

最終課題に関する事後情報

Post information on the final assignment



これは、タイの首都バンコクの都市高速の橋梁で生じた、実際の劣化事例である。This is a deterioration example of real bridges of urban expressway in Bangkok, capital city of Thailand.

社会問題化してすぐに、担当者は現地の複数の大学等の研究機関と連携して、次スライド以降に示す調査、対策を行った。After it became a social problem, the manager immediately carried out investigations and countermeasures shown in the following slides in cooperation with several research institutes such as universities.

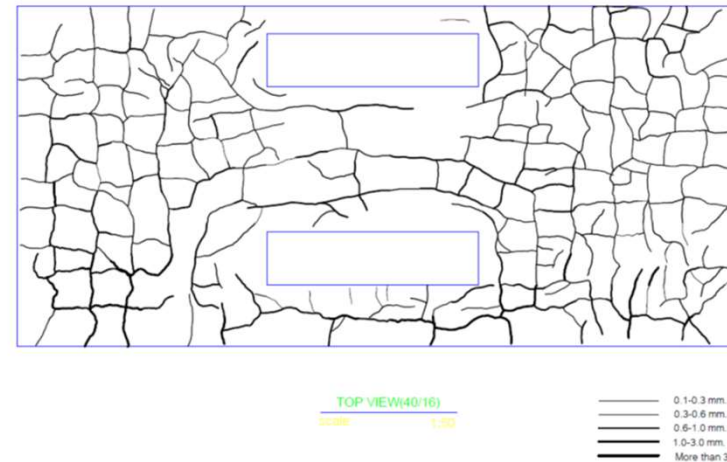
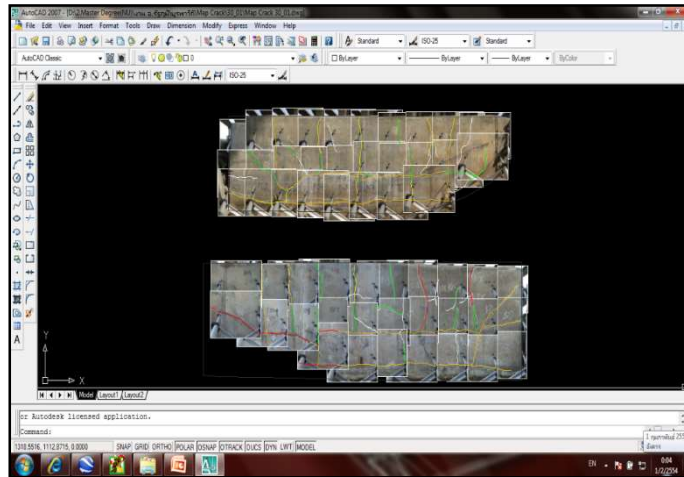
亀甲状のひび割れが生じていたことから、ASRが損傷の原因として疑われた。It was considered that ASR is a cause of the damage because of the random crack pattern.

最終課題に関する事後情報

Post information on the final assignment

1. 劣化状況の詳細調査 Detailed investigation on the damage state

該当区間の橋梁に対して近接目視を行い、ひび割れマップを作成 Crack maps were prepared for bridges in the target region by closed visual inspection.



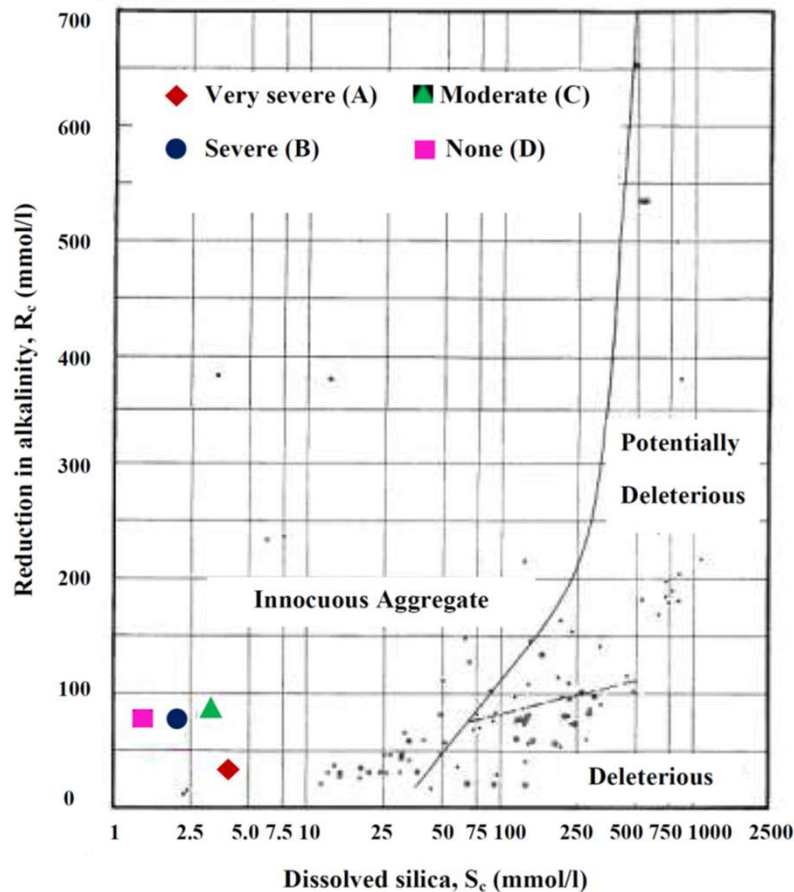
ひび割れの情報(長さの合計など)に基づき、損傷レベルを区分 The damage levels were defined based on the crack information such as total crack length.

