2ND. LARGEST INDUSTRY IN US

580,000+ SMALL BUSINESSES
10+ MILLION EMPLOYED
WHAT YOU MAY LEARN

- THEY DON’T BUILD THEM LIKE THEY USE TO - A HISTORY LESSON (AND THAT’S GOOD)
- YOU CAN’T FIX IT (AND THAT’S GOOD, TOO)
- COMPONENTS, ASSEMBLIES - HOW THEY MAY AFFECT YOUR HOUSE
- HOW TO HIRE THE “APPROPRIATE” PERSON
- HOW TO (MAYBE) GET WHAT YOU EXPECTED
- COMMON PROBLEMS
- THE THIN LINE OF INSPECTION (AKA YOU GET WHAT YOU PAY FOR)
- HOW TO CONTRACT YOUR EXPECTATIONS
Residential Construction Systems and Maintenance

HOW DID IT ALL START?

This cave is perfect but drafty & cold

Neighborhood's Changing, I don't feel safe.

Need to get rid of the smoke and I want a new door

With the baby and your mother, we need more space

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
HOUSING DEVELOPED FROM AVAILABLE MATERIALS & NEEDS

Nature Provides

Humans Improvise Using What’s Available
A BRIEF RECENT U.S. HISTORY OF RESIDENTIAL, CONSTRUCTION

1700's

Antebellum

Post Civil War

Early 20th Century

URBAN

1700's

Antebellum

Post Civil War

Early 20th Century

RURAL

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
“WHICH MODEL TO FOLLOW?”

REGIONAL & PERSONAL

GREEN & GREEN
Bungalow Style

FRANK LLOYD WRIGHT
Falling Waters
Prairie Style

MIES VAN DER ROHE

Farnsworth House

UTILITARIAN & MANUFACTURED

LE CORBUSIER

"Form Follows Function"
"Less is More"

“The house is a machine for living in”.

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
AN INDUSTRY MATURS

PROBLEM

Hard to build- No Lay-Out
Bringing In Materials
Unsanitary
No Personal Space
Crowded
No Open Space
No Ownership

Required a New Way of Construction

MASS PRODUCTION ASSEMBLY LINE

SOLUTION

Subdivisions

New Towns

Reston, Va

Columbia, Md.

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
EVOLUTION OF LIGHT (RESIDENTIAL) CONSTRUCTION

US Industrial Revolution & WW I
- Agricultural Mechanical Revolution drives people to cities
- WW I ramps up mass production

Warren Bechtel & Steven Bechtel (Son)
1920’s & 1930’s Railroads & Hoover Dam
Construction by Process & Machinery
Time a consideration

As a Contractor there are three choices:
1. We can build a quality house
2. We can build a fast house
3. We can build an inexpensive house

As the Owner, you can make only two choices
(Old Axiom)
SECRET TO MASS (HOUSING) PRODUCTION: BUILD ‘CHASSIS’ FOR HOUSES JUST AS DETROIT DOES FOR AUTOMOBILES......
HENRY J. KAISER

Abraham Levitt & William Levitt (Son)
1930’s Luxury Homes in Westchester
Post WWII Basic 2-3 bedroom Cape Cod on Long Island
By 1955, one house completed every 16 minutes
Cost and Time can be FIXED
HOW TO CONTROL QUALITY, PRICE AND TIME?

Assemble, don’t build
Standardize components, don’t create
Simplify, don’t confuse

WWII Military-
Project Management
NASA-
Critical Path Project Management
PEOPLE STILL WANT TO CUSTOMIZE & PERSONALIZE
Evolution of Light (Component) Construction

- Handmade Doors & Windows → Standard Sizes and Shapes
- Plaster → Drywall
- Wood Beams → Trusses
- Single Strand Electrical Wire → 3-Wire Insulated
- Wood Sheathing & Sub-Floor → Plywood → Insulated Fiberboard
- Random Sizes → 2 foot x 4 foot Modules → Metric
- Terra Cotta & Lead Pipe → Cast Iron → PVC Pipe

Over 1,200 new products each year

Globalization Hits.....

