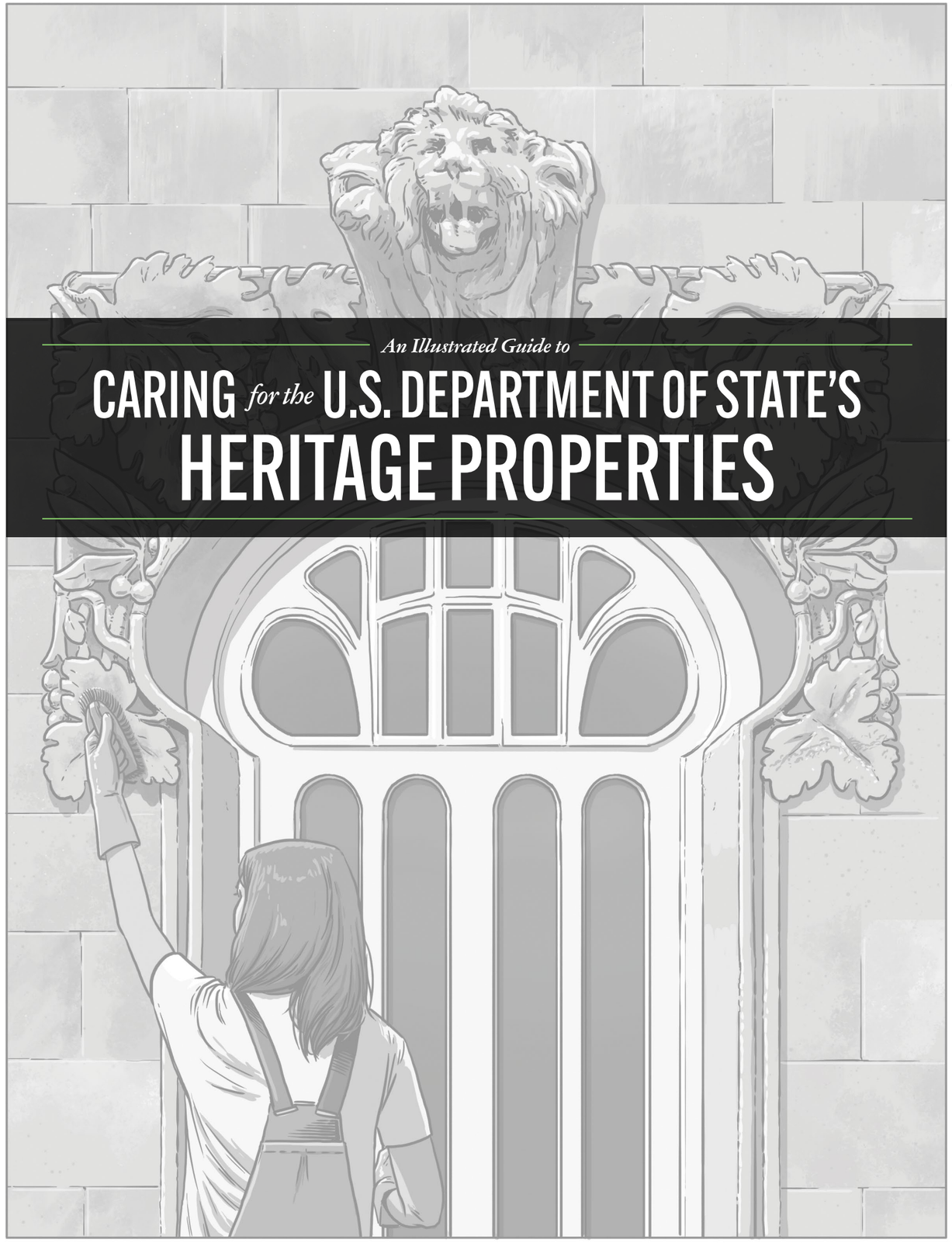
An Illustrated Guide to

CARING *for the* U.S. DEPARTMENT OF STATE'S HERITAGE PROPERTIES



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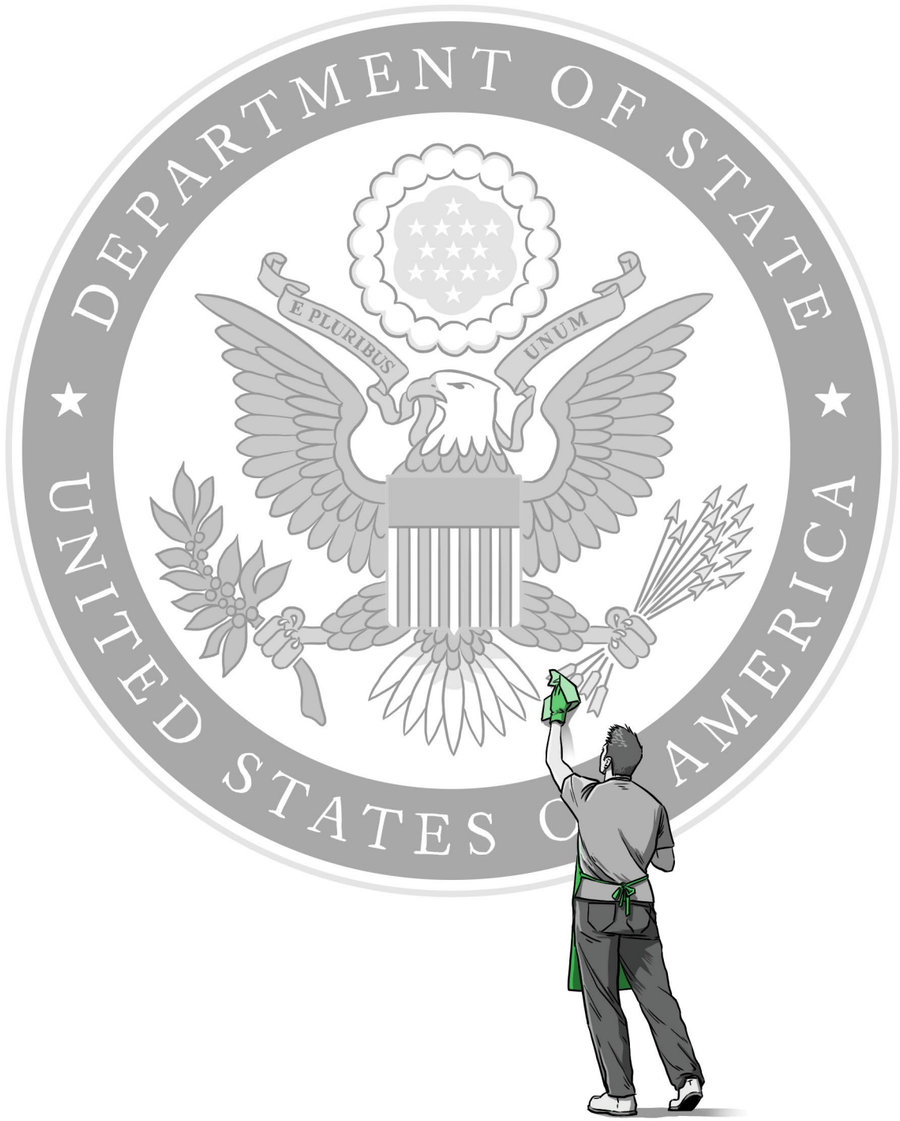

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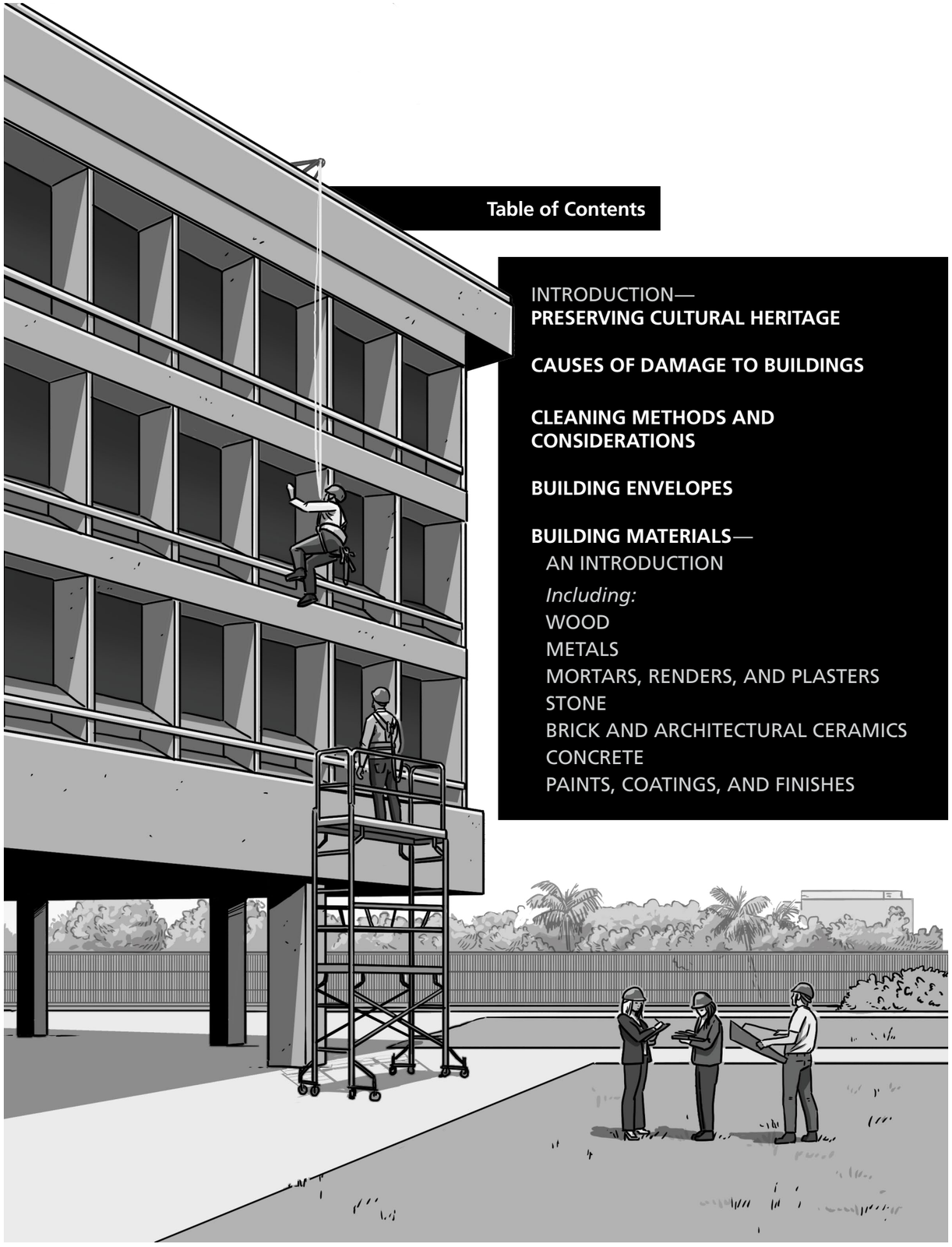
CARING *for the* U.S. DEPARTMENT OF STATE'S HERITAGE PROPERTIES

Created by Johnna Rizzo and Matthew Twombly

CULTURAL HERITAGE



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Introduction

Preserving Cultural Heritage

The Office of Cultural Heritage (CH) in the Bureau of Overseas Buildings Operations manages a stewardship program for the U.S. Department of State's culturally, historically, and architecturally significant properties. Care for the collection of buildings, landscapes, architectural elements, objects, and other heritage items is integral to the U.S. diplomatic mission abroad, strengthening communal ties through a shared cultural appreciation and preservation.

To preserve these properties' cultural significance, it is important to recognize that historic structures were created using traditional methods and materials that require compatible maintenance approaches. It is also important to note that this manual presents a specific perspective typical of contemporary Western conservation philosophy, but the U.S. Department of State's global portfolio requires sensitivity to diverse regional practices and perspectives. Effective preservation requires learning from local sources, materials, and methods while considering both the physical environment and cultural context. Some structures, such as a *tukul* in Ethiopia, carry ceremonial purposes and intangible values that must be respected and considered in their conservation.

The CH team, headquartered in Washington, D.C., with offices in Buenos Aires, London, Paris, and Rome, is available to assist with any questions or concerns about the Cultural Heritage portfolio. CH conducts site visits and works remotely with Facilities Management teams at post along with local specialists to preserve, repair, and restore heritage sites and structures for their continued appreciation and use.

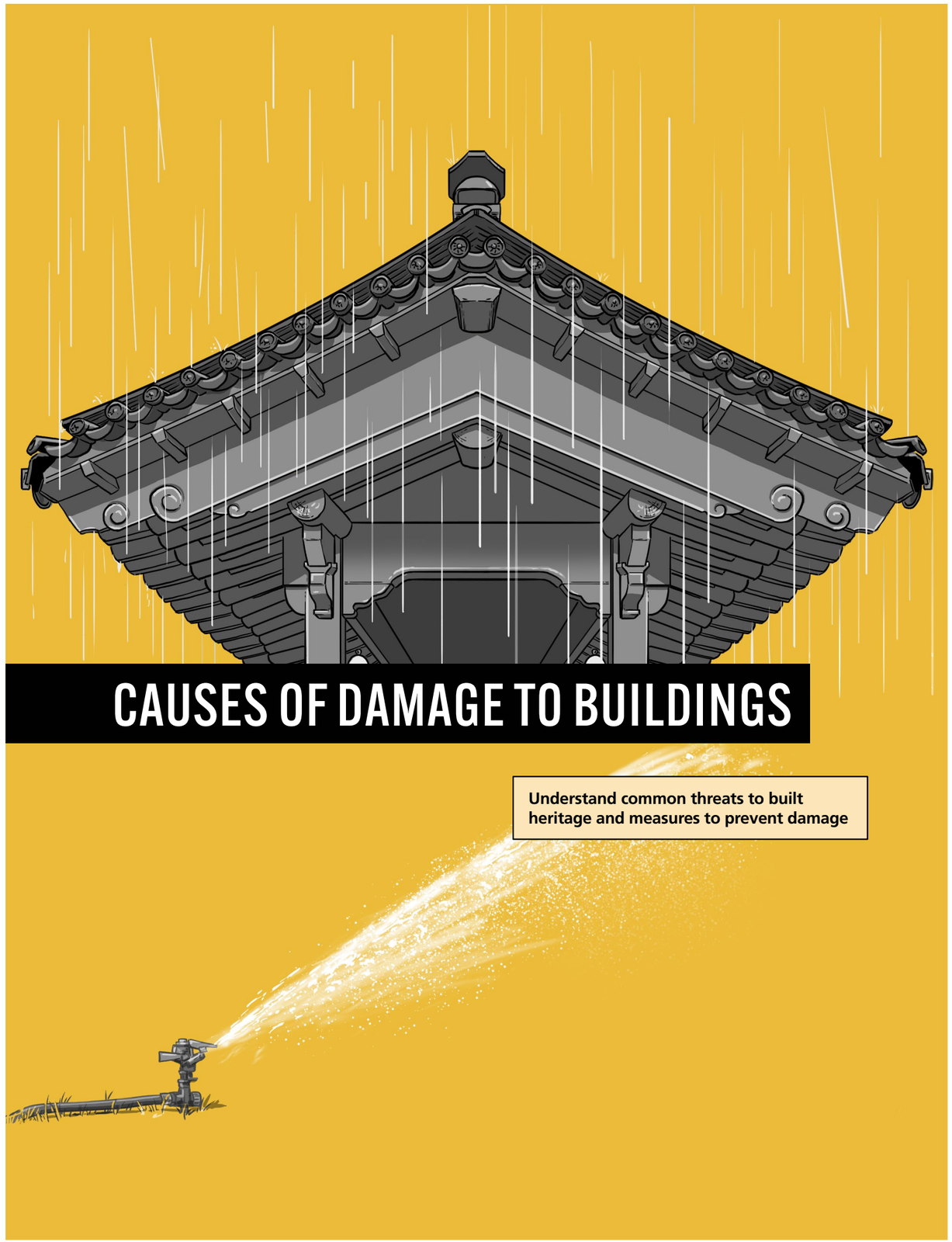
For daily stewardship, we depend on you.

The Preservation High Five

The "preservation high five" distills the core principles of heritage conservation to five key actions.

1. Identify and solve the cause of the problem.
2. Consider adverse impacts to heritage materials.
3. Use the gentlest, most effective method.
4. Use compatible materials and methods.
5. Prioritize retention over replacement.

Thank you for incorporating these principles into your preservation projects.



CAUSES OF DAMAGE TO BUILDINGS

Understand common threats to built heritage and measures to prevent damage

Causes of Damage to Buildings

CATASTROPHIC EVENTS HAPPEN TO HERITAGE PROPERTIES. BUT MORE OFTEN IT'S DAY-TO-DAY FACTORS THAT AFFECT THE SOUNDNESS OF A BUILDING.

FIXING DAMAGE AFTER THE FACT OR EVEN STAVING OFF DAMAGE AS IT IS OCCURRING ALONE IS INEFFECTIVE.

IT IS ESSENTIAL TO TREAT THE CAUSE AND FIND THE SOURCE— AND STOP IT FROM HAPPENING.

TYPICAL CAUSES OF DAMAGE INCLUDE:

NATURAL AND MAN-MADE DISASTERS,

INAPPROPRIATE MATERIAL CHOICES,

NEGLECT OR DEFERRED MAINTENANCE,

PESTS,

AND WATER. MORE OFTEN THAN NOT, WATER IS THE MECHANISM OF DECAY.

U.S. EMBASSY
HAVANA, CUBA

DAMAGE CAN MANIFEST IN A LOT OF DIFFERENT WAYS. YOU WILL SEE ANOMALIES LIKE:

CRACKING

DIFFERENTIAL SETTLEMENT

STAINING

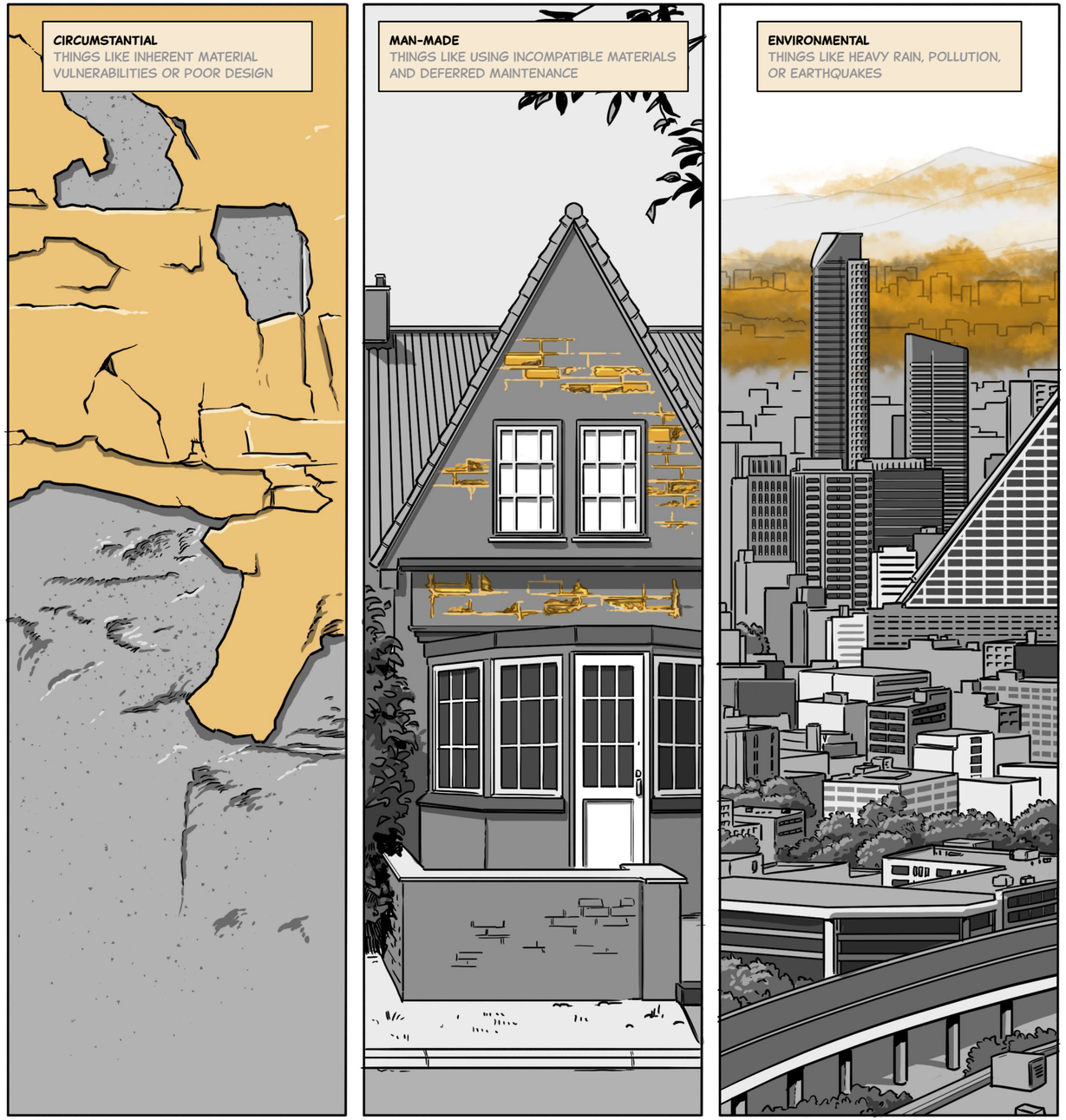
CORROSION

FRIABILITY

LOSS

THESE CAN BE EXACERBATED BY WELL-INTENTIONED BUT INCOMPATIBLE INTERVENTIONS THAT SOLVE THE SYMPTOMS BUT NOT THE UNDERLYING ISSUE, SUCH AS PAINTING OVER STAINS IN LIEU OF CLEANING.

DAMAGE SOURCES GENERALLY FALL INTO 3 CATEGORIES:

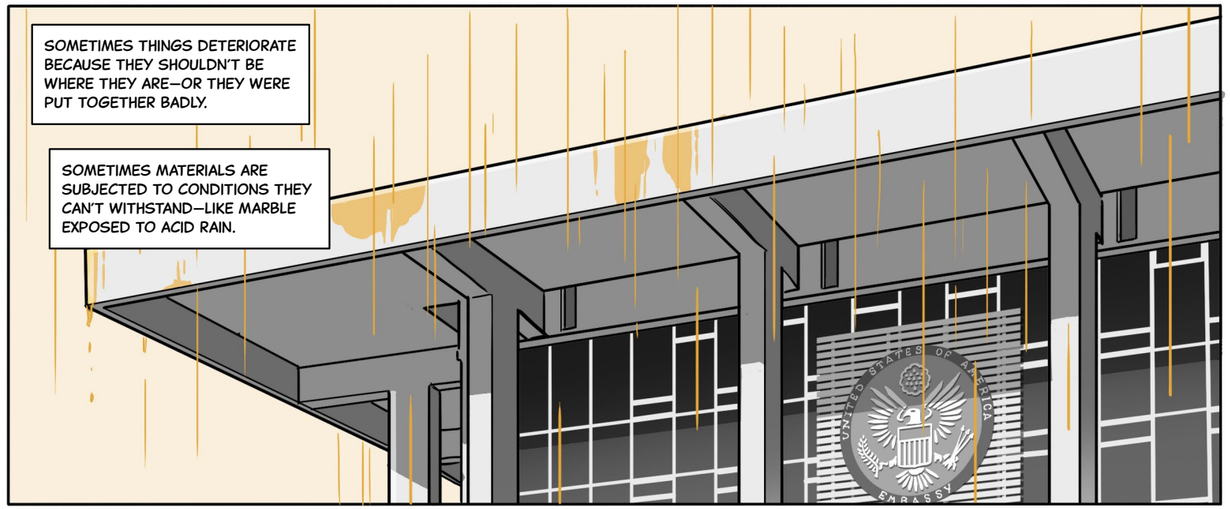


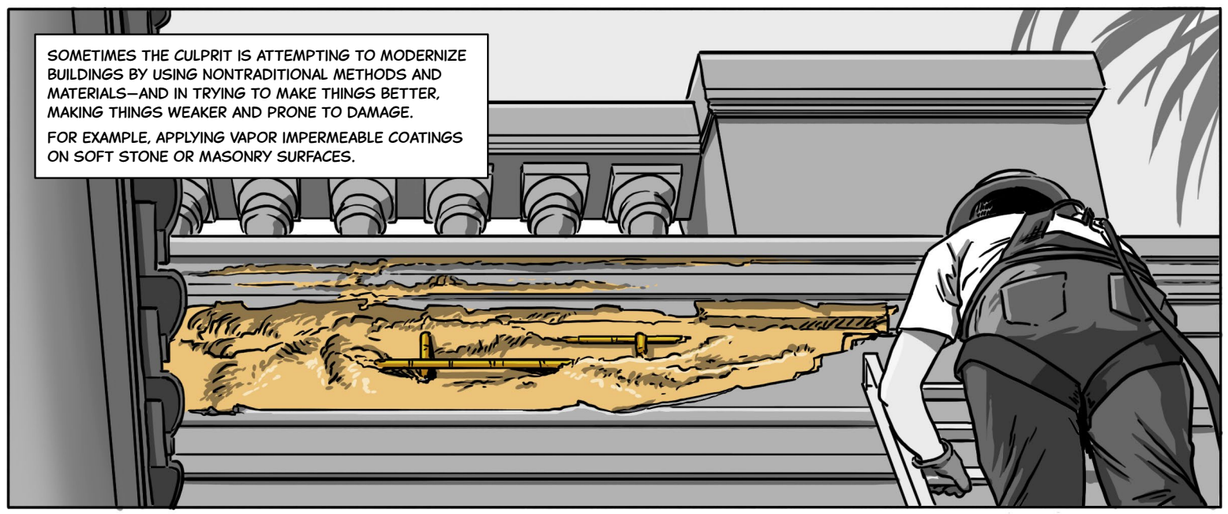
GETTING TO THE ROOT CAUSE OF DAMAGE IS A PROCESS OF ELIMINATION.

ASK:

- ☐ WAS THERE A BIG EVENT, LIKE AN EARTHQUAKE OR HURRICANE?
- ☐ ARE THERE OTHER, LESS SUDDEN, ENVIRONMENTAL FACTORS, LIKE WEATHERING?
- ☐ IS THE MATERIAL ITSELF AT FAULT DUE TO SOME INHERENT VULNERABILITY?
- ☐ IS THERE A MATERIAL INCOMPATIBILITY?
- ☐ IS THERE WATER AROUND—LEAKING, DRIPPING, OR SEEPING UNSEEN?
- ☐ WAS SOMETHING DONE INADVERTENTLY THAT SET OFF THIS PROBLEM?

Circumstantial Damage





SOMETIMES MATERIALS HAVE INHERENT CHARACTERISTICS THAT NEED TO BE MANAGED OR ACCEPTED.

FOR EXAMPLE, STONE MAY HAVE BEEN DYNAMITED WHEN QUARRIED AND MICRO-CRACKING WAS INTRODUCED.

OR STONE CAN HAVE INCLUSIONS THAT CAN IMPACT ITS MECHANICAL AND PHYSICAL QUALITIES DOWN THE ROAD.

OR NON-POTABLE OR SALT WATER OR UNCLEAN SAND COULD HAVE BEEN USED IN CONCRETE, WHICH IMPACTS DURABILITY.

SOMETIMES BRICKS WEREN'T FIRED AT THE RIGHT TEMPERATURE OR CERAMIC TILES WERE DAMAGED IN THE KILN.

OR TREES DIDN'T HAVE AN OPTIMAL GROWTH ENVIRONMENT.

SOMETIMES THINGS HAVE POOR DETAILING OR HAVE BEEN MODIFIED.

SOMETIMES THERE ARE UNSEEN MATERIAL INCOMPATIBILITIES IN SECONDARY MATERIALS, LIKE EMBEDDED REINFORCEMENT.

EXPOSURE TO MARINE SALTS, ACID RAIN, OR EVEN STANDING PUDDLES CHANGES THE ALKALINITY OF THE CONCRETE AND CREATES CONDITIONS THAT CAN AFFECT THE STEEL INSIDE, WHICH MIGHT START TO RUST, EXPAND, AND EXFOLIATE OR CRACK THE CONCRETE.

BAND-AID REPAIRS CAN EXACERBATE THE PROBLEM BECAUSE THEY DON'T ADDRESS THE UNDERLYING ISSUE. FOR EXAMPLE, BEFORE SPALLED CONCRETE IS REPAIRED, THE CORROSION ON THE SURFACE OF THE REBAR INSIDE THE CONCRETE THAT IS CAUSING THE SPALLING MUST BE CLEANED AND TREATED.

Man-made Damage

DESPITE BEST EFFORTS, CARETAKERS TOO MAY DAMAGE A MATERIAL. PERHAPS AN INTENTION TO IMPROVE PERFORMANCE INADVERTENTLY MAKES THINGS WORSE, LIKE INTRODUCING A RIGID MODERN MORTAR INTO A SOFTER HISTORIC STONE WALL.

POOR DECISION-MAKING CAN LEAD TO AVOIDABLE DAMAGE SUCH AS GALVANIC CORROSION, WHICH OCCURS BECAUSE DISSIMILAR METALS WERE PUT TOGETHER.

NEGLECT AND DEFERRED MAINTENANCE—OFTEN DUE TO NOT ENOUGH ACCESS OR LIMITED RESOURCES AND STAFF—ARE DAMAGE CULPRITS AS WELL.

AS IS USING—AND OVER-USING—BUILDINGS IN WAYS THAT WERE NOT ORIGINALLY INTENDED. EVENTS CAN TAX BUILDING LOADS.

MAN-MADE DISASTERS LIKE WAR HAPPEN ALL TOO OFTEN. BUT MORE OFTEN IT CAN BE EVERYDAY HUMAN ERROR THAT INSTIGATES DETERIORATION, EVEN IF WELL-MEANING.

AND BECAUSE OF THEIR PLACE IN DIPLOMACY, DEPARTMENT OF STATE BUILDINGS ARE AFFECTED BY WEAR AND TEAR FROM EVENT SETUP AND BREAKDOWN, AND FREQUENT CHANGES IN OCCUPANCY AND MANAGEMENT, OFTEN RESULTING IN QUICK-FIX APPROACHES OVER ACTUAL REPAIR AND REGULAR MAINTENANCE.

Environmental Damage

THOUGH MAJOR STRUCTURAL DAMAGES HAPPEN IN PLACES PRONE TO NATURAL DISASTERS LIKE EARTHQUAKES, IT IS THE INEVITABLE EVERYDAY FORCES OF NATURE THAT MOST OFTEN RESULT IN DAMAGE.

CARETAKING INVOLVES THINKING ABOUT A BUILDING'S CONTEXT—THE GEOGRAPHY, CLIMATE, AND SURROUNDINGS WHERE IT LIVES.

LIKE PROXIMITY TO THE OCEAN OR A BODY OF WATER.

OR CHEMICAL REACTIONS LIKE CORROSION BEING SPED UP BY WARM TEMPERATURES AND MARINE ENVIRONMENTS.

OR NEARBY TREES DROPPING THINGS THAT CAUSE STAINING OR CLOGGED GUTTERS.

OR A BUILDING'S ORIENTATION EXPOSING ONE SIDE TO ALL THE WIND-DRIVEN RAIN.

OR EXPOSURE TO HOT-AND-COLD CYCLES.

OR BIOLOGICAL GROWTH BECAUSE A BUILDING IS ALWAYS IN THE SHADE.

OR PLANTS AFFECTING DRAINAGE OR HAVING THEIR ROOTS ENCROACH.

OR EVEN DISRUPTIONS BELOW GROUND—LIKE A METRO.

NATURAL DISASTERS

CULTURAL HERITAGE BUILDINGS ARE ON SIX CONTINENTS, SO NATURAL DISASTERS OF EVERY KIND MAY AFFECT THEM.

EARTHQUAKES

WILDFIRES

HURRICANES, TYPHOONS, AND OTHER STORMS

TORNADOES

FLOODS

HURRICANES AND TYPHOONS AND THEIR ACCOMPANYING WIND AND WIND-DRIVEN RAIN AND SUBSEQUENT FLOODING ARE THE MOST FREQUENT CULPRITS OF NATURAL DISASTER DAMAGE.

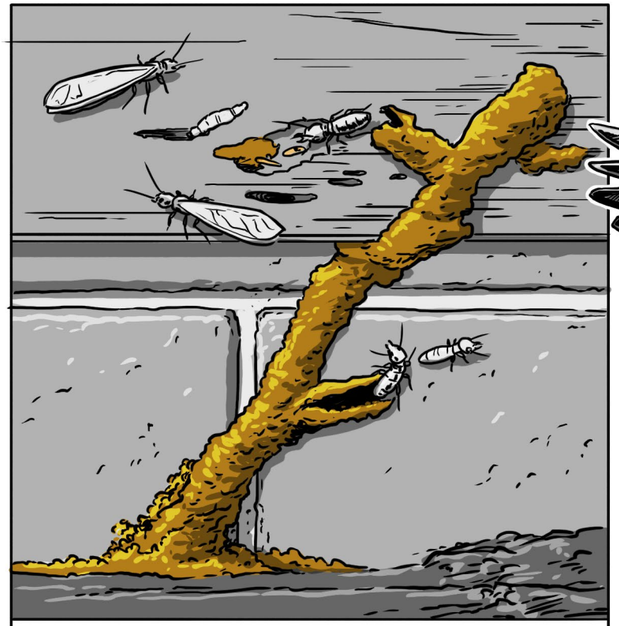
CLIMATE CHANGES CAN EXACERBATE THESE PROBLEMS.

LIGHTNING CAUSES FIRES AND TREES TO FALL DOWN ONTO BUILDINGS, AS WELL AS ELECTRICAL PROBLEMS.

*WELL-MAINTAINED BUILDINGS FARE BETTER IN DISASTERS WITH A HIGHER SURVIVABILITY.

PESTS

LOCATION, SITUATION, AND THE MATERIALS THAT YOUR BUILDING IS MADE OF ALL COME INTO PLAY WHEN IT COMES TO PESTS.



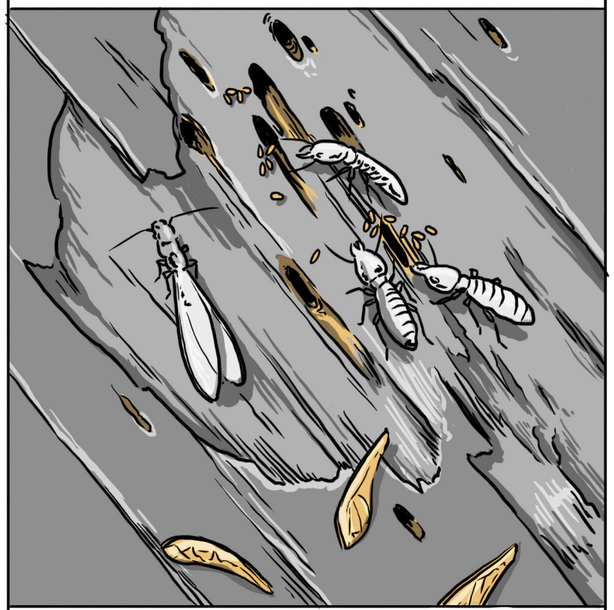
SUBTERRANEAN TERMITES:

LOOK FOR MUD TUBES, MUD-AND-SAWDUST FRASS, WINGS, FLYING INSECTS, HOLES OR CHANNELS IN WOOD.

*SUBTERRANEAN TERMITES EAT REALLY FAST.

DRYWOOD TERMITES:

LOOK FOR PINHOLES IN THE WOOD, FRASS PELLETS, WINGS, FLYING INSECTS.



ALSO MAKE SURE TO LOOK AT SHIPPING, BOTH SENT AND RECEIVED. CRATES OR CONTENTS COULD HAVE PESTS STOWING AWAY.

PIGEONS:

LOOK FOR BIRDS, POOP, NESTS.

BATS:

(CAN GET INTO WALLS AND ATTICS)

LOOK FOR POOP, WHICH CAN BE TOXIC.

RODENTS—INCLUDING MICE, RATS, AND SQUIRRELS:

(CAN GET INTO REALLY SMALL AREAS AND LOVE ATTIC SPACES)

LOOK FOR DROPPINGS, GNAW MARKS, SCURRYING.

Structural Damage and Deformation

MACRO

NOT ALL CRACKS ARE ACTIVE, PROBLEMATIC, OR INDICATIVE OF A STRUCTURAL ISSUE. CRACKS DO HOWEVER ALLOW WATER IN.

AN ENGINEER CAN HELP DETERMINE THE TYPE AND SEVERITY OF CRACKS.

SETTLEMENT AND DIFFERENTIAL SETTLEMENT: CAN AFFECT ALL KINDS OF MATERIALS, THOUGH BRITTLE AND RIGID BUILDINGS ARE MORE SUSCEPTIBLE TO DAMAGE THAN FLEXIBLE SYSTEMS

LOADING, THRUSTS, AND FAILURES: A RESULT OF FORCES SUCH AS COMPRESSION AND UPLIFT

A BUILDING'S PRIMARY STRUCTURAL ELEMENTS ARE ITS WALLS, WHICH SUPPORT VERTICAL LOADS (GRAVITY, SNOW, PONDING WATER) AND RESIST PERIODIC LOADS LIKE WIND AND EARTHQUAKES. WALLS DISTRIBUTE LOADS TO THE GROUND THROUGH FOUNDATIONS.

SECONDARY LOAD-CARRYING ELEMENTS ARE ROOFS AND FLOORS, WHICH DISTRIBUTE VERTICAL AND HORIZONTAL LOADS TO WALLS.

THERMAL AND MOISTURE MOVEMENT: DIFFERENT MATERIALS RESPOND DIFFERENTLY TO TEMPERATURE AND MOISTURE. SOME EXPAND AND CONTRACT MORE THAN OTHERS FROM EXPOSURE TO HEAT AND COLD AND MOISTURE ABSORPTION AND LOSS.

SEISMIC BEHAVIOR: SHAKING FROM EARTHQUAKES EXERTS HORIZONTAL FORCES. HEAVY OR TALL BUILDINGS ARE MORE PRONE TO DAMAGE FROM THESE FORCES THAN SHORT AND LIGHTWEIGHT BUILDINGS.

SHAKING MAY INDUCE CRACKING, DISPLACEMENT, SEPARATION OF WALLS AND FLOORS OR ROOFS, OR COLLAPSE.

MICRO

SOMETIMES THINGS START SMALL BUT WHEN LEFT UNMANAGED CAN WREAK AS MUCH DAMAGE AS A MACRO SOURCE—LIKE CORRODING I-BEAMS OR RUSTING REBAR.

ACID RAIN AND OTHER POLLUTANTS: CAN CAUSE CHEMICAL REACTIONS WITH MATERIALS

COLD AND WARM SPOTS IN BUILDINGS: RESULTS IN MICRO-CRACKING, FRIABILITY, SURFACE LOSS

BIOLOGICAL: MOLD, ALGAE, LICHENS, AND MOSS CREATE FILMS ON SURFACES; FUNGUS CAN EAT INTO OR CHEMICALLY ALTER MATERIALS.

PLANT MATTER: CAN BE BOTH PHYSICALLY AND CHEMICALLY DAMAGING TO POROUS SURFACES. THEY HAVE ROOTS AND THE BY-PRODUCTS OF THEIR GROWTH CAN BE ACIDIC.

IVY AND CREEPING PLANTS CAN BE EXTREMELY DESTRUCTIVE, AND YOU CAN'T SEE WHAT'S HAPPENING BEHIND THEM, CREATING BLIND DAMAGE.

OVERUSE OF BIOCIDES CAN ADD SALTS OR CREATE BIOFILMS THAT ARE RESISTANT TO TREATMENT.

SALTS: INTRODUCED FROM THE ATMOSPHERE OR CONSTRUCTION MATERIALS LIKE CEMENTITIOUS MORTARS

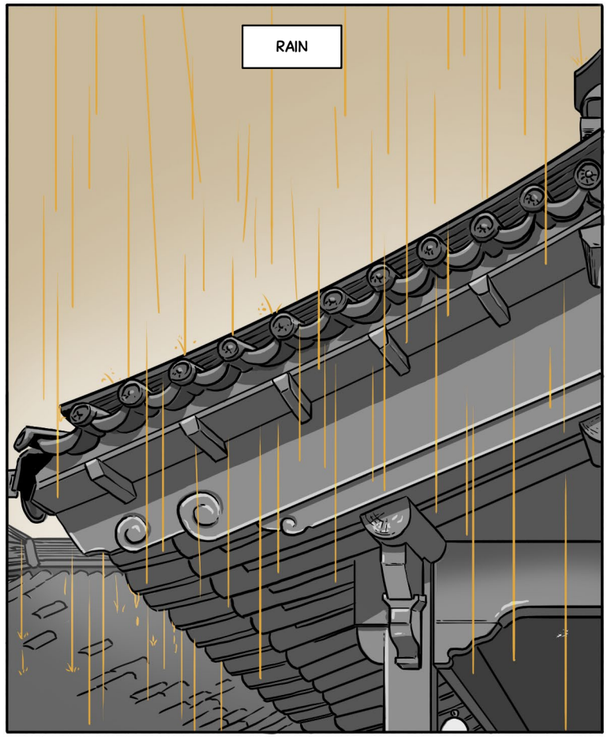
PEOPLE: IN OUR ATTEMPTS TO REPAIR THINGS WE CAN INTRODUCE INCOMPATIBLE MATERIALS.

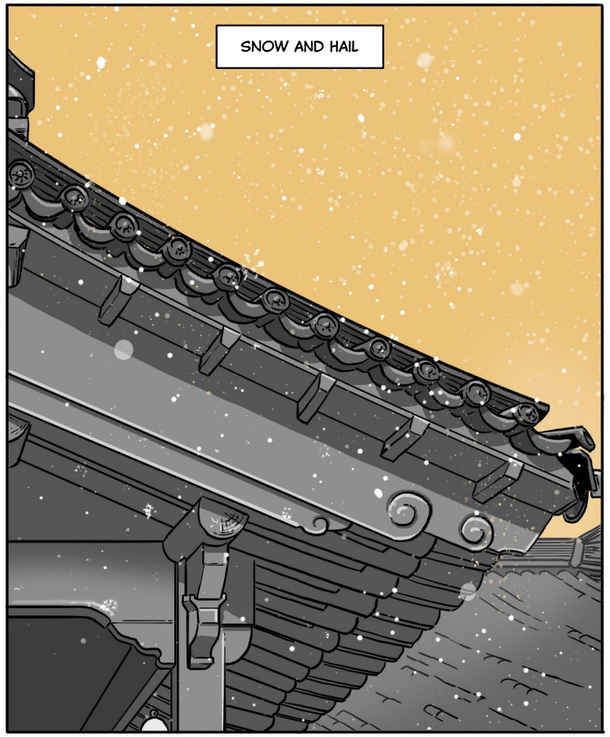
POOR DRAINAGE: PERHAPS GRADING ISN'T WORKING, SO WATER ISN'T BEING DIVERTED FROM THE BASE OF THE BUILDING, OR WATER ISN'T ROUTED OFF THE ROOF BECAUSE OF FLASHING ISSUES OR CLOGGED GUTTERS OR DOWNSPOUTS.

