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CANADIAN STANDARDS AND RECOMMENDED PRACTICES

AIRPORT ENGINEERING

ASG-20

PAVEMENT CONSTRUCTION: METHODS AND INSPECTION

Public Works and Government Services Canada
Real Property Services Branch
Architectural and Engineering Services
Engineering Division, Airport Engineering

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1.0 MANAGERIAL SUMMARY

1.1 SCOPE

This manual presents the current Public Works and Government Services Canada (PWGSC) standards and guidelines related to pavements at Canadian airports including; the workmanship to be achieved on construction, the major technical duties and responsibilities related to the inspection of these projects, and the methods to be followed in fulfilling these responsibilities.

1.2 OBJECTIVES

This manual is designed as a reference for designers and specification writers involved with the design and construction of pavement structures at Canadian airports, and for the guidance of field supervisory and inspection personnel responsible for the quality control and quality assurance of pavement construction projects.

1.3 EMPHASIS

Because of the unique operational environment under which airport pavements are constructed and required to perform, PWGSC requirements for construction materials, workmanship and construction quality control differ from those of most other agencies.

This manual is intended as a guide to ensure that these differences in requirements are recognized and implemented. Failure to follow these standards and guidelines without due consideration of the engineering implications could seriously reduce the life cycle cost-effectiveness of pavement facilities.

The quality of pavement construction is dependent on the quality of the materials used, the quality of workmanship and proper supervision and inspection. There is to be a continued emphasis by Public Works and Government Services Canada on quality control and quality assurance to ensure the construction of high quality pavements.

1.4 RESPONSIBILITIES

The Regional Center of Expertise (COE), PWGSC, Architectural and Engineering Services (A&ES) is responsible for ensuring that the standards contained in this manual are implemented on airport pavement construction projects.

PWGSC, Real Property Services Branch, A&ES, Engineering Division, Airport Engineering is responsible for maintaining and updating this manual on a continuing basis.

1.5 CANCELLATION

This document cancels and supersedes ASG - 20 (AK-68-22), Pavement Construction: Methods and Inspection, dated September 1994.

2.0 CONSTRUCTION METHODS

2.1 GENERAL SPECIFICATIONS

2.1.1 CANADIAN NATIONAL MASTER SPECIFICATIONS

Standard i) The Canadian National Master Specifications (NMS) shall be used for the preparation of contract specifications for Canadian airfield pavement construction projects.

Guideline i) NMS sections should be edited to meet the specific requirements and conditions of each project on the basis of sound engineering judgement, complete and accurate site information, and the standards and guidelines contained in this manual.

2.1.2 ENVIRONMENTAL PROTECTION

Standard i) Contract documents shall include requirements for the protection of the environment during construction as specified in the Canadian Environmental Protection Act (CEPA) and all applicable Federal, Provincial and Municipal statutes and authorities having jurisdiction.

2.2 EARTHWORK SPECIFICATIONS

2.2.1 UNDERGROUND UTILITIES

Standard i) The location and depth of all underground service and utility lines shall be proven by the Contractor by test excavation or other method approved by the engineer, prior to commencing general excavation operations. Contractor shall contact the appropriate utility authorities having jurisdiction to confirm locations.

Guideline i) All reasonable efforts should be made to provide the contractor with accurate records of the location of buried services, but the responsibility for proving these locations should remain the contractor's.

2.2.2 TOPSOIL

Standard i) Topsoil shall be salvaged prior to any excavation work and either stockpiled for later use, re-spread immediately, used as common fill in designated areas, or sold off-site if so desired by the airport authority.

Standard ii) Topsoil shall not be handled when wet.

Standard iii) Topsoil shall not be stockpiled on-site more than 3.5 m high.

2.2.3 ROCK EXCAVATION

Standard i) All blasting operations on airport property shall be co-ordinated with the airport air traffic control and/or flight services personnel. Contract specifications shall provide for co-ordination of each individual blast in accordance with applicable codes.

2.2.4 BORROW PITS AND DISPOSAL AREAS

Standard i) Borrow pits and disposal areas on airport property shall be located and constructed to comply with airport zoning requirements as specified in TP 312, Aerodrome Standards and Recommended Practices, to preserve line-of-site requirements for air traffic safety purposes, and to conform with environmental standards.

Guideline i) Borrow pits and disposal areas should be indicated in the contract plans.

Guideline ii) Borrow pits and waste disposal areas on airport property should be located to minimize interference with airport traffic and future development.

2.2.5 PLACING AND COMPACTING FILLS

Standard i) Fills shall be placed and compacted to the specified density in properly drained, uniform, homogeneous layers and in accordance with ASG-06 Pavement Construction: Materials and Testing.

Standard ii) Frozen materials shall not be placed in fill areas. Fills shall not contain organic matter.

2.2.6 SUBGRADE COMPACTION

Standard i) The top 150 mm of cohesive subgrades and the top 300 mm of non cohesive subgrades shall be scarified then compacted to a denser state than common fill materials as stipulated in the manual ASG-06 Pavement Construction: Materials and Testing, and this additional compaction requirement shall be paid for as a separate contract item.

Standard ii) The in-situ subgrade shall be scarified and remixed prior to compaction to obtain maximum uniformity.

Standard iii) In fill areas, stones larger than 150 mm in diameter shall not be placed within 0.5 m of the subgrade surface.

Standard iv) In cut areas, stones larger than 150 mm in diameter shall be removed from within the specified depth for subgrade compaction.

Standard v) In graded areas, stones larger than 50 mm in diameter shall not be placed within 100 mm of finished grade.

2.2.7 FINISHED SURFACES

Standard i) Finished pavement subgrades shall be within 25 mm of design grade, but not uniformly high or low.

Standard ii) Finished surfaces in graded areas shall be within 30 mm of design elevation, but not uniformly high or low.

