ARMED SERVICES BOARD OF CONTRACT APPEALS

Appeals of --	)	
	)	
Lamb Engineering & Construction Company	)	ASBCA Nos. 53304, 53356, 53357,
	)	53358, 53359
Under Contract No. DAHA02-98-C-0001	)	

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OPINION BY ADMINISTRATIVE JUDGE REED

These appeals arise under a construction contract. The underlying claims involve alleged directed or constructive changes, mostly arising out of specifications that are claimed to be ambiguous or defective, and differing site conditions. The Board will decide entitlement only.

Two other appeals were previously docketed under the contract as ASBCA Nos. 53360 and 53361. Under ASBCA No. 53360, the Board issued a decision on a government motion for partial summary judgment concerning the government's delay in awarding the contract. *Lamb Engineering & Construction Co.,* ASBCA No. 53360, 03-1 BCA ¶ 32,055. The parties later settled or withdrew those portions of the claims and appeals related to delays, inefficiencies, acceleration, and liquidated damages. By a Dismissal Order dated 10 July 2003, ASBCA Nos. 53360 "(Delay, Inefficiencies and Acceleration)" and 53361 "(Liquidated Damages)" were "dismissed with prejudice" and ASBCA Nos. 53304, 53356, 53357, 53358, and 53359 were "partially dismissed only to the extent of any and all delay and acceleration claims submitted by appellant."

FINDINGS OF FACT

Solicitation and Award of the Contract

1. On 29 October 1997, the Departments of the Army and the Air Force, National Guard Bureau, U.S. Property and Fiscal Officer for Arizona (the government), issued an invitation for bids (IFB) concerning a project to modify 28 ammunition storage magazines, also known as "igloos," located at Camp Navajo, Bellemont, Arizona, to allow for storage of Trident I rocket motors. Expansion of a rail holding area, utility work, and site improvements were included in the project. (Government's Board Rule 4 appeal file, ASBCA No. 53304 (53304-R4), tab 1 at 1, 3, 18, tab 2 at 1; government's Board Rule 4 appeal file, ASBCA Nos. 53356, 53357, 53358, 53359, 53360, 53361 (53356-R4), tab 2 at 40, specifications § 01140, ¶ 1.1.1a.) As revised, the IFB consisted of almost 600 pages of contractual documents and specifications, and about 100 contract drawings. The project was designed by ICF Kaiser Engineers, Inc. (ICF), Oakland, California, an architect-engineer contractor (A-E) for the Department of the Navy, Southwest Division, Naval Facilities Engineering Command under a separate contract. (Tr. 7/190-96; 53304-R4, tab 2 at 2; 53356-R4, tabs 2-3)

2. The IFB incorporated by reference the following pertinent standard provisions: FAR 52.233-1, DISPUTES (OCT 1995)--ALTERNATE I (DEC 1991); FAR 52.236-2, DIFFERING SITE CONDITIONS (APR 1984); FAR 52.236-3, SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK (APR 1984); FAR 52.243-4, CHANGES (AUG 1987); FAR 52.246-12, INSPECTION OF CONSTRUCTION (AUG 1996) (53304-R4, tab 1 at 5-6).

3. The drawings and specifications show and describe the typical existing igloo as a soil-covered, reinforced concrete, half-cylinder or arch shaped structure, about 81 feet long and about 26 feet wide at the floor elevation with vertical walls enclosing the rear and the front (53356-R4, tab 2 at 34-35, specifications § 01110, ¶ 1.1.1, tab 3, drawing A-3, IGLOOS TYPICAL FLOOR PLAN).

4. Lamb Engineering & Construction Company (LEC, contractor, or appellant) participated in a pre-bid site visit in December 1997 or January 1998. LEC was represented at the pre-bid site visit by its chief estimator, Gary Baird. Snow partially covered the ground at the time of the site visit. Among other activities, participants toured the site on a large motor coach type bus, including a visit to the borrow area described in the specifications at § 02301, ¶ 2.1.2.5. The borrow area consisted of one large stockpile of soils materials for use by the awardee. The stockpile varied from 10 to 20 feet higher than the surrounding terrain at the highest points, was about 40-50 feet wide, and was 350-500 feet long. It was perpendicular to the main road, that is, the participants primarily could see the width of the stockpile, not the length, which stretched away from the main road. Another contractor had been borrowing materials from the

stockpile at the end nearest the main road within 4 months previous to the site visit. The bus twice drove slowly past the stockpile on the main road about 100 yards from the stockpile. From that distance, with snow on some portions of the ground, one could see larger clumps of soils materials including rocks or hard material as defined below. However, we find that one would not be able to discern the size, consistency, or character of such materials. (Finding 10, below, § 02301, ¶¶ 1.2.10, 1.2.13; tr. 3/139-43, 5/84-86, 6/85-91, 207-10; 53304-R4, tab 1 at 2, tab 18 at 18)

5. LEC's Mr. Baird confirmed that the borrow stockpile was identified as such during the pre-bid site visit by Cullen Hollister, the government project engineer at Camp Navajo. In his brief testimony (about 11 minutes recorded on about 11 pages of transcript), Mr. Baird provided little other information concerning LEC's bid. At the hearing, Mr. Hollister testified that he announced to the attendees on the bus that "this [is] the intended borrow site for the non-classified fill, the arch back cover, the general site fill, anything that wasn't under a structure. And that it would contain six[-]inch plus material that needed to be removed . . . so they had some sort of idea about the effort involved . . . ." Mr. Hollister had not, previous to the hearing, related this information, which, according to the government, portends a crushing or screening operation to process borrow. In an e-mail dated 17 May 1998, Mr. Hollister takes the opposite position—that the contract language seems to preclude the necessity of a crushing or screening operation. When the government amended the solicitation to add that screening of material might be required for "General Backfill Beside Structures," it did not make the same amendment in connection with "Fill for Concrete Arch Magazines." (Finding 10 below, § 02301, ¶¶ 2.1.2.2, 2.1.2.3; tr. 3/139-49, 6/5-12, 84-89, 114; government's supplemental consolidated Board Rule 4 appeal file for ASBCA Nos. 53304, 53356, 53357, 53358, 53359, 53360, 53361 (supp. R4), tab G-690, ¶ 2) We are not persuaded that Mr. Hollister, in connection with the work described here, announced at the pre-bid site investigation that crushing or screening of all material in the borrow would be required and should be included in the bid.

6. Access to the borrow stockpile was by way of a rough and rutted dirt road (tr. 6/91-92; supp. R4, tab G-661 at 4274, top photograph).

7. During the pre-bid site visit, the group exited the bus and walked around 3-5 typical igloos. The only remarkable things noted by Mr. Baird were vegetation growing over the arches of the igloos and elk grazing nearby. (Tr. 3/143-44)

8. The IFB refers to and incorporates a geotechnical report by Copeland Geotechnical Consultants, Prescott, Arizona dated 27 August 1997. That report addressed subsurface data that had been compiled for the government. It described native soils at the site as primarily sandy clay and clay, medium to high plasticity with moisture well above the plastic limit, firm to very stiff consistency, classified as CL-CH.

Under that description, CL is lean clay and CH is fat clay. On-site road and driveway base material at the site was described as "fill, cinders," classified as SC-GC (clayey sand-clayey gravel). Gravel is defined as particles of rock that will pass a 3-inch sieve. No soil investigation or classifications for the stockpile of borrow materials was included. LEC did not review the geotechnical report prior to bidding. (Tr. 2/26-27, 112-14, 6/133, 7/241-42; app. supp. R4, tab A140 at 3781; 53304-R4, tab 2, specifications § 00102, ¶ 1.3.1; supp. R4, tab G-651 (ASTM D 2487 (1993) at 4161-66, ¶¶ 1.5, 3.1 (note 4), 3.1.1, 3.1.3, 11.1.1, 11.1.2, Table 1, Figures 1a, 3 and ASTM D 4318 (1995) at 4172-73, ¶ 3.2.3, tab G-739 at 1523-25, 1529-30, 1532)

9. Revision 1 to the IFB, dated 26 January 1998, after the site visit by prospective offerors, added drawing Nos. GT-1 through GT-5, SOIL BORING LOGS, SHEETS 1-5, among other things. Those drawings show the boring logs that were included in the geotechnical report. One subsurface boring at each of the 28 igloos is indicated. Each test boring was accomplished at a typical location near the front of each igloo. The boring logs indicate "Cinder Fill" at the surface adjacent to 19 igloos, ranging from 12-30 inches deep. Each of those logs further indicates the next soil layer as CL-CH, the primary native soil classification at the site of the igloos, generally described on the boring logs as sandy clay or clay, medium to high plasticity, sometimes with sand or gravel lenses. Four logs show rock near the existing surface. The log for igloo No. B114 describes a 36-inch layer of cinder fill under which was found basalt rock which was very difficult to drill. Igloo B204 shows a 24-inch layer of cinder fill over a rock layer of lightly to moderately weathered limestone. At B211, 30 inches of cinder fill was found over a layer of moderately to heavily weathered limestone. The log for C108 reveals a 4.5-foot layer of CL, sandy clay, medium to high plasticity, moderately stiff to stiff, no cementation, under which is a layer of lightly weathered limestone. The log for C117 describes 24 inches of cinder fill below which is a layer of CL, sandy clay, medium plasticity, moderately firm to stiff, no cementation, with CL-CH below. B201 shows 12 inches of cinder fill below which is an 18-inch layer of high plasticity gravelly clay, followed below by CL-CH. Three logs show asphalt with underlying cinder fill. C109 indicates 1.5 inches of asphalt, 6 inches of cinder fill and then CL-CH. C110 and C118 both show 1 inch of asphalt with underlying cinder fill of, respectively, 18 and 23 inches, under which was found CL-CH. (Tr. 2/111-12; 53356-R4, tab1 at 18-19, 27, tab 3, drawings GT-1 to GT-5; supp. R4, tab G-739 at 1527, 1557-84)

10. Specifications included in the IFB provided as follows in relevant part (following the pre-bid site visit, specifications § 02301, ¶¶ 1.5e., 2.1.2.2, 3.4, and 3.5.5, and § 02302, ¶ 2.1.6, among other provisions, were amended by Revision 1 to the IFB (53356-R4, tab 1 at 18-20, tab 2 at 29):

SECTION 01110

SUMMARY OF WORK

PART 1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

1.1.1 Project Description

The work includes furnishing all labor, materials, and equipment required to modify . . . existing earth covered reinforced concrete igloo magazines in the construction of the Trident I . . . Motor Storage Facilities . . . .

The work includes removal of the existing earth covering; . . . replace earth cover, . . . a new motorized blast-resistant door; . . . a new mechanical equipment room; HVAC equipment, . . . concrete apron to facilitate motor movement into and out of the igloo . . . .

1.1.2 Work for Each Igloo Magazine

1.1.2.1 Headwall

Demolish and remove portions of existing reinforced concrete headwall. . . . Construct reinforced concrete headwall designed for blast loading . . . .

1.1.2.2 Blast-Resistant Door

Remove existing door . . . . Furnish and install motorized blast-resistant door. . . .

1.1.2.3 Concrete Pavement Apron

Demolish and remove the existing concrete apron. . . . Construct reinforced concrete apron. . . . Conform cinder base or asphalt concrete pavement at apron edge.

. . . .

1.1.2.9 Dehumidifying and Heating System

> Furnish and install . . . ductwork . . . . Provide penetrations through existing igloo magazine arch and new headwall for ductwork. . . .

(53356-R4, tab 2 at 34-36)

SECTION 01450

QUALITY CONTROL

PART 1 GENERAL

. . . .

1.3 INFORMATION FOR THE COR

> Deliver the following to the COR:
>
> a. Contractor Quality Control Report . . . .

1.4 QC PROGRAM REQUIREMENTS

> Establish and maintain a [quality control] program . . . .

(53356-R4, tab 2 at 91-92)

SECTION 01455

FACILITY EVALUATION TESTS

PART 1 GENERAL

1.1 DESCRIPTION

> Facility Evaluation Tests (FETs) included in Attachment A to this Specification are intended to document specified contract compliance in certain areas of special interest to the Government. FETs are checks of the as-built facility against the original Facility Design Criteria (FDC) for

missile product operations. Follow-on installation of missile handling equipment by others requires that all parameters in the FDC be met.

(53356-R4, tab 2 at 111)

FACILITY EVALUATION TESTS

MODIFICATION OF IGLOO MAGAZINES

CAMP NAVAJO

SECTION 01455 - ATTACHMENT A

. . . .

2.0 MAGAZINE ARCHITECTURAL/STRUCTURAL INTERFACES

. . . .

2.4 TEST PROCEDURE

. . . .

2.4.2 Magazine Interior

. . . .

2.4.2.2 Magazine Access

(FV [Field Verification])	Verify that a 16’-0” wide by 10’-0” high minimum clear opening into the magazine is provided.

2.4.2.3 Clear Storage Envelope

(FV)	Verify that the magazine interior has a minimum useable clear storage envelope (height, width,

and length) as shown on
Construction Plans . . . .

(53356-R4, tab 2 at 114, 118-19)

SECTION 02220

SITE DEMOLITION

. . . .

PART 3 EXECUTION

. . . .

3.2.2 Paving and Slabs

Remove concrete . . . slabs as indicated. . . .

(53356-R4, tab 2 at 202, 204)

SECTION 02301

EARTHWORK FOR STRUCTURES AND PAVEMENTS

PART 1 GENERAL

1.1 REFERENCES

. . . .

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

. . . .

ASTM D 1557 (1991) . . . Compaction . . . of Soil . . .

. . . .

ASTM D 2487 (1993) Classification of Soils for Engineering Purposes . . .

. . . .

1.2 DEFINITIONS

. . . .

1.2.6 Controlled Fill

A specified soil mix or gradation of materials constructed to attain maximum bearing strength and minimize consolidation or differential settlement under a load. Controlled fill is sometimes called "structural fill."

. . . .

1.2.9 Fill

Specified material placed at a specified degree of compaction to obtain an indicated grade or elevation.

1.2.10 Hard Material

Weathered rocks, dense consolidated deposits or conglomerate materials . . . which are not included in the definition of "rocks" but which usually require the use of heavy excavation equipment . . . .

. . . .

1.2.13 Rock

. . . [L]arge boulders, buried masonry, or concrete other than pavement, exceeding ½ cubic yard in volume. . . .

1.2.14 Soil

The surface material of the earth's crust resulting from the chemical and mechanical weathering of rock and organic material.

. . . .

1.2.17 Unsatisfactory Material

. . . Unsatisfactory materials . . . include man-made fills, refuse, frozen material, uncompacted backfills from previous construction, unsound rock . . . or other deleterious or objectionable material.

. . . .

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria:

. . . .

c. The character of the material to be excavated or used for subgrade is as indicated. Rock or hard material as defined in paragraph entitled "Definitions," will not be encountered.

. . . .

e. Suitable general site backfill and cinder material

in the quantities required are available <u>on site within a 2 mile radius of project site</u>. [Underlining added; underlined language substituted and added in Revision 1 to the IFB]

. . . .

PART 2 PRODUCTS

2.1 EARTH MATERIALS

. . . .

2.1.2 Soil Materials

Provide materials free from debris, roots, wood, scrap materials, vegetable matter, refuse or frozen material.

Maximum particle size permitted is 6 inches.
Use excavated material from the site for the work indicated when material falls within the requirements specified herein.

2.1.2.1 Controlled Fill

Provide materials classified as GW, GP, SW or SP by ASTM D 2487 where indicated. . . .

2.1.2.2 General Backfill Beside Structures

Soft, spongy, highly plastic, or otherwise unstable material is prohibited. Material shall be unclassified but shall contain sufficient fines to ensure proper compaction. Material shall be classified as GP, GM, GC, SP or SM by ASTM D 2487. If more material is required than is available from on-site excavation, then provide that material from approved sources <u>on Camp Navajo. Screening of material may be required</u>. [Underlining added; underlined language added in Revision 1 to the IFB]

2.1.2.3 General Site Fill, Backfill and Fill for Concrete Arch Magazines

Provide a soil material from the site that can be readily compacted to the specified densities. Materials shall be classified as GP, GM, GC, SP, SM or SC by ASTM D 2487.

. . . .

2.1.2.5 Borrow

Provide materials meeting requirements for general site fill. Obtain borrow materials in excess of those furnished from excavations described herein from the project site as directed by the COR.

(53356-R4, tab 1 at 18-19, tab 2 at 206, 208-213)

PART 3 EXECUTION

. . . .

3.2 SURFACE PREPARATION

3.2.1 Clearing and Grubbing

Unless indicated otherwise, remove trees, logs, stumps, shrubs, brush and all vegetation and organic contaminants within the limits of construction. . . . Grub out matted roots and roots over 2 inches in diameter to at least 18 inches below the existing surface. . . .

3.2.2 Stockpiling Topsoil

Strip approved topsoil to a depth of 4 inches from the site where excavation or grading is indicated and stockpile separately from other excavated material. Locate topsoil so that the material can be used readily for the finished grading. Protect and store in segregated piles until needed.

. . . .

3.3 EXCAVATION

Excavate to contours and dimensions indicated. . . . Notify the COR immediately in writing in the event that it becomes necessary to remove rock, hard material, or other material defined as unsatisfactory to a depth greater than indicated and an adjustment in contract price will be considered in accordance with the Contract clause entitled “Differing Site Conditions.”

3.3.1 Site Grading Procedures

. . . .

b. Approach Drives and Apron Slabs: Remove all asphalt pavement, concrete aprons, cinders, obvious fill down to the native clay subgrade soils, and any unstable soils (loose, disturbed, wet, etc.)

c. Mechanical Building: Remove all existing fill soils and a minimum of 2.0 feet of the native clay soils from below the finished subgrade level. This may result in total removal of several feet due to the undulating condition of the ground surface adjacent to the present igloos and the final finished floor elevation.

. . . .

3.4 BORROW MATERIALS

Provide borrow materials to meet requirements and conditions of general site fill, backfill and fill for concrete arch magazines. A source of borrow materials for general backfill is available on the site. Obtain borrow materials for general backfill from sources within the limits of Government property. All other materials shall be imported materials unless otherwise indicated or specified. [Underlining added; underlined language substituted and added in Revision 1 to the IFB]

3.5 FILLING AND BACKFILLING

3.5.1 Fill Placement

. . . .

c. Fill materials shall be placed and compacted in horizontal lifts of a thickness compatible with the compaction equipment to be used and the type of soil to be compacted.

. . . .

3.5.5 Fill for Concrete Arch Magazines

Carefully place fill to prevent dislodging waterproofing system and to avoid damage to waterproofing. Place fill in

> 8-inch uniform layers loose thickness. Compact each lift as specified herein before the overlaying lift is placed. . . . Do not exceed 24 inches in maximum difference in grade elevation around the magazines during filling operations. Operate compaction equipment perpendicularly to the long axis of the magazine. . . . <u>Operation of compaction equipment exceeding 1500 lbs is restricted to maintain the following required minimum clearances from the arch wall at the following depths [of fill] above arch footing:</u>

<u>Compaction Over Arch</u>

<u>Depth of Cover Over Footing</u>	<u>Required Clearance From Arch</u>
<u>Less than 3 Feet</u>	<u>1 Foot</u>
<u>Between 3 Feet and 6 Feet</u>	<u>4 Feet</u>
<u>Greater than 6 Feet</u>	<u>8 Feet</u>

[Underlining added; underlined language substituted and added in Revision 1 to the IFB]

3.5.6 Final Backfill for Utilities

> Construct backfill (final backfill) for . . . utility appurtenances using the material and compaction requirements specified herein for the adjacent or overlying work. Bedding and initial backfill requirements are specified in Section 02302, “Excavation, Backfilling, and Compacting for Utilities.”

. . . .

3.9 COMPACTION

> Compact each layer or lift of material specified so that the in-place density tested is not less than the percentage of maximum density specified in Table III.

TABLE III

	Percent ASTM D 1557 Maximum Density	
	Cohesive Material	Cohesionless Material
Fill, Embankment and Backfill		
General Site Fill and General Backfill	90	90
General Backfill beside structures	90	90
Controlled fill and under footings, pavements and structures	95	95
Refill and undercut materials	N/A	95

. . . .

3.10 FINISH OPERATIONS

3.10.1 Site Grading

Grade to finished grades indicated within 0.10 foot. . . .

. . . .