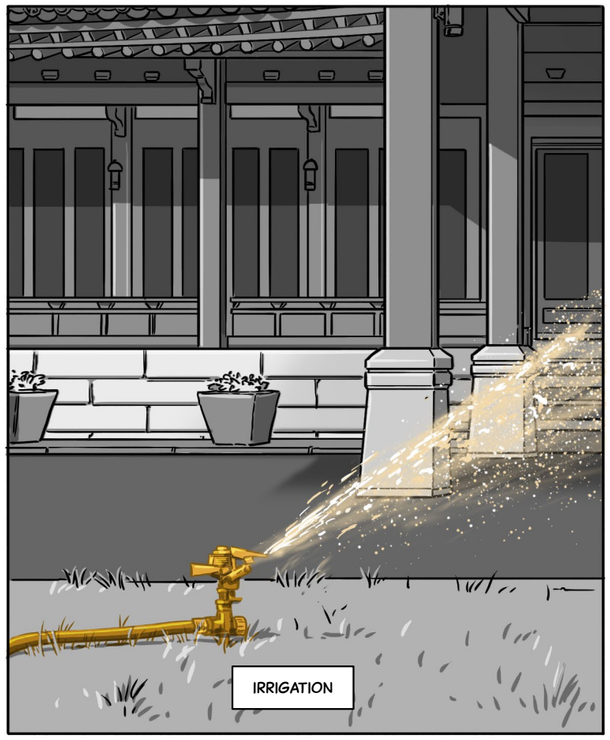
MOISTURE INGRESS: SUCH AS RISING DAMP BEING SOAKED UP LIKE A SPONGE INTO A WALL

Building Enemy No. 1: Water

WATER IS A HERITAGE STRUCTURE'S GREATEST THREAT. AND A STEADY ONE. A BUILDING IS UNDER CONSTANT SIEGE FROM

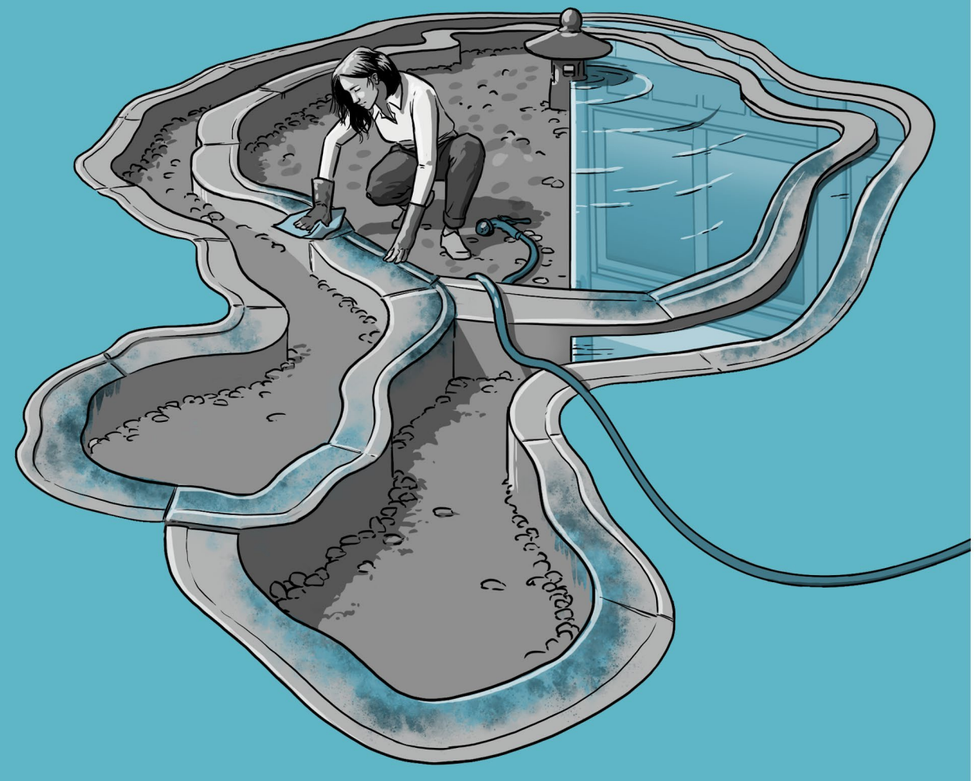






CLEANING METHODS AND CONSIDERATIONS

Guidance for routine cleaning and conservation projects



Cleaning Methods and Considerations

THE MALTA AMBASSADOR'S RESIDENCE, 1894, IS CONSTRUCTED OF LOCAL GLOBIGERINA LIMESTONE.

A RED PATINA DEVELOPS OVER TIME, ADDING HISTORY AND CONTEXT TO THE BUILDING.

CLEANING MUST BE CAREFULLY DONE TO PRESERVE THIS PATINA.

THE KEY TO PRESERVING PATINA AND THE VISUAL EVIDENCE OF THE PASSAGE OF TIME OF OUR HERITAGE PROPERTY COLLECTION IS A MINIMAL INTERVENTION APPROACH. IT MEANS ALWAYS TRYING THE GENTLEST METHOD OF CLEANING POSSIBLE FIRST, NO MATTER THE MATERIAL OR IF IT IS LOCATED INSIDE OR OUTSIDE.

TANGIER LEGATION
BUILT 1821

BIG DOESN'T ALWAYS MEAN TOUGH. AND JUST BECAUSE SOMETHING IS OUTSIDE DOESN'T MEAN IT ISN'T FRAGILE AND DOESN'T NEED SPECIAL CARE.

CONSIDER A BUILDING AS WELL AS ITS ENVIRONMENT. WHAT TYPES OF THINGS SURROUND IT AND ACT ON IT?

MAINTENANCE IS PREVENTATIVE AND INCREDIBLY IMPORTANT TO HELP AVOID DAMAGE AND FUTURE DETERIORATION OR LOSS.

The Right Kind of Cleaning

IT'S INCREDIBLY IMPORTANT TO CLEAN THE RIGHT WAY.

CLEANING ITSELF CAN DO DAMAGE OR MAKE EXISTING DAMAGE WORSE IF IMPROPER METHODS AND CLEANING MATERIALS ARE USED.

THE FIRST QUESTION TO ASK IS "WHAT ARE YOU TRYING TO REMOVE? IS IT DIRT, BIOLOGICAL, METALLIC STAINING?"

THE ANSWER WILL INFORM THE METHOD.

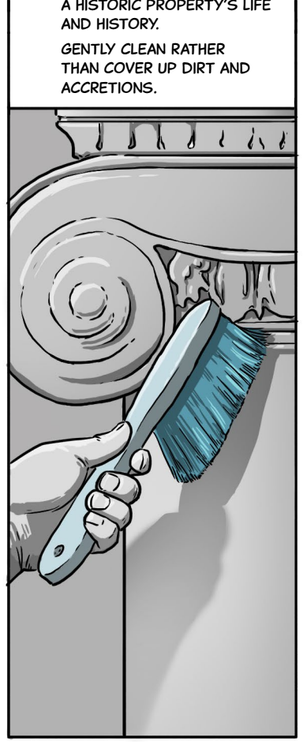
BEING CAREFUL, OBSERVANT, AND SENSITIVE GOES A LONG WAY, TOO. TAKE A LITTLE BIT OF EXTRA CARE WITH HERITAGE ARCHITECTURE.

4 BIG THINGS TO REMEMBER THAT APPLY TO ANY HERITAGE PROPERTY:

1 OPT FOR DRY CLEANING WHENEVER POSSIBLE. NEVER LET LIQUID STAND OR POOL. WATER IS ONE OF A HISTORICAL PROPERTY'S WORST ENEMIES.

2 BE WARY OF OVERCLEANING AND DON'T TRY TO MAKE IT LOOK NEW. HERITAGE BUILDINGS HONOR THE PASSAGE OF TIME AND THE PATINA OF AGE IS PART OF A HISTORIC PROPERTY'S LIFE AND HISTORY.

GENTLY CLEAN RATHER THAN COVER UP DIRT AND ACCRETIONS.



3 ALWAYS LOOK FIRST, AND FROM AS MANY SIDES AS YOU CAN. YOUR BEST TOOLS ARE YOUR EYES AND A CAREFUL APPROACH TO RECOGNIZE DAMAGE AND FIND ITS SOURCE.

4 CLEANING IS AN IRREVERSIBLE PROCESS. ONCE YOU REMOVE SOMETHING DURING CLEANING, YOU CAN'T PUT IT BACK ON. THAT INCLUDES PATINA AND SOMETIMES PIECES OF THE BUILDING MATERIALS THEMSELVES. ALWAYS USE THE GENTLEST METHODS POSSIBLE.

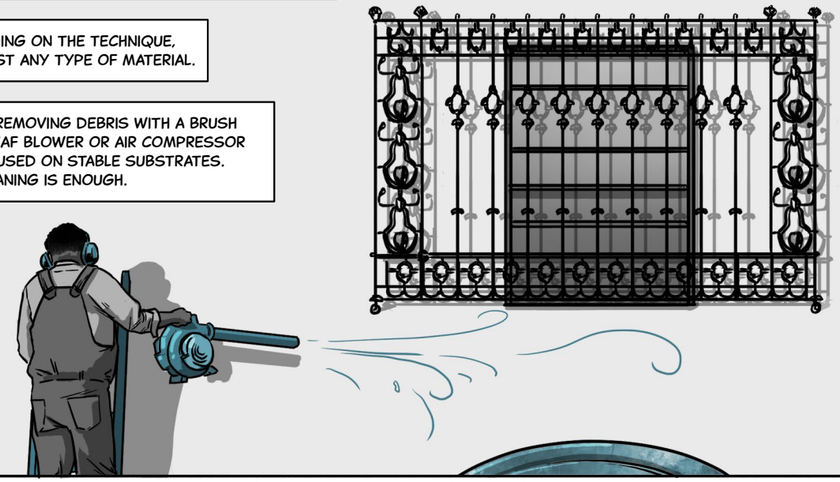
POSTS HAVE THE OPTION TO CLEAN IN-HOUSE, BUT CAN ALSO EMPLOY A SPECIALTY CONTRACTOR. OBO CH AND OBO FAC ROOF AND FACADE PROGRAM ARE AVAILABLE TO HELP SCOPE LARGE-SCALE OR SPECIALIZED PROJECTS. FOR ANY MAJOR CLEANING PROJECTS THAT ARE NOT ROUTINE, CH NEEDS TO BE INVOLVED. CLEANING HAS AESTHETIC AS WELL AS CONSERVATION IMPLICATIONS. TESTING AND MOCKUPS SHOULD BE INCLUDED IN ANY CLEANING PROGRAM BEFORE IT IS IMPLEMENTED.

Dry Cleaning

CLEANING WITHOUT WATER OR WET SOLVENTS—CALLED DRY CLEANING—SHOULD BE CONSIDERED IF A BUILDING MATERIAL IS REALLY POROUS, THERE ARE WATER ISSUES, OR THERE IS A LOT OF FENESTRATION.

DRY METHODS, DEPENDING ON THE TECHNIQUE, CAN BE USED ON ALMOST ANY TYPE OF MATERIAL.

FOR EXTERIORS, START BY REMOVING DEBRIS WITH A BRUSH OR BROOM. AN ELECTRIC LEAF BLOWER OR AIR COMPRESSOR AT LOW PRESSURE CAN BE USED ON STABLE SUBSTRATES. OFTEN, THAT LEVEL OF CLEANING IS ENOUGH.



OTHER DRY CLEANING METHODS REQUIRING PROFESSIONAL SUPPORT AND CH INPUT INCLUDE:

DRY MICROABRASIVE IS AN EXTREMELY GENTLE VERSION OF SANDBLASTING.

MEDIA INCLUDE THINGS LIKE PRECIPITATED CHALK (SOFTEST), WALNUT SHELLS, GARNET POWDER, OR ALUMINUM OXIDE (THE MOST AGGRESSIVE FORM OF DRY MICROABRASIVE THAT IS ACCEPTABLE IN OUR HERITAGE CONTEXT).

IT IS CRUCIAL TO SELECT A MEDIUM HARD ENOUGH TO TAKE OFF THE GRIME BUT NOT SO HARD THAT IT DAMAGES THE SUBSTRATE MATERIAL.

IT'S ALSO IMPORTANT TO CONTAIN THE DUST AND DEBRIS GENERATED BY THE PROCESS.

DRY ICE BLASTING—AN ABRASIVE TECHNIQUE THAT REDUCES CONTAINMENT REQUIREMENTS—MAY ALSO BE USED ON SUBSTRATES THAT HAVE THICKER ACCUMULATIONS OR ACCRETIONS.

PEELABLE PRODUCTS SHOULD ONLY BE USED ON SUBSTRATES THAT ARE EXTREMELY SOUND. THESE ARE SPRAYED OR APPLIED WITH A BRUSH, LET SIT FOR A SPECIFIED PERIOD, THEN PEELED OFF.

LASER CLEANING MIGHT BE EMPLOYED TO CLEAN DARK SOILING OFF LIGHT SUBSTRATES. BOTH TIME-CONSUMING AND TEDIOUS BECAUSE IT WORKS AT A SMALL SCALE, IT IS A COMPARATIVELY EXPENSIVE OPTION.

Wet Cleaning

CONTACT CH FIRST BEFORE ANY WET CLEANING, WHICH INVOLVES EITHER WATER OR SOLVENTS.

NEVER USE WET CLEANING ON WATER-SENSITIVE SURFACES.

WET CLEANING MAY BE USED ON MOST EXTERIOR MATERIALS. THE GENTLEST FORM OF WET CLEANING IS INTRODUCING A LOW-PRESSURE, LOW-VOLUME AQUEOUS MIST OR STEAM TO DISLODGE ACCRETIONS.

SOMETIMES THESE WILL FALL OFF ON THEIR OWN; SOMETIMES A BRUSH IS NEEDED ONCE THEY ARE LOOSENED.

NEXT GENTLEST IS WATER FROM A HOSE WITH A GARDEN NOZZLE ATTACHMENT.

WHAT'S IN THE WATER MATTERS. IT IS HELPFUL TO INSTALL AN IN-LINE HOSE FILTER TO LIMIT DEPOSITION OF SALTS THAT CAN CAUSE CHEMICAL REACTIONS (SUCH AS SULFATES AND CHLORIDES) OR OTHER MINERALS THAT CAN STAIN OR BUILD UP (SUCH AS IRON AND CALCIUM).

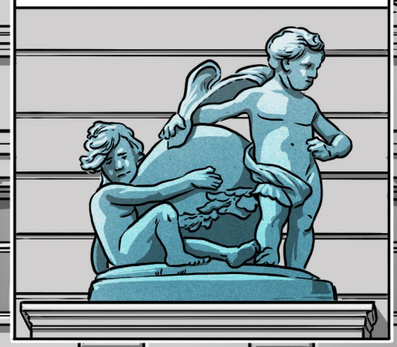
THE ADDITION OF A GENTLE CLEANING AGENT—DETERGENT, BIOCIDE, OR OTHER CHEMICAL AGENT—IS A NEXT STEP. ALWAYS SEND TECHNICAL AND SAFETY DATA SHEETS TO CH FIRST, OR CH CAN RECOMMEND APPROPRIATE SITE-SPECIFIC PROTOCOLS AND PRODUCTS.

POULTICING MIGHT BE USED FOR LOCALIZED STAINING OR ACCRETIONS. POULTICING COMBINES PRODUCTS APPLIED IN AN ABSORPTIVE INERT MEDIA SUCH AS CLAY OR PAPER. IT IS APPLIED AND LEFT TO DRY, THEN SCRAPED OFF WITH A PLASTIC PUTTY KNIFE AND RINSED.

ADDING WATER TO MICROABRASIVES IS THE NEXT LEVEL.

Things to Consider

PROJECTING ELEMENTS' CONDITION DICTATES GENTLER CLEANING. DECORATION CAN FALL OFF OR BE DAMAGED BY RUBBING, ABRASION, WATER, OR CHEMICALS. FIRST ASSESS THE FRAGILITY OF WHAT YOU ARE ABOUT TO TOUCH. CONTACT CH IF ANYTHING IS IN A DELICATE STATE BEFORE ATTEMPTING EVEN THE GENTLEST CLEANING REGIMEN.



THINK ABOUT IF YOU HAVE A WATER-SENSITIVE SUBSTRATE OR DECORATION. IF YOU ALREADY HAVE WATER ISSUES, INTRODUCING LARGE VOLUMES OF WATER MAY NOT BE APPROPRIATE.

WATER IS HEAVY. WHEN IT FILLS THE VOIDS OF A POROUS MATERIAL, YOU ARE CHANGING THE WEIGHT AND LOAD OF THAT MATERIAL.

PREWET POROUS SURFACES BEFORE APPLYING CLEANING SOLUTIONS SO THAT THE WATER FILLS THE PORES AND PREVENTS CLEANING CHEMICALS FROM PENETRATING AND POTENTIALLY CAUSING DAMAGE.

FOR EXTERIORS

WETTING SURFACES TOO FREQUENTLY AND CYCLIC WETTING AND DRYING, LIKE WITH SPRINKLERS, IS DAMAGING OVER TIME.

WATER CAN ALSO INTRODUCE THERMAL SHOCK IF THE WATER IS COLD AND THE SUBSTRATE IS HOT, OR VICE VERSA.

CLEANING POROUS SURFACES WITH WATER OUTSIDE SHOULD ONLY BE DONE WHEN THERE IS NO RISK OF FREEZING, WHICH CAN CAUSE CRACKING AS WATER EXPANDS WITHIN PORES.

BUILDING EXTERIORS SHOULD BE CLEANED ONLY EVERY 1 TO 5 YEARS, DEPENDING ON THE LOCATION.

Things to Avoid

SANDBLASTING AND POWER WASHING ARE GENERALLY TO BE AVOIDED. THESE HARSH MODERN CLEANING METHODS ARE NOT WELL SUITED FOR DELICATE HISTORIC MATERIALS.

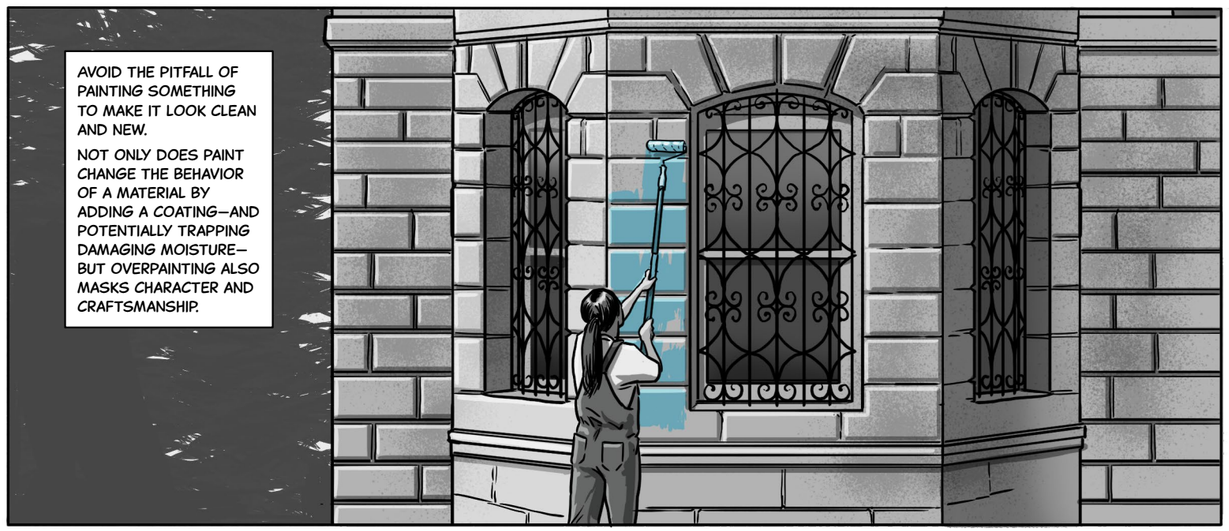
SANDBLASTING CAN CAUSE SEVERE ABRASION—THINK OF IT LIKE EXFOLIATING YOUR SKIN TO THE POINT OF BLEEDING.

POWER WASHING DRIVES WATER DEEPLY INTO POROUS SURFACES, CAUSING SURFACE DAMAGE INCLUDING VISIBLE SWIRL MARKS AND LOSS OF MATERIAL, INTRODUCING THERMAL SHOCK, AND DISSOLVING SALTS THAT THEN MOVE AROUND INSIDE STONE.

IT CAN EVEN DRIVE MOISTURE INTO THE INSIDE OF THE BUILDING.

AVOID THE PITFALL OF PAINTING SOMETHING TO MAKE IT LOOK CLEAN AND NEW.

NOT ONLY DOES PAINT CHANGE THE BEHAVIOR OF A MATERIAL BY ADDING A COATING—AND POTENTIALLY TRAPPING DAMAGING MOISTURE—BUT OVERPAINTING ALSO MASKS CHARACTER AND CRAFTSMANSHIP.



ALWAYS FOLLOW OSHA OR LOCAL SAFETY REGULATIONS.

AND BEFORE YOU START CLEANING, MAKE SURE YOU HAVE THE PROPER TOOLS CLOSE AT HAND TO KEEP BOTH YOU AND THE OBJECTS SAFE:

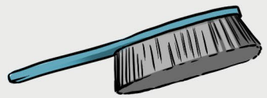
GLOVES (PREFERABLY NITRILE)

DUST MASK OR N95 MASK

GOGGLES

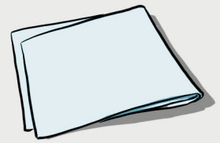
Supplies and Equipment: Interiors

BANNISTER BRUSH OR LONG, FLAT SOFT BRUSH

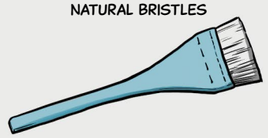


WRAP ANY METAL PIECES WITH BLUE TAPE OR CHAMOIS TO PREVENT SCRATCHES.

MICROFIBER CLOTHS OR CLEAN COTTON RAGS



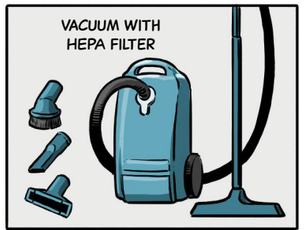
DUST BRUSHES WITH SOFT, NATURAL BRISTLES



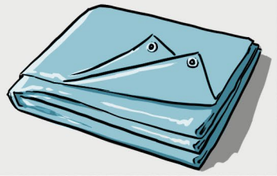
MAKE SURE THE HANDLE IS SOFT TOO, SO IT WON'T SCRATCH EITHER.

BROOMS ARE OKAY FOR FLOORS—BUT PAY ATTENTION AROUND PAINTED LEGS OF FURNITURE AS PAINT CAN FLAKE.

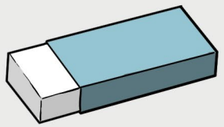
VACUUM WITH HEPA FILTER



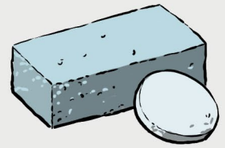
TARP OR DROPCLOTH



WHITE VINYL OR KNEADED RUBBER ERASERS FOR SMUDGE REMOVAL ON NONHISTORIC FINISHES

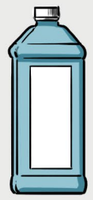


SOOT SPONGE OR COSMETIC SPONGE



COLORLESS WINDOW CLEANER WITHOUT AMMONIA—TO BE USED ONLY ON WINDOW GLASS!

ALCOHOL (ETHANOL AND ISOPROPANOL)



DISTILLED WATER

*COLLECTION CARE KITS ARE AVAILABLE UPON REQUEST.

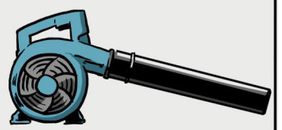
Supplies and Equipment: Exteriors

METAL BRISTLE BRUSH (STEEL, BRASS, ETC.)

USE LIKE METAL TO CLEAN LIKE, I.E., STEEL BRISTLE TO CLEAN STEEL OR IRON.

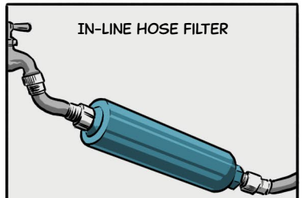
WHISK BROOM

ELECTRIC LEAF BLOWER



SOFT BRISTLE BRUSH

IN-LINE HOSE FILTER

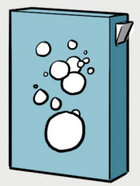


HOSE AND NOZZLE

SCOURING PAD

MILD DETERGENT THAT IS PH NEUTRAL

CONFIRM WITH CH BEFORE USE.

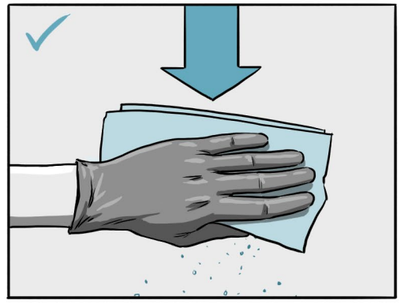


Guidelines: Interiors

MATERIAL SPECIFIC CLEANING METHODS ARE INCLUDED IN EACH MATERIAL SECTION, BUT THE FOLLOWING ARE GOOD GENERAL GUIDELINES.

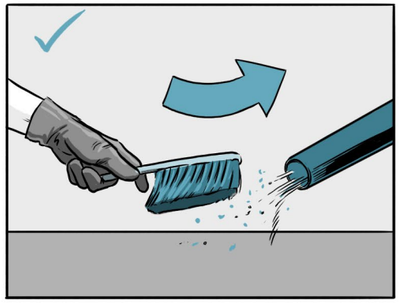
DO

ALWAYS CLEAN FROM TOP TO BOTTOM.

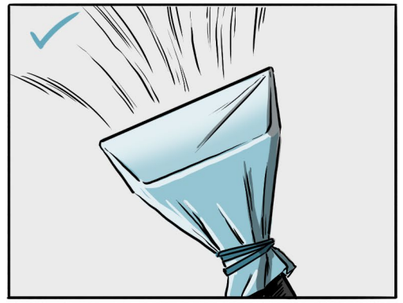


VACUUMS AND DUST BRUSHES MAKE A GREAT TEAM.

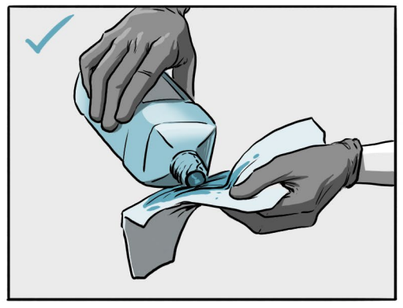
USE THE SOFT BRUSH TO DIRECT DEBRIS INTO THE VACUUM'S NOZZLE RATHER THAN PLACING THE NOZZLE DIRECTLY ON AN OBJECT.



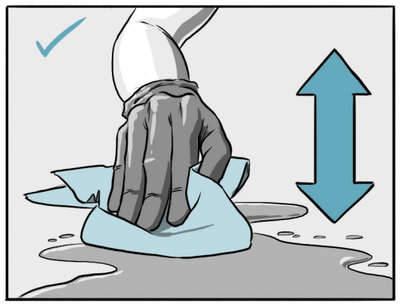
ATTACH CHEESECLOTH OR NYLON HOSIERY TO THE OPENING OF THE VACUUM TO AVOID SUCKING UP LOOSE, SMALL, OR DELICATE PIECES. DO NOT USE A ROTARY BRUSH.



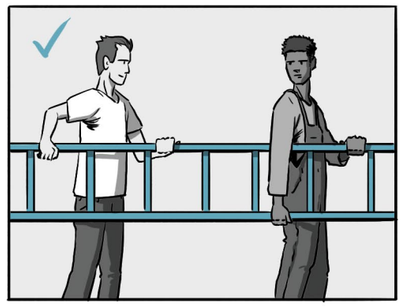
IF WET CLEANING IS ALLOWED, APPLY WATER OR ALCOHOL TO A CLOTH, NEVER DIRECTLY ONTO THE OBJECT.



FOR SPILLS, DAB, NEVER WIPE.

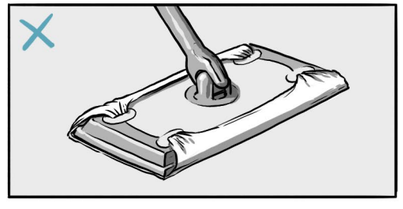


IF YOU'RE WORKING AT HEIGHTS AND WITH LADDERS, YOU SHOULDN'T WORK ALONE. GET HELP FROM A TEAMMATE.



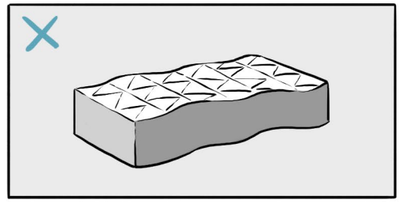
AVOID

SWIFFERS. THEY CAN SNAG AND LEAVE RESIDUES. TRY NYLON CLOTHS WITH ELECTROSTATIC PROPERTIES INSTEAD.



FEATHER DUSTERS. FEATHER SPINES CAN SCRATCH. SYNTHETIC DUSTERS ARE A BETTER OPTION.

MAGIC ERASERS ARE MILDLY ABRASIVE AND CAN LEAVE RESIDUES THAT CAN ACCELERATE AGING.

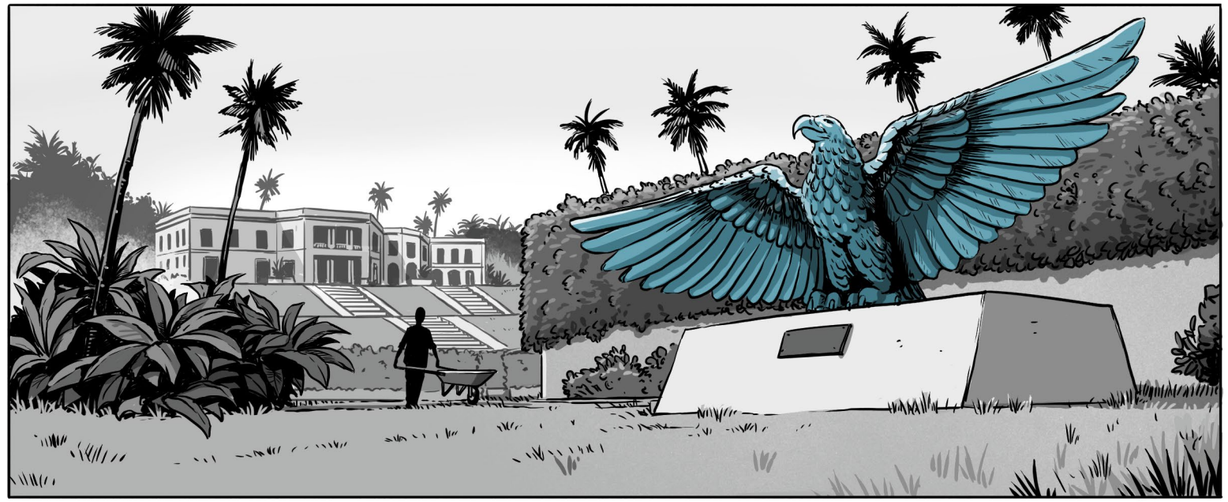


SATURATED MOPS. MOST DAMAGE TO OBJECTS HAPPENS BECAUSE OF EXCESS WATER.

SOLVENTS AND COMMERCIAL CLEANERS. CLEANERS LIKE PLEDGE MAY REACT WITH SURFACES AND LEAVE DAMAGING RESIDUES.

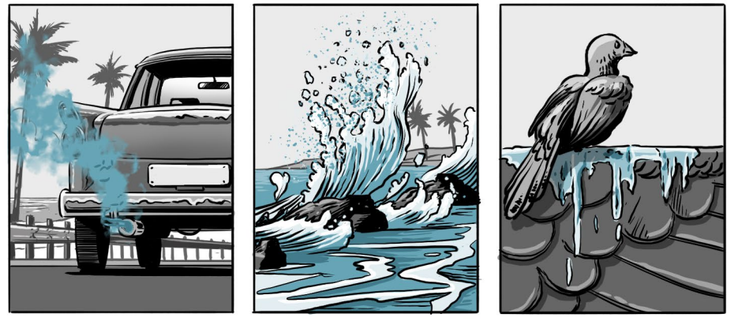
IF YOU WANT TO USE SOMETHING BEYOND A DRY BRUSH OR CLOTH, CH CAN ADVISE IF WHAT YOU INTEND TO USE IS OKAY OR MAKE SUGGESTIONS.

Guidelines: Exteriors



ENVIRONMENTAL FACTORS, LIKE POLLUTANTS AND MARINE CLIMATES, WILL DETERMINE CLEANING REQUIREMENTS.

REACH OUT TO CH AND LET US KNOW ABOUT YOUR ENVIRONMENT TO HELP YOU COME UP WITH A SCHEDULE OR PLAN.



REPAIR BEYOND ROUTINE MAINTENANCE REQUIRES THE CULTURAL HERITAGE OFFICE'S INVOLVEMENT.

OR IF THE SCOPE OF WORK IS LARGE, PLEASE REACH OUT TO CH FOR A WORK PLAN AND ASSISTANCE IN FUNDING.

DO

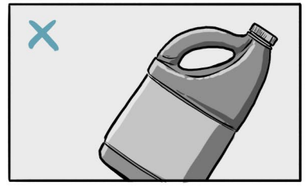
DIRECT SPRINKLERS AWAY FROM WALLS AND FOUNDATIONS.

BE AWARE OF CLIPPINGS AND ROCKS THAT CAN BE FLUNG.

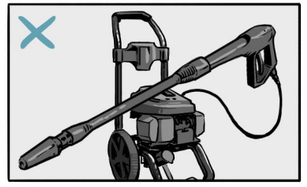
SKIP FERTILIZERS, WHICH ARE ESSENTIALLY SALTS AND CAN DAMAGE BUILDING MATERIALS.

AVOID

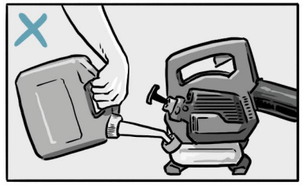
BLEACH



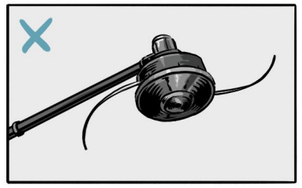
POWER WASHING AND SANDBLASTING

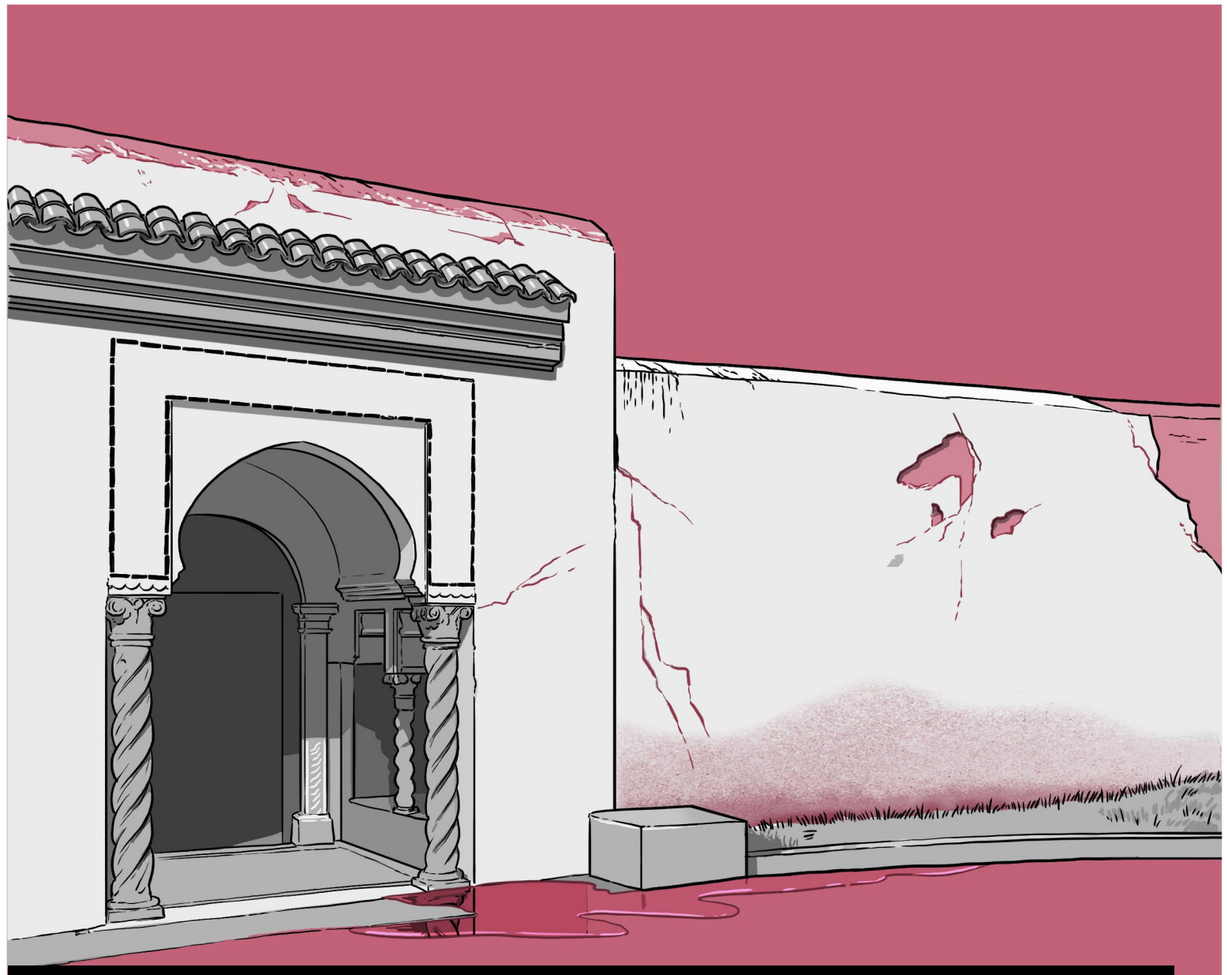


GASOLINE-POWERED LEAF BLOWERS, WHICH CAN DRIP MOTOR OIL



WEED WHACKERS





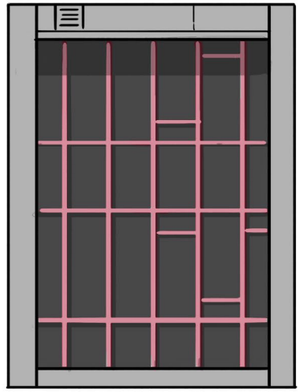
BUILDING ENVELOPES

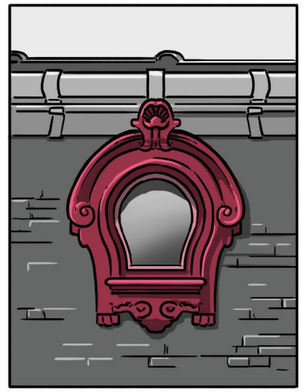
Practical and aesthetic considerations
for maintaining building exteriors

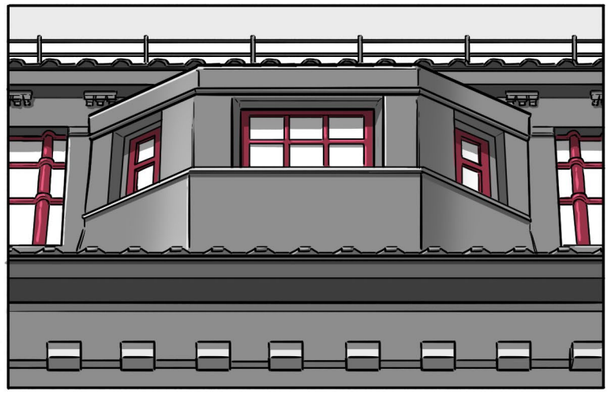
Building Envelopes

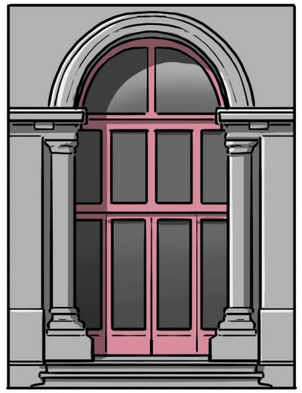
A BUILDING'S ENVELOPE, OR EXTERIOR SKIN, FUNCTIONS AS A SYSTEM WITH 3 MAJOR SUBSYSTEMS THAT ALL WORK TOGETHER. THEY ARE ROOFS, WALLS, AND FENESTRATION (OR WINDOWS AND DOORS).

A PROBLEM IN ONE OF THE SYSTEMS, OR EVEN ONE OF THE PARTS OF ONE OF THE SYSTEMS, JEOPARDIZES THE WHOLE.



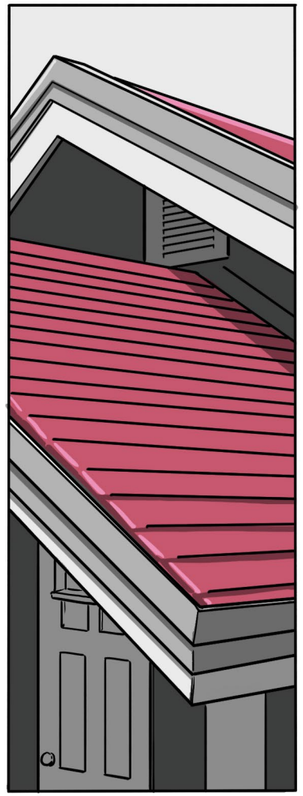


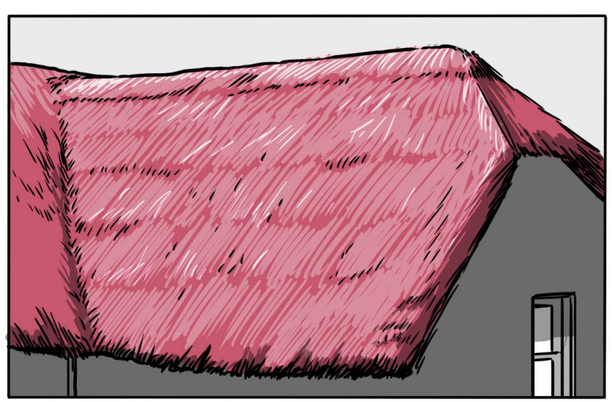


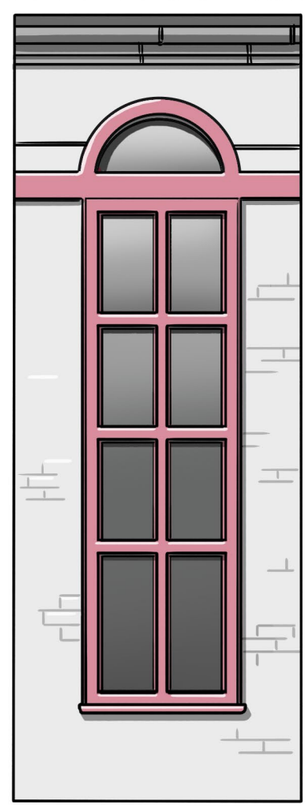


IT'S ALSO MPORTANT TO KEEP IN MIND THAT ONE ROOF OR WALL OR WINDOW OR DOOR IS NOT EQUAL TO EVERY OTHER. THERE ARE MANY KINDS OF ROOF, WALL, AND FENESTRATION SYSTEMS.

