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Automating construction phase detection and progress visualization using unity: An integrated framework for scheduling, reporting, and 4D Simulation

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A R T I C L E I N F O

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A B S T R A C T

Construction projects often face inefficiencies in progress monitoring, reporting, and communication due to fragmented workflows and reliance on manual processes. This study presents an integrated Unity-based framework that automates construction phase detection, generates structured schedules and progress reports, and visualizes project evolution in 4D. The framework includes three core modules: (1) AutoPhaseDetector, which classifies building components by geometry and naming conventions into construction phases; (2) ConstructionProgressManager, which animates project progress on a timeline through fade-in rendering; and (3) ExcelExporter, which generates comprehensive CSV/Excel reports including schedules, progress tracking, and material costs. A seven-story reinforced concrete building model was used as a case study to validate the system. Results demonstrate efficient automatic sequencing of piles, structural components, architectural elements, and MEP installations, with synchronized visualization and exportable reports. Compared with manual scheduling, the framework reduces preparation time, improves clarity, and provides a foundation for integration with BIM workflows. Future extensions may include machine learning–based classification and IoT-based real-time updates.

1. Introduction

Construction projects are inherently complex, involving multiple stakeholders, interdependent activities, and extensive resource coordination. Effective monitoring and reporting of construction progress are critical to ensure that projects are delivered on time, within budget, and with the desired quality. Traditional methods of progress monitoring typically rely on tools such as Gantt charts, critical path method (CPM) scheduling, and spreadsheets. Although these methods are systematic, they often lack integration with the three-dimensional representation of the building, making it difficult for stakeholders to intuitively understand the construction sequence. Furthermore, progress reporting in these traditional approaches is largely manual, which increases the likelihood of inconsistencies, delays, and miscommunication among project participants.

With the advent of Building Information Modeling (BIM), the concept of linking three-dimensional geometry with time dimension—commonly referred to as 4D simulation—has significantly advanced project visualization and communication. 4D BIM enables stakeholders to visualize the planned sequence of construction activities in a simulated environment, which in turn reduces errors, enhances collaboration, and supports decision-making. However, the widespread use of 4D BIM in practice still faces challenges. One of the main limitations is that most existing workflows rely heavily on manual classification of model elements and the external preparation of schedules in specialized software such as Microsoft Project or Primavera P6. This dependence on manual processes results in inefficiencies and prevents real-time integration between model-based data and project monitoring systems [1–3].

Recent research has explored automated methods to reduce the manual effort required for phase classification and schedule generation [4]. Approaches such as rule-based classification, attribute-driven phase assignment, and machine learning have been proposed to improve efficiency. Despite these advances, there remains a gap in providing an integrated framework that seamlessly combines automatic phase detection [5], construction scheduling, reporting, and visualization in one unified environment.

This study addresses these limitations by developing a Unity-based framework that integrates phase detection, project scheduling, and 4D visualization. Unlike conventional workflows that depend on multiple software tools, the proposed framework incorporates three core modules directly into Unity: the AutoPhaseDetector, which automatically classifies building components into

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construction phases based on geometric properties and naming conventions; the ConstructionProgressManager, which visualizes project progress using a timeline-driven simulation with gradual object rendering; and the ExcelExporter, which generates structured reports that include schedules [6], progress tracking, and material cost estimates.

The objective of this research is to demonstrate how game engine technology, specifically Unity, can be leveraged to unify scheduling, reporting, and visualization within a single environment. By applying the framework to a case study of a seven-story reinforced concrete building, the study highlights its effectiveness in automating construction phase detection, reducing manual scheduling effort, and generating synchronized reports and visualizations. The findings contribute to the ongoing discourse on digital construction by presenting a practical, interactive, and extensible framework that supports progress monitoring and communication in real-world projects.

2. Literature Review

2.1. Traditional Scheduling and Monitoring

Conventional methods of construction scheduling and monitoring have relied heavily on tools such as Gantt charts and Critical Path Method (CPM) scheduling. These methods are systematic in structure and provide clear visualization of project timelines, task dependencies, and critical activities [7,12]. However, they are inherently disconnected from the physical characteristics of the project, as they represent progress in abstract tabular or bar chart formats rather than linking directly to the geometry of the building model [13]. As a result, updates to these schedules often remain manual, delayed, and dependent on the subjective judgment of site managers or engineers. This reliance on human interpretation can lead to inconsistencies among stakeholders, as different individuals may record and interpret progress differently. In large and complex projects, these inconsistencies accumulate, creating significant gaps in monitoring accuracy and reducing the effectiveness of progress communication [14,15].

2.2. BIM and 4D Construction Simulation

The introduction of Building Information Modeling (BIM) has transformed project management by allowing geometric and semantic data to be integrated into digital models. One of the most significant advancements enabled by BIM is 4D construction simulation, in which three-dimensional model components are linked to project schedules [8,9,16]. This integration enables stakeholders to visualize construction sequences in time-based simulations, allowing them to better understand dependencies, identify potential conflicts, and anticipate logistical challenges before they occur [17].

Numerous studies have highlighted the benefits of 4D simulation. By linking construction tasks to corresponding 3D elements, 4D visualization reduces communication barriers among architects, engineers, contractors, and clients. It improves coordination, reduces design and sequencing errors, and enhances overall project clarity [10,18,19]. Despite these advantages, limitations remain. Automation in linking BIM models to construction schedules is still underdeveloped, and most workflows require manual alignment between model elements and scheduling platforms [20,21]. This limits the scalability of 4D simulation and restricts its use to projects where sufficient resources and technical expertise are available.

