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IBTTA Annual Meeting and Exhibition
Attendee Registration List - By Organization :: September 15 - 17, 2019 :: Halifax, Nova Scotia

First Name	Last Name	Organization	Title	Country	Member Type
Tori	Bentkover	A10 Associates, LLC	Chief Operating Officer	USA	Non-Member
Jessica	Tocco	A10 Associates, LLC	CEO	USA	Non-Member
Sidney	Edmonds	Accenture LLP	Transit and Transportation Lead	USA	Sustaining Member
Martin	Malone	Accenture LLP	Technology Consultant	USA	Sustaining Member
Gary	Markle	Accenture LLP	Director	USA	Sustaining Member
Rowan	Miranda	Accenture LLP	Managing Director-Health & Public Service	USA	Sustaining Member
Jesse	Samberg	Accenture LLP	Sr. Advisor	USA	Sustaining Member
John	Vasilj	Accenture LLP	Managing Director	USA	Sustaining Member
Ricardo	Almeida	Accenture, Consultores De Gestao, S.A.	Principal Director	Portugal	Non-Member
Barry	Colford	AECOM	Vice President and Preservation Practice Leader for Comp	USA	Sustaining Member
Kevin	Cornish	AECOM	Senior Vice President	USA	Sustaining Member
Victoria	Dewey	AECOM	Director of Toll Operations and Delivery Excellence	USA	Sustaining Member
Robert	Edelstein	AECOM	Senior Vice President	USA	Sustaining Member
Jordi	Graells	AECOM	Senior Advisor	USA	Sustaining Member
Rowdy	Kemnitz	AECOM	Director, Operations and Maintenance	USA	Sustaining Member
Carrie	Mackenzie	AECOM	Project Manager	USA	Sustaining Member
Shawn	Moore	AECOM	Senior Toll System Specialist	USA	Sustaining Member
Suzanne	Murtha	AECOM	Associate Vice President, Connected and Automated Tech	USA	Sustaining Member
Brad	White	AECOM	Vice President	USA	Sustaining Member
Ronald	Wilson	AECOM	Director of Operations	USA	Sustaining Member
Richard	Young	AECOM	Vice President, Project Manager	USA	Sustaining Member
Alain	Estiot	AETC	Principal	France	Honorary Member
Massimo	Schintu	AISCAT (Associazione Italiana Società Concessionarie Autostrade e Trafori)	Executive Director	Italy	Group Member
Emanuela	Stocchi	AISCAT (Associazione Italiana Società Concessionarie Autostrade e Trafori)	Director of International Affairs	Italy	Group Member
Sharon	Adair	Alliance for Toll Interoperability	Vice President	USA	Partner
Barbara	O'Connor	Alliance for Toll Interoperability	Director of Business Development	USA	Partner
Maria	Johnson	AllianceOne Receivables Management Inc.	SVP Business Development	USA	Sustaining Member
Phil	Silver	Amazon Web Services	Transportation Leader - State & Local Government	USA	Associate Member
Gavin	O'Donnell	Arup	Associate Director	Ireland	Non-Member
David	O'Keefe	Arup	Director, Intelligent Transport Solutions	Ireland	Non-Member
Christophe	Boutin	ASFA (Association Professionnelle Autoroutes et Ouvrages à Péage)	Executive Director	France	Group Member
Malika	Seddi	ASFA (Association Professionnelle Autoroutes et Ouvrages à Péage)	Director of International Affairs	France	Group Member
René	Moser	ASFINAG	Head of Strategy, International Affairs & Innovation	Austria	Operator Member
Amanda	Corson	Atkins N.A.	VP/Director, Consulting Services Practice	USA	Sustaining Member
Thomas	Delaney	Atkins N.A.	Vice President	USA	Sustaining Member
Rami	Harb	Atkins N.A.	Vice President	USA	Sustaining Member
Ted	Hull-Ryde	Atkins N.A.	Vice President, BD&S, DOT	USA	Sustaining Member
Thomas	Lowe	Atkins N.A.	Senior Division Manager	USA	Sustaining Member
Francis	O'Connor	Atkins N.A.	Senior Vice President, Director of National Tolls	USA	Sustaining Member
Jennifer	Tsien	Atkins N.A.	Program Director	USA	Sustaining Member
Wally	Caldwell	Atlantic Highways Management Corporation Limited	General Manager	Canada	Non-Member
Francisca	Almeida	A-to-Be, powered by Brisa	Marketing Manager	Portugal	Associate Member

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Henrique	Cordeiro	A-to-Be, powered by Brisa	VP Sales, USA	Portugal	Associate Member
Duarte	Marques	A-to-Be, powered by Brisa	Business Development Manager	Portugal	Associate Member
José	Medeiros	A-to-Be, powered by Brisa	Business Development Manager	Portugal	Associate Member
Luis	Nunes	A-to-Be, powered by Brisa	Chief Sales Officer	Portugal	Associate Member
Eduardo	Ramos	A-to-Be, powered by Brisa	CEO	Portugal	Associate Member
Pedro	Sobral	A-to-Be, powered by Brisa	Business Development Manager	Portugal	Associate Member
Jason	Wall	A-to-Be, powered by Brisa	Chief Executive Officer, USA	USA	Associate Member
Jeffrey	Wolff	A-to-Be, powered by Brisa	Vice President	USA	Associate Member
Ilaria	De Biasi	Autostrada del Brennero S.p.A	Project Manager	Italy	Group Member
Gustavo	Baez	Baez Consulting, LLC	President	USA	DBE/WBE/MBE/SBE Member
Danie	Botha	Bakwena Platinum Corridor Concessionaire (PTY) LTD	Pavement & Contracts Engineer	South Africa	Non-Member
Glenn	Deitiker	BancPass, Inc.	Chief Technology Officer	USA	Associate Member
John	Freund	BancPass, Inc.	President	USA	Associate Member
Andrew	Fremier	Bay Area Toll Authority, Metropolitan Transportation Commission	Deputy Executive Director, Operations	USA	Operator Member
Ken	Hoang	Bay Area Toll Authority, Metropolitan Transportation Commission	Deputy Project Manager	USA	Operator Member
Winnie	Lum	Bay Area Toll Authority, Metropolitan Transportation Commission	Financial Analyst	USA	Operator Member
Jim	Macrae	Bay Area Toll Authority, Metropolitan Transportation Commission	Principal Project Manager - Express Lanes	USA	Operator Member
Victor	Wong	Bay Area Toll Authority, Metropolitan Transportation Commission	Financial Analyst	USA	Operator Member
Nisa	Hester	Bechtel Infrastructure Corporation	Project Coordinator	USA	Associate Member
John	Tarascio	Bechtel Infrastructure Corporation	Construction Manager	USA	Associate Member
John	Andrews	Bestpass, Inc.	President & CEO	USA	Associate Member
Joe	Clavelle	Bestpass, Inc.	Vice President, Business Development	USA	Associate Member
Heather	Nolan	Bestpass, Inc.	Senior Vice President of Product & Strategy	USA	Associate Member
Warren	Askew	Blue Water Bridge Canada	Chief Operating Officer	Canada	Operator Member
Gabriel	Calvert	BRiC-TPS LLC	Program	USA	Associate Member
Chris	Hurley	BRiC-TPS LLC	Chief Financial Officer	USA	Associate Member
Rukesh	Maharaj	BRiC-TPS LLC	COO	USA	Associate Member
Isabel	Meharry	Buffalo & Fort Erie Public Bridge Authority	Director	USA	Non-Member
Ron	Rienas	Buffalo & Fort Erie Public Bridge Authority	General Manager	USA	Non-Member
Joseph	Andl	Burlington County Bridge Commission	Deputy Executive Director	USA	Operator Member
Stanley	Ozalis	Burlington County Bridge Commission	Director of IT and ETC	USA	Operator Member
James	Shanahan	CardConnect	President-CardConnect East	USA	Associate Member
Rush	Taggart	CardConnect	Technical Sales Executive	USA	Associate Member
David	Aron	CDM Smith	Planner V	USA	Sustaining Member
James	Beattie	CDM Smith	CSL / Senior Program Manager	USA	Sustaining Member
Yagnesh	Jarmarwala	CDM Smith	Senior Project Manager	USA	Sustaining Member
Kamran	Khan	CDM Smith	Senior Vice President	USA	Sustaining Member
Marwan	Madi	CDM Smith	National Technology Practice Lead	USA	Sustaining Member
Christopher	Mwalwanda	CDM Smith	Vice President, Client Service Manager, Toll Finance & Tec	USA	Sustaining Member
Edward	Regan	CDM Smith	Senior Vice President	USA	Sustaining Member
Terri	Slack	CDM Smith	Vice President, National Toll Program Manager	USA	Sustaining Member
William	Chapman	Central Texas Regional Mobility Authority	Chief Financial Officer	USA	Operator Member

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Jeffrey	Dailey	Central Texas Regional Mobility Authority	Deputy Executive Director	USA	Operator Member
Dee Anne	Heath	Central Texas Regional Mobility Authority	Director of External Affairs	USA	Operator Member
Steve	Pustelnyk	Central Texas Regional Mobility Authority	Director of Community Relations	USA	Operator Member
David	Singleton	Central Texas Regional Mobility Authority	Board Member	USA	Operator Member
Jeffrey	Holland	Chesapeake Bay Bridge-Tunnel District	Executive Director	USA	Operator Member
John	Malbon	Chesapeake Bay Bridge-Tunnel District	Commissioner	USA	Operator Member
Thomas	Meehan	Chesapeake Bay Bridge-Tunnel District	Commission Vice President	USA	Operator Member
Frederick	Stant	Chesapeake Bay Bridge-Tunnel District	Commissioner	USA	Operator Member
Michael	Giambra	Chubb	Vice President, Inland Marine - Engineered Risks	USA	Associate Member
Eric	McWhorter	Citilog	Business Development Manager – North America West	USA	Non-Member
Ryan	Eskridge	CMI Group	Director of Sales	USA	Associate Member
Tawnya	Clark	Cofiroute USA, LLC	Chief Operating Officer & Chief Commercial Officer	USA	Sustaining Member
David	Hartt	Cofiroute USA, LLC	Senior Vice President, IT	USA	Sustaining Member
Gary	Hausdorfer	Cofiroute USA, LLC	President & Chief Executive Officer	USA	Sustaining Member
Gabriel	Valadez	Cofiroute USA, LLC	Program Manager	USA	Sustaining Member
Craig	Bettmann	Cogensia	Senior Vice President, Client Solutions	USA	Associate Member
Patrick	Riley	Cogensia	Vice President, Business Development	USA	Associate Member
Richard	Mudge	Compass Transportation and Technology		USA	Associate Member
Buzz	Holland	Computer Aid, Inc. - Tolls Practice	Senior Business Consultant	USA	Sustaining Member
Clayton	Howe	Computer Aid, Inc. - Tolls Practice	Director Business Development	USA	Sustaining Member
Marc	Deflin	Conduent Transportation	Senior Director	USA	Sustaining Member
Scott	Doering	Conduent Transportation	Vice President and General Manager	USA	Sustaining Member
Joy	Jacob	Conduent Transportation	Marketing Manager	USA	Sustaining Member
Ken	Philmus	Conduent Transportation	Senior Director, Global Business Development	USA	Sustaining Member
David	Schnell	Conduent Transportation	Senior Director	USA	Sustaining Member
Andrew	Tate	Conduent Transportation	Director, Sales - Tolling	USA	Sustaining Member
Reid	Kuhn	CSG Systems	Sales Director	USA	Associate Member
Michael	Woods	CSG Systems	Client Business Executive, Customer Communications Ma	USA	Associate Member
Joe	Custer	Cubic Transportation Systems, Inc.	VP, Finance & Strategy	USA	Sustaining Member
Tim	Morrison	Cubic Transportation Systems, Inc.	Services Operations Director	USA	Sustaining Member
Chris	Walsh	Cubic Transportation Systems, Inc.	Sr Solutions Architect	USA	Sustaining Member
Ian	Woodroffe	Cubic Transportation Systems, Inc.	Sr VP, Strategy & Business Development	USA	Sustaining Member
Andrew	Joyce	CVO Holding Company, LLC	Program Manager	USA	DBE/WBE/MBE/SBE Member
Joseph	Soliz	CVO Holding Company, LLC	Business Development Manager	USA	DBE/WBE/MBE/SBE Member
Jason	Morrison	Daktronics	Transportation Niche Manager	USA	Non-Member
Lauren	Willoughby	Darlington Partners	Senior Investment Associate	USA	Non-Member
George	Christopher	Douglas Stuart LLC	CEO	USA	DBE/WBE/MBE/SBE Member
Mario	Toscano	Drive Engineering Corp.	President, Sr. ITS/Traffic Engineer	USA	DBE/WBE/MBE/SBE Member
Donald	Cohrs	Dulles Greenway (TRIP II)	Chief Operating Officer	USA	Non-Member
Eric	Hunn	Duncan Solutions, Inc.	VP, Tolling, DMV Services and Collection Services	USA	Associate Member
Francoise	Bergan	E-470 Public Highway Authority	Board Member	USA	Operator Member
Jessica	Carson	E-470 Public Highway Authority	Director of Operations	USA	Operator Member

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John	Diak	E-470 Public Highway Authority	Board Member	USA	Operator Member
Steven	Douglas	E-470 Public Highway Authority	Board Member	USA	Operator Member
Bill	Holen	E-470 Public Highway Authority	Board Member	USA	Operator Member
Kenneth	Kreutzer	E-470 Public Highway Authority	Board Member	USA	Operator Member
Roger	Partridge	E-470 Public Highway Authority	Board Member	USA	Operator Member
Tim	Stewart	E-470 Public Highway Authority	Executive Director	USA	Operator Member
Charles	Tedesco	E-470 Public Highway Authority	Board Member	USA	Operator Member
Heidi	Williams	E-470 Public Highway Authority	Board Member	USA	Operator Member
Ramon	Borges	EAC Consulting, Inc.	ITS/Tolling Solutions Lead Engineer	USA	Associate Member
Enrique	Crooks	EAC Consulting, Inc.	President	USA	Associate Member
Andrew	Pierce	EAC Consulting, Inc.	Senior Project Manager	USA	Associate Member
Naoki	Kobayashi	East Nippon Expressway Company Limited	General Manager	Japan	Operator Member
Arata	Shirato	East Nippon Expressway Company Limited	Manager	Japan	Operator Member
Tomomichi	Takahashi	East Nippon Expressway Company Limited	Managing Director/Senior Executive Officer/Operation Director	Japan	Operator Member
Yuki	Terada	East Nippon Expressway Company Limited	Chief Manager	Japan	Operator Member
Martin	Stone	Egis	Chief Operating Officer, Business Development	USA	Sustaining Member
Imran	Virani	Egis	CFO	France	Sustaining Member
Madeline	Washington	Egis	Controller	USA	Sustaining Member
David	Sullivan	Elizabeth River Crossings, OpCo LLC	Director of Revenue	USA	Operator Member
Mahrokh	Arefi	emovis	CEO (U.S.)	USA	Associate Member
Daniel	Freitas	emovis	IT Manager	USA	Associate Member
Sylvain	Gaudreau	emovis	Support & Services Manager	USA	Associate Member
Serge	Le Yannou	emovis	Head of Central Support & Services	USA	Associate Member
Charlie	Mitchell	emovis	Senior Program Manager	USA	Associate Member
Juan	Rodriguez	emovis	Project Manager	USA	Associate Member
Benoît	Rossi	emovis	Head of Marketing & Communication	France	Associate Member
David	Blackstock	ETC	Manager, Software Delivery	USA	Sustaining Member
Simon	Cheng	ETC	Executive Vice President, Back Office Systems	USA	Sustaining Member
Kevin	Holbert	ETC	Executive Vice President, Business Development	USA	Sustaining Member
Bret	Kidd	ETC	CEO	USA	Sustaining Member
Colleen	Lauless	ETC	Marketing Communications Manager	USA	Sustaining Member
Randy	Moore	ETC	Vice President, Business Development	USA	Sustaining Member
Raj	Nagaraju	ETC	Director, Back Office Systems	USA	Sustaining Member
Tom	Owen	ETC	Executive Vice President, Roadside Solutions	USA	Sustaining Member
Julia	Waterson	ETC	Executive Vice President of Finance	USA	Sustaining Member
Saida	Williams	ETC	Director, Marketing and Business Development	USA	Sustaining Member
Richard	Adler	E-Transit, Inc.	President	USA	Associate Member
Kevin	Harbarger	Eurofins MET Laboratories, Inc	Senior Business Development Executive	USA	Associate Member
P.J.	Wilkins	E-ZPass Group/IAG Service Corp.	Executive Director	USA	Associate Member
Ron	Fagan	Fagan Consulting	Managing Partner	USA	Associate Member
Claudio	Occhipinti	Fagan Consulting	Senior Transportation Systems Consultant	USA	Associate Member
Robert	Redding	Fagan Consulting	Senior Transportation Consultant	USA	Associate Member

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Nanette	Harrell	Faneuil, Inc.	Managing Director - Transportation, Head of Digital	USA	Sustaining Member
Anna	Van Buren	Faneuil, Inc.	President & CEO	USA	Sustaining Member
Sascha	Schoell	FEIG ELECTRONIC GmbH	Key Account Manager	Germany	Non-Member
Frank	McCartney	FGM Consulting	Principal	USA	Honorary Member
John	Flynn	Fiserv	Sales Executive	USA	Non-Member
Cherian	George	Fitch Ratings	Global Head of Infrastructure and Project Finance	USA	Sustaining Member
Scott	Monroe	Fitch Ratings	Director	USA	Sustaining Member
Anne	Tricerri	Fitch Ratings	Associate Director	USA	Sustaining Member
Danny	Lengyel	Fortran	VP	Canada	Non-Member
Hung Ji	Wang	Freeway Bureau	Branch Chief of First Engineering Office	Taiwan Republic of China	Operator Member
Michael	Holder	Gannett Fleming	Vice President, Transportation Services	USA	Associate Member
Jason	McCartney	Gannett Fleming	Project Manager	USA	Associate Member
Keith	Mullins	Gannett Fleming	Vice President	USA	Associate Member
Matthew	Schiemer	Gannett Fleming	Vice President	USA	Associate Member
Jeff	Weiss	Gannett Fleming	Senior Toll Consultant	USA	Associate Member
Andrew	Passen	GC Services Limited Partnership	Director, Business Development	USA	Non-Member
Jeffrey	Mulder	Gentex Corporation	Product Engineer	USA	Non-Member
Patricia	Horan	GeoPat Consulting LLC	Principal	USA	DBE/WBE/MBE/SBE Member
Richard	Carrier	GeoToll, Inc.	CEO	USA	Associate Member
Kirk	Logan	Global Agility Solutions	Vice President of Client Services	USA	Associate Member
Martin	Tyson	Global Agility Solutions	Chief Revenue Officer	USA	Associate Member
William	Doughty	Greenman-Pedersen, Inc.	Project Manager / Team Leader	USA	Sustaining Member
Paul	Forte	Greenman-Pedersen, Inc.	Director of Special Projects	USA	Sustaining Member
Joseph	Nemmer	Greenman-Pedersen, Inc.	Executive Vice President / WNY Branch Manager	USA	Sustaining Member
Peter	Blight	Halifax Harbour Bridges	Colliers Project Manager	Canada	Operator Member
Bill	Book	Halifax Harbour Bridges	Board Member	Canada	Operator Member
Ahsan	Chowdhury	Halifax Harbour Bridges	Bridge Engineer	Canada	Operator Member
Vicki	Harnish	Halifax Harbour Bridges	Board Member	Canada	Operator Member
Kathy	Jourdain	Halifax Harbour Bridges	Consultant	Canada	Operator Member
Cheryl	Kempton	Halifax Harbour Bridges	MACPASS Supervisor	Canada	Operator Member
Shawn	Laba	Halifax Harbour Bridges	Tolling Supervisor	Canada	Operator Member
Daryl	Lowe	Halifax Harbour Bridges	Operations Manager	Canada	Operator Member
Alison	MacDonald	Halifax Harbour Bridges	Communications Manager	Canada	Operator Member
Lisa	Mackinnon	Halifax Harbour Bridges	Finance Supervisor	Canada	Operator Member
Janet	MacMillan	Halifax Harbour Bridges	Board Member	Canada	Operator Member
Michael	McFeters	Halifax Harbour Bridges	Chief Financial Officer	Canada	Operator Member
Sheri	Murphy	Halifax Harbour Bridges	Manager, Tolling & Technology	Canada	Operator Member
Dave	Power	Halifax Harbour Bridges	HHB Safety Consultant	Canada	Operator Member
Frank	Robinson	Halifax Harbour Bridges	Maintenance Engineer	Canada	Operator Member
Steven	Snider	Halifax Harbour Bridges	General Manager & CEO	Canada	Operator Member
Stephan	Heimburg	Hardesty & Hanover, LLC	Highway Practice Lead	USA	Non-Member
Jamshid	Raofi	Hardesty & Hanover, LLC	Business Development	USA	Associate Member

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Vince	LoBianco	Harris & Harris, Ltd	Vice President, Sales	USA	Associate Member
Dennis	Bruce	HDR	Principal Economist	Canada	Associate Member
Andrew	Cadmus	HDR	Toll Operations Consultant	USA	Associate Member
Carrie	McInerney	HDR	Section Manager ATST	USA	Associate Member
Carita	Parks	HDR	Senior Communications Coordinator	USA	Associate Member
Carl	Wong	HDR	Associate Vice President	Canada	Associate Member
Joey	Yang	HDR	Director of Transportation Technology	USA	Associate Member
Bill	Halkias	HELLASTRON (Hellenic Association of Toll Roads Network)	IRF President	Greece	Group Member
Stavros	Stavris	HELLASTRON (Hellenic Association of Toll Roads Network)	President	Greece	Group Member
Paul	Richard	Highway 104 Western Alignment Corporation	General Manager	Canada	Non-Member
Koji	Hokke	Highway Toll Systems Co., Ltd.	General Director	Japan	Associate Member
Shingo	Miyamoto	Highway Toll Systems Co., Ltd.	Deputy Manager	Japan	Associate Member
Naoki	Ohta	Highway Toll Systems Co., Ltd.	Board Member	Japan	Associate Member
Akira	Saigo	Highway Toll Systems Co., Ltd.	Senior Manager	Japan	Associate Member
Takeshi	Wada	Highway Toll Systems Co., Ltd.	Senior Engineer	Japan	Associate Member
Snehal	Ambare	HNTB Corporation	Project Manager	USA	Sustaining Member
Nicholas	Antonucci	HNTB Corporation	Vice President	USA	Sustaining Member
Phillip	Brake	HNTB Corporation	Senior Vice President	USA	Sustaining Member
Scott	Cooper	HNTB Corporation	Vice President, National Toll Practice Consultant	USA	Sustaining Member
Tim	Cote	HNTB Corporation	Associate Vice President	USA	Sustaining Member
James	Drapp	HNTB Corporation	Vice President	USA	Sustaining Member
James	Ely	HNTB Corporation	National Tolls Advisor	USA	Sustaining Member
Spencer	Franklin	HNTB Corporation	Vice President	USA	Sustaining Member
Tim	Garrett	HNTB Corporation	Vice President	USA	Sustaining Member
Brad	Guilmino	HNTB Corporation	Director of Advisory	USA	Sustaining Member
Stephen	Haag	HNTB Corporation	Chief Information Officer	USA	Sustaining Member
Kevin	Haboian	HNTB Corporation	Chief Sales Officer	USA	Sustaining Member
Arthur	Hadnett	HNTB Corporation	Regional Growth Officer	USA	Sustaining Member
Richard	Herrington	HNTB Corporation	Vice President, National Toll Sector Director	USA	Sustaining Member
Kevin	Hoeflich	HNTB Corporation	Chairman, Toll Services	USA	Sustaining Member
Greg	Hulsizer	HNTB Corporation	Vice President, Toll Market Practice Leader, West Division	USA	Sustaining Member
Thomas	Hutchinson	HNTB Corporation	Associate Vice President	USA	Sustaining Member
Mike	Inabinet	HNTB Corporation	Central U.S. President	USA	Sustaining Member
Steve	Knobbe	HNTB Corporation	Vice President	USA	Sustaining Member
Kristi	Lafleur	HNTB Corporation	Consultant	USA	Sustaining Member
Tanya	Langman	HNTB Corporation	Director of Financial Services	USA	Sustaining Member
Roland	Lavallee	HNTB Corporation	Vice President	USA	Sustaining Member
Alex	Lawrason	HNTB Corporation	Associate Vice President	USA	Sustaining Member
Gregory	Le Frois	HNTB Corporation	Senior Vice President	USA	Sustaining Member
Christopher	Lester	HNTB Corporation	Deputy Office Leader	USA	Sustaining Member
Chris	Lory	HNTB Corporation	VP, Tolls Practice Leader	USA	Sustaining Member
John	Lynch	HNTB Corporation	Associate Vice President	USA	Sustaining Member

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Douglas	Mann	HNTB Corporation	Senior Vice President	USA	Sustaining Member
Stephen	Novosad	HNTB Corporation	Associate Vice President	USA	Sustaining Member
Mary Jane	O'Meara	HNTB Corporation	Vice President	USA	Sustaining Member
Daniel	Papiernik	HNTB Corporation	Toll Practice Leader / Mid-Atlantic, Associate Vice-Preside	USA	Sustaining Member
Heather	Reavey	HNTB Corporation	Vice President	USA	Sustaining Member
Robert	Slimp	HNTB Corporation	CEO	USA	Sustaining Member
Alberto	Sosa	HNTB Corporation	Vice President	USA	Sustaining Member
Michael	Sweeney	HNTB Corporation	Executive Vice President	USA	Sustaining Member
David	Talley	HNTB Corporation	Policy and Financial Consultant	USA	Sustaining Member
Emily	Tapia-Lopez	HNTB Corporation	Director of Strategic Initiatives	USA	Sustaining Member
Lisa	Thompson	HNTB Corporation	Vice President	USA	Sustaining Member
Alan	Williamson	HNTB Corporation	Senior Project Manager - Program Management	USA	Sustaining Member
Kary	Witt	HNTB Corporation	Vice President	USA	Sustaining Member
George	Zilocchi	HNTB Corporation	Consultant	USA	Sustaining Member
Usha	Elyatamby	IBI Group	Director, Intelligent Systems	Canada	Sustaining Member
Donovan	Guin	IBM	US Lead, Tolling & Congestion Charging	USA	Sustaining Member
Cheryle	Arnold	IBTTA	Web Services and Event Production	USA	IBTTA Staff
Ancilla	Brady	IBTTA	Director, Membership & Business Development	USA	IBTTA Staff
Kristin	Bromberg	IBTTA	Marketing Manager	USA	IBTTA Staff
Bill	Cramer	IBTTA	Communications Director	USA	IBTTA Staff
Neil	Gray	IBTTA	Director of Government Affairs	USA	IBTTA Staff
Lisa	Jewell	IBTTA	Research Specialist	USA	IBTTA Staff
Pat	Jones	IBTTA	Executive Director and CEO	USA	IBTTA Staff
Wanda	Klayman	IBTTA	Deputy Executive Director	USA	IBTTA Staff
Terri	Lankford	IBTTA	Membership & Business Development Manager	USA	IBTTA Staff
Cindy	Norcross	IBTTA	Director, Research & Technology	USA	IBTTA Staff
Cathy	Pennington	IBTTA	Chief Financial Officer	USA	IBTTA Staff
Harry	Smith	IBTTA	Meeting Registrar, Member Services Manager	USA	IBTTA Staff
Anna	Sohriakoff	IBTTA	Meetings Manager	USA	IBTTA Staff
Tamara	Seaver	Icenogle Seaver Pogue, P.C.	Shareholder	USA	Associate Member
José	Alvarez	Illinois Tollway	Executive Director	USA	Operator Member
John	Mashia	IMS, Inc	President & COO	USA	Associate Member
Lee	Vanderpool	IMS, Inc	CEO	USA	Associate Member
Mark	Vanderpool	IMS, Inc	Director of Business Development	USA	Associate Member
Brian	Patno	Indra	Director, Transportation USA	USA	Associate Member
Scot	Goettsch	INEX TECHNOLOGIES	VP of Sales, Global Tolling Solutions	USA	Associate Member
Alex	Sarin	INEX TECHNOLOGIES	Vice President of Product Development	USA	Associate Member
Arthur	Korfin	Innovative Products LLC	President	USA	Associate Member
Geoff	Korfin	Innovative Products LLC	Vice President	USA	Associate Member
Johnny	Redman	Intercomp Company	Transportation & Enforcement Manager	USA	DBE/WBE/MBE/SBE Member
Marc	Ott	International City/County Management Association	Executive Director	USA	Non-Member
Peter	Federhko	International Road Dynamics, Inc.	Vice President of North America Sales	Canada	Non-Member

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Rish	Malhotra	International Road Dynamics, Inc.	Regional Manager	Canada	Non-Member
Mark	Bandy	Jacobs Engineering Group	Regional Solutions Leader - Americas West	USA	Sustaining Member
Stan	Cann	Jacobs Engineering Group	Director of Transportation	USA	Sustaining Member
Michael	Werner	Jacobs Engineering Group	Program Director	USA	Sustaining Member
Carol	Bozarth	Jafa Technologies, Inc.	President	USA	DBE/WBE/MBE/SBE Member
Robert	Frank	Jafa Technologies, Inc.	Senior Toll Consultant	USA	DBE/WBE/MBE/SBE Member
Edward	Mulka	Jafa Technologies, Inc.	Executive Vice President	USA	DBE/WBE/MBE/SBE Member
Frank	Long	JAI Traffic Solutions	Director of Sales, Traffic Solutions	USA	Associate Member
Richard	Schlittler	JAI Traffic Solutions	ITS Field Engineer	USA	Associate Member
Altamash	Ahmed	Kapsch TrafficCom	Vice President- Back Office Solution Center, NA	USA	Sustaining Member
Christopher	Body	Kapsch TrafficCom	Vice President, Sales - NE Region	USA	Sustaining Member
Nicole	Busse	Kapsch TrafficCom	Senior Manager, Marketing & Communications	USA	Sustaining Member
Robert	Corion	Kapsch TrafficCom	Senior Vice President Delivery and Operations	USA	Sustaining Member
Edward	Fuchs	Kapsch TrafficCom	Director of Pricing Management	USA	Sustaining Member
Don	Hicks	Kapsch TrafficCom	Vice President, Sales and Business Development - Southern	USA	Sustaining Member
Raman	Jafroudi	Kapsch TrafficCom	Director of Sales, Canada	USA	Sustaining Member
JB	Kendrick	Kapsch TrafficCom	Senior Vice President	USA	Sustaining Member
Tim	Klawa	Kapsch TrafficCom	Sr. Pre-Sales Engineer	USA	Sustaining Member
Steve	Little	Kapsch TrafficCom	Mid-Atlantic Regional Manager	USA	Sustaining Member
Chelsie	McKittrick	Kapsch TrafficCom	Marketing Communications Project Manager	USA	Sustaining Member
Christopher	Murray	Kapsch TrafficCom	President & CEO	USA	Sustaining Member
Jaymin	Patel	Kapsch TrafficCom	Solution and Product Manager, Tags, Readers, Antennas	Canada	Sustaining Member
Andrew	Peppard	Kapsch TrafficCom	Director, Sales	USA	Sustaining Member
Duffy	Sardo	Kapsch TrafficCom	Vice President eCommerce & Digital Business	USA	Sustaining Member
Thomas	Siegl	Kapsch TrafficCom	Director Product Delivery	Austria	Sustaining Member
Darby	Swank	Kapsch TrafficCom	Vice President of Electronic Tolling Solutions	USA	Sustaining Member
Daniel	Toohey	Kapsch TrafficCom	Vice President Sales, Program Manager - E-ZPass	USA	Sustaining Member
Richard	Van Hyning	Kapsch TrafficCom	Regional Technical Delivery Manager	USA	Sustaining Member
Lee	Ensminger	KCI Technologies, Inc.	Project Manager	USA	Non-Member
Elizabeth	Yue	Kentucky Transportation Cabinet	Innovative Finance Analyst	USA	Operator Member
Mary	Doherty	Keville Enterprises Inc.	Office Manager	USA	DBE/WBE/MBE/SBE Member
Christine	Keville	Keville Enterprises Inc.	President & CEO	USA	DBE/WBE/MBE/SBE Member
Jess	Helmlinger	Kistler Instrument Corporation	Business Director	USA	Non-Member
Julia	Bennett-Ward	KPMG LLP	Manager	USA	Associate Member
Cesar	Diaz-Plaza Perez	KPMG LLP	Director, Deal Advisory	USA	Associate Member
Christopher	Melton	Kyra Solutions, Inc.	VP / Managing Director	USA	Sustaining Member
Devang	Patel	Kyra Solutions, Inc.	VP of Consulting & Projects	USA	Sustaining Member
Catherine	Larson	Larson Consulting Associates LLC	CEO	USA	DBE/WBE/MBE/SBE Member
Marie-Florence	Chandonnet	LeddarTech	Account Manager	Canada	Non-Member
Dominic	Otis	LeddarTech	Field Application Engineer	Canada	Non-Member
Nathan	Maloney	Leonardo/ELSAG LPR Solutions	Vice President, Marketing & Communications	USA	Associate Member
Ben	Miller	Leonardo/ELSAG LPR Solutions	VP International and New Business Development	USA	Associate Member

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First Name	Last Name	Organization	Title	Country	Member Type
Laura	Huizinga-Barton	Lindsay Transportation Solutions	Regional Manager	USA	Associate Member
Brian	Harms	Linebarger Law Firm	Toll Operations Director	USA	Sustaining Member
James	Harris	Linebarger Law Firm	Partner & National Tolls Director	USA	Sustaining Member
Billy	Rodgers	Linebarger Law Firm	National Marketing	USA	Sustaining Member
Stuart	Rankin	Louis Berger U.S.	Engineer	USA	Sustaining Member
Jignesh	Patel	Lumenor Consulting Group	President	USA	Non-Member
Bruce	Van Note	Maine Department of Transportation	Commissioner	USA	Operator Member
Erin	Courtney	Maine Turnpike Authority	Public Outreach & Marketing Manager	USA	Operator Member
Douglas	Davidson	Maine Turnpike Authority	CFO and Treasurer	USA	Operator Member
John	Sirois	Maine Turnpike Authority	Director of Finance	USA	Operator Member
Richard	Somerville	Maine Turnpike Authority	Director of E-ZPass Operations	USA	Operator Member
William	Yates	Maine Turnpike Authority	Director of IS and Communications	USA	Operator Member
John	O'Neill	Maryland Transportation Authority	Chief Operating Officer	USA	Operator Member
Mohamed	Meguid	McGill University	Professor	Canada	Non-Member
Stephan	Andriuk	Miami-Dade Expressway Authority	Deputy Executive Director/Director of Toll Operations	USA	Operator Member
Javier	Rodriguez	Miami-Dade Expressway Authority	Executive Director	USA	Operator Member
Juan	Toledo	Miami-Dade Expressway Authority	Deputy Executive Director/Director of Engineering	USA	Operator Member
Larry	Bankert, Jr.	Michael Baker International	Associate Vice President, Toll Services	USA	Sustaining Member
Christine	Caruso	Milligan Partners LLC	Project Manager	USA	Associate Member
Keziah	Cruz	Milligan Partners LLC	Management Analyst	USA	Associate Member
Dave	DiAngelo	Milligan Partners LLC	Toll Systems Specialist	USA	Associate Member
Kevin	Ko	Milligan Partners LLC	Blockchain Developer	USA	Associate Member
Matt	Milligan	Milligan Partners LLC	Managing Partner	USA	Associate Member
Tyler	Milligan	Milligan Partners LLC	Managing Partner	USA	Associate Member
Jack	Opiola	Mobility Plus LLC	President/CEO	USA	Associate Member
Justine	Tietjen	MTA Bridges and Tunnels	Deputy Chief Engineer	USA	Operator Member
Dave	Sullivan	Multilink, Inc.	DOT / Transportation President	USA	Associate Member
Michael	Burchell	Neology	Technical Sales Engineer	USA	Sustaining Member
William	DeSena	Neology	Program Manager	USA	Sustaining Member
Sean	Zeng	Neology	VP Business Development	USA	Sustaining Member
John	Keller	New Jersey Turnpike Authority	Executive Director	USA	Operator Member
Takeo	Nakamura	NEXCO-Central	Management Officer	Japan	Operator Member
Atsushi	Onishi	NEXCO-Central	Employee	Japan	Operator Member
Hidemitsu	Yumoto	NEXCO-Central	Director	Japan	Operator Member
Kenneth	Bieger	Niagara Falls Bridge Commission	Chief Executive Officer	USA	Non-Member
Stephanie	Dafoe	Niagara Falls Bridge Commission	Manager of Human Resources, Security & Agency Relatio	USA	Non-Member
Lew	Holloway	Niagara Falls Bridge Commission	Director	USA	Non-Member
Barton	Maves	Niagara Falls Bridge Commission	Commissioner	Canada	Non-Member
Charles	McShane	Niagara Falls Bridge Commission	Commissioner	Canada	Non-Member
Marvin	Butler	North Carolina Department of Transportation, Turnpike Authority	Deputy Director	USA	Operator Member
James	Eden	North Carolina Department of Transportation, Turnpike Authority	Executive Director	USA	Operator Member
Tim	Carter	North Texas Tollway Authority	Board Member	USA	Operator Member