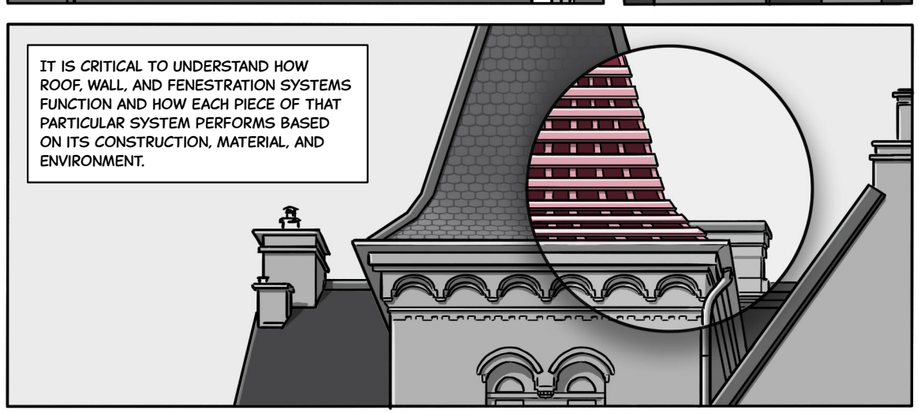
COMPONENTS AND MATERIALS OFTEN DIFFER. THERE CAN BE REGIONAL CONSTRUCTION DIFFERENCES AS WELL. SOME PLACES MIGHT NOT HAVE WOOD AVAILABLE TO CREATE FRAMING OR ROOF SHINGLES, FOR EXAMPLE.







IT IS CRITICAL TO UNDERSTAND HOW ROOF, WALL, AND FENESTRATION SYSTEMS FUNCTION AND HOW EACH PIECE OF THAT PARTICULAR SYSTEM PERFORMS BASED ON ITS CONSTRUCTION, MATERIAL, AND ENVIRONMENT.



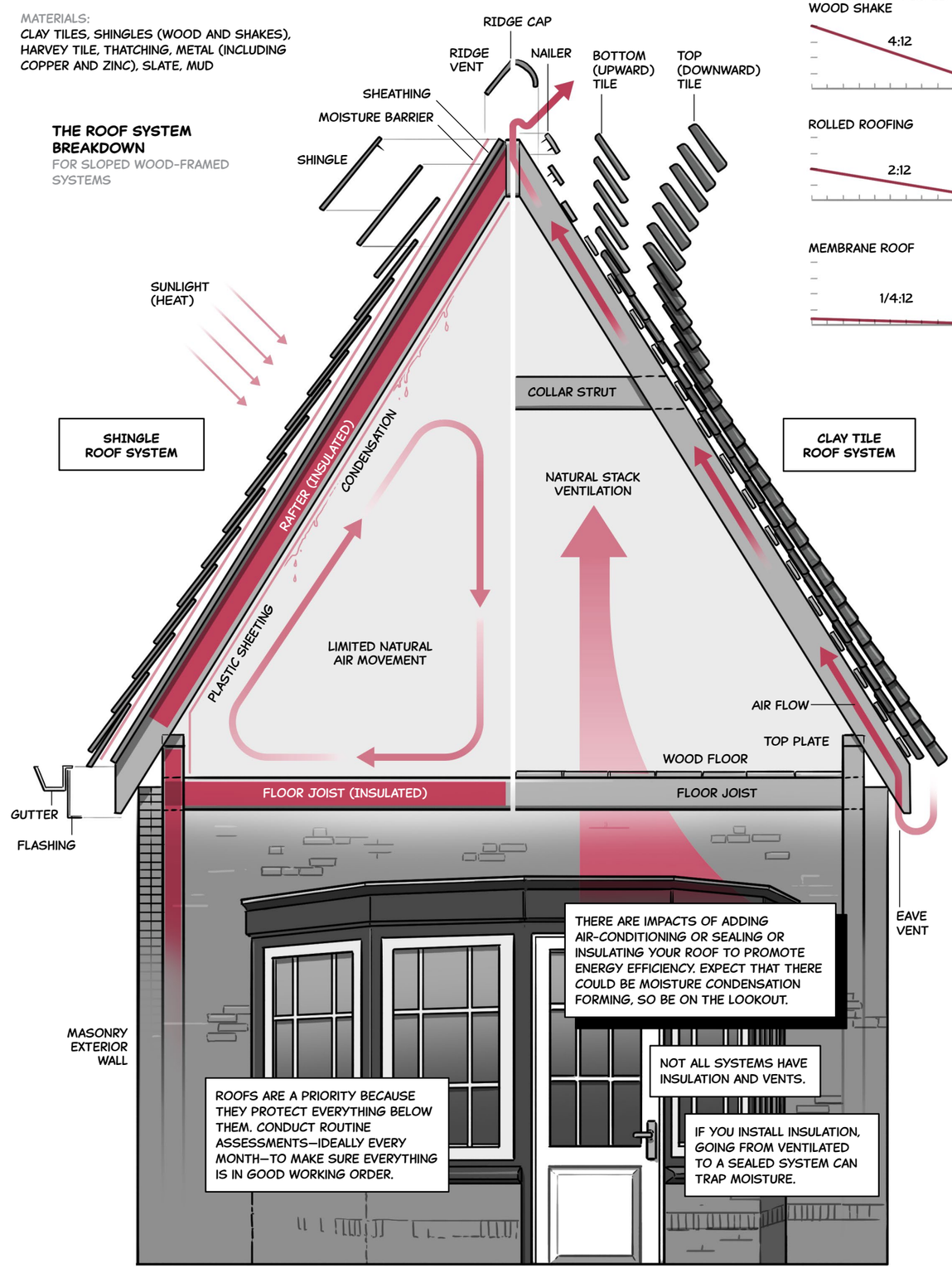
VILLA OTIUM
OSLO, NORWAY

ENVELOPE COMPONENTS SERVE ESSENTIAL FUNCTIONS AND ARE ALSO IMPORTANT CHARACTER-DEFINING FEATURES OF HERITAGE PROPERTIES. INSENSITIVE INTERVENTIONS CAN ADVERSELY IMPACT THEIR PERFORMANCE AND APPEARANCE.

Roofs

MATERIALS:
CLAY TILES, SHINGLES (WOOD AND SHAKES), HARVEY TILE, THATCHING, METAL (INCLUDING COPPER AND ZINC), SLATE, MUD

THE ROOF SYSTEM BREAKDOWN
FOR SLOPED WOOD-FRAMED SYSTEMS



MINIMUM ROOF SLOPES

SHINGLE, CLAY TILE, SLATE, WOOD SHAKE
4:12

ROLLED ROOFING
2:12

MEMBRANE ROOF
1/4:12

THINGS TO LOOK OUT FOR

LIFTED OR MISSING TILES OR SLATE

HAZING, CHIPPING, CRACKING, FADING, OR ANY DISCOLORATIONS ON TILES

EXCESS LEAF FALL

CUPPING OF WOOD SHINGLES

BREACHES, ESPECIALLY ON VERTICAL-TO-HORIZONTAL INTERFACES LIKE PARAPETS OR CHIMNEYS OR AREAS OF CHANGE IN SLOPE

PENETRATIONS LIKE HOLES DRILLED IN THE ROOF FOR ELECTRIC OR CABLES

GUTTER AND DOWNSPOUT BLOCKAGES WITH LEAVES OR ICE OR BIRD AND INSECT NESTS

*MAKE SURE YOU KNOW WHERE THE WATER GOES AFTER IT LEAVES THE DOWNSPOUT.

CORROSION ON METAL

OPEN SEAMS ON METAL FROM THERMAL EXPANSION AND CONTRACTION

WATER PONDING

MISSING OR LOOSE FLASHING

MONITOR THE EXPOSURE TO SUNLIGHT. LONG-TERM EXPOSURE CAUSES MATERIALS TO BEND TOWARD SUNLIGHT AND HARDENS SEALANTS AND GASKETS.

IN AREAS OF SUBSTANTIAL MOISTURE, NAILS CAN RUST MORE QUICKLY AND IRON MIGHT STAIN AND BIOLOGICAL ACTIVITY CAN INCREASE.

FLAT ROOFS CAN HOLD STANDING WATER, COMMONLY REFERRED TO AS PONDING. ADEQUATELY DESIGNED THROUGH-WALL SCUPPERS AND ROOF DRAINS ARE CRITICAL IN THEIR PROTECTION.

TILE ROOFS HAVE A LOT OF NOOKS AND CRANNIES FOR MOSS AND ALGAE TO GROW IN...

...AND BIG TREES DROP BIOLOGICAL MATTER.

YOU MIGHT WANT TO DO ADDITIONAL CHECKS IF THERE HAS BEEN:

FREEZING TEMPERATURES

2 INCHES OR MORE OF SNOWFALL OR RAINFALL

CONSISTENTLY HEAVY POLLUTION OR ACID RAIN

A SEISMIC EVENT

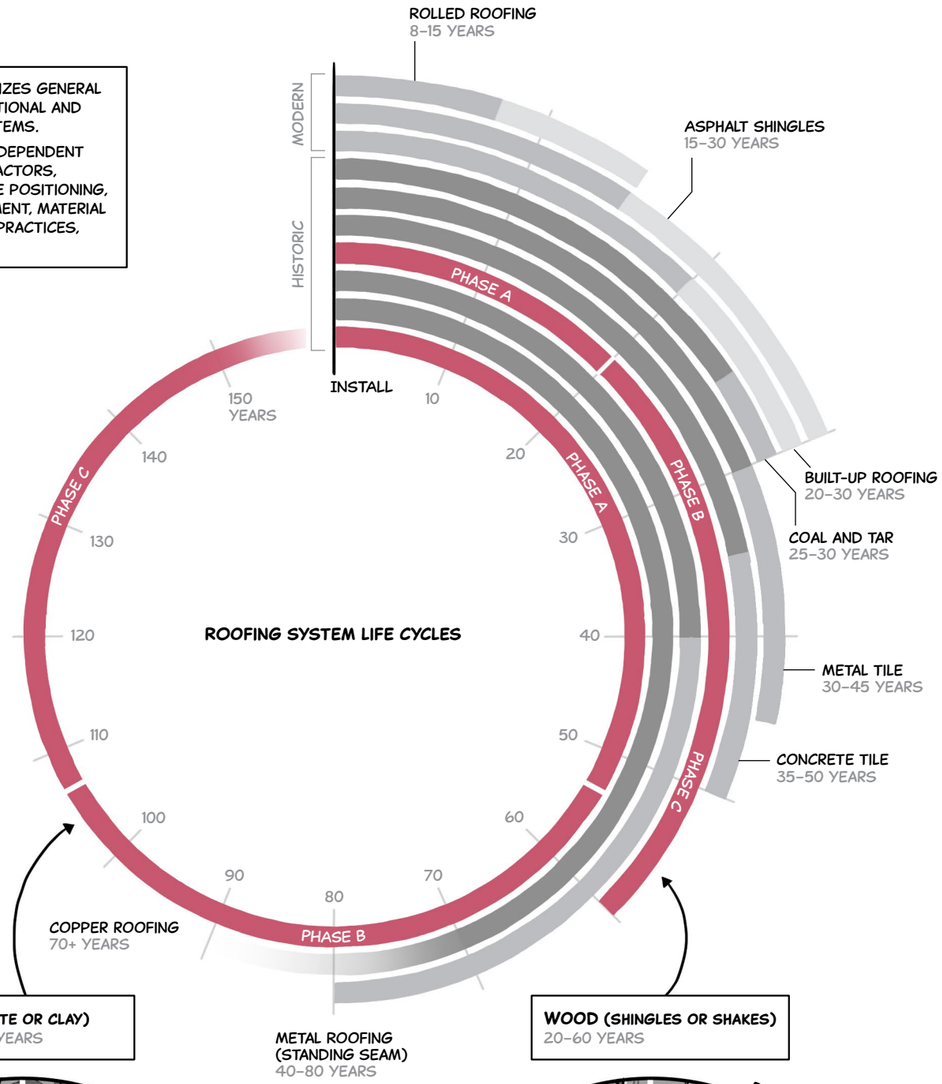
A HURRICANE, TORNADO, OR OTHER HIGH-WIND EVENT

A FIRE—INCLUDING NEARBY FOREST FIRES, WHICH MIGHT LOFT EMBERS

IF DAMAGE REQUIRES ANYTHING BEYOND PATCHING IN-KIND OR SMALL REPAIRS, REACH OUT TO OBO FACILITIES ROOF AND ENVELOPE TEAM AND OBO CH TO DIAGNOSE PROBLEMS.

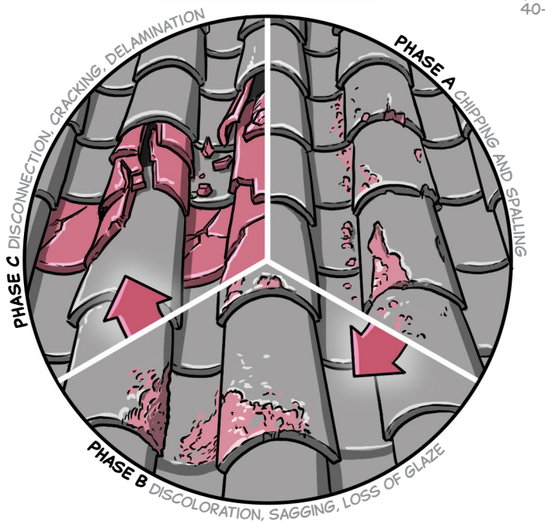
THIS DIAGRAM SUMMARIZES GENERAL LIFE CYCLES FOR TRADITIONAL AND MODERN ROOFING SYSTEMS.

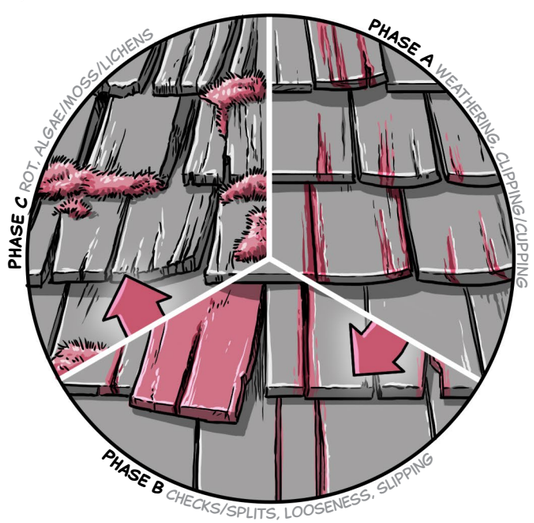
THESE LIFE SPANS ARE DEPENDENT ON A WIDE RANGE OF FACTORS, INCLUDING APPROPRIATE POSITIONING, ROOF SLOPE, ENVIRONMENT, MATERIAL QUALITY, INSTALLATION PRACTICES, AND MAINTENANCE.



TILE (SLATE OR CLAY)
100–150+ YEARS

WOOD (SHINGLES OR SHAKES)
20–60 YEARS





Routine Maintenance for Roofs

REMOVE DEBRIS LIKE STICKS AND BRANCHES WITH A BROOM OR ELECTRIC LEAF BLOWER OR JUST USE YOUR HANDS.

BEFORE YOU WALK ON A ROOF, ASK:

CAN I DAMAGE THE ROOF IF I WALK ON IT? WOULD ACCIDENTALLY KICKING IT BREAK PIECES, LIKE TILES?

ALSO ASK YOURSELF:

IS THIS SAFE?

DO I FEEL COMFORTABLE WORKING FROM HEIGHTS?

DO I HAVE THE NECESSARY PERSONAL PROTECTIVE EQUIPMENT (PPE)?

IF YOU DON'T KNOW, ASK CH.

WATER AND MILD DETERGENT OR BIOCIDES MIGHT BE NECESSARY FOR STUBBORN STAINS OR BIOLOGICAL GROWTH LIKE MOLD OR ALGAE.

DON'T EVER LEAVE STANDING WATER.

CHECK FLASHINGS AT HORIZONTAL AND VERTICAL INTERFACES.

MOSS CAN BE SCRAPED OFF WITH PLASTIC PUTTY KNIVES.

SWEEP OR SCRAPE OFF BIRD POOP. STAINING AND RESIDUE MIGHT NECESSITATE WATER AND A SCRUB BRUSH. USE PROPER PPE, INCLUDING GLOVES AND EYE AND RESPIRATORY PROTECTION.

KEEP GUTTERS AND DRAINAGE CLEAR.

FOR ATMOSPHERIC POLLUTANTS OR DIRT, START WITH A WHISK BROOM. IF NECESSARY, A HOSE MAY BE USED ON A LOW SETTING WITH A SCRUB BRUSH.

A LITTLE BIT OF CAREFUL PLANNING PAYS OFF—THE INTERVENTION SHOULD NEVER DO MORE DAMAGE.

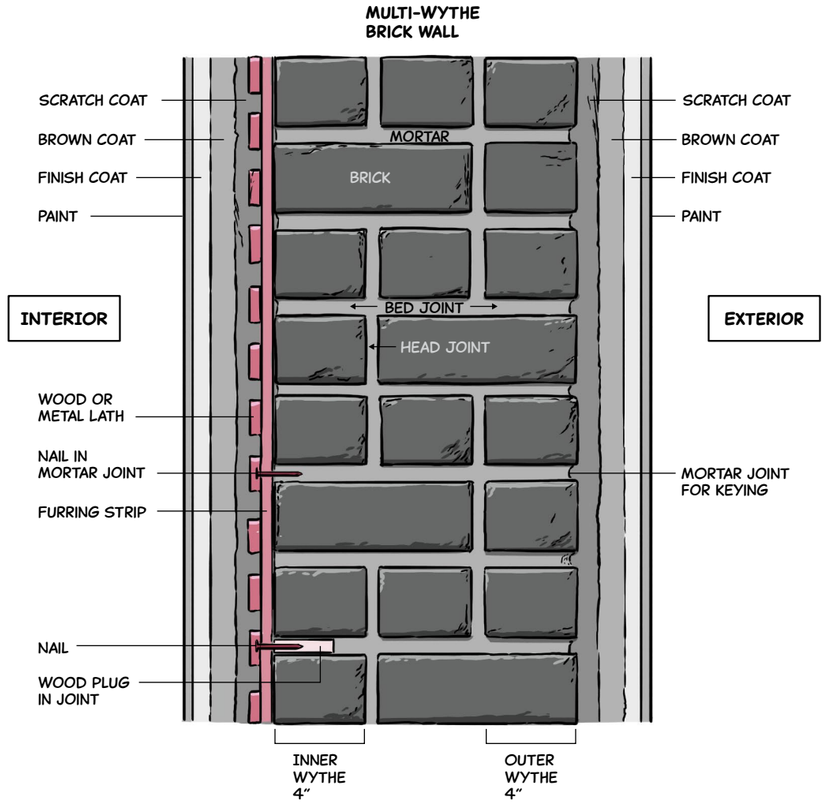
Walls

MATERIALS:
CONCRETE, STUCCO, STONE AND BRICK MASONRY OR VENEER, GLAZED TILES, WOOD

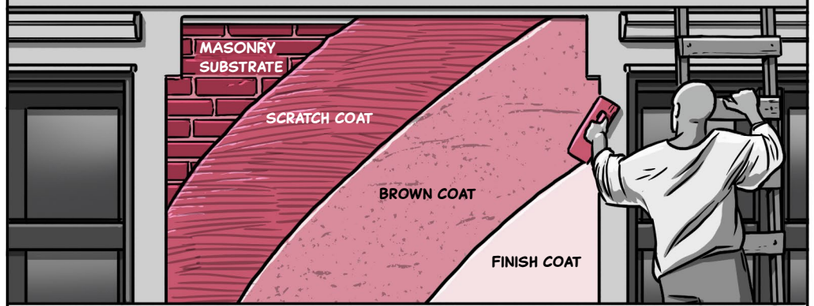
WALLS ARE A STRUCTURAL SYSTEM THAT PROVIDES SUPPORT FOR THE FLOORS AND ROOF.

MASONRY IS A TWO-COMPONENT SYSTEM: UNITS (BRICK, BLOCK, TILE) FORM THE STRENGTH AND MORTAR (LIME, CEMENT, MUD) ADHERES THEM TOGETHER. THE UNIT AND MORTAR NEED TO BE COMPATIBLE. TRADITIONALLY MORTARS ARE SOFTER AND LESS STIFF THAN THE UNITS.

BASEMENTS AND FOUNDATIONS ARE EXTENSIONS OF THE WALL SYSTEM THAT EXIST BELOW GRADE.



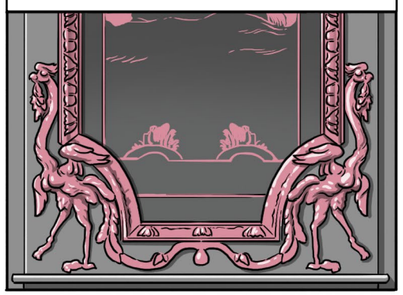
WALLS MAY HAVE COATINGS LIKE RENDERS (MOST OFTEN APPLIED TO MASONRY OR CONCRETE).



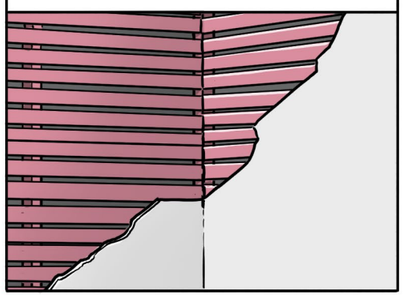
SOMETIMES PART OF THAT STUCCO IS REMOVED TO CREATE A DESIGN CALLED SGRAFFITO.

OR WALLS MAY HAVE EMBELLISHMENTS LIKE FRIEZES OR FRESCOES.

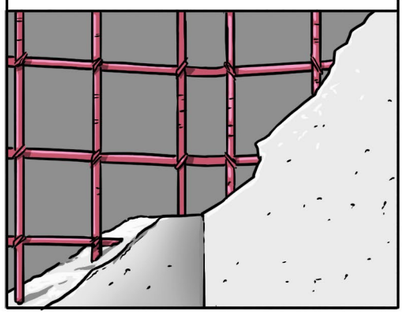
SINCE INTERIOR WALLS ARE SHELTERED FROM THE ELEMENTS, THEY MAY BE DECORATED WITH MORE FRAGILE MATERIALS LIKE WALLPAPER, DISTEMPER PAINT, OR WATER GILDING.



UNSEEN BEHIND THEIR FINISHES, WALLS MIGHT HAVE WOOD LATH OR METAL LATH AND FIBER-GLASS MESH FOR SHRINKAGE CONTROL AND TO PUSH THE PLASTER INTO.



STONE OR CONCRETE WALLS MIGHT HAVE METAL SUPPORTS LIKE STEEL REINFORCEMENT BAR (COMMONLY KNOWN AS REBAR) OR I-BEAMS.



WALL DAMAGE IS A SYMPTOM, BUT FURTHER THOUGHT IS NEEDED TO DETERMINE THE CAUSE.

LOOK OUT FOR THE FOLLOWING CONDITIONS:

- LACK OF BONDING OF STUCCO TO SUBSTRATE. WALL SOUNDS HOLLOW WHEN YOU TAP ON IT
- BULGING
- DIFFERENTIAL SETTLEMENT, WHERE ONE SIDE OF A BUILDING IS SETTLING MORE THAN THE OTHER
- RACKING, WHERE THE BUILDING IS HINGING AT ITS BASE AND UPPER PORTION CAN MOVE LEFT TO RIGHT
- CRACKING, SPALLING, EFFLORESCENCE, OR FALLEN DEBRIS
- RISING DAMP, WHERE WATER IS DRAWN THROUGH SMALL VOIDS WITHIN A MATERIAL FROM WET TO DRIER AREAS
- LEAKS IN HORIZONTAL-TO-VERTICAL INTERFACE AREAS AND CRACKS AROUND WINDOW OPENINGS, DOOR LINTELS, AND CHIMNEY AND PARAPETS
- ANYTHING THAT LOOKS OUT OF PLACE OR DIFFERENT

THE WALL SYSTEMS FOR HISTORIC BUILDINGS ARE TYPICALLY SOFT AND NEED TO ALLOW FOR MOISTURE TRANSPORT. THEY ARE OFTEN SUBJECT TO WATER GETTING INTO THE SYSTEM AND BEING SOAKED UP BY THE SUBSTRATE. TOO MUCH OR THE WRONG KIND OF PAINT DOESN'T ALLOW THE SYSTEM TO BREATHE—OR THE WATER TO GET OUT.

PAYING SPECIAL ATTENTION TO MORTAR

WHILE COMMON IN MODERN BUILDINGS, PORTLAND CEMENT INTRODUCES AND TRAPS SALTS IN BRICK AND STONE WALLS. CEMENT MORTARS ARE STIFFER THAN TRADITIONALLY SOFT HISTORIC MORTARS AND MASONRY UNITS, FORMING STRESS CONCENTRATIONS AT JOINTS AND DAMAGING SOFTER SURROUNDING MATERIALS.

MORE WALL TYPES TO CONSIDER

SOMETIMES WALLS ARE FREESTANDING AND ONLY SUPPORT THEMSELVES.

THEY MIGHT BE GARDEN WALLS,

OR PARAPETS,

OR BOUNDARY WALLS.

THESE WALLS ARE MORE EXPOSED TO THE ELEMENTS ON ALL SIDES.

RETAINING WALLS ARE ACTED ON BY SOIL AND WIND AND CAN BE HIT BY CARS OR LAWN MOWERS.

CHIMNEYS AND PARAPETS CAN FALL VICTIM TO EARTHQUAKES BECAUSE OF THEIR MASS, HEIGHT ABOVE GROUND, AND LACK OF LATERAL BRACING.

ROUTINE MAINTENANCE FOR EXTERIOR WALLS

OPT FOR CLEANING FIRST. IF YOU FEEL LIKE THE WALL MIGHT NEED PAINTING, CONSULT WITH CH.

FOR LARGE-SCALE PROJECTS LIKE WHOLE FACADES, CH WILL SCHEDULE AND HELP COORDINATE FUNDING.

IF DECORATIVELY PAINTED (PATTERNED OR FRESCO), CONTACT CH FOR HELP CREATING A TREATMENT PLAN.

IF BIOLOGICAL STAINING (MOLD, ETC.) IS PRESENT, CAN USE A COMMERCIALLY AVAILABLE RESTORATION-GRADE BIOCIDE. PLEASE CONTACT CH FOR RECOMMENDATIONS.

Fenestration, aka Doors and Windows

MATERIALS:
WOOD, METALS INCLUDING ALUMINUM AND STEEL, LEAD CAMES, GLASS

SUPPORT IS NEEDED IF A WALL OR ROOF IS BREACHED FOR AN OPENING. LOADS NEED TO BE REDISTRIBUTED WITH THE ADDITION OF STONE, STEEL, OR CONCRETE LINTELS, MASONRY ARCHES, OR WOOD HEADERS.

THINGS TO LOOK OUT FOR:

- CONFIRM YOUR STRUCTURE IS NOT DETERIORATED OR DAMAGED. LOOK FOR CRACKS AND DISPLACEMENT IN WALL AND OPENINGS. AREAS OF CONTINUED MOISTURE COULD BE INDICATIVE OF INTERVENTIONS.
- MAKE SURE YOUR SUPPORT SYSTEM ISN'T DAMAGED. CRACKED MASONRY AROUND OPENINGS COULD INDICATE STEEL IS CORRODING AND PUSHING FROM THE INSIDE, COMMONLY KNOWN AS RUST JACKING. OR A WOOD LINTEL MIGHT CRACK AT THE BOTTOM.
- WATCH FOR BROKEN GLASS, EITHER OVER TIME (AS IN SETTLEMENT) OR SUDDENLY (AS IN AN EARTHQUAKE).
- WOOD ELEMENTS CAN DETERIORATE OR BECOME DISPLACED.
- THERMAL CYCLING CAN BULGE STAINED GLASS.

HOW TO TELL IF WATER IS GETTING IN

LOOK AROUND THE PERIMETER OF THE WINDOW TO MAKE SURE IT IS CAULKED, ESPECIALLY AT THE TOP AND BOTTOM.

LOOK AT THE SILL. DOES IT HAVE BIOLOGICAL GROWTH, ROUGHENING OF WOOD GRAIN, OR PEELING PAINT?

CHECK AROUND DOOR LOCKS AND HARDWARE. THE ADDITIONAL HOLES FOR THESE ELEMENTS ALLOW WATER TO CREEP IN.

WINDOWS AND DOORS STRENGTHENED FOR SECURITY PURPOSES CAN BE EXTREMELY HEAVY. HERITAGE BUILDINGS COMMONLY LACK SUFFICIENT CAPACITY AND STIFFNESS TO SUPPORT THESE SYSTEMS. INSTALLATION OF THESE SYSTEMS IS INVASIVE, REQUIRING CONNECTION TO THE FLOORS AND WALLS. WITHOUT CONSIDERATION, THESE CAN RESULT IN CONSIDERABLE DAMAGE.

MAKE A CHECKLIST OF ALL THE CONSIDERATIONS AND EVALUATE RISK TO THE BUILDING AND CONSIDER IF THERE ARE OTHER OPTIONS.

Routine Maintenance for Windows

OLD LEGATION
SEOUL, SOUTH KOREA

INTERIORS

FOR WINDOW FRAMES, DEFER TO PROTOCOLS FOR THE TYPES OF MATERIALS (SUCH AS STEEL, PAINTED OR VARNISHED WOOD).

FOR DECORATIVE GLASS OR LEADED GLASS, USE A SOFT BRISTLE BRUSH OR MICROFIBER RAG.

A COMMERCIAL WINDOW CLEANER WITHOUT AMMONIA CAN BE USED FOR WINDOW PANES, BUT IT SHOULD NEVER BE SPRAYED DIRECTLY ONTO THE GLASS.

AVOID GETTING THE CLEANER ON THE SURROUNDING WOOD OR METAL OR DRAPERIES.

ONLY USE COMMERCIAL CLEANER ON GLASS WITHOUT UV OR SECURITY FILMS. FOR WINDOWS WITH FILMS, USE A WATER-DAMPENED RAG.

EXTERIORS

A COMMERCIAL WINDOW CLEANER CAN BE USED FOR EXTERIOR WINDOW PANES, BUT IT SHOULD NEVER BE SPRAYED DIRECTLY ONTO THE GLASS.

BRUSH OFF DEBRIS FROM FRAME BEFORE WET CLEANING.

IF YOU ARE GOING TO USE SOAP AND WATER, MAKE SURE THAT OPENINGS AROUND THE WINDOW ARE PROTECTED SO THAT WATER DOESN'T LEAK INTO THE INTERIOR. USE MINIMAL WATER.

LEADED GLASS CAN GET MINERAL DEPOSITS OR STREAKS. THESE CAN BE REMOVED FROM GLASS WITH NYLON SCOURING PADS. TEST AN AREA FIRST TO MAKE SURE THE PADS DON'T SCRATCH THE GLASS.

METAL HARDWARE CAN BE TREATED LIKE METALWORK FOR LUBRICATION NEEDS.

WHETHER ROOFS, WALLS, OR WINDOWS, MAKE SURE TO ANALYZE ALL THE PARTS OF THE SYSTEM.

THERE MIGHT BE MORE COMPONENTS INVOLVED THAN WHAT IS IMMEDIATELY VISIBLE ON THE SURFACE.

BEFORE UNDERTAKING ANY REPAIRS, INCLUDING LOCALLY REPLACING SMALL PARTS OF THE SYSTEM, PLEASE CONSULT CH.

BUILDING MATERIALS
AN INTRODUCTION

Material matters: typical characteristics and interventions for building materials at U.S. Department of State heritage sites

Building Materials—An Introduction

BUILDINGS ARE AT RISK FROM HAZARDS AND THEIR MATERIALS' INHERENT VULNERABILITIES.

CHANCERY ANNEX
OFFICE BUILDING
BRATISLAVA, SLOVAKIA

THOSE VULNERABILITIES ARE SOMETIMES A RESULT OF STRESSES INTRODUCED BY WHERE A BUILDING LIVES.

OFTEN THEY ARE A RESULT OF HOW A BUILDING MATERIAL REACTS TO ITS ENVIRONMENT.

(FOR EXAMPLE, METALS CAN CORRODE WHEN EXPOSED TO MARINE SALTS.)

AND VERY OFTEN THEY ARE A RESULT OF HOW WELL A MATERIAL AND DESIGN FIT A PLACE.

(ENVIRONMENTAL CONDITIONS LIKE SANDSTORMS AND POLLUTION CAN TEST CONCRETE, FOR INSTANCE.)

CARE AND MAINTENANCE PROTOCOLS CAN EITHER HELP OR HINDER EXISTING CONDITIONS.

UNDERSTANDING BUILDING MATERIALS AND THEIR SPECIFIC QUALITIES AS WELL AS LOCAL BUILDING METHODS AND CUSTOMS HELPS DETERMINE WHAT IS HAPPENING TO A BUILDING. THIS KNOWLEDGE CAN ALSO HELP PROTECT AND PREVENT DAMAGE.

THE FOLLOWING PAGES EXPLAIN COMMON MATERIALS IN DETAIL TO HELP DETERMINE WHAT MIGHT BE THE CAUSE OF DAMAGE—AND TO OFFER SOLUTIONS FOR PREVENTIVE CARE, MAINTENANCE, AND REPAIR.

Considering Position

CONSIDER WHERE A MATERIAL IS ON A BUILDING. DEGREES OF EXPOSURE AFFECT MATERIAL DEGRADATION.

THERE IS A DISTINCTION BETWEEN INTERIOR AND EXTERIOR WALLS, FOR EXAMPLE.

OR EVEN AT WHAT LEVEL A MATERIAL LIVES. FOR EXAMPLE, HOW HIGH OR LOW SOMETHING IS ON A WALL.

ALSO THINK ABOUT HOW FAR SOMETHING STICKS OUT.

CARVED ORNAMENT AND PROJECTING ELEMENTS HAVE MORE SURFACE AREA EXPOSED TO THE ELEMENTS, MAKING THEM SUSCEPTIBLE TO DETERIORATION FROM MULTIPLE SIDES. AS A RESULT, THREE-DIMENSIONAL DECORATION CAN DETERIORATE FASTER.

AREAS CLOSE TO OR BELOW GRADE ARE OFTEN EXPOSED TO MORE MOISTURE FROM THE GROUND, WATER DISCHARGING FROM DOWNSPOUTS, OR MAINTENANCE EFFORTS LIKE IRRIGATION AND HOSING DOWN PAVEMENTS.

WATER CAUSES OR PERPETUATES MOST DAMAGING CONDITIONS, AND IT CAN EXACERBATE DETERIORATION WHEN COMBINED WITH THINGS LIKE DEICING SALTS OR REINFORCED CONCRETE.

TAKING POSITIONING INTO ACCOUNT IS PART OF A SUCCESSFUL MONITORING AND PREVENTIVE MAINTENANCE PROGRAM.

PALAZZO MARGHERITA
ROME, ITALY

Considering Capabilities

TO BE ABLE TO DIAGNOSE A CONDITION, IT IS IMPORTANT TO UNDERSTAND THE INHERENT CHARACTERISTICS OF A MATERIAL AS WELL AS ITS STRENGTHS AND WEAKNESSES.

FOR EXAMPLE, WOOD FRAME BUILDINGS ARE LIGHT AND FLEXIBLE SO THEY CAN BEND MORE EASILY IN SEISMIC AND HIGH WIND EVENTS.

MASONRY IS BRITTLE, SO IT IS MORE EASILY DAMAGED IN EARTHQUAKES, BUT BECAUSE OF THEIR MASS BUILDINGS ARE OFTEN RESILIENT IN HIGH WINDS.

A MATERIAL'S PROPERTIES AS WELL AS ITS CONTEXT WILL DETERMINE HOW IT PERFORMS.

Considering Mixed Materials and Repair Methodologies

A BUILDING IS ALMOST NEVER JUST ONE MATERIAL. BUILDINGS ARE COMPOSITES.

AND THE DEPARTMENT OF STATE'S HERITAGE PROPERTIES ARE IN EVERY CONCEIVABLE ENVIRONMENT IN THE WORLD, WHICH MEANS THE MATERIALS ARE EXPOSED TO EVERY CONCEIVABLE MECHANISM OF DETERIORATION.

RESPONSES TO DAMAGE CAN MAKE THINGS BETTER OR WORSE. EVALUATE THE MOST EFFICIENT AND DURABLE APPROACH. DOING REPAIRS QUICKLY OR WITH IMPROPER METHODS OR MATERIALS SETS UP PROBLEMS DOWN THE ROAD.

STONE

GLASS

METAL

CONCRETE

IT IS ALSO VITAL TO DOCUMENT HERITAGE STRUCTURES WITH PHOTOS AND A NARRATIVE ABOUT CONDITION AND REPAIRS.

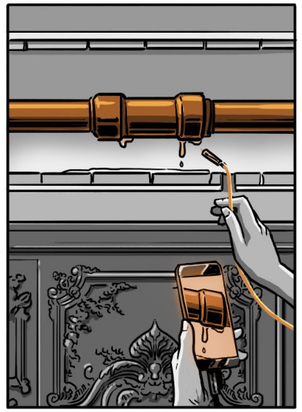
CH AND POST SHOULD KEEP RECORDS OF MATERIALS USED FOR MAINTENANCE, WHICH CAN INFORM FUTURE REPAIRS BASED ON PAST PERFORMANCE. AND NEW STAFF COMING IN CAN BENEFIT BY KNOWING WHAT IS THERE.

U.S. EMBASSY CHANCERY
ATHENS, GREECE

Principles of Repair

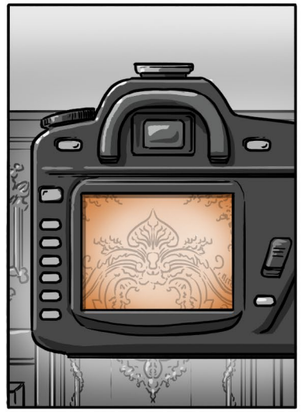
STEP 1:
ASSESS AND DOCUMENT THE CONDITION.

STEP 2:
INVESTIGATE AND MITIGATE THE CAUSE.



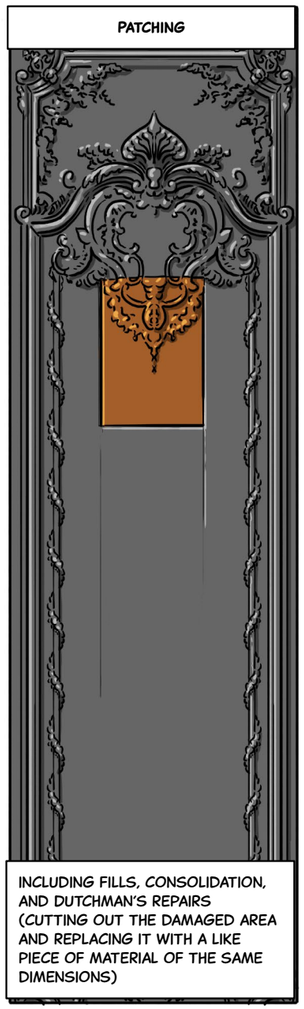
STEP 3:
SCOPE AND HIRE A SPECIALIST IF NEEDED.

STEP 4:
DOCUMENT THE TREATMENT PROCESS.



THE MAIN REPAIR TYPES THAT COVER MOST MATERIALS ARE:

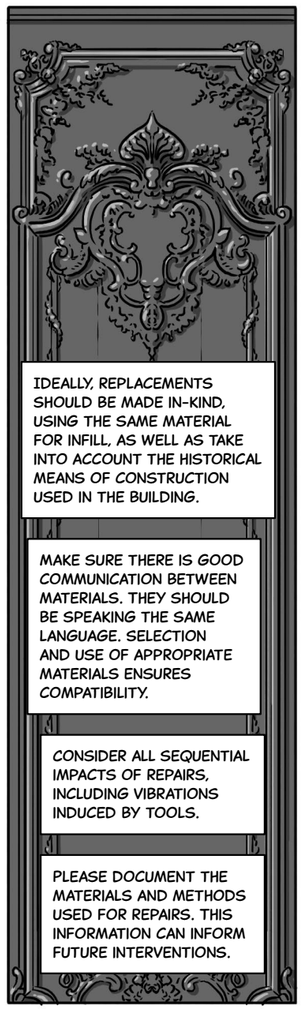
PATCHING



INCLUDING FILLS, CONSOLIDATION, AND DUTCHMAN'S REPAIRS (CUTTING OUT THE DAMAGED AREA AND REPLACING IT WITH A LIKE PIECE OF MATERIAL OF THE SAME DIMENSIONS)

WHOLE UNIT REPLACEMENT

STRUCTURAL REPAIRS



IDEALLY, REPLACEMENTS SHOULD BE MADE IN-KIND, USING THE SAME MATERIAL FOR INFILL, AS WELL AS TAKE INTO ACCOUNT THE HISTORICAL MEANS OF CONSTRUCTION USED IN THE BUILDING.

MAKE SURE THERE IS GOOD COMMUNICATION BETWEEN MATERIALS. THEY SHOULD BE SPEAKING THE SAME LANGUAGE. SELECTION AND USE OF APPROPRIATE MATERIALS ENSURES COMPATIBILITY.

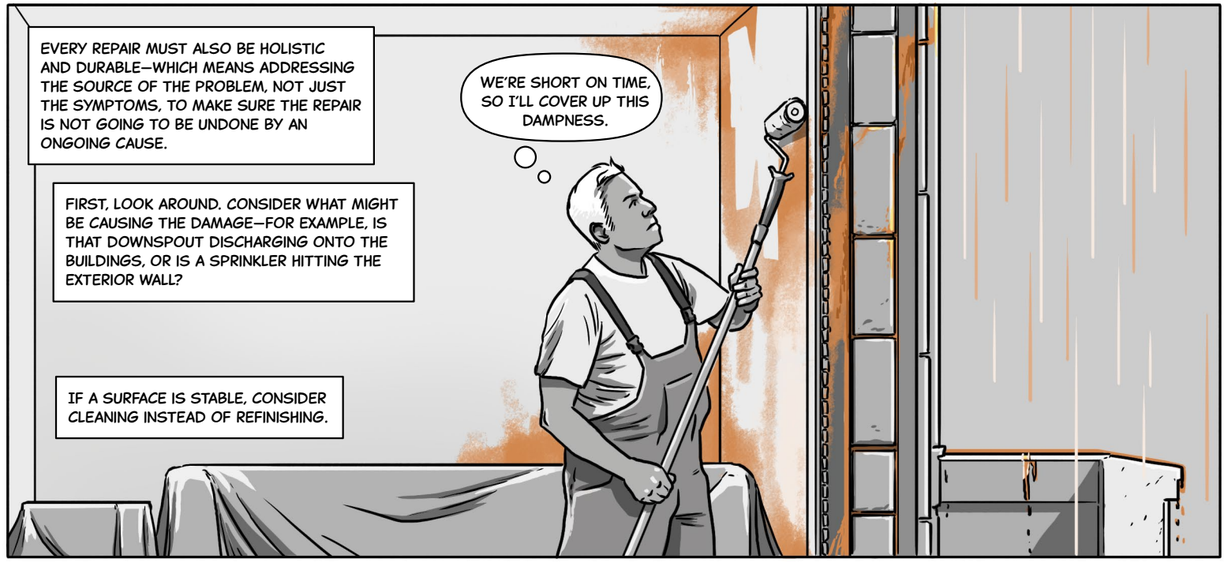
CONSIDER ALL SEQUENTIAL IMPACTS OF REPAIRS, INCLUDING VIBRATIONS INDUCED BY TOOLS.

PLEASE DOCUMENT THE MATERIALS AND METHODS USED FOR REPAIRS. THIS INFORMATION CAN INFORM FUTURE INTERVENTIONS.

EVERY REPAIR MUST ALSO BE HOLISTIC AND DURABLE—WHICH MEANS ADDRESSING THE SOURCE OF THE PROBLEM, NOT JUST THE SYMPTOMS, TO MAKE SURE THE REPAIR IS NOT GOING TO BE UNDONE BY AN ONGOING CAUSE.

FIRST, LOOK AROUND. CONSIDER WHAT MIGHT BE CAUSING THE DAMAGE—FOR EXAMPLE, IS THAT DOWNSPOUT DISCHARGING ONTO THE BUILDINGS, OR IS A SPRINKLER HITTING THE EXTERIOR WALL?

