Proposed aesthetic architectural patterns to support damaged buildings and to use demolition products in the reconstruction of war-affected areas in Syria.

Proposal Summary

The long war in Syria has led to the demolition of a large part of the buildings in many Syrian cities, and the other part was damaged. Therefore, it is necessary to think of developing scientific solutions to deal with the large quantities of rubble resulting from this destruction and to benefit from them by offering scientific and practical solutions.

The process of recycling rubble is one of the most important solutions in dealing with large quantities of demolition products and re-use of these rubble in the areas to be reconstructed, especially since the Syrian state needs large sums of money for reconstruction and the use of existing demolition products will significantly reduce these costs.

This research is the first step on the road to reconstruction, and this will be explained by the goal of the research, which is divided into several Axes

The first axis: It will present a scientific method for evaluating buildings in the affected areas and determining the buildings suitable for housing and re-consolidation and restoration by specifying scientific indicators through which the condition of the buildings can be assessed, then using aesthetic forms to support the structural elements, whether it is with metal structures with studied structural shapes and sections or other appropriate methods.

The second axis: making use of the large quantities of demolition waste available near the areas to be reconstructed by studying the properties of these ruins and conducting experimental studies to develop elements for concrete or non-concrete buildings so that the developed models are used in the new buildings.

The third axis: Conducting an economic study to determine the feasibility of using the developed elements of demolition waste and the amount of savings that can be achieved through field data and a comparison of the amount of costs required by the process of transporting demolition products in the affected areas.

Key words: Reconstruction - Recycling of rubble - Reinforcement in aesthetic forms

Introduction

The great destruction that occurred in the infrastructure and urban buildings and the consequent serious thought of how to deal with the buildings affected by the war and how to demolish them and sort their rubble into several types according to the type (concrete blocks, blocks, stones, iron, wood and aluminum) in order to make the most of these materials in the reconstruction phase, neglecting the study, which results in reserving large areas of land to store these materials on the basis that they are not useful and to find ways to dispose of them without benefit. These ruins and use them in the next stage.

The recycling process includes separating usable materials (concrete and regular blocks, bricks, wood and iron), where some of these materials can be recycled again for the same use and others can be reconfigured for different uses even though concrete cannot be broken into the basic components of it. (Aggregate and cement), it can be recycled in order to obtain aggregates that were used in the production of concrete with different uses (be one of the raw materials in the cement industry in specific proportions for the production of clinker, or it can be added during grinding clinker with lime, through a process of recycling Remnants of buildings (concrete) can be replaced by part of the natural aggregate = as the use of crushing products of demolition products for concrete elements with natural aggregates (with a certain size) or as an alternative to natural aggregates in the production of the concrete mixture and is considered a solution for the continued use of materials resulting from concrete residues)

- The reused aggregate is called Recycled Aggregate -RA

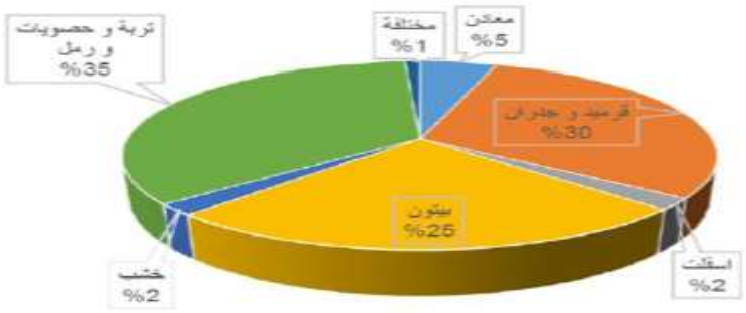
The concrete resulting from the use of reused aggregates RA is called:

