LIFE-365 SERVICE LIFE PREDICTION MODEL FOR CONCRETE STRUCTURES BASIC INPUT INSTRUCTIONS

LIFE-365 is a model that allows designers and specifiers to input values for various concrete mix designs, type of reinforcement used, CNI (calcium nitrite) and other additives, as well as for sealers and waterproofing agents, to obtain a service life prediction for their structure. Unfortunately, MCIs have not been included as direct inputs in the first versions of the model. The model does allow user defined inputs, and this is where you can insert values and show the benefits of using Cortec's MCI products. To use LIFE-365 (and MCI admixtures in the model), you simply follow these instructions:

1) Go to Programs, Find and Open LIFE-365 V2.2.1. If you do not have the most current version of LIFE-365, you can download it from <u>www.LIFE-365.org</u>.

2) The following screen will pop up on your computer. Click "yes" to open and use the model.

Use	r Agreement
	This Computer Program and accompanying Manual are intended for guidance in planning and designing concrete construction exposed to chlorides in service. These items are intended for the use of individuals who are competent to evaluate the significance and limitations of their content and recommendations and who will accept responsibility for the application of the material it contains. The members of the consortium responsible for the development of these materials shall not be liable for any loss or damage arising therefrom. Performance data included in the Computer Program and the Manual are derived from publications in the concrete literature and from manufacturers' product literature. Specific products are referenced for informational purposes only. Users are urged to read the Manual to understand the capabilities and limitations of the Computer Program.
	Do you agree? Yes No Remember my choice

3) The program will open and display this screen:



4) You can click on "Settings" next to the Project Tab, and then select "Default Settings and Parameters" to change the default values in the model (i.e. from metric to US units, default location, etc.).

- a) Do this before opening a new project if you do after starting a project you will have to close and re-start.
- b) Once settings are as you need them, Fill in the Project details including Title, Analyst, Description, Date.

5) Click on "Project" in the top left corner of the screen, and then select "New".

6) The following page will open.

Life-365 v2.2.1 <new projects<="" th=""><th>- January 14, 2014</th><th>State State of the local division in the loc</th><th>and the other designed to the</th><th>and some on the second second</th><th></th><th></th></new>	- January 14, 2014	State State of the local division in the loc	and the other designed to the	and some on the second second					
Project Settings									
Current Project	Project Exposure Concrete Mixtures Inde	vidual Costs Life-Cycle Cost	t Service Life Report L	CC Report					
Save project	Mentify Project								
Save project as Export project data	Title New Project			Analyst Analyst	Analyst Analyst				
Close project	Description Default settings for a new project	t,		Date 05/27/2015	Date 05/27/2015				
Steps	Select Structure Type and Dimensions								
Define project	Type of structure slabs and walls	• (1-D) 🔻							
Define alternatives	Thickness (mm)	200.0	1			160.00 mm			
Define mix designs	(init)	200.0							
Compute service life	Reinf. depth (mm)	60.0	200.00 mm			0			
Compute life-cycle cost	Area (square m)	10000	0			0			
Cottingo	> Volume of concrete 2 000 0 cub me								
Help for this window	Chloride concentration units % wit conc								
Set default values	Chionde concentration dints 76 wc conc.								
About Life-365™	Define Economic Parameters		Life-36	5 will model service life for depths up t	o 250.0; see Users Manual for discussion				
This tab lists the default	Base veri 2014 Analysis period (vrs) 150 Inflation rate (%) 180% Real discount rate (%)								
values to be used in all of your	Define Alternatives (up to 6)								
analyses.			Add a new alt	Delete currently selected alt					
		1	- the other at						
	Name (double-click to edit)	A project that uses the nor	mal mix of concrete	Description (double-clic)	Description (double-click to edit)				
	Alternative 1	A project that uses the a ne	ew mix of concrete						
6.00	Current Analysis Default Settings and Parar	neters Online Help							

7) Fill in project details in top section that includes Title, Analyst, Description, as well as the project parameters - type of structure, thickness, depth of reinforcement (cover), etc. The box that says "Analysis Period (yrs)" is where you put in your desired service life of the structure. Default value is 75 years, you can increase/decrease depending on project requirements. You can change the settings for the inflation rate and real discount value if you feel they are different than the default parameters.

9) The bottom section is where you "Define Alternatives" of the project – There are only two there to start - a "Base Case" option and "Alternative 1" option. You can double click within these areas to change the titles and descriptions. You can click the "Add Alternative" button to add up to a total of six scenarios for evaluation.

10) At a minimum, we suggest running a base case and a "MCI" alternative.

