WORLD BANK GROUP

Summary of **Outcomes**

Consultancy Services for Vulnerability Assessment & Prioritized Investment Plan for Critical Assets in Dhaka **(S-4)**

PROTEK-YAPI® Engineering Consultancy

NKY

SHELTECH

August ***2022***

Contents

Project **Description**

In recent years, Bangladesh has reformed its approach to natural disastrous events like cyclone and flood. The threat of an earthquake, however, is less visible but significant given that Bangladesh lies on the seismically active zone of Indian plate.

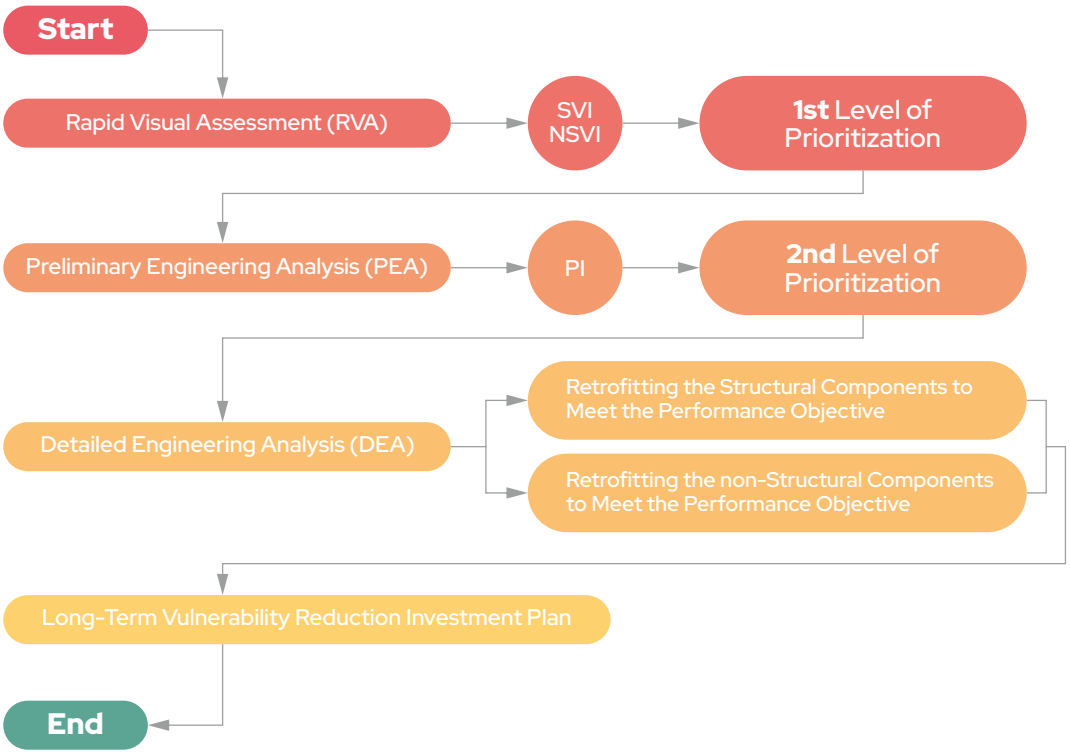
The project's general goal is to empower RAJUK, and stakeholders with knowledge to create an environment for promoting higher standards and ethics for construction and development through understanding of hazards, vulnerability and risk of Greater Dhaka with technologies that enable spatial visualization and data sharing.

1 Introduction

Summary of **Outcomes**

The S-04 project is a very specific project that aims at the hearth of Dhaka resiliency, which is upgrading and retrofitting of the vulnerable existing buildings. This is also the most important component of any effective Disaster Risk Reduction (DRR) program. The main objective of the project is to derive technical data of buildings and estimate their expected performance and plan for retrofitting them to save lives and reduce the risk of injury and fatality in future earthquakes.

To achieve this goal, 3252 important buildings composed of 5.3 million square meters, have been surveyed using the Rapid Visual Assessment (RVA) methodology through a specially developed Android/Apple based application. Then by a prioritization methodology, 578 of those buildings, composed of 1 million square meters went through Preliminary Engineering Analysis (PEA). The objective of PEA was, first to develop a ranking system for a given population of building stock considering both the technical and financial issues; then to prioritize the buildings according to prioritized index that is consisting of both the technical and cost considerations. Finally, 187 of the buildings, composed of more than 0.4 million square meters are went through in-depth Detailed Engineering Analysis (DEA). At the end, the long-term investment plan is developed based on a sound, reliable and comprehensive approach, using valuable field data. The road map of S04 Project is demonstrated here.



2 Developing Methodologies

In order to achieve the targets of project, at the initiation, RVA, PEA, DEA, RVA based Prioritization and PEA-Based Prioritization methodologies were developed.