2.3. Rule-Based Phase Classification

In response to the challenges of manual scheduling, researchers have proposed rule-based and attribute-driven methods to classify model elements into construction phases. These approaches rely on predefined rules based on geometry, material properties, or naming conventions to automatically map BIM components to their corresponding activities [11,22]. For example, structural components such as columns or beams can be identified by keywords in their object names, while height-based rules can distinguish between foundation elements and upper floors [23].

Although rule-based approaches improve efficiency by reducing repetitive manual tasks, they often require preprocessing of the BIM model or reliance on specific authoring tools. In practice, BIM models may not always follow standardized naming conventions, which can limit the effectiveness of rule-based methods [24]. Furthermore, these approaches are not fully integrated into a seamless project management workflow, as they typically operate as standalone preprocessing steps rather than as part of an automated scheduling and monitoring system [25].

2.4. Gaps in Practice

A review of current literature and practice reveals persistent gaps in how BIM and 4D simulation are applied in construction. Integration between automatic classification, scheduling, and visualization remains fragmented, often requiring multiple software platforms and manual intervention [26]. Reporting workflows for materials, costs, and delays are also separated from visualization, typically existing as static spreadsheets or textual reports rather than interactive, model-linked outputs [27].

Another gap lies in the underutilization of game engines such as Unity or Unreal Engine. While these platforms offer real-time rendering, interactive visualization, and integration capabilities, their application to construction progress monitoring is still limited [28]. Existing studies rarely exploit the potential of game engines to unify classification, reporting, and visualization in a single environment [29].

This study aims to address these gaps by proposing an integrated framework developed in Unity. The framework embeds phase detection, scheduling logic, reporting mechanisms, and 4D visualization into one cohesive system, eliminating the need for fragmented workflows. By doing so, it not only reduces manual effort but also enhances communication through interactive simulations and structured reports.

3. System Architecture

The proposed framework adopts a modular and extensible architecture that integrates automated phase classification, 4D progress visualization, and structured reporting into a single interactive environment. Developed within the Unity engine, the system emphasizes data interoperability, real-time feedback, and user interactivity, enabling seamless transformation of Building Information Modeling (BIM) data into an informative construction management platform.

3.1. Overall Framework Design

The architecture is organized into three functional layers — data interpretation, simulation control, and report generation — each represented by a dedicated Unity module. Communication between these layers is achieved through standardized data exchange protocols and shared data objects, ensuring flexibility for integration with various BIM formats such as IFC, Revit exports, or custom CSV inputs. ***Figure 1*** illustrates the overall framework structure and interaction among components.

1. **AutoPhaseDetector**
   This module performs initial preprocessing of imported BIM models. Using Unity's mesh analysis and metadata parsing capabilities, it extracts both geometric and semantic information from the model. The detector identifies construction elements based on spatial hierarchy and naming conventions, then maps them to predefined construction phases. Unlike traditional BIM tools that rely heavily on manual tagging, the AutoPhaseDetector introduces a rule-based and language-independent classification approach, reducing the need for repetitive human intervention.
2. **ConstructionProgressManager**
   Serving as the core of temporal simulation, this module manages construction sequencing, visualization, and user interaction. Each building component receives a set of attributes—such as start day,

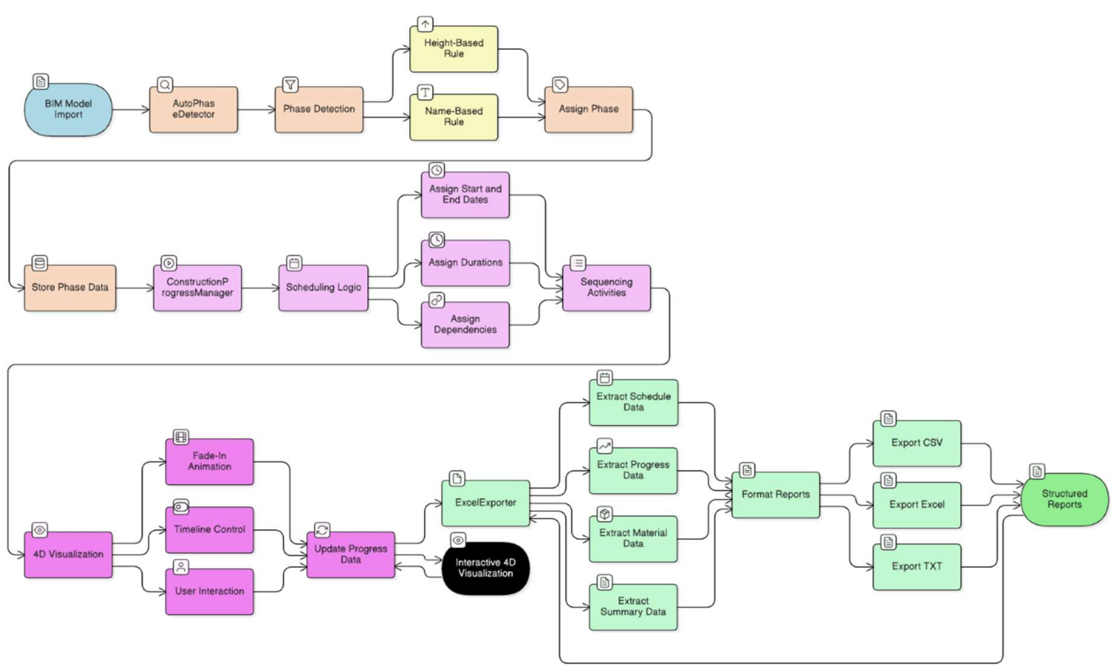

Figure 1. *Overall Framework Diagram*

duration, and dependency relations—that are automatically derived from the classified data. Through Unity's animation and shader systems, the ConstructionProgressManager visualizes the assembly process with fade-in transitions, color overlays, and optional time-based effects. The timeline interface allows stakeholders to pause, rewind, or accelerate the simulation, providing an immersive way to evaluate construction efficiency or identify bottlenecks.

