State of California
**DEPARTMENT OF TRANSPORTATION**

Business, Transportation and Housing Agency

# Memorandum

***Flex your power!***
***Be energy efficient!***

**To:** MALCOLM DOUGHERTY
Director

**Date:** February 6, 2013

**From:** BARTON J. NEWTON
State Bridge Engineer
Deputy Division Chief, Structure Policy & Innovation
Division of Engineering Services

PHILIP J. STOLARSKI
State Materials Engineer
Deputy Division Chief
Materials Engineering and Testing Services and
Geotechnical Services
Division of Engineering Services

**Subject:** **Gamma-Gamma Logging (GGL) Data Integrity**

The purpose of this memorandum is to transmit the following three final reports and provide a context to the conclusions. In addition, at the end of this memorandum are the numerous improvements to the practices and procedures of the Foundation Testing Branch to improve internal controls.

1. Final Report of the Gamma-Gamma Logging Data Integrity Review (GamDat) Team
2. Gamma-Gamma Logging Peer Review Report
3. GamDat Cases, Structural Evaluations Report

First and foremost, there are no concerns regarding the intended performance of any of the structures, as constructed, resulting from any findings of the GamDat review. The data manipulation at the center of this issue was so exceedingly rare, and so limited in scope, that it cannot reasonably undermine confidence in any of the structures on which it occurred.

The collection and use of the data obtained through California Test Method (CTM) 233 during construction is only one of the many quality assurance steps to validate the quality of the concrete placed in the pile. The acceptance and overall expected performance of the foundation pile is determined by many considerations including the design and construction requirements, the various quality control measures by both the contractor and the Department of Transportation (Caltrans), as well as the CTM 233 test.

As you are aware, in September 2008, a Caltrans Foundation Testing Branch (FTB) technician intentionally manipulated GGL test data. In response, Caltrans began to fully review the FTB policies and procedures; and to subject the existing GGL test data to a more rigorous evaluation

to verify all data issues have been identified. This stricter evaluation of existing GGL test data goes beyond all previous efforts to identify any additional irregularities in test data, assists Caltrans in improving the FTB operations, and confirms adequate controls are in place.

In December of 2011, GamDat Team was formed to review the integrity of all known GGL data, including both electronic and physical testing records, and to determine if additional potential irregularities of GGL test results exist. The GamDat Final Report presents the findings of reviewing existing GGL test data from over 23,000 unique tests on foundation piles spanning an eighteen year period from 1994 to 2011.

In order to ensure objectivity and transparency of this review, the GamDat review was peer reviewed by an external panel of leading technical experts led by the Federal Highway Administration (FHWA). The findings, conclusions and recommendations can be found in the Gamma-Gamma External Peer Review Report. Finally, structural evaluations were conducted on any questionable data irregularity regarding actual structures to ensure that no structural performance issues exist.

The GamDat review of existing GGL data and testing procedures was extensive and comprehensive. Previous reviews of GGL data were very limited for the reasons provided in the GamDat Report. Of the over 23,000 unique data files reviewed, the presence of only eleven irregularity cases were indentified. The irregularity cases found were of two types; data and operational. The data irregularity cases definitely exist while the operational irregularity cases are plausible or likely to exist based on the evidence. The possibility of additional data or operational irregularity cases is remote.

As noted above, eleven data irregularity cases were identified, including the three originally identified prior to the GamDat Team review effort. Nine involve the actual testing of a foundation pile. A structural evaluation was performed in eight of those cases. On one of the cases, (La Sierra OH), the foundation pile was retested and did not require a structural evaluation. As noted above, the evaluations confirmed that there are no concerns regarding the performance of any of the structures for these eight cases.

The following is a brief description of each of the eleven cases and the resulting impact.

<u>Manual Analysis ID-10 (SE Connector, Bridge No. 56-0802F, 08-RIV-215)</u>
The time stamp analysis shows evidence of irregular testing chronology and suggests that data collected from one tube twice was used to represent data for an adjacent tube. A structural evaluation was completed and determined that the structure will perform as intended.

