Concrete deteriorates

The life of concrete is said to be about 50 years, but various deteriorations further shorten the life.

1, Alkali aggregate reaction

Although concrete is alkaline, the alkali component reacts with the stone in the concrete to produce a jelly-like substance that expands in volume around the stone. This jelly crushes pebbles and generates radial cracks,
greatly reducing concrete strength. In the end, countless cracks crush concrete and pile up rocks.

2, Cracks due to drying shrinkage

Since concrete expands and contracts due to temperature differences and humidity differences, fine cracks are
generated on the surface. When this crack reaches a depth that reaches the internal rebar, the rebar corrodes
with the water that has entered.

3, Rebar corrosion

Reinforcing bars corrode and increase in volume at the same time.
Ultimately, the volume is said to increase by 2-4 times, and this pressure causes cracks in the concrete. When the distance between the reinforcing bars is close, the cracks are connected in the same plane as the
reinforcing bars, and eventually the concrete from the reinforcing bars to the surface peels off. Since the depth of normal reinforcing bars is about 5cm, the concrete of 1m square and 5cm thickness is 125kg, and it is a threat that it falls from a high place.

4. Harm caused by salt

In concrete structures near the coast, rebar corrosion progresses at a faster rate than usual because salt enters from surface cracks.

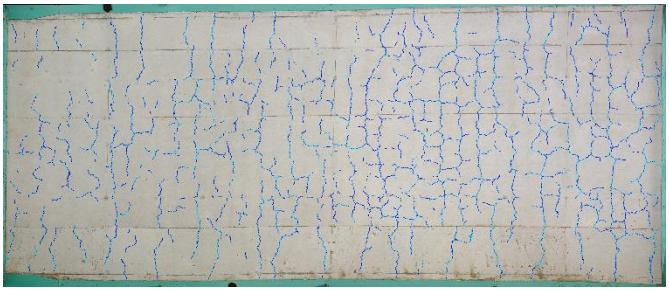
Since the various types of deterioration described above proceed in combination, the life of the structure may reach as early as 20 years. Depending on the structure, it can be demolished and rebuilt depending on the degree of deterioration. However, it costs a lot of money, and it takes a considerable amount of time to complete the construction, placing a heavy burden on the lives of the residents.
In order to avoid this, it is important to conduct a survey in advance and make appropriate repairs to effectively extend the life of the structure.

Repair and extend the life of deteriorated concrete structures

Measures for deteriorated structures begin with an accurate survey.

1, Crack investigation

The length and width of the crack are measured accurately, and the crack depth is measured where the width is large. The crack length represents the degree of overall degradation, and the crack density distribution is the same as the degradation distribution. Deterioration is also progressing at high crack densities. The larger the crack width, the deeper the crack, but the ratio of width to depth differs depending on the presence or absence of reinforcing bars.



Crack investigation on the underside of the bridge (accuracy 0.1mm)

Crack length of the collected core

Left: 162mm, Right: 165mm

Alpha Product's FOCUS can conduct accurate crack investigation with 0.1mm accuracy without using a scaffold.
The company's SEEC can measure crack depth without core collection.

2, Concrete strength

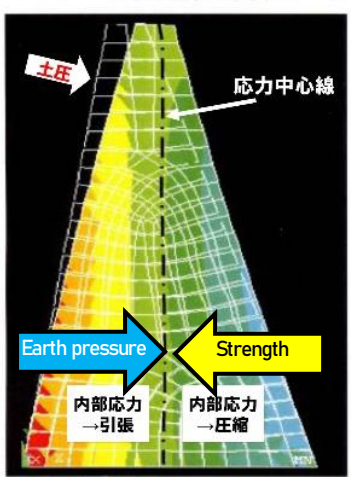
If the strength of the concrete is below the design value, there is a high possibility of collapse.
Therefore, measuring the strength of concrete is an important element of the survey, but the current method is to collect a core and conduct a destructive test. However, this method is expensive and takes time to obtain test results.

Collected core sample.
It takes one day to collect one of this length.
This is further cut to a length of 20 cm
and a strength test is performed.

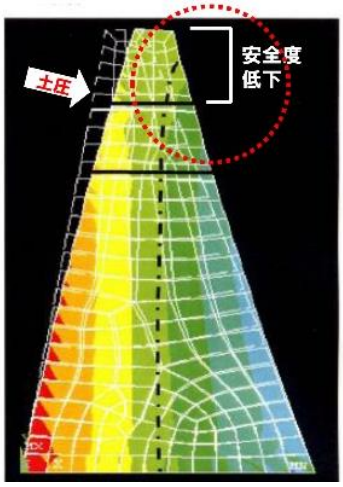
Alpha Product's SEEC can measure concrete strength without core collection.

