

The Warrenton Aquatics and Recreation Facility

Warrenton, Virginia



Derek DiPiazza

Construction Management



The Warrenton Aquatics and Recreation Facility

■ Presentation Outline

- Project Introduction
- Analysis I
 - Construction Ethics
- Analysis II
 - Fabric Duct
- Analysis III
 - Structural Redesign
- Conclusions
- Q&A





The Warrenton Aquatics and Recreation Facility

Project Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

Project Overview

- Cost
 - \$22 Million
- Size
 - 59,738ft²
- Schedule Duration
 - 18 Months
- Building Function
 - Aquatic and Recreation Facility
- Building Spaces
 - Competition Swimming Pool, Leisure Swimming Pool, Spectator Seating, Locker Rooms, Fitness Room, Juice Bar, Office Space





The Warrenton Aquatics and Recreation Facility

Project Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Existing Conditions

- Open Site
- Access from North and South

■ Project Architecture & Building Envelope

- Combination of Metal Shingles, Beige Brick, and Simulated Stone Façade
- Standing Seam Metal Roof
- Silo Entrance Incorporates Local Architecture



The Warrenton Aquatics and Recreation Facility

Project Introduction

Analysis I
Construction Ethics

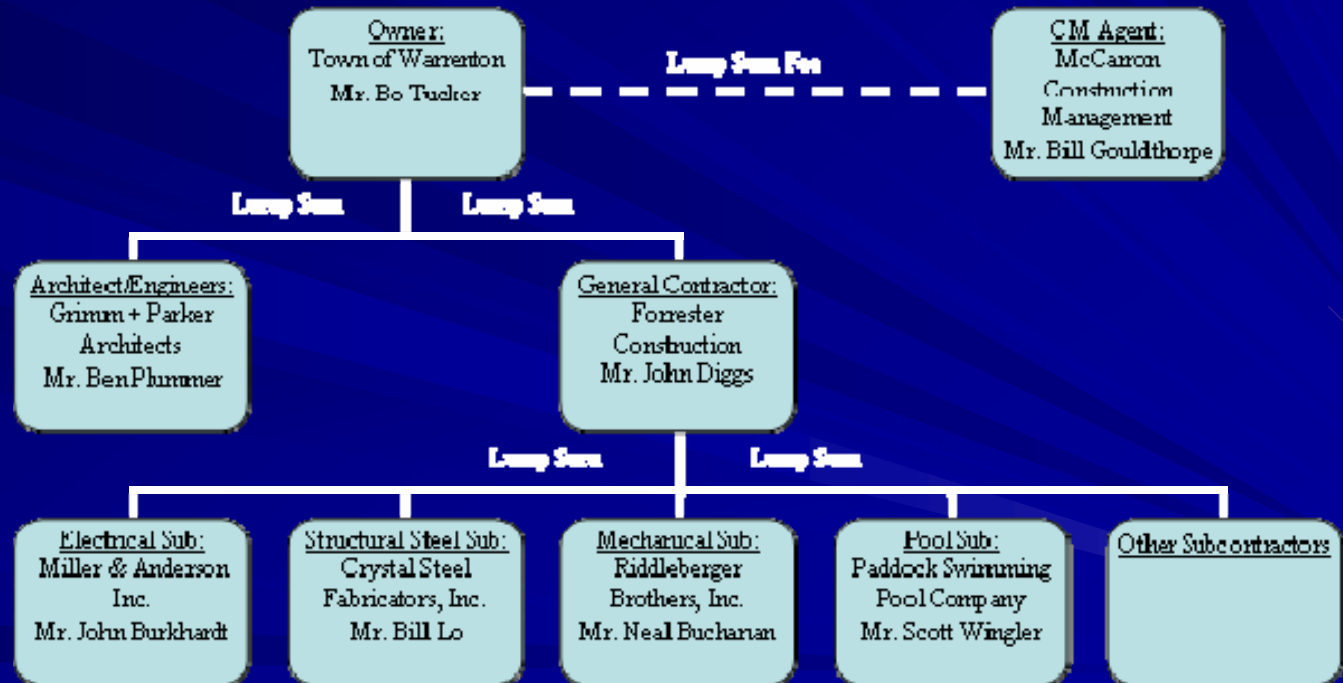
Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

Project Team & Delivery





The Warrenton Aquatics and Recreation Facility

Project Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Relevant Building Systems

– Mechanical System

- 4 AHU's, 3 Energy Recovery Units
- Metal Ductwork Intensive for Large, Open Spaces

