ENGINEERING SCIENCES

The International Journal of Engineering Sciences
Vol. 2, No. 2, 2026, pp. 215-233
ISSN 3104-8897

https://international-journal-of-engineering-sciences.jo

Vertical spatial organisation at Al Bayan Mosque

A drawing based audit of floor areas and access routes

Ahmed Eissa Abu Eshqair[1], Abdulazziz Alwaqfy[2], Salameh Mujahed Muneef[3]

[1] Architect, Saudi Arabia. Email: Ahmed_eshqair@gmail.com

[2] Architect, Saudi Arabia. Email: Abdulazziz1981s@gmail.com

[2] Civil Engineer,, Saudi Arabia. Email: mujahed.salameh12@gmail.com

*** Corresponding Author**: Ahmed Eissa Abu Eshqair; Ahmed_eshqair@gmail.com

DOI: https://doi.org/

ARTICLE INFO

Article history
Received June 20, 2026
Revised July 03, 2026
Accepted Nov 04, 2026

Keywords
Mosque architecture,
architectural drawing audit,
mezzanine,
spatial organisation,
CAD geometry

ABSTRACT

Floor-area schedules are often used to compare building levels and describe how a religious building distributes space. Their reliability depends on whether each area is linked to the correct drawn boundary. This study audits the architectural drawings of Al Bayan Mosque, , and examines how the partial upper floor, or sadda, relates to the ground-floor prayer hall and its approach from the site. Closed area worksheets and floor-plan geometry were extracted from the AutoCAD drawing and registered by translation. Plan findings were checked against a PDF export and two architectural sections. The worksheet labelled ground floor measures 95.157 m² and matches the closed sadda outline to the precision of the exported CAD coordinates. The larger worksheet, labelled sadda, measures 152.579 m² and corresponds to the main ground-level envelope, although the perimeter drawn on the ground plan yields 151.707 m² under an explicit closure rule. The worksheet labels therefore reverse the apparent distribution between levels. Across the two plausible ground-level boundaries, the upper projected area is 62.37–62.72% of the ground projected area. The sections show a partial upper floor 3.83 m above the main prayer hall and the recovered drawings document a stair connection. Combining contour registration, boundary sensitivity and plan–section reading makes the interpretation traceable and reveals which access questions require evidence beyond a drawing set.

This is an open-access article under the CC–BY-SA license.

ENGINEERING SCIENCES
The International Journal of Engineering Sciences
https://international-journal-of-engineering-sciences.jo
Vol. 2, No. 2, 2026, pp. 215-233
ISSN 3104-8897

1. Introduction

Architectural plans and area schedules describe the same building through different abstractions [1]. An area schedule collapses a boundary into a number and assigns it to a named floor. A plan shows the boundary in relation to walls, openings and adjacent spaces. A section locates it in height and reveals whether a drawn outline corresponds to a floor, an opening or a projected envelope. When one of these representations disagrees with the others, the inconsistency can alter architectural interpretation even if the arithmetic total appears correct. This problem matters in a mosque with a partial upper floor because a floor-area label can change the apparent relationship between the main prayer hall and the space above it [2.3.4].

The Al Bayan Mosque drawing set provides an opportunity to examine such a discrepancy. Its area worksheet assigns 95.16 m² to the ground floor and 152.50 m² to the *sadda*, the term used in the drawings for the partial upper level. The corresponding plans and sections depict a broad ground-level envelope and an upper slab that occupies only part of that envelope. Because the plan sheets also show walls and lines below the upper level, a visual comparison alone does not resolve which outline the worksheet measures. A reproducible test must recover the area boundaries, match them to the correct drawing and state how any incomplete perimeter was closed.

The study addresses three questions. First, which floor does each area worksheet describe when compared directly with the CAD geometry? Second, how much does the inferred proportion of upper to ground area change when the ground boundary is defined using the worksheet or the plan linework? Third, which connections and level changes can be traced between the sidewalk, prayer hall, sanitary rooms and upper floor on the available drawings?

The research contribution is an auditable way to link area attribution to architectural interpretation. It uses both the shape of a boundary and its agreement with the floor plan, then checks the interpretation in section. The case is particularly informative because transposing two floor labels preserves their combined total. An arithmetic check on the total alone would therefore miss the discrepancy.

2. Literature and analytical framework

2.1 Configuration and circulation in mosque design

Mosque-layout studies have shown how the relationship between worship spaces, transitional areas and entrances can be described through spatial configuration. Mustafa and Hassan (2013) compared the layouts of early Ottoman mosques through space syntax and examined relationships between configuration and functional efficiency[5]. Redjem and Mazouz (2022) mapped the permeability of medieval Algerian mosques through sequences involving outside space, entrances, transitional spaces and prayer halls[6]. Fadakari and Andaroodi (2024) examined how entrances, courtyards and other spaces mediate connections in Qajar-period Sultani mosques[7]. These studies support analysing the position and sequence of spaces alongside their individual dimensions, consistent with Hillier and Hanson's (1984) account of spatial configuration. Their numerical measures depend on explicitly defined nodes, links and boundaries[8].

Geometry contributes a different kind of evidence. Ali and Mustafa (2023b) combined shape grammar and graph techniques to classify mosque layouts[9]. Their study of visibility investigated spatial and volumetric relationships in prayer halls (Ali & Mustafa, 2023a), illustrating why a floor

plan alone cannot account for the vertical dimensions of a worship space[10]. In the Jordanian context, Al-Mughrabi et al. (2021) examined how contemporary mosque form relates to the spatial organisation of internal functions[11]. This case extends these lines of inquiry at the scale of a single design by examining how floor attribution, external levels and the partial upper floor interact in one drawing set.

Research on wayfinding has also linked floor-plan configuration to the ease with which people navigate buildings (O'Neill, 1991) [12]. That relationship motivates attention to junctions and decision points in the case-study plans. Actual navigation, travel time and congestion require behavioural evidence. The drawings support a description of available connections and level changes, and such a description can guide what a future site study measures.

