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# S500 BIM Best Practices: Case Studies

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**Ecobuild America and AEC-ST Conference**  
May 22, 2008 Anaheim, CA

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# Presentation Topics

- Cathedral Hill Hospital Project
- Integrated Form of agreement (IFOA)
- Design Assist Approach
- Project Tools
- Software Tools Used
- Group Training
- Prefab
- Delivery Staging
- Experimentation with BIM

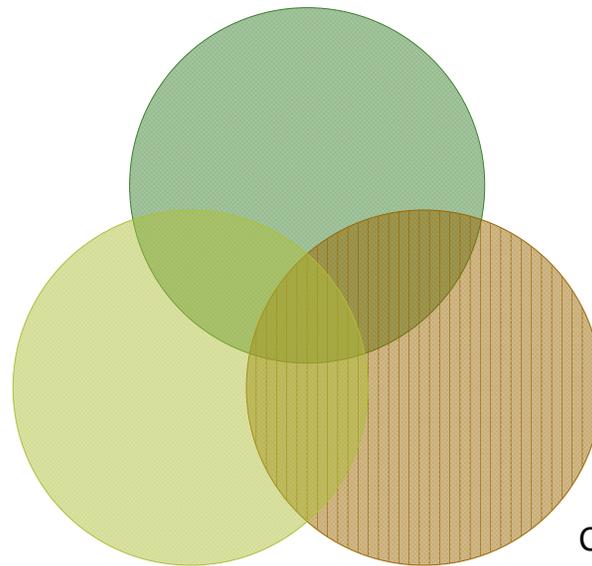
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# Cathedral Hill Hospital

- New Hospital to be constructed in San Francisco
- Proposed Building Statistics
  - 865,000 sf
  - 17 Stories
  - 555 beds
  - 24 Labor, Delivery and Rooms
  - 19 ORs
  - 34 ER Treatment Rooms

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IFOA



BIM

Collocation of Trade Partners

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# Integrated Form of Agreement

- One agreement signed by OAC
- No separate general conditions
- Provides formation of team elements
  - Core teams
    - Core group for Project
    - Core group for BIM
- Integrated Project Delivery Team (IPDT)
- Senior Management Team
- Incentive Sharing Plan

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# Design Assist Approach

- Prequalify the subcontractors
  - Do they have VDC capabilities
- Engage the subcontractors on the project early
  - Constructability Review During Design
- Collocation work environment

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# Project Tools

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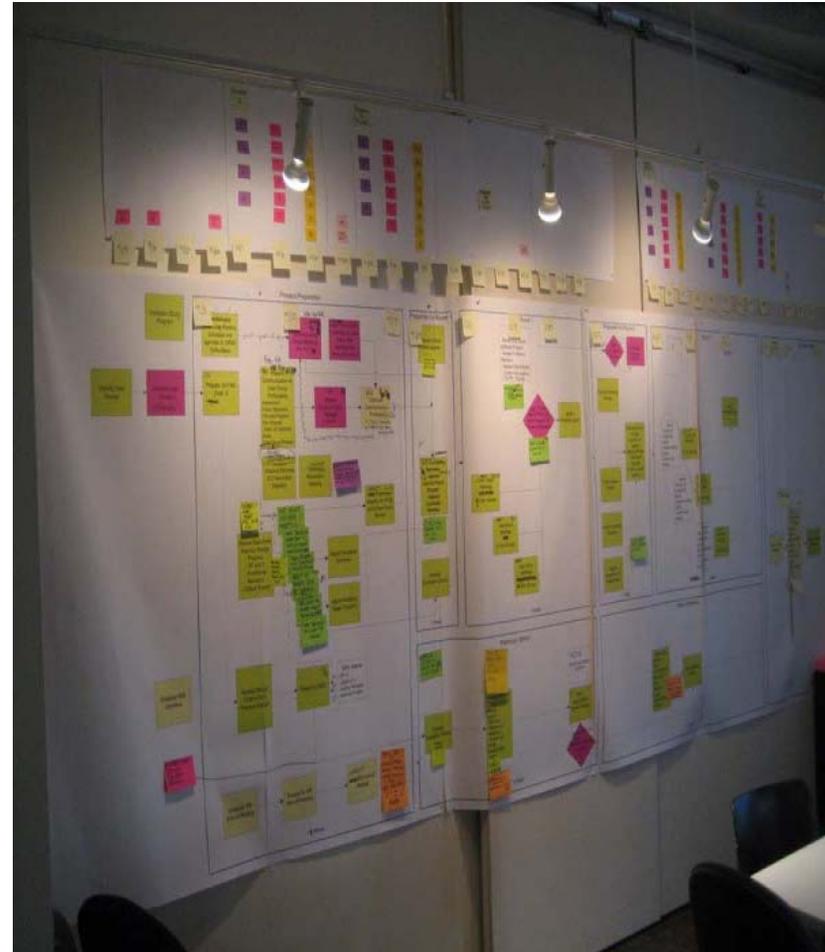
Value Stream Mapping  
Last Planner System® (LPS)

