May 7th, 2012

**LACMA**
**Project: Simon Rodia Watts Towers**

**Re: Ground Penetrating Radar Investigation to Detect Subsurface Voids**

We appreciate the opportunity to work with you on your project in Watts, CA on April 18th and 23rd, 2012.

Ground penetrating radar was used to scan the slab area at the Watts Towers in order to detect voids below the slab and to determine concrete thicknesses. We used a 1600 MHz GPR antenna to perform the scanning with the SIR-3000 processing unit. This antenna will penetrate to a depth of up to 18"-24" depending on the conditions in the concrete. Each slab section was scanned thoroughly with side by side scans so as to cover the entire area.

GPR works by sending electromagnetic pulses into the material being scanned. The pulses return to the antenna at varying speeds based on the conductivity of the materials. Higher conductivities such as metal return the signal faster while lower conductivities such as air return slower. We were able to locate any significant voids below the concrete but slight delamination between layers of concrete was not significant enough to be seen by GPR. We were also able to detect areas of the concrete that appeared very different, containing higher concentrations of metallic or conductive materials.

The concrete thicknesses in each slab section are listed below and the screen shots and photos will explain each of the areas of concern. Feel free to contact me with any questions you may have.

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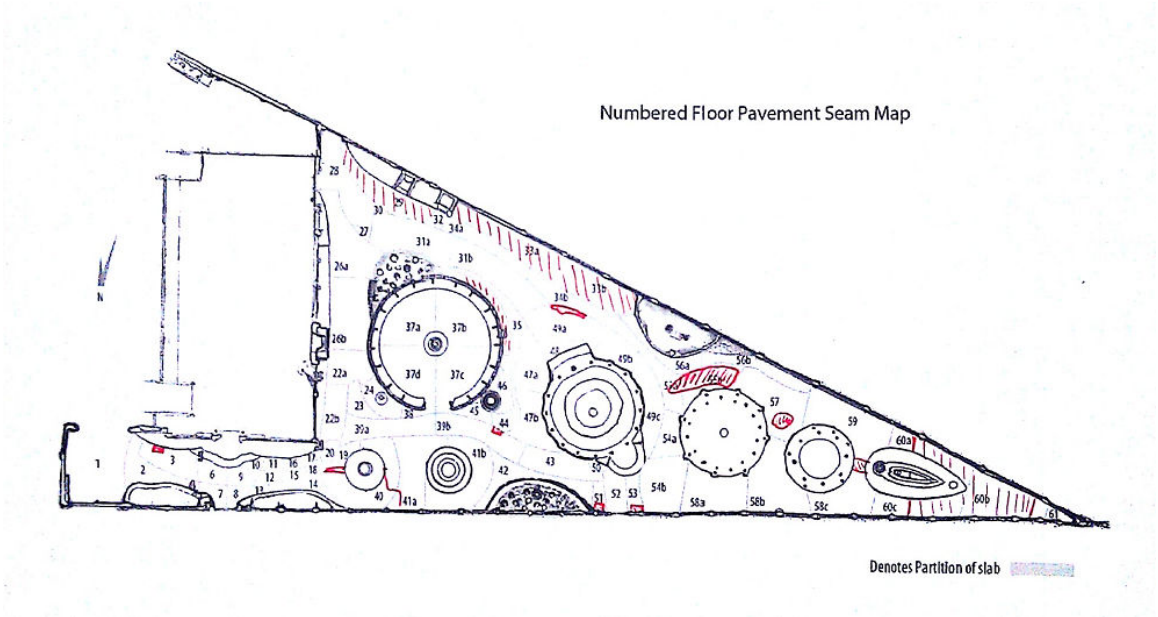
**Concrete Thicknesses**

| Slab Sections | Slab Thickness |
|---|---|
| 1 | 4.5" |
| 2 | 3.5" |
| 3 | 3" |
| 4 | 3.5" |
| 5 | 3.5" |
| 6 | 3.5" |
| 7 | 3.5" |
| 8 | 3.5" |
| 9 | 3.5" |
| 10 | 3.5" |
| 11 | 3.5" |
| 12 | 3.5" |
| 13 | 3.5" |
| 14 | 3.5" |
| 15 | 3.5" |
| 16 | 3.5" |
| 17 | 3.5" |
| 18 | 3.5" |
| 19 | 3" |
| 20 | 4" |
| 21 | 4" |
| 22a | 6" |
| 22b | 3.5" |
| 23 | 3.5" |
| 24 | ? |
| 25 | 4.5" |
| 26a | 5" |
| 26b | 5" |
| 27 | 3" |
| 28 | 3" |
| 29 | 4"(?) |
| 30 | 3.5" |
| 31a | 3.5" |
| 31b | 3.5" |
| 32 | 4" |
| 33a | ? |
| 33b | ? |
| 34a | 4" |
| 34b | 4" |

| | |
|---|---|
| 35 | 4.5" |
| 36 | ? |
| 37a | 7.5" |
| 37b | 7.5" |
| 37c | 7.5" |
| 37d | 7.5" |
| 38 | 3" |
| 39a | 2.75" |
| 39b | 2.75" |
| 40 | 2.75" |
| 41a | 3.25" |
| 41b | 3.25" |
| 42 | 3.75" |
| 43 | 2.5" |
| 44 | ? |
| 45 | ? |
| 46 | ? |
| 47a | 5.25" |
| 47b | 4.25" |
| 48 | 4.25" |
| 49a | 4.25" |
| 49b | 4.25" |
| 49c | 4.25" |
| 50 | 3.25" |
| 51 | 3.25" |
| 52 | 3.25" |
| 53 | 3.25" |
| 54a | 4" |
| 54b | 4" |
| 55a | 3.5" |
| 55b | 2.75" |
| 56a | ? |
| 56b | ? |
| 57 | 5" |
| 58a | 4.5" |
| 58b | 4.5" |
| 58c | 4.5" |
| 59 | 4.5" |
| 60a | 4.5" |
| 60b | ? |
| 60c | 4.5" |
| 61 | 6" |

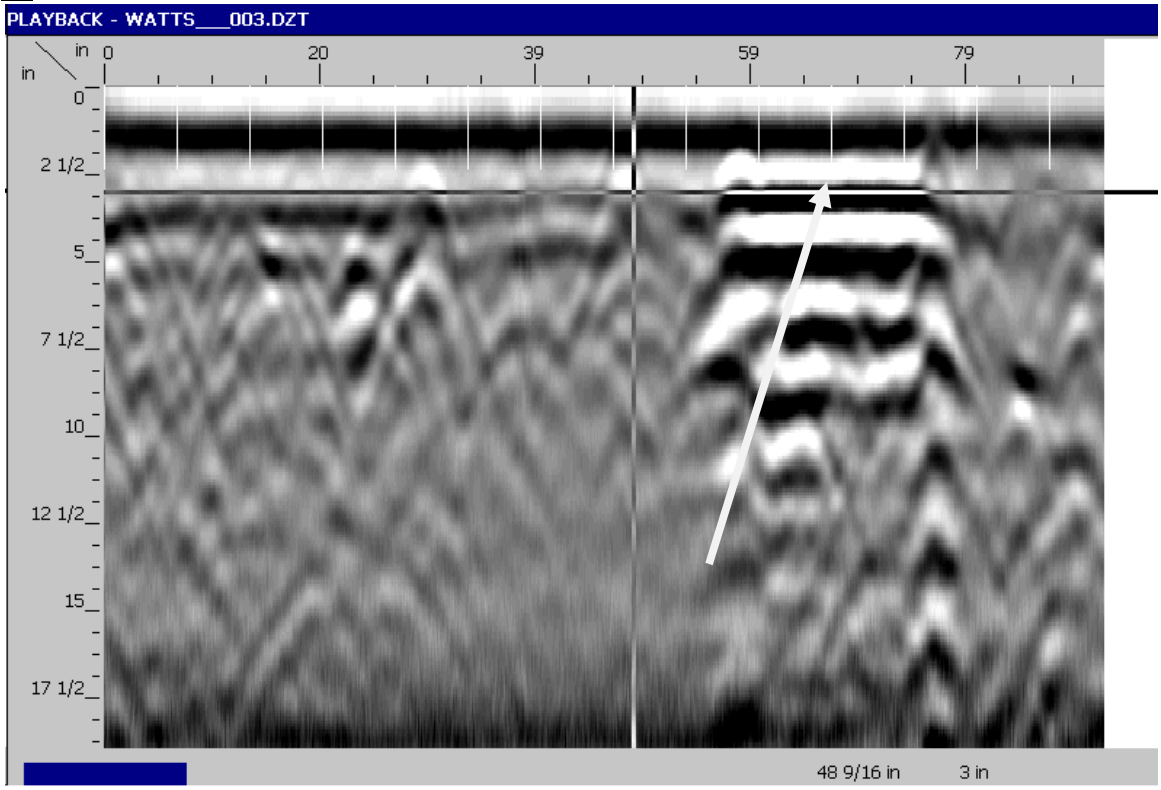



Areas of concern marked in red to be explained on the following pages. The numbers above each screen shot and photo are referring to the slab sections on this map.