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James	Hofmann	North Texas Tollway Authority	Executive Director and CEO	USA	Operator Member
John	Mahalik	North Texas Tollway Authority	Board Member	USA	Operator Member
Benton	Tempas	Northwest Parkway LLC	IT Director	USA	Operator Member
David	Ling	Nova Scotia Department of Transportation and Infrastructure Renewal	Toll Operations Manager	Canada	Non-Member
Troy	Webb	Nova Scotia Department of Transportation and Infrastructure Renewal	District Director	Canada	Non-Member
Lauren	Hakos	Ohio Turnpike and Infrastructure Commission	Training and Development Manager	USA	Operator Member
Anthony	Yacobucci	Ohio Turnpike and Infrastructure Commission	Chief Engineer	USA	Operator Member
David	Machamer	Oklahoma Turnpike Authority	Assistant Executive Director, PIKEPASS and Toll Operation	USA	Operator Member
Kirk	Avila	Orange County Transportation Authority	General Manager	USA	Operator Member
Ellen	Lee	Orange County Transportation Authority	Project Manager	USA	Operator Member
Blanca	Perez-Marin	Parsons Corporation	Senior Project manager	Canada	Associate Member
Marcus	Flores	Passport Labs, Inc.	Associate Product Manager	USA	Associate Member
Khristian	Gutierrez	Passport Labs, Inc.	Chief Revenue Officer	USA	Associate Member
Zach	Toomey	Passport Labs, Inc.	Sales Executive	USA	Associate Member
Tom	Wiese	Passport Labs, Inc.	Director, Tolling & Transit	USA	Associate Member
Tom	DiGiacomo	Payit, LLC	Director of Business Development	USA	Associate Member
Mike	Wons	Payit, LLC	Chief Client Officer	USA	Associate Member
Harold	Worrall	PayTollo	Consultant	USA	Associate Member
Abenezzer	Yohalashet	PayTollo	Head of Tolling	USA	Associate Member
Philip	Mennell	Penn Credit Corporation	Senior Business Development Executive	USA	Associate Member
George	Nyikita	Pennoni Associates Inc.	Senior Consultant	USA	Associate Member
Jeffrey	Purdy	Pennoni Associates Inc.	Associate Vice President	USA	Associate Member
Mark	Compton	Pennsylvania Turnpike Commission	Chief Executive Officer	USA	Operator Member
Kenneth	Juengling	Pennsylvania Turnpike Commission	GeoAnalytics Information Officer	USA	Operator Member
Myneca	Ojo	Pennsylvania Turnpike Commission	Director of Diversity and Inclusion	USA	Operator Member
Christopher	Parker	Pennsylvania Turnpike Commission	Traffic Operations Manager	USA	Operator Member
Stacia	Ritter	Pennsylvania Turnpike Commission	Director of Policy & Fare Collection	USA	Operator Member
Timothy	Scanlon, PE	Pennsylvania Turnpike Commission	Director of Traffic Engineering and Operations	USA	Operator Member
Craig	Shuey	Pennsylvania Turnpike Commission	Chief Operating Officer	USA	Operator Member
Robert	Taylor	Pennsylvania Turnpike Commission	Chief Technology Officer	USA	Operator Member
Fred	Kowell	Port of Hood River	Chief Financial Officer	USA	Operator Member
Michael	Burgess	Prime AE Group, Inc.	Sr. Vice President	USA	Non-Member
Michael	Tamer	Proponisi	Chief Executive Officer	USA	Associate Member
Scott	Thomas	Proponisi	Senior Partner	USA	Associate Member
Reddy	Patlolla	P-Square Solutions LLC	President	USA	DBE/WBE/MBE/SBE Member
Shane	Savgur	P-Square Solutions LLC	Vice President, System Engineering	USA	DBE/WBE/MBE/SBE Member
Kenneth	Kolberg	PSS	Roadway Safety Consultant	USA	Associate Member
Adam	Leigh	PSS	Safety Consultant	USA	Associate Member
David	McKee	PSS	Vice President of Sales and Marketing	USA	Associate Member
Craig	McLwee	Q-Free	Director of Tolling Product Development	USA	Associate Member
Jos	Nijhuis	Q-Free	CEO	Netherlands	Associate Member
Bill	Rapp	Q-Free	Executive Vice President of Tolling Solutions	USA	Associate Member

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First Name	Last Name	Organization	Title	Country	Member Type
Mary	Brooks	Quest Corporation of America, Inc.	Vice President	USA	DBE/WBE/MBE/SBE Member
Jill	Cappadoro	Quest Corporation of America, Inc.	Vice President	USA	DBE/WBE/MBE/SBE Member
Robert	Combs	RapidToll Systems, Inc.	President	USA	Associate Member
Richard	Dunne	Raytheon HTMS	Business Development Director, NMS Product Support, In	USA	Sustaining Member
Seamus	McCormick	Raytheon HTMS	Director of HTS	USA	Sustaining Member
Colleen	Murphy-Vincent	Raytheon HTMS	Operations & Growth Lead – HTS	USA	Sustaining Member
James	Bird	Red Fox ID LTD	Senior Field Technician	United Kingdom	Associate Member
Steve	Bird	Red Fox ID LTD	Chief Executive Officer	United Kingdom	Associate Member
Paul	Lowry	RevSpring	Director, Business Development	USA	Non-Member
Kathryn	Coleman	Rhode Island Turnpike and Bridge Authority	Manager of Tolling and Operations	USA	Operator Member
Buddy	Croft	Rhode Island Turnpike and Bridge Authority	Executive Director	USA	Operator Member
Kathryn	O'Connor	Rhode Island Turnpike and Bridge Authority	Director of Tolling and Operations	USA	Operator Member
Eric	Offenberg	Rhode Island Turnpike and Bridge Authority	Director of Engineering	USA	Operator Member
Joi	Dean	Richmond Metropolitan Transportation Authority	Chief Executive Officer	USA	Operator Member
Theresa	Simmons	Richmond Metropolitan Transportation Authority	Director of Operations	USA	Operator Member
Mark	Feltham	RideFlag Technologies, Inc.	CTO	Canada	Associate Member
Mike	Papineau	RideFlag Technologies, Inc.	President	Canada	Associate Member
Stephanie	Blanco	Riverside County Transportation Commission	Capital Projects Manager (Toll)	USA	Operator Member
Aaron	Hake	Riverside County Transportation Commission	External Affairs Director	USA	Operator Member
James	Burnett	RK&K	Director	USA	Sustaining Member
David	Raines	RK&K	Senior Manager – Toll Practice Lead	USA	Sustaining Member
Fred	Bergstresser	Royal Truck & Equipment	Government Accounts Manager	USA	Non-Member
Tom	Livingston	RRD	Strategic Sales Executive	USA	Associate Member
Michael	Davis	RS&H	VP, Tolls and Technology Service Group Leader	USA	Associate Member
Kevin	Palmer	RS&H	VP, Tolls Technology Leader	USA	Associate Member
Chelsea	Scheid	RS&H	Structural Engineer	USA	Associate Member
Stephen	Sayle	Sayle Group	CEO	Canada	Non-Member
Susan	Buse	SBuse Consulting	President	USA	DBE/WBE/MBE/SBE Member
Mike	Willingham	Sebring Airport Authority	Executive Director	USA	Non-Member
María	Moreno	SEOPAN	International Department Director	Spain	Group Member
Tad	Galloway	SICK, Inc.	Account Executive	USA	Associate Member
Brian	Owens	SICK, Inc.	Account Manager	Canada	Associate Member
George	Thiel	SICK, Inc.	Account Executive	USA	Associate Member
Max	Crunit	SlotChannelUS, LLC	Principal	USA	Non-Member
Elizabeth	Kaufman	SmartBrief	Account Director	USA	Non-Member
Michael	Brown	Southwest Research Institute	Institute Engineer	USA	Non-Member
Rick	Gobeille	Stantec Consulting Services Inc.	Senior Principal	USA	Sustaining Member
Liz	Horta	Stantec Consulting Services Inc.	Transportation Consultant	USA	Sustaining Member
Suzanne	Seegmuller	Stantec Consulting Services Inc.	Senior Transportation Specialist	USA	Sustaining Member
Richard	Armstrong	Star Systems International, Ltd	Managing Director, Star Systems America	USA	Associate Member
Julie	Cooper	Star Systems International, Ltd	Senior Executive Manager - EMEA	Hong Kong	Associate Member
Stephen	Lockhart	Star Systems International, Ltd	Chief Technology Officer	USA	Associate Member

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First Name	Last Name	Organization	Title	Country	Member Type
Diane	Gutierrez-Scaccetti	State of New Jersey Department of Transportation	Commissioner	USA	Operator Member
Heather	Aquino	State Road & Tollway Authority	Deputy Executive Director	USA	Operator Member
Annie	Gillespie	State Road & Tollway Authority	Director of Engineering	USA	Operator Member
Mary	Sallach	State Road & Tollway Authority	Director of Strategic Initiatives	USA	Operator Member
Christopher	Tomlinson	State Road & Tollway Authority	Executive Director and Board Secretary	USA	Operator Member
Ken	Edwards	Strait Crossing Bridge Limited	Manager of Information Systems	Canada	Non-Member
Lars Fuhr	Pedersen	Sund & Baelt Holding	Technical Director, CTO	Denmark	Non-Member
Kevin	Bennick	SWC Group	Vice President of Business Development	USA	Associate Member
Jeff	Hazzard	SWC Group	COO / President	USA	Associate Member
Jeff	Hurt	SWC Group	CEO	USA	Associate Member
Daniel	Alvarez	Tampa-Hillsborough Expressway Authority	Board Member	USA	Operator Member
Vincent	Cassidy	Tampa-Hillsborough Expressway Authority	Chairman of the Board	USA	Operator Member
Sue	Chrzan	Tampa-Hillsborough Expressway Authority	Director of Public Affairs & Communications	USA	Operator Member
Robert	Frey	Tampa-Hillsborough Expressway Authority	Director of Planning and Innovation	USA	Operator Member
Anna	Quinones	Tampa-Hillsborough Expressway Authority	Project Manager	USA	Operator Member
Joseph	Waggoner	Tampa-Hillsborough Expressway Authority	CEO/Executive Director	USA	Operator Member
Laura	Cardaiolo	Tattile Srl	PM Traffic	Italy	Non-Member
Jim	Kennedy	Tattile Srl	VP Business Development - ALPR	USA	Non-Member
Donald	Halvorsen	TE Connectivity	Business Development Manager	USA	Non-Member
Miso	Mihajlovski	TE Connectivity	Account Manager	USA	Non-Member
Francesco	Del Pizzo	Telepass SpA	Chief Sales Officer	Italy	Sustaining Member
Lisa	Gauvin	The CCS Companies	Vice President, Partnership Development	USA	Associate Member
David	Ulrich	The CCS Companies	SVP Partnership Development	USA	Associate Member
Thye	Lee	The Federal Bridge Corporation Limited	Vice President, Engineering and Construction	Canada	Operator Member
John	Lopinski	The Federal Bridge Corporation Limited	Director	Canada	Operator Member
Colleen	Sim	The Federal Bridge Corporation Limited	Operations Manager	Canada	Operator Member
Mark	Muriello	The Port Authority of New York & New Jersey	Deputy Director, Tunnels, Bridges & Terminals	USA	Operator Member
Wade	Dorland	The Seaway International Bridge Corporation, Ltd.	General Manager	Canada	Operator Member
James	Wheeler	The Seaway International Bridge Corporation, Ltd.	Manager, Maintenance & Technical Services	Canada	Operator Member
Wes	Guckert	The Traffic Group	President & CEO	USA	Non-Member
Robert	Horr	Thousand Islands Bridge Authority	Executive Director	USA	Operator Member
Susan	Mowers	Thousand Islands Bridge Authority	Manager, IT	USA	Operator Member
Timothy	Sturick	Thousand Islands Bridge Authority	Deputy Executive Director	USA	Operator Member
Richard	Arce	TollPlus LLC	COO & CCO	USA	Sustaining Member
Mark	Cantelli	TollPlus LLC	VP, Head of Global Delivery	USA	Sustaining Member
Antoine	Cogez	TollPlus LLC	CFO	USA	Sustaining Member
Suresh	Kakarla	TollPlus LLC	CEO	USA	Sustaining Member
Saïd	Majdi	TollPlus LLC	Senior Solution Architect	USA	Sustaining Member
Jason	Stein	TollPlus LLC	VP, Business Development	USA	Sustaining Member
Ilze	Stander	Trans African Concessions (PTY) Limited	Chief Financial Officer	South Africa	Non-Member
Shimon	Avraham	Trans Israel	Vice President, Concessions	Israel	Non-Member
Greg	Blocker	TransCore, LP	Vice President, International Toll and ITS	USA	Sustaining Member

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First Name	Last Name	Organization	Title	Country	Member Type
Don	Brady	TransCore, LP	Vice President of Business Development	USA	Sustaining Member
Scott	Brosi	TransCore, LP	AVP, Sales	USA	Sustaining Member
Chris	Eeles	TransCore, LP	Vice President, Program Manager	USA	Sustaining Member
Paula	Flowers	TransCore, LP	VP, Legal Affairs	USA	Sustaining Member
Kelly	Gravelle	TransCore, LP	EVP, Chief Technical Officer	USA	Sustaining Member
Yousuf	Kamal	TransCore, LP	Manager, Marketing & Business Development	USA	Sustaining Member
Alice	Klemashevich	TransCore, LP	Associate Vice President	USA	Sustaining Member
Robert	Landry	TransCore, LP	Vice President	USA	Sustaining Member
Barry	Mickle	TransCore, LP	Tolls Program Director	USA	Sustaining Member
Ricky	Nefzer	TransCore, LP	Executive Vice President and General Manager	USA	Sustaining Member
Sean	Persaud	TransCore, LP	VP and Managing Director, North East	USA	Sustaining Member
Dick	Schnacke	TransCore, LP	Vice President, Industry Relations	USA	Sustaining Member
Jim	Wilson	TransCore, LP	Southeast Tolls Program Director	USA	Sustaining Member
Rachel	Cahill	Transport Infrastructure Ireland	Tolling Chief Finance Officer	Ireland	Operator Member
Cathal	Masterson	Transport Infrastructure Ireland	Head of Tolling	Ireland	Operator Member
Samuel	Johnson	Transportation Corridor Agencies	Chief Toll Operations Officer	USA	Operator Member
Michael	Kraman	Transportation Corridor Agencies	Chief Executive Officer	USA	Operator Member
Amy	Potter	Transportation Corridor Agencies	Chief Financial Officer	USA	Operator Member
Michael	Discenza	Transurban	CFO-North America	USA	Operator Member
Adam	Greenhouse	Transurban	Treasury	USA	Operator Member
Trisha	Cinquini	TrustCommerce	Sr. Solutions Consultant	USA	Non-Member
Jee	Kim	TTI Consulting	Business Development Coordinator	USA	Associate Member
Michael	Kolb	TTI Consulting	Principal	USA	Associate Member
Stanley	Weiss	TTI Consulting	Principal	USA	Associate Member
Payman	Dargahi	TxDOT	Toll Operations Manager	USA	Operator Member
Eric	Golynsky	UBS Financial Services, Inc.	Executive Director	USA	Associate Member
Michael	Lexton	UBS Financial Services, Inc.	Managing Director	USA	Associate Member
Julius	Kanyamunyu	Uganda National Roads Authority	Business Development Specialist	Uganda	Operator Member
Jeffrey	Kidwell	UScontracting, Inc.	Senior Integration Engineer	USA	Non-Member
Kevin	Maynard	UScontracting, Inc.	Director of Commercial Products	USA	Non-Member
Philip	Underhill	Verra Mobility	Senior Vice President, Strategic Partnerships	USA	Sustaining Member
Jeremy	Orawiec	Versilis Inc.	Business Development Executive	Canada	Associate Member
Marie-Claude	Séguin	Versilis Inc.	Vice President	Canada	Associate Member
Dan	Schlaff	Via	Urban Mobility Strategist	USA	Non-Member
Andrew	Bunn	Virginia Department of Transportation	Student	USA	Operator Member
David	Caudill	Virginia Department of Transportation	Division Administrator, Tolling Operations Division	USA	Operator Member
Patty	Rubstello	Washington State Department of Transportation	Assistant Secretary, Urban Mobility & Access	USA	Operator Member
Lisa	Goldberg	Weris, Inc.	Talent Acquisition Manager	USA	DBE/WBE/MBE/SBE Member
Melanie	Harrison	Weris, Inc.	Business Development	USA	DBE/WBE/MBE/SBE Member
Zongwei	Tao	Weris, Inc.	President	USA	DBE/WBE/MBE/SBE Member
Christopher	Tremblay	Windsor Detroit Borderlink Limited	Manager, Maintenance & Plant Operations	Canada	Non-Member
Carlos	Campo	WSP USA	Assistant Vice President	USA	Sustaining Member

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First Name	Last Name	Organization	Title	Country	Member Type
Robert	Clifford	WSP USA	Vice President, Area Manager	USA	Sustaining Member
Jeffrey	Heilstedt	WSP USA	Senior Vice President - National Director of Tolling Service	USA	Sustaining Member
David	Huter	WSP USA	Transportation Program Manager	USA	Sustaining Member
Thomas	Krueger	WSP USA	Director of Back Office Tolling Operations	USA	Sustaining Member
Michael	Mangione	WSP USA	Senior Vice President	USA	Sustaining Member
Patrick	McGowan	WSP USA	Senior Vice President, Director Mobility Operations	USA	Sustaining Member
Philip	Miller	WSP USA	Associate Vice President	USA	Sustaining Member
Markell	Moffett	WSP USA	Transportation Operations Strategy Specialist	USA	Sustaining Member
David	Sparks	WSP USA	Director Toll Operations	USA	Sustaining Member
Christopher	Swenson	WSP USA	Assistant Vice President	USA	Sustaining Member
Victor	Teglasi	WSP USA	Senior Supervising Engineer	USA	Sustaining Member
John	Trotta	WSP USA	National Director Client Services	USA	Sustaining Member
Matthew	Woodhouse	WSP USA	Consultant	USA	Sustaining Member
David	Andalcio	Wynndalco Enterprises, LLC	CEO	USA	DBE/WBE/MBE/SBE Member
Mark	Burris	Zachry Department of Civil Engineering, Texas A&M University	Herbert D. Kelleher Professor and Associate Department I	USA	Non-Member

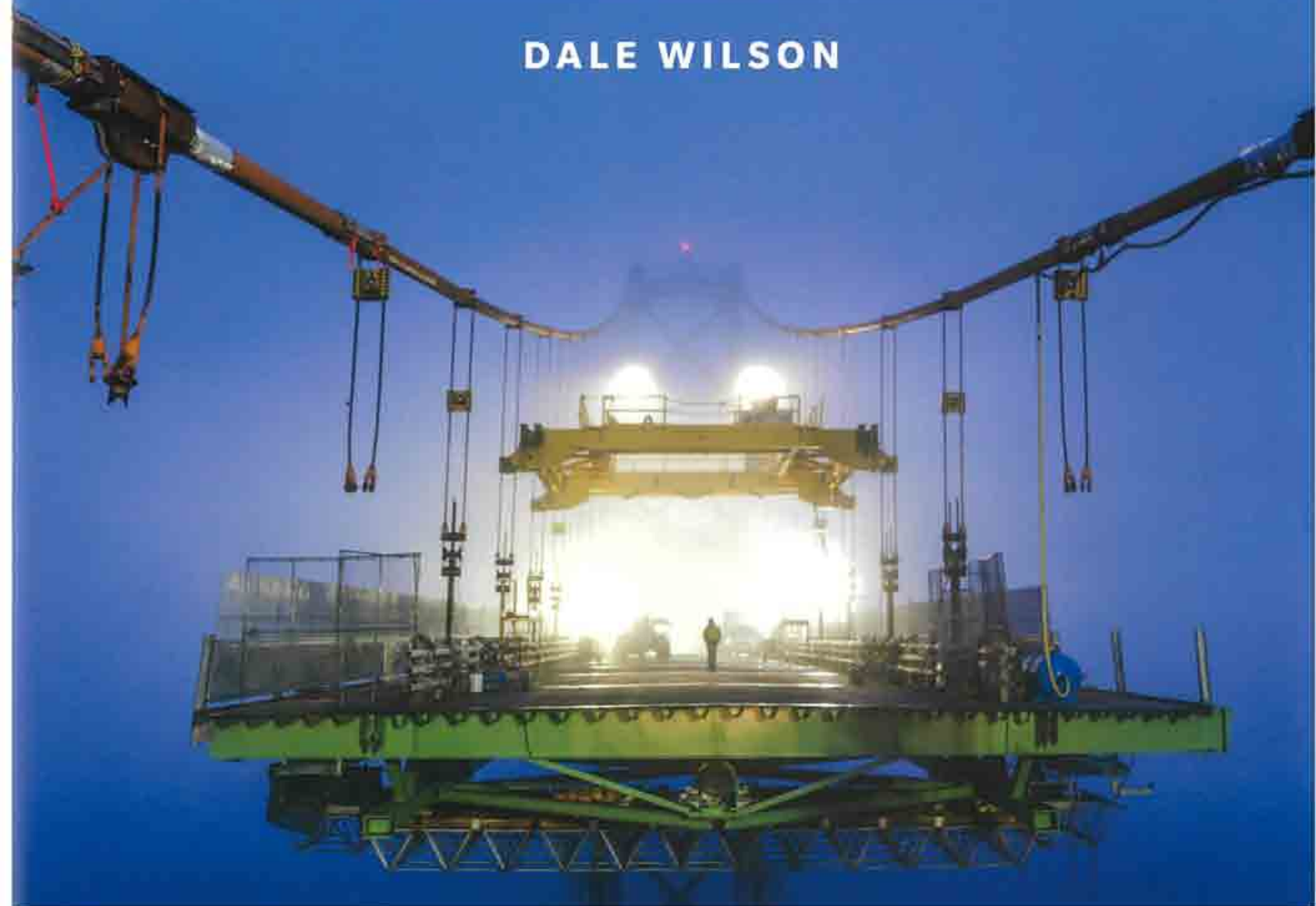
附錄二

大提升計畫(The Big Lift)攝影專輯

THE BIG LIFT

REDECKING THE MACDONALD BRIDGE

DALE WILSON



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Published by:

Halifax Harbour Bridges
125 Wyse Road
Dartmouth, NS, B2Y 3Y2
902.463.2800

Photography by: Dale Wilson, Cow Bay, NS

Design by: Rick Smith, Halifax, NS

Edited by: Alison MacDonald, Dartmouth, NS

Printed and Bound in Canada by: Friesens, Altona, MB

Library and Archives Canada Cataloguing in Publication

Wilson, Dale, author, photographer

The Big Lift : Redecking the Macdonald Bridge / Dale Wilson.

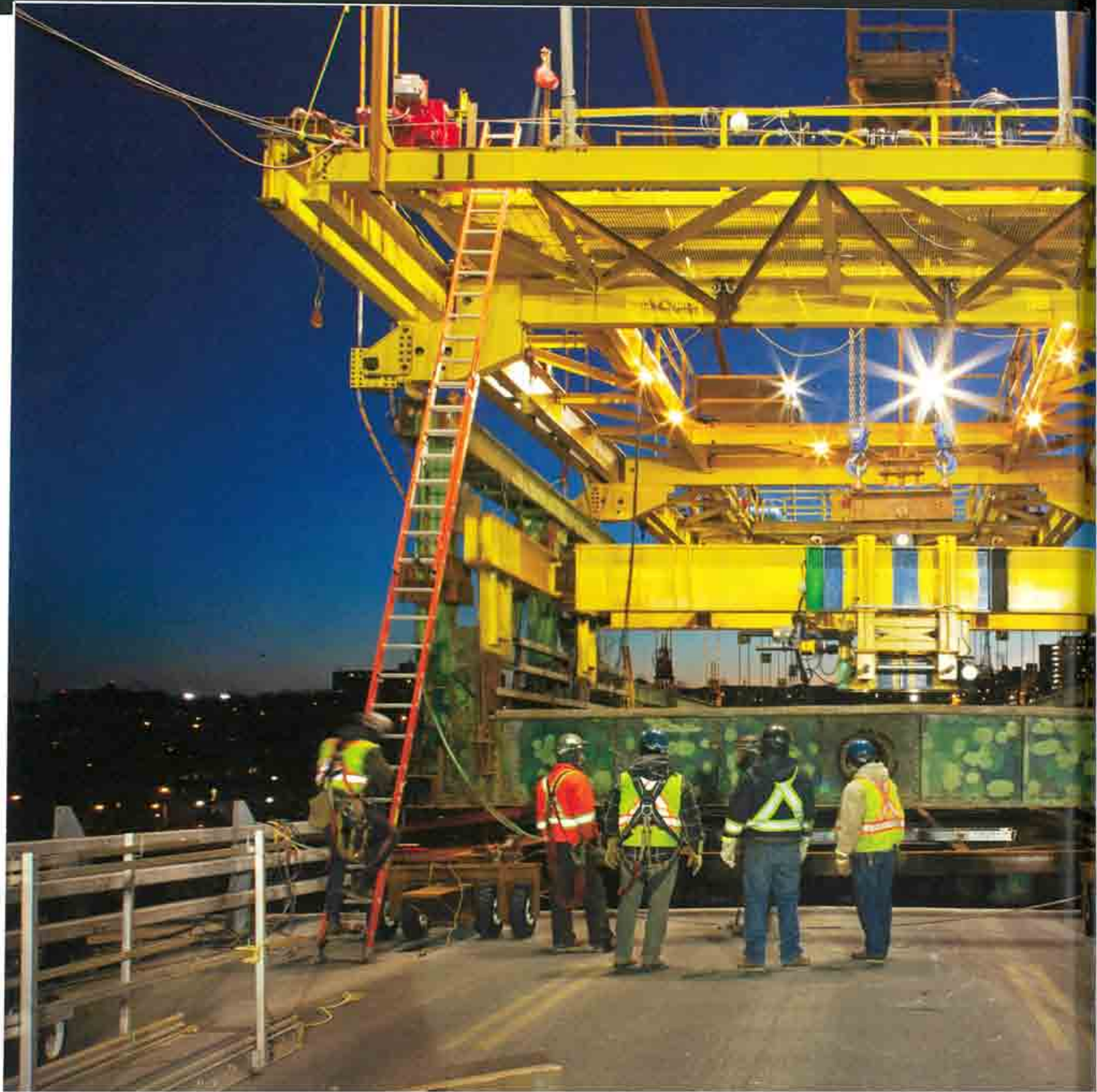
ISBN 978-0-9959607-0-1 (hardcover)

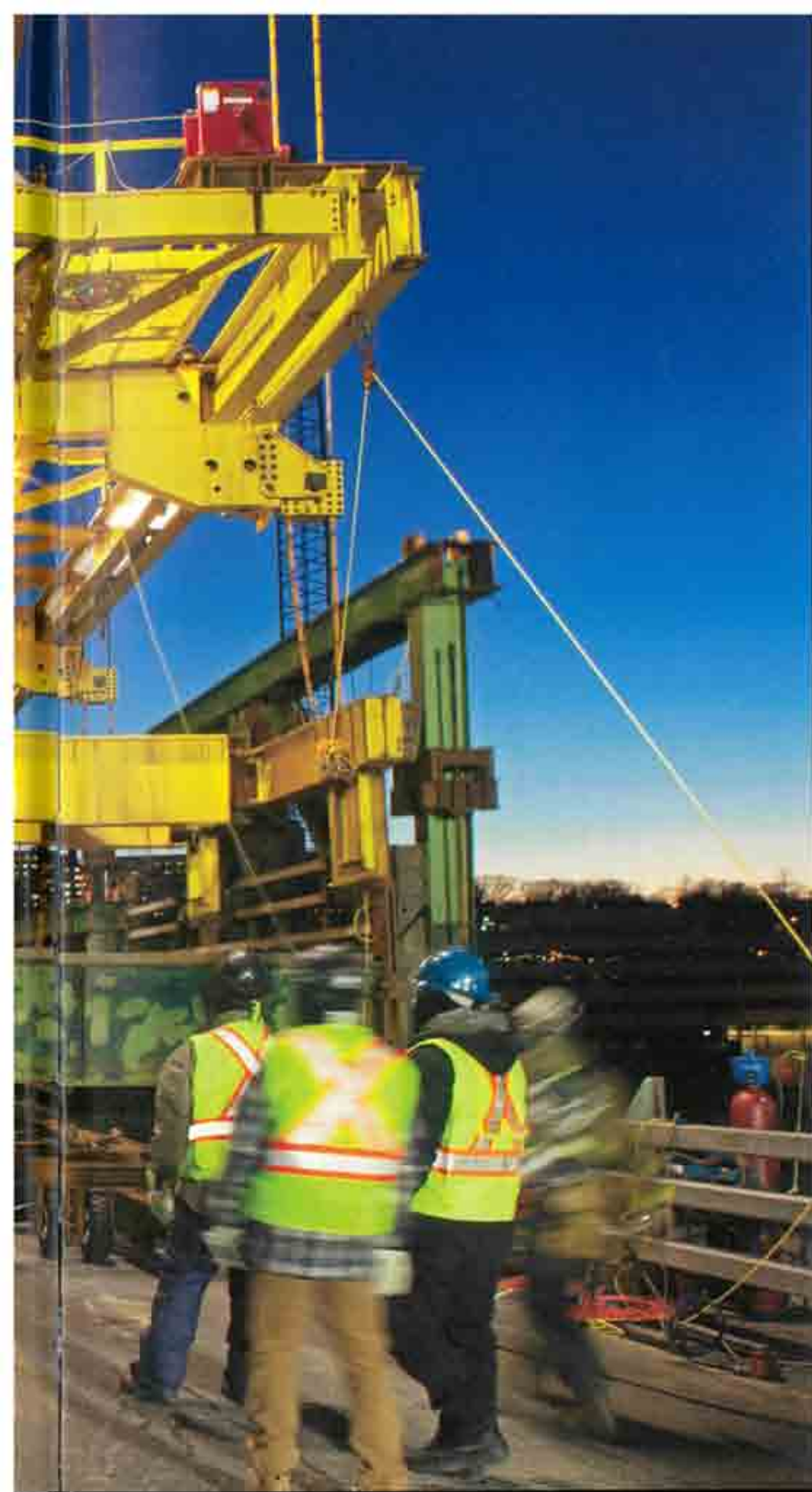
1. Angus L. Macdonald Bridge (Dartmouth and Halifax, N.S.)--
Maintenance and repair. 2. Angus L. Macdonald Bridge (Dartmouth
and Halifax, N.S.)--Maintenance and repair--Pictorial works.

I. Halifax Harbour Bridges (Nova Scotia), issuing body II. Title.

FC2346.67.W55-2017 388.1'3209716225 C2017-902713-1

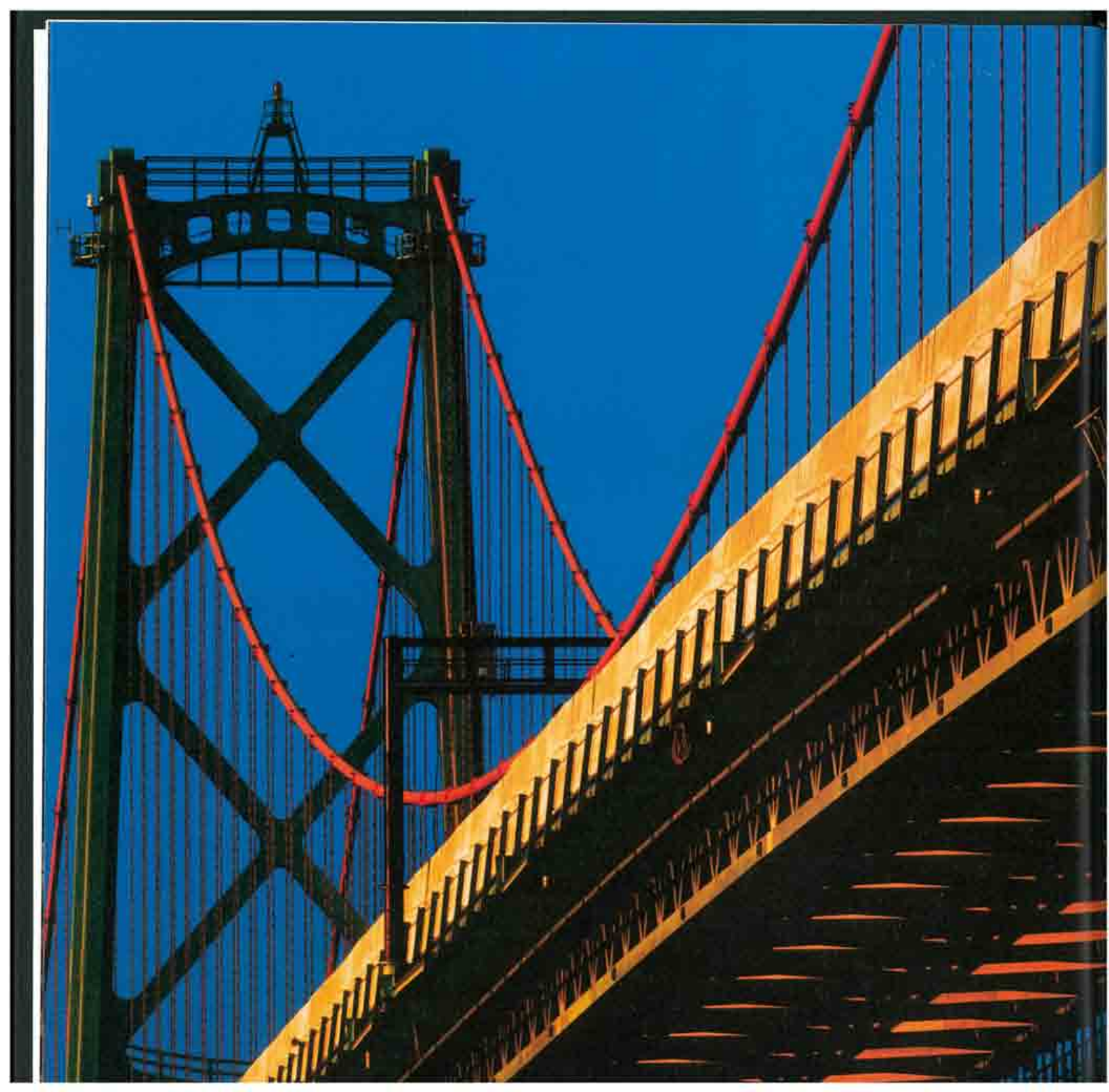
This book is dedicated to the engineers and Ironworkers:
those who design and those who build the design.





THE BIG LIFT

REDECKING
THE MACDONALD
BRIDGE





FOREWORD

THE STORY OF THE BIG LIFT begins in the mid-1990s when the Halifax-Dartmouth Bridge Commission was planning to add a third lane to the Macdonald Bridge to relieve growing traffic congestion. At that time the engineers said there was no need to replace the deck because it was serviceable for another 15 to 20 years.

Fast forward to 2009. The board of commissioners, under the leadership of then board chair, Tom Calkin, approved the design engineering for the Macdonald Bridge suspended spans deck replacement project, now known as the Big Lift. The bridge was safe but the time had arrived to replace the suspended spans to reduce maintenance and extend the life of the bridge.

Thus began an eight-year project: five years of planning and engineering and almost three years of construction. It included replacing most of the infrastructure on the suspended span of the bridge: the road deck, the floor beams, the stiffening truss and the suspender ropes.

Construction projects usually mean disruption and the Big Lift was no exception. I want to thank the bridge users and people who live and work around the bridge for your patience.

