“Overcoming Engineering Obstacles to Walkable Thoroughfare Design … Case Studies”

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ABSTRACT

This paper provides unique lessons learned from four recent transportation design success stories. Each of these projects highlights solutions that helped bridge the divide between traditional, walkable thoroughfare design and conventional, highway-oriented engineering practice. The author will show how these designs for healthy, walkable thoroughfares are carried through the planning and engineering design process. The case studies presented cover varying phases of design, highlighting conflicts that arose and the solutions provided to maintain the integrity of the original concept plans. Case studies include the following projects:

- Design of Court Square Plaza in Montgomery, Alabama
- Planning and traffic analysis for Maybank Highway in Charleston, South Carolina
- Unique walkable parking solutions for downtown Savannah, Georgia;
- Walkable thoroughfare designs from the Pass Christian, Mississippi Comprehensive Plan.

INTRODUCTION

Another title for this paper could have been “Overcoming Obstacles to Engineering Walkable Thoroughfare Designs”, as the obstacles we encounter are typically not engineering problems, per se, but rather conflicting design objectives. Put simply, for decades we were taught to design thoroughfares for the fastest safe speeds while achieving the greatest vehicle throughput. In contrast, current practice recognizes that many compact urban areas need walkable thoroughfares which require lower design speeds with secondary emphasis on vehicle throughput. Capacity is primarily created via complete networks. When examining the physics of pedestrian crashes and the characteristics of highly walkable places (which are recognizable by the large numbers of pedestrians found walking there), the design issues are readily apparent to most engineers. Pedestrians thrive where cars travel slowly, and cars travel slowly where pedestrians thrive.

Unfortunately, the bulk of traffic engineering and geometric design guidance focuses on fostering faster motor vehicle speeds. We assign traffic level of service based on expected vehicle operating speed and delay, and we design roadways and intersections to permit the highest practical operating speeds. HPE has found that even when engineers want to apply lower design speed, existing guidance, recommendations, standards, and codes frequently thwart their efforts. The case studies herein describe several ways HPE has successfully provided engineers with a path forward to yield great walkable thoroughfare designs.

The earliest work described here, from 2006, predates publication of the ITE/CNU Recommended Practice "Designing Walkable Urban Thoroughfares – A Context Sensitive Approach." In fact, that document includes some of the lessons learned and described here. This recent experience provides deeper insights into the Walkable Thoroughfares document, and will, the author hopes, provide engineers with a greater understanding of walkable thoroughfare methods. Each case study highlights a different problem and describes key findings.

Case Study 1, Court Square Plaza, describes the design process used to augment an already-let street project and create a more walkable urban thoroughfare. The new design recreated a shared space plaza, a design concept unfamiliar in this country for many years. Significant design obstacles were overcome, allowing the current pedestrian-friendly plaza to emerge.

Case Study 2, Maybank Highway, describes a "battle of traffic models" in which traffic operations software was used to verify a community's vision of walkable thoroughfares, as opposed to fast highways through the town centers. In early attempts to implement the approved design, local engineers ran headlong into conflicting guidance between conventional engineering practice and design experience with walkable thoroughfares.

Case Study 3, Savannah Parking Study, describes what happens when one of America's most famous, historically-planned cities attempts to "modernize" its parking standards. Conventional thoroughfare design guidance was incompatible with James Oglethorpe's famous Savannah Squares, requiring a new approach to overcome this significant engineering obstacle.

Case Study 4, Pass Christian, is a "rubber meets the road" story of what can happen when engineers actually try to implement a walkable thoroughfare design, only to find the designs conflict with state law. Through careful review of the design objectives and intended function of the thoroughfare, a walkable engineering solution emerged in the end.

CASE STUDIES

Case Study 1: Court Square Plaza – Montgomery, AL

Court Square Plaza is an example of how traffic engineering standards can be met and applied in innovative ways to reclaim public spaces for multimodal movement. In this instance, the Manual on Uniform Traffic Control Devices (MUTCD) includes a provision that engineering judgment should be exercised in the selection and application of traffic control devices. Offering "Standards" and "Guidance" for the installation of traffic control devices, the MUTCD provided the framework for HPE's design and allowed the flexibility to create a great walkable space, reminiscent of European-style plazas.

HPE, working with the City staff and residents, recommended a space that serves pedestrians and motorists alike, with appropriate use of traffic control devices. Forgoing the more conventional roundabout design originally proposed and creating a less-regulated space helped emphasize the multi-use function of the design for both automobiles and pedestrians (**Figure 1**). The explicit emphasis of HPE's design was to manage vehicle speeds and, thus, increase pedestrian safety along this historically significant street, which leads directly to the Alabama State Capital. The new plaza concept is similar to Court Square's historical form, but with modifications to address 21st century concerns regarding vehicle speed. An historic 1885 fountain serves as a focal point, around which the traffic circulates, with the deflection helping to manage traffic speeds. The addition of rough, cobbled texture to the design also helps create lower speeds and enhance the area's walkability.

