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In Today's Presentation…

Introduction

Depth Study: Construction in Secure Environments

Breadth Analysis: Elevated Floor System

Breadth Analysis: Sensitive Compartmented Information Facilities (SCIF)

Conclusions

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Background Information…

Location:	2691 Technology Drive Annapolis Junction, Maryland
Building Size:	101,960 square feet
Number of Stories:	4
Type of Building:	Office and Light Testing Facility Secure Facilities Building Use Group: "B" (Business)
Delivery Method:	Design-Bid-Build
Dates of Construction:	April 2004 – July 2005

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Background Information…

Lighting/Electrical:

3000A Main Switchboard

2'x4' and 2'x2' Recessed Fluorescent Lights

Structural:

Steel Braced Frame

CIP Concrete Slabs

Spread & Column Footings

Architecture:

Exterior Precast Panels

Exterior Glass/Aluminum Curtain Wall System

Mechanical:

5 Rooftop AHUs

Fan powered VAV boxes

Electric Water Heaters

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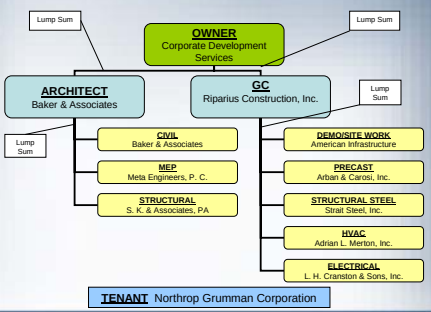
Project Team…



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Costs…

All cost information was held due to confidentiality.

Base Building Estimate

$19 million

General Conditions Estimate

$762,100

Structural Systems Estimate

$9 million

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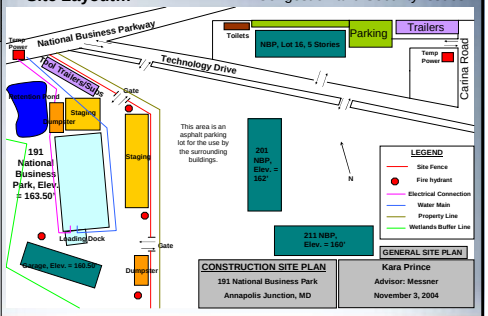
Site Layout… Congestion and Security Issues



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Focus for my depth and analyses…

Construction

and

Security

Requirements

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Security has always been an issue.

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Security has always been an issue.

There are countless papers and articles written about security and buildings, including "DoD Minimum Antiterrorism Standards for Buildings", but…

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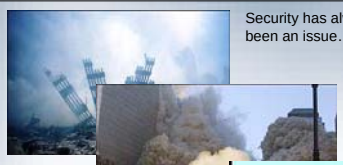

Security has always been an issue…

There are countless papers and articles written about security and buildings, but…

There is limited text addressing construction in secure environments.

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Research…

Two Methods of Research:

1. Survey
2. Literature Review

Goal:

- Create a potential listing of problem areas.
- Determine if security requirements decreases level of productivity.
- Determine if schedules become unreliable due to security.
- Create a listing for strategies that may be implemented.
- *Create a guide that may be used by industry members.*

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Survey Participants…

Question	Responses	Most Frequent Response
Years of Experience in the Industry	Range from 3 years to 27 years	
Years of Experience with Secure Environments	Range from less than 1 year to 5 years	
Projects	Federal Building, Office Building, Laboratory, Research and Development Center, Data Center, Hospital	Office Building
Owners	Federal, Government Contractor	Federal
Project Delivery Methods	Design-Bid-Build, Design-Build, Construction Management	Design-Build

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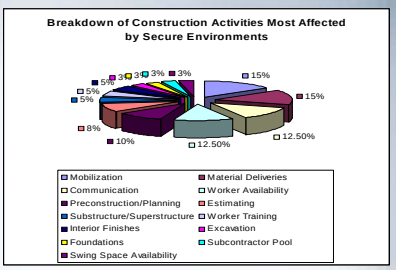
Potential Listing of Problem Areas…



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Percent Reductions…

Construction Activity	Range of Percent Responses	Average Percentage
Material Deliveries	10% to 50%	30%
Mobilization	5% to10%	9%
Worker Training	0% to10%	5%
Communication	0% to 25%	13%
Worker Availability	0% to 33%	18%
Preconstruction/Planning	0% to 5%	4%
Interior Finishes	0% to 400%*	57%
Staff transitions/Turnover	0% to 30%	15%
Estimating	-	-
Excavation	-	-
Foundation	-	-
Substructure/Superstructure	-	-
Safety Training	-	-
Subcontractor Pool Impacts	-	-

*This percentage is restricted to one particular case.

