                                                                      Aeronautics H-40

                                                      HANGAR SPECIFICATIONS

Section 1.00 - General

            1.10     These specifications are prepared to establish the minimum dimensions, material, design and erection criteria of hangars for approval by the Nebraska DOT / Division of Aeronautics and for eligibility for funds under Aeronautics' Revolving Hangar Program.  The exact door sizes or dimensions shall be as called for herein, unless specified otherwise in the Notice to Bidders, the Proposal Form or on the plans.  The exact number, size and location of the hangar or hangars shall be as noted in the Proposal Form and shall be in accordance with the approved Airport Layout Plan for the airport.

                        1.11     All hangars which are to be erected under the Revolving Hangar Program shall be erected upon airports owned by a Municipality\* or by the State; however, these specifications may be used as guides for the construction of hangars on any airport provided all local codes and laws are complied with.

                        1.12     The various types of hangars covered by these specifications shall be designated as shown on Figure No.1, page 11 of these specifications as Standard T-Hangars (STH), Nested T-Hangars (NTH) or Shop - Storage Hangars (SH).

                        1.13     The Municipality, or the owner of the airport, shall designate the area where the hangar is to be built, in accordance with the approved Airport Layout Plan, and establish or designate the finished floor elevations.  The building supplier shall include in his design computations and plans, for the proposed construction, the size and shape of the necessary foundation and footings to support the building, according to the minimum standards included herein; however, the local codes or the requirements of the specific building, depending upon local soil conditions, whichever is the most critical, shall not be exceeded.  **A maximum soil bearing of 2,000 pounds per square foot shall be used for building design purposes.**

                        1.14     The corner end spaces of the completed hangar(s) which are not required for airplane storage, will not be required to be furnished or finished, unless called for in the Proposal Form.  The furnishing of hangar(s) with this space enclosed would not be cause for rejection of the complete hangar(s); provided, that in no case shall the furnishing of the walls for this space be an additional cost to the complete hangar(s) computed on the basis that this end-corner space is not to be furnished for enclosure.  The interior "L" shaped partition for this end-corner of the complete hangar(s) would not be required; however, the additional interior partition amy be requested.

                        1.15     The hangar(s) shall be designed and fabricated as a permanent structure, but **shall be capable of being dismantled, moved and re-erected with no loss of material except possibly a few bolts, screws, clips, or minor hardware parts which may be embedded in concrete.  It shall be designed to allow a future extension of additional units of similar design at either end without modification or change of the basic structural design and bracing of the units of the original building.**  All necessary base plates, anchor bolts, door tracks and guides, and connecting hardware to be installed in or attached to any concrete foundation or footings shall be furnished by the bidder as soon as possible after the award of a contract, to permit incorporation of same into the foundations and footings for receiving the remaining building units or parts.  The Municipality may, if noted in the Notice to Contractors or indicated as an option in the Proposal Form, have the foundation and footing work accomplished by others.

SECTION 2.00 - MATERIAL AND DESIGN

            2.10 GENERAL

                        2.11     The basic size of each T unit for the Standard T-hangar shall be sufficient to provide an **opening with a minimum clear horizontal width of 39'6"** through the door and for wing span, and a **minimum clear vertical height of 11'0"**above the finished floor elevation with the door in the open position.  The depth of each unit bay shall be sufficient to provide a **minimum of 29'7" inside clear dimension** from the rear wall of each bay unit to the inside of the closed hangar door.  Each "T" shaped unit stall shall be partitioned so as to form individual units with a **minimum clear dimension of 18'6" between walls or columns**(center bay clearance through which the aircraft tail section must pass).  In each unit the minimum clear with 39'6" shall extend from the hangar doors back to the center of each bay unit and the **minimum clear width of 18'6"** shall extend from the center o each bay unit to the rear wall of the unit.  Each unit shall have the clear vertical height above the finished floor for the door height being furnished for the full depth of the unit.  The door openings shall center on the center of the tail section bay on each unit.

                        2.12     The basic size of each T unit for the Nested T-Hangar (NTH) shall be the same as for the Standard T-Hangar(STH).

                        2.13     The **minimum size of a shop or storage hangar (SH) shall be a 40' x 60' building with at least one large hangar door with a clear horizontal opening of 39'6" and a clear vertical height of 12'0"**, and one walk-in door for pedestrian access to the building.