11) Once alternatives are listed, click on the "Exposure" tab which appears just right of the project tab at the top of the screen. This is where you will input the location of your project (if in Canada or the USA), or you will need to select a Canadian or USA location with similar weather and exposure conditions to your project area. Alternatively, you can take the time to input all weather and exposure conditions for your area as a "user defined" exposure.

12) Once location is determined, click on the tab to the right of "Exposure" called "Concrete Mixtures". You will see this screen.



Before you make changes, the alternatives are going to appear to have the same initiation, propagation, and service life times. You will need to change the parameters for each alternative to get the proper information.

- a) Click on the "base case" line and then begin to change all mix design parameters to those that your base case will have. Do not add any inhibitor admixtures at this time use the alternatives for comparing them.
- b) After the base case scenario is entered, click on the "Calculate Service Life" button at the top of the page. You will see that the Base Case now appears to have a different life than the rest of the alternatives.
- c) Repeat steps 1 & 2 for each alternative, by clicking on the name of the alternative you wish to enter next.
- d) Make sure to include inhibitor, membranes, sealer, different reinforcing options as appropriate for each alternative.
- e) To do an option using MCI (as it is NOT included in the drop down inhibitor list), run scenario the same as instructions listed above first, but do NOT select an inhibitor option.
- f) After you have clicked "Calculate Service Life" on the MCI option, go back and click on the box in the middle section that says "Custom". It will allow you to then change the input parameters needed to evaluate MCI.
- g) Change the C_t to 0.18%.
- h) Change the propagation period (Prop. (yrs)) value. According to ASTM G109 testing, MCI admixtures slow corrosion rates by 5-13 times compared to a control. We suggest using a conservative value of 5 times reduction and inputting a value of 30 years (Base Case value is 6 years, multiply that by 5 as it will take 5 times longer to

have damage if MCI is keeping rates low = 30 years). If the scenario includes epoxy coated steel, we suggest changing the propagation period to 44 years (Epoxy Coated Steel has a propagation value of 20 years in the model, which is 14 years more than the control – so we take our original 30 year suggestion for MCI and add an additional 14 years to it for the epoxy coated steel = 44 years).

- i) MCI does not change the D_{28} , m, or hydration values, so they should remain as the numbers already appearing in the boxes.
- j) Once the custom C_t and Prop (yrs) input values have been entered, hit the "Calculate Service Life" button one more time.
- k) You can use the alternatives to compare various scenarios of your project.

13) After all alternatives have been entered, click on the "Individual Costs" tab which is just to the right of the "Concrete Mixtures" tab. Your screen will look like this:

Fluject Settings												
	r	1	-									
Current Project	Project Exposure Concrete Mixtures Individual Costs Life-Cycle Cost Service Life Report LCC Report											
Save project	Concrete and Repair Unit Costs											
Export project data	Set Concrete Costs Default Concrete and Repair Costs											
Close project	Set Concrete Costs (2,000 cub. met.) Required user input											
Steps	Alternative	\$/cub. met.	User?	To consistely control	No						*	
Define project	Base case	\$100.01	🔲 User	There are two types of	of mixes that ne	ed costs: (1) the basic	mix designs, you need to mix which has the concre	the cost listed in the De	efault Concrete and Repa	air Costs tab	
Define alternatives	Epoxy Bar	\$100.01	User	above; and (2) an alte	ernative mix that	at includes	SCMs and in	nhibitors. If you have an alt	ernative mix, you need	to input the ready-mix co	ost of this	
Define mix designs	MCI MCI + Enory	\$100.01	User	concrete in the Set C	oncrete Costs	table to the	left.					
Compute service life	CNI 15 I/cu m.	\$100.01	User	Du default the Set Co	noroto Conto	tabla lista ti		oh mix design on the has	is mix east. To input th	a ready mix cost of an all	E E	
Define project costs	CNI + Epoxy	\$100.01	User	By default, the Set Concrete Costs table lists the cost of each mix design as the basic mix cost. To input the ready-mix cost of an alternative mix, click on the listed value of that cost in the center column of the table. If you need to reset this cost to the basic mix cost update the listed value of that cost in the center basic								
Compute life-cycle cost				the right of the cost.								
Settings				100000000000000000000000000000000000000								
Help for this window				Note: Be sure to revie	ew the default v	alues for in	nportant con	istituent costs, listed in the	e Default Concrete and	I Repair Costs tab above	fo ORETM will	
Set default values	1	Calculate costs		runnermore, ir any or your concrete mixes include a memorane or searer and you have imputed your own concrete cost to the relt, Life-305** Will still add to that concrete cost of the membrane or sealer.								
About Life-305""	-											
In the Initiation Time	Alternatives											
Uncertainty panel, the two	Select Alternative Base case -			Project Costs for Base case								
graphs show the computed				Cost name	Start year	End year	Interval	Amount	units	\$/sq. m.	Total	
uncertainty in concrete mix	Itom	Othe	(2) tent	Construction cost	0	0	0	10,000	sq. m.	\$38.46	\$384,635	
computed by the methodology	Concrete Cost	2 000 cub met	\$200.020	Repair cost	28	150	10	1,000	sų, m.j	\$399.99	8399,990	
used in Life-365™ (see the	Rebar Cost	186,480 kg	\$184,615	S.								
Users Manual for details).	Inhibitor Cost	0 L	\$0	<u>[</u>								
When comparing mixes in the	Construction c	1LS	\$384,635	Cost Timeline for Alternative: Base case								
taller skinnier rune has less	Repair cost	1.000 sq. m.	\$399 990			20	30 40	50 60 70	80 90 1			
uncertaintyabout the service												
life, while a mix with a shorter.				Construction cost	n.							
				Construction cost								
wider curve has more	Repair cost											
wider curve has more uncertainty about service life. This tab is only enabled when												
wider curve has more uncertainty about service life. This tab is only enabled when the above 'Compute												
wider curve has more uncertainty about service life. This tab is only enabled when the above 'Compute Uncertainty' box is checked.												