3.11 FIELD QUALITY CONTROL

3.11.1 Sampling

Furnish one 50 pound composite sample for each 500 cubic yards of . . . fill material being placed. . . .

3.11.2 Tests

Table IV

Material Type	Location of Material	Test Frequency
. . . .		
Fills and Backfills	Structures (beside)	One test per side of structure per 2000 square feet taken 12 inches below finished grade.
. . . .		

Test fill and backfill and granular fill . . . gradation limits. . . . Perform density tests in randomly selected locations . . . : one test per 1,000 square feet in each layer of lift . . . . Determine moisture content of soil material in place at every location where in-place density is tested. . . . Test a minimum number of times as specified herein and in Table IV.

(53356-R4, tab 1 at 18, 20, tab 2 at 215-17, 219-20, 222-26)

SECTION 02302

EXCAVATION, BACKFILLING, AND COMPACTING FOR UTILITIES

PART 1 GENERAL

. . . .

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria:

. . . .

e. Suitable backfill and bedding material in the quantities required are available at the project site.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

Provide soil materials as specified below free of debris, roots, wood, scrap material, vegetable matter . . . .

. . . .

2.1.3 Gravel

Clean, coarsely graded natural gravel, crushed stone, cinders or a combination thereof having a classification of GW or GP . . . for bedding. . . .

. . . .

2.1.6 Pipe Bedding

TABLE 02302-1 UTILITY EARTHWORK REFERENCES

PIPE MATERIALS	SPECIFICATION	MATERIALS REFERENCE	. . .
. . . .			
b. Corrugated Steel Pipe	. . .	02302 Bedding shall be gravel.	. . .
c. Glass Fiber Reinforced (FRP) Duct	15191	UL 181 [UL 181 relates to materials for fabrication of air duct, not soils materials]	. . .

d. Polyvinyl Chloride (PVC) Nonpressure Pipe	. . .	. . . bedding shall be gravel	. . .

. . . .

Material for pipe bedding shall be gravel.

. . . .

PART 3 EXECUTION

. . . .

3.2 GENERAL EXCAVATION AND TRENCHING

. . . Excavate . . . unyielding material to an overdepth at least 6 inches below the bottom of the pipe . . . . Overexcavate soft, weak, or wet excavations to a depth of 12 inches. Use bedding material placed in 6 inch maximum layers to refill overdepths to the proper grade. . . . Grade bottom of trenches accurately to provide uniform bearing and support for each section of pipe . . . or bedding material as indicated or specified at every point along its entire length . . . .

. . . .

3.3 BEDDING

Of materials and depths as specified for utility lines . . . . Place bedding in 6 inch maximum loose lifts. Provide uniform and continuous support for each section of structure . . . .

. . . .

3.6 BACKFILLING

> Construct backfill in two operations (initial and final) as indicated and specified in this section. Heavy equipment shall not be used as a method of compaction for mechanical ducts. Place initial backfill in 6 inch maximum loose lifts to one foot above pipe . . . or duct unless otherwise specified. Ensure that initially placed material is tamped firmly under pipe haunches. . . . Place the remainder of the backfill (final backfill) in 9 inch maximum loose lifts . . . .

3.7 COMPACTION

> Use hand-operated, plate-type, vibratory, or other suitable hand tampers in areas not accessible to larger rollers or compactors. Avoid damaging pipes . . . . Compact material in accordance with the following unless otherwise specified. . . .
>
> . . . .

3.7.2 Compaction of Pipe . . . Bedding

> Compact to 95 percent . . . maximum density.

3.7.3 Compaction of Backfill

> Compact initial backfill material surrounding pipes . . . or ducts, to 95 percent . . . maximum density. Compact succeeding layers of final backfill to 95 percent . . . maximum density. . . .
>
> . . . .

3.10 FIELD QUALITY CONTROL

> Test bedding, backfill . . . to specified requirements. . . . Test bedding and backfill for moisture-density relations . . . .

(53356-R4, tab 2 at 227, 231-37)

SECTION 02921

TURF

PART 1 GENERAL

. . . .

1.3 SUBMITTALS

Submit the following . . . .

. . . .

1.3.2 SD-10, Test Reports

a. Topsoil composition tests . . . .

. . . .

1.6 EXTENT OF WORK

Provide . . . topsoiling . . . of all newly graded finished earth surfaces . . . .

. . . .

PART 2 PRODUCTS

. . . .

2.2 TOPSOIL

2.2.1 Existing Soil

Modify existing soil to conform to the requirements specified in paragraph titled “Composition.”

2.2.2 On-Site Topsoil

Reusable surface soil stripped and stockpiled on site if requirements specified for topsoil in paragraph titled "Composition" are met.

2.2.3 Off-Site Topsoil

Conform to requirements specified in paragraph titled "Composition." Additional topsoil shall be furnished by the Contractor.

2.2.4 Composition

Containing from 8 to 10 percent organic matter as determined by the topsoil composition tests . . . .

(53356-R4, tab 2 at 303-07)

SECTION 03100

CONCRETE FORMS AND ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification . . . .

AMERICAN CONCRETE INSTITUTE (ACI)

. . . .

ACI 347R (1994) Formwork for Concrete

. . . .

PART 3 EXECUTION

. . . .

3.2 FORMED SURFACES

3.2.1 Tolerances

ACI 347R and as indicated.

(53356-R4, tab 2 at 313-15)

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification . . . .

. . . .

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(1990) Tolerances for Concrete Construction and Materials

. . . .

PART 3 EXECUTION

. . . .

3.4 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.4.1 Defects

. . . The surface of the concrete shall not vary more than the allowable tolerances of ACI 347R. . . .

. . . .

3.4.3 Formed Surfaces

3.4.3.1 Tolerances

ACI 117 and as indicated.

(53356-R4, tab 2 at 319, 328, 331-32)

SECTION 07600

FLASHING AND SHEET METAL

PART 1 GENERAL

. . . .

1.2 SUBMITTALS

. . . .

1.2.1 SD-04, Drawings

a. All flashing and sheet metal items

Indicate thicknesses . . . .

. . . .

PART 2 PRODUCTS

2.1 MATERIALS

Furnish sheet metal items . . . . Fabricate sheet metal items of the materials specified below and to 24 gage thickness. . . .

2.1.1 Exposed Sheet Metal Items

. . . The following items shall be considered as exposed sheet metal: . . . fascias, including fascia for Mechanical Room; . . . eave flashing . . . .

2.1.2 Steel Sheet, Zinc-Coated (Galvanized)

. . . .

2.1.2.1 Finish

Exposed exterior items of zinc-coated steel sheet shall have a baked-on, factory-applied color coating . . . . color shall be as indicated.

(53356-R4, tab 2 at 399-400)

SECTION 15191

FIBERGLASS REINFORCED PLASTIC (FRP) DUCT

. . . .

PART 2 PRODUCTS

2.1 MATERIALS

. . . Duct [and] fittings . . . shall be supplied by the same manufacturer. . . . mechanical couplings will not be permitted.

2.1.1 FRP Duct and Fittings

. . . Duct . . . shall be listed . . . for direct burial application. . . .

. . . .

2.1.1.4 Fittings

Fittings shall be fabricated from straight duct and meet the same depth of burial requirements as duct . . . .

. . . .

PART 3 EXECUTION

3.1 FRP DUCT FIELD ASSEMBLY

Field assembly shall be in accordance with the manufacturer's written instructions and installation procedures as approved by the COR.

. . . .

3.1.6 Connections to Metal Duct

. . . Do not transmit expansion and load forces of metal duct to the FRP duct. . . .

. . . .

3.2 FRP DUCT INSTALLATION

Install FRP ductwork in accordance with the manufacturer's instructions and as indicated. Bedding and backfilling are specified in Section 02301, "Earthwork for Structures and Pavements".

. . . .

3.4 DUCT SUPPORTS

Support duct with stainless steel strap anchor to the exterior of the igloo magazine wall with stainless steel structural shapes and straps where ductwork is not adjacent to wall.

3.5 FIELD INSPECTION AND TESTS

. . . .

3.5.3 Field Tests

> 3.5.3.1 Pneumatic Tests
>
> Prior to backfilling, pneumatically test all FRP ducts and fittings and all FRP duct to metal fittings at a pressure of 15 psig . . . .
>
> . . . .
>
> 3.6 BACKFILLING OF DUCTS
>
> . . . [P]lace and compact backfill as specified in Section 02301, "Earthwork for Structures and Pavements".

(53356-R4, tab 2 (cont. in book 2 of 13) at 489-94)

11. Appellant's president, Michael R. Lamb, submitted LEC's bid dated 6 February 1998. The bid was based on accessible, government-furnished, usable soil materials within 2 miles of the site. No processing of soils materials was anticipated in the bid price. LEC supplied no contemporaneous bid or bid preparation documents. Contract No. DAHA02-98-C-0001 (the contract) was awarded to appellant on 16 March 1998 by Lieutenant Colonel (LTC) James E. Cobb, Arizona Army National Guard, contracting officer (CO), in the original unmodified total amount of $7,469,972.00, the sum of 4 fixed-price contract line items. (Tr. 3/28-30, 5/16; 53304-R4, tab 1 at 1-2)

12. LTC Cobb effectively delegated Administrative CO (ACO) authority to a contract specialist, Ginger R. Domingos. The contractor's representatives understood that Ms. Domingos was authorized to act as the ACO. Ms. Domingos was a warranted CO, with a $2 million limitation on her authority, and was later appointed CO for the contract when LTC Cobb departed his position in August 1999. (Tr. 5/6, 16-17, 217-20, 307-09)

13. Colonel (COL) Triphahn, the Camp Navajo commander, was the appointed COR. He effectively delegated COR responsibility to Mr. Hollister. COL Triphahn was not authorized to change the terms of the contract or obligate government funds under the contract. (Tr. 1/116-17, 5/15-16)

14. From the contractor's perspective, the "man . . . really running the show" and with whom the contractor's general superintendent, Michael J. Goddard, interacted daily at the project site was Mr. Hollister (tr. 2/36-37, 3/5, 8-9).

15. A notice to proceed dated 25 March 1998 was issued by the government to the contractor and received by LEC on that date (53356-R4, tab 4).

Borrow and Igloo Earth Cover

16. LEC mobilized to the site and began work on the rail holding area and at C108 in May 1998. Initial tasks at the igloo included excavation and removal of existing arch cover soils materials. (Finding 3; tr. 1/76-77)

17. LEC bid the project with the understanding that the existing arch cover soils materials had vegetation on them, that the vegetation would need to be stripped, and that topsoil would then be stripped and stockpiled. LEC recognized that additional new earth cover for the igloos was to be placed because the arch replacement cover was deeper and had a larger footprint. The extra soils materials were to be obtained by the contractor from the borrow stockpile. (Findings 4-5, 7, 10, § 02301, ¶¶ 3 to 3.2.2, § 02921, ¶¶ 2 to 2.2.2; tr. 1/85-86)

18. LEC encountered little or no suitable topsoil above the native soils materials when it started stripping C108. High clay content was found after weeds were removed. The clay soil contained large "clods" of clay that "would clump up almost like rocks." Rocks and "all kinds of debris," including "chunks" of concrete, were also uncovered. Beneath the vegetation layer, the soils materials were "very similar" throughout. No topsoil was segregated. The contract indicated and the parties agreed that the soils materials removed from the arch cover would be placed back onto the arch. Mr. Hollister, with CO knowledge and approval, expressed the government's position that the materials would need to be screened or processed to remove or break down clumps or particles of soil and other materials that were 6 inches or greater. (Finding 10, § 02301, ¶ 2.1.2, findings 14, 16; tr. 1/86-88, 2/160-61, 3/12-28, 34-36, 77-78, 6/215-16; appellant's supplemental consolidated Board Rule 4 appeal file for ASBCA Nos. 53304, 53356, 53357, 53358, 53359, 53360, 53361 (app. supp. R4), tab A148 at 3; 53356-R4, tab 10, ¶ 10, tab 11, ¶ 2.g.)

19. LEC immediately, informally, and verbally objected to the requirement that it screen soil removed from the arch before placing it back over the arch and further objected to screening the borrow. Mr. Lamb asserted that LEC's bid did not anticipate any screening of borrow because the contract characterized the available borrow as "suitable." He explained that screening was specifically described in connection with "a specific type of material," "General backfill beside structures," and that "there may be a little segregation" required. However, Mr. Lamb saw no such requirement in connection with "general site fill, backfill, and fill for concrete arch magazines." In any event, screening was necessary during performance of the contract work to remove particles in excess of 6 inches. Mr. Lamb opined that the clay soils (CL) being removed from the arch were not suitable to be placed over the arch as replacement cover. The borrow stockpile also contained rocks. (Finding 10, § 02301, ¶¶ 1.2.13, 1.5c., 1.5e., 2.1.2.2 to

2.1.2.3; tr. 1/85-88, 93-95, 3/12, 26-27, 178-79, 5/100-05, 6/113-21; 53356-R4, tab 10, ¶ 10, tab 12; supp. R4, tab G-587)

20. The concern with rocks or soil particles 6 inches or greater did not, at first, constrain the placement of igloo cover material outside the area directly over the arch of an igloo. That is, placement of rocks or soil particles 6 inches or greater was allowed by the government over the "toe" of the igloo cover, defined as that portion of the cover not directly above the igloo arch, at least 30 inches from the arch at the footing level, and outward at an angle of 60-75 degrees from the horizontal. The government later, on or about 7 October 1998, based on specifications § 02301, ¶¶ 1.2.14, 2.1.2, and 2.1.2.3, reneged on that placement method and banned 6-inch materials from the entire arch cover, from toe to toe, top to bottom. (Finding 10; tr. 1/105-06, 3/15; 53356-R4, tab 10, ¶ 10, tab 12)

21. LEC screened the materials using a government-supplied "grizzly," a large sloped screen. This required extra handling of soils materials, extra steps to dump soils materials through the grizzly, and extra work to transport and to repair the grizzly. After screening, the screened soil was removed from beneath the screen for placement on the igloo arch cover. Rejected material was removed from in front of the screen and spoiled. LEC was required to employ an additional bucket loader and operator. Extra labor was needed to clear clay clumps from on top of the grizzly screen. Some material that was six inches or larger in one dimension, but smaller in another dimension, fell through the grizzly sideways. Laborers were then required to remove such materials from the arch cover by hand using rakes and shovels. Compaction equipment operators sometimes stopped operating the equipment and removed materials by hand. Extra work was performed on account of the screening requirements. However, LEC did not always remove all 6-inch and larger material. (Tr. 1/88-91, 3/15-22, 125-26, 177-78, 6/121; app. supp. R4, tab A150 at 19, 25; 53356-R4, tab 10, ¶ 10, tab 11, ¶ 2.g., tab 18, tab 23, ¶ 2.a., tab 27, ¶ 4, tab 30, tab 32, ¶ 2.a., tabs 33-34)

22. LEC was required to load and transport unacceptable or rejected material to a spoils area. Kay Barlow, LEC's project manager, maintained progress photographs for the job among other duties. He photographed areas of spoil and counted at least 250 dump truck loads of spoil. (Tr. 3/151-56, 175-76; app. supp. R4, tab A150 at 22, 27)

23. A subcontractor performed the above-described excavation, screening, and earthmoving work for the first 14 igloos. For the second 14 igloos, LEC performed the work and performed more effectively, concerning 6-inch or larger material, than the subcontractor had performed. (Tr. 1/91-92, 6/121)

24. LEC, by letter dated 30 November 1998, formally notified the government that it considered the screening requirements to be extra work as a consequence of

differing site conditions. Attached to the notice letter was a soils analysis by an engineering firm. The soils analysis opined that an LEC-provided soil sample from the government-furnished borrow stockpile was soil group CL, further described as sandy lean clay (borderline fat clay based on the liquid limit of the sample). This was LEC's first test report for borrow stockpile materials. The soil test was not disputed by the government. Instead, the soil placed to that date was accepted by the government and the government began to identify additional borrow sources. (Tr. 1/106-07, 2/30-39, 47-48, 165-66, 3/126, 5/103-04; app. supp. R4, tab A68)

25. In a letter dated 3 December 1998, the government acknowledged receipt of the differing site conditions notice. The government did not consider the required screening to be a change; however, the government reacted to the soils classification report by identifying additional borrow sources: (1) material in the berms of open storage areas near the igloos (so-called "Y-sites" designated by the government in an e-mail to Mr. Barlow on or about 24 November 1998) and (2) excess material from excavation of drainage ditches at the site. The government asserted that LEC had spoiled some usable soils materials in conjunction with hauling away unusable material and concrete. (Tr. 1/107-09, 5/102-05, 6/129; app. supp. R4, tab A150 at 2; 53356-R4, tabs 14, 16, 19)

26. With the exception of one site, the Y-sites yielded soils materials classified as "GC," further described as "Clayey Gravel with Sand." The Y-sites material was usable; however, LEC was obliged to remove vegetation and to screen unsatisfactory materials such as "junk, rocks . . . tires, wood. . . . all kinds of garbage" (tr. 1/110). After screening, usable material was loaded and transported to the igloos; unusable material was loaded and transported to spoil piles. The government required that the Y-sites be graded for drainage after borrow was removed. (Finding 10, § 02301, ¶ 1.2.17; tr. 1/110-15, 3/30-31, 83-84, 219-20, 5/106-07, 6/130-33; app. supp. R4, tab A150 at 2-4; 53356-R4, tabs 14, 19, 20)

27. As the designated alternative borrow areas were depleted, the government designated additional alternate borrow areas on Camp Navajo. This material also required screening for clay, rock, and debris. At least one designated alternate borrow area was not used because, as soon as appellant employed excavation equipment at that site, it was clear that the soils materials were not suitable as borrow. (Tr. 1/115-20, 3/169-73) There is no evidence that the additional alternate borrow areas were not within the 2-mile radius of the project.

28. LEC's letter dated 4 January 1999 made clear that LEC considered the materials removed from the existing igloo arches and the borrow materials to be out of compliance with the soils classification requirements of specifications § 02301. LEC also complained of a lack of compliant material. Finally, LEC asserted that the differing

site conditions were causing extra costs. (App. supp. R4, tab A71) Required soils materials for replacement arch cover included GC and SC soil classifications (finding 10, § 02301, ¶¶ 1.1, 2.1.2.3). Both soils include a clay component. The major distinction of GC and SC from CL is that the former are coarse-grained soils and CL is a fine-grained soil. By definition, soil that is predominately clay, such as CL but not GC or SC, which are predominately gravel and sand, respectively, "can be made to exhibit plasticity (putty-like properties) within a range of water contents . . . ." (Finding 10, § 02301, ¶ 1.1; supp. R4, tab G-651, ASTM D 2487 at 4162-63, ¶¶ 3.1.1 to 3.1.3, and Table 1)

29. When all government-identified potential borrow on Camp Navajo had been used, the government located off-site borrow and verbally directed LEC, on 3 June 1999, to obtain approved soils materials from that off-site source. That direction was confirmed in bilateral contract Modification No. P00027 (mod 27), dated 18 June 1999, by which the parties agreed to import to the site 7,700 tons of "Backfill and Fill for Concrete Arch Magazines," at $6.49 per ton, that met the requirements of specifications § 02301, ¶¶ 2.1.2 and 2.1.2.3, so-called "dirty cinders." (Tr. 1/120-26, 2/168-69, 3/180-81, 5/107-09, 249-50; 53356-R4, tab 35)

30. The parties agreed, in bilateral mods 29-31, to obtain an additional 29,000 tons of dirty cinders that required screening. The reference to specifications § 02301, ¶ 2.1.2, in each of mods 29-30 as drafted by the government, was removed by LEC before executing the mods because LEC continued to take the position that it was not responsible for screening since it posited that ¶ 2.1.2 was not applicable to arch replacement cover materials. In mod 31, the reference to specifications § 02301, ¶ 2.1.2, was not included by the government. A lesser volume of the imported dirty cinders was rejected by screening, compared with on-site materials; therefore, less material had to be removed and dumped elsewhere. (Finding 10; tr. 1/123-28, 5/111; 53356-R4, tabs 39, 42, 44)

31. Mods 27 and 29-31 all included the following release language: "The Contractor hereby accepts the adjustment in the contract price and/or period of performance set forth in the Supplemental Agreement, as the complete, equitable and final adjustment for the change requirements/conditions authorized by this supplemental agreement" (53356-R4, tabs 35, 39, 42, 44).

