Slide 1: Welcome
Thank you for your interest in Identifying Surface Defects on Concrete Slabs. When White Cap customers come in for repair materials, it’s important that we know what defects are, what causes them, and how – or if – the defect can be repaired.

Slide 2: Course Instructions
Before we begin, let me point out a few features.

On the left, you’ll see two tabs. Use the Notes tab to follow this narration. Click on the Outline tab to track your progress through this course. You can click on a section or page to navigate back to it.

On the top right, you’ll see Attachments and Exit. Click on Attachments to download additional resources for this program. Click on Exit to leave this program at any time. Your progress through the course will be saved. When you open the course again, you’ll start at the slide you last completed.

On the bottom there are three buttons: the Play/Pause button and the Forward and Backward buttons. Use the Play or Forward buttons to advance to the next page. Use the Backward button to go back to a previous page. Use the Pause button to pause the program briefly if you need to stop to take a note, for example, and click Pause again to resume the program.

Please note that you cannot skip sections of this program. You must view them in order. You will not be able to advance until you have completed each page.

Click the Play or Forward button to advance to the next page. As you progress through the course, you’ll know you can advance when the Play/Pause button blinks light blue and the narration has ended.

Slide 3: Connection Recommendations
To ensure a successful connection throughout the program, we recommend that you:

- Use one of the following recommended web browsers: Microsoft Internet Explorer 7 or Microsoft Internet Explorer 8.
- Use a wired broadband connection.
- Keep ALL windows associated with the course open while completing the course. If a window in your browser opens during the process of starting the course, then leave it open.
- Close all other programs.
Slide 4: Course Agenda
This course is separated into the three sections shown. Each section will walk you through common surface defects, how they are caused, and how – or if – they can be repaired. We recommend you take notes while viewing this presentation. This will help you learn and remember the information presented.

After each section, there will be a short learning check, or assessment. You’ll have to pass the assessment before advancing to the next section.

Slide 5: Learning Objectives
This program will help you properly question customers about defects so that you can identify and offer a repair solution, if possible. By the end of this course, you will be able to:
1. Identify and describe eight common surface defects found on concrete slabs.
2. Describe the basic concept of joints and the common cracking patterns that happen at joints.
3. Describe how weather conditions relate to defects and be able to suggest proper repair materials.

SECTION 1: COMMON SURFACE DEFECTS FOUND ON CONCRETE SLABS

Slide 6
Surface defects are non-structural imperfections that occur on hardened concrete slabs. Defects occur in the upper portion of the slab. Most surface defects are related to problems with the mix design or a poor finishing technique.

Slide 7: Popouts
The American Concrete Institute (ACI) defines popouts as the deformation caused when small portions break away from a concrete surface due to a localized internal pressure. The pressure results from clay or stones absorbing water and expanding, causing them to pop out from the concrete, leaving shallow depressions. Popouts commonly have some source of the stone or clay particle in the depression.

Often, expansion occurs in freezing temperatures as water in concrete expands into ice crystals. Popouts can become severe on concrete surfaces that experience numerous freeze-thaw cycles. A freeze-thaw cycle is the period during which the concrete temperature falls below and rises above 32 degrees Fahrenheit.

Popouts are typically cosmetic with little effect on a slab’s strength or durability. Since the problem is caused when aggregates absorb water, the concrete producer is often to blame for this deformation. The producer is responsible for creating a mix design that contains durable aggregates.

How contractors repair popouts will depend on the severity of the problem. If the popouts are isolated deformations or very widely scattered, they can be easily patched. Contractors first remove the remaining portion and any loose concrete. They then refill the depression with cement mortar or an epoxy patching mixture.

When a concrete slab has numerous, closely positioned popouts, the contractor may opt to treat the slab’s surface, rather than repairing individual deformations. After removing the popout’s stone remnants and any weakened surface concrete, they place a thin, bonded concrete overlay. White Cap carries the supplies necessary for both repair options.