3. **ExcelExporter**
   The reporting module transforms simulation outputs into structured datasets. It connects to Unity's backend scripts that track progress parameters and resource allocations during runtime. Upon completion, it compiles this data into standardized CSV and Excel reports, including progress summaries, cost breakdowns, and variance analyses. This automated documentation process minimizes manual data handling and enhances consistency across reporting cycles.

3.2. Data Flow and Intermodule Communication

Data exchange among the three modules follows a sequential yet cyclic pattern. Initially, raw BIM data enters the AutoPhaseDetector, which classifies and stores objects in a shared data repository. The ConstructionProgressManager retrieves this data to generate the simulation timeline and visual outputs. During or after simulation, the ExcelExporter accesses both static and dynamic datasets to produce analytical reports.

To ensure robustness, the modules communicate through serialized JSON files and Unity's internal data models, which allow scalability for large projects. This architecture also enables future extensions, such as integration with real-time site data from IoT sensors or drones for progress validation.

For this study, the BIM model was imported from the Autodesk Revit 2022 sample project, which includes architectural, structural, and MEP components as can be seen in *Figure 3*. This ensures that the framework can handle multidisciplinary data and perform classification across all major domains of building design.

3.3. Technical Integration in Unity

Unity serves as both the visualization and execution platform. The framework utilizes C# scripts to manage procedural logic, leveraging Unity's coroutine system for asynchronous updates during time-based animation. Material shaders handle dynamic transparency, while UI components—such as sliders and control panels—facilitate user interaction as can be seen in *Figure 2*. All modules are encapsulated as independent scripts to allow modular debugging, updates, and reuse across different projects.

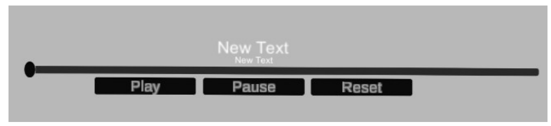

Figure 2. *Slider UI Design*

3.4. Design Principles and Advantages

The system architecture is built around three principles: modularity, automation, and interactivity. Modularity ensures each component can be maintained or extended independently. Automation reduces human error and accelerates repetitive tasks such as classification and report generation. Interactivity allows end-users to visualize progress and evaluate construction performance in a highly engaging way. Together, these principles establish a unified, self-contained environment that connects design data to project management insights without relying on third-party scheduling or visualization software.

4. Methodology

The methodology focuses on transforming raw BIM data into structured construction phases, simulating progress over time, and generating reports that support decision-making. The framework applies both rule-based detection and logical sequencing to ensure that construction activities follow realistic order and timing.

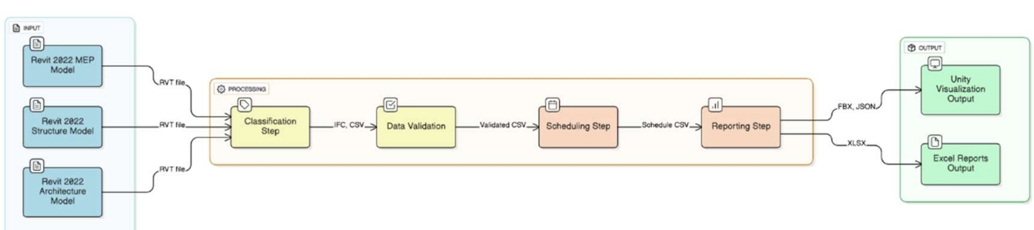

Figure 3. *Data Flow Diagram*

4.1. Phase Detection

All building objects imported into Unity are analyzed based on two primary criteria:

- **Height-based rules:** Elements are grouped according to their vertical (Y-axis) position relative to the model. This makes it possible to distinguish between substructure elements such as piles and foundations, structural frames at various floors, and higher-level architectural or MEP components.
- **Name-based keywords:** Components are matched against predefined terms in multiple languages. This ensures that even models built with varied naming conventions can be classified accurately.

Objects are assigned to the most probable construction phase based on these rules. The system thus minimizes manual intervention while ensuring consistent classification across projects.

4.2. Scheduling Logic

The scheduling module follows a sequential workflow like conventional construction practices:

1. Piles and foundations are completed first.
2. Each floor progresses in sequence, beginning with columns, followed by beams and slabs.
3. Architectural elements such as walls, windows, and finishes are installed once the structural frame is complete.
4. MEP systems are executed in the final stage.

Durations are parameterized to reflect practical construction timing. For instance, columns may take three days, slabs five days, and MEP installations fifteen days. By adjusting these parameters, the framework can adapt to different project scales and complexity levels.