- Structural & Non-Structural Vulnerability Index Methodology
- Manual of Application " PY-RVA-URP"
- RVA-Based Prioritization Methodology for Public Buildings
- Preliminary Engineering Assessment & Analysis Procedure for Prioritized Public Buildings
- Detailed Engineering Analysis Methodology for Dhaka Critical Facilities

3 Rapid Visual Assessment

Summary of **Outcomes**

1. Define the goals & objectives of the RVA program & how the results will be used

2. Select the Program Manager & the Supervising Engineer

3. Define the scope of the program and develop the budget

4. Perform Pre-Field Planning

5. Select & Modify the Data Collection Form

6. Select & Train the Screeners

7. Acquire & review of pre-field building data

8. Review Existing Construction Drawing , if available

9. Perform field screening of building

10. Check the quality of screening data

11. File the screening data in the record -keeping system

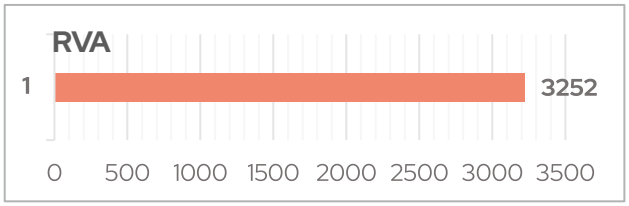
12. RVS results available for the RVS authority to use for decision making

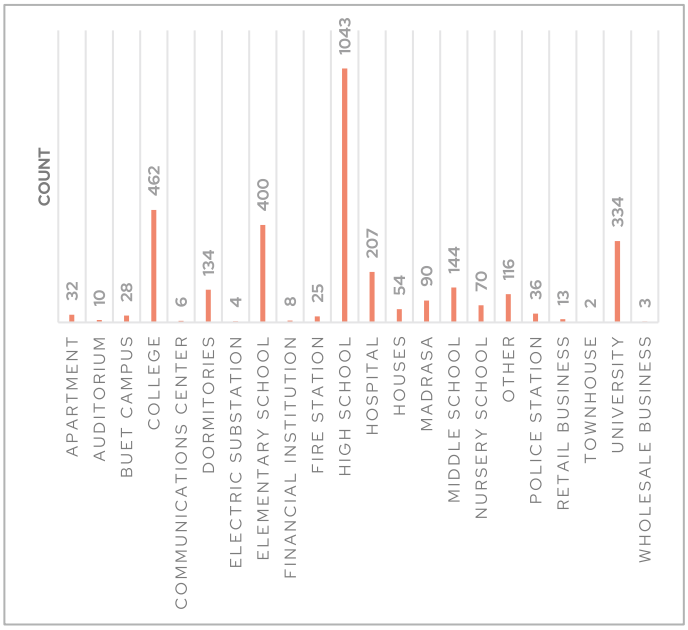
3 Rapid Visual Assessment

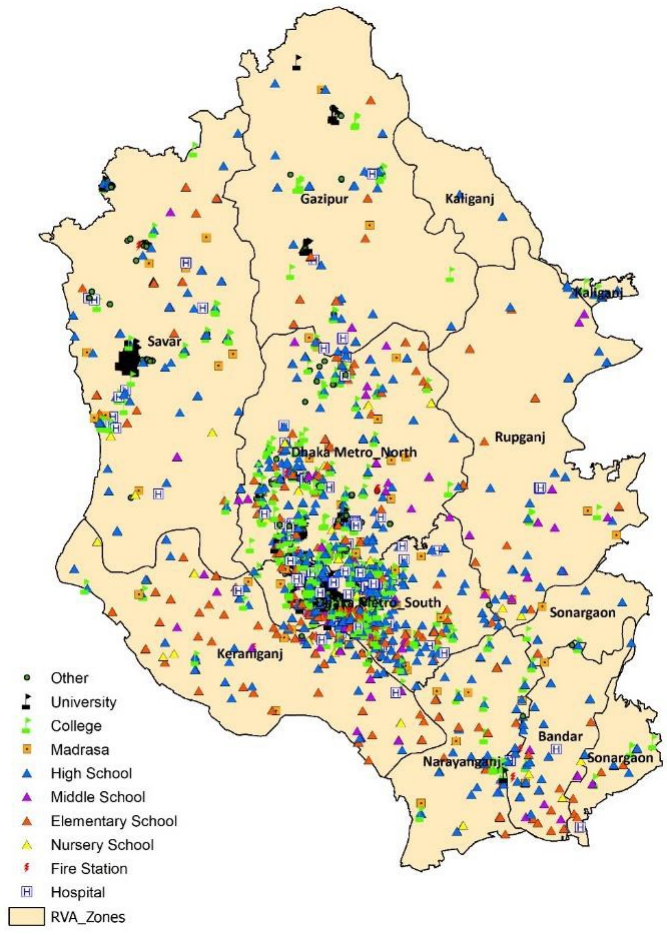
Summary of **Outcomes**

3.1 Distribution of Buildings in RVA Stage

The numbers and distributions of buildings in the RVA stage are depicted in the following figures.



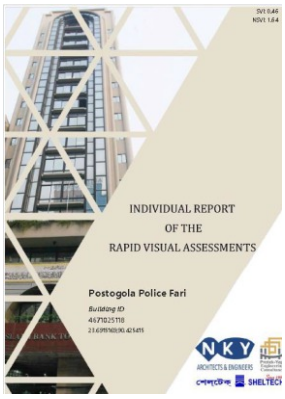


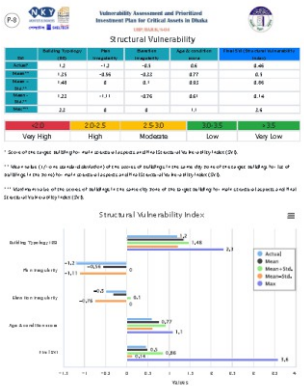


3.2 Using Application for RVA

For facilitating the RVA process of 3252 buildings, we used an android-based application.

3.3 Individual Report





The application was capable of developing an individual report in which all structural and non-structural scoring is addressed.