Slide 8: Discoloration
ACI defines concrete discoloration as a departure of color from that which is normal or desired. Listed below are a few of the more common discoloration issues. We’ll explain each of these in greater detail so that you can question contractors about their specific problem, help identify the cause, and offer a possible solution (if there is one).
Slide 9: Discoloration
Contractors often notice discoloration in recently placed concrete. These variations occur in different batches due to a change in the mix design. Different ratios of sand to aggregate, changing moisture content, or different aggregate or cement source, can cause discoloration.

The number-one culprit for discoloration of concrete from one truckload to the next is the water-to-cement ratio. Simply put, a change in the amount of water from one load to the next creates different shades of colors in fresh concrete.

Slide 10: Discoloration
Contractors can cause slab discoloration during finishing activities. Often, discoloration is caused during troweling. The concrete surface will often appear lighter along the edges and hard-to-reach areas where hand troweling took place, and darker in areas where power trowels were used.

Discoloration due to batch variation and finishing often becomes less pronounced as the concrete cures and bleaches in direct sunlight. If the problem persists, there are some penetrating sealers that when applied to a hardened concrete will slightly alter the surface color. However, cracks, or any other surface flaws will not be masked.

Slide 11: Calcium Chloride
Calcium chloride is an admixture contractors use in late fall, winter, or early spring when the temperatures are near or below freezing to shorten set time. Discoloration resulting from calcium chloride most often appears as a mottled surface color, such as light spots on a dark surface.

The discoloration is caused by bleed water that carries calcium chloride to the surface during the curing process. Large aggregate particles near the surface block the bleed water’s movement to the surface, creating lighter spots on the surface of the concrete.

Slide 12: Calcium Chloride
Contractors can mitigate discoloration from calcium chloride. One method is to scrub and rinse the affected area with water. This may not completely remove the different shades of colors, but often improves the slab’s overall appearance.

Slide 13: Calcium Chloride
Contractors can also mitigate calcium chloride discoloration by using a diluted muriatic acid solution; normally about a 1 percent concentration. The solution is poured onto the surface and left to soak. If the discoloration is extreme, the surface can be scrubbed with the acid solution. It’s important to remind contractors to rinse the slab prior to using an acid-based solution and hose it off within 15 minutes of the solution’s application.

Slide 14: Rust Staining
You’ve probably seen rust-stained concrete on bridges or roadways. But have you ever wondered what causes rust staining in concrete?

There are a few factors responsible for the rust staining on concrete surfaces. When reinforcement is placed too close to the surface, bleed water can oxidize the steel reinforcement. When the water dries on the surface, it leaves behind a rust-like discoloration. This cause is usually easy to identify by the patterns of the rust stain mirroring the steel placement within the slab.

Slide 15: Rust Staining
Wire ties left protruding too high above the wire or rebar can be another cause of rust stains. If there is steel in the slab, and calcium chloride was used when the concrete was placed, far worse implications result because of the corrosive effects of calcium chloride on steel.
Slide 16: Rust Staining
Another source for rust staining could be the aggregates. Some coarse and fine aggregates contain forms of iron that oxidize when exposed to water, leaving rust stains. As the aggregate oxidizes, it commonly dissolves, leaving a popout-like depression on the concrete surface. Contractors can adopt the same patching procedure as previously described for popouts.

Slide 17: Rust Staining
Normally, this discoloration is not a serious concern. Contractors can try to mitigate this type of staining by applying sealers to the concrete that restrict water evaporation. But, if the concrete starts to peel from the reinforcement, contractors should consult an engineer to determine the potential for structural damage.

Slide 18: Lignite Coloring
Lignite is a type of coal, often brown or black in color. Small lignite particles are intermixed in many river sand sources, especially those from rivers in Midwest regions of the U.S. During placing, workers draw lignite particles to the slab’s surface through vibration. Lignite is lighter in weight than the sand, and the vibration causes the coal to settle in the slab’s upper surface.

Slide 19: Lignite Coloring
When the lignite comprises very fine particles, the lignite discoloration most often appears as a salt-and-pepper look on the slab. The best solution is often the application of a coating or tinted sealer to hide the effect. When the lignite is more lump-like, contractors should treat the discoloration like they would a popout.