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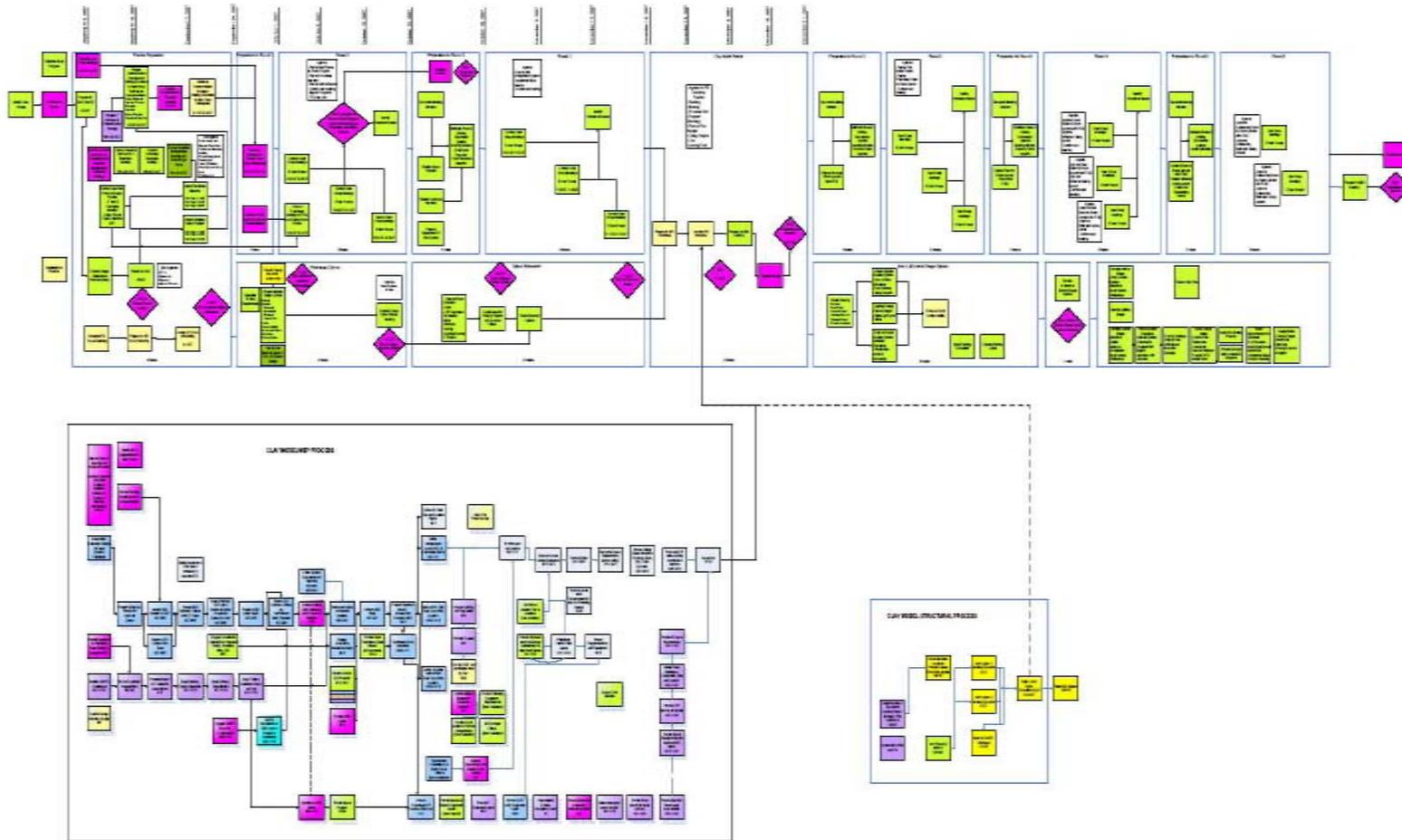
# Value Stream Mapping

