Impact of acid precipitation on historical monuments and statues

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n / ;A A

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w A c A;A3127:A w A n c A37;A3127:A AG c A21;A3127 A

A A A w A A c A fA fA A A A ;A A w ;A A

3129A A ;A A A A w A

Abstract

A A fA A fA A An A A A A A fA An n A A A An A A
A A A A ;A ;A A n Av A A A A Aw An A n A n A A fA
A ;A c A n ;A A fA A fA An A fA n Av A A fA A c A A A w n A fA
A A A ;A A A A fA fA A A A A A fA A A A A A A c A
n A w A A A A A n A A A A A A w n A A A A A c A
n A Av ;A fA;A A fA A A A ;A n ;A Aw A ;A n A A A A
A A A c A A An n A A A A A A fA n A c A A A A w A
fA n A c A A A A An ;A n ;A An c A w A A A A fA A A fA A A A
A fA n A A A c A c A A A fA A A A fA A c ;A c A fA A
;A A c A A A A A A fA A A A A A A A fA A A A A fA A
n A fA A A A A w A w A A fA A A fA A A n A fA A A A A
A c A n A A A An A fA A c A A fA ;An n ;A A A A A
;A A A fA A A A A fA A A A An A A n A fA A A A A
A An n A A A n A A A A A n A Aw A An A An A
w A A A A n A fA A A A A A A w A A fA n A A A A A
A w A n n A fA A w A An A fA A A A A An n A A A

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AG A .Gurcan Gurgen;A n A fA n A ;AG A fA ;A A
w ;A1771;A n / ;A A E-mail address:A @ A

1. Introduction

n A An n A A A A w A y Afb A A fb A
 A Afb A fb A n A w A A A A A n A A An n A
 A A A A y Afb A A A n A A A A A
 c A A A A A Afb n A n c A w A w n A A A A
 A n A A A A A A Afb y w A A A Afb Afb A A
 A c A A A A A A ;A A A Ac n A A Ac A A
 w A A A A A A A A A Afb Afb A A A A n c A
 A A Afb A A A w n Afb A A A Afb A A A w A
 fb A A w A A A An n A A Afb n A n n A A
 A A Afb A A A
 A

2. What is acid rain?

y A A A A ;A A n A Afb A A AfbSO₂
) A y A NO_x) A y A A n Afb n A A ;Afb ;A A
 n c A A A A A A An A)H₂O A A n Ac n A
 A A(H₂SO₄) A A A(HNO₃) A A A A A A A
 A A Afb A A A A A Afb ;A ;A / A A A A A
 ;A Afb A A A A n A A A A A fb A A A
 n A) c A Afb ;A²¹9 A A Afb A n A A A A
 w Afb A A A A A A A A A A A w n A A A
 A fb A A A An A nfb A A A A n A A A
 n A A A A Afb A A A A A A A n Afb A A A
 fb A A A2973Ac A c A An A A c A A Afb Afb A A A
 Afb An A A Afb An ;AN ;A A n A) ;A
 2¹93 A w A An A w A A Ac A A A A A A
 fb n A A A Afb Afb A A Afb A A n Afb A A A
 A A A A A A2¹71 A A A A Afb A A
 w Afb Afb A A w A A A A A An Afb j A n A A
 w A A A A Afb n A A Afb A A AG A A A
 A A A Afb A Ac A Ac A A A A A A
 fb A c n Ac AA c A c n A
 A A A Ac A Afb n A A A A A n A Afb A A A
 w n A A A ;A n A A ;A Aw A Ac Afb Aw A A
 A A A Ac A A A A Aw Afb A A n A7 7 A A A
 A Aw Afb A A A A A Afb A An fb Afb Afb A
 A w A A A fb A A A Afb A Aw Afb Ac A5 5 A A A
 Afb An A A Afb AA A w Afb w n A n A Ac Afb
 A A A A A n Ac A A A A A w A A A A A A
 fb A A Afb A A A A A nfb An Afb A A A w n A A A
 n j A w A A A n A A A w Afb Aw A A ;A A
 c A A A A An A A A n A A Ac A w A n ;A
 A A A A A A Afb A c A y A2 A A A A
 c A A2 A A2 3 Afb n A A Afb Afb c A y A A A
 A n A A An A w Afb A Ac j A Afb Afb A A A
 A n A Afb A
 A A A ;A A A A w Afb A w n ;A A A A A
 ;A A A A An A w n A A n A Ac A A A A A
 An c A Afb A A An n A A fb Afb A n A A
 A A A A n A A A ;A A n A A Afb
 An n A A A A w A2111A A A n A n A
 A A n Ac A A Afb A27A A31A A A A n ;A A Afb c A

