Exhibit “A”

Scope of Service

Time Dependent Load Response of Flexible Pipe Subjected to Sustained Loading

Submitted to:

The Florida Department of Transportation
Research Center
605 Suwannee Street, MS 30
Tallahassee, FL 32399

Project Manager: Mr. Rick Renna, P.E.

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SIMPSON GUMPERTZ & HEGER

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Background

The Department of Transportation desires to implement early deflection testing of pipe installation, targeting full inspection of pipes after placing 3 feet of cover, and re-inspection of those pipes that indicate problems may be developing. To accomplish this goal, time-dependent deflection data is needed on flexible pipes so that, at early inspection, the Department will be able to flag those pipes whose deflections are within the 5% specification tolerance but may ultimately exceed the acceptable tolerance at the time of project acceptance. Thus, the time dependent deflection of spiral rib steel, spiral rib aluminum, HDPE and PVC pipe will be tested and evaluated for both 24" and 36" diameter sections. While there is a plethora of information on the mechanical properties and material attributes of the four, there is a scarcity of time-dependent deflection data on the performance of pipes during the first few months after installation, installed in typical less than perfect field conditions.

This research will gather the needed creep data using the large 20 feet by 10 feet by 8 feet rigid container built under FDOT Project BD530. The soil box was design to limit its wall deformations to less than two millimeters, when subjected to a geostatic earth pressure of 118 psi (147 ft of overburden). Thus, the box design is targeted to eliminate boundary effects when testing dual pipes up to 36" in diameter. The box was completed after several design improvements recommended by a panel of soil box experts and resides in an non-air conditioned, open structure at the University of Florida' Coastal Laboratory in Gainesville.

Objectives and Supporting Tasks

The objective of the project is to facilitate the Department's plan to implement early pipe inspection by improving the understanding of pipe/soil interaction of the three types of pipe (corrugated metal [aluminum and steel], corrugated HDPE, and PVC) at initial application (i.e., after 3 ft. of cover placement) and their creep characteristics for the first 30 – 60 days thereafter. The Department's focus is on the time dependent pipe-soil system stiffness under normal (not ideal) construction practices, not on the independent

stiffness and creep of the pipe. Thus, this project is not targeted at refining installation practices, but rather at documenting early pipe-soil system creep from the current level of construction practices.

