

NASA Systems Engineering Handbook

Work Breakdown Structure (WBS)

CEE320 VDC Seminar

Sangwoo Cho

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Overview

- Definition of WBS
- Role of WBS
- Development of WBS
- Common Errors of WBS
- Class Discussion: Project Status Reporting



Definition of WBS

“Hierarchical Breakdown of Work”

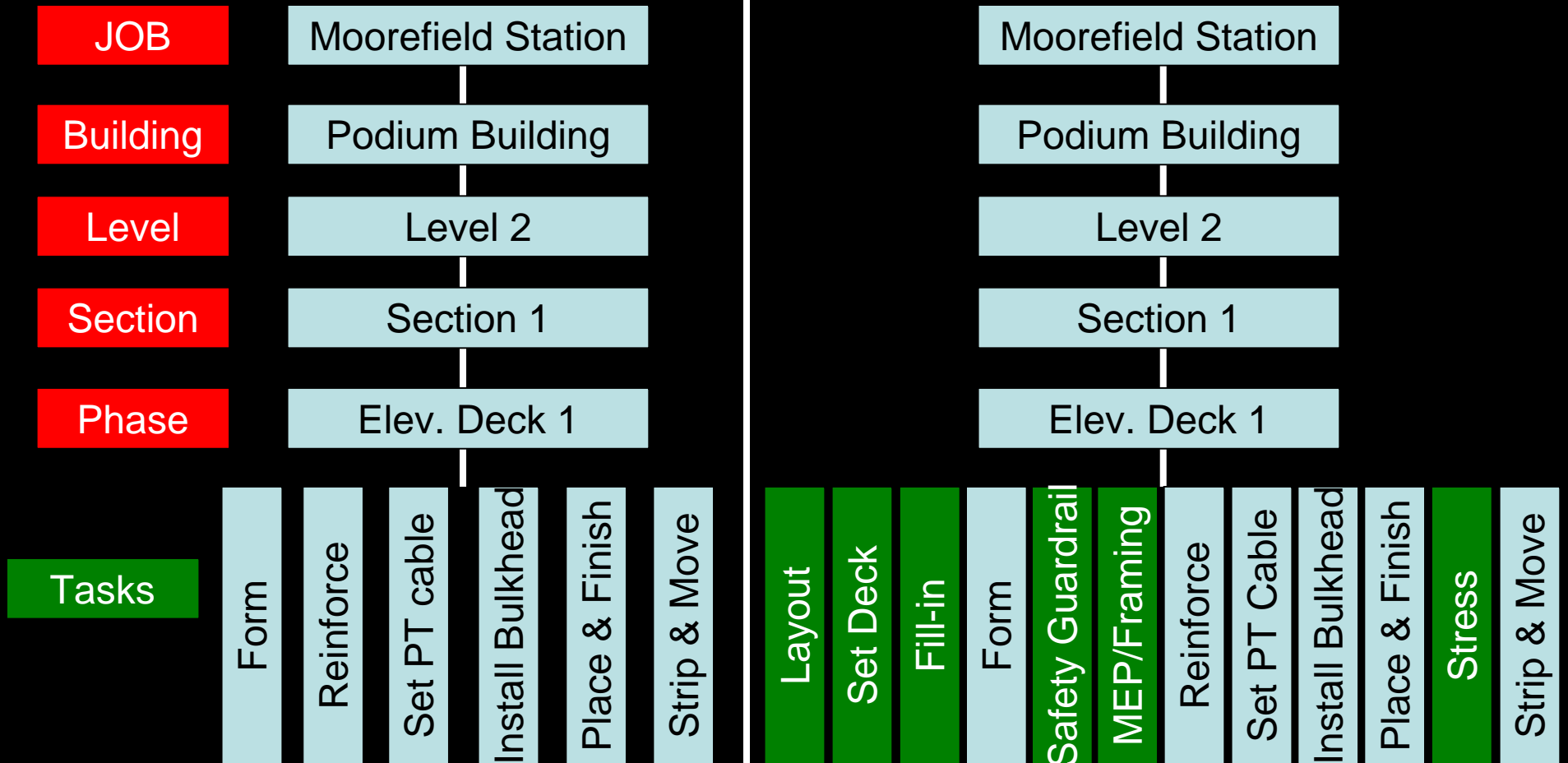
- Product-based
- Hierarchical division of deliverable items and associated services
- Level of Details = Management’s desire for cost account level appropriate to risks to be managed
- WBS = PBS plus any necessary service elements
 - : - management
 - Engineering
 - Fabrication
 - Verification