Recycled Concrete

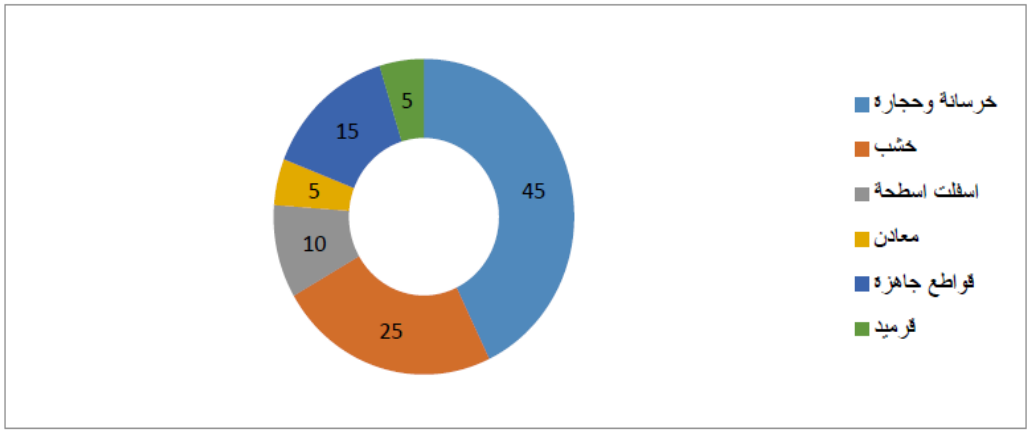
Reused aggregate RA consists of two main components: natural aggregate and cement suspended paste. The amount of suspended matter greatly affects the engineering properties, the aggregate durability and thus the RCA properties.

Previous studies indicate that natural aggregates can be replaced by recycled aggregates by up to 20% or more in the production of new concrete. (1) _

Studies have been conducted to find out the components of building rubble that differ from one country to another. The following diagrams show the components of demolition rubble in both Syria and the United States:



الشكل(١) مكونات الأنقاض التقديرية في سوريا - [7]



الشكل (٢) مكونات الأنقاض في الولايات المتحدة . [8]

Perhaps knowing the components of rubble contributes to understanding the benefits expected from recycling of rubble by determining the possible benefit from each of the components. Perhaps the most prominent benefits can be summarized as follows:

Wood: improvements to spoiled ones and their reuse in new engineering works or as fertilizer or boiler fuel.

Scrap metal: The Steel Iron Organization reports that 100% of rebar is made from recycled scrap and 25% of steel strips use recycled scrap.

Non-iron metals: aluminum, copper, lead and zinc, can be used in homes or as a feedstock in some industries.

Glass: If the glass is not broken, it can be used in new homes or in damaged places, and if it is broken it can be used as a very good fiberglass.

Concrete, stones and building materials: leveling of the site, backfilling, landscaping, and roads. Improvements can be made to them and used in concrete again.

Sand and clay: can be used as CRDM [7]

On the other hand, there are a large number of buildings in the affected areas that do not need to be demolished, but rather to be restored and reinforced. Therefore, engineering methods must be found to support these buildings for reuse and to save large costs that would have been paid as a result of the reconstruction of these buildings.

The problem and objective of the research: (Questions and objectives)

The large size of rubble in the Syrian governorates and the huge numbers of buildings that need strengthening and the necessity to search for urgent technical solutions to this problem without neglecting the economic aspects of the technologies to be used and converting this damage into a beautiful architectural form to reuse those buildings.

• Taking advantage of demolition products will protect the state's natural resources (quarries - beaches - mountains ... etc.)

• Organizing the collection of rubble, as there are huge volumes of concrete rubble resulting from the demolition that ends up in illegal dumps.

• Treating these debris with the aim of producing new materials, including suitable for use in buildings.

• Producing new building materials with environmental properties and economic advantages (solid concrete hollow concrete blocks ...

• Consolidating many buildings will save significant costs involved in reconstructing those buildings

The importance of the recycling process also emerged, as one of the three methods that lead to the disposal of solid waste resulting from human activity on Earth, namely:

Landfill.

Burning.

Recycling.

It helps in reducing its quantity and risk, and it should be noted that the process of constructing incinerators to get rid of waste causes pollution to the environment, in addition to its high cost, while the construction of landfills causes high costs to reserve the lands needed for this. From here emerged the process of (solid waste recycling) as one of the best solutions. Accepted to dispose of solid waste.

 The high cost of raw materials (extraction and transportation), as well as their scarcity in the required urban areas.

 The specifications of recycled materials converge with those of natural or industrial products.

Waste management programs in many countries focus on reducing the volumes of waste resulting from economic, human and industrial waste of all kinds. It also focuses on encouraging recycling, rather than sending materials to landfills or incinerators.

It is useful when managing the recycling process to classify demolition debris according to the location and cost of recycling.

This is done in the following sequence:

Recycle some of the rubble on site to reduce transportation and handling costs.

 Recycle locally, off-site, by means of separation and limited treatment.

Recycling in central stations.

 Recycling in the large stations after leaving the central stations.

The classification of demolition debris according to the possibility of recycling, in the appropriate location according to what was mentioned previously, is a very useful matter of economic and technical feasibility, and is consistent with the goals and programs of the waste recycling process. During year 2015 more than forty percent of solid waste were been recycled in the United States of America to be usable instead of sending it to landfills.