Manual Analysis ID-11 (Lake Hodges, Bridge No. 57-1134R, 11-SD-15)
The time stamp analysis shows evidence of irregular testing chronology and suggests that data collected from one tube twice was used to represent data for adjacent tube. A structural evaluation was completed and determined that the structure will perform as intended.

Manual Analysis ID-12 (Route 580 Overhead Sign #19, 04-ALA-580)
This was a previously identified falsification case of a GGL test performed on March 19, 2008. The pattern matching analysis confirmed prior findings. A structural evaluation was completed and determined that the structure will perform as intended.

Manual Analysis ID-13 (La Sierra Overhead, Bridge No. 56C-0571, 08-RIV-91)
This was a previously identified falsification case of a GGL test performed on September 17, 2008. The pattern matching, calibration constant, and depth consistency analyses confirmed prior findings. A different technician retested the pile on September 23, 2008 and a final report completed September 24, 2008 indicated that the pile is acceptable.

Manual Analysis ID-52 (Braddock Drive Undercrossing Retaining Wall, 07-LA-405)
This was a previously identified falsification case of a GGL test performed on April 9, 2007. Pattern matching (file renaming) analysis show that a data file from one test was renamed and used to represent a test on a different tube and pile. A structural evaluation was completed and determined that the structure will perform as intended.

Manual Analysis ID-18 (Sawtelle Blvd Undercrossing Retaining Wall, 07-LA-405)
The pattern matching (file renaming) analysis show that a data file from one test was renamed and used to represent a test on a different tube and pile. A structural evaluation was completed and determined that the structure will perform as intended.

Manual Analysis ID-17 (Benicia Martinez, Bridge No. 28-0153R, 04-CC, SOL-680)
The time stamp analysis shows evidence of irregular testing chronology, and suggests that data collected from one tube twice was used to represent data for an adjacent tube. A structural evaluation was completed and determined that the structure will perform as intended.

Manual Analysis ID-33 (Benicia Martinez, Bridge No. 28-0153R, 04-CC, SOL-680)
The time stamp analysis shows evidence of irregular testing chronology and suggests that data collected from one tube twice was used to represent data for an adjacent tube. A structural evaluation was completed and determined that the structure will perform as intended.

Manual Analysis ID-76 (Benicia Martinez, Bridge No. 28-0153R, 04-CC, SOL-680)
The time stamp analysis shows evidence of irregular testing chronology and suggests that data collected from one tube twice was used to represent data for an adjacent tube. Subsequent manual analysis revealed an anomalous sequence of zero gamma count data for one of the tests

that was not reproduced in plots in the final report. Examination of the Excel files used for engineering analysis of the data revealed that the anomalous zero values were replaced with data copied from an adjacent tube. A structural evaluation was completed and determined that the structure will perform as intended.

Manual Analysis ID-2 and ID-15 (CTM 233 Qualification Tests)
The pattern matching analysis initially flagged six data files acquired during the qualification testing of blocks. There is clear evidence of data replacement (copy/paste/deletion) as a means to eliminate irregular spikes and offsets found in the recorded data. There is strong evidence to indicate the spikes were caused by proximity of a active adjacent source which will not occur during actual field foundation testing. The 2012 qualification testing of the standard reference concrete block provided good qualification test results. The effect on actual field GGL tests on structures conducted following 2007 is non-existent.

Manual Analysis ID-4 (CTM 233 Calibration Tests)
Calibration constant and fidelity analysis tools indicate clear evidence of manual alteration of density and gamma count data in a file used for gamma probe calibration. There is no evidence to support that this data was actually used in the annual calibration performed in 2004. The impact of this finding to actual field GGL tests is none.

There were other observed unusual test data found and procedures used, but these were found to be inconsequential. These include null data values, zero data counts, and testing performed in time mode versus depth up/down mode. There is no evidence that these occurrences were caused by intentional manipulation. Test results with zero counts or consecutive null values were evaluated for impact and found to have no negative impact to the structural performance of the structures.