**#3**

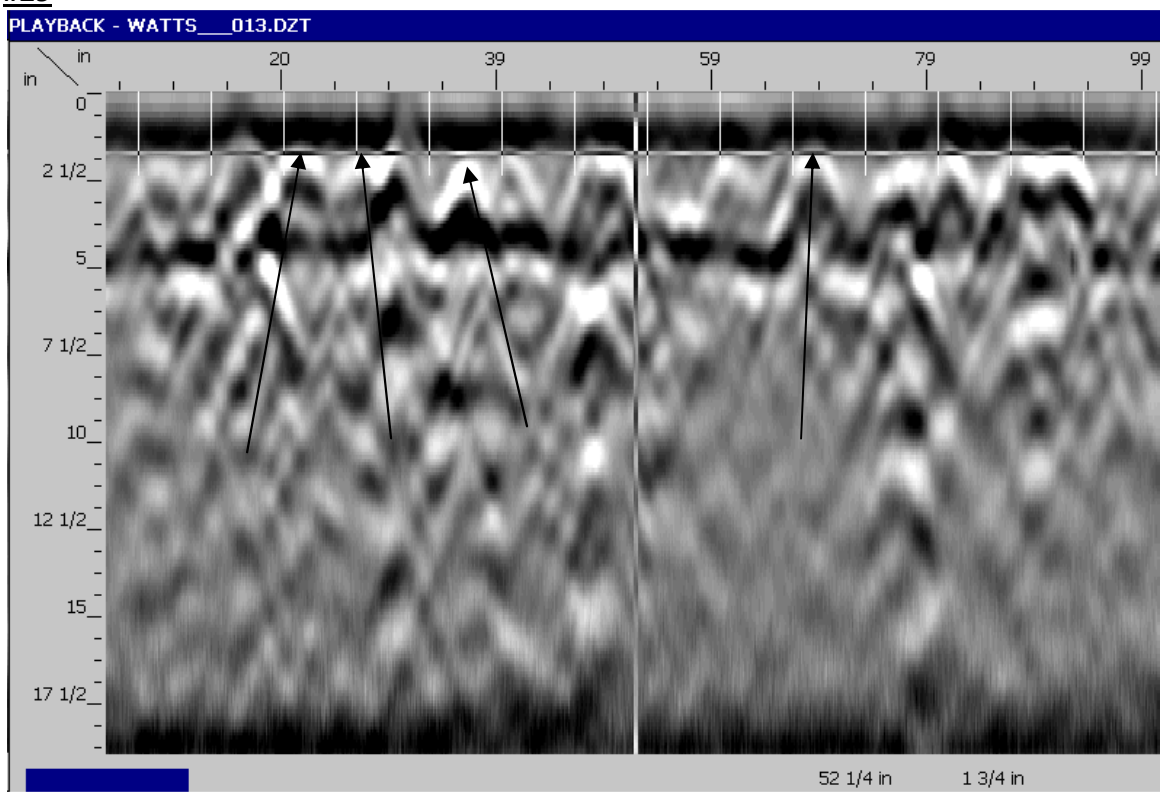
**#3**

**#3**



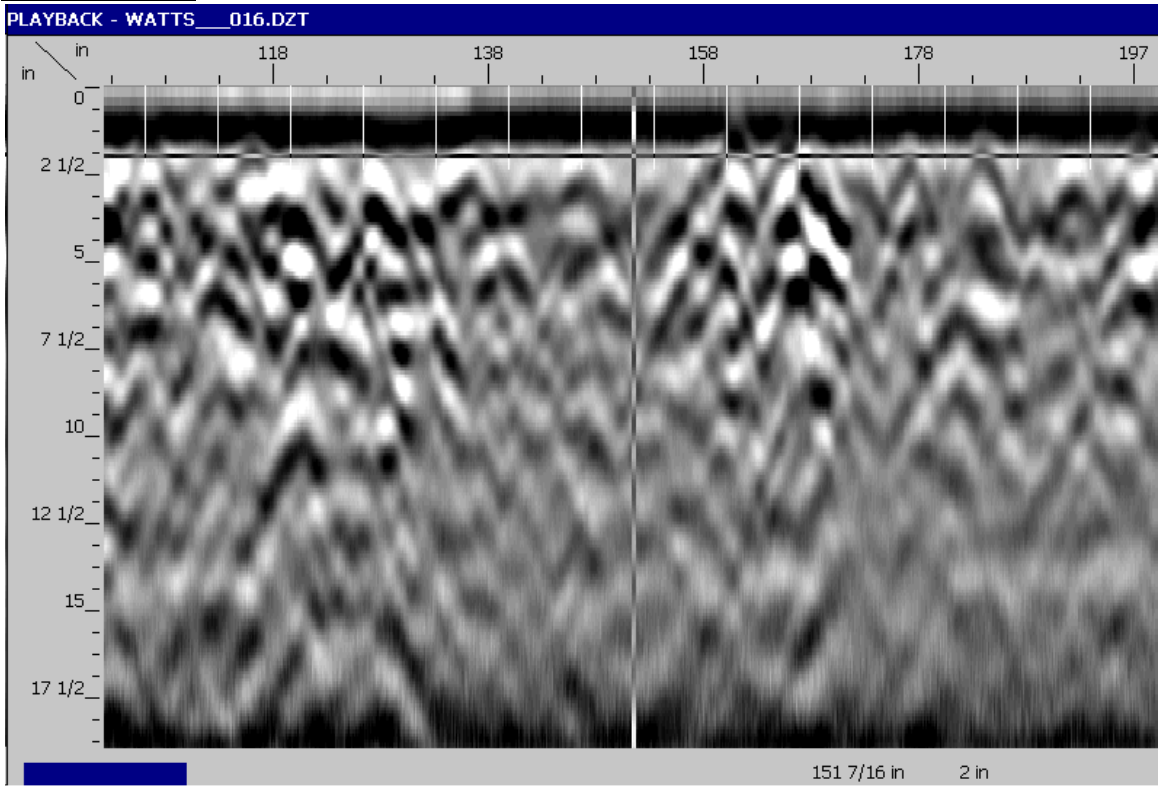

The screen shot above shows the void in slab section #3 at a depth of 3”. The void is represented by the black band at the bottom of the slab. The change in conductivity from the slab to the air below causes a negative reflection which forms the black band.