I also want to thank our board of commissioners, chaired by Wayne Mason, for their leadership and strong governance. And to HHB employees, all of whom have been involved in the success of this project. Finally, to the project partners and the men and women who worked through all the worst weather Mother Nature could throw at them.

The interest the Big Lift has generated locally, nationally and internationally has been fascinating to witness. It's been a once-in-a-lifetime project and an engineering feat.

With this project complete the Macdonald Bridge will serve our community for at least another generation.

Enjoy this collection of photos.

Steve Snider
General Manager and CEO
Halifax Harbour Bridges





AN EXTRAORDINARY STORY

You're going to do what? You plan on removing each section of bridge deck, lower it to a waiting barge, lift the replacement section from a second barge, do this all over a weekend and open the bridge to commuters by Monday morning? And this has only been done once before in the world – and in weather conditions far less severe than those in Halifax? Seriously?

Nearly two years after that first informal briefing, I stand with hundreds of residents enjoying the tailgate party-like atmosphere on the Dartmouth waterfront looking up at the first gaping hole in the bridge deck. Somehow, seemingly defying physics, the Angus L. Macdonald Bridge is stronger than before and is a testament to the incredible expertise and professionalism of those working to deliver this story.

The *extraordinary* in this story comes with names like Murray (Walrus) Marten, Jon Eppell, Lesley Mercer and Cowboy Joe. These are the ironworkers, engineers, operations administrators and traffic control staff, and the hundreds more like them. They come from Cuba, Ireland, United States, Venezuela and the many corners of Canada and Nova Scotia.

They have worked in the stifling heat of the paving shed, the finger-numbing cold of –30 degree temperatures, endured rain coming in sideways and the mid-summer sun scorching their already burned necks. Once the pencils and slide rules are pushed aside, the metal fabricated and the deck segments replaced, and all the layers of production are peeled back, the Big Lift story is of these *extraordinary* people.

This is their story.

Dale Wilson

June, 2017



THE VISIONARIES

IN 1796, when prosperous Dartmouth businessman Jonathan Tremain looked across Halifax Harbour, it is highly unlikely he considered the 1.5 kilometre wide harbour was at one time the much narrower Sackville River. He wanted an efficient way to transport his goods to the lucrative Halifax market. Mr. Tremain never completed his vision of building the first bridge across the Harbour despite an Act of legislation giving him the authority to do so.

One can only imagine the conversations Arthur W. Godfrey and John Starr had as they stood on the shoreline near current day Tufts Cove in 1842. Not unlike Mr. Tremain before them, it is unlikely they considered how the scrubbing and scouring action of the previous two million years of glacial activity shaped the sub-surface topography of the Narrows. Much to their disappointment it would be the siltation from the latest glacier—the Wisconsinan—that would render the harbour floor unsuitable to support their dream of constructing a bridge. So ended their notion of finding an efficient way to transport goods to the Halifax market. Mr. Starr would later become famous as the industrialist behind Starr Manufacturing, and the Starr Skate.

Finally, in 1884, the feat of traversing the harbour was accomplished when the Intercolonial Railway completed a wooden train bridge that crossed from Tufts Cove in Dartmouth to Richmond on the western shore. Starr Manufacturing did have a prominent role when they constructed what is believed to be the first swing bridge designed and constructed in Canada, allowing continuous vessel passage to and from Bedford Basin. The first commercial crossing was in 1885 when a railcar load of sugar began its journey from the refinery in Woodside bound for Vancouver. A September gale in 1891 would overpower the bridge and it collapsed. It was promptly rebuilt but collapsed again just two years later and the project was abandoned. The railway ultimately built a spur line between Shearwater and Windsor Junction along the eastern shore of the harbour.

Just as the ebb and flow of the tides that twice daily influence the sea level of the harbour, so too was there a rise and fall in the level of bridge construction dialogue during the early part of the 20th century. Various boards of trade, commercial interests and citizen groups began advancing the initiative again, until federal politicians decreed they were not interested in infusing money in the bridge project. Again, any hope of building a bridge was stalled.

Local interest groups long realized an efficient means of transporting goods and people between the cities of Halifax and Dartmouth would improve the economies of the region. It would not be until the end of World War II, and a provincial government bent on providing economic stimulus, was the conversation reinitiated with vigour and conviction. On March 1, 1952 Premier Angus L. Macdonald turned the sod and proclaimed: *When the work is completed it will be a boon and convenience to thousands, nay, hundreds of thousands, of traveller.* Unfortunately, Premier Macdonald did not live to see his dream come to fruition. Thirty seven months later his wife, Agnes Macdonald, would cut the opening ribbon amid the skirl of bagpipes, twirl of majorette's batons and the scarlet and serge of Mounties and Bengal Lancers.

Surely even the most ardent advocate could not have imagined the positive social engineering impact the Angus L. Macdonald Bridge would generate. Within a very short time the town of Dartmouth incorporated as a city, complete with all the conveniences of a growing population. Within just six years the population of Dartmouth more than doubled. Suburbia also expanded at a rapid pace and the traffic lanes leading to the tolls were bumper to bumper with cars. Officials estimated the Macdonald Bridge would carry one million vehicles per year when it opened. In its first year of operation the bridge witnessed 2.5 million vehicle crossings, and today the Macdonald Bridge accommodates more than 12 million crossings annually.

Just as Premier Macdonald's estimate of hundreds of thousands of travellers was far too conservative, most certainly Tremain, Starr and Godfrey could never have envisioned in their wildest imaginations the positive economic impact the span would have on both sides of Halifax harbour, and indeed, the province of Nova Scotia.

The Big Lift extends the life of the *Old Bridge* making it new again, carrying out exactly what those early visionaries imagined: efficiently and effectively moving people and goods to and fro in a safe manner.

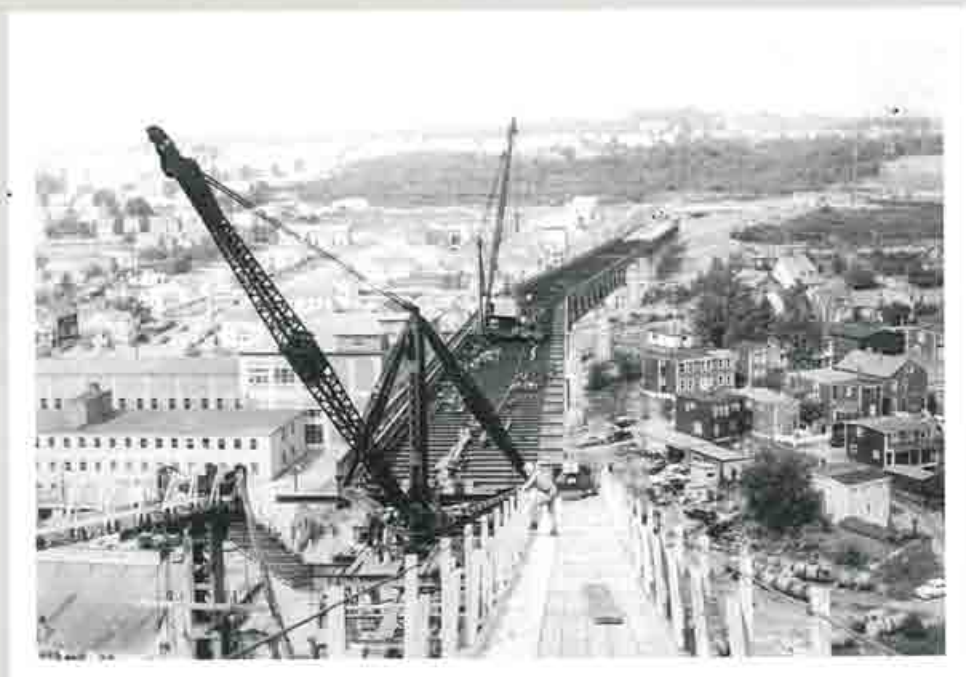


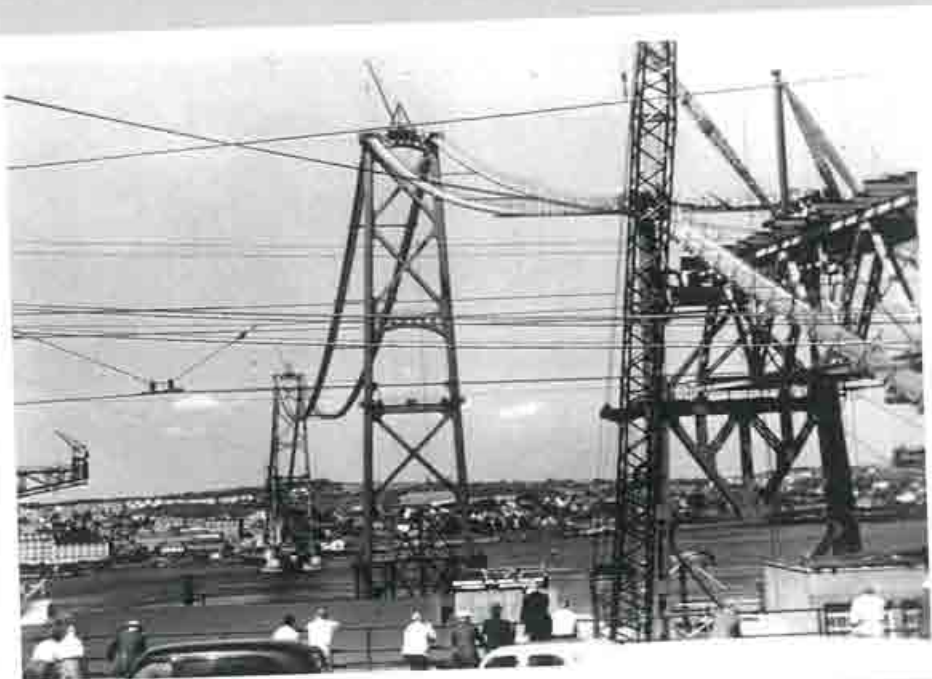








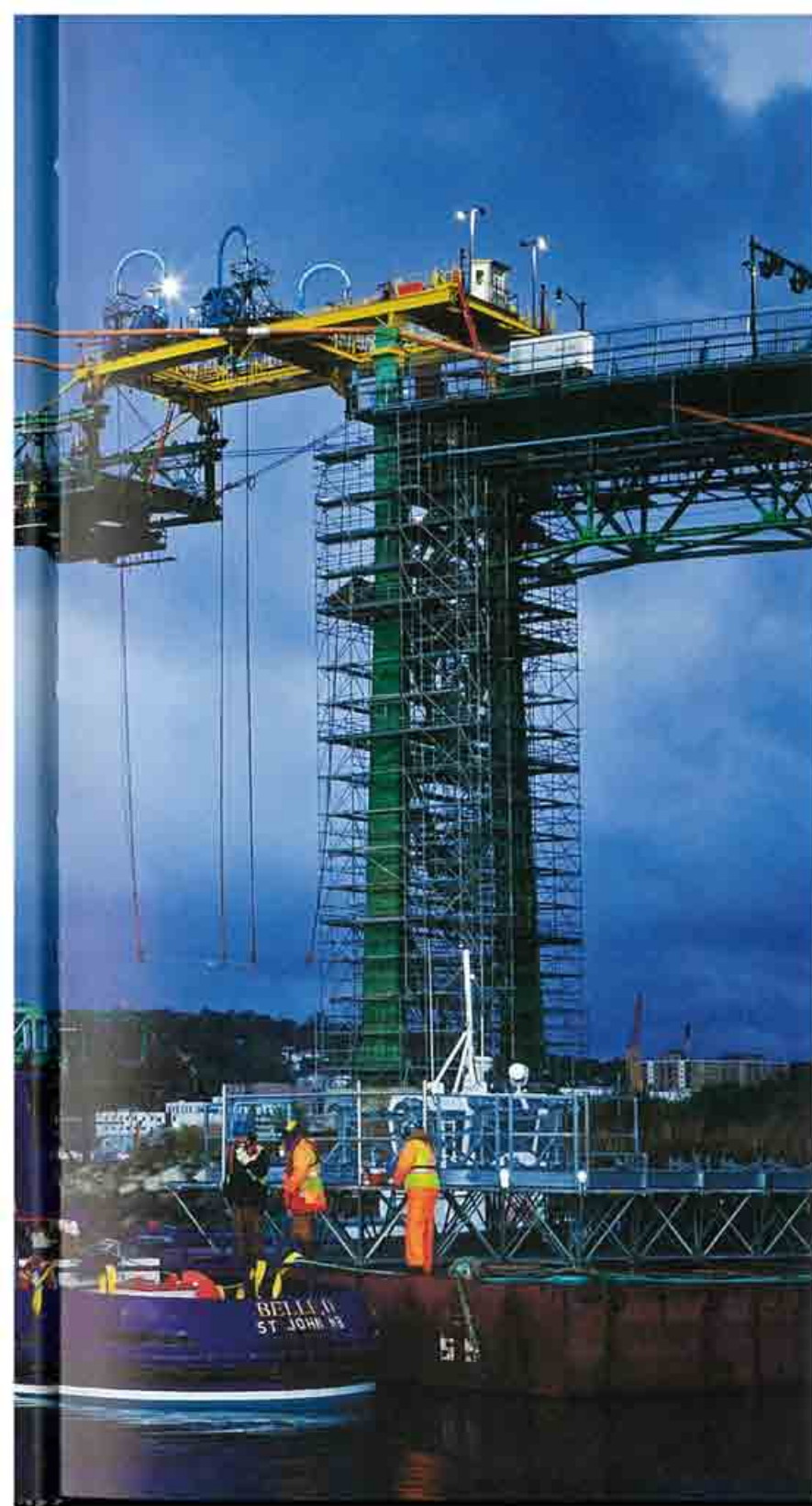






SATURDAY, OCTOBER 17, 2015 was a gorgeous autumn day. Onlookers of all types and stripes congregate along every nook and cranny of Dartmouth's Shore Road in search of the perfect vantage point as D1 is lowered to the waiting barge. Before long this previously quiet neighbourhood was hosting the tallgate-like-party, complete with traffic congestion.





SEEMINGLY DEFYING PHYSICS, and with a gaping hole in the bridge deck, the nearly two-year long process of strengthening and extending the lifespan of the Macdonald Bridge begins with the replacement of Section D1.

Holding the separated bridge together, the yellow lifting gantry awaits the early morning crew change to hook on to the replacement section below. By Monday morning the new section will have been replaced, *buttoned down*, and the bridge returned to morning commuters rushing to work.

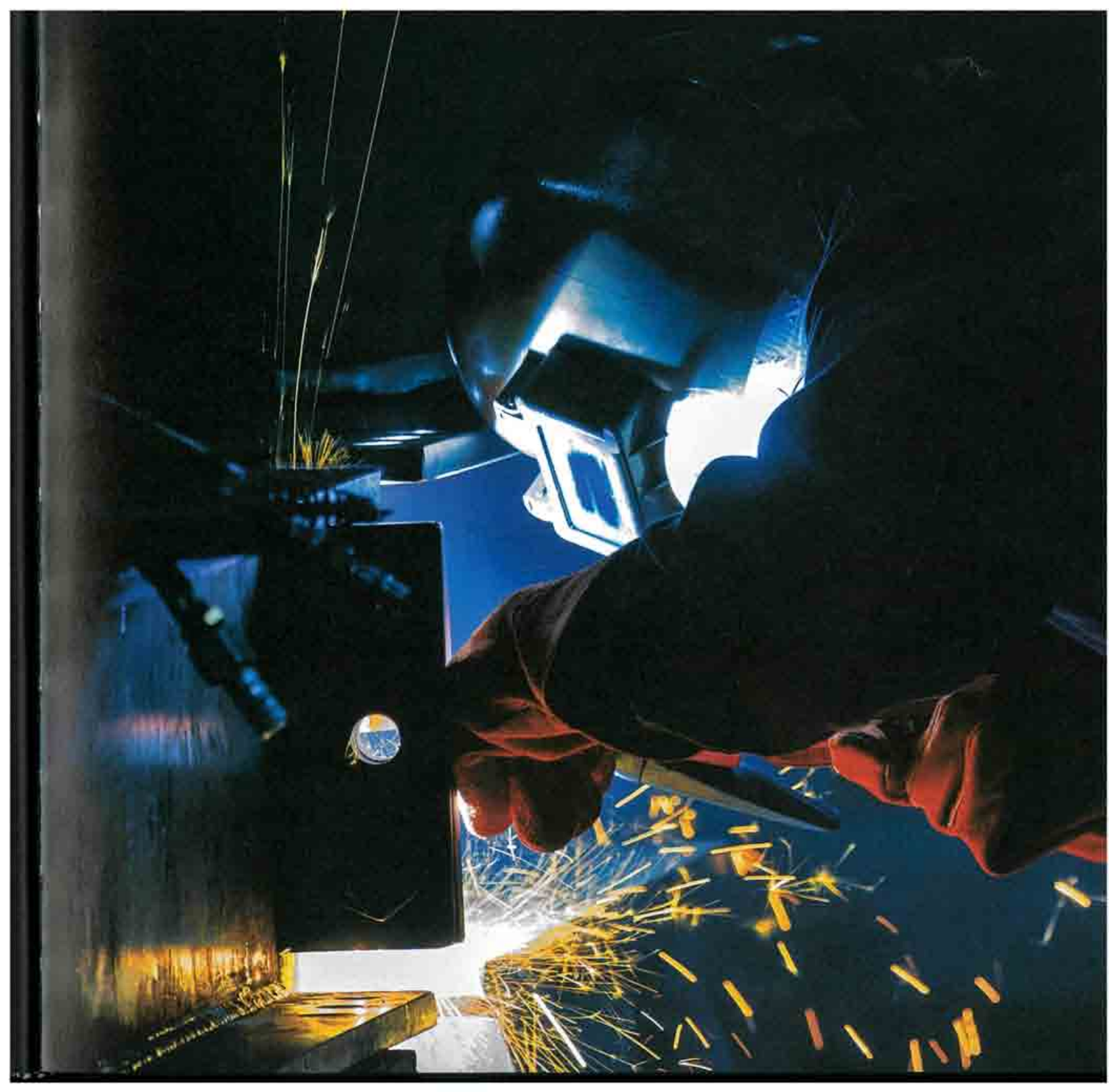
This process will be duplicated another 30 times as the Dartmouth and mid-span segments are completed. The final 16 segments on the west side of the Halifax tower will follow a similar process.

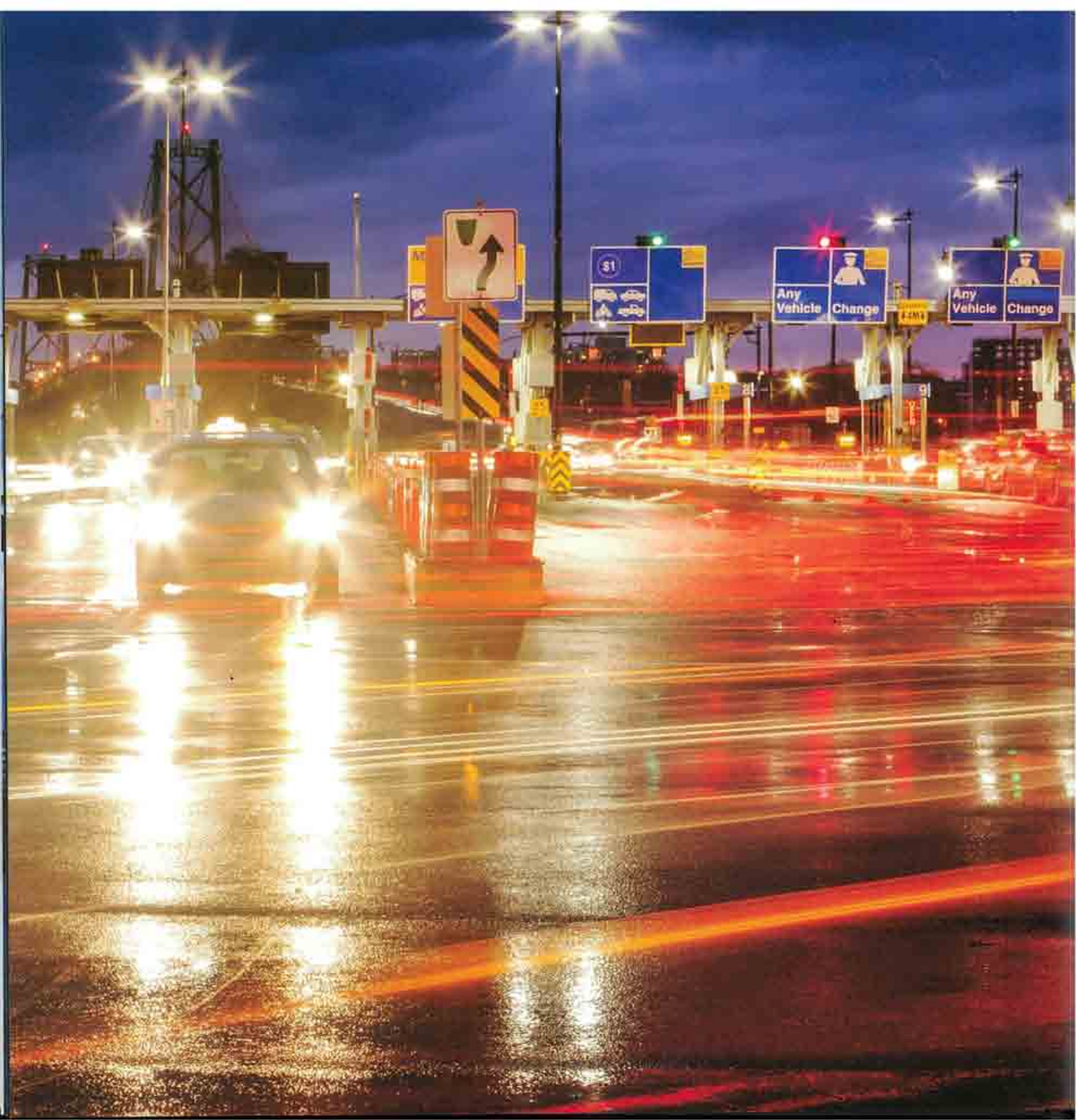
The Halifax segments will be lifted by a crane located in the Royal Canadian Navy Dockyard and then transported along the bridge deck to the gantry to be lowered into final position.

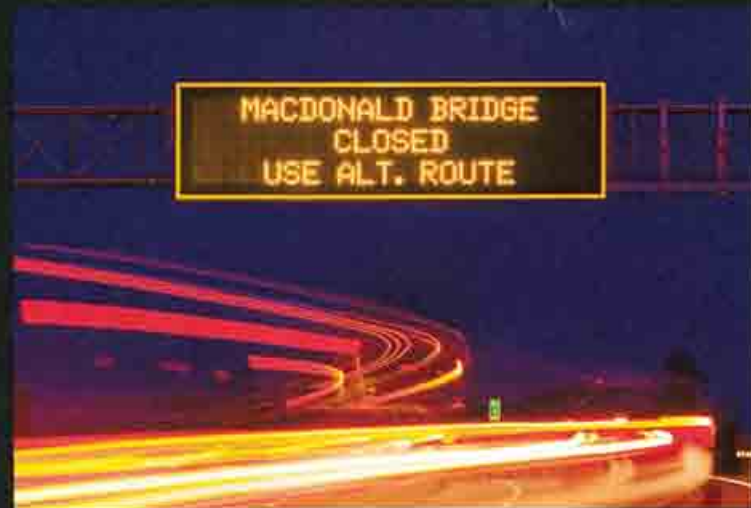
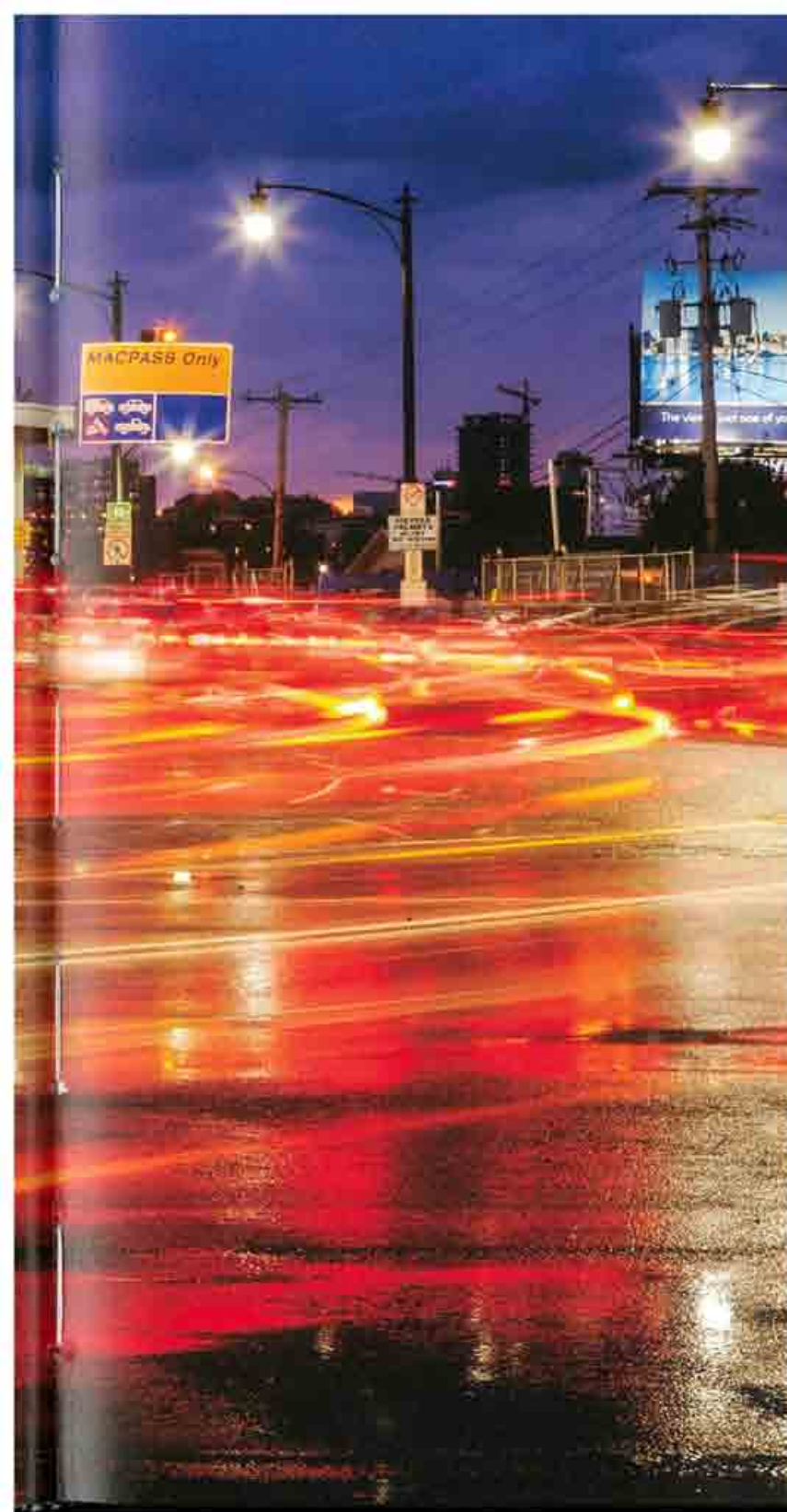


SLOWLY MOVING ALONG its computer generated track, a plasma cutter makes the first cuts in the fabrication process. The superheated electrically ionized gas cuts through the steel like a hot knife passing through cold butter. Thickness of the steel can vary between 10, 12 and 14mm thick, depending upon where the steel might be located in the segment.

Once a sheet of steel enters the Cherubini Metal Works main fabrication plant in Woodside, it will progress through nine workstations, and take approximately two weeks of production time to complete one segment.





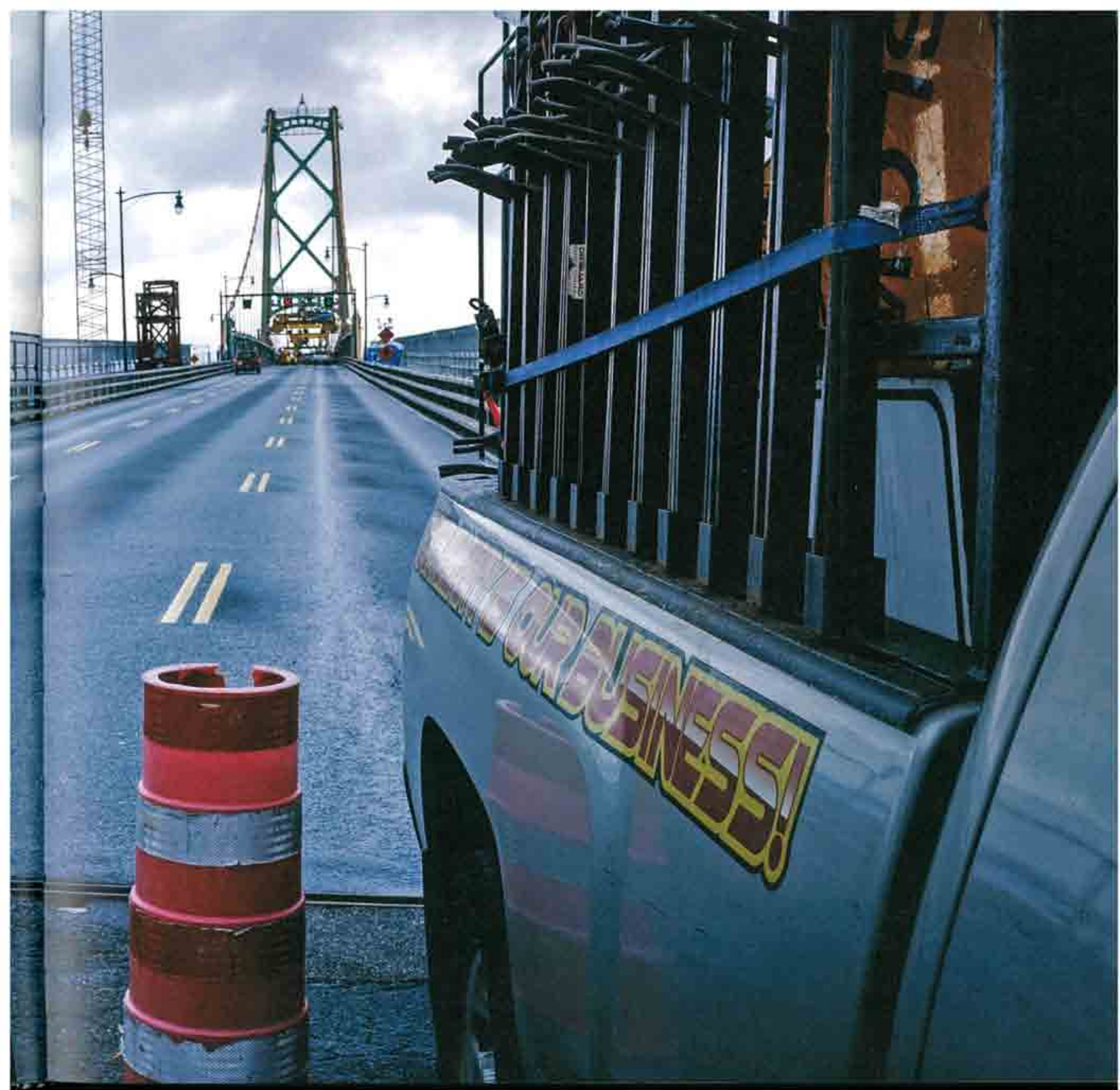


WHEN THE FIRST SOD WAS TURNED at the intersection of North and Barrington Streets on March 1, 1952, planners estimated the Macdonald Bridge would facilitate up to 1 million vehicle crossings per year. Little could they have imagined the “Old Bridge” would eventually accommodate an average of 48,000 vehicle crossings per weekday (over 12 times the estimated amount). On April 2, 2017 — the 62nd anniversary of its opening — a total of 656,144,863 vehicles had crossed the Macdonald Bridge.

On the evening of October 16, 2015, at 6:50pm, when the photo at left was made, commuters were going about their daily business. Ten minutes later strategically positioned highway sign boards informed drivers the Macdonald Bridge was closed.


Within minutes of the bridge closing, heavy equipment and workers proceeded through the toll booths to commence work on Section D1 — the first deck section scheduled for replacement — and the much anticipated first “Big Lift.”



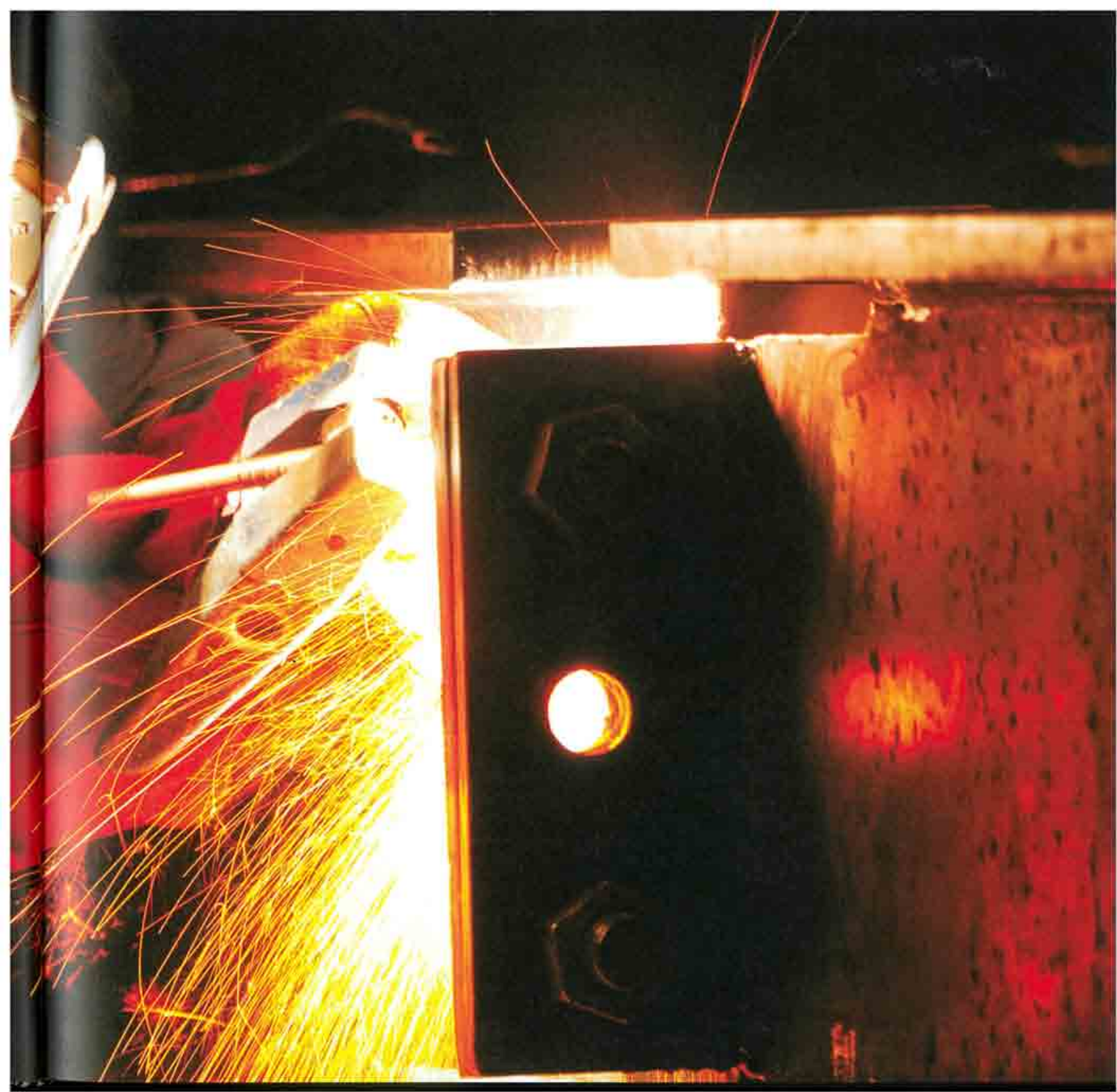








Welding at Cherubini Metal Works
main fabrication plant in Woodside.