Definition of WBS: WBS vs PBS

PBS

WBS

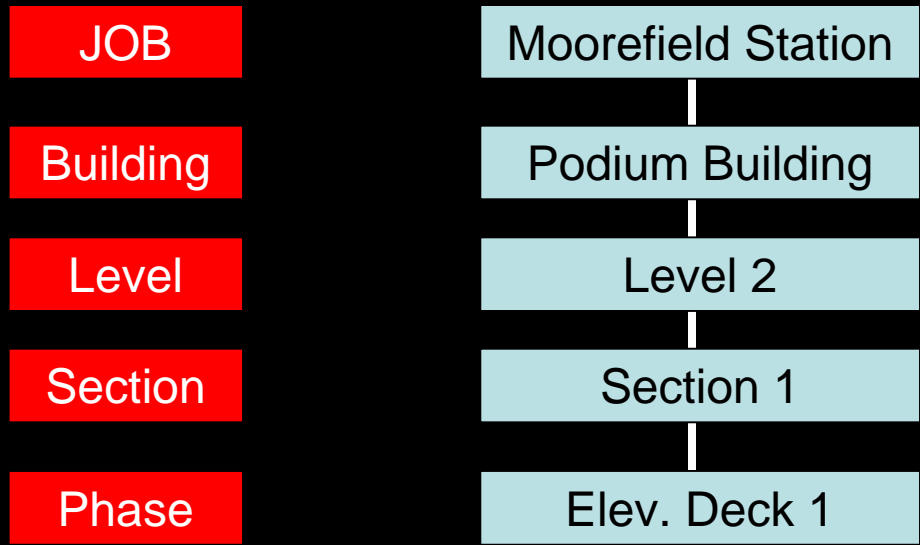


Source: Accu-Crete

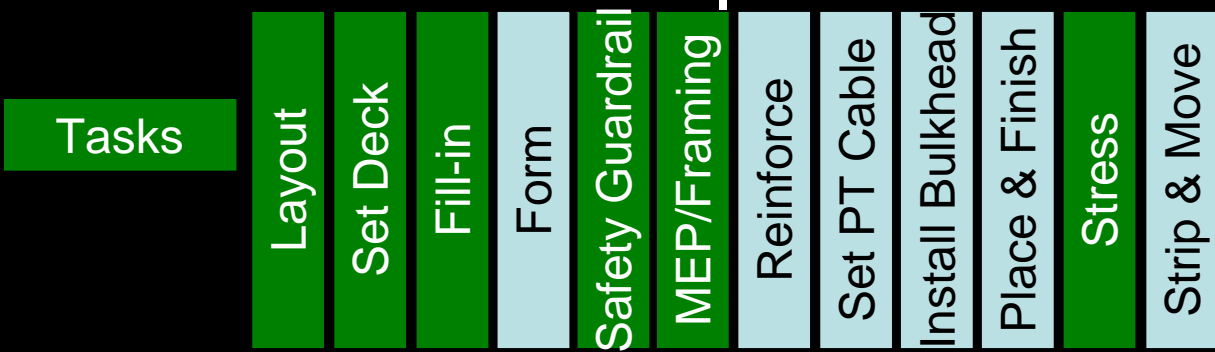


Definition of WBS: WBS vs PBS

WBS



Elevated Slab		9.5d	Jan-15-09 ...	Jan-29-09 ...		
P.L2.51000-20	Layout	0.1d	Jan-15-09 ...	Jan-15-09 ...		
P.L2.51300-10	Set Deck (SET #1 - 11,284 SF)	2.5d	Jan-15-09 ...	Jan-20-09 ...		
P.L2.51300-20	Fill-in	2.0d	Jan-16-09 ...	Jan-20-09 ...		
P.L2.51300-30	Edge Form and Anchors	2.0d	Jan-16-09 ...	Jan-20-09 ...		
P.L2.51300-50	Safety Guardrail	1.0d	Jan-19-09 ...	Jan-20-09 ...		
P.L2.OT-10	MEP/Framing	0.5d	Jan-19-09 ...	Jan-20-09 ...		
P.L2.54000-10	Steel/PT	3.0d	Jan-19-09 ...	Jan-22-09 ...		
P.L2.51300-40	Bulkhead	1.0d	Jan-21-09 ...	Jan-22-09 ...		
