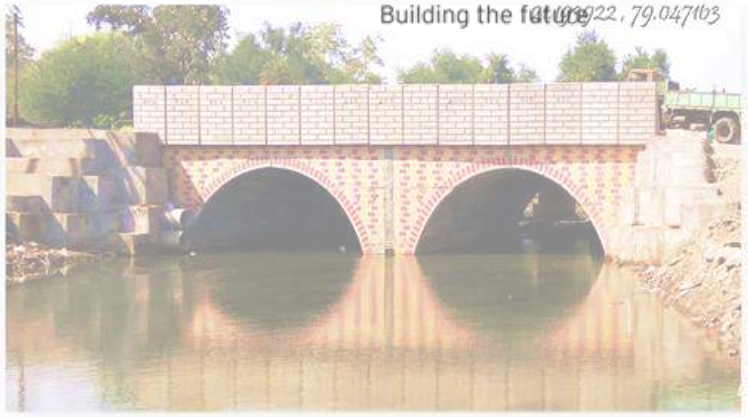
LITHELYARCH® Technology

MODERN ARCH INFRASTRUCTURE

Building the future






LITHELYARCH® Bridge Project

Email: contact@modernarchinfra.com | Mob: +91 99309 79393

MAJOR ARCH BRIDGE, NATIONAL HIGHWAY

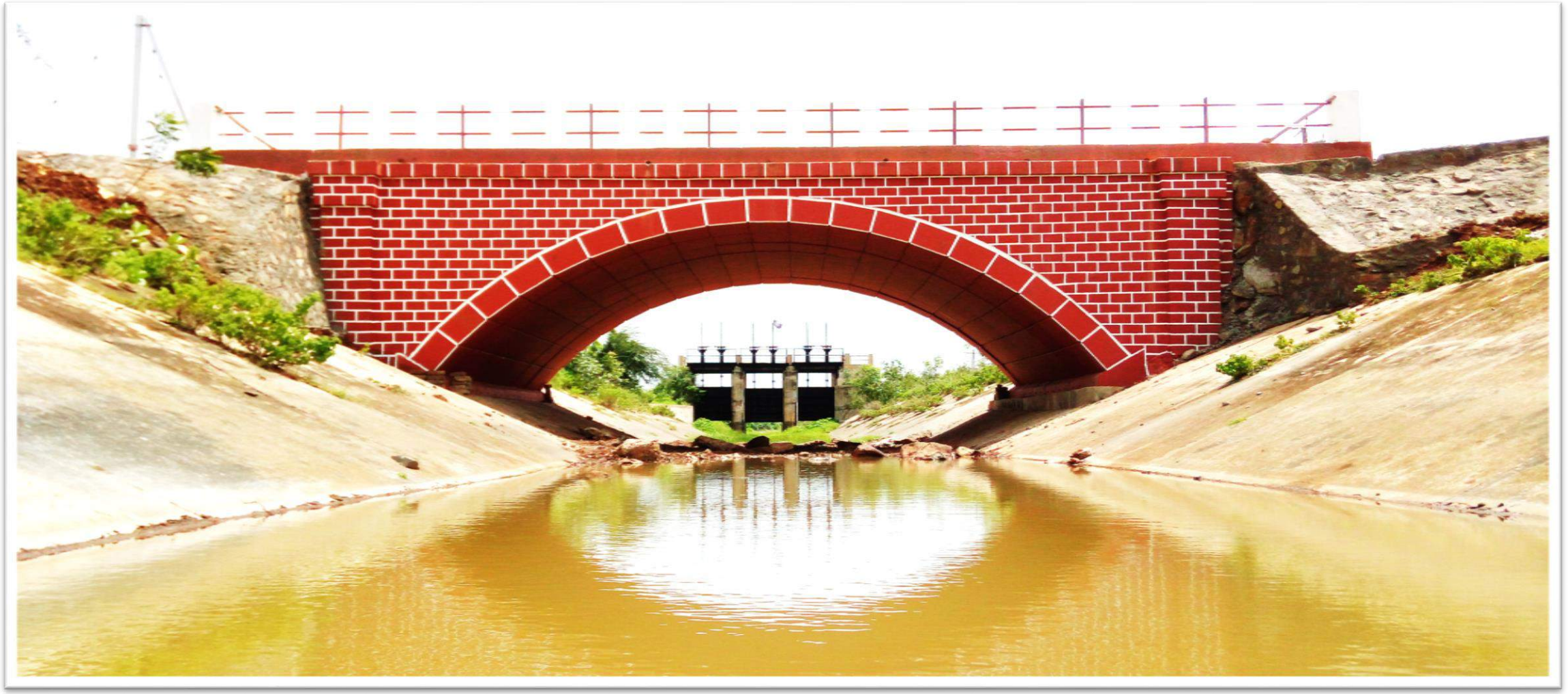
MAJOR ARCH BRIDGE ON KARAD-VITA ROAD (78.69m), NATIONAL HIGHWAY

MAJOR ELEVATED ARCH BRIDGE, PUNE

PWD

MAJOR ARCH BRIDGE TARALI RIVER (118.77m), MAHARASHTRA

Single Span Arch Bridge on Irrigation Canal



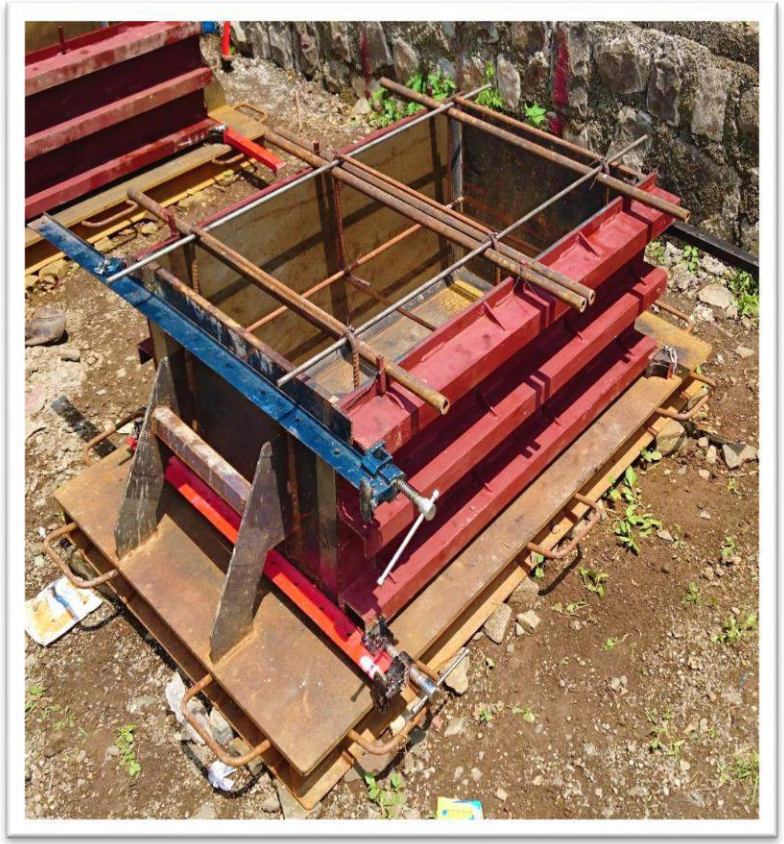
Survive 120 years without any Structural Maintenance

Six Span Arch Bridge

Bridge Length 84m (Submersible Bridge)

PCC Piers & Abutment

Arch Block casting



Concrete Blocks in Line and Level

Wire rope for joining of blocks, ready for screed-concrete.

60mm Screed Concrete

Arch Strips Ready For Lifting After 60mm Screed Concrete.

3-Point Lift

5-Point Lift

Arch strips arrived on Site

Pre-cast Socket to Rest Arch Strips

Socket Placed on Piers

Socket and Arch Placed on Piers

Full Lift of Arch Strip

Full Lift of Arch Strip

5-Point Full Lifting of Flat Arch

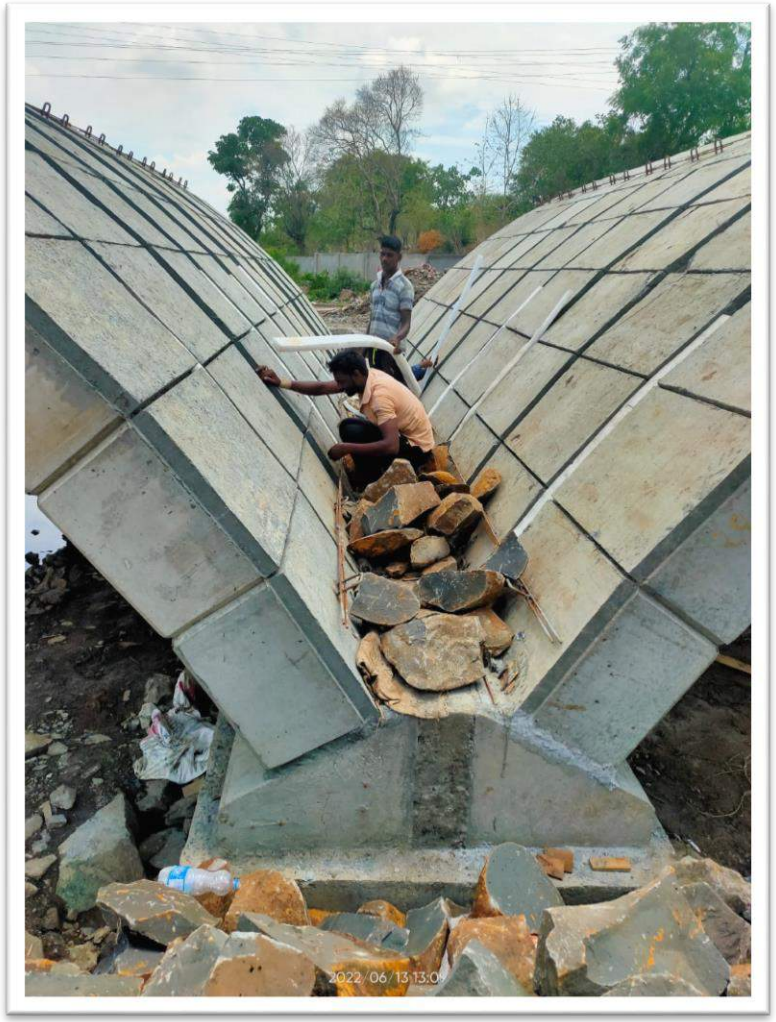
5-Point Full Lifting of Semi-circular Arch

