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Life Cycle Cost Literature Survey and Database for Concrete

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KEYWORDS

Asphalt, Bridges, Buildings, Concrete, Cost, Life cycle cost, Offshore structures, Parking structures, Pavement, Pipe, Railroads, Steel

ABSTRACT

Life cycle cost analysis is currently a valuable tool in the construction industry and will become more so as resources become more scarce. Selecting the materials and components of structures and pavements based on a life cycle cost analysis can significantly decrease the lifetime cost of construction, maintenance and repair.

This literature survey gathers life cycle cost information for concrete and competing materials from a variety of sources, summarizes the results, and describes the resulting searchable database. The database is a resourceful tool for those who would like to obtain additional information on life cycle cost analysis and results. The searchable life cycle cost database with abstracts, in Filemaker Pro® format, is available to Portland Cement Association (PCA) member companies, PCA staff, and cement promotion groups.

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Life Cycle Cost Literature Survey and Database for Concrete

Katie Amelio and Martha G. VanGeem*

INTRODUCTION

Selecting the materials and components of structures and pavements based on a life cycle cost analysis can significantly decrease the lifetime cost of construction, maintenance and repair. Selecting materials and components based on initial costs disregards future costs over the intended life of the system such as maintenance, repair, and reconstruction. This literature survey gathers life cycle cost information for concrete and competing materials from a variety of sources, summarizes the results, and describes the resulting searchable database. The database is a resourceful tool for those who would like to obtain additional information on life cycle cost analysis. The results include reports on bridges, buildings, pipe, offshore structures, parking structures, pavements, railroads, general use and other parts of the infrastructure. Report types, such as models or cost comparisons, are also indicated.

LITERATURE SELECTION

Procedure for Selection

A broad literature search for articles concerning life cycle costing was undertaken. A list of resources searched may be found in the Appendix A. Keywords searched include life cycle costing, concrete, cost, methodology, asphalt, steel and aluminum. The relevant articles were then compiled into a searchable database and categorized based on structure and report type.

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Structure Types

The structure types selected for categories in the database were: asphalt, bridges, buildings, concrete pipes, composites, general use, infrastructure, offshore structure, parking structure, pavement, and railroads. The "general use" category encompasses articles for components used in more than one type of structure.

Report Types

The report types selected for categories in the database were: background, case studies, comparisons, computer models and software, cost detail, cost models and methods, and research. Articles grouped as "background" include entries for a variety of structure types, however the articles focus on the overall topic of life cycle cost analysis including overviews, surveys, criticisms, proceedings, and conferences. The "case studies" are articles that focus on a particular structure or material. "Comparison" articles compare structures made with different materials. Articles listed under "computer models and software" cover various computer programs and software to assess the life cycle cost of a construction project. Many of these articles are structure specific, and most pertain to bridges. "Cost detail" articles contain example cost calculations for a life cycle cost analysis. Articles describing various methodologies and examples of life cycle cost analyses are grouped under the category of "cost models and methods." "Research" articles are entries focused on research concerning how to best model life cycle costs.

RESULTS

Table 1 presents the contents of the database in a matrix of structure type versus report type. The numbers within each cell of the matrix correspond to the record number of an article in the life cycle cost database. The contents of the database by record number without the abstracts is presented in Appendix B. For example, in Table 1, the "33" under "Background" and "Offshore Structures" refers to record number 33 in Appendix B. The full searchable database including abstracts is in FileMaker Pro® format and is available to Portland Cement Association (PCA) member companies, PCA staff, and cement promotion groups.

SUMMARY AND CONCLUSIONS

Selecting the materials and components of structures and pavements based on a life cycle cost analysis can significantly decrease the lifetime cost of construction, maintenance and repair. Selecting materials and components based on initial costs disregards future costs over the intended life of the system such as maintenance, repair, and reconstruction. This literature survey gathers life cycle cost information for concrete and competing materials from a variety of sources, summarizes the results, and describes the resulting searchable database. The results include reports on bridges, buildings, pipe, offshore structures, parking structures, pavements, railroads, general use and other parts of the infrastructure. Report types, such as models or cost comparisons, are also indicated.

A report table presents the contents of the database in a matrix of structure type versus report type. The contents of the database by record number without the abstracts are presented in Appendix B. The full searchable database with abstracts is in FileMaker Pro® format and is available to PCA member companies, PCA staff, and cement promotion groups.

Life cycle cost analysis is currently a valuable tool in the construction industry and will become more so as resources become more scarce.