Slide 20: Blistering
ACI defines blistering as the irregular raising of a thin layer at the surface of a placed cementitious mixture during, or soon after, completion of the finishing operation. Simply put, concrete blisters result from prematurely finishing the slab’s surface. This action traps bleed water and air bubbles immediately below the surface of the slab. Depending on the severity, there can be a few or many bumps on the surface of the concrete.

When discussing this defect, ask the contractor some questions about the concrete placement to help identify the cause, such as:

- Was the concrete placed in the spring or fall when the ground could have been frozen or very cold?
- Did the concrete mix contain air-entraining admixtures?
- Was the slab steel-troweled?

Contractors should take some precautions to ensure the bleed water and escaping air has had ample opportunity to escape the surface of the concrete before finishing. These include, never steel troweling air entrained concrete, adopting proper vibration procedures, and delaying finishing as long as possible.

Repair of a concrete slab suffering from blisters is for cosmetic purposes. When blistering is confined to a localized area, contractors can often scrape off the loosened material and apply a simple patch.

When blistering affects a large area, contractors often sandblast, shot blast, or jet wash the surface. During this operation, contractors should be sure to wear the appropriate safety gear, such as glasses, gloves, and protective clothing.

When the surface is properly prepared, it is covered with an overlay or coating, extending to the unaffected area. An alternative method would be to cover the surface with a stain or coating. White Cap carries the necessary supplies and equipment to do the job.
Slide 21: Dusting
ACI defines dusting as the development of a powdered material at the surface of hardened concrete. Dusting is easily identified. It looks like chalky, powdery dust on the surface of the concrete. Efforts to sweep off the residue don’t work, since the broom’s scraping action breaks away material from the slab’s weakened surface.

Dusting is most commonly caused by premature finishing of a concrete surface. It’s too soon to finish the surface while there is water present on the surface or before the bleed water and air has escaped the concrete. Premature finishing creates a hardened upper crust with a high water-to-cement ratio and reduced compressive strength. Other causes of dusting can be from neglect. If the concrete is not properly protected from rain or winds or not properly cured immediately after placement, dusting can result.

Dusting can also result from improper heater ventilation, particularly for interior floors placed in winter. When heaters are not properly vented, enclosed areas can contain high levels of carbon dioxide. The excess CO2 can react with the concrete to carbonate the surface. This weakens the concrete, and can lead to dusting any time after the concrete is placed.

Concrete dusting is a cosmetic issue. Repair most dusting conditions by first removing the loose material and applying a floor hardener or concrete densifier. Both of these products are available in White Cap stores.

Slide 22: Scaling
ACI defines scaling as local flaking or peeling of the near-surface portion of hardened concrete or mortar. Scaling can be easily identified because areas of the slab’s surface appear to have peeled off the remaining concrete. It is such a common defect that engineers have developed guidelines on how to describe the problem.

- Light scaling of concrete describes a problem when the displaced concrete does not expose coarse aggregate;
- Medium scaling involves loss of surface mortar from 5 to 10 mm in depth and exposure of coarse aggregate;
- Severe scaling involves loss of surface mortar from 5 to 10 mm in depth with some loss of mortar surrounding aggregate particles 10 to 20 mm in depth;
- Very severe scaling involves loss of coarse aggregate particles as well as mortar generally to a depth greater than 20 mm.

Slide 23: Scaling
Scaling has many causes. Two common causes related to contractors are:

- Prematurely finishing of fresh concrete while bleed water is still on the surface. The water becomes trapped under the surface, creating a weakened plane that breaks away from the rest of the concrete slab.
- Workers can over-compact the upper crust when finishing concrete, forcing coarse aggregate down into the slab, weakening the upper surface. This poor work practice can also decrease the amount of air voids in the concrete.

Slide 24: Scaling
Sometimes scaling occurs after the concrete was poured as a result of environmental factors.

- Rain on the surface of fresh concrete while it is finished can produce severe scaling.
- Freeze-thaw conditions, deicing salts, and moisture make concrete susceptible to scaling.
- Certain types of lawn fertilizers can cause scaling.

