Comments to Florida Department of Transportation
Pavement Type Selection Process

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DISCOUNT RATE

Current Florida DOT LCCA procedures use the same real discount rate of 4% for both materials. As the Life Cycle Cost Analysis (LCCA) results (and future expenditures) are highly impacted by discount rate, it is important to identify and incorporate measurable economic variables that reflect the actual inflation rate of each product. Using data from industry recognized sources such as the Bureau of Labor Statistics (BLS) the US Geological Survey (USGS) and FDOT, it can be shown that asphalt and concrete have different inflation rates. As such, in order to get a true and accurate estimate of future expenditures and each pavement's Net Present Value (NPV), the LCCA should use each material's inflation rate.

Discussion:

The discount rate is used to account for the time value of money and all State Highway Agencies follow the FHWA recommendation to use the same "real" discount rate when comparing alternatives. According to FHWA, a *"Real discount rates reflect the true time value of money with no inflation premium and should be used in conjunction with non-inflated dollar cost estimates of future investments."***Error! Bookmark not defined.**

While reference 1 states that 4% is a "good practice" value; more recent recommendations in FHWA's Nov 13, 2008 Technical Memorandum (reference 2) state:

> *"The Final Policy Statement on Life -Cycle Cost Analysis (LCCA), published in the Federal Register on September 18, 1996, recommends that future agency costs should be discounted to NPV or equivalent uniform annual costs using appropriate (real) discount rates. Discount rates should be consistent with OMB Circular A-94. The trend over the past 10 years indicates a discount rate in the range on 2-4 percent is reasonable.*

Table 1 shows the OMB recommended discount rates since 1979[3]. As can be seen, the current OMB recommended "real" discount rate is 2.7%, which is well below FDOT's current real discount rate of 4%. It should also be noted that there are only 5 occurrences of a discount rate of 4% or greater in the last 20 years, and that the last time a 4% or greater discount rate was recommended by OMB was in 2000.

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[1] Life-Cycle Cost Analysis in Pavement Design, Pavement Division Interim Technical Bulletin, U.S. Department of Transportation, Federal Highway Administration, FHWA Publication No. FHWA-SA-98-079, September 1998.
[2] *Clarification of FHWA Policy for Bidding Alternate Pavement Type on the National Highway System*, U.S. Department of Transportation, Federal Highway Administration, Nov 13, 2008 http://www.fhwa.dot.gov/pavement/081113.cfm
[3] OMB Circular A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, http://www.whitehouse.gov/omb/circulars_a094/ .

Table 1: OMB Recommended Real 30 Year Treasury Interest Rates (Discount Rates)

Year	30 Year Real Treasury Discount Rate	Year	30 Year Real Treasury Discount Rate
1979	5.4	1995	4.9
1980	3.7	1996	3.0
1981	4.8	1997	3.6
1982	7.9	1998	3.8
1983	5.6	1999	2.9
1984	6.4	2000	4.2
1985	7.4	2001	3.2
1986	6.7	2002	3.9
1987	4.4	2003	3.2
1988	5.6	2004	3.5
1989	6.1	2005	3.1
1990	4.6	2006	3.0
1991	4.2	2007	3.0
1992	3.8	2008	2.8
1993	4.5	2009	2.7
1994	2.8	2010	2.7

Treasury Interest Rates for 30 Year Maturities

As mentioned, the use of the same real discount rate assumes that the inflation rate for the different alternatives and materials are the same. The real discount rate is calculated by subtracting the inflation rate from the interest rate.

$$\textit{Real Discount Rate} = \textit{Interest Rate} - \textit{Inflation Rate} \qquad \text{Eq. 1}$$

For public works projects, the interest rate is typically assumed to be the nominal interest rate on other public investments whose duration matches the public works project duration, such as 30-year U.S. Treasury Notes and Bonds.

For the inflation rates, the major assumption is that the items being compared are similar to the general rate of inflation. This is not a valid assumption. Figure 1 below shows the Producer Price Indexes for Cement, Ready Mix Concrete, Asphalt Paving, the Producer Price Index for all Commodities and the Consumer Price Index. [4] Though not equal, the inflation rates for the PPI, CPI, Cement, Ready Mix Concrete are generally increasing at the same rate (4.1% to 4.8%), while asphalt has been increasing at the much faster rate of 7%. While Figure 1 is based on national data, the same trend holds for state data.