2.3 SUB-BASE AND BASE SPECIFICATIONS

2.3.1 PLACING AND COMPACTION

Standard i) Sub-base and base course materials shall be placed and compacted so that:

(1) Lifts of material are uniform, homogeneous, and properly drained throughout construction;

(2) Materials are uniformly compacted to the specified density;

(3) Materials are not placed while frozen.

2.3.2 FINISHED SURFACES

Standard i) Finished sub-based surfaces shall be within 25 mm of the design grade, but not uniformly high or low.

Standard ii) Finished base course and cement stabilized base surfaces shall be within 6 mm of the design grade, but not uniformly high or low.

Standard iii) Segregation of the finished base or cement stabilized base course shall not be accepted.

2.3.3 CEMENT STABILIZED-BASES: ADDITIONAL REQUIREMENTS

Standard i) Where forms are not used and adjacent lanes are placed more than 30 minutes apart, the side of the initially placed lane shall be cut back to a vertical face of fully compacted material. At the end of lanes and at the end of each day's work, a transverse joint shall be constructed by cutting back to a vertical face of fully compacted material.

Standard ii) Completed cement stabilized-bases shall be protected with a bituminous curing membrane of RS-1 emulsified asphalt, applied as soon as possible after completion of final rolling.

2.3.4 PROOF-ROLLING

Standard i) For airfield pavements, proof-rolling shall be carried out at a specified level of the sub-base or base course so that all points on the subgrade surface are subjected to three passes of the standard proof-roller.

Standard ii) The standard proof-roller is a rubber-tired roller with four wheels abreast, a total mass of 45,360 kg, a maximum centre-to-centre wheel spacing of 740 mm and a tire inflation pressure of 0.62 MPa.

Guideline i) The level where proof-rolling is to be carried out should be indicated on the contract drawings.

Guideline ii) If the use of alternative proof-rolling equipment is requested by the Contractor, a new level of proof-rolling should be determined based on loading characteristics of the new proof roller.

Guideline iii) The speed of the proof-roller should not exceed 75 metres per minute.

2.4 ASPHALT PLANT SPECIFICATIONS

2.4.1 PLANT REQUIREMENTS

Standard i) Asphalt plants shall conform to the requirements of ASTM D995.

Standard ii) For dryer drum mixing plants, fine and coarse aggregates (split on 4.75 mm screen) shall be fed through separate cold bins from separate stockpiles.

Standard iii) Silos or bins used for storing hot mix shall be equipped to prevent segregation of the mix.

Standard iv) Elevators to silos or storage bins shall be equipped to permit the diversion and wastage of unsuitable mix.

Standard v) Additional requirements for the operation of asphalt plants shall be in accordance with MS-3, Asphalt Plant Manual, Asphalt Institute.

2.4.2 PLANT OPERATION

Standard i) The moisture content of the mix at the point of discharge shall be less than 0.2 percent by mass of mix.

Standard ii) The mixing temperature shall be determined in accordance with CAN/CGSB 16.3 and the applicable asphalt cement viscosity data.

Standard iii) The aggregate temperature at mixing shall be within 5 degrees C of the cement temperature.

Standard iv) Asphalt cement shall not be heated in storage tanks to a temperature greater than 160 degrees C.

Standard v) Silos or storage bins for hot mix shall be kept filled to at least one-third of their capacity during production and paving.

Standard vi) Hot mix shall not be stored in silos or storage bins for more than 8 hours.

2.5 ASPHALT PAVING SPECIFICATIONS

2.5.1 PRIME COATS

Standard i) Base course surfaces shall be primed at least 24 hours prior to paving.

Guideline i) Primer should be an RM-20 or MC-30 (CAN/CGSB 16.1) applied at a rate not exceeding 2.25 L/m^2.

Guideline ii) As an alternative, an asphalt emulsion such as SS-1h (to CAN/CGSB 16.2) may be used as a primer.

Guideline iii) Precautions should be taken to minimize disturbance of primed surfaces by vehicles.

2.5.2 SURFACE PREPARATION FOR OVERLAYS

Standard i) Previously sealed asphalt and Portland cement concrete pavement cracks or joints shall be cleaned of all materials which may cause problems during construction and refilled with a suitable material prior to overlay.

Standard ii) Unsealed or recently formed cracks shall be filled with a suitable sealant material prior to overlay.

Standard iii) Existing pavement markings shall be removed prior to overlay.

Guideline i) Cracks greater than 25 mm should be refilled with a sand-asphalt slurry, sand-cutback asphalt mixture or hot-poured rubberized joint/crack sealer. A small amount of Portland cement (no more than 5%) may be added to the slurry to minimize bleeding of sealing material.

Guideline ii) Where base materials have been washed out from beneath major cracks, and replaced with excess crack sealer over the years, the pavement should be cut out and patched with hot-mix asphalt concrete prior to overlay.

Guideline iii) Where extensive surface cracking is encountered, cold milling, localized patching, replacement or repair of existing surface layer should be considered during the design stage.

2.5.3 TACK COATS

Standard i) Existing paved surfaces to be overlaid shall be cleaned and tack coated with a emulsified or cutback asphalt sufficiently in advance of paving to permit proper setting of tack coat.

Guideline i) Tack coat should normally be an SS-1 or SS-1h emulsified asphalt (CAN/CGSB-16-2-M89) for concrete or asphalt surfaces. Other emulsified or cutback asphalt materials may be used to suit site conditions.

Guideline ii) Over existing asphalt and Portland cement concrete (PCC) pavements and between lifts of new pavement the emulsified asphalt material should be diluted at a rate of 1:1 with clean water and then applied at a rate of not exceeding 0.5 L/m^2.