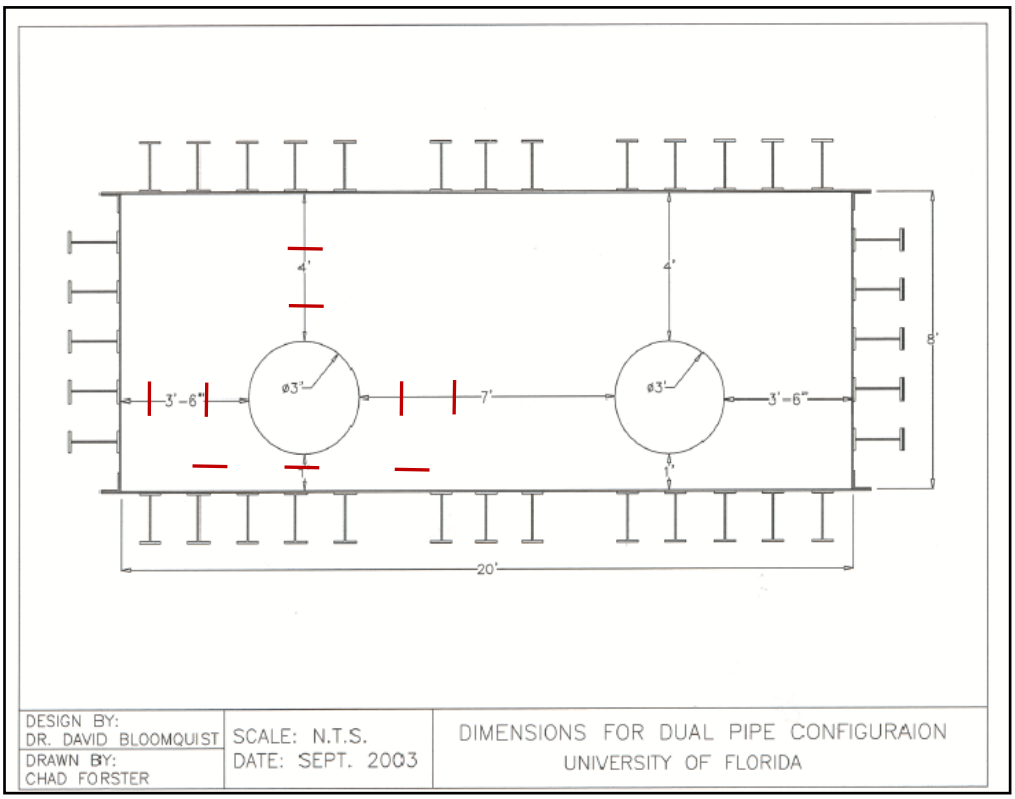
Approach

The Department's State Materials Office (SMO) will randomly select pipes from manufacturers and then perform typical qualification and index tests to validate the quality of the selected pipes. The approach is to bed two similar material pipes (for redundancy) in the soil box, add soil cover, and then apply a surface load via hydraulic lifting bags. Haunch compaction will be deliberately neglected to encourage deflection under loading. The soil box's observation portals will allow for ongoing measurement of the pipe's diameter for monitoring the pipes' geometry during all phases of construction and loading. In addition, strategically placed strain gages on the soil box (exterior surface) will verify the structural response of the enclosure during loading (a valuable addition in evaluating soil box performance).

Finally distributed earth pressure cells will be located beneath, around and above the pipes to observe the soil pressures as they relate to pipe deformation.

TASK 1: In order to reduce friction along the walls of the box, twin greased visqueen sheets will be installed on the inside walls of the soil box. This also allows the installed pipes to be free moving against the walls of the soil box, including the entry portal area.

TASK 2: A one foot layer of well compacted bedding material (A-3) will then be added. Small (4 inch diameter) earth pressure cells will be inserted into the soil beneath each pipe's invert and one diameter away from the pipe on either side of it. The figure below shows the layout of the earth pressure cells for one of the pipes.



Earth Pressure Cell Locations - red

TASK 3: Twin pipes of the same size and material will be laid onto the bedding material and soil added as backfill. To encourage deflection, 85% Standard Proctor Density (SPD) will be targeted with deliberately poor haunch compaction. As the backfill is placed, additional earth pressure cells will be placed at strategic locations around the pipes (see figure on previous page). Both vertical and horizontal soil stresses near and far field will be obtained. In addition, a layer of soil pressure cells (not shown) measuring vertical soil stress will be installed at the bottom of the box to allow a determination that the entire vertical load applied at the top of the box is transmitted to the bottom of the box. To verify the soil box's rigidity, strain gages will be attached to the exterior of the walls to monitor stresses during load application.

TASK 4: In order to simulate variable high groundwater conditions expected in Florida, the soil backfill will be flooded with water at a soil load of approximately 5 ft. of

overburden and allowed to drain out. This will allow soil movement around the pipes' corrugations, haunches, and spring lines. Cone Penetrometer tests will be performed to obtain the relative density of the soil. In addition, relative density tests (sand cone and nuclear) will be conducted at various stages. This approach to obtaining in-situ soil density will help minimize any changes in soil properties for subsequent load tests. Finally, the loading system - consisting of 2 foot square steel plates and lifting bags will then be placed on the soil surface and the soil box top bolted down to serve as the reaction force.

TASK 5: The FDOT State Materials Office will perform standard CD (consolidated drained) tests on representative samples of the soil used in the load tests. Two to three densities and confining pressures will be conducted on replicate specimens. In addition, 1-D compression tests will be performed at two to three different densities.

