

MEMORANDUM

Date: 3/13/17

Re: Revision #2 - Pavement Design Software interim and supplemental to Pavement Design Standards

MGPEC Members,

The Metropolitan Government Pavement Engineers Council (MGPEC) developed and released a pavement design program designed to take into account the AASHTO Design Guidelines and the needs of the Denver Metropolitan area from Fort Collins to Colorado Springs. The Design software has gone through several editions since release. Unfortunately, MGPEC has not been able to keep up with the high-speed growth of operating systems. For example, the current pavement design software will work on most computers with Windows XP and older versions. However, there are compatibility issues with Windows 7.

Currently, a MGPEC task force is revising the Pavement Design Standards to allow a more open approach of using the 1993 AASHTO design procedure and thus use of third party software for pavement designs. A final version of the design standard will be completed in 2017. During this interim, several on-line software programs will be accepted when performing designs of roadway pavement structures. These software programs are listed below and all have a hold harmless clause.

Agencies using design software other than the MGPEC software need to consider that these programs might not take into account swelling/collapsing soils, freeze thaw conditions, subgrade drainage, and/or other special conditions of interest that may and will come up. The MGPEC Design Standards along with Agency requirements need to be considered when inputting design parameters into the software (i.e. such as growth, ESAL loading, vehicle types). Recommended MGPEC parameters can be found on the pages attached to this memo labeled "Recommended MGPEC Pavement Design Inputs" and default MGPEC parameters can be found in the MGPEC Pavement Design Standards. Use of other pavement design parameters (in accordance with AASHTO '93 design procedure) is acceptable if the values are corroborated by a Professional Engineer with local pavement design experience.

Software Name	Notes
PaveExpress	Asphalt Design (Preferred by Asphalt Industry)
PerRoad	Asphalt Design Alternative
PerRoad Expres	Asphalt Design Alternative
WINPAS 12	Concrete Design (Preferred by Concrete Industry)
StreetPave12	Concrete Design Alternative
MGPEC PV Design	

MGPEC will assess other pavement design software on request and if appropriate, authorize the software as an acceptable alternative.

Feel free to contact me with any questions or further guidance,

Jim Katzer
MGPEC Chair

Recommended MGPEC Pavement Design Inputs

1) MGPEC Subgrade Characterization & Correlations to Resilient Modulus [M_r]:

- **The use of Unconfined Compressive Strength** is currently allowed **but discouraged**. Report Design M_r as: 100% M_r for 'drained subgrade', 75% M_r for 'not drained subgrade.'

The use of one of these methods is allowed for all soil types:

- Laboratory derived M_r
- R-value correlation: (CDOT *pre-2015 Pavement Design Manual*, also shown in current MGPEC Equation 9)
- California Bearing Ratio correlation: $M_r = 2,555 * [CBR]^{0.64}$

2) Subgrade Mitigation

Low-Strength Subgrade Mitigation: Subgrade with $M_r < 5,000$ psi shall require the use of an Intermediate Stiff Layer (ISL) beneath pavement. The ISL shall be an unbound aggregate base course, Mechanically Stabilized ABC, or Chemically Stabilized subgrade layer.

Expansive Soil Mitigation: The following treatment depths should be used based on representative swell potential of the subgrade soils or as identified by the geotechnical engineer (under 200 psf surcharge). The moisture content of the subgrade *must be* maintained until placement of the ISL/pavement structure.

- Low Swell, < 2 percent: 12 inches moisture condition and recompaction
- Moderate Swell, 2 to 5 percent: 3 feet of moisture conditioning and recompaction
- High Swell, 5 percent or more, or claystone: 5 feet of moisture conditioning and recompaction

3) Use 1993 AASHTO flexible design equation:

- S_o = Overall Standard Deviation = 0.44
- Asphalt Strength Coefficient [**a1**] = 0.44 [Assumes Agency approved Superpave mixes]
- Aggregate Base Course strength coefficient [**a2**] [CDOT Class 5 or 6 with minimum R-value of 78]
 - Soft Subgrade [$M_r < 5,000$ psi] = 0.08 (Unbound ABC)
 - Firm Subgrade [$M_r \Rightarrow 5,000$ psi] = 0.11 (Unbound ABC)
- Chemical Stabilized Subgrade use [**a2** or **a3**] = 0.12 [Assumes 160 psi strength. May justify higher per 2014 CDOT Pavement Manual, Section 3.5]
- Mechanically Stabilized Base use [**a2**] = 0.15 (6 inches to 12 inches of ABC over MGPEC Type II Geogrid)

4) Use 1993 AASHTO rigid design equation:

- S_o = Overall Standard Deviation = 0.34
- Concrete Flexural Strength [**3rd point beam**] = [S_c] = 650 psi

- **Modulus of Elasticity = $[E_c]$ = 3,400,000 psi**
- **Estimate K-value** from ACPA K-value Calculator found at:
<http://apps.acpa.org/applibrary/KValue/>
Recommended value for unbound granular $M_r = 20,000$ psi
- **Drainage Coefficient $C_d=1$** , assume subgrade has been considered in 1) above
- For additional concrete design values, go to the current MGPEC Pavement Design Standard.

5) MGPEC Overall Reliability $[Z_r]$ – Same for Flexible (HMA) & Rigid (PCCP) Equations:

- Arterial & Industrial Streets: $Z_r = 95\%$
- Commercial and Collectors Streets: $Z_r = 90\%$
- Local & Residential Street: $Z_r = 80\%$

6) Change in Serviceability Index = $[\Delta PSI]$ & Terminal Serviceability $[P_t]$ Index for traffic categories:

- Arterial, Industrial, Commercial and Collector Streets = 2.0 ($P_t = P_{\text{terminal}} = 2.5$)
- Local & Residential Streets = 2.5 ($P_t = P_{\text{terminal}} = 2.0$)

Agencies using design software other than the MCPEC software need to consider that these programs might not take into account swelling/collapsing soils, freeze thaw conditions, subgrade drainage, and/or other special interest conditions that may and will come up. The MGPEC Design Standards along with Agency requirements need to be considered when inputting design parameters into the software (i.e. such as growth, ESAL loading, vehicle types).

March 13, 2017 by MGPEC Pavement Design Standards Task Force. Concurrence of MGPEC Steering Committee.