

# AE Senior Thesis Presentation

Dr. Richard Mistrick and Prof. Ted Dannerth | April 13, 2011 | Lighting/Electrical

### THESIS SCOPE OF WORK

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• Lighting Depth

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- Exterior Space | North Façade
   Circulation Space | Main Lobby
   Large Work Space | Classroom
   Special Purpose Space | Natatorium
- Electrical Branch Circuit Redesign
- Electrical Depth
  - Wire/Conduit vs. MC Cable Feeders
    SKM Power Tools Analysis
- MAE Focus
  - Daylighting Natatorium
- Breadth Topics
  - Mechanical SHW Natatorium
    Structural SHW on Roof

### PRESENTATION

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### Lighting Depth

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- Electrical Depth
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- MAE Focus
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- Breadth Topics
   Mechanical SHW Natatorium

## SMC CAMPUS CENTER

### **BUILDING OVERVIEW**

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 Site and Location University of Maryland Baltimore Campus

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• Size 110,000 Square Feet

- Total Project Cost \$43,400,000
- Primary Functions Education Spaces Food and Dining Health and Relaxation Recreational Spaces

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Introduction/Overview

Electrical Depth Wire vs. MC Cable

Lighting Depth Main Lobby Classroom Natatorium

MAE Focus Daylighting Breadth Topic Mechanical

Conclusion

Acknowledgements



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• Owner University of Maryland 1

- Architect WTW Architects, Inc.
- MEP Henry Adams, LLC
- Structural WBCM
- CM/PC Whiting- Turner



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Introduction/Overview

Electrical Depth Wire vs. MC Cable

Lighting Depth Main Lobby

Classroom Natatorium

MAE Focus Daylighting

Breadth Topic Mechanical

Acknowledgements

Conclusion

	SMC CAMPUS CENTER	WIRE/CONDUIT VS. MC CABLE FEEDERS	
Introduction/Overview Electrical Depth Wire vs. MC Cable Lighting Depth Main Lobby Classroom Natatorium MAE Focus Daylighting Breadth Topic Mechanical		<ul> <li>Objectives</li> <li>Consider performance related issues between copper and aluminum conductors for electrical distribution <ul> <li>Electrical</li> <li>Mechanical</li> <li>Reliability</li> <li>Cost</li> </ul> </li> <li>Consider economic and schedule impacts of replacing existing copper wire and conduit feeders with all-in-one assembly of MC cable</li> </ul>	
Conclusion			
Acknowledgements			
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	SMC CAMPUS CENTER	WIRE/CONDUIT VS. MC CABLE FEEDERS			I	FINA	L CO	MPARIS	SON			
		<ul> <li>Electrical</li> <li>Cu conducts current better than Al → need larger wire for Al</li> </ul>	1	FEI		. NO. OF WHEE SEE	]	Fotal Cost	Crew Da	ays C	Cost/SF	TOTAL COST
Introduction/Overview Electrical Depth		<ul> <li>Increased diameter = more efficient conductor utilization</li> <li>Mechanical</li> </ul>		Existing	Wire/Condu	uit	\$1	85,664.14	44		\$1.69	172.88 1966.20 1113.60 1428.03
Wire vs. MC Cable Lighting Depth		<ul> <li>Larger Al wire approaches tensile strength of Cu</li> <li>Thermal expansion of Al far greater than Cu</li> </ul>		Proposed	l MC Cable		\$8	86,784.25	22		\$0.79	
Main Lobby Classroom Natatorium		<ul> <li>Reliability</li> <li>Cu oxidizes completely. Al oxidation stops → increased life</li> </ul>	'	FE Savings			\$	98,879.89	22	_		TAL COS
MAE Focus Daylighting		<ul> <li>Wide variety of connections to meet requirements for Cu and Al</li> </ul>		Savings 1	Percentage	1	4	53%	50%	5.05	4.05	116.00 1130.00
Breadth Topic Mechanical		Cost     Most obvious advantage for Al is lower motorial and installation sost		LS201	EDIM221	1 1 1 1 1 0170 F.M.	4 12 DOCEMA (DAT AND DOTEMAN DOCEMAN DOCEMAN DOCEMAN DOCEMAN DOCEMAN DOCEMAN DOCEMAN	#1 AWG	123	3.65	2.85	799.50
Conclusion Acknowledgements		<ul> <li>Most obvious advantage for Ar is lower material and instantion cost</li> <li>Al is abundant with a steady market</li> <li>Price of Cu continues to rise</li> </ul>			MA BEGRARM BECOM HE REQUERE BECOM HE COME INFO	LL         L         UP (C) AND           UT1         0         UT141, AND           UT1         0         UT142, AND           UT1         0         UT141, AND	COLUMN 10 01 00 AABS     COLUMN 10 01 00 AABS     COLUMN 10 01 AABS	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	J.M.         L.J.         Mail         L.M.           548         1.54         6.95         2.87           548         5.97         9.92         2.87           549         5.97         9.92         2.87           549         5.91         6.92         2.87           549         5.91         6.92         2.87           549         5.91         6.92         2.87           549         5.91         6.92         2.87           549         5.41         6.91         2.87           549         5.42         6.91         2.87           549         5.42         6.91         2.87           549         5.42         6.91         2.87           549         5.42         6.93         1.87	A.M.         LIBLIN           4.43         425.01           3.43         425.01           3.43         475.02           3.43         100.06           2.43         100.06           3.43         100.06           3.43         100.06           3.43         100.06           3.43         100.06           4.43         100.06           4.43         200.00		
					0 1041 104 8 com 1980	0 3 (314) AMG 277 0 (314) AMG	DATENCE CHERNES	510° 44 538 155 538 510° 233 241 687 530	100 101 011 207 220 0.14 0.40 2.28	140 111140 2.33 142623 1975a, 1896a.14		