We summarize the research problem in a number of questions:

 How will the damaged buildings be evaluated and what indicators are required to determine the demolition decision?

 Is it possible to solve the problem of rubble in the affected cities, and what are the available means within a proposed period of time?

 Is it necessary to search for technological methods that allow making use of recycled debris, taking into account the architectural form of the building?

 What are the expected benefits of recycling rubble and the potential for using it in vital projects?

To answer these questions, the objective of the research was set by proposing a methodology for strengthening the damaged buildings and developing a vision for beautiful architectural forms that are used as structural elements in buildings, as well as proposing the use of architectural elements from recycled materials to solve the problem of rubble in areas destroyed by the war, taking into account the economic aspects and the available capabilities and thus Creating laboratory specific methods for recycling aggregates and studying the effect of the properties of concrete manufactured using recycled pebbles (mechanical resistance, durability, wear, impregnation, volumetric weight, operability ... etc.), to finish studying the properties of manufactured products during the research using recycled pebbles and conducting the required analytical study and comparing results. studying.

Project description

The approach that you will use in the research is a descriptive approach and content analysis based on a field survey of the case of the study, recording all current operating data and all knowledge that the work team possesses and storing them to benefit from this data in support of the decision. Experimental methods will also be relied on to choose a mixture of demolition products that can be used. For the reconstruction of buildings and the integration of the research elements, metal elements in beautiful architectural shapes will be used to support the structural elements of the buildings that do not need to be removed.

The rapid urbanization in most countries, and the need for new buildings and new requirements compatible with population growth, is a major problem related to securing the raw materials needed to produce concrete in these buildings, especially the gravels, which constitute the largest volume of these materials. The fact that a large number of buildings have been out of service in Syria as a result of the war in recent years has also posed a real problem. Which required its demolition and removal to form rubble that is difficult to manage and store due to its large sizes.

These rubble were used in a timid way in Syria, and their use was limited to road filling and contributing to the gravel bedrock layers of roads and squares. However, the oppressive investment of quarries, the offense to the aesthetic appearance of our mountains and our nature, and the necessity to dispose of these rubble paved the way for research into the possibility of using them as a relative alternative to natural gravel in concrete and other cement products. Therefore, our interest in this research will focus on recycling rubble with the aim of using it to produce concrete and other building materials, and the mechanisms of utilizing the recycled gravel through its use in the concrete industry, by conducting a preliminary treatment of rubble pebbles resulting from demolition and mixing them with proportions that reflect their actual proportions in waste In reality. And it is what will push us to develop this research to include hollow concrete blocks, internal partitions and concrete mixes.

The need to use these rubble in construction works appears to be more demanding at this stage, especially after the significant increase in transport prices, the lack of energy sources, and most of the quarries are fully and unfairly invested in many areas, which made it necessary to search for other quarries or Sources of gravel materials that do not require an extra cost to use.

The rubble will need a special industry to extract the gravel of various sizes, so that it is ready for use in concrete installations. Therefore, studies on the investment of rubble must be coupled with a parallel study of the feasibility of recycling, and the use of advanced technology that allows obtaining recycled pebbles that are comparable to their physical and mechanical properties of natural gravel currently used in construction projects.

Laboratory preparation of debris

A sufficient quantity of demolition rubble will be brought from one of the war-affected areas, for laboratory treatment before characterization and use in the process of manufacturing laboratory samples.

The first stage: bringing the rubble from the areas in the countryside of Lattakia (concrete, block, ceramics)

Tiles and other materials (.

The second stage: sorting the rubble manually, then starting the process of preliminary crushing of samples by using the appropriate tools to convert them into smaller sizes. Then, using the automatic crusher of the laboratory of the Faculty of Civil Engineering at the University of Nisreen to convert them into samples of an acceptable diameter. After the initial milling process is completed manually, the resulting materials will be placed in bags, and then entered into the automatic crusher, which can control the diameter of the stones resulting from the crushing process through a moving arm that enlarges or reduces the crusher opening and thus controls the diameter of the stones.

Third stage: characterization of recycled pebbles and testing on them.

Before starting the pouring of the concrete mixes, the recycled pebbles and natural pebbles will be characterized by conducting a series of experiments to find out the properties of these materials. The tests that will be performed on recycled and natural civilizations can be summarized as follows:

1. Love Analysis.

2. Measurement of apparent volumetric weight and solid volumetric weight.

3. Measurement of the wear factor according to Los Angeles.

4- Measuring the cleanliness of the civilizations by sand equivalent.

