(rev 10/99)

LOUISIANA TRANSPORTATION RESEARCH CENTER RESEARCH PROPOSAL

(LTRC USE ONLY) DATE OF RECEIPT

LTRC PROJECT NO.
LTRC 10-5ST

STATE PROJECT NO. SIO# 30000138

PART I: GENERAL INFORMATION

1. AMOUNT REQUESTED (SAME AS PART III)

$ 199,961 (211,919) modified

2. DURATION OF PROJECT

ANTICIPATED START DATE 02/2011 . ACTUAL START DATE 5/2/11
DURATION IN MONTHS 16 ENDING DATE ~~5/1/12~~ 9/1/12 BF

3. TITLE OF RESEARCH PROPOSAL (PLEASE BE BRIEF)

Development of Guidelines for Transportation of Prestressed Concrete Girders

4. NAME AND BUSINESS ADDRESS OF PROPOSER (INDIVIDUAL, INSTITUTION, FIRM, OR CORPORATION)

Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road
Northbrook, Illinois 60062

5. NAME, TITLE, AND MAILING ADDRESS OF PRINCIPAL INVESTIGATOR (BEARING SCIENTIFIC RESPONSIBILITY)

Jonathan C. McGormley, P.E., S.E.
Associate Principal
Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road
Northbrook, Illinois 60062

TELEPHONE NUMBER AND EXTENSION OF BUSINESS OFFICE
847.272.7400

TELEPHONE NUMBER AND EMAIL ADDRESS OF PRINCIPAL INVESTIGATOR
847.753.7234
jmcgormley@wje.com

6. MAJOR SUB-DIVISION THAT WILL CONDUCT RESEARCH
Northbrook

7. NAME AND TITLE OF CO-PRINCIPAL INVESTIGATOR
Richard E. Lindenberg
Senior Engineer
Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road

PART II: APPROVAL

RECOMMEND BY THE ASSOCIATE DIRECTOR LTRC, RESEARCH
Mark Morvant, P.E. — DATE 3/3/11

RECOMMENDED BY THE DIRECTOR, LTRC
Harold R. Paul, P.E. — DATE 3 MAR 11

RECOMMENDED BY CHAIRMAN, LTRC POLICY COMMITTEE
Richard Savoie, P.E. — DATE 3.25.11

RECOMMENDED BY IMPLEMENTATION SPONSOR
Richard Savoie, P.E. — DATE 3.22.11

APPROVED BY THE DOTD SECRETARY
Sherri H. LeBas, P.E. — Eric Kalivoda for Sec. LeBas — DATE 3/25/11

APPROVED MODIFICATIONS:
(LTRC USE ONLY)

PART III AMOUNTS REQUESTED FOR PROJECT (For period of time indicated in Part 1 Item 2) - Page 2 (See Detail By Task Worksheet)

ITEM	Personnel / Position	Percent of Time on Project	Total Hrs.	FUNDS (Omit Cents)			
				Rate	Total Proj. Cost	Fiscal Year '11	Fiscal Year '12
1. PERSONNEL	Jonathan C. McGormley - Associate Principal	27.2	264	$ 62	$ 16,289	$ 4,566	$ 11,723
	Richard E. Lindenberg - Senior Engineer	24.3	236	$ 46	$ 10,941	$ 3,523	$ 7,418
	John Fraczek - Senior Principal	3.5	34	$ 78	$ 2,642	$ 777	$ 1,865
	Mark E. Moore - Principal	2.5	24	$ 76	$ 1,819	$ 455	$ 1,364
	Lee Lawrence - Principal	1.4	14	$ 68	$ 956	$ 137	$ 820
	Brian J. Santosuosso - Senior Engineer	9.9	96	$ 47	$ 4,538	$ 756	$ 3,782
	Douglas D. Crampton - Senior Engineer	7.6	74	$ 49	$ 3,622	$ 2,153	$ 1,468
	Jeffery Caldwell - Senior Engineer	6.0	58	$ 48	$ 2,761	$ 381	$ 2,380
	Associate III	6.2	60	$ 39	$ 2,311	$ 924	$ -
	Associate II	5.4	52	$ 31	$ 1,611	$ 124	$ 1,488
	Senior Specialist	6.0	58	$ 34	$ 1,975	$ 545	$ 1,430
	Total Salaries and Wages		970		$ 49,464	$ 14,341	$ 35,123
	Plus 1.96.02 OH - See Total Indirect Costs						
	Total Personnel Costs						
2. NON EXPENDABLE EQUIPMENT	Gyroscopes/DC Accelerometers w/ Tilt Output		3	$ 1,500	$ 4,500	$ -	$ 4,500
	Tri-axial Acccerometers w/ Cables		1	$ 1,200	$ 1,200	$ -	$ 1,200
	Accelerometer Signal Conditioning Module		1	$ 1,700	$ 1,700	$ -	$ 1,700
	Total Non-Expendable Equipment				$ 7,400		$ -
3. CONSUMABLE SUPPLIES							
	Total Consumable Supplies				$ 12,780		$ 12,780
4. TRAVEL	Out-of State Travel - Kick-Off Meeting				$ 1,712	$ 1,712	$ -
	Out-of State Travel - Instrumentation Installation				$ 6,859	$ -	$ 6,859
	Out-of State Travel - Grider Transportation Monitoring				$ 1,955	$ -	$ 1,955
	Out-of State Travel - Interim Report Presentation				$ 906	$ -	$ 906
	Out-of State Travel - Guidelines Training Workshop				$ 906	$ -	$ 906
	Out-of State Travel - Final Report Presenation				$ 906	$ -	$ 906

	Total Travel			$ 13,243	$ 1,712	$ 11,531
5. OTHER EXPENSES	(2) Digital camera	16	$ 4	$ 64	$ -	$ 64
	Data Acquisition Equipment	12	$ 165	$ 1,980	$ -	$ 1,980
	(2) Tri-axial Accelerometers w/ Cables	16	$ 25	$ 400	$ -	$ 400
	(2) Extensometers	16	$ 10	$ 160	$ -	$ 160
	GPS Unit	8	$ 10	$ 80	$ -	$ 80
	Generator	3	$ 25	$ 75	$ -	$ 75
	Marine Battery Cell - 6 Batteries	8	$ 35	$ 280	$ -	$ 280
	Document Fees	4	$ 75	$ 300	$ 300	$ -
	Express Mail	12	$ 14	$ 168	$ -	$ 168
	Reports	10	$ 50	$ 500	$ -	$ 500
	Total Other Expenses			$ 4,007	$ 300	$
6. TOTAL DIRECT COSTS				$ 86,894	$ 16,353	$ 70,541
7. TOTAL INDIRECT COSTS (attach documentation to substantiate indirect cost rate and method of application in Part VIII)		1.9602 OH	11% Profit	$ 113,066	$ 32,781	$ 80,285
8. TOTAL COSTS (Total of 6 & 7)				$ 199,961	$ 49,134	$ 150,827

Project
Precast Girder Transportation Study
WJE No. 2010.5518

Overhead Rate
196.02 %

Rate Classification
Cost Plus Fixed Fee

Profit
11.0 %

Task	WJE Labor Hours	WJE Fees	Overhead and Fringe Benefits	Fixed Fee (Profit)	Sub Total WJE Fee + Profit	WJE Direct Expenses	Sub Total WJE	Services By Others	Total	% of Grand Total
1 Literature Search	22	$1,235	$2,421	$402	$4,059	$300	$4,359	$0	$4,359	2.2
2 Parametric Study	44	$2,419	$4,743	$788	$7,950	$0	$7,950	$0	$7,950	4.0
3 Girder Buckling and Cracking Analysis	66	$3,161	$6,197	$1,029	$10,388	$0	$10,388	$0	$10,388	5.2
4 Instrumentation Plan	106	$5,118	$10,031	$1,666	$16,815	$0	$16,815	$0	$16,815	8.4
5 Instrumentation Installation	124	$5,927	$11,617	$1,930	$19,474	$28,382	$47,855	$0	$47,855	23.9
6 Transportation Monitoring	80	$3,989	$7,819	$1,299	$13,106	$3,651	$16,756	$0	$16,756	8.4
7 Data Analysis	96	$4,474	$8,769	$1,457	$14,699	$0	$14,699	$0	$14,699	7.4
8 Interim Report	120	$6,395	$12,536	$2,082	$21,014	$906	$21,920	$0	$21,920	11.0
9 Transportation Guidelines/Design Modifications Development	74	$4,350	$8,526	$1,416	$14,292	$0	$14,292	$0	$14,292	7.1
10 Guidelines and Design Modifications Workshop	74	$3,728	$7,307	$1,214	$12,248	$906	$13,154	$0	$13,154	6.6
11 Final Report	122	$6,262	$12,275	$2,039	$20,576	$906	$21,482	$0	$21,482	10.7
12 Project Administration/Kick-off Meeting	42	$2,407	$4,719	$784	$7,910	$2,380	$10,290	$0	$10,290	5.1
Total	970	$49,464	$96,960	$16,107	$162,531	$37,430	$199,961	$0	$199,961	100.0

Project
Precast Girder Transportation Study
WJE No. 2010.5518

WJE Wages

Professional Staff (Loaded Rate)

Task		Jonathan C. McGormley	Richard E. Lindenberg	John Fraczek	Mark E. Moore	Lee Lawrence	Brian J. Santosuosso	Douglas D. Crampton	Jeffery Caldwell	Associate III	Associate II	Senior Specialist	Fee Total
		Associate Principal	Senior Associate	Senior Principal	Principal	Principal	Senior Associate	Senior Associate	Senior Associate				
		$203	$152	$255	$249	$224	$155	$161	$156	$127	$102	$112	
1 Literature Search	Hours	12	4	2	0	0	0	0	0	4	0	0	22
	Fee	$740	$185	$155	$0	$0	$0	$0	$0	$154	$0	$0	$1,235
2 Parametric Study	Hours	12	12	4	4	0	4	4	0	0	4	0	44
	Fee	$740	$556	$311	$303	$0	$189	$196	$0	$0	$124	$0	$2,419
3 Girder Buckling and Cracking Analysis	Hours	4	4	2	0	0	0	40	0	16	0	0	66
	Fee	$247	$185	$155	$0	$0	$0	$1,958	$0	$616	$0	$0	$3,161
4 Instrumentation Plan	Hours	16	44	2	2	2	12	0	8	4	0	16	106
	Fee	$987	$2,040	$155	$152	$137	$567	$0	$381	$154	$0	$545	$5,118
5 Instrumentation Installation	Hours	26	26	0	0	0	26	0	26	0	10	10	124
	Fee	$1,604	$1,205	$0	$0	$0	$1,229	$0	$1,238	$0	$310	$341	$5,927
6 Transportation Monitoring	Hours	16	32	0	0	0	16	0	16	0	0	0	80
	Fee	$987	$1,484	$0	$0	$0	$756	$0	$762	$0	$0	$0	$3,989
7 Data Analysis	Hours	4	48	4	2	0	20	2	0	0	16	0	96
	Fee	$247	$2,225	$311	$152	$0	$945	$98	$0	$0	$496	$0	$4,474
8 Interim Report	Hours	48	18	4	4	2	8	8	4	16	0	8	120
	Fee	$2,962	$834	$311	$303	$137	$378	$392	$190	$616	$0	$272	$6,395
9 Transportation Guidelines/Design Modifications Development	Hours	20	8	10	8	6	0	10	0	12	0	0	74
	Fee	$1,234	$371	$777	$606	$410	$0	$489	$0	$462	$0	$0	$4,350
10 Guidelines and Design Modifications Workshop	Hours	32	12	2	0	0	4	4	0	0	8	12	74
	Fee	$1,974	$556	$155	$0	$0	$189	$196	$0	$0	$248	$409	$3,728
11 Final Report	Hours	44	16	4	4	4	6	6	4	8	14	12	122
	Fee	$2,715	$742	$311	$303	$273	$284	$294	$190	$308	$434	$409	$6,262
12 Project Administration/Kick-off Meeting	Hours	30	12	0	0	0	0	0	0	0	0	0	42
	Fee	$1,851	$556	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,407
Fee Total	Hours	264	236	34	24	14	96	74	58	60	52	58	970
	Fee	$16,289	$10,941	$2,642	$1,819	$956	$4,538	$3,622	$2,761	$2,311	$1,611	$1,975	$49,464

Part IV - BIOGRAPHICAL SKETCHES - Provide b ches for professional personnel already selected who are to be actively engaged i oject. The following questions should be completed with co-principal researcher immediately following principal researcher, followed by othe essional personnel.

