

SPECIAL PROVISIONS
Job Number: 12-027
Park Point Communications Tower
November, 2012

CITY of DULUTH
PROJECT SPECIFICATIONS

Park Point Communications Tower

City of Duluth, MN
411 West 1st St.
Duluth, MN 55802

City Project #: 12-027
MSA Project #: 00616038

Bid #: 12-23DS Park Point Communications Tower

Opening Date: 11/28/2012

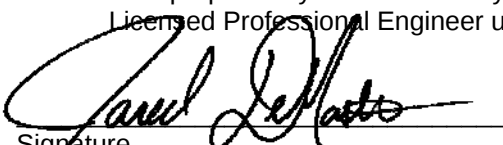
Time: 2:00 PM

Place: RM 106A City Hall

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SPECIFICATIONS SIGNATURE PAGE

I HEREBY CERTIFY THAT THIS PLAN, specification or report
was prepared by me or under my direct supervision and that I am a duly
Licensed Professional Engineer under the laws of the State of Minnesota.


Signature

Jared DeMaster, P.E.

11/01/2012
Date

448815
License No.

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(APPENDIX A) Geotechnical Report

Certified Payroll Checklist CDBG Funding Only rev 4/5/11

Data for Labor Cost Bidding

Instructions to Bidders – Engineering 6/02/10

MNOPS Intrastate Anti-Drug/Alcohol Misuse Prev Asmt

Operator Qualification Contractor Covered Tasks

Prevailing Wage Rate(s) US DOL, Highway, MN120001, 6/15/12; US DOL Heavy, MN120105, 7/6/12, MN DLI, 7/5/12

Project Insurance Requirements 7/13//09

Request for Bids form

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The following forms and regulations/rules/statutes and interpretations, which are incorporated by reference in this contract, are available on the World Wide Web at the sites listed below. The City of Duluth will use its best efforts to ensure that the most recent, applicable forms and regulations/rules/statutes and interpretations are included on the web sites provided; however, if you are the successful bidder, prior to signing the contract, you are responsible for comparing the versions of the forms and regulations/rules/statutes and interpretations attached to the contract which you are signing with the versions on the web to ensure conformity.

THE VERSIONS OF THE FORMS AND REGULATIONS/RULES/STATUTES and INTERPRETATION ATTACHED TO THE CONTRACT WILL BE CONTROLLING. HARD COPIES OF ALL FORMS ARE AVAILABLE AT THE ENGINEERING DIVISION, EXCEPT THE NON-COLLUSION AND AFFIRMATIVE ACTION POLICY STATEMENT, WHICH ARE AVAILABLE AT THE CITY OF DULUTH PURCHASING DEPARTMENT.

Item listing from web:

FORM	WEB SITE
Affidavit of Non-Collusion (required by awarded contractor only)	www.duluthmn.gov/engineering/construction_documents.cfm
Affirmative Action Policy Statement/Certificate - EEO (required by awarded contractor only)	www.duluthmn.gov/engineering/construction_documents.cfm
Bidder's Label for submitting project bids	www.duluthmn.gov/engineering/construction_documents.cfm
Certified Payroll Report form WH347 (front side only)	www.dol.gov/whd/forms/WH347.pdf
Contractor's Haul Route	www.duluthmn.gov/engineering/construction_documents.cfm
Contractor-Vendor form MnDOT (12-2010)	www.dot.state.mn.us/const/labor/documents/forms/contractor-vendor-form.pdf
Debarment/Suspension Notice 6-8-2012	www.dot.state.mn.us/pre-letting/prov/order/suspension.pdf
IC-134 form	www.taxes.state.mn.us/Forms_and_Instructions/ic134.pdf
IC-134 on-line submittal (click: Submit Contractor Affidavit; r-side of screen)	www.mndor.state.mn.us/
MN Rules 5200.1105 & .1106	www.duluthmn.gov/engineering/construction_documents.cfm
MN Statutes 177.41 to 177.44	www.revisor.mn.gov/statutes/?id=177
MNOPS Intrastate Anti-Drug/Alcohol Misuse Prev Asmt	www.duluthmn.gov/engineering/construction_documents.cfm
Month End Trucking Report Form A & B (12-10)	www.dot.state.mn.us/const/labor/forms.html
Month-End Trucking Report Statement of Compliance (12-10)	www.dot.state.mn.us/const/labor/forms.html
Notice to Bidders Prompt Payment to Subs	www.duluthmn.gov/engineering/construction_documents.cfm
One-Call Instructions	www.duluthmn.gov/engineering/construction_documents.cfm
Operator Qualification Contractor Covered Tasks	www.duluthmn.gov/engineering/construction_documents.cfm
Purchasing Division General Specifications	www.duluthmn.gov/engineering/construction_documents.cfm
Request to Sublet TP-21834 (5-12-09)	www.duluthmn.gov/engineering/construction_documents.cfm
Statement of Compliance Form (12-10)	www.dot.state.mn.us/const/labor/forms.html
Supplemental General Conditions Part II 4/15/11	www.duluthmn.gov/engineering/construction_documents.cfm
Trucking Company-Vendor form MnDOT (12/2010)	www.dot.state.mn.us/const/labor/documents/forms/trucking-company-vendor-form.pdf

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NOTICE TO ALL BIDDERS:

The City of Duluth Public Works & Utilities Department – Engineering Division 2011 Edition Standard Construction Specifications book and any addendums or supplements is incorporated by reference and is deemed to be a part hereof as if fully incorporated and set forth herein. The Standard Construction Specification is available on the City website at www.duluthmn.gov/engineering/index.cfm.

SP-1 SCOPE OF WORK

In general, the Work of this Project includes the construction of a new 140 foot tall self-supporting communications tower. The work will include excavation, backfill, foundation, steel self-supporting communications tower, site grading, demolition of existing tower and support wires, removal of existing communication building, and related items of construction.

SP-1.2 CONSTRUCTION ACTIVITIES SEQUENCING RESTRICTIONS

These construction activity sequencing restrictions are intended to manage the inconvenience to residents due to very limited right of way, maximize safety, and maintain constructability. The Contractor shall coordinate with the Engineer on a regular basis to evaluate construction sequencing effectiveness.

- A) The existing tower and telemetry building must remain in operation during construction of the new tower.
- B) The existing tower may not be demolished before the new tower is constructed and ready to operate. Operations must be transferred from the existing tower to the new tower with less than 12 hours of downtime.
- C) Contractor shall coordinate with the City for communication service disruption, such as but not limited to transferring service from the existing tower to the new tower. The Contractor shall provide notice three weeks in advance of any planned communication service disruption
- D) Per City request, the contractor shall be required to allow beach access from 22nd Street South during construction. The existing path to the north shall not be obstructed during construction to allow beach access.
- E) Contractor follows all provisions of permanent and temporary easements.

SP-1.3 CONTACT INFORMATION

Questions regarding this project shall be directed to: Joe Miller with City of Duluth at 218-730-4432; or Tari Rayala with the City of Duluth at 218-730-4434.

SP-2 (1606) CONTRACTOR STORAGE AREA

The provisions of Mn/DOT 1606 are supplemented with the following:

The contractor shall have access as shown on the construction drawings.

SP-3 (1702) PERMITS, LICENSES, AND TAXES

The provisions of Mn/DOT 1106 and Duluth Standard Specifications are supplemented with the following:

SP-3.2 The State of Minnesota through its Department of Natural Resources (DNR) requires license agreements for utility crossings. The license agreement between the City and the State includes coordination, safety, insurance provisions. The Contractor shall comply with all State's requirements.

SP-3.3 Prior to using any privately acquired disposal areas or borrow material sources, the Contractor shall furnish the Engineer copies of the agreement with the owners of such property.

SP-4 (1717) PROTECTION AND RESTORATION OF PROPERTY

The provisions of Mn/DOT 1717 are supplemented as follows:

Private Property are immediately adjacent to the area of work and include several houses near the area of construction. The Contractor shall protect both the structures and private property during construction. The Contractor shall perform a building and site inspection as directed by the Engineer and provide a documentation report prior to performing the construction work. A copy of the documentation report, including photographs, shall be provided to the Engineer. All costs for site condition inspections shall be considered incidental to the contract and no separate compensation will be made.

SP-5 (1806) DETERMINATION AND EXTENSION OF CONTRACT TIME

The Contract Time will be determined in accordance with the provisions of Mn/DOT 1806 and the following:

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SP-5.1 Construction operations shall be started on or before **December 15, 2013** or within ten (10) calendar days after the date of award by City Council resolution, whichever is later; however, the Notice to Proceed letter will be the official authorization to commence construction operations.

SP-5.2 All work required under this Contract shall be finally completed by **October 11, 2013**.

Phase 1 shall include a minimum of the following:

- Successful installation of the new communications tower (complete).

Phase 2 shall include a minimum of the following:

- Switchover of all existing equipment from the existing communications tower to the new communications tower.
- The new communications tower is operational.
- Coordinate reconstruction of telephone, cable, power utilities.
- This work cannot start until the City is finished building the RTU Telemetry Building.

Phase 3 shall include a minimum of the following:

- Complete disposal of construction and misc. debris and materials.
- The existing tower, guy wires, telemetry buildings has been demolished.
- Complete disposal of construction and misc. debris and materials.
- Completion of the restoration of all misc areas disturbed by construction activities.

SP-5.3 All work required under this contact shall be **final by September 1, 2013**.

Final Completion shall include completion of all remaining items including, but not limited to:

- Restoring the work site to an equal or better than condition which existed prior to starting the work.
- Restoration vegetation shall be well established.
- Cleaning and restoration of any material derived for the construction area.
- Completing all items addressed in final project closeout punch list.
- Submittal of all required testing and installation reports and notice of substantial completion.
- Conduct and coordinate final project walk-through with owner, engineer, and stakeholders.
- Submitting final project closeout documentation inclusive of closeout letter and final pay request.

SP-5.4 CONSTRUCTION MILESTONES

The Contractor shall meet the following dates for substantial and final completions.

<u>Calendar Date</u>	<u>Contract Event</u>
December Council Meeting	Tentative Notice to Proceed
May 21, 2013	Phase 1 Complete
July 30, 2013	Tentative Phase 2 Begins (Tentative Operation Transfer to New Tower)
August 16, 2013	Tentative Phase 2 Complete
August 30, 2013	Tentative Phase 3 Existing Communications Tower Demolished and Project Substantial Completion
October 11, 2013	Final Completion

SP-5.5 The provisions of Mn/DOT 1806.1C(3) are modified to the extent that the phrase "during the inclusive period from November 15 to April 15," is deleted. A similar phrase set forth in the second paragraph of Mn/DOT 1807.2 is also deleted.

SP-5.6 No work which will restrict or interfere with traffic shall be performed between 12:00 noon on the day preceding and 6:30 a.m. on the day following any consecutive combination of a Saturday, Sunday, and legal holiday without written permission from the Engineer. If the Contractor chooses not to work at all on the day preceding the holiday period, no working day charges will be assessed. If the Contractor chooses to work prior to 12:00 noon on the day preceding the holiday period or if the Contractor obtains written permission to work after 12:00 noon on the day preceding the holiday period, working day charges will be assessed only for the actual hours worked.

SP-5.7 When all, or a portion, of the Contract Time is specified as a calendar completion date, as provided in Mn/DOT 1103, the time is presumed to have been determined by considering the Proposal quantities, normal weather for the locality and season of the year, and the necessity of having the work completed by the specified date. The time may be extended by the Engineer only in accordance with the following:

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When the Contract Time is specified as a fixed calendar completion date, any time extensions granted must be justified on the basis of unavoidable delay in starting or completing the progress controlling operations, and then, only when and to the extent that it is shown that delay time could not be overcome and the work brought back on schedule through reasonable adjustments in the Progress Schedule. Provided the Contractor has made all reasonable efforts to maintain an adequate and acceptable Progress Schedule, the specified completion date may be extended as the Engineer determines to be justified, for any of the following reasons:

- 1) Delays caused by failure of the City Council to award the Contract at least 10 calendar days in advance of the latest date specified for beginning construction operations.
- 2) Delays caused by an earthquake, flood, cloudburst, cyclone, tornado, or other cataclysmic phenomenon of a nature beyond the power of the Contractor to foresee and make preparations in defense against.
- 3) Delays caused by acts of the Government or a political subdivision, or by acts of the public enemy, including fires, epidemics, and strikes not caused by improper acts or omissions of the Contractor.
- 4) Delays caused by an action or non-action of the Department, such as suspension of work by order of the Engineer through no fault on the Contractor.
- 5) Delays caused in incompleteness of work being done by other Contractors or utility owners, or due to other unforeseeable interferences not the fault of the Contractor.
- 6) Delays direction attributable to the performances of Extra Work or increased quantities or work.
- 7) Extraordinary delays in delivery or materials, resulting from strikes, lockouts, freight embargoes, governmental acts, or sudden disaster, or a nature beyond the power of the Contractor or his/her supplier to foresee and forestall.

Delays caused by plant and equipment failure, and delays due to unsuitable weather or conditions resulting therefrom, will not be allowed as justification for time extension except when and only to the extent the Engineer considers justified in view of unavoidable circumstances or events. Normal weather delays and the usual plant and equipment failures must be allowed for establishing work schedules. An extension of time may be granted for such delays as are considered to be in excess of the normal, but only when it is shown that the lost time would not reasonably be made up through acceleration of the remaining work. Failure to prosecute the work continuously and effectively for the full time allowed, with adequate work force and schedule, will be cause for denial of any such time extension that may otherwise be allowed.

SP-6 **(1807.1) FAILURE TO COMPLETE WORK ON TIME**

Liquidated damages will be assessed at a rate of \$10,000 for each calendar day that Phase 1 objectives are not satisfied.

Liquidated damages will be assessed at a rate of \$1,000 for each calendar day that Phase 2 objectives are not satisfied.

Liquidated damages will be assessed at a rate of \$1,000 for each calendar day that Phase 3 objectives are not satisfied.

Liquidated damages will be assessed at a rate of \$1,500 for each calendar day that Final Completion objectives are not satisfied.

The liquidated damages as set forth above may apply equally, separately, and may be assessed concurrently.

SP-7 **COLD WEATHER PRECAUTIONS**

The Contractor shall be prepared to provide construction blankets or ground thawing as needed to facilitate construction activities if required. Ground thawing or insulating shall be incidental to the construction of the associated general roadway, piping, and buried utilities.

SP-8 **METHOD OF PAYMENT**

Payment for construction items described below shall be included with the bid items listed in the "Request for Bids". Any construction activities, items, or materials not specifically listed under one of the following payment items shall be incidental to the Mobilization tank lump sum price.

SP-9 **TRAFFIC SIGNS**

All street signs shall be protected per City Specification 2564. Signs shall be maintained in service for the duration of the project. Temporary installations of signs shall be as approved by the Engineer.

SP-10 **RECORD DRAWINGS**

The Engineer will provide the Contractor with a suitable set of contract drawings on which the Contractor shall record daily records of changes and deviations from the contract. All buried or concealed piping, conduits, or similar items shall be located by dimensions and elevations on the record drawings.

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- SP-10.1 The daily record of changes shall be the responsibility of Contractor's field superintendent. No arbitrary mark-ups shall be permitted. At completion of the project, the Contractor shall submit the marked-up record drawings to the Engineer.
- SP-10.2 The contractor shall coordinate with engineer GPS documentation of all underground items. Cost to uncover any items not documented shall be the responsibility of the contractor. Proper notice and coordination with the engineer shall be the responsibility of the contractor.
- SP-11** **TRAFFIC CONTROL**
Contractor shall abide by all requirements of the Minnesota Manual of Uniform Traffic Control Devices (MMUTCD), including field manual, latest edition. Traffic control signs and devices shown on drawings shall be provided at a minimum, and additional signs and devices may be required based on Contractor staging.

**REQUEST FOR BID****DATE** 11/28/2012**BID #** 12-23DS Park Point Communications Tower

RETURN BY BID OPENING TIME TO:

PURCHASING DIVISION
100 CITY HALL
Duluth, MN 55802
Dennis Sears
PHONE: 218-730-5340
FAX: 218-730-5921

City of Duluth Park Point Communications Tower
PROJECT NO. 12-027

BID OPENING DATE At 2:00 PM, Wednesday, November 28th, 2012

Note: all bids must be written, signed and transmitted in a sealed envelope, plainly marked with the bid number, subject matter, and opening date. The City of Duluth reserves the right to split award where there is a substantial savings to the City, waive informalities and to reject any and all bids. Bidder should state in proposal if bid price is based on acceptance of total order. Sales tax is not to be included in the unit price. Bidder to state freight chargers if the proposal F.O.B. is shipping point, freight not allowed. Low bid will not be the only consideration for award of bid. All pages shall be signed or initialed by authorized bidder's representative as indicated at the bottom of the page(s) of the request for bid form.

RETURN BID IN DUPLICATE WITH DUPLICATE DESCRIPTIVE LITERATURE
FOR BID RESULTS, ENCLOSE A SELF-ADDRESSED, STAMPED ENVELOPE WITH BID

BID DEPOSIT REQUIREMENTS: 5% OF BID AMOUNT

Deposit shall mean cash, cashier's check or corporate surety bond payable to or in favor of the City of Duluth.

A PERFORMANCE BOND AND A PAYMENT BOND shall be required of the successful bidder, BOTH in the full amount of the bid.

INSUREANCE CERTIFICATE required per attached requirements.

Designated F.O.B. Point:

Engineering Division

Tax:

Federal Excise Tax Exemption

Jobsite(s)

Account No. 41-74-0056 K

Vendor Email Address: _____ FREIGHT CHARGE \$ _____

NAME: _____

TOTAL BID PRICE # _____

ADDR1: _____

TO INCLUDE ANY ADDITIONAL PAGES.

ADDR2: _____

ADDR3: _____

BY: _____

PAYMENT TERMS \$ _____

(Print)

(Title)

F.O.B. POINT \$ _____

(Signature)

(Tele. #)

DELIVERY DATE \$ _____

The City of Duluth is an Equal Opportunity Employer.

C I T Y O F D U L U T H

DATE: 11/28/2012

BID #: 12-23DS Park Point Communications Tower

*****SCHEDULE OF PRICES*****

Duluth 2009 Comprehensive Supervisory Control and Data Acquisition
City Project No.12-027
Bid No. 12-23DS Park Point Communications Tower

Make all extensions and total the bid.

Item No.	Spec. #	Qty	U/OM	Item Description	Unit Price	Total Price
001		1	Each	Exhibit A (Must Be Returned With The Bid)	\$ _____	\$ _____
						TOTAL \$ _____

PRE-QUALIFIED SYSTEM INTEGRATOR:

ADDENDUM RECEIPT ACKNOWLEDGEMENTS:

ADDENDUM NO. _____, DATED _____

ADDENDUM NO. _____, DATED _____

ADDENDUM NO. _____, DATED _____

TOTAL BID IN WORDS:

CONTRACTOR NAME:

THE CONTRACTOR AGREES TO ALL OF THE
PROVISIONS CONTAINED IN THE CONTRACT
DOCUMENTS. ENCLOSED HERewith FIND A
CERTIFIED CHECK OR BID BOND IN THE
AMOUNT OF AT LEAST 5% OF THE AMOUNT OF
PROPOSAL MADE PAYABLE TO THE CITY OF
DULUTH AS A PROPOSAL GUARANTEE WHICH IT
(see additional page(s))

(Initial)

C I T Y O F D U L U T H

DATE: 11/28/2012

BID #: 12-23DS Park Point Communications Tower

IS AGREED BY THE UNDERSIGNED WILL BE
FORFEITED IN THE EVENT THE FORM OF
CONTRACT AND BOND IS NOT EXECUTED, IF
AWARDED TO THE UNDERSIGNED.

**The bidder hereby certifies that he/she has received
the City of Duluth Public Works/Utilities Department -
Engineering Division Standard Construction Specifications 2007
booklet and has incorporated the terms hereof in its bid.**

SIGNED: _____ FOR

A PARTNERSHIP (OR)

A CORPORATION INCORPORATED UNDER THE
LAWS OF THE STATE OF:

PRESIDENT _____
VICE-PRES. _____
SECRETARY _____
TREASURER _____

ADDRESS(ES) _____

BEING DULY SWORN, DEPOSES AND SAYS THAT
THERE ARE NO OTHER PERSONS COMPRISING
ABOVE COMPANY OR FIRM THAN THE ABOVE
NAMES, AND THAT THERE ARE NO PERSONS
OR CORPORATIONS INTERESTED IN THE
FORGOING PROPOSALS, EITHER AS PRINCIPAL
OR SUBCONTRACTOR, OTHER THAN THE ABOVE
NAMES; ALSO THAT THE PROPOSALS ARE MADE
WITHOUT ANY CONNECTION WITH ANY PERSON
OR PERSONS MAKING ANY PROPOSAL FOR THE
ABOVE WORK; THAT THEY ARE IN ALL
RESPECTS FAIR AND WITHOUT COLLUSION OR
FRAUD; AND THAT NO PERSON ACTING IN ANY
OFFICIAL CAPACITY FOR THE CITY OF DULUTH
IS DIRECTLY OR INDIRECTLY INTERESTED
THEREIN, OR IN ANY PORTION OF THE PROFIT
THEREOF.

(see additional page(s))

(Initial)

C I T Y O F D U L U T H

DATE: 11/28/2012
BID #: 12-23DS Park Point Communications Tower

SUBSCRIBED AND SWORN TO BEFORE ME THIS

DAY OF A.D.,

NOTARY PUBLIC

IMPORTANT NOTE BIDDERS:
PLEASE DISREGARD THE NOTE ON PAGE 1
REGARDING SALES TAX FOR THIS BID. ALL
APPLICABLE SALES AND/OR USE TAXES ARE
TO BE INCLUDED IN BID PRICING. ALSO,
ALL BIDS ARE TO BE F.O.B. JOBSITE.
THE BLANK ON PAGE ONE FOR FREIGHT IS TO
TO BE LEFT BLANK.

Delivery Contact: Joe Miller
Facility Management
218-730-4430

(Initial)

LINE NO.	SPEC. NO.	ITEM DESCRIPTION	UNIT OF MEASURE	ESTIMATED QUANTITY	UNIT PRICE	TOTAL PRICE
1	-	MOBILIZATION/DEMOBILIZATION, BONDING, INSURANCE PHASE 1	LS	1	\$ -	\$ -
2	33 81 15	NEW COMMUNICATIONS TOWER PHASE 1, COMPLETE	LS	1	\$ -	\$ -
3	-	MOBILIZATION/DEMOBILIZATION, BONDING, INSURANCE PHASE 2	LS	1	\$ -	\$ -
4	-	OPERATION TRANSFER TO NEW TOWER PHASE 2, COMPLETE	LS	1	\$ -	\$ -
5	-	MOBILIZATION/DEMOBILIZATION, BONDING, INSURANCE PHASE 3	LS	1	\$ -	\$ -
6	-	EXISTING TOWER TELEMERTY BUILDING DEMOLISHED PHASE 3, COMPLETE	LS	1	\$ -	\$ -

NEW COMMUNICATIONS TOWER WEIGHT CAPACITY _____ POUNDS

ADDITIVE ALTERNATES

A1	-	NEW 1/2 INCH COMMUNICATIONS CABLE INSTALLED	LS	1	\$ -	\$ -
A2	-	NEW 7/8 INCH COMMUNICATIONS CABLE INSTALLED	LS	1	\$ -	\$ -
A3	-	NEW 1-1/4 INCH COMMUNICATIONS CABLE INSTALLED	LS	1	\$ -	\$ -

GRAND TOTAL _____

1
2
3
4
5
6
7
8
9
10

INFORMATION AVAILABLE TO BIDDERS

Portions of reports and drawings used by the Engineer in the preparation of the Bidding Documents are attached to this document. Bidders are responsible for their own interpretation, verification, and use of the Technical Data contained in these reports and drawing. These Technical Data include:

- Geotechnical Report of soil borings performed at the project site.
- Sketches depicting information on the existing communications tower to be demolished.
- Specification Sheets on Existing Tower Antennas

END OF SECTION

Geotechnical Evaluation Report

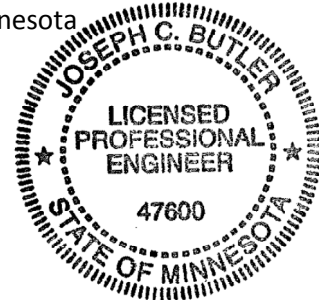
Proposed Park Point Communications Tower
22nd Avenue South
Duluth, Minnesota

Prepared for the

City of Duluth

Professional Certification

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota



Joseph C. Butler, PE
Project Engineer
License Number: 47600
October 16, 2012

Project DU-12-05256

Braun Intertec Corporation

October 16, 2012

Project DU-12-05256

City of Duluth
c/o Jared DeMaster, PE - MSA Professional Services, Inc.
301 West First Street
Duluth, MN 55802

Re: Geotechnical Evaluation
Proposed Park Point Radio Tower
22nd Avenue South
Duluth, Minnesota

Dear Mr. DeMaster:

We are pleased to present this Geotechnical Evaluation Report for the proposed Park Point Radio Tower. A summary of our results, and a summary of our recommendations in light of the geotechnical issues influencing design and construction, is presented below. More detailed information and recommendations follow.