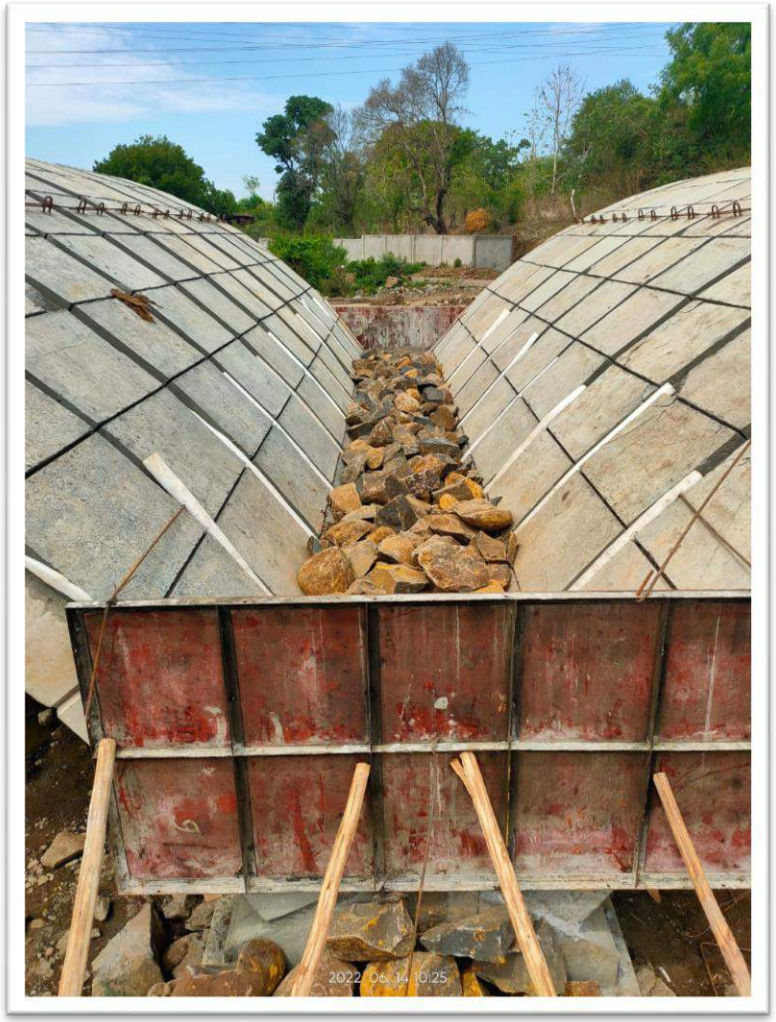
Arch Strip Placed on Socket, Self Stabilized.

All Arches Placed on Socket

Concrete Work as a Spandrel Wall

Concrete Work as a Spandrel Wall





Concrete Work as a Spandrel Wall

Plum Concrete for Backfill (Concrete & Rubble)

Arch Strips in Skew Bridge.

Basic Structure Finished.

Four Span Arch Bridge

PWD PUNE

Fast Construction.

Three Span Elevated Arch Bridge

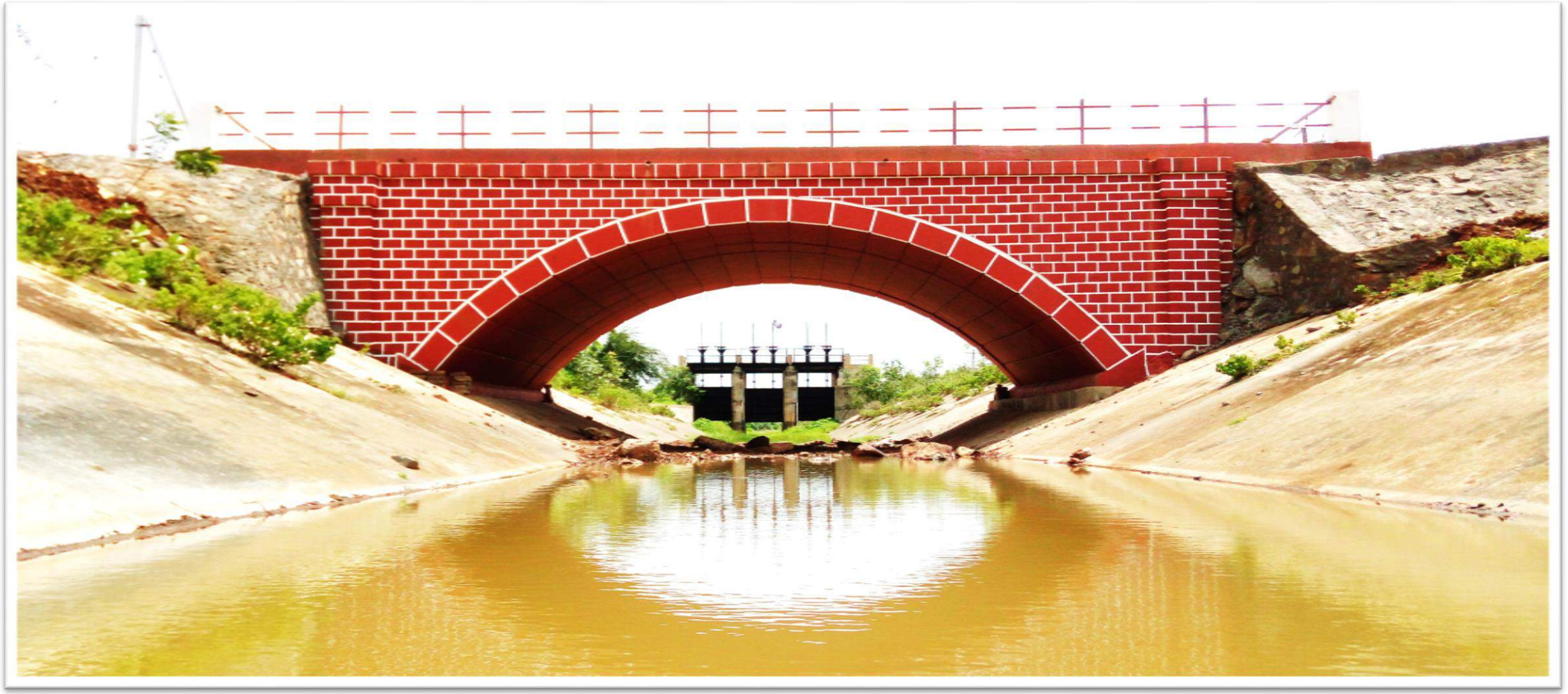
No Steel, No Maintenance…

Two Span Arch Bridge Underpass

Cost Effective than Traditional Slab Bridge.

Single Span Arch Bridge on Irrigation Canal

PWD AMRAVATI



Survive 120 years without any Structural Maintenance

Six Span Arch Bridge

Bridge Length 84m (Submersible Bridge)

MAJOR ARCH BRIDGE, NATIONAL HIGHWAY,

NH

MAJOR ARCH BRIDGE ON KARAD-VITA ROAD (78.69m), NATIONAL HIGHWAY

MAJOR ELEVATED ARCH BRIDGE, PUNE

PWD, Maharashtra

MAJOR ARCH BRIDGE PUNE (118.77m), MAHARASHTRA

LITHELYARCH Bridge for Wildlife Over Pass (WOP)

MSRDC

Samruddhi Mahamarg
(Nagpur-Mumbai Super Communication Expressway)

