#### FORT PICKETT REGIONAL TRAINING INSTITUTE – PHASE II MILITARY BARRACKS BLACKSTONE, VA



PENN STATE AE SENIOR CAPSTONE PROJECT KENDALL MAHAN CONSTRUCTION MANAGEMENT OPTION ADVISOR: PROFESSOR FAUST





KENDALL MAHAN CONSTRUCTION MANAGEMENT OPTION



# INTRODUCTION





BARTON MALOW U.S. ARMY CORPS OF ENGINEERS VIRGINIA ARMY NATIONAL GUARD



# SCHEDULE ACCELERATION & MANAGEMENT





BILLETING BUILDINGS BLACKSTONE, VA

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# **PROJECT LOCATION:**

• BLACKSTONE, VIRGINIA

#### **BUILDING PARAMETERS:**

- # OF BULDINGS: 3
- **# OF FLOORS:** 2 STORIES

## **PROJECT PARAMETERS:**

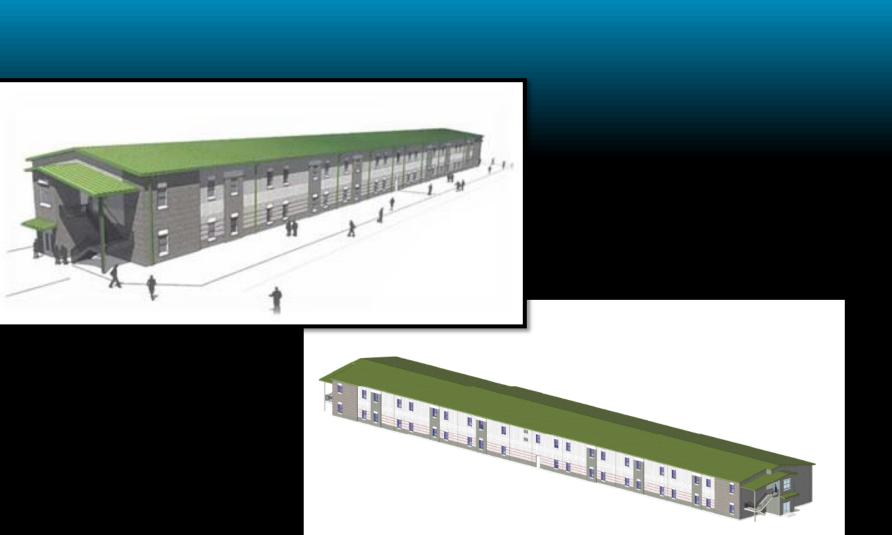
- **COST:** \$28 M
- **CONTRACT TYPE:** GMP
- **DELIVERY METHOD:** DESIGN-BUILD
- **TIMELINE:** 10/25/10 12/31/11

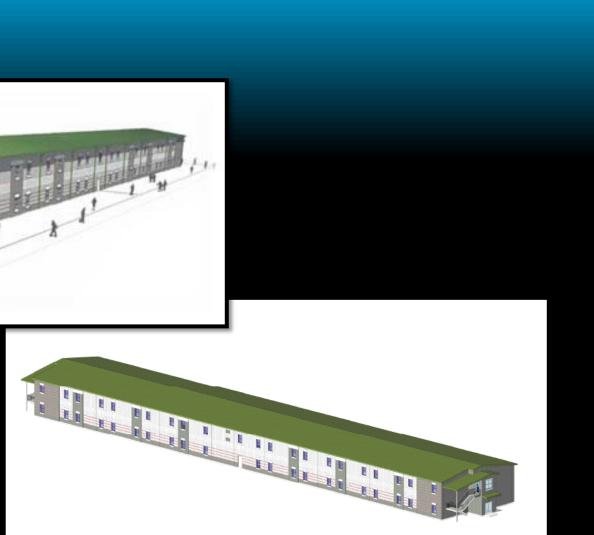
### PROJECT BACKGROUND



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• AREA: 116,400 SF (~40,000 SF / BUILDING











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#### **PROBLEM:**

- •
- EXTENSIVE COORDINATION

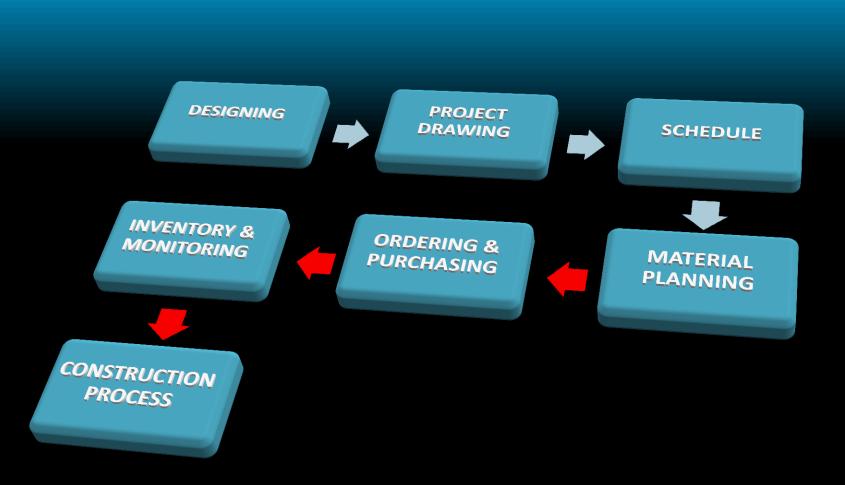
# **BACKGROUND:**

- SECOND FLOOR STRUCTURAL SYSTEM
- 774 HOLLOW-CORE PLANKS
- 20 DIFFERENT MEMBERS

#### MATERIAL TRACKING TECHNOLOGY



 PRECAST HOLLOW-CORE PLANKS ARE MOST CRITICAL ACTIVITY MATERIAL MANAGEMENT PROCESS



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FLAWS IN MATERIAL MANAGEMENT PROCESS





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# **MEADOWLANDS STADIUM:**

- \$998M PROJECT
- 3,200 PRECAST CONCRETE MEMBERS

# **UCSC PORTER B COLLEGE:**

- DOORS, FRAMES, & HARDWARE
- 50-80% TIME SAVINGS FOR DFH TASKS

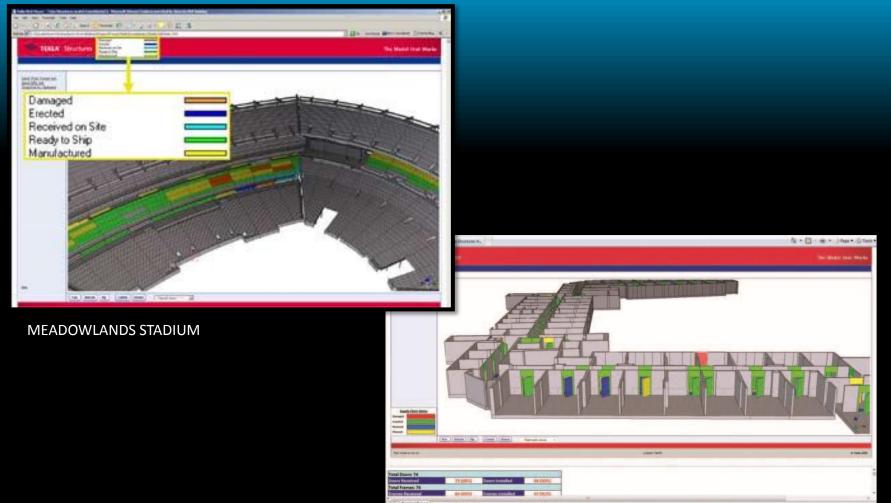
## MATERIAL TRACKING TECHNOLOGY



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STRICT SCHEDULE WITH UPCOMING FOOTBALL SEASON • SAVED \$1M & 10 DAYS OFF THE SCHEDULE

• ELIMINATED TYPICAL 2% JOB COST RELATED TO QA/QC AND REORDERS







#### UCSC PORTER B COLLEGE



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# MATERIAL TRACKING TECHNOLOGY





## **MATERIAL TAGS:** PROJECT CONSIDERATIONS ADEQUATE SPACE ACCESSIBILITY

- BARCODE LABELS
  - CHEAPEST
  - LOW RANGE

# HARDWARE:

- iPAD
- OTTERBOX DEFENDER CASE
- OPTICON BLUETOOTH
- PRINTER



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Active RFID Tags	Passive RFID Tags	Barcode Tags	Barcode Labels
100 Meter read range; can be read under snow & ice	10 – 20' read range; cannot be read under snow & ice	Less than 1' read range; cannot be read under snow and ice	Less than 1' read range; cannot be read under snow and ice
Does not require line of site to scan; can be used with inventory sweeps to update GPS location	Does not require line of site to scan	Does require line of site to scan	Does require line of site to scan
\$\$\$	\$\$	\$	

MATERIAL TAGGING SYSTEMS









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VELA SYSTEMS

# **SOFTWARE:**

- VELA SYSTEMS FIELD SOFTWARE

  - VELA MOBILE •
  - FIELD BIM
- - 4D MODEL
- BARTENDER BARCODING
  - PRINT BARCODES ON-SITE
- ITUNES IPAD MANAGEMENT

## MATERIAL TRACKING TECHNOLOGY



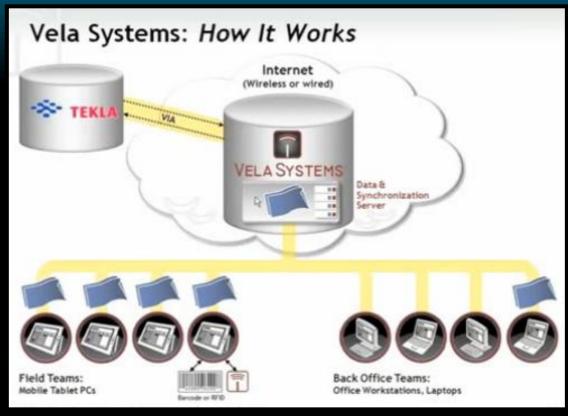
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USED ON FORT PICKETT PROJECT FOR PUNCHLIST & SAFETY

UNLIMITED USER LICENSE TEKLA STRUCTURES – BIM TECHNOLOGY

MATERIAL STATUS INDICATOR

**BLUETOOTH & BARTENDER APPLICATIONS** 





MATERIAL TRACKING PROCESS MAP



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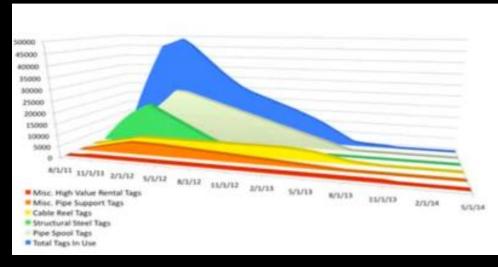


**IMPLEMENTATION:** 

- DEFINE SCOPE OF WORK DEVELOP WORK FLOW DIAGRAMS • MANAGED BY QC MANAGER • 4 PHASE TRACKING PROCESS ASSOCIATE TAGS AT MANUFACTURING FACILITY

- MANAGE NUMBER OF TAGS IN USE



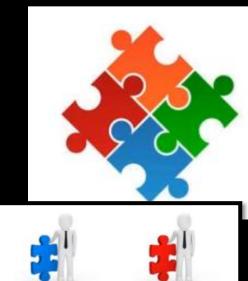


TAGS IN USE

### MATERIAL TRACKING TECHNOLOGY



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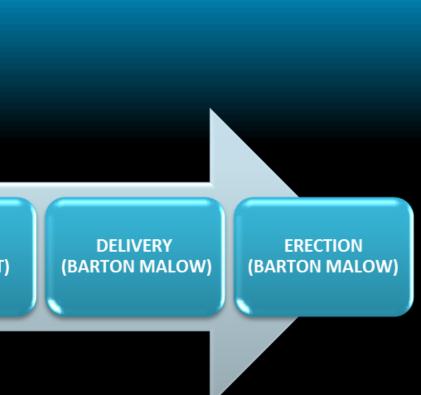




MANUFACTURING (GATE PRECAST)

INSPECTION (GATE PRECAST)





MATERIAL TRACKING PHASES





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#### **RESULTS:**

- COST SAVINGS

- TRACK TOOLS & EQUIPMENT

## **RECOMMENDATION:**

### MATERIAL TRACKING TECHNOLOGY



#### **Cost to Implement Material Tracking**

Item	Existing System
Vela	
System	\$4,800
Base Services	\$1,500
Training	\$1,800
Field BIM	-
Field BIM Services	-
iPad	\$600
OtterBox Case	\$75
NavisWorks	-
Opticon Scanner	-
Bartender	-
Barcodes	-
Totals	\$8,775

COST TO IMPLEMENT - \$9,300 • 2% SAVINGS IN QA/QC ISSUES - \$440,463 LIQUIDATED DAMAGES - \$2,281/DAY • ONE-TIME COST & CAN BE APPLIED TO OTHER BUILDING COMPONENTS • 2-4 HOURS/DAY SAVED IN PAPERWORK REDUCED THEFT AND VANDALISM RISKS

 PROCEED FORWARD WITH MATERIAL TRACKING SYSTEM DUE TO THE ELEVATED RISK ASSOCIATED WITH THE HOLLOW-CORE PLANKS

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Proposed System	Additional Cost
\$7,600	\$2,800
\$1,500	\$0
\$1,800	\$0
\$4,200	\$4,200
\$1,500	\$1,500
\$600	\$0
\$75	\$0
-	\$0
\$250	\$250
\$250	\$250
\$300	\$300
\$18,075	\$9,300





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## SHORT INTERVAL PRODUCTION SCHEDULE





#### **PROBLEM:**

- CREW MANAGEMENT
- 3 BUILDINGS IN ERECTION SEQUENCE

# **BACKGROUND:**

- 774 PRECAST FLOOR PLANKS
- SET PLANKS PLACE REBAR GROUT



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PRECAST HOLLOW-CORE PLANKS ARE MOST CRITICAL ACTIVITY

#### Hollow-core Plank Erection Dates (N Dur-Side Building 700 North South Building 500 North South Building 600 West East



Not Including Grout, Rebar, etc.)					
ation	Start	Finish			
3	11/18/10	11/24/10			
3	11/29/10	12/1/10			
3	12/6/10	12/8/10			
3	12/10/10	12/14/10			
3	12/13/10	12/16/10			
3	12/17/10	12/22/10			



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# SHORT INTERVAL PRODUCTION SCHEDULE





SIGNS DESIGNATE WORK AREA & ACTIVITIES

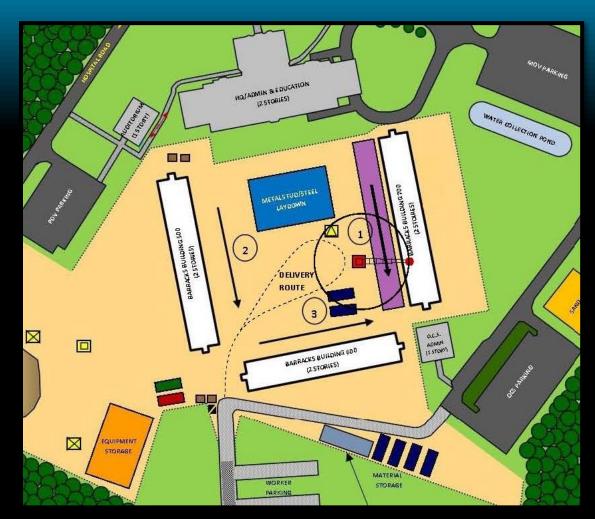
## **IMPLEMENTATION:**

- TRADITIONAL SIPS •
- DISTINCT WORK AREAS
- 6 CRANE LOCATIONS
- ESTABLISH CRITICAL DATES
- THANKSGIVING HOLIDAY
- (4) 10-HOUR WORK WEEK
- WORK BUFFER



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#### HOLLOW-CORE PLANK ERECTION SITE PLAN



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# SHORT INTERVAL PRODUCTION SCHEDULE



Cost Savings		
	Unadjusted Cost	Adjusted Cost
		(Time=1.085) (Location=0.849)
Mobile Truck Crane	\$3,575.00	\$39,325
Project Overhead	\$72,929.88	\$78,199
	Total Cost Savings	\$117,524

#### **RESULTS:**

- RESEQUENCED WORK
- •
- SAVED 11 WORK DAYS
- SAVED \$117,524

## **RECOMMENDATION:**

OF THE HOLLOW-CORE PLANKS



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		S	nort Inte	erval Pr	oductio	n Sched	ule				
			١	Neek of 1	1/22 - 11/	<b>/2</b> 6					
					or: Gate P						
			Acti	vities: Hol	low Core	Planks					
Antota	Mor	nday		sday		nesday	Thu	rsday	Fri	day	T-1-1-0
Activity	АМ	PM	AM	PM	AM	PM	AM	PM	AM	PM	Total Man Hours
Install Rebar - 700 North	2	2	2	2							32
Grout - 700 North	2	2	2	2							32
Mobilize Crane - 700 South	1						]				4
Set Planks - 700 South	5	6	6	5			-	ζag			88
Demobilize Crane - 700 South				1							4
Layout - 500 North			2					l nanksgiving Holiday			8
Layout - 500 South				2			-				8
Install Rebar - 700 South					2	1	-	IKSI			12
Grout - 700 South					2	1	] _	uar L			12
Mobilize Crane - 500 North					1		'	-			4
Set Planks - 500 North					5	6	]				44
Cleanup						2					8
Manpower Totals	10	10	12	12	10	10	0	0	0	0	256
Equipment Totals (Crane Hrs)	4	4	4	4	4	4	0	0	0	0	24