S S	MC CAMPUS CENTER	OVERALL DESIGN GOALS	
Introduction/Overview Electrical Depth Wire vs. MC Cable <b>Lighting Depth</b> Main Lobby Classroom Natatorium MAE Focus Daylighting Breadth Topic Mechanical		<ul> <li>Modern <ul> <li>New building within historic downtown Baltimore, MD</li> <li>Cutting-edge, energy efficient equipment</li> </ul> </li> <li>Interactive <ul> <li>Students, Faculty, and Staff</li> <li>Flexibility for various activities</li> <li>Create a dynamic campus community</li> </ul> </li> </ul>	
Conclusion Acknowledgements			
Iosh Winemiller   An	vril 13, 2011   Liohtino /Electrical		REDEFINING COLLABORATION

#### 1 Ħ SMC CAMPUS CENTER H MAIN LOBBY P • Design Criteria and Considerations Inviting and Open Variety of Circulation Paths Introduction/Overview Visual Guidance Dining Facility Student Lounges Information/Elevators Electrical Depth Wire vs. MC Cable Lighting Depth Main Lobby Stairs Classroom Hierarchy of Elements Curved Ceiling Information Desk Natatorium 1910 MAE Focus Daylighting Sentry Center for Business Manhattan, New York Breadth Topic Mechanical • IESNA Recommendation • 10 fc (H) Conclusion • ASHRAE 90.1-2007 LPD Acknowledgements • 1.3 W/SF, 2.3 W/SF with decorative











SMC CAMPUS CENTER	MAIN	LOBBY		
Introduction/Overview Electrical Depth Wire vs. MC Cable Lighting Depth Main Lobby Classroom Natatorium MAE Focus Davlighting	90.00 17.0 11.5 15.0 12.5 12.9 12.5 12.9 12.5 12.9 12.5 12.9 12.5 12.9 12.5 12.5 12.5 12.5 12.5 12.5 12.5 12.5		<ul> <li>Design Summary</li> <li>Welcoming</li> <li>Provides Visual Guidance</li> <li>Hierarchy of Elements</li> <li>Meets IESNA and ASHRAE LPD</li> </ul>	
Daylighting	Main Lobby Lig	nting Performance	23.00	
Mechanical		Recommended As Designed	18.75	
Conclusion	General Ambient (H)	10 fc 14 fc	625	
Acknowledgements	Lighting Power Density (W/SF)	1.3 / 2.3 1.84	000 Romanee (Fg)	

