Precast Pavement Slabs for Rockaway Blvd. Intersection Replacement

Nassau-Queens Expressway

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The Fort Miller Co., Inc.
The Super-Slab® System (JPCPS) – Key Features

- Simple slab-on-grade system
- Standard dowels and tie bars (JRPCP)
- Built-in bedding grout distribution (to insure full and complete support)
- Techniques for precision grading
- Capability of providing 3-dimensional surfaces
Dowel and Tie Bar Connection

- Slots on the bottom protect grout from de-icing chemicals
- Dove tail slots provide resistance to dowel pop-out

Dowel Grout
2500 psi before traffic
Bedded (primarily) With Precisely Graded Fine Aggregate Material

<table>
<thead>
<tr>
<th>SIZE</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>½&quot;</td>
<td>100</td>
</tr>
<tr>
<td>#4</td>
<td>80 -100</td>
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<tr>
<td>#10</td>
<td>55-75</td>
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<tr>
<td>#40</td>
<td>10-40</td>
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<tr>
<td>#200</td>
<td>0-20</td>
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**Fine Bedding Material**

- Fully compacted subgrade
- Acts as cushion on DGB
- Bond breaker between DGB and new slabs
- Provide grade control for new slabs
Bedding Insured By Filling Voids (if they exist) With Bedding Grout

Installing Bedding Grout

• Used only to fill voids
• Flow rate: 17 – 20 seconds
• 600 psi in 12 hours
Two Types of Slabs

*Slab shape depends on geometry of pavement surface*

- Single Plane
- Warped Plane
Super-Slab 3D Technology

- Develop digital surface model of the pavement
- Extract “x”, “y”, “z” values (from model) for every corner of every slab
- Use values to fabricate slabs in specially designed forms
- Use same values to prepare subgrade surface

(x1, y1, z1) (x2, y2, z2) (x3, y3, z3) (x4, y4, z4)
What We Are Emulating

Concrete Pavement Fully Bedded With Accurate Surface
Effective Load Transfer Dowels at Joints (to be sawed)

(If you can possibly cast good concrete in place and get a good cure, don’t use precast!)
Engineering & Design

• Three key steps to designing a successful Super-Slab Project:
  ▪ Survey
  ▪ Slab Layout
  ▪ Slab Design
Survey

The project needs a complete Northing, Easting and Elevation survey (‘X’, ’Y’, ’Z’) of the area containing Precast Concrete Pavement Slabs.
Hybrid Survey used

Existing conditions:
Survey provided by contractor per the contract specifications.

- Slab limits needed to be established.
- Elevations at Super-Slab to existing pavement match points.
- Utilities (‘x’, ‘y’, ‘z’ survey & size of casting)

Proposed conditions:
Contract grading plans will show elevations.
Developing Slab Layout Drawing

Produce a 2D plan view drawing of all longitudinal and transverse joints; as well as, incorporating all utilities shown on the contract plans and contractor’s survey.

Owner’s standards will be used to accomplish the layout, where applicable.

All slabs to be sized to fit shipping constraints to the job site as well as sized for handling on the job site.
Longitudinal Joints

Match all existing (or proposed) longitudinal joints where possible.

- As roadway widths increase (turning lanes, entrance & exit ramps) panels need to be split for shipping purposes.
- At breaks in cross slopes (except crown lines) longitudinal joints are added (shoulders).
Transverse Joints

Follow the owners recommendation for slab lengths (where possible).

Slab lengths will vary depending upon locations of existing utilities.

Owner’s utility standards will be used to size slabs at and around utility locations.
Typical Utility Details

**Plan View - Utility 1**
Detail shows "MH" middle of slab.

**Plan View - Utility 2**
Detail shows "MH" on transverse joint.

**Plan View - Utility 3**
Detail shows "MH" left hand side of road. Detail similar for right hand side of roadway.
Typical Utility Details Cont’d
Typical 2D Slab Layout Drawing
Slab Layout Approvals

After the 2D slab layout is complete it is submitted to the owner/owner’s representative for approval.
Slab Design

Slab design is more than concrete thickness and required reinforcement - these are supplied on the contract plans.

The most intricate part of the Super-Slab design is converting the survey data supplied by the contractor and data supplied in the contract plans into a 3D “Tin” or “Mesh”.
Created “Tin”

Typical “Tin” developed with contractor’s supplied survey. Each point represents a survey shot.

The image above represents what Fort Miller works with to develop the final slab layout. The “Tin” is refined in a survey software package to create a more gradual, workable and accurate “Tin”.
“Tin” Check

The “Tin” is checked for accuracy multiple ways. One way is by the use of contours as shown below. We also evaluate the along the slab edges with the use of profiles.
Once the 3D “Tin” is checked it is overlaid with the 2D slab layout. The slabs are then projected onto the “Tin”. Every corner of every precast concrete slab will now have a Northing, Easting and Elevation associated with it.
Shop Drawing Information

The data collected from the corner points are put into a spreadsheet which will calculate slab geometry, center of gravity, warp of the slab, among many other features. This spreadsheet will produce the tables shown here.

