

Gaza's 2023 War Rubble Removal: Is a 15-Year Timeframe Exaggeration?

Eng. Asem Alnabeh



Title of the paper: Gaza's 2023 War Rubble Removal: Is a 15-Year Timeframe Exaggeration?

Prepared by: Eng. Asem Al-Nabih

August 2024

5 Al-Sahl Street, Ramallah - Palestine

Email: almarsad@almarsad.ps

Website: www.almarsad.ps

All rights reserved ©

Social and Economic Policies Monitor "Al Marsad"

2024

Nothing About Us, Without Us: Does It Really Need 15 Years to Clear the Rubble?

Numerous reports from international organizations and experts have addressed the challenges of post-war reconstruction, offering their perspectives on how to respond to the war's catastrophic impact on the Gaza Strip: the large-scale destruction of infrastructure, the suspension of education, the near-total collapse of the healthcare system, and the shutdown of vital water and electricity networks. These effects have left behind profound humanitarian crises—a tragic number of orphaned children, many still missing under the rubble, and thousands displaced, now living in conditions that lack even the most basic standards of life.

Given the findings in these reports, it is essential to clearly and directly reflect the local community's perspective on reconstruction. The Social and Economic Policies Monitor – Al Marsad, therefore, formed a research group composed of specialists and scholars from Gaza. These experts, who have endured the successive wars on Gaza over the past fifteen years, have closely observed several reconstruction efforts, many of which have faltered along the way.

The research group plans to produce a series of policy papers aimed at guiding rapid, short-term responses and planning for medium- and long-term recovery and reconstruction efforts, all rooted in insights from Gaza. The aim is twofold: to avoid flawed recommendations that could lead to misguided and complex interventions in the future and to prevent such recommendations from inadvertently playing into Israel's strategy of obstructing reconstruction by making it slow and burdensome—turning it into a punitive measure against Gaza's people and pushing them toward despair, such as the claim that rubble removal alone could take fifteen years.

The first paper in this series, titled "Gaza's 2023 War Rubble Removal: Is a 15-Year Timeframe Exaggeration?" is written by Eng. Asem Alnabeh, who is currently working closely with the emergency committees on the ground in Gaza. Drawing from his hands-on experience in reconstruction, Alnabeh provides a technical analysis of rubble removal, one of the most formidable challenges facing reconstruction efforts. Estimates suggest that more than 35 million tons of rubble have accumulated across Gaza's governorates—a massive amount that far surpasses the debris left by previous wars. With the ongoing systematic destruction, this figure is expected to exceed 40 million tons in the coming weeks. Lurking unexploded ordnance and insufficient heavy machinery also pose serious risks that could significantly delay the rubble removal process if not addressed through a carefully devised strategic plan.

The paper challenges the international organizations' claims that rubble removal will take fifteen years. Alnabeh argues that this projection is unreasonable, noting that if debris removal relies on the limited capacity of just 100 trucks, as outlined in the UN's 15-year timeframe, the process could stretch beyond twenty years. Instead, the paper advocates for involving local, regional, and international companies, employing local labor, and deploying a fleet of 1,000 to 1,500 trucks working extended hours, which could complete the rubble removal within a year. Rubble removal and reconstruction should also proceed in parallel rather than one after the other. In other words, reconstruction efforts need not be delayed until the debris is fully cleared. To make this possible, any reconstruction agreement must ensure unimpeded access for equipment and companies into Gaza, free from Israeli restrictions.

The removal of rubble is one of the most formidable challenges in Gaza's reconstruction efforts. Estimates indicate that over 35 million tons of rubble accumulated across all governorates of the Gaza Strip. This unprecedented scale, compounded by the shortage of heavy machinery and the lurking danger of unexploded ordnance, threatens to extend the rubble removal process sine die unless a robust, well-planned strategic approach is not leveraged. However, this report posits that with the right resources—adequate machinery, extended working hours, well-trained teams, and the integration of advanced technologies--this daunting mission can be completed within a year. Such efforts should be synchronized with robust coordination and cooperation among all involved parties.