**#29**



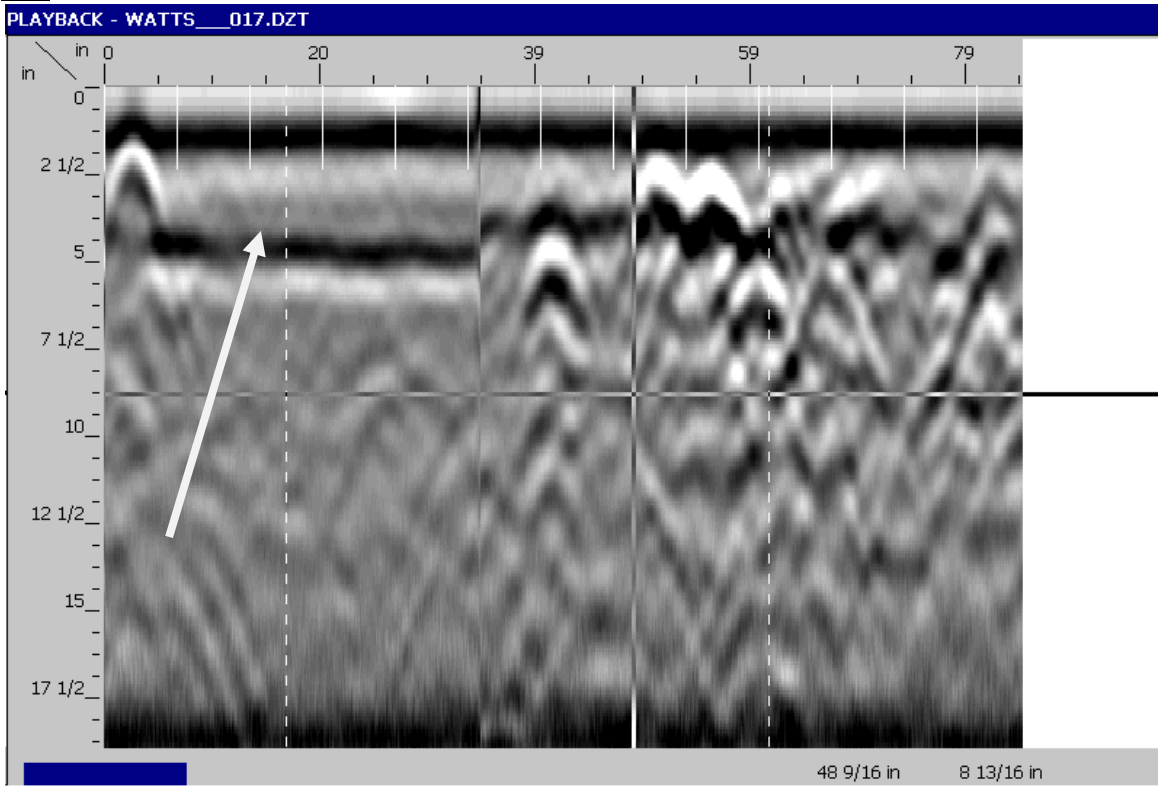

The screen shot above shows the data from slab section #29. This concrete is different than most of the other sections. There are many metallic reflections inside of the concrete beginning at a depth of 1 ¾". This is not a wire mesh or reinforcing; they appear to be random reflections due to the material or aggregate in the concrete. These were found throughout this section. The arrows are pointing out several of these reflections. These reflections made the concrete thickness very difficult to determine.

**#33a and #33b**



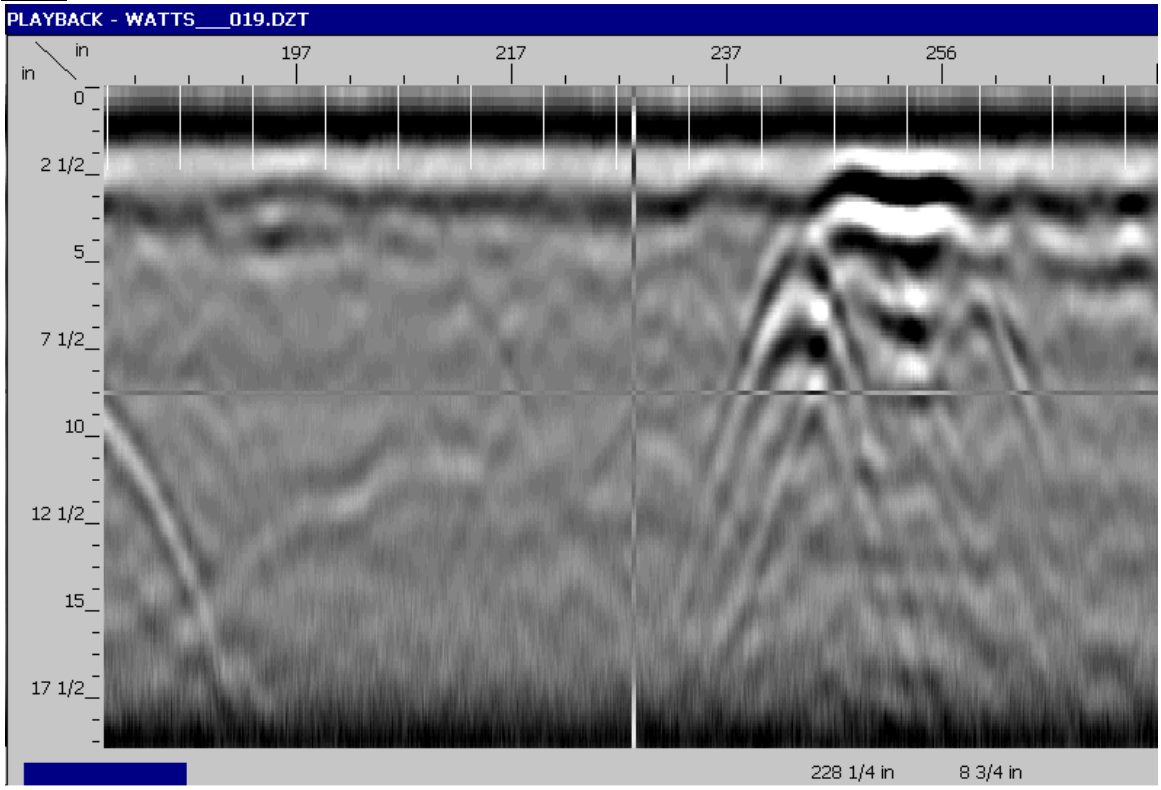

The above screen shot is from slab sections #33a and #33b. This section also contains random reflective material inside of the concrete beginning at a depth of 1 ¾". We were unable to determine the concrete thickness in this area.

**#36**




The above screen shot shows data from slab sections #35 and #36. The left side of the data shows the typical consistent concrete in section #35. The white arrow is pointing out the horizontal black band that represents the bottom of the slab. The change from the slab to the soil below causes the black band reaction which is how the slab thickness was calculated. The right side of the data was collected from area #36. This section of concrete contains metallic reflections in the concrete's aggregate mix.

**#39b**



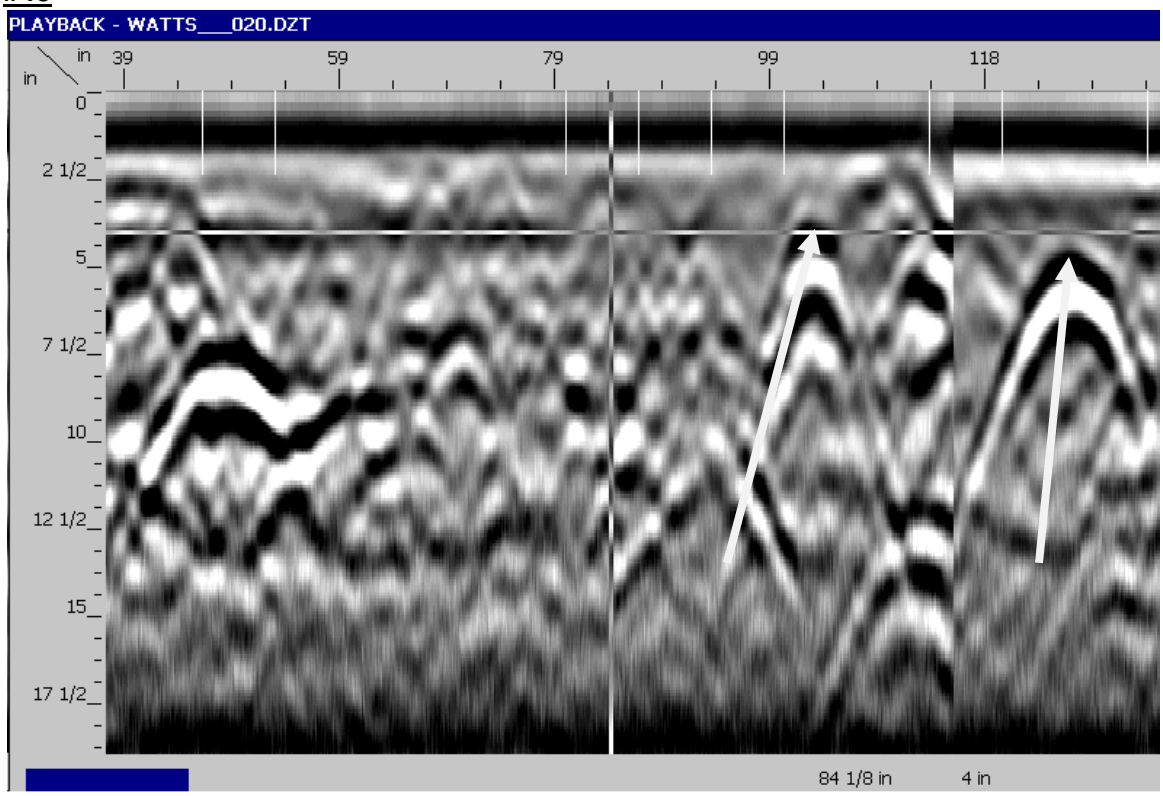

The above screen shot shows the void that was found in slab section #39b at a depth of 2.75". Its location is shown in the following pictures.