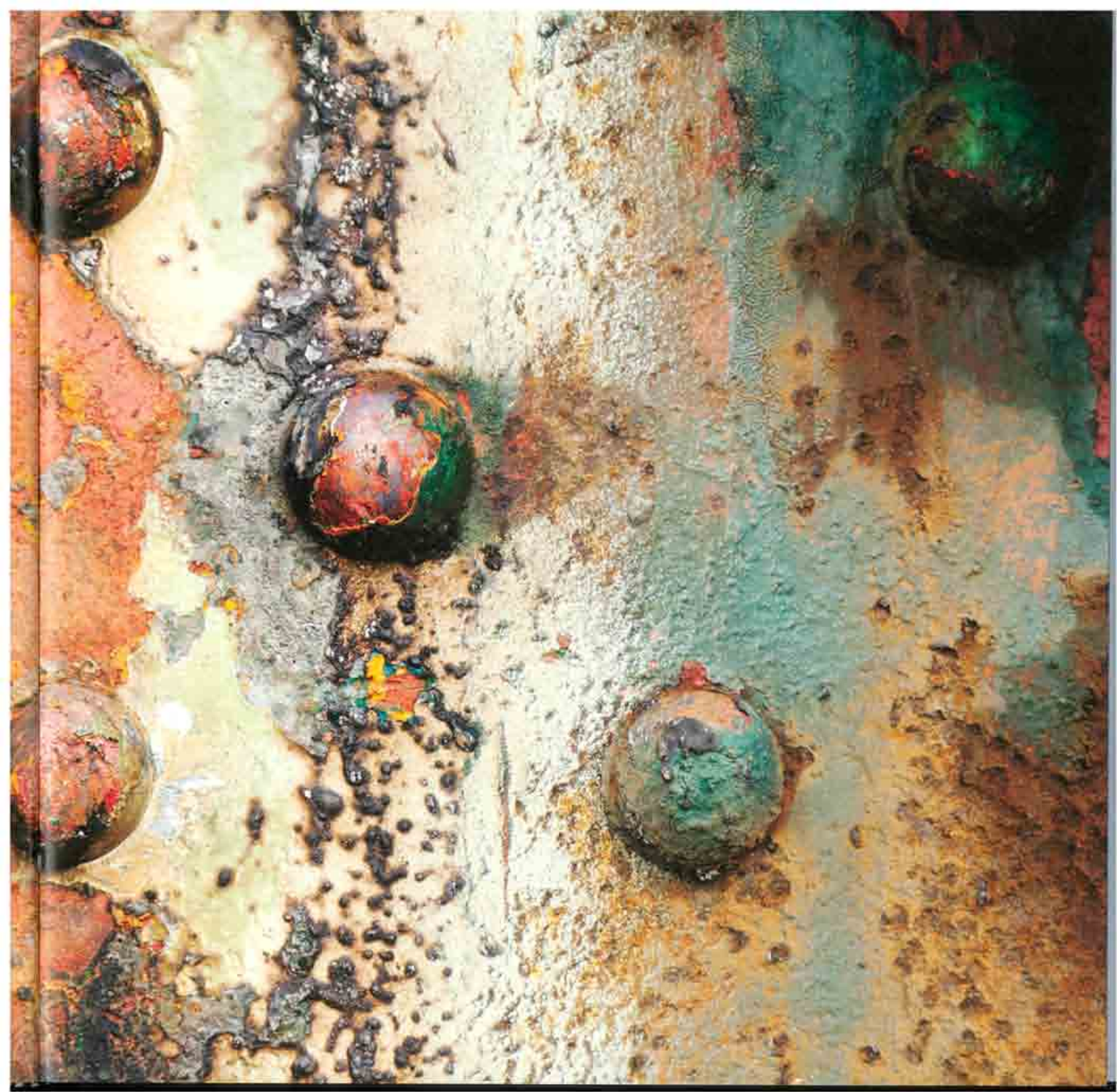
LIKE A MONSTER LOBSTER CLAW,

the “shear jaws” attachment on the Cat excavator make quick order of the removed deck sections.

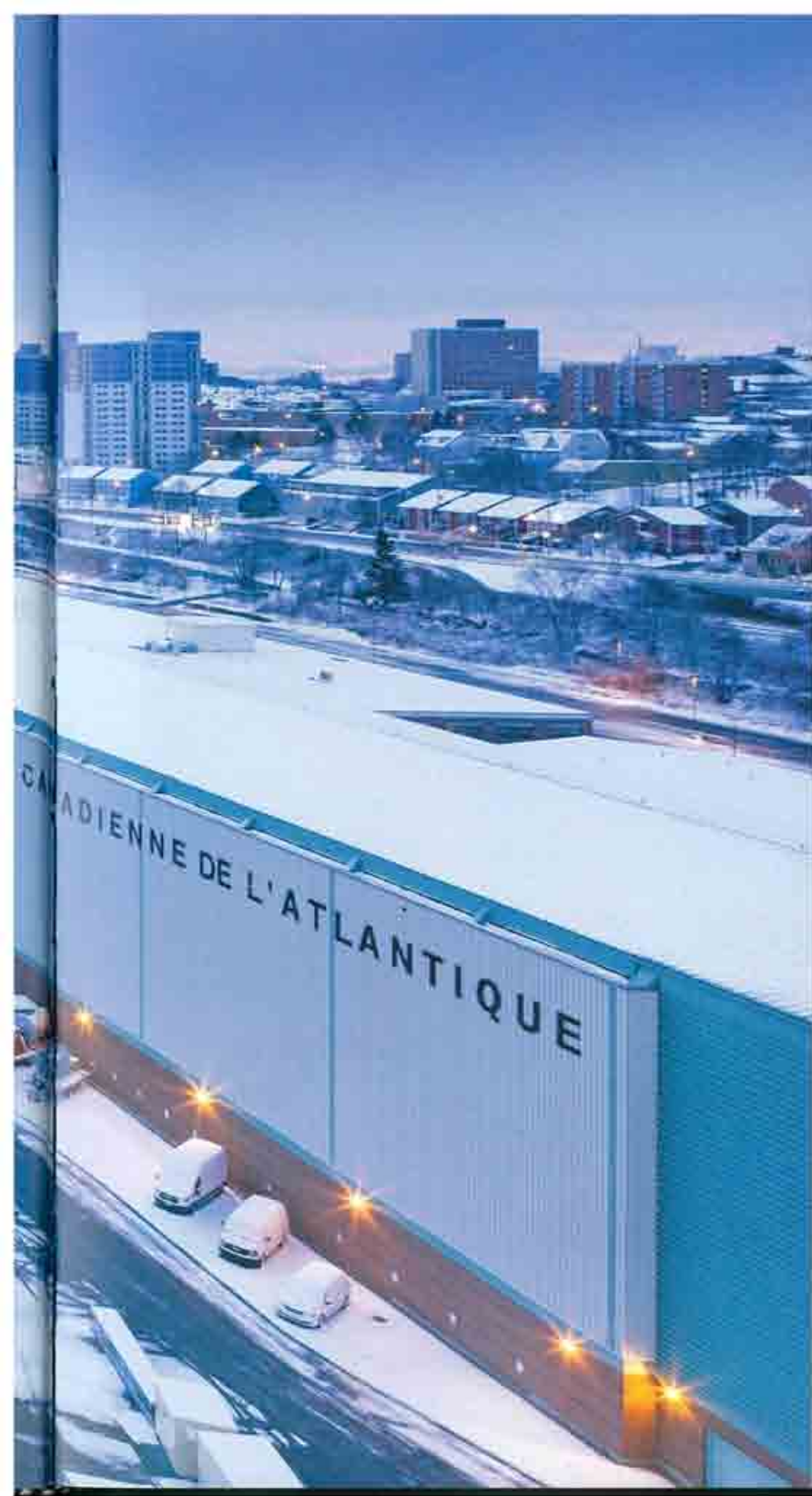
In a matter of a few hours each section is dissected and chopped into one metre lengths, loaded onto trucks and hauled to Dartmouth Metals Burnside facility. Next, the pieces are loaded into containers and shipped to one of several smelter ovens. The “Old Bridge” is then molten into new metal to start a new life, thus completing the recycling process.

It was a strategic decision to recycle and reuse as much of the removed sections as practical, resulting in approximately 99% of all metal receiving a second life. Rumour has it that the remaining 1% of steel were the original rivets saved as souvenirs by some of the crews.









WHEN THE NORTHERN WIND bites through the frost with mind-numbing effectiveness, feet are as cold as the steel upon which they are planted and the generators have sputtered their last cough and gone quiet, it can be said: *It is cold.*

Such was the case on this quiet Sunday morning in January when the temperature and wind combined forces to plummet the mercury to a teeth-rattling -32 degrees.

On such mornings, as an ironworker looks south toward the mouth of Halifax Harbour and views Georges, McNabs and Lawlor Islands, it is easy to allow the mind to drift much farther to the tropical islands of the Caribbean.

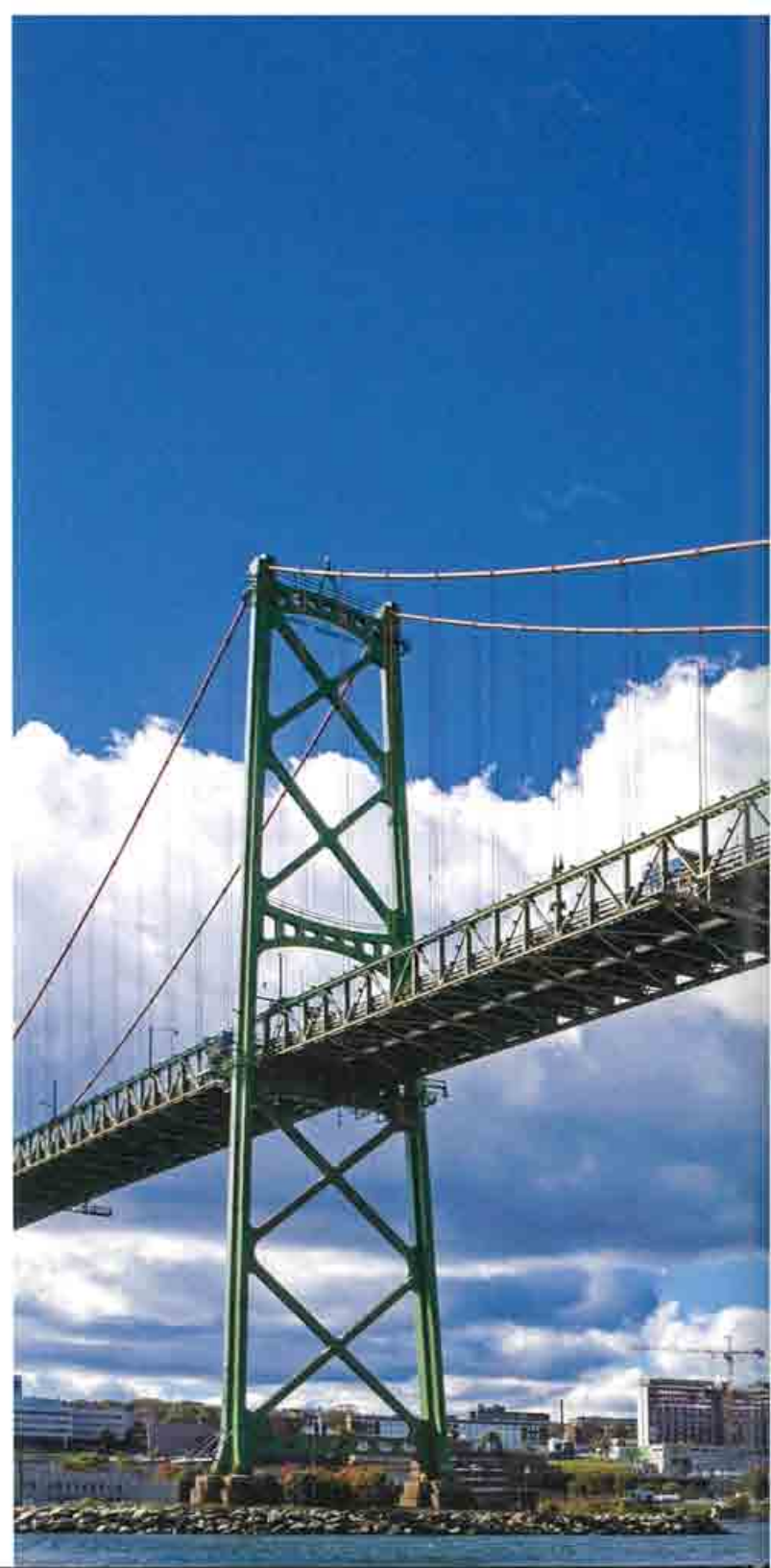




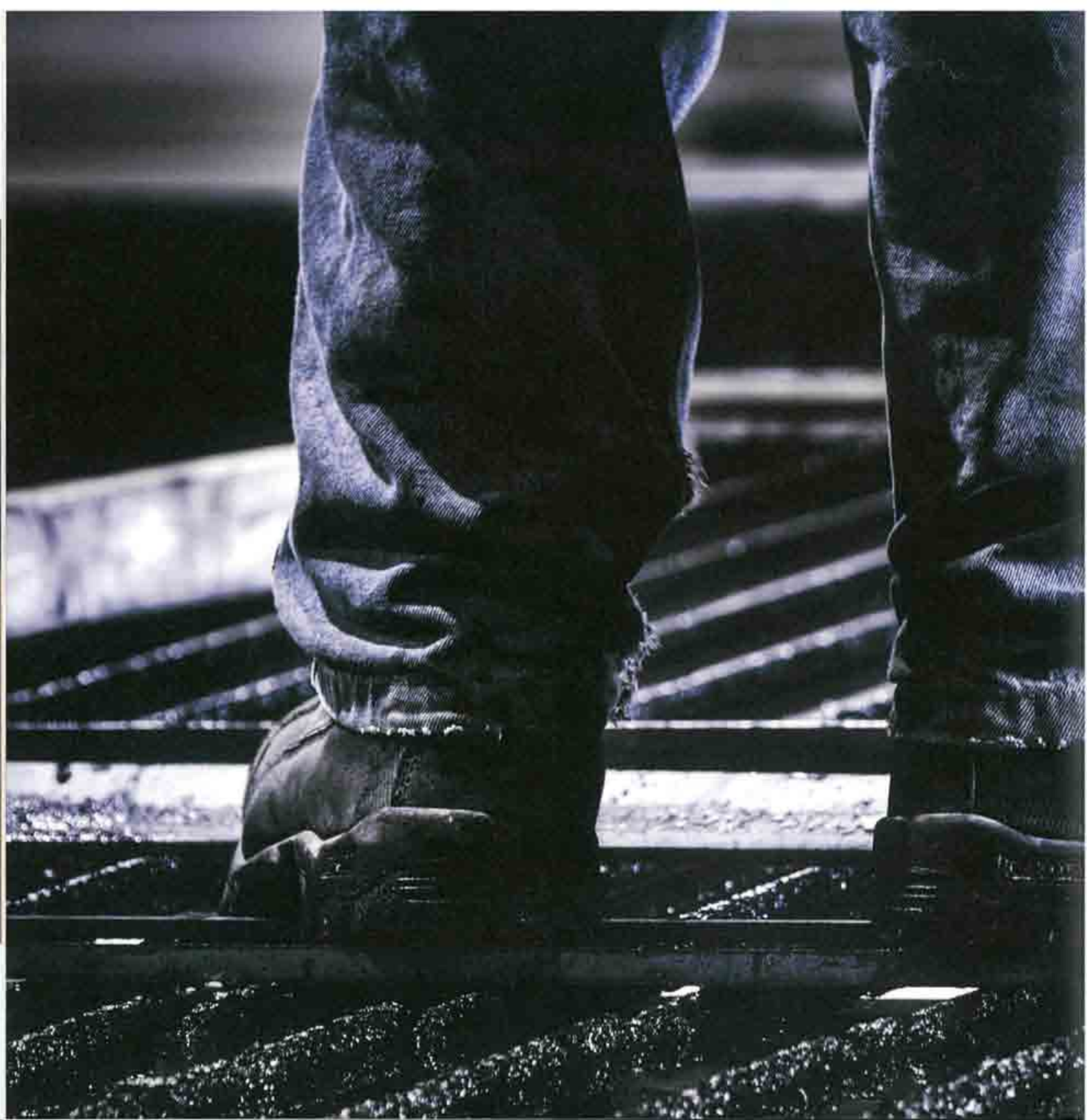


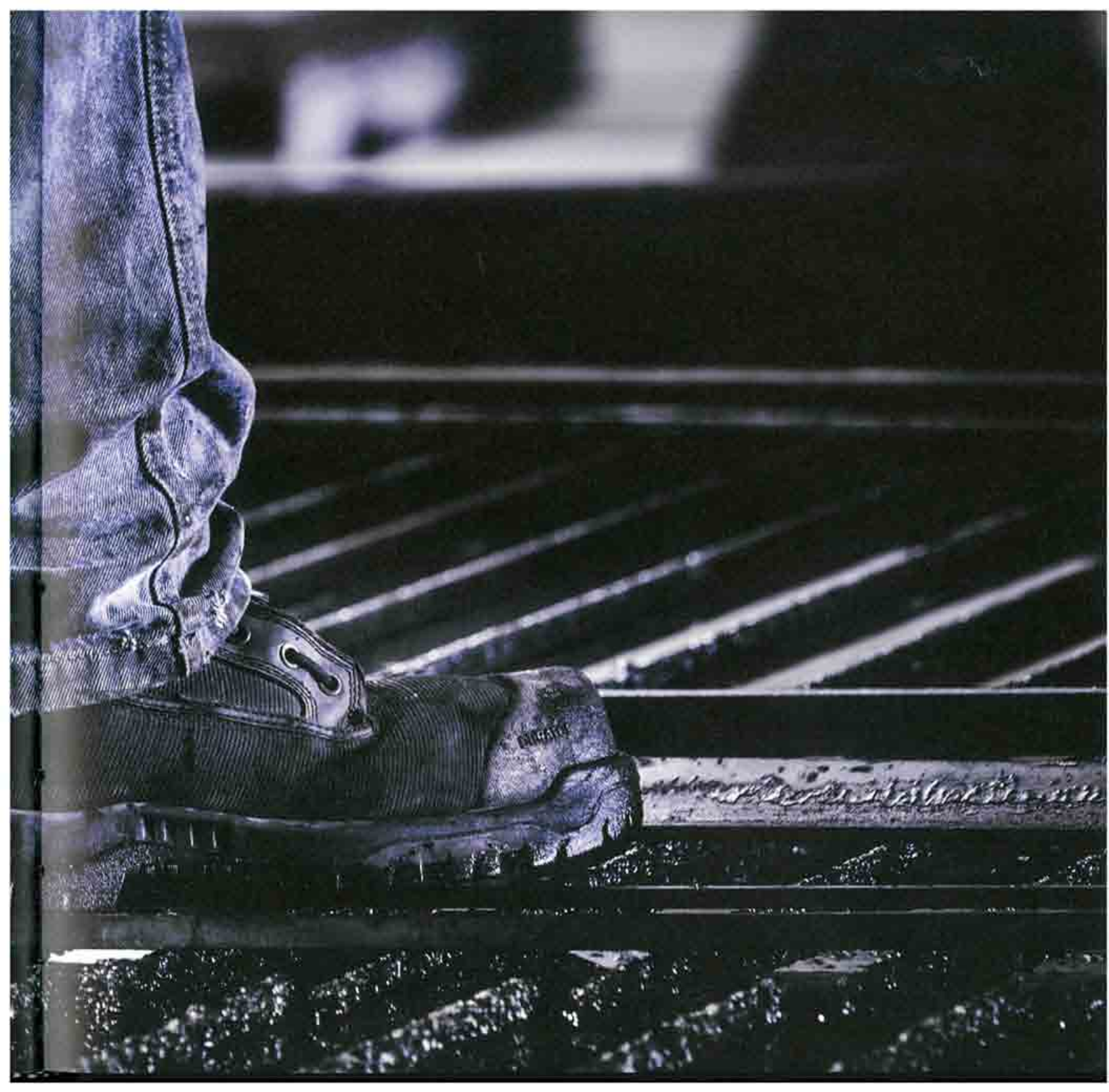


ON SUNDAY MORNING, October 18, 2015
Section D1 started its ascent, and by mid-afternoon
was being bolted in position. Over the next
16 months, 45 more sections will have been
replaced. Ultimately, two sections would be
replaced per weekend as crew expertise advanced.







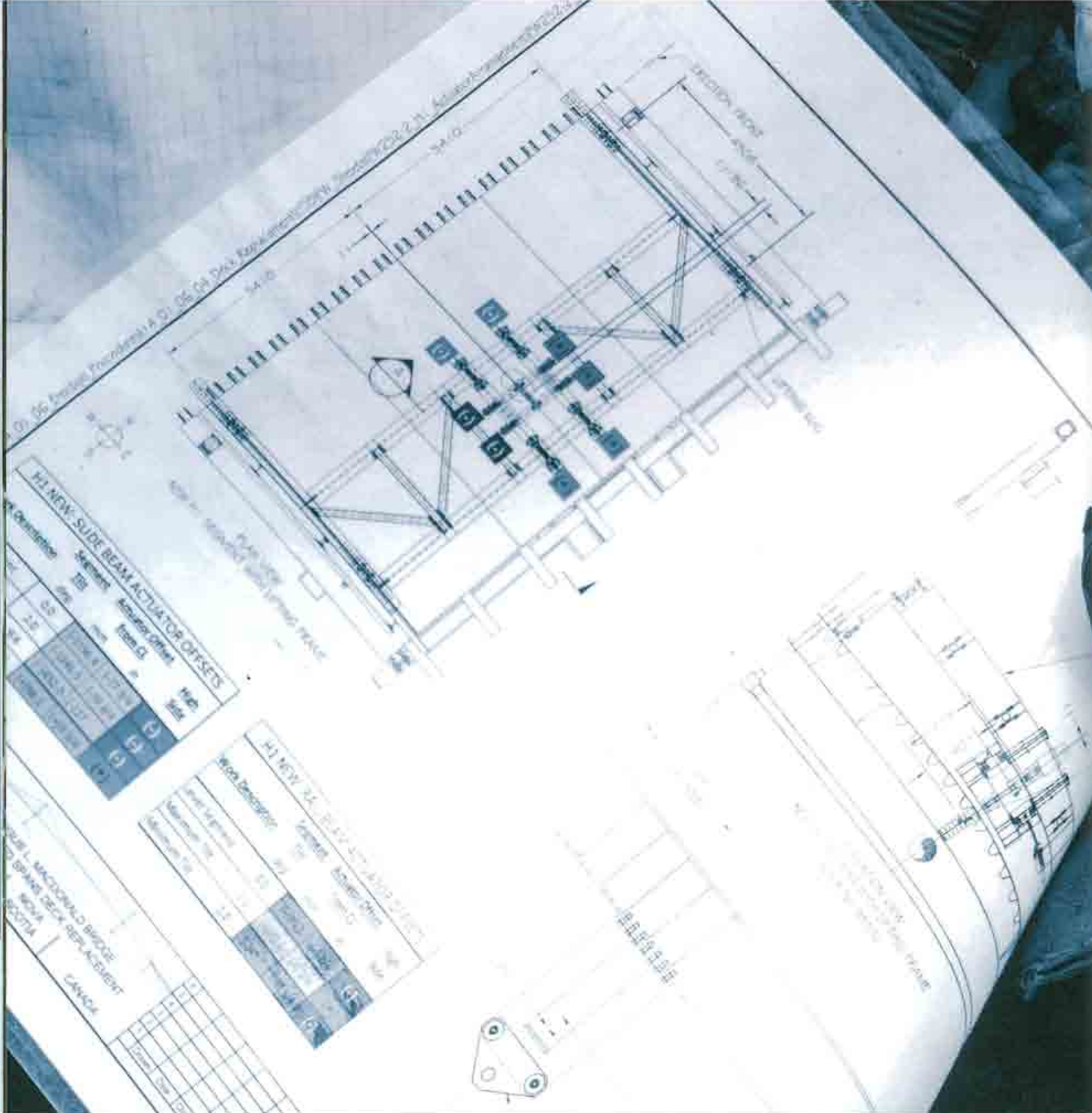






UPON COMPLETION OF FABRICATION each section is transported across the yard at Cherubini Metal Works and enters the paint facility. The section would remain with the painters an average of four days, dependent upon humidity and temperature. Prior to moving to the paving facility located next door, the painters would thoroughly inspect the dried paint and apply any small touch-ups as necessary.

Painting the deck sections consumed approximately 40,000 litres of paint. The pedestrian and bicycle lanes required an additional 10,000 litres.



HI NEW SUIDE BEAM ACTUATOR OFFSETS

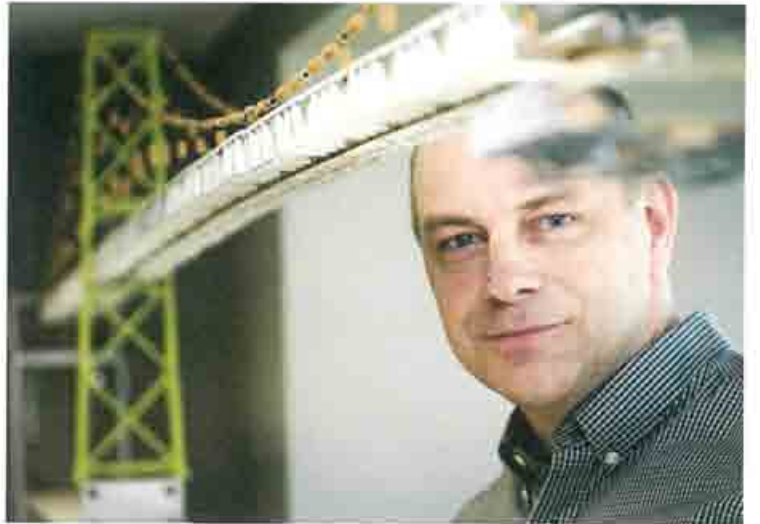
Quantity	Segment	Material	Notes
25	10	Form G	
25	11	Form G	
25	12	Form G	
25	13	Form G	

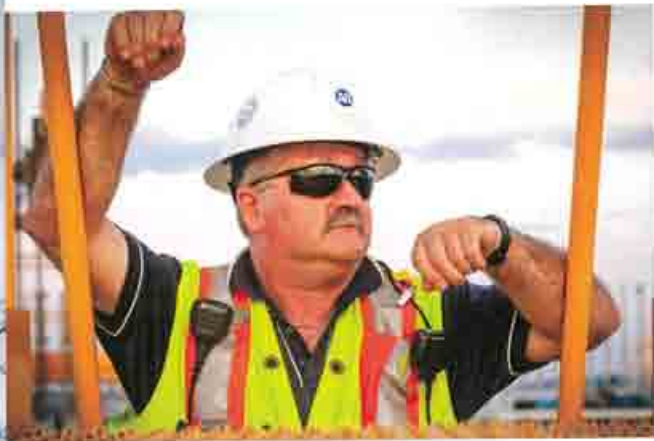
HI NEW 25' BEAM SUPPORT SYSTEM

Quantity	Segment	Material	Notes
25	14	Form G	
25	15	Form G	
25	16	Form G	
25	17	Form G	

THE L. MACDONALD BRIDGE
 GRAND DECK REPLACEMENT
 CANADA

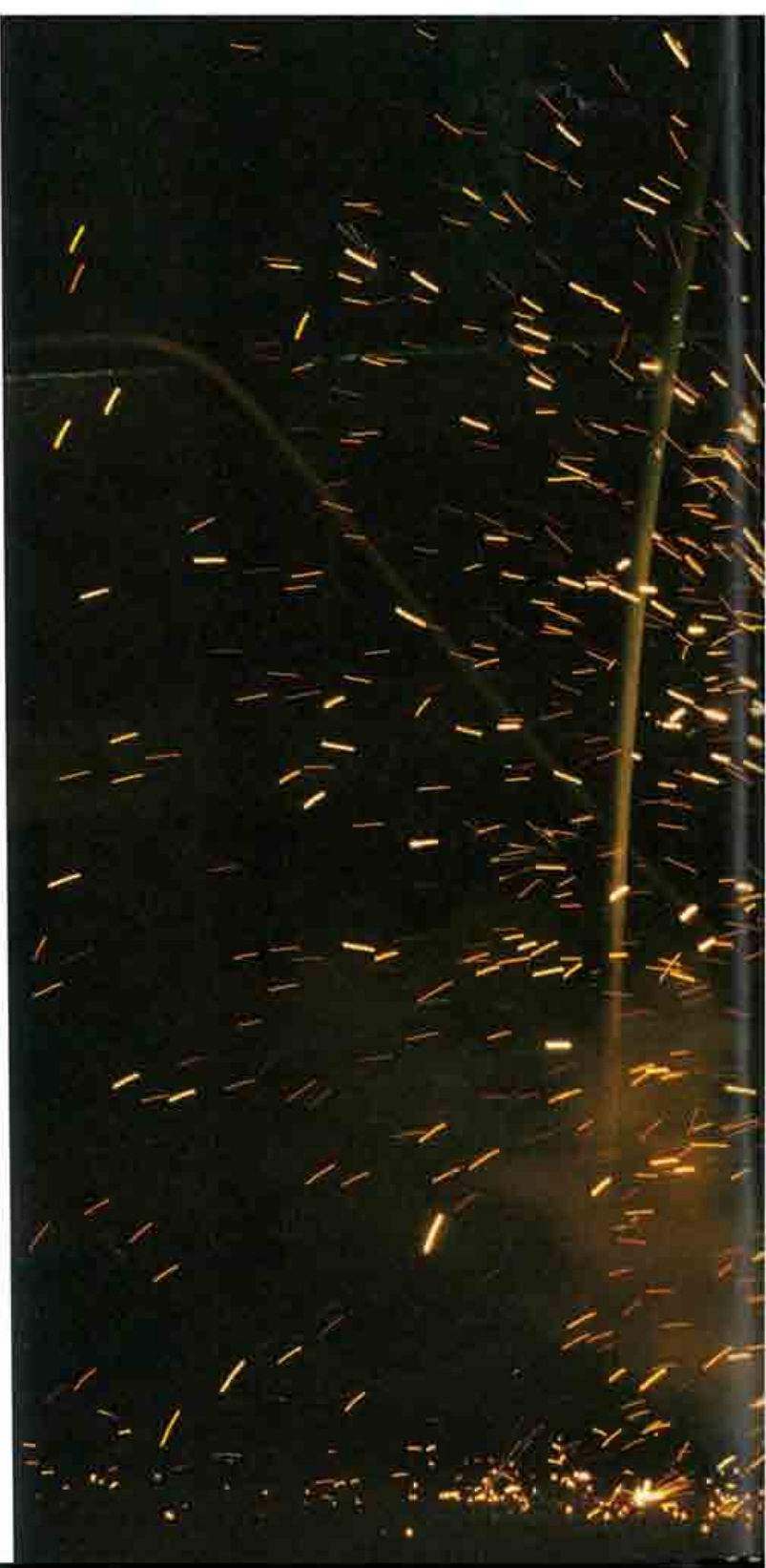
Item	Qty	Unit	Notes





THE THERMAL LANCE is the device that created the great cascading light show each weekend.

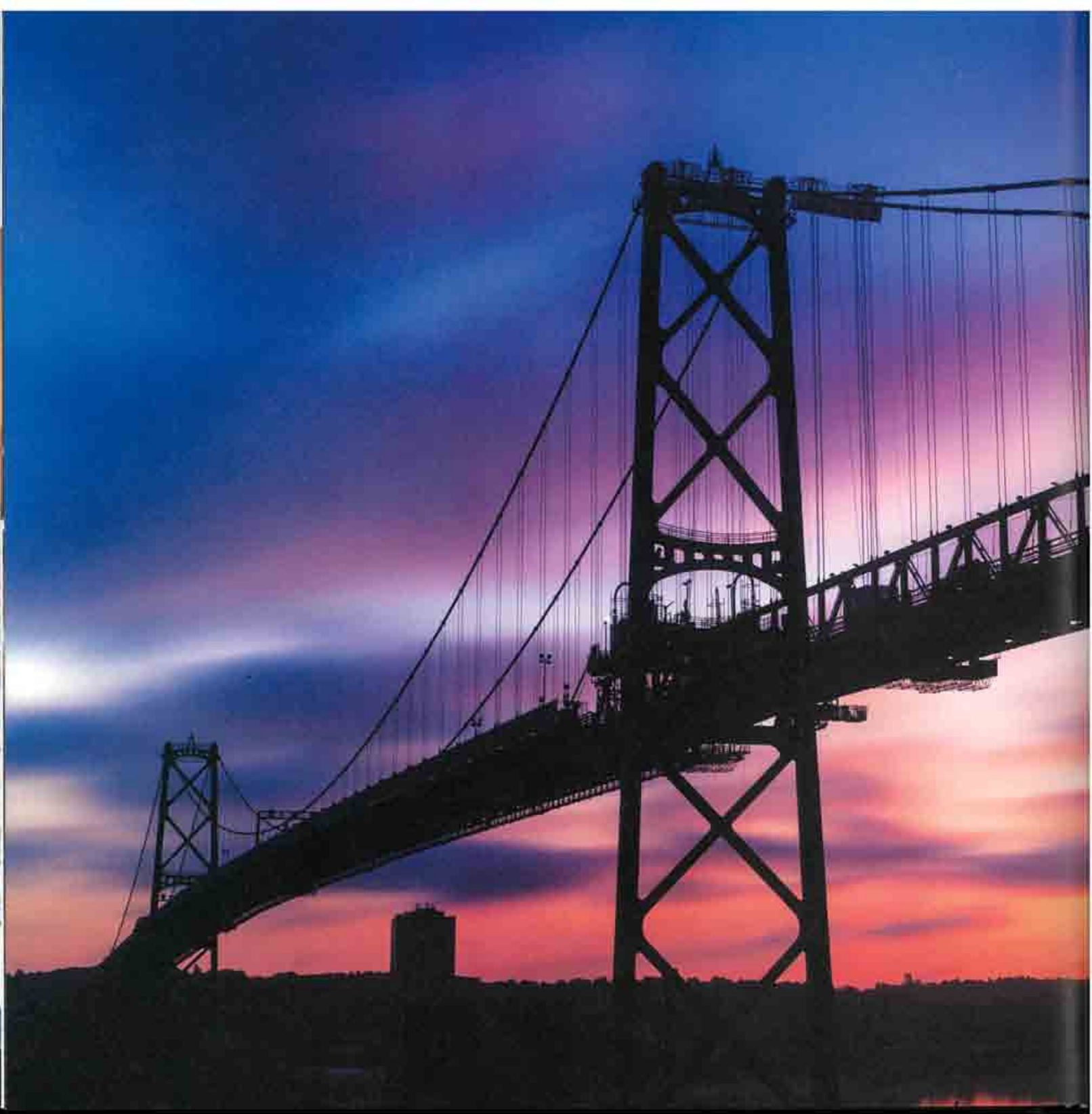
The lance is a long steel tube packed with alloy steel or aluminum rods. When the rod is ignited with an oxyacetylene torch, it quickly reaches the very high temperatures required for cutting the steel. The ironworker controlling the lance can adjust the heat and cutting speed by regulating the high-pressure oxygen that travels down the length of the now melting rod.