Summary of Results

Two standard penetration test borings were completed for the project. Both borings encountered poorly graded sand and poorly graded sand with silt to the termination depths of the borings.

Penetration resistances in the borings indicated the sands above an elevation of 137 1/2 (on our assumed datum) were loose to medium dense with average blows per foot (BPF) of about 10. Below this elevation the penetration resistances generally ranged from 38 BPF to 50 blows for 6 inches of drive, indicating they were dense to very dense.

We would like to note that the increase in relative density corresponded closely to the groundwater elevation observed in the borings.

Groundwater was measured or estimated to be down approximately 10.8 and 16.3 feet as our borings were advanced. These depths correspond to an elevation of about 137 1/2 on our assumed datum. We also measured the water surface of Lake Superior; this elevation was about elevation 137 on our assumed datum. We would expect the groundwater elevation to coincide with and fluctuate in unison with the water surface of Lake Superior.

Summary of Recommendations

The geologic profile appears to be suitable for support of the tower on a mat footing (pad and pier) foundation type, or on drilled piers. We would like to note that if a mat footing is considered, we recommend the bottom of mat be set at or above elevation 139 to avoid excavation dewatering.

For purposes of this report, we recommend assuming a groundwater level at a depth of about 10 feet, or an elevation of 137 1/2. Submerged unit weights should be used for soils and concrete below this depth.

From a construction perspective, the project team should be aware that excavations for footings or the construction of a pier foundation will penetrate moist sands to near the 10-foot depth, where the sands will become water bearing. The need for casing and drilling slurry to support the sides of a drilled excavation should be anticipated.

Since the sands are non-cohesive, the edges of excavations will tend to slough and the sands will be likely to erode during a rain event.

Remarks

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please Joe Butler at 218.624.4967 or jbutler@braunintertec.com.

Sincerely,

BRAUN INTERTEC CORPORATION



Joseph C. Butler, PE
Associate Principal / Project Engineer



Mark W. Gothard, PE
Principal Engineer

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Appendix

Boring Location Sketch

Log of Boring Sheets ST-1 and ST-2

Descriptive Terminology

Drilled Pier Soil Strength and p-y Parameters

A. Introduction

A.1. Project Description

The City of Duluth is planning a new radio tower. The radio tower is referred to as the park point radio tower and will be located about 60 feet southeast of an existing radio tower located 375 feet northeast of the intersection of 22nd Avenue East and Minnesota Avenue in Duluth, Minnesota.

The proposed tower will be self supported and will have an equipment shelter building (ESB).

A.2. Purpose

The purpose of a geotechnical evaluation is to characterize subsurface geologic conditions at selected exploration locations and evaluate their impact on the design and construction of the radio tower foundation.

A.3. Reference Documents

To facilitate our evaluation, we were provided with or reviewed the following information or documents:

- Sheet G-3 – Proposed Site Plan, Sheet G-4 – Proposed Site Layout, and Sheet S-1 Tower Base.
- A Geologic Map of Minnesota, Quaternary Geology by Howard Hobbs and Joseph Goebel, dated 1982.
- Aerial photos from Google Earth, dated 8/28/2010.

A.4. Site Conditions

The proposed tower site is currently occupied by a guyed radio tower. The proposed tower will be located about 60 feet southwest of the existing tower base. The proposed tower will be located on an existing walking path. The path will be relocated as part of the project.

The site topography is rolling, with sand dunes and there is a beach to the northeast. Lake Superior is located about 200 feet northeast of the proposed tower.

A.5. Scope of Services

Our scope of services for this project was submitted to Mr. Jared DeMaster of MSA Professional Services as a Proposal dated September 26, 2012. We received authorization to proceed from Mr. DeMaster on September 28, 2012. Tasks performed in accordance with our authorized scope of services included:

- Performing a reconnaissance of the site to evaluate equipment access to exploration locations.
- Staking and clearing exploration locations of underground utilities.
- Performing 2 penetration test borings to a nominal depth of 50 feet.
- Preparing this report containing a boring location sketch, exploration logs, a summary of the geologic materials encountered, and recommendations for structure subgrade preparation and the design of the proposed tower foundation.

Our scope of services was performed under the terms of our Master Services Agreement between MSA Professional Services and Braun Intertec Corporation.

A.6. Boring Location and Elevations

The desired boring locations were chosen by MSA Professional Services. We staked the borings in the field by measuring with a cloth tape and estimating right angle from the existing radio tower fence.

Ground surface elevations at the boring locations were referenced to the top of the base of the existing radio tower foundation. We assigned this reference an arbitrary elevation of 150.0.

B. Results

B.1. Exploration Logs

B.1.a. Log of Boring Sheets

Log of Boring sheets for our penetration test borings are included in the Appendix. The logs identify and describe the geologic materials that were penetrated, and present the results of penetration resistance tests performed within them, and groundwater measurements.

Strata boundaries were inferred from changes in the penetration test samples and the auger cuttings. Because sampling was not performed continuously, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may also occur as gradual rather than abrupt transitions.

B.1.b. Geologic Origins

Geologic origins assigned to the materials shown on the logs and referenced within this report were based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance and other in-situ testing performed for the project, and (4) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.

B.2. Geologic Profile

B.2.a. Geologic Materials

Two standard penetration test borings were completed for the project. Both borings encountered poorly graded sand and poorly graded sand with silt to the termination depths of the borings.

Penetration resistances in the borings indicated the sands above an elevation of 137 1/2 (on our assumed datum) were loose to medium dense with average blows per foot (BPF) of about 10. Below this elevation the penetration resistances generally ranged from 38 BPF to 50 blows for 6 inches of drive, indicating they were dense to very dense.

We would like to note that the increase in relative density corresponded closely to the groundwater elevation observed in the borings.

B.2.b. Groundwater

Groundwater was measured or estimated to be down approximately 10.8 and 16.3 feet as our borings were advanced. These depths correspond to an elevation of about 137 1/2 on our assumed datum. We also measured the water surface of Lake Superior; this elevation was about elevation 137 on our assumed datum. We would expect the groundwater elevation to coincide with and fluctuate in unison with the water surface of Lake Superior.

Seasonal and annual fluctuations of groundwater should also be anticipated.

C. Basis for Recommendations

C.1. Design Details

C.1.a. Radio Tower Structure Loads

We understand the proposed radio tower will be a self supporting tower with an equilateral triangular cross-section. Center to center spacing between the three tower touchdown points will measure about 14 feet. We have assumed uplift and compression loads will be less than 500 kips per tower leg.

We anticipate up lift will be resisted by:

- the weight of the mat foundation and the soil placed on top of it, or
- The weight of concrete in the drilled piers and the total friction of soils on the sides of drilled piers.

We understand the foundation designs typically considered for similar self supporting towers include a mat foundation and drilled piers (shafts).

C.1.b. Equipment Shelter Building

We anticipate loads associated with the equipment shelter building (ESB) will be very light, less than 1,000 pounds per foot of wall. ESB buildings are typically constructed on a thickened edge structural floor slab and are heated in winter. We understand settlement and heave are not considered critical to the performance of the structure.

C.1.c. Anticipated Grade Changes

We have assumed the finished grade at the base of the proposed radio tower will be set near the existing grade at Boring ST-1, which is located near the elevation of the existing radio tower.

For the purpose of this report we have assumed the finished grade will be set at or about elevation 148 on our assumed datum. This will require a cut of about 5 feet near Boring ST-2.

C.1.d. Precautions Regarding Changed Information

We have attempted to describe our understanding of the proposed construction to the extent it was reported to us by others. Depending on the extent of available information, assumptions may have been made based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, we should be notified. New or changed information could require additional evaluation, analyses and/or recommendations.

C.2. Design Considerations

The geologic profile appears to be suitable for support of the tower on a mat footing (pad and pier) foundation type, or on drilled piers. We would like to note that if a mat footing is considered, we recommend the bottom of mat be set at or above elevation 139 to avoid excavation dewatering.

For purposes of this report, we recommend assuming a groundwater level at a depth of about 10 feet, or an elevation of 137 1/2. Submerged unit weights should be used for soils and concrete below this depth.

Our recommendations for support of the tower and ESB are presented below in Section D.

C.3. Construction Considerations

From a construction perspective, the project team should be aware that excavations for footings or the construction of a pier foundation will penetrate moist sands to near the 10-foot depth, where the sands will become water bearing. The need for casing and drilling slurry to support the sides of a drilled excavation should be anticipated.

Since the sands are non-cohesive, the edges of excavations will tend to slough and the sands will be likely to erode during a rain event.

D. Recommendations

D.1. Site Subgrade Preparation

D.1.a. Topsoil Stripping

We recommend removing topsoil (if any) and vegetation from the tower foundation area. If deeper excavations are necessary to remove soft or organic materials, to provide lateral support to replacement backfill and additional required fill, we recommend oversizing (widening) the excavations horizontally by one (1) foot beyond the outer edges of the tower location for each one (1) foot the excavations extend below bottom-of-footing, slab, or pavement subgrade elevations.

D.1.b. Selecting Excavation Backfill and Additional Required Fill

On-site soils free of organic material and debris can be considered for reuse as backfill and fill during general site grading, although the onsite sand soils are likely below their optimum moisture content for compaction. Moisture-conditioning (wetting) may be necessary to achieve the required compaction levels. We recommend that imported material needed to replace excavation spoils or balance cut and fill quantities during grading, consist of similar mineral soils.

D.1.c. Placement and Compaction of Backfill and Fill

We recommend spreading backfill and fill in loose lifts of approximately six (6) to twelve (12) inches, depending on the type of compaction equipment. We recommend compacting backfill and fill in accordance with the minimum criteria presented below in Table 1. The relative compaction of utility backfill should be evaluated based on the structure below which it is installed, and vertical proximity to that structure.

Table 1. Compaction Recommendations Summary

Reference	Relative Compaction, percent (ASTM D 698 – standard Proctor)	Moisture Content Range from Optimum, percentage
Below foundations	100	65 percent to 102 percent
Below slabs and above foundations	95	65 percent to 115 percent
Below aggregate surfaces and pavements, within 3 feet of subgrade elevations	100	65 percent to 102 percent
Below pavements, more than 3 feet below subgrade elevations	95	65 percent to 115 percent
Below landscaped surfaces	95	65 percent to 115 percent

D.2. Tower Spread Footing (Mat) Foundation Design

D.2.a. Embedment Depth

For frost protection, we recommend embedding the tower footing at least 72 inches below the lowest adjacent grade. At that depth, we anticipate the footing subgrade soils will consist of compacted fill or native lacustrine sand.

D.2.b. Surface Compaction

To improve the density of the bearing soils, we recommend the sands exposed at the footing excavation bottom be surface-compacted using a large (750 pounds minimum) plate compactor.

D.2.c. Net Allowable Bearing Pressure

For the typical roughly 30-foot square mat foundation, we recommend the tower footing exert a maximum net allowable bearing pressure of 2,000 pounds per square foot (psf), including all transient loads. This value includes a safety factor of at least 3.0 with regard to bearing capacity failure.

D.2.d. Settlement

We estimate that total settlements of the described mat footing foundation will amount to less than one-half inch under the reported loads.

D.2.e. Lateral Resistance and Uplift

Lateral loads transmitted to foundations can be resisted by passive resistance on the sides of the foundation and friction along the base of the foundation. An unfactored coefficient of sliding friction of 0.35 can be used for the interface of the concrete foundation and the bearing soil when calculating resistance to sliding. The designer should select and apply an appropriate factor of safety to the sliding friction value.

We recommend using an unfactored unit weight of 110 pounds per cubic foot (pcf) for design of shallow foundation elements to resist uplift. For foundations cast against an undisturbed vertical face of soil or where engineered fill is placed beside the foundation, the allowable passive pressure acting on the vertical projection of the foundation edge may be calculated using an equivalent fluid pressure of 330 pcf; this value does not include a factor of safety and is based on an effective unit weight of 110 pcf and a passive earth pressure coefficient (K_p) of 3.

D.3. Tower Pier Foundation Design

D.3.a. Design Parameters

Design parameters for drilled pier design are provided in the tables in the Appendix. We have provided one set of design parameters, which apply to both the sustained and transient loading conditions.

D.3.b. Pier Diameter

To facilitate removal of potential boulders during construction and shaft inspection and evaluation, we recommend a minimum drilled shaft diameter of 36 inches.

D.3.c. Drilled Shaft Support

We anticipate that the pier shaft will have to be at least partially cased to prevent caving. A drilling slurry will also be necessary to excavate the shaft in the sand soils throughout the depth explored. Telescoping casings may be required for longer shafts. With telescoping casings, the largest casing is set at the top of the shaft, and subsequent casings becoming progressively smaller with the smallest casing having a diameter equal to the design diameter of the pier. To help accommodate telescoping casings for this project, we recommend assuming a 6-inch increase in diameter per casing.

D.3.d. Concrete Placement

Care should be taken during concrete placement to avoid segregation of the concrete caused by the material striking reinforcing steel or the side of the casings/excavation. A tremie may be required.

It is possible to pull telescoping casing in such a way as to construct the drilled pier at its design diameter for its entire length. This practice, however, risks leaving loose material against the pier and effectively reducing confinement offered to the pier. To avoid problems associated with this situation, we recommend that the concrete be placed to the full diameter of the drilled shaft.

If, prior to placing concrete, more than two (2) inches of water or drilling fluid are present in the shaft, we recommend placing the concrete with a tremie pipe, although the concrete should then be designed for a slump between approximately four (4) and six (6) inches.

D.3.e. Obstructions

As the shafts for the piers are drilled, obstructions may be encountered that cannot be removed with conventional drilling equipment. In our opinion, an obstruction can be considered to consist of a dense concentration of cobbles, boulders, detached rock slabs or other material, natural or man-made, that impedes drilling with conventional augers and requires special equipment including but not necessarily

limited to, core barrels, air compressors, or hand excavation tools to penetrate. The obstruction can be considered to have been penetrated once conventional augering can resume.

D.3.f. Inspection

We recommend having the pier drilling observed by geotechnical engineer or a technician working under a geotechnical engineer. The excavated soils should be classified and compared to the soils encountered by the soil boring to verify the friction and cohesion recommendations.

D.4. Equipment Shelter Building

We recommend the ESB slab be embedded a minimum of one foot for erosion protection. Based on the conditions encountered in the borings, we anticipate that the equipment shelter building will be underlain by native or filled poorly graded sand that is considered non frost susceptible.

D.5. Aggregate Pavement

D.5.a. Subgrade Proof-Roll

Prior to placing aggregate surface material, we recommend proof-rolling pavement subgrades to determine if the subgrade materials are loose, soft or weak, and in need of further stabilization, compaction or subexcavation and recompaction or replacement.

D.5.b. Materials and Compaction

We recommend specifying crushed aggregate meeting the requirements of Minnesota Department of Transportation (Mn/DOT) Specification 3138 for Class 5. We recommend that the aggregate surface be compacted to a minimum of 100 percent of its maximum standard Proctor dry density.

D.6. Construction Quality Control

D.6.a. Excavation Observations

We recommend having a geotechnical engineer, or a technician working under a geotechnical engineer, observe all excavations related to tower foundation construction. The purpose of the observations is to evaluate the competence of the geologic materials exposed in the excavations and the adequacy of required excavation oversizing.

D.6.b. Materials Testing

We recommend density tests be taken in excavation backfill and any required fill placed above or below spread footings.

We also recommend slump, air content and strength tests of Portland cement concrete.

D.6.c. Cold Weather Precautions

If site grading and construction is anticipated during cold weather, all snow and ice should be removed from cut and fill areas prior to additional grading. No fill should be placed on frozen subgrades. No frozen soils should be used as fill.

Concrete delivered to the site should meet the temperature requirements of ASTM C 94. Concrete should not be placed on frozen subgrades. Concrete should be protected from freezing until the necessary strength is attained. Frost should not be permitted to penetrate below footings.

E. Procedures

E.1. Penetration Test Borings

The penetration test borings were conducted with a floatation tire all terrain carrier-mounted drill rig equipped with hollow-stem auger. The borings were performed in accordance with ASTM D 1586. Penetration test samples were taken at 2 1/2- or 5-foot intervals. Actual sample intervals and corresponding depths are shown on the boring logs.

The penetration test boreholes were grouted with bentonite per Minnesota Department of Health (MDH) Environmental Borehole guidelines.

E.2. Material Classification and Testing

E.2.a Visual and Manual Classification

The geologic materials encountered were visually and manually classified in accordance with ASTM Test Method D 2488. A chart explaining the classification system is attached. Samples were sealed in jars or bags and returned to our facility for review and storage.

E.3. Groundwater Measurements

The drillers checked for groundwater as the borings were advanced, when drilling was complete and checked again prior to grouting and removal of the hollow-stem auger, as noted on the boring logs.

F. Qualifications

F.1. Variations in Subsurface Conditions

F.1.a. Material Strata

Our evaluation, analyses and recommendations were developed from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth, and therefore strata boundaries and thicknesses must be inferred to some extent. Strata boundaries may also be gradual transitions and can be expected to vary in depth, elevation and thickness away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until additional exploration work is completed or construction commences. If any such variations are revealed, our recommendations should be re-evaluated. Such variations could increase construction costs, and a contingency should be provided to accommodate them.

F.1.b. Groundwater Levels

Groundwater measurements were made under the conditions reported herein and shown on the exploration logs and interpreted in the text of this report. It should be noted that the observation period was relatively short and groundwater can be expected to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

F.2. Continuity of Professional Responsibility

F.2.a. Plan Review

This report is based on a limited amount of information and a number of assumptions were necessary to help us develop our recommendations. It is recommended that our firm review the geotechnical aspects of the designs and specifications, evaluate whether the design is as expected and if any design changes

have affected the validity of our recommendations, and if our recommendations have been correctly interpreted and implemented in the designs and specifications.

F.2.b. Construction Observations and Testing

It is recommended that we be retained to perform observations and tests during construction. This will allow correlation of the subsurface conditions encountered during construction with those encountered by the borings and provide continuity of professional responsibility.

F.3. Use of Report

This report is for the exclusive use of the parties to which it has been addressed. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

F.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix

MINNESOTA AVENUE

22ND AVE

BITUMINOUS DRIVEWAY

RAMP

APPROX. R/W LINE

GRAVEL

CONCRETE

FIRE HALL NO. 5

DECK

HOUSE

GAR

HOUSE

HOUSE

SHED

SHED

EXISTING GUY WIRE
FOUNDATION PIERS
(TYPICAL)

EXISTING GUY
WIRES
(TYPICAL)

EXISTING
TOWER

APPROXIMATE
EXCAVATION
LIMIT

30'X30' APPROXIMATE
TOWER FOUNDATION
SLAB (BELOW GRADE)

14'X14' APPROXIMATE
TOWER FOOTPRINT

THIS LINE 140' FROM
EXISTING BUILDINGS

ST-1

ST-2

PRELIMINARY

LAKE SUPERIOR

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\DULUTH\2012\05256.GPJ BRAUN_V8_CURRENT.GDT 10/15/12 13:40

Braun Project DU-12-05256 Geotechnical Evaluation Proposed Park Point Radio Tower 22nd Avenue South Duluth, Minnesota					BORING: ST-01 LOCATION: See attached sketch.		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: 10/1/12		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes	
148.4	0.0	SP	POORLY GRADED SAND, fine-grained, brown, moist, loose. (Lacustrine Deposit)			Ground surface elevations at the boring locations were referenced to the top of the existing tower foundation. We assigned this reference an arbitrary elevation 150.0. An open triangle in the water level (WL) column indicates the depth at which groundwater was observed while drilling. Groundwater levels fluctuate. Mud rotary drilling techniques used below 16 feet.	
				5			
				9			
				10			
139.4	9.0	SP	POORLY GRADED SAND, fine-grained, brown, wet to waterbearing, dense. (Lacustrine Deposit)				
				38	▽		
136.4	12.0	SP	POORLY GRADED SAND, fine- to medium-grained, brown, waterbearing, dense to very dense. (Lacustrine Deposit)				
				38			
				52			
				50/5"			
				44			
120.4	28.0	SP	POORLY GRADED SAND, fine-grained, with a trace of roots, brown, waterbearing, medium dense. (Lacustrine Deposit)				
				17			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\DULUTH\2012\05256.GPJ BRAUN_V8_CURRENT.GDT 10/15/12 13:40

Braun Project DU-12-05256 Geotechnical Evaluation Proposed Park Point Radio Tower 22nd Avenue South Duluth, Minnesota					BORING: ST-01 (cont.) LOCATION: See attached sketch.		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: 10/1/12		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes	
116.4	32.0						
115.4	33.0						
		SP-SM	POORLY GRADED SAND with SILT, fine-grained, with lenses of Silt, brown, waterbearing, very dense. (Lacustrine Deposit)	75			
				56			
				86			
				77			
97.4	51.0		END OF BORING.				
			Water observed at a depth of 10.8 feet while drilling.				
			Boring immediately backfilled with bentonite grout.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\DULUTH\2012\05256.GPJ BRAUN_V8_CURRENT.GDT 10/15/12 13:40

Braun Project DU-12-05256 Geotechnical Evaluation Proposed Park Point Radio Tower 22nd Avenue South Duluth, Minnesota					BORING: ST-02 LOCATION: See attached sketch.		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: 10/1/12		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes	
153.8	0.0	SP	POORLY GRADED SAND, fine-grained, brown, moist, loose. (Lacustrine Deposit)				
				8			
				10			
				10			
				11			
				7			
139.8	14.0	SP	POORLY GRADED SAND, fine- to medium-grained, brown, waterbearing, medium dense to very dense. (Lacustrine Deposit)				
				27	▽		
				38			
				46			
				54			
				37			
				Mud rotary drilling techniques used below 21 feet.			