#### H H SMC CAMPUS CENTER H CLASSROOM F • Design Criteria and Considerations Dynamic Visual Environment Classroom | Meeting | Audiovisual Flexibility of light levels Flynn Impressions → Spacious vs. Closure Introduction/Overview Electrical Depth Wire vs. MC Cable Accent Focal Walls Lighting Depth Main Lobby • Front $\rightarrow$ whiteboard, podium, AV screen Classroom • IESNA Recommendation Reading/Writing: 30 fc (H) Conference: 30 fc (H), 5 fc (V) Whiteboard: 5 fc (V) Natatorium MAE Focus Daylighting Breadth Topic Mechanical • ASHRAE 90.1-2007 LPD Conference/Meeting/Multipurpose: 1.3 W/SF Classroom/Lecture/Training: 1.4 W/SF Conclusion Acknowledgements Spacious Closure









#### F H SMC CAMPUS CENTER CLASSROOM • Design Summary 11 17 • Functional and Flexible • Accents Front of Room Introduction/Overview • Excellent Performance Electrical Depth Wire vs. MC Cable Lighting Depth Main Lobby Classroom Natatorium **Classroom Lighting Performance** 87.50 75.00 82.50 50.00 37.50 25.00 12.50 MAE Focus Daylighting Recommended As Designed LPD (W/SF) Breadth Topic Mechanical Conclusion Acknowledgements

#### 1 H H SMC CAMPUS CENTER NATATORIUM • Design Criteria and Considerations Glare on Water Direct and Reflected Light Distribution Introduction/Overview Electrical Depth Wire vs. MC Cable Daylight Integration North Glazing Lighting Depth Main Lobby Psychological Impression • Environment . V V Strong Chemicals High Humidity Natatorium MAE Focus Daylighting University Aquatics Center Minneapolis, Minnesota • IESNA Recommendation Class IV Pool Surface: 30 fc (H) Class IV Pool Deck: 10 fc (H) Breadth Topic Mechanical CV < 0.30</li> Max/Min < 4:1</li> Conclusion Acknowledgements • ASHRAE 90.1-2007 LPD • Sports Arena: 1.4 W/SF, 2.4 W/SF with decorative







	SMC CAMPUS CENTER	Ť		NAT	TATO	RIUM	
Introduction/Overview Electrical Depth Wire vs. Mc Cable Lighting Depth Main Lobby Classroom Nataforium MAE Focus Daylighting Breadth Topic Mechanical Conclusion Acknowledgements		Natatorium R Pool Surface (H) CV Max/Min LPD (W/SF)	Lighting Per           30 fc           10 fc           < 0.30           < 4:1           1.4   2.4	Iformance           As Designed           33 fe           25 fe           0.09   0.14           1.56   2.53           0.85	40.00 35.00 20.00 15.00 10.00 8.00 0.00 Uumance		
							L_Diffuse (Cd(SqN)

	SMC CAMPUS CENTER	DAYLIGHTING - NATATORIUM	
Introduction/Overview Electrical Depth Wire vs. MC Cable		<ul> <li>Objectives</li> <li>Complete a shading study for skylight implementation</li> <li>Improve quality of daylight integration from the north façade</li> <li>Provide a comprehensive daylighting analysis to maximize lighting energy savings throughout the year</li> </ul>	
Lighting Depth Main Lobby Classroom Natatorium		Building Specifics     Location: Baltimore. MD	North Elevation
MAE Focus Daylighting Breadth Topic Mechanical		<ul> <li>Latitude: 39.29 N</li> <li>Longitude: 76.61 W</li> <li>Electric Lighting: Indirect Asymmetric (T5HO – 5000 lms)</li> </ul>	
Conclusion Acknowledgements		Target Illuminance: 30 fc	West Elevation East Elevation
T 1 XV2' 11			

