REPUBLIC OF LEBANON
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ADMA BRIDGE REHABILITATION STUDY

تقرير تحميل الجسر وقياس الانخساف ونسبة الضغط في الخرسانة

LOAD TEST REPORT FOR THE CONCRETE STRUCTURE OF THE ADMA BRIDGE

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Introduction

Adma bridge rehabilitation study consists of testing the bridge which consists of 5 lanes, 2 lanes from Beirut to Tripoli and 3 lanes in the opposite way, and a planted median separating both ways.

This test was carried out in a similar vein of the French technical guide, "Loading tests on road bridges and footbridges", published in October 2006 by "SETRA" (service d'Etudes techniques des routes et autoroutes) by statically loading the bridge with up to 10 fully loaded "Actros" trucks following different sequences and measuring the required deflection data in order to analyze the actual condition of the bridge.

Description of Works

As per the French technical guide "SETRA", the traffic passing on and below the bridge to be tested should be redirected.

Therefore, an official letter was sent to the concerned party stating the reason and permission to redirect the traffic flow. On April 3, 2018, at 11:00 pm, the traffic on the Adma bridge was redirected on secondary roads in order to empty the bridge and load it with specific weights and measure accurate deflections.

The test was carried out by loading the bridge in different sequences with fully loaded "ACTROS" trucks. Each single lane from mountain-side to sea-side was loaded separately with 2 trucks in front to back orientation. Surveying targets were placed by the surveying team at each single beam at its quarter, mid and third quarter span in order to measure the deflection caused by the respective loading scenario.

At the end of every loading sequence/scenario, surveyors measured the deflection of the bridge at each specified target using two total stations placed at the end of each side of the underpass. In addition, at the end of each loading sequence a point cloud modeling equipment (3D-Model machine- FARO) scanned the bridge and as a result recorded the deflection at mid span of each beam and developed a 3D surface of the hole structure.

Trucks used in the Loading Sequence

10 Mercedes Actros Trucks were used in our test. Detailed in table below:

Table 1: Truck Schedule

Truck Designation	Plate Number	Number of Axles	Load Capacity (Tons)	Position from reference axis to the tuck front Axle (m)
A	361533 M	4	60	25.7
B	364897 M	4	55	11
C	353941 M	4	55	15.6
D	364173 M	4	55	11
E	335306 M	3	55	31
F	771625 M	3	55	18
G	357544 M	4	55	30.5
H	364173 M	3	55	18
I	363102 M	3	55	31
J	360434 M	4	60	18

Note:

The experimental total equivalent uniform applied load on the bridge was equal to 6.93 KN/m^2 which should be greater than the theoretical equivalent applied load of 2.5 KN/m^2, as per EN 1991-2 and Setra.