Igloo Replacement Cover Compaction

32. In preparing LEC's bid, Mr. Lamb assumed that some compaction of arch replacement cover fill would be required. However, he did not anticipate any particular measure of compaction because heavy equipment could not be operated over the arch and because, according to Mr. Lamb, the compaction table included in the specifications did not specify a particular level of compaction for materials to be placed over the igloo

arches. Instead, he anticipated that the bucket on the trackhoe to be used to place the soil would "tamp" the soil "to keep it in place and to form the . . . mound over the . . . existing igloo." At the hearing, Mr. Lamb acknowledged an ambiguity or an omission between the requirement in the specifications to compact the arch replacement cover "as specified herein" and his interpretation that the specifications lacked any specific degree of compaction. (Finding 10, § 02301, ¶¶ 1.1, 3.5.5, 3.9, Table III; tr. 1/97-98, 2/33-36, 121-23)

33. LEC asserted during performance that no specific degree of compaction for arch replacement fill was required by the contract. The government directed LEC to achieve 90% compaction for the arch replacement cover. Thereafter, in addition to tamping with a trackhoe bucket, LEC sprayed water on the soils to assist with consolidation. (Tr. 1/133-34; 53356-R4, tab 19, tab 21 at 773-74, tab 27 at 801, ¶ 5)

34. Mr. Hollister directed LEC to employ a roller attached to a trackhoe arm to compact the arch cover replacement materials (tr. 1/134, 3/125; app. supp. R4, tab A150 at 21).

Borrow Stockpile Access Road

35. To prevent heavy equipment from getting stuck using the access road to the borrow area, LEC improved the road by filling low areas and by leveling the adjacent drainage ditch. Appellant trucked "a small number of loads of [government-furnished] cinder" road base material to the site. After the material was dumped from the truck, a loader was employed to spread and to compact the material. (Tr. 1/134-35, 2/57-59, 3/173-74, 209-10, 6/91-93; app. supp. R4, tab A150 at 10-11; supp. R4, tab G-661 at 4273 (lower photograph), 4274 (upper photograph))

36. The parties cite no evidence in their briefs concerning whether the condition of the borrow access road worsened between the time of the pre-bid site visit and when LEC began performance of the work under the contract. The parties cite no evidence in their briefs that explains whether appellant's bid anticipated work to improve the borrow access road.

Borrow and Igloo Claim and Appeal

37. In a letter dated 10 July 2000, LEC requested an equitable adjustment in the amount of $580,390.32 and 631 days of delay related to (1) processing (screening and hand sorting) existing igloo arch cover and borrow materials that did not satisfy the specifications, (2) removal, hauling, and disposal pf rejected materials, (3) more stringent compaction requirements, compaction of "out-of-spec" material with a high clay content, and extra compaction testing, (4) construction of a road to the borrow stockpile, and (5)

costs to prepare the earthwork "claim" (53356-R4, tab 45 at 874). The request did not specifically isolate the alleged extra costs related to the government requirement that the Y-sites be graded for drainage after borrow was removed; however, at ¶ 18 of its complaint, LEC asserts that it "was ordered to regrade and restore" the Y-sites. The government answer, ¶ 18, admits that it "imposed on LEC [a requirement] to take steps to facilitate drainage . . . ."

38. By letter dated 1 November 2000, Mr. Lamb, in his capacity as LEC's president, certified the claim in the amount of $580,390.32. The government received the claim letter on 6 November 2000. (53304-R4, tab 65C)

39. In a CO final decision (COFD) dated 11 April 2001, Ms. Domingos denied the claim (finding 12; 53356-R4, tab 50 at 1339-40).

40. By counsel's letter dated 23 April 2001, appellant timely appealed from the COFD dated 11 April 2001. The Board docketed these matters as ASBCA No. 53356.

<u>Additional Concrete and Road Materials Removal</u>

a. <u>Aprons at B114 and B116</u>

41. Drawing A-1, ARCHITECTURAL SYMBOLS AND SCHEDULES, includes a legend showing a symbol, among others, for concrete. "<u>GENERAL NOTES</u>" No. 2 on the drawing provides: "EARTHWORK, APRONS AND DRAINAGE WILL NOT BE TYPICAL AND WILL VARY WITH EACH IGLOO AS SHOWN ON CIVIL DRAWINGS." The "<u>CIVIL LEGEND</u>" on drawing C-1, PROJECT SITE PLAN, CIVIL LEGEND AND SYMBOLS includes, among others, a symbol for "PORTLAND CEMENT CONCRETE" that is consistent with the symbol on drawing A-1 for concrete. (53356-R4, tab 3)

42. Consistent with pertinent specifications, drawing A-2, IGLOOS TYPICAL DEMOLITION PLAN, at the plan view, notes "CONCRETE APRON AT ENTRY" "REMOVE EXISTING." The notations are connected by an arrow with a rectangular cross-hatched area shown as 6 feet wide across the front of the existing igloo headwall and extending 7 feet, 10 inches outward from the headwall. (Finding 10, § 01110, ¶ 1.1.2.3, § 02220, ¶ 3.2.2; 53356-R4, tab 3)

43. Drawing A-3, IGLOOS TYPICAL FLOOR PLAN, shows a rectangular horizontal concrete apron in front of the igloo front wall, the so-called "HEADWALL." The apron is not shown with dimensions and includes the notes "CONCRETE APRON" "SEE CIVIL DRAWINGS." (53356-R4, tab 3)

44. Each igloo, as modified by the work, is separately shown on a drawing entitled SITE PLAN - CIVIL MODIFICATIONS followed by each igloo number, *e.g.*, "IGLOO C108." The drawings depict a combination of existing features and structures as completed when modified. Existing features are shown in lighter, narrower print and lines. Modified structures, *i.e.*, new requirements are shown in bold, wider print and lines. Existing topographical indications show the transition from the front of each igloo to the adjacent road, essentially a driveway. (Tr. 2/209-10, 7/205-06; 53356-R4, tab 3, drawings C-2 through C-28, drawing C-34)

45. In addition to the driveway transition topographical lines, the drawings for B114 and B116, drawings C-14 and C-15, respectively, show an existing trapezoidal feature within which is the symbol for concrete as depicted on drawings A-1 and C-1. No specific dimensions are indicated; however, each drawing includes a scale which shows that the existing trapezoid is about 20 feet wide at the headwall side and about 40 feet wide at the road side. (Tr. 2/206-11, 7/205-07; 53356-R4, tab 3)

46. The contractor complained that the concrete aprons at B114 and B116 were larger than expected and cost more to remove. The government referred LEC to the indications on drawings C-14 and C-15, explained above. (Tr. 3/155-59, 6/38; app. supp. R4, tab A148 at 30-31; 53304-R4, tab 20 at 2; 53356-R4, tab 3; supp. R4, tab G-720)

b. <u>Roadway-Apron Transition at B117</u>

47. Each igloo, as modified by the work, was to have a new larger apron. Drawing C-29, TYPICAL DETAILS - IGLOO APRON, depicts the new apron as a rectangle about 26 feet wide and extending about 30 feet outward in front of the headwall. A trapezoidal structure extends another 19 feet outward beyond the rectangle toward the road and expands in width to about 56 feet on the road side of the structure. (Finding 10, § 01110, ¶ 1.1.2.3; 53356-R4, tab 3)

48. The typical apron plan view on drawing C-29 shows about the final 5 horizontal feet at the road end of the new apron trapezoidal feature as extending into the existing road. Detail 1 on drawing C-29 indicates that the road and apron meet at the same elevation; however, a note on the detail, with an arrow pointing to the apron, provides: "DEPTH VARIES, SEE NOTE 8." Note 8 on the drawing, in pertinent part, describes the apron-road interface: "WITHIN EXISTING CINDER BASE ROADS, REMOVE AND REPLACE COMPACTED CINDER OVER FILTER FABRIC TO A DEPTH OF 8 [INCHES]. WITHIN EXISTING PAVED ROADS, SAWCUT AND REMOVE EXISTING PAVEMENT AND EXISTING BASE. PLACE 8 INCHES COMPACTED BASE COURSE OVER FILTER FABRIC, PRIME COAT AND 4 INCHES ASPHALT CONCRETE PAVEMENT." (53304-R4, tab 15; 53356-R4, tab 3)

49. Drawing C-16 shows the site plan for B117. The nearest readable spot elevation for the road near the new apron location is 7,146.24 feet. The apron elevation is shown as 7,146.30 feet, a difference of less than 1 inch. (53356-R4, tab 3)

50. When the contractor placed the new apron at B117, at the elevation shown on the pertinent drawing, the top of the apron was about four inches below the existing road surface. This was unacceptable to the government. LEC was directed to remove additional material from the road so that the road could be built back up to a point that smoothly transitioned onto the new apron. (Tr. 3/160-61, 5/221-22; 53304-R4, tabs 15, 23, 24 at 2, ¶ 6.d.)

c. Additional Concrete and Road Materials Removal Claim and Appeal

51. In a letter dated 7 December 1999, the contractor requested an equitable adjustment amounting to $6,936.33 for the alleged additional costs of removing concrete and asphalt at B114, B116, and B117. By letter dated 1 November 2000, received by the government on 6 November 2000, these matters were presented as a claim in the same amount. (53304-R4, tabs 25, 65C)

52. In a COFD dated 12 December 2000, Ms. Domingos denied the claim (53304-R4, tab 29).

53. By counsel's letter dated 12 March 2001, hand-delivered to the Board on that date, appellant timely appealed from the COFD dated 12 December 2000. The Board docketed these and other matters, explained below, as ASBCA No. 53304.

Concrete Blast Door Openings

54. Under the contract, LEC was required to remove the existing headwall and construct a new, cast-in-place "reinforced concrete headwall . . . designed for blast loading." In front of the new headwall, the contractor was to erect a new sliding "blast-resistant door." The door is shown to be 17 feet, 7 inches wide and 10 feet, 8 inches high. (Finding 10, § 01110, ¶¶ 1.1 to 1.1.2.2; tr. 1/219; 53356-R4, tab 3, drawings A-1, portions showing DOOR SCHEDULE, DOOR TYPES, TYPE-SL (SLIDING), A-3, S-6, IGLOOS BLAST DOOR FRAMING & DETAILS, with details entitled FRONT ELEVATION OF BLAST DOOR and SECTION A)

55. The door schedule on drawing A-1 shows the door opening in the new headwall as 16 feet by 10 feet. On drawing A-3, a CRITICAL CLEAR STORAGE AREA, 16 feet wide and running the length of each igloo, is shown and is indicated in cross-section on drawings C-30, TYPICAL DETAILS - MISCELLANEOUS, TYPICAL ARCH

COVER detail, section A, and M-2, IGLOOS - TYPICAL HVAC SECTIONS AND SCHEDULES, section A. Drawing A-4, IGLOOS TYPICAL FRONT & REAR ELEVATIONS, FRONT ELEVATION detail depicts the door width as 16 feet. Drawing A-6, IGLOOS TYPICAL SECTIONS, at section A, shows a rectangle within the arch, labeled 16' x 10' DOOR OPENING & CLEAR STORAGE AREA. On drawing A-9, IGLOOS BLAST DOOR ELEVATIONS, the portion of the drawing entitled BLAST DOOR FRONT ELEVATION, depicts horizontal and vertical lines marked, respectively, 16'-0" DOOR OPENING and 10'-0" DOOR OPENING. Drawing A-12, IGLOOS TYPICAL CANOPY DETAILS, CANOPY - PLAN detail shows a 16-foot wide dimension at the indication of CANOPY OVER DOOR OPENING. A similar notation, 16'-0" x 10'-0" CONCRETE OPENING FOR BLAST DOOR, appears within a rectangle on the portion of drawing S-2, IGLOOS TYPICAL HEADWALL ELEVATION AND DETAILS, entitled HEADWALL ELEVATION. Section M of that drawing also shows a door opening of 16 feet. Drawing S-3, IGLOOS TYPICAL HEADWALL FOUNDATION PLAN AND SECTIONS, FOUNDATION PLAN detail reveals the same dimension. Section D, drawing S-4, IGLOOS TYPICAL HEADWALL SECTIONS, depicts a 10-foot height for the door opening. (53356-R4, tab 3)

56. No explicit tolerances are provided in the contract specifications or drawings specifically for the door opening. To the extent that standards and tolerances are mentioned for concrete work, it is only by reference to standard ACI publications, specifically ACI 347R (1994) and ACI 117 (1990). (Finding 10, §§ 03100, 03300; tr. 1/220, 6/50-51; 53356, tab 3, drawing S-1, GENERAL NOTES AND TYPICAL DETAILS, <u>GENERAL NOTES</u>, <u>GENERAL</u>, ¶ 2.A.)

57. ACI 347R (1994), by its own terms, relates to standards for formwork and surface irregularities for concrete formed thereby, not concrete structures. It provides, in pertinent part: "Suggested tolerances for concrete structures can be found in ACI 117." ACI 347R recommends that A-E design personnel specify tolerances and suggests the use of a system of classes of surfaces (Class A, B, C, or D). None of that was specified in the contract. According to the government's structural engineering expert witness, Les Dittert, the tolerances listed in ACI 347R do not refer to dimensions for cast-in-place concrete. We find that ACI 347R (1994) is not pertinent to the door opening. (Tr. 1/220-22, 247-50, 7/5, 18, 101-09, 158-61; 53304-R4, tab 33 at 2, preface, ¶ 1.1, at 11-12, ¶¶ 3.3 to 3.4, table 3.4)

58. ACI 117 (1990), in a so-called "MANDATORY SPECIFICATION CHECKLIST" again refers to Classes A-D for surfaces related to cast-in-place concrete for buildings (53304-R4, tab 32 at 3). The specifications here did not follow that checklist. When asked the tolerances for the door opening, Mr. Dittert referred to ACI 117, § 4, "CAST-IN-PLACE CONCRETE FOR BUILDINGS," ¶ 4.6, "Openings through members," and ¶ 4.6.1, "*Cross-sectional size of opening* . . . - ¼ [inch] . . . + 1 in." as dimensional tolerances. Mr. Dittert's explanation consisted of little more than

reading the ACI 117 language and he then referred to definitions in ACI 116 which is not in the record. However, on cross-examination, he affirmed that the headwall is a "member." The question and answer imply, at least, that ACI 117, ¶ 4.6.1 is applicable to the tolerances for the opening through the headwall at the blast door. Mr. Hollister opined that the ¶ 4.6.1 tolerance is "[t]he closest we can use," meaning it was the "closest definition for the . . . door opening." (Tr. 6/204-07, 7/101-07, 158-61; 53304-R4, tab 64 at 1, ¶ 5)

59. The government, based on the FET, objected to new door openings that provided less than 16 feet of clear space for access to the critical clear storage area. The parties jointly took measurements of the door openings at igloos. The measurements were taken across the door openings between steel "embeds" that were installed by the contractor at the front corners of the sides and at the front corner of the top of the door openings. The first set of igloo measurements showed some door openings to be 0.25 to 0.5 inch less than required. Measurements from concrete to concrete, that is where concrete protruded past the steel embeds, were up to 2 inches too narrow in some instances. (Finding 10, § 01455; tr. 3/69-70, 163-66, 205, 6/42-45, 55-67; 53304-R4, tabs 35-36, 41, 43; supp. R4, tab G-685 at 2005-06, tab G-713)

60. Initially, the government was allowing no tolerance. That is, the door opening, to be acceptable, had to be at least 16 feet of clear width and 10 feet of clear height. Later a minus 0.25 inch tolerance was allowed (the CO referred to the condition as "OOT [out of tolerance] but acceptable"); thereby allowing a minimum acceptable width of 15 feet, 11.75 inches and a minimum acceptable height of 9 feet, 11.75 inches. The government ultimately accepted door openings of at least 15 feet, 11.6875 inches. (Tr. 1/251-58, 3/165-66, 6/56; 68-69; 53304-R4, tabs 41, 46, 59)

61. In compliance with government direction, the contractor ground the protruding concrete back to the embeds. At one door opening, embeds at the top were removed and the concrete patched to attain the required opening dimension. By letter dated 25 February 1999, the contractor asserted that such work was a compensable change and demanded a contract modification. The CO, in a letter dated 1 March 1999, denied the demand. (Tr. 3/165, 5/33-36, 6/62; 53304-R4, tabs 36, 47 at 1, 4, tabs 56, 59) Appellant has not directed the Board to any evidence that grinding beyond a tolerance of - 0.25 inch was performed.

62. In a letter dated 22 December 1999, the contractor claimed $20,631.78 plus 26 delay days for grinding concrete back to the embeds on 9 igloos. In a COFD dated 28 November 2000, issued as contract mod 35, provided to the contractor under a letter dated 13 December 2000, CO Domingos denied the claim. (53304-R4, tabs 63, 65A)

63. By counsel's letter dated 12 March 2001, hand-delivered to the Board on that date, appellant timely appealed from the COFD dated 28 November 2000. The Board docketed this matter, and others explained above and below, as ASBCA No. 53304.

Flashing

64. The contractor's submittal for flashing and sheet metal was shown on a shop drawing of a "Wood Nailer Detail," which depicted a "Metal Edge." The submittal did not specify, among other things, the type metal, thickness of the metal edge, or finish color. The CO marked the submittal form "APPROVED" in the appropriate block on the first page and also checked a "SEE REVERSE" block. On the reverse of the submittal form, a handwritten comment noted: "Approved with exceptions as noted." On the attached wood nailer detail shop drawing, handwritten entries were added by or for the government: "Exceptions . . . Sheet metal material & gage to be identified; galvanized steel sheet minimum gauge 24." (Finding 10, § 07600, ¶¶ 1 to 2.1.2.1; tr. 1/236, 2/145; 53304-R4, tabs 5, 13)

65. The EXTERIOR FINISH SCHEDULE on drawing A-1, portion entitled METAL SIDING & TRIM, indicates "FACTORY APPLIED . . . COLOR: . . . EVERGREEN KELLY GREEN . . ." (53356-R4, tab 3).

66. To galvanize steel is to coat it with zinc to prevent corrosion. Applying a baked-on, factory-applied color coating finish is a separate process or a separate step in a corrosion prevention process. (Finding 10, § 07600, ¶¶ 2.1.2, 2.1.2.1; tr. 6/23-24; GENERAL ENGINEERING HANDBOOK 164-65, § 4, ¶ 26 (Charles Edward O'Rourke *et al.* eds., McGraw-Hill Book Co. 2d ed. 1940); WEBSTER'S THIRD NEW INTERNATIONAL DICTIONARY 932 (1986))

67. A subcontractor, Centimark Construction (Centimark), supplied and installed the sheet metal flashing. The installed flashing had no color finish; *i.e.*, the bare galvanized steel sheet metal flashing was silver in color with no "baked-on, factory-applied color coating" as required by the specifications. (Finding 10, § 07600, ¶ 2.1.2.1; tr. 2/143-48; app. supp. R4, tab A148 at 25)

68. Kenneth William Davis, the contractor's home office (Salt Lake City, Utah) project manager was informed that the government, in making its inspection of the igloos, had stated that the flashing was the wrong color and required that the flashing be green in color. Mr. Davis investigated. He determined that "the specifications clearly called for it to be green." Mr. Davis then contacted the subcontractor and was informed by unnamed Centimark representatives "that they had just done what the Government had told them to do in the submittal." When the submittal was returned to it, Centimark did not inform the contractor of their alleged view that the government, by the submittal

exception, had made a change. Mr. Davis and other unnamed representatives for the contractor then "looked at that submittal and on that submittal it was indicated that they were to take exception to the specification . . . and give them a galvanized finish on the flashing." "We [the contractor - Mr. Davis and others - after the fact] perceived this that they want us to use a galvanized sheet metal, silver galvanized sheet metal." (Tr. 2/135-47; 53304-R4, tab 7 at 2, item A4c comment, tab 8, ¶ 2.m., tab 12) No Centimark representative testified at the hearing.