**#39b**

This is the void in slab section #39b.

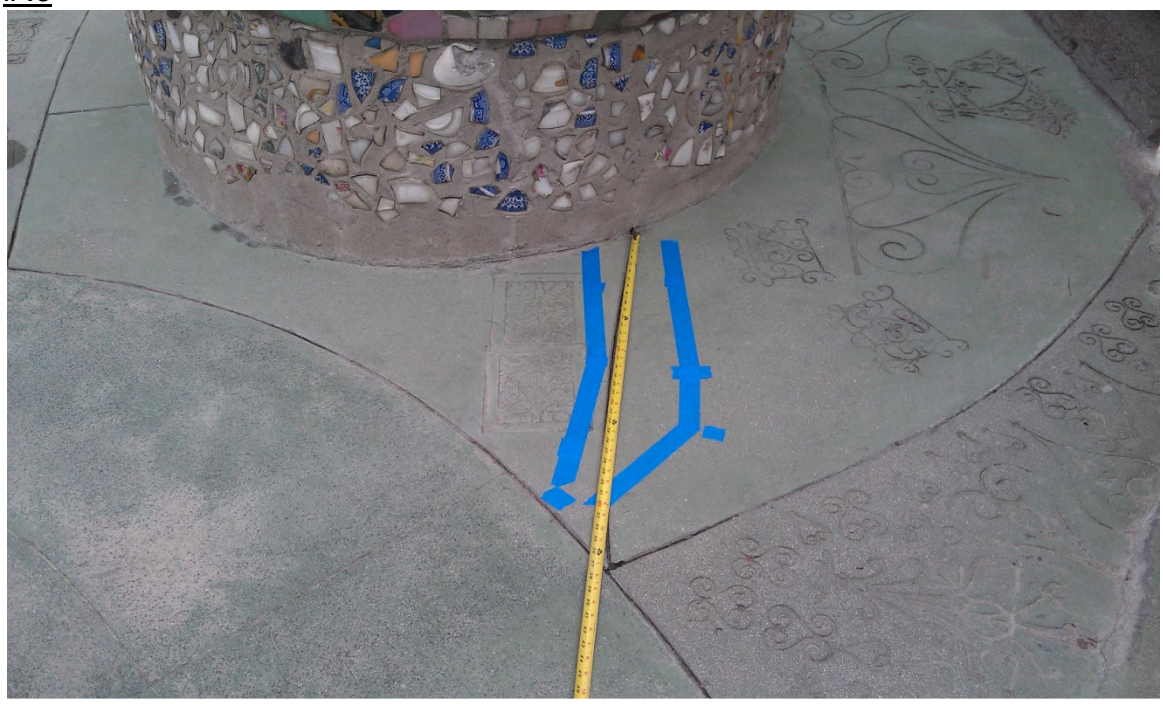
**#39b**

**#40**



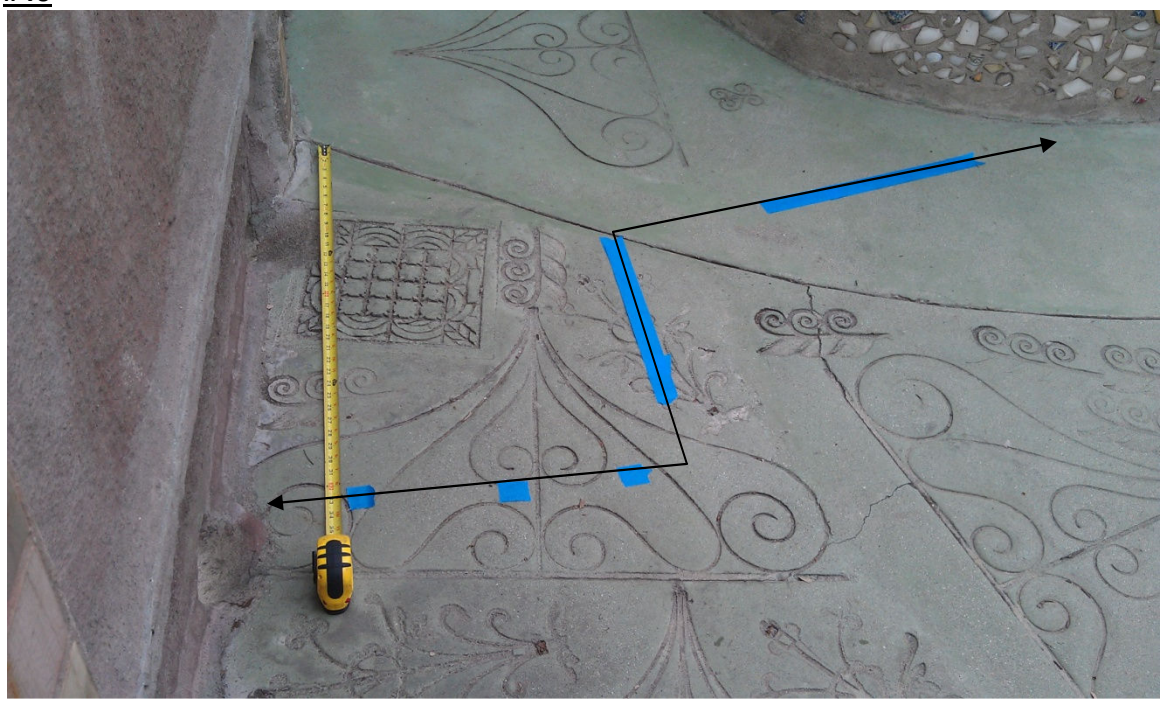

The above screen shot shows both voids that were found in slab section #40. They will be explained further on the following pictures.

**#40**



This is the first, smaller void in slab section #40 at a depth of 4”.