4.3. Progress Manager

The ConstructionProgressManager controls the visualization of construction progress. Elements gradually fade from transparent to opaque according to the assigned construction day, providing stakeholders with an intuitive representation of project advancement. Interactive tools within Unity, including a timeline slider and play/pause functionality, allow users to review sequences at their own pace.

4.4. Excel Exporter

The ExcelExporter module generates reports that are synchronized with the simulated construction process. Randomized variations in costs and delays are incorporated to simulate real-world uncertainty, making the reports more reflective of actual project conditions. A clear overview of each function can be seen in *Table 1*.

5. Implementation

The proposed framework was implemented within Unity 2022, leveraging its capabilities for real-time rendering and interactive simulation. The system was designed with modularity in mind, where each functionality—phase detection, scheduling, visualization, and reporting—was encapsulated within dedicated C# scripts. This modular structure not only simplifies debugging and updates but also supports scalability for future extensions.

- **Platform and Tools:** Unity served as the central platform due to its strong 3D visualization and timeline control capabilities. External data exchange was handled via CSV and TXT formats, ensuring interoperability with spreadsheet tools such as Microsoft Excel.
- **Programming Logic:** Phase classification scripts analyzed object geometry and metadata upon model import. Scheduling algorithms then assigned construction durations and sequential logic, while the visualization manager-controlled material transparency to simulate progress.
- **Testing Environment:** The system was tested on a Windows 11 workstation with an Intel i7 CPU and 16 GB RAM. This hardware configuration ensured smooth handling of models with thousands of BIM elements while maintaining real-time visualization.

***Table 1**. Function Description Table*

Module	Function	Input	Output
AutoPhaseDetector	Classifies model elements into construction phases	BIM model (geometry, names)	Phase-tagged components
ConstructionProgressManager	Assigns durations, manages simulation	Phase-tagged components	Animated timeline, Unity visualization
ExcelExporter	Generates structured reports	Phase + schedule data	CSV/Excel reports (schedule, costs, delays)

- **Workflow:** BIM models created in Autodesk Revit were exported to FBX format and imported into Unity. Once imported, the scripts automatically classified components, generated schedules, visualized construction sequences, and exported structured reports.

This implementation demonstrates how a widely available game engine can serve as a robust environment for integrating 4D simulation, scheduling, and reporting.

6. Case Study

6.1. Project Overview

Figure 4 shows a seven-story steel building, visually clad with concrete to replicate reinforced concrete finishes, was selected as the test project to evaluate the system's effectiveness. The BIM model incorporated foundations, piles, structural frames (columns, beams, slabs), architectural finishes, and MEP systems. In total, more than 7,000 objects were represented, providing a sufficiently large and complex dataset to demonstrate the framework's scalability while remaining manageable for validation.

Figure 4. *Seven-story Steel Building*

6.2. Detected Phases

The AutoPhaseDetector categorized all elements into construction phases, producing the following classification:

- Piles/Foundation: 93 objects
- Columns: 990 objects
- Beams/Slabs: 1,749 objects
- Architectural elements: 3,576 objects
- MEP systems: 747 objects

This classification aligned with typical construction workflows and confirmed the effectiveness of the rule-based detection system.

6.3. Schedule Results

Based on predefined parameters, the ConstructionProgressManager generated an estimated 223-day construction schedule. The sequencing of activities adhered to industry practice: piles and foundations were scheduled first, followed by structural frames, architectural works, and finally MEP installations. The scheduling logic ensured that task dependencies were respected—for instance, beams and slabs were only placed after the supporting columns were completed. This output demonstrated the system's ability to generate realistic schedules directly from classified BIM data.

6.4. Reports

The ExcelExporter produced multiple data outputs that replicated common project control documents:

- **Schedule.csv** included start and end dates for all phases, task durations, and resource requirements.
- **Progress.csv** tracked planned versus simulated progress, including random delays to mimic real-world uncertainty.
- **Materials.csv** estimated quantities of major construction resources such as concrete, reinforcement, bricks, glass, piping, and HVAC ducts. Costs were automatically calculated using assumed unit prices.
- **Summary.txt** provided an executive overview of project timeline, total costs, and identified delays.

All these files are included in *Appendix A*, where sample outputs are provided for reference and validation.

6.5. Visualization

Construction progress was displayed interactively within Unity. Elements transitioned from transparent to opaque to signify completion, while a slider-based timeline allowed users to navigate the project visually. The simulation provided a floor-by-floor representation, making it easier for stakeholders to understand progress compared to static charts.

7. Results and Discussion

The framework was evaluated based on accuracy, efficiency, and visualization quality.

- **Accuracy:** The rule-based phase detection achieved approximately 95% classification accuracy, with most errors occurring in ambiguous components such as complex façade systems or mixed-use objects. These errors highlight the limitations of relying solely on height and name-based rules.
- **Efficiency:** Report generation was completed in under one minute, compared to several hours when prepared manually. This represents a substantial reduction in administrative workload and demonstrates the potential for automation in construction reporting workflows.
- **Visualization Quality:** Unity's rendering capabilities produced a smooth 4D simulation, providing stakeholders with an interactive tool for monitoring progress. The integration of play/pause controls and day counters enhanced usability, making it suitable for both technical teams and non-technical clients.

Limitations:

1. Misclassification can occur when naming conventions are inconsistent or incomplete.
2. Material estimation relied on geometric approximations rather than direct BIM metadata, reducing accuracy in detailed cost analysis.
3. The system currently lacks integration with scheduling software such as Primavera P6 or MS Project, which may limit adoption in firms already committed to those tools.