Scaling often occurs within a year of the concrete’s placement. Contractors should be reminded to place a sealer on newly installed concrete after the curing period. And, they should advise owners not to use deicing salts for the first year.
Slide 25: Scaling
This defect, unless it is categorized as very heavy scaling, can be treated as a cosmetic repair. Treatment involves a thorough cleaning of the surface prior to repair. When cleaning the surface for repair it must be free of any foreign material such as oil, paints, or dirt.

The entire weakened and loose surface must be removed prior to applying the overlay. This is especially true when deicing materials caused the scaling. Contractors can either patch or overlay the affected areas with concrete, latex-modified concrete, or a polymer-modified repair mortar.

Slide 26: Scaling
White Cap carries the necessary high-pressure washers and sand blasters to remove the weakened surface. Don’t forget to remind the contractors of the necessity to purchase the required safety supplies needed to operate the repair equipment.

Slide 27: Crazing
ACI defines craze cracks as fine, random cracks or fissures in a concrete surface. Often referred to as crazing, these defects are cosmetic, unsightly, and affect the structural integrity of the concrete. Typically, crazing is most apparent when the surface is slightly wetted.

Crazing most often occurs when contractors place concrete on hot and windy days with low humidity. These conditions cause a rapid evaporation of the water from the concrete’s surface. Proper curing of the slab will promote proper strength gain while preventing rapid evaporation of water from the concrete.

If the proper measures aren’t taken, surface defects can result. Once you determine the defect is crazing, you have an opportunity to explain it was caused by improperly curing the concrete slab.

White Cap carries curing compound, which, when applied shortly after the concrete is placed, will help prevent crazing from occurring. No treatment exists for craze cracks. Some contractors have tried to apply a sealer on the surface to mask the patterns. Others have applied an acid stain that can transform a defect into a decorative floor. The use of evaporation retarders can also help prevent crazing from occurring.

Slide 28: Drying Shrinkage Cracks
Concrete is referred to as being “plastic” when it is setting. When water evaporates from plastic concrete too quickly, it shrinks. This is called plastic shrinkage, and it can cause the concrete to crack before it sets. Plastic shrinkage cracks occur when there’s such a rapid evaporation of water from the slab’s surface that the slab can’t dry as one piece.

A combination of high temperatures, low humidity, and wind causes the surface to lose water faster than it can be replaced by bleed water. Normally, plastic shrinkage cracks parallel one another and aren’t too far apart.

Slide 29: Drying Shrinkage Cracks
Plastic shrinkage is also referred to as drying shrinkage. The best way to prevent shrinkage cracks is to place concrete during optimum weather conditions. Avoid placing concrete at times of high heat, low humidity, and high winds. Early mornings, evenings, or even night pours are recommended when hot conditions exist.

To avoid drying shrinkage:
- Add retarding admixtures to help prevent concrete from setting (and drying) too quickly.
- Set up wind barriers around the pour to minimize air flow over the concrete. Spray a fine mist of water on the slab to reduce the rate of evaporation.
- Add synthetic fibers to the concrete mix to help reduce the possibility of cracking, so long as proper precautions are taken.
- Apply curing compound to the concrete to help slow the evaporation of bleed water.
• Cover the surface with wetted materials that retain moisture, such as burlap or curing blankets. The use of evaporation retards can also help prevent plastic shrinkage.
• Finally, keeping the concrete slab wet for the first few days and following the preceding recommendations will help prevent drying shrinkage cracks.

**Slide 30: Drying Shrinkage Cracks**
When concrete slabs are properly designed and when the reinforcement is properly placed, plastic shrinkage cracks are considered cosmetic in nature. As long as the cracks do not open up or move, contractors can apply a sealer to help improve the floor's appearance.

If a crack does open up, contractors should monitor it to be certain that there's no structural issue. Non-structural open cracks can be filled using proper patching installation techniques and materials.

**Slide 31: Delamination**
ACI defines delamination as a splitting, cracking, or separation of a cementitious material in a plane roughly parallel to, and generally near the surface. Delamination generally affects large areas, and can often only be detected through non-destructive tests such as tapping or dragging a chain across the surface.