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
<table>
<thead>
<tr>
<th>YEA!!</th>
<th>RAT’S!!</th>
</tr>
</thead>
<tbody>
<tr>
<td>THAT’S GOOD</td>
<td>THAT’S BAD</td>
</tr>
<tr>
<td><strong>EIFS</strong></td>
<td><strong>Leaks, Causes Rot &amp; Mold</strong></td>
</tr>
<tr>
<td>Durable, Inexpensive</td>
<td></td>
</tr>
<tr>
<td><strong>Synthetic Stucco</strong></td>
<td></td>
</tr>
<tr>
<td>Inexpensive, Paintable</td>
<td></td>
</tr>
<tr>
<td><strong>Aluminum Siding</strong></td>
<td><strong>Dents, Alum Nails Fail</strong></td>
</tr>
<tr>
<td>Inexpensive, Paintable</td>
<td></td>
</tr>
<tr>
<td><strong>Drywall</strong></td>
<td><strong>Joints Show and Fail</strong></td>
</tr>
<tr>
<td>Inexpensive, Paintable</td>
<td></td>
</tr>
<tr>
<td><strong>Aluminum Wiring</strong></td>
<td><strong>Heat, Expands/Contracts</strong></td>
</tr>
<tr>
<td>Inexpensive, Good Conductor</td>
<td></td>
</tr>
<tr>
<td><strong>QUEST Pipe</strong></td>
<td><strong>Joints Leak, Brittle w/ Age</strong></td>
</tr>
<tr>
<td>Quick Connect, Easy Runs</td>
<td></td>
</tr>
<tr>
<td><strong>“Hanging” Decks</strong></td>
<td><strong>Rots Band Board- Collapse</strong></td>
</tr>
<tr>
<td>Direct House Connection</td>
<td></td>
</tr>
</tbody>
</table>

Following process is KEY to preventing problems-

NO MORE “OLD SCHOOL”
COMPONENTS & LIFE SPANS

ALL COMPONENTS HAVE DIFFERENT LIFESPANS

WE ACCEPT THE NEED TO FIX A LEAKY SUN ROOF

WE BALK AT THE NEED TO FIX A LEAKY HOUSE ROOF

THE OLDER A HOUSE GETS THE MORE MAINTENANCE IT REQUIRE
UNTIL..... MAINTENANCE BECOMES ALMOST CONTINUOUS

NEW PRODUCTS COBBLED ON OLD HOUSES

"MAKING IT FIT"

ENLARGING EXISTING TO ACCOMMODATE NEW

FINDING THE UNEXPECTED

PLUS- WE KEEP FINDING NEW THINGS WE WANT IN HOUSES

BUT WHY NOW? NEVER HAD SO MUCH MAINTENANCE BEFORE!
WHY ARE MAINTENANCE & RENOVATION PROJECTS GROWING?

#1: Entropy- AKA Varying Component Lifespans

#2: Longer Stay at the Same House

#3: Changing Lifestyles & Working From Home

#4: Efficiencies- we want it cheaper, faster,

#5: Regulations and Building Code Updates
"I said from the very beginning, I don't want a big house, I don't want big grounds, I don't want the trouble with the maintenance and all of that."

Nancy Reagan

"Our summer cottage in Newport is frightfully expensive."

Alice Vanderbilt

“No man who owns his own house and lot can be a Communist. He has too much to do”

William Levitt

1952
#2 LIVING IN THE SAME HOUSE LONGER

Mobility rates age 65+

- 1990-1995: 16.8%
- 2010: 5.4%
- 2016: 1.7%

**US Census Mobility Rates**

**Translation:**
We are outliving the lifecycle of components of our homes

- Roofing
- Wood rot
- Windows

**OLD WAY:**
House needs:
* New Roof
* Another bath

**NOW:**
Replace in Place !!
#3 CHANGING LIFESTYLES

Changing Lifestyles

- Family Rooms ➔ Media Rooms
- Dining Room ➔ Entertainment Kitchens
- Master Closets ➔ Fitness Rooms
- Porches / Decks ➔ Sun Rooms, Hot Tubs