Table 1 - Matrix of Database Contents by Report and Structure Type*

Structure Type	Report Type						
	Background	Case Studies	Comparisons	Computer Models & Software	Cost Detail	Cost Models & Methods	Research
Asphalt	133, 219	-	220, 221	-	72	-	-
Bridges	4, 5, 6, 23, 25, 29, 40, 41, 50, 90, 114, 132, 137, 141, 142, 171, 176, 184, 213, 222, 233	81, 131, 150, 152, 189	61, 96, 103, 153, 230	15, 18, 27, 115, 229, 239	7, 202, 203	14, 22, 28, 35, 47, 49, 108, 182, 236, 242	1, 10, 79, 97, 99, 107, 118, 161, 179, 217
Buildings	8, 30, 58, 65, 93, 105, 145, 167, 168, 172, 186	57, 95, 104, 147, 148, 170, 206	64, 100, 110, 122, 160, 165, 185	-	62, 98, 243	86, 87, 92, 124, 129, 231	37, 59, 63, 82, 162
Concrete Pipes	17, 94, 146, 169, 197	-	88, 144, 174	-	11, 45	19, 235	-
Composites	151	-	16, 205, 214	-	-	177	-
General Use	31, 34, 39, 85, 119, 134, 173	-	117, 164	-	-	24, 116, 232	83, 121
Infrastructure	3, 36, 89, 109, 125, 240	-	-	-	-	192	-
Offshore Structure	33	-	66, 159	-	-	-	-
Parking Structure	120, 157	-	60	-	-	46	-
Pavement	26, 32, 38, 42, 51, 52, 68, 70, 73, 76, 77, 78, 101, 102, 112, 113, 126, 127, 128, 130, 138, 139, 143, 149, 154, 166, 175, 181, 188, 191, 204, 210, 216, 241	12, 13, 53, 74, 91, 178, 183, 209, 211, 223, 224, 225, 226, 227, 238	43, 44, 54, 55, 56, 69, 71, 80, 140, 155, 158, 180, 190, 194, 196, 198, 199, 200, 201, 208, 234	20, 84	-	9, 48, 67, 75, 106, 111, 136, 156, 187, 218, 228	2, 21, 135, 207, 212, 215, 237
Railroads	-	-	123, 195	-	-	163	-

* Numbers in cells refer to the record numbers in database and Appendix B.

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APPENDIX A – RESOURCES

The electronic databases and Internet search engines used to find relevant articles and reports are presented in Table A1.

Table A1 – Listing of Resources Searched

Name	Sponsor
NERAC	Outside search service using multiple commercial and government databases
Compendex	Ei Compendex
TRIS	U.S. Department of Transportation
Worldcat	OCLC
ACI Abstracts	American Concrete Institute
Cnet.com	Cnet Inc.
Proceedings First	British Library Association
World Ceramics Abstracts	Cambridge Scientific Abstracts
METADEX	Cambridge Scientific Abstracts
Dissertation Abstracts	ProQuest Digital Dissertations
Britannica.com	Encyclopedia Britannica
Papers First	British Library Association
Wilson Select Plus	OCLC
ABI Inform	OCLC
TRAN web	Northwestern University Transportation Library
First Search	OCLC
Articles First	OCLC
ASCE Journal Database	American Society of Civil Engineers
Infotrac	Infotrac
Web of Science	ISI Database
Periodical Abstracts	OCLC
U.S. DOT	U.S. Department of Transportation
University of Houston Life Cycle Costing Reference List	University of Houston
Engineered Materials Abstracts	Cambridge Scientific Abstracts

APPENDIX B – DATABASE CONTENTS BY RECORD NUMBER

1. National Engineering Technology Corporation (Beal, D.B.)
Life cycle cost analysis for bridges
National Cooperative Highway Research Program
09/01/00

2. Florida Atlantic University
A unified approach to concrete mix design for durability in cement and life cycle cost optimization
Florida Department of Transportation
09/15/01

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Life cycle costing in municipal construction projects
Journal of Infrastructure Systems, Vol. 1, No. 2, pp. 5-14
1996

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Report on the feasibility of using life cycle cost criteria in evaluation of bridge structural alternatives
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Deterioration models and life cycle costing, for local street concrete pavements, within the city of Stonnington
Transport Proceedings - Conference of the Australian Road Research Board ARRB Transport Research Ltd, Vermont, Australia. p 34-48.
1998

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Concrete Pipe news, VOL. 38 NO. 3, PP. 3-7
1986

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Evaluating FRP bridge costs
Reinf. Plast, 43, No.2, Feb.1999, p.20
1999

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Least cost (Life Cycle) analysis of concrete culvert, storm sewer, and sanitary sewer systems (ASTM Standard)
Jun 95 Copyright, 4 page(s), American Society for Testing and Materials
1995

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Microcomputer analysis for project level PMS life cycle cost studies for rigid pavements
Mar 92 143 page(s), Maryland Univ., College Park. Dept. of Civil Engineering
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