2.2 From area attribution to access evidence

The analysis uses three related forms of evidence. In plan, the area worksheets and traced outlines establish the horizontal extent assigned to each level. In section, floor and slab datums identify the vertical relationship between those outlines. At the scale of the site, the street, sidewalk and external platform establish where changes in elevation occur before a person reaches the prayer hall. Each reading tests a different part of the same architectural interpretation.

This distinction also matters for access. ISO 21542:2021 considers approaches to buildings and circulation within them, alongside other usability and accessibility concerns (International Organization for Standardization, 2021) [13]. In the present study it informs the choice to inspect the sequence from sidewalk to building interior and the link between floors. The case assessment is documentary. The geometric evidence identifies steps, levels and drawn connections. A determination of accessibility or regulatory compliance would require measured details and the applicable requirements for the project.

2.3 Floor area checking and digital boundary verification

Automated area calculation and permit checking both depend on a traceable relationship among geometry, semantic identifiers and measurement rules. Noardo et al. (2022) used IFC models to extract information for planning checks and assessed whether the submitted models supplied the information those checks required[14]. Zhu and Ma (2026) automated area derivation from IFC, including the resolution of an exterior contour and the treatment of height and shaft conditions[15]. Tsai et al. (2026) addressed the production of residential permit drawings by generating coordinated area diagrams, calculations and compliance statements from BIM data[16]. These methods rely on explicit information about the building or use rules to construct an area boundary from model geometry.

In a legacy drawing package, the printed floor label can conflict with the geometry even when the tabulated areas add up. The present audit addresses that specific failure mode. It traces each printed worksheet to a CAD entity, compares it against both documented plan contours under a common registration rule, and uses the section to check which level the matched boundary represents. It retains the two defensible versions of the larger boundary to show their effect on the reported floor-area ratio. This is a diagnostic comparison of selected projected outlines. It does not derive code-defined floor area, automatically discover all possible contours, or establish general performance on other drawing packages.

ENGINEERING SCIENCES
The International Journal of Engineering Sciences
https://international-journal-of-engineering-sciences.jo
Vol. 2, No. 2, 2026, pp. 215-233
ISSN 3104-8897

3 Materials and methods

3.1 Case and source material

This study adopts a documentary architectural case study design (Groat & Wang, 2013) to examine Al Bayan Mosque in Jeddah, Saudi Arabia[17]. The unit of analysis is the mosque design as documented in the architectural drawings. The title block of the reviewed drawing sheet indicates the year 2026, plot number 753, basin number 114, and reference number 1722 .The reported dimensions, levels and circulation traces therefore refer to the supplied drawings, and no geographic inference about a Jeddah site is drawn. The primary source is the supplied AutoCAD DWG. Its derived 14-page PDF provides the viewable sheet sequence, labels, level notes and contextual drawing details. Both files represent the same drawing set, so agreement between them checks the interpretation across representations of one source. It does not independently validate constructed conditions. PDF page references in this article refer to the recovered export, whose first three pages include topographic and site drawings. Pages 4–5 contain the area worksheets and summary, pages 6–7 the ground and upper plans, page 8 the roof drainage drawing, and pages 11–12 sections A–A and B–B. The analysis uses the recovered architectural material and the relevant CAD entities.

The DWG was converted to DXF using LibreDWG through @mlightcad/libredwg-web 0.9.0. The converted geometry was inspected in Python with ezdxf 1.4.4. The drawing declares metre units, which were checked against the dimension of 11.76 m shown across the main envelope on the site plan and worksheet. The corresponding CAD distance is 11.763 m. Only planar x and y coordinates enter the area calculations. Vertical levels are taken from the labelled architectural drawings.

3.2 Registration and boundary rules

Four polylines were selected: the two closed worksheet contours and one relevant outline from each floor-plan block. Nested block transformations were applied before analysis. For each contour the minimum x and maximum y were subtracted from its vertices. This translation aligns the shared west and north extrema without rotating or rescaling the geometry. The overlay was inspected for agreement in the shared 11.763 m span, the diagonal and stepped segments, and the location of corners. For both pairs we evaluated each boundary against the other in both directions. Each line segment was subdivided at intervals of at most 0.001 m. For each sample we calculated its shortest Euclidean distance to the other boundary's continuous line segments. The sampled directed maximum is a lower estimate of the continuous directed Hausdorff distance. Since point-to-boundary distance is 1-Lipschitz, half the sampling interval (0.0005 m) bounds the possible shortfall. The larger directed maximum estimates the symmetric Hausdorff distance. Polygon intersection and symmetric difference were calculated with GEOS using vertices rounded to a 0.0000001 m grid to collapse floating-point artefacts around coincident vertices. Full-precision coordinates were retained for area, distance and CSV export. As a check on the floor attribution, both printed worksheet contours were compared with both plan candidates. The same registration and polygon overlay rules were used for all four combinations. Intersection over union (IoU) is the intersection area divided by the union area. This cross-pair comparison evaluates the alternatives among the selected contours, with the plan labels taken from the drawings and section evidence.

Each closed polygon area was calculated with the shoelace formula[18]. using the ordered CAD vertices. The main ground-plan outline is open by 0.466 m along its west boundary. For the ground-plan estimate, a straight segment was added between its existing endpoints. The comparison reports the area of this closed polygon and the area of the larger closed worksheet as two boundary definitions. The closure spans two nearly collinear vertices on the west envelope alignment. It is a geometric convention for area integration. The range captures the effect of the two boundary choices examined here.

The resulting areas are projected geometric areas. The analysis follows the traced outlines without applying deductions for walls, stair openings or other features that a net-area or statutory measurement convention might treat differently. Calculations use full CAD precision, and intermediate precision is reported for verification. Appendix A identifies the entities and transformation steps. The accompanying CSV records the full-precision coordinates.