NAME OF PRINCIPAL INVESTIGATOR	TITLE
Jonathan C. McGormley	Associate Principal

DATE OF BIRTH	PLACE OF BIRTH	SEX	CITIZENSHIP 9 US 9 OTHER (SPECIFY)
02/02/1969	US	M	US

EDUCATION (DEGREES CONFERRED - IDENTIFY HONORARY DEGREES IN FIELD)	DEGREE	INSTITUTION CONFERRING	FIELDS	YEAR
	B.S.	University of Cincinnati	Civil Engineering	1992
	M.S.	Purdue University	Civil Engineering	1994

In his seventeen years with WJE, he has served as Project Manager and Lead Engineer on structure instrumentation assignments, where strain and deflection measurements were obtained. These structures have included steel girder bridge girders with fatigue sensitive details, lift span and bascule bridge mechanical components, transit rails and tie systems, aluminum overhead sign truss, and large diameter air main flanges. He has also served as Project Manager and Lead Inspector of fatigue and fracture inspections of major highway bridges throughout the US. Through these assignments he has gained experience with magnetic particle testing and sample removal for fractographic studies. He routinely provides consulting services to a number of local bridge contractors addressing repair and construction related issues. He has provided construction inspection services for major and minor bridge repair projects. He is well versed in a number of bridge analysis software packages and has performed detailed analysis for load rating, failure investigations, and bridge design. Prior to joining WJE, Mr. McGormley worked as a research technician in the University of Cincinnati structural laboratory, assisting in the instrumentation and dynamic field testing of a composite plate girder bridge. As a graduate student at Purdue University, he carried out research into the performance of epoxy coated shear reinforcement in concrete beams.

Mr. McGormley co-developed and is an instructor for the Bridge Construction Inspection and Bridge Rehabilitation Design courses sponsored by NHI. Mr. McGormley is a member of the Transportation Research Board where he participates on Committees AFF40 Dynamics and Field Testing of Bridges and AFF20 Steel Bridges. He has authored a paper on bond of epoxy coated shear reinforcing steel, as well as numerous papers on fatigue and fracture of girders.

NAME OF CO-PRINCIPAL INVESTIGATOR	TITLE
Richard E. Lindenberg	Senior Associate

DATE OF BIRTH	PLACE OF BIRTH	SEX	CITIZENSHIP 9 US 9 OTHER (SPECIFY)
11/17/1971	US	M	US

EDUCATION (DEGREES CONFERRED - IDENTIFY HONORARY DEGREES IN FIELD)	DEGREE	INSTITUTION CONFERRING	FIELDS	YEAR
	B.C.E.	Georgia Institute of Technology	Structures	1995
	M.S.	University of Illinois	Structural Engineering	2005

Since joining WJE in 2001, Mr. Lindenberg has participated in a wide range of projects involving the design, inspection, evaluation, instrumentation, analysis, and construction observation of various structures. He has focused on the development of instrumentation software systems and the correlation of instrumentation data with analytical models. Mr. Lindenberg has developed and tested a variety of health monitoring technologies, such as wireless sensors, laser measurement, GPS synchronization, GPS geolocation, data sensor mapping, database systems, and photogrammetry. Relevant technology implementation includes the development of a system where video and acceleration data were synchronized real-time to determine the causes of vibrations. A highly mobile version of the vibration monitor, with all the equipment stored in a shippable sized suitcase and capable of running off batteries, has been implemented in the field. In addition, he has researched and developed for WJE the usage of GPS systems in instrumentation systems for the purposes of geolocation and synchronization of multiple systems. This work has included the prototyping of a mobile monitoring package capable of collecting instrumentation data synchronized with instrumentation data. Lastly, he has work extensively with the analysis and modeling of instrumentation data. In particular, he has used sensor mapping of field instrumentation data to show deformations, temperatures, and stresses mapped on 3D finite element models.

In 2010, Mr. Lindenberg accepted the Martin P. Korn award from the Precast/Prestressed Concrete Institute (PCI) with his co-author for a paper titled "Volume-Change Response of Precast Concrete Buildings." This research included the development and monitoring of instrumentation at multiple garages across the US. He also development the finite element models to correlate the measured behavior. He is currently WJE's project manager and investigator for NIST funded research on the Development of Rapid, Reliable, and Economic Methods for Inspection and Monitoring of Highway Bridges, which is a Joint Venture between WJE, National Instruments and University of Texas.

Part IV - BIOGRAPHICAL SKETCHES - Continued

NAME	TITLE
John Fraczek	Senior Principal

DATE OF BIRTH	PLACE OF BIRTH	SEX	CITIZENSHIP 9 US 9 OTHER (SPECIFY)
06/24/1946	US	M	US

EDUCATION (DEGREES CONFERRED - IDENTIFY HONORARY DEGREES IN FIELD)	DEGREE	INSTITUTION CONFERRING	FIELDS	YEAR
	B.S.	Stanford University	Civil Engineering	1968
	Ph D.	Cornell University	Structural Engineering	1975

Mr. Fraczek has worked at WJE for a total of 23 years. For an 8-year interim period, Mr. Fraczek served as the President and CEO of Construction Technology Laboratories, Inc. (CTL) a structural/architectural engineering, testing, and materials technology firm that dealt with a broad range of problems related to construction materials and structural systems. As a Senior Principal with WJE in Northbrook, Illinois, he has been involved in a broad variety of consulting activities with an emphasis on concrete structures. He has investigated low strength concrete problems, cracking of bridge decks and slabs on grade, plastic shrinkage cracking, concrete exposed to elevated temperatures, and various techniques for bonding new to existing concrete. He is actively involved in research on corrosion and concrete durability conducted at WJE.

Mr. Fraczek is a member of American Concrete Institute (ACI), American Society of Civil Engineers (ASCE), Structural Engineers Association of Illinois, Prestressed Concrete Institute (PCI), Concrete Reinforcing Steel Institute, Building Officials and Code Administrators International, and the American Segmental Bridge Institute. He is a former member of ACI Committee 348 - Structural Safety and the ASCE - EMD Committee on Experimental Analysis and Instrumentation. His authorship includes Corrosion Protection of Prestressing Systems in Concrete Bridges, A Review of Electrochemical Principles as Applied to Corrosion of Steel in a Concrete or Grout Environment, ACI Survey of Concrete Structure Errors, and Mechanical Connections in Cold Formed Steel: Comprehensive Test Procedures and Evaluation Methods. For several years, he served as a principal speaker in a nationwide seminar series on concrete repair and restoration sponsored by ACI.

NAME	TITLE
Mark E. Moore	Principal

DATE OF BIRTH	PLACE OF BIRTH	SEX	CITIZENSHIP 9 US 9 OTHER (SPECIFY)
03/30/1957	US	M	US

EDUCATION (DEGREES CONFERRED - IDENTIFY HONORARY DEGREES IN FIELD)	DEGREE	INSTITUTION CONFERRING	FIELDS	YEAR
	B.S.	Purdue University	Civil Engineering	1979
	M.S.	University of Texas, Austin	Engineering	1982

Mr. Moore is actively involved in the research of prestressed concrete structures. He served as the program manager for the Federal Highway Administration's NDE Validation Center located at the Turner Fairbank Highway Research Center in McLean, Virginia. As program manager, he demonstrated experience in developing, managing, and conducting scientific programs and studies related to evaluation and assessment of NDE techniques for highway bridges. Through this significant project, he has been actively involved in a broad range of research for evaluation of highway bridges, including ground-penetrating radar for evaluation of concrete bridge decks, radiography for evaluation of prestressed and post-tensioned cable elements, Barkhausen and Nonlinear Harmonic stress measurements in post-tensioned systems, ACFM and Eddy Current devices for flaw detection, non-contact displacement measurements using laser systems, and testing of 40-year old prestressed concrete box beams reinforced with FRP. Mr. Moore's analytical work has included the analysis of reinforced concrete, pre-stressed concrete, and steel structures. This work has included extensive use of computer models for analysis of structural systems. He has also developed a comprehensive set of computer programs for the analysis and redesign of prestressed concrete bridge girders.

Mr. Moore's publications include papers on the design and analysis of prestressed concrete bridge members. He has authored several papers on the performance of prestressed concrete members fabricated using epoxy-coated prestressing strand. Mr. Moore is an active member of the American Concrete Institute (ACI), the American Society of Civil Engineers (ASCE), the American Society of Nondestructive Testing, the Prestressed/Precast Concrete Institute (PCI), and the Post Tensioning Institute (PTI). He is currently the chairman of the PCI Technical Committee on Prestressing Strand and the PTI Technical Committee on Grouting. Additionally, he serves on ACI Committee 423, Prestressed Concrete, the PCI Technical Committee on Bridges, and the PTI Technical Committee on Cable Stay Bridges.

Part IV - BIOGRAPHICAL SKETCHES - Continued

NAME	TITLE
Lee Lawrence	Principal

DATE OF BIRTH	PLACE OF BIRTH	SEX	CITIZENSHIP 9 US 9 OTHER (SPECIFY)
03/29/1963	US	M	US

EDUCATION (DEGREES CONFERRED - IDENTIFY HONORARY DEGREES IN FIELD)	DEGREE	INSTITUTION CONFERRING	FIELDS	YEAR
	B.S.	University of Texas, Austin	Civil Engineering	1986
	M.S.	University of Texas, Austin	Civil Engineering	1998

Since joining WJE in 1999, Mr. Lawrence's consulting activities have included investigating and designing repairs for deterioration, distress, or failure of structures and a wide variety of construction materials. He also has extensive experience in evaluating concrete material problems associated with strength deficiencies, environmental and chemical deterioration, and material incompatibility, utilizing petrographic, chemical, and analytical diagnostic methods. During Mr. Lawrence's eleven years with the Texas Department of Transportation (TxDOT) he gained experience in the design and construction of concrete structures and bridges, including cast-in-place and precast concrete structural elements. Serving as the State Precast Concrete Fabrication Engineer from 1993 to 1999, Mr. Lawrence managed a group of engineers and inspectors charged with the responsibility for inspection of all plant fabricated precast concrete beams and other concrete products used in the transportation infrastructure. These responsibilities included fabrication inspection and the oversight of storage and transportation to project sites of over a million lineal feet of prestressed bridge beams per year. While at TxDOT and since joining WJE, Mr. Lawrence has investigated the cause and extent of damage and designed repairs for numerous prestressed concrete beams.

Mr. Lawrence is professionally affiliated with American Concrete Institute (ACI) and the ACI Central Texas Chapter where he served as former President, the American Society of Civil Engineers where he served as former chair of the Forensics Committee, and Precast/Prestressed Concrete Institute (PCI). Through PCI he serves as the Materials Technologies Committee Chair and PCI Plant Certification/Personnel Training Committee.

NAME	TITLE
Brian J. Santosuosso	Senior Associate

DATE OF BIRTH	PLACE OF BIRTH	SEX	CITIZENSHIP 9 US 9 OTHER (SPECIFY)
07/13/1979	US	M	US

EDUCATION (DEGREES CONFERRED - IDENTIFY HONORARY DEGREES IN FIELD)	DEGREE	INSTITUTION CONFERRING	FIELDS	YEAR
	B.S.	Lehigh University	Civil Engineering	2001
	M.S.	Lehigh University	Civil Engineering	2003

Since joining WJE in 2002, Mr. Santosuosso has acquired extensive experience on projects involving non-destructive test methods including strain and displacement monitoring, ultrasonic testing, magnetic particle testing, and visual inspection of bridges and ancillary structures. He has experience in fatigue and fracture of steel bridge components, including the retrofit of fatigue sensitive details. His other projects involved ultrasonic testing of steel pressure piping, removal and replacement of steel bridge truss members under live load, and repair and balancing of vertical lift and bascule bridges. In addition, he has performed many structural and material evaluations and condition surveys.

Relevant projects have included development and installation of health monitoring system for the Benicia-Martinez Bridge in Martinez, California; instrumentation during removal of a truss panel point in the Murray Baker Bridge in Peoria, Illinois; inspection of the US 34 Great River Bridge including precast concrete girder and welded steel girder approach spans and the main cable stayed spans in Burlington, Iowa; bridge balancing of four leaf bascule bridge and non-destructive testing of steel bridge trunnions for Congress Parkway bascule bridge in Chicago Illinois. Mr. Santosuosso is a Licensed Structural Engineer in Illinois. He is an AWS certified welding inspector and has completed the NHI Course on Safety Inspection of In-service Bridges.