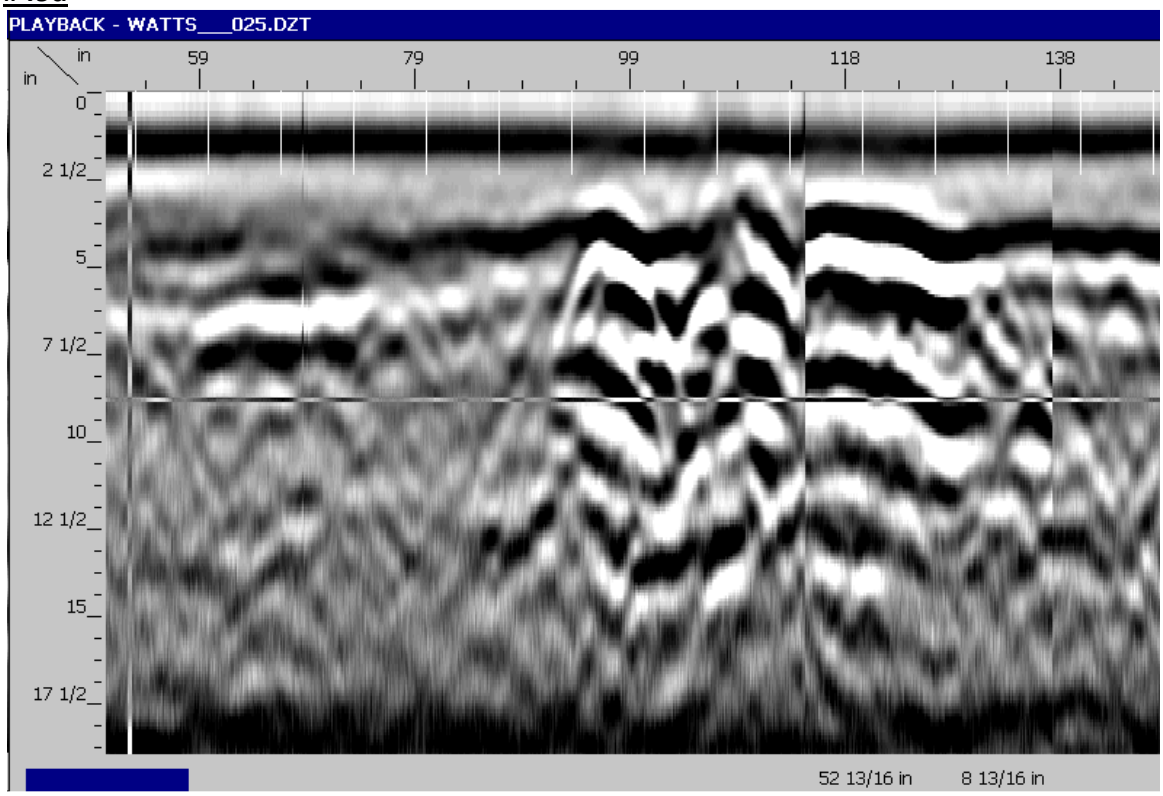
**#40**



This is the other void that was found in section #40 and crossing into #41a. It appeared to be possibly a pipe directly below the slab rather than a void. It is only about 2” wide and follows the path of the arrows in the photo.

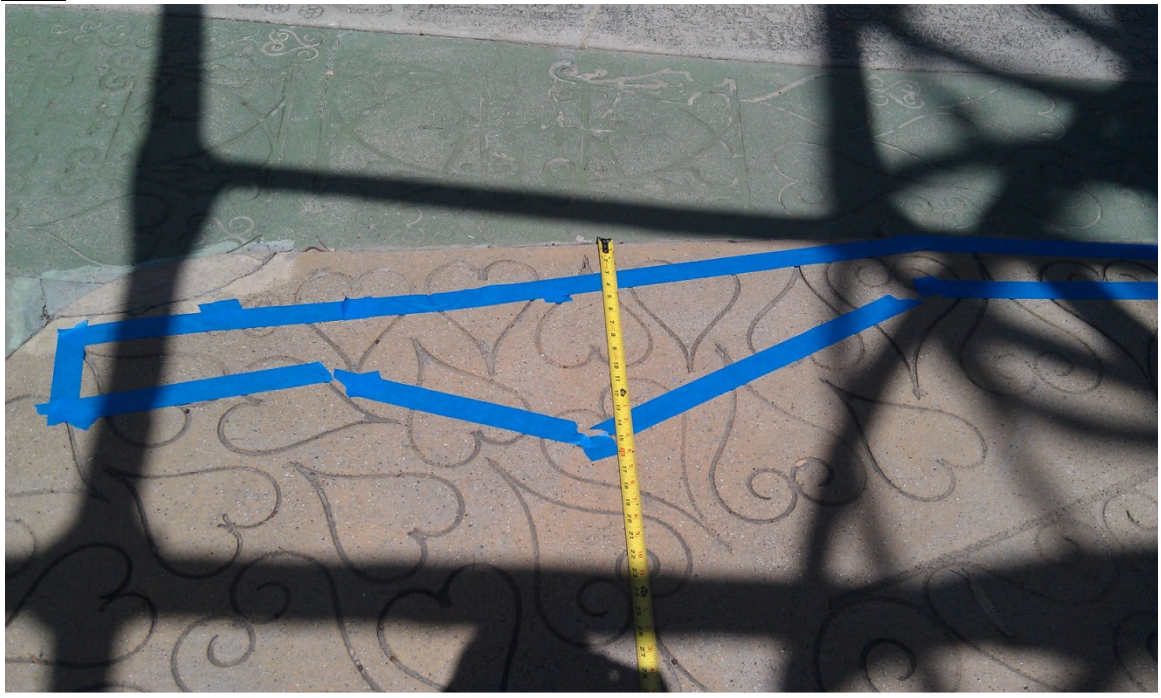
**#40**

**#49a**



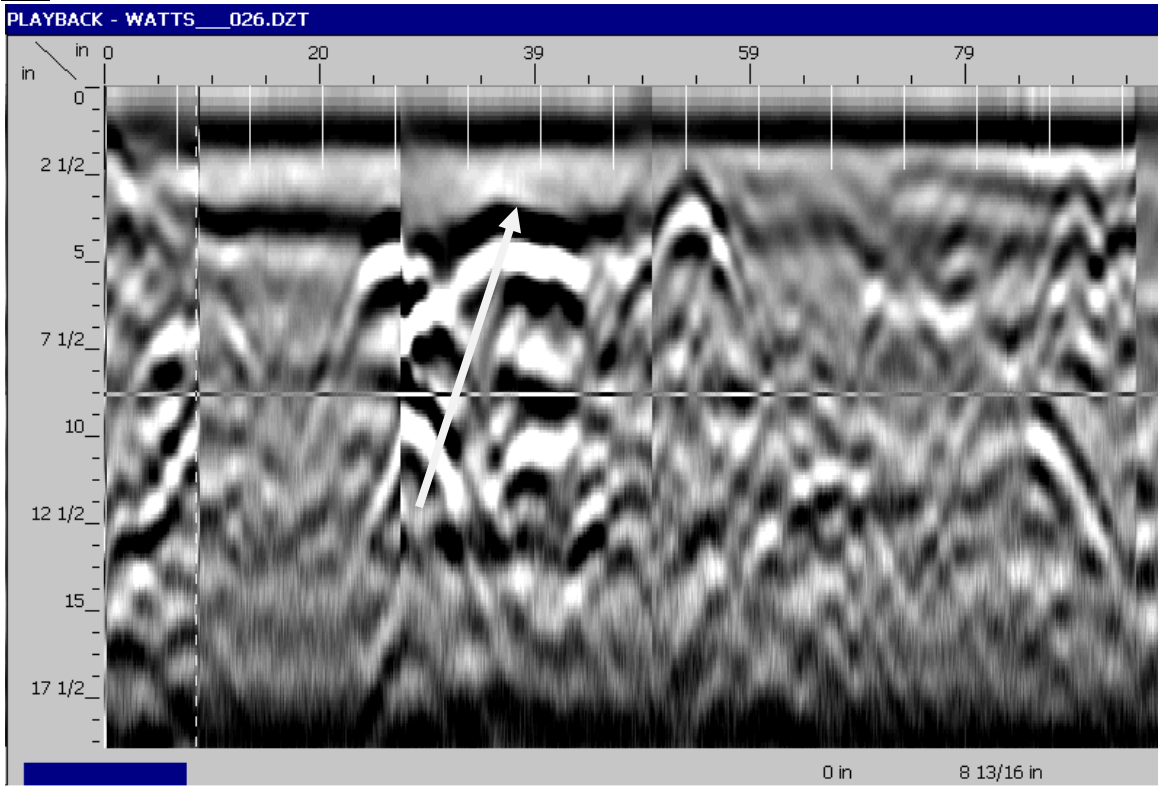

The above screen shot shows the void that was found directly below the slab in slab section #49a. The following photos will show its location.