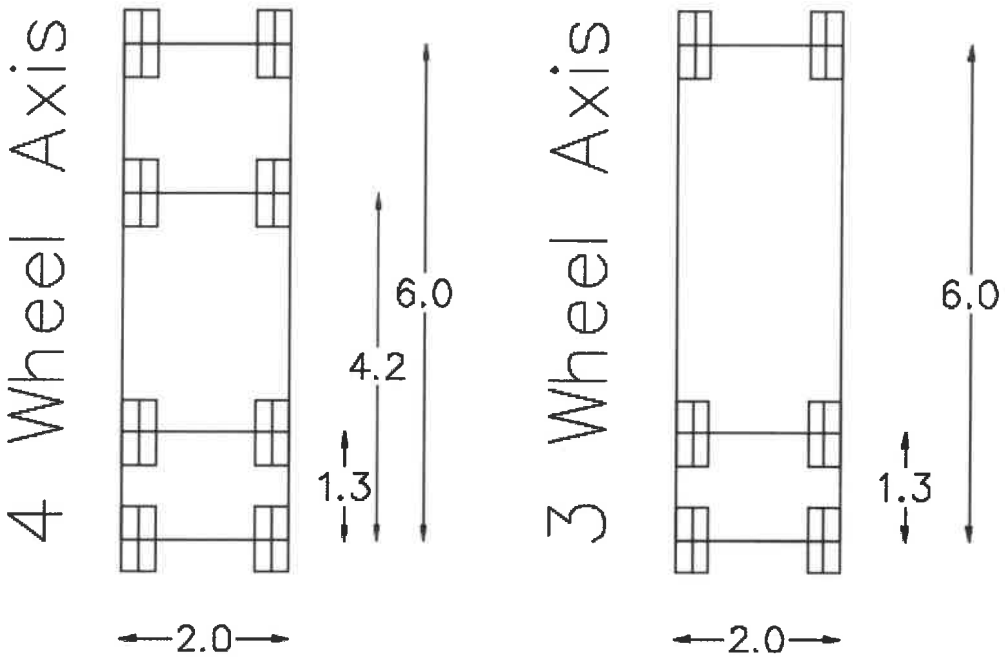

Figure 1: Truck Type and Dimensions

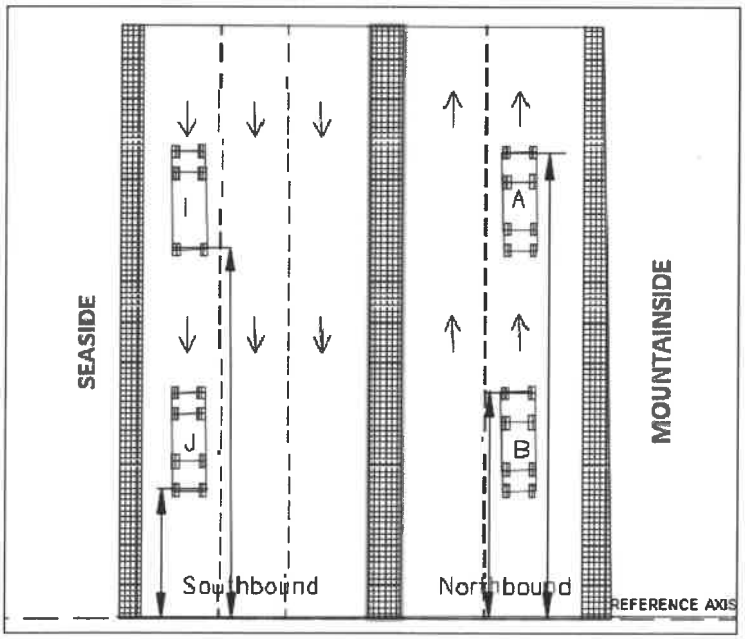

Figure 2 Sketch Example

Note: This sketch shows the different distances measured from the reference axis to the front axle of trucks in different scenarios.