Part IV - BIOGRAPHICAL SKETCHES - Continued

NAME	TITLE
Douglas D. Crampton	Senior Associate

DATE OF BIRTH	PLACE OF BIRTH	SEX	CITIZENSHIP 9 US 9 OTHER (SPECIFY)
07/28/1976	US	M	US

EDUCATION (DEGREES CONFERRED - IDENTIFY HONORARY DEGREES IN FIELD)	DEGREE	INSTITUTION CONFERRING	FIELDS	YEAR
	B.S.	University of Illinois, Urbana-Champaign	Civil Engineering	1998
	M.S.	University of Texas, Austin	Civil Engineering	2002

Since joining WJE in 2000, Mr. Crampton has participated in a wide range of projects involving the design, inspection, evaluation, rehabilitation, analysis, and construction observation of bridge structures. Much of this work has focused on the use of finite-element software to analyze bridge structural elements, both for design of new structures and evaluation of existing structures. Mr. Crampton is familiar with the AASHTO LRFD Bridge Design Specifications, Standard Specifications for Highway Bridges, as well as the load rating of bridges using Load and Resistance Factor Rating (LRFR) methodology.

Following a partial ceiling collapse of a tunnel structure constructed during the Central Artery/Tunnel project, WJE was retained to perform a "Stem to Stern" Safety Review of all transportation structures included part of Boston's "Big Dig" project. Mr. Crampton served as team leader for the concrete viaduct portion of this project, which involved a peer review of approximately 49,000 linear feet of concrete viaduct construction, which includes 128 separately identified structures. Typical structures for this project included precast segmental box girder construction, precast bulb-tee girders, and precast box beams. Mr. Crampton performed and coordinated peer review and analysis tasks including a review of project drawings, independent design reviews, finite-element analyses, physical testing, and field inspection of bridge of these concrete bridge structures. Mr. Crampton is a Licensed Structural Engineer in Illinois and is located in Northbrook, Illinois.

NAME	TITLE
Jeffrey Caldwell	Senior Associate

DATE OF BIRTH	PLACE OF BIRTH	SEX	CITIZENSHIP 9 US 9 OTHER (SPECIFY)
10/29/1973	US	M	US

EDUCATION (DEGREES CONFERRED - IDENTIFY HONORARY DEGREES IN FIELD)	DEGREE	INSTITUTION CONFERRING	FIELDS	YEAR
	B.S.	Tulane University	Civil Engineering	1996

Mr. Jeffrey Caldwell began his career with WJE in 1998, and has since gained valuable experience in the evaluation and repair of distressed or deteriorated structures. His project experience includes dynamic analysis of structures; on-site monitoring; structural investigations; and the design of repair. Mr. Caldwell is also an instructor for the Bridge Construction Inspection course organized and sponsored by the National Highway Institute (NHI) and has taken the NHI Course, Bridge Rehabilitation Evaluation and Design and Fracture Critical Inspection Techniques for Steel Bridges.

Mr. Caldwell has also performed quality audits for precast concrete plants for the National Precast Concrete Association and the American Concrete Pipe Association where he has inspected and observed field/laboratory testing at over 200 precast concrete manufacturing facilities throughout North America and abroad. Mr. Caldwell works in the Boston, Massachusetts office of WJE. He is a licensed professional engineer in Louisiana and five other states.

Part IV - BIOGRAPHICAL SKETCHES - Continued.

NAME	TITLE
WJE Staff	Associate II

An Associate II holds a Master's degree in a related engineering field or a Bachelor's degree in a related engineering field with three years of related experience. An Associate II is responsible for the following tasks:

Assists with the evaluation, investigation, and design of repairs for building envelope and structural systems.
Assists with other tasks related to evaluating structures.
Works as a project associate responsible for moderately complex tasks.
Assists with the drafting of sections of project reports and/or construction documentation.
Assists project manager with general project administration

NAME	TITLE
WJE Staff	Associate III

An Associate III holds a Master's degree in a related engineering field with 3 years of related experience or a Bachelor's degree in a related engineering field with six years of related experience. An Associate III is responsible for the following tasks:

Assists with the evaluation, investigation, and design of repairs for building envelope and structural systems.
Assist with other tasks related to evaluating structures.
Drafts sections of project reports and/or construction documentation.
Provides technical assistance to other staff in one or more areas of practice.
Assists project manager with general project administration

NAME	TITLE
WJE Staff	Senior Specialist

A Senior Specialist holds an Associate's degree in related field and has five years of relevant work experience. A Senior Specialist is responsible for the following tasks:

Works on assignments as the lead technician and project technician.
Has significant expertise in several technical areas.
Plan, set up, conduct, and assess the validity of tests and inspections.

PART V

TITLE VI STATEMENT

The attention of the proposed research contracting agency or institution is directed to the need to comply with the requirements of Title VI of the Civil Rights Act of 1964.

Wiss, Janney, Elstner Associates, Inc. (Name of Contracting Agency) acknowledges that we are aware of the requirements of Title VI and will not discriminate on the basis of race, creed, sex, or national origin and will endeavor to involve the members of minority groups in the conduct of the proposed contract research study.

TECHNICAL RESEARCH PROPOSAL

Details of the proposed plan and other necessary data shall be typed (double-spaced) in accordance with the sequence and requirements defined in Chapter 2 of the LTRC Research Procedure Manual. Continue numbering pages in sequence for the entire proposal using the continuation sheet.

SUMMARY OF PROPOSED RESEARCH

PART VI Problem Statement

Prestressed concrete girders are an economical superstructure system for bridges. With the advent of higher strength concretes and more efficient cross sections, the use of long span (> 100 feet) prestressed concrete girders has become commonplace. Routinely, girders exceeding 150 feet in length and depths of 6 feet are now specified. Such long span girders require special consideration during manufacturing, transporting, handling, and erecting. Many forces associated with construction of a precast concrete girder are well understood – less, however, is known about the forces a girder is subjected to during transport. While girders are designed for strong axis loadings and thus can readily accommodate such loadings during transport, they are typically braced in service and hence may have inadequate resistance to lateral or lateral-torsional load effects. As a result, girders have arrived on jobsites exhibiting cracks indicative of weak axis bending or torsion. In other instances, trucks transporting girders have rolled as the girders laterally buckled. These transportation problems can delay construction while the girders are repaired or replaced, and lead to a reduced service life as moisture and chlorides infiltrate unrepaired cracked girders.

The Louisiana Department of Transportation and Development (LaDOTD) has observed these transportation problems with prestressed concrete girders. Building on research into girder stability design by Laszlo and Imper [1][2], and estimations of transportation stresses by Mast [3][4], the LaDOTD recently instrumented two 150 foot long prestressed bulb-tees during transport in an effort to assess the forces on the girders. Transportation of these instrumented girders resulted in some weak axis cracking.

PART VII Objectives of Research

The objective of this research is to develop guidelines that the LaDOTD can apply to the future design and transport of prestressed concrete bridge girders to avoid cracking and stability issues. The guidelines are anticipated to define acceptable methods of girder support and tie down during transport, recommend safe girder response limits during transportation, suggest road conditions/geometries to be avoided on transportation routes, provide a checklist for accepting precast concrete girders at the jobsite, and suggest design changes to improve girder shipping performance. The research objective is expected to be met through execution of the following tasks:

- Review previous published literature and test results on precast concrete girder transportation design and associated loadings.
- Identify the relevant parameters associated with transporting precast concrete girders.
- Measure the following responses of long span precast girders during transport from the precast yard to the jobsite:
    - Concrete and steel strains
    - Accelerations - multi-axial
    - Roll and estimated deflections
- Using the measurement data, calculate the girder stresses measured during transport and compare to previously developed predictive concrete cracking models.
- Develop girder response spectra from the acceleration data and use them to calculate girder stresses and deflection profiles as an assessment of girder vulnerability to cracking and instability. We are of the view that resonance effects may play a significant role in the development of large girder strains.
- Measure trailer suspension and girder support stiffnesses.
- Correlate key girder responses during transport with GPS coordinates to facilitate characterization of road conditions, i.e., smoothness, cross slope, speed, vertical and horizontal curves.
- Identify critical locations for likely cracking in the tested girder types under prescribed transportation loading conditions.
- Assess the suitability of responses (strains, accelerations, deflections) as a basis for forming the transportation guidelines and design modifications, and the application of these recommendations to other girder types and lengths.
- Present the findings and recommendations to the LaDOTD and precast industry in report and training formats for consideration and possible implementation.

PART VIII Scope

This research will examine the behavior of two long-span instrumented precast concrete girders as each is transported from the precast yard to a separate jobsite. From detailed analyses of these results, practical and readily implementable transportation and design guidelines will be developed to minimize the potential for weak axis cracking and instability of long span girders during transportation.

PART IX Research Work Plan

The increasingly longer and more slender precast concrete girders used in today's bridge structures are more susceptible to cracking and instability during handling and shipping. Unfortunately, the forces associated with transporting girders are not well defined, in part because they depend on a number of different parameters. The following research work plan is proposed to quantify transportation forces experienced by precast concrete girders and to develop applicable transportation guidelines and design changes to avoid cracking and instability.

1. Method of Procedure

(a) Approach

Wiss, Janney, Elstner Associates, Inc. (WJE) engineers have carried out numerous instrumentation projects where an assessment of girder stresses and deflections was required. Through these projects, we have developed a unique understanding of structural behavior as well as specialized capabilities to more accurately measure and define it. The proposed research, as detailed in the following twelve tasks, is intended to identify and quantify the forces imposed on long span precast concrete bridge girders during shipping. Through this research, we propose developing guidelines and design recommendations for the LaDOTD to be used in future precast concrete girder bridge projects.

Task 1 - Literature Search

A review of previous research, industry publications, and known girder performance problems will be conducted. A portion of this work has already commenced in preparing this proposal and is partially complete. WJE has been in the forefront of precast concrete research for over 50 years and was involved in the testing of some of the first precast prestressed concrete girders used by the Illinois State Toll Highway Authority in 1956. WJE is an active member of the Prestressed Concrete Institute (PCI) and has access to other research and industry experts. As part of this task, we will contact other transportation agencies and obtain information on relevant shipping practices for precast concrete girders for review.

Task 2 - Parametric Study

Previous research has identified parameters affecting girder stability during handling and transportation. These parameters can be grouped into several broad categories, including girder

geometry, girder properties, casting information, trailer characteristics, service loads, and environmental conditions. From this earlier research, we will assess the significance of each parameter as it pertains to this study and identify how each parameter can be quantified or established.

Girder property (concrete, reinforcing steel and prestressing steel, reinforcement placement) and geometric (cross section, span, etc.) parameters will be used in the selection of the girders for instrumentation. We anticipate that many of the casting information parameters, such as release strength, camber, losses, etc., are routinely collected by the precaster and will be available for the research. The trailer characteristics and service loads will be measured using the proposed instrumentation. Parameters associated with environmental conditions will be considered; however, due to the relatively short duration of the transportation component, many could probably be assumed as being constant.

Task 3 - Girder Buckling and Cracking Analysis

Predictive cracking and buckling equations will be employed to assess the design behaviors of the test girders. Stratford, et. al. [5] determined that for typical girder sections, the non-dimensional buckling load of a simply supported girder is $w_{cr} = 28.5\sqrt{\frac{(GJEI_y)}{L^3}}$. Variables include G = shear modulus, J = St. Venant's torsion constant, E = Young's modulus, Iy = moment of inertia about the minor axis, and L = beam length.

From Mast, it was found that girders supported from below—as they are during transportation—have sufficient torsional stiffness but less roll angle stiffness due to the flexible supports. This can lead to long span beams rolling sideways and subsequently laterally buckling. The factor of safety against instability is defined as the ratio of the resisting moment arm to the applied overturning moment arm as follows:

$FS = \frac{r(\theta_{max} - \propto)}{\overline{z_o}\theta_{max} + e_i + y\theta_{max}}$ where θ_{max} = tilt angle at which cracking occurs, r = Kθ/w, Kθ = rotational spring constant of support (roll stiffness), w = self weight of girder, $\overline{z_o}$ = deflection of the center of gravity of the girder due to bending about the weak axis caused by self-weight over a simple support, ei = initial eccentricity of the center gravity of the girder, $\propto$ = superelevation angle or tilt angle of support, and y = height of center of gravity of girder above roll axis.

When the girder cracks, its stiffness is reduced which can influence its deflections. A simplified relationship was developed by Mast to consider the effective stiffness. For tilt angles that produce top flange tensile stresses that exceed $7.5\sqrt{f_c'}$ (the commonly accepted modulus of rupture), the effective stiffness, $I_{eff} = I_g/(1 + 2.5\theta_{max})$.

A finite element model of a trailer supported girder will be developed to estimate stresses under different load conditions. The finite element model will also be used to evaluate the sensitivity of various parameters. Areas of high tensile stresses which could lead to potential cracking under various load conditions will be located using the model. This information will be used to position the instrumentation on the test girders and to assist inspectors as to where to look for cracks on arrival of the girder at the jobsite.

