

# Idaho Incubation Fund Program

## Bi-Annual Progress Report Form

**Proposal No.** IF13-003  
**Name:** An Chen and Richard Nielsen  
**Name of Institution:** University of Idaho  
**Project Title:** Development of an Energy Efficient Integrated FRP-confined Precast Concrete Sandwich Roof Panel for Green Buildings

**Information to be reported in your progress report is as follows:**

**1. Provide a summary of project goals/milestones for the period just completed, accomplishments for the period just completed, and plans and goals for the coming quarter:**

1) Project goal/milestone for the period ending in June 15<sup>th</sup>, 2013:

- Complete bending test of scaled specimens.
- Start creep test.
- Construction of full-scale specimens.
- Business plan development.

2) Accomplishments:

### *Bending tests of scaled specimens*

Based on the findings from the progress report ending in December 31, 2012, bending tests on four scaled specimens sandwich panels with FRP plates at top and two sides have been completed. The specimens were 9 ft long and 2 ft wide, as shown in Figure 1. Bottom concrete wythe was 3 inch thick. Two thicknesses of 1 inch and 3 inch were considered for top concrete wythe to be potentially used for regular roof and green roof. The two concrete wythes were separated by a 4 inch thick foam core. Four specimens were tested, with two for each group (Figure 2).

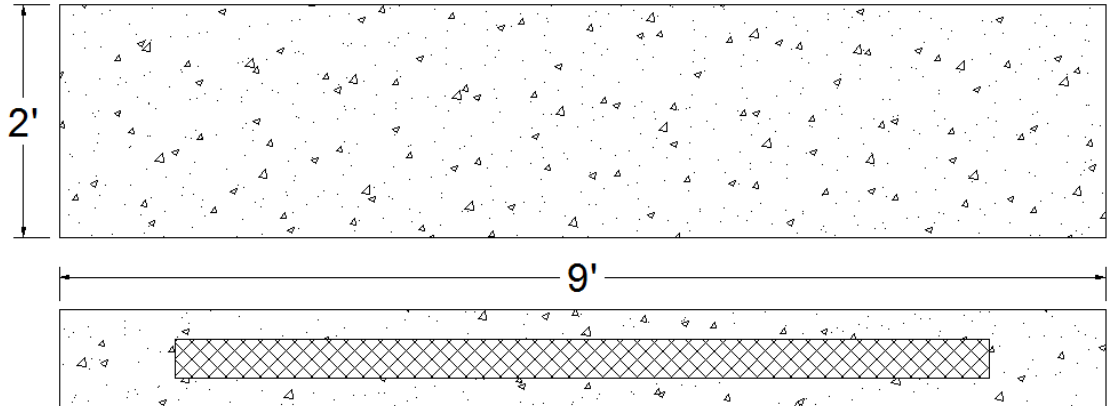


Figure 1: Slab Dimensions



Figure 2: Testing Set-up

Three-point bending tests were conducted, with a schematic plan and photo of the test setup shown in Figure 3 and Figure 4, respectively. Strain gages were bonded along the depth of the specimen to study composite behavior. Load-displacement relation was recorded to study stiffness. All specimens were tested until failure to study strength and failure modes. The specimens failed due to bending failure, as shown in Figure 5. A typical load-displacement curve is shown in Figure 6.

