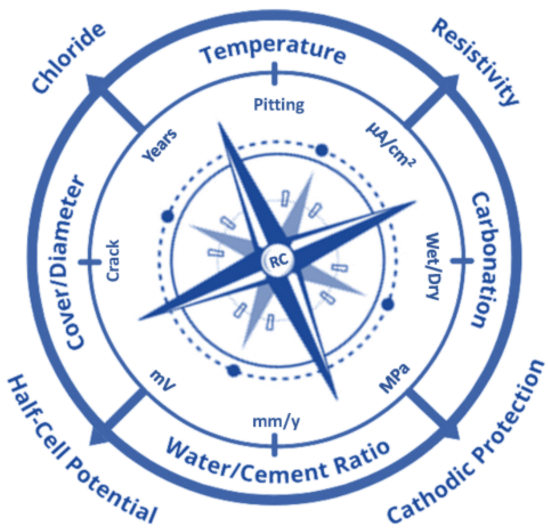


Corrosion Modeling Software and Corrosion Prediction Software Series

Concrete-Compass®: Corrosion Modeling and Life Prediction of Reinforced Concrete Structures

The Ultimate Software Solutions to Costly Concrete Corrosion

Version 9.23

★ **Performance** ★ **Functionality** ★ **Usability**

Anytime Anywhere Any Device Any OS

No USB dongles No installation No Browser Plug-ins

Contact Us for Licensing Details

Why WebCorr | Performance Guarantee | Unparalleled Functionality | Unmatched Usability | Any Device Any OS | Free Training & Support | CorrCompass

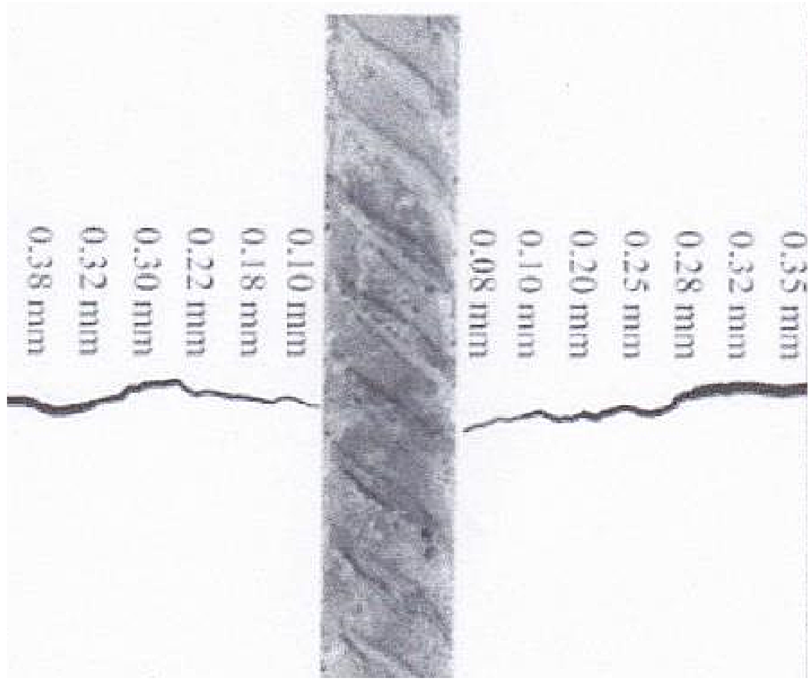
Overview of Concrete-Compass Software for Concrete Corrosion Modeling and Life Prediction

Concrete corrosion refers to corrosion of the reinforcing steels in concrete structures such as buildings, car parks, road beds, bridge decks and bridge substructures, concrete marine structures, and many industrial facilities. Concrete corrosion is a world-wide problem that leads to cracking, staining, spalling, and ultimately structural weakness. Concrete-Compass is the only device and OS independent software tool on the market for concrete corrosion modeling and life prediction of reinforced concrete structures. Designers, architects, engineers, consultants, operation personnel, maintenance and inspection engineers can quickly determine the concrete corrosion rate, the crack width at different depth of concrete cover from the concrete surface to the reinforcing steel, and the remaining life of the RC structure, anytime, anywhere, on any device running any OS without the need to install or download anything. Concrete-Compass also predicts the effectiveness of cathodic protection and the minimum cathodic protection polarization required to reduce the corrosion rate to a level that can meet the design life of the RC structure. Concrete-Compass software models the effects of the following critical factors on concrete corrosion:

- Age of structure
- Code allowable maximum crack width
- Concrete compressive strength
- Concrete tensile splitting strength
- Rebar diameter
- Concrete cover thickness
- Water cement ratio
- Temperature of concrete
- Polarization by cathodic protection
- Service environment
- Half-cell potential
- Concrete resistivity
- Total chloride (acid-soluble chloride) in concrete
- Free chloride (water-soluble chloride) in concrete
- Chloride to hydroxide ratio (Cl/OH)

The outputs of Concrete-Compass include the following:

- The predicted corrosion current density
- The predicted corrosion rate
- The cumulative rebar diameter loss
- The remaining rebar diameter
- The carbonation depth
- The remaining life (time to reach the code allowable maximum crack width)
- The minimum CP polarization required to meet the design life
- The crack width at concrete surface, at reinforcement, and at mid-point of cover thickness
- The residual bond strength (MPa) affected by reinforcement corrosion
- The corrosion reduction factor by cathodic protection, a measure of the effectiveness of cathodic protection
- The effect of rebar position (top layer vs. bottom layer)
- The effect of corrosion type (pitting vs. uniform corrosion)



Figures below show the screen shots of Concrete-Compass.

