# Accelerated Urban Concrete Paving- UDOT SR-39 (12th Street, Ogden Utah)

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## Abstract

Highways, streets, and roads in urban areas are crucial to America's transportation system. Constructing, maintaining and reconstructing urban roadways can be accomplished in a sustainable, cost effective manner. Urban paving can, however, be complicated by maintaining access to businesses and residents. Additionally, traffic flow must be maintained throughout the construction project so as not to inconvenience the traveling public. Further, urban roadways typically incorporate multiple and varied utilities in or around the roadway that need to be addressed. SR-39, known as 12th Street in Ogden, in Northern Utah, is one of these challenging projects. The Utah Department of Transportation (UDOT) had a short time frame for reconstruction and a desire to have a sustainable, long-lasting surface that would limit disturbance to residences and businesses located on this vital corridor in Northern Utah. This paper will explore how innovative thinking addressed many of the common concerns associated with urban paving and how this project can serve as an example of why accelerated urban concrete paving is a sustainable, viable paving solution for DOTs and municipalities.

## Background

12th Street in Ogden is a major arterial that links historic downtown Ogden with the major mountain ski resorts which have brought large revenue-generating outdoor equipment manufacturers to the area. Recreational traffic is not the only headache on the road, it is also a major truck thoroughfare linking the city of Ogden to Interstate 15. It is estimated that the AADT is 23,000 with 16% truck traffic. In the eastern section of 12th Street many historic homes and neighborhoods utilize this road exclusively. Due to these factors, scheduling concrete placements was critical. Innovation, forward thinking, and partnering by the contractor and UDOT were essential.

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12th Street in Ogden was a first of its kind concrete paving project in Utah. Projects of this size and scope have typically been designed as a mill and fill overlay with asphalt. UDOT officials wanted a pavement with a long design life to limit the impact to property owners along this corridor so they decided to try a mill and fill concrete overlay. UDOT had an aggressive 100 calendar day timeline to complete the project to minimize disruptions to the traveling public and others along the project route. With this being an accelerated mill and fill type project there were limited funds to redo curb and gutter. The new concrete pavement had to match existing curb and gutter. It was also important to address all the utility concerns while maintaining proper base and cover requirements for concrete paving.

**Design**

As previously stated, the original scope of this project was to mill a portion of the existing asphalt and overlay with a new asphalt course. The pavement design utilized the MEPDG model. Cores were taken and it appeared most of the damage to the existing pavement was in the top four inches of the existing asphalt. The existing asphalt was about 6.5 inches thick. Removing four inches of existing asphalt and replacing four inches of hot mix asphalt (HMA) gave UDOT a life of about 15 years. Because 12th Street is in an urban area with existing curb and gutter which needed to remain because of budget constraints, additional pavement thickness was not a possibility. Additionally, milling more than 4 inches of existing asphalt would require this project to be a total reconstruct which could possibly include utility work. Falling Weight Deflectometer (FWD) testing was performed to determine the strength of the subbase under the asphalt pavement. The results showed that the subbase had sufficient life remaining. From the original plans for the project, UDOT identified that there were approximately 12 inches of untreated base course (UTBC) under the existing asphalt. After determining that the best asphalt design scenario would yield a 15 year pavement life, concrete pavement was modeled to determine if a longer pavement life could be achieved. A routine concrete overlay would not be possible due to the height constraints in meeting the existing curb elevations. A full depth concrete pavement was then modeled. A 10 inch thick concrete pavement was determined to have a 35+ year life which would meet UDOT's expectations for

this project. In order to have a 10 inch thick pavement, 3.5 inches of UTBC would have to be removed resulting in 8.5 inches of UTBC remaining. Based upon the strength that UDOT calculated from the FWD testing, 8.5 inches of UTBC would be sufficient for a 10 inch concrete pavement design. A total reconstruction would not be necessary and utilities would be spared. The concrete design was also the most economical design in terms of life cycle cost analysis (see CP Tech Center 2014).

**Innovation**

Working together, UDOT and the contractor, Geneva Rock, introduced many innovative solutions to common concrete paving issues such as manhole block outs and meeting existing curb and gutter. In regard to the manholes and water valves in the pavement, traditional practice was to form blockouts in the pavement for these utilities. This practice increased preparation time, complicated mainline paving, and required additional concrete pours and curing to fill the blockouts. Smoothness around these blockouts was decreased and grinding was typically required to maintain the desired finish. To address this issue, Geneva Rock submitted a design that would raise the manholes and water valves into the pavement so that block outs would not be required. This innovation proved to increase the overall aesthetics and smoothness of this new concrete corridor while at the same time helping to meet the aggressive construction schedule.

Challenges arose shortly before paving was to commence when it was discovered that the joint layout plan was proving to be difficult to incorporate into the existing curb and gutter. It was feared that reflective cracking may appear due to the incongruent joint layout of the pavement and that of the existing curb. It was therefore decided by the project team to install expansion board between the curb and gutter and the new pavement. With expansion board in place the need to match joints to the inconsistent curb and gutter was eliminated. To date there is no reflective cracking in either the new pavement or the curb and gutter. This solution will also be beneficial in the future as this existing curb and gutter will need to be replaced long before the newly placed 35 +year concrete pavement.