**#49a**



**#49a**

**#51**

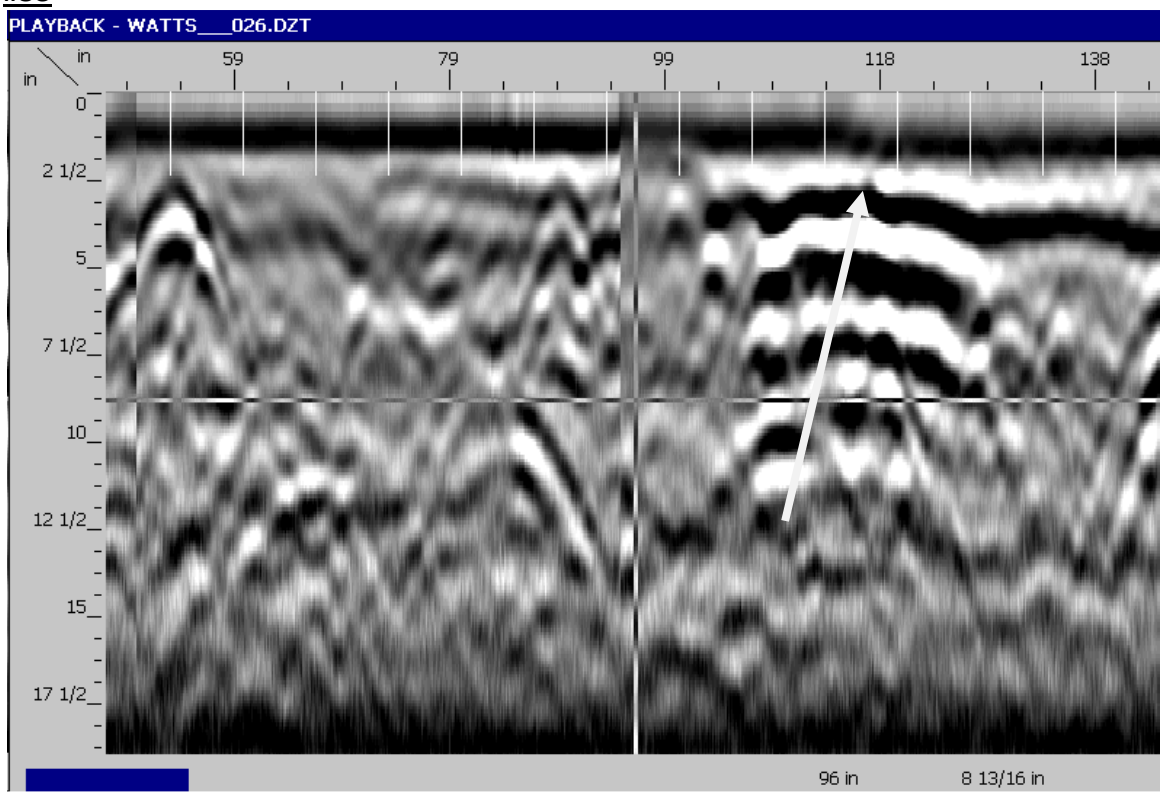



The screen shot above shows the void in slab section #51 directly below the slab at a depth of 3.25”.

**#51**

**#51**

**#53**

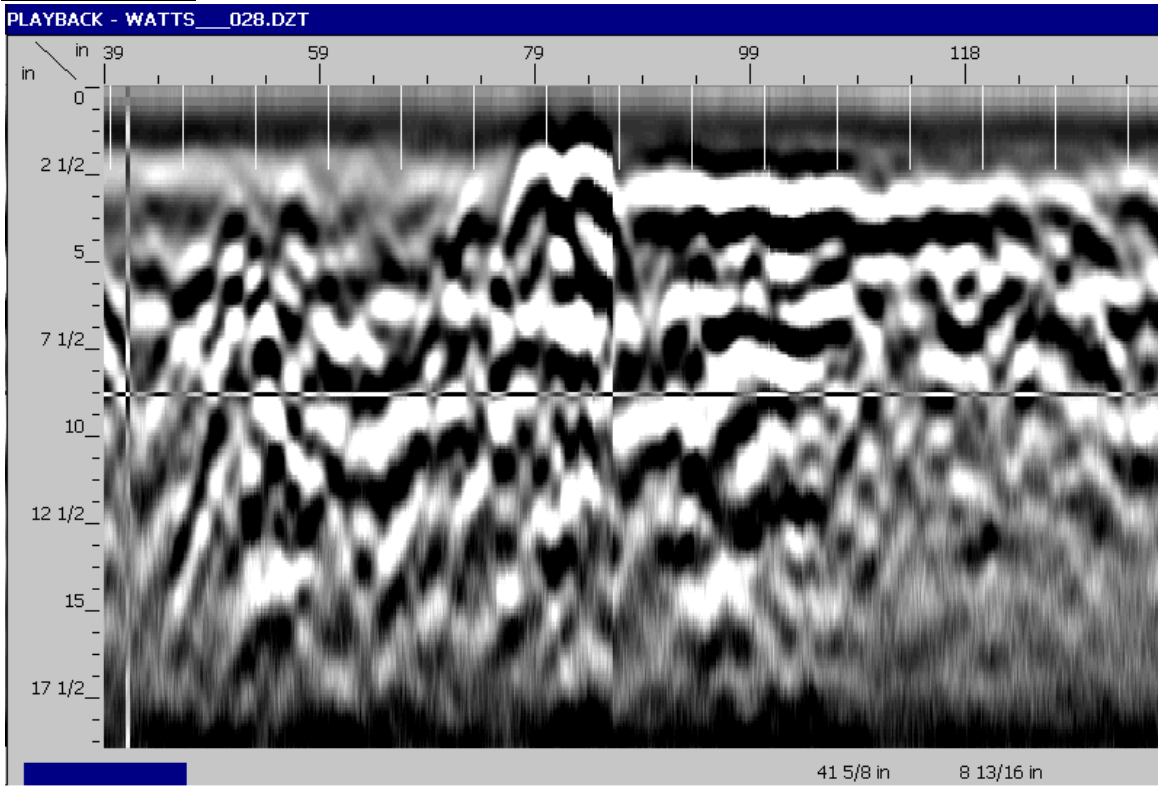



The above screen shot shows the void in slab section #53 directly below the slab at a depth of 3.25”.

