



Appendix B Cost Adjustment Factors

This appendix provides information on how to calculate and apply cost adjustment factors, including those for escalation, area cost, and health and safety productivity.

Escalation

Costs that have been derived from sources that are one year old or more should be updated or escalated to the base year. This can be done using the following equation:

$$C_b = C_o (F_b / F_o)$$

where C_b is the base year or current cost, C_o is the old cost, F_b is the base year or current index factor, and F_o is the index factor for the old cost.

Escalation indexes are available from both private and public sources. Most are published on a monthly or annual basis. An example index is Engineering News Record's (ENR) building cost index, which is based on a 20-city average of labor rates for bricklayers, carpenters, and iron workers plus material costs for structural steel, portland cement, and lumber using a certain number of labor hours and material quantity. Monthly factors for this index, from January 1978 to July 2000, are shown in Exhibit B-1. The index is also available at

<http://www.enr.com/cost/costbci.asp>.

Exhibit B-1 ENR Building Cost Index													
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG.
1978	1609	1617	1620	1621	1652	1663	1696	1705	1720	1721	1732	1734	1674
1979	1740	1740	1750	1749	1753	1809	1829	1849	1900	1900	1901	1909	1819
1980	1895	1894	1915	1899	1888	1916	1950	1971	1976	1976	2000	2017	1941
1981	2015	2016	2014	2064	2076	2080	2106	2131	2154	2151	2181	2178	2097
1982	2184	2198	2192	2197	2199	2225	2258	2259	2263	2262	2268	2297	2234
1983	2311	2348	2352	2347	2351	2388	2414	2428	2430	2416	2419	2406	2384
1984	2402	2407	2412	2422	2419	2417	2418	2428	2430	2424	2421	2408	2417
1985	2410	2414	2406	2405	2411	2429	2448	2442	2441	2441	2446	2439	2428
1986	2440	2446	2447	2458	2479	2493	2499	2496	2504	2511	2511	2511	2483
1987	2515	2510	2518	2523	2524	2525	2538	2557	2564	2569	2564	2589	2541
1988	2574	2576	2586	2591	2592	2595	2598	2611	2612	2612	2616	2617	2598
1989	2615	2608	2612	2615	2616	2623	2627	2637	2660	2662	2665	2669	2634
1990	2664	2668	2673	2676	2691	2715	2716	2716	2730	2728	2730	2720	2702
1991	2720	2716	2715	2709	2723	2733	2757	2792	2785	2786	2791	2784	2751
1992	2784	2775	2799	2809	2828	2838	2845	2854	2857	2867	2873	2875	2834
1993	2886	2886	2915	2976	3071	3066	3038	3014	3009	3016	3029	3046	2996
1994	3071	3106	3116	3127	3125	3115	3107	3109	3116	3116	3109	3110	3111
1995	3112	3111	3109	3100	3096	3095	3114	3121	3109	3117	3131	3128	3112
1996	3127	3131	3135	3148	3161	3178	3190	3218	3246	3284	3304	3311	3203
1997	3332	3333	3323	3364	3377	3396	3392	3385	3378	3372	3350	3370	3364
1998	3363	3372	3368	3375	3374	3379	3382	3391	3414	3423	3424	3419	3391
1999	3425	3417	3411	3421	3422	3433	3460	3474	3504	3505	3498	3497	3456
2000	3503	3523	3536	3534	3558	3553	3545						

Area Cost Factors

Costs that are based on national averages or on geographic locations other than the site should be adjusted for location using area cost factors (ACFs). This can be done using the following equation:

$$C_s = C_o (F_s / F_o)$$

where C_s is the cost for the site location, C_o is the cost based on other location, F_s is the area cost factor for the site, and F_o is the area cost factor for other location.

ACFs are available from both private and public sources. Most are updated yearly for their publication. National and state averages for ACFs (current as of March 10, 2000), as maintained by the USACE for military construction use, are provided in Exhibit B-2 below, as an example. These factors are based on local construction costs of labor, material, and equipment, and other factors such as weather, climate, seismic, mobilization, overhead and profit, labor availability, and labor productivity. The most current ACFs can be downloaded through the USACE Cost Engineering Branch website at <http://www.hq.usace.army.mil/cemp/e/es/pax/321/321.pdf>.

Exhibit B-2			
USACE Area Cost Factors as of March 10, 2000			
Location	Area Cost Factor	Location	Area Cost Factor
Alabama	0.85	Nebraska	0.94
Alaska	1.61	Nevada	1.14
Arizona	0.98	New Hampshire	1.05
Arkansas	0.87	New Jersey	1.18
California	1.18	New Mexico	1.01
Colorado	1.03	New York	1.23
Connecticut	1.05	North Carolina	0.85
Delaware	1.02	North Dakota	1.04
Florida	0.87	Ohio	0.99
Georgia	0.85	Oklahoma	0.87
Hawaii	1.48	Oregon	1.10
Idaho	1.06	Pennsylvania	1.03
Illinois	1.15	Rhode Island	1.06
Indiana	0.99	South Carolina	0.87
Iowa	1.06	South Dakota	0.95
Kansas	0.93	Tennessee	0.87
Kentucky	0.94	Texas	0.82
Louisiana	0.89	Utah	1.03
Maine	1.06	Vermont	0.92
Maryland	0.89	Virginia	0.92
Massachusetts	1.12	Washington	1.07
Michigan	1.17	West Virginia	0.95
Minnesota	1.07	Wisconsin	1.14
Mississippi	0.87	Wyoming	0.99
Missouri	0.97	Washington, D.C.	0.95
Montana	1.13	National Average	1.00