Typical table submitted for approval during the shop drawing review stage.

Typical table shown on the Super-Slab shop drawings.
Typical Slab Layout Drawing

Shop drawings supplied with individual slabs labeled (mark number) in sequence for setting and slab corners labeled for orientation.
Step by Step
Installation Details
(what you will see tonight)
Step 1 – Lay Out Slabs

- Continuous installations must be laid out with total station equipment
  - Must replicate original “x”, “y”, “z” survey
  - Grades for off-set rail must be calculated
  - Leading edges (Panel points) must be laid out
Lay Out Slabs Accurately

Leading edge mark and panel point grade (cut or fill mark)

Use total station (preferably) to layout continuous installations (leave marks that will last)
Step 2 – Removal

Slab crab bucket most efficient (and can be used for removal of existing CTB)

Use right size (and enough) trucks!
Step 3 – Precision (Super) Grading (Important Key Operation)

- **Super-Grading**
  - The process of grading fully-compacted bedding material to a surface accuracy of ± 3 mm
- Requires specialized grading equipment
  - Using an accurate frame of grade reference
  - The grade of the adjacent pavement rarely accurate
Benefits of Super-Grading

• Provides accurate grade control for slabs
  ▪ Set slabs only once

• Provides “nearly complete” subgrade support without grout
  ▪ Slabs can be opened to traffic right away
  ▪ Minimizes volume of bedding grout required

• Allows un-grouted slabs to be used immediately
Preparing Sub-Base (Rockaway Blvd.)

Install 2” ±
(leaving room for bedding material)

Compaction
Setting Hand Operated Grader (H.O.G.) Rails

Rail Setting Notes:

1. Build panel point shim blocks to match required cuts and fills. Use 1.5” thick block for 0” cut and 0” fill. Add or subtract from 1.5” to make up required panel point shim block.
2. Place panel point shim blocks at panel points along the off set line. Refer to rail setting profile drawing.
3. Assemble rail sections over the panel point shim blocks.
4. Place the pin straight edge on the assembled (but not adjusted) rail sections making sure the pin straight edge shim blocks are directly over the panel point shim blocks.
5. Adjust the rail by adjusting screws until all of the pins line up with the top surface of the pin straight edge.
Continuous Grading
With H.O.G.

Three Steps

First Pass (1/4” high)

Compaction

Last Pass (done)
(over 500 LF per night possible)
Step 5 Placing Slabs (the easy part)

Number of Slabs and Sizes

• 2389 Slabs (total on Rockaway Blvd.)
• Thickness – 225 mm
• Width – Varies
• Lengths – Varies
• Weight – Varies (8 – 12 T)
Prior to Placing Slabs

Check with Depth Gage
Trim with Edge Trimmer (below)

Bond Breaker on Transverse Edge

Shims on Leading Edge Corners
Placing Slabs To Panel Point Marks

Setting Crew
One Man in Each Corner

Setting To Leading Edge Marks

String Line
Step 6 - Dowel Grouting

- Dowel Grout is “hot grout”
  - Reaches 2500 psi in two hours
- Keep mixture below 60 degrees
  - Use Ice Water to Control Temp.
- Use Proper Nozzle
- Keep Dowel Grout Moving
  - Do not let it sit in hoses
- Wash Out Grout Pump Frequently
- 15 minutes per slab
Bedding Grout

- Mixture of Cement, Water & Admixture
  - Flow rate of 17 - 20 seconds
  - Must flow into thin voids
- Reaches 2 MPa ± in 12 hours
- Use Proper Nozzle
- Keep Holes filled
Joints

- Treated as construction joints (in CIP)
  - Maximum width ≤ ½"
    - As placed joints vary from 0” to ½”
  - Joints are filled with dowel grout
    - Bond breaker on one side of joint
  - Top 2” sawed to uniform ½” width and sealed with silicon sealant
How About Smoothness?

- Small differences between slabs are to be expected
  - There are tolerances allowed (by necessity) in the slabs
  - There are tolerances allowed in the grading
- Super-Slab® specifies finished surfaces $\pm 1/8''$
  - May be acceptable for slow speed traffic
- For best International Roughness Index - grind
  - Grinding is a known and accepted practice
Production Rates

• Grading, Placement, Grouting Rates
  ▪ 8 – 10 Slabs (1500 – 2000 SF) per Hour
  ▪ 12’ x 13.5’ (avg.) slabs
• Average rate on this project
  ▪ 39 slabs (in about 6 hours) per shift
  ▪ 526.5 LF. = 6300 – 6800 SF per Shift
• Maximum production rate
  ▪ 52 slabs = 702 LF. = 8424 SF (in one night)
Precast Pavement
is
Premium Pavement Under Pressure
A Good Tool For Difficult Locations
Keys to Success
(Still More to Learn)

Good engineering
Open minds
Real partnering