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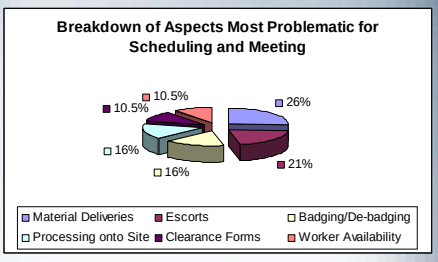
Security Aspects Most Problematic…



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Security effects on Schedules and Communication…

- ❑ Schedules shown to be UNRELIABLE for most cases!
- ❑ Communication hindered due to…
  - "X-raying" mail
  - Email attachment limitations
  - Confidentiality of drawings and specs

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Strategies to manage security…

- ❑ Before going onsite, the team must have a complete understanding of all security requirements.
- ❑ Coordination between workers and security agency is key to process quickly.
- ❑ Create a separate facility on site to handle all security.
- ❑ Convey detailed expectations and the impacts of security to workers.
- ❑ Dedicate one individual to handle security only.
- ❑ Develop a highly detailed schedule including all tasks and activities.

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Literature Review…

- ❑ Vulnerability analysis, Risk assessment, Technology requirements, and Design of the systems → ACCURATE COST
- ❑ Handle documents properly → AVOID REPERCUSSIONS
- ❑ Use fewer personnel to handle documents → PROVIDE SAFETY AND SECURITY

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Overview of Breadth Analysis I…

Existing Elevated Floor System:

- 6" Total Slab
- 20 Gauge Metal Decking
- 3" Lightweight Concrete
- WWF – 6"x6" W 2.9 x W2.9
- Chairs 1" from top of slab

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Overview…

Existing Elevated Floor System:

- 6" Total Slab
- 20 Gauge Metal Deck
- 3" Ligh
- [illegible] x W2.9
- [illegible] 1" from top of slab

[illegible]eight concrete?

- Higher fire rating, smaller slab thickness, smaller member sizes

(according to the engineers)

VIBRATION AND SECURITY NOT ADDRESSED!

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Vibration Analysis…

Preliminary Assessment (Hanagan):

- Concrete Weight – Light weight Concrete
- Steel Frame Type – Rolled beams/girders
- Construction Type – Composite
- Deck Type – Composite

C1 = 0.449 (from chart based on deck thickness and total slab thickness)

C2 = 0.120 (from chart)

C1 + C2 = 0.449 + 0.120 = 0.569 > 0.5

UNACCEPTABLE FOR VIBRATION!!!

However, **original structure is structurally sound** (based on calculations made from LRFD).

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Vibration Analysis…

Re-design of Elevated Slab (Hanagan):

- Concrete Weight – Normal Concrete
- Steel Frame Type – Rolled beams/girders
- Construction Type – Composite
- Deck Type – Composite

C1 = 0.343 (from chart based on deck thickness and total slab thickness)

C2 = 0.102 (from chart)

C1 + C2 = 0.343 + 0.102 = 0.445 < 0.5

ACCEPTABLE FOR VIBRATION!!!

Re-designed structure is structurally sound (based on calculations made from LRFD).

*Note: Other concerns (fire protection, HVAC, etc) must be considered for a full re-design but were not researched in this thesis.

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Schedule Impacts…

Original Schedule

Activity	Duration (days)	Start	Finish
FRP CIP 2nd Floor Slab & Cure	30	30-Aug-04	08-Oct-04
FRP CIP 3rd Floor Slab & Cure	38	01-Sept-04	22-Oct-04
FRP CIP 4th Floor Slab & Cure	15	20-Sept-04	08-Oct-04
FRP CIP Roof Slab & Cure	11	24-Sept-04	08-Oct-04
TOTAL	**94**		

Note: Schedule is coordinated with precast erection.

Schedule durations *remain the same* for both light weight and normal weight concrete slabs.