– Structural System

- Structural Steel
- CIP Concrete
- Masonry



Analysis I

Construction Ethics



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Problem

- Industry has tainted image
- Uneven playing field
- Poor social responsibility

■ Goals

- Define the need for ethics training
- Develop training program for industry and universities



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Methodology

- Research the current methods for ethics training in the industry
- Develop and distribute ethical need survey
- Identify top ethical transgressions
- Create training program
- Quantify results from exit survey
- Make necessary conclusions



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Initial Research

- Industry relies on codes
 - CMAA
 - ASCE
- Companies do not train
 - Expectations when hired
- Survey results



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

Question Description	Yes (%)	No (%)
Consider Ethics Vital to Job	95	5
Ethical Transgressions more Likely in Construction Industry	45	55
Consider Ethics a Competitive Advantage	74	26
Ethical Transgressions a Necessity to Maintain Competitive Advantage	32	68
Bottom Line more Important than Ethical Practices	21	79
Promotion based on Schedule and Budget Performance over Ethics	42	58
Rewarded for Ethical Job Performance	42	58
Behave More Ethically if Rewarded	87	13
Company Conducts Employee Training	89	11
Company Offers Ethics Training	16	84
Would like to have Course on Construction Ethics	73	27



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Ethical transgressions defined

- Barbara Jackson, California Polytechnic State University
- Surveyed industry members
- Rated the top 15 transgressions based on frequency and severity



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

Number	Frequency Issue	Mean	Seriousness Issue	Mean
1.	Improper or Questionable Bidding	3.3178	Alcohol and Drug Abuse	4.0870
2.	Misrepresentation of Completed Work or Value of Work	3.3031	Improper or Questionable Bidding	3.9437
3.	Poor Quality Control or Quality of Work	3.1063	Failure to Protect Public Health, Safety, or Welfare	3.8750
4.	Technical Incompetence or Misrepresentation of Competence	3.0063	Poor Quality Control or Quality of Work	3.8213
5.	Abuse of Company Resources	2.9969	Abuse of Client Resources	3.6677
6.	Alcohol and Drug Abuse	2.7262	Improper Relations with Clients, Contractors, etc.	3.6270
7.	Failure to Reconcile Employee or Subcontractor Concerns	2.7081	Conflicts of Interest, Improper Political/Community Involvement	3.5696
8.	Abuse of Client Resources	2.6563	Misrepresentation of Financial Status or Records	3.5688
9.	Conflict of Interest, Improper Political/Community Involvement	2.6375	Technical Incompetence or Misrepresentation of Competence	3.5643
10.	Mishandling Sensitive Information	2.4769	Failure to Protect the Environment	3.5497
11.	Failure to Protect Public Health, Safety, or Welfare	2.4594	Failure to Reconcile Employee or Subcontractor Concerns	3.4563
12.	Discrimination, Favoritism, or Harassment	2.4206	Mishandling Sensitive Information	3.4517
13.	Misrepresentation of Financial Status or Records	2.4149	Discrimination, Favoritism, or Harassment	3.4222
14.	Failure to Protect the Environment	2.3673	Abuse Company Resources	3.3836
15.	Improper Relations with Clients, Contractors, etc.	2.3187	Misrepresentation of Completed Work or Value of Work	3.0503
	Average Mean	2.7277		3.6025



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Construction Ethics Program

- Program created in PowerPoint
- Defines each transgression
- Proposes solution to each
- Situational quizzes
- Final Exam
- Alternate ANGEL Format



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Quantifying Program Results – Exit Survey

No.	Question	Yes	No
1.	Do you consider the program to be a valid tool for ethical training?	100%	0%
2.	Would you recommend this program to your coworkers/peers?	91%	9%
3.	After completion of the program, would you act more ethically within the construction industry?	73%	27%
4.	Would you like your company/university to use this program as its means to train employees on ethical practices?	82%	18%
5.	Do you think that the program would fit into your companies/universities training program or learning curriculum?	73%	27%
6.	Is the benefit of taking the program worth the cost of it to your employer?	82%	18%
7.	Is the benefit of taking the program worth the time invested by the employees/students?	73%	27%
8.	Do you consider this training program to be a better alternative to your company's current method of addressing ethical practices?	91%	9%



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Conclusions

- Construction Ethics Training Program is valid tool
- The program is better alt. to current ethical training methods
- People will act more ethically

■ Recommendation

- All companies and universities should use this tool to increase ethical practices in order to construct buildings more ethically

