC
- Local Law 10/80
- gargoyle
- decision

## ACTIVITIES

### 1. Using a caulking gun

#### **Materials:**

- caulking guns
- acrylic latex caulk
- knife
- nail or awl
- laytex painters' tape
- household rags
- caulking slickers



#### **Procedures:**

- Clean the area to be caulked by removing dirt, loose paint, and old caulk, and be sure the area is dry before you begin.
- Sand edges of area being caulked, if necessary, and use a small brush or old paintbrush to sweep away dust.
- Load a tube of caulk into a caulking gun, making sure it's well seated at both ends.
- Use a utility knife to cut the tip of the spout. Cut off as little as possible, taking into consideration the size of the 'bead' of caulk you need. Cut the spout at an angle.
- Check to see if there is a second seal at the base of the long spout. Puncture it with a nail or piece of wire. (Some caulking guns have a tip cutter and a puncturing device.)
- Hold the gun at a 45 degree angle at the top of the crack to be filled.
- Slowly squeeze the trigger and pull the gun down, pressing it along the crack for a continuous bead of caulking.
- Use your finger to gently press the caulk into the corner or crack, followed by a damp rag to clean off the excess caulk.



## 2. Determining masonry hardness

This system can be used to roughly determine the hardness of bricks and mortar. Similar to Mohs' Scale of Mineral Hardness, it ranks brick and mortar from softest to hardest on a scale from 1 to 10: the higher the number, the harder the masonry. It also provides a numerical way to communicate the severity of masonry deterioration that otherwise could only be described by words or images. Try the system using a mason's hammer, a cold chisel, and a slotted screwdriver, without dramatic feats of strength. Tested areas will need to be repaired afterwards.



### Brick Assessment

- 0 - The bricks have totally disintegrated
- 1 - The brick face has spalled  $\frac{1}{4}$  to 3 inches and the surface remaining can be scratched with the finger
- 2 - Bricks have an intact face with rounded edges
- 3 - The bricks are spalling in scaly layers that can be pulled apart by hand
- 4 - Bricks cannot be scratched with the fingernail, nor crumbled by hand
- 5 - The screwdriver carves into the surface of the brick approximately  $\frac{1}{4}$  inch
- 6 - The screwdriver must be driven in with the hammer to make the  $\frac{1}{4}$  inch indent
- 7 - The screwdriver no longer penetrates
- 8 - The chisel is needed to crack the brick
- 9 - The chisel makes no indentation, but sheers brick
- 10 - A brick with no deterioration having recognizable facial qualities



### Mortar Assessment

- 0 - No evidence of mortar within at least 1 to  $\frac{1}{2}$  inch of the wall face
- 1 - Sand-like mortar crumbles when poked with finger or screwdriver
- 2 - Mortar is easily removed with screwdriver but joint face is intact
- 3 - Mortar collapses cleanly and breaks adhesion from brick when scored with screwdriver
- 4 - Mortar pops out with slight spalling at brick edges when tapped with screwdriver
- 5 - Screwdriver does not dislodge mortar; chisel removes mortar without brick damage
- 6 - Brick edges and corners are slightly marred when mortar is removed with chisel
- 7 - Successive hammer blows to chisel are necessary to dislodge mortar, brick is intact
- 8 - Successive hammer blows dislodge mortar, marring brick edges
- 9 - Mortar is stronger than the brick; hitting mortar with hammer and chisel crack brick
- 10 - Successive blows with hammer and chisel damage the less durable brickwork

*Mr. Russack's system has the potential for allowing masons involved in building conservation and preservation to communicate the condition of any brick with a high degree of consistency under the Russack hardness system.*

**Elliot O. Edwards Jr., U.S. Army Corps of Engineers**

Results following masonry testing at Factors Walk Retaining Wall, Savannah, Georgia

## Chapter 11: Up on the Roof

### Roofing and Masonry

#### Roof Materials:

Clay tile, standing seam metal, slate  
Slate shapes

#### Bituminous Roofs:

Built-up or hot-mopped  
Modified bitumen or torch-down  
EPDM

Cold fluid applied roofing systems  
Roof maintenance

#### Masonry and Roofs:

Parapets, flashings, coping and chimneys

- Height Safety: Certificate of Fitness

#### Concrete Repairs:

Preparation, repairing cracks, repairing spalls, addressing corroded rebar

#### The Tools

Part 11: Mason's ruler

#### People, Places, and Things: 2000 to 2011

William "Refrigerator" Perry  
Attribute: perseverance  
Urban homesteading

#### Buildings of the Era

Montgomery Plaza  
Fort Worth, TX

#### Quotes and Lyrics

#### Up on the Roof

#### Synopsis

#### Activities:

1. Repairing concrete cracks
2. Repairing concrete spalls
3. Installing a faux cold fluid applied roof membrane



## Roofing and Masonry

You might be wondering, “What do roofs have to do with masonry?”— a lot, actually. There is a London Guild called “The Worshipful Company of Tylers and Bricklayers.” Tylers are installers of clay and terra cotta roofing tiles. Tylers, or roofers, have been part of a masonry guild for over five hundred years. Today they are still considered to be trade brothers of bricklayers.

Clay or terra cotta tiles were used by the ancient Greeks to drain water from roofs. When European settlers came to the American colonies, they brought their construction methods with them, including different types of roofs. Clay roofing tiles, common throughout England, France, Holland, and Spain were used in Boston, Jamestown, Saint Augustine, and the missions of California. Before it became New York, the Dutch colony of New Amsterdam had a roofing tile industry along the Hudson River. The English word roof is from the Dutch word *roef*, which means roof.

Wood-shingled roofs were commonly featured on early American houses because they required less structural support, and the materials were abundant and less expensive. But roofs of clay tile were a necessity for fire protection on the city houses, built close together. Clay or terra cotta materials provided that defense, along with better protection against wind, rain, and snow. These features made them the preferred urban roofing material centuries ago, and tile roofs are still seen today in cities worldwide.

## Roofing Materials

### Clay tile

Clay tiles can be flat, curved or arched, and designed to overlap or interlock. Roofing tiles are usually dark orange or red in color. If properly maintained, they can last up to 100 years. Although durable, they are heavy and require a sturdy structural support system. They usually require some form of sub-roofing underneath, or additional waterproofing like a bituminous membrane or a cementitious coating. Some kinds of tile, such as the barrel shapes, were laid over vertical strips of wood and fastened with copper wire.



*Spanish roofing tiles*



*English clay roofing tiles*



*Flat clay roofing tiles in NYC*

### Standing seam metal roof

A standing seam roof is a series of metal panels set vertically along a steep pitched roof. They are attached to the underlying roof surface, and then joined together by clenching and bending the ends over to form the standing seam. They shed ice and protect against wind better than shingled roofs. Aluminum and galvanized steel are the least expensive metals used, but copper is the most preferred because it has a life expectancy of a century or more. The metal is usually coated for greater durability and can be of any desired color.

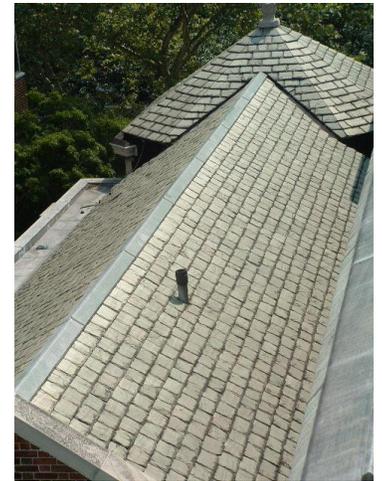


*Standing seam roof*

### Slate

Slate is a common roofing material in colder climates because it can endure up to a century's worth of weather and wind. It is typically black, gray, or green, but there are some red varieties that are used mostly for decorative patterns.

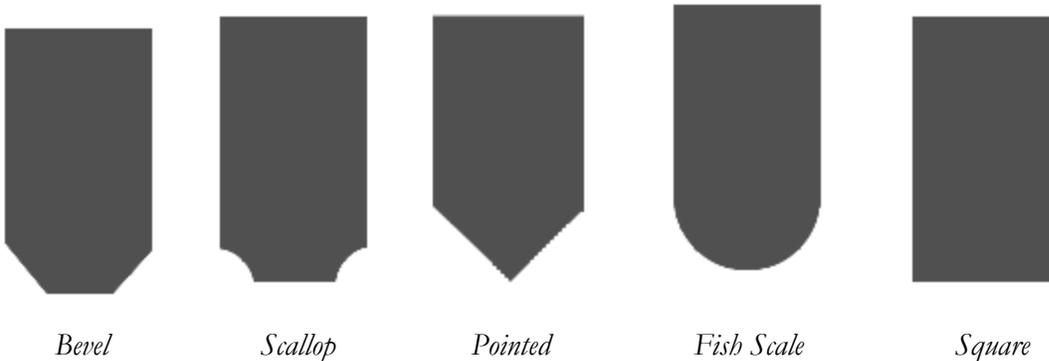
Slate is very heavy and requires additional roof reinforcement to support the weight. Although durable, it requires maintenance as gets older. Slate was a common roofing material and was installed by professionals called "slaters." There are still many slate roofs, especially in New England and Pennsylvania, but slaters are becoming less common. Slate is also being replaced with synthetic materials that have a slate-like appearance and require less skill to install.



*Slate roof*

### Roof slate shapes

Slate not only comes in different colors, it is often cut into different shapes to make decorative patterns. The shapes are along the bottom edge that is most exposed to the elements. Here are a few of those patterns:



## Bituminous Roofs

Because city roofs tend to be flat, shingles are not the most common type of urban roofing material. Historically, first coal tar, and then oil-based products, were used on city roofs to shed water and protect buildings from the elements.

The most common urban roofs today include:

- built-up or hot-mopped bitumen
- modified bitumen
- EPDM

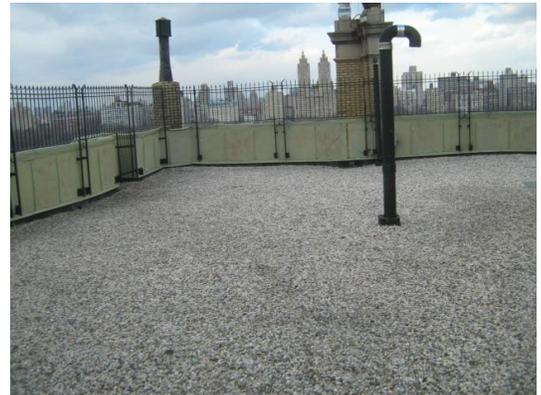


*Flat urban roof*

## Built-up or hot-mopped

A built-up roof or hot-mopped roof consists of layers of roofing membrane laid atop each other with hot asphalt spread in between. The hot asphalt is applied with thick, heavy mops; hence the name, “hot-mopped.” Asphalt is tar made from processed crude oil that is mixed with an aggregate like sand or fine gravel. Another word for asphalt is *bitumen*.

The membrane used for hot mopped roofs looks like tar paper, but it’s reinforced with glass fibers or polyester for extra strength. Roofing membranes are also called “felt,” and they are packaged in rolls. The rolls are laid flat on a roof and coated with melted asphalt heated to about 400°F in a large kettle. A typical built-up roof consists of four layers of asphalt and three layers of felt—with the asphalt providing the waterproofing, and the felt providing reinforcement. To protect the roof from ultraviolet sun rays, which will cause it to shrink and crack, the roof surfacing is usually covered with a layer of gravel which is also known as the “aggregate.” Larger stones are known as “ballast.”



*Hot-mopped roof with aggregate*

### Modified bitumen or torch-down

A modified bitumen roof is basically a built-up roof manufactured with all the elements combined into the membrane and applied onto a roof with a torch. Here is how it is applied:

Rolls, about three foot long, of what appears to be tar paper are hoisted up onto a roof deck. A flat roof that does not yet have a membrane is called a “deck.” The rolls are modified bitumen roofing. They are positioned correctly and then kicked out flat onto the deck while being heated with a portable propane torch. The heat from the torch melts the asphalt and other materials in the roll and attaches it to the roof deck. Usually two layers of modified bitumen are laid down, with the bottom one having a smooth surface, and the top one having a mineral surface that looks like large grains of sand. The mineral, or granulated surface, protects the membrane from ultraviolet sun rays.

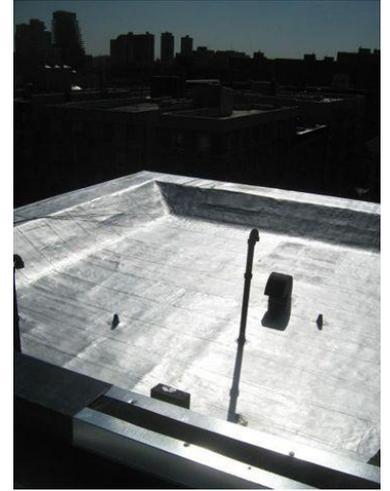
Another way of protecting the top layer, instead of having a granulated surface, is to coat a smooth membrane with a shiny aluminum-based paint. The coating, called “aluminum,” reflects sunlight and prevents the roof from absorbing heat.

### Ethylene Propylene Diene Monomer or EPDM

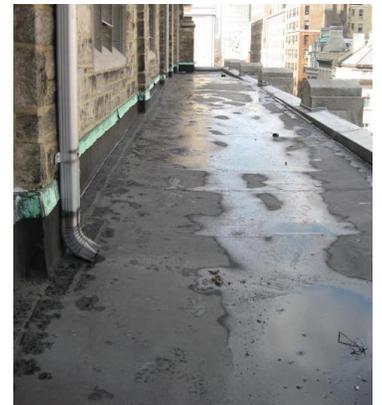
EPDM roofs are sometimes called “rubber roofs” because the materials used give it a “rubberized” quality. Those materials are ethylene and propylene, which are processed from oil and natural gas. EPDM is attached to the deck in large sheets which can be installed quickly. Proper installation is necessary to prevent the large sheets from being pulled away in heavy winds.

### Cold fluid applied roofing systems

A relatively new type of roofing uses a liquid adhesive instead of asphalt. The thick, gooey liquid is called “resin,” and it is applied with paint rollers over a roof deck. Then a layer of fabric called “fleece,” made of fiberglass and other materials, is laid over it, absorbing the liquid. More resin is applied, forming a unified, seamless covering. Additional layers are applied with sand or other fine aggregates broadcast (meaning spread out) for a protective covering along the topmost layer. The installation requires no heat, hence the name, “cold fluid applied roofing.” This type of roofing is durable, easy to install, and it does not use asphalt— which must be melted in a kettle during installation. Cold fluid applied roofs protect flat roofs with a tough, watertight surface that allows for innovative possibilities such as “green roofs.”



*Aluminum coating*



*EPDM roof*

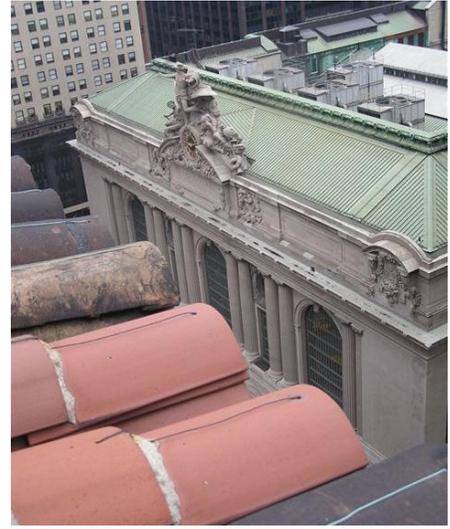


*Cold fluid applied roof*

## Roof maintenance

Roofs are supposed to stay watertight. That is their primary, and most important, function. Replacing a roof is a time-consuming and expensive endeavor, so a great deal of care should be given for its upkeep and maintenance. A routine maintenance program should include regular inspections, the immediate repair of any damages, and a regular unclogging of drains.

A roof is only as good as its materials, installation, maintenance, and warranty. A “material warranty” is a guarantee from the manufacturer that the roofing materials used won’t fail for a certain number of years. But a roof’s warranty will not be considered valid if there is inferior workmanship during its installation or any damage, defects or neglected maintenance along the perimeter masonry walls.



*Replaced clay tiles*

## Masonry and Roofs: Parapets, flashings, coping and chimneys

There are miles of protective walls along city roof perimeters. These walls are called parapets. The word parapet is a military term, derived from the Italian word *parapetto*, meaning a chest-high wall for defense. Parapet walls are typically made of brick or block and because of their exposure to the elements, they usually require more attention than other walls below. Because they intersect with the building’s roof, they also require a system of flashing to attach the vertical parapet to the horizontal roof.