TASK 6: Since the principal parameter to be measured is pipe deflection, a LVDT (electronic dial gage) based profiler will be built to obtain frequent pipe geometries during backfilling, loading and maintenance load application (i.e., creep). In order to verify that this instrument is performing as designed, 3-D digital measurement of the pipes' circumference will also be taken for comparison. This laser profiling (per FDOT specifications) will be conducted by Carter Pipe Inspections.
Vertical and horizontal diametric deflections, circumferential shortening, local pipe strains, and soil stresses (from the earth pressure cells) will be obtained during deflection creep testing.

TASK 7: The pipes will be loaded from the top in increments. The first loading will be a simulated 10 foot deep burial by applying 8.33 psi (plus losses) to the bags. The 8.33 psi pressure will be held and time dependent data recorded. This will then be increased to 20 feet and then 50 feet depths while maintain the loads at each "depth" until the deflections stabilize. During each loading "hold", creep of the pipe diameter will be monitored. The settlement of the top of the soil will also be measured using string

potentiometers. The load application will be incremental and at each stage the profiler, stress cells and strain gages read. Finally, the surcharge load will continue to be increased in incremental steps to perhaps up to 75% of the expected pipe yield stress. Then, the steps will be reversed to observe any hysteresis effects.

The deflection versus load will be plotted on semi-log paper so trends can be extrapolated from their slopes.

TASK 8: Subsequent Tests

A matrix of the testing program is shown below:

TESTING PROGRAM

PIPE	DIAMETER	DIAMETER
M294 HDPE	36 INCH	24 INCH
M294 HDPE W/ TRENCH BOX	36 INCH	
STEEL - SPIRAL RIB	36 INCH	24 INCH
STEEL - SPIRAL RIB W/ TRENCH BOX	36 INCH	
F949 PVC	36 INCH	
ALUMINUM - SPIRAL RIB	36 INCH	

Thus, four (dual) tests will be conducted on the 36” pipes while two tests will be repeated on 24” diameter HDPE and steel pipes. The purpose of these subsequent tests is to provide input data for the finite element modeling task. To account for the impact of a contractor’s using a trench box for pipe installation, two additional soil box tests will be added using a trench box to install the pipe backfill. Though the trench box movement is expected to affect only soil consolidation, the trench box effects will be examined on both 36” HDPE and 36” CMP pipe, thus bracketing the least stiff to most stiff pipes in this research.

An ancillary test will be performed on short sections of the pipe in a compression machine. These parallel plate tests will also provide input for the FEM analysis.

TASK 9: A FEM analysis will be performed by Dr. Tim McGrath. ABAQUS software will be used to both analyze the soil box data as well as a predictor of other size pipes' deformation characteristics.

TASK 10: A draft final report will be prepared and submitted to FDOT for review. After comments from DOT are addressed, the report will be presented to Industry in Tallahassee. Industry comments will be solicited and addressed, resulting in a Final Report.

Work not included in this scope of service is not to be performed and will not be subject for compensation by the Department.

Use of Graduate Student(s) and other Research Assistants

Since this will be a time intensive project, several student researchers will be required. They will assist in sensor installation, soil compaction measurements and subsequent pipe deformation and soil stress gage readings. These will be undergraduate students and hence tuition costs are not applicable.

One masters student will be responsible for the data reduction and to provide data needed for the FEM analysis.

Equipment

The majority of instrumentation (soil stress gages, strain gages) is already on hand so no funds are requested for them.

Other needed equipment is listed below. All of these purchases will be made at the commencement of the project:

1. Lifting Bags and Accessories: twenty additional bags are needed to apply the load to the pipes. The high strength tubing, hydraulic pump and steel loading plates will complete the soil box testing system.
2. LVDT profiler: this device will be built in-house at UF.

The university, upon receipt of any purchased equipment, shall forward to the Research Center a copy of the purchase invoice/property description (as detailed in Exhibit C – Budget),serial number and receipt. The Department will prepare and forward inventory control label(s), which the university shall have affixed to the property.