69. In compliance with the government's direction that the flashing be green in color and because 7-8 flashing installations had been finished, the contractor installed a green "coverup" on finished roofs. Green flashing was installed in the first instance thereafter. (Tr. 2/144-48, 6/22-23; 53304-R4, tabs 12, 13; supp. R4, tab G-661 at 4277, upper photograph)

70. By letter dated 19 May 1999, with an attached letter and proposal from Centimark, the contractor asserted that the submittal exceptions were a change and the requirement to change the flashing back to a green color was also a change. A contract price increase of $7,925.19 was proposed. The request was denied by the government. (53304-R4, tabs 12, 13)

71. The proposal was modified upward to $18,314.34 in a letter dated 3 December 1999. The contractor claimed that Centimark had completed the flashing on 14 igloo mechanical rooms and that LEC had installed flashing on the backside of 5 headwalls before the government objected to the flashing color. The government again denied the request. By letter dated 1 November 2000, the contractor submitted this claim and others for a COFD. (53304-R4, tabs 14, 16, 65C)

72. In a COFD dated 28 November 2000, mod 34, provided to the contractor under a letter dated 13 December 2000, CO Domingos denied the claim. By counsel's letter dated 12 March 2001, hand-delivered to the Board on that date, appellant timely appealed from the COFD dated 28 November 2000. The Board docketed this matter, and others explained above, as ASBCA No. 53304. (53304-R4, tab 17A)

<u>FRP Ductwork</u>

73. Eighteen-inch diameter FRP supply and return ducts are shown on drawings M-1, IGLOOS - TYPICAL HVAC FLOOR PLAN, and M-2, running between the mechanical room and igloo. Drawing T-2, VICINITY MAP AND LOCATION MAP, among others, shows the new mechanical room to be constructed in front of and toward one end of the new headwall. The new headwall at that end also serves as the side wall of the new mechanical room. The FRP ducts run through the replacement arch cover, *i.e.*, underground (refer to Drawings A-3, indication at "TOE OF SLOPE" at top left of

drawing and A-5, IGLOOS TYPICAL SIDE ELEVATIONS, profile entitled "ELEVATION SIDE-2"). The ducts penetrate the mechanical room wall/headwall parallel with the long axis of the igloo arch. The top of the FRP supply duct exits about 2 feet, 6 inches above the mechanical room floor, runs horizontally about 2 feet, 6 inches past the wall, bends 90 degrees toward the igloo, continues horizontally about 4 feet, 6 inches, then bends upward at an angle of about 45 degrees, running about 15 feet, more than halfway up the arch curvature, getting closer to the outer arch wall as it goes higher, to the point of connection with the 0.25 inch thick steel duct that penetrates the arch about ¾ of the way up the arch. At and near the connection, the duct is shown inches from the outer surface of the igloo concrete arch. The return duct penetrates low on the arch wall, about 4 feet, 6 inches above the finish floor, at an upward angle of about 20 degrees. The FRP return duct runs outward from the 0.25 inch thick steel duct connection at that angle for about 3 feet, then bends to horizontal, continues more than 6 feet, bends 90 degrees, and continues horizontal about 5 feet, 6 inches feet to the connection with the 0.25 inch thick steel sleeve at the headwall penetration about 4 feet, 3 inches above the mechanical room floor at the duct bottom. At about the first 3 feet of the top of the supply duct and the final 3 feet of the bottom of the return duct nearest the headwall, the ducts are only about 1 foot, 9 inches apart, with the return duct directly above the supply duct. Notes 3 and 4 on drawing M-1 specify that ducts inside the mechanical room and igloo are to be galvanized steel, buried ductwork is to be FRP "PIPE" designed for 8 feet of ground cover. Drawing A-7, MECHANICAL ROOM SECTION & TYPICAL DETAILS, detail 6, HVAC DUCT PENETRATION THROUGH HEADWALL, depicts a 1.5-inch wide, 14 gauge stainless steel tightening band where the FRP duct attaches at the headwall penetration. Drawing A-8, IGLOOS TYPICAL DETAILS, details 3 and 4, DETAIL HVAC RETURN DUCT AT PENETRATION THROUGH CONC ARCH and DETAIL HVAC SUPPLY DUCT AT PENETRATION THROUGH CONC ARCH, respectively, show straps for securing the FRP duct to the steel ductwork. The tightening bands and straps are secured by clamps that tighten by way of a machine screw not unlike an automotive radiator hose clamp. (Finding 10, § 15191, ¶¶ 2 to 2.1.1.4, finding 54; tr. 2/77, 3/43-45, 6/152-58, 240-41; 53356-R4, tab 3; app. supp. R4, tab A149 at 1, 3-4)

74. An underground perforated drain line (a so-called "french drain") encircles and runs alongside and parallel to the concrete footings of the igloo arch and the back of the headwall at each magazine. The 1 foot, 6-inch wide drain line trench is adjacent to the arch footing and the headwall footing. The concrete footing extends about one foot beyond the arch toe and about 5 feet behind (beyond) the headwall vertical member. (Tr. 1/197-200, 6/156-57; 53356-R4, tab 3, drawings A-3, C-2 through C-28, drawing C-30, detail 1, drawing C-34, drawing M-2, SECTION A, circle within rectangle at middle bottom, drawing S-3, details entitled FOUNDATION PLAN and SECTION B) The drain line trench ran under the FRP ducts where the trench and ducts intersect. However, the evidence does not support a finding that the trench traversed the area directly below

the FRP connections to the steel duct. (Tr. 1/197-200, 3/92; 53356-R4, tab 3, drawings A-7, detail 6 and M-2, SECTION A)

75. During design of the FRP ductwork, the A-E contacted Spunstrand, Inc. (Spunstrand) and wrote the specifications around Spunstrand products (tr. 8/34). The contractor's submittal for FRP ductwork, dated 6 May 1998, included Spunstrand's specifications for installation of FRP ducts under a concrete slab, which is not the condition shown on the drawings. The record does not show that Spunstrand has developed standard manufacturer's recommendations for the application required on this project to the extent that sloped trenches would be required to conform to the FRP duct "geometry," although these were "the closest to the installation" required here. As built, the contractor did not comply with Spunstrand specifications that were part of its FRP duct submittal to the extent that trenches were required. As further explained below, trenches for the FRP ducts were not feasible in all locations. (Tr. 1/165-66, 2/75-76, 125-26, 231, 254-56, 3/224-25, 4/183-84, 213-15, 5/150, 7/208-11, 243-46)

76. The contract requires that FRP assembly and installation accord with the manufacturer's instructions (finding 10, § 15191, ¶¶ 3.1, 3.2). Spunstrand specifications as submitted by LEC, provide as follows:

SPECIFICATIONS FOR
SPUNSTRAND UNDERSLAB AIR DUCT

. . . .

INSTALLATION
[1] . . . Duct to be installed in a trench . . . [allowing] for a minimum of 4" pea gravel or *dry* sand to completely encase the duct. . . .

. . . .

INSTALLATION INSTRUCTIONS FOR
SPUNSTRAND UNDERSLAB AIR DUCT

GENERAL
[2] Spunstrand Duct is a semi-rigid . . . product designed to deflect approximately 5% under external load without structural damage. . . .

[3] It is important . . . to properly provide uniform support for the duct by carefully placing the backfill material under and around the duct. . . .

[4] When installed underground, the load of the soil above the duct tends to flatten the duct and make it wider. As the duct tries to widen, the walls push into the soil at the sides developing a resistance that helps support the vertical load. The higher the soil resistance, the less the duct will deflect. Proper installation techniques are necessary to prevent excessive deflections and the resulting failure of the duct by buckling.

TRENCH CONSTRUCTION

[5] The surface at the bottom of the trench should be continuous, smooth . . . . Where this criteria cannot be accomplished, the trench bottom should be over excavated to allow a minimum of 4 inches of bedding material under the duct.

[6] . . . The minimum distance between the duct and the trench [sides] is four (4) inches . . . .

. . . .

INSTALLATION

[7] . . . If long sections are to be assembled [outside] the trench . . . the duct run should be supported along its length to avoid strain that may overstress or buckle the duct or damage the joints. Lay the duct in the trench so that it bears evenly on the bedding . . . throughout its entire length. . . .

. . . .

BACKFILLING

[8] When backfilling . . . care shall be exercised to avoid shock loads. Uniform backfilling is required to maintain the duct in a round configuration at all times. Pea gravel or dry sand should be used as backfill under, around and over the duct.

> [9] The backfill around the duct should be placed in layers on each side of the duct. Take care to compact the material under the haunches of the duct and bring the backfill up in roughly even lifts to avoid uneven loading on the duct walls.
>
> [10] Mechanical compaction is not recommended due to the extreme care required to avoid damage to the duct. Water settling of the backfill is unsatisfactory because flotation of the duct is the usual result if the operation is done properly. Hand tamping is the recommended method. Pea gravel as dumped from a wheel barrow is approximately 85% compacted. With hand tamping or rodding, pea gravel backfill compaction will approach 95%.
>
> [11] Space parallel duct systems sufficiently far apart to allow compaction equipment to compact the soil between the ducts. Compact the soil between the ducts in the same manner as recommended for a single duct with particular attention to the compaction around and under the haunches of the ducts.
>
> . . . .
>
> [12] It is not recommended that an engineered fill be brought up around ducts because of the potential for damage from the compaction equipment and the potential for uneven loading which could result in collapse. Rather, the engineered fill should be completed to the designed elevation, then the desired trench is dug and the duct installed in the recommended manner.

(53356-R4, tab 51 at 1352, 1356, 1358-59)

77. Based on the Spunstrand specifications, which provide that the FRP duct is designed to deflect approximately 5% under external load without structural damage, we find that if an 18-inch diameter duct deflects up to about 0.9 inch (approximately 5% of 18 inches is about 0.9 inch) it is not susceptible to structural damage (finding 76, ¶ [2]).

78. The general area below, around, and above the FRP ducts, except for their immediate surrounding area, was designed to be filled with soils materials as specified for concrete arch replacement fill. According to the government's structural engineering expert witness, Mr. Dittert, who also participated in the design of the project, but did not

design the FRP duct configuration or size, the final design for the duct was to allow the duct to "settle with the soil fill underneath the ductwork" (tr. 7/16-18, 26). To reach that conclusion, he assumed pre-award, during design of the project, that the soil beneath the ducts would be compacted to 95% density. His simple, quick review calculations at that time indicated that settlement potential was low enough that any movement "would not cause any distress for the duct penetration as shown on drawing A-7, detail six," the headwall penetration. Mr. Dittert had not previously worked with FRP duct. The record does not reveal the specifics of Mr. Dittert's calculations; however, his summary statements indicate his belief during design review that the FRP duct could remain intact only if it experienced less than 0.5 inch of soil settlement. The specific amount of soil settlement anticipated by the design was not shown; however, statements by ICF personnel tend to indicate that they expected no settlement if the underlying soils were compacted in accordance with contract requirements. The 1997 pre-award geotechnical report showed that the earth-covered igloos dated from about 1943 and that total settlement of 0.5 inch could be expected. (Findings 8, 10, § 02301, ¶¶ 2.1.2.3, 3.5.6; tr. 7/16-31, 154; app. supp. R4, tab A104, ¶ 11; 53356-R4, tab 3, drawing M-1, note 4; supp. R4, tab G-739 at 1525-26)

79. The contract specified that the arch cover replacement fill was to be compacted to 90%, at most, not 95%. Only the bedding, initial backfill, and final backfill in the immediate vicinity of the duct was to be compacted to 95%. (Finding 10, § 02301, ¶ 3.9, § 02302, ¶ 3.7.2 to 3.7.3, finding 76, ¶ [10]). To that extent, Mr. Dittert's analysis proceeds on an incorrect and optimistic assumption.

80. In reviewing the FRP design for ICF, Mr. Dittert noted a concrete saddle support under a horizontal run of the supply duct. The saddle was located about midway along the horizontal run between the 90 degree turn toward the arch and the point at which the supply duct crossed over the toe of the arch. Mr. Dittert caused the support to be removed from the design because the support would create a "hard spot." His view was that supporting "a flexible structure at one point so any load from that large part of the duct would be collected by the duct" at the "hard spot" would act "like a knife" and "create [an] excessive concentrated load which would split or break the duct at that point." (Tr. 7/23-25; 53356-R4, drawing M-1, parallel lines across supply duct indicated as "CONCRETE SADDLE DUCT SUPPORT" (the saddle support requirement was removed from the design, as described above; however this drawing indication inadvertently was not removed))

81. With reference to the manufacturer's recommendations, Mr. Dittert explained how the duct should be placed in a trench. The arch cover fill should be brought up to the level of the duct location. A trench should then be excavated into the fill. Bedding should be placed in the trench, the duct installed, and the same material as bedding then placed around the duct evenly. Having described that method, Mr. Dittert's more

practical suggestion was to fill with granular material all the way up from *in situ* soil. Reading those recommendations in conjunction with the contract requires reference to § 15191, ¶ 3.6. There, the reader is referred to § 02301. That section generally provides for fill placement, ¶ 3.5.1, and for backfill or bedding for utilities, ¶ 3.5.6. That paragraph refers to § 02302. Section 02302, ¶ 2.1.6, requires gravel, defined at ¶ 2.1.3 as natural gravel, crushed stone, cinders, or a combination of materials classified as GW or GP, for bedding (for gravel bedding, Spunstrand recommends pea gravel). Section 02302, ¶¶ 3.2 and 3.6 require a trench for initial backfill or bedding of 6-12 inches in which bedding is placed in 6-inch maximum loose lifts or layers. Placement, per Spunstrand recommendations and the contract, § 02302, ¶¶ 3.6 to 3.7.3, must be equalized and compacted by hand to 95% maximum density on each side of the duct to maintain duct roundness. (Findings 10, 76, ¶¶ [1, 3, 4, 8-10, 12]; tr. 7/32-34, 178-79) The contract specifications and Spunstrand's recommendations do not conflict. To the extent they differ, they can readily be reconciled and harmonized.

82. Appellant's structural engineering expert witness was John G. (Jay) Bartram. Mr. Bartram had provided engineering and design services to Spunstrand for about eight years at the time of the hearing, comprising about 5-7% of his work. He had completed about 30-40 projects for Spunstrand. Mr. Bartram opined, and we find, that the Spunstrand duct supplied for the project was compliant with the product required by the contract and suitable for the intended burial. Mr. Bartram finds that FRP failure on account of inadequate flexibility at connections to a structure is a "common problem." He also agreed that filling to the level of the duct and then digging a trench for the bedding and pipe would have been "the ideal approach" to duct installation. (Tr. 4/149-51, 161-67, 192-93, 207-10, 235-36, 9/39-40; app. supp. R4, tab A147 at 6, 7, ¶ 1, at 8, ¶ 6, tab A152 at 1, paragraph entitled "BURIED DUCT LOADS")

83. Fill was not placed beneath the location of the ducts prior to their installation. LEC's FRP duct subcontractor, Mechanical Services and Systems, Inc. (MSS), was employed only to install the FRP ducts above ground. That is, fill was to be placed and compacted later and by another subcontractor. Spunstrand supplied training to MSS personnel for attaching FRP lengths at FRP joints only and later checked only the above ground work. There is no record of any deficiencies noted by Spunstrand in that context. (Tr. 2/51-54, 4/6, 15-24, 6/158, 7/36; app. supp. R4, tabs A61, A149 at 2-4; supp. R4, tab G-581 at 3871, first paragraph and Article I, tab G-630 at 4051-52, first paragraph and Article I)

84. When MSS had the first FRP ducts assembled and ready for pressurized testing, it raised questions concerning how the connections between FRP and steel were designed to withstand 15 psig (pounds) of pressure specified by the contract. The questions were forwarded through LEC and the government to ICF. The A-E determined that the tightening band would not work. Mr. Bartram agreed. ICF lowered the required

test pressure and changed the connection detail, by a sketch dated 14 September 1998, from the tightening band to a combination of slotted fasteners and self-drilling, self-tapping fasteners (screws) supplemented by seal and tape around the joint. The A-E provided the sketch to the government. The government passed the new connection requirements and sketch to the contractor, thereby changing the connection requirements. (Finding 10, § 15191, ¶ 3.5.3.1, finding 73, drawing A-7, detail 6, drawing A-8, details 3 and 4; tr. 1/160-63, 4/24-26, 58-60, 202-03, 5/314, 6/153, 237-38, 7/231-33; app. supp. R4, tab A52, sketch SK-A12, upper detail; 53356-R4, tab 67)

85. Mr. Hollister also questioned the shear forces to be carried at the duct-to-steel connection. ICF noted that its design anticipated a more flexible duct than was being provided by the contractor and that the changed connection detail, in addition to being able to withstand the test and operating pressures in the duct, would make a more substantial attachment such that shear forces would be better transferred. However, the A-E also warned that the joint would not hold if the backfill beneath the duct was not properly compacted. Proper compaction was a consistent ICF theme. Mr. Bartram noted that the FRP duct-to-steel design created, in effect, a steel beam securely fastened to concrete structures from which the duct cantilevered out. The duct, when rigidly fastened to the steel, became part of the beam and was intolerant of any movement which could be caused by weight loaded by soil on top of the duct or soil settlement below. (Tr. 4/206-07, 5/313, 6/150-52, 7/214-19, 231; app. supp. R4, tab A147 at 5; 53356-R4, tab 67 at 1396, ¶ Sk-12, tab 70; supp. R4, tab G-702)

86. In the contractor's post-award request for information (RFI) dated 15 September 1998, LEC asked the government to provide the methods that were "visualized" during design for filling and compacting under, around, and over the FRP ducts. LEC had come to the conclusion that it would be "nearly impossible to do if not impossible to" achieve 95% compaction around the ducts where they crossed each other and where the supply duct went up the side of and came very close to the igloo arch. The government replied that it would be satisfactory to use a "gravel," sand, or other easily compactable material as long as it was contained and would not "move out from under." (Finding 10, § 02301, ¶ 3.5.6, § 02302, ¶¶ 2.1.3, 2.1.6, § 15191, ¶¶ 3.2, 3.6; tr. 1/163-65, 2/77-78, 3/36-41, 6/147-50, 8/70-71; app. supp. R4, tab A55; 53356-R4, tab 54, ¶ 1, tab 66)

87. Mr. Lamb knew that FRP bedding was specified as "granular material," such as gravel or cinder sand. However, the FRP ducts at the first igloo, C108, were backfilled completely with arch cover replacement fill. The record is not entirely clear regarding this work at the second igloo, C109, although some cinder sand fill was placed in the vicinity of the FRP ducts (finding 92 below). After C109, LEC placed arch cover replacement fill under the duct area followed by a berm of arch cover replacement fill around the perimeter of the area over which the ducts ran. Cinder sand was then placed

in lifts inside the bermed area, under and around the FRP ducts. The contractor placed and compacted cinder sand, by hand, around and between the ducts. (After C108 and C109, the FRP backfilling operation described here is in compliance with the government's response to the contractor's RFI dated 15 September 1998 (finding 86, finding 91 below)) Compaction was by water sprayed from a hose, shovels, rodding, and with a concrete vibrator. A layer of uncompacted arch cover replacement fill was placed over the top of the supply duct. The A-E observed the work and did not object to water compaction. In fact, ICF, after an inspection of backfilling operations, mentioned water jetting as a proper compaction method. Rodding is also an acceptable compaction method. However, the record does not show an ongoing program by LEC to test the level of compaction for arch replacement cover or cinder sand as required by the contract, § 02301, ¶¶ 3.11 to 3.11.2, § 02302, ¶ 3.10. Prior to failure of some FRP duct connections, the cinder sand compaction level was not tested after it was placed under and around the ducts. (Finding 10; tr. 1/169-70, 2/76-78, 103-06, 176-82, 223-30, 3/36-46, 86-98, 166-70, 182-89, 220-40, 5/121-23, 6/139-47, 158-64, 239, 7/36, 45-46, 8/47-49; app. supp. R4, tab A30 at 4, ¶ 2.l., tab A65 at 1630, ¶ C1, tab A149 at 6-10, 13; supp. R4, tabs G-654, -740) There is no evidence in the record that cinder sand self-compacts as does pea gravel when dumped (finding 76, ¶ [10]); however, cinder sand was acceptable as FRP duct initial backfill (tr. 8/37-38).

88. By letter dated 15 October 1998, LEC contended that the manufacturer's instructions to use pea gravel or dry sand for fill around the FRP ducts exceeded the requirements of § 02301, ¶ 2.1.2.3 and that the additional requirement to fill with such materials was a compensable change (app. supp. R4, tab A61; 53356-R4, tab 74).