- It is a Lean technique used to analyze the flow of materials and information currently required to bring a product or service to a consumer.
- Used to identify opportunities for improvement in lead time.
- Capture Current State or Traditional method.
- Create Future State with Emphasis on Removing Waste.

# Mapping Sessions



# Electronic Capture of VSM



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# Last Planner System®

- PPC Tracking of Reliable Promises
- Plus / Delta Practice
- Share Learning Across the Project
- One week of work at a time
- Done in a collaborative meeting

# Weekly Work Plan Page 1

Integrated Project Delivery Team

Weekly Work Plan

CPMC - Cathedral Hill Hospital

Cathedral Hill Hospital 02-21-2008 WWP													
Integrated Project Delivery Team California Pacific Medical Center Cathedral Hill Hospital Preconstruction			CATEGORIES OF VARIANCE						TOTAL ACTIVITIES				
SCHEDULE ID NUMBER REPEAT ASSIGNMENT DESCRIPTION Criteria for release of assignments Defined - Sound - Proper Sequence - Right Size - Able to Learn RESPONSIBLE PARTY			1	Contracts / Revisions	9	Incorrect Time Estimate	ACTIVITIES COMPLETED		0		PERCENT		N/A
			2	Prior Work Not Complete	10	Off Project Demands	PLANNED COMPLETE:						
			3	Information Not Available	11	Unforeseen Conditions	As Planned		x				
			4	Poor Task Description	12	Other Project Demands	Repeat		x				
			5	Staff Not Available	13	I Forgot	Repeat More than Once		x				
			6	Materials Not Available	14		Released at Risk		abcdef				
			7	Conditions of Satisfaction	15								
			8	Task Sequence Change	16								
			STARTING ON				21-Feb-08		PPC ANALYSIS				
			Thu	Fri	Sat	Mon	Tue	Wed	DONE ?		REASONS FOR VARIANCE		
			21-Feb	22-Feb	23-Feb	25-Feb	26-Feb	27-Feb	YES	NO	Category		
<b>Sutter Health / California Pacific Medical Center</b>													
	x	Schedule Meeting with Navigator for Week of Feb 25 (request from SG Planning Team)	Merv D	x									
	x	Follow-up with Carl G on 3rd Party Plan Reviewer Meeting Date	Merv D	x									
		Verify Approval to Distribute Presentation Material to City Planning	Merv D	x	x		x	x	x				
		Request Verification of 96 hr JAHCO Requirement for Emergency Power (vs 72 hrs)	Merv D	x	x		x	x	x				
		Confirmation that Design Deliverables List Meets Sutter's Expectations to Arlee M	Merv D	x	x		x	x	x				
<b>Degenkolb</b>													
<b>Herrick</b>													
		Put together a ROM for reinforced column wrap	Bob H	x	x		x	x					
		Update the cost model	Bob H		x								
<b>HerreroBoldt</b>													
002574		Submit Draft Construction Data to Marchese	Andy S		x								
		Upload Current Master Schedule to Collaboration Site	Baris L	x									
	x	Create Base Isolation A3 to Core Group	Baris L	x	x								
217105		Issue the PO for DIS prototype testing	Baris L	x	x		x	x	x				
112400		Interviews for shoring D/B scope	Baris L		x								
581300		Review Drywall Proposals and Schedule Final Interviews	Paul K	x	x		x	x	x				
		Finalize RLWP through May 12, 2008 to CPMC	Paul R	x	x		x	x	x				
322700		Draft RFP for Metal Panel Contractor	Rob P	x	x		x	x	x				
<b>Marchese</b>													
		Provide Update on Access to DBC for SG Acoustic Study	Bob P					x	x				
<b>Pankow</b>													
		Put together a ROM for reinforced column wrap	Andy B	x	x		x	x					
	x	Provide Schedule Input to Hakan	Lonnie A	x	x		x	x	x				
	x	Confirm Paul K Escalation Spread	Lonnie A					x					
<b>Rosendin Electric Inc</b>													
		Prepare for MEP Focus at TVD Meeting (lighting)	Bob W	x	x		x	x					
		Complete Electrical Portion of Chiller A3	Bob W	x									
<b>Silverman and Light</b>													