MAJOR ARCH BRIDGE, MAHARASHTRA

PWD PUNE

LITHELYARCH® for Cut and cover Tunnels

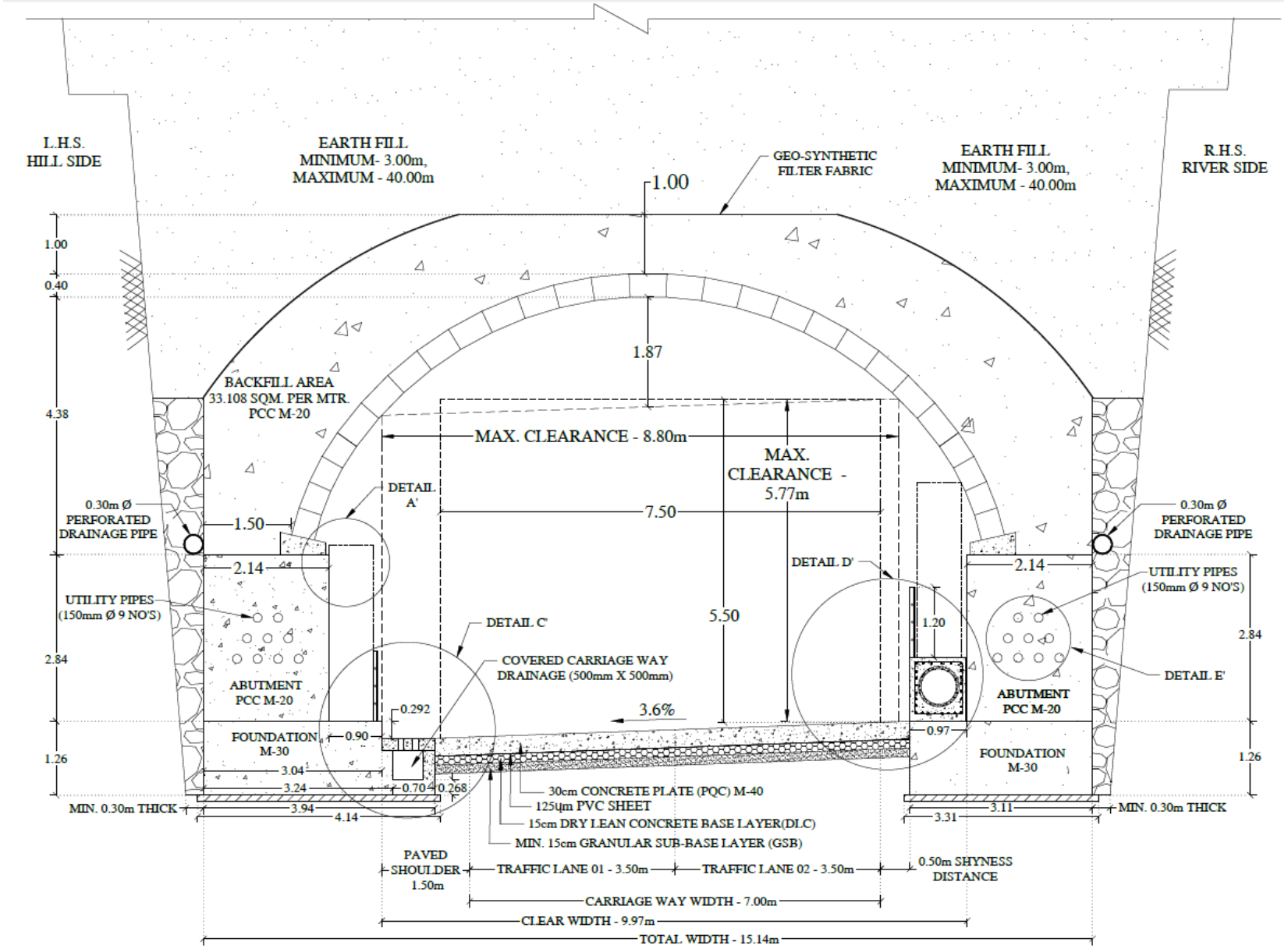
LITHELYARCH® Cut & Cover Tunnels

- **The LITHELYARCH® Cut and Cover Tunnel System is a revolutionary solution to ensure landslide protection and all-weather connectivity for highways in hilly terrains.**

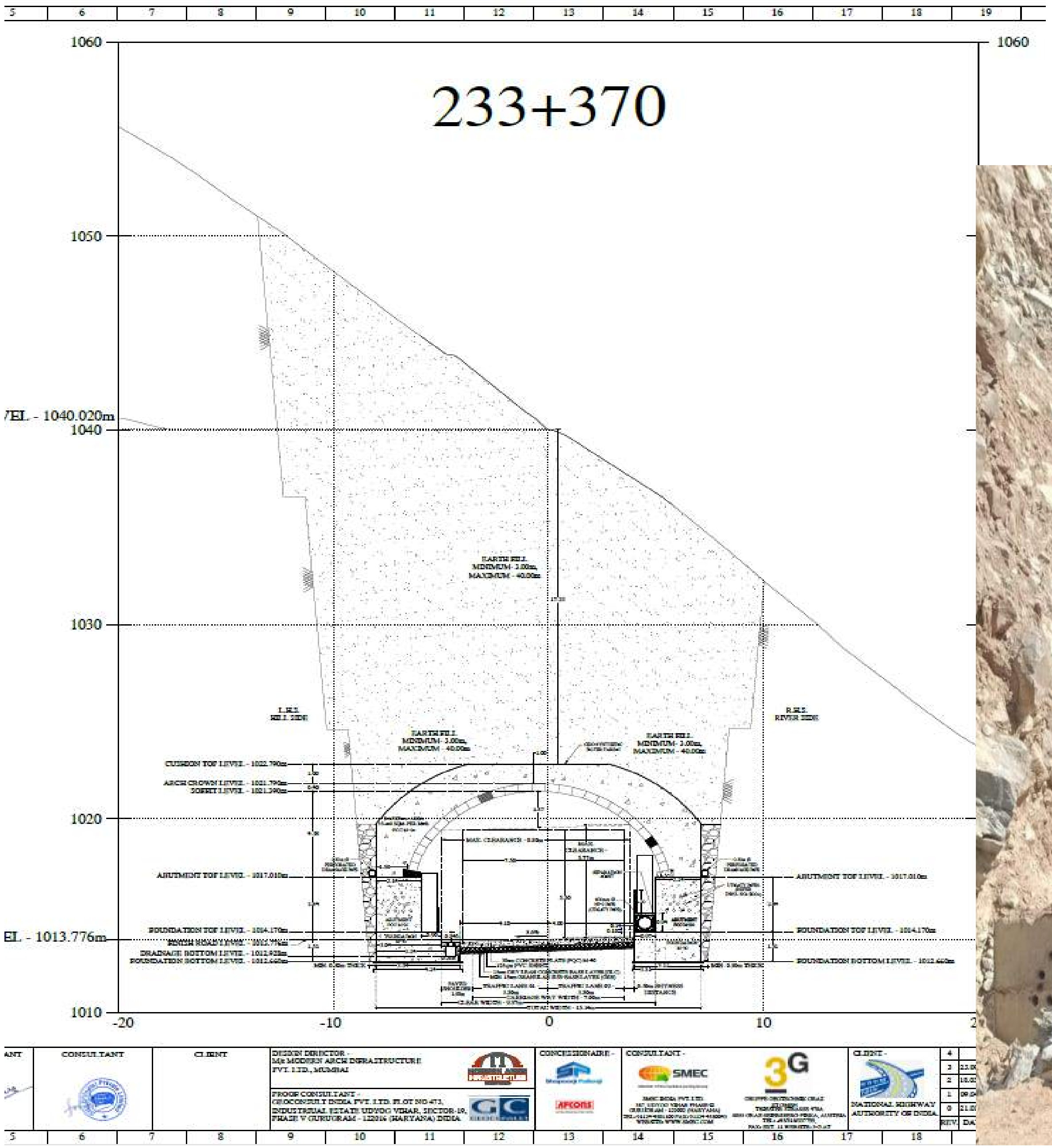
- **The Accelerated Construction system is designed to suit varying carriageway requirements and has no-limit to the amount of fill above the arch.**

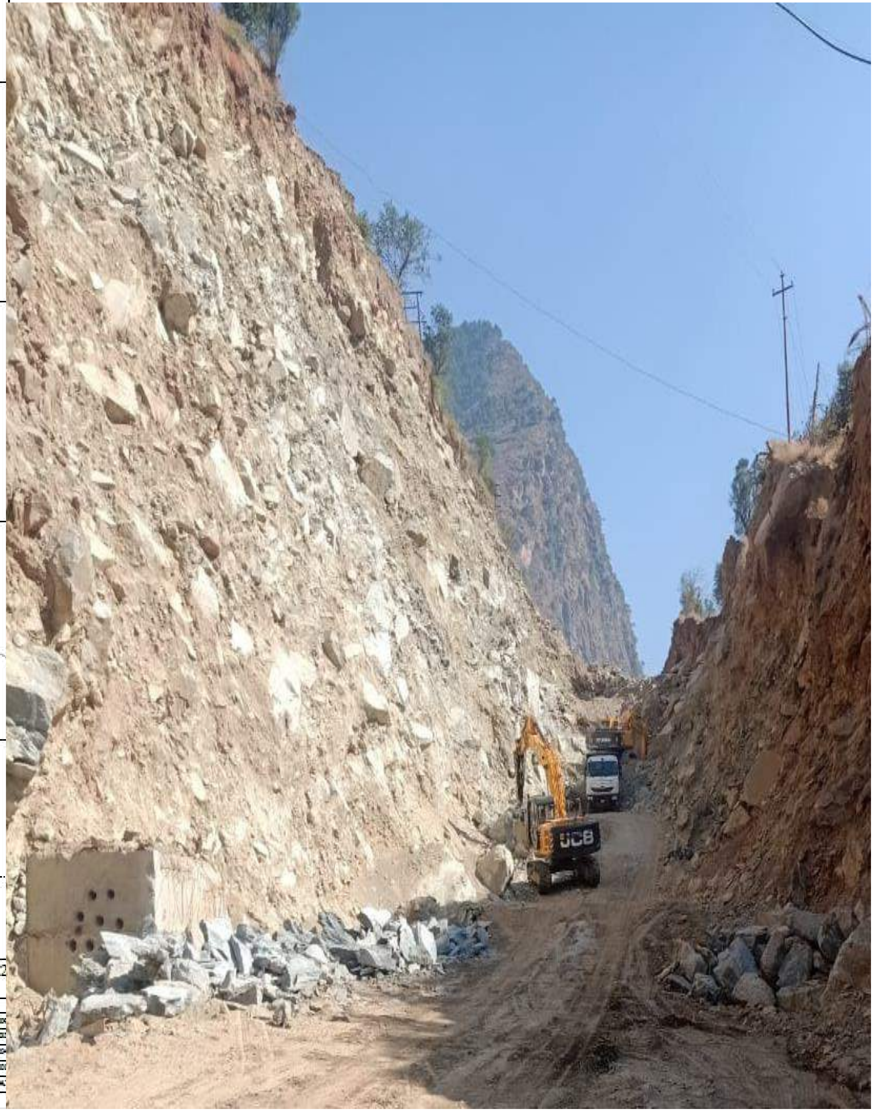
- **The system is already under implementation by the MoRTH in the state of Himachal Pradesh.**