Task 4 - Instrumentation Plan

From the parametric and analytical studies, an instrumentation plan detailing the type, location, timing, installation procedures, and recording frequency of the proposed instrumentation will be provided to the Project Review Committeee (PRC) for review and approval. The intent of the instrumentation is to assess the following:

1. Roll of the girder relative to the supports
2. Accelerations of the girder at midspan and the supports
3. Stresses in the girder at maximum location for vertical stresses (midspan), torsional stresses (supports), and lateral stresses (midspan)

To accomplish this, we intend to measure the roll of the girder using gyroscopes or DC accelerometers (with tilt output) at the midspan and supports. Accelerations will be measured with tri-axial accelerometers along the centroidal axis at the midspan and supports. Stresses in the girders will be measured in the concrete using embedded concrete strain gages and on mild steel reinforcement using electrical resistance gages. Vertical stresses will be measured at the top and bottom near midspan; and the torsional and lateral stresses will be measured with a pair of gages mounted on the sides of the top and bottom flanges at the supports and midspan, respectively. Mild reinforcement steel gages will be installed midspan. A pair of extensometers will be installed on the surface of the concrete for verification of data. Estimates of vertical displacement, sweep, and twist of the girder can be made through the existing measurements and finite element model correlation. Lastly, four thermocouples will be installed to measure concrete temperature at selected locations to assist with the strain behavior response analysis.

Instrumentation will be scanned at 2 kHz to evaluate the spectral response and stresses in the girder, as well as the input from the supports. Peak and median response will be logged every 10 seconds. Software will be configured to trigger to collect 10 second waveforms of acceleration, roll, or strain events. Triggers will be estimated based on analysis and field calibration to assure for a reasonable amount of full

waveform responses. In addition, a GPS will be attached to the data acquisition system and will simultaneously log the geolocation of the girders at synchronized 10 second intervals. This information will be used to correlate girder responses with roadway conditions. All data will be stored digitally on attached flash memory. A small secondary data acquisition will monitor the four thermocouples and store the data digitally at approximately 15 min. intervals.

Approximately 36 channels of data will be monitored during transportation of each girder. The investigators have developed comparable data acquisition systems including the collection of geolocation data using National Instruments Compact RIO hardware with associated signal conditioning modules. The compact hardware takes up minimal space. The data acquisition system will be stored in a weather-tight box that will travel with the girder as it shipped from the precast yard to the jobsite. It also has the necessary shock and temperature requirements for the work. When landline power is not available, such as when the girders are in transit, power will be supplied by an array of marine batteries. This configuration will allow for monitoring across multiple days.

Task 5 - Instrumentation Installation

The instrumentation will be installed in three phases. The first phase will occur prior to casting of the girder and involve the installation of strain gages with the lead wires routed out of the girder to enable casting of the girders. The second phase will consist of installing the remaining gages with supporting hardware accessories. Measurements of initial sweep will be made. The time between the first and second phases is anticipated to be about a day and will require only one mobilization.

The third instrumentation installation phase will occur prior to shipping the girder. The suspension stiffness of the tractor and jeep will be measured. In addition, the stiffness of the bearing material used to support the girders during shipping will also be measured. Consideration will be given to the placement of the girder on the supports along its length. Typically the girder is positioned inboard of the girder ends to reduce the span and the influence of any dynamic loads. A stress check of the shipping cantilevers is performed to verify that the forces are within limits. Once the girder is placed on the trailer, a visual inspection of the girder will be carried out to identify any cracks along the girder. The cracks will be marked for future reference. The extensometers and remaining instrumentation will be installed. The concrete gages will be positioned to avoid existing cracks. All of the gages will be calibrated and prepared for shipment of the girder. Baseline readings will be taken, including sweep measurements. Appropriate weatherproofing will be used to maintain signal integrity.

Task 6 - Transportation Monitoring

When the girders are scheduled to be shipped, we will be on site to complete the third phase of instrumentation installation—connection of the instrumentation to the data acquisition system. Measurements will be taken and reviewed with the last set of baselines. The measured changes in strain will be compared with estimates for expected creep and shrinkage. Once everything is secure and the girder cleared to leave the precast yard, we will begin recording of the data.

As part of the precaster and girder selection process, we will examine proposed transportation routes to determine which offers the desired road conditions required to generate the various girder responses typically encountered during shipping. Anticipated road conditions include travel at various speeds, turns with and without superelevation, vertical sag and crest curves, railroad crossings, and rough ride quality roads. Instrumentation data and GPS location data will be collected throughout the entire route. The first day of transit we plan to accompany the girder with coordinated stops to review the data and verify the trigger levels are adequately set. If the route takes place over multiple days, the additional data would be considered lagniappe and picked up with the instrumentation.

After arriving at the jobsite, we will visually inspect the girders for cracks and crack extensions. Crack widths will also be measured and documented with photos. Girder sweep be measured. The data collection will be suspended unless the girder is being immediately erected, in which case, we would propose monitoring the girder until it is set on its bearing pads. The gages will then be disconnected and removed, concluding the field test portion of the project. We have planned for the girder transportation and unloading to take up to two days.

Task 7 - Data Analysis

The digital data collected from the field testing will be post-processed to develop time histories of each data channel. Reinforcing steel and concrete stresses will be calculated from the strain data. The acceleration data will be examined to determine and analyze the response to transient, as well as the steady state response. The spectral response from fast Fourier transform (FFT) analysis will be compared with the calculated girder stresses based on the known properties and support configuration.

The route location will be plotted along with the associated stress responses in the girder. The peak responses along the route with the associated trigger data will be plotted along with estimates of comparable crack limits. We anticipate a site visit to further characterize the conditions which produced significant responses in the girders. Data will also be reviewed interactively using sensor mapping of the instrumentation on a three-dimensional finite element model. The review will include an interactive stress

analysis, as well as estimates of the rigid body and girder deformations by double integration of the acceleration data.

Analysis of the field instrumentation data will be further compared to the finite element models. This data will then be used to verify and further calibrate the model composition and loads.

Task 8 - Interim Report

An interim report presenting the results of the field testing will be produced. The scope of the interim report will include all work carried out in Tasks 1 to 7. The report will be presented by either the Principal or Co-Principal Investigator to the Project Review Committee (PRC) for review and comment.

Task 9 - Transportation Guidelines and Design Modifications Development

The interim report and review comments received from the PRC will form the basis for developing possible transportation guidelines and design modifications. The measured stresses will be used to evaluate how the girders performed against the existing LaDOTD long span precast girder transportation practices, including design standards. The suitability of applying these possible recommendations to other girder shapes and span lengths will be addressed.

A checklist will be developed to aid bridge inspectors with girder acceptance. The checklist will include locations of potential cracks in the studied girders.

Task 10 - Guidelines and Design Modifications Workshop

A workshop will be developed that incorporates the findings and recommendations of the study. WJE has extensive experience developing training courses, including the National Highway Institute courses for Bridge Construction Inspection, Bridge Rehabilitation Design, and the one-day Bridge Inspection Non-destructive Evaluation Showcase (BINS) course recently presented in Baton Rouge. LaDOTD engineers and consultants will participate in the precast girder transportation study workshop. The objective of the workshop will be to train the participants in using the checklist and possible design modifications. Adult learning methods will be incorporated into the workshop. Feedback from the workshop participants will be incorporated into the final report. The Principal or Co-Principal Investigator will present the workshop.

Task 11 - Final Report

A final report will be prepared that documents the precast concrete girder transportation study. The report will include specifics as to how the research can be practicably applied to LaDOTD procedures and design practices. Issues associated with applying the recommended procedures and practices will be discussed. Criteria for evaluating the success of the research recommendations will provided for future bridge projects using long span precast concrete girders. The Principal or Co-Principal Investigator will

present the final report to the LaDOTD after acceptance of the report.

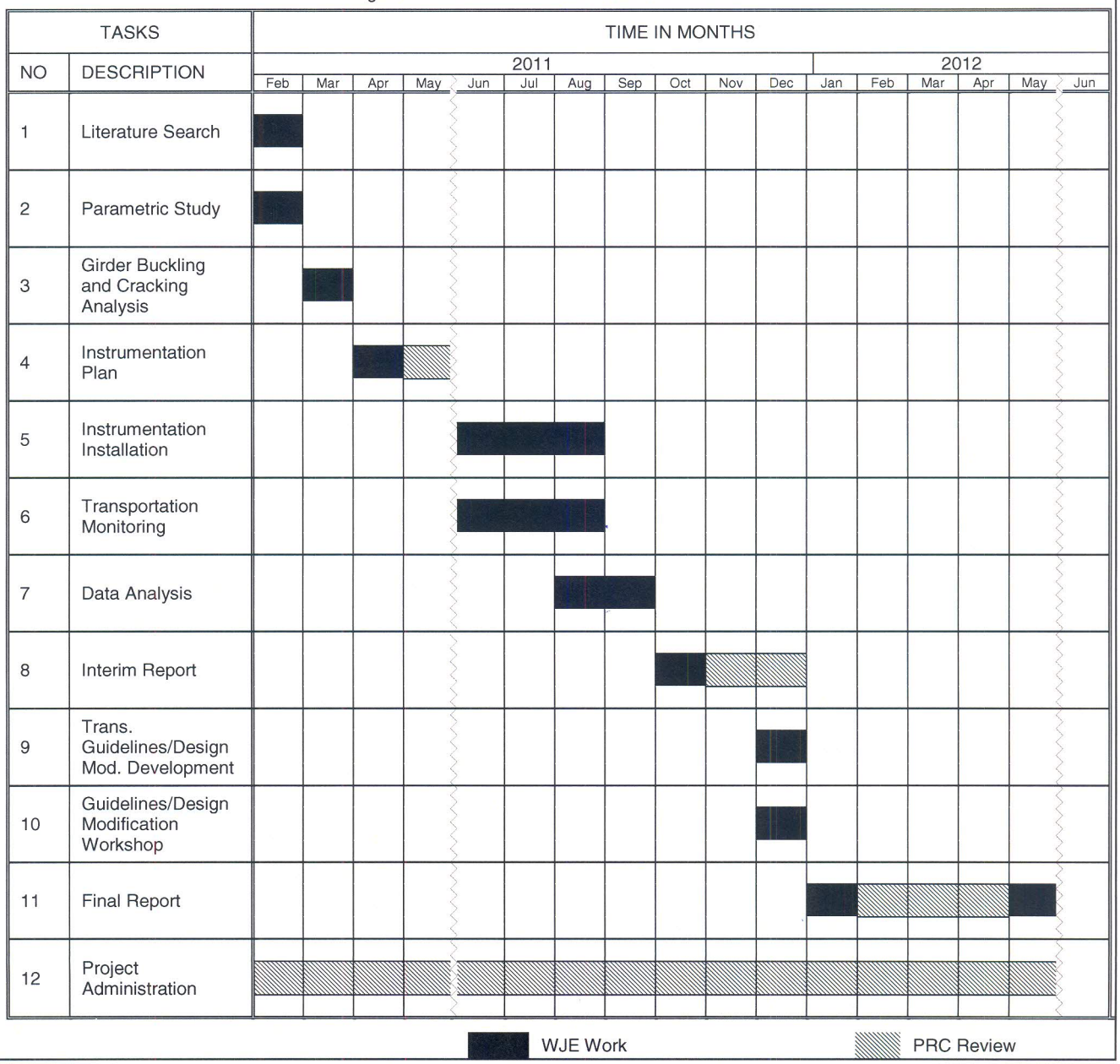
Task 12 - Project Administration

Under this task, we will include efforts associated with preparing for the kick-off meeting at the beginning of the project. The co-investigators will attend the meeting. A conference call will be established to permit the other team members to participate. Also included in this task will be the preparation of invoices and other necessary project correspondence.

(b) Work Schedule

A schedule identifying the tasks outlined above is included as Figure 1. The work is anticipated to be complete within 24 months. Included in that time is one month review time for the interim report and three months review time for the final report.

Figure 1. RESEARCH STUDY WORK SCHEDULE



(c) Deliverables

The following are the deliverables for this project. Refer to the project schedule for deliverable submission dates.

1. Instrumentation Plan - May 2011
2. Interim Progress Report - October 2011
3. Interim Progress Report Presentation - December 2011
4. Visual Inspection Check List - December 2011
5. Guidelines and Design Modifications Workshop - December 2011
6. Final Report - January 2012
7. Final Report Presentation - May 2012

2. Staffing Plan

The staff of WJE includes recognized experts with extensive experience in the inspection, structural analysis, assessment, and instrumentation and field testing of existing transportation structures. This experience, coupled with our ability to develop cost effective repair or rehabilitation designs, provide construction documents, and assist with construction observation services during repair, has allowed WJE to effectively extend the service life of many bridge structures. WJE has built its business providing immediate attention to our clients' needs and remaining current with the latest technology.