# Weekly Work Plan Page 2

**Integrated Project Delivery Team**

Weekly Work Plan

CPMC - Cathedral Hill Hospital

411600	Provide Additional Detail for OSHPD Phased Submittal to Arlee M	Mike G	X	X		X	X	X					
<b>SmithGroup</b>													
X	Send Scope of Work to SGH to Prepare Proposal	Arlee M	X										
	Finalize RLWP through May 12, 2008 to CPMC	Janette N	X	X		X	X	X					
X	Schedule Turnover of Typical Rooms to MEP	Matt D	X	X		X	X	X					
X	Send Scott Muxen List of lessons learned to be published to the group.	Matt D	X	X									
<b>Southland Industries</b>													
	Prepare for MEP Focus at TVD Meeting	Mike N	X	X		X	X						
	Complete AHU Manufacturer Interviews	Mike N	X	X		X	X						
<b>Ted Jacob Engineering Group</b>													
	Confirm layout of P4 tanks and access to inside of tanks for SG	Shulamit R	X	X		X							
411600	Provide Additional Detail for OSHPD Phased Submittal to Arlee M	Shulamit R	X	X		X	X	X					
	Coordinate with Mechanical/Plumbing and Drop Steel at Courtyard	Shulamit R					X						
<b>Integrated Project Delivery Team</b>													
<b>Core Group</b>													

# Weekly Work Plan Page 3

Integrated Project Delivery Team

Weekly Work Plan

CPMC - Cathedral Hill Hospital

Workable Backlog											
	DESCRIPTION	RESPONSIBLE PARTY	STARTING ON						PPC ANALYSIS		REASONS FOR VARIANCE
			21-Feb-08						DONE?		
			Mon 21-Feb	Tue 22-Feb	Wed 23-Feb	Thu 24-Feb	Fri 25-Feb	Sat 26-Feb	YES	NO Category	
	Schedule Meeting with SF Fire Marshal	Arlee M									
	Present on the Function/Interaction of the Core Group at Next Last Planner	David L									
	Prepare Overview of TVD Plan to Tuesday TVD Meeting	John K									
	Provide Commissioning Plan Update to Core Group	John K									
	Provide FPD Document Check in to Arlee M	Merv D									
	Follow-up to Expedite Payment Process	Paul R									
	A3 for Aluminum Cable	Paul R									
	Propose to IPDT how Escalation Adjustments will be Handled	Paul R									
	Prepare Subcontract Joining Process with Legal Council	Rob P									
	Scott to provide update on Autodesk proposal engagement timeline	Scott M									
	Provide Utility Rates (water, gas, electric) based on current CPMC utility usage	Tony B									