Internet Based Workforce

- Libraries ➔ Home Offices ➔ His Office / Her Office

Multi-generational living

- Extra Bedroom ➔ In-House Suites

Cost

- A fraction of the cost of new

Does anyone remember
- Parlors
- Receiving Rooms
- Sleeping Porches
- Tea Rooms
- Mud Rooms
#4 EFFICIENCIES- CHEAPER FASTER

Environmental Awareness

Less Pollution

Lower Operating Costs

Improved Products

Longer Lifespans

Less Maintenance with Greater Performance

New Products

Things we didn’t know we couldn’t live without

Multi-functional products
#5 REGULATIONS & BUILDING CODE UPDATES

Local & State

Building code updates every two years

- Building
- Mechanical
- Fire
- Electrical
- Plumbing

Local Ordinances

- Site & Drainage
- Chesapeake Bay
- Tree
- Buffers

Federal

- Lead Paint
- Asbestos
- OSHA
- Wetlands
- Fish & Wildlife

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
END OF SESSION #1

Questions?

INSTRUCTOR- JOE CROSS
ELEMENTS OF MAINTENANCE

CSI CONSTRUCTION SPECIFICATIONS INSTITUTE

01 GENERAL CONDITIONS
02 EXISTING CONDITIONS
03 CONCRETE
04 MASONRY
05 METALS
06 WOOD, PLASTICS & COMPOSITES
07 THERMAL & MOISTURE PROTECTION
08 OPENINGS
09 FINISHES
10 SPECIALTIES
11 EQUIPMENT
12 FURNISHINGS
13 SPECIAL CONSTRUCTION
14 CONVEYING EQUIPMENT
15 FIRE SUPPRESSION
16 PLUMBING
17 HEATING VENTILATING & AIR CONDITIONING
18 INTEGRATED AUTOMATION
19 ELECTRICAL
20 COMMUNICATIONS
21 ELECTRONIC SAFETY & SECURITY
22 EARTHWORK
23 EXTERIOR IMPROVEMENTS
24 UTILITIES
25 TRANSPORTATION
26 MATERIALS PROCESSING & HANDLING
27 ELECTRICAL POWER GENERATION

SYSTEMATIC WAY OF COVERING ALL CONSTRUCTION

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
ELEMENTS OF MAINTENANCE

Existing Conditions
FROM THE GROUND UP: SOIL

Dirt’s Dirt, Isn’t it?

O horizon (loose and partly decayed organic matter)
A horizon (mineral matter mixed with some humus)
E horizon (light colored, zone of leaching)
B horizon (accumulation of clay from above)
C horizon (partially altered parent material)
unweathered parent material

How to Use

1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.

4. List the map unit symbols that are in your area.

Symbols
27C
56B
131B
134A
148B
151C

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018

JC & York Co- it’s a marble cake
ELEME NTS OF MAINTENANCE

Existing Conditions
Foundation & Soil Profile- What you can’t see

ASSUMED SOIL BEARING CAPACITY 2,500 psf

Original Surface
Lot Clearing & Fill
Varies by type & compaction
1,000-4,000 psi
Clay Lens
Varies by moisture
100-12,000 psi
Unconsolidated
Silt – 800 psi
Consolidated Earth – 2,000-12,000 psi
ELEMENTS OF MAINTENANCE

CONCRETE (FOOTINGS, SLABS, DRIVEWAYS AND FLAT WORK)

Follow the PISS Rule:
Put In Some Steel
Concrete is strong but very brittle

MASONRY:
Brick, Concrete Block (CMU) & Stone
Costly, mostly footers, fireplaces and brick veneer

Concrete Strength
Varies according to the amount of Water or cement added from 50 psi to 18,000 psi. Standard mix for residential use is 2,500 psi