14) On any scenarios that used MCI, you will need to add the cost of the MCI into the base mix price. Do this by clicking on the alternative name(s) that used MCI and adding the cost into the \$/sq ft or \$/cu meter box. For instance, base case cost per cubic meter is \$100.01, you would change that to \$125.01 (I estimated a cost of \$25/cubic meter for MCI – add whatever cost MCI is in your area to the base cost).

15) Once you have updated the MCI cost, hit the button that says "Calculate Costs".

16) You have now finished inputing all data necessary. You can click on the tab "Life-Cycle Cost" to get the following information:



17) Click on the "Service Life Report" tab to see:



18) Click on "LCC Report" tab to see:

Life-365 v2.2.1 < new project>	- January 14, 2014	and the second	A REAL PORT OF TAXABLE PARTY.					
Project Settings								
Current Project	Project Exposure Concrete I	Mixtures Individual Costs Life-Cyc	le Cost Service Life Report LCC	Report				
Save project Save project as Export project data Close project			Va 🔻					
Steps			Life-365 v2.2 - I	_ife-Cycle Costs	5			
Define project Define alternatives Define exposure		Project: Bridge						
Compute service life Define project costs		Analyst: Jessi	ţ,	Date: 05/27/2015				
Settings			Life-Cy	cle Costs				
Help for this window		Name	Construction Cost	Barrier Cost	Repair Cost	Life-Cycle Cast		
Set default values About Life-365™		Base case	\$38.46 per sq. m.	\$0.00 per sq. m.	\$400.04 per sq. m.	\$438.50 per sq. m.		
ips		Epoxy Bar	\$44.62 per sq. m.	\$0.00 per sq. m.	\$330.53 per sq. m.	\$375.14 per sq. m.		
ife-365™ produces two		MCI	\$43.46 per sq. m.	\$0.00 per sq. m.	\$157.47 per sq. m.	\$200.93 per sq. m.		
eports: a SL Report of each Iternative's service life		MCI + Epoxy	\$49.62 per sq. m.	\$0.00 per sq. m.	\$123.75 per sq. m.	\$173.37 per sq. m.		
stimates, and an LCC Report		CNI 15 l/cu m.	\$42.96 per sq. m.	\$0.00 per sq. m.	\$156.85 per sq. m.	\$199.82 per sq. m.		
ost.		CNI + Epoxy	\$49.12 per sq. m.	\$0.00 per sq. m.	\$123.27 per sq. m.	\$172.38 per sq. m.		
		Graphs						
		Life-Cycle Cost, by Alternative		Constant Costs				
		450 1 400 1 350 1 4 200 1 4 200 1 4 200 1		u 'bs Jad \$) 30 50 45 40 30 30 50 50 50 50 50 50 50 50 50 50 50 50 50	Ulinin			
	4 Page 1 of 1							
	Current Analysis Default Settin	ngs and Parameters Online Help						

19) The "Service Life Report" and "LCC Report" can be saved or printed for future use. If Saving, make sure to change it to a PDF file type from Jasper Reports so you can open and view it on any computer, not just in LIFE 365.

Save			the state of the s	X
Save įr	n: 🚺 LIFE 365 I	Examples	• 🧳 📂 🛄 •	
Recent Items	📕 St Louis G	arage		
Desktop				
My Documents				
Computer				
	File <u>n</u> ame:	[<u>S</u> ave
Network	Files of type:	JasperReports (*.jrprint)		Cancel
		lasperReports (* irprint)		