ACCELERATED DEPENDENT ACTIVITIES SAVINGS IN THE FORM OF CRANE RENTAL AND GENERAL CONDITIONS

IN THE BEST INTEREST OF THE FORT PICKETT PROJECT TO UTILIZE A SIPS FOR THE ERECTION



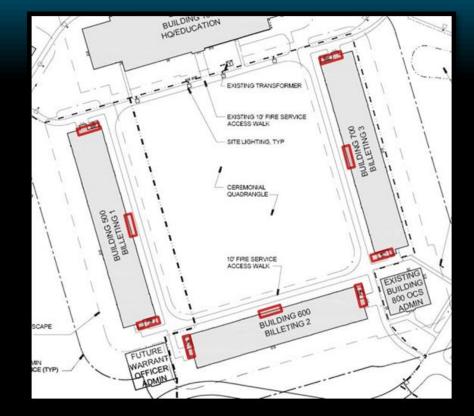
SIPS PRODUCED FOR HOLLOW-CORE PLANKS



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BUILDING ENTRANCES

## **PROBLEM:**

- COMPLEX CMU VENEER
- QUALITY WITH MORTAR JOINTS
- BUILDING ACCESSIBILITY

# **BACKGROUND:**

- 58,700 SF OF BLOCK

# PRECAST FAÇADE PANELS



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 MULITPLE TEXTURES: PRECAST CONCRETE LINTELS, SMOOTH FACE CMU, SPLIT FACE CMU • MULTIPLE COLORS: WINE, BLACK, GREY









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**BUILDING 500 (80 PANELS)** 

**BUILDING 600 (70 PANELS)** 

**BUILDING 700 (80 PANELS)** 

#### **PRECAST MANUFACTURERS:**

- GATE PRECAST
- SHOCKEY PRECAST •

**Concrete Panel** 

Panel Systems (59

Sandwich Panel

Concrete Panel w

Sandwich Panel w

# PRECAST FAÇADE PANELS



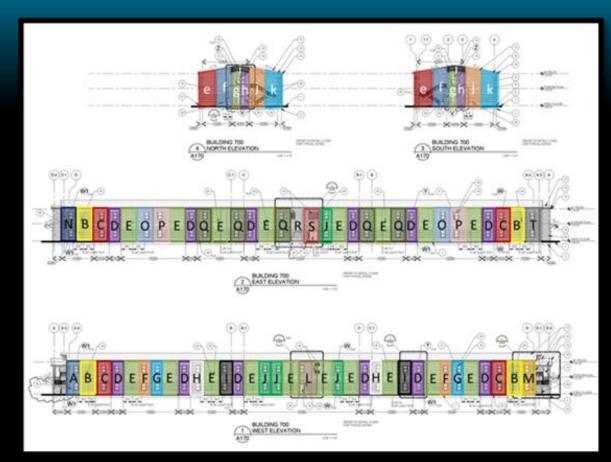
BARTON MALOW

NITTERHOUSE CONCRETE PRODUCTS

#### **DESIGN:**

- PANELS SPAN TWO FLOORS
- 230 PANELS
- 34 DIFFERENT PANELS
- 7 PANEL WIDTHS

9,700 SF)				
	Cost/SF	Thickness	Weight	Cost of Panel System
	\$20	7″	88 PSF	\$1,194,000
	\$30	9″	88 PSF	\$1,791,000
/ CMU Embeds	\$25	7"	88 PSF	\$1,492,500
// CMU Embeds	\$35	9″	88 PSF	\$2,089,500



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#### PANEL DESIGNATIONS & TAKEOFF



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#### **DESIGN:**

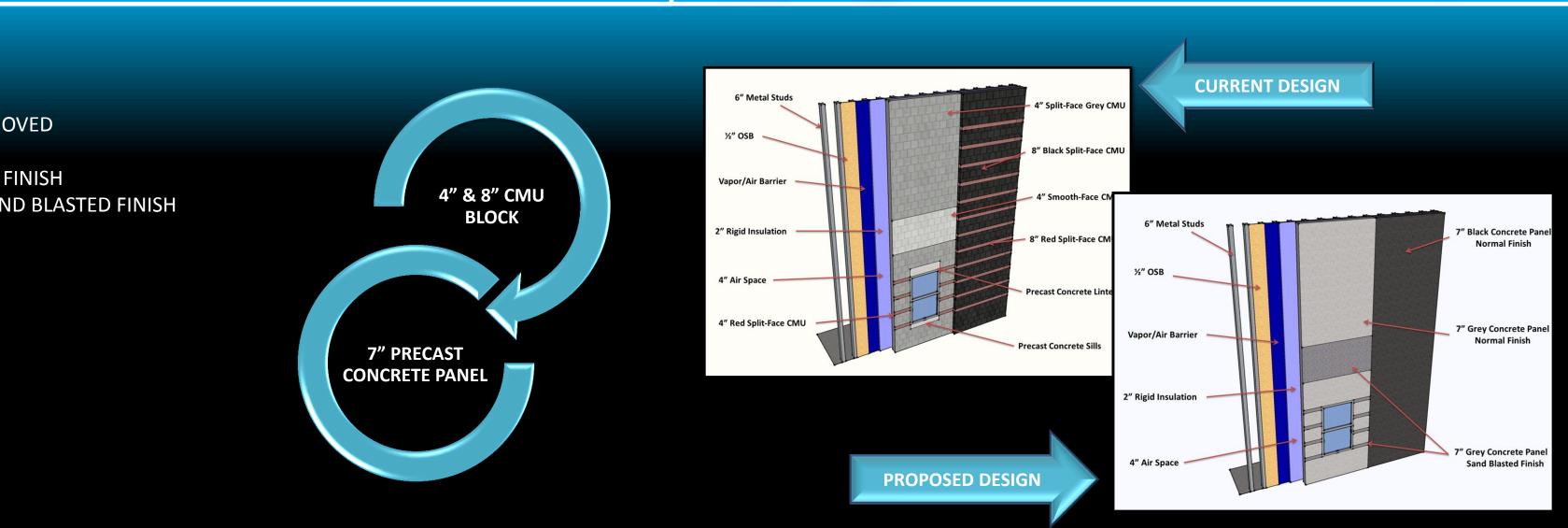
- BUMP-OUTS REMOVED
- LINEAR STRIPS
- GREY AND BLACK FINISH
- NORMAL AND SAND BLASTED FINISH

#### PANEL FINISHES

# PRECAST FAÇADE PANELS



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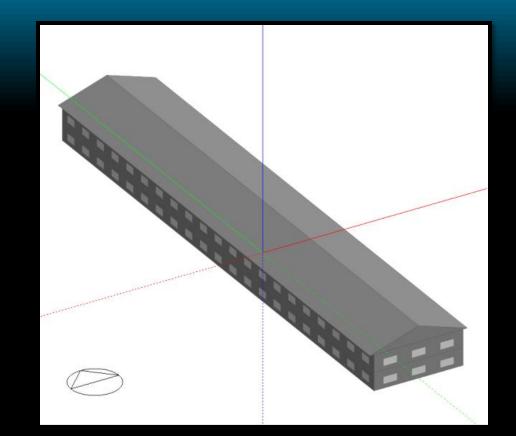






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ENERGY ANALYSIS MODEL

## **ENERGY ANALYSIS:**

- DESIGN BUILDER ENERGY PLUS
- CMU VENEER

  - R-VALUE: 36.976 SF-F-H/BTU
- PRECAST CONCRETE PANELS

  - R-VALUE: 36.354

# PRECAST FAÇADE PANELS



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MODEL DESIGNED USING BUILDING SPECIFICS FROM BARRACKS

• U-VALUE: 0.028 BTU/HR-SF-F

• SURFACE RESISTANCE: 0.227 SF-F-HR/BTU

• U-VALUE: 0.028 BTU/HR-SF-F

• SURFACE RESISTANCE: 0.227 SF-F-HR/BTU

NEARLY IDENTICAL THERMAL PROPERTIES

Outer surf	ace
3.6250in	Concrete Block (Medium)
4.0000in	Air gap 100mm (downwards)
2.0000in	PUR Polyurethane Board (Diffusion TIGHT)
0.1000in 0.5000in	Urethane/polyurethane (thermal break)(not to scale) Oriented strand board (OSB)(not to scale)
6.0000in	MW Glass Wool (rolls)
0.6250in	Gypsum Plasterboard(not to scale)
Inner surfa	ace

#### CMU VENEER





Outer surf	ace
7.0000in	Concrete, Reinforced (with 2% steel)
4.0000in	Air gap 100mm (downwards)
2.0000in	PUR Polyurethane Board (Diffusion TIGHT)
0.1000in 0.5000in	Urethane/polyurethane (thermal break)(not to scale) Oriented strand board (OSB)(not to scale)
6.0000in	MW Glass Wool (rolls)
0.6250in	Gypsum Plasterboard(not to scale)
Inner surfa	ace



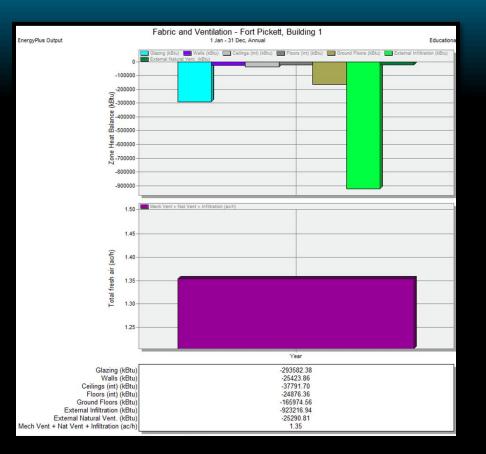


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HEAT TRANSFER FOR ENCLOSURE

#### **ENERGY ANALYSIS:**

- CMU VENEER
  - HEAT LOSS: 24,684 kBTU
- PRECAST PANELS
  - HEAT LOSS: 25,423 kBTU

# PRECAST FAÇADE PANELS

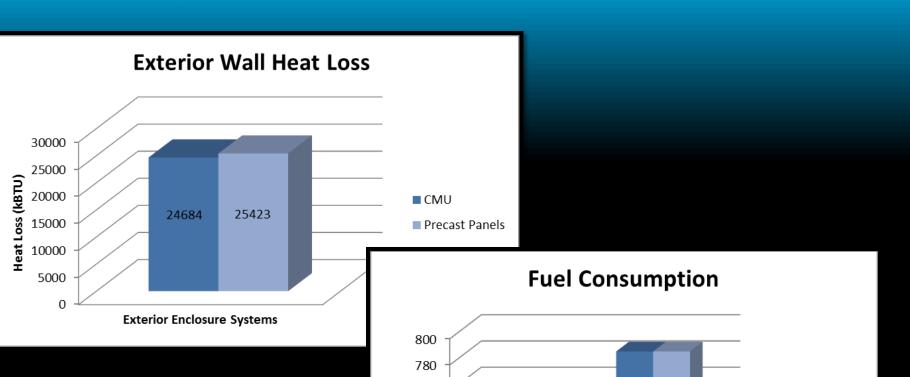


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ELECTRICITY CONSUMPTION: 707,301 kBTU GAS CONSUMPTION: 784,870 kBTU

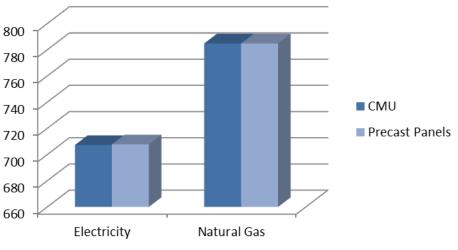
ELECTRICITY CONSUMPTION: 707,801 kBTU GAS CONSUMPTION: 784,890 kBTU

CMU ENCLOSURE PEFORMED BETTER, BUT THE ADVANTAGE IS SO MINIMAL THAT SIGNIFICANT WEIGHT SHOULD NOT BE PLACED ON ENERGY ANALYSIS FOR FINAL DECISION



-



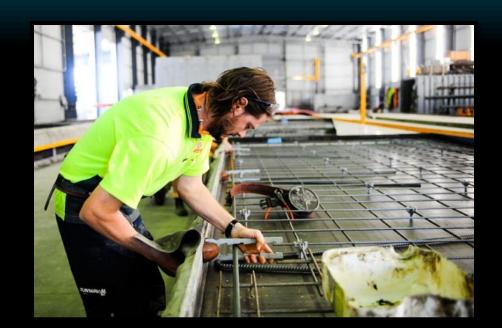






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# **MANUFACTURING:**

- CONTROLLED WORK ENVIRONMENT
- REDUCED SAFETY INCIDENTS
- FAVORABLE WORKING HEIGHTS

# **QUALITY CONTROL:**

- HIGHER QUALITY OF WORK
- PCI CERTIFIED

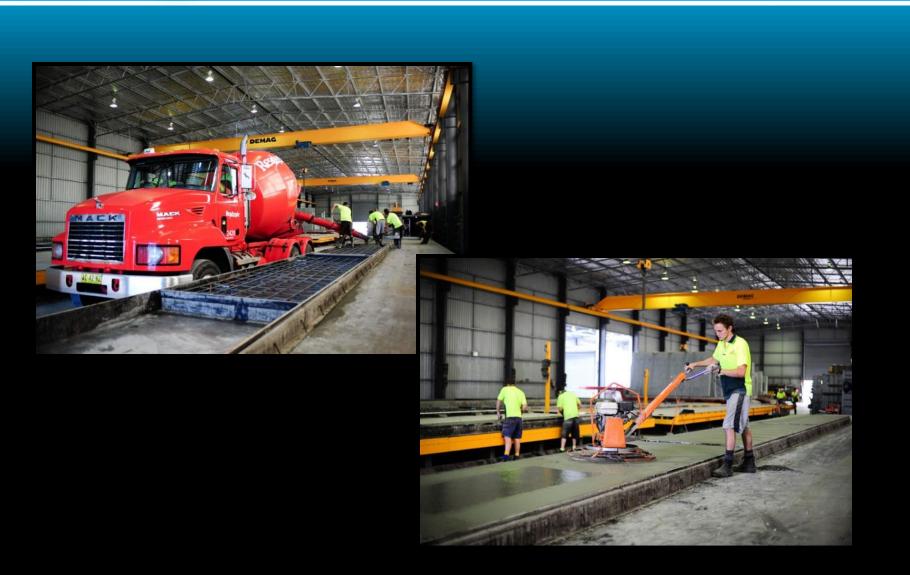
# PRECAST FAÇADE PANELS



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 MUST PASS TWO UNANNOUNCED INSPECTION S TO MAINTAIN CERTIFICATION **RESULTS IN CONSISTENT WORK PRACTICES** 



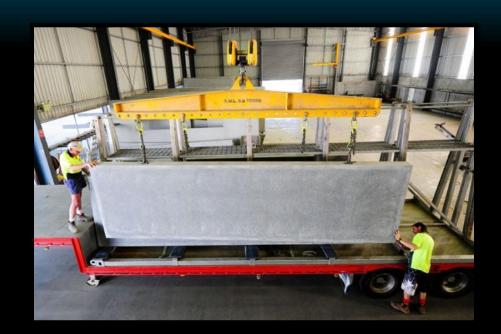




BILLETING BUILDINGS BLACKSTONE, VA

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## **DELIVERY:**

- SHIPPED FROM CHAMBERSBURG, PA
- 250 MILES, 5 HOURS

## **ERECTION:**

- 40 TON CRAWLER CRANE
- 6 CRANE LOCATIONS
- 15-20 PANELS ERECTED/DAY

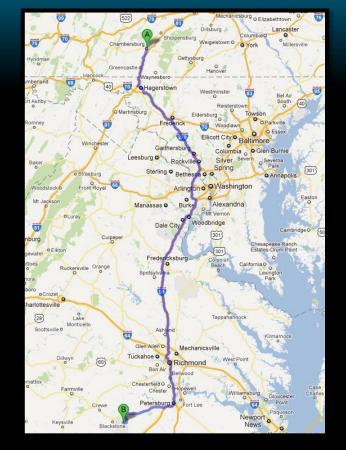
# PRECAST FAÇADE PANELS

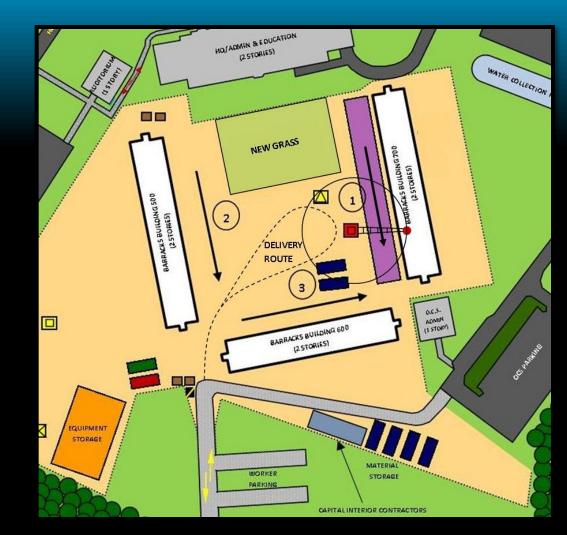


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 12' X 50' TRUCK BED MOST ECONOMICAL USE NON-STAINING, SHOCK ABSORBING MATERIAL

PICKED FROM POINTS SPECIFIED IN SHOP DRAWINGS





DELIVERY ROUTE



PRECAST PANEL ERECTION SITE PLAN



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Building Enclosure Activity Accelerations					
Activity	Duration/Building	Duration/Project			
CMU Wall					
Erect CMU Walls	50	150			
Clean CMU Walls	20	60			
Total	70	210			
Precast Panels					
Erect Panels	5	15			
Seal Joints/Clean Panels	20	60			
Total	25	75			
Days Saved on Enclosure	45	135			