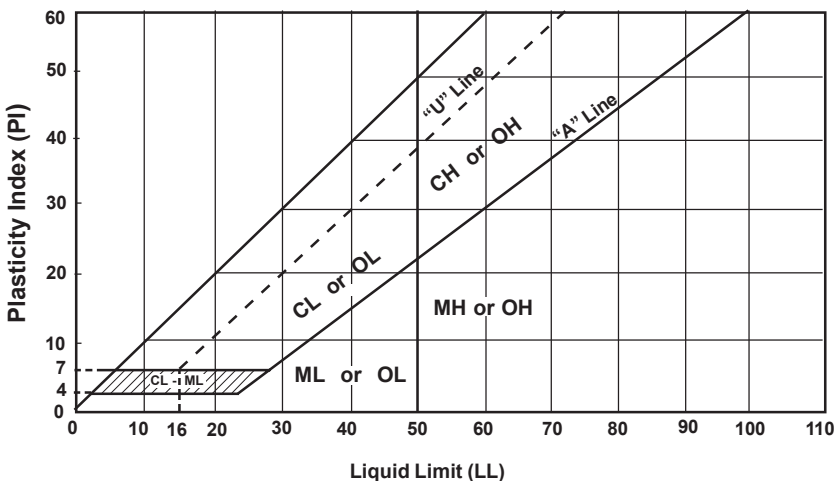
(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\DULUTH\2012\05256.GPJ BRAUN_V8_CURRENT.GDT 10/15/12 13:40

Braun Project DU-12-05256 Geotechnical Evaluation Proposed Park Point Radio Tower 22nd Avenue South Duluth, Minnesota					BORING: ST-02 (cont.) LOCATION: See attached sketch.		
DRILLER: M. Heinzen		METHOD: 3 1/4" HSA, Autohammer		DATE: 10/1/12		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes	
121.8	32.0		POORLY GRADED SAND, fine- to medium-grained, brown, waterbearing, medium dense to very dense. (Lacustrine Deposit) <i>(continued)</i>				
				54			
115.8	38.0	SP-SM	POORLY GRADED SAND with SILT, fine-grained, with lenses of Silty Sand, brown, waterbearing, very dense. (Lacustrine Deposit)				
				80			
				57			
102.8	51.0		END OF BORING. Water observed at a depth of 16.3 feet while drilling. Boring immediately backfilled with bentonite grout.	83			

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^a					Soils Classification	
					Group Symbol	Group Name ^b
Coarse-grained Soils more than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels 5% or less fines ^e	$C_u \geq 4$ and $1 \leq C_c \leq 3$ ^c	GW	Well-graded gravel ^d	
			$C_u < 4$ and/or $1 > C_c > 3$ ^c	GP	Poorly graded gravel ^d	
	Gravels with Fines More than 12% fines ^e	Fines classify as ML or MH	GM	Silty gravel ^{d f g}		
		Fines classify as CL or CH	GC	Clayey gravel ^{d f g}		
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands 5% or less fines ⁱ	$C_u \geq 6$ and $1 \leq C_c \leq 3$ ^c	SW	Well-graded sand ^h	
			$C_u < 6$ and/or $1 > C_c > 3$ ^c	SP	Poorly graded sand ^h	
	Sands with Fines More than 12% ⁱ	Fines classify as ML or MH	SM	Silty sand ^{f g h}		
		Fines classify as CL or CH	SC	Clayey sand ^{f g h}		
Fine-grained Soils 50% or more passed the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line ^j	CL	Lean clay ^{k l m}	
			PI < 4 or plots below "A" line ^j	ML	Silt ^{k l m}	
		Organic	Liquid limit - oven dried < 0.75	OL	Organic clay ^{k l m n}	
			Liquid limit - not dried < 0.75	OL	Organic silt ^{k l m o}	
	Silts and clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay ^{k l m}	
			PI plots below "A" line	MH	Elastic silt ^{k l m}	
		Organic	Liquid limit - oven dried < 0.75	OH	Organic clay ^{k l m p}	
			Liquid limit - not dried < 0.75	OH	Organic silt ^{k l m q}	
Highly Organic Soils		Primarily organic matter, dark in color and organic odor		PT	Peat	

- a. Based on the material passing the 3-in (75mm) sieve.
b. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders or both" to group name.
c. $C_u = D_{60} / D_{10}$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
d. If soil contains $\geq 15\%$ sand, add "with sand" to group name.
e. Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
f. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
g. If fines are organic, add "with organic fines" to group name.
h. If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.
i. Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
j. If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
k. If soil contains 10 to 29% plus No. 200, add "with sand" or "with gravel" whichever is predominant.
l. If soil contains $\geq 30\%$ plus No. 200, predominantly sand, add "sandy" to group name.
m. If soil contains $\geq 30\%$ plus No. 200 predominantly gravel, add "gravelly" to group name.
n. PI ≥ 4 and plots on or above "A" line.
o. PI < 4 or plots below "A" line.
p. PI plots on or above "A" line.
q. PI plots below "A" line.



Laboratory Tests

DD	Dry density, pcf	OC	Organic content, %
WD	Wet density, pcf	S	Percent of saturation, %
MC	Natural moisture content, %	SG	Specific gravity
LL	Liquid limit, %	C	Cohesion, psf
PL	Plastic limit, %	ϕ	Angle of internal friction
PI	Plasticity index, %	qu	Unconfined compressive strength, psf
P200	% passing 200 sieve	qp	Pocket penetrometer strength, tsf

Particle Size Identification

Boulders	.....	over 12"
Cobbles	.....	3" to 12"
Gravel	.....	
Coarse	.....	3/4" to 3"
Fine	.....	No. 4 to 3/4"
Sand	.....	
Coarse	.....	No. 4 to No. 10
Medium	.....	No. 10 to No. 40
Fine	.....	No. 40 to No. 200
Silt	.....	< No. 200, PI < 4 or below "A" line
Clay	.....	< No. 200, PI ≥ 4 and on or above "A" line

Relative Density of Cohesionless Soils

Very loose	.....	0 to 4 BPF
Loose	.....	5 to 10 BPF
Medium dense	.....	11 to 30 BPF
Dense	.....	31 to 50 BPF
Very dense	.....	over 50 BPF

Consistency of Cohesive Soils

Very soft	.....	0 to 1 BPF
Soft	.....	2 to 3 BPF
Rather soft	.....	4 to 5 BPF
Medium	.....	6 to 8 BPF
Rather stiff	.....	9 to 12 BPF
Stiff	.....	13 to 16 BPF
Very stiff	.....	17 to 30 BPF
Hard	.....	over 30 BPF

Drilling Notes

Standard penetration test borings were advanced by 3 1/4" or 6 1/4" ID hollow-stem augers unless noted otherwise. Jetting water was used to clean out auger prior to sampling only where indicated on logs. Standard penetration test borings are designated by the prefix "ST" (Split Tube). All samples were taken with the standard 2" OD split-tube sampler, except where noted.

Power auger borings were advanced by 4" or 6" diameter continuous-flight, solid-stem augers. Soil classifications and strata depths were inferred from disturbed samples augered to the surface and are, therefore, somewhat approximate. Power auger borings are designated by the prefix "B."

Hand auger borings were advanced manually with a 1 1/2" or 3 1/4" diameter auger and were limited to the depth from which the auger could be manually withdrawn. Hand auger borings are indicated by the prefix "H."

BPF: Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6" into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6" increments and added to get BPF. Where they differed significantly, they are reported in the following form: 2/12 for the second and third 6" increments, respectively.

WH: WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WR: WR indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

TW indicates thin-walled (undisturbed) tube sample.

Note: All tests were run in general accordance with applicable ASTM standards.

Project: Park Point Radio Tower

Boring(s): ST-1

Loading Condition: Transient or Sustained

Summary of Strength Parameters

Depth Interval, feet	Material Description	Estimated Unit Weight, pcf	Estimated Cohesion, psf	Estimated Friction Angle, degrees	Allowable Passive Pressure, psf	Allowable Uplift Adhesion/ Friction, psf	Allowable Compressive Adhesion/ Friction, psf	Allowable End-Bearing Capacity, psf
0-9	Sand(SP)	110	0	29	0-2900	0-70	0-90	--
9-12	Sand(SP)	63	0	41	4700-5600	70-90	100-120	--
12-28	Sand(SP)	68	0	47	7600-14700	90-160	110-220	--
28-33	Sand(SP)	60	0	34	7900-9000	170-190	230-260	5400-6200
33-51	Sand with Silt(SP-SM)	68	0	48	17900-26400	180-270	240-360	6200-9100

Notes: Dual values represent values at top and bottom of stratum, respectively.
The allowable passive pressure values contain a factor of safety of three.
Adhesion/friction values include a factor of safety of two.
End-bearing capacities include a factor of safety of three.

File: ST-1 DRLPIR

Project: Park Point Radio Tower

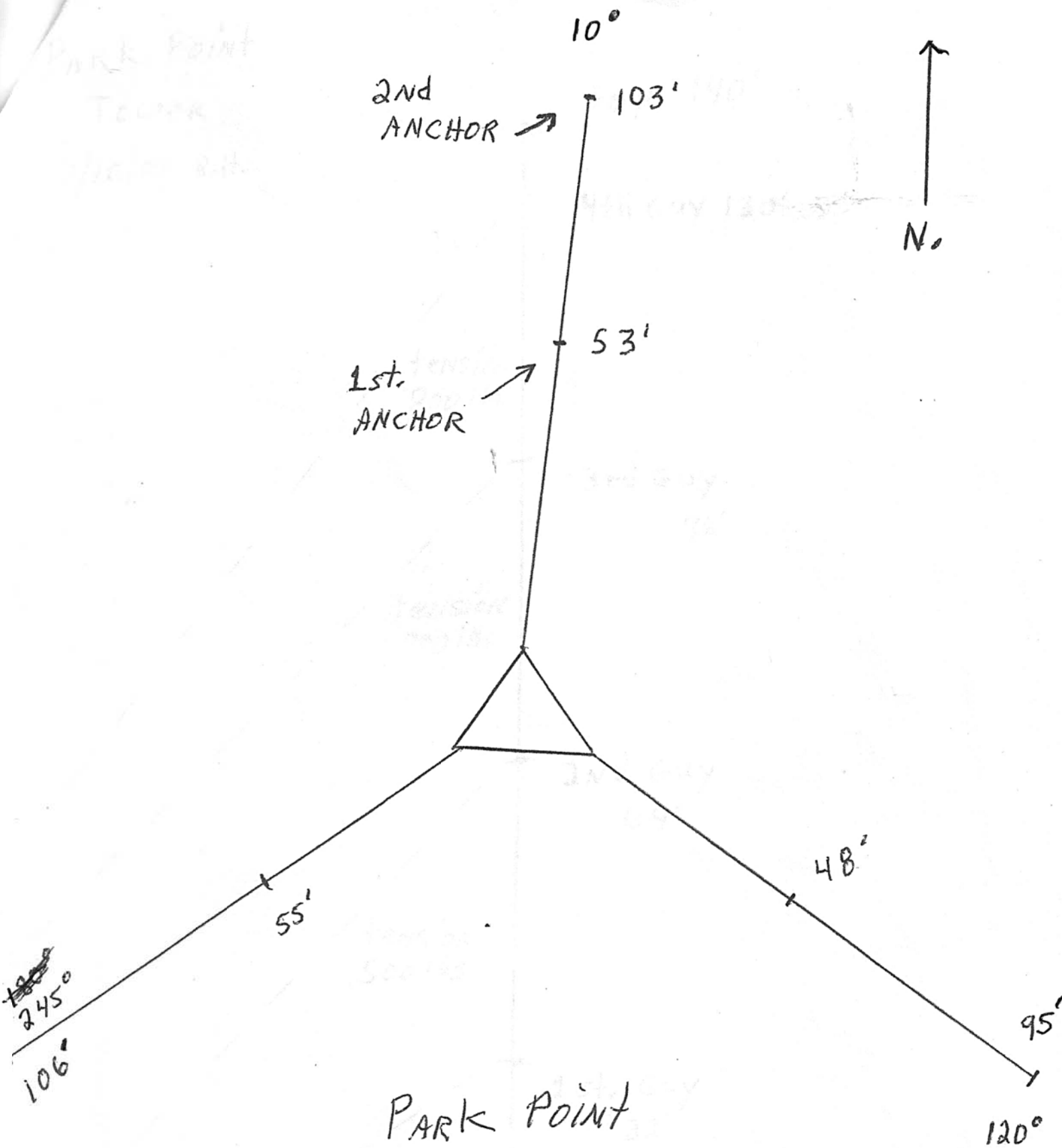
Boring(s): ST-1

Loading Condition: Transient

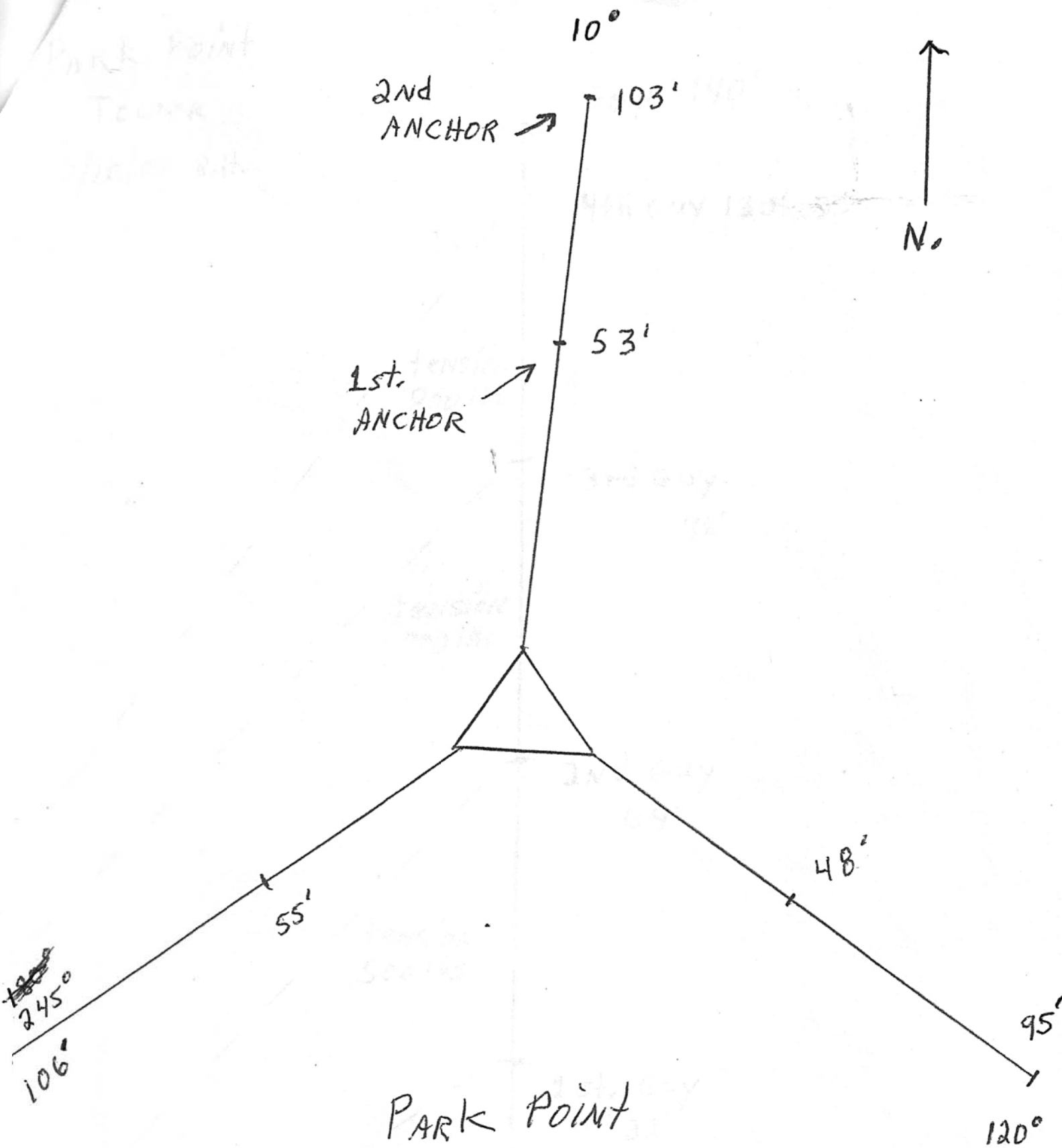
Summary of p - y parameters.

Depth Interval, feet	Material Description	Adjusted BPF	Static & Cyclic Modulus, "Dry" Sand, pci	Static & Cyclic Modulus, Submerged Sand, pci	Static Modulus, Clay,pci	Cyclic Modulus, Clay, pci	ϵ_{50}
0-9	Sand(SP)	7	20	20	NA	NA	NA
9-12	Sand(SP)	49	280	150	NA	NA	NA
12-28	Sand(SP)	85	560	260	NA	NA	NA
28-33	Sand(SP)	22	100	60	NA	NA	NA
33-51	Sand with Silt(SP-SM)	96	660	300	NA	NA	NA

File: ST-1 DRLPIR



PARK POINT
Tower
7/10/08 R.H.



PARK POINT
Tower
7/10/08 R.H.

Park Point

Tower

7/10/08 R.H.

130'

4' OMNI @
137'

96'

4' OMNI @
109'

64'

20' OMNI @ A.E.M.S.
70' ALS-400
Gold-X

ALL ANTENNAS
@

10°

32'



Super Stationmaster™ Omni Fiberglass Antenna, 151.5-159.5, 7.4dBi, N Female

Product Description

Super Stationmaster VHF base station antennas incorporate the design features of 9 MHz broadband capability, improved lightning protection and true omnidirectional gain in excess of 5 dBd. Note: Below 150 MHz, rated gain is 4.8 dBd due to length constraints. Side mounting hardware is available for the 220 to achieve special radiation patterns.



220 Series

Features/Benefits

• Fiberglass construction protects radiating elements in corrosive environments. • DC grounded – affords lightning protection. • Copper radiating elements minimize possibility of intermod generation.

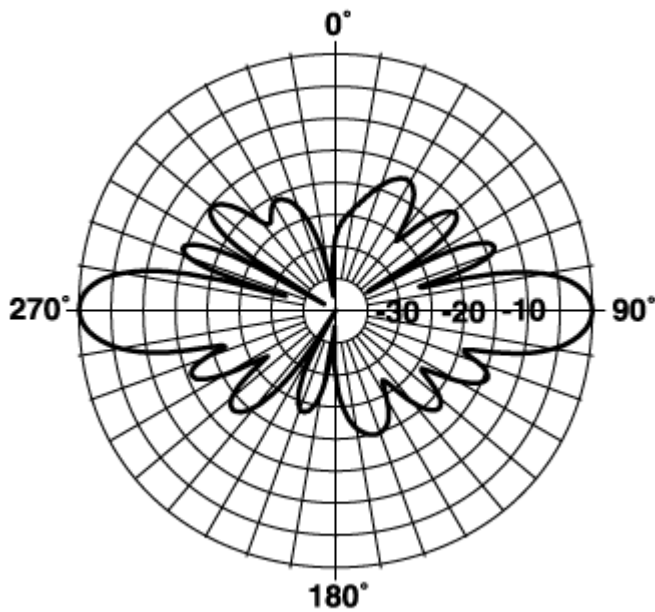
Technical Specifications

Frequency Band	25-299.9 MHz
Horizontal Pattern	Omnidirectional
Antenna Type	Fiberglass Omni
Electrical Down Tilt Option	Fixed
Gain, dBi (dBd)	7.4 (5.3)
Frequency Range, MHz	151.5-159.5
Connector Type	N Female
Connector Location	Bottom
Mount Type	Fixed
Electrical Downtilt, deg	0
Orientation	Upright
Mounting Hardware	46 Clamp Set
Rated Wind Speed, km/h (mph)	160 (100)
Gain (Omni), dBi (dBd)	7.39 (5.25)
VSWR	< 1.6:1
Vertical Beamwidth, deg	18
Polarization	Vertical
Maximum Power Input, W	500
Lightning Protection	Direct Ground
3rd Order IMP @ 2 x 43 dBm, dBc	-130
Impedance, Ohms	50
Overall Length, m (ft)	6.34 (20.8)
Element Housing Length, m (ft)	5.67 (18.6)
Mounting Pipe Diameter, m (in)	0.07 (2.75)
Support Pipe Length, m (ft)	0.69 (2.25)
Weight, kg (lb)	11 (24)
Radiating Element Material	Copper
Element Housing Material	Fiberglass
Support Pipe Material	Aluminum Alloy
Max Wind Loading Area, m ² (ft ²)	0.217 (2.34)
Survival Wind Speed, km/h (mph)	200 (125)
Bend Mom @ Rated Wind 1" Below Top of Mt Pipe, N m (ft lbf)	1196 (882)
Wind Load - Side @ Rated Wind, N (lbf)	418 (94)
Shipping Weight, kg (lb)	25 (55)
Packing Dimensions, HxWxD, mm (in)	6400 x 100 x 100 (251.96 x 3.94 x 3.94)
Packing Dimensions - HxWxD, m (ft)	6.4 x 0.1 x 0.1 (21 x 0.33 x 0.33)
Shipping Dimensions of Accessory - HxWxD, m (ft)	Packed w/antenna
Shipping Mode	Common Carrier

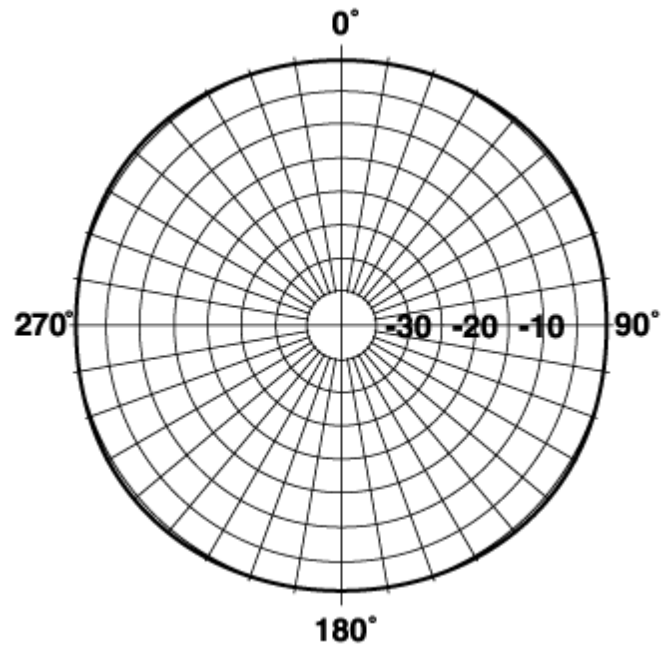
Notes

Super Stationmaster™ Omni Fiberglass Antenna, 151.5-159.5, 7.4dBi, N Female

Other Documentation



Vertical Pattern



Horizontal Pattern



Omnidirectional Fiberglass Antenna, 154-174, 2.1dBi, N Female

Product Description

These antennas feature a very broad frequency band and rugged construction. Radiating elements are constructed of copper alloy, encased in a weather resistant low loss fiberglass radome. The BA1010 "Heavy Duty" is permanently affixed to a unique mounting fixture which allows mounting on top of or along-side of most vertical supports. Due to their wide bandwidth, they are ideal for use as emergency backup antennas. Their size and mounting fixtures allow for easy storage and fast installation. Alternative mounting hardware is available for most applications.



BA1010 Series

Features/Benefits

• **Broadband** – reduces backup inventory and the need for multiple antennas. • **Fiberglass radome** protects radiating elements in hostile environments. • **Copper elements** maximize system performance while minimizing the possibility of intermod.