Concrete-Compass ® Version 9.23: Corrosion Modeling and Life Prediction of Reinforced Concrete Structures

Structure Location/ID		XYZ Building at 123 ABC Street			
Design life	years	50	Rebar diameter	mm	20.000
Age of structure	years	10.000	Concrete cover thickness	mm	35.000
Code allowable maximum crack width	mm	0.300	Water cement ratio	w/c	0.500
Concrete compressive strength	MPa	40.000	Temperature of concrete	°C	10.00
Concrete tensile splitting strength	MPa	4.000	Polarization by cathodic protection	mV	0.00

Service environment for assessment of carbonation if applicable (select from options A to D)		N/A
Dry or permanently wet	Interior of buildings with low air humidity; Components permanently submerged in water	A
Wet, rarely dry	Concrete surfaces subject to long-term water contact; Many foundations	B
Moderate humidity	Concrete inside buildings with moderate or high air humidity; External concrete sheltered from rain	C
Cyclic wet and dry	Concrete surfaces subject to water contact	D
Service environment for assessment of chloride-induced corrosion if applicable (select from options A to F)		D
Moderate humidity	Concrete surfaces exposed to airborne chlorides	A
Wet, rarely dry	Swimming pools; Concrete exposed to industrial waters containing chlorides	B
Cyclic wet and dry	Parts of bridges exposed to spray containing chlorides. Pavements, Car park slabs	C
Exposed to airborne salt but not in direct contact with sea water	Structures near to or on the coast	D
Permanently submerged in seawater	Parts of marine structures	E
Tidal, splash and spray zones	Parts of marine structures	F

Supplementary measurements if available			
Measured half-cell potential, V (CSE)	Yes	-0.450	The probability of corrosion as per ASTM-C876 is >90%.
Measured concrete resistivity, Ω.cm	No		
Measured water-soluble chloride (wt%)	No		
Measured corrosion current, μA/cm²	Yes	2.000	Rebar depassivated, corrosion rate is high.

Prediction Results		Top layer of rebar	Pitting		
Measured corrosion current density	μA/cm²	2.000	Remaining life (time to reach crack width limit)	years	0.000
Predicted corrosion rate	mm/y	0.0234	Min. CP polarization required to meet design life	mV	64.86
Cumulative rebar diameter loss	mm	0.4672	Crack width at concrete surface	mm	0.928
Remaining rebar diameter	mm	19.533	Residual bond strength (MPa)	with stirrup	17.517
Carbonation depth	mm	16.572	Corrosion reduction factor by CP	Vcorr/Vcp	1

Figure 1 Concrete-Compass Predicts the rate of Concrete corrosion and the remaining life of RC structures.

Under the specified conditions shown in Figure 1 above, Concrete-Compass predicts that the design life of 50 years with a crack width limit of 0.300 mm is not met. The crack opening at the concrete surface is 0.928 mm, the residual bond strength with (stirrups) is 17.517, and the carbonation depth is 19.189 mm. The minimum CP polarization required to reduce the corrosion rate to a level that can meet the design life (crack width limit of 0.300 mm) is 64.86 mV. In Figure 2, with cathodic protection polarization of 64.86 mV, Concrete-Compass predicts the remaining life is 40 years, thus meeting the design life of 50 years (age 10 + 40). Figure 3 shows that at age 50, the predicted crack width is 0.304 mm, meeting the design limit of 0.3 mm.

The predictive engine used in Concrete-Compass for corrosion modeling and life prediction of reinforced concrete structures complies with applicable international standards and relevant industry best practices.

Using Concrete-Compass is as easy as 1-2-3.

(1) Enter the design data.

(2) Select the service environment.

(3) Review the prediction results.

The following figures show the screen shots of Concrete-Compass.

Concrete-Compass ® Version 9.23: Corrosion Modeling and Life Prediction of Reinforced Concrete Structures

Structure Location/ID		XYZ Building at 123 ABC Street			
Design life	years	50	Rebar diameter	mm	20.000
Age of structure	years	10.000	Concrete cover thickness	mm	35.000
Code allowable maximum crack width	mm	0.300	Water cement ratio	w/c	0.500
Concrete compressive strength	MPa	40.000	Temperature of concrete	°C	10.00
Concrete tensile splitting strength	MPa	4.000	Polarization by cathodic protection	mV	64.86