3.4 Prioritization Method

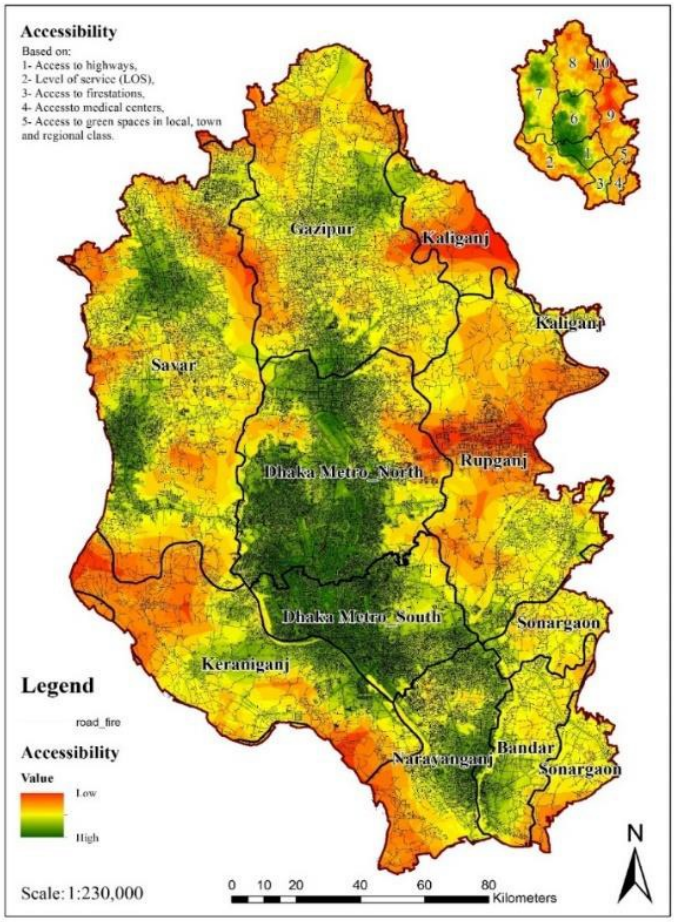
For the sake of prioritization, not only the structural vulnerability index is used, but also the non-structural features are employed.

Building Vulnerability (VS)
- Structural Vulnerability Index
- Non-Structural Vulnerability Index

Building Importance (BIS)
- Number of stories
- Size
- Functionality

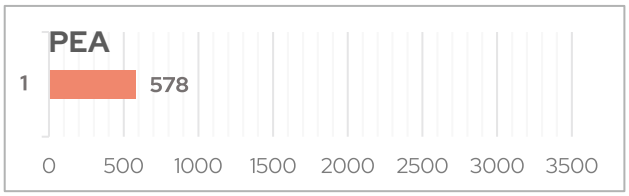
Urban Context (UCS)
- Location
- Accessibility
- Usage during EQ.
- Shelter
- Uninterrupted operation

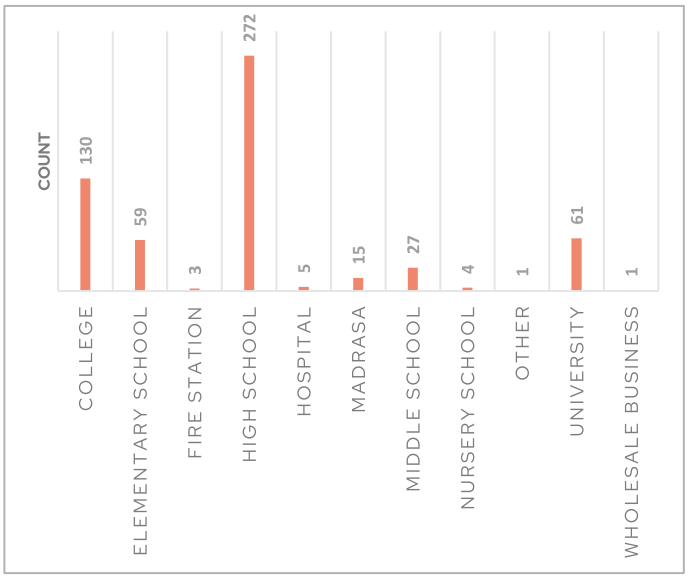
Economic Impact (EIS)
- Financial loss
- Economic consequences
- Loss of life
- Down-time/Business interruption