P.L2.51700-10	Pour	1.0d	Jan-22-09 ...	Jan-23-09 ...		
P.L2.54000-20	Stress	1.0d	Jan-26-09 ...	Jan-27-09 ...		
P.L2.51800-10	Strip and Move	1.5d	Jan-27-09 ...	Jan-29-09 ...		

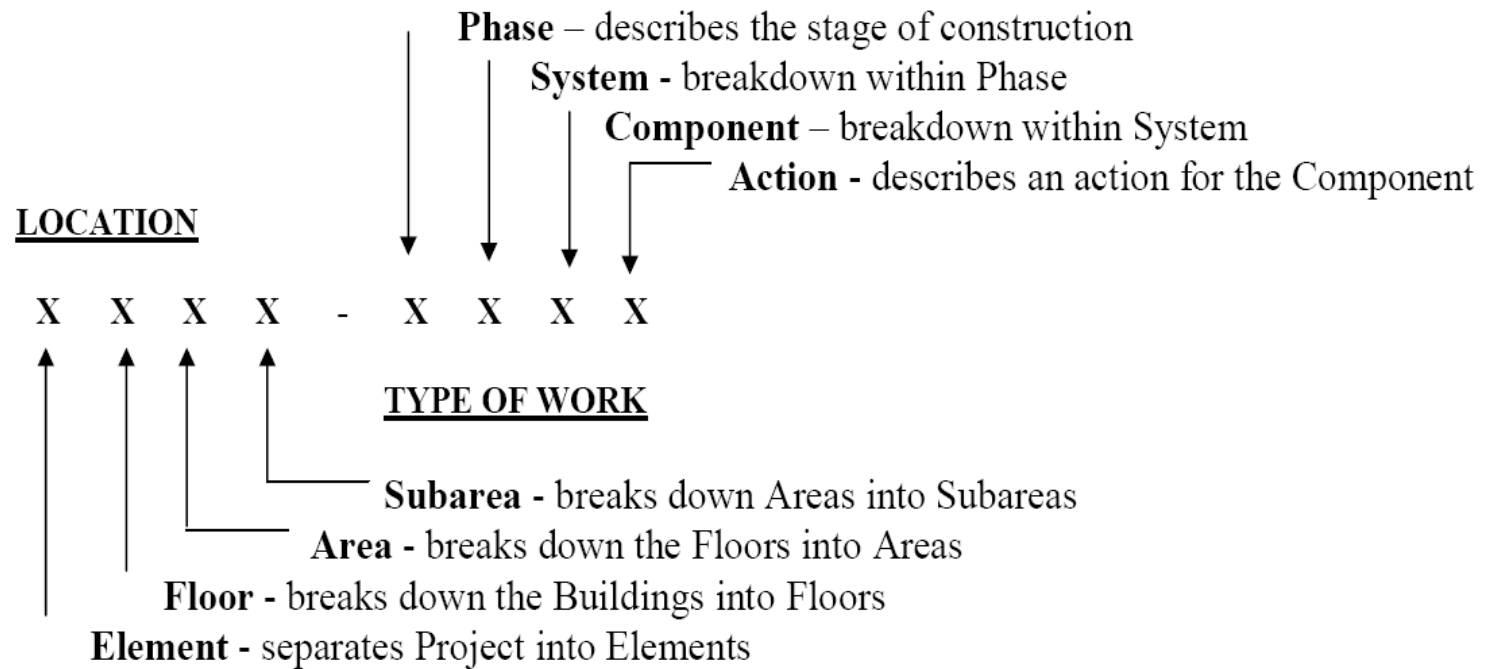


Source: Accu-Crete



Definition of WBS: In Practice

Work Breakdown Structure



Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	2000						
					JUL	AUG	SEP	OCT	NOV	DEC	
2400-32101	F/R/P SOMD Lvl 4 Elem2 Seq 7	4	03NOV00	08NOV00							
2500-32101	F/R/P SOMD Lvl 5 Elem2 Seq 8	4	09NOV00	14NOV00							
2600-32101	F/R/P SOMD Lvl 6 Elem2 Seq 13	4	16NOV00	21NOV00							
2700-32101	F/R/P SOMD Lvl 7 Elem2 Seq 14	4	27NOV00	01DEC00							
2800-32101	F/R/P SOMD Roof Elem2 Seq 15	4	05DEC00	08DEC00							