Scenarios

Loading Scenarios

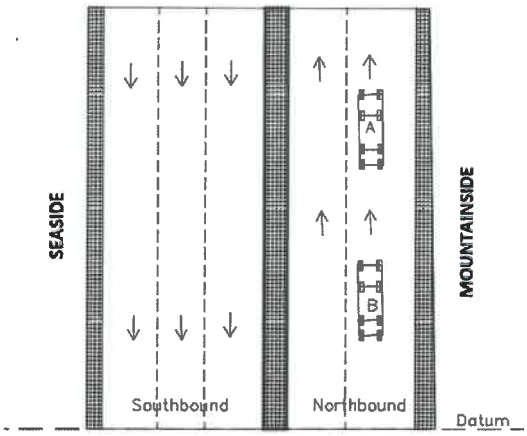

Figure 3 Scenario 1

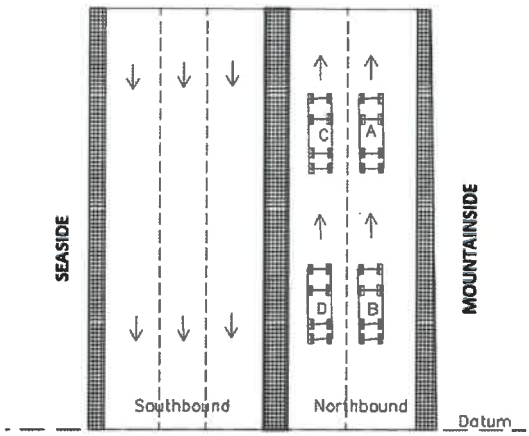

Figure 4 Scenario 2

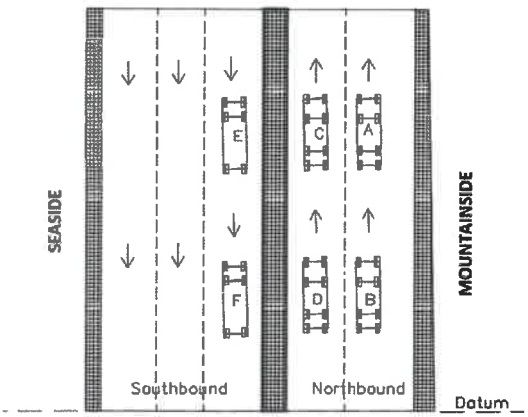

Figure 5 Scenario 3

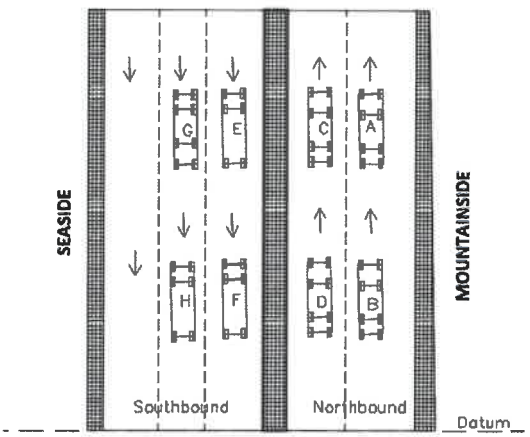

Figure 6 Scenario 4

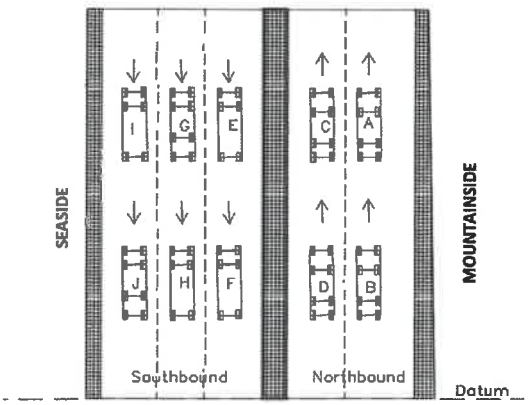

Figure 7 Scenario 5

Unloading Scenarios

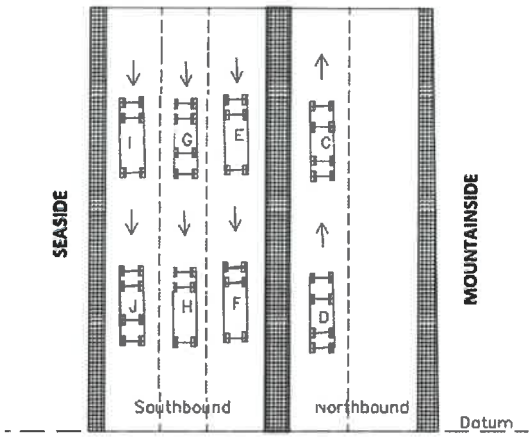

Figure 8 Scenario 6

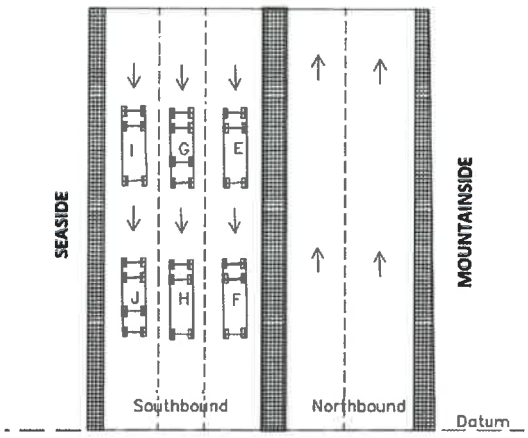

Figure 9 Scenario 7

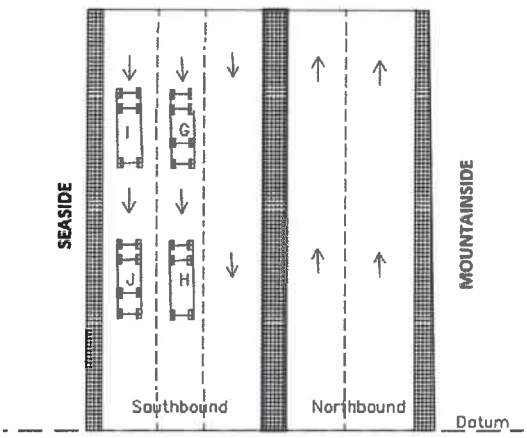

Figure 10 Scenario 8

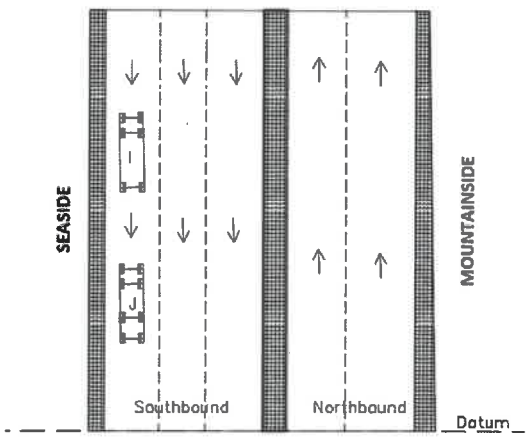

Figure 11 Scenario 9

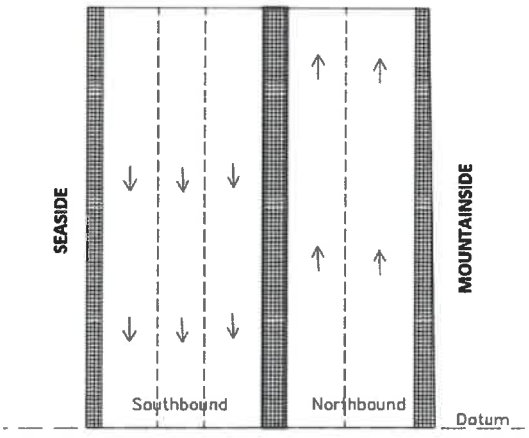

Figure 12 Scenario 10

Results

Below you can find the deflections of each beam at its three different benchmarks measured on site using two total stations and a laser 3D sweep machine (FARO).

SCENARIO 1

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 1	1/4	0.7	
	1/2	1.2	1.7
	3/4	1.3	
BEAM 2	1/4	1.3	
	1/2	1.4	0.4
	3/4	0.3	
BEAM 3	1/4	1.1	
	1/2	0.6	0.9
	3/4	0.6	
BEAM 4	1/4	0.4	
	1/2	0.4	1.4
	3/4	-0.2	
BEAM 5	1/4	0.2	
	1/2	0.1	1.4
	3/4	0.4	
BEAM 6	1/4	0.8	
	1/2	0	0.7