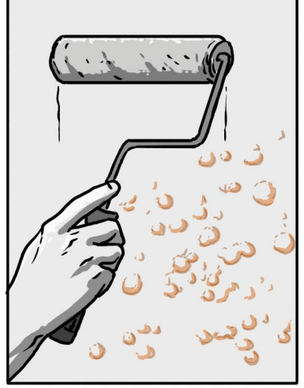
IF A SURFACE IS STABLE, CONSIDER CLEANING INSTEAD OF REFINISHING.



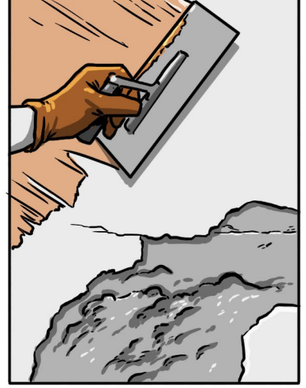
Repair and Maintenance No-No's

SOME GENERAL RULES FOR TREATMENTS TO AVOID INCLUDE:

APPLICATIONS OF IMPERMEABLE COATINGS TO POROUS SUBSTRATES



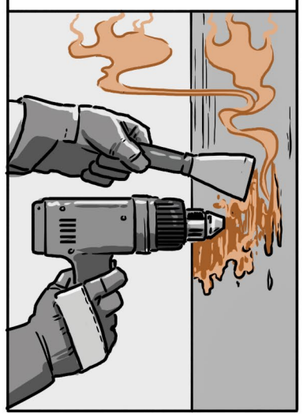
INTRODUCTION OF PORTLAND CEMENT TO HISTORIC WALL TYPES



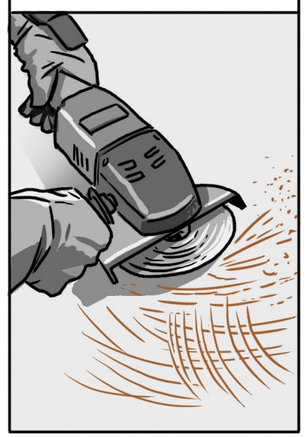
ABRASION USING SANDBLASTING

CLEANING WITH A PRESSURE (POWER) WASHER

TAKING OFF PAINT USING HEAT, A FLAME, OR HEAT GUN...

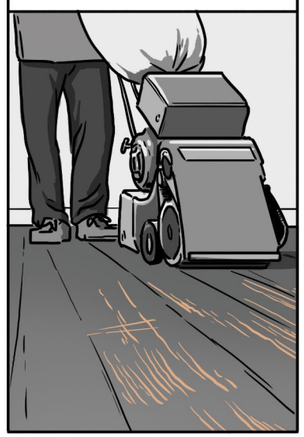


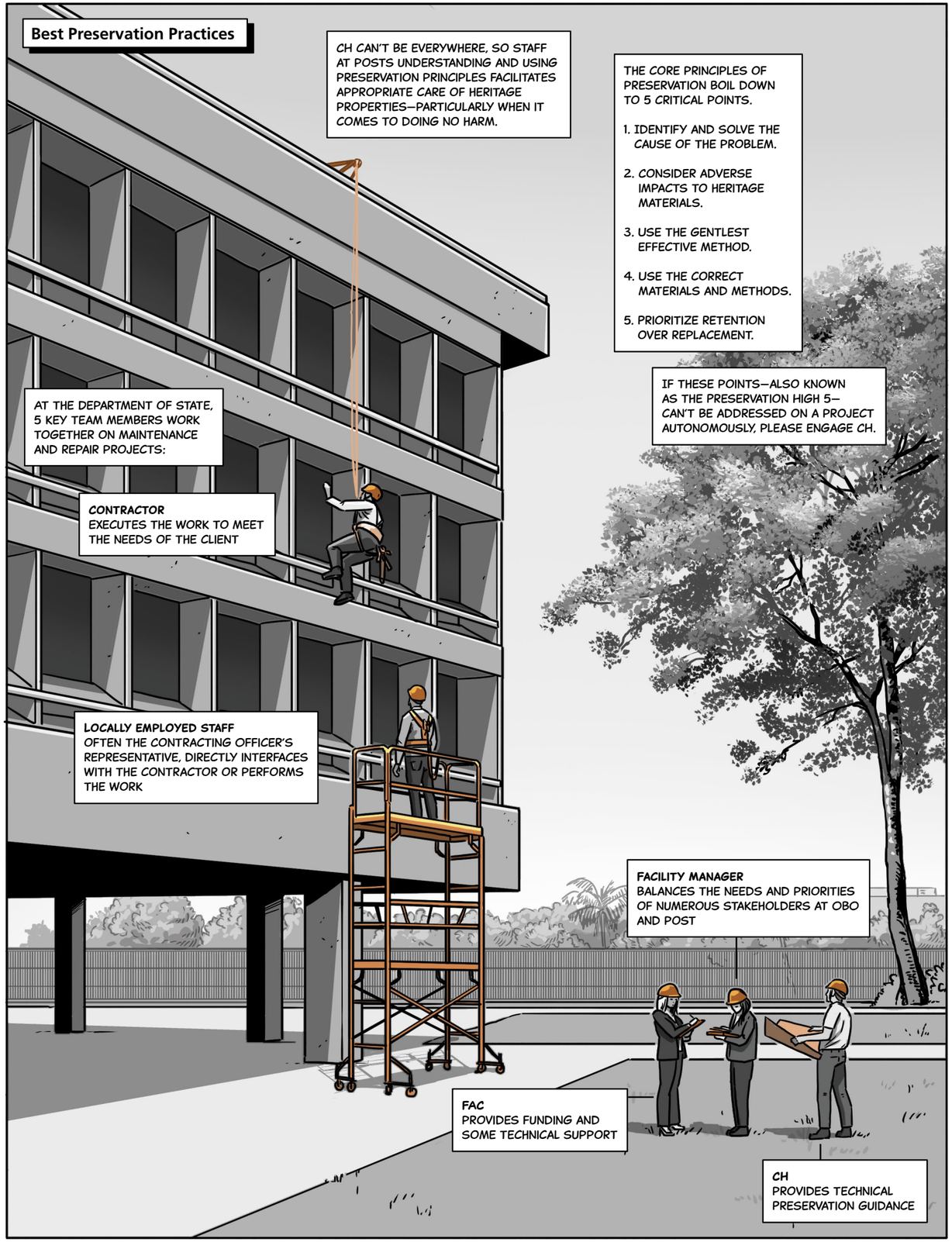
...OR A GRINDING WHEEL



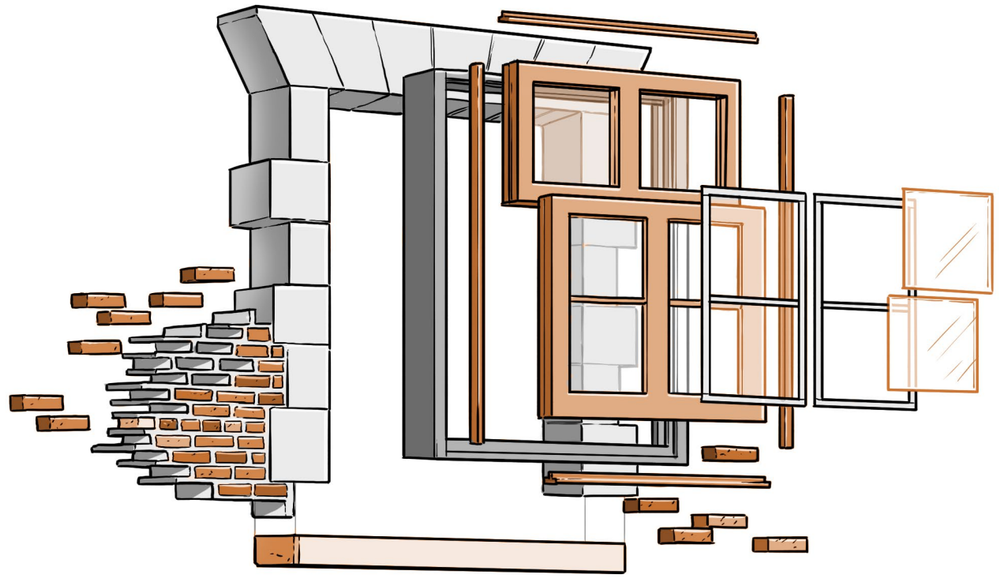
USING HARSH CLEANING METHODS LIKE ACIDIC SOLUTIONS

DRUM SANDING WOODEN FLOORS





THESE CHECKLISTS OUTLINE TYPICAL STEPS TAKEN FOR COMPLETING PRESERVATION PROJECTS. CH IS ALWAYS AVAILABLE TO HELP.



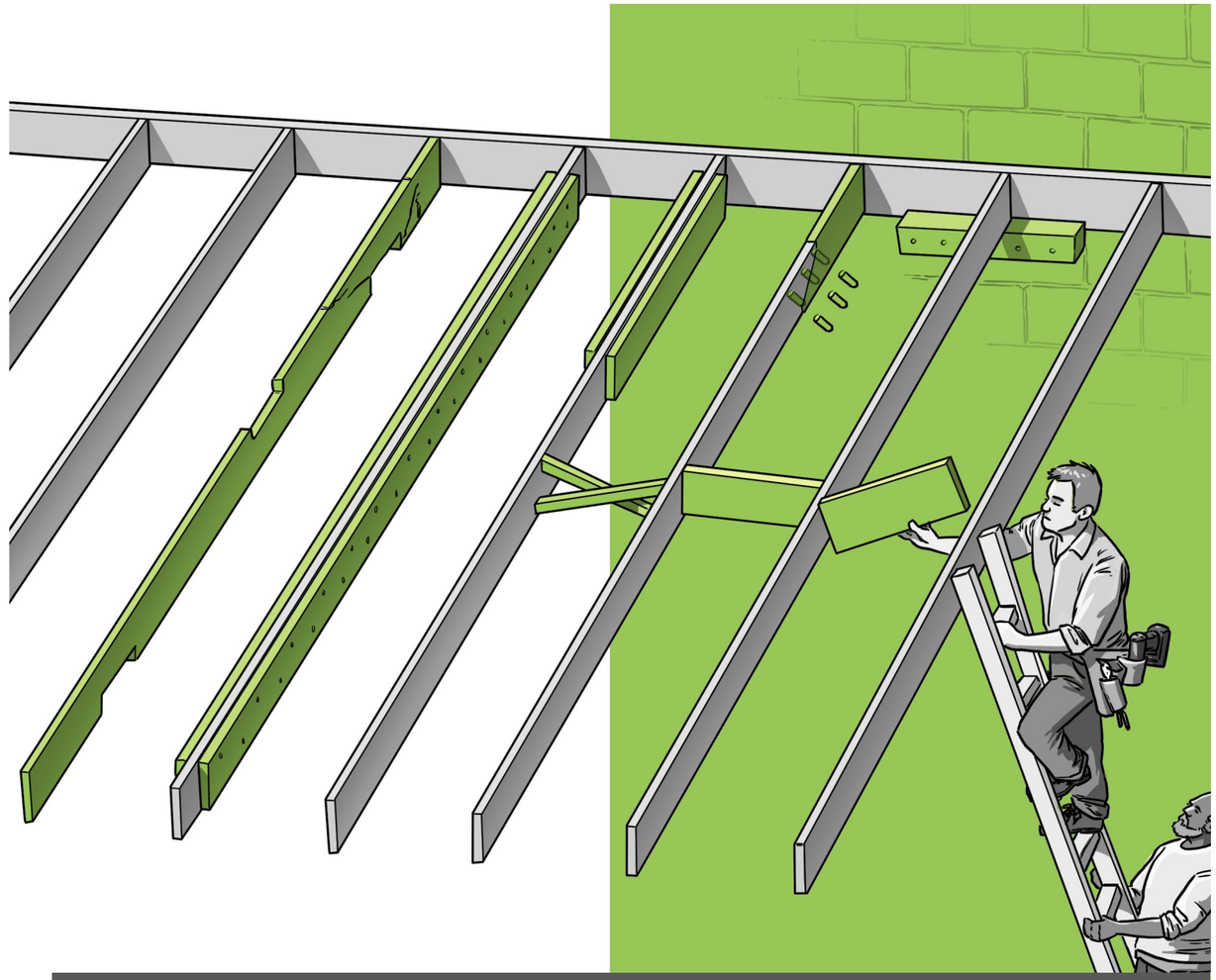
BEFORE BEGINNING ANY REPAIR, FIRST ASK: WHAT EXACTLY IS IT THAT I NEED TO DO?

TYPICAL STEPS FOR A CONTRACTED PROJECT THAT INCLUDES DESIGN AND CONSTRUCTION:

- ☐ PERFORM A CONDITIONS ASSESSMENT. IDENTIFY THE AREAS THAT NEED REPAIR.
- ☐ COMPLETE PERFORMANCE TESTING—FOR EXAMPLE, PROBES, INFARED, OR PAINT ANALYSIS.
- ☐ DESIGN THE REPAIR.
- ☐ CONTRACT THE REPAIR.
- ☐ DO MOCK-UPS.
- ☐ MONITOR THE CONSTRUCTION.
- ☐ FINALIZE PUNCH LIST AND DO A PROJECT CLOSEOUT WITH DOCUMENTATION.

TYPICAL STEPS FOR LOCALIZED OR SMALL-SCALE MAINTENANCE AND REPAIR PROJECT CARRIED OUT IN-HOUSE:

- ☐ IDENTIFY THE AREAS THAT NEED REPAIR. LOOK FROM ALL SIDES.
- ☐ DO YOU NEED TO EXTRACT SOMETHING, LIKE A BROKEN TILE?
- ☐ BEFORE YOU REMOVE, DECIDE HOW FAR THE REMOVAL AREA IS GOING TO EXTEND AND HOW ARE YOU GOING TO PUT IT BACK TOGETHER.
- ☐ INSTALL TEMPORARY PROTECTIONS LIKE A TARP, PLASTIC SHEETING, OR SCAFFOLDING TO PROTECT SURFACES FROM THE WORK AND THE ELEMENTS.
- ☐ DOUBLE-CHECK TO MAKE SURE THE REPAIR MATERIALS MATCH THE EXISTING SYSTEM AND STRUCTURE.
- ☐ IT'S NOT ENOUGH TO MAKE SURE THE MATERIALS ARE THE SAME; YOU NEED TO MAKE SURE THE REPAIR IS THE SAME. CAREFULLY FOLLOW INSTALLATION INSTRUCTIONS.
- ☐ REMEMBER TO ALWAYS HAVE YOUR ACCESS ROUTE TO THE REPAIR AND THE SAFETY SYSTEMS IN PLACE REVIEWED BY POST'S OCCUPATIONAL SAFETY AND HEALTH OFFICER AND HAVE FACILITIES DOUBLE-CHECK ALL INSTALLATION.
- ☐ SOME MATERIALS MAY BE HARD TO GET. CH CAN HELP DISCUSS ALTERNATE OPTIONS, AND IN SOME CASES SUPPLY A SMALL AMOUNT OF THE MATERIAL.



BUILDING MATERIALS WOOD

Wood

MATERIAL CHARACTERISTICS:
RENEWABLE RESOURCE, GOOD STRENGTH-TO-WEIGHT RATIO, SUSCEPTIBLE TO MOISTURE DETERIORATION

THINGS LIKE:
MAPLE, OAK, WALNUT, MAHOGANY, TEAK, CYPRESS, FIR, PINE, CEDAR

USED FOR:
FLOOR JOISTS AND ROOF BEAMS (STRUCTURAL); DOORS AND WINDOWS (FENESTRATION); FLOORING, PANELING, MILLWORK, RAILINGS AND BANISTERS (DECORATIVE)

HARDWOOD (DECIDUOUS)

SOFTWOOD (EVERGREEN)

CHARACTERIZED AS EITHER HARDWOOD (ORIGINATING FROM DECIDUOUS TREES, WHICH GENERALLY LOSE THEIR LEAVES EVERY YEAR) OR SOFTWOOD (FROM EVERGREEN SOURCES), THE DESIGNATION HAS LESS TO DO WITH THE ACTUAL DENSITY OF THE WOOD ITSELF AND BOTH CAN BE USED IN STRUCTURAL AND DECORATIVE WAYS.

BECAUSE OF ITS ORGANIC NATURE, WOOD IS BOTH RESILIENT—WITH ENOUGH FLEX TO WITHSTAND HIGH WINDS—AND VULNERABLE—SUSCEPTIBLE TO ATTACK BY TINY INSECTS AND FUNGI.

BECAUSE OF ENVIRONMENTAL CONDITIONS, IT IS ALSO A HIGHLY VARIABLE MATERIAL.

TWO TREES FROM THE SAME FOREST WILL HAVE DIFFERENT BUGS, DIFFERENT SOIL, DIFFERENT LIGHT LEVELS.

THE SAME SPECIES OF TREE FROM DIFFERENT PARTS OF THE WORLD WILL HAVE DIFFERENT LIVES.

BIOLOGICAL AGENTS, LIKE DRYWOOD TERMITES, CAN BE INTRODUCED BY SHIPPING WOOD FROM ONE PART OF THE WORLD TO THE NEXT.

WOOD IS THE BUILDING MATERIAL MOST OFTEN AFFECTED BY BUG INFESTATIONS.

BUT IT'S NOT JUST BUGS; SOME FUNGI ACTUALLY EAT WOOD, IN PARTICULAR THE CELLULOSE AND/OR LIGNIN.

WOOD IS EASY TO WORK WITH AND MANIPULATE AND LENDS WARMTH AND CHARACTER TO BUILDINGS. IN CERTAIN PARTS OF THE WORLD, WOOD SPECIES IS OFTEN REFLECTIVE OF PLACE, SUCH AS IN THIS ROOF AT THE HISTORIC TEAK HOUSE AT THE U.S. EMBASSY IN BURMA (MYANMAR).

AS A RESULT, WOOD IS A COMMON MATERIAL IN THE U.S. DEPARTMENT OF STATE'S BUILDINGS.

TEAK HOUSE, U.S. EMBASSY COMPOUND
RANGOON, BURMA (MYANMAR)

WOOD IS OFTEN WHERE YOU CAN'T SEE IT, LIKE FLOOR JOISTS AND ROOF BEAMS AND OTHER FRAMING ELEMENTS; IN FACT, IT PROVIDES THE MAJORITY OF FLOORING AND ROOFING SUPPORT.

BUT IT IS ALSO ABUNDANTLY USED FOR ITS VISUAL APPEAL AS FLOORING, BOISERIE PANELING, CABINETRY, DECORATIVE DOORS AND WINDOWS, STAIR RAILINGS AND BANISTERS, AND TRIM AND MILLWORK.

Material Vulnerabilities

THE WAY WOOD IS CUT AND DRIED CAN AFFECT ITS PERFORMANCE.

THERE ARE 3 WAYS THAT A LOG CAN BE CUT UP FOR DIMENSIONAL LUMBER:

PLAIN SAWN/FLAT SAWN IS DOWN THE LENGTH OF THE TRUNK (TOP OF TREE TO ROOTS);

QUARTER-SAWN IS WHERE GROWTH RINGS ARE PERPENDICULAR TO THE HORIZONTAL CUT; AND

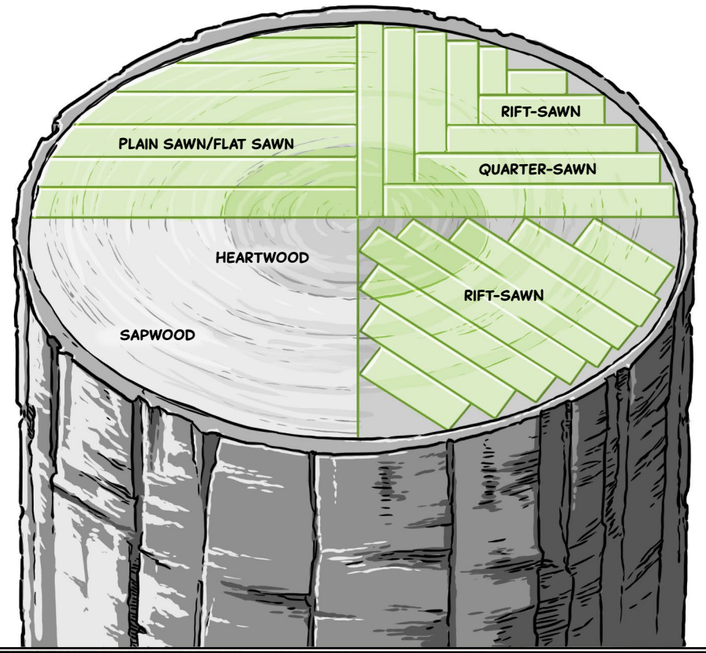
RIFT-SAWN IS WHEN BOARDS ARE CUT RADIALLY WITH GROWTH RINGS NEARLY PERPENDICULAR TO THE BOARDS' HORIZONTAL CUT.

THE GRAINING AND RELATIONSHIP TO THE CUT COULD CAUSE INHERENT VULNERABILITY.

WHERE WOOD COMES FROM IN THE TREE ALSO PLAYS A PART.

HEARTWOOD IS DENSER AND HARDER.

SAPWOOD IS CLOSER TO THE BARK AND IS MORE SUSCEPTIBLE TO INFESTATION AND FUNGAL DECAY.



WOOD READILY TAKES IN AND RELEASES MOISTURE, CAUSING DIMENSIONAL CHANGES.

TOO MUCH OR TOO LITTLE MOISTURE IS PROBLEMATIC LARGELY BECAUSE OF SWELLING OR SHRINKING.

MOISTURE FLUCTUATIONS AND RESULTANT MOVEMENT CAN CAUSE SPLITTING, CRACKING, AND OTHER TYPES OF DAMAGE.

SYNTHETIC COATINGS, MEANT TO KEEP WATER OUT, CAN ACTUALLY TRAP MOISTURE, CAUSING WOOD TO ROT. TRADITIONAL FINISHES, LIKE WAX AND SHELLAC, OR STAINS DO NOT TRAP MOISTURE.

CONSIDER APPLYING PRESERVATIVES SUCH AS BORATES TO ALL CUTS, NOTCHES, AND DRILLED HOLES PRIOR TO INSTALLATION TO MINIMIZE DETERIORATION CAUSED BY MOISTURE, INSECTS, AND BIOLOGICAL ACTIVITY.

CH CAN HELP WITH COATING SELECTION.

WOOD CAN DEFORM IF NOT PROPERLY DRIED BEFORE PUT INTO USE—TIMBERS CAN TWIST (LIKE BOWING) OR WARP (LOOK WAVY INSTEAD OF STRAIGHT) OR SHRINK.

WOOD IS ALSO SUSCEPTIBLE TO UV DAMAGE AND CAN DISCOLOR, CRACK, OR DEFORM WITH EXPOSURE TO SUNLIGHT. UV LIGHT ALSO AFFECTS NATURAL AND SYNTHETIC FINISHES SUCH AS WAX, SHELLAC, VARNISH, AND PAINT.

WOOD IS EASILY ABRADED OR GOUGED, AND IT WEARS READILY WITH HEAVY USE OR EXPOSURE.

IN INTERIORS, WOOD IS SUBJECT TO FOOT TRAFFIC. FURNITURE IS DRAGGED ACROSS FLOORS AND BUMPED INTO DOOR MOLDINGS. CHAIR LEGS SLAM INTO BASEBOARDS.

Things to Look Out For

MOST WOOD DAMAGE STEMS FROM MOISTURE EXPOSURE OVER THE SHORT OR LONG TERM, LIKE A SUDDEN PIPE BURST OR AN UNDETECTED LEAK.

WOOD TAKES UP WATER PARALLEL TO ITS GRAIN, LIKE A BUNCH OF STRAWS.

WOOD MOVES NOT ONLY IN RESPONSE TO FLUCTUATING MOISTURE LEVELS BUT ALSO TO THERMAL CYCLING AND LOADING. WOOD EXHIBITS PERMANENT DEFORMATION WHEN LOADED OVER LONG DURATIONS. FOR INSTANCE, OLD HOUSE FLOOR JOISTS DEFLECTING.

RECURRING PELLETIZED OR DUSTY FRASS MAY INDICATE AN ACTIVE INSECT INFESTATION. BUGS EAT WOOD TO HYDRATE. INSECT ACTIVITY IS OFTEN A RESULT OF WOOD'S ELEVATED MOISTURE CONTENT DUE TO A SUSTAINED HIGH RELATIVE HUMIDITY OR LIQUID MOISTURE SOURCE LIKE CONDENSATION OR A LEAK.

WHITE ROT IS A FUNGUS THAT CONSUMES THE LIGNIN (STRIPS OF FIBERS IN THE WOOD).

THE WOOD WILL TEAR AND LOOK WHITE OR BLEACHED.

BROWN ROT IS A FUNGUS THAT CONSUMES CELLULOSE AND CHANGES WOOD'S APPEARANCE TO LOOK LIKE LITTLE CUBES.

WOOD BECOMES LIGHTWEIGHT AND LOSES STRENGTH.

FUNGAL GROWTH MAY PRESENT AS A CRUST OR A FILM ON THE SURFACE OF THE WOOD. MOLD GROWING ON A SURFACE CAN ALSO CHANGE COLOR.

IN STRUCTURAL MEMBERS, PROLONGED EXPOSURE TO MOISTURE REDUCES THEIR STRENGTH AND ALLOWS FOR IRREVERSIBLE DISPLACEMENT SUCH AS DEFLECTION AND CRUSHING.

FOR DECORATIVE MILLWORK AND WOOD FLOORS, ASK:

ARE THERE STAINS, FADING, OR DISCOLORATION?

IS THERE FADING OR DISCOLORATION FROM UV LIGHT?

IS THERE DARKENING FROM AGING VARNISH OR ACCUMULATED DEBRIS IN WAX COATINGS?

IS THERE WARPING OR DISPLACEMENT FROM MOISTURE OR FLUCTUATING RELATIVE HUMIDITY?

ARE THERE CRACKS, CHECKS, OR WIDENING JOINTS?

Routine Care for Wood

INTERIORS
PANELING AND MILLWORK

REMEMBER TO WORK FROM HIGH TO LOW.

DUST IN THE DIRECTION OF THE GRAIN USING A SOFT BRISTLE BRUSH.

USE A SOOT SPONGE OR MAKEUP SPONGE FOR SMUDGES.

FREQUENCY OF CLEANING: AS NEEDED, LIKELY 1–2 TIMES A YEAR

VARNISHED

DRY CLEAN AS A RULE, BUT A DAMP SPONGE MAY BE USED IF NECESSARY.

PAY ATTENTION TO THE CONDITION OF THE WOOD ITSELF. FINISHES THAT ARE CRACKED CAN TRAP WATER.

WOOD FLOORS
PARQUET OR DECORATIVE INLAY AND ORIGINAL TO THE HOUSE

VACUUM OR SWEEP DEBRIS FIRST.

MAY REQUIRE OCCASIONAL MOPPING WITH A DAMP MOP.

DO NOT USE CHEMICAL CLEANERS.

DO NOT ALLOW WATER TO POOL ON FLOORS.

INTERIOR FLOORS MAY BE WAXED, USING FELT BUFFING PADS.

DON'T GET OVERZEALOUS AND POLISH OR REFINISH FLOORS WITHOUT CH'S HELP.

PAINTED (INTERIORS)

OKAY TO USE A DAMP SPONGE ON NON-HISTORIC PAINT FINISHES. TEST IN AN INCONSPICUOUS PLACE FIRST TO MAKE SURE THE PAINT DOESN'T COME OFF.

FOR DECORATIVE HISTORIC PAINTWORK, OR TENACIOUS MARKS, STAINS, OR FLAKING PAINT, REACH OUT TO CH.

DO NOT BE OVERZEALOUS IN YOUR MAINTENANCE AND REPAINT. YOU RISK LOSING THE ORIGINAL CHARACTER.

GILDED (INTERIORS)

USE ONLY SOFT BRUSHES LIKE PONY HAIR OR SHEEP HAIR, WITH DEBRIS DIRECTED INTO A COVERED VACUUM NOZZLE.

DO NOT USE WATER. IT MAY CAUSE GILDING ON INTERIOR SURFACES TO COME OFF.

FREQUENCY OF CLEANING: CAREFULLY SWEEP DUST INTO A VACUUM AS NEEDED TO REMOVE ABRASIVE DEBRIS BEFORE IT CAN BE GROUND IN.

EXTERIORS

ALL WOODEN BUILDING ELEMENTS STARTED AS TREES. BUT WITHOUT THEIR NATURAL DEFENSES, WOOD ELEMENTS NEED PROTECTING.

IN EXTERIOR CONTEXTS, PRIORITIES ARE KEEPING WOOD DRY AND KEEPING DEBRIS OFF THEM.

DO NOT REFINISH OR FILL IN CHIPPING PAINT WITHOUT CH'S SUPPORT.

WATER AND A MILD PH NEUTRAL DETERGENT MAY BE USED ON FINISHED EXTERIOR WOODWORK.

DON'T FLOOD WITH WATER WHEN RINSING OR SATURATE.

ROYAL SALA
BANGKOK, THAILAND

FREQUENCY OF CLEANING: AS NEEDED

Repair Protocols

COSMETIC REPAIR

TIPS FOR REFINISHING WOOD:

TRY CLEANING BEFORE REFINISHING.
ALWAYS TEST BEFORE DIVING IN.
WORK WITH LOCAL EXPERTS.
CONTACT CH FOR ASSISTANCE.

MINIMIZE SANDING. IT CAN REMOVE TOO MUCH WOOD. TRADITIONAL FINISHES CAN BE STRIPPED WITH AN APPROPRIATE SOLVENT—ALCOHOL FOR SHELLAC AND MINERAL SPIRITS FOR WAX.

SYNTHETIC COATINGS MUST BE REMOVED MECHANICALLY BY SANDING USING AN ORBITAL OR ROTARY SANDER WITH A FINER GRIT. DO NOT USE BELT OR DRUM SANDERS—THEY ARE TOO AGGRESSIVE!

PAINTS AND VARNISHES ON WOOD ARE BOTH DECORATIVE AND PROTECTIVE. BE CAREFUL SELECTING THE TYPE OF FINISH.

TRAPPING MOISTURE IS A CONCERN WHEN COATING WOOD. NATURAL WAX OR OIL FINISHES OR WATER-BASED STAINS ARE PREFERRED. THEY OFFER PROTECTION WHILE ALLOWING WATER TO EVAPORATE OUT. TRADITIONAL, OIL-BASED PAINTS ARE ALSO ACCEPTABLE FOR WINDOWS, DOORS, AND TRIM. FINISHES, ESPECIALLY ON EXTERIORS, NEED TO BE METICULOUSLY MONITORED AND MAINTAINED.

BEFORE STRIPPING PAINT FROM WOOD, CONTACT CH TO DETERMINE WHETHER A PAINT ANALYSIS FOR DOCUMENTATION IS NEEDED.

ARCHITECTURAL REPAIR

SOMETIMES ARCHITECTURAL INTERVENTIONS WILL COMPLEMENT OR NEED TO PRECEDE A FRAMING REPAIR.

WOOD IS EASY TO WORK WITH AND FORGIVING. THESE QUALITIES ARE TRUE FOR ITS REPAIR TOO.

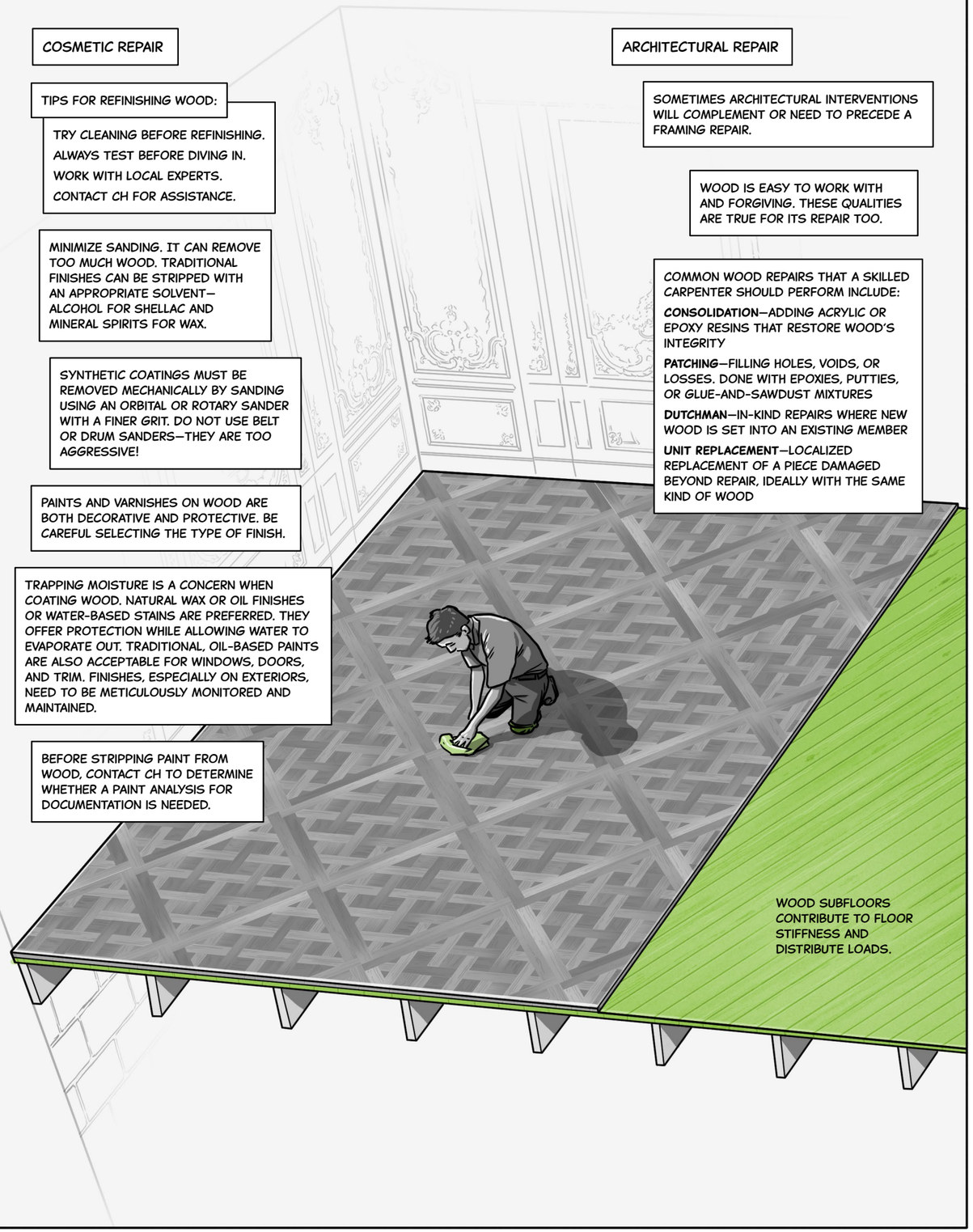
COMMON WOOD REPAIRS THAT A SKILLED CARPENTER SHOULD PERFORM INCLUDE:

CONSOLIDATION—ADDING ACRYLIC OR EPOXY RESINS THAT RESTORE WOOD'S INTEGRITY

PATCHING—FILLING HOLES, VOIDS, OR LOSSES. DONE WITH EPOXIES, PUTTIES, OR GLUE-AND-SAWDUST MIXTURES

DUTCHMAN—IN-KIND REPAIRS WHERE NEW WOOD IS SET INTO AN EXISTING MEMBER

UNIT REPLACEMENT—LOCALIZED REPLACEMENT OF A PIECE DAMAGED BEYOND REPAIR, IDEALLY WITH THE SAME KIND OF WOOD



STRUCTURAL REPAIR

ROOF, WALL, AND FLOOR SYSTEMS ARE THE "BONES" OF A BUILDING AND ARE PART OF THE HERITAGE FABRIC.

TIPS FOR WOOD FRAMING REPAIRS:

LOOK AT ENDS OF WOOD MEMBERS NEAR VERTICAL TO HORIZONTAL INTERFACES WHERE MOISTURE COLLECTS. ROT CAN LEAD TO LOSS OF MATERIAL.

STRUCTURAL DISTRESS CAN BE DUE TO MATERIAL VULNERABILITIES, POOR DETAILING, AND CONSTRUCTION METHODS. WITH ITS MANY SPECIES, WOOD HAS CONSIDERABLE VARIABILITY IN ITS MATERIAL CHARACTERISTICS. OLDER WOOD COMMONLY HAS TIGHTER GRAIN AND AS A RESULT MORE STRENGTH AND DURABILITY THAN MODERN SPECIES. SPECIES, GRADE, AND DURABILITY ARE IMPORTANT CONSIDERATIONS IN FRAMING SYSTEMS AND THEIR REPAIR.

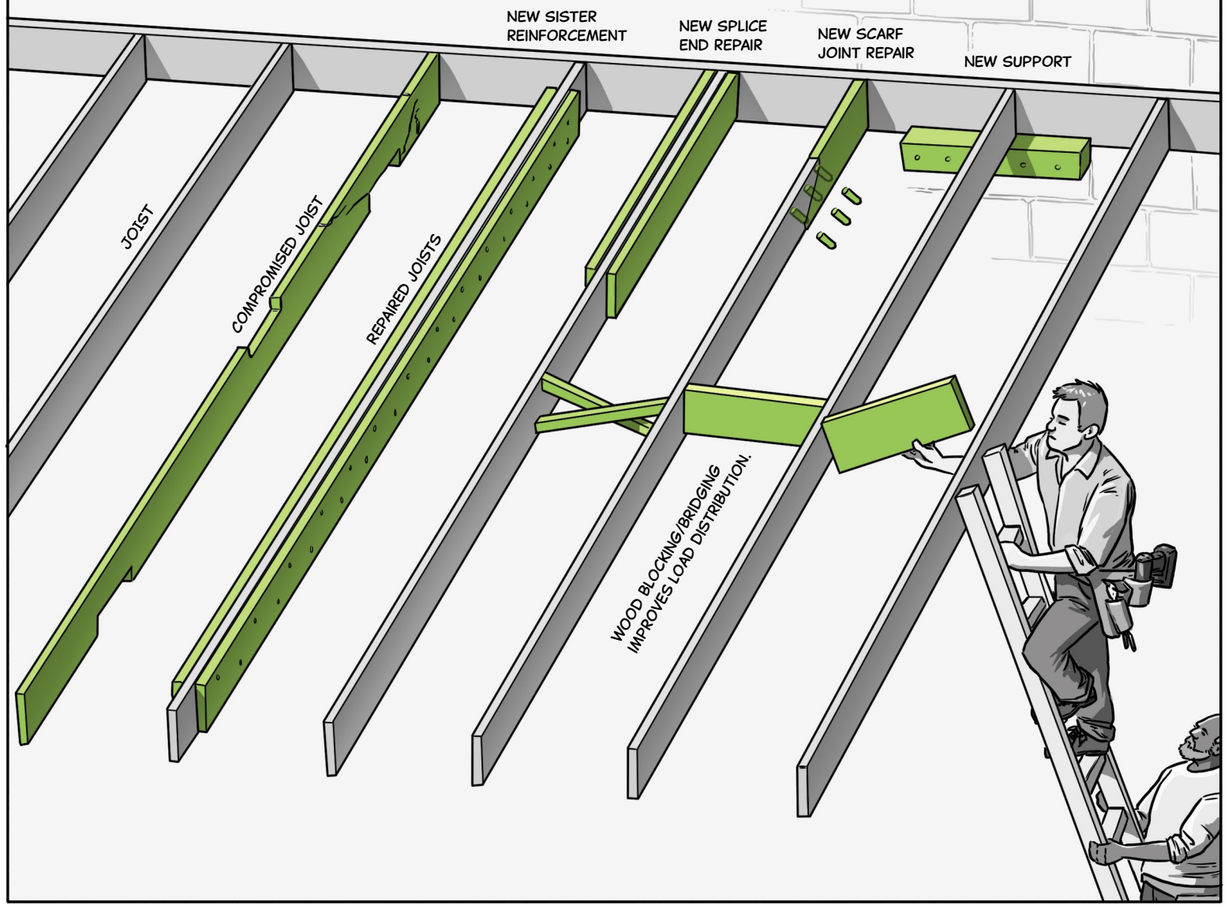
SPLICE, SCARF, SISTER, AND RE-SUPPORT ARE A FEW FRAMING REPAIR CONCEPTS TO EXPLORE. IN SITU REPAIRS PRESERVE MATERIAL, MINIMIZE INVASIVENESS, SAVE TIME, AND REDUCE COST. OFTEN, SHORING ISN'T NEEDED.

SPLICES REPAIR LOCALIZED END DETERIORATION WHEN PLACED ON BOTH SIDES OF THE ORIGINAL MEMBER. SPLICES ARE CONSTRUCTED OF SOLID SAWN OR ENGINEERED WOOD, STEEL PLATES, AND FASTENED WITH NAILS, SCREWS, AND/OR BOLTS.

SCARFS ARE GOOD OPTIONS IF THERE IS A DESIRE TO UTILIZE HISTORIC TIMBER FRAMING METHODS. TEMPORARY SUPPORT IS REQUIRED. SCARFS ARE CONSTRUCTED OF WOOD MATCHING THE ORIGINAL AND CONNECTED WITH TIGHT JOINTS AND HARDWOOD PEGS.

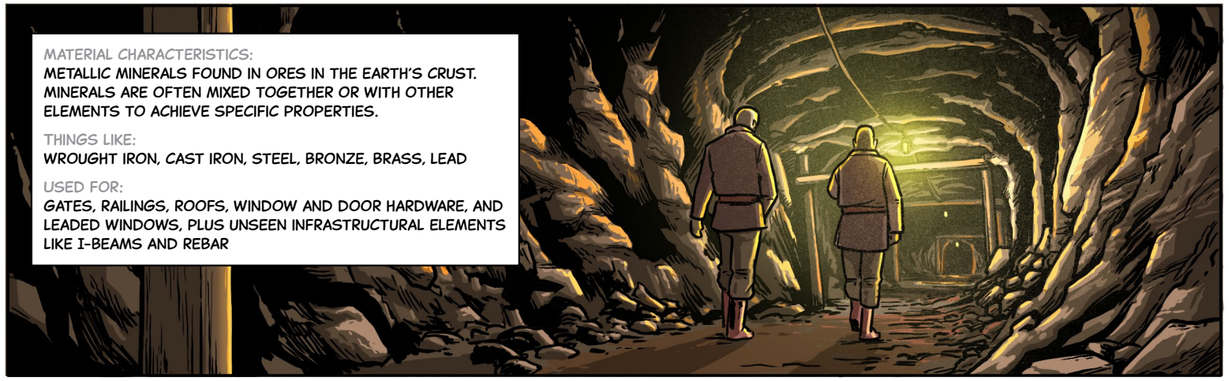
LIKE SPLICES, **SISTERS** ARE LONGER SIDE-MOUNTED MEMBERS USED TO INCREASE STRENGTH AND STIFFNESS OF AN EXISTING DETERIORATED OR UNDERSIZE MEMBER.