3.3 Reading levels and connections

The plan and section audit distinguished three observations: labelled elevations, physically drawn connections, and aspects of operation that the source leaves unresolved. The ground plan and site plan identify the approach and adjoining service spaces. The upper plan provides the stair landing and the extent of the *sadda*. Sections A–A and B–B place both levels within one volume and show the relationship between the upper slab and open space above parts of the main hall. Spot levels were subtracted only where the reference surfaces could be named. Differences between sidewalk spot levels and the hall describe level separations on the sheet. To document the horizontal sequence, we traced centreline sketches on the recovered PDF to connect perimeter openings, steps, door openings, the exterior platform and the stair/landing. Points were labelled at changes of surface or access. A height was assigned to a transition only where a labelled spot level identifies the relevant surface or room. Dashed service segments mark interpretations where the exact threshold or connecting alignment cannot be established from the sheet. Route lines describe plan geometry, and their length, direction of operation and simultaneous use were not measured.

4. Results

4.1 Floor attribution and sensitivity

As the floor plans and sections took shape, the area comparison documented how the sadda's partial footprint related to the prayer hall below. The worksheet listing 95.16 m² aligns with the sadda outline. After registration, both outlines enclose 95.157 m² to three decimal places. The sampled directed distances are approximately 0.0000032 m in both directions, and the symmetric distance is below 0.001 m under the conservative sampling bound. The intersection area is 95.156960 m², and the symmetric difference is approximately 0.000022 m² (Table 2). The diagonal defining the exposed edge of the upper slab provides a distinctive check on attribution. Figure 4 reproduces the two captions and values as drawn on page 4 and their repeated attribution in the original page 5 summary. The overlay ties those two captions to the selected worksheet outlines and the entity handles in Appendix A. The ground-plan block also carries a projected contour of this diagonal. Its presence in that block is consistent with a projection over the hall. The upper plan and the sections determine the level to which the contour belongs.

ENGINEERING SCIENCES
The International Journal of Engineering Sciences
https://international-journal-of-engineering-sciences.jo
Vol. 2, No. 2, 2026, pp. 215-233
ISSN 3104-8897

As the ground-floor plan was developed, the area comparison traced two representations of the main ground-level envelope. The worksheet labelled *sadda* shares the plan's overall width, depth, and stepped perimeter. Its simplified outline includes an angled projection and encloses 152.579 m². The corresponding plan contour follows the outer envelope lines along its longer segments, spans openings where the outline abstracts from the wall construction, and includes offsets and additional vertices around the south-eastern projection. Closing the 0.466 m gap along its western edge for the comparison yields an area of 151.707 m², a difference of 0.872 m² between the rounded estimates (Figure 1C). The south-eastern deviations are localised (Figure 1D). Here the sampled distances are 0.250 m from worksheet to plan and 0.320 m in the reverse direction. The overlap is 151.706499 m² and the symmetric difference is 0.872922 m². The result supports reassignment to ground level while keeping both estimators visible. The two estimates refer to the main ground-level polygon. The separately scheduled minaret and ancillary building are outside this comparison as accounting categories, and the analysis does not establish whether all independently scheduled projections are mutually exclusive.

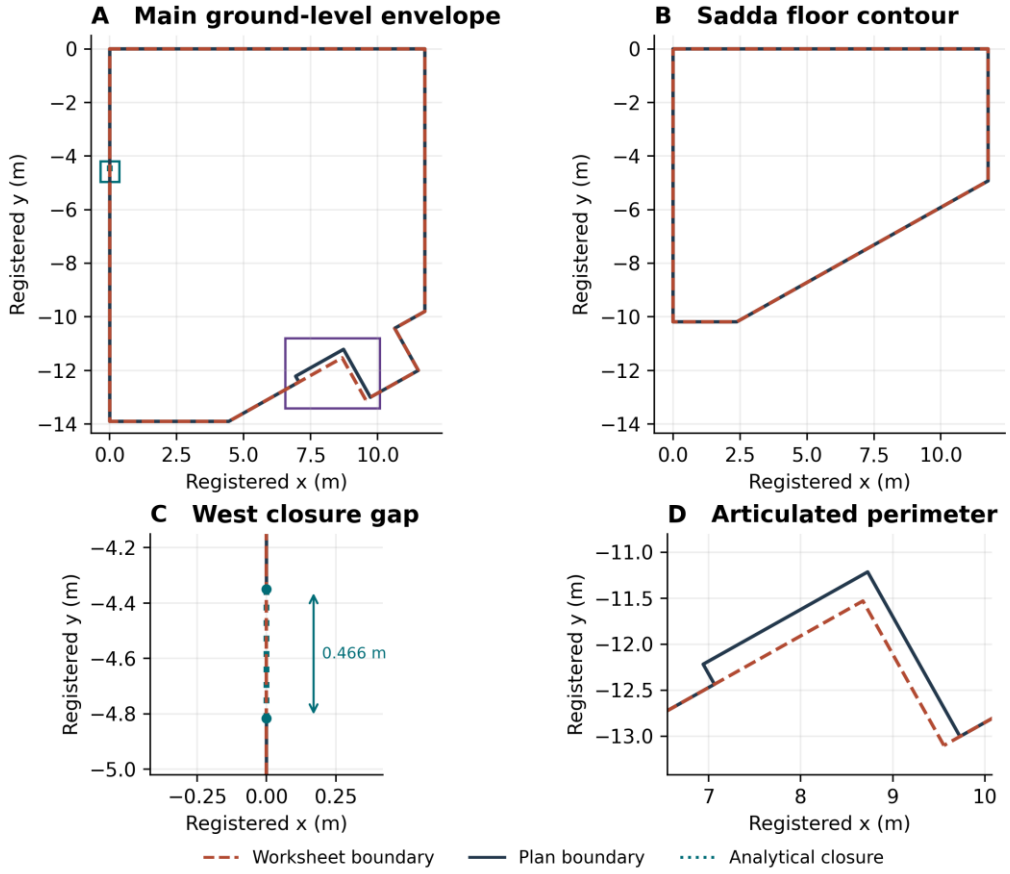


Figure 1. Registered worksheets and floor-plan contours. Panels A and B show the compared pairs. Panel C enlarges the west-edge closure and panel D shows the locally offset outline at the south-eastern projection. The dotted line denotes the added closure segment. Source geometry from the DWG.