Service environment for assessment of carbonation if applicable (select from options A to D)		N/A
Dry or permanently wet	Interior of buildings with low air humidity; Components permanently submerged in water	A
Wet, rarely dry	Concrete surfaces subject to long-term water contact; Many foundations	B
Moderate humidity	Concrete inside buildings with moderate or high air humidity; External concrete sheltered from rain	C
Cyclic wet and dry	Concrete surfaces subject to water contact	D
Service environment for assessment of chloride-induced corrosion if applicable (select from options A to F)		D
Moderate humidity	Concrete surfaces exposed to airborne chlorides	A
Wet, rarely dry	Swimming pools; Concrete exposed to industrial waters containing chlorides	B
Cyclic wet and dry	Parts of bridges exposed to spray containing chlorides. Pavements, Car park slabs	C
Exposed to airborne salt but not in direct contact with sea water	Structures near to or on the coast	D
Permanently submerged in seawater	Parts of marine structures	E
Tidal, splash and spray zones	Parts of marine structures	F

Supplementary measurements if available			
Measured half-cell potential, V (CSE)	Yes	-0.450	The probability of corrosion as per ASTM-C876 is >90%.
Measured concrete resistivity, Ω.cm	No		
Measured water-soluble chloride (wt%)	No		
Measured corrosion current, μA/cm²	Yes	2.000	Rebar depassivated, corrosion rate is high.

Prediction Results			Top layer of rebar	Pitting	
Measured corrosion current density	μA/cm²	2.000	Remaining life (time to reach crack width limit)	years	39.999
Predicted corrosion rate under CP	mm/y	0.0016	Min. CP polarization required to meet design life	mV	64.86
Cumulative rebar diameter loss	mm	0.0327	Crack width at concrete surface	mm	0.045
Remaining rebar diameter	mm	19.967	Residual bond strength (MPa) with stirrup		17.976
Carbonation depth	mm	16.572	Corrosion reduction factor by CP	Vcorr/Vcp	14

Figure 2 Concrete-Compass predicts concrete corrosion, crack width, bond strength, and cathodic protection requirement.

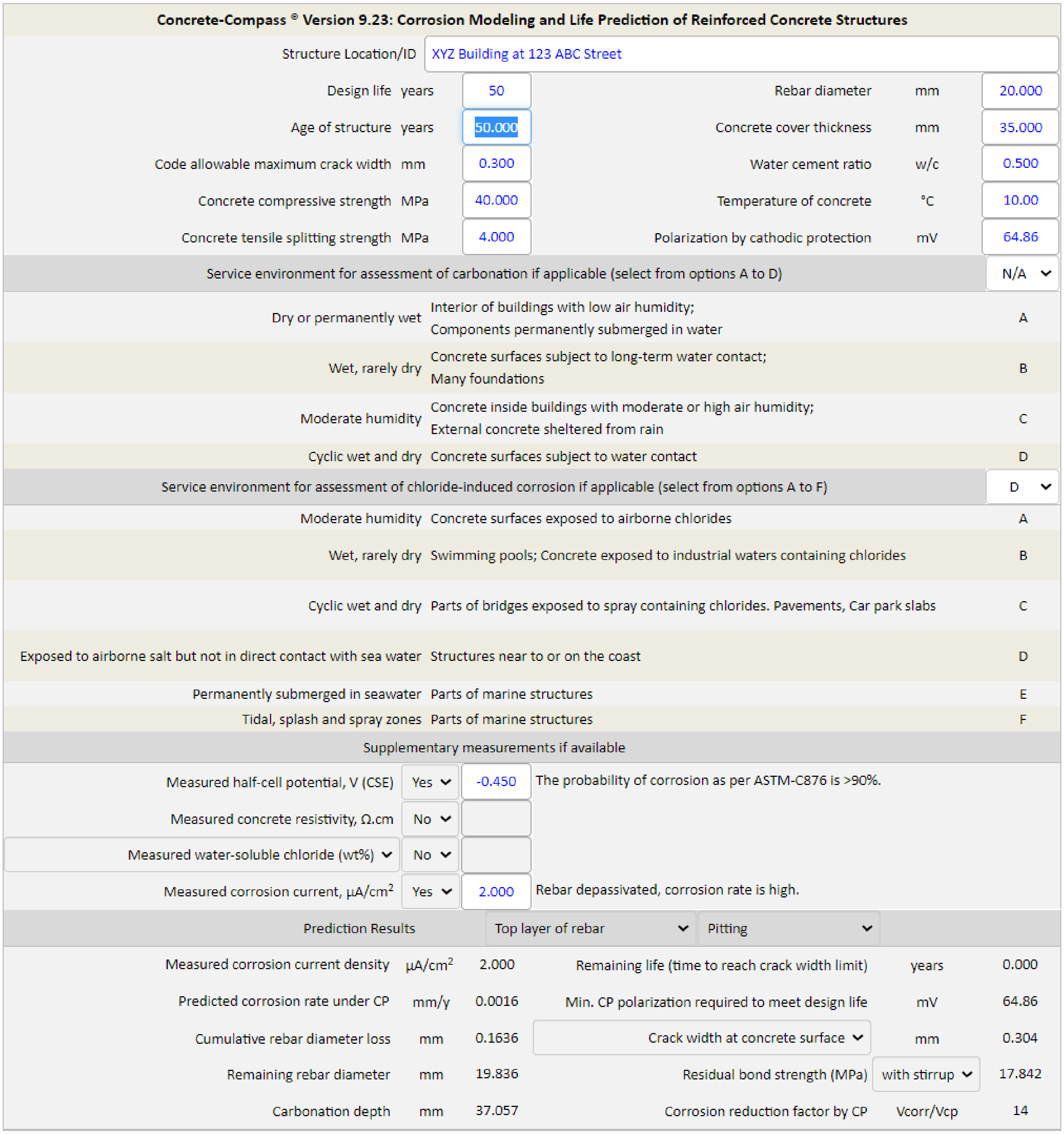


Figure 3 Concrete-Compass predicts concrete corrosion and effectiveness of cathodic protection.