*Parapet*



*Cap flashing being installed*

There are two types of flashing on a parapet wall: base flashing and cap flashing. Base flashing is roofing material and it looks like part of the roof curving up onto the wall. Cap flashing is a strip of metal inserted into the parapet masonry to protect the top edge of the base flashing.

Flashing is also used around chimneys and other roof fixtures to prevent water intrusion. Because of movement between the vertical and horizontal walls, flashing systems are vulnerable and can cause leaks if they are not installed or maintained properly.

Copings are covers designed to keep water out of, and away from, parapet walls. They are usually made of stone, cast stone, or terra cotta. The word coping comes from the Medieval Latin word *cappa*, meaning cap. Copings are wider than a parapet so that they overhang on one or both sides and allow water to flow off then away from the parapet.



*Copings*

Chimneys vent smoke and fumes from a building's boiler or heating system. The word chimney is from the Greek word *kaminos*, meaning fireplace or oven. Chimneys are often made of brick and lined with sections of terra cotta for fireproofing. The terra cotta lining inside a chimney is called a "flue." The word flue is from the Old French word *fluie*, meaning stream. Some city apartments still have fireplaces—more for atmosphere than heating—and each one has its own separate chimney flue to carry smoke away. The upper sections of chimneys receive the most wear and deterioration as the masonry is in contact with both hot gases and cold air. Sometimes specialized metal caps are installed atop chimneys to help the smoke and fumes exit.



*Chimney and caps*

## Concrete Repairs

A replaced roof is only as good as the surface it's applied to. Since many flat roof decks are made of concrete, the concrete must be in excellent condition, or repaired to that condition, before installing a replacement roof. If the concrete repairs are not addressed correctly, the life expectancy of the new, replacement roof will be limited. Some defects to look for once an old roof is removed and the concrete slab is exposed are: cracks, spalls, and corroded reinforcing steel.

### Preparation

Most concrete repairs fail because of poor surface preparation. All defective concrete must be removed and this can be done with high-pressure water, grinding and scarifying machines, or the old-fashioned jackhammer. Care must be taken when using any of these methods; but with jackhammers; there is also a possibility of creating additional smaller cracks called "microcracking".



*Cracked concrete*

## Repairing Cracks

Cracks in concrete can be injected with epoxy to restore strength, but some are filled with caulk to allow flexibility and movement. For epoxy injection repairs, the crack is cleaned by vacuuming or flushing with water, allowed to dry, injected with epoxy and sealed with a gel to prevent the epoxy from running out. Caulking also requires a thorough cleaning and drying of the crack. Then a sponge-like rope called “backer rod” is set into the crevice and it gets covered with caulking that is pressed in or allowed to settle and cure.

### HEIGHT SAFETY: CERTIFICATE OF FITNESS

Operating motorized scaffolding equipment that climbs along the outside of a building is dangerous work. Besides courage, a skilled mason in New York City is required to carry with them a card called a “Certificate of Fitness.” This means the holder has passed a series of tests and is capable of working on pipe staging and operating electric motorized platform rigs.

The same skills and knowledge that translate to safe work on vertical surfaces are useful for working on flat or pitched roofs one hundred or more feet in the air. The key words for such work are caution, awareness and most of all, safety.



*Safely working scaffolding*

## Repairing Spalls

Spalling is the flaking or crumbling of a concrete surface. It occurs due to water damage, the freeze-thaw cycle, or a poor installation (usually because the concrete was poured when the temperatures were too hot or cold). Excessive use of salt to thaw ice will also cause spalling. Spalling concrete can be repaired by removing the damaged areas and replacing them with a special concrete repair mortar. This mortar is similar to the material used to repair stone. For concrete repairs, it is often recommended that the mortar should not be “feather edged.” Feather edging is thinly spreading out the mortar along the edges of the opening to meet the level surface of the surrounding concrete. The entire patching area should be cut square and prepared deep enough to allow the new material to form a firm bond.

## Addressing Corroded Rebar

When rusted, corroded or otherwise deteriorated rebar is uncovered, the concrete around it is removed to provide at least  $\frac{3}{4}$  inches clearance on all sides. If you can put your



*Concrete repair with new rebar*

finger around it, you've got the right clearance. The steel is then cleaned completely to remove all rust, or if it is significantly deteriorated, it must be removed and replaced.

Replacement is done by welding new rebar to the old or by securing it into a drilled hole filled with epoxy, then attaching it to the existing rebar with wire.

The exposed, repaired or replaced rebar is then coated with a rust-prohibitive paint and new concrete is poured into the square-cut opening, or it is patched with repair mortar.

## The Tools

### Part 11: Mason's ruler

The mason's ruler is a measuring instrument, made of wood with brass hinges, which folds at about 8-inch increments. It has standard marking of feet and inches on one side, and lines with red and black numbers on the other side. Those markings on the back side help to determine a wall's height in individual courses (black numbers), and total number of courses necessary (red numbers) to reach a determined height.



*Mason's ruler*

If a wall needs to be built to a specific height, the spacing ruler is used to “hit” that height with the correct number of brick courses and uniformly sized mortar joints. Here's how it works:

- Suppose you wanted to build a wall with standard brick and there's a window opening  $49 \frac{1}{2}$  inches above the ground. How many brick courses would you need to hit that opening?
- Standard bricks are designed so six courses and six mortar joints of  $\frac{3}{8}$  inch equals 16 inches.
- You measure up with the front side of the ruler.
- Hold  $49 \frac{1}{2}$  inches in place and look at the back side of the spacing ruler.
- You find a mark with the numbers 6 in black, and 18 in red.
- Every course of brick you lay should hit the marks that have the black number 6.
- The red number 18 indicates the number of brick courses you'll need to hit the height of the window opening.

## People, Places, and Things

### 2000 to 2011

#### People: Who?

- Born in Aiken, South Carolina.
- Played football at Clemson University, winning the National Championship his freshman year.
- Was selected in the first round of the 1985 NFL draft by the Chicago Bears.
- As a defensive lineman, the 6-foot, 2-inch, 382-pound rookie was named “The Refrigerator” or “The Fridge.”
- The Chicago Bears won 16 out of 17 games and beat the New England Patriots in Super Bowl XX.
- The game was a rout for Chicago, but also memorable, as this large rookie scored a touchdown from the one-yard line.
- Fans remember his song and dance with teammates: “The Super Bowl Shuffle.”
- After 8 more years with the Bears, played with the Philadelphia Eagles, and the London Monarchs of the World League of American Football; delved into professional wrestling and boxing.
- Returned to Aiken, South Carolina, and started working with a masonry contractor; then started his own masonry construction company.
- After battling alcohol addiction, he was recently stricken with Guillain-Barre syndrome, a disease that affects the nervous system. He was hospitalized for nearly half a year but is recovering.



“Refrigerator” Perry

#### **William “Refrigerator” Perry: professional football player, masonry contractor**

“You put up six scaffolds, then lay brick all day in 100-degree heat. We’ll see what kind of shape you’re in.”

**William Perry**

#### **Attribute: perseverance**

To persevere means remaining dedicated to a purpose, idea, or task through all obstacles and discouragement. It comes from the Latin word *perseveres*, meaning very serious.

## People, Places, and Things

### Urban Homesteading

Urban homesteading is the act of taking available city space, (be it a vacant lot or an apartment balcony) and turning it into a productive garden. It's getting "back to the land" when there is very little land available.

Besides gardening, urban homesteading may include a lifestyle of cooking from scratch, canning and freezing organic foods, stocking the pantry when fruits and vegetables are in season and reducing energy consumption.

Urban Homesteaders support local farmers who bring produce into the city's community or farmer's markets or pick their own fresh fruits and vegetables at nearby farms.

Urban Homesteading is a growing movement of urban families who want to live healthier and work with others in their community for a more meaningful way of life. It is an adventure in practicality for those who love the city and want to improve it; one green, square foot at a time.



*Urban gardeners*

### Building of the Era

#### Montgomery Plaza, Fort Worth, Texas

Built in 1928 as a Montgomery Ward retail store, this Mission Revival style mail-order center was once the largest building in Texas. It survived floods and tornadoes, but not the economic downturn that closed the building in 2001. It was "re-born" two years later to become a center for fine dining, sophisticated shopping, and luxury condominiums. It is located near Fort Worth's Cultural District, renowned museums, the Will Rogers Center, and the Trinity River parks.



*Montgomery Plaza*

Mission Revival style represents the heritage of the southwest United States.

Some of its architectural characteristics are:

- walls built to look like adobe
- earth-colored stucco
- flat roofs
- rows of log-like beams that protrude through exterior walls
- recessed windows

## Quotes and Lyrics

“Our greatest weakness lies in giving up. The most certain way to succeed is always to try just one more time.”

**Thomas A. Edison**

“Success is going from failure to failure without loss of enthusiasm.”

**Winston Churchill**

“The man who never made a mistake never made anything.”

**Gerard Lynch**

### Up on the Roof

“Up on the Roof,” a song written by Gerry Goffin & Carole King, was recorded by The Drifters in 1962. It was a very popular “rhythm and blues” song representing the urban dream. James Taylor made it a hit again in the 1970s. It became an anthem of hope when he sang it at a concert for New York City following the September 11, 2001 terrorist attacks. Here are the lyrics:

When this old world starts getting me down  
And people are just too much for me to face  
I climb way up to the top of the stairs  
And all my cares just drift right in to space

On the roof it’s peaceful as can be  
And there the world below can’t bother me

Let me tell you now  
When I come home feelin’ tired and beat  
I go up where the air is fresh and sweet  
I get away from the hustling crowds  
And all that rat race noise down in the street

On the roof’s the only place I know  
Where you just have to wish to make it so  
Oh, let’s go  
Up on the roof



*The Drifters*

At night the stars put on a show for free  
And darling, you can share it all with me

I keep a-telling you  
Right smack down in the middle of town  
I found a paradise that's trouble proof  
So if this world starts getting you down  
There's room enough for two up on the roof

Up on the roof  
Everything's all right  
Up on the roof  
Come on baby  
Up on the roof  
Up on the roof

### **Synopsis**

After reading this chapter, you should now have a better understanding or be able to identify the following:

- clay tile
- slate
- bitumen
- allumination
- parapet
- flue
- flashing
- coping
- urban homesteading
- perseverance

## ACTIVITIES

### 1. Repairing concrete cracks

Many city roofs are made of concrete. Concrete cracks. Here are repair methods for filling cracks:

#### Materials:

- caulking gun
- sonolastic caulking
- painters tape
- putty knife
- broom
- brush
- cardboard strips
- duct tape
- razor knife
- dishwashing liquid
- rags
- isopropyl alcohol
- plastic spoon



#### Procedures:

- Use a screwdriver to clean away debris.
- Clean the crack of dirt and debris with a wire and/or painter's brush.
- Do not wash out with water; make sure the repair area is dry.
- Install backer rod.
- Apply painter's tape about 1/4 inch along the edge of the crack. This will provide a straight uniform edge.
- Apply sololastic caulk using a caulking gun.
- Install the caulk along the length and breadth of the crack.
- Press the caulk into the crack with the round part of a plastic spoon. Apply more caulk as necessary and smooth again.
- Remove painter's tape and discard.
- Use isopropyl alcohol to remove excess caulking from hands and clothes.



## 2. Repairing concrete spalls

The following method is used for patching concrete spalls less than 3 inches deep:

### Materials:

- scraper
- chisel (or large slotted screwdriver)
- hammer
- concrete patching mortar
- trowels
- mixing buckets
- water
- brooms



### Procedures:

**Note:** Proper preparation is important to assure a successful repair.

- Use a scraper, chisel (or screwdriver), and hammer to chip away any flakes or loose concrete.
- Clean the crack with a wire brush to remove any dirt and debris.
- Rinse out the cracked area with clean water.
- Mix up a small batch of concrete patching material according to the manufacturer's directions.
- Moisten the area, but do not leave puddles.
- Use a trowel to apply, then smooth, the patching material.
- Mist the area occasionally to prevent it from drying too quickly.
- Allow the patch repair to dry thoroughly before walking on the surface.



## 3. Installing a faux cold fluid applied roof membrane

### Materials:

- flour
- water
- whisk
- green, yellow, and brown food coloring
- CAD paper or remnants of cloth fabric approximately 2x3 feet
- paint brushes and paint rollers
- rags





*Cold fluid applied resin and fleece*

**Procedures:**

- Combine flour and water in mortar pan or wheel barrow using a cooking whisk.
- Add food coloring to obtain the green/gray of cold fluid applied roofing resin.
- Mix and add water or flour to obtain a thick liquid, but not paste, consistency.
- Use the faux resin to reproduce the process used in cold fluid applied roofing.
- Apply to paper or cloth (faux fleece) with rollers and brushes.
- The object is to penetrate the faux fleece membrane completely and to practice applying the thick semi-sticky, resin-like material to sheets of fleece-like paper or fabric.



*Faux resin and fleece*

## Chapter 12: Here Today, Green Tomorrow

### Thinking Green

- LEED

### Old Buildings are Friendly Buildings

### Green = Masonry Conservation

- G-r-e-e-n B-u-i-l-d-i-n-g-s



### What is a Green Roof?

### The Tools

Part 12: The square

### People, Places, and Things: Today into the future

Easy Eddie and Butch: gangsters and heroes

Attribute: courage

Masonry methods and materials of the future

Roofs to farm and walls that grow

### Building of the Era

Chicago City Hall

Chicago, Illinois

### Quotes

### Synopsis

### Testimonial of Lena M.

Lena M. - ADC Youthbuild Student of the Year, 2011

### Activities:

1. Care of masonry tools
2. Growing sedum for green roofs

## Thinking Green

If you live in or travel to a city, look around. What do you see, besides buildings? People, people and more people. Buildings are important, but their main responsibility is to protect people and provide shelter. They do that best by being safe, clean, weathertight and energy efficient.

Buildings that are energy efficient not only protect people against the exterior elements (heat, cold, wind, rain), they also conserve the resources used within it (heating, cooling, electricity) and provide adequate natural resources (sunlight, clean water, fresh air) along with enough energy to keep everything running smoothly.



*Cities are people*

Buildings can do this best by being “green”. The term *green* refers to an intelligent way of designing, constructing and maintaining buildings. It incorporates:

- less wasteful construction methods
- reusing or recycling original building materials
- a resourceful use of local or renewable materials
- planned maintenance using cleaners that are less harmful to the environment

A green building is a multi-level team effort amongst architects, engineers, owners, contractors, maintenance workers and craftsmen. This team also requires knowledgeable masons to help conserve the buildings of yesterday for those who will use them tomorrow.

## Using Energy Efficiently

A building starts to become green through thoughtful ways of using energy efficiently, and practical ideas about conserving natural resources. The purpose of energy efficiency is to reduce the need for fossil fuels such as oil, coal, and natural gas. These fuels can't be replaced or replenished, and their supplies are limited.

There are new technologies that utilize reliable, alternative natural energy sources to reduce the use of fossil fuels. Three that are now being used in cities are solar panels, wind turbines, and geothermal pumps.

Solar panels collect the heat generated by sunlight, while turbines harness the wind; both of these can be used to convert natural power into electricity.



*Solar panel*

Geothermal pumps circulate water collected from below the earth's surface, where the temperature is a steady 50 to 60°F. Circulating this water through a building cools it in the summer and heats it in the winter.

These and other systems are being developed to utilize available renewable resources to meet increasing demand for energy.

### Conserving Natural Resources

These are a few ways to use energy wisely:

- Salvaging and re-using construction materials such as brick, stone, and wood, rather than throwing them into landfills
- Using materials manufactured within 500 miles to reduce shipping and transportation, which requires fossil fuels like gasoline and oil
- Making sure construction materials are durable, and appliances have a long life span. Something built cheaply or poorly will get thrown away and add to the already overwhelming garbage/land-fill problem.
- Conserving fresh water. Holding vats, called cisterns, can collect rain water from roofs for use on home garden plants or to flush toilets.
- Repairing/maintaining windows to reduce heating and cooling loss; and using windows to their maximum potential for day lighting to provide natural heating.
- Using materials made from organic, renewable sources such as cork and bamboo. This reduces the amount of oil and other fossil fuels required to make plastics and other synthetic materials.
- Changing wasteful habits. There are many easy ways to save energy—that are as simple as turning off lights in a room that's not occupied.

### More Green Thoughts and Ways

Green thinking goes beyond creative methods and useful innovations for conserving water, capturing wind, directing sunlight, or salvaging local materials. It includes cost-effective ways to “enhance indoor environment quality,” which means living comfortably by using heating, cooling, and ventilation systems wisely. This not only helps to conserve a building's resources, it lowers the overall cost of energy to help everyone live more comfortably.