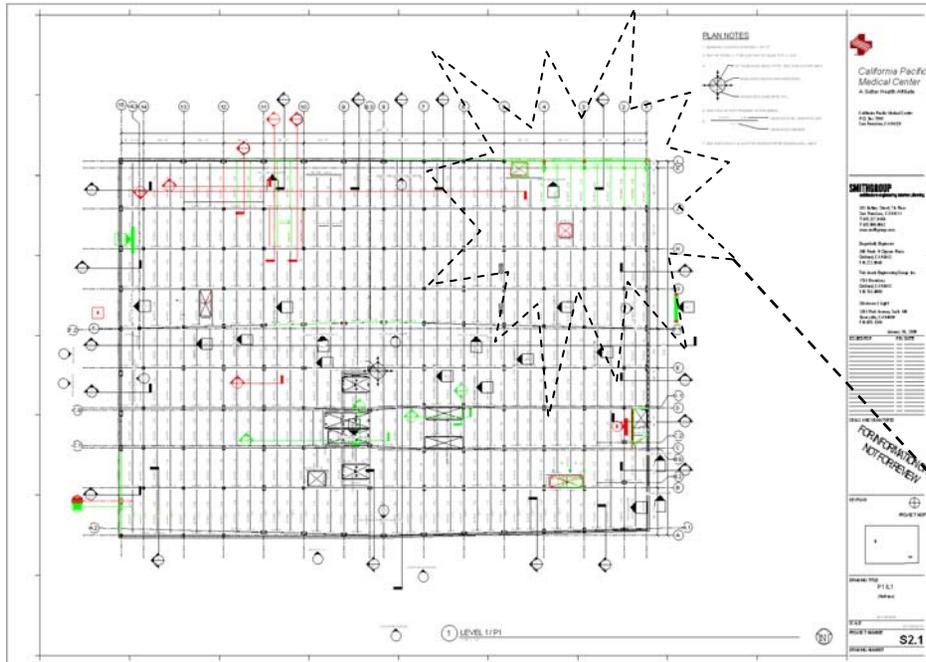
Meeting Parking Lot		
	DESCRIPTION	ORIGINATOR
	Tunnel construction, which project is it in (Hospital or MOB)?	Chuck K

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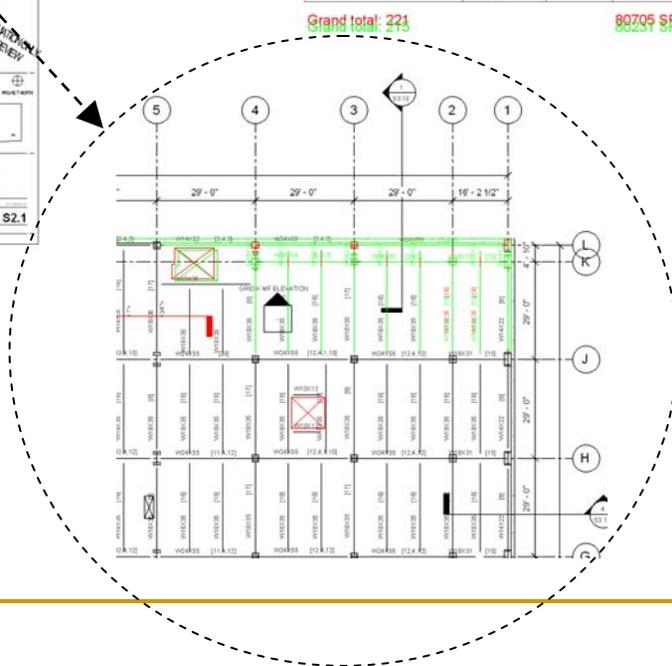
# Software Tools Used