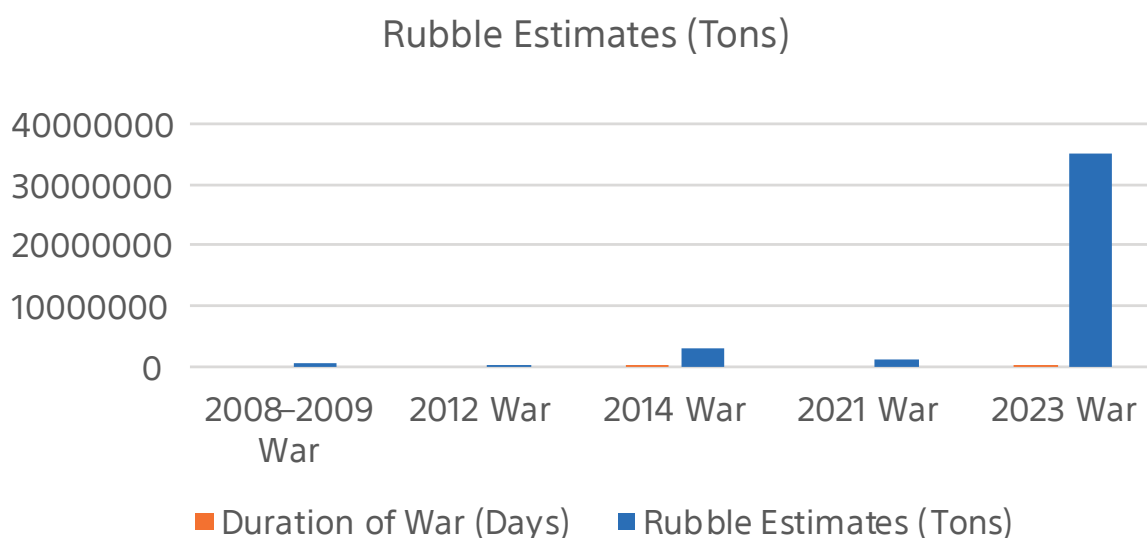
Table of Content

Introduction	5
Rubble Estimates in Past Wars on Gaza.....	5
Key Challenges to the Rubble Removal in Gaza.....	6
Situation Overview	6
Rubble Contents	6
Rubble Volume Estimation Method	7
Rubble Removal Scenarios.....	7
Why the 15-Year Rubble Removal Scenario Is Unreasonable?	7
Key Factors Impacting Rubble Removal Operations	7
How Rubble Removal Can Be Completed in One Year.....	8
Economic Benefits of Rubble Removal.....	8
Rubble Removal Phases and Steps.....	9
Key Machinery for Rubble Removal Operations.....	10
Rubble Disposal and Reuse.....	11

Introduction

Since 2008, the Gaza Strip has endured several wars, with each inflicting a significant trail of damage across sectors and leaving behind varying amounts of rubble. The ongoing war that began in October 2023 has led to an exponential increase in the amount of rubble across the cities and communities of Gaza. Differing in their estimates of the extent of the destruction and the time required to clear the rubble, relevant organizations and institutions converge on one stark truth: The scale of devastation is unprecedented. The volume of rubble will require immense concerted efforts to be cleared—a critical first step toward post-war reconstruction.

Rubble Estimates in Past Wars on Gaza



War	Duration of War (Days)	Rubble Estimates (Tons)
2008-2009 War	22	600,000
2012 War	8	250,000
2014 War	51	3,000,000
2021 War	11	1,200,000
2023 War	300	35,000,000