	3/4	0.4	
BEAM 7	1/4	-0.5	
	1/2	0.2	1
	3/4	0	
BEAM 8	1/4	0.2	

SCENARIO 1

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
	1/2	1	1.4
	3/4	0.3	
BEAM 9	1/4	0.2	
	1/2	0.3	1.8
	3/4	0.2	
BEAM 10	1/4	0.1	
	1/2	0.1	1.2
	3/4	-0.2	
BEAM 11	1/4	-0.5	
	1/2	0.1	1.3
	3/4	-0.3	
BEAM 12	1/4	0.2	
	1/2	0.5	1.2
	3/4	0.1	
BEAM 13	1/4	-0.1	
	1/2	-0.2	0.9
	3/4	0.6	
BEAM 14	1/4	0.4	
	1/2	0.1	-
	3/4	0.1	
BEAM 15	1/4	0.4	
	1/2	0	-
	3/4	-0.1	

SCENARIO 2

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 1	1/4	1.6	
	1/2	2.6	1.7
	3/4	1.7	
BEAM 2	1/4	1.5	
	1/2	2.2	1.3
	3/4	1.1	
BEAM 3	1/4	1.2	
	1/2	1.4	2.4
	3/4	0.9	
BEAM 4	1/4	0.6	
	1/2	0.8	2.2
	3/4	1.1	
BEAM 5	1/4	0.8	
	1/2	1.3	2
	3/4	1	
BEAM 6	1/4	0.8	
	1/2	-0.4	2.9
	3/4	0.3	
BEAM 7	1/4	0.4	
	1/2	0.8	2.3
	3/4	0.4	
BEAM 8	1/4	0.3	
	1/2	1.4	2.4
	3/4	0.5	
BEAM 9	1/4	0.4	
	1/2	0.6	3.3
	3/4	0.3	

SCENARIO 2

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 10	1/4	0	
	1/2	0.2	2.5
	3/4	0.2	
BEAM 11	1/4	-0.4	
	1/2	0.4	2.2
	3/4	-0.1	
BEAM 12	1/4	0.3	
	1/2	0.4	2.5
	3/4	0.2	
BEAM 13	1/4	-0.1	
	1/2	-0.3	1.9
	3/4	0.6	
BEAM 14	1/4	0	
	1/2	-0.1	-
	3/4	0	
BEAM 15	1/4	-0.1	
	1/2	-0.1	-
	3/4	0	

