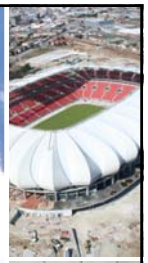
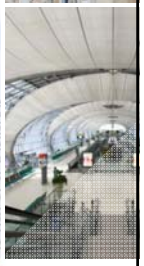
ICRI MONTRÉAL SPRING CONVENTION

TOUR DE MONTRÉAL CONCRETE DURABILITY





ENGINEERING A WORLD OF POSSIBILITIES

WSP

TOUR DE MONTRÉAL
STADIUM CONCRETE DURABILITY EVALUATION

MONTRÉAL LANDMARK

CULTURAL SIGNIFICANCE

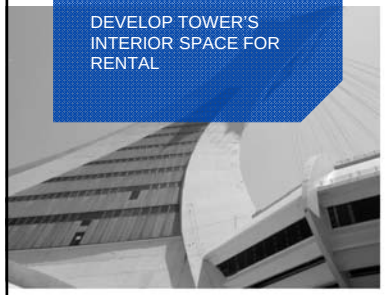
TOUR DE MONTRÉAL
STADIUM CONCRETE DURABILITY EVALUATION

TOWER CONSTRUCTION

TOUR DE MONTRÉAL
RENOVATIONS

TOURIST ATTRACTION

DEVELOP TOWER'S INTERIOR SPACE FOR RENTAL



RÉNOVATION DE LA TOUR

PROJET 1 : RÉFECTION DE L'ENVELOPPE EXTÉRIEURE

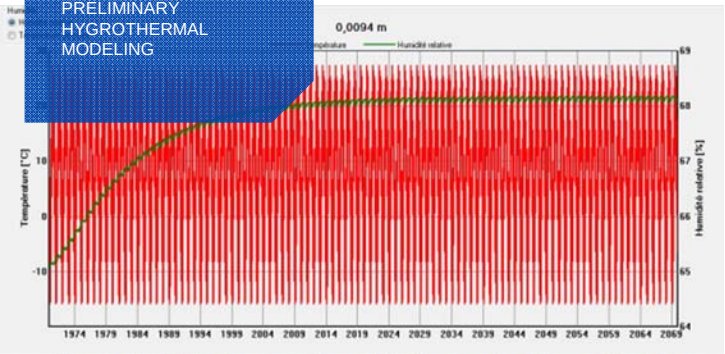
WSP CANADA INC

No PROJET RIO : 97-001
NO PROJET STRUCTURE: 151-05163-P1

- LOT 02061: DÉMOLITION TREUILS ET CÂBLES
- LOT 02071: DÉMOLITION PANNEAUX DE BÉTON ET VITRAGE
- LOT 05121: STRUCTURE POUR MUR RIDEAU ET RENFORTS DE DALLES
- LOT 03001: RÉFECTION DES PAROIS DE BÉTON ET MEMBRANE
- LOT 05161: ANCRAGES POUR LAVAGE DE VITRE

TOUR DE MONTRÉAL
STADIUM CONCRETE DURABILITY EVALUATION

PRELIMINARY HYGROTHERMAL MODELING



Exemple de stabilisation : graphique de l'option 2, voile 457mm, côté extérieur

TOUR DE MONTRÉAL
STADIUM CONCRETE DURABILITY EVALUATION

WILL AN INCREASE IN RH LEAD TO TOWER CONCRETE DAMAGE?

(NOTE THE PHOTO IS NOT OF THE OLYMPIC STADIUM)

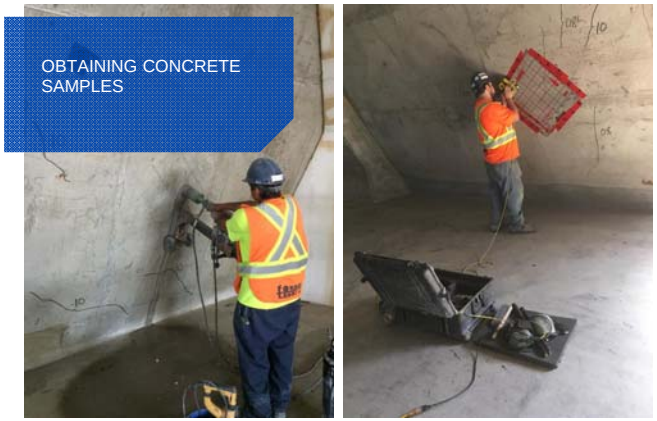
WHAT CAUSES CONCRETE DETERIORATION?