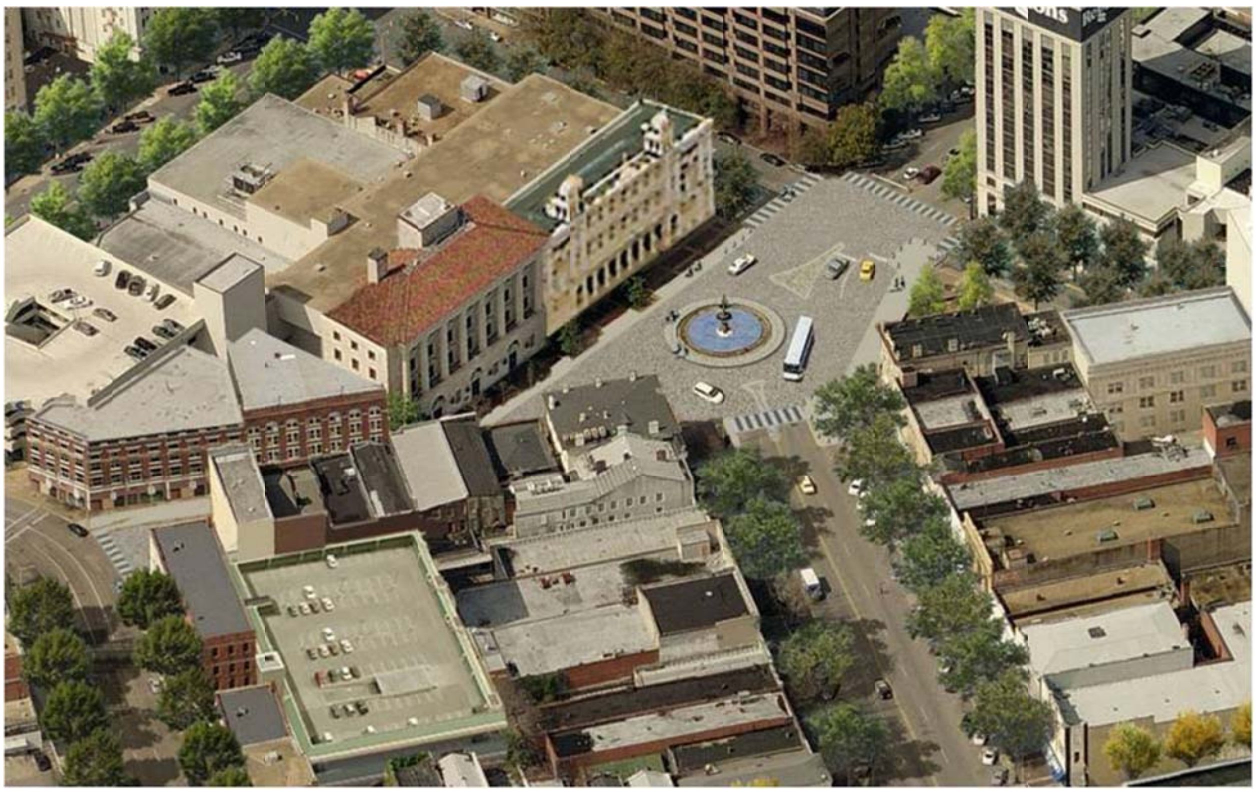


Figure 1: Conceptual Plan for Court Square Plaza
Illustration prepared by Dover, Kohl & Partners

Traffic control devices for the plaza were limited to splitter islands, stop signs, and "Keep Right" signs on two approaches to the fountain. HPE selected a limited number of traffic control signs and markings to reinforce that this plaza is a shared space that should not be seen as motor vehicle dominant. Primary speed control is achieved through the turning path adjacent to the fountain, the four way stop, the narrow entrances and the pavement texture. As documented via practice in the Netherlands, Hans Monderman was able to achieve some speed management by applying the minimum positive guidance at key intersections. Typical edge markings were purposefully omitted from the design since the low vehicular speeds and high street lighting were sufficient to create much-needed walkability and satisfy the City of

Montgomery's standards, while maintaining the safety of the intersection. For instance, the Manual suggests that all roundabouts be marked with paint on the roadway using a yellow line on the inner side and a white line on the outer side. However, the plaza is not a true roundabout, though it has similar functions. Under the low speed environment of the plaza and the high level of street lighting, these markings would be redundant and their addition would not further benefit drivers or pedestrians. Eliminating these roadway markings contributes to the pedestrian orientation of the space without compromising safety.

Another alternative design involved the use of alternating color pavement for crosswalks, stop bars, and lane separators in lieu of painted pavement markings. The textured cobble pavers used to help manage the speed of vehicular traffic were predominantly grey. HPE also specified white concrete pavers to replace the usual paint markings within traffic control devices. This was consistent with the MUTCD, as the white pavers provide a contrast to the grey road pavers. However, it was inconsistent with the Standard, which indicates that white pavement should only be used for shoulders and certain channelized islands. HPE noted that with the concrete brick pavement, painted lines would be difficult and costly to maintain, so the more permanent white pavers were called for, maintaining the integrity of the design.

Again, creating an inviting pedestrian-oriented space through a combination of conventional traffic control devices and other speed management elements was essential to this design. The built design is effective in managing vehicle speeds, as an a.m. period traffic speed study found the new average vehicle speed through the plaza was 18 mph, and the top speed recorded was 26 mph. Even at the high end of the recorded speeds, HPE observed vehicles yielding to pedestrians. The design speed for the plaza is 25 mph.

Applying the MUTCD in innovative ways as well as collaboration with the City of Montgomery allowed these design changes to take effect and helped to create a more walkable area in a historically significant area of the city. With its close proximity to the State Capital, Court Square Plaza now has a multimodal, pedestrian-oriented design that highlights the character of the area and increases the safety of those who wish to enjoy it. Ensuring that the traffic control devices meet the context of their surroundings, as opposed to boilerplate application, yielded safe and effective movement of vehicles and pedestrians. This project has helped bridge the divide between walkable spaces design and conventional motor vehicle oriented design.