2.5.4 PLACING ASPHALT

Standard i) All asphalt concrete on airfield pavements, including levelling courses, shall be placed using self-propelled asphalt pavers equipped with and controlled by automatic screed controls operating on a taut string line, laser, or grade-matching ski or shoe.

Standard ii) Hydraulic screed extensions on pavers shall not be used on airfield pavements unless they are equipped with tamping bars, auger extensions, vibrators and screed heaters. Auger extensions shall extend to within 0.5 m of the paver end plate.

Standard iii) The surface of a finished asphalt concrete pavement shall be within 5 mm of design grade, but not uniformly high or low, and shall have no irregularities exceeding 5 mm when checked with a 4.5 m straight edge placed in any direction.

Standard iv) For airfield pavements, contract documents shall provide for the construction of a test strip in a non-critical area to ensure that any problems with equipment, mix behaviour, or compaction are resolved prior to the start of paving on centre-line. The test strip shall consist of at least 500 tonnes and involve more than one lane, so that joint compaction and finishing techniques can be established.

Standard v) Paving lanes shall not exceed 500 m in length to ensure the construction of hot joints between subsequent paving lanes.

Standard vi) Transverse joints shall be cut back to a full depth vertical face and tacked prior to continuing a lane.

Standard vii) All longitudinal joints (except hot joints paved in echelon) shall be cut back by at least 100 mm, cleaned and tack coated with a hot asphalt cement or an asphalt emulsion prior to paving against them.

Standard viii) Longitudinal joints in succeeding lifts shall be offset by at least 50 mm. Transverse joints in succeeding lifts shall be offset by at least 600 mm.

2.5.5 COMPACTION

Standard i) A minimum of two rollers at least one pneumatic and one steel drum, shall be at the paving site at all times during paving.

Guideline i) For thin overlays a vibratory roller should not be used and one roller should be pneumatic with adjustable tire pressure and equipped with skirts.

2.6 PORTLAND CEMENT CONCRETE PAVING SPECIFICATIONS

2.6.1 BATCHING AND MIXING EQUIPMENT

Standard i) Portland cement concrete batching plants, stationary, and mobile mixers shall conform to the requirements of CAN/CSA-A23.1.

Standard ii) If the concrete mix contains crusher screenings as a constituent, the batching plant shall be equipped to proportion them separately from the sand.

Standard iii) Mobile mixers (transit mixers) shall be equipped with a reliable revolution counter that can be reset.

Standard iv) Ensure that 50% of the total aggregate required for the project is stockpiled prior to commencing Portland cement concrete production and paving.

2.6.2 CEMENT TEMPERATURE

Standard i) The temperature of the cement shall not exceed 65 degrees C at the time of mixing.

2.6.3 DELIVERY TIME

Standard i) The maximum elapsed time from initial mixing to complete discharge of mixes transported by agitating equipment shall be 90 minutes. For mixes transported by non-agitating equipment, the maximum elapsed time shall be 45 minutes.

2.6.4 CONCRETE PLACING AND SPREADING

Standard i) Concrete spreaders shall be self-propelled and shall be designed to mechanically spread concrete forward and laterally without segregation.

Standard ii) Slip form spreaders shall be crawler-track mounted and automatically controlled for line and grade from a stringline or wire.

2.6.5 CONSOLIDATION

Standard i) Internal vibration shall be used to consolidate all concrete slabs greater than 200 mm thick.

2.6.6 FINISHING AND TEXTURING

Standard i) All concrete pavements shall be given a burlap drag finish parallel to movement of the paving train and/or broom finished perpendicular to the movement of the paving train.

Standard ii) Concrete pavements on runways shall be textured by transverse wire comb leaving grooves in the surface of the concrete 5 mm wide x 5 mm deep at 20 mm centres.

Standard iii) The surface of a finished Portland cement concrete pavement shall be within 5 mm of design grade, but not uniformly high or low, and shall have no irregularities exceeding 5 mm when checked with a 4.5 mm straight edge placed in any direction.

2.6.7 CURING

Standard i) Concrete shall be cured for a minimum of 4 days by a liquid curing membrane applied in two applications 24 hours apart from each other and each at the application rate recommended by the manufacturer.

Standard ii) Concrete shall be protected from freezing for a minimum of seven days after placing.

Guideline i) Alternate curing methods in accordance with CAN/CSA A23.1 may be used to suit special project requirements.

Guideline ii) Where skid resistant characteristics are a requirement, the suitability of regular sealing compounds compared with curing/sealing compounds should be investigated, so that the use of curing/sealing compounds can be restricted if required.

2.6.8 CONSTRUCTION JOINTS

Standard i) A keyed transverse construction joint shall be formed whenever paving is stopped for more than 30 minutes. At the end of a day's paving this joint shall be constructed at a transverse contraction joint location.

Standard ii) Construction joints (both longitudinal and transverse) shall be tooled where fresh concrete abuts hardened concrete so that the true location of the joint is clearly visible. Edges shall not be rounded beyond the dimensions of the joint sealant reservoir, which will be saw-cut later.

2.6.9 CONTRACTION JOINTS

Standard i) Weakened sections, for control of transverse cracking, shall be constructed at locations shown on the drawings by either sawing or insertion into plastic concrete of polyethylene strips, to the depths shown in ASG-23 Airport Civil Engineering Standard Drawings.

Standard ii) If sawing is to be used, the contractor shall maintain stand-by equipment on-site in case of equipment failure.

Standard iii) Saw-cuts shall be flushed with water and then sprayed with curing membrane as soon as the free water has dried.

2.6.10 JOINT SEALING

Standard i) The reservoir kerf for joint sealing shall be formed by saw cutting after the concrete has cured for a minimum of four days.

Standard ii) Saw kerfs shall be flushed with high pressure water immediately after sawing and cleaned with a steel wire brush or wheel.