- Revit
  - Architectural
  - Structural
- AutoCAD
  - Third Party
- NavisWorks
- Innovaya
- TimberLine Estimating
- Desktop Take Off
- Primavera P6
- Free Software
  - Autodesk Design review
  - NavisWorks Freedom Viewer

# Sample of Design Review Usage



Wall Material Takeoff					
Family and Type	Description	Width	Material Area	Material Volume	Count
Basic Wall: 10" Damper	VISCOUS WALL DAMPER	0' - 10"	12982 SF	10818.34 CF	172
Basic Wall: 12" Concrete	CONCRETE SHEAR WALL	1' - 0"	2185 SF	2156.06 CF	11
Basic Wall: Exterior - 6" Concrete	STEP FOR LOWERED DECK	0' - 6"	756 SF	361.02 CF	15
Basic Wall: Retaining - 12" Concrete	CONCRETE RETAINING WALL	1' - 0"	15240 SF	15214.83 CF	17
Basic Wall: Retaining - 16" Concrete	CONCRETE RETAINING WALL	1' - 4"	22324 SF	29763.61 CF	4
Basic Wall: Retaining - 18" Concrete	CONCRETE RETAINING WALL	1' - 6"	27219 SF	40828.12 CF	2
<b>Grand total: 224</b>			<b>80705 SF</b>	<b>99141.97 CF</b>	



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# Group Training

- Software Training with Multiple Companies
  - Split cost
  - Fill class
- Class for Project Managers
- Train the Trainers
- What we have done so far

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# Using the Model for Prefabrication

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Production Planning  
CNC Part Cutting  
Fabrication of Assemblies  
Staging Delivery to Field

# Model Used for Production Planning

REL\_PREFAB\_DETAIL\_TPWR#100.001

JOB NAME: \_\_\_\_\_ JOB NUMBER: \_\_\_\_\_ DATE ORDERED: \_\_\_\_\_  
 TYPE: \_\_\_\_\_ QUANTITY: \_\_\_\_\_ DATE REQUIRED: \_\_\_\_\_  
 FORM NO: \_\_\_\_\_ PHONE: \_\_\_\_\_

QTY	SIZE	DESCRIPTION
1.	1 1/2	1 1/2 WATT METAL HALIDE
2.	1 30'	12/2 MC CABLE (BK)
3.	1	SS 2-1/8" 1/2" & 3/4" KO
4.	1	GROUND LEADS
5.	1	POWER LEADS
6.	1	WAGO
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		

ALWAYS VERIFY MATERIALS MEET JOB SPECIFICATIONS

SPECIAL INSTRUCTIONS:

DRAWN DATE: 02-07-2007

**Southland Industries**  
 Design - Build - Maintain  
 775 Commercial Street  
 Redwood City, CA 94063  
 (P) 1-408-878-3277  
 (F) 1-408-970-3276

Job Name:	Carino Medical Group	Date Due on Job:	AM	Download Number:	001
Job Number:	5616373	Detailer Name:	Jerry Shepard	Field Foreman Name:	Jim Burrows
Sheet Number:	OF	Detailer Phone Number:	550-0202	Foreman Phone Number:	408-210-1208

Shop Instructions: Order loose DM/Ward from shop  
 Shipping Instructions: Ship with factory frames.

Clean and Bag Level: None    Exposed: \_\_\_    Weld: \_\_\_    Seal: \_\_\_

Keep T&M Tag: \_\_\_

**Square to Round**

Pattern #:

Color: Brown

Building Level: 1st FLOOR

Building Area: SE

Prefabrication Sheets Directly from the 3d Model.

Above: Sheet Metal for CNC Cutting  
 Left: Electrical Prefabrication

# Model Used for Automatic Part Creation

Today's current practice uses CNC control for automatic cutting of part



Upper: Structural steel cutter.  
Lower: Sheet metal cut from a plasma cutter.

# Model Used for Prefabricated Assembly of Parts

Use of cut sheets to assemble parts



Above: Electrical fab  
Upper right: Structural steel fab.  
Lower right: Sheet metal fab.