            2.20 STRUCTURAL DESIGN

                        2.21     All materials supplied for any building to be erected under these specification shall be as a minimum, the requirements noted below; however, in no case shall the limits of any material be exceeded, nor shall the local codes, ordinance or statutes which may be more restrictive, be exceeded.

                                    ALL DESIGN CALCULATIONS FOR ANY STRUCTURAL MEMBER OR MEMBERS OF ANY HANGAR SHALL BE SUBMITTED WITH THE BIDDER'S PROPOSAL, AND SHALL BE CLEARLY SET FORTH IN ORDER THAT THEY MAY BE READILY CHECKED.

                        2.22     All structural steel, milled and built-up sections shall be designed in accordance with "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings", by the American Institute of Steel Construction.  All formed light gauge steel members shall be designed in accordance with "Specification for the Design of Light Gauge Steel Structural Members" by the American Iron and Steel Institute.  All structural steel shall be of standard, new billet carbon steel shapes.

                        2.23     The complete building shall be designed for a **minimum roof live load of 20 lbs per square foot** on the horizontal projection in addition to the dead load.  The **design wind load shall be a minimum of 15 lbs. per square foot on the vertical projection of the hangar**.  The wind load, live load and dead load shall be computed in such a manner that all members will withstand the probable maximum stresses in all elements of the structure with the hangar doors in either the open or closed positions.  The roof system shall be designed to meet each of the following conditions, when separately applied: (1) Live load plus dead load; (2) half of the live load on one-half of the roof with the wind load acting upward and normal to the roof sheets on the cantilevered half, thus producing a reversal of stresses in the truss members; (3) wind load on end walls; and (4) wind load on side walls and roof.

                        2.24     The structure may be designed using inclined chord umbrella type shop fabricated trusses cantilevering over and supporting the large hangar doors through the "T" unit section of the Standard Hangar (STH).  The structure shall be supported in such a manner to provide the necessary clear opening space and provide sufficient support that deflection will be held to an absolute minimum.  Structures utilizing trusses spanning the full hangar door width shall have absolute minimum deflection.

                        2.25     Adequate wind bracing shall be provided in the walls and roof of the structure to safely withstand the design loads and to provide proper rigidity.  Such bracing may be utilized for attachment of the wall and roof covering provided that members are designed to carry the combination of stresses incurred.  In the event any member is built up to a composite section, adequate lacing shall be designed so that the combination of stresses will not exceed the maximum allowable stresses nor result in excessive deflection and will be in with the design specifications.

                        2.26     Structural steel shall conform to the "Standard Specifications for Structural Steel for Bridges and Buildings, Serial Designation A 7" of the American Society of Testing Materials, as amended to date.

            2.30  WALL COVERING

                        2.31     Exterior covering for the walls and the gable ends of the building frame shall be a **minimum of 26 gauge** steel ribbed channels or corrugated metal.  Sheets shall be sufficient length to eliminate end lapping or field cutting on the end wall section to eave height and shall be placed on the building with the ribbed channels or corrugations running vertically.  Gable ends shall be furnished with sheets requiring no end lapping except at the eave height lap.  End laps for gable end sheets over the wall sheets shall provide a minimum lap of four (4) inches.  Wall sections and gable end sheets shall be furnished and installed with sufficient approved type fasteners to provide a rigid connection, each fastener being equipped with a lead seal or neoprene washer to provide a weather tight seal.  As a minimum, wall sheets shall be fastened to the building framework at each end of the sheet and at intermediate girts with fasteners at a minimum of eight (8) inches on centers.  One sheet-metal screw or equal with lead or neoprene washer shall be installed on all sides laps between girts at a maximum spacing of 24 inches on centers.  Gable ends shall be installed with sufficient fasteners to firmly secure the sheets to all end roof truss members on eight (8) centers.

                        2.32     In lieu of wall and partition bracing and covering as called for in Section 2.25, the bidder may furnish approved galvanized interlocking self-supporting panels and sufficient hardware for erection; provided, that these section provide sufficient strength in accordance with the design requirement of the building.