5. Measurement of total impregnation.

The gradient gradient test will be performed on the recycled samples and the natural samples based on the requirements of 2002 (2002 / the Syrian standard for grain gradation)

The fourth stage: casting concrete cubic samples with correct scientific dimensions and with different replacement ratios.

To prepare laboratory samples from concrete with and without recycled pebbles, a concrete mixture must be designed depending on the gradient results of the agglomerate, and on the measured properties of them. We will rely on the French method of designing concrete mixes with different replacement ratios for natural pebbles and recycled pebbles.

Certified in concrete mixtures, noting that the recycled pebbles are intended as a mixture consisting of rubble prepared in different weight ratios.

Experiments to be performed on soft concrete

• Texture measurement by the cone method

• Measuring the volumetric weight of soft concrete.

• Casting samples.

The experiments on hardened concrete are

• Measurement of resistance to simple pressure.

Measurement of the maximum water impregnation.

• Volumetric weight measurement.

• Measuring durability.

And in order to find out the accuracy of the results and the similarity of the samples, it is necessary to calculate the standard deviation of the total tested samples

And the calculation of the coefficient of variation, which gives a clear idea of the similarity of the samples cast from one mixture and the accuracy of the results given.

Fifth stage: conducting the necessary tests on concrete samples (resistance to simple pressure -

Impregnation, specific weight ...) to study the effect of substitution ratios on the physical and mechanical properties, and we will rely on pouring concrete mixes on the automatic mixer, where each component of the dry mix is weighed independently, the mold is removed on the next day and the samples are placed in water for 28 days.

Sixth stage: Measuring the effect of concrete durability by changing the substitution ratio by subjecting the hardened concrete samples from all mixtures to an accelerated durability test.

To study the effect of recycled pebbles on the durability of the concrete that will be produced, accelerator durability tests will be performed on concrete samples by immersing them in a 5% concentrated brine solution, and verifying the loss of resistance after immersion.

As for the stages of manufacturing cement blocks and internal partitions, these stages can be summarized as follows:

• Preparation of materials (lenticular sand, recycled gravel, mulch sand, cement, water, hard natural crushed pebbles).

Measuring the weights of materials according to the design of each mixture.

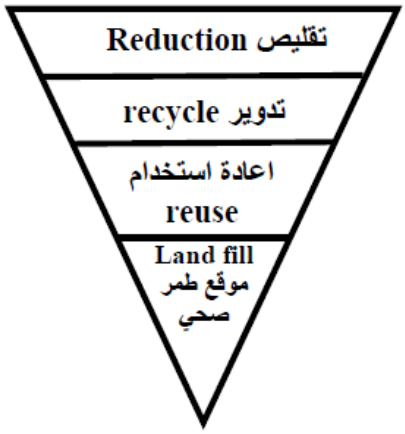
• Mixing the materials according to the replacement ratios in their dry form, then adding water gradually to reach the homogeneous mixture.

Gradually pour the mixture into the mold with the process of shaking and then pressing.

• Putting samples in water for 28 days before testing them.

Research Design and Methods

To manage demolition waste in the affected areas, the first option that is taken into account is to reduce the amount of waste by reducing the buildings to be demolished and studying the possibility of consolidating and re-investing them. The second option is to recycle those waste for reuse in the reconstruction, and the last option is to transfer to sanitary landfills as well. The attached figure shows.



Demolition waste management options

The research that we will prepare will focus on the process of reducing the volume of rubble and recycling through the following stages:

First: Estimating the volume of litigations: -

Some previous studies, research, and methods approved by the National Society for Building Housing in America have been analyzed, and we will carry out our current study studying the estimated quantities of rubble in a number of Syrian cities, as the sources of statistics and the General Company for Roads and Bridges indicate that the Eastern Ghouta in the Damascus countryside governorate had a population of about 2.2 million People. To calculate the number of houses on the average number of the Syrian family, which is 5.2 (5.2) individuals, the number of houses = 5.2200,000 / 5.2 = 423,000 housing units, for example.

This stage will focus on the process of collecting data on the affected areas and calculating the quantities of rubble resulting from demolition in these areas using numerical survey methods as well as statistical data.