# SCHEDULE IMPACT:

- REDUCED FAÇADE ERECTION FROM 50 TO 5 DAYS 1 WEEK ADDED TO STRUCTURAL SCHEDULE FOR CONNECTIONS REPLACED CLEANING DURATION WITH CLEANING AND SEALING
- FAÇADE ACTIVITIES RESEQUENCED
- **REDUCED ENCLOSURE DURATION BY 14.5 WEEKS**
- POTENTIAL TO ACCELERATE SCHEDULE BY 10 WEEKS
- NOT ALONG THE CRITICAL PATH ROOF

# PRECAST FAÇADE PANELS



Schedule Impacts Building 700							
		Previous		Proposed			
Activity	Start	Finish	Duration	Start	Finish	Duration	Days Saved
	Date	Date		Date	Date		
Exterior Sheathing	12/23/10	3/7/11	53	1/24/11	3/18/11	40	13
Vapor Barrier/Insulation	1/13/11	3/31/11	56	1/31/11	4/1/11	45	11
Erect Masonry/Panels	1/7/11	5/20/11	96	3/28/11	4/8/11	10	86
Seal Joints/Clean	1/27/11	6/3/11	92	4/11/11	5/6/11	20	72
Punch Windows	2/4/11	6/10/11	91	4/18/11	5/13/11	20	71
Aluminum Storefronts	5/13/11	5/17/11	3	4/20/11	4/22/11	3	0
Caulk Exterior of Windows	6/16/11	7/11/11	18	4/20/11	5/13/11	18	0
Caulk Exterior of Doors	6/6/11	6/10/11	5	4/25/11	4/29/11	5	0
Leak Test Windows & Storefronts	7/25/11	7/28/11	4	5/16/11	5/19/11	4	0
Overall	12/23/10	7/28/11	156	1/24/11	5/19/11	84	72

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# **COST IMPACT:**

- ELIMINATED LULL & SCAFFOLDING
- SAVED ON GENERAL CONDITONS
- ORIGINAL ENCLOSURE COST: \$2,490,660
- •
- SAVED \$1,094,129

# PRECAST FAÇADE PANELS



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 ELIMINATED BUDGET FOR FAÇADE WASHES AND CHEMICAL TREATMENT ELIMINATED COSTLY CHANGE ORDER FOR SOFFIT/MASONRY JOINT

PRECAST PANEL SYSTEM COST: \$1,701,897

#### Cost of Precast Panel System

½″OSB Sheathing
Air/Vapor Barrier
2" Rigid Insulation
7" Precast Panels (Material/Delivery/Installation)
Black Finish on Panels
Sandblasting Finish on Panels
Joints
Connections



	Cost/Quantity	Quantity	Cost		
	\$1.09	59,700 SF	\$65,073		
	\$0.33	59,700 SF	\$19,701		
	\$1.84	59,700 SF	\$109,848		
)	\$20/SF	59,700 SF	\$1,194,000		
	\$0.50/SF	13,294 SF	\$6,647		
	\$3.50/LF	1,924 LF	\$6,734		
	\$0.25 LF	5,574 LF	\$1,394		
	\$5.00 SF	59,700 LF	\$298,500		
Total Cost \$1,701,8					



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Time Savings from Use of Precast Panels	
	Duration
Prior to Constructing Building Enclosure	4.5 Weeks
Post Construction of Building Enclosure	10 Weeks
Total Time Saved	14.5 Weeks

#### **RESULTS:**

- SAVED \$1,094,129
- HIGHER LEVEL OF QUALITY
- **REDUCED SITE CONGESTION**
- ALTERED ARCHITECTURAL APPEARANCE

## **RECOMMENDATION:**

# PRECAST FAÇADE PANELS





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 REDUCED ENCLOSURE ACTIVITIES BY 14.5 WEEKS POTENTIAL TO ACCELERATE SCHEDULE BY 10 WEEKS

• DUE TO THE SAVINGS ASSOCIATED WITH THE SCHEDULE AND COST, I WOULD IMPLEMENT THE PRECAST PANEL SYSTEM WITH OWNER APPROVAL OF THE ARCHITECTURAL CHANGE

Cost Savings
CMU Wall Enclosure
CMU Walls
Precast Panel Enclosure
Precast Walls
General Conditions (10 Weeks)
Total Cost Sa



	\$2,490,660
Total	\$2,490,660
	\$1,701,897
	\$305,366
Total	\$1,396,531
vings	\$1,094,129

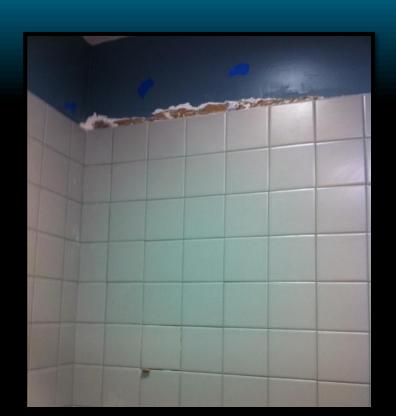


BILLETING BUILDINGS BLACKSTONE, VA

KENDALL MAHAN CONSTRUCTION MANAGEMENT OPTION







**CERAMIC TILE/GWB JOINT** 

#### **PROBLEM:**

- •
- QUALITY OF WORK

  - DOOR HEIGHTS

# **BACKGROUND:**

- 101 SHARED BATHROOMS

# **POTENTIAL SOLUTIONS:**

- UTILIZE OFF-SITE MANUFACTURING FACILITY MODULARIZE ENTIRE BUILDING
- MODULARIZE BATHROOM UNITS KULLMAN BUILDINGS

## MODULARIZED BATHROOM UNITS



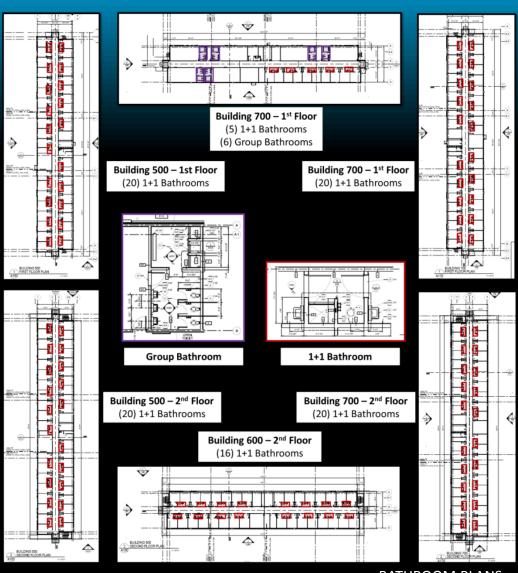


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AMOUNT OF WORK IN BATHROOMS COMPARED TO ROOMS MULTIPLE TRADES WORKING IN CONCENTRATED AREA **CERAMIC TILE/GWB JOINTS** 

BUILDING 600 CONTAINS 5 GROUP BATHROOMS







BATHROOM PLANS

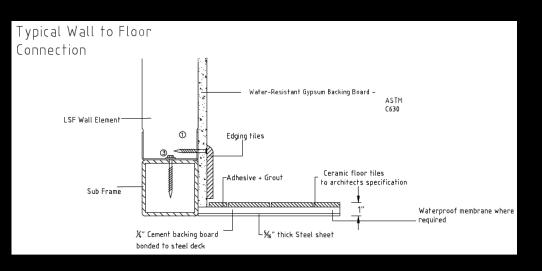


BILLETING BUILDINGS BLACKSTONE, VA

KENDALL MAHAN | CONSTRUCTION MANAGEMENT OPTION







#### **DESIGN:**

- EARLY PLANNING & PROCUREMENT
- •
- EXTENSIVE COORDINATION
- DESIGN-BUILD

# **CONSIDERATIONS:**

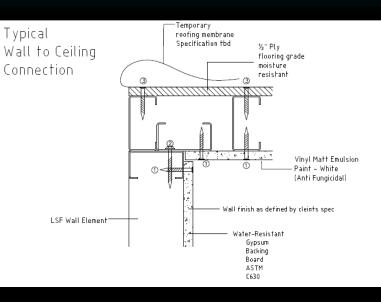
- CONSTRUCTION SCHEDULE
- SHIPPING SIZES
- POD TO STRUCTURE CONNECTIONS
- SLAB DEPRESSIONS
- FLOOR TO FLOOR HEIGHT
- FIRE PENETRATIONS
- CORRIDOR WALL FINISHES

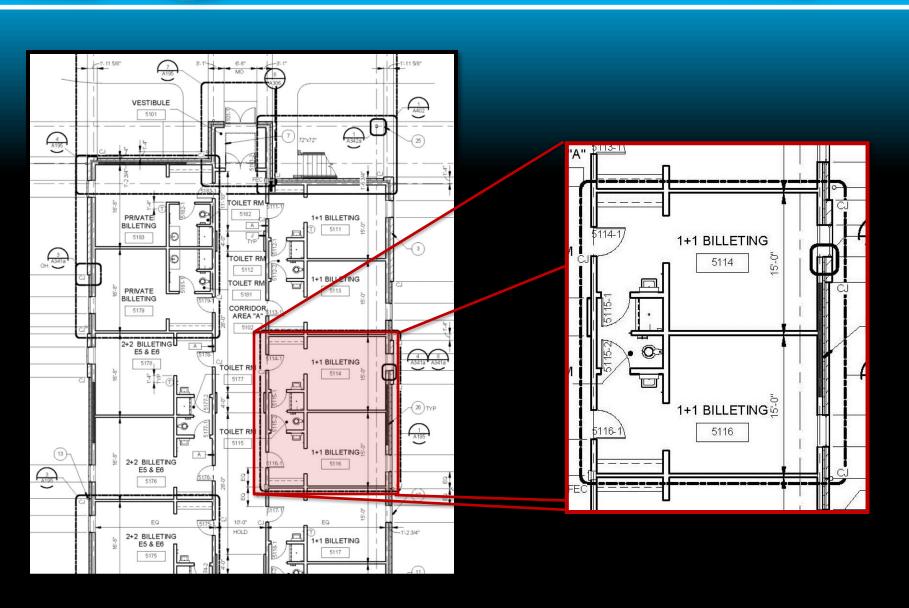
## MODULARIZED BATHROOM UNITS



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MULTIITUDE OF RESPONSIBLE PARTIES











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#### MEP:

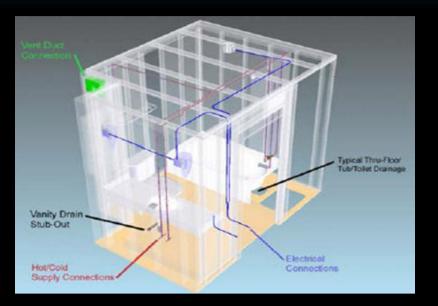
- SINKS LOCATED OUTSIDE OF ROOMS 4 DRAIN CONNECTIONS HOT AND COLD CONNECTIONS LIMITED HVAC WORK COORDINATE CONNECTIONS AND RISERS FACILITATE USING 3D MODELING

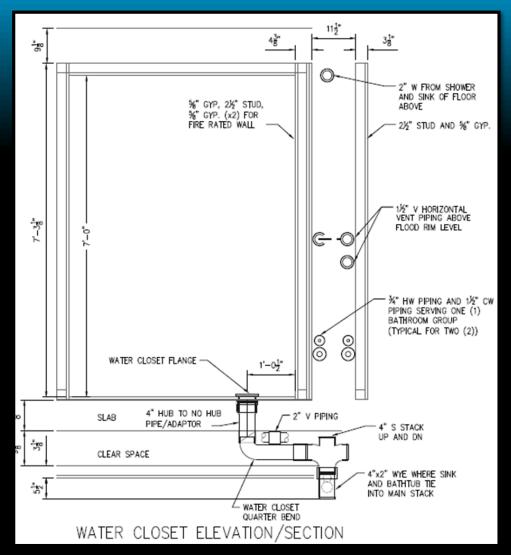
#### MODULARIZED BATHROOM UNITS





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MEP CONNECTIONS





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# **MANUFACTURING:**

- HIGHER PRODUCTIVITY
- **REDUCES WASTE BY 10X**

## **QUALITY CONTROL:**

- BETTER ACCESSBILITY TO WORK
- PEFORM RIGOROUS TESTS BEFORE BEING SHIPPED

## MODULARIZED BATHROOM UNITS





pe of Test	Descrip
ak Testing of Mains Cold Water	A press
stem (Set and Test Pressure gulators)	within t pressure
ak Testing of Domestic Hot ater Supply System (Set and	A presso within t
st Pressure Regulators)	and pre
ak and Functional Testing of	A functi
e Waste Pipes, Traps, etc.	detect f system.
tting of Toilet Level Flushing	A functi recomm
HB overflows	perform A functi
	require
ower Flow Rate Setting	A functi
	require head is
ower Temperature Setting	A functi
	tempera require
nctional Electrical Appliance	A functi
sting	applian
ectrical System Conformity and	A presci
fety Testing	code eq
	continui
	that all:

 SHIFTS WORK FROM FIELD TO CONTROLLED ENVIRONMENT LESS SAFETY AND WEATHER PROBLEMS • 25% CHEAPER LABOR COSTS COMPARED TO FIELD

LEVEL OF QUALITY UNACHIEAVABLE IN THE FIELD



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sure test required to identify any potential leaks the mains cold water supply system, period held and

sure test required identifying any potential leaks the domestic hot water supply system, period held

ional water test to ensure actual drainage and or leaks. Period air test 50mm or 75 mm complete

ional test to ensure that the manufacturers' mendation for cistern flush volumes and nance are met.

onal and visual test in accordance with nents to ensure all overflows functional correctly.

onal and visual test in accordance with ments to ensure that the flow rate of the shower set correctly.

onal test to ensure that the thermostatic ature of the shower is set in accordance with ment. Max temperature if required.

ional test to ensure that all fitted electrical ces work correctly.

ribed test in accordance with IEE Regulations (or uivalent) to ensure safety performance. Insulation, ity, polarity checks, visual and dimensional check service outlets are to drg's, labeled and capped.

#### QUALITY CONTROL TESTS PERFORMED PRIOR TO SHIPMENT

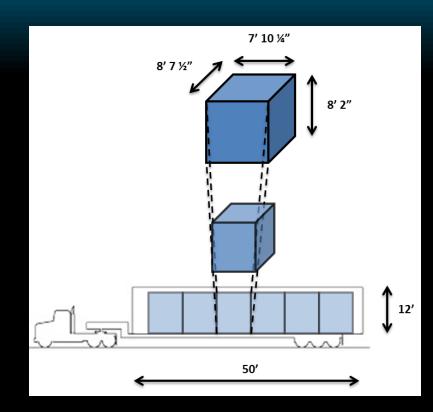




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#### SHIPPING DIAGRAM

#### **DELIVERY:**

- WRAPPED AND WEATHERPROOFED
- COVERED TRUCK

- 17 TRUCKS

# **PLACEMENT:**

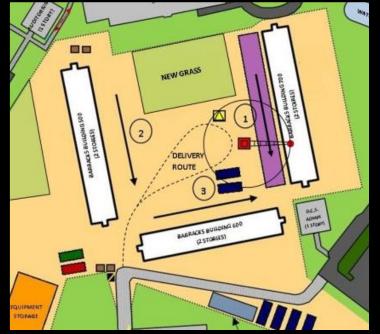
- 25 TON MOBILE TRUCK CRANE
- 2 MAN CREW TO PLACE IN BUILDING
- SET 12 PODS/DAY
- SPECIAL EQUIPMENT TO MOVE PODS

## MODULARIZED BATHROOM UNITS



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#### • 370 MILES FROM KULLMAN'S FACILITY IN LEBANON, NJ PLANNED TO SHIP WITHOUT SPECIAL PERMITTING













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#### **INSTALLATION:**

- MEP TEMPLATE
- PARTITION WALLS AND ROUGH IN •
- MOVE POD INTO PLACE
- CONNECTION TO STRUCTURE
- •

# MODULARIZED BATHROOM UNITS



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 MEP CONNECTIONS – TOP DOWN STRATEGY FRAME INTO BULDING AND FINISH











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# MODULARIZED BATHROOM UNITS

## SCHEDULE IMPACT:

- LITTLE IMPACT TO HVAC WORK

- ALONG THE CRITICAL PATH
- SHORTENED FIT-C

Fit-Out Schedule A Bathrooms Built in Bathroom Pods





 PODS PLACED IN BUILDINGS PRIOR TO PLANK AND TRUSS ERECTIONS POD INSTALLATIONS DO NOT INTERFERE WITH INTERIOR WORK

O	UT	BY	8	W	EE	KS

cceleration									
	Fit-Out Start Date	Fit-Out Finish Date	Duration (Days)						
Field	2/8/11	10/17/11	180						
	2/8/11	8/19/11	139						
		Total	41						

#### Estimated Schodula Poductio

Estimated Schedule Reduction	n			
	Percentage Reduced	Old Duration	New Duration	Days Saved
Cement Board	90%	21	3	18
Ceramic Tile	90%	15	3	12
Plumbing Fixtures	50%	22	11	11
Door Frames	50%	25	13	12
Doors/Hardware	50%	15	8	7
Plumbing Rough-in	50%	25	13	12
Plumbing Piping Installation	50%	25	13	12
Metal Stud Wall Framing	30%	25	18	7
Insulate Walls	30%	11	8	3
Hang Drywall	30%	18	12	6
Finish Drywall	30%	59	42	17
Paint	30%	53	37	16
Electrical Rough-in	30%	52	37	15
Light Fixtures	20%	7	6	1
Power and Lighting Wiring	20%	30	24	6
HVAC Ductwork	5%	43	41	2