Standard iii) Immediately before sealing, saw kerfs shall be dried with compressed air, then the bond breaker shall be inserted.

Standard iv) Sealants shall be installed in accordance with the manufacturer's instructions.

Guideline i) During sealant installation, Contractor should be trained by a technical representative of the manufacturer for the first two days of operation to ensure the product be installed in strict conformity with the manufacturer's instructions.

2.6.11 DEFECTIVE CONCRETE

Standard i) Concrete, which is defective due to honeycombing, freezing, insufficient slab thickness or insufficient strength (see ASG-06, Pavement Construction: Materials and Testing) shall be removed and replaced.

3.0 CONSTRUCTION INSPECTION

3.1 GENERAL RESPONSIBILITIES

3.1.1 CONSTRUCTION QUALITY CONTROL

Standard i) During construction of pavements, all work shall be executed in conformance with the contract plans and specifications. This quality of work shall be ensured during construction through a quality control program of inspection and testing.

Standard ii) Inspection of the various aspects of pavement construction shall be carried out throughout a project to ensure this conformance. Where deviations or problems occur, which could have a detrimental effect on pavement quality, immediate and effective measures shall be taken within the terms of the contract to ensure that they are corrected by the contractor.

Standard iii) The inspection requirements contained in this manual shall be implemented in careful co-ordination with the following PWGSC manuals related to supervision and quality control of related construction activities.

(1) ASG-06 Pavement Construction: Materials and Testing

(2) ASG-28 Pavement Construction Record

Guideline i) Normally, all official direction to the contractor concerning the quality of the work should be provided by designated resident engineer.

Guideline ii) Whenever deviations from the contract plans or specifications are considered in the field, the designer should be consulted concerning the impact of these changes on the pavement design.

3.1.2 QUALIFICATIONS OF INSPECTION PERSONNEL

Standard i) Pavement construction inspectors shall be thoroughly knowledgeable in the currently accepted industry practices, equipment, and techniques for the phases of construction work that they are inspecting.

Standard ii) Pavement construction inspectors shall be thoroughly familiar with these and other established standards related to the phases of work that they are inspecting and shall have continuous access to these standards.

3.1.3 DAILY DIARIES

Standard i) Records of inspection activities shall be maintained in hard-bound daily diaries, which shall remain the property of the Engineer.

3.1.4 WEIGH SCALE TICKETS

Standard i) Before weighing materials for payment, weigh scales shall be inspected and certified accurate by Consumer and Corporate Affairs Canada, Weights and Measures Inspection Branch.

Standard ii) Truck loads of materials to be paid for by weigh shall be weighed by a representative of the Engineer, or by automatic device that imprints the weight directly onto a ticket or card.

Standard iii) Haul trucks shall be weighed with all axles in a single operation.

Standard iv) Weigh scale tickets shall be collected, certified, and recorded upon delivery on-site by a representative of the Engineer.

Guideline i) If contract documents require that the contractor provide weigh scales and a scale house, the contractor shall have the scales inspected and certified. Scales should normally be re-tested monthly, depending on usage.

Guideline ii) Haul trucks should be tared at least once a day at irregular times, in the same condition as they will be weighed when loaded (i.e., including driver, spare tires, and accessories).

Guideline iii) Weights of loads dispatched and loads received on grade should be totalled and balanced daily and compared to the contractor's records.

3.1.5 ENVIRONMENTAL PROTECTION

Standard i) The designated construction inspection staff shall be responsible for ensuring conformance by the contractor with provisions of the contract specifications dealing with environmental protection.

3.2 AGGREGATE PRODUCTION

3.2.1 AGGREGATE SOURCES

Standard i) Aggregate sources shall be inspected visually prior to preliminary acceptance or be proven in writing by the contractor to ensure that there will be an adequate supply of consistent material that meets or is capable of meeting the specified requirements.

Standard ii) Subsequent to preliminary acceptance the designated resident engineer shall arrange for the sampling and testing of the material prior to final acceptance for use.

Standard iii) Subsequent periodic inspections of an aggregate source shall be carried out throughout production to ensure early detection of changes in the materials being extracted.

Guideline i) The inspector should ensure that clearing, grubbing, and stripping of overburden are carried out sufficiently in advance of the pit or quarry face so that deleterious materials do not contaminate aggregates.

Guideline ii) Where an aggregate source is non-homogenous, the inspector should establish with the contractor a pattern of selective excavation that will result in production of a consistent material.

Guideline iii) The inspector should ensure that provincial regulations regarding the development and restoration of aggregate sources are complied with.

3.2.2 CRUSHING AND SCREENING

Standard i) Crushing and screening plant operations shall be regularly inspected throughout production to eliminate any changes in the product.

Guideline i) Where plant is being erected at a new or infrequently used aggregate source, a period of adjustment may be required until the plant is producing satisfactory material. During this period, adjustments to the plant should be based on product test results. Records should be kept of where materials are stockpiled so that unsatisfactory materials can be kept separate from those that are acceptable.

Guideline ii) When a change in product is noted by visual inspection, immediate action should be taken to identify the reason for the change and test results should be examined to determine if the product still meets specified requirements. When the product does not meet the specified requirements, immediate action should be taken to prevent contamination of previously produced, acceptable material.

3.2.3 STOCKPILING

Standard i) Aggregate handling and stockpiling operations shall be regularly inspected to ensure that stockpiling procedures used will prevent contamination, segregation or degradation of the aggregates.

Standard ii) Aggregates shall be stockpiled in sufficient quantities to ensure that there will be no construction delays due to insufficient aggregate production.

3.3 EARTHWORK AND SUBGRADE

3.3.1 GENERAL REQUIREMENTS

Standard i) All aspects of earthwork operations and subgrade preparation shall be continuously inspected, including the following:

(1) cut and borrow excavation;

(2) Handling of topsoil;

(3) hauling and placement of fill materials;

(4) compaction of fill materials;

(5) Preparation, compaction, and grading of subgrade;

(6) removal and replacement of unsuitable materials.