The ways a building is maintained, cleaned, and operated also requires important environmental considerations. Products that release unhealthy chemicals into the air—those with volatile organic compounds (VOCs)—should not be used; and an orderly, systematic maintenance program should be undertaken at regular intervals. These practices will provide assurance that every system in a building is running smoothly, works efficiently, and provides maximum energy savings.



*Caulking*

## LEED

L.E.E.D. stands for Leadership in Energy and Environmental Design. It's a system for rating the sustainability and energy efficiency of new buildings, and major renovations of older buildings. Buildings qualify for Platinum, Gold, Silver, or Certified designations according to points earned in these five categories:

- Sustainable Sites
- Water Efficiency
- Energy & Atmosphere
- Materials & Resources
- Indoor Environmental Quality

To get these points, the building's design, construction, materials, maintenance, and performance are taken into consideration, from the planning process through to completion of construction. After occupancy, the building's heating, electrical, ventilation, sewage, and water systems are monitored to keep an account of energy usage.



*Energy conservation training*

## Old Buildings are Friendly Buildings

The word sustainable is from the old French word *sustenir*, meaning to hold up, support, or endure. In the language of green buildings, sustainability means maintaining a structure or system without exhausting natural resources or causing severe ecological damage. The following are a few insights concerning sustainability of the masonry, ventilation and windows of older buildings.

### Masonry

Many older buildings were constructed with masonry for durability and fire safety. Masonry buildings constructed before the development of steel framing in the late 19<sup>th</sup> century have thick walls that store heat in the winter and help keep interiors cool in the summer. These buildings were designed and built by intelligent people who understood the demands of their regional climate and landscape. When restored correctly, an old building's unique features can bring about energy savings by reducing the use of heating fuel in the winter and air conditioning in the summer.



*Flatiron Building, New York City, built in 1902*

## Ventilation

Before air conditioning was invented, most buildings had ways of providing natural ventilation. High ceilings and big windows allowed air to circulate with the help of strategically placed fans. Window shades, awnings, eaves, and overhangs provided shade from the sun while still allowing air to circulate.

## Windows

Many older buildings took advantage of natural light and air circulation with skylights and transoms. Skylights are windows set into the building's roof that provide direct, natural light. Transoms are movable windows above doors, and are designed to allow air movement between rooms.



*Flatiron Building, 2011: 109 years old and aging gracefully*

Large windows can let more sunlight into a room. This light, called natural “day lighting,” helps to reduce electricity used for illumination. Effective use of windows can also help increase comfort by circulating air. Windows typically have two parts, called an upper and lower sash. The word sash is from the old French word *chassis*, meaning a frame or box. Opening the top sash allows warm air to escape. Opening the bottom sash allows cool air to enter. Using windows this way can help to provide “passive cooling,” which is the effective movement of air throughout a building without the use of fans or air conditioning. Opening exterior windows and interior doors can provide passive cooling throughout an entire building through a process known as “cross ventilation.”

With proper maintenance, older windows can maintain their energy efficiency and character, or be made more efficient with the addition of storm windows. Heat loss around windows can also be reduced by repairing gaps, or by using caulk, putty, and other sealants.

## Preservation

The preservation of a building is the ultimate recycling project. Here are a few reasons why:

- Old buildings were often designed to be efficient.
- Preservation maximizes the use of existing materials.
- Preventing demolition decreases the amount of debris going into landfills and reduces new construction waste.
- Preservation uses less energy to manufacture, transport, and install new materials.
- Old buildings were usually constructed with the intent of lasting a long time.

You wouldn't trade in your grandmother for a newer one just because she's old, would you? It's the same thing to be considered when you see a building about to be demolished.

Older buildings have proved their worth because they have held up over time. They've endured; which is exactly what the word sustainability means.

## Green = Masonry Conservation

Suppose you are about to start a masonry restoration project. All of the work items are along the roof and will not need scaffolding. The project includes:

- replacing bricks
- re-pointing mortar joints
- patching the concrete deck
- installing new flashing
- caulking the stone coping joints
- cleaning the parapets
- installing a new green roof



*Green methods for masonry conservation*

Besides installing the new green roof, what else could you do to make this project environmentally friendly, or green?

Here are some suggestions:

**Bricks:** Use salvaged or recycled bricks to replace damaged ones. Be sure they are durable and the right size, shape and color for the project.

**Mortar joints:** Use a vacuum attachment on electric grinders when cutting out the old mortar joints. This keeps dust out of the air, and the collected mortar (now powder) can be re-cycled and used to make other building materials, such as concrete.

**Concrete:** Use materials made no more than 500 miles away. Using local products reduces fuel consumption and carbon emissions from vehicles, and benefits local industries.

**Flashing:** New flashing can be purchased from a distributor who uses recycled metals in the manufacturing process.

**Caulking:** Use caulk that emits low VOCs. The environmentally safe caulk is less harmful to the environment and is as durable as the brands that have harmful ingredients.

**Cleaning:** Use environmentally friendly cleaners and, if necessary, collect and dispose of the used water instead of letting it flow into local sewage systems or waterways.

**Roof:** It is estimated that more than 136 million tons of construction and demolition debris are generated in the United States each year. There are green disposal companies that collect and remove construction debris. Instead of taking it to a landfill, they sort out items that can be reused, and recycle them. These green disposal companies also provide a chart listing the percentage of the materials salvaged, recycled, and reused. Recyclable construction waste on this project might include the old roof.

**Note:** Debris containing asbestos or other hazardous materials would not be recycled or reused, but discarded in an environmentally friendly manner.

## GREEN BUILDINGS

**Green Buildings by the letters.**

This chart provides a few green thoughts



*Natural resources*

**G – Green roofs.** They absorb carbon dioxide and provide oxygen. They also soak up rain water instead of letting it overflow sewers.

**R – Reuse, renovate, restore, resuscitate, and resurrect existing buildings.**

**E – Efficiency.** Using highly efficient heating/cooling systems, lights, appliances, and water-efficient toilets.

**E – Energy.** Use renewable sources – like sun, wind, water, waves, and geothermal.

**N – Natural Resources –** know what they are, and use them with care.

**B – Build with recycled materials and those made nearby.**

**U – Use common sense when selecting construction materials and building designs.**

**I – Insulate ceilings and walls. Use caulk around windows.**

**L – Light.** Use natural day lighting.

**D – Design rooms for multiple uses, for practicality, and versatility.**

**I – Indoor environment quality –** maximum ventilation and light, minimum sound and odors.

**N – Not replenishable –** Understand that the earth has a limited supply of resources.

**G – Geothermal –** A fossil fuel saving heating and cooling alternative.

**S – Sustainable –** To endure.

## What is a Green Roof?

A green roof is the top part of a building that sustains a variety of plant life directly on its exposed surface. It contains especially selected vegetation that can endure heat, draught, cold, wind- and has the ability to soak up rainwater. Its green color makes it look like a field or garden—hence the name “green roof.”

A green roof has vegetation planted in special soil that is installed over a durable roofing membrane. It also has a protective barrier directly under the soil to prevent roots from damaging the membrane. There are two types of green roofs: Extensive and Intensive.

Extensive green roofs have two to six inches of soil. They grow grasses, wildflowers, moss, and a special plant called seedum.

Seedum are hardy plants with short roots and an ability to store a lot of water. They can survive with little nutrition in harsh conditions, including heat or drought. Extensive roofs can be planted in soil like a typical flower bed, or in trays that fit tightly together to look like a field or lawn, but can be moved and rearranged.

Intensive roofs have deeper soil, typically eight to twenty-four inches, and can maintain a greater variety of plants, including vegetables, shrubs and sometimes even trees. The additional work to build these roofs is intensive; hence its name. They require a roofing support system that can hold a lot of weight. They can also require regular maintenance and irrigation depending on the plants and soil depth.

Extensive green roofs usually can't be walked on, and could turn brown during an extremely dry summer; but, they require minimal maintenance and are less expensive than intensive green roofs. Intensive green roofs might be more expensive and require more work, but they can also provide a growing place for fruits and vegetables.



*Green roof*



## Reduce, Prevent and Conserve

Three reasons for installing a green roof are reduce, prevent and conserve:

1. Green roofs **reduce** pollution by turning fumes and gases into oxygen. Urban areas are on average about 10 degrees hotter than surrounding areas due to their dark roofs and streets, a phenomenon called the “heat island effect.” Green roofs **reduce** a city’s heat by absorbing sunlight.
2. Green roofs **prevent** storm water runoff that flows into a city’s sewer system. The green plants absorb 60% to 100% of the rain that falls on them. That **prevents** the contamination and pollution which accumulates on roofs from washing into local waterways.
3. Green roofs **conserve** the building’s energy by providing insulation that prevents heat or cooling loss throughout the year. They **conserve** building materials by protecting the roof membrane from direct weather, sunlight, and freeze/thaw cycles, thereby increasing its longevity.

## The Tools

### Part 12: The square

A square is a flat, metal, L-shaped tool, usually with numbers etched along one face. It is used for marking (or laying out) right angles at the start of a building project, and for maintaining right angles along the masonry at window or door openings during construction. It is also used as a straight edge to check stone work during the cutting process.



*The square*

Sometimes referred to as a “builder’s square” or “carpenter’s square,” it usually measures twenty-four inches by sixteen inches. The longer arm of the “L” is called the blade. It is slightly wider than the shorter arm, which is called the tongue. The outside corner where the tongue and blade meet is called the heel.

The markings on the square help to determine the pitch of a roof and other intricate mathematical calculations.

In Catholic iconography, the carpenter’s square is the symbol for Saint Thomas the Apostle. He is reported to have built a church with his own hands, in Malipur, East India, and is the patron saint of builders.



*St. Thomas symbol*

## People, Places, and Things

### Today into the future

#### People: Who?

#### Easy Eddie and Butch: gangsters and heroes

##### Gangsters

Al Capone was the most fearsome crime boss in Chicago during the 1920s and 30s; and perhaps the most infamous of all gangsters. He was feared because of all the murders, beatings, robberies and other crimes he and his men committed - and because he never got caught.

One reason Capone got away with everything was because he had a very good lawyer, named “Easy Eddie,” who somehow managed to keep his boss out of prison. To show his appreciation, Al Capone took care of his lawyer. Easy Eddie had lots of money, cars, servants, a house as big as a Chicago city block, (his wife had her own car and her own chauffeur). He had everything...except peace of mind.

Easy Eddie was troubled. He had a son he loved very much. Even after giving him all the best things money could buy, it hurt Eddie to think that some day his son would find out that his Dad was a crook. So, Easy Eddie decided he'd do something about it. He would do the right thing. He knew he was risking his life; but having his son look up to him with pride was more important than all the money Capone could give him.

Eddie went to the authorities with Al Capone's tax records, and soon afterwards, Capone was convicted of tax evasion and sent to prison. Easy Eddie knew that his boss would get even. But it was more important to be a good example to his son. One day, as Easy Eddie was walking down a Chicago street, a car pulled up next to him, and a machine gun blast ended his life.

To some, Easy Eddie was a snitch, and he got what he deserved. But that's not what this story is about. This is about doing the right thing, no matter how difficult or scary.

##### Heroes

Years later at the start of World War II, another young man from Chicago, named Butch, was a fighter pilot on an aircraft carrier in the Pacific. While flying a mission with his squadron, he noticed that his fuel gauge was low and that he wouldn't be able to get back to the carrier after his mission. So he radioed the flight leader, and was told to leave the formation and return to the ship.

As he was flying back alone, he saw in the distance a squadron of enemy planes heading towards the aircraft carrier. With all the fighter



*World War II air combat*

planes gone, the ship was now nearly defenseless against a Japanese attack. (From the start of the war the Japanese knew the only way they could win was to destroy all our ships in the Pacific—and we didn't have many. That would force the United States into a quick surrender.) Butch knew he was the only one who could stop these planes.

There aren't many men who would run (or fly) towards nine people who wanted to kill him. But that's what Butch did. He dove right into the formation of Japanese planes. He shot down one... two... three... four, and five. He was going after the sixth when his ammunition ran out. So, he dove at planes trying to clip off a wing, or tail, or anything to stop them. Seeing they couldn't succeed with their attack, the few remaining enemy planes turned around and retreated.

Butch landed on the carrier, but with all the commotion during the attack, no one realized what he had done. It was only after the film in his camera was developed, (fighter planes were equipped with movie cameras to learn more about enemy flying maneuvers) that everyone realized Butch had risked his life and saved the aircraft carrier. Butch became the first American fighter ace of World War II; and for his courage he was awarded the Medal of Honor.

He returned to the United States to receive the medal from President Roosevelt, and all the accolades of a hero. But Butch didn't stick around to become a movie star or a celebrity, even though many wanted him to stay. He returned to his squadron in the Pacific.

Several months after his return, while flying a dangerous night mission, Butch was shot down over the Pacific. He was killed by an enemy's blazing machine gun...the same way his father was killed by a machine gun on the streets of Chicago.

You see, Butch was Easy Eddie's son.

If you're wondering about Butch's last name, there's a big airport in Chicago named after him: it's called O'Hare.

### **Attribute: courage**

The word courage is from the Latin and old French words *cuor*, meaning heart.

Courage is a quality of the heart, which means a person's mind and spirit that enables them to overcome difficult, dangerous, or even deadly situations. It takes courage to do what's right, no matter what the cost, circumstances, or outcome.



*Butch O'Hare*

“Without courage, all other virtues lose their meaning.”  
**Winston Churchill**

## Things: Masonry methods and materials of the future

Some masonry tools have remained unchanged for thousands of years. Others have advanced from a straight line into a laser beam. Here are a few of the innovative tools and materials used on construction sites today, and tomorrow:

Laser Level - Uses a laser beam to assure a level and plumb for wall construction or determine excavation depths.

Laser Distance Measuring Tool - Uses a laser beam to automatically measure distance at the push of a button.

Ultrasonic cleaning - Uses high frequency sound waves and a special cleaning solution to remove surface dirt, grime, soot, etc.

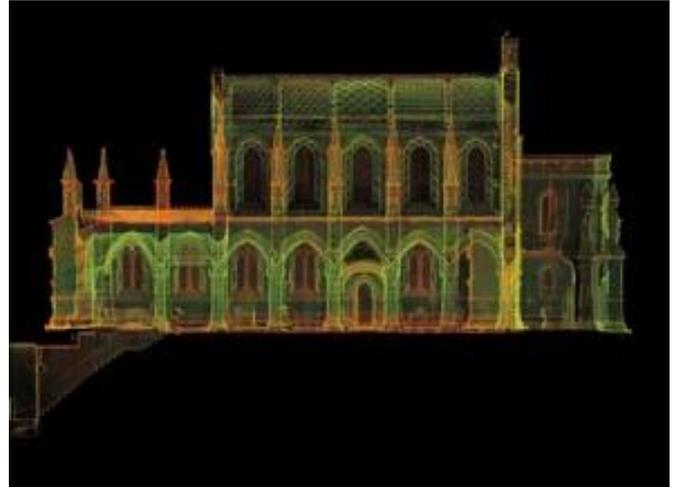
Impact Echo - Uses a hammer outfitted with a receiving transducer to sound out a material and illustrate the echoes as wave signals. It is used to locate voids in concrete slabs, decks, bridges, etc.

Electromagnetic Detection - Uses an electric current to generate a magnetic field. It is used for locating rebar in concrete.

Infrared Thermography - Uses cameras or video equipment to register the surface temperature of roofs or building façades. It is also known as heat imagery, and it provides information for energy efficiency studies, or to evaluate moisture infiltration.

Fiber Optics - Uses flexible optical fibers to view the interior of inaccessible areas such as the space in cavity walls.

Pervious Concrete - Used for paving, it is a type of concrete that is strong and durable, but lets rain water pass through to drain into the ground. This helps prevent overflow into sewers which pollutes waterways.



*Laser scanning*



*Thermal scanner*

### Things: Roofs to farm and walls that grow

There are acres of tar and gravel rooftops in a city that could be converted into gardens, or even farms. Imagine foods grown on top of buildings and distributed directly to the people in the neighborhood—enough fresh fruits and vegetables to feed the entire community. With hydroponic gardens and living walls, it could happen.



*Hydroponic*

### Hydroponic gardens

The word hydroponic combines two Greek words, *hydro*, meaning water, and *ponics*, meaning labor. Hydroponic gardening grows plants without soil. The vegetation is cultivated by flowing nutrient-rich water along their root systems. This steady flow provides life-sustaining nutrition which, in a controlled environment, could develop a year-round harvest. Chefs in New York City are already buying and serving fresh produce in the middle of winter from hydroponic gardens in Hackettstown, New Jersey.