3, The present situation is grasped by computer simulation (FEM mathod) from the crack condition and concrete strength.

The numerical values of the above two survey results will be analyzed by FEM to confirm the current state of the structure.



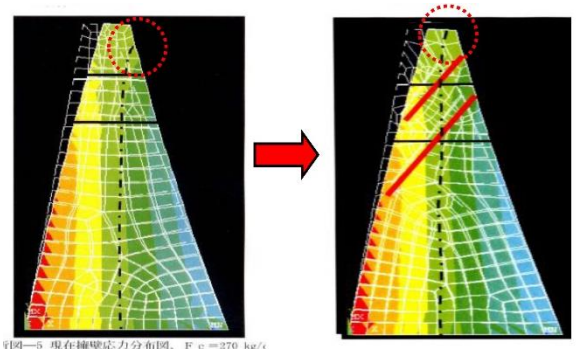
Cross section at completion



Degraded current cross section

Compared to when completed, there are now two penetration cracks, and the structure cannot cope with earth pressure from the left.
Therefore, the earth pressure from the left and the center line of the opposing stress from the right are off the center.
This indicates that the structure above the through crack is likely to fall.

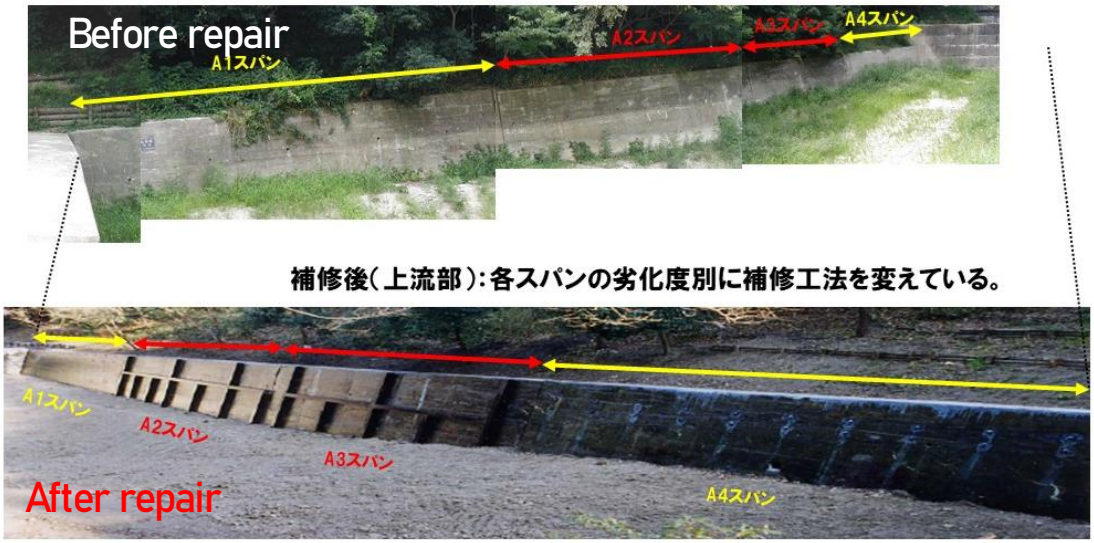
Since the physical strength is reduced by the penetration crack, the steel material is inserted and reinforced.
Insert steel into the current settings above and simulate.



The left is a cross-section of a deteriorated current structure, and the right is a cross-section when steel is inserted.
The balance line between earth pressure and proof stress has almost recovered to the state when completed.
Since the degree of recovery according to the thickness of the steel material to be inserted can be confirmed, it is possible to select the optimum cost and effect.

FEM after repair by inserting steel

Continuous wall actually repaired using this technique



The cost of repair was half that of the conventional method.

Dam repaired in the same way

The repair cost was about 2/3 that of the conventional method, including the cost of cable cranes for material transportation.

This method can accurately predict the life after repair.

The feature of this method is that the current structural strength and the strength after repair can be confirmed numerically by FEM analysis.

Therefore, if it is assumed that the deterioration progresses from the completion to the present time, it can be predicted how many years it will take to deteriorate to the state before the repair.