SCENARIO 3

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 1	1/4	2.1	
	1/2	2.4	2.9
	3/4	2.2	
BEAM 2	1/4	1.9	
	1/2	2.4	1.8
	3/4	1.9	
BEAM 3	1/4	1.8	
	1/2	1.7	1.5
	3/4	1	
BEAM 4	1/4	1	
	1/2	1.3	2.1
	3/4	1.7	
BEAM 5	1/4	1.4	
	1/2	1.3	1.9
	3/4	1.1	
BEAM 6	1/4	1	
	1/2	2.4	2.2
	3/4	1.3	
BEAM 7	1/4	0.5	
	1/2	1.5	2.3
	3/4	0.7	
BEAM 8	1/4	0.7	
	1/2	2.2	1.6
	3/4	1.2	
BEAM 9	1/4	1.2	
	1/2	1.4	3.6
	3/4	0.7	

SCENARIO 3

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 10	1/4	0.5	
	1/2	1.1	3.4
	3/4	0.4	
BEAM 11	1/4	0	
	1/2	0.9	2.2
	3/4	0.2	
BEAM 12	1/4	0.8	
	1/2	1.1	2.8
	3/4	0.6	
BEAM 13	1/4	0.2	
	1/2	0.6	2.3
	3/4	0.7	
BEAM 14	1/4	0.1	
	1/2	0.3	-
	3/4	0.3	
BEAM 15	1/4	0.1	
	1/2	0.2	-
	3/4	0.2	

SCENARIO 4

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 1	1/4	1.9	
	1/2	2.8	3.1
	3/4	2.9	
BEAM 2	1/4	1.9	
	1/2	2.4	3.4
	3/4	1.9	
BEAM 3	1/4	1.8	
	1/2	1.9	2.3
	3/4	1.2	
BEAM 4	1/4	1.1	
	1/2	1.7	2.6
	3/4	1.4	
BEAM 5	1/4	1.6	
	1/2	2	2.1
	3/4	1.1	
BEAM 6	1/4	1.3	
	1/2	2.7	2.5
	3/4	1	
BEAM 7	1/4	1	
	1/2	1.5	2.1
	3/4	1	
BEAM 8	1/4	1	
	1/2	2.7	2.7
	3/4	1.3	
BEAM 9	1/4	1.3	
	1/2	2.1	1.9
	3/4	1	

SCENARIO 4

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 10	1/4	0.5	
	1/2	1.4	2.6
	3/4	0.9	
BEAM 11	1/4	0.7	
	1/2	1.6	1.2
	3/4	0.6	
BEAM 12	1/4	1.1	
	1/2	1.6	1.3
	3/4	0.9	
BEAM 13	1/4	0.6	
	1/2	1.3	1.4
	3/4	1	
BEAM 14	1/4	0.6	
	1/2	0.8	-
	3/4	0.6	
BEAM 15	1/4	0.4	
	1/2	0.7	-
	3/4	0.4	

SCENARIO 5

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 1	1/4	2.3	
	1/2	2.5	2.4
	3/4	2.2	
BEAM 2	1/4	1.9	
	1/2	2.6	1.5
	3/4	2.7	
BEAM 3	1/4	1.8	
	1/2	2	1.2
	3/4	1.1	
BEAM 4	1/4	1.2	
	1/2	1.9	2.9
	3/4	1.9	
BEAM 5	1/4	1.7	
	1/2	2	3.5
	3/4	1.2	
BEAM 6	1/4	1.3	
	1/2	2	3.9
	3/4	1.5	
BEAM 7	1/4	1.5	
	1/2	2.1	3.6
	3/4	1.3	
BEAM 8	1/4	1.2	
	1/2	3.1	3.3
	3/4	1.5	
BEAM 9	1/4	1.8	
	1/2	2.3	2.7
	3/4	1.2	

SCENARIO 5

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 10	1/4	0.9	
	1/2	2.3	2.1
	3/4	1.3	
BEAM 11	1/4	0.9	
	1/2	2.4	1.3
	3/4	0.9	
BEAM 12	1/4	1.8	
	1/2	2.6	1.8
	3/4	1.6	
BEAM 13	1/4	1.6	
	1/2	2.2	0.9
	3/4	1.9	
BEAM 14	1/4	0.9	
	1/2	1.9	-
	3/4	1.3	
BEAM 15	1/4	0.9	
	1/2	1.4	-
	3/4	1	