When corrosion current density is measured, Concrete-Compass models the effects of corrosion current density and the service environment on the crack width and the remaining life of the RC structures. If the corrosion current density of reinforcing steel is not measured but concrete resistivity data is available, Concrete-Compass models the effects of concrete resistivity and the service environment on the risks of concrete corrosion and predicts the crack width and the remaining life of the RC structures (Figure 4). Figure 5 shows that Concrete-Compass models the effects of chloride content in concrete, measured as the total chloride (acid-soluble chloride) or free chloride (water-soluble chloride). If no measurement data are available, Concrete-Compass models the effect of the service environment in accordance with BS EN 206 and predicts the crack width and remaining life of the RC structures (Figure 6).

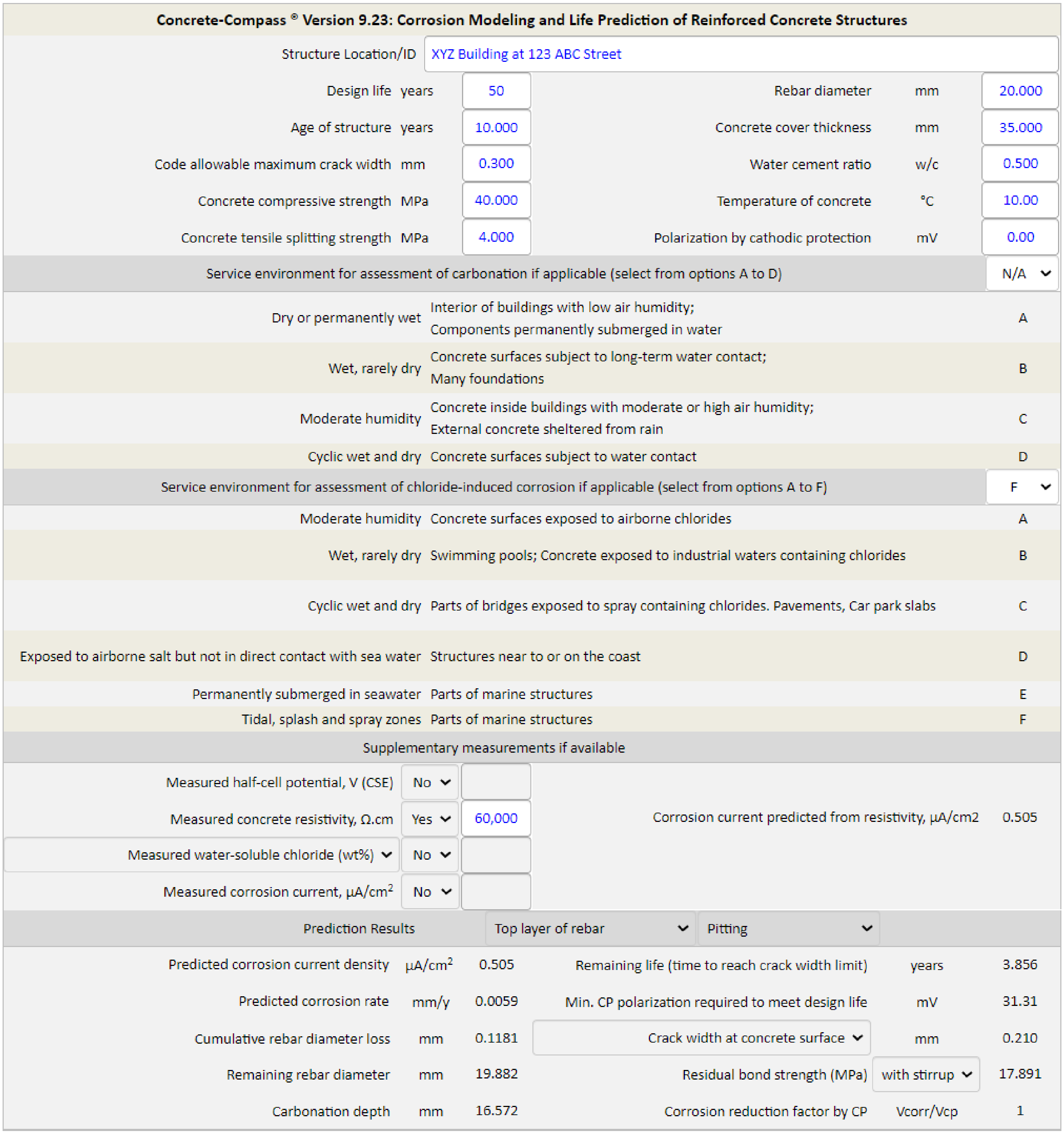


Figure 4 Concrete-Compass predicts concrete corrosion, crack width and remaining life from concrete resistivity data.