Source: Mortenson, Walt Disney Concert Hall Project



Role of WBS

- Project and Technical Planning and Scheduling
- Cost Estimating and Budget Formulating
- Scope Defining
- Project Status Reporting
- Product Documenting



Development of WBS

“Top-Down Structure”

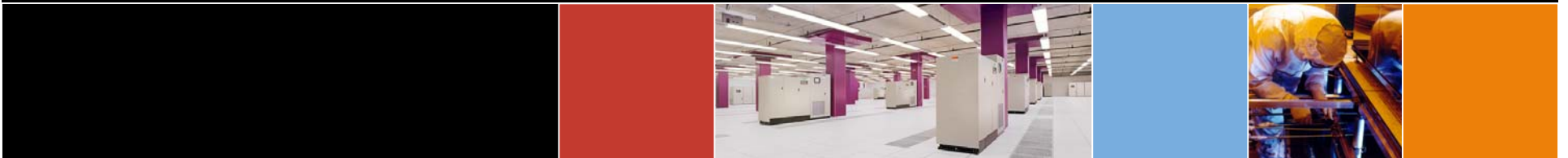
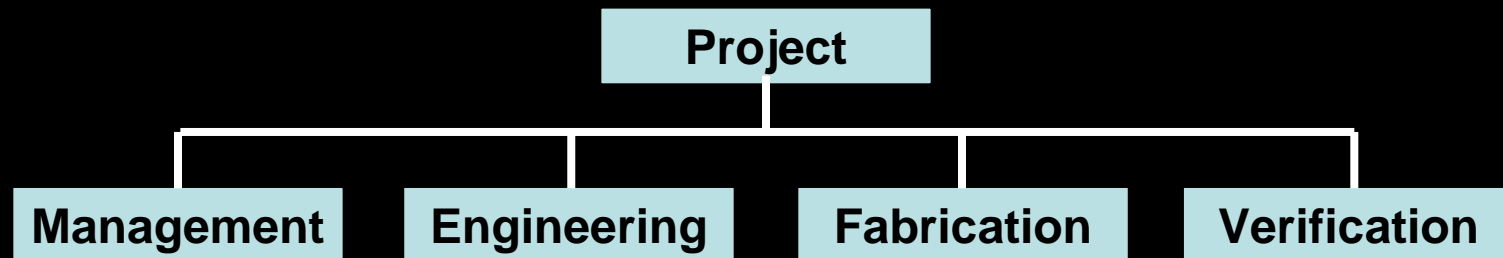
1. Develop PBS
2. Define Appropriate Services
 - Management
 - Engineering
 - Fabrication
 - Verification
 - Activities not modeled
3. Derive WBS by Combining 1 + 2