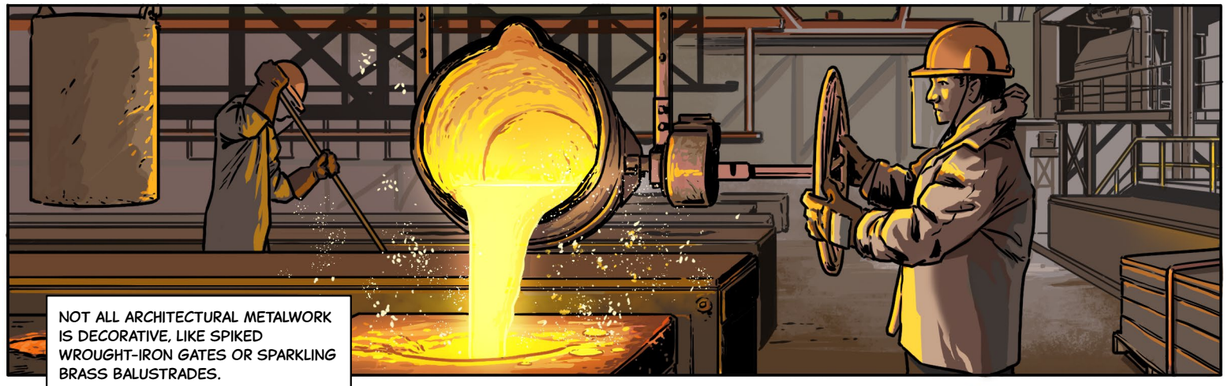
RE-SUPPORTS CAN BE ADDED TO FURTHER ASSIST WOOD FRAMING, INCLUDING LEDGERS AT BEARING ENDS OR POSTS MIDSPAN. THESE KEEP THE ORIGINAL MEMBER IN SERVICE.

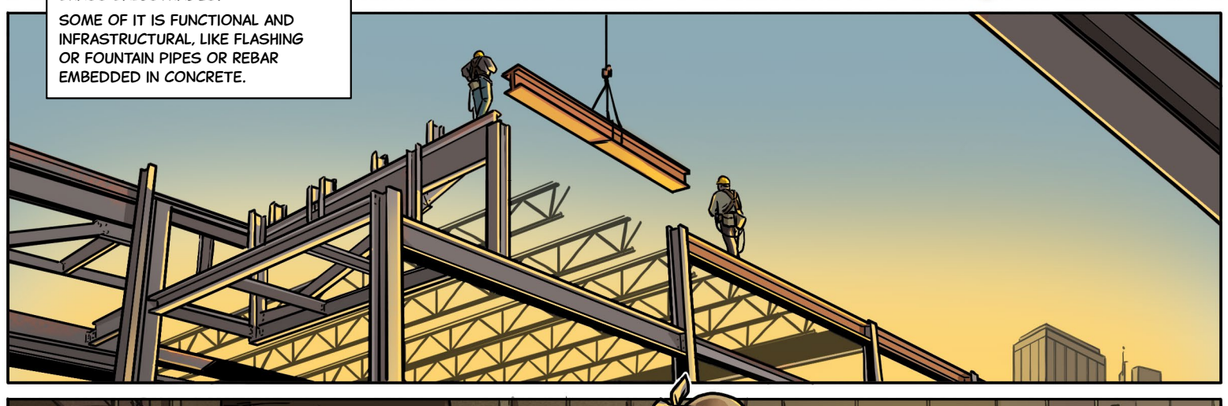


BUILDING MATERIALS METALS

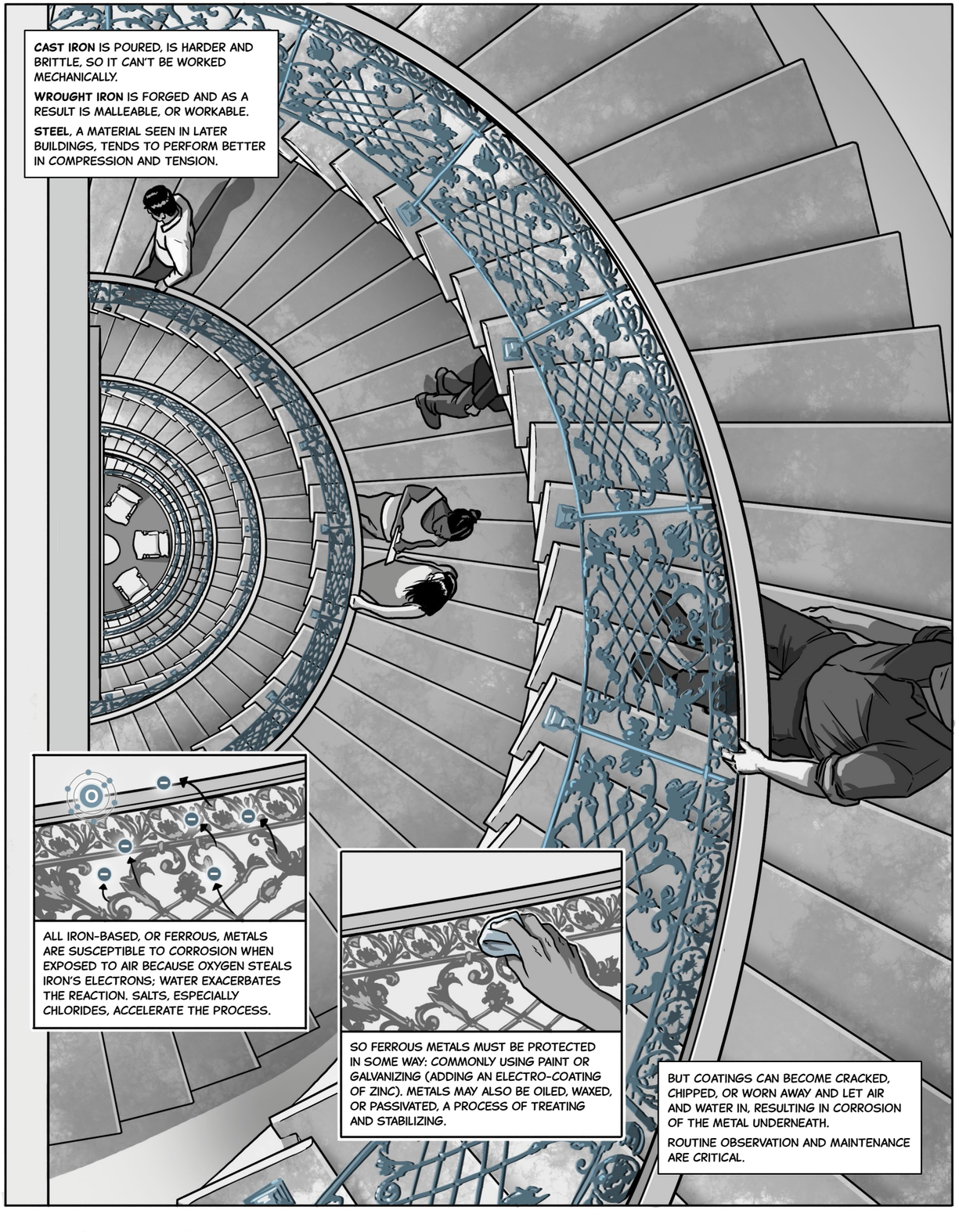
Metals







Ironwork



Copper Alloys

COPPER ALLOYS ARE COMBINATIONS OF COPPER WITH OTHER METALS. THE MOST COMMON ARE BRONZE (COPPER AND TIN) AND BRASS (COPPER AND ZINC).

THESE ARE OFTEN USED FOR HARDWARE AND FASTENERS, FOR FIXTURES IN KITCHENS AND BATHROOMS, OR FOR ORNAMENTATION ON GATES AND RAILINGS.

BECAUSE OF THEIR MALLEABILITY AND RELATIVE RESISTANCE TO MOISTURE-BASED CORROSION COMPARED WITH LESS NOBLE METALS, COPPER ALLOY METALS ARE ALSO USED IN DRAINAGE SYSTEMS, IN CLADDING FOR ROOFS, AND FOR SCULPTURAL ELEMENTS ON BUILDINGS—SUCH AS FINIALS AND WEATHERVANES.

ATMOSPHERIC CONDITIONS WILL AFFECT A COPPER ALLOY METAL'S COLOR, TURNING THEIR SURFACES SHADES OF RED, GREEN, OR BLACK.

BRONZE'S BROWN PATINA USUALLY HAS TO DO WITH EXPOSURE TO OXYGEN.

COPPER ALLOYS ALSO DISCOLOR BECAUSE OF OXIDATION. THESE PATINAS ARE STABLE OXIDES THAT ACTUALLY HELP PROTECT THE UNDERLYING METAL. WELL-DEVELOPED PATINAS ARE OFTEN DESIRABLE FOR AESTHETIC REASONS AND REFLECT THE AGE OF THE ARCHITECTURE, SO THEY SHOULD OFTEN BE PRESERVED.

Lead

LEAD IS THE SOFTEST OF THE COMMON METALS AND IS MALLEABLE AT AMBIENT TEMPERATURES.

SOMETIMES LEAD IS USED FOR ROOFS, GUTTERS, FLASHINGS, AND DOWNSPOUTS. AND LEAD CAMES ARE CRUCIAL ELEMENTS OF LEADED WINDOWS AND STAINED GLASS.

LEAD IS ALSO OFTEN IN PLACES YOU CAN'T SEE. LOOK OUT FOR LEAD IN CONNECTIONS.

Metals' Lesser Qualities

ANYTIME YOU HAVE WATER IN CONTACT WITH METAL, ESPECIALLY SLIGHTLY ACIDIC OR ALKALINE WATER, IT ACCELERATES THE METAL BEING ROBBED OF ITS ELECTRONS, RESULTING IN CORROSION AND LOSS OF MATERIAL.

RAINWATER LEADERS AND GUTTERS ARE PARTICULARLY SUSCEPTIBLE.

METAL PIPES SUCH AS IRON OR COPPER CAN CARRY IONS THAT CAN DEPOSIT ONTO AND DISCOLOR POROUS SURFACES.

THERE ARE A LOT OF HEALTH IMPLICATIONS IF LEAD IS INGESTED OR INHALED.

Things to Look Out For

NOTE THE COLOR AND TEXTURE OF A METAL'S PATINAS TO MAKE SURE THEY ARE STABLE:

CORROSION ON STEEL IS RUST.

COPPER ALLOYS CAN CORRODE IN DIFFERENT COLORS, BUT MOST OFTEN SHADES OF BLACK OR GREEN.

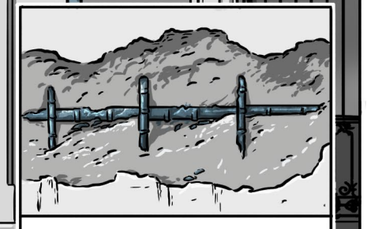
LEAD MOST OFTEN CORRODES IN SHADES OF WHITE.

CHECK FOR ANY DISCOLORATION, PITTING, FLAKING, PATINA LOSS, OR HOLES.

A BREAK IN METAL IS OFTEN DUE TO CORROSION.

LOOK FOR WATER POOLING AROUND EMBEDDED METAL RAILINGS. THESE CAN CORRODE AND CAUSE PROBLEMS TO BOTH THE METAL AND THE MATERIAL IT IS IN CONTACT WITH.

CORRODING METAL REINFORCEMENT INSIDE CONCRETE CAN CAUSE IT TO DISCOLOR AND CRACK.



RUST RESULTS IN LOSS OF CROSS SECTION AND CAN EXERT STRESS IN ADJOINING MATERIALS BECAUSE OF VOLUMMETRIC EXPANSION, COMMONLY REFERRED TO AS RUST JACKING.

How to Maintain Metalwork

INTERIORS

THE MAJORITY OF IRON METALWORK IN AN ARCHITECTURAL CONTEXT IS PAINTED BECAUSE EXPOSED FERROUS METAL WILL CORRODE.

IF THE SURFACE IS WAXED, IT CAN BE BUFFED WITH A MICROFIBER CLOTH.

FOR UNFINISHED SURFACES, REACH OUT TO CH TO SEE IF THEY SHOULD BE WAXED, VARNISHED, OR OTHERWISE PROTECTED.

EXTERIORS

REGULARLY BRUSH DEBRIS OFF OF METAL SURFACES. IF NEEDED, WASH STABLE METAL SURFACES WITH FILTERED WATER FROM A HOSE MIXED WITH A FEW DROPS OF FREE AND CLEAR DISH SOAP. SCRUB WITH A SOFT BRUSH AND RINSE THOROUGHLY.

DON'T LEAVE STANDING RINSE WATER TO PUDDLE ON METALWORK. AFTER FINAL RINSE, BLOT WITH PAPER TOWELS OR A COTTON TERRY TOWEL.

MAKE SURE OBJECTS ARE NOT IN THE PATH OF SPRINKLERS OR WET AND REWET IN ANY WAY.

IF HARDWARE, SUCH AS HINGES, NEED TO BE LUBRICATED, USE A GRAPHITE LUBRICANT. AVOID LITHIUM OR WD-40.

FREQUENCY OF CLEANING:
AS NEEDED, PROBABLY ONCE A YEAR

OXIDATION

CONTACT CH TO DISCUSS BEFORE ADDRESSING ANY OF THE FOLLOWING CONDITIONS, PARTICULARLY FOR DECORATIVE METALWORK.

IF POLISHED BRASS OR BRONZE HAS OXIDIZED, OR DARKENED, USE A COMMERCIAL POLISH OR POLISHING COMPOUND SPECIFICALLY INTENDED FOR USE ON BRASS OR COPPER ALLOYS.

APPLY ACCORDING TO LABEL.

POLISH RESIDUE MUST BE COMPLETELY REMOVED USING ETHANOL OR ISOPROPANOL ON EITHER COTTON BALLS OR A MICROFIBER CLOTH.

CORROSION

ACTIVE CORROSION OF METALWORK NEEDS TO BE ABRASIVELY REMOVED WITH A METAL BRISTLE BRUSH.

CAN USE SCOURING PADS OR SANDPAPER WITH ANY OF THE TYPES OF METALS.

WORK WITH A SPECIALIST AS CARE SHOULD BE TAKEN NOT TO DAMAGE THE UNDERLYING PATINA OR SUBSTRATE.

IF IRON OR STEEL, ONCE ALL LOOSE RUST HAS BEEN REMOVED, USE RUST CONVERTERS TO STABILIZE AND TREAT AGAINST FURTHER CORROSION, A PROCESS CALLED PASSIVATING. TANNIC AND PHOSPHORIC ACID SOLUTIONS ARE OFTEN USED.

CHECK WITH CH FOR MATERIALS.

MAKE SURE TO USE LIKE METAL WITH LIKE METAL. FOR EXAMPLE, FOR BRONZE AND BRASS, USE A BRONZE OR BRASS BRISTLED BRUSH.

LOCALIZED REPAINTING IRON OR STEEL

NEVER PAINT ON A LOOSE, FLAKY SURFACE.

ONCE YOU HAVE A CLEAN, STABLE SURFACE, IRON OR STEEL OBJECTS MUST BE REPAINTED TO PREVENT FURTHER CORROSION.

FIRST PRIME WITH A CORROSION-INHIBITING PRIMER, THEN PUT A TOPCOAT ON.

USE PAINTS SPECIFIED FOR FERROUS METAL SURFACES.

PROTECT ADJACENT SURFACES WHILE PAINTING.

MATCH EXISTING SURFACE COLOR OR REACH OUT TO CH FOR RECOMMENDATIONS.

Repair Protocols

METAL IS VERSATILE AND MALLEABLE AND CAN BE CHEMICALLY COMPLEX.

BECAUSE METAL IS A REACTIVE SUBSTRATE, IT SHOULD OFTEN BE TREATED BY A SPECIALIST. BEYOND SPOT REPAIRS OR APPLICATION OF WAX, CH SHOULD BE INVOLVED.

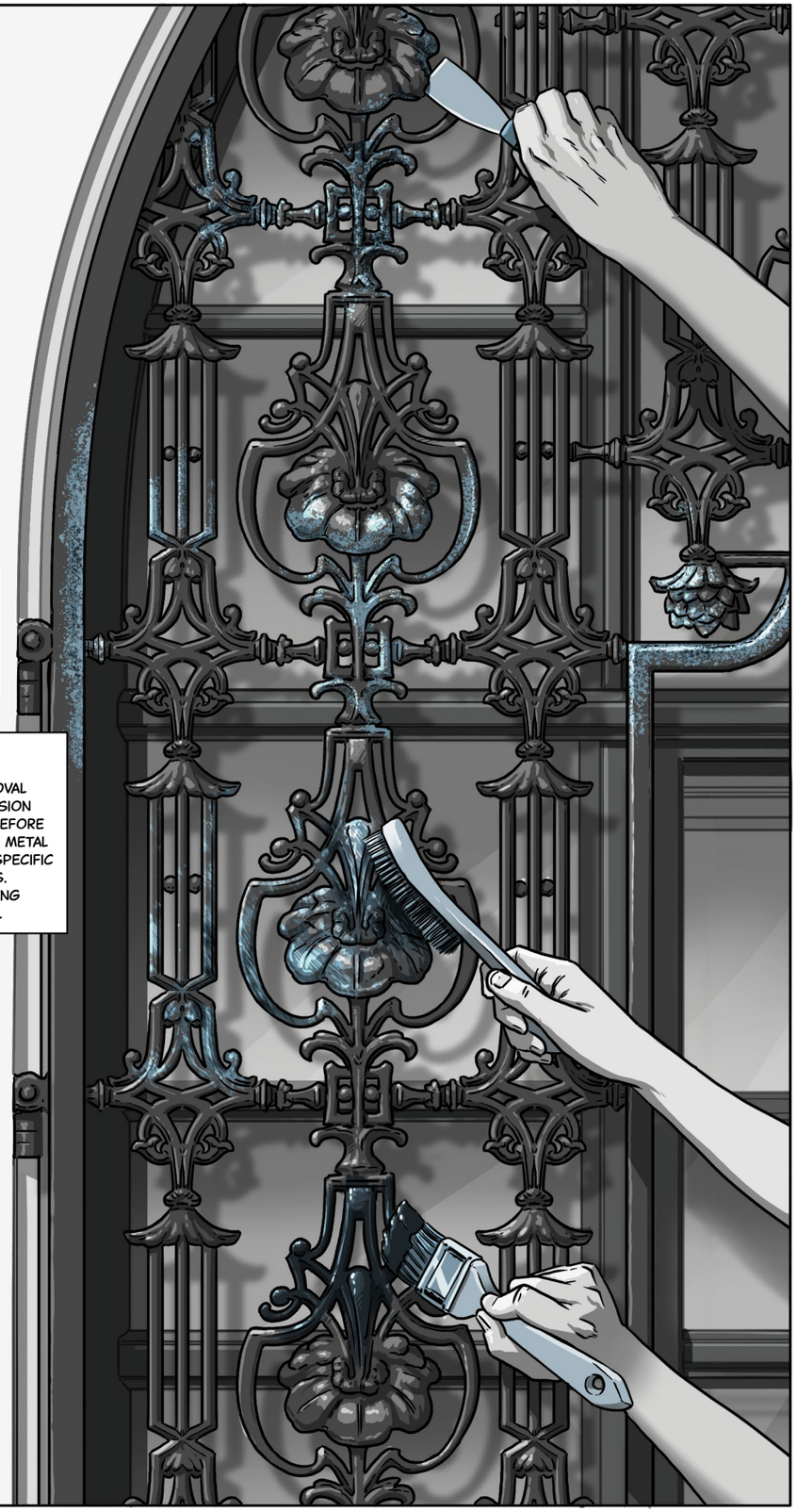
SURFACE COATINGS

COATINGS ON METAL ARE BOTH DECORATIVE AND PROTECTIVE. REGULAR OBSERVATION CAN HELP IDENTIFY DETERIORATION EARLY. ROUTINE MAINTENANCE WILL ENSURE COATINGS AND SUBSTRATES REMAIN IN GOOD CONDITION.

DECORATIVE ARCHITECTURAL BRASS, BRONZE, OR COPPER ARE OFTEN POLISHED OR PATINATED. THEIR SURFACES CAN BE PROTECTED WITH WAX OR LACQUER, WHICH REQUIRE PERIODIC REAPPLICATION.

WHEN PAINT ON METAL BEGINS TO CRACK OR FLAKE, LOCALIZED AREAS OF CORROSION CAN DEVELOP. REMOVAL OF DAMAGED FINISHES AND CORROSION FROM THE SUBSTRATE IS NEEDED BEFORE REPAINTING. STRIPPING PAINT FROM METAL SUBSTRATES CAN BE DONE USING SPECIFIC CHEMICAL OR ABRASIVE PROCESSES. IF STRIPPING PAINT OFF METAL, DOING A PAINT ANALYSIS FIRST IS CRITICAL.

SUBSTRATES REQUIRE FINISHING, SUCH AS PRIMING AND PAINTING, WITH COATINGS INTENDED FOR METAL. COATING TYPES AND APPLICATION METHODS ARE SPECIFIC TO METAL TYPE AND CONTEXT.



ARCHITECTURAL REPAIRS

CORROSION IS THE PRIMARY DETERIORATION MODE FOR METALS, BUT METAL FEATURES CAN ALSO CRACK OR DEFORM IN RESPONSE TO STRESS.

SOME COMMON METAL CONDITIONS AND CORRESPONDING REPAIRS INCLUDE:

MECHANICAL REMOVAL AND CHEMICAL PASSIVATION OF CORROSION PRODUCT

REPLACEMENT OF LOST OR DAMAGED COMPONENTS

ADDRESSING DISTORTIONS LIKE TWISTED, BENT, OR WARPED ELEMENTS

INFILLING CRACKS, PITTING, OR LOSSES WITH COMPOSITE REPAIR MATERIALS OR NEW METAL

KEEP IN MIND, METAL OBJECTS MAY NEED TO BE DEINSTALLED AND TREATED OFFSITE FOR COMPREHENSIVE PAINT REMOVAL AND REPAIRS REQUIRING HEAT SUCH AS BRAZING OR WELDING.

STRUCTURAL CONSIDERATIONS

STEEL FRAMING IS COMMON IN EARLY "FIRE-PROOF" CONSTRUCTION. AN I-BEAM IS ENGINEERED TO BE LIGHT, STRONG, STIFF, AND EFFICIENT.

STEEL TENDS TO DETERIORATE WITH LIMITED AIR MOVEMENT WHEN ENCASED IN MASONRY OR CONCRETE WHERE MOISTURE AND SALTS ARE PRESENT.

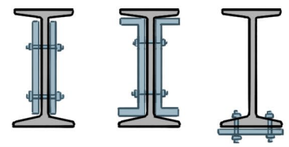
STEEL BEAMS CAN BE REPAIRED AND REINFORCED INSTEAD OF REPLACED. COMMON EXAMPLES INCLUDE:

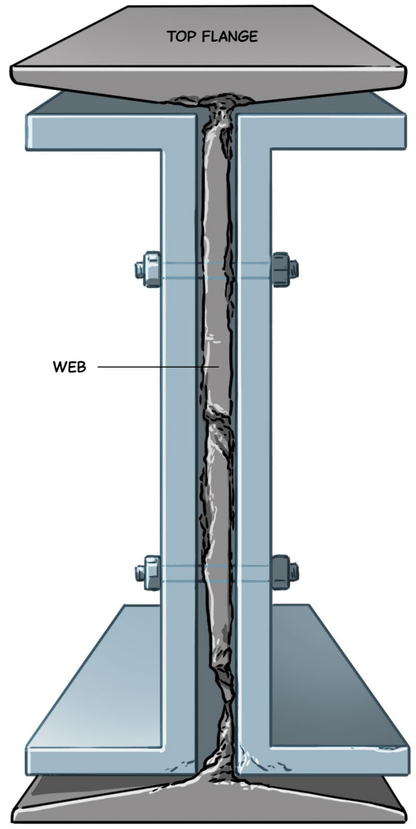
LOSS OF CROSS SECTION

SECTION LOSS MUST BE QUANTIFIED. REPAIRS ARE INTENDED TO RESTORE ORIGINAL CAPACITY AT AREA OF LOSS.

IF A WEB IS DETERIORATED, APPLY STEEL PLATES TO BOTH SIDES. IF A FLANGE IS DETERIORATED, ADD A PLATE TO IT. IF BOTH WEB AND FLANGES HAVE LOSS, INSTALL CHANNELS OR BENT PLATES. MAKE REPAIRS SYMMETRICAL AND AVOID SINGLE-SIDED REPAIRS.

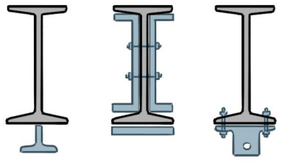
THERE ARE TWO METHODS OF ATTACHING STEEL REPAIRS: BOLTS AND WELDS. CONNECTION TYPE CAN BE INTERCHANGEABLE. SELECTION IS DEPENDENT ON CONSTRUCTABILITY. BOLTS ARE MORE STRAIGHTFORWARD BUT ACCESS IS CRITICAL. WELDS ARE QUICKER AND STRONGER BUT REQUIRE TESTING TO CONFIRM FEASIBILITY AND TEMPORARY PROTECTIONS AGAINST HEAT AND FIRE.





SUPERFICIAL CORROSION

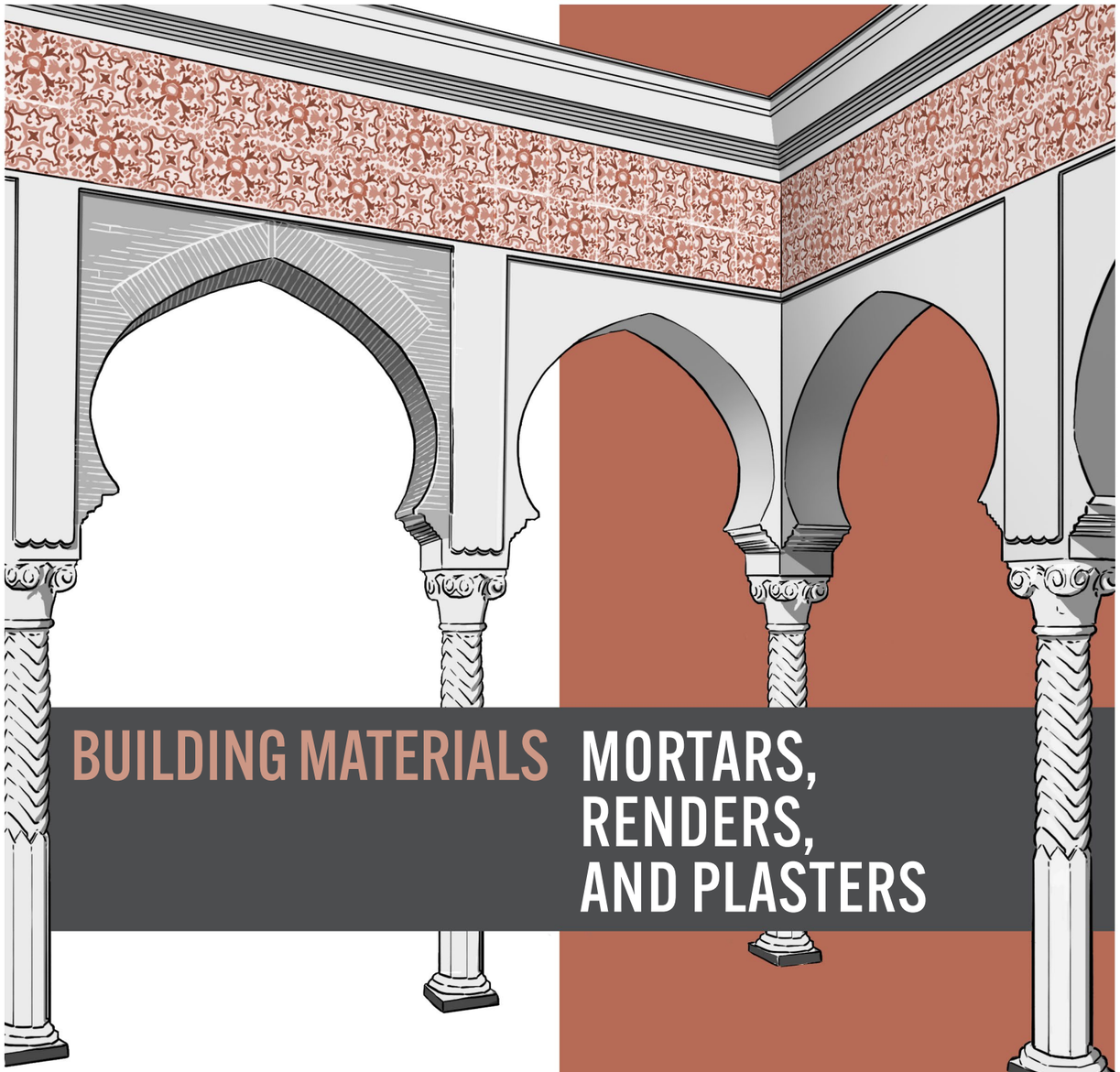
HORIZONTAL SURFACES OF I-BEAMS COLLECT WATER AND COMMONLY DEVELOP CORROSION. BECAUSE WEBS ARE THINNER THAN FLANGES, THEY EXHIBIT HOLES FROM CORROSION OFTEN WHERE THE TWO MEET. SUPERFICIAL RUST CAN BE MECHANICALLY REMOVED TO SOUND STEEL AND COATED WITH A RUST-INHIBITING PRIMER.



LOAD DEMANDS

BUILDING CHANGES CAN INCREASE LOAD DEMANDS. REINFORCEMENTS EFFECTIVELY INCREASE BEAM DEPTH TO INCREASE STRENGTH AND STIFFNESS. APPROACHES INCLUDE WELDED TEES, BUILT-UP SECTIONS, AND TRUSSED BEAMS.

NOTE: STRUCTURAL REPAIRS MUST BE DESIGNED BY A QUALIFIED ENGINEER. CALCULATIONS MUST BE PROVIDED WITH THEIR DESIGN.



BUILDING MATERIALS MORTARS, RENDERS, AND PLASTERS

Mortars, Renders, and Plasters

MATERIAL CHARACTERISTICS:
ABUNDANT GLOBALLY, POROUS, INORGANIC, PLASTIC WHEN WET AND HARD AND BRITTLE WHEN DRY

THINGS LIKE:
BEDDING AND POINTING MORTAR, STUCCO, DECORATIVE PLASTERWORK

USED FOR:
MASONRY WALL CONSTRUCTION, COVERING WALLS AND CEILINGS, CAST OR MOLDED DECORATION

MORTARS ARE USED FOR BEDDING, SETTING, AND JOINING MASONRY INCLUDING BRICK AND STONE AND CONCRETE AND TILE.

BUT MORTAR IS NOT JUST FOR PIECING TOGETHER.

STUCCO, ALSO CALLED RENDER, IS A TYPE OF MORTAR APPLIED TO SURFACES ON EXTERIORS.

IT IS CALLED FLAT PLASTER WHEN APPLIED INSIDE TO WALLS AND CEILINGS. PLASTER CAN ALSO BE CAST OR MOLDED OR SCULPTED FOR DECORATIVE MOLDINGS OR ORNAMENTATION.

THOUGH THE PARTICULARS OF THEIR INGREDIENTS MAY VARY, AT THEIR CORE, MORTARS, GROUTS, STUCCOS, RENDERS, AND PLASTERS ARE COMPOSED OF THE SAME 3 ESSENTIAL COMPONENTS:

AN **AGGREGATE**, A **BINDER**, AND **WATER**.

THERE ARE INFINITE RECIPES AND EACH CHANGES THE MATERIAL'S PROPERTIES.

Mortars

MORTAR IS MADE OF:

AN **AGGREGATE**

USUALLY SAND OR STONE, TILE, OR BRICK DUST DEPENDING ON LOCAL TRADITIONS.

A **BINDER**

HISTORICALLY, SLAKED LIME, HYDRAULIC LIME, GYPSUM, AND NATURAL CEMENT; TODAY, MOST OFTEN PORTLAND CEMENT.

AND **WATER**

SOMETIMES HAIR OR PLANT FIBERS ARE ADDED TO HELP PREVENT SHRINKAGE.

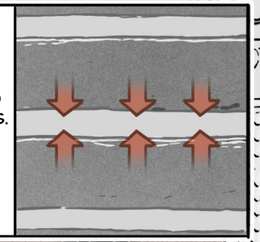
OTHER MATERIALS MAY BE ADDED TO IMPROVE WORKABILITY. FOR EXAMPLE, EGGS ARE ADDED TO TRADITIONAL MORTARS IN ALGIERS.

MORTAR CAN BE DIFFERENT CONSISTENCIES. IT CAN BE THICK AND TROWELED ON OR THIN AND INJECTED, SUCH AS A FLUID GROUT.

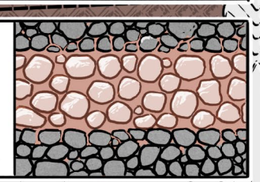
VILLA MONTFELD
ALGIERS, ALGERIA

THOUGH ITS COMPOSITION IS SIMPLE, MORTAR HAS MYRIAD USES. IN THIS ROOM, FOR EXAMPLE, IT IS USED IN CONSTRUCTION OF THE WALLS, ASSEMBLY OF DECORATIVE STONE ELEMENTS, AND APPLIED FINISHES.

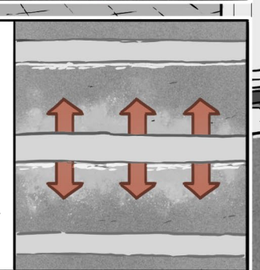
MORE THAN AN ADHESIVE AGENT, MORTAR ABSORBS THE DAMAGING WATER AND SALTS INTRODUCED INTO MASONRY WALL SYSTEMS. WHEN MORTAR IS REPLACED PERIODICALLY AS INTENDED, THIS SACRIFICE KEEPS THE WALL SYSTEM INTACT.



TO DO THIS JOB, MORTAR MUST BE AS POROUS OR MORE POROUS THAN THE MASONRY UNITS OR DECORATIVE FINISHES LIKE TILE IT SURROUNDS.



IF MORTAR IS TOO RIGID IN COMPARISON TO THE SUPPORTING MASONRY AND WATER CAN'T PENETRATE IT, MOISTURE WILL MOVE INTO THE SURROUNDING MASONRY UNITS, WHICH CAN CREATE DAMAGE LIKE FRIABILITY, SPALLING, AND EFFLORESCENCE—AND EVENTUAL FAILURE.



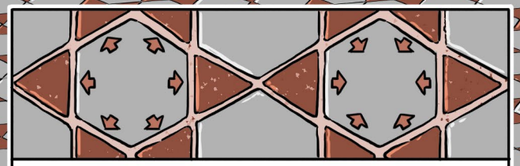
HISTORIC MASONRY ENEMY №1:
PORTLAND CEMENT

WHILE COMMONLY USED IN 20TH C. BUILDINGS, PORTLAND CEMENTS INTRODUCE NEW SALTS AND TRAP EXISTING SALTS BECAUSE OF THEIR DENSITY AND LACK OF PERMEABILITY. THEIR RELATIVE STIFFNESS COMPARED WITH TRADITIONAL MORTARS OFTEN INITIATES ADDITIONAL FORMS OF DETERIORATION, LIKE CRACKING OF MASONRY UNITS.

Things to Look Out For

INSPECT MORTAR JOINTS ROUTINELY TO ASSESS CONDITION. MORTAR JOINTS WILL REQUIRE PERIODIC REPOINTING WITH A COMPATIBLE MORTAR.

CH CAN HELP COMPLETE A MORTAR ANALYSIS TO INFORM REPAIRS.



THE MORTAR JOINTS ARE THE ELEMENT THAT ALLOWS TILE FLOORS TO MOVE WITH TEMPERATURE AND MOISTURE-BASED EXPANSION; THEREFORE, THE GROUT NEEDS TO BE LESS STIFF THAN THE TILES SO IT CAN BE ELASTIC AND ACT AS A SHOCK ABSORBER TO PREVENT THE TILES FROM CRACKING.

PAY SPECIAL ATTENTION TO THE SIDES OF THE BUILDING THAT ARE MORE EXPOSED TO DAMAGE INSTIGATORS, LIKE DRIVING RAIN.

BECAUSE THEY ARE HORIZONTAL AND GET MORE WEAR AND TEAR, PAVERS REQUIRE MORE FREQUENT MORTAR REVIEW.

IN MARINE CLIMATES OR CLIMATES WITH SEASONAL STORMS LIKE TYPHOONS OR HURRICANE SEASON, CHECK MORTAR AT THE END OF HEAVY RAINY CYCLES.

REVIEW MORTAR AFTER ANY NATURAL OR MAN-MADE HAZARD EVENT.

Renders

RENDERING IS THE PROCESS OF COVERING AN EXTERIOR WALL WITH A LAYER OF MORTAR. A RENDER'S PURPOSE IS TO MAKE A SURFACE UNIFORM. IT CAN ALSO KEEP WATER OFF THE STRUCTURAL PORTION OF THE WALL, PROTECTING THE UNDERLYING SUBSTRATE.

BUT RENDERS MAY ALSO INCLUDE ARTISTIC EMBELLISHMENTS, LIKE FRESCOS OR SGRAFITTI.

RENDERS IN A HISTORIC CONTEXT INCLUDE LIME BINDERS—SUCH AS HYDRATED LIME, LIME PUTTY, OR NATURAL HYDRAULIC LIME—NATURAL CEMENT, OR CLAY.

IN ADDITION TO AGGREGATE, SOMETIMES THINGS LIKE PLANT FIBERS OR HAIR WERE ADDED TO HELP WITH SHRINKAGE AND CRACKING DURING CURING. AT TIMES, HORSE HAIR, DONKEY HAIR, GOAT HAIR, OR THE HAIR OF HIGHLAND CATTLE—NOT OFTEN HUMAN HAIR. IN CONTEMPORARY PRODUCTS, FIBERGLASS THREADS REPLACE HAIR.

U.S. EMBASSY
LJUBLJANA, SLOVENIA

MORE TEXTURE OR RELIEF ON THE SUBSTRATE WALL INCREASES THE SURFACE AREA AND HELPS WITH THE RENDER'S ADHESION, GIVING IT A TOOTH, AS IT IS SAID.

OFTEN RENDERS ARE COATED WITH A LIMEWASH TO HELP KEEP MOISTURE OUT AND FOR AESTHETIC PURPOSES.

Things to Look Out For

RENDERS DON'T LAST FOREVER AND HAVE TO BE REAPPLIED PERIODICALLY, MAYBE EVERY FEW DECADES.

CHALLENGING ENVIRONMENTAL CONDITIONS, INCOMPATIBLE REPAIRS USING PORTLAND CEMENT, POOR DRAINAGE, AND IMPERMEABLE COATINGS LIKE MANY SYNTHETIC PAINTS THAT TRAP MOISTURE IN WALLS ALL CAN LEAD TO FAILURES.

SOME SIGNS OF MOISTURE DAMAGE ARE BUBBLING, DELAMINATION, OR CHUNKS DETACHING.

MOVEMENT OF THE BUILDING—LIKE EARTHQUAKES OR SETTLEMENT—CAN CAUSE CRACKING, SPALLS, AND LOSSES.

MORTARS, RENDERS, AND PLASTERS ARE APPLIED IN LAYERS, SOMETIMES CALLED "COATS" OR "LIFTS."

IF THE LAYERS ARE APPLIED TOO THICKLY, A RENDER BECOMES TOO HEAVY, TAKES A LONG TIME TO DRY, AND CAN FALL OFF THE WALL.

How to Clean Renders

RINSING A RENDER DOWN WITH A HOSE OR MILD SOAP AND WATER IS GENERALLY ALL THAT IS RECOMMENDED.

UNFINISHED RENDERS SHOULD BE CLEANED LIKE STONE.

LIMEWASHES ARE GENERALLY INTENDED TO BE RENEWED EVERY 5 TO 10 YEARS. IN THE INTERIM, SURFACES CAN BE CLEANED IF DIRTY AND DISCOLORED.

Plasters

PLASTERING TYPICALLY REFERS TO THE PROCESS OF COVERING AN INTERIOR WALL. LIKE RENDERS, FLAT PLASTER IS ALSO APPLIED IN LAYERS.

DECORATIVE INTERIORS CAN INCLUDE ORNAMENTAL PLASTER CORNICES, MOLDINGS AROUND DOORS AND WINDOWS, AND MOLDED PLASTER PANELING ON WALL SURFACES OR AS ROSETTES AROUND LIGHT FIXTURES.

PLASTER MOLDINGS ARE OFTEN APPLIED TO A WOOD SUPPORT IN LAYERS, THEN THE FINISH PLASTER IS CREATED WITH A PROFILE THAT IS RUN ALONG THE SURFACE TO SHAPE AND SMOOTH IT FOR CONTINUOUS MOLDING AROUND THINGS LIKE CHAIR RAILS AND CORNICES. THESE ARE CALLED RUNNING MOLDS.

PLASTER CAN ALSO BE SCULPTED IN PLACE OR CAST AND APPLIED AS ORNAMENTAL UNITS—LIKE DENTILS OR FLORAL MOTIFS.

IN HISTORIC BUILDINGS, PLASTER IS OFTEN APPLIED TO WOOD LATH OR LATH-LIKE SUPPORTS OR SOMETIMES DIRECTLY TO MASONRY. IN LATER BUILDINGS, PLASTER IS APPLIED TO WIRE MESH.

THE BINDER IN TRADITIONAL PLASTER IS MOST OFTEN LIME PUTTY OR GYPSUM (PLASTER OF PARIS), OR A MIX OF THE TWO. HAIRS AND FIBERS CAN BE INCORPORATED TO HELP WITH SHRINKAGE. FINISH PLASTER CAN BE SANDED OR UNSANDED.

HISTORICALLY, MOST INTERIOR PLASTER WAS FINISHED WITH A TRADITIONAL PAINT LIKE OIL, DISTEMPER, OR LIMEWASH.

THE MAJORITY OF PLASTER SURFACES ARE NOW COATED WITH ACRYLIC PAINT. IF ONLY A FEW COATS ARE APPLIED, THEN MOISTURE CAN STILL MOVE IN AND OUT. BUT WHEN APPLIED THICKLY, ACRYLIC PAINT BECOMES A PROBLEM.

Things to Look Out For

PLASTER IS SENSITIVE TO WATER—INCLUDING FROM SOURCES LIKE POOR DRAINAGE, LEAKING PIPES, LEAKING FIRE SUPPRESSION SYSTEMS, OR LEADERS LEAKING INSIDE WALLS.

THE PIECES OF PLASTER THAT EXTEND THROUGH THE LATH, CALLED KEYS, CAN BREAK OVER TIME—ESPECIALLY ON CEILINGS NOT HELPED BY GRAVITY—LEADING TO PLASTER DETACHMENT.

MIGHT SEE CRACKS WHERE THE BUILDING IS MOVING OR AFTER SEISMIC AND HURRICANE EVENTS.

MIGHT SEE LOSS FROM IMPACT DAMAGE.

WATER CAN CAUSE CHUNKS OF PLASTER TO FALL.

MOLDED PLASTER THAT GETS CYCLICALLY WET AND DRY WILL START TO MELT, ESPECIALLY IF IT INCLUDES WATER-SENSITIVE GYPSUM.

ROSETTES AROUND LIGHT FIXTURES ARE OFTEN NAILED INTO THE CEILING AND THOSE NAILS CAN CORRODE AND FAIL WITH MOVEMENT OF THE BUILDING, WATER, OR IF THE FIXTURE HAS FREQUENTLY BEEN INSTALLED OR DE-INSTALLED.

NAIL OR ANCHOR HOLES OR DAMAGE FROM MOVING FURNITURE HAPPENS FREQUENTLY.

IF PAINT IS APPLIED TOO THICKLY AND IN MULTIPLE COATS, IT WILL MASK DETAIL, AND IT CAN LIMIT OPERABILITY OF MOVEABLE ITEMS SUCH AS DOORS, WINDOWS, AND SHUTTERS.

TRAPPED MOISTURE CAN CAUSE THE FINISH TO BUBBLE.

Repair Protocols

MORTAR IS INTENDED TO BE PERIODICALLY REPLACED. BEGIN BY CONDUCTING A VISUAL AND HANDS-ON ASSESSMENT TO DETERMINE IF THE EXISTING MORTAR IS FRIABLE OR DETACHING. IF SO, REPAIR OR REPLACEMENT IS LIKELY NECESSARY.