Figure 2 shows the FDOT Bituminous Concrete Index,[5] the FDOT AC 20/30 Index,[6] a cement index developed from the USGS data,[7] and the BLS data for cement, concrete and liquid asphalt

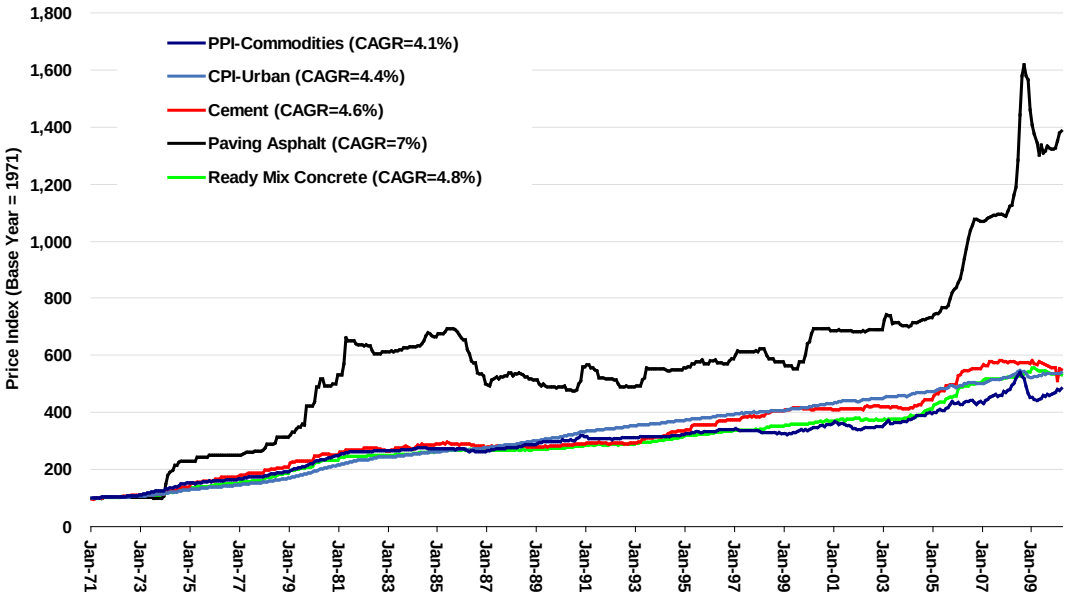
[4] U.S. Department of Labor, Bureau of Labor Statistics http://www.bls.gov/ppi/home.htm and http://data.bls.gov/cgi-bin/srgate Paving Asphalt Series ID = wpu13940113, Cement Series ID = wdu13220131 and wpu13220161, Ready Mix Concrete Series ID = wpu1333, CPI-Urban Series ID = CUUR0000SA0, PPI-Commodities Series ID = WPU00000000 (Note 1971 was used as a base year because it is the first year that Ready Mix Concrete Data is available). (Additional construction Material Series ID are: Liquid Asphalt - wpu05810112; Steel - wpu1017; Aggregate - wpu1321; Highway Construction - PCUBHWY--BHWY--)

[5] FDOT Quaterly Trends Report, http://www.dot.state.fl.us/specificationsoffice/Estimates/Trends/Files/QuarterlyPriceTrends.pdf

since January 2000. As can be seen, both the liquid asphalt and cement data follow reasonably well the BLS data, showing that the national BLS data provides reasonable results.

