NCHRP Synthesis 38-01
Quality Assurance in Design-Build Projects
AASHTO SOC 2008

Douglas D. Gransberg, PhD, PE
Professor
University of Oklahoma, Norman, OK, USA

Keith R. Molenaar, PhD
Associate Professor
University of Colorado at Boulder, Boulder, CO
Quality Assurance Practices

- Synthesis Scope: to address how QA is conducted in the following DB delivery methods:
  - Design-Build
  - Design-Build-Maintain
  - Design-Build-Operate-Maintain
  - Finance-Design-Build-Operate-Maintain
- Major thrust: define proper level of owner quality management activities.
Literature Review

- Lots written about QA – very little written about QA in the DB context.
- Major theme: “the fox may be guarding the henhouse.”
- Content analysis of DOT DB policy documents – either silent or overly general on QA in DB.
- Almost nothing written on the subject of design quality in DB.
38-01 DB RFP Content Analysis

- 60 transportation DB RFPs from 24 states, 1991 - 2006
- Majority since 2000
- 16 roadway projects
- 13 bridge projects
- 23 combined roadway/bridge
- 8 other
DB RFP Geographic Distribution

- DC: 1
- MD: 1
- USDOT: 1

Map shows the geographic distribution with numbers indicating the count in each state.
38-01 RFP Content Analysis

- Quality by Qualifications: 33
- Quality by Specified Program: 14
- Quality by Evaluated Program: 8
- Quality by Performance Criteria: 3
- Quality by Warranty: 1
- Quality by Performance Criteria: 0
RFP division of quality management responsibilities: Verification and acceptance testing

<table>
<thead>
<tr>
<th>Division of Responsibilities</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOT QA only</td>
<td>31</td>
</tr>
<tr>
<td>Design-builder QA only</td>
<td>2</td>
</tr>
<tr>
<td>DOT &amp; 3rd party</td>
<td>2</td>
</tr>
<tr>
<td>DOT &amp; Design-builder</td>
<td>1</td>
</tr>
<tr>
<td>Design-builder &amp; 3rd party</td>
<td>1</td>
</tr>
<tr>
<td>Can’t tell from RFP</td>
<td>23</td>
</tr>
</tbody>
</table>
Owner’s responsibilities in DB termed “project quality assurance” or PQA

Includes for BOTH design and construction:
- Oversight
- Independent assurance
- Verification
- Acceptance

Owner delegates the specific responsibilities for design and construction QA & QC in its RFP.
Quality Management Spectrum

Additional Owner Acceptance Activities not required - DOT or 3rd Party doing QA

DBr does CQC

DOT does DQA/DQC & CQA

DBr does DQC & CQC

DOT does DQA & CQA

DBr does DQC & CQA/CQC

DOT does DQA

DBr does all QA/QC

DBr = Design-builder
DQC = Design Quality Control
CQC = Construction Quality Control
DOT = Owner
DQA = Design Quality Assurance
CQA = Construction Quality Assurance
Design-Build Project Quality Assurance Model

1. Project Acceptance
   - Independent Assurance
     - Design Released for Construction
       - Design Quality Assurance
         - Design Quality Control
     - Construction Released for Final Payment
       - Construction Quality Assurance
         - Construction Quality Control
   - Independent Assurance