SCENARIO 6

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 1	1/4	1.2	
	1/2	1.4	3.6
	3/4	0.6	
BEAM 2	1/4	0.8	
	1/2	1.7	3.5
	3/4	2.3	
BEAM 3	1/4	1.3	
	1/2	1.5	3
	3/4	0.7	
BEAM 4	1/4	0.8	
	1/2	1.4	3.5
	3/4	1.4	
BEAM 5	1/4	1.3	
	1/2	2	3.8
	3/4	0.6	
BEAM 6	1/4	1.2	
	1/2	0.4	3.7
	3/4	1.4	
BEAM 7	1/4	0.5	
	1/2	1.5	3.9
	3/4	0.9	
BEAM 8	1/4	1.1	
	1/2	3	3.4
	3/4	1.4	
BEAM 9	1/4	1.4	
	1/2	2.5	3.4
	3/4	1.3	

SCENARIO 6

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 10	1/4	1.1	
	1/2	1.8	3.5
	3/4	1.3	
BEAM 11	1/4	1.1	
	1/2	2.5	1
	3/4	1.5	
BEAM 12	1/4	1.9	
	1/2	2.6	1.3
	3/4	1.9	
BEAM 13	1/4	1.7	
	1/2	2.3	0.3
	3/4	2.2	
BEAM 14	1/4	1.1	
	1/2	2	-
	3/4	1.4	
BEAM 15	1/4	1.2	
	1/2	1.4	-
	3/4	0.9	

SCENARIO 7

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 1	1/4	1.4	
	1/2	0.8	3.9
	3/4	1.2	
BEAM 2	1/4	0.6	
	1/2	1.1	3.4
	3/4	1	
BEAM 3	1/4	1.1	
	1/2	0.6	2.3
	3/4	0.2	
BEAM 4	1/4	0.3	
	1/2	0.5	2.1
	3/4	0.7	
BEAM 5	1/4	0.9	
	1/2	1.2	1.4
	3/4	0.5	
BEAM 6	1/4	1.1	
	1/2	0.9	1
	3/4	1	
BEAM 7	1/4	0.9	
	1/2	1.4	0.7
	3/4	0.9	
BEAM 8	1/4	0.9	
	1/2	2.4	1.3
	3/4	1.2	
BEAM 9	1/4	1.9	
	1/2	2.2	0.3
	3/4	1.1	

SCENARIO 7

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 10	1/4	1	
	1/2	1.8	0.1
	3/4	1	
BEAM 11	1/4	0.8	
	1/2	2.2	0.1
	3/4	1.3	
BEAM 12	1/4	1.9	
	1/2	2.9	0.8
	3/4	1.6	
BEAM 13	1/4	1.7	
	1/2	2.3	0.5
	3/4	2.4	
BEAM 14	1/4	1	
	1/2	2	-
	3/4	1.4	
BEAM 15	1/4	1.1	
	1/2	1.6	-
	3/4	1	

SCENARIO 8

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 1	1/4	1.3	
	1/2	0.6	4.2
	3/4	1.6	
BEAM 2	1/4	0.8	
	1/2	1.1	4.7
	3/4	1.9	
BEAM 3	1/4	1	
	1/2	0.8	2.4
	3/4	0.1	
BEAM 4	1/4	0.1	
	1/2	0	3.6
	3/4	0.7	
BEAM 5	1/4	1.1	
	1/2	0.8	2.2
	3/4	0.2	
BEAM 6	1/4	0.9	
	1/2	0.7	4.7
	3/4	0.8	
BEAM 7	1/4	0.4	
	1/2	0.9	4.7
	3/4	0.6	
BEAM 8	1/4	0.6	
	1/2	2.1	3.2
	3/4	1.3	
BEAM 9	1/4	1.3	
	1/2	1.6	3.5
	3/4	0.7	

SCENARIO 8

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 10	1/4	0.7	
	1/2	1.5	2.4
	3/4	1.1	
BEAM 11	1/4	1.1	
	1/2	1.9	0.2
	3/4	1.1	
BEAM 12	1/4	1.6	
	1/2	2.3	1.5
	3/4	1.5	
BEAM 13	1/4	1.4	
	1/2	2.2	0.8
	3/4	1.4	
BEAM 14	1/4	0.9	
	1/2	1.8	-
	3/4	1.3	
BEAM 15	1/4	1.1	
	1/2	1.5	-
	3/4	0.8	

SCENARIO 9

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 1	1/4	1.5	
	1/2	1.3	3.6
	3/4	1	
BEAM 2	1/4	0.5	
	1/2	0.9	2
	3/4	1.6	
BEAM 3	1/4	0.9	
	1/2	0.6	2.1
	3/4	0	
BEAM 4	1/4	0	
	1/2	0.5	3.6
	3/4	0.7	
BEAM 5	1/4	0.9	
	1/2	0.5	3.5
	3/4	0.1	
BEAM 6	1/4	0.8	
	1/2	-0.3	4.1
	3/4	0.9	
BEAM 7	1/4	-0.5	
	1/2	0.8	2.5
	3/4	0.3	
BEAM 8	1/4	0.2	
	1/2	1.5	2.2
	3/4	0.7	
BEAM 9	1/4	0.9	
	1/2	1	2.7
	3/4	0.4	