Health and Safety Productivity

Unless effects are already accounted for, factors that reflect decreased productivity due to required health and safety levels of protection should be applied to costs for labor and construction equipment used in a crew makeup. The levels of protection, which are determined based on the hazards to workers that might be present at a hazardous waste site, are classified as follows:

- ◆ Level A: Fully encapsulating vapor-tight suit with full-facepiece, self-contained breathing apparatus (SCBA) or supplied-air respirator.
- ◆ Level B: Totally encapsulating suit, not necessarily vapor-tight, with full-facepiece SCBA or supplied-air respirator.
- ◆ Level C: Chemical protective, full body suit with full-face, canister air-purifying respirator.
- ◆ Level D: Basic work uniform (i.e., coveralls, gloves, hardhat, boots, faceshield or goggles). Modified Level D adds a chemical protective, full body suit (i.e., Level C without respirator).

Factors associated with decreased productivity due to protective equipment and clothing as described above include restricted mobility, heat stress requiring break time, and time for safety meetings, suit-up, suit-down, decontamination, and air tank changes. All of these factors reduce crew production rates.

As an example, the productivity factors used by the USACE for Hazardous, Toxic, and Radioactive Waste (HTRW) projects are shown in Exhibits B-3 and B-4, for light and heavy work, respectively, as published in *Construction Cost Estimates* (USACE 1997). The factors in these exhibits are based on a productivity study conducted in 1994 and are applied to crew production rates in the Unit Price Book (UPB), which are based on “clean” site conditions, to develop adjusted rates based on the health and safety level of protection. The decreased production rate has an impact on cost by either increasing the time required to complete the activity or prompting the cost engineer to add crews.

As an approximate method (e.g., development of cost estimate during FS), the inverse of these factors can be applied to the unadjusted cost of an element to reflect decreased productivity for that item. This can be done using the following equation:

$$C_l = C_o (1 / F_l)$$

where C_l is the cost for the assumed level of protection, C_o is the cost unadjusted for level of protection, and F_l is the productivity factor from Exhibit B-3 or B-4.

The productivity factors do not apply to material costs, treatment equipment costs, or other costs that do not include crew costs.

Exhibit B-3**HTRW Productivity Factors - Light Work**

VARIABLES	U/M	LEVEL A			LEVEL B			LEVEL C			LEVEL D MODIFIED			LEVEL D		
		T < 70	70<T<85	T > 85	T < 70	70<T<85	T > 85	T < 70	70<T<85	T > 85	T < 70	70<T<85	T > 85	T < 70	70<T<85	T > 85
A. Standard Losses	Min	160	160	160	140	140	140	128	128	128	76	76	76	32	32	32
B. Scheduled / Heat Stress Breaks	Min	60	90	120	43	65	86	35	63	101	30	47	63	30	33	44
C. Dexterity Losses	Min	78	69	60	74	69	64	55	51	44	4	4	3	5	5	5
D. Total Time Lost per 8 hr MD	Min	298	319	340	257	274	290	218	242	273	110	127	142	67	70	81
E. Productive Time per 8 hr MD	Min	182	161	140	223	206	191	262	238	207	370	353	338	413	410	399
F. Productive Time on Clean Site	Min	430	430	430	430	430	430	430	430	430	430	430	430	430	430	430
G. HTRW Productivity Factor		0.42	0.37	0.33	0.52	0.48	0.44	0.61	0.55	0.48	0.86	0.82	0.79	0.96	0.95	0.93

Notes: 1. Standard Losses account for all time losses independent of temperature variations. They include safety meetings, instructions, donning / doffing PPE, decontamination, switching air supply / filters, monitoring delays, and cleanup.

2. Scheduled / Heat Stress Breaks account for all paid rest periods per manday.

3. Dexterity Losses are based on subjective opinions of the percentage that PPE slows down a normal worker because of factors such as discomfort, clumsiness, weight, and restricted breathing and communication. The number of minutes actually worked is reduced by the percentage representing the average response for that particular PPE level.

4. Values for A, B, and C were derived by averaging the survey responses for each PPE level. Responses that varied greatly from the average were subject to omission at the author's discretion.

5. Total Paid Time = 480 minutes

6. 50 min delay on clean site = 10 min. safety meeting & instructions + 10 min. cleanup + 30 min. breaks

7. Calculations: D = A + B + C U/M = Unit of Measure
 E = 480 - D MD = Man-Day
 F = 480 - 50 Min = Minutes
 G = E / F T = Temperature Farenheit

8. Level A protection is used in extreme emergency situations only. Productivity factors for Level A should be used with caution because they were extrapolated from 2 data points.

Source: Engineering Instructions (EI 01D0101) - Construction Cost Estimates (USACE 1997)