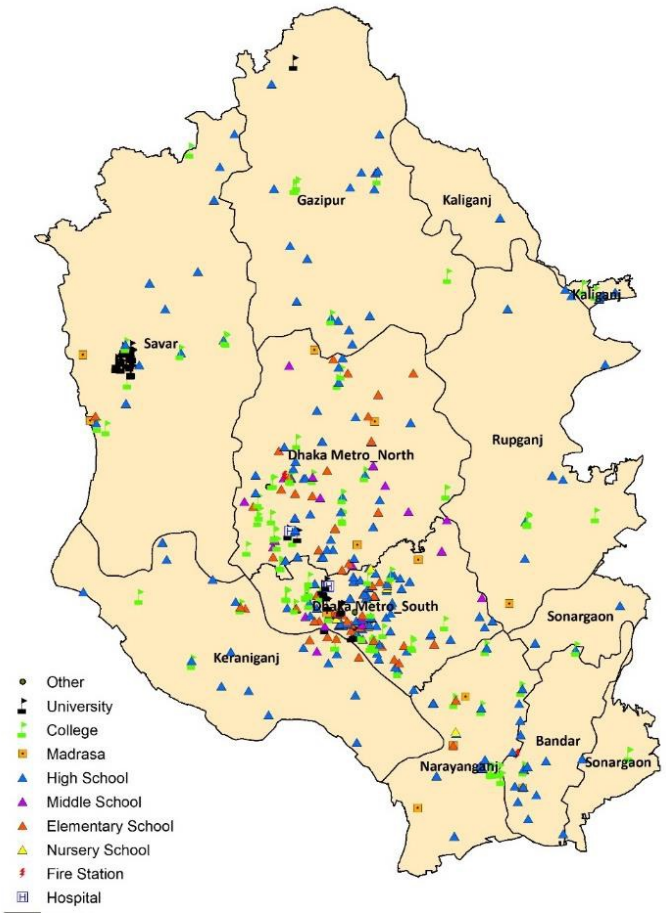


3.5 Prioritized Buildings for PEA Stage

The numbers and distributions of buildings prioritized for PEA stage are depicted in the following figures.

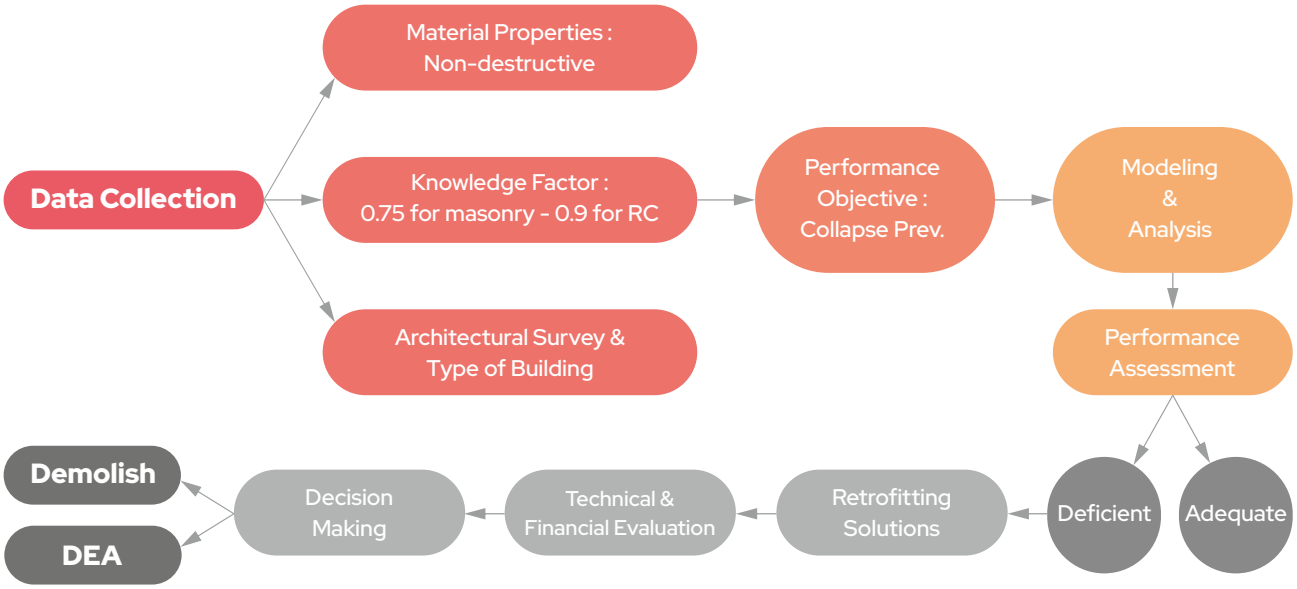






4 Preliminary Engineering Analysis

Summary of **Outcomes**



4.1 Survey

The configuration of building as well as the material strength is collected through non-destructive tests.

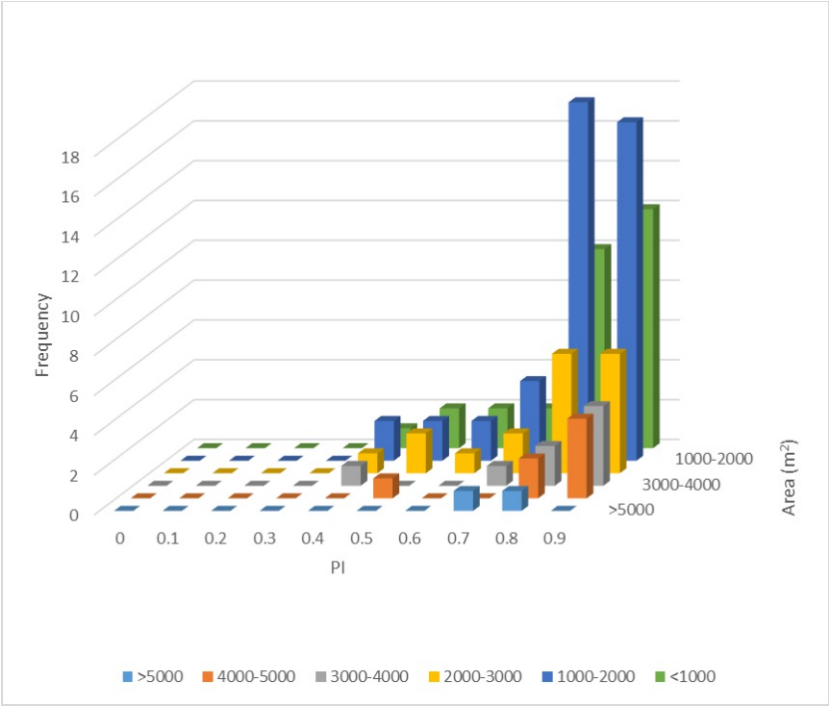
Table: Estimating Compressive Strength of Concrete using the Correlations.