Project Quality Assurance
### Possible DB Quality Management Organizations

<table>
<thead>
<tr>
<th>Type</th>
<th>Design QA</th>
<th>Design QC</th>
<th>Construction QA</th>
<th>Construction QC</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>DBr</td>
<td>DBr</td>
<td>DBr</td>
<td>DBr</td>
<td>DOT oversight of design and construction</td>
</tr>
<tr>
<td>Type 2</td>
<td>DBr</td>
<td>DBr</td>
<td>DOT or 3rd</td>
<td>DBr</td>
<td>DOT and 3rd party share construction QA</td>
</tr>
<tr>
<td>Type 3</td>
<td>DBr</td>
<td>DBr</td>
<td>DBr and DOT</td>
<td>DBr</td>
<td>DOT and DBr share construction QA</td>
</tr>
<tr>
<td>Type 4</td>
<td>3rd</td>
<td>DBr</td>
<td>3rd</td>
<td>DBr</td>
<td>3rd party QA; DBr QC</td>
</tr>
<tr>
<td>Type 5</td>
<td>3rd and DBr and DOT</td>
<td>DBr</td>
<td>3rd and DBr and DOT</td>
<td>DBr</td>
<td>QA is shared; DBr QC</td>
</tr>
<tr>
<td>Type 6</td>
<td>DOT</td>
<td>DBr</td>
<td>DBr</td>
<td>DBr or 3rd</td>
<td>DOT Design QA only</td>
</tr>
<tr>
<td>Type 7</td>
<td>DBr</td>
<td>DBr</td>
<td>DOT</td>
<td>DBr or 3rd</td>
<td>DOT oversight of design</td>
</tr>
<tr>
<td>Type 8</td>
<td>DOT</td>
<td>DBr</td>
<td>DOT</td>
<td>DBr</td>
<td>DOT QA; DBr QC</td>
</tr>
<tr>
<td>Type 9</td>
<td>DOT</td>
<td>DBr</td>
<td>DOT or 3rd</td>
<td>DBr or 3rd</td>
<td>3rd party is involved in construction QA or QC</td>
</tr>
<tr>
<td>Type 10</td>
<td>DBr and DOT</td>
<td>DBr</td>
<td>DOT</td>
<td>DBr</td>
<td>DOT &amp; DBr share Design QA only</td>
</tr>
<tr>
<td>Type 11</td>
<td>DBr and DOT</td>
<td>DBr</td>
<td>DBr and DOT</td>
<td>DBr</td>
<td>DOT &amp; DBr share QA</td>
</tr>
<tr>
<td>Type 12</td>
<td>DOT</td>
<td>DOT</td>
<td>DBr</td>
<td>DBr</td>
<td>DOT oversight of construction</td>
</tr>
<tr>
<td>Type 13</td>
<td>DOT</td>
<td>DOT</td>
<td>DOT</td>
<td>DBr</td>
<td>DBr Construction QC only; traditional DBB QM</td>
</tr>
<tr>
<td>Type 14</td>
<td>DOT</td>
<td>DOT</td>
<td>DOT</td>
<td>DOT</td>
<td>Force account project done with DOT forces</td>
</tr>
</tbody>
</table>

**NOTE:** DBr = Design-builder; DOT = Department of Transportation (i.e. the project’s owner); 3rd = Third party (independent firm retained to conduct QA and QC or independent assurance responsibilities)
## Possible QA Responsibility Assignment

<table>
<thead>
<tr>
<th>Responsible Entity</th>
<th>Design</th>
<th>Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design-Builder’s Construction Quality Manager</td>
<td>Coordination/communication as required</td>
<td>Construction Quality Control: the responsibility of the Construction Quality Manager.</td>
</tr>
<tr>
<td>Department of Transportation plus 3rd party quality consultants (if required)</td>
<td>Design Quality Assurance: verification and reviews by the DOT and/or 3rd party quality consultants. Includes over-the-shoulder reviews, compliance checks, and audits.</td>
<td>Project Quality Assurance: audits and inspections of the construction performed by the DOT and/or 3rd party quality consultants. Includes testing, audits and independent verification/acceptance.</td>
</tr>
</tbody>
</table>
Type 1 QA Organization

Project Quality Assurance

Project Acceptance

Design Released for Construction

Construction Released for Final Payment

Independent Assurance

Design Quality Assurance

Construction Quality Assurance

Owner's Responsibility

Design-bUILDER'S Responsibility

Independent Assurance

Design Quality Control

Construction Quality Control
Type 7 QA Organization

- Project Acceptance
  - Independent Assurance
    - Design Released for Construction
      - Design Quality Assurance
        - Design Quality Control
  - Construction Released for Final Payment
    - Construction Quality Assurance
      - Construction Quality Control
      - Shared
    - Independent Assurance

Owner's Responsibility

Design-builder's Responsibility

Project Quality Assurance
The Independent Engineering Consultant is jointly hired by the owner and the concessionaire but 100% of the Owner Verification Testing (OVT) is paid for by the owner.
Conclusions

- DB solicitation documents and DOT DB policy documents should contain specific guidance regarding QA.
- New set of quality management activities – PQA
- Need to use a 2-step DB selection process to promote quality through quality-focused submittals in both steps
- 90% of DB RFPs used a best-value award. Allows quality to be emphasized through weighting scheme
Conclusions

- Design quality management is not receiving sufficient emphasis in DB.
- DOTs incorporate standards specs and allow the design-builder to optimize means and methods.
- Perception that DB will degrade quality persists and should be considered when DOTs develop their DB quality management programs.
Summary

- DOT cannot transfer its ultimate responsibility for quality through its DB contracts...therefore, each project’s PQA plan should be established at the earliest stage of project development.
- Final report should be published in the next couple months.
- Will be available free on the TRB Synthesis web site.