Cement
a powder of alumina, silica, lime, iron oxide, and magnesium oxide burned together in a kiln and finely pulverized and used as an ingredient of mortar and concrete;

Concrete
a composite material composed of coarse aggregate bonded with a fluid cement that hardens. Most concretes are lime
ELEMENTS OF MAINTENANCE

METALS
- Steel Beams
- Pipe Columns
- Angle Iron Lintels

WOOD
- Original Platform
- Framing System

PLASTICS & COMPOSITS

INTEGRATED CONCRETE FORMS (I C F)
INTEGRATED CONCRETE FORMS (ICF)

Insulating Concrete Forms (ICFs) are a type of construction material that is formed by hollowed foam blocks that are stacked along the exterior walls of a building, reinforced with steel rebar, and then filled with concrete. The ICFs insulate the concrete, using some of best insulating materials like Expanded Polystyrene (EPS) and create a resilient wall that provides energy efficiency, noise reduction, and strength to the overall structure.

Most ICF companies manufacture insulated concrete forms in 4”, 6”, 8” and 10” cavity widths and in several shapes.
Elements of Maintenance

Framing

Material Revolution-
Engineered Lumber
Wood Composites
Steel Studs
Wall Panels

Span
2 x 10 SYP 17’-4”
Wood Floor Truss 25’
Less Deflection

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
ELEMENTS OF MAINTENANCE

Treated Wood- Not so simple anymore

http://preservedwood.org/TechResources/SmartphoneApp.aspx
ELEMENTS OF MAINTENANCE

Thermal & Moisture Protection

Roofing
- Asphalt Type & Weight
- Metal
- Sheet Membranes
- Slope

Flashing
- Plumbing Vent Stocks
- Counter Flashing

Insulation
- Granular/Batt/Foam
- Air Stops
- Thermal Bridging

Caulking is for Boats
Sealants are for Construction

http://www.finehomebuilding.com/2004/05/01/making-sense-of-caulks-and-sealants
**Elements of Maintenance**

A Special Cross News Bulletin... MOISTURE LEVELS AFFECT ALL THINGS!!

### Moisture of Wood By Temperature & Humidity

<table>
<thead>
<tr>
<th>Temp</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>6.3</td>
<td>7.9</td>
<td>9.5</td>
<td>11.3</td>
<td>13.5</td>
<td>16.5</td>
<td>21</td>
</tr>
<tr>
<td>40</td>
<td>6.3</td>
<td>7.9</td>
<td>9.5</td>
<td>11.0</td>
<td>13.5</td>
<td>16.5</td>
<td>21</td>
</tr>
<tr>
<td>50</td>
<td>6.2</td>
<td>7.9</td>
<td>9.5</td>
<td>11.0</td>
<td>13.5</td>
<td>16.5</td>
<td>21</td>
</tr>
<tr>
<td>60</td>
<td>6.2</td>
<td>7.8</td>
<td>9.4</td>
<td>11.0</td>
<td>13.3</td>
<td>16.2</td>
<td>20.7</td>
</tr>
<tr>
<td>70</td>
<td>6.2</td>
<td>7.7</td>
<td>9.2</td>
<td>11.0</td>
<td>13.1</td>
<td>16</td>
<td>20.5</td>
</tr>
<tr>
<td>80</td>
<td>6.1</td>
<td>7.6</td>
<td>9.1</td>
<td>10.0</td>
<td>12.9</td>
<td>15.7</td>
<td>20.2</td>
</tr>
<tr>
<td>90</td>
<td>5.9</td>
<td>7.4</td>
<td>8.9</td>
<td>10.0</td>
<td>12.8</td>
<td>15.4</td>
<td><strong>19.8</strong></td>
</tr>
<tr>
<td>100</td>
<td>5.8</td>
<td>7.2</td>
<td>8.7</td>
<td>10.0</td>
<td>12.3</td>
<td>15.1</td>
<td>19.5</td>
</tr>
</tbody>
</table>

A 2% change in Humidity can expand hardwoods 1/32”
Kiln dried lumber delivered to a Virginia site will vary from 8%-18% +

Moisture Meters are **ESSENTIAL** to Quality Residential Construction

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
ELEMENTS OF MAINTENANCE

Openings – Doors & Windows

Energy Star.gov

What makes a window energy-efficient?