LITHELYARCH® Cut & Cover Tunnels



TYPICAL CROSS SECTION OF ARCH CUT AND COVER


233+370
1060
1050
1040
1030
1020
1010
VEL. - 1040.020m
EL. - 1013.776m
-20
-10
0
10
EARTH FILL
L.H.S.
HILL SIDE
R.H.S.
RIVER SIDE
CONSULTANT
CLIENT
CONCESSIONAIRE -
CONSULTANT -
CLIENT -
SMEC
3G
NATIONAL HIGHWAY AUTHORITY OF INDIA



LITHELYARCH® Cut & Cover Tunnels

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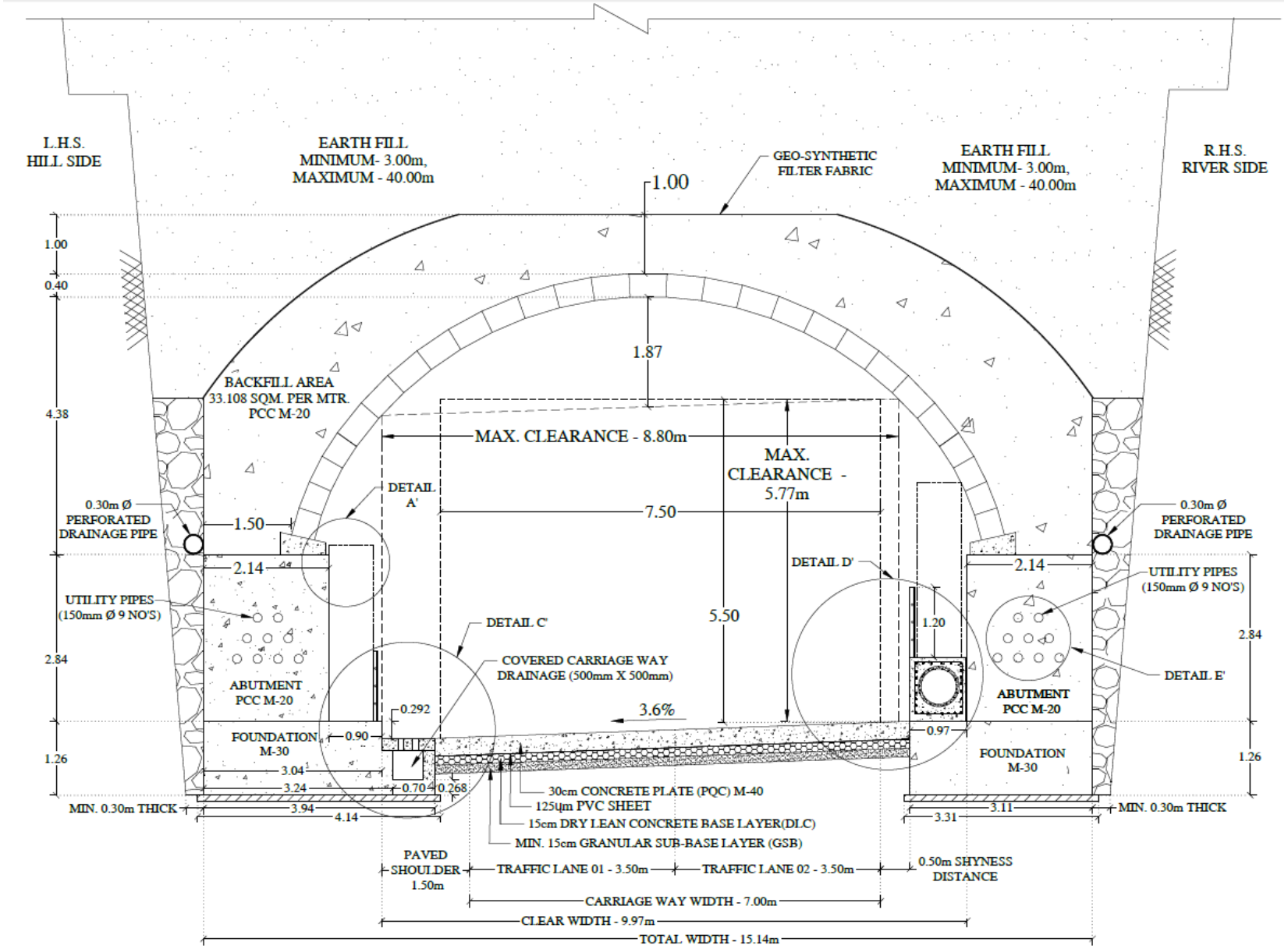
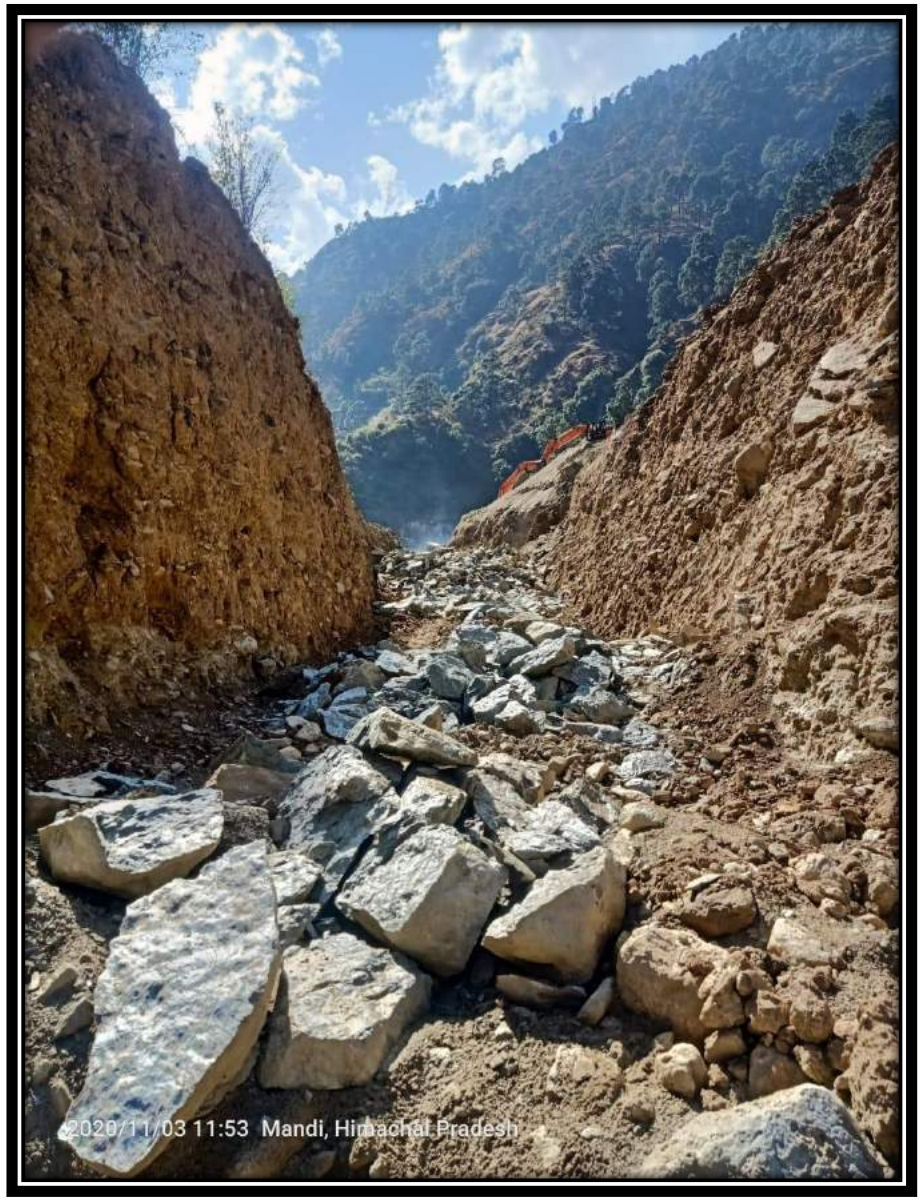
LITHELYARCH® Cut & Cover Tunnels