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Cost Impact to Bathrooms								
	Cost/Bathroom	Total Cost						
Bathrooms Built in Field								
Labor	\$4,866	\$491,466						
Material	\$8,286	\$836,886						
Total	\$13,152	\$1,328,352						
Bathroom Pods								
Labor (25% Savings)	\$3,650	\$368,650						
Material	\$8,286	\$836,886						
Additional Material	\$1,548	\$156,348						
Total	\$12,628	\$1,361,884						
Total Additional Cost	\$1,216	\$33,532						

### **COST IMPACT:**

- ADDITONAL MA
- CONCRETE DEPR
- SAVED 8 WEEKS
- 25% SAVINGS IN
- 5% SAVINGS FRO
- COST OF BATHRO
- COST OF BATHRO
- SAVED \$213,903

# MODULARIZED BATHROOM UNITS



TERIALS: PARTITION WALL, ¼" STEEL FLOOR PLATE, ¼" CEMENT BOARD
RESSIONS
IN GC COSTS
I LABOR COSTS
OM DELIVERIES
OOMS BUILT IN FIELD: \$1,276,329
OOMS PODS: \$1,062,426
3

Cost Impact of Using Pods	Cost Impact of Using Pods								
	Unadjusted Cost	Adjusted Cost (Time=1.085) (Location=0.849)							
Bathrooms Built in Field									
Cost of Construction	\$1,328,352	\$1,223,631							
Lull	\$42,800	\$39,426							
Deliveries	\$13,272	\$13,272							
	Total	\$1,276,329							
Bathroom Pods									
Cost of Construction	\$1,361,884	\$1,254,520							
Concrete Depressions	\$16,877	\$15,547							
Crane	\$17,875	\$16,466							
Pod Install Crew	\$9,306	\$8,572							
Deliveries	\$12,608	\$11,614							
General Condition Savings	\$265,200	\$244,293							
	\$1,062,426								
	Total Cost Savings	\$213,903							

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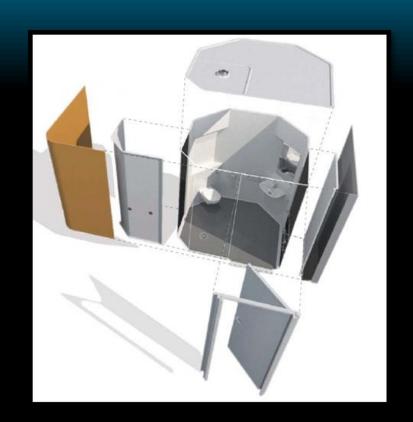




KENDALL MAHAN | CONSTRUCTION MANAGEMENT OPTION







#### **RESULTS:**

- SAVED \$213,903
- HIGHER LEVEL OF QUALITY
- LESS WORKERS ON SITE

## **RECOMMENDATIONS:**

AND SCHEDULE BENEFITS

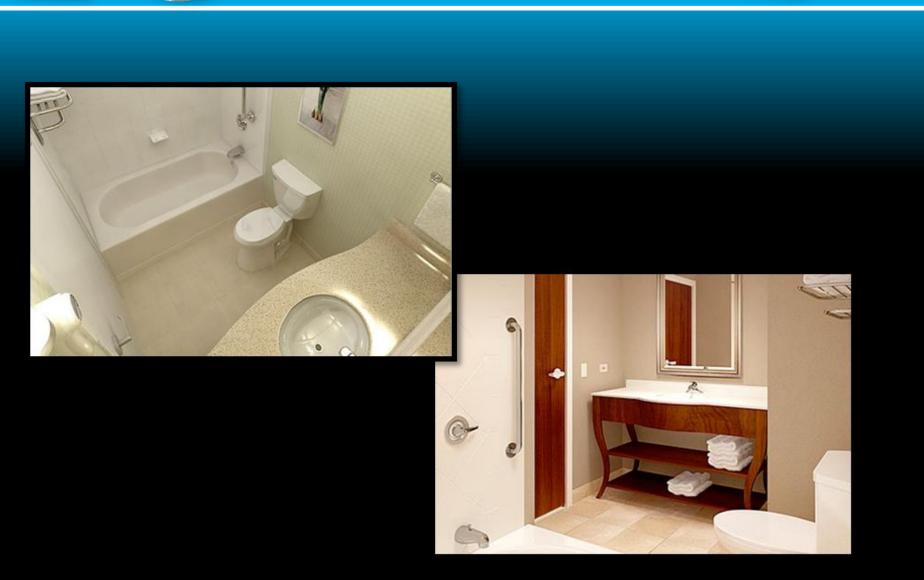
# MODULARIZED BATHROOM UNITS



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ACCELERATED FIT-OUT SCHEDULE BY 8 WEEKS

• UTILIZE BATHROOM PODS ON THE REGIONAL TRAINING INSTITUTE DUE TO QUALITY, COST,









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# **ANALYSIS #1: MATERIAL TRACKING TECHNOLOGY**

- ONE TIME COST
- - BATHROOM PODS
  - PRECAST PANELS
  - SIPS
- ALLEVIATES POTENTIAL RISKS

#### **ANALYSIS #2: SIPS**

- ACCELERATED SCHEDULE BY 11 DAYS
- SAVED \$117,524

# CONCLUSION



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COST \$9,300 TO IMPLEMENT SYSTEM

# CAN BE APPLIED TO VARIOUS OTHER BUILDING COMPONENTS:

 SAVINGS PRIMARILY ATTRIBUTED TO RESEQUENCING OF WORK MINIMIZES RISKS ASSOCIATED WITH CRITICAL PATH

# **ANALYSIS #3: PRECAST FAÇADE PANELS**

- ACCELERATED ENCLOSURE SCHEDULE BY 10 WEEKS
- SAVED \$1,094,129
- REDUCED SITE CONGESTION
- POTENTIAL TO SAVE BY REDUCING FLOOR TO FLOOR HEIGHTS
- ALTERED THE ARCHITECTURAL APPEARANCE
- SHOULD BE INVESTIGATED FOR STRUCTURAL IMPLICATIONS
  - LATERAL LOADS

# **ANALYSIS #4: MODULARIZED BATHROOM UNITS**

- ACCELERATED FIT-OUT SCHEDULE BY 8 WEEKS
- SAVED \$213,903
- DELIVERS A HIGHER QUALITY PRODUCT
- SHOULD BE INVESTIGATED FOR STRUCTURAL IMPLICATIONS
  - SLABS, LOAD BEARING WALLS





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# TOTAL SCHEDULE SAVINGS – 2 WEEKS

TOTAL COST SAVINGS - \$1,416,256

**MINIMIZED RISK** 

**IMPROVED QUALITY** 





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# ACADEMIC ACKNOWLEDGMENTS:

- PENN STATE AE FACULTY
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- PROFESSOR FAUST THESIS ADVISOR
- DR. LEICHT

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- BARTON MALOW
- US ARMY CORPS OF ENGINEERS
- VIRGINIA ARMY NATIONAL GUARD
- DAVIS CONSTRUCTION
- NITTERHOUSE CONCRETE PRODUCTS
- VELA SYSTEMS
- HENSEL PHELPS
- KULLMAN

# ACKNOWLEDGEMENTS



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- BRIAN CLARKE
- FRIENDS AND FAMILY







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# QUESTIONS?





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General Conditions	Estimate												
Code	ltem	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P	Quantity	Project Total	Project Total Incl O&P
Divison 01- General Re													
01 31 13.30 0020	Insurance - Builders Risk, Standard, Minimum				Job					0.24%	28177099.98	•	• • • • • • • • • • • • • • • • • • • •
01 31 13.30 0250	Insurance - General Liability, Maximum				Job					0.62%	28177099.98		
01 31 13.90 0020	Performance Bond - For Buildings, Minimum				Job					0.60%	28177099.98		
01 32 13.50 0650	Scheduling - Rule of Thumb, CPM Scheduling, Large Job (\$50M)				Job					0.05%	28177099.98	•	
01 32 33.50 0500	Photographs - Aerial Phots, Initial Fly-over, 6 Shots, 1 Print Ea., 8" x 10"				Set	845			845	925	11		
01 41 26.50 0020	Permits - Most Cities, Minimum				Job					0.05%	28177099.98	•	* ***
01 45 23.50 0050	Testing and Inspecting Services - For Steel Building Maximum				Job				4725	5200	1		
01 31 13.20 0100	Field Personnel - Field Engineer				Week		975		975	1500	90		•
01 31 13.20 0120	Field Personnel - Project Engineer				Week		1265		1265	1950	90		
01 31 13.20 0200	Field Personnel - Project Manager				Week		2075		2075	3175	90		
01 31 13.20 0220	Field Personnel - Project Administrator				Week		2375		2375	3650	90	\$ 213,750.00	\$ 328,500.00
01 31 13.20 0100	Field Personnel - Quality Control Manager				Week		975		975	1500	90	\$ 87,750.00	\$ 135,000.00
01 31 13.20 0240	Field Personnel - Assistant Superintendent				Week		1750		1750	2675	90	\$ 157,500.00	\$ 240,750.00
01 31 13.20 0280	Field Personnel - Senior Superintendent				Week		2200		2200	3375	90	\$ 198,000.00	\$ 303,750.00
01 31 13.20 0100	Field Personnel - Intern				Week		975		975	1500	12	\$ 11,700.00	\$ 18,000.00
01 51 13.80 0600	Temporary Utilities - Power for Job Duration Incl. Elevator, Etc., Minimum				CSF Fir				47	51.5	164	\$ 7,708.00	\$ 8,446.00
01 51 13.80 0700	Temporary Utilities - Temporary Construction Water Bill per Month				Month	62			62	68	11	\$ 682.00	\$ 748.00
01 51 33.40 6410	Temporary Utilities - Rent Toilet Portable Chemical				Ea.	0.11	18.65	56	168	180.1	360	\$ 60,480.00	\$ 64,836.00
01 52 13.20 0550	Office and Storage Space - Trailer, Furnished, No Hookups, 50' x 12' Rent per Month				Ea.	360			360	395	10.5	\$ 3,780.00	\$ 4,147,50
01 52 13.20 0700	Office and Storage Space - Add Air Conditioning, Rent per Month, Add				Ea.	41.5			41.5	45.5	10.5	\$ 435.75	\$ 477.75
01 52 13.20 0800	Office and Storage Space - Add Delivery, Add per Mile				Mile	4.6			4.6	5.05	75	\$ 345.00	\$ 378.75
01 52 13.20 1350	Office and Storage Space - Storage Boxes, 20' x 8', Rent per Month				Ea.	71.5			71.5	78.5	10.5	\$ 750.75	\$ 824.25
01 52 13.40 0120	Field Office Equipment Rental Average				Month	200			200	220	10.5	\$ 2.100.00	\$ 2,310.00
01 52 13.40 0120	Field Office Expense - Office Supplies, Average				Month	86			86	94.5	10.5	\$ 903.00	\$ 992.25
01 52 13.40 0140	Field Office Expense - Telephone Bill, Incl. Long Distance				Month	81			81	89	10.5	\$ 850.50	\$ 934.50
01 52 13.40 0160	Field Office Expense - Lights & HVAC				Month	152			152	167	10.5	\$ 1.596.00	\$ 1.753.50
01 54 09.60 6220	Protective Equipment - Safety Supplies and First Aid Kits				Month	24.5			24.5	27	90		
01 56 13.90 0250	Winter Protection - Tarpaulin Polyester Reinf, w/ Integral Fastening System 11 Mils Thick	2 Clab	1600	0.01	SF	0.8	0.34		1.14	1.41	25000		
01 55 23 50 0050	Roads and Sidewalks - Roads, Gravel Fill, No Surfacing, 4" Gravel Depth	B-14	715		SY	4	2.43	0.45	6.88	8.6	1700		
01 56 23.10 1300	Barricades - Stock Units, 6' High, 8' Wide, Plain, Buy				Ea.	435			435	480	10		
01 56 23.10 1300	Barricades - Barricade Tape, Polyethylene, 7 mil, 3" Wide x 500' Long Roll				Ea.	25			25	27.5	20		
01 56 26.50 0250	Temporary Fencing - Rented Chain Link, 6' High, Over 1000' (Up to 12 mo.)	2 Clab	300	0.053	LF	3.29	1.83		5.12	6.45	2440		•
01 58 13.50 0020	Signs - High Intensity Reflectorized, No Posts, Buy	2 0120	500	0.055	SF	26.5	1.05		26.5	29.5	200		
01 71 23.13 1400	Construction Lavout - Crew for Roadway Lavout, 4 Person Crew	A-8	1	32	Dav	20.5	1475	70	1545	2300	20		
01 74 13.20 0020	Cleaning Up - After Job Completion, Allow, Minimum	~~			Job		14/3		1.545	0.30%	28177099.98		•
01 74 13.20 0050	Cleaning Up - Cleanup of Floor Area, Continuous, Per Day, During Construction	A-5	24	0.75	MSF	17	25.5	1.87	26.07	38.93	11640		
01 91 13.50 0100	Building Commissioning - Basic Building Commissioning, Minimum	×-3	24	. 0.75	%	1.7	23.3	1.67	20.07	0.25%	28177099.98		
01 91 13.30 0100	beneng commissioning - basic beneng commissioning, winning				~					0.25%	Total	•	
Divison 02- Existing Co	nditions										Total	2,350,055.00	2,050,443.31
02 21 13.09 0020	Topographical Surveying - Convential, Minimum	A-7	3.3	7.273	Acre	18.2	340	21	379.2	565.00	10	\$ 3,792.00	\$ 5,650.00
02 21 13:39 0020	Boundary and Survey Markers - Lot Location and Lines, Large Quantities, Average	A-7	1.25		Acre	51.5	900	55.5		1500.00	10		
02 21 13.13 0600	Boundary and Survey Markers - Monuments	A-7	10		Ea.	30.5	113		150.45	212.00	3		
02 21 13.13 0800	Boundary and Survey Markers - Monuments Boundary and Survey Markers - Property Lines, Perimeter, Cleared Land	A-7	1000		LF	0.03	1.13	0.95	1.23	1.82	2440		
02 32 13.10 0020	Borines and Exploratory Drilline - Borines, Initial Field Stake Out & Determination of Elevations	A-6	1000		Dav	0.05	690	69.5		1125.00	2440		
02 32 13.10 0020	Borings and Exploratory Drilling - Drawings Shoing Boring Details	A-0		10	Total		300	03.5	300	375.00	2		
02 32 13.10 0200	Borings and Exploratory Drilling - Report and Recommendations for P.E.				Total		700		700	875.00	2		+
02 32 13.10 0200	Borings and Exploratory Uniling - Report and Recommendations for P.E. Borings and Exploratory Drilling - Mobilization and Demobilization, Minimum	B-55	4		Total		204	231	435	565.00	2		+
02 32 13.10 0300	Borings and Exploratory Uniling - Mobilization and Demobilization, Minimum Borings and Exploratory Drilling - Borings, Earth, Drill Rig and Crew with Truck Mounted Auger	B-55		24	Day		815	925	1740	2275.00	2		
02 52 13:10 1400		0-00	1	24	Week	525	812	925	525	578.00	90	• • • • • • • • • • • • • • • • • • • •	
02 41 19.23 0700	Rubbish Handling - Dumpster, Weekly Rental, 1 Dump/Week, 40 C.Y. Capacity (13 Tons)				week	525			525	578.00			
											Total	\$ 71,674.05	\$ 87,051.80

Project Total \$ 1,621,773.65 \$ 2,983,495.31

# APPENDICES – GENERAL INFO



BARTON MALOW

#### DETAILED GC ESTIMATE

U.S. ARMY CORPS OF ENGINEERS VIRGINIA ARMY NATIONAL GUARD





BILLETING BUILDINGS BLACKSTONE, VA

KENDALL MAHAN CONSTRUCTION MANAGEMENT OPTION

#### **REBAR TAKEOFFS**

Rebar (03 21 10.60	0400) Elevated Slab	s #5		
	Bar Length (LF)	Quantity (Ea.)	Total (LF)	Weight (Ton)
Building 500/700	20	108	2160.00	1.13
	18.17	1	18.17	0.01
	12.08	4	48.32	0.03
	11.66	1	11.66	0.01
	11.33	4	45.32	0.02
	7.33	4	29.32	0.02
	6.00	171	1026.00	0.54
	0.66	184	121.44	0.06
			Total	1.80
Building 600	20.00	96	1920.00	1.00
	14.42	2	28.84	0.02
	14.00	1	14.00	0.01
	11.33	4	45.32	0.02
	7.33	4	29.32	0.02
	6.33	2	12.66	0.01
	6.00	151	906.00	0.47
	0.66	162	106.92	0.06
			Total	1.60

#### Hollow-C

Crane Mo Crane Der Set Planks Set Planks Install Re Install Re

## APPENDICES - SIPS





BARTON MALOW U.S. ARMY CORPS OF ENGINEERS VIRGINIA ARMY NATIONAL GUARD

#### DURATIONS

Core Plank Activity Dura	tions		
·	Quantity	Daily Output	Days
obilization	1.11 Ea.	7.20 Ea.	0.14
emobilization	1.11 Ea.	7.20 Ea.	0.14
ks & Grout (500/700)	20,455 SF	3,200 SF	6.39
ks & Grout (600)	17,977	3,200 SF	5.62
ebar (500/700)	1.80 Ton	1.45 Ton	1.24
ebar (600)	1.60 Ton	1.45 Ton	1.10

	Activity	Days Needed	Days Given	Buffer
Building 700 (N/S)	Mobilize Crane	0.14*	0	0.86*
	Set Planks	2.13	2	-0.13
	Demobilize Crane	0.14*	0	0.86*
	Install Rebar	1.24	2	0.76
	Grout	1.07	2	0.93
		4.44	6	0.56
Building 500 (N/S)	Mobilize Crane	0.14*	0	0.86*
	Set Planks	2.13	2	-0.13
	Demobilize Crane	0.14*	0	0.86*
	Install Rebar	1.24	2	0.76
	Grout	1.07	2	0.93
		4.44	6	0.56
Building 600 (W/E)	Mobilize Crane	0.14*	0	0.86*
	Set Planks	1.87	2	-0.13
	Demobilize Crane	0.14×	0	0.86*
	Install Rebar	1.10	2	0.76
	Grout	0.94	2	0.93
		3.91	6	2.09