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Schedule Impacts…

#	Area	Days 1	2	3	4
1	F2 S1	1	2		
2	F2 S2		1	2	
3	F2 S3			1	2

KEY
F = Floor
S = Section

#	SIPS Activity
1	Edge Form
	Chairs
	WWF
2	Place Concrete
	Finish Concrete

If schedule needs to be driven for any reason:

76 Days Saved in the Schedule!!

Activity	Duration	Start	Finish
FRP CIP 2nd Floor Slab	9	30-Aug-04	09-Sept-04
FRP CIP 3rd Floor Slab	9	02-Sept-04	14-Sept-04
FRP CIP 4th Floor Slab	9	07-Sept-04	17-Sept-04
FRP CIP Roof Slab	9	10-Sept-04	22-Sept-04
TOTAL	36		
ACTUAL TOTAL DURATION	18		

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Cost Impacts…

Light weight concrete is an additional $2.75/CY
(According to RS Means 1999)

Cost of Original: Lightweight	Cost of Revised: Normal Weight	Difference In Cost
$7,657,000	$5,702,000	$1,955,000

Normal weight concrete costs significantly less!

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Value Engineering…

Light weight Concrete - versus - Normal weight Concrete

- Light weight is *harder to place* during construction
- Light weight concrete *costs more*
- Light weight is *harder to achieve the same level of quality*

Therefore Normal Weight Concrete is a better value engineering idea!!!

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Security: Sound Attenuation…

- Sensitive Compartmented Information Facilities (SCIF) require:

  Sound Transmission Class (STC) 45 or greater

  (Director of Central Intelligence Directive)

- DCID requires a minimum of 8" thick reinforced concrete construction of walls, floor, and ceiling.

- Northrop Grumman constructs SCIFs using *permanent drywall construction*.

  This is allowed because they have immediate response force within their facilities.

More about SCIFs in next section…

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Security: Sound Attenuation…

Question: Is the 6" total normal weight slab enough to prevent sound attenuation through the elevated floor system?

Answer: YES!

According to Director of Physical Security at Northrop Grumman, 6" total slab is ideal and exceeds STC 45.

Question: Are there other ways to increase the STC rating for the SCIF space?

Answer: YES!

Sound masking devices, structural enhancements with high density building materials, and/or a stand off distance could be implemented.

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Sensitive Compartmented Information Facilities (SCIF)

"room or area in which Sensitive Compartmented Information (SCI) may be stored, used, discussed, or processed"

Sensitive Compartment Information (SCI)

"any information that is classified by the United States government"

Important to understand the construction, mechanical, and electrical requirements of a SCIF…

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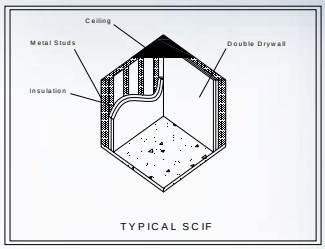
Construction Requirements…

Walls, ceiling, and floor must be permanently constructed and attached to each other (DCID).



TYPICAL SCIF

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Construction Requirements (According to DCID)…

	General Requirements	Types of Materials
Doors	- Only one primary entrance allowed. - Exit door may be required. - Doors must be closed at all times unless for emergencies. - Must be plumb in frame and of sufficient strength. - Need automatic door closure, GSA approved combination lock, and access control device. - Hinge pins located exterior of the SCIF will be treated to prevent removal.	- Solid wood core door, min 1 ¾" thick - 16 gauge metal cladding over wood or comp materials, min 1 ¾". Metal cladding continuous and cover entire front and back. - Metal fire or acoustical protection doors, min 1 ¾" - Joined metal rolling door, min 22 gauge
Windows	- Windows which allow visual surveillance must be made opaque or covered with items such as blinds to prevent surveillance. - Windows at ground level will be covered with materials to prevent entry. - Perimeter windows at ground level shall be covered by an Intrusion Detection System.	

General Construction Requirements for SCIF Doors and Windows

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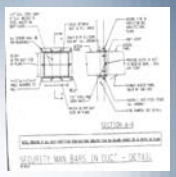
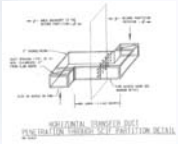
Mechanical Requirements…

Physical protection of Vents, Ducts, and Pipes (DCID)

- All vents, ducts, and similar openings in excess of 96 square inches that enter or pass through SCIF must be protected with either bars, grilles, or commercial metal duct sound baffles that meet appropriate sound attenuation.
- Based on TEMPEST accreditation, it may be required that all vents, ducts, and pipes have a non-conductive section installed at the interior perimeter.
- An access port to allow visual inspection of the protection in the vent or duct should be installed inside the secure perimeter of the SCIF. If the port is installed outside the perimeter of the SCIF, it must be locked.





If light can be seen in an area outside SCIF, sound transfer is great.