The section of 12$^{th}$ Street in Ogden addressed in this project had more residential stakeholders than other sections of this main arterial. The residential component required a smooth, quiet and safe pavement surface. In order to meet these requirements the contractor instituted another first for UDOT, a longitudinal Astroturf drag. This pavement surface texture ensured the proper skid resistance for the roadway while reducing the noise generated by the traveling public (ACPA 2009).

**Safety**

Safety was a priority for UDOT and Geneva Rock on the 12$^{th}$ Street project. UDOT and the contractor were concerned with the safety of their construction crews, the traveling public, and the many homeowners and businesses along 12$^{th}$ Street. During the project, weekly jobsite

safety meetings were held with topics that were pertinent to the current phase of the project. The paving crews also held daily safety meetings reminding personnel of the current hazards that might be encountered on the project that day. Crew members were reminded and encouraged to report any issue that they feel might be unsafe for any of the project stakeholders. To assure the public's safety, increased traffic barrels marking the edge of pavement along the roadway where placed so that no vehicle would drive into the closure area. Extra caution tape was also used to encompass recent concrete pours to assure no vehicles drove on the freshly paved surfaces. Constructing pedestrian ramps was determined to make pedestrian navigation along sidewalk between consecutive ramps impractical without some sort of special accommodations. Therefore the sidewalk was simply closed and redirected to the opposite side of the road. To insure public involvement and promote safety on this project, a consultant team was hired to keep the traveling public up to date on any major and even minor closures that were to take place. This team did an amazing job at handling the public's questions and concerns regarding the project. This group also fielded any complaints that came in during the project and worked to resolve any public concerns.

**Traffic Management**

The traffic management strategy was designed to help minimize the impact on the traveling public but, at the same time, not inconvenience the construction schedule and property owners along 12$^{th}$ Street. Twenty foot lanes that tied into the curb and gutter were paved first, both east bound then west bound lanes, with the middle of the roadway completed last. During construction, traffic was reduced to one lane of travel in each direction. Traffic was first moved into the middle of the roadway to allow the construction of outside lanes and shoulders. Once opening strength was achieved on the outside lanes, traffic was switched onto the new pavement. Construction of the center lanes and turning lanes was then completed with cross movement only being allowed at intersections. Paving in this manner helped minimize the impact on local stakeholders.

Project constraints required this project to be separated into two major areas, east and west of Monroe Boulevard.(See Figure 1 for phasing plan.) Monroe Boulevard is a city street that intersects 12$^{th}$ Street about halfway through the project. This intersection and the temporary concrete truck delivery routes made phasing this project in two sections more appealing than working continuous from one end to the other.

Figure 1: Construction Phasing Plan


Management of traffic operations was accomplished in tandem between Geneva Rock and a contracted traffic management firm. Traffic Control Maintainers who had been certified by UDOT were designated and helped maintain a safe traffic flow. Geneva Rock utilized traffic control devices including signs, drums, vertical panels, arrow boards, and variable message boards to insure the safety and direction of the traveling public.

## Construction

Construction on 12th Street in Ogden began in June 2011. Concrete pavement paving started in early July of that year. The project plan had a target completion date of September 1, 2011. Due to the adoption of the aforementioned construction innovations, the project actually finished in mid-August, two weeks ahead of the aggressive 100 day schedule.

The scope of 12th Street in Ogden included 61,185 square yards of 10 inch thick doweled concrete pavement. Joint spacing was placed in a 12'x15' pattern, independent of the joints in the isolated existing concrete curb and gutter. The elevation of the concrete pavement was controlled by the use of a stringline which was used to guide the concrete paver. Stringline elevation control was critical due to the existing curb and gutter having variable elevations. The stringline was placed just outside the curb line and helped guide the paver while the paver track rode on the existing gutter pan. Surveyed elevation stakes were provided every thirty feet to help ensure that the stringline was set at the proper elevation. Concrete paving was completed using either a Gomaco Commander III paver or a 2-Track Gomaco 2600 slipform paver. A portable concrete batch plant was set up in an industrial area about one mile from the beginning of the

project. The concrete plant batched the concrete in 9 yard increments which were loaded and transported in open end dump trucks. Concrete was sampled and tested per UDOT specifications. Dump trucks traveled to the project site and delivered the concrete in front of the paver. Most of the concrete placements occurred at night to alleviate traffic concerns and more importantly to address hot weather concreting concerns caused by the typical 90-105 degree summer days in Utah.

When blockouts were needed due to construction constraints, they were later completed by hand placements using a roller tube to ensure constant smoothness. The contractor worked with the many businesses and residents to keep access to their locations open. The contractor was able to negotiate group access points with these stakeholders thereby eliminating as many blockouts as possible. In order to facilitate access to homeowner and business driveways, steel plates were used to bridge over fresh concrete to keep access open until the concrete had fully cured.