Key Challenges to the Rubble Removal in Gaza

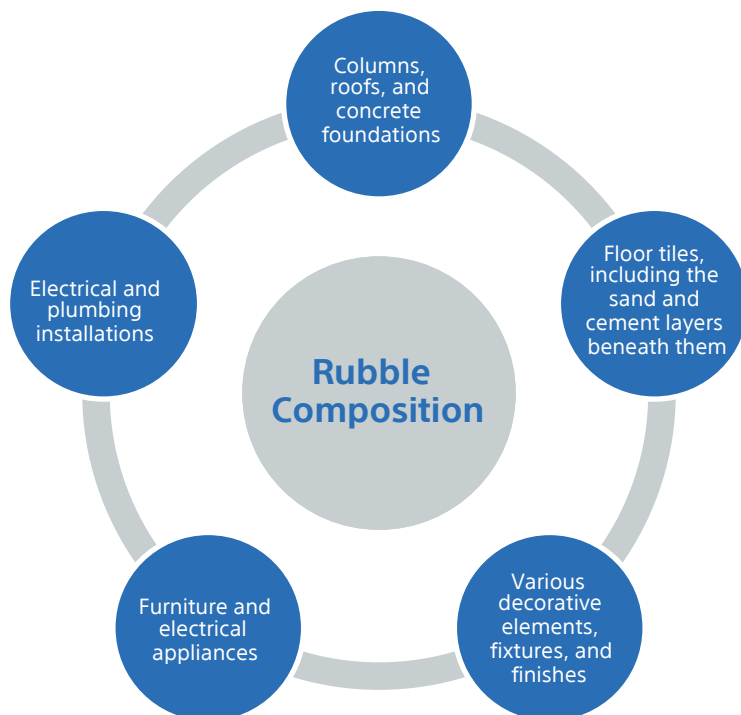
- The volume of rubble is unprecedented.
- Most of the heavy rubble removal machinery—bulldozers, trucks, and excavators—has been destroyed, crippling the efforts of municipalities, the Ministry of Public Works, and the private sector.
- The destruction of 250,000 square meters of roads has severely complicated the access of machinery to affected areas.
- A critical shortage of fuel for road clearing and rubble removal operations.
- Entire neighborhoods have been levelled, complicating rubble removal given the accumulation of rubble over vast, devastated blocks.
- Lack of experience in managing rubble on this scale.
- The confined geography of the Gaza Strip further limits options for managing and disposing of the rubble.
- Thousands of bodies are still trapped under the ruins of destroyed homes.
- Significant documents and valuable possessions remain buried under the rubble.
- Presence of unexploded ordnance and bombs in some of the affected sites and homes.

Situation Overview

The rubble from the 2023 war is estimated to range between 25 and 40 million tons. According to United Nations (UN) figures, this massive accumulation, a consequence of months of intense Israeli bombardment, has reached approximately 40 million tons. The rubble is dispersed across the entire Gaza Strip, with the largest concentrations in Gaza City and Khan Younis, the most densely populated areas and home to vital facilities and infrastructure.

Rubble Contents

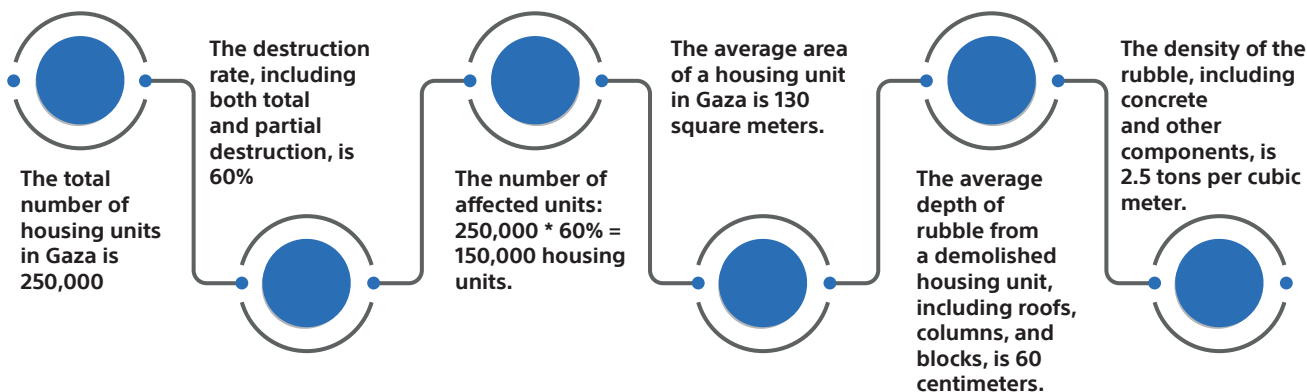
While rubble is often perceived as containing remains of columns, roofs, and concrete foundations, it encompasses far more, adding to its volume and weight, particularly in cases of total destruction.



Rubble Volume Estimation Method

Several methods may be used to estimate the volume of rubble, each based on different assumptions. The equation below outlines a set of assumptions to better understand and quantify the scale of rubble in Gaza.

I. Rubble Volume Calculation Assumptions



II. Total Rubble Weight Equation

- Total estimated rubble weight in Gaza = (# of affected housing units * Average area per unit * Average rubble depth per unit after destruction * Rubble density).
- The total estimated weight of rubble = $150,000 * 130 * 2.5 * 0.6$.
- The estimated weight of rubble from housing units is 29,250,000 tons.
- An additional 5 million tons of rubble from the destruction of public infrastructure, public buildings, universities, and other facilities can be added as an estimated quantity.
- The total estimated rubble is approximately 35 million tons.