Delamination typically occurs when workers prematurely finish the surface, closing voids and sealing bleed water below the surface of the concrete. There are several reasons contractors would accidentally seal concrete too soon. On hot days with low humidity, bleed water evaporates as it reaches the surface. Since the bleed water evaporated, contractors won't see it on the surface and will assume the concrete has set.

Conversely, in late fall and early spring, cool sub-grades slow the set time of concrete. Contractors could wait and wait, but may still seal the concrete prematurely because of the slow set time. In both scenarios, premature finishing seals in water and air just below the surface. The thin top layer hardens and ultimately peels off.

The top eighth of an inch of concrete is made up of fine cement and fine aggregate. Premature sealing prevents bleed water and air from escaping the surface, resulting in delamination of the top one-eighth inch of the surface. A heavy chain or hammer can be used to check the severity of delamination on a slab once it has been discovered. The trick is to listen for a hollow sound. The deeper the resulting sound, the more severe the delamination.

This defect can be repaired. The entire weakened and loose surface must be removed prior to applying the overlay and the surface must be free of any foreign material such as oil, paints, or dirt. Repair strategies may include overlaying concrete, latex-modified concrete, or a polymer-modified repair mortar.

White Cap carries the necessary equipment including shot blasters, high pressure washers and sand blasters to remove the weakened surface. Don't forget to remind the contractors of the necessity to purchase the required safety supplies to operate the repair equipment.

**Slide 32: Section 1 Summary**
Being able to identify different types of concrete defects will instill a confidence in contractors as they work with you to determine how to repair it. White Cap wants you to be confident, too, in suggesting materials to contractors such as curing compounds, curing blankets for covering concrete, overlay materials, equipment necessary to repair the slab, and safety equipment needed to make the repair.
**Slide 33: Section 1 Assessment**
This short assessment will test your knowledge of common defects found on concrete slabs. You must answer eight of 10 questions correctly to advance to Section 2. You will receive feedback after answering each question.

If you do not pass on your first attempt, that's OK. You will be directed to the beginning of the section where you can review the concepts again before re-attempting the assessment. Click Next to begin.

**SECTION 2: NON-STRUCTURAL CRACKS AND HOW THEY ARE RELATED TO JOINTS**

**Slide 34**
Non-structural cracks are very often related to finishing or installation errors. This section will help you identify reasons concrete cracks, how contractors control cracking with joints, and common defects that occur at joints.

**Slide 35**
Concrete may crack for several reasons. Knowing why concrete cracks will help you, as a White Cap associate, address measures to prevent it from cracking and in other cases help you recommend control or repair strategies when it cracks.

**Slide 36: Excess Water**
Excess water in fresh concrete is one of the biggest factors that cause concrete to crack. With too much water in the mix, more water must evaporate, increasing the shrinkage of the concrete.

**Slide 37: Improper Curing**
Improper curing can cause cracking. After applying a curing compound, it’s imperative to keep the concrete wet for the first few days. Rapid drying causes concrete to crack. High temperatures, low humidity, and poor curing practices allow the water to evaporate from the surface at an accelerated rate. Prevent cracking by placing concrete with a low water-to-cement ratio, applying curing compound, and keeping the slab wet for the first few days. These practices will slow water evaporation and allow the concrete to gain enough strength to be more resistant to cracking.

**Slide 38: Pre-mature or Over-Finishing**
Other causes of cracking are premature-finishing or over-finishing concrete while the bleed water is still on the surface of the slab.

**Slide 39: Insufficient Strength**
Placing concrete that isn't strong enough for the end-use can cause cracking. A low-strength concrete can’t bear a heavy load without cracking because it’s not strong enough.

**Slide 40: Improper Compaction**
Improper compaction of the sub-base will eventually lead to the ground beneath the concrete settling unevenly. This can cause the concrete footing or foundation to crack.