- Quality frame materials
- LOW “E” Coated Glass
- Argon Fill
- Spacer
- Insulated Frame
- Multiple Panes

Potential Savings
Tax Deductions
15% + Energy Save

Windows

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>U-FACTOR 1</th>
<th>SHGC 2</th>
<th>Prescriptive</th>
<th>Equivalent Energy Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>≤0.27</td>
<td>Any</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥0.28</td>
<td>≥0.32</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥0.29</td>
<td>≥0.37</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥0.30</td>
<td>≥0.42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Central</td>
<td>≤0.30</td>
<td>≤0.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Central</td>
<td>≤0.30</td>
<td>≤0.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southern</td>
<td>≤0.40</td>
<td>≤0.25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SKylights

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>U-FACTOR 1</th>
<th>SHGC 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>≤0.50</td>
<td>Any</td>
</tr>
<tr>
<td>North Central</td>
<td>≤0.53</td>
<td>≤0.35</td>
</tr>
<tr>
<td>South Central</td>
<td>≤0.53</td>
<td>≤0.28</td>
</tr>
<tr>
<td>Southern</td>
<td>≤0.60</td>
<td>≤0.28</td>
</tr>
</tbody>
</table>

Air Leakage ≤0.3 cfm/ft²

1  Btu/h ft² °F
2  Solar Heat Gain Coefficient

Energy Star.gov
ELEMENTS OF MAINTENANCE

Finishes, Specialties, Equipment & Furnishings

The sky is not the limit, only the beginning....

Zsa Zsa went home to find decorations for her new house. I’m not saying she went overboard, but when she returned, her shopping spree had lifted Hungry out of its post war depression. ..... Bob Hope.

“To infinity and beyond” (sign in a Va. Beach decorator’s shop)

Molded/extruded
Plastic Trim & Decorations

Wood, Laminate & Composite Floors

Dimensionally Stable
Machine Acrylic Finish
Easy to Install – Hard on Knees

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
## Elements of Maintenance

### Interiors & Finishes

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drywall</strong></td>
<td>Types, Thicknesses</td>
</tr>
<tr>
<td><strong>Finish Woods &amp; Molding</strong></td>
<td>Finger-jointed, Plastic, Hardwoods</td>
</tr>
<tr>
<td><strong>Paints &amp; Finishes</strong></td>
<td>Encapsulate, Low Volatility</td>
</tr>
<tr>
<td><strong>Closets &amp; Dressing Rooms</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Tile</strong></td>
<td>Thin-set, Thick-set, Commercial</td>
</tr>
<tr>
<td><strong>Commercial Cabinets - The Revolution</strong></td>
<td>Modular, Pre-finished, Oodles of Features</td>
</tr>
<tr>
<td><strong>Flooring</strong></td>
<td>Anything goes anywhere (remember the transition strip)</td>
</tr>
</tbody>
</table>
ELEMENTS OF MAINTENANCE

Plumbing - Distribution

Copper vs. Cross-Linked Polyethylene (PEX & XLPE)

Copper - Rigid, Expensive, Skilled Labor and Proven. Bursts on freezing, right angles, more joints.

Flexible - Flexible, Inexpensive, easy to run, requires little training, degrades in sunlight, fewer joints, higher pressures, expands on freezing.

Plumbing – Hot Water Supply

Tanks vs. Tankless

Tanks - Lower material & labor costs, Limited volume.

Tankless - Greater cost, Continuous volume

Popular in Europe and Japan because:
Fewer bathrooms and water fixture units
220 volt electrical system (vs. US 110 volt)

Unusually Large Water Bills & Leaks - What Happened?
Elements of Maintenance

Plumbing – Waste Disposal (Sewer) Lines

PVC replaced Cast Iron sewer pipe circa 1965.