#### SMC CAMPUS CENTER H **DAYLIGHTING - NATATORIUM** • Mechanical Penthouse Shading Study Introduction/Overview MECH ECCUPINENT MSOS March 21 June 21 December 21 Electrical Depth Wire vs. MC Cable Lighting Depth Main Lobby SPINNING ROOM 504 Classroom Natatorium 4:00 PM ╤┋╧╘╹╒╢ MAE Focus Daylighting n Breadth Topic Mechanical Conclusion 出出 Acknowledgements $\implies$ N

#### SMC CAMPUS CENTER H **DAYLIGHTING - NATATORIUM** • Mechanical Penthouse Shading Study Introduction/Overview MECH ECCUPINENT MSOS November 21 January 21 February 21 Electrical Depth Wire vs. MC Cable Lighting Depth Main Lobby SPINNING ROOM 504 Classroom Natatorium 4:00 PM ╤┋╧╘╹╒╢ MAE Focus Daylighting n Breadth Topic Mechanical Conclusion 出出 Acknowledgements $\implies$ N







## SMC CAMPUS CENTER

## DAYLIGHTING - NATATORIUM

### Daylight Distribution

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### Performance Summary

- Manual control of shades to minimize direct sun penetration
- 37% lighting energy savings (9750 kWh)
- · Connection to outdoors promotes relaxation

ables (KWh)											10	
one Grand T	otal											
January	February	March	April	May	June	July	August	September	October	November	December	Total
1166.4	1080.0	1217.7	1147.5	1080.0	1171.8	1117.8	1196.1	1193.4	1166.4	950.4	855.9	13343.4
422.7	346.13	327.54	255.47	202.24	207.84	189.65	240.88	310.08	335.68	340.14	333.64	3512.03
430.43	352.22	331.79	264.52	207.88	215.2	195.79	249.99	317.87	341.86	345.95	339.93	3593.5
735.96	727.77	885.9	882.97	872.11	956.59	922.0	946.1	875.52	824.53	604.44	515.96	9749.89
	ables (KWh) ne Grand Tr January 1166.4 422.7 430.43 735.96	bles (KWh) ne Grand Total January February 1166.4 1080.0 422.7 346.13 430.43 352.22 735.96 727.77	ables (XXM)           Grand Total           January         February         March           1166.4         1080.0         1217.7           422.7         246.13         327.54           400.43         352.22         331.79           735.96         727.77         885.9	Sahari (Yold)           Grand Total           January         February         March         April           1566.4         1980.0         1217.7         147.5           452.7         246.13         322.54         256.4           352.222         331.79         245.52           375.56         727.7         885.9         802.97	Jahles (Wai)           Grand Total           Jannay         Pohuny         Norch         April         Merch           1866.4         5080.0         1217.7         1167.5         2080.0           422.7         346.13         22254         255.47         202.24           303.43         352.22         331.79         245.52         207.88           725.56         72.77         85.9         92.27         87.11	Same SW-9         Ket         Ket         Ser         January         February         Ket         January         January         Relative         Ket         January         January         January         January         January         Lipits         January         January <thjanuary< th="">         January         January</thjanuary<>	Same 100%         March         March	Same Steve         More         More         May         James         May         Appendix         Magest           James         February         Notics         Appendix         May         May         Jamest         May         Appendix         May         Jamest         May         Jappendix         Jappendix	Asian (Abru)           Jowa         Mark         April         No         Angil         Sentender           Janes         Bando         121.7         11.02         101.24         111.26         108.4         108.14           Janes         Janes         20.72         16.10         20.74         20.84         108.4         108.14         108.14           App.7         Jan.10         20.74         20.74         20.74         10.84         10.60         10.02           App.7         Jan.10         20.74         20.74         20.74         10.74         10.85         10.00           App.7         Jan.10         20.74         27.84         20.24         27.84         10.84         10.00           App.4         20.74         27.84         20.24         27.84         10.84         10.02           App.4         20.74         27.84         20.24         27.84         20.24         20.84         10.84         10.84           App.4         20.25         20.85         27.21         20.24         20.24         10.74         17.85	Same 100%         View         Not         Not         Not         Appendix         Same Not         Same Not <td>Not         Not         Note: Not</td> <td>Same More 9 Search Mall         Mo</td>	Not         Not         Note: Not	Same More 9 Search Mall         Mo