WJE has assembled an experienced Project Team from our Northbrook, Illinois, Atlanta, Georgia, Austin, Texas, and Boston, Massachusetts offices to undertake this research. Project members have been selected based on their technical capabilities and availability to complete the project within the schedule outlined in the solicitation.

Mr. Jonathan C. McGormley, P.E., S.E. will serve as Principal Investigator having the responsibility for coordinating communications with LaDOTD. Mr. McGormley will be an active participant in the research and will have oversight responsibility for all aspects of the project. He will be responsible for the presentations and workshops. Mr. Richard Lindenberg will serve as a Co-Investigator having the responsibility for developing the instrumentation system and the analysis/correlation of the field data with analytical models. Mr. John Fraczek, P.E., S.E. will serve a Research Advisor for this project where he will assist with the planning and preparation of the field instrumentation. He will also advise on development of transportation guidelines and design modifications. Messrs. Mark Moore, P.E., S.E. and

Lee Lawrence, P.E. will serve as Technical Advisors for this research project. Mr. Moore is based in our Atlanta, Georgia office while Mr. Lawrence is located in our Austin, Texas office. Mr. Brian J. Santosuosso, P.E., S.E. will serve as Project Engineer assisting with the field instrumentation. Mr. Douglas Crampton, P.E., S.E. will function as Project Engineer, leading the analysis efforts and coordinating the evaluation of the stresses in the precast girders due to transportation as well as reviewing any previous analyses. For this research, Mr. Caldwell, P.E. will serve as Project Engineer responsible for coordination with the precaster and obtaining the required casting information. He will also serve as Engineer of Record should documents require a professional seal in the State of Louisiana. Mr. Caldwell is located in WJE's Boston, Massachusetts office. Refer Table 1 for a summary of hours for each task. Note that Fiscal Year 2010-2011 includes Tasks 1 to 4 and Fiscal Year 2011-2012 includes Tasks 5 to 12.

Table 1. Hour Distribution by Task

Task	Jonathan C. McGormley	Richard E. Lindenberg	John Fraczek	Mark E. Moore	Lee Lawrence	Brian J. Santosuosso	Douglas D. Crampton	Jeffery Caldwell	Associate III	Associate II	Senior Specialist	Total Hours
1 Literature Search	12	4	2	0	0	0	0	0	4	0	0	22
2 Parametric Study	12	12	4	4	0	4	4	0	0	4	0	44
3 Girder Buckling and Cracking Analysis	4	4	2	0	0	0	40	0	16	0	0	66
4 Instrumentation Plan	16	44	2	2	2	12	0	8	4	0	16	106
5 Instrumentation Installation	26	26	0	0	0	26	0	26	0	10	10	124
6 Transportation Monitoring	16	32	0	0	0	16	0	16	0	0	0	80
7 Data Analysis	4	48	4	2	0	20	2	0	0	16	0	96
8 Interim Report	48	18	4	4	2	8	8	4	16	0	8	120
9 Transportation Guidelines/Design Modifications Development	20	8	10	8	6	0	10	0	12	0	0	74
10 Guidelines and Design Modifications Workshop	32	12	2	0	0	4	4	0	0	8	12	74
11 Final Report	44	16	4	4	4	6	6	4	8	14	12	122
12 Project Administration/Kick-off Meeting	30	12	0	0	0	0	0	0	0	0	0	42
Total Hours	264	236	34	24	14	96	74	58	60	52	58	970

3. Facilities Available

WJE's headquarters and main laboratory facility is located in Northbrook, Illinois. This facility includes over 90,000 sq. ft. of office, library, testing, and laboratory space featuring state-of-the art load application, instrumentation, and data collection equipment. WJE also maintains eighteen Branch Office locations in fifteen states, strategically located throughout the continental United States and Hawaii.

WJE is unique from other engineering consulting firms in that WJE maintains a testing laboratory facility to support structural and materials investigations and applied research projects. As a company, WJE is strongly committed to the use of existing and emerging technologies for the evaluation and assessment of bridge, building and other structures. WJE has maintained in-house laboratory facilities since its formation in 1956. The WJE laboratory facilities in Northbrook, Illinois have grown over the last 55 years to include a Structural Laboratory, Materials Laboratory, Electronics and Instrumentation Laboratory, Model Shop, Welding Shop, Concrete Mixing and Conditioning Laboratories, and several Chemical Laboratories. WJE has the capability to conduct specialized testing, designed by our in-house experts, or standard tests specified by American Society of Testing Materials (ASTM). Several current ASTM standard tests can be traced to testing that originated at WJE as part of one of our projects. WJE is, and has been, a pioneer in the testing of precast and reinforced concrete and its constituent materials.

WJE offers the following laboratory space for this project should it be required:

- *Structural laboratory* - WJE's 7,000 sq. ft state-of-the-art Structural Laboratory includes a structural test floor consisting of a 24-in. thick reinforced concrete slab-on-grade with an integral grid system of tie-downs for supporting test specimens and frames, and which can accommodate a wide array of structural test frames and test setups. Overhead cranes and up to 30 feet vertical clearances permit full-scale specimen testing. A concrete batching plant, located on-site, permits preparation of experimental concrete mixes, and a welding area provides equipment for electric arc, gas and MIG welding. Three universal testing machines having 60,000, 120,000, and 500,000 pound capacity are available for testing large-scale specimens. Large specimen static and dynamic testing can also be accommodated using in-house, servo-controlled hydraulic actuated loading equipment. Specialized load frames using modular structural shapes can be fabricated for almost any test program.
- *Electronics and instrumentation laboratory* - Our Electronics and Instrumentation Laboratory is used for the design, construction, and repair of electronic sensing equipment, transducers, data acquisition systems, and other electronic instrumentation circuitry. Our equipment is intended for use in both

laboratory and field assignments. Computer-based data acquisition systems capable of static and dynamic data acquisition, custom designed panel boards and circuitry, and cellular based and telemetry communications for data transmission are a few of the capabilities developed by WJE experts in this area. Also included in this area is the data analysis lab, used for the analysis of dynamic, seismic and sound test data, and the experimental mechanics lab, where bench top strain gage applications, residual stress measurements, Rockwell and Brinell hardness testing, and other experimental projects are conducted.

- *Concrete laboratory and conditioning rooms* - A Concrete Laboratory and Conditioning Rooms are available for both concrete and masonry investigations. These facilities can fabricate, cure, and test specimens intended for material evaluation. WJE has complete cement testing and concrete mixing facilities for testing of plastic and hardened concrete, and a staff of technicians certified in concrete batching, mixing and testing. Concrete batching facilities include a 5 cu. ft pan mixer and a smaller 1.5 cu. ft pan mixer. The laboratory is routinely inspected and certified by the Cement and Concrete Reference Laboratory of the U.S. Department of Commerce, the City of Los Angeles and the International Conference of Building Officials (ICBO). Three room-size laboratories, with temperature and humidity control including fog and dry cure rooms, exist for standard ASTM mortar, concrete, and paint testing at the WJE Northbrook facility. Five smaller environmental chambers are also available. These provide an extra-ordinary range of temperature and humidity conditions for specialized testing. The environmental chambers range in size from a "walk-in" unit with a volume of 2500 cu. ft to two medium-size units with volumes of about 60 cu. ft.
- *Model shop* - The model shop is equipped with a wide assortment of wood and metal working power tools for the fabrication of fixtures, test frames, test support apparatus and models.
- *Materials research laboratory* - An extensive Materials Research Laboratory has developed as the result of our previous work for NCHRP, FHWA and other sponsored research initiatives. This facility is dedicated to the evaluation of corrosion protection systems for reinforcing steel and prestressing strand and the materials associated with the prevention of deterioration. Corrosion resistant materials, such as ceramic, nylon, stainless steel, nickel, copper, and titanium, are routinely investigated in this laboratory. Dedicated data acquisition and environmental chambers for accelerated aging of large-scale specimen were developed to support corrosion investigations.
- *Chemical laboratories* - The Chemical Laboratories at WJE are available for detailed chemical analysis of construction materials including concrete, steel, wood, composites, coatings, glass, sealant,

adhesives, organic and inorganic compounds, etc. Capabilities include petrographic examination of concrete and mortars; scanning electron microscope studies; X-ray diffractometry and emission spectroscopy; ultraviolet, infrared, and atomic-absorption spectroscopy; and differential thermal analysis. A variety of accelerated weathering equipment is also available. The majority of the ASTM tests typically *conducted on concrete and masonry can be conducted in our Chemical Laboratories.*

- *Library Facilities* - WJE maintains a current technical reference library, including reference books, periodicals, and WJE report files for the engineering practice of the company. A staff librarian handles interlibrary loans and maintains contact with other libraries. The WJE On-Line Computer Library Center provides access to large technical libraries, including the Northwestern University Library in Evanston, Nerac Document Services, Illinois, and the John Crerar Library in Chicago, Illinois, one of the best technical reference libraries in the country. WJE is a member of the North Suburban ~Library System (NSLS) and the Illinois Library System (ILLNET) which has access to all major computer reference data bases (NTIS, HRIS, Dialogue, etc.) though System Reference. WJE also utilizes ACI Abstracts and other data base reference search engines to thoroughly search for current articles related to the transportation of prestressed concrete girders.

For this project, WJE has much of the necessary equipment to carry out the instrumentation and field testing proposed in the research plan including the data acquisition system, accelerometers, and extensometers. Expendable elements such as the strain gages and wire will be purchased specifically for this project. Non-expendable equipment purchased for this project include an accelerometer signal conditioning module for the data acquisition system, tri-axial accelerometer, and three gyroscopes or D.C. accelerometers with tilt output.

4. Significance of Research

Cracking and instability of long span precast concrete girders during transportation can delay construction while the girders are repaired or replaced and lead to a reduced service life as moisture and chlorides infiltrate unrepaired cracked girders. The proposed research will attempt to quantify the loading imposed on girders during transportation. Research carried out 20 to 25 years ago has been used as the basis for designing girders for transportation stresses. However, with the use of longer girders and more efficient girder cross sections, instances of instability and cracking still occur during transportation and handling. A PCI advisory on I-girder stability during handling and construction was issued in 2009 warning about long-term sweep[6]

An initial review of the published literature on the subject of transportation stresses in long span precast concrete girders has found no previous research in which actual girders have been instrumented to measure transportation and handling stresses. However, this review does not include several unpublished studies carried out by the precast industry and bridge owners – including LaDOTD. The earlier published research [1] [2] [3] [4] [5] has focused on developing analytical models to maintain stability and prevent cracking. Work by Mast [4] measured the roll stiffness of the trailer suspension systems and subjected a girder to tilt. More recent research work carried out by the University of Florida [7] examined lateral bracing of long span Florida bulb-tee girders. They utilized numerical analysis techniques to quantify the buckling capacities of girders as a function of girder cross section, span, and bridge skew. They also considered girder sweep, bearing pad creep, bracing stiffness, as well as developing a preliminary study on lateral wind loads on girder stability.

The tasks described under this research plan will help to quantify the forces imposed on girders during shipping. Roadway conditions that cause particular loading events will be documented. Locations of potential cracking will be identified to assist bridge inspectors with acceptance of the girders at the jobsite.

5. Implementation

Practical recommendations to implement the findings of the research will be presented in the final report and as part of the training workshop. We envision that the recommendations will include guidelines for transportation as well as modifications to current design practices. The field testing should provide quantitative effects of trailer roll stiffness, girder supports, and roadway characteristics on the girder behavior. The LaDOTD and the precast industry could use the proposed guidelines to modify trailer suspension, adjust the girder support points on the trailer, and select different stiffness bearing pads and tie downs. In addition, proposed shipping routes could be evaluated to ensure that roadway characteristics indentified in the study as having negative effects on the girders are avoided.

Modifications to precast girder design practices are possible based on the outcomes of the study. The changes may include the addition of prestressing in the top flange to account for the loads or a reduction in supported span lengths during transportation to keep concrete stresses below cracking limits. The proposed modifications would be released via a design memorandum through LaDOTD.

We believe our research plan also offers the LaDOTD an opportunity to improve its girder acceptance practices beyond the proposed bridge inspector checklist. Using readily available off-the-shelf technology, we envision the future development of a simple battery-powered monitoring device that could be placed

on a girder to assess its shipping stresses. The device would produce a record that will aid in resolving acceptance disputes. To use the device, the girder section and span length would be selected and the device temporarily affixed to the girder during transportation. At the jobsite, the bridge inspector would remove the device and check for any warnings indicating the girder has been subjected to forces greater than approved. Girders arriving without warnings could be visually inspected and accepted while those with warnings could be conditionally accepted until analysis and visual inspection confirms their conformance with the project specifications. The device could serve a quality assurance role by allowing inspectors to assess the condition of proposed delivery routes and allow the precaster to change the route to avoid roadway characteristics that were shown to produce unacceptable responses.