Slope and the “Need for Speed”
Water needs at least ¼” of fall in one foot along a smooth surface to drain

Add solids and semi-solids and you need at least 2” in 12 feet to clear a line.

Add congealed grease, dirt, et. al. and you have a clog

Clean-outs, Metal Snakes & Power Washing

FYI- In James City & York, clogs are usually your problem unless the clog is in the manhole of street.
ELEMENTS OF MAINTENANCE

With over a 1,000 new products a year.....

Where can I find out about all these new products?

Without Googling and getting recommendations
For about 5,000 contractors near you!

SWEETS.com
(The Products Bible)

The Leading Building Product Information Source for Architects*
*Architect Needs Study, conducted by Kadence International

Click here to go directly to Sweets

Need Customer Care? Call now.
1-800-393-6343
or email us at:
support@construction.com

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
END OF SESSION #2

Questions?

INSTRUCTOR-
JOE CROSS

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
ELEMENTS OF MAINTENANCE

HVAC - Heating, Ventilation, Air Conditioning

DESIGN REVOLUTION

OLD

AMOUNT OF COOLING
(GROSSLY SIMPLIFIED)

+ GEOGRAPHIC LOCATION
+ TOTAL CUBIC FEET IN HOUSE
= TONS OF AC

OLD AIR VOLUME

NO. BEDROOMS X 150 CFM
LIVING RM & KITCHEN @ 240 CFM
BATHS @ 100 CFM

TO A TOTAL OF 1,800 CFM
(BECAUSE THAT WAS A STANDARD AIR HANDLER)

NEW

MANY FACTORS
• WINDOW GLASS/RM
• ORIENTATION OF RM
• SIZE OF RM
• TREE COVERAGE ON LOT
• CHIMNEY(S)
• CAN LIGHTS COVERED
• GAS OR ELECTRIC RANGE
• SIZE OF AIR VENTS
• LENGTH FROM SOURCE
• ETC.
Elements of maintenance

HVAC - Heating, Ventilation, Air Conditioning

Heat Pumps
Air Sourced
Ground Sourced

Perfectly Clear?
Oh, Sorry!
Let’s go to the cartoon......
ELEMENTS OF MAINTENANCE

HVAC- Heating, Ventilation, Air Conditioning

To see Video Shown in Class, Please go to YOUTUBE an paste this link

https://www.youtube.com/watch?v=14MmsNPtn6U&t=35s
Elements of maintenance

HVAC - Continued

SEER RATINGS
(Seasonal Energy Efficiency Ratings)

<table>
<thead>
<tr>
<th>Year</th>
<th>SEER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>6</td>
</tr>
<tr>
<td>1985</td>
<td>7</td>
</tr>
<tr>
<td>1991</td>
<td>8</td>
</tr>
<tr>
<td>2005</td>
<td>12</td>
</tr>
<tr>
<td>2013</td>
<td>13</td>
</tr>
<tr>
<td>2017</td>
<td>17</td>
</tr>
</tbody>
</table>

Filters - Change when you switch from heating to cooling cycles (2x/yR)

Warranties & How they work

New wrinkles

Programmable thermostats

Reasons you can fix your HVAC
1. You completely understand the previous video
2. You have a Mechanical Eng degree

Reasons you can’t fix your HVAC
1. It will void any warranty
2. It’s high voltage
3. You can’t buy the fried control board or leaked refrigerant gas

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
ELEMENTS OF MAINTENANCE

ELECTRICAL-

AMOUNT OF SERVICE
- 1950’s: 50 AMPS
- 1960’s: 150 AMPS
- 1970’s: 200 AMPS
- 1990’s: 400 AMPS

SERVICE DEPENDS ON NUMBER OF BREAKER SLOTS IN PANEL BOX

Breakers & Mini-breakers

WIRE
COPPER VS. ALUMINUM

JUNCTION BOXES
PLASTIC VS. METAL

USUAL ELECTRICAL ISSUES
CRITTERS
DEAD OUTLETS
LOOSE WIRES IN OUTLETS

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
Ohm’s Law / Watt’s Law

**Description and practical example:**

Ohm’s Law states the relationship between voltage, current, and resistance. Given the relationship between these three elements, once you know any two of them, it is possible to calculate the third. Watt’s Law is similarly useful in figuring out the relationship between power, voltage, and current.