- Return ducts use Z boot

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Electrical Requirements…

- Panel boards must be located inside room.
- Dielectric is required for all conduits running through SCIF space. Dielectric is any medium that does not allow the passage of electric force through.
- For SCIFs that require less than 100 kVa, a UPS and transformer is required to change the voltage.

(Manager of Electrical Engineering at Northrop Grumman)

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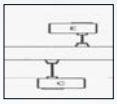
Mechanical Re-design…

- Current system does not account for security concerns of a SCIF (aka no man bars and sound attenuators)
- Two fan powered VAV boxes giving off 2200 CFM in area

1300 CFM
\+ 900 CFM
2200 CFM



- Using Hourly Analysis Program (HAP) Version 4.20a,

1445 CFM needed for room

DIFFERENCE OF 755 CFM!!

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Mechanical Re-design…

1. Existing duct (38x14) removed and new duct (40x16) will be manufactured and installed– this will include man bars, sound lining, and reducers
2. 1300 CFM VAV box removed
3. 900 CFM VAV box will be re-used for new duct
4. 755 CFM VAV box will be manufactured for new duct
5. 545 CFM VAV box will be manufactured and installed elsewhere in open floor space
6. Return duct (20x14) manufactured since there is no existing
   - Return duct sized using Trane's Ductulator
7. Z boot will be manufactured and installed in new duct

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Value Engineering…

Cost for HVAC: Renovating Existing versus Installing Secure HVAC Initially	
Renovation of Original System	**Initially Installing Secure System**
Steps: •Existing duct and VAV boxes must be removed •New duct manufactured and installed – including reducers, sound lining, and man bars •900 CFM VAV box installed •545 CFM VAV box manufactured and installed •755 CFM VAV box manufactured and installed	Steps: •Duct manufactured and installed – including reducers, sound lining, and man bars •900 CFM VAV box manufactured and installed •545 CFM VAV box manufactured and installed •755 CFM VAV box manufactured and installed
Costs: •*Removal of existing supply duct- $500* •*Removal of VAV box - $340* •Supply Duct Manufactured - $1000 •Return Duct Manufactured - $1700 •Man bars - $560 •545 CFM VAV box - $550 •755 CFM VAV box - $650 •Installation of supply duct - $480 •Installation of return duct - $630 •Installation of VAV boxes - $480 •Supply diffusers - $60 •Return diffusers - $40 •Z boot - $510	Costs: •Supply Duct Manufactured - $1000 •Return Duct Manufactured - $1700 •Man bars - $560 •*900 CFM VAV box - $700* •545 CFM VAV box - $550 •755 CFM VAV box - $650 •Installation of supply duct - $480 •Installation of return duct - $630 •Installation of VAV boxes - $480 •Supply diffusers - $60 •Return diffusers - $40 •Z boot - $510
Total Cost: $7500	Total Cost: $7360
Cost Difference: $140	

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Value Engineering…

However,

costs did not take into consideration the additional planning costs needed to renovate the existing system versus initially installing a secure HVAC duct.

Therefore,

initially installing a secure system is a better value engineering idea.

Kara Prince
Construction Management
AE Senior Thesis 2005
Penn State University

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Conclusions…

Security must be addressed in all aspects of building engineering (Structural, Mechanical, Electrical, Construction)

- Survey and literature review provided valid insights into better understanding construction in secure environments and strategies that can be implemented for a construction job.
- Elevated floor slab needed to be re-designed for vibration. The re-designed 6" slab provided a sufficient STC rating for the SCIF however STC ratings may be improved through additional methods.
- SCIFs have many security requirements. The existing mechanical system needed to be renovated to meet the standards.
- Value Engineering: Normal weight concrete and initially installing a secure duct.

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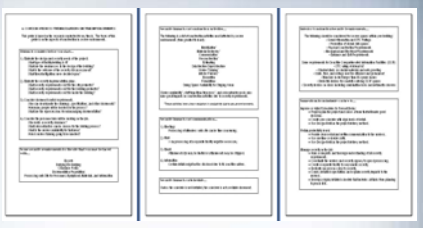
Goal Fulfilled…



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Acknowledgements:

· Northrop Grumman Corporation Electronic Systems
· Corporate Development Services
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· My AE peers (Jon, Emily, & Holly) and friends
· Most importantly: Mom, Dad, and Ryan

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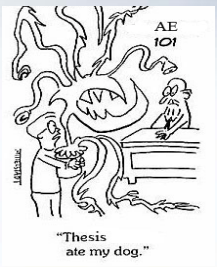
Questions?



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