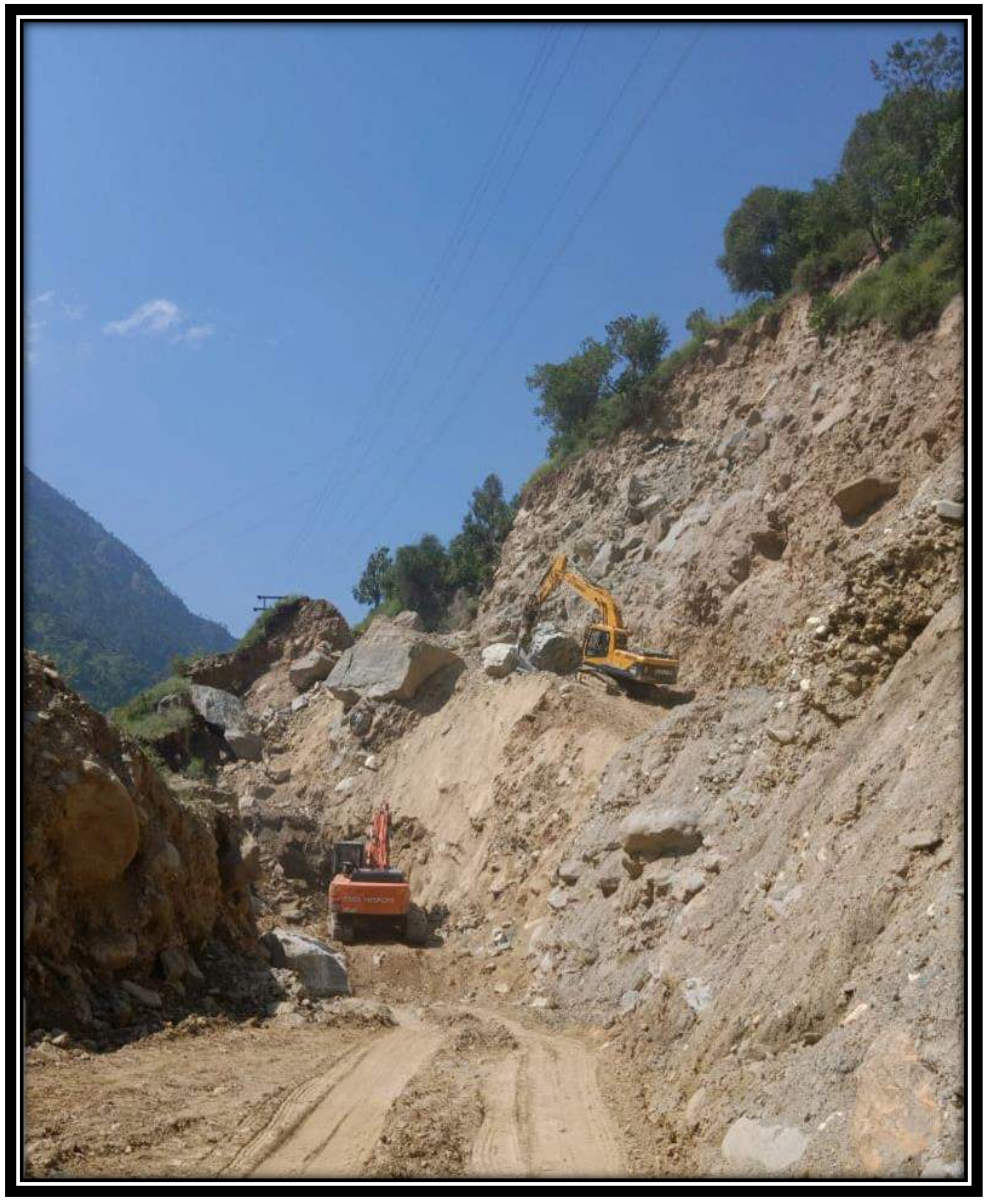


TYPICAL CROSS SECTION OF ARCH CUT AND COVER

Construction of LITHELYARCH®
Cut & Cover Tunnel

1) Cutting of Hill





1) Cutting in Slope

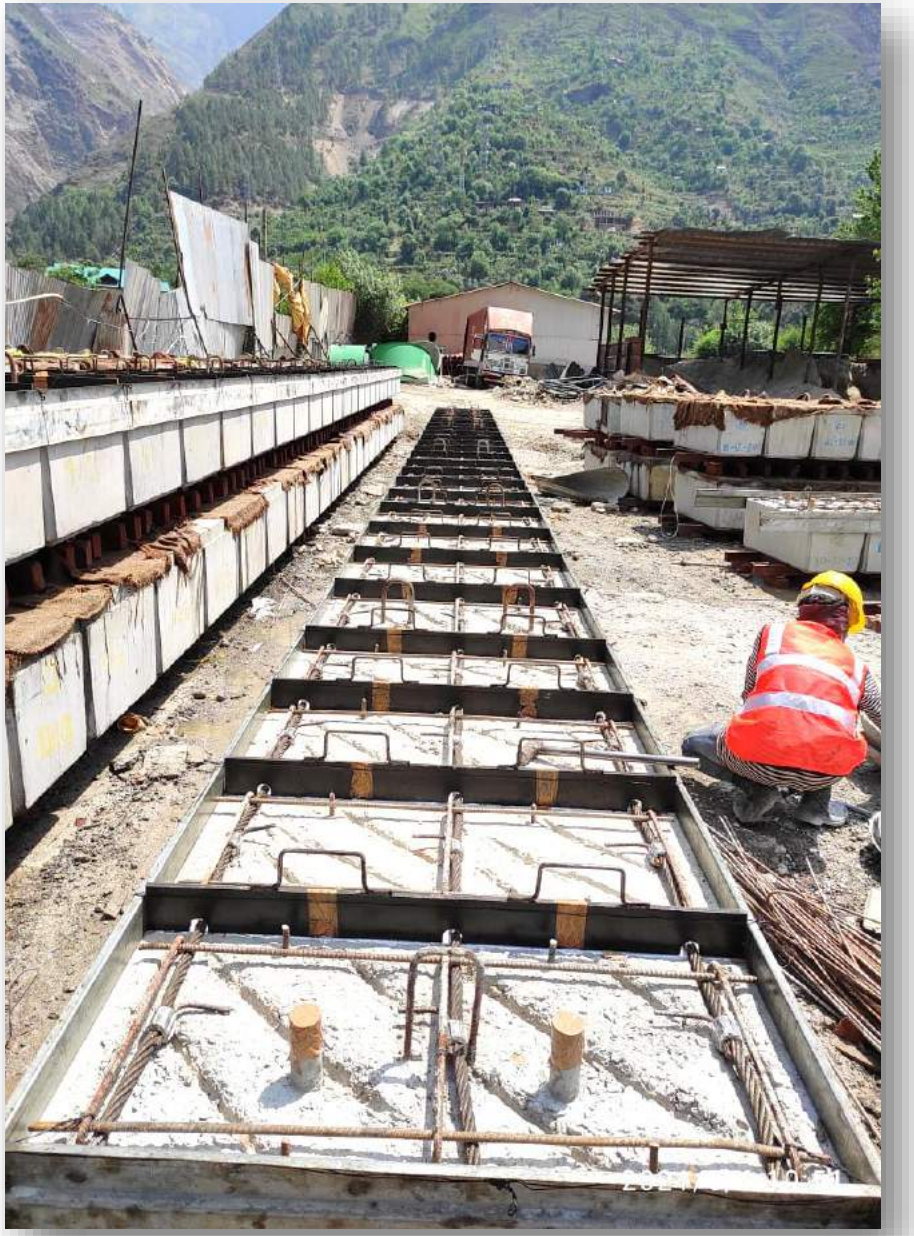
2) PCC Foundation

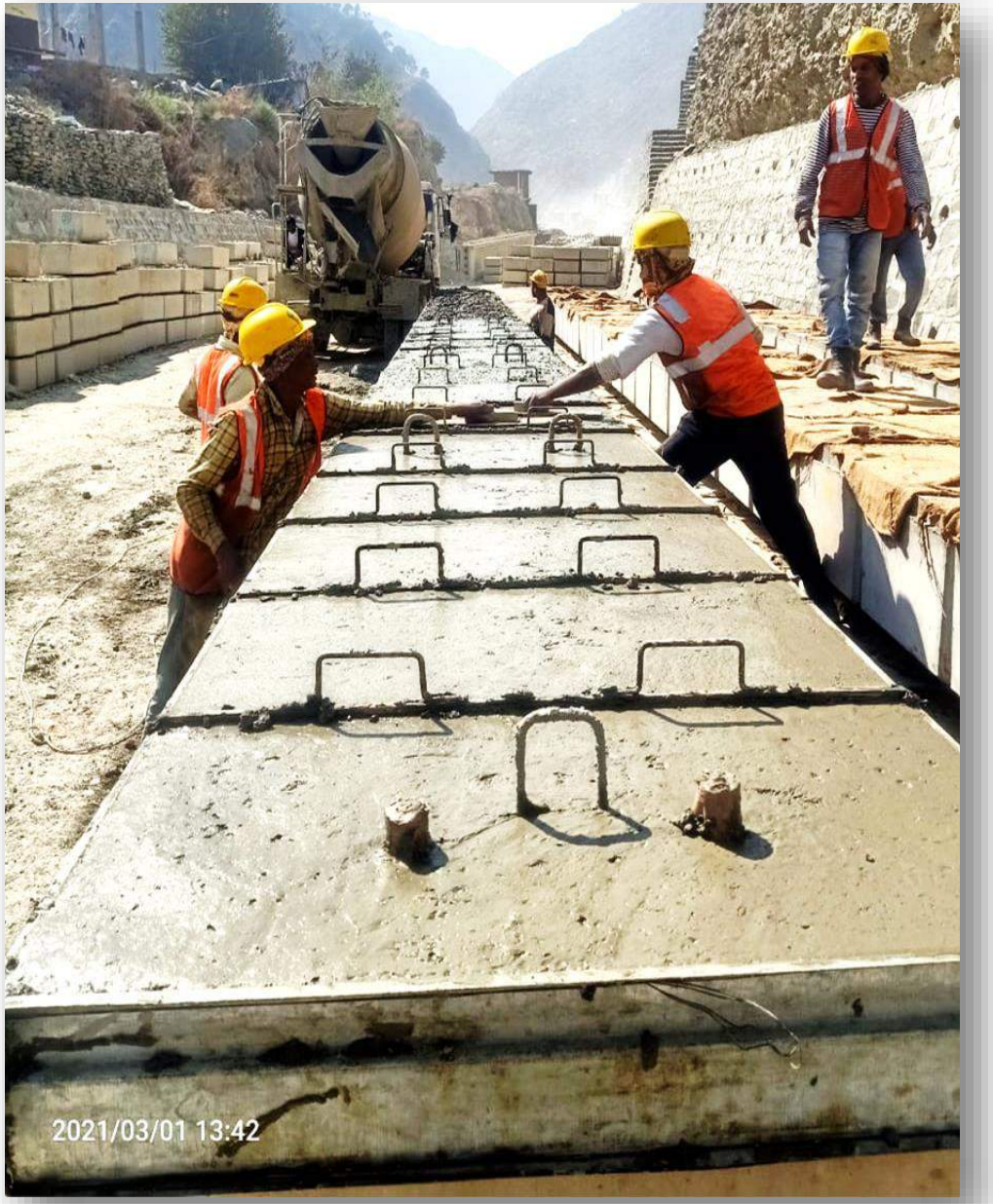
2) PCC Foundations and Abutments

2) PCC Abutments

3) Casting Yard

3) Precasting Activity

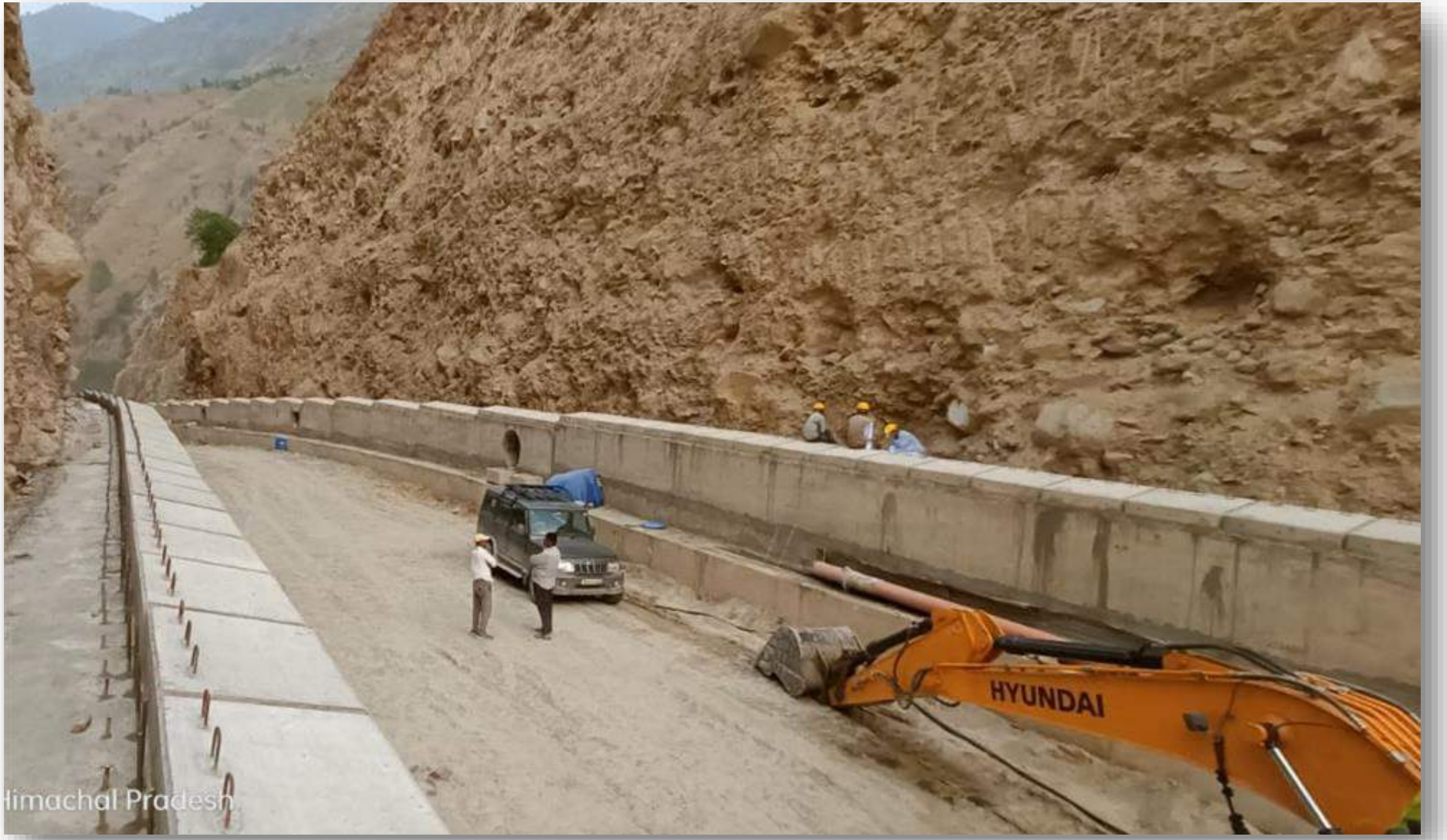




4) Socket Placing on Abutment Top

4) Socket Placing on Abutment

4) Socket Placing on Abutment



4) Socket Placing on Abutment

5) Half Lift of Arch Strips at Casting Yard

5) Half Lift of Arch Strips at Casting Yard

6) Lifting of Arch Strips on site.

7) Lifting of Arch Strips on site.

7) Placing of Arch Strips on Abutments.

7) Placing of Arch Strips on Abutments.

8) Waterproofing above Arch.

8) Backfill above Arch.

8) Backfill above Arch.

8) Backfill above Arch.

9) Finishing work of Cut & Cover .

9) Finishing work of Cut & Cover .

Providing Solutions….

MODERN ARCH
INFRASTRUCTURE
Building the future

Arches are forever..

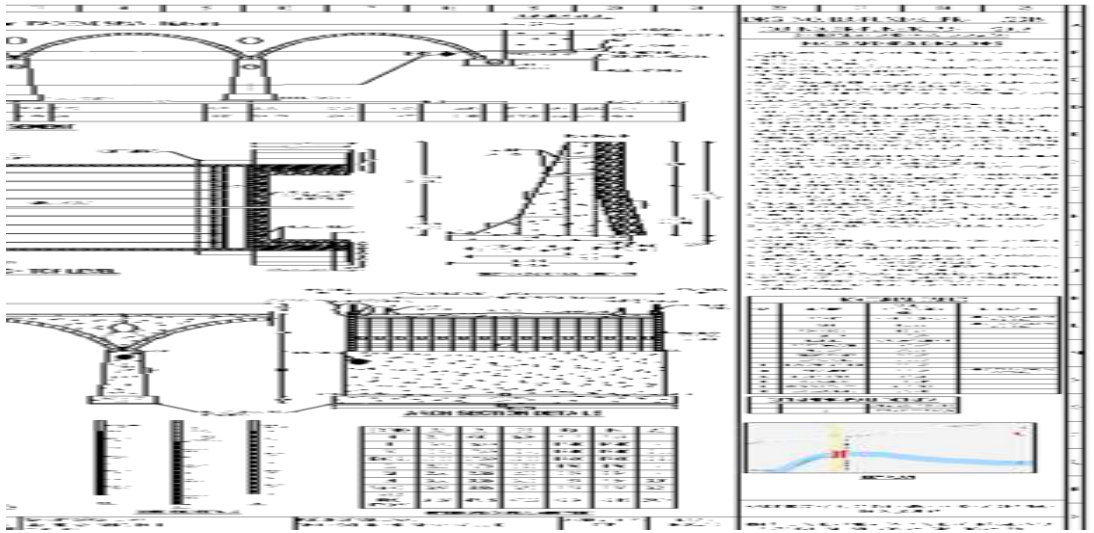
Email: contact@modernarchinfra.com | Mob: +91 99309 79393

Turnkey Services for Infrastructure Clients

As a technology and solution services provider, MAI has closely consulted private and government infrastructure clients over the entire project lifecycle. Our services include:

1. Structural Designing
2. Detailed Drafting and Estimation
3. Tender Preparation (Government clients)
4. Project Planning
5. Project Management

MAI has provided DPR and Consultancy services for over 50 LITHELYARCH® Projects



High Level Bridges

Turnkey Services for Infrastructure Clients

Identifying the need to provide an end-to-end solution to its infrastructure clients, MAI has developed over the last 2 years an in-house team of skilled project engineers, project planners and managers to position itself as a **Design & Build** solution provider for LITHELYARCH® projects.

MAI works as a turnkey solution provider or pre-casting and erection service provider based on the needs of individual clients.

Major River Crossings

Turnkey Execution

- 1 National Highway Major Bridge open for traffic
- 6 State Highway Minor Bridges open for traffic
- 6 State Highway Minor Bridges under construction

Pre-Casting and Erection

- 17 State Highway Minor Bridges executed
- 1 x 370 RMT Cut and Cover under execution
- 1 x Wildlife Overpass under execution

How have we grown

MAI has developed, introduced and commercialised the LITHELYARCH® Technology in India. When incorporated in 2017, MAI positioned itself as a technology service and consultancy company, however having understood the need of the Indian clients for a turnkey solution provider, MAI pivoted to a Design and Engineering model in 2019.