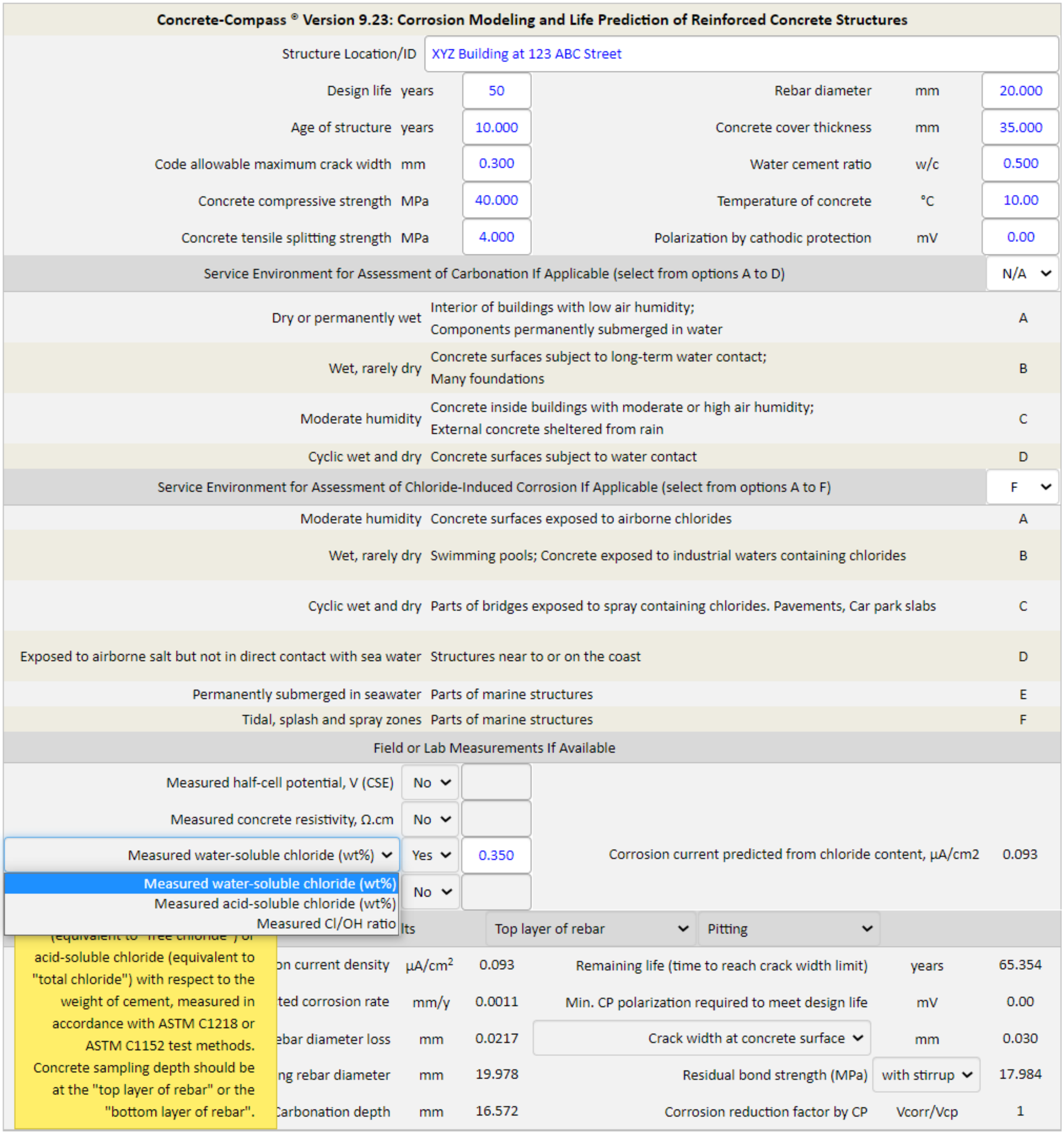


Figure 5 Concrete-Compass models the effects of total chloride (acid-soluble chloride), free chloride (water-soluble chloride), and Cl/OH ratio on the corrosion rate.

Concrete-Compass ® Version 9.23: Corrosion Modeling and Life Prediction of Reinforced Concrete Structures

Structure Location/ID		XYZ Building at 123 ABC Street			
Design life	years	50	Rebar diameter	mm	20.000
Age of structure	years	10.000	Concrete cover thickness	mm	35.000
Code allowable maximum crack width	mm	0.300	Water cement ratio	w/c	0.500
Concrete compressive strength	MPa	40.000	Temperature of concrete	°C	10.00
Concrete tensile splitting strength	MPa	4.000	Polarization by cathodic protection	mV	0.00

Service environment for assessment of carbonation if applicable (select from options A to D)		N/A
Dry or permanently wet	Interior of buildings with low air humidity; Components permanently submerged in water	A
Wet, rarely dry	Concrete surfaces subject to long-term water contact; Many foundations	B
Moderate humidity	Concrete inside buildings with moderate or high air humidity; External concrete sheltered from rain	C
Cyclic wet and dry	Concrete surfaces subject to water contact	D
Service environment for assessment of chloride-induced corrosion if applicable (select from options A to F)		F
Moderate humidity	Concrete surfaces exposed to airborne chlorides	A
Wet, rarely dry	Swimming pools; Concrete exposed to industrial waters containing chlorides	B
Cyclic wet and dry	Parts of bridges exposed to spray containing chlorides. Pavements, Car park slabs	C
Exposed to airborne salt but not in direct contact with sea water	Structures near to or on the coast	D
Permanently submerged in seawater	Parts of marine structures	E
Tidal, splash and spray zones	Parts of marine structures	F