Travel

In order for the Co-PI to monitor the various stages of testing, two trips are requested for Dr. McGrath to visit the Coastal Lab in Gainesville (where the soil box is housed). In addition, one trip to Tallahassee to meeting with FDOT and Industry representatives is requested.

One trip to Tallahassee for the PI is requested also to meet with the above personnel. Both the PI and Co-PI will provide details of the Project, Conclusions and if needed recommendations to FDOT on their Pipe Inspection Specifications.

All travel shall be in accordance with Section 112.061, Florida Statutes. FDOT employees may not travel on research contracts.

Deliverables

The major deliverables of the project are listed below:

1. **Technical Recommendations**. Based on the outcome of the tests, the PIs will provide FDOT with technical recommendations on the re-inspection of flexible pipe types and sizes tabulated below. These recommendations will be used to trigger additional final inspection beyond the proposed initial inspection after 3 ft. of backfill above the pipe.

Pipe Material Type	Size Range
Spiral Rib Steel Pipe	18” – 72”
Spiral Rib Aluminum Pipe	18” – 60”
F949 PVC Pipe	18” – 36”
M294 High Density Polyethylene Pipe	18” – 60”

2. **Progress Reports** The university will submit quarterly progress reports to the Research Center. The first report will cover the activity that occurred in the 90 days following the issuance of the Task Work Order.

   Reports will be submitted within 30 days of the end of the reporting period. **Reports are due even if little or no progress has occurred (in which case, the report should explain delays and/or lack of progress)**. Progress reports should be sent in MS Word to Sandra Bell, sandra.bell@dot.state.fl.us .

   Progress reports must include the following information:

   Contract Number, Task Work Order Number, and Title

   Work performed during the period being reported
   Work to be performed in the following period
   Anticipated modifications (i.e., to funding, schedule, or scope). This section is for reporting/informational purposes, not for officially requesting an amendment. Note: To request an amendment to a contract, the contractor must provide the project manager with the appropriate information (i.e., what is being requested with justification) in the required format. If the project manager concurs with the request, he/she shall forward it with his/her approval and commentary, as

appropriate, to the Research Center for administrative review and processing (pending available funds, etc.)

A Progress Schedule updated to reflect activities for the period being reported.

Failure to submit progress reports in a timely manner may result in termination of the work order.

3. **Draft Final Reports** The draft final report will be submitted to Sandra Bell, sandra.bell@dot.state.fl.us. It will be edited for technical accuracy, grammar, clarity, organization, and format prior to submission to the Department for technical approval. Draft final reports will be prepared in accordance with the Guidelines for Preparing Draft Final and Final Reports (http://www.dot.state.fl.us/research%2Dcenter/Program_Information/Guidelines%20for%20Preparing%20a%20Final%20Report%2012-07.pdf).

4. **Final Reports** Once the draft final report has been approved, the university will prepare the final report. The university will deliver a minimum eight (8) copies of the final report in MS Word on CD/DVD to
   The Florida Department of Transportation
   Research Center, MS 30
   605 Suwannee Street
   Tallahassee, FL 32399-0450

   The CD/DVD should be labeled in a professional manner and include at a minimum the contract number, Task Work Order number, project title, and date.

5. **Project Certification** The Sponsored Research office or appropriate authority will submit as a final deliverable a project certification prepared according to university compliance standards.

Project Schedule

The following EXCEL schedule is provided on the next page. It shows that the project can be completed in 24 months. Given the exploratory nature of this work, the project duration is set to 30 months.

Project Kick-off Teleconference

A kickoff meeting shall be scheduled to occur within the first 30 mdays of execution by the University. As a minimum, the project manager and the principal investigator will attend. The Research Center staff will be advised of the meeting and given the option to attend. Other parties may be invited, as appropriate. The subject of the meeting will be to review and discuss the project's tasks, schedule, milestones, deliverables, reporting requirements, and deployment plan. A summary of the kickoff meeting shall be included in the first progress report.