**#53**

**#53**

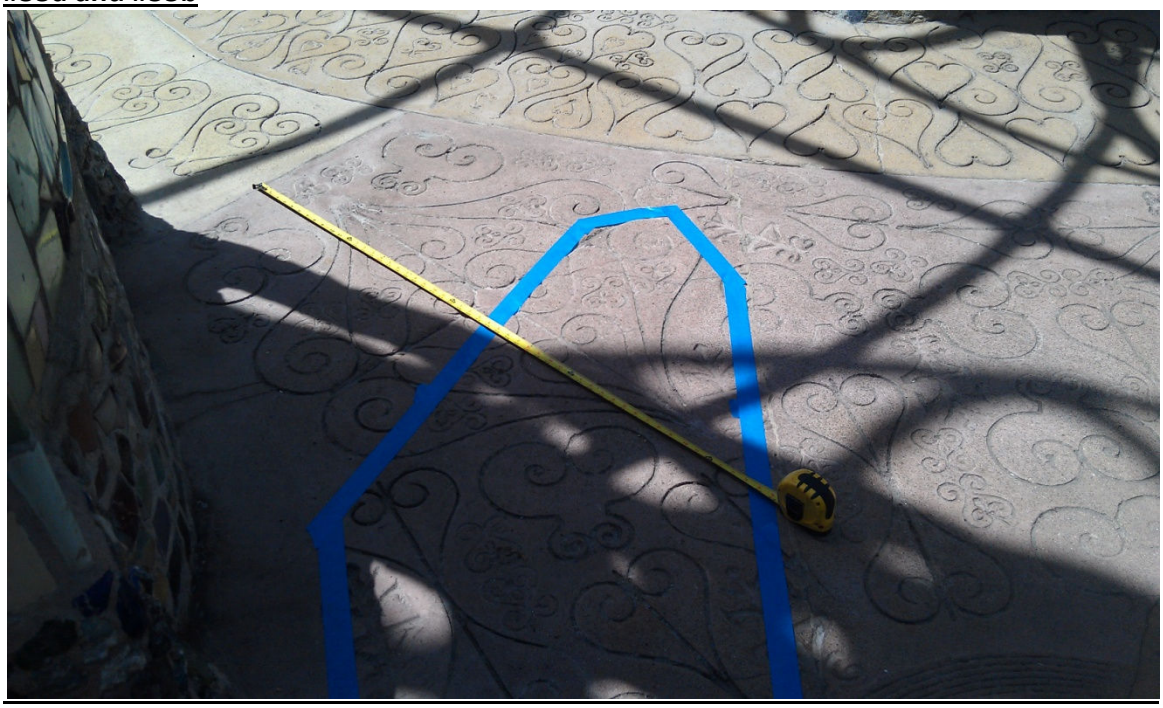
**#55a and #55b**



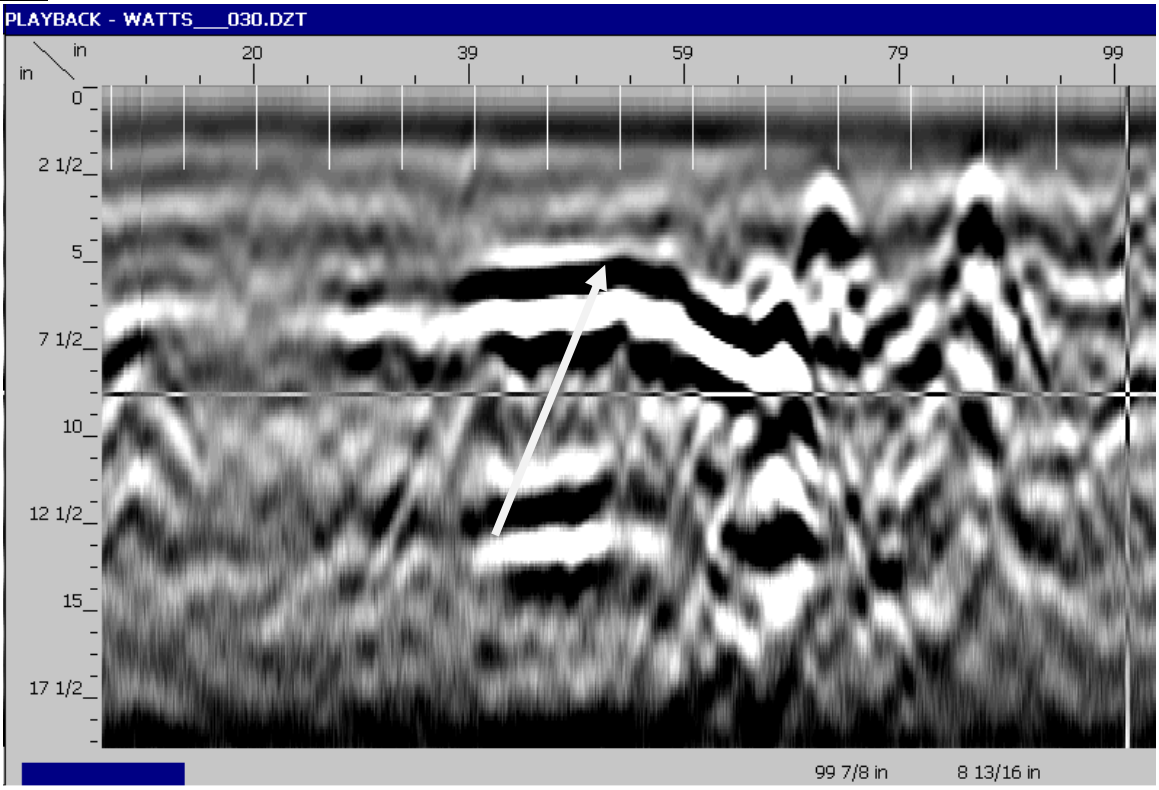

The above screen shot shows slab sections #55a and #55b. This area does not contain a void. This concrete appears very different from most of the surrounding sections. It contains very reflective or metallic aggregate beginning at a depth of 1 ¾". This area is shown in the next two photos.