Supplementary measurements if available

Measured half-cell potential, V (CSE)	No	
Measured concrete resistivity, Ω.cm	No	
Measured water-soluble chloride (wt%)	No	
Measured corrosion current, µA/cm²	No	

Prediction Results		Top layer of rebar	Pitting		
Predicted corrosion current density	µA/cm²	7.000	Remaining life (time to reach crack width limit)	years	0.000
Predicted corrosion rate	mm/y	0.0818	Min. CP polarization required to meet design life	mV	95.42
Cumulative rebar diameter loss	mm	1.6352	Crack width at concrete surface	mm	3.305
Remaining rebar diameter	mm	18.365	Residual bond strength (MPa)	with stirrup	16.281
Carbonation depth	mm	16.572	Corrosion reduction factor by CP	Vcorr/Vcp	1

Figure 6 Concrete-Compass predicts concrete corrosion, crack width and remaining life of RC structures in accordance with BS EN 206 concrete exposure class.

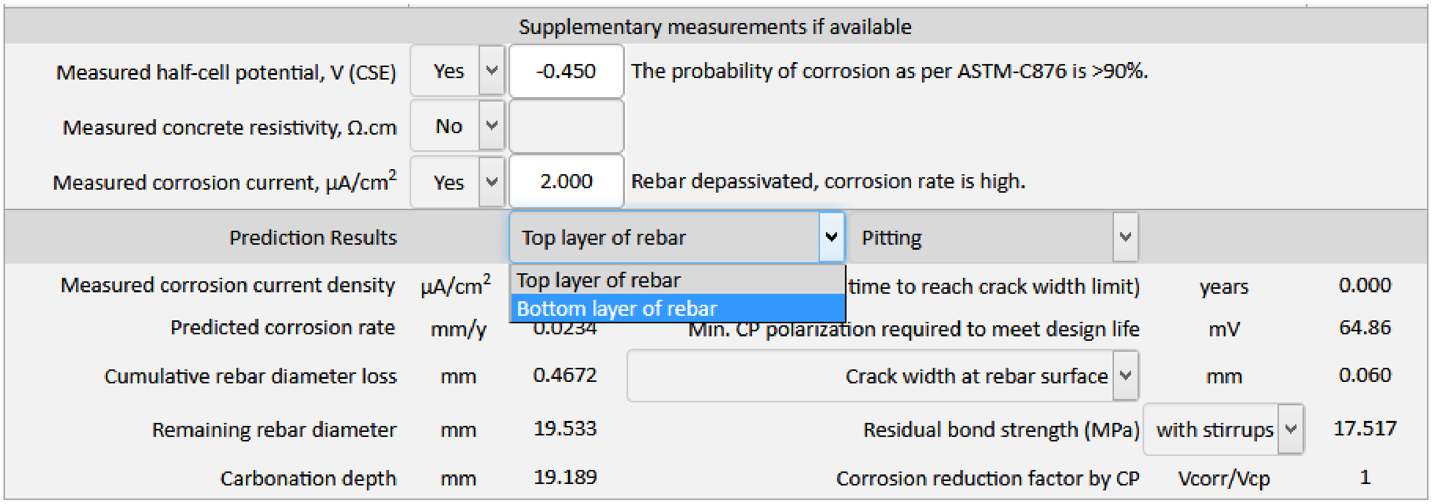


Figure 7 Concrete-Compass predicts corrosion of top layer and bottom layer of steel reinforcement in RC structures.