**Slide 41: A Proper Control Joint**
Engineers and contractors can control unwanted concrete cracking with the use of control, expansion, and isolation joints. By studying how concrete contracts and expands as the moisture and the temperature of the concrete changes, engineers have developed rules about joint placement. The idea is to incorporate joints into the concrete early enough to help control where it cracks. It also can create a more visually pleasing slab.
Slide 42: Creating Joints to Control Cracking
Click on the terms to the left to listen to the definition of that term. Please note that the narration will provide information beyond the text presented on the screen. This additional information is available to download by using the Attachments link at the top right.

Some pages have more information than others and will have a scroll bar on the right you can use to see additional text on the screen. If a page has an image, you can click on the image to enlarge it. Click on it again to shrink it.

Joints in concrete are created either with a grooving tool, wood strips, or a concrete saw; each has its advantages. Joints are used to help control where concrete cracks. This interaction will discuss how and why contractors create three different types of joints.

Grooving Tools
The grooving tool is cheap in comparison to a concrete saw, but attempting to place a joint across a slab with a grooving tool can be challenging. With a grooving tool, the joint is placed while the concrete is still in its green state.

Concrete Saws
If contractors use a concrete saw, they have to wait until the concrete sets enough that it won’t chip or dislodge stones. It also must be able to support the weight of the saw and the operator. With a saw, contractors must return within four to twelve hours of the concrete hardening. If the contractor waits too long, the cracking within the concrete will have already taken place and the joints will not serve their purpose.

Workers cutting concrete with saws should be wearing proper safety equipment. Notice that water is sprayed to keep dust down.

Joints and Shrinkage
The majority of shrinkage on a concrete slab occurs within the first few months. This is a result of the evaporation of water from the slab. As it shrinks, there is friction or resistance, by the abrasiveness of the ground below the slab. This causes tension to the slab, resulting in cracking. This can’t be prevented; rather, it must be controlled.

Control Joints
Contractors can pre-weaken the slab by starting a crack at the surface with a grooving tool or a concrete cutting saw. A saw-cut or tooled groove placed in the concrete early in the curing process will create weak spots along the concrete slab called control joints. When the concrete cracks, it’ll crack at the weakest places in the concrete, the control joints. White Cap carries the tools necessary to create control joints.

Expansion joints
Concrete slabs contract when they cool and expand as temperatures rise. Expansion joints are used to allow for contraction and expansion between separate concrete slabs. A compressible material is placed between the two slabs to prevent unwanted build-up of debris and allow the slabs to react to weather conditions without the possibility of spalling if the slabs grind together as they expand.

Isolation joints
When concrete slabs are connected to existing structures, isolation joints are often used to reduce the possibility of damage by acting as shock absorbers. An isolation joint must be used anywhere a slab connects to walls or columns because concrete expands as it is heated.

Without isolation joints, pressures generated by the expanding slab can cause severe damage to the slab or to the connecting surface element. Because walls and columns will have footings that are deeper than slabs, the expansion effects will be different between the two elements.
Slide 43
Joints help to minimize unwanted cracking in concrete, but they are susceptible to their own defects. This interaction will introduce you to four common defects that occur at joints.

Heaving
Heaving is a result of freeze-thaw cycles of subgrade soils. When water in subgrade soil freezes and expands, it can elevate the concrete slab. Short of removing the concrete, the soil beneath the slab, and replacing the soil with quality fill, there isn’t much that can be done. Heaving can create a tripping hazard because the joint between two sections of the slab allows the concrete to move. Once the subgrade soil thaws, the slab should return to its normal elevation.

Settlement
Concrete settles as a result of an improperly compacted sub-base, the presence of organic materials rotting below the slab, or because of soil erosion. Before placing concrete, all organic material, sod, or top soil should be removed. The excavation should be backfilled with clean fill sand. In addition to using the proper material under the concrete, the material must be dampened and compacted using a plate compactor.

If a contractor has a settlement problem with concrete, there is a solution. A concrete slab can be raised by slabjacking or raising concrete with polyurethane. Both techniques involve drilling small holes into the slab and hydraulically pumping the mixture under the slab until the slab has returned to the desired level.