**#55a and #55b**

**#55a and #55b**



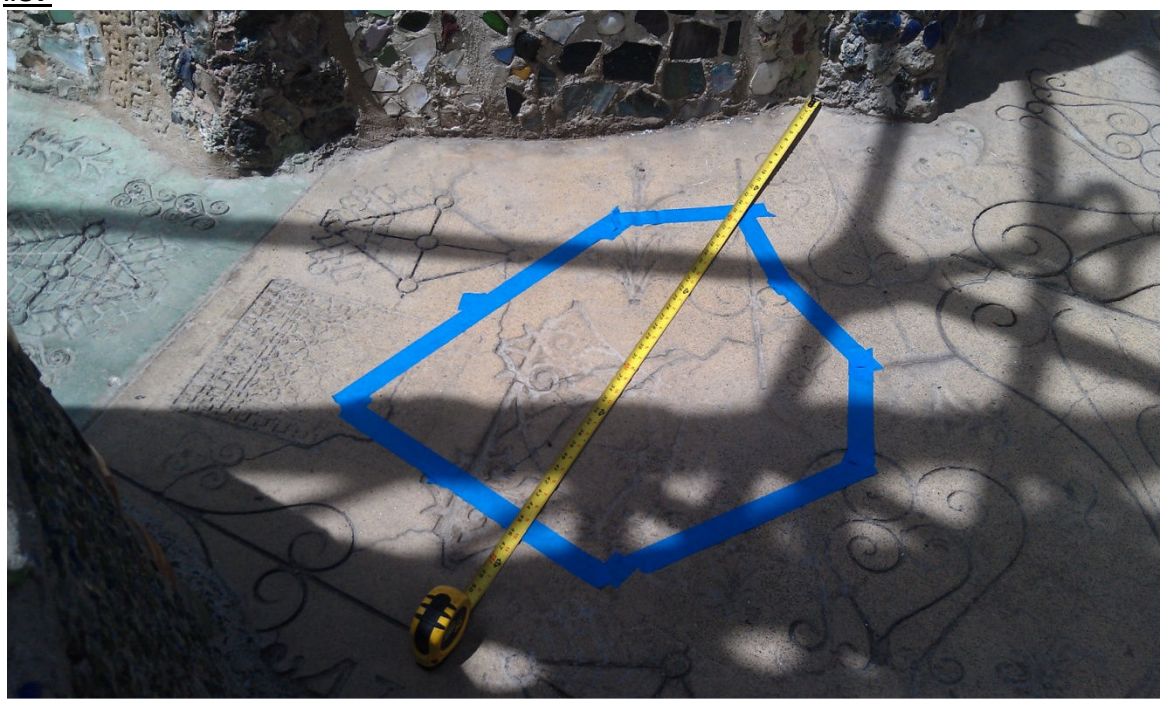
**#57**



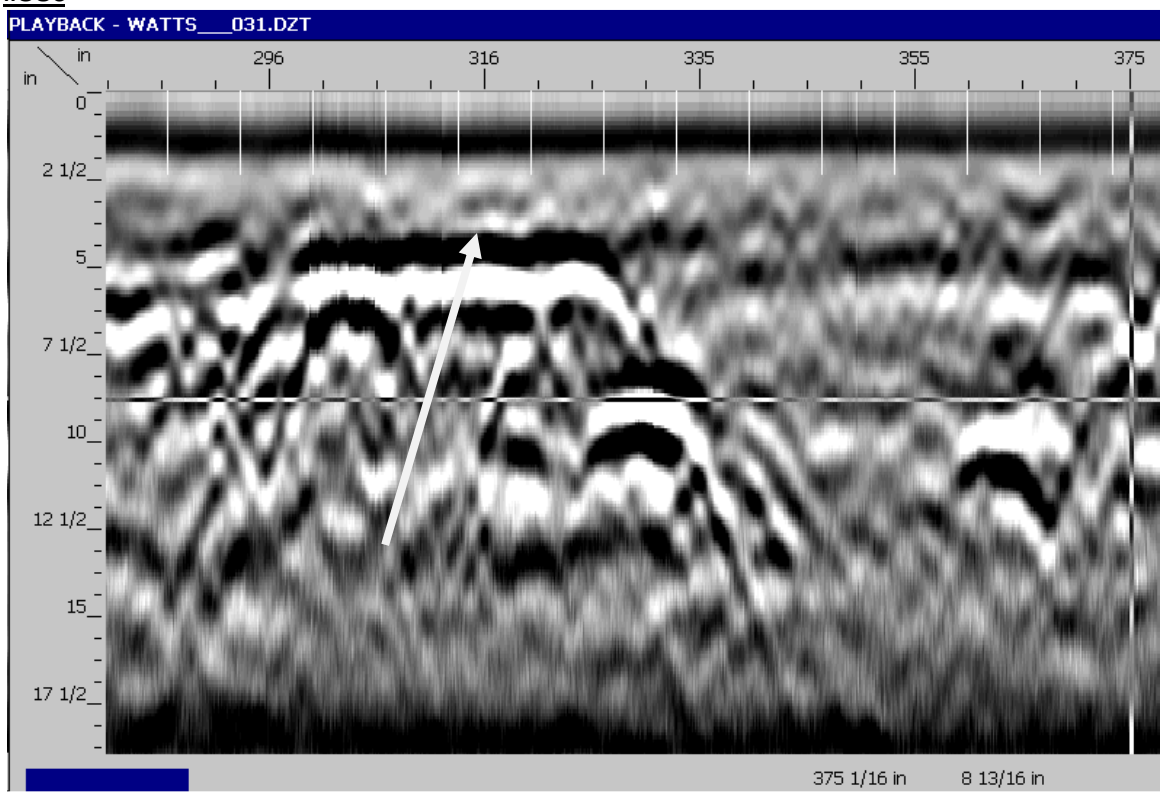

The above screen shot shows the void below slab section #57. This is the most significant void we found. We cannot give void thicknesses but this void appeared to be the brightest of the voids we found.

**#57**

**#57**



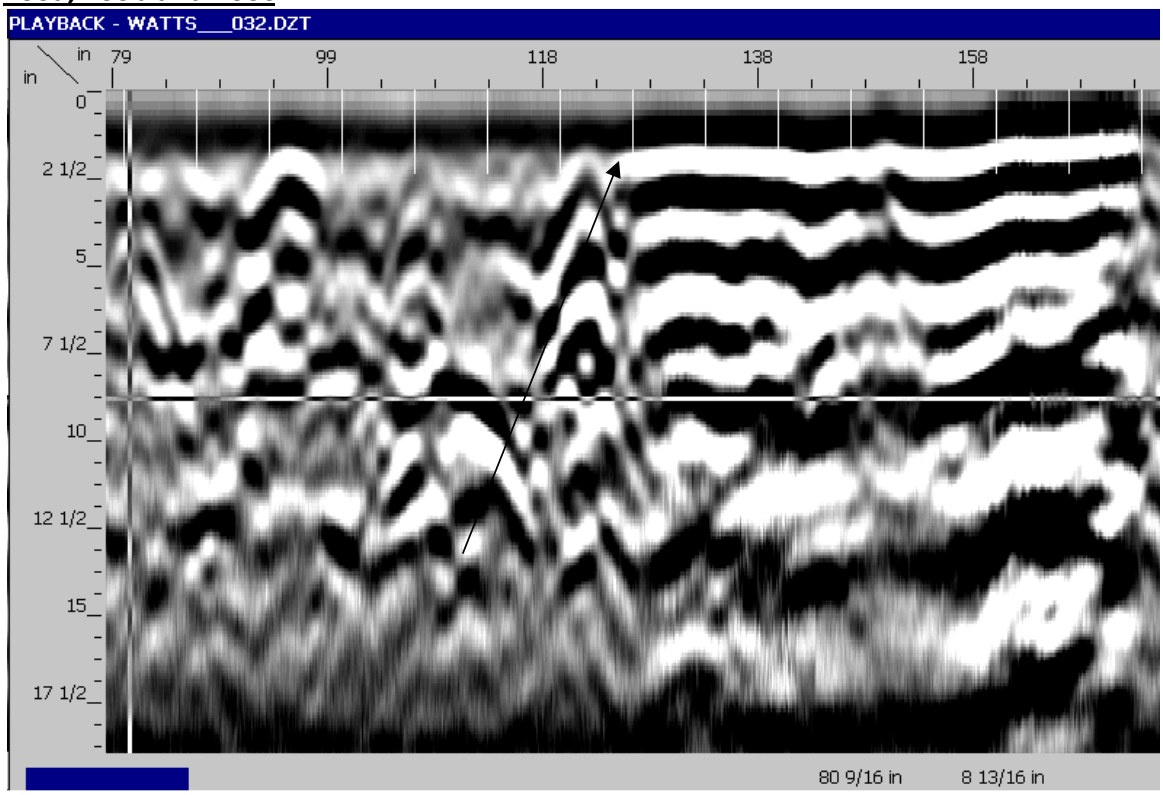
**#58c**




The above screen shot shows the void that was found below the slab in slab section #58c at a depth of 4.5”.

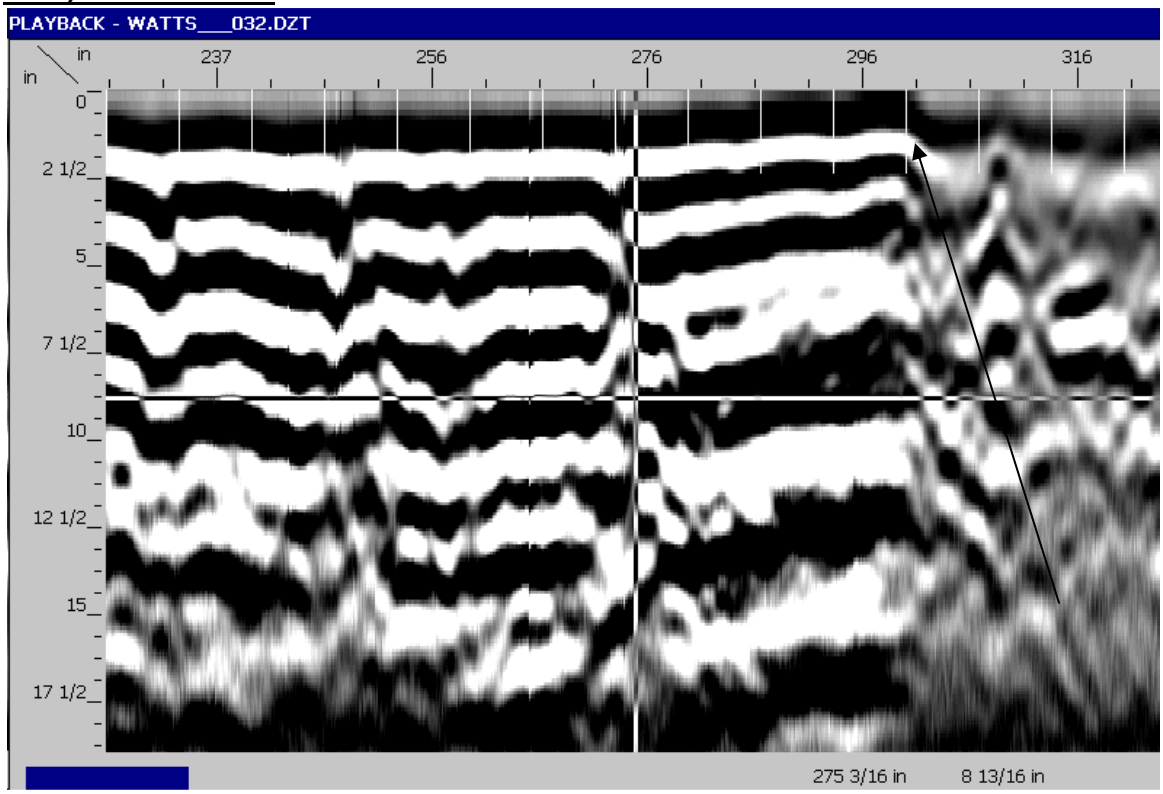
**#58c**

**#60a, #60b and #60c**




The above screen shot shows an area in #60a and #60c where the slab or concrete aggregate changes. The right side of this data contains what appears to be almost solid metal reflection at a depth of 1 ¾". We believe this is due to a different concrete being used that contains a very reflective or conductive material.

**#60a, #60b and #60c**




The above screen shot shows where the reflective area ends in area #60b.

**#60a, #60b and #60c**

The area between the two pieces of blue tape is where the concrete contains the reflective material.

**#60a, #60b and #60c**

The area between the two pieces of blue tape is where the concrete contains the reflective material.

Signed,

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