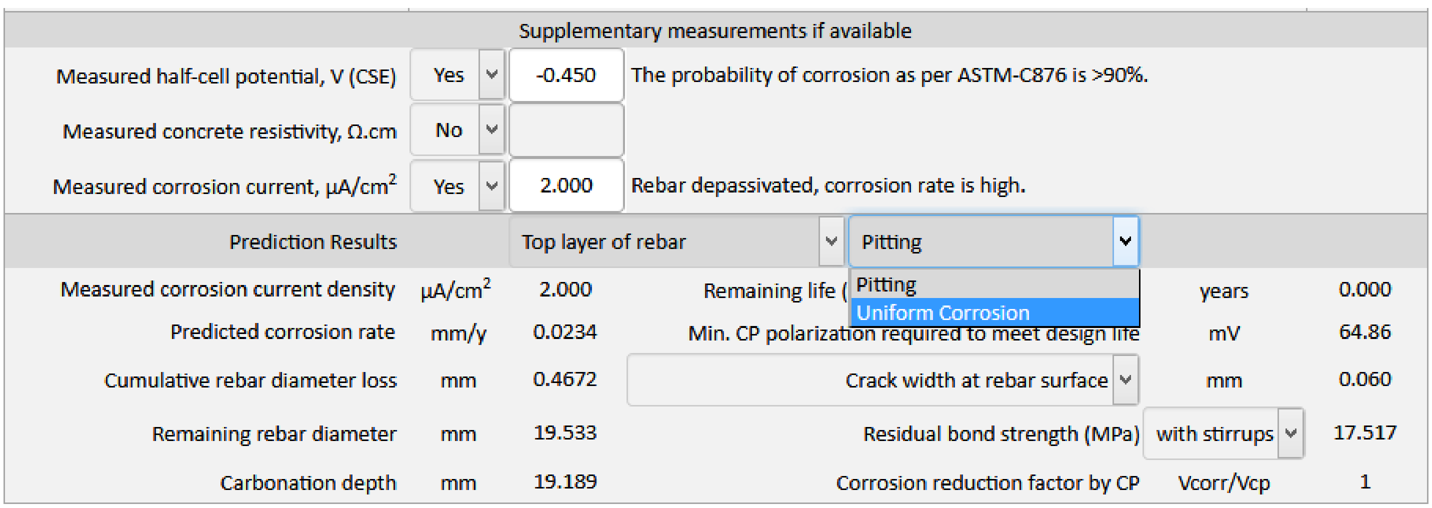


Figure 8 Concrete-Compass predicts the effect of corrosion types on the crack width and remaining life of RC structures.

Concrete-Compass models and predicts the effects of rebar position (top layer vs. bottom layer) and types of corrosion (pitting vs. uniform corrosion) on the crack width and remaining life of RC structures (Figures 9 & 10). The crack width at different depth of over from concrete surface to the rebar surface is modeled and predicted by Concrete-Compass (Figures 9-11). The effect of stirrups on the residual bond strength is also accounted for in the software (Figure 12).

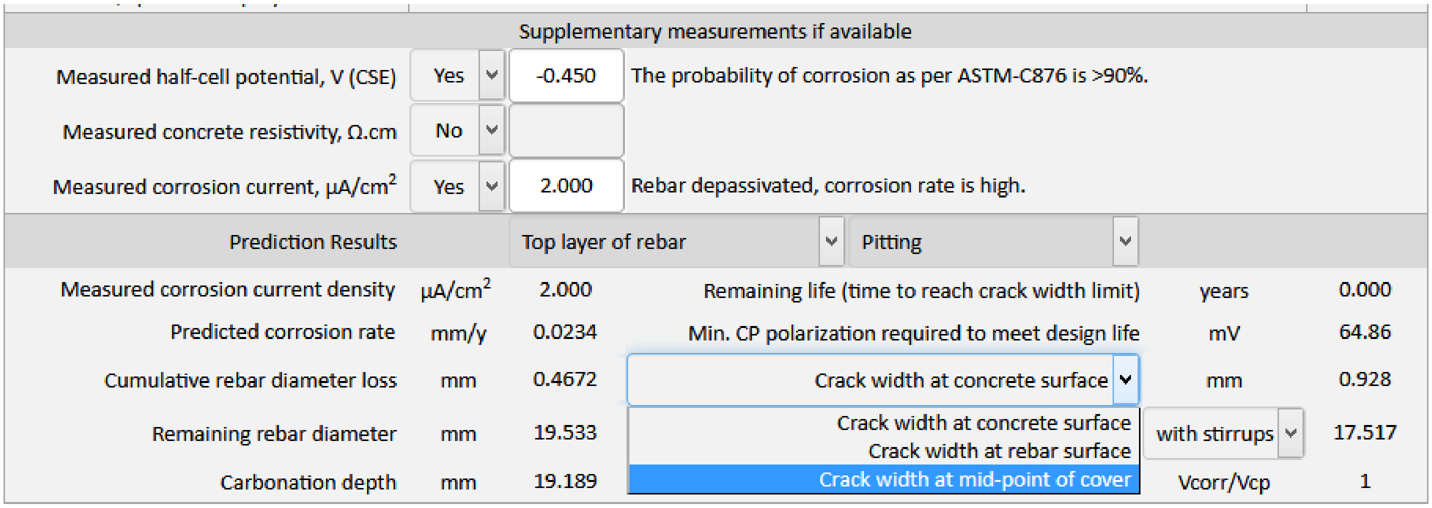


Figure 9 Concrete-Compass predicts the crack width at different depth of concrete cover.

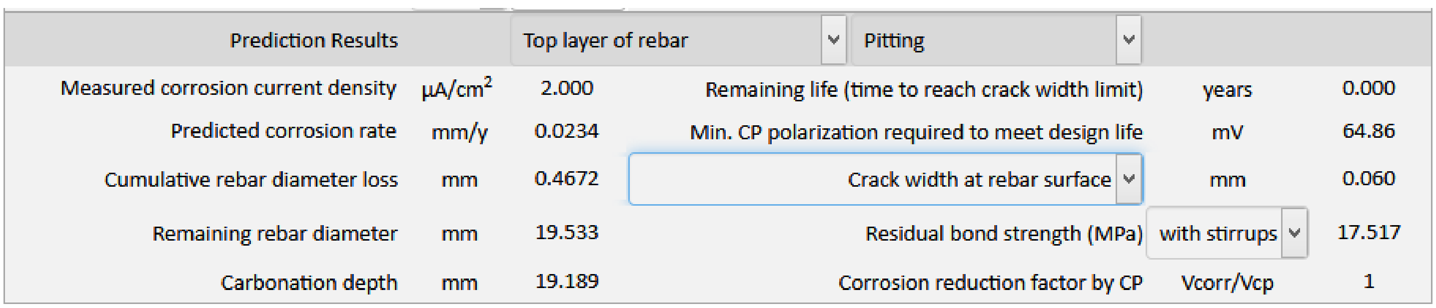


Figure 10 Concrete-Compass predicts the crack width at different depth of concrete cover, crack width at rebar surface.