Analysis II

Fabric Duct



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Problem

- Corrosive Environment
- Seasonal Ductwork Systems
- Labor and Cost Intensive
- Large Building Load

■ Goals

- Reduce Schedule
- Reduce Cost
- Increase Duct Quality



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Methodology

- Complete takeoff of current system including cost and duration
- Design fabric duct system
- Determine cost and duration
- Analyze structural effects
- Compare duct properties
- Conclusion & recommendation



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Design Considerations

- Air Flow
- Dispersion
- Fabric Breathability



■ Comparison Criteria

- Cost
- Duration
- Structure Load
- Duct Properties





The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

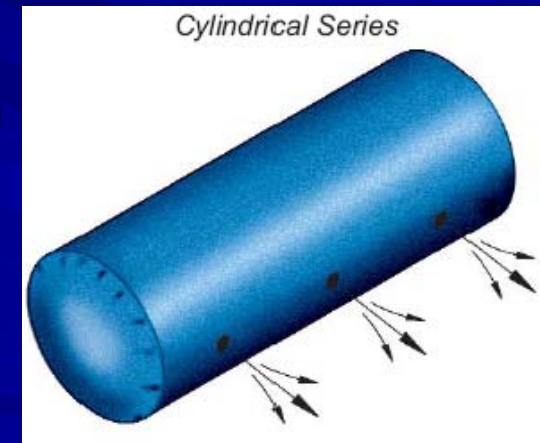
Analysis III
Structural Redesign

Conclusions

Q & A

■ Outcome

- Single duct distribution system
- Over \$90,000 in savings
- Schedule savings of 35 days
- Load/Ft reduced from 9 lbs/ft to less than 1lb/ft
- Duct properties
 - Better air distribution
 - Less maintenance
 - Not corrosive
 - Better air quality
 - Anti-Microbial
 - No dust settling





The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Conclusion

- The fabric duct system is superior in every comparison

■ Recommendations

- The fabric duct system should be installed over the double walled, spiral aluminum ductwork in the aquatic spaces
- Fabric duct should be considered in all large, open layout spaces

Analysis III

Structural Redesign



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Problem

- Mixed system use
- Local site congestion
- Labor and cost intensive

■ Goals

- Determine the best structural column option in the aquatic spaces
- Reduce Schedule
- Reduce Cost



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Methodology

- Determine building loads
- Design steel column
- Design reinforced masonry pilaster
- Conduct comparative analysis
- Conclusion & recommendation



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Design Considerations

- Loading requirements
- Space requirements

■ Design Results

- W10x33 Steel Member
- 24"x24" reinforced pilaster

■ Comparison Criteria

- Cost
- Schedule
- Constructability



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Outcome

Structural Column Cost Comparison				
Type of Column	Quantity	Material Cost	Labor Cost	Total Cost
Concrete	156.4	\$305.00	\$365.00	\$104,788.00
Steel	1056	\$40.00	\$2.37	\$44,742.72
Pilaster	1056	\$37.00	\$25.00	\$65,472.00

Steel Savings=\$60,045

Structural Column Schedule Comparison				
Type of Column	Quantity	Daily Output/Crew	No. Crews	Total Duration
Concrete	156.4cy	17.7cy	1.0	8.8
Steel	1056lf	1025lf	1.0	1.0
Pilaster	1056vlf	18vlf	3.0	19.6

Steel Duration Savings= 18.6Days



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Constructability Outcome

– CIP Requirements

■ Formwork

■ Pump

■ Scaffolding

– Steel

■ Crane

– Pilaster

■ Scaffolding





The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Conclusions

- The steel columns are less expensive, save time, and require no additional erection equipment
- The masonry pilaster is also a better alternative

■ Recommendation

- The use of W10x33's steel members should be used as the columns that support the roof trusses in the aquatic spaces of building

Conclusions



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Construction Ethics

- Definite need for ethical training
- Effective method for developing ethics in industry and universities

■ Fabric Duct

- Fabric system is cheaper, faster to install, lighter, and provides better properties

■ Structural Redesign

- Steel system is cheaper, faster to install, and provides better constructability



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

■ Acknowledgments

- Penn State Department of Architectural Engineering
- Forrester Construction Company
- DuctSox Inc.
- Rickmond Engineering
- B2E Consulting Engineers
- Grimm and Parker Architects
- AE Students

■ Special thanks to my family, friends, and Katie



The Warrenton Aquatics and Recreation Facility

Project
Introduction

Analysis I
Construction Ethics

Analysis II
Fabric Duct

Analysis III
Structural Redesign

Conclusions

Q & A

Questions???