Second: An analytical study of work progress in rubble recycling projects

The General Company for Roads and Bridges is one of the main public companies working in the field of rubble recycling in Syria, and its projects include:

1 Demolishing and recycling rubble in Harasta.

2 Demolishing and recycling rubble in the city of Homs.

The purpose of the projects: the demolition of buildings and their rotation to be used in road projects as a base layer

Difficulties and problems at work:

1- Weak funding, lack of financial liquidity for continuous work, and work stoppage due to lack of funding.

2- The available technology has poor performance, lacks primary screening rooms, and there are no sifters and conveyor belts

In addition to the manual sorting of iron and metals, and the absence of magnetic separation equipment.

3- The loss in the operating energy of the crusher as a result of the failure to achieve continuity in its supply in the rubble, which causes

A waste of time and an increase in operating costs.

4- The methods used do not achieve the required benefit from the recycled aggregate due to the inability to use it in

The area of concrete due to the presence of dust residues, obstructive materials, oils and other contaminants that are not allowed

Using partially recycled aggregate in construction.

In this stage, the methods used in sorting and crushing the used rubble and crushers and the time periods required to dispose of these quantities will be studied using the regular methods and statistical analysis.

Third: Evaluating the condition of the buildings in the study area

Not all buildings located in demolished areas must be removed. Therefore, it is necessary to propose scientific indicators that the technical committees use during the damage assessment process to help the decision-maker, whether he will remove all buildings or can some of them be used and reinforced and restored.

The nature of buildings and their structural structures in the affected areas will be studied using structural analysis software, and then studying the behavior of the structural elements under the influence of different loads, in order to finally reach

the development of economic and social indicators that enable the decision maker to link to the peace decision to remove the studied building or support it through multi-criteria decision-making programs.

Fourth: Developing architectural models for consolidation

After determining the damaged buildings that can be supported, a case study will be conducted where aesthetic architectural structures will be proposed to be combined with the structural elements of the building by studying the structural structure and conducting a structural analysis of the proposed shapes and then proposing the appropriate cladding to connect the supported building to a beautiful architectural shape.

Before thinking about the consolidation process, a statistical analysis will be made of the structural elements most exposed to damage as a result of military battles, whether facades, columns, tiles, or prizes, and thus a metallic architectural form with an aesthetic form will be proposed. The district of Al-Minniyah will be studied and its structural behavior studied to determine the optimal shape.

After proposing the metal architectural models, the appropriate and harmonious cladding with the architectural form and suitable alternatives for this cladding will be studied to obtain the best results.

Fifth: The experimental study of the use of demolition products in the internal partitions and some other elements

In order to benefit from the results of the demolition in the reconstruction, work will be done on proposing internal partitions in smart shapes so that they can be used in the buildings to be constructed instead of the removed buildings. It will include choosing the mixture, materials and ratios required to reach the resistances and reference standards for internal partitions. The research can also be expanded to include the study of some types of concrete mixtures resulting from the introduction of demolition products into the mixture.

Initially, the methods of collecting and sorting civilizations from the affected areas should be studied

Grinding civilizations with milling equipment available in the laboratory of the Faculty of Civil Engineering

Designing experiments for concrete mixtures or for partitions, with the study of different percentages of demolishing materials

Study the behavior and durability of cast elements

Design of metal molds for the production of concrete blocks or internal partitions that can be installed inside buildings

Sixth: the economic study

The construction sector waste represents about 30% of the world's total waste that is dumped in landfills and sanitary landfill sites. How much 805 to 90% of that waste is recyclable, while no more than 25% of it is recycled, given its size and its great economic and environmental impact. It can be saved as a result of rotation.

• An economic analysis study can be made to compare the costs of the building constructed without or with the use of demolition

• Conducting an analytical study of the costs of producing a unit of measure from natural and recycled materials

• Studying and assessing the environmental impact of concrete production and the toxic emissions that cause annually the emission of 2 billion tons of carbon dioxide.

• Estimating the amount of savings in the cost and time required for construction at the level of the total affected areas.

Expected Project Outcomes

1. A survey and digital study to determine the size of the debates and their components.

2. Establish reference standards and indicators to determine the buildings that can be reinforced and the buildings that must be demolished.

3. Development of beautiful architectural models that are used as structures for the structural elements to be supported.

4. Developing concrete mixes from recycled materials and using part of them in the internal partitions of buildings.

5. The recycled pebbles will give acceptable values of resistance to simple stress when used in different proportions in concrete, which opens the door to a wide contemplation of their use in concrete construction in civil establishments.

