

## **IMPORTANCE OF CRACK INVESTIGATIONS- MARINA APRON SLABS**

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In an effort to illustrate the critical importance of apron slab health for your Marina facility, we will discuss and look at the real effects that normal wear and tear can have on these slabs and the corrective measures needed to insure it's normal life span.

These illustrations are based on our vast history, knowledge and the repair methods faced over the last several years.

First, the typical anatomy of a Marina apron:

Marinas serve a wonderful purpose. Boats are stored and maintained at most facilities and most have very large lifts (fork and travel lifts) in order to move these vessels around. Most Marina owners recognize that the boats of today are getting bigger and heavier...possibly overloading the original design characteristics of the facility. Marinas constructed 10-15-20 years ago are probably not suited to handle these larger lifts and vessels. The apron slab was originally designed to handle a given maximum weight. If these weights are exceeded, failure will (and does) happen. Even though a slow process, it all begins with a simple crack in the slab.

Please understand that the concrete travel surface is only a "coating" for the tread path of the lifts. If the slab is resting on a very well compacted soil zone, cracks should not appear. Should the typically weak underlying soils begin to settle or erode, this allows for slab flexing that forms the crack. With enough lift travel, these cracks will expand and multiply very rapidly for several reasons. We have learned that because these aprons are located directly adjacent to a water body, the acting tides do have an active role in the weakening of compacted soils, and/or the seawall structure could have active leaks that are eroding soil. The simple fact to complete success in building a seawall/apron structure is to totally waterproof the entire area. But this cannot happen as the tides rise and fall each day, saturating, then exiting the soil. This occurs at the seawall. Should you dig down on the landward side of the seawall, you will see that the water table rises and falls in direct correlation to the tidal level. This water comes up through the soil, even if your seawall panels are 10-15' below the mudline. This we cannot control...but locking the soils in place is possible and we accomplish that task daily.

Once the soils lose their compaction values, the slab begins to flex. With each flex, the soils become weaker and weaker. The weights exerted on the slab drive the soils deeper until, ultimately, a void is created. Once the cracking begins, these cracks act as an exit point for the soil fines and also an entry point for land born water intrusion. Keep in mind that rain water AND boat/forklift runoff water (sea/salt) will begin penetrating the slab and contact the steel reinforcement. With any steel/water contact, you begin the corrosion effect and the rebar will begin to deteriorate and expand, thus eventually spalling the concrete travel surface first, and then total slab failure when the cracking continues to the next (bottom) mat of steel reinforcement.

Can this all be prevented? Probably not! But it can be controlled. That's why Seawallpros carries this message to all Marina owners.

Knowing that it is nearly impossible to close an entire Marina facility to replace the affected slabs, and knowing that full cure on fresh concrete is 28 days, rip-out-and-replace is not a viable option.

Some illustrations:



While coring an apron slab for the installation of point-loaded pin pilings, we always run into this situation. Even though this boring was made to full depth (20”), pulling it reveals total separation at the level of the first mat of steel reinforcing. You can see in picture 2 that the steel has corroded and expanded to form this separation.

The compaction values had fallen to the point that there were voids up to 2” evident throughout the approximate 9000 sq. ft. of apron at this particular Marina. During coring, all cores fell when the drill made it all the way through.



Now that the apron slab is evidenced to be in bad shape and in desperate need of repair, what should the operator do? In this instance, pin pilings were installed in the “heavy traffic areas” at great expense. These pilings were drilled down to bedrock and a custom fabricated support bracket was installed on top of the pin pile. Hydraulic jacks were then installed to exert 40,000 p.s.i. of lifting force and left overnight for pressure verification before the re-pour of the patch.



After the installation of the pin piles, Seawallpros injected our 2-part polyurethane foam to lift the other (less traveled) areas and to fill the voids found underneath the entire slab apron. Even inside of the boat storage area, we lifted, by injection, the slab back to original grade (3.5") *WITH* a 185,000 lb. lift resting on top. This lifting foam compresses upon itself to produce extreme pressures to lift any concrete structure. This is accomplished by drilling small, 3/8" holes through the slab and fitting with injector ports.

Once all of the structural components were properly leveled and supported, we still had the problem of the slab delamination's. This process of repair is tedious and very time consuming. Because all of the identified spall separations were located in the upper 10" of the slab (first mat of steel reinforcement), we elected to drill the slab to a depth of 12" in a tight grid pattern to intersect each and every crack, known and unknown and begin injecting a low viscosity epoxy resin, designed to bond the two layers back together and provide additional seal and life to the steel reinforcement.

Epoxy injection resins have a very short, usable, pot-life! When the 2 components are mixed, they allow for a working time of approximately 30 minutes before they begin to harden. Packing the mixed resin in ice allows for an additional 8-10 minutes but as mentioned, the known and unknown spalling requires injection at every port. Very light pressure is needed to "push" the epoxy blend into the cracks without aggravating the crack or "blowing" the top portion out. Once these products are installed, they must be allowed to fully cure (72 hours) before any heavy traffic is allowed to transverse the area.

Back to "It all starts at a simple crack"!

The repair mentioned above was real. It was extremely expensive and took 2-1/2 months to complete. It took daily meetings and a lot of planning in order for both us and the Marina to continue operating in conjunction with Marina clients and daily boat travel. Actually, with the right planning, most repairs can be accomplished without any disruptions to the Marina business. But why wait until it gets this bad?

Marina owners and operators need to pay special attention to their concrete. In the case here, if they had contacted us earlier, we could have saved them a lot of time and especially a lot of money. If the problem is identified early, the problem can be remedied quickly. The longer one waits, the more difficult and costly the repair will become. That simple first crack should sound an alarm in any Marina operators mind. If it's cracked, there is a problem! And that problem will not fix itself.

Seawallprosfl has the knowledge and hands-on experience to coordinate the repair. Some require just a few simple borings while others need full-blown engineering services to best determine the needed repairs. It's all in the timing! Wait too long and the expenses become greater. Catch the problem quick and the repair becomes quick...and a lot less money! \$20,000-\$650,000 ??? These numbers represent the range of repair that we have done here in Florida. Which would you prefer?

If you would like a free walk-through inspection of your facility, just give us a call. We have several inspectors roaming the State and can typically get to you in a weeks time. We love to have Management join us to explain our findings as we see them. We also offer fully documented, videoed and still picture inspection of seawalls for a nominal fee.

Located outside the U.S.? We are available to travel to bring our expertise to any Marina in the world. We really have become the "Go To Guys" when Marinas are in need.

Delaying the inevitable will only equate to bigger headaches and costs in the future. Just like rust, erosion never sleeps!

Contact us today!

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