3.3.2 MATERIALS

Standard i) Soils to be used in pavement embankment and subgrade construction shall be inspected and selected on the basis of their engineering suitability and cost-effectiveness.

Standard ii) Fill materials shall be selected to achieve maximum uniformity of subgrade conditions.

Guideline i) The use or existence of the following unsuitable materials beneath pavement structures should be avoided:

(1) frost-susceptible soils,

(2) weak or compressible soils,

(3) soils containing organic matter, frozen lumps, roots, logs, or stumps,

(4) excessively wet soils that cannot be practicably dried out or stabilized,

(5) sandy pockets of soil in cohesive subgrade soils.

Guideline ii) Frost susceptible subgrade soils existing in pockets should be removed to the depth of frost penetration or to 1.2 m below subgrade level, whichever is less, as shown in Appendix A, of this manual. Where small quantities are involved, or where the depth of the material only slightly exceeds the above excavation depth, the materials should be excavated to its full depth.

Guideline iii) Unsuitable materials excavated from subgrade should be replaced with soils similar in nature to the surrounding material.

3.3.3 EARTHWORK LOGISTICS

Guideline i) An earthwork inventory plan should be prepared at the outset of a major earthwork project, showing required and available materials.

Guideline ii) An earthwork logistics plan should be developed with the contractor to ensure optimum use of available materials.

Guideline iii) Borrow pits and waste disposal areas should be developed in a manner that protects resources of good borrow or granular material for future use.

Guideline iv) Double handling of materials at the expense of the owner should be minimized. The contractor may double-handle materials at contractors own expense.

Guideline v) Unsuitable materials should not be disposed of in potential hard-surface areas.

3.3.4 PLACING AND COMPACTING FILLS

Guideline i) The layer thickness of common fills, which can be properly compacted, should be determined on the basis of field density tests taken at the bottom portion of the layer.

Guideline ii) Finished subgrade surfaces should be well-compacted and free of ruts, depressions, or loose material prior to placing sub-base material.

Guideline iii) Finished graded areas should include a minimum of 100 mm of topsoil cover that is free of ruts, depressions, roots, rocks, and debris and should be rolled to a tight, dense condition. Where topsoil is not available or too expensive, a special analysis of soil properties for germination and treatment is required for proper selection of fertilizer and seed mixture.

3.4 SUB-BASE AND BASE COURSES

3.4.1 PLACING AND COMPACTING

Standard i) The placement and compaction of granular materials and cement stabilized bases shall be continuously inspected.

Guideline i) The maximum permitted lift thickness for granular materials should be based on the contractor's ability to compact them as determined by field density tests taken at the bottom of the lift.

Guideline ii) Additional field density testing should be carried out where visual inspection suggests inadequate compaction.

Guideline iii) Where problems are encountered in placing or compacting sub-base or base materials, the inspector should ensure that proper precautions are taken to protect the integrity of the pavement structure. The following are typical situations and solutions.

(1) If the subgrade material is a silt, which might migrate into a coarse sub-base material, a minimum 150 mm thick layer of sand or sandy gravel should first be placed on the subgrade as separation medium. This layer should normally be treated as a separate pay item and should not be included for payment with the sub-base. Truck loadings and tire pressures should be controlled to prevent excessive rutting or deflection of the subgrade.

(2) If the subgrade or sub-base is a sand, which shears under the tires of construction equipment, special precautions should be taken during placement of the base or sub-base material to prevent contamination.

(3) The loose surface of sub-base materials such as clean, uniform sands, should normally be confined by the next layer of material in order to obtain the specified compaction.

(4) The use of geogrids or geotextiles may be used under special circumstances.

3.4.2 FINISHED SURFACES

Guideline i) Finished sub-base, base course, and stabilized base surfaces should be checked for elevation and grade compliance through the use of boning rods, survey instrument or laser in transverse, longitudinal, and diagonal directions.

Guideline ii) Localized depressions or segregated areas on the finished base course surface should be repaired using the 25 mm maximum sized aggregate as specified in ASG-06, Pavement Construction: Materials and Testing, Chapter 2.0. This material should not be used over extensive areas.

3.4.3 CEMENT STABILIZED BASES

Guideline i) The inspector should ensure that the moisture content is maintained within 2 percent of optimum during placing and compaction operations. The surface should be kept continuously moist until application of the curing membrane.

Guideline ii) The inspector should determine the application rate of the curing membrane by field trial. Curing membrane should be applied at a rate of 1.35 L/m^2 or as required to provide a continuous film, and should be maintained for at least 7 days.

3.4.4 PROOF-ROLLING

Standard i) Proof-rolling shall be supervised continuously by the Engineer.

Guideline i) Alternate proof-rolling equipment should be approved when the standard roller is not available or when a reduced tire pressure is necessary to prevent shearing of the sub-base.

Guideline ii) If alternate proof-rolling equipment is approved, the level of proof-rolling, should be recalculated to result in an equivalent subgrade loading.

Guideline iii) Non-uniformities, in the subgrade, detected during proof-rolling should be corrected by removing the base and sub-base materials, excavating the subgrade to a suitable depth, backfilling and re-compacting the subgrade then replacing and compacting the base and sub-base materials.

Guideline iv) Where shear failure occurs in the base or sub-base course during proof-rolling, the gradation and crushed content of the base materials should be rechecked and local failure areas checked for segregation or high moisture content. The defective base or sub-base course should be repaired or replaced at the contractor's expense.

3.5 ASPHALT PLANTS

3.5.1 INITIAL INSPECTION

Standard i) Asphalt plants shall be inspected for conformance to the specification requirements and any deficiencies shall be corrected prior to paving.