Figure 2: Court Square Plaza Today

Case Study 2: Maybank Highway, Charleston SC

Maybank Highway is a two lane rural highway traversing Johns Island, southeast of Charleston, SC. The study area focused on the 3.75 mile section of Maybank Highway from Main Road/Bohicket Road on the west, to the Stono River Bridge on the east of Johns Island. A series of community visioning workshops, sponsored by the City of Charleston in 2007 resulted in a plan for a series of rural villages and hamlets, connected by a fine-grained network of streets. These "gathering places" are to be linked by a two lane Maybank Highway, refashioned to include on-street parking, Main Street style commercial nodes, and walkable vehicle speeds. To augment Maybank Highway, additional capacity will be provided by a network of additional two-lane streets. The workshop ultimately called for continued support of the rural and suburban quality of the island, specifically recognizing the need to enhance policies that yield planned growth without compromising the unique character of Johns Island.

In 2008, the LPA Group (LPA) consultants performed a study that resulted in plans to widen Maybank Highway to four divided lanes, proposing a high-speed, limited-intersection, 65-foot ROW highway design. Recognizing that this plan was in sharp contrast to residents' desire for preserving the rural, two lane corridor, LPA analyzed a two—lane concept with a limited, supplementary network of walkable thoroughfares. Their cursory results indicated that a two lane facility would not provide sufficient traffic capacity.

The community objected and the City of Charleston and Charleston County hired Hall Planning & Engineering (HPE) to prepare a more complete analysis of the two lane highway concept. The HPE analysis uses the same base data as the previous analysis, but with more detailed modeling of the area's proposed finer street network and its expected impacts on the future traffic flow on Maybank Highway.

The key issues included the following:

- create a proposed, viable, feasible alternative thoroughfare network; preparing traffic projections correlated to the previous study;
- create a simulated travel network in Synchro™ version 7;
- convince the City, County, and SC DOT that the proposed analysis and plan were reasonable, accurate, and viable.

HPE was responsible for resolving the above issues, while maintaining integrity of original plan prepared by the community. Starting where the earlier community visioning effort ended, HPE and the City determined the placement of a viable expanded street network. This network of existing, planned and proposed additional thoroughfares was constructed by looking at existing roads, rights of way that could be built upon, potential environmental impacts and negotiations with land owners for verbal approval of conceptual streets. The alternative network had to avoid wetlands and other sensitive areas, including allees of heritage live oak trees threatened under the four lane plan, as well as avoid existing neighborhoods, houses and built-up locations. The final proposed network is shown in **Figure 3**.

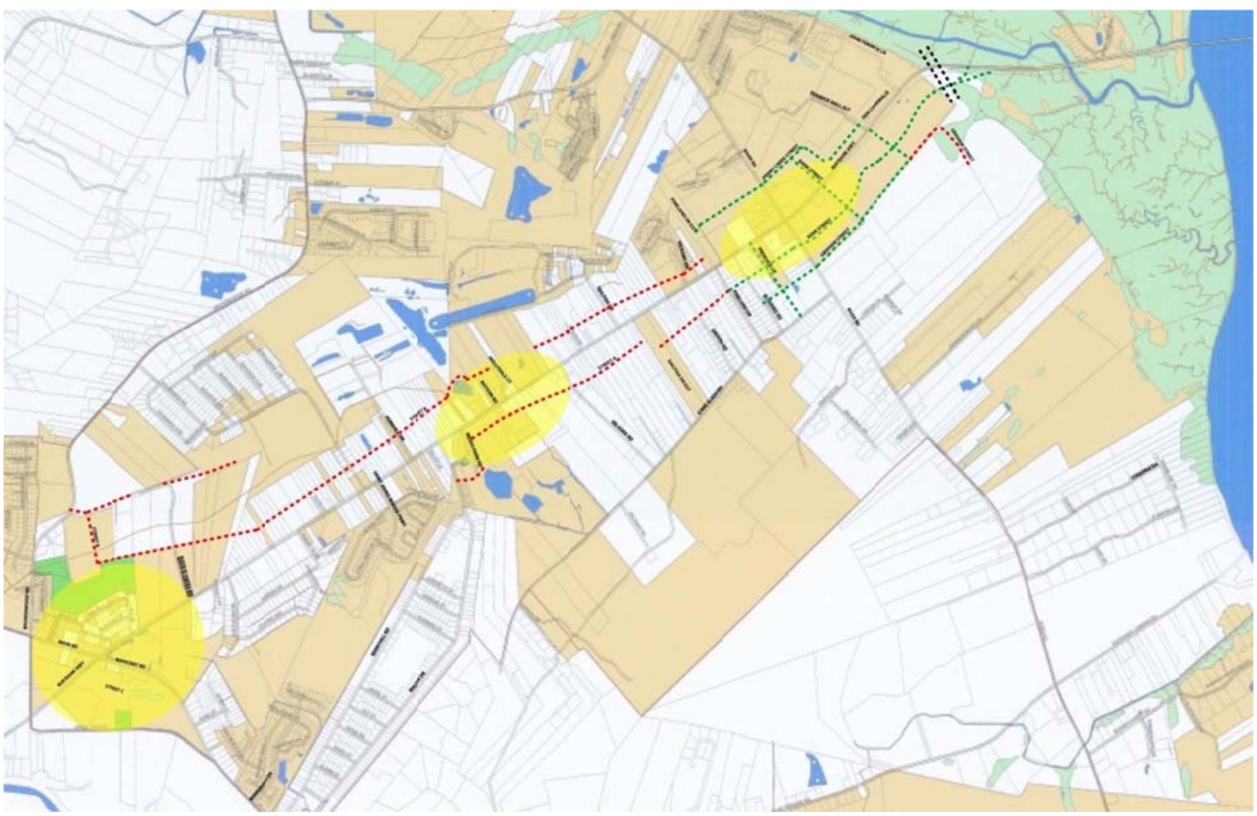


Figure 3: Maybank Highway Additional Network (shown in dotted green and red)
City Proposed Gathering Places are Conceptually Highlighted in Yellow Bubbles

Preparation of traffic projections required work with the local Council of Governments (BCDCOG) to adjust the future land use projections to redirect growth into rural hamlets, per the community land use vision. This resulted in a shifting of trip volumes, compared to the previous analysis, slightly reducing the volume of future trips assigned to Maybank Highway. Turning movements, however, were factored directly from the previous analysis, to ensure compatibility between the models – an “apples to apples” scenario, even though the land use assumptions were actually “apples to oranges.”