		S	hort Inte	erval Pre	oductio	n Sched	lule				
			1	Week of 1	1/15 - 11,	/19					
			Sub	xontrac to	r: Gate P	recast					
			Actà	vities: Hol	low Core	Planks					
Activity	Mo	nday	Tue	eday	Wede	iesday	Thu	rsday	Fri	iday	Total Man Hours
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	I Gall Mail Real
Coordination Meeting					2	2					15
Layout - 700 North					2						8
Layout - 700 South						2					4
Set Up Batch Plant					2	2					26
Mobilize Crane - 700 North							1				4
Set Planks - 700 North							5	6	6	4	84
Demobilize Crane - 700 North										1	4
Cleanup										1	4
Manpower Totals	0	0	0	0	6	6	6	6	6	6	140
Equipment Totals (Crane Hrs)	0	0	0	0	0	0	4	4	4	4	16



# SIPS – WEEK 1



BILLETING BUILDINGS BLACKSTONE, VA

KENDALL MAHAN | CONSTRUCTION MANAGEMENT OPTION

# SIPS – WEEK 2

		S	hort Inte	erval Pro	duction	n Sched	ule				
			١	Neek of 1	1/22 - 11/	26					
			Sub	contracto	e: Gate Pr	recast					
			Activ	rities: Hol	low Core I	Planks					
A settinger	Mor	iday		sday		vesday	Thu	eday	87	day	Total Man Hours
Activity	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	Foat Man Pours
Install Rebar - 700 North	2	2	2	2							22
Grout - 700 North	2	2	2	2							22
Mobilize Crane - 700 South	1							_			4
Set Planks - 700 South	5	6	6	wh							8
Demobilize Crane - 700 South				1				-			4
Layout - 500 North			2					5			8
Layout - 500 South				2				Ξ.			8
Install Rebar - 700 South					2	1		Thanksgrong Holday			12
Grout - 700 South					2	1		2			12
Mobilize Crane - 500 North					1			-			4
Set Planks - 500 North					5	6					44
Cleanup						2					8
Manpower Totals	10	10	12	12	10	10	0	0	0	0	256
Equipment Totals (Crane Hrs)	4	4	4	4	4	4	0	0	0	0	24

Activity	
Install Rebar - 700 South	
Grout - 700 South	
Sat Planks - 500 North	
Demobilize Crane - 500 Nort	h
Grout - 500 North	
Install Rebar - 500 North	
Mobilize Crane - 500 South	
Sat Planks - 500 South	
Demobilize Grane - 500 Sout	h
Layout - 600 East	
Layout - 600 West	
Install Rebar - 500 South	
Grout - 500 South	
Mobilize Crane - 600 West	
Set Planks - 600 West	
Demobilize Crane - 600 West	
Cleanup	
Manpower Totals	
Equipment Totals (Crane Hrs	

## APPENDICES - SIPS

#### SIPS - WEEK 3

	Short Interval Production Schedule										
			Week of 1	1/29 - 12	/3						
	Subcontractor: Gate Precast										
		Activ	rities: Holi	low Core I	Planks						
Mor	nday	Tue	iday	Wedr	wsday 👘		sday	Pri-	áay 👘	Total Man Hours	
AM	PM	AM	PM	AM	PM	AM	PM	AM	PM		
2	2									15	
2	2									16	
6	5									41	
	1									4	
		2	2	2	2					22	
		2	2	2	2					22	
		1								4	
		5	6	6	5					88	
					1					4	
				2						8	
					2					8	
						2	2	2	1	28	
						2	2	2	1	28	
						1				4	
						ม	6	6	w	8	
									1	4	
									2	8	
10	10	10	10	12	12	10	10	10	12	416	
4	4	4	4	4	4	4	4	4	4	40	

Short Interval Production Schedule											
	Week of 12/6 - 12/10										
				contracto							
			Activ	vities: Holl	low Core I	Planks					
Activity	Mor	nday		sday		iesday	Thur	sday		day	Total Man Hours
in Section 1	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	1945. Intell Province
Install Rebar - 600 West	2	2	2	2							32
Grout - 600 West	2	2	2	2							32
Mobilize Crane - 600 East	1										4
Set Planks - 600East	5	6	6	5							8
Demobilize Crane - 600 Bast				1							4
install Rebar - 600 East					2	2	2	2			32
Grout - 600 East					2	2	2	2			32
Cleanup		Ē'			<u>['</u>	<u>['</u>		<u>['</u>	4	3	28
Inspection by USACE					<u> </u>	<u>['</u>				1	4
Manpower Totals	10	10	30	10	4	4	4	4	4	4	255
Equipment Totals (Crane His)	4	4	4	4	0	0	0	0	0	0	16





BARTON MALOW U.S. ARMY CORPS OF ENGINEERS VIRGINIA ARMY NATIONAL GUARD



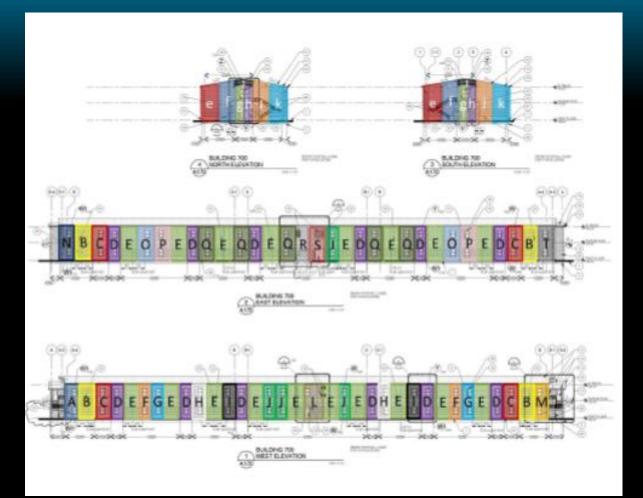
# SIPS – WEEK 4

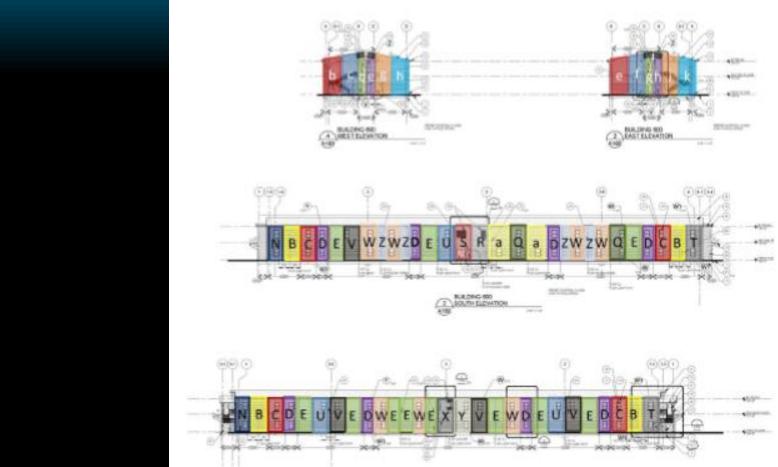


BILLETING BUILDINGS BLACKSTONE, VA

KENDALL MAHAN | CONSTRUCTION MANAGEMENT OPTION

#### PANEL DESIGNATIONS BUILDING 500







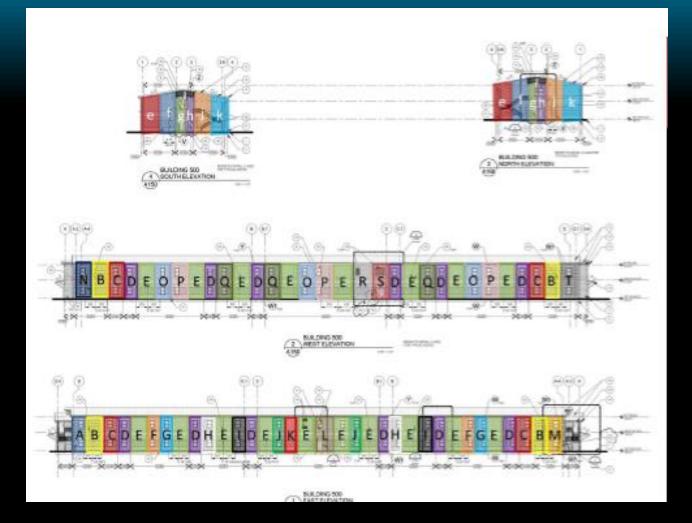
# APPENDICES - PRECAST PANELS



BARTON MALOW U.S. ARMY CORPS OF ENGINEERS VIRGINIA ARMY NATIONAL GUARD

#### PANEL DESIGNATIONS BUILDING 600

# PANEL DESIGNATIONS BUILDING 700





BILLETING BUILDINGS BLACKSTONE, VA

KENDALL MAHAN | CONSTRUCTION MANAGEMENT OPTION

## PANEL TAKEOFFS

Panel Type	Description	Width (FT)	Height (FT)	Acres (SF)	Weight/Panel (LBS)	Quantity	Total Width (FT)	Total Height (FT)	Total Area (SF)	Total Weight (LBS)
A	Bump Out, Window (1,2), Black	6.66	24.33	210.70	18541.41	2	17.32	48.65	421.40	17082.8
8	Bump Out, Window (1,2), Black	12.00	24.33	291.96	25692.48	12	144.00	291.96	3503.52	306309.7
c	Window (1,2)	11.66	24.33	283.69	24964.53	12	139.92	291.96	3404.25	299574.3
D	Bump Out, Window (1,2), Black	8.66	24.33	210.70	18541.41	32	277.12	778.56	6742.33	590325.0
2	None	12.00	24.33	291.96	25692.48	43	564.00	1143.51	13722.12	1207546.5
F	Window (1,2)	6.66	24.33	210.70	18541.41	4	34.64	97.32	\$42.79	74165.6
G	Window (1,2)	8.66	24.33	210.70	18541.41	4	34.64	97.32	842.79	74165.6
H	Window (1,2)	9.66	24.33	235.03	20682.45	4	38.64	97.32	940.11	82729.7
l	Window (1,2)	9.66	24.33	235.03	20682.45	4	38.64	97.32	940.11	82729.7
	Windows (1,2)	7.33	24.33	178.34	15693.82	6	43.98	145.96	1070.03	94162.9
ĸ	None	6.60	24.33	210.70	18541.41	1	8.65	24.33	210.70	18541.4
L	Door, Window (2)	12.00	24.33	291.96	25692.48	2	24.00	48.66	583.92	\$1384.9
м	Bump Out, Windows (1,2), Black	8.66	24.33	210.70	18541.41	2	17.32	48.66	421.40	17082.8
N	Bump Out, Window (1,2), Black	11.33	24.33	275.66	24257.98	4	45.32	97.32	1102.64	97031.9
0	Window (1,2)	12.00	24.33	291.95	25692.48	5	60.00	121.68	1459.80	126462.4
P	Windows (1,2)	12.00	24.33	291.96	25692.48	5	60.00	121.68	1459.80	126462.4
Q	Window (1,2)	12.00	24.33	291.96	25692.48	10	120.00	243.30	2919.60	256924.8
R	Louver	12.00	24.33	291.96	25692.48	3	36.00	72.99	875.88	77077.4
\$	Door, Louver	12.00	24.33	291.96	25692.48	3	36.00	72.99	475.84	77077.4
т	Window (1,2), Black	11.33	24.33	275.66	24257.98	4	45.32	97.32	1102.64	97031.9
U .	Window (2)	12.00	24.33	291.96	25692.48	3	36.00	72.99	875.88	77077.4
V.	Window (2)	12.00	24.33	291.96	25692.48	- 4	48.00	97.32	1167.84	102769.9
W	Window (2)	12.00	24.33	291.96	25692.48	7	64.00	170.31	2043.72	179847.3
x	Door, Window (2)	12.00	24.33	291.96	25692.48	1	12.00	24.33	291.96	25692.4
Y	Window (2)	12.00	24.33	291.96	25692.48	1	12.00	24.33	291.96	25692.4
z	None	7.33	24.33	178.34	15693.82	4	29.32	97.32	713.36	62775.2
	Windows (1)	12.00	24.33	291.96	25692.48	2	24.00	48.65	563.92	\$1384.9
ь	None	12.00	26.33	315.96	27804.48	6	72.00	157.96	1895.76	366826.8
c	None	12.00	28.33	339.95	29916.48	6	72.00	169.96	2039.76	179496.8
d	Door, Window (2)	6.33	25.33	160.34	14009.82	6	37.95	151.96	962.03	84658.9
e	Door, Window (2)	6.33	25.33	160.34	14109.82	6	37.98	151.96	962.03	\$4658.9
f	None	12.66	4.66	59.00	5191.61	6	75.96	27.96	353.97	31149.6
Ē	None	12.00	28.33	139.95	29916.48	6	72.00	169.96	2039.76	179496.8
h	None	12.00	28.33	139.95	29916.48	6	72.00	169.96	2009.76	179496.8
					Totala	230	2470.76	5573.66	59703.42	5,253,900.7

'	Task Name	Duration	Start	Finish	Sep	2nd Ouerter Apr	No		3rd Quarter Jun	Jan	4th Ouart Aug	ler -
1	Phase II	662 days	Sat 2/27/10	Mon 9/10/12			1 1405	· 1	an an	***		
2	Construction - Building 700	352 days		Thu 12/29/11					Construction - Building 700	,		
3	Building 700 - Core & Shell	250 days	Wed 8/25/10	Wed 8/10/11					Building 700 - Core & Shell			
4	Prepare Building Pad	5 days	Wed 8/25/10	Tue 8/31/10			Prepare Building Pad					
5	U/G Work	10 days	Wed 9/1/10				<ul> <li>U/G Work</li> </ul>					
6	Foundations	15 days	Mon 9/13/10	Fri 10/1/10			Foundations					
7	Backfill Foundations/Re-Grade	5 days	Mon 10/4/10	Fri 10/8/10			Backfill Foundations/	Re-Grade				
8	Slab on Grade	23 days	Mon 10/11/10	Wed 11/10/10			Slab on Grade					
9	Erect Structural Steel Level 1	6 days	Wed 11/3/10	Wed 11/10/10			<ul> <li>Erect Structural</li> </ul>	Steel Level 1				
10	Load Bearing Stud Walls Level 1	66 days	Mon 11/8/10	Mon 2/7/11			L L	oad Bearing Stud Wa	Is Level 1			
11	Hollow Core Floor System North	3 days	Wed 12/8/10	Fri 12/10/10			Hollow Cor	e Floor System North				
12	Topping Edge Forms	3 days	Tue 12/14/10	Thu 12/16/10			Topping 5	dge Forms				
13	Hollow Core Floor System South	3 days	Tue 12/14/10	Thu 12/16/10			Hollow Co	re Floor System Sout	h			
14	MEP Hollow Core R/I's	10 days	Mon 12/20/10	Fri 12/31/10			<ul> <li>MEP Ho</li> </ul>	llow Core R/I's				
15	Exterior Sheathing North El	5 days	Thu 12/23/10	Wed 12/29/10			<ul> <li>Exterior</li> </ul>	Sheathing North El				
16	Wall Vapor Barrier/Insulation North El	5 days	Mon 1/3/11	Fri 1/7/11				apor Barrier/Insulati	on North El			
17	Masonry Splitface North El	10 days	Fri 1/7/11	Thu 1/20/11			- Mas	onry Splitface North	8			
18	Prep/Pour Topping Slab	4 days	Mon 1/10/11	Thu 1/13/11			Prep/	Pour Topping Slab				
19	Erect Structural Steel Level 2	10 days	Mon 1/17/11	Fri 1/28/11			Ere	ct Structural Steel Le	vel 2			
20	Load Bearing Stud Walls Level 2	35 days	Mon 1/17/11	Fri 3/4/11				Load Bearing Stud	Walls Level 2			
21	Clean Brick North El	5 days	Thu 1/27/11	Wed 2/2/11			Ci	ean Brick North El				
22	Set and Pour Stairs	8 days	Thu 1/27/11	Mon 2/7/11			S	et and Pour Stairs				
23	Roof Trusses	11 days	Fri 2/4/11	Fri 2/18/11				Roof Trusses				
24	Punch Windows North El	2 days	Fri 2/4/11	Mon 2/7/11			ΞP	unch Windows North	E1			
25	Exterior Sheathing East El	5 days	Tue 2/8/11	Mon 2/14/11				Exterior Sheathing Ea	st El			
26	Structure Complete	0 days	Fri 2/18/11	Fri 2/18/11			•	Structure Complete				
27	Exterior Sheathing South El	5 days	Fri 2/18/11	Thu 2/24/11				Exterior Sheathing:	outh El			
28	Wall Vapor Barrier/Insulation East El	10 days	Fri 2/18/11	Thu 3/3/11				Wall Vapor Barrier	/Insulation East El			
29	Install SIPS Panels	26 days	Tue 2/22/11	Tue 3/29/11				Install SIPS Pa	nels			
30	Exterior Sheathing West El	5 days		Mon 3/7/11				Exterior Sheathing	West El			
31	Masonry Splitface East El	15 days	Thu 3/10/11	Wed 3/30/11				Masonry Split	ace East El			
32	Wall Vapor Barrier/Insulation South El	5 days	Thu 3/10/11	Wed 3/16/11				Wall Vapor Barr	er/insulation South El			
33	Wall Vapor Barrier/Insulation West El	10 days		Thu 3/31/11				<ul> <li>Wall Vapor Ba</li> </ul>	mier/Insulation West El			
34	Roof Insulation/Ice Shield	33 days	Thu 3/31/11	Mon 5/16/11				Roof Is	sulation/ice Shield			
35	Clean Brick East El	3 days	Fri 4/8/11	Tue 4/12/11				Clean Brick	Last El			
36	Masonry Splitface South El	10 days	Fri 4/8/11	Thu 4/21/11				<ul> <li>Masonry 5</li> </ul>	plitface South El			
37	Punch Windows East El	5 days		Thu 4/21/11				Punch Win				
38	Clean Brick South El	5 days	Mon 5/2/11					Clean Br	ick South El			
39	Masonry Splitface West El	15 days	Mon 5/2/11					Maso	nry Splitface West El			
40	Aluminum Storefronts	3 days		Tue 5/17/11					sum Storefronts			
41	Punch Windows South El	2 days		Mon 5/16/11				Punch	Windows South El			
42	Metal Boofing	40 days	Wed 5/18/11						Metal Roofing			
43	Clean Brick West El	3 days	Wed 6/1/11					I Cla	in Brick West El			
44	Caulk Exterior Block/Door Frames	5 days	Mon 6/6/11					<b>T</b> Ca	ulk Exterior Block/Door Frames			
45	Punch Windows West El	5 days	Mon 6/6/11					<b>T</b> Pu	nch Windows West El			
46	Caulk Windows/Exterior	18 days	Thu 6/16/11						Caulk Windows/Exterior			
47	Fascia/Trim/Soffit /Gutters/Downspouts	28 days	Fri 6/3/11	Tue 7/12/11					Fescia/Trim/Soffit /Gutters/Do	wnspouts		
48	Exterior Canopies	8 days		Tue 7/12/11					Exterior Canopies			
49	Leak Test Windows & Storefronts	4 days	Mon 7/25/11						Leak Test Windows & Storef	ronts		
50	Exterior Complete	0 days		Wed 8/10/11					Exterior Complete			
iort Die	ckett Regional Training Institute					Page 1						endell Maher
	Ione, VA					Lugar v						