Technical Specifications

Frequency Band	25-299.9 MHz
Horizontal Pattern	OmniDirectional
Antenna Type	Fiberglass Omni
Electrical Down Tilt Option	Fixed
Gain, dBi (dBd)	2.1 (0)
Frequency Range, MHz	154-174
Connector Type	N Female
Connector Location	Bottom
Mount Type	Fixed
Electrical Downtilt, deg	0
Mounting Hardware	Stainless Steel U-Bolts (E380-03F)
Rated Wind Speed, km/h (mph)	160 (100)
VSWR	< 1.5:1
Vertical Beamwidth, deg	80
Polarization	Vertical
Maximum Power Input, W	500
Lightning Protection	Direct Ground
Flexible Extensions	None
Impedance, Ohms	50
Overall Length, m (ft)	1.4 (4.6)
Mounting Pipe Diameter, m (in)	0.08 (3)
Support Pipe Length, m (ft)	0.3 (1)
Weight w/o Mtg Hardware, kg (lb)	4 (8.8)
Radiating Element Material	Brass
Element Housing Material	Fiberglass
Radome Color	White RAL9010
Support Pipe Material	Black Anodized Aluminum
Max Wind Loading Area, m ² (ft ²)	0.08 (0.86)
Shipping Weight, kg (lb)	6.1 (13.4)
Shipping Dimensions of Accessory - HxWxD, m (ft)	Packed w/ antenna
Shipping Mode	UPS

Notes

Other Documentation

Product Specifications



VHLP800-1 1-6WH

800 mm | 2.6 ft ValuLine® High Performance Low Profile Antenna, single-polarized, 10.700–11.700 GHz, CPR90G, white antenna, polymer white radome without flash, standard pack—one-piece reflector



CHARACTERISTICS

General Specifications

Packing	Standard pack
Radome Color	White
Radome Material	Polymer
Reflector Construction	One-piece reflector
Antenna Input	CPR90G
Antenna Color	White
Antenna Type	VHLP - ValuLine® High Performance Low Profile Antenna, single-polarized
Diameter, nominal	800 mm | 2.6 ft
Flash Included	No
Polarization	Single

Electrical Specifications

Beamwidth, Horizontal	2.2 °
Beamwidth, Vertical	2.2 °
Cross Polarization Discrimination (XPD)	30 dB
Electrical Compliance	Brazil Anatel Class 2 | ETSI 302 217 Class 2 | US FCC Part 101A
Front-to-Back Ratio	59 dB
Gain, Low Band	36.9 dBi
Gain, Mid Band	37.4 dBi
Gain, Top Band	38.3 dBi
Operating Frequency Band	10.700 – 11.700 GHz
Radiation Pattern Envelope Reference (RPE)	7091C
Return Loss	17.7 dB
VSWR	1.30

Mechanical Specifications

Fine Azimuth Adjustment	±10°
Fine Elevation Adjustment	±25°

Product Specifications



VHLP800-11-6VWH

Mounting Pipe Diameter	50 mm–115 mm | 2.0 in–4.5 in
Net Weight	22 kg | 49 lb
Side Struts, Included	0
Side Struts, Optional	0
Wind Velocity Operational	180 km/h | 112 mph
Wind Velocity Survival Rating	250 km/h | 155 mph

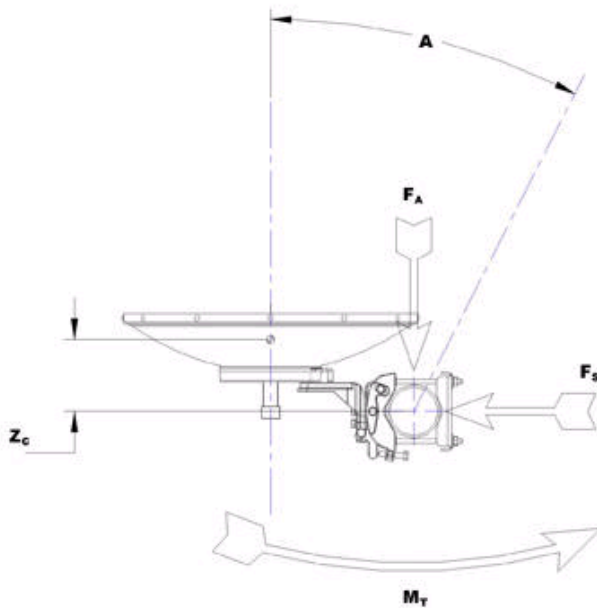
Wind Forces At Wind Velocity Survival Rating

Axial Force (FA)	1500 N | 337 lbf
Side Force (FS)	743 N | 167 lbf
Twisting Moment (MT)	673 N•m
Weight with 1/2 in (12 mm) Radial Ice	35 kg | 77 lb
Zcg with 1/2 in (12 mm) Radial Ice	305 mm | 12 in
Zcg without Ice	178 mm | 7 in

Product Specifications

VHLP800-11-6VWH

Wind Forces At Wind Velocity Survival Rating Image



Packed Dimensions

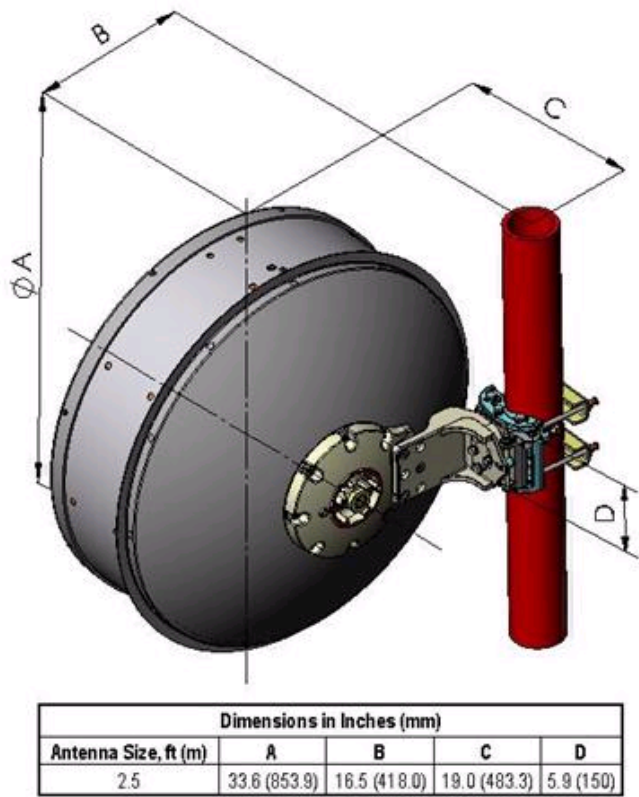
Gross Weight, Packed Antenna	30.0 kg	|	66.1 lb
Height	650.0 mm	|	25.6 in
Length	900.0 mm	|	35.4 in
Volume	0.5 m ³		
Width	900.0 mm	|	35.4 in

Product Specifications

VHLP800-11-6WH



Antenna Dimensions And Mounting Information



Regulatory Compliance/Certifications

Agency	Classification
ISO 9001:2008	Designed, manufactured and/or distributed under this quality management system

* Footnotes

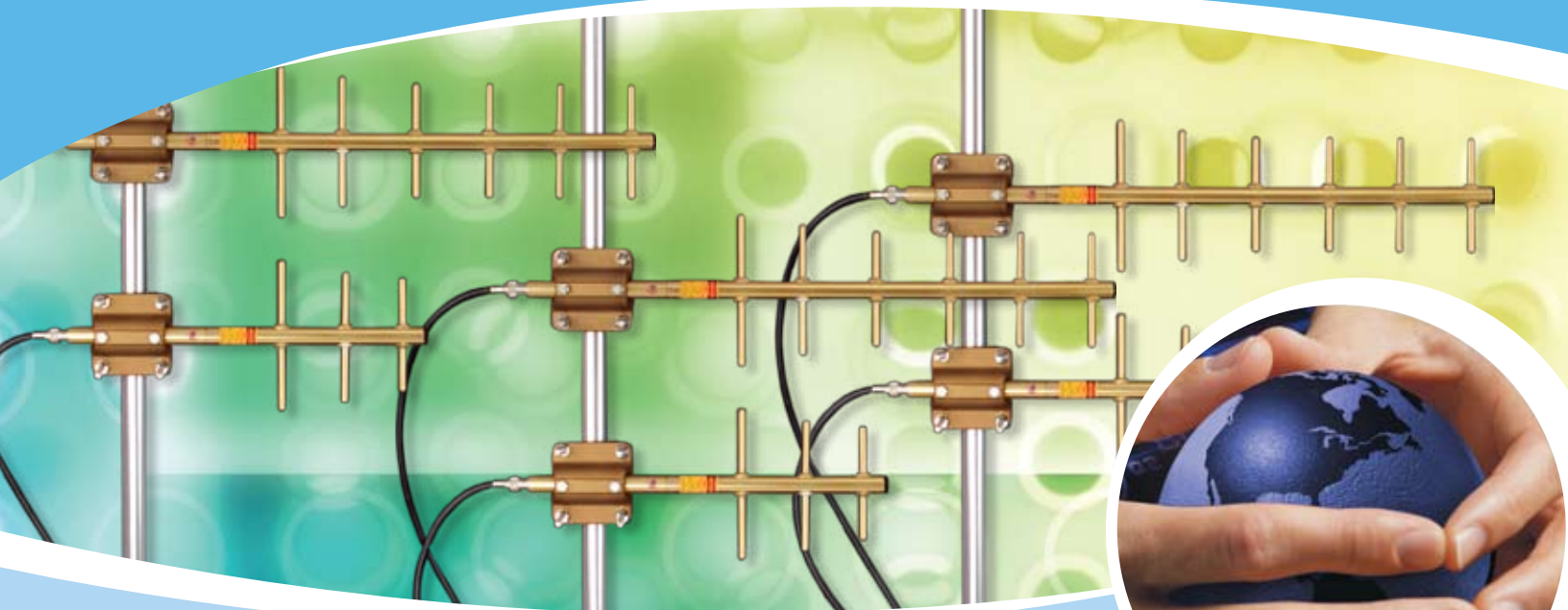
Axial Force (FA)	Maximum forces exerted on a supporting structure as a result of wind from the most critical direction for this parameter. The individual maximums specified may not occur simultaneously. All forces are referenced to the mounting pipe.
Cross Polarization Discrimination (XPD)	The difference between the peak of the co-polarized main beam and the maximum cross-polarized signal over an angle twice the 3 dB beamwidth of the co-polarized main beam.
Front-to-Back Ratio	Denotes highest radiation relative to the main beam, at 180° ±40°, across the band. Production antennas do not exceed rated values by more than 2 dB unless stated otherwise.
Gain, Mid Band	For a given frequency band, gain is primarily a function of antenna size. The gain of Andrew antennas is determined by either gain by comparison or by computer integration of the measured antenna patterns.
Operating Frequency Band	Bands correspond with CCIR recommendations or common allocations used

Product Specifications

VHLP800-11-6VWH



	throughout the world. Other ranges can be accommodated on special order.
Packing	Andrew standard packing is suitable for export. Antennas are shipped as standard in totally recyclable cardboard or wire-bound crates (dependent on product). For your convenience, Andrew offers heavy duty export packing options.
Radiation Pattern Envelope Reference (RPE)	Radiation patterns determine an antenna's ability to discriminate against unwanted signals under conditions of radio congestion. Radiation patterns are dependent on antenna series, size, and frequency.
Return Loss	The figure that indicates the proportion of radio waves incident upon the antenna that are rejected as a ratio of those that are accepted.
Side Force (FS)	Maximum side force exerted on the mounting pipe as a result of wind from the most critical direction for this parameter. The individual maximums specified may not occur simultaneously. All forces are referenced to the mounting pipe.
Twisting Moment (MT)	Maximum forces exerted on a supporting structure as a result of wind from the most critical direction for this parameter. The individual maximums specified may not occur simultaneously. All forces are referenced to the mounting pipe.
VSWR	Maximum; is the guaranteed Peak Voltage-Standing-Wave-Ratio within the operating band.
Wind Velocity Operational	The wind speed where the antenna deflection is equal to or less than 0.1 degrees. In the case of ValuLine antennas, it is defined as a maximum deflection of 0.3 x the 3 dB beam width of the antenna.
Wind Velocity Survival Rating	The maximum wind speed the antenna, including mounts and radomes, where applicable, will withstand without permanent deformation. Realignment may be required. This wind speed is applicable to antenna with the specified amount of radial ice.



global solutions :
local support™

Gold Series Directional Yagi antennas provide industry leading design features with long term optimal performance

Laird Technologies' premium series Directional Yagi antennas are fully gold anodized for corrosion resistance. All UHF and above frequency antennas feature internal matching to assure broad bandwidth and resistance to severe weather conditions. There is no gamma match to ice up, corrode or detune. Our engineering staff has also optimized the product family for forward gain by computer analysis and then field-tested each for conformance.

Features and Benefits:

- All UHF and higher frequency antennas feature 360-degree welds around each element and an end-of-boom N connector feed with an internal transmission line feeding the driven element.
- Every Yagi is tuned on a network analyzer for best power match and lowest VSWR.
- All Yagi antennas ship complete with a high quality cast aluminum mounting kit that includes stainless steel hardware and allows vertical or horizontal orientation during installation. (VHF models require light assembly)

Applications

- Point to point directional and multiple point to omnidirectional outdoor antennas applications used by private organizations and government agencies around the globe.
- Typical applications include transportation such as railroad switching, remote locations reporting examples that include oil fields and weather conditions and meter data transmissions for utilities.

For sales information:

In the USA please telephone +1-800-323-3757

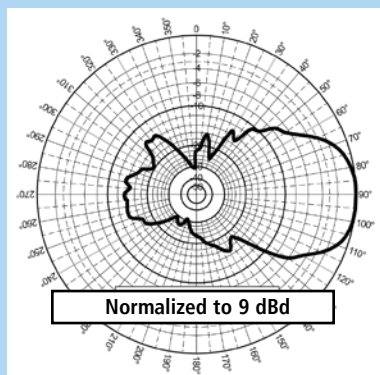
In Asia please telephone +886-2-2286-2828

In Europe please telephone +46-8-555-722-00

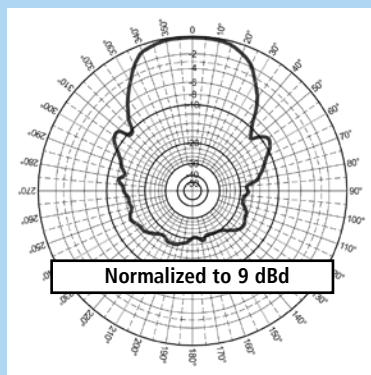
or visit: www.lairdtech.com

SPECIFICATIONS:

Electrical		Mechanical	
Frequency Range:	896 – 970 MHz	Material:	Aluminum
Frequency Bandwidth:	74 MHz	Length:	27.688"
VSWR:	< 2:1	Height:	6.75"
Return Loss:	-10dB max	Boom Diameter:	.875"
Nominal Gain:	9 dBd	Weight:	3.9 lbs
Front to Back Ratio:	20 dB	Rated Wind Velocity:	150 mph (241 kph)
Maximum Power:	300 W	Rated Wind Velocity: (with 0.5" radial ice)	80 mph (130 kph)
Nominal Impedance:	50 Ω	Equivalent Flat Area	0.2492 sq. ft.
Polarization:	Vertical or Horizontal	Cable:	None
Pattern:	Directional	Termination:	N-Female connector
Horizontal Beamwidth: (For Horizontal Polarization)	56°	Color:	Gold or Black Anodized
Vertical Beamwidth: (For Vertical Polarization)	52°	Lightning Protection:	Lightning Arrestor LABH350NN (Sold Separately)
Tuning:	Fixed Tune	Mounting Included	Heavy duty cast aluminum bracket accommodates up to 7/8" mast
Transmitting/Receiving:	Both		



Vertical-to-Vertical Polarization
Azimuthal Pattern (Y, Z, or E-plane)



Horizontal-to-Horizontal Polarization
Azimuthal Pattern (Y, Z, or H-plane)

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Base Station Antennas

MFB 900 MHz Omnis

MAXRAD®

An ISO-9001 Registered Company

MFB Series, 900 MHz Fiberglass Omnidirectional Antennas

The MFB 900 MHz series consists of base matched half wave antennas encapsulated in heavy duty fiberglass radomes with a thick walled aluminum mounting base for reliable long term use. All models are DC grounded and UPS shippable.

Features

- White ultra-violet resistant pultruded fiberglass radome
- Thick walled aluminum mounting base
- Unity/3dB/5dB/7dB models (rated in dbd)
- Wideband models available
- UPS shippable
- Exceptional value

General Specifications:

Radiator Material:

Coated steel wire

Radome Material:

.65" pultruded white fiberglass

Termination:

Unity and 3dB models: N Female

Wideband models: N male with 16" jumper

5dB and 7dB models: N male with 16" jumper

RPC: reverse polarity TNC

Lightning Protection:

DC grounded

Mounting Method:

Mast or wall mounted.

Mounting hardware is sold separately.

MMK1: light duty mast mount for antennas under 30"

MMK3: light duty mast mount for antennas over 30"

MMK4: heavy duty mast mount

MMK6: cast mounting bracket

MBSWM: wall mounting bracket for antennas over 30"
(two are required)**Wind Survival:**

100 mph

Mounting Base Diameter:

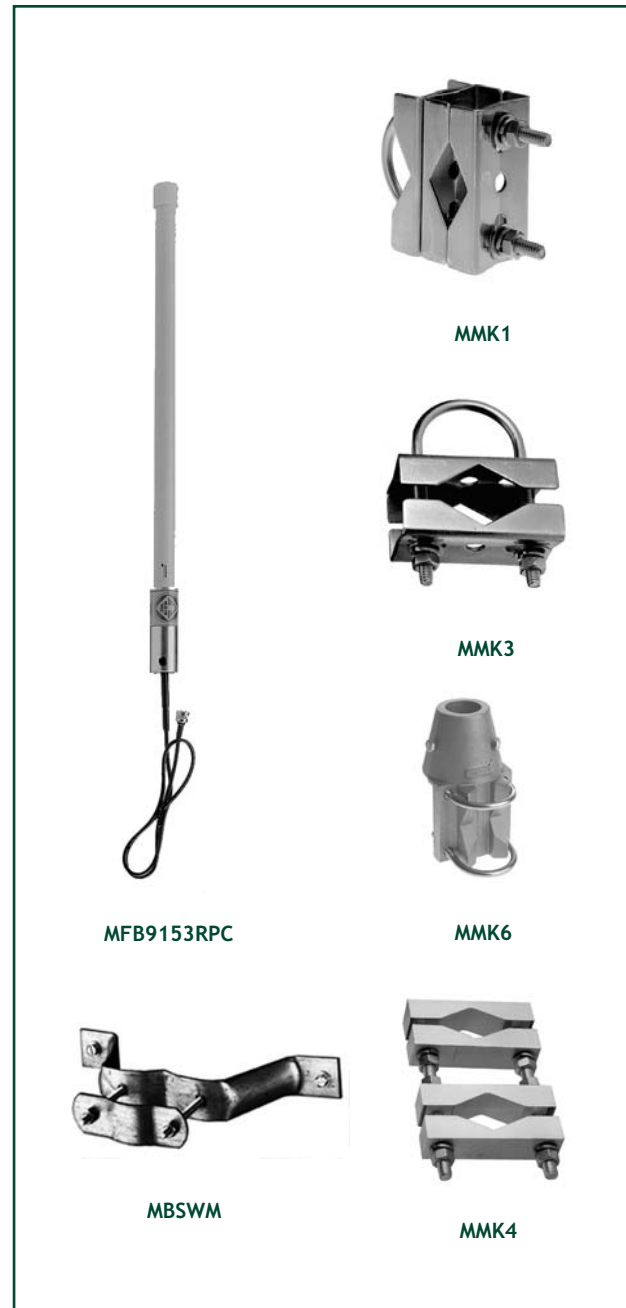
1-5/16"

Maximum Power:

150 Watts

Nominal Impedance:

50 Ohms



900 MHz

Electrical Specifications

Model #	Frequency Range	Factory Tuned Frequency	Gain	Bandwidth @ 1.5:1 VSWR	Vertical Beamwidth @ 1/2 Power
MFB8960	896-940 MHz	898 MHz	Unity	40 MHz	75°
MFB9150	902-928 MHz	915 MHz	Unity	20 MHz	75°
MFB9300	928-932 MHz	930 MHz	Unity	5 MHz	75°
MFB9380	896-940 MHz	938 MHz	Unity	40 MHz	75°
MFB8963	896-940 MHz	898 MHz	3dB	30 MHz	40°
MFB9153	902-928 MHz	915 MHz	3dB	20 MHz	40°
MFB9303	928-932 MHz	930 MHz	3dB	5 MHz	40°
MFB9383	896-940 MHz	938 MHz	3dB	30 MHz	40°
MFB8965	896-940 MHz	898 MHz	5dB	20 MHz	22°
MFB9155	902-928 MHz	915 MHz	5dB	20 MHz	22°
MFB9305	928-932 MHz	930 MHz	5dB	5 MHz	22°
MFB9385	896-940 MHz	938 MHz	5dB	20 MHz	22°
MFB8967	896-940 MHz	898 MHz	7dB	20 MHz	17°
MFB9157	902-928 MHz	915 MHz	7dB	20 MHz	17°
MFB9307	928-932 MHz	930 MHz	7dB	5 MHz	17°
MFB9387	896-940 MHz	938 MHz	7dB	20 MHz	17°
MFB9153RPC	902-928 MHz	915 MHz	3dB	20 MHz	40°
MFB9153STRPC	902-928 MHz	915 MHz	3dB	20 MHz	40°
MFB9157RPC	896-940 MHz	915 MHz	7dB	20 MHz	17°
MFBW8903	890-960 MHz	925 MHz	3dB	70 MHz	40°
MFBW8905	890-960 MHz	925 MHz	5dB	70 MHz	22°

Mechanical Specifications

Model #	Equivalent Flat Plate Area	Lateral Thrust @ Rated Wind	Bending Moment @ Rated Wind	Height	Weight	List Price
MFB8960	.06 sq ft	2.3 lbs	1.4 ft-lbs	14"	.75 lbs	\$88.40
MFB9150	.06 sq ft	2.3 lbs	1.4 ft-lbs	14"	.75 lbs	\$88.40
MFB9300	.06 sq ft	2.3 lbs	1.4 ft-lbs	14"	.75 lbs	\$88.40
MFB9380	.06 sq ft	2.3 lbs	1.4 ft-lbs	14"	.75 lbs	\$88.40
MFB8963	.12 sq ft	4.3 lbs	4.7 ft-lbs	26"	1.25 lbs	\$132.60
MFB9153	.12 sq ft	4.3 lbs	4.7 ft-lbs	23.25"	1.25 lbs	\$132.60
MFB9303	.12 sq ft	4.3 lbs	4.7 ft-lbs	26"	1.25 lbs	\$132.60
MFB9383	.12 sq ft	4.3 lbs	4.7 ft-lbs	26"	1.25 lbs	\$132.60
MFB8965*	.22 sq ft	8.0 lbs	14.2 ft-lbs	48"	1.75 lbs	\$176.80
MFB9155*	.22 sq ft	8.0 lbs	14.2 ft-lbs	48"	1.75 lbs	\$176.80
MFB9305*	.22 sq ft	8.0 lbs	14.2 ft-lbs	48"	1.75 lbs	\$176.80
MFB9385*	.22 sq ft	8.0 lbs	14.2 ft-lbs	48"	1.75 lbs	\$176.80
MFB8967*	.44 sq ft	15.8 lbs	62.5 ft-lbs	96"	4.00 lbs	\$194.48
MFB9157*	.44 sq ft	15.8 lbs	62.5 ft-lbs	96"	4.00 lbs	\$194.48
MFB9307*	.44 sq ft	15.8 lbs	62.5 ft-lbs	96"	4.00 lbs	\$194.48
MFB9387*	.44 sq ft	15.8 lbs	62.5 ft-lbs	96"	4.00 lbs	\$194.48
MFB9153RPC	.12 sq ft	4.3 lbs	4.7 ft-lbs	23.25"	1.25 lbs	\$145.29
MFB9153STRPC	.12 sq ft	4.3 lbs	4.7 ft-lbs	23.25"	1.25 lbs	\$145.29
MFB9157RPC	.44 sq ft	15.8 lbs	62.5 ft-lbs	96"	4.00 lbs	\$210.64
MFBW8903	.12 sq ft	4.3 lbs	4.7 ft-lbs	26"	1.25 lbs	\$145.29
MFBW8905	.22 sq ft	8.0 lbs	14.2 ft-lbs	48"	1.75 lbs	\$176.80

* For N female connector add \$10.00

SECTION 01 11 16

WORK BY OWNER

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of Division 01 shall govern work of this section.