Common Errors of WBS

1. Functions Without Products

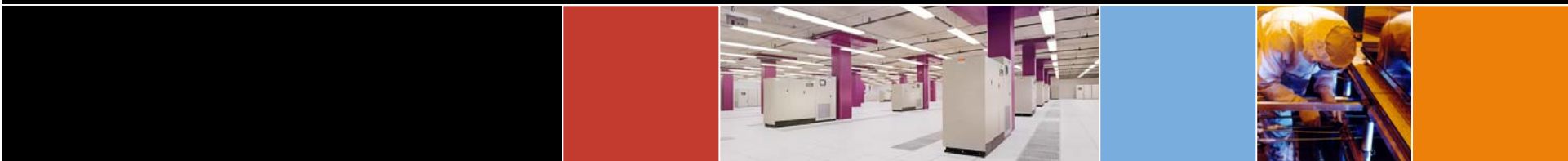
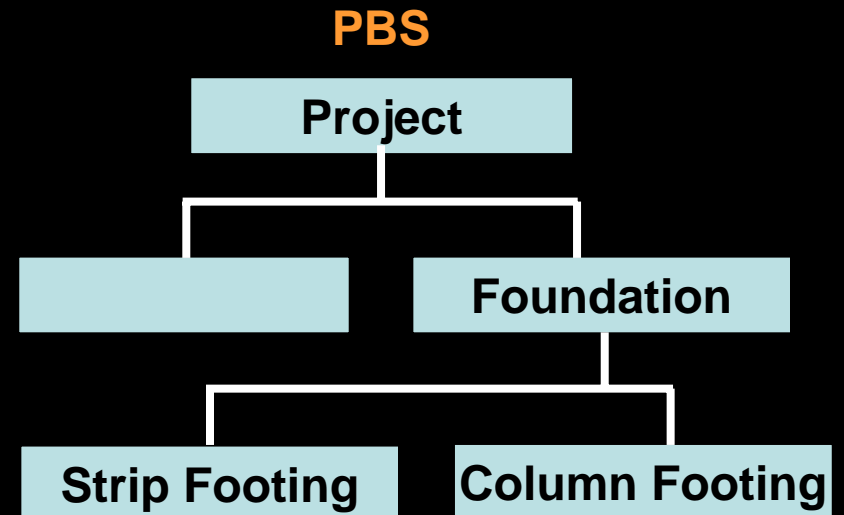
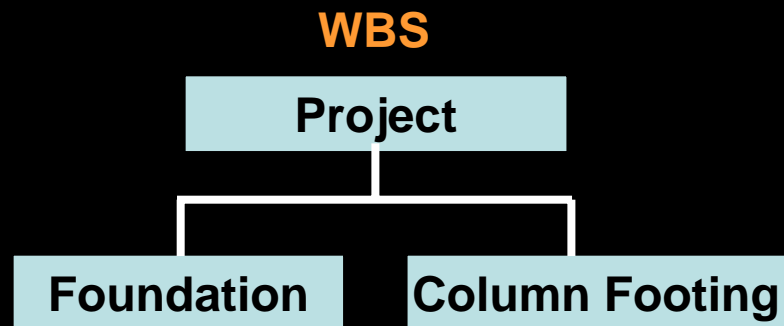
: This WBS describes only functions, not the products



Common Errors of WBS

2. Inconsistency with PBS

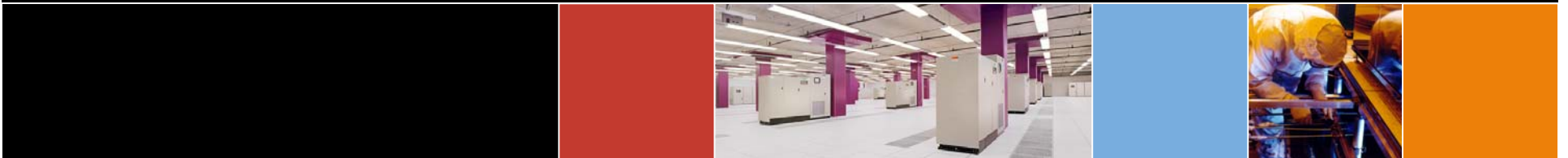
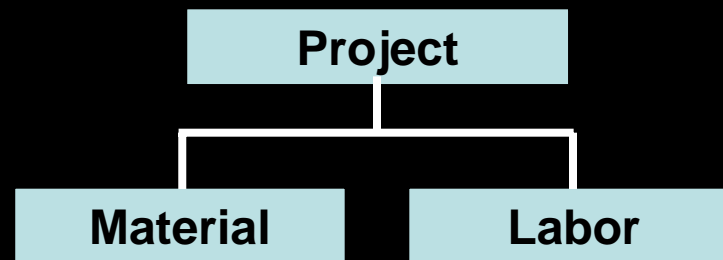
: This WBS is inconsistent with PBS



Common Errors of WBS

3. Inappropriate Branches

: This WBS has branch points that are not consistent with the way the WBS elements will be integrated



Class Discussion: Project Status Reporting

CCC's Seven Level Work Breakdown Structure

1. Construction project
 2. Construction areas (section engineer, project engineer, superintendent)
 3. Subareas (site engineer, superintendent)
 4. Discipline/Standard building units (bill item)
 5. Activities (bill item, how client is billed)
 6. Cost: Workgroup
 7. Cost: Operations/cost code
6. Progress: Objects