89. LEC's letter dated 15 October 1998 and Mr. Hollister's concerns prompted Ms. Domingos to task the A-E for a site visit and review of the contractor's FRP installation work (tr. 5/123-26, 6/169-71). Mr. Hollister had expressed his ongoing concerns to the contractor regarding the backfilling operations (tr. 3/47, 6/169-76). On 5-6 November 1998, the A-E inspected the work site, observed backfilling under the FRP ducts, and suggested "staging the duct installation work after the cinder/sand soils are filled and compacted up to the lower level of the ducts" (tr. 7/36, 45; app. supp. R4, tab A65 at 1630, ¶ C1). Mr. Dittert and others from Kaiser walked on the cinder sand being placed as backfill but not yet completed, noting that their weight left footprints in the sand for lack of adequate compaction (tr. 7/37). Mr. Dittert also "tested" the top layer of soil over the ducts and the cinder sand, in several places, by pushing the blunt end of a broken shovel handle, vertically, into the materials. Pushing by hand caused the shovel handle to penetrate 3-4 inches into the fill. Based on Mr. Dittert's comparison of his pushing effort to his recollection of a standard definition in a reference manual that is not in the record, which describes dropping a 140-50 pound weight from a height of 30 inches, he defined the fill as "very loose." Mr. Dittert predicted duct joint failures if the soil under the ducts was loose or if voids appeared, which could allow the ducts to

"deflect . . . several inches." He recommended that all fill under the FRP ducts placed to that date be "removed and replaced [with] compacted backfill." ICF was concerned that the compaction was inadequate. (Tr. 3/48, 7/35-43, 219-21; app. supp. R4, tab A63, tab A65 at 1628, 1630, ¶ C1; 53356-R4, tab 77, ¶ 1) There is no evidence in the record that Mr. Dittert's recommendation was implemented by the government.

90. Mr. Lamb opined that trenching below and placing bedding materials for the supply duct running up the side of the igloo arch "wouldn't work." Accordingly, the contractor did not intend and never attempted to excavate trenches under the FRP ducts. (Tr. 2/81-82, 125-26) By choosing to assemble the ducts first, then place supporting soils materials, it was impracticable to trench, backfill, and compact under the ducts using effective, measurable compaction methods (tr. 6/145-46, 236). After the duct failures and in connection with preparation for the corrective work described below, the A-E documented a method of placement of backfill under the FRP ducts and "initial backfill up to duct levels" prior to connection of the ducts. However, the document also depicts a "more practical" application by placing pea gravel in the entire area under the FRP ducts and acknowledges the difficulty of placing pea gravel given the "duct geometry," which we take to mean the inclined portion of the supply duct as well as the location near the back of the headwall where the ducts are close together and directly over and under each other. When the author of the ICF document, Kevin Forde, was asked at the hearing to explain the construction placement of the process described in his letter, his response began: "I can't." (Tr. 7/56, 8/5-22, 60-61; supp. R4, tab G-722 at 1709-10) Mr. Lamb persisted in his view that the method described was not feasible, overall; however, he admitted that placement and compaction could proceed in this manner to a point just below the lowest ducts (tr. 8/15-16, 60-69; supp R4, tab G-722 at 1714). No witness, including Mr. Dittert and Mr. Forde, could explain how the fill, trenching, and bedding method of fill and backfill placement could be accomplished, as a practical matter, in connection with that portion of the supply duct that bends 45 degrees up from horizontal and runs to the connection high on and very close to the igloo arch or the location where the ducts were over and under one another.

91. During the A-E's visit on 5-6 November 1998, Mr. Barlow for LEC and Mr. Hollister for the government separately discussed the A-E's concerns and agreed that the contractor's cinder sand backfilling effort was being performed satisfactorily with self-compaction, some mechanical efforts by hand, and water spray compaction. Mr. Hollister was not wholly satisfied with compaction efforts; however, he did not agree with all of the A-E's observations during the visit. There were no other government complaints about LEC's cinder sand backfilling operation until duct failures were discovered. (Tr. 2/77-78, 3/45-49, 177, 189-91, 6/169-82, 244, 300, 7/235-37; app. supp. R4, tab A63; supp. R4, tab G-685 at 1919, 1945)

92. On or before 5 January 1999, the government discovered that FRP ducts had broken at C109 at or near the top of the return duct connections to the steel sleeve at the igloo and at the headwall, and at C112 at or near the top of the return duct connection to steel at the igloo. The top of the return duct was deformed at the connection to steel at one end or the other at C108, but had not torn. The top of the return duct had broken at the connection to steel at one end or the other at C110, C111, and C114. These tears were "sheared off" at the end of the steel sleeve "like taking a knife and whacking [the FRP duct]." Separation at C116, at an unspecified location, was observed. Cinder sand fill in the vicinity of FRP ducts at C109 was tested on 13 January 1999 and found to be compacted to 87%. The contractor stopped backfilling at the FRP ductwork in place at C117 and C118. (Tr. 1/171-79, 215-16, 3/49-55, 191-92, 6/305-06; app. supp. R4, tab A72, tab A75 at 1, 3, tab A77, ¶ 3, tab A78, ¶ 2.m., tab A149 at 14-17, 21; 53356-R4, tab 37 at 837, tab 81)

93. By letter dated 14 January 1998 (sic-1999), the government directed preparation of a plan for and repair of damaged FRP ducts (app. supp. R4, tab A77, last two paragraphs; 53356-R4, tab 93). On 29 January 1999, LEC tested the compaction of cinder sand under FRP ducts at C112, C114, and C116. Compaction density measured 87%, 88%, and 95%, respectively. (53356-R4, tab 37 at 837-38) The contractor unearthed the FRP ducts at the seven igloos where ducts had been backfilled (tr. 1/172-74, 3/52-53; app. supp. R4, tab A149 at 15-16, 18-20; 53356-R4, tab 81).

94. ICF personnel, including Mr. Dittert, examined the duct failures. The parties contacted Spunstrand for assistance and were referred to Mr. Bartram. LEC was in contact with Mr. Bartram for assistance with developing a plan to overcome what the contractor contended were government design deficiencies. LEC also retained a soils consultant concerning the underlying native clay soil beneath the FRP duct locations. The A-E retained Mr. Bartram to provide recommendations for a solution to the FRP failures. Mr. Bartram acknowledged that even a small amount of settlement under the ducts, by native soils or by backfill, could cause the ducts to act as a beam and fail as they did in this instance. He questioned the FRP design in that it lacked joints that were flexible and opined that a utility trench would be necessary for the ducts to be shielded from the weight of soil placed above the duct, although he also doubted the viability of trenching that portion of the supply that rises at a 45-degree angle. (Finding 85; tr. 1/185-94, 2/99-101, 4/172-80, 272-73, 5/156, 171-76, 262-63, 6/190-91, 7/48-50, 120; 53356-R4, tabs 90-91, 95 at 1459, tab 97)

95. The upshot of Mr. Bartram's involvement was government direction to LEC, by letter dated 24 February 1999, to remove any earlier backfill down to native soil, to place pea gravel in lifts as backfill under the FRP, to compact the backfill by hand to 95% density taking care with compaction and in roughly equal lifts under and on each side of the haunches of the pipe, to provide temporary supports for the ducts at or near

the elbows while backfilling, to place a flexible connection or boot (able to flex up to 2 inches) over the connection of the FRP duct to the steel duct, and to fasten with additional steel hose clamps, tape, and sealant. That letter was supplemented by a government letter dated 4 March 1999, which attached sketches and a catalog cut for flexible connector products. A government letter dated 9 March 1999 provided additional clarification and sketches directing the backfilling. Following field tests of government-proposed connectors by the contractor, the specific flexible connector to be used (able to flex up to 1 inch) was agreed by the parties as indicated in the contractor's letter dated 10 March 1999. That letter also confirmed the government's direction concerning the expanded area within which pea gravel would be placed as backfill from the level of native soils to the top of the duct area and from the headwall outward beyond the ducts and 6 to 8 feet from the headwall. (Tr. 2/102-03, 5/179-90, 267, 314-15, 6/191-93, 273; app. supp. R4, tab A149 at 22; 53356-R4, tabs 97, 99-100, 104-05, 108-09)

96. The remedial work on FRP ducts required that the contractor perform extra work. All fill in and around the ducts at seven igloos was removed. Waterproofing and roofing materials were removed and replaced around the four FRP-to-steel connections at nine igloos. The ducts were disconnected and replaced at those nine igloos. Flexible connectors and protective sleeves were added at all igloos. Temporary bracing was employed while FRP-to-steel connections were made. Ductwork was re-tested at nine igloos. Pea gravel backfill was placed at all igloos. (Tr. 1/210-11; app. supp. R4, tab A149 at 23-29; 53356-R4, tabs 111-12)

97. The CO unilaterally issued mod 25, dated 24 March 1999, in the amount of $16,250.00 for 560 tons, at $29.50 per ton, for "suitable" FRP bedding material, *i.e.*, pea gravel (finding 10, § 02302, ¶ 1.5e.; 53356-R4, tab 115). The quantity calculations were based on Ms. Domingos' rendering of so-called "neat lines" from ICF sketches. At the hearing, Ms. Domingos acknowledged that her calculations were short by 168 tons. (Tr. 5/192-95; 53356-R4, tab 105 at 1503-05, tab 183)

98. Mr. Bartram's overall opinion was that the FRP duct was destined to fail because the design did not take proper account of the probability of soil settlement around the duct, the duct's inability to tolerate any movement, and the necessity for a flexible connector. He is not a geotechnical soils engineer and assumed a range of settlement values based on a general understanding of the soil types found at the jobsite. Mr. Bartram based his opinion on his apparent belief, consistent with his view of the government pre-award soils report, that the project was designed to withstand settlement of up to 0.5 inch but that later information developed for LEC indicated possible settlement of up to 2 inches under 12 feet of fill. In his view, the upper duct, *i.e.*, the supply duct would "see even more settlement;" however, the failures primarily occurred at the lower duct, *i.e.*, the return duct at the igloo. Mr. Bartram also thought the

settlement problem would be exacerbated by the french drain trench; however, that trench does not traverse the area directly below the connections. Mr. Bartram's analysis used some incorrect values concerning the depth of fill beneath the ducts and ignored the "shadow" effect of having one duct buried directly over another duct. He mixed or confused the return and supply ducts in analyzing the depth of fill. He also assumed at least 90% compaction of the arch replacement fill, a value that LEC did not consistently achieve. These values and assumptions tend to show the design in a worse light than is supported by the record. His incorrect information, at least initially, that the FRP-to-steel connections did not involve screws penetrating the FRP material tend to show the design in a better light than is supported by the record. However, in the final analysis, ICF and Messrs. Dittert and Bartram all agree that 0.5 inch of settlement would meet or exceed the strength of the FRP duct. (Findings 74, 78, 92-94; tr. 4/167-69, 218-33, 263-73; app. supp. R4, tab A147 at 3-4, ¶¶ x, 1, 2, 5, 8-10, at 5, ¶ 15, at 6, 7, ¶ 3, at 15; supp. R4, tab G-769 at 4)

99. Mr. Dittert's analysis discounted settlement of in-situ soils under the FRP ducts because the ducts were, in part, located over the concrete arch and above the new concrete headwall slab and because the previous igloo earth cover had been loaded onto that area, consolidating the underlying soils, for about 50 years as of the date of the project. He is not a geotechnical engineer. Mr. Dittert opined that settlement of the backfill beneath the ducts, because not properly and adequately compacted, caused the duct failures, not settlement of the underlying in-situ soils. Mr. Dittert prepared a "finite element" computer analysis of a soil "wall," essentially a slice of the replacement arch cover at the return duct location, separated into 182 elements or one cubic foot segments. The model assumed a horizontal return duct and no settlement of *in situ* soil. A computer run based on 90% compaction of granular soil under the ducts calculated settlement at the duct of about 0.1 inch. Mr. Dittert made an "engineering judgment," *i.e.*, an educated guess: 0.1 inch settlement would not cause the failure that occurred. He then assumed 35% compaction, applied a "coefficient of variation of soil modulus of elasticity for this material [that is] only one-fifth of the 90% relative density fill, as recommended by NAVFAC DM-7." ("Modulus of elasticity" of soil is "the compressibility of the soil," *i.e.*, how much the soil would "deflect or compress," which varies with depth. Standardized values from tables in NAVFAC DM-7, a Navy publication, were entered as parameters in the computerized calculation.) Based on one-fifth as much compaction, he determined that short term settlement would be five times greater or 0.5 inch (0.1 inch x 5). When asked if 0.2 inch displacement would cause the duct to fail as it did here, Mr. Dittert stated that he could not answer and that unless he made "an analysis of a different kind of this joint," any answer would be "highly speculative." (Tr. 7/16, 50-51, 62-82, 138-42, 153-54, 187; supp. R4, tab G-769 at 1-2, 4-5, 7) To an extent, Mr. Dittert's conclusions are driven by his previous misgivings about the lack of compaction he observed in the field. His judgment that the calculated settlement would

occur in the short term was based, in part, on the fact that the ducts failed in the short term. To that extent, the reasoning is circular. (Findings 78, 85, 89, 94; tr. 7/86-88, 187)

100. Mr. Dittert's analysis and judgments were based on the originally specified connection with the tightening band, not the slotted screws. The FRP duct might have cracked at the points where the screws penetrated the duct. (Tr. 7/87-90) However, cracks at the screws did not cause duct failure (finding 92).

101. For modulus of elasticity values, Mr. Dittert used values from charts in NAVFAC DM-7 based on his understanding of the soil qualities of cinder sand. Without a sieve analysis of the cinder sand actually placed by the contractor, he assumed coarse sand. Material with more fine particles, such as a fine sand, would be stronger. (Tr. 7/75-78) No soils analysis of the cinder sand used here is in the record.

102. Mr. Bartram performed a simple and conservative finite element analysis in rebuttal to that performed by Mr. Dittert. Mr. Bartram agreed that it could vary 10-15% from his worst case estimate if more analytical elements had been incorporated. His analysis considered the stresses of the FRP duct-on-steel connection by way of comparison with a cylindrical tank sitting atop a saddle support, a structure for which standard code provisions have been developed (and which tends to parallel Mr. Dittert's pre-award design review concerns with the concrete saddle). Mr. Bartram determined that the FRP duct mounted onto the edge of the steel duct, with settlement of as little as 0.125-0.15 inch, would fail. Mr. Bartram questioned the wisdom of screws attaching the ducts, as changed by the government, and the lack of extra layers of material in the FRP duct or a rubber gasket between the FRP duct and steel sleeve to take up some of the bearing force. Concerning the screw fasteners, he believed that the load should have been transferred "to the steel sleeve as a 'belt' from the side over the top with this end band acting in tension. However, [the changed fastening] detail slotted the belt right where it is in maximum tension." Mr. Bartram's analysis predicted failure at the screws that would contribute to failure of the duct. (Finding 80; tr. 9/18-73, 86, 97-98, 122-23; app. supp. R4, tab A152)

103. The ducts sheared off at the front and top of the overlap of the FRP duct over the steel sleeve, not at the screws. The FRP duct properties used by Mr. Bartram in his analysis were of lower strength than in his earlier analysis and opinion. The assumed ducts in his later report were "minimum duct properties for fiberglass" (tr. 9/79) as specified in a national code (ASME RTP-1) that is not called out in the contract. Spunstrand FRP duct material "is usually a bit above those values" (tr. 9/80-81). Mr. Bartram's analysis discounts support from soil beneath the duct for up to 3-4 feet out from the igloo arch and assumes a void in the underlying soil at that location. His analysis and opinion are not reliant on soil type, placement, or compaction. His view is that if the soil settled as little as 0.15 inch (an "arbitrary" (tr. 9/76) figure to which his

analysis was geared), for any reason, the FRP duct could fail. (Finding 92; tr. 1/179, 3/54-55, 6/305-07, 9/73-92, 122-23; app. supp. R4, tab A152)

104. Mr. Dittert responded by explaining that Mr. Bartram's analysis was based on a computer model that was too simplistic, ignored certain load transfers, used arbitrary or unproven values, and was based on formulas derived for analyzing horizontal tanks placed on supporting saddles that are not applicable in this situation. This latter criticism is contradictory of Mr. Dittert's use of similar considerations when he expressed, in his pre-award design review, concerns with a concrete saddle beneath the FRP ducts. Mr. Dittert's modified analysis is more complex (2,200 v. 182 elements), more completely considers the component materials within the FRP duct, takes the screws into account at the FRP-to-steel connection, and correctly shows the slope of the return duct as it connects to and exits the steel duct at the igloo arch. No changes were made in his soil assumptions. (Findings 80, 98, 102; tr. 9/140-49; supp. R4, tab G-770)

105. Mr. Dittert's modified analysis, showing the return duct exiting the igloo at the correct incline, focusing on the center line of the duct rather than the bottom, and assuming movement as previously calculated of about 0.1 inch (rounded up from a calculated value of about 0.07 inch), indicates that maximum stress would occur at the top of the FRP duct in the portion of the duct from the end of the steel sleeve to 1.5 longitudinal inches outward (tr. 9/155-58, 167-77, 215-16; supp. R4, tab G-770 at 4-5, 14, 22, "Y-TRANS" value at joint 133, at 28-35). The maximum stress to the top of the FRP duct given that amount of settlement would be about 2,430 pounds per square inch, according to the analysis, which is less than the maximum allowable of 4,855. Mr. Dittert's written analysis concludes with the judgment that the "duct failures . . . could have been . . . avoided if [placement in proper lifts] of [all granular] backfill in [an area] about eight feet by twelve feet . . . under and around the ducts had been compacted [to about 90%] with powered hand tools, as specified," and the duct placed on compacted material. (Tr. 9/190-91, 216-30; supp. R4, tab G-770 at 5) His testimony concludes with the judgment that the overriding problem was placing the FRP ducts without underlying support, a lack of compaction of the soil under the FRP ducts, and insufficiently compacted soil over the return duct which slid down the arch wall pulling the duct off the steel sleeve (tr. 9/230-31). Mr. Dittert's analysis did not evaluate stresses on the ducts at the actual amount of observed settlement.

106. Mr. Dittert explained that the self-tapping screws indicated on Sketch SK-A12 were appropriate for sheet metal applications but not for the 0.25 inch thick steel sleeves onto which the FRP ducts attached. In his view, the FRP duct was not fixed to the steel sleeve. (Tr. 9/202-04)

107. Placement of the FRP ducts without any support beneath may have placed undue stress on the ducts (finding 10, § 15191, ¶¶ 3.1.6, 3.4; tr. 9/220, 231-32).

108. In May 1999, LEC commissioned a study by Western Technologies, Inc. (WTI), Flagstaff, Arizona, to conduct field sampling and laboratory testing of existing fill and native soils at the site for the purpose of determining the settlement potential of the soils. In a report dated 17 August 1999, WTI supplied soils information and calculated that placement of 4 or 12 feet of new fill weighing 125 pounds per cubic foot could cause settlement of from 0.25 inch to 0.75 inch or from 0.5 inch to 2 inches, respectively. The report did not estimate the time period over which such settlement could occur. The weight used, 125 pounds per cubic foot, was an assumed value based on typical Flagstaff soils, not testing at the site. (Tr. 4/96-138; app. supp. R4, tab A146)

109. Craig Wiedeman, appellant's expert geotechnical engineering witness and a principal with WTI explained that settlement of the native soils at the site, when new fill is loaded on top, occurs over the short and the long term. Short term settlement is characterized as the elastic portion of the settlement, can be as much as 30% of the total settlement that occurs, and happens within the first month of placement of fill. Short term settlement of the underlying native soils would be in addition to settlement of the new fill placed. New fill, even if compacted to 95%, consolidates under its own weight by 1-3% of the height of placement. Mr. Wiedeman's opinions are based on estimates and rules of thumb, not observed conditions at the site. (Tr. 4/70-107)

110. The specified criterion for FRP duct was 8 feet of overlying fill (finding 73), halfway between WTI's assumed values of 4 and 12 feet of fill. Interpolating halfway between the estimates for 4 and 12 feet of fill, a reasonable designer could reasonably assume a maximum of up to 1.375 inches of settlement (halfway between the WTI-estimated maximums of 0.75 inch and 2 inches) in the native underlying soils. Thirty percent of 1.375 inches, or 0.4125 inch of that settlement, could occur in the short term. The fill of 8 feet could settle, even if properly and adequately compacted, up to 3% of 8 feet, or a maximum of 2.88 inches. A conservative design criterion, based on Mr. Wiedeman's estimates, would be to estimate settlement of 2.88 inches, well beyond the ability of FRP duct to flex (finding 77). Using the low end of assumed values estimated by WTI and Mr. Wiedeman totals at least 0.96 inch of total estimated settlement (1% of 8 feet of new fill or 0.96 inch, discounting settlement of native soils completely) (tr. 4/103-04). A minimum of 0.96 inch of settlement at the low end approximates the deflection criterion stated in Spunstrand specifications for underslab placement of FRP ducts (finding 76, ¶ [2]). However, even this lowest value exceeds 0.5 inch of flex at which FRP duct would start to fail as agreed by expert witnesses for each party (finding 98).