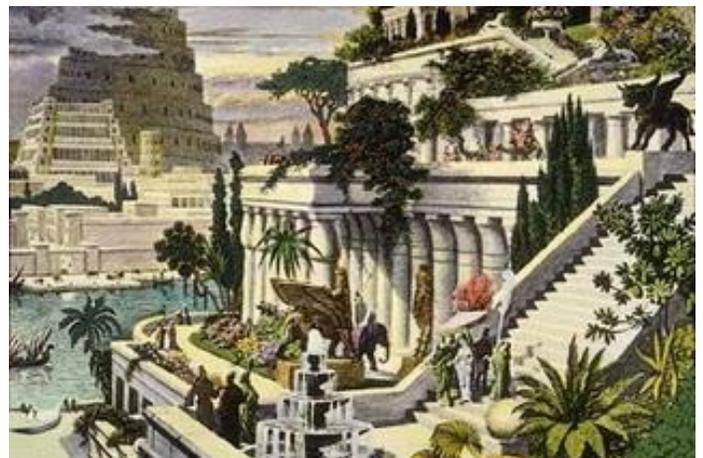


*Hydroponic gardening*

### Green walls

Green walls are panels with several inches of soil and plants held in place with stainless steel mesh. The panels are anchored to a wall covered with a waterproof membrane. Plants grown on these panels, just like plants in a regular garden, are open to air and sunlight, and are maintained by weeding, pruning, fertilizing, and harvesting.

Although extraordinary, the idea of green walls is not a new one. They existed nearly three thousand years ago in the Hanging Gardens of Babylon, known as one of the Seven Wonders of the Ancient World.



*Hanging Gardens of Babylon*

## Building of the Era

### Chicago City Hall, Chicago, IL

When completed in 1911, Chicago's City Hall was just another masonry government/office building. But 100 years later, it's a showpiece of the city's green thinking. Centrally located downtown, it is one of the most highly acclaimed structures in the city. Its façade was restored in 1967 to preserve its Classical features, and in 2001, an extensive and intensive green roof was installed. There are now over one hundred species of plants growing atop the eleven-story building, serving as a living crown upon the head of a proud queen.



*Chicago City Hall, circa 1911*

“Eventually, I think Chicago will be the most beautiful great city left in the world.”

**Frank Lloyd Wright**



*Chicago City Hall, green roof*

## Quotes

“Like a city whose walls are broken through is a person who lacks self-control.”

**King Solomon**

“Now this is not the end. It is not even the beginning of the end. But it is, perhaps, the end of the beginning.”

**Winston Churchill**

## Synopsis

After reading this chapter you should now have a better understanding or be able to identify the following:

- green
- sustainable
- transom
- VOC
- geothermal
- intensive green roof
- pervious
- hydroponic
- courage

## Testimonial of Lena M.

An Abyssinian Development Corp. Youthbuild 2011 Student of the Year, Lena M. is a recipient of a World Monument Fund scholarship for a summer internship in Chile to repair adobe homes and teach residents English.

*I'm starting a youth program at my church to help kids stay in school, find their potential, and fix their community.*

## ACTIVITIES

### 1. Care of masonry tools

Good masonry tools are not cheap. They are made well and will last a long time if cared for properly. There is a tradition amongst masons (that seems to be universal.) When an older mason can no longer put in an honest day's work, he'll decide it's time to "hang up the tools." Sometimes he'll give them to a son, nephew or other family member in the trade. Some old bricklayers give their entire bag of well-used and well-kept trowels, jointers, pointers, hammer, and levels to a colleague or foreman on the work crew. Whoever receives them inherits more than just a bag of old tools—they inherit the history and memory of the buildings that were built or repaired, and the years of hard work that fed a family. It's a solemn and symbolic farewell.



Take care of your tools.

They represent who you are and the amount of pride you put into your work.

#### Materials:

- wire brush
- masonry sand
- bucket
- mason's hammer
- boiled linseed oil
- turpentine (or paint thinner)
- rags
- sandpaper
- small paint brush
- dust brush (old paint brush)



#### Procedures:

##### Cleaning metal

The coarse grains of sand will clean the metal of a trowel blade in the same manner that sandpaper smooths wood.

- Pour several inches of masonry sand into a bucket.
- Stir trowels, jointers, pointers, and hammers around in it to remove accumulated mortar.



- Brush off the sand with a dust brush.
- Any mortar that remains can be lightly scrubbed with a wire brush.
- Heavier accumulations of mortar can be tapped off with a mason's hammer followed by the wire brush and more sand treatments.

### Preserving wood

A wooden level requires respect. It judges your work to determine if it is level and plumb. Linseed oil is a thick, sticky liquid that is pressed out of flax seeds. The flax plant is grown for its beautiful ornamental blue flower, but its practical use is for making linen, rope, and even cigarette paper. Linseed oil protects wood and gives it a rich, glowing color. Old dry wood comes back to life as the oil soaks in.

Boiled linseed oil mixed, or “cut,” with a small amount of turpentine or paint thinner is easier to work with than raw linseed oil.

**Note:** Caution must be taken with linseed oil and especially the rags used to apply it. Linseed oil is flammable and the rags spontaneously catch fire without warning. As the oil evaporates, a chemical reaction causes a combustion that could ignite. Be sure to let the rags air dry before disposal.



- Clean level and wooden parts of trowels, hammer, and joiners of all mortar using 120 grit or higher sandpaper; dust with dust brush.
- Pour about ¼ cup linseed oil into small container.
- Add small amount of turpentine or paint thinner and stir.
- Dip paint brush in and apply to wood surface.
- Let the oil absorb into the wood for about 5 minutes.
- Polish and remove excess oil with dry rag.
- Apply additional coats to very dry wood.
- Clean glass and metal edges of level.
- Allow overnight drying time.
- Air dry the rags, and then dispose of them properly.



## 2. Growing sedum for green roofs

Even if you don't have the provision, resources, or location to install an extensive green roof, the plants can be grown for possible use...in the future.

### Materials:

- sedum
- potting soil
- plastic trays

### Procedures:

- Put potting soil in trays.
- Plant seeds in potting soil.
- Provide water and a location for sunlight.
- Use a builder's square to align the trays.



## **Closing**

### **The Conclusion and the Start**

Evensong

What A Wonderful World

[Link to Louis Armstrong rendition of  
What A Wonderful World](#)



Synopsis:

About masonry

About tools

About history

About people

About moral attributes

About places

About things

About buildings

And how to

Web Resources

Photograph and Drawings Credit

About the Author

Back cover

## **Evensong**

Evensong, or Evening Song, is a service with reflective prayers and songs that takes place at dusk in many cathedrals. It is a traditional way of giving thanks for the day past; and a time for the peaceful calming of the spirit, in preparation for the night. Evensong ends with a reminder to go in peace and to serve others.

In the opening pages of Chapter One, a suggestion was made to listen to the masonry of a city. “Open your ears and you’ll hear it...” If you indeed do this, you might sense a brief moment when the swirling, sweltering city seems to be speaking with music, or a song. When you hear it, pause and listen, and think to yourself...



*Evensong*

## **What A Wonderful World**

This song was written by Robert Thiele and George David Weiss, and recorded by Louis Armstrong in 1968. Armstrong is considered by many to be the greatest of all Jazz musicians. His genius as a trumpet player and inventive singing are legend. The jazz songs he recorded in the 1920's are considered classics, and his rendition of the Broadway show tune "Hello Dolly" took the #1 song honors from the Beatles during the summer of 1964. Recording "What A Wonderful World" at the age of 66 made Armstrong the oldest male singer to have a hit song at the top of the charts.



*Louis Armstrong*

This link features Louis Armstrong performing "What A Wonderful World."  
[http://www.youtube.com/watch?v=n5jIUZuk0JQ&feature=youtube\\_gdata\\_player](http://www.youtube.com/watch?v=n5jIUZuk0JQ&feature=youtube_gdata_player)

The following photographs were taken at green roof installations in New York City.

*Closing*



I see trees of green, red roses, too.



I see them bloom, for me and you.

*Closing*



And I think to myself,  
What a wonderful world.



I see skies of blue, and clouds of white.

*Closing*



The bright blessed day, dark sacred night.  
And I think to myself...



What a wonderful world.

*Closing*



The colors of the rainbow, so pretty in the sky.



Are also on the faces,

*Closing*



...of people going by.



I see friends shaking hands, sayin', "How do you do?"  
They're really sayin', "I love you."

*Closing*



I hear babies cryin', I watch them grow.  
They'll learn much more, than I'll ever know.



And I think to myself,  
What a wonderful world.

*Closing*



Yes, I think to myself...



What a wonderful world....

Oh, yeah!

## Synopsis

Primer is from the from the Latin word *primaries*, meaning the first. It refers to a simple book used to teach reading, or any book of basic principles. A principle is a general truth, or a guiding sense of obligations for right conduct.

The following basic principles have been explored in *Masonry History Integrity*, an *Urban Conservation Primer*.

### About masonry

- cement
- mortar
- bricks
- blocks
- stone
- terra cotta
- concrete
- plaster
- stucco
- breathable coating
- lime and whitewash
- façade cleaning
- maintenance
- green technology

### About tools

- trowel
- level
- jointer & pointer
- hammer
- brick set
- stone carving tools
- stone patching tools
- line, line block and line pin
- concrete floats
- chalk line, plumb line
- hawk
- brushes
- caulking gun
- mason's ruler
- builders square

**About history**

- Guilds
- The Erie and Pennsylvania canals
- Anti-Masons
- The Industrial Revolution
- The Civil War
- Reconstruction
- The City Beautiful Movement
- World War One
- The Great Migration
- Civilian Conservation Corp.
- World War Two
- Red Ball Express
- The USS Mason
- Latino migration
- Urban Renewal
- Historic Preservation
- Urban Homesteading

**About people**

- Solomon Willard
- Joseph Aspden
- Andrew Jackson
- Arthur MacArthur
- Theodore Roosevelt
- Thomas Edison
- Winston Churchill
- Earl Barthe
- Joseph C. Rodriguez
- Mies Van der Roe
- Len Bias
- Refrigerator Perry
- Edward O'Hare
- Butch O'Hare
- Louis Armstrong

**About moral attributes**

- motivation
- ingenuity
- endurance
- heritage
- character
- inspiration
- determination
- sisu
- valor
- dedication
- decision making
- perseverance
- courage

**About places**

- London, England
- Rosendale, NY
- Saint Louis, MO
- Warsaw, Poland
- Dresden, Germany
- Los Angeles, CA

**About things**

- masonry work
- team work
- work site safety
- Guilds
- Master Craftsman
- Mechanics and Tradesman's hall
- mechanics
- plumb
- canals
- hydraulic
- mortar joint profiles
- brick bonds
- vitrification
- factories
- Moh's mineral hardness scale

- trade schools
- skyscrapers
- plaster lath and keys
- scagliola
- egg & dart and crown molding
- medallions
- coffered ceilings
- MSDS
- pressure washer
- cavity wall construction
- urban sprawl
- urban renewal
- glass box buildings
- steel construction
- parge coats
- EFIS
- waterproofing membranes
- Local Law 10/80
- Mission Revival architecture
- preventative maintenance
- Russack brick and mortar field test
- hot mopped, torch-down, EPDM, cold fluid applied roofs
- standing seam, slate roofs
- flashing, parapets and chimneys
- gargoyles
- sustainability
- LEED
- Hanging Gardens of Babylon
- green construction
- green roof
- hydroponic gardening
- laser levels
- Infrared thermography
- ultrasonic cleaning
- impervious concrete
- Evensong

**About buildings**

- Saint Paul's Chapel, NYC
- Row houses, Philadelphia PA
- U.S. Custom House, Charleston, SC
- Union Station, Washington, DC
- Ingalls Building, Cincinnati, OH
- Montgomery Plaza, Fort Worth, TX
- The Renaissance Center, Detroit, MI
- Quincy Market, Boston, MA
- Tract Houses, Los Angeles, CA
- City Hall, Chicago, IL

**And how to**

- build pipe staging
- mix mortar
- repoint mortar joints
- lay bricks
- carve stone
- patch stone
- lay bricks to the line
- make faux terra cotta clay dough
- make terra cotta molds
- build a concrete form
- mix & pour concrete
- repair plaster medallion
- make plaster casting from mold
- parge a wall with stucco
- mix and use whitewash and lime wash
- sound out stucco
- clean a façade, safely
- maintain a roof
- use a power washer
- use a caulking gun
- repair concrete cracks
- patch concrete spalls
- install a cold fluid applied roof membrane
- use a square
- clean and care of masonry tools
- grow and maintain a green roof

This primer is about masonry, history and integrity. It describes basic methods and materials to teach masonry building trade skills. It also provides stories to illustrate a few people and events from United States and world history. But integrity - that is something that can't be taught like trade skills, for hands to learn; nor is it memorized with the mind, like facts and dates. The word integrity comes from the Latin word *integritatem*, meaning soundness, wholeness, completeness. Integrity means being honest in everything, all the time. It is a personal decision to always be faithful and honorable.

This book contains information about masonry and history...  
But integrity is not a tool, to be used then thrown away.  
It's a muscle to be exercised, every day.  
It's not a lesson that's learned or taught.  
It's a life long goal, continually sought.

The conclusion of "Masonry History Integrity, An Urban Conservation Primer" does not finish this exploration. It merely offers direction for a journey just begun.

## WEB RESOURCES

### Prelude

“NYC population” U.S. Census Bureau  
<http://quickfacts.census.gov/qfd/states/36/3651000.html>

“Biennial Report 2007-2008” NYC Department of Buildings  
[http://www.nyc.gov/html/records/pdf/govpub/4907biennial\\_report\\_printer\\_version\[1\].pdf](http://www.nyc.gov/html/records/pdf/govpub/4907biennial_report_printer_version[1].pdf)

New York State Department of Education Career and Technical Education  
<http://www.p12.nysed.gov/cte/tradeandtech/careerareas.html>

“History” The Abyssinian Baptist Church  
<http://www.abyssinian.org/about-us/history/>

### Chapter 1

#### The Tools: Trowel, Mason’s Level

“The Scientific Revolution” by Robert A. Hatch  
<http://www.clas.ufl.edu/users/ufhatch/pages/03-Sci-Rev/SCI-REV-Home>

#### Who? Solomon Willard

*Stories in Stone: Travels Through Urban Geology* by David B. Williams  
Available from <http://books.google.com>

“The First Railroad in America: 1826-1926” Granite Railway Company  
<http://67.20.88.32/legacy/railway/firstrr1.htm>

“Quincy Quarries Reservation” Massachusetts Department of Conservation and Recreation  
<http://www.mass.gov/dcr/parks/metroboston/quincyquarries.htm>

“Bunker Hill Monument” City of Boston  
<http://www.cityofboston.gov/freedomtrail/bunkerhill.asp>

#### Attribute: Motivation

“Definition of Motivation” by Wendy Pan  
<http://ezinearticles.com/?Definition-of-Motivation&id=1567108>

#### Guilds

“Guild and Livery Companies: A Brief History” Guild of Scholars  
<http://gofs.co.uk/guild.aspx?name=4>

“Medieval guilds” by Gloria J. Betcher, Iowa State University  
<http://www.public.iastate.edu/~gbetcher/373/guilds.htm>

**“Craft Guilds and Christianity in Late Medieval England”** by Gary Richardson  
[http://works.bepress.com/gary\\_richardson/9/](http://works.bepress.com/gary_richardson/9/)

**“Guildhall”** City of London  
<http://www.cityoflondon.gov.uk>

**“About the Company”** The Worshipful Company of Masons  
<http://www.masonslivery.co.uk>

## Coat of Arms

**“The Worshipful Company of Masons”** The Livery Companies Database  
<http://81.130.213.163:8002/cgi-bin/lcl.exe?a=d&k=FKTDSMEXT>

## The Mechanics & Tradesmen Library, NYC

**“The General Society of Mechanics & Tradesmen”**  
<http://www.generalsociety.org/>

## Building of the Era: St. Paul’s Chapel, NYC

**“St. Paul’s Chapel, New York City”** Sacred Destinations  
<http://www.sacred-destinations.com/usa/new-york-city-st-pauls-chapel.htm>

## Quotes

**“Gung Ho”** China the Beautiful  
<http://www.chinapage.com/word/gungho.html>

## Activities: Draw a personal coat of arms

**“Symbolism of Heraldic Colors, Furs, Lines & Ordinaries”**  
<http://www.fleurdelis.com/meanings.htm>

**“Design Your Own Coat of Arms Lesson Plan”** ArtHouse  
<http://www.storyboardtoys.com/gallery/coat-of-arms-lesson-plan.htm>

## Chapter 2

### Limestone, Quicklime, and Lime Mortars

**“Limestone Rocks”** Rock Hounds  
<http://www.fi.edu/fellows/fellow1/oct98/expert/limestone.htm>

**“How Lime is Made: The Lime Cycle”** Lime Association  
[http://www.lime.org/lime\\_basics/index.asp](http://www.lime.org/lime_basics/index.asp)

**“Lime Mortar”** by Mario Cantin, Masonry Magazine  
<http://www.masonrymagazine.com/1-06/lime-mortar.html>

**“Building Stones”**

<http://www.selectstone.com/stones/building-stones/>

**“Cheney lime”**

<http://www.cheneylime.com/>

**Natural Cement**

**“Engineering Breakthroughs: Underwater Cement”** by Steve Johnson

[http://web.bryant.edu/~ehu/h364proj/fall\\_98/johnson/underwatercement.htm](http://web.bryant.edu/~ehu/h364proj/fall_98/johnson/underwatercement.htm)

**“Conversion of Temperature”**

<http://www.mathsisfun.com/temperature-conversion.html>

**“Traditional mortars: A History of Cement”** Portland Cement Association

<http://www.rumford.com/articlemortar.html>

**“How Many? A Dictionary of Units of Measurement”** by Russ Rowlett

<http://www.unc.edu/~rowlett/units/dictB.html> See Barrel Weights.