                        2.33     No windows or doors, except the large hangar doors, are to be furnished, unless specified in the Proposal For, except for the shop or storage hangar which shall have a walk-in door.

                        2.34     The bottom framing member to which all wall sheets (or partition sheets) are fastened shall be of sufficient strength and rigidity to support its portion of the sheet and provide adequate wind and load bracing between the wall column supports (10' to 20' span as the case may be) without requiring a continuous foundation and footing, in order that the building column supports may be erected on concrete piers only.  These bottom framing members shall be readily adaptable to either types of foundation support and shall be designed to mount securely to the piers, columns or column supports and to carry all loads imposed with minimum deflection.  In case a continuous foundation or floor is placed under the wall sections, this bottom framing member shall be a steel section, capable of being fastened to the concrete and to the bottoms of the sheets as well as to the column supports.

            2.40  ROOF COVERING

                        2.41     The roof pitch for a gable type roof shall normally be a **minimum of four inches per foot**.  A lesser pitch, **from four inches per foot to one inch per foot, will be allowable if each transverse foot sheet is a continuous sheet,** extending from the foot gable to the outside eave of the roof.  A flat roof, (pitch of less that =one inch per foot) will be allowed of each transverse roof sheet is one continuous sheet for the entire width of the roof, or the end lapping of sheets will at least six inches and occur over purlins or supports and are secured and sealed with a continuous bead of caulking compound at least one-half inch wide.

                        2.42     The roof covering shall be a **minimum of 26 gauge steel** ribbed channels or corrugated metal.  Where a roof pitch of four (4) inches per foot or more is used, sheets shall be of sufficient length so that an end lap shall occur only over the purlins or supports and with a minimum end lap of six (6) inches.  Roof sheets shall be placed on the building with ribbed channels or corrugation running parallel to the slope of the roof.  Approved lead seal or neoprene washer fasteners or equal shall be installed to adequately secure the sheets to the roof purlins on eight (8) inch centers.  One sheet-metal screw or equal with lead or neoprene washer shall be installed to secure all side laps between purlins at a maximum spacing of twenty-four (24) inches.

                        2.43     The roof ridge shall be installed with an approved galvanized metal roof ridge roll, designed to lap and match the ribbed channel or corrugations of the roof sheets by sufficient width to provide a weather tight lap.  Approved filler strips shall be furnished to seal the ridge or approved formed ribbed channel or corrugated sheets may be furnished to seal the ridge.  Approved weather tight fasteners shall be provided on eight (8) inch centers on both sides.

                        2.44     Adequate flashing shall be installed to make all joints and intersections weather tight and provide a neat and uniform covering.  All flashing shall be a minimum of 24 gauge galvanized sheeting and shall be fabricated and installed to assure a weather tight building.

            2.50     PARTITIONS

                        2.51     Partition covering shall be a **minimum of 28 gauge** ribbed channels or corrugated steel to be installed in the same manner as the wall and end sections.  Material furnished and installed to cover trusses may be galvanized flat steel sheets to cover the truss completely from the f=roof sheets to the wall height sheets with sufficient side and bottom end lap/.  Adequate bracing members and fasteners shall be installed to secure the metal sheets at both ends and at all intermediate girts through the wall height sections.   Fasteners used in partitioning need not be weather tight.  Partitions shall be installed to completely separate each of the regular and nested "T" storage units from floor level to roof covering and shall be bird proof.  Cutting around the top of the sheets to fit the roof purlins or flush type roof bracing will be permitted.

            2.60     DOORS

                        2.61     Large Hangar Doors.  Hangar doors shall be of metal construction in accordance with the manufacturing standard and shall be bottom supported or overhead suspension type, either overhead canopy (solid or bi-fold), or overhead suspended sliding-folding configuration.  Doors shall be equipped with sturdy fastening devices top and bottom as required to secure them against wind either in the closed or open position.  Required door guides, buffer plates, rubrail, approved hardware and/or tracks to provide maximum smooth uncomplicated operation shall be installed.  The doors must be capable of being easily operated by one person.  Doors must provide full opening for the complete hangar door clearance called for in Section 2.10, or called for in the Proposal Form.  Doors shall be equipped with padlock plates and hasps.

