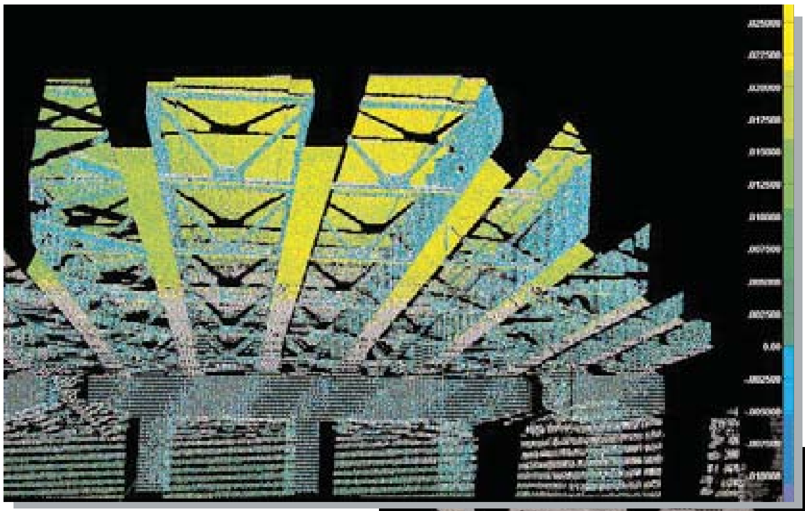
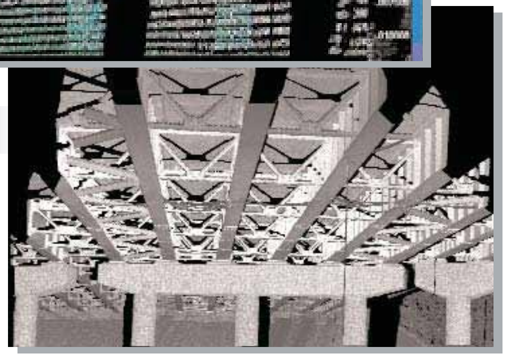
Optech

Field Notes

Civil Engineering: Bridge Deflection Analysis





Images from top: False colour deflection image, reference point cloud image and photograph of survey scene.

The Florida Department of Transportation (FDOT) regularly tests the structural capacity of bridges in the state. To accomplish this, a predetermined amount of weight is loaded onto the bridge and increased incrementally. The bridge deflection is measured at each loading interval. The maximum load of the bridge is observed when the relationship between the load and the measured deflection becomes non-linear.

The method of measurement is currently labour-intensive, costly and inconvenient. Prior to the tests a number of stress monitors and deflection gauges must be mounted under the bridge. To do this highway lanes must be closed and a team of workers has to manually mount the sensors. Depending on the number of sensors, setup may take 1-3 days to complete.

Both FDOT and Optech felt this was a process that could be significantly improved using the ILRIS-3D laser scanner. As such, ILRIS-3D was used to do the bridge analysis simultaneously during a test on the I10-exit 30 bridge in Tallahassee, Florida. The purpose of the test was three-fold:

1. To demonstrate that the resolution of the scanner was sufficient to detect millimetric deflections.
2. To demonstrate that the accuracy of the scanner was adequate for engineering analysis of this type. As such, conventional measurements were used as the benchmarks.
3. To prove that ILRIS-3D provided a more cost-effective, convenient and safe way to do the analysis.

ILRIS-3D Method

Scanning a scene with the ILRIS-3D involves very little setup, unlike the traditional method used. ILRIS-3D was set up on the shoulder of the highway, under the bridge. Since the unit is completely eye safe, no lane closure was required. Before the bridge was loaded it was scanned once with ILRIS-3D. This scan was used as the control scan.

The bridge was subsequently loaded and scanned incrementally with three weights, at magnitudes of 96,000 lbs., 144,000 lbs., and 192,000 lbs.

To measure the deflection of the bridge, each loaded scan was compared with the control scan (no load). Measurements within 1 metre of the deflection gauge anchor were used in the statistical model; 3,000 measurements were used in each case.

Results and comparison on reverse side

Bridge Deflection Analysis Results

Major Considerations:

	Traditional Method	ILRIS-3D
Safety Concerns	Yes	No
Lane Closure	Yes	No
Product Quality	Low resolution	High resolution 3D model
Project Scope	Large scale, permits required	Small scale, no permits, little setup

Accuracy Comparison:

LOAD	ILRIS-3D: Control vs. Load Comparison		Traditional Method	ILRIS-3D Deflection vs. Traditional Method Deflection
	Average (m)	St. Dev. (m)	Measured Deflection (m)	
96,000 lbs.	0.010 m	0.003 m	0.011 m	0.001 m
144 000 lbs.	0.014 m	0.003 m	0.016 m	0.002 m
196,000 lbs.	0.021 m	0.003 m	0.019 m	0.002 m

Project Breakdown:

	Traditional Method	ILRIS-3D
Setup time	16 hours	5 minutes
Min. # People Required	2	1
Total Labour	32 hours	5 minutes
Data Collection Time*	1 minute (read and record measurements)	15 minutes (total)
Min. # People Required	1	1
Total Hours	1 minute	15 minutes
Total Data Processing Time	< 5 minutes	30 minutes

** Does not include loading and load removal times*

Comparative Summary:

	Traditional Method	ILRIS-3D
Total # of Measurements	<500	>1,000,000
Time to Completion	~32 hours	~50 minutes
Time per Measurement	230 seconds	0.003 seconds
Final Data Output	Numeric Comparison	3D structural visualization

A safer, higher density, better dataset was created with >95% TIME SAVINGS

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