👍 Energy	Tables (KWh)											ec.	x
Controlled .	Zone Grand T	otal											
	January	February	March	April	May	June	July	August	September	October	November	December	Total
Base	2332.8	2160.0	2435.39	2295.0	2160.0	2343.6	2235.6	2392.2	2386.8	2332.8	1900.8	1711.8	26686.8
Optimal	1589.1	1426.13	1545.24	1402.97	1282.24	1379.64	1307.45	1436.98	1503.48	1502.08	1290.54	1189.54	16855.43
Algorithm	1596.83	1432.22	1549.49	1412.02	1287.88	1387.0	1313.59	1446.09	1511.27	1508.26	1296.35	1195.83	16936.9
Savings	735.96	727.77	885.9	882.97	872.11	956.59	922.0	946.1	875.52	824.53	604.44	\$15.96	9749.89

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Introduction/Overview

Electrical Depth Wire vs. MC Cable

Lighting Depth Main Lobby Classroom Natatorium

MAE Focus Daylighting

Breadth Topic Mechanical Conclusion

Acknowledgements









SMC CAMPUS CENTER	CONCLUSION	
Introduction/Overview Electrical Depth Wire vs. MC Cable	<ul> <li>Lighting Design</li> <li>Respectful to the urban campus environment, while creating a unique visual identity for the UMB campus</li> <li>Promotes interaction and flexibility through the use of modern equipment</li> <li>Complies with IENSA recommendations and ASHRAE power density</li> </ul>	
Lighting Depth Main Lobby Classroom Natatorium	<ul> <li>Daylighting</li> <li>Total system savings of 37% over the course of a year</li> <li>Psychological benefits of connection to the outdoors</li> </ul>	
MAE Focus Daylighting Breadth Topic Mechanical	<ul> <li>Electrical Design</li> <li>Cost effective solution (50%) for aluminum MC cable feeder replacement</li> </ul>	
Acknowledgements	<ul> <li>Mechanical - SHW</li> <li>Promotes green energy projects with a 70% reduction in steam consumption</li> </ul>	
Josh Winemiller   April 13, 2011   Lighting/Electrical		

	SMC CAMPUS CENTER	ACKNOWLE	DGEMENTS	
introduction/Overview Electrical Depth Wire vs. MC Cable .iehting Depth		<ul> <li>Penn State AE Faculty</li> <li>Dr. Mistrick</li> <li>Dr. Houser</li> <li>Prof. Dannerth</li> <li>Prof. Holland</li> <li>Prof. Parfitt</li> </ul>	<ul> <li>UMB Campus</li> <li>Kate McManus</li> <li>Bill Crockett</li> <li>Stacy Hosenfeld</li> <li>Mike Krone</li> </ul>	
Main Lobby Classroom Natatorium MAE Focus Daylighting Breadth Topic Mechanical Conclusion		<ul> <li>Henry Adams, LLC</li> <li>Doug Tebera</li> <li>Jim Good</li> <li>WTW / WT</li> <li>Barton Schindel</li> <li>Michael Carper</li> </ul>	<ul> <li>Lutron Technologies</li> <li>Charles Stone</li> <li>Sandra Stashik</li> <li>Shawn Good</li> </ul>	
Acknowledgements		All my Family, Friends,	and Fellow AE Students	

#### E H SMC CAMPUS CENTER COMMENTS AND QUESTIONS 13 10 17 17 MIL THE P Introduction/Overview Electrical Depth Wire vs. MC Cable V Sale and Lighting Depth Main Lobby INTER PRETA PREVER AND AND Classroom 121 Natatorium MAE Focus Daylighting C ORR 12.45 Breadth Topic Mechanical Conclusion Acknowledgements