To ensure that the GamDat review was performed in a fully transparent manner, an external expert review panel, led by the Federal Highway Administration (FHWA), was formed to: (1) evaluate Caltrans' current GGL testing procedures and practices; (2) perform a technical evaluation of the analysis methodology used by the GamDat Team; and (3) provide recommendations for FTB testing improvements.

The general findings of the FHWA review panel are that the GamDat Team has reasonably and comprehensively reviewed all available electronic GGL data files. The review has, to a high degree of certainty, uncovered any data irregularities. The results of the review has shown no appearance of systemic or unit-wide intention of data falsification. The review team recommends that Caltrans should focus efforts on future prevention measures that are outlined in this report.

To ensure the integrity of future GGL data, and to further ensure that adequate quality control measures are in place, the recommendations provided in the GamDat Report and the external peer review report will be forwarded to the Deputy Division Chief responsible for the Foundation Testing Branch unit for implementation. The following GGL testing improvements have been implemented or are currently in progress:

A Three Phase Mitigation Plan (3PMP) and a Foundation Testing Management, Practices, and Procedures Manual (FTMPP Manual) is being developed to ensure the FTB work is performed in a manner consistent with Caltrans policies and regulatory mandates. The 3PMP and the FTMPP Manual will promote quality assurance, internal controls and asset stewardship with specific performance measures while ensuring accountability.

The following procedures, policies and corrective measures were developed and implemented in Phase I.

1. In November 2011, the new FTB supervisor instructed the FTB staff to continue utilizing the data transmission practices to protect against test data falsification. This included the requirement for test data to be sent directly to the project engineer for review.
2. In December 2011, the FTB management team performed evaluations of past FTB operations and test practices. The data generated from this analysis provided a framework to develop corrective measures and new administrative and operational internal controls.
3. From January 2012 to May 2012, the FTB team supported Caltrans auditors to evaluate the FTB's system of internal control to determine whether adequate and effective policies, procedures, and processes are in place to ensure proper operational (e.g., FTB test services) and administrative (e.g., time reporting, vehicle usage) functions. This audit period selected was from November 1, 2010 to November 30, 2011.
4. In February 2012, the FTB developed and implemented timesheet, travel expense and overtime internal controls.
5. Project Tracking Database - A project tracking database was developed and implemented in April 2012 to track FTB foundation testing on all active and completed projects.
6. In April 2012, the FTB implemented administrative controls and procedures to effectively monitor and manage vehicle utilization.
7. The process to develop the Foundation Testing Management Practices and Procedures Manual (FTMPP) was started in May 2012. Note: completion is scheduled for March 2013.
8. Gamma Gamma Logging (GGL) Quality Control Checklist - In June 2012, the FTB team developed and implemented GGL Quality Control (QC) checklist. This serves as an assessment tool to verify the accuracy of GGL data sets received. The checklist also includes specific factors that peers and supervisors review to ensure testing technicians are following the appropriate testing procedures.

9. In June 2012, the FTB developed and implemented a process to ensure all GGL tests were subject to a "Peer Review" resulting in a second review (engineer) of all test data to ensure accuracy and quality. Lastly, the FTB supervisor performs a final review of all gamma gamma test results/conclusions.
10. FTB staff received the Expectations for Employee's, METS/GS Directive #2 dated June 1, 2012, to communicate responsibilities relating to overtime use and approvals, timesheet reporting, vehicle usage, safety and the importance of complying with Caltrans policies.
11. GGL Data Checker Tool – The GamDat Team provided the FTB with the final GGL Data Checker Tool in October 2012. The FTB immediately implemented the GGL Data Checker tool. GGL data sets, once received, are processed through the GGL Data Checker tool. The checker tool is used as a means to focus on the prevention of GGL data falsification risks and also identifies irregularities in the data.

The transmittal of these final reports brings a conclusion to the Gamma-Gamma Logging (GGL) Data Integrity Review.

Attachments