Table 1. Attribution of the two worksheets and the corresponding CAD areas.

Label in worksheets and summary	Scheduled area (m²)	Worksheet CAD area (m²)	Corresponding plan feature	Plan CAD area (m²)
Ground floor	95.16	95.157	Partial upper floor (*sadda*)	95.157
Sadda	152.50	152.579	Main ground-level envelope	151.707

Table 2. Registered geometric agreement for each worksheet–plan pair.

Pair	Worksheet → plan (m)	Plan → worksheet (m)	Intersection (m²)	Symmetric difference (m²)
Ground envelope	0.250	0.320	151.706499	0.872922
Sadda	<0.001	<0.001	95.156960	0.000022

The distances are sampled directed maxima. The larger directed maximum estimates the symmetric Hausdorff distance, with a possible shortfall of up to 0.0005 m before rounding. Extra digits in the overlap areas document the numerical comparison and do not represent survey precision.

Table 3. Intersection over union for all worksheet–plan combinations.

Printed worksheet	Main ground-level plan (%)	Sadda plan (%)
Sadda · 152.50 m²	99.428	62.366
Ground floor · 95.16 m²	62.724	100.000

The upper pair rounds to 100.000% at the displayed precision. Both printed worksheets have greater overlap with the plan associated with the opposite floor label. The comparison tests assignment of the selected contours and does not test how consistently different analysts would select those contours.

The printed component values on page 4 sum to 95.16 m² and 152.50 m², respectively. Their agreement with the printed subtotals confirms the arithmetic of the displayed components, while the geometry identifies the reversed attribution. The 152.50 m² subtotal is 0.079 m² below its worksheet polygon. Separately, the four displayed ancillary-building component areas on page 5 add to 19.79 m² against a printed subtotal of 19.80 m². That one-hundredth difference could arise from rounding before summation. The underlying component precision would be needed to distinguish rounding from transcription. The summary's displayed categories add to 271.66 m². This value is retained as a source-reported total.

Using the labels in the printed schedule literally gives a *sadda*-to-ground ratio of 160.26%. With the geometric attribution, the CAD ratio becomes 62.37% against the larger worksheet and 62.72% against the closed ground-plan perimeter. The 0.36 percentage-point spread, calculated before rounding the individual ratios, is small relative to the change produced by correcting the floor labels. The result is a description of relative projected extent under the tested boundary definitions. It neither expresses net usable area nor establishes the number of people the spaces can accommodate.

4.2 Site and vertical organisation

ENGINEERING SCIENCES
The International Journal of Engineering Sciences
https://international-journal-of-engineering-sciences.jo
Vol. 2, No. 2, 2026, pp. 215-233
ISSN 3104-8897

The site drawing marks a plot approximately 20 m on each side and depicts the main building within a perimeter enclosure. The main prayer floor is labelled +54.15 m. The external platform near the prayer hall is marked +53.70 m, placing it 0.45 m below the prayer level. The three labelled sidewalk levels on the road-facing side are +53.56, +53.68 and +53.80 m. The corresponding vertical separations to the hall level are 0.59, 0.47 and 0.35 m. The separate street spot levels are +53.36, +53.48 and +53.60 m. Each of the three drawn street–sidewalk pairs differs by 0.20 m. These values establish the scale of the level changes at the site edge and approach. Which elevations a visitor encounters in sequence depends on the entry point and route.

The *sadda* floor is at +57.98 m, or 3.83 m above the prayer hall. Sections A–A and B–B show the upper slab terminating before it spans the full hall. This leaves an open vertical zone next to the slab and a lower portion of the hall beneath it. The main roof-slab datum is +61.03 m, 3.05 m above the *sadda* floor. In both sections the drawn clear heights are 6.50 m from the prayer floor to the roof underside in the open zone, 3.45 m from the prayer floor to the underside of the *sadda*, and 2.67 m from the *sadda* floor to the roof underside. These are the sectional clear dimensions at the labelled positions. The 3.83 m and 3.05 m differences compare the floor and slab datums (Table 4).

Table 4. Level relationships and labelled clear heights.

Reference surfaces	Lower datum (m)	Upper datum (m)	Difference (m)	PDF evidence
Sidewalk spot levels to prayer floor	+53.56 to +53.80	+54.15	0.35 to 0.59	pp. 3, 6
External platform to prayer floor	+53.70	+54.15	0.45	pp. 3, 6, 11
Prayer floor to *sadda* floor	+54.15	+57.98	3.83	pp. 6–7, 11–12
Sadda floor to main roof-slab datum	+57.98	+61.03	3.05	pp. 3, 11–12
Prayer floor to roof underside (open zone)	+54.15	Roof underside	6.50 clear	pp. 11–12
Prayer floor to *sadda* underside	+54.15	*Sadda* underside	3.45 clear	pp. 11–12
Sadda floor to roof underside	+57.98	Roof underside	2.67 clear	pp. 11–12

