GEOLOGICAL SURVEY OF CANADA

OPEN FILE 5593

Compendium of Reports and Databases Prepared Through the Canada-France Ground Freezing Experiments Under Contract to NRCan

S.L. Smith and M.M. Burgess (compilers)

2007

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2007: Compendium of Reports and Databases Prepared Through the Canada-France Ground Freezing Experiments Under Contract to NRCan. Geological Survey of Canada Open File 5593, 5 p.

Open files are products that have not gone through the GSC formal publication process.

Background to the Open File

The Canada-France Pipeline Ground Freezing Project was conducted by Canadian and French scientists between 1982 to 1994. Canadian participation was largely through Carleton University and led by professors P.J. Williams and M.W. Smith. The Government of Canada, through Energy Mines and Resources (EMR), later Natural Resources Canada (NRCan), supported this project over its lifetime through funding from the Federal Program on Energy Research and Development (PERD). In the latter stages of the project between1990 and 1994, it was also supported by industry. Six long-term ground freezing experiments were conducted in a controlled environment facility, operated by the Centre National de la Recherche Scientifique and located in Caen, France, to investigate and improve understanding of the frost heave process associated with chilled buried pipelines in northern terrain.

Research results were published through peer-reviewed scientific journals and conference proceedings. Detailed annual reports were also submitted by Carleton University to EMR and NRCan as part of contractual obligations. However, only the first few contract reports were released as government Open Files. The Geological Survey of Canada (GSC) of NRCan has thus undertaken to make all the contract reports publicly available by converting the reports to electronic format (PDF files) and compiling these in one GSC Open File publication. Considerable data were generated through the Caen experiments and submitted to NRCan. These data include soil temperature, soil heave, pipe heave and strain and soil pressure around the pipe. Following the first series of experiments conducted between 1982 and 1989, the GSC compiled all data in spreadsheet format. This compilation was carried out under contract by L.E.C. Engineering Ltd, and consisted of a series of Lotus 1-2-3 spreadsheet files. These have been converted to MS Excel format and to tab delimited ascii files, and are included in this Open File. There have been no changes to the structure of the files. The report submitted by L.E.C. Engineering, also included in this Open File, provides the documentation on the database. Data from the first freeze period of the second set of the experiments conducted between 1990 and 1992 are also included in the Open File along with the related documentation. These data complement the May 1992 contract report submitted by Carleton University to NRCan.

We wish to acknowledge the support provided by PERD throughout the Caen experiments, and for the present compilation of data and reports. We also acknowledge Dr. Alan Judge of GSC (and of the former Earth Physics Branch) of EMR/NRCan, who was the scientific authority for the contracts awarded to Carleton University and L.E.C. Engineering, and who provided the commitment and leadership for the long-term support of the Caen project. The assistance provided by J. Chartrand and D. Riseborough in the preparation of the digital files included in this Open File is also appreciated.

The opinions and interpretations expressed in the various contract reports are those of the authors of the reports not NRCan. The databases included are those which were provided to GSC by the contractors and we have made no judgements on their accuracy.

Sharon Smith and Margo Burgess
Geological Survey of Canada
Natural Resources Canada
2007

Reports Included in the Open File

All reports are in PDF format and can be found in the “Reports” folder in the Open File. The report number may be used to find the corresponding PDF file.

1. Burgess, M., Lemaire, G., Smith, M. et Williams, P.J., 1982. Etude du gel des sols autour d'une conduite refroidie enterrée dans une station experimentale - Phase I". Rapport final et rapport interimaire: Faisabilite d'une étude des contraintes d'une conduite enterrée dans un sol soumis au gel, 42 pp. (Previously published as Earth Physics Branch Open File 82-18)

2. Geotechnical Science Laboratories, Carleton University, 1983. Investigation of Soil Freezing in Association with a Buried Chilled Pipeline in a Large-Scale Test Facility Phase 2 and Interim Report - Analyses of Stresses Developed in Pipeline Buried in Freezing Ground. Report submitted to Earth Physics Branch, Energy Mines and Resources Canada, August 1983, 41 pp. (Previously published as Earth Physics Branch Open File 83-18)

3. Geotechnical Science Laboratories, Carleton University, 1984. Analyses of Stresses Developed in Pipelines Buried in Freezing Ground. Final Report submitted to Earth Physics Branch, Energy, Mines and Resources Canada. February, 1984. 64 pp. (Previously Published as Earth Physics Branch Open File 84-9)

4. Laboratoires de science geotechnique, Université Carleton, 1984. Analyse des contraintes developées dans les canalisations enterrées dans un sol soumis au gel. Rapport final pour la Direction de la physique du globe, le Ministère d'Energie, mines et ressources, février, 1984. 62 pp.