Despite these limitations, the study confirms that the framework can significantly streamline progress tracking and communication, while offering a flexible foundation for future extensions.

8. Conclusion

This study introduced an integrated Unity-based framework for automated construction phase detection, scheduling, reporting, and 4D visualization. By combining BIM data with rule-based classification and interactive simulation, the system demonstrated significant improvements in both efficiency and communication clarity.

The key contributions of the framework can be summarized as follows. First, the AutoPhaseDetector implemented rule-based algorithms that successfully automated phase detection, thereby reducing the need for extensive manual classification. Second, ExcelExporter produced structured schedules and material reports within seconds, ensuring consistency and minimizing human error. Third, the ConstructionProgressManager enabled an interactive 4D simulation, allowing stakeholders to visualize progress dynamically and improving understanding of construction workflows.

Despite these promising outcomes, further work remains to be done. Future research will explore the use of machine learning techniques to classify ambiguous or atypical elements, thereby enhancing the accuracy of the system. In addition, the framework can be extended by linking with IoT sensor data to provide real-time updates of progress status, ensuring that both planned and actual construction performance are captured dynamically.

Furthermore, writer currently investigating the integration of this framework with **Microsoft Project** and **Primavera P6**. Establishing interoperability with these widely used scheduling platforms will make schedule development more seamless and user-friendly for industry practitioners and will ensure that the framework can be readily adopted in real-world project management contexts.

Overall, the study provides a strong foundation for bridging the gap between BIM models and practical project management workflows. It demonstrates that game engines such as Unity are not only suitable for visualization but also capable of serving as central platforms for automation and data-driven decision-making in digital construction management.