- Reinforcing corrosion:
  - Chloride contamination
  - carbonization
- Freeze-thaw damage

(NOTE THE PHOTO IS NOT OF THE OLYMPIC STADIUM)

TOUR DE MONTRÉAL
STADIUM CONCRETE DURABILITY EVALUATION

OBTAINING CONCRETE SAMPLES



TOUR DE MONTRÉAL
STADIUM CONCRETE DURABILITY EVALUATION

INSUFFICIENT SALT CONCENTRATION TO PROMOTE DETERIORATION

ydrosolubles

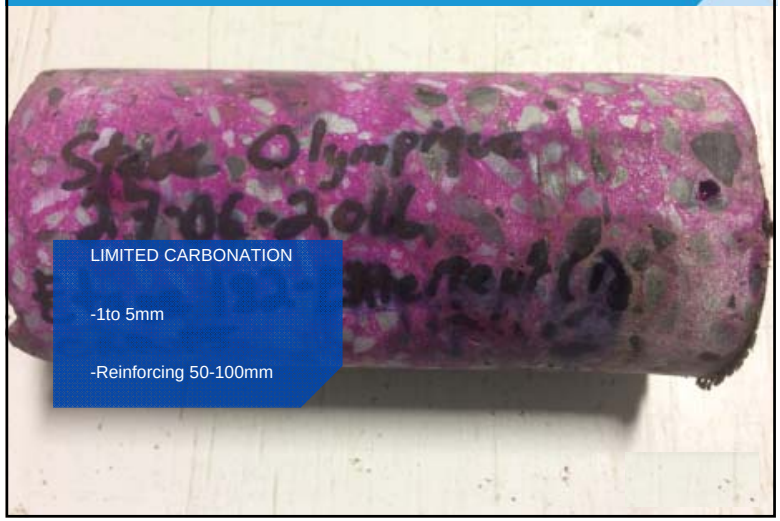
broyées sur leur entière profondeur et envoyées pour analyses
ions chlorures hydrosolubles selon la méthode d'essai CSA
umis dans le tableau suivant et à l'annexe C.

Tableau 1 Résultats des analyses chimiques

Carotte n°	Hauteur de test	Ions chlorures (mg/kg)	Ions chlorures (% de la masse du béton)	Ions chlorures* (% de la masse du liant)
STOL 339-CAR1	Mur Sud	13	0,0013	0,0061
STOL 306-CAR3	Mur Sud	12	0,0012	0,0056
STOL 283-CAR4	Mur Sud	14	0,0014	0,0066
STOL 260-CAR7	Mur Nord	13	0,0013	0,0061
STOL 260-CAR9	Mur Sud-Ouest	17	0,0017	0,008
STOL 237-CAR10	Mur	12	0,0012	0,0056
STOL 182-CAR13	Mur	<10	<0,001	<0,0047

* Estimé pour un béton de 50MPa.

TOUR DE MONTRÉAL
STADIUM CONCRETE DURABILITY EVALUATION



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STADIUM CONCRETE DURABILITY EVALUATION

TOUR DE MONTRÉAL
STADIUM CONCRETE DURABILITY EVALUATION

SATURATION CRITICAL TESTING (S-CRIT)

- 5 -

by frost, of freezing characteristics of
ions between materials properties and frost

DIFINITION OF FROST RESISTANCE (Reports 1 and 2)

The frost resistance, F, is defined;

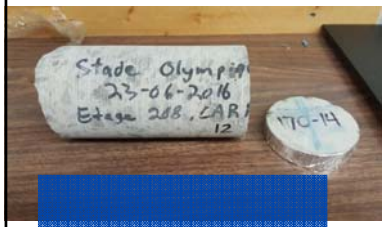
$F = S_{CR} - S_{ACT}$ (2)

If S_{CR} is considered constant the frost resistance will vary with time according to the way S_{ACT} varies with time. Frost damage will occur when F<0 at subfreezing temperatures.

Hence the problem of frost resistance is of a statistical nature since the occurence of the dangerous combination subfreezing temperature and too high water content depends on statistical factors such as frequency of freezing point passages, of wetness of the environment etc.

CHOICE OF MATERIALS AS REGARDS FROST RESISTANCE (Reports 1 and 2)

TOUR DE MONTRÉAL
STADIUM CONCRETE DURABILITY EVALUATION



S-CRIT TESTING…

TOUR DE MONTRÉAL
STADIUM CONCRETE DURABILITY EVALUATION

S-CRIT TESTING RESULTS

Sample ID	Wf	Wref	Vac. Sat. (VS)	Porosity	Critical Freeze Thaw Saturation	
	MC wt	MC wt	MC wt	%	% VS	MC wt
260-6	4.6%	2.1%	7.1%	16.1%	72%	5.1%
208-12	5.2%	2.1%	7.1%	16.1%	79%	5.6%
170-14	5.4%	2.2%	8.0%	18.1%	78%	6.3%
237-11	5.4%	2.3%	8.3%	18.6%	78%	6.5%
322-2	4.6%	1.9%	7.3%	16.7%	78%	5.7%
283-5	4.1%	2.1%	6.8%	15.9%	74%	5.1%
260-8	4.5%	2.2%	8.4%	19.2%	77%	6.5%

Table 3- Results of free water saturation, reference water content, vacuum saturation, and critical freeze thaw saturation testing

TOUR DE MONTRÉAL
STADIUM CONCRETE DURABILITY EVALUATION

OTHER CONCERNS AND COMMENTS…

-Coating on inside face of exterior wall

TOUR DE MONTRÉAL
STADIUM CONCRETE DURABILITY EVALUATION

CLOSING CONCLUSIONS

-1970'S AND 1980'S CONCRETE IS DURABLE AND HIGH QUALITY

-EXPECTED NEW INTERIOR ENVIRONMENT PRESENTS LOW RISK TO CONCRETE DETERIORATION

-S-CRIT TESTING PROVIDED EFFECTIVE MEANS TO EVALUATE RISK

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