Implementation

The recommendations from this research are intended to become initial deflection targets during the proposed early laser ring inspection after 3 ft. of cover above the pipe. Pipe whose initial deflection is between the initial target deflection and the Department's 5% limitation will be targeted for re-inspection before constructing the final layer of riding surface. As Department construction project results unfold, these 3 ft. targets will be adjusted based on field experience.

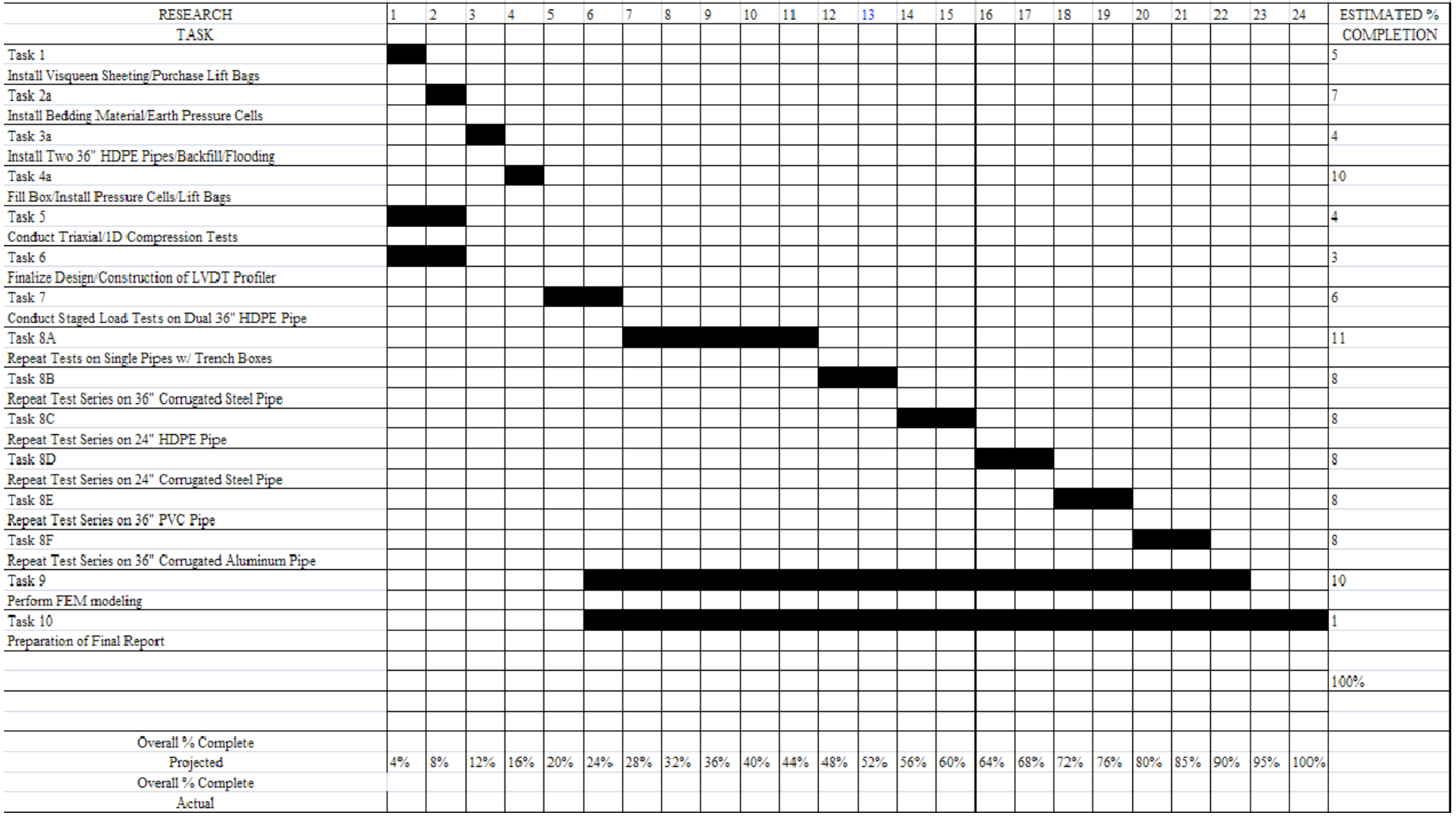
Contact Information

Dr. David Bloomquist, P.E., can be contacted at 365 Weil Hall, Department of Civil and Coastal Engineering, University of Florida, Gainesville Florida, 32611. The PI's email address is dave@ce.ufl.edu and phone number is 352-392-9537, ext 1547.
The Project Manager is Mr. Rick Renna, P.E. at the FDOT in Tallahassee. He can be contacted via email, Rick.Renna@dot.state.fl.us or via telephone, 850-414-4351.

FLORIDA DEPARTMENT OF TRANSPORTATION
RESEARCH CENTER

PROJECT SCHEDULE

Project Title	Time Dependent Load Response of Flexible Pipe Subjected to Sustained Loading				
FDOT Project No.	To be Determined	FY	2009	Month	Jun
Research Agency	University of Florida				
Principal Investigator	Dr. David Bloomquist, Dr. Tim McGrath				



Overall % Complete Projected	4%	8%	12%	16%	20%	24%	28%	32%	36%	40%	44%	48%	52%	56%	60%	64%	68%	72%	76%	80%	85%	90%	95%	100%
Overall % Complete Actual																								