# APPENDICES – PRECAST PANELS



BARTON MALOW U.S. ARMY CORPS OF ENGINEERS VIRGINIA ARMY NATIONAL GUARD

#### **CURRENT ENCLOSURE SCHEDULE**

_												
10 Y	Task Name	Duration	Start	Finish	-	2nd Quarter			3rd Quarter			4th Quarter
1	Phase II	662 days	Sat 2/27/10	Mon 9/10/12	Sep	Apr	Nov		Jun	Phase =	Jèn	Aug
	Construction - Building 700	352 days		Mon 9/10/12 D Thu 12/29/11					Construction-B	<b>11110</b> 700	7	í - '
3	Building 700 - Core & Shell	250 days		0 Wed 8/10/11		1			Building 700 - Core		1	1
4	Prepare Building Pad	5 days		0 Tue 8/31/10	1 '		Prepare Building Pad			/	1	1 1
5				Tue 9/14/10	4 '		U/6 Work				1	1
6	U/G Work Foundations	10 days			4 '		Foundations				1	1
7		15 days 5 days	Mon 9/13/10 Mon 10/4/10		4	1	Backfill Foundations/Re	Ba-Grade			1	1
8	Slab on Grade	23 days		0 Wed 11/10/10	i i	1	Slab on Grade	AP-GEBGE			1	1
9	Erect Structural Steel Level 1	6 days		Wed 11/10/10 Wed 11/10/10	-	1	Erect Structural St	Steel Level 1			1	1
10		66 days		Mon 2/7/11	4 '	1	-	ad Bearing Stud	ad Walls Level 1		1	1
10		3 days		Mon 2/7/11 Fri 12/10/10	1 '	1		e Floor System N			,	1
12		3 days		0 Thu 12/16/10	.f. '	1	Topping Edg		Autor.		,	1
13		3 days		0 Thu 12/16/10 0 Thu 12/16/10		1		re Floor System :	e fouib		1	1 1
14		10 days		0 Fri 12/31/10	1	1		How Core R/I's			1	1 1
14	MEP Hollow Core R/I's Prep/Pour Topping Slab	4 days		Thu 1/13/11	1 '	1	_	Pour Topping Sia			1	1
15					4 '	1		ct Structural Stee			1	1
10		10 days	Mon 1/17/11 Mon 1/17/11		· · · · · · · · · · · · · · · · · · ·	1			ng Stud Walls Level 2		1	1
15		40 days	Mon 1/17/11 Mon 1/24/11		<b>/</b> '	1		erior Sheathing N			1	1
10	annon annon ann an a	5 days 8 days	Mon 1/24/11 Thu 1/27/11		1 '	1	-	et and Pour Stairs			1	1
20		5 days	Mon 1/31/11		· · · · · · · · · · · · · · · · · · ·	1			er/Insulation North El		,	1
20		5 days 11 days		Fri 2/18/11	4 '	1		as vapor barrier, Roof Trusses	/mumon maran -		1	1
21					· · · · · · · · · · · · · · · · · · ·	1		xterior Sheathing	(or Fast FI		1	1
22		5 days	Mon 2/7/11 Mon 2/14/11		<b>/</b> '	1			arrier/Insulation East El		1	1
25		10 days	Mon 2/14/11 Ed 2/18/11		4 '	1	_	Structure Compl			1	1
		0 days 26 days	Fri 2/18/11		4	1		Install SIPS			,	1
25	Install SIPS Panels Exterior Sheathing South FI	26 days 5 days		Tue 3/29/11 Fri 3/4/11	4	1		Exterior Sheat			1	( , , , , , , , , , , , , , , , , , , ,
26		5 days 5 days	Mon 2/28/11 Mon 3/7/11		4 '	1	_	-	athing South El Barrier/Insulation South El		1	( , , , , , , , , , , , , , , , , , , ,
27 28	_	-	Mon 3/7/11 Mon 3/14/11		4 '	1			heathing West El		1	( , , , , , , , , , , , , , , , , , , ,
28		5 days 10 days	Mon 3/14/11 Mon 3/21/11		4 '	1			por Barrier/Insulation West El		1	( , , , , , , , , , , , , , , , , , , ,
30		10 days	Mon 3/21/11 Mon 4/4/11		A '	1		_			,	1
30		1 day	Mon 4/4/11 Tree 4/5/11		<b>/</b> '	1			recast Panels North/South El recast Panels East El		,	1
		2 days 2 days	Tue 4/5/11 The 4/7/11	Wed 4/6/11	<b>/</b>	1		_			,	1
32		2 days	Thu 4/7/11		4 '	1		_	recast Panels West El Ioní Insulation/Ice Shield		1	1
33		33 days		Mon 5/16/11	· · · · · · · · · · · · · · · · · · ·	1			toof Insulation/ice Shield oints/Clean Panels North El		1	1
34		5 days	Mon 4/11/11		4	1			h Windows North El		1	1 1
35		2 days	Mon 4/18/11		4	1		_			1	1 1
		5 days 3 days	Mon 4/18/11		4	1			Joints/Clean Panels East El		1	1 1
37		3 days	Wed 4/20/11		4	1			ninum Storefronts aulk Windows /Exterior		1	1
38		18 days	Wed 4/20/11		4	1			aulk Windows/Exterior		1	1
39		5 days	Mon 4/25/11		4	1			hch Windows East El Linints (Clean Panels South Fl		,	1
40		5 days	Mon 4/25/11		4	1			il Joints/Clean Panels South El dk Exterior Block /Door Eremen		1	1 1
41		5 days	Mon 4/25/11		4	1			Ik Exterior Block/Door Frames	1	1	1 1
42		2 days	Mon 5/2/11		4	1			nch Windows South El al Inints //Tean Panals West Fl		1	1 1
43		5 days	Mon 5/2/11		4	1		_	al Joints/Clean Panels West El		1	1 '
44		5 days	Mon 5/9/11		4	1			unch Windows West El Lask Tast Windows & Storefron		1	í ľ
45		4 days	Mon 5/16/11		4 '	1			Leak Test Windows & Storefron Matel Boofing	/#\$8	1	1
46		40 days		1 Tue 7/12/11	Metal Roofing					1		
47		28 days		Tue 7/12/11	-1 '	1			Fascia/Trim/Soffit /Gut	/Mers/Downspo	A <b>4</b>	1
48		8 days		Tue 7/12/11	-1 '	1			<ul> <li>Exterior Canoples</li> <li>Exterior Complete</li> </ul>	-	1	1
49	Exterior Complete	0 days	Wed 8/10/11	Wed 8/10/11	·′	1			Exterior Complete	*	′	<u> </u>
.												,



## PROPOSED ENCLOSURE SCHEDULE



BILLETING BUILDINGS BLACKSTONE, VA

KENDALL MAHAN | CONSTRUCTION MANAGEMENT OPTION



## WIND LOADS

Wind Loads	Wind Loads									
Basic Wind Speed (3 sec Gust)	V = 90 mph	ASCE Fig. 6-1								
Importance Factor	I = 1.0	ASCE Table 6-1								
Exposure Category	С	ASCE Sec. 6.5.6.3								
Internal Pressure Coefficient	+/- 0.18 (Enclosed)	ASCE Fig. 6-5								

Lateral Wind Pressures		
Windward	16.58 psf	Controls
Leeward	13.87 psf	

manty Factor, Kd	
Struct	
ched Roofs	
iimneys, Tanks, an Square Hexagonal Round	d
lid Signs	
en Signs and Latti	0
ussed Towers Triangular, squar All other cross se	
	Structi Maia Wind Forc Components and cched Roofs timneys, Tanks, an Square Hexagonal Round lid Signs een Signs and Latti

#### APPENDICES – PRECAST PANELS



Table 6-3

BARTON MALOW U.S. ARMY CORPS OF ENGINEERS VIRGINIA ARMY NATIONAL GUARD

#### ASCE REFERENCES

Туре	Directionality Factor Ka
esisting System adding	0.85 0.85
	0.85
milar Structures	
	0.90 0.95 0.95
•	0.85
ranework	0.85
rectangular ns	0.85 0.95

has been calibrated with combinations of loads his factor shall only be applied when used in mbinations specified in 2.3 and 2.4.

6.511.5.2 Components and Cladding. The pressure coeffi-6.5.12.2.3 Flexible Buildings. Design wind pressures for the cients for the design of parapet component and cladding elements are taken from the wall and roof pressure coefficients as specified lowing equation in Section 6.5.12.4.4.

6.5.12 Design Wind Loads on Enclosed and Partially Enclosed Buildings.

#### 6.5.12.1 General.

6.512.1.1 Sign Convention, Positive pressure acts toward the surface and negative pressure acts away from the surface.

6.512.1.2 Critical Load Condition. Values of external and internal pressures shall be combined algebraically to determine the most critical load.

6.512.1.3 Tributary Areas Greater than 700 ft<sup>2</sup> (65 m<sup>2</sup>).  $p_p = \text{combined net pressure on the parapet due to the combi-$ Commonent and cladding elements with tributary areas greater than '00 ft2 (65 m2) shall be permitted to be designed using the provisions for MWFRSs.

6.5.12.2 Main Wind-Force Resisting Systems.

6.512.2.1 Rigid Buildings of All Heights. Design wind pressures for the MWFRS of suildings of all heights shall be determinec by the following equation:

#### $p = q GC_p - q_1 (GC_{p_1}) (1b/n^2) (N/m^2)$ (6-17 where

- at height h
- roofs of enclosed buildings and for negative internal pressure evaluation in partially enclosed buildings
- $q_i = q_2$  for positive internal pressure evaluation in partially enclosed buildings where height z is defined as the level of the highest opening in the building that could affect where the positive internal pressure. For buildings sited in wind-borne debris regions, glazing that is not impact
- resistant or protected with an impact resistant covering, shall be treated as an opening in accordance with Section 6.5.9.3. For positive internal pressure evaluation, qi may conservatively be evaluated at height h
- $(q_i = q_h)$  G = gust effect factor from Section 6.5.8 $C_p$  = external pressure coefficient from Fig. 6-6 or 6-8
- $(GC_{p})$  = internal pressure coefficient from Fig. 6-5

q and q<sub>i</sub> shall be evaluated using exposure defined in Section 6.5.6.3. Pressure shall be applied simultaneously on windward 6.5.12.4 Components and Cladding. and leeward walls and on 100f surfaces as defired in Figs. 6-6 and

#### 6.5.12.2.2 Low-Rise Building, Alternatively, design wind ares for the MWFRS of low-rise buildings shall be deterned by the following ecuation: $p = q_{\nu}[(GC_{\nu}) - (GC_{\nu})]$ (lb/fr<sup>2</sup>) (N/m<sup>2</sup>)

ca = velocity pressure evaluated at mean roof height h us exposure defined in Section 6.5.6.3 ) - external pressure coefficient from Fig. 6-10  $C_{\mu}$  = internal pressure coefficient from Fig. 6-5

MWFRS of flexible buildings shall be determined from the fol-

#### $p = qG_{1}C_{p} - q_{1}(GC_{p}) (lh/fr^{2}) N/m^{2}$ (6-19)

where  $q_i$ ,  $q_i$ ,  $C_{p_i}$  and  $(GC_{p_i})$  are as defined in Section 6.5.12.2.1 and  $G_f =$  gust effect factor is defined as in Section 6.5.82.

6.5.12.2.4 Parapets. The design wind pressure for the effect of parapets on NWFRSs of rigid, low-rise, or flexible buildings with flat, gable, or hip roofs shall be determined by the following equation

(6-20)

(6-21)

 $p_{\sigma} = q_{\rho}GC_{\sigma}$  (lbfr<sup>2</sup>)

#### where

- nation of the net pressures from the front and back paranet surfaces. Plus (and minus) signs signify net cressure acting toward (and away from) the front (exterior) side of the parapet
- = velocity pressure evaluated at the top of the parapet GCau = combined net pressure coefficient
- = +1.5 fcr windward parapet = -1.0 fcr leeward parapet

6.5.12.3 Design Wind Load Cases. The MWFRS of buildings of all heights, whose wind loads have been determined under the provisions of Sections 6.5, 12.2.1 and 6.5.12.2.3, shall be designed for the wind load cases as defined in Fig. 6-9. The eccentricity e  $q = q_z$  for windward walls evaluated at height z above the for rigid structures shall be measured from the geometric center of the building face and shall be considered for each principal  $q = q_h$  for leeward walls, side walls, and roofs, evaluated axis  $(e_x, e_y)$ . The eccentricity e for flexible structures shall be determined from the following equation and shall be corsidered  $q_i = q_h$  for windward walls, side walls, beward walls, and for each principal axis  $(e_X, e_Y)$ :

 $e = \frac{e_Q + 1.2I_Z \sqrt{(g_Q Q e_Q)^2 + (g_R R e_Z)^2}}{1 + 1.2I_Z \sqrt{(g_Q Q)^2 + (g_R R)^2}}$ 

- $e_Q =$  eccentricity e as determined for rigid structures in Fig. 6-9  $e_8$  = distance between the elastic shear center and center of mass of each floor
- 12. go, Q. g., A shall be as defined in Section 6.5.8 The sign of the eccentricity e shall be plus or minus, whichever
- causes the more severe load effect. EXCEPTION: One-story buildings with & less than or equal to 30 ft. buildings two stories or less framed with light-frame construction, and buildings two stories or less designed with flexible diaphragms need only
- he designed for Load Case 1 and Load Case 3 in Fig. 6-9.

#### 6.5.12.4.1 Lew-Rise Buildings and Buildings with $h \leq$

60 ft (18,3 m). Design wind pressures o elements of low-rise buildings and buildings with  $h \le 60$  ft 8.3 m) shall be determined from the following equation:

#### $p = q_k[(GC_i) - (GC_{ji})]$ (b/fl<sup>2</sup>) (N/m<sup>2</sup>) (6-22)

- $q_a$  = velocity pressure evaluated at mean roof heighth using exposure defined in Section 6.5.6.3  $(C_n) = \text{external pressure coefficients given in Figs. 6-11}$
- through 6-16  $FC_{\mu\nu}$ ) = internal pressure coefficient given in Fig. 6-5

ASCE 7-05

	Heig	ht above	1 0000	Expo
	grout	nd level, z	SNOW1	В
	ft	(m)	Case 1	Case 2
	0-15	(0-4.6)	0.70	0.57
	20	(6.1)	0.70	0.62
- E	25	(7.6)	0.70	0.66
	30	(9.1)	0.70	0.70
E	40	(12.2)	0.76	0.76
	50	(15.2)	0.81	0.81
	60	(18)	0.85	0.85
	70	(21.3)	0.89	0.89
1	80	(24.4)	0.93	0.93
	90	(27.4)	0.96	0.96
	100	(30.5)	0.99	0.99
	120	(36.6)	1.04	1.04
	140	(42.7)	1.09	1.09
	160	(48.8)	1.13	1.13
	180	(54.9)	1.17	1.17
	200	(61.0)	1.20	1.20
	250	(76.2)	1.28	1.28
	300	(91.4)	1.35	1.35
	350	(106.7)	1.41	1.41
	400	(121.9)	1.47	1.47
	450	(137.2)	1.52	1.52
	500	(152.4)	1.56	1.56

Velocity Pressure Exposure Coefficients, Kh and K

#### Case 1: a. All components and cladding.

b. Main wind force resisting system n low-rise buildings designed using Figure 6-10.

Exposure (Note 1)

C D

Cases 1 & 2 Cases 1 & 2

- Case 2: a. All main wind force resisting systems in buildings except those in low-rise buildings designed using Figure 6-10.
- b. All main wind force resisting systems in other structures.
- The velocity pressure exposure coefficient K<sub>z</sub> may be determined from the following formula:
- For 15 ft.  $\leq z \leq z_{e}$ For z < 15 ft.
- $K_z = 2.01 (z/z_2)^{2/\alpha}$  $K_z = 2.01 (15/z_0)^{2/\alpha}$
- Note: z shall not be taken less than 30 feet for Case 1 in exposure B.
- α and zg are tabulated in Table 6-2.
- Linear interpolation for intermediate values of height z is acceptable.
- Exposure categories are defined in 6.5.6.