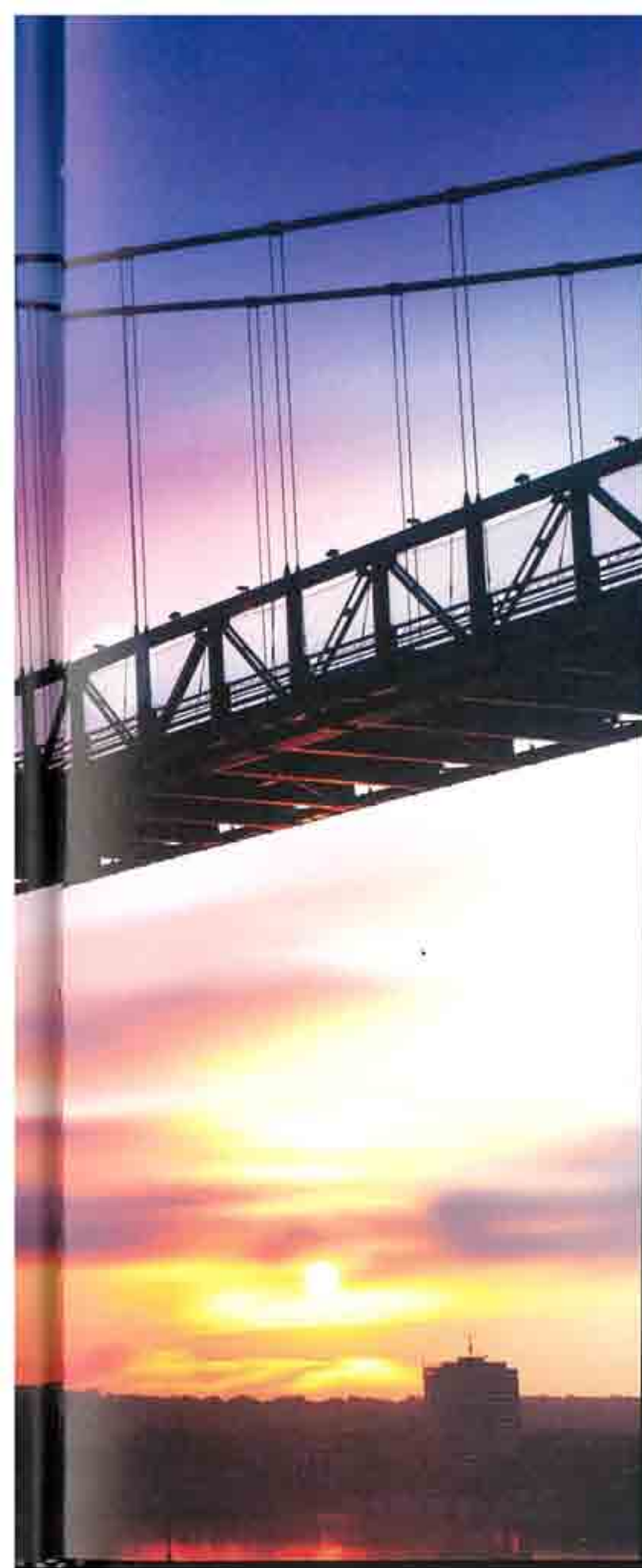












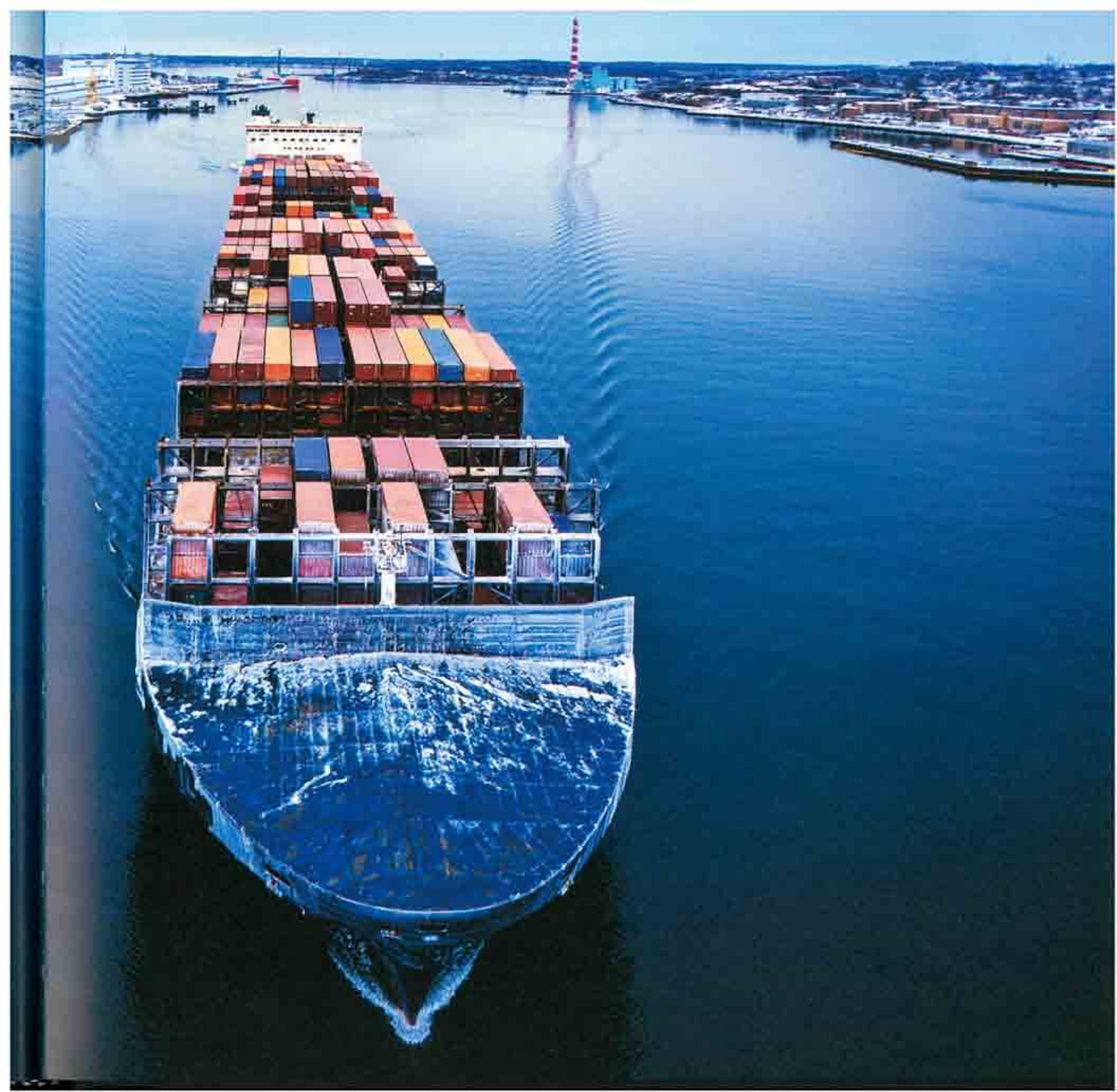
WITH THE DAILY CITY BUSTLE still an hour or so away, workers on the bridge deck are blessed with a mosaic of colour as the sun shines its first rays of the day on downtown Dartmouth.

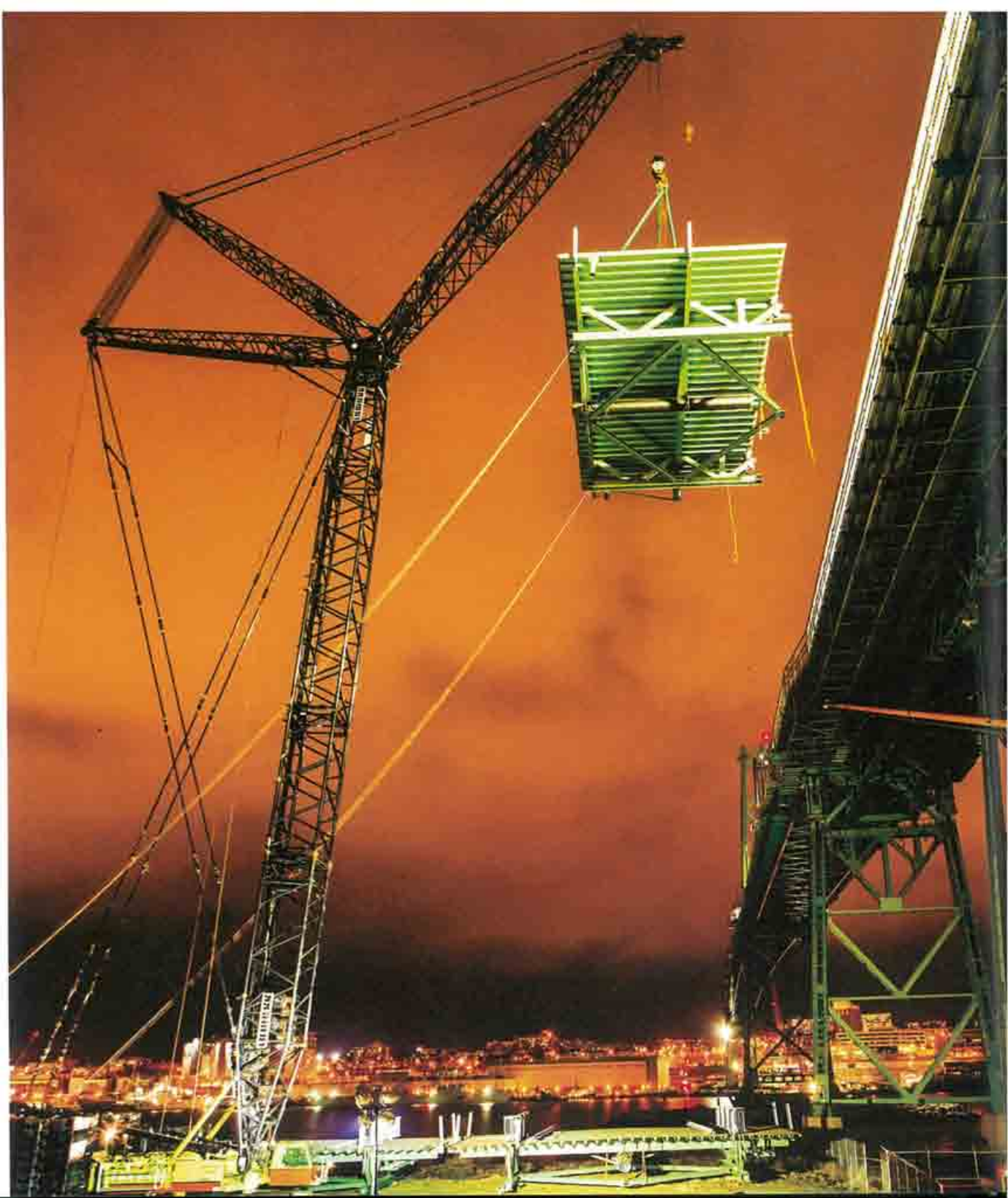
As each deck segment is replaced, the final elevation is adjusted by raising or lowering the suspension cables with hydraulic jacks. Transit levels ensure the final elevation is kept within tolerance.

AS THE PORT OF HALIFAX increases its shipping capacity, the frequency and size of the vessels also increase. In order to be prepared for future growth of these large ships — often exceeding 290 metres in length — specifications called for the deck of the Macdonald Bridge to be two metres higher than the Old Bridge at mid-span.

The ACL *Atlantic Conveyor* is a regular visitor to Bedford Basin and the Fairview Cove Container Terminal.







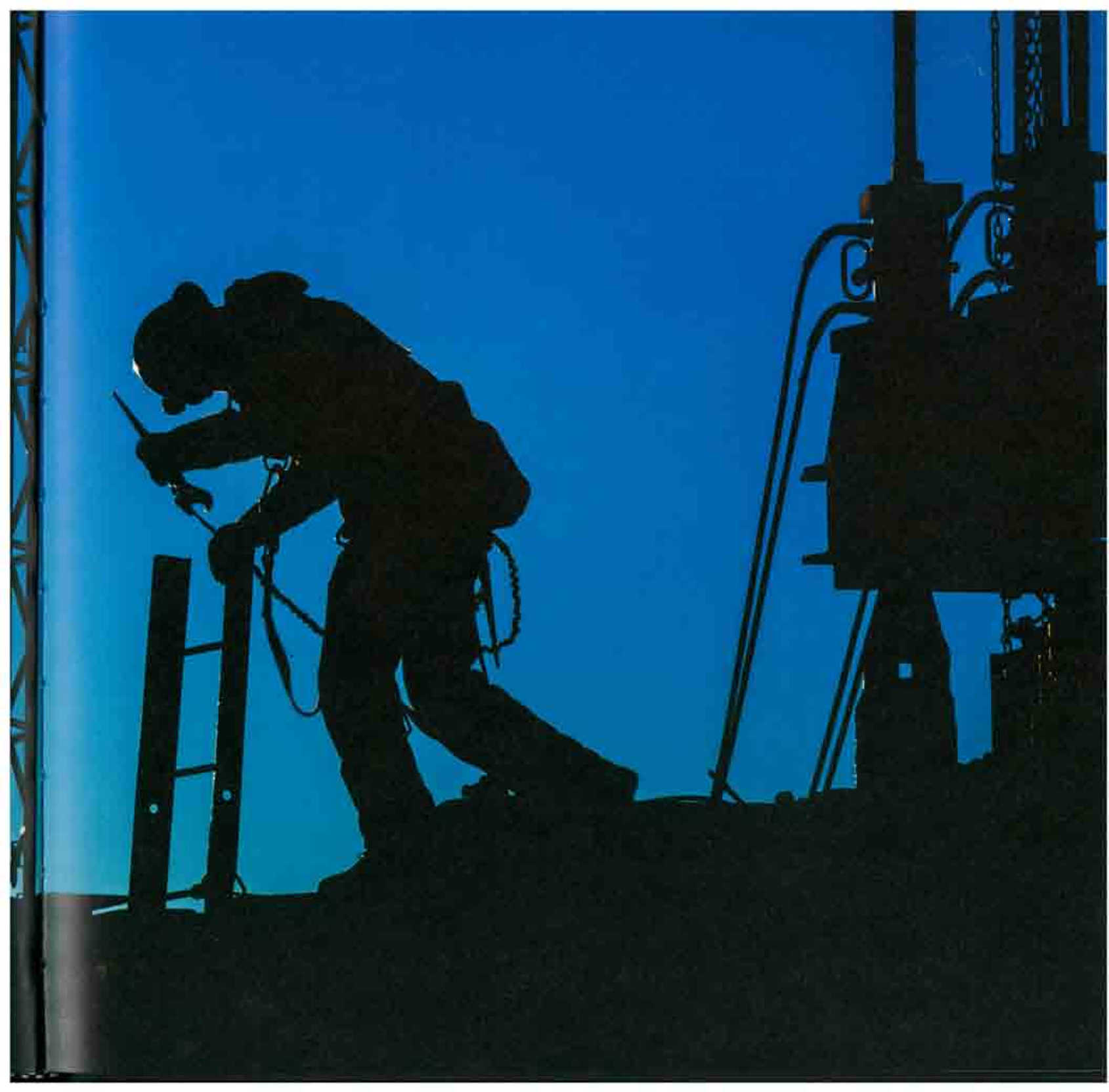
SIXTY TONNES OF STEEL known as Section 31 dangles from the massive Manitowoc 16000 crane used to move the section from the Dartmouth yard to the bridge deck.

Once each section is craned above and cleared of the suspension cables it is then meticulously lowered to the waiting Self Propelled Modular Transporter (SPMT). Like a centipede on steroids, the multi-wheeled, articulating SPMT traverses the length of the bridge to the Halifax side. At this point a second smaller crane lowers S-31 to a segment of the Navy Dockyard that has been reserved for the Big Lift project.

As much work as possible throughout the Big Lift project was contracted to local companies, benefitting the local and Nova Scotia economy. The SPMT, a dream toy of any remote-controlled car aficionado, was supplied and operated by Total Transport & Rigging of Halifax.



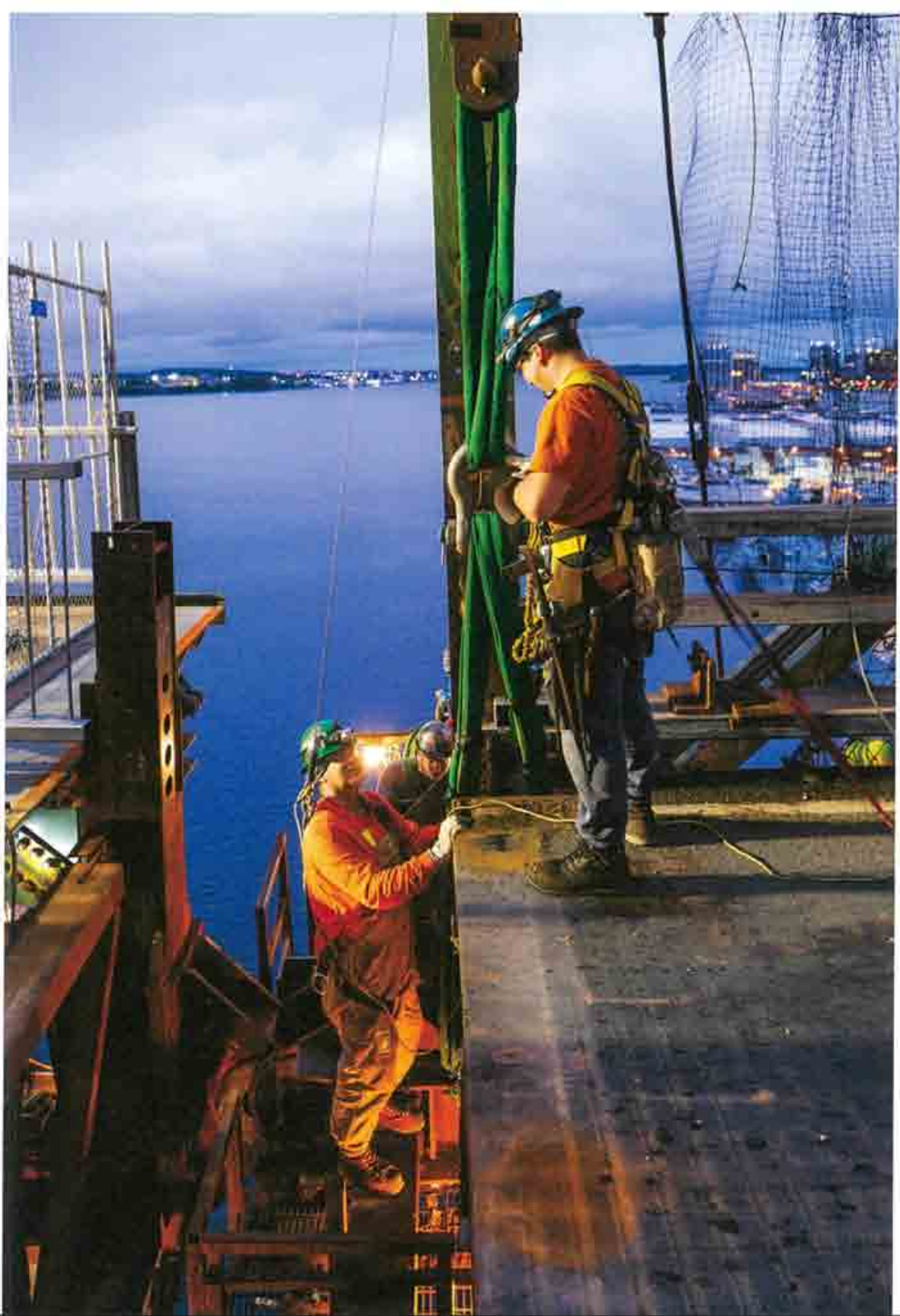




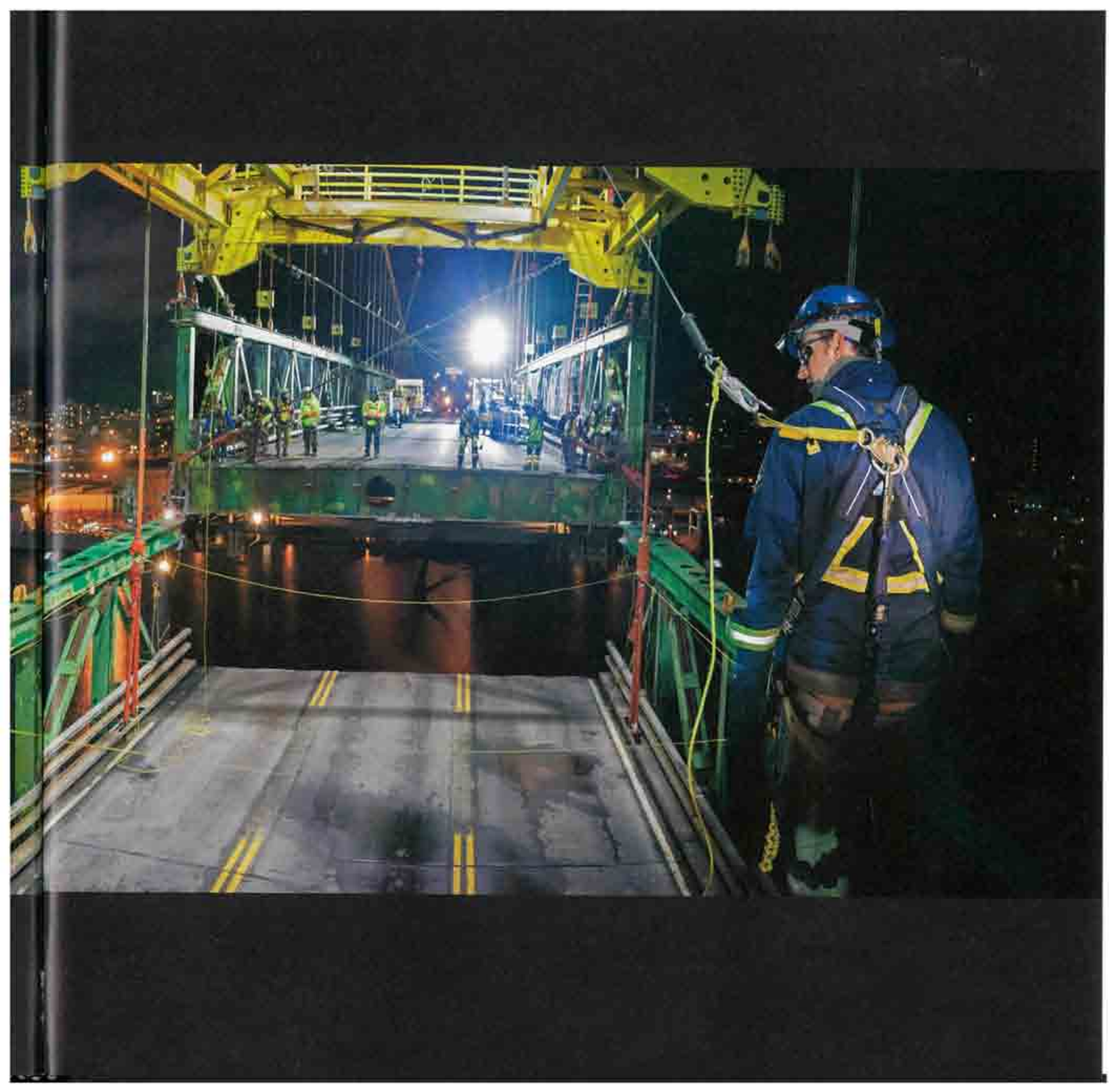












Local
732





BY LOOKING CAREFULLY along the length of the curvature of the guardrail it is possible to see precisely the centre point of the span.













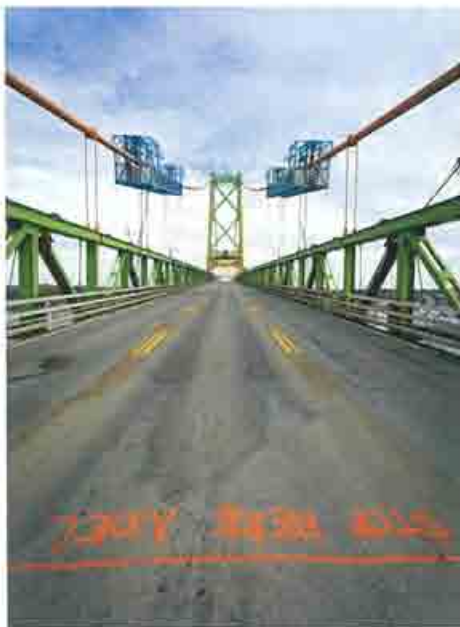
AN IRONWORKER FROM LOCAL 752

goes to his office wearing the tools of his trade.

The tool belt is sometimes called a riggers belt or a structural belt, and often times is labelled a pain in the back. The belt when completely outfitted can often exceed 7.5 kilograms, and must be balanced in order to allow the worker to keep his equilibrium ensuring personal safety when working on narrow beams at great heights.

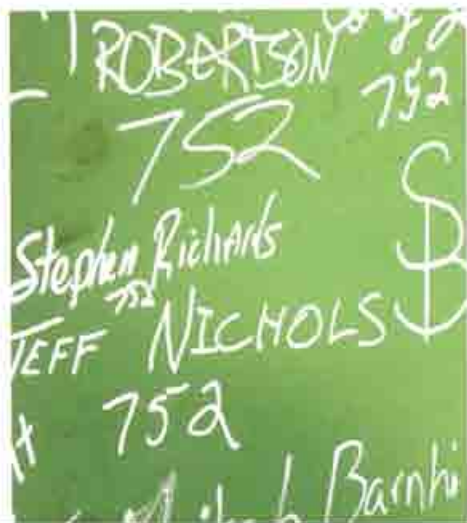
Personal Protection Equipment (PPE) and appropriate safety training was a requirement for all personnel on the job site.

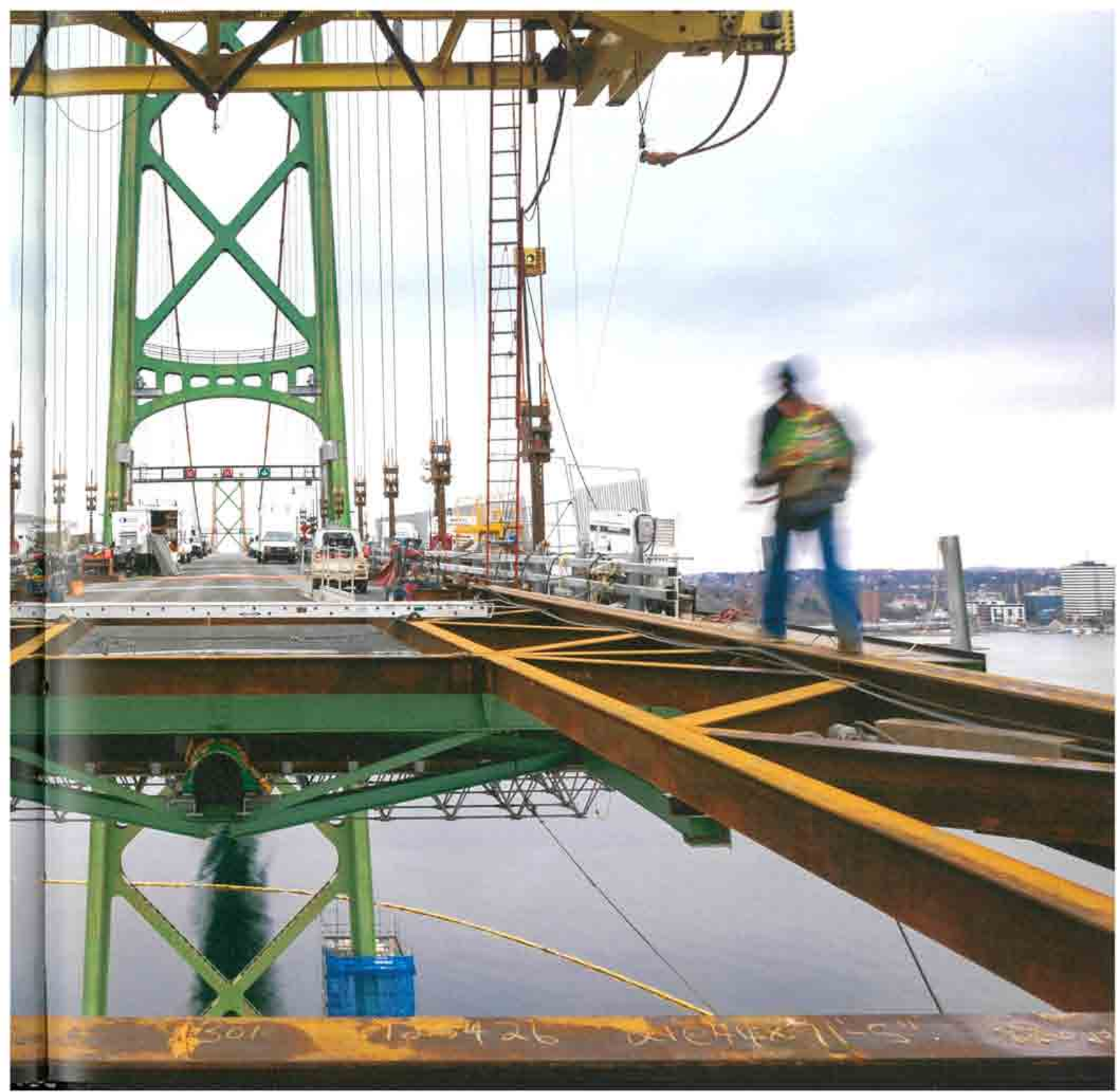
There was a fine balance required on particularly cold days between tools, PPE and warm clothing to ensure worker safety and comfort.



ONE CAN ONLY IMAGINE why Noel should stop here. Many messages were written between the workers on the steel during the Big Lift project. Some were technical, others were instructional, and others were... *colourful*.

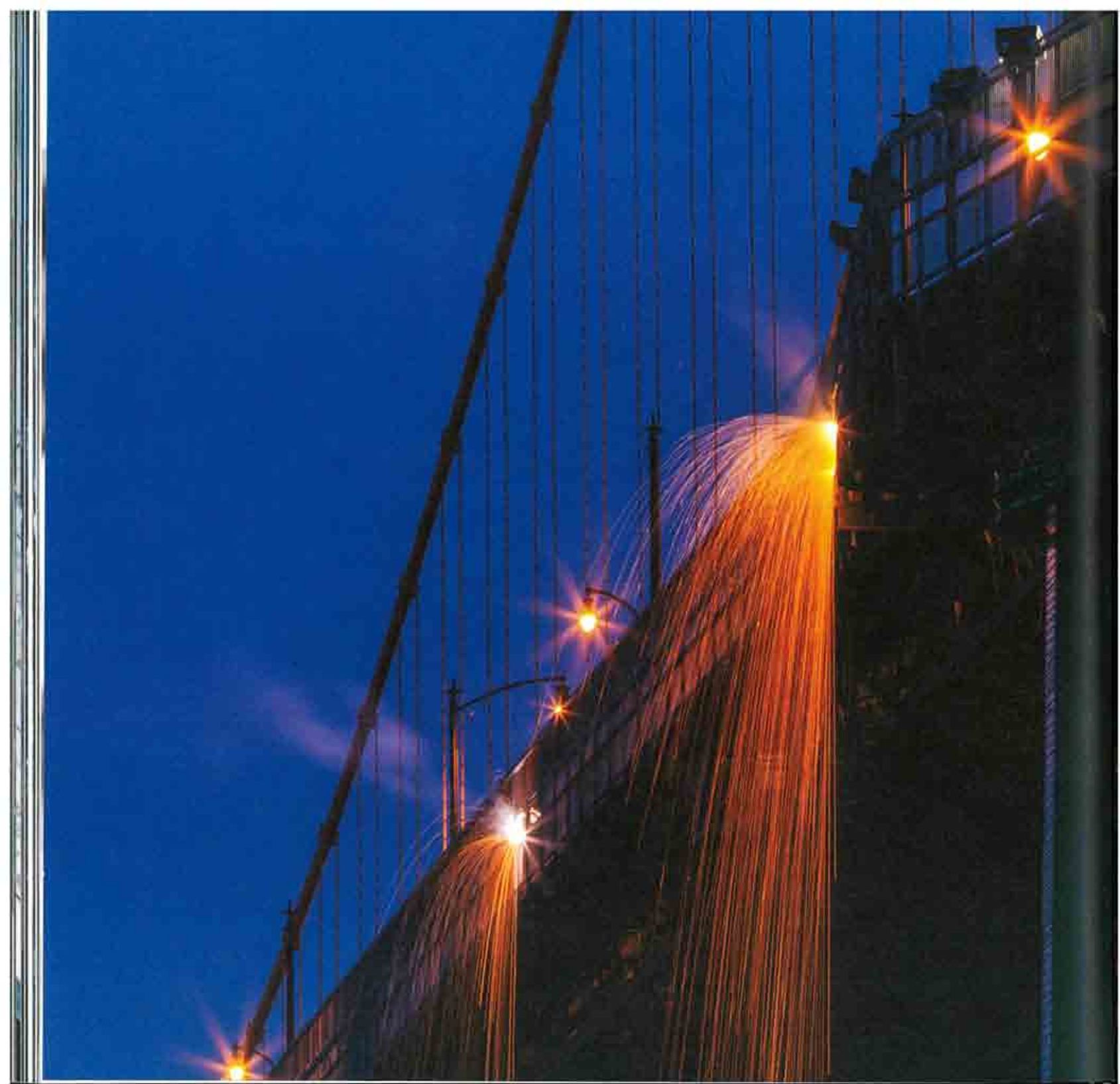
Section 46, the last section to be raised, is signed by Ironworkers Local 752 prior to being lifted into position.