Source: CCC



Class Discussion: Project Status Reporting

DPR Construction
Drywall - Quantity Complete

Job Name: Revised Stanford T.I
Job No: 01-26013-DI

Foreman: MARK

Description	mPower Cost Code	Est. Q.		Hrs.	Prev. Wk Qty Cmplte	Current Week	Total Qty	Wkly Hours Used	Total Hours Used	Hours Remaining
	0110 →	12800								
Layout Interior	08-0120	2,500	EA	2,500	2474	—	2474	2058	2474	26
Frame Full.Ht Walls	08-0130	25,630	LF	6,615	23767	324	24091	32	5602	1013
Bracing	08-0141	2,318	EA	345	2180	—	2180	—	312	33
Wall Furring	08-0150	567	LF	176	567	—	567	—	146	30
Frame Shaft Walls	08-0160	2,554	LF	963	2500	100	2600	48	886	77
Frame Soffits	08-0180	7,500	LF	2,682	6794	358	7152	112	1938	744
Frame Ceilings	08-0190	46,615	SF	2,097	34736	2112	36848	88	1671	426
Specialty Frame	08-0210	4,169	EA	4,169	3805	64	3869	3924	3869	300
Welding	08-0240	400	EA	400	104	—	104	—	104	296
Install Insulation	08-0250	308,618	SF	1,110	166541	—	166541	—	662	448
Acoustic Caulk	08-0260	1,960	LF	44	3375	—	3375	—	75	-31
Install Backing	08-0270	186,452	LF	4,244	152352	2880	155232	96	3756	488
Hang Drywall	08-0280	1,056,904	SF	12,267	997929	23936	1021865	272	11793	474
Install Reveals	08-0310	1,720	LF	80	1150	—	1150	—	46	34
Stocking Materials	08-0360	143	EA	143	124	—	124	134	124	19
Scapping Clean/Up	08-0370	2,610	EA	2,610	884	—	884	1092	884	—
Fire Caulking	08-0380	35,298	LF	1,270	23155	480	23655	16	882	388
Fire Spray	08-0381	33,932	LF	1,222	14838	1440	16278	48	560	662
Training	08-0389	75	EA	75	140	—	140	150	140	-65
DRYWALL PATCHING	08-0281				105	—	105	121	105	
TOTALS:				43,012				776	36029	5362

This Report for Period/Week Ending 8-1-08

Source: DPR Construction Inc.