Sl. No.	Member	Level	Member ID	Average Ultra pulse Velocity (UPV), m/s	Compressive Strength (Mpa)
UPV-1	Column	GF	B-10	2707	25.2
UPV-2	Column	GF	D-9	2465	21.6
UPV-3	Column	GF	D-8	2555	22.9
UPV-4	Column	GF	A-4	3024	31
UPV-5	Column	GF	C-5	2845	27.6

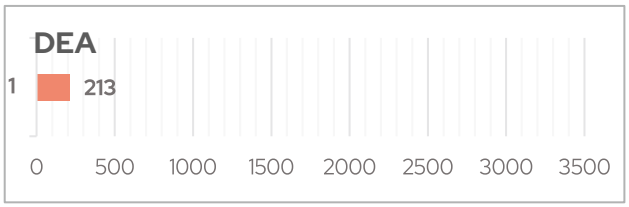
4.2 PEA-Based Prioritization

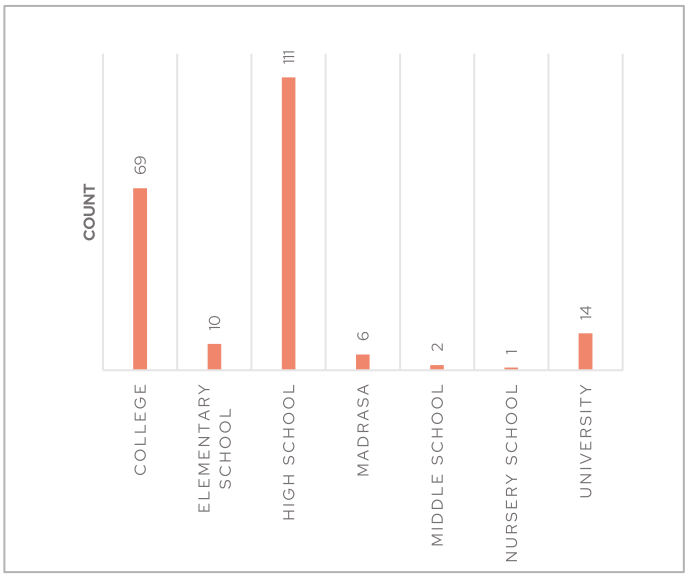
Based on the Prioritized index, the buildings are prioritized for DEA stage.

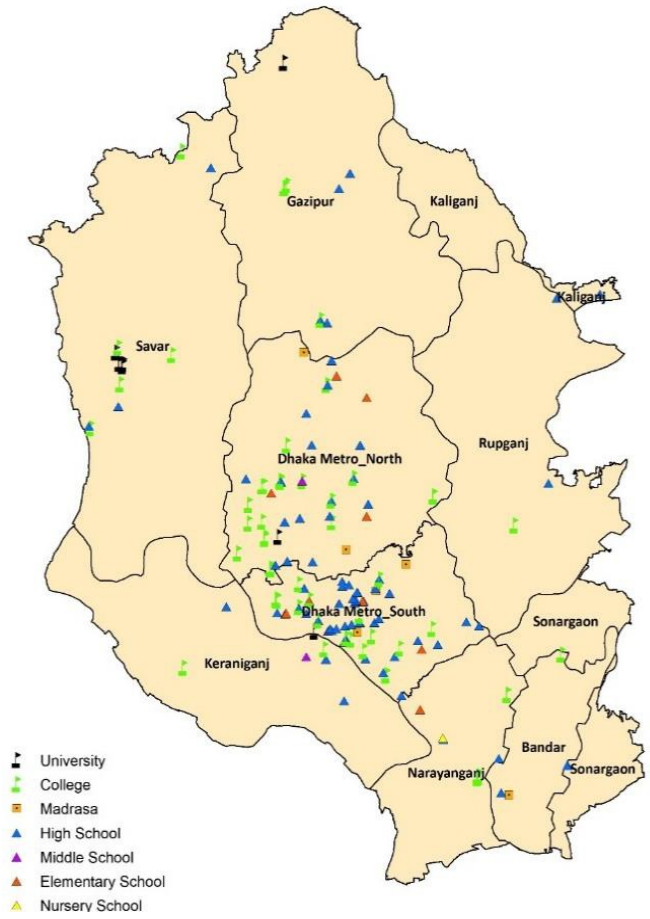
- Prioritization Index (PI)
- Covering Most Critical Buildings with Different Characteristics
- Definition of Different Bins
- Extraction of Distribution of Buildings
- Identification of Eligible Buildings Keeping the Original Distribution Based on the Facility Oriented Concepts