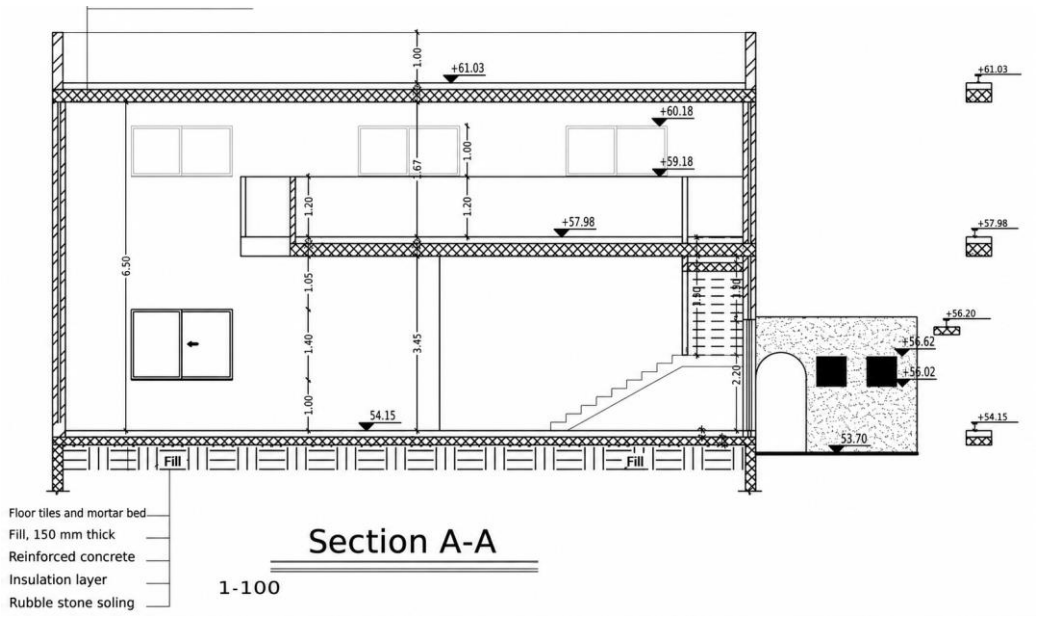


Figure 2. Section A–A shows the main prayer floor, stair, partial upper floor and roof slab. Source: supplied mosque drawing, recovered PDF p. 11, cropped.

4.3 Circulation and service relationships

Figure 3 documents the approach sequence and the two kinds of onward connection. Trace P1–P5 begins at the sidewalk, passes through the north-eastern opening in the perimeter, reaches the exterior steps, and enters through a drawn door on the oblique entrance line. The nearest sidewalk annotation to the illustrated approach is +53.68 m. That annotation is a nearby spot level, and the drawing does not give a level at the perimeter opening P2. The nearby exterior platform is labelled +53.70 m. The upper entrance landing and prayer hall are both marked +54.15 m. The resulting platform-to-hall difference is 0.45 m. It should not be read as a rise measured at every point along the exterior trace.

The two sanitary rooms are labelled for women and men and show +53.72 m spot levels. Figure 3 sketches two candidate approaches from the prayer hall. An opening and steps on the north side of the hall lead towards the northern apron and the men's room (S1–S2). The second trace returns to the exterior platform via the main entrance, follows the western side and approaches the women's room (S3). The dashed service traces indicate that exact doorway continuity and the geometry of the last transition require clarification. Subtracting the labelled room level from the hall level gives 0.43 m. This is a difference between the documented surfaces and does not establish the level at either service threshold.

The vertical trace returns from the prayer hall through the main entrance and follows the exterior platform to the western stair door (V1). The plan shows steps at that door and a stair turning along the west and north edges of the hall (V2). The upper plan shows the continuation to the landing (V3), with the *sadda* floor marked +57.98 m (V4). The drawing does not label the first stair landing or every tread. The recovered sheets provide no documented alternative step-free vertical connection. The graphic shows overlapping drawn alignments along portions of the approach. It does not establish simultaneous movement, congestion, access compliance or actual use of the upper level.

ENGINEERING SCIENCES
The International Journal of Engineering Sciences
https://international-journal-of-engineering-sciences.jo
Vol. 2, No. 2, 2026, pp. 215-233
ISSN 3104-8897