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Appendix A

Materials List - 7-floor Office

Phase	Material	Quantity	Unit	Unit Cost	Total Cost	Supplier	Status
Foundation & Piles	Concrete (Foundation)	79.28	mÂ^3	148.63	11783.62	ABC Concrete	Delivered
Foundation & Piles	Rebar Steel	12420.86	kg	1.63	20297.13	Steel Suppliers Inc	Delivered
Level 1 Columns	Structural Steel Columns	26.1	tons	1782.66	46533.03	Steel Suppliers Inc	InTransit
Level 1 Columns	Concrete (Column's Mantel)	70.18	mÂ^3	138.37	9710.74	ABC Concrete	Ordered
Level 1 Beams & Slabs	Structural Steel Beams	30.74	tons	1283.67	39461.17	Steel Suppliers Inc	Ordered
Level 1 Beams & Slabs	Concrete (Slabs)	58.78	mÂ^3	167.42	9841.52	ABC Concrete	Ordered
Level 1 Beams & Slabs	Formwork	404.23	mÂ^2	27.65	11178.83	BuildForm Co	NotOrdered
Level 2 Columns	Structural Steel Columns	30.21	tons	1622.63	49020.41	Steel Suppliers Inc	InTransit
Level 2 Columns	Concrete (Column's Mantel)	39.17	mÂ^3	173.16	6783.25	ABC Concrete	Ordered
Level 2 Beams & Slabs	Structural Steel Beams	33.87	tons	1496.41	50678.15	Steel Suppliers Inc	Ordered
Level 2 Beams & Slabs	Concrete (Slabs)	90.59	mÂ^3	154.51	13997.42	ABC Concrete	Ordered
Level 2 Beams & Slabs	Formwork	213.06	mÂ^2	26.13	5567.04	BuildForm Co	NotOrdered
Level 3 Columns	Structural Steel Columns	32.27	tons	1780.2	57442.93	Steel Suppliers Inc	InTransit
Level 3 Columns	Concrete (Column's Mantel)	62.84	mÂ^3	134.11	8427.35	ABC Concrete	Ordered
Level 3 Beams & Slabs	Structural Steel Beams	15.69	tons	1320.86	20720.98	Steel Suppliers Inc	Ordered
Level 3 Beams & Slabs	Concrete (Slabs)	85.36	mÂ^3	142.32	12148.91	ABC Concrete	Ordered
Level 3 Beams & Slabs	Formwork	438.26	mÂ^2	33.72	14777.98	BuildForm Co	NotOrdered
Level 4 Columns	Structural Steel Columns	31.16	tons	1641.39	51151.25	Steel Suppliers Inc	InTransit
Level 4 Columns	Concrete (Column's Mantel)	38.17	mÂ^3	141.06	5384.05	ABC Concrete	Ordered
Level 4 Beams & Slabs	Structural Steel Beams	20.3	tons	1215.19	24662.77	Steel Suppliers Inc	Ordered
Level 4 Beams & Slabs	Concrete (Slabs)	92.02	mÂ^3	129.54	11920.83	ABC Concrete	Ordered
Level 4 Beams & Slabs	Formwork	491.27	mÂ^2	34.42	16910.77	BuildForm Co	NotOrdered
Level 5 Columns	Structural Steel Columns	29.87	tons	1413.93	42237.11	Steel Suppliers Inc	InTransit
Level 5 Columns	Concrete (Column's Mantel)	53.1	mÂ^3	172.2	9143.79	ABC Concrete	Ordered
Level 5 Beams & Slabs	Structural Steel Beams	25.49	tons	1346.85	34336.45	Steel Suppliers Inc	Ordered
Level 5 Beams & Slabs	Concrete (Slabs)	61.97	mÂ^3	144.33	8944.8	ABC Concrete	Ordered
Level 5 Beams & Slabs	Formwork	455.56	mÂ^2	36.07	16433.19	BuildForm Co	NotOrdered
Level 6 Columns	Structural Steel Columns	21.02	tons	1226.87	25783.89	Steel Suppliers Inc	InTransit
Level 6 Columns	Concrete (Column's Mantel)	67.94	mÂ^3	175.7	11937.26	ABC Concrete	Ordered
Level 6 Beams & Slabs	Structural Steel Beams	32.59	tons	1280.26	41728.65	Steel Suppliers Inc	Ordered
Level 6 Beams & Slabs	Concrete (Slabs)	84.27	mÂ^3	145.23	12238.47	ABC Concrete	Ordered
Level 6 Beams & Slabs	Formwork	314.66	mÂ^2	25.8	8119.72	BuildForm Co	NotOrdered
Level 7 Columns	Structural Steel Columns	25.43	tons	1284.11	32650.71	Steel Suppliers Inc	InTransit
Level 7 Columns	Concrete (Column's Mantel)	53.85	mÂ^3	132.31	7125.28	ABC Concrete	Ordered
Level 7 Beams & Slabs	Structural Steel Beams	32.83	tons	1119.25	36747.43	Steel Suppliers Inc	Ordered
Level 7 Beams & Slabs	Concrete (Slabs)	46.7	mÂ^3	135.32	6320.09	ABC Concrete	Ordered
Level 7 Beams & Slabs	Formwork	456.48	mÂ^2	41.6	18988.22	BuildForm Co	NotOrdered
Level 8 Columns	Structural Steel Columns	20.26	tons	1344.76	27242.07	Steel Suppliers Inc	InTransit
Level 8 Columns	Concrete (Column's Mantel)	44.09	mÂ^3	121.78	5368.95	ABC Concrete	Ordered
Level 8 Beams & Slabs	Structural Steel Beams	26.17	tons	1250.67	32729.93	Steel Suppliers Inc	Ordered
Level 8 Beams & Slabs	Concrete (Slabs)	40.73	mÂ^3	161.64	6583.36	ABC Concrete	Ordered
Level 8 Beams & Slabs	Formwork	387.61	mÂ^2	28.23	10941.98	BuildForm Co	NotOrdered
Roof Columns	Structural Steel Columns	23.97	tons	1793.45	42987.62	Steel Suppliers Inc	InTransit
Roof Columns	Concrete (Column's Mantel)	63.39	mÂ^3	151.87	9628.06	ABC Concrete	Ordered
Roof Beams & Slabs	Structural Steel Beams	34.34	tons	1383.4	47501.19	Steel Suppliers Inc	Ordered
Roof Beams & Slabs	Concrete (Slabs)	84.41	mÂ^3	129.58	10937.46	ABC Concrete	Ordered
Roof Beams & Slabs	Formwork	316.38	mÂ^2	31.42	9939.36	BuildForm Co	NotOrdered
Level 1 Architecture	Bricks	13289.07	units	0.74	9828.6	BuildMat Supply	NotOrdered
Level 1 Architecture	Glass Panels	116.78	mÂ^2	132.66	15491.89	GlassTech	NotOrdered
Level 1 Architecture	Aluminum Frames	441.57	m	81.76	36102.01	Metal Works Ltd	NotOrdered
Level 2 Architecture	Bricks	6053.61	units	0.99	5963.17	BuildMat Supply	NotOrdered
Level 2 Architecture	Glass Panels	131.85	mÂ^2	144.68	19075.6	GlassTech	NotOrdered
Level 2 Architecture	Aluminum Frames	343.88	m	55.84	19202.19	Metal Works Ltd	NotOrdered
Level 3 Architecture	Bricks	12029.25	units	0.59	7100.8	BuildMat Supply	NotOrdered
Level 3 Architecture	Glass Panels	225.06	mÂ^2	112.79	25383.82	GlassTech	NotOrdered
Level 3 Architecture	Aluminum Frames	374.8	m	73.14	27413.96	Metal Works Ltd	NotOrdered
Level 4 Architecture	Bricks	13403.42	units	0.66	8863.82	BuildMat Supply	NotOrdered
Level 4 Architecture	Glass Panels	228.12	mÂ^2	96.08	21917.09	GlassTech	NotOrdered
Level 4 Architecture	Aluminum Frames	320.98	m	79.46	25505.85	Metal Works Ltd	NotOrdered
Level 5 Architecture	Bricks	10444.33	units	0.92	9584.59	BuildMat Supply	NotOrdered
Level 5 Architecture	Glass Panels	199.77	mÂ^2	99.62	19900.27	GlassTech	NotOrdered
Level 5 Architecture	Aluminum Frames	485.16	m	48.96	23752.34	Metal Works Ltd	NotOrdered
Level 6 Architecture	Bricks	9497.88	units	1.15	10921.48	BuildMat Supply	NotOrdered
Level 6 Architecture	Glass Panels	261.98	mÂ^2	107.06	28046.05	GlassTech	NotOrdered
Level 6 Architecture	Aluminum Frames	286.76	m	51.14	14663.75	Metal Works Ltd	NotOrdered
Level 7 Architecture	Bricks	8123.37	units	0.68	5525.28	BuildMat Supply	NotOrdered
Level 7 Architecture	Glass Panels	121.32	mÂ^2	125.34	15205.69	GlassTech	NotOrdered
Level 7 Architecture	Aluminum Frames	457.44	m	74.09	33890.88	Metal Works Ltd	NotOrdered
Level 8 Architecture	Bricks	8321.47	units	0.85	7079.41	BuildMat Supply	NotOrdered
Level 8 Architecture	Glass Panels	149.37	mÂ^2	111.85	16706.46	GlassTech	NotOrdered
Level 8 Architecture	Aluminum Frames	354.4	m	69.09	24487.1	Metal Works Ltd	NotOrdered
Roof Architecture	Bricks	7407.73	units	0.69	5123.16	BuildMat Supply	NotOrdered
Roof Architecture	Glass Panels	138.84	mÂ^2	133.08	18477.16	GlassTech	NotOrdered
Roof Architecture	Aluminum Frames	367.61	m	68	24997.85	Metal Works Ltd	NotOrdered
MEP Installation	Electrical Cables	2561.11	m	6.38	16328.62	ElectroSupply	NotOrdered
MEP Installation	PVC Pipes	1428.22	m	7.29	10418.89	PlumbPro	NotOrdered
MEP Installation	HVAC Ducts	492.03	m	36.67	18041.58	Climate Systems	NotOrdered