111. After the FRP ducts were fitted with flexible connectors and backfilled with pea gravel, the return duct connection at the igloo arch on nine magazines had deflected as much as about one inch within about two weeks of installation (tr. 3/197-99, 6/193-95,

249-52; app. supp. R4, tab A141 at 7, tab A151 at 9, 17, 25, 32, 39, 46, 53). We are unable to determine, based on this record, whether the deflection was caused by settlement of backfill or the inherent flexibility of the flexible connectors or a combination of the two.

112. By letter dated 27 June 2000, LEC submitted a request for an equitable adjustment for extra FRP duct work in the amount of $404,445.49, exclusive of delays and impacts that were to be presented separately. The contractor alleged extra work and costs arising from conflicts between the drawings and specifications related to FRP installation, changes to duct testing, compaction, and connections, importation of off-site backfill materials, impossibility, design flaws, changes to the design, and rework to correct the resulting duct failures. Claim certification followed in a letter dated 1 November 2000, received by the government on 6 November 2000. (53304-R4, tab 65C; 53356-R4, tab 125)

113. The CO denied the claim in a letter dated 11 April 2001. By counsel's notice of appeal letter dated 23 April 2001, hand-delivered to the Board on that date, appellant appealed from the CO final decision. The Board docketed the appeal as ASBCA No. 53357. (53356-R4, tab 130)

Blast Door Plates

114. Drawing T-3, ABBREVIATIONS, shows the symbol for "PLATE," the letters P and L overlapping. Drawing S-5, IGLOOS SECTIONS AND DETAILS, at details 3 and 4, indicates 0.75 x 6 x 6-inch or 1 x 6 x 6-inch plates at each location where the notation "S10" or "C10" appears adjacent to each end of the blast door. The plates are on the headwall and on adjacent pilasters, on each side of the door, between which the specified new blast door fits as shown on drawing S-4, sections G and H. Drawing S-6, detail entitled FRONT ELEVATION OF BLAST DOOR and section A, show S10 as 4 horizontal H-shaped members within each blast door and C10 as 2 horizontal C-shaped members, one each at the top and near the bottom within each blast door. (Finding 10, § 01110, ¶ 1.1.2.2; tr. 6/77, 7/93-94; 53356-R4, tab 3)

115. A plate adjacent to each S10 and at each C10, mounted on the concrete structures in front of and behind the door, amounts to 24 plates at each door ((4 S10s + 2 C10s) = 6 x 2 (adjacent to each end of door) x 2 (adjacent to front and back of door)) (tr. 7/94-95).

116. On or about 21 October 1999, near the end of work at the site, the government verbally notified the contractor that all work to install plates had not been completed. The matter had not been noted in previous government inspections but was noted by the government in an FET inspection. The government, by letter dated

25 October 1999, directed LEC to install 24 plates at each door. (Finding 10, § 01455, ¶ 1.1; tr. 1/230-32, 2/157-58, 5/51-52; 53356-R4, tabs 132, 133).

117. Details related to the security hasp for the blast door are shown on drawing A-13, TYPICAL IGLOO SECURITY HASP & EMBEDDED PIPE DETAILS, pursuant to note 4 on drawing S-5. The only indication that might be relevant on drawing A-13 is at detail 2 entitled PLAN. There, the security hasp is shown with an adjacent item marked "STEEL PLATE" but with no other indication of the size; however, the rendering of the plate on the drawing is similar to that shown at details 3 and 4, drawing S-5. Other details that show the security hasp or the embedded box where the security hasp is to be installed, such as section J on drawing S-7, IGLOOS BLAST DOOR DETAILS, shown adjacent to the security hasp location on the front elevation on drawing S-6, with a note "NOTCH IN FRONT [plate] FOR SECURITY HASP," omit any specific reference to plate size. However, an unspecified plate is indicated. Other details, such as section G and section H on drawing S-4 and section N on drawings S-5, indicated on drawing S-2 at the detail entitled "HEADWALL ELEVATION" near the location of the embedded box for the security hasp, show no plate. The drawings referenced here had purposes other than to show the steel plates, *e.g.*, architectural details or reinforcing bar details. Mr. Davis agreed that every feature of the work is not shown or repeated on every drawing detail. (Tr. 2/201-04, 6/77-78, 7/97-100; 53356-R4, tab 3)

118. At the hearing, Mr. Davis explained that appellant and the door plate subcontractor, Industrial Door Contractors, Inc. (IDC) interpreted the drawings as showing 14 plates, one for each of 4 S10s, in front of and behind the door at each end of the door, minus the two plates at S10 adjacent to the security hasp location where no plate is shown at detail N, drawing S-5 (tr. 2/154-57). According to appellant's counsel, IDC's letter dated 27 October 1999, protesting government direction to add more plates, indicates an interpretation that would show 19 plates (app. br. at 43, ¶ 204). We understand that interpretation and IDC's letter to start from 24 plates and then exclude the four plates that would be installed at C10 locations at the top of the doors and one plate at the security hasp on one side of the door. (53356-R4, tab 133; supp. R4, tab G-619) No IDC representative testified at the hearing. IDC installed a varying number of plates at the doors, totaling 532 plates, which averages 19 per door, but ranging from as few as 10 to as many as 20, always excluding one plate at the security hasp location (tr. 5/55, 6/73-74).

119. In a letter dated 24 August 2000, the contractor requested an additional payment of $15,248.99 for installation of the alleged extra plates. The matter was included as a part of appellant's claims letter dated 25 September 2000. (53304-R4, tab 65B; 53356-R4, tab 149)

120. The CO denied the claim in her final decision dated 11 April 2001. LEC timely appealed to the Board by counsel's letter dated 23 April 2001. The Board docketed the matter as ASBCA No. 53358. (53356-R4, tab 157)

Alleged Additional Earthwork Materials Quantities

121. Suitable general site backfill and cinder material were to be provided by the government from sources within a 2-mile radius of the project site. Suitable backfill and bedding material for utilities were to be provided by the government from sources at the project site. (Finding 10, § 02301, ¶ 1.5e., § 02302, ¶ 1.5e.)

a. Cinder Sand

122. Bedding for corrugated steel (metal) pipe (CMP), FRP duct, and PVC pipe was specified to be gravel. FRP duct initial backfill and bedding could be gravel or other specified materials, including cinders. (Finding 10, § 02302, ¶¶ 2.1.3, 2.1.6)

123. Sufficient quantities of gravel and other materials were not available from government sources for bedding and initial backfill for CMP and PVC. Therefore, appellant was directed to purchase and to transport sand onto Camp Navajo for that purpose. LEC provided a proposal for importation of cinder sand for CMP and PVC bedding and "Other Applicable Areas." Bilateral mod 8, including a release by LEC, was agreed to for 735 tons of CMP bedding and initial backfill material, only, at a price of $7.76 per ton. (Tr. 1/137-43, 5/199-201, 6/218-19; 53356-R4, tab 105 at 1500, ¶ 7, tabs 158, 162)

124. The government does not dispute that cinder sand was used as bedding for PVC pipe (53356-R4, tab 178; government br. at 123, ¶ 292).

125. LEC was responsible for providing structural fill beneath the new mechanical equipment room slabs. Cinder sand was used for that purpose, calculated by the contractor as 104.76 tons based on neat lines derived from contract drawing S-8, MECHANICAL ROOM TYPICAL SECTIONS AND DETAILS with increases for variable thicknesses of slabs, conditions at the site, compaction, and waste. (Finding 10, § 02301, ¶¶ 2.1.2.1, 3.3.1c., 3.10.1; tr. 1/137-44; 53356-R4, tab 3, tab 178 at 1869, tab 182; app. br. at 46, ¶ 226)

126. Prior to failure of the FRP ducts, LEC elected to use cinder sand for all FRP fill at five igloos (at the first igloo, no cinder sand was placed, only arch replacement cover material; the second igloo is not clear). At those five igloos, cinder sand was placed by the contractor within a berm of arch replacement cover materials rather than only as initial backfill near the FRP and as pipe bedding. (Findings 78, 81, 87, 92-93)

127. After the FRP failures, the ducts were unearthed (finding 93). The cinder sand removed at five igloos was not accounted for in the record by credible evidence, although the CO was aware of hearsay comments that the cinder sand was spread over the igloos as replacement cover. She conceded that if appellant could prove that quantities of cinder sand were used as arch replacement cover, then the contractor should be compensated in accordance with the prices paid by the government for dirty cinders that were imported for that purpose. (Tr. 5/284-85, 296-97)

128. Appellant claims that 2,635.64 tons of cinder sand was imported by the contractor to the project site. From that total, it subtracts 735 tons and 104.76 tons, leaving an alleged uncompensated total of 1,795.88 tons (2,635.64 – 735 – 104.76). (Tr. 1/142-43; 53356-R4, tab 178 at 1869, 1874-76)

b. Pea Gravel

129. In directing and accepting the remedial work to repair failed FRP ducts, the government required an expanded area within which pea gravel was to be placed below the FRP ducts, not limited to the volume that would be required for initial backfill and bedding only. It is undisputed that pea gravel was not available on Camp Navajo for use by appellant. Therefore, the government unilaterally issued mod 25 for 560 tons of pea gravel at $29.50 per ton. The CO's neat line calculations were based on sketches prepared by the A-E that show vertical lines theoretically separating the pea gravel from adjacent arch replacement materials. The CO admitted that the calculations were short by 168 tons. Absent retaining structures, it would be impossible for pea gravel or the adjacent arch replacement cover materials to stand on a vertical plane. Given the incline to be achieved by placing pea gravel as arch cover at the location of the FRP ducts, it is unrealistic to expect pea gravel to conform to the lines shown in the sketches used by the CO to make her calculations. (Findings 95-97; 53356 *et al.,* compl. & answer, ¶¶ 99; tr. 1/145-47; 53356-R4, tab 105 at 1499, ¶ 2, at 1503-04, tab 109, fifth paragraph)

130. LEC claims that 1,356.39 tons of pea gravel was imported by the contractor to the project site, leaving an alleged uncompensated amount of 796.39 tons (1,356.39 - 560) (53356-R4, tab 178 at 1877).

c. Dirty Cinders

(1) Dirty Cinders - Topsoil

131. Under the contract, appellant was to strip and stockpile four inches of topsoil for placement on top of the arch replacement cover materials; however, there was little topsoil on the igloos that differed from the balance of the existing arch cover soils

materials (finding 10, § 02301, ¶ 3.2.2, finding 18; tr. 1/149-50). To the extent that insufficient topsoil was present to perform the contract work, if established by testing of soil composition as specified in the contract, the contractor was responsible for providing topsoil from existing soils materials or for obtaining additional topsoil (finding 10, § 02921). There is no evidence in the record that appellant performed and submitted topsoil composition tests or made any effort to produce compliant topsoil from existing soils materials.

132. The replacement arch cover was deeper and larger than the existing cover (finding 17). When the government supply of borrow for replacement arch cover was exhausted, the parties agreed to mods 27 and 29-31 by which the government agreed to pay for 36,700 tons of dirty cinders at $6.49 per ton (findings 29-31). Appellant asserts that it actually imported and placed 37,691.81 tons of material for arch replacement cover (53356-R4, tab 178 at 1871), leaving a claimed uncompensated tonnage of 991.81 tons (37,691.81 – 36,700).

133. The CO declined to allow payment for what she asserted was the volume of dirty cinders that were placed by LEC in lieu of the required 4-inch layer of topsoil that should have been stockpiled or provided by the contractor (tr. 5/112; 53356-R4, tab 40).

(2) <u>Dirty Cinders – Structural Fill</u>

134. As found above in finding 125, the contractor was responsible for providing structural fill beneath the new mechanical equipment room slabs and cinder sand was used for that purpose. LEC claims that dirty cinders were also used for structural fill "for CMP at aprons, duct banks at road crossings, and at some CMP at Y-sites and PVC trench locations" and as structural backfill "under the mechanical room floor slabs and footings, and under other footings as necessary" (53356-R4, tab 178 at 1868, 1871).

135. Testimony cited by appellant in its post-hearing brief for the claim (tr. 3/148; refer to app. br. at 49, ¶ 242) does not support that proposition. However, the government presented no evidence that refutes the explanatory letter written earlier by LEC (53356-R4, tab 178) and the government allowed, by mod 16, payment for a quantity of dirty cinders for structural fill (53356 *et al.*, answer at 35, ¶ 107). LEC claims that it calculated 2,154.41 tons for structural fill for which it was responsible but imported 6,047.36 tons for structural fill, leaving an alleged uncompensated quantity of 3,892.95 tons (6,047.36 – 2,154.41) of dirty cinders (53356-R4, tab 178 at 1871, 1880).

d. <u>Pit Run</u>

136. So called "pit run" is the same as dirty cinders except that pit run was processed off-site through a grizzly, that is, screened, while dirty cinders were

screened on-site. The contractor made the decision to have dirty cinders screened off-site, at additional expense, when the on-site grizzly was broken or was being repaired. (Finding 21; tr. 1/152-53, 3/179-81; 53356-R4, tab 178 at 1872)

137. Appellant claims that it screened about 20 loads or 384.85 tons of dirty cinders into pit run off-site (tr. 1/153; 53356-R4, tab 178 at 1872, 1881). Mr. Lamb's hearing testimony was that the pit run was used as arch replacement cover; an earlier LEC letter asserted that it was placed "around some of the French drains" (tr. 1/152; 53356-R4, tab 178 at 1868).

e. Aggregate Base Course (ABC)

138. Contract drawing C-29, note 8, required, in relevant part, that appellant remove and replace compacted cinders where new igloo aprons overlapped existing cinder base roads (finding 48).

139. A schematic of underground electrical lines, among other things, is shown on contract drawing E-4, IGLOOS TYPICAL POWER PLAN & DETAILS, at the detail entitled "TYPICAL IGLOO POWER AND SPECIAL SYSTEMS PLAN." The detail shows lines marked "UG-P" and "UG-C" crossing the existing main road in front of the typical igloo and connecting to a power pole on the opposite side of the road. Contract drawing E-6, IGLOOS TYPICAL ELECTRICAL DETAIL, detail 2, entitled "POWER TRENCH DETAIL," with reference to drawing E-4, indicates an underground reinforced concrete duct bank through which UG-P and UG-C run. The detail also shows the "EXISTING PAVEMENT AND GRAVEL BASE" as "RED CINDER" and further provides that the duct bank trench is to be backfilled with "AGGREGATE BASE MATERIAL." (53356-R4, tab 3)

140. LEC presented no evidence that "CINDER BASE ROADS" or "RED CINDER" "EXISTING PAVEMENT AND GRAVEL BASE" is the same as ABC, "AGGREGATE BASE MATERIAL," or "BASE COURSE." LEC did not prove that ABC, "AGGREGATE BASE MATERIAL," and "BASE COURSE," as used here, differ.

141. Mr. Hollister rejected the cinder material removed from the cinder base roads at the igloo aprons and in duct bank trenches dug across cinder base roads. He would not allow it to be placed back onto the roads, claiming that it was in poor condition and contaminated. He directed the use of ABC. (Tr. 1/154; 53356-R4, tab 178 at 1872)

142. It was LEC's responsibility to provide structural fill replacement materials. At the apron overlap and underground electrical lines duct bank trench, the contractor intended to place the removed cinder material back into the excavation. Appellant

planned to and did use ABC in other applications under the contract where the contractor was required to provide the materials. For all purposes, LEC claims that it provided 3,946.03 tons, including an estimated quantity of 1,538.61 tons for which appellant was responsible. The remaining quantity, 2,407.42 tons (3,946.03 – 1,538.61) is the alleged additional uncompensated amount of ABC directed by the government. (Finding 10, § 02301, ¶¶ 1.2.6, 1.5e., 2.1.2.1; tr. 1/153-54; 53356-R4, tab 178 at 1872, 1882)

f. Additional Earthwork Materials Quantities Claim

143. By certified claim letter dated 1 November 2000, with reference to a demand letter dated 25 September 2000, LEC sought a total of $114,231.60 for alleged additional quantities of earth materials. The government received the claim letter on 6 November 2000. (Findings 128, 130, 135, 137, 142; 53304-R4, tabs 65B-C)

144. In a final decision dated 11 April 2001, the CO denied the claims related to alleged additional quantities of cinder sand except to the extent of mods issued under the contract, pea gravel except for mod 25 plus 168 additional tons at a price of $4,956.00, dirty cinders, pit run, and ABC (53356-R4, tab 186 at 1902, 1904).

145. By counsel's letter dated 23 April 2001, the contractor timely appealed the CO's partial denial of the claim. The Board docketed the appeal as ASBCA No. 53359.

DECISION

For the most part, the matters to be decided involve allegations of directed or constructive changes. A constructive change occurs where a contractor performs work beyond the contract requirements without a formal order under the Changes provision of the contract, due either to an informal order from, or through the fault of, the government. If the CO or other authorized person, without issuing a formal change order, requires the contractor to perform work or to utilize materials which the contractor regards as being beyond the requirements of the pertinent contract specifications or drawings, the contractor may elect to treat the CO's directive as a constructive change order and prosecute a claim for an equitable adjustment. *Ets-Hokin Corp. v. United States*, 420 F.2d 716, 720 (Ct. Cl. 1970); *M.A. Mortenson Co.*, ASBCA No. 53229, 05-1 BCA ¶ 32,837 at 162,469; FAR 52.243-4 (finding 2).

In order to decide whether a constructive change has occurred, we examine the pertinent contract language and drawing indications to interpret the contract requirements. Proper contract interpretation involves harmonizing all the terms of the contract as a whole, giving a reasonable meaning to all provisions, and rendering no provision useless, inexplicable, meaningless, inoperative, void, insignificant, or superfluous. *Arizona v. United States*, 575 F.2d 855, 863 (Ct. Cl. 1978); *ECI Construction, Inc.*, ASBCA No. 54344, 05-1 BCA ¶ 32,857 at 162,808.

LEC contends that the constructive changes at issue here arose from either ambiguous or defective specifications propounded by the government. A contract is ambiguous if it has more than one reasonable interpretation. *E.L. Hamm & Associates, Inc. v. England*, 379 F.3d 1334, 1341 (Fed. Cir. 2004); *ECI Construction*, 05-1 BCA at 162,808. If an ambiguity exists, we may examine extrinsic evidence showing how the parties arrived at their respective contract interpretations. *Walashek Industrial & Marine, Inc.*, ASBCA No. 52166, 00-1 BCA ¶ 30,728 at 151,792; *see Dureiko v. United States*, 209 F.3d 1345, 1357 (Fed. Cir. 2000) (given ambiguities in a release**,** court turned to parties' extrinsic evidence of intent to aid interpretation).

If the ambiguity is patent, a prospective contractor may not rely on that interpretation without first seeking clarification from the government. *Newsom v. United States*, 676 F.2d 647, 649 (Ct. Cl. 1982); *ECI Construction*, 05-1 BCA at 162,809. Where the ambiguity is latent, a prospective contractor may normally rely on a reasonable interpretation. *United States v. Turner Construction Co.*, 819 F.2d 283, 286 (Fed. Cir. 1987); *Centex Construction Co.*, ASBCA Nos. 51906, 51908, 03-2 BCA ¶ 32,379 at 160,227, *aff'd*, 122 Fed. Appx. 512 (Fed. Cir. 2005). A subjective unexpressed intention of a party cannot overcome a reasonable contract interpretation. *ITT Arctic Services, Inc. v. United States*, 524 F.2d 680, 684 (Ct. Cl. 1975); *SUFI Network Services, Inc.*, ASBCA No. 54503, 04-2 BCA ¶ 32,714 at 161,867, *aff'd on recons.*, 04-2 BCA ¶ 32,788.