Using Synchro 7, HPE built the proposed network from the earlier steps and assigned the updated traffic. HPE started with the original trip assignments and modified these based on the additional available network. In locations where a movement LOS exceeded LOS D, HPE moved trips to a logical, secondary portion of the network, reflecting the tendency of drivers to use alternative routes to congested thoroughfares. In addition, the revised BCDCOG travel demand forecasts also shifted some demand to the area outside of Maybank Highway.

HPE compared the results of the proposed network analysis to the four lane Maybank Highway option. Through trip diversion to the alternative network, HPE was able to achieve the same LOS on Maybank Highway as the four lane option, while keeping the two lane geometry reflected in the community vision. Each step of this process was openly reviewed with the City, County and state, in an attempt to achieve unanimity and confidence in the outcomes. HPE made modifications along the way, at the request of the other parties, and received their consensus on the key steps of trip projection, network construction and Synchro analysis. In addition to Synchro, HPE used SimTraffic to evaluate the performance of the network for an entire peak hour of simulated traffic. HPE prepared over 15 alternative model modifications to address the concerns of the other parties.

One key issue was the distribution of traffic at the foot of the Stono River Bridge. HPE tested the “pitchfork” alignment of thoroughfares modified from a Glatting, Jackson study for Johns Island to distribute traffic through a proposed town center area, thereby relieving the overloaded intersection at Maybank Highway and River Road. **See Figure 4.**

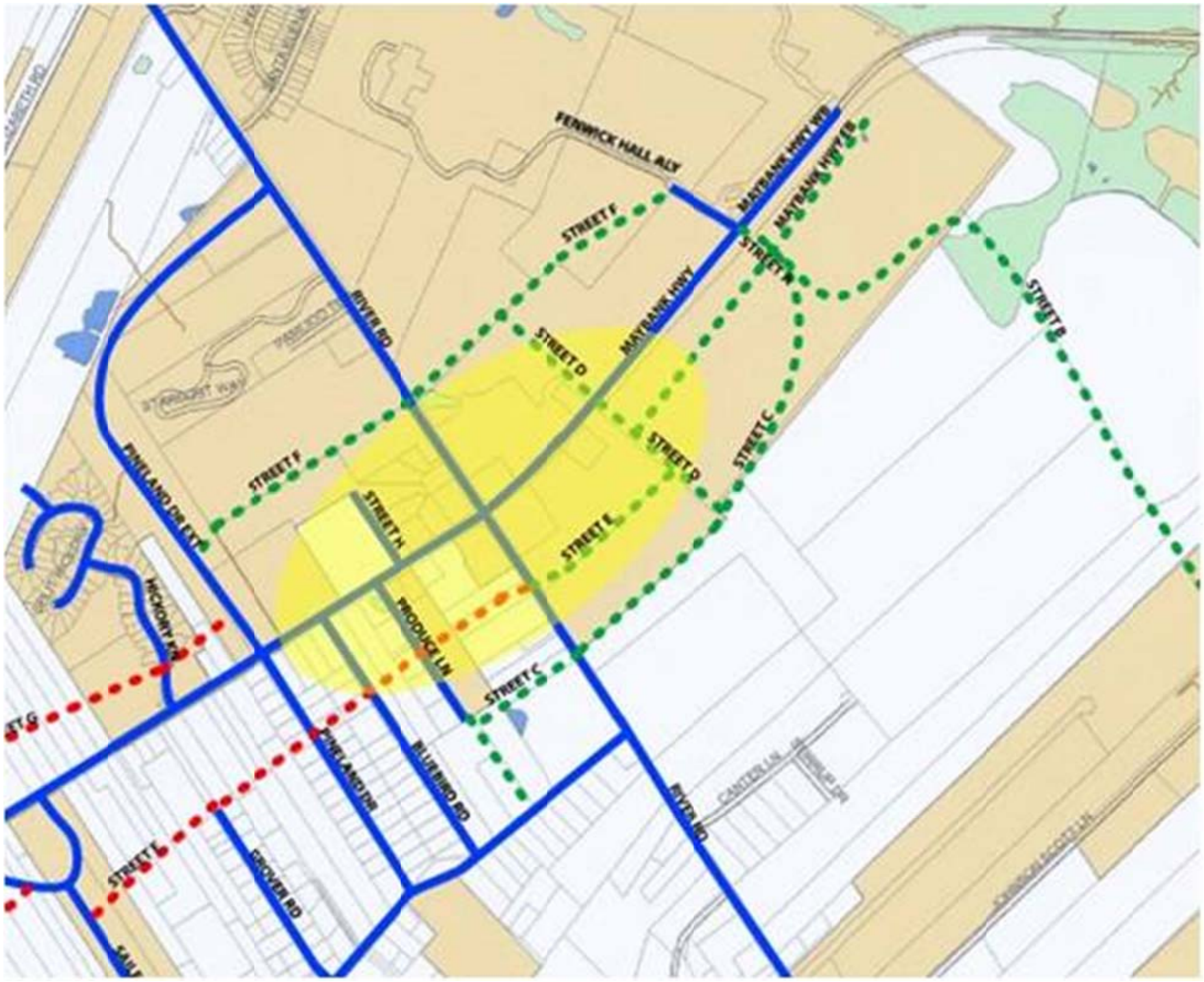


Figure 4: Maybank Highway Pitchfork (Strategy for Dispersing Traffic from Bridge)

The pitchfork thoroughfares allowed traffic to flow naturally to intersections north or south, depending on the intended destination per the regional demand model, rather than channeling all traffic into one single intersection at Maybank and River. In the final networks, this intersection performed better than the proposed intersection in the four lane plan, and had fewer lanes, resulting in a more walkable thoroughfare design. This design respected the community vision to a much greater degree than the four lane highway option. The additional network consisted of either two lane rural roads or two lane town/village streets with on-street parking and with character and scale in keeping with the community vision.