3.5.2 CALIBRATION

Standard i) Portable plants set up specifically for Canadian airfield pavement projects shall be fully calibrated in the presence of a designated inspector.

Standard ii) Calibration data for permanent plants shall be reviewed by the inspector prior to the commencement of mixing and shall be available throughout the project in case changes are necessary.

Guideline i) At least three different gate settings or belt speeds should be used to develop aggregate calibration curves.

Guideline ii) At least three different trials should be made to calibrate each sprocket or valve setting on bitumen pumps. Direct reading bitumen meters should be calibrated to within 0.2 percent of the actual quantity pumped at a minimum of two pumping rates spanning the probable range of pumping rates during production.

Guideline iii) All temperature measuring and recording devices should be calibrated over the range of working temperatures.

Guideline iv) Final adjustments to plant settings should be based on both the test results of materials and the behaviour and appearance of mix during paving preparations. Once finalized, plant settings should not be changed without the approval of the designated inspector.

Guideline v) Where anti-stripping additives, such as dry hydrated lime or a hydrated lime slurry are specified, add the hydrated lime mixture to the aggregates on the cold feed belt. Calibrate, meter and interlock the anti-stripping additive material flow to ensure amounts are added at the rate specified in the job mix formula.

Guideline vi) Where liquid anti-stripping or other additives which are to be added to the asphalt cement storage tanks are specified, ensure adequate and homogeneous mixing of the additive with the asphalt cement, in accordance with the manufacturers recommendations.

3.5.3 PRODUCTION RATE

Guideline i) A production rate should be established that ensures:

(1) adequate mixing - 30 - 75 s for batch plants and for continuous mix plants, not less than 45 s;

(2) a moisture content of less than 0.2 percent at the point of discharge of the mix.

Guideline ii) The plant production rate should be co-ordinated with the rate of paving to allow for continuous plant operation.

Guideline iii) The plant production rate should not be allowed to exceed the manufacturer's recommended rate.

3.5.4 PRODUCTION INSPECTION

Standard i) Asphalt plant production operations shall be periodically inspected and all plant settings shall be checked and recorded at start-up, shut-down and at frequent intervals in between.

Guideline i) Plant operations should be inspected following the recommendations of The Asphalt Plant Manual, MS-3, Asphalt Institute.

Guideline ii) The mix discharge temperature should be continuously monitored by means of a recording pyrometer.

Guideline iii) The aggregates should be monitored for changes in their moisture content by taking measurements on the coarse and fine aggregates each day prior to the start of production.

3.5.5 ASPHALT CEMENT RECORDS

Standard i) A daily record of the asphalt cement used shall be maintained.

Standard ii) For payment purposes, asphalt cement quantities shall be determined from direct measurements.

Guideline i) Asphalt quantities should normally be determined from plant storage tank measurements and weigh tickets of deliveries received. Storage tanks should have a volume chart with temperature calibration for measuring with dip stick, as supplied by the manufacturer, and a calibrated flow meter.

Guideline ii) Average daily asphalt content should be determined from daily asphalt cement usage and the amount of mix produced, for comparison to asphalt extraction test measurements.

3.6 ASPHALT PAVING

3.6.1 GENERAL

Standard i) All aspects of the asphalt paving operation shall be continuously inspected by qualified inspectors.

3.6.2 PRIME COATS

Guideline i) The proper application rate of prime coats should be determined by the inspector by field trial. This rate should be as high as the surface can absorb in a 24-hour period and should normally be between 0.90 and 2.25 L/m^2.

Guideline ii) Allow prime coat material to cure completely prior to commencing paving operations. After 24 hours, excess prime coat material should be treated by applying a suitable sand blotter material. Excess blotter material should be swept up and removed.

3.6.3 TACK COATS

Guideline i) The proper application rate for tack coats should be determined by the inspector by field trial. This rate should be just sufficient to provide a thin uniform coat over the existing pavement surface.

3.6.4 PLACING ASPHALT

Standard i) Paving equipment proposed for use shall be inspected prior to commencing placing operations, for conformance to specified requirements and to confirm that the equipment is in acceptable operating condition. All deficiencies in paving equipment shall be corrected prior to paving.

Guideline i) Paving should normally be started at the crown or on the high side of a grade. When paving a runway, taxiway or heavily-trafficked area of an apron, a test strip should first be constructed in a non-critical area of the pavement.

Guideline ii) String lines for automatic screed controls should be checked for grade at every support and should be within 3 mm of design grade.

Guideline iii) Straight edge measurements should be made at all transverse joints throughout their construction to ensure tolerances are met. The frequency for surface straight edge measurements is given in ASG-06, Pavement Construction: Materials and Testing, Appendix J, Minimum quality Control Testing Requirements.

Guideline iv) Irregularities in cold pavement should be corrected by saw-cutting and removing the affected area and replacing with new hot mix. Skin patches should not be permitted.

3.6.5 COMPACTION

Guideline i) The test strip, mentioned in Placing Asphalt paragraph of this section, should be used to establish an optimum rolling pattern. Comparative readings taken with a nuclear density gauge should be used to establish a paving pattern and the number of passes to achieve the maximum density of the asphalt using the available equipment. The actual density achieved should then be determined by coring to determine if additional rolling equipment will be required.

3.6.6 PAVING RECORDS

Guideline i) A paving record should be maintained including starting and finishing chainages and offsets of each day's work, tonnage laid, thickness calculation, and problems encountered. The paving record should be submitted daily for inclusion in the pavement construction record.

3.7 PORTLAND CEMENT CONCRETE PRODUCTION

3.7.1 BATCHING AND MIXING EQUIPMENT

Standard i) Batching plants, stationary mixers, and each individual truck mixer shall be inspected for conformance with CAN/CSA-A23.1 and the specification requirements. Any deficiencies shall be corrected prior to paving.