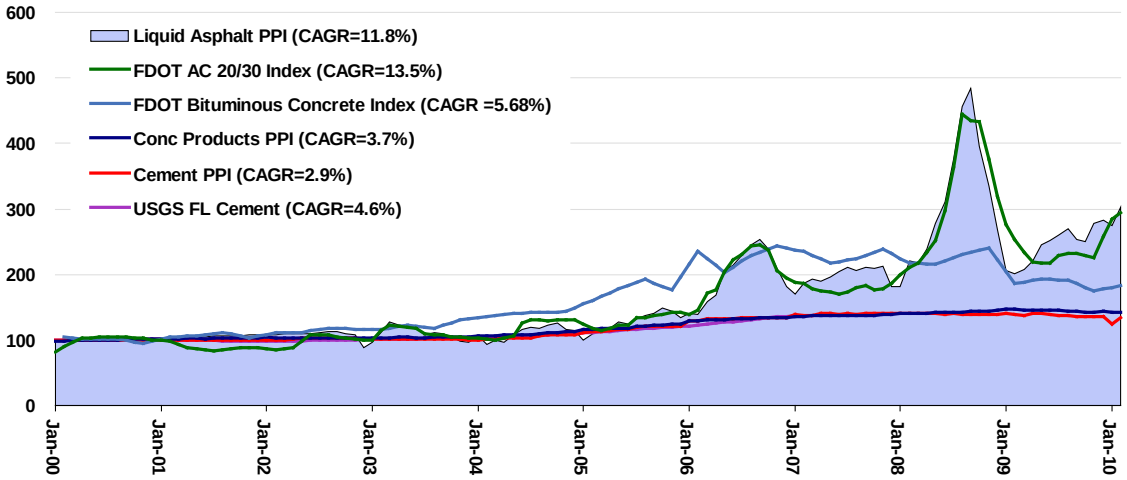
Figure 1: Producer Price Indexes (Base Year = 1971)

(CAGR = Compound Annual Growth Rate or Inflation Rate)[8]



Through March 2010

Figure 2: Price Indexes for Materials using Local Data (Base Year = 2000)



Note that FDOT does have a Portland Cement Concrete Index (see Figure 3) and as FDOT has stated, their data for concrete pavement does not follow the national trends. However, in

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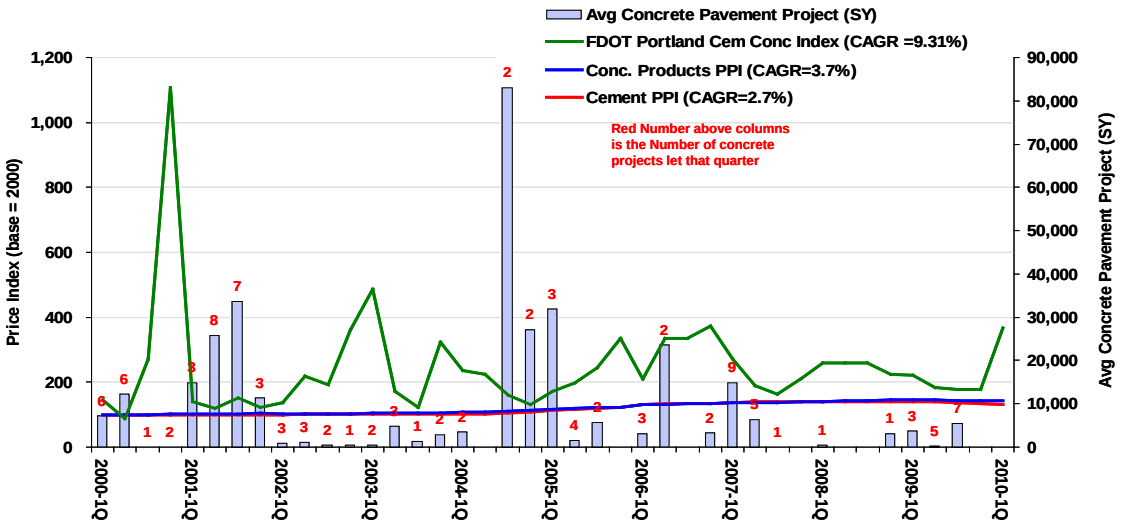
[6] FDOT Fuel and Bituminous Price Index, http://www.dot.state.fl.us/construction/fuel&bit/fuel&bit.shtm

[7] Cement Prices, US Geological Survey, Minerals Yearbook (Tables 11 or 12 depending on the year) http://minerals.usgs.gov/minerals/pubs/commodity/cement/ (last year of data is 2007)

[8] CAGR = (Current Value / Begin Value)$^{1/n}$ – 1 where n = number of periods between current and beginning values

reviewing the data, it is believed that the reason that the FDOT data does not follow the national trend is due to the small number of projects, and small size of projects let in Florida. That is, because the data is limited, changes from one quarter to the next are highly influential. Coupled with this is the fact that most FDOT concrete projects are very small and thus they have high unit prices. When combined, these two issues have caused the FDOT Concrete Pavement Index to be highly variable, and most likely not representative of actual economic conditions.