The County and their consultants remained committed to the four lane option, even though all concerns, critiques and issues had been addressed in the analysis process. The plan was finally resolved through an Urban Land Institute (ULI) Technical Advisory Panel (TAP) jury process, which confirmed the HPE two-lane Maybank Highway analysis as valid, while slightly modifying the pitchfork design. After the ULI TAP recommendation, the County adopted the "pitchfork", two-lane plan for Maybank

Highway. HPE continues to work with the County and City to refine the design of the pitchfork, as described in the following example.

Following the initial ULI findings, the County began initial design of the pitchfork network streets. At an intermediate review meeting, HPE noted the resulting designs were for higher speed streets (45 mph) that exceed the walkable thoroughfare design speeds of 30 mph or less. In discussion with the design engineers, HPE discovered that the engineers were simply following their standard design guidelines for these types of streets, which are rural today, as the town center has not yet been built. Through conversation with the design engineers, HPE was able to reframe the design question to specify a lower design speed, based on the planned land use for the area. With this guidance of a lower design speed, the engineers were then able to prepare revised drawings yielding plans closer to the originally-specified walkable thoroughfares.

Case Study 3: Savannah Parking and Transportation Analysis - Savannah, GA

The City of Savannah has the opportunity to provide more on-street parking and better manage its existing supply. Current policies and several challenges prevent parking from being utilized to its fullest potential. HPE prepared a parking and transportation analysis that examined why and offered suggestions that are context appropriate, optimizing this asset for the City's Central Business District. A major goal was to balance vehicular traffic mobility and the excellent pedestrian mobility, for which Savannah is internationally known, by maintaining its compact urban form.

Working with City staff, HPE divided downtown Savannah into three pilot areas, representing different contexts. Pilot locations are Broughton Street, Johnson Square and Oglethorpe Square (**Figure 5**). These recommendations per location are intended to be used as a guide for parking policies throughout Savannah in areas of similar context and character.