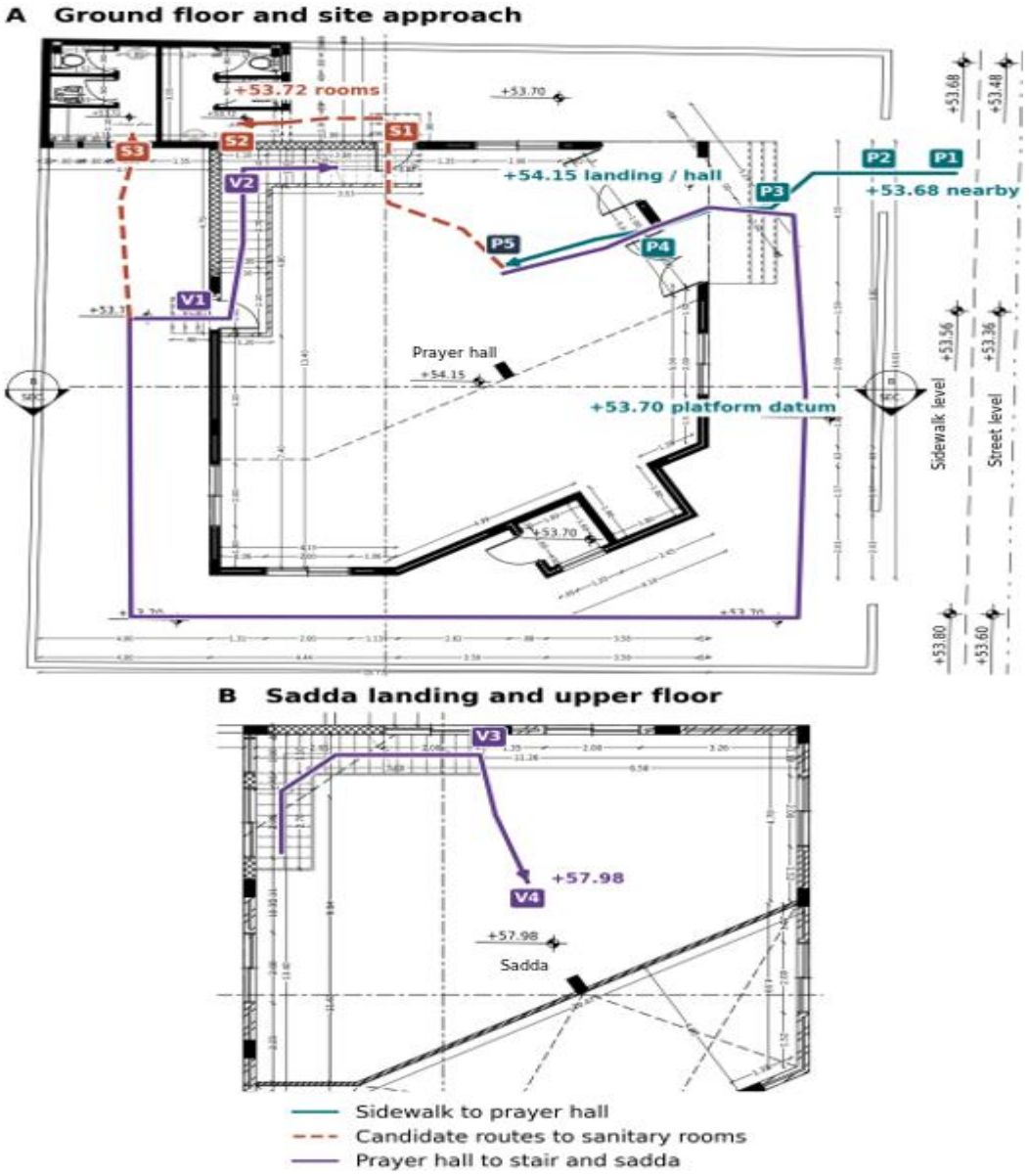


Figure 3. Traceable approach and circulation on the ground floor and *sadda*. P1–P5 indicate sidewalk, perimeter opening, exterior steps, oblique entrance and prayer hall. S1–S3 indicate the north hall opening and two candidate sanitary-room approaches. V1–V4 indicate the west stair entrance, stair turn, upper landing and *sadda*. The ground and upper excerpts are from recovered PDF pp. 6–7. Spot levels are drawn values and intermediate threshold levels without labels remain unspecified.

5. Discussion

5.1 Why the attribution matters

The case shows how a building can have a plausible aggregate area and still be mischaracterised floor by floor. Reading the schedule in isolation would lead to the conclusion that the *sadda* is larger than the ground floor. Yet the registered smaller

worksheet matches the occupied upper contour, and the sections show the partial slab. The critical distinction is between agreeing totals and agreeing spatial identities. A drawing audit should therefore carry the worksheet label, the CAD boundary and the floor-plan relationship together whenever area is used to support a claim about the building.

The larger outline also demonstrates how boundary choice can survive a successful attribution check. Both larger polygons describe the main ground-level zone, but they handle some local perimeter details differently. The resulting change in ratio is modest. This makes the broad relationship between levels robust to these two boundaries, while preserving a reason to document which polygon is used for any exact quantity. The two values would be inadequate substitutes for a formal occupancy-load calculation or a permit schedule because each of those uses requires its own boundary and measurement conventions.

5.2 Relating the section to use

Prior mosque studies use configuration to understand access hierarchies and relationships between worship and support spaces (Mustafa & Hassan, 2013; Redjem & Mazouz, 2022; Fadakari & Andaroodi, 2024) [5.6.7]. This case adds a specific documentary problem to that line of inquiry. On an upper-floor sheet, the outer envelope can remain visible as a projection even where the floor does not extend. Treating all visible linework as enclosing comparable functional space would conflate projected building form with the area at the current level. The section and CAD contour together clarify which part of the envelope has a floor at +57.98 m.

The stair and sanitary rooms sit at the edge of the main hall. The path from the prayer hall to the western stair door traverses the exterior platform in the illustrated reconstruction, and the stair shifts vertical movement to the edge of the hall. This distinction between adjoining spaces in plan and the route that actually connects their drawn thresholds is material to the reading. A study of everyday operation could test this interpretation during ordinary prayers and peak congregation by recording route choices, stopping points and which entrances are in use. Observing the use of the *sadda* separately would also allow a comparison between its nominal geometric provision and its practical role.

5.3 Transferability and limitations

Use on another drawing package would require identifiable and legible floor labels, a confirmed common drawing unit, comparable boundary definitions and sufficient plan and section evidence to identify the level of each contour. Registration by translation requires corresponding drawings with the same orientation and scale. Rotation, differing drawing scales, curved boundaries, holes and open or self-intersecting contours require their own documented alignment or geometry rules. If only raster plans are available, an analyst would need a defensible scale calibration and a separate estimate of digitisation uncertainty. The overlap and distance thresholds should be interpreted against the drawing precision and intended measurement convention of each case.

The four-way overlap comparison supports the assignment among the selected contours in this drawing package. A second analyst has not independently identified the candidate boundaries, and the procedure has not been tested on a second project. A replication should have an analyst select and document candidate boundaries without access to the first selection or pairing, then compare the selected entities, closures, and assignments before resolving discrepancies. Testing the same

The International Journal of Engineering Sciences
https://international-journal-of-engineering-sciences.jo
Vol. 2, No. 2, 2026, pp. 215-233
ISSN 3104-8897

protocol on a second drawing set would assess whether the decision rules remain practical when the contour alternatives differ.

The PDF and DWG represent one design package. They cannot establish as-built conditions, a later revision or a site in Jeddah. Some layout tabs were unrecoverable in the PDF, and some annotations use legacy fonts. The quantitative findings use the geometric entities and dimensions recoverable from the documents. Site measurements and evidence of building operation would be needed to assess usable floor area, actual capacity, upper-level use, accessibility compliance or drainage performance.

6. Conclusion

A plan–section audit of Al Bayan Mosque resolved a floor-area attribution error in the drawing schedule. The 95.16 m² worksheet belongs to the partial upper level. The approximately 152 m² worksheet describes the main ground-level envelope, with a local boundary discrepancy relative to the ground plan. Using two explicit ground boundaries, the *sadda* occupies 62.37–62.72% of the compared ground-level projection. The drawings place that upper floor 3.83 m above the prayer hall and connect the levels by a stair at the hall's edge. The result illustrates how a reproducible contour comparison can correct the interpretation of a building even when its printed aggregate area appears internally consistent.