                        2.62     The type of hangar doors to be installed shall be clearly shown on the drawings submitted with the bidder's proposal.  These drawings shall indicate the door's weight and method of suspension, operation and all fastenings.

                        2.63     Any guide proposed to be used for bottom guides on sliding or bottom supported doors shall be designed to minimize the collection of water, ice, snow and debris, and shall provide a definite means of permitting drainage.  A continuous sub-surface channel will not be approved.

                        2.64     Doors shall be design ed for minimum weight and maximum strength and shall be capable of withstanding the design wind load of the building in open or closed position.  For the sliding or sliding-folding door a series of rectangular shaped (tubular) framings of at least 14 gauge metal with 24 gauge panels, or approved equivalent, is required.  This design is to be shop welded construction with sufficient interlocking rails welded to the individual frame and panels to provide rigidity and strength.  On the sliding-folding type door, a continuous multiple fold (accordion pleat fold) will not be approved.

                        2.65     Walk=in and Access doors.  The walk-in or access door to an end corner unit or shop hangar unit shall be of nominal clear width of 32 inches and a nominal clear height of 6 feet 8 inches and of the hollow-metal, panel type, 1 3/4 inches thick "flush", fabricated from 20 gauge galvanized steel sheets, with full honeycomb core and edges mechanically locked and welded.  The door frame shall be 16 gauge galvanized steel channels, into which the wall girts will be framed and the frame shall be attached to the concrete slab or foundation with at least two anchor bolts at each jamb.  Hinge jambs shall be reinforced, and jambs and headers shall be flashed for water tightness.  Door hinges shall be galvanized template built type with removable pins, shall be interlocking and each door shall e hung on three hinges.  The threshold shall be interlocking aluminum type anchored to the concrete floor or foundation with counter sunk screws, and shall be designed to counterflash the door.

                                    A door installed in a large hangar door of the bi-fold, overhead or canopy type shall be referred to as a service door.  All bi-fold, overhead or canopy type doors, which must be operated or opened from within the hangar, either by hand or electrically, shall have a service door installed in the large hangar door.  The **service door shall have a nominal clear width of 32 inches and a nominal clear height of 6 feet 8 inches**and shall be factory installed.  All such service doors shall be installed in the same general area in each large hangar door, and the large hangar door opening mechanism shall be located in the same immediate area.

                                    All walk-in, access and service doors shall be completely weather tight, and furnished with a heavy duty cylindrical lock with three (3) for each lock.  Three (3) master keys which will operate all locks on all doors installed shall be furnished.

            2.70     PAINTING

                        2.71     ALL EXTERIOR AND INTERIOR FERROUS METALS, EXCEPT BOLTS, ROUGH HARDWARE AND METALS WITH NON-FERROUS COATINGS, SHALL BE COVERED WITH A SHOP COAT OF RUST INHIBITIVE PAINT, INCLUDING ANY FIELD CUTS OR WELDS.

            2.80     Concrete

                        2.81     Concrete used for the foundations footing, floors and hangar ramps shall be constructed of portland cement concrete consisting as a minimum of the following proportions:

**Sand-Gravel   480-510 lbs per sack of cement (94#)**

**Cement               6 sacks per CY of Concrete**

**Water                          55 lbs max. per sack of cement**

                                    The cement-aggregate ration may not be decreased from that shown above and the water-cement ratio may not be exceeded.  Should a sand-gravel-limestone aggregates mix wish to be used, the limestone shall not exceed thirty (30) percent of the total aggregate used.

SECTION 3.00 - EXCAVATION AND GRADING

            3.10 GENERAL GRADING

                        3.11     This item shall include the necessary grading of the site for the proposed hangar or hangars, and shall include as necessary the stripping of all sod, grass, debris, or unsuitable material in the area, and the fill required, if any, to raise the elevation of the area to that required as a minimum on which to place the hangar floor and ramps.

                                    The fill material shall not contain large rock, logs, brush, grass , roots or other unsuitable material.  The contractor shall accomplish the work with equipment approved by the Municipality and to the lines and grades as staked for the finished hangar floor elevations.  The contractor shall keep the area around the hangar graded or shaped so that the area will generally drain during the period of construction.  Unless specifically called for in the Proposal Form, the necessary general grading will not be paid for directly, but shall be considered as incidental to the furnishing and erecting of the hangar building.