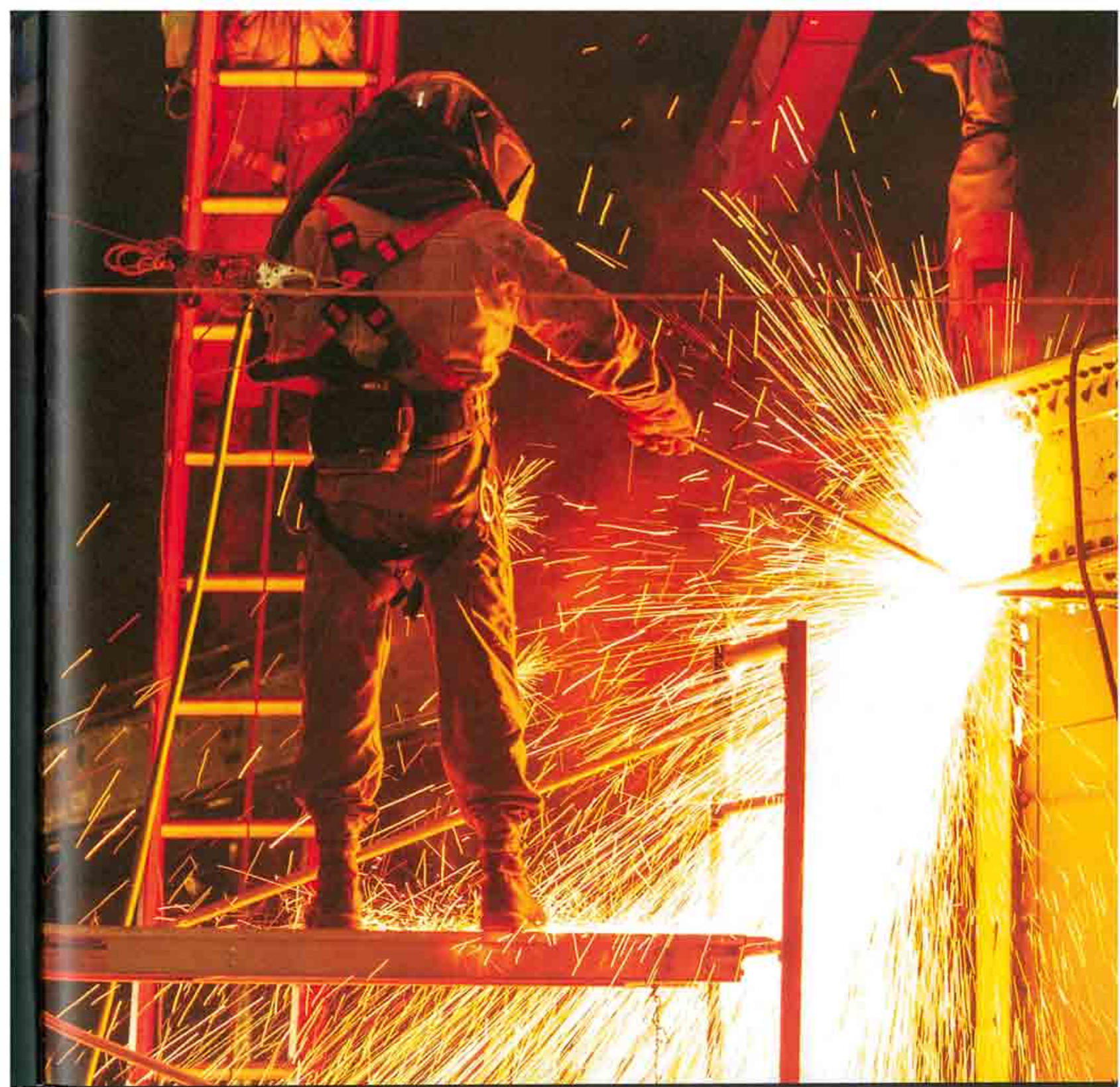


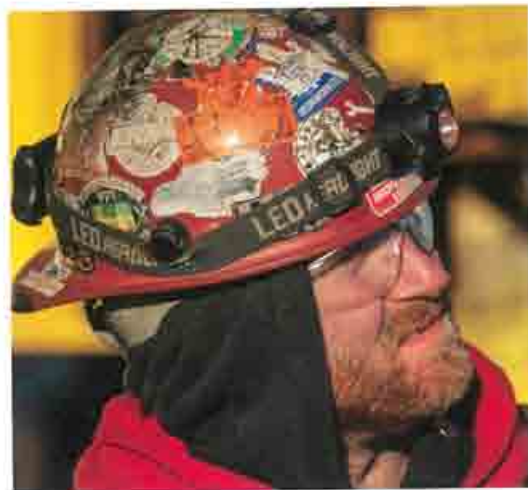




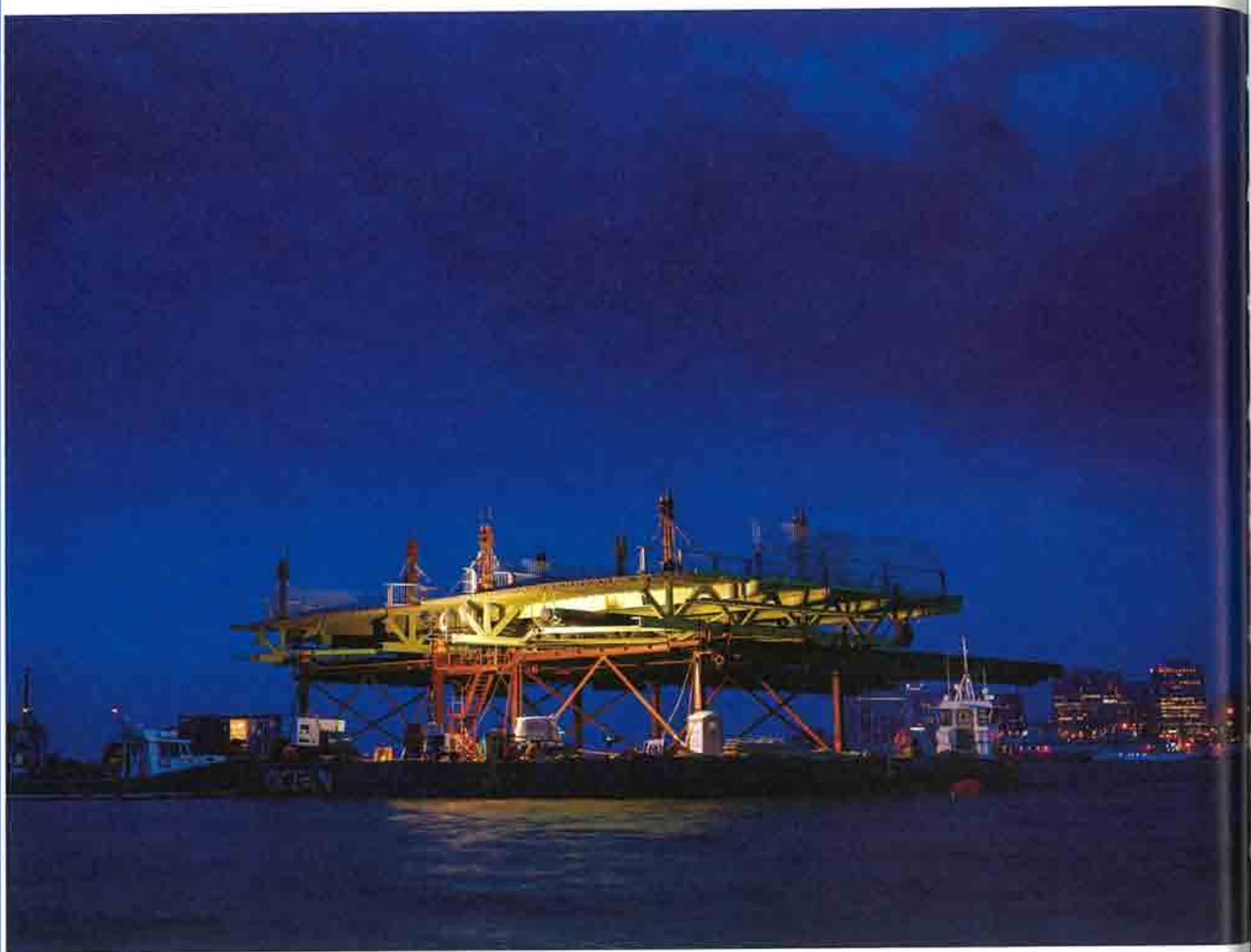














05

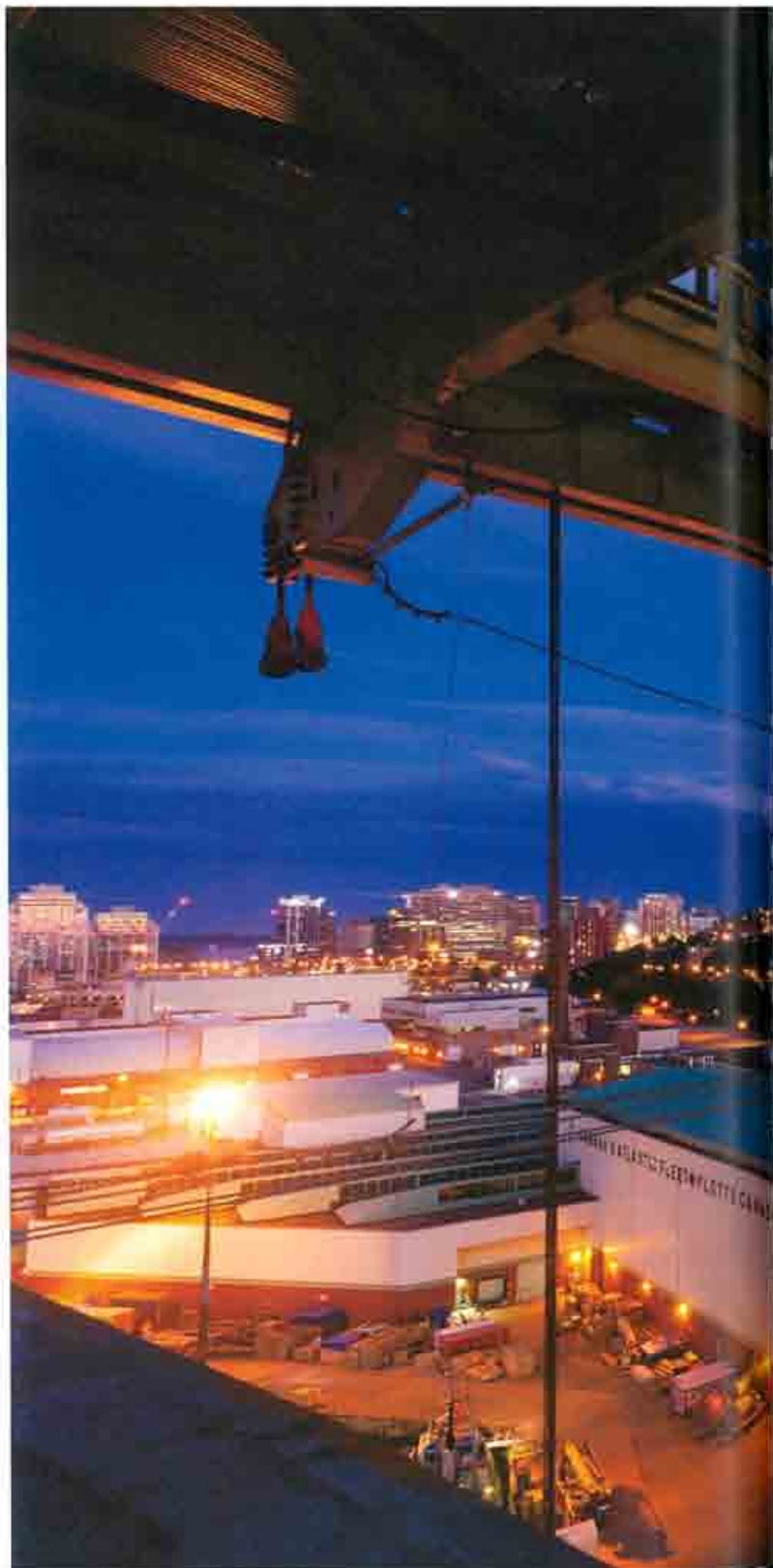
08

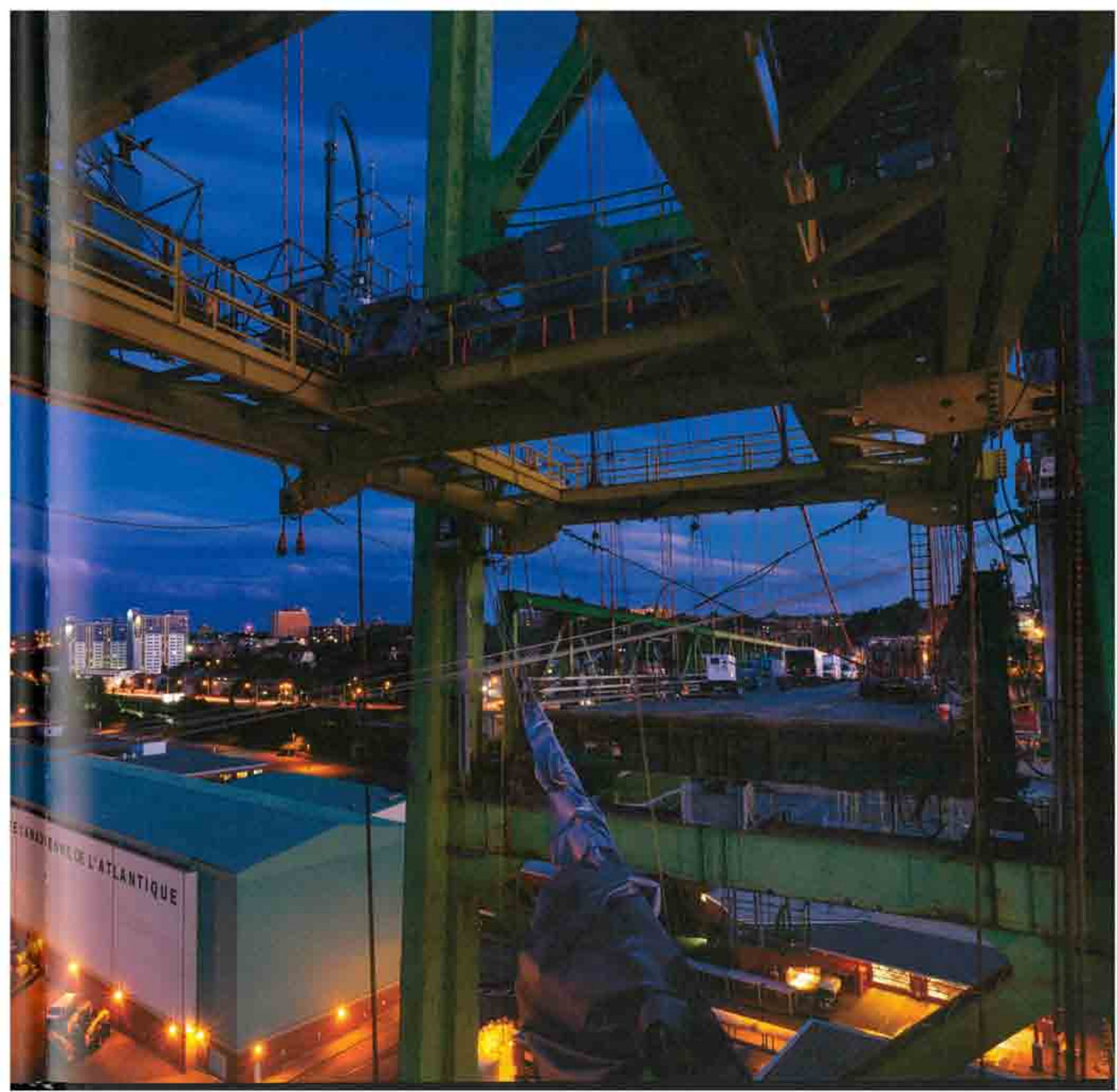
06



FDR, otherwise known as fog, drizzle, rain was an all too frequent companion that workers had to endure.











PEDAL POWER has evolved to an important mode of moving people back-and-forth across Halifax Harbour. During the closure a continuously-operating shuttle service was provided to transport cyclists and pedestrians.

The first section of the bridge to be removed was a small portion of the pedestrian walkway, as seen on the facing page. The sidewalk and bike lanes were repurposed as hiking and trail bridges around Nova Scotia.

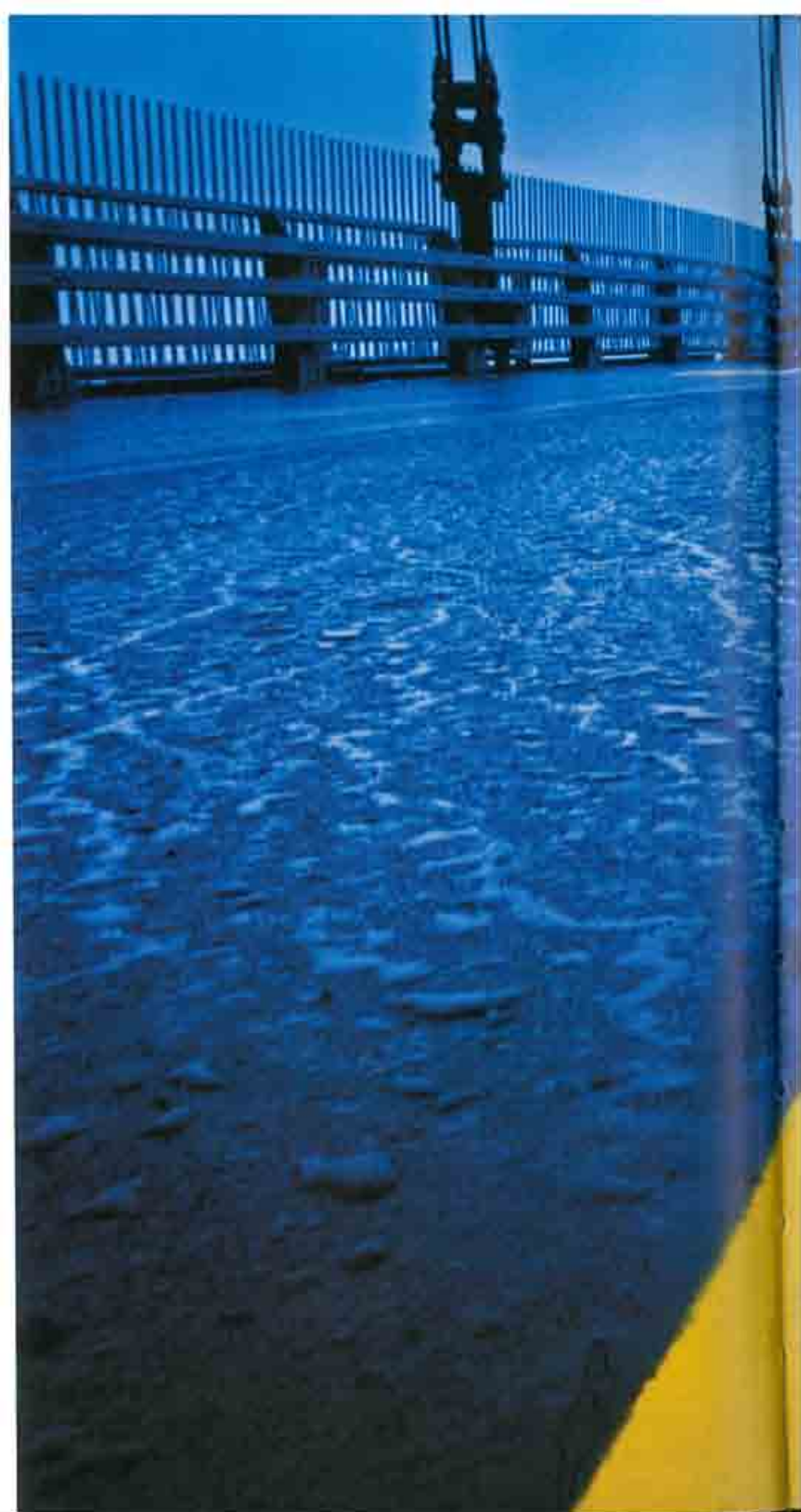
When the Macdonald Bridge opened in 1955, the toll for a pedestrian was a nickel, the cyclist was charged a dime and a horse and rider was 25 cents. Today cyclists and pedestrians travel for free, and horses are no longer permitted to cross the bridge.

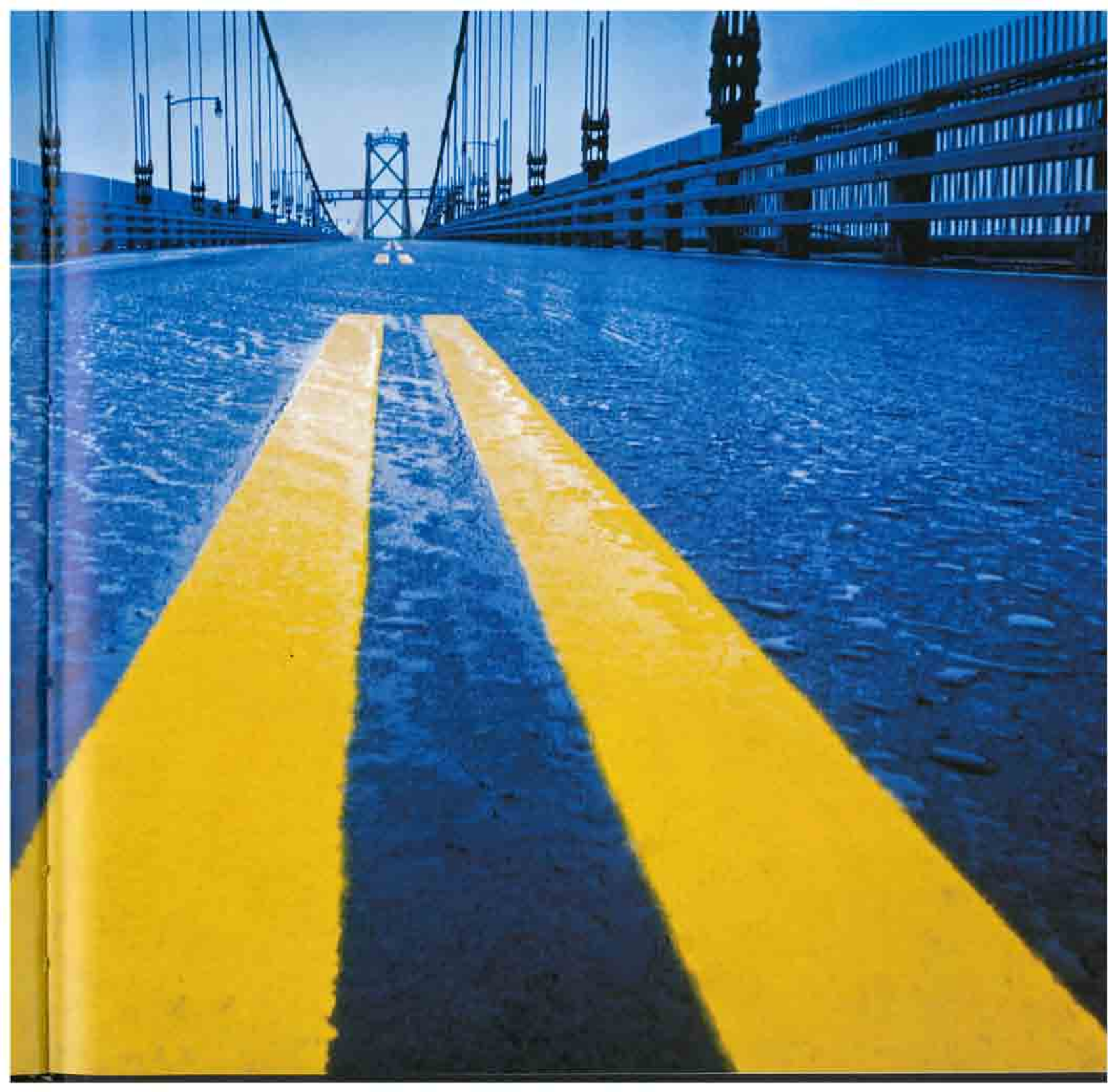


THE FOUNDATION LAYER of asphalt was applied at Cherubini Metal Works, located approximately 10 kilometres away in the community of Woodside. The final application of asphalt was applied after the sections were installed.

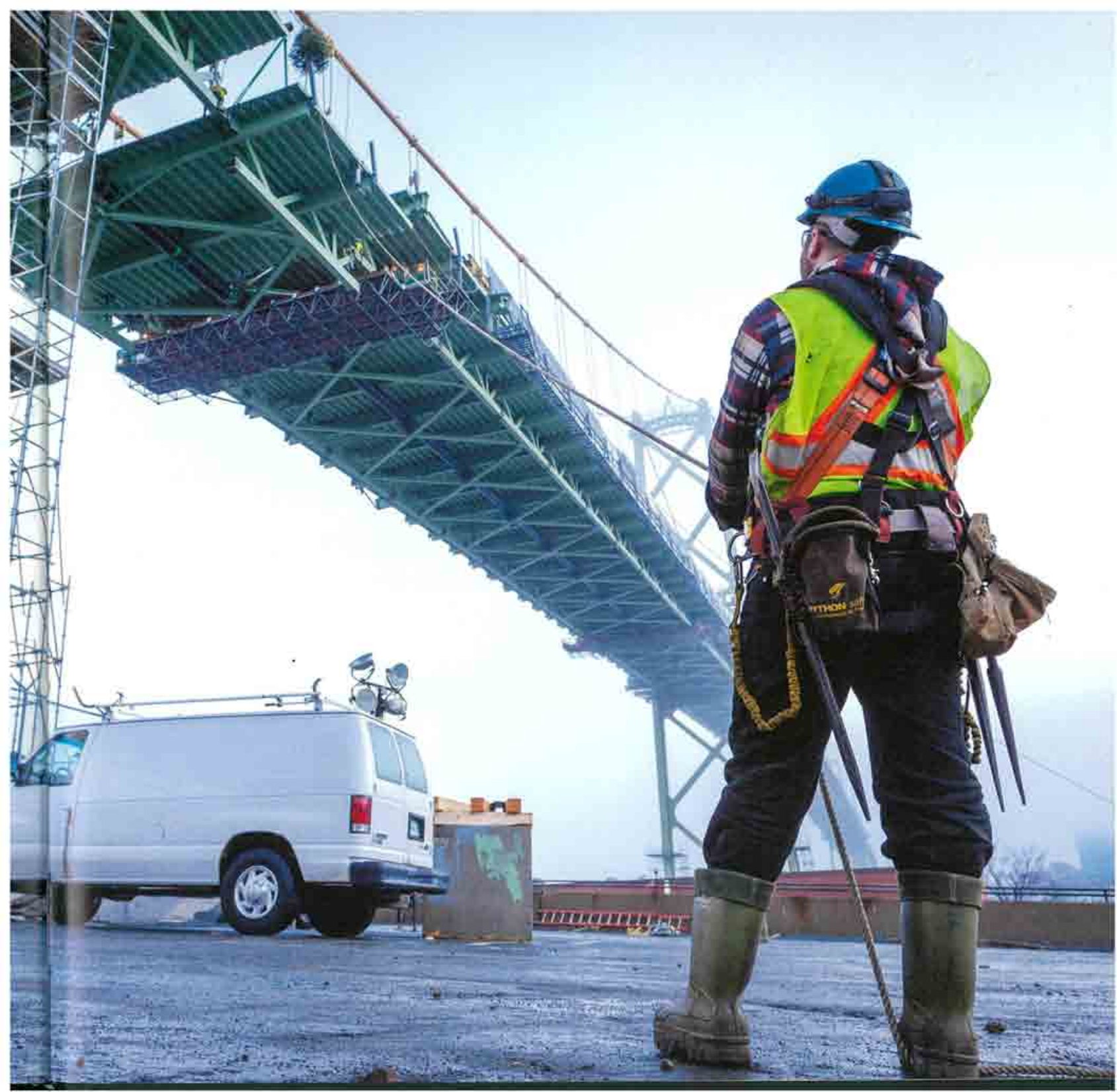
Epoxy asphalt was used on the Big Lift due to its enhanced life and thinner application, thus reducing the overall weight of the bridge deck.

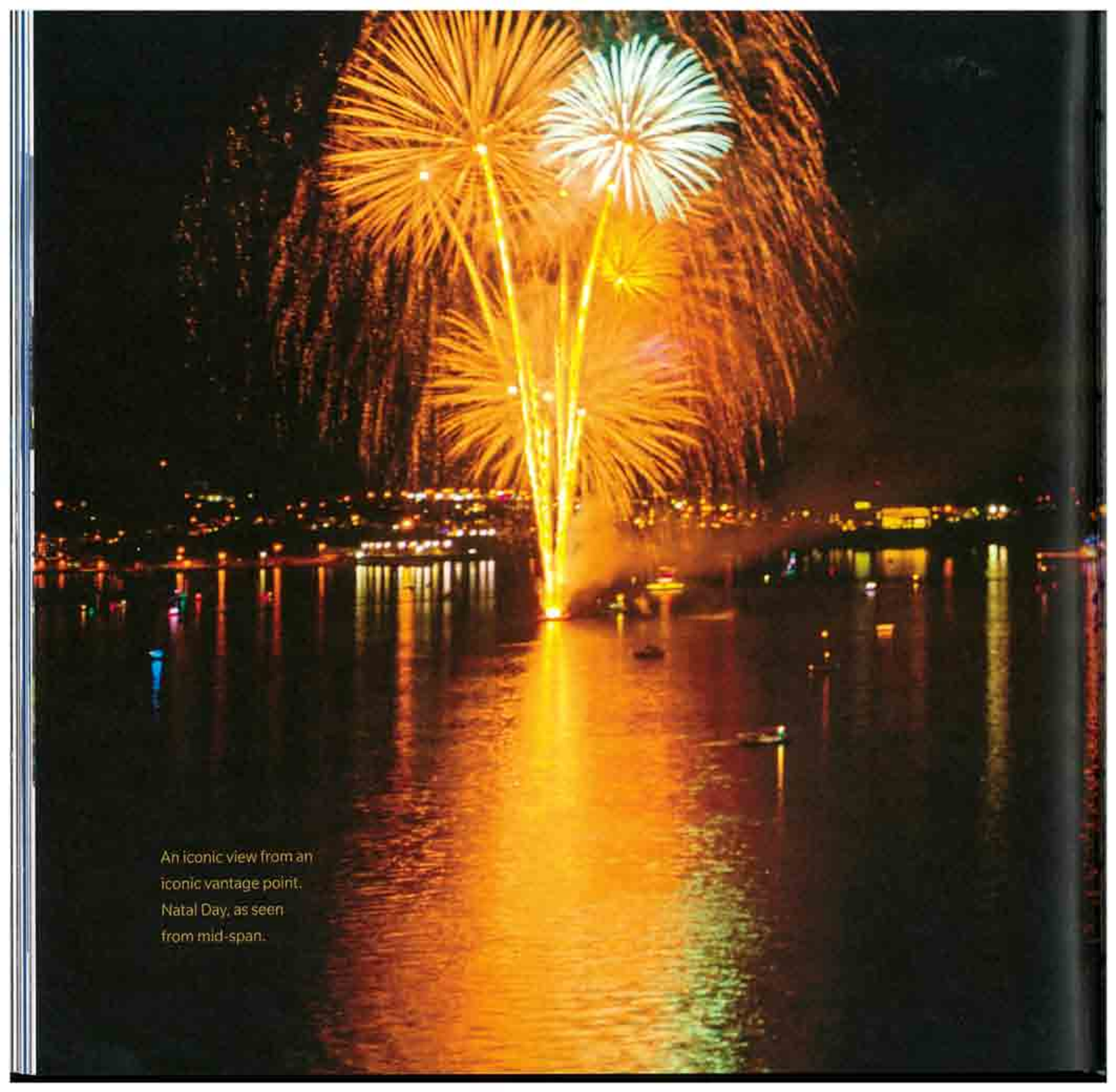
Halifax Harbour Bridges is the only known user of epoxy asphalt in Atlantic Canada. This is the same material and process that was used to resurface the San Francisco Bay Bridge in 2013.



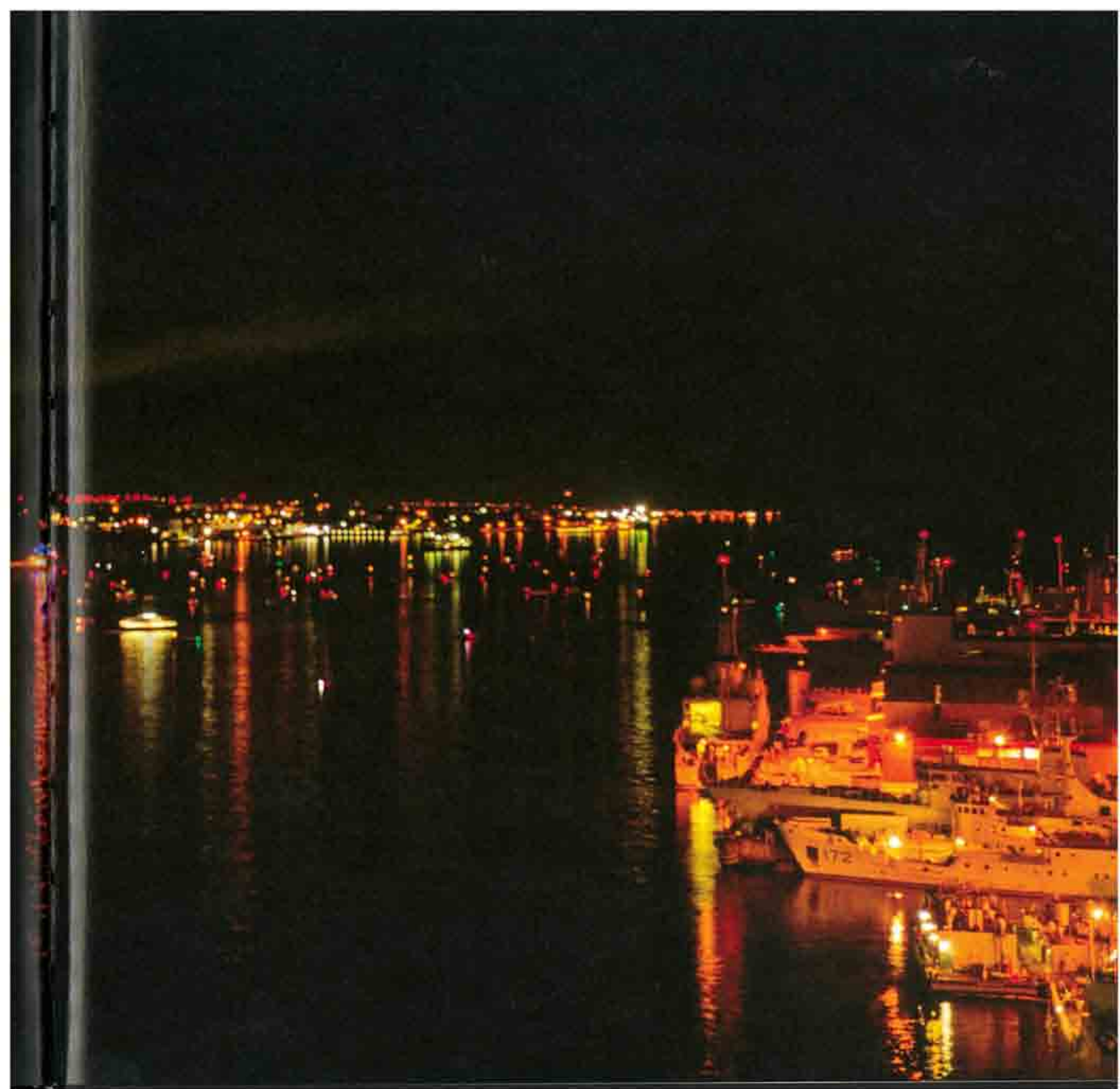






A night-time photograph capturing a spectacular fireworks display over a large body of water. The sky is filled with numerous large, fan-shaped bursts of light in shades of yellow, orange, and green. The fireworks are reflected in the calm water below, creating a shimmering effect. In the background, the city lights of a coastal town are visible, with buildings and streets illuminated. The overall scene is festive and celebratory.

An iconic view from an
iconic vantage point.
Natal Day, as seen
from mid-span.



BIG LIFT PARTNERS

OUR SINCERE THANKS to our partners who worked with us to ensure the Macdonald Bridge remains safe for future generations. And thank you to our neighbours and our customers for your patience through this once-in-a-lifetime project. Special recognition goes to Halifax Transit, the Halifax Port Authority and the Department of National Defense for their collaboration and partnership over the last several years.

Air Liquide	Finnoe Design LLC	Red-D-Arc
All Canada Crane	Groupe Océan	Risksmart
Amman & Whitney	Halifax Regional Municipality	RKO Steel Ltd.
American Bridge Company Canada	Harbourside Engineering Consultants	RMI Marine Ltd.
Anixter	Hazmasters Inc.	RWDI Air Inc.
Atlantic Hardchrome Ltd.	Industrial Safety World Inc.	Safway Services Canada Inc.
Auto Locators	Integrated Hydraulics & Industrial Services	Sani Engineering Ltd.
Axis Mobility Services	Ironworkers Local 752	Sancton Access Inc.
AW Leil Cranes & Equipment	Irving Equipment Ltd.	Sani Engineering Ltd.
Black & McDonald	JAMAC	Servant Dunbrack McKenzie & MacDonald Ltd.
Bradken Canada Manufactured Products Ltd.	Killick Group	Singleton and Associates
Brockman Engineering Inc.	Klohn Crippen Berger	Skarborn Engineering Ltd.
Cahill Group	L&A Metalworks	SNC - Lavalin
CBCL	MacFarlands	Stantec
CFM	MacGregor's Custom Machining Ltd.	TEAM Industrial Services
Cherubini Metal Works Ltd.	Mageba Group	Trans Canada Coatings Consultants Ltd.
COWI North America Ltd.	Marid Industries Ltd.	Top Construction Ltd.
Cumberland Paving & Contracting Ltd.	Marsh Canada Ltd.	United Rentals
Dartmouth Metals and Bottle Ltd.	McInnes Cooper	Williams Form Engineering Corporation
Duron Atlantic Ltd.	M&J Total Transport and Rigging	WireCo WorldGroup
D.S. Brown Company	M & R Engineering Ltd.	VSL International Ltd.
The Dyson Corporation	Munters Corporation	Zieman Engineering LLC
Eagle Beach Contractors Ltd.	On Guard Traffic Control	
Eastern Fence	Optimum Controls Corporation	
	Pennine Control Systems Ltd.	



THE BIG LIFT showcases dozens of photographs from a collection of thousands made by Nova Scotian photographer Dale Wilson, while on assignment with Halifax Harbour Bridges.

A labour of love documenting an engineering marvel and industrial beauty, the photographer introduces us to the people who made it happen, and how they made it happen.

Dale Wilson has masterfully captured forever the lasting legacy of **THE BIG LIFT**.



ISBN: 978-0-9959607-0-1



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附錄三

Evolution of Asset Management at MTA Bridges and Tunnels

Evolution of Asset Management at MTA Bridges and Tunnels

Justine Tietjen P.E.