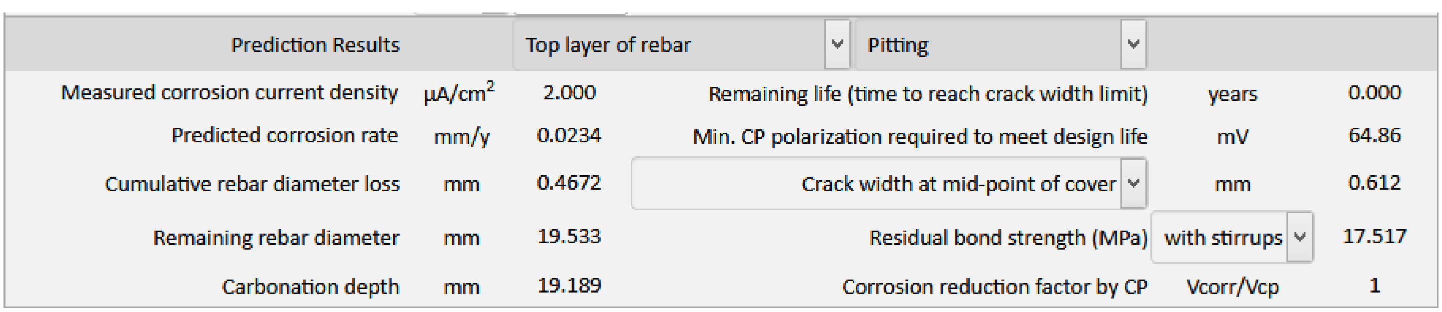


Figure 11 Concrete-Compass predicts the crack width at different depth of concrete cover, crack width at mid-point of cover.

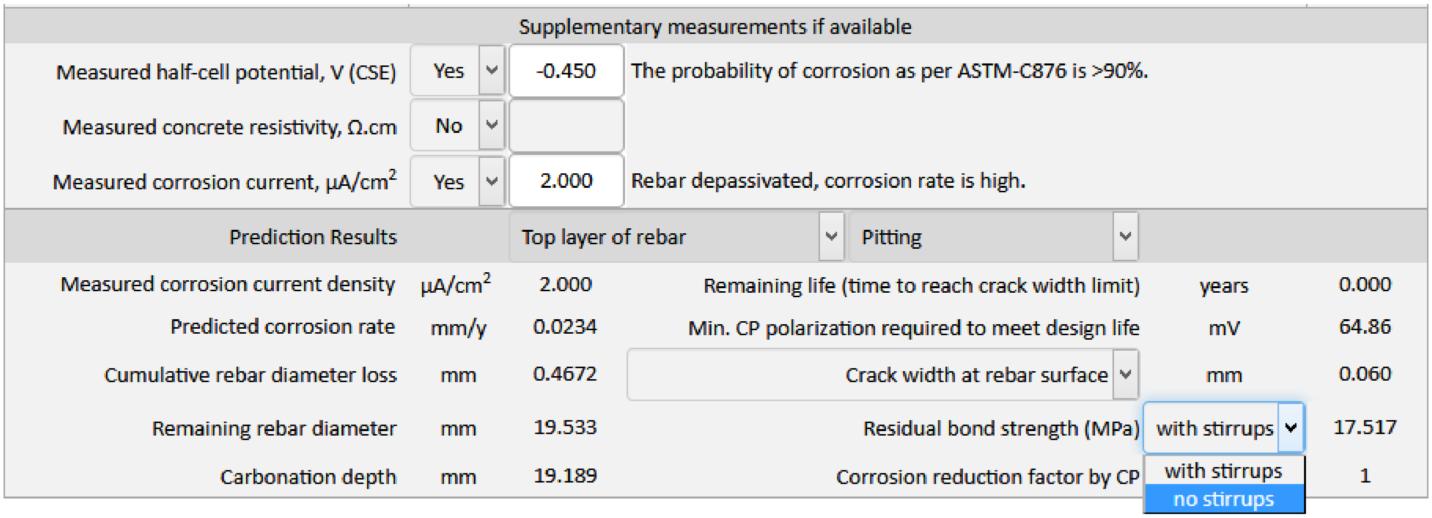


Figure 12 Concrete-Compass predicts the residual bond strength and the effect of stirrups.

The powerful applications of Concrete-Compass are truly unlimited in engineering design, concrete corrosion prediction and modeling, cathodic protection design and optimization, and remaining life prediction of RC structures under the various service environments.

Click here to contact us for licensing details and experience the power of Concrete-Compass.