**Electrical properties:**
- Electromotive Potential, measured in Volts, is represented by V (or E)
- Current, measured in Amperes, is represented with the letter I
- Resistance, measured in Ohms, is represented by R (or the Greek letter Ω)
- Power, measured in watts, is represented by the letter W

\[
\begin{align*}
\text{According to Ohm’s Law:} & \\
V & = I \times R \\
I & = \frac{V}{R} \\
R & = \frac{V}{I}
\end{align*}
\]

\[
\begin{align*}
\text{According to Watt’s Law:} & \\
P & = V \times I \\
P & = I^2 \times R
\end{align*}
\]

**Real world example:**
Suppose you wanted to figure out how many 500-watt lighting instruments you could plug into a circuit without blowing a fuse. First, you would need to know how much current can be drawn through the circuit. Most homes have 15 amp circuits installed. At MassArt, most of the circuits are on 20 amp circuit breakers. So the total power available would be:

\[
W = V \times I \quad (\text{Watts} = \text{Volts} \times \text{Amps})
\]

\[
110 \times 20 = 2200 \text{ watts}
\]

We multiply the volts times the amps (which are known quantities) and see that: 110V x 20amps = 2200 watts

So whatever we plug into our circuit has to be less than 2200 watts, because that’s all the power available in this circuit.

**Answer:** You could safely plug four 500-watt lights into the circuit (or two 1000watt lights) - with a 200 watt safety margin.

500 + 500 + 500 + 500 = 2000 watts
COMMON PROBLEMS

THE BIG THREE

MOISTURE
CRITTERS
LIFE SPANS

SOLUTIONS

HIGHER CRAWL SPACES
CRAWL SPACE FANS
CUT BACK/ REMOVE TREES
POSITIVE CRAWL SPACE DRAINAGE
POKE HOLE PLASTIC "CUPS"
POWER WASH SIDING DURING LOW HUMIDITY

MOISTURE

PRECIP 1990-2017 AVER 50”/YR
SUMMER REL HUMID 1990-2017 AVER 78%
ALL ORGANICS SOAK WATER INCLUDING INSECTS & RODENTS
MOLD STARTS GROWING IN MEDIA WITH AT LEAST 18 % MOISTURE
WOOD ROT STARTS AT 22% MOISTURE
AC DUCTS CONDENSE MOISTURE AT ABOUT 1 PINT/HR/10’ RUN
AFFECTS MOSTLY CRAWL SPACES, DECKS, SIDING AND TRIM

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
COMMON PROBLEMS

THE BIG THREE

MOISTURE

CRITTERS

LIFE SPANS

RODENTS
(SQUIRRELS/RATS/MICE)

INSECTS
(TERMITES & ROACHES)

LOVE DAMP CRAWLSPACES

TUNNELS

BIRDS
(WRENS/ FINCHES)

FERAL CATS
(DON’T FEED)

RABBITS
(DRAW OTHERS)

ALL LOVE ATTICS FOR NESTS

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
COMMON PROBLEMS

THE BIG THREE
MOISTURE
CRITTERS
LIFE SPANS

DEPENDS ON

• QUALITY OF MATERIALS
• PERIODIC MAINTENANCE
• LOCAL ENVIRONMENT
• USAGE

WARRANTIES:

• UNLICENSED – NONE
• LICENSED – 1 YR AFTER COMPL
• EQUIPMENT PASS-THRU VARIES

EVERY ENGINEERED PRODUCT HAS A DESIGNED LIFESPAN

MOST PROVIDE A WARRANTY TO END USER FOR A PORTION OF LIFESPAN USED

“Your use of our product may alter its life expectancy and the provided warranty.”