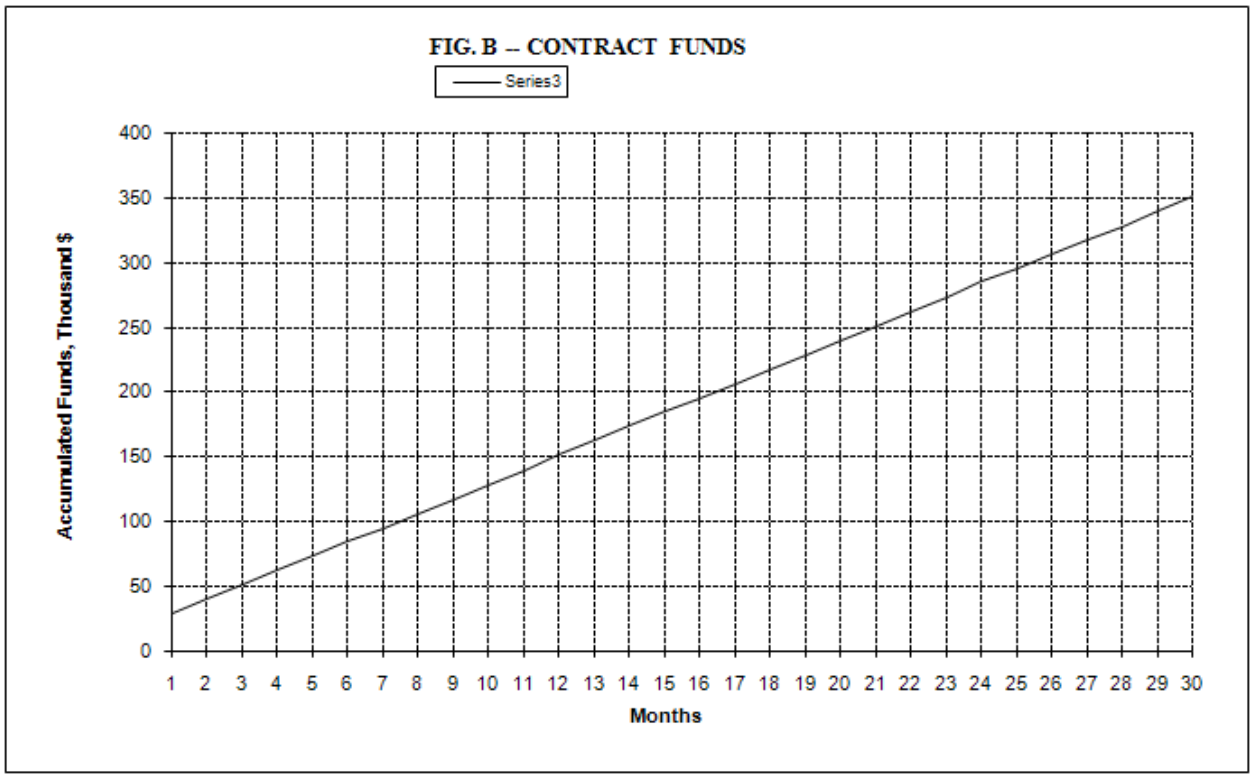


FIG. B -- CONTRACT FUNDS
Series3
Accumulated Funds, Thousand $
400
350
300
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Months