Data availability

The study used the project DWG and its 14-page architectural PDF export supplied for analysis. The supplementary file Al_Bayan_Mosque_Contour_Coordinates.csv contains the full-precision source, transformed and registered vertices for all four contours. The fields printed_label_en and geometric_assignment_en state the original floor designation and the adopted geometric assignment separately for every vertex. Appendix A documents the transformation and computation steps, and Figure 4 reproduces the source evidence underlying the competing floor labels. The complete drawing set is not deposited in a public repository.

References

1. What Is an Architectural Plan — and Why Does It Matter?, Friday, March 27, 2026, keiser design group, https://keiserdesigngroup.com/blog/architectural-plan/
2. DIVISION OF ENGINEERING AND ARCHITECTURE, Bachelor's Degree in Architecture DESIGN SYSTEMS IN THE LAYOUT OF SPACE IN ARCHITECTURE TASK N. 3, https://www.scribd.com/document/948354888/The-arrangement-of-the-floor-plan-in-architecture
3. Maksoud A, Alawneh SIA, Hussien A (2025;), "Multi-objective optimized mosque architecture geometry design in Sharjah, UAE: integration of computational design and minimal surfaces in the design process". Smart and Sustainable Built Environment, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/SASBE-09-2024-0385
4. Putra, S., Youssef, T., Ahmed, D., & Jasafat, J. (2025). Modern Mosque Architecture and its Impact on Islamic Identity: A Study of Mosques in European Countries. Journal of Noesantara Islamic Studies , 2(2), 88–98. https://doi.org/10.70177/jnis.v2i2.1850
5. Faris Ali Mustafa, Ahmad Sanusi Hassan, Mosque layout design: An analytical study of mosque layouts in the early Ottoman period, Frontiers of Architectural Research, Volume 2, Issue 4, 2013, Pages 445-456, ISSN 2095-2635,, https://doi.org/10.1016/j.foar.2013.08.005
6. Redjem, M., Mazouz, S. Spatial and social interaction in medieval Algerian mosques: a morphological analysis using space syntax. Built Heritage 6, 17 (2022). https://doi.org/10.1186/s43238-022-00064-y
7. Fadakari, M.M., Andaroodi, E. Patterns in the spatial configuration of Sultani Mosques in the Qajar period: a comparative study using space syntax and layout-based analysis. Built Heritage 8, 28 (2024). https://doi.org/10.1186/s43238-024-00141-4
8. Sam Griffiths,2011. Temporality in Hillier and Hanson's Theory of Spatial Description: Some Implications Of Historical Research For Space Syntax, https://www.researchgate.net/publication/361919075_Temporality_in_Hillier_and_Hanson%27s_Theory_of_Spatial_Description_Some_Implications_Of_Historical_Research_For_Space_Syntax
9. Faris Ali Mustafa, Ahmad Sanusi Hassan, Mosque layout design: An analytical study of mosque layouts in the early Ottoman period, Frontiers of Architectural Research, Volume 2, Issue 4, 2013, Pages 445-456, ISSN 2095-2635,, https://doi.org/10.1016/j.foar.2013.08.005
10. Ali, L. A., & Mustafa, F. A. (2023). Mosque Typo-Morphological Classification for Pattern Recognition Using Shape Grammar Theory and Graph-Based Techniques. Buildings, 13(3), 741. https://doi.org/10.3390/buildings13030741
11. Ahmad Drnaserthabet, Naser Thabet Al-Mughrabi, Mutasem Azmi Al-Karablieh, Drmayyadahfahmi Hussein, Aseel Al-Ayash, June 2021, Spatial Design Methods of Contemporary Mosques: Originality and Modernity Case Study: Mosques of Jordan, Design Engineering 2021(5):1921- 1939, https://www.researchgate.net/publication/352179108_Spatial_Design_Methods_of_Contemporary_Mosques_Originality_and_Modernity_Case_Study_Mosques_of_Jordan
12. Michael J. O'Neill, Evaluation of a Conceptual Model of Architectural Legibility,Volume 23, Issue 3, https://doi.org/10.1177/0013916591233001

The International Journal of Engineering Sciences
https://international-journal-of-engineering-sciences.jo
Vol. 2, No. 2, 2026, pp. 215-233
ISSN 3104-8897

13. ISO 21542:2021. Building construction - Accessibility and usability of the built environment, 1 June 2021. https://accessible-eu-centre.ec.europa.eu/content-corner/digital-library/iso-215422021-building-construction-accessibility-and-usability-built-environment_en

14. Francesca Noardo, Teng Wu, Ken Arroyo Ohori, Thomas Krijnen, Jantien Stoter, IFC models for semi-automating common planning checks for building permits, Automation in Construction, Volume 134, 2022, 104097, ISSN 0926-5805, https://doi.org/10.1016/j.autcon.2021.104097

15. Xueying Zhu, Jun Ma,2026. Integrative framework for automated building area calculation from IFC data, Automation in Construction, Volume 187, 106911, ISSN 0926-5805, https://doi.org/10.1016/j.autcon.2026.106911

16. Meng-Han Tsai, Ren-Jie Li, Yu-Jiun Cheng,2026. BIM-integrated automation of floor area calculation and compliance documentation for residential permit drawings, Journal of Building Engineering, Volume 132, 2026, 117560, ISSN 2352-7102, https://doi.org/10.1016/j.jobe.2026.117560

17. Rania Aburamadan, Claudia Trillo, 2020. Applying design science approach to architectural design development, Frontiers of Architectural Research, Volume 9, Issue 1,2020, Pages 216-235, ISSN 2095-2635, https://doi.org/10.1016/j.foar.2019.07.008

18. Lee, Y. & Lim, W. (2017). Shoelace Formula: Connecting the Area of a Polygon and the Vector Cross Product. Mathematics Teacher, 110(8), 631–636. https://doi.org/10.5951/mathteacher.110.8.0631

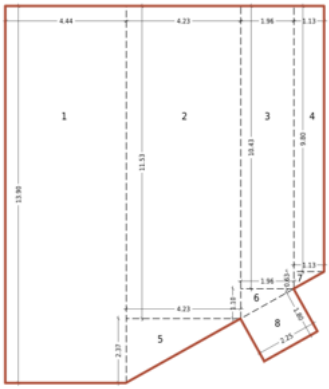
Appendix A Reproduction of area computations