3.7.2 PLANT CALIBRATION

Standard i) The calibration of all weigh scales and fluid dispensers shall be checked by a designated qualified inspector and verified for conformance with CAN/CSA-A23.1 prior to paving.

3.7.3 CONCRETE MIXING

Guideline i) The manufacturer's ratings for stationary and mobile mixers should not be exceeded unless it can be demonstrated that a mix of acceptable uniformity can still be produced. The uniformity test criteria given in CAN/CSA-A23.1 should be used except that the acceptance range of the variance of the highest and lowest values of 3 slump test samples should be 10 mm and the rejection range should be 30 mm.

Guideline ii) The mixing times specified in CAN/CSA-A23.1 should not be reduced unless the above uniformity requirement can be met at the reduced mixing time.

Guideline iii) Mix uniformity should be spot-checked at random intervals or if problems are encountered during construction due to variability or workability of the concrete. If the requirements noted above are not met, immediate action should be taken to diagnose and correct the problem.

3.7.4 PRODUCTION INSPECTION

Standard i) The concrete-batching plant and stationary mixing operations shall be periodically inspected to ensure consistency and quality of component materials, consistent and accurate operation, and consistency in the visual characteristics of the mix.

Standard ii) Mobile mixers (transit mix trucks) shall be periodically inspected for water addition, number of revolutions, elapsed time, and consistency in the visual characteristics of the mix.

Guideline i) Particular attention should be paid to changes in the moisture content of the aggregates. Washed aggregates should be allowed to drain for at least 24 hours prior to use. The moisture content of the fine aggregate should be measured prior to start of production each day.

Guideline ii) Gradation changes or changes in the particle shape of any aggregate should also be accommodated by adjusting batch weights or preparing a new series of trial mixes.

3.7.5 PRODUCTION RECORDS

Standard i) A daily record of concrete production and cement usage shall be maintained.

Standard ii) For payment purposes, cement quantities shall be determined by direct measurement.

Guideline i) Cement quantities should be determined from cumulative batch weights if the plant is equipped to automatically record these. These should be compared daily to measured quantities in storage and weigh tickets of deliveries received. Differences should be resolved daily.

Guideline ii) The average daily cement content should be calculated daily and compared to the mix design.

Guideline iii) The volume of concrete produced at the plant should be compared daily to the volume placed in the field as determined by area and specified thickness. Differences that cannot be explained as normal wastage or rejected materials should be resolved daily.

Guideline iv) The average admixture dosage rate should be calculated daily and compared to the mix design.

3.8 PORTLAND CEMENT CONCRETE PAVING

3.8.1 GENERAL

Standard i) All aspects of the Portland cement concrete paving operation shall be continuously inspected by designated inspectors.

3.8.2 PREPARATIONS FOR PAVING

Guideline i) Prior to paving, forms should be carefully inspected for stability, grade, and alignment. Elevation of forms should be checked with a rod and level at 6 to 7 m intervals and should be within 3 mm of design grade. Horizontal alignments should be within 10 mm of design line.

Guideline ii) String lines for slip form paver control should be checked for grade and alignment of every support, and should be within the tolerances above. Slip form paver should have sufficiently long trailing forms consistent with the slump requirements to avoid slumping of edges.

Guideline iii) Keyway dimensions and location are critical and should be checked for conformance to the contract documents.

Guideline iv) Unless protected by a curing membrane, the surface of the base course should be damp prior to placing concrete on it.

3.8.3 CONCRETE PLACING AND SPREADING

Standard i) Concrete paving equipment proposed for use shall be inspected prior to commencing placing and spreading operations, for conformance to specified requirements and to confirm that the equipment is in acceptable operating condition. All deficiencies in paving equipment shall be corrected prior to paving.

Standard ii) Vibration shall not be used to move concrete. Concrete shall be placed as close as possible to it's final position.

Guideline i) Bridge deck finishers operating on fixed forms should only be permitted if allowed by specifications and it can be demonstrated that concrete can be spread uniformly without vibrating and without segregation.

3.8.4 CONSOLIDATION

Guideline i) Equipment with vibrators designed to move transversely through the concrete should not be permitted unless the contractor can demonstrate that adequate, uniform consolidation will be obtained, by constructing a demonstration strip off-site at his expense. If such equipment is approved, care should be taken to co-ordinate the forward speed of the machine with the transverse speed of the vibrating unit, and frequent checks on the uniformity of the placed concrete should be made.

3.8.5 FINISHING

Guideline i) After the pavement has been struck off, a 4.5 m straight edge should be used to take measurements at regular intervals prior to burlap dragging or combing, particularly at the edges of slip-formed slabs, and defective areas should be corrected while concrete is still plastic.

3.8.6 CURING

Guideline i) The first application of curing compound should be after final finishing and once all free-standing surface water has disappeared.

Guideline ii) The second application of curing compound should be applied within 24 hours of the first application and in accordance with manufacturer's recommendations.

Guideline iii) Curing compound should be applied to slab sides and initial joint saw cuts as early as possible.

3.8.7 CONTRACTION JOINTS

Guideline i) Sawing should be started as soon as the concrete is hard enough that aggregate particles will not be torn from the surface. If cracking occurs ahead of the saw, the contractor should be directed to saw every second joint to the end of the run and then return to cut the intermediate joints.

Guideline ii) Where polyethylene strips or other preformed strips specified are used, they should be inserted after mechanical finishing, but before the burlap finish and combed texture is applied. Four mil, V-shaped polyethylene strips should be inserted using a rolling circular blade travelling on a portable bridge to ensure that joints are formed straight and true. Depending on the workability of the concrete, the blade may have to be run across the slab once to cut the concrete, and a second time to press the strip into the slab. The surface should be hand or machine-floated after insertion of the strips, to eliminate any marks or bumps from the insertion operation. A few centimetres at the beginning and the end of each strip should protrude about 3 mm above the surface to made it easier to locate the joint later.