Chipping
Chipping or spalling happen when two slabs grind together as a result of expansion. Sometimes the expansion joint material becomes inelastic or is no longer in place. Stones and debris can accumulate in the joint, contributing to chipping or spalling when the slabs expand.

Curling
Curling describes the ends of a slab curling up or down. One common cause of curling is when the curing rate is different between the top and the bottom of the slab. For example, placing a slab on a cold sub-base can cause uneven curing, with the top of the slab setting quicker than the bottom. If this occurs at an expansion or isolation joint, the curling slab can cause damage as a result of spalling or chipping of the concrete.

Slide 44: Section 2 Summary
Knowing why joints are used, how they are created, and defects that occur at joints will help you work with contractors to address issues and select the proper repair materials.

Slide 45: Section 2 Assessment
This assessment will test your knowledge of specific joint defects, causes, and remedies. You must answer eight of 10 questions correctly to advance to Section 3. You will receive feedback after answering each question.

If you do not pass on your first attempt, that’s OK. You will be directed to the beginning of the section where you can review the concepts again before re-attempting the assessment. Click Next to begin.

SECTION 3: SURFACE DEFECTS CAUSED BY WEATHER AND AMBIENT CONDITIONS

Slide 46
The weather is normally a contractor’s number one concern when placing concrete. Cold weather and hot weather concreting each has its own measures, concerns, and needs pertaining to equipment and materials required to pour, cure, and finish concrete properly. This section will address how weather conditions affect concrete and related surface defects.
Slide 47: Weather’s Impact on Concrete Placement
Contractors must monitor weather conditions when placing concrete slabs. Knowing what specialized equipment or materials are needed for each weather scenario will allow you to better anticipate the needs of contractors. This interaction will introduce basic weather conditions and placement considerations. We’ll go into greater depth about warm and cold weather concreting techniques shortly.

Warm Weather
High temperatures in the summer heat up the aggregate, cement, and at times, even the water. The combined effect of this heat, in addition to low humidity and wind, can cause a wide array of issues. First and foremost, there are concerns of shrinkage cracks due to rapid evaporation of water from the concrete. Hot weather conditions will also increase water demand, which will decrease the strength and will also accelerate the rate of setting.

Cold Weather
Cold weather has the opposite effect on concrete, cooler weather lowers the temperature of materials; low ambient temperatures draw any heat gains from the heat of hydration, slowing the set time of concrete. Two potential issues arise in cold weather projects: lower strengths and blistering.

Optimum Conditions
The optimum temperature to place concrete is between 50 and 70 °F, but as you might imagine, that’s not always possible. White Cap carries the materials and equipment necessary to allow contractors to place concrete regardless of the temperature.

High Wind
Placing concrete on hot, windy days will dry the surface of the slab causing plastic shrinkage cracks. According to ACI, the effects of high air temperature and low relative humidity are more pronounced with increases in wind speed. As a result of the wind, the surface will harden sealing in air and bleed water. This promotes delamination. Using a wind break will help lower the possibility of shrinkage issues when placing concrete during times of high winds.

Low Humidity
High heat and low humidity causes the bleed water to evaporate immediately upon reaching the surface of the slab. This makes it difficult for contractors to predict the concrete’s workability. Workers have a tendency to start finishing the concrete prematurely because they don’t see the bleed water reach the surface. Premature finishing seals in air and bleed water.

Keep this in mind during summer months so that you can remind contractors placing concrete in these conditions to use a water mister above the slab. This will slow the evaporation of water at the surface, reducing the issue of plastic cracking.

Materials for Concrete Placement
Contractors need to be conscious of the weather at the time of placement. Having the proper tools on hand will reduce the potential of defects occurring in the concrete. White Cap carries products for placing concrete in all weather conditions.

Slide 48: Cold Weather Concerns & Defects
ACI defines cold weather concreting as a period when the average temperature falls below 40 degrees Fahrenheit for more than three successive days. When temperatures approach freezing, contractors need to adopt procedures to prevent fresh concrete from freezing.