PART X Supporting Data

1. Previous Work by Researchers

WJE is an interdisciplinary engineering, architecture, and materials science firm specializing in the evaluation, field testing, and rehabilitation of existing transportation and building structures. With a current staff of approximately 380 professionals and technical experts, WJE has performed more than 80,000 projects since its origin in 1956. WJE annually conducts approximately 5,000 projects.

WJE has conducted numerous research projects with various clients and is familiar with the challenges associated with managing such projects. For this project, WJE offers LaDOTD a nationally recognized engineering firm specializing in the evaluation and assessment of bridges and structures. Our knowledge of structural behavior and material performance is supported by technical expertise in non-destructive testing. With this experience, WJE is uniquely qualified to provide engineering and testing services for the investigation of structures suffering from deterioration, structural deficiencies, or fatigue cracking problems. With over 50 years of investigation and repair design experience, WJE possesses the capabilities necessary to identify and solve problems that arise during construction and throughout the service life of bridge and transportation-related structures.

WJE has carried out projects with relevant aspects as to those proposed in the research plan. The projects can be characterized as research projects, precast concrete projects, and instrumentation projects.

Research Projects

WJE has a long history of providing consulting and research services to NHCRP, FHWA, industry groups, and state departments of transportation. This has included numerous studies associated with the design, performance, and protection of concrete bridge structures. Several of these projects required us to develop or modify design standards. Example research projects include:

- NCHRP Report 313 - Corrosion Protection of Prestressing Systems in Concrete Bridges
- NCHRP Report 380 - Transverse Cracking for Newly Constructed Bridge Decks
- FHWA DTFH61-91-R-00088 - Guide Design Specifications for Bridge Temporary Works
- FHWA DTFH61-96-R-00054 - Development of Nondestructive Evaluation Validation Center
- PCI - Volume Change Movement and Forces in Precast Concrete Buildings

Precast Concrete Projects

Since its inception, WJE has been heavily involved with the precast concrete industry. We are routinely asked to evaluate cracking and distress in precast concrete structures. Example precast concrete projects include:

- An elevated rail line in the northeast was plagued with deteriorating precast bearing connections across a multi-mile span. WJE was retained to determine the causes and recommend repairs. WJE's work included field instrumentation, full-size lab tests of panels, field inspections, and analytical models.
- The runway system at LaGuardia Airport was extended over Long Island Sound in the early 1960s using precast/prestressed and post-tensioned concrete girders and precast/prestressed stay-in-place forms. WJE was retained to determine the feasibility of the retrofit design to address corrosion of the prestressing strands. WJE's work included instrumentation and testing of girder samples.
- After many years of extensive deterioration the city of Chicago reconstructed the Wacker Drive Viaduct. As a part of the project WJE was retained to develop a health monitoring system in a representational section. WJE's work included the development of a full size prototype tested to failure, and the development of the health monitoring system consisting of corrosion probes, tilt meters, strain gages, and LVDT's.

Instrumentation Projects

WJE distinguishes itself from other consulting engineering firms by our ability to carry out field instrumentation projects. These capabilities allow us to better assess the behavior of structures. Representative instrumentation projects include:

- WJE instrumented an aluminum sign truss over an interstate highway for the purposes of measuring its behavior under truck passages and wind load events. Instrumentation included strain gages, accelerometers, web camera, and weather station. The data was remotely transmitted to Northbrook for analysis.
- The transit authority in Chicago was having rail cracking problems throughout its system. WJE instrumented portions of the track and monitored car passages to calculate the effective stress range

experienced by the rail.

- Cracking was found throughout the two-girder bridge at fatigue sensitive details. WJE installed strain gages and LVDTs to measure the response of the girders and details under control truck loads. Recommendations were made to extend the fatigue life of the bridge.

2. Results Obtained by Others:

A preliminary literature search was carried out to assess the current state of the practice with regard to transportation and handling of prestressed concrete girders. As discussed in Part IX - 4, the earlier published research focused on developing analytical models to maintain stability and prevent cracking. A paper prepared by Mast [4] focused on transportation stresses associated with the roll stiffness of the trailer and jeep. More recent research examined the influence of bearing stiffness on girder sweep.

Several precast concrete girder design manuals and practices including those by the LaDOTD [8], Kansas Department of Transportation (KDOT) [9], Washington State Department of Transportation (WsDOT) [10] [11], and PCI Bridge Design Manual [12] were reviewed. WsDOT design parameters for shipping and handling include the following:

Condition	Shipping Parameter
Impact Factor (Upward or Downward)	0.8 or 1.2
Roll stiffness of trailer	32000 in-kips/rad for W < 164 kips 40000 in-kips/rad for 164 < W < 182 kips 48000 in-kips/rad for 182 < W < 200 kips
Max. superelevation	6 %
Girder sweep tolerance	1/8 in. per 10 ft
Lifting device or truck support lateral tolerance	1.00 inch
Compression stresses	$f_c = 0.6\acute{f}_c$
Tension - without bonded mild reinforcement - with bonded mild reinforcement sufficient to resist total tension	$f_t = 0.0948\sqrt{f_c}$ $f_t = 0.237\sqrt{f_c}$

KDOT accounts for dynamic forces on prestressed girders during transportation by checking the tension in the top flange over the temporary supports. Often times the girder support points are set in from the girder ends to reduce the span length. The cantilevered ends can be subjected to dynamic forces which reduce the dead weight resulting in critical tension stresses in the girder top flange. The cantilever ends are checked for a value of three times the girder weight to account for the dynamic forces. This approach is consistent with the PCI Design Handbook [13].

3. Amounts Requested

WJE requests that a budget of $199,961 be established for this research project. This amount includes an overhead rate of 196.02 with 11 percent profit. An audited indirect expense report for the most current year is attached as an appendix. WJE currently owns much of the instrumentation equipment for this

project and will rent this equipment per the attached cost tables. We plan on purchasing several pieces of instrumentation as part of the research project to supplement the number of accelerometers we currently own and due to the specialty nature of the gyroscopes. Travel costs have been kept to a minimum by combining tasks where appropriate. We intend on making two trips for each girder to instrument and monitor.

PART XI
List of References

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WJE | ENGINEERS
ARCHITECTS
MATERIALS SCIENTISTS

Wiss, Janney, Elstner Associates, Inc.

Financial Statements

Years Ended December 31, 2009 and 2008

CONFIDENTIAL

BDO

BDO Seidman, LLP
Accountants and Consultants

Wiss, Janney, Elstner Associates, Inc.

Contents

BDO Seidman, LLP
Accountants and Consultants

233 N. Michigan Ave., Suite 2500
Chicago, Illinois 60601
Telephone: (312) 856-9100
Fax: (312) 856-1379

CONFIDENTIAL

Independent Auditors' Report

To the Board of Directors
Wiss, Janney, Elstner Associates, Inc.

We have audited the accompanying balance sheets of Wiss, Janney, Elstner Associates, Inc. (the "Corporation") as of December 31, 2009 and 2008, and the related statements of operations, changes in stockholders' equity and cash flows for the years then ended. These financial statements are the responsibility of the Corporation's management. Our responsibility is to express an opinion on these financial statements based on our audits.

We conducted our audits in accordance with auditing standards generally accepted in the United States of America. Those standards require that we plan and perform the audits to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes consideration of internal control over financial reporting as a basis for designing audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Corporation's internal control over financial reporting. Accordingly, we express no such opinion. An audit also includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements, assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for our opinion.

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of Wiss, Janney, Elstner Associates, Inc. as of December 31, 2009 and 2008, and the results of its operations and its cash flows for the years then ended in conformity with accounting principles generally accepted in the United States of America.

BDO Seidman, LLP

Chicago, Illinois
February 12, 2010

CONFIDENTIAL

Financial Statements

Wiss, Janney, Elstner Associates, Inc.

Balance Sheets

December 31,	2009	2008
	Assets	
Current Assets		
Cash and cash equivalents	**$ 13,954,300**	$ 12,079,200
Accounts receivable	**18,110,000**	21,907,100
Work in process	**7,717,600**	7,428,700
Other current assets	**2,360,300**	3,148,900
Total Current Assets	**42,142,200**	44,563,900
Property and Equipment	**19,843,800**	20,091,700
Other Assets	**867,400**	457,200
Total Assets	**$ 62,853,400**	$ 65,112,800
	Liabilities and Stockholders' Equity	
Current Liabilities		
Debt	**$ 1,916,200**	$ 2,182,400
Accounts payable	**2,598,600**	2,310,500
Accrued expenses	**16,544,300**	19,181,300
Advance billings	**2,332,000**	3,580,000
Total Current Liabilities	**23,391,100**	27,254,200
Other Liabilities		
Debt	**7,257,100**	9,173,400
Other	**6,368,500**	5,636,400
Total Other Liabilities	**13,625,600**	14,809,800
Stockholders' Equity		
Common stock	**18,700**	16,900
Additional paid-in capital	**13,011,300**	10,375,800
Retained earnings	**12,978,200**	12,785,200
Accumulated other comprehensive loss	**(171,500)**	(129,100)
Total Stockholders' Equity	**25,836,700**	23,048,800
Total Liabilities and Stockholders' Equity	**$ 62,853,400**	$ 65,112,800

See accompanying notes to financial statements.

Wiss, Janney, Elstner Associates, Inc.

Statements of Operations

Year ended December 31,	2009	2008
Revenue		
Professional services fees	$ 95,554,400	$ 90,960,100
Adjustments to fees	(5,829,300)	(4,874,400)
Net fees	89,725,100	86,085,700
Other revenues	1,495,400	1,676,500
Total net revenues	91,220,500	87,762,200
Direct Operating Expenses		
Salaries	42,725,300	39,735,600
Fringe benefits	10,572,400	10,239,900
Facilities	7,528,500	7,331,100
Depreciation and amortization	2,553,100	2,365,300
Professional development	2,282,100	2,679,600
Accounts receivable allowances and write-offs	1,356,800	893,100
Computer hardware and software maintenance	1,042,700	1,039,900
Professional fees	1,030,200	918,600
Business insurance	886,600	833,300
Marketing and advertising	358,400	391,400
Miscellaneous	1,362,500	1,272,100
Total direct operating expenses	71,698,600	67,699,900
Earnings After Direct Operating Expenses	19,521,900	20,062,300
Indirect Operating Expenses		
Incentive and bonus	17,911,100	18,974,400
Postretirement benefits	333,000	307,200
Total indirect operating expenses	18,244,100	19,281,600
Earnings from Operations	1,277,800	780,700
Other Expenses		
Loss on disposal of property and equipment	21,300	8,300
Interest, net	890,200	847,500
Net other expenses	911,500	855,800
Earnings (Loss) Before Income Taxes	366,300	(75,100)
Income tax provision (benefit)	173,300	(51,400)
Net Earnings (Loss)	$ 193,000	$ (23,700)

See accompanying notes to financial statements.

Wiss, Janney, Elstner Associates, Inc.

Statements of Changes in Stockholders' Equity

	Common Stock * Shares Issued and Outstanding	Common Stock * Par Value	Additional Paid-in Capital	Retained Earnings	Accumulated Other Comprehensive Income (Loss)	Total Stockholders' Equity	Comprehensive Income (Loss)
Balance, January 1, 2008	1,579,000	$ 15,800	$ 8,642,000	$ 12,808,900	$ 77,600	$ 21,544,300	
Retirement of common stock	(61,000)	(600)	(944,300)			(944,900)	
Issuance of common stock	173,000	1,700	2,678,100			2,679,800	
Comprehensive income							
Net loss				(23,700)		(23,700)	$ (23,700)
Other comprehensive loss, net-of-tax							
Postretirement medical benefit							
Prior service cost						6,400	6,400
Net actuarial loss						(36,700)	(36,700)
Mark-to-market on interest rate swap contracts						(176,400)	(176,400)
Other comprehensive loss					(206,700)		(206,700)
Total comprehensive loss							$ (230,400)
Balance, December 31, 2008	1,691,000	16,900	10,375,800	12,785,200	(129,100)	23,048,800	
Retirement of common stock	(17,000)	(200)	(256,000)			(256,200)	
Issuance of common stock	192,000	2,000	2,891,500			2,893,500	
Comprehensive income							
Net earnings				193,000		193,000	$ 193,000
Other comprehensive loss, net-of-tax							
Postretirement medical benefit							
Prior service cost						6,400	6,400
Net actuarial loss						(119,900)	(119,900)
Mark-to-market on interest rate swap contracts						71,100	71,100
Other comprehensive loss					(42,400)		(42,400)
Total comprehensive income							**$ 150,600**
Balance, December 31, 2009	**1,866,000**	**$ 18,700**	**$ 13,011,300**	**$ 12,978,200**	**$ (171,500)**	**$ 25,836,700**	

*$.01 par value; 3,000,000 shares authorized.