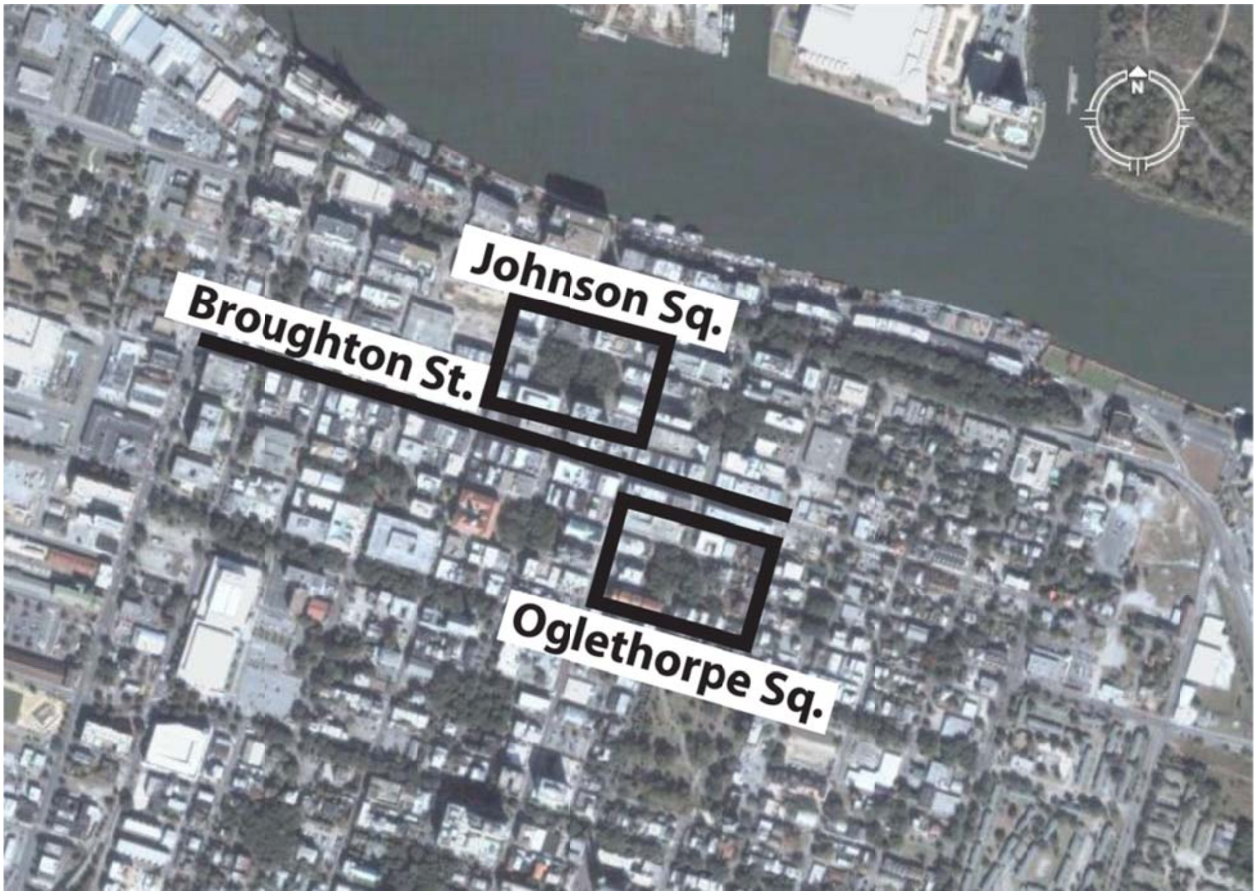


Figure 5: Savannah Parking Analysis Pilot Study Areas

Each of these pilot areas represented a certain context and function within downtown Savannah. It is important to understand the context because certain parking elements and policies are only appropriate in certain contexts. Those contextual traits were linked to a specific Transect zone[i] (see endnote).

The Broughton Street corridor is demonstrative of a T-5 zone (Urban Center), with its urban nature, a large number of land uses, higher density, articulated building style, wide sidewalks, multiple business entrances, on-street parking and street trees. The presence of these characteristics leads to slower speeds and greater walkability. Parking turnover is observed to be high based on the large number of land uses present.

Johnson Square is one of the densest and most urban areas in downtown Savannah. It is currently dominated by large users, such as banking institutions and offices. The building heights, mixture of uses and density resembles the most urban transect zone, T-6 (Urban Core).

Oglethorpe Square is the least urban pilot area analyzed. This square though mostly in a T-5 zone, borders closely with a T-4, General Urban zone, whereby the uses are less diversified and the intensity of development is lower. Oglethorpe Square also closely borders the more residential areas of downtown.

HPE measured the "walkability" of the three pilot areas to assess total mobility. "Walkability" is a term used in this effort to describe the extent to which places are comfortable for pedestrians, cyclists and transit users. Grading a location's walking environment is basic to assessing its total mobility. In this effort, the index was specifically utilized to better understand the impact of parking on Savannah's overall walkability.

For HPE's Walkability Index, the following ten criteria indicate the quality of the walking experience as applied to existing conditions of the three pilot areas:

1. Speed
2. Pavement Width
3. On-street Parking
4. Sidewalk Width
5. Connectivity
6. Pedestrian Features
7. Street Enclosure
8. Land Use Mix
9. Façade Design
10. Transit/Bicycle

The results of applying the HPE Walkability Index to Broughton Street are an average of 94 points out of 100, indicating a "highly walkable" street. The first and last blocks of the Broughton Street study area were excluded, as outliers where walkability is obviously decreased by the presence of large, unadorned, single-use buildings. The results of applying the Index to Johnson Square are an average of 86 points out of 100 for "very walkable". The score is somewhat lower than that obtained for Broughton Street. The main difference is land use and enclosure – land uses around the square were much less diversified and the buildings around the square are far larger and taller than those along Broughton Street, with much fewer entrances. The results of applying the Index to Oglethorpe Square are an average of 89 points out of 100, again, "very walkable".

HPE's parking recommendations, for each pilot area, were broken into several main themes:

- Function
- Timing
- Physical Layout of spaces

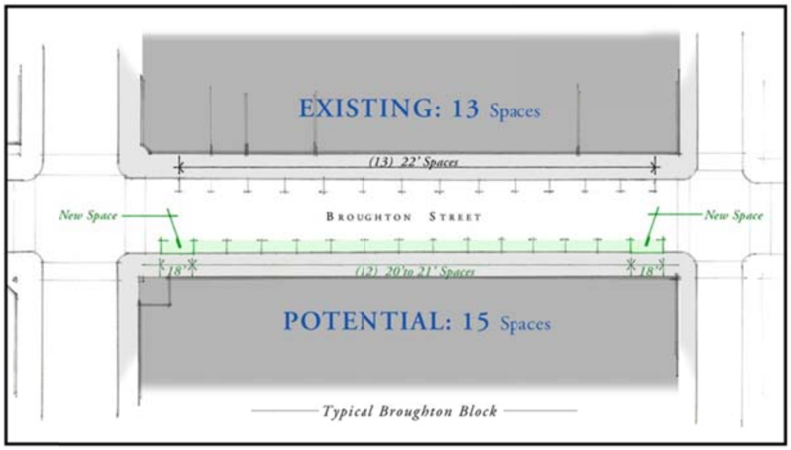
HPE provided recommendations for parking controls to assure that the on-street parking supply "functions" and is used in a manner consistent with the adjacent land use. For example, retail and commercial areas typically have many customers visiting for short periods of time. This means that the curbside parking near retail businesses should not be occupied by all day parkers and high turnover of these parking spaces is needed to provide parking for numerous users throughout the day.

It was essential for Savannah to regulate parking use, to encourage more efficient use of parking resources and more efficient travel. The City of Savannah should make the most convenient parking spaces available to certain higher-value uses.