# Using the Model to Stage Deliveries to Project



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# VDC Glossary

- 3d: Computer graphics that use 3 dimensional representation of an object having length, width and height.
- ADT: is a version of Autodesk's flagship product, AutoCAD, with tools and functions specially suited to architectural work. The product line was renamed to AutoCAD Architecture in 2008.
- AEC: Architecture, Engineering and Construction
- AIA: American Institute of Architects
- AutoCAD: AutoCAD is a CAD software application for 2D and 3D design and drafting, developed and sold by Autodesk, Inc.
- BIM: Stands for both Building Information Model and Building Information Modeling. It is the process of generating and managing a building information model throughout the life cycle of a building.
- BuildingSMARTalliance: Formerly IAI. To create a format for open interoperability and full lifecycle implementation of building information models.
- CAD: Computer Aided Drafting
- CADD: Computer Aided Design and Drafting
- GSA: General Services Administration. An independent agency of the United States government, established in 1949 to help manage and support the basic functioning of federal agencies. The GSA supplies products and communications for U.S. government offices, provides transportation and office space to federal employees, and develops government wide cost-minimizing policies, among other management tasks.
- IAI: International Alliance for Interoperability.
- IFC: Industry Foundation Classes. Data model that is a neutral and open specification that is not controlled by a singular vendor or group of vendors. It is an object oriented file format with a data model developed by the International Alliance for Interoperability (IAI) to facilitate interoperability in the building industry, and is a commonly used format for Building Information Modeling.
- IFOA: Integrated Form of Agreement Master Contract Agreement used on Sutter Health Projects signed by OAC.
- Integrated Practice or Integrated Project Delivery: Leveraging intellectual and physical resources using the best available tools to produce the highest quality product. It requires everyone on the team to share their knowledge with one another.
- LCI: Lean Construction Institute. Visit [www.leanconstruction.org](http://www.leanconstruction.org).
- LPS: Last Planner System®. System introduced by LCI to create and improve predictability of workflow on a project.

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# VDC Glossary

- Level of Detail: The amount of data carried with in the modeled object.
- MEP: Mechanical, Electrical and Plumbing
- MEP-FP: Mechanical, Electrical, Plumbing and Fire Protection
- Navis: NavisWorks JetStream is a 3D design review package for Microsoft Windows currently developed by Autodesk. JetStream allows users to open and combine 3D models, navigate around them in real-time and review the model using a set of tools including comments, redlining, viewpoint, and measurements. A selection of plug-ins enhances the package adding interference detection, 4D time simulation, photorealistic rendering and PDF-like publishing.
- NCS: National CAD Standards. Standards for CAD drawn files.
- NBIMS: The National Building Information Model Standard project
- *nD*: Beyond 3d.
- NIBS: National Institute for Building Sciences
- NIST: National Institute of Standards and Technology
- OCA: Office of Chief Architect
- PBS: Public Buildings Service
- Revit: Autodesk Revit is architectural BIM software for Microsoft Windows, currently developed by Autodesk, which allows the user to design with parametric modeling and drafting elements. BIM is a new CAD paradigm that allows for intelligent, 3D and parametric object-based design. In this way, Revit provides full bi-directional association. A change anywhere is a change everywhere, instantly, with no user interaction to manually update any view.
- VBE: Virtual Building Environment. See VDC, same as.
- VBR: Virtual Builders Roundtable. A group of construction practitioners that are committed to the development of virtual building process and technology within the construction environment.
- VDC: Virtual Design and Construction. The use of integrated multi-disciplinary performance models of design-construction projects, including the Product (i.e., facilities), Work Processes and Organization of the design - construction - operation team in order to support explicit and public business objectives. "VDC models are virtual because they show computer-based descriptions of the project." (Kunz & Fischer 2007)
- Virtual Building: See VDC, same as.

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# Questions