THE SAND OR AGGREGATE INCLUDED IN A MIX IMPARTS BOTH MECHANICAL AND CHEMICAL PROPERTIES, AND ALSO AFFECTS THE WAY IT LOOKS. MAKE SURE TO MATCH COLOR AND GRAIN SIZE.

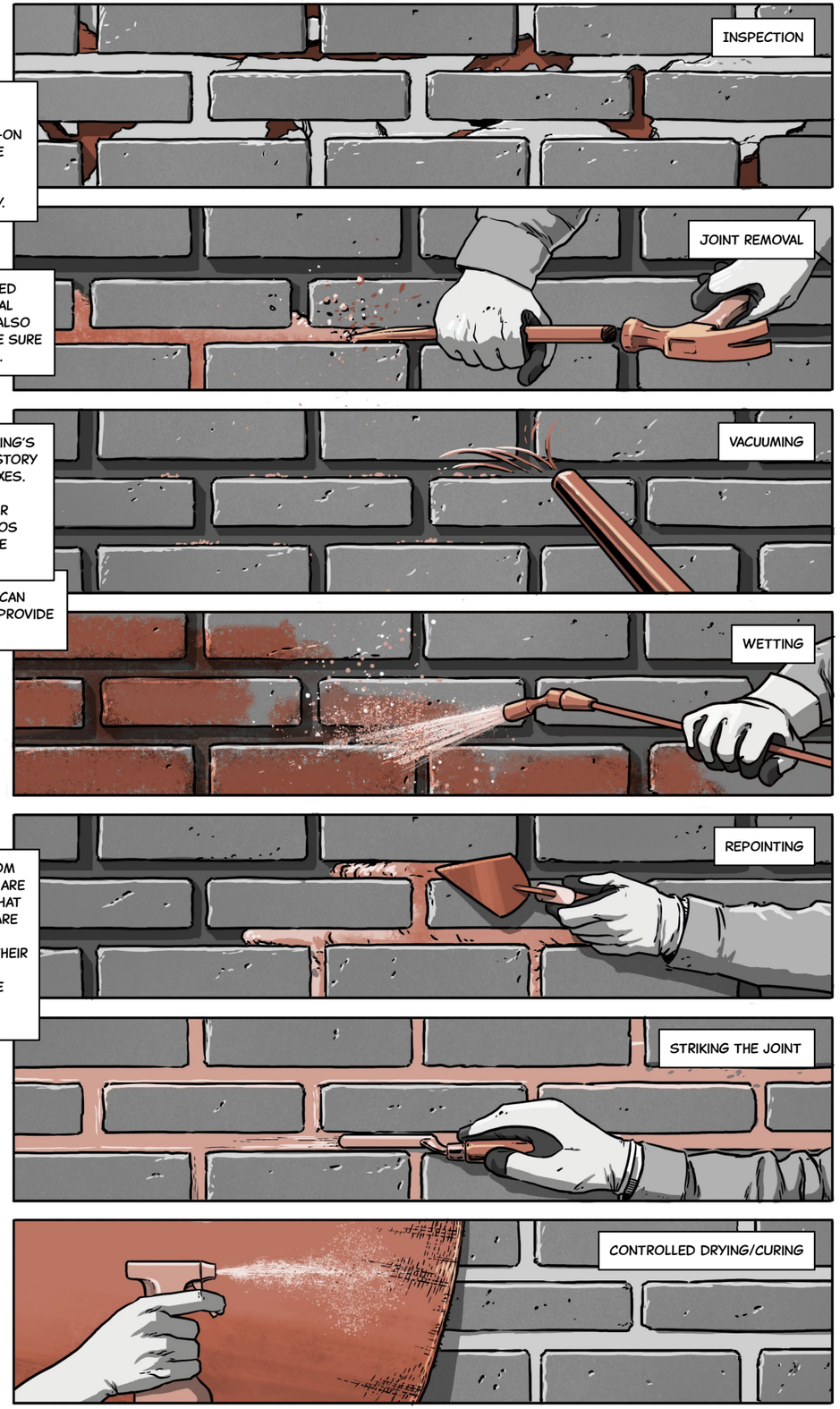
SEARCH FOR RECORDS ON THE BUILDING'S CONSTRUCTION OR MAINTENANCE HISTORY FOR NOTES ON ORIGINAL MORTAR MIXES. STAYING AS CLOSE AS POSSIBLE TO ORIGINAL RECIPES—INCLUDING SIMILAR MATERIALS AS WELL AS SIMILAR RATIOS OF EACH—ENSURES THAT REPAIRS ARE COMPATIBLE.

IF NOTES ARE NOT AVAILABLE, CH CAN SPECIFY AN APPROPRIATE MIX OR PROVIDE AN ANALYSIS TO INFORM REPAIRS.

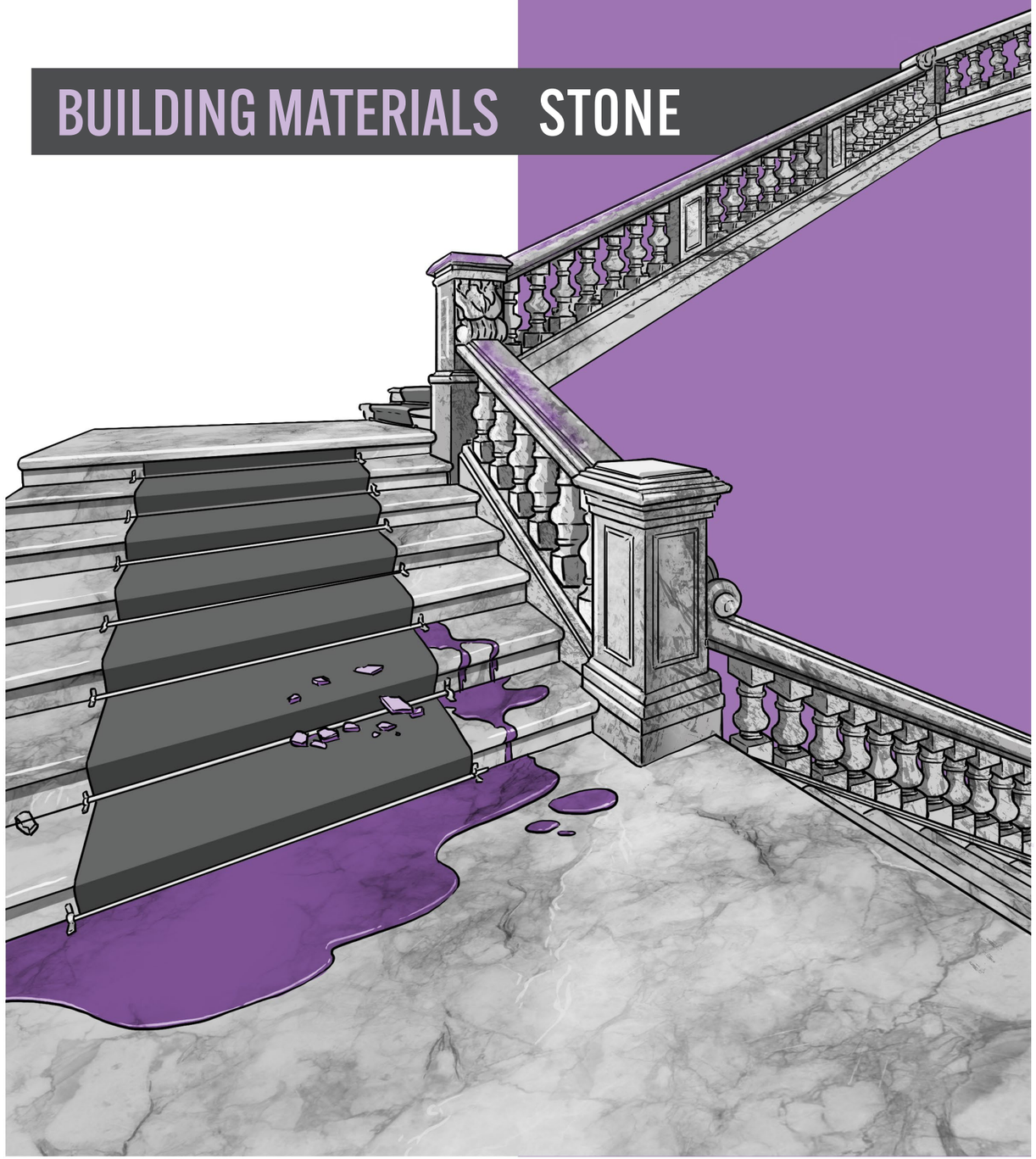
COMPATIBLE MORTARS ARE FREE FROM SALTS. PORTLAND CEMENT BINDERS ARE NOT APPROPRIATE FOR BUILDINGS THAT PREDATE THE 20TH CENTURY. THEY ARE NOT COMPATIBLE WITH TRADITIONAL MASONRY MATERIALS BECAUSE OF THEIR RELATIVE STRENGTH, RIGIDITY, AND DENSITY. THESE DIFFERENCES CAUSE SERIOUS PROBLEMS THAT ARE NOT EASILY RESOLVED.

SEE SECTION ON FINISHES FOR APPLIED COATINGS ON MASONRY.

MORTARS SHOULD DRY SLOWLY TO PREVENT SHRINKAGE AND CRACKING.



BUILDING MATERIALS STONE



Stone

MATERIAL CHARACTERISTICS:
NATURALLY OCCURRING AND HIGHLY VARIED, COMMONLY POROUS AND BRITTLE, STRONG IN COMPRESSION

THINGS LIKE:
LIMESTONE, MARBLE, TRAVERTINE, SANDSTONE, GRANITE, SLATE

USED FOR:
WALLS, FLOORS, ARCHES, COLUMNS, CORBELS, FIREPLACES

THERE ARE 3 CLASSES OF ROCK:

EXTRUSIVE IGNEOUS ROCK

IGNEOUS

INTRUSIVE IGNEOUS ROCK

MAGMA

*GRANITE, TUFF, BASALT

EROSION

TRANSPORTATION

UPLIFT TO SURFACE

PRESSURE

...METAMORPHIC

HEAT

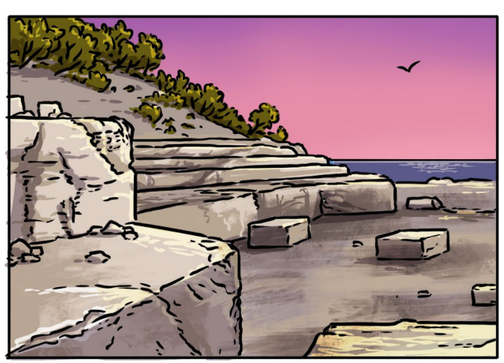
*MARBLE, GNEISS, SLATE, QUARTZ, SCHIST

BURIAL AND SEDIMENTATION

...AND SEDIMENTARY.

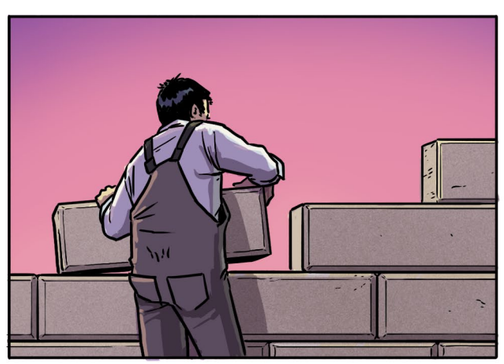
PRESSURE

*SANDSTONE, LIMESTONE, TRAVERTINE



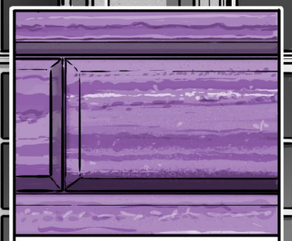
DEPARTMENT OF STATE HERITAGE PROPERTIES FEATURE ALL TYPES. OFTEN LOCAL MATERIALS QUARRIED NEAR BUILDING SITES ARE USED. SEDIMENTARY STONES LIKE LIMESTONE AND SANDSTONE ARE WELL-KNOWN AND WIDELY USED BECAUSE OF THEIR AVAILABILITY AND EASE TO QUARRY AND CUT.

STONE IS SO PRIZED, OFTEN RENDER IS CAST TO MIMIC ITS APPEARANCE.

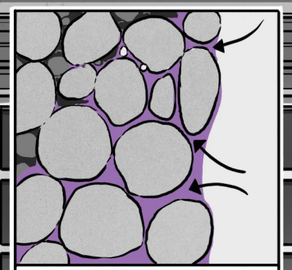


SEDIMENTARY ROCK IS MADE UP OF LAYERS OF SEDIMENT THAT UNDER HEAT AND PRESSURE BECOME FUSED TOGETHER. BECAUSE OF THOSE FUSED LAYERS, IT IS SUSCEPTIBLE TO EXFOLIATION AND SCALING—OFTEN DRIVEN BY THE PRESENCE OF MOISTURE.

HÔTEL DE TALLEYRAND
PARIS, FRANCE



STRATIFIED LAYERS MUST BE PLACED HORIZONTALLY SO THAT WATER IS LESS LIKELY TO SEEP BETWEEN LAYERS AND CAUSE THEM TO SLOUGH OFF.

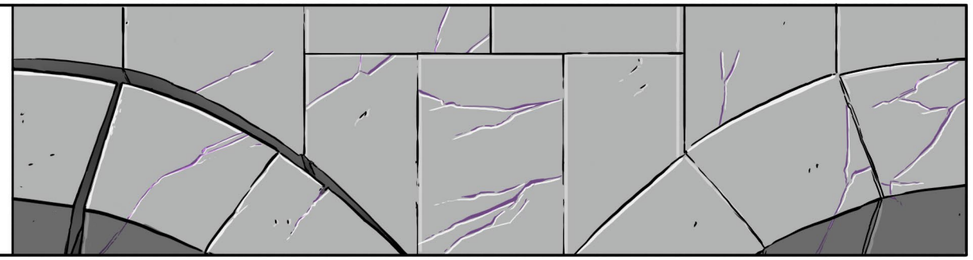


STONES WITH SMALL, TIGHTLY PACKED GRAINS AND HIGH POROSITY, LIKE MANY LIMESTONES AND SANDSTONES, WILL READILY DRAW UP WATER THROUGH CAPILLARY ACTION. MOISTURE FROM THE GROUND TRAVELING UPWARD THROUGH WALLS VIA CAPILLARY ACTION IS CALLED RISING DAMP, COMMONLY SEEN IN BASEMENT AND FOUNDATION WALLS.

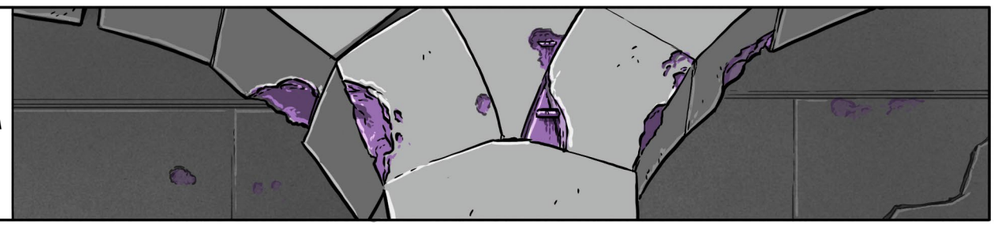
SOME STONE IS COMPOSED OF CALCIUM CARBONATE—SUCH AS LIMESTONE, TRAVERTINE, AND MARBLE—WHICH IS SUSCEPTIBLE TO ACID RAIN AND DRY POLLUTANTS LIKE CAR EXHAUST. CHEMICAL REACTIONS BETWEEN SULFUROUS DEPOSITS AND CALCIUM IN THE STONE CAN RESULT IN THE FORMATION OF UNSIGHTLY AND DAMAGING BLACK GYPSUM CRUSTS.

Signs of Damage—And Their Source

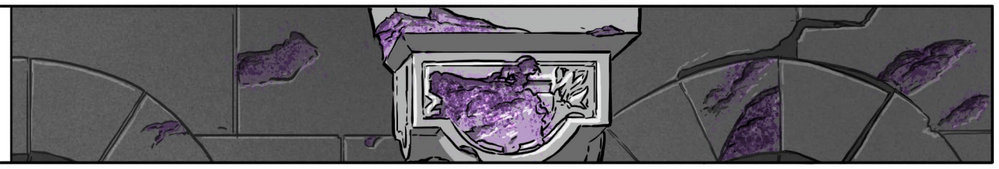
CRACKING:
COULD BE CAUSED BY THERMAL STRESS FROM FREEZE-THAW CYCLING, OR MECHANICAL STRESSES FROM MOVEMENT LIKE SETTLEMENT, VIBRATION, EXPANSION OF CORRODING ANCHORS, IMPROPER LOADING, OR EVEN IMPACTS FROM CONSTRUCTION ACTIVITIES OR HEAVY EQUIPMENT.



SPALLING:
A SPALL IS A POTATO CHIP-LIKE CHUNK THAT POPS OFF PARALLEL TO THE SURFACE OF STONE AS A RESULT OF EXPANSION FROM CORRODING EMBEDDED ANCHORS, SALTS, THERMAL CYCLING, OR IMPROPER POINTING OF MORTARS.

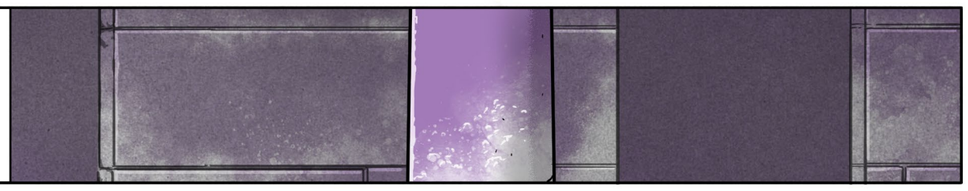


SCALING AND EXFOLIATION:
PEELING AND SURFACE LOSS OF STONE OFTEN CAUSED BY WEATHERING, SALT CRYSTALLIZATION, ABRASION, OR THERMAL CYCLING.

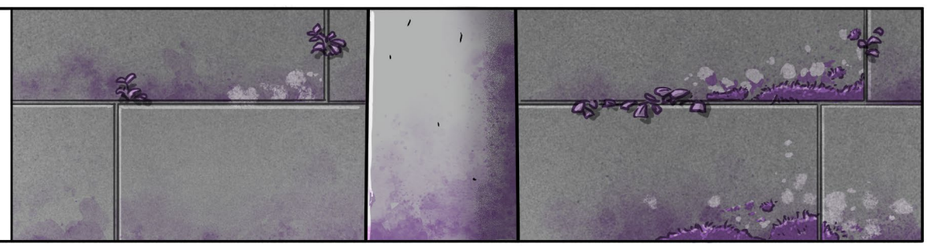


EROSION AND FRIABILITY (OR DISAGGREGATION):
OFTEN CHARACTERIZED AS A STONE FEELING LIKE SUGAR. THIS INDICATES A BREAKDOWN OF THE SUBSTANCE KEEPING THE STONE GRAINS TOGETHER.

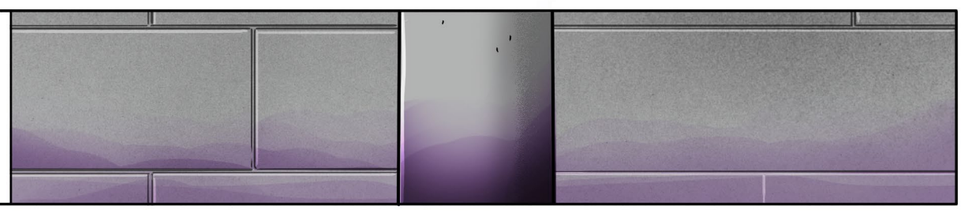
EFFLORESCENCE:
WHEN WATER CARRYING SALTS EVAPORATES OUT OF A POROUS STONE, THE SALTS CAN CRYSTALLIZE AND EXPAND, CREATING A WHITE BLOOM ON THE SURFACE. CAN ALSO CAUSE FRIABILITY, SCALING, OR SPALLS.



BIOLOGICAL GROWTH OR BIOLOGICAL FILM: FUNGI AND ALGAE CAN CAUSE DISCOLORATION OR STAINING—INCLUDING BROWN, GREEN, RED, AND OFTEN BLACK—WHICH CAN ALSO BE ACIDIC. ALSO LOOK FOR LICHEN, MOSS, OR VEGETATION. A PLANT GROWING OUT OF A CRACK OR JOINT MEANS WATER AND ROOTS ARE INSIDE, AND IT WILL CONTINUE TO EXPAND AND GROW.



TRAPPED MOISTURE:
BECAUSE IT IS POROUS, STONE TAKES UP MOISTURE AND NEEDS TO BREATHE. SOME APPLIED COATINGS, LIKE ACRYLIC PAINTS AND SILICONE-BASED WATER REPELLENTS, CAN TRAP MOISTURE AND DEGRADE STONE FROM THE INSIDE.

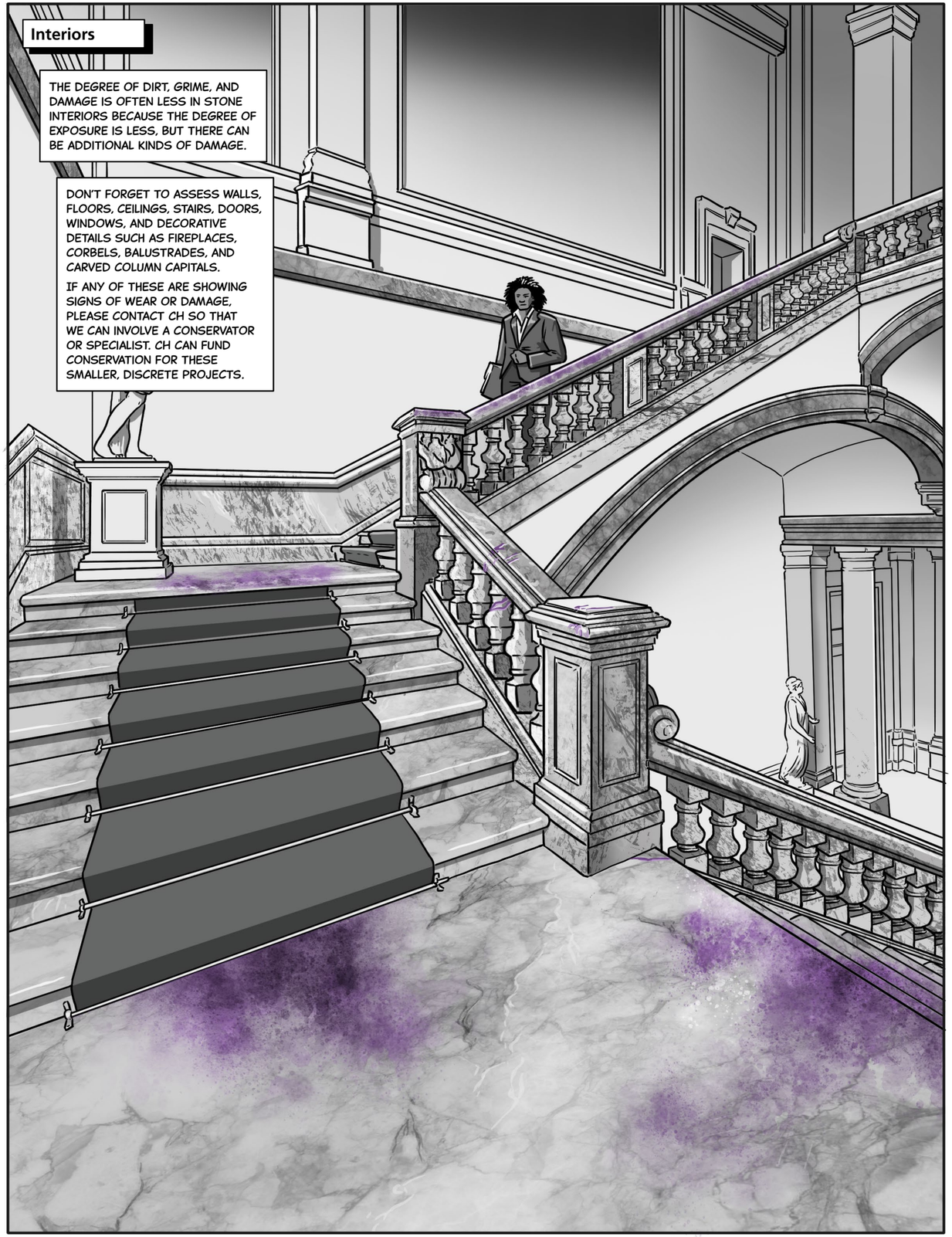


Interiors

THE DEGREE OF DIRT, GRIME, AND DAMAGE IS OFTEN LESS IN STONE INTERIORS BECAUSE THE DEGREE OF EXPOSURE IS LESS, BUT THERE CAN BE ADDITIONAL KINDS OF DAMAGE.

DON'T FORGET TO ASSESS WALLS, FLOORS, CEILINGS, STAIRS, DOORS, WINDOWS, AND DECORATIVE DETAILS SUCH AS FIREPLACES, CORBELS, BALUSTRADES, AND CARVED COLUMN CAPITALS.

IF ANY OF THESE ARE SHOWING SIGNS OF WEAR OR DAMAGE, PLEASE CONTACT CH SO THAT WE CAN INVOLVE A CONSERVATOR OR SPECIALIST. CH CAN FUND CONSERVATION FOR THESE SMALLER, DISCRETE PROJECTS.



Things to Look Out For

THOUGH INTERIORS ARE CLIMATE-CONTROLLED, THEY CAN BE AFFECTED BY EXTERIOR ENVIRONMENTAL CONDITIONS. HVAC SYSTEMS CAN MAKE INTERIORS TOO DRY OR INTRODUCE MOISTURE AND CONDENSATION. OVER-CONDITIONING INTERIORS CAN PULL IN EXCESS HUMIDITY FROM OUTSIDE.

CEILINGS ARE SUSCEPTIBLE TO ROOF AND PLUMBING LEAKS.

PAY ATTENTION TO SOILING PATTERNS IN HEAVILY TOUCHED AREAS LIKE DOORFRAMES, RAILINGS, AND AROUND DOORKNOBS OR LIGHT SWITCHES. THESE AREAS ACCUMULATE SOILING AND DAMAGE FROM GRIME, BODY OILS, AND EXCESS WEAR.

CRACKING IN INTERIORS CAN OCCUR FROM STRUCTURAL SETTLEMENT, DISPLACEMENT, OR MOVEMENT FROM NATURAL HAZARDS SUCH AS EARTHQUAKES OR HURRICANES.

ABRASION AND LOSS CAN HAPPEN MORE READILY ON FLOORS DUE TO WEAR AND TEAR FROM FOOT TRAFFIC AND SLIDING FURNITURE. MORTAR JOINTS WEAR MORE QUICKLY, TOO.

ADDITIONALLY, DEBRIS FALLS, DWELLS LONGER, AND ACCUMULATES IN GREATER QUANTITIES ON A HORIZONTAL SURFACE.

AND WATER SITS AND ABSORBS MORE READILY.

MATS OR CARPETING MIGHT BE USEFUL FOR PROTECTING FLOORS.

EFFLORESCENCE AND ASSOCIATED CONDITIONS LIKE FRIABILITY AND EROSION ARE COMMON ON BASEMENT WALLS AND FLOORS SINCE THEY ARE EXPOSED TO ADDITIONAL MOISTURE BELOWGROUND.

Routine Care for Stone (Unfinished or Unpainted)

EXTERIORS

REMOVE ORGANIC DEBRIS LIKE LEAVES, GRASSES, OR DIRT WITH A WHISK BROOM OR STIFFER BRISTLE BRUSH.

POWER WASHING OR SANDBLASTING ARE GENERALLY TOO AGGRESSIVE AND CAN INTRODUCE DAMAGE.

LIMIT THE USE OF WATER IF THERE ARE OPEN JOINTS OR MORTAR OR GROUT LOSSES OR ANY EVIDENCE OF EFFLORESCENCE.

IF YOU HAVE A FLAKY OR EASILY CRUMBLED SURFACE, AVOID SCRUBBING EVEN WITH A SOFT BRUSH.

DO NOT OVERPAINT.

FREQUENCY OF CLEANING:
AS NEEDED

INTERIORS

REMOVE DEBRIS LIKE COBWEBS AND DUST BY BRUSHING AWAY OR VACUUMING.

FOR SMUDGES, SPILLS, OR GRIME, TRY A SPONGE DAMPENED WITH WATER. SPIT ON A Q-TIP IS ALSO APPROPRIATE FOR SMALL AREAS.

STONE FLOORS REQUIRE VACUUMING BEFORE APPLYING A DAMP MOP. DO NOT ALLOW WATER TO POOL AND AVOID ACIDIC CLEANING AGENTS.

FREQUENCY OF CLEANING:
ONCE A YEAR. MORE FREQUENTLY FOR HORIZONTAL SURFACES LIKE MANTELS AND FLOORS

Repair Protocols

SUPERFICIAL (OR SURFACE) TREATMENTS

DESALINATION: IF SUBSTRATES ARE LADEN WITH SALTS, THEIR REMOVAL USING WATER COMPRESSES MAY BE REQUIRED PRIOR TO COMPLETING OTHER REPAIRS.

CLEANING IS THE MOST COMMON AND FREQUENT MAINTENANCE REQUIREMENT FOR STONE. CLEANING IS IRREVERSIBLE AND CAN BE DAMAGING IF DONE INCORRECTLY. ALWAYS TEST BEFORE DIVING IN. WORK WITH LOCAL EXPERTS AND CONTACT CH FOR GUIDANCE.

EXTERIOR CLEANING CAN OFTEN BE ACCOMPLISHED WITH WATER ALONE.

BUT SOME SUBSTRATES ARE SENSITIVE AND REQUIRE SPECIAL METHODS. CH CAN HELP ESTABLISH APPROPRIATE METHODS FOR CLEANING, MAINTENANCE, AND REPAIR.

CONSOLIDATION: CONSERVATION-GRADE PRODUCTS MAY BE APPLIED BY SPECIALISTS TO RESTORE COHESION BETWEEN THE GRAINS OF FRIABLE OR "SUGARING" STONE.

ARCHITECTURAL REPAIRS

COMMON STONE REPAIRS THAT A CONSERVATOR OR MASON SHOULD PERFORM INCLUDE:

PATCHING
COMPOSITE FILLS FOR HOLES, VOIDS, OR LOSSES DONE WITH MORTARS OR CONSERVATION-GRADE RESINS OFTEN BULKED WITH STONE DUST

REPOINTING
REPLACEMENT OF MORTAR IN JOINTS USING A COMPATIBLE MORTAR THAT'S SOFTER THAN THE STONE. INSTALLATION DEPTH USUALLY ABOUT TWICE THAT OF THE HEIGHT OF THE JOINT

DUTCHMAN
IN-KIND REPAIRS WHERE NEW STONE MATCHING THE EXISTING IS CUT TO FILL THE SPECIFIC SIZE AND SHAPE OF A LOSS

REPLACEMENT
LOCALIZED REPLACEMENT OF A COMPLETE UNIT OF DIMENSIONAL OR CARVED STONE USING THE SAME OR A COMPATIBLE TYPE OF STONE

BONDING/ADHERING
A CHEMICAL ADHESIVE JOIN WHERE TWO FRAGMENTS OR PIECES OF STONE ARE GLUED TOGETHER USING A CONSERVATION-GRADE ADHESIVE

PINNING AND **ANCHORING** STRADDLE THE REALMS OF ARCHITECTURAL AND STRUCTURAL INTERVENTIONS.

PINNING

STABILIZES CRACKS OR DEVELOPING SPALLS OR JOINS PIECES OF STONE TOGETHER. PINS SHOULD BE MADE OF AN INERT MATERIAL WITH PROPERTIES COMPLEMENTARY TO THOSE OF THE STONE—COMMONLY THREADED STAINLESS STEEL, FIBERGLASS, OR ALUMINA CERAMIC SEATED IN GROUT OR ADHESIVE. PIN DIAMETER AND EMBEDMENT DEPTH ARE PROPORTIONAL TO THE SIZE OF THE REPAIR. AIM TO USE THE FEWEST NUMBER OF THE SMALLEST SIZED PINS NECESSARY.

ANCHORING

ENGINEERED SYSTEMS FOR REATTACHING LARGE OR HEAVY ELEMENTS. COMMONLY MADE OF STAINLESS STEEL, ANCHORS DERIVE THEIR CAPACITY THROUGH MECHANICAL OR ADHESIVE CONNECTIONS TO THE SUBSTRATE. REPAIRS NEED TO BE DESIGNED BY A LICENSED ENGINEER BASED ON CALCULATIONS. EXPLORATORY PROBES AND TESTING MAY BE REQUIRED. NUMEROUS TYPES OF ANCHORS ARE AVAILABLE, EACH WITH SPECIFIC APPLICATIONS—CONTACT CH FOR SUPPORT.

RUST JACKING

EMBEDDED METALS, SUCH AS HANDRAILS, OFTEN CORRODE AND DAMAGE STONE AND OTHER MASONRY. CORROSION EXPANDS AND EXERTS TENSION IN BRITTLE MASONRY MATERIALS—COMMONLY CALLED "RUST JACKING"—RESULTING IN SPALLS AND DISPLACEMENT THAT REQUIRE REATTACHMENT THROUGH ANCHORING OR DUTCHMAN REPAIRS.

CAST STONE, LIKE THIS FACADE OF PALACIO BOSCH IN BUENOS AIRES, CAN BEHAVE LIKE NATURAL STONE. AND CAN DETERIORATE IN SIMILAR WAYS, SO TREATMENTS ARE SIMILAR.

BUILDING MATERIALS

BRICK AND ARCHITECTURAL CERAMICS

Brick and Architectural Ceramics

MATERIAL CHARACTERISTICS:
CLAY BASED, MADE FROM A NATURAL EARTHEN MATERIAL, COMES IN A VARIETY OF SIZES AND SHAPES, CAN BE BRITTLE AND BREAK UNDER IMPACT, POROUS

THINGS LIKE:
BRICK, TERRA-COTTA, GLAZED OR UNGLAZED TILE

USED FOR:
ROOF TILES, INNER WYTHE OR INFILL FOR STONE OR RENDERED WALLS, VAULTING BASES (STRUCTURAL); FLOORS, WALLS, CEILINGS (DECORATIVE)

CLAY BUILDING MATERIALS HAVE ANCIENT ORIGINS.

INDUSTRIAL PRODUCTION OF FIRED BRICKS DATES TO THE EARLY ROMAN EMPIRE AND TERRA-COTTA EVEN EARLIER.

THE USE OF CERAMIC FLOOR TILES GOES BACK TO THE 4TH MILLENNIUM B.C.E. IN THE MIDDLE EAST AND ASIA.

TILE IS HISTORICALLY COMMON AS FLOORING AND ROOFING IN CENTRAL AND SOUTH AMERICA.

IN WESTERN EUROPE, MASTERS IN DELFT AND PORTUGAL SET A STANDARD FOR CRAFTSMANSHIP AND GLAZED DECORATION.

CLAY IS A CHAMELEON, AN ARCHITECTURAL MATERIAL WITH AN INCREDIBLE BREADTH OF APPEARANCES AND USES.

IT MAY BE DRIED, BAKED, OR FIRED, GLAZED OR UNGLAZED.

AMONG ITS MANY USES, CLAY CAN BE FORMED INTO STURDY RECTANGULAR MASONRY BRICKS FOR WALLS, CURVED INTO ARCED ROOF TILES, OR BECOME TINY CERAMIC PIECES TO PLACE JUST SO TO CREATE DECORATIVE MOSAICS.

TERRA-COTTA CAN BE EXTRUDED OR CAST INTO ORNAMENTAL ELEMENTS.

BRICK IS STONE'S MORE MANAGEABLE (AND LESS EXPENSIVE) COUSIN BECAUSE IT COMES ALREADY FORMED IN HAND-SIZE PIECES. BRICK IS A WORKHORSE WHEN USED FOR EXTERIOR WALLS. IT CAN BE USED TO FORM A STRUCTURE OR AS A VENEER.

BUT ARCHITECTURAL CERAMICS REALLY SHINE AS DECORATIVE DETAILS, WHERE THE OPTIONS ARE NEARLY ENDLESS BECAUSE THE MATERIAL IS SO EASILY SCULPTED OR CAST.

CLAY PRODUCTS CAN ALSO BE BEHIND-THE-SCENES STRUCTURAL: BRICK OR TERRA-COTTA CAN BECOME THE INNER WYTHE AND INFILL FOR WALLS OR FORM THE BASE OF VAULTING.

CLAY PRODUCTS CAN ALSO BE ORNAMENTALLY STRUCTURAL: TILES CREATE INTERIOR FLOORS AND WALLS, AND TERRA-COTTA CAN BE FIRED INTO HOLLOW BLOCKS TO FORM EXTERIOR COURTYARDS.

THE MINERALS INHERENT IN THE CLAY MIX ARE RESPONSIBLE FOR THE CHEMICAL REACTIONS THAT OCCUR DURING FIRING. THEY ALSO INFLUENCE BOTH APPEARANCE AND PERFORMANCE WHEN IN PLACE.

IRON OXIDE PROVIDES THE TYPICAL RED COLOR OF TERRA-COTTA, FOR EXAMPLE.

AT HIGH TEMPERATURES, CALCIUM CARBONATE BREAKS DOWN TO PROVIDE A SOURCE OF CALCIUM OXIDE, WHICH IMPROVES THE MECHANICAL AND CHEMICAL STRENGTH OF THE CLAY AND REDUCES SHRINKAGE FROM FIRING.

SILICA (PRESENT IN ALL CLAY MINERALS) VITRIFIES, OR MELTS, FILLING THE VOIDS IN THE CLAY BODY. IT HARDENS WHEN IT COOLS.

FIRING A CERAMIC BOTH HARDENS IT AND CREATES A DENSE OUTER SKIN—OR AT EXTREMELY HIGH TEMPERATURES, A GLASSY SKIN—HELPING FEND OFF WATER ABSORPTION IN THE NATURALLY POROUS MATERIAL AND MAKING IT MORE DURABLE AND WEATHER RESISTANT. GLAZE ALSO FORMS A GLASSLIKE COATING THAT CAN FURTHER HELP TILES RESIST WATER.

FIRING IMPARTS STRENGTH AND COHESION, BUT ALSO BRITTLENESS, SO BRICK, TILE, AND TERRA-COTTA ARE EASILY DAMAGED BY DIRECT IMPACTS.

INCONSISTENT FIRING AFFECTS PERFORMANCE, AS DO POOR RAW MATERIALS IN THE CLAY MIX OR INCLUSIONS THAT CAN MAKE THE MATERIAL MORE PRONE TO THE EFFECTS OF EXTERNAL FACTORS.

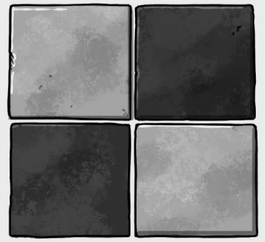
Some Ceramic Tile Types

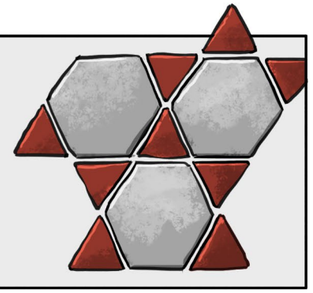
UNGLAZED:

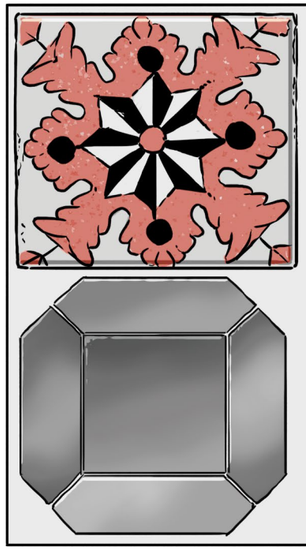
QUARRY TILES ARE CUT FROM SLABS OF CLAY. THEY ARE MACHINE-MADE USING THE EXTRUSION PROCESS, WHICH CREATES DESIRED SHAPES BY PUSHING THE MATERIAL THROUGH DIES.

TERRA-COTTA PAVERS ARE A CRUDER, THICKER VERSION OF QUARRY TILE MADE GENERALLY BY PRESSING CLAY DUST BUT SOMETIMES BY EXTRUSION.

ENCAUSTIC TILES ARE PRESSED CLAY DUST OF DIFFERENT COLORS INLAID INTO THE SURFACE DURING FABRICATION TO CREATE DESIGNS.

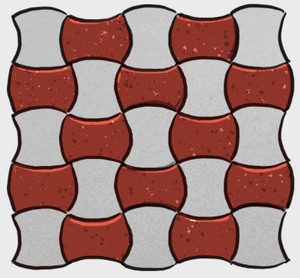


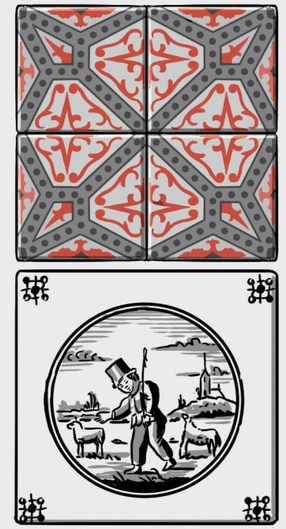


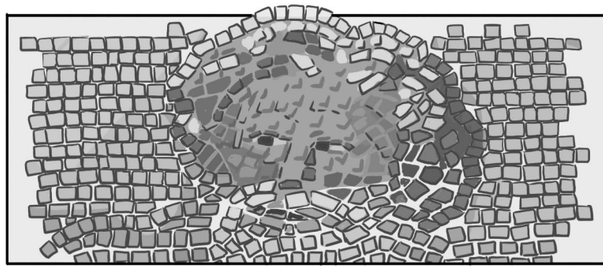


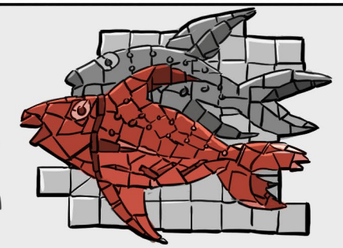
GLAZED:

MOST CERAMIC TILES ARE DECORATED WITH A GLAZE THAT'S EITHER BRUSHED ONTO THE SURFACE OR ADDED BY DIPPING THE TILE INTO IT BEFORE FIRING. GLAZES ARE MADE WITH METALLIC OXIDES AND PIGMENTS THAT IMPART COLOR WHEN FIRED. THOUGH EVEN GLAZED TILES REMAIN SOMEWHAT POROUS.









MOSAIC:

MOSAIC TILES, ALSO KNOWN AS TESSERAE, ARE VERY SMALL AND CAN BE SQUARE OR CUT INTO SHAPES. EITHER GLAZED OR UNGLAZED, MOSAICS CAN BE USED TO CREATE PATTERNS OR SOMETIMES IMAGES. (TESSERAE CAN ALSO BE MADE OF STONE OR GLASS.)

Strength Considerations

CONTEMPORARY BRICKS ARE GENERALLY DENSER, HARDER, AND MORE UNIFORM AS A RESULT OF GREATER CONSISTENCY AMONG RAW MATERIALS, STANDARDS OF MANUFACTURE, AND HIGHER FIRING TEMPS.

HAND-PRESSED BRICK (HISTORIC) IS SOFTER THAN EXTRUDED (CONTEMPORARY) BRICK.

FLOOR TILES ARE OFTEN THICKER AND HARDER THAN WALL TILES BECAUSE THEY ARE FIRED LONGER AND/OR AT HIGHER TEMPERATURES.

*THE WORD "TILE" REFERS TO ITS USE AS A FINISH—NOT ITS MATERIAL COMPOSITION. NOT ALL TILES ARE CERAMIC. SOME ARE CEMENT AND ARE CURED RATHER THAN FIRED AND NEED TO BE CARED FOR AS CONCRETE.