Appendix A (cont.)

Cost Summary by Phase

Phase	Total Material Cost
Foundation & Piles	32080.74
Level 1 Columns	56243.76
Level 1 Beams & Slabs	60481.52
Level 2 Columns	55803.66
Level 2 Beams & Slabs	70242.6
Level 3 Columns	65870.28
Level 3 Beams & Slabs	47647.86
Level 4 Columns	56535.3
Level 4 Beams & Slabs	53494.38
Level 5 Columns	51380.9
Level 5 Beams & Slabs	59714.43
Level 6 Columns	37721.16
Level 6 Beams & Slabs	62086.85
Level 7 Columns	39775.98
Level 7 Beams & Slabs	62055.74
Level 8 Columns	32611.02
Level 8 Beams & Slabs	50255.27
Roof Columns	52615.68
Roof Beams & Slabs	68378.01
Level 1 Architecture	61422.5
Level 2 Architecture	44240.95
Level 3 Architecture	59898.58
Level 4 Architecture	56286.76
Level 5 Architecture	53237.2
Level 6 Architecture	53631.28
Level 7 Architecture	54621.85
Level 8 Architecture	48272.96
Roof Architecture	48598.17
MEP Installation	44789.1
Total Project Material Cost:	1539995

Appendix A (cont.)

Phase Status Summary	
Not Started:	28
In Progress:	1
Completed:	0
Delayed:	0

Construction Progress Report - 7-floor Office

Phase	Planned Start	Actual Start	Planned End	Actual End	Status	Progress	Days Behind/Ahead	Issues
Foundation & Piles	Day 0	Day 1	Day 12	Day 11	InProgress	71.20%	1	
Level 1 Columns	Day 14	-	Day 17	-	NotStarted	0.00%	-	
Level 1 Beams & Slabs	Day 18	-	Day 23	-	NotStarted	0.00%	-	
Level 2 Columns	Day 24	-	Day 27	-	NotStarted	0.00%	-	
Level 2 Beams & Slabs	Day 28	-	Day 33	-	NotStarted	0.00%	-	
Level 3 Columns	Day 34	-	Day 37	-	NotStarted	0.00%	-	
Level 3 Beams & Slabs	Day 38	-	Day 43	-	NotStarted	0.00%	-	
Level 4 Columns	Day 44	-	Day 47	-	NotStarted	0.00%	-	
Level 4 Beams & Slabs	Day 48	-	Day 53	-	NotStarted	0.00%	-	
Level 5 Columns	Day 54	-	Day 57	-	NotStarted	0.00%	-	
Level 5 Beams & Slabs	Day 58	-	Day 63	-	NotStarted	0.00%	-	
Level 6 Columns	Day 64	-	Day 67	-	NotStarted	0.00%	-	
Level 6 Beams & Slabs	Day 68	-	Day 73	-	NotStarted	0.00%	-	
Level 7 Columns	Day 74	-	Day 77	-	NotStarted	0.00%	-	
Level 7 Beams & Slabs	Day 78	-	Day 83	-	NotStarted	0.00%	-	
Level 8 Columns	Day 84	-	Day 87	-	NotStarted	0.00%	-	
Level 8 Beams & Slabs	Day 88	-	Day 93	-	NotStarted	0.00%	-	
Roof Columns	Day 94	-	Day 97	-	NotStarted	0.00%	-	
Roof Beams & Slabs	Day 98	-	Day 103	-	NotStarted	0.00%	-	
Level 1 Architecture	Day 104	-	Day 114	-	NotStarted	0.00%	-	
Level 2 Architecture	Day 115	-	Day 125	-	NotStarted	0.00%	-	
Level 3 Architecture	Day 126	-	Day 136	-	NotStarted	0.00%	-	
Level 4 Architecture	Day 137	-	Day 147	-	NotStarted	0.00%	-	
Level 5 Architecture	Day 148	-	Day 158	-	NotStarted	0.00%	-	
Level 6 Architecture	Day 159	-	Day 169	-	NotStarted	0.00%	-	
Level 7 Architecture	Day 170	-	Day 180	-	NotStarted	0.00%	-	
Level 8 Architecture	Day 181	-	Day 191	-	NotStarted	0.00%	-	
Roof Architecture	Day 192	-	Day 202	-	NotStarted	0.00%	-	
MEP Installation	Day 203	-	Day 223	-	NotStarted	0.00%	-	

Appendix A (cont.)