(Old Salesman’s disclaimer)

Go on, Go on, You saw the lady with a mustache. To see the bearded lady, you have to pay more. Quality pays you know.

WC Fields

Residential Construction Systems and Maintenance
Christopher Wren Association Lifelong Learning 2018
COMMON PROBLEMS

THE LESSER TWO

INCOMPATIBLE PRODUCTS

CONTRACTOR ERROR

Products are designed for wide application, but not every application

Conflicting local and federal rules can result in less optimal results

Local tradesmen may not follow the manufacturers instructions

Products can be used in unintended applications that don’t work.
COMMON PROBLEMS

THE LESSER TWO

INCOMPATIBLE PRODUCTS

CONTRACTOR ERROR

Lack of product knowledge and training

“Git-er-dun” philosophy

Inability to think through problems

Time of completion trumps quality

Lack of coordination between trades
COMMON PROBLEMS

FINALLY- EVERYTHING IS A SYSTEM

Designed and engineered as a system
Installed and serviced by trained and authorized representatives
For more and more specific applications
Forcing the local trades to specialize

Chimney Sweeps
Foundation Repairs
Plumbers who specialize in
Water Heaters
Sinks & Faucets

Decks & Patios
Insulation
Disposals & Clogs

Moisture

( Even Closets )
COMMON PROBLEMS

A WORD ABOUT THE BUILDING CODE

Dates at least back to the Code of Hammurabi
US- City of Baltimore 1859, Chicago Fire 1871
Hurricane Andrew- Florida

“IT MEETS CODE, IT PASSES”


THE BUILDING CODE IS A MINIMUM STANDARD

ONE STEP LESS IN ANY AREA AND THE HOUSE IS CONDEMNED FROM HABITATION

Yea!! Our house got a D-
COMMON PROBLEMS

BUILDING PERMITS AND CODE INSPECTIONS

**FACT:** Most Va. Localities require a building permit form any replacement

**FACT:** Many repair men don’t have a license capable of pulling a permit

**FACT:** Any homeowner can pull a building permit

**FACT:** The permit holder is responsible for inspections & meeting code

You take out the permit and the locality holds you responsible for meeting permit requirements.
COMMON PROBLEMS

REVIEWS AND CODE INSPECTIONS

**USUAL REVIEW & APPROVALS**

- Site Plan
- Erosion & Sedimentation Control Plan
- Storm water Management Plan
- Architectural & HOA approvals

**USUAL INSPECTIONS**

<table>
<thead>
<tr>
<th></th>
<th>Rough-In</th>
<th>Complete</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Plan &amp; E/S</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Clearing &gt; 2,000 sf</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Footer</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foundation &amp; Crawl Space</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Framing</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Roofing</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Electrical</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Plumbing</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Mechanical</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Insulation</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Special</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CALL MISS UTILITY

Homeowners & Contractors Request a Ticket Here!

Call Before You Dig

Va811.com

Dial 811 in Virginia

DOMINION WILL NOT SET METER AND ENERGIZE HOUSE WITHOUT

Certificate Of Occupancy

Residential Construction Systems and Maintenance

Christopher Wren Association Lifelong Learning 2018
COMMON PROBLEMS

A WORD ABOUT HOME INSPECTORS

The have their place in finding:
• Gross flaws in plain sight
• Symptoms
• Items that previously met code
  (but do not now).

They have their limitations in
• Using a check-off template method
• The amount of time they spend.
• Looking behind the symptoms
• Understanding system problems

ALWAYS ORDER A FULL REPORT

A STATE LICENSE IN ANY AREA IS NO GUARANTEE
INDUSTRY TRENDS

“WHICH MODEL TO FOLLOW?”

HOUSING INDUSTRY IS FOLLOWING THE AUTO INDUSTRY

EUROPEAN MODEL

LE CORBUSIER

"The house is a machine for living in”.

CAR & HOUSING REPAIRS INCREASINGLY REQUIRE A PRO