Deputy Chief Engineer, Program Operations and Asset Management
Engineering and Construction


87th Annual Meeting and Exhibition of IBTTA, September 16, 2019



Overview


- Background on MTA Suspension Bridges
- Asset Management at B&T
- Master Planning for the Future
- Asset Management Program Strengths and Gaps

Facility Overview




Bronx-Whitestone Bridge

Single level bridge with 2 main cables
Opened to traffic: 1939
Length of main span: 2,300 feet
Length of each side span: 735 feet



Throgs Neck Bridge

Single level bridge with 2 main cables
Opened to traffic: 1961
Length of main span: 1,800 feet
Length of each side span: 555 feet



Robert F. Kennedy Bridge

Single level bridge with 2 main cables
Opened to traffic: 1936
Length of main span: 1,380 feet
Length of each side span: 672 feet



Verrazzano-Narrows Bridge

Double Decked Bridge with 4 main cables
Opened to traffic: 1964
Length of main span: 4,260 feet
Length of each side span: 1,215 feet

APP3-4

Asset Management at MTA B&T

- Since the inception of its Capital Program in 1992, MTA B&T has maintained and improved its facilities via both Capital and Operating Investments

Maintenance and Capital Programs

- Bridge Preservation Program – contracted routine maintenance such as joint repair, spot painting, bridge and pier washing, cleaning of drainage systems, etc.
- Painting Program – ensures structural elements are protected from the elements
- Rolling 20-Year planning process for major structural rehabilitation, reconstruction and replacement



20-Year Master Plans / 5-Year Capital Program

- 20-Year Master Plans are based upon:
 - Asset Condition / Condition Trends
 - Structural Element Level Risk Analysis
 - A multi-hazard risk / resiliency review
 - Review for compliance with modern standards
 - Review of regional transportation needs
- 20-Year Plan is updated every 5 years, and a new detailed 5-Year Program is developed

APP3-6

Asset Conditions

- Asset Conditions are recorded as part of the Federally Mandated Biennial Inspection
- MTA B&T has recorded the condition of every single element on its structures since the inception of the Federal Bridge Inspection Program
 - Data includes non-structural as well as structural elements on the bridges, as well as off bridge elements such as retaining walls
 - Condition trends document either improvement or dis-improvement due to investment or lack thereof

APP3-7

Asset Conditions

- Special inspections are performed on critical elements that cannot be assessed visibly such as the main cables



APP3-8

Element Level Risk Assessment

- MTA B&T is performing an element level risk assessment on the structures to help prioritize investments across assets in a similar condition given funding constraints
- Elements are assessed for both vulnerability modes and criticality of failure
 - Vulnerability Modes**
 - Failure Mode
 - Likelihood of detection
 - Capacity over demand ratio
 - Exposure to dynamic loads and fatigues
 - Probability of damage or deterioration
 - Remaining service life
 - Criticality Scoring**
 - Operational impact
 - Hazard severity
 - Structural redundancy / fracture critical

Scoring results in a Risk Priority Number for each element

		Criticality Score				
		1	2	3	4	5
Vulnerability Score	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5

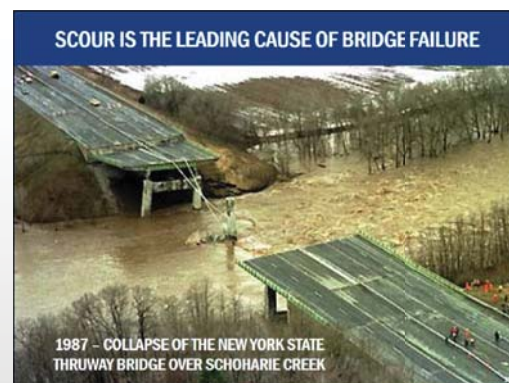
APP3-9

Structural Health Monitoring

- MTA B&T is embarking on a study to develop a strategic and integrated Weigh-In-Motion / Structural Health Monitoring Program for its bridges to enhance its Asset Management
- The goals of the program are as follows:
 - Provide greater situational awareness of structural conditions in real time to help with the development of inspection and repair strategies
 - Provide enhanced awareness of structural conditions during extreme events
 - Monitor vulnerable structural elements identified during element level risk assessments
 - Reduce inspection costs and provide supplemental inspection data
 - Determine load specific reactions of members at risk
 - Develop site specific live load design criteria for evaluation of structural members and for use during design of replacement structures

Risk / Resiliency Mitigation

- In addition to the element specific structural risks, bridges are subject to a variety of natural and man-made hazards including:
 - Seismic
 - Wind
 - Structural overloads from heavy trucks
 - Fire
 - Scour
 - Vessel Impacts

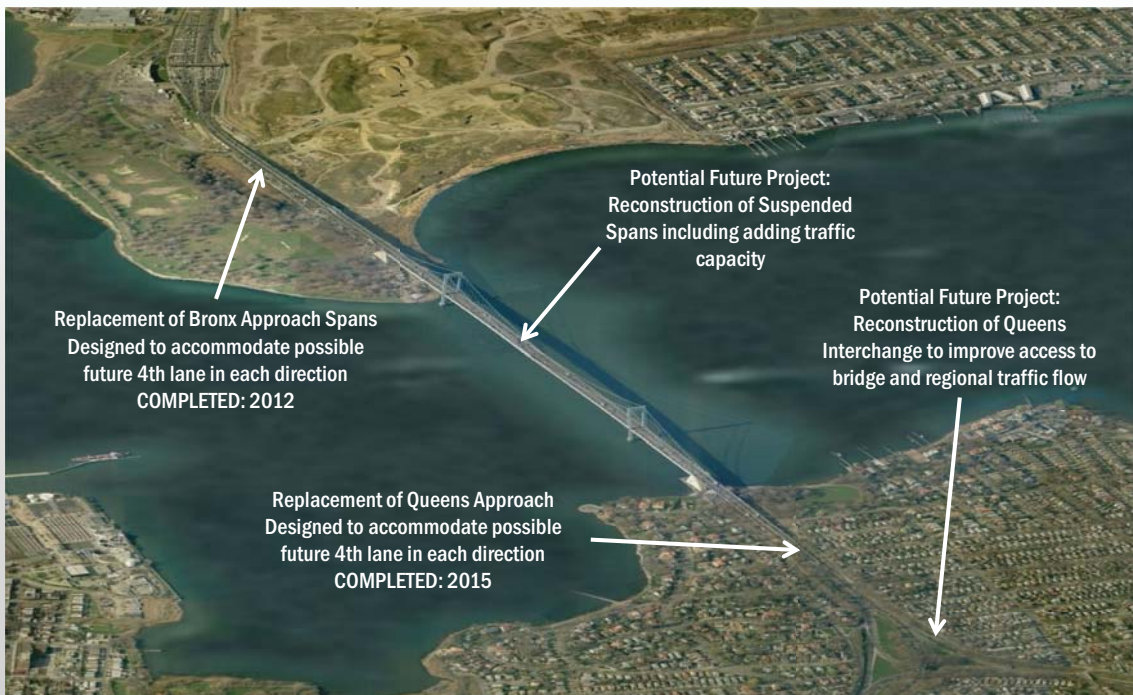


Regional Mobility Improvements / Structural Upgrades

- MTA B&T suspension bridges are critical links between communities and in the regional highway network
- 20-Year planning allows the Authority to plan not only to address deteriorating conditions in a timely manner, but also to make significant improvements to eliminate functionally obsolete structures and improve regional mobility
 - There are ongoing long term plans for major regional mobility improvements at each of the Authority’s suspension bridges

APP3-12

Bronx-Whitestone Bridge Improvements and Future Planning Considerations

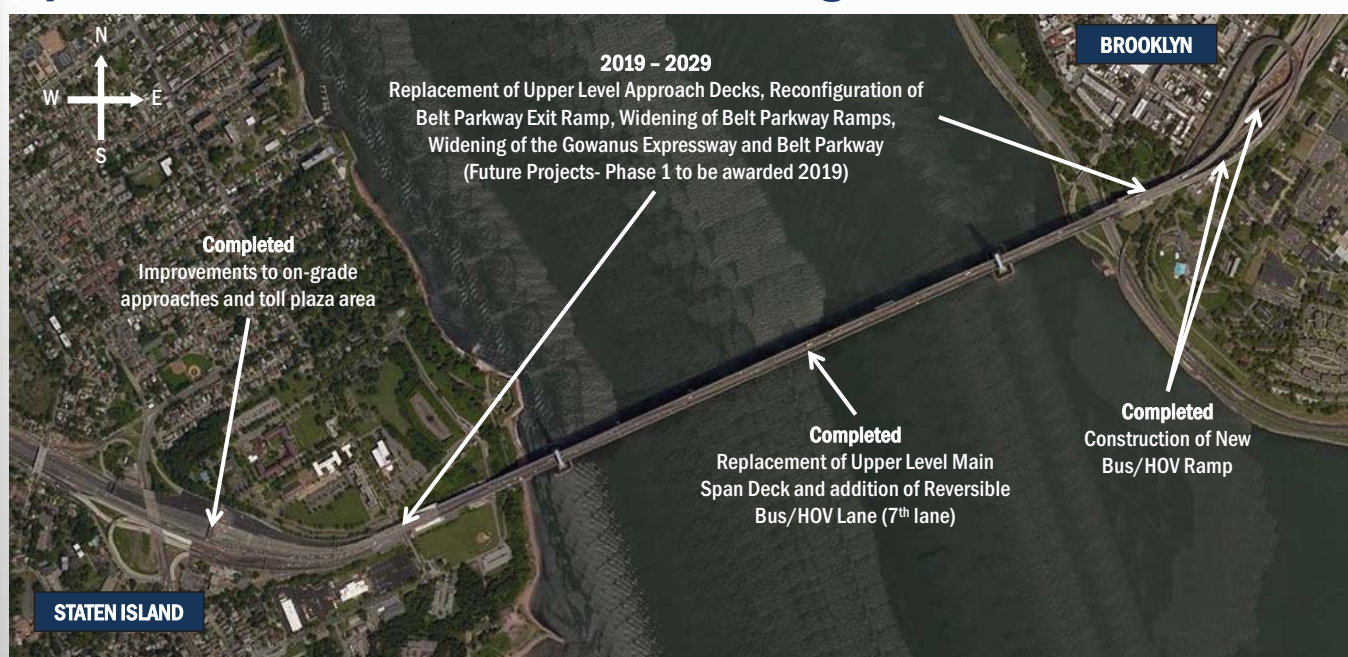


APP3-13

Throgs Neck Bridge Improvements and Future Planning Considerations



Verrazzano-Narrows Bridge Improvements and Future Planning Considerations



Robert F. Kennedy Bridge Improvements and Future Planning Considerations



APP3-16

Master Planning for the Future

- As discussed above, B&T Capital projects address multiple goals
 - State of Good Repair and extension of service life (dehumidification of cables, deck replacement, structural retrofits, etc.)
 - Resiliency (both structural and non-structural, electrical, communications, etc.)
 - Upgrades to current design standards
 - Upgrades to account for overweight vehicles
 - Upgrades to eliminate functional obsolescence
 - Other risk mitigation such as vessel impact, scour, security
 - Regional interoperability improvements and added traffic capacity
 - Aesthetics

APP3-17

Asset Management Program Strengths and Gaps

- Strengths: B&T has a robust informal Asset Management Program
 - Outstanding Inspection Program and documentation of asset conditions, age, and expected service life
 - Ongoing documentation of structural and other types of risk
 - Ongoing or recently completed master planning studies
 - Ongoing evaluation of technologies to improve data capture
- Gaps:
 - Formalized tracking and linking of maintenance expenditures to individual assets – under development
 - Central data warehouse linked to BIM tool for visualization of issues to erase project planning – under development

APP3-18

Questions?

APP3-19

附錄四

Risk and Asset Management

Risk and Asset Management

Barry Colford, PE, CEng., FICE.
Vice President, Complex Bridge Practice,
AECOM

APP4-2

Challenges

- We are now all expected to do more with less resources (funding and labor)
- The assets are aging
- Climate:
 - 1.5 degree rise since 1880
 - More intense storms
 - 100 year floods twice as frequent as 40 years ago
- Societal Changes
 - More stringent H&S requirements
 - More intense public scrutiny
 - More environmental requirements



APP4-3

Can we keep doing this?



APP4-4

Asset management

- Does not replace existing good practice, instead it provides the framework within which this practice may be more effectively implemented, managed and complemented by other processes
- It is not maintenance management
- Authorities should have asset management requirements common to all transport assets (e.g. roads, structures, tunnels, ports, airports and buildings)
- provides a systematic and holistic framework for the management of a group of assets to:
 - deliver specified Levels of Service
 - while minimizing whole life costs

Transportation Asset Management is a **strategic** and **systematic** process of operating, maintaining, upgrading, and expanding physical assets effectively throughout their lifecycle. It focuses on **business** and **engineering** practices for resource allocation and utilization, with the objective of better decision making based upon quality information and well defined objectives.

APP4-5

What do we get from Asset Management?

Improves

- Financial performance
- Economic performance

Fundamental Questions: Answer those questions that drive most of the expenditure decisions:

- Which capital projects to undertake, when, and why?
- What work should my operations and maintenance crews be doing, where, and why?
- When to Repair, Refurbish, and Replace

"Tell the story":

- For decision makers/public create a business case to drive investment in operations, maintenance, and capital spending.
- Paper / decision trail

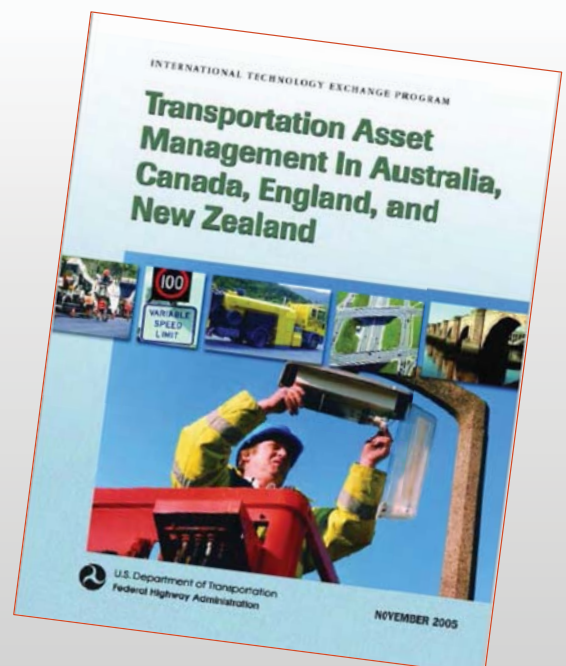
FHWA Require:

- Readily meet FHWA MAP 21 /FAST reporting requirements
- TAMP plans must be submitted and based on risk

FHWA Study of Asset Management

2005 Study of Asset Management in four countries:

- England
- New Zealand
- Australia
- Canada



England

In England, The Highways Agency (now Highways England) has a Structures Management Information System (SMIS), a repository of condition data for all structures on the national network.

- One of the most important drivers for asset management in England has been governmental directives on transport policy and accounting procedures. A tradition of managing road assets began in 1825 when Parliament stated that it was government's "duty to maintain" infrastructure built with public funds.
- The privatization of the road network in the UK over the past 25 years made a asset management the main tool in the management of the UK's roads and bridges. Key Performance Indicators, Risk Analysis and Whole Life Costing were required to measure performance and determine prioritization.



New Zealand

- New Zealand has been a world leader in many aspects of road network management
- The maintenance activities on the network have been privatized- meaning good information and effective management are essential
- In asset management, New Zealand has implemented innovative performance-based maintenance contracts, established a performance-oriented asset management decision making structure
- Risk management, key performance indicators and whole life costing are all used



Australia- New South Wales

- Management of the road network is outsourced
- The analysis procedures and prioritization schemes used depend on the type of asset program being considered.
- For network and road capacity expansion, benefit-cost analyses are used to justify investment.
- Infrastructure asset management projects are prioritized through a risk management process



Canada -Alberta

- Mid-1990s outsourcing to private companies.
- Systematically identifying deficiencies and allocating resources was an important part asset stewardship responsibilities.
- An asset management program based on risk was viewed as serving this function

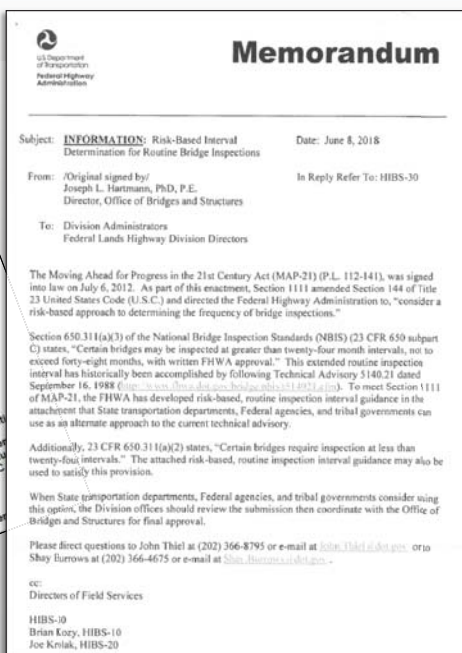


FHWA study concluded

- All of the highway management programs the team studied in the three countries:
- Had privatized the road network
- Used asset management and the concept of risk for establishing investment priorities.
- The study concluded that:
- Most U.S. asset management experience does not have the same level of application.
- Risk concepts need to be incorporated more systematically into U.S. asset management efforts.

Risk Based Asset Management

- FHWA has now recognized that Risk is key to managing assets



Defining and Quantifying Risk

Cause of Death	Probability of occurrence
Heart Attack	1 in 5
Hospital Infection	1 in 38
Car Accident	1 in 84
Bike Accident	1 in 4,919
Air Accident	1 in 5,051
Shark Attack*	1 in 60,453
Lightning	1 in 79,746
Train Crash	1 in 156,169

*Shark data represents number of attacks worldwide, not deaths.



Kutai Kartanegra Bridge



APP4-16



APP4-17

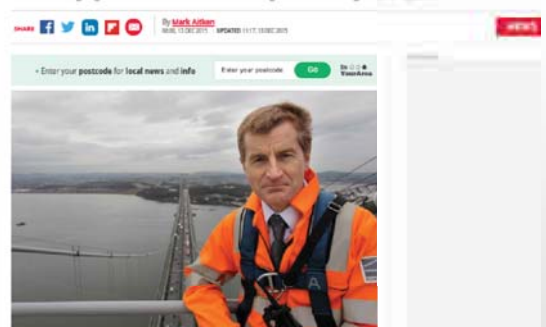
Management of Risk



For Owners it is all about managing risk- but who owns the risk? Is it the Engineers in the Authority; the Executives or the Politicians?

This bridge cannot cope: Engineer raised alarm about the Forth Road crossing TEN MONTHS ago

CONFIDENTIAL papers show Chief Engineer Barry Colford identified problems with the bridge's ability to carry heavy loads on vehicles weighing more than 150 tonnes until load-bearing beams were strengthened.



The operator of the Forth Road Bridge was told of a need for repairs 10 months ago, a leaked email has revealed. Forth Road Bridge closure



Risk Based Asset Management for Bridges

- We usually base all our bridge asset management on condition alone
- Each element is assigned a quantitative score based on the vulnerability and criticality of each element.
- The product of the criticality score and the vulnerability score is called the Risk Priority Number (RPN).
- The method provides the owner with a ranking of elements most at risk.
- This ranking can be used to determine the capital program and frequency of inspection for each component



Risk Analysis Theory

- Determine how critical each element of the bridge or tunnel is and examine how vulnerable each element is by using a number of metrics.
- In essence Criticality x Vulnerability is a way of calculating Risk.
- Risk = Likelihood x Consequence is **Vulnerability x Criticality**.
- Criticality x Vulnerability = Risk Priority Number (RPN). The higher the number the higher the risk.
- Once an RPN is assigned to a bridge or tunnel element then maintenance, capital planning and inspection can all be prioritized in a methodical way based on the risk to the Owner.

Vulnerability and Criticality

Vulnerability Metrics

- Failure Mode
- Likelihood of detection
- How hard is the component working and what is its condition (C/D ratio)
- Dynamic Load and Fatigue
- Probability of Damage or Deterioration

Criticality Metrics

- Operational Impacts
- Hazard Severity
- Structural Redundancy/Fracture Critical

Weighting of the Vulnerability and Criticality metrics can also be carried out. For the Vulnerability Metrics this will weight the importance of each individual metric. For the Criticality Metrics the three metrics can be weighted again to differentiate between individual metrics but also to differentiate between bridges.

Capital Program

- How do we determine which capital projects to prioritize if we have multiple assets?
- Ranking by priority using risk analysis techniques is used. The RPN values already established for each of the elements on the bridges are the building blocks to enable the prioritization of projects to be determined as shown in the example below:

Bridge	Capital Project	RPN
A	Suspender Replacement	20
B	Pin and Link Replacement	18
C	Main Cable Inspection	25
A	Main Cable Dehumidification	25
D	Finger Joint Replacement	18
D	Anchorage Dehumidification	22
B	Deck Repairs	15
C	Tower Painting	10

Inspection Frequencies

- Inspection frequency can be varied with risk of damage or failure.
- Beneficial in three ways:
 - Elements that are most at risk of failure are inspected more frequently
 - Resources and staff can be used more efficiently
- Increasing the inspection frequency of critical components provides more assurance of the long term structural integrity



PESTLE Analysis

- Structural and Operational Risks have been accounted for in prioritizing projects
- Owners Authority may wish to also look at all of the risks that can be included in a PESTLE (political, economic, social, technical, legal and environmental) analysis
- Would involve evaluating all these risks if each individual project was not carried out.
- Economic, political, social and legal issues are in many cases directly tied to operational risk.



Deterioration Curves

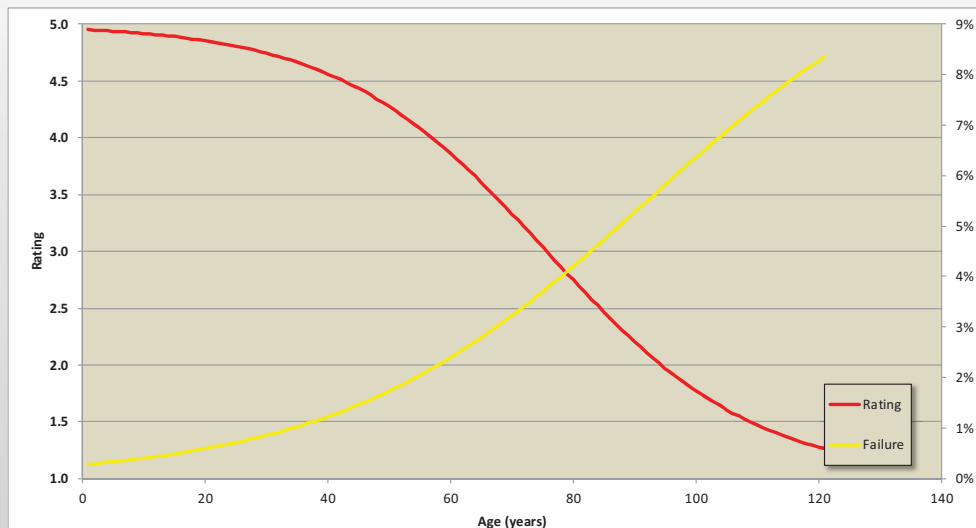
Example Calculation

14 <<User-selected Model No. from "Curves" Guideway, Track, Bridges

Decay Curve		AC Curve			Failure Curve			Years to 2.5	Revised Useful Life
Constant	Age	C0	C1	C2	C0	C1	C2		
4.3832	(0.0587)	0.4181	3.6229	(0.0399)	0.1097	3.6260	(0.0399)	83.3942	83.3942

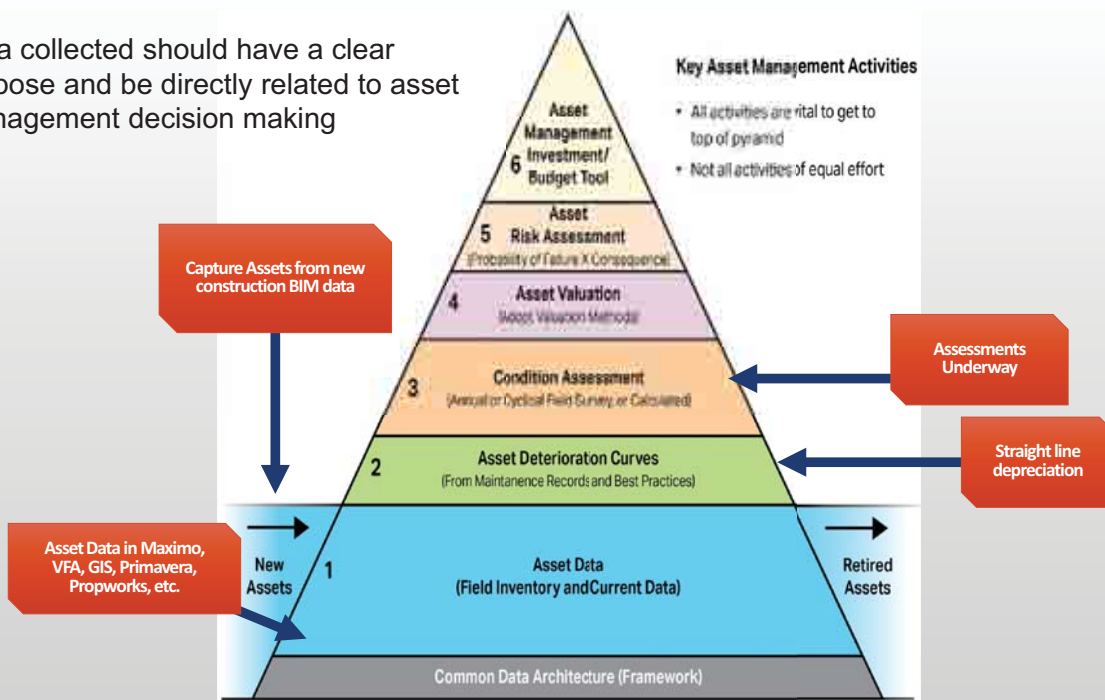
Results

Age	Rating	AC	Failure
0	4.95	1.0875%	0.2844%
1	4.95	1.1306%	0.2957%
2	4.94	1.1752%	0.3074%
3	4.94	1.2216%	0.3195%
4	4.94	1.2698%	0.3321%
5	4.93	1.3198%	0.3452%
6	4.93	1.3717%	0.3588%
7	4.93	1.4256%	0.3729%
8	4.92	1.4816%	0.3876%
9	4.92	1.5396%	0.4027%
10	4.91	1.5998%	0.4185%
11	4.91	1.6623%	0.4349%
12	4.90	1.7271%	0.4518%
13	4.90	1.7943%	0.4694%
14	4.89	1.8641%	0.4877%
15	4.88	1.9364%	0.5066%
16	4.88	2.0113%	0.5262%
17	4.87	2.0890%	0.5466%
18	4.86	2.1696%	0.5676%
19	4.85	2.2531%	0.5895%
20	4.84	2.3396%	0.6121%
21	4.84	2.4292%	0.6356%
22	4.83	2.5220%	0.6599%
23	4.82	2.6182%	0.6851%
24	4.81	2.7177%	0.7111%
25	4.79	2.8208%	0.7381%
26	4.78	2.9275%	0.7661%
27	4.77	3.0379%	0.7950%
28	4.76	3.1521%	0.8249%
29	4.74	3.2703%	0.8558%
30	4.73	3.3925%	0.8878%



Asset Management Simplified Process

Data collected should have a clear purpose and be directly related to asset management decision making



Conclusions

Asset Management of bridges is changing and the rate change will increase especially with BIM.

Current methods of using Biennial Inspections and Special Inspections to identify Maintenance and Capital Programs may not be meeting needs

A methodology based on identifying risk will give owners assurance, over the Service Life of all their assets, of:

- Structural Integrity
- User Safety
- Operational Efficiency
- Best Value



附錄五

Halifax Harbour Bridges-“Bridge Asset
Management”-Past-Present and Future



A. Murray MacKay Bridge

Angus L. Macdonald Bridge

Halifax Harbour Bridges-“Bridge Asset Management”-Past-Present and Future

Ahsan Chowdhury P. Eng., M. Eng.
Chief Bridge Engineer
Halifax Harbour Bridges

HHB Assets

- Two Long Span Suspension Bridges
- Toll Infrastructures
- 16 Ancillary Structures
- Approach roads
- Buildings



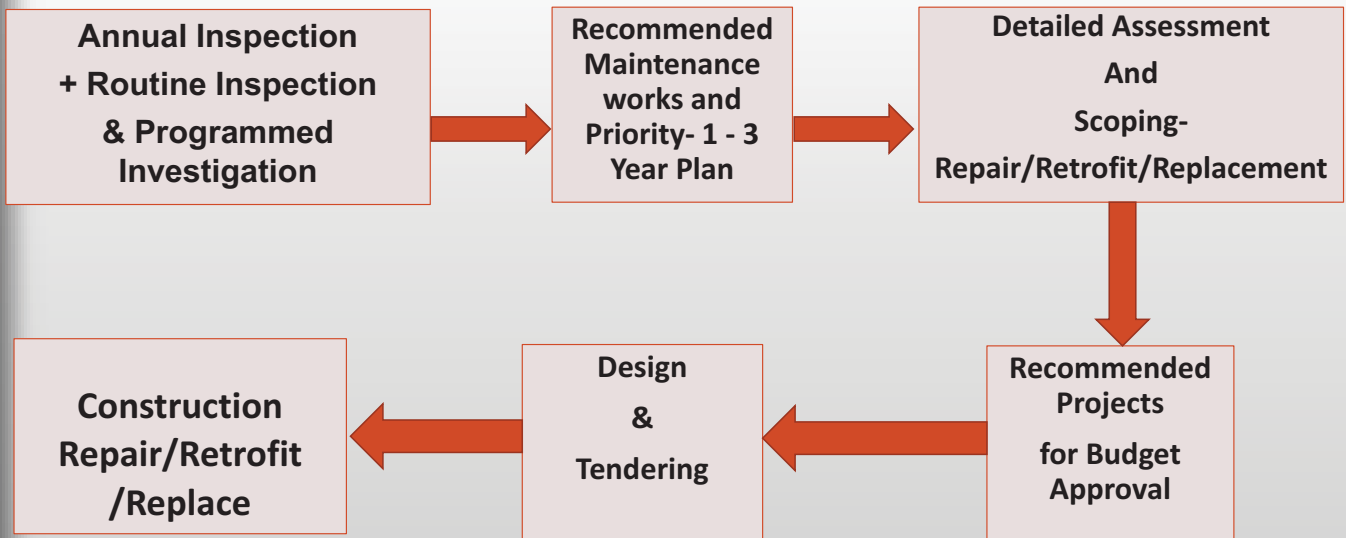
Figure D30: Victoria Road Overpass (VRO) – General View



Figure D27: Princess Margaret Overpass (PMO) – General View (South Face)



Current Model- Inspection-Evaluation- Maintenance



APPS-4

Report Card- Annual Inspection

Number ID	Element	Location	Maintenance Recommendation	Maintenance Type	Priority
2018-AMM-3	Bearings	HAb (free)	Continue to monitor the bearings.	Monitor Condition	1-3y
2018-AMM-5	Bearings	H2 (fixed)	Reposition longitudinal restraints prior to undertaking vertical bearing replacements in the future (if required).	Bearing Repair	7y+
2018-AMM-10	Bearings	D3 (fixed)	Continue to monitor the bearings.	Monitor Condition	1-3y
2018-AMM-12	Bearings	D5 (free)	Continue to monitor the bearings.	Monitor Condition	1-3y
2018-AMM-16	Bearings	DAb (free)	Continue to monitor the bearings.	Monitor Condition	1-3y
2018-AMM-17	Expansion Joints	HAb, HCB, DCB, DAb	Clean debris from joint.	Bridge Cleaning	< 1y
2018-AMM-18	Expansion Joints	D5	Repair or replace the expansion joint gland.	Expansion Joint Repair	< 1y
2018-AMM-20	Expansion Joints	DCB	Monitor gland on north side.	Expansion Joint Repair	< 1y
2018-AMM-21	Girder Span Access	HGS b/w Pier H1 and HCB	Clean and repair coatings at welded connections.	Minor Steel and Coating Repair	4-7y
2018-AMM-22	Girder Span Access	Pier D5	Fix the access doorways at Pier D5.	Access Maintenance	1-3y
2018-AMM-23	Girder Span Access	HGS/DGS	Consider modifying floor hatches to facilitate safe operation.	Access Maintenance	1-3y

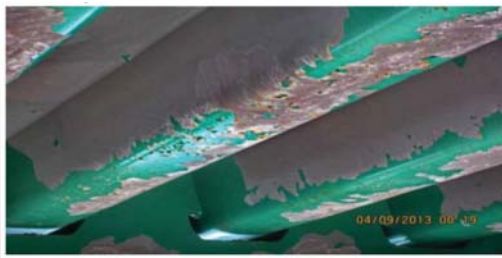
APPS-5

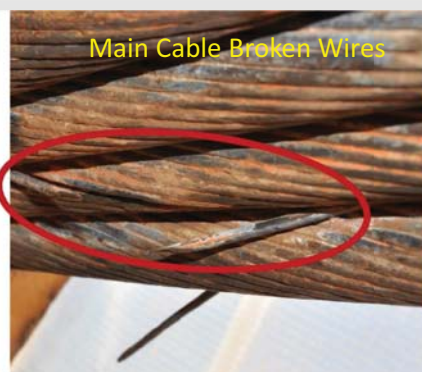
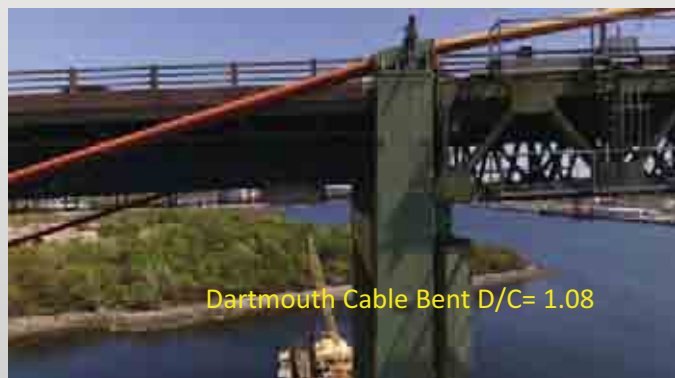
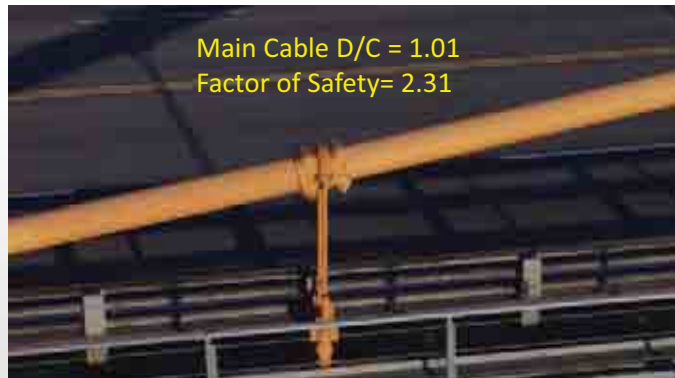
Investigation Report & Maintenance Status- Concrete Foundation

Pier No.	Priority	Depth of Concrete Removal, mm			
		North	East	South	West
W.Abutment	Medium	350	180	250	200
Bent H3	Low	200	200	200	200
Bent H2	Medium	330	300	200	200
Bent H1	High	250	250	250	330
West Cable Bent	Very low	-	-	-	-
West Main Pier	Very low	-	-	-	-
East Main Pier	Very low	-	-	-	-
East Cable Bent	Completed	-	-	-	-
Bent D1	Very low	-	-	-	-
Bent D2	Medium	300	280	180	300
Bent D3	Medium	250	300	200	185
Bent D4	Medium	240	300	280	250
Bent D5	High	180	250	290	300
Bent D6	Completed	-	-	-	-
Bent D7	Low	180	180	180	185
Bent D8	Medium	300	170	180	180
Bent D9	Completed	-	-	-	-
Bent D10	Completed	-	-	-	-
Bent D11	Completed	-	-	-	-
East Abutment	Low	200	200	200	200

Pier	Priority	Status
Halifax Abutment	Medium (3-5 years)	Complete 2017
H3	Low (5-10 years)	Complete 2017 (Seized Bearings)
H2	Medium (3-5 years)	Complete 2017
H1	High (1-3 years)	Complete 2014
HCB	Very Low (10-15 years)	2013 (Rock Anchor installed for Stability)
HMT	Very Low (10-15 years)	2024
DMT	Very Low (10-15 years)	Underwater Concrete Investigation 2019
DCB	High (1-3 years)	Complete 2012
D1	Very Low (10-15 years)	2024
D2	Medium (3-5 years)	2019 (construction)
D3	Medium (3-5 years)	2020
D4	Medium (3-5 years)	2020
D5	High (1-3 years)	Complete 2014
D6	High (1-3 years)	Complete 2016
D7	Low (5-10 years)	2022
D8	Medium (3-5 years)	2020
D9	Medium (3-5 years)	Complete 2013
D10	Medium (3-5 years)	Complete 2013
D11	Medium (3-5 years)	Complete 2013
Dartmouth Abutment	Low (5-10 years)	2022

Asset Conditions-Challenges & Issues





Recent Development- Element Level Detailed Inspection

$$WADI = \frac{\sum_{i=1}^n LIF_i * MDI_i}{\sum_{i=1}^n LIF_i}$$

$$DI \text{ FOR 'CORROSION IN STEEL ELEMENTS'} = \frac{(A_1 * 1 + A_2 * 2 + A_3 * 3 + A_4 * 4)}{(A_1 + A_2 + A_3 + A_4)}$$

$$RPN = GIF * WADI$$

- GIF- Global Importance Factor
- DI- Defect Impact
- WADI- Weighted Average Defect Impact
- RPN- Risk Priority Number

Risk Vs Intervention

RPN	Timeframe for intervention
80 - 100	Immediate action required
75-80	Action suggested within one year. Monitor component
25-75	Action suggested within 2-5 years. Increase frequency of inspection
0-25	Continue regular inspection

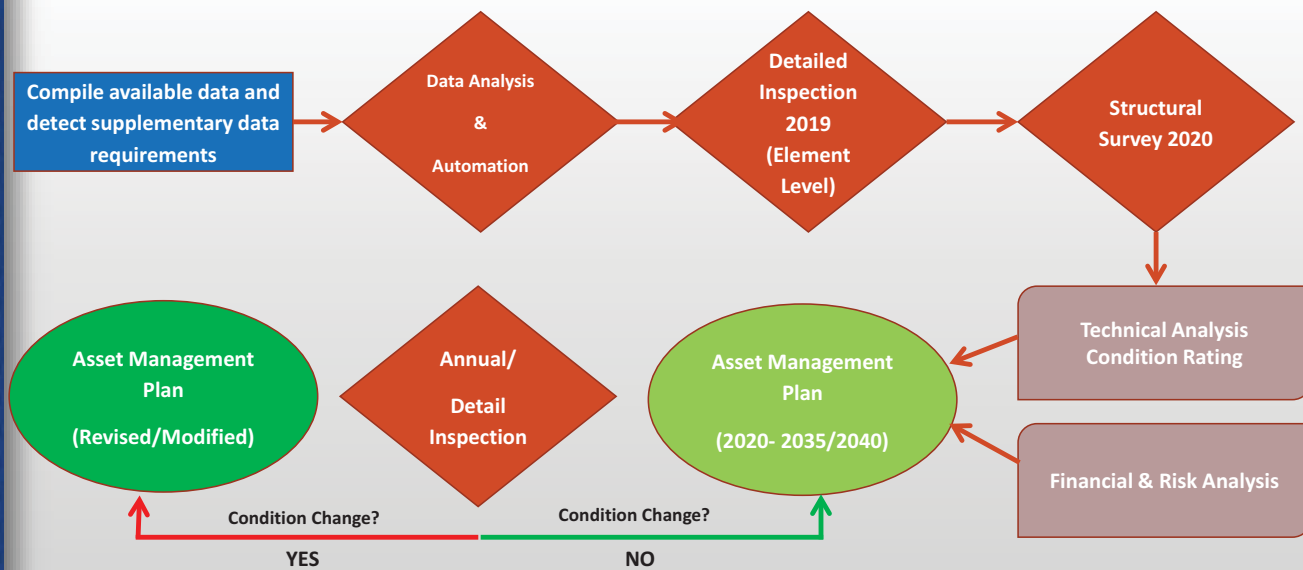
APPS-10

Deck (OSPD) Detail Inspection Results

Date (dd/mm/yyyy)	Segments Inspected	GIF	WADI	RPN	Timeframe for Intervention
03/06/2016	H1	20	1.38	27.60	Action suggested within 2-5 years. Increase frequency of inspection
28/06/2016	M4	20	1.28	25.60	Action suggested within 2-5 years. Increase frequency of inspection
24/05/2017	D12	20	1.55	31.06	Action suggested within 2-5 years. Increase frequency of inspection
24/05/2017	1/2 D13	20	2.23	44.62	Action suggested within 2-5 years. Increase frequency of inspection
28/06/2017	M1	20	1.04	20.80	Continue regular inspection
24/05/2017	1/2 M2	20	2.29	45.80	Action suggested within 2-5 years. Increase frequency of inspection
28/06/2017	1/2 M2	20	1.00	20.00	Continue regular inspection
24/05/2017	1/2 M3	20	1.60	32.10	Action suggested within 2-5 years. Increase frequency of inspection
11/07/2017	D14	20	1.03	20.51	Continue regular inspection
11/07/2017	1/2 D15	20	1.01	20.28	Continue regular inspection
21/08/2017	1/2 D15	20	1.08	21.63	Continue regular inspection
21/08/2017	1/2 D16	20	1.12	22.30	Continue regular inspection
30/08/2017	1/2 M22	20	1.04	20.79	Continue regular inspection
30/08/2017	M23	20	1.01	20.21	Continue regular inspection

APPS-11

Risk and Data Based Bridge Asset Management Plan:



Asset Management Model:



Bridge Information Model and Management System- BIMMS

The purpose of BIMMS is to develop and implement an automated bridge information and management system to visualize and manage the asset in efficient and cost-effective manner.