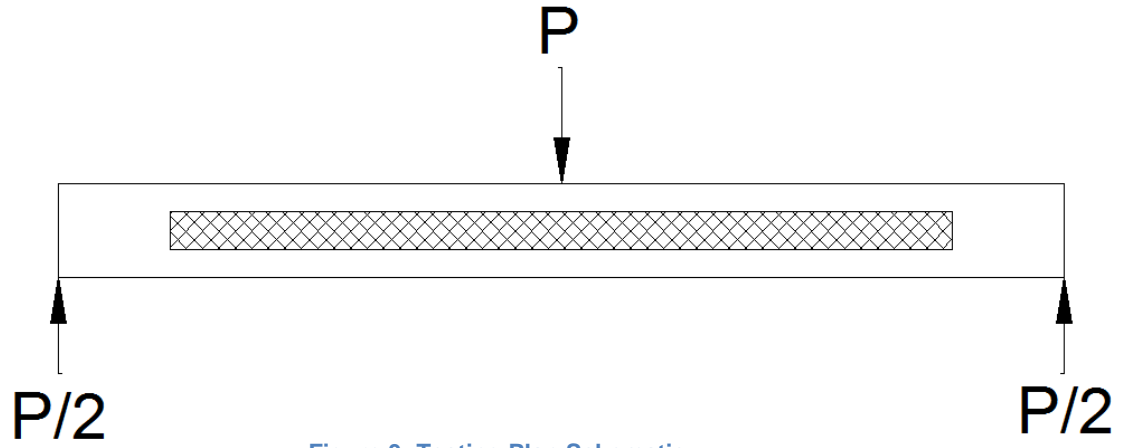


Figure 3: Testing Plan Schematic



Figure 4: Test in Progress



Figure 5: Bending Failure Crack Pattern

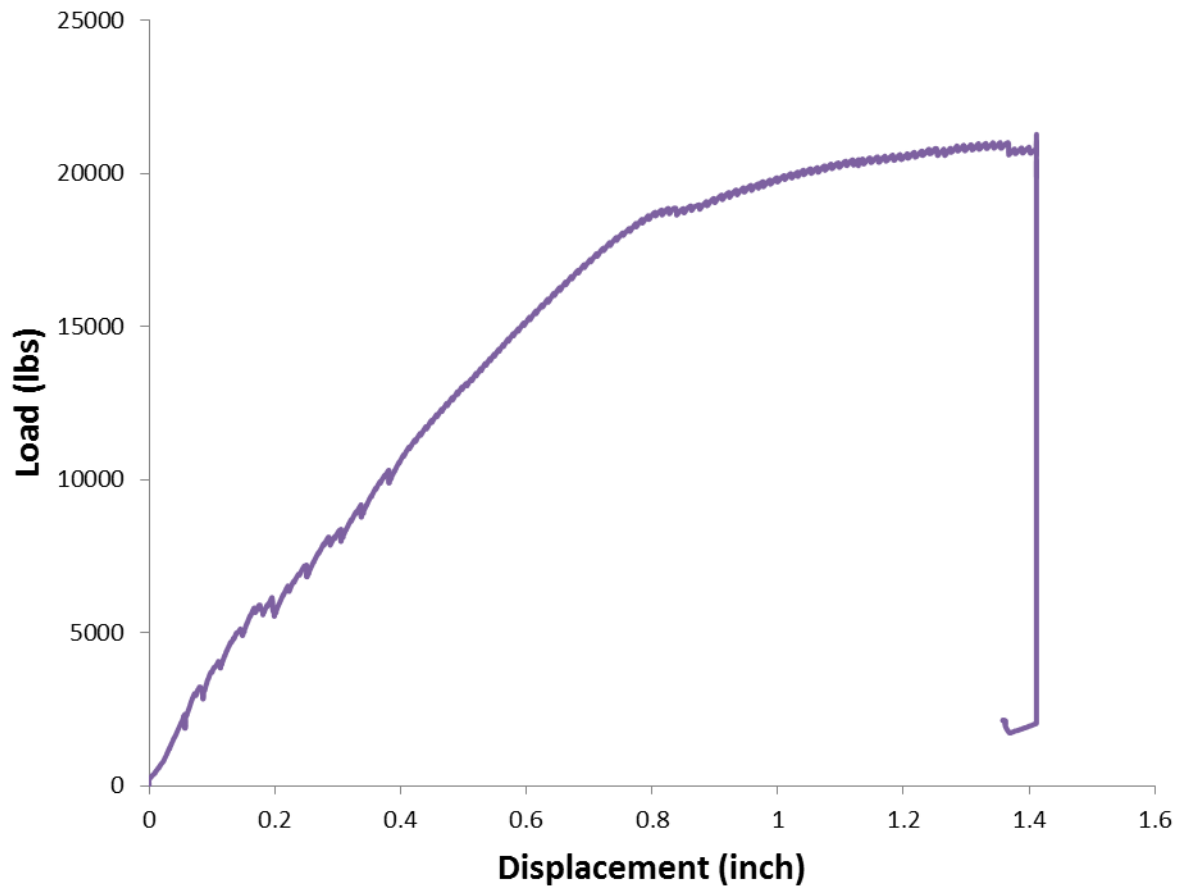


Figure 6: Load vs. Displacement for 10" Sandwich Panel

*Creep tests of scaled specimens*

Creep test is conducted to study long-term deflection of the panels under

sustained loads. The same specimens as described above are subjected to a four-month creep in bending at ~30% of the static capacity, as determined from the static tests. Four specimens are tested, including a solid panel, a panel without FRP plate, and two specimens as described above (Figure 7). The test is ongoing and the results will be reported in the final report.



Figure 7: Creep Test Set-up

#### *Construction of Full-Scale Specimens*

Full-scale specimens, 16 ft long and 2 ft wide, was constructed considering both 1 inch and 3 inch top concrete wythes (Figure 8).



Figure 8: Full Scale Slabs

*Development of a Business Plan:*

A business plan is under development with the commercialization partner. The plan will combine the technology developed in this research and another one funded by Department of Energy.

3) Plan and Goals for the final report:

The plan and goals for the final report include:

- Complete creep tests: The results of creep tests will be included in the final report.
- Complete evaluation of Full-Scale Specimens: Bending tests will be conducted. The performance will be evaluated and the failure modes will be characterized.
- Complete Development of a Business Plan: A complete business plan will be developed with the commercialization partner and included in the final report.

2. **Provide a summary of budget expenditures for the period just completed:**  
 See below for a summary of budget expenditure ending in November 2012.

**Table 1: Budget Summary Ending in May 2013**

Grant Summary Report for FC2886 (May 2013)

**Back to Budget/Grants**

REPORT fwrsumr  
 COAS: 9