4.3 DEA Prioritized Buildings



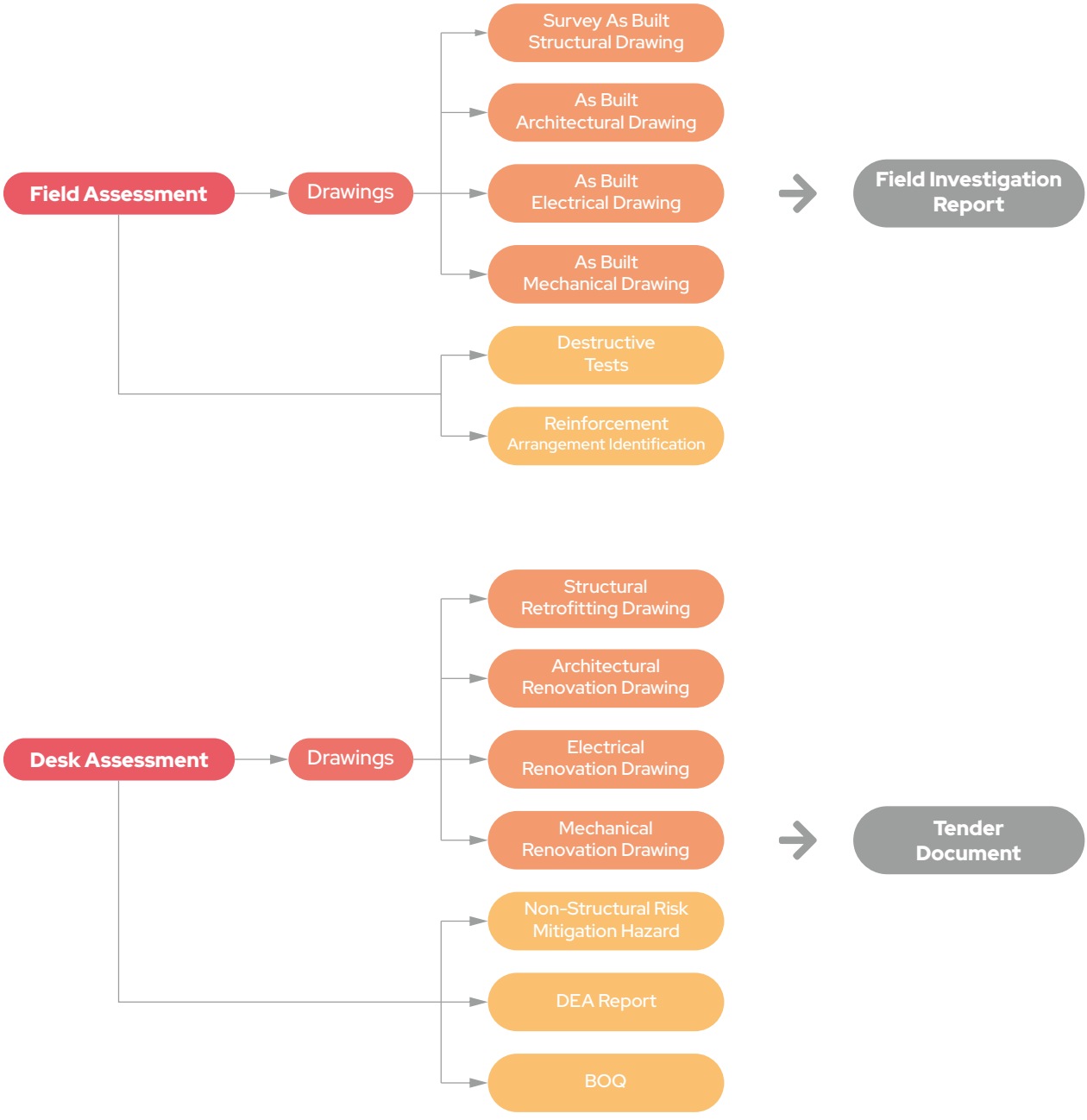




5 Detailed Engineering Analysis

Summary of **Outcomes**

The overall process **(DEA)** is depicted here.



5 Detailed Engineering Analysis

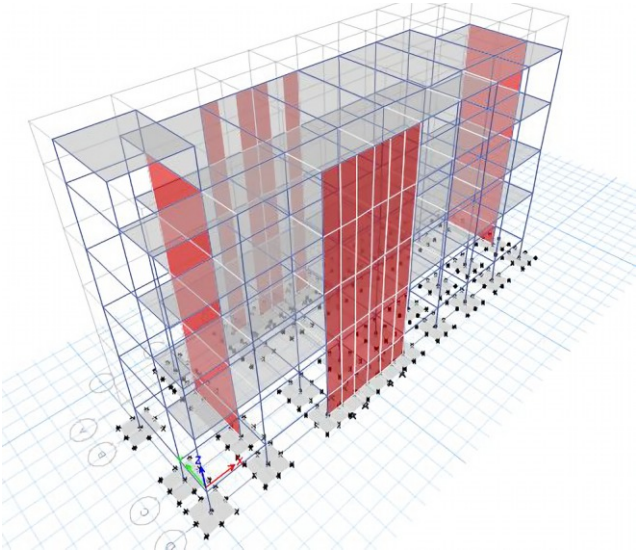
Summary of **Outcomes**

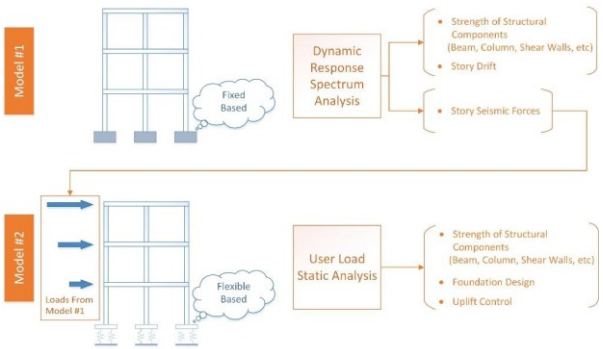
5.1 Survey

The configuration of structure has been surveyed and the destructive tests for material strength have been performed.