1.02 DESCRIPTION OF WORK

- A. The City will construct a new radio telemetry building next to the new communications tower. The City will construct this new radio telemetry building after the new communications tower is completed.
- B. The City will be performing this work approximately from May 31, 2013 to July 29, 2013.
- C. The new radio telemetry building shall be completed before the Contractor transfers service and antennas from the existing communications to the new communications tower

PART 2 PRODUCTS AND MATERIALS (N/A)

PART 3 CONSTRUCTION METHODS (N/A)

PART 4 MEASUREMENT AND PAYMENT (N/A)

END OF SECTION

SECTION 01 29 73

SCHEDULE OF VALUES

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of Division 1 shall govern work of this section.

1.02 APPLICABLE PUBLICATIONS (NONE)

1.03 DESCRIPTION OF WORK

- A. Provide a detailed breakdown of the Contract Price showing amounts and quantities allocated to each of the various parts of the Work, as specified herein and as required by General Conditions.
- B. Upon request of Engineer, support amounts and quantities with data substantiating their correctness.

1.04 RELATED WORK ELSEWHERE

- A. Procurement and Contracting Requirements - Division 00 (All Sections)

1.05 SUBMITTALS (NONE)

1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

1.07 FORM AND CONTENT OF SCHEDULE OF VALUES

- A. Schedule shall be typed on 8-1/2-inch by 11-inch white paper. Contractor's standard forms and automated printout will be considered for approval by Engineer upon request. Include following:
1. Project title.
 2. Project location.
 3. Owner.
 4. Engineer.
 5. Engineer's project number.
 6. Name and address of Contractor.
 7. Contract designation.
 8. Date.
- B. Identify installed value of Work in sufficient detail to serve as basis for computing values for progress payments during construction.
- C. Provide a separate listing of general items, such as bonds, insurance, mobilization, field supervision, construction facilities, allowances, and record documents.

1 D. Follow Project Manual table of contents as format for listing component items. At a
2 minimum, listing shall include material cost and total installed cost for each
3 Specification Section for each structure as listed in this Section.

4 1. Identify each line item with number and title of respective Specification
5 Division and Section.

6 2. Include directly proportional amount of Contractor's overhead and profit.

7 3. For items on which progress payments will be requested for stored materials,
8 break down value into:

9 a. Cost of materials, delivered and unloaded.

10 b. Total installed value.

11 E. Provide listing of items for sitework and for each structure as follows:

12 1. Sitework

13 2. Testing

14 3. Mobilization/demobilization

15 4. Bonds and insurance

16 5. Field Office

17 F. Sum of values listed shall equal total Contract Price.

18 PART 2 PRODUCTS AND MATERIALS (N/A)

19 PART 3 CONSTRUCTION METHODS (N/A)

20 PART 4 MEASUREMENT AND PAYMENT (N/A)

21
22 END OF SECTION

SECTION 01 31 19

PROJECT MEETINGS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of Division 01 shall govern work of this section.

1.02 APPLICABLE PUBLICATIONS (NONE)

1.03 DESCRIPTION OF WORK

- A. Preconstruction Meeting. A Preconstruction Meeting will be scheduled and conducted by the Engineer and shall be attended by representatives of the Owner, Contractor and all subcontractors as deemed required by the Engineer. The purpose of the meeting will be to identify all project participants, review project requirements and specifications, establish the method of making pay requests and other matters that may be deemed necessary to be discussed. At this meeting, the Contractor shall submit the proposed construction schedule for review, consensus by the parties and approval. The Contractor shall also submit a schedule of values for the work to be used as the accounting format for all progress payments.

- B. Construction Progress Meetings. Brief weekly meetings, as deemed necessary by the Engineer, will be held and shall be attended by all Contractors. The purpose of the meeting will be to coordinate work schedules, review the project progress and other matters that may be deemed necessary to be discussed.

1. A construction progress meeting agenda shall be prepared as deemed necessary to the Engineer.
2. All construction progress meeting attendees shall be fully prepared prior to the meeting and shall be ready to discuss issues raised as they relate to their work. This shall include, but not be limited to, providing revised schedules, milestone activities, specific requirements for subordinate construction and any proposed or completed changes required for their work.

1.04 RELATED WORK ELSEWHERE

- A. Procurement and Contracting Requirements - Division 00 (All Sections)

1.05 SUBMITTALS (NONE)

1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

PART 2 PRODUCTS AND MATERIALS (N/A)

PART 3 CONSTRUCTION METHODS (N/A)

PART 4 MEASUREMENT AND PAYMENT (N/A)

END OF SECTION

SECTION 01 33 00

SUBMITTALS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of Division 01 shall govern work of this section.

1.02 APPLICABLE PUBLICATIONS (NONE)

1.03 DESCRIPTION OF WORK

- A. The work under this section shall cover furnishing submittal information as required by the contract drawings, other specification sections and as specified herein.

1.04 RELATED WORK ELSEWHERE

- A. Procurement and Contracting Requirements - Division 00 (All Sections)

- B. Submittal Log - Section 01 33 23

1.05 SUBMITTALS

- A. As soon as possible after Notice to Proceed, submit brochures of catalog cuts and specifications for all new equipment. Submittal of product data shall comply with the requirements for Submittals.

- B. Prior to fabrication or installation, submit Submittals for review. Each submittal shall consist of the minimum number of copies as listed on the submittal log. Two will be returned to the Contractor. Should more than two copies of reviewed Submittals be necessary for Contractor's use and distribution, the Contractor shall supply additional sufficient number of Submittals for review as required.

- C. Submittals shall include layout details, schedules, setting instructions, and manufacturer's literature. Concrete reinforcing steel Submittals shall include a concrete pouring sequence for structures with vertical construction joints.

1. Submittals shall be identified with the name of the project, numbered consecutively and bear the stamp of review of the Contractor as evidence that all drawings have been checked by the Contractor for accuracy and compatibility with contract requirements. Drawings not so checked and noted will be returned without being examined.
2. Partial lists will not be considered; Submittals for each part of work shall be complete in one submittal.

- D. If information on previously submitted Submittals is altered, in addition to the notations made by the Engineer, the Contractor shall bring all changes to the

attention of the Engineer. Corrections or changes indicated on reviewed Submittals shall not be considered an order for extra work.

E. Submittals will not be considered reviewed unless they bear the stamp of review and signature of the Engineer. Drawings will be reviewed for general design only. Dimensions and fit of units of various parts shall be the Contractor's responsibility.

F. Prior to work at the site, submit samples allowing reasonable time for review and testing. Submit samples in sufficient quantity (minimum of five), of adequate size showing quality, type, color range, finish and texture. Label each sample stating material, description, applicable specification sections, intended use, project name, and Contractor's name.

G. Order no materials subject to sample review until receipt of written shop drawing review. Materials installed shall match reviewed samples. No review of samples shall be taken in itself to change or modify contract requirements beyond the expressed stipulations of the review letter.

H. All Submittals for major equipment must be reviewed and delivery dates scheduled prior to performing any work at the site. A revised work schedule shall be submitted weekly showing corrected delivery dates.

1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

A. Prior to start up of the equipment, the Contractor shall provide the Engineer with operation and maintenance manuals as listed on the submittal log. The manuals shall include the following:

1. Supplier and manufacturer's name, address, telephone number, and local representative's name, address and telephone number. Sources of service and parts and a list of local repair services, supply houses, and potential sources for the types of repairs and equipment parts.
2. Complete and accurate set of record drawings including drawing dimensions, schematics of hydraulics, wiring, and piping.
3. Warranties and bonds shall be included in manual.
4. Catalog literature complete with test data and performance data and ratings.
5. Specify equipment function, normal operating, and limiting conditions.
6. Assembly, installation, alignment, adjusting, and checking instructions.
7. Operating instructions for start-up, shutdown, routine and normal operation.
8. Emergency operating instructions indicating range and flexibility during emergencies.
9. Detailed service information including schedule of recommended maintenance.
10. Troubleshooting, common operating problems, problems that might occur in unit/process. List probable causes and discuss control/prevention.
11. Detailed safety section covering the operation and maintenance of unit. Contractor shall supply a complete list of equipment service numbers, model numbers, electrical requirements, manufacturer's names, etc.

12. The correct model number shall be designated where the literature covers more than one model.
13. For items assembled by the Contractor, the Contractor shall write and provide duplicate operation and maintenance instructions.
14. Data shall be folded to 8-1/2 inch x 11 inch size and placed into hard cover binders. Material shall be grouped according to specifications section and filed behind individual filing tab pages on which the following is to be typed: Item, Manufacturer, Contractor's Order Number, Supplier's Order Number, Manufacturer's Order Number.
15. Manuals shall be delivered to the Engineer for approval prior to job completion.

1.07 PERMITS AND APPROVALS

- A. Obtain and submit copies of all permits, code inspections, and approval documents, as specified.

1.08 CONSTRUCTION SCHEDULE

- A. Submit a minimum of five copies of a schedule of operation prior to construction. The schedule shall provide for activities of the various trades and shall be sequenced to provide a minimum of interruption to the operation of existing facilities. Allow ample time for the Owner to alter operations as required by the construction of the various components of the work. Revised and updated construction schedule shall be provided throughout the construction as deemed necessary and requested by the Engineer.
- B. The construction schedule shall be supplemented by a list of Submittals, dates they will be submitted for approval and a reasonable time allowance for review.

1.09 START-UP REPORTS

- A. Where equipment startup by a factory-trained representative is required, a minimum of three copies of the start-up report shall be submitted which describe the representatives activities and installation approval.
 1. Start-up report shall be a typewritten document containing descriptive information specifically identifying the piece by equipment, all tests conducted, and the results of the tests.
 2. Start-up role log, with the dated signatures of those conducting and accepting all start-up instructions and tests shall be provided as part of the report.
- B. Substantial completion will not be issued until all start-up reports have been submitted.

1.10 RECORD DRAWINGS

- A. The Engineer will provide the Contractor with a suitable set of contract drawings on which daily records of changes and deviations from contract shall be recorded. All buried or concealed piping, conduit, or similar items shall be located by dimensions and elevations on the record drawings.
1. The daily record of changes shall be the responsibility of Contractor's field superintendent. No arbitrary mark-ups will be permitted.
 2. At completion of the project, the Contractor shall submit the marked-up record drawings to the Owner.

1.11 SUBMITTAL LOG

- A. A submittal log is included as Section 01 33 23 of this Project Manual, which lists the minimum required Submittals, product data, samples, and operation and maintenance manuals. Additional submittals not listed on the log may be required by the Engineer during the course of construction. All submittals to the Engineer shall include the submittal number shown on the log. The minimum number of copies to be submitted is shown on the submittal log. Any additional copies required by the Contractor may be submitted in addition to the number shown on the log.

PART 2 PRODUCTS AND MATERIALS (N/A)

PART 3 CONSTRUCTION METHODS (N/A)

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

- A. Submittals shall be paid for at the bid price in accordance with one of the following methods, unless indicated otherwise in the Bid Schedule or Special Procedures - Division 01.
- B. All work specified herein shall be considered in each of the measurement and payment method(s) stipulated, unless indicated otherwise in the Bid Schedule or Special Procedures - Division 01.

4.02 SUBMITTALS

- A. Submittals, Inclusive. The cost for all submittals shall be considered inclusive to payment for work related to the respective equipment, associated construction, or utility, unless indicated otherwise in the Bid Schedule or Special Procedures - Division 01.

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of Division 01 shall govern work of this section.

1.02 APPLICABLE PUBLICATIONS (NONE)

1.03 DESCRIPTION OF WORK

- A. Provide quality control for all work performed under this contract as described in this section.

1.04 RELATED WORK ELSEWHERE

- A. Procurement and Contracting Requirements - Division 00 (All Sections)

- B. Submittals - Division 01

- C. Material and Equipment - Division 01

1.05 SUBMITTALS (NONE)

1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

1.07 QUALITY ASSURANCE

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

- B. Comply with manufacturers' instructions, including each step in sequence.

- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

- E. Perform work by persons qualified to produce workmanship of specified quality.

- F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.08 TOLERANCES

- A. Monitor tolerance control of installed products to produce acceptable work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.09 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents, except where a specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. The contractual relationship, duties, and responsibilities of the parties in Contract nor those of the Engineer shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.10 MOCK-UP

- A. Tests will be performed under provisions identified in this section and identified in the respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups are representative of the quality required for the work.
- D. Where mock-up has been accepted by Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so.

1.11 INSPECTING AND TESTING LABORATORY SERVICES

- A. Contractor shall be responsible for concrete testing as outlined in Division 03 of these specifications. For other testing, Owner will appoint, contract, and pay for the services of an independent firm to perform inspecting and testing.

- 1 B. The independent firm will perform inspections, tests, and other services specified in
2 individual specification sections and as required by the Engineer or the Owner.
- 3 C. Inspecting, testing, and source quality control may occur on or off the project site.
4 Perform off-site inspecting or testing as required by the Engineer or the Owner.
- 5 D. Reports will be submitted by the independent firm to the Engineer indicating
6 observations and results of tests and indicating compliance or non-compliance with
7 Contract Documents.
- 8 E. Cooperate with independent firm; furnish samples of materials, design mix,
9 equipment, tools, storage, safe access, and assistance by incidental labor as
10 requested.
- 11 1. Notify Engineer and independent firm 24 hours prior to expected time for
12 operations requiring services.
- 13 2. Make arrangements with independent firm and pay for additional samples
14 and tests required for Contractor's use.
- 15 F. Testing or inspecting does not relieve Contractor from the responsibility to perform
16 Work to contract requirements.
- 17 G. Retesting required because of non-conformance to specified requirements shall be
18 performed by the same independent firm on instructions by the Engineer. Payment
19 for retesting will be charged to the Contractor by deducting inspecting or testing
20 charges from the Contract Sum/Price.

21 1.12 MANUFACTURERS' FIELD SERVICES AND REPORTS

- 22 A. When specified in individual specification sections, require material or product
23 suppliers or manufacturers to provide qualified staff personnel to observe site
24 conditions, conditions of surfaces and installation, quality of workmanship, start-up
25 of equipment, and test, adjust and balance of equipment as applicable, and to initiate
26 instructions when necessary.
- 27 B. Report observations and site decisions or instructions given to applicators or
28 installers that are supplemental or contrary to manufacturers' written instructions.
- 29 C. Submit report within 30 days of observation to Engineer for information.

30 PART 2 PRODUCTS AND MATERIALS (N/A)

31 PART 3 CONSTRUCTION METHODS (N/A)

32 PART 4 MEASUREMENT AND PAYMENT (N/A)

33
34 END OF SECTION

SECTION 02 41 16.23

DEMOLITION – EXISTING COMMUNICATIONS TOWER

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of Division 01 and Special Provisions shall govern work of this section.

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the reference thereto.
1. Code of Federal Regulations (CFR), Title 29, Chapter XVII - Occupational Safety and Health Administration (OSHA), Department of Labor, Part 1926 Regulations:
 - a. Subpart N - Cranes Derricks, Hoists, Elevators and Conveyors, Current Edition.
 - b. Subpart P - Excavations, Current Edition.
 - c. Subpart T - Demolition, Current Edition.
 - d. Subpart U - Blasting and Use of Explosives, Current Edition.
 2. State of Minnesota, Department of Transportation, Standard Specifications for Construction, Current Edition.

1.03 DESCRIPTION OF WORK

- A. The work under this section shall cover the demolition of the existing communications tower, guy wires, concrete foundations, guy wire anchors, and existing telemetry buildings. The existing communications tower is approximately 140 feet tall.
- B. The existing communications tower will not be demolished before the new communications tower is ready for operation. Operations must be transferred from the existing tower to the new tower with as little service interruption as possible prior to demolition of the existing communications tower. Contractor will coordinate with the City for planned communication service disruption, such as but not limited to transferring service from the existing tower to the new tower.
- C. The existing antenna equipment on the existing communications tower will be retained by the City.
- D. It will be the Contractor's responsibility to obtain and pay for any permits required.

1.04 RELATED WORK ELSEWHERE

- A. Procurement and Contracting Requirements – City of Duluth, Special Provisions

- B. Submittals - Division 01
- C. Sequencing and Scheduling – Special Provisions
- D. Grading – Special Provisions
- E. Trenching and Backfilling – Special Provisions
- F. Seeding and Sodding – Special Provisions

1.05 SUBMITTALS

- A. Provide a detailed sequence of operation for demolition and removal work in accordance with Submittals - Division 01 of these specifications to ensure the minimum interruptions of the Owner's operations.

1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

PART 2 PRODUCTS AND MATERIALS

2.01 EXPLOSIVES

- A. The use of explosives will not be permitted.

PART 3 CONSTRUCTION METHODS

3.01 GENERAL

- A. All demolition work shall comply with the State of Minnesota, Department of Transportation, Standard Specifications for Construction, Current Edition and with Subsection 1926, Subparts N, P, T and U of the Code of Federal Regulations, Title 29, Chapter XVII - Occupation Safety and Health Administration, Department of Labor.

3.02 PROTECTION OF UTILITIES

- A. Before commencing demolition work, preserve in operating condition active utilities traversing the project site; protect property, including but not limited to mains, manholes, catch basins, valve boxes, poles, guys and other appurtenances.

3.03 TRAFFIC

- A. Conduct demolition operations and the removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

1 3.04 PROTECTIONS

- 2 A. Provide barricades to ensure the public safety. Conduct operations to prevent
3 damage by falling debris or other cause to adjacent buildings, structures, and other
4 facilities as well as persons. Provide interior and exterior shoring, bracing, or
5 support to prevent movement or settlement or collapse of structures to be demolished
6 and adjacent facilities to remain. Excavations, shorings and barricades shall with the
7 requirements of the Code of Federal Regulations (CFR), Title 29, Chapter XVII -
8 Occupational Safety and Health Administration (OSHA), Department of Labor, Part
9 1926.

10 3.05 DAMAGES

- 11 A. Promptly repair damages caused to adjacent facilities by demolition operations, as
12 directed by the Engineer and at no cost to the Owner.

13 3.06 EXISTING CONDITIONS

- 14 A. The Owner assumes no responsibility for the actual condition of the tower to be
15 demolished.

16 3.07 DEMOLITION, GENERAL

- 17 A. Proceed with demolition in accordance with approved sequence of operations.
18 Provide controls as practicable to confine dust and dirt in the immediate area of
19 demolition.

20 3.08 BELOW GRADE DEMOLITION

- 21 A. Demolish all abandoned structures to a depth of not less than 24 inches below the
22 existing ground surface. In addition, demolish and remove all below grade wood,
23 metal and floor construction.

24 3.09 DISPOSAL OF DEMOLISHED MATERIALS

- 25 A. Remove from the site all debris, rubbish, and other materials resulting from
26 demolition operations. Items of salvageable value shall become the property of the
27 Contractor. Storage or sale of items of salvageable value on the site will not be
28 permitted. Debris, rubbish, and other materials must be transported from the site as
29 they are removed.

30 3.10 RESTORATION

- 31 A. The site shall be restored to the existing grades and conditions after the demolition is
32 complete.
33 1. All disturbed turf areas shall be restored with similar materials and to a
34 condition equal to or better than previously existed. Refer to Special
35 provisions.

2. Any pavement or sidewalk disturbed shall be replaced with similar construction equal to or better than the items removed.

B. Temporary erosion control measures shall be provided by the Contractor in accordance with SWPP.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Demolition – Existing Communications Tower shall be paid for at the bid price in accordance with one of the following methods, unless indicated otherwise in the Bid Schedule or Special Procedures - Division 01.

B. All work specified herein shall be considered in each of the measurement and payment method(s) stipulated, unless indicated otherwise in the Bid Schedule or Special Procedures - Division 01.

1. Demolition – Existing Communications Tower, Lump Sum. Payment shall be made at the contract lump sum price bid for all work relating to demolition of the Existing Communications Tower and Telemetry Building.

END OF SECTION

1 SECTION 03 11 13

2
3 STRUCTURAL CAST-IN-PLACE CONCRETE FORMING

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS

- 6 A. Applicable provisions of Division 01 shall govern work of this section.

7 1.02 APPLICABLE PUBLICATIONS

- 8 A. The following publications of the issues listed below, but referred to thereafter by
9 basic designation only, form a part of this specification to the extent indicated by the
10 reference thereto.

- 11 1. American Concrete Institute (ACI) Annual Book of ACI Standards:
12 a. ACI 117/177R - Specifications for Tolerances for Concrete
13 Construction and Materials and Commentary, Current Edition.
14 b. ACI 301 - Specifications for Structural Concrete, Current Edition.
15 c. ACI 302.1R - Guide for Concrete Floor and Slab Construction,
16 Current Edition.
17 d. ACI 311.4R - Guide for Concrete Inspection, Current Edition.
18 e. ACI 318 - Building Code Requirements for Structural Concrete,
19 Current Edition.
20 f. ACI 347 - Guide to Formwork for Concrete, Current Edition.
21 g. ACI ASCC-1(05) - The Contractor's Guide to Quality Concrete
22 Construction, Third Edition.
23 h. ACI SCM-24 - Concrete Repair Basics, Current Edition.
24 i. ACI SP-4 - Formwork for Concrete, Current Edition.
25 j. ACI SP15 - Field Reference Manual: Standard Specifications for
26 Structural Concrete ACI 301 with Selected ACI Reference, Current
27 Edition.
28 k. ACI SP-71 - ASTM Standards in ACI 318, Current Edition.
29 2. American Plywood Association (APA) Specifications and Standards:
30 a. APA PS1 - Plywood Design Specification, Current Edition.

31 1.03 DESCRIPTION OF WORK

- 32 A. The work covered under this section shall consist of furnishing all materials,
33 equipment and labor required to furnish all formwork for cast-in-place concrete as
34 shown on the contract drawings and specified herein.
- 35 B. The work shall include formwork, shoring for cast-in-place concrete, and installation
36 into formwork of items by other such as anchor bolts, setting plates, bearing plates,
37 anchorages, inserts, frames, nosings and other items to be embedded in concrete.

1 1.04 RELATED WORK ELSEWHERE

2 A. Procurement and Contracting Requirements - Division 00 (All Sections)

3 B. Concrete Accessories - Division 03

4 C. Concrete Reinforcing - Division 03

5 D. Cast-in-Place Concrete - Division 03

6 E. Joint Sealers – Division 07

7 1.05 SUBMITTALS (NONE)

8 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

9 PART 2 PRODUCTS AND MATERIALS

10 2.01 DESIGN

11 A. The design and engineering of the formwork and its accessories shall be the
12 responsibility of the Contractor. Formwork shall be designed, erected, supported,
13 braced and maintained so as to safely support all vertical and lateral loads until such
14 loads can be supported by the concrete structure.