            3.20 EXCAVATION

                        3.21     The necessary excavation of any material for the construction of the necessary foundations, footings floors or hangar ramps shall be in the minimum widths and depths as noted in Section 4.00, or as called for on the approved plans.  All costs in connection with the necessary excavation shall not be paid for directly, but shall be considered as incidental.

            3.30 FINISHED GRADING

                        3.31     After the hangar building has been erected and completed , all areas adjacent to the building and for a distance of at least thirty (30) feet from the edge of the building or to the surfaced taxiway, if existing, and all areas disturbed during construction shall be graded to provide drainage away from the building.  This will include hauling in all material for compacting the backfill around the foundation walls, the grading and shaping of all slopes an d drainage area, and the disposal of all surplus materials to the satisfaction of the Municipality.

SECTION 4.00 - FOUNDATIONS, FOOTINGS, FLOORS AND HANGAR RAMPS

            4.10 GENERAL

                        4.11     The concrete to be used in the construction of foundations, footings, floors or hangar ramps for the proposed building shall as a minimum meet the requirements of Section 2.81 of this specification.  If the building supplier indicates on the approved plans for the building that concrete of a mixture that will produce a specified compressive strength or a greater cement - aggregate ratio is to be used, the more stringent requirements shall be met.

                        4.12     Foundations and Footings.  The necessary foundation, footings, column supports, bearing walls or other substructure building items shall be of the size and shape, and at the location shown on the building suppliers plans for the building furnished.  In no case will **foundation walls be less than eight (8) inches in thickness nor less than thirty (30) inches below finished ground line.**  An additional width of foundation wall on the exterior side thereof through the full width of the guides, buffer plates, rub rails or other necessary door hardware.  The **individual piers or column supports shall be a minimum depth of 36 inches below the finish floor grade.**  All individual piers or column supports shall be to the same top elevation as the outer foundation walls, unless noted otherwise on the plans.

                        4.13     The size and location of any required reinforcement in the foundations, footings or slabs shall be as stated on the plans furnished by the hangar building supplier.  All necessary base plates anchor bolts and foundation ties shall be provided by the hangar building supplier along with a foundation and footing plan to assure proper installation of same.

                        4.14     The natural soil may be used as forms for the placing of concrete, provided care is used during excavation to maintain the sides or walls of the cut in a vertical direction and the minimum width of the foundation or footing is maintained.  The portion of the foundation from two inches below finished ground line to the top of the foundation walls must be formed with either metal or wood forms to maintain the required elevation, and alignment and shape.

                        4.15     The foundation walls, footings and piers must be properly covered and cured for a minimum of three (3) days prior to the erecting of or placing of any steel hangar members thereon.

            4.20 FLOORS

                        4.21     The hangar floor, either full or partial, shall be constructed of the same concrete design proportions used for the footings and foundation walls as a minimum.  The floors shall consist of, as a minimum, **a four inch concrete slab reinforced with 6-6, 10-10 welded wore mesh, or a five inch unreinforced concrete slab, either one on a four inch sand subbase placed on a well tamped subgrade.**

                        4.22     **At all places where the concrete floor adjoins the foundation walls or an individual pier or column support, a piece of premolded expansion joint material at least one-half inch in thickness shall be placed for the full depth of the concrete slab.**

                        4.23     The placing of a partial floor shall as a minimum, extend from the large hangar door to the center of the unit and for a width to match the full tail section width of the unit.

                        4.24     The joints cut in the floor slabs, either partial or full floors, shall be spaced at one-fourth the full hangar bay depth and one-fourth the full hangar bay door width.

                                    The sizes of the concrete floors to be furnished, as specified i the Proposal Form are:

                                                (a) Full hangar floor, or

                                                (b) Partial hangar floors (central part).

                        4.25     The floor, either partial or full, must be cured for a period of seven (7) days prior to being used to support any power operated equipment or vehicles.