5.2 Detailed Assessment of Structure

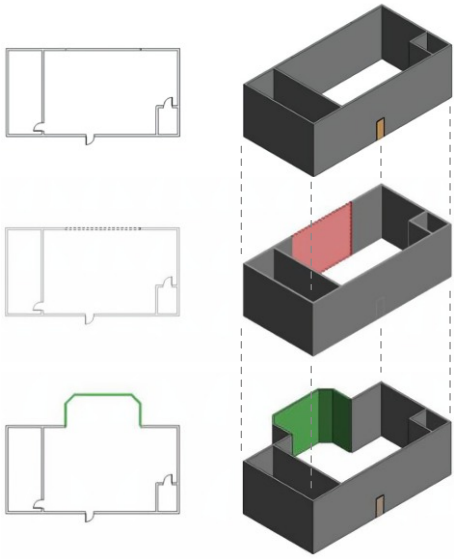
The approach is shown here. the fixed based and flexible based are employed.





5.3 Renovation in Revit

The Revit software is used for the 3d modeling.



Existing Building

Existing Element
Phase Created : Existing
Phase Demolished : None

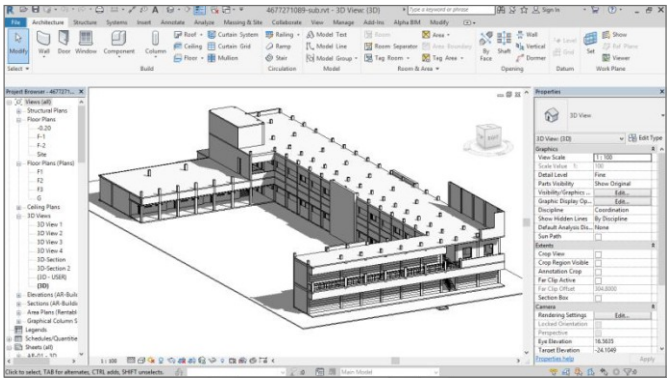
Modification

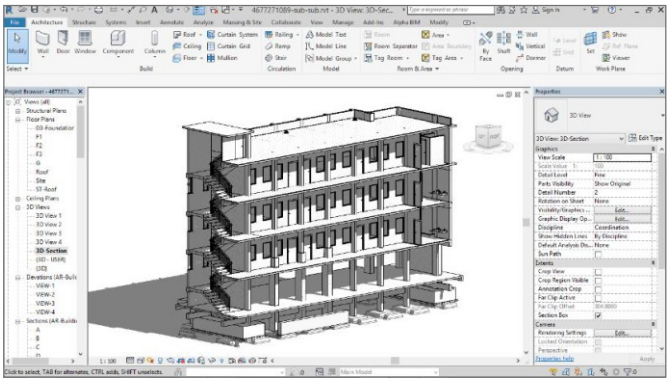
Demolished Element
Phase Created : Existing
Phase Demolished : New Construction