15 B. Determination of loads and design shall be in accordance with ACI 301 and ACI
16 347.

17 2.02 FORMS

18 A. Forms may be wood, plywood, concrete-form-grade hardboard, metal or other
19 acceptable material which will produce smooth, true surfaces.

20 1. Provide lumber dressed on at least two edges and one side for tight fit.

21 2. Metal forms shall have smooth surfaces free from any pattern, irregularities,
22 dents, bends and sags.

23 2.03 SHORING

24 A. All shoring members shall be of such design and material to safely support all dead
25 and working loads throughout the placing and curing period. Shoring shall be placed
26 to prevent sagging and settlement.

27 2.04 FORM TIES AND ACCESSORIES

28 A. Form ties shall be factory-fabricated, adjustable-length, removable or snapoff metal,
29 designed to prevent form deflection, and to prevent spalling concrete surfaces upon
30 removal.

1 B. For exposed concrete surfaces, provide ties so that the portion remaining with the
2 concrete after removal is 1 inch to 1-1/2 inches inside the finished face of the
3 concrete.

4 C. Unless otherwise indicated, provide form ties which will not leave holes larger than 1
5 inch in diameter in concrete surfaces.

6 2.05 FORM COATING COMPOUND

7 A. Form coating compound shall be a commercial formulation that will not bond with,
8 stain, nor adversely affect concrete surfaces and not impede the wetting of surfaces
9 to be cured with water or curing compounds. Forms for concrete surfaces requiring
10 subsequent treatment shall receive a type of coating that will not impair bond or
11 adhesion.

12 B. Form coating compound for steel forms shall conform with all requirements stated
13 above and shall be of rust-preventative type.

14 PART 3 CONSTRUCTION METHODS

15 3.01 GENERAL

16 A. Responsibility. The design and construction of formwork shall be the sole
17 responsibility of the Contractor.

18 B. Earth forms are not acceptable or permitted.

19 C. Construct forms to the exact sizes, shapes, lines and dimensions shown, as required
20 to obtain accurate alignment, location, grades, level and plumb in finished
21 construction and to maintain tolerances in accordance with ACI 301. Provide for
22 openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets,
23 chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features
24 required. Chamfer all corners of concrete exposed to view using chamfer strips. Use
25 selected materials to obtain required finishes.

26 D. Forms shall be sufficiently tight to prevent leakage of concrete. Temporary openings
27 shall be provided in the inside form of all wall forms and in column forms to
28 facilitate cleaning and inspection immediately before placing concrete.

29 E. Assemble forms so their removal will not damage concrete and adjacent materials.

30 3.02 FORMWORK

31 A. Forms shall conform in general to shape, line, grade and dimensions of members as
32 shown on contract drawings, and shall have the strength and stability to insure
33 finished concrete within the tolerances specified in ACI 347.

1. Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from those other trades.
2. Exterior edges of all exposed concrete, unless otherwise specified, shall have a chamfer strip placed in form to provide bevel of sharp edges. Chamfer strips shall be 3/4-inch by 3/4-inch by 45° wood, plastic, or rubber.
3. Accurately place and secure in position, prior to placing concrete, all anchors, bolts, inserts and other items furnished under other sections of the specifications and for other contractors on the project.

B. Formwork shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports.

C. Formwork shall be properly braced or tied together so as to maintain position and shape and insure safety to workman and passersby.

D. Temporary openings may be provided on all wall and column forms to limit the free fall of the concrete to less than 4 feet and should be so located as to facilitate the placing and consolidation of the concrete. The ports shall be spaced no more than 6 feet apart to limit the horizontal flow of concrete.

E. All forms shall be cleaned and rubbed smooth prior to placing to insure true forming surfaces for all concrete surfaces.

3.03 FORM TIES AND ACCESSORIES

A. Internal wall ties shall contain positive stops at the required wall thickness. The exterior clamp portions of the pipe shall be adjustable to permit tightening of forms. Ties shall provide a positive disconnection 1 inch to 1-1/2 inches inside the finished face of the concrete. Cutting ties back from face of wall or use of wire ties will not be permitted. All tie and plug holes shall be filled with non-shrink grout after forms are removed.

B. All concrete tie locations shall be watertight. Wall ties shall be fitted with tapered rubber plugs at all locations specified under Special Procedures - Division 01.

C. Accessories shall be used only for the purpose intended and shall in no way interfere with the placing of concrete. Removal of accessories shall in no way impair or disturb finish concrete surfaces. Accessories shall be compatible with formwork and ties and shall maintain the watertight integrity of the formwork system.

D. Design of all form ties and accessories shall be adequate for all concrete placement, horizontal and vertical, to prevent failures and blowouts.

3.04 FORM COATINGS

- A. Coat form contact surfaces with form bond breaker compound before reinforcement is placed. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
- B. Coat steel forms with form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.
- C. Clean reinforcing steel that has become contaminated with form coating to the satisfaction of the Engineer prior to placing concrete.

3.05 EMBEDDED ITEMS

- A. Items embedded in concrete shall be properly cleaned to be free from oil or foreign matter that would weaken the bond of the concrete to these items.
- B. Install in the formwork requisite inserts, anchors, sleeves and other items specified under other sections of these specifications; close end conduits, piping and sleeves embedded in concrete with caps or plugs.
- C. Conduits or pipes embedded in slabs of larger outside diameter than 1-1/2 inches, or when pipes and conduits come closer than 1 inch from either the upper or lower surface of the slab, provide expanded metal or wire mesh laid and extended beyond conduit or piping at least 8 inches on all sides; space conduits or pipes closer than 3 diameters on centers, place to avoid changing locations of reinforcement for indicated locations.

3.06 CONSTRUCTION JOINTS

- A. Make construction joints where indicated on the contract drawings; additional construction joints are subject to prior approval of the Engineer; locate additional construction joints to least impair the strength of the structure.
- B. Form keyways and joints as indicated on the contract drawings.
- C. Continue reinforcing steel and wire fabric across construction joints, unless noted otherwise.
- D. Install premolded joint filler at locations indicated on the contract drawings; extend filler from bottom of concrete; joints shall be carefully cleaned, free from dust, mortar or other loose materials before installation; seal as indicated on the contract drawings.
- E. Make splices in premolded filler in manner to preclude penetration of concrete between joint faces.

3.07 EXPANSION JOINTS

- A. Expansion joints shall be placed where indicated on the contract drawings; reinforcement, corner protection angles or other fixed metal items embedded in or binded to continuously shall not extend through expansion joints; finish concrete slab edges along expansion joints neatly with slightly rounded edging tool; leave joints in the completed work carefully tooled and free of mortar and concrete.
- B. Joints between slabs on earth and vertical surfaces, including columns, piers, walls, machinery foundation and other fixed structures shall have expansion joint material placed on abutting vertical surfaces.
- C. Joints to receive joint compound shall have premolded expansion filler strips at proper level placed below finished floor with slightly tapered, dressed, oiled wood strip secured temporarily to top thereof; install wood strip of depth to form groove at least 1 inch deep; after concrete has set, remove strip; fill groove with light colored joint compound for poured application; fill joint grooves flush, to be slightly concave, after drying as specified in Joint Sealers - Division 07.

3.08 CONTROL JOINTS

- A. Install vertical control joints as indicated on the contract drawings, and where not indicated not more than 20 feet apart; locate specifically as follows:
 - 1. Align with window jambs or at center of window openings; place not over 10 feet from corners or offsets; where concrete walls change either thickness or height; where change in wall sections occurs.
 - 2. At each control joint, extend only alternate horizontal reinforcement bars through the joint; seal control joints with concrete colored joint compound.
- B. Install control (contraction) joints in slabs as indicated on the contract drawings, and where not indicated locate specifically as follows:
 - 1. Space at a minimum of 25 feet on center; locate at column spacings where practical; at each joint, cut reinforcing mesh so only alternate wires extend through joint.
 - 2. If column spacing exceeds 25 feet on center, provide intermediate joints as well; resulting panels shall be approximately square; elongated and L-shaped panels shall not be acceptable.
 - 3. Provide 1/4 inch wide saw - cut control joints to a depth equivalent to 1/3 the slab thickness; cut as soon as the slab will support the weight of the saw and operator and not damage the surface and not more than 8 hours after completion of concrete placement.
- C. Apply joint compound to all control and construction joints after concrete has sufficiently cured; clean joint slot; fill joint with light colored compound for poured application; fill joint grooves flush, to be slightly concave after drying, as specified in Joint Sealers - Division 07.

3.09 WATERSTOPS

- A. Install waterstops of the sizes and shapes indicated on the contract drawings; support and protect that portion of the waterstop which extends beyond the bulkhead during placing of concrete and subsequent removal of forms.
 - 1. Continuous at construction and expansion joints.
 - 2. Material, size and shape as indicated on the contract drawings and in Concrete Accessories - Division 03.
- B. Make field splices by heat - sealing, maintaining the continuity of the ribs and bulbs, and allow the splice to cool before stressing; field splice must be watertight; repair damaged waterstops.

3.10 FORM/SHORING REMOVAL

- A. Arrange forms to allow stripping without removal of principal shores, where required to remain in place.
- B. Removal of forms shall be accomplished in such a manner as will prevent injury to concrete and insure complete safety of structure. Removal times listed below are minimum and may be increased by the Engineer as job conditions warrant.
 - 1. Where structure as a whole is supported on shores, vertical forms such as beam and girder sides, columns, and similar vertical forms may be removed 24 hours after completion of pour, providing concrete has hardened sufficiently to sustain its own weight and to prevent injury.
 - 2. Wall forms shall not be removed in less than 24 hours after pouring, unless otherwise required for curing.
 - 3. Supporting forms and shoring must remain in place until concrete can carry any loads to be imposed upon it and in no case shall be removed in less than seven (7) days.
 - 4. Forms ties, requiring any operation in removal of forms which would tend to destroy bond between tie and concrete in order to remove form, shall not be disturbed for seven (7) days after completion of pour.
 - 5. The time periods stipulated above may be reduced if strength results of concrete so indicate adequate conditions.
- C. Notify the Engineer before the forms are removed in order that an examination of the newly-stripped surfaces may be made prior to patching.

3.11 REPAIR TIE HOLES

- A. After removal of form tie, the holes shall be filled as follows:
 - 1. Thoroughly clean and dampen.
 - 2. Fill solid with patching mortar.
- B. Make repairs uniform in color and finish with surrounding concrete.

3.12 EXPOSED SURFACES

- A. Exposed surfaces shall be Carborundum rubbed to take off fins; fill pores, stone pickets, honeycombs, etc., with non shrink grout as follows:
1. Repair immediately after form removal and inspection by the Engineer.
 2. Remove concrete surrounding defect to sound concrete, then wet affected area.
 3. Brush on bonding agent, mixed and applied in accordance with manufacturer's recommendations.
 4. Consolidate patch grout and strike off to leave the patch slightly higher than the surrounding surface.
 5. Finish the repaired area flush with the surrounding area after the patch has been in place for one hour, or as prescribed by the manufacturer.
- B. Perform patching before curing compound is applied; cure patched areas in the same manner as adjacent concrete; make repairs uniform in color and finish with surrounding concrete.
- C. Exposed surfaces shall be protected from excessive sun, wind and rain, and kept wet until curing compound is applied. When ambient temperature falls below 40°F heat aggregate and mixing water; clear all forms, reinforcement and subgrade of snow and ice; cover all freshly placed concrete with tarpaulins, and provide heat to maintain a temperature of 70°F for at least three days or 50°F for five days; rate of cooling after end of protection period shall be accomplished in a manner approved by the Engineer.

3.13 REUSE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in the work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for the new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.
- C. Do not use "patched" forms for concrete surfaces exposed to view.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

- A. Structural cast-in-place concrete forming shall be paid for at the bid price in accordance with one of the following methods, unless indicated otherwise in the Bid Schedule or Special Procedures - Division 01.

1 B. All work specified herein shall be considered in each of the measurement and
2 payment method(s) stipulated, unless indicated otherwise in the Bid Schedule or
3 Special Procedures - Division 01.

4 4.02 STRUCTURAL CAST-IN-PLACE CONCRETE FORMING

5 A. Structural Cast-in-Place Concrete Forming, Inclusive. When no quantity is provided,
6 structural cast-in-place concrete forming shall be considered inclusive to payment for
7 work associated with cast-in-place concrete.
8

9 END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of Division 01 shall govern work of this section.

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the reference thereto.

1. American Concrete Institute (ACI) Specifications and Standards:
 - a. ACI 315 - Manual of Standard Practice for Detailing Reinforced Concrete Structures, Current Edition.
 - b. ACI 318 - Building Code Requirements for Structural Concrete and Commentary, Current Edition.
2. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards:
 - a. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement, Current Edition.
 - b. ASTM A184 - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement, Current Edition.
 - c. ASTM A185 - Standard Specification for Steel Welded Wire Reinforced, Plain for Concrete, Current Edition.
 - d. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement, Current Edition.
3. American Welding Society (AWS), Specifications and Standards:
 - a. AWS D12.1 - Welding Reinforcing Steel, Metal Inserts, and Connections in Reinforced Concrete Construction, Current Edition.
4. American Association of State Highway Transportation Officials (AASHTO), Specifications and Standards:
 - a. AASHTO M182 - Specification for Burlap Cloth Made from Jute or Kenaf, Current Edition
5. Concrete Reinforcing Steel Institute (CRSI) Specifications and Standards:
 - a. CRSI - Manual of Standard Practice, Current Edition.
 - b. CRSI - Recommended Practice for Placing Reinforcing Bars, Current Edition.
 - c. CRSI - Recommended Practice for Placing Bar Supports, Specifications and Nomenclature, Current Edition.
 - d. CRSI - Recommended Practice for Reinforcing Bar Splices, Current Edition.

1.03 DESCRIPTION OF WORK

- A. The work under this section shall cover furnishing and installing concrete reinforcing as shown on the contract drawings and as specified herein.

1.04 RELATED WORK ELSEWHERE

- A. Procurement and Contracting Requirements - Division 00 (All Sections)
B. Concrete Accessories - Division 03
C. Cast-in-Place Concrete - Division 03

1.05 SUBMITTALS

- A. Contractor shall submit such product literature and catalog cuts of materials to be supplied to relate these materials to the specification. Information shall be in conformance with requirements of Submittals - Division 01 of these specifications.
1. Submit detailed reinforcing drawings prepared in accordance with ACI 315, including bar schedule with bar marks and bends indicated.
 2. Comply with CRSI Manual of Standard Practice showing bar schedules, stirrup spacing, diagrams of bent bars and arrangements of concrete reinforcement. Include special reinforcement required at openings through concrete.
 3. Verify dimensions and make proper allowance for fitting together work of other trades.
- B. Submit a certification attesting that reinforcing steel meets the requirements of ASTM A615, including Supplementary Requirements S1, and that welded steel wire fabric meets the requirements of ASTM A185.
1. Submit certified copies of mill reports, tensile and bend tests for reinforcing steel on projects where the quantity of reinforcing exceeds 15 tons.
 2. For information only, submit manufacturer's data and instruction for proprietary items, including reinforcement and accessories.

1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

PART 2 PRODUCTS AND MATERIALS

2.01 REINFORCEMENT

- A. Steel Bar Reinforcement. Main reinforcing and stirrups; ASTM A615, Grade 60.
- B. Welded Wire Fabric. Welded wire fabric, ASTM A185, 6 x 6 - W1.4 /W1.4, unless otherwise specified or indicated on the contract drawings.
- C. Steel Tie Wire. Steel tie wire, ASTM A82, plain, cold-drawn, 16 gauge or heavier.

- 1 D. Supports For Reinforcement. Bolsters, chairs, spacers and other devices for spacing,
2 supporting and fastening reinforcement in place complying with CRSI Manual of
3 Standard Practice. For slabs on grade where base material will not support chairs,
4 use supports with sand plates or horizontal runners to locate mesh properly in slab.
5 Provide hot-dipped galvanized or plastic-coated accessories in contact with forms for
6 sight exposed concrete; stainless steel accessories for sandblasted or bushhammered
7 concrete.

8 PART 3 CONSTRUCTION METHODS

9 3.01 FABRICATION

- 10 A. Fabricate and place to shapes and dimensions indicated or required to carry out intent
11 of contract drawings and these specifications.
- 12 B. Bends for stirrups and ties shall be made around a pin having a diameter not less than
13 four times the diameter of reinforcing bar. Bends for other bars shall be made around
14 a pin having a diameter not less than six times diameter of bar, except that for bars
15 larger than 1 inch, pin shall be not less than eight times diameter of bar.
- 16 1. Perform cutting and bending in the shop; bend and cut steel cold. Heating of
17 reinforcement will not be permitted. Do not bend or straighten bars in a
18 manner that will injure the material.
- 19 2. Field bending of bars shall not be allowed without the Engineer's approval.
- 20 C. Tagging shall be with metal, linen, or rope fiber tags filled in with machine or
21 waterproof ink. Paper tags shall not be allowed.
- 22 D. Reinforcing bars shall conform accurately to the dimensions shown on the contract
23 drawings.

24 3.02 PRODUCT DELIVERY, STORAGE AND HANDLING

- 25 A. For reinforcing steel fabricated on-site, shop from the mill in bundles, limited to one
26 size and length, tagged with a waterproof tag showing the name of the mill, heat
27 number, grade and size of the bars and identifying number.
- 28 B. For reinforcing steel fabricated off-site, deliver in bundles identified as to structure
29 and shop drawing number. Identify each individual bar with a waterproof tag
30 showing the grade, size and bar mark from the approved bar schedule.
- 31 C. Protect reinforcing steel and wire fabric from damage and from dirt, oil grease, other
32 foreign matter, and rust-causing condition. Do not store reinforcement in direct
33 contact with the ground.

1 3.03 CLEANING

- 2 A. Before placing and before pouring concrete, all reinforcement shall be thoroughly
3 cleaned of all oil, dirt, loose mill scale, loose rust, or foreign matter that will destroy
4 or reduce bond.

5 3.04 PLACING REINFORCEMENT

- 6 A. Placement. Metal reinforcement shall be accurately placed in accordance with
7 approved Submittals and adequately secured in position by concrete or metal chairs
8 or spacers. Nails shall not be driven into forms to support reinforcement nor shall
9 wire ties come in contact with forms.

- 10 B. Splicing. Lap at splices shall be sufficient to transfer stress between bars by bond
11 and shear.

- 12 1. Furnish reinforcing bars in full lengths as indicated on the contract drawings
13 and approved Submittals.
14 2. Do not splice bars unless indicated on the contract drawings or approved by
15 the Engineer in writing. When authorized, make splices in accordance with
16 ACI 318; perform welding in accordance with AWS D12.1.
17 3. Splices generally shall be avoided at points of maximum stress. Minimum
18 splice lap for stressed bars shall be forty times bar diameter.

- 19 C. Offsets in longitudinal bars at change of cross section shall be placed in region of
20 lateral support. Slope of inclined portion of offset shall not be more than one in six
21 and, in tied columns, ties shall be spaced not over 3 inches on centers for a distance
22 of 1 foot below actual point of offset.

- 23 D. Embedded Items. The Contractor shall provide for the installation of all items
24 embedded in the concrete, such as coil rod inserts, anchor bolts, dowels, etc., as
25 shown on the contract drawings or as provided for in other Divisions of these
26 specifications.

- 27 1. All dowel bars shall be tied securely in place before pouring concrete.
28 2. Provide for clearances with appurtenant materials and devices.

- 29 E. Drilled and Grouted or Epoxy Dowel Installation. Existing concrete which will be
30 incorporated into new work and requiring integration with new concrete will be
31 doweled as indicated on the contract drawings and as follows:

- 32 1. Drill hole in existing concrete of size that is 3/4 inch larger in diameter than
33 diameter of dowel bar. Incline the hole in the concrete such that the non-
34 shrink grouting or epoxy will be retained in the hole.
35 2. Fill hole with non-shrink grouting or epoxy.
36 3. Immediately place dowel bar into hole.
37 4. Allow grout or epoxy to take initial set before disturbing dowel bar.

- 1 F. Steel Reinforcing Fabric. Reinforce as detailed on the contract drawings; and where
2 not indicated, reinforce with wire fabric, place 2 inches from the top of the slab.
- 3 1. Flat sheets shall be used whenever available. Wire fabric shall lap 6 inches
4 on side joints and 12 inches on end joints. Properly secure with annealed
5 wire. Fabric shall be raised and secured in the correct location using
6 permanent supports. Raising the fabric by hook during placement of
7 concrete shall NOT be permitted.
- 8 2. Alternately, in tight quarters and around appurtenances and openings, lap
9 mesh reinforcement not less than one mesh space plus 2 inches, and tie.
- 10 G. Concrete Cover. The minimum cover of concrete for all reinforcement shall conform
11 to the dimensions indicated on the contract drawings, which indicate the clear
12 distance from the edge and end of the reinforcement to the face of the concrete
13 surface. Provide clearance and spacing indicated on the contract drawings and
14 approved Submittals, where so indicated.
- 15 1. Where no clearances are indicated, the thickness of the concrete cover over
16 reinforcement shall be as follows:
- 17 a. Concrete cast against and permanently exposed to earth - 3 inches;
18 b. Formed concrete exposed to earth or weather - 2 inches;
19 c. Formed concrete not exposed to earth or weather - 1-1/2 inches;
20 d. Slabs not exposed to earth or weather - 1 inch.

21 PART 4 MEASUREMENT AND PAYMENT

22 4.01 GENERAL

- 23 A. Concrete reinforcing shall be paid for at the bid price in accordance with one of the
24 following methods, unless indicated otherwise in the Bid Schedule or Special
25 Procedures - Division 01.
- 26 B. All work specified herein shall be considered in each of the measurement and
27 payment method(s) stipulated, unless indicated otherwise in the Bid Schedule or
28 Special Procedures - Division 01.

29 4.02 CONCRETE REINFORCING

- 30 A. Concrete Reinforcing, Inclusive. When no quantity is provided, concrete reinforcing
31 shall be considered inclusive to payment for work associated with cast-in-place
32 concrete.
33

34 END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of Division 01 shall govern work of this section.

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the reference thereto.

1. American Concrete Institute (ACI), Annual Book of ACI Standards:
 - a. ACI 117/177R - Standard Specification for Tolerances for Concrete Construction and Materials and Commentary, Current Edition.
 - b. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete, Current Edition.
 - c. ACI 209.1R - Report on Factors Affecting Shrinkage and Creep of Hardened Concrete, Current Edition.
 - d. ACI 301 - Specification for Structural Concrete, Current Edition.
 - e. ACI 302.1R - Guide for Concrete Floor and Slab Construction, Current Edition.
 - f. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete, Current Edition.
 - g. ACI 305R - Hot Weather Concreting, Current Edition.
 - h. ACI 306.1 (R2002) - Standard Specification for Cold Weather Concreting, Current Edition.
 - i. ACI 308R - Guide to Curing Concrete, Current Edition.
 - j. ACI 309R - Guide for Consolidation of Concrete, Current Edition.
 - k. ACI 311.4R - Guide for Concrete Inspection, Current Edition.
 - l. ACI 318/318R - Building Code Requirements for Structural Concrete and Commentary, Current Edition.
 - m. ACI 530/530.1/530R/530.1R - Building Code Requirements for Commentary for Masonry Structures and Specification for Masonry Structures and Related Commentaries, Current Edition.
 - n. ACI ASCC-1(05) - The Contractor's Guide to Quality Concrete Construction, Third Edition.
 - o. ACI CP-10/PACK - Craftsman Study Package for ACI Certification of Concrete Flatwork Technician/Finisher, Current Edition.
 - p. ACI MCP06 - ACI Manual of Concrete Practice, Parts 1 through 6, and Index, 2006 Edition.
 - q. ACI SCM-24 - Concrete Repair Basics, Current Edition.
 - r. ACI SP4 - Formwork for Concrete, Current Edition.