Concerning alleged defective specifications, there exists an implied warranty that "if the contractor is bound to build according to plans and specifications prepared by the owner, the contractor will not be responsible for the consequences of defects in the plans and specifications." *United States v. Spearin*, 248 U.S. 132, 136 (1918). A contractor is entitled to recover any additional costs incurred to produce a workable result in lieu of the defectively specified item(s). *White v. Edsall Construction Co.*, 296 F.3d 1081, 1084, 1087 (Fed. Cir. 2002). Any added costs attributable to the design defect are recoverable as a constructive change. *Cable and Computer Technology, Inc.*, ASBCA No. 47420, 48846, 03-1 BCA ¶ 32,237 at 159,408.

Design specifications and drawings are those that describe in precise detail the materials to be incorporated into the work and the methods by which the work is to be performed. The contractor is required to follow design specifications and drawings "as one would follow a road map." *J. L. Simmons Co. v. United States*, 412 F.2d 1360, 1362 (Ct. Cl. 1969); *M.A. Mortenson Co.*, 05-1 BCA at 162,469.

ASBCA No. 53304

a. Alleged Additional Concrete at B114 and B116

The contractor contends that B114 and B116 had larger existing concrete aprons than are depicted on the demolition drawing. Appellant characterizes that depiction as a defective specification and submits that removal of additional concrete was a change that resulted in extra costs (app. br. at 61-62).

The government argues that the typical demolition drawing must be read in conjunction with the civil drawings that depict each igloo and adjacent concrete apron. According to the government, drawing notes state "that the aprons would not be 'typical'" (government br. at 130, ¶ 312). On the separate civil drawings for B114 and B116, the government relies on depictions of existing concrete to be removed that are larger than the typical aprons.

Reasonable study and interpretation of the drawings, drawing notes, and specifications reveal that existing concrete aprons were to be removed at each igloo, that each igloo could differ from the typical apron to be removed, that lighter lines, symbols, and words on the drawings relate to existing features of the work, and that the civil drawings for B114 and B116 show the larger concrete aprons actually encountered and removed by appellant at those two igloos (finding 10 (specifications § 01110, ¶ 1.1.2.3, § 02220, ¶ 3.2.2), findings 41-46) The specifications are not defective. The work to remove the existing concrete aprons at B114 and B116 was required by the contract and is not a change.

Appellant's assertions do not rely on a reasonable interpretation of the contract as a whole. Its interpretation seems to focus almost exclusively on drawing A-2, the demolition plan, to the exclusion of other contract language and indications. Appellant is correct that the note on drawing A-1, stating in part that the aprons may vary from typical and that the civil drawings should be consulted, does not explicitly refer to existing earthwork and concrete aprons to be removed. It is also true that the note does not limit its terms to new work. (Finding 41) Given that this job required extensive removal of existing earthwork and concrete aprons at each igloo as well as placement of new, larger earth cover and concrete aprons (findings 17, 42, 47), the only reasonable interpretation of the note is that it applies to all work. In any event, LEC's contentions ignore the specific requirements shown on the drawings for B114 and B116.

b. Alleged Additional Asphalt Removal at B117

Appellant submits that when it placed the new apron for B117 to the elevations shown on the drawings, those elevations did not match the existing asphalt roadway.

The contractor contends that the depicted elevations are in error and constitute defective specifications that breached the implied warranty of accuracy. Accordingly, says the contractor, it was required to remove a portion of the roadway and place it to match the new apron elevation at B117. LEC says this was a compensable change.

The government contends that the contract, correctly interpreted, required that the new apron "conform" to, that is, make a "smooth transition" to the adjacent roadway. This could be accomplished, contends the government, by contractor verification of "actual field conditions . . . before starting work." (Government br. at 131, ¶ 313) The requirement to verify the conditions, cited by the government here, is taken from a structural drawing note that has no connection with the concrete aprons (53356-R4, tab 3, drawing S-1, note 3).

In this instance, the contractor performed in accordance with government-provided detailed design information related to the elevations at which the new concrete apron was to be placed at B117. The result was unsatisfactory to the government and additional work and costs were required of LEC to bring the work into compliance with the government's expectations. (Findings 47-50) Appellant is entitled to recover those extra costs under the Changes provision of the contract.

The government's position – that LEC should have verified the elevations provided in the contract documents, to the hundredth of a foot, and thereby avoided the problem – would have required, at the least, a detailed survey of the roadway in front of every igloo. Such a position negates any possibility of reliance by a reasonable contractor on any information, no matter how detailed, when provided by the government.

The "smooth transition" argument is based on the government's interpretation of specifications § 01110, ¶ 1.1.2.3 (finding 10), which requires that the roadway "[c]onform" to the apron edge. This interpretation is informed by the government's requirement, not expressed in the contract, that large specialized vehicles be able to deliver cargo to the igloos (tr. 5/26-27). As such, it is the government's unexpressed subjective interpretation of the contract and cannot bind LEC. An alleged earlier agreement in the field, as asserted by Mr. Hollister, to account for a similar "field change" (53304-R4, tab 15) is not documented as an authoritative resolution of the problem here.

c. Concrete Blast Door Openings

Appellant contends that the specifications here are ambiguous concerning the tolerance for the horizontal door opening dimension and that the government's direction to grind concrete back to the steel embeds is a change requiring extra work entitling the contractor to an equitable adjustment. The government-imposed tolerances for the door dimensions, according to appellant, were contrary to the contract specifications and industry standards. The government argues that the blast door openings are susceptible of only one reasonable interpretation when read in conjunction with the appropriate industry standard.

The blast door opening is an area of "special interest to the Government" such that verification tests are specifically called out for a "minimum clear opening into the magazine" of 16 feet wide and 10 feet high and "a minimum usable clear storage envelope" within the igloo as shown on the contract drawings. Consistent with those requirements are contract drawings depicting a "CRITICAL CLEAR STORAGE AREA" and a door opening that is 16 feet wide and 10 feet high. (Finding 10, § 01455, ¶¶ 1.1, 2.4.2.2, 2.4.2.3, findings 54, 55)

No tolerances that would allow a deviation from those dimensions are set out in the contract (findings 56, 57). Accordingly, the government was entitled to performance in satisfaction of these unambiguous contractual requirements since the government generally has the right to insist on performance in strict compliance with the contract and may require a contractor to correct nonconforming work. *S .S. Silberblatt, Inc. v. United States*, 433 F.2d 1314, 1323 (Ct. Cl. 1970); *Advanced Engineering & Planning Corp.*, ASBCA Nos. 53366, 54044, 05-1 BCA ¶ 32,935 at 163,129.

Appellant argues that the tolerances set out in ACI 347R (1994) should be enforced. We disagree because ACI 347R is not applicable to the situation presented (finding 57). The evidence that supports the proposition that ACI 117 (1990) tolerances are applicable also is not persuasive. However, if the particular tolerances in ACI 117, later relied upon by the government, are applicable, there is no evidence that the government required the contractor to perform beyond the requirements imposed by that reference (findings 58-61). We conclude that the contract is not ambiguous and that the concrete grinding performed by the contractor was required to bring the work into compliance with the contract's terms.

d. <u>Alleged Flashing Changes</u>

Appellant argues that the government changed the flashing color by way of an "exception" noted on the contractor's flashing submittal that conformed to the contract. The contractor and its subcontractor allegedly began performance in accordance with their interpretation of the government's exception on and approval of the submittal. The government observed the performance of up to 14 applications by appellant in accordance with appellant's interpretation. Appellant contends that a change was directed when the government changed the flashing color back to the originally specified color.

The government posits that the contract terms are unambiguous concerning the flashing and that the exception noted by the government on LEC's submittal did not change the contract. Instead, says the government, the contractor misinterpreted the exception which had nothing to do with the color of the flashing. If appellant relied on its own interpretation, it did so at its own risk, according to the government, because if appellant's work varied from that specified, appellant was required to notify the government and obtain approval.

The parties, in part, argue over whether the submittal was necessary, whether it was complete, whether approval by the government was required, and whether it was wise for the government to provide comments called exceptions. None of these matters is dispositive of the claim. No variance from the clear requirements of the contract was requested by LEC and none was directed by the government.

If the submittal was necessary and if it should have addressed flashing, it was not comprehensive because it did not show the type metal, the thickness of the metal, or the finish color of the metal to be compliant with the contract's clear terms. The government approval comments specifically addressed only the type metal required (galvanized steel sheet) and its thickness (minimum gauge 24). The comments only reiterated clear contract requirements and did not address the finish color, which is a matter separate from galvanization and thickness of metal. Since galvanization and color-coating are separate matters, the government's lack of any "exception" to the absence of a specified color in the submittal is no more a change than is the contractor's lack of any mention of color a request for a variance from the specified color. (Findings 64-66)

The evidence of the subcontractor's interpretation of the "exceptions" is unconvincing hearsay about an unreasonable interpretation. It is not apparent that appellant shared the subcontractor's interpretation prior to its being questioned by the government. However, regardless of the timing of appellant's interpretation of the submittal approval comments, there is no explanation for why the government was not asked to clarify the alleged change since the evidence shows that both the subcontractor and appellant thought the contract was clear and unambiguous. Both planned to provide green color flashing. (Findings 67, 68)

We can see no reasonable interpretation of the government's submittal review comments that would constitute a change in the finish color from baked-on, factory-applied green color coating to no baked-on, factory-applied color coating. The government's direction that the flashing be green in color (finding 69) was not a change.

Appellant contends that the government allowed the non-conforming performance to continue for an inordinate time. This circumstance has not been proven to be a cause or reasonable explanation for the subcontractor's or appellant's interpretation of the submittal approval comments. In any event, quality control was the contractor's responsibility (finding 2, FAR 52.246-12(b), (c)(3), finding 10, § 01450).

ASBCA No. 53356 - Borrow and Igloo Changes or Differing Site Conditions

a. Existing Igloo Arch Cover and Government-Provided and Imported Borrow

LEC contends that the specifications are defective to the extent that they recite that government-provided replacement arch cover fill materials would be available within two miles of the site and would be suitable for use without processing. The government argues that appellant was or should have been aware, pre-award, of the requirement that materials with a dimension greater than six inches would need to be removed by the contractor prior to placement as arch cover fill.

Replacement arch cover fill materials were derived from five sources: (1) existing arch cover fill to be reused; (2) the original government-designated borrow stockpile described in the specifications and noted during the pre-bid site visit; (3) the first alternative borrow from so-called Y-sites and drainage ditches; (4) other alternative borrow sites on Camp Navajo; and (5) off-site imported borrow. Off-site borrow was not contemplated for use as arch cover fill prior to award of the contract. (Findings 4, 5, 10, § 01110, ¶ 1.1.1, § 02301, ¶¶ 1.5e, 2.1.2, 2.1.2.3, 2.1.2.5, 3.4, findings 25, 27, 29)

(1) Existing Arch Cover and Designated Borrow Stockpile

We are told little of appellant's interpretation of the contract at time of bid except that LEC, relying on § 02301, ¶ 1.5e, expected the existing arch cover and borrow stockpile to be suitable in every respect (soil classification and gradation or particle size) with no requirement to process the material (findings 5, 7, 10, 11). LEC was obliged to read the entire contract and factor into its bid a reasonable interpretation of all the terms found in the contract, including the geotechnical report referred to and incorporated into the contract. Reading ¶ 1.5e and the other references that concern arch replacement cover, we agree almost completely with appellant as explained below.

Pursuant to § 01110, ¶ 1.1.1 and § 02301, ¶¶ 2.1.2, 2.1.2.3, 2.1.2.5, and 3.4 of the specifications, appellant was to provide Camp Navajo soils materials for arch replacement cover. Section 02301, ¶ 1.5e provides that appellant could bid in reliance on that material being suitable. Wholesale screening was not reasonably to be expected. The specifications, at § 02301, ¶ 2.1.2, do indicate the prospect of removal of certain deleterious items (*i.e.*, frozen material, debris, word, scrap materials). Such is characterized as unsatisfactory in ¶ 1.2.17. Considering the plain language, "unsatisfactory" material (¶ 1.2.17) is the antithesis of "suitable" (¶ 1.5e). The contract language makes clear, at ¶ 1.5e, that rock and hard material would not be encountered. (Finding 10).

Appellant's representative observed the existing arch cover and the designated borrow stockpile prior to bidding (findings 4, 5, 7). Viewed from a distance, items that exceeded 6 inches were visible on the surface of the borrow stockpile. However, we are not convinced that any prospective offeror would have been able to determine, from mere observation, whether the large items were clumps of soils materials that would break up when handled or were unsatisfactory materials, hard materials, or rocks as defined. And, of course, no judgment would be possible about the consistency or volume of such objectionable material below the surface of the borrow stockpile or the existing igloo arch cover. No pre-award subsurface exploration or analysis of either the existing arch cover or the borrow stockpile had been undertaken by the government and its geotechnical consultant (finding 8).

The contract specifications, § 02301, ¶ 2.1.2.3, make clear that the arch replacement fill was required to be classified as GP, GM, GC, SP, SM, or SC (finding 10). Absent contrary indications in the contract (there were none; findings 8-9), LEC reasonably could presume that the soil would mostly consist of one or more of the required soil classifications, not a predominately clay material from which it might have to remove clay "clods" or "clumps." The government admits as much: "the Government was responsible to provide borrow material that met the listed soil classifications" and "The only reasonable interpretation of the requirements for the borrow material is that it must meet the listed classifications" (government br. at 136, 141, ¶¶ 327, 337).

It was learned during performance that the existing arch cover and the designated borrow stockpile were classified as CL, a predominately clay material and not among the soil classifications required for arch cover replacement fill (finding 10, § 02301, ¶ 2.1.2.3, findings 19, 24, 28). When the government learned of the soil classification of the borrow stockpile materials, it immediately diverted appellant to alternate borrow sites (finding 25).

To the extent that the contract indicated that the existing arch cover and the borrow stockpile would be suitable, LEC attempted to perform in reliance on the government's detailed design specifications (findings 1, 17-19), and incurred increased costs in screening clay clods or clumps and other deleterious items that exceeded 6 inches, out of the existing arch cover and the borrow stockpile and in removing that material (compl. & answer, ¶¶ 16 (government admits that "high clay content of the soil made screening particularly difficult"); findings 18, 19, 21, 22, 24, 28; government br. at 138, ¶ 332 (government admits "There is no dispute that LEC incurred costs in screening the six-inch material out of the borrow material.")). The specifications were defective and extra work resulted from the ensuing constructive change.

Farnsworth & Chambers Co., ASBCA No. 3602, 57-1 BCA ¶ 1323, cited by the contractor, supports our decision. In that case, soils materials that were made available by the government from borrow pits and that were to be placed by a contractor could be no larger than 2.5 inches at the largest dimension. The CO relaxed that requirement but the contractor was required to set up a screening process and a crushing operation. The Board determined that the contractor's obligation to process the material could not be expanded without limit to a crushing operation to "manufacture . . . acceptable material," 57-1 BCA at 4200. We understand this decision, as applied here, to mean that LEC's obligation to remove particles larger than 6 inches could not be expanded to require removal of (1) clay clods and clumps that should not have been anticipated in the soil classifications that were classified by the government as acceptable arch replacement fill, (2) rock or hard material that was not to be encountered, or (3) large pockets of unsatisfactory material.

However, appellant should have anticipated removal of a relatively small component of roots and vegetable matter or isolated items of debris, wood, scrap materials, and refuse (but not concentrated pockets of such materials as would indicate backfills from previous construction) (finding 10, § 02301, ¶¶ 1.2.17, 2.1.2). The extent of that expectation is a matter for quantum determination.

The government contends that Mr. Hollister's announcement on the bus during the pre-bid site investigation served to alert prospective bidders, including appellant, that screening all material from the borrow stockpile would be necessary. We are not convinced that Mr. Hollister made the alleged announcement in 1997-98 that he "repeated" for the first time at the hearing. The amendment that was issued a few weeks after the site visit does not add a reference that would corroborate Mr. Hollister's alleged statement, although the amendment does address and add a requirement to screen other material (but not replacement arch cover). Further Mr. Hollister had no authority to change the contract requirements, absent CO knowledge and approval. (Findings 4, 5, 9, 10, § 02031, ¶¶ 2.1.2.2 – 2.3, finding 13) Even if the announcement was made and heard by all persons on board the large bus (a proposition not supported by the record, findings 4-5), the lack of authority in such statements is addressed by the contract's terms. FAR 52.236-3(b) (finding 2).

(2) Alternative Y-Sites Borrow and Other Camp Navajo Borrow Sites

Authorized government personnel directed appellant to borrow from the alternative Y-sites and drainage ditches and other alternative borrow sites on the installation (findings 25, 27). LEC moved equipment to and among the Y-sites and other alternative sites and removed, loaded, and transported junk, rocks, tires, wood, garbage, clay, and debris from the Y-sites and other alternative sites to spoil areas (findings 26-

27). Extra work was performed by appellant to that extent. Additional extra work also was performed when LEC was directed to grade the Y-sites for drainage after borrow was removed (findings 26, 37). The Y-sites were near the igloos, within the 2-mile radius of the project, and there is no evidence that the other alternative borrow sites were outside the 2-mile radius of the project site (findings 26-27). There is no proof that extra costs were incurred for removing, loading, and transporting soils materials from the alternative borrow sites to the extent that such materials were compliant with contract requirements for use as arch replacement cover. Segregation of extra costs to remove, load, and transport unsatisfactory material from the costs to do the same with compliant soils materials is a matter for quantum.

b. Igloo Cover Compaction

The government's insistence that earth cover on the igloos be compacted to 90% density is, according to appellant, a constructive change. The contractor argues that the compaction specifications are defective and/or that no specific degree of compaction was specified for the arch replacement cover. The government points to contract provisions that required compaction.

In preparing LEC's bid, Mr. Lamb interpreted the contract to mean that some degree of compaction of the arch replacement cover would be required but that no particular level of compaction had been specified in the contract. At the hearing, Mr. Lamb recognized that the contract referred to compaction of the arch replacement cover "as specified herein" and admitted that the language presented an ambiguity in connection with his interpretation. (Finding 10, § 02301, ¶ 3.5.5, finding 32)

The ambiguity belatedly recognized by Mr. Lamb is an obvious one. The contract includes a general reference to "a specified degree of compaction" of fill (specifications § 02301, ¶ 1.2.9). The replacement arch cover is a type of fill "that can be readily compacted to the specified densities" and that is to be compacted in "each lift as specified herein" (specifications § 02301, ¶¶ 2.1.2.3, 3.5.5). These references are followed two pages later in the specifications by a compaction paragraph requiring that the contractor "Compact each . . . lift of material specified so that the in-place density tested is not less than the percentage of maximum density specified in Table III" (§ 02301, ¶ 3.9). Table III appears on the next page and requires 90-95% compaction for all types of fill except cohesive material used for "Refill and undercut materials," to which compaction requirements are listed as "N/A." (Finding 10)

Appellant made no attempt to clarify this obvious ambiguity prior to bidding. Even if the ambiguity is not viewed as obvious, we cannot agree that appellant's pre-bid interpretation is reasonable. The "specified degree of compaction" and similar language is ignored by LEC's interpretation since Mr. Lamb believed that there was no applicable specified degree of compaction but did not explain that his interpretation in any way relied on the definition of arch replacement cover being "Refill" using "Cohesive material," the only category of fill with no specified compaction level.

Further, the record does not support a finding that appellant compacted the arch replacement cover to 90% density, the level of compaction directed by the government. LEC's theory of recovery is constructive change; however, a condition precedent for such recovery is that appellant's performance requirements were enlarged by the government direction to compact to 90% density. There is insufficient proof that appellant, by spraying water on the replacement arch cover to assist consolidation and by employing a roller attached to a trackhoe arm (findings 33, 34), performed any greater level of compaction than was required under its original interpretation of the compaction requirements.

c. <u>Road Construction to Borrow Area</u>

LEC contends that the government directive "to construct a road to the supposedly 'suitable' and available borrow area" (app. br. at 70) was a change that caused appellant to incur additional costs. This part of the claim must be denied. The condition of the road was or should have been known prior to bid, allowing appellant to factor improvement costs, if necessary for its choice of construction equipment, into its bid (findings 4-6). The evidence is insufficient to allow us to find that the government directed LEC to improve the road (findings 35-36). There is no proof that the condition of the road was worse when LEC began using the road compared with its condition at the time of bidding; therefore, nothing the government did or failed to do caused the necessity to improve the road (finding 36). We conclude that the contractor improved the road for its own benefit and convenience.

d. <u>Claim Preparation Costs</u>

Claim preparation costs are not argued by appellant in its brief. This claim or part of the claim has been abandoned.