#### ASCE REFERENCES

	Wind Force Resisting System - Method 2 n ≤ 60 ft. c 6-10 (cont'd) External Pressure Coefficients, GC <sub>pf</sub> Low-rise Walls &		Low-rise Walls & Roofs							
nclosed, Pa	etially F						Low-fise wans & Roots			
nclosed, Pa	ruany r.	ncioscu	Dunning							
			_			10				
Roof Angle 0					Building	g Surface		-		
(degrees)	1	2	3	4	5	6	1E	2E	3E	4E
	0.40	-0.69	-0.37	-0.29	-0.45	-0.45	0.61	-1.07	-0.53	-0.43
0-5	0.40	-0.69	-0.48	-0.43	-0.45	-0.45	(0.80	-1.07	-0.69	40.64
30-45	0.56	0.21	-0.43	-0.37	-0.45	-0.45	0.69	0.27	-0.53	-0:48
90	0.56	0.56	-0.37	-0.37	-0.45	-0.45	0.69	0.69	-0.48	-0.46
patterns , Cornbin obtain t 5. For the 4T sha Torsion referen 6. Except by negl 7. For the for flat 8. The root for a di paralle windw the pre 9. Notatia	are appli ations of the most s torsional 1 be 25% exption: ess fram cible diagal loadin the corner for mome ceting with design o roofs, us of pressui stance fr to the di ard wall, ssure coe m: percent 6 of least	ed to cac external load cass, of the fi One stor- ed with 1 shragms - g shall an ent-resist and force f the MW e $\theta = 0^{\circ}$ er coeffic om the et rection c whichev fficient ( of least f	and interr and interr sings. cs shown l all design y building ight frame need not b upply to all ting frame s on roof s VFRS pro- and locate day of roo of the MW cr is less; $GC_{af}$ for Z porizontal	such as the second seco	ares (see e pressut ssures (z less than cton, and ed for the sic load p al horizo earl resis 2 2/3 bou egative in 5 0.5 tim ng design inder of on or 0.4H ft (0.9 m earl that	Figure 6-: res in zono ones 1, 2, or equal 1 i building t torsional atterns us ntal shear stance in a ndary at th Zone 2 c es the hor Zone 2/2F a, whicher ). eave height	s two stori l load case sing the fig shall not	evaluated ted with a 1 m), build es or less s, gures belo be less thi parallel t gth of the be appli- nension o g to the ri gto the ri ller, but n	I as required in a required in the required in the set of the set	, 2T, 3T, o stories 1 with d at each etermined line or g te 2/2E ding the shall use
	*		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		a la	and a second				)* **
	Tr	ansvers	se Direct	tion		Load		gitudina	I Direct	ion

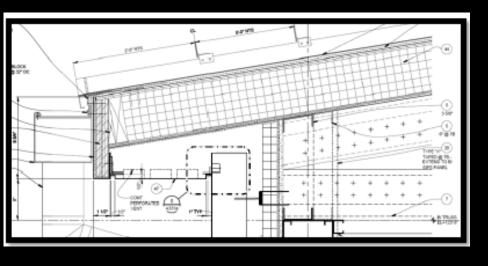


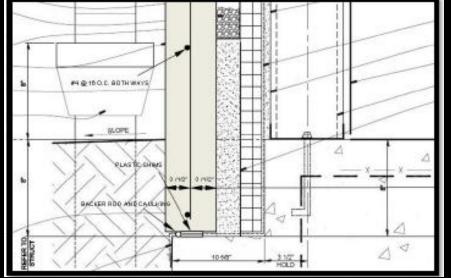
BILLETING BUILDINGS BLACKSTONE, VA

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# **TOP AND BOTTOM CONNECTIONS**

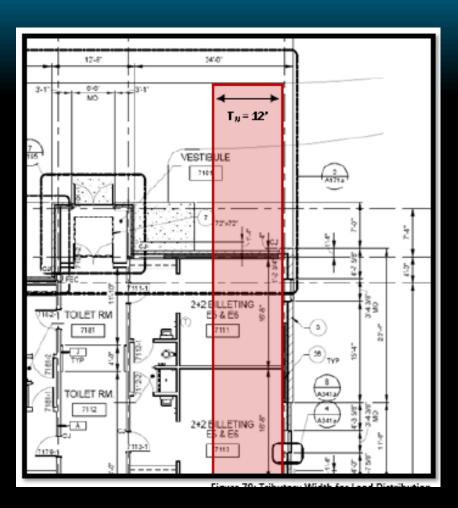




## APPENDICES – PRECAST PANELS

LOAD PATH





Design Loads	
Roof Dead Loads	
Roofing	5.0 PSF
Sheathing/Insulation	3.5 PSF
Cold Formed Metal Trusses	3.5 PSF
Ceiling	5.0 PSF
Mech. & Misc.	5.0 PSF
Dry Pipe Sprinkler	3.0 PSF
Total	25 PSF
Roof Live Loads	
Total	20 PSF
Floor Dead Loads	
8" Hollow-Core Precast Plank	62 PSF
2" Concrete Topping Slab	25 PSF
Mech./Electrical	3 PSF
Ceiling	5 PSF
Sprinklers	2.5 PSF
Misc.	2.5 PSF
Total	100 PSF
Floor Live Loads	
Total	125 PSF

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# **DESIGN LOADS**



BILLETING BUILDINGS BLACKSTONE, VA

KENDALL MAHAN | CONSTRUCTION MANAGEMENT OPTION

#### PANEL DESIGN

	Panel Design	Bredth	# 1	Structurel	Analy 513			
	Provided by Drawings : E	XPOSLICE C						
	V	= 90 mph						
		L = 1.0						
	c	rCp1 = = 0.18						
	Provided by ASCE 7-05:	K4 = 0.85 4	* 7.56 6-4)					
	man of more 1 car	K2+ = 1.0 -1	lamogeneous Tapogra	ph				
		6- = 0.85	0-					
	9= = 0.00256 Kete+Kg V	1.1.						
9	9== 0.00256 (0.85) (1.	07 (0.55) (40) + (	1.0)					
GW	= 14.78							
"ONEND"								
	92 = 0.00296 (0.90) (1.0	)(0.85)(40) (1.0	2					
	: 15.86							
	9 = 0.00256 (0.44) (1.0)	(0.85) (ta)" (	(0)					
	= 16.57							
	6 m 20 1							
	92 = 0.00256 (0.9%)(10) = 17.27	(0.85) (90) (1	0)					
	Velocity Bussice ("Table 6-3 from Asce)							
	height (4)	<u>Ka</u>	2= (PSE)					
	0-05	0.85	14.98					
	20	0,90	15.86					
	25	0,94	16.57					
	27.5 30	0.98 0.98	16.92					
	10	0.10	11.21					
	96= h 0 275 = 1	16.92 psf						
	G-Cps = 6.80 (wind	word) (Fig 6	-10)					
	G.C. # = -0.69 [Lee	word)						
	P=qu [ccpt - 6C							
	Windund: P = (L.92 p. 4) [(0. + 16.58	80) - ( to 18)						
	+ 16.58		(= lonhals					
	conind: P= (10.592 psc) (1-0	2.64) - (10.18)						
	= 13.87	12101						

		NASS STATE
	$P = 16.58 \text{ psf} \times 1^{\circ} \text{ Strip Width}$ $= 16.58 \text{ plf}$ $= 16.58 \text{ plf}$	
	P=16.58 psf x 1 Strip Width	
	P P P	
	= 16.58 pt - 24	
	→       · · · · · · · · · · · · · · · ·	
	→¥ *	
'n	Let h= 7" Concrite	
awawy	$M_{\text{lower}} = \frac{\omega l^2}{2} = \frac{(11.58 \text{ ps} l)(2N^2)^2}{2} = 1.193 \text{ K.F.t}$	
X	Let d= 3.5" as sit in the muldle, since one layer	of Conference
		- terming
	Asimin = 2 = Vfc bd.	
	$A_{S,min} = \begin{cases} \frac{3\sqrt{F_c}}{F_1} & bd \\ 2\infty & \frac{bd}{F_1} & \leftarrow Controls \end{cases}$	
	Asing = <u>2005 (12) (3.5"</u> = 0.14 in <sup>2</sup> 60000	
	$a = \frac{A_5 f_{y}}{6.85 f_{c}'b} + f_{c}' = 5000 part from Parel M$	enufactura
	$a = A_s(c_0) = 1.18A_s$	
	0.55(5)(12)	
	$\phi m_n = \phi A_s f_y (d - q_e)$	
	(1.193) (12) = (09) AS (60) (3.5 - 1.18A/2)	
	$\frac{14.316}{14.316} = 1.89A_{\rm S} = 31.86A_{\rm S}^{-1}$	
	As= 0.077 104	
	Use #4 @ 16", 0.500 0,1400" (Renter	ing Table)
	$p = \frac{A_2}{bd} = \frac{0.15}{(12)(2.5)} = 0.00.557 > 0.0012$	from ACI Code
	DA (12)(3.57	
	Horizontal Reinforcement	
	Prinin = 0.002 for love	
	Alma = pbd = (0.002)(12")(3.5") = ,084 1,2	
	Use #4 0 16	

	No.
0	Chuck Sheeri
	$V_{0} = \frac{\omega l}{2}$
	= (16.58pt)(12) = (100 94)
	: 0.699 K
	99 15 = d 2 JFC bd (99) = (0.75)(2) (VS00)(12) d
10	a= 6.678
"ONIMO"	Let h=7"
~	$7 = d + d_0 / + cc$
	7 = d + .52 + 15 d= 3 2 0.078" :, 6K
-	
C	
-	

## APPENDICES – PRECAST PANELS



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	Faindation Design	Breadth # 1	Structural Malysis				
	1 allaation wesign	C TRUGTIN IN T	THE PARTY AND A STATE				
	From Davings: Roof DLT	= 25psf					
	floor DLy	e luo pst					
	Red Lly	= 20 pst	d Anna) + Warst Case Scenario				
	9a = 2.5K26	i i i i i i i i i i i i i i i i i i i					
	14 = 4000 p	*					
	Frest Depth =	36*					
	way of Cal D	the all the la days	and the Sec				
	* Assuming all First Assor * Assensing the reinforcing	S would in the page	the are Areliate				
The last		- magen - f. r	00				
JWG	Q. 125yst		24°r				
-avenut	LL= 76pst	1	Knunz' - T				
X		the state of the s					
		neof Faust	1				
	PL= ICCPSF						
	H= 17545 24		+				
			1 15'				
	Exterior WWW Klauchen		Typical 1+1 Rec. Floor Floor				
	Py = (Rost DLy + Flow DLy)(Tw) + Preved Porel						
	$= (s$						
	- (2) 45+ + 100 ps	+/112 / + 1150 pc	L)( - 12")(24)				
	= 3600 plF						
	= 3.6 KIL						
	0 10 1 0	N. Yes					
	PL = (Reaf LL + Floor	(LLY)(Tw)					
	= (20 pst + 125 ps	4)(12)					
	= 1740 plf						
	= 1.74 KH						
	* She LL > 100 pt	st, Do Not Noval +	o Reduce				
	$P = P_0 + P_1$						
	= 3.0KIF +1.74 KIF						
	= 5,74 KK						

Lenex to go	to the next page in the document
0	Grade Brain Church : From Drawings: GB-1 > With c 1'6" Height = 2'5" Rendering = 2 416 Long Box Top + Bottom
	* Assome Grade Beam is simply supported
	w= 5.34 Kif z'
CAMPANY	GRADE GEAM (GB-1)
×	$m_{\rm U} = \frac{1}{8} l = 10^{\circ}$ the langest span for 6.8-1
	s (5.34 KUF) (10 <sup>1</sup> ) <sup>2</sup> 8
0	$a = \frac{A_{0}F_{y}}{a_{0}F_{0}F_{y}} b$
	$= \frac{(0.85 m^3) (66 ks_1)}{(0.75) (4' ks_1) (h^{\circ})},$
	$d = 24^{4} - 3^{4} - 0.73^{4}$
	= 76,625"
	$m_{n} = A_{5} f_{\gamma} \left( d_{-} \frac{q_{2}}{2} \right)$ $= \left( 0.58 \frac{n}{2} \right) \left( 60 \text{ Ks}_{1} \right) \left[ 20.628^{n} - \frac{0.56^{n}}{2} \right] \left( \frac{1}{12^{n}} \right)$
	= (0.3%) (week) [ week] = 74 ] ( 12-7
0	$C = \frac{\alpha}{\delta \kappa s}$
0	= 0.46 <sup>N</sup> 0.55
	= 1.01"



## **GRADE BEAM DESIGN**

Click to go to the	e next page in the document	
0	$\mathcal{E} = 0.003 (d-c)$ = 0.003 (20.62* - 1.01)	
	$= \frac{0.003 (20.67 - 1.01)}{60^{\circ}}$ $= 0.058$ $= 0.058$ $= 0.06267 = 3 \phi - 6.9$	
	$\phi m_n = \phi m_n$	
anamy	$m_{\omega} \leq \phi  m_{\alpha}$ $G_{\alpha, q} \times H \leq \mathcal{D}, q  (98.9 \times A)$	
	$G_{0,2} \times H \leq SO_{0,0} \times H$ OK for Alexander $V_{L} = 2\sqrt{F_{L}^{2}} b_{L} d$	
	+ 2 J(400,00) (15") (24) = 47.0 K	
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BILLETING BUILDINGS BLACKSTONE, VA

KENDALL MAHAN | CONSTRUCTION MANAGEMENT OPTION

#### BATHROOM TAKEOFFS

	Length (FT)	Height (FT)	Area (SF)
Shower/Sink Wall	7	8	56
Water Closet/Sink Wall	7	8	56
Room Wall	8.66	8	69.28
		Total	181.28

Stud Walls (3-5/8")							
	Length (FT)	Height (FT)	Area (SF)				
Switch Wall	8.66	8	69.28				
Divider Wall	3.33	8	26.64				
		Total	95.92				

Acoustic Insulation									
	Length (FT)	Height (FT)	Area (SF)						
Shower/Sink Wall	7	8	56						
Water Closet/Sink Wall	7	8	56						
Room Wall	8.66	8	69.28						
		Total	181.28						

GWB/Paint			
	Length (FT)	Height (FT)	Area (SF)
Switch Wall	7	4	28
Shower/Sink Wall	7	8	56
Door	3	-7	-21
Shower Tile	3.5	-7	-24.5
Water Closet/Sink Wall	7	8	56
Door	3	-7	-21
Water Closet Tile	3.5	-4	-14
Divider Wall	7.33	8	58.64
Divider Wall Non Shower Side	3.5	-7	-24.5
Shower Wall	3.5	1	3.5
Water Closet Wall	3.5	4	14
		Total	111.14

	Length (FT)	Height (FT)	Area (SF)
Switch Wall	7	4	28
Shower/Sink Wall	4	7	28
Water Closet/Sink Wall	7	7	49
Door	1	4	- 4
Divider Wall	7.33	7	51.31
Divider Wall Non Shower Side	3.83	-3	-11.49
Shower Wall	3.5	7	24.5
Water Closet Wall	3.5	4	14
		Total	187.32

	Length (FT)	Height (FT)	Area (SF)
Floor			103
Switch Wall	7	4	28
Shower/Sink Wall	4	7	28
Water Closet/Sink Wall	7	7	49
Door	1	4	4
Divider Wall	7.33	7	51.31
Divider Wall Non Shower Side	3.83	-3	-11.49
Shower Wall	3.5	7	24.5
Water Closet Wall	3.5	4	14
		Total	290.32