- s. ACI SP15 - Field Reference Manual: Standard Specifications for Structural Concrete ACI 301 with Selected ACI Reference, Current Edition.
- t. ACI SP-71 - ASTM Standards in ACI 318, Current Edition.
- 2. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards:
 - a. ASTM C33 - Standard Specification for Concrete Aggregates, Current Edition.
 - b. ASTM C70 - Standard Test Method for Surface Moisture in Fine Aggregate, Current Edition.
 - c. ASTM C94 - Standard Specification for Ready-Mixed Concrete, Current Edition.
 - d. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-inch or [50 mm] Cube Specimens), Current Edition.
 - e. ASTM C125 - Standard Terminology Relating to Concrete and Concrete Aggregates, Current Edition.
 - f. ASTM C127 - Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate, Current Edition.
 - g. ASTM C128 - Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Fine Aggregate, Current Edition.
 - h. ASTM C131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine, Current Edition.
 - i. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete, Current Edition.
 - j. ASTM C150 - Standard Specification for Portland Cement, Current Edition.
 - k. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete, Current Edition.
 - l. ASTM C191 - Standard Test Methods for Time Setting of Hydraulic Cement by Vicat Needle, Current Edition.
 - m. ASTM C219 - Standard Terminology Relating to Hydraulic Cement, Current Edition.
 - n. ASTM C226 - Standard Specification for Air-Entraining Additions for Use in the Manufacture of Air-Entraining Hydraulic Cement, Current Edition.
 - o. ASTM C233 - Standard Test Method for Air-Entraining Admixtures in Concrete, Current Edition.
 - p. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete, Current Edition.
 - q. ASTM C311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for use as a Mineral Admixture in Portland-Cement Concrete, Current Edition.

- r. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete, Current Edition.
- s. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete, Current Edition.
- t. ASTM C535 - Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine, Current Edition.
- u. ASTM C566 - Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying, Current Edition.
- v. ASTM C595 - Standard Specification for Blended Hydraulic Cement, Current Edition.
- w. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete, Current Edition.
- x. ASTM C688 - Standard Specification for Functional Additions for Use in Hydraulic Cements, Current Edition.
- y. ASTM C989 - Standard Specification for Slag Cement for Use in Cement and Mortars, current edition.
- 3. Portland Cement Association (PCA) Standards and Specifications:
 - a. PCA - Design and Control of Concrete Mixtures, Current Edition.

1.03 DESCRIPTION OF WORK

- A. The work covered under this section shall cover furnishing all materials, equipment and labor required to construct all cast-in-place concrete as shown on the contract drawings and as specified.

1.04 RELATED WORK ELSEWHERE

- A. Procurement and Contracting Requirements - Division 00 (All Sections)
- B. Submittals - Division 01
- C. Concrete Quality Control - Division 01
- D. Structural Cast-in-Place Concrete Forming - Division 03
- E. Concrete Accessories - Division 03
- F. Concrete Reinforcing - Division 03

1.05 SUBMITTALS

- A. Submit such product literature and catalog cuts of materials to be supplied to relate these materials to the specification. Information shall be in conformance with requirements of Submittals - Division 01 of these specifications.
- B. Concrete Design Mix

1. Prior to the start of placing of concrete, submit the design mix for each class of concrete, indicating that the concrete constituents and proportions will result in a concrete mix meeting the physical requirements for each class of concrete specified. Submit with the design mix, laboratory test reports and manufacturer's certificates attesting the conformance of constituents with these specifications.
2. Do not vary the proportions of the constituents or source of material of the approved mix without submitting corresponding test result documentation to the Engineer for review and approval.
3. Design mix shall indicate proportions of cement, aggregate and water, and names and proportions of admixtures and air-entraining agents.
4. Provide certification that the design mix complies with all ACI and ASTM requirements.

1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

PART 2 PRODUCTS AND MATERIALS

2.01 CEMENT

- A. Cement shall be Portland Cement ASTM C150 Type I or IA, except as otherwise noted or approved. Type III cement shall only be used for Class L concrete, or when approved by the Engineer.
- B. A singular brand and manufacturer of cement shall be used for the entire work.

2.02 FLY ASH

- A. Fly ash shall conform to ASTM C618 Class C.
- B. A singular source of fly ash shall be used for the entire work.

2.03 SLAG

- A. Slag shall be ground granulated blast furnace slag conforming to ASTM C989.

2.04 AGGREGATE

- A. Aggregate shall consist of clean, hard durable sand, gravel, crushed gravel or crushed rock.
- B. Aggregate shall conform to the requirements of ASTM C33. Fine and coarse aggregate shall meet ASTM C33 grading requirements. Coarse aggregates shall be graded in accordance with ASTM gradations as follows:
 1. 3/4 inch maximum coarse aggregate - ASTM No. 67
 2. 1-1/2 inch maximum coarse aggregate - ASTM No. 467

- 1 C. Maximum aggregate size shall be as defined in the Concrete Schedule, or where not
2 defined in the Concrete Schedule, as defined by dimensional constraints for cast-in-
3 place concrete as follows.
- 4 1. Not larger than one-fifth of the narrowest dimension between sides of the
5 forms;
 - 6 2. Not larger than one-third the thickness of the slab;
 - 7 3. Not larger than three-fourths of the minimum clear spacing between
8 individual reinforcing bars or wire, bundles of bars, or prestressing tendons
9 or ducts.

10 2.05 MIXING WATER

- 11 A. Mixing water shall be natural or treated water, clean and free from injurious amount
12 of oil, acid, alkali, chlorides and sulfates, other common salts, organic matter or other
13 deleterious substances.
- 14 B. Mixing water shall yield cement paste complying with the requirements ASTM C109
15 and ASTM C191.

16 2.06 ADMIXTURES

- 17 A. All admixtures are subject to the written approval of the Engineer and shall be used
18 in strict accordance with the manufacturer's recommendations.
- 19 1. Air-Entraining Admixture
 - 20 a. All concrete exposed to weather and freeze-thaw cycles shall be air-
21 entrained, unless otherwise specified.
 - 22 b. Air-Entraining admixture shall conform to ASTM C260.
 - 23 c. Air-Entrainment shall be as indicated for each class as in the
24 Concrete Schedule.
 - 25 2. Water-Reducing, Set-Controlling Admixtures
 - 26 a. Water-Reducing, Set-Controlling admixtures shall conform to ASTM
27 C494, Type A for water-reducing, Type C for accelerating, Type D
28 for water-reducing and retarding, and Type E for water-reducing and
29 accelerating.
- 30 B. Admixtures containing calcium chloride or soluble chloride shall not be used.

31 2.07 CURING AND SEALING COMPOUND - INTERIOR

- 32 A. Membrane-forming curing compound shall meet the moisture retention requirements
33 of ASTM C309, Type 1. Kure-N-Seal, Sonneborn Division of BASF; Sealtight Seal
34 Cure-309, W.R. Meadows, Inc.; Eucocure, Euclid Chemical Co.; or equal.
- 35 B. Shall be compatible with surface finish.

2.08 CURING COMPOUND - EXTERIOR

- A. Curing compound shall comply with ASTM C309, Type 2; resin, white pigmented.

PART 3 CONSTRUCTION METHODS

3.01 COORDINATION

- A. Examine the drawings and specifications for work of other sections or other contractors and coordinate such work with the requirements of this Section; make provisions for installation of such items as sleeves, pipes, conduits, inserts and hangers in a manner that will not impair or weaken concrete construction.

3.02 READI-MIX CONCRETE

- A. Acceptability and Use. Readmix concrete shall be designed on the basis of strength, durability, impermeability, and exposure condition, as required for the intended use of the structure by methods specified in ACI 211.1 and ACI 318. All readmix concrete shall comply with the water-cement ratio for each specific class of concrete as specified in the Concrete Schedule. Concrete design mix, complete with sample test results shall be submitted to the Engineer for approval prior to placing any concrete.

1. Failure to Meet Strength Requirements. Failure to meet strength requirements shall be as defined in Concrete Quality Control- Division 01 of these specifications.

2. Watertight Concrete. All concrete exposed to earth or water shall be watertight, shall have a water-cement ratio as specified, and shall be air-entrained as specified in the Concrete Schedule.

a. Construct keyways as indicated on the contract drawings.

b. Provide damp-proofing membrane as indicated on the contract drawings.

3. Waterproof Concrete. All concrete for water retaining structures shall be waterproof, shall have a water-cement ratio as specified, and shall be air-entrained as specified in the Concrete Schedule.

a. Construct keyways and waterstops as indicated on the contract drawings.

- B. Mix Proportioning. Mix proportioning shall be the responsibility of the Contractor and shall be submitted for review and approval by the Engineer, in accordance with these specifications.

1. Select proportions for concrete to obtain the quality requirements for the class of concrete as specified in the Concrete Schedule. Contractor, at their expense, shall have an approved independent laboratory prepare design mixes for each specified concrete class.

2. Slump. Slump for class of concrete shall be as specified in the Concrete Schedule. The Contractor shall at their expense, make field slump tests in

1 accordance with ASTM C143 and Concrete Quality Control-Division 01 of
2 these specifications.

3 3. Adjustment to Concrete Mixes. Design mix adjustments may be requested
4 by the Contractor when characteristics of materials, conditions, weather, test
5 results, or other circumstances warrant. Laboratory test data for revised
6 design mixes and strength results shall be submitted and approved before
7 using in the work. No change in contract price will be allowed for these
8 changes.

9 4. Addition of Water to the Batch. Addition of water to the batch delivered to
10 the site shall be in strict accordance with ASTM C94. This shall be the
11 Contractor's responsibility and by their direction, following consultation with
12 the Engineer.

13 a. Addition of water to the batch shall be one time only. Total gallons
14 of water added to the batch shall be recorded on the load ticket,
15 which shall be supplied to the Engineer prior to that delivery truck
16 leaving the site. If water is permitted to be added to mixed concrete
17 upon arrival at the job, an additional mixing of 30 revolutions of the
18 drum shall be required.

19 b. Contractor shall adjust the water-cement ratio of the batch to the
20 corresponding value based on the addition of water to the batch and
21 shall submit this information to the Engineer with adjusted strength
22 data for the final batch proportion.

23 c. At no time shall the addition of water cause the water-cement ratio
24 specified in the concrete class schedule to be exceeded.

25 3.03 GENERAL

26 A. Unless otherwise specified, conform to ACI 304, 305, and 306 for concrete
27 installation requirements such as preparation, mixing, conveying, depositing, curing,
28 and cold and hot weather requirements; consolidate concrete in accordance with ACI
29 309.

30 B. Concrete not placed within 90 minutes or 300 revolutions, whichever occurs first,
31 after the first mixing of the cement and aggregates will be rejected.

32 C. Contractor shall indicate on record set of Drawings at site, for review prior to
33 installation, a pouring program for concrete work showing unit of operation, method
34 of pouring, installation of construction/control joints, expansion joints and all
35 necessary work.

36 D. Proper grade marker or stakes shall be used by Contractor to establish grades for
37 ramps, platforms, sidewalks, slopes to drains, inlets, etc.

38 E. Trenches, forms, conveying equipment shall be prepared to receive concrete in
39 accordance with ACI 304.

- 1 F. Place concrete footings upon undistributed clean surfaces, free from frost, ice, mud
2 and water; when foundation is on dry soil or pervious material, lay waterproof
3 sheathing paper over earth surfaces to receive concrete.
- 4 G. Rock surfaces upon which concrete is to be placed, make level, clean, free from all
5 objectionable coatings, water, mud, debris, loose semi-detached or unsound
6 fragments; level surfaces to receive sand cushion placed to minimum thickness of
7 2 inches.
- 8 H. Immediately after placement, protect concrete from premature drying, excessively
9 hot or cold temperature and mechanical injury; maintain with minimum moisture loss
10 and relatively constant temperature for the period necessary for hydration of the
11 cement and hardening of the concrete.
- 12 I. All freshly cast concrete shall be protected from damaging effects of the elements
13 freezing, rapid drop in temperature and loss of moisture and from future construction
14 operations.

15 3.04 PREPARATION OF EQUIPMENT AND PLACE OF DEPOSIT

- 16 A. Before placement, clean equipment for mixing and transporting the concrete; remove
17 debris and ice from all surfaces upon which concrete is placed; clean reinforcement
18 of dirt, loose rust, and mill scale, or other coatings.
- 19 B. Remove water from all areas before depositing concrete; before depositing new
20 concrete on or against concrete that has set, thoroughly roughen; clean existing
21 surfaces of laitance, foreign matter or loose particles; retighten forms; slush existing
22 surfaces with neat cement grout coat; place new concrete before grout has attained
23 initial set; give horizontal construction joints grout brush coat of cement, fine
24 aggregate, in same proportions as concrete to be placed.
- 25 C. Thoroughly wet the stone base on which slabs are to be placed where no vapor
26 barrier is indicated.
- 27 D. Check compaction of fill and proper grade for slabs-on-grade. Check screeds and
28 exercise care to prevent disturbing screeds during placement. Provide for
29 construction joints in slabs-on-grade at 20 feet maximum in each direction unless
30 shown otherwise on the contract drawings. Place expansion joint material at
31 junctures of slabs-on-grade with vertical walls and as otherwise shown.
- 32 E. Remove debris, excess form oil, and water from formwork; avoid washing newly
33 deposited concrete.

34 3.05 MIXING

- 35 A. Ready-mixed concrete shall be mixed and delivered in accordance with ASTM C94
36 and ACI 304. The production facilities shall comply with the requirements of the

1 National Ready Mixed Concrete Association Certification Plan as regards materials
2 storage and handling, batching equipment, central mixer, truck mixers, agitators,
3 non-agitating units, ticketing system, etc.

4 B. Do not over-mix; do not use concrete which is retained in mixers so long as to
5 require additional water in excess of design mix water to permit satisfactory placing;
6 retempering of mix is not permitted.

7 C. Concrete shall be delivered to the site of the work and the mixed concrete discharged
8 completely within 1-1/2 hours after water has been added to cement. In hot weather,
9 or under conditions contributing to quick stiffening of concrete, this time may be
10 reduced by the Engineer.

11 D. Concrete delivered shall arrive at the site having a temperature not less than
12 50 Degrees F nor greater than 85 Degrees F, unless otherwise permitted by the
13 Engineer.

14 3.06 CONVEYING

15 A. Convey concrete from the mixer to the final deposit by methods that will prevent
16 segregation or loss of materials.

17 B. Use of aluminum conveyances is not permitted.

18 3.07 CONCRETE PLACEMENT

19 A. Place concrete, including drops greater than 60 inches using recommended practices
20 in accordance with ACI 304 and ACI 318. Once pouring operation commences, it
21 shall be carried out as a continuous operation until a section is completed.

22 B. Deposit concrete as nearly as practical in its final position to avoid segregation due to
23 rehandling or flowing; do not use vibrators to move concrete horizontally within the
24 forms.

25 C. Do not use retempered concrete or concrete contaminated by foreign material.

26 D. Plan and conduct concrete placement to insure that the concrete is kept plastic and
27 that the concrete is free of cold joints.

28 E. Where there is a time delay greater than 45-minutes between adjacent concrete
29 placement, a bulkhead construction joint, complete with waterstops where required,
30 must be installed.

31 F. Do not commence placing when the sun, heat, wind or limitations of facilities
32 provided prevent proper finishing or curing.

33 G. Discontinue concreting when the descending natural air temperature falls lower than
34 40 Degrees Fahrenheit unless preparations are made and in place to heat or insulate

concrete in accordance with the cold weather concreting requirements of this specification.

H. Concrete for walls shall be deposited in approximately horizontal layers not to exceed 18 inches in height to avoid segregation due to rehandling and flowing.

I. Concrete shall not be placed or poured in water. Water level shall be removed or lowered in a manner approved by Engineer. Excess water shall not be permitted. Powdering a mixture of cement to absorb excess water shall not be permitted.

J. Concrete shall be placed before initial set has occurred. Placing should be carried on in such manner that the concrete in the form is still plastic and can be integrated with fresh concrete.

K. Contractor shall notify Engineer of concrete pouring schedule one day in advance of pour to allow for inspection of reinforcing and forms.

L. Bottom dump buckets may be used for transporting mixed concrete to the desired location. Particular care shall be taken to avoid jarring or bumping as this may cause segregation.

M. Where chutes are used to transport concrete, they shall be of metal or wood with metal lining and should have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal so that the concrete will travel fast enough to keep the chute clean but slow enough to avoid segregation of materials. The end of each chute shall be provided with a baffle to help prevent segregation, or the concrete should be discharged through a tremie or elephant trunk directly into the form.

N. Elephant trunks and/or tremies shall be used in walls and columns to prevent free fall of the concrete and to allow the concrete to be placed through the cage of reinforcing steel.

O. Pumping equipment shall be of suitable type, without Y-sections, and with adequate pumping capacity. Loss of slump in pumping shall not exceed 1-1/2 inches.

3.08 CONSOLIDATION

A. Each concrete layer placed shall be compacted by mechanical internal vibrating equipment supplemented by hand spading, rodding, or tamping.

B. The period of concrete vibration shall not be less than two seconds nor more than five seconds at any one point.

C. Consolidate concrete thoroughly as it is placed in order to secure a dense mass; work concrete well around the reinforcement and embedded items and into the corners of the forms.

- D. Use internal vibrators inserted vertically over the entire area of the placement; form vibrators not permitted; internal vibrators shall maintain a minimum of 5000 impulses when submerged in concrete.
- E. Vibrate until voids are eliminated, coarse aggregate is suspended in mortar, and entrapped air bubbles begin to rise to the surface; concrete should move back into the space vacated by the vibrator; vibration duration shall be limited only to the time necessary to produce consolidation without causing segregation.
- F. Space vibrator insertions such that the area visibly affected by the vibrator overlaps the adjacent just-vibrated area by a few inches.
- G. Penetrate at least 6 inches into previously placed layers in order to bond between layers and avoid cold joints.
- H. Take care not to over-vibrate air entrained concrete; place vibrator to eliminate honeycombing but avoid excess vibrating that bleeds all entrapped air from the mix.
- I. Do not use vibrators to transport concrete.

3.09 JOINTS AND KEYWAYS

- A. Construct expansion, control, and isolation joints and keyways only where indicated on the drawings or at additional locations approved by the Engineer (and as shown on the Standard Details).
- B. Where the placing of concrete is discontinued, clean off laitance and other objectionable material to a sufficient depth to expose sound concrete as soon as concrete is firm enough to retain its form; smooth the top surface of concrete adjacent to the forms with a trowel to minimize visible joints on exposed faces.
- C. Immediately upon completion of the work of placing concrete, remove accumulations splashed upon the reinforcement and the surfaces of the forms; perform this removal before concrete takes its initial set; clean reinforcing steel carefully to prevent damage to the concrete steel bond.
- D. Do not halt work within 18 inches of the top of any face.
- E. For bonded horizontal joint construction, roughen the surface and expose the aggregate; clean the surface thoroughly by wet sandblasting, by cutting with high-pressure water jet or by other approved methods; perform cleaning after the concrete has hardened to prevent raveling of the surface below the desired depth.
- F. Before bonding concrete is placed, clean the surface of loose or soft particles or other objectionable materials and keep wet for a minimum period of 12 hours.
- G. Cover the cleaned and saturated surface with a coating of neat cement grout and deposit new concrete before the grout has attained its initial set.

3.10 CURING

- A. Concrete shall be wet cured by immersion of moisture-retaining covers in conformance with ACI 308 or shall receive curing compound in accordance with ACI 309.
- B. Water curing is the preferred method of protection for curing concrete other than under hot weather conditions; cover exposed surfaces with a saturated material (burlap or cotton mats) and keep wet continuously with a soil soaker hose for 7 curing days for all concrete except high early strength concrete; leave covering in place, without wetting, for an additional 3 days.
- C. A curing day is defined as 24-hour day when the concrete surfaces are kept moist and the uniform temperature of the concrete mass is between 55 Degrees Fahrenheit and 75 Degrees Fahrenheit.
- D. Curing shall start as soon as free surface water disappears after finishing. Where forms are not removed immediately, curing shall be accomplished in a manner acceptable to the Engineer.
- E. Curing compounds may not be used on surfaces that are to receive additional concrete, paint or tile.
- F. Curing and sealing compound shall not be applied to steel reinforcing anchors, water stops, construction joints, or surfaces to be bonded to other concrete.
- G. When using a curing compound, keep surfaces moist after the forms are removed, and the form tie holes repaired; after the surfaces are finished, apply the curing compound according to the manufacturer's recommendations; remove forms only as required to advance repair of tie holes and minor defects.
- H. Slabs: Immediately following slab finishing, apply liquid membrane-forming curing compound or begin water curing before the surface becomes dry.
- I. Vertical Surfaces: When the forms are removed entirely, spray the surface with water and allow it to reach a uniformly damp appearance with no free water on the surface; apply curing compound or begin water curing.
- J. For curing concrete under hot weather conditions, see Hot Weather Requirements in this section.
- K. For curing concrete under cold weather conditions, see Cold Weather Requirements in this section.

3.11 CONCRETE WALL FINISHES

- A. Complete screeding and darbying of top of walls before excess moisture or bleeding water is present on the surface.

- 1 B. Do not begin subsequent finishing operations until surface water has disappeared.
- 2 C. Refer to Concrete Schedule, included in this specification section, for finish type at
- 3 each location, defined as follows:
- 4 1. Rough Form Finish: (Type W1)
- 5 a. No form facing materials specified.
- 6 b. Patch tie holes and defects.
- 7 c. Chip off fins 1/4 inch or more in height.
- 8 2. Smooth Form Finish: (Type W2)
- 9 a. Use a form facing material that will produce a smooth, hard, uniform
- 10 texture on the concrete.
- 11 b. Keep seams to a practical minimum.
- 12 c. Patch tie holes and defects.
- 13 d. Remove all fins.
- 14 3. Smooth Rubbed Finish: (Type W3)
- 15 a. Produce a Smooth Form Finish.
- 16 b. Wet surface and rub with a Carborundum brick until uniform color
- 17 and texture are produced.
- 18 c. Perform rubbing no later than 24 hours after forms are removed.
- 19 d. Do not use any cement grout other than the paste drawn from the
- 20 concrete itself by rubbing.
- 21 e. Thoroughly wash the surface with water.
- 22 4. Smooth Troweled Finish: (Type W4)
- 23 a. Produce a Smooth Rubbed Finish.
- 24 b. After wet-rubbing, finish with a steel trowel to increase compaction
- 25 of fines and to provide maximum density.
- 26 5. Smooth Finish (Grout Cleaned): (Type W5)
- 27 a. Use for architectural surfaces exposed to general view, unless other
- 28 indicated.
- 29 b. Mix 1 part portland cement and 1-1/2 parts fine sand with sufficient
- 30 water to produce grout having consistency of thick paint; use white
- 31 portland cement in combination with normal portland cement to
- 32 achieve uniform surface color after drying.
- 33 c. Wet surface of concrete and uniformly apply grout with brush or
- 34 spray gun completely filling air bubbles; surface with a wood float
- 35 scouring wall vigorously.
- 36 d. Allow grout to partially set for one to two hours, depending on
- 37 weather conditions; in hot dry weather, keep damp, using fine fog
- 38 spray.
- 39 e. When grout has hardened sufficiently to be scraped from wall with
- 40 edge of steel trowel without removing grout from small air holes, cut
- 41 off all grout that can be removed with trowel.
- 42 f. Allow surface to dry thoroughly then rub vigorously with dry burlap
- 43 to completely remove dried grout; there shall be no visible film or
- 44 grout remaining after this rubbing.
- 45 g. The entire cleaning operation for any area must be completed the day
- 46 it is started; no grout shall be left on overnight, and sufficient time

shall be allowed for grout to dry after it has been cut with trowel so it can be wiped off clean with burlap.