*Handbook of cost data for contractors and engineers* by Halbert Powers Gillette

Available from <http://books.google.com>. See Table IV, p. 540.

**Portland Cement**

**“History of Cement”** Cement Association of Canada

<http://www.cement.ca/en/Manufacturing/History-of-Cement.html>

**“Concrete Technology”** Portland Cement Association

[http://www.cement.org/tech/faq\\_natural\\_cement.asp](http://www.cement.org/tech/faq_natural_cement.asp)

**“On the History of Portland Cement after 150 Years”** by Christopher Hall

<http://www.cmse.ed.ac.uk/MSE3/Cement/Hall76.pdf>

**Mortar: The Art of Mixing**

**“What is Sand?”** The International Sand Collector’s Society

[http://www.sandcollectors.org/What\\_is\\_Sandx.html](http://www.sandcollectors.org/What_is_Sandx.html)

**“Mortar and Cement Details”**

<http://www.masonryworktools.com/mortar.html>

**“Tools of the Trade”** Pavingexpert.com

<http://www.pavingexpert.com/tools01.htm> See definitions of shovel and spade.

**Repointing: The Art of Fixing**

**“Tuckpointing Brick and Masonry, Tips and Techniques”**

[http://www.troweltrades.com/tuckpointing\\_brick/](http://www.troweltrades.com/tuckpointing_brick/)

**“Repointing Mortar Joints in Historic Masonry Buildings”** by Robert C. Mack, FAIA, and John P. Speweik

<http://www.nps.gov/hps/tps/briefs/brief02.htm>

## The Tools: Jointers and Pointers

“Masonry How-To Basics”

<http://www.masonryforlife.com/HowToBasics.htm>

## Joseph Aspdin

“History and Manufacture of Portland Cement” Portland Cement Association

[http://www.cement.org/basics/concretebasics\\_history.asp](http://www.cement.org/basics/concretebasics_history.asp)

## The Erie and Pennsylvania Canals

“Stories from PA History: Crossing the Alleghenies”

<http://explorepahistory.com/story.php?storyId=10&chapter=4>

“The Erie Canal: A Brief History” New York State

<http://www.canals.ny.gov/cculture/history/>

“Erie Canal: The Building of the Great Western Canal” by Matt Rosenberg

<http://geography.about.com/od/urbaneconomicgeography/a/eriecanal.htm>

## Places, Things

“The Philadelphia Row House”

[http://www.rowhouse-magazine.com/featuredHomes/featuredRows\\_phillyRows.html](http://www.rowhouse-magazine.com/featuredHomes/featuredRows_phillyRows.html)

“Carstairs Row” by Timothy Horning

<http://www.phillyhistory.org/blog/>

## Quotes and Lyrics

“Erie Canal Song”

<http://www.eriecanalsong.com/>

## Sidebars

“Hydraulic: Definition”

<http://www.wordiq.com/definition/Hydraulic>

## Types of Mortar M-S-N-O-K

“Mortar Mixes” MC<sup>2</sup> Estimators’ Reference

[http://www.mc2-ice.com/support/estref/popular\\_conversion\\_files/masonry/mortar.htm](http://www.mc2-ice.com/support/estref/popular_conversion_files/masonry/mortar.htm)

“Mortar and Cement Details”

<http://www.masonryworktools.com/mortar.html>

“History and Manufacture of Portland Cement” Portland Cement Association

[http://www.cement.org/basics/concretebasics\\_history.asp](http://www.cement.org/basics/concretebasics_history.asp)

## Joint Profiles

“Photographs and Descriptions of Historic Masonry Details”

<http://www.degruchymasonry.com/recipes.html#details>

## Chapter 3

### Bricks: Kilns and Clinkers

“The History of Bricks and Brickmaking”

[http://www.brickdirectory.co.uk/html/brick\\_history.html](http://www.brickdirectory.co.uk/html/brick_history.html)

“Fun Trivia: The Great Fire of London”

<http://www.funtrivia.com/en/History/Great-Fire-of-London-14214.html>

“Brickwork Basics”

<http://www.pavingexpert.com/featur09.htm>

### Brick Bonds and Patterns

“Tiling and Bricklaying” The Worshipful Company of Tylers and Bricklayers

[http://www.tylersandbricklayers.co.uk/index.php?option=com\\_wrapper&view=wrapper&Itemid=121](http://www.tylersandbricklayers.co.uk/index.php?option=com_wrapper&view=wrapper&Itemid=121)

“Looking at bricks” by David A. Reid

<http://plato.acadiau.ca/courses/educ/reid/geometry/brick/bricklayer.html>

### Blocks: cement and cinders

“How to Lay Concrete Blocks”

<http://www.penningtonblockco.com/howto.html>

“Concrete Masonry Unit (CMU) Construction” by Dave Hultenius

<http://faculty.delhi.edu/hultencd/A220-Week2-Lecture-Web.html>

### Brick vs. Block - What’s the Difference?

“Bricks”

<http://www.sizes.com/materls/bricks.htm>

“A Brick, is a Brick, is a Brick... Or is it?” by Jennie Farnsworth

<http://www.masonrymagazine.com/3-04/concrete.html>

### The Tools: Mason’s Hammer, Brick set

“Masonry How-To Basics”

<http://www.masonryforlife.com/HowToBasics.htm>

### Who? Andrew Jackson

“American Leaders: Andrew Jackson” by John Lord

<http://www.humanitiesweb.org/human.php?s=h&p=c&a=b&ID=310>

**“Andrew Jackson Biography”** *Encyclopedia of World Biography*  
<http://www.notablebiographies.com/Ho-Jo/Jackson-Andrew.html>

**“Andrew Jackson”**  
<http://www.american-presidents.com/andrew-jackson>

## St. Louis

**“Brick Built”** St. Louis Public Library  
<http://www.slpl.org/slpl/interests/article240086073.asp>

**“St. Louis: Becoming a City”**  
<http://www.nps.gov/jeff/planyourvisit/becoming-a-city.htm>

## Vitrification

**“The Story of Bricks”** Oolitic Middle School Industrial Technology  
<http://www.scribd.com/doc/7843392/BRICKS-Oolitic-Middle-School>

**“Hephaistos”** Theoi Greek Mythology  
<http://www.theoi.com/Olympios/Hephaistos.html>

**“Vulcan”** Encyclopedia Mythica Online  
<http://www.pantheon.org/articles/v/vulcan.html>

## The Masonic Order & Anti-Masons

**“About the Company”** The Worshipful Company of Masons  
<http://www.masonslivery.co.uk/html/about-the-company-the-masons-company/>

**“The Anti-Masonic Party”**  
<http://www.u-s-history.com/pages/h271.html>

## Industrial Revolution

**“The Industrial Revolution: An Overview”** by Robert Wilde  
<http://europeanhistory.about.com/od/theindustrialrevolution/p/OverIndRev.htm>

**“Summary of the Industrial Revolution”** (Test your knowledge.)  
<http://www.schoolhistory.co.uk/lessons/industrialrevolution/industrialsummary.htm>

## Quotes and Lyrics

**“Bluegrass Songs: John Henry”**  
[http://www.traditionalmusic.co.uk/bluegrass-lyrics/John\\_Henry.html](http://www.traditionalmusic.co.uk/bluegrass-lyrics/John_Henry.html)

**“The Legend of Casey Jones”**  
<http://www.tennesseehistory.com/class/CaseyJones.htm>

**Activities: Cut a brick with hammer and brick set**

**“Cutting Brick”**

[http://www.tpub.com/content/construction/14043/css/14043\\_240.htm](http://www.tpub.com/content/construction/14043/css/14043_240.htm)

**Activities: Build a brick wall**

**“Bricklaying”**

<http://www.pavingexpert.com/featur09.htm#blay>

**“Preservation of Historic Adobe Buildings”**

<http://www.nps.gov/hps/tps/briefs/brief05.htm>

## Chapter 4

### The City Rocks!

**“A Web Gallery of Stone Buildings and Their Building Stone”**

<http://www.gly.uga.edu/railsback/BS-Main.html>

**“Granite Rock Facts”**

<http://www.buzzle.com/articles/granite-rock-facts.html>

### Identifying Urban Stonework

**“Gneiss”**

<http://hyperphysics.phy-astr.gsu.edu/hbase/geophys/gneiss2.html>

**“Quartzite #1”**

<http://csmres.jmu.edu/geollab/Fichter/MetaRx/Rocks/quartzite1.html>

### The Art of Stonework

**“Elements of Stone Masonry”** Pasvalco

<http://www.pasvalco.com/Elements%20of%20Stone%20Masonry.htm>

### The Art of Repairing Stone

**“Historic Preservation - Technical Procedures”**

<http://w3.gsa.gov/web/p/HPTP.NSF/gsa.govAllProceduresDisplay/0445522R>

**“Indent Repairs to Sandstone Ashlar Masonry”**

<http://www.historic-scotland.gov.uk/informguide-ashlar.pdf>

### Mohs' Mineral Hardness Scale

**“Gemstones and Mohs Scale”**

<http://gemologyonline.com/mohs.html>

**“The Apatite Mineral Group”** The Mineral & Gemstone Kingdom

<http://www.minerals.net/mineral/apatite.aspx>

## Who? Arthur MacArthur

### “Arthur MacArthur’s Flag”

[http://www.homeofheroes.com/hallofheroes/1st\\_floor/flag/1bf\\_mac.html](http://www.homeofheroes.com/hallofheroes/1st_floor/flag/1bf_mac.html)

### “Arthur MacArthur, Jr.” Arlington National Cemetery

<http://www.arlingtoncemetery.net/amacart.htm>

## Medal of Honor

### “The United States Army Medal of Honor”

<http://www.army.mil/medalofhonor/>

## Civil War Statistics

### “Map: The Battle of Shiloh Begins” PBS, NPS

<http://www.pbs.org/civilwar/war/map4.html>

### “African-American Soldiers in the Civil War”

<http://www.history.com/topics/african-american-soldiers-in-the-civil-war>

## Some Recent Statistics

### “Building Blocks for Father Involvement” Head Start Resource Center

<http://www.headstartresourcecenter.org/fatherhood/Resources/root/data/Building%20Blocks/HSBCCombo4.1.pdf>

## Reconstruction

### “Emancipation Proclamation” by Abraham Lincoln, January 1, 1863

[http://www.archives.gov/exhibits/featured\\_documents/emancipation\\_proclamation/transcript.html](http://www.archives.gov/exhibits/featured_documents/emancipation_proclamation/transcript.html)

### “Lesson 3: The First Reconstruction Era” by D. Zizwe Poe

<http://www.lincoln.edu/history/his206/lessons/lesson3.htm>

## Building of the Era: The U.S. Custom House, Charleston, SC

### “United States Custom House”

<http://www.cr.nps.gov/nr/travel/charleston/usc.htm>

## Quotes and Lyrics

### “Confederate and Union Civil War Lyrics” Gettysburg National Military Park, National Park Service

[http://americancivilwar.com/Civil\\_War\\_Music/song\\_lyrics/](http://americancivilwar.com/Civil_War_Music/song_lyrics/)

## Activities: Letter Carving in Stone

### “Historic Scotland”

<http://www.historic-scotland.gov.uk/index.htm>

## Activities: Patching Stone with Repair Mortar

### “Boston Restoration Supply”

[http://www.bostonrestorationsupply.com/jahn\\_m100.html](http://www.bostonrestorationsupply.com/jahn_m100.html)

## Chapter 5

### Terra Cotta - Practical and Decorative

“The Preservation of Historic Glazed Architectural Terra-Cotta” by de Teel Patterson Tiller  
<http://www.nps.gov/hps/tps/briefs/brief07.htm>

### Knowing Terra Cotta

“Chapter VIII: Architectural Terra Cotta” from *Building Construction and Superintendence* (F. E. Kidder, 1906)  
<http://chestofbooks.com/architecture/Construction-Superintendence/>

### Repairing Terra Cotta

“Ornamental Maintenance: An Architectural Primer on Terra Cotta” by Steven Secon  
<http://cooperator.com/articles/521/1/Ornamental-Maintenance/Page1.html>

“Streetscapes-Woolworth Building” by Christopher Gray (*New York Times*, September 9, 2007)  
<http://www.nytimes.com/2007/09/09/realestate/09scap.html>

### The Tools: Line, Line blocks, Line pins

“Brickwork Basics-Bricklaying”  
<http://www.pavingexpert.com/featur09.htm#blay>

“Masonry How-To Basics”  
<http://www.masonryforlife.com/HowToBasics.htm>

### Who? Theodore Roosevelt

“Sagamore Hill”  
<http://www.nps.gov/sahi/index.htm>

“Geography Statistics- Land Acreage”  
[http://www.statemaster.com/graph/geo\\_lan\\_acr\\_tot-geography-land-acreage-total](http://www.statemaster.com/graph/geo_lan_acr_tot-geography-land-acreage-total)

“Theodore Roosevelt Quotes”  
[http://www.brainyquote.com/quotes/authors/t/theodore\\_roosevelt.html](http://www.brainyquote.com/quotes/authors/t/theodore_roosevelt.html)

### The City Beautiful Movement

“The City Beautiful Movement” by Adam Sowder  
<http://geography.about.com/od/urbaneconomicgeography/a/citybeautiful.htm>

### Trade schools

“Vocational Education, Industrial Education, and Trade Schools” Howard R. D. Gordon (from *Encyclopedia of Children and Childhood in History and Society*)  
<http://www.faqs.org/childhood/Th-W/Vocational-Education-Industrial-Education-and-Trade-Schools.html>

“The History of Vocational Schools” by Stephanie Daniels  
[http://www.ehow.com/about\\_5417363\\_history-vocational-schools.html](http://www.ehow.com/about_5417363_history-vocational-schools.html)

“Hampton and Its Students” by M. F. Armstrong and Helen W. Ludlow  
<http://docsouth.unc.edu/church/armstrong/summary.html>

### **Building of the Era: Union Station**

“Union Station in Washington, DC”  
<http://www.dcpages.com/gallery/Union-Station-Washington-DC/>

“Union Station”  
<http://www.nps.gov/history/nr/travel/wash/dc80.htm>

“History of Union Station”  
<http://www.unionstationdc.com/info/stationhistory>

### **Williamson Free School**

“About Williamson”  
<http://www.williamson.edu/about/index.htm>

### **Quotes**

“Message to Garcia”  
<http://www.freeenterpriseland.com/GARCIA.html>

“How I carried the message to Garcia” by Colonel Andrew Summers Rowan  
<http://www.foundationsmag.com/rowan.html>

### **Activities: Making faux terra cotta “clay-dough”**

“Home Made Play Dough Recipes”  
<http://www.applesaucekids.com/LinkPage/PlayDoug.html>

### **Activities: Mold making**

“From Plaster to Polyvinyls: A Review of Dental Impression Materials” by Richard J. Reinitz  
<http://www.dentalcompare.com/spotlight.asp?spotlightid=9>

## **Chapter 6**

### **It’s a Concrete World**

“History of Cement” Cement Association of Canada  
<http://www.cement.ca/en/Manufacturing/History-of-Cement.html>

“Cement and Concrete Basics” Portland Cement Association  
[http://www.cement.org/basics/concretebasics\\_history.asp](http://www.cement.org/basics/concretebasics_history.asp)

“A History of Cement” Portland Cement Association  
<http://www.rumford.com/articlemortar.html>

“Calcium Chloride Material Safety Data Sheet”

<http://www.avantormaterials.com/search.aspx?searchtype=msds>

## Concrete, Reinforced, Pre-cast, and Cast Stone

“Precast Concrete” by Bill Palmer

<http://www.concretenetwork.com/precast-concrete/>

“History of Concrete” from *Reinforced Concrete: Preliminary Design for Architects and Builders* by R.E. Shaeffer, McGraw-Hill, 1992.