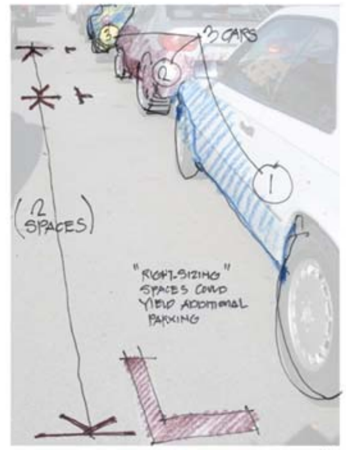
For “Timing”, HPE provided recommendations for the duration of regulated parking spaces, established by functional group and context zone and adjacent use. Specific duration, time of day and day of week regulations was reviewed for application by context zone and pilot area plan. HPE noted that efficient parking is achieved through proper placement, pricing, monitoring and enforcement. Savannah’s compact, highly walkable urban structure requires even greater focus on these strategies than standard suburban patterns where walking is not a significant factor. HPE proposed the following strategies for planning and operations that will optimize parking, offering financial benefits to local businesses, while adequately accommodating residents and visitors:

1. Monitoring
2. Pricing and Payment
3. Duration
4. Enforcement
5. Education

HPE delineated the physical layout types and dimensions of parking spaces for use in each context zone and pilot area. The physical form of public parking types, including on-street, parallel, angle and perpendicular parking and parking in lots and structures were established. Precise, physical recommendations were provided for each pilot area, highlighting the placement, style and size of spaces. In many cases, regularizing the size of parallel parking spaces yielded additional supply, as on Broughton Street. **Figure 6** below illustrates how restriping and providing more uniform spaces would yield additional spots.



Broughton Street: Increased Parking Concept/Strategy



3 Cars Parked within 2 Spaces Suggests the Potential for Additional Parking Spaces by "Right-Sizing" Spaces

Figure 6: Physical Parking Arrangement – Strategy for Increased Parking along Broughton Street
Illustration prepared by Sottile & Sottile

Implementation of these recommendations and standards will require augmentation to State of Georgia codes (O.C.G.A § 40-6-203(a)(2)). The standards found within this code are appropriate for many places, particularly in suburban locations where motor vehicle speeds are high and connectivity is low. They are not appropriate in an urban, walkable place like Savannah, where speeds are low enough to provide ample turning of vehicles onto side streets and where multiple connections and locations are available for fighting fires. In fact, these urban design elements are quite necessary in creating a walkable, thriving community and constitute something many new towns are striving to replicate. HPE recommended the City of Savannah work with advocacy groups around the state to augment State Code and assisted in providing the appropriate language to modify the code.

HPE's findings and recommendations are listed here:

- Provide more bicycle racks
- Implement new technology to monitor on-street parking occupancy
- Create a seasonal pricing scheme
- Post any new parking regulations on the City website
- Shorten bus stop bays on Broughton Street, Barnard Street and Bull Street
- Standardize stall lengths to 20'-21'
- Establish legal language justifying deviation from State Codes in urban, walkable settings
- Replace head-in angle parking with reverse (head out) angle parking to increase safety and parking inventory
- Move or remove underutilized turn lanes and passenger/freight loading zones
- Additional spaces were located along Broughton Street (15-25 new), Johnson Square (13) and Oglethorpe Square (7).

HPE's conclusions resulted in a net gain of 35-45 parking spaces within the three pilot locations: Broughton Street, Johnson Square and Oglethorpe Square. These recommendations will further promote a friendly and safe environment for the City's pedestrians and bicyclists. HPE also provided strategies to increase parking turnover through improved operations and pricing.

Case Study 4: Pass Christian, MS Walkable Thoroughfare Design

HPE participated in a post-Katrina design charrette for Pass Christian, MS, providing recommended walkable thoroughfare sections as part of a revised Comprehensive Plan. In the downtown area, these walkable thoroughfares were calibrated to the previously-existing, historical thoroughfares and included 9' or 10' travel lanes and 7' or 8' parking lanes, with one travel lane in each direction (no one-way streets) (see **Figure 7**). Curbs were designed as "straight" i.e., no bulb-outs or curb extensions, due to the already-walkable dimensions of the streets. When redevelopment began to occur in Pass Christian, a local engineering firm prepared street plans using, instead, conventional thoroughfare design standards, including 12' travel lanes and bulb-outs (see **Figure 8**). HPE was contacted by the city's planner and asked to provide assistance to the local firm with implementation of the thoroughfare sections contained in the Comprehensive Plan.

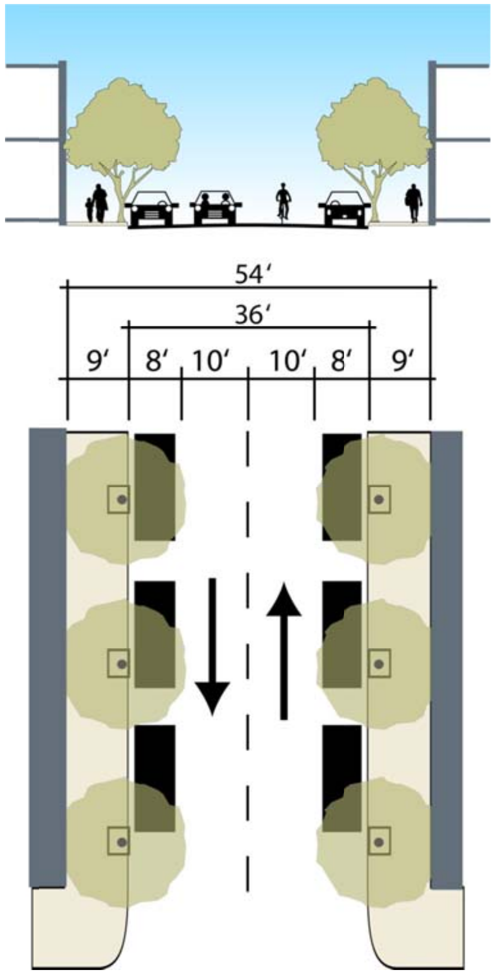


Figure 7: Proposed Downtown Thoroughfare

HPE reviewed the proposed plans and provided comments regarding points of deviation between the proposed plans and the coded thoroughfare designs. However, the most critical action HPE conducted was a collaborative, face to face meeting with the local engineers, in Pass Christian, in which the plans were rolled out and marked up together. HPE also walked the area with the local engineers and engaged in discussion of the various issues facing the downtown streets. These included traffic circulation for large trucks, fire truck access, and parking requirements for downtown buildings as they were rebuilt (Pass Christian's downtown was almost completely demolished during Hurricane Katrina, leaving only curb faces and sidewalks in most locations). The issue of expected travel speeds, and the effect of travel speeds on walkability, was also discussed, and HPE shared its findings and practices with the local engineers regarding this topic.