Rubble Removal Scenarios

Scenario 1: A 15-Year Effort

According to estimates by the UN and other international organizations, the removal of rubble is expected to take many years. A UN report suggests that the process could extend over 15 years, based on the deployment of 100 trucks dedicated to clearing the rubble. (See reference 1)

Scenario 2: A One-Year Solution

However, under an alternative scenario, if the required resources and equipment are made available, the rubble removal could be accomplished within a single year.

Why the 15-Year Rubble Removal Scenario Is Unreasonable?

- This projection fails to consider the experiences of other countries in managing large-scale rubble removal.
- It neglects critical factors that could significantly reduce the timeline, such as increasing the deployment of heavy machinery, extending work hours, and leveraging the private sector's capacity.
- The report assumes a very limited deployment of trucks for rubble removal—just 100. This is a fleet size that a single private company in Gaza might possess.

Key Factors Impacting Rubble Removal Operations

1. The availability and deployment of heavy machinery;
2. The number of daily working hours;
3. The workforce dedicated to rubble removal tasks;
4. The integration and effective use of technology and advanced techniques in the removal process;

How Rubble Removal Can Be Completed in One Year

To complete the rubble removal mission within a year, several key elements must be in place. While the pace of this operation is likely to be influenced by various political dynamics, the following technical elements are instrumental in expediting the completion of the process within the proposed timeframe:



Deployment of
1,000 trucks



Implementing a two-shift work
system, totaling twelve hours of
operation each day



Concurrent removal of
unexploded ordnance and other
war remnants alongside rubble
clearance in different areas



Utilization of 100
excavators



Reliance on the capabilities of the
local private sector



Strategic use of dynamite to
demolish existing buildings that
are beyond repair and use



Operation of 200 high-performance
bulldozers



Collaboration with regional and
international companies



Increased engagement of
Palestinian labor and contractors
from the Gaza Strip and West Bank

Economic Benefits of Rubble Removal

- Rubble removal offers employment to thousands of workers, providing a source of income for those engaged in these operations.
- The initiative will also create jobs for thousands of heavy machinery operators across the region.
- By supporting private sector companies, rubble removal can enhance job creation and boost the local economy.
- This process will encourage growth in related sectors, such as fuel, machinery maintenance, and equipment imports and contracting.
- It also provides income source opportunities for disadvantaged groups, such as animal cart drivers.
- There are investment prospects in the recycling and reuse of rubble, such as extracting iron and converting rubble into profitable materials, which can attract business ventures.
- Reducing road reconstruction costs by using some of the rubble as a base layer under asphalt, allowing the savings to be reinvested in reconstruction and development projects.
- Utilizing some of the rubble as a base layer under asphalt for road reconstruction can lower infrastructure costs, allowing the saved resources to be redirected toward broader reconstruction and development efforts.

Rubble Removal Phases and Steps

To effectively and safely remove 35–40 million tons of rubble in Gaza, a comprehensive plan should be developed, addressing logistic, technical, and environmental challenges and impacts and covering the following phases:

I. Planning and Coordination

- A comprehensive damage assessment should be implemented: This step involves the evaluation of the composition and distribution of the rubble across Gaza.
- An extensive survey should be undertaken to identify primary rubble sites and assess the volume and type of rubble at each location.
- Risk assessment: Regular assessments should be made to identify hazardous materials such as asbestos, lead, or unexploded ordnance.
- High-priority areas should be prioritized based on population density and strategic importance.
- Sites where the bodies of victims remain under the rubble should be identified.
- Locations where owners need to recover valuable items buried beneath the rubble should also be identified.
- Advanced technological infrastructure: Software and technological systems, such as geographic information systems and project management software, should be deployed to track and manage rubble.
- A detailed rubble removal action plan should be developed, including relevant timelines, required human and material resources, and necessary environmental measures.

II. Equipment and Machinery Provision

- A list of the heavy machinery needed for rubble removal should be developed.
- Engagement of the private sector is essential, ensuring that companies affected by the loss of assets and equipment are adequately compensated.
- Sorting equipment and crushers for recycling purposes should be secured.
- All other necessary supplies, equipment, machinery, and protective gear must be provided.

III. Logistics and Site Management

- Logistics management involves organizing the transportation and storage of removed rubble, including identifying landfill sites, recycling facilities, or disposal locations.
- Site management requires careful planning and organization of work areas to optimize efficiency and ensure safety.
- Rubble Central collection points should be identified before it is transported to final disposal or recycling sites.
- Landfill sites need to be identified and prepared for the disposal of non-recyclable rubble, with careful consideration of environmental impact.
- Recycling stations should be established or enhanced to process rubble for use in construction and other industries.