            4.30     HANGAR RAMPS

                        4.31     Hangar ramps may be constructed to serve the individual T-hangar units.  If hangar ramps are constructed, the material for construction of the ramps shall comply with the requirements of Section 2.81, and shall be a **five (5) inch reinforced portland cement concrete slab with 6-6, 10-10 welded wire mash, or a six (6) inch unreinforced concrete slab, or may be constructed of asphaltic concrete, a minimum of six (6) inches in thickness, the surface of which is treated with a coal tar emulsion.**  Both pavements shall be placed on a subgrade compacted for a depth of six (6) inches to a density of at least 90 percent of the maximum density at a moisture content between 75 to 110 percent of the optimum moisture as determined be aasho Method T-99.  Hangar ramps may also be constructed of asphaltic concrete of lesser thickness, should the proposed hangar be place on an existing paved apron or slab, so that a smooth transition to the apron and adequate drainage is provided.

                        4.32     If the paving of hangar ramps are approved to be included in a contract for a hangar, along with the Aeronautics' Revolving Hangar Program, the State participation will be limited to a **ramp 15 feet wide by 27.0 feet long, 45 square yards of pavement.**  More ramp pavement may be constructed; however, State participation will be limited to a maximum of 45 square yards of ramp pavement.  A specification for ramp construction must be included in the Proposal Form to establish a unit price for ramp pavement.

SECTION 5.00 - DESIGN DRAWINGS AND PLANS FOR ERECTION OF BUILDING

            5.10 GENERAL

                        5.11     The bidder submitting a proposal for furnishing and erecting a hangar building shall furnish and erect the building with his own forces, or forces under his direct control.

                        5.12     Each bidder shall submit with his proposal form for a hangar, two (2) complete sets of the hangar drawings showing as a minimum, material sizes, type of bracing dimensions, fastening devices, wa well as details of walls, partitions, doors, flashings, columns, foundations, footings and construction to provide a complete weather proof and bird proof hangar as specified herein.

                        5.13     Each bidder shall also submit with his proposal for a hangar, a copy of the design computation showing the design of all structural members of the building.  The design computations shall be set forth in such a manner that they may be easily checked.

                        5.14     The Municipality may elect to contract for the necessary concrete work for the footings, foundations, floor, partial floors and/ or hangar ramps subsequent to receiving bids for the proposed hangar, if so noted in the Proposal Form.  The bidder may be requested t furnish the necessary steel, anchor bolt or ties to be imbedded in the concrete foundations for footings and plans for their exact locations prior to the delivery of the building to the site.

SECTION 6.00 - PROPOSALS, ACCEPTANCE OF BIDS AND PAYMENTS

            6.10 GENERAL

                        6.11     Sealed bids for furnishing all items as noted in the Proposals Form. and as required in these specifications, will be accepted for consideration by the Municipality at the time and place designated in the Notice to Contractors.

                        6.12     The Municipality reserves the right to waive any or all technicalities , to reject any or all bids, and to make an award to its best interest.

                        6.13     Hangar bids will be judged on their individual merits as outlined and defined in the accompanying hangar plans.

            6.20 ACCEPTANCE

                        6.21     All items specified to be furnished in the Proposal Form and in accordance with these specifications under their respective sections shall be considered as a complete building, furnished and/or erected, and shall be bid for the complete unit price for each item as a complete unit.

                        6.22     If a contract is awarded for "Supplying and Erecting" a hangar, periodic monthly estimates for payment may be processed, with the amounts computed on the basis of the percentage of the building furnished and work accomplished to date.

                        6.23     If the Proposal Form provides an item for foundation, footings and floors, and a contract is awarded, periodic estimates for payment will be processed, computed on the percentage of the work accomplished to date.

                        6.24     The Municipality will make periodic inspections of the building site, materials used and progress made by the contractor, to see that the intent of the contract and the construction of the proposed building are being accomplished to its satisfaction.  Periodic estimates and payments may be reviewed and approved on the basis o such inspections.

                        6.25     The final acceptance of a completed building or the completion of the construction contract is the responsibility of the Municipality.  All estimates, including the final estimate and payment to the contractor, will be made by the Municipality.  The Nebraska DOT / Division of Aeronautics is to a party to any contract.  Under an agreement with the Municipality, Aeronautics will advance State funds to assist the Municipality to accomplish the construction of a hangar; however, the funds advanced must be repaid to Aeronautics over a specified period of time, and the availability of such funds should not be considered by any bidder or contractor as a condition of his proposal.