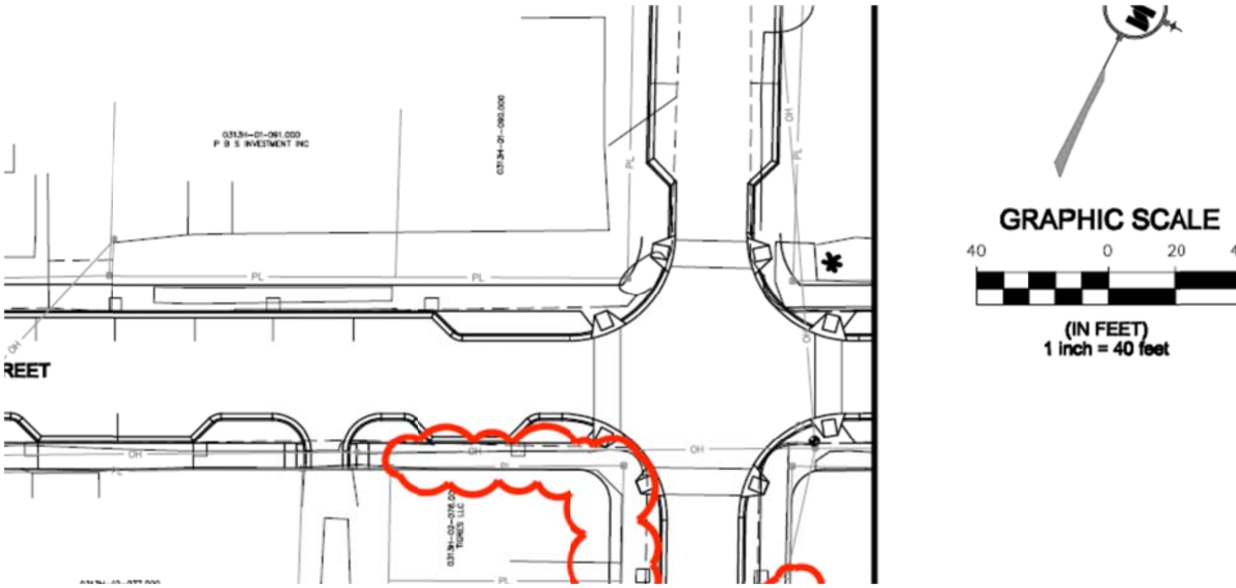


Figure 8: Design Drawings used 12' Travel Lanes and Bulb-outs

During the discussions with the local engineers, HPE found the primary design constraint was design speed. By state law, the lowest allowable design speed was 30 mph. This essentially tied the hands of the local engineers, forcing them to use the larger conventional street dimensions for lane widths, to match the 30 mph design speed. The larger lane widths were then to be mitigated through the use of curb extensions. The engineers did not express any particular misgivings about the narrower, coded walkable thoroughfare dimensions, and in fact agreed that these dimensions would be advantageous to the re-creation of a walkable downtown Pass Christian. The engineers also had mixed feelings regarding the curb extensions, but saw them as necessary when using the 30 mph design speeds.

HPE reviewed the state statutes and determined that local municipalities were allowed to set a lower speed limit in their downtown areas, if desired, through a simple act of the local governing body. Working with local City staff, HPE prepared legislative language defining the downtown area to function as a walkable, multi-modal district and, thus, setting the design speed and speed limit in this area to 20 mph. This language was adopted by the local government, thereby allowing the local engineering company to redesign the thoroughfares using the coded walkable thoroughfare standards provided by HPE.

The lessons learned from this experience have been used many times by HPE. Quite often, walkable thoroughfare standards do indeed vary from the conventionally-accepted AASHTO recommendations, upon which many, if not most, local government standards are based. Without adequate statutory support for the walkable thoroughfare standards, design engineers can be placed in a difficult situation, being asked to design streets that do not satisfy adopted engineering standards. In addition, the engineers may not always understand the negative relationship between higher traffic speeds and good walkability, as this subject is not addressed in most engineering guidance documents. Therefore, HPE has learned to start by listening carefully to the local/conventional engineering perspective, asking questions as necessary to fully understand the perceived design constraints and considerations. Then, by framing the walkable thoroughfares as an engineering problem, e.g., the management of travel speeds through the design of the thoroughfare, HPE has been able to work with local engineers to identify barriers to this objective and address those barriers. Most often, the problem can be addressed through adoption of appropriate design codes and standards to provide alternative dimensions for use in the design process.

CONCLUSION

These four case studies demonstrate unique strategies for overcoming design conflicts. Through our experience, we have found that these conflicts arise for innocent reasons, but nonetheless stand in the way of designing and creating walkable, livable, sustainable places. The most helpful design principle insists that adjacent context determine the function, scale and character of the thoroughfare in question. Until recently, the paradigm of designing primarily for automobiles was dominant. This approach is changing, but until its vestiges are finally overcome, tailored solutions like those presented in this paper will continue to be necessary when designing for the three forgotten modes of walking, cycling and transit.

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[i] The Transect organizes the natural, rural, suburban, and urban landscape into categories of density, complexity, and intensity. See the Center for Applied Transect Studies (CATS) website for more information: www.transect.org.