Figure 3: FDOT Portland Cement Concrete Index in relation to other Indexes and Project Size (Base Year = 2000)



Note: Although asphalt price inflation and volatility are the reasons that "price adjustment clauses" were introduced; the use of a "price adjustment clause" to compensate for the volatility of liquid asphalt, while at the same time using a "real" discount rate to account for future costs is contradictory and inconsistent.

Recommendation:

To address the issue of different inflation rates, we recommend you follow the procedures outlined in the Department of Army's publication "*Economic Analysis: Description and Methods*"[9] and the Department of Commerce's publication "*Life Cycle Costing Manual for the Federal Energy Management Program.*"[10] These publications deal with the inflation rates that differ from the general inflation rate in one of two ways:

[9] Economic Analysis: Description and Methods, Army Pamphlet 415-3, Department of the Army, August 10, 1992, http://www.army.mil/usapa/epubs/xml_pubs/p415_3/head.xml (see specifically Section 3-6)

[10] Life-Cycle Costing Manual for the Federal Energy Management Program, National Institute of Standards and the US Department of Commerce, NIST Handbook 135, http://www.bfrl.nist.gov/oae/publications/handbooks/135.pdf (see specifically Chapter 3, Section 3.3)

1) Estimate future costs (termed current dollars in these publications) to the year of activity by inflating today's costs using the appropriate rate of inflation and then discount back using "nominal" discount rates.[11]
2) Escalate the today's constant dollar by the difference of the general inflation rate and the commodities inflation rate to the year of activity and then discount back using "real" discount rates. Basically this involves developing 2 real discount rates: one for concrete using its inflation rate and one for asphalt using its inflation rate,

It is important to recognize that either of these two ways will produce the same results, and if the inflation rates of the different materials are the same, it will give the same results as the procedures outlined by FHWA in reference 1. Of these two ways presented, we prefer method 1 because:

- It is transparent with the assumptions of interest and inflation. From a financial perspective is it easier to judge whether or not the inputs are indicative of the financial situation of the agency (much in the same manner knowing the pavement designs helps engineers judge whether or not the rehabilitation schedules are correct).
- Agencies can account for the different underlying inflation rates associated with the different materials of each alternate by using long term historical inflation rates. Because inflation rates are not embedded in the real discount rate calculation, the inflation rate becomes just another input.
- Because future costs are inflated, the agency has a much clearer estimate of what their future cash expenditures will be and what they need to plan for in regard to program spending based on the analysis of their pavement selection process.

While it may be argued that the future rates are unknown, the Bureau of Labor Statistics has 50 years of construction history data with which to calculate inflation rates for most construction materials[12]. And while "past performance is not guarantee of future returns," an agency can do a sensitivity analysis or a probabilistic analysis to see how varying the individual rates affect the results. However it is handled, it is important to understand that any error based on selecting the slightly wrong rate is better than ignoring inflation altogether and not accounting for different underlying inflation rates or planning correctly for future expenditures.

Recommended Process for Establishing Inflation and Discount Rates:

To provide guidance with nominal inflation and nominal discount rates, FDOT should develop a table such, updated 1 to 4 or more times a year, showing the asphalt and concrete inflation rates based on the Bureau of Labor Statistics inflation rates for the series described in reference 4. For the nominal discount rates, use the Nominal 30 Year Interest Rates on Treasury Notes and Bonds from the OMB circular A-94, Appendix C (reference **Error! Bookmark not defined.**), which is updated every December for the following year.

[11] For "nominal" discount rates, we recommend the current 30 year Nominal Interest Rates on Treasury Notes and Bonds of Specified Maturities from OMB Circular A-94, which is currently 4.5%.
[12] Since 1960, asphalt's the historical inflation rate has been growing between 1.6% and 2.8% faster than cement and concrete inflation rate.