IV. Rubble Removal Process

- The removal operations should be carried out according to the established priorities, with a focus on the most impacted areas.
- Crushers should be used to break down the rubble into smaller, more manageable pieces, facilitating easier transport and disposal.
- The rubble should be sorted to separate recyclable materials.
- The sorted materials should be repurposed for the production of building blocks and concrete and utilized in infrastructure projects.
- Environmental and Safety Considerations
- Safety monitoring: Strict safety protocols should be implemented to protect workers and locals.
- Environmental risk management: Safeguards should be put in place to protect public health, with particular attention to the risks posed by dust and other pollutants.
- Public health: Provide measures to protect public health, especially concerning dust and other pollutants.
- Worker training: Workers should be trained in the safe and effective use of equipment, general safety procedures, and handling of potential accidents.
- Personal protective equipment (PPE): Adequate protective gear must be provided and used to shield workers from dust, chemicals, and physical harm.

VI. Funding and International Cooperation:

- Coordination with specialized agencies: Collaboration with municipalities, local authorities, international organizations, and private companies is essential to ensure efficient and effective rubble removal. This collaboration should be in line with laws, regulations, and approved plans, with all necessary permits in place.
- Project funding: Securing the necessary funding to cover operational costs, including the purchase of equipment, worker training, and logistics management.
- Partnership with the local private sector: Engaging and coordinating with local Palestinian companies is vital, making them a key actor in the rubble removal efforts.
- Partnership with international companies: International firms may be needed for specialized activities, such as the safe disposal of hazardous materials and unexploded ordnance, and to provide expertise in recycling and reusing rubble. However, it is imperative to prioritize the employment of local labor throughout the process.

Key Machinery for Rubble Removal Operations

The scale of rubble removal in Gaza requires the use of heavy, specialized machinery capable of managing vast amounts of rubble with efficiency and safety—including:

- Excavator for digging up and lifting heavy rubble (this machinery can be fitted with various attachments, such as hammers, to break apart concrete and other materials);
- Backhoes for digging and lifting rubble in small and confined work areas (given that they combine the features of an excavator and a loader);
- Wheel Loaders for loading rubble into transport trucks and effectively managing large volumes of rubble;
- Dump Trucks for transporting rubble from demolition sites to landfills or recycling centers;
- Bulldozers for pushing rubble, leveling the ground, and preparing the sites for reconstruction;
- Crushers for breaking down rubble into smaller, manageable sizes or for repurposing in construction projects;
- Vibratory Screens for sorting rubble by size, facilitating recycling and reuse;
- Rubble Sorting Equipment for separating different materials, such as concrete, iron, and glass, to streamline the recycling process.
- Metal and Explosives Detectors for locating and removing unexploded ordnance and buried metals within the rubble;
- PPE for staff protection during rubble removal operations (e.g., safety helmets, boots, and goggles).

Rubble Disposal and Reuse

- **Fragile coastline reinforcement:** Rubble from buildings can be repurposed to reinforce sections of the coastline, particularly those at risk from severe erosion. This should be guided by evidence-based studies.
- **Beachfront expansion:** Strategic infill operations can increase the Gaza Strip's land area by 3,000 to 5,000 dunams, extending 200 to 400 meters into the sea, depending on the region's topography. These reclaimed areas could be integrated into a broader waterfront redevelopment plan, with particular care taken to protect sandy beaches designated for swimming.
- **Gaza port development:** The rubble, varying in size, can be effectively utilized to develop and expand Gaza's port as part of a comprehensive reconstruction plan.
- **Artificial offshore islands:** Larger and medium-sized rubble can be repurposed to create artificial islands, which could be developed into tourist sites and facilities.
- **Street tile and brick production:** Rubble can be used to manufacture ecofriendly street tiles or building bricks, contributing to construction efforts.
- **Recycled concrete production:** By processing rubble through crushing, it can be transformed into coarse and fine aggregates for use in concrete production and road construction.
- **Road compaction layer substitute:** Rubble can be recycled and utilized as a base course layer under asphalt in road projects, providing an essential material for road compaction after being crushed into various sizes.

References:

Reference 1: Burke, J. (2024, July 15). *Clearing Gaza of almost 40m tonnes of war rubble will take years, says UN* . Retrieved from <https://rb.gy/1ekm1t>