See accompanying notes to financial statements.

Wiss, Janney, Elstner Associates, Inc.

Statements of Cash Flows

Year ended December 31,	2009	2008
Cash Flows From Operating Activities		
Net earnings (loss)	$ 193,000	$ (23,700)
Net other comprehensive loss	(42,400)	(206,700)
Depreciation and amortization	2,553,100	2,365,300
Accounts receivable and work in process reserves	(98,400)	370,300
Provision for deferred income taxes	(428,100)	(58,500)
Net loss on disposal of property and equipment	81,600	8,300
Changes in:		
Accounts receivable	3,871,300	(3,784,400)
Work in process	(264,700)	(911,900)
Prepaid expenses and other	(50,200)	(1,692,800)
Other assets	(71,500)	(33,300)
Accounts payable and accrued expenses	(2,856,900)	7,621,500
Other long-term liabilities	920,300	852,600
Net cash provided by operating activities	3,807,100	4,506,700
Cash Flows From Investing Activities		
Property and equipment – acquisitions	(1,827,000)	(2,283,200)
Property and equipment – lessor allowances	(570,800)	(591,200)
Cash sales of property and equipment	11,000	2,800
Net cash used in investing activities	(2,386,800)	(2,871,600)
Cash Flows From Financing Activities		
Repayment of debt	(2,182,500)	(1,352,500)
Proceeds from issuance of debt	-	2,366,800
Repurchase of common stock	(256,200)	(944,900)
Sale of common stock	2,893,500	2,679,800
Net cash provided by financing activities	454,800	2,749,200
Increase in Cash and Cash Equivalents	1,875,100	4,384,300
Cash and Cash Equivalents, beginning of year	12,079,200	7,694,900
Cash and Cash Equivalents, end of year	$ 13,954,300	$ 12,079,200
Supplemental Disclosures of Cash Flow Information		
Interest paid	$ 658,000	$ 987,400
Income taxes paid	$ 786,000	$ 1,063,900

See accompanying notes to financial statements.

1. Nature of Operations and Significant Accounting Policies

Nature of Operations

Wiss, Janney, Elstner Associates, Inc. (the "Corporation") is an interdisciplinary firm of structural engineers, architects and materials scientists specializing in the investigation of, and design of repairs for, distressed conditions in buildings, bridges and related structures primarily located in the United States.

Reporting Period

The Corporation's fiscal year ends on the Sunday closest to December 31. The year 2009 covers the 53-week period from December 29, 2008 through January 3, 2010 and the year 2008 covers the 52-week period from December 31, 2007 through December 28, 2008. For purposes of financial reporting, the years described above are noted as being full calendar years, beginning January 1 and ending December 31.

Accounting Standards Codification

Effective with the financial statements for the year ending December 31, 2009, the Corporation adopted Financial Accounting Standards Board Accounting Standards Codification ("ASC" or "the Codification") 105-10, *"Generally Accepted Accounting Principles,"* which becomes the single official source of authoritative, nongovernmental generally accepted accounting principles in the United States. The only impact of the adoption of ASC 105-10 was to change all references to authoritative accounting literature referenced in the Corporation's notes to the financial statements.

Cash and Cash Equivalents

The Corporation invests its cash in a money market fund, which in turn invests in government and short-term debt securities and, therefore, bears minimal risk. Such investments are considered cash equivalents for purposes of reporting cash flows.

The amount of cash deposited at the Corporation's primary bank typically exceeds the federally insured amount. The Corporation has assessed the financial strength of its bank and determined the risk of default to be minimal.

1. Nature of Operations and Significant Accounting Policies *continued*

Accounts Receivable

Amounts invoiced for professional services and reimbursable expenses are included in accounts receivable. The Corporation establishes an allowance for amounts that ultimately may be uncollectible, based upon specific-identification and historical experience.

Work in Process

Amounts for professional services and reimbursable expenses on which revenue has been accrued but not invoiced are included in work in process. These balances are stated at negotiated billing rates for professional time and at marked-up cost for reimbursable expenses, where applicable. The Corporation establishes an allowance for amounts that ultimately may be unbillable.

Property and Equipment

The Corporation's investments in property and equipment are stated at cost. Depreciation is calculated using the straight-line method over the estimated useful lives of the assets. Leasehold improvements are amortized using the straight-line method over the lesser of the useful lives of the improvements or the remaining terms of the leases. The estimated useful lives are as follows:

Asset Classification	Years
Buildings and improvements	15 – 40
Leasehold improvements	5 – 11
Office furniture and fixtures	5 – 7
Engineering equipment	5 – 7
Computer equipment	3 – 5
Automobiles and trucks	3 – 5
Purchased computer software	3

1. Nature of Operations and Significant Accounting Policies *continued*

Hedging Instruments

The Corporation accounts for derivative financial instruments under ASC 815, *"Accounting for Derivative Instruments and Hedging Activities,"* as amended and interpreted, which requires all derivatives to be recorded in the balance sheet at their fair values. Changes in the fair values of the derivatives are recorded in each period as other comprehensive income or loss.

Accumulated Other Comprehensive Loss

Accumulated other comprehensive loss consists of actuarial gains or losses, prior service costs, and transition assets or obligations related to postretirement benefits that have not yet been included in net postretirement benefits expense, and unrecognized gains and losses on interest rate swaps, all net of tax.

Revenue

Professional services fees are recognized based upon the date those services are performed. Adjustments to revenue include provisions for unbillable amounts, including proposal time. Other revenues consist of income earned from laboratory services, equipment rental and affiliated consultant services.

Uncertainty in Income Taxes

The Financial Accounting Standards Board issued ASC 740-10-25, *"Accounting for Uncertainty in Income Taxes,"* which:

1. requires that the realization of an uncertain income tax position must be more likely than not (that is, greater than 50% likelihood of receiving benefit) before it can be recognized in the financial statements,
2. mandates that the recorded amount must be the most likely amount realized assuming a review by the tax authorities having all relevant information and applying current conventions,
3. establishes financial statement classification of tax related penalties and interest, and
4. sets narrative disclosures regarding unrecognized tax benefits.

1. Nature of Operations and Significant Accounting Policies *continued*

Uncertainty in Income Taxes continued

On January 1, 2009, the Corporation adopted the provisions of ASC 740-10-25. The adoption of these provisions did not have a material impact on the Corporation's financial statements.

Fair Value of Financial Instruments

On January 1, 2008, the Corporation adopted ASC 820-10, *"Fair Value Measurements."* Fair value estimates are made at a specific point in time based on relevant market information about the financial instrument. These estimates are subjective in nature and involve uncertainties and matters of significant judgment and, therefore, cannot be determined with precision. Changes in assumptions could significantly affect the estimates.

The carrying amounts for cash and cash equivalents, accounts receivable, accounts payable and accrued expenses approximate fair value due to the short-term nature of these instruments.

Use of Estimates

The preparation of financial statements in conformity with accounting principles generally accepted in the United States of America requires management to make estimates and assumptions that affect the amounts reported in the financial statements and accompanying notes. Actual results could differ from those estimates.

Reclassifications

Certain amounts previously reported have been reclassified to conform to the current year's presentation.

2. Accounts Receivable

Accounts receivable at December 31 consists of:

	2009	2008
Professional time and expenses	$ 19,819,100	$ 23,690,500
Less allowance for uncollectible amounts	1,709,100	1,783,400
Net	$ 18,110,000	$ 21,907,100

3. Work in Process

Work in process at December 31 consists of:

	2009	2008
Professional time and expenses	$ 8,227,200	$ 7,962,400
Less allowance for unbillable amounts	509,600	533,700
Net	$ 7,717,600	$ 7,428,700

4. Other Current Assets

Other current assets at December 31 consists of:

	2009	2008
Prepaid insurance	$ 743,300	$ 748,700
Current income tax receivable	660,000	1,400,000
Deferred income taxes	478,000	576,800
Prepaid expenses	435,600	381,100
Other	43,400	42,300
Total	$ 2,360,300	$ 3,148,900

5. Property and Equipment

Property and equipment at December 31 consists of:

	2009	2008
Land	**$ 1,452,200**	$ 1,452,200
Buildings and improvements	**15,431,800**	15,372,100
Leasehold improvements	**5,155,900**	4,722,600
Computer equipment	**3,780,800**	3,212,000
Office furniture and fixtures	**2,812,800**	2,639,700
Engineering equipment	**2,635,900**	2,488,600
Purchased computer software	**1,078,200**	1,071,600
Automobiles and trucks	**460,600**	511,700
Construction in progress	**1,007,000**	252,000
	33,815,200	31,722,500
Less accumulated depreciation and amortization	**13,971,400**	11,630,800
Net	**$ 19,843,800**	$ 20,091,700

6. Debt

The Corporation and Harris N.A. (the "Bank") entered into an Amended and Restated Credit Agreement dated March 19, 1999, as last amended April 30, 2008 (the "Prior Agreement"). The Prior Agreement consisted of a mortgage loan, three term notes, and a revolving credit note. On December 8, 2008, the Corporation replaced the Prior Agreement with a new Amended and Restated Credit Agreement (the "Credit Agreement"). The Credit Agreement provided for the refinancing of two of the outstanding term notes, and increased the borrowed amount of one of those term notes. The Credit Agreement consists of three term notes and a revolving credit note.

6. Debt *continued*

Under the terms of the Credit Agreement, substantially all of the Corporation's assets are pledged as collateral. Certain covenants of the Credit Agreement require the maintenance of specified levels of tangible net worth, net operating earnings before bonuses, interest and taxes, and debt service coverage. Dividends, capital expenditures and capital lease obligations are restricted. In the event of a default, additional interest may be imposed and the loans may be called. The Corporation was in compliance with all covenants under the Credit Agreement as of December 31, 2009 and 2008, and for the years then ended.

In 2008, the Corporation acquired $462,400 in property and equipment through a series of capital lease transactions. The terms of those leases are further discussed in Note 8. There were no capital lease transactions in 2009.

Debt at December 31 consists of:

	2009	2008
Term Note 1	$ **4,000,000**	$ 5,000,000
Term Note 2	**3,000,000**	3,333,300
Term Note 3	**1,638,800**	1,831,600
Revolving credit	**-**	-
Capital lease obligations	**534,500**	1,190,900
Total	**9,173,300**	11,355,800
Less current debt	**1,916,200**	2,182,400
Long-term debt	$ **7,257,100**	$ 9,173,400

Term Note 1 originated in March 1999 and was due to mature in March 2009 with a balloon payment of $3,200,000. The Corporation chose to refinance the outstanding balance in December 2008 and borrow an additional $1,530,000 to fund capital expenditures. The new loan balance of $5,000,000 is payable in quarterly installments of $250,000 plus interest, maturing in December 2013. Concurrent with the refinancing, the Corporation entered into an interest rate swap agreement, effectively fixing the floating portion of the interest rate at 4.48%. The original Term Note 1 required quarterly principal installments of $135,000 plus interest. Interest was fixed at 7.25%.

6. Debt *continued*

Term Note 2 originated in February 2006 and was due to mature in June 2013. The Corporation chose to refinance the outstanding balance in December 2008 and pay an early termination fee of $152,400. The new note balance of $3,333,300 is payable in quarterly installments of $83,300 plus interest with a balloon payment of $1,750,000 due in December 2013. Concurrent with the refinancing, the Corporation entered into an interest rate swap agreement, effectively fixing the floating portion of the interest rate at 4.72%. The original Term Note 2 required quarterly principal installments of $66,700 plus interest. Interest was fixed at 7.56%.

Term Note 3 originated in June 2003 and is due to mature in June 2013. The note is payable in quarterly installments of $48,200 plus interest with a balloon payment of $964,000 due in June 2013. Interest is fixed at 5.72%.

The Revolving Credit Note allows the Corporation to borrow up to $4,000,000 at a defined interest rate. At December 31, 2009 and 2008, no balance was outstanding.

Maturities of debt in each of the next five years ending December 31 and aggregated thereafter are as follows:

2010	$ 1,916,200
2011	1,670,500
2012	1,526,100
2013	4,060,500
2014	-
Thereafter	-
Total	$ 9,173,300

In addition, the Credit Agreement permits the Corporation to guarantee term loans made by the Bank to employees for the sole purpose of purchasing common stock of the Corporation. At December 31, 2009 and 2008, the Corporation guaranteed loans totaling $7,212,400 and $6,136,400, respectively.