<u>ASBCA No. 53357 - Alleged FRP Ductwork Changes</u>

Appellant argues "that the failure of the FRP ductwork and the resultant changes in the ductwork installation were the result of improper design of the ductwork system by ICF Kaiser, the Government's [design A-E]" (app. br. at 70). To overcome that failure, appellant asserts that changes were directed by the government to provide for different ductwork connection materials and details and to require different backfill materials and procedures. Those changes allegedly caused appellant to incur additional costs to remove fill from around the ducts, to change the duct connections, to remove and to replace waterproofing, and to place different backfill materials. We agree in part but conclude that appellant was partially responsible on account of its placement of the FRP ducts and performance of compaction (or lack of compaction) below and around FRP ducts that did not comply with contract requirements.

The government contends that nothing in the contract directs appellant to follow a certain sequence in performing the FRP work, in particular how to backfill around the FRP ducts. We disagree. The government further argues that improper backfill and compaction by appellant as well as appellant's chosen sequence of the work, not a defective design, caused the FRP failure. We agree in part but conclude that aspects of the design were faulty and that the government directed extra work to overcome those defects.

One contributing cause of the FRP duct failures, attributable to the government, relates to the flexibility of the ducts. The FRP ducts used here were designed to deflect about 0.9 inch without structural damage. A load on an FRP duct causes the duct to flatten and to widen, that is, it reshapes itself from a circle to an oval. We mainly rely on the opinion of appellant's structural engineering expert, Mr. Bartram, which we understand to mean that when mounted on an unyielding 0.25 inch thick steel sleeve or duct, the FRP ducts, if deflected, cannot flatten to the full extent of their design capability. The government's design required such a connection. (Findings 73, 74, 76, ¶¶ [2, 4], findings 77, 82, 85, 94, 95, 98, 102, 103)

Testimony by Mr. Bartram and the structural engineering expert for the government, Mr. Dittert, and by the government's project engineer, Mr. Hollister, shows that the FRP duct here, mounted on steel, would fail if it deflected 0.5 inch and was susceptible of failure if it flattened as little as 0.125 inch (findings 78, 98, 99, 102). Mounting the flexible FRP duct on the inflexible steel edge created a "hard spot" as the weight of the fill and the ducts themselves concentrated along and near the edge of the steel such that the steel acted "like a knife" and caused the FRP duct to shear off along that connection (findings 80, 82, 85, 92, 94, 98, 99, 102, 103, 105).

Given the above engineering parameters, the design engineers and the government considered compaction of soil beneath and around the duct to be of paramount importance. They anticipated no settlement if compaction was performed in accordance with contractual requirements. We agree that proper compaction is clearly specified; however, the engineering judgment that <u>no</u> settlement would result if proper compaction was achieved is unwarranted in this location and under these circumstances. That engineering judgment is another contributing cause of the FRP duct failure that is attributable to the government. The government's pre-award soils investigation indicated total settlement of 0.5 inch. Appellant's geotechnical engineering expert, Mr. Weiderman, who provided the only expert evidence on the subject, projected settlement of a minimum of 0.96 inch and probably more over an unspecified time. Mr. Dittert made summary and optimistic calculations during his pre-award review of the drawings and specifications that indicate low but not zero settlement potential. (Findings 78, 79, 85, 89, 91, 98, 99, 105, 108-11) We conclude that specifying flexible-FRP-to-inflexible-steel connections and assuming zero settlement of the underlying soils was a design error that led to defective specifications. This defect in the specifications was not obvious and was not known to the contractor.

The other contributing cause of the duct failures, attributable to both parties as explained below, concerns pipe-laying and compaction requirements. Reading and harmonizing the contract requirements and the manufacturer's written instructions reveals the requirements for FRP installation (finding 10, § 15191, ¶ 3.1). No record evidence shows that the manufacturer has developed written instructions and installation procedures tailored to the application required on this project (finding 75); however, the standard recommendations are, in part, applicable to any FRP pipe-laying and compaction scenario. The FRP ducts were to be placed over native soils that are adjacent to the existing igloo after removal of the existing igloo arch cover fill. Fill for concrete arch structures was specified to be placed in 8-inch loose lifts, compacted to 90% density with equipment appropriate for use in the vicinity of the concrete arch. That fill was to be placed above the native soils until it reached a level in the immediate vicinity of the location for the ducts. (Finding 10, § 01110, ¶ 1.1.2.9, § 02301, ¶¶ 1.2.9, 2.1.2.3, 3.5.5, 3.9, findings 33, 78, 79, 81)

Following placement of arch replacement cover backfill, a trench in that backfill was specified to allow for placement of initial backfill (bedding, *i.e.*, gravel as defined in the contract, pea gravel, or dry sand) and the FRP duct pipe. The trench was to be 6-12 inches deep. Initial backfill was to be placed in 6-inch maximum loose lifts allowing for a minimum of 4 inches under the duct and compacted to 95% using suitable hand-operated compaction equipment. (Finding 10, § 02301, ¶ 3.5.6, § 02302, ¶¶ 2.1.3, 2.1.6, 3.2, 3.6, 3.7.3, finding 76, ¶¶ [1, 5-8, 12], findings 99, 81, 82)

The contractor's work method of assembling and hanging the FRP ducts prior to trenching made trenching much less practical if not impractical. Trenching as specified could have been accomplished below the supply duct location until the point where it bends upward to ascend the arch curvature and below the return duct as it exits the arch wall until it goes over the top of the supply duct. To that extent, appellant's work method contributed to the problems encountered by the parties. However, no record evidence explains how such trenching could have been performed for that portion of the supply duct as it travels upward or the return duct as it crosses over the supply duct. The design was in part defective or commercially impracticable to perform. Ultimately, the problem was resolved by the parties' joint and more practical approach to filling beneath the FRP ducts. Cinder sand or pea gravel was placed within a berm from the underlying soils upward. (Findings 73, 76, ¶ [11], 81, 83, 86-87, 90-91, 94-95)

Appellant did not attempt to construct trenches for the FRP ducts in the manner specified for the reasons explained above (findings 75, 86). Appellant made a judgment to install the FRP ducts first and to fill under and around the ducts thereafter without trenching. Accordingly, the FRP ducts were assembled and hung in the air between the rear of the headwall and the igloo arch with no support except the fasteners at each end. That method runs contrary to contract requirements that specify "uniform bearing and support for each section of pipe" and may have placed undue stress on the ducts. (Finding 10, § 02302, ¶¶ 3.2 to 3.3, finding 76, ¶¶ [3, 7], findings 83, 86, 90, 107) Second, no bedding materials as specified in the contract were placed under and around FRP ducts at the first igloo (finding 87). Third, compaction efforts by appellant under and around FRP ducts were not shown by testing to be adequate (findings 87, 92, 93).

We have attempted to reconcile the expert opinions and have noted certain deficiencies related to those opinions; however, we have relied on the opinions to the extent indicated above (findings 73, 78, 80, 82, 89, 98-110). Our judgment is that the FRP duct failures resulted from multiple contributing causes.

As to each of the causes attributable to the government, the contract drawings and specifications constitute design specifications to which the implied warranty of specifications applies. The contract, properly interpreted, provided a "road map" for specified FRP materials and for placement and testing of fill and bedding beneath and around the FRP ducts and installation of the ducts, including the connections to the igloo arch and the headwall. *J. L. Simmons Co.*, 412 F.2d at 1362; *Cable and Computer Technology*, 03-1 BCA at 159,408-09.

The design errors and defective specifications as well as appellant's construction shortcomings, to the extent those short-comings did not result from the design, caused the overall failures and the remedial work that was required to unearth the ducts and to replace the sheared FRP pipe and certain waterproofing and roofing materials. The share of responsibility for the increased costs to unearth the ducts and to replace the sheared FRP pipe and other items is a matter to be resolved in quantum proceedings.

Appellant also is entitled to an equitable adjustment for specific changes directed by the government where LEC performed in accordance with the contract and government direction. That is, changes directed by the government to FRP-to-steel coupling requirements and the addition of flexible connectors by the government following failures of FRP ducts are compensable changes for which the government is liable.

The unmodified contract required tightening bands and straps for the FRP-to-steel connection. Ample evidence shows that connecting flexible FRP to inflexible 0.25 inch thick steel created a hard spot at which the FRP was likely to fail. The A-E also determined that the originally specified connection would not be adequate for the pressures to which the ducts would be subjected. (Findings 73, 80, 82, 84, 85) On this basis, the government changed the connection requirement, thereby requiring extra work (finding 84).

The record also shows that the inflexible coupling specified for the FRP-to-steel connection was inadequate for the downward movement of the underlying soil mass that was anticipated (findings 77, 78, 85, 92, 94). To accommodate the need for flexibility, the government directed use of flexible connectors and sleeves to protect the connections (findings 95, 96). The government's suggestion that the flexible connectors were added as a precaution for LEC's convenience is not supported by the facts. Mr. Bartram recommended use of flexible connectors. The government adopted that recommendation and directed their use by LEC. (Finding 95)

Finally, in directing the remedial repairs of the FRP ducts, the government directed use of temporary supports for the ducts at or near the elbows and directed placement of pea gravel as fill beneath and around the FRP ducts (finding 95). The government paid for importation of some pea gravel (finding 97). We do not question the wisdom of temporary supports; however, we find no contract requirement for their use. Accordingly, the government added a new requirement and a work method not necessarily required by the contract. In addition, while pea gravel is suitable for the application here, it was not exclusively called out by the contract or the manufacturer's recommendations (finding 76, ¶ [1], finding 81). Specifying pea gravel, to the exclusion of other acceptable products, was a compensable change.

<u>ASBCA No. 53358 - Blast Door Plates</u>

The contractor asserts that after it had delivered and installed the blast door plates and after the government had accepted the blast door plates, the government directed that additional steel plates be installed. Appellant contends that it had installed the correct number of steel plates at the doors pursuant to its reasonable interpretation of the contract. The best that can be said for the government, according to LEC, is that the contract is latently ambiguous concerning the number of steel plates to be included at each blast door. However, the contractor suggests that the contract drawings are defective in showing what the government wanted or needed.

The question of acceptance is one of fact that must be proved by appellant. *Hogan Construction, Inc.*, ASBCA No. 39014, 95-1 BCA ¶ 27,398 at 135,595. In its post-hearing brief, for the first time, appellant asserts that the government had accepted the work prior to notification that more blast plates were required (app. br. at 44, ¶ 205, at 77). Appellant has not proved acceptance by the government. The government had inspected the work, had overlooked the alleged discrepancy in earlier inspections, but had notified LEC, prior to acceptance, that the work was deficient. Government inspections are for the government's benefit, do not constitute or imply acceptance, and did not relieve appellant of its quality control responsibilities. (Finding 2, FAR 52.246-12(c), finding 10, § 01450, finding 116)

The government contends that appellant's interpretation of the pertinent contract drawings is unreasonable and that the contract is unambiguous. We agree that LEC's interpretation is unreasonable.

The drawing indications and the drawing notes, when read together and harmonized, require that a plate be installed on the headwall and on the pilaster adjacent to each C10 or each S10 location at each blast door (findings 114, 115, 117). The contractor and its subcontractor, IDC, had differing interpretations, neither of which takes all relevant contract provisions into account. Appellant's interpretation, as explained at the hearing, ignores clear requirements for plates to be installed adjacent to C10 locations. We are not convinced that IDC shared that interpretation. Based on their performance prior to any dispute, we are uncertain of their interpretation. However, if IDC intended to install 19 plates per door, that interpretation, which was not directly supported by evidence from the subcontractor, unreasonably omits some but not all plates adjacent to C10 locations. (Finding 118)

As set forth above, a contract interpretation is not reasonable if it fails to give meaning to all relevant contract provisions. Even if LEC's interpretation as explained by Mr. Davis at the hearing was found to be reasonable, there is insufficient proof that it was relied upon by the contractor in bidding.

<u>ASBCA No. 53359 - Alleged Additional Quantities of Earthwork Materials</u>

The government was responsible for supplying suitable soils materials of certain types (finding 121). Appellant claims that sufficient quantities of such materials were not available and that appellant was obliged to import the materials. Appellant further asserts that the government failed fully to reimburse appellant for imported materials. The government submits that it correctly paid LEC for all materials with the possible exception of cinder sand (gov't br. at 165, ¶ 400; CO "Domingos agreed to pay for the volume of cinder sand at the dirty cinders price if LEC can prove that it was used as arch fill . . . .")

a. Cinder Sand

The government was responsible for providing bedding for CMP, FRP ducts, and PVC pipe but lacked sufficient quantities of the proper materials for those purposes (findings 121-23). Appellant used a combination of cinder sand and dirty cinders as bedding for CMP and PVC pipe (findings 123, 124, 134, 135). The parties agreed to compensation for 735 tons of cinder sand for use with CMP, only, and that quantity must be subtracted from any amount due (findings 123, 128). The evidence indicates that the government accepted cinder sand as bedding for PVC pipe (finding 124). LEC is entitled to an equitable adjustment for the actual quantity of cinder sand it obtained for CMP and PVC pipe bedding and the quantity that would have been needed as initial backfill and bedding beneath FRP ducts at 5 or 6 igloos where it was used. Actual quantities are a matter for quantum determination.

LEC was responsible for providing a combination of cinder sand and dirty cinders for use as structural fill beneath the new mechanical room slabs (findings 125, 134, 135). The actual quantity of cinder sand used for this purpose must be subtracted from the total quantity of cinder sand actually provided by LEC (finding 128).

The contractor used cinder sand for fill beneath the FRP ducts at five or six igloos rather than only as initial backfill and bedding (finding 126). The contract allowed for the use of cinders, among other materials, as bedding for the FRP ducts (finding 122). The government did not show that cinder sand was unsuitable for this purpose and the government seemed prepared to accept cinder sand as FRP fill. Their concern was with the lack of compaction, not the fill material. (Findings 81, 87-91, 127) Accordingly, we cannot fully credit the government's argument that the cinder sand placed beneath the FRP ducts (some portion of 1,795.88 tons) accounts for the alleged uncompensated quantity of cinder sand (gov't br. at 123, ¶ 292—"It is unclear where the cinder sand was eventually used."). Pursuant to finding 127, proven quantities of cinder sand that were placed as arch replacement cover, if any, when removed as FRP fill are compensable at the dirty cinders price because cinder sand, a more refined and higher-priced product, was not necessary for arch replacement fill. As noted above, the government admits as much (gov't br. at 165, ¶ 400). These are matters for quantum determination.

b. Pea Gravel

The government directed the use of pea gravel as fill beneath FRP ducts and accepted pea gravel in the manner placed by LEC. The government was responsible for providing bedding for FRP ducts but lacked sufficient quantities of the proper materials for those purposes. (Findings 121, 129) The contractor is entitled to be paid for importation of pea gravel for use as fill beneath the FRP ducts. The amount allowed in mod 25 must be subtracted from any amount due.

c. Dirty Cinders

(1) Topsoil

To the extent that dirty cinders were used in lieu of topsoil that should have been stripped and stockpiled by LEC for later use over the arch replacement fill, the contractor is responsible for any added costs. The record does not support appellant's argument that dirty cinders were necessary as a substitute for insufficient quantities of topsoil. (Findings 131-32)

(2) Structural Fill

The government was responsible for providing bedding for CMP and PVC pipe but lacked sufficient quantities of the proper materials for those purposes (findings 121-23). Appellant used a combination of cinder sand and dirty cinders as bedding for CMP and PVC pipe (findings 123, 124, 134, 135). The government compensated LEC, in mod 16, for a quantity of dirty cinders for use as structural fill and that quantity must be subtracted from any amount due (finding 135). LEC is entitled to an equitable adjustment for the actual quantity of dirty cinders it obtained for CMP and PVC pipe bedding.

The contractor was responsible for providing a combination of cinder sand and dirty cinders for use as structural fill beneath the new mechanical room slabs (findings 125, 134-35). The actual quantity of dirty cinders used for this purpose must be subtracted from the total quantity of dirty cinders actually provided (finding 135).

As explained in findings 123 to 125 and above, LEC also claims that it used cinder sand as structural fill beneath CMP, PVC, and mechanical room slabs and footings. Those quantities are appellant's responsibility.

d. Pit Run

The contractor alleges that it was obliged to import dirty cinders that had been processed, so-called pit run, when the government did not provide materials at the site, as promised in the contract and when the government's screen was not available for appellant's use in processing imported dirty cinders. Appellant submits that it is entitled to be compensated for buying 384.85 tons of pit run. The government contends that it was not obliged to provide a screen and that the grizzly was unavailable because the contractor damaged it. We conclude that there is no evidence in the record that the government directed the purchase of pit run. (Findings 136, 137)

e. Aggregate Base Course (ABC)

The contractor asserts that it was required by the contract to use ABC under the igloo aprons, mechanical rooms, sidewalks, concrete equipment pads, and new asphalt roads. Including wastage, that amounted to 1,538.61 tons. In addition, argues appellant, the government directed an additional use of ABC where appellant planned to remove and to replace cinder-based roads with the same excavated materials at certain igloo aprons and duct bank trenches. LEC alleges that the total ABC imported amounted to 3,946.03 tons, leaving 2,407.42 tons uncompensated by the government. (Finding 142)

LEC acknowledges that it was responsible for structural fill, including ABC (finding 142). The contract shows that "BASE COURSE" was required under the igloo aprons at "CINDER BASE ROADS" and that "AGGREGATE BASE MATERIAL" was required as backfill for duct bank trenches across "RED CINDER" roads (findings 138, 139). LEC did not show that cinder base roads and red cinder are the same as ABC. The contractor also did not prove that the government, by directing the use of ABC, was ordering something different from "BASE COURSE" or "AGGREGATE BASE MATERIAL" as required by the contract. (Findings 140, 141)

SUMMARY

ASBCA No. 53304

To the extent that LEC removed a portion of the roadway and replaced it to match the new apron elevation at B117, ASBCA No. 53304 is sustained. Appellant is entitled to an equitable adjustment for this work plus interest from 6 November 2000 (findings 51-53) pursuant to the Changes and Disputes provisions of the contract (finding 2) and the Contract Disputes Act until paid. In all other respects, ASBCA No. 53304 is denied.

ASBCA No. 53356

As explained above in decision part a.(1)-(2) under this appeal, appellant is entitled to an equitable adjustment in connection with screening clay and other deleterious items that exceeded 6 inches, out of the existing arch cover and borrow materials. LEC should have expected to remove some amount of roots and vegetable matter or pockets of debris, wood, scrap materials and refuse. Interest must be added to the net amount of the equitable adjustment from 6 November 2000 (findings 37-40) until paid. In all other respects, ASBCA No. 53356 is denied.

ASBCA No. 53357

As explained above, this appeal is sustained in part and denied in part. Assignment of extra costs to contributing causes that are attributable to the government or to appellant are matters for quantum determination. Appellant is entitled to an equitable adjustment plus interest from 6 November 2000 (findings 112, 113) until paid.

ASBCA No. 53358

The appeal is denied.

ASBCA No. 53359

LEC is entitled to an equitable adjustment for importation of proven quantities, if any, of cinder sand, pea gravel, and dirty cinders (as structural fill) as explained above. Interest on any monetary amount due must be added in accordance with the Disputes provision of the contract from 6 November 2000 until paid (findings 2, 143-45). To that extent, ASBCA No. 53359 is sustained. In all other respects, it is denied.

Dated: 23 January 2006

STEVEN L. REED
Administrative Judge
Armed Services Board
of Contract Appeals

I concur

MARK N. STEMPLER
Administrative Judge
Acting Chairman
Armed Services Board
of Contract Appeals

I concur

EUNICE W. THOMAS
Administrative Judge
Vice Chairman
Armed Services Board
of Contract Appeals

I certify that the foregoing is a true copy of the Opinion and Decision of the Armed Services Board of Contract Appeals in ASBCA Nos. 53304, 53356, 53357, 53358, 53359, Appeals of Lamb Engineering & Construction Company, rendered in conformance with the Board's Charter.

Dated:

CATHERINE A. STANTON
Recorder, Armed Services
Board of Contract Appeals