**Pavement Smoothness**

Pavement smoothness was determined by using a UDOT approved and certified California type profilograph or profiler. UDOT personnel inspected all contractor performed profilograph testing. The maximum specified profile index for this project was 5 in/mile, on a 0.2 in blanking band. The project specified must grind locations were areas deviating 0.3 inches per 25 feet. Initial profilograph results showed an average smoothness of 7.4 in/mile. This required the contractor to perform some pavement surface grinding. After this grinding was completed, the average smoothness on the finished roadway was 5.38 in/mile.

**Quality**

Delivering a quality roadway that will last for many years was the desire of both UDOT and Geneva Rock. To insure this goal was met, all personnel involved in the project took steps to insure quality assurance. A pre-paving construction meeting was held with the contractor and UDOT. During the meeting, items of concern such as innovations new to UDOT were discussed in an effort to resolve questions before issues could arise during construction.

A proven concrete paving mix design was submitted and trial batched by Geneva Rock. This concrete mix was designed to meet the standard specification created by UDOT for this project. Geneva Rock selected high quality mix components that would help meet the plastic and hardened concrete requirements for the construction schedule and the long term durability of the road. Figure 2 shows the mix proportions for this project. The mix design incorporated 20% by weight Class F fly ash replacement of the ASTM C150 Type II/V Portland cement. The use of fly ash helped reduce the carbon foot print of the pavement by 20% over a traditional non-engineered concrete mixture.

Figure 2. PCCP Mix Design.

Project: SR-39, 12th Street in Ogden

| | |
|---|---|
| Compressive Strength: | 4000 PSI at 28 days |
| Aggregate Size: | 1"- 25MM |
| Air | 5.0 to 7.5% |
| Water/Cement ratio: | 0.44 |
| Slump: | 1.00 to 5.00 in |
| Unit Weight: | 138.58 pcf |

| Constituent | Type | Quantity | Density | Volume |
|---|---|---|---|---|
| Cement | ASTM C150 Type II/V | 489 lb | 3.150 | 2.49 |
| Pozzolan | ASTM C618 Class F | 122 lb | 2.300 | 0.85 |
| Water | Potable | 269 lb | 1.000 | 4.31 |
| Coarse Aggregate | AASHTO M80 | 1716 lb | 2.590 | 10.59 |
| Fine Aggregate | AASHTO M6 | 1150 lb | 2.610 | 7.06 |
| Air entraining Admix. | | 4.00 floz (US)/yd3 | | 0.00 |
| Water Reducer Admix. | | 18.33 floz (US)/yd3 | | 0.00 |
| Air % | | 6.3 | | 1.70 |
| | Total | 3742 | | 27.00 |

During construction Geneva Rock contracted with an independent testing firm to perform quality control/quality assurance testing on concrete placed on the project. This was done in addition to and alongside the UDOT acceptance concrete testing performed by UDOT technicians. Concrete cylinders were also taken to help Geneva Rock know the in-place concrete strength of the pavement for pavement loading purposes.

Finally, concrete test results were routinely reviewed to assure compliance of concrete placed. The average concrete 28-day compressive strength for the project was 4,985 psi. UDOT specifications require 4,000 psi in 28days. The contractor incurred no concrete related penalties on this project.

**Sustainability**

Sustainability is an increasingly important element in the design and construction of the built environment and transportation infrastructure. Sustainability, and sustainable design, continues to increase in importance as resources grow more scarce, the cost of energy increases, and environmental stewardship is integrated into all elements of the built environment design and

construction. Due to its local availability, versatility, and hallmark longevity, Portland cement concrete is the most widely used building material on the planet (next to water), with approximately 25 billion tons of concrete manufactured globally every year. (WBCSD) Concrete is widely used in footings, foundations, floors, bridges, retaining walls, barriers, pavements, curb and gutter, and sidewalks. (Laker, et, all) By utilizing a concrete pavement on 12th Street in Ogden, UDOT has a pavement that will last more than twice as long as comparative asphalt designs. This increased life will reduce the amount of natural resources needed throughout the life of the pavement and will reduce the amount of maintenance required.

Concrete pavement also has many other intrinsic environmental benefits for the urban setting. An exhaustive work by the National Concrete Pavement Technology Center, "Sustainable Concrete Pavements, A Manual of Practice" (2012) highlights how concrete pavements, are sustainable paving solutions. In the case of urban paving, the document discusses how concrete pavement can reduce the heat island effect common in many cities. Concrete's light color and high reflectance are found to be cooler than dark paving materials. This greater reflectance of concrete can also reduce the amount of artificial lighting needed to insure safety on city streets and roads. The reduction in lighting can also decrease light pollution which is beneficial in residential neighborhoods. Studies have also shown reduced emissions and enhanced fuel efficiency for vehicles traveling on concrete surfaces (ACPA Greener Highways).

**Conclusion**


The transportation systems in urban areas are complex and vital to citizens who live in these cities.

Highways, streets, and roads have a major impact on economic development and America's way of life. SR-39, 12th Street in Ogden proves that urban paving can be accomplished sustainably and cost effectively through the use of concrete inlays. This project also introduced many cost saving, quality-improving innovations that can be integrated by any DOT or municipality. 12th Street in Ogden is an environmentally responsible pavement that answers many of the questions about accelerated urban concrete paving.

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