SUSTAINABLE PAVEMENTS:
LENGTHENING THE LIFE OF YOUR PARKING ASSETS

(WHITE PAPER)

By Fernando Pons, P.E., MBA, LEED AP
Pons & Associates, LLC; Herndon, VA
fpons@ponsassociates.com



INTRODUCTION AND CONTEXT

Building system assets such as roofs, facades, HVAC systems, and even foundation systems, are constructed to meet their intended design life, are regularly guaranteed by the contractor or manufacturer, and are proactively maintained by owners. These building system assets currently monopolize the design and maintenance life cycle dollars of retail and commercial properties.

Pavements, on the other hand, are generally not viewed as valuable building/site assets affecting the owner's pro forma or having significant economic value. They are often under-designed, under-constructed, and under-maintained, and are typically relegated to a secondary role, to be addressed and dealt with as a deferred maintenance item 3, 5, or 10 years after construction is complete, if at all. This reactive and passive approach with pavements, and all parking assets including garage structures, does not make technical, sustainable, or business sense, and often results in capital outlays in the several $100,000s for at-grade pavements [and up to or exceeding $1M for parking garage structures] before design lives are reached.

Large at-grade pavement capital outlays are typically initiated, unexpectedly, when one of the following events occurs before the end of the pavement's design life (typically either 10 or 20 yrs):

1. Pavement patching/repair work gets to be a <u>reoccurring spring time event</u>
2. Complaints from on-site personnel mount due to unacceptable <u>disruption of operations</u>
3. Premature chronic distress or widespread pavement failure prompts unscheduled <u>complete reconstruction</u>.

Reacting to any of the above events inevitably results in higher life cycle costs, increases maintenance costs, and leads to unacceptable loss of revenue. This white paper reviews a few traditional and non-traditional strategies to lengthen the life of your at-grade pavements and ultimately help the owner's pro forma (predictions of future capital expenditures).

THE TRADITIONAL PAVEMENT PLANNING PROCESS: COMMON PITFALLS

Under the current typical design-bid-build project delivery for new pavement construction, the geotechnical engineer-of-record provides subgrade improvement and thickness design recommendations;

the civil engineer-of-record takes these recommendations and prepares pavement design drawings and specifications; and, finally, a pavement subcontractor, working for the general contractor, competitively bids and constructs the specified pavements. Also under this scenario, the designers are often encouraged or directed to design pavement systems that are inexpensive (i.e., marginal), and therefore likely to fail prematurely. Failure is further “encouraged” by the soil-structure interaction complexities; quality control and quality assurance are often not adequate; and the pavement constructor is permitted to rely on change orders for unanticipated conditions while being directed to construct pavements that have no margin of error.

Premature pavement failures are often related to one or a combination of the following pitfalls (among others):

- Poor understanding and modeling of anticipated traffic patterns through the life of the pavements
- Under-characterization of soil and groundwater conditions
- Under-estimation of external environmental conditions such as repeated freeze-thaw cycles
- Under-estimation of man-placed historic fill soils at the site
- Lack of proper pavement draining media (both free-draining aggregate base and pavement subdrains)
- Unanticipated changes in the near-surface groundwater-moisture-regime through the life of the pavements
- No consideration of how future on-site or nearby development will impact near-surface groundwater conditions
- Poor workmanship (in particular non-uniform pavement thicknesses in asphaltic concrete; inadequate sealing and detailing of joints for concrete; and inadequate slope drainage)
- Poor quality control/assurance controls especially when pavements are constructed on poor subgrade soils or backfilled areas.

PUSHING THE ENVELOPE: SUSTAINABILITY

In addition to the pavement development pitfalls encouraged by common practice, building facilities are increasingly built either on abandoned, redeveloped or environmentally-impaired sites, especially in large urban centers, military bases, or industrial settings, resulting in further challenges and additional potential pitfalls leading to premature failure. Given a climate of escalating construction and energy costs, limited available “greenfield” sites close to urban cores, and heightened awareness and desirability for sustainable design solutions, we believe that constructing pavements that fall short of their design lives will be the exception in the future rather than the norm.

The trend moving forward should be to plan, design and build longer-lasting pavements <u>that match</u> the longer life cycle lives of other building systems such as structural systems (50+ years), HVAC systems (20 - 30+ years), and roofing systems (15 – 20 years for conventional roofs and up to 50 years for green roofs). Retail and commercial properties sustainably built to last longer are likely to hold their value on the balance sheet without major unanticipated post-construction investments from owners. Proper planning of the design, construction, maintenance, and decommissioning stages of pavement systems can result in substantial short- and long-term cost savings.