Inherent Vulnerabilities

AFTER FIRING, BRICK AND CERAMICS RETAIN A POROSITY THAT CAN MAKE THEM SUSCEPTIBLE TO MOISTURE-DRIVEN DAMAGE, LIKE FREEZE-THAW CYCLES.

A BRICK'S OUTER FIRESKIN IS DENSER THAN THE MORE POROUS MATERIAL JUST BELOW IT. SALT CRYSTALLIZATION AND FREEZING WATER EXERTS PRESSURE WITHIN PORES, WHICH CAN CAUSE THE FIRESKIN TO SPALL OR DELAMINATE.

SOME GLAZES CAN BECOME PITTED OR POWDERY WITH AGE, OR CAN CRACK, FLAKE, DELAMINATE FROM THE CLAY BODY, OR CRAZE—WHICH MEANS DEVELOP A NETWORK OF CRACKS, LIKE SHATTERING WITHOUT BREAKING. CRAZING CAN TRAP DIRT OR INCREASE MOISTURE ABSORPTION OF THE TILE.

UNGLAZED TILES ARE READILY ABSORPTIVE, SO PORES CAN GET CLOGGED AND UNSUITABLE COATINGS CAN'T BE REMOVED.

Things to Look Out For

LOOK FOR:
ATMOSPHERIC SOILING
DISCOLORATION
BIOLOGICAL GROWTH
EFFLORESCENCE
SPALLING OR GLAZE LOSS
FAILING JOINTS

CEMENTITIOUS MORTARS ARE TROUBLESOME BECAUSE THEY ARE DENSER AND STRONGER THAN BRICK OR TERRA-COTTA, SO DAMAGING WATER WILL MOVE PREFERENTIALLY INTO THE BRICK OR TERRA-COTTA. LOOSE, CRACKED, BROKEN, OR UNBONDED TILE OR TERRA-COTTA CAN RESULT.

POLLUTED ENVIRONMENTS ALSO INTRODUCE ACIDIC SALTS. WHEN SALTS DISSOLVED IN WATER ARE ABSORBED INTO A BRICK'S PORES, THEY CAN DRY AND RECRYSTALLIZE, CAUSING PITTING, DISAGGREGATION, FRIABILITY, AND EFFLORESCENCE.

WEATHERING AND WEAR ON FLOORS CAN BE UNEVEN DUE TO TRAFFIC PATTERNS.

BRICK AND CERAMIC MATERIALS HOLD UP IF TAKEN CARE OF, BUT BECAUSE THEY ARE BRITTLE, THEY ARE PRONE TO CHIP AND BREAK DUE TO VIBRATION, IMPACT, FREEZE-THAW CYCLING, AND STRUCTURAL DISPLACEMENT.

THINK ABOUT WHAT IS BEING ROLLED OVER TOP OF FLOORS AND BE CAREFUL OF DROPPING TOOLS OR SLAMMING LADDERS.

Routine Care

BRICK EXTERIORS

POWER WASHING AND SANDBLASTING ARE GENERALLY TOO AGGRESSIVE AND CAN INTRODUCE DAMAGE.

LIMIT THE USE OF WATER IF THERE ARE OPEN JOINTS, MORTAR OR GROUT LOSSES, OR ANY EVIDENCE OF EFFLORESCENCE.

IF YOU HAVE A FLAKY OR EASILY CRUMBLED SURFACE, AVOID SCRUBBING EVEN WITH A SOFT BRUSH.

DO NOT PAINT.

REMOVE ORGANIC DEBRIS LIKE LEAVES, GRASSES, AND DIRT WITH A WHISK BROOM OR STIFFER BRISTLE BRUSH.

FREQUENCY OF CLEANING:
AS NEEDED; FLOORS MORE OFTEN THAN FACADES

BRICK INTERIORS

REMOVE DEBRIS LIKE COBWEBS AND DUST BY BRUSHING AWAY OR VACUUMING.

FREQUENCY OF CLEANING:
AS NEEDED

TILEWORK AND TERRA-COTTA

SAME AS BRICK.

CANNOT BE CLEANED ABRASIVELY. ABRASIVES WILL DETERIORATE THE MATERIAL AND INCREASE LOSSES TO CERAMICS AND THEIR GLAZES.

LET CH KNOW IF THERE IS ANY CRACKING OR FLAKING OF TILES OR DETERIORATION OF MORTAR JOINTS.

BRICK AND TILE FLOORS

SWEEP OR VACUUM FIRST TO REMOVE DUST, DIRT, AND DEBRIS.

ONLY USE A VACUUM AFTER CAREFULLY EVALUATING THE CONDITION OF THE FLOOR TO ENSURE LOOSE FRAGMENTS WON'T GET SUCKED UP AND LOST.

MAY REQUIRE MOPPING. USE A DAMP MOP ONLY IF NECESSARY AND DON'T ALLOW WATER TO POOL ON FLOORS. IF SOAP IS NEEDED, USE SOMETHING EASY TO RINSE. DO NOT USE ACIDIC CLEANERS OR DEGREASERS.

DON'T POLISH OR REFINISH FLOORS WITHOUT CH'S HELP.

FREQUENCY OF CLEANING:

COULD BE SWEPT UP TO EVERY DAY TO GET ABRASIVE DIRT OFF SURFACE BEFORE IT CAN BE GROUND IN.

A MAINTENANCE CHECK SHOULD BE DONE TWICE A YEAR DURING SHOULDER SEASONS.

Repair Protocols

FOR TRADITIONAL BUILDINGS, CONSIDER IF THE MATERIALS WERE SOURCED LOCALLY, AND IF THOSE HERITAGE MATERIALS ARE STILL AVAILABLE.

PROPER MAINTENANCE OF MORTAR JOINTS HELPS PREVENT DAMAGE TO BRICK AND TILES.

TO PRESERVE THE ORIGINAL MATERIAL (OR TO AVOID UNIT REPLACEMENT), SURFACE LOSSES AND CRACKS CAN OFTEN BE PATCHED TO MATCH.

MISSING OR BROKEN UNITS MAY NEED REPLACING. WORK WITH CH TO STUDY THE EXISTING MATERIALS AND SOURCE COMPATIBLE RESTORATION MATERIALS. SPECIALISTS CAN BE RETAINED FOR REPAIRS.

AMERICAN OR COMMON BOND

IF CRACKS ARE FORMED IN BRICKS AND MORTAR JOINTS, IT MAY BE NECESSARY TO STITCH THE CRACK TOGETHER AGAIN EITHER BY TOOTHING BRICK OR USING STAINLESS STEEL DOWELS ACROSS JOINTS.

BRICK PATTERNS

RUNNING BOND

ENGLISH BOND

FLEMISH BOND

MOST OFTEN, REPAIRS WILL INVOLVE TREATING MORTAR JOINTS RATHER THAN THE CERAMIC UNIT ITSELF.

KEEPING UP WITH THE MORTAR WILL HELP CIRCUMVENT THE NEED FOR REPLACEMENT OF CERAMIC OR TILES.

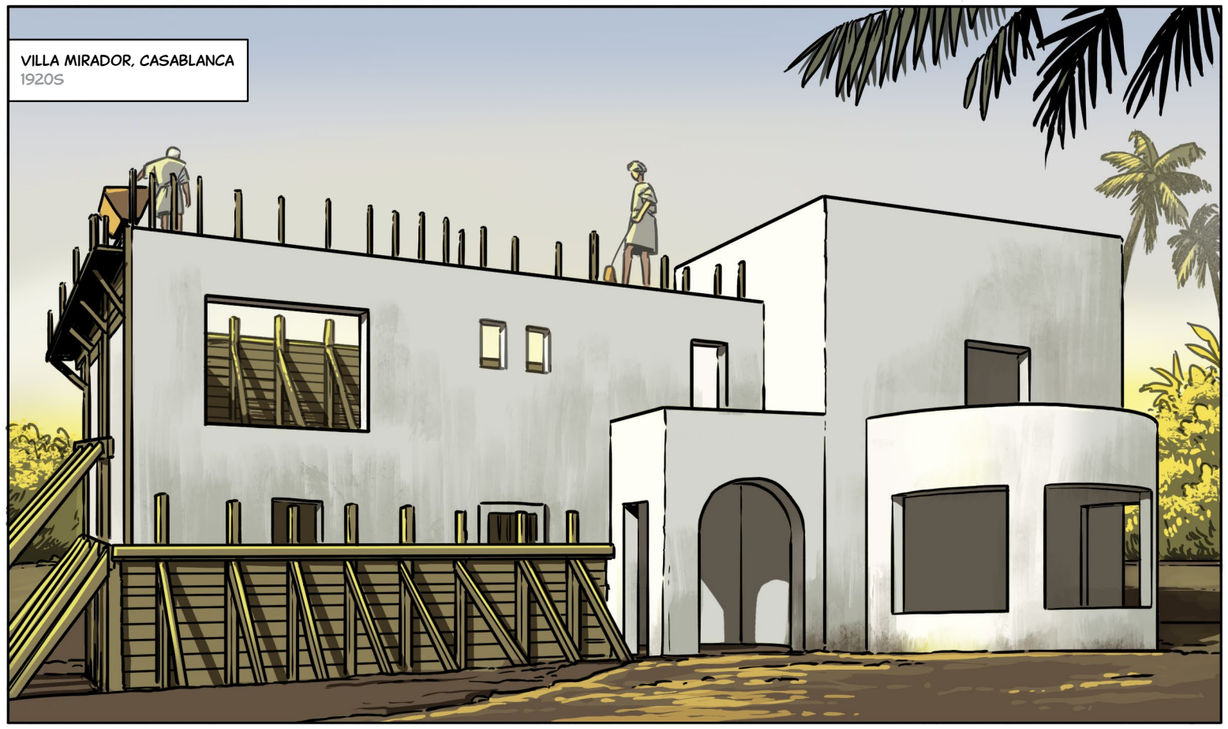
REMEMBER JOINT MATERIALS ARE SACRIFICIAL AND SHOULD BE LESS STIFF THAN THE TILE.

SINCE MOST CERAMIC FLOORS ARE PROTECTED BY A FIRESKIN OR GLAZE, AN ADDITIONAL PROTECTIVE COATING IS GENERALLY NOT NEEDED. THE ADDITION OF A COATING OFTEN INCREASES MAINTENANCE REQUIREMENTS AND COSTS. PENETRATING SEALERS OR IMPREGNATORS FOR UNGLAZED TILES SHOULD BE EVALUATED BY CH BEFORE USE.

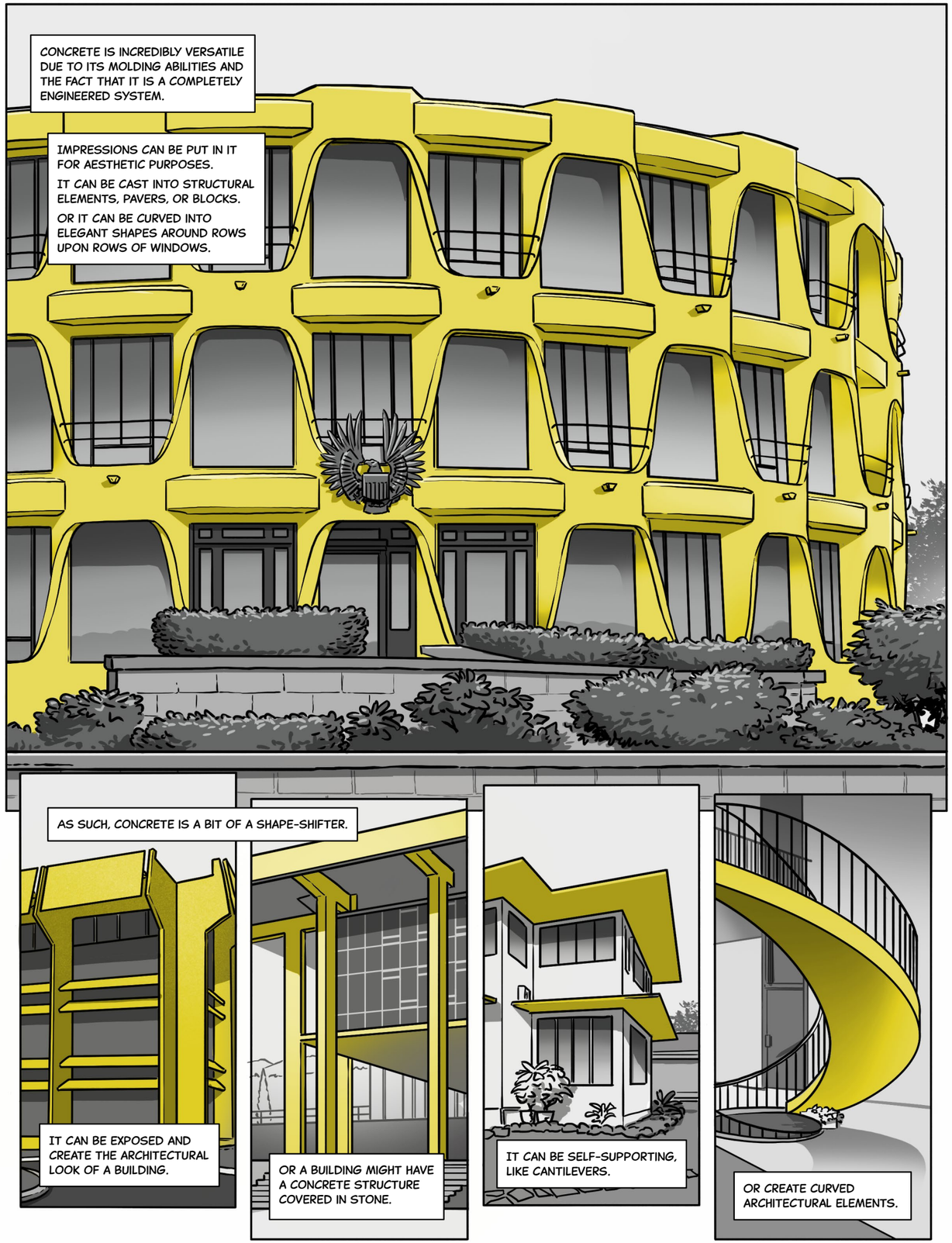
BUILDING MATERIALS CONCRETE

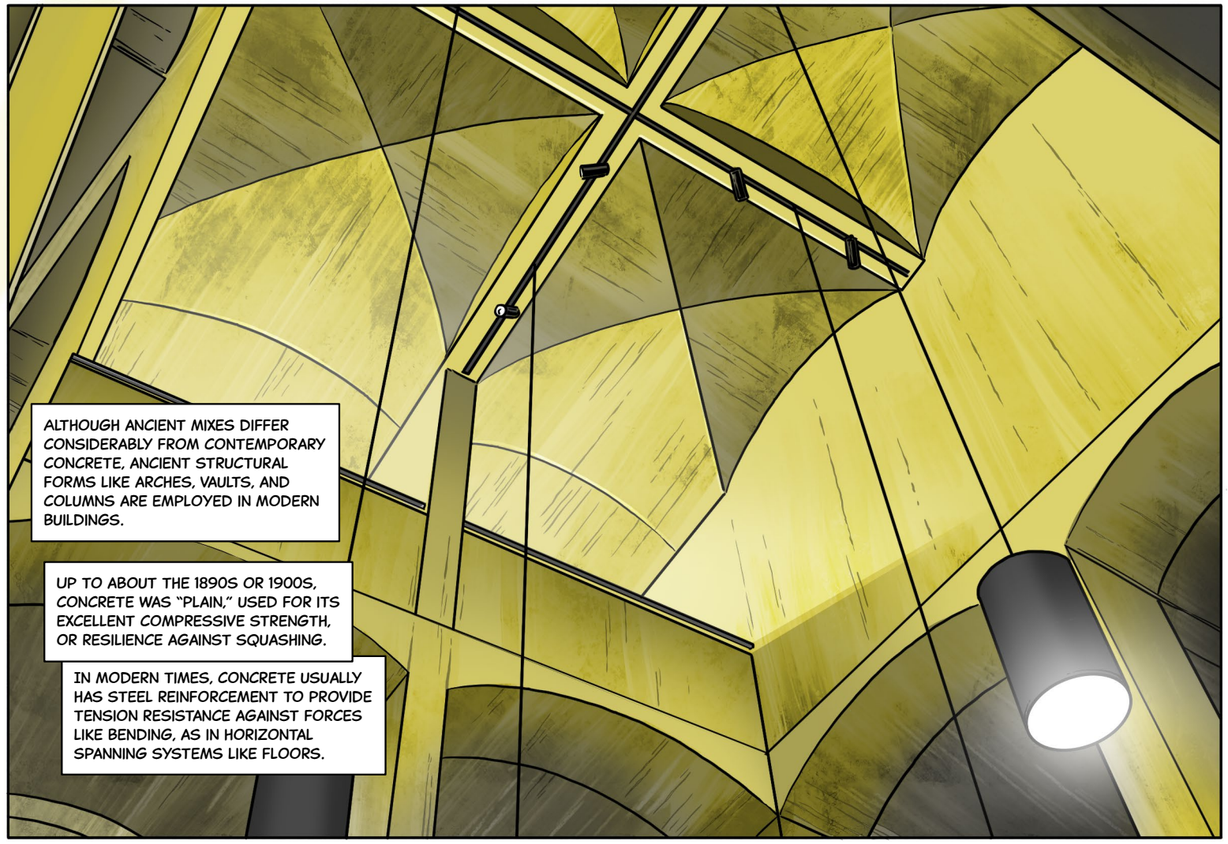
Concrete


MATERIAL CHARACTERISTICS:
MAN-MADE, DURABLE, HIGH COMPRESSIVE STRENGTH, MOLDABLE BECAUSE IT GOES FROM A FLUID TO A SOLID
THINGS LIKE:
MASS CONCRETE, REINFORCED CONCRETE, TABBY, TERRAZZO
USED FOR:
FOUNDATIONS, COLUMNS, BEAMS, JOISTS, FLOOR SLABS, ROOF SLABS, WHOLE BUILDINGS; CAST AS FINIALS, LINTELS, AND DECORATIVE ELEMENTS


VILLA MIRADOR, CASABLANCA
1920S


CASABLANCA CONFERENCE
1943


CONCRETE IS INCREDIBLY VERSATILE DUE TO ITS MOLDING ABILITIES AND THE FACT THAT IT IS A COMPLETELY ENGINEERED SYSTEM.
IMPRESSIONS CAN BE PUT IN IT FOR AESTHETIC PURPOSES.
IT CAN BE CAST INTO STRUCTURAL ELEMENTS, PAVERS, OR BLOCKS.
OR IT CAN BE CURVED INTO ELEGANT SHAPES AROUND ROWS UPON ROWS OF WINDOWS.
AS SUCH, CONCRETE IS A BIT OF A SHAPE-SHIFTER.
IT CAN BE EXPOSED AND CREATE THE ARCHITECTURAL LOOK OF A BUILDING.
OR A BUILDING MIGHT HAVE A CONCRETE STRUCTURE COVERED IN STONE.
IT CAN BE SELF-SUPPORTING, LIKE CANTILEVERS.
OR CREATE CURVED ARCHITECTURAL ELEMENTS.



ALTHOUGH ANCIENT MIXES DIFFER CONSIDERABLY FROM CONTEMPORARY CONCRETE, ANCIENT STRUCTURAL FORMS LIKE ARCHES, VAULTS, AND COLUMNS ARE EMPLOYED IN MODERN BUILDINGS.

UP TO ABOUT THE 1890S OR 1900S, CONCRETE WAS "PLAIN," USED FOR ITS EXCELLENT COMPRESSIVE STRENGTH, OR RESILIENCE AGAINST SQUASHING.

IN MODERN TIMES, CONCRETE USUALLY HAS STEEL REINFORCEMENT TO PROVIDE TENSION RESISTANCE AGAINST FORCES LIKE BENDING, AS IN HORIZONTAL SPANNING SYSTEMS LIKE FLOORS.

CONCRETE IS A COMPOSITE OF MIXED MATERIALS.

THE BASIC RECIPE:

A **BINDER** (HISTORICALLY LIME, MORE RECENTLY CEMENTS)

A **SMALL AGGREGATE** (SAND)

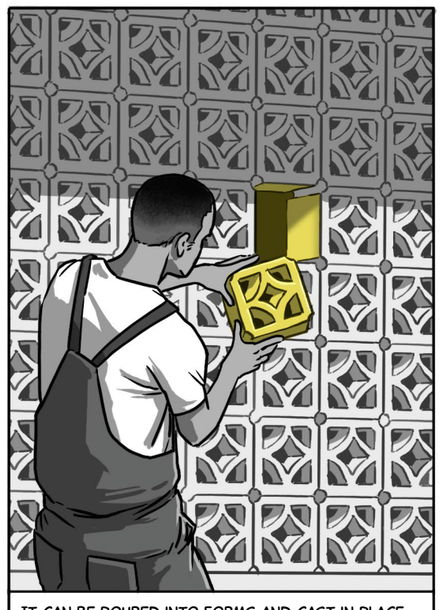
A **LARGE AGGREGATE** (SHARP, HARD PIECES OF STONE)

WATER

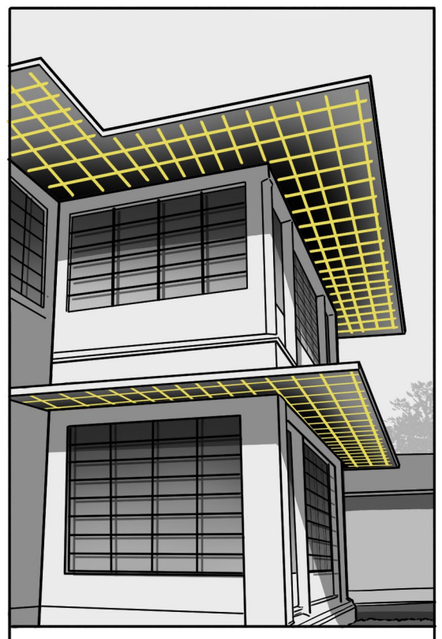
THE BINDER AND WATER CREATE THE CEMENT PASTE, OR MATRIX, AROUND THE AGGREGATE.

TERRAZZO ADDS IN CHIPS OF GRANITE, MARBLE, OR GLASS.

CONCRETE RECIPES ARE ADJUSTABLE FOR STRENGTH AND DURABILITY. DECIDE FIRST WHAT THE CONCRETE NEEDS TO DO, THEN DESIGN THE MIX.



IT CAN BE POURED INTO FORMS AND CAST IN PLACE OR CAST IN MOLDS TO CREATE DISCRETE UNITS. BEAMS AND SLABS CAN BE PREFABRICATED AND SHIPPED TO BUILDING SITES. HOWEVER, TRANSPORT AND VIBRATIONS CAN CAUSE DAMAGE. PREFABRICATED CONCRETE CONNECTIONS CAN BE MORE FINICKY THAN CAST-IN-PLACE CONSTRUCTION.



WHEN STEEL REINFORCEMENTS ARE ADDED, CONCRETE ELEMENTS CAN BE MADE EVEN SMALLER AND THINNER FOR UNIQUE ARCHITECTURAL FEATURES. STEEL ALSO HELPS REDUCE CRACKING AS CONCRETE SHRINKS DURING CURING AND UNDER THERMAL CYCLING.

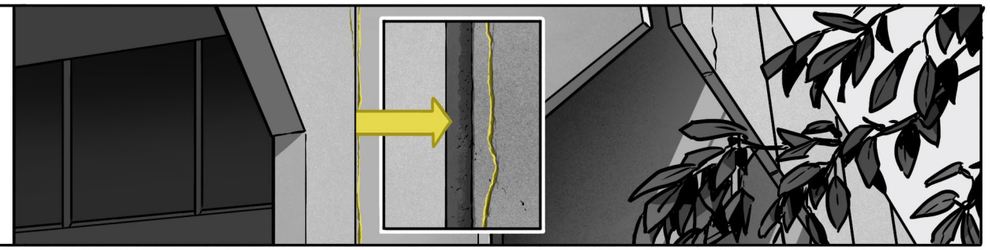
Concrete's Properties

SINCE CONCRETE IS MIXED, THE MEANS AND METHODS INFLUENCE THE FINAL PRODUCT.

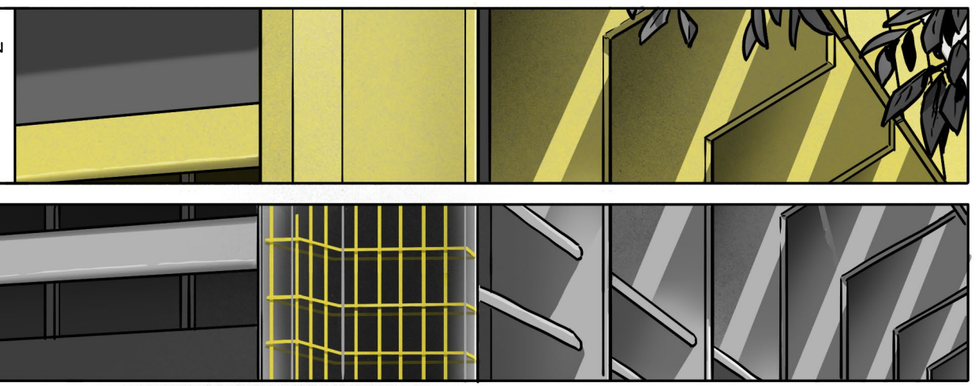
ADDITIVES TO THE MIX OR TOO MUCH WATER TO MAKE IT MORE FLOWABLE OR TO SLOW THE CURING PROCESS DOWN CAN INTRODUCE WEAKNESSES BY ALTERING PHYSICAL AND CHEMICAL PROPERTIES.

ALL CONCRETE CRACKS. MOVEMENT JOINTS, SUCH AS EXPANSION AND CONTROL JOINTS, ARE INCORPORATED SO THAT IT CRACKS IN DESIGNATED PLACES.

CONCRETE CAN CRACK AS IT SHRINKS BECAUSE OF WATER LOSS DURING CURING OR FROM THERMAL EXPANSION AND CONTRACTION.



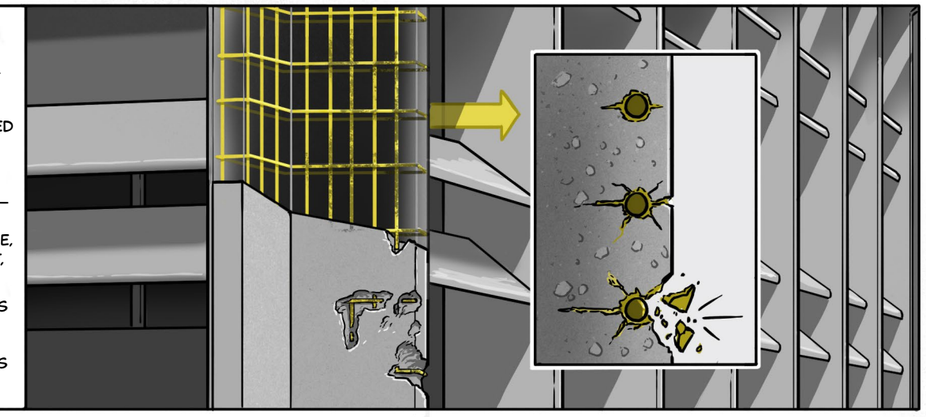
CONCRETE GAINS STRENGTH THROUGH A CHEMICAL REACTION CALLED HYDRATION. 28 DAYS IS THE GENERAL CURING TIME REQUIRED TO REACH A CONCRETE'S SPECIFIED STRENGTH, BUT THE CURING PROCESS CONTINUES OVER TIME.



CONCRETE IS A RELATIVELY HEAVY BUILDING MATERIAL. REINFORCED CONCRETE ALLOWS FOR THINNER MEMBERS AND IMPROVED STRUCTURAL PERFORMANCE.

FRESH CONCRETE HAS A HIGH ALKALINITY. CONCRETE'S HIGH PH CREATES A PASSIVE OXIDE LAYER ON THE STEEL REBAR INSIDE, PROTECTING IT FROM CORROSION. CONCRETE'S PH IS LOWERED THROUGH A PROCESS CALLED CARBONATION—WHEN ATMOSPHERIC CARBON DIOXIDE REACTS WITH THE CALCIUM HYDROXIDE IN THE CEMENT PASTE TO FORM CALCIUM CARBONATE—STARTING AT THE CONCRETE SURFACE AND PROGRESSING INWARD. OVER TIME, THE PROTECTIVE OXIDE LAYER IS LOST, ENABLING STEEL TO CORRODE.

WHEN ADVANCED CORROSION EXPANDS AND EXERTS PRESSURE ON BRITTLE SUBSTRATES LIKE CONCRETE, IT'S CALLED RUST JACKING, AND IT RESULTS IN CRACKS AND SPALLS.



CONCRETE, WHILE ROBUST, DETERIORATES FROM EXPOSURE TO SALTS AND ACIDS FROM POLLUTION, ACID RAIN, SOILS, MARINE ENVIRONMENTS, DEICING PRODUCTS, POOL CHEMICALS, AND FERTILIZERS. THESE CAN REDUCE THE PH OF THE CEMENT PASTE AND EXACERBATE CORROSION OF EMBEDDED METALS.

Things to Look Out For

WATCH FOR:

IRON OXIDE STAINING

CRACKING

OR CRACKS GETTING BIGGER

CRACKS WILL BE FOLLOWED BY SPALLS

DIAGONAL CRACKS, WHICH MAY MEAN A WALL OR COLUMN IS ROTATING OR SETTLING

MOVEMENT, POTENTIALLY BIGGER GAPS BETWEEN CONNECTIONS

BE DILIGENT ABOUT CRACKS AND NOTIFY AN ENGINEER. ONE METHOD TO DETERMINE WHETHER A CRACK IS WIDENING IS TO DRAW A STRAIGHT PENCIL LINE PERPENDICULAR TO THE CRACK AND RECORD THE DATE.

CONCRETE IS QUITE DURABLE, BUT THAT DOESN'T MEAN THE MATERIAL HAS AN INFINITE LIFE CYCLE.

CONCRETE STRUCTURES NEED WATCHING AND ROUTINE MAINTENANCE, SUCH AS CLEANING. NEW CONDITIONS SHOULD BE ADDRESSED RIGHT AWAY TO PREVENT PROGRESSIVE DAMAGE. DO A FULL ONCE-OVER EVERY YEAR AND AFTER ANY NATURAL OR MAN-MADE HAZARD EVENT.

Routine Care of Concrete

GENERALLY, CLEAN CONCRETE AS YOU WOULD STONE.

START BY REMOVING DEBRIS WITH A BRUSH, BROOM, OR VACUUM (DEPENDING ON IF INTERIOR OR EXTERIOR).

WATER FROM A GARDEN HOSE FILTERED WITH INLINE FILTER, A NATURAL BRISTLE BRUSH, AND A MILD DETERGENT ARE ACCEPTABLE FOR EXTERIORS.

NO POWER WASHING OR SANDBLASTING.

AVOID ACIDS WHEN SCRUBBING STAINS. ACIDS CHANGE THE PH OF THE CONCRETE LOCALLY. ACIDS CAN ALSO DAMAGE CONCRETE BY DISSOLVING CEMENTITIOUS OR CALCAREOUS COMPOUNDS.

FOR IRON OXIDE STAINS, CALL CH TO HELP.

Repair Protocols

EACH CONCRETE MIX IS UNIQUE AND THE RECIPES FOR CONCRETE ARE CONSTANTLY CHANGING.

KNOW AND DOCUMENT THE MIX. AND PAY ATTENTION TO WHAT THE CONTRACTOR IS CREATING.

REMEMBER TO IDENTIFY AND REMEDY THE CAUSE OF DAMAGE AS PART OF A REPAIR EFFORT.

SPECIALISTS MAY REPAIR HOLES OR CRACKS BY INJECTING GROUT OR EPOXY. CH CAN HELP DESIGN REPAIR METHODS AND MATERIALS.

STITCHING LARGER CRACKS TOGETHER WITH STAINLESS STEEL BARS OR CARBON FIBER MAY GET THE SIDES OF THE CRACK TO TALK TO EACH OTHER AGAIN.

PINS CAN BE INSTALLED TO PROVIDE A MECHANICAL BOND FOR NEW CONCRETE REPAIRS. RELYING ON MECHANICAL BONDS RATHER THAN A CHEMICAL BOND ALONE IS ENCOURAGED.

SYNTHETIC BONDING AGENTS CAN IMPEDE MOISTURE TRANSMISSION. USE OF BONDING AGENTS SHOULD BE EVALUATED WITH CH.

CRACKS AND SPALLS USUALLY OCCUR BECAUSE SOMETHING HAS MOVED OR A BAR INSIDE IS CORRODING.

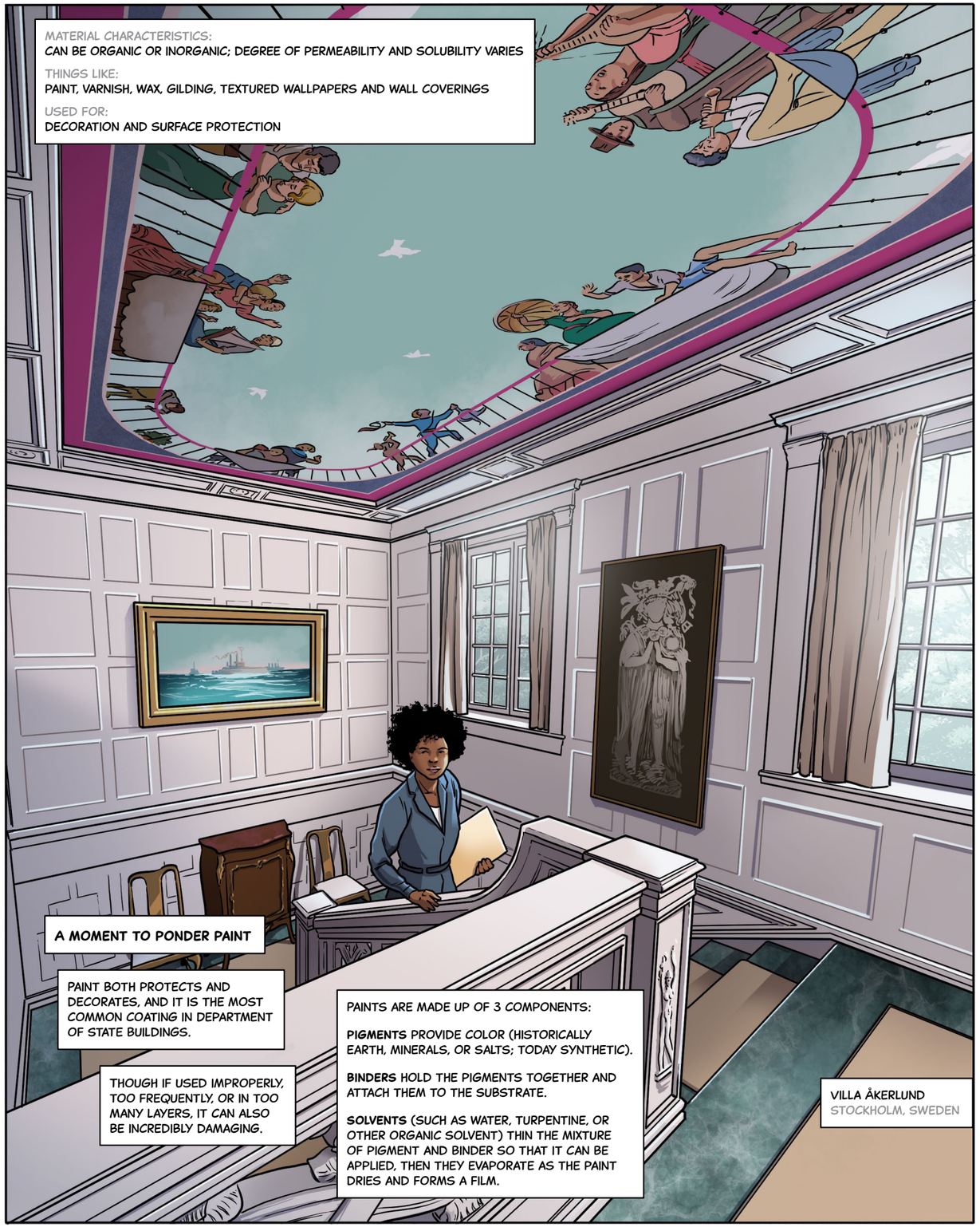
CONCRETE SHOULD BE REMOVED BACK TO SOUND MATERIAL. ONCE THE METAL IS EXPOSED AND CLEANED OF ALL RUST, APPLY A RUST INHIBITING PRIMER. PATCH WITH A COMPATIBLE MORTAR TO MATCH IN-KIND.

CONTACT AN ENGINEER IF CORROSION OF REBAR IS EXTENSIVE.

RUST RESULTS IN LOSS OF CROSS SECTION AND CAN EXERT STRESS IN ADJOINING MATERIALS BECAUSE OF VOLUMETRIC EXPANSION, COMMONLY REFERRED TO AS RUST JACKING.

BUILDING MATERIALS PAINTS, COATINGS, AND FINISHES

Paints, Coatings, and Finishes



A Primer of Paints and Coatings

FINISHES THAT MIGHT BE IN YOUR DEPARTMENT OF STATE BUILDING

LIMEWASH

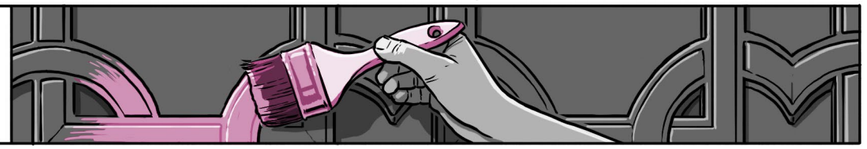
LIMEWASH—A THIN SUSPENSION OF LIME (CALCIUM HYDROXIDE) IN WATER—IS HIGHLY PERMEABLE AND COMPATIBLE WITH LIME STUCCOS, PLASTERS, AND STONE AND OTHER MASONRY. LIMEWASH CAN BE PIGMENTED. OTHER MINERAL-BASED FINISHES BEYOND LIMEWASH ARE COMMERCIALLY AVAILABLE.

CARNAUBA WAX

CARNAUBA WAXES, USING PLANT-BASED INGREDIENTS FROM A PALM TREE, ARE USED TO PROTECT FLOORS AND PROVIDE SHINE.

OIL PAINT

OIL PAINTS ARE HISTORICALLY COMPOSED OF PIGMENT (OFTEN LEAD), TURPENTINE OR WHITE SPIRIT, AND A DRYING OIL (MOST OFTEN LINSEED OIL) THAT REACT WITH AMBIENT OXYGEN TO FORM A CONTINUOUS AND FLEXIBLE FILM.

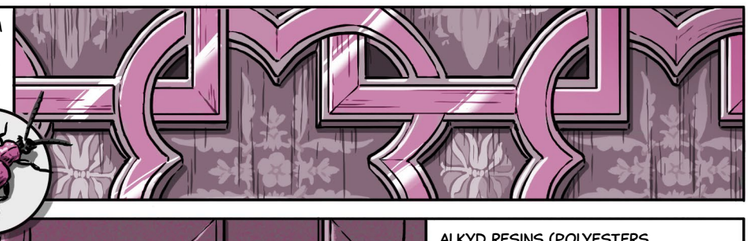


DISTEMPER

DISTEMPERS—CHALK PAINT PIGMENTED AND BOUND WITH ANIMAL GLUE—ARE USED ONLY IN INTERIORS BECAUSE OF WATER SENSITIVITY. HIGHLY PERMEABLE AND ALKALI RESISTANT, THEY ARE APPROPRIATE FOR COATING LIME PLASTER. LATER VERSIONS INCLUDE A SMALL AMOUNT OF BOILED LINSEED OIL, WHICH MAKES THEM MORE DURABLE BUT STILL HIGHLY PERMEABLE.

VARNISH

VARNISHES—CONSISTING OF HARD NATURAL RESINS FROM PLANTS (SUCH AS COPAL, DAMMAR, OR ROSIN) OR INSECTS (SUCH AS SHELLAC FROM THE LAC BEETLE)—ARE WIDESPREAD, MOST OFTEN FOR COATING FLOORS AND MILLWORK. THEY SOMETIMES HAVE PIGMENTS ADDED TO HELP RESIST UV DEGRADATION. CONTEMPORARY VARNISHES INCLUDE URETHANE COATINGS LIKE SPAR VARNISH, WHICH IS STILL UV SENSITIVE.



RESIN

ALKYD RESINS (POLYESTERS CHEMICALLY REACTED WITH DRYING OILS) ARE A FASTER-DRYING OPTION TO TRADITIONAL OIL PAINT. A MULTITUDE OF SYNTHETIC RESIN PAINT OPTIONS ARE AVAILABLE, INCLUDING EPOXIES, URETHANES, RUBBERS, AND THE UBIQUITOUS ACRYLIC AND VINYL EMULSIONS SUCH AS LATEX PAINT.

PARAFFIN

PARAFFIN WAX, DISTILLED FROM PETROLEUM, IS OFTEN USED TO COAT WOOD. EXPOSURE TO UV CAN INITIATE CROSS-LINKING AND CHANGE ITS PROPERTIES, LIKE SOLUBILITY. MICROCRYSTALLINE IS A REFINED TYPE OF PARAFFIN WAX.

WALLPAPER

WALLPAPERS, USUALLY APPLIED ON TOP OF A LINING CANVAS OR LINING PAPER, ARE POPULAR DECORATIVE COVERINGS.

GILDING

GILDING, OR APPLYING THIN METAL FINISHES LIKE LEAF OR POWDERS TO SURFACES, IS USED DECORATIVELY.

Things to Look Out For

COATINGS NEED TO BE COMPATIBLE WITH THE SURFACE ON WHICH THEY'RE APPLIED, ALLOWING FOR VAPOR TRANSMISSION AND MOVEMENT OF THE SUBSTRATE. BE WARY OF ELASTOMERIC COATINGS, WHICH ARE FLEXIBLE BUT CAN INTRODUCE PROBLEMS BECAUSE THEY LACK PERMEABILITY.

WATCH OUT FOR:
CRACKING
BUBBLING
BLISTERING
DISCOLORATION
STAINING
PEELING

PAINT APPLIED IN MULTIPLE SUCCESSIVE COATS (SUCH AS FROM FREQUENT MAKE-READIES) RESULTS IN THICK APPLICATIONS THAT MASK ORNAMENT AND DECORATION.

NO MATTER WHAT YOU COAT A MATERIAL WITH, WATER WILL ALWAYS FIND A WAY IN...

MODERN COATINGS ARE OFTEN DESIGNED TO BE IMPERMEABLE. OR IF THEY ARE APPLIED TOO THICKLY OR IN TOO MANY LAYERS, THEY BECOME IMPERMEABLE. THEN WHEN WATER GETS IN, IT CAN'T GET OUT, AND CAUSES DETERIORATION OF THE SUBSTRATE, MAKING IT DIFFICULT FOR FINISHES TO ADHERE.

THE MOST COMMON PATHWAYS FOR WATER ARE:

- MICROMOVEMENTS CAUSE COATINGS TO CRACK OR OPEN ALONG JOINTS. THESE FISSURES ALLOW MOISTURE IN.
- RISING DAMP
- POOR WATER MANAGEMENT FROM IMPROPER DRAINAGE OR EXCESSIVE HARDSCAPING CONTRIBUTES TO PONDING AND INGRESS.

A GENERAL RULE OF THUMB IS, THE GLOSSIER THE PAINT, THE LESS PERMEABLE.