Position	Inspection Area (m ²)	AAR Rating	Crack Length (m)					Total Crack Length (m)	Crack Area* (m ²)	Crack Index** (x 10 ⁻² %)
			0.1-0.3 mm.	0.3-0.6 mm.	0.6-1.0 mm.	1.0-3.0 mm.	≥ 3.0 mm.			
29/24	49.500	Moderate	49.10	9.01	0.70	0.64	-	59.45	0.0157	3.2
30/01	56.400	Moderate	61.70	68.90	19.30	11.94	-	161.84	0.0707	12.5
30/07	65.900	Severe	52.48	82.86	26.64	35.65	2.92	200.55	0.1492	22.6
33/02	72.325	Severe	9.00	42.28	34.29	66.01	11.81	163.39	0.2157	29.8
41/10	56.250	Severe	6.39	27.18	20.29	2.00	34.87	90.73	0.1384	24.6
25/17	42.560	Severe	3.65	24.29	51.66	31.18	3.06	113.84	0.1245	29.3
40/16	64.350	Severe	8.20	42.96	63.12	43.58	13.59	171.45	0.1994	31.0
42/23	66.825	Severe	16.95	89.91	24.60	11.75	0.31	143.52	0.0880	13.2

最終課題に関する事後情報

Post information on the final assignment

2. コアコンクリートのASR促進試験による残存反応の推測 Prediction of future remaining ASR reaction by acceleration tests of core samples of concrete



いくつかのサンプルで、今後もASRが引き続き起こるという結果が出た。実構造物に対する点検を継続して行い、経過観察することになった。

In several samples, it was found that ASR reaction continuously occurs in the future. It was determined that inspection of the real structures is conducted in a routine basis.

最終課題に関する事後情報

Post information on the final assignment

3. 実橋梁の載荷試験 Loading tests of real bridges

フーチングの周囲をある程度洗堀し、(安全に影響を及ぼさない程度の)荷重をトラックを積載することで作用させ、変形やひび割れの進展・拡幅状況を調査した。

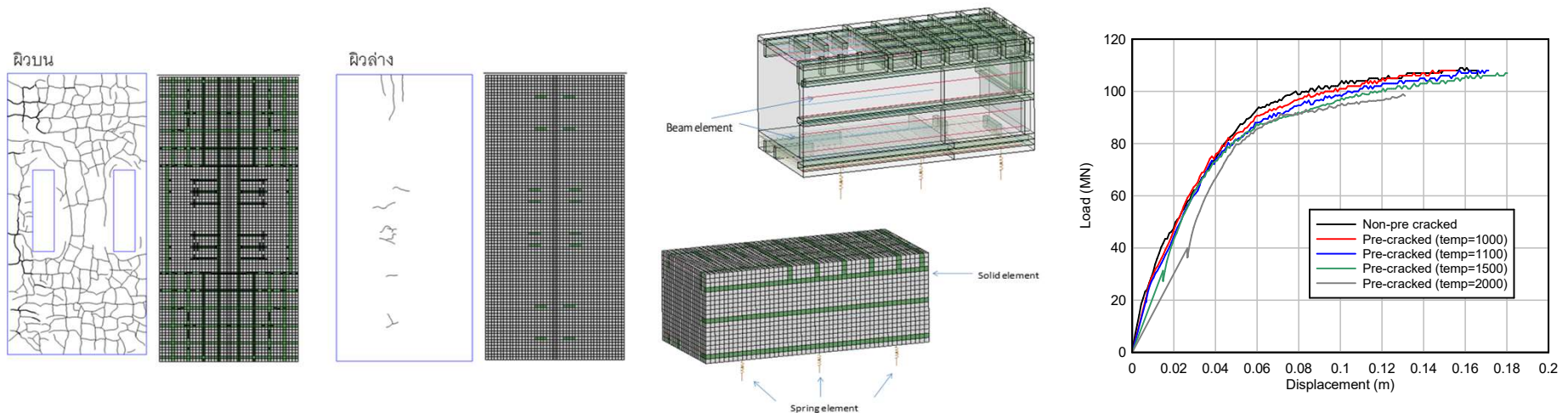
A part of surrounding soil of the footings was removed and load was applied by putting heavy vehicles on the bridge (the load level does not affect the safety), and then deformation and crack propagation was investigated.



最終課題に関する事後情報

Post information on the final assignment

4. 有限要素解析によるシミュレーションを実施 Simulations by Finite Element Analysis were conducted.



実際の構造物に荷重をかけて壊すことはできないため、シミュレーション上で荷重を作用させ、耐荷力などを調査。

Since they cannot collapse the real structures, load was applied to the structure in simulations.

将来に備えて、損傷がさらに進んだケースについてもシミュレーションを実施。

Considering the future condition, simulations were also conducted for the cases that ASR is more progressed.

最終課題に関する事後情報

Post information on the final assignment



以上の検討結果から、下記の方針が定められた。From the investigations, countermeasures were determined as follows.

1. 現時点での安全性に大きな影響はないと考えられることから、大掛かりな補強工事を行わない。Massive strengthening is not conducted because the safety seems to be not significantly affected at the present state.
2. ただし、将来的に損傷がさらに進行する可能性があるため、それを食い止めるための対策として、ひび割れ樹脂注入による補修を行う。However, considering the possibility of further damage progress in the future, as a countermeasure for preventing it, repair of the cracks by resin injection method is conducted.
3. 補修後は、現時点での損傷の有無にかかわらず、定期的な点検・記録を行う。After the repair, regardless of the presence of damages at the present state, inspection and record are conducted in a routine basis.