GRANT SUMMARY REPORT  
 FROM INCEPTION THROUGH MAY-2013

RUN DATE: 10-Jun-2013  
 TIME: 10:18 AM  
 PAGE:

1

Inception Date: 01-JUL-12  
 End Date: 30-JUN-13

Budget/Title: FC2886: SBOE Energy Eff Integrated FRP  
 P/I Manager: An Chen

Percent of Time Remaining: 8%

		ADJUSTED BUDGET	INCEPTION TO DATE ACTIVITY	BUDGET RESERVATIONS	AVAILABLE BALANCE	MONEY REMAINING
01	Salaries	24,600.00	20,368.00	0.00	4,232.00	17%
02	Fringe Benefits	3,000.00	2,526.26	0.00	473.74	16%
03	Irregular Help	9,269.00	6,267.30	0.00	3,001.70	32%
04	Travel	653.42	99.90	0.00	553.52	85%
05	Other Expense	8,116.58	9,754.46	0.00	-1,637.88	-20%
07	< \$5K Capital Outlay	1,130.00	46.98	0.00	1,083.02	96%
10	Trustee/Benefits	3,231.00	6,812.00	0.00	-3,581.00	-111%
	GRANT TOTALS	50,000.00	45,874.90	0.00	4,125.10	8%
	Personnel Costs	36,869.00	29,161.56	0.00	7,707.44	21%
	Other Direct Costs	13,131.00	16,713.34	0.00	-3,582.34	8%
	Indirect Costs	0.00	0.00	0.00	0.00	0%

RELEASE: 8.5.1

3. **List patents, copyrights, plant variety protection certificates received or pending:**

N/A

4. **List invention disclosures, patent, copyright and PVP applications filed, technology licenses/options signed, start-up businesses created, and industry involvement:**

An international application for filing in the US receiving office has been filed on December 13, 2012, with an application number of PCT/US12/69291 and a title of *Concrete Building Panel*. There is some interest from the industry on this technology.

5. **Include funding burn rate:**

The funding burn rate was 92% as of May 2013.

6. **Any other pertinent information:**

Two abstracts have been accepted by ASCE Engineering Mechanics Institute Conference (EMI2013) to be held in August 2013 in Chicago. As a training process, two students will attend the conferences and present the abstracts. They will also visit an industrial collaborator which is close to the conference site. Some journal papers are in preparation and expected to be submitted in later 2013.