Since then, MAI has gained significant traction from both government and private infrastructure clients and the company is now focused towards geographical expansion of its engineering services and increased investment in new product development

50+ Projects

Design services provided for bridges, cut & cover tunnels and wildlife overpasses

30+ Bridges

Pre-casting and engineering services being provided

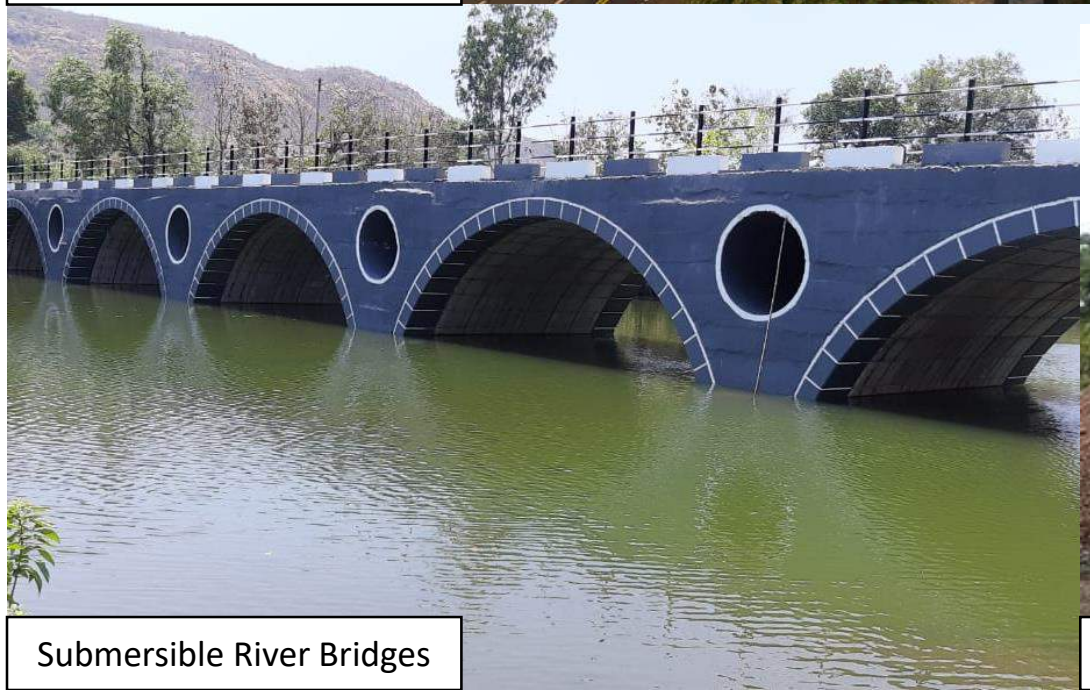
Cut & Cover Tunnels

Implementing India's 1st Pre-Cast Cut and Cover Tunnel in Himachal Pradesh

40+ Members

In-house team of Designers, Engineers and Managers

Wildlife Overpasses



Submersible River Bridges

Vehicular Underpasses

Thank You....

MODERN ARCH
INFRASTRUCTURE
Building the future

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On site cut section for “Cut and cover”

On site cut section for “Cut and cover”

OFFICE OF THE SUPERINTENDING ENGINEER ,
DESIGNS CIRCLE (BUILDINGS),
P.W.DEPARTMENT, 4TH FLOOR,
KONKAN BHAVAN, NAVI MUMBAI 400 614 .

PHONE : OFFICE : (022) 27571328 INTRANET PHONE : 2001003	FAX : (022) 27571559
E-MAIL : brdesgmum.se@mahapwd.com	Website : www.mahapwd.com
Outward No. : SEDC(BR)/ 641 /2017	Date : 11 /04/2017.

To,
Mr. Chetan Pawar.
Arch Infra Pvt. Ltd.
Nagpur 440 010.

Subject : **Approval of Construction Technology for Construction of non-reinforced precast arch Bridge – Lithely Arch Bridge.**

Reference : Your letter dated 20-Mar4ch 2017, Arh/32017NGP-7.

We thank you for presentation on precast arch bridge design and construction method. This office has studied the innovative method of construction of non-reinforced precast arch bridge, also known as Lithely Arch Bridge.

As per detail drawings, estimates, structural analysis and proof load testing reports presented by you, and after detail study of facts and figures this office accept this construction methodology for Arch Bridges not only in urban areas but also in rural and interior parts of state.

We found this technology is cost effective, easy to construct and have numerous advantages like it has no structural reinforcement, eventually minimal maintenance, design and developed for full highway loading with respect to class 70R from IRC-6. Construction time required is much lesser than conventional bridges. Bridges constructed by above mentioned method has similar life span that of conventional stone arch bridges.

This office recommends to all State PWD divisions and all other concerned Departments including Municipalities, Corporations to take the benefit of this technology for construction of bridges. Cost comparison w.r.t. conventional arch bridge due to topography, type of strata, and Hydrology is recommended to get economical benefits.

(S.S. Dhonge)
Superintending Engineer (BR.),
Designs Circle (P.W.),
Konkan Bhavan, Navi Mumbai.

विश्वेश्वरय्या राष्ट्रीय प्रौद्योगिकी संस्थान, नागपूर (भारत) - ४४० ०१०
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY, NAGPUR (INDIA) - 440 010
DEPARTMENT OF APPLIED MECHANICS
Phones : 0712 2801076 EPABX 2222828, 2236330/31/32 Extn.:1076 Fax: 0712-223230,2223969

Ref. No. VNIT/AMD/AYV/1563/1005
0 3 MAR 2017

To,
Mr. Raju Shahade,
Arch Infra, Nagpur

Sub: Proof load testing of unreinforced arch bridge at Gorewada, Nagpur

Ref: Your letter No. Nil Dt. 07-02-2017
Our letter No. VNIT/AMD/AYV/1563, Dated 11-02-2017
Your letter No. Nil Dt. 11-02-2017

Sir,

This is in reference with the above; the proof load testing on the unreinforced bridge has been carried out during 12 - 14, Feb, 2017.

Please find enclosed herewith the report of Proof load testing of unreinforced arch bridge at Gorewada.

Thanking you

Yours faithfully

Dr A K Chatterjee
Dean (R & C)

Dr R K Ingle
Head of the Department

Dr A Y Vyavahare
Assistant Professor

4.1 Percentage Recovery

Percentage recovery of deflection is calculated using the dial-gauge readings recorded after 24 hrs of the unloading cycle.

1. Initial dial-gauge reading = *R1* = 0.00 mm
2. Final dial-gauge reading after placement of test load = *R2* = 1.01 mm
3. Dial-gauge reading after 24 hrs of placement of test load = *R3* = 1.09
4. Dial-gauge reading after removal of test load = *R4* = 0.95 mm
5. Dial-gauge reading after 24 hrs of removal of test load = *R5* = 0.09 mm
6. Total deflection = *(R3 - R1)*
7. Total recovery of deflection after 24 hrs of removal of loading = *(R3- R5)*
8. Percentage recovery of deflection

after 24 hrs of removal of loading $= \frac{(R3-R5)}{(R3-R1)} \times 100 = 91.74\ \%$

4.2 Acceptance Criterion

The criterion of acceptance is based on recovery of deflection after removal of test load. The acceptance criterion recommended for Reinforced Concrete Bridge as per Indian Road Congress Special Publication 51-1999 is used for acceptance.

5.0 Conclusion

The proof load test of arch bridge across Pioli River, Gorewada, Nagpur, is carried out for 70R (track) load including allowance for the impact. Total load is placed on the bridge span for 24 hrs and percentage recovery is calculated. Based on the observations recorded during the proof load testing, following observations are drawn.

1. No visible cracks are observed in any part of soffit of the arch bridge,
2. No excessive deformation or absorbability is observed in any part of test span of bridge,
3. 91.74 % percent recovery of the deflection is observed after removal of 78.60T load placed on the span of arch bridge for 24 hrs, which is greater than minimum percentage recovery of deflection at 24 hrs after removal of test load as per the acceptance criterion recommended in Indian Road Congress Special Publication 51-1999 for Reinforced Concrete Bridge.

This report is related to the actual condition of arch bridge across Pioli River, Gorewada, Nagpur on date 12 - 14 Feb; 2017. The report is being issued on the basis of proof load test results. The Institute will not be responsible for any liability arising out of any unforeseen acts/ reasons beyond control of the Institute.

Dr R K Ingle
Head of the Department

Dr A Y Vyavahare
Assistant Professor

Indian Road Congress (IRC)

TECHNICAL PAPER

LITHELYARCH® BRIDGE - CONSTRUCTION OF PRECAST, UNREINFORCED ARCH BRIDGE FOR MAHARASHTRA PWD AT KOREGAON, SATARA





S.S. Bhonge [1] C.P. Joshi [2] P.M. Kide [3] S.S. Mane [4] C.T. Pawar [5]

ABSTRACT

Arch bridges are one of the oldest forms of bridge construction and have been around for thousands of years. Brick and stone arch bridges have proven to be highly durable as most of them have remained serviceable after hundreds of years.

In contrast, many bridges built using modern materials like steel, pre-stressing tendons and bearings have required extensive repair and strengthening after being in service for a relatively short span of their design life. RCC, beam and slab bridges built around 1970s, even though they had design life of 120 years, have shown signs of deterioration within just 20–30 years and indeed many have already been replaced. In contrast, significant numbers of masonry arch bridges are still in service from thousands of years after being constructed. The development of faster methods of bridge construction, such as reinforced concrete, caused a considerable decline in construction of masonry arch bridge in last 60 years. However, loss of strength due to corrosion of steel reinforcement in RCC structures is a growing concern and resulting in increased expenditure on maintenance and strengthening of structures.

This paper explores the construction of four span, precast PCC arch bridge that have been built for road traffic under a Maharashtra PWD (Public Works Department) at Koregaon, Satara district of Maharashtra state. This paper also discusses the results of proof load test carried out on similar LITHELYARCH® bridge at Nagpur, Maharashtra.