- h. After entire surface has been grout cleaned, wipe off any slightly dark spots or streaks with fine abrasive hone.

3.12 CONCRETE SLAB FINISHING

A. Complete screeding and darbying slabs before excess moisture or bleeding water is present on the surface.

B. Do not begin subsequent finishing operations until surface water has disappeared and the concrete will sustain foot pressure with only approximately 1/4 inch indentation.

C. Refer to Concrete Schedule, included in this specification section, for finish type at each location, defined as follows:

1. Smooth Float Finish: (Type S1)

- a. Consolidate concrete with a power-driven disc-type float or a combination floating-troweling machine with metal float shoes attached.
- b. Machines which have a water attachment for wetting the concrete during the finishing operation are prohibited.
- c. Check and level surface plane to a tolerance not exceeding 1/4 inch in 10 feet when tested with a 10-foot straightedge. Cut down high spots and fill low spots; immediately after re-leveling, refloat surface to a uniform, smooth, granular texture.
- d. Where slab drainage is indicated, take care to maintain accurate slopes for drainage.

2. Steel Troweled Finish: (Type S2)

- a. Produce a Smooth Float Finish.
- b. After float finishing, steel trowel surface as specified in Concrete Schedule to increase the compaction of fines and to provide maximum density and wear resistance.
- c. Steel Troweled Finish: Screed and bull float or darby. Give preliminary float finish, true, even and free from depressions; float surface with hand or machine floats; compact surface with not less than 2 thorough and complete steel troweling operations.
- d. Tolerance on finished steel troweled floors in no instance shall exceed 1/8 inch in 10'-0" on surface; where floor drains occur, slope floors to drains.
- e. Buffing: After concrete floors have been properly cured, buff thoroughly to remove soluble salt incrustation or other foreign substances.

3. Integral Finishes: (Type S3)

- a. Use for slabs where some material other than concrete will be the final wearing surface.

1 3.17 CONCRETE FILL FOR COMPOSITE FLOOR DECK

- 2 A. Fill over composite floor deck shall be lightweight aggregate concrete; no admixtures
3 containing chloride salts or other deleterious materials shall be used; lightweight
4 concrete shall not exceed 100 pcf weight.

5 3.18 PERIMETER INSULATION

- 6 A. Install perimeter insulation at building foundation wall and under floor slab as shown
7 on the contract drawings.

8 3.19 HOT WEATHER REQUIREMENTS

- 9 A. Comply with ACI 305R unless otherwise specified herein below.

- 10 B. Hot weather conditions are deemed to exist when the temperature in the forms is
11 75 Degrees Fahrenheit or above, or a combination of high air temperature, low
12 relative humidity and wind velocity impair the quality of fresh or hardened concrete;
13 take protective measures for mixing, transporting and placing concrete in accordance
14 with ACI 305R.

- 15 C. The temperature of the concrete at the place of discharge may not exceed 85 Degrees
16 Fahrenheit.

- 17 1. If ice is used to lower temperature, place crushed, shaved or chipped ice
18 directly into the mixer as part or all of the mixing water; mix until ice is
19 completely melted.
20 2. Record the concrete temperature at the time of discharge.

- 21 D. Do not add water that will cause the proportions to exceed the maximum water-
22 cement ratio shown in Table I.

- 23 1. Notify the Engineer before adding any water to the concrete mix.
24 2. Record the amount of water added to the concrete at the jobsite.

- 25 E. Discharge concrete within 45 minutes or 100 revolutions, whichever occurs first,
26 after the first mixing of cement and aggregates.

- 27 F. Placing and Curing:

- 28 1. Place concrete promptly upon arrival.
29 2. Provide at least one standby vibrator for each 3 vibrators in use.
30 3. Protect concrete from direct sunlight; keep forms covered and moist by
31 means of water sprinkling or the application of continuously wetted burlap or
32 cotton mats for a minimum of 24 hours. Windbreaks and/or sunshades shall
33 be provided as directed by the Engineer.
34 4. When forms are removed, provide wet cover to the newly exposed surfaces
35 to avoid exposure to hot sun and wind.
36 5. Continue specified water curing methods for 10 days; leave covering in place
37 4 additional days; do not permit alternate wetting and drying cycles.

- 1 6. For slabs on grade, beam and deck concrete, and other horizontal placements
2 protect the surface between finishing operations using one or more of the
3 following methods:
4 a. Careful use of a fog nozzle.
5 b. Spreading and removing polyethylene sheeting between finishing
6 operations.
7 c. Application of mono-molecular film after the strike-off.
- 8 G. During extremes in weather, floor slabs shall not be cast unless the slab is protected
9 by a roof and other suitable protective measures are provided. After curing has been
10 completed, the floor shall be exposed to the air for 48 hours prior to allowing traffic
11 on the floors.

12 3.20 COLD WEATHER REQUIREMENTS

- 13 A. Comply with ACI 306.1 (R2002) unless otherwise specified herein below.
- 14 B. Cold weather is defined any time when the daily temperature is 40 Degrees
15 Fahrenheit or lower during placement and the protection period. If at any time
16 during the progress of the work, the temperature drops below 40 Degrees F., the
17 Contractor shall make suitable provisions to protect the concrete by use of insulation
18 materials such as blankets, mats, etc., and equipment for providing artificial heat.
- 19 C. Combustion type temporary heating devices shall be vented outside of any temporary
20 enclosure and building envelope. Combustion gases shall not be allowed in any
21 temporary enclosure and building envelope.
- 22 D. Protect concrete surfaces from freezing for at least 24 hours after placement.
- 23 E. All surfaces in contact with newly-placed concrete including formwork,
24 reinforcement and subgrade must be above 35 Degrees Fahrenheit.
- 25 F. Use preparation methods capable of producing concrete with a temperature not more
26 than 85 Degrees Fahrenheit, and not less than 55 Degrees Fahrenheit, at the time of
27 placement.
- 28 G. Do not heat concrete ingredients to a temperature higher than that necessary to keep
29 the temperature of the mixed concrete, as placed, within the specified temperatures.
30 (Do not heat water in excess of 140 Degrees Fahrenheit.)
- 31 H. Concrete shall have a temperature of not less than 55 Degrees Fahrenheit when
32 placed; mix concrete at a temperature between:
33 1. 60 Degrees Fahrenheit and 70 Degrees Fahrenheit when outside air
34 temperature is above 30 Degrees Fahrenheit.
35 2. 65 Degrees Fahrenheit and 75 Degrees Fahrenheit when outside air
36 temperature is between 0 Degrees Fahrenheit and 30 Degrees Fahrenheit.

3. 70 Degrees Fahrenheit and 80 Degrees Fahrenheit when outside air temperature is below 0 Degrees Fahrenheit.

I. Follow concrete placement with tarpaulins or other readily movable coverings, so only a few feet of concrete is exposed to the outside air at any time.

J. Maintain the temperature and moisture conditions specified in all parts of the newly placed concrete by covering, insulating, housing or heating; arrange for protection methods in advance of placement.

K. Maintain concrete at a temperature of not less than 55 Degrees Fahrenheit nor more than 70 Degrees Fahrenheit for a period of 3 days after placement.

L. A thermometer accurate to plus or minus 2 Degrees F shall be placed under the curing blanket. Additional insulation shall be supplied as required to maintain the temperature above 55 Degrees F.

M. After the curing period, the temperature of the exposed surface shall not be permitted to drop faster than 30 Degrees F in 24 hours.

N. Do not remove forms during the initial protection period.

O. Protect insulation against wetting that will impair its insulating value using moisture-proof cover material; keep insulation in close contact with concrete.

P. Construct enclosure to withstand wind and snow loads and be reasonably airtight; provide sufficient space between the concrete and enclosure to permit free circulation of heated air.

Q. Use vented heaters; do not permit heaters to heat or dry concrete locally. Unvented salamanders or other heaters which produce carbon dioxide as by-products shall not be permitted within enclosures or inside buildings. If heaters are used, precautions shall be taken to prevent drying of the slab through the use of water jackets or other suitable methods.

R. Maintain relative humidity above 40% within heated enclosures before construction supports are removed.

S. Monitor temperature to insure concrete is kept within specified limits recording time and concrete temperature every 8 hours.

T. Assure concrete has developed necessary strength before removing forms; provide additional test cylinders with the same protection as the structure they represent to verify concrete strength before construction supports are removed.

U. If water curing is used, terminate at least 12-hours before end of temperature protection period. Permit concrete to dry.

1 V. After the required protection period gradually reduce the concrete temperature within
2 an enclosure or insulation at a rate not to exceed 20 Degrees Fahrenheit per day until
3 the outside temperature has been reached.

4 W. Apply membrane forming curing compound to concrete surfaces during the first
5 period of above-freezing temperatures after forms are stripped and before air
6 temperature rises to 50 Degrees Fahrenheit; apply membrane forming curing
7 compound to slabs as soon as finishing operations are completed, except where live
8 steam curing is used.

9 3.21 DELIVERY TICKETS

10 A. With each load of concrete delivered to the job there shall be furnished by the
11 ready-mixed concrete producer duplicate delivery tickets, one for the Contractor and
12 one for the Engineer. Delivery tickets shall provide the following information:

- 13 1. Date and serial number of ticket;
- 14 2. Name of ready-mixed concrete plant;
- 15 3. Job location;
- 16 4. Contractor;
- 17 5. Type and brand name of cement;
- 18 6. Mix number or specified cement content in bags per cubic yard of concrete;
- 19 7. Truck number;
- 20 8. Time dispatched stamped by a time clock;
- 21 9. Amount of concrete in load in cubic yards;
- 22 10. Admixtures in concrete, if any;
- 23 11. Maximum size of aggregate;
- 24 12. Water added at job, if any;
- 25 13. Slump of concrete ordered
- 26

TABLE 1
CONCRETE CLASS SCHEDULE

Parameter Value	Compressive Strength (PSI) 28-Day	Water-Cement Ratio Maximum	Air Content Range (%) Minimum-Maximum	Slump Range (Inches) Minimum-Maximum	Coarse Aggregate (Inches) Maximum
Class A	4,000	0.5	1 to 2	2 to 4	3/4
Class B	4,000	0.5	1 to 2	2 to 4	1-1/2
Class C	4,000	0.5	5 to 7	2 to 4	3/4
Class D	4,000	0.5	4 to 6	2 to 4	1-1/2
Class E (Interior)	3,000	0.5	1 to 2	2 to 4	3/4
Class F (Exterior)	3,000	0.5	5 to 7	2 to 4	1-1/2
Class G	2,000	0.67	1 to 2	4 to 6	1-1/2
Class H	5,000	0.45	1 to 2	2 to 4	3/4
Class I	5,000	0.45	1 to 2	2 to 4	1-1/2
Class J	5,000	0.45	5 to 7	2 to 4	3/4
Class K (Exterior)	5,000	0.45	4 to 6	2 to 4	1-1/2
Class L	3,000 psi @24 hours	0.40	5 to 7 4 to 6	2 to 4 2 to 4	3/4 1-1/2

TABLE 2
CONCRETE SCHEDULE
USES AND PROPERTIES

Use	Finish	Class and Considerations
Structural (not including water-retaining structures)		
Foundations and footings, (non-exposed)	W1	Class A
	W1	Class B
Exposed foundations	S2 Top, W5 Sides	Class C
	S2 Top, W5 Sides	Class D
Buried walls and footing walls, (Interior)	W1	Class A
	W1	Class B
Buried walls and footing walls, (Exterior)	W1	Class C
	W1	Class D
Exposed walls	S2 Top, W5 Sides	Class C
	S2 Top, W5 Sides	Class D
Slabs and floors, (Exterior)	S2 or S4	Class C
	S2 or S4	Class D
Slabs and floors, (Interior)	S2 or S4	Class A
	S2 or S4	Class B
Beams, joists, bond beams, spandrels and lintels	W5	Class A
Topping for precast decking, (Interior)	S2 or S4, Top W5 Sides	Class E
Topping for precast decking, (Exterior)	S2 or S4, Top W5 Sides	Class F
Equipment pads and bases	S2 Top, W5 Sides	Class E (Interior)
	S2 Top, W5 Sides	Class F (Exterior)
Curbing, sidewalk, endwalls, staircases, driveways and ramps	S4 Top, W5 Sides	Class C
	S4 Top, W5 Sides	Class D
Manhole bases and benches	Special Construction	Class E
Pavement base, cradles and inlet walls	Special Construction	Class E
		Class F
Mass and fill	None	Class G
Traffic areas requiring early access or use	Special Construction	Class L
Water Retaining Structures		
Slabs and bases (Interior)	S2	Class H
	S2	Class I
Slabs and bases (Exterior)	S2	Class J
	S2	Class K
Buried walls, (Interior)	W1	Class H
	W1	Class I
Buried walls,	W1	Class J

(Exterior)	W1	Class K
Exposed walls	S2 Top, W5 Sides	Class J
	S2 Top, W5 Sides	Class K
Fillets	S2 Top, W5 Sides	Class E
	S2 Top, W5 Sides	Class F
Severe Exposure (Chemical Resistant)		
Slabs and bases	S2	Class H
(Interior)	S2	Class I
Slabs and bases	S2	Class J
(Exterior)	S2	Class K
Buried walls,	W1	Class H
(Interior)	W1	Class I
Buried walls,	W1	Class J
(Exterior)	W1	Class K
Exposed walls	S2 Top, W5 Sides	Class J
	S2 Top, W5 Sides	Class K
Fillets	S2 Top, W5 Sides	Class E
	S2 Top, W5 Sides	Class F

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Cast-in-place concrete shall be paid for at the bid price in accordance with one of the following methods, unless indicated otherwise in the Bid Schedule or Special Procedures - Division 01.

B. All work specified herein shall be considered in each of the measurement and payment method(s) stipulated, unless indicated otherwise in the Bid Schedule or Special Procedures - Division 01.

4.02 CAST-IN-PLACE CONCRETE

A. Cast-in-Place Concrete, Lump Sum. When so provided, payment for cast-in-place concrete shall be made at the contract lump sum price bid or as specified in Special Procedures - Division 01.

B. Cast-in-Place Concrete, Inclusive. When no quantity is provided, cast-in-place concrete shall be considered inclusive to payment for work associated with the related structure, utility, or improvement.

END OF SECTION

SECTION 33 81 15

FREE STANDING COMMUNICATION ANTENNA TOWER

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Application provisions of Division 1 shall govern the work of this section.

1.02 APPLICABLE PUBLICATIONS

- A. The following publication of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable.
 - 1.
- B. CODES STANDARDS AND SPECIFICATIONS
 - 1. The manufacturing, construction and installation of all the equipment associated with this tower shall follow all of the codes, standards, and specifications sited in the TIA Standard, local building codes, and this document.
 - a. In the event of a conflict between the TIA Standards, local Building Codes, or this document, the document with the most stringent requirement shall govern.
 - 2. Materials and construction of the tower foundations will conform to the concrete foundations installation and quality control specifications listed in the appropriate section of the standards listed in the American Concrete Institute (ACI) and the American Society *for* Testing and Materials (ASTM) documents.
- C.

1.03 DESCRIPTION OF WORK

- A. The work specified herein shall include the furnishing of all materials, equipment, labor, and supervision necessary to design, fabricate, deliver, install, and test a complete freestanding tower as identified on the contract drawings.
- B. The labor specified herein includes but is not limited to engineering, software, development, fabrication, equipment installation, testing, and documentation.
- C. The work specified herein includes coordination with the City and the Engineer. Additional costs due to inadequate coordination as required herein shall be borne solely by this contractor.
- D. The manufacturing, construction and installation of the tower and its associated equipment shall follow all of the codes, standards, and specifications sited in the

ANSI/TIA STANDARD-222-G-2(here after referred to as the TIA Standard).

- E. The work specified herein includes the design of a complete freestanding communication tower and foundation. The design must be performed by a Licensed Professional Engineer. The structure shall meet and comply with all guide lines and codes based on the loads and location.
- F. The new freestanding tower height is 130.98 feet. The top of new freestanding tower will be at elevation 749.48. The overall structure height shall not be higher than 752.48 feet in elevation.
- G. The work specified herein includes the fabrication, delivery, off loading, and storage of one freestanding communication tower to the proposed location shown in the contract documents.
- H. The work specified herein includes relocating existing antennas from the existing communications tower and installing on the new communications tower on new supports.
- I. The work specified herein includes on-site factory representation to assist owner and contractor in the erection and installation the structure. The tower provided shall provide written certification the tower is installed per the design requirements.

1.04 SCOPE

- A. This section of the specifications establishes the requirements for the fabrication and erection of a freestanding self-supporting communication tower for use in a regional Public Safety telecommunications system.
 - 1. The tower shall be designed as a Class III structure.
 - a. The primary use for this tower will be for essential Public Safety Communications.
- B. Two (2) full sets of drawings detailing the foundation design and assembly instructions for the tower must be supplied to the City's Project Manager before construction at the site begins.
- C. Contractor must provide the City of Duluth, MN a complete and orderly summary of the tower stress analysis showing loading considerations, tower and base reactions, member sizes, allowable stresses and maximum computed forces in members.
 - 1. The analysis is to be certified by a registered professional engineer licensed in the State of Minnesota with experience in tower design.
- D. Contractor shall provide a dedicated, full-time field supervisor.
 - 1. This contractor-employee will be assigned and available through all phases of construction.
 - 2. Responsibilities will include, but not be limited to:

- a. All building permits required for the project.
 - b. Verification of the tower location.
 - c. Finished grade and construction of foundations.
 - d. Delivery and erection of tower.
 - e. Joint inspection of construction.
- E. Analysis and Design
 - 1. All design and analysis computations and installation drawings of the tower and foundation shall be certified and stamped by a registered professional engineer licensed in the State of Minnesota with experience in tower design.
- F. The GENERAL, SUPPLEMENTAL and other CONDITIONS of the Contract and the GENERAL REQUIREMENTS (Division 1) are hereby made part of this Section.
- G. This Section includes all labor, materials, equipment and related services to furnish and install antennas and towers for telemetry.
 - 1. Locations and height as shown on the Drawings.
 - 2. Evaluation of existing conditions and installation locations.
 - 3. New equipment and accessories including towers, foundations, cable attachments and accessories.
 - 4. Installation.
- H. SOIL CONDITIONS (PROVIDED BY OWNER)
 - 1. Soil conditions shall not be assumed.
 - a. A Geotechnical Engineering Report of the tower site is included in Attachment A.

1.05 SUBMITTALS

- A. Submit shop drawings in accordance with Division 01.
- B. Submit complete design with all design calculation for Tower and Foundation . MFR shall release information and grant owner and agents or the owner to use information in the bidding and construction of the site and foundation.
- C. Submit copies of all shop drawings to the Engineer to include the following:
 - 1. Dimensions.
 - 2. Descriptive data.
 - 3. Foundation designs stamped by a professional engineer for the State of Minnesota.
 - 4. Installation instructions.
- D. Upon completion of the job, as built drawings and a complete operation and maintenance manual (3 copies) shall be furnished to the Engineer for transmittal to the Owner.

1.06 OPERATION & MAINTENANCE MANUALS AND INSTRUCTIONS

- A. The manuals shall include operating and maintenance literature for all components provided, including cut sheets, performance data, diagrams, and maintenance schedules. The submitted literature shall be in sufficient detail to

allow for the installation, operation, adjustment, calibration, maintenance and removal of each component provided.

- B. Preparation of this document shall be in conformance with the requirements stated in Submittals Division 01 of these specifications. The Contractor shall submit to the Engineer for review, an outline of any variations of information for the operation and maintenance manuals and other documentation he proposes to prepare.

1.07 QUALITY ASSURANCE

- A. All materials, equipment, and parts shall be new and unused of current manufacture.

1.08 WARRANTY

- A. The manufacturer shall warranty the tower being supplied to the owner against defects in workmanship and materials for a period of five (5) years.

1.09 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver equipment in manufacturer's original, unopened cartons.
- B. Cover and store equipment to prevent damage.
- C. Handle so as to prevent damage during installation

PART 2 PRODUCTS

2.01 MANUFACTURE

- A. Acceptable manufactures include
 1. EEI Tower, Ehreshmann Engineering as represented by Larson Data Communications
 2. Glenn Martin Towers
 3. Titan Towers
 4. Sabre Towers and Poles
 5. Or pre-approved equal.

2.02 DESIGN:

- A. The tower manufacturer shall provide tower structural and foundation designs, certified by a Professional Engineer licensed in the state of the final installation.
 1. Design shall be in accordance with ANSI/TIA-222-G (county and state), with design loads for the location of tower installation.
 2. Provide certified design. Design shall include documentation showing tower face widths, member sizes, tower steel weights and base reactions.
 3. Design shall include foundations based on the site specific geotechnical report, as attached (if not attached, then a presumptive soils foundation

design should be used for bidding purposes).

B. Design Parameters:

1. 90 MPH wind with no ice.
2. 50 MPH wind with $\frac{3}{4}$ inch radial ice on all exposed tower and antenna surfaces.
3. Structure use Class III, essential communication services.
4. Wind Exposure C, open spaces.
5. Topographic Category 1, flat or rolling.

C. Tower Design.

1. Hot dipped galvanized steel construction, 3 legged triangular tower.
2. *Minimum 3 foot face width at top of tower.*
3. *Maximum 40 feet of straight section at top of tower.*
4. Provide step bolts up one tower leg, and on all legs of 2-bay sections, for erection purposes.
5. Provide a cable type safety climb system on the climbing leg to the full height of the tower. Ninety (90) degree cable guide brackets shall be installed at a spacing of no more than twenty five (25) feet. Attachment of the cable guide bracket slots shall be alternated, slot openings left and right, so as to prevent the cable from being easily freed from the cable guides by wind and weather.
6. Feed lines shall be up one face of the tower with no stacking.

D. Accessories:

1. *Nine (9) hole wave guide ladder, to the full tower height, up one face. The waveguide/cable ladder shall have snap in and bolt in capacity with waveguide/cable ladder rail spacing at no more than three (3) feet.*
2. A halo ground ring shall be provided around the perimeter of the foundation and attached to each tower leg. Details of the halo ground shall include a minimum of two (2) ground rods, each a minimum of 10 feet, and EIA grounding kit with 2/0 lead and attachment to leg for each of three (3) legs.
3. Provide steel leg to leg templates for tower legs for foundation construction. Provide tower leg bolts and required anchors.
4. One (1) waveguide/cable bridge kit including two (2) direct bury posts and three (3) trapeze hangars. The waveguide/cable bridge shall be twenty-four (24) inches wide minimum.

2.03 ANTENNAS:

E. TOWER DESIGN CRITERIA

1. Refer to Drawing S-2 Tower Requirements for tower antenna loading and placement.
2. The supports shall be 4' minimum truss support arms, or equal. The support shall be designed to connect to the tower and support the project identified antenna and the loads for Duluth, MN.

PART 3 EXECUTION

PART 4 PAYMENT

2.04 FREE STANDING COMMUNICATION ANTENNA TOWER

- A. Progress payments for the contract shall be made on the following schedule:
 1. 40% upon completion of the tower foundation.
 2. 30% upon completion of the tower erection.
 3. 20% upon installation of the antennas and accessories
 4. 10% upon final acceptance of all work and punch list completion.

END OF SECTION