3.8.8 JOINT SEALING

Guideline i) A representative of the sealant manufacturer should be on site at the start of the sealing operation to ensure proper procedures are followed for the product.

3.8.9 DEFECTIVE CONCRETE

Guideline i) When replacing defective concrete, at least 3.5 m section of slab should be removed for its entire width. A joint should be formed around the perimeter of the replacement slab.

Guideline ii) Surface irregularities should be corrected by grinding where possible. Surface patching should not be permitted as a construction procedure.

Guideline iii) Spalled areas and broken edges should be cut back to sound concrete and replaced with concrete.

Guideline iv) Slabs with cracks resulting from late sawing of contraction joints should be replaced or, if not extensive, occasional random cracks may be repaired using epoxy compounds specifically designed for structural repair of concrete structures.

3.9 PREPARATION FOR RESURFACING

Guideline i) The condition, extent, and severity of cracks and joints in existing surfaces should be closely examined prior to the design and construction of overlays. In the case of cracking, the cause should be investigated.

Guideline ii) Where secondary cracking and pumping of base material occurs, with materials lost being replaced by copious amounts of crack sealer and runway sand and other incompressible materials, cracks (where secondary cracking has occurred) should be cut open and examined for loss or contamination of base underneath, and in any case the pavement in the area of the crack should be removed and replaced prior to overlay. In some cases base course may need repair as well.

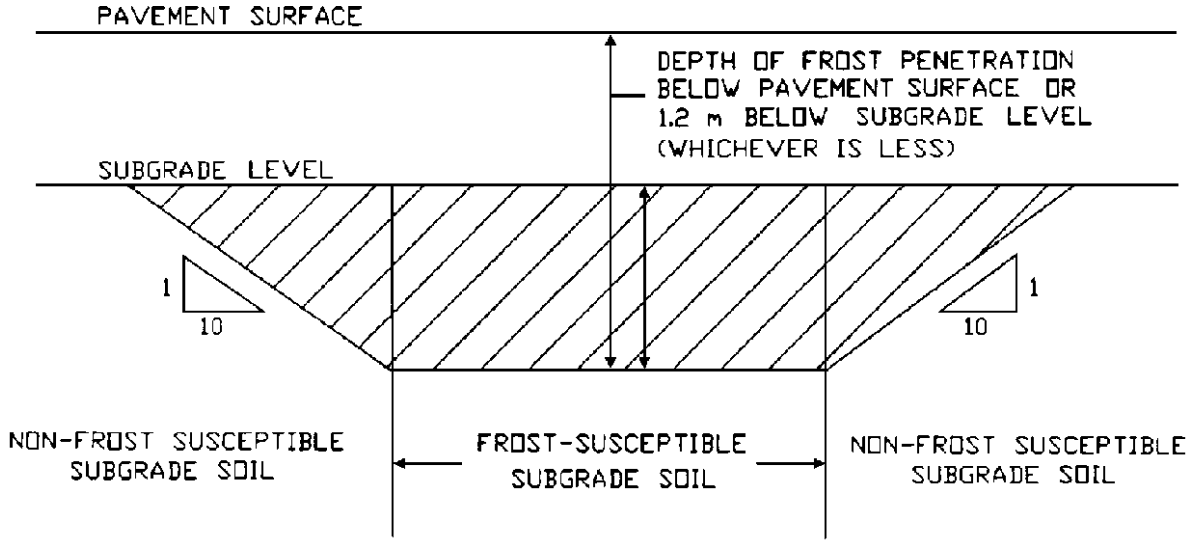
Guideline iii) It is essential that all traces of crack or joint sealer be removed from a pavement surface prior to overlaying. This is especially critical for transverse cracks as the hot mix of the overlay will shove across the crack on rolling and cause a bump in the mat. On further rolling this bump will crack. Longitudinal joints do not usually represent a problem in this regard as rolling is almost always in the same direction as the crack.

Guideline iv) The requirement to remove pavement paint markings depends on the thickness of the overlay, thickness of the paint markings, paint bond to the surface, etc. Tack coat will normally prevent shoving of the hot mix over marking. Heavy wire brooming or a light pass with a grader blade will probably be sufficient to remove paint which is likely to lose its bond.

Guideline v) Areas of heavy rubber build-up and oil and gas contamination should also be cleaned prior to overlay.

APPENDIX A

TREATMENT OF POCKETS OF FROST-SUSCEPTIBLE SUBGRADE SOIL



EXCAVATE HATCHED AREA AND BACKFILL WITH NON-FROST SUSCEPTIBLE SOIL.

FOR OTHER UNSUITABLE MATERIALS EXCAVATE TO DEPTH AUTHORIZED BY ENGINEER.

RELATED DOCUMENTS

RELATED PWGSC DOCUMENTS

ASG-06 Pavement Construction: Materials and Testing

ASG-23 Airport Civil Engineering Standard Drawings

ASG-28 Pavement Construction Record

OTHER RELATED DOCUMENTS

Annual Book of ASTM Standards, American Society for Testing and Materials, Philadelphia, Pa.

Canadian General Standards (CAN/CGSB), Canadian General Standards Board, Ottawa, Ontario

National Standards of Canada (CAN/CSA), Canadian Standards Association, Rexdale, Ontario

Canadian National Master Construction Specifications (NMS), Construction Specifications Canada, Toronto, Ontario

Asphalt Plant Manual (MS-3), Asphalt Institute, Lexington, Kentucky

TP 312, Aerodrome Standards and Recommended Practices, Transport Canada, Ottawa, Ontario.

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