Users will have easy access to all relevant information (**inspection reports, drawing, photos, repair history, condition ratings; repair priority number with color coding and WO**) at their fingertips.

GIS based 3D Bridge Model:

<http://esrica->

atlantic.maps.arcgis.com/apps/webappviewer3d/index.html?id=8363ad2e38b64305b9714069d83983fc



APP5-14

Thank You!

Questions?

APP5-15

附錄六

Optimizing TCO Through Digital Asset Management, Data and New Technologies



OPTIMISING TCO THROUGH DIGITAL ASSET MANAGEMENT, DATA AND NEW TECHNOLOGIES

APP6-2



APP6-3

AGENDA

- Brief presentation of Sund & Bælt Assets
- Results
- Total Cost of Ownership – TCO
- Digital Asset Management
- *New technologies*
- Conclusions & Perspectives

3
APP6-4

STOREBÆLT BRIDGES

Europe's largest bridge, world #3,
1624 m main span, 254 m pylons,
65 m passage height

17.5 km Highway, 18.5 km Railway,
State Guarantee Model

Approx 25 mill passengers per year,
> 25,000 vessels

Bridges, Tunnels, Roads &
Railways

APP6-3

DIGITAL STRATEGY

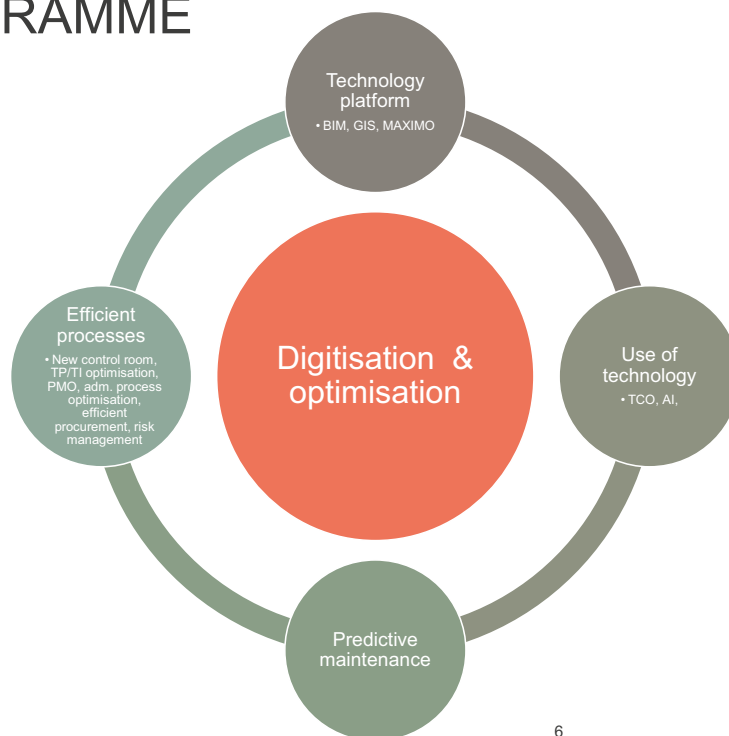
New technologies bring greater efficiency

- Ensure 2% annual productivity
- High quality standards & high accessibility/safety levels for our customers
- Ensure optimal TCO for new constructions
- Sharing knowledge through cooperation

Data from Drones, Sensors & Robots

- Increased Digitisation of our maintenance
- Big Data & Analytics, AI (Artificial Intelligence)
- New data sources; robots/drones/sensors
- Digital models: GIS, BIM, AR

OPTIMISATION AND DIGITISATION PROGRAMME



RESULTS

OPEX

- Reduced maintenance & operation cost – target 10% in 5 years – more than on track
- Higher quality – prolonged lifetime & better asset conditions
- More knowledge from data & models

CAPEX

- Reduced renewal cost – budget index
- Better TCO in new projects with data models

TOTAL COST OF OWNERSHIP

Total Cost of Ownership (TCO) is a financial model intended to help owners determine the total cost of assets over their lifetime.



Optimising TCO in new projects



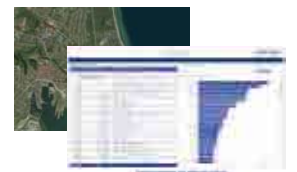
Typical types of TCO



TCO benchmark - By normalising data, TCO models from different operating models can be used to compare and transfer best-practice



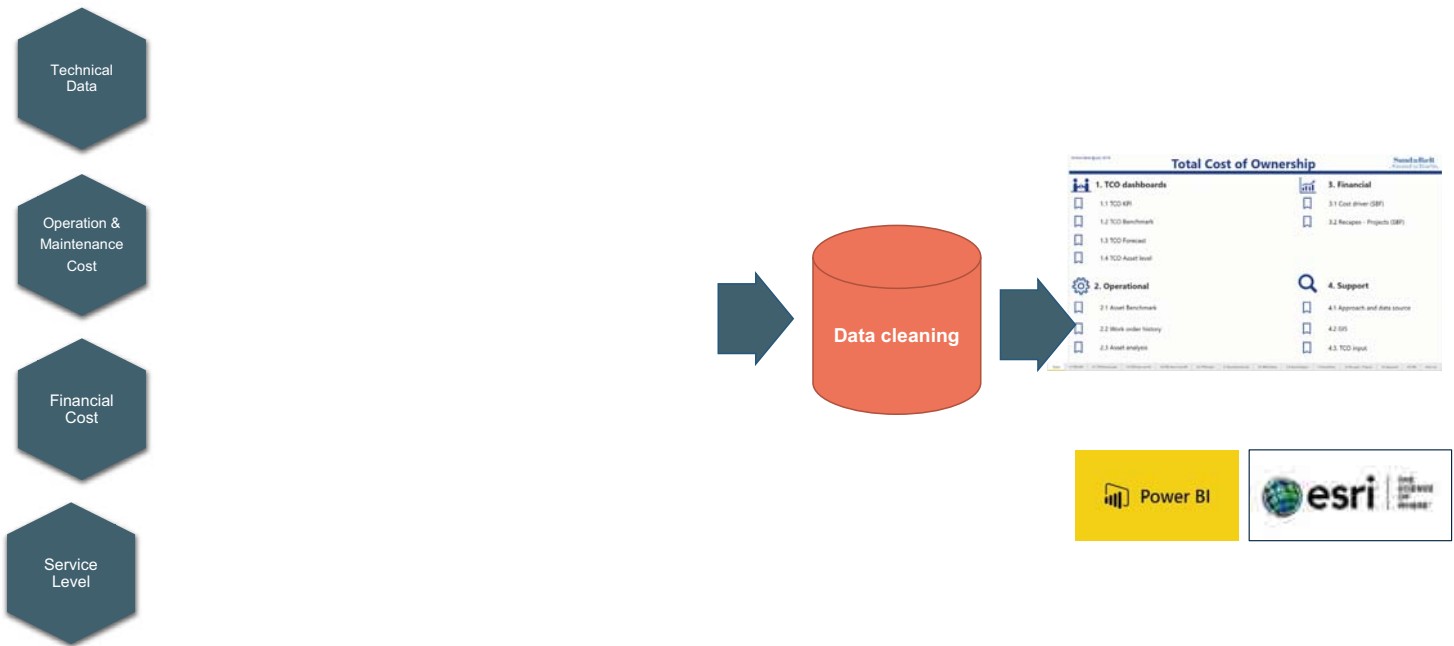
TCO model – Digital twin enables TCO simulations and optimisation by analysis and adjustment on high impact drivers and service levels



TCO at Asset level. All cost within Asset lifetime is calculated at Asset TCO.



THE TCO ENGINE - DATA MODEL



THE TCO APPROACH IS NOT BREAKING NEWS...

The fundamental spirit of the organisation is to continuously strive for improvement

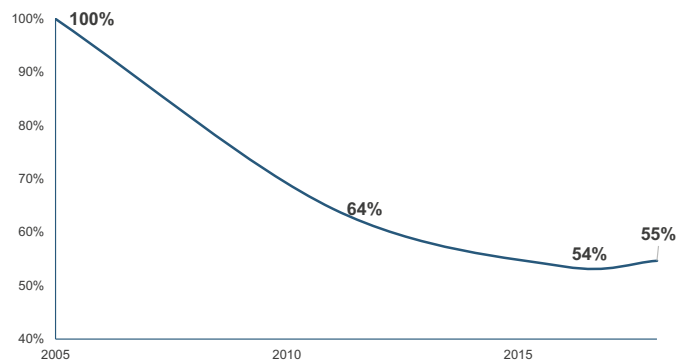
The TCO approach on the Great Belt Link has **reduced the reinvestment budget to index 55%** compared with the planned budget in 2005



Investment in new technology to reduce operational cost and predict failures.



Fully implemented EAM and SCADA system capturing operational data and maintenance history.



TCO AS AN OPERATING TOOL



Before

Copious spreadsheets and long lists of unstructured data.

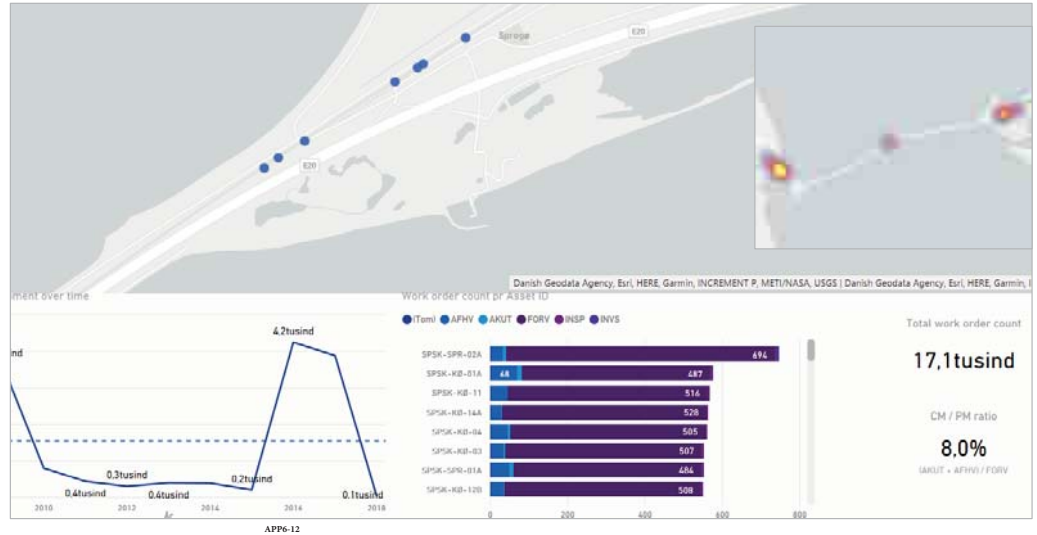
Work order history in note form means that failures can be described in endless ways.

e.g. one asset group 17,000 work orders

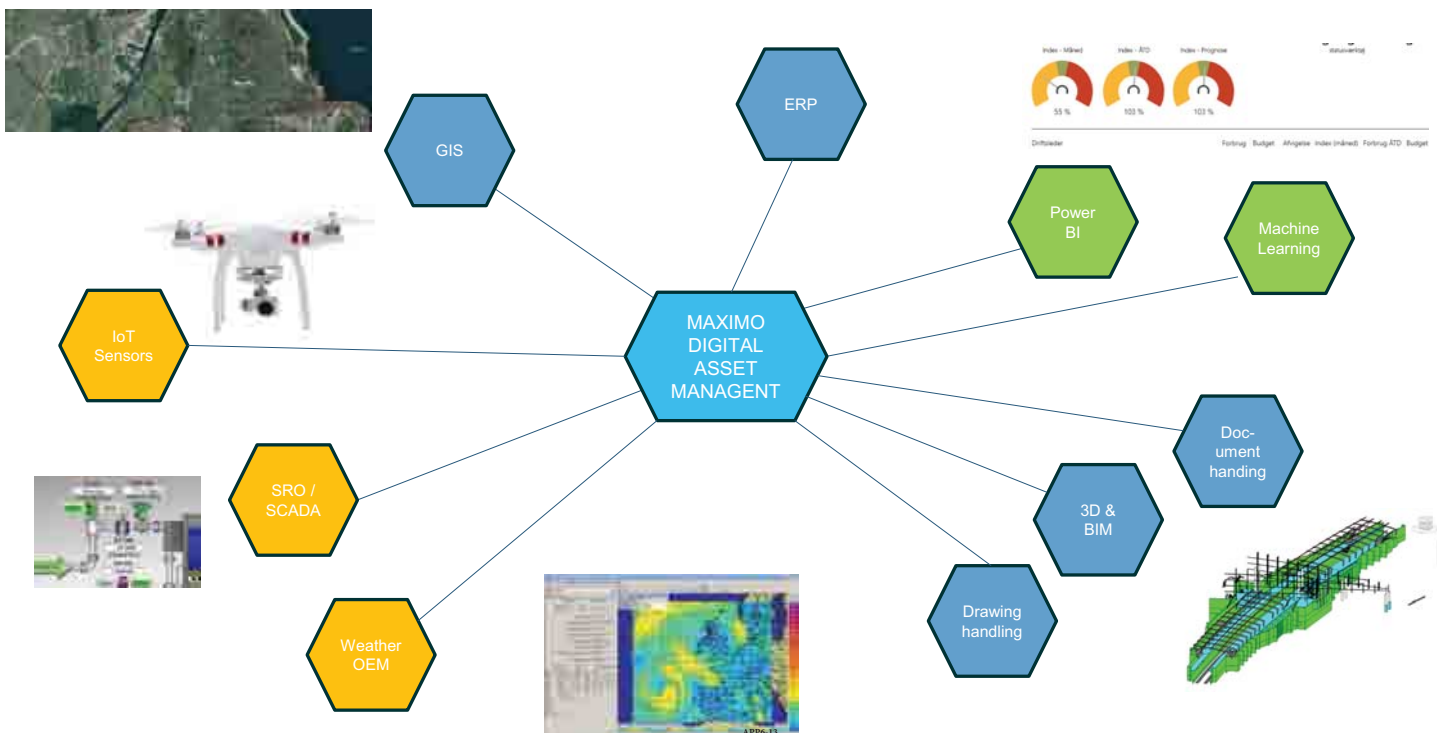
Tvangskinner (profillet) Løse bolte
 Nordtunnel - L 634 IBO Koerledning - 2. HSP - Hakkkontakt (jkt. 4.2 i T138.04.50)
 FORV - Koeling af E3-udstyr FC024 (aarligt lovpaaigt eftersyn)
 T138.02.S4.B1.28005M - Kontrolplan for eftersyn af D58 1994 drev
 Kontrolfor fodre for brud- revner og fastgørelse
 Skærvogn FCC5 868-3 - Kontrol af bromskodders slidtage
 Kontrolkontakt 24/23 afbrydes med et stykke isolerende materiale.
 Dato og tidspunkt:
 Kontrolmærkat med initialer og dato for eftersyn paaklaebes
 Korsoer - L 564 - Spor 3 - km 109.703 - Maal C (i mm) - Koerledning
 Maaling med tangampereometer omkring tilledninger
 K oplysning: Korrekt symmetri paa V haenger
 TILSTAND - Udskiftning af en halv tungepaert H/V
 Spor 3- km 130.350
 2. hovedspor - km 129.740
 Sikkerhedskutter - er det defekt skal det udskiftes
 Sprøge Teknibygning - VTS Taldrum
 Størbetjeningskontakt: Lampen udskiftes i tilfælde af defekt lampe
 Funktionstest af material der skal bruges til nattes arbejde.
 Trækstanger eftersers
 Motor- 1.5 Filter-oleiekopling til koelblæser- centrifugefilter - Kontroller og rens filter holder
 Nykontandhjul: Adskilt/renset
 Koerledning: koertraaden haenger i fellet
 AU.LS.KT.000042 Løvpaaigtstavle VBA2
 Bro opsang: Corona

Now:

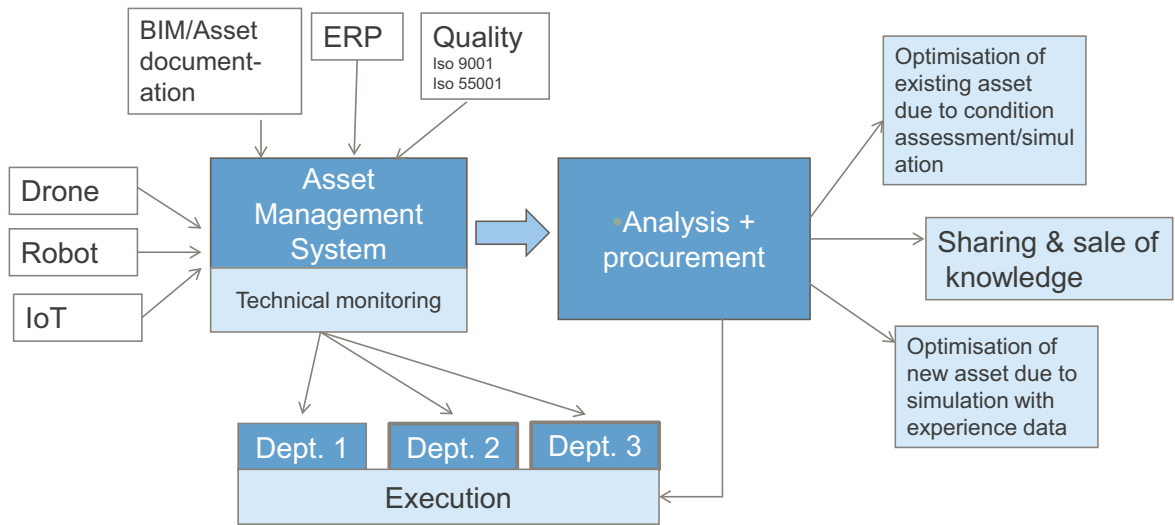
- Structured data by machine learning (NLP)
- Easy access to data through dynamic dashboards with integrated GIS maps
- Every operational manager can run cost drive analysis



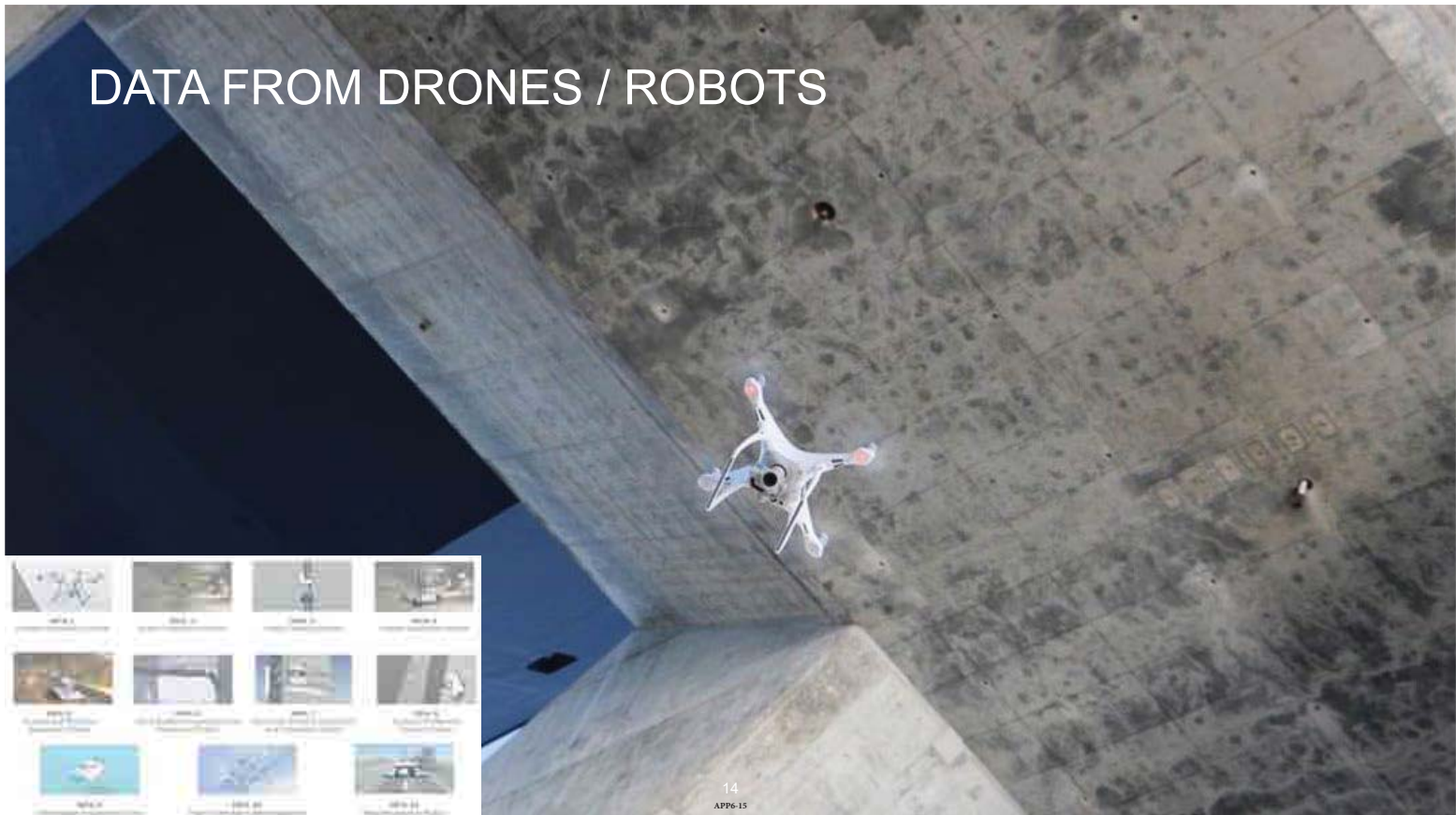
MAXIMO AS PART OF OVERALL DIGITISATION



DIGITAL MAXIMO CONCEPT



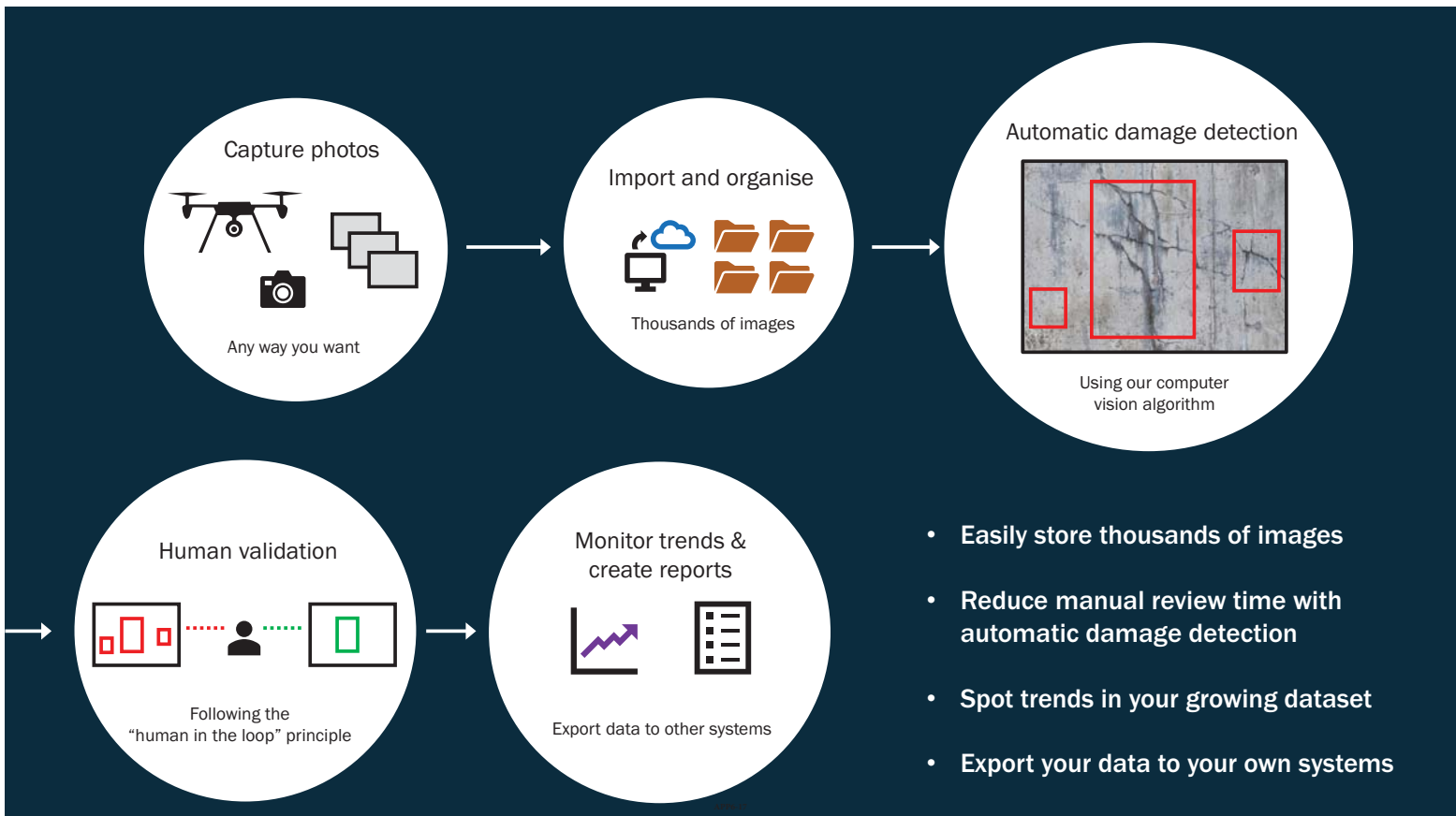
DATA FROM DRONES / ROBOTS

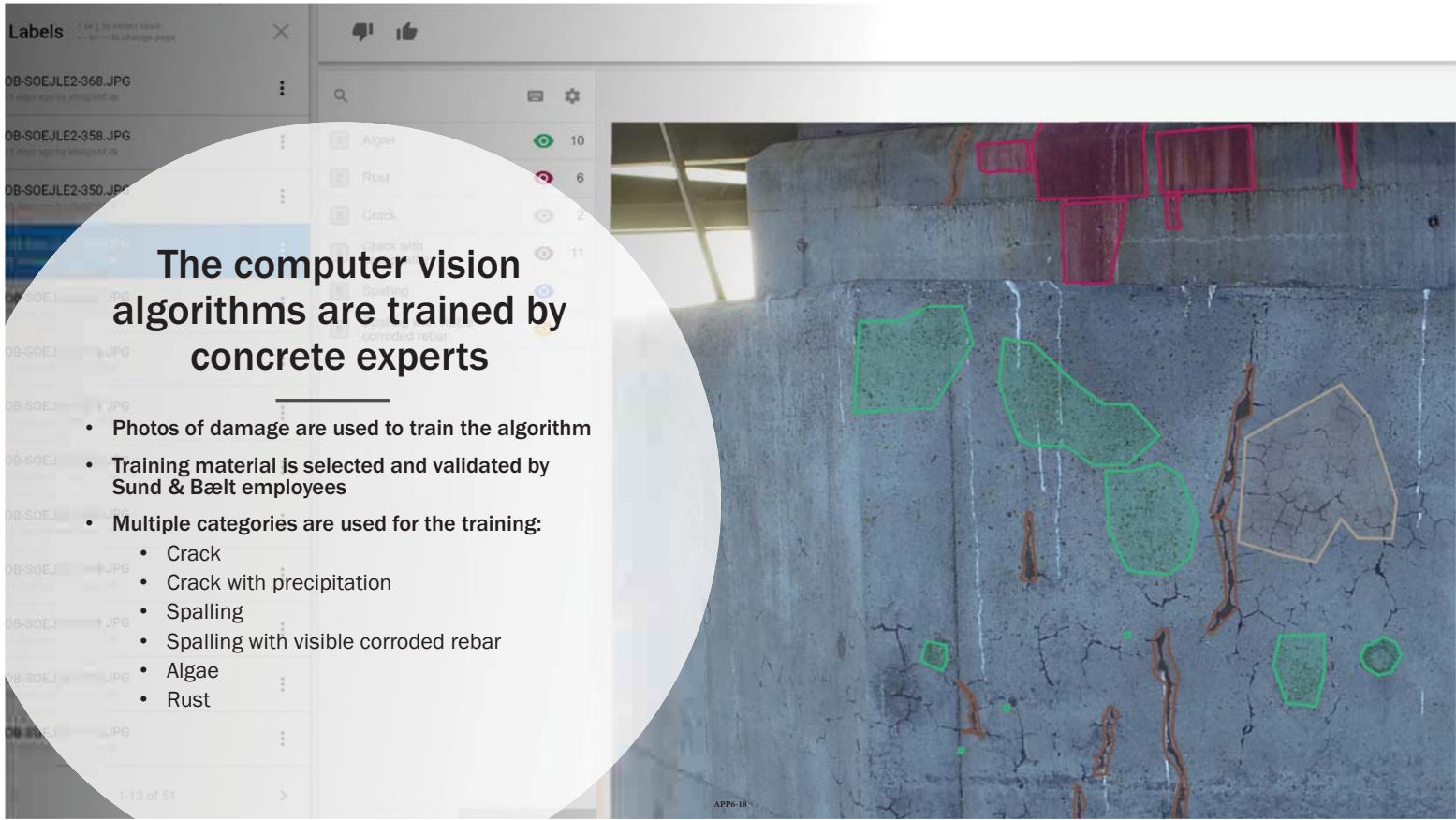


WHY? BEFORE AND NOW



15
APP6-16



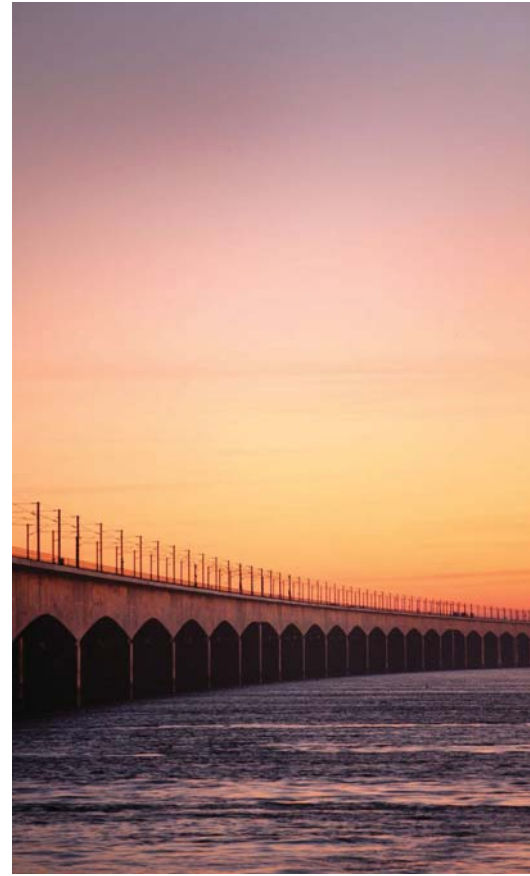


The computer vision algorithms are trained by concrete experts

- Photos of damage are used to train the algorithm
- Training material is selected and validated by Sund & Bælt employees
- Multiple categories are used for the training:
 - Crack
 - Crack with precipitation
 - Spalling
 - Spalling with visible corroded rebar
 - Algae
 - Rust

CONCLUSIONS & PERSPECTIVES

- Datadriven Asset Management improves the efficiency of operations and maintenance
- The Maximo AM system supports a long-term focus on maintenance, holistic approach to the management of risks and assists in accessing information / knowledge-sharing
- TCO focus contributes to a long lifetime, good condition, customer focus & reduced total costs
- Opportunities to gain much more detailed information about our assets are increasing with the rapid advance of technologies for collecting and analysing data
- We will have more data from sensors, robots & models
- Opportunities from AI/Machine Learning/ Cognitive Analysis in our Asset Management will increase
- Predictive maintenance will advance
- The sharing of knowledge and data will improve data models



THANK YOU – QUESTIONS ?

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