6. Obtaining concrete with high cubic resistances

7. It is expected that the recycled pebbles will not be suitable in terms of their hardness for use in concrete according to the international specifications standards, which require values for the wear factor of not more than 30%, but it is expected that these pebbles when used with natural pebbles will give good values for resistance to simple stress. Concrete is suitable for use in structural elements.

8. With regard to the impact of the durability of the concrete used as recycled gravel, the most appropriate replacement ratios will be determined to ensure good durability of the concrete.

9. We expect that most of the results related to the use of recycled fine gravel in the manufacture of cement products that will be studied will confirm the suitability of these materials to a large extent for the manufacture of cement products.

10. Verify that the waste recycling option is an economical and better option compared to transferring the rubble to landfills and dumps.

Resources and tools used

Resources are divided into several sections that complement each other to form the research system, and these resources are:

• The human resource, which is a scientific work team that will conduct the research, in addition to a group of engineering cadres who will collect field data from the affected sites. A group of workers will also contribute to the completion of the research who will bring the rubble and transport it from the areas where the rubble is available to the laboratories of the College. Civil Engineering at Tishreen University.

• Materials: The materials that will be used in the research consist of demolition materials in addition to the natural preparations necessary for the installation of concrete mixtures of gravel and sand. The research also requires metal sections for the structures that will be used in reinforcement and binder materials such as cement and additives that are required to conduct the necessary tests.

• Equipment and Tools: A large number of equipment available in the laboratory of the Faculty of Civil Engineering, including sieves, cubes, cylinders, mixing and grinding equipment, and experimental equipment, will be used to study the behavior of the elements that will be produced from recycled materials such as hammers, automatic crusher, scales and experimental equipment.

• The used software: it is the structural analysis software, as well as the purchase of some scientific references related to the research topic.

• Mechanisms: small trucks used to transport demolition materials and civilizations, and small cars to transport the work team and engineering staff who will collect information, workers who will sort the rubble, and small trucks to load the materials in the transport vehicles.

Research Team Information Table

Name of Res. Team Member in English	Name of Res. Team Member in Arabic	University / Institute In English	Position / Title	% of time spent on project	No. of months	Incentive per month (LE)	Number of other projects and their IDs	Total % of time spent on other projects	Contact No
Abdul wahab El Kadi	عبد الوهاب القاضي	AASTMT(PI)							
Fayez Ali Jrad	فايز علي جراد	Tishreen University							

Table of Eligible Cost

Eligible costs	Break downs		AASTMT support (L.E.)
(A) Staff Cost	PI		
	Dr Alkadi & Dr Jrad		30 000
	Technicians and/or Labor		30 000
	Consultation fees		20 000
	Total		**100 000**
(B) Equipment	Equipment		40 000
	Spare parts		30 000
	Total Equipment		**70 000**
(C) Expendable Supplies & Materials	Stationary		60 000
	Miscellaneous Laboratory, Field supplies, Materials		60 000
	Total expendable Supplies & Materials		**120 000**
(D) Travel	Internal Transportation		40 000
	Accommodation		20 000
	Total travel		**60 000**
(E) Other Direct Costs	Services	Manufacture of specimens & prototypes	50 000
		Acquiring access to specialized reference sources databases or computer software	10 000
		Computer services	20 000
	Report preparation		30 000
	Publications & patent Costs		20 000
	Workshops organization or Training		10 000
	Others (explain)		10 000
	Total other direct costs		**150 000**
(G) Total Costs			**500 000**

DETAILED PLAN ON PROJECT'S ACTIVITIES (GANTT CHART):

Activity Name	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Main 1: Field Data collection												
Sub 1.1 Determine the affected areas	x	x										
Sub 1.2: Estimating the quantities of rubble		x	x									
Sub 1.3: Determine the quality of rubble			x									
Main 2: Building Assessment Indicators												
Sub 2.1: Reinforcement of damaged buildings			x	x								
Sub 2.2: Reinforcement of damaged buildings				x	x							
Sub 2.3: Metal Prototyping Test				x	x							
Sub 2.4: Installation of metal structures					x							
Sub 2.5: Determine the texture of the structures						x						
Main 3: Recycling of demolition products												
Sub 3.1: Sorting the rubble						x	x					
Sub 3.2: Preparing the concrete mixture							x	x				
Sub 3.3: Casting samples							x	x	x			
Sub 3.4 Test samples in the laboratory								x	x			
Sub 3.5: Study the behavior of the new mixture								x	x	x		
Main 4: Feasibility study												
Sub 4.1: Price analysis for materials										x		
Sub 4.2: Case study											x	
Sub 4.3: Economic comparison of results											x	x

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