CONSTRUCTION PROJECT SUMMARY
7-floor Office
2025-10-05 17:31

PROJECT INFORMATION

Location: Taipei, Taiwan
Contractor: Gaillard Co.,Ltd.
Total Phases: 29
Total Duration: 223 days
Overall Progress: 0.0%

PHASE STATUS

Foundation & Piles
Days: 9 to 12
Duration: 12 days
Status: InProgress
Progress: 71.2%
Workers: 12
Materials Cost: $32080.74

Level 1 Columns
Days: 14 to 17
Duration: 3 days
Status: NotStarted
Progress: 0.0%
Workers: 8
Materials Cost: $56243.76

Level 1 Beams & Slabs
Days: 18 to 23
Duration: 5 days
Status: NotStarted
Progress: 0.0%
Workers: 11
Materials Cost: $60481.52

Level 2 Columns
Days: 24 to 27
Duration: 3 days
Status: NotStarted
Progress: 0.0%
Workers: 9
Materials Cost: $55803.66

Level 2 Beams & Slabs
Days: 28 to 33
Duration: 5 days
Status: NotStarted
Progress: 0.0%
Workers: 16
Materials Cost: $70242.60

Level 3 Columns
Days: 34 to 37
Duration: 3 days
Status: NotStarted
Progress: 0.0%
Workers: 16
Materials Cost: $65870.28

Level 3 Beams & Slabs
Days: 38 to 43
Duration: 5 days
Status: NotStarted
Progress: 0.0%
Workers: 21
Materials Cost: $47647.86

Level 4 Columns
Days: 44 to 47
Duration: 3 days
Status: NotStarted
Progress: 0.0%
Workers: 18
Materials Cost: $56535.30

Level 4 Beams & Slabs
Days: 48 to 53
Duration: 5 days
Status: NotStarted
Progress: 0.0%
Workers: 14
Materials Cost: $53494.38

Level 5 Columns
Days: 54 to 57
Duration: 3 days
Status: NotStarted
Progress: 0.0%
Workers: 12
Materials Cost: $51380.90

Level 5 Beams & Slabs
Days: 58 to 63
Duration: 5 days
Status: NotStarted
Progress: 0.0%
Workers: 13
Materials Cost: $59714.43

Level 6 Columns
Days: 64 to 67
Duration: 3 days
Status: NotStarted
Progress: 0.0%
Workers: 15
Materials Cost: $37721.16

Level 6 Beams & Slabs
Days: 68 to 73
Duration: 5 days
Status: NotStarted
Progress: 0.0%
Workers: 12
Materials Cost: $62086.85

Level 7 Columns
Days: 74 to 77
Duration: 3 days
Status: NotStarted
Progress: 0.0%
Workers: 21
Materials Cost: $39775.98

Level 7 Beams & Slabs
Days: 78 to 83
Duration: 5 days
Status: NotStarted
Progress: 0.0%
Workers: 8
Materials Cost: $62055.74

Level 8 Columns
Days: 84 to 87
Duration: 3 days
Status: NotStarted
Progress: 0.0%
Workers: 19
Materials Cost: $32611.02

Level 8 Beams & Slabs
Days: 88 to 93
Duration: 5 days
Status: NotStarted
Progress: 0.0%
Workers: 8
Materials Cost: $50255.27

Roof Columns
Days: 94 to 97
Duration: 3 days
Status: NotStarted
Progress: 0.0%
Workers: 21
Materials Cost: $52615.68

Roof Beams & Slabs
Days: 98 to 103
Duration: 5 days
Status: NotStarted
Progress: 0.0%
Workers: 21
Materials Cost: $68378.01

Level 1 Architecture
Days: 104 to 114
Duration: 10 days
Status: NotStarted
Progress: 0.0%
Workers: 20
Materials Cost: $61422.50

Level 2 Architecture
Days: 115 to 125
Duration: 10 days
Status: NotStarted
Progress: 0.0%
Workers: 10
Materials Cost: $44240.95

Level 3 Architecture
Days: 126 to 136
Duration: 10 days
Status: NotStarted
Progress: 0.0%
Workers: 19
Materials Cost: $59898.58

Level 4 Architecture
Days: 137 to 147
Duration: 10 days
Status: NotStarted
Progress: 0.0%
Workers: 17
Materials Cost: $56286.76

Level 5 Architecture
Days: 148 to 158
Duration: 10 days
Status: NotStarted
Progress: 0.0%
Workers: 18
Materials Cost: $53237.20

Level 6 Architecture
Days: 159 to 169
Duration: 10 days
Status: NotStarted
Progress: 0.0%
Workers: 12
Materials Cost: $53631.28

Level 7 Architecture
Days: 170 to 180
Duration: 10 days
Status: NotStarted
Progress: 0.0%
Workers: 18
Materials Cost: $54621.85

Level 8 Architecture
Days: 181 to 191
Duration: 10 days
Status: NotStarted
Progress: 0.0%
Workers: 9
Materials Cost: $48272.96

Roof Architecture
Days: 192 to 202
Duration: 10 days
Status: NotStarted
Progress: 0.0%
Workers: 13
Materials Cost: $48598.17

MEP Installation
Days: 203 to 223
Duration: 20 days
Status: NotStarted
Progress: 0.0%
Workers: 12
Materials Cost: $44789.10

FINANCIAL SUMMARY

Total Material Cost: $1539995.00

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