New Construction

New Element
Phase Created : New Construction
Phase Demolished : None

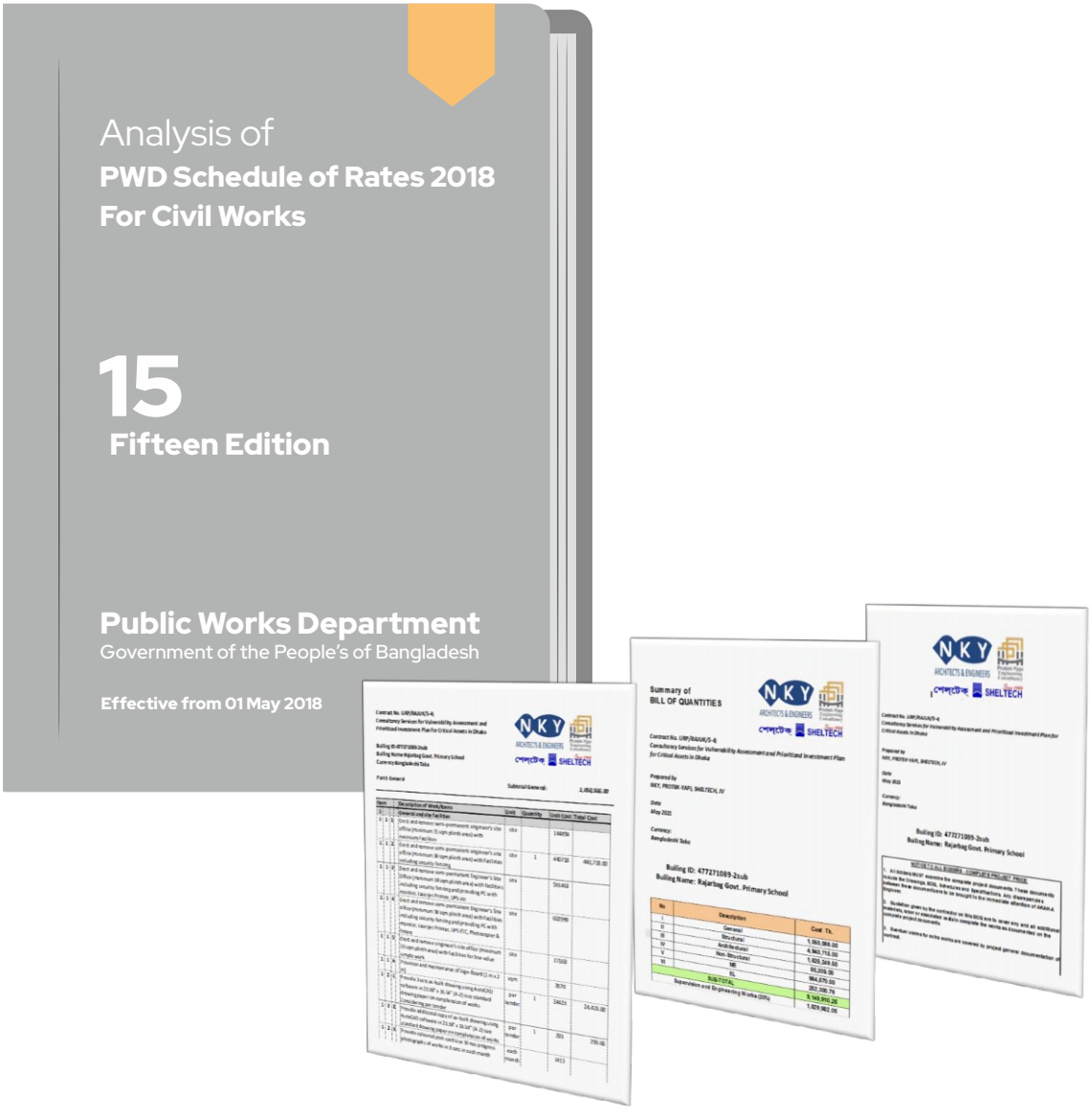
AUTODESK® REVIT® Structures





5.4 BOQ

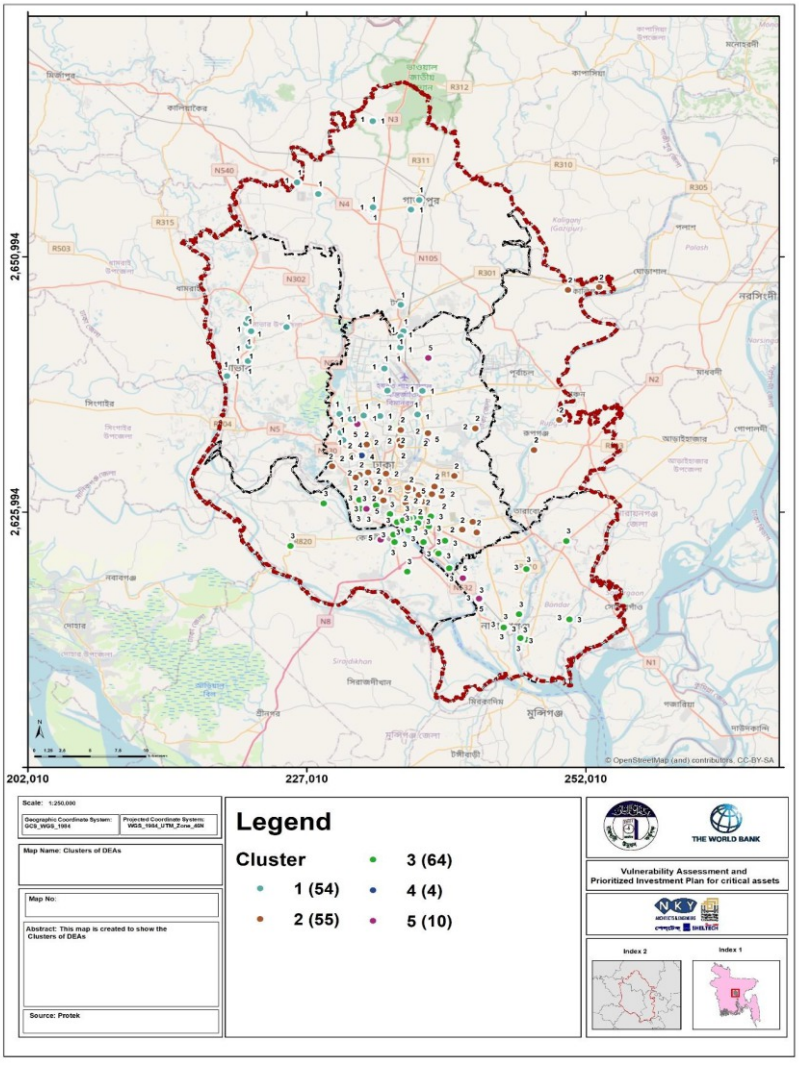
After completion of detailed design, the bill of quantilty is provided as below:



Tender Documents

For preparation of tender documents, 5 clusters are identified as below :

Cluster	Number	Cost (US Dollar)	Ministry
Cluster 1	54	22,677,899.32	Ministry of Education
Cluster 2	55	21,479,579.92	Ministry of Education
Cluster 3	64	20,897,492.43	Ministry of Education
Cluster 4	4	2,172,748.52	Ministry of Health and Family Welfare
Cluster 5	10	3,027,800.88	Ministry of Primary and Mass Education



August ***2022***

Summary of **Outcomes**

Consultancy Services for Vulnerability Assessment and Prioritized Investment Plan for Critical Assets in Dhaka **(S-4)**

PROTEK-YAPI® Engineering Consultancy NKY SHELTECH

JV.Group is an international consortium of three research partners, as follows : NKY, Protek-Yapi and Sheltech Co.