5. Laboratoires de science geotechnique, Université Carleton, 1984. Expérimentation sur le gel d'un sol et d'une canalisation enterrée et refroidie dans une installation d'essai de grandes dimensions, 3e phase. Rapport final pour le ministère d'Energie, mines et ressources, Direction de la physique du globe, septembre, 1984. 73 pp.

6. Geotechnical Science Laboratories, Carleton University, 1985. Analyses of Stresses Developed in Pipelines Buried in Freezing Ground. Final Report submitted to Earth Physics Branch, Energy Mines and Resources Canada, May 1985, 44 pp.

7. Geotechnical Science Laboratories, Carleton University, 1986. Investigation of Frost Heave as a cause of Pipeline Deformation". Final Report submitted to Earth Physics Branch, Energy Mines and Resources Canada, January, 1986. 71 pp.

8. Geotechnical Science Laboratories, Carleton University, 1986. Thermodynamics and mechanics of freezing soil around a Pipeline. Final Report submitted to the Earth Physics Branch, Energy Mines and Resources, November 1986. 111 pp.

9. Geotechnical Science Laboratories, Carleton University, 1988. The Third Freeze Cycle of the Canada–France Ground Freezing Experiment. Final Report submitted to Permafrost Research

Section, Terrain Sciences Division, Geological Survey of Canada, Energy Mines and Resources Canada, January, 1988. 78 pp.

10. Geotechnical Science Laboratories, Carleton University, 1988. Canada-France Ground Freezing Experiment: Phase VII, Spatial Variability of Heave around a Pipeline and the Effects of repeated Freezing and Thawing. Report submitted to Permafrost Section, Terrain Sciences Division, Geological Survey of Canada, Energy Mines and Resources Canada, July, 1988. 35 pp.

11. Geotechnical Science Laboratories, Carleton University, 1988. Canada–France Pipeline-Ground Freezing Experiment: Phase VIII. Fourth freeze cycle. Report submitted to Permafrost Section, Terrain Sciences Division, Geological Survey of Canada, Energy Mines and Resources Canada, July, 1988.

12. Geotechnical Science Laboratories, Carleton University, 1991. Canada–France Pipeline-Ground Freezing Experiment: Phase IX, Fourth Thaw. Report to Permafrost Section, Terrain Sciences Division, Geological Survey of Canada, Energy Mines and Resources Canada, June, 1991.

13. Geotechnical Science Laboratories, Carleton University, 1991. Canada–France Pipeline-Ground Freezing Experiment: Frozen Transition Experiment. Experimental Design, Planning and Start-up Phase. Report submitted to Permafrost Section, Terrain Sciences Division, Geological Survey of Canada, Energy Mines and Resources Canada, July, 1991.

14. Geotechnical Science Laboratories, Carleton University, 1992. Canada–France Pipeline-Ground Freezing Experiment: Frozen Transition Experiment First Freeze Period and Pipe Relaxation Period. Report submitted to Permafrost Section, Terrain Sciences Division, Geological Survey of Canada, Energy Mines and Resources Canada, May, 1992.

15. Geotechnical Science Laboratories, Carleton University, 1993. Canada–France Pipeline Ground Freezing Experiment: Frozen Transition Experiment Second Freeze Period. Report submitted to Permafrost Section, Terrain Sciences Division, Energy Mines and Resources Canada and seven companies. May 1993.

16. L.E.C. Engineering Ltd. 1989. Pipe heave and bending strain data for the Caen Frost Heave Test Facility. Report submitted to Permafrost Section, Terrain Sciences Division, Geological Survey of Canada, February 1989.

17. L.E.C. Engineering Ltd. 1990. Database for the Caen Frost Heave Test Facility. Report submitted to Permafrost Section Terrain Sciences Division, Geological Survey of Canada, July 1990.

18. L.E.C. Engineering Ltd. 1991. Database for the Caen Frost Heave Test Facility. Report submitted to Permafrost Section Terrain Sciences Division, Geological Survey of Canada, March 1991.

Data Files Included in the Open File

The folder “Data 1982-89” contains the database compiled by L.E.C. Engineering Ltd. (1989, 1990, 1991) under contract to GSC. The final data files that accompanied the report by L.E.C. Engineering Ltd. (1991) have been converted to MS Excel (Excel folder) and tab delimited files ascii (Ascii folder) files. The file names and the file structure have been retained so that the user may consult the report for a description of the contents of each file and the fields in the database. Since the original database was provided on a series of disks, the files associated with each disk have been placed in corresponding folders (i.e. Disk 1 to Disk 8) to match up with the descriptions in the original report.

The folder “ Data 1990-92” contains data generated by the first freeze period of the second set of the experiments and complements the May 1992 report of the Geotechnical Science Laboratories. The original files have been converted to MS Excel (Excel folder) and tab delimited files ascii (Ascii folder) files. The file names and structure have been retained. A description of the files along with the section of the appropriate report associated with the data are provided in the file “Data Descriptions.xls” and also in the tab delimited ascii file “Data Descriptions.txt”.