[http://www.ce.memphis.edu/1101/notes/concrete/section\\_2\\_history.html](http://www.ce.memphis.edu/1101/notes/concrete/section_2_history.html)

## Pouring Concrete: The Plot Thickens

“What is Concrete?”

<http://www.concretenetwork.com/concrete.html>

“Cement and Concrete Basics” Portland Cement Association

[http://www.cement.org/basics/concretebasics\\_history.asp](http://www.cement.org/basics/concretebasics_history.asp)

## Who? Thomas Edison

“Cement” The Thomas Edison Papers, Rutgers University

<http://edison.rutgers.edu/cement.htm>

“Inventions” The Thomas Edison Papers, Rutgers University

<http://edison.rutgers.edu/inventions.htm>

## Whoa - Heavy! Concrete Facts

“Dig a Little Deeper” Mineral Information Bureau

<http://cmase.uark.edu/teacher/workshops/GEMS-lessons/Full%20Set%20of%20Minerals%20in%20Society.pdf>

“Cement and Concrete Basics” Portland Cement Association

[http://www.cement.org/basics/concretebasics\\_history.asp](http://www.cement.org/basics/concretebasics_history.asp)

## World War I Statistics

“World War 1.net”

<http://www.worldwar-1.net/index.htm>

“Pop Culture 1910” U.S. Bureau of the Census

[http://www.census.gov/history/www/through\\_the\\_decades/fast\\_facts/1910\\_fast\\_facts.html](http://www.census.gov/history/www/through_the_decades/fast_facts/1910_fast_facts.html)

“World War I”

[http://www.makingthemodernworld.org.uk/stories/the\\_age\\_of\\_the\\_mass/04.ST.01/](http://www.makingthemodernworld.org.uk/stories/the_age_of_the_mass/04.ST.01/)

## Building of the Era: Ingalls Building

“Concrete contractor.com”

<http://www.concretecontractor.com/concrete-construction-projects/ingalls-building/>

## Quotes

**“Captain John Smith”**

<http://www.web-books.com/Classics/ON/B1/B1583/07MB1583.html>

## Activities

**“Concrete calculations”**

<http://mathcentral.uregina.ca/QQ/database/QQ.09.03/john2.html>

## Chapter 7

### Gypsum and Plaster

**“A Brief History of Plaster and Gypsum”** Association of Lifecasters International

[http://www.artmolds.com/ali/history\\_plaster.html](http://www.artmolds.com/ali/history_plaster.html)

**“The Mineral Gypsum”** Amethyst Galleries

<http://www.galleries.com/minerals/sulfates/gypsum/gypsum.htm>

### The Traditional Three Coats

**“Introduction: Preserving Historic Ornamental Plaster”** by David Flaharty

<http://www.oldhouseweb.com/how-to-advice/introduction-preserving-historic-ornamental-plaster.shtml>

### Scagliola

**“Scagliola”** Evergreene Architectural Arts

<http://evergreene.com/services/scagliola/>

**“What is Scagliola”** Asney Scagliola

<http://www.scagliola.biz/whatis.html>

### Repairing Plaster Disasters

**“Repairing Historic Flat Plaster Walls and Ceilings”** by Mary Lee MacDonald

<http://www.nps.gov/hps/tps/briefs/brief21.htm>

**“A Simple Lime Plaster Cornice”** byrnesurfaces

<http://byrnesurfaces.wordpress.com/2011/01/05/25/>

**“Preserving Historic Ornamental Plaster”** by David Flaharty

<http://www.nps.gov/hps/tps/briefs/brief23.htm>

### Who? Winston Churchill

**“Churchill: Leader and Statesman”** The Churchill Centre and Museum

<http://www.winstonchurchill.org/learn/biography/biography/churchill-leader-and-statesman>

**“A Timeline of Winston Churchill”**

<http://www.winston-churchill-leadership.com/timeline.html>

**“Winston Churchill’s Dangerous New York Mistake”**

[http://www.newyorkology.com/archives/2007/08/winstons\\_church\\_1.php](http://www.newyorkology.com/archives/2007/08/winstons_church_1.php)

**World War II Statistics**

**“World War II Summary”** Oracle ThinkQuest

<http://library.thinkquest.org/10927/sumww2.htm>

**“Table 17: Population of the 100 Largest Urban Places: 1940”** U.S. Bureau of the Census

<http://www.census.gov/population/www/documentation/twps0027/tab17.txt>

**The Red Ball Express**

**“African Americans Gain Fame as World War II Red Ball Express Drivers”** by Rudi Williams, American Forces Press Service, U.S. Department of Defense

<http://www.defense.gov/news/newsarticle.aspx?id=43934>

**The USS Mason**

**“USS Mason (DE-529), 1944-1947”** Naval History & Heritage

<http://www.history.navy.mil/photos/sh-usn/usnsh-m/de529.htm>

**“Proudly We Served, The Story of The USS Mason and Her Crew”**

<http://www.ussmason.org/>

**“Mary Berkeley Minor Blackford (1802-1896)”** Virginia Memory, Library of Virginia

[http://www.virginiamemory.com/online\\_classroom/union\\_or\\_secession/people/mary\\_blackford](http://www.virginiamemory.com/online_classroom/union_or_secession/people/mary_blackford)

**Buildings of the Era: Warsaw, Dresden, London**

**“The WWII Homefront: Warsaw, Poland”** Oracle ThinkQuest

<http://library.thinkquest.org/15511/data/encyclopedia/warsaw.htm>

**“Preserving the World’s Great Cities”** by Anthony M. Tung

<http://www.anthonymtung.com/excerpts.htm>

**Quotes**

**“Sisu”** Urban Dictionary

<http://www.urbandictionary.com/define.php?term=sisu>

**Chapter 8**

**Old Coats Stucco**

**“Historical Notes on the Origin of Stucco”** Safra Colors

<http://www.venetianplastering.com/historyofstucco.pdf>

## The “How” of Stucco

“The Preservation and Repair of Historic Stucco” by Anne Grimmer  
<http://www.nps.gov/history/hps/tps/briefs/brief22.htm>

## Stucco Finishes and Textures

“Historical Notes on the Origin of Stucco” Safra Colors  
<http://www.venetianplastering.com/historyofstucco.pdf>

## Sounding Out - The Ring of Truth

“Ornamental Maintenance: An Architectural Primer on Terra Cotta” by Steven Secon  
<http://cooperator.com/articles/521/1/Ornamental-Maintenance/Page1.html>

“Stucco” Historic Charleston  
[http://www.historiccharleston.org/preservation/tech\\_stucco.html](http://www.historiccharleston.org/preservation/tech_stucco.html)

## Faux Brownstone

“Just What is Brownstone?” The Wolfe Pack  
<http://www.nerowolfe.org/hm/tidbits/WhatIsBrownstone.htm>

## New Skin – Whitewash, Limewash, and Coatings That Breathe

“Durability of Traditional and Modified Limewash” by Sarah Jackson  
<http://ncptt.nps.gov/2011/study-on-the-durability-of-traditional-and-modified-limewash/>

## The Tools: The hawk and steel trowel

“Masonry Tools/Plastering Tools”  
<http://www.hand-tools-manufacturers.com/masonry-tools.html>

## Who? Joseph C. Rodriguez

“Sergeant Joseph C. Rodriguez” Eugene E. Obregon/Congressional Medal of Honor Memorial Foundation  
<http://www.obregoncmh.org/theyforty/JosephRodriguez.html>

## Latino Migration to U.S.

“Hispanic Americans” Ed. by R.A. Giusepi, History World International  
<http://history-world.org/hispanics.htm>

“Uneasy Neighbors: A Brief History of Mexican-U.S. Migration” Harvard Magazine (May-June 2007)  
<http://harvardmagazine.com/2007/05/uneasy-neighbors-a-brief-html>

“America in Ferment: The Tumultuous 1960s-Viva La Raza”  
[http://www.digitalhistory.uh.edu/database/article\\_display.cfm?HHID=386](http://www.digitalhistory.uh.edu/database/article_display.cfm?HHID=386)

## Cavity wall construction

“Cavity wall detail” by Ryan Ballinger for this publication

## Activities

“Limewash: Compatible Coverings for Masonry and Stucco” by Peter Mold and Richard Godbey  
[http://www.lime.org/documents/lime\\_basics/limewash.pdf](http://www.lime.org/documents/lime_basics/limewash.pdf)

## Chapter 9

### Clean Outside-Façade Washing

“Façade Cleaning” by Stephen Varone and Peter Varsalona  
[http://www.randpc.com/ask/ate\\_FacadeCleaning.html](http://www.randpc.com/ask/ate_FacadeCleaning.html)

“Understanding the Importance of Pressure Washers' PSI and GPM”  
<http://www.ultimatewasher.com/articles/pressure-washer-psi-gpm.htm>

“Dangers of Abrasive Cleaning to Historic Buildings” by Anne E. Grimmer  
<http://www.nps.gov/hps/tps/briefs/brief06.htm>

“Masonry Cleaning and Paint Stripping” Abstract Masonry Restoration  
<http://www.masonry-restoration.com/paint-stripping.htm>

“Brick Houses” by William Kibbel III  
<http://www.oldhouseweb.com/how-to-advice/brick-houses.shtml>

“Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings” by Robert C. Mack, FAIA and Anne Grimmer  
<http://www.nps.gov/hps/tps/briefs/brief01.htm>

“Removing Graffiti from Historic Masonry” by Martin E. Weaver  
<http://www.nps.gov/hps/tps/briefs/brief38.htm>

### Pressure washing machine

“The Art of Pressure Washing” by Jon Tobey  
<http://www.finchomebuilding.com/PDF/Free/021162094.pdf>

### Efflorescence

“Efflorescence: Cause and Control” Masonry Institute of America  
<http://www.masonryinstitute.org/pdf/612.pdf>

“Efflorescence: What’s this White Stuff on my Paving?”  
<http://www.pavingexpert.com/eff01.htm>

## Preparations, Precautions, and Personal Procedures

### “Restoration Cleaning”

[http://www.prosoco.com/Training/pres002\\_files/frame.htm](http://www.prosoco.com/Training/pres002_files/frame.htm)

## The Tools: Brushes

### “Masonry How-To Basics”

<http://www.masonryforlife.com/HowToBasics.htm>

### “Brushes and Tools”

<http://www.bontool.com/category1.asp?D=mason&S=mas%5Fbrush&G=&C=&N=1>

## Who? Mies Van der Rohe

### “Ludwig Mies van der Rohe (1886-1969)”

<http://www.designboom.com/portrait/mies/bg.html>

### “Mies van der Rohe Dies at 83” by Alden Whitman, (*New York Times*, August 19, 1969)

<http://www.nytimes.com/learning/general/onthisday/bday/0327.html>

## Steel Structures

### “Welding Taking over from Rivets in Skyscraper Construction”

<http://www.1920-30.com/architecture/rivets-welding.html>

## Glass box buildings

### “Haus Proud” by Jonathon Keats, *ForbesLife Magazine*, September 21, 2009

<http://www.forbes.com/forbes-life-magazine/2009/0921/bauhaus-90th-anniversary-designers.html>

### “Inman News Features: A Window into ‘Glass Box’ Flaws”

[http://www.viningsmortgage.com/Library/Market\\_News/Inman\\_News\\_Features.html?ID=www.inman.com/inmaninf/storyxml/news/130412](http://www.viningsmortgage.com/Library/Market_News/Inman_News_Features.html?ID=www.inman.com/inmaninf/storyxml/news/130412)

## Waterproofing membranes

### “Rising Damp” by Tim Hutton

<http://www.buildingconservation.com/articles/risingdamp/risingdamp.htm>

## Urban Renewal

### “Jane Jacobs, 89; Writer, Activist Spoke Out Against Urban Renewal” by Adam Bernstein (*Washington Post*, April 26, 2006)

<http://www.washingtonpost.com/wp-dyn/content/article/2006/04/25/AR2006042501026.html>

### “Part Eleven: Interstates and Urban Renewal”

[http://www.tnhistoryforkids.org/students/h\\_11](http://www.tnhistoryforkids.org/students/h_11)

## Activities

### “Brick Cleaning Techniques”

[http://www.troweltrades.com/cleaning\\_new\\_brick/](http://www.troweltrades.com/cleaning_new_brick/)

## Chapter 10

### Maintenance: Care and Repair

#### “Public Housing Repairs Can’t Keep Pace With Need” by Cara Buckley (*New York Times*, October 24, 2010)

[http://www.nytimes.com/2010/10/25/nyregion/25repairs.html?pagewanted=2&\\_r=2&ref=todayspaper](http://www.nytimes.com/2010/10/25/nyregion/25repairs.html?pagewanted=2&_r=2&ref=todayspaper)

#### “In State Parks, the Sharpest Axe is the Budget’s” by William Yardley (*New York Times*, June 6, 2011)

[http://www.nytimes.com/2011/06/07/us/07parks.html?\\_r=1&hp](http://www.nytimes.com/2011/06/07/us/07parks.html?_r=1&hp)

#### “Historic Scotland”

<http://www.historic-scotland.gov.uk/index/heritage/conservation.htm>

#### “The Center of Peace-God” Institut du Patrimoine Wallon

<http://www.institutdupatrimoine.be>

### The Tools: Caulking Gun

#### “Today in Science History: January 16-Events” See: Caulking gun patent.

[http://www.todayinsci.com/1/1\\_16.htm](http://www.todayinsci.com/1/1_16.htm)

### Who? Len Bias

#### “For Many, Bias’ Death Still Resonates” (*Washington Times*, June 19, 2006)

<http://www.washingtontimes.com/news/2006/jun/19/20060619-022829-6975r/>

### People: Anonymous

#### “Ornamental Maintenance: An Architectural Primer on Terra Cotta” by Steven Secon

<http://cooperator.com/articles/521/1/Ornamental-Maintenance/Page1.html>

#### “Playing it ‘Safe’ with Façade Inspections” by Stephen Varone and Peter Varsalona

[http://www.randpc.com/ask/ate\\_LL1080.html](http://www.randpc.com/ask/ate_LL1080.html)

### Architects and Engineers

#### “Ask the Engineer” Rand Engineering & Architecture, PC

<http://www.randpc.com/ask/index.html>

### Building of the Era: Quincy Market, Boston, MA

#### “Faneuil Hall, Quincy Market History” Faneuil Hall Boston

<http://www.faneuilhallboston.com/faneuilhallhistory/>

**“Benjamin C. Thompson, 84, Architect Of Festive Urban Marketplaces, Is Dead”** by David W. Dunlap (*New York Times*, August 20, 2002)  
<http://www.nytimes.com/2002/08/20/arts/benjamin-c-thompson-84-architect-of-festive-urban-marketplaces-is-dead.html>

## Civilian Conservation Corps, One Million Trees

**“Civilian Conservation Corps (CCC), 1933-1941”**  
<http://www.u-s-history.com/pages/h1586.html>

**“About MillionTreesNYC”**  
<http://www.milliontreesnyc.org/html/about/about.shtml>

**New York Restoration Project**  
[http://www.nyrp.org/Greening\\_Sustainability/MillionTreesNYC](http://www.nyrp.org/Greening_Sustainability/MillionTreesNYC)

## Historic Preservation

**“About the National Trust for Historic Preservation”**  
<http://www.preservationnation.org/about-us/>

## Determining Masonry Hardness

**“Guidelines for Evaluating the Condition of Brick Masonry and Mortar”** (Russack System of Masonry Hardness U.S. General Services Administration, Historic Preservation Technical Procedures)  
<http://w3.gsa.gov/web/p/hptp.nsf/02e2bfa0e29bc7dc852565cc00590728/b90c491c7c1f2838852565c50054b3aa?OpenDocument>