The DXF modelspace worksheet handles are 5C5F5C08 (larger) and 5C653EF9 (smaller). The ground plan is inserted at 5C63850E, with perimeter source entity 5C65D38A. The *sadda* plan is inserted at 5C6377A6, with source contour 5C64D170. To reproduce the plan geometry, locate the polyline in its source BLOCK definition. Read the ordered vertices and interpret its elevation and extrusion in the entity's object coordinate system (OCS). Convert them to the containing block's coordinates with ezdxf vertices_in_wcs(). Follow the INSERT references from modelspace to the leaf and record their handles outermost first. Apply each INSERT's matrix44() to the points innermost first, including the block base point and the insertion object's scale, orientation and offset. This gives modelspace WCS coordinates. The selected ground and sadda entities are each one block below modelspace. The two worksheet entities have no INSERT transformation. Use the CSV's registered coordinates, or subtract minimum x and maximum y from the transformed planar vertices of each contour separately. Close the ordered vertex sequence by joining the last point to the first. For the ground plan this is an analytical straight segment of 0.466353 m because the source polyline is open. The other three closure edges follow the native closed flag. The CSV lists each source vertex once and marks the closure convention explicitly. The stable identifiers ground_worksheet and sadda_worksheet encode geometric assignment. Their printed designations are Sadda and Ground floor, respectively, and appear in the separate printed-label field. The source DWG SHA-256 is 3c2307b70cd72f03cc7d1330e4bf7e607f1deab0a400039f16593ed5aef55ec9.

For ordered vertices (x_i, y_i), the projected area is half the absolute sum of $(x_i y_{i+1} - x_{i+1} y_i)$ over all successive pairs, with the last vertex paired with the first. The CSV preserves the parsed double-precision coordinates, exported with 17 significant digits. Apply the point-to-segment sampling and polygon-overlay precision specified in Section 3.2 to reproduce the boundary metrics.

ENGINEERING SCIENCES
The International Journal of Engineering Sciences
https://international-journal-of-engineering-sciences.jo
Vol. 2, No. 2, 2026, pp. 215-233
ISSN 3104-8897

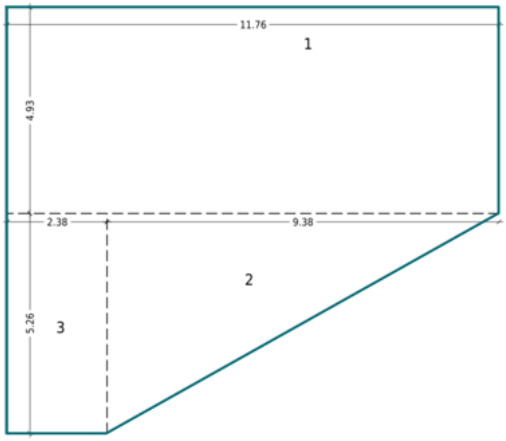
A p. 4 "Sadda area" · 152.50 m²



Sadda area

61.71 m²	4.44 * 13.90	1
48.78 m²	4.23 * 11.53	2
20.44 m²	1.96 * 10.43	3
11.07 m²	1.13 * 9.80	4
5.01 m²	2.37 * 4.23 * 0.50	5
1.08 m²	1.10 * 1.96 * 0.50	6
0.36 m²	0.63 * 1.13 * 0.50	7
4.05 m²	1.80 * 2.25	8
152.50 m²	Total	

B p. 4 "Ground-floor area" · 95.16 m²



Ground-floor area

57.97 m²	4.93 * 11.76	1
24.67 m²	5.26 * 9.38* 0.5	2
12.52 m²	5.26 * 2.38	3
95.16 m²	Total	

C p. 5 Area summary · original row labels and totals

Area summary

Proposed area for approval	Approved area	Total area	Floor name
95.16 m²		95.16 m²	Ground floor
152.50 m²		152.50 m²	Sadda

Figure 4. Source evidence for the floor label inversion. Panel A shows the worksheet captioned *masāḥat al-sadda* (sadda area), printed as 152.50 m². Panel B shows the worksheet captioned *masāḥat al-arḍī* (ground-floor area), printed as 95.16 m². Panel C shows the original area-summary rows, ground floor 95.16 m² and sadda 152.50 m². The outlines in A and B highlight the CAD boundaries traced for calculation, while the frames in C highlight the corresponding printed rows. Excerpts from recovered architectural PDF pp. 4–5.

Ethical Considerations

Not applicable. This study did not require ethical approval because it does not include human or animal subjects and does not involve any personal or sensitive data.

List of Abbrevations:

(IoU): Intersection over union.

Acknowledgment:

The author would like to express their sincere gratitude to **The International Journal of Engineering Sciences** - Noor Al-Ilm for Publishing and Distribution for their generous support in waiving all publication fees and facilitating the publication of this manuscript free of charge. Their commitment to promoting scientific research and supporting researchers is highly appreciated.

Author Contribution:

Author Contributions: All authors contributed equally to the main contributor to this paper. All authors read and approved the final paper.

Declaration of generative AI and AI-assisted technologies in the writing process

The authors hereby declare that no generative artificial intelligence or AI-assisted technologies were used at any stage during the preparation of this manuscript, including language editing, proofreading, or content development. The authors take full responsibility for the originality and integrity of the work presented in this publication.

Funding:

This research received no external financial funding. The authors also acknowledge **The International Journal of Engineering Sciences**, Noor Al-Ilm for Publishing and Distribution, for providing a full waiver of the publication fees. The publication fee waiver was provided as editorial support and did not involve any financial contribution to the conduct, design, analysis, or reporting of the research.

The International Journal of Engineering Sciences
https://international-journal-of-engineering-sciences.jo
Vol. 2, No. 2, 2026, pp. 215-233
ISSN 3104-8897

Conflicts of Interest:

"The authors declare no conflict of interest."