-			-	

Detailed 1+1 Bathro	iom Estimate												
			Daily	Labor									Project Total Incl
Code	Item	Crew	Output	Hours	Units		Labor	Equipment		Total Incl O&P	Quantity	Project Total	O&P
08 12 13.13 0100	Standard Hollow Metal Frames, 16 gs. Up to 3-3/4" Jamb Depth, 7'-0' High, 3'-0'' W, Single	2 Carp	16	1.000		143.00	43.00		186		2		
08 13 13.13 0640 09 22 16.13 1740	Hollow Metal Doors, Hollow Core, 1-3/4" Thick, Full Panel, 20 ga, 3'-0" x 7'-0"	2 Carp	17 481	0.941		420.00	40.50		460.5	520	2		
	Non-Structural Metal Stud Framing, Non-Load Bearing, Galv, B' High, 20 Ga. Studs, 3-7/8" Wide, 16" O.C.	1 Carp											+
09 22 16.13 1780	Non-Structural Metal Stud Framing, Non-Load Bearing, Galv, 8' High, 20 Ga. Studs, 6'' Wide, 16'' O.C.	1 Carp	469	0.017		0.63	0.73		1.36		182		
09 22 26.13 8320	Ceiling Suspension Systems For Gypsum Board or Plaster, 1-1/2" Carriers, 24" O.C. with 7/8" Channels, 24" O.C.	1 Lath	310	0.026		0.34					103		
09 28 13.10 0200	Cementitious Backerboard, On Wall, 3' x 6' x 3/8' Sheets	2 Carp	350	0.046		0.82	1.97		2.79		188		• • • • • • • •
09 29 10.50 0530	High Abuse Gypsum Board, Fiber Reinforced, Screwed to Studs, 3/8' Thick On Wells, Taped, Finished, Compound Skim Cost Level 3 Finish	2 Carp	700	0.023		0.88	0.98		1.86		112		
09 29 10.50 0570	High Abuse Gypsum Board, Fiber Reinforced, Screwed to Studs, 3/8" Thick On Ceiling, Taped, Finished, Compound Skim Cost Level 3 Finish	2 Carp	550	0.029		0.88	1.25		2.13		103		
09 30 13.10 3310	Ceramic Tile, Porcelain Type, 1 Color, 2" x 2", Thin Set	D-7	190	0.084		4.26	3.04		7.3		291		
09 30 13.10 4600	Ceramic Tile, Add For Epoxy Grout, 1/16" Joint, 2" x 2" Tile	D-7	820	0.020		0.59	0.71		1.3		291		•
09 81 16.10 1500	Acoustic Insulation, Blanket, 3" Thick	1 Cap	910	0.009		0.50	0.38		0.88		182		+
09 91 23.35 0140	Doors & Windows, Interior Latex, Doors, Flush, Both Sides, Incl. Frame & Trim, Rool & Brush, Primer & 2 Coats Latex	1 Pord	5	1.600		11.75	60.00		71.75		2		+
09 91 23.72 1200	Walls & Ceilings Interior, Latex, Primer, Paint 3 Coats, Smooth Finish, Spray	1 Pord	1625	0.005		0.15	0.18		0.33		112		
10 28 13.13 0010	Curtain Rod, Stainless Steel, 1" Diameter	1 Carp	13	0.615		34.50	26.50		61		1		
10 28 13.13 4300	Robe Hook, Single, Regular	1 Carp	36	0.222		11.30	9.55		20.85		1		+
10 28 13.13 6200	Toilet Tissue Dispenser, Surface Mounted, SS, Double Roll	1 Carp	24	0.333		22.50	14.35		36.85		1		•
10 28 13.13 7400	Tumbler Holder, Tumbler Only	1 Carp	30	0.267		41.50	11.50		53		1		+
22 41 13.40 1100	Water Closet, Tank Type, Vitreous China, Incl. Seat, Supply Pipe w/Stop, 1.6 gpf, Foor Mounted	Q-1	5.3	3.019		240.00	146.00		386		1		+
22 41 16.10 6960	Lavatories, Rough-in, Supply, Waste and Vent	Q-1	1.66	9.639		420.00	465.00		885		2		
22 41 23.20 4200	Shower, Rough-in, Supply, Waste and Vent	Q-1	2.05	7.805		485.00	375.00		860		1		
22 42 13.40 3400	Water Closet, Rough-in, Supply, Waste and Vent	Q-1	2.84	5.634		365.00	272.00		637		1		
22 42 39.10 0972	Automatic Flush Sensor and Operator For Water Closets, Standard	1 Plum	8	1.000		415.00	53.50		468.5		1		+
23 37 13.30 1000	Aluminum Air Return, 6" x 6"	1 Shee	26	0.308		17.55	15.90		33.45		1		+
23 33 46.10 1600	Flexible Air Ducts, Costed Fiberglass Fabric, Non-Insulated, 8"	1 Q-9	200	0.080		2.10	3.72		5.82		3		+
26 05 90.10 2770	Residential Wiring, 20' Avg. Runs, Switch Devices, Decorator Style, S.P. Touch Dimmer, Type MC Cable	1 Elec	14.3	0.559		46.50	28.00		74.5		1		+
26 05 90.10 6000	Residential Wiring, 20' Avg. Runs, Lighting Outlets, Type MC Cable	1 Elec	24	0.333		17.25	16.75		34		2		+
26 27 26.10 4800	Low Voltage Switching, Switchplates, 1 Gang, 1, 2, or 3 Switch, Plastic	1 Elec	80	0.100		4.67	5.05		9.72		1		+
26 51 13.50 3250	Interior Lighting Fixture, Inc. Lamps, Mounting, Hardware & Connections, Fluor. Recess Mounted, Troffer, 1'W x 4'L, Two 32 W T8	1 Elec	5.3	1.509		134.00	76.00		210		1		
26 51 13.50 3470	Interior Lighting Fixture, Inc. Lamps, Mounting, Hardware & Connections, Fluor. Recess Mounted, Troffer, 6" Diameter	1 Elec	20	0.400	Ea.	67.50	20.00		87.5	104	1		
												\$ 10,380.12	\$ 13,152.87
Concrete Work													
03 11 13.35 7500	Cast-In-Place Forming Concrete, Elevated Slabs, Depressed Area Forms to 12" High, 4 Use	C-1	300	0.107		0.78	4.36		5.14		31.33		
03 11 13.65 3500	Cast-In-Place Forming Concrete, Slab-On-Grade, Depressed Area Forms to 12" High, 4 Use	C-1	300	0.107		0.6	4.36		4.96		31.33		
03 31 05.0300	Normal Weight Structural Concrete - 4000 psi Concrete				CY	103			103		0.16		
03 31 05.35 0300	Normal Weight Structural Concrete - Structural Lightweight				CY	128.8			128.8		0.16		
03 31 05.70 1400	Placing Concrete - Elevated Slabs, Less than 6", Pumped	C-20	140	0.457			16.8				0.16		+
03 31 05.70 4350	Placing Concrete - Slab on Grade, Up to 6", Pumped	C-20	130	0.492			18.1		24.15		0.16		
03 35 29.30 0350	Finishing- Power Screed, Bull Flost, machine Flost & Trowel (Ride-On)	C-10E	4000	0.005	SF		0.23	0.06	0.29	0.4	103	\$ 29.87	\$ 41.20
Additional Material													
05 12 23.62 0050	Structural Steel, Plates, 1/4" Think (10.2 lb/SF)				SF	11.50			11.5		103		
09 22 16.13 1740	Non-Structural Metal Stud Framing, Non-Load Bearing, Galv, 8' High, 20 Ga. Studs, 3-5/8" Wide, 16" O.C.	1 Carp	481	0.017		0.45	0.72		1.17		8.7		+
09 28 13.10 0090	Cementious Backerboard, On Floor, 3" x 6" x 1/4" Sheets	2 Carp	525	0.03	SF	0.34	1.31		1.65	2.29	103		•
												\$ 1,364.63	\$ 1,547.59

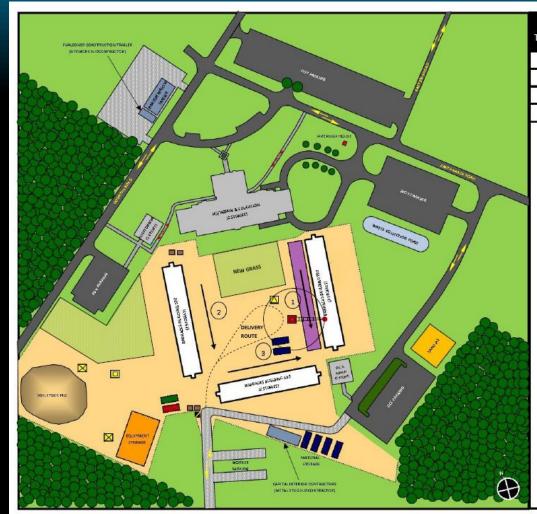
## APPENDICES - PODS





BARTON MALOW U.S. ARMY CORPS OF ENGINEERS VIRGINIA ARMY NATIONAL GUARD

# **PIOD ERECTION SITE PLAN**





FORT PICKETT REGIN RAINING INSTITUTE F	
BLACKSTONE, VIRGINI	А
April 4, 2012	
Kendali Mahan	
POD UNIT INSTALL PHA	SE
SYMBOLS NEW BUILDINGS EXISTING BUILDINGS EXISTING BUILDINGS EXISTING BUILDINGS EXISTING BUILDING EXISTING BUILDING VEHICLIAR TRAFBC PEDESTRIAN WALKWAY VEHICLIAR TRAFBC PEDESTRIAN WALKWAY VEHICLIAR TRAFBC CONSTRUCTION FENCE CONSTRUCTION FENCE RECYCLING CONTAINER PORTABLE TOLET EMPORATE TOLET EMPORATE TOLET EMPORATE TOLET EMICONIC STELLESCORING UFF UULL ERAVAERCRAHE MEDICINSTELL AREA PEDINSTELL AREA PEDINSTELL AREA	



BILLETING BUILDINGS BLACKSTONE, VA

KENDALL MAHAN | CONSTRUCTION MANAGEMENT OPTION

#### **CURRENT FIT-OUT SCHEDULE**

ID	Task Name	Duration	Start	Finish		2nd Quarter		3rd Quarter		4th Quarter
					Sep	Apr	Nov	Jun	Jan	Aug
	Phase II	662 days		Mon 9/10/12	٩ ٩				Phase II	
2	Construction - Building 700	352 days		Thu 12/29/11		<b>~</b>			Regtion - Building 700	
3	Building 700 - Fit-Out	180 days		Mon 10/17/11					ng 700 - Fit-Out	
4	Begin 700 Fit-Out	0 days		Tue 2/8/11			Begin 70			
5	Layout/Top Track	20 days		Mon 3/7/11				it/Top Track		
6	Metal Stud Wall Framing	25 days	Tue 2/15/11					tal Stud Wall Framing		
7	Door Frames	25 days	Wed 2/16/11				Doc			
8	Electrical R/I	52 days	Tue 2/22/11					Electrical R/I		
9	Fire Alarm R/I	30 days	Tue 2/22/11	Mon 4/4/11				re Alarm R/I		
10	Drywall Corrdiors Above Ceiling	20 days	Tue 3/1/11	Mon 3/28/11				wall Corrdiors Above Ceiling		
11	Plumbing R/I	25 days	Tue 3/1/11	Mon 4/4/11			Pl	umbing R/I		
12	Duct Supports	25 days	Tue 3/1/11	Mon 4/4/11				uct Supports		
13	Set Mechanical Equipment	22 days	Fri 3/4/11	Mon 4/4/11				t Mechanical Equipment		
14	Fire Suppression Piping Above Ceiling	27 days	Tue 3/8/11	Wed 4/13/11			<b></b> 3 F	ire Suppression Piping Above	Ceiling	
15	Pull Feeders to Electrical Panels	18 days	Fri 3/11/11	Tue 4/5/11			E Pu	ull Feeders to Electrical Panels		
16	HVAC Ductwork	43 days	Tue 3/15/11	Thu 5/12/11				HVAC Ductwork		
17	Fire Supression Drops	20 days	Tue 3/29/11	Mon 4/25/11				Fire Supression Drops		
18	HVAC Piping	20 days	Mon 4/4/11	Fri 4/29/11				HVAC Piping		
19	Plumbing Piping Installation	25 days	Mon 4/4/11	Fri 5/6/11				Plumbing Piping Installation	n	
20	Cable Tray	20 days	Mon 4/4/11	Fri 4/29/11			<b>C</b> 3	Cable Tray		
21	Power and Lighting Wiring	30 days	Thu 4/14/11	Wed 5/25/11			C	Power and Lighting Wiring	ug .	
22	Cement Board in Bathrooms	21 days	Wed 5/4/11	Wed 6/1/11				Cement Board in Bathro	oms	
23	Hang Drywall	18 days	Mon 5/16/11	Wed 6/8/11				Hang Drywall		
24	Insulate Walls	11 days	Mon 5/23/11	Mon 6/6/11				Insulate Walls		
25	Finish Drywall	59 days	Thu 6/9/11	Tue 8/30/11				Finish Dryw	ali	
26	Paint	53 days	Mon 6/27/11	Wed 9/7/11				Paint		
27	Ceiling Grid	10 days	Tue 7/5/11	Mon 7/18/11				Ceiling Grid		
28	Light Fixtures	7 days	Fri 7/8/11	Mon 7/18/11				Light Fixtures		
29	Doors/Hardware	15 days	Tue 7/19/11	Mon 8/8/11				Doors/Hardwa	re	
30	Ceramic Tile	15 days	Mon 7/25/11	Fri 8/12/11				Ceramic Tile		
31	Energize Light Fixtures	0 days	Tue 7/26/11	Tue 7/26/11				🔶 Energize Light Fi	xtures	
32	Drop Ceiling Tile	28 days	Wed 7/27/11	Fri 9/2/11				Drop Ceiling	; Tile	
33	Install Millwork	49 days	Wed 8/10/11	Mon 10/17/11				Insta	Millwork	
34	VCT Flooring	25 days	Wed 8/10/11	Tue 9/13/11				VCT Floori	ng	
35	Trim	21 days	Wed 8/10/11	Wed 9/7/11				Trim		
36	Plumbing Fixtures	22 days	Mon 8/15/11	Tue 9/13/11				Plumbing	Fixtures	
37	Window Sills	3 days	Wed 8/17/11	Fri 8/19/11				Window Sills		
38	Final Clean	5 days	Wed 9/21/11	Tue 9/27/11				Final Cle	an	
39	BMC Pre-Final Inspections	4 days	Wed 9/28/11	Mon 10/3/11				BMC Pr	e-Final Inspections	
40	BMC Punchlist Corrections	10 days	Tue 10/4/11	Mon 10/17/11				BMC	Punchlist Corrections	
	ckett Regional Training Institute cone, VA					Page 1				Kendali Maha CM Optic

D	Task Name	Duration	Start	Finish	Fan	2nd Quarter	New	3rd Quarter		lan	4th Quarter
1	Phase II	662 days	Sat 2/27/10	Mon 9/10/12	Sep	Apr	Nov	Jun	Phase II	Jan	Aug
2	Construction - Building 700	352 days	Wed 8/25/10		Ĩ			Construct	ion-Cailding 700		Ĩ
3	Building 700 - Fit-Out	139 days	Tue 2/8/11			•		Building 7		-	
4	Place Bathroom Pods Level 1	2 days	Mon 12/6/10				T Place Bathroom P				
5	Place Bathroom Pods Level 2	2 days	Wed 2/2/11				-	nroom Pods Level 2			
6	Begin 700 Fit-Out	0 days		Tue 2/8/11			♦ Begin 70				
7	Layout/Top Track	20 days		Mon 3/7/11				t/Top Track			
8	Metal Stud Wall Framing	18 days	Tue 2/15/11					Stud Wall Framing			
9	Door Frames	13 days	Wed 2/16/11				Door I				
10	Electrical R/I	37 days	Tue 2/22/11					lectrical R/I			
11	Fire Alarm R/I	30 days	Tue 2/22/11					re Alarm R/I			
12	Drywall Corrdiors Above Ceiling	20 days		Mon 3/28/11				wall Corrdiors Above Ceil	ing		
13	Plumbing R/I	13 days		Thu 3/17/11				bing R/I			
14		25 days		Mon 4/4/11			_	uct Supports			
15	Duct Supports Place Bathroom Pods Level 1	1 day		Wed 3/2/11				Bathroom Pods Level 1			
15	Place Bathroom Pods Level 1 Place Bathroom Pods Level 2	1 day		Thu 3/3/11			-	Bathroom Pods Level 2			
10		22 days		Mon 4/4/11				t Mechanical Equipment			
18	Set Mechanical Equipment			Wed 4/13/11				ire Suppression Piping Ab	ove Ceiling		
10	Fire Suppression Piping Above Ceiling Pull Feeders to Electrical Panels	27 days 18 days		Tue 4/13/11				III Feeders to Electrical Pa			
20				Tue 5/3/11				HVAC Ductwork			
20	HVAC Ductwork	41 days						Fire Supression Drops			
21	Fire Supression Drops	20 days	Tue 3/29/11 Thu 3/17/11	Mon 4/25/11 Wed 4/13/11				IVAC Piping			
22	HVAC Piping	20 days						umbing Piping Installation			
23	Plumbing Piping Installation	13 days	Thu 3/17/11					Cable Tray			
24	Cable Tray	20 days	Mon 3/21/11					Power and Lighting Wirir	and the second se		
	Power and Lighting Wiring	24 days	Thu 3/24/11								
26	Cement Board in Bathrooms	3 days	Tue 4/5/11					ement Board in Bathroom			
27	Hang Drywall	12 days	Mon 4/25/11					Hang Drywall Insulate Walls			
28	Insulate Walls	8 days	Thu 4/28/11								
29	Finish Drywall	42 days	Wed 5/11/11					Finish Drywall			
30	Paint Ceilles Ceid	37 days	Mon 5/30/11					Paint			
31	Ceiling Grid	10 days	Mon 6/6/11					Ceiling Grid			
32	Light Fixtures	6 days		Thu 6/16/11				Light Fixtures			
33	Doors/Hardware	8 days		Mon 6/20/11				Doors/Hardware			
34	Ceramic Tile	3 days	Mon 6/13/11					Ceramic Tile	hunor		
35	Energize Light Fixtures	0 days	Thu 6/16/11					Energize Light Fix			
36	Drop Ceiling Tile	28 days	Mon 6/20/11					Drop Ceiling			
37	Plumbing Fixtures	11 days		Fri 7/15/11				Plumbing Fixture Install Mill			
38	Install Millwork	28 days	Mon 7/11/11					Install Mil			
39	VCT Flooring	25 days	Mon 7/11/11					VCT Floorin	'B		
40	Trim	21 days	Mon 7/11/11					Trim			
41	Window Sills	3 days	Mon 7/18/11					T Window Sills			
42	Final Clean	5 days	Mon 7/25/11					T Final Clean			
43	BMC Pre-Final Inspections	4 days	Mon 8/1/11					BMC Pre-Fir			
44	BMC Punchlist Corrections	10 days	Mon 8/8/11	Fri 8/19/11				BMC Punc	chlist Corrections		
	kett Regional Training Institute				1	Page 1					Kendall Ma
Blackst	one, va										CM Op

#### APPENDICES - PODS



BARTON MALOW U.S. ARMY CORPS OF ENGINEERS VIRGINIA ARMY NATIONAL GUARD

#### PROPOSED FIT-OUT SCHEDULE

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#### ION SITE PLAN