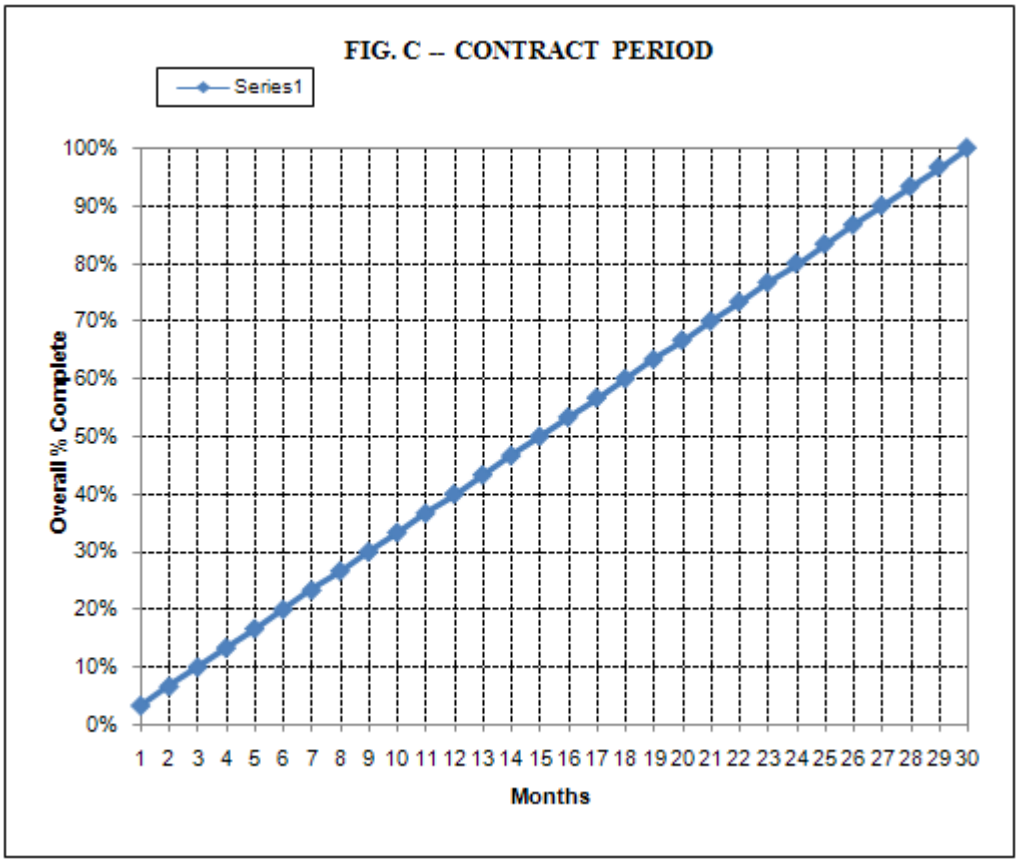


FIG. C -- CONTRACT PERIOD
Series1
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Overall % Complete
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Months