SCENARIO 9

	READING LOCATION	* Deflection by Total Station (cm)	** Deflection by 3D Sweep (cm)
BEAM 10	1/4	0.2	
	1/2	1	2.8
	3/4	0.5	
BEAM 11	1/4	-0.2	
	1/2	1.2	0.3
	3/4	0.6	
BEAM 12	1/4	1	
	1/2	1.4	0.1
	3/4	1.1	
BEAM 13	1/4	1.2	
	1/2	1.3	0.1
	3/4	1.4	
BEAM 14	1/4	0.4	
	1/2	1.5	-
	3/4	0.8	
BEAM 15	1/4	0.8	
	1/2	1.4	-
	3/4	0.6	

Summary

	MAX Deflection (cm) (by total Station)	Location	Scenario
BEAM 1	2.9	3/4 Span	4
BEAM 2	2.7	3/4 Span	5
BEAM 3	1.9	1/2 Span	4
BEAM 4	1.9	1/2Span and 3/4 Span	5
BEAM 5	2	1/2 Span	4,5,6
BEAM 6	2.7	1/2 Span	4
BEAM 7	2.1	1/2 Span	5
BEAM 8	3.1	1/2 Span	5
BEAM 9	2.5	1/2 Span	6
BEAM 10	2.3	1/2 Span	5
BEAM 11	2.5	1/2 Span	6
BEAM 12	2.9	1/2 Span	7
BEAM 13	2.4	3/4 Span	7
BEAM 14	1.8	1/2 Span	8
BEAM 15	1.6	1/2 Span	7

Loading Test

Figure 13 Loading (Scenario 5) View

Figure 14 Bridge Facade During Loading

Figure 15 Labeled Points for Deflection Reading

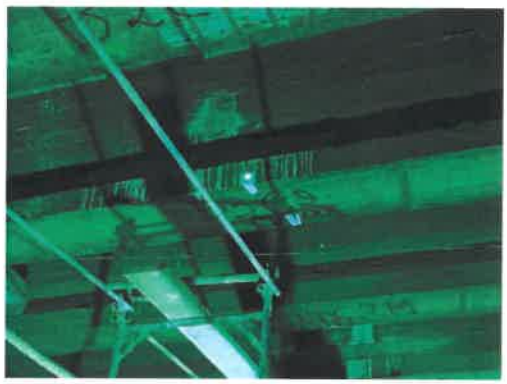

Figure 16 Labeled Points for Deflection Reading

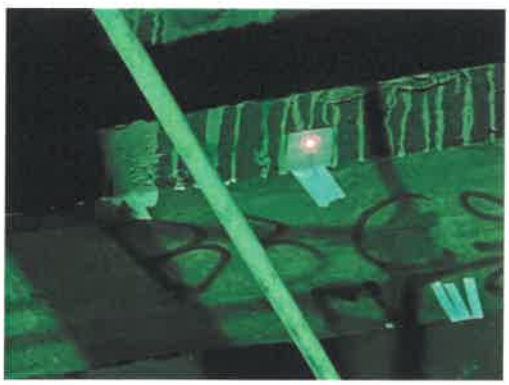

Figure 17 Labeled Beam

Figure 18 Total Station

Figure 19 3D Modelling

Appendix A

Request for Work Facilitation

الجمهورية اللبنانية
وزارة الأشغال العامة والنقل
المديرية العامة للطرق والمباني

المديرالعام

م ط ع/٩٠

٢٨ شباط ٢٠١٨

سعادة قائمقام كسروان

الموضوع : طلب تسهيل مهمة لوضع دراسة انشائية حول سلامة جسر محوّل أدما - قضاء كسروان

اشارة الى الموضوع اعلاه،

نحيطكم علما" أننا كلّفنا شركة كريدو بموجب العقد رقم ٢١ تاريخ ٢٠١٧/٤/١٢ لوضع دراسة انشائية تتعلّق بجسر محوّل أدما تستلزم اغلاق مسارب الجسر ، كل اتجاه على حدة ، أمام حركة السير لفترات متقطّعة قد تصل الى اربع أو خمس ساعات بين منتصف الليل والخامسة صباحا" وعلى ثلاثة مراحل أي خلال ثلاثة أيام من الأسبوع لكل مسرب ، اذا دعت الحاجة الى ذلك للتمكّن من اجراء اختبار تحميل الجسر وقياس الانخسافات ونسبة الضغط في الخرسانة الاسمنتية.