;A A3129 An Afb A A A An n A A A c A Afb A A)2 ;A3 17 A

A) ;An c ;A n ;A w A A n A wAc A An A A A A
Afb A A A A A A A
n A An An A Afb A A c A A A A A
• A c A A A
• A c A
• A A A A A
• A A A A A A
• A A A A A
• Afb AAw Afb A A y A
A A A ;A A A wAc A y w A A An A Afb A A
A An A A A A A w A A A A A A A A
Afb A A A A A n ;A ;A ;A A A n A
) ;A3127 AN c A A AAw A A An n A wA n A A A A
n c Afb An A A A A A
A

3. The use of marble

A AfbAn c A A A A A An ;A A A ;A A
n Afb A n A ;An w A ;A A Afb A ;A
A A ;A A ;An r ;A c Ac A Afb Afb A j A A n A A
G n ;A A A A A ;A ;A n wAc ;A A A
A n Afb A A ;A3127 A A n Afb n ;A An A n Ac A A A
AC Afb A A A A A A A ;A A A Afb A w A
Afb A A A A Afb An n A A A An c A A
fbAy n Afbn c Ac A A A Afb A A A A
A A Afb A A A n A)3 A AC ;A A A n A A n ;A A
An c A A A A) ;A3127 A fb ;A A An A A A ;A
A A A A A A A ;A Ay n A A A A A A

4. How are these works getting destroyed?

A y A) 2 ;A A A A Afb An A A n A A A
;A A A A A) 3 An A A A Afbn c A A A A
A A n A) 4A3 2 A n A A A A n A A A
w A A ;A A A A ;A A A Afb A n A A An c Afb A
)C ;A3114: A c ;A3124 A A n A A A n A A A A
Afb n An c A Afb A A Ac A A n Afb n A A A
A A A A n A Afb A A An n A A A
A :A w ;A A A A A n A Afb n A A A A
A A w A An n Afb A A A A Afb A A A

5. What can be done?

y A Afb A A Aw A w ;A n A A A A ;A An A
n A Afb A A A A Afb Afb A A A c A A
A A ;A A A A Afb Afb A A An n A A
c n Afb A Afb ;Aw A A Afb A c n AAw An A
An n A Ac Aw Afb Aw A A A A A A A
A An n ;A An A A A n A A c n Ac A A A A
A A A A ;A n A n A A A An c Ac A A
A Afb A Afb A A Ac A A A Afb n A
A A Afb A n An A Afb A A A w Afb A A A A

ffb A A A A A A A A A A A A w A A
 Afb A A A A A A A A A
 A A ;A Afb A A A A .A

- A n A An A A A ;A ;A W A
- n A A n A A A w A A A A A
- A A fb A Aw A n A c A ;A A
- A A A A A A A c ;A Afb A Ay n Aw c A
 fb ;A An A A A A

A

A A A A A A A A A A n A A
 fb n A A A w A A A w Afb A A A fb A A Afb A
 A Ay A A j A nfb A

A

G A A ;A n Afb A A A A fb n A A A .A

- A
- A A
- n A A
- A A

A

5.1. Consolidation

fbw c A A A fb A w A A n n A A A Afb ;A
 ;A ;A Afb ;A A Afb A A A A n w A A
 c ;A ;A A w A A A A c A A Afb A A A A
 A A A A n c A A A n n A fb A A A An A A A
 A A A

5.2. Plastic repair

A A A A A A Afb An A A A n A A Afb A
 A A A A A Afb A A ;A y ;A A A

5.3. Cosmetic repair

A fb A A A ;A n A A A Afb r A A fb A A
 n A A n A ;An A n A A Afb A A A An A
 A A A c A A A y A

A

5.4. Application of the laser beam

A fb An A A A Afb A A A A fb A A
 A A fb A A A A fb An Afb A fb A ;A A A A A
 w An A Afb Ay Afb A A A Afb Afb A A A
 r A A A A A w A A Afb A A A A A A
 Afb w A A A A w Afb A A n Afb A A A
 c A A A An A A
 A A A Afb A A A A A A fb Afb Afb A A A
 fb A A ;An c An n A A ;A A A Afb A A A A A
 A A w Afb A y A A A A A fb A A A A
 A

A

A

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c ;A A3124 A A An j A A fA .A A ;A fA A A Anternational Journal of Scientific Engineering and Technology, 2)9 ;A93 997 A
c ;A ;A&A fA ;A A2119 AExperimental reversal of acid rain effects A A .A A A&A A
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<http://n/21295755/N N 5 C1 W N 5 C1>
N A

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