Cold weather conditions slow setting time and strength gain, thus delaying finishing and form removal. Contractors need to keep fresh and recently placed concrete well above freezing. They often use accelerating admixtures, heaters, curing blankets, and hot air blowers to help speed setting. Delamination may occur if contractors finish the concrete prematurely in cold weather conditions.
Excessive temperature cracking and blistering can occur when poor concreting techniques are used in cold weather. Temperature cracking can occur due to large differences in temperature throughout the concrete slab and are often a sign of a structural failure. Temperature cracks often have evidence of slab movement. Blistering can occur if the slab is not thoroughly and evenly warmed.

Contractors can prepare the site prior to and while placing concrete to help remedy the effects of cold weather. In some cases, they may choose to enclose the area and use heaters to heat the air and ground. Contractors can’t place concrete on frozen ground. They may need to use ground heaters to heat the sub-grade and forms sufficiently prior to placing concrete.

In cold weather, concrete contractors must rely on curing compounds and should always cover concrete after finishing. Insulated blankets, tarps, and straw can be used to retain the heat generated by the concrete. It aids proper curing and prevents concrete from freezing.

Knowing these tips will help you recommend the proper equipment and materials for cold weather concreting. White Cap offers everything from insulating blankets, heaters, to curing compounds; all are necessary when placing concrete in cold weather.

**Slide 49: Hot Weather Concerns & Defects**

Let’s switch gears and focus on hot weather concreting.

There are a number of concerns and potential defects resulting from hot weather concreting. Contractors should consider adopting specific procedures when the temperature reaches or exceeds 77 degrees Fahrenheit. Being aware of these conditions will allow you to help contractors select the materials and supplies needed for hot weather concreting.

Problems associated with hot weather concreting can occur at any time of the year, but generally occur during the summer. Concrete placed in hot weather will have an increased demand for water, which can often lead to reductions in its compressive strength.

Rapid evaporation of water from the concrete’s surface can induce shrinkage cracking. Concrete will set faster in hot weather, requiring quicker finishing. Premature finishing can seal in bleed water, causing delamination.

Contractors should know to order concrete with a set retarder during hot weather placement; this will help slow the set time. They should know to dampen the sub-base and place concrete with a low slump.

In hot weather, a contractor must be ready to immediately apply curing compounds and to cover the slab with burlap, or a similar material, and keep it wet. Additionally, it’s important to cut joints in a timely manner to control cracking.

White Cap carries the products necessary to allow placement of concrete during hot weather conditions. Contractors will need curing compounds, sprayers, burlap, high pressure water misters, and concrete saws.

**Slide 50: Section 3 Summary**

Preventing defects comes down to being conscious of weather conditions at the time of placement and using the right equipment. Knowing how concrete reacts to weather conditions allows you to take steps ahead of time to avoid issues and allows you to suggest products to help mitigate surface defects caused by weather related conditions.
Slide 51: Section 3 Assessment
This short assessment will test your knowledge of weather’s impact on concrete placement and finishing. You must answer four of five questions correctly to advance to complete this course. You will receive feedback after answering each question.

If you do not pass on your first attempt, that’s OK. You will be directed to the beginning of the section where you can review the concepts again before re-attempting the assessment. Click Next to begin.

Congratulations!
Congratulations! You have completed Identifying Common Surface Defects on Concrete Slabs. Before you go, there are few things we’d like to share with you.

Recap
You should now be able to:
1. Identify and describe eight common surface defects found on concrete slabs.
2. Describe the basic concept of joints and the common cracking patterns that happen at joints.
3. Describe how weather conditions relate to defects and suggest proper repair materials.

Resources
Thank you for your time. White Cap’s core value is customer service. By improving our overall understanding of the businesses in which our customers work, we can better help them achieve success.

Look for additional programs and resources, such as the items listed here, on the TRADE Center.

Last Slide
Close this program by clicking Exit at the top right. Look for these blue buttons on the page for your next action.

The Course Exit button will close the course launch page.

The Course Forward button will take you to a course feedback form, where you can rate this course. Clicking the Course Forward button after filling out the feedback form will take you to your certificate of completion.

You also will be able to find your certificate of completion under the My Training tab on the main TRADE Center page.