Class Discussion: Project Status Reporting



Job Costing - Total Cost Report
Detail by Phase
01-DPR Construction, Inc - RWC

Date: 08/07/08
Time: 01:15 PM
Page: 1 of 2

Job	Phase	Cat	Control Estimate	Approved External Changes	Category Transfers	Revised Estimate	Pending Change Orders	ROM Change Orders	Projected Contract	Committed Costs	Do Not Proceed	Do Not Proceed Anticipated	Projected Total Costs	Over/Under	
26013-DI	Stanford Outpatient Center - TI Drywall														
08-0100	Drywall System	51	0	10,825	0	10,825	0	0	10,825	0	0	0	10,825	10,825	0
08-0102	DW: Gypsum Board - Material	20	389,000	0	0	389,000	0	0	389,000	159,057	0	0	106,432	284,489	124,511
08-0103	DW: Vendor Stocking	20	70,000	0	0	70,000	0	0	70,000	57,730	0	0	19,321	77,051	-7,051
08-0104	DW: Fasteners - Material	20	71,000	0	0	71,000	0	0	71,000	45,004	0	0	14,785	56,789	11,231
08-0105	DW: Caulking/Sealant - Material	20	113,000	0	0	113,000	0	0	113,000	15,789	0	0	15,675	31,467	81,533
08-0106	DW: Metal Framing Materials	20	900,694	0	0	900,694	0	0	900,694	726,799	0	0	276,543	1,003,342	-102,640
08-0107	DW: Specialty Components - Material	20	178,000	0	0	178,000	0	0	178,000	22,449	0	0	159,876	182,325	-4,325
08-0109	DW: Equipment / Other	30	158,000	0	0	158,000	0	0	158,000	165,152	0	0	49,321	214,473	-58,473
08-0110	DW: Drywall Supervision	10	150,000	0	0	150,000	0	0	150,000	117,805	0	0	8,701	126,506	23,494
08-0120	DW: Layout - Drywall	10	241,300	0	0	241,300	0	0	241,300	218,281	0	0	32,028	250,309	-9,009
		30	0	0	0	0	0	0	0	963	0	0	0	963	-963
08-0130	DW: Frame Full Ht. Walls	10	514,500	0	0	514,500	0	0	514,500	404,495	0	0	11,701	416,196	98,304
08-0141	DW: Wall Bracing	10	26,810	0	0	26,810	0	0	26,810	29,661	0	0	1,255	30,916	-4,106
08-0150	DW: Wall Furring	10	12,320	0	0	12,320	0	0	12,320	12,475	0	0	0	12,475	-155
08-0160	DW: Install Shaftwall	10	74,830	0	0	74,830	0	0	74,830	62,997	0	0	0	62,997	11,833
08-0180	DW: Frame Soffits	10	208,600	0	0	208,600	0	0	208,600	144,613	0	0	5,297	149,910	58,690
08-0180	DW: Frame Soffits	10	163,100	0	0	163,100	0	0	163,100	121,131	0	0	18,152	139,283	23,817
08-0190	DW: Frame Ceilings	10	324,240	0	0	324,240	0	0	324,240	297,256	0	0	14,785	312,041	12,199
08-0210	DW: Specialty Framing, Radius, Etc	10	31,080	0	0	31,080	0	0	31,080	8,817	0	0	11,988	20,805	10,475
08-0240	DW: Welding	10	86,310	0	0	86,310	0	0	86,310	54,513	0	0	11,740	66,253	20,057
08-0250	DW: Wall Insulation	20	75,000	0	0	75,000	0	0	75,000	47,346	0	0	2,345	49,691	25,309
08-0260	DW: Acoustic Caulk	10	3,430	0	0	3,430	0	0	3,430	9,613	0	0	0	9,613	-6,183
08-0270	DW: Install Strap Beacking	10	330,050	0	0	330,050	0	0	330,050	268,967	0	0	22,201	291,168	38,882
08-0280	DW: Hang Drywall Walls	10	954,030	0	0	954,030	0	0	954,030	848,080	0	0	23,343	871,423	82,607
08-0281	DW: Drywall Patch	10	20,000	0	0	20,000	0	0	20,000	8,793	0	0	7,193	15,987	4,013
08-0310	DW: Arch. Reveals	10	6,020	0	0	6,020	0	0	6,020	3,395	0	0	1,668	5,032	988
08-0360	DW: Stocking Materials	10	11,130	0	0	11,130	0	0	11,130	9,691	0	0	692	10,383	747
08-0370	DW: Scrapping/Clean-Up	10	203,000	0	0	203,000	0	0	203,000	98,933	0	0	52,403	151,336	51,664
08-0380	DW: Fire Caulking	10	94,990	0	0	94,990	0	0	94,990	83,465	0	0	13,146	76,631	18,359
08-0381	DW: Fire Spray	10	94,990	0	0	94,990	0	0	94,990	30,817	0	0	16,143	46,981	48,029
08-0389	DW: Training / Safety	10	10,500	0	0	10,500	0	0	10,500	16,146	0	0	0	16,146	-5,646
		40	-13,061	0	0	-13,061	0	0	-13,061	622	0	0	-13,683	-13,061	0
08-0400	DW: Taping General	10	96,810	0	0	96,810	0	0	96,810	75,822	0	0	21,471	97,292	-492
		20	45,000	0	0	45,000	0	0	45,000	28,377	0	0	12,088	40,475	4,525
		30	10,000	0	0	10,000	0	0	10,000	0	0	0	3,212	3,212	6,788
08-0401	DW: Taping Top Coat	10	131,670	0	0	131,670	0	0	131,670	95,187	0	0	22,425	117,612	14,058

Source: DPR Construction Inc.



Class Discussion: Project Status Reporting

1. What are limitations of utilizing WBS-generated schedule for project status reporting?
2. Is it possible to generate cost-loaded WBS-generated schedule?
3. How do we match WBS operations not modeled with cost codes?