The fast construction, low life cycle cost, no maintenance costs and longer design life of arch bridges over alternative bridge designs were key reasons to incorporate these designs in "Type Plan of Maharashtra PWD" published in 2018.

1. INTRODUCTION

IRC:SP:61-2004 highlights that "The past decade has indicated a somewhat different picture with damages due to extensive corrosion of reinforcement and pre-stressing steel used in bridges. There was general and comfortable attitude (false assumption) that reinforced and pre-stressed elements were more durable." Also " Surveys in America and U.K. also have shown that the cost of repairs or replacement of Reinforced Cement Concrete bridges is often more than the original cost of bridge itself."

India is developing country and spending on infrastructure is all time high, hundreds of bridges are being build every week. We must give a thought on type of structures we are building, spending on its maintenance, its Whole Life Cost (WLC), replacement time and long-term effects of those bridges on nation's economy.

The Public Works Department (PWD) of Government of Maharashtra recommends the use of the precast PCC arch bridges and introduced standard drawings with guidelines for the same in 'Type Plans of Bridges (2018)' also states "Precast PCC Arch Bridges Are Preferred Where Regular Maintenance of Structure Is Not Possible, in Coastal Areas Where Corrosion of Reinforcement is to Be Avoided, Requires Fast Construction and Aesthetic is Primary Requirement."

The development of the arch was one of the most noteworthy events in the history of construction. The attributes of strength, stiffness, durability and minimal maintenance of arch bridges is acknowledged by structural engineers throughout the world. In addition, their aesthetic qualities are universally acclaimed, so much so that there are hundreds of thousands of arch bridges in the world, some over 2000 years old.

[1] Superintending Engineer Design Circle, PWD Maharashtra, Email : brdesgmum.se@mahapwd.com
[2] Secretary (Roads), PWD Maharashtra & President, IRC, Email : sec.pwdroads@maharashtra.gov.in
[3] Secretary, PMGSY, Maharashtra, Email : sec.pmgsy@mahapwd.com
[4] Superintending Engineer, PWD Maharashtra, Email : satara.se@mahapwd.com
[5] Technical Director, Modern Arch Infrastructure, Nagpur, Email : contact@modernarchinfra.com

79th IRC NAGPUR 2018 INDIAN ROADS CONGRESS

Certificate

This is to certify that *Modern Arch Infrastructure, Nagpur* has been awarded *1st prize for best stall in Innovative Product Category* at the "Technical Exhibition" of 79th Annual Session, Indian Roads Congress organized by Public Works Department, Government of Maharashtra held at Divisional Sports Complex Stadium, Mankapur, Nagpur from 22nd November to 25th November 2018.

B. D. Theng
SE, NH, Nagpur
Chairman, Technical Exhibition Committee

Ramesh Hotwani
SE, PMGSY, Nagpur
Local Organizing Secretary

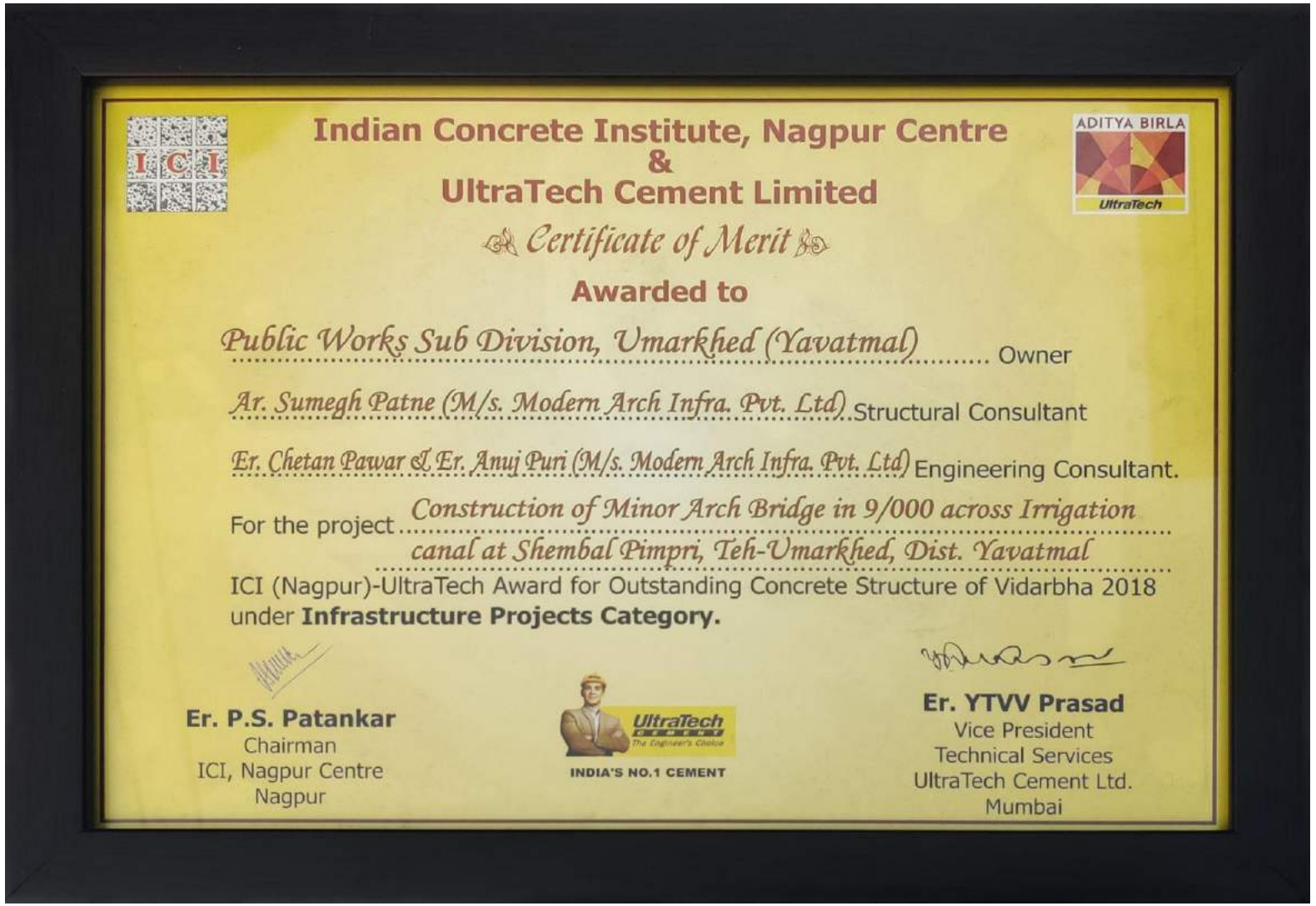
Awards


ADITYA BIRLA
UltraTech
Certificate of Merit
Awarded to
Public Works Sub Division
Umarkhed (Yawatmal)
In recognition of being the Client of the project
"Construction of Minor Arch Bridge in 9/000
across irrigation canal at Shembal Pimpri
Teh.-Umarkhed, Dist.-Yawatmal"
which has been conferred
ICI (Nagpur)-UltraTech Award
For
Outstanding Concrete Structure of Vidarbha Region
Year 2018
Category: Infrastructure Project
UltraTech
The Engineer's Choice
INDIA'S No. 1 CEMENT


India concrete institute
New Delhi Centre
Er. C.T. Pawar
Speaker
CONCRETE 2019
Precast Concrete for Sustainable Construction


ICI (Nagpur)
UltraTech Award
For Outstanding Concrete Structure
of Vidarbha Region Year 2018
Category: Infrastructure Projects
"Construction of Minor Arch Bridge
in 9/000 across irrigation canal at
Shembal Pimpri,
Teh. -Umarkhed, Dist.-Yawatmal"
Mr. Sachin Dikkar
M/s. Aadvann Infrastructure
Mumbai
UltraTech
INDIA'S NO.1 CEMENT

Awards



Indian Concrete Institute, Nagpur Centre
&
UltraTech Cement Limited

Certificate of Merit

Awarded to

Public Works Sub Division, Umarkhed (Yavatmal) ..... Owner

Ar. Sumegh Patne (M/s. Modern Arch Infra. Pvt. Ltd) Structural Consultant

Er. Chetan Pawar & Er. Anuj Puri (M/s. Modern Arch Infra. Pvt. Ltd) Engineering Consultant.

For the project *Construction of Minor Arch Bridge in 9/000 across Irrigation canal at Shembal Pimpri, Teh-Umarkhed, Dist. Yavatmal*

ICI (Nagpur)-UltraTech Award for Outstanding Concrete Structure of Vidarbha 2018 under **Infrastructure Projects Category.**

Er. P.S. Patankar
Chairman
ICI, Nagpur Centre
Nagpur

INDIA'S NO.1 CEMENT

Er. YTVV Prasad
Vice President
Technical Services
UltraTech Cement Ltd.
Mumbai

Certificate of Merit
Awarded to
Er. Chetan Pawar & Er. Anuj Puri
M/s. Modern Arch Infrastructure Pvt. Ltd.
Nagpur
In recognition of being the Engineering Consultant of the project "Construction of Minor Arch Bridge in 9/000 across irrigation canal at Shembal Pimpri Teh.-Umarkhed, Dist.-Yawatmal" which has been conferred ICI (Nagpur)-UltraTech Award For Outstanding Concrete Structure of Vidarbha Region Year 2018 Category: Infrastructure Project

INDIA'S No. 1 CEMENT

Ribbed Arch

Office Team

Site Team

Thank You…

MODERN ARCH
INFRASTRUCTURE
Building the future

Email: contact@modernarchinfra.com | Mob: +91 99309 79393