U.S. CONSULATE
BARCELONA, SPAIN

IN ADDITION TO MOISTURE DAMAGE, CRACKING, DELAMINATION, AND EMBRITTLING OF FINISHES, ORGANIC COATINGS CAN ALSO BE EATEN BY ROACHES AND BECOME MOLDY.

WALLPAPERS WERE HISTORICALLY INSTALLED USING AN ANIMAL HIDE GLUE, WHICH IS WATER-SOLUBLE.

LEAKS WILL CAUSE IT TO COME AWAY FROM THE WALL.

DETACHMENT OF PAPERS ALSO OCCURS BECAUSE OF CYCLIC RELATIVE HUMIDITY FLUCTUATIONS OR SUSTAINED RELATIVE HUMIDITY ABOVE 50 PERCENT.

ELEVATED RH WILL ATTRACT INSECTS, LIKE SILVERFISH AS WELL AS ROACHES, THAT EAT THE GLUE.

SILVERFISH LOVE WALLPAPER.

WALLS CAN ALSO BE COVERED BY FABRICS, WHICH ARE ADHERED BY A GLUE OR TACKED WITH LITTLE NAILS THAT CAN FAIL.

WITH WOOL AND SILK THERE IS ALWAYS THE POSSIBILITY OF MOTHS.

GILDING ON INTERIORS—APPLIED TO PLASTER OR WOOD OR METAL—IS OFTEN WATER-GILDED, SO IT IS WATER SENSITIVE.

WHEN THE SURFACE IS WETTED, THE GILDING WILL COME OFF.

EVEN IF GILDING IS VARNISHED, IT STILL NEEDS MONITORING AND PROTECTING.

Routine Care for Wall Coatings

FLAT, VERTICAL WALL SURFACES REQUIRE ONLY INFREQUENT DUSTING.

FOR DECORATIVE WORK, USE A PONY HAIR OR HAKE BRUSH TO GET DUST OUT OF CREVICES.

WHITE VINYL OR KNEADED ERASERS CAN BE USED TO REDUCE SMUDGES, SCUFFS, AND FINGERPRINTS ON REPAINTED SURFACES. DO NOT USE ERASERS ON HISTORIC OR DECORATIVE FINISHES.

WALLPAPERS OR FABRIC WALL COVERINGS ONLY NEED DUSTING ABOUT ONCE A YEAR WITH A WIDE BANNISTER BRUSH.

TEXTURED WALLPAPERS MAY REQUIRE MORE FREQUENCY.

USE A LIGHT HAND, AS WALLPAPERS CAN SCRATCH.

A DAMP RAG CAN BE USED ONLY ON NON-WATER-SOLUBLE PAINTED SURFACES IN CASE OF SPILLS.

DO NOT GET PAPER AND FABRIC WALL COVERINGS WET!

CONTACT CH IN THE EVENT OF A SPILL, LEAK, OR TEAR.

DON'T DEFAULT TO REPAINTING. OPT FOR CLEANING FIRST. IF YOU FEEL LIKE THE WALL MIGHT NEED PAINTING, CONSULT WITH CH.

WALLS WITH TOO MANY PAINT LAYERS ARE UNSIGHTLY, LOSE DEFINITION, CAN'T BREATHE, AND TRAP MOISTURE.

Repair Protocols

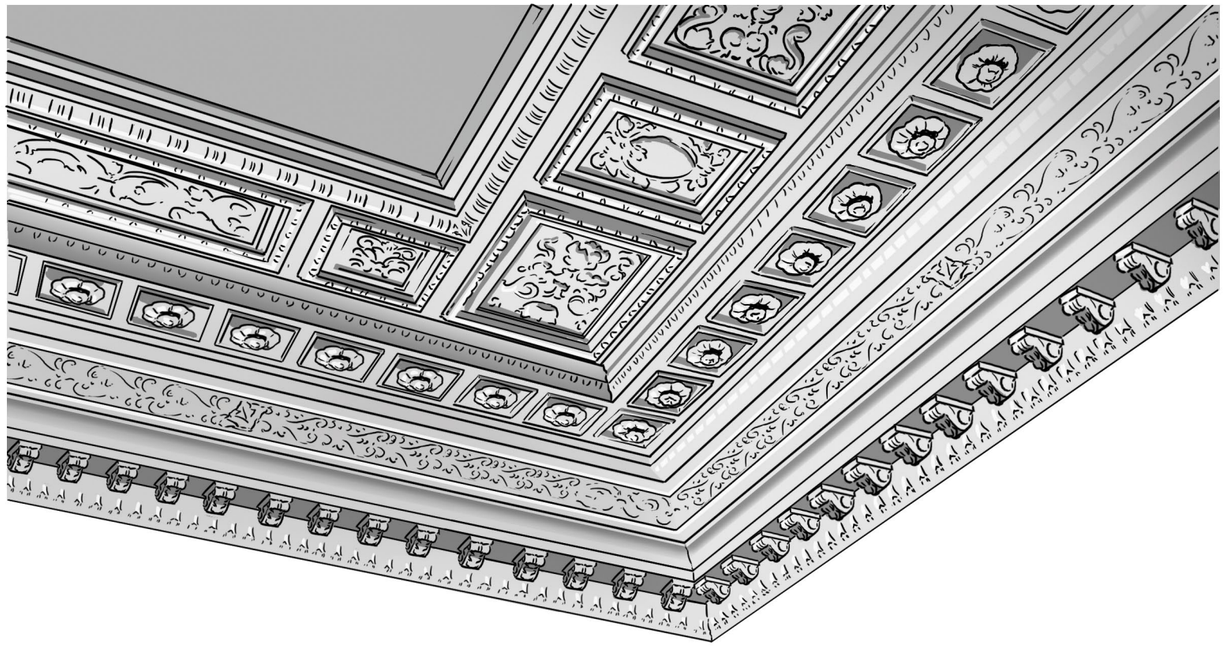
PAINTS, COATINGS, AND OTHER FINISHES CONTRIBUTE TO A BUILDING'S CHARACTER AND SIGNIFICANCE. THEIR STUDY CAN PROVIDE IMPORTANT INFORMATION ABOUT THE HISTORY, EVOLUTION, AND PAST APPEARANCE OF A SPACE OR SURFACE.

WHEN PLANNING REPAIRS, CONSIDER THE RESEARCH NEEDED TO INFORM THE PROJECT. ANALYSIS SHOULD OFTEN PRECEDE MATERIAL SELECTION, REMOVAL, OR TREATMENT. EXISTING FINISHES AND CONDITIONS NEED TO BE DOCUMENTED TO GUIDE MAINTENANCE OR RESTORATION. REMOVAL OF FINISHES WITHOUT DOCUMENTING THEM FIRST DESTROYS VITAL EVIDENCE ABOUT A BUILDING'S PAST LIFE.

FINISH REMOVAL—WHETHER CHEMICAL OR MECHANICAL—MUSTN'T CAUSE DAMAGE. TESTING IS OFTEN REQUIRED TO ESTABLISH OPTIMAL METHODS. APPROPRIATE SUBSTRATE PREPARATION CAN BE DETERMINED WITH CH.

SELECT REPAIR MATERIALS FOR THEIR APPROPRIATENESS AND COMPATIBILITY. THE PROPERTIES OF A COATING WILL AFFECT ITS PERFORMANCE AS WELL AS THE DURABILITY OF THE SUBSTRATE. MATCHING THE PROPERTIES OF MAINTENANCE MATERIALS WITH THOSE USED IN THE ORIGINAL CONSTRUCTION OFTEN RESULTS IN MORE COMPATIBLE REPAIRS. MOST CONTEMPORARY COATINGS LACK THE BREATHABILITY, FLEXIBILITY, OR BOTH OF TRADITIONAL COATINGS—AND THEY DIFFER AESTHETICALLY. A DIFFERENT APPROACH MAY NEED TO BE CONSIDERED FOR HISTORIC SURFACES ALREADY REPAINTED WITH CONTEMPORARY PAINT COATINGS.

INTERVENTIONS ON ORIGINAL HISTORIC SURFACES, MURALS, OR OTHER INTEGRAL ARTWORKS SHOULD BE EVALUATED AND TREATED BY A CONSERVATOR.



Dedication

The Office of Cultural Heritage dedicates this volume to Tobin Tracey, CH's founding director, whose vision and support have shaped our professional preservation practice and created a lasting framework for stewardship of U.S. Department of State cultural heritage resources.

And to our colleagues and partners around the world whose invaluable contributions were essential in shaping this manual's objectives: demystifying building conservation principles and common material issues, providing straightforward methods for practical care, and empowering staff at all levels.

Please contact obo-ops-chstructures@state.gov with feedback or suggestions for ways we can improve this or other tools for conservation.

Select Resources for Further Information

Applied Technology Council, assessments following earthquakes (ATC-20), windstorms and floods (ATC-45)
https://atcouncil.org/training-info1

Architecture of Diplomacy: Building America's Embassies **(2nd edition)**
Jane Loeffler, New York: Princeton Architectural Press, 2011

Association for Preservation Technology International, Practice Points
https://www.apti.org/practice-points

Canadian Conservation Institute, Notes and Publications
https://www.canada.ca/en/conservation-institute.html

Getty Conservation Institute, Publications and Resources
https://www.getty.edu/conservation/publications_resources

A Glossary of Historic Masonry Deterioration Problems and Preservation Treatments
compiled by Anne E. Grimmer, Washington, DC: National Park Service, 1984
https://www.nps.gov/orgs/1739/upload/book-glossary-masonry-deterioration.pdf

Historic Building Facades: The Manual for Maintenance and Rehabilitation
New York Landmarks Conservancy, New York: Wiley, 1997

Historic England, Technical Guidance
https://historicengland.org.uk/advice/technical-advice

Historic New England, Property Care White Papers
https://www.historicnewengland.org/preservation/for-professionals-students/property-care-white-papers

International Council of Monuments and Sites (ICOMOS), Conservation Charters and Doctrinal Texts
https://www.icomos.org/charters-and-doctrinal-texts/, https://www.icomos.de/data/pdf/i-0421-1332-10.pdf

ICOMOS International Scientific Committee on the Analysis and Restoration of Structures of Architectural Heritage (ISCARSAH), Guidelines (2024)
https://iscarsah.org/documents

National Park Service, National Center for Preservation Technology and Training
https://www.nps.gov/subjects/ncptt/online-resources.htm

National Park Service, Secretary of the Interior's Standards for the Treatment of Historic Properties
https://www.nps.gov/orgs/1739/secretary-standards-treatment-historic-properties.htm

National Park Service, Technical Preservation Services, Preservation Briefs
https://www.nps.gov/orgs/1739/preservation-briefs.htm

National Preservation Institute, Trainings
https://www.npi.org/trainings

Society for the Protection of Ancient Buildings (SPAB), Technical Advice Notes
https://www.spab.org.uk/advice/technical-advice-notes

United Nations Office for Disaster Risk Reduction, Sendai Framework for Disaster Risk Reduction (2015)
https://www.undrr.org/implementing-sendai-framework/what-sendai-framework

U.S. General Services Administration, Preservation Tools and Resources
https://www.gsa.gov/real-estate/historic-preservation/historic-preservation-policy-tools/preservation-tools-and-resources

OBO's Office of Cultural Heritage Resources for Heritage Properties, available at:
https://usdos.sharepoint.com/sites/OBO-CH
https://oboculturalheritage.state.gov

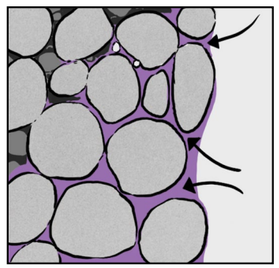
ALLOY: in metals such as copper, a solid mixture of two or more metallic elements

ANCHORING: securing materials to a substrate to maintain stability

BIOFILM: staining or discoloration caused by the presence of fungi, algae, lichens, or other plant material often found on porous outdoor surfaces; a biocide is commonly used to treat

BRICK: a rectangular unit made of dried or fired clay, sand, iron oxides, and other components

BUILDING ENVELOPE: the exterior components and systems comprising a building's enclosure, including the walls, roofing, and fenestration



◄ **CAPILLARY ACTION:** the movement of liquid, typically water, through the pores and capillaries of a solid surface caused by the attraction of the liquid molecules to each other and to the solid material

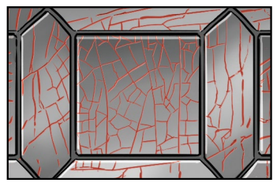
CARBONATION: a reduction in the pH of concrete caused by atmospheric carbon dioxide reacting with calcium hydroxide in cement paste to form calcium carbonate

CEMENTITIOUS MORTAR: a mortar that is bound by cement

CHARACTER-DEFINING: prominent or distinctive attributes, features, or elements that contribute to the physical character of a place and its significance

COMPRESSION: forces pushing on an object from all sides, resulting in the object getting smaller (opposite of **TENSION**)

CONSOLIDATION: applying a chemical binding agent to a porous substrate like wood, masonry, or concrete to reestablish cohesion between friable fibers or grains



CONTROL JOINT/EXPANSION JOINT: a designated gap in construction materials or systems that allows for movement and volumetric changes

CORROSION: the degradation of metal due to reactions with its environment resulting in a more stable oxide (like rust); acids, bases, and salts can accelerate reactions

◄ **CRAZING:** a network of numerous, irregular, thin superficial cracks producing a crackled or hazy appearance

CURING: a physical or chemical change that occurs in a material to produce a finished product

DEFLECTION: the natural vertical or horizontal displacement of a spanning structural member under a load

DEFORMATION: permanent displacement of a material or system due to an imposed force or action

DELAMINATION: the separation, peeling, scaling, or loss of layers often resulting from weathering and exfoliation along the bedding planes of sedimentary stones

◄ **DIFFERENTIAL SETTLEMENT:** permanent displacement of a building commonly due to poor underlying soils, excessive applied stresses, or deterioration to foundations, often resulting in floor and wall movement and cracking

DISAGGREGATION: the breakdown of a material into smaller fragments and grains, sometimes referred to as sugaring

DISPLACEMENT: temporary or permanent movement of an element from a preexisting position, typically due to stresses from loading or environmental fluctuations

DISTEMPER: historically used water-based paint composed of pigments typically bound with animal glue or casein, a protein found in milk

DRY CLEANING: cleaning that does not involve a liquid, such as dusting or vacuuming

DUTCHMAN: commonly used in wood and stone, a repair method that replaces a small ► area of damage by cutting it out and replacing with a matched material

EFFLORESCENCE: white powdery or crusty salts occurring on the surface of a porous material as a result of salts solubilizing in water, migrating through pores, and then the water evaporating

ELASTOMERIC: containing elastomers, or synthetic polymers with elastic properties similar to rubber

EXFOLIATION: similar to delamination, a term often used to describe peeling, flaking, or sloughing of natural stone often along bedding planes

EXTRUSION: the process of moving a material through a mold to form a shape over a continuous length

FACADE: exterior face of a building, often referring to its architectural front

FENESTRATION: the arrangement of windows and doors on the exterior faces of a building

FERROUS: containing iron

FILLS: a type of repair, often cosmetic, that includes patching or using materials to fill cracks, voids, or other losses to make them flush with the surrounding surface

FLASHING: thin, impervious sheets of material, usually metal, placed at junctions where building components meet at differing angles, used to facilitate drainage and prevent water penetration

FRIABILITY: the quality of a material being friable, or crumbly and powdery ►

FRIEZE: the central band of a classical entablature or a decorative band in a stringcourse

FRESCO: a mural painted into fresh, still wet lime plaster

GALVANIC CORROSION: an electrochemical reaction between two dissimilar metals in which one corrodes preferentially in the presence of an electrolyte, usually water

GALVANIZED: a metal, often ferrous, having a sacrificial layer of zinc applied to protect it from corrosion

GILDING: a decorative finish of metallic leaf, often gold, applied to a metal, wood, ► or other material

HERITAGE BUILDING/HERITAGE PROPERTY: a structure or site with historical, cultural, natural, educational, or artistic significance

I-BEAM: a beam, most often metal, that in cross section looks like a capital "I" and provides tension and compression forces needed to resist bending across distances

IMPERMEABLE COATING: an applied membrane that prevents moisture, either liquid or vapor, from passing through

INCOMPATIBLE INTERVENTION: attempted repairs or alterations using inappropriate or unsuitable methods or materials that potentially cause damage

IN-KIND REPAIR: treatment of damage or deterioration using materials and methods of the same type and quality of the original

INTERFACE: where two or more pieces abut and may be joined mechanically or chemically

◄ **LATH:** a surface, often made of strips of wood or expanded metal mesh, onto which plaster can be applied to form a mechanical connection

LIMEWASH: also called whitewash; a traditional paint made principally of water and slaked lime

LINTEL: a structural beam supporting masonry, typically over an opening in a wall such as a window or door

LOAD: a force applied to a building's structure either permanently (dead load) or transiently (live load)

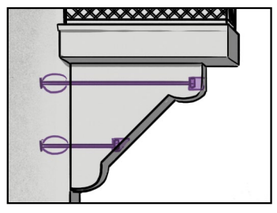
MALLEABLE: the ability of a material, often a metal, to be worked, hammered, or pressed into shape

MATERIAL PROPERTIES: intrinsic characteristics of a substance—such as density, melting point, hardness, color, conductivity—that inform its behavior

MASONRY: a construction assembly utilizing individual units commonly made of clay, stone, or concrete

MECHANICAL: a physical, rather than chemical, connection or cleaning method

MECHANICAL PROPERTIES: characteristics of a material under applied stress, including its resistance to tension or compression, its flexibility or stiffness, malleability, brittleness, and hardness



◄ **MECHANICAL ANCHORS:** embedded connections within a substrate using physical rather than chemical adhesion

MINIMAL INTERVENTION: a tenet of contemporary Western conservation theory that promotes minimal interference in the physical treatment of materials and the use of preventive conservation measures for preservation

MORTAR: often a mixture of lime or cement, sand, and water that sets to form a hard solid material; mortar joints, the space between masonry units such as bricks or stones that are filled with mortar, help walls breathe and are intended to be replaced periodically to preserve the masonry units

ORIENTATION: the direction or position of the bedding planes or foliation formed by layers of sedimentation in sedimentary and metamorphic stones

OXIDATION: a degradation process in which a material chemically reacts with oxygen to form an oxide; oxidation reactions often form a deposit or discoloration on the surface of a material such as metal

PARAPET: an extension of an exterior or interior wall above or through the roof

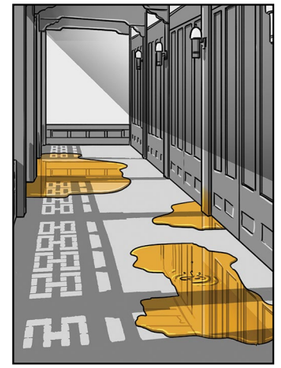
PASSIVATING: a chemical treatment that renders a material, often metal, inert to increase its corrosion resistance; rust conversion is a form of passivation that involves chemically treating rust to convert iron oxides into a more stable compound

PATCHING: a discrete repair that involves filling a loss in a substrate with a compatible material

PATINA: the accumulated surface layer on a material formed by aging, wear, chemical reactions (oxidation), or biological activity; it can be protective and aesthetic, reflecting history and authenticity

PINNING: a method of joining two or more objects or systems together with dowels, usually to provide stability

PONDING: the accumulation of standing water on horizontal surfaces of buildings such as flat roofs or terraces because of improper or clogged drainage ►



PORTLAND CEMENT: a modern hydraulic cement of high compressive strength, high stiffness, and low permeability that is too hard for use with historic masonry and is prone to damaging it

POROUS/POROSITY: having microscopic spaces or voids through which air or liquid can pass

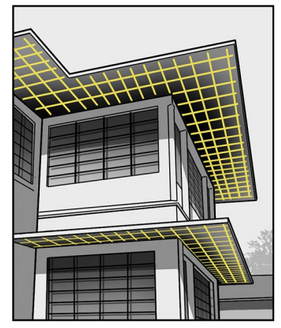
POULTICE: an absorbent, often pasty substance moistened with water or a specific solution and applied to a substrate for the purpose of cleaning, such as for stain or accretion removal

PPE (PERSONAL PROTECTIVE EQUIPMENT): safety equipment utilized by all workers to reduce exposure to injuries and exposures to damaging environments, including hard hats, safety glasses, ear protection, masks or respirators, gloves, reflective vests, and harnesses ►

PREVENTATIVE (PREVENTIVE) CARE/MAINTENANCE: measures and actions aimed at avoiding or minimizing future deterioration; preventive care typically includes indirect measures such as environmental or risk management

RACKING: the permanent deformation of a building out of vertical plumbness—i.e., a lean—usually a result of loss of stiffness or damage to a lateral force-resisting system in an earthquake or high wind event

REBAR: a reinforcement rod, commonly of steel and round, inserted into plain concrete to improve its tensile, shear, compressive, and bending capabilities ►



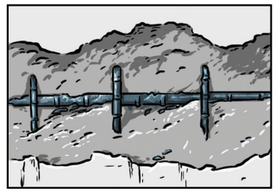
REINFORCED CONCRETE: a composite material utilized globally since the 19th century that combines the compressive strength of plain concrete and the tensile strength of embedded steel reinforcement (typically round bars or mesh)

RELATIVE HUMIDITY: the amount of water in the air relative to the ambient temperature

REPOINTING: removing and replacing deteriorated mortar in masonry joints

RESIN: an amorphous organic material, either naturally derived (like rosin and shellac) or synthetic (such as acrylic, epoxy, and other polymers); when cured, forms a rigid solid used in coatings, adhesives, and plastics

RETAINING WALL: a wall that supports an unbalanced level of soil on either side, relying on its own weight—sometimes combined with the soil weight or additional supports—to resist overturning and sliding

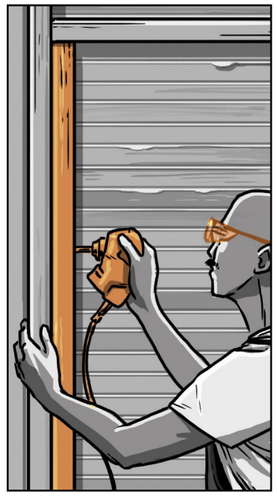


RISING DAMP: the upward rise of moisture within a porous building material, often starting in basements or at grade (see **CAPILLARY ACTION**)

ROUTINE MAINTENANCE: performing regular, recurring, preventative hands-on activities to maintain performance and extend life cycles of materials and systems

◀ **RUST JACKING:** the expansion of corrosion of a ferrous element; if embedded, the increase in volume can exert significant stresses, often resulting in cracking and displacement of the surrounding material

SCARF: a joinery method that commonly marries two shorter pieces end to end to form a longer member; used to repair damaged timbers while keeping existing sound material in place



SCUPPER: an opening through a parapet that drains water from a horizontal surface, such as a roof or deck, to the exterior of a structure, preventing ponding

SEISMIC BEHAVIOR: the response of a structure to earthquakes

SETTLEMENT: the downward vertical movement of soil or the ground surface, typically because of increases in applied stress or softening of soils due to exposure to moisture or deterioration to foundation systems

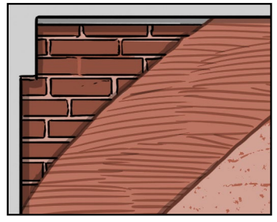
SGRAFFITO: a decorative technique where a surface is scratched through to reveal a different color layer underneath

◀ **SISTER:** the marrying of two or more timber structural members to increase cross-sectional area, strength, and stiffness

SPALLING: detachment of irregular-size fragments from stone, brick, or concrete, often induced by freeze-thaw action, salts, or corrosion of embedded metal

SPLICE: the marrying of two or more timber structural members similar to a sister, but shorter in length; used to address a deficiency locally and without significant strength or stiffness increases

STRUCTURAL REPAIR: a repair that addresses deterioration and deficiencies to the vertical and lateral load carrying elements of a construction above and below grade, such as the exterior walls, columns, beams, and roof and floor framing



◀ **SUBSTRATE:** the base material upon which another material is applied or built

TENSION: the act or force of pulling an object away from another or itself (opposite of **COMPRESSION**)

THERMAL CYCLING: the repeated processes of exposure to temperature extremes throughout the life cycle of a material or system; resulting expansion and contraction can induce stresses, often leading to cracking or buckling of brittle and or stiff materials

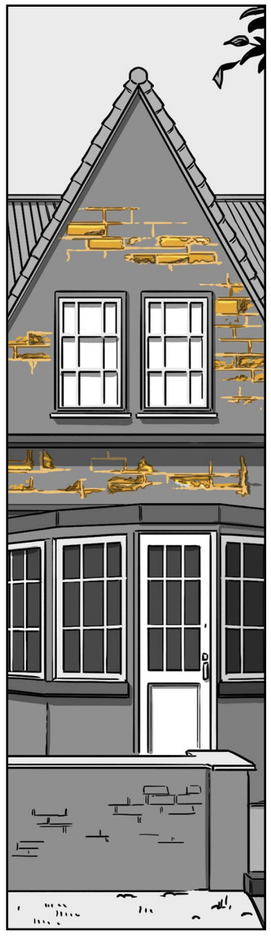
VITRIFY/VITREOUS: to convert something into a glassy substance typically with exposure to heat; vitreous is a descriptive term for materials with glasslike characteristics in their appearance or composition

VOLUMETRIC EXPANSION: see **RUST JACKING**

WATER SENSITIVE: describes a substance that can react with water

WATER SOLUBLE: describes a substance that can be dissolved in water

WYTHE: a section of wall construction measuring one masonry unit thick



INCLUDED IN *CAUSES OF DAMAGE TO BUILDINGS*

U.S. Embassy Havana Chancery, 1953, Havana, Cuba. Designed by Harrison & Abramovitz.

◀ ***Staff Residence, The Hague***, 1921, The Hague, Netherlands. Designed by F. de Bock.

U.S. Embassy Athens Chancery, 1961, Athens, Greece. Designed by Walter Gropius and partners at The Architects Collaborative.

U.S. Embassy Cairo Deputy Chief of Mission Residence, Villa Alaili Bey, 1925, Cairo, Egypt. Designed by Michel Liberman.

U.S. Embassy Lisbon Ambassador's Residence, Casa Carlucci, 1861, Lisbon, Portugal.

U.S. Embassy Pretoria Deputy Chief of Mission Residence, 1945, Pretoria, South Africa.

Mitsui Housing Compound, 1981, Tokyo, Japan. Designed by Harry Weese & Associates.

U.S. Embassy Helsinki Ambassador's Residence, 1940, Helsinki, Finland. Designed by Harrie T. Lindbergh.

U.S. Embassy Seoul Ambassador's Residence, Habib House, 1976, Seoul, South Korea. Designed by Zo Zayong, Shin Young Hun, and Stuart L. Knoop.

INCLUDED IN *CLEANING METHODS AND CONSIDERATIONS*

U.S. Embassy Valetta Ambassador's Residence, Villa Apap Bologna, 1894, Attard, Malta.

Tangier Old Legation, gifted to the United States in 1821, Tangier, Morocco.

Grand Staircase in the Mel Sembler Building, U.S. Embassy to the Holy See, 1924, Rome, Italy. Designed by Ugo Giovannozzi.

U.S. Embassy Algiers Deputy Chief of Mission Residence, Villa Oued El Kilai, ca. 1700, Algiers, Algeria.

U.S. Embassy Tokyo Ambassador's Residence, 1930, Tokyo, Japan. Designed by Harold Van Buren Magonigle and Antonin Raymond.

U.S. Embassy Seoul Ambassador's Residence, Habib House, 1976, Seoul, South Korea. Designed by Zo Zayong, Shin Young Hun, and Stuart L. Knoop.

U.S. Embassy Vienna Chancery, 1903, Vienna, Austria. Designed by Ludwig Baumann.

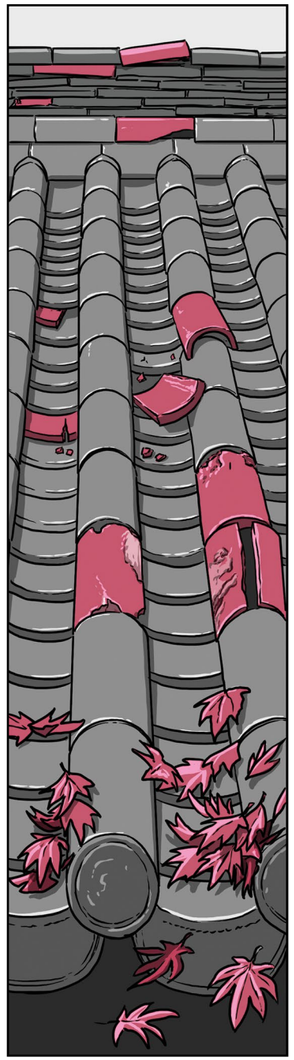
U.S. Embassy Havana Ambassador's Residence, 1941, Havana, Cuba. Designed by Paul Franz Jaquet, Leland W. King Jr., and Frederick Larkin for U.S. Department of State Office of Foreign Buildings Operations.

INCLUDED IN *BUILDING ENVELOPES*

U.S. Embassy Pretoria Ambassador's Residence, Hill House, 1940, Pretoria, South Africa. Design attributed to Vivian Rees-Poole.

U.S. Embassy Paris Ambassador's Residence, 1852, Paris, France. Designed by Louis Tullius Joachim Visconti and Félix Langlais.

U.S. Embassy Oslo Ambassador's Residence, Villa Otium, 1911, Oslo, Norway. Designed by Henrik Bull.



U.S. Embassy Dublin Chancery, 1964, Dublin, Ireland. Designed by John Johansen and Michael Scott.

U.S. Embassy Copenhagen Ambassador's Residence, 1885, Copenhagen, Denmark. Designed by J. Vilhelm Petersen.

U.S. Embassy Pretoria Deputy Chief of Mission Residence, 1945, Pretoria, South Africa.

Staff Residence, The Hague, 1921, The Hague, Netherlands. Designed by F. de Bock.

◀ ***Seoul Old American Legation***, 1883, Seoul, South Korea.

Rangoon Teak House, U.S. Embassy Rangoon Chancery Annex Office Building, 1933, Rangoon, Burma (Yangon, Myanmar).

U.S. Consulate General Quebec and Consul General Residence, 1949, Quebec, Canada. Designed by Mathers & Haldenby.

Gilded Chinese lacquer panels in the Pontalba Salon at the U.S. Embassy Paris Ambassador's Residence, early 18th century. Salvaged from the Hôtel D'Havre and installed in the Hôtel de Pontalba, 1852-1876. Paris Cultural Heritage Collection.

Murals by Darius Vilas i Fernandez, ca. 1920, at Torre Godó Eguia, U.S. Consulate General Barcelona. Barcelona Cultural Heritage Collection.

U.S. Embassy Algiers Deputy Chief of Mission Residence, Villa Oued El Kilai, ca. 1700, Algiers, Algeria.

U.S. Embassy Helsinki Ambassador's Residence, 1940, Helsinki, Finland. Designed by Harrie T. Lindeberg.

INCLUDED IN *BUILDING MATERIALS: AN INTRODUCTION*

U.S. Embassy Bratislava Chancery Annex Office Building, Bratislava, Slovakia.

U.S. Embassy Bangkok Sala Thai and Royal Sala Pavilions, 1951 (reconstructed 2010), Bangkok, Thailand.

U.S. Embassy Cairo Chancery, 1989, Cairo, Egypt. Designed by Andre F. Houston.

Former U.S. Embassy Colombo Chancery, 1984, Colombo, Sri Lanka. Designed by Victor Lundy. Demolished 2023.

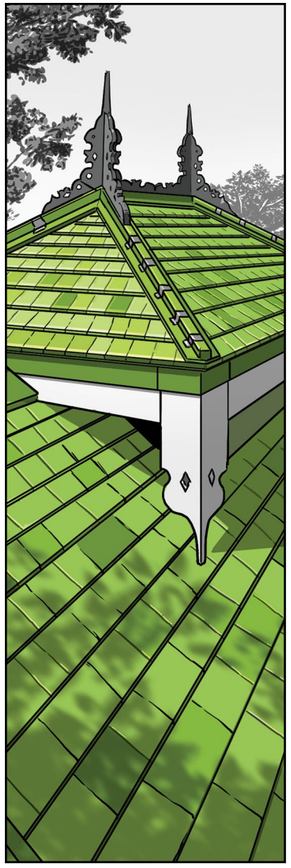
U.S. Embassy Rome Chancery, Palazzo Margherita, 1886, Rome, Italy. Designed by Gaetano Koch for Prince Boncompagni Ludovisi.

Rangoon Teak House, U.S. Embassy Rangoon Chancery Annex Office Building, 1933, Rangoon, Burma (Yangon, Myanmar).

U.S. Embassy Athens Chancery, 1961, Athens, Greece. Designed by Walter Gropius and partners at The Architects Collaborative.

Regency-style boiserie, ca. 18th century, in the library of Villa Petschek, U.S. Embassy Prague Ambassador's Residence. Prague Cultural Heritage Collection.

U.S. Embassy Montevideo Chancery, 1969, Montevideo, Uruguay. Designed by I.M. Pei.



INCLUDED IN *WOOD*

◀ ***Rangoon Teak House, U.S. Embassy Rangoon Chancery Annex Office Building***, 1933, Rangoon, Burma (Yangon, Myanmar).

Tea Room, U.S. Embassy Tokyo Ambassador's Residence, 1930, Tokyo, Japan. Designed by Harold Van Buren Magonigle and Antonin Raymond.

U.S. Embassy Lima Ambassador's Residence, 1945, Lima, Peru. Designed by Paul Franz Jaquet and Leland W. King Jr. for U.S. Department of State Office of Foreign Buildings Operations.

Library at Villa Petschek, U.S. Embassy Prague Ambassador's Residence, 1929, Prague, Czechia. Designed by Max Spielmann and Alfred Breslauer.

Spanish decorative pine ceiling in Byne House, early 18th century, U.S. Embassy Madrid Deputy Chief of Mission Residence. Madrid Cultural Heritage Collection.

Gilded Chinese lacquer panels in the Pontalba Salon at the U.S. Embassy Paris Ambassador's Residence, early 18th century. Salvaged from the Hôtel D'Havre and installed in the Hôtel de Pontalba, 1852-1876. Paris Cultural Heritage Collection.

U.S. Embassy Bangkok Royal Sala, 1951 (reconstructed 2010), Bangkok, Thailand.

Ballroom at Palacio Bosch, U.S. Embassy Buenos Aires Ambassador's Residence, 1912, Buenos Aires, Argentina. Designed by René Sergent.

INCLUDED IN *METALS*

Spiral staircase in the Rathausstrasse Apartments, 1882, Vienna, Austria.

U.S. Embassy Oslo Ambassador's Residence, Villa Otium, 1911, Oslo, Norway. Designed by Henrik Bull.

U.S. Embassy Madrid Deputy Chief of Mission Residence, Byne House, 1885, Madrid, Spain.

Bronze door at Villa Åkerlund, U.S. Embassy Stockholm Ambassador's Residence, 1930, Stockholm, Sweden. Designed by Knut Perno.

Bronze door lock in the shape of a fish at the Seoul Old American Legation, 1883, Seoul, South Korea.

Decorative window grilles at the U.S. Embassy Tokyo Ambassador's Residence, 1930, Tokyo, Japan. Designed by Harold Van Buren Magonigle and Antonin Raymond.

INCLUDED IN *MORTARS, RENDERS, AND PLASTERS*

U.S. Embassy Algiers Deputy Chief of Mission Residence, Villa Oued El Kilai, ca. 1700, Algiers, Algeria.

U.S. Embassy Ljubljana Chancery, 1897, Ljubljana, Slovenia. Designed by Alfred Bayer.

Plasterwork in the entryway of the Rathausstrasse Apartments, 1882, Vienna, Austria.

Louis XVI Salon at the U.S. Embassy Paris Ambassador's Residence, 1852, Paris, France. Designed by Louis Tullius Joachim Visconti and Félix Langlais.

INCLUDED IN *STONE*

George C. Marshall Center, Hôtel de Talleyrand, 1769, Paris, France.

U.S. Embassy Belgrade Deputy Chief of Mission Residence, 1934, Belgrade, Serbia. Designed by Grigorije Samojlov.

Grand Staircase in the Mel Sembler Building, U.S. Embassy to the Holy See, 1924, Rome, Italy. Designed by Ugo Giovannozzi.

◀ ***The American Cemetery***, Tripoli, Libya.

Limestone and verde antico marble fireplace surround at Byne House, ca. 1617, U.S. Embassy Madrid Deputy Chief of Mission Residence. Madrid Cultural Heritage Collection.

U.S. Embassy Baku Chancery, 1912, Baku, Azerbaijan. Designed by A. Polyakov.

U.S. Embassy Buenos Aires Ambassador's Residence, Palacio Bosch, 1912, Buenos Aires, Argentina. Designed by René Sergent.

INCLUDED IN *BRICK AND ARCHITECTURAL CERAMICS*

Delft tile fireplace surround at Van Heukelom House, date unknown, U.S. Consulate General Amsterdam, 1913, Amsterdam, Netherlands.

Glazed Ottoman-period tiles at Villa Montfeld, U.S. Embassy Algiers Ambassador's Residence, 1863, Algiers, Algeria.

Glazed azulejos adorning the Lion Fountain, 18th century, at the U.S. Embassy Lisbon Chancery. Lisbon Cultural Heritage Collection.

U.S. Embassy Copenhagen Ambassador's Residence, 1885, Copenhagen, Denmark. Designed by J. Vilhelm Petersen.

U.S. Embassy Pretoria Deputy Chief of Mission Residence, 1945, Pretoria, South Africa.

Swimming pool mosaic by Vicente Manansala, 1965, at the U.S. Embassy Manila Ambassador's Residence. Manila Cultural Heritage Collection.

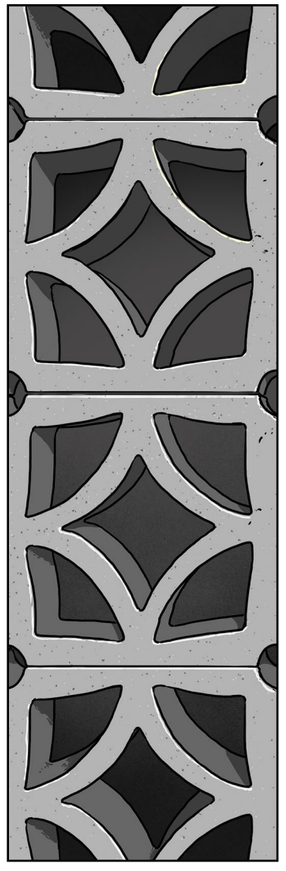
Mosaic tile floor depicting Neptune in Villa Oued El Kilai, date unknown, U.S. Embassy Algiers Deputy Chief of Mission Residence, Algiers, Algeria.

Glazed tile floors at the U.S. Consulate General Naples and Consul General Residence, 1953, Naples, Italy. Designed by George Howe and Mario De Renzi.

U.S. Consulate General Quebec and Consul General Residence, 1949, Quebec, Canada. Designed by Mathers & Haldenby.

Delft tiled stove at Villa Åkerlund, early 18th century, U.S. Embassy Stockholm Ambassador's Residence. Stockholm Cultural Heritage Collection.

Tangier Old Legation, gifted to the United States in 1821, Tangier, Morocco.



INCLUDED IN *CONCRETE*

U.S. Consul General Residence Casablanca, Villa Mirador, 1935, Casablanca, Morocco. Designed by Jean Balois.

U.S. Embassy Dublin Chancery, 1964, Dublin, Ireland. Designed by John Johansen and Michael Scott.

Former U.S. Embassy Colombo Chancery, 1984, Colombo, Sri Lanka. Designed by Victor Lundy. Demolished 2023.

U.S. Embassy Athens Chancery, 1961, Athens, Greece. Designed by Walter Gropius and partners at The Architects Collaborative.

U.S. Embassy Panama Ambassador's Residence, 1943, Panama City, Panama. Designed by Paul Franz Jaquet for U.S. Department of State Office of Foreign Buildings Operations.

Stair Hall at the U.S. Embassy Madrid Ambassador's Residence, 1955, Madrid, Spain. Designed by Alan Jacobs with Garrigues & Middlehurst.

U.S. Embassy Lisbon Chancery, 1979, Lisbon, Portugal. Designed by Fred Bassetti and Company.

◀ ***Breeze-block screen wall at Roosevelt House, U.S. Embassy New Delhi Ambassador's Residence***, 1962, New Delhi, India. Designed by Edward Durrell Stone.

U.S. Embassy Montevideo Chancery, 1969, Montevideo, Uruguay. Designed by I.M. Pei.

U.S. Consulate General Fukuoka, 1960, Fukuoka, Japan. Designed by George T. Rockrise with Clark & Beuttler (Associated Architects).

INCLUDED IN *PAINTS, COATINGS, AND FINISHES*

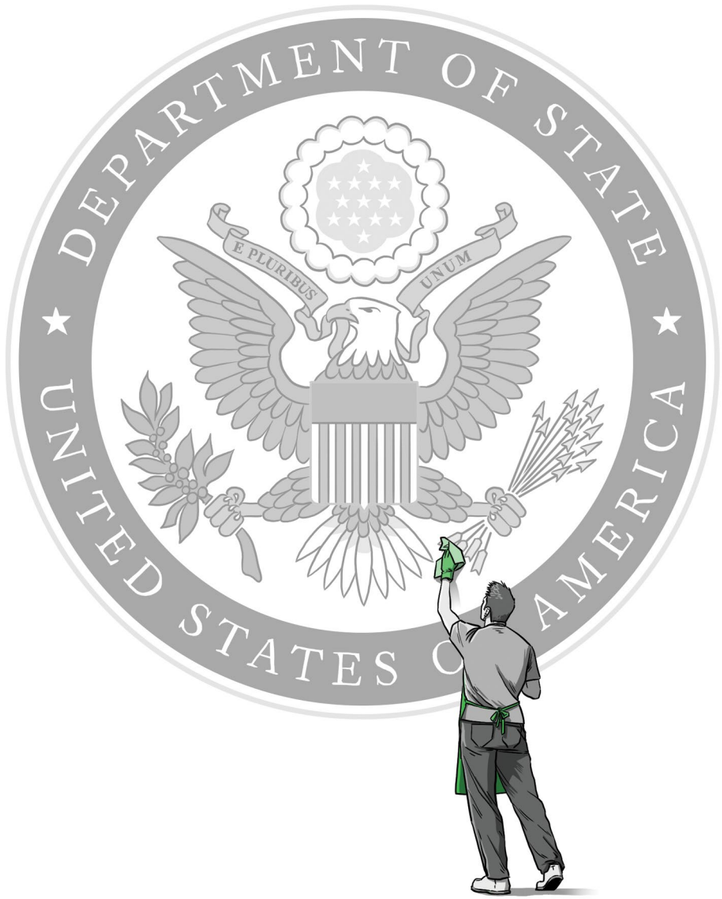
Marouflage ceiling mural in the Stair Hall at Villa Åkerlund by artist Kurt Jungstedt, ca. 1930, U.S. Embassy Stockholm Ambassador's Residence. Stockholm Cultural Heritage Collection.

Spanish decorative pine ceiling in Byne House, early 18th century, U.S. Embassy Madrid Deputy Chief of Mission Residence. Madrid Cultural Heritage Collection.

Murals by Darius Vilas i Fernandez, ca. 1920, at Torre Godó Eguia, U.S. Consulate General Barcelona. Barcelona Cultural Heritage Collection.

Gilded Chinese lacquer panels in the Pontalba Salon at the U.S. Embassy Paris Ambassador's Residence, early 18th century. Salvaged from the Hôtel D'Havre and installed in the Hôtel de Pontalba, 1852-1876. Paris Cultural Heritage Collection.

Chinese hand-painted wallpaper, mid-18th century, at Winfield House, U.S. Embassy London. London Cultural Heritage Collection.



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