## Quotes

**“A Historical Sketch of Factors Walk Retaining Wall and an Investigation into the Cause of the Wall’s Erosion”** by Elliot O. Edwards Jr. (*Georgia Journal of Science*, Vol. 64, No. 4, 2006)  
<http://facstaff.gpc.edu/~jaliff/GAJSci64-4.pdf>

## Chapter 11

### Roofing and Masonry

**“Welcome to the Tylers and Bricklayers”**  
<http://www.tylersandbricklayers.co.uk/>

**“The Preservation and Repair of Historic Clay Tile Roofs”** Anne E. Grimmer and Paul K. Williams  
<http://www.nps.gov/history/hps/tps/briefs/brief30.htm>

### Roofing materials

**“Standing Seam Metal Roofing”**  
<http://www.archmetalroof.com/standing-seam-roofing.html>

**“Cold Fluid Applied Roofing Product Information”**  
<http://www.roofcoatings.org/product.html#coldapplied>

**“Roof Warranties”** by Stephen Varone and Paul Varsalona  
[http://www.randpc.com/ask/ate\\_RoofWarranties.html](http://www.randpc.com/ask/ate_RoofWarranties.html)

**“Replacing a Roof: Hot or Cold System?”** by Stephen Varone and Paul Varsalona  
[http://www.randpc.com/ask/ate\\_RoofReplace.html](http://www.randpc.com/ask/ate_RoofReplace.html)

## Roof Slate Shapes

**“Frequently Asked Questions”**  
<http://www.durableslate.com/faq.html>

## Parapets, copings, flashing and chimneys

**“Roofs and Chimneys”** Historic Charleston  
[http://www.historiccharleston.org/preservation/tech\\_roofs.html](http://www.historiccharleston.org/preservation/tech_roofs.html)

## Certificate of Fitness

**“Certificate of Fitness”** New York City Fire Department  
[http://www.nyc.gov/html/fdny/html/c\\_of\\_f/coff.shtml](http://www.nyc.gov/html/fdny/html/c_of_f/coff.shtml)

## Concrete deck repairs

**“Concrete Crack Repair Evaluation”**  
<http://www.concretenetwork.com/concrete-repair/evaluate.html>

**“Structural Concrete Repairs”**  
<http://www.concretenetwork.com/concrete-repair/structure.html>

**“Delaminations in Concrete Slabs”**  
<http://www.concretenetwork.com/concrete-delamination.html>

## The Tools: Mason’s ruler

**“How to Read a Brick Mason’s Ruler”**  
[http://www.ehow.com/how\\_7551503\\_read-brick-masons-ruler.html/](http://www.ehow.com/how_7551503_read-brick-masons-ruler.html/)

## Who? William “The Refrigerator” Perry

**“William ‘The Refrigerator’ Perry”** by Ross Porter  
<http://realsportsheroes.com/william-the-refrigerator-perry/>

## Building of the Era: Montgomery Plaza, Fort Worth, TX

**“Old Icon: New Life: Montgomery Ward”** by Elizabeth Lunday (*MultiFamily Executive*, September 2007)  
<http://www.multifamilyexecutive.com/design/old-icon-new-life-montgomery-ward.aspx>

**“Visual Dictionary of Southwestern Style”**  
[http://www.sucasamagazine.com/contents/visual\\_dictionary.html](http://www.sucasamagazine.com/contents/visual_dictionary.html)

**“Montgomery Plaza History”**  
<http://montgomeryplaza.com/montgomery-plaza/history/>

## Urban homesteading

“Urban Homesteading Today-Why Do It?”

<http://www.urbanhomesteadingtoday.com/>

“The Darvaes Family: Pioneering the Urban Farm”

<http://www.urbanfarmonline.com/urban-farm-videos/urban-farming-legends/dervaes-family.aspx>

“The Urban Homesteading Phenomenon: Self-sufficiency in a City Lot” by J.C. Wilkinson

<http://www.brighthub.com/environment/green-living/articles/18506.aspx>

## Quotes and Lyrics

“Welcome to Brickmaster-the Website of the Red Mason” by Gerard Lynch

<http://www.brickmaster.co.uk/>

## Chapter 12

### Thinking Green

“Sustainable” Whole Building Design Guide

<http://www.wbdg.org/design/sustainable.php>

“Sustainable Historic Preservation” Whole Building Design Guide

[http://www.wbdg.org/resources/sustainable\\_hp.php](http://www.wbdg.org/resources/sustainable_hp.php)

“Japanese, in Shortage, Willingly Ration Watts” by Norimitsu Onishi (*The New York Times*, July 28, 2011)

[http://www.nytimes.com/2011/07/29/world/asia/29electricity.html?\\_r=1&ref=todayspaper/](http://www.nytimes.com/2011/07/29/world/asia/29electricity.html?_r=1&ref=todayspaper/)

### Old Buildings are Friendly Buildings

“Conserving Energy in Historic Buildings” by Baird M. Smith, AIA

<http://www.nps.gov/hps/tps/briefs/brief03.htm>

“The Repair of Historic Wooden Windows” by John H. Myers

<http://www.nps.gov/hps/tps/briefs/brief09.htm>

“The Repair and Thermal Upgrading of Historic Steel Windows” by Sharon C. Park, AIA

<http://www.nps.gov/hps/tps/briefs/brief13.htm>

“Heating, Ventilating, and Cooling Historic Buildings” by Sharon C. Park, AIA

<http://www.nps.gov/hps/tps/briefs/brief24.htm>

### LEED

“U.S. Green Building Council”

[www.usgbc.org](http://www.usgbc.org)

### Green = Masonry Conservation

“Making Your Repair Projects Green” by Stephen Varone and Peter Varsalona

[http://www.randpc.com/ask/ate\\_GreenRepairProjects.html](http://www.randpc.com/ask/ate_GreenRepairProjects.html)

## What is a Green Roof?

### “Green Roof Fact Sheet”

[http://www.randpc.com/improve/cis\\_GreenRoofFactSheet.html](http://www.randpc.com/improve/cis_GreenRoofFactSheet.html)

### “Up on the Roof” by Verlyn Klinkenborg (*National Geographic*, May 2009)

<http://ngm.nationalgeographic.com/2009/05/green-roofs/klinkenborg-text/5>

## Who? Eddie and Butch O’Hare “Gangsters & Heroes”

### “Lieutenant Commander Edward H. (“Butch”) O’Hare” Department of the Navy

<http://www.ibiblio.org/hyperwar/OnlineLibrary/photos/pers-us/uspers-o/e-ohare.htm>

### “Butch O’Hare and Easy Eddie” (*Veterans Magazine*, March 2005)

<http://www.veteransmagazine.com/membersarea/MagazineIssues/06thmag/butchandeddie.pdf>

## Masonry methods/materials of the future

### “Laser Scanning” Historic Scotland

<http://www.historic-scotland.gov.uk/index/heritage/conservation/conservation-initiatives/laserscanning.htm>

### “Preservation Tech Notes” National Park Service Technical Preservation Services

<http://www.nps.gov/history/hps/tps/technotes/PTN40/definitions.htm>

### “Concrete is Remixed with Environment in Mind” by Henry Fountain (*The New York Times*, March 31, 2009)

<http://www.nytimes.com/2009/03/31/science/earth/31conc.html>

### “The Seismic Retrofit of Historic Buildings” by David W. Look, AIA, Terry Wong, PE, and Sylvia Rose Augustus

<http://www.nps.gov/hps/tps/briefs/brief41.htm>

## Roofs to farm and walls that grow

### “Green Walls Archive” George Irwin, ed.

[http://www.greenroofs.com/archives/green\\_walls.htm](http://www.greenroofs.com/archives/green_walls.htm)

### “Greenhouse Projects Nurture Produce and Workers” by Glen Collins (*The New York Times*, March 2, 2011)

[http://www.nytimes.com/2011/03/02/dining/02Greenhouse.html?\\_r=1&scp=1&sq=Hackettstown&st=cse](http://www.nytimes.com/2011/03/02/dining/02Greenhouse.html?_r=1&scp=1&sq=Hackettstown&st=cse)

### “Hanging Gardens of Babylon” by Lee Krystek

<http://www.unmuseum.org/hangg.htm>

## Building of the Era: City Hall, Chicago, IL

### “Chicago City Hall Green Roof” American Society of Landscape Architects

<http://www.asla.org/meetings/awards/awds02/chicagocityhall.html>

## Activities: Care and keeping of masonry tools

### “Flax”

<http://www.worldjute.com/flax.html>

## Activities: Install green roof trays

### “Lesson: Green Roof Design” Science NetLinks, eGFI

<http://teachers.egfi-k12.org/lesson-green-roof-design>

# PHOTOGRAPH AND ILLUSTRATION CREDITS

## Prelude

Abyssinian Baptist Church Choir. Instant Encore  
<http://www.instantencore.com/concert/details.aspx?PIid=5052970>

## Chapter 1

Safety, Skyscraper Exhibit. Copyright 2007 Helene Alonso/Liberty Science Center (used with permission)  
<http://www.lsc.org/lsc/ourexperiences/exhibits/skyscraper>

Plumb Bob. Clipart ETC, Florida Center for Instructional Technology  
[http://etc.usf.edu/clipart/26100/26199/plumbbob\\_26199.htm](http://etc.usf.edu/clipart/26100/26199/plumbbob_26199.htm)

Bunker Hill Memorial. Clipart ETC, Florida Center for Instructional Technology  
[http://etc.usf.edu/clipart/13600/13601/bunker-hill\\_13601.htm](http://etc.usf.edu/clipart/13600/13601/bunker-hill_13601.htm)

Passenger Train. Clipart ETC, Florida Center for Instructional Technology  
[http://etc.usf.edu/clipart/14500/14559/pass-train\\_14559.htm](http://etc.usf.edu/clipart/14500/14559/pass-train_14559.htm)

Coat of arms. The Worshipful Company of Masons (image and caption used with permission)  
<http://www.masonsdelivery.co.uk/>

Chinese railroad workers, 1880s. Photo courtesy of the Pajaro Valley Historical Association, from National Museum of American History Curriculum Guide 10/2  
<http://americanhistory.si.edu/onthemove/learning/pdf/1.3.pdf>

## Chapter 2

Rosendale mines by Suzanne Weiss (used with permission)

Mason. Clipart ETC, Florida Center for Instructional Technology  
[http://etc.usf.edu/clipart/19500/19544/mason\\_19544.htm](http://etc.usf.edu/clipart/19500/19544/mason_19544.htm)

Canal Boat and Mules. Library of Congress, Reproduction Number: LC-USZ62-68308  
<http://www.loc.gov/pictures/item/2004668361/>

Locks on the Erie Canal. Clipart ETC, Florida Center for Instructional Technology  
[http://etc.usf.edu/clipart/55600/55616/55616\\_erie\\_canal.htm](http://etc.usf.edu/clipart/55600/55616/55616_erie_canal.htm)

Erie Canal Map (edited)  
<http://eriecanalmap.com/>

Row houses, Philadelphia. Library of Congress, Reproduction Number: LC-USF34-064150-D  
<http://www.loc.gov/pictures/item/fsa2000044855/PP/>

View of Erie Canal by John William Hill, 1829  
<http://www.history.rochester.edu/canal/>

## Chapter 3

**Brick molder.** Library of Congress, Reproduction Number: LC-USF33-012819-M3  
<http://www.loc.gov/pictures/item/lsa1998001448/PP/>

**Drying brick.** Library of Congress, Reproduction Number: LC-USZ62-94329  
<http://www.loc.gov/pictures/item/92516505/>

**Adobe construction.** Library of Congress, Reproduction Number: LC-USF33-012826-M1  
<http://www.loc.gov/pictures/item/lsa1998001481/PP/>

**Andrew Jackson. Painting by Thomas Sully, 1824**  
<http://www.loc.gov/pictures/item/99404956/>

**Saint Louis, MO in 1855.** Library of Congress, Reproduction Number: LC-DIG-pga-01318  
<http://www.loc.gov/pictures/item/2006690475/>

**Hephaistos. Clipart ETC, Florida Center for Instructional Technology**  
[http://etc.usf.edu/clipart/1400/1451/hephaistus\\_1.htm](http://etc.usf.edu/clipart/1400/1451/hephaistus_1.htm)

**Masonic symbol. Clker.com, by William**  
<http://www.clker.com/clipart-120258.html>

**Coalbrookdale at night (1801) by Philip Jakob Louthembourg the Younger**  
[http://commons.wikimedia.org/wiki/File:Philipp\\_Jakob\\_Louthembourg\\_d.\\_J.\\_002.jpgrbourg\\_d.\\_J.\\_002.jpg](http://commons.wikimedia.org/wiki/File:Philipp_Jakob_Louthembourg_d._J._002.jpgrbourg_d._J._002.jpg)

**Factory buildings, ca. 1870.** Library of Congress, Reproduction Number: LC-DIG-ppmsca-23156  
<http://www.loc.gov/pictures/item/2004662457/>

**Locomotive tunnel, 1895.** Library of Congress, Reproduction Number: LC-D426-713  
<http://www.loc.gov/pictures/item/2004707438/>

## Chapter 4

**Michelangelo Moses. Wikipedia: Prasenber**  
[http://en.wikipedia.org/wiki/File:Moses\\_San\\_Pietro\\_in\\_Vincoli.jpg](http://en.wikipedia.org/wiki/File:Moses_San_Pietro_in_Vincoli.jpg)

**Stone replacement drawing. Historic Scotland (used with permission)**  
<http://www.historic-scotland.gov.uk/index.htm>

**Apatite crystals.**  
[http://en.wikipedia.org/wiki/File:Apatite\\_crystals.jpg](http://en.wikipedia.org/wiki/File:Apatite_crystals.jpg)

**Planting of U.S. flag. Clipart ETC, Florida Center for Instructional Technology**  
[http://etc.usf.edu/clipart/63400/63465/63465\\_flag.htm](http://etc.usf.edu/clipart/63400/63465/63465_flag.htm)

**Arthur MacArthur, 19 years old.**  
<http://www.offthemall.com/Military/civilwar/ulthm4.htm>

**Medal of Honor.** Library of Congress, Reproduction Number: LC-DIG-fsac-1a35467  
<http://www.loc.gov/pictures/item/lsa1994000002/PP/>

**Civil War battle.** Library of Congress, Reproduction Number: LC-USZC4-12604

<http://www.loc.gov/pictures/item/2005691156/>

**Reconstruction of the South.** Library of Congress, Reproduction Number: LC-DIG-pga-02837

<http://www.loc.gov/pictures/item/2004669124/>

**U.S. Custom House by Carol M. Highsmith.** Library of Congress, Reproduction Number: LC-DIG-highsm-10614

<http://www.loc.gov/pictures/resource/highsm.10611/>

**Confederate camp.** Library of Congress, Reproduction Number: LC-USZC4-13352

<http://www.loc.gov/pictures/item/2006686265/>

## Chapter 5

**Roosevelt at Union Station.** Library of Congress, Reproduction Number: LC-DIG-npcc-31775

<http://www.loc.gov/pictures/item/npc2008012276/>

**Washington, DC National Mall postcard.** Published by B.S. Reynolds/Colorcraft

<http://sidewalksprouts.wordpress.com/history/city-beautiful-movement/>

**Children's garden.** Library of Congress, Reproduction Number: LC-DIG-ggbain-14366

<http://www.loc.gov/pictures/item/ggb2005014366/>

**Bricklaying, Hampton Institute.** Library of Congress, Reproduction Number: LC-USZ62-59187

<http://www.loc.gov/pictures/item/98502981/>

**Young men at Hampton Institute.** Library of Congress, Reproduction Number: LC-USZ62-119869

<http://www.loc.gov/pictures/item/97515098/>

**Roosevelt and Rough Riders.** Library of Congress, Reproduction Number: LC-USZC4-7934

<http://www.loc.gov/pictures/item/96521936/>

**Union station.** Library of Congress, Reproduction Number: LC-USZ62-91596

<http://www.loc.gov/pictures/item/96511794/>

**Loggia-Union Station, DC.** Wikipedia: Agnostic Preachers Kid

[http://en.wikipedia.org/wiki/File:Loggia\\_-\\_Union\\_Station,\\_DC.jpg](http://en.wikipedia.org/wiki/File:Loggia_-_Union_Station,_DC.jpg)

**Union Station, Washington DC, wide angle.** Wikipedia: Derek Heidelberg

[http://en.wikipedia.org/wiki/File:Union\\_StationDC.jpg](http://en.wikipedia.org/wiki/File:Union_StationDC.jpg)

**General Calixto Garcia.** Clipart ETC, Florida Center for Instructional Technology

[http://etc.usf.edu/clipart/55900/55918/55918\\_garcia\\_calix.htm](http://etc.usf.edu/clipart/55900/55918/55918_garcia_calix.htm)

## Chapter 6

**Coliseum.** Karen's Whimsy

<http://karenswhimsy.com/roman-gladiators.shtm#>

Thomas Edison. Library of Congress, Reproduction Number: LC-USZ62-105139

<http://publicdomainclip-art.blogspot.com/2007/10/thomas-edison.html>

Removing the dead from the trenches. Library of Congress, Reproduction Number: LC-USZ62-62655

<http://www.loc.gov/pictures/resource/cph.3b10296/>

Photo of World of Concrete logo. Flickr: danieleralte.