7. Accrued Expenses

Accrued expenses at December 31 consists of:

	2009	2008
Incentive awards	$ 10,000,000	$ 12,000,000
Vacation and other employee benefits	2,361,100	1,906,500
Payroll and related taxes	1,558,900	2,508,300
401(k) plan contributions	1,002,300	1,127,400
Real estate taxes	320,000	330,000
Property and equipment costs	280,500	186,000
Other	1,021,500	1,123,100
Total	$ 16,544,300	$ 19,181,300

8. Leases

The Corporation leases office and warehouse space and equipment under noncancelable operating leases. Certain office and warehouse leases include provisions for the payment of a proportionate share of executory costs consisting of real estate taxes, insurance, maintenance and utilities. Rent expense is recognized using the straight-line method over the life of the lease and, consequently, the accompanying balance sheets include deferred rent in other liabilities, representing lease expense recognized but not yet paid. Total rent expense under the operating leases including executory costs was $3,659,800 and $3,497,300 for the years ending December 31, 2009 and 2008, respectively.

Several of the office space leases include an incentive provided by the landlord toward the cost of leasehold improvements. The value of the incentive allowances is included as leasehold improvements in property and equipment, with a corresponding liability included in other liabilities. Both the asset and liability are amortized on a straight-line basis over the lesser of the life of the lease or the useful life of the underlying asset. In the event the Corporation should default on the lease, the unamortized cost of those improvements must be reimbursed to the landlord. Unamortized leasehold improvements and the equivalent corresponding liability totaled $2,440,400 and $2,220,700 at December 31, 2009 and 2008, respectively.

8. Leases *continued*

The Corporation acquired certain office furniture and fixtures, engineering equipment and computer equipment financed by capital leases with 36- or 48-month terms. Details of the capitalized leased assets included in property and equipment are as follows:

	2009	2008
Office furniture and fixtures	**$ 1,305,600**	$ 1,305,600
Engineering equipment	**23,300**	23,300
Computer equipment	**711,400**	711,400
Computer software	**24,100**	24,100
Total	**2,064,400**	2,064,400
Less accumulated depreciation	**1,194,800**	724,000
Net capitalized leased assets	**$ 869,600**	$ 1,340,400

Exclusive of executory costs on the operating leases, future minimum lease payments in each of the next five years ending December 31 and aggregated thereafter are as follows:

	Operating Leases	Capital Leases
2010	$ 3,442,500	$ 416,400
2011	3,541,300	148,400
2012	3,218,800	-
2013	3,035,100	-
2014	2,653,300	-
Thereafter	8,224,100	-
Total	$ 24,115,100	564,800
Less imputed interest		30,300
Net present value of payments		534,500
Less current portion		390,100
Long-term capital lease obligations		$ 144,400

9. Other Liabilities

Other liabilities at December 31 consists of:

	2009	2008
Postretirement medical benefits	**$ 3,122,300**	$ 2,611,100
Lessor-provided leasehold allowances	**2,440,400**	2,220,700
Deferred rent	**805,800**	616,400
Deferred income taxes	**-**	188,200
Total	**$ 6,368,500**	$ 5,636,400

10. Derivative Financial Instruments and Hedging Activities

Derivative Financial Instruments

The Corporation utilizes certain derivative financial instruments to reduce the risk of changes in cash interest payments related to its long-term debt. The derivative instruments are limited to interest rate swap agreements which are not exchange-traded and are over-the-counter customized transactions.

The Corporation's interest rate swap agreements are cash flow hedges and, to the extent that the agreements remain effective, are accounted for pursuant to ASC 815 by recording the effective portion of the change in fair value of the hedged transaction in accumulated other comprehensive income or loss. In the event that hedge accounting no longer applies, the Corporation will recognize all changes in the fair value of the derivative instrument, as well as any effect previously recorded in accumulated other comprehensive income or loss, attributed to the derivative transaction, in the statement of operations.

In 2008, the Corporation entered into an interest rate swap agreement with Harris N.A. to hedge the Corporation's exposure to fluctuations in LIBOR on $8,333,300 of 3-month LIBOR-based debt through December 31, 2013. The notional balance for this interest rate swap is $7,000,000 and $8,333,300 at December 31, 2009 and 2008, respectively. This swap agreement qualifies for hedge accounting treatment in accordance with ASC 815.

10. Derivative Financial Instruments and Hedging Activities *continued*

Derivative Financial Instruments continued

The aggregate fair value of derivative instruments in liability positions on December 31, 2009 and 2008, was $184,700 and $309,400, respectively, and represents the estimated amount the Corporation would need to pay if the contract was terminated before maturity, principally resulting from market interest rate decreases. The value is based on significant level II inputs in the form of quoted LIBOR interest rate information. The change in fair value of the Corporation's interest rate swap agreements is recognized in other comprehensive loss, net of deferred income tax. In 2008, a loss of $176,400, net of a deferred tax benefit of $133,000, was recognized. In 2009, a relative gain of $71,100, net of a deferred income tax of $53,600, was recognized. The agreement was perfectly effective throughout the periods ended December 31, 2009 and 2008 and is expected to be effective throughout its life.

11. Retirement Benefit Plans

401(k) Plan

The Corporation sponsors a 401(k) plan which is available to all eligible employees, based on each employee's age and employment status as defined in the plan. Under the plan, the Corporation matches a portion of employee contributions, the cost of which was $3,022,900 and $3,050,300 in 2009 and 2008, respectively.

Medical Benefits

The Corporation sponsors a retiree medical insurance plan, comprised of two programs - a Pre-Medicare program (for participants under age 65) and a Medicare Supplement program (for participants age 65 and older). An employee who retires between the ages of 55 and 64, with ten years of service ("Early Retiree"), is offered participation in the Pre-Medicare program. An employee who retires at or after age 65, with five years of service ("Retiree") is offered participation in the Medicare Supplement program. Upon attaining age 65, an Early Retiree's participation in the Pre-Medicare program terminates, and they are offered participation in the Medicare Supplement program. Qualifying spouses and domestic partners of Early Retirees or Retirees may elect participation in the program that corresponds to their age and Medicare eligibility.

11. Retirement Benefit Plans *continued*

Medical Benefits continued

Under the Pre-Medicare program, medical coverage is provided under the Corporation's group insurance program, with the participant paying a retiree medical insurance premium. The Corporation will contribute a portion of the medical insurance premium based on the following schedule:

Years of Service	Percent Paid By the Corporation
10 – 19	20%
20 – 29	40%
30 or more	60%

Under the Corporation's Medicare Supplement program, the Corporation will reimburse each participant a portion of the premium for Medicare supplement insurance they procure, based upon the following schedule:

Years of Service	Monthly Benefit Paid By the Corporation
5 – 9	$ 31.25
10 – 19	52.50
20 – 29	93.75
30 or more	125.00

The amount is not linked to medical cost inflation.

The Corporation accrues postretirement medical benefits earned during the years an employee provides services, based on an actuarial calculation. Changes in actuarial assumptions made in the year resulted in an $116,200 loss, recognized through other comprehensive loss, net of a deferred income tax benefit of $50,000.

11. Retirement Benefit Plans *continued*

Medical Benefits continued

The unfunded benefit obligation was $3,235,700 and $2,712,500 at December 31, 2009 and 2008, respectively. A discount rate of 6.00% and 6.50% was used to calculate the unfunded obligations for 2009 and 2008, respectively.

For measuring the liability and expense, a 5% annual rate of increase in the per capita claims cost was assumed for 2009 and 2008. In 2009, the effect of a one-percentage-point increase in the assumed health care costs trend rate would result in an increase in the postretirement benefits obligation of approximately $223,500, while a decrease in the trend rate would reduce the obligation by approximately $188,000.

Qualified retiree medical expenses paid by the Corporation, net of premiums received from participants, totaled $50,200 and $51,200 in 2009 and 2008, respectively. Benefits expected to be paid during the next ten years are as follows:

2010	$	113,400
2011		126,400
2012		133,200
2013		150,200
2014		190,000
2015 – 2019		1,457,500
Total	$	2,170,700

The Corporation's retiree medical insurance plan is not governed by provisions of the Employment Retirement Security Act of 1974. While management of the Corporation expects to continue the retiree medical insurance plan indefinitely, and has never indicated any intention to terminate the plan, the Corporation retains the right to amend or terminate it at any time.

12. Common Stock

The Corporation maintains a program of offering common stock to eligible employees at a price equal to the Corporation's adjusted book value as defined in the Amended and Restated Stockholders' Agreement dated April 30, 1999 ("Stockholders' Agreement"). All transactions must be authorized by the Board of Directors and made within certain restrictions defined by the Stockholders' Agreement and the Credit Agreement. In 2009 and 2008, $2,893,500 and $2,679,800, respectively, of common stock were issued.

The Stockholders' Agreement also requires that upon the death, permanent disability or termination of employment of an employee, all common stock held must be repurchased by the Corporation at a price defined in the Stockholders' Agreement. In 2009 and 2008, $256,200 and $944,900, respectively, of common stock were repurchased. At December 31, 2009, the Corporation's repurchase obligation was approximately $134,000.

13. Income Taxes

The federal and state income tax provision (benefit) for the years ended December 31 consists of:

	2009	2008
Current	$ 569,400	$ (148,800)
Deferred	(396,100)	97,400
Net income tax provision (benefit)	$ 173,300	$ (51,400)

The Corporation's effective income tax rates were 47% and 68% for 2009 and 2008, respectively.

The Corporation's effective income tax rate generally varies from the statutory tax rate due to certain expenses which are nondeductible in the calculation of taxable income and differences in estimates from actual expenses used to calculate the tax provision within a specific year.

13. Income Taxes *continued*

Deferred Income Taxes

Deferred tax assets and liabilities are recognized for the future tax consequences attributable to differences between the financial statement carrying values of existing assets and liabilities and their respective tax bases. Accordingly, the deferred tax assets and liabilities included in the accompanying balance sheets reflect temporary differences in the valuation of allowances for uncollectible amounts, depreciation and amortization, postretirement medical obligations, and the valuation of interest rate swap agreements. In addition, the amount of any future tax benefits is reduced by a valuation allowance to the extent such benefits are not expected to be fully realized.

Deferred tax assets and liabilities are measured using enacted tax rates expected to apply to taxable income in the years in which those temporary differences are expected to be recovered or settled. The effect on deferred tax assets and liabilities of a change in tax rates is recognized in income in the period that included the enactment date.

Deferred tax assets and liabilities at December 31 consist of:

	2009	2008
Current		
Deferred assets	$ 1,052,500	$ 1,142,400
Deferred liabilities	(574,500)	(565,600)
Net current deferred assets	$ 478,000	$ 576,800
Noncurrent		
Deferred assets	$ 1,265,400	$ 1,058,200
Deferred liabilities	(926,700)	(1,246,400)
Net noncurrent deferred assets (liabilities)	$ 338,700	$ (188,200)

13. Income Taxes *continued*

Uncertainty in Income Taxes

In 2009, the Corporation adopted ASC 740-10-25, *"Accounting for Uncertainty in Income Taxes."* No adjustment was made to the beginning retained earnings balance, as the ultimate deductibility of all tax positions is highly certain but there is uncertainty about the timing of such deductibility. No interest or penalties have been accrued relative to tax positions. As a result, no liability for uncertain tax positions has been recorded at December 31, 2009.

Should the Corporation need to accrue interest or penalties on uncertain tax positions, it would recognize the interest as interest expense and the penalties as other expenses.

14. Related Parties

The Corporation maintains a series of agreements with an Illinois professional service corporation ("PC") which is independently owned by three members of senior management of the Corporation and is doing business as WJE Engineers & Architects, PC. Under these agreements, the Corporation licenses the "WJE" trademark to the PC, provides professional personnel and administrative support services to the PC at agreed upon rates, and purchases all of the PC's accounts receivable at a discounted rate. The PC is a named insured on the Corporation's insurance policies and the Corporation indemnifies the PC by agreement.

A summary of transactions between the Corporation and the PC is as follows:

		2009		2008
Professional services provided	$	**5,646,700**	$	6,734,500
Receivables purchased, net		**5,682,000**		6,730,100
Net	$	**(35,300)**	$	4,400
Year-end accounts payable balance	$	**49,700**	$	25,000

15. Commitments and Contingencies

The Corporation is involved in litigation arising in the ordinary course of business. Although the outcome of these matters cannot presently be determined, management does not expect that the resolution of these matters will have a material adverse effect on the Corporation's financial position or results of operations.

16. Subsequent Events

For the fiscal year ending December 31, 2009, the Corporation adopted the provisions of ASC 855-10, *"Subsequent Events."* The Corporation evaluated subsequent events through the date the accompanying financial statements were available to be issued, February 12, 2010. There were no events which had a material impact on the Corporation's financial statements for 2009 and 2008.

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