It is important to point out that the pavement planning process should encompass consideration of not only the design and construction stages of development (the traditional approach), but also serious early consideration to maintenance, reconstruction, and decommissioning activities which have a direct impact in pro forma financial statements (i.e., life-cycle costs). Planning for sustainable pavements means undertaking a systems-approach during the initial stages of pavement design, in consideration of the economic, social, and environmental impacts of pavement development. It may also be necessary to use risk management and life-cycle costing techniques to properly assess and mitigate financial risks during the life of the pavements, as well as benchmarking pavement performance throughout its life by using established pavement index (PI) condition surveys.

Specific elements of sustainable development strategies include construction materials recycling opportunities, for example the reuse of on-site recycled asphalt pavement (RAP) in off-site hot-mixed asphalts plants, the reuse of recycled concrete from on-site demolition activities as new pavement subbase or general aggregate – assuming the material is properly segregated, crushed and processed - and full-depth reclamation of on-site pavements. Porous pavement and low impact development (LID) designs should also be considered as cost-saving options to reduce stormwater runoff quantity and improve stormwater quality.

STRATEGIES TO LENGTHEN THE LIFE OF YOUR PAVEMENTS

Ultimately, the optimal pavement design is the technically-feasible most economical solution that achieves established goals, balancing both short-term and life-cycle considerations. Pavement designs should be benchmarked with regard to the following seven drivers:

1. Traffic Conditions
2. Subsurface Conditions
3. External Environmental Conditions
4. Cost (Long- and Short-term considerations)
5. Property Use (Current and Future)
6. Project/Contract Delivery Mechanisms
7. Sustainability

The following table outlines available, innovative strategies that can be applied to lengthen the life of your pavements, as they relate to these seven drivers.

Table 1
Strategies to Lengthen the Life of Parking Assets

Common Strategies (Often overlooked)	Sustainable Strategies
■ Consider future development and its impact on near-surface moisture changes. ■ Consider site grading and its impacts on the final pavement subgrade conditions ■ Understand the site hydrogeology and beware of underground near-surface water. Consider and encourage implementation of pavement subdrain systems, and free-draining subbase (relatively fines-clean aggregate such as ASTM No. 57 stone generally drains better than compacted road base DOT ¾" stone).	■ Take advantage of possible cost savings from reuse of recycled materials, given careful consideration to the state-of-the-art in the locality, as well as the relevant DOT guidelines. ■ Explore sustainable solutions such as porous pavements to limit stormwater volumes. ■ Take advantage of increasing low impact development (LID) best management practices (BMPs) to minimize stormwater volumes as well as improve stormwater

quality.

- Don't be afraid to chemically treat poor subgrade soils (e.g., lime, cement, flyash) assuming a benchmarking testing program is conducted to determine an adequate mix, and/or experts are involved/consulted.
- Establish specific pavement design criteria consistent with the optimized pavement life cycle objectives.
- Consider geogrid reinforcement of poor soil subgrades as a proven solution.
- Have your design performed by an experienced engineer, especially if urban, poor soil, shallow groundwater or historic fill conditions are known to exist.
- Pre-qualify your pavement contractors. Retain them directly. Hold them accountable for the design life of the system. Ask for references.
- Implement a pro-active maintenance program (similar to a roofing maintenance program) – inexpensive crack and joint sealing as well as sealcoating and overlaying should be performed periodically.
- Perform pavement index (PI) condition surveys to benchmark your pavement performance and fine-tune your maintenance program through the life of the pavements.
- Provide adequate construction oversight.
- Hold the contractors and designers accountable for their work and the long-term performance of pavements.
- Ask the contractor to develop a Construction Materials Recycling Plan for approval of the owner and the design team. The Plan should clearly outline possible Contractor/Owner shared savings.
- Consider alternate project/contract delivery mechanisms such as design-build (D-B). Pavement construction can be an excellent candidate for D-B as it lends itself to a performance specification, leaving the D-B team free to use innovative technologies and engineering to reduce cost while extending the useful life of the pavements.
- Consider an incentive bonus structure to benchmark and reward both short-term as well as long-term pavement performance. This bonus program should target owner construction managers as well as pavement contractors – for example, the project manager or constructor may receive a bonus, as a percent of realized life-cycle cost savings, at the end of 5, 10 and 20 yrs. based on objective periodic pavement index (PI) condition surveys.
- Have a Decommissioning Plan, as well as a Redevelopment Plan. The future likelihood that your site will be redeveloped is higher now, given a climate of escalating construction and energy costs, limited available "greenfield" sites close to urban cores, and heightened awareness and desirability for sustainable design solutions.