<http://www.flickr.com/photos/46490238@N06/5363586041/>

Ingalls Building, Cincinnati. Don Prout, Cincinnati views.net (used with permission)

[http://www.cincinnativiews.net/downtown\\_buildings\\_1.htm](http://www.cincinnativiews.net/downtown_buildings_1.htm)

John Smith. Clipart ETC, Florida Center for Instructional Technology

[http://etc.usf.edu/clipart/30300/30387/johnsmith\\_30387.htm](http://etc.usf.edu/clipart/30300/30387/johnsmith_30387.htm)

## Chapter 7

Plasterers at the Hampton Institute, ca. 1900. Library of Congress, Reproduction Number: LC-USZ62-45706

<http://www.loc.gov/pictures/resource/cph.3a45892/>

Sistine Chapel. Wikipedia: Erzalibillas

[http://en.wikipedia.org/wiki/File:Creaci%C3%B3n\\_de\\_Ad%C3%A1n\\_\(Miguel\\_%C3%81ngel\).jpg](http://en.wikipedia.org/wiki/File:Creaci%C3%B3n_de_Ad%C3%A1n_(Miguel_%C3%81ngel).jpg)

Rosette. Evergreene Architectural Arts (used with permission)

<http://evergreene.com/projects/basilica-of-the-assumption-of-the-blessed-virgin-mary/>

Plaster repair. Evergreene Architectural Arts. Photo by author (used with permission)

New Amsterdam Theater after Restoration. Evergreene Architectural Arts (used with permission)

<http://evergreene.com/projects/new-amsterdam-theater/>

Winston Churchill. Cambridge College Archives Centre. Churchill Press Photographs: CHPH 1A/F2/29

[http://www.chu.cam.ac.uk/archives/education/churchill\\_era/illustrations/CHPH\\_1A\\_F2\\_29.php](http://www.chu.cam.ac.uk/archives/education/churchill_era/illustrations/CHPH_1A_F2_29.php)

Red Ball Express. U.S. Army Transportation Museum

[http://3.bp.blogspot.com/\\_TZ4zYEBSw1I/RdjKyPHE2UI/AAAAAAAAAOs/l6GmqrwABfA/s1600-h/black\\_history\\_red\\_ball\\_2.jpg](http://3.bp.blogspot.com/_TZ4zYEBSw1I/RdjKyPHE2UI/AAAAAAAAAOs/l6GmqrwABfA/s1600-h/black_history_red_ball_2.jpg)

Earl Barthé. Maida Owens, Louisiana Folklife Program, Louisiana Division of the Arts (used with permission)

<http://www.louisianafolklife.org/FOLKLIFEimagebase/FLImagesListing.asp?Page=3>

Eisenhower tours rubble of Warsaw. Library of Congress, Reproduction Number: LC-DIG-ppmsca-19261

<http://www.loc.gov/pictures/resource/ppmsca.19261/>

Firemen in bomb-damaged London. New Times Paris Bureau Collection, USIA, National Archives, Record Number: 306-NT-901C-11

<http://www.flickr.com/photos/pingnews/1858333045/>

Wreckage of Dresden. Eon Images, Eon ID: 4390 (used by permission)

<http://www.eonimages.com>

**Soldiers in Wernberg, Germany. National Archives, Record Number: 111-SC-205298**

<http://www.archives.gov/research/military/ww2/photos/images/ww2-120.jpg>

**USS Mason Crew. U.S. Navy. National Archives, Record Number: 080-G-218861**

<http://www.history.navy.mil/photos/images/g210000/g218861.jpg>

## Chapter 8

**Tom Sawyer whitewashing a fence. Library of Congress, Reproduction Number: LC-USZ62-72507**

<http://www.loc.gov/pictures/item/2003665527/>

**Sergeant Joseph C. Rodriguez. Obregon/CMH Foundation.**

<http://www.obregoncmh.org/theforty/JosephRodriguez.html>

**Urban Sprawl, Los Angeles. Flickr: ATIS547**

<http://www.flickr.com/photos/albaum/1362641756/>

**Map, Areas of Freedom and Slavery in 1820 A.D. The Work of God's Children.**

[http://www.marysrosaries.com/collaboration/index.php?title=File:Areas\\_of\\_Freedom\\_and\\_Slavery\\_in\\_1820\\_A.D.\\_001.JPG/](http://www.marysrosaries.com/collaboration/index.php?title=File:Areas_of_Freedom_and_Slavery_in_1820_A.D._001.JPG/)

**Tract houses by Dorothea Lange. Library of Congress, Reproduction Number: LC-USF34-019627-C**

<http://www.loc.gov/pictures/item/fsa2000003159/PP/>

## Chapter 9

**Ludwig Mies van der Rohe. The Steedman Exhibit, St. Louis Public Library**

<http://exhibits.slpl.org/steedman/data/Steedman240088950.asp?thread=240091124>

**Woolworth Building under Construction. Library of Congress, Reproduction Number: LC-DIG-ggbain-10570**

<http://www.loc.gov/pictures/item/ggb2004010570/>

**The Renaissance Center, Detroit, MI. Wikimedia: Yavno**

<http://commons.wikimedia.org/wiki/File:RenCen.JPG>

**Urban photo by Eric Bowers**

<http://www.urbanphoto.net/blog/author/bowers/>

**Booker T. Washington. Clipart ETC, Florida Center for Instructional Technology**

<http://etc.usf.edu/clipart/mysearch.php?searchWords=Booker+T.+Washington+&mySubmit=Search>

## Chapter 10

**Maintenance is Preservation by George Martin. Plaster restoration workshop, Hopewell Furnace National Historical Site (used with permission of Lisa Sasser)**

<http://www.nps.gov/hofu/index.htm>

**Penn Station. Library of Congress, Reproduction Number: LC-USZ62-74598**

<http://www.loc.gov/pictures/item/2003677433/>

**Eddystone Lighthouse. Clipart ETC, Florida Center for Instructional Technology**

[http://etc.usf.edu/clipart/15100/15141/eddylight\\_15141.htm](http://etc.usf.edu/clipart/15100/15141/eddylight_15141.htm)

**Faneuil Hall. Clipart ETC, Florida Center for Instructional Technology**

[http://etc.usf.edu/clipart/13500/13583/faneuil\\_13583.htm](http://etc.usf.edu/clipart/13500/13583/faneuil_13583.htm)

**Warsaw 1945. Polish archive, Marek Tuszyński's collection**

[http://upload.wikimedia.org/wikipedia/commons/1/12/Rebuilding\\_of\\_Warsaw\\_%281945%29.jpg](http://upload.wikimedia.org/wikipedia/commons/1/12/Rebuilding_of_Warsaw_%281945%29.jpg)

**Warsaw Today. Collection of Irv Detwiler (used with permission)**

**Dresden, 1990. Frauenkirche in Dresden by Jim Winstead**

<http://www.flickr.com/photos/jimwinstead/173973236/>

**Frauenkirche Today. Collection of Irv Detwiler (used with permission)**

**London Blitz. New Times Paris Bureau Collection, USIA, National Archives, Record Number: 306-NT-3173V**

<http://www.flickr.com/photos/pingnews/1858060385/>

**Civilian Conservation Corps. Library of Congress, Reproduction Number: LC-USF34-061420-D**

<http://www.loc.gov/pictures/item/fsa2000042047/PP/>

**Solomon's Temple. Clipart ETC, Florida Center for Instructional Technology**

[http://etc.usf.edu/clipart/69600/69686/69686\\_temple.htm](http://etc.usf.edu/clipart/69600/69686/69686_temple.htm)

## Chapter 11

**Slate Shapes. Durableslate.com**

<http://www.durableslate.com/faq.html>

**Refrigerator Perry by Ryan Ballinger.**

**Montgomery Plaza. Montgomeryplaza.com**

<http://montgomeryplaza.com/montgomery-plaza/>

**Album Cover of "Up on the Roof" by The Drifters (Rhino)**

<http://www.rhino.com/shop/product/the-drifters-the-roof-the-best-the-drifters-us-release>

## Chapter 12

**FlatIron Building. Library of Congress, Reproduction Number: DN-0001198A. Chicago Daily News negatives collection, Chicago History Museum**

<http://hdl.loc.gov/loc.ndlpcoop/ichicdn.n001198a>

**Green Roof Layers. Rand Engineering and Architecture, PC (used with permission)**

[http://www.randpc.com/improve/cis\\_GreenRoofFactSheet.html](http://www.randpc.com/improve/cis_GreenRoofFactSheet.html)

**Saint Thomas Builders Square. The Work of God's Children**

[http://www.marysrosaries.com/collaboration/index.php?title=File:St\\_Thomas\\_Square\\_and\\_Spear\\_001.jpg](http://www.marysrosaries.com/collaboration/index.php?title=File:St_Thomas_Square_and_Spear_001.jpg)

**Butch O'Hare. Official U.S. Navy Photograph, Number: 80-G-K-13830**

<http://www.ibiblio.org/hyperwar/OnlineLibrary/photos/images/k13000/k13830.jpg>

**World War II Combat. The Armchair Empire**

<http://www.armchairempire.com/Previews/multi-platform/heroes-of-the-pacific.htm>

**Laser Image used with permission from Historic Scotland**

<http://www.historic-scotland.gov.uk/index/heritage/conservation/conservation-initiatives/laserscanning.htm/>

**Hanging Gardens of Babylon. Public Domain Clip Art**

[http://2.bp.blogspot.com/\\_TZ4zYEBSw1I/RpEnElgEqrI/AAAAAAAAABl0/mG2vXjFXwEo/s1600-h/7\\_wonders\\_hanging\\_gardens\\_2.jpg](http://2.bp.blogspot.com/_TZ4zYEBSw1I/RpEnElgEqrI/AAAAAAAAABl0/mG2vXjFXwEo/s1600-h/7_wonders_hanging_gardens_2.jpg)

**Chicago City Hall under Construction. Library of Congress**

<http://memory.loc.gov/ndlpcoop/ichicdn/n0084/n008404.jpg>

**Chicago City Hall Green Roof by Tom Fletcher (used with permission)**

<http://ngm.nationalgeographic.com/2009/05/green-roofs/klinkenborg-text>

**What a Wonderful World**

Louis Armstrong

The Red Hot Jazz Archive

<http://www.redhotjazz.com/louie.html>

youtube link:

[http://www.youtube.com/watch?v=n5jIUZuk0JQ&feature=youtube\\_gdata\\_player](http://www.youtube.com/watch?v=n5jIUZuk0JQ&feature=youtube_gdata_player)

**Closing**

Evensong by Peter Ellenshaw

[http://www.swoyersart.com/peter\\_ellenshaw/evensong.htm](http://www.swoyersart.com/peter_ellenshaw/evensong.htm)

Louis Armstrong. Library of Congress, Reproduction Number LC-USZ62-127236

<http://www.loc.gov/pictures/resource/cph.3c27236/>

## About the Author



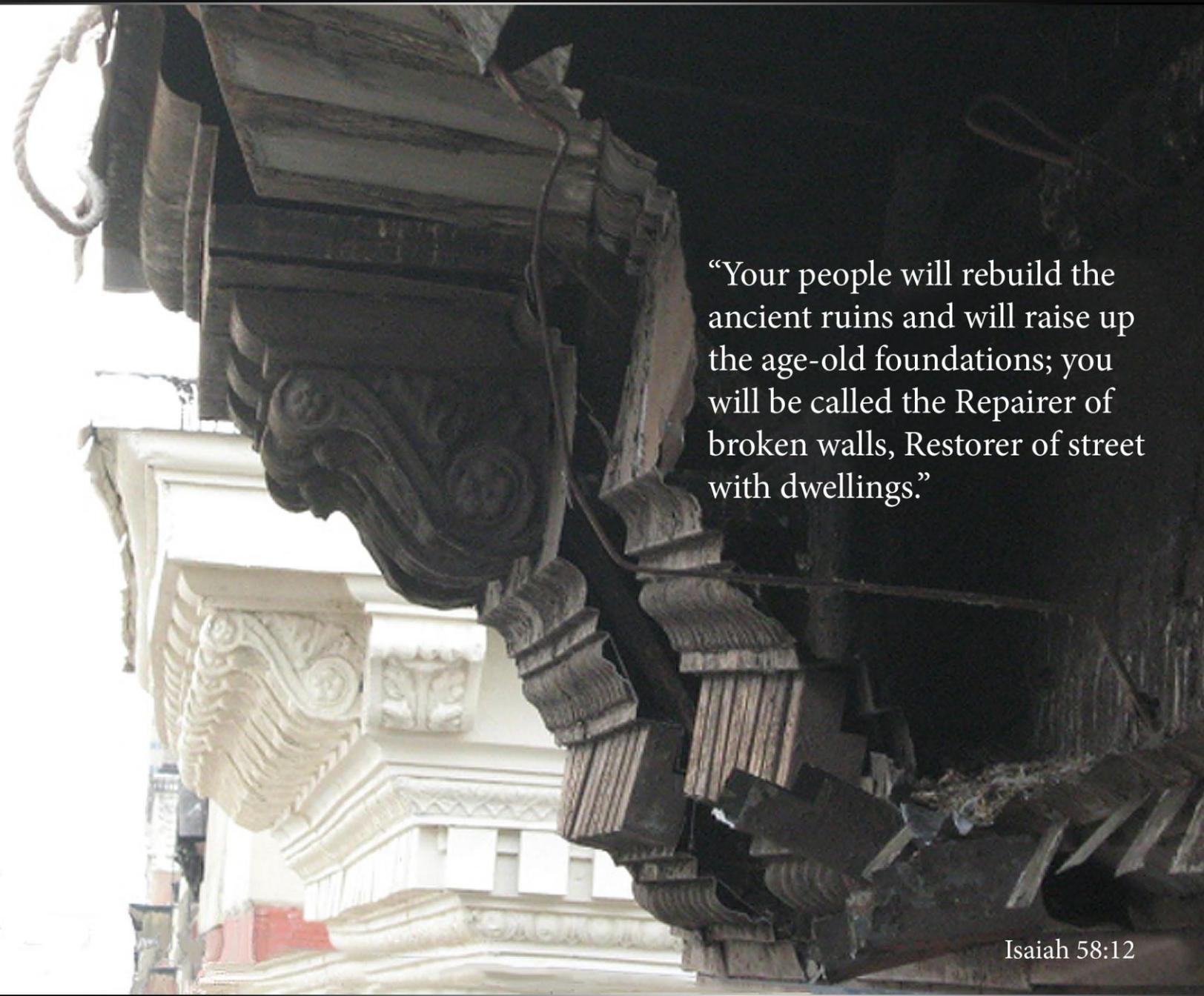
Thomas E. Russack is a third-generation New York City bricklayer with 40 years experience in the construction trades. He learned masonry from his uncle, Al Lutzkow, (NYC IMI Local #34) who gave him a trowel and an opportunity to learn the trade.

Mr. Russack is the Senior Project Associate for Rand Engineering & Architecture, P.C., a LEED Green Associate with Master's Degrees in Management and Historic Preservation. He has worked on thousands of buildings, including numerous National and New York City Landmarks.

He is currently the Masonry Preservation and Building Conservation Instructor for the Abyssinian Development Corporation's Workforce Development "YouthBuild" program, in Harlem. His Master's thesis, "The Development Of An Introductory Preservation Masonry Program For High School Age Students" is the basis of the training curriculum.

The textbook *Masonry, History, Integrity - An Urban Conservation Primer* is derived from all these experiences and was initiated by a grant from the National Park Service Division of Preservation Technology and Training.

He is the third of five brothers, and lives in Harlem with his wife and two daughters.



“Your people will rebuild the ancient ruins and will raise up the age-old foundations; you will be called the Repairer of broken walls, Restorer of street with dwellings.”

Isaiah 58:12