للتفضّل بأخذ العلم والطلب من الجهات الأمنية تسهيل مهمة الشركة المذكورة اعلاه .

المدير العام للطرق والمباني بالتكليف

المهندس طانيوس بولس

٢٨ شباط ٢٠١٨

KREDO SAL
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بيروت في ٥ شباط ٢٠١٨

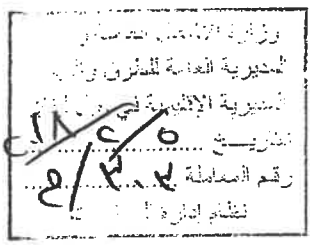
رقم: P-1709-054/18

حضرة المدير الإقليمي في جبل لبنان المحترم

وزارة الأشغال العامّة والنقل

الموضوع: طلب تسهيل مهمّة.

المرجع: العقد رقم ٢١ تاريخ ٢٠١٧/٤/١٢ لوضع دراسة إنشائيّة حول سلامة جسر محوّل أدما – قضاء كسروان.



تحيّة واحتراماً،

بالإشارة إلى الموضوع والمرجع المبيّنين أعلاه،

ولمّا كانت إحدى المهام الموكلة إلينا من ضمن الدراسة الإنشائيّة المتعلّقة بجسر محوّل أدما تستلزم إغلاق مسارب الجسر، كل إتّجاه على حدة، أمام حركة السير لفترات متقطّعة قد تصل إلى أربع أو خمس ساعات للتمكّن من إجراء إختبار تحميل الجسر وقياس الإنخساف ونسبة الضغط في الخرسانة،

وحيث إنّنا سوف نحاول القيام بالقياسات في فترة الليل ما بين منتصف الليل والساعة الخامسة صباحاً وذلك على ثلاثة مراحل أي خلال ثلاثة أيام من الأسبوع لكل مسرب، إذا دعت الحاجة إلى ذلك، وسوف نقوم بالتنسيق مع مفرزة جونية والعمل بإرشاداتها،

جئنا بكتابنا هذا نتمنّى عليكم تسليمنا كتاب تسهيل مهمّة والإيعاز لمَن يلزم لدى الإدارة ولدى كافة الجهات الرسميّة والأمنيّة المعنيّة التنسيق معنا وتسهيل مهمّتنا بغية إنجاز الأعمال المطلوبة منّا بشكل يخفّف من الإزعاج الّذي يمكن أن يلحق بسالكي هذا الجسر، قدر المستطاع.

ونرفق طيّه مصوّراً يظهر الخطّة المقترحة من قِبَلنا لتحوير السير خلال فترة إغلاق الجسر.

وتفضّلوا بقبول فائق احترامنا وتقديرنا

شركة كريدو ش.م.ل.

المهندس جان كرم

نائب المدير العام

مرفقات

ج.ك./ر.ش.

NOTES:

1. SATELLITE IMAGERY WAS TAKEN IN JUNE; 2016.
2. ALL TEMPORARY TRAFFIC SIGNS SHALL CONFORM TO THE LATEST LIBNOR STANDARDS ROAD EQUIPMENT (ROAD TRAFFIC SIGNS FASICULE 2).

No.	REVISION	DATE
04		
03		
02		
01		

CLIENT:
REPUBLIC OF LEBANON
MINISTRY OF PUBLIC WORKS AND TRANSPORT
DIRECTORATE GENERAL OF ROADS AND BUILDINGS

CONSULTANT:
KREDO SAL
CARMEL BLDG., BAYDEH ST., ACHRAFIEH, BEIRUT - LEBANON

PROJECT REFERENCE: P-1709

PROJECT NAME:
ADMA BRIDGE REHABILITATION STUDY
ADMA, CAZA KSEROUANE

DRAWING TITLE:
CONSTRUCTION WORKS
TRAFFIC DIVERSION PLAN

DRAWN:	DESIGNED:	CHECKED:	APPROVED:
N.A.	M.S.	C.B.	G.K.

DATE:	SCALE:
DECEMBER - 2017	N.T.S

FILE NAME: